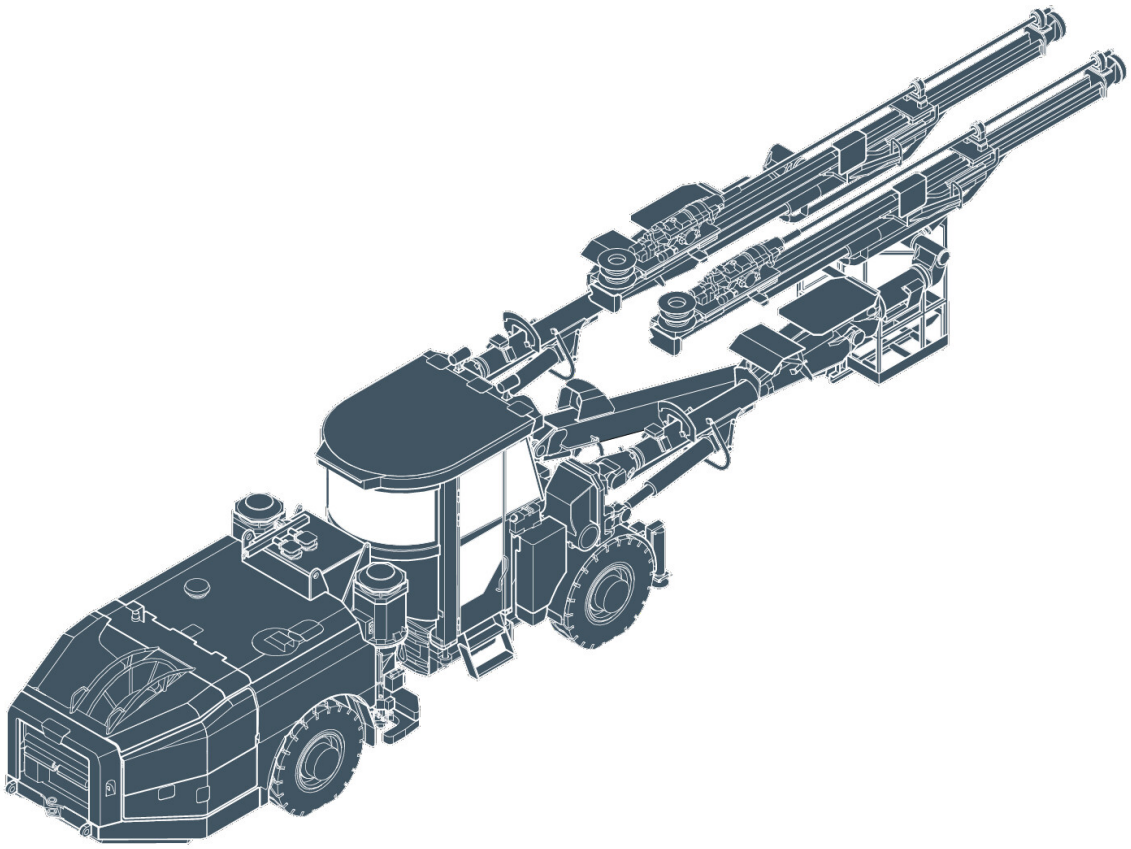
Safety

# Boomer L1D, L2D



**Original Instructions**
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Epiroc

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# 1 Introduction

## 1.1 Feedback and Contact Information

Epiroc works actively to develop and continuously improve its products and associated documentation. Provide your feedback on products and documentation by contacting your local supplier at https://www.epiroc.com, under "Contact us."

## 1.2 The Purpose of the Safety Manual

This safety manual contains important information that must be followed to prevent accidents and property damage while working with and around the machine. The manual is designed to do the following:

- Provide information to detect and prevent hazardous situations.
- Provide information about safe, correct, and economical use of the machine and related equipment.
- Provide information on risks involved and the hazard zones.
- Provide information on safety equipment and safety signs posted on the machine.
- Provide information about environmental regulations.

This manual is one part of the complete machine delivery and its related equipment.

This manual does not replace the necessary training that is required for the handling of the machine and its related equipment.

The information in this manual and all applicable local regulations must be followed.

## 1.3 Target Group

The information in this publication is intended for everyone involved in the application, operation, and maintenance of the machine and related equipment. All readers are expected to possess basic competence regarding mining methods, construction methods, and the machines used for that kind of operation.

## 1.4 Safety Messages in Publications

Safety messages in publications declare hazards and the related measures to avoid the hazards in that particular situation. The safety messages contain signal words (Danger, Warning, Caution, and Notice) that relate to the consequences of those specific hazards. The information in safety messages must be always followed.

The following are examples of safety message structure. Safety message contains:

- Signal word to determine the degree of the hazard.
- Hazard states the potential source of a hazard. For example: Rotating parts, Hot surface, and so on.
- Consequence of the hazard, if not avoided.
- Method to avoid the hazard.

**DANGER**

**Hazard**

The signal word "DANGER" indicates a hazardous situation which will result in death or serious injury if not avoided.

▶ The method to avoid the hazard is written here.

**WARNING**

**Hazard**

The signal word "WARNING" indicates a hazardous situation which could result in death or serious injury if not avoided.

▶ The method to avoid the hazard is written here.

**CAUTION**

**Hazard**

The signal word "CAUTION" indicates a hazardous situation which could result in minor or moderate injury if not avoided.

▶ The method to avoid the hazard is written here.

***NOTICE***

**Hazard**

The signal word "NOTICE" contains information that is not related to bodily injury yet considered important. In a "NOTICE" the damage is related to machines, components, or systems.

▶ The method to avoid the hazard is written here.

# 2 Product Liability

The owner or lessee is responsible for:

- Using the machine only for intended purposes
- Knowing the limitations of the machine and not exceeding the design limits
- Following the instructions in the relevant machine documentation
- Using the machine only when it is in good condition and fully-maintained
- Providing safety training and making sure that all local regulations are followed
- Obtaining and distributing the relevant documentation to operating personnel, maintenance personnel, and other relevant personnel.

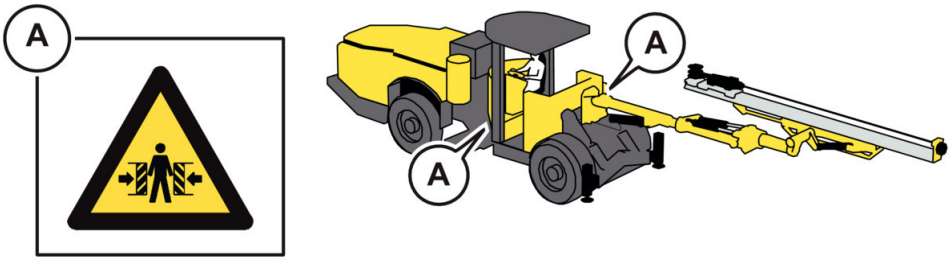
# 3 Risks and Hazards

## 3.1 Stored Energy Hazard

Before operating the machine, personnel must be aware of the following dangers regarding stored energy:

- Hydraulic components can move.
- The hydraulic system controls the components.
- Related control circuits affect the hydraulic components.
- Components that could cause personal injury and property damage must be prevented from moving.
- No part of the body must be in a position where component movement can cause physical injury.
- Component movement cannot be prevented in some situations, for instance:
  - If the hydraulic system fails
  - If the hydraulic system disengages
  - If the hydraulic system receives a control signal resulting in component movement
- All sources of potential energy must be released.
- Personnel must ensure that any possible component or machine movement is mechanically prevented.

## 3.2 Crushing Hazard



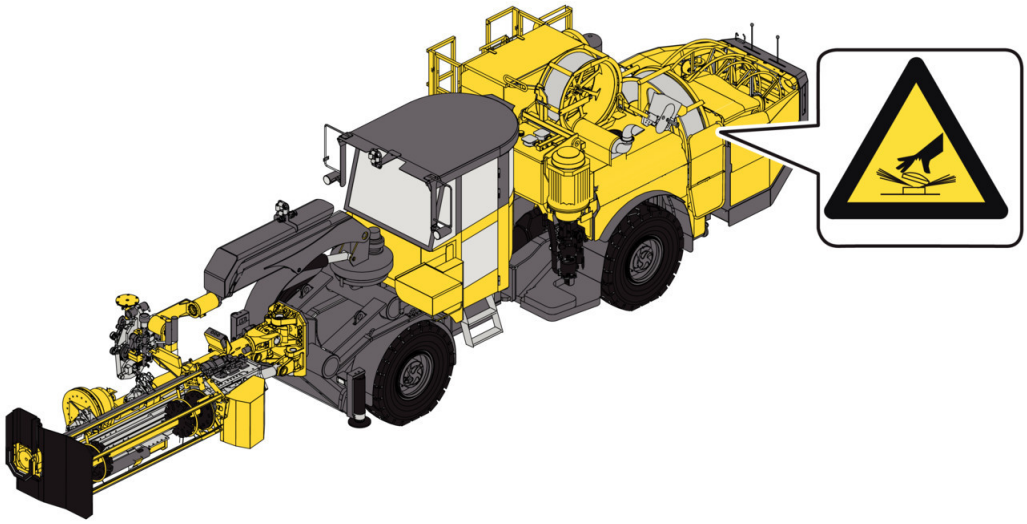

*Crushing Hazard*

Crushing hazards exist due to moving machine parts during turning of the machine.

To minimize risk:

- Stay clear from the articulation point when the machine is running.

## 3.3 Scalding Hazard



*Scalding Hazard*

High liquid temperature can cause a risk of scalding.

To minimize risk:

- Release the pressure before removing the cap.

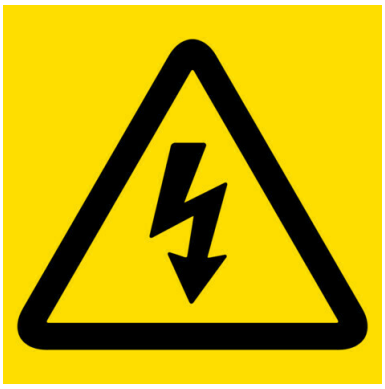
## 3.4 Rock Fall Hazard

Falling rock from the heights can cause a risk while working underground.

To minimize risk:

- Never work or stand under unreinforced rock.
- Always use Personal Protective Equipment (PPE).

## 3.5 Electric Shock Hazards



*Dangerous Voltage Hazard Sign*

There is a risk of electric shock while working with the machinery. The risk must be considered during:

- Connecting or disconnecting the electrical supply to the low voltage battery or to and between machines.
  - Turn off power supply before plugging the connectors in or out.
  - Avoid water around the cables.

- Cleaning and performing maintenance procedures around electrical cabinets, low voltage battery, connectors, and cables.
  - Only authorized personnel must work involving cables, electrical cabinets, and connectors.
  - Do not use high pressure to clean electrical components.

## 3.6 Pressurized Systems Hazard

Leaking fluid systems can cause fluid injection into flesh and erosion of flesh.

To minimize risk:

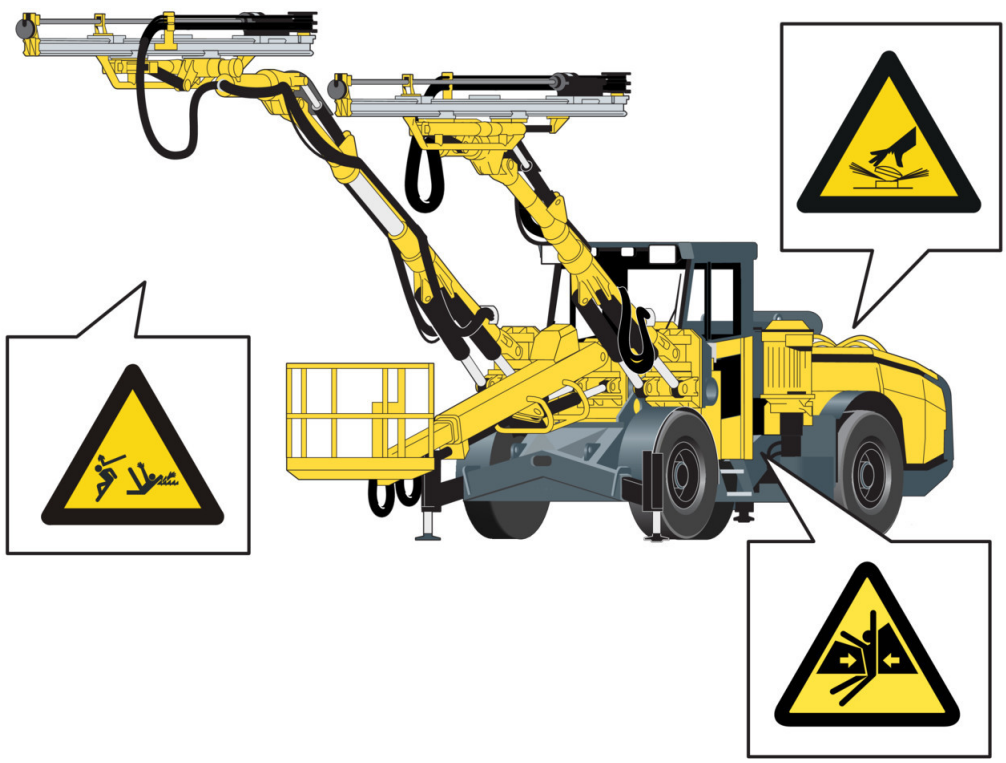
- Make sure that the system is depressurized before maintenance work is started.
- Replace worn hoses.
- Never replace a high-pressure hose with a hose of lower quality than the original.
- Never replace a high-pressure hose with a hose that has a removable coupling.

## 3.7 Hazard Zones

The risk areas of the rig are zones within or around the rig where a person is exposed to risk of injury and health hazards.

The following points must be observed for the risk areas of the factory delivered rig to apply:

- good ventilation must be provided while the diesel engine is running.
- hearing protection, protective safety glasses and helmet must be used in the vicinity of the rig when the rig is operating.

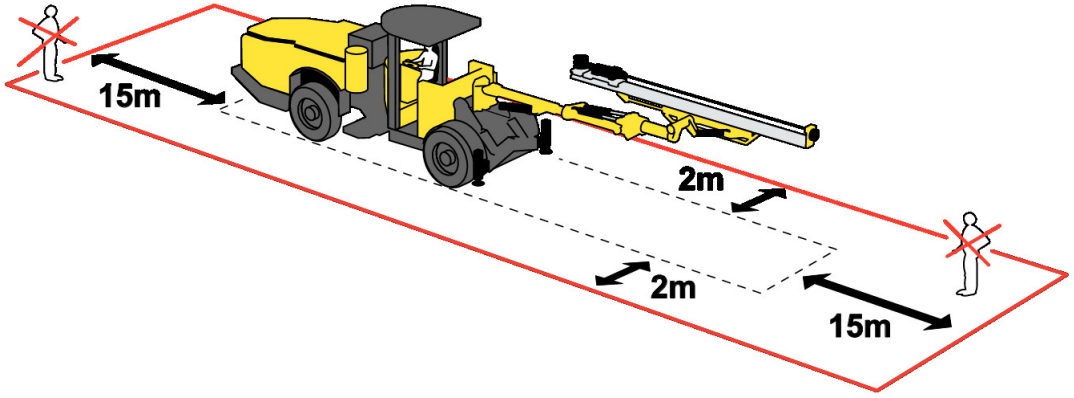


*Risk areas on the rig*

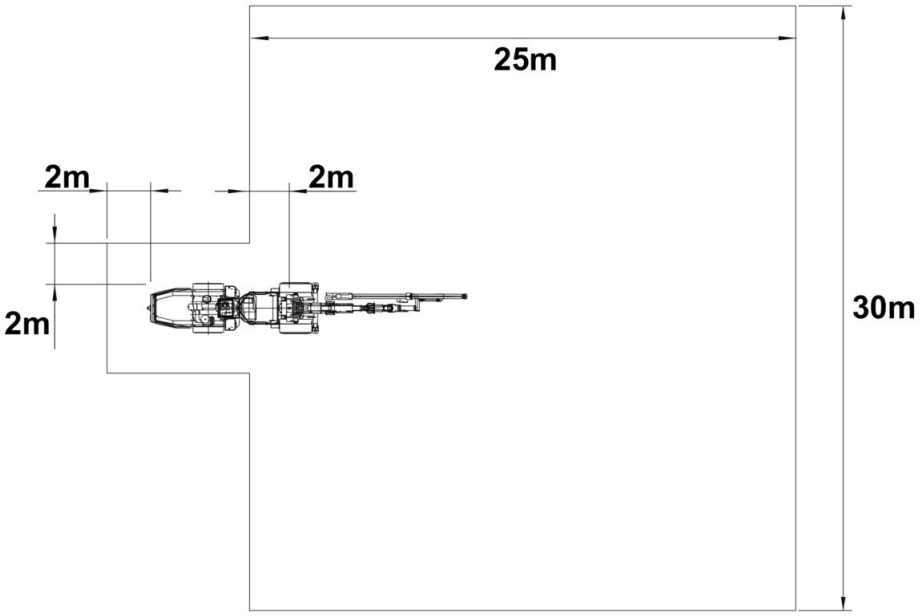
All risk areas on the rig are marked with warning signs. For the meaning of the signs, see Signs chapter.

Observe the following when tramming the machine:

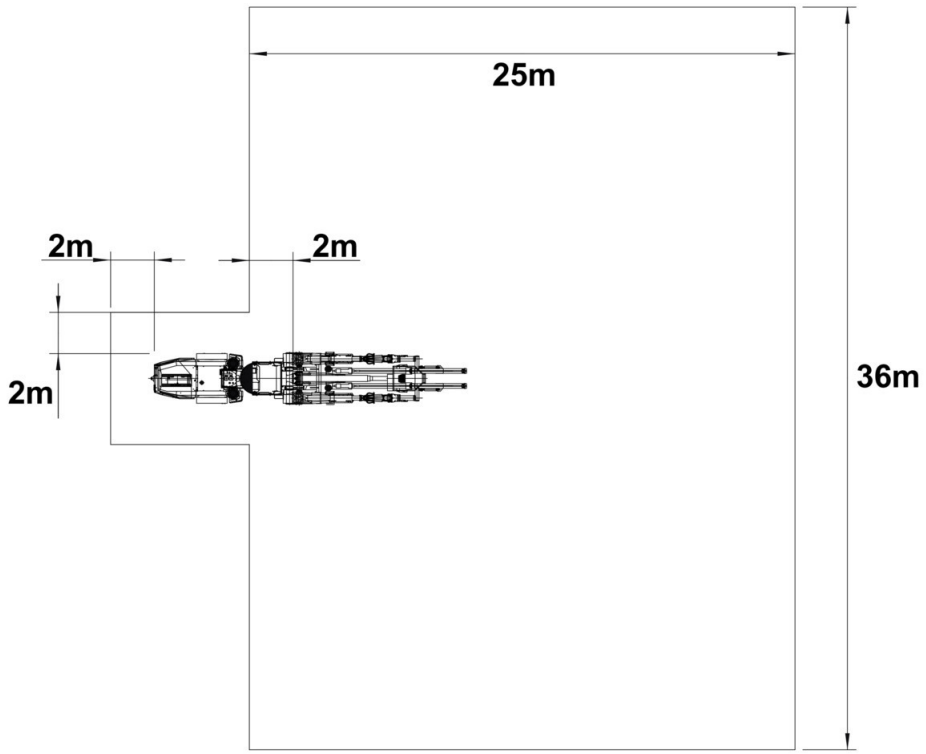
- Make sure that no one is in the machine direction of travel.
- Make sure that no one remains in the machine hazard zone.




*Risk Area During Tramming*




*Risk area for Boomer M1, L1, E1*




*Risk area for Boomer M2, L2, E2*

## 3.8 Safe Area

The operator station, irrespective of the machine being equipped with cab or canopy is the only safe area on the machine.

The area outside the machine hazard zones is considered the safe area around the machine.

Refer to topic "Hazard Zones."

## 3.9 Work Requiring Special Authorization

Only authorized or trained personnel, depending on the type of system must do all the diagnosis, repairs, maintenance, and troubleshooting.

- Electrical system
- Climate control unit
- Air and hydraulic system
- Mechanical system
- Machine software
- Tires and wheels
- Crawler tracks
- Air conditioning unit
- Diesel particulate filter
- Battery System

## 3.10 Working in the Risk Areas of the Rig

Fault finding or working in the rig's risk area involves risk. Accordingly, always carry out the fault finding or the work with great care and accuracy. For further safety regulations, see Safety, Safety regulations.

> ! ***NOTE:*** *Pay attention to the rig's warning signals when you are in the vicinity of the rig, see Safety, Warning Signals.*

### 3.10.1 Specific Expertise

Specific expertise is required for:

**The electrical system**

- Diagnosis of and work on the electrical system must only be performed by appropriately authorized electricians.

**Hydraulic systems**

- Diagnosis of and work on the hydraulic system must only be performed by specially trained personnel.

**Tires and Rims**

- All work on tires and wheels must be carried out by specially trained maintenance personnel. It is important to ensure that correct procedures are followed and that the right tools are used.

**Refrigerant System (Air Conditioner)**

- Diagnosis of and work on the air conditioner refrigerant system must only be performed of specially trained maintenance personnel.

### 3.10.2 Hazard Zones Precaution Measures

All work in the hazard zone requires certain precautions:

- The electric motors and diesel engine must be switched off during fault finding and work within the hazard zone of the rig.
- Hydraulic, pneumatic, and water systems must be depressurized with diagnosis and work in the hazard zone of the rig.
- The power supply of the rig must be disconnected and locked during fault finding and working within the hazard zone of the rig (unplugged and socket locked with a padlock).
- When working in the hazard zone of the rig, secure all components that can move, with supports or strapping before the diagnosis or work is started.

## 3.11 General Risks with Hydraulic Systems

A rock drill has many components and implementations that are controlled by a hydraulic system, either directly or indirectly. Before working with, or inspecting any part, it is important that the individual has good knowledge of how components move and are controlled by the hydraulic system components including the related control circuits.

Before working on or inspecting any component, it must be physically prevented from moving in a way that could cause injury to the mechanic, injury to individuals in the vicinity or damage to property. The mechanic must stay away from the component movement to avoid injury. If the hydraulic system fails, disengages, or receives a control signal, the component tends to move.

Attention must be drawn to the possibility of situations where component or machine movement could react to the release of potential energy. Wherever appropriate there must be confirmation that all measures have been taken to make sure that all sources of potential energy have been relieved and that movement has been physically prevented.

It is also the responsibility of individuals to make sure that all applicable safety regulations have been, and are being observed both before and during any work or inspection is carried out.

# 4 Safety Precautions

## 4.1 General Safety Guidelines

- Personnel operating the machine must be trained and knowledgeable about the machine and the dangers involved.
- Follow the safety instructions and observe the warnings provided in the machine documentation.
- Have manuals readily available to the operator.
- Observe local safety and health regulations.
- Before starting the machine, make sure that all personnel is cleared from the machine hazard zones.
- Observe the machine warning signals.
- Check the safety equipment and emergency stops before each shift and after moving the machine.
- Make sure that the brakes are applied and that the wheels are blocked. Also, at the end of each shift, make sure that the machine is on its jacks when parked.
- Make sure that the brakes are applied and that the wheels are blocked when the machine is parked or left unattended.
- Make sure that the machine is secured with the wheel blocks. Also at the end of the shift, make sure that the machine is on its jacks when parked.
- Step on designated areas only. Do not step on open hatches.
- If the machine or a machine system stops due to an indicated fault, do not use the equipment. Call maintenance personnel.
- Use the equipment only after all faults are rectified.
- Make sure that all control levers are working satisfactorily.
- Do daily maintenance checks before each shift.
- Work done with the machine involves impact on the surrounding environment, for example, vibrations and landslides. All work must be done in accordance with the local safety directives.
- Make sure that needless tools and material are cleared from the work area.
- Checks and adjustments made while the machine is in operation must include at least two people. One person must be within the reach of an emergency stop, while having a good overview of the work.
- No work must be done near the machine when there is a risk of lightning.
- Remove all tools, electrical cords, and other loose items from the machine before starting.
- Always keep safety equipment like HF(Hydrogen Fluoride) gas detector near the machine that is essential to determine the concentration rates of Hydrogen Fluoride.
- All controls must be deactivated for manual handling of drill bits and drill steels on the rig.

## 4.2 Personal Protection

- Always use the following while working with or near the machine:
  - Safety helmet
  - Approved and close-fitting clothing with high visibility
  - Safety shoes or boots
  - Hearing protection
  - Protective safety glasses
  - Seat belt
  - Other necessary safety gear
- Secure long hair.
- Do not wear jewelry.
- Always use protective gloves while handling components, cleaning the machine, and doing maintenance.
- Use hearing protection with high noise reduction capacity.

For some applications, sound pressure levels can be high even with hearing protection.

- Always use protective safety glasses when using a hammer, as chips or debris can cause eye injury.
- Use a hammer with a soft face when driving hardened pins.
- Use a respirator in dusty conditions.
- Make sure that compressed air for cleaning the machine does not exceed 2 bar (30 psi).
- Wear a protective face shield and clothing when cleaning with compressed air.
- Make sure that all respiratory equipment is capable to protect against exposure to Hydrogen Fluoride (HF).
- Always have an eye-rinsing flask filled with clean water.

## 4.3 Safety Precautions During Lifting, Installing, and Connecting

- Make sure that only authorized personnel lift, install, and connect the equipment.
- De-energize the machine before lifting, installing, connecting a component or equipment on machines.
- Use only approved tools and methods.
- Use lifting devices for lifting heavy components.
- Use lifting devices that are inspected and approved and are in compliance with local regulations.
- Only attach lifting equipment to specified lifting points.
- Make sure that no personnel are present under a suspended load.
- Use only ladders and platforms designed for that specific purpose.

## 4.4 Safety Precautions during Tramming

- Follow local traffic regulations.
- Observe that no personnel are present within the machine hazard zone or in the direction of travel.

- Be cautious that impaired visibility can cause a collision risk and also severe injuries.
- Always check ground conditions where the machine is in operation.
- Adapt the speed to the terrain.
- Never exceed the maximum allowed inclination angles for the machine.
- Make sure that the boom system is set to the correct tramming position.
- Make sure that no material is on the conveyor when tramming.

## 4.5 Safety Precautions during Operation

- Check that pedals and controls are easily accessed by the operator before starting the machine. If the controls are not accessible to the operator, the machine must not be operated.
- Make sure that all warning signals on the machine are tested before starting the machine (for example, brake lights, and turn signal).
- Make sure that all controls, indicators, and fire extinguishers (optional items) are working satisfactorily.
- Make sure that all warning signs and safety labels are in place, clean, and fully legible.
- Always test the brakes before operating the machine.
- Report any damage or defects immediately.
- Keep all doors closed while the machine is in operation in order to not disrupt the flow of cooling air and to avoid reducing the amount of noise suppression. A door can be kept open for a short period, only if necessary.
- Keep all doors closed and use the safety chain or corresponding safety feature during operation of the machine to prevent from falling out.
- Keep all doors closed while the machine is in operation in order to not disrupt the flow of cooling air and to avoid reducing the amount of noise suppression.
- Do not lean against closed doors. Doors can be opened from the outside or, the door handle can be unintentionally activated.
- Turn the rotation off when manually handling drill bits and drill rod.
- Activate the machine functionality of collecting dust (water flushing, water mist, or dust collector) during drilling. Rock dust is created during the drilling process and is harmful to the health.
- Stay clear from the exhaust cleaning unit and the exhaust pipes on exhaust openings. High temperature gases escape from the unit.
- Switch off the diesel engine before refueling. Do not handle flammable liquids near hot surfaces, sparks, or a naked flame.
- When working from the service platform, at least one operator must be present on the ground.
- During regeneration, the exhaust gases and the exhaust Aftertreatment System become extremely hot. Do not touch the exhaust Aftertreatment System. Do not cover the exhaust Aftertreatment System or expose it to any flammable materials.
- Carry out standstill regeneration only on an open terrain and in safe distance away from flammable objects.
- Do not use any fuel combustion promoter, such as ethyl ether.

## 4.6 Safety Precautions during Service and Maintenance

- Turn off the machine.
- Switch off the main power supply.
- Switch off both the main battery system (VCB) and the 24-V battery system (VCA) during service and maintenance work on the machine.

- Turn off the main battery switch (VCB), disconnect the VCA and VCB connectors from the main battery system. Lock the connectors in the hangers with a personal lock before working on the battery system.

> ***NOTE:*** *Do not start the maintenance work or reconnect the connectors immediately. Always wait 5 minutes.*

- Switch off the battery isolation switch and secure it with a security pin.
- Follow maintenance procedures in accordance with the maintenance schedule.
- Before working on the machine, make sure that all parts are cooled down.
- Start service or maintenance on the machine only when the machine is on firm and level ground.
- Make sure that the work area is illuminated and clean.
- Make sure that systems are depressurized before starting service or maintenance.
- Make sure that the electrical system is de-energized before starting service or maintenance.
- Secure and strap moveable components before starting service or maintenance.
- If one or more of the following conditions are required for fault-finding or other work, the task must be done by at least two people. One person must be within the reach of an emergency stop while having a good overview of the work being done.
  - The motors or engines are switched on.
  - The hydraulic pumps are activated.
  - The hydraulic, pneumatic, or water systems are pressurized.
  - The electric power is switched on.
- If one or more of the following conditions are required for fault-finding or other work, the task must be done by at least two people. One person must be within the reach of an emergency stop while having a good overview of the work being done.
  - The engine is switched on.
  - The hydraulic pumps are activated.
  - The hydraulic system is pressurized.
  - The electric power is switched on.
- Install the articulation lock in the locked position before starting service or maintenance.
- Tighten the rock drill to the folding plate before doing any maintenance work on the rock drill.
- Secure the boom and bucket in the raised position before starting service or maintenance.
- Restore the articulation lock when work is complete.
- Always secure the dump box and the cab in the raised position before starting service or maintenance under a raised dump box or cab.
- Empty the conveyor and lower the conveyor to the ground before starting service or maintenance.
- Always lower the digging system to the ground before starting service or maintenance.

## 4.7 Safety Precautions Working with Pressurized Components

- Pressurized components must not be exposed to welding or heat treatment.

- Safety equipment such as pressure gauges, pressure control devices, and safety valves must be used while working with pressurized components.
- Installation, design, and connections related to the pressure valve must not be modified.

## 4.8 Safety Precautions Working with Compressor

- Stop the machine if there is an indication that the compressor is overheated.
- Do not open any inspection hatch until the equipment has cooled down.
- Check and maintain the safety devices such as safety valves and over-pressure devices regularly.
- Avoid clogging the compressor with paint, carbonized oil, or dirt, which could disrupt compressor operation.
- Check pressure and control gauges regularly and replace with new ones when they can no longer measure the permitted values.
- Position the machine so that no dust blows against it.
- Close the compressor air outlet valve before connecting or disconnecting a hose. Make sure that the hose is fully-vented before disconnecting.
- Make sure that the open end of the hose or air line is steady before blowing compressed air from the other end. Impact from a loose end could cause injury or damage.
- Do not use external force on the air outlet valves, for example, pulling the hoses.
- Do not install extra equipment directly on air outlet valve. For example, a water separator or a lubricating device.
- Use distribution lines, hose couplings, clamps, and air hoses which are of correct dimension and suitable for the working pressure. Do not use damaged or worn hoses.
- Make sure that there is no pressure before removing the oil filler plug.
- Make sure that compressed air for cleaning the machine does not exceed 2 bar (30 psi).

## 4.9 Safety Procedures During Work in Special Circumstances

In the following special circumstances it may be necessary to divert from prescribed measures:

- Motors or engines are turned on.
- The hydraulic pumps are activated.
- The hydraulic system is pressurized.
- The pneumatic system is pressurized.
- The electric power is switched on.
- The water system is pressurized.

If one or more of the above conditions are required for fault-finding or other work, the task must be performed by at least two people. One person must be within the reach of an emergency stop, while having a good overview of the work being performed.

## 4.10 Special Safety Regulations for the Particle Filter

These safety instructions apply to machines fitted with particle filter, which meet the emission requirements Stage III A or Tier 4.

The particle filter regeneration is started automatically as required. On regeneration, the exhaust gases and exhaust system become very hot. Regeneration can be prevented with a button on the driving panel, see Operator's instructions, chapter Controls, operation..

- In environments or situations where the heat from regeneration can be a danger, regeneration should always be prevented.

If regeneration is prevented for too long, the power of the diesel engine will gradually diminish, see Operator's instructions, chapter Tramming..

## 4.11 Power Supply Cable

**WARNING**

**Risk of Short Circuit or Fire**

Can cause serious injuries or death.

Can cause material damage.

- ▶ Make sure that you use a cable with sufficient area for the current ambient temperature and power output of the machine.
- ▶ Make sure that the cable is intact before using the machine. Replace the cable in the event of damage, discoloration, or deformation.
- ▶ Make sure that the cable is routed on the tunnel floor so that it is protected from being driven over by other mobile machines.
- ▶ Unwind the whole cable for intensive operation.
- ▶ Make sure that the cable does not overheat during intensive use of the machine.

For intensive operation with short intervals for cooling down, there is a risk of the cable overheating. For instance, during long drilling cycles with a short time between the cycles.

Many external factors affect the ability of the cable to cool down. For example:

- The number of layers on the reel.
- The ambient temperature.
- The air exchange.
- The dirt accumulation.

Therefore, make a habit of always unreeling the entire length of the cable during operation.

## 4.12 Guarantee

- Use only Epiroc original parts.

Any damage or operational interruptions caused by using spare parts not manufactured by Epiroc are not covered by the warranty or product liability.

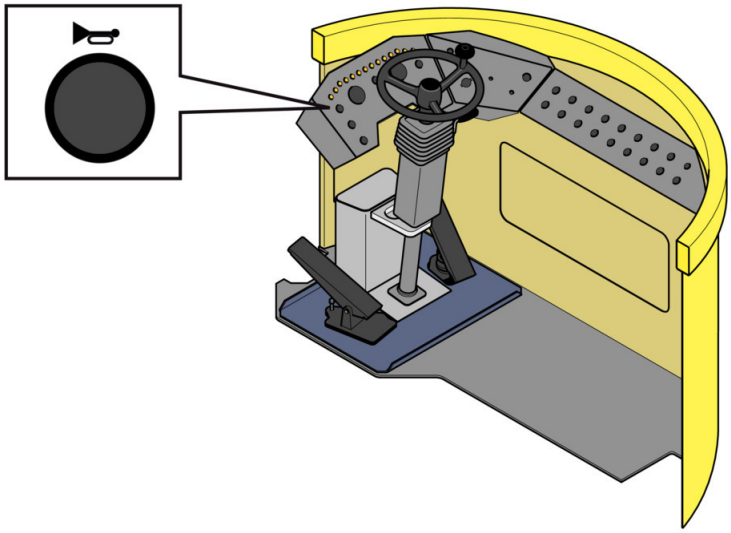
- Epiroc renounces any responsibility for damage caused by unauthorized modification to the machine and its equipment.
- Overloading the machine can result in unnoticed damage during normal usage to the machinery. Such damage is not covered by the warranty.
- The manufacturer is not liable for damage caused by inappropriate use.
- Damage to equipment or injury to personnel that occurs as a result of substandard repairs or older unrepaired damage, is not covered by the warranty.

# 5 Warning Signals

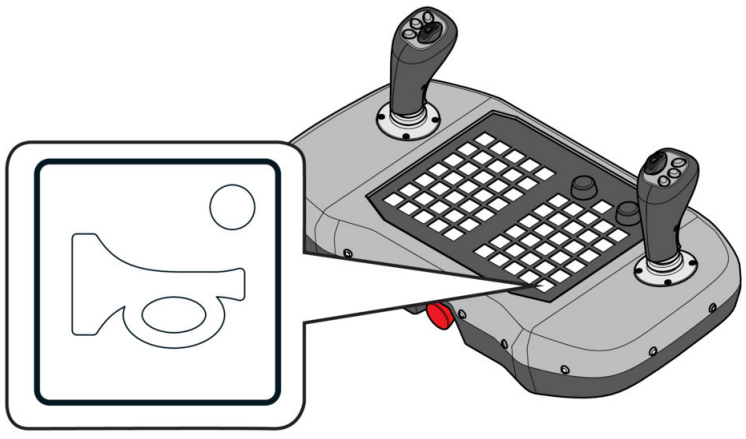
## 5.1 Acoustic Warning

### 5.1.1 Signal Horn Button Location

The signal horn can be used to draw the attention of personnel around the machine during an operational sequence, movement of the machine, or during an emergency.



*Signal Horn on Driving Panel*



*Signal Horn on Operating Panel for Machines with RCS 5*

### 5.1.2 Reversing Alarm

The drill rig has a reversing alarm that sounds loudly when the drill rig is reversing. This is to ensure the attention of bystanders that the drill rig is reversing.

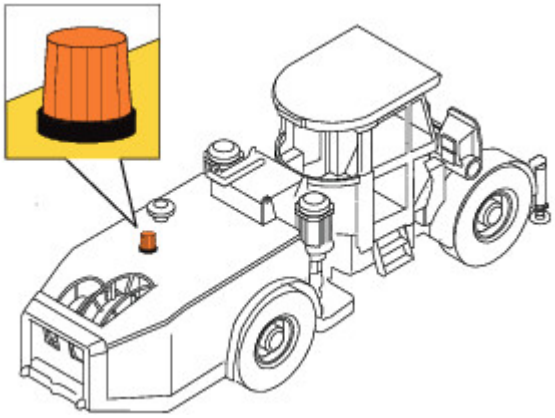
### 5.1.3 Start Alarm

A start alarm sounds during start-up to indicate that the machine has been started and that the power to the machine and the systems is activated. The alarm stops automatically a few seconds after start-up.

## 5.2 Visual Warning

### 5.2.1 Warning Beacon

The rig is equipped with a warning beacon that lights up when the ignition is switched on. This is in order to ensure the attention of bystanders when the rig is about to be moved.



*Warning beacon*

# 6 Safety Functions

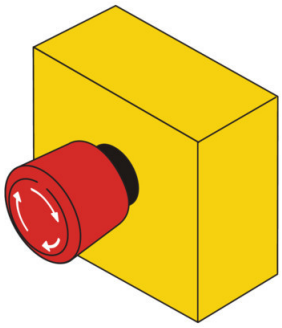
## 6.1 Emergency Stop

**NOTICE**

**Machine Damage**

Incorrect use of emergency stops can cause technical problems or damage to the machine and related equipment.

- ▶ Only use emergency stops in hazardous situations, or when a hazardous situation is likely to arise.



*Example of an Emergency Stop*

**WARNING**

**Moving Components**

The rock drill does not stop immediately after an emergency stop is pressed, which can result in an injury or damage.

- ▶ Stay clear of drill rig area until it comes to a complete halt.

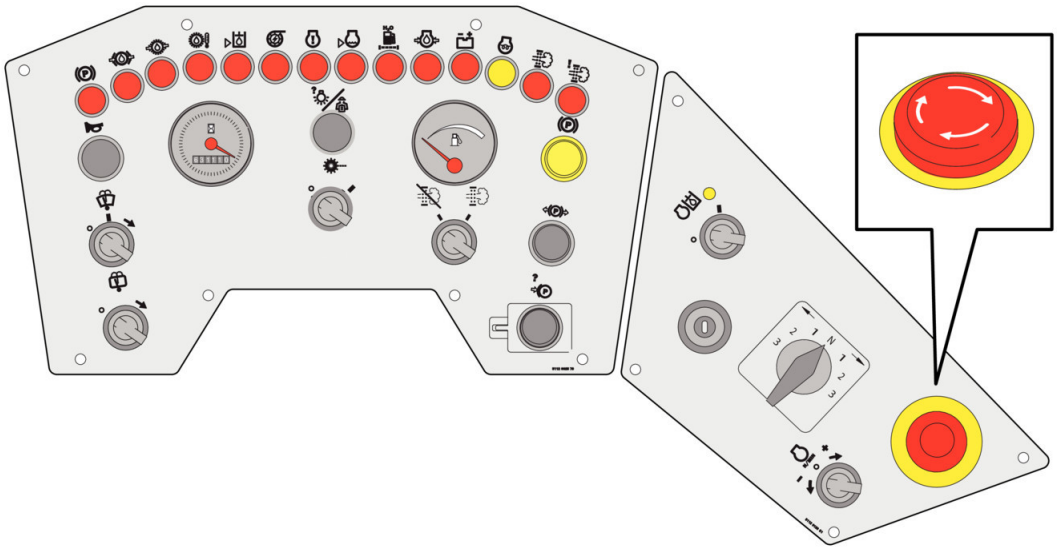
- When an emergency stop is pressed, power to the machine is cut and the machine stops. All the emergency stops on the drill rig, control consoles, remote panels, crawler (if present), and power packs, break the same circuit.
- The power supply to all the machine units is cut off but the main power switch is in the ON position. Hydraulic pressure is maintained in the system to prevent unwanted downward movement.
- In the event of hose rupture or other dangerous situation, activate the emergency stops to stop the diesel engine and the hydraulic pumps automatically.

When the emergency stop button is pressed:

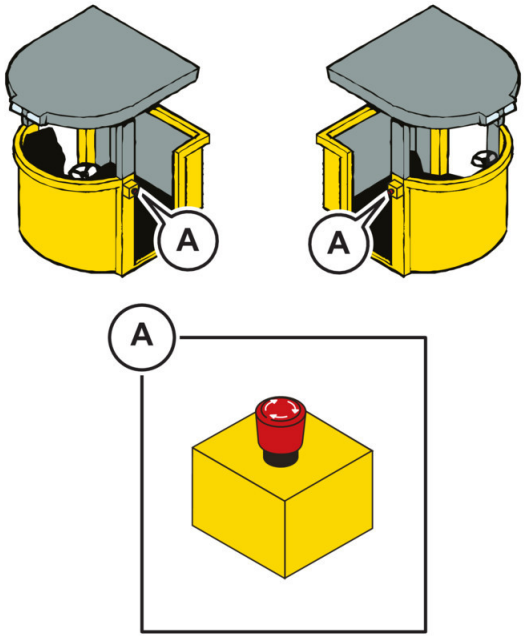
- The engine is turned off.
- The parking brakes are applied.
- The electric motor is turned off.
- The transmission goes into neutral position.
- The headlights are switched on.
- The fuel supply is interrupted.

> ***NOTE:*** *The emergency stop must be reset after being activated.*

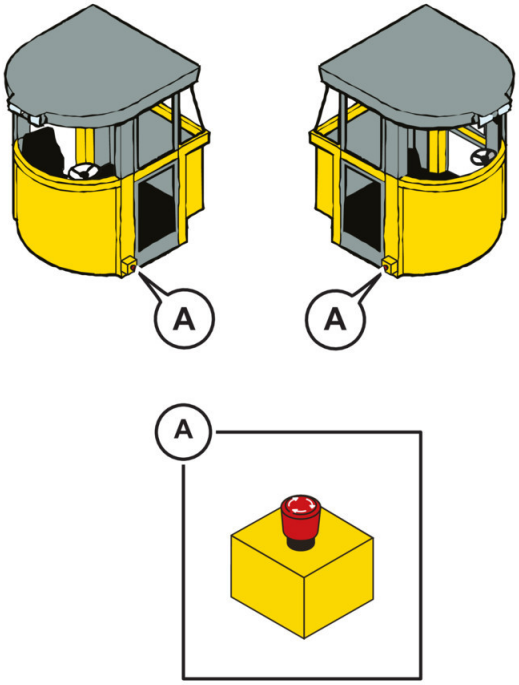
### 6.1.1 Location of Emergency Stop



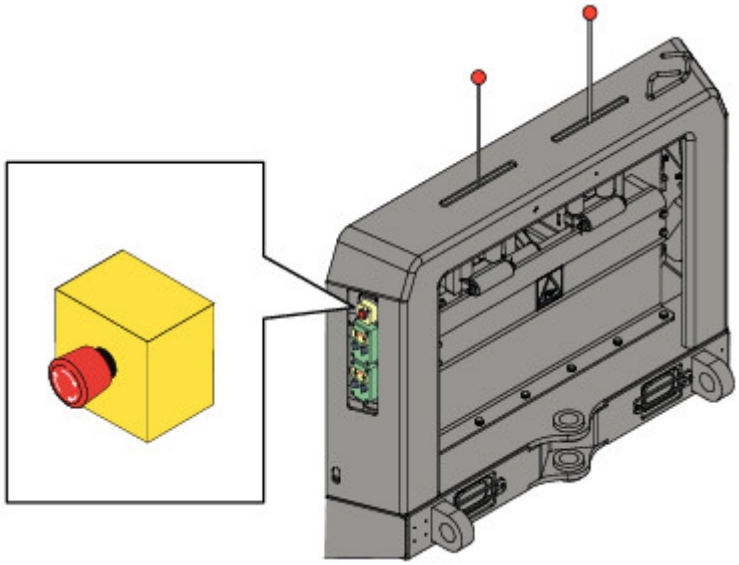
*Emergency Stop on Driving Panel*



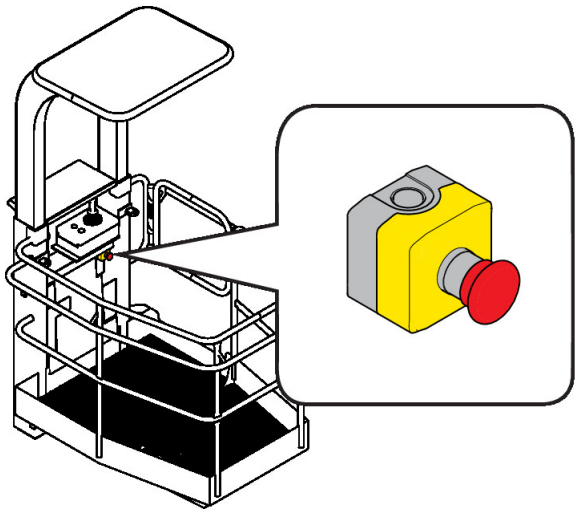

*Emergency Stop on Operators Station*




*Emergency Stop on Cabin*



*Emergency Stop on Rear Frame*



*Emergency Stop on Service Platform*

## 6.2 Firefighting Equipment

### 6.2.1 Description of Fire Extinguishers

The handheld fire extinguishers are **optional.**

Make sure that the machine is equipped with approved portable fire extinguishers in accordance with the local regulations and laws that apply. The machine is equipped with designated locations for the fire extinguishers.

#### Classification of Fires

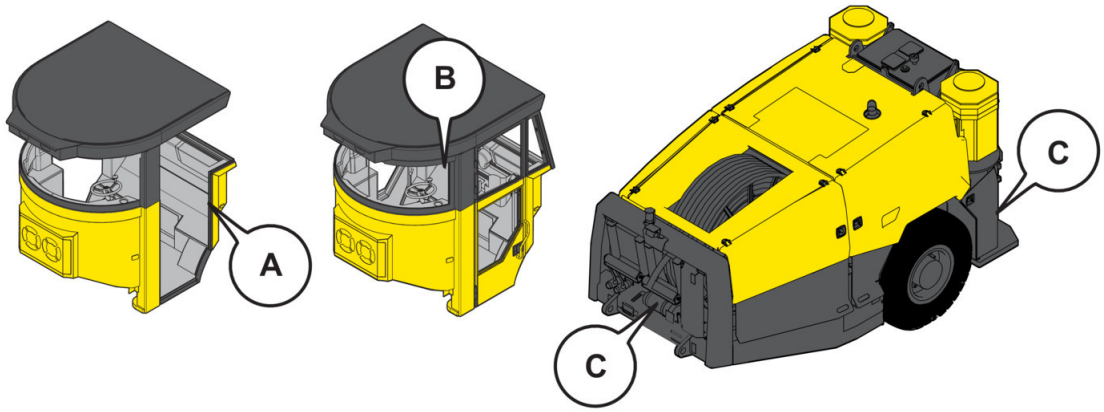
| Class | Type of Fire |
|---|---|
| A | Fires of common materials that burn with both flames and glow (for example, most interior materials) |
| B | Fluid fires such as gasoline and oil |
| C | Gas fires |

Obey the instructions on the fire extinguisher.

#### Locations of Fire Extinguishers

The handheld fire extinguishers are **optional.**

| | |
|---|---|
| ! | ***NOTE:*** *The machine is equipped with designated locations for fire extinguishers.* |




*Designated Locations for Fire Extinguishers*

| | | | |
|---|---|---|---|
| A | Fire extinguisher location for machine with canopy | B | Fire extinguisher location for machine with cab |
| C | Fire extinguisher location on machine. | | |

! ***NOTE:*** *Location of the fire extinguishers on machine differs depending on rig model.*

### 6.2.2 Fire suppression system

Several different manual and automatic fire fighting systems are available as an option. These systems use powder, liquid or gas (e.g. carbon dioxide). They are used to extinguish any engine fires and in certain cases fires in electrical cabinets.

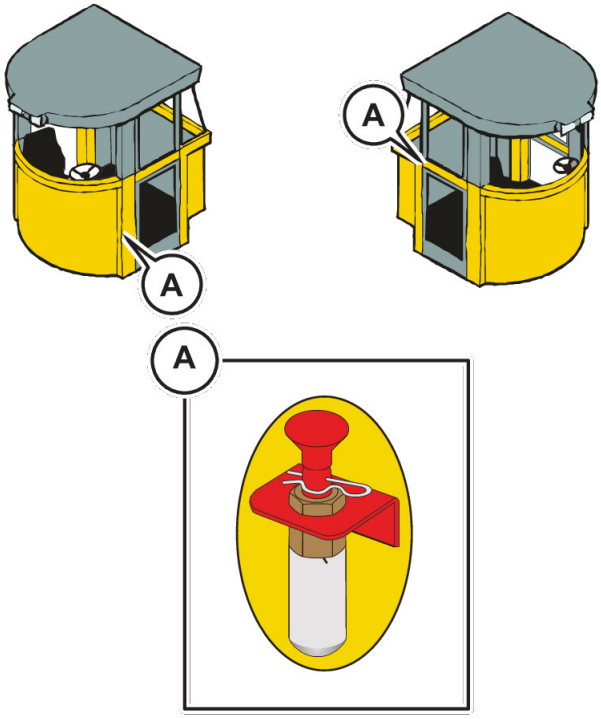
The fire fighting systems are not designed to extinguish all types of fire, especially large collections of flammable materials with ample supplies of oxygen. It is therefore necessary to provide additional means of extinguishing residual fires should the fire fighting systems not succeed in extinguishing it completely.

For further information on the fire fighting system, see maintenance instructions, Fire fighting equipment.

For further information on fire fighting system of Presto or Fogmaker type, see enclosed instruction book from the supplier.

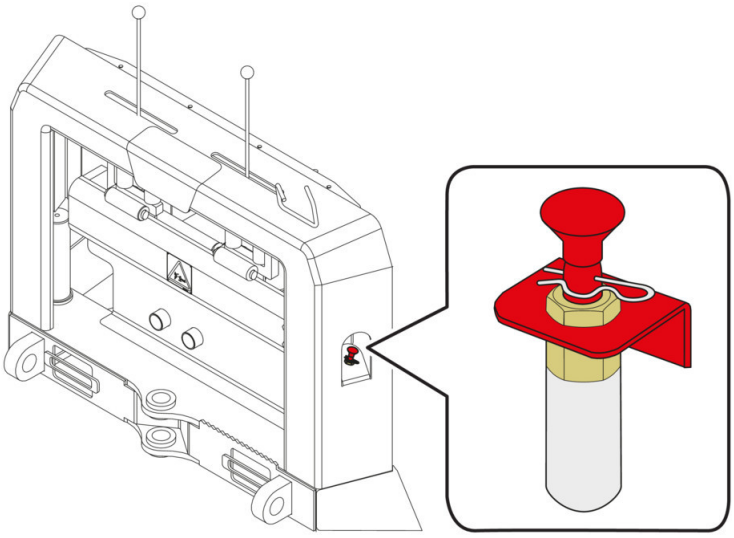
#### Location of Fire Fighting System Actuators

The automatic fire suppression system is an option.




*Location of Actuator on Operator Station, Cab or Canopy*

For machines with cab lift, the actuator is on the frame behind the cab on the right-hand side.



*Location of Actuator on Rear Frame*

### 6.2.3 In Case of Fire - Fire Extinguisher

| | |
|---|---|
| ! | ***NOTE:*** *Follow local regulations if there is fire.* |

1. Bring the machine to a complete stop.
2. Apply the parking brake.
3. Stop the engine.

4. Use a handheld fire extinguisher to extinguish the fire.

> ! ***NOTE:*** *Use the handheld fire extinguisher according to the manufacturer instructions.*

5. Perform the following steps only if this action does not jeopardize safety:
   a. Turn off the battery isolation switch.
   b. Close the fuel supply valve.

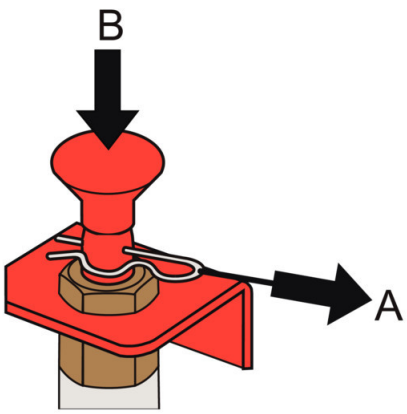
> ! ***NOTE:*** *Restart the machine only when the cause of fire has been established and faults have been corrected.*

6. Replace used fire extinguishers with approved new extinguishers.
7. Clean out any extinguisher residue in the machine before operation.

### 6.2.4 In Case of Fire - Automatic Fire Suppression System

> ! ***NOTE:*** *Follow local regulations in case of fire.*

Activating the automatic fire suppression system activates the emergency stop.




*Activating Automatic Fire Suppression System Manually*

Precondition ✓ The parking brake is applied.

1. To activate the automatic fire suppression system, pull the pin (A) and push the activating device (B).

Step result ➔ The emergency stop is activated and the power to the machine is cut.

2. Perform the following steps only if this does not jeopardize safety.
   a. Extinguish the fire using a handheld fire extinguisher, if necessary, as per the manufacturer instructions.

b. Turn off the main power switch and battery isolation switch, or whichever is present on the machine.

c. Close the fuel supply valve, if present.

> ***NOTE:*** *Have a fire extinguisher ready in case the fire reignites.*

> ***NOTE:*** *Do not restart the machine until the cause of fire has been established and faults have been corrected.*

3. Replace the used fire extinguishers with approved new extinguishers and inspect the automatic fire suppression system.
4. Clean out any extinguisher residue in the machine before operation.

## 6.3 FOPS

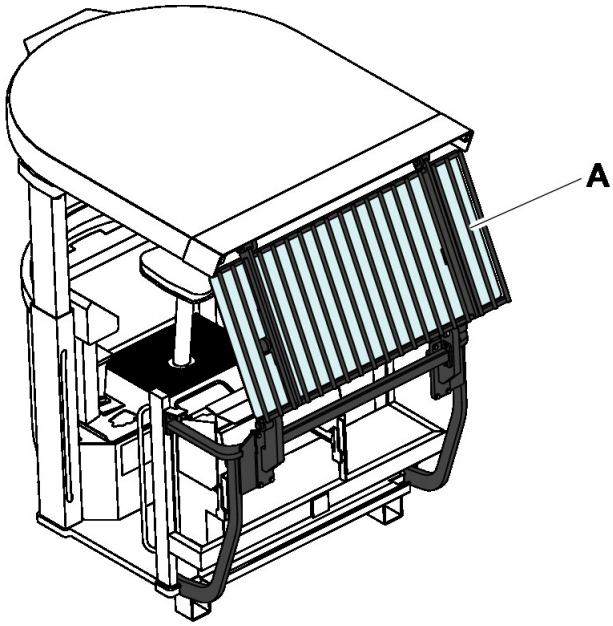
- The rig is equipped with FOPS = Falling Object Protective Structure. FOPS protects the driver from falling objects.
- Rigged equipped with "low cabin, only for seated operator" are only FOPS-approved for seated operator. This cabin is not FOPS-approved for a standing operator.
- If the FOPS structure is damaged, contact Epiroc's local customer center before starting any repair attempts.
- Do not change the structure of the FOPS!
- Changes such as welding, borehole cutting or mounting of tools in the FOPS structure may weaken the structure and render the FOPS certification invalid, and reduce the protection.

A data plate shows that the rig is equipped with FOPS. It is located on the carrier unit of the operator's seat.




*Data plate FOPS*

## 6.4 Grizzly Bar




Grizzly bar (A) protects the operator from any landslides in the front.

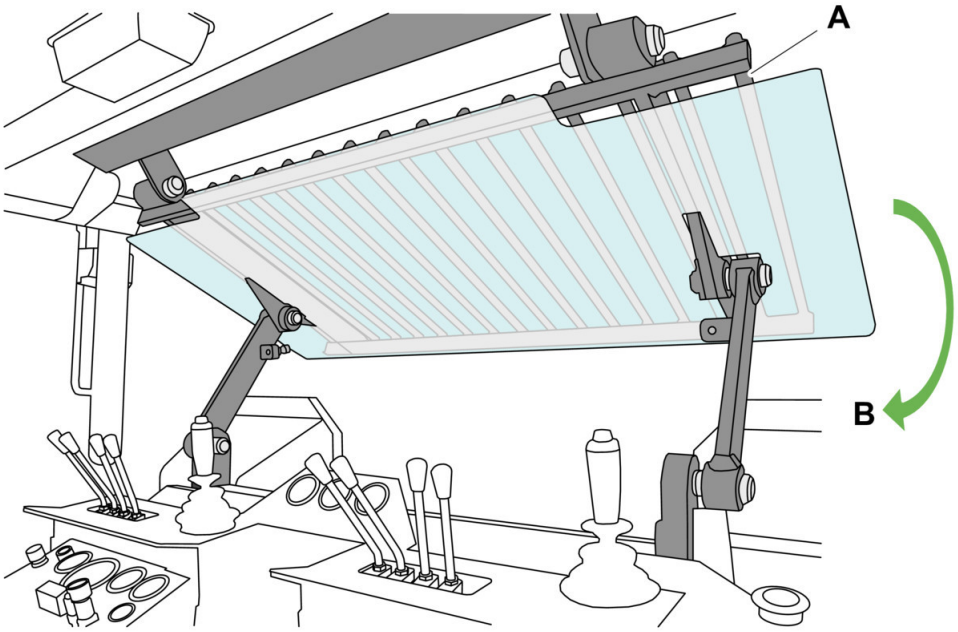
### 6.4.1 Lowering Canopy

**CAUTION**

**Risk of Crushing Injuries**

Moving parts can cause severe personal injury

- ▶ Observe caution when raising and lowering the canopy and grizzly bar.
- ▶ Carefully follow the instructions.



Precondition ✓ Operator seat is folded forward.

○ Lower the canopy until the grizzly bar (A) is in horizontal position (B).

### 6.4.2 Raising Canopy

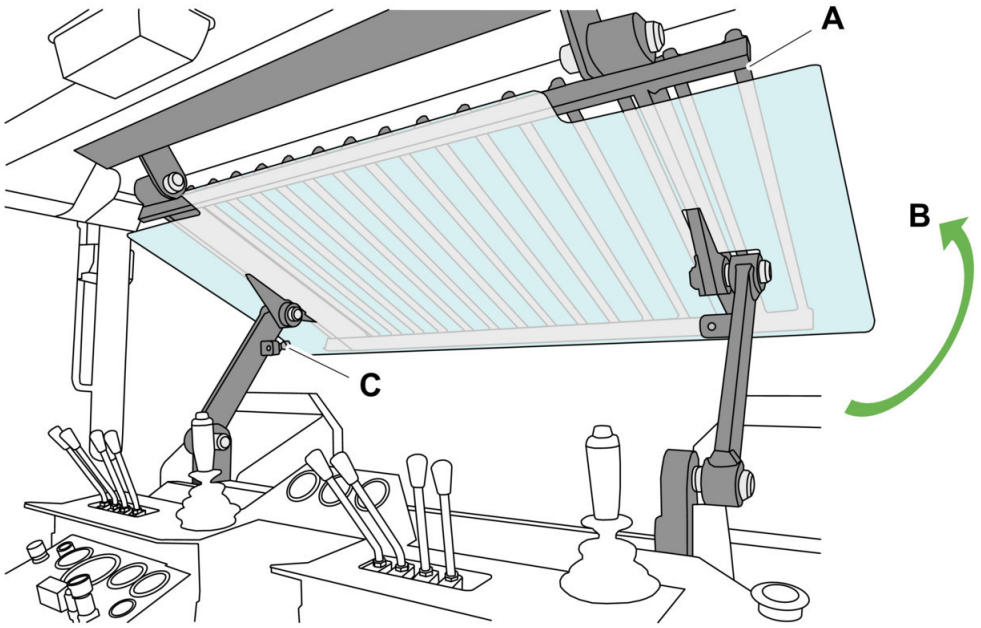
**⚠ CAUTION**

**Risk of Crushing Injuries**

Moving parts can cause severe personal injury

▶ Observe caution when raising and lowering the canopy and grizzly bar.

▶ Carefully follow the instructions.




○ Raise the canopy until the grizzly bar (A) is in a vertical position (B) against the stop (C).

# 7 Signs

## 7.1 General Guidelines for Signs

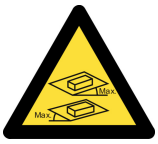
- It is essential that all machine signs are in correct locations, are clean and fully legible.
- To clean a sign, use only a soft cloth, water, and soap. Do not use solvent, gasoline, and the like.
- Replace any missing or damaged signs. Contact your Epiroc representative for new safety signs.

## 7.2 Prohibition Signs

| Image | Description |
|---|---|
|  | No admittance.<br>No admittance for unauthorised personnel.<br>Violation of these instructions can result in personal injury. |
|  | Do not step here. |

## 7.3 Warning Signs

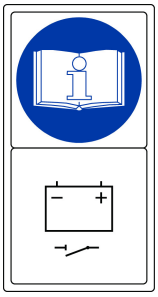
| Image | Description |
|---|---|
|  | High noise level.<br>Can permanently impair hearing.<br>Use approved hearing protection. |
|  | Danger of slippery surfaces.<br>Can cause severe injuries.<br>Always pay extra caution when walking on the hoods. |
|  | Hand and body crush<br>Could cause severe injuries. |
|  | Danger of scalding from hot surface.<br>Can cause severe injuries.<br>Do not touch the surface. |

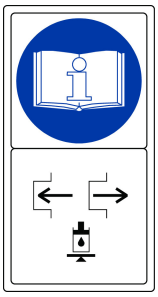
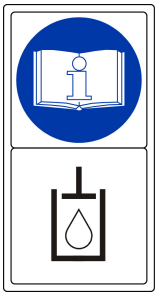
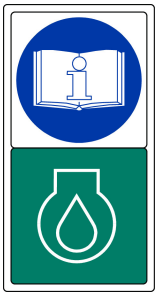
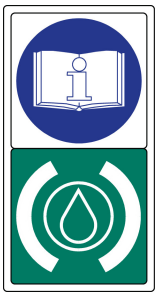
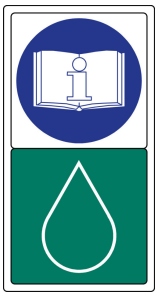
| Image | Description |
|---|---|
|  | Can cause severe injuries.<br>Release the pressure before removing the cap. |
|  | Danger from moving and rotating parts.<br>Could cause severe injuries. |
|  | Danger from swinging and crushing parts.<br>Can cause severe injuries.<br>Keep away from hazard zones during operation. |
|  | Risk of scalding.<br>Could cause severe injuries. |
|  | The boom falls diagonally during service work or breakdown.<br>Can cause personal injury or property damage.<br>Secure boom using straps or supports during service work. |
|  | Danger of tipping over if permitted inclination angles are exceeded.<br>Incorrect handling can cause personal injury and damage to the machine. |
|  | Danger of tipping when tramming<br>Injuries and damage to machine could occur.<br>When tramming the machine, the booms and other positioning units must be retracted to the maximum and positioned straight forward without being swung out.<br>During tramming at inching speed, at a maximum speed of 1 km/h (0.62 mph), the booms and feeder and other positioning units must only be swung out within the swing radius of the machine. |
|  | Tipping risk during drilling<br>Can cause severe injuries and property damage.<br>Extend the jacks to a maximum during machine operation and keep the jacks in contact with ground and fully relieve the weight on the wheels. |
|  | High voltage<br>Incorrect handling can be fatal.<br>Work on electrical systems must be carried out by authorized electricians. |

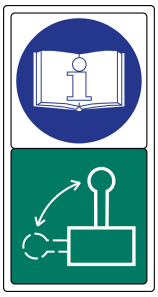
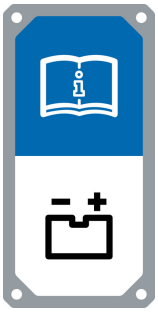
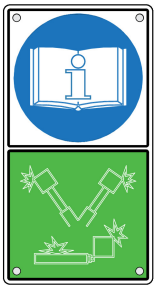
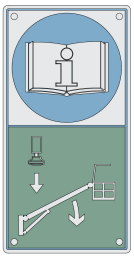
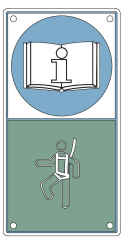
| Image | Description |
|---|---|
|  | Service platform.<br>Danger of crushing service platform.<br>Can cause severe injuries.<br>A manned service platform must only be operated from the cage, not from the operator station. |
|  | Example of maximum load permitted, including one operator, on the service platform.<br>Overload can cause severe injuries and property damage.<br>Other possible loads: 300, 350, 400, 500, 560 and 1000kg. |
|  | Maximum load permitted on the service platform.<br>Overload can cause severe injuries and property damage. |
|  | Maximum load permitted, including operator, on the service platform.<br>Overload can cause severe injuries and property damage. |
|  | Side crush service platform.<br>Could cause severe injuries. |
|  | Maximum number of persons permitted in the service platform.<br>Overload can cause severe injuries. |
|  | Refrigerants under pressure.<br>Can cause severe injuries.<br>Risk of compressor breaking down.<br>Refrigerant service to be carried out by authorised personnel only.<br>Do not use air conditioning in the event of refrigerant breakdown, leak or faults. |
|  | Laser Beam |

| Image | Description |
|---|---|
|  | Laser Beam<br>Risk of injury to eyes.<br>Do not look at the beam. |
|  | Laser Beam<br>Risk of injury to eyes.<br>Do not look at the beam.<br>Do not put optical instruments in the way of the beam. |
|  | Laser Beam.<br>Risk of injury to eyes.<br>Avoid exposure to radiation. |

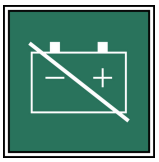
## 7.4 Mandatory Action Signs

| Image | Description |
|---|---|
|  | Read the instructions.<br>Incorrect use of the machine may cause personal injury and property damage.<br>Observe the indications given by the warning signs and follow instructions to avoid serious injuries. |
|  | Read the instructions.<br>The rig is equipped with a battery isolation switch. |

| Image | Description |
|---|---|
|  | Read the instructions.<br>The carrier battery supplies the hydraulic oil level switch with current.<br>The battery isolation switch must be turned on when drilling is in progress.<br>Make sure to switch off the battery isolation switch when rig is not in operation. If not done the battery gets discharged. |
|  | Read the instructions.<br>The hydraulic system must be filled with hydraulic oil. |
|  | Read the instructions.<br>Fill with engine oil. |
|  | Read the instructions.<br>Fill with brake fluid. |
|  | Read the instructions.<br>Fill with lubricant. |

| Image | Description |
|---|---|
|  | Read the instructions to activate the emergency stop. |
|  | Use seat belt. |
|  | Alternator<br>• Read the instructions<br>• This machine is equipped with an alternator<br>• Disconnect the battery cables before removing the alternator or regulator and when giving the battery a booster charge<br>• When performing electrical welding on the machine or fitted equipment, detach the charging regulator cables as well |
|  | Read the instructions.<br>Collisions with tunnel walls and other equipment must be avoided while the service platform is in use. |
|  | Read the instructions.<br>Pull the button to lower service platform in the event of no hydraulic pressure. |
|  | Read the instructions.<br>Safety harness must be worn. |

## 7.5 Information signs

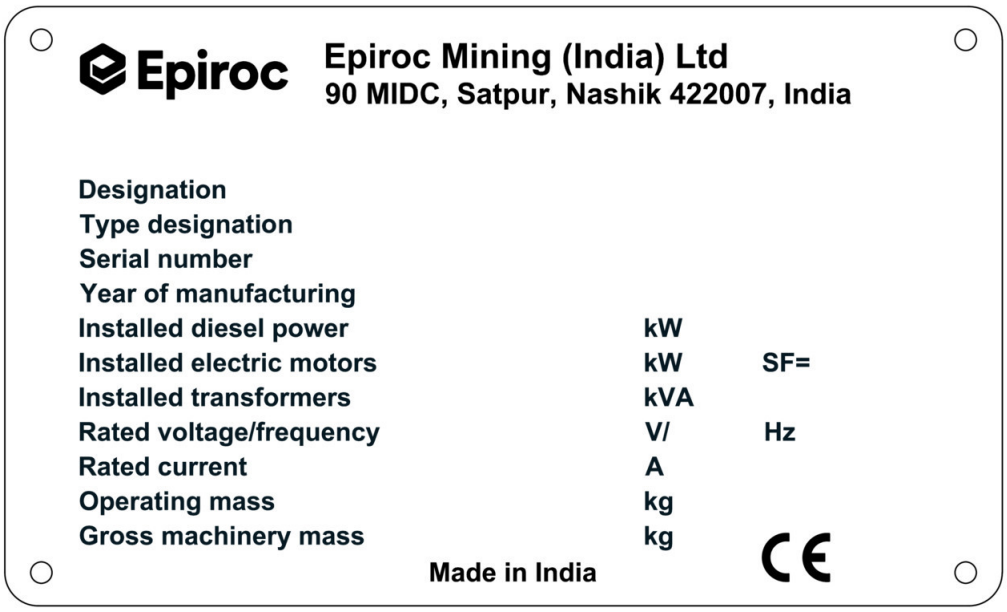
| Image | Description |
|---|---|
|  | Fire extinguisher |
|  | Fire fighting system actuator |
|  | Emergency exit |
|  | Lifting eye |
|  | Water inlet |
|  | Air intake |
|  | Fuel |
|  | Fuel cock |
|  | Battery isolation switch |
|  | Draining point |

| Image | Description |
|---|---|
|  | Washer fluid |
|  | Lubrication point |

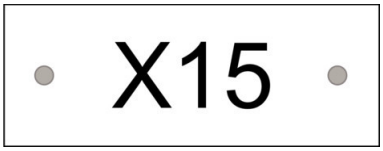
## 7.6 Other Signs

- **Data plates**
  - Rig data plate, see Operator's instructions Technical Data Rig.
  - Part component data plate (e.g. for a boom)
- **Decal signs**
- **Identity plates**

All electrical components have their own sign with an identifying name.




*Example data plate*




*Example of identity plate*

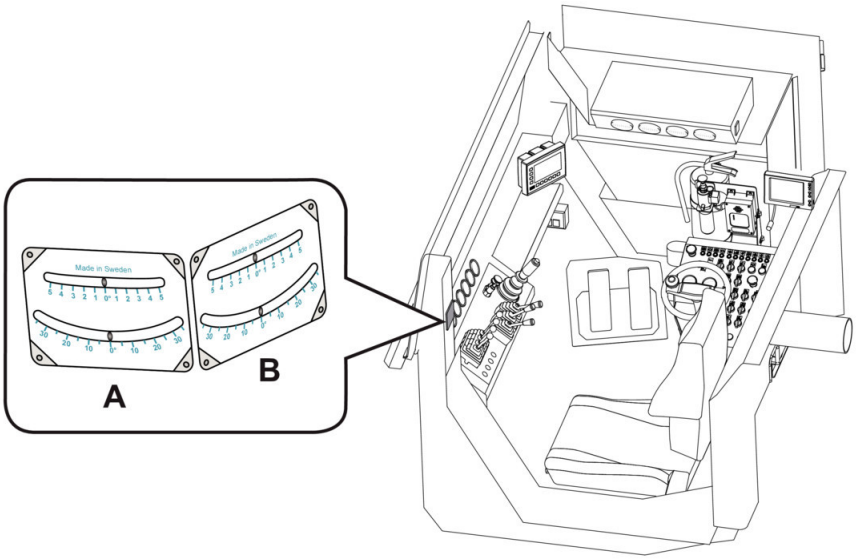
# 8 Stability

The machine is sufficiently stable for its intended operations. There is no risk of overturning during intended use. The stability and grade limits that are provided for the different working positions correspond with the angles at which the machine will not overturn.

The machine operator is responsible for machine stability. If the operator questions machine stability for any reason, stop the machine and consult with a supervisor.

> ! ***NOTE:*** *This information is valid for a machine in its original factory configuration. Unauthorized modifications or extra equipment can cause instability.*

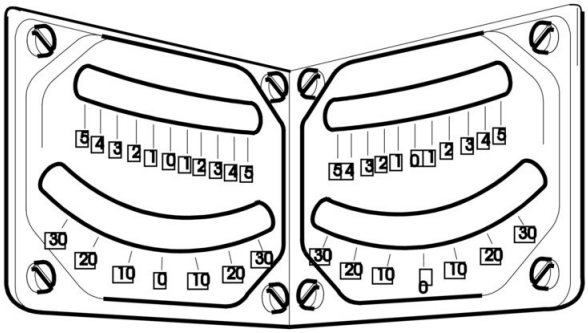
## 8.1 Spirit Level




*Positioning of Machine Spirit Level*

| | | | |
|---|---|---|---|
| A | Lateral | B | Longitudinal |

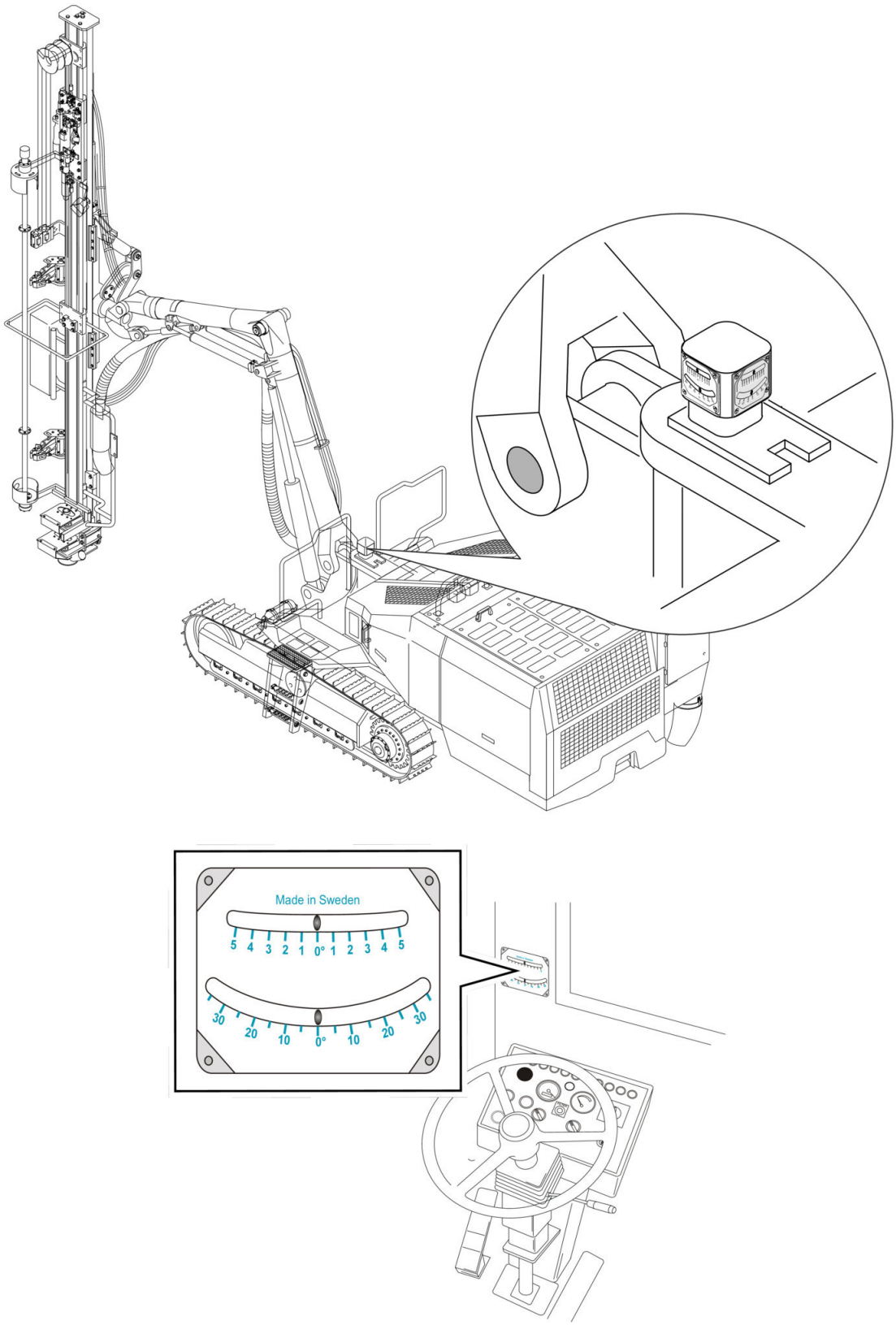
> ! ***NOTE:*** *The signs can be separately located each on its own window pillar.*



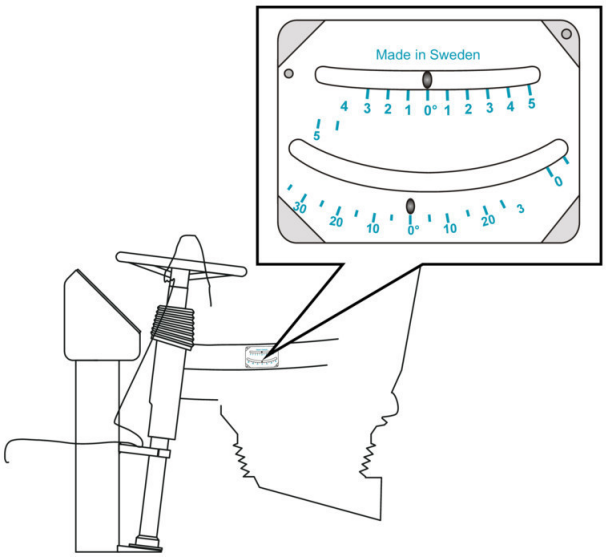
*Spirit Level*



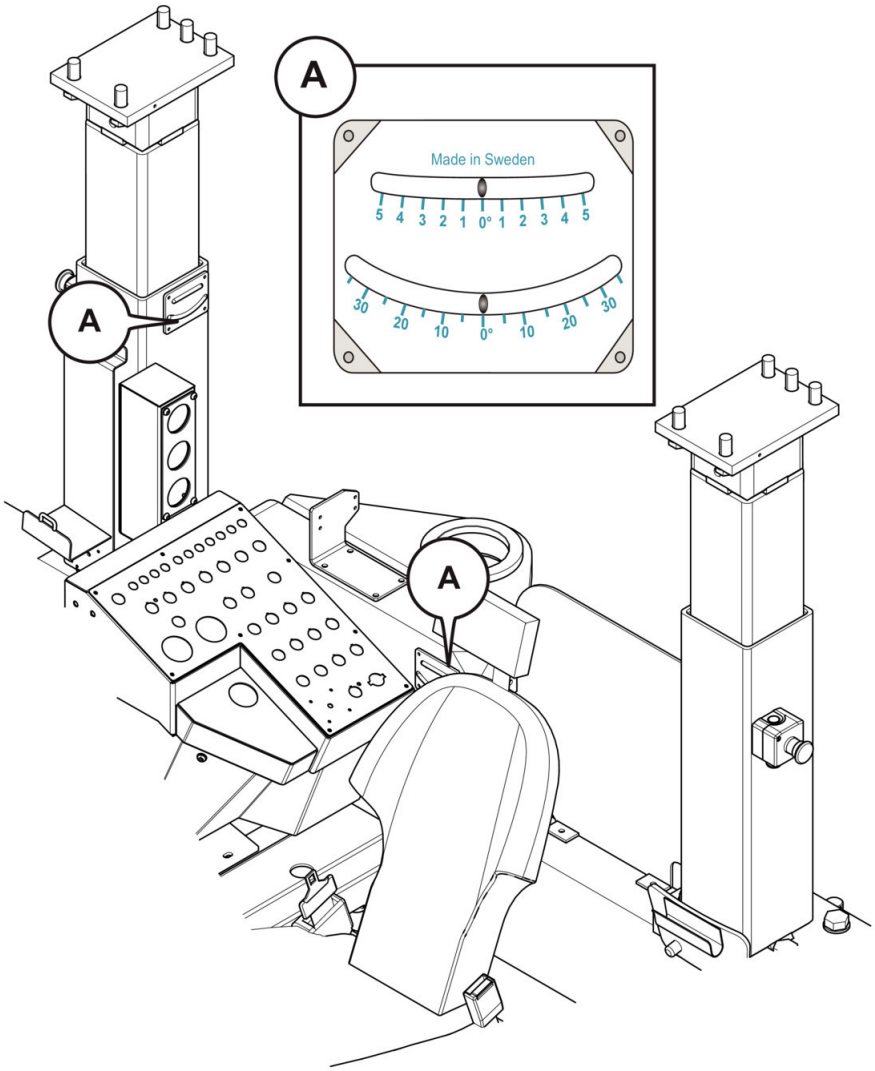
*Spirit Level*




*Spirit Level, Longitudinal*




*Spirit Level, Lateral*




*Spirit Level*




| | | | |
|---|---|---|---|
| A | Spirit level | | |



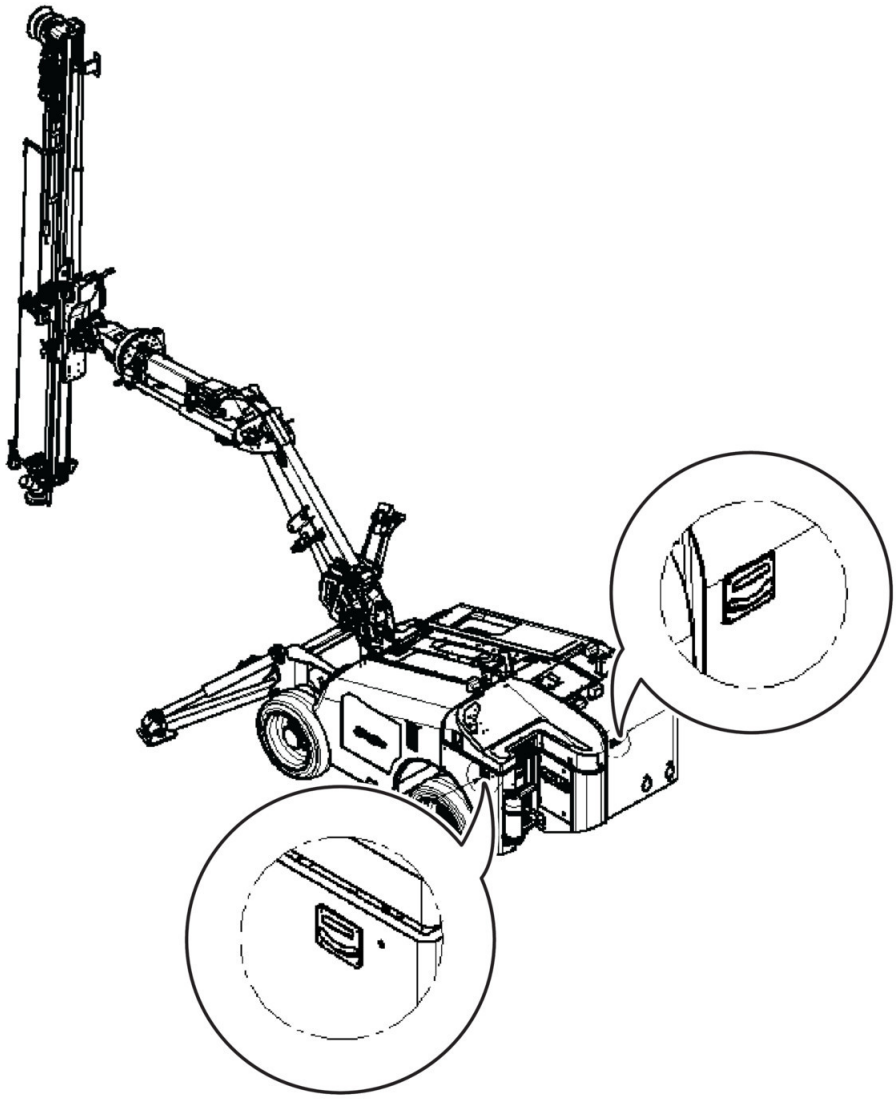

| | | | |
|---|---|---|---|
| A | Spirit level | | |



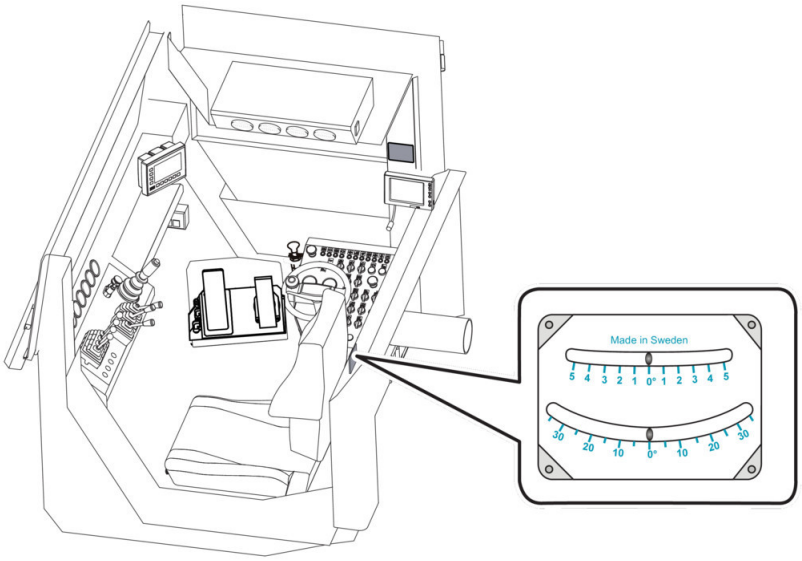

| | | | |
|---|---|---|---|
| A | Spirit level | | |



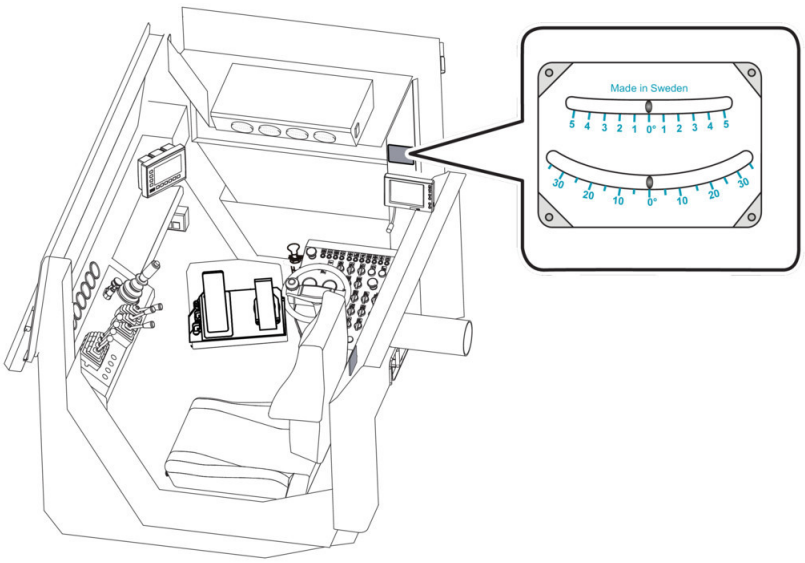

| | | | |
|---|---|---|---|
| A | Spirit level | | |



*Spirit Level*




*Spirit Level, Lateral*




*Spirit Level, Longitudinal*

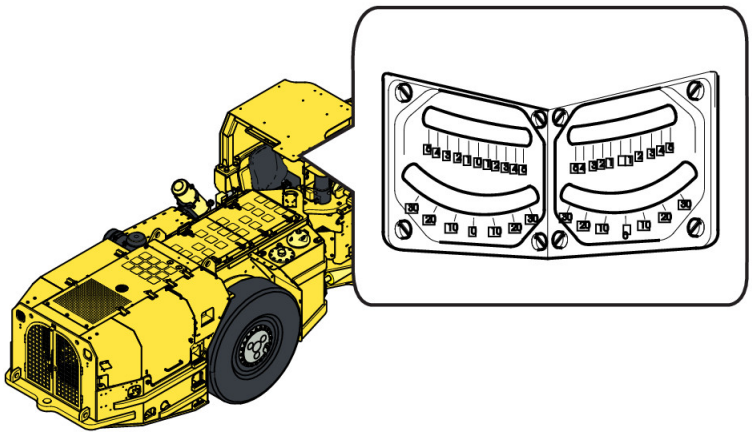
> ***NOTE:*** *The system is an option.*

The spirit level shows at which angle the machine is standing. The machine can tip over if the allowed inclination angles are exceeded.

The gradient meter shows the chassis frame inclination and not the ground inclination.

**See Reference Documentation**

Technical Data in the Operation manual for details about allowed inclination angles.



## 8.2 Rig Stability during Different Operations

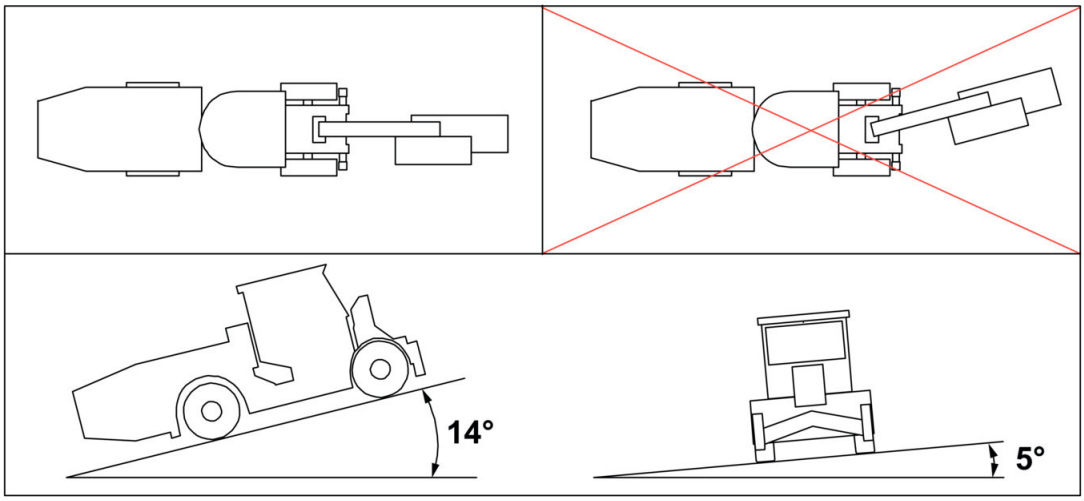
The angles specified for the different work operations below correspond with the inclinations at which Epiroc stipulates the rig should not tip over.

> ***NOTE:*** *In the event of sudden boom movements, one of the rig's wheels may lift from the ground, even within the specified stability angles.*

> ***NOTE:*** *The stipulated stability only applies for rigs that have not been modified with, for example, retrofitted equipment that has not been approved by Epiroc.*

### 8.2.1 Stability during Tramming at Normal Speeds

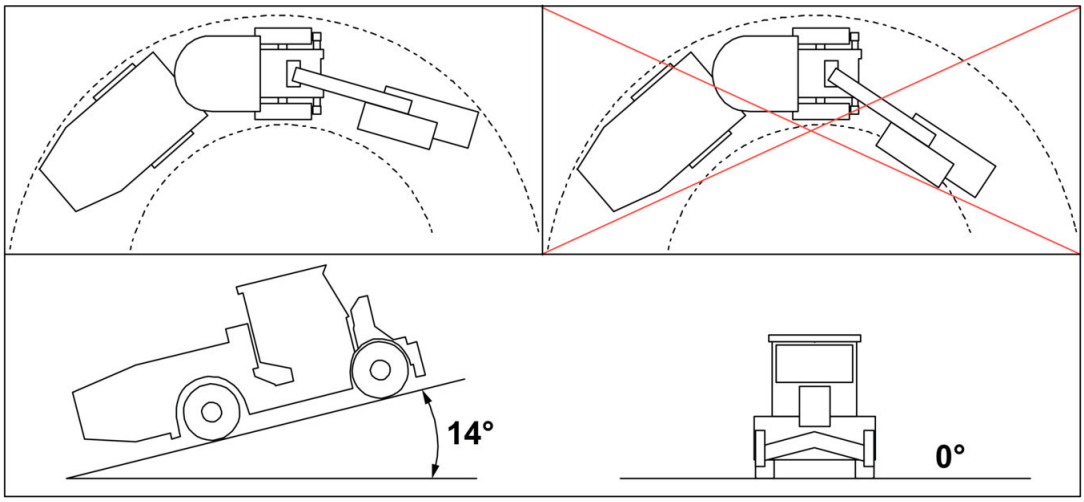
- Tramming means operating the rig forward at normal tramming speed.
- Booms, feeders and any other positioning units must be max. retracted and aligned with the rig's line of symmetry, i.e. positioned straight forward, and positioned in tramming position, see Operator's instructions Positioning.




- While tramming at normal speeds, the maximum machine inclination in the tramming direction is ± with a camber of ± 5º.

> ***NOTE:*** *In the event of sudden boom movements, one of the wheels can lift from the ground, even within the specified stability angles.*

### 8.2.2 Stability during Tramming below 1 km/h



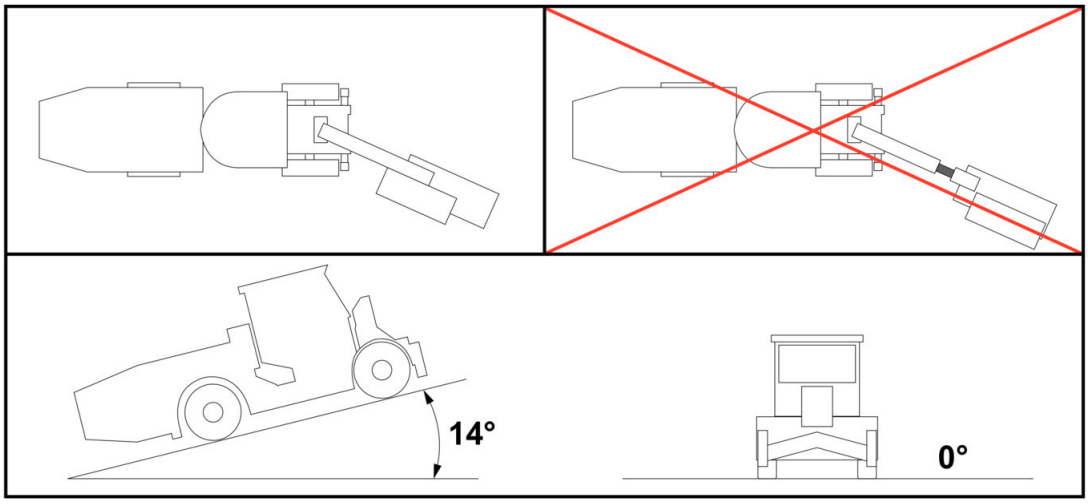

- While tramming at speeds below 1 km/h, the maximum machine inclination in the tramming direction is ± with camber of ± 0°.
- When adjusting booms, feeds, and other positioning units around tight turns, the units must be fully retracted and only be swung out within the turning radius of the machine.

**See Reference Documentation**

See the dimension drawing for the stability limitations and the correct positioning of the units.

### 8.2.3 Stability for Parked Rig

- Parked rig means that the rig is stationary and that the parking brake is applied.
- Booms, feeders, and any other positioning units must be max. retracted and may then be swung out to the maximum.

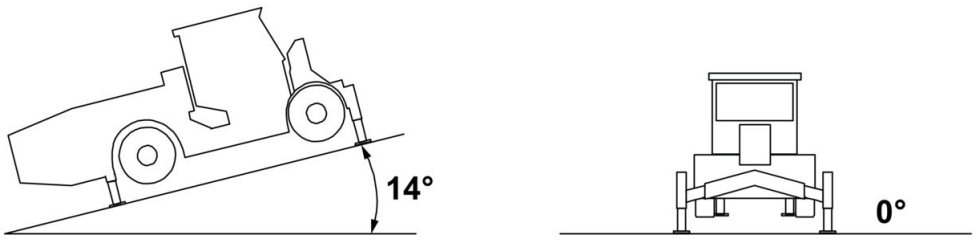



*Stability for parked rig*

With the rig parked, the rig can handle a longitudinal downhill incline of ± 14° with a camber of ± 0°.

### 8.2.4 Stability for Supported Rig

- A supported rig is a rig which is supported on its jack. If the jack extends sideways, it shall be at its maximum extension.




*Stability for supported rig*

With the rig erected, the rig can handle a longitudinal downhill incline of ± 14° with a camber of ± 0°.

# 9 Noise and Vibration

## 9.1 Noise Levels and Vibration Values

| DECLARED NOISE EMISSION VALUES | | Drilling, free field |
|---|---|---|
| A-weighted sound power, $L_{WAd}$ (reference 1 pW) in decibels **(dual-number declaration)** | COP 1838 | 123 ± 3 |
| | COP 3038 | 126 ± 3 |
| A-weighted emission sound pressure level, $L_{pA}$ (reference 20 µPa), measured in decibels at the workstation. **(dual-number declaration)** | Cabin | 75 ± 3 |
| A-weighted emission sound pressure level, $L_{pA}$ (reference 20 µPa), in decibels, close to the machine. **(dual-number declaration)** | COP 1838 | 103 ± 3 |
| | COP 3038 | 106 ± 3 |
| Weighted whole-body vibration value [m/s $^2$], seated **(dual-number declaration)** | Cabin | 0.07 ± 0.07 |
| Weighted whole-body vibration value [m/s $^2$], standing **(dual-number declaration)** | Cabin | 0.07 ± 0.07 |

The values were determined in accordance with the sound test code in EN 16228-1 and EN16228-2 based on the basic standards ISO 3747, ISO 11201 and ISO 11203 ( Q2=20 close to machine, free field, remote control, service) and ISO 2631-1.

**Dual-number**

The declared noise emission values are, when they are combined, the sum of measured values and uncertainty. They represent an upper limit of the range, in which measured values are likely to be included.

Peak C-weighted sound pressure level is lower than 130 dB.

## 9.2 Declared Values

- The declared values for noise and vibration were obtained by testing in accordance with the stated standards and are comparable with the declared values of other machines tested in accordance with the same standards.
- The declared values are not adequate for use in risk assessments, as values measured in individual work places may be higher.

- The actual noise levels and vibration values to which an individual is exposed to are unique and dependent on the work practices, reflections from walls, road conditions, duration of exposure time and the physical health of the individual.
- Incorrect use of the machine can cause health problems due to whole-body vibration and noise. A guide on the management of vibration is available in ISO/TR 25398 and on hearing protectors in EN 458.
- Epiroc recommends a program of health surveillance to detect early symptoms caused by exposure to noise and vibrations, so that management procedures can be modified to prevent future impairment.

## 9.3 Causes of High Noise Levels

Noise levels higher than the stated values are likely to occur when:

- Working with open cab doors and windows
- Removing drill pipe or drill bit during percussive drilling
- Working underground
- Incorrectly using the machine
- Working with increased load when compared to specified values
- Using compressed air

## 9.4 Effects of Noise

Exposure to noise can result in adverse health effects, such as:

- Permanent hearing loss
- Tinnitus
- Fatigue and stress
- Balance issues
- Poor attention
- Impaired ability to communicate
- Impaired ability to perceive acoustic signals and warning signals

## 9.5 Noise Reduction Factors

To reduce risk from exposure to noise:

- Do regular maintenance on sealing strips and noise suppression.
- Use approved hearing protection or plugs. Refer to guide, EN 458.
- Inspect and maintain all hearing protection regularly. For example, replace the hearing protection seals every six months.
- Use helmet goggles if using hearing protection or, use ear plugs when using goggles or protective safety glasses. Goggles and protective safety glasses reduce the effect of the hearing protection.
- Make sure that ear plugs fit correctly in ear canals. Incorrect sizing of ear plugs reduces the damping effect.

- Consider noise reflections from walls and roofs, while calculating actual noise levels. The noise levels, due to reflection, can be 1–12 dB higher and depend on:
  - The height and width of the mine drift or tunnel
  - The characteristics of the noise source
  - The acoustic absorption factor of the rock in the mine or tunnel
  - Low-frequency noise levels during the movement of machines underground
- Stay clear of the machine work area during non-working hours.
- Take frequent breaks to avoid continued exposure to noise levels.
- Do regular maintenance of door and cab seals, insulation, and mufflers.
- Work with a closed cab door and closed windows.
- Consider the higher noise level due to reflections from walls in the mine. The noise levels can be 1–12 dB higher, depending on:
  - The height and width of the mine drift
  - The characteristics of the noise source
  - The acoustic absorption factor of the rock in the mine
- Stay clear of the machine work area during non-working areas.
- Take frequent breaks in quiet areas to avoid continued exposure to noise levels.
- Do regular maintenance of the door and cab seals, insulation, and mufflers.
- Work with a closed cab door and closed windows.
- Consider the higher noise level due to reflections from walls in the mine. The noise levels can be 1–12 dB higher, depending on:
  - The height and width of the mine drift
  - The characteristics of the noise source
  - The acoustic absorption factor of the rock in the mine
- Stay clear of the machine work area during non-working areas.
- Take frequent breaks in quiet areas to avoid continued exposure to noise levels.

## 9.6 Noise Combined with Other Risk Factors

Noise, in combination with other risk factors, can cause serious health issues.

- Vibration and noise in combination can cause higher health risks.
- People with sensitive conditions (for example, pregnancy) and people already with impaired hearing may need protection against noise even at lower levels.
- Exposure to ototoxic substances and noise may increase the risk of hearing damage (even under 80 dB). For example, styrene, toluene and xylene, and certain solvent mixtures are ototoxic. Certain fuels such as kerosene and certain metals such as mercury and lead have also been proven to be potentially ototoxic.

## 9.7 Additional Information, Vibrations

One should take whole body vibration into consideration if travel stretches are driven for long periods of a working day. Indicated values in the manual apply when drilling. Many factors affect whole body vibration, including speed, work cycle and ground. If the correct seat type in accordance with ISO 7096 class EM 3 (drill rigs with rubber tires) is used, the vibration will probably be less. But the driver affects these factors most because the driver controls speed, the work cycle, road selection, etc.

For more information about how to combat the vibration levels at your worksite, see ISO/TR 25398.

**Guideline for reducing vibration levels during tramming:**

- Use the proper type, size of machine with optional equipment and attachment/tools for the task.
- Drill rigs are not intended for the transport of personnel, use appropriate vehicles for this purpose.
- Keep the ground in good condition:
  - Remove larger stones and obstacles.
  - Fill holes and ditches.
  - Provide machines and schedules time in order to maintaining the condition of the terrain.
- Adjust speed and operation, and chose suitable routes to minimize vibration levels.
  - Reduce speed in rough terrain.
  - Drive around obstacles and uneven ground.
  - If work is performed in rough terrain an option could be to use the machine with remote control.
- Perform these operations smoothly:
  - steering
  - braking
  - acceleration
  - shifting gears
- Make sure that the seat is maintained and correctly adjusted.
  - Adjust the set and its suspension for the operator weight and height.
  - Do not overload the seat (see specification).
  - Inspect and maintain suspension and adjustment mechanism.
  - Use the seat belt.
- Minimize vibration during long work cycles or long periods of tramming.
  - Use the option boom suspension if available.
  - Reduce speed to avoid bouncing.
  - Transport the machine between worksites if possible.
- Other risk factors may also be cause back pain. They can be reduced by:
  - Adjust seat and controls to achieve good posture.
  - Adjust mirrors to minimize twisted posture.
  - Provide breaks to reduce long periods of sitting.
  - Avoid jumping from down from the machine.
  - Minimize repeated handling and lifting of heavy objects.

# 10 Environmental Protection

## 10.1 Environmental Guidelines

The negative impact a machine has on the environment depends highly on its use and condition. A well-maintained, fully-functional, and correctly-used machine has the least overall negative environmental impact regarding operation and maintenance. Read and follow the given guidelines when using or working with the machine.

> ! ***NOTE:*** *Observe the local risk analysis for the local worksite.*

> ! ***NOTE:*** *Obey local regulations concerning the use and maintenance of machinery.*

- Make sure that operators and maintenance personnel are adequately trained.
- Use biologically-degradable hydraulic fluids and lubricants when refilling the systems for machine operation. Contact Epiroc for more information. See https://www.epiroc.com
- Avoid prolonged idling and switch off the engine when not required.
- Use automatic speed control, if available.
- Use the oil according to the service instructions and the construction site regulations.

## 10.2 Oils and Greases

- Leaking hydraulic couplings and grease are hazardous to the environment. Do regular checks and make sure that there are no leaks on the machine.
- Contact Epiroc at https://www.epiroc.com for information about biologically-degradable hydraulic fluid and lubricants.

## 10.3 Fuel Spill

Fuel spill is a fire hazard and an environmental hazard. Avoid fuel spills when filling the tank. Fuel fumes are extremely explosive.

## 10.4 Exhaust Gases

- Exhaust gases are toxic. Good ventilation is necessary when the engine is running.
- Regular maintenance of the air filters can keep emission levels low.

## 10.5 Handling of Spills and Waste during Maintenance

- Clean the oil and fuel residue and spills in accordance with local regulations.
- Dispose of expired or worn out batteries in accordance with local regulations.
- Do not burn residual oil or flush it into drains or water systems.
- Collect oil-content waste, such as filters and rags, in separate containers and dispose it in accordance with local regulations.

- Do not mix coolant and brake fluids with oil spills. Collect coolant, brake fluids, and oil spills in separate containers, and dispose in accordance with local regulations.
- A used diesel particulate filter must be handed over to an authorized dealer.

## 10.6 End-User Responsibility during Disposal of the Machine

Always follow local environmental regulations for disposing of waste and for recycling.

A worn out machine must be handled and disposed of in such a way that maximizes the percentage of recyclable material. The negative impact on the environment must be as low as possible. If the end user has inadequate knowledge about disposal, a locally-authorized disposal company must be hired.

The following points must be considered during disposal of the machine:

- All steel structures, copper, and aluminum found in electric cables can be recycled.
- Make sure that fluids are drained and filters are removed and handled in accordance with local regulations.
- Most plastic parts are recyclable. Check the material type and date marked on each plastic part to determine if that part can be recycled.
- Rubber parts are not considered as hazardous waste and can be disposed of according to local environmental regulations. Hydraulic hoses must be cleaned before they can be disposed of.
- Air conditioning equipment must be taken to an approved recycling facility.
- The windshield and other cab windows must be disposed of as waste, not as normal glass recycling.
- Electrical components, such as batteries and circuit boards, must be taken to an approved electrical recycling facility.
- Contact Epiroc for instructions on the disposal procedure of the main battery system (VCB).
- A used diesel particulate filter must be handed over to an authorized dealer.

# 11 EC - Declaration of Conformity

! *NOTE: The declaration of conformity applies only to the machines delivered within the European Union. The declaration relates exclusively to the machinery in the state in which it was placed on the market, and excludes components which are added and/or operations carried out subsequently by the final user.*

! *NOTE: This EC - Declaration of Conformity is an extract of the original declaration and must not be seen as a CE certificate. The original EC - Declaration of Conformity is machine-specific and delivered as a separate document together with the other technical documentation.*

**Postal Address:**

Epiroc Mining India Ltd.

Pl.No:-90, MIDC Area

Satpur Colony, Nashik, Maharashtra 422007

India

We, Epiroc Mining India Ltd., declare that the machine to which this declaration relates, is in conformity with demands specified in the Council of the European Union directive of 17 May 2006, relating to harmonization of the legislation of the member countries concerning machinery (2006/42/EC).

## 11.1 Additional Directives

The additional directives that are applicable for this machine are:

- 2014/30/EU
- 2014/68/EU.

## 11.2 Harmonized Standards

The harmonized standards that are applicable for this machine are:

- EN 16228-1:2014
- EN 16228-2:2014

## 11.3 Notified Body

Where appropriate, there is information about the notified body for type approval and number on EC type examination certificate on the original declaration.

## 11.4 Issuer

The following details are found on the original declaration:

- Issuer's signature
- Issuer's position
- Place of issuance
- Date of issuance.

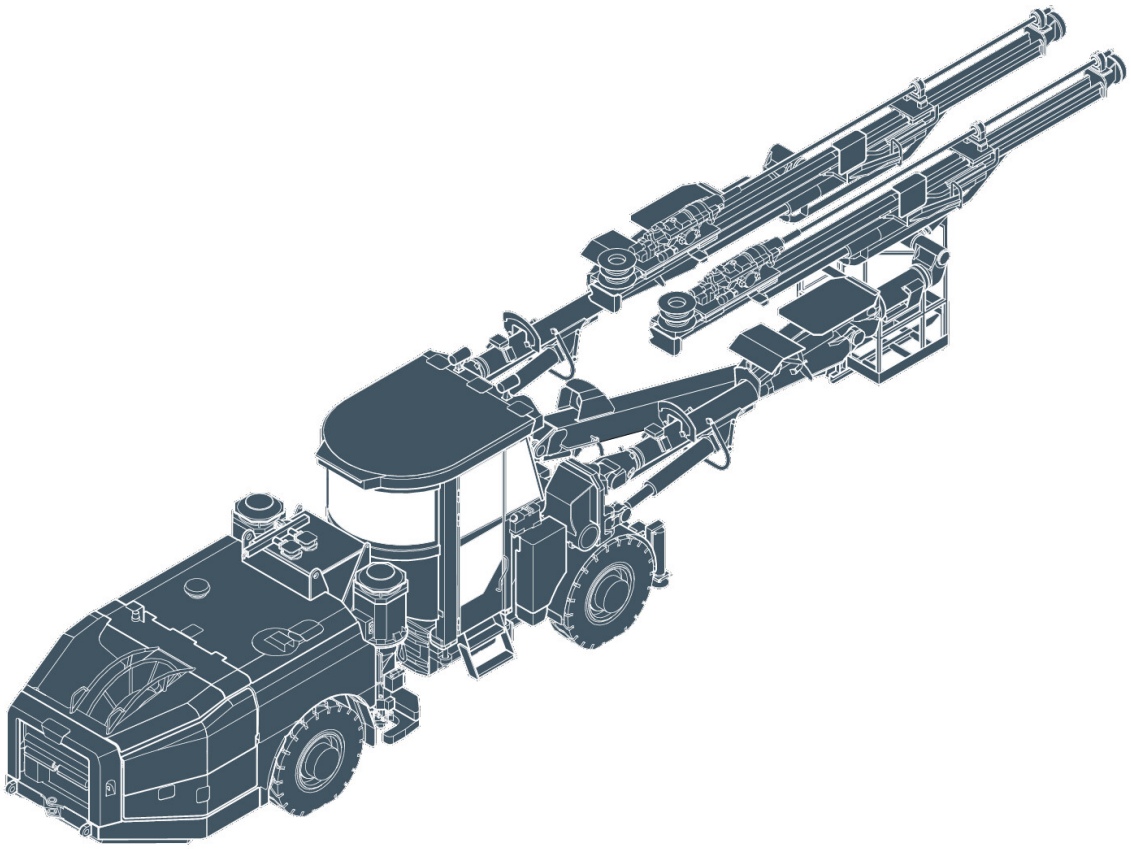
2020-02-14 | No: TIS0000978.002 en-US

Epiroc

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Operation

# Boomer L1D, L2D



**Original Instructions**
2020-06-25 | No: TIS0000976.003 en-US

Epiroc

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# 1 Introduction

## 1.1 Safety First

Always read the information in the safety manual before starting to use the machine or before starting any maintenance work.

## 1.2 The Purpose of this Publication

The Operation manual is intended to:

- Give an overall description of methods, required calculations, and settings.
- Give an overall description of machine features.
- Instruct the operator regarding applicable controls, handling, and operation of the machine.
- Instruct the operator about doing maintenance and troubleshooting.

## 1.3 Target Group

The information in this publication is intended for everyone involved in the application, operation, and maintenance of the machine and related equipment. All readers are expected to possess basic competence regarding mining methods, construction methods, and the machines used for that kind of operation.

## 1.4 Feedback and Contact Information

Epiroc works actively to develop and continuously improve its products and associated documentation. Provide your feedback on products and documentation by contacting your local supplier at https://www.epiroc.com, under "Contact us."

# 2 Product Description

## 2.1 Intended Use of the Product

The rock drill rig and related equipment are designed for drilling holes in opencast mines, in quarries, and on construction sites.

The machine and related equipment are designed for drilling holes in tunnels and mines.

The machine and related equipment are designed for excavation of rock and ore in underground mines.

The machine is designed for loading, hauling, and dumping rock and ore within the field of mining and construction work.

This machine is designed for drilling blastholes in open-pit mines using rotary and percussive action.

The machine is designed for drilling holes for water well applications using either rotary air, mud, or down-hole-drilling techniques.

The Rock Drill is designed for drilling holes in surface applications such as quarries and construction sites.

The machine with peripheral equipment is solely designed for drilling holes in tunnels and mines and to install rock bolts.

The Serpent high-pressure fans are designed to supply fresh air through long fan tubes in tunnels and mines.

The machine is designed for industrial use only.

- The machine is designed for concrete spraying in underground environments.
- The machine is designed for industrial use only.

The machine and related equipment are designed for surface exploration and investigation drilling.

It is designed solely for this purpose.

## 2.2 Misuse of the Product

Any use that is not described in the section Intended Use of the Product are forbidden.

Examples of Misuse and forbidden use:

- Lifting or transporting loads or people
- Transporting the loads or people.
- Transporting people
- Supporting objects
- Slam the bucket hard into the face of roof during cleaning or scaling.
- Breaking Rock with Bucket.
- Scaling rock
- Cleaning stopes and drill locations using the feed
- Using the boom to help the machine move up inclines
- Using the machine for pioneering or earth moving
- Traveling along inclines greater than those specified

- Traveling on soft, unstable ground without enough load-bearing capacity to support and maintain machine stability
- Towing other machines or equipment
- Tramming the machine outside the work area.
- Towing the machine outside the work area.
- The machine is not designed for use in a potentially explosive atmosphere.

The list is not exhaustive.

**WARNING**

**Misuse of the Product**

Using the machine for tasks other than what is described in the instructions can cause serious injury or death.

▶ Read and understand the instructions before using the machine, and become familiar with the permitted tasks and machine capabilities.

▶ The instructions must be followed in all applications and tasks when using the machine.

***NOTICE***

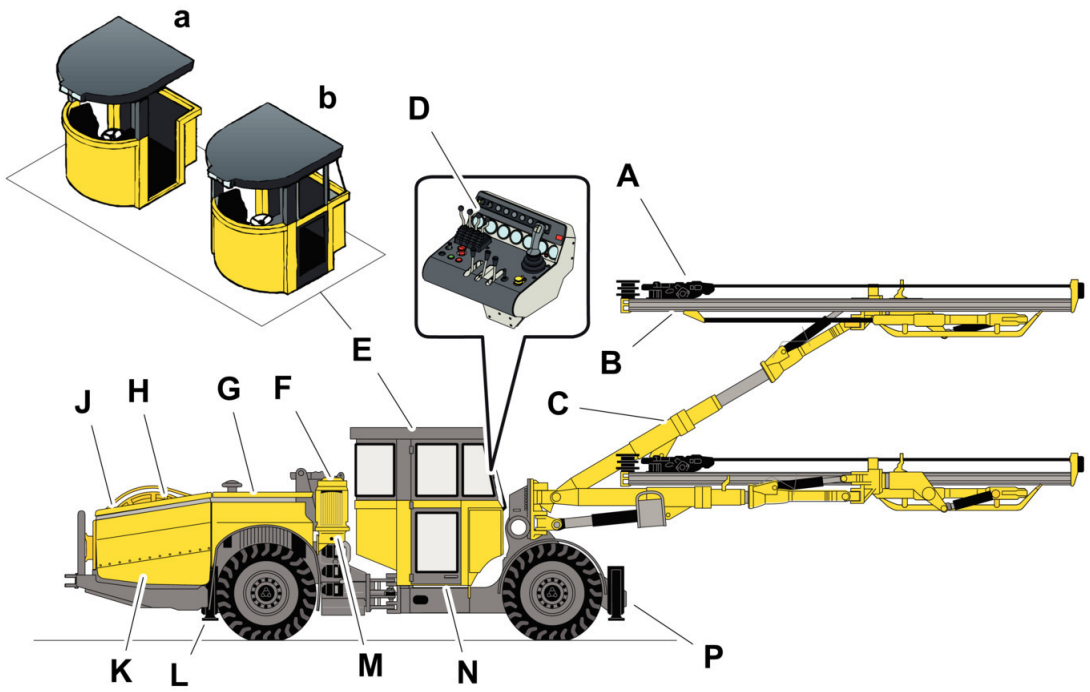
**Machine Damage**

Misuse of the machine can cause problems or damage the machine and related equipment.

▶ Read and understand the instructions before using the machine.

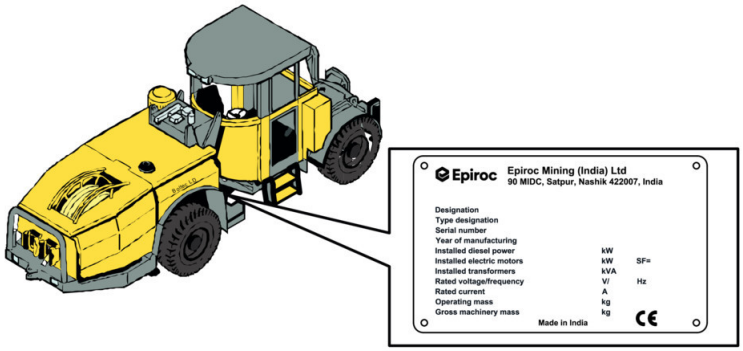
▶ Follow the instructions and use the machine as intended.

## 2.3 Main Components




| | | | |
|---|---|---|---|
| A | Drill | B | Feeder |
| C | Boom | D | Operator panel |
| Ea | Canopy | Eb | Cab |
| F | Hydraulic oil tank | G | Diesel engine |
| H | Cable reeling unit | J | Hose reeling unit |
| K | Electric cabinet | L | Rear Jack |
| M | Hydraulic pumps | N | Extendable steps |
| P | Front jacks | | |

## 2.4 Data Plate




*Location of data plate*

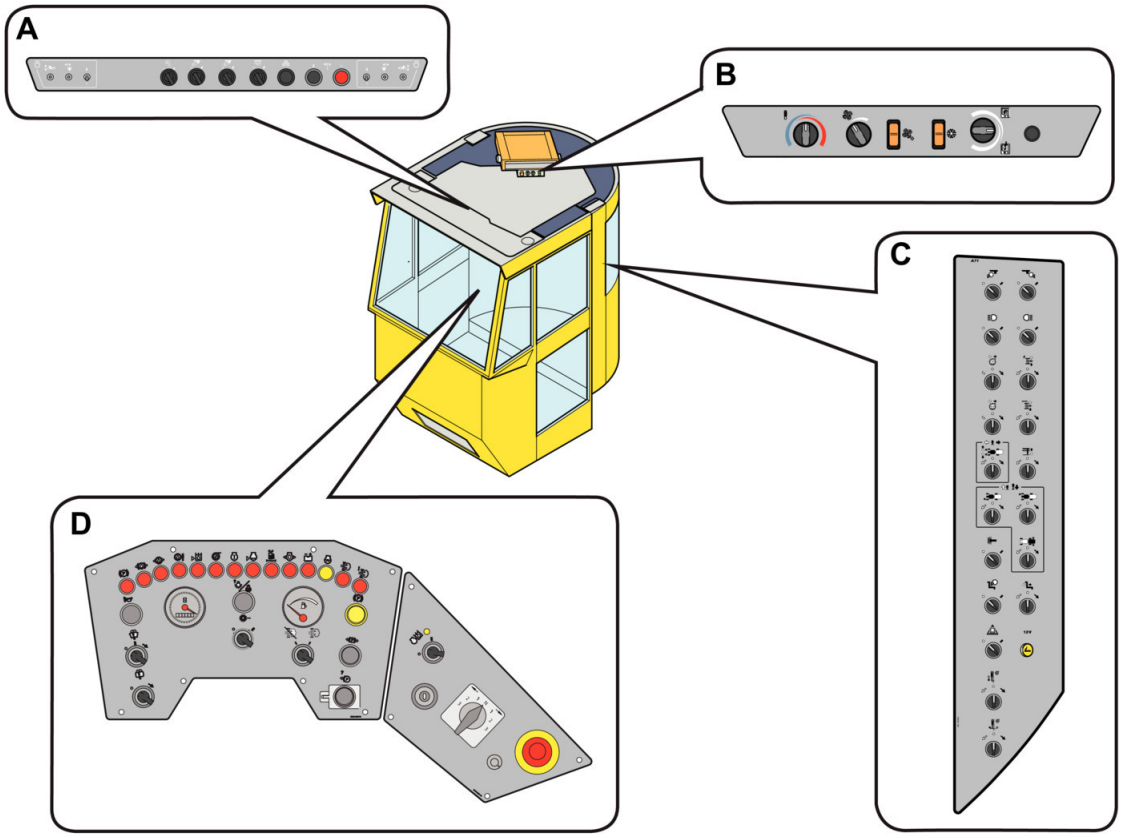
The rig carries a data plate which contains the following data:

- Product name
- Product type
- Serial number
- Installed diesel engine power
- Installed electric motor power
- Installed transformers
- Rated voltage
- Rated frequency
- Gross weight

! ***NOTE:*** *The data plate that is installed on the machine varies depending on the type, specification, and territory in which the machine is operated.*

The data plate indicates if the machine is CE certified or EAC certified. If no CE or EAC marking is present on the data plate, the machine is neither CE or EAC certified.

# 3 Controls and Instruments

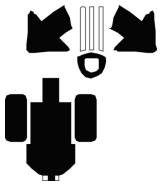


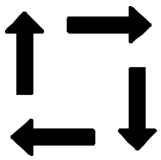
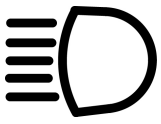

*Operator Compartment*

| | | | |
|---|---|---|---|
| A | RCS and lighting panel | B | Climate control panel |
| C | Panel for reeling units, support legs and related functions | D | Driving panel |

> ***NOTE:*** *The appearance of the panels may vary, depending on choice of options.*

## 3.1 Lighting Panel

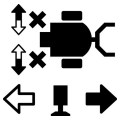
| Image | Description |
|---|---|
|  | Align left spotlight vertically. |
|  | Align spotlight horizontally |

| Image | Description |
|---|---|
|  | Spotlight On/Off |
|  | Align right spotlight vertically |
|  | USB port |
|  | Drill stop in auto mode |
|  | Drill stop in manual mode |
|  | Warning lamp and reset button for drill stop and ROM |
|  | Laser sensor drill stop and ROM |
|  | Work lights left and right On/Off |
|  | Interior lighting on/off |
|  | Network outlet |

| Image | Description |
|---|---|
|   | RCS system On/Off |

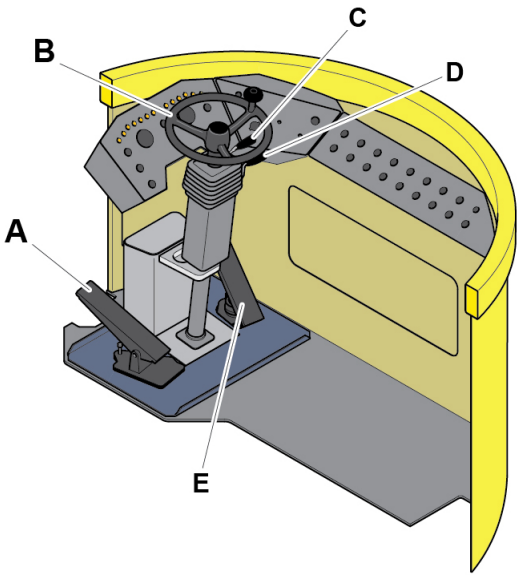
## 3.2 Hydraulic Panel

### Hydraulic panel functions

| Buttons | Functions | Description |
|---|---|---|
| S130  | Switch drilling, only EH / DH rigs | Button anticlockwise = activated<br>Button turned clockwise = activated.<br>This position is used for drilling and enables the diesel engine to attain sufficient speed for drilling. The parking brake is applied automatically when the button is turned to this position. |
| S147  | Step lighting | Knob turned clockwise = on, knob turned anti-clockwise = off. |
| S150  | Cabin heater | Turn clockwise (1) = On<br>Turn anticlockwise (0) = Off |
| S207  | Moves front jacks laterally | Button clockwise = jack out<br>Button anticlockwise = jack in. |
| S209  | Jack, rear | Button clockwise = down<br>Button anticlockwise = up |
| S210  | Jack, front left | Button clockwise = down<br>Button anticlockwise = up |
| S211  | Jack, front right | Button clockwise = down<br>Button anticlockwise = up |
| S248  | Cable reeling unit | Button clockwise = reel out<br>Button anticlockwise = reel in<br><br>Not used on diesel hydraulic rigs. |
| S249  | Water-hose reeling unit | Button clockwise = reel out<br>Button anticlockwise = reel in |

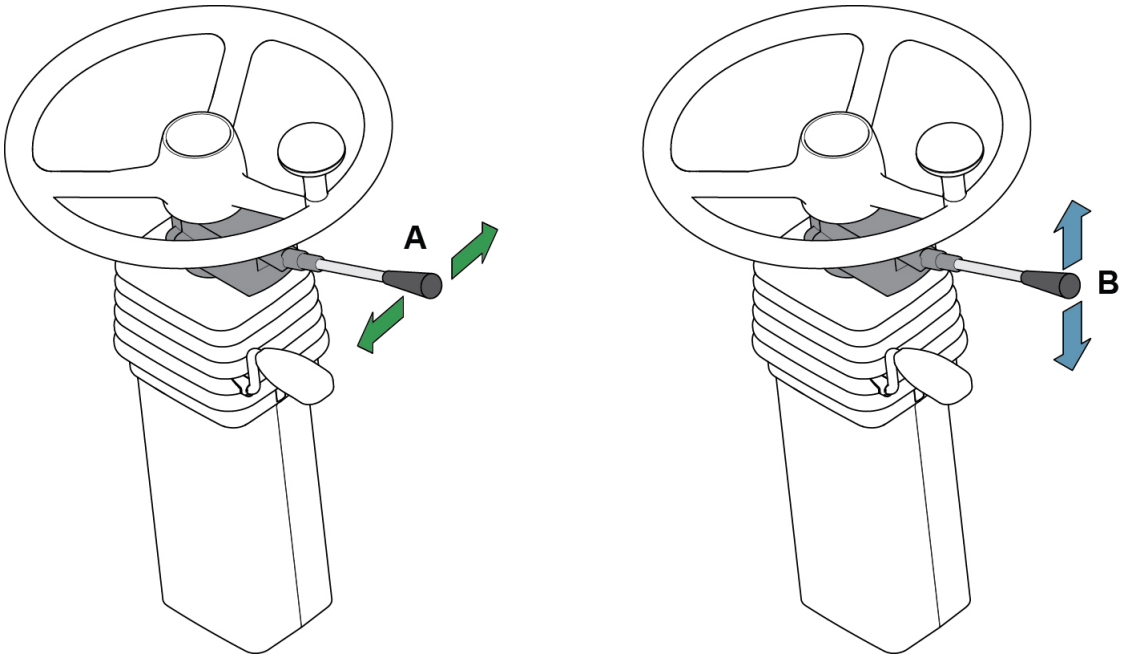
| Buttons | Functions | Description |
|---|---|---|
| S250  | Warning beacon | Manual control of warning light off/on |
| S282  | Only Cabletec<br>Cable arm extension | Button clockwise = extension out<br>Button anticlockwise = extension in |
| S283  | Only Cabletec Cable arm swing | Button clockwise = arm swings out<br>Button anticlockwise = arm swings in |
| S307:1/S307:2  | Running lights | Running lights, located on the roof.<br>Shine forward |
| S308:1/S308:2  | Running lights | Running lights, located on the carrier.<br>Shine forward |
| S312  | Cable guide on cable reeling unit, not DH rigs | Not used on diesel hydraulic rigs. |
| S313  | Hose guide on water hose reeling unit | Knob turned to move the hose reel sideways and to obtain a more even distribution of the hose on the reel. |
| S314  | Step extension | Button clockwise = step out<br>Button anticlockwise = step in |
| S500  | Canopy | Button anticlockwise = up<br>Button clockwise = down<br>The knobs are used at the same time to operate the roof up/down and for adjustment so that the roof stays parallel as it moves up/down. |
| X131   | Socket 12V. | Can be used for e.g. communications radio |

## 3.3 Driving Controls




| | | | |
|---|---|---|---|
| A | Brake pedal | B | Steering wheel |
| C | Lever for turn signals and head light | D | Lever for adjusting the steering wheel |
| E | Throttle pedal | | |

## 3.4 Turn Signals and Headlight Lever

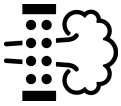



| | | | |
|---|---|---|---|
| A | Turn signals right or left | B | Headlight ON and OFF |

## 3.5 Driving Panel Functions

### Driving panel lamps

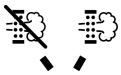
| Designation | Function | Description |
|---|---|---|
| H200  | Glow plug preheating indicator lamp | When the ignition switch is turned to position 1 the lamp will come on if glow plug preheating is necessary. |
| H201  | Battery charging indicator lamp. | Under normal tramming conditions, the lamp should be out to indicate that the battery is charging. The lamp is on when the ignition is on. Contact maintenance personnel if the lamp comes on during tramming. |
| H202  | Diesel engine lubricating oil pressure indicator lamp. | If the pressure is too low, the lamp comes on and the parking brake is applied. In this event, switch the engine off immediately and rectify the cause. Contact maintenance personnel. |
| H203  | Hydraulic oil level indicator lamp. | This lamp comes on if the level in the hydraulic oil tank is too low. In this event, top up the hydraulic oil immediately. A warning is also displayed on the operator panel display. |
| H204  | Engine temperature indicator lamp. | The lamp comes on when the temperature is too high. The engine must be switched off immediately and maintenance personnel contacted if the lamp comes on during tramming. |
| H205  | Transmission temperature indicator lamp. | If fluid becomes too hot, the lamp illuminates and the parking brake is applied. Contact maintenance personnel. |
| H206  | Parking brake indicator lamp. | This lamp comes on when the parking brake is applied. |
| H207  | Diesel engine air filter monitor indicator lamp. | This lamp comes on if the diesel engine air filter becomes clogged. Contact maintenance personnel to have the filter changed. |

| Designation | Function | Description |
|---|---|---|
| H208  | Brakes, hydraulic pressure indicator lamp. | The lamp comes on if brake pressure is too low (if there is no hydraulic pressure the brakes are applied). Stop the rig immediately and contact service personnel. |
| H209  | Cable reeling unit indicator lamp. | Not used on diesel hydraulic rigs. |
| H210  | Coolant water level indicator lamp. | This lamp comes on if the level of coolant water in the engine's cooling system is too low. Contact maintenance personnel. |
| H219  | Transmission hydraulic pressure indicator lamp. | If the transmission pressure is too low, this lamp comes on and the parking brake is applied. Contact maintenance personnel. |
| H220/H236  | Diesel engine general alarm indicator lamp/diagnostic lamp | See the Deutz engine manual for information. |
| H242  | Indicator lamp for regeneration of particle filter | Lamp flashing = particle filter needs regenerating<br>Continuous light = regeneration in progress.<br>See chapter Tramming, particle filter |
| H247  | Indicator lamp for high ash level in the particle filter | If the ash level is too high in the particle filter then the lamp illuminates with a constant glow. The particle filter cannot then be regenerated but must be replaced, contact maintenance personnel. |
| H248  | Signal lamp for water in fuel filter | The lamp will come on when water must be drained from the fuel filter. Contact maintenance personal |

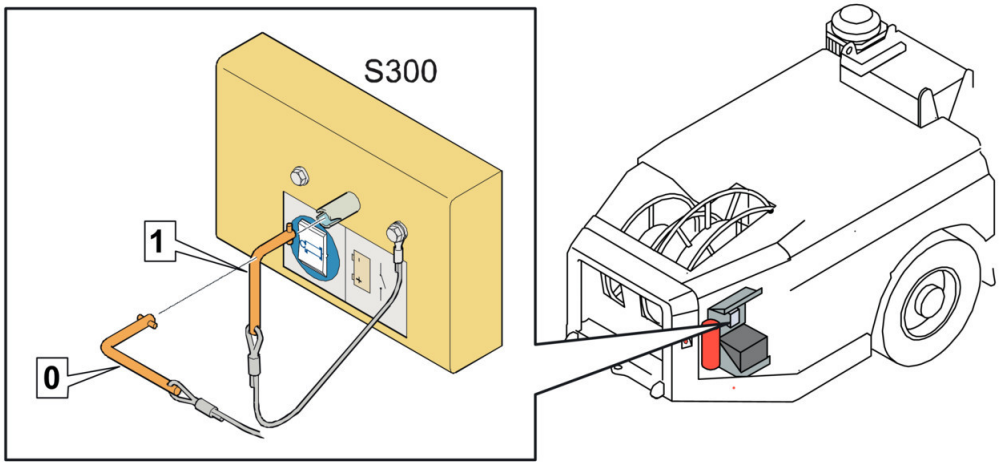
## Driving panel controls

| Designation | Function | Description |
|---|---|---|
| P110  | Hour counter | Displays diesel engine operating time. |
| P111  | Tank meter | Displays amount of fuel. |

| Designation | Function | Description |
|---|---|---|
| S178  | Lamp test | Press the button to check the panel lamps. |
| S178  | Diagnostic button | When the button is pressed, a fault code flashes. |
| S133:2  | Emergency stop | Stops the diesel engine and all rig operation. Applies the parking brake. |
| S136  | Bypassing the cable reeling unit's limit position | When the button is pressed the cable reeling unit's limit valve switch is bypassed. |
| S137  | Gear selector switch | Before the rig can be started the gear selector switch must be in neutral (N).<br>The gear selector switch must also be in neutral so that the diesel engine can attain the high speeds required for drilling. |
| S138  | Parking brake | Raised button = Deactivated (only if diesel engine running). Depressed button = Activated. |
| S139  | Ignition switch | Position 1 = ignition on and glow plug preheating<br>Position 2 = Starts the engine. To start the engine, the gear selector switch must be in neutral and the parking brake applied. |
| S141  | Hydraulic pressure (Diesel engine hydraulic pump) | Hydraulic pressure On / Off. Button illuminates up when hydraulic pressure is On. |
| S145  | Windscreen wipers and windscreen<br>Front | Turn the knob clockwise:<br>- Position 1 = windscreen wipers on<br>- Position 2 (spring loaded) = windscreen wipers and washers on. |
| S157  | Test button, interlock chain | Depress the button to check the interlock chain. |

| Designation | Function | Description |
|---|---|---|
| | | (The interlock chain senses: engine oil pressure, brake circuit hydraulic pressure, transmission fluid pressure and the cable reeling unit's limit valve switch.)<br><br>! ***NOTE:*** *Pressing the button also applies the parking brake.* |
| S186<br> | Signal Horn | |
| S146<br> | Windscreen wipers and windscreen<br>Rear | Turn the knob clockwise:<br>- Position 1=Washers 3 seconds, then wash and wipe.<br>- Position 0=Wipe 5 seconds and then stop. |
| S305<br> | Hand throttle, diesel engine | Turn knob clockwise to increase the diesel engine revs when the hydraulic pump is used often, for example when positioning the feeder. Turn the knob counterclockwise to reduce the revs.<br><br>! ***NOTE:*** *Diesel hydraulic rigs do not have hand throttle.* |
| S306<br> | Regeneration of particle filter | Button clockwise = regeneration enabled<br>Button anticlockwise = regeneration disabled<br>See chapter Tramming, particle filter |
| S309<br> | Laser | Laser On/Off |

## 3.6 Battery Isolation Switch

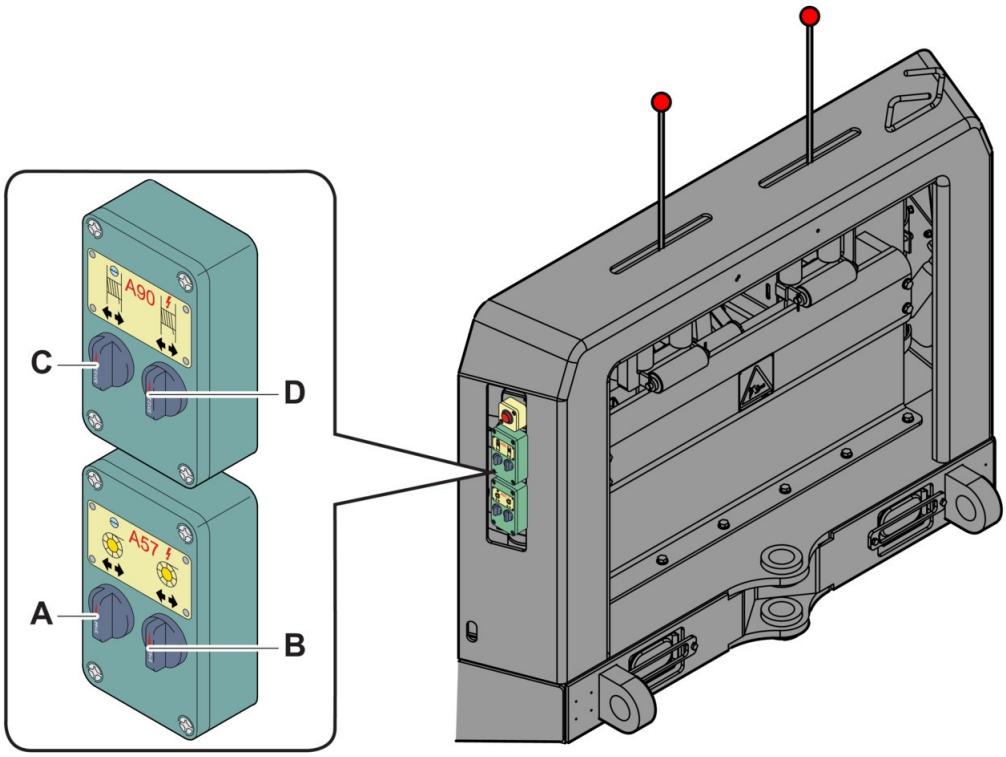



*Battery isolation switch*

| | | | |
|---|---|---|---|
| 0 | Off | 1 | On |

## 3.7 Dual Command for Reeling Units

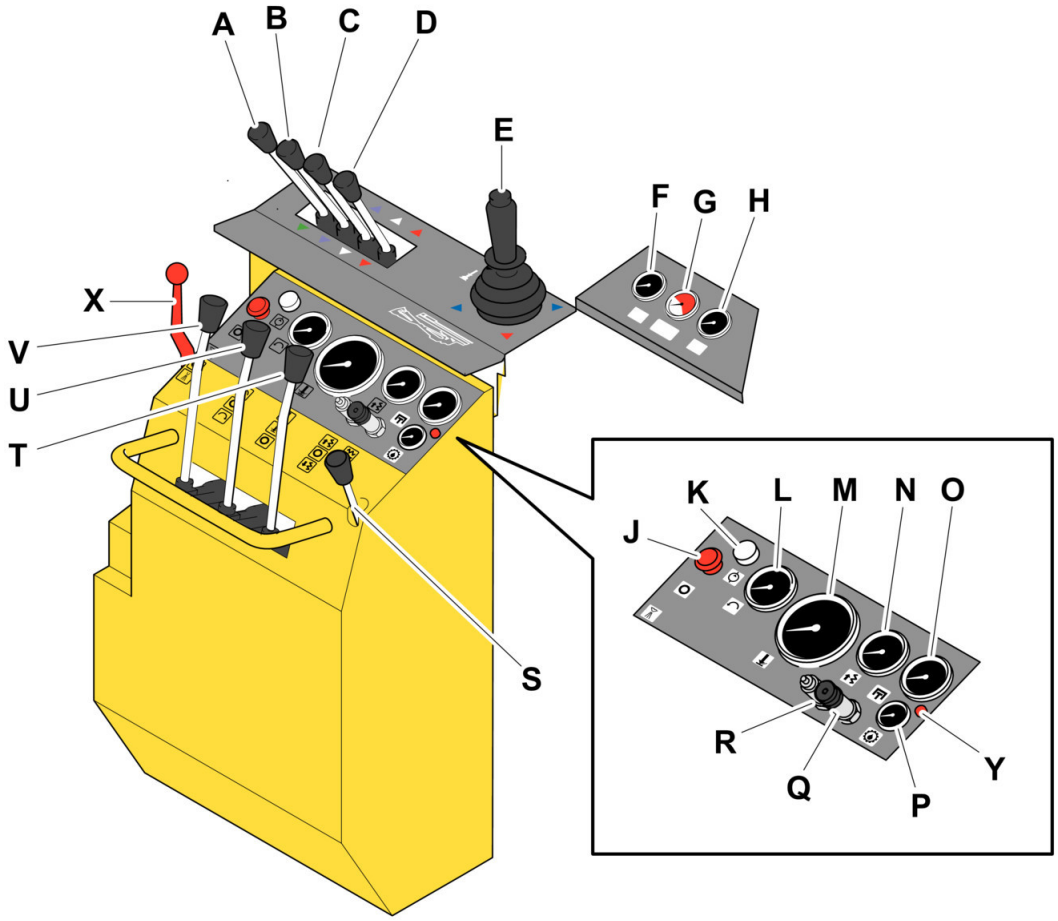
The Dual Command for Reeling Units is **optional** equipment.




| Knob | Function | Description |
|---|---|---|
| A | Water hose reeling unit | • Turn knob counterclockwise = wind<br>• Turn knob clockwise = unwind |
| B | Cable reeling unit | • Turn knob counterclockwise = wind<br>• Turn knob clockwise = unwind |

| Knob | Function | Description |
|---|---|---|
| C | Hose guide | • Turn knob counterclockwise = maneuver left<br>• Turn knob clockwise = maneuver right |
| D | Cable guide | • Turn knob counterclockwise = maneuver left<br>• Turn knob clockwise = maneuver right |

## 3.8 Control Panel DCS




*Operator Panel*

| | | | |
|---|---|---|---|
| A | Feed Rotation | B | Feed lookout |
| C | Boom extension | D | Feed Extension |
| E | Boom positioning | F | Water pressure |
| G | Return filter status | H | Air pressure |
| J | Stopping the hydraulic pump | K | Starting the hydraulic pump |
| L | Rotation pressure | M | Percussion pressure |
| N | Feed pressure | O | Damper pressure (only DCS 1800) |

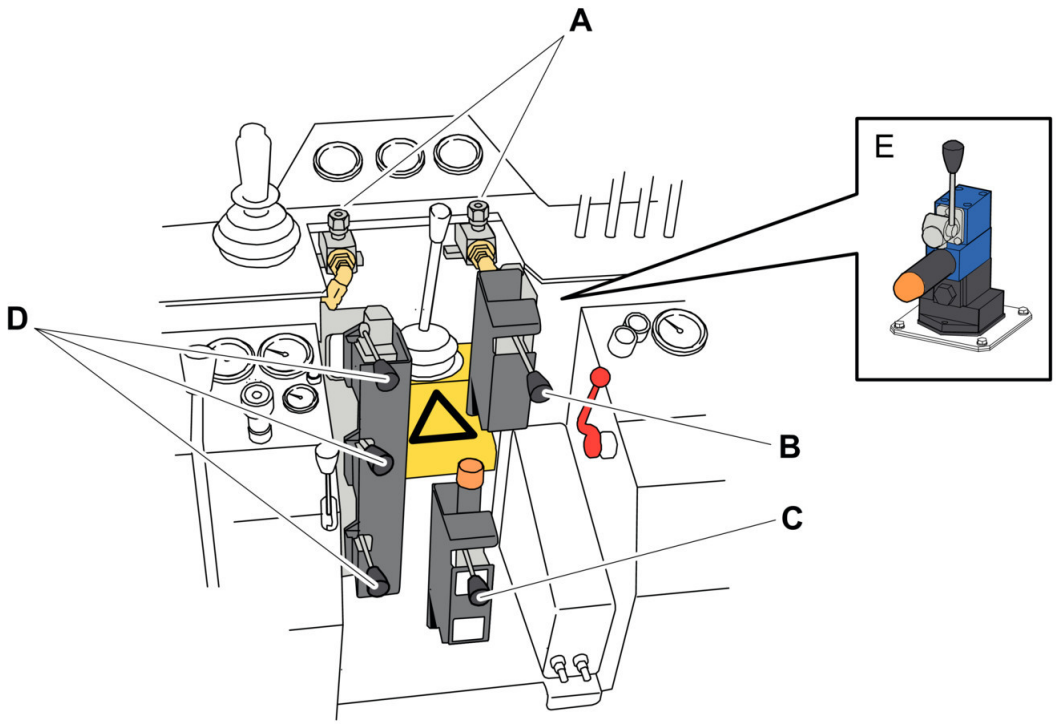
| | | | |
|---|---|---|---|
| P | Lubrication air pressure ECL | Q | Feed pressure for full drilling |
| R | Feed pressure for collaring | S | Selecting small hole/ reaming hole (option) |
| T | Feed | U | Percussion |
| V | Rotation | X | Flushing air / water |
| Y | Indicator lamp for low lubricating oil level or low lubricating air pressure | | |

Some options require additional levers. These are then placed on the side of the operator panel, see the illustrated example below.

- Activating the water mist (water mist).
- Selecting drilling/bolting

Bolting position involves maximum feed pressure and disconnection of the anti-jamming function.

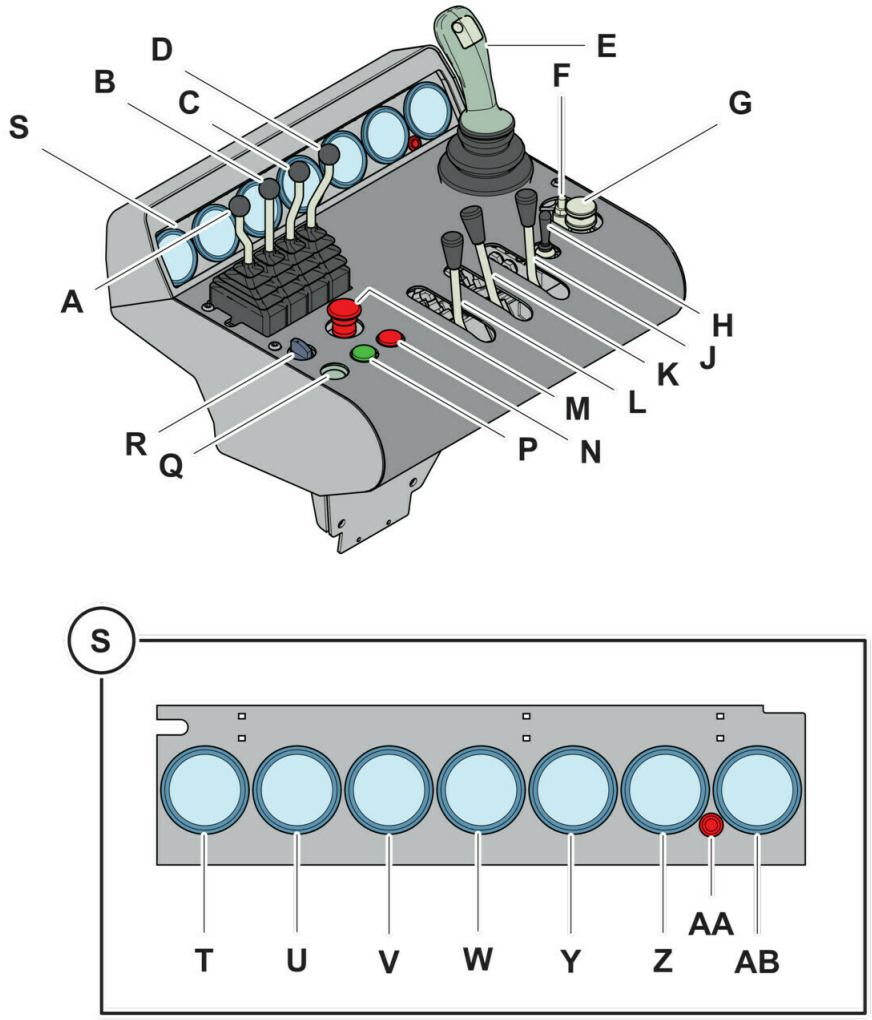
- RAS (Rod Adding System)
- Rapid feed telescope feeder




*Example of Location of Levers and Controls for Options*

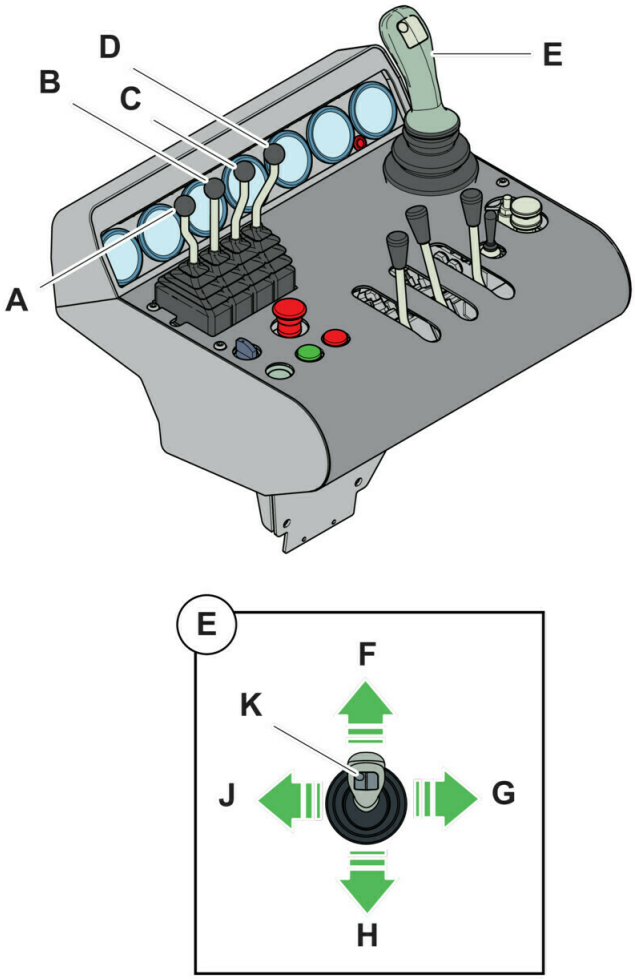
| | |
|---|---|
| A | Regulating water quantity |
| B | Selecting drilling/bolting |
| C | Activation of water mist pump |
| D | Levers for operating RAS |
| E | Lever for rapid feed telescope feeder |

## 3.9 Control Panel PCS




*Control Panel*

| | | | |
|---|---|---|---|
| A | Feed rotation | B | Feed tilt/look out |
| C | Boom extension | D | Feed extension |
| E | Positioning lever, multifunction | F | Regulation of feed pressure, collaring |
| G | Control of feed pressure, drilling | H | Flushing air or water |
| J | Drilling lever, feed | K | Drilling lever, percussion |
| L | Drilling lever, rotation | M | Emergency stop |
| N | Stop hydraulic pump | P | Start hydraulic pump |
| Q | (Option) | R | Mode switch |
| T | Water pressure | U | Air pressure |
| V | Rotation pressure | W | Percussion pressure |
| Y | Feed pressure | Z | Damper pressure |
| AA | Lamp, lubrication oil tank level | AB | Lubricant oil pressure |




*Positioning Lever Functions*

| | | | |
|---|---|---|---|
| A | Feed rotation | B | Feed tilt/look out |
| C | Boom extension | D | Feed extension |
| F | Boom movement down | G | Boom movement right |
| H | Boom movement up | J | Boom movement left |
| K | Anti-parallel switch | F+K | Anti-parallel down |
| G+K | Feed swing right | H+K | Anti-parallel up |
| J+K | Feed swing left | | |

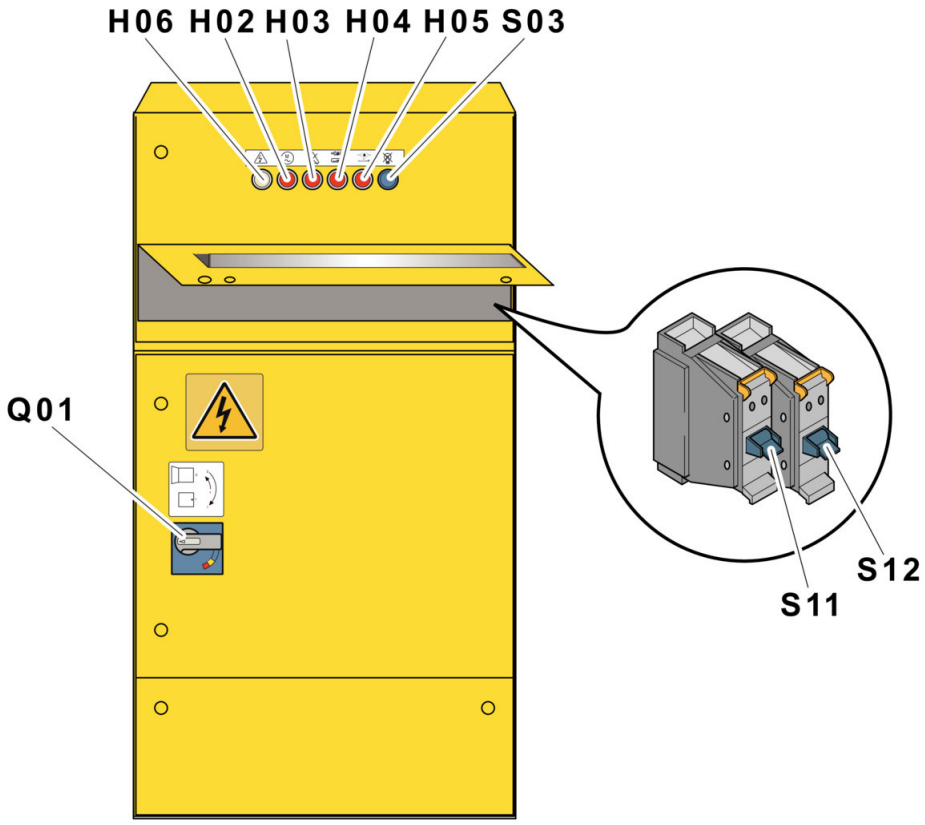
## 3.10 Electric cabinet, IEC

**WARNING**

**Dangerous Voltage**

Risk of serious personal injury.

- ▶ Make sure the system is inactivated before starting any work. The electrical system may only be serviced by an authorized electrician.




*Electric cabinet, IEC standard*

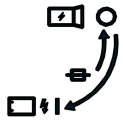
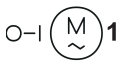
The following table describes the electric cabinet's buttons, switches and indicator lamps. The number of motor switches (S11, S12 ....) depends on the number of electric motors on the machine.

There are three different types of IEC electric cabinet.

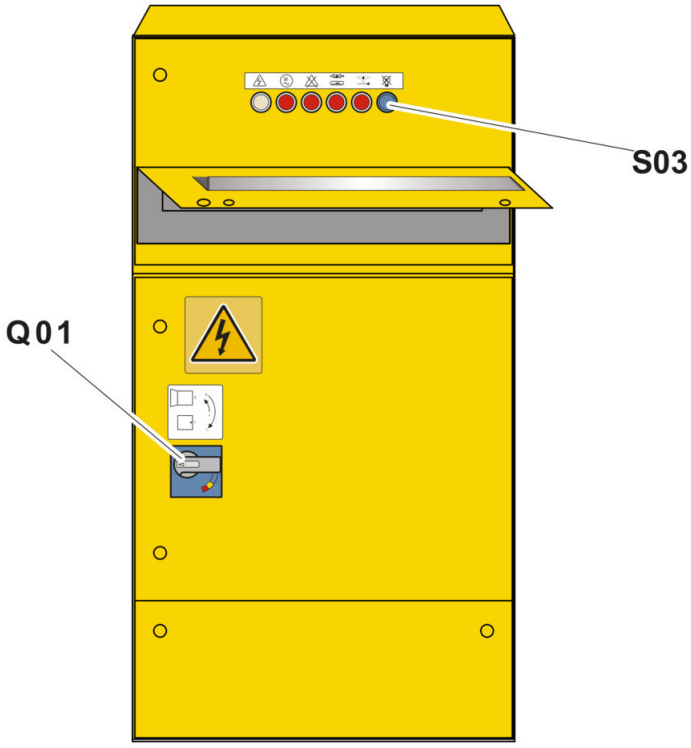
- With Y/D start
- With soft start
- With direct start

**NOTE:** *Externally the three IEC cabinets have the same appearance. For the differences between the cabinets see Maintenance instructions, Electrical system, IEC.*

### 3.10.1 Lamps, Buttons, and Switches IEC

| Symbol | Designation | Function | Description |
|---|---|---|---|
|  | H02 | Indicator lamp | Motor overload<br>• The lamp comes on if the motor is overloaded. |
|  | H03 | Indicator lamp | Phase sequence fault<br>• The lamp comes on if a phase sequence fault occurs. |
|  | H04 | Indicator lamp | Hydraulic oil level low<br>• The lamp comes on if the oil level is too low. |
|  | H05 | Indicator lamp | • Switches off the electric motor when the hydraulic oil temperature reaches 70 °C (158 °F). |
|  | H06 | Indicator lamp | Main power<br>• The lamp comes on when the main power is ON. |
|  | S03 | Button | Lamp test<br>• All lamps in the electric cabinet must come on when this button is pressed |
|  | Q01 | Switch | Main switch<br>• Power supply switch |
|  | S11<br>S12<br>S13<br>S14 | Switch | Motor switch<br>• Must be in position 1 when in operation<br>• In position 0, the control voltage is cut off. |

## 3.11 Resetting Emergency Stop




The panel varies for different electric cabinets.

1. Pull out the emergency stop that is activated.
2. Turn the main power switch (Q01) to position 0 and then to 1 to switch on the electric cabinet.
3. Press (S03) to check that the cabinet indicator lamps are working if the electric cabinet has a lamp test button (S03).
4. Press the ESC key to reset the error message on the operator panel display screen.

# 4 Directional Control Equipment

## 4.1 System Description

### 4.1.1 Feed Angle Measurement

Directional control FAM (Feed Angle Measurement) is available in two designs:

- FAM I with angle indication
- FAM II with angle indication and hole depth measurement

The angle indication involves measurement and indication of the feed direction.

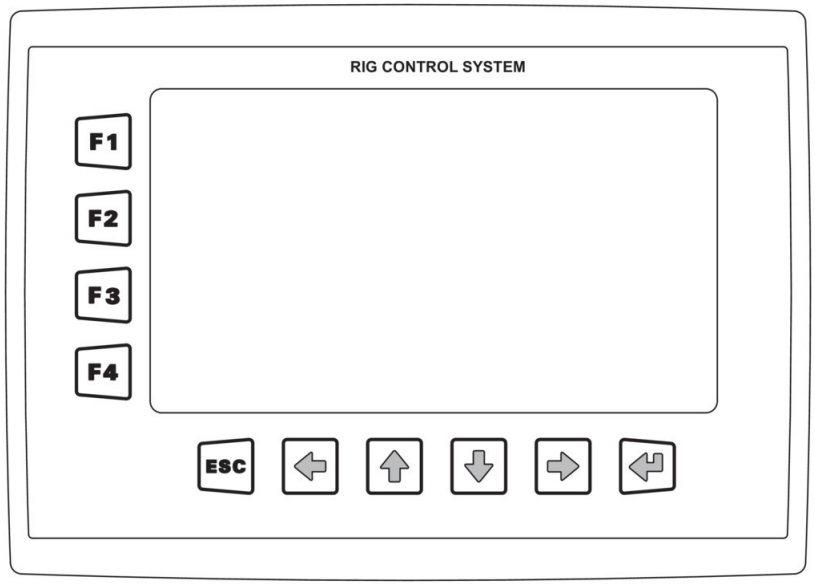
The system calculates the deviation from the defined reference direction from which the feed direction gives a full depth drill hole (not drill rod length). The deviation is presented in centimeter (cm).

> ***NOTE:*** *Specify a reference direction and a length for a full depth drill hole for the system to present the correct values.*

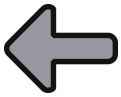
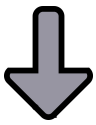
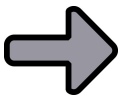
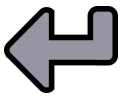
The system also shows angle indication and also instantaneously attained hole depth when drilling if it is equipped with hole depth measurement.

### 4.1.2 System Hardware

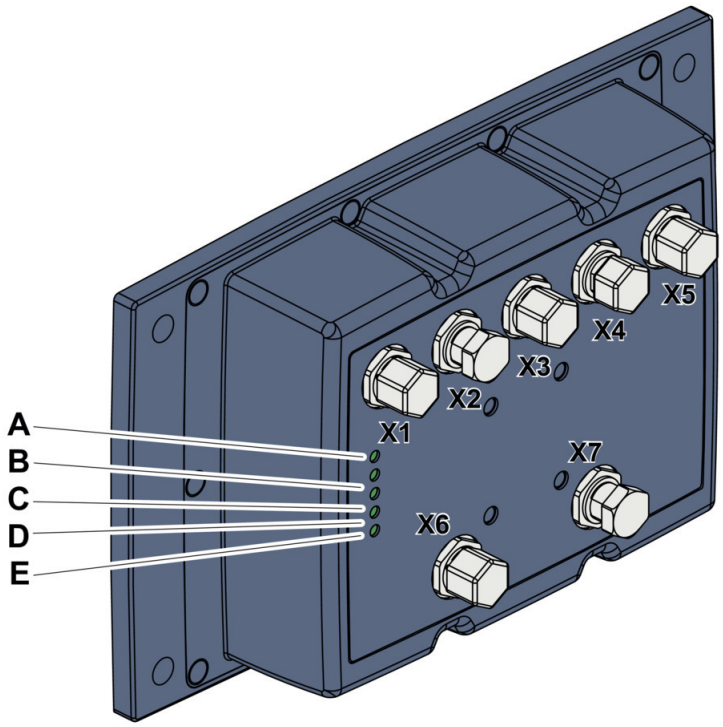
#### Operation Control Panel




> ***NOTE:*** *From the working menu for drift drilling, the arrow keys can be used to move the feed in small increments.*

| Button | Function | Description |
|---|---|---|
|  | Direct selection buttons F1–F4 | • These buttons are only active in certain menus and are then linked to a symbol. |
|  | ESC key | • Backs one step in the menu structure.<br>• Undoes a numerical value entered.<br>• Pressing ESC instead of Enter, erases an input value. |
|  | Left arrow key | • Moves the cursor to the left. |
|  | Up arrow key | • Moves the cursor upwards.<br>• Increases a numerical value. |
|  | Down arrow key | • Moves the cursor downwards.<br>• Decreases a numerical value. |
|  | Right arrow key | • Moves the cursor to the right. |
|  | Enter key | • Confirms a selected option or a changed numerical value.<br>• Activates the fields where a numerical value has been changed. |

### Application, Display, and CCI Module




## Connections

| Contact | Function |
|---|---|
| X1 | Power supply voltage |
| X2 | CAN network 2 |
| X3, X4 | CAN network 1 |
| X5 | Address plug |
| X6 | COM2 |
| X7 | USB 1/COM1 |

## Pin Configuration

| Contact | Type | Pin 1 | Pin 2 | Pin 3 | Pin 4 | Pin 5 |
|---|---|---|---|---|---|---|
| X1 | Four-pin M12, male contact | +24 V supply voltage | +24 V supply voltage | GND | GND | N/A |
| X2,X3,X4 | Five-pin M12, male contact (X2, X4), or female contact (X3) | NC (Not Connected) | CAN +24 V | CAN GND | CAN_H | CAN_L |

| Contact | Type | Pin 1 | Pin 2 | Pin 3 | Pin 4 | Pin 5 |
|---|---|---|---|---|---|---|
| X5 | Five-pin M12, male contact | Bit 2 | Bit 1 | GND | Bit 0 | Bit 3 |
| | Each address bit is connected to GND (ground). The address plug can be connected to eight different addresses. The address plug also determines the speed (baud rate) for the module. | | | | | |

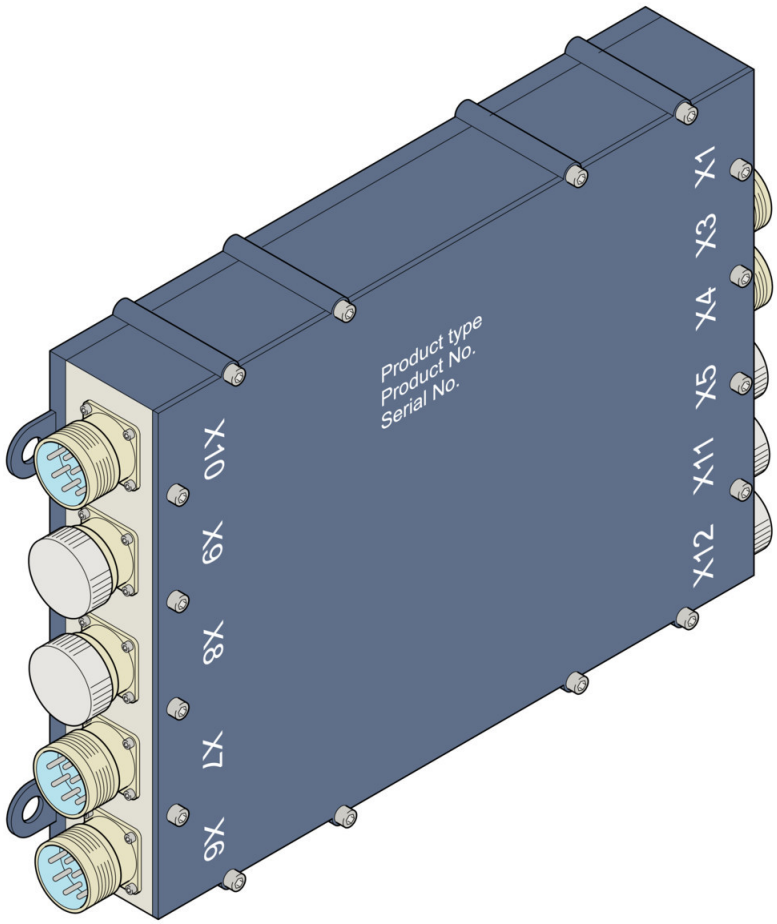
## Pin Configuration

| Contact | Type | Pin 1 | Pin 2 | Pin 3 | Pin 4 | Pin 5 | Pin 6 | Pin 7 | Pin 8 |
|---|---|---|---|---|---|---|---|---|---|
| X6 | Eight-pin M12, male contact | DCD | RxD | TxD | DTR | GND | DSR | RTS | CTS |
| X7 | Eight-pin M12, female contact | Vbus USB | D- USB | D+ USB | GND USB | NC | RxD COM1 | GND COM1 | TxD COM1 |

## LED Functions

| LED | | Color | Description |
|---|---|---|---|
| A | Module status | Green | • The LED flashes twice per second when the system starts.<br>• The LED flashes once per second when CAN communication is in progress.<br>• The LED flashes five times per second when there is no CAN communication or if the I/O module is starting up. |
| B | CAN1 status: | Red | • The LED flashes when communication is established.<br>• LED is OFF when there is no communication. |
| C | CAN2 status: | | |
| D | CAN1 V+ | Green | • The green LED light glows when supply voltage is maintained.<br>• LED is OFF when there is no supply voltage. |
| E | CAN2 V+ | | |

### Resolver Module




| Contact | Function |
|---|---|
| X1 | Power supply module |
| X3, X4 | CAN network |
| X5 | Address plug |
| X6–X9 | Resolver inputs |
| X10 | Encoder input |
| X11, X12 | Analog inputs |

## Pin Configurations

| Contact | Type | Pin 1 | Pin 2 | Pin 3 | Pin 4 | Pin 5 | Pin 6 |
|---|---|---|---|---|---|---|---|
| X1 | Four-pin M12, male contact | +24 V supply voltage | +24 V supply voltage | GND | GND | N/A | N/A |
| X3, X4 | Five-pin M12, male contact | NC (Not Connected) | CAN +24 V | CAN GND | CAN High | CAN Low | N/A |

| Contact | Type | Pin 1 | Pin 2 | Pin 3 | Pin 4 | Pin 5 | Pin 6 |
|---|---|---|---|---|---|---|---|
| | (X3), or female contact (X4) | | | | | | |
| X5 | Five-pin M12, male contact | Bit 2 | Bit 1 | GND | Bit 0 | Bit 3 | N/A |
| | Each address bit is connected to GND (ground). The address plug can be connected to eight different addresses. | | | | | | |
| X6, X7, X9 | Six-pin conin-verse, male contact | Ref + | Ref - | Sine signal | Sine GND | Cosine signal | Cosine GND |
| X10 | Six-pin conin-verse, male contact | +15 V | +15 V | Signal A | GND | Signal B | GND |
| X11, X12 | Five-pin M12, male contact | GND | +15 V | NC | NC | Cosine GND | N/A |

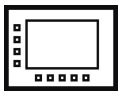
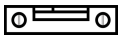
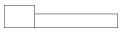
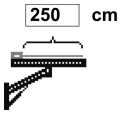
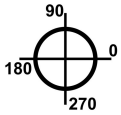
### LED Functions Status View

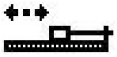
| LED Color | Description |
|---|---|
| Green | • When the system starts, the LED flashes twice per second.<br>• When CAN communication is in progress, the LED flashes once per second.<br>• When there is no CAN communication or if the I/O module is starting up, the LED flashes five times per second. |
| Red | The LED flashes in the event of communication error. |

## 4.1.3 Symbols in Menus

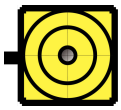
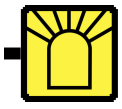
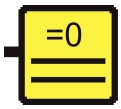
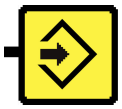
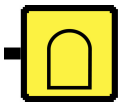
The symbols that are used by Epirocs various programs for directional control are explained in the table.

| Symbol | Explanation | Symbol | Explanation |
|---|---|---|---|
|  | • Settings and information regarding the machine |  | • Diagnostics |
|  | • Calibration of fan inclination angle sensor |  | • User |

| Symbol | Explanation | Symbol | Explanation |
|---|---|---|---|
|  | • Display module |  | • Display brightness |
|  | • Sensor angles |  | • Calibration of angle sensor |
|  | • Machine inclination sensor |  | • Calibration of machine inclination sensors |
|  | • Lookout angle for fan inclination, feed tilt. The arrow moves with changes in feeder position |  | • Horizontal angle shown when the lookout angle is not shown, i.e. when the feeder rotates to close to the horizontal |
|  | • Rotation<br>• The arrow moves with the changes in feeder position |  | • Deviation from the reference plane (distance indication) |
|  | • Positive rotation direction |  | • Positive inclination direction |
|  | • Cradle position |  | • Setting and information regarding to angle sensors |
|  | • Directional control FAM and ARI 157/1257 = length of full depth drilled hole<br>Length of full depth drill hole is the maximum depth that can be drilled with current drill steel<br>• Other directional equipment, ARI =length of drill steel. |  | • Setting and information regarding the angle display and hole depth measurement |
|  | • Penetration rate |  | • Hole depth |
|  | • Zero point for rotation angle |  | • The value displays the divergence of the drill bit at the hole bottom |

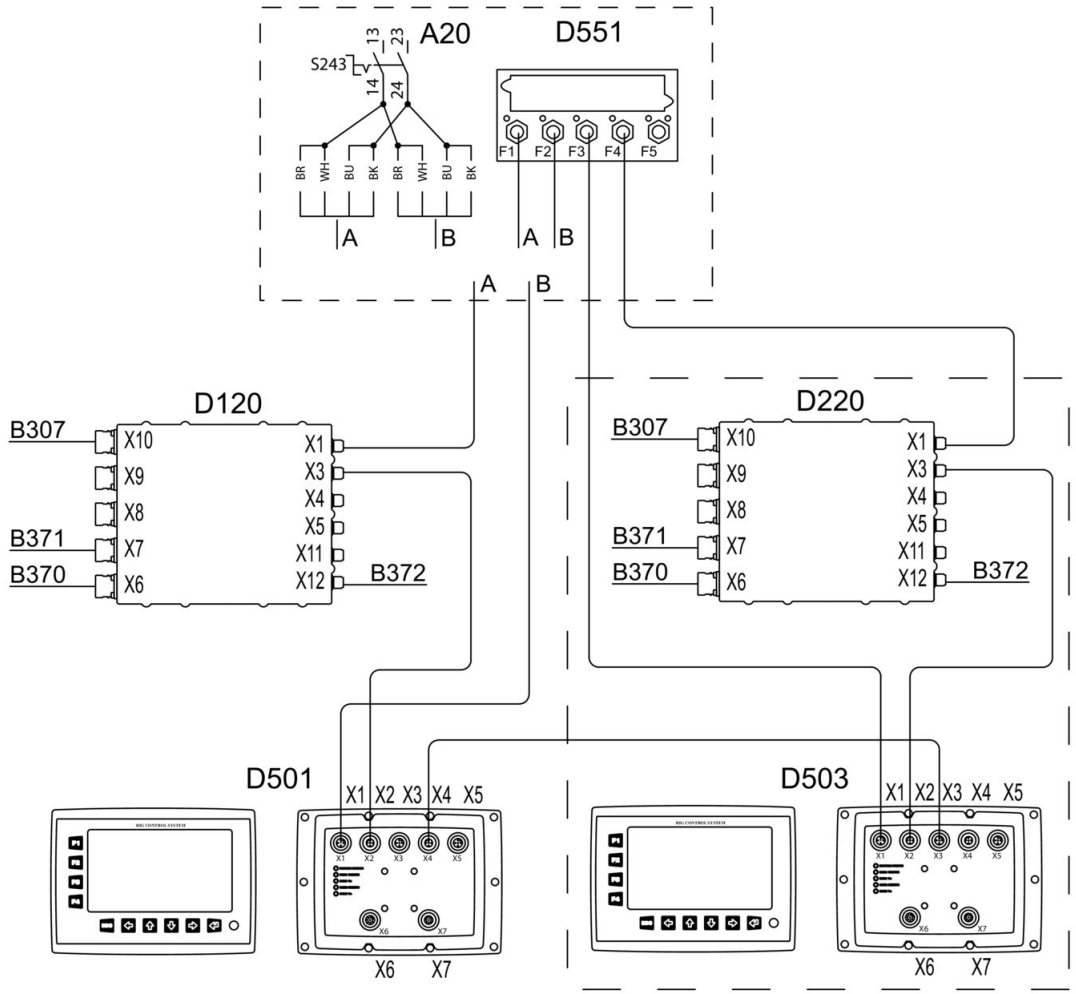
| Symbol | Explanation | Symbol | Explanation |
|---|---|---|---|
|  | • Warning<br>• Shows that an error has occurred |  | • Boom swing |
|  | • Longitudinal inclination of the machine |  | • Lateral inclination of the machine |
|  | • Feed lookout |  | • Feed rotation |
|  | • Feed swing |  | • Boom lift |
|  | • Boom swing |  | • Feed swing, left |
|  | • Feed swing, right |  | • Boom extension |
|  | • Feed lookout down |  | • Feed lookout up |
|  | • Movement distance of rock drill (BMHT option) |  | • Movement distance of upper beam (BMHT option) |

### 4.1.4 Buttons in Menus

| Symbol | Explanation | Symbol | Explanation |
|---|---|---|---|
|  | • Selects working menu for drift drilling |  | • Selects working menu for production drilling |
|  | • Sets parallel holding |  | • Sets relative reference direction |
|  | • Selects machine view |  | • Selects relative reference direction view |

### 4.1.5 RCS

#### System Layout




| Designation | Description |
|---|---|
| A20 | Switches, Boomer S1 D-DH |
| D551 | Fuse cabinet, Boomer M / L |
| D120 | Resolver module boom 1 |
| D220 | Resolver module boom 2 |
| D501 | Display 1 |
| D503 | Display 2 |
| B370 | Angle sensors, boom swing |
| B371 | Angle sensors, feed swing |
| B372 | Inclination sensor, feed inclination |
| B307 | Length sensor, hole depth measurement (option) |

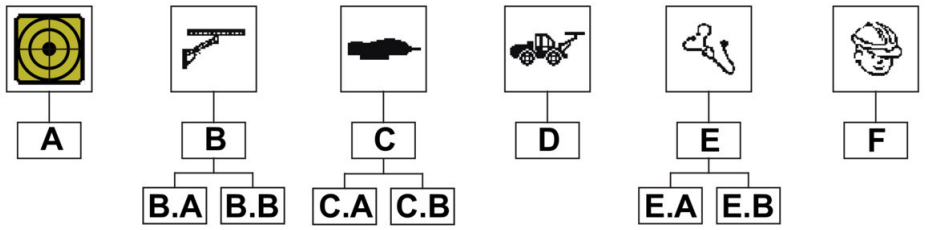
See machine documentation for component placement.

**See reference documentation**

Component placement in machine documentation

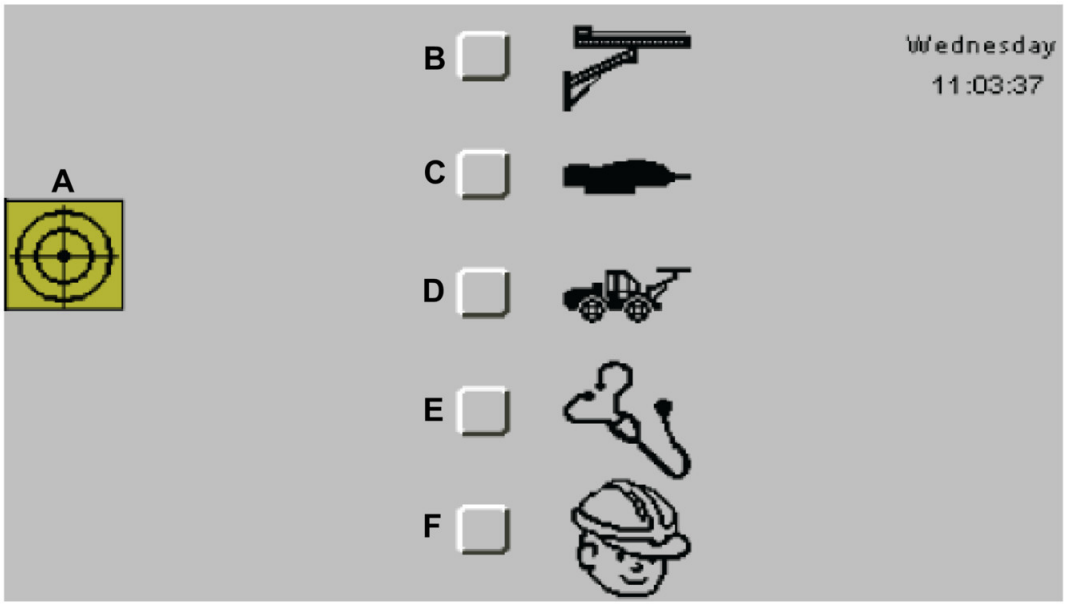
## 4.2 Menu Description

### 4.2.1 Menu Structure




| | | | |
|---|---|---|---|
| A | Working menu drift drilling | B | Sensors menu |
| C | Settings menu | D | Rig menu |
| E | Diagnostic menu | F | User menu (Password menu) |

**Main Menu**

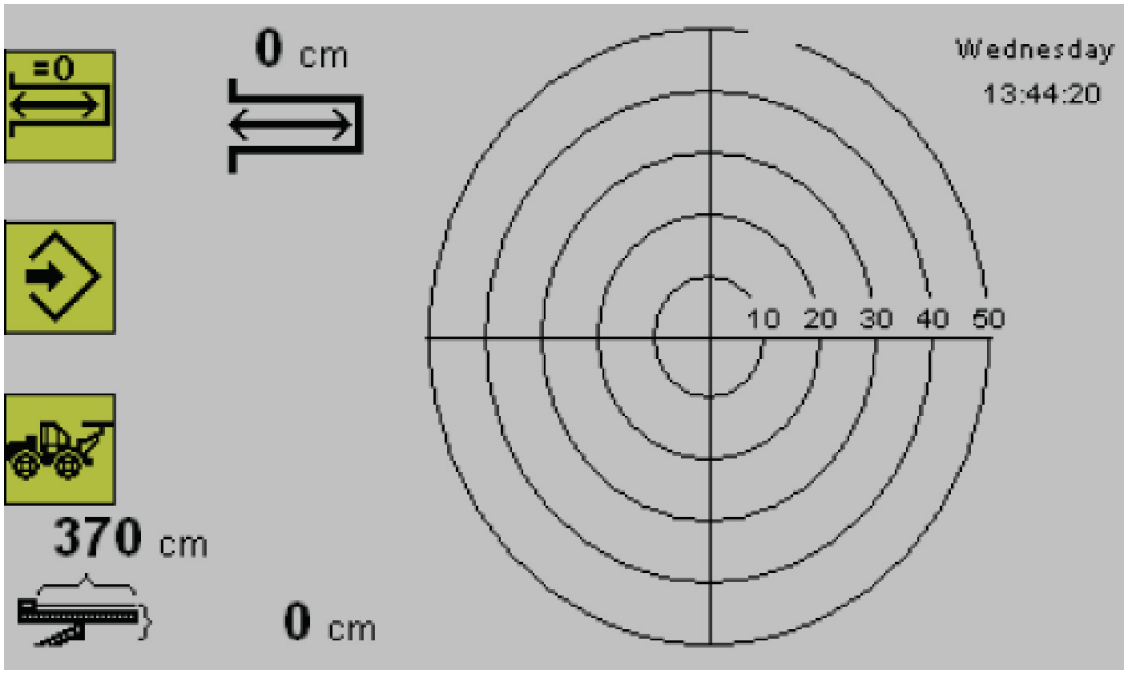



Main menu is shown when the system starts.

Choose the following alternatives:

- Working menu for drift drilling (A).
- Sensors menu (B) to check sensor angles or to calibrate boom sensors.
- Settings menu (C) for setting full depth drilled hole.
- Rig menu (D) for setting the brightness and the clock.
- Diagnostic menu (E).
- User menu (F) to specify a password for where a password is required.

### Working Menu Drift Drilling



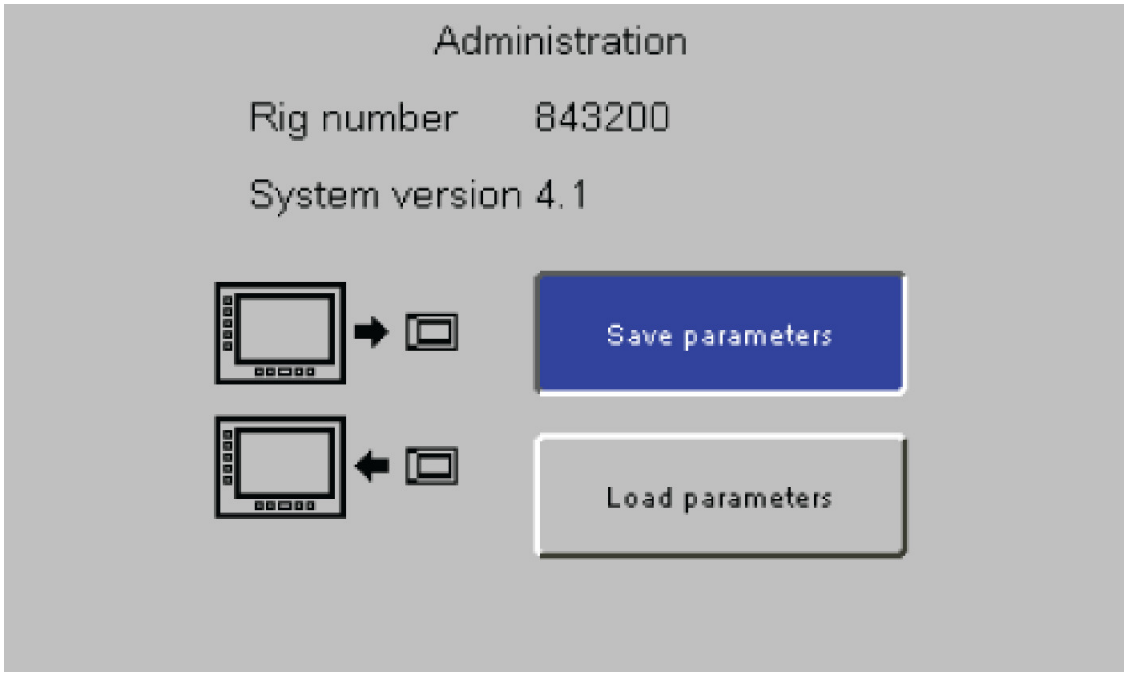

Using working menu drift drilling:

- Set the reference direction.
- Select view, machine reference direction, and relative reference direction.

Working menu shows:

- Length of full depth drilled hole
- Hole depth measurement (FAM 2)
- Warning triangle if there is error

### Administration Menu

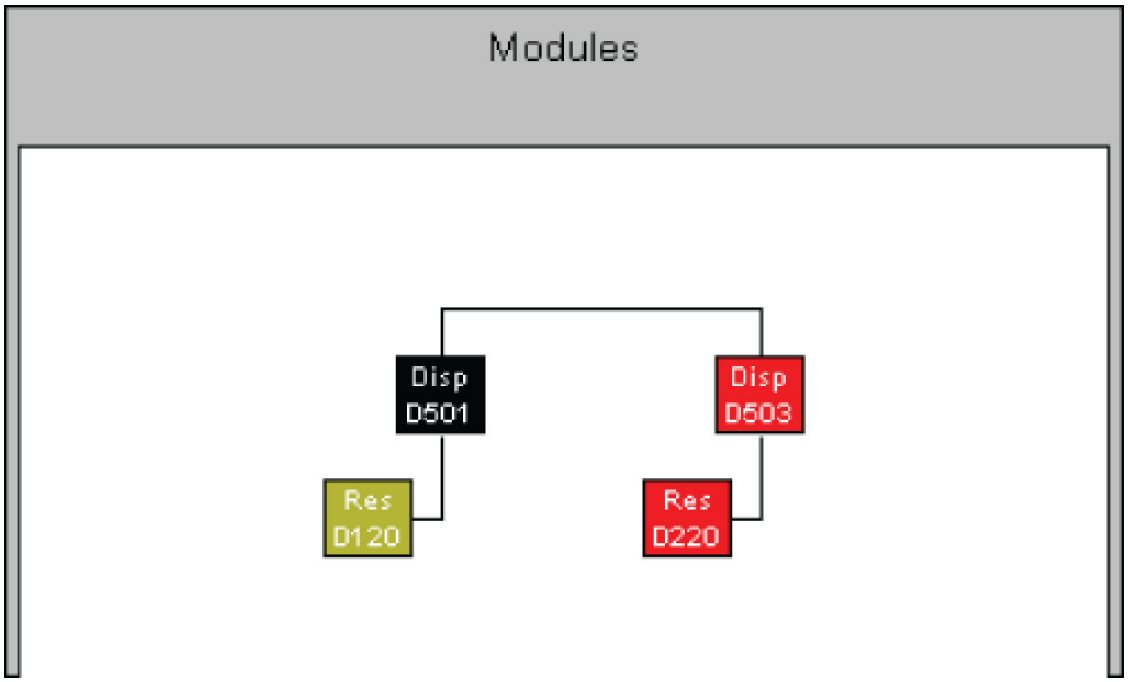


**Administration** menu shows:

- **Rig number** and **System version**
- **Save parameters**
- **Load parameters**

> ***NOTE:*** *The menu is password protected.*

### Modules Menu

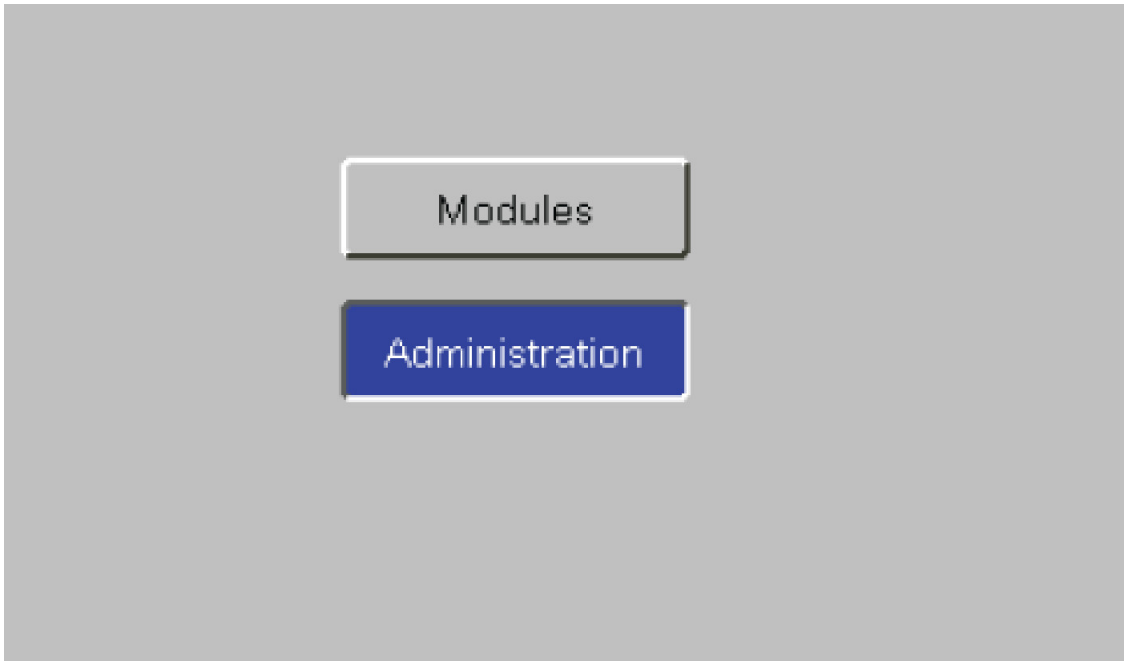



**Modules** menu shows module status.

- Green = OK
- Red = Error
- Black = Selected

Press ENTER to view further information about the selected module.

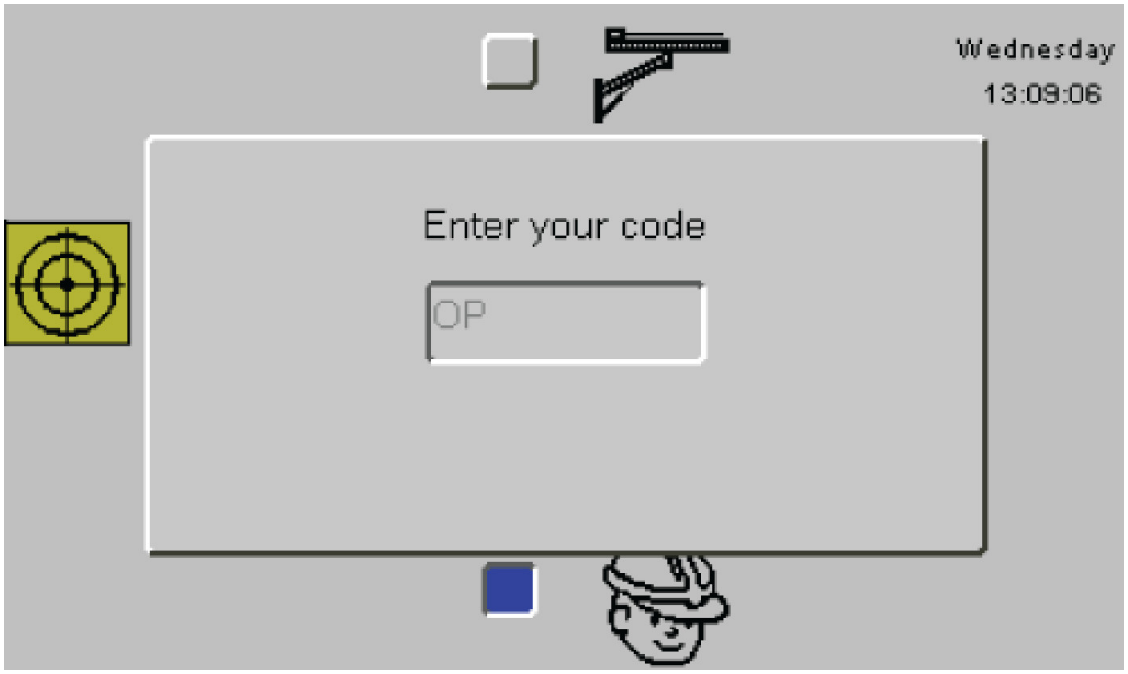
### Diagnostics Menu




Diagnostic option menu shows:

- Fault finding in **Modules**
- **Administration** (only shows for logged-in users)

### User Menu

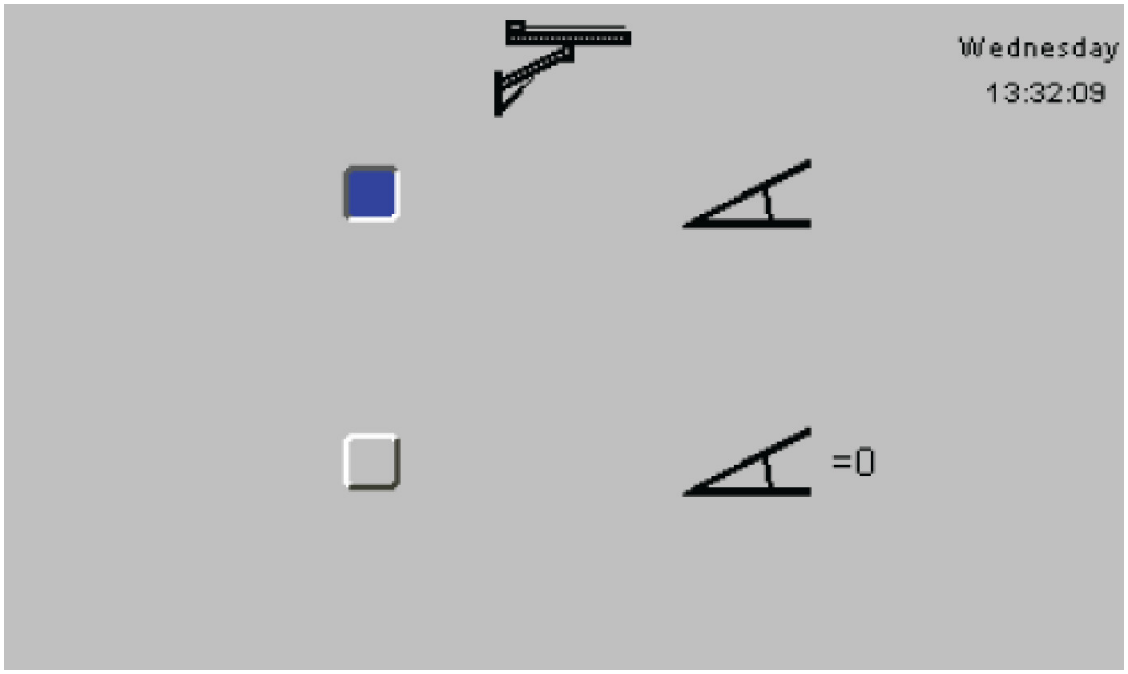



User menu shows:

- The menu for entering a password.

A password is required for access to certain menus.

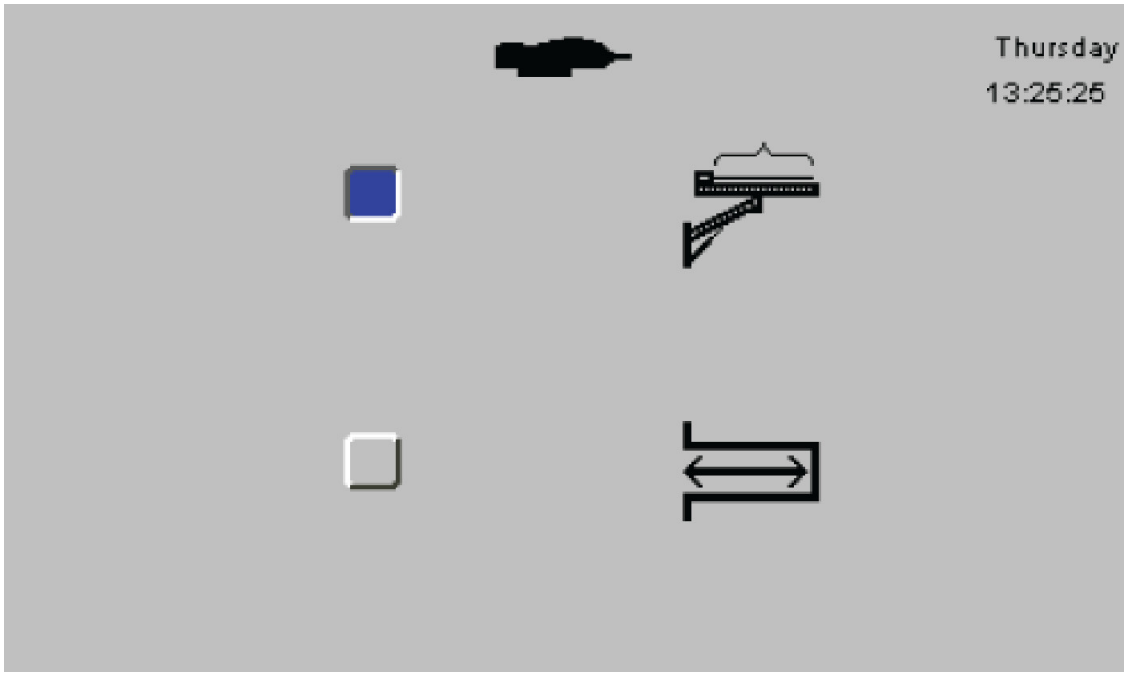
### Sensors Menu




Sensors menu is an option menu used to:

- show angle measurements
- calibrate boom angle sensor (only shown for logged-in users)

### Settings Menu

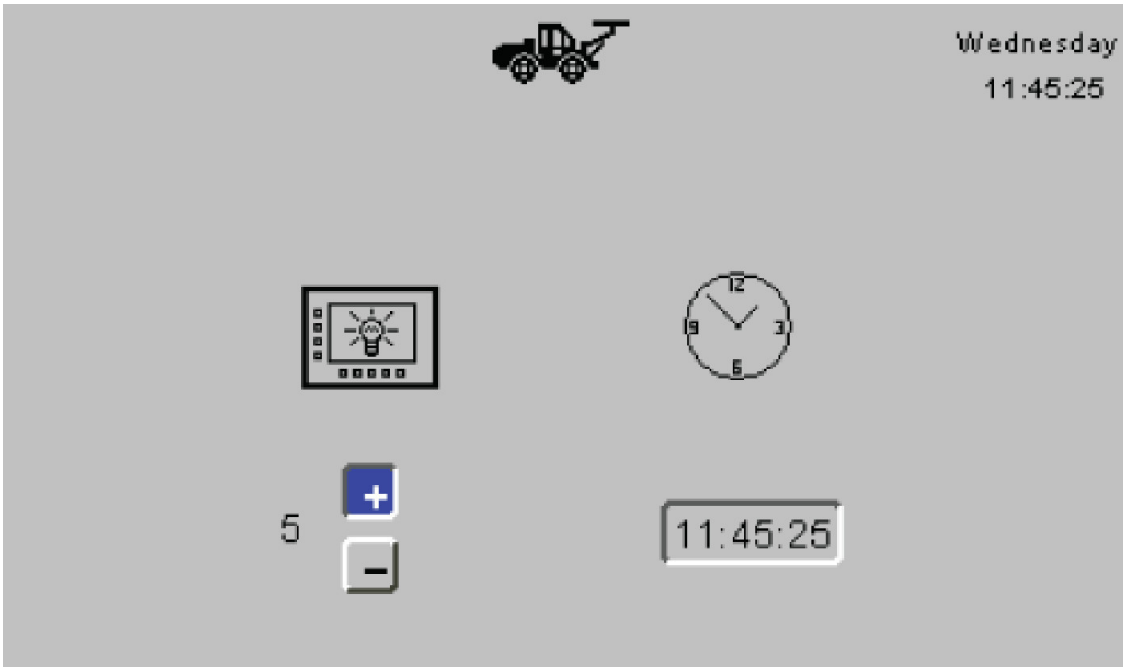



Settings option menu shows:

- Length of full-depth drilled hole
- Calibration of hole depth measurement

This menu is only shown for FAM 2 system. FAM 1 system is presented directly on settings menu for length of full-depth drilled hole.

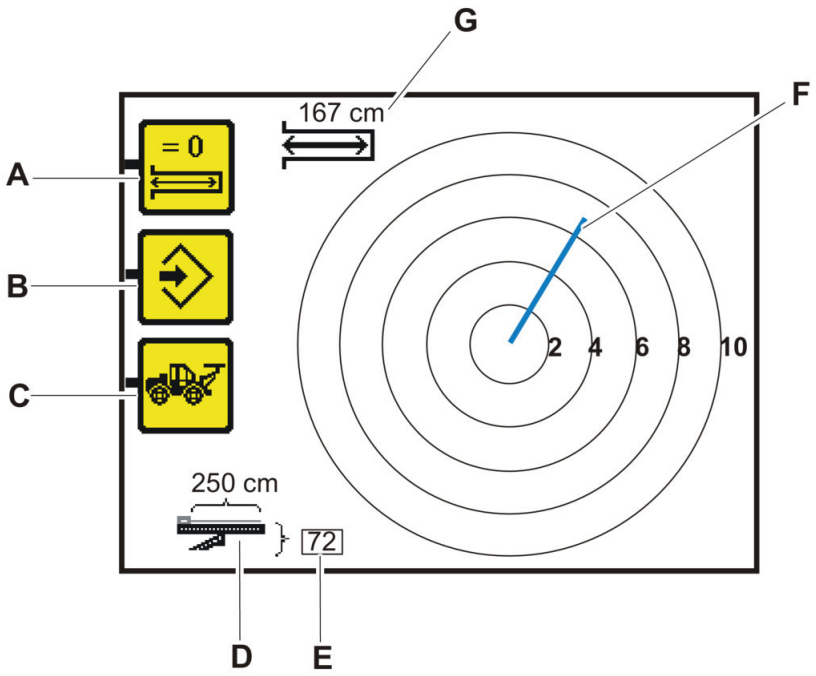
### Rig Menu




This menu is used to:

- set display brightness with setting values 1–9;
- set the clock.

## 4.2.2 Working Menu




| | | | |
|---|---|---|---|
| A | Zeroing hole depth measurement | B | Reading of user-defined reference direction |
| C | Selection of reference direction | D | Maximum hole depth |

| | | | |
|---|---|---|---|
| E | Vertical deviation | F | Feed direction |
| G | Measured hole depth | | |

- The feed direction is shown graphically in the form of a target where the bull-eye represents the starting point of the hole.
- The target shows the finishing point of the hole in the blast.
- The hole ends up in the center of the target if the feed is according to the reference direction. Otherwise there is a deviation in feed direction that is indicated with the line (F).

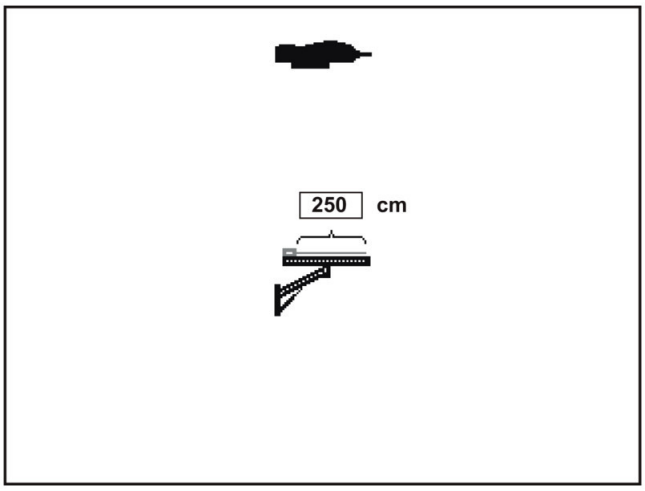
According to the illustration, the hole deviates about 7 cm (2.75 in.) both vertically and horizontally.

- The angle display is based on drilling the maximum depth of the hole (D).

Maximum hole depth must be set before the angle display starts working.

- The type of reference direction is selected using (C).
  - Selecting the rig symbol enables the predefined reference direction which is the machine longitudinal axis.
  - Selecting the tunnel symbol enables the optional reference direction to be defined.
- The measured hole depth (G) is displayed when the hole depth measurement option is selected.
- The hole depth measurement is zeroed by selecting (A).

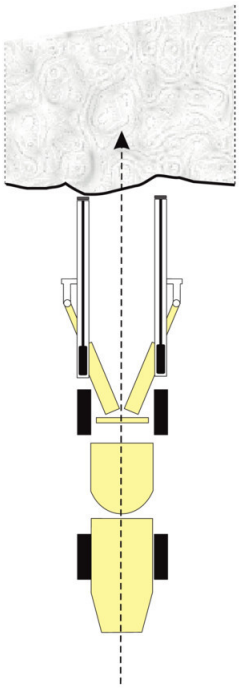
### Setting Maximum Hole Depth



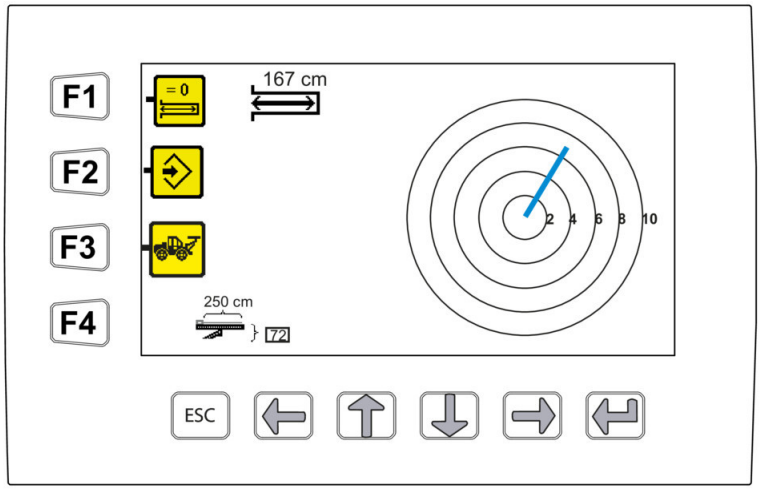

1. Select the icon for setting the maximum hole depth from the **Settings** menu.
2. Place the cursor on the box with the numerical value and press Enter key.
3. Using the right and left arrow keys place the cursor over the digit (ones, tens, or hundreds) to be changed.
4. Using the up or the down arrow key, increase or decrease the value.
5. Press Enter key to save the new value.

### Selecting Rig Reference Direction

Rig reference direction means that the longitudinal axis of the rig is used as reference direction.



*Rig Reference Direction*




*Working Menu on Operation Control Panel*

1. Open the working menu on the operation control panel.
2. Press button **F3** to show the rig symbol.

Step result ➔ Rig symbol is shown in the working menu.

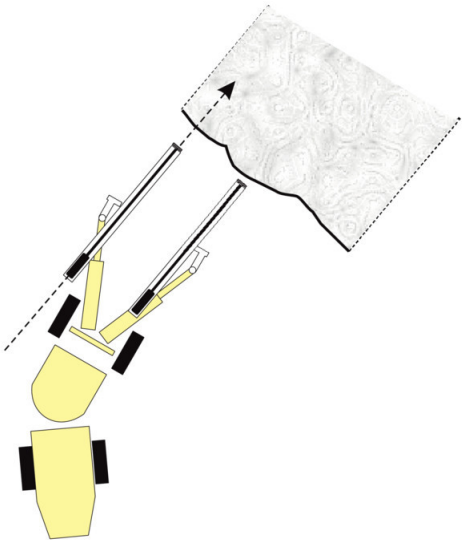
3. Rig reference direction is selected if the rig symbol is displayed in the working menu.

Step result ➔ The system shows the direction of the feed in relation to the longitudinal direction of the rig.

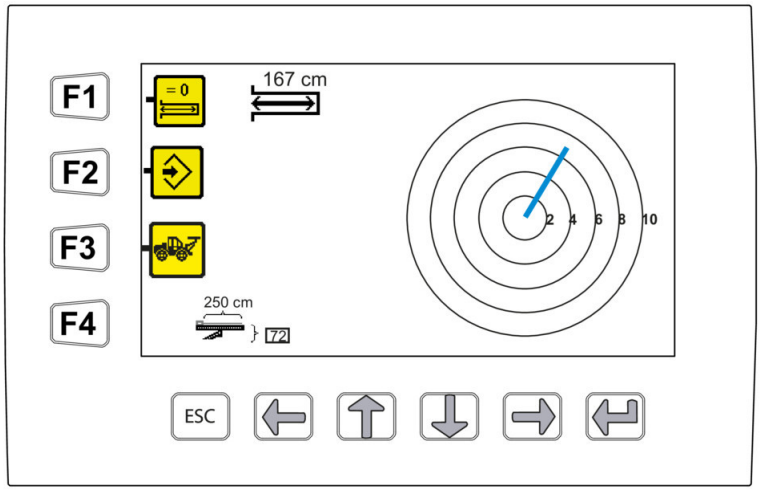
This alternative can be used when it is possible to set up the rig in alignment with the drilling direction.

### Selecting Tunnel Reference Direction

Tunnel reference direction requires a user-defined reference direction.



*Tunnel reference direction*




*Working Menu on Operation Control Panel*

1. Align the feeder in the desired drilling direction.
2. Open the working menu on the operation control panel.
3. Press button **F3** to display the tunnel symbol instead of the machine symbol.
4. Press button **F2**. The system reads the new reference direction that is the direction of the feed.

Step result

➔ The line on the target disappears and a dot replaces it, in the center of the target.

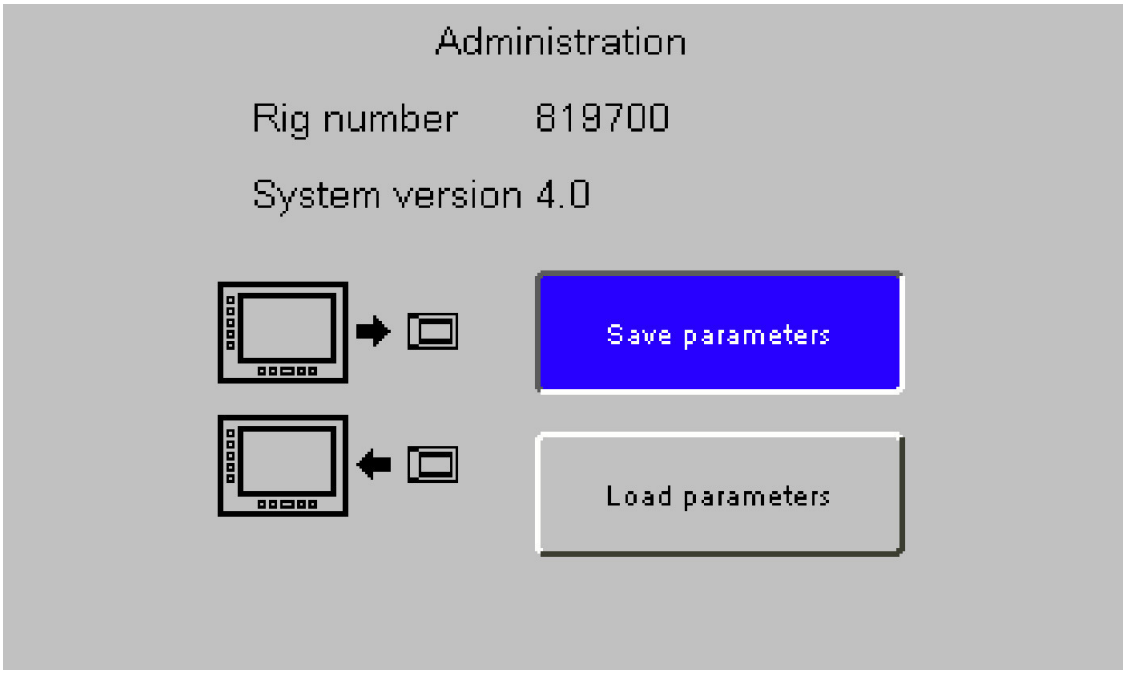
! ***NOTE:*** *After reading the reference direction, it applies to all the booms on the machine.*

## 4.3 Software Management

The Rig Control System, FAM and related software are supplied and installed from the factory when the equipment is new. A USB stick is included with the delivery. This is used for system software backup, parameter backup and storage of the log file. A new USB stick is supplied whenever the equipment is upgraded with new options and functions. An upgrade or update can be sent electronically and then loaded using the existing USB stick for installation.

### 4.3.1 Software Installation

#### Saving Parameter




Save the parameter settings to the USB memory stick before replacing application module or loading new software.

Then it is possible to return to old parameter settings by loading them back to the system.

1. Insert the USB memory stick into the USB port at the rear of the display.
2. Go to the **Administration** menu.
3. Select **Save parameters** to save the existing data.
4. Select **Load parameters** to load the existing data.
5. Remove the USB memory stick from the USB port when a message appears on the display prompting that the operation has finished.

#### Loading New Software

Load the new software when a module is replaced or the existing software is being upgraded.

Sometimes, a new boot program must be installed when the new software is installed.

The boot program is then loaded in the same manner as described.

Precondition
- ✓ Boot program is loaded first.
- ✓ All parameters are saved to an empty USB memory stick.

1. Switch off the electrical supply to the system and wait about ten seconds.
2. Connect the USB stick with the new software to the USB port.
3. Switch on the electrical supply to the system.
4. Wait until the loading is complete.

Step result
- ➔ A message appears informing the operator to reboot and start the system.

5. Wait until a menu with four options is shown on the display.
6. Select the option **Code Load**.
7. Respond to the question on whether the machine parameters have been saved.

> ! ***NOTE:*** *It is important that the parameters of the machine are saved. If the data is not saved, cancel loading new software and save parameters first.*

8. Switch off the electrical supply to the control system and remove the USB stick.
9. Restart the system and load the existing parameters.
10. Check that the number of percussion hours, electric motor hours, compressor hours, and number of drill-meters correspond with the values recorded before the installation.

## 4.4 Sensor Calibration

The following is required to calibrate the sensors:
- Digital spirit level
- Tape measure

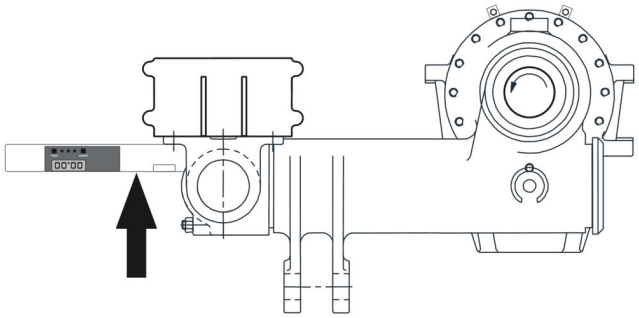
The sensors must be calibrated in the order specified. The rig must be in level when calibrating.

### 4.4.1 Adjusting Feed Lookout Cylinder

Precondition
- ✓ The cylinder is placed at the bottom and locked throughout the adjustment for the setting to be accurate.

1. Set the boom so that the feeder can be rotated freely between end positions.
2. Operate the rock drill to the rear of the feeder.
3. Retract the feed extension to its rear position.
4. Operate the boom extension to its front position.

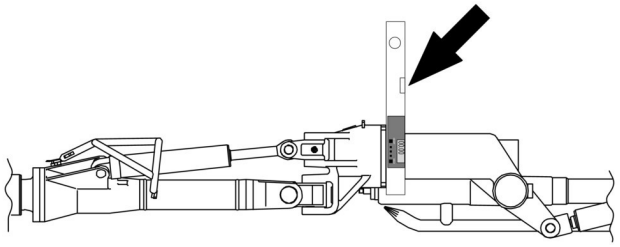
5. Set the rotation axis so that the feeder is level ± 5° with the rock drill on the upper side.



*Lookout Axis, Horizontal*

6. Use the front tripod to set the rotation axis horizontally by measuring the bolted joints.

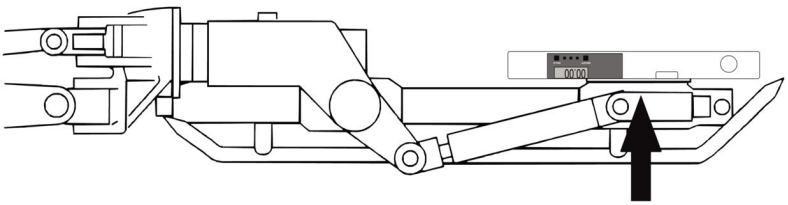
   The spirit level must show 90° and the precision is ± 0.1°.



*Rotation Axis, Horizontal*

7. Check that the feeder is horizontal, longitudinally parallel to the rotation axis, and precision is ± 0.1°.

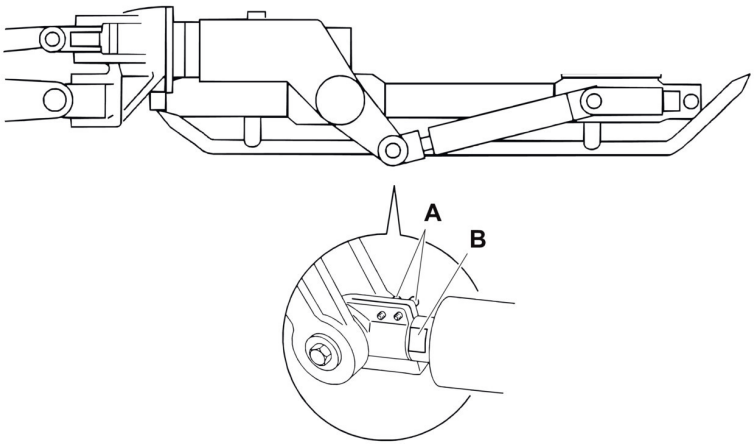
   Measurement is done against the feed holder.



*Feeder, Horizontal*

8. If the feeder is not horizontal, then adjust the lookout cylinder mechanically until the feeder is parallel to the rotation axis and precision is ± 0.1°.

   a. Loosen the screws (A) and rotate the cylinder shaft (B).




*Mechanical Adjustment of the Feed Lookout Cylinder, Horizontal*

   b. Measure the angle on the feed holder with the spirit level. The spirit level should now be reading 0 ± 0.1°. Rotate the feeder 180º so that the rock drill is under the feeder.

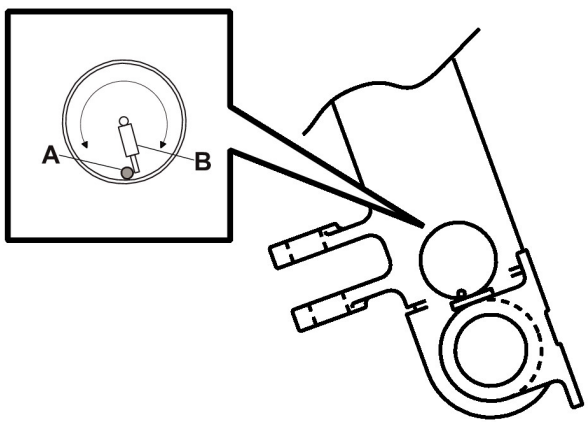
   c. Read the angle again on the feed holder with the spirit level and check the values against each other.

      If the difference is large, more than 1.5º, check that the feed lookout cylinder is not fitted loosely, leaking or broken.

## 4.4.2 Inclination Sensor

### Basic Adjustment and Coarse Calibration

1. Set the boom so that the feeder can be operated to both its end positions.
2. Operate the rotary actuator to end position against the mechanical stop, right-hand feeder to the right, and left-hand feeder to the left.
3. Remove the sensor screws in the holder.




*Inclination Sensor*

4. Rotate the sensor to align the stop screw (A) down to the floor and screw it in position so that the sensor pendulum arm (B) moves freely.
5. Operate the rotary actuator forward and back to both its end positions.

   Make sure that the pendulum arm (B) inside the sensor rotates to the correct position.

Step result ➔ The sensor end position is adjusted.

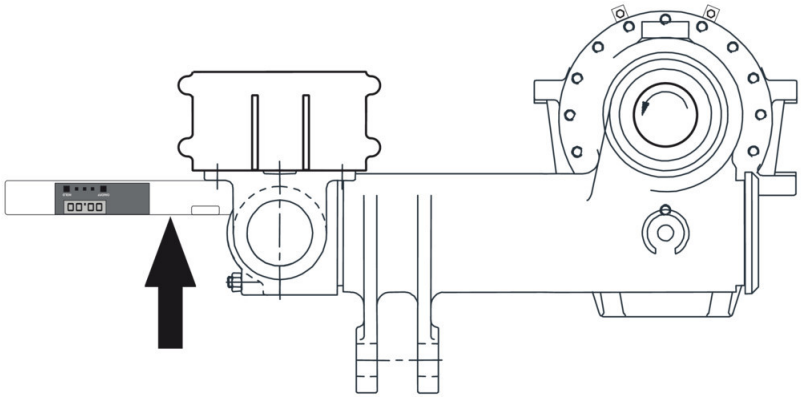
6. Go to the **Calibration** menu and press the **Reset** button for Inclination of feed.
7. Raise the front of the feeder 15° with the feed lookout cylinder.
8. Measure the angle of the feed holder with a spirit level.

   Change the coefficient on the menu so that the angle on the display and the measured angle correspond and it is positive.

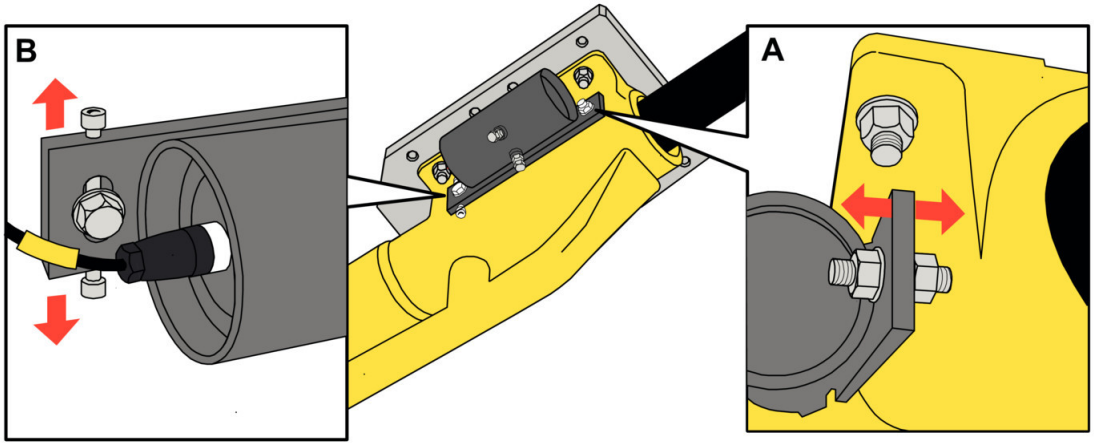
   Precision is ±0.5°.
9. Check that the positive value of the angle increases when the feeder is raised further at the front with the feed lookout cylinder.

### Mechanical Adjustment

> ***NOTE:*** *If the sensor is not within the tolerance, the adjustment must be repeated.*



*Feeder in Horizontal Position*




*Mechanical Adjustment of the Inclination Sensor*

1. Set the boom so that the feeder can be rotated to both its mechanical end positions and fully run in the feed lookout cylinder.
2. Set the rotation axis so that the feeder is level, ±0.1°, with the rock drill on the upper side.

   Measure against the underside of the feed holder.
3. Press the **Reset** button for inclination sensor on the **Calibration** menu.
4. Rotate the feeder 180° so that the rock drill is under the feeder. Read the angle in the **Calibration** menu.

   The difference from the previous reading must not be greater than 0.1º + the angle difference on the feed holder. The angle of the feed holder is measured in the section **Adjusting the feed lookout cylinder**. If the difference between the angles is greater than 0.1º:

   a. Adjust the sensor bracket on the feed holder in accordance with adjustment (B).
   b. Remove the screws and move the sensor so that the value on the display is in between the values.
   c. Tighten the screws and check that the sensor is within the tolerance.
5. Rotate the feeder back and weigh it in according to step 2.
6. Check that the angle deviation is within the tolerance and Reset the sensor in **Calibration** menu.
7. Rotate the feeder 90° so that the feeder is above the boom with the rock drill on the side. Read the angle in the Calibration menu.

   The difference from the previous reading must not be greater than 0.1° + half the angle difference on the feed holder. The angle of the feed holder is measured in the section **Adjusting the feed lookout cylinder**. If the difference between the angles is greater than 0.1°:

   a. Adjust the sensor bracket on the feed holder in accordance with adjustment (A).
   b. Remove the screws and move the sensor so that the value on the display is in between the values.
   c. Tighten the screws and check that the sensor is within the tolerance.
8. Operate feed rotation forward and backward between the end positions and at the same time check that the angle is not greater than 0.1° + the angle difference on the feed holder. The angle of the feed holder is measured in the section **Adjusting the feed lookout cylinder**.

### Resetting Inclination Sensor

1. Rotate the feeder so that it is approximately level (±5°) with the rock drill upwards.
2. Set the feeder horizontal by operating the front tripod.

   Measure on the feed holder. Precision is ±0.05°.
3. Go to **Calibration** menu.
4. Press the reset button for the inclination of feed to reset the inclination sensor.

5. Raise the front of the feeder approximately 30°.

   Measure the angle of the feeder on the feed holder with a spirit level.

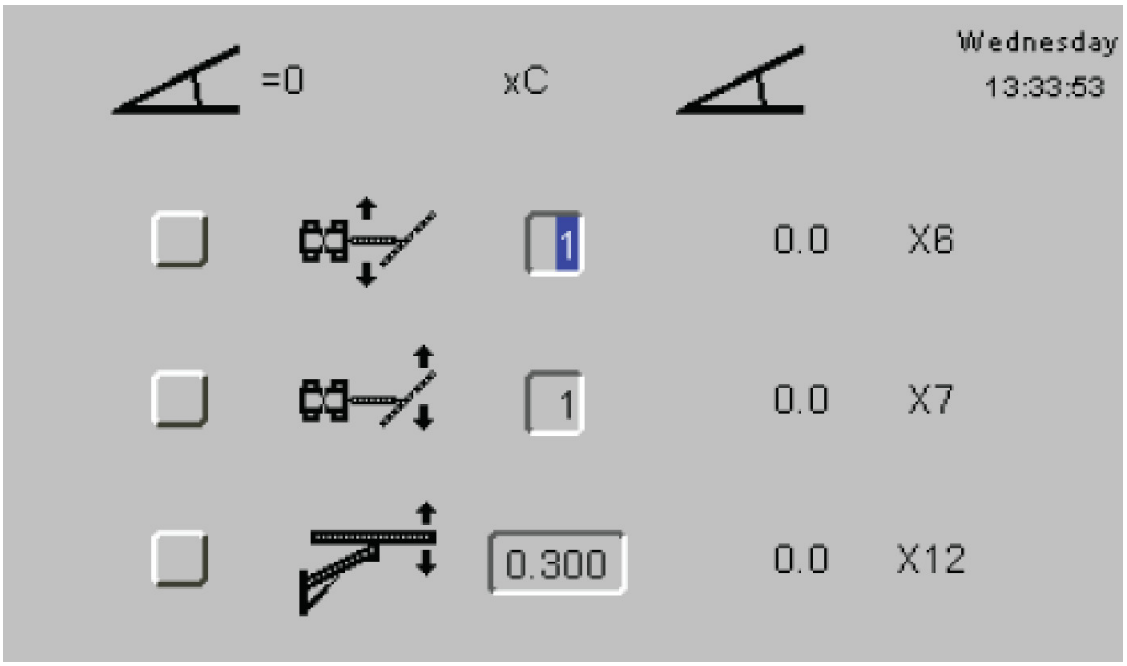
6. Change the coefficient for the inclination of feed so that the angle on the display is the same as the measured value and has a plus sign.

   Precision ±0.1º.

7. Calibrate the inclination sensor for all the booms before calibrating the side angles.

### 4.4.3 Front and Rear Side Angle Sensors

#### Resetting Rear Side Angle




Precondition ✓ Machine is parked on a flat and leveled surface.

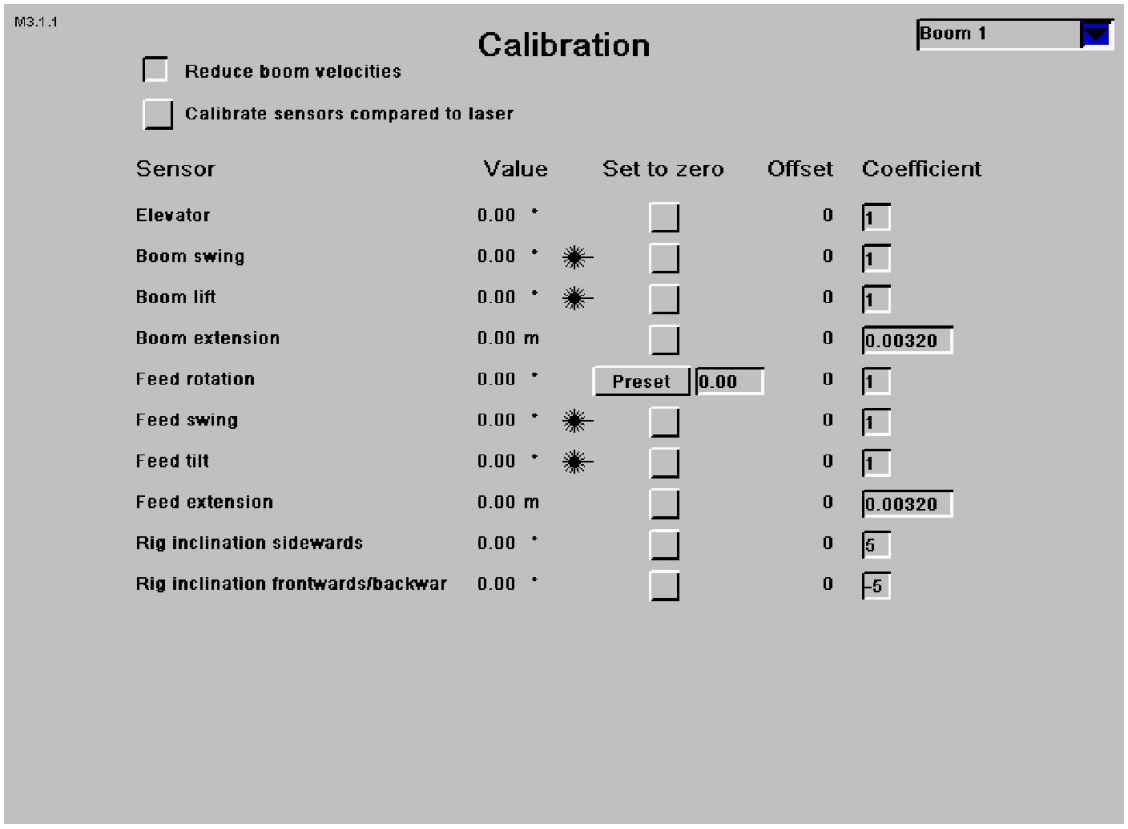
1. Rotate the feeder so that the rock drill is above the feeder.
2. Adjust one boom at a time so they are pointing straight ahead laterally.
3. Check that the rear boom cylinders are extended equal lengths using a rule.

   ! ***NOTE:*** *Applies only to straight boom plates.*

   For angled boom plates, another method is used to check that the booms are parallel to the machine for a wider target surface.

4. Go to the **Calibration** menu.
5. Reset the rear side angle by activating the **reset** button.
6. Repeat steps 1 to 5 for all booms.

### Resetting Front Side Angle



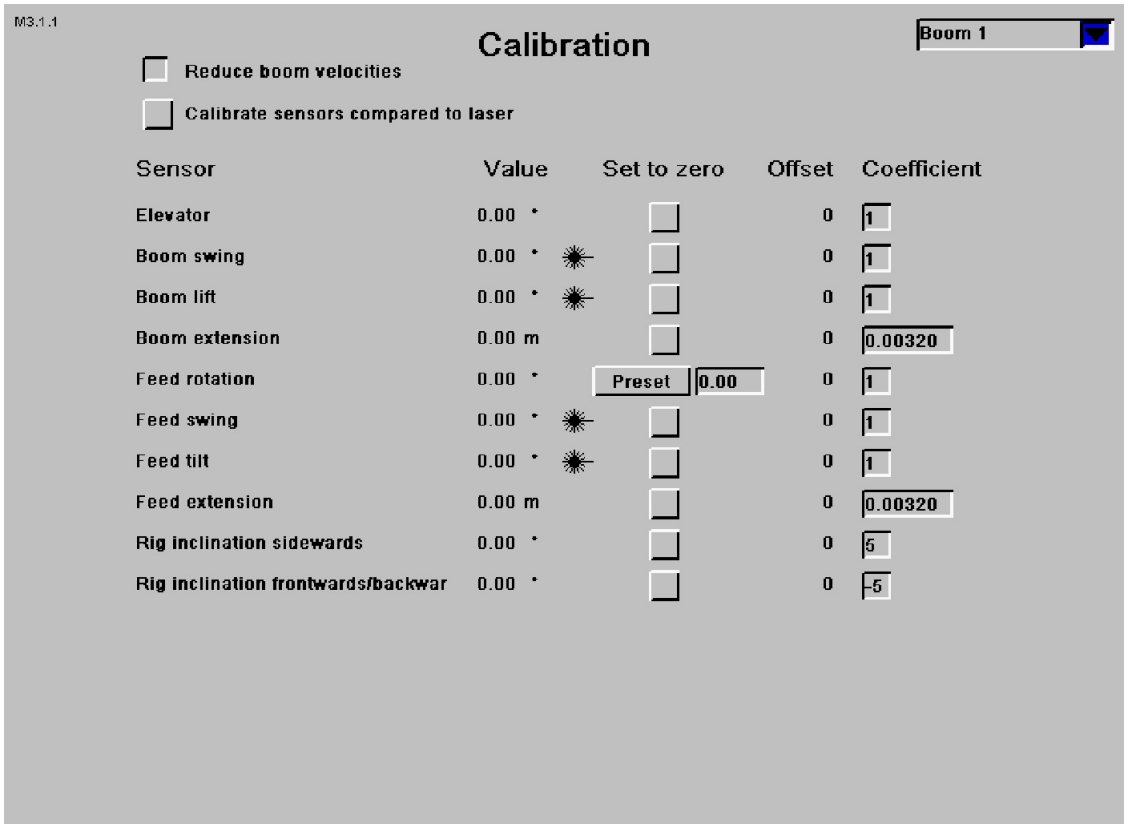

Precondition
- ✓ Machine is parked on a flat and leveled surface.
- ✓ The position of the newly calibrated rear boom cylinders must not be changed when calibrating the front side angles.

1. Adjust boom one until the feeder is parallel with the boom.

   Use a rule to measure the front boom cylinders. The cylinders must be run out with an equal amount.
2. Go to the **Calibration** menu.
3. Reset the front side angle for boom one by activating the button.
4. Position the feeders for the other booms parallel to boom one.

   ! ***NOTE:*** *Measure with a tape measure or rule for precision of ±5 mm.*
5. On the **Calibration** menu, reset front side angle for the other booms by activating the button.

### Setting Coefficient for Rear and Front Side Angles




Precondition ✓ Machine is parked on a flat and leveled surface.

1. Go to the **Calibration** menu.
2. Set the coefficient for the rear side angle, boom swing, so that it increases when the boom is moved to the right.
3. Set the coefficient for the front side angle, feed swing, so that it increases when the feeder is moved to the right.
4. Repeat steps 1 to 3 for all the booms and then position them straight and roughly to the same height.

## 4.4.4 Rock Drill Position (Option - Hole Depth Measurement)

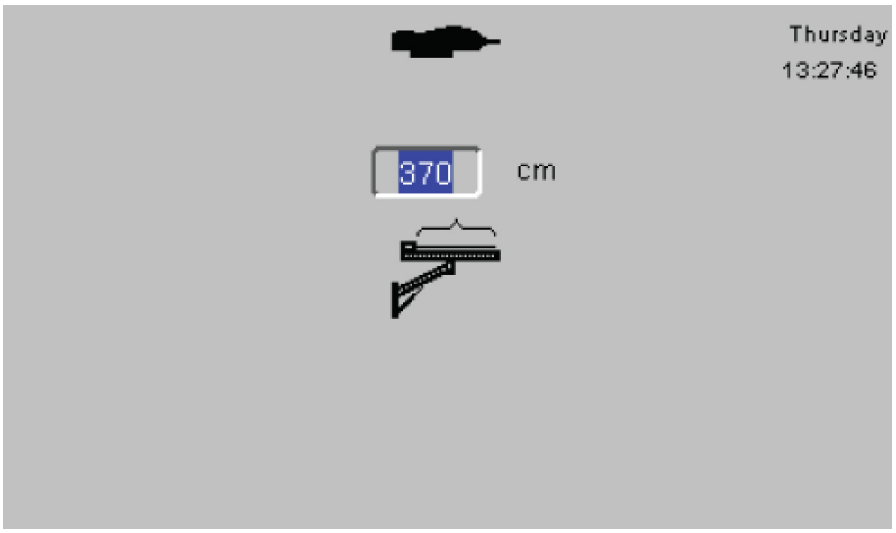
### Setting Feed Length

1. Operate the rock drill all the way to the rear of the feed and mark the location.

> ! ***NOTE:*** *Enter the measured feed length if the machine is equipped with* **Hole Depth Measurement** *option.*

2. Operate the rock drill to the front of the feed and measure the total distance that the rock drill has moved.

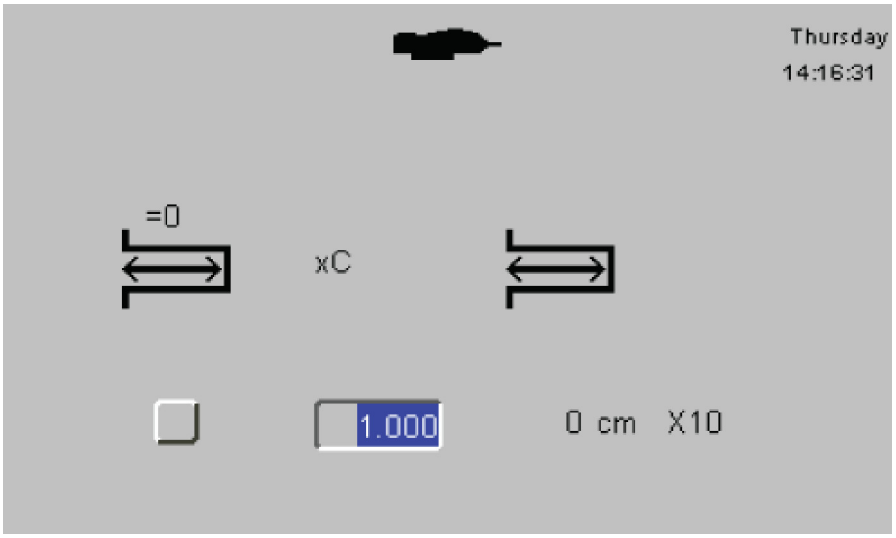
3. Enter the measured feed length, on the **Settings** menu.




**Settings** *Menu*

### Calibrating Length Sensor

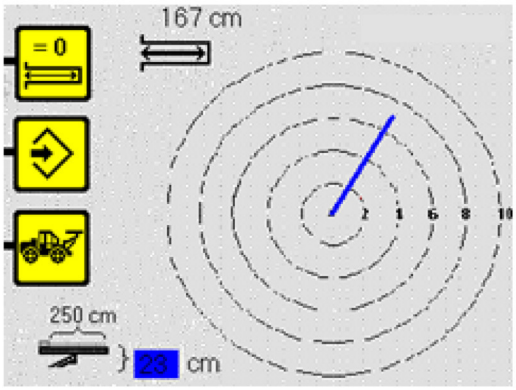
1. Run the rock drill to the rear end of the feeder.
2. Go to **Calibration of the length sensor** on the menu.




3. Press the **Reset** button on the menu to reset the sensor.
4. Run the rock drill from the rear end position to the front-end position on the feeder.
5. Measure the distance between both end positions with a tape measure.
6. Change the coefficient (xC) on the menu so that the length for the hole depth corresponds with the measured value.
7. Reverse the rock drill so that the cradle is on the center of the feeder.
8. Measure the distance from the rock drill to the feeder and check that the measured value corresponds with the value on the display.

### Checking Angle Sensors

1. Go to working menu drift drilling on the main menu.




2. Level the machine, and check with the spirit level.

   Precision is ±0.1º

3. Operate the feed lookout cylinder on all booms to the full so the FAM system display correct values.

4. Perform the following positioning:

   a. Swing the booms so that the rear tripod is swung slightly to the left.

   b. Rotate the feeders so that they can be operated close to each other.

   c. Swing the feeders slightly to the right and operate them as close to each other as possible.

   d. Set the feeders fully parallel to each other.

> ! ***NOTE:*** *The values for boom swing and feed swing do not need to be the same. It is important that the feeders are fully parallel in relation to each other.*

5. Check that all booms indicate similar values.

   All booms must show equivalent directions on the display.

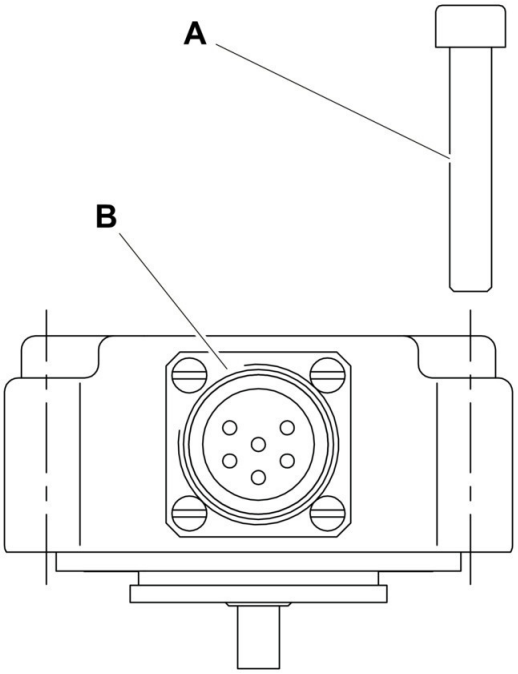
   All booms must show equivalent values for lookout in cm.

   The booms must show a direction that corresponds to the direction of the machine.

> ! ***NOTE:*** *The line that runs from the center of the target points in the direction that the feeder must point in relation to the machine. The length that the feeder points to the side is specified in cm with the numbers at each respective ring.*

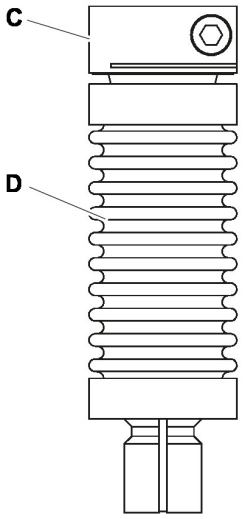
# 4.5 Replacement of Components

## 4.5.1 Replacing Angle Sensor



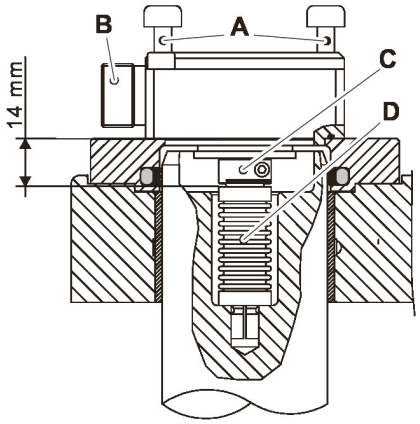

*Angle Sensors*

1. Clean the area where the sensor is built into the boom joint.
2. Disconnect the cable from the cable connector (B).
3. Remove the four hexagon socket screws (A) on the sensor.
4. Remove the sensor and bellows coupling. The bellows coupling consists of two parts:
   a. Part (C) is attached on the sensor by hexagon socket screw.
   b. Part (D) is attached in the boom joint by a hexagon socket screw in the bottom of the coupling.




*Bellows Couplings*

5. Attach part (D) of the new bellows coupling into the boom joint and tighten the hexagon socket screw in the bottom.




*Boom Joint*

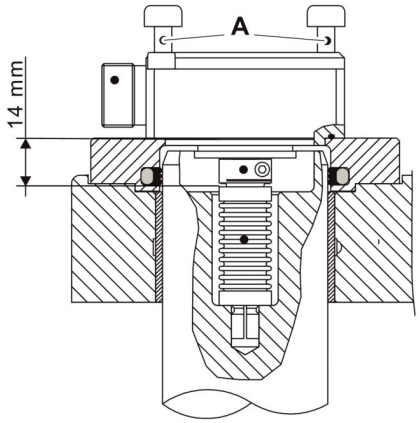
6. Check that the correct attaching dimension is obtained.
7. Attach part (C) of the bellows coupling onto the new sensor.
8. Attach the sensor in the boom joint so that its connector is pointing in the correct direction regarding the run of the cable.

   Make sure that the splines of the bellows coupling (on the part that is mounted on the sensor) are in the correct groove on the part that is mounted in the boom joint.
9. Press down the sensor while tightening the four hexagon socket screws (A).
10. Connect the cable to the cable connector (B).
11. Calibrate the sensor.

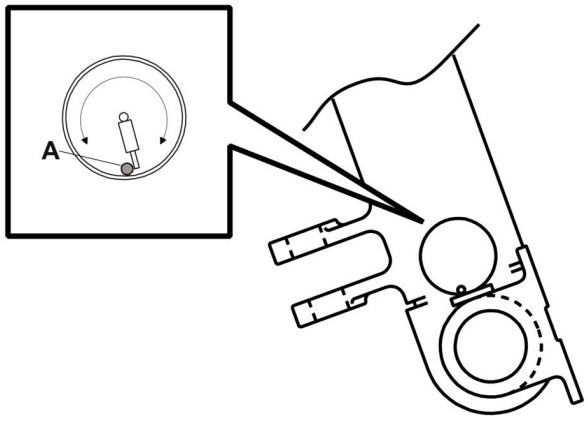
### 4.5.2 Replacing Inclination Sensors

1. Rotate the feeder to one of the end positions.
2. Disconnect the cable from the existing sensor.
3. Remove the locking screws on the sensor protection and pull the sensor out of the protection.
4. Install the new sensor in the protection with the connector facing forwards (towards the drill bit).

5. Turn the sensor so that the stop screw (A) is down.



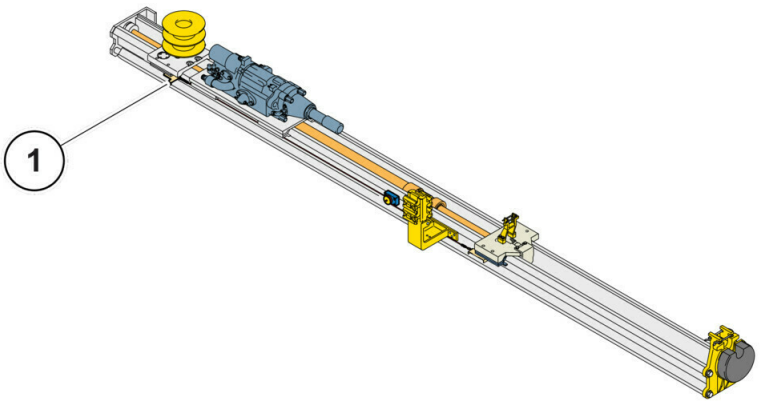

> ***NOTE:*** *The end positions for feed rotation vary depending on how the feeder is fitted on the boom. However, the sensor must always be fitted with the stop screw down, irrespective of the type of boom and feeder.*

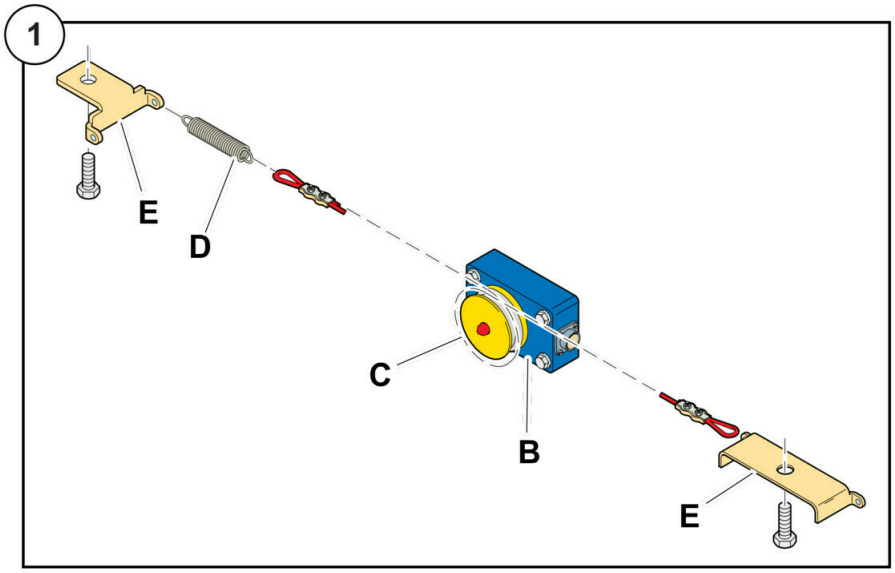



6. Lock the sensor in place with the locking screws on the sensor protection.
7. Connect the cable to the new sensor.
8. Calibrate the replaced sensor.

### 4.5.3 Replace Cradle Length Sensor

> ***NOTE:*** *There are two variants of sensors for cradle positioning. One is a length sensor on the feed, and one is an oil flow gauge on the carrier.*




Precondition ✓ The sensor (B) is filled with lubricant grease before screwing it to the beam as the lubrication nipple lubricates only the seal.

1. Lay the wire one turn around the wire pulley (C).

> ! ***NOTE:*** *Note the direction of the coil (C), the spring side of the wire must be closest to the beam.*

2. Adjust the wire length so the spring (D) is 100 mm (3.93 in).

> ! ***NOTE:*** *The spring is 70 mm (2.75 in) unloaded.*

3. Run the feed cylinder in and out and check that the wire does not get tangled.

> ! ***NOTE:*** *The wire attachment (E) is in two parts when assembling.*

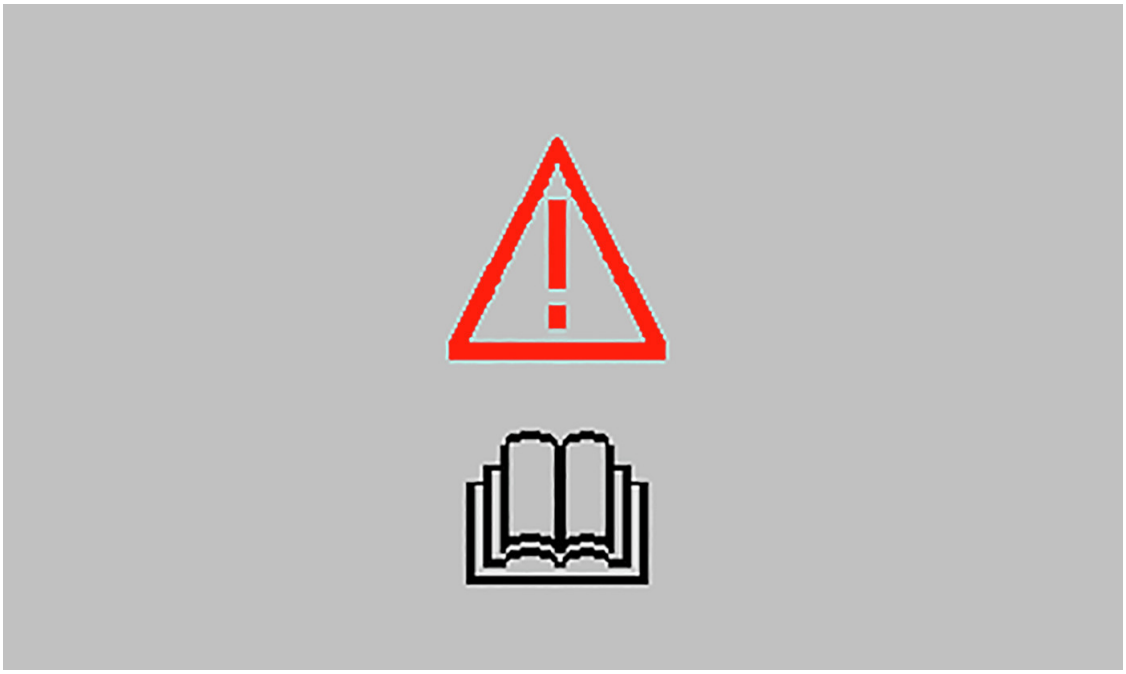
### 4.5.4 Replacing Resolver Module

1. Disconnect all the connections from the resolver module.

2. Remove the address plug and terminating resistor and connect them to the corresponding contacts on the new resolver module.
3. Connect the supply voltage, display module, and sensor to the correct contacts.
4. Calibrate the sensors.

## 4.6 Troubleshooting

### 4.6.1 Fault Indication



The system indicates a fault by:

- Displaying a warning on the operation control panel display.
- Showing a warning triangle ⚠ in the lower right-hand corner of the display.

The warning triangle is shown either in the main menu or the working menu.

#### Causes of Fault Indication

The reasons of fault indications are:

- When a fault arises in CAN communication.
- When the display and resolver module have contact and not for a problem between the I/O and resolver modules.
- Defective cable between resolver module and sensor
- Defective sensor
- Defective resolver module
- Defective display module

Check the CAN cables for contact and check that the system ID plugs and termination resistors are connected properly when the warning is displayed.

| | |
|---|---|
| ! | ***NOTE:*** *The cause of the fault is found using the fault finding menus.* |

### 4.6.2 Function Checking and Fault Finding

#### Module Fault Indication

> ***NOTE:*** *If in any case status "_" is shown it indicates that contact with the module has been broken.*

## Display/Application module

| | | |
|---|---|---|
| **CAN Communication** | **OK** | • Normal |
| | **ERR** | • Check the CAN cables.<br>• Check that the module is operating. The LED light must flash slowly (1 Hz). |
| **Version** | It shows the module software version. | If there is an extra version that is indicated in parentheses, it is that version that must be used according to the program card. If a module shows two different versions, download new software. |

## Resolver module

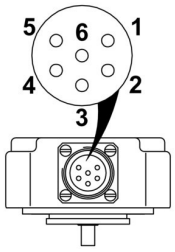
| | | |
|---|---|---|
| **CAN Communication** | **OK** | • Normal. |
| | **ERR** | • Check the CAN cables.<br>• Check that the module is operating. The LED light must flash slowly (1 Hz). |
| **Version** | It shows the module software version. | If there is an extra version that is indicated in parentheses, it is that version that must be used according to the program card. If a module shows two different versions, download new software. |
| **Memory** | **OK** | • Normal. |
| | **ERR** | • Replace the module. |
| **Supply voltage** | Supply voltage ≥ 24 V. | • Normal. |
| | Supply voltage < 24 V | • Check cables and connectors. |
| **Sensor supply voltage encoder** | Supply voltage ≥ 15 V. | • Normal. |
| | Supply voltage < 15 V | • Check cables and connectors. |
| **Sensor supply voltage analog** | Supply voltage ≥ 4.5 V | • Normal. |
| | Supply voltage < 4.5 V | • Check cables and connectors. |

| | | |
|---|---|---|
| **Sensor supply voltage resolver** | **OK** | • Normal. |
| | **ERR** | • Supply voltage deviates by more than 10%. |
| **Inputs channel** | **OK** | • Normal. |
| | **ERR** | • Check cables and connectors. |

### Checking Angle Sensor

By measuring the winding resistance of the sensor, it is possible to determine whether the sensor and the cable between resolver module and sensor are working.

1. Disconnect the cable from the contact on the resolver module.
2. Take readings across the cable pins:
   a. Across pins 1 and 2. The resistance is approximately 36 ohms.
   b. Across pins 3 and 4. The resistance is approximately 105 ohms.
   c. Across pins 5 and 6. The resistance is approximately 105 ohms.




> ***NOTE:*** *Make the same measurement on the sensor pins if the value varies largely.*

3. Disconnect the cable from the sensor contact.
4. Measure across the sensor pins.

   If the same fault is obtained as when measuring on the cable, the sensor must be replaced. Otherwise assume that the fault is in the cable.

   If fault finding shows that both cable and sensor are intact and free from faults, the fault probably lies in the resolver module.

## 4.7 Technical Data

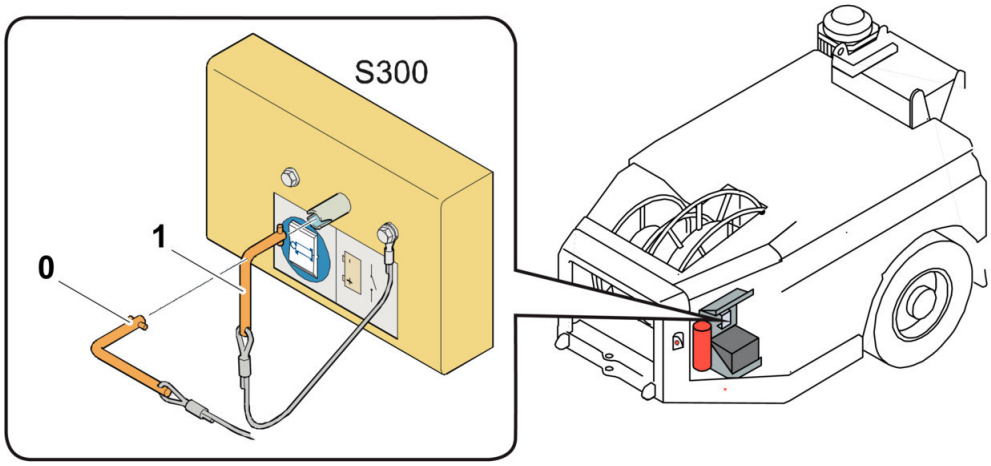
**Directional Control Equipment**

| | |
|---|---|
| Supply voltage | 24-V DC stabilized |
| Communication system | CAN |

# 5 Operation

## 5.1 Startup and Shutdown

### 5.1.1 Battery Isolation Switch




| | | | |
|---|---|---|---|
| 0 | OFF | 1 | ON |

### 5.1.2 Turning On Main Power

Precondition
- ✓ The main power cable is connected to the tunnel outlet and secured to the tunnel wall.
- ✓ Correct voltage is used.

1. Turn the electric cabinet main switch to position 1.
2. Press the lamp test button and check that all the indicator lamps on the electric cabinet come on.

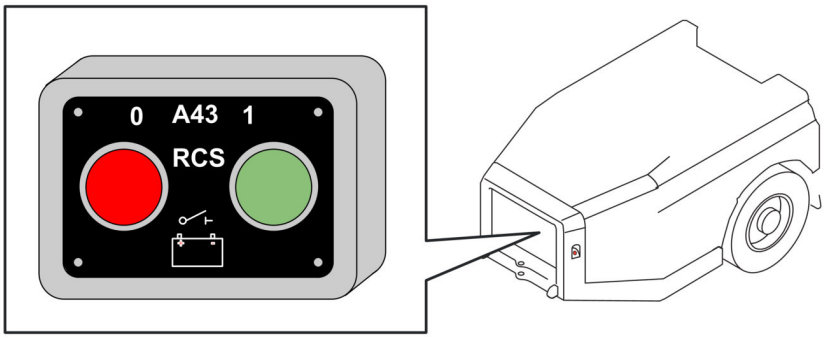
Step result
- ➔ If an indicator lamp does not come on, investigate and rectify the cause.

3. Check that all the electric cabinet motor switches are in position 1.

### 5.1.3 Checking Before Starting the Engine

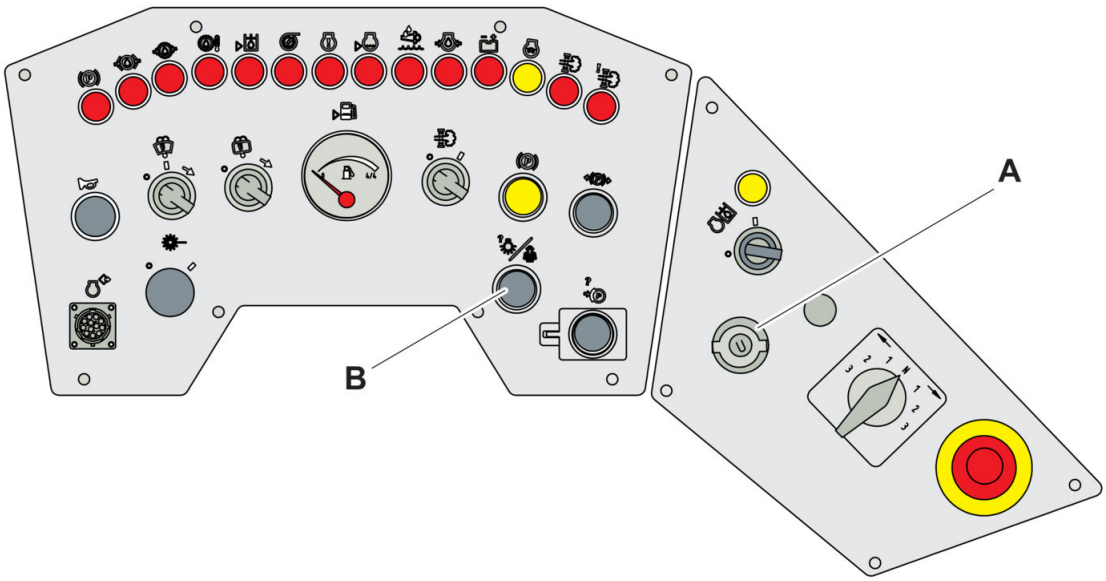
- ○ Check the engine oil level, fuel level, hydraulic oil level, water level, and the coolant level and refill as necessary.

- Check that the particle filter is not attached to the flashing unit.




- Push the button (1) on the battery isolation switch (A43) to start the power supply to the machine and start the control system.

### 5.1.4 Starting the Diesel Engine




***NOTE:*** *Certain machines have a function that prevents electric motors and diesel engine running at the same time. Electric motors are automatically switched off when the diesel engine is started. The diesel engine must first be switched off to restart the electric motors.*

Precondition

- ✓ Daily maintenance checks are completed.
- ✓ Battery isolation switch is in the ON position.
- ✓ No emergency stop is activated.
- ✓ Parking brake is applied.
- ✓ Gear selector switch is in the neutral position.
- ✓ Knob for diesel positioning is in OFF position.

1. Preheat the engine by turning the ignition (A) to the ignition on and glow plug preheating position.

Step result

➔ The preheating lamp turns on when the preheating starts.

The lamp turns off after approximately after 30–60 seconds when the engine is preheated.

2. Press the button (B)  to check lamps on control panel.

Step result

➔ All indicator lamps turns on.

If a lamp does not turn on, then turn off the machine and rectify the issue.

3. Turn the ignition (A) to the start position until the engine starts.

> ***NOTE:*** *The machine starts after few seconds when the key is in the start position if the machine is equipped with start warning.*

Step result

➔ The start alarm turns on.

All the other indicator lamps turns off, except the parking brake lamp.

If any of the indicator lamps does not turn off or the engine does not start, then check the following:

- The fuses in the control panel
- The main fuse in the battery isolation switch

## 5.2 Operator Environment

### 5.2.1 Swinging Seat to Operator Position

The swinging seat is **optional** equipment.

**WARNING**

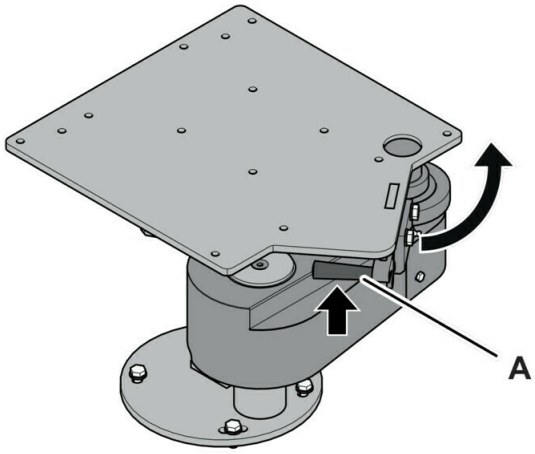
**Rotating Component**

If the swing arm lock mechanism is not properly locked or if the belt tension is not correct, it can cause severe personal injury and machine damage.

▶ Be accurate when adjusting the lock mechanism swing arm to make sure that the mechanism locks properly.

▶ Make sure that the belt tension is correct.

The seat is in driving position.




*Swing Arm Mechanism for Moving the Seat Between Driving and Operation Positions.*

1. Loosen the seat swing arm mechanism by pulling the lever (A) on the left-hand side upwards.
2. Pull the seat towards the operation panel.
3. Lock the swing arm mechanism by releasing the lever (A) so that the locking wedge enters locking slot.
4. Check that the lock is in the right position.

### 5.2.2 Raising and Lowering the Cab

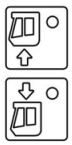
Cab or Canopy lift is an **optional** function.

**WARNING**

**Moving Cab**

There is a risk of serious injury or death when tilting or raising the cab.

▶ No personnel under the cab when it is operated.



*Cab Lift Up and Down on the Keypad*

Hydraulic pressure from the diesel engine or the electric pump is used to raise and lower the cab.

***NOTE:*** *Do not turn the diesel position knob if the machine is running with electric pump.*

***NOTE:*** *The option is not applicable if the machine is equipped with an ROPS.*

Precondition ✓ The RCS and hydraulic pump are running.

○ Press the cab lift button to lift the cab.

Step result ➔ The warning lamp on the valve posts starts to flash for few seconds before the movement starts and goes out when the cab movement is finished.

○ Press the cab lift down button to lower the cab.

Step result ➔ The warning lamp on the valve posts starts to flash for few seconds before the movement starts and goes out when the cab movement is finished.

### 5.2.3 Raising and Lowering the Canopy

Cab or Canopy lift is an **optional** function.

**WARNING**

**Moving Canopy**

There is a risk of serious injury or death when raising or lowering the canopy.

▶ Make sure that no personnel are under the canopy when it is operated.

**NOTE:** *Do not turn the diesel position knob if the machine is running with electric pump.*

Hydraulic pressure from the diesel engine or the electric pump is used to raise and lower the canopy.

1. Turn the knob on driving panel to ON position.

Step result ➔ Hydraulic pressure is loaded.

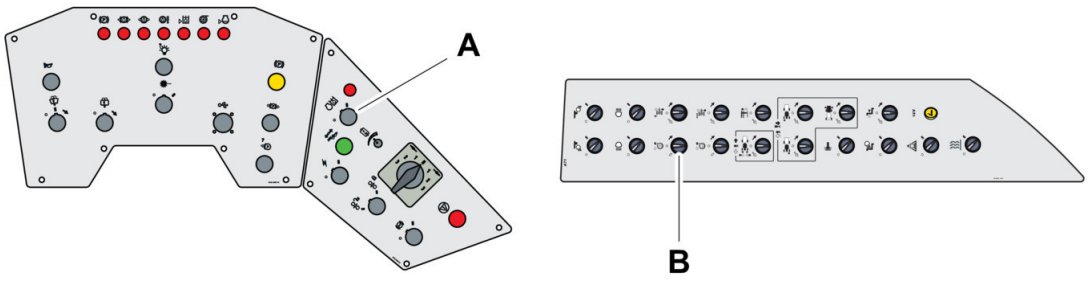
2. Turn the knob counterclockwise direction on driving panel to raise the canopy or in clockwise direction to lower the canopy.

3. Turn the knob to OFF position.

## 5.3 Operating Reeling Units

### 5.3.1 Unwinding Main Power Cable from Reeling Unit

There are two alternative ways to unwind the cable. Under normal operation, the cable reel must not be operated hydraulically when unwinding. The cable must be pulled out through the gear slip coupling instead.




Precondition ✓ The main power cable is connected to the tunnel outlet and secured to the tunnel wall.

Optional step ➤ Unwind the cable using the gear slip coupling.

a. Drive the machine forwards.

Step result ➔ The cable unwinds as the cable reeling unit coupling slips.

Optional step ➤ Use the hydraulic motor of the cable reeling to unwind the cable if it could not be done using the slip coupling.

a. Turn knob (A) to ON position to start hydraulic pressure.

b. Turn knob (B) clockwise and hold in position cable reel out.
Releasing the toggling knob, stops the unwinding.

Step result ➔ The cable unwinds when holding the knob in cable reel out position.

| ! | ***NOTE:** The cable can easily become tangled when using the hydraulic motor for unwinding.* |
|---|---|

The indicator lamp on the control panel illuminates when there are three turns of cable remaining on the reeling unit. When only one turn remains, the parking brake is applied.

To release the parking brake, push and pull out the parking brake button on the control panel.

c. Turn knob (A) to OFF position.

### 5.3.2 Winding Main Power Cable onto Reeling Unit

**⚠ CAUTION**

**High-Voltage Cable**

Incorrect operation can cause personal injury.

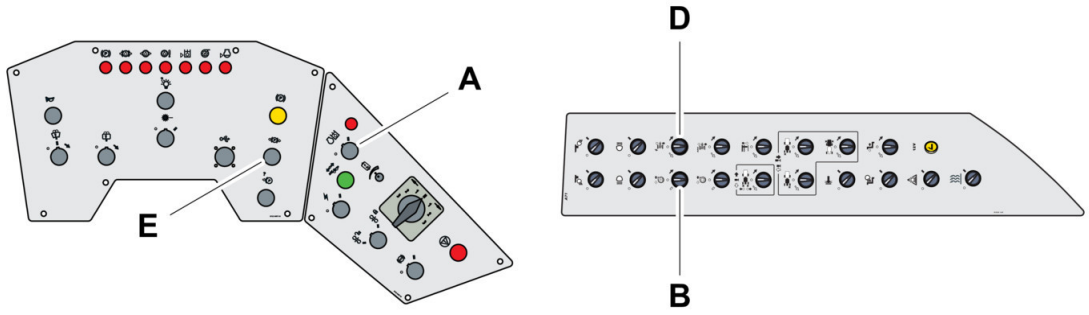
▶ Move the gear selector switch to reverse before moving the machine again, or the cable is pulled away from its mounting.

**NOTICE**

**Risk of Damage to Cable Reel Unit**

Incorrect operation can cause damages to the collector in cable reel unit.

▶ Turn off the main electric power before winding the main power cable.




Precondition ✓ The main power cable is connected to the tunnel outlet and secured to the tunnel wall.

1. Turn knob (A) to ON position to start hydraulic pressure.
2. Turn knob (B) counterclockwise to cable reel in position.
3. Reverse the machine.

Step result ➔ The cable winds onto the cable reeling unit.

Optional step ➤ Some machines have a cable guide function which can be used for winding the cable evenly across the reel.

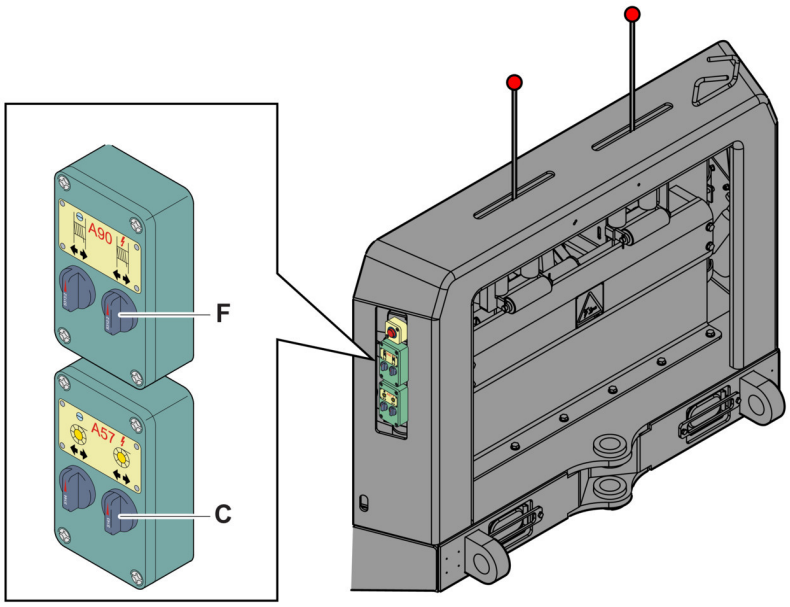
a. Turn the knob (D) to activate the cable guide.

b. When the guide indicator reaches end position, turn the knob (D) in opposite direction.

! ***NOTE:*** *If the limit switch lamp is on, press down the button (E) for the first few minutes while the machine reverses. Pressing the button (E) disengages the reeling unit limit sensor.*

4. Stop reversing the machine when there is little cable that is left to wind.
5. Turn knob (B) clockwise to OFF position.
6. Wind up the last bit of the cable using the cable reeling unit knob (C) on the dual command to achieve better control.

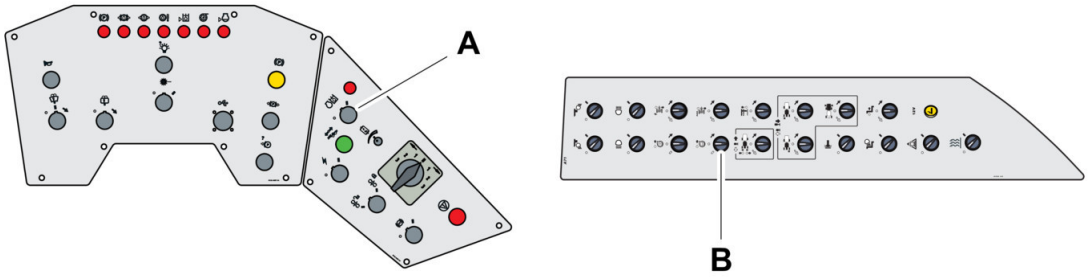
! ***NOTE:*** *Use the cable guide knob (F) so that the cable winds up across the whole reeling unit.*




7. Turn knob (A) to OFF position.

### 5.3.3 Unwinding Water Hose from Reeling Unit

There are two alternative ways to unwind the hose. Under normal operation, the hose reel must not be operated hydraulically when unwinding. The hose must be pulled out through the gear slip coupling instead.




Precondition ✓ The water hose is connected to the tunnel water outlet and secured to the tunnel wall.

Optional step ➤ Unwind the hose using the gear slip coupling.

a. Drive the machine forwards.

Step result ➔ The hose unwinds as the hose reeling unit coupling slips.

Optional step ➤ Use the hydraulic motor of the hose reeling to unwind the hose if it could not be done using the slip coupling.

a. Turn knob (A) to ON position to start the hydraulic pressure.

b. Turn knob (B) to hose reel out position.

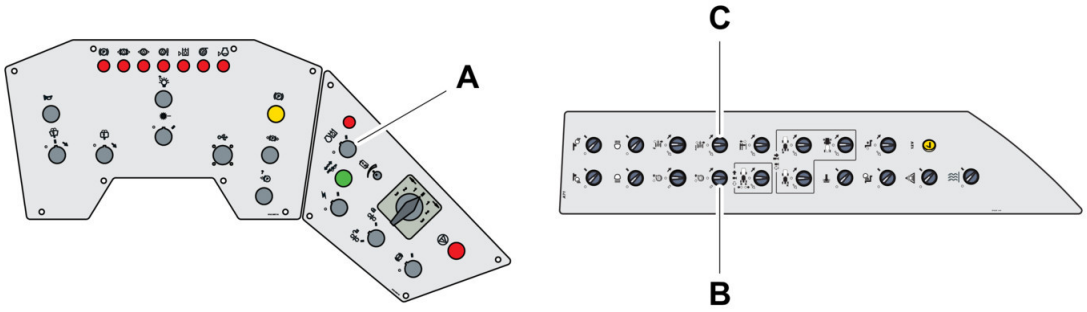
Releasing the toggling knob stops the unwinding.

Step result ➔ The hose unwinds when holding the knob in hose reel out position.

> ***NOTE:*** *The hose can easily become tangled when using the hydraulic motor for unwinding.*

c. Turn knob (A) to OFF position.

### 5.3.4 Winding Water Hose onto Reeling Unit




Precondition ✓ The water hose is connected to the tunnel water outlet and secured to the tunnel wall.

1. Turn knob (A) to ON position to start hydraulic pressure.
2. Turn knob (B) to hose reel in position.
3. Reverse the machine.

Step result ➔ The hose winds onto the hose reeling unit.

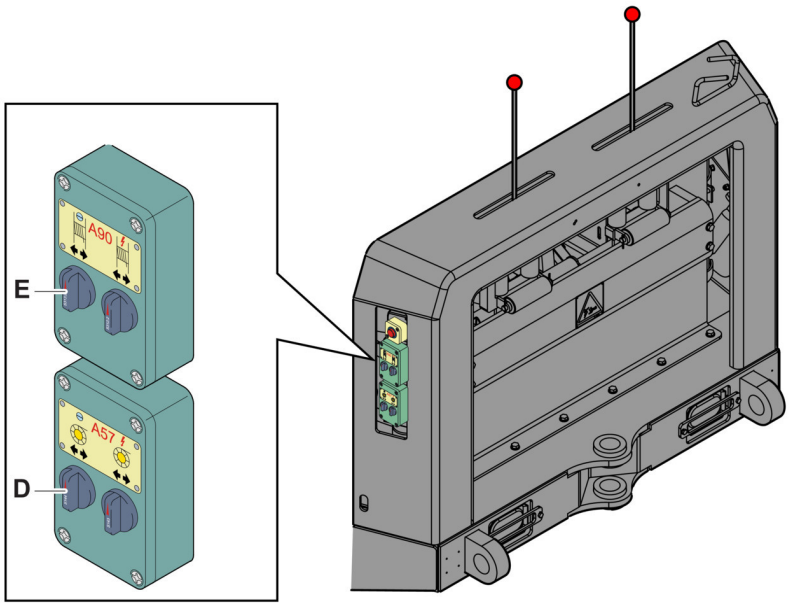
Optional step ➤ Some machines have a hose guide function which can be used for winding the hose evenly across the reel.

a. Turn the knob (C) to activate the hose guide.

b. When the guide indicator reaches end position, turn the knob (C) in opposite direction.

4. Stop reversing the machine when there is little hose that is left to wind.
5. Turn knob (B) to OFF position.
6. Wind up the last bit of the hose using the water hose reeling unit knob (D) on the dual command to achieve better control.

> ***NOTE:*** *Use the hose guide knob (E) so that the hose winds up across the whole reeling unit.*




7. Turn knob (A) to OFF position.

## 5.4 Tramming or Driving

### 5.4.1 Safety Precautions Before Tramming/Driving

**WARNING**

**Tipping Risk**

Incorrect handling and accidental machine movements can lead to tipping over of a machine which can cause serious injury or death.

- Always wear a seat belt when tramming the machine.
- Always turn the machine on level ground.
- Follow stability instructions with allowed inclination angles of the machine.
- Do not put the gear selector switch in neutral when tramming up or downhill.
- Reposition the booms and feed or other positioning units to tramming position after temporary swung out in narrow passages.
- Do not swing out booms and feed or other positioning units to the side if tramming on inclinations or sloping track.
- Never swing out booms and feed and/or other positioning units more than necessary during operation.
- When booms and feed and/or other positioning units are swung out within the machine swing radius, the machine must only be moved at maximum 1 km/h.

**WARNING**

**Tipping Risk**

Incorrect handling and accidental machine movements can lead to tipping over of a machine which can cause serious injury or death.

▶ The parking brake is automatically applied if the transmission is in neutral position for more than 8 second.

### 5.4.2 Preparations before Tramming

 First read: Safety Precautions Before Tramming/Driving [▶ 76]

 First read: Safety Precautions Before Tramming/Driving

 First read: Safety Precautions Before Tramming/Driving

Before tramming, check the following:

- Bolting unit and the screen handler (if present) are positioned to not obstruct the view or interfere in operation.
- Boom/booms with associated feed is/are positioned in tramming position.
- Service platform is positioned in the tramming position.

! ***NOTE:*** *Applies to machines equipped with service platform (option).*

- Cab or canopy is lowered.

! ***NOTE:*** *Applies to machines equipped with cab lift (option).*

- Boom extension is fully retracted and that the boom bracket on type X and W machines is in its lower position.
- Operator is seated correctly with the back against the seat cushion when the brake pedal is pushed down.
- Seat belt is fastened.
- There is no alarm or warning indication on the display.
- Steering, brakes, and the controls for boom and bucket are functional.
- Steering, brakes, and dump systems are functional.
- Jacks are retracted.
- Remove the stinger extension.

! ***NOTE:*** *Applies to machines equipped with stinger extension (option).*

- Position the drilling unit to tramming position.

- Operator is seated correctly with the back against the seat cushion when the brake pedal is pushed down.
- Seat belt is fastened.
- No alarm or warning indicators comes on.
- Headlights are ON.
- All personnel are cleared from machine hazard zone.
- Brake test is performed.

### Filling Fuel Manually

**WARNING**

**Flammable and Toxic Liquid**

Fuel is toxic and can cause injury. Fuel is flammable and causes burns, serious personal injury, or death.

- ▶ Shut off the engine.
- ▶ Use personal protective gear.
- ▶ Do not handle flammable fluids near hot surfaces, sparks, or flames.
- ▶ Clean up fuel spills.

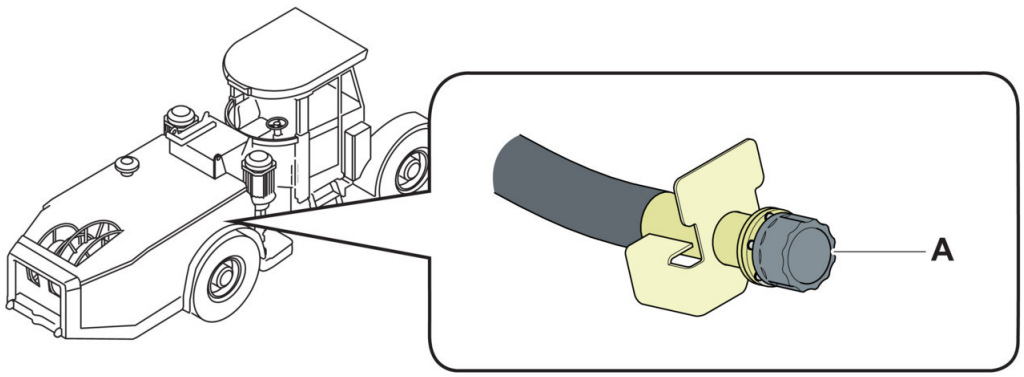
***NOTICE***

**Damage to Diesel Engine or Particle Filter**

The use of fuel of a lower quality other than recommended by the diesel engine manufacturer, damages the diesel engine and particle filter.

- ▶ Always use the recommended fuel.

Avoid filling fuel if there is a risk of contamination, for example, in windy or wet weather, or when there is dust in the air.




Precondition
- ✓ The diesel engine is off.
- ✓ The tank and the tank cover are clean.

1. Remove the filler cap (A).
2. Fill with fuel.

**Diesel Fuel Tank Volume**

| 6-Cyl. Engine | 4-Cyl. Engine | Diesel Hydraulic Engines |
|---|---|---|
| 165 litre (43.59 gallon) | 110 litre (29.05 gallon) | 398 litre (105.14 gallon) |

| Diesel Tank Volume |
|---|
| 400 L (105 gal) |

| Diesel Tank Volume |
|---|
| 370 L (97 gal) |

| Diesel Tank Volume |
|---|
| 127 L (33 gal) |

| Diesel Tank Volume |
|---|
| 626 L (165 gal) |

| Diesel Tank Volume |
|---|
| 500 L (132 gal) |

| Diesel Tank Volume |
|---|
| 95 L (25 gal) |

| Diesel Tank Volume |
|---|
| 760 L (201 gal) |

| Diesel Tank Volume |
|---|
| 396 L (104.61 gal) |

### 5.4.3 Positioning before Tramming

First read: Safety Precautions Before Tramming/Driving [▶ 76]

1. Maneuver the drill to its rear end position on the feeder.
2. Maneuver the feeder to its rear end position.

   If the machine is installed with telescopic feeder (BMHT), it must be fully retracted to its shortest position.

3. Rotate the feeder clockwise until the feed holder retaining shaft is vertical.
4. Retract the boom extension completely.

   If the machine is installed with RHS in combination with service platform then the RHS carousel must be completely emptied for the machine to be operated at inching speed and positioned in the parking position.

   Operation in tramming position is permitted when the drill steel are in the RHS carousel.

> ***NOTE:*** *The RHS carousel must always be emptied before tramming of the machine by personnel other than the machines normal operator.*

### 5.4.4 Basic Tramming

First read: Safety Precautions Before Tramming/Driving [▶ 76]

1. Select the direction of travel and gear with the gear selector switch.

> ***NOTE:*** *Select a gear based on the driving conditions.*

> ***NOTE:*** *Changing between first, second and third gears can be carried out while travelling if diesel engine revs are adapted accordingly.*

2. Release the parking brake.
3. Press the throttle pedal and adjust the speed to the terrain.
4. Check the warning lamps frequently during tramming. Report faults to maintenance personnel.

> ***NOTE:*** *Detect the faults early to avoid consequential damage.*

### 5.4.5 Tramming Uphill or Downhill

First read: Safety Precautions Before Tramming/Driving [▶ 76]

**WARNING**

**Tipping Risk**

Incorrect handling and accidental machine movements can lead to tipping over of a machine which can cause serious injury or death.

- ▶ Perform brake test before tramming in ramp.
- ▶ Perform brake test before tramming long uphill or downhill slopes.
- ▶ Do not select neutral gear while tramming uphill or downhill.
- ▶ Adapt speed and gear in uphill, downhill, and sideway slopes.
- ▶ Adapt the speed to ground conditions and line of sight.
- ▶ Adjust height of booms temporarily when approaching end of downhill to make sure that units do not collide with the ground. Do not exceed stability requirements during temporary adjustment.

***NOTICE***

**Damage to Diesel Engine**

Improper tramming downhill can damage the diesel engine.

- ▶ Do not exceed the engine rpm stated by the engine manufacturer.
- ▶ Use the same gear downwards as upwards.
- ▶ Use the complementary brakes to reduce speed downwards.

Any over rpm will be logged in the EMR of the diesel engine.

Turn switch to 1 for temporary maneuvering of hydraulic units while diesel engine is running. Turn switch to 0 when temporary maneuvering has been completed.

### 5.4.6 Turning During Tramming

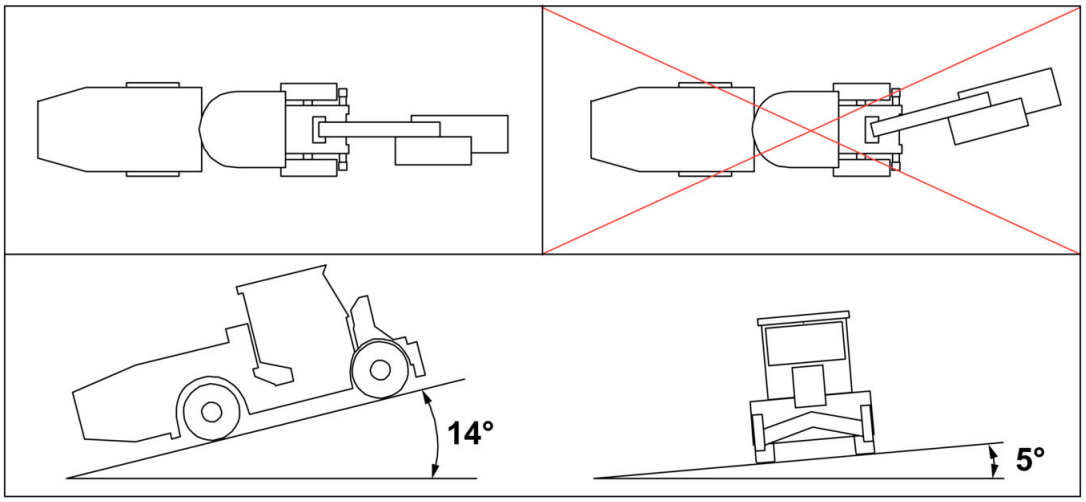
First read: Safety Precautions Before Tramming/Driving [▶ 76]

- ○ Turn smoothly and safely to avoid instability and excessive wear
- ○ Adapt the speed to ground conditions and line of sight before turning
- ○ Adapt speed and gear in uphill, downhill, and sideway slopes
- ○ If booms and feeders must be adjusted in tight turns, reduce to inching speed (max 1 km/h). Do not exceed stability requirements during temporary adjustment

Turn switch to 1 for temporary maneuvering of hydraulic units while diesel engine is running. Turn switch to 0 when temporary maneuvering has been completed.

### 5.4.7 Stability during Tramming at Normal Speeds

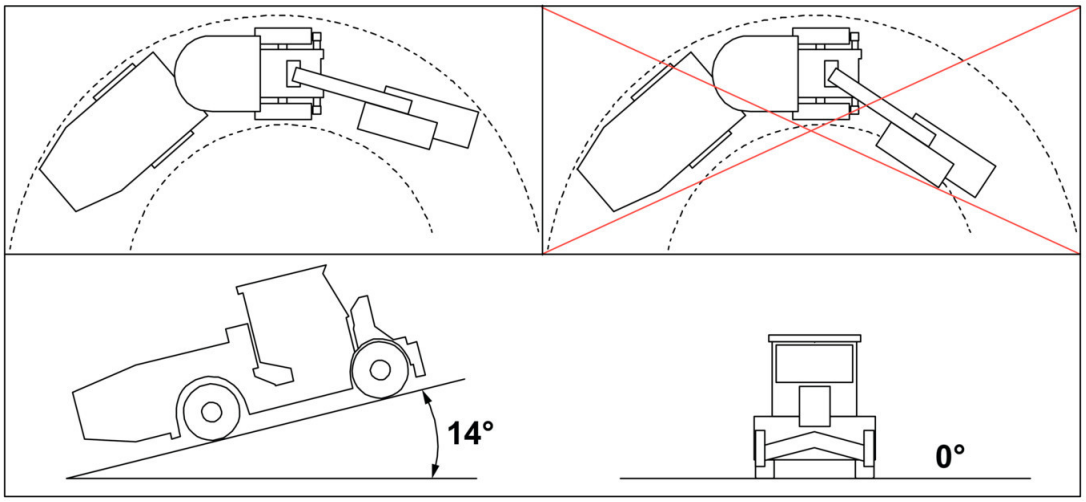
- Tramming means operating the rig forward at normal tramming speed.
- Booms, feeders and any other positioning units must be max. retracted and aligned with the rig's line of symmetry, i.e. positioned straight forward, and positioned in tramming position, see Operator's instructions Positioning.




- While tramming at normal speeds, the maximum machine inclination in the tramming direction is ± with a camber of ± 5°.

> ***NOTE:*** *In the event of sudden boom movements, one of the wheels can lift from the ground, even within the specified stability angles.*

### 5.4.8 Stability during Tramming below 1 km/h




- While tramming at speeds below 1 km/h, the maximum machine inclination in the tramming direction is ± with camber of ± 0°.
- When adjusting booms, feeds, and other positioning units around tight turns, the units must be fully retracted and only be swung out within the turning radius of the machine.

### 5.4.9 Checking After Tramming

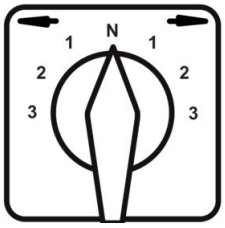
- Make sure that the machine is parked in a leveled surface.
- Examine the machine visually for damages and leak externally.
- Make sure to disconnect the battery power.

  Turn the battery isolation switch to the OFF position.

### 5.4.10 Park the Machine

| | |
|---|---|
| ! | ***NOTE:*** *Before switching off the battery isolation switch, wait approximately 40 seconds after the diesel engine is switched off, otherwise the EMR fails.* |

| | |
|---|---|
| ! | ***NOTE:*** *Run the engine in low idle speed for approximately one minute after relieving the load.* |




1. Apply the parking brake.
2. Set the gear selector switch to neutral position.
3. Lower the jacks until the wheels are clear of the ground.
4. Switch off the diesel engine by turning the ignition key to the OFF position.
5. Turn off the lighting.
6. Turn the battery isolation switch to (0) position to disconnect the power to the machine.

### 5.4.11 Operating Boom

1. Turn the knob on driving panel to ON position to load the hydraulic pressure.

Step result

➔ The yellow lamp turns ON.

2. See Positioning instructions to operate the boom.
3. After positioning, the knob must be turned to OFF position.

## 5.5 Particle Filter Regeneration

### 5.5.1 Start Standstill Regeneration

This equipment is **optional**.

**WARNING**

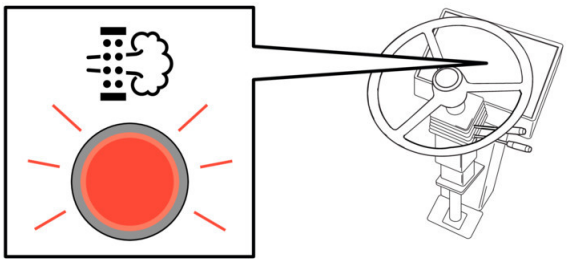
**Very High Exhaust Temperatures**

Can cause serious personal injury and damage to property.

- ▶ Do not touch the exhaust system.
- ▶ Park the machine in the open air during regeneration.
- ▶ Never cover the exhaust system.
- ▶ Never let flammable materials come in contact with the exhaust system.

A certain soot level of the diesel particulate filter requires a standstill regeneration. The Standstill regeneration cleanses the diesel particulate filter of the exhaust gas system. That means that the soot in the diesel particulate filter is burned.

Standstill regeneration is done as soon as possible when requested. Otherwise power reduction starts. Request is done by a flashing regeneration lamp on the operators panel and a regeneration symbol in the menu status bar.



When regeneration is in progress, the symbol high exhaust temperature is shown as a warning in the menu status bar.

***NOTE:*** *Ignoring of the standstill regeneration leads to conditions to be solved by Deutz service.*

***NOTE:*** *Short intervals (<10 hours) between standstill regenerations is signs of engine failure.*

***NOTE:*** *The number of standstill regenerations is monitored. When indicated by the engine warning lamp on the operators panel and a symbol on the menu status bar, the engine oil and engine oil filter must be replaced and the EMR must be reset by Deutz or Epiroc service.*

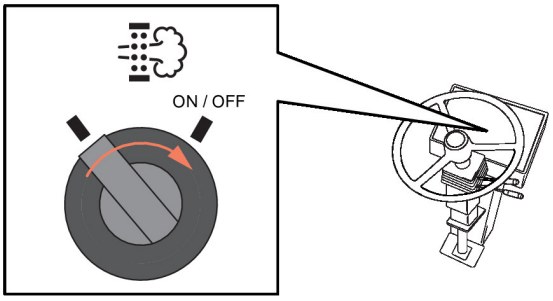
***NOTE:*** *The control system displays remaining standstill regeneration time and time since last standstill regeneration.*

***NOTE:*** *Do not use the machine during the standstill regeneration. The regeneration lasts for 35–40 minutes.*

Precondition
- ✓ The regeneration lamp is flashing.
- ✓ The machine is parked safely by fulfilling the interlocks with activated parking brake, the gear in neutral and the diesel positioning knob in OFF position.

1. Position the machine on open terrain at a safe distance to flammable objects.
2. Warm up the engine.

   The engine must reach normal operating temperature.
3. Operate the engine in idling.
4. Turn and release the standstill regeneration knob to the ON/OFF-position to the right.




Step result
➔ The knob returns to neutral-position automatically.

The standstill regeneration process starts.

The regeneration lamp lights constantly during the regeneration and goes off when finished.

**See Reference Documentation**

Diesel engine instruction manual

### 5.5.2 Interrupting Standstill Regeneration

This equipment is **optional**.

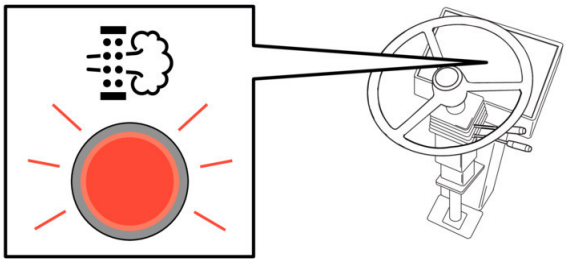
**WARNING**

**Very High Exhaust Temperatures**

Can cause serious personal injury and damage to property.

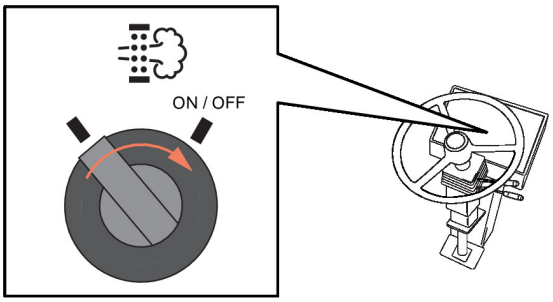
- ▶ Do not touch the exhaust system.
- ▶ Park the machine in the open air during regeneration.
- ▶ Never cover the exhaust system.
- ▶ Never let flammable materials come in contact with the exhaust system.

The standstill regeneration can be interrupted at any time. The regeneration lamp on the operators panel keeps flashing until standstill regeneration has been done without interruption.



! ***NOTE:*** *The control system displays time since last standstill regeneration.*

Optional step ➤ Turn and release the standstill regeneration knob to the ON/OFF-position to the right.




Step result ➔ The knob return to neutral-position automatically.

The standstill regeneration stops.

The regeneration lamp on the operators panel flashes.

Optional step ➤ Remove the interlocks and operate the machine.

Step result ➔ The standstill regeneration stops.

The regeneration lamp on the operators panel flashes.

| **See Reference Documentation** |
| --- |
| Diesel engine instruction manual |

### 5.5.3 Replacing Diesel Particulate Filter

This equipment is **optional**.

**⚠ WARNING**

**Burning Hazard**

Cause service personal injury as the exhaust gases and exhaust system becomes hot during regeneration.

- ▶ Do not touch the exhaust system.
- ▶ Do not cover the exhaust system.
- ▶ Do not expose the exhaust system to any flammable materials.

The diesel particulate filter requires replacement after a high filter running time as non-combustible residues, ash, accumulate in the filter.

When the diesel particulate filter has reached a critical ash level and requires replacement, the ash lamp lights up and a symbol in the menu status bar appears.

The machine can operate normally until the replacement is carried out. After a while power reduction starts.

***NOTE:*** *The soot and ash level is monitored and displayed in the control system as percentage values.*

Precondition ✓ The ash lamp is indicating.

○ Contact Deutz service for replacement.

**See Reference Documentation**

Diesel engine instruction manual

## 5.6 Positioning

### 5.6.1 Safety Precautions Before Positioning

**WARNING**

**Moving Parts**

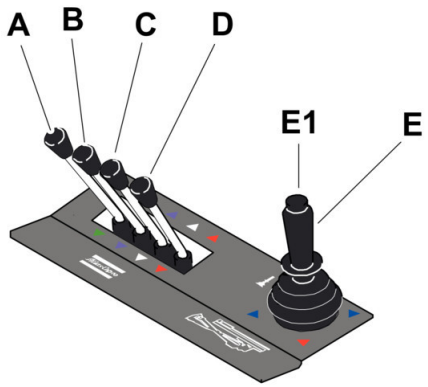
Can cause serious personal injury.

▶ Make sure no one is inside the working range of the boom before operating.

▶ Make sure that the machine is raised on the jacks.

### 5.6.2 System Settings

#### Boom Activation




*Section of operator panel for boom and feeder positioning*

| | | | |
|---|---|---|---|
| A | Feed rotation control lever | B | Tilt cylinder control lever |
| C | Boom extension control lever | D | Feed extension control lever |
| E1 | Anti-parallel button | E | Boom positioning control lever |

The control levers are direct-acting. The boom has hydraulic parallel holding of the feeder, which means that all the holes can be drilled parallel to each other. Each cylinder is marked using a color coded system where the color of the cylinder corresponds with the color marking on the lever that controls it.

This simplifies learning and makes it easier to directly select the correct direction for each lever. The speed of the cylinders is proportional to the travel of the levers, which makes controlling the boom smooth and adaptive.

### 5.6.3 Machine Positioning

**WARNING**

**Tipping Risk**

Incorrect handling and accidental machine movements can lead to tipping over of a machine which can cause serious injury or death.

- Always wear a seat belt when tramming the machine.
- Always turn the machine on level ground.
- Follow stability instructions with allowed inclination angles of the machine.
- Do not put the gear selector switch in neutral when tramming up or downhill.
- Reposition the booms and feed or other positioning units to tramming position after temporary swung out in narrow passages.
- Do not swing out booms and feed or other positioning units to the side if tramming on inclinations or sloping track.
- Never swing out booms and feed and/or other positioning units more than necessary during operation.
- When booms and feed and/or other positioning units are swung out within the machine swing radius, the machine must only be moved at maximum 1 km/h.

**WARNING**

**Tipping Risk**

Incorrect handling and accidental machine movements can lead to tipping over of a machine which can cause serious injury or death.

- The parking brake is automatically applied if the transmission is in neutral position for more than 8 second.

Precondition ✓ The machine is correctly aligned.

1. Tram the machine to the drilling place.
2. Position it at right angles to the center of the tunnel face, parallel to the direction of drilling. It must be possible to maneuver the booms past the parts of the rock face that protrude the most.
3. Set up the machine on its jacks. Start with the front jacks and then the rear jacks until the machine is leveled (observe the spirit level in the cab).

End result ➔ The machine is ready for drilling.

> ***NOTE:*** *The following points are important to observe:*
> - The machine must be raised so that none of the wheels is in contact with the ground.
> - The machine must be standing steadily while drilling to avoid disturbing the navigation.

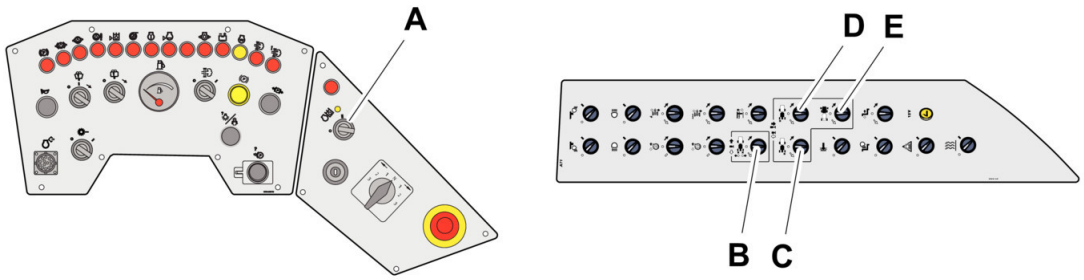
### 5.6.4 Lowering Jacks

**WARNING**

**Moving Parts**

Can cause serious personal injury.

- ▶ Make sure no one is inside the working range of the boom before operating.
- ▶ Make sure that the machine is raised on the jacks.




1. Turn the knob (A) to the ON position to load the hydraulic pressure.
2. Turn the knob (B) to the OUT position to move the front jacks sideways.
3. Turn the knobs (C) and (D) to the DOWN position to lower the front jacks.
4. Adjust the position of the machine using the jacks so that the machine is standing horizontally.

> ***NOTE:*** *Observe the spirit level in the cab.*

5. Turn the knob (E) to the DOWN position to lower the rear jacks until the wheels are clear off the ground.
6. Adjust the position of the machine using the jacks so that the machine is standing horizontally.

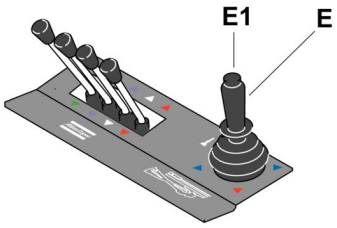
> ***NOTE:*** *Observe the spirit level in the cab.*

7. Turn the knob (A) to the OFF position.

### 5.6.5 Raising and Swinging the Boom

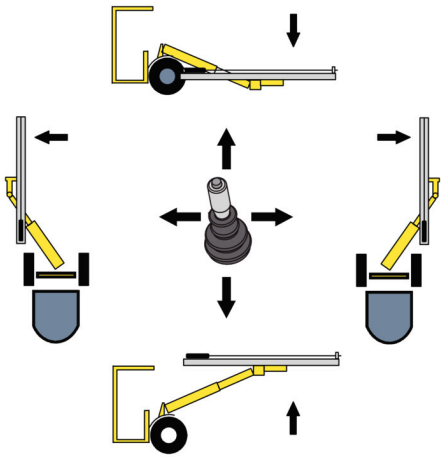
1. Use the control lever for boom positioning (E) when lifting and slewing the boom.

> **NOTE:** *Do not press the button on top of the lever (E1).*




*Boom positioning control lever*

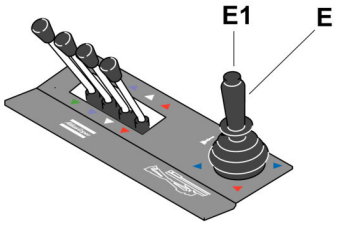
> **NOTE:** *The tilt cylinder must be retracted to its innermost position in order to obtain parallel holes.*



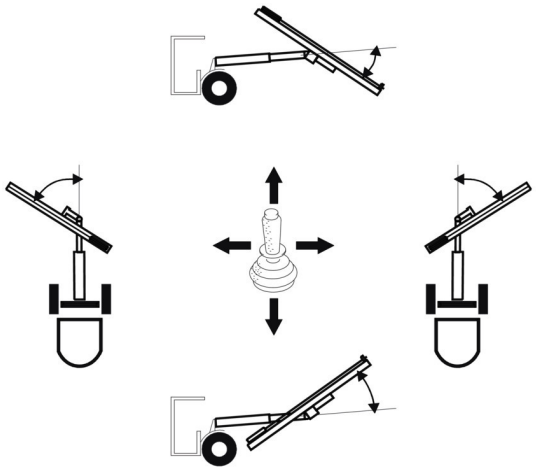
*Raising and slewing the boom*

### 5.6.6 Swinging and Inclination of Feeder

1. The control lever for boom positioning (E) is used for slewing and inclining the feeder.
2. The anti-parallel button (E1) should be depressed and held during lever movements.



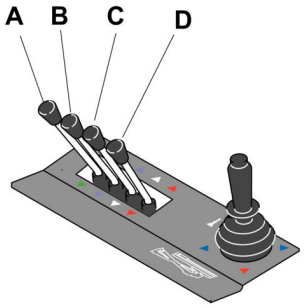

*Boom positioning control lever*



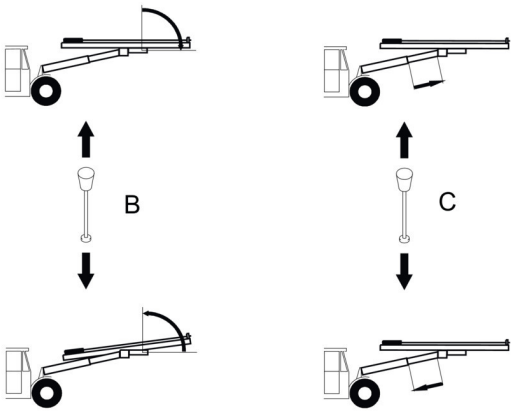
*Slewing and inclining the feeder*

### 5.6.7 Tilt Cylinder and Boom Extension

1. Use control lever (B) to operate the tilt cylinder.



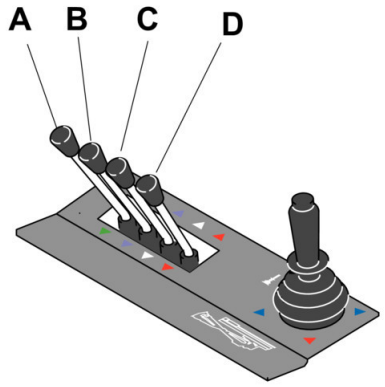

*Control levers*



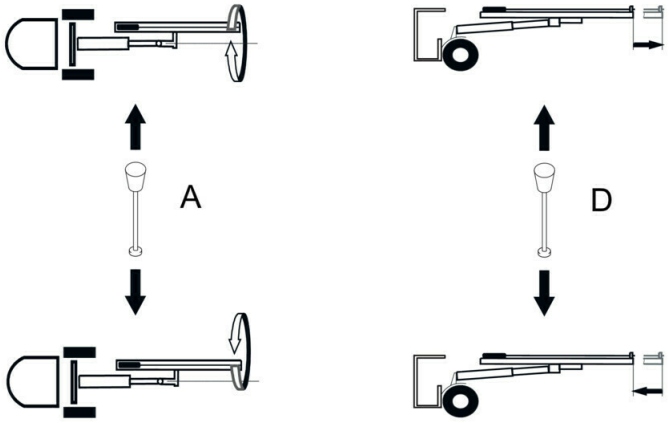

*Tilt cylinder and boom extension*

2. Use Control lever (C) to operate the boom extension.

### 5.6.8 Rotation and Feed Extension




*Section of Operator Panel*




*Feed Rotation and Feed Extension*

1. Use control lever (A) to operate feed rotation.

> ***NOTE:*** *For PCS, the lever works in opposite direction.*

2. Use control lever (D) to operate feed extension. Feed extension is used to bring the feed up to the rock face.

### 5.6.9 Telescope Feed Locking



*Lever*

The telescope feed has two different designs to lock the beam cylinder.

1. One-way restrictors for beam locking.

   The restrictors must be fully closed to lock the feed in shortest position.

   The restrictors must be fully opened to let the feed to operate in full length.

2. Lever for beam locking.

   The lever must be in the locked position to lock the feed in shortest position.

   The lever must be in the unlocked position to let the feed to operate at full length.

| | |
|---|---|
| ! | ***NOTE:*** *The feed pressure must be adjusted during drilling to optimize the feed force.* |

| | |
|---|---|
| ! | ***NOTE:*** *The feed beam and slide pieces must be clean and properly adjusted.* |

# 5.7 Drilling

## 5.7.1 Drilling System

### DCS 1800 and PCS 1800S

The DCS 1800 (Direct Steering System) is a drilling system with manual direct-control valves while the PCS 1800S (Pilot Steering System) is a drilling system with pilot-control valves. Both the systems are designed for drills COP 1638, COP 1838 and COP 2238.

The drilling system comprises of various subsystems:

- Hydraulic systems
- Electrical system
- Water system
- Air and lubrication system

The hydraulic system contains one pump unit per drill.

Each pump unit consists of three pumps. One pressure compensated axial plunger pump which only supplies percussion. One more pressure compensated axial plunger pump supplying oil to feed, positioning, compressor, water pump, and also to the damper of the drill.

The electrical system supplies the electric motors for the hydraulic pumps, the lubrication pumps, the lighting, and the battery charger, and controls the solenoid valves.

Water is used to flush the cuttings from the drill hole and to cool the hydraulic system. A hydraulically powered pressure booster pump on the machine increases the pressure to make sure that sufficient amount of water is reaching the drill hole.

To lubricate certain parts, each drill is supplied with lubricant by an electric piston pump. The oil is distributed in the drill using compressed air from a hydraulic screw compressor on the machine. This air also prevents debris from entering the drill.

The drilling systems can be fitted with various options (optional equipment), for example:

- Reaming hole bit
- Extension drilling
- Water flow monitor
- Air flushing equipment

## 5.7.2 Safety Precautions Before Drilling

**⚠ WARNING**

**Moving Parts**

The rock drills can be put in motion when the high voltage battery is turned on which results in serious personal injury.

▶ Set all levers and switches in NEUTRAL position before turning on the high voltage battery.

▶ Set all levers and switches in NEUTRAL position when finished drilling.

**WARNING**

**Moving Parts**

The rock drills can be put in motion when the diesel engine is started which can cause serious personal injury.

- ▶ Set all levers and switches in neutral position before starting the diesel engine.
- ▶ Set all levers and switches in neutral position when finished drilling.

**WARNING**

**Dust and Particles**

Inhalation of dust and particles can cause serious health problems.

- ▶ Make sure water flushing, water mist or dust collector is activated during drilling.

**WARNING**

**Sensitive Levers**

Accidental movement of the levers can cause serious personal injury.

- ▶ Never use the control panel as a storage surface.
- ▶ Faulty or worn components must be replaced.

**WARNING**

**Risk of Personal Injury**

Improper use and inadequate maintenance of RHS equipment could lead to personal injury and damage to the equipment.

- ▶ Only use the equipment for its intended purpose.
- ▶ Check the equipment regularly.

### 5.7.3 Safety Precautions Working with Power Supply Cable

**WARNING**

**Risk of Short Circuit or Fire**

Can cause serious injuries or death.

Can cause material damage.

- ▶ Always use a cable with sufficient area for the current ambient temperature and power output of the machine.
- ▶ Make sure that the cable is intact before using the machine. Replace the cable in the event of damage, discoloration, or deformation.
- ▶ Make sure that the cable is routed on the tunnel floor so that it is protected from being driven over by other mobile machines.
- ▶ Unwind the whole cable for intensive operation.
- ▶ Make sure that the cable does not overheat during intensive use of the machine.

For intensive operation with short intervals for cooling down, there is a risk of the electrical cable overheating. For instance, during long drilling cycles with a short time between the cycles.

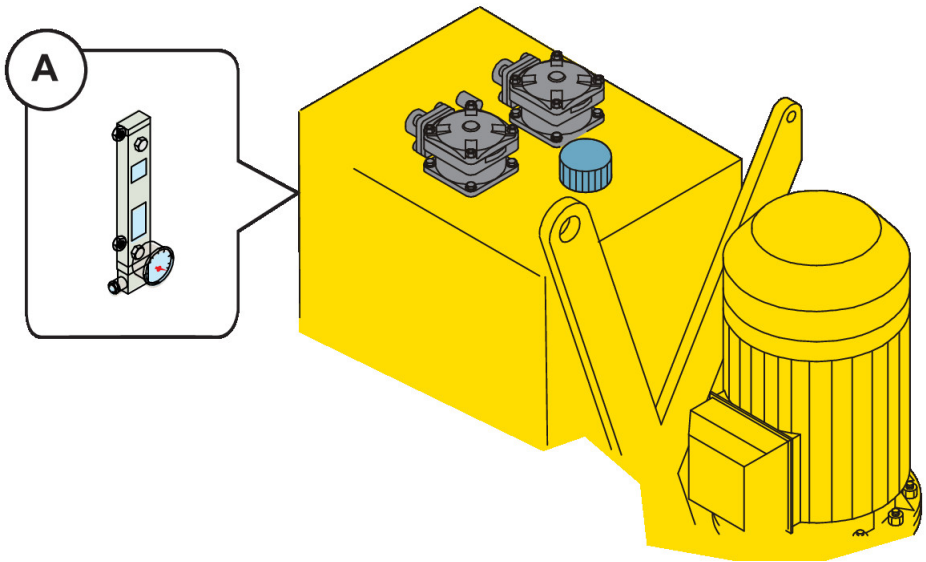
Many external factors affect the ability of the electrical cable to cool down. For example:

- The number of layers on the reel.
- The ambient temperature.
- The air exchange.
- The dirt accumulation.

Therefore, make a habit of always unreeling the entire length of the electrical cable during operation.

### 5.7.4 Preparing for Drilling

#### Check Oil Levels



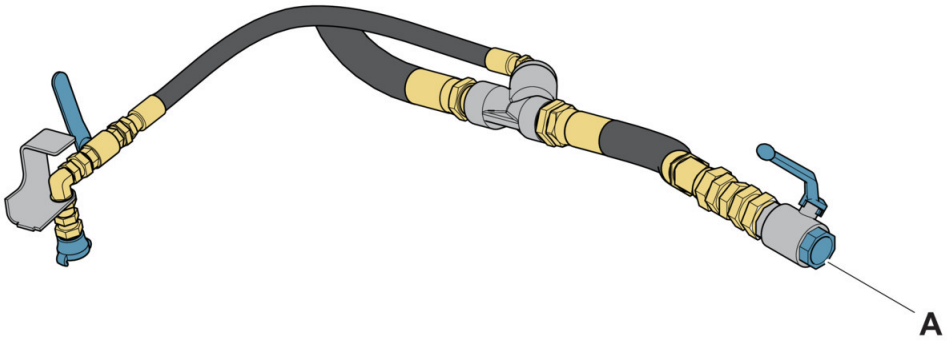
1. Check the oil level in the hydraulic oil reservoir (A).

   Top up if necessary.

2. Check the oil level in the lubricating oil tank.

   Top up if necessary.

### Connecting to Water Supply




Precondition ✓ The water hose is clean and free from damage.

○ Connect the water hose to the water inlet (A).

### Setting up the Rig

With each new setting-up of the rig it is essential that it is correctly aligned. See Safety, Rig stability.

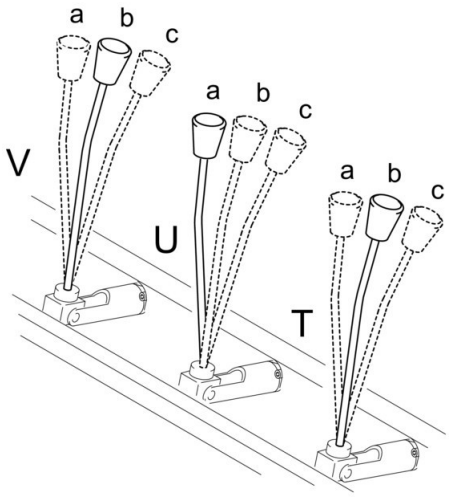
1. Manoeuver the rig to the where drilling is to take place.
2. Position it at right angles to the centre of the tunnel face, parallel to the direction of drilling. It must be possible to manoeuver the booms past the parts of the rock face that protrude the most.
3. Set up the rig on its jacks.
4. Start with the front jacks and then the rear jacks until the rig is level (observe the spirit level in the cabin).

   ! ***NOTE:*** *The following points are important to observe:*
   - The rig must be raised so that none of the wheels is in contact with the ground.
   - The rig must be standing steadily while drilling to avoid disturbing the navigation.

5. Adjust the direction of each boom as specified by the surveyor. See operator's instructions Positioning.
6. The rig is now ready for drilling.

## 5.7.5 Drilling Levers

The various procedures are described later in this manual.



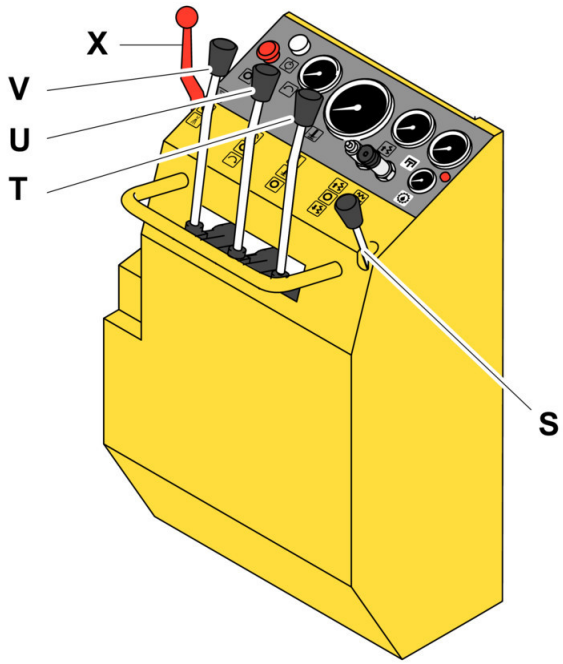

*Different positions of drilling levers*

| | |
|---|---|
| V | Rotation control lever |
| U | Percussion control lever |
| T | Feed control lever |

## Drilling lever functions in various positions

| Position | Function |
|---|---|
| $V_a$ | Rotation right |
| b | Neutral |
| c | Rotation left |
| $U_a$ | Neutral |
| b | Collaring |
| c | Full drilling |
| $T_a$ | Reverse feed |
| b | Neutral |
| c | Feed forward |

### 5.7.6 Activating Collaring and Full Drilling




*Levers for collaring and full drilling*

1. Make sure that the drilling levers are in neutral position.
2. Start the hydraulic pump with start button (S105).
3. Make sure that the selector lever (S) for small hole/reaming hole is in the desired position. Option.
4. Position the boom and feeder for drilling and apply the feeder dowel firmly against the rock. See operator's instructions Boom handling.
5. Start water flushing with lever (X). Make sure the valve is fully open.
6. Start rotation drilling, left rotation - by moving the lever (V) forward.
7. **Collaring:**Start low percussion pressure by moving the lever (U) to its middle position. Start forward feed at the same time by moving the lever (T) forward. Low feed pressure is obtained automatically.

   Feed pressure can be adjusted using the feed pressure knob.
8. **Full drilling:** Start high percussion pressure by moving the lever (U) to its forward position once the bit has come some way into the rock. High feed pressure is obtained automatically.

   Feed pressure can be adjusted using the feed pressure knob.
9. Once a hole is drilled, the percussion unit is automatically switched off and reverse feed is automatically engaged. When the drilling machine has reached its rear end position, move the rotation lever (V) and feed lever (T) to their neutral positions.
10. Turn off water flushing with the water/air flushing lever (X).
11. Repeat steps 4 to 10 above for the next hole.

### 5.7.7 Cease Drilling

Move the drilling levers to neutral position. See section Drilling levers.

### 5.7.8 Air Blowing of Drilled Hole, Option

1. Stop the feed and rotation when finished drilling a hole.
2. Blow the hole clean for 5-10 seconds by moving the lever (X) to its rearmost position.
3. Then move the rock drill to the rear end position with the control lever (T), after air blowing is completed.
4. Position for the next hole and perform a new collaring.

### 5.7.9 Changing Drill Bit

**NOTICE**

**High Impact Percussion**

Risk of damage to drill

▶ Never start percussion with the drill bit in mid-air.

**WARNING**

**Rotating Parts**

There is a risk of serious injury or death as clothing can get caught in the machine.

▶ Stop the drill rotation before changing drill bits.

▶ Always turn off the hydraulic pumps if the operator station is left unmanned.

1. Make sure that the drill bit is supported against the rock.

   Supporting the drill bit can be done in two alternative ways:

Alternative step a. Switch off drilling when a hole is almost fully drilled.

Alternative step b. Collar the hole so the bit just gets a hold in the rock and switch off drilling.

2. Use the drill percussion without rotation to loosen the drill bit.

   **NOTE:** *Water flushing must be activated during removal.*

3. Switch off the hydraulic pumps.
4. Replace the drill bit manually.

### 5.7.10 MWD Logging

MWD (Measure While Drilling) is an option for logging of drilling data while drilling is in progress.

The following drilling data is logged:

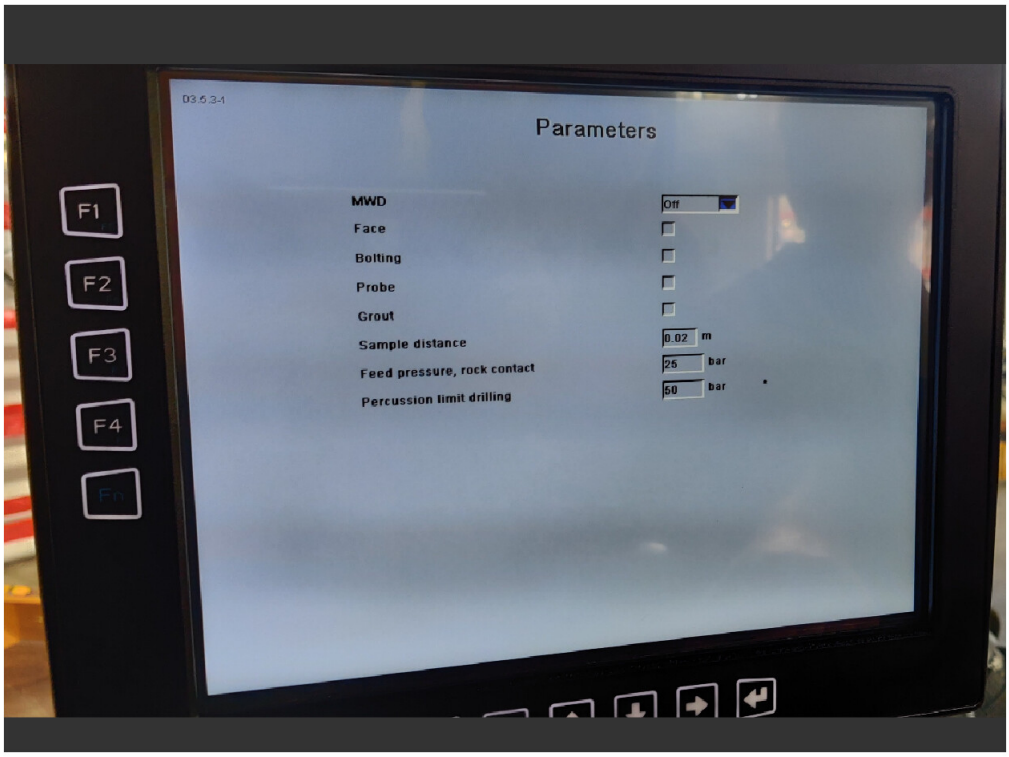
- Hole length (mm)
- Percussion pressure (bar)
- Feed pressure (bar)
- Rotation pressure (bar)
- Rotation speed (rpm)
- Damper pressure (bar)
- Flush pressure (water or air) (bar)
- Flush flow (water or air) (litres/min)
- Penetration rate (dm/min)

With the MWD function active, drilling data for the drilled holes that are selected for logging are logged at a certain interval. Each boom and rock drill has its own log file. The log file can be analyzed and inspected using a computer. The file type is always (.MWD).

MWD logging is used to map the rock characteristics, which means that demands on accuracy are high. Logging incorrect values means incorrect determination of rock characteristics, which can have great consequences for example, mapping and assessing the need for rock reinforcement.

Great demands are placed on determining the position of the measured values. For example, an incorrectly localized water-bearing jointing zone could have a resulting effect on injection.

### Activating MWD Logging



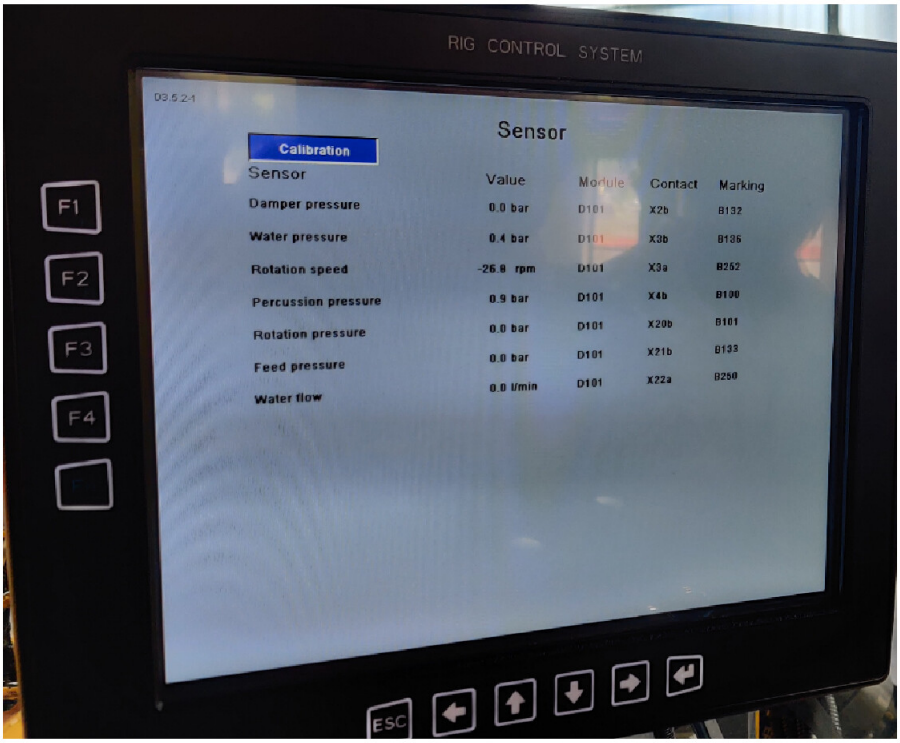

1. Select **MWD** to be **On**.

Step result ➔ Logging is performed for all holes following the drill plan.

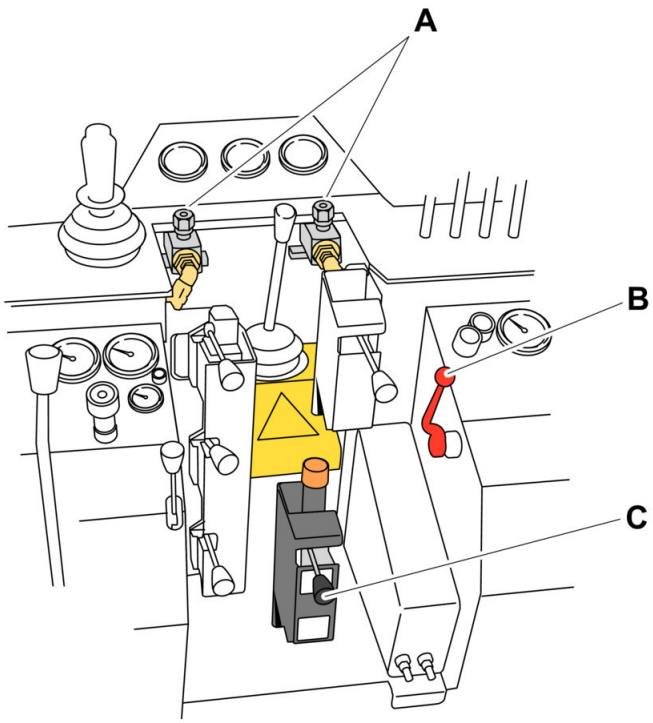
Optional step ➤ Optional: Activate the desired **Type of drilling**.

Step result ➔ MWD-log the holes in different types of drilling

### Sensors




## 5.7.11 Drilling with Water Mist




1. Before drilling with water mist:
   a. Start the pumps.
   b. Pull the flushing lever (B) back to flush the air and check that the air comes out from the drill bit.

c. Regulate the water volume mixture with regulators (A) to the exact quantity.

2. Activate the pump for water mist with lever (C).
3. Carry out the drilling and adjust the water mixture with the regulators (A), if necessary.

> ***NOTE:*** *If the flushing air flow falls below 3 bar, then pressure sensor B142 is activated and switches off the percussion and the pump for water mist. The same takes place if the flushing air flow lever (B) is moved to the off position or the position for water flushing during drilling.*

> ***NOTE:*** *If the lever for water mist (C) is unintentionally activated during drilling with water flushing, then the percussion is switched off.*

4. The percussion and the pump for water mist are switched off automatically when the limit sensor on the feeder is activated.

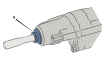
### 5.7.12 Checks during Drilling

**⚠ CAUTION**

**Aggravated Faults**

Simple faults in hydraulic, pneumatic or electrical systems can aggravate and cause personal injury.

- ▶ Call for service personnel if a fault occur in a system while drilling is in progress.
- ▶ Do not experiment with the systems.

| | |
|---|---|
| Rock drill  | • Make sure that the rubber boot (drill collar) is fitted on the drill adapter when carrying out rising drilling.<br>• Always be observant for any oil or water leaks from the rock drill. |
| Hydraulic oil and lubrication oil | • Check oil level in the hydraulic tank and top up as necessary.<br>• Check temperature of the hydraulic oil on the hydraulic tank temperature gauge. The temperature must be between 30-60 °C during constant drilling.<br>• Make sure that there is oil in the lubricating oil tank and top up as necessary. |

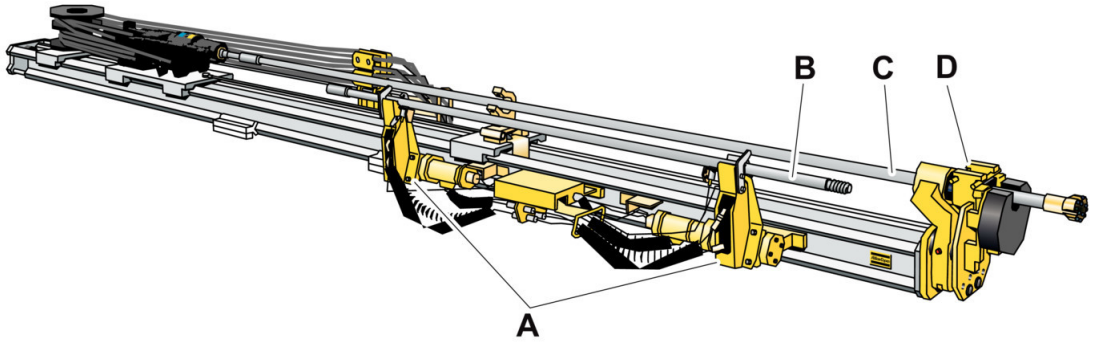
| | |
|---|---|
| Hoses and couplings | • Make sure that the percussion hoses to the rock drill do not vibrate abnormally. Vibrating hoses indicate malfunctioning accumulators on the rock drill. Stop drilling immediately and check or replace the accumulator.<br>• Make sure that the hoses do not get trapped or jammed.<br>• Make sure that there are no leaks in hoses or couplings. Tighten or change leaking couplings and hoses. |
| Pressure gauges | • Monitor the pressure gauges on the drilling panel. Stop drilling if they display abnormal values and investigate. |
| Indicator lamps | • Check the fault indicator lamps on the electric cabinet and investigate if any lamps come on. |

### 5.7.13 Extension Drilling

The extension drilling is an **optional** function.

| **See Reference Documentation** |
|---|
| Drill stop and ROM System |

#### Extension Drilling Equipment

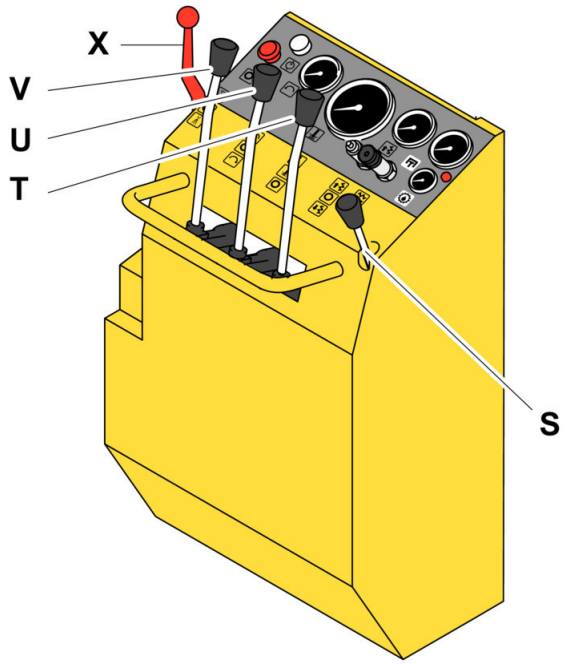



| | | | |
|---|---|---|---|
| A | RAS arms with gripper claws | B | Extension rod |
| C | Drill rod | D | Hydraulic drill rod support, BSH 110 |

Extension drilling equipment is available in two different versions. Both involve manually jointing and removing one or more rods.

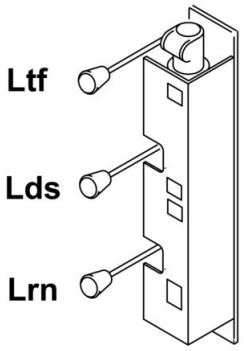
- Hydraulic drill rod support BSH 110
- RAS (Rod Adding System) with hydraulic drill rod support BSH 110 and two RAS arms with gripper claws for adding and removing the extension rods

### Extension Drilling Panel



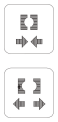

*Section of operator panel*

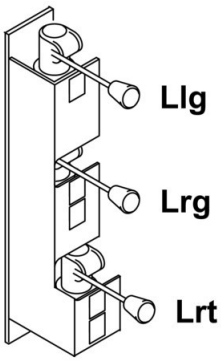
| | |
|---|---|
| X | Flushing air / water |
| V | Rotation lever |
| U | Percussion lever |
| T | Feed lever |
| S | Small hole/reaming hole selector lever, option |




*Lever for manual rod adding and manual RAS*

## Description of levers

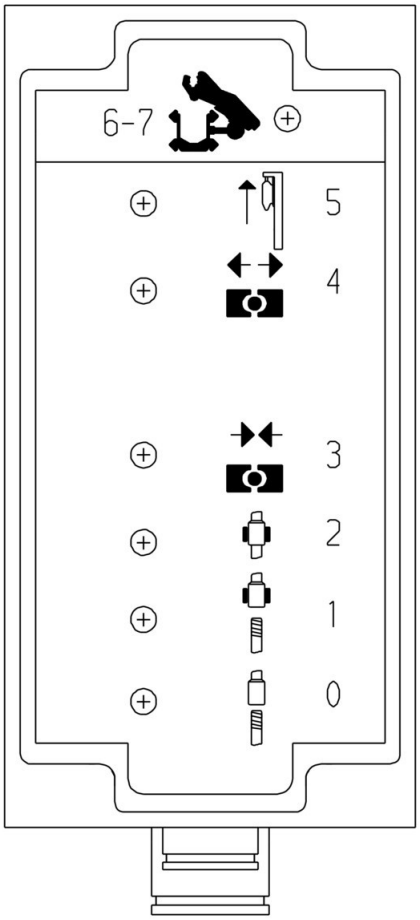
| Symbol | Lever designation | Description |
|---|---|---|
|  | Ltf<br>(Lever thread feeding) | Threading/Extension drilling (spring-back lever) |
|  | Lds<br>(Lever drill support) | Close and open drill-rod support. |
|  | Lrn<br>(Lever rod number) | Multi-rod drilling/Single rod drilling |




*Levers for RAS*

## Description of levers

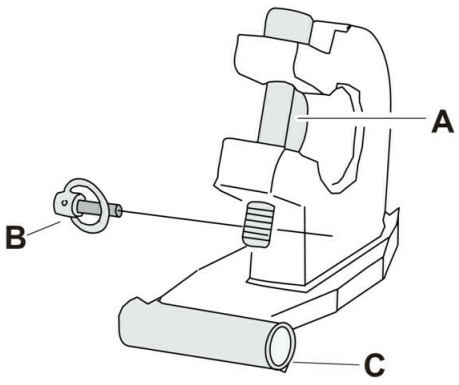
| Symbol | Lever designation | Description |
|---|---|---|
|  | Llg<br>(Lever loose grip) | Control position (spring-back lever) |
|  | Lrg<br>(Lever rod grip) | Close and open gripper claws. |
|  | Lrt<br>(Lever rod transfer) | Rotate the RAS arms towards drilling centre/Rotate the RAS arms away from drilling centre.<br>RAS arms = rod transfer arms |




*Position indication for RAS*

| | |
|---|---|
| 0 | Rock drill shank adapter free from drill rod |
| 1 | Front join free |
| 2 | Drill rod joins in support |
| 3 | Drill-steel support can be closed |
| 4 | Drill-steel support must be opened |
| 5 | Rock drill in forward end position |
| 6-7 | RAS arms in drilling centre |

### Preparing for Extension Drilling with Drill Rod Support



1. Remove pin (B).
2. Remove bolt (A).
3. Place the bolt in holder (C).
4. Change the front drill rod support bush to the correct dimension so that the joint between two drill rods can pass without obstruction.
5. Select the auto drilling function using the control lever for drilling or auto drilling to prevent automatic drill return.

### Extension Drilling with BSH 110

1. Drill in the first rod.

> ! ***NOTE:*** *Open the drill steel support with the control lever for the hydraulic drill steel support before the join between the drill rod and shank adapter reaches forward to the drill steel support.*

2. Hammer against the bottom of the hole to separate the drill rod from the shank adapter.
3. Make sure that the threaded joint is in the drill steel support and close the drill steel support with the control lever for the hydraulic drill steel support.
4. Work loose the shank adapter from the drill rod by activating feed backwards with the control lever for threading, extension drilling and rotation right with the control lever for rotation.
5. Reverse the drill with feed control lever so that there is space to thread in a new drill rod.
6. Turn off the hydraulic pumps.
7. Screw together the new drill rod by hand with the drill rod that was drilled into the rock.
8. Start the hydraulic pumps and move the drill forwards with the feed control lever so that the shank adapter comes as close as possible to the threaded joint.
9. Turn off the hydraulic pumps.
10. Screw together the drill rod by hand with the shank adapter.
11. Start the hydraulic pumps and tighten the joints by activating feed forwards with the control knob for thread feed and rotation left with the control lever for rotation.
12. Open the drill steel support with the control lever for the hydraulic drill steel support.
13. Start drilling.
14. Repeat steps 3 - 13 for each new drill rod to be added.

### Removing Drill Rods BSH

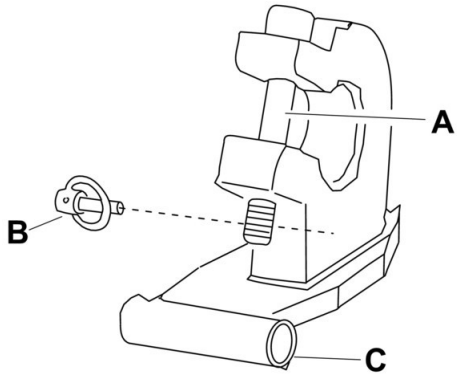
1. Make sure the drill steel support is open.
2. Hammer against the bottom of the hole to loosen the joins.

3. Make sure the front join on the last drill rod is lying in the drill steel support.
4. Close the drill steel support with the control lever for the hydraulic drill steel support.
5. Fully unthread one of the drill rods' joints by activating feed backwards with the control knob for thread feed and rotation right with the control lever for rotation.
6. Turn off the hydraulic pumps.
7. Loosen the other end of the drill rod by hand.
8. Start the hydraulic pumps and move the drill to the drill steel support.
9. Thread the shank adapter together with the next drill rod by activating feed forwards with the control knob for thread feed and rotation left with the control lever for rotation.

> ! ***NOTE:*** *Do not screw together too tightly so the join cannot be unscrewed. The last drill rod must be screwed tight however.*

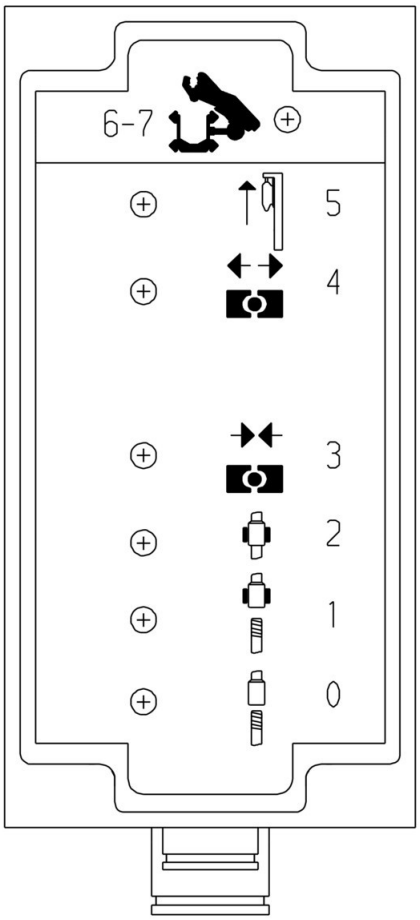
10. Open the drill steel support with the control lever for the hydraulic drill steel support.
11. Repeat steps 3 - 10 with the remaining drill rods.

### Preparing for Extension Drilling with RAS

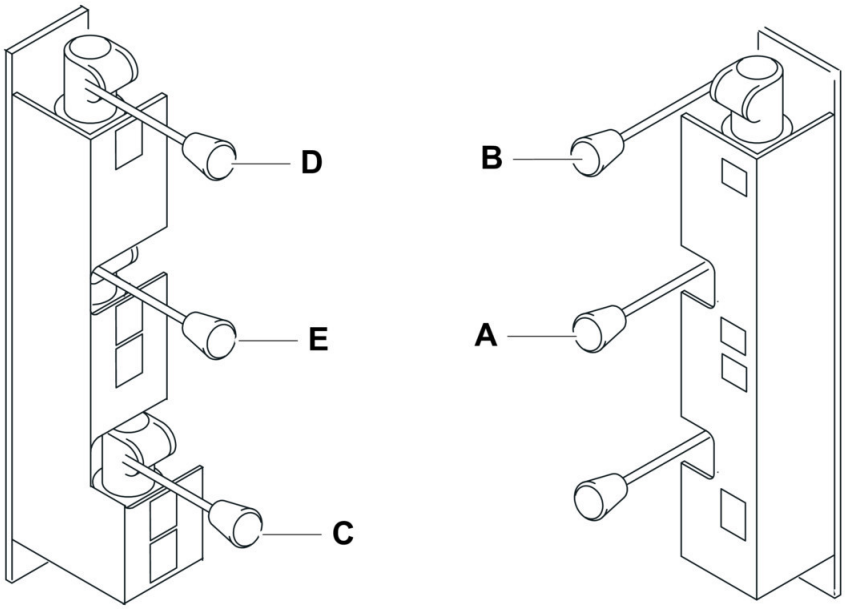



1. To remove bolt from intermediate drill rod support:
   a. Remove pin (B).
   b. Remove bolt (A).
   c. Place the bolt in holder (C).
2. Change the front drill rod support bush to the correct dimension so that the joint between two drill rods can pass without obstruction.
3. Select the multi-rod drilling function with lever (Lrn) to prevent automatic rock drill return.
4. Open the gripper claws with lever (Lrg).
5. Place a extension rod in the RAS arms.
6. Close the gripper claws with lever (Lrg).

### Extension Drilling with RAS




*Position indication for RAS*




*Levers for RAS*

1. Close the drill rod support with lever (A).

2. Drill with the first rod.

> ! ***NOTE:*** *Open the drill rod support with lever (A) before the join between the drill rod and the shank adapter reaches the drill rod support.*

3. Open the drill rod support when lamp (4) on the box is ON to indicate the position.
4. The percussion ceases automatically when the rock drill reaches the front of the feeder.

Step result ➔ Indicator lamp (5) is ON.

5. Keep the rotation and feed lever in neutral position.
6. Operate the percussion and feed lever until the joint is loosen.
7. Close the drill rod support with lever (A).
8. Remove the shank adapter from the drill rod support with lever (B).
9. Back up the rock drill with the feed lever so that there is room for the drill rod that is placed in the RAS arms.
10. Move the RAS arms in towards the drill center with lever (C).
11. Attach both the joints by moving lever (B) to threading position while holding lever (D) in control position until each joint is attached tight.

    Lever (D) has a return spring to re-position its original location.
12. Open the RAS arm gripper claws with lever (E).
13. Move the RAS arms away from the drilling centre with lever (C).
14. Open the drill-steel support with lever (A).
15. Repeat the steps for the next rod.

### Removing Drill Rods RAS

1. Open the drill-steel support (if closed) with lever (Lds).
2. Knock loose the drill rod joins using the percussion and feed lever.
3. Back up the rock drill with the feed lever until the threaded joint between the two drill rods is located in the drill-steel support.

    Once the join has attained its correct position in relation to the drill-steel support, the lamp (2) will come on.
4. Close the drill-steel support with lever (Lds).
5. Move the RAS arms in towards the drilling centre with lever (Lrt).
6. Close the RAS arm gripper claws with lever (Lrg) so that the gripper claws grab the drill rod.
7. Screw on the rock drill shank adapter to the drill rod with lever (Ltf).

8. Unscrew the drill rod from the front join by moving lever (Ltf) to the threading position while holding lever (Llg) in control position until the front join goes free.

   Lamp (1) will come on when the front join is free.

   Lever (Llg) has a return spring.

9. Release the lever (Llg).
10. Continue unscrewing until the rear join is free.

    Lamp (0) will come on when the rear join is free.

11. Move the RAS arms away from the drilling centre with lever (Lrt).
12. Open the RAS arm gripper claws with lever (Lrg).
13. Stop the hydraulic pumps and remove the drill rod from the RAS arms if more than two rods have been joined.
14. Move forward the rock drill with the feed lever until it approaches the join.

    Lamp (4) will come on when the rock drill is close to the join.

15. Join the shank adapter to the join on the drill rod using lever (Ltf).
16. Repeat the above steps for the next rod.

### 5.7.14 Freeze Prevention Measures

The water system must be drained if temperatures drop close to or below 0 °C, see operator's instructions Daily inspection.

### 5.7.15 Bolting

This equipment is **optional**.

#### Preparing for Bolting with Swellex

**WARNING**

**Falling Rocks**

When bolts expand, surrounding rock can fall and cause serious injury.

- ▶ Scale the rock thoroughly before a bolt is installed.
- ▶ Use tube sleeves if the rock has surface cracks.
- ▶ Adapt the length of the tube sleeves or the number of the tube sleeves according to the quality of the rock.

**WARNING**

**High Water Pressure**

The extremely high water pressure form the pump can cause personal injury.

- ▶ Rectify leaks in high pressure lines and couplings immediately.

1. Make sure that the equipment is not damaged.
2. Make sure that the water pressure of the pump is set for the bolt type to install the bolt.

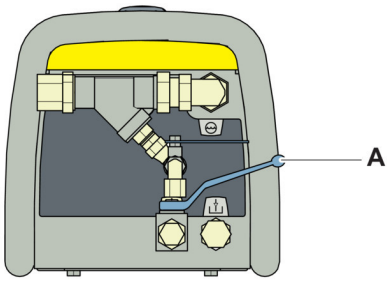
   The pump water pressure can be set at 240 bar (3,480.91 psi) or 300 bar (4,351.13 psi).

   A tensile test is recommended when the first bolt is installed.

| Bolt Type | Water Pressure |
|---|---|
| Swellex Mn16, Pm16, and Midi Swellex | 240 bar (3,480.94 psi) |
| Swellex Mn12, Mn24, Pm12, Pm24, Standard Swellex, and Super Swellex | 300 bar (4,351.13 psi) |

> ! ***NOTE:*** *Epiroc disclaims all responsibility if bolts are expanded with the incorrect water pressure.*

3. Make sure that the hydraulics and water is connected.
4. Activate the pumps hydraulic pressure with lever (A).




### Install Bolts with Swellex Arm

**⚠ WARNING**

**Falling Rocks**

Falling rocks can cause serious injury.

- ▶ Never stand directly below a bolt which is being installed.
- ▶ Use the full length of the installation arm to stand under secure rock when the bolt is expanded.

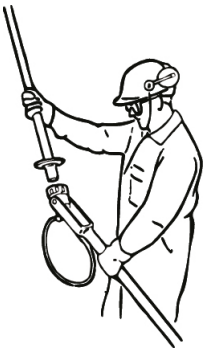
1. Make sure that the bolt sleeve is clean and not damaged.

Optional step ➤ If a washer is being used, attach it to the bolt before the bolt is inserted into the hole.

Use a tube sleeve if necessary.

Optional step ➤ If the bolt is longer than 2 m (78.73 in.), insert the bolt a short way into the hole

2. Insert the bolt into the chuck on the Swellex arm.

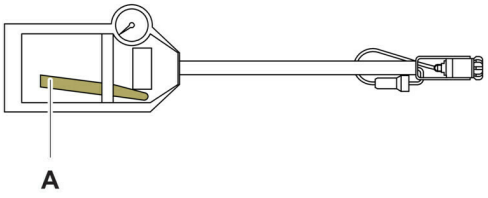


3. Make sure that the bolt reaches to the bottom of the chuck.
4. Insert the bolt into the drill hole using the Swellex arm.
5. Press the bolt hard against the opening of the drill hole.



6. Press the trigger (A) fully to activate the pump.

> ! ***NOTE:*** *If trigger (A) is not fully pressed, the three-way valve leaks. If the three-way valve leaks, the pressure is not reached.*




7. Keep the trigger pressed in until the set pressure for the pressure valve has been reached and maintained for 6 seconds.
8. Release the trigger and allow the water to flow out of the bolt.
9. Wait a few seconds until the pressure in the bolt has dropped to save the seals.
10. Remove the installation arm from the bolt.

    A tensile test is recommended when the first bolt is fitted.

> ! ***NOTE:*** *The pump must never pump water for longer than 10 minutes at a time. If the pump continues despite releasing the trigger, there is a leak in the high-pressure line.*

### Safe Bolting System

Safe bolting system is optional on the machine.

Safe bolting system can be used while working under the unsecured rocks. Safe bolting system has two applications:

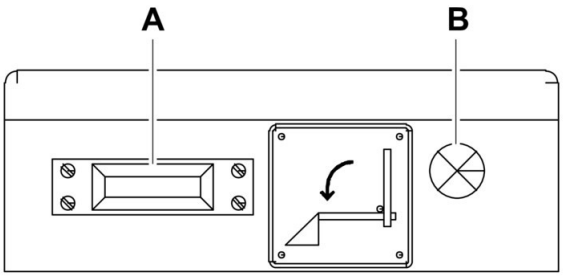
- Changing drill bit and drill rods
- Bolting with split set type rock bolt

Safe bolting system means that there is the option to turn the feed. So that the feed spike points toward the operator station. Then the drill bit or drill rods can be changed or a rock bolt can be positioned in the feed without the need to leave the machine.

### Overview of Safe Bolting System

SBS has a function that prevents the operator inadvertently moving the drill bit, drill steel or bolt towards the operator's station and avoid causing serious personal injury and damage to property. It comprises a warning lamp, a three-way switch with "enable function" located on the control panel beside the operator's station, and an inductive sensor mounted on the rotary actuator.

The three-way switch makes the operator take part actively in all boom and feed movement when the feed has a lookout angle greater than 90°.




*Control panel SBS*

| | |
|---|---|
| A | Button with "enable function" |
| B | Warning lamp |

### Function

An inductive sensor located on the lookout axis is active when the lookout angle is less than 90°. When the sensor is inactivated (i.e. when the feed lookout angle is greater than 90°), the holding voltage will activate a relay. The relay will in turn cut the voltage to:

- Valve to diesel positioning.
- Loading of positioning pump.
- rotation flow discharge valve(s)

The relay is closed when:

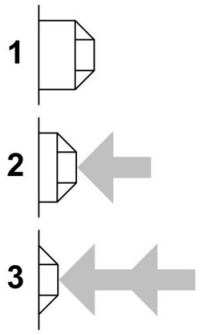
- The inductive sensor is active (lookout angle is less than 90°).
- When the three-way switch is pressed to middle position (while the lookout angle is greater than 90°).

In order to move the boom and feed as well as operate the rock drill rotation, the threeway switch must bypass the inductive sensor. This is done by holding the three-way switch in its middle position. The sensor is activated when the switch is completely depressed and completely released.

A back-pressure valve which opens at approx. 30 bar is used prevent the stand-by pressure from escaping into the system.

If the machine is fitted with a telescope feed, there will be another pilot-controlled check valve. This valve confines the pressure in the feed cylinders so that the oil is not drained, thereby allowing movement.

When the feed is positioned to change drill bit, for example, the inductive sensor will indicate when the lookout angle exceeds 90° and the positioning pump will be relieved, the rock drill rotation will be stopped and the warning lamp on the operator's panel will come on. Button (A), which is a spring-return three-way switch, must be pressed to position 2 before positioning can continue.




*Button (A)*

| | | | |
|---|---|---|---|
| 1 | Position 1, button inactive | 2 | Position 2 |
| 3 | Position 3, button fully depressed | | |

Pressing button (A) to position 2 will load the positioning pump, the warning lamp will go out and the rock drill rotation can be activated. Releasing button (A) completely or pressing it to position 3 will break the system.

### Parts of Safe Bolting System

The following components are included in the Safe Bolting System (for each boom):

- Feed holder with increased lookout angle (+90°).
- Inductive sensor.
- Flag that activates the inductive sensor.

Activates the inductive sensor within the lookout area less than 90°.

- Three-way switch with "enable function" on control panel.
- One relay.
- One warning lamp on control panel.

The lamp comes on when the lookout angle is greater than 90° and the three-way switch is released or completely depressed.

- Electrical connections in power supply cubicle.

Controls the shut-off valve for loading the positioning pump.

- Electrical connections in chassis.

Shuts the valve to diesel positioning.

- Shut-off valve for rotation flow on rotation hose between rotation pump and rotation valve.

When the shut-off valve is active, oil is sent to the rotation valve and when it is inactive, oil is sent to the tank.

- Back-pressure valve on positioning pump.

Prevents the stand-by pressure from escaping into the system.

- Pilot-controlled check valve (applies to telescope feed only).

Prevents inadvertent feed with telescope feed due to its own weight.

- Working platform directly connected to the operator's station, option.

Functional extra platform for Safe Bolting.

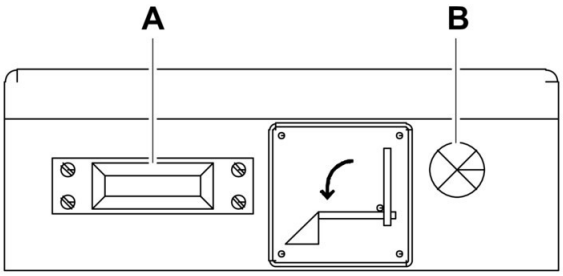
### Location of Safe Bolting System

- The inductive sensor is mounted on the rotary actuator at the end of the lookout axis and the flag on the end of the lookout axis.
- The pilot-controlled check valve is mounted between the branching to the piston rod side of the upper beam's feed cylinder and the pressure reducing valve to the piston side of the lower beam's feed cylinder.

The pilot pressure is taken from the piston side of the upper beam's feed cylinder.

### Check of Safe Bolting System

! ***NOTE:*** *When checking the function of SBS, take care to position the feed in a deliberate and safe manner.*




1. Position the feed until the lookout angle exceeds 90°.
2. Make sure that the following happens (when the lookout angle exceeds 90°):

Step result

➔ Warning lamp on the operator panel comes on.

Positioning pump idles.

Rock drill rotation stops.

3. Press in button (A) and start to position the feed.
4. Make sure that the following happens (when the button is pressed in):

Step result

➔ Warning lamp on operator panel goes out.

Positioning pump loads.

Rock drill rotation can be activated again.

5. Release button (A) while the feed is being positioned.
6. Make sure that the following happens (when button released):

Step result

➔ Warning lamp on the operator panel comes on.

Positioning pump idles.

Rock drill rotation stops.

7. As long as the above procedure is correct, you can now start bolting or change drill bit and drill rod, but if the procedure is incorrect, the fault must be rectified immediately.

### Changing Drill Bit and Drill Steel of Safe Bolting System

1. The preparation required before changing drill bit and drill steel is the same as before drilling. See operator's instructions Drilling: Before drilling.
2. Check the function of SBS, see section on Function check.
3. Release the drill bit and drill steel if necessary before positioning starts.
4. Position the feed until the front points in the desired direction, for example, towards the operator's platform.

> ! ***NOTE:*** *When the lookout angle exceeds 90°, press in and hold the button (A) to position (2). Continue positioning the feed.*

5. Release button (A).
6. Remove the drill bit and drill steel.
7. Fit a new bit and drill steel.
8. Press in and hold button (A) to position 2.
9. Reposition the feed to its original position.

> ! ***NOTE:*** *When the lookout angle is less than 90°, release button (A) and continue to position the feed.*

### Preparation for Bolting with Split Set

1. The preparation required before bolting is the same as before drilling, see operator's instructions Drilling: Before drilling.
2. Check the function of SBS, see section on Function check.
3. Position the feed to drill a hole.

### Drilling and Bolting for Bolting with Split Set

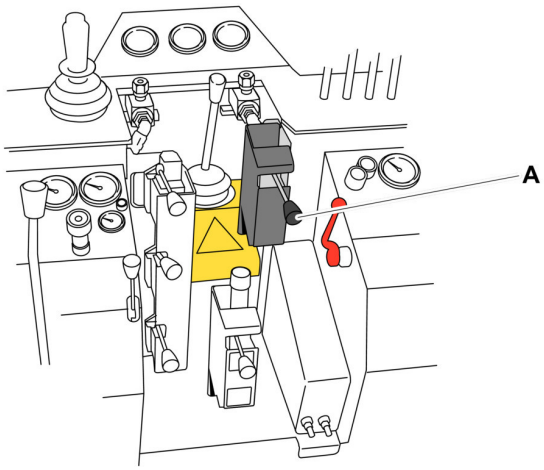
1. Drill a hole, see section Drilling.

> ! ***NOTE:*** *Follow the bolt manufacturer's recommendations regarding hole dimensions.*

2. Carry out the necessary measures after drilling, see section Drilling, After Drilling.

3. Make sure that the lever (A) for selection of drilling or bolting is in the position for "bolting".

Step result ➔ The feed force is maximum.




*Lever for selecting drilling/bolting*

4. Release the drill rod if necessary.
5. Position the feed until it comes under a secured roof.
6. Remove the drill rod.
7. Fit the bolt adapter to the rock drill.
8. Fit a suitable bush to the drill rod support.
9. Remove the intermediate drill rod support if necessary.
10. Insert the bolt through the drill rod support and secure it on the bolt adapter.

> ! ***NOTE:*** *The choice of bolt depends on the bolt manufacturer's recommendations concerning hole dimensions.*

11. Position the feed to its original position (against the drill hole).
12. Feed the bolt into the hole.
13. Start percussion to ram in the bolt.

> ! ***NOTE:*** *Observe the bolt manufacturer's recommendations.*

### Restore Drilling of Bolting with Split Set

1. Position the feed until it comes under a secured roof.
2. Replace the intermediate drill rod support if necessary.
3. Remove the bush from the drill rod support.
4. Remove the bolt adapter from the rock drill.
5. Equip the drill rod again.

6. Make sure that the lever for selection of drilling and bolting is in the position for "drilling".
7. Position the feed to the next hole.

## 5.8 Maneuvering the Service Platform

The service platform is **optional** equipment.

### 5.8.1 Safety Precautions Before Using the Service Platform

**WARNING**

**Crushing Risk**

Risk of crushing injuries.

- ▶ Make sure no one is inside the risk area of the service platform before maneuvering.

**WARNING**

**Service Platform Overload and Instability**

An overloaded platform is unstable which results in a risk of tipping and person of falling. This can cause serious injury or death.

- ▶ Do not exceed the specified maximum load of the service platform.
- ▶ All extra equipment that is fitted to the platform decreases the payload corresponding number of kilograms.
- ▶ The specified maximum load for the platform includes the weight of the persons to be present on the platform.
- ▶ Distribute the weight evenly across the whole platform if the maximum load is approached.
- ▶ The jacks must be extended and fully relieve the weight on the wheels.

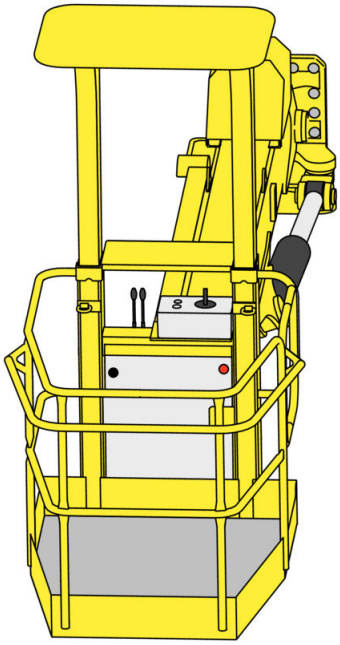
**CAUTION**

**Incorrect Use of Service Platform**

Incorrect use of the service platform can result in serious injury and property damage.

- Never climb on the platform guardrail, either on the inside or the outside.
- When the platform is staffed, only operate the platform from the cage of the platform.
- Always have assistance by at least one person in the vicinity, not in the platform, that can help in an emergency.
- Always wear a safety harness in the platform.
- Always anchor the safety harness to the platform.
- Do not use the platform for lifting.
- Do not use the platform to press in bolts.
- Only use the working platform for persons under a secured roof.
- Collisions with other equipment and tunnel walls must be avoided while the platform is in use.
- Do not press the boom and platform against other objects.
- Check the structure and welding very thoroughly if there is a collision.
- Repair any damage before taken the platform into service again if there is a collision.
- Damaged load-bearing components must be replaced without exception after collision.
- All inspections and repairs must be done by appropriate qualified personnel.

### 5.8.2 Service Platform Application



The service platform may only be used as a working platform for persons under a secured roof. All other use is forbidden, involves danger to life and is considered inappropriate.

Examples of **inappropriate** use:

1. Using the platform for lifting
2. Using the platform for pushing the bolts

Collisions with other equipment and tunnel walls must be avoided while the platform is in use. In addition, avoid pressing the boom and platform against other objects. If there is a collision as described above, the structure and welding must be checked very thoroughly and any damage repaired before the platform is taken into service again. Damaged load-bearing components must be replaced without exception!

All inspections and repairs must be performed by appropriately qualified personnel. Assigning such work to unqualified personnel involves danger to life!

Epiroc is not responsible for personal injury caused by incorrect handling, faulty use or falling rock.

### 5.8.3 Functions of Service Platform

**Functions from the operator cabin**

The following functions can be controlled with the control lever:

- Raising/lower the service platform
- Slewing the service platform

**Functions from the service platform basket**

- Raising/lowering and slewing the service platform
- Tilting the platform basket
- Extending/retracting the telescope
- Raising/lowering the service platform's protective roof
- Slewing the platform basket

### 5.8.4 Activating and Deactivating the Service Platform

**Activating from the operator cabin**

- Start any of the rig's hydraulic pumps by activating any of the booms, or
- Start the diesel engine and activate diesel positioning pump.

| | |
|---|---|
| ! | ***NOTE:*** *For diesel operation, see operator's instructions, Tramming.* |

**Activating from the service platform basket**

1. When working in the service platform, first move the service platform to the required location.

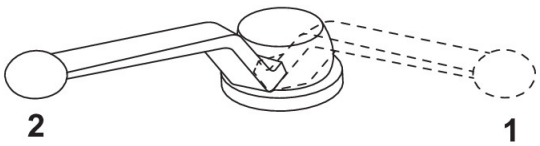



*Lever to activate/deactivate the service platform*

| | |
|---|---|
| A | Lever to activate/deactivate the service platform |

2. Before performing any work from the service platform, move lever to position (1).

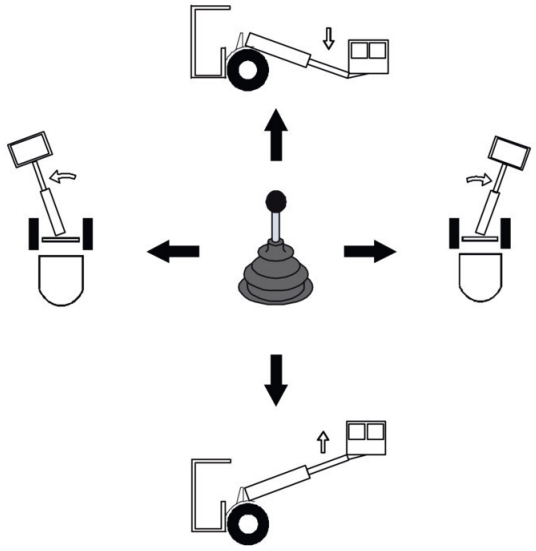
   The service platform is now deactivated, which means that it cannot be operated from the service platform nor from the operator platform.



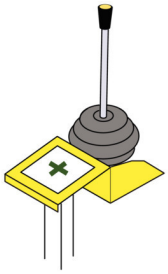

*Lever positions*

3. To be able to move the service platform, move lever to position (2).

### 5.8.5 Raising, Lowering, and Swinging the Service Platform from Operator cabin

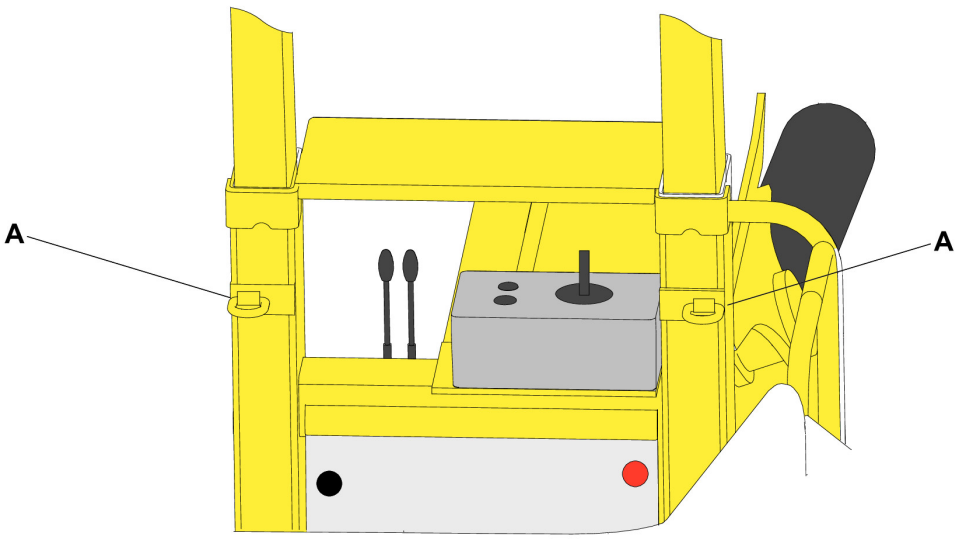


1. Move the lever for desired function.



*Service platform control lever*

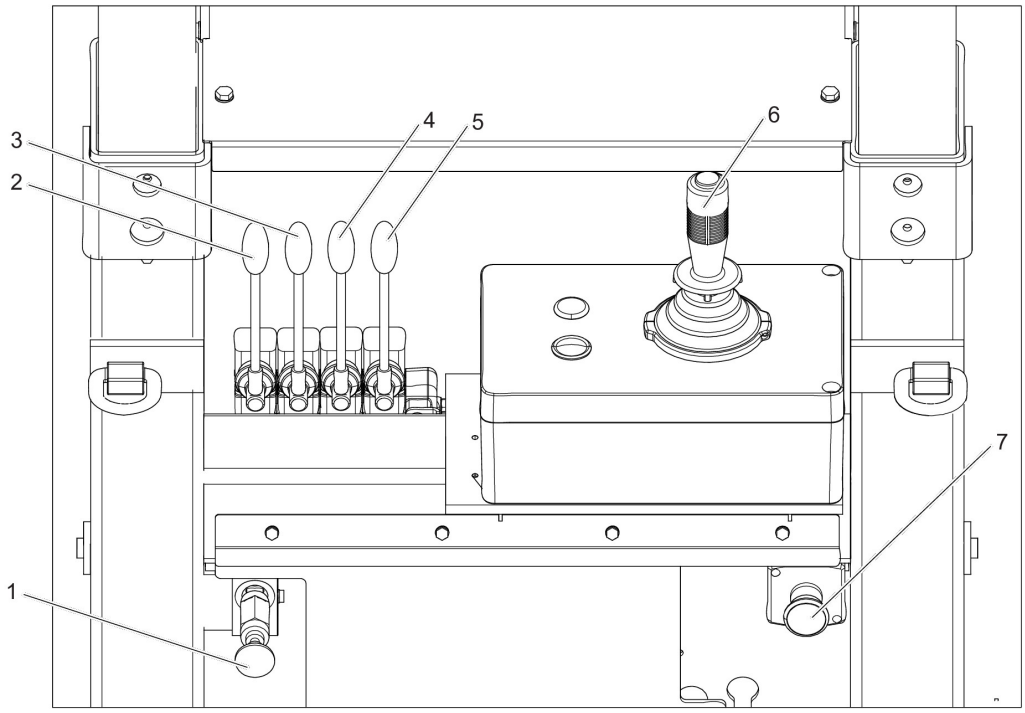
### 5.8.6 Attaching Safety Harness to Service Platform




A safety harness must be used and attached when working from the service platform.

- Attach the safety harness to the intended eyes (A) on the service platform.

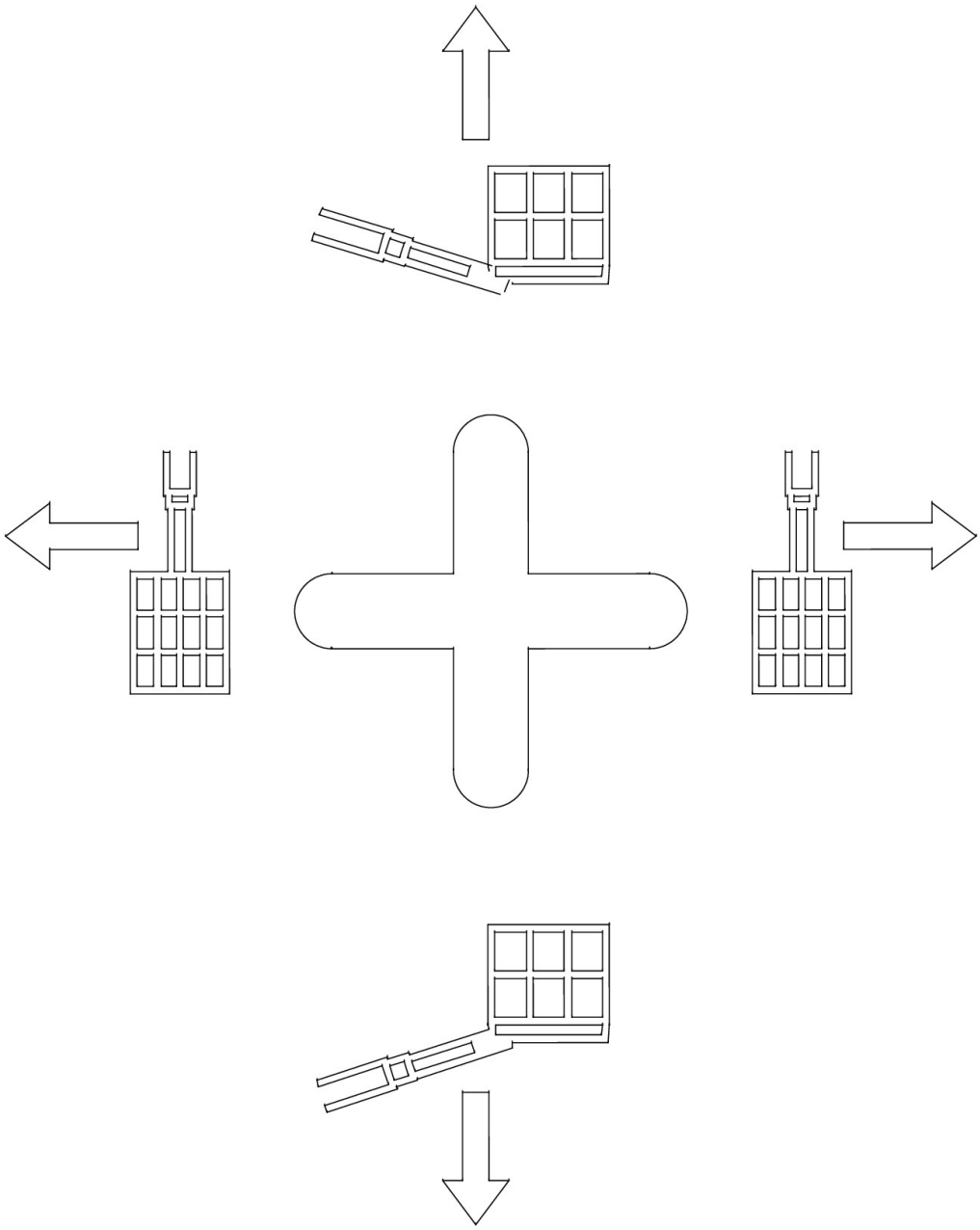
### 5.8.7 Service Platform Control Panel




*Control panel*

| | | | |
|---|---|---|---|
| 1 | Pull-button for the emergency lowering of the service platform | 2 | Lever for raising and lowering the service platform's protective roof (option) |
| 3 | Lever for slewing the service platform basket(option) | 4 | Lever for tilting of the service platform basket |
| 5 | Lever for the extension and retraction of the telescope tube | 6 | Lever for raising, lowering the service platform and moving it left, right |
| 7 | Emergency stop | | |

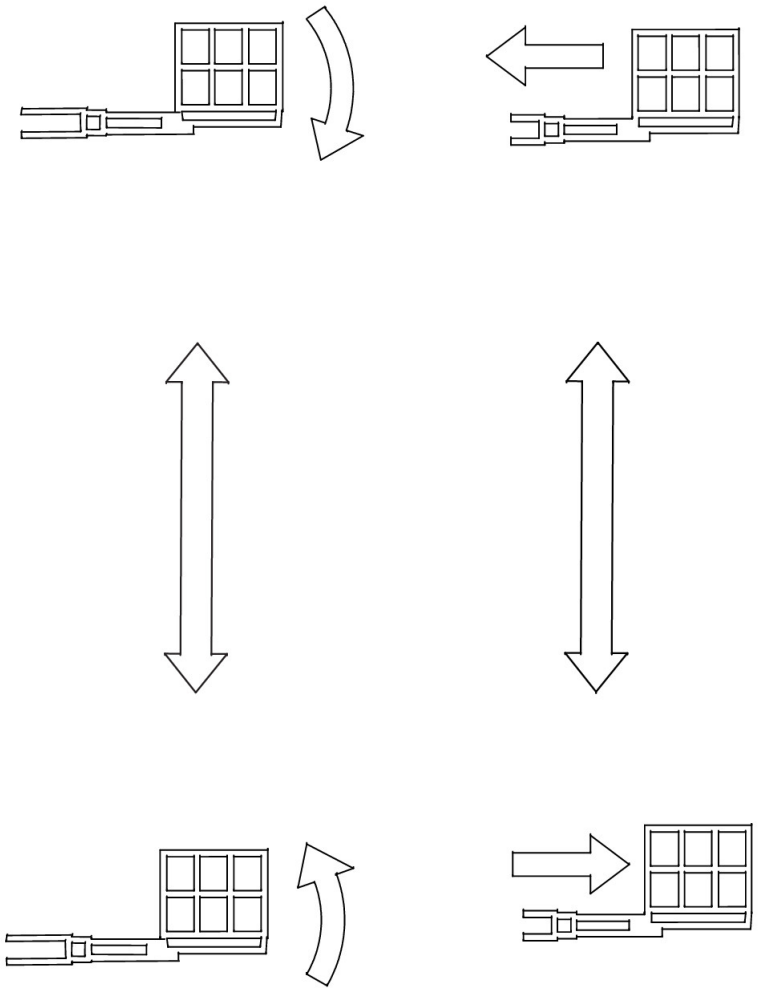
### 5.8.8 Raising, Lowering, and Slewing the Service Platform from the Basket



| Precondition | ✓ The service platform is activated |
|---|---|

- ○ Move the control lever(6).

### 5.8.9 Telescoping and Tilting the Service Platform from the Basket

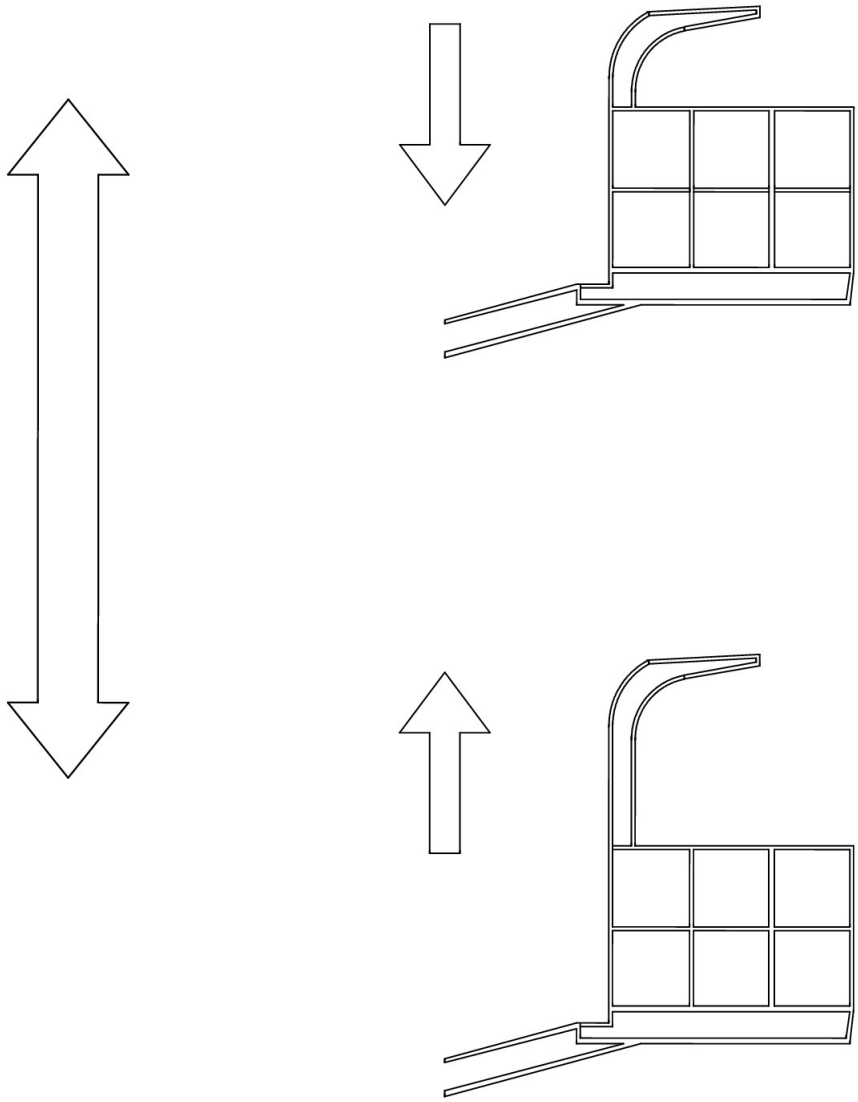


Precondition ✓ The service platform is activated.

1. Move the control lever (4) for tilting and lever (5) for telescopic function.

### 5.8.10 Raising and Lowering the Service Platform Protective Roof from the Basket

! ***NOTE:*** *This attachment is an option.*

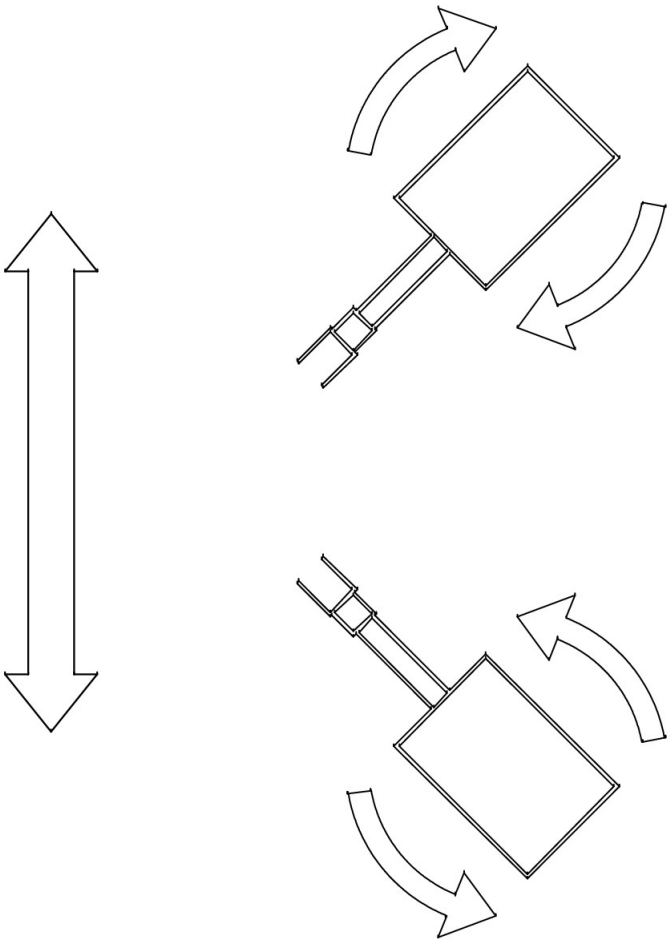


Precondition ✓ The service platform is activated.

- ○ Move the control lever (2).

### 5.8.11 Slewing the Service Platform Basket

| | |
|---|---|
| ! | ***NOTE:*** *This attachment is an option.* |

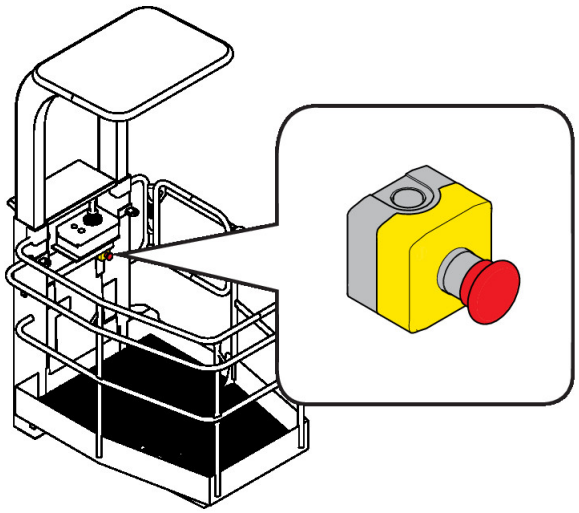


Precondition ✓ The service platform is activated.

- ○ Move the control lever (3).

### 5.8.12 Emergency Stop on Service Platform

The emergency stop in the basket and on the operator panel deactivates all the functions of the rig. After resetting the emergency stop, the main switch must be reset if the rig is being powered from the mains. See operator's instructions Electrical system.



! ***NOTE:*** *In case of emergency while on the service platform, press the Emergency Stop button (7).*

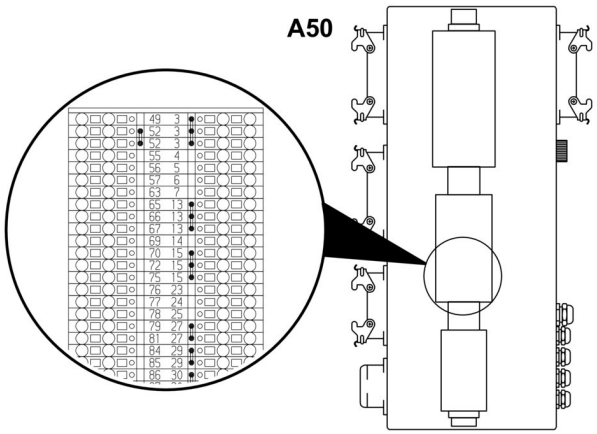
### 5.8.13 Emergency Mode on Service Platform

In exceptional cases, the emergency stop on the service platform can be put out of operation.

! ***NOTE:*** *The emergency stop must only be put out of operation in an emergency situation to rescue personnel on the service platform.*

#### In the Event of Unintentional Emergency Stop of the Service Platform

1. Connect a strap between plinth 5 and 85 in electric cabinet A50, see illustration above.




*Strapping the emergency stop*

2. Reset the electric cabinet switch.
3. Lower the service platform
4. Remove the strap between plinth 5 and 85.
5. Check the function of the emergency stop.

### 5.8.14 Emergency Lowering of Service Platform in the Event of Power Failure

First read: Safety Precautions Before Using the Service Platform [▶ 121]

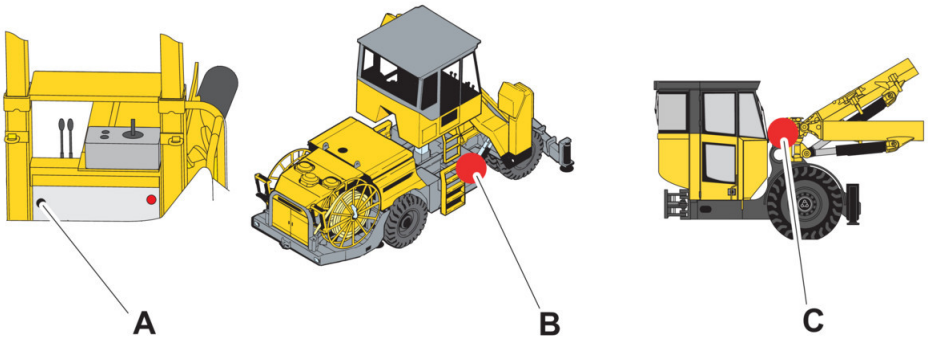
The diesel engine is the reserve unit of service platform in the event of a power failure.

1. Start the diesel engine.
2. Lower the service platform.

> ***NOTE:*** *Do not use the service platform again before the fault has been rectified or power is restored.*

### 5.8.15 Emergency Lowering of Service Platform in the Event of No Hydraulic Pressure

First read: Safety Precautions Before Using the Service Platform [▶ 121]




Neither the electric motors or diesel engine starts.

1. Make sure that it is safe to lower the platform vertically, and nothing underneath that is trapped.
2. Lower the platform with one of these alternatives:

Alternative step
a. Pull the button (A) under the cage control panel.

Alternative step
b. Pull the button (B) on three and four boom rigs.

Alternative step
c. Pull the button (C) on one and two boom rigs.

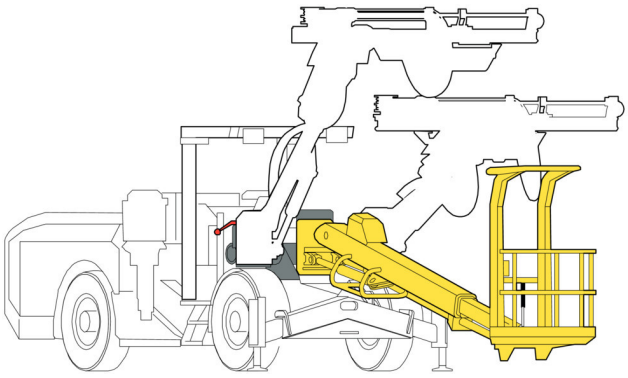
> ***NOTE:*** *The emergency lowering buttons (A), (B), and (C) cannot be used to raise or swing the platform.*

### 5.8.16 Tramming and Parking Position

Before parking or moving the machine the service platform must be positioned so that it does not obscure the aim devices. At the same time it must not collide with the boom(s) either.

1. Raise the boom(s) so that there is clearance to manoeuvre the service platform.
2. Fully retract the service platform boom extension.

3. Operate the service platform down so that it does not obscure the aim devices or make contact with the surface below.



*Service Platform in Tramming Position*

4. Check whether the platform needs to be raised further in order to avoid making contact with the ground when the machine is lowered from the jacks.
5. Check that the service platform is empty of loose objects.

# 6 Transport

## 6.1 Preparations Before Hoisting

**WARNING**

**Risk of Crushing**

Crushing can cause serious personal injury or death.

- ▶ Use extreme caution when slinging and hoisting heavy objects.
- ▶ Hoisting must take place at the center of gravity.
- ▶ Only use slings that are intact and designed for the load they will carry.
- ▶ Fasten the straps to lifting eyes, if available.
- ▶ Do not approach a suspended load.

Before transporting in shafts or similar, it is necessary to disassemble the machine fully or partially.

Observe the following when disassembling, hoisting, and assembling:

- Clean the entire machine with water and detergent containing a grease solvent before disassembling.
- Mark hoses, pipes, and other connections to make reassembly easier and prevent mix-ups.
- Make sure that everything is clean when disassembling hydraulic, compressed air, and water flushing hoses. Immediately plug all hoses, nipples and hydraulic oil pipes, or seal.
- Use properly secured lifting device of generous dimension.

## 6.2 Before Loading the Machine onto the Transport Vehicle

**WARNING**

**Tipping Risk**

The tipping over of a machine can cause serious injury or death.

- ▶ Lock the articulation lock before hoisting the machine.
- ▶ Adapt transportation equipment to the dimensions and weight of the machine.
- ▶ Check that all hatches are properly locked.

- Position feed and booms as low as possible.
- Positions feed horizontally.
- To tram onto transport vehicle: Follow separate driving instruction sheet.

- To lift the machine onto transport vehicle: Use adequate lifting device and attach only to marked lifting points.
- The articulation lock must be installed in locked position before loading the machine onto the transport vehicle.

### 6.2.1 Articulation Lock

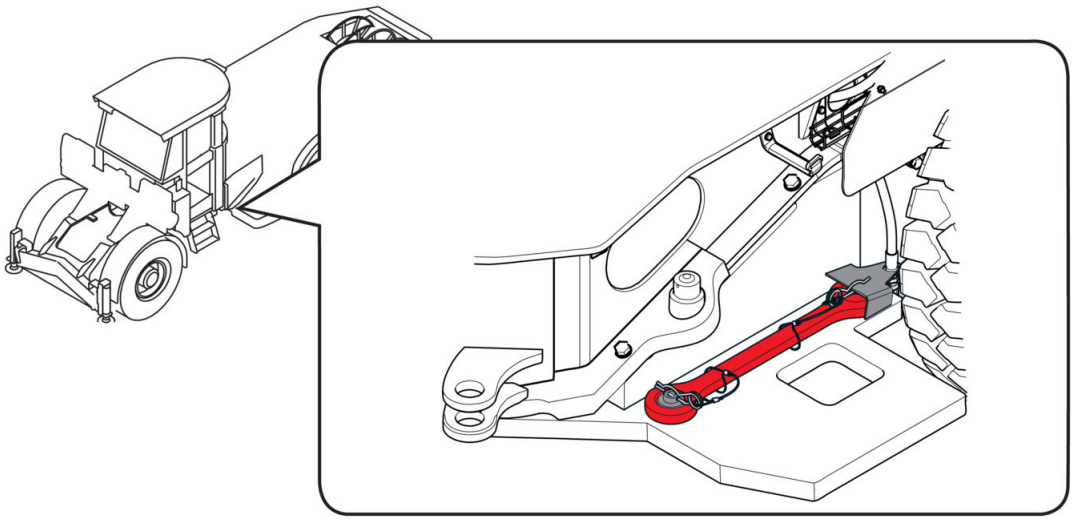
**WARNING**

**Crushing Hazard**

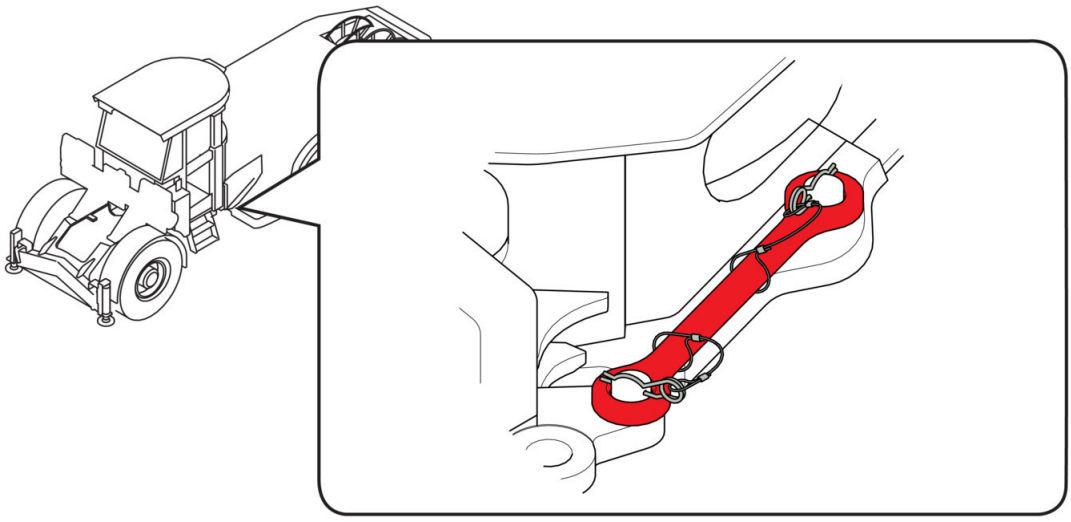
Machine movement can cause serious injury or death.

▶ Make sure that the machine is not in motion when placing the articulation lock.

▶ Be careful when handling the articulation lock.



*Articulation Lock in Stored Position*



*Articulation Lock in Locked Position*

- The articulation lock is used to prevent the machine from turning side to side.

- The articulation lock must be installed in locked position before starting service or maintenance.

## 6.3 Towing

### 6.3.1 Safety Precautions before Towing

**WARNING**

**Machine Movement**

The machine has no working brakes when it is being towed which can cause serious injury or death.

- ▶ Always attach a tow bar between the machine and the towing machine before releasing the brakes or removing the cardan shafts.
- ▶ Make sure that the towing machine and the tow bar are suitable to pull the load.

***NOTICE***

**Incorrect Towing**

Starting the machine when towing could damage the hydraulic transmission seriously.

- ▶ Do not start the machine by towing.

### 6.3.2 Preparing for Towing

 First read: Safety Precautions before Towing [▶ 137]

Tow the carrier only if it is necessary.

Do not tow the carrier more than 1 km (0.621 mile) or at a speed greater than 5 km/h (3.10 miles/h).

***NOTE:*** *The brakes do not function while the machine is being towed.*

1. Connect a tow bar between the machine and the towing machine.
2. Disable the parking brake mechanically.
3. Disassemble the cardan shaft from the drive train.
4. If the diesel engine is not working, disconnect the steering cylinder.

# 7 Daily Maintenance

## 7.1 About Daily Maintenance

> ***NOTE:*** *To make sure optimal availability of the machine and its equipment, it is of utmost importance that daily maintenance is carried out in accordance with the recommendations.*

The objective for the daily maintenance of the machine is to:

- Detect faults at an early stage
- Facilitate servicing
- Allow scheduled maintenance and planned reconditioning work to be performed
- Prevent costly secondary damage
- Prevent breakdowns
- Prevent personal injury

> ***NOTE:*** *If a fault is detected, only operate the machine or the equipment when all fault is rectified.*

## 7.2 Visual Check

> ***NOTE:*** *As soon as a fault is detected, note it and report to maintenance personnel.*

- Check the closure, locks and seals of doors, hatches and opening panels.
- Check safety devices.
- Check hoses and cables.
- Check oil levels.
- Check lubrication points.
- Check leakage and wear.
- Check any faults in the function of the controls.

## 7.3 Wash Machine Externally

> ***NOTE:*** *Do not spray water directly against the opening on the intake manifold of the diesel engine.*

- Rinse the machine with water at least once a day to remove drill cuttings, mud, and dirt.

  The feed and front part of the boom are important to keep clean.

## 7.4 Check Condition of Signs

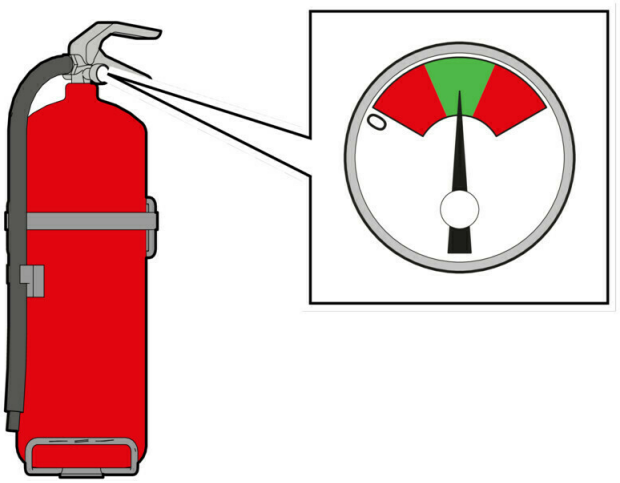
- Check that all signs are in place.

  Compare with the drawing.

- Check that all signs are intact, clean, and fully readable.

  Replace defect or missing signs.

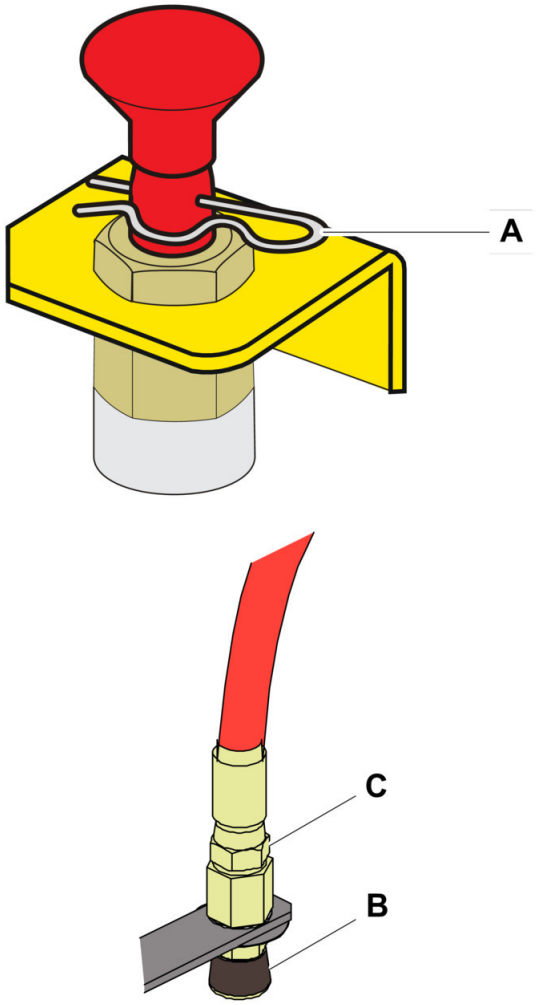
## 7.5 Check Fire Extinguishers



- Check that the indicator is in the green zone. Replace the fire extinguisher if the indicator is in the red zone.
- Check the seals for damage. Replace the seals if necessary.
- Check the fire extinguisher body and holder for damage. Replace the fire extinguisher if necessary.

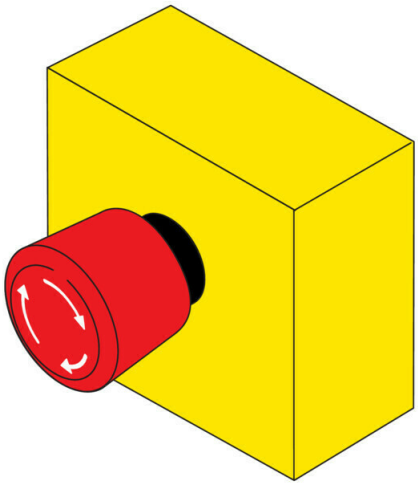
> ! ***NOTE:*** *Follow the instructions on the handheld fire extinguisher for further maintenance.*

## 7.6 Check Fire Fighting System




- Check system components for mechanical damage or corrosion.
- Check that the trigger lock pin (A) is in place.
- Check that the seals are not broken.
- Check that the tank pressure gauge is in the green zone, if present.
- Check that the nozzles are clean and that the protective caps (B) are attached.
- Check that all couplings (C) are tightened.
- Check that all hoses are intact and that all hose retainers are securely bolted or welded.
- Check that the system is running and that no fault indications are illuminated.

## 7.7 Check Emergency Stops



- Check the function of all emergency stops on the machine.

## 7.8 Check Feed

- Clean the sliding surfaces of feed holder and cradle with water.
- Check for leaks and damage on all hoses.

## 7.9 Check Boom Condition

- Check and rectify any damage and leaks on the boom.

## 7.10 Check Drill Rod Support

- Check all pipes, nipples, hoses, and rectify any damage and leaks.

## 7.11 Check Hydraulic System

- Check the oil level in the hydraulic oil tank using the oil sight glass.
- Check that the return oil filter is not clogged.

  A symbol on the control system display warns if the filter is clogged.
- Check hydraulic hoses for leaks and damage.
- Check oil level in the ECL lubrication tank. Use Cop Oil.

| Hydraulic Oil Tank Volume |
| --- |
| |

| Lubrication Oil ECL |
| --- |
| 5 litres (1.3 gallon) |

## 7.12 Check Compressor GAR 5 and GAR 30

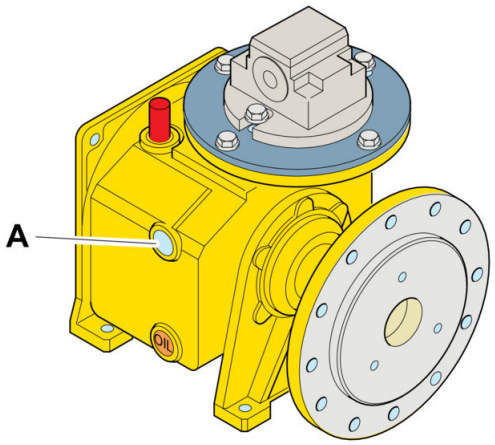
- Check oil level in air reservoir.
- Check condition of air filter and replace if necessary.
- If a cyclone filter is installed on the air filter unit, check the particle level in the reservoir and empty if necessary.

**See Reference Documentation**

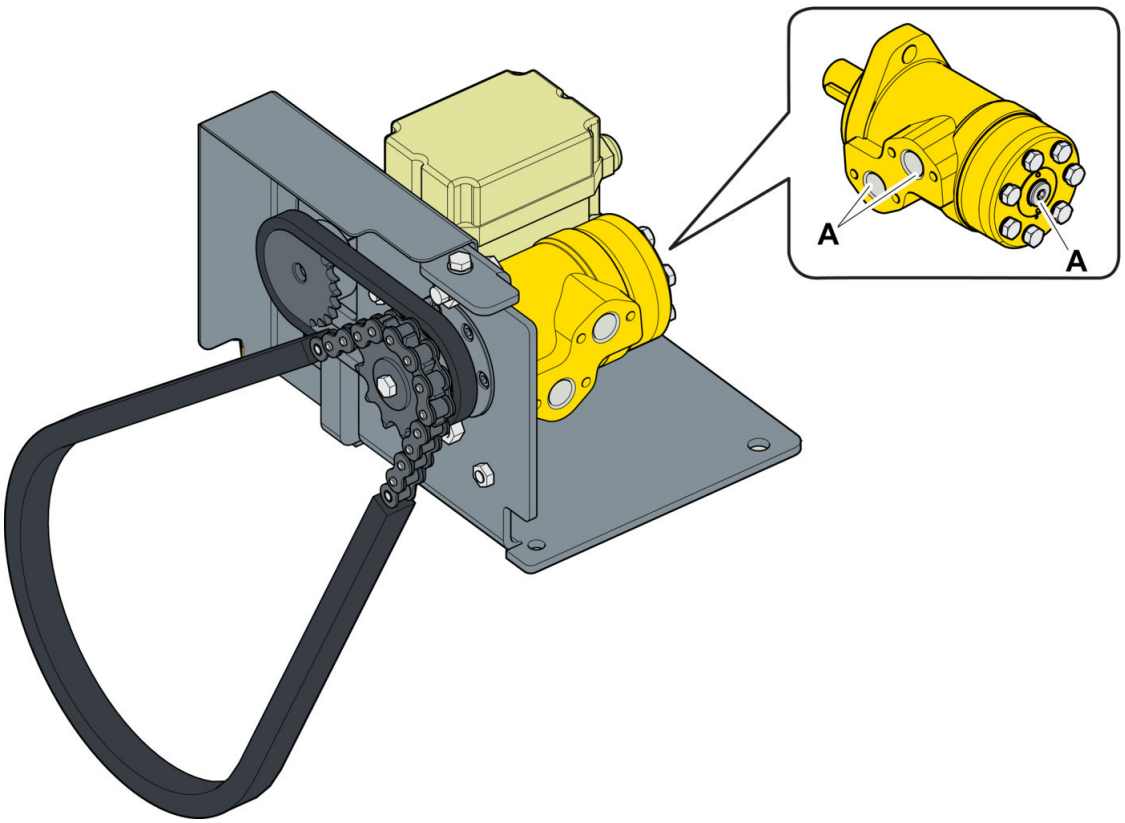
| |
|---|
| Compressor instruction manual |

## 7.13 Check Reeling Units

- Check oil level on the gears. See maintenance instructions.
- Check the hose connections for leaks.
- Rotate the cable reel on the cable reeling unit collector to avoid flashover in the cable reeling collector due to oxidization.




- Check the oil level through the level glass (A) and top up if necessary.
- Check the hose connections for leaks.
- Rotate the cable reel on the cable reeling unit collector to avoid flashover in the cable reeling collector due to oxidization.




- Check the hose connections (A) for leaks.
- Rotate the cable reel on the cable reeling unit collector to avoid flash-over in the cable reeling collector due to oxidization

## 7.14 Clean Water Strainer

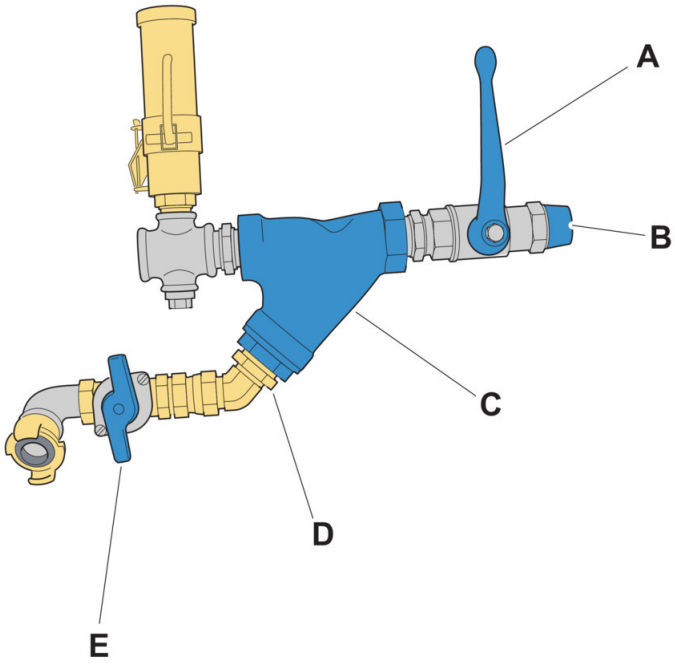
**WARNING**

**High System Pressure**

There is a risk of personal injury when working with pressurized systems.

- ▶ Do not perform maintenance work while the machine is operating.
- ▶ Check that the hydraulic, water, and air systems are depressurized and that the electrical system is de-energized before starting to work on these systems.

**NOTE:** *Clean the strainer regularly to maintain the proper flow.*




Precondition
- ✓ The hose reeling unit is connected to the water supply if the machine is equipped with a water supply.
- ✓ The hose connection points are clean.

1. Connect a water supply to the water inlet (B) on the machine.
2. Open the main stop valve (A).
3. Open the valve (E) and let water run through the water strainer (C).
4. Remove the end piece (D) if the water strainer is damaged.
5. Remove the strainer drum.
6. Clean the strainer drum or replace with a new one if necessary.

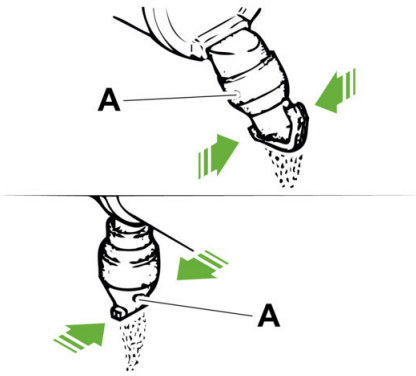
## 7.15 Empty Engine Air Filter Evacuation Valve

**NOTICE**

**Engine Damage**

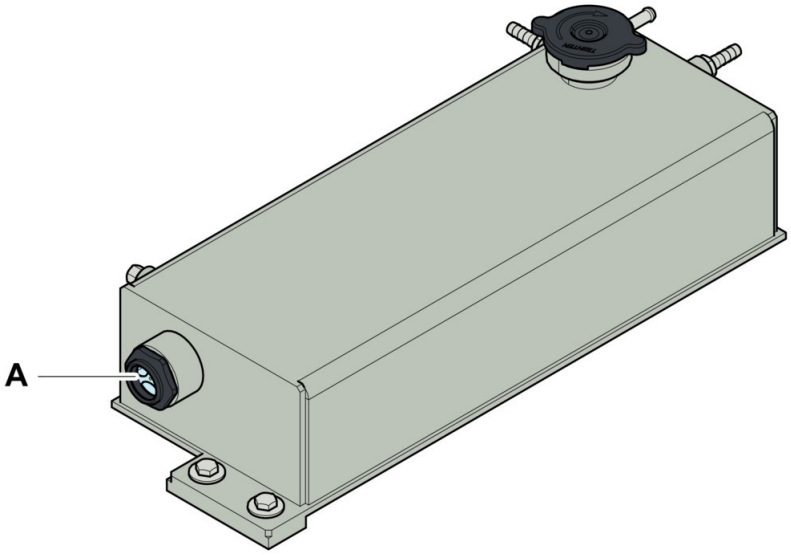
Operating the machine without evacuation valve installed or with a damaged evacuation valve leads to extreme deterioration of air filtration, and can damage the engine in the long term.

▶ Check and clean the evacuation valve as scheduled or more often if necessary.




- Empty the evacuation valve (A) by squeezing the slit together in the direction of the arrows.
- Clean the slit at regular intervals.

## 7.16 Check Coolant Level




Precondition
- ✓ The engine has reached room temperature.
- ✓ The machine is leveled.

- Check the coolant level on the sight glass (A) on the expansion vessel.
  The level must be between the MIN and MAX mark.
  Add coolant if necessary.

## 7.17 Check Diesel Engine Oil Level

**WARNING**

**Hot Surface**

Hot components can cause serious personal injury.

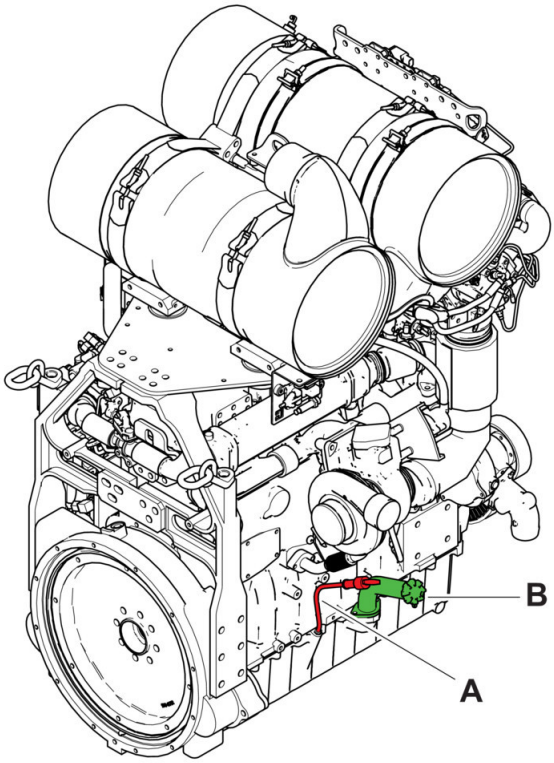
- ▶ Turn off the machine and allow the components to cool down before starting maintenance work.
- ▶ Use Personal Protective Equipment (PPE).
- ▶ Be careful when draining hot fluids.
- ▶ Do not handle flammable fluids near hot surfaces, sparks, or open flames.

**WARNING**

**Burning Hazard**

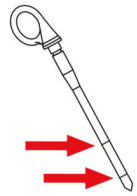
High oil temperature can cause serious personal injury.

- ▶ Shut off the engine.
- ▶ Use working gloves, face shield, and cover your arms with long sleeves.




Precondition ✓ The diesel engine is turned off.

1. Check that the oil level is between the upper and lower mark on the dipstick (A).



2. Top up the oil through the filler cap (B), if necessary.

> ***NOTE:*** *Only use engine oil that the engine manufacturer approves for engine and type of operation.*

| See Reference Documentation |
|---|
| Diesel engine instruction manual |

| Specification | Capacity |
|---|---|
| Total capacity engine oil tank | 8.2 L (2.2 gal) |

| Specification | Capacity |
|---|---|
| Volume between upper and lower marks on the dipstick | 2.0 L (0.5 gal) |

## 7.18 Check Diesel Engine Sealing Integrity

- Visually check the diesel engine for leaks.

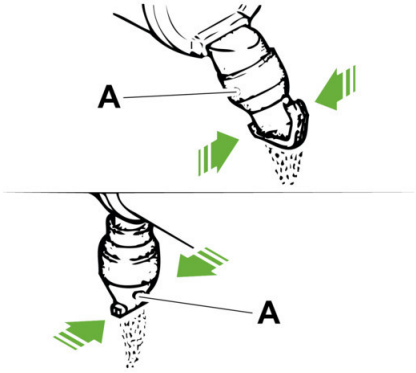
## 7.19 Empty Engine Air Filter Evacuation Valve

***NOTICE***

**Engine Damage**

Operating the machine without evacuation valve installed or with a damaged evacuation valve leads to extreme deterioration of air filtration, and can damage the engine in the long term.

- ▶ Check and clean the evacuation valve as scheduled or more often if necessary.




- Empty the evacuation valve (A) by squeezing the slit together in the direction of the arrows.
- Clean the slit at regular intervals.

## 7.20 Check Parking Brake

**NOTICE**

**Property Damage**

Risk of overheating the transmission system.

▶ Do not perform the brake test for longer than four seconds.

Precondition
- ✓ The machine is parked on a flat and leveled surface.
- ✓ The parking brake is applied.

1. Start the diesel engine and engage second gear.
2. Gradually increase engine rpm to maximum.
3. Check the machine movement.

   If the machine moves, then the brakes must be repaired or replaced before operating the machine.

## 7.21 Check Service Brake

**NOTICE**

**Property Damage**

Risk of overheating the transmission system.

▶ Do not perform the brake test for longer than four seconds.

Precondition
- ✓ The machine is parked on a flat and level surface.
- ✓ The diesel engine is turned on.

1. Press and hold the brake pedal down.
2. Release the parking brake.
3. Engage second gear.
4. Gradually increase engine rpm to maximum.
5. Check the machine movement.

Step result
- ➔ If the machine moves, then the brakes must be repaired or replaced before operating the machine.

**NOTICE**

**Property Damage**

Risk of overheating the transmission system.

▶ Do not perform the brake test for longer than four seconds.

Precondition
- ✓ The machine is parked on a flat and leveled surface.

1. Start the machine.
2. Press the brake pedal and hold it down.
3. Release the parking brake.
4. Select drive.
5. Gradually increase motor rpm to maximum.
6. Check the machine movement.

   If the machine moves, then the brakes must be repaired or replaced before operating the machine.

**NOTICE**

**Property Damage**

Risk of overheating the transmission system.

▶ Do not perform the brake test for longer than four seconds.

Precondition
- ✓ The machine is parked on a flat and level surface.
- ✓ The diesel engine is turned on.

1. Press the brake pedal and hold it down.
2. Release the parking brake.
3. Engage first gear.
4. Gradually increase engine rpm to maximum.
5. Check the machine movement.

Step result ➔ If the machine moves, then the brakes must be repaired or replaced before operating the machine.

## 7.22 Check Rock Drill

- ○ Inspect and clean the rock drill.

| See Reference Documentation |
| --- |
| Rock drill instruction manual |

## 7.23 Clean the Water Strainer on Swellex Pump

- ○ Clean the water strainer on Swellex pump H1 and HC1.

## 7.24 Check Swellex Pump for Leaks

The swellex pump is **optional** equipment.

- ○ Check for leaks on the overflow hole on the underside of the pump.

Step result ➔ If the pump leaks more than ten drops per minute, the seals must be replaced with new ones.

## 7.25 Check Service Platform

- ○ Check tightening torque for all bolted joints and adjust if necessary.

  All bolted joints are tightened to the torque specified by Epiroc Standard unless otherwise stated.
- ○ Check for leaks on the hydraulic systems.
- ○ Check for damage on piston rods and cylinders on the hydraulic systems.

## 7.26 Check Bolted Swing Stop

- ○ Check that all bolted swing stops are in place. Examples of places where they can be is the boom and articulation area.

## 7.27 Check Articulation Lock

- Check for damages.
- Check that all locking pins are in place.

## 7.28 Check Lamps on Driving Panel

Precondition ✓ The ignition switch is ON.

- Check that the lamps on the driving panel are working by pressing the lamp test button.

# 8 Technical Data

## 8.1 Boomer L1 D

> ***NOTE:*** *A brief summary of data follows. For more detailed information, see the maintenance instructions.*
>
> ***NOTE:*** **Length refers to the rig in tramming position, i.e. feeder and boom fully contracted. Varies depending on type of boom and feeder, see also the dimension drawing for the rig.*

| Description | Data |
|---|---|
| Length* | 12 - 17 m |
| Width | 2.25 m |
| Height, rig with cabin (depending on carrier type and height option) | 2.9 - 3.38 m |
| Height, rig with canopy, can be lowered 695 mm (depending on carrier type and height option) | 2.96 - 3.34 m |
| Weight | See data plate |
| Installed electric power capacity | See data plate |
| Voltage | See data plate |
| Frequency | See data plate |
| Permitted inclination angles | See safety, Rig stability |
| Stability | complies with CEN |
| Ambient temperature | 0 to +40 °C |

## 8.2 Boomer L2 D

> ***NOTE:*** *A brief summary of data follows. For more detailed information, see the maintenance instructions.*
>
> ***NOTE:*** *Length refers to the rig in tramming position, i.e. feeder and boom fully contracted. Varies depending on type of boom and feeder, see also the dimension drawing for the rig.*

| Description | Data |
|---|---|
| Length, tramming position | 14.3 - 16.4 m |
| Width | 2.6 m |

| Description | Data |
|---|---|
| Height, rig with cabin | 2.99 - 3.38 m |
| Height, rig with canopy, can be lowered 695 mm | 3.01 - 3.34 m |
| Weight | See data plate |
| Installed electric power capacity | See data plate |
| Voltage | See data plate |
| Frequency | See data plate |
| Permitted inclination angles | See Safety, Rig stability |
| Stability | Complies with CEN |
| Ambient temperature | 0 to +40 °C |

## 8.3 Capacities

> ***NOTE:*** *Volumes may vary depending on e.g. hose lengths. When refilling a component you must always check that the correct level is obtained.*

| Fluid reservoir | Volume (litres) |
|---|---|
| Hydraulic oil reservoir | 250 |
| Lubrication oil for rock drill | 5 |
| Engine oil, diesel engine, Deutz TCD 4.1 | 11.5 |
| Engine oil, diesel engine, Deutz TCD 6.1 | 17.5 |
| Engine oil, diesel engine, Deutz 2013 L04 | 11.0 |
| Hydraulic transmission, Clark 24 000 | 27.0 |
| Hydraulic transmission, Clark 32 000 | 35.5 |
| Hub gear on wheel axle, Dana 123 | 2.1 |
| Central gear on wheel axle, Dana 123 | 13.5 |
| Hub gear on wheel axle, Dana 114 | 4.5 |
| Central gear on wheel axle, Dana 114 | 21 |
| Hub gear on wheel axle, Dana 113 | 2.6 |
| Central gear on wheel axle, Dana 113 | 17 |
| Compressor, GAR 5 | 4.8 |
| Compressor, GAR 30 | 9.0 |
| Cable reeling unit gear | 1.7 |
| Hose reeling unit gear | 2.2 |

| Fluid reservoir | Volume (litres) |
|---|---|
| Diesel fuel tank, 4-cyl engine | 110 |
| Diesel fuel tank, 6-cyl engine | 175 |
| Coolant for diesel engine Deutz TCD 4.1 | 27.0 |
| Coolant for diesel engine Deutz TCD 6.1 | 35.3 |
| Coolant for diesel engine, Deutz 2013 L04 | 29.0 |
| Coolant for diesel engine, Deutz 2012 L06 | 35.0 |
| Air conditioning unit, cooling compressor oil | 0.15 |

## 8.4 Diesel Engine

### Deutz TCD 2013 L06

| Description | Value |
|---|---|
| Rated power at 2,300 rpm | 173 KW (235 hp) |
| Torque at 1,500 rpm | 907 Nm (668.96 ft-lb) |

### Deutz TCD 2013 L04

| Description | Data |
|---|---|
| Rated power at 2300 rpm | 120 KW* |
| Norm max torque at 1500 rpm | 618 Nm* |
| Swept volume | 4.76 $dm^3$ |
| Idling speed | 800±30 rpm |
| Cooling | Water-cooled |
| Alternator | 80 A |
| | 24 V |
| Starter | 4 KW |
| | 24 V |
| Weight | 450 kg |
| Weight including cooling core | 561 kg |

### Deutz TCD 4.1

| Description | Data |
|---|---|
| Rated power at 2400 rpm | 115 KW* |
| Norm max torque at 1600 rpm | 610 Nm* |

| Description | Data |
|---|---|
| Swept volume | 4.0 dm $^3$ |
| Lowest idle rpm | 600 rpm |
| Cooling | Water-cooled |
| Alternator | 100 A |
| | 24 V |
| Starter | 4 KW |
| | 24 V |
| Weight | 400 kg |

### Deutz TCD 6.1

| Description | Data |
|---|---|
| Rated power at 2300 rpm | 180 KW* |
| Norm max torque at 1450 rpm | 1000 Nm* |
| Swept volume | 6.1 dm $^3$ |
| Lowest idle rpm | 600 rpm |
| Cooling | Water-cooled |
| Alternator | 100/140 A |
| | 24 V |
| Starter | 4 KW |
| | 24 V |
| Weight | 520 kg |

## 8.5 Feeder 6000 Series

> ***NOTE:*** *The total length of the feed depends on the type of drill and the length of drill steel for which it is intended. By adding the following length to the length of the drill steel (XX) (XX/XX), it is possible to obtain the overall length of the feed.*

| Description | Length |
|---|---|
| BMH 63XX | 1580mm |
| BMH 68XX | 1580mm |
| BMH 69XX | 1680mm |
| BMHT 63XX/XX | 1590mm |

| Description | Length |
|---|---|
| BMHT 68XX/XX | 1590mm |
| BMHT 69XX/XX | 1690mm |

> ! ***NOTE:*** *Only the weight of the shortest and longest standard feed is specified for each type of feed.*

| Description | Weight |
|---|---|
| BMH 6312 - BMH 6321 | 425 - 540 kg |
| BMH 6812 - BMH 6821 | 430 - 570 kg |
| BMH 6912 - BMH 6921 | 480 - 640 kg |
| BMHT 6314/08 - BMHT 6318/10 | 635 - 680 kg |
| BMHT 6814/08 - BMHT 6818/10 | 640 - 690 kg |
| BMHT 6914/08 - BMHT 6918/10 | 690 - 745 kg |

## 8.6 BUT 35 SL

> ! ***NOTE:*** *All weights are in respect of boom, excluding feeder and rock drill.*

### Weight

| Description | Data |
|---|---|
| Complete boom, including hydraulic hoses | 3045 kg (6713.07 lb) |
| Rear boom section | 1700 kg (3747.85 lb) |
| Intermediate boom section | 395 kg (870.82 lb) |
| Front boom section | 640 kg (1410.96 lb) |

### Length

| Desription | Data |
|---|---|
| Telescope contracted | 6232 mm (245 in.) |
| Telescope extended | 8032 mm (316 in.) |

## 8.7 BUT 35 M

> ! ***NOTE:*** *All weights are in respect of boom, excluding feeder and rock drill.*

### Weight

| Description | Data |
|---|---|
| Complete boom, including hydraulic hoses | 3060 kg ( 6,746 lb) |
| Rear boom section (1) | 1700 kg (3,747 lb) |
| Intermediate boom section (2) | 410 kg (903 lb) |
| Front boom section (3) | 640 kg (1,410 lb) |

### Length

| Description | Data |
|---|---|
| Telescope contracted | 7252 mm (285 in.) |
| Telescope extended | 9052 mm (356 in.) |

## 8.8 BUT 35 L

! ***NOTE:*** *All weights are in respect of boom, excluding feeder and rock drill.*

### Weight

| Description | Data |
|---|---|
| Complete boom, including hydraulic hoses | 3200 kg (7,054 lb) |
| Rear boom section (1) | 1840 kg (4,056 lb) |
| Intermediate boom section (2) | 410 kg (903 lb) |
| Front boom section (3) | 640 kg (1,410 lb) |

### Length

| Description | Data |
|---|---|
| Telescope contracted | 7952 mm ( 313 in.) |
| Telescope extended | 9752 mm ( 383 in.) |

## 8.9 Service Platform P2, P3

### Maximum Load

| | |
|---|---|
| for platform with canopy | 400 kg |
| for platform with canopy and cage swing | 350 kg |

### Swing Angle and Lifting Area

| | |
|---|---|
| for platform with canopy | 45º |
| for platform with canopy and cage swing | Up 60º |
| | Down 35º |

### Work Radius P 2

| Model | Largest radius | Smallest radius |
|---|---|---|
| P2-MD-10.3 | 10300 | 6355 |

### Weight for Platform Including Canopy - P 2

| Model | Weight |
|---|---|
| P2-MD-10.3 | 2028 kg |

### Miscellaneous

| | |
|---|---|
| System pressure | 200 bar |

## 8.10 Swellex H1

**Water**

| | |
|---|---|
| Water pressure, in | 2-20 bar (29.0 to 290.07 psi) |
| Maximum water pressure, out | 320 bar (4641.21 psi) |
| Maximum water consumption | 17 litres/minute (4.49 g/min) |
| Maximum water temperature | 70 °C (158 °F) |

**Hydraulic**

| | |
|---|---|
| Minimum hydraulic pressure | 150 bar (2175.57 psi) |
| Maximum hydraulic pressure | 250 bar (3625.94 psi) |
| Flow | 40 litres/minute (10.56 g/min) |

**Weight**

| | |
|---|---|
| Pump unit | 36 kg (79.36 lb) |

**Size**

| | |
|---|---|
| Pump unit (length × width × height) | 550 mm × 280 mm × 270 mm (21.65 in. × 11.02 in. × 10.62 in.) |

## 8.11 Incoming Water Line Hoses

| Recommended Hose Sizes | mm | in. |
|---|---|---|
| Hose dimension, 2-boom machine | 38 | 1.5 |

## 8.12 Pumps

**Main Pump (Positioning and Percussion Unit)**

| | |
|---|---|
| Type | Axial plunger pump |
| Model | A10V |
| Displacement | 71 cm $^3$/rev |
| Displacement (rigs with the function for selecting drilling/bolting) | 100 cm $^3$/rev |

**Rotation pump**

| | |
|---|---|
| Type | Gear pump |
| Model | P330 |
| Displacement | 48 cm $^3$/turn |

**Rotation and compressor pump**

| | |
|---|---|
| Type | Gear pump |
| Model | PGP640/620 |
| Displacement, rotation | 50 cm $^3$/turn |
| Displacement, compressor | 26 cm $^3$/turn |

**Pump for positioning/steering and brake**

| | |
|---|---|
| Type | Dual gear pump |
| Model, positioning/steering and brake | P315 |
| Displacement, positioning | 20 cm $^3$/turn |
| Displacement, steering and brake | 40.6 cm $^3$/turn |

**Hydraulic Tank**

| | |
|---|---|
| Volume, min | 200 litres |
| Volume, max | 250 litres |

## 8.13 Brake Systems

| Service Brake | |
|---|---|
| System | Dual independent circuits. Hydraulic disk brakes in oil bath in both axels. |
| Hydraulic pressure | 80–85 bar (1160.3 to 1232.82 psi) |

| Parking and Emergency Brake | |
|---|---|
| System | SAHR (Spring Applied Hydraulic Released) |
| Maximum hydraulic pressure | 35 bar (507.63 psi) |

| Parking and Emergency Brake | |
|---|---|
| System | MICO |
| Maximum hydraulic pressure | 75 bar |

| Parking and Emergency Brake | |
|---|---|
| System | SAHR (Spring Applied Hydraulic Released) |
| Maximum hydraulic pressure | 25 bar (362.59 psi) |

## 8.14 Power Train

### Wheels

| Description | Data |
|---|---|
| Tyres L1, L2 (boom and engine section) | 14.00 x 24 |
| Rims L1, L2 (boom and engine section) | 10.00 x 24 |
| Tyre pressure | 10 bar |
| Tightening torque wheel nuts | 550 Nm |

### Steering/Brakes

| Description | Data |
|---|---|
| Control valve | Danfoss OSPB 800 LS |
| Gear pump: | |
| Steering cylinder | VOAK 125/63-400 |
| Steering wheel turns, lock-to-lock | 6.0 turns from full left lock to full right lock |

### Front axle

| Description | Data |
|---|---|
| Shaft type | DANA 114/51 |
| Max. load | 28000 kg |
| Weight | 950 kg |

### Rear axle

| Description | Data |
|---|---|
| Shaft type | DANA 114/51 |
| Max. load | 7000 kg |
| Weight | 950 kg |

## 8.15 Transmission

| Clark 24 000 long drop | kg | lb |
|---|---|---|
| Weight | 333 | 734.13 |

| Clark 32 000 long drop | kg | lb |
|---|---|---|
| Weight | 490 | 1,080.3 |

| Clark 32 000 | kg | lb |
|---|---|---|
| Weight | 502 | 1,106.7 |

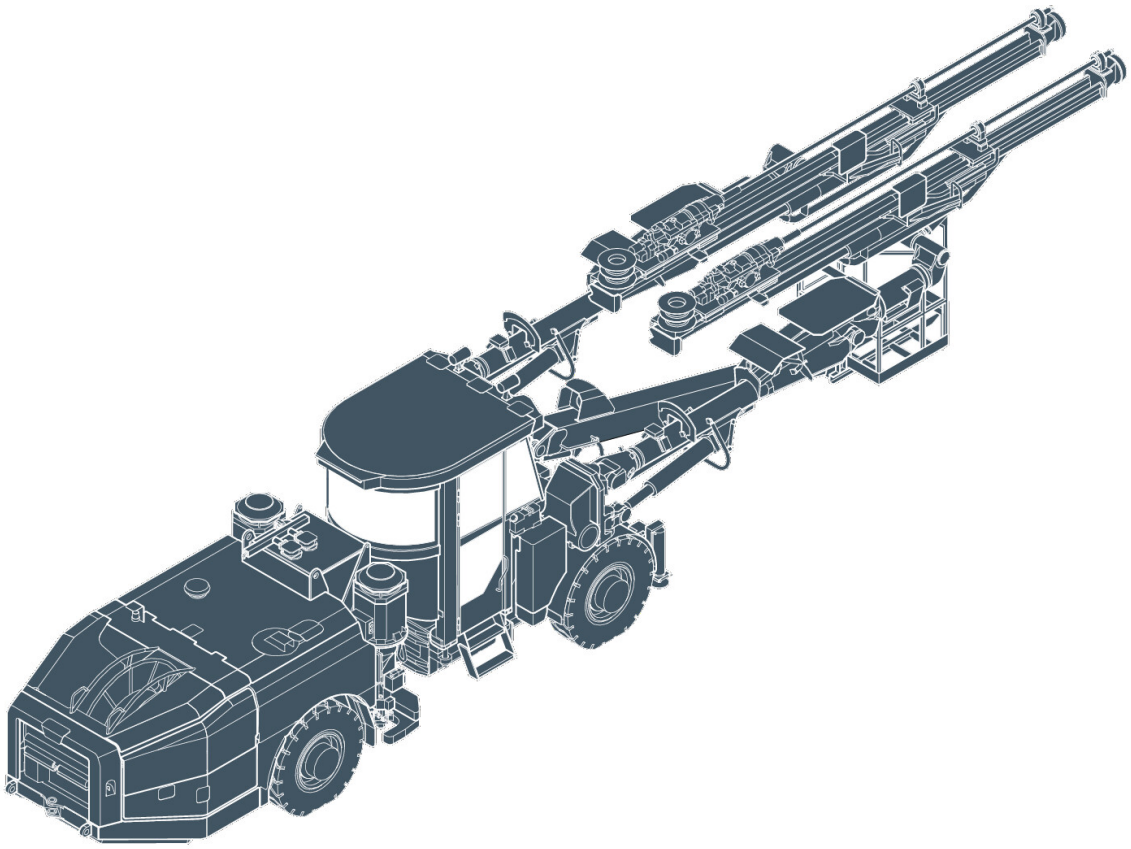
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Maintenance

# Boomer L1D, L2D



**Original Instructions**
2020-02-14 | No: TIS0000977.002 en-US

Epiroc

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# 1 Introduction

## 1.1 Safety First

Always read the information in the Safety manual before starting to use the machine or before starting maintenance work.

## 1.2 Purpose of This Publication

The maintenance manual gives instructions to lubrication, inspection procedures, and measures to take, following a specific number of operating hours.

Use this section to get the most out of the equipment and always follow the instructions that are given.

## 1.3 Target Group

The information in this publication is intended for everyone involved in the application, operation, and maintenance of the machine and related equipment. All readers are expected to possess basic competence regarding mining methods, construction methods, and the machines used for that kind of operation.

## 1.4 Product Warranty

The product warranty relies on correct use, maintenance, and repair of the machine and its components at all times.

- Use only Epiroc original parts. Any damage or operational interruptions caused by using spare parts of other manufacturers than Epiroc will not be covered by warranty.
- Epiroc is not liable for any damage caused by unauthorized modification to the machine and its equipment.
- Epiroc is not liable for damage caused by inappropriate use.
- Overloading the machine can result in damage to the structure which is not noticed during normal usage. Such damage is not covered by the warranty.
- Damage that occurs as a result of inadequate maintenance, substandard repairs, or damage to equipment that is attributable to older unrepaired damage, is not covered by the warranty.
- Read the Epiroc warranty policy.

## 1.5 Feedback and Contact Information

Epiroc works actively to develop and continuously improve its products and associated documentation. Provide your feedback on products and documentation by contacting your local supplier at https://www.epiroc.com, under "Contact us."

# 2 About Maintenance Management

## 2.1 Maintenance Management and Hour Meters

Maintenance management is organized in scheduled intervals.

Scheduled intervals supplement each other. A longer interval comprises maintenance tasks supplementary to tasks from a shorter interval. Maintenance management must be done regularly at the shortest interval of the unit or function (whichever comes first during operation of the machine).

Operational maintenance is planned based on the following hour meters:

- Hour meter for the power pack and power pack equipment
- Hour meter for the hydraulic breaker

Calendar based maintenance applies to all:

- Rubber details
- Lubricants that risk breaking up during standstill
- Pressure vessels
- Corrosive substances and where age, substance regression and environmental exposure are decisive to maintenance factors.
- Hour meters for the different pumps
- Hour meters for the rock drill operation system
- Hour meter for the engine
- Hour meter for the electric motor
- Time-based maintenance is vital for:
  - All rubber components
  - Lubricants that are at risk of breaking during standstills
  - Pressure vessel corrosion and wear
  - Substance regression
  - Environmental exposure
- Hour meter for the electrical traction motor
- Time-based maintenance is vital for:
  - All rubber components
  - Lubricants that are at risk of breaking during standstills
  - Pressure vessel corrosion and wear
  - Substance regression
  - Environmental exposure
- Hour meter for the engine
- Time-based maintenance is vital for:
  - All rubber components
  - Lubricants that are at risk of breaking during standstills
  - Pressure vessel corrosion and wear
  - Substance regression
  - Environmental exposure
- Hour meter for the electrical motor.

- Calendar based maintenance applies to all rubber components, lubricants that are at risk of breaking up during stand stills, pressure vessels corrosion and such where age, substance regression and environmental exposure are vital to maintenance factors.

! ***NOTE:*** *Local conditions can affect the scheduled intervals.*

## 2.2 Maintenance Records

- Correct record keeping enables maintenance personnel to identify the correct maintenance records and to evaluate problems and high-cost areas.
- All maintenance procedures must be checked off as each inspection or procedure is completed.
- Quantities of replenished lubricants and fluids, and pressure and flow readings, must be recorded.
- Any faults or deviations must be recorded irrespective of whether they have been rectified or are waiting for rectification.

## 2.3 Oil Analysis

Epiroc recommends the establishment of an oil analysis program. A program with regular oil analysis can discover problems and the approach of maximum wear limits and the system performance checks.

The objective of a preventative maintenance program is diagnosis and repair before failure. Good sampling techniques and independent laboratory analysis are considered primary elements of a good program.

! ***NOTE:*** *Oil analysis must not be used to determine if oil can be reused after the recommended service life. Replace oil within the recommended service intervals even if the oil analysis shows that the oil remains within the set requirements. An extensive analysis program can help to identify the optimum service intervals.*

# 3 Maintenance Schedule

**⚠ WARNING**

**Failure to Observe Safety Instructions**

Can cause severe injury or death

- ▶ Read the Safety Manual before operating, doing maintenance, service, or repairs on the machine.
- ▶ Know where the safety signs are on the equipment and understand their meanings.
- ▶ Obey all safety signs and warning statements.

The maintenance schedule shows those items requiring regular service and the interval at which they are done. A regular service program is geared to the items listed under each interval. These intervals are based on average operating conditions. In the event of severe, dusty, or wet operating conditions, more frequent maintenance than specified is necessary. Before each consecutive interval is done, all the maintenance requirements from the previous interval must also be done.

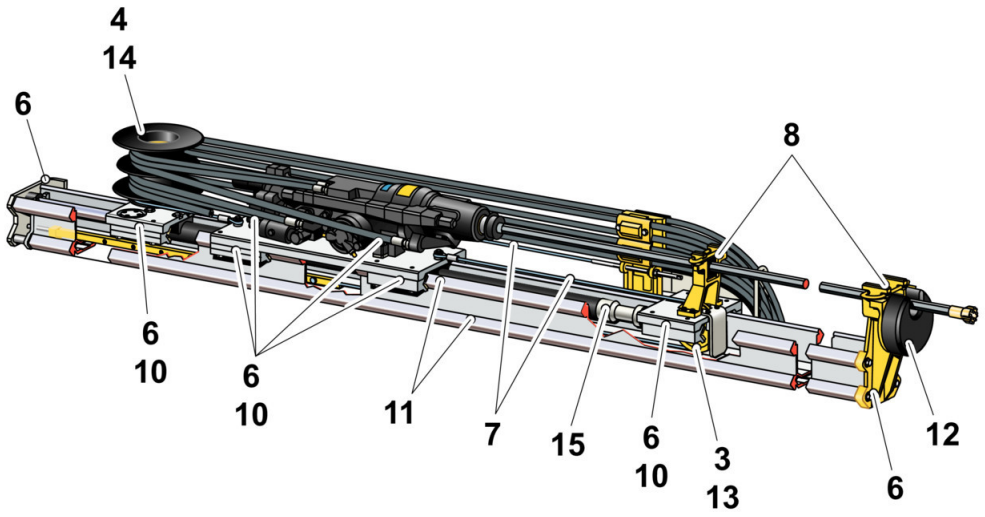
! ***NOTE:*** *If the machine is operating under severe conditions (such as dusty air), the scheduled maintenance must be reduced.*

! ***NOTE:*** *Refer to the manufacturer's operation and maintenance manual for the required maintenance schedules and procedures for the specific diesel engine.*

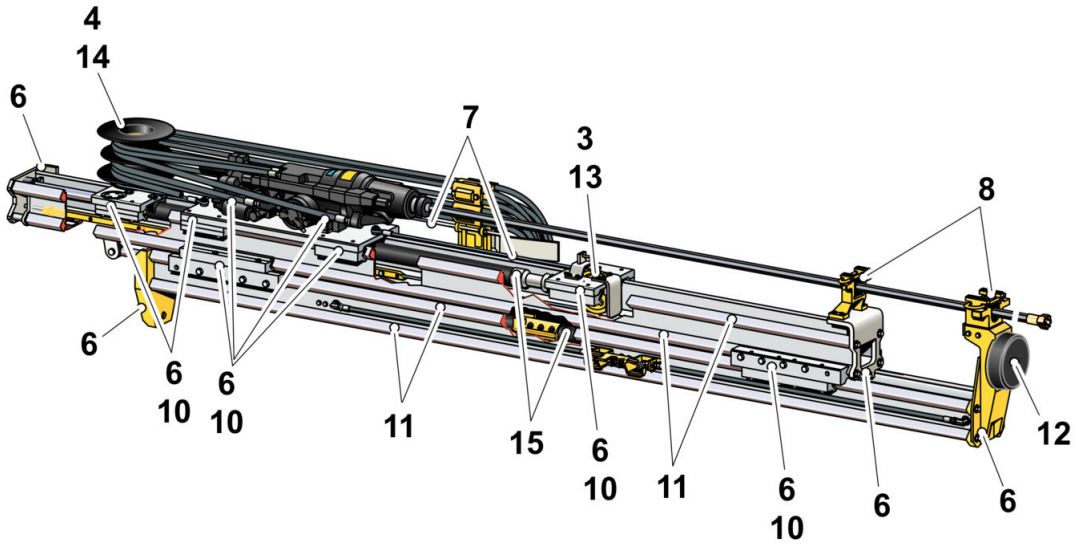
! ***NOTE:*** *Refer to the manufacturer's operation and maintenance manual for the required maintenance schedules and procedures for the specific electric motor.*

# 3.1 Machine Check points

## 3.1.1 Feeder BMH 6000

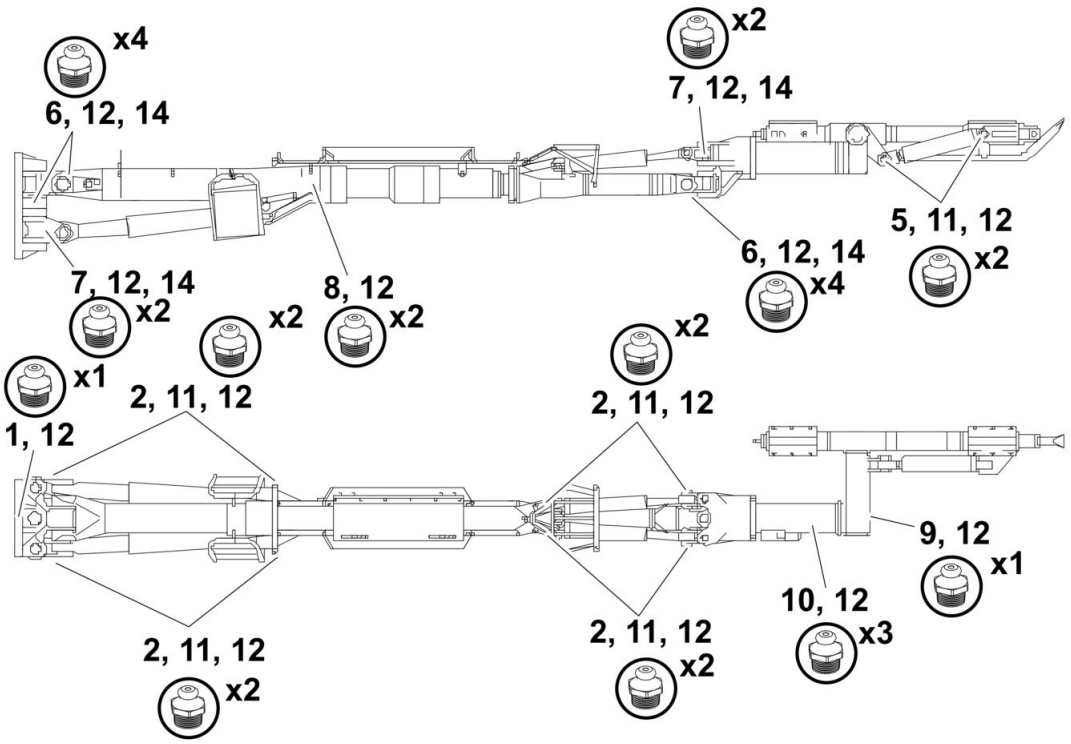



*Check points, feeder BMH 6000*



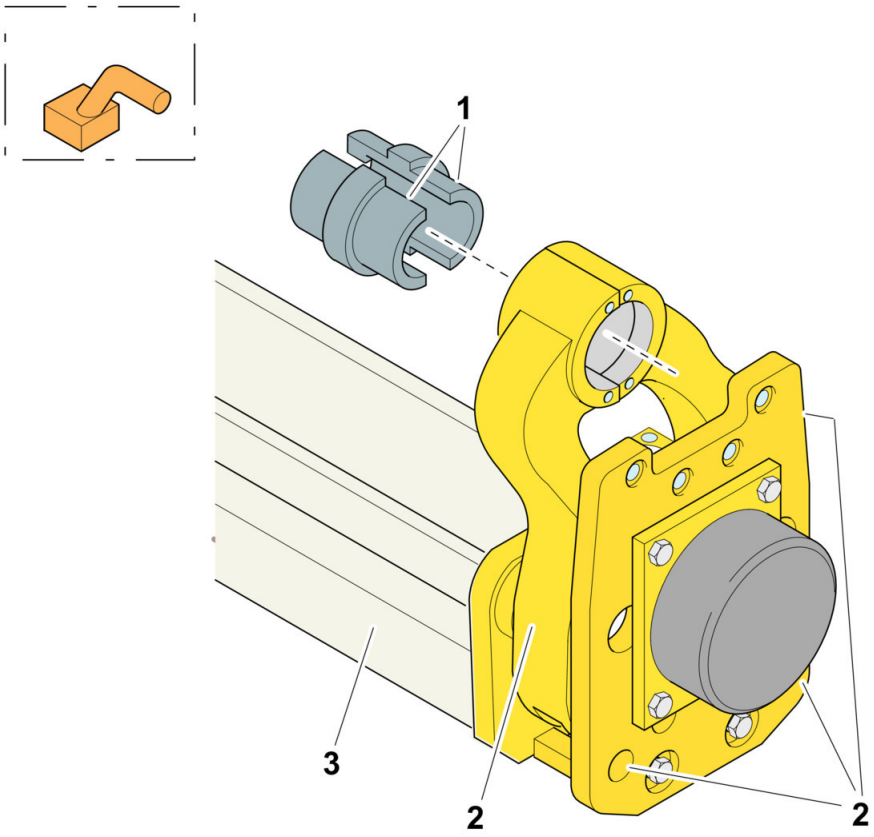

*Check points, feeder BMHT 6000*

### 3.1.2 Boom BUT 35



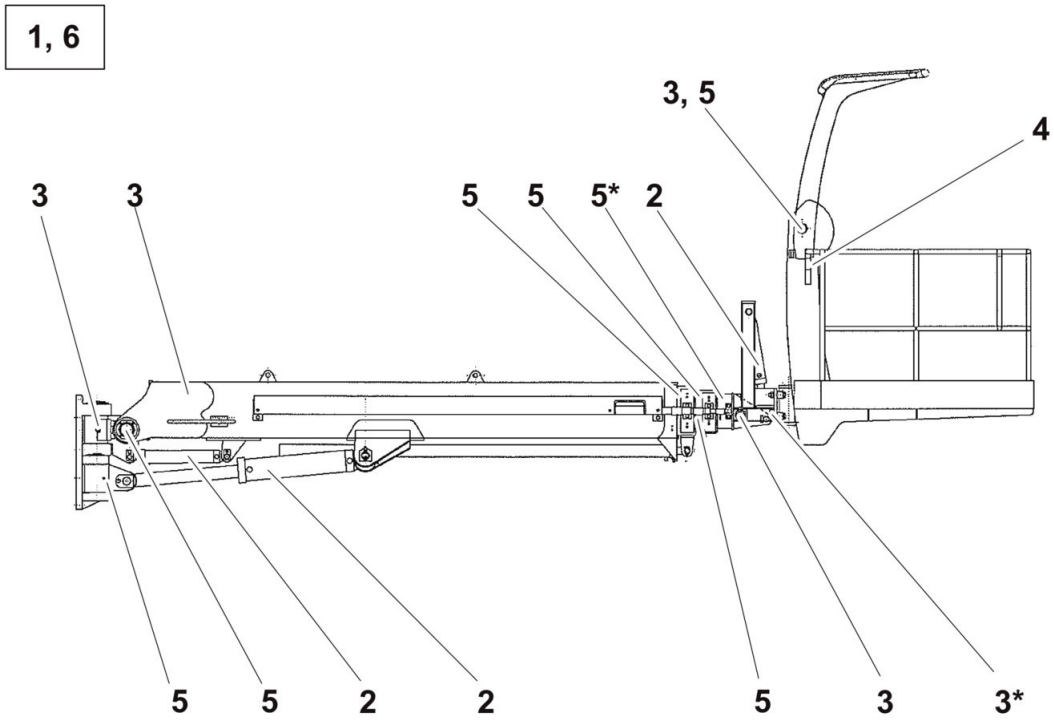

*Check points, boom BUT 35 G*

### 3.1.3 BSH 110 Drill Steel Support




*Checklist, drill steel support BSH 110*

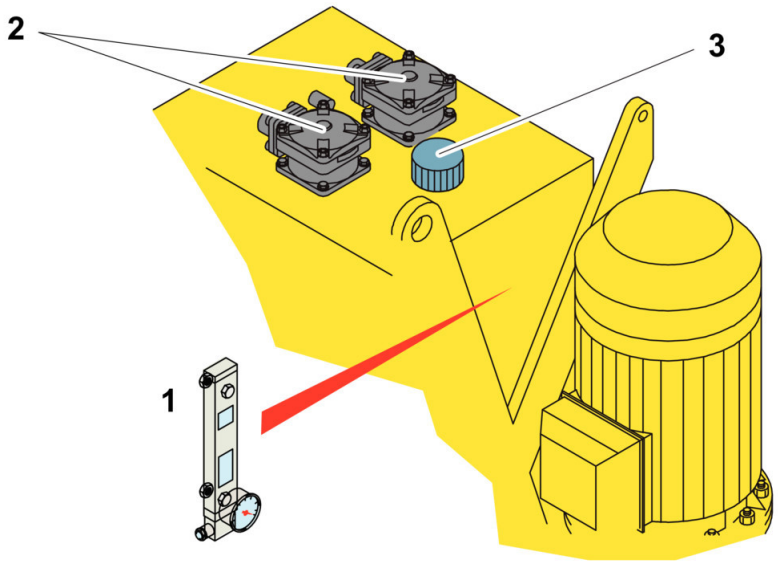
### 3.1.4 Service Platform P2, P3



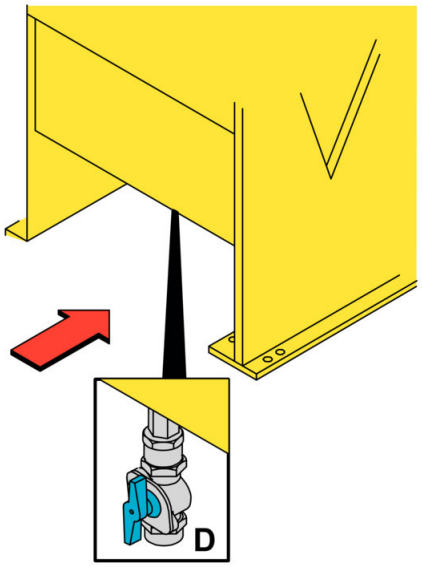

*Check points, service platform P2, P3*

| | |
|---|---|
| * | Only applies to service platform P3 |

### 3.1.5 Hydraulic Systems

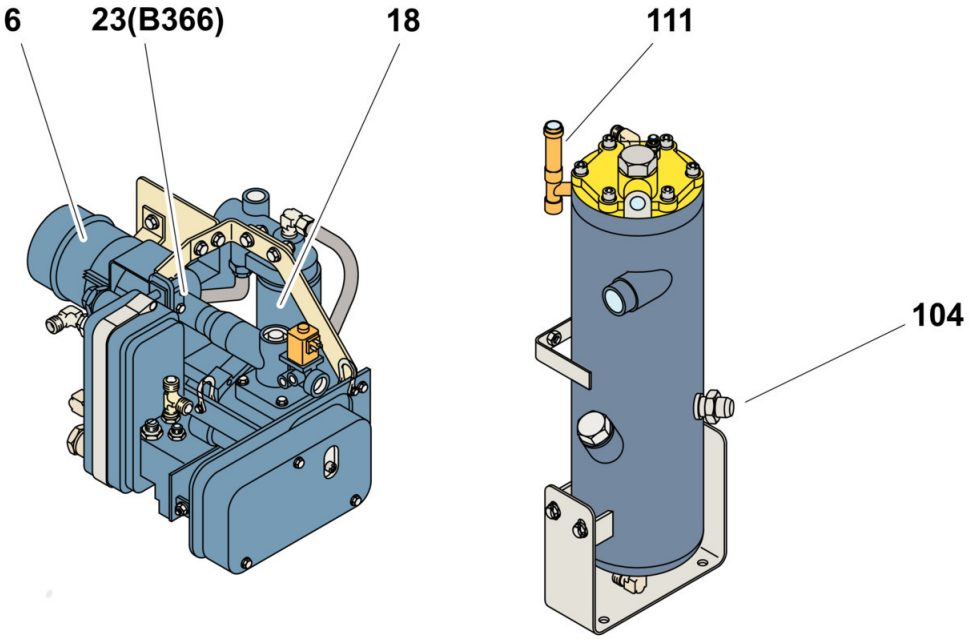



*Check points, hydraulic system*



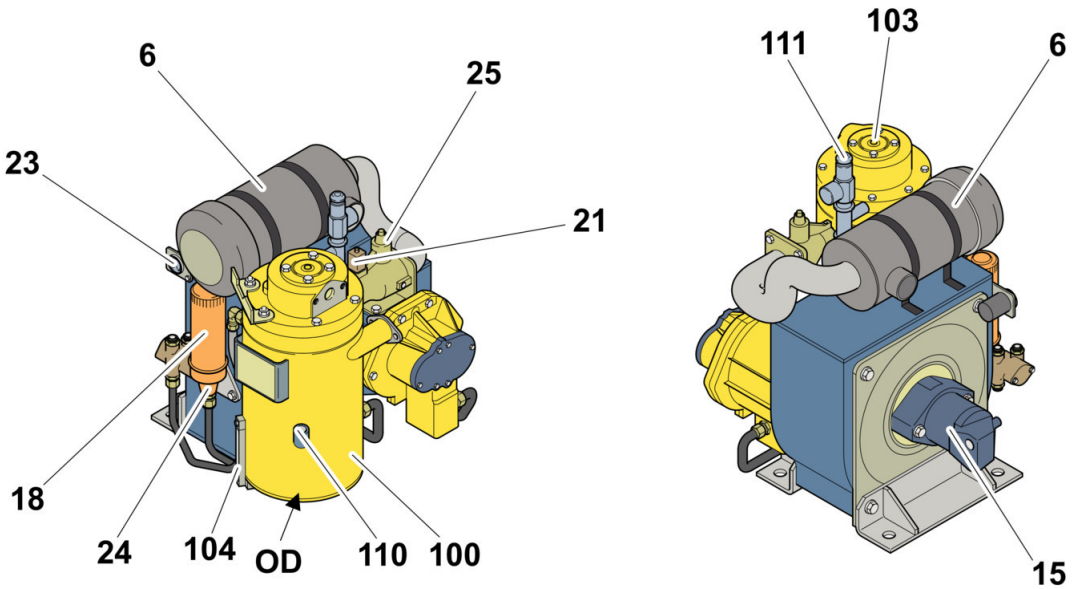

*Check points, hydraulic system*

### 3.1.6 Compressor GAR 5



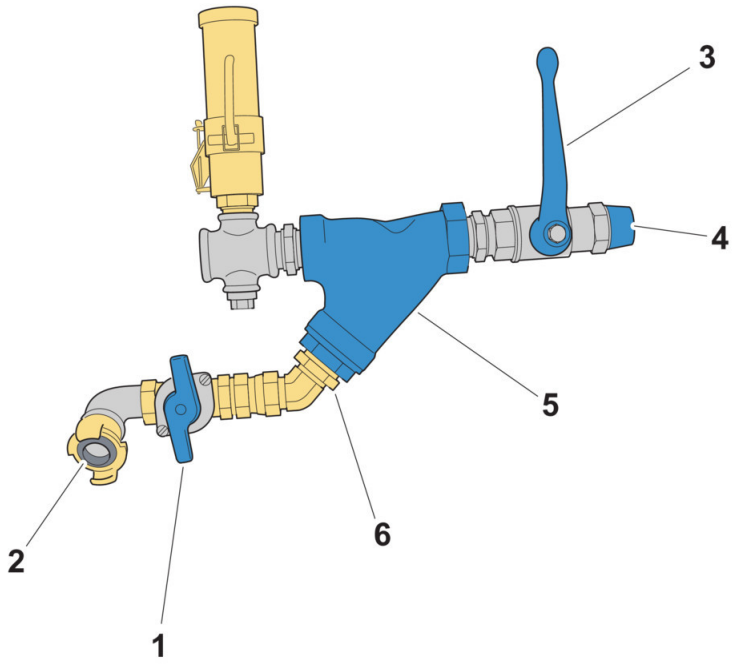

*Check points, compressor GAR 5*

### 3.1.7 Compressor GAR 30



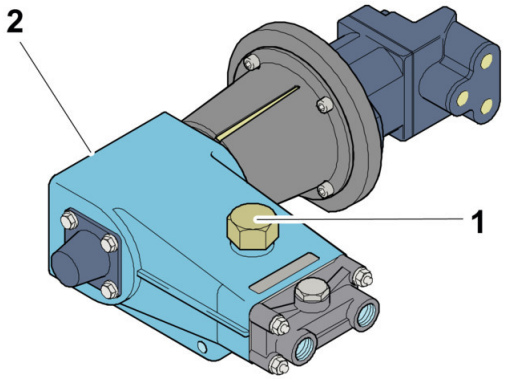

*Check points, compressor GAR 30*

### 3.1.8 Water System




*Check points, water system*

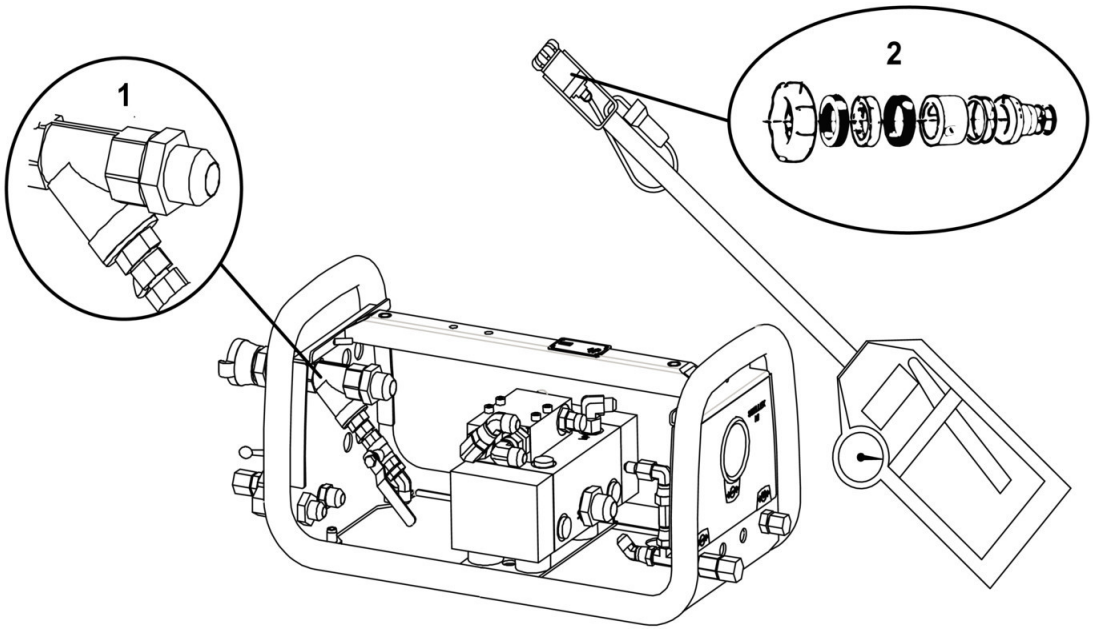
### 3.1.9 Cat Pump




*Check points, CAT pump*

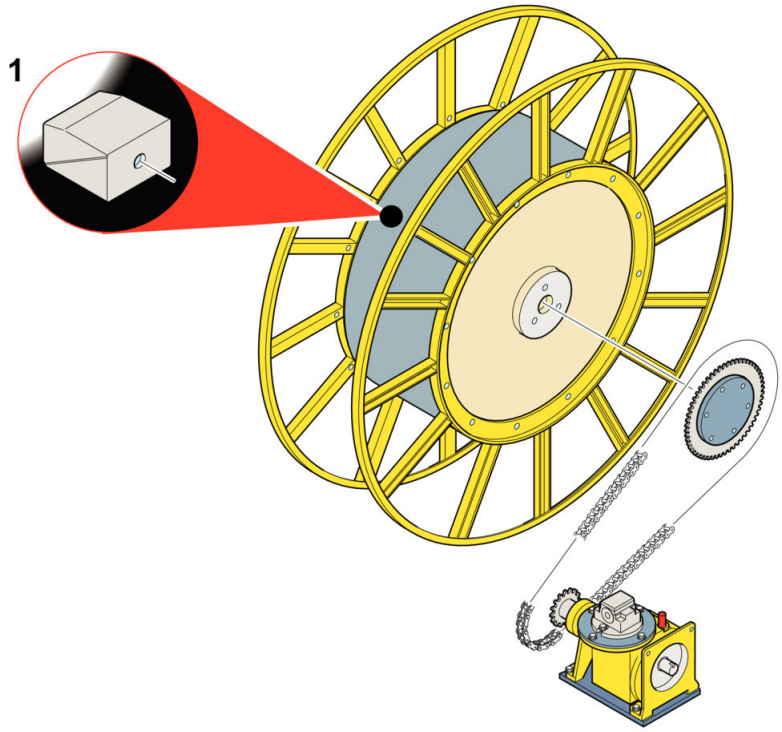
| | | | |
|---|---|---|---|
| 1 | Oil filling orifice | 2 | Sight gauge |

### 3.1.10 Swellex Pump H1 and HC1



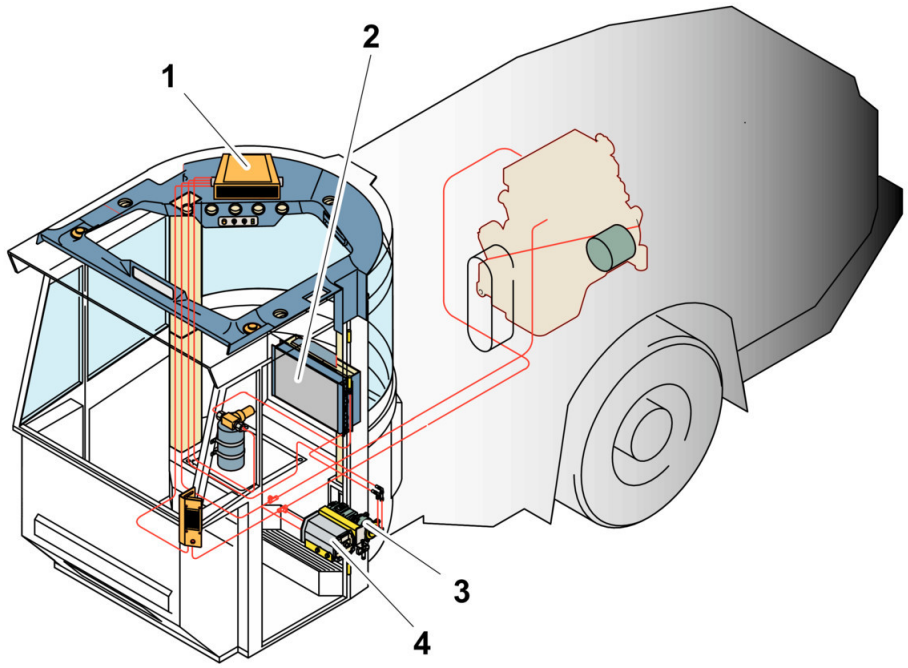

*Check points, Swellex pump*

### 3.1.11 Cable Reeling Unit Collector




*Check points, cable reeling unit collector*

### 3.1.12 Climate Unit




*Check points, climate unit*

## 3.2 Maintenance Tables

### 3.2.1 Maintenance Every 50th Percussion Hours or Weekly

**Feeder BMH**

| Check point | Description | Action | Reference |
|---|---|---|---|
| - | Complete feeder | Clean | |
| 3 | Pull rope pulleys | Lubricate | |
| 4 | Water-hose drum | Lubricate | |
| 6 | Bolted joints | Check tightness | |
| 7 | Pull and return rope | Check wear and tension | |
| 8 | Drill steel bushings | Check wear | |
| 10 | Slide pieces | Check play and wear | |
| 11 | Slide rails | Check wear and other damage | |
| 12 | Dowel | Check wear | |

## Boom

| Check point | Description | Action | Reference |
|---|---|---|---|
| 1 | Boom attachment | Lubricate | |
| 2 | Front and rear cylinders | Lubricate | |
| 5 | Feed lookout cylinder | Lubricate | |
| 6 | Boom link | Lubricate | |
| 7 | Cylinder link | Lubricate | |
| 8 | Telescope bearing | Lubricate<br>Operate telescope while lubricating | |
| 9 | Attachment shaft | Lubricate | |
| 10 | Rotation unit | Lubricate | |
| 11 | Hoses, cylinders, valves, valve blocks | Inspect for damage and leaks | |
| 12 | Grease nipples | Inspect for damage | |
| - | Hydraulic pressure | Check pressure settings | |
| - | Threaded joints | Check tightness | See maintenance instructions, Boom |

## Drill-Steel support BSH

| Description | Action | Reference |
|---|---|---|
| Drill-steel support | Check and replace worn or damaged parts | |

## Service platform P2, P3

| Check point | Description | Action | Reference |
|---|---|---|---|
| - | Telescope tube | Extend the telescope tubes fully and apply grease. Then operate the tubes in and out to distribute the grease evenly | |
| - | Bolted joints, all | Check tightness and rectify as necessary | |
| 1 | Hydraulic systems | Check the oil level in the carrier hydraulic tank with the service platform in transport position | |

| Check point | Description | Action | Reference |
|---|---|---|---|
| 3 | Structural components | Check for cracks and other damage | |
| 4 | Control levers | Check that levers are not sticking or damaged | |
| 5 | Hose retainer | Lubricate | |
| 5 | Boom attachment | Lubricate | |
| 5 | Boom links | Lubricate. The rear boom links must be lubricated in two stages in order to ensure the whole boom link has been thoroughly lubricated<br>• The service platform must be raised from the ground for the first stage. Fill the nipples with grease<br>• Then lower the service platform carefully to the ground to relieve the boom link. Fill the same nipples again with grease | See maintenance instructions Service platform, Rear boom link bushings |
| 5 | Cylinder bearings | Lubricate | |
| 5 | Cage | Lubricate | |

## Hydraulic systems

| Check point | Description | Action | Reference |
|---|---|---|---|
| 3 | Breather filter | Check for clogging, replace if necessary | |
| D | Hydraulic oil reservoir | Drain condensation | |

## Compressor GAR 5 and GAR 30

| Check point | Description | Action | Reference |
|---|---|---|---|
| 6 | Air filter | Check the air filter condition and replace if necessary | See maintenance instruction, Compressor |

### Cable reeling unit collector, option

| Check point | Description | Action | Reference |
|---|---|---|---|
| 1 | Cable reeling unit collector | Clean | |
| 1 | Cable reeling unit collector | Check and retighten joints | See maintenance instructions Reeling units. |

### Cat pump

| Check point | Description | Action | Reference |
|---|---|---|---|
| 2 | Oil level | Top up as necessary | |
| - | Water leak | | |
| - | Oil leak | | |

### Swellex

| Check point | Description | Action | Reference |
|---|---|---|---|
| 2 | Chuck seals | To be replaced if necessary | |

### Automatic lubrication

| Description | Action | Reference |
|---|---|---|
| Lubrication function | Check that grease comes out at all locations | |

### Service platform P2, P3

| Description | Action | Reference |
|---|---|---|
| Bolted joints, all | Check tightness and rectify as necessary | |

### Air conditioning unit

| Check point | Description | Action | Reference |
|---|---|---|---|
| - | Cooling element | Check the drain for condensation. The drain hose is under the operator's cabin on the right hand side of the rig. | |
| - | Hoses and hose coupling | Inspect for damage and wear | |

| Check point | Description | Action | Reference |
|---|---|---|---|
| - | View glass | Check that there are no bubbles other than when switching the compressor ON and OFF. The side glass is on the operator's cabin on the right hand side of the rig. | |
| 2 | Condenser element | Make sure, the condenser element airways are free from dirt | |
| 1 | Climate unit | Clean or change fresh air filter | |
| 3 | Compressor attachment | Inspect for damage and wear | |
| 4 | Heater unit | Check the connecting line for damage and wear<br>Make sure, the ground connection is intact | |

### Swivelling seat

| Description | Action | Reference |
|---|---|---|
| Seat swing arm | Check seat swing arm<br>This check should be performed every percussion hours or every week. | See maintenance instructions, Swivelling seat |

### Membrane dryer SDR6

| Description | Action | Reference |
|---|---|---|
| Particle filter | Check the indicators for the particle filters | See maintenance instructions, Membrane dryer SDR6 |

## 3.2.2 Maintenance Every 250th Percussion Hours

### Feeder

| Check point | Description | Action | Reference |
|---|---|---|---|
| - | Limit switches | Check function and for leaks | |
| 13 | Pull rope pulley bearings | Check wear | |

| Check point | Description | Action | Reference |
|---|---|---|---|
| 14 | Bearing hose drum | Check wear | |
| 15 | Hydraulic cylinder | Check function and for leaks | |
| - | Rock drill | Inspect the rock drill's retaining bolts and replace them if necessary | See maintenance instructions, Feeder |

### Boom BUT 35, BUT 36

| Check point | Description | Action | Reference |
|---|---|---|---|
| 14 | Bearing points | Inspect for damage and leaks | |

### Service platform P2, P3

| Check point | Description | Action | Reference |
|---|---|---|---|
| 6 | Whole service platform | Inspect the service platform thoroughly | |

### Hydraulic Systems

| Check point | Description | Action | Reference |
|---|---|---|---|
| 3 | Breather filter | Change breather filter | See maintenance instructions, Hydraulic system. |

## 3.2.3 Maintenance Every 500th Percussion Hours

### Compressor GAR 5, GAR 30

| Check point | Description | Action | Reference |
|---|---|---|---|
| 111 | Safety valve | Check the safety valve for the air receivers | See maintenance instructions, Air system. |
| 6 | Air filter | Clean filter's coarse separator and replace as necessary | |
| - | Compressor | Clean | |
| 100 | Air receiver | Changing oil | See maintenance instructions, Air system. |

| Check point | Description | Action | Reference |
|---|---|---|---|
| 18 | Oil filter | Change compressor oil filter | |
| - | Compressor and air receiver | Check hoses and hose connections | |

### Cat pump

| Check point | Description | Action | Reference |
|---|---|---|---|
| 1 | Oil | Change oil | |

## 3.2.4 Maintenance Every 1000th Percussion Hours

### Hydraulic Systems

| Check point | Description | Action | Reference |
|---|---|---|---|
| 2 | Return oil filter | Change return oil filter | |
| - | Particle filter water separator | Change particle filter | See maintenance instructions, Water separator |

### Membrane dryer SDR6

| Description | Action | Reference |
|---|---|---|
| Membrane dryer SDR6 | Check the air humidity after the Membrane filter | See maintenance instructions, Membrane dryer SDR6 |

## 3.2.5 Maintenance Every 2000th Percussion Hours

### Compressor GAR 5, GAR 30

| Check point | Description | Action | Reference |
|---|---|---|---|
| 23 | Temperature monitor | Check temperature monitor | |
| - | Separator element | Change separator element in air receiver | See maintenance instructions, Compressor |
| - | Compressor | Check electrical connections | |

### 3.2.6 Maintenance Every 50th Diesel Engine Hours or Weekly

#### Handheld fire extinguisher

| Description | Action | Refer-ence |
|---|---|---|
| Handheld Fire Extinguisher | Break up the powder in the container by carefully striking the container with a rubber mallet. | |

#### Power train

| Description | Action | Reference |
|---|---|---|
| Tyres | Check tyre pressure. Adjust as necessary | See maintenance instructions, Power train. |
| Transmission | Check oil level | See maintenance instructions, Power train. |
| Wheel axles | Check tighten bolted joints (to frame) | |

### 3.2.7 Maintenance Every 100th Diesel Engine Hours

#### Diesel Engine

| Description | Action | Reference |
|---|---|---|
| Battery connections | Clean and grease the terminals | |

#### Brake system

| Description | Action | Reference |
|---|---|---|
| Brake system | Check the pressure for both the service and parking brake | See maintenance instructions, Brake system. |

#### Cooling system

| Description | Action | Reference |
|---|---|---|
| Radiator | Clean the radiator | See maintenance instructions chapter, Cooling system |

### 3.2.8 Maintenance Every 250th Diesel Engine Hours

#### Fire extinguishing system, option

| Description | Action | Reference |
|---|---|---|
| Complete system | • Fire inspection<br>• Maintenance | |

#### Power train

| Description | Action | Reference |
|---|---|---|
| Central lubrication | Check hoses and nipples | |
| Final drive | Check oil level. Top up as necessary | |
| Hub gear | Check oil level. Top up as necessary | |
| Wheel nuts | Check tightening torques. | See maintenance instructions, Power train |
| Spider joint | Check hoses and nipples. Fill with grease. | |

#### Diesel engine

| Description | Action | Reference |
|---|---|---|
| Air filter | Replace filter insert | See maintenance instructions, Diesel engine |

### 3.2.9 Maintenance Every 500th Diesel Engine Hours

#### Diesel engine

| Description | Action | Reference |
|---|---|---|
| Fuel tank | Drain the fuel tank. | See maintenance instructions, Diesel engine |
| Oil filter | Change oil filter | See maintenance instructions, Diesel engine |
| Engine oil | Change engine oil | See maintenance instructions, Diesel engine |
| Air filter | Replace safety cartridge | See maintenance instructions, Diesel engine, Air system |
| Valve clearance | Adjust valve clearance | |

| Description | Action | Reference |
|---|---|---|
| | ! ***NOTE:*** *May only be carried out by an authorised specialist.* | |

## Cooling system

| Description | Action | Reference |
|---|---|---|
| Coolant | Check the anti-freeze concentration | See maintenance instructions chapter, Cooling system |

## Power train

| Description | Action | Reference |
|---|---|---|
| Transmission | Change oil and oil filter<br>! ***NOTE:*** *When using Dexron II oil or Dexron II equivalents, oil changes can be carried out at 1000-hour intervals* | See maintenance instructions, Power train. |

## Brake System

| Description | Action | Reference |
|---|---|---|
| Brake disks | Check wear and replace as necessary | See maintenance instructions, Brake system |

## Reeling units

| Description | Action | Reference |
|---|---|---|
| Gears | Change Oil | |
| Gears | Adjust slip coupling | See maintenance instructions, Reeling units. |
| Drive chain | Check tension | See maintenance instructions, Reeling units. |

### 3.2.10 Maintenance Every 1000th Diesel Engine Hours

#### ROPS, cabin brackets

| Description | Action | Reference |
|---|---|---|
| ROPS bolts | Check-tighten the ROPS bolts (specific inspection torque) | See maintenance instructions FOPS/ROPS |
| Frame brackets | Inspect for cracks | |
| Damper | Inspect the condition and attachment of the damper elements | |

#### Diesel engine

| Description | Action | Reference |
|---|---|---|
| Hoses and connections | Check hoses and couplings | See maintenance instructions, Diesel Engine, Check/Tighten Engine Suspension Bolts |
| Fuel filter | Change fuel filters. Halve the interval in the event of poor fuel quality | See maintenance instructions Diesel engine, Changing fuel filter |
| Preliminary fuel filter | Change the preliminary fuel filter. Changing the preliminary fuel filter Halve the interval in the event of poor fuel quality If the warning lamp comes on, the pre fuel filter must be drained immediately | See maintenance instructions Diesel engine, |
| Battery and cables | Inspect | |
| After cooler | Drain the after-cooler | See maintenance instructions Cooling System, Drain the After-cooler |
| Heating element | Check function | |
| V-belt | Check belt wear Change drive belt if necessary | See maintenance instructions Diesel Engine, Belts |
| Engine pads | Change where necessary | See maintenance instructions, Diesel Engine, Change Engine Pads |
| Engine suspension | Check/tighten engine suspension bolts, replace damaged parts | See maintenance instructions, Diesel Engine, Check/Tighten Engine Suspension Bolts |

### 3.2.11 Maintenance Every 2000 Diesel Engine Hours

> ***NOTE:*** *These maintenance points may only be carried out by an authorised specialist.*

#### Diesel engine

| Description | Action | Reference |
|---|---|---|
| Valve clearance | Adjust | |
| V-belts and tension pulley | Inspect | |
| Particle filter | Check the filter insert Check the spark plug in the burner | |

> ***NOTE:*** *For maintenance to be carried out on diesel engines with longer intervals than 2000 diesel engine hours see Deutz operator's instructions. The instruction manual can be obtained from Epiroc. Contact Epiroc's local customer centre.*

#### Power train

| Description | Action | Reference |
|---|---|---|
| Articulated joint | Check for wear. Change if necessary. | |
| Final drive | Change oil | See maintenance instructions, Power train |
| Hub gear | Change oil | See maintenance instructions, Power train |

### 3.2.12 Maintenance Every Year

The following maintenance must be performed once a year, irrespective of how many hours the diesel engine has been running.

#### Diesel engine

| Description | Action | Reference |
|---|---|---|
| Engine monitoring system | Inspect<br>***NOTE:*** *May only be carried out by an authorised specialist.* | |
| Preliminary fuel filter | Change preliminary fuel filter | See maintenance instructions, Diesel engine |

| Description | Action | Reference |
|---|---|---|
| | If the warning lamp comes on, the pre fuel filter must be drained immediately. | |

### 3.2.13 Maintenance Every other Year

The following maintenance must be performed once every other year, irrespective of how many hours the diesel engine has been running.

#### Diesel engine

| Description | Action | Reference |
|---|---|---|
| Air filter | Replace air filter | See maintenance instructions Diesel engine, Air system. |
| V-belt and tension pulley | Change V-belt and tension pulley<br>! ***NOTE:*** *May only be carried out by an authorised specialist.* | |
| Crankcase ventilation | Check breather valve<br>! ***NOTE:*** *May only be carried out by an authorised specialist.* | |

#### Cooling system

| Description | Action | Reference |
|---|---|---|
| Coolant | Change the coolant | See maintenance instructions chapter, Cooling system |

### 3.2.14 Cat Pump

**After 50 hours operation**

| Check point | Description | Action | Reference |
|---|---|---|---|
| 1 | Oil level | Change oil | |

### 3.2.15 Maintenance for Commissioning New Diesel Engine

> ***NOTE:*** *These maintenance points may only be carried out by an authorised specialist.*

| Reference | Action | Reference |
|---|---|---|
| Fuel system | Bleed | See maintenance instructions, Diesel engine |
| Fuel filter | Check the fuel filters and the preliminary fuel filter and change them if necessary | See maintenance instructions, Diesel engine |
| Oil level | Check oil level. . | See maintenance instructions, Diesel engine |
| Engine oil | Check engine oil quality. | |
| Oil leak | Check for oil leaks. | |
| Coolant | Check the anti-freeze concentration | See maintenance instructions, Cooling system |
| Coolant | Check level. Top up as necessary with the correct coolant concentration for the temperature in question. . | See maintenance instructions, Cooling system |
| Air filter | Replace air filter . | See maintenance instructions, Diesel engine, Air system |
| After cooler | Drain the charge air cooler | See maintenance instructions, Cooling system |

# 4 Specifications

## 4.1 Standard Tightening Torques for Bolted Joints

All critical joints are tightened to torque as specified in Epiroc Standard 4369:01 K unless specified otherwise. If so, it is specified in the maintenance instructions for the component in question.

> ! ***NOTE:*** *All bolted joints in the table must be lubricated with Molykote 1000 or corresponding thread lubricant with coefficient of friction 0.11 µ.*

### Epiroc Standard 4369:01 K.

| Size | Strength Class | Torque in Nm. | | Tolerance ± |
|---|---|---|---|---|
| | | Nm | lb-ft | |
| M6 | 8.8 | 9 | 6.638 | 1 |
| M8 | 8.8 | 23 | 16.963 | 2 |
| M10 | 8.8 | 44 | 32.452 | 5 |
| M12 | 8.8 | 76 | 56.054 | 8 |
| M14 | 8.8 | 120 | 88.507 | 12 |
| M16 | 8.8 | 187 | 137.92 | 19 |
| M20 | 8.8 | 365 | 269.290 | 37 |
| M24 | 8.8 | 627 | 462.451 | 63 |
| M12 × 1.25 | 10.9 | 114 | 84.082 | 6 |
| M16 × 1.5 | 10.9 | 276 | 203.561 | 15 |
| M18 × 1.5 | 10.9 | 460 | 339.27 | 20 |
| M6 | 12.9 | 15 | 11.06 | 2 |
| M8 | 12.9 | 38 | 28.027 | 4 |
| M10 | 12.9 | 75 | 55.31 | 8 |
| M12 | 12.9 | 128 | 94.40 | 13 |
| M14 | 12.9 | 203 | 149.725 | 20 |
| M16 | 12.9 | 315 | 232.332 | 32 |
| M20 | 12.9 | 615 | 453.600 | 62 |
| M24 | 12.9 | 1058 | 780.340 | 106 |

## 4.2 Type Designation Signs for Ordering Spare Parts

Type designation signs are posted on the larger components. Always quote the type designation and serial number when ordering spare parts or making inquiries regarding the products. Type designations and serial numbers are also specified in Machines Online (MOL). Spare parts can be ordered from Epiroc.

# 5 General Machine Condition

## 5.1 Wash Machine Externally

Disconnect firefighting equipment if steam washing or high-pressure washing is used.

- Rinse the machine with water at least once a day to remove drill cuttings, mud, and dirt.

  The feed, front part of the boom, and track frames are important to keep clean.

> ! ***NOTE:*** *Never spray water directly against the opening of the diesel engine intake manifold.*

## 5.2 Examine the Condition of Signs

- Make sure that all signs are in place.
- Make sure that all signs are intact, clean, and fully readable.
- Always replace defective or missing signs.

## 5.3 Check Condition of Hatches and Locks

Check the condition of hatches and the locks on enclosures, cabinets, and service points.

1. Check the condition of the closing, locking, and opening mechanisms of all hatches.
2. Check that the seals are positioned correctly and that they are intact.
3. Lubricate the hinges. Apply universal grease to grease nipples.
4. Lubricate lock mechanisms with Teflon-based lock lubricant or equivalent.

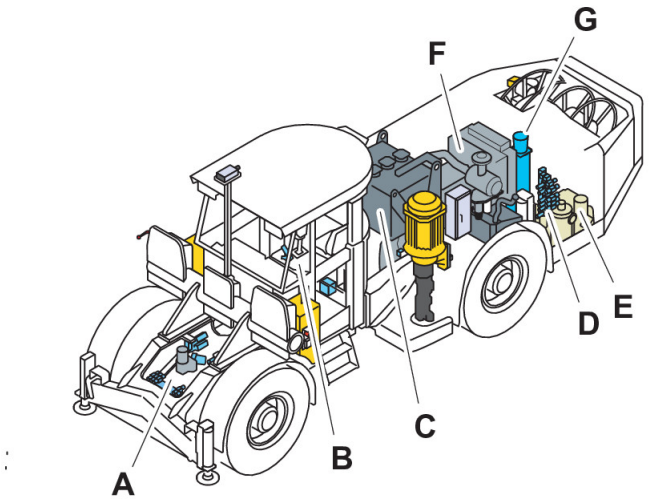
## 5.4 Markings and plates

Signs are placed on the larger carrier components. Always quote the type designation and serial number when ordering spares or inquiring about the carrier. The type designation and serial number are specified on a separate document, MI (Machine Identification). Spares can always be ordered from Epiroc.

# 6 Component Locations

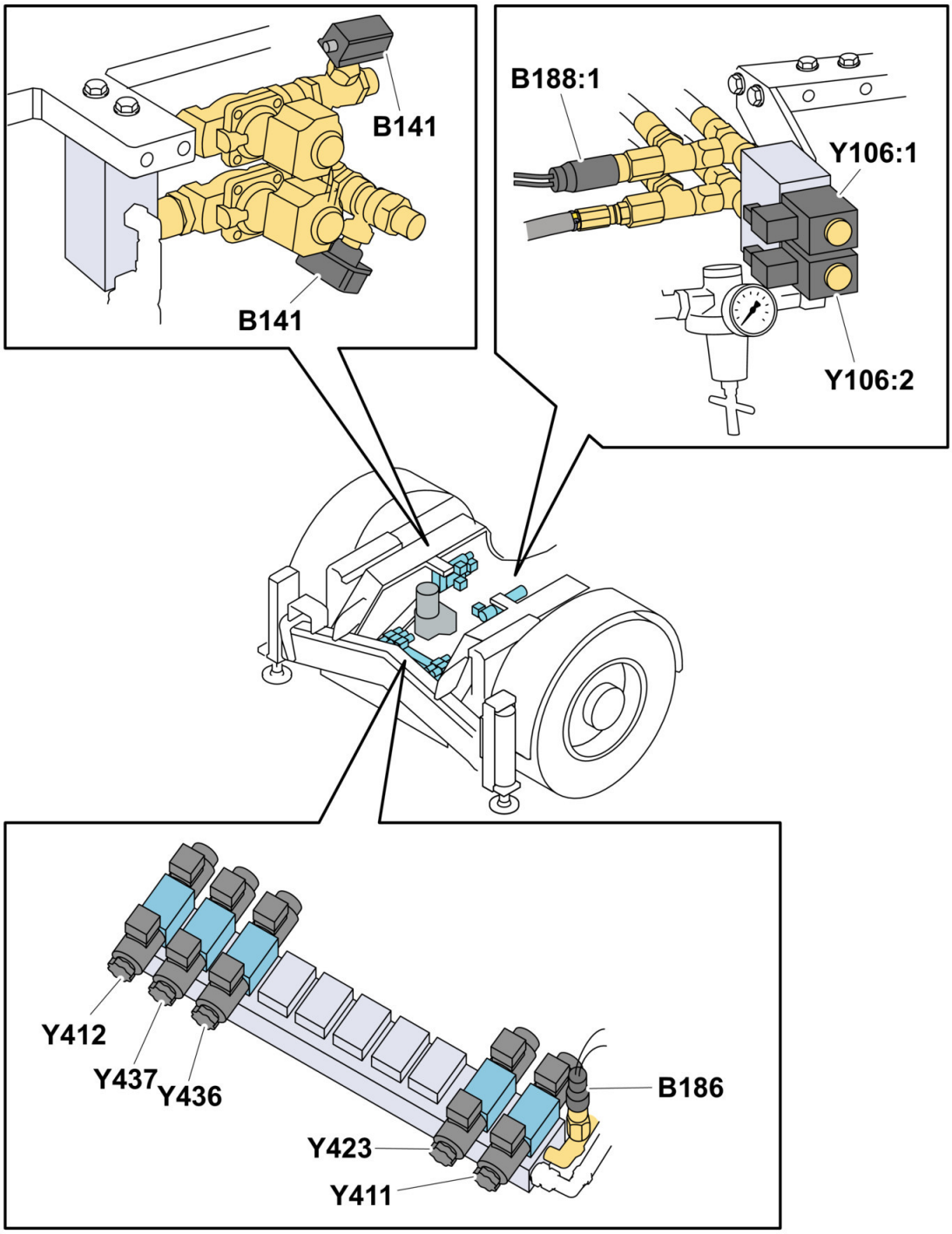
## 6.1 Unit Location References

The component locations vary depending on the options with which the machine is equipped.



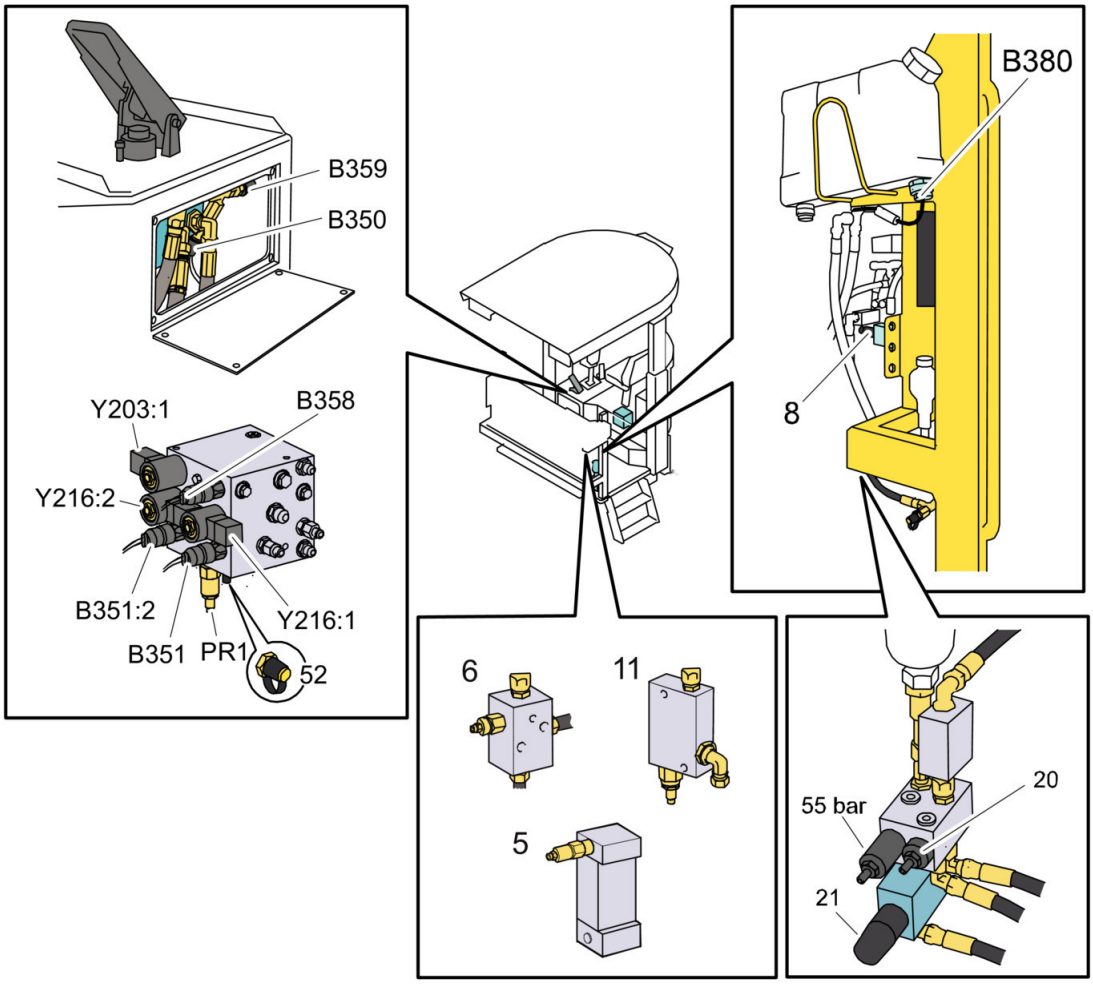

| | | | |
|---|---|---|---|
| A | Boom frame | B | Operator station |
| C | Hydraulic pumps and tank | D | Valve plate and rear frame |
| E | Compressor | F | Engine/Motor and transmission |
| G | Water pump | | |

## 6.2 Valves, Sensors, and Pressure Test Outlets on Boom Frame



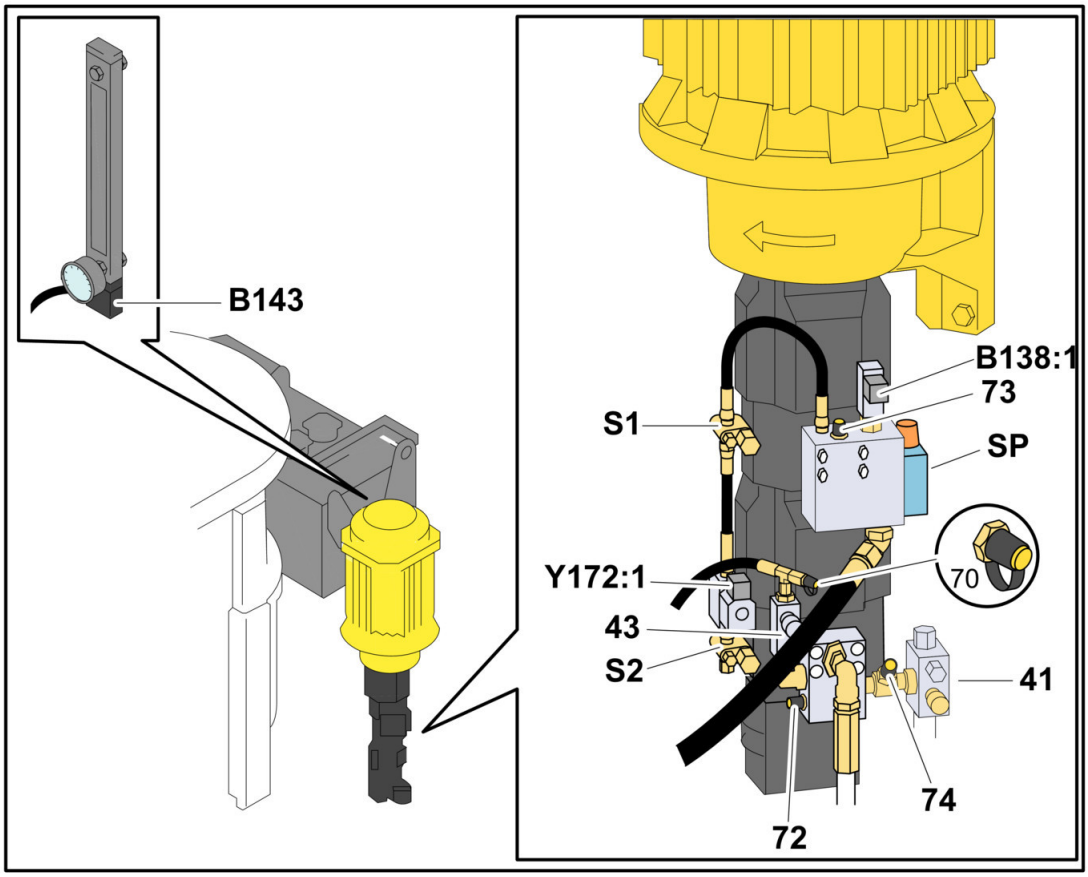

*Location of valves and sensors - Boom frame*

## 6.3 Valves, Sensors, and Pressure Test Outlets on Operator's station




*Location of valves and sensors - Operator's station*

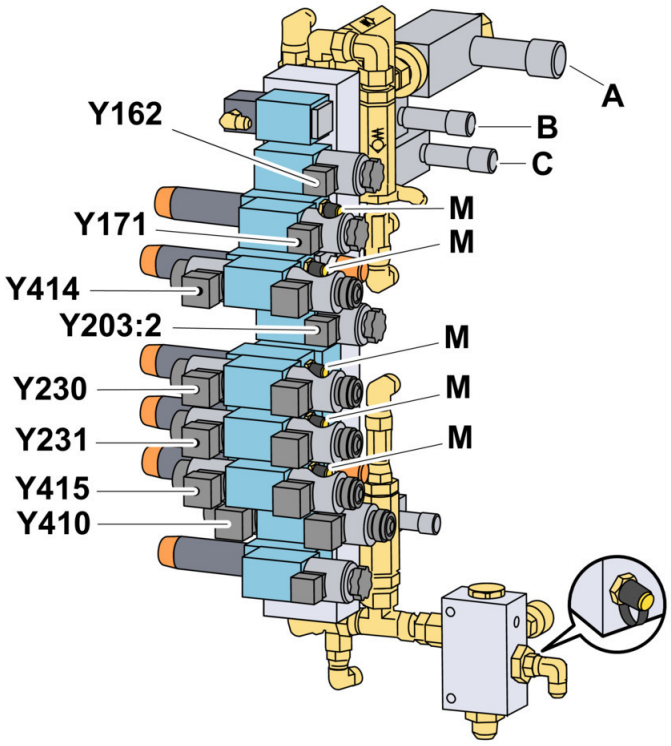
## 6.4 Valves, Sensors, and Pressure Test Outlets on Hydraulic pumps and tank




*Location of valves, sensors and pressure test outlets - Hydraulic pumps and tank*

| | |
|---|---|
| S1 | Percussion pump control valve |
| S2 | Positioning pump control valve |
| SP | Percussion pump sequential valve |

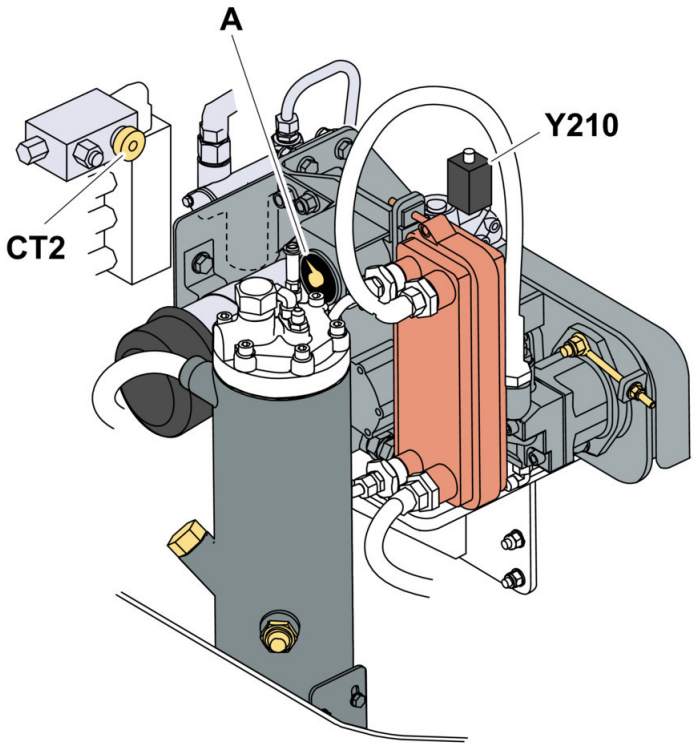
## 6.5 Valves, Sensors, and Pressure Test Outlets on Valve plate, engine frame




*Location of valves and pressure test outlets - Valve plate, engine frame*

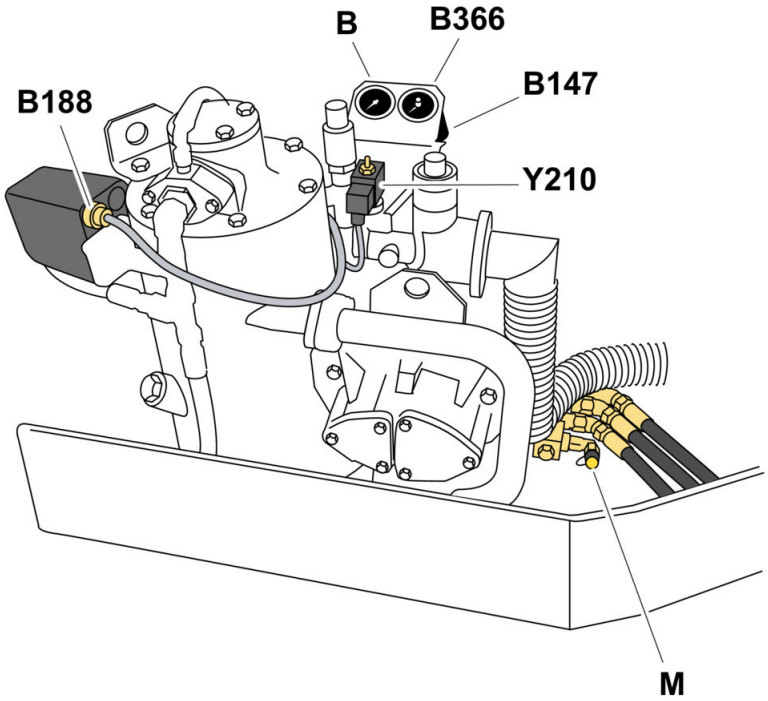
| | |
|---|---|
| A | Flow regulator water pump's speed |
| B | Flow regulator compressor's speed |
| C | Flow regulator compressor's booster speed |
| M | Test outlet |

## 6.6 Valves, Sensors, and Pressure Test Outlets on Compressor




*Location of valves, sensors and pressure test outlets - Compressor GAR5*

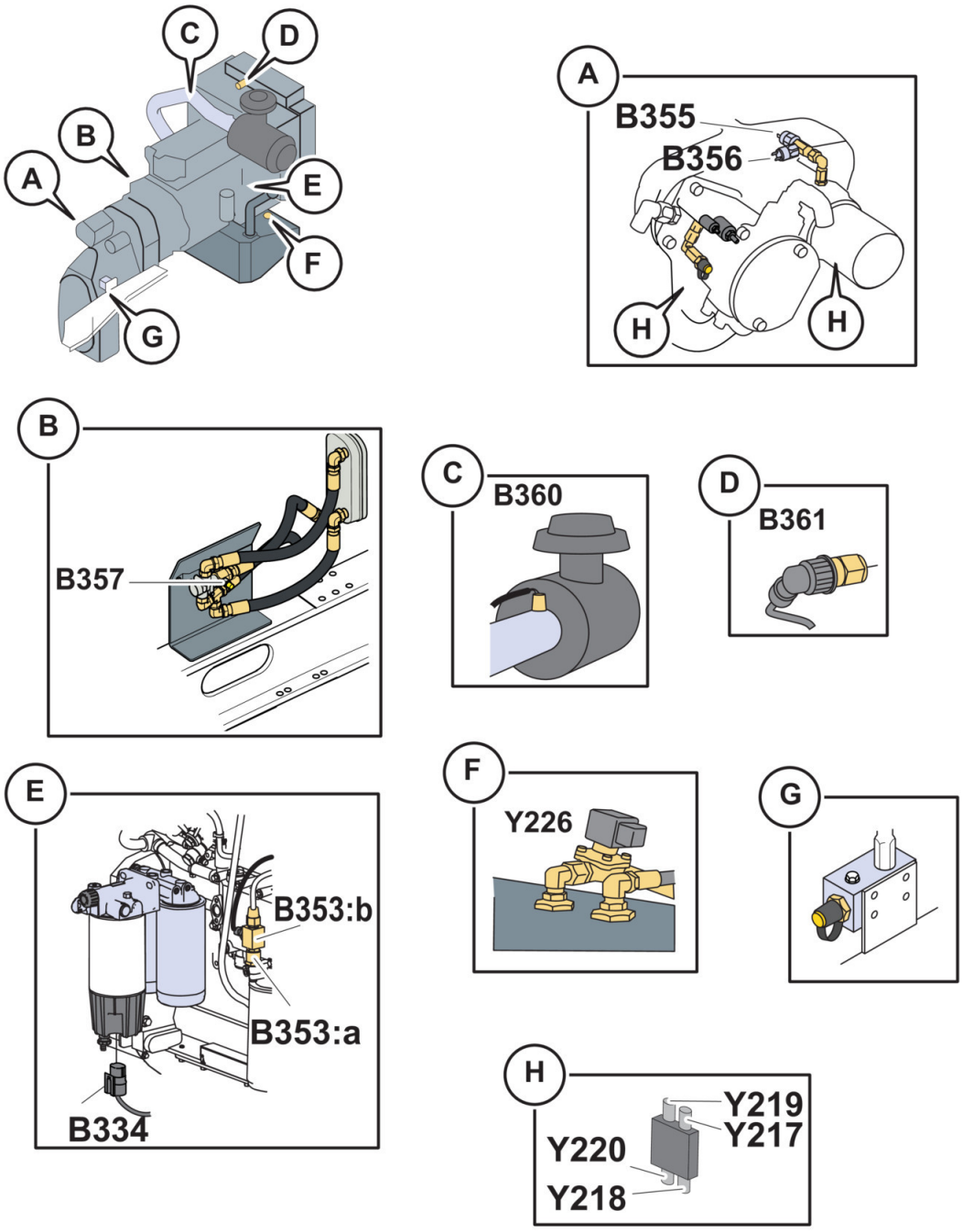
| | |
|---|---|
| A | Temperature monitor |




*Location of valves, sensors and pressure test outlets - Compressor GAR 30*

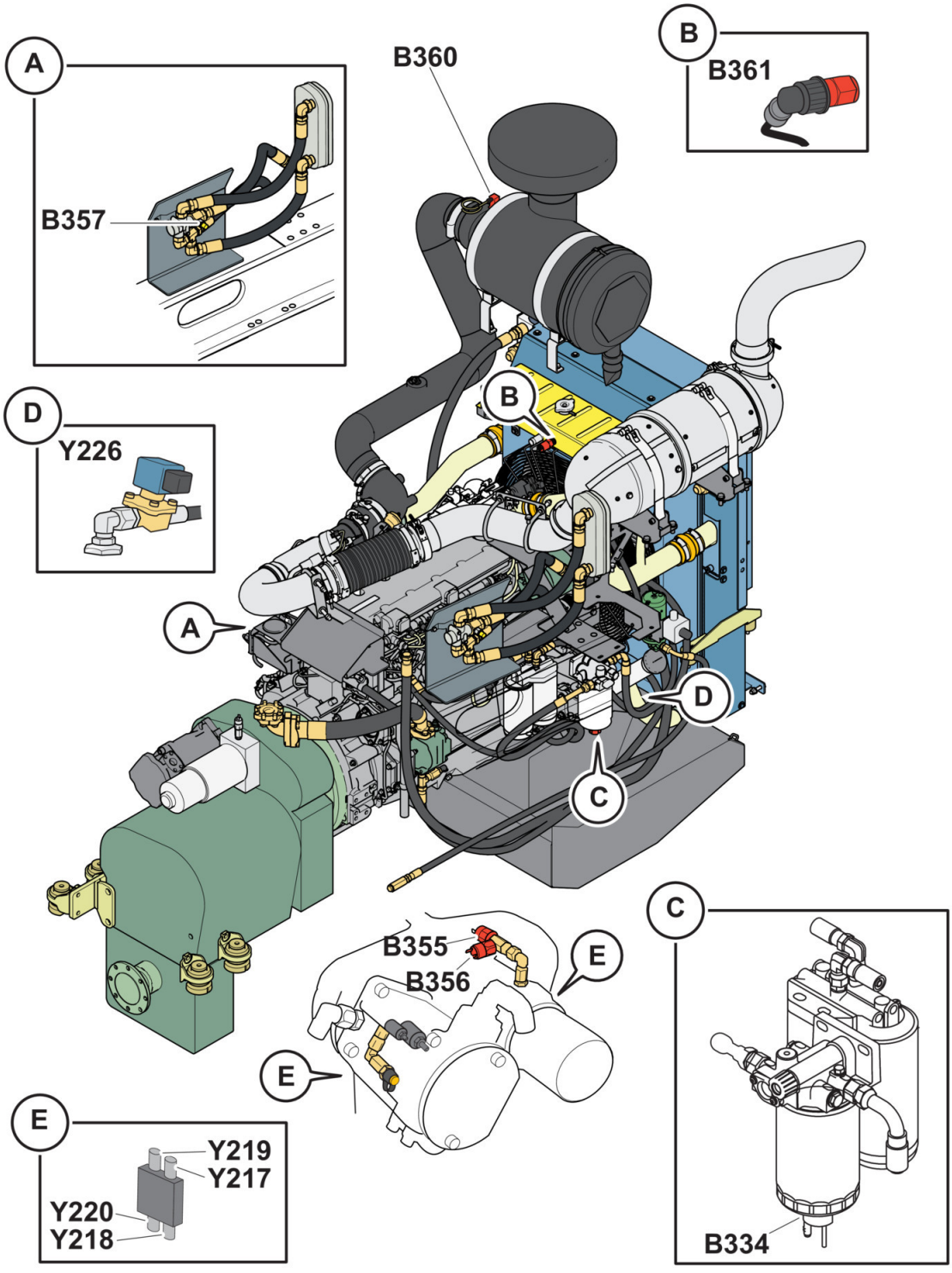
| | |
|---|---|
| B | Air pressure gauge |
| M | Test outlet |

## 6.7 Valves, Sensors, and Pressure Test Outlets on Engine and transmission - Deutz TCD 2012 and TCD 2013




*Location of valves, sensors and pressure test outlets - Engine and transmission*

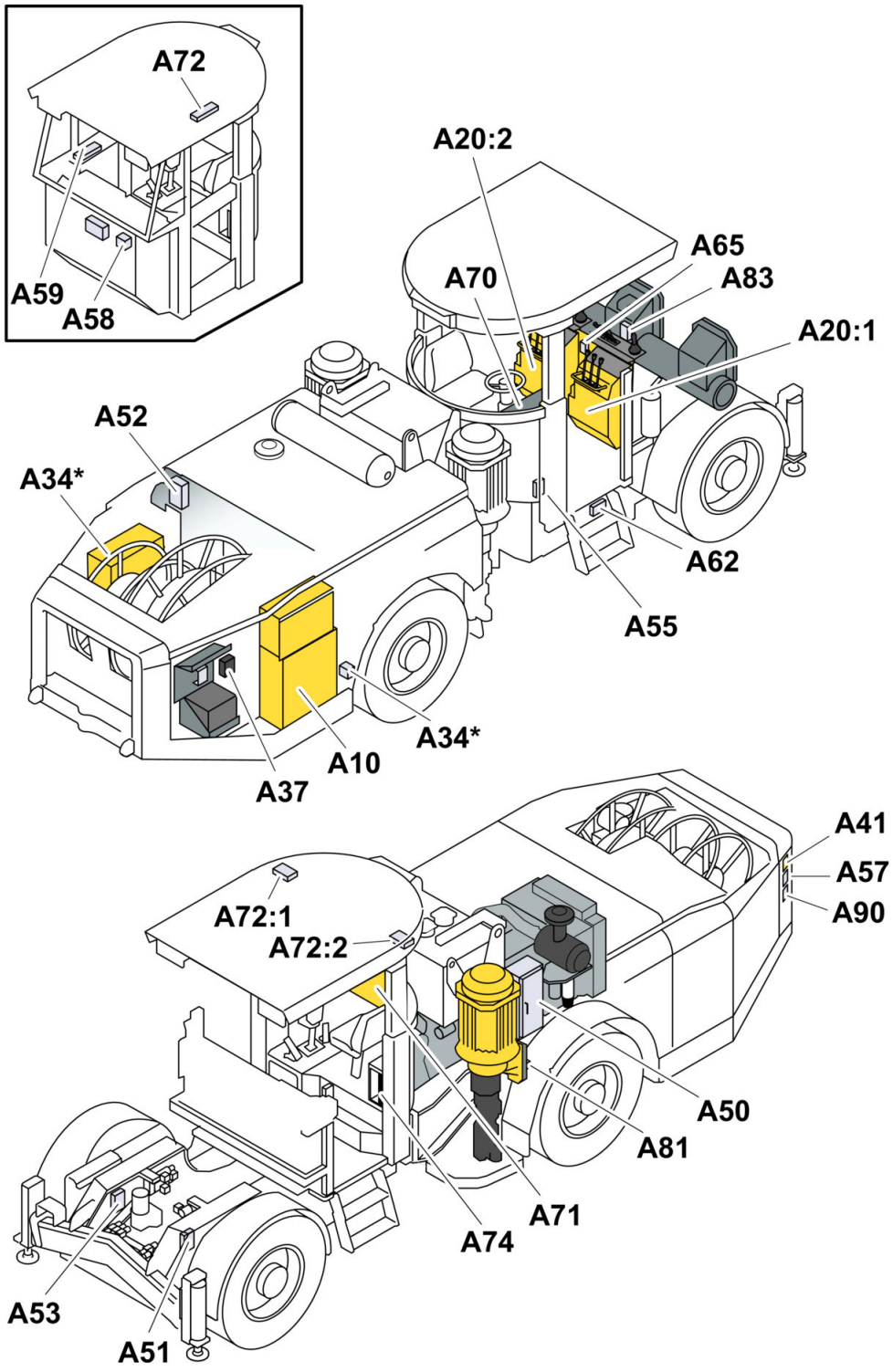
## 6.8 Valves, Sensors, and Pressure Test Outlets on Engine and transmission - Deutz TCD 4.1 and TCD 6.1




*Location of valves, sensors and pressure test outlets - Engine and transmission*

| | |
|---|---|
| A | Valve locations vary depending on transmission |

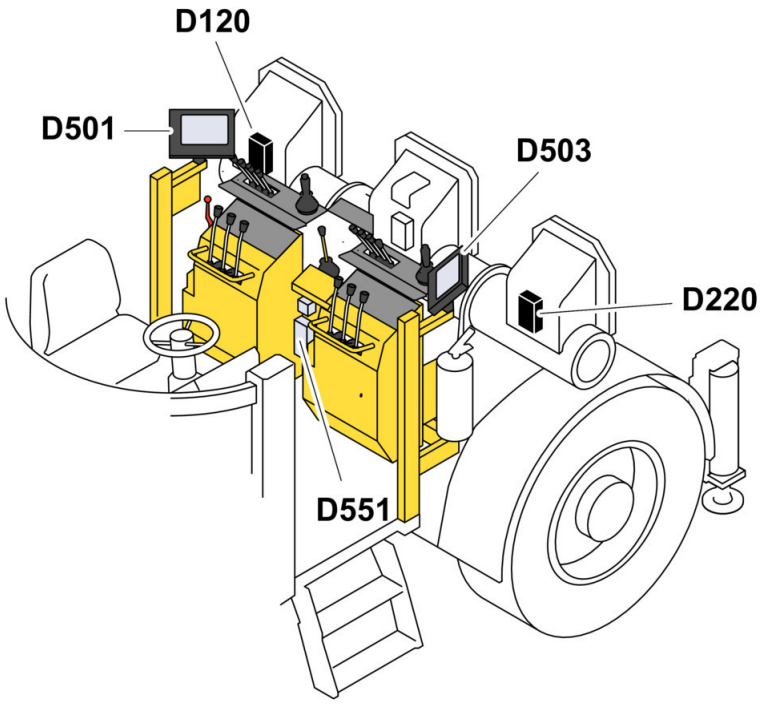
## 6.9 Overview of Electric Cabinets and Electric Boxes




*Location of electric cabinets and electric boxes*

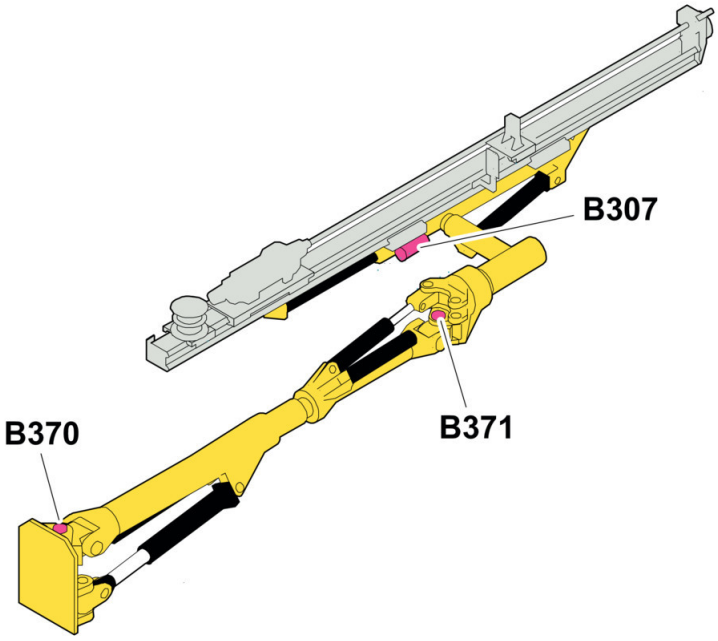
| | |
|---|---|
| * | Alternative location depending on options specified |

## 6.10 Overview of Modules and Fuse Boxes



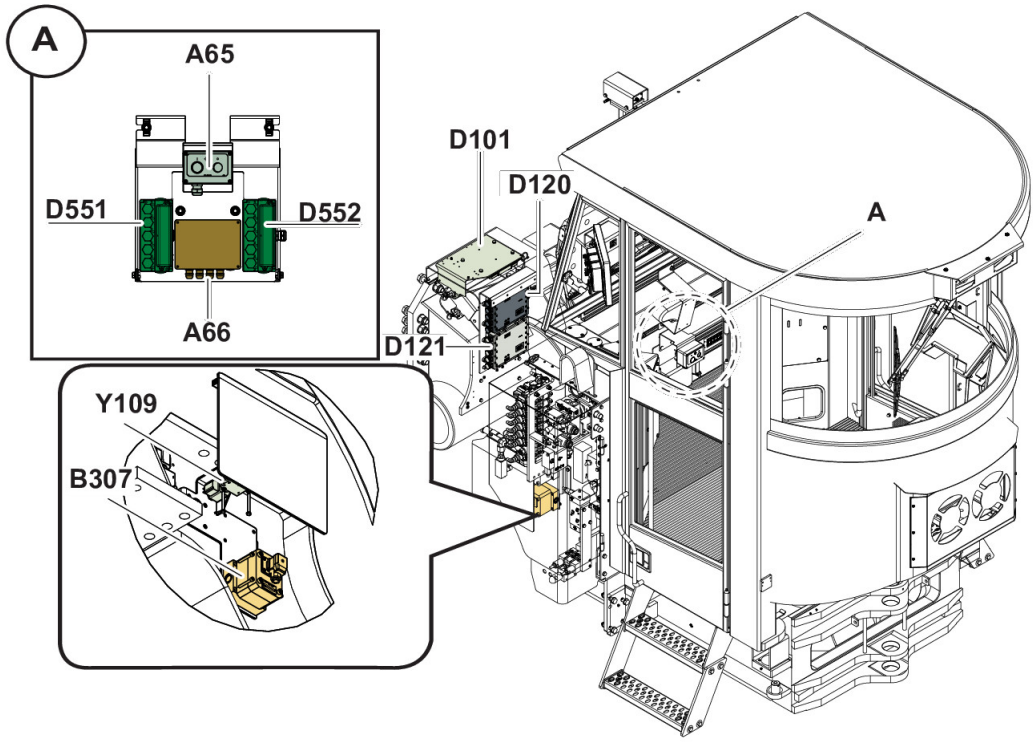

*Modules and fuse boxes*

## 6.11 Sensors on Boom



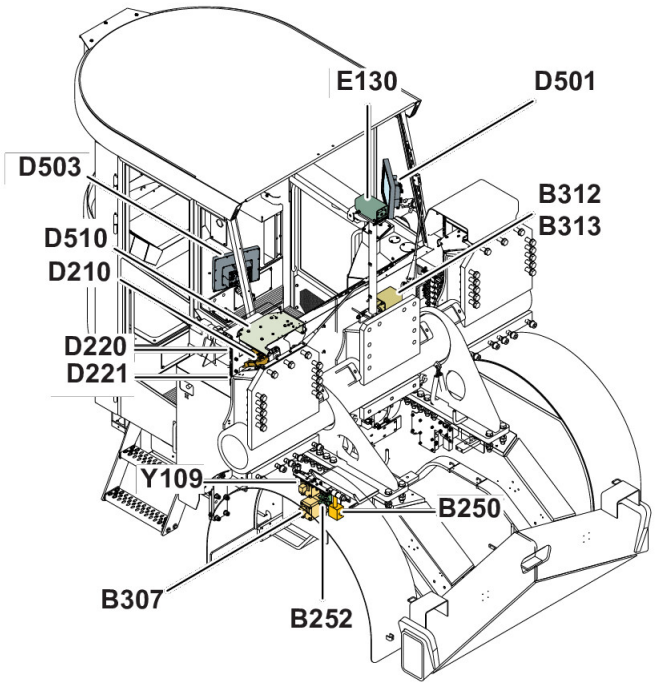

*Location of sensor*

## 6.12 Electronic Components FAM3 and MWD




| | | | |
|---|---|---|---|
| A65 | Control Box | D551 | Fuse Box |
| D552 | Fuse Box | A66 | Apparatus Panel |
| B307 | Hole depth measuring BMH | D101 | I/O Module MWD |
| D120 | Resolver Module | D121 | Resolver Module |

## 6.13 MWD




| | | | |
|---|---|---|---|
| E130 | Laser Unit | D501 | Display |
| B312 | Inclinometer | B313 | Inclinometer |
| B250 | Flowmeter Water | B252 | Rotation flow |
| B307 | Hole depth measuring BMH | D220 | Resolver Module |
| D221 | Resolver Module | D201 | I/O Module MWD |
| D510 | I/O Module FAM3 | D503 | Display |

# 7 Fire Fighting Equipment

## 7.1 Safety Measures

- Remove flammable material from the machine.
- Make sure to avoid the accumulation of flammable items in the machine. Leftover oil and fuel could intensify the fire or spread it to the other areas.
- Most important of all for avoiding fires in the machine are:
  - Periodic inspection and preventive service at the points where fire can break-out easily such as engine bay, electrical system, turbo, manifolds, break system.
  - Regular cleaning of all areas where flammable materials like oil, grease, hydraulic fluids, and other waste can accumulate.
- It is important that the automatic fire suppression system is inspected at least once a year by an authorized service company. Contact Epiroc local customer center for information regarding authorized service companies.

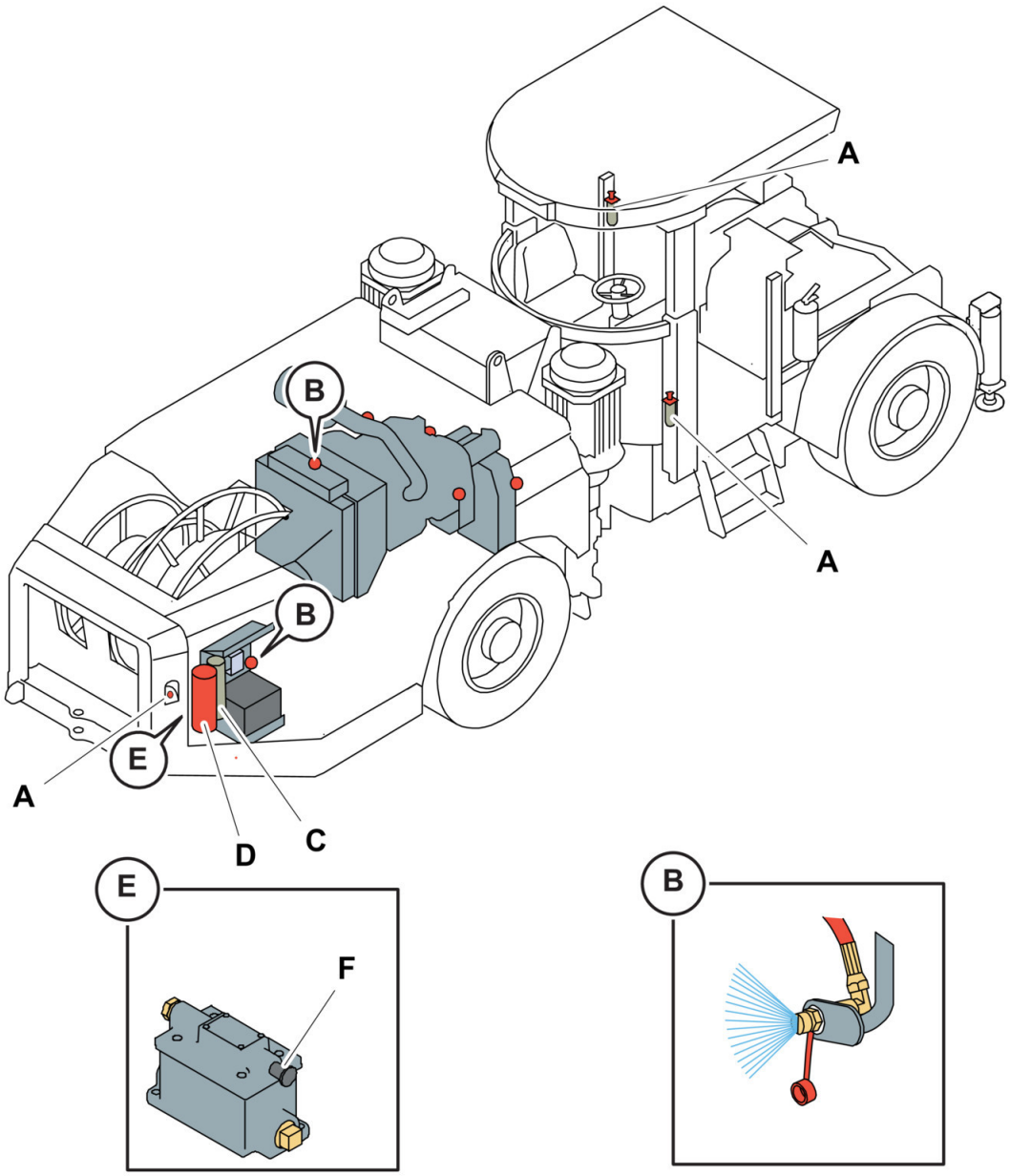
## 7.2 Description of Ansul Manual System

The automatic fire suppression system is an option.

The Ansul manual release system is a fire suppression system that must be activated manually. When triggered, the following occurs:

- Extinguishing starts
- The diesel engine and electric motors are switched off
- The fuel supply is cut off
- The parking brake is applied
- Emergency stop is activated

### 7.2.1 Location of Ansul Manual Equipment




| | | | |
|---|---|---|---|
| A | Activators | B | Nozzles |
| C | Drive gas cartridge | D | Extinguishing medium container |
| E | Automatic emergency stop | F | Manual reset button |

## 7.3 Description of Ansul Checkfire System

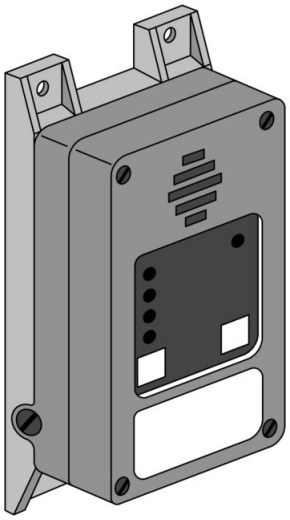
The automatic fire suppression system is an option.

The machine can be equipped with one of several available manual or automatic automatic fire suppression systems.

Ansul CheckFire system consists of a system with sensors that automatically activate the automatic fire suppression system in the case of fire. The system can also be activated manually. When triggered the following occurs:

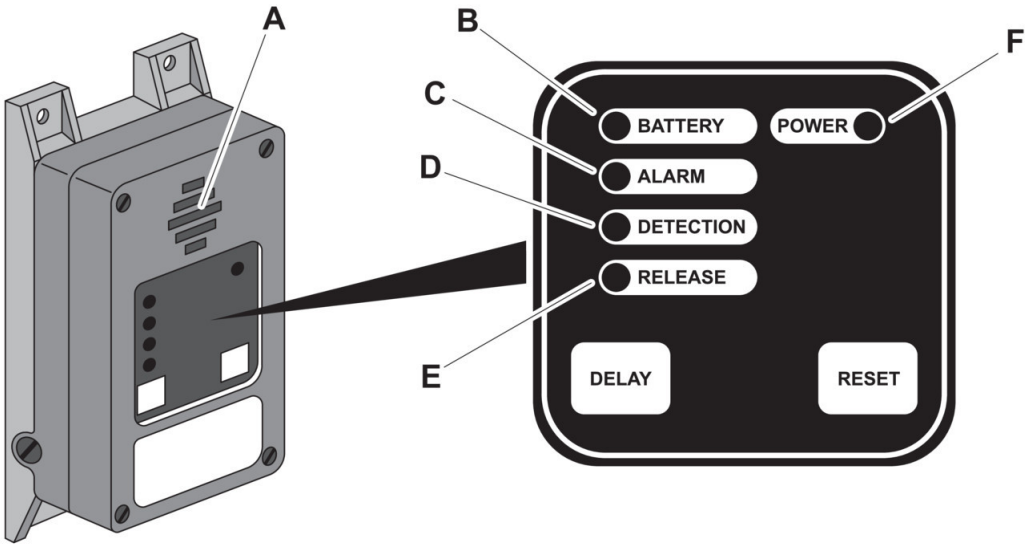
- Extinguishing starts
- The diesel engine is switched off
- The fuel supply is cut off
- The parking brake is applied
- Emergency stop circuit broken

## 7.4 Description of Ansul Central Unit



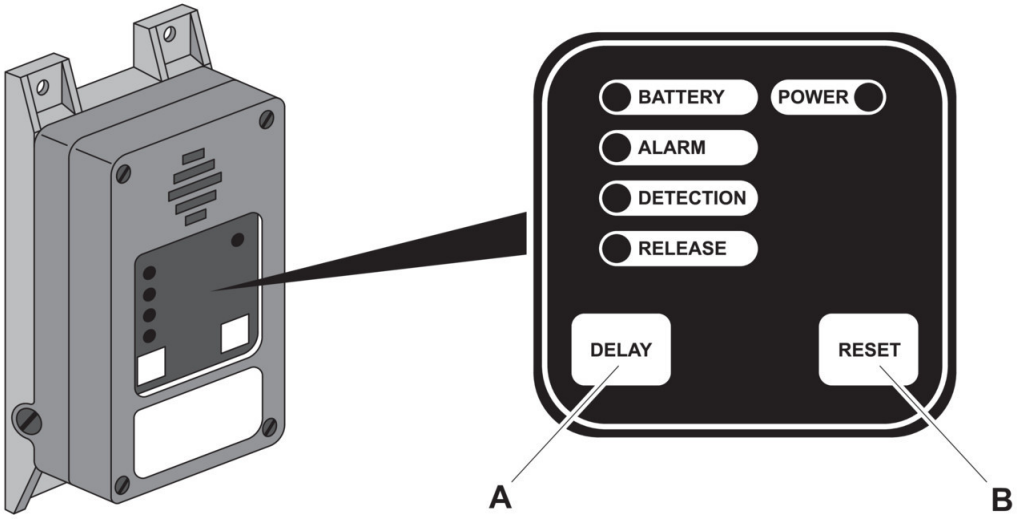
- This central unit is used for Ansul Auto and Ansul CheckFire type of system.
- The central unit operates in automatic mode.

The detector coil and triggering circuit are monitored continuously and any faults result in a signal from the central unit.




*Signals*

| | | | |
|---|---|---|---|
| A | Sound signal | B | Yellow LED flashes every ten seconds if battery level is low |
| C | Red LED flashes if alarm on detector coil, or the system is activated manually | D | Yellow LED flashes every ten seconds together with an acoustic signal if there is fault in detector coil |
| E | Yellow LED flashes every ten seconds together with an acoustic signal if there is fault in triggering circuit | F | Green LED flashes every three seconds if automatic fire suppression system is engaged |



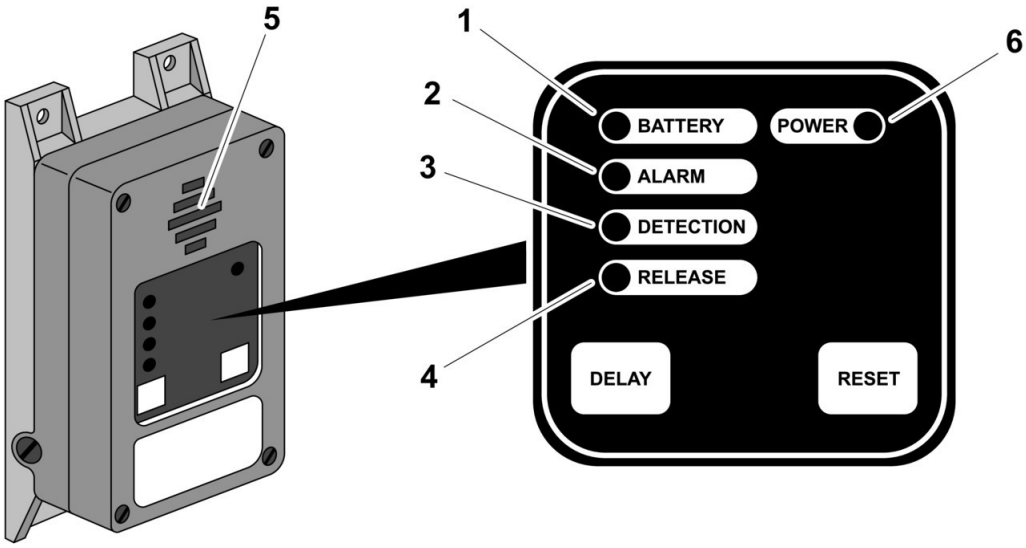

*Buttons*

| | | | |
|---|---|---|---|
| A | Delay<br>• There is a delay of five seconds between detection or alarm and deployment of the system. A press on the button (A) during this time adds a delay of five extra seconds.<br>• The button (A) can also be used for fault finding. | B | Reset<br>• The reset button (B) is used to restart the central unit if, for example, it indicates that a fault has occurred.<br>• If a fault has occurred, the fault must be rectified before the button (B) is used.<br>• When the button (B) is pressed and held, three short audible and lamp signals are emitted to confirm the reset. |

## 7.5 Diagnostics of Ansul Central Unit

If the central unit's "DELAY" button is depressed when the unit's LEDs are signalling about a problem then the LEDs flash a fault code. If there are several faults then the central unit selects the fault code that should be displayed based on a predetermined priority. When a fault has been rectified and "DELAY" is depressed again the next fault code is displayed if several faults have arisen.

The table below explains what the different fault codes mean.




*Signals*

### Fault codes

| Code | Description |
|---|---|
| Yellow LED (1) flashing | Internal battery disconnected |
| Yellow LED (1) and red LED (2) flashing | External battery disconnected |
| Yellow LED (4) flashing | Triggering circuit open |
| Yellow LED (4) and red LED (2) flashing | The system has deployed |
| Yellow LED (3) flashing | Fault in detector coil |

## 7.6 Heat Detector

The heat detector is used for Ansul, Ansul CheckFire, and Forrex automatic fire suppression system.

The detector coil consists of two separated spring wires. The insulation between the wires melts at 180 °C (356 °F) and they make contact with each other and then the fire suppression system deploys.

## 7.7 Description of Ansul Fire Suppression System

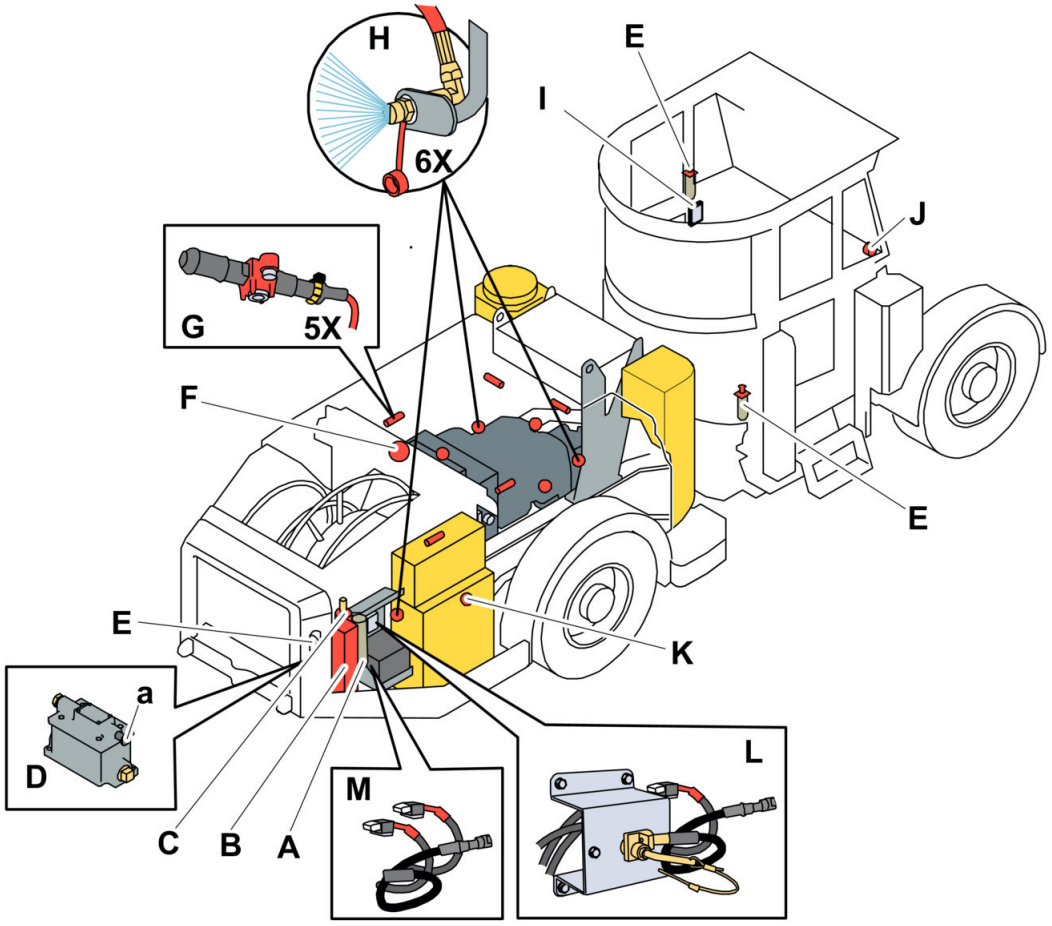
The automatic fire suppression system is an option.

The machine can be equipped with one of several available manual or automatic fire suppression systems.

Ansul fire suppression system consists of a system with sensors that automatically activate the automatic fire suppression system in the case of fire. The system can also be activated manually. When triggered the following occurs:

- Extinguishing starts
- The diesel engine is switched off
- The fuel supply is cut off
- The parking brake is applied
- Emergency stop circuit broken
- The battery isolation switch is switched off

### 7.7.1 Location of Ansul Auto Equipment




*Location of fire fighting system components*

| | | | |
|---|---|---|---|
| A | Drive gas container | B | Extinguishing medium container |
| C | Carbon dioxide container | D | Automatic emergency stop |
| Da | Manual reset button | E | Activators |
| F | Siren | G | Detectors |
| H | Nozzles | I | Central unit |
| J | Alarm lamp | K | Carbon dioxide nozzle |
| L | Automatic disconnection of the battery | M | Fuses for the fire fighting system |

## 7.8 Description of Forrex Automatic System

The automatic fire suppression system is an option.

The Forrex automatic system consists of a fire suppression system and a fire alarm. The system triggers automatically when fire is detected. The system can also be activated manually. When the system is triggered the following occurs:

- Extinguishing starts
- The engine and electric motors are switched off
- On diesel powered rigs the fuel supply is cut off
- The parking brake is applied
- The emergency stop is activated

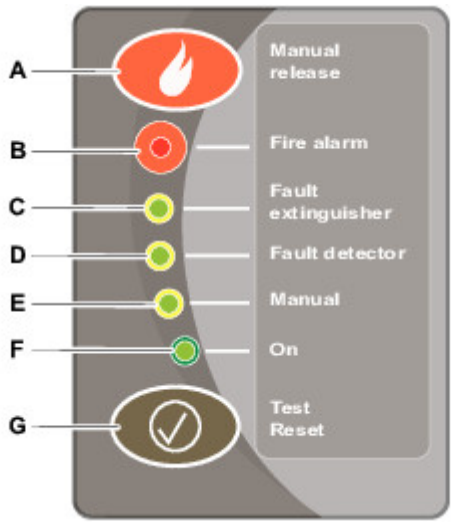
Delayed triggering is used in some versions of the Forrex automatic system when fire is detected automatically. The system then deploys fire suppression automatically after a delay of 7 seconds from when the fire is detected and the fire alarm starts. The purpose of the delay is to have time to alert the suppression system in the mines before the machine is switched off. The delay is also connected in the event of electrical activation on the central unit trigger button. The automatic fire suppression system starts without a delay when the releasing device is activated manually.

## 7.9 Description of Forrex Central Unit

The Central Unit and Forrex control panel are used for the Forrex automatic fire suppression system.

The central unit consists of a junction box and a front panel.

The central unit operates in automatic mode. The detectors and triggering circuit are monitored continuously and any faults can be read on the control panel instantaneously.




*Buttons and Signals*

| | | | |
|---|---|---|---|
| A | Button for manually triggering the system | B | Red LED goes on if a fire alarm |
| C | Yellow LED goes on if a fault arises in the triggering circuit or container | D | Yellow LED goes on if a fault arises in the detector coil |

| | | | |
|---|---|---|---|
| E | Yellow LED goes on when the system is in manual mode | F | Green LED goes on when the supply voltage is connected |
| G | Button for testing and resetting the extinguishing system. | | |

Press and hold the Test / Reset button (G) to test the Central Unit.

- The LEDs lights up one by one. The alarm, both sound and signal light, then turns on.
- The control panel automatically returns to operating mode after test.

## 7.10 Fire Inspection after Modification of the Machine

The automatic fire suppression system is an option.

Precondition ✓ The machine has been modified.

○ Contact an authorized service company to inspect over the automatic fire suppression system.

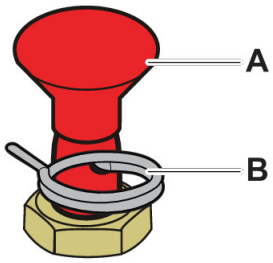
**Contact Epiroc**

Contact an Epiroc local customer center for further information.

## 7.11 In Case of Fire - Manually Activating the Fire Suppression System

The automatic fire suppression system is an option.

! ***NOTE:*** *Follow local regulations if there is a fire.*




1. Pull out the lockpin (B).
2. Press the activating button (A).

Step result ➔ The automatic fire suppression system activates.

The emergency stop is activated.

The power to the machine is disconnected.

! ***NOTE:*** *Have a fire extinguisher ready if the fire reignites.*

> ***NOTE:*** *Restart the machine only when the actions after fire has been carried out.*

## 7.12 Actions after Fire

> ***NOTE:*** *Restart the machine only when the cause of fire has been established and all faults have been corrected.*

Precondition ✓ The handheld fire extinguishers have been used.

1. Replace used fire extinguishers with approved new extinguishers.
2. Inspect the firefighting equipment.
3. Replace damaged parts on the machine.
4. Clean out any extinguisher residue in the machine before operation.

Precondition ✓ The automatic fire suppression system has been used.

1. Clean the nozzles and pipes and replace if necessary.
2. Recharge the automatic fire suppression system before using the machine again.
3. On machines that are installed with Ansul fire suppression system a triggered battery isolation switch must be manually reset.
4. Inspect the firefighting equipment and system.
5. Replace damaged parts on the machine.
6. Clean out any extinguisher residue in the machine before operation.

Precondition ✓ Firefighting equipment has been used.

Optional step ➤ The rig is equipped with Fogmaker firefighting equipment:

a. Contact an authorized service company to check over the firefighting equipment.

> ***NOTE:*** *The fire alarm sounds until authorized maintenance personnel shut it off. Mute the fire alarm by pressing the Test button for approximately 10 seconds.*

Only use the machine when the firefighting equipment has been reset.

b. Replace damaged parts on the machine.

c. Clean out any extinguisher residue in the machine before operation.

Optional step

➤ The rig is equipped with Ansul CheckFire firefighting equipment:

a. Inspect the firefighting equipment and system.
b. Clean the nozzles and pipes and replace if necessary.
c. Recharge the firefighting equipment before using the machine again.
d. Reset the triggered battery isolation switch manually.
e. Replace damaged parts on the machine.
f. Clean out any extinguisher residue in the machine before operation.

**Contact Epiroc**

Contact an Epiroc local customer center for further information.

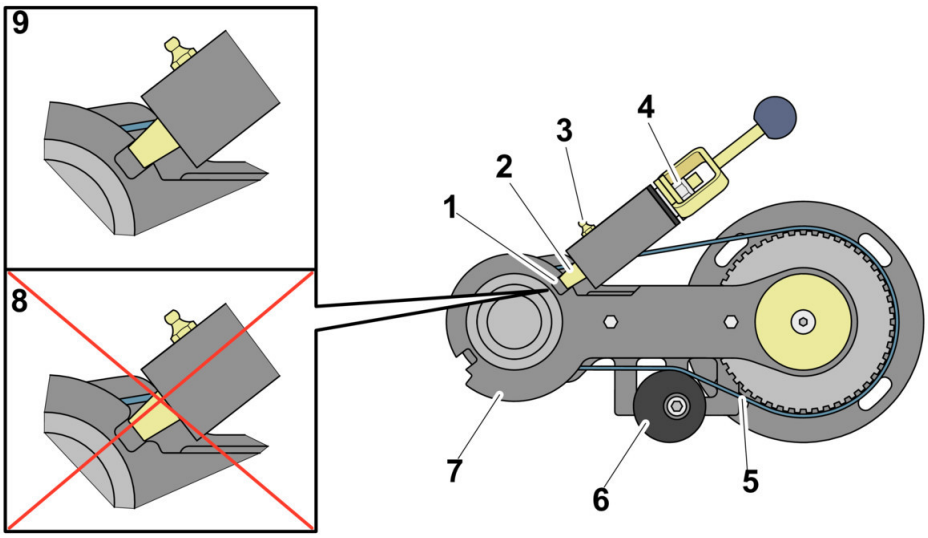
# 8 Operator Environment

## 8.1 Check Swivelling Seat Swing Arm

**WARNING**

**Serious Injury**

- Deficient adjustment of the lock mechanism's swing arm can be dangerous and can cause personal injury and material damage.

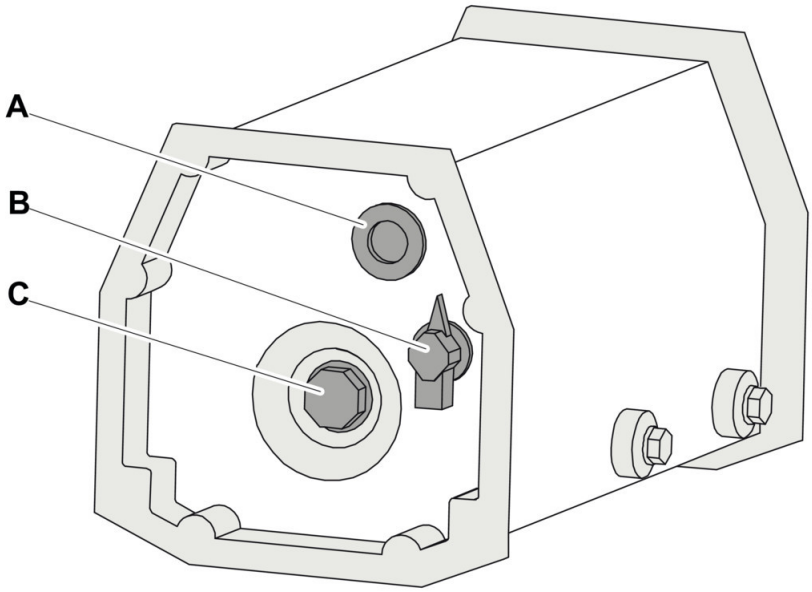



*Swing arm*

1. Check the belt (5).
2. Tension the belt as required using belt tensioner (6), and tighten at intervals of 10° at once until there is no gap between the belt and the gears.
3. Check that the lock pin (2) is properly inserted into the lock slot (1).
4. Adjust the lock pin as required with the lock nut (4).
5. Lubricate through the grease nipple (3) to ensure lock pin functionality.
6. Check the wear on the edges of the lock slot.

   The edges should appear as in figure (9), if it appears as in figure (8), replace the swivel arm (7).

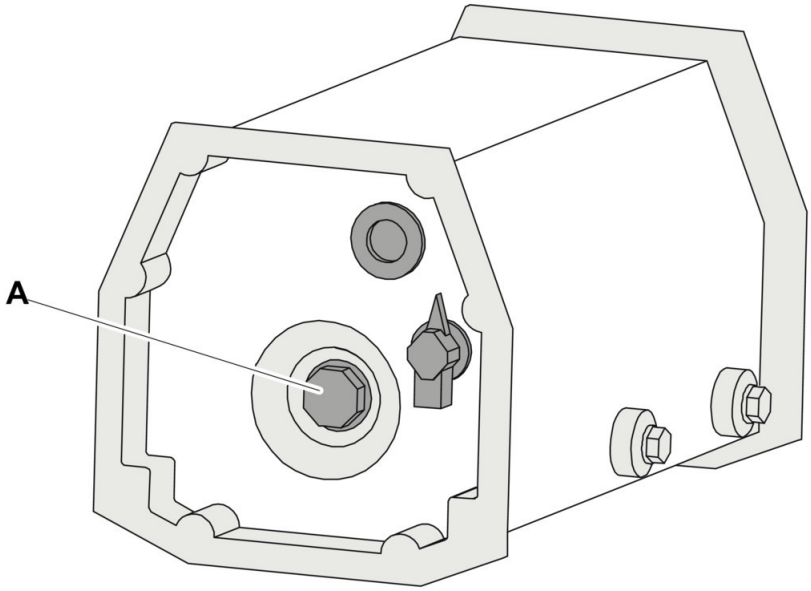
## 8.2 Check Electric Heater




- Check if automatic circuit breaker has been tripped.
  If it is tripped, reset with button (A).
- Check if output is 2 kW or 3 kW.
  Output can be set with the knob (B).
  The setting must be 2 kW to avoid overload.
- Check that the pump rotor is not jammed with the control screw (C).
- Check for damage or wear in the connecting line.
- Check that the ground connection is intact.

## 8.3 Check Heater Pump Rotor

The pump rotor gets jammed if the heater is not used for a long time.




1. Remove the cover (A).
2. Turn on the pump and check if the pump rotor rotates.

Alternative step
a. If the pump rotor rotates, turn off the pump and go to step 4.

Alternative step
b. If the pump rotor does not rotate, turn off the pump and go to step 3.

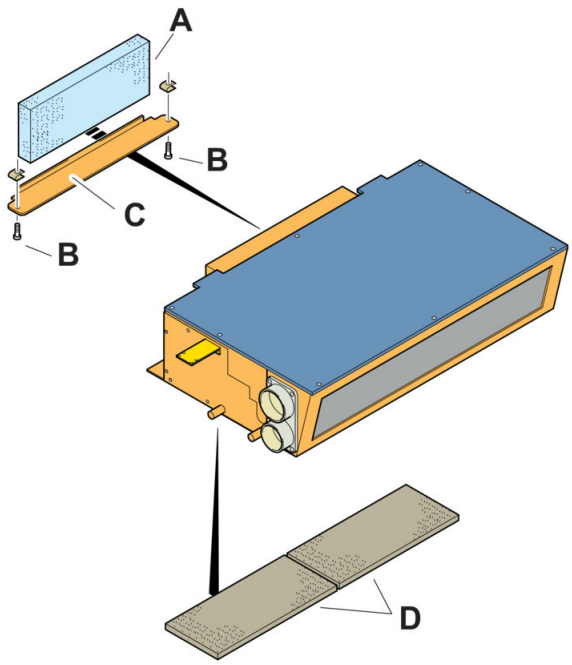
3. Try to turn the pump rotor with the control screw.

Alternative step
a. If the pump rotor turns, go to step 4.

Alternative step
b. If the pump rotor does not turn, the heater must be replaced.

4. Install the cover (A).

## 8.4 Check Fresh Air Filter and Recirculation Filter



1. Remove screws (B).
2. Remove metal plate (C).
3. Remove fresh air filter (A) and recirculation filter (D).
4. Check filters.

Step result

➔ Clean filters if necessary.

Replace filters if efficiency becomes impaired despite cleaning the filter regularly.

## 8.5 Check Air Conditioning Unit

**WARNING**

**Refrigerant below Pressure**

Working on refrigerant below pressure can cause serious injury.

▶ Make sure that only authorized personnel carries the service of refrigerant system.

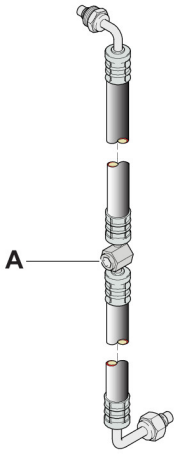
***NOTICE***

**Damage to Compressor for air conditioning unit**

Risk of compressor breaking down.

▶ Do not use the system with too little refrigerant, leakage, or any other fault until it is rectified.

1. Check the drain for evaporator on air conditioning unit.
2. Check that the condenser element airways are free from dirt and clean it often.
3. Check hoses and couplings for damage, wear, and leaks.
4. Check sight glass (A).



There must be no bubbles, except when compressor comes ON and OFF.

5. Check compressor attachment for damage and wear.

## 8.6 Adjusting Air Conditioning Unit Compressor Speed

○ Adjust the compressor speed of the air conditioning unit to 1500 rpm using the flow valve under Y156.

## 8.7 Troubleshooting Air Conditioner

**WARNING**

**Refrigerant below Pressure**

Working on refrigerant below pressure can cause serious injury.

▶ Make sure that only authorized personnel carries the service of refrigerant system.

| Fault Symptom | Action |
|---|---|
| No heating | Check for air in the diesel engine cooling system. |
| No cooling at all | Check the fuses, electrical connections, compressor ground, electromagnets, switches, and pressure switches. |
| | Check the expansion valve and temperature control valve. |
| | Check the coolant hoses. |
| Poor cooling | Check the fresh air fan. |
| | Check whether the air is passing the evaporator in the unit. |
| | Check that the evaporator and condenser are not clogged and that the filter in the air intake is not dirty. |
| | Check that the expansion valve capillary tube is firmly tightened against the evaporator outlet pipe. |
| | Check that the thermostat does not cut out too early. |
| Uneven cooling | Check that the connections to switches, magnetic coupling, or pressure switch are not loose. |
| | Check that the expansion valve is not clogged. |
| | Check that the system is filled and that the thermostat is working. |
| Abnormal noise | Check that the compressor retaining bolts are tightened. |
| | Check that the system is filled sufficiently and not overfilled. |
| | Check that the expansion valve is in working order. |
| | Check that the airflow across the evaporator is sufficient. |

| Fault Symptom | Action |
| --- | --- |
| | Check that the condenser is clean and the airflow is sufficient. |

- Abnormal system noise is often related to incorrectly assembled components. If the compressor is noisy at a certain speed and the noise disappears when the speed increases or decreases, there is probably nothing wrong with the compressor itself. The difference between the pressure on the suction side and the pressure side also affects the level of noise. A compressor with low suction makes more noise than a compressor with high suction. Likewise, a compressor with high pressure makes more noise because it puts more load on bearings and other components.

# 9 Boom Unit

## 9.1 Safety Precautions before Working on Boom Unit

**WARNING**

**Disassembling and Assembling Components**

Can cause personal injury.

- ▶ Components that could move or fall down must be securely supported or strapped in place during service and maintenance work.

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

**WARNING**

**Moving Parts**

Can cause personal injury.

- ▶ Shut off the machine and lock the battery isolation switch before starting any work.
- ▶ Make sure that the hydraulic pump is off and that the system is depressurized before starting work.

## 9.2 Boom Overview




*Boom*

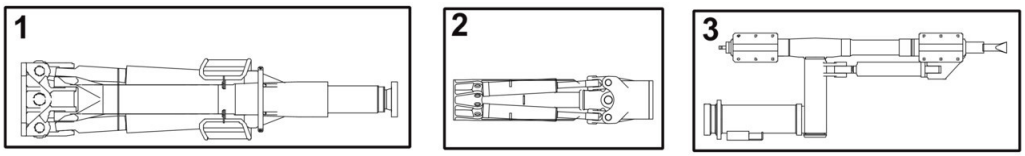
| | | | |
|---|---|---|---|
| 1 | Attachment plate | 2 | Rear boom cylinders |
| 3 | Telescopic unit | 4 | Front boom cylinders |
| 5 | Boom head | 6 | Rotary actuator |
| 7 | Tilt cylinder | 8 | Feed extension cylinder |
| 9 | Bulkhead connection | | |

The hydraulic boom is a telescopic boom with 360° feed rotation. It features three-point suspension at front and rear. Each three-point suspension unit includes two hydraulic cylinders which, through series connection in pairs, provide parallel feed both vertically and horizontally.

A tilt cylinder enables the feeder to be positioned for roof and cross-cut drilling.

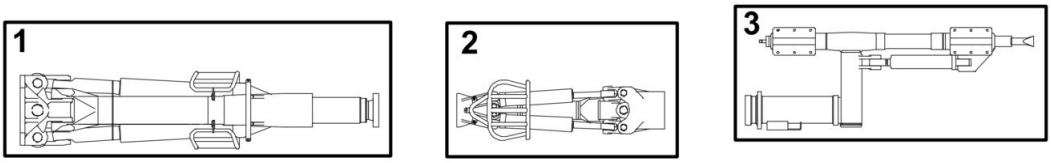
The rotary motion is obtained by a hydraulic rotary actuator and transferred via a stub shaft to the feeder.

Boom BUT 35 G is available in two different basic versions, model M (medium) and model L (large). Both models are available for left-mounted and right-mounted feeder and with or without bulkhead connection.



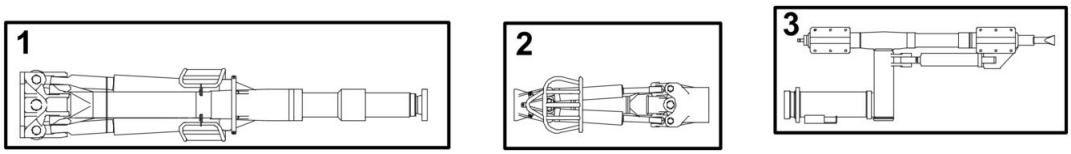

*BUT 35 G model S, left-mounted feeder*

| | | | |
|---|---|---|---|
| 1 | Rear boom section | 2 | Intermediate boom section |
| 3 | Front boom section | | |




*BUT 35 G model M, left-mounted feeder*

| | | | |
|---|---|---|---|
| 1 | Rear boom section | 2 | Intermediate boom section |
| 3 | Front boom section | | |




*BUT 35 G model L, left-mounted feeder*

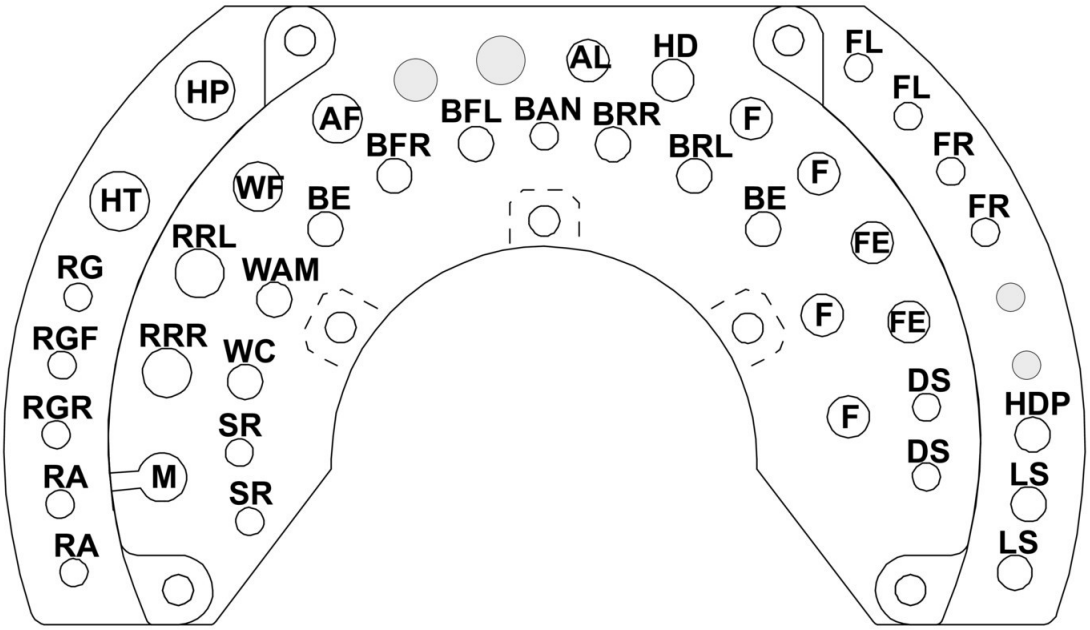
| | | | |
|---|---|---|---|
| 1 | Rear boom section | 2 | Intermediate boom section |
| 3 | Front boom section | | |

## 9.3 Starting To Use a New Boom

When starting to use a new or reconditioned boom, or one that has been out of service for a long period, the following steps should be taken:

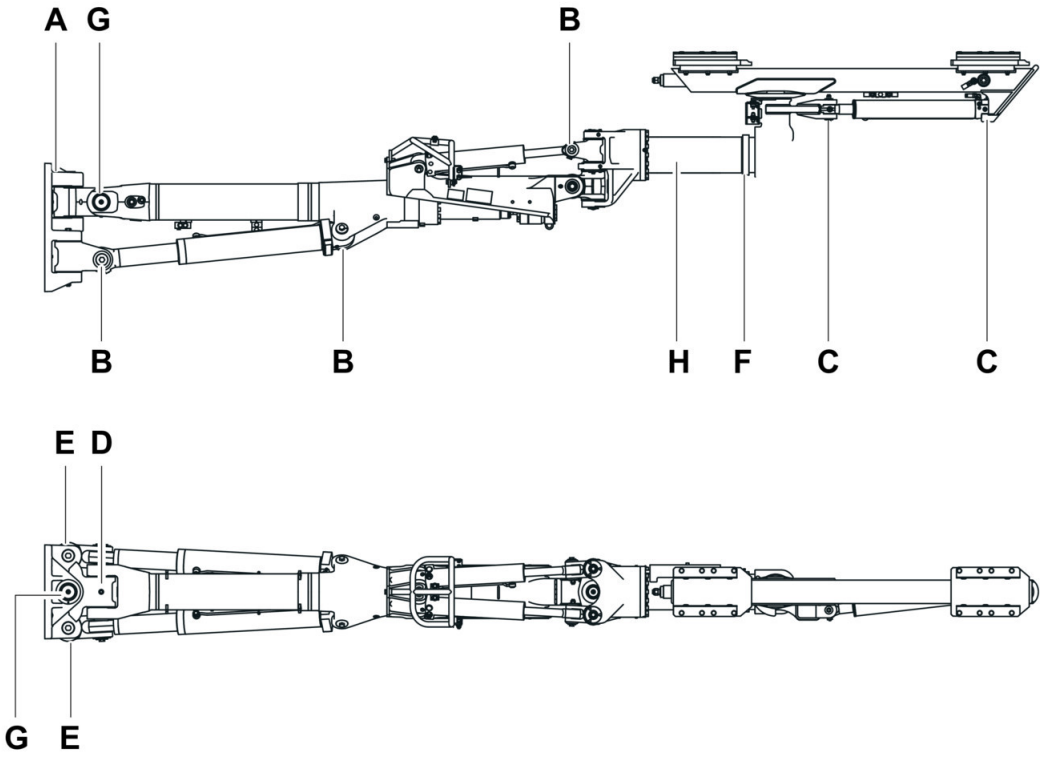
1. Lubricate the boom as described in the maintenance schedule. It is important for lubrication to be effective right from the start.
2. Thoroughly clean all piston rods and sliding surfaces that have been treated with corrosion inhibitor.
3. Check and retighten all bolted joints and expander shafts at least once every shift during the first week the boom is in use.
4. Make sure the pressure in the hydraulic circuits is correctly adjusted. The pressure should be 195-220 bar in the high-pressure circuit and 40 bar in the pilot circuit.
5. Check all operating movements to ensure that all hydraulic cylinders travel to their end positions.
6. Also check that no hoses can be caught up or pinched and that no oil leakage occurs.

## 9.4 Hose Location in Bulkhead Connection




| | | | |
|---|---|---|---|
| AF | Air flushing | AL | Air lubrication |
| BAN | Anti-parallel holding | BE | Boom extension |
| BFL | Left boom cylinder front | BFR | Right boom cylinder front |
| BRL | Left boom cylinder rear | BRR | Right boom cylinder rear |
| DS | Hydraulic drill rod support, option | F | Feed |
| FE | Feed extension | FL | Tilt cylinder |
| FR | Feed rotation | HD | Percussion drain |
| HDP | Reflex damper, drill | HP | Percussion in |
| HT | Percussion tank | LS | Automatic drill return |
| M | Electric cable, option Rod Adding System (RAS) | RA | Rod handling arm, option RAS |
| RG | Claw gripper, option RAS | RGF | Front claw gripper, rod handling, option RAS |
| RGR | Rear claw gripper, rod handling, option RAS | RRL | Rotation left, drill |
| RRR | Rotation right, drill | SR | Stinger, option |
| WAM | Water mist, option | WC | Water lubrication feed, option |
| WF | Water flushing | | |

## 9.5 Lubricate Boom




*Boom BUT 36*

- Lubricate boom attachment (A).
- Lubricate front and rear cylinders (B).
- Lubricate feed lookout cylinder (C).
- Lubricate boom link (D).
- Lubricate cylinder link (E).
- Lubricate telescope bearing (F).

> ! ***NOTE:*** *Operate telescope while lubricating.*

- Lubricate attachment shaft (G).
- Lubricate rotation unit (H).

## 9.6 Check Grease Nipples on Boom

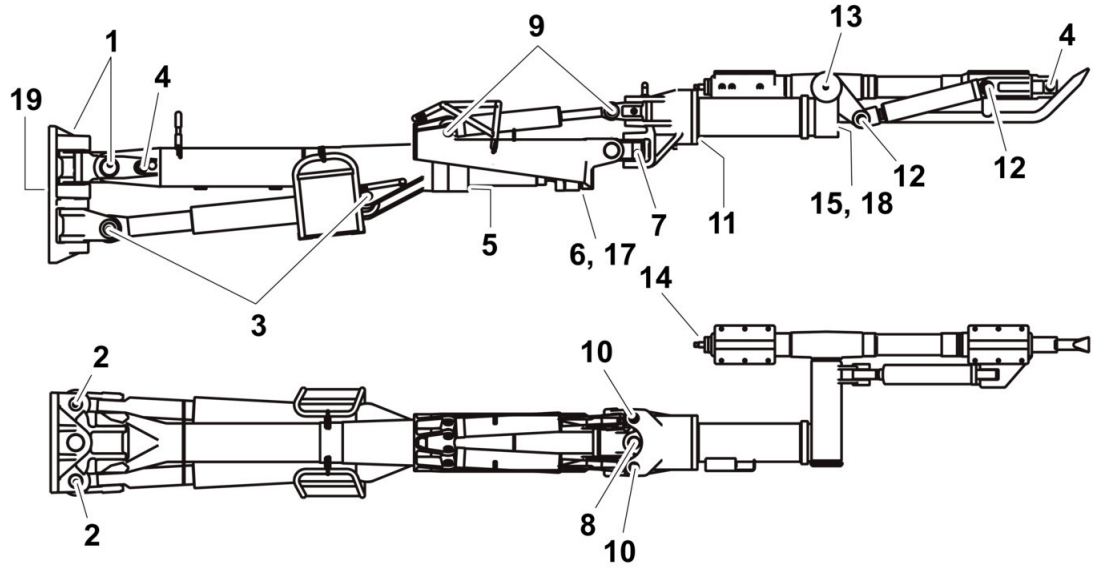
- Check the grease nipples on the boom for damage.

Step result ➔ Replace if necessary.

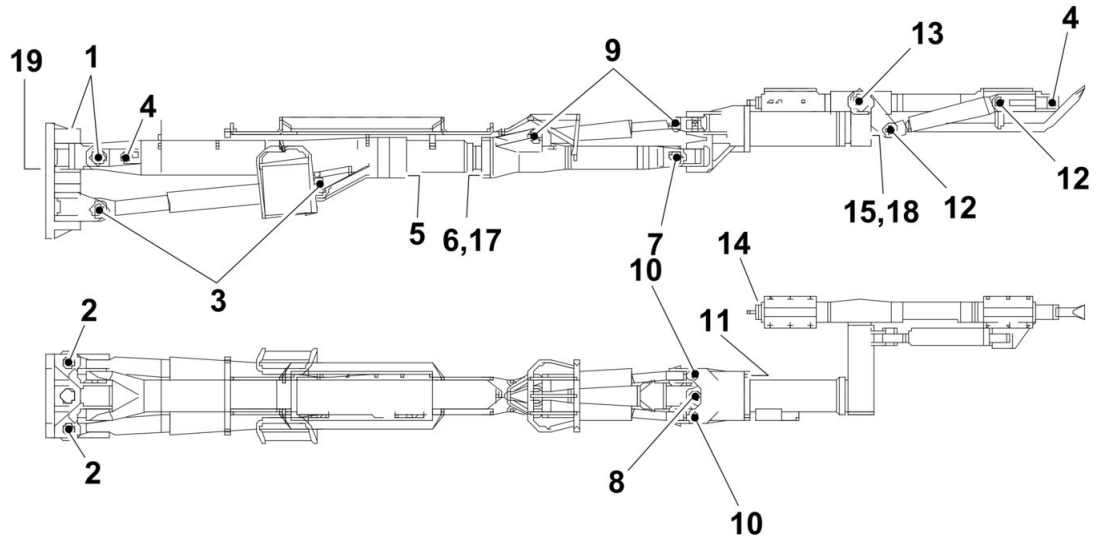
## 9.7 Check Tightening Torques on Boom on BUT 35G

The following table specifies the bolted joints requiring a special tightening torque. Other bolted joints can be tightened to the torque specified in Epiroc standard K4369, see maintenance instructions General.

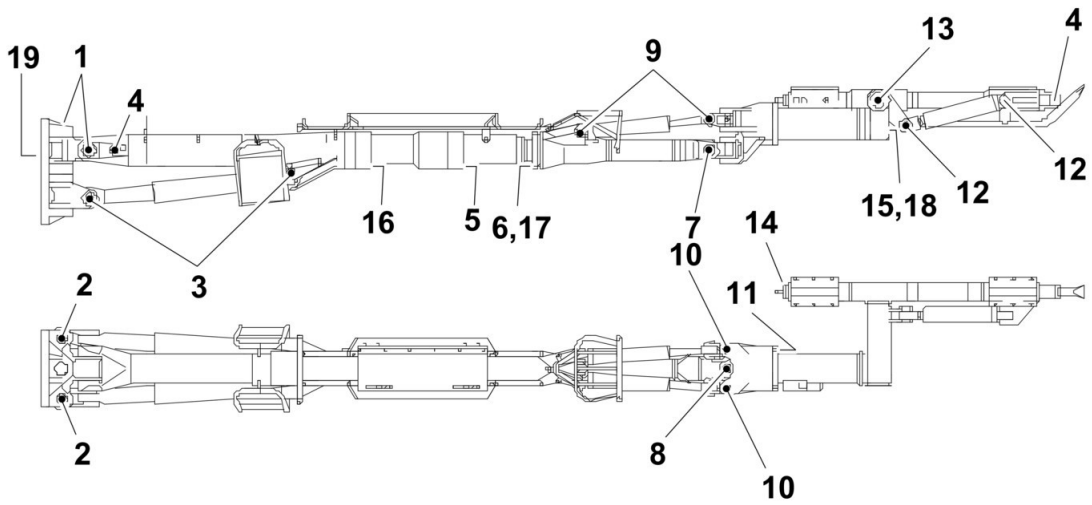
> **NOTE:** *All bolted joints in the following table should be lubricated with Molycote 1000 thread grease or other thread grease having a friction coefficient of 0.11 µ.*




*Bolted joint BUT 35 model S*




*Bolted joints, BUT 35 G model M*




*Bolted joints, BUT 35 G model L*

## Tightening torques

| No. | Bolted joints | Thread | Torque Nm | Tolerance +/- Nm | Quantity |
|---|---|---|---|---|---|
| 1 | Bolt, rear boom link | M20 | 365 | 36 | 2 |
| 2 | Expander shaft, rear cylinder link | M20 | 290 | 50 | 2 |
| 3 | Expander shaft, rear cylinder | M20 | 290 | 50 | 4 |
| 4 | Expander shaft, telescope cylinder and feed extension cylinder | M16 | 195 | 20 | 2 |
| 5 | Bolt, bearing housing-rear boom body (model S and M)<br>Bolt, bearing housing-extension (model L) | M16 | 315 | 31 | 16 |
| 6 | Bolt, telescope-front boom attachment | M16 | 315 | 31 | 12 |
| 7 | Bolt, front boom link | M20 | 365 | 36 | 1 |
| 8 | Bolt, front boom link | M16 | 187 | 18 | 1 |
| 9 | Expander shaft, front cylinder | M16 | 195 | 20 | 4 |
| 10 | Expander shaft, front cylinder link | M16 | 195 | 20 | 2 |
| 11 | Bolt, front boom attachment-rotary actuator | M16 | 315 | 31 | 15 |
| 12 | Expander shaft, tilt cylinder | M16 | 195 | 20 | 2 |

| No. | Bolted joints | Thread | Torque Nm | Tolerance +/- Nm | Quantity |
|---|---|---|---|---|---|
| 13 | Bolt, feed holder-attachment shaft | M12 | 128 | 13 | 4 |
| 14 | Lock nut, feed extension cylinder | M24 | 290 | 50 | 1 |
| 15 | Bolt, rotary actuator-cover | M12 | 128 | 13 | 4 |
| 16 | Bolt, extension-rear boom body | M16 | 315 | 31 | 16 |
| 17 | Bolt, telescope-intermediate boom section | M12 | 128 | 13 | 12 |
| 18 | Bolt, feed holder-rotation unit | M12 | 315 | 31 | 16 |
| 19 | Bolt, attachment plate-boom console | M24 | 630 | 60 | 18 |

! ***NOTE:*** *The bolts in bolted joint number 19, attachment plate-boom console, must be of strength class 12.9. The strength class for other joints is given in the spare parts list for the boom.*

## 9.8 Check Hoses, Cylinders, Valves, and Valve Plates

- Check for damage and leaks.

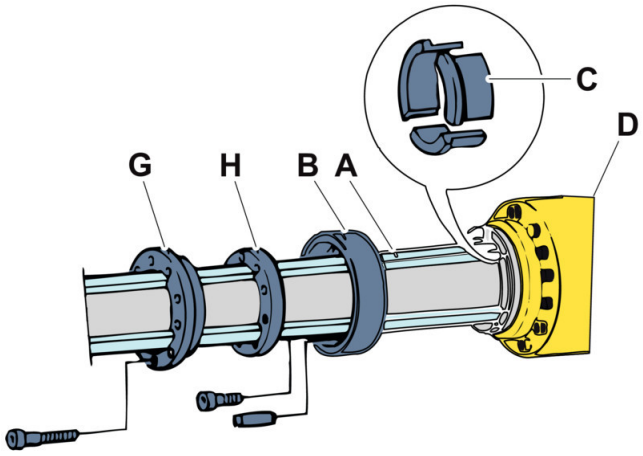
## 9.9 Check Hydraulic Pressure

- Check the pressure setup.

## 9.10 Check Bearing Points

- Check bearing points for damage and leakage.

## 9.11 Checking the Bushings in the Bearing Housing

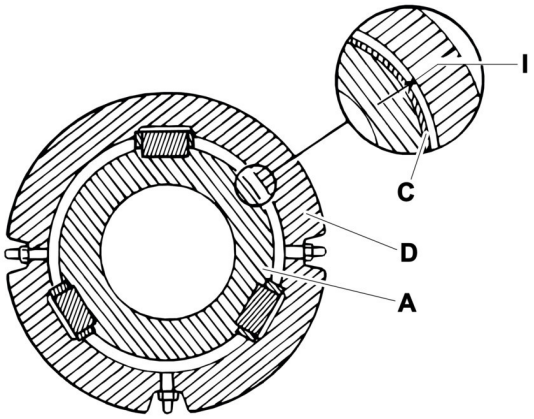



*Checking the bushings in the bearing housing*

| | | | |
|---|---|---|---|
| A | Telescope tube | B | Cover |
| C | Bushings | D | Bearing housing |
| G | Washer | H | Seal |

Thoroughly inspect the telescope device for signs of damage and wear.

1. Extend the telescope tube (A).
2. Remove the washer (G) and seal (H) and then undo the cover (B).
3. Measure the play (I) between the telescope tube (A) and the two upper bushings (C). If the play is greater than 1 mm, remove the bearing housing (D) and change the worn bushings.




*Play between the telescope tube and bushings*

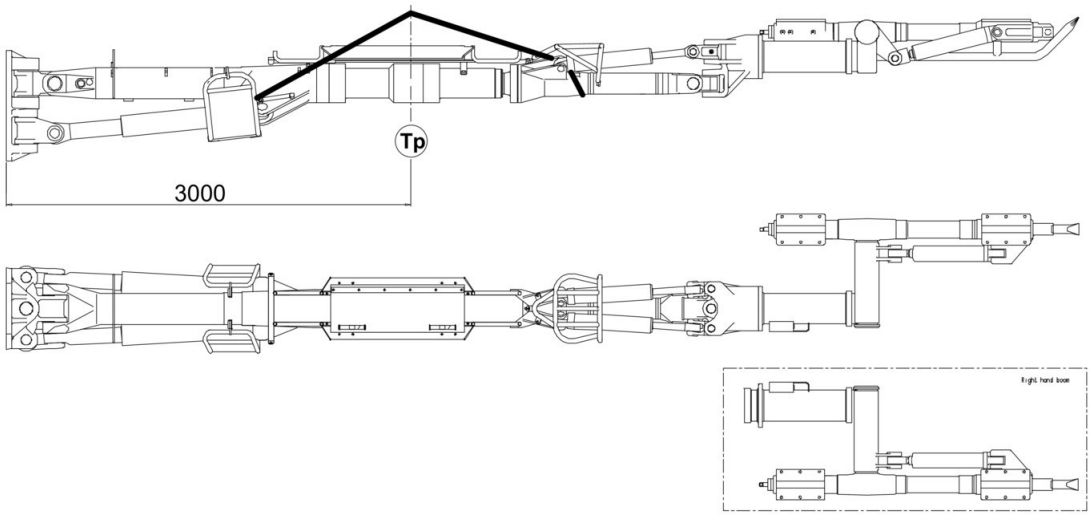
## 9.12 Hoist the Boom

**WARNING**

**Heavy Objects**

Slinging and hoisting heavy objects can cause personal injury.

- ▶ Lift at the center of gravity.
- ▶ Only use slings which are intact and designed for the load that is to be carried.
- ▶ Fasten the straps to lifting eyes when available.
- ▶ Do not stand under the object being hoisted.

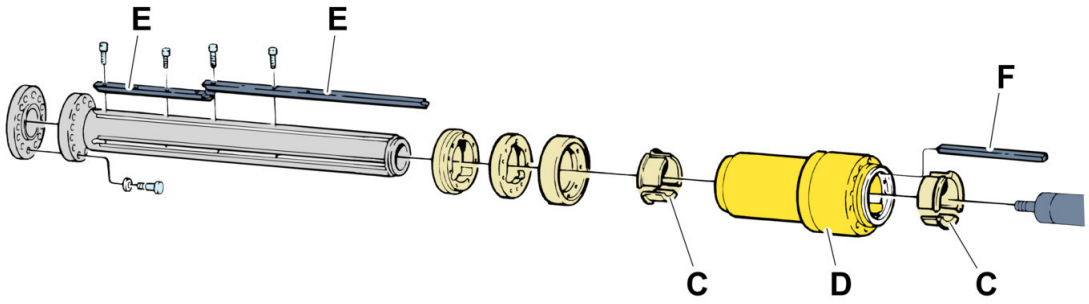



*Slinging BUT 35 G, model L*

1. Check that the lifting device is designed for the load it is to carry.
2. Attach the sling and adapt the positions so that the lifting takes place as close as possible to the center of gravity.
3. Hoist carefully.

> ***NOTE:*** *Make sure that the boom does not start to swing and that the slings do not start to slide off.*

## 9.13 Checking Keys on Telescope Device



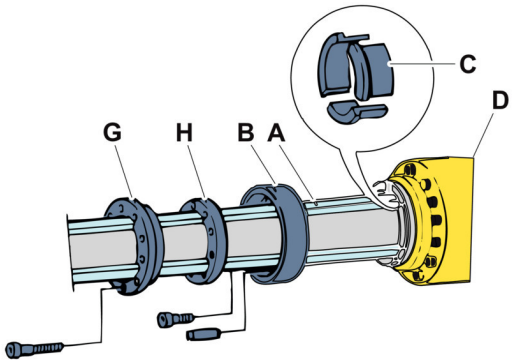

*Telescope device*

| | | | |
|---|---|---|---|
| C | Bushing | D | Bearing housing |
| E | Keys | F | Slide rails |

1. Check the keys (E) carefully. If they are deformed, the damaged area should be ground smooth in order to avoid future damage to the drill cradles (F), bearing housing (D) and bushings (C).

## 9.14 Checking Slide Rails on Telescope Device

1. Remove the washer (G) and seal (H) and then undo the cover (B).
2. Place the feeder on a support and rotate the boom so that the load is taken up on only one side of the keys.
3. The slide rails (F), see above figure, can then be removed from the bearing housing and inspected. Change them if they are worn or scratched.

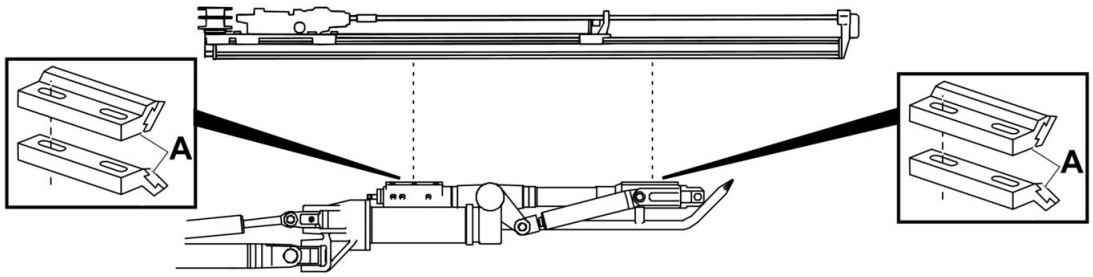



*Bearing housing*

| | | | |
|---|---|---|---|
| A | Telescope tube | B | Cover |
| C | Bushing | D | Bearing housing |
| G | Washer | H | Seal |

# 9.15 Disassembling the Boom

## 9.15.1 Disassembly of Feeder




*Dismantling the feeder*

1. Fit slings round the feeder before dismantling it so that it cannot fall down.
2. Detach all hoses from the feed hose retainer.
3. Unscrew the feed extension cylinder from the feeder.
4. Remove the feeder from the boom by unscrewing the holders (A) from the feed holder.

## 9.15.2 Disassembling Boom Body BUT 35 SL

**WARNING**

**Disassembling and Assembling Components**

Can cause personal injury.

- ▶ Components that could move or fall down must be securely supported or strapped in place during service and maintenance work.

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

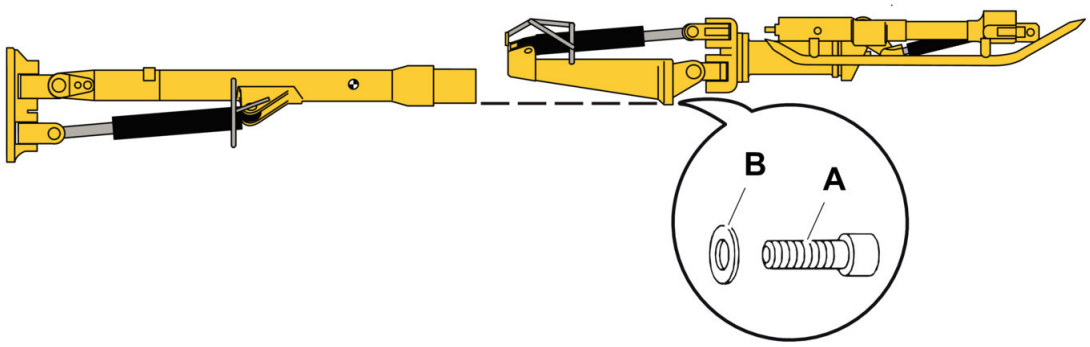
- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

**WARNING**

**Moving Parts**

Can cause personal injury.

- ▶ Shut off the machine and lock the battery isolation switch before starting any work.
- ▶ Make sure that the hydraulic pump is off and that the system is depressurized before starting work.




The boom can be shortened by separating it between the telescope tube and front boom beam.

Precondition ✓ The front boom beam is secured with slings or supported in stands.

1. Disconnect the hydraulic hoses from the cylinders.
2. Plug the hoses and nipples.
3. Disconnect the sensor cables.
4. Remove bolts (A) and washers (B).

### 9.15.3 Disassembling Boom Body BUT 35 M and L

**WARNING**

**Disassembling and Assembling Components**

Can cause personal injury.

▶ Components that could move or fall down must be securely supported or strapped in place during service and maintenance work.

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

▶ Do not stand under the heavy object being lifted.

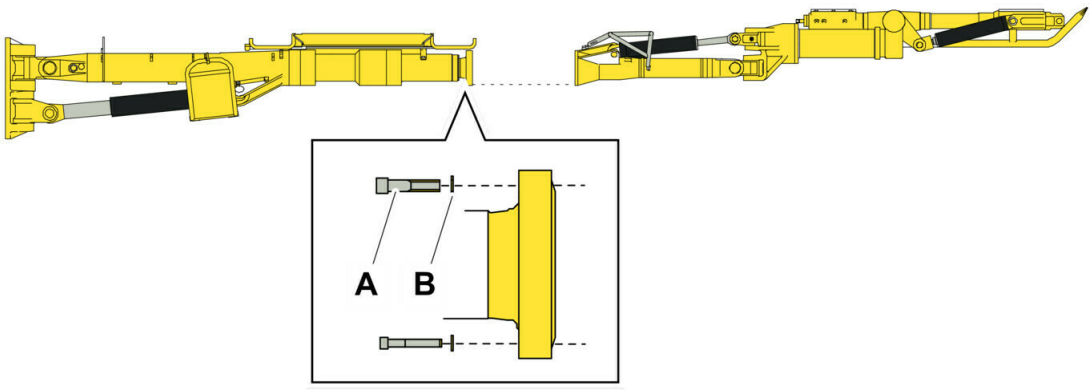
▶ Use adequate lifting device.

**WARNING**

**Moving Parts**

Can cause personal injury.

- ▶ Shut off the machine and lock the battery isolation switch before starting any work.
- ▶ Make sure that the hydraulic pump is off and that the system is depressurized before starting work.




The boom can be shortened by separating it between the extension tube flange and front cylinder bracket.

Precondition ✓ The front boom beam is secured with slings or supported in stands.

1. Disconnect the hydraulic hoses from the cylinders.
2. Plug the hoses and nipples.
3. Disconnect the sensor cables.
4. Remove bolts (A) and washers (B).

## 9.16 Disassembly Boom Extension

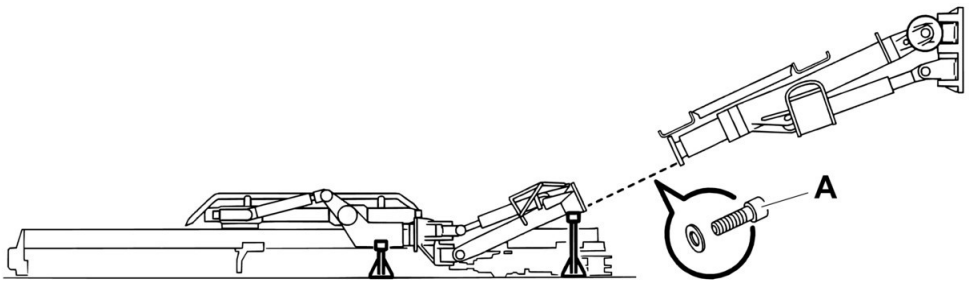
**CAUTION**

**Disassembling Boom Extension**

Can cause personal injury.

- ▶ Observe great care when Disassembling the boom extension.
- ▶ Support rotary actuators and front boom beam securely before removing the boom extension.

The boom must be separated before the telescope device can be removed for maintenance or replacement.

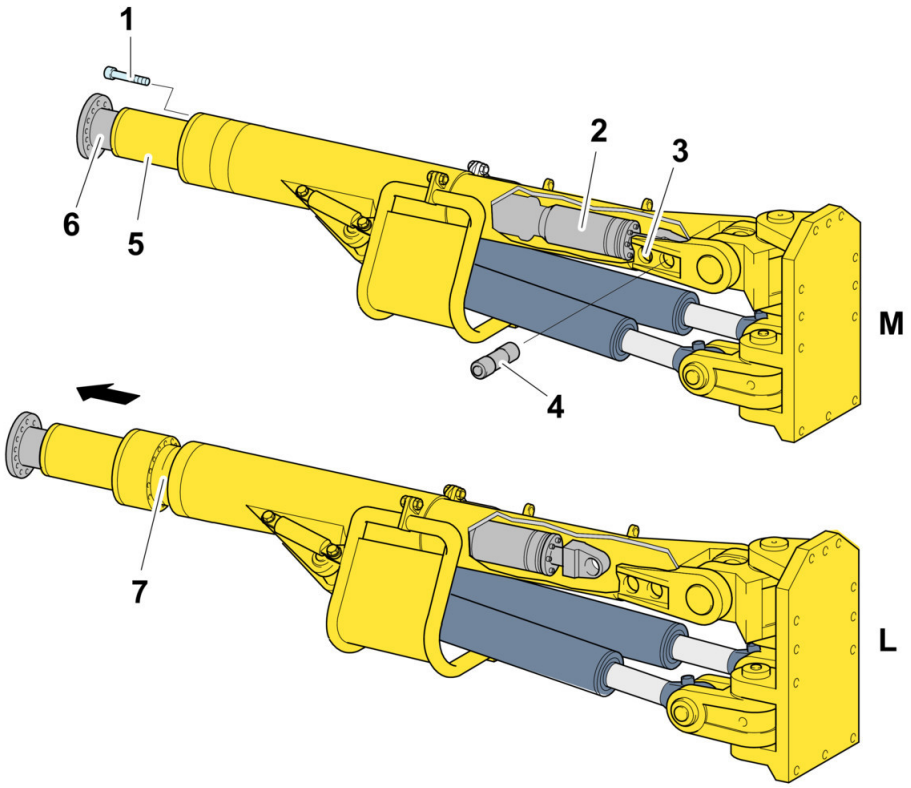



*Dismantling the boom*

1. Extend the telescope to its front end position.
2. Rotate the feed beam up and down.
3. Lower the boom until the feed beam rests on the ground.
4. Position supports firmly under the rotary actuator and front boom beam before removing the telescope.
5. Remove the bolts (A) from the front boom beam.

## 9.17 Disassembly of Telescope and Bearing Housing

The figure below shows the BUT 35 G model M. The method of dismantling the telescope and bearing housing is the same as for model L. The only difference is that the bearing housing (5) on model L is screwed into the extension segment (7) instead of in the rear boom body.




*Dismantling of telescope and bearing housing*

1. Retract the telescope to the rear end position.
2. Fit slings round the bearing housing (5). Use an overhead crane or hoist, etc.

3. Detach the hydraulic hoses (3).
4. Loosen the bolts (1) for the bearing housing (5).
5. Remove the expander shaft (4).
6. Carefully withdraw the telescope tube (6), cylinder (2) and bearing housing (5).

## 9.18 Disassemble Expander Shafts

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

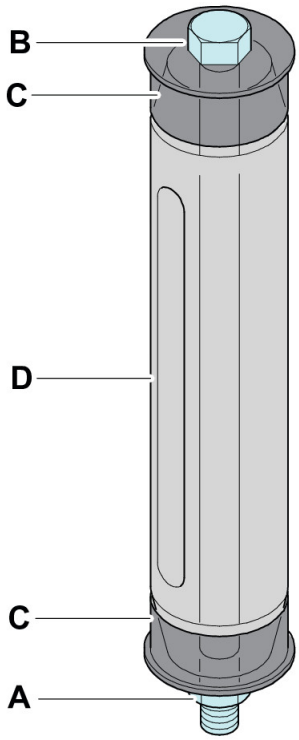
- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

**WARNING**

**Moving Parts**

Can cause personal injury.

- ▶ Shut off the machine and lock the battery isolation switch before starting any work.
- ▶ Make sure that the hydraulic pump is off and that the system is depressurized before starting work.



Precondition ✓ The part of the boom that is held by the expander shaft is secured with slings or rests on stands.

1. Remove nut (A).
2. Pull out bolt (B).
3. Install a bolt appropriate to threads in the bushings (C) and tighten it until one of the bushings loosens.
4. Remove the other bushing.
5. Remove shaft (D).

## 9.19 Assembling Expander Shafts

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

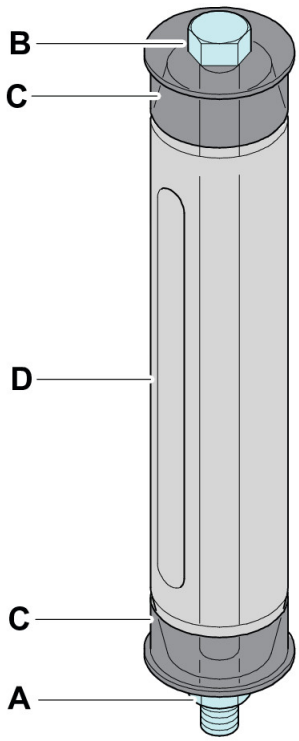
**WARNING**

**Moving Parts**

Can cause personal injury.

- ▶ Shut off the machine and lock the battery isolation switch before starting any work.
- ▶ Make sure that the hydraulic pump is off and that the system is depressurized before starting work.

Play can be eliminated by tightening the lead-through bolt.




1. Lubricate the shaft (D).
2. Install the shaft (D) in the cylinder lug or link.
3. Attach bushings (C).

> ! ***NOTE:*** *Make sure that the bushings are located symmetrically at the attachment point.*

4. Install the bolt (B) and nut (A) in the expander shaft and tighten to recommended special tightening torques.

> ! ***NOTE:*** *If the play cannot be eliminated, replace or repair is necessary. If it is tightened too much, the attaching lug could crack.*

# 10 Rotation Unit

## 10.1 Safety Precautions before Working on Rotation Unit

**WARNING**

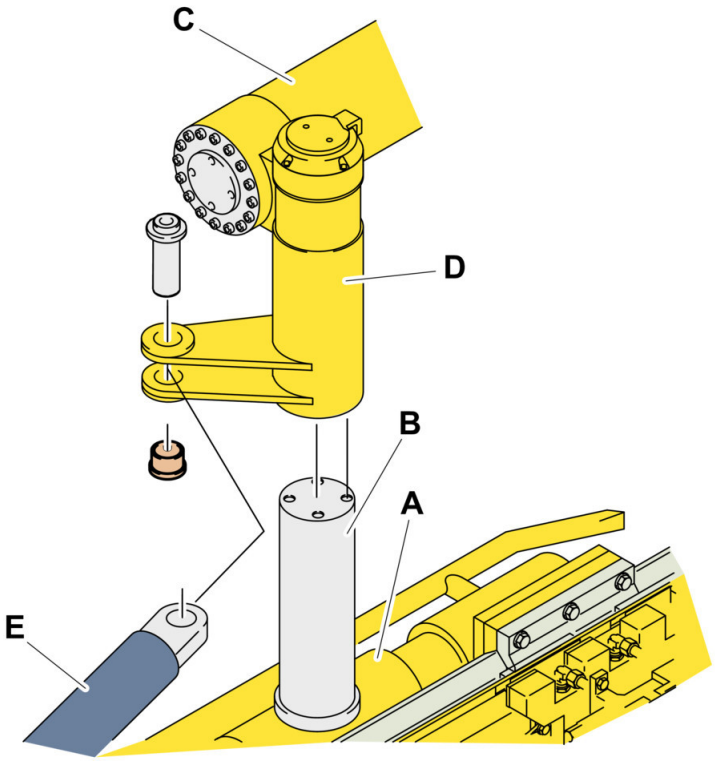
**Disassembly Rotation Unit**

Can cause personal injury.

- ▶ Observe great care when disassembly the rotation unit.
- ▶ Support the feed unit securely so that it is stable.

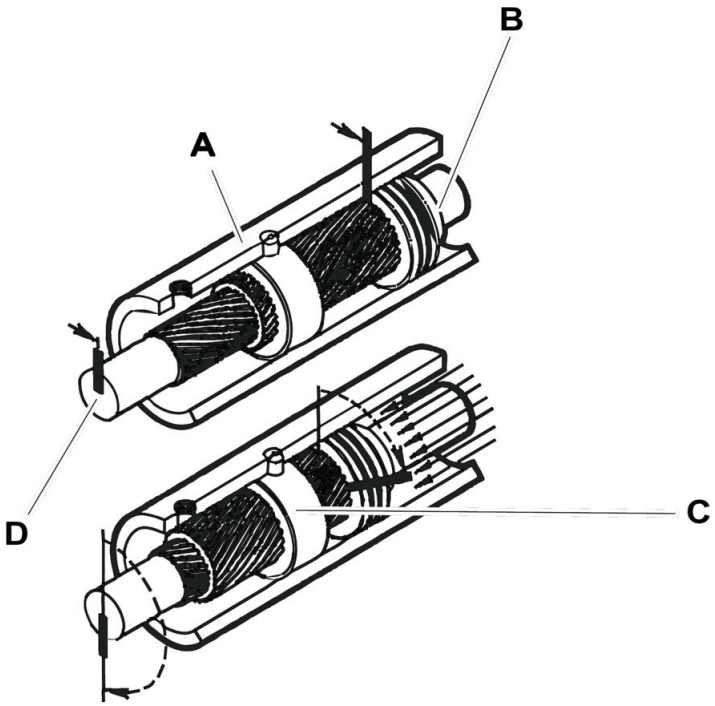
## 10.2 Rotation Unit Overview

The rotation unit consists of a rotary actuator and a bearing housing that is attached to the feed holder attachment shaft.




| | | | |
|---|---|---|---|
| A | Feed holder | B | Attachment shaft |
| C | Rotary actuator | D | Bearing housing |
| E | Tilt cylinder | | |

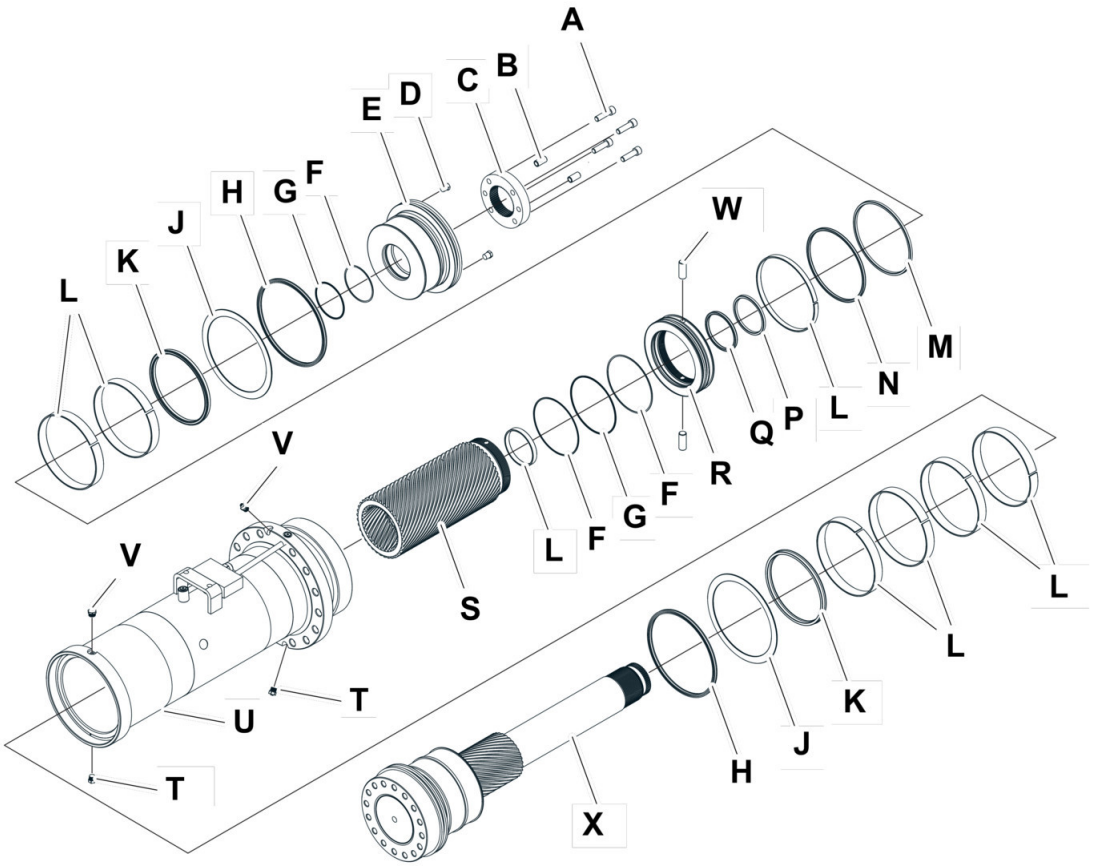
## 10.3 Function of Rotary Actuators




The rotary actuator for boom rotation, which is attached to the front of the telescope unit, converts the linear movement of piston (B) into a rotary movement. The rotary actuator for feed swing, which is mounted at right angles on the rear rotary actuator, has the equivalent function.

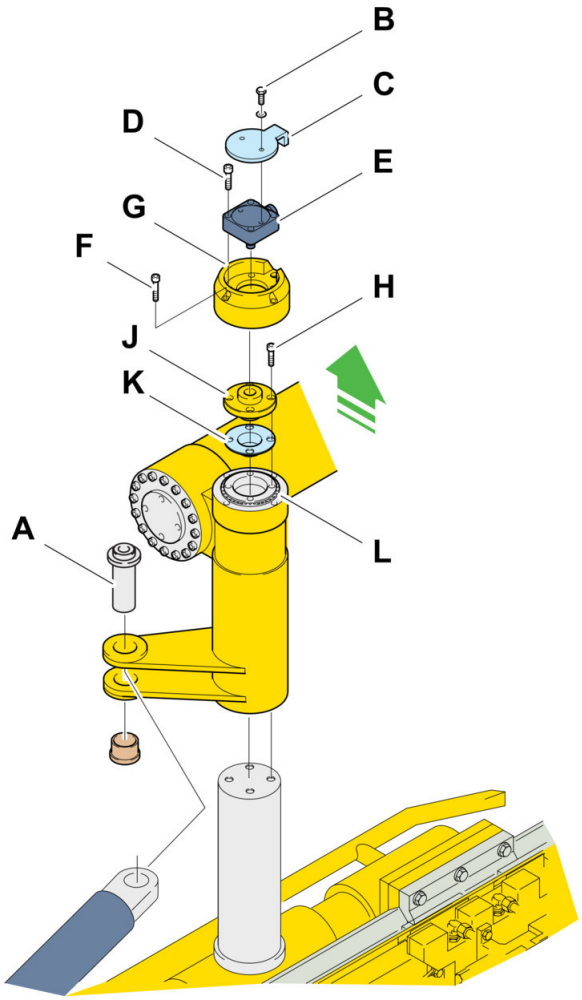
The rotary actuator consists of a housing (A) with a ring gear (C) and two moving parts: a piston (B) and a shaft (D). The shaft has splines that engage with the internal splines of the piston. The external splines of the piston engage with the ring gear splines. The piston moves back and forth in the housing and the splines rotate the shaft.

## 10.4 Main Components of Rotary Actuator




| | | | |
|---|---|---|---|
| A | Bolt | B | Plug |
| C | Retaining ring | D | Locking pin |
| E | Cover | F | Thrust ring |
| G | O-ring | H | Seal |
| J | Washer | K | Shaft seal |
| L | Wear ring | M | Outer piston seal |
| N | Outer piston seal (without O-ring) | P | Inner piston seal |
| Q | Inner piston seal (without O-ring) | R | Piston skirt |
| S | Piston | T | Grease relief valve |
| U | Housing | V | Lubricating nipple |
| W | Locking pin | X | Shaft |

## 10.5 Removing Rotary Actuator from Boom



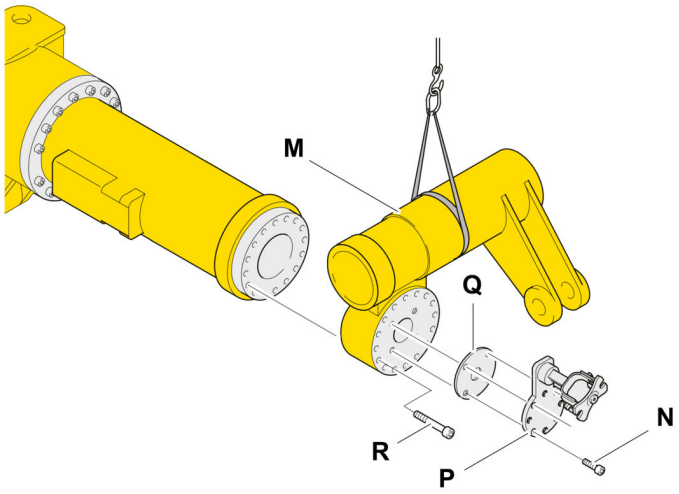

Precondition ✓ Supports are positioned firmly under the feed.

1. Rotate the feed 90º until the feed and the rock drill are under the boom.
2. Disassemble the expander shaft (A) for the tilt cylinder.
3. Remove the bolts (B) and protection (C).
4. Remove the bolts (D) and sensor (E).

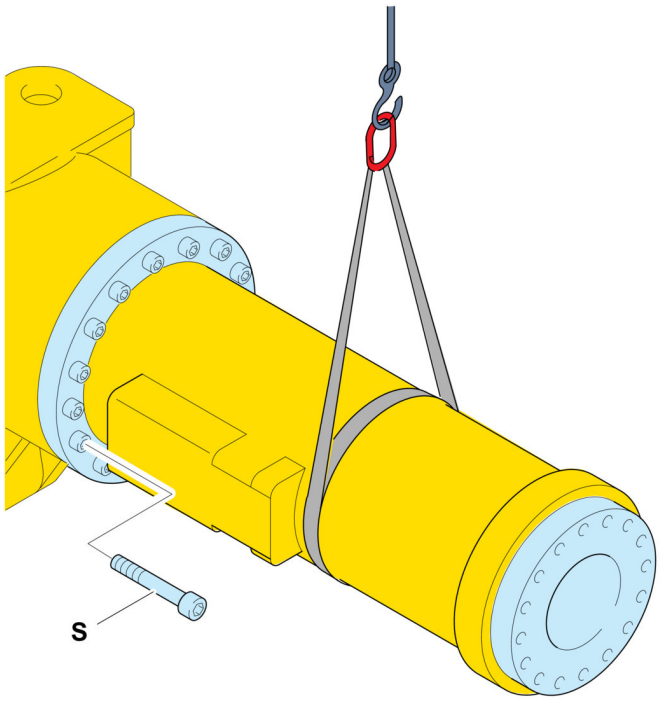
> ! ***NOTE:*** *Applies only to machines with the RCS electronic control system and one of the ABC Regular or ABC Total options.*

5. Remove the bolts (F) and the outer cover (G).
6. Remove the bolts (H), the inner cover (J), and the shim (K).
7. Disconnect the hydraulic hoses that are connected to the feed.
8. Plug all hoses and connections.
9. Lift the boom straight, without damaging the sliding bearings (L) in the bearing housing.

10. Rotate the bearing housing (M) so it reaches its original position.




11. Attach slings around the bearing housing (M).
12. Remove the bolts (N), hose retainer (P) and cover (Q).
13. Remove the bolts (R) and remove the bearing housing.
14. Remove the hydraulic hoses from the overcenter valve.
15. Plug the hoses and connections.
16. Attach slings around the rotary actuator.
17. Remove the bolts (S).



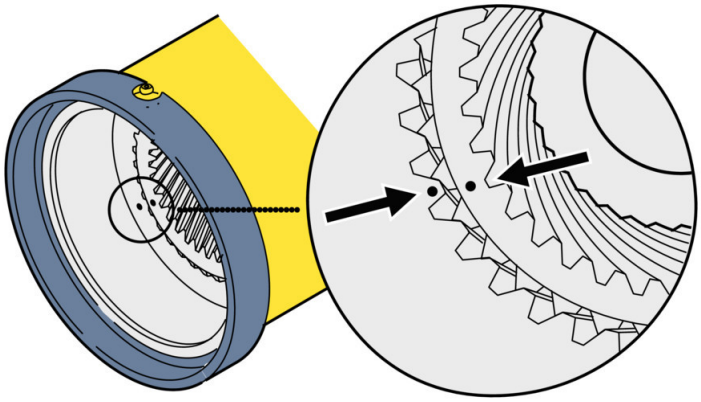

18. Remove the rotary actuator from the boom head.

## 10.6 Disassembly of Rotary Actuator

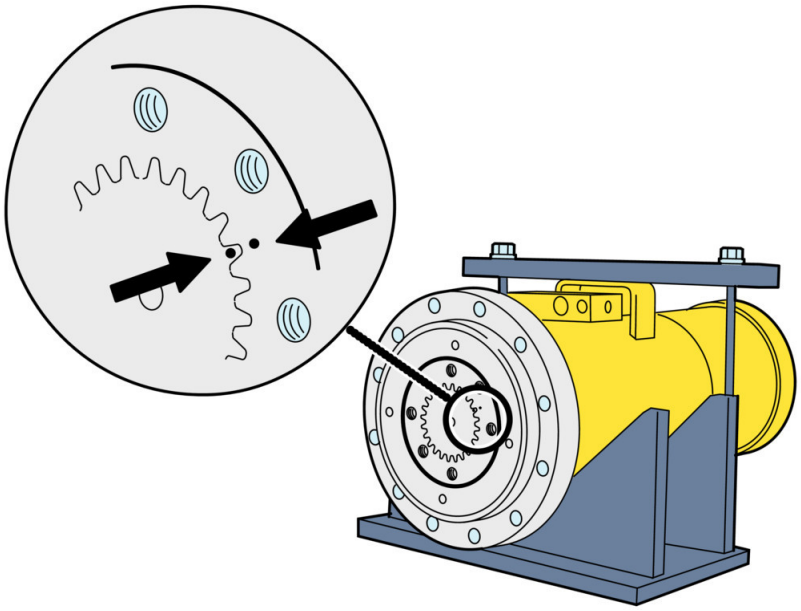
> ***NOTE:*** *When assembling the component parts of the rotary actuator, the splined parts (shaft and piston) must be refitted in their original positions.*

There are two permanent position marks:

- One mark for piston-ring gear
- One mark for shaft-piston



*Permanent marking piston-ring gear*

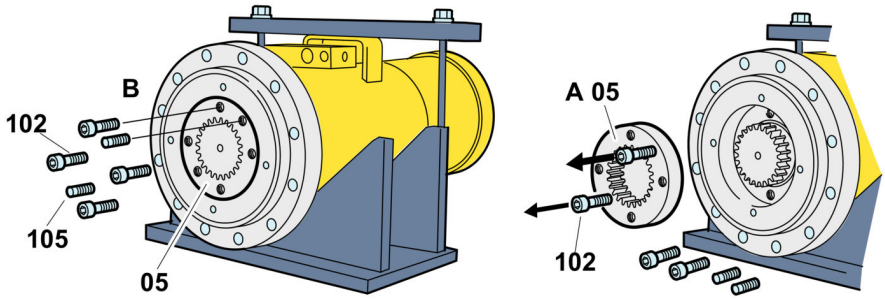


*Permanent marking shaft-piston*

Assembly of the rotary actuator will be facilitated if additional positioning marks are made during dismantling.

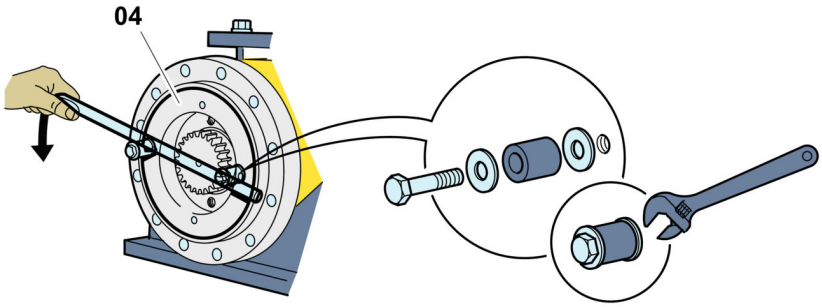
1. Place the rotary actuator on a clean workbench.
2. Remove all hydraulic connections.
3. Remove the overcentre valve and associated components.
4. Mark the relative positions of the retaining ring (05), cover (04) and shaft (02) using a scriber or pen.

5. Unscrew the bolts (102) and plugs (105). Screw two of the bolts (102) in the threaded holes of the retaining ring (05). By means of the bolts, remove the retaining ring from the shaft splines (ring gear).




*Removing the retaining ring*

6. Screw two bolts with washers or sleeves in the cover (04) and use a tommy bar or similar to unscrew the cover from the shaft.

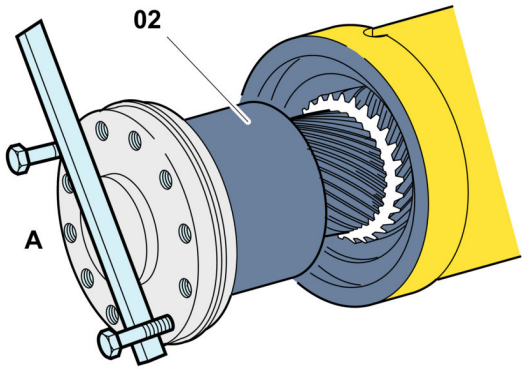



*Removing the cover*

> ***NOTE:*** *In certain cases the cover may be screwed in extremely hard. An iron bar can then be welded to the cover to provide greater leverage.*

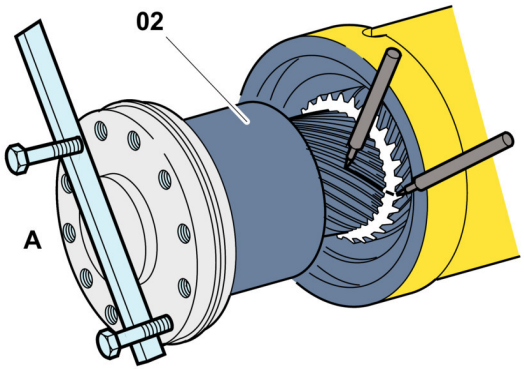
7. Screw two bolts in the shaft (02) flange. These bolts enable the shaft to be turned with the aid of a tommy bar or similar. Turn the shaft clockwise. It will start to rotate out of the housing.

> ***NOTE:*** *Do not turn the shaft so much that it no longer engages with the piston. Before the shaft is unscrewed all the way out its position relative to the piston must be marked, see next point.*




*Removing the shaft*

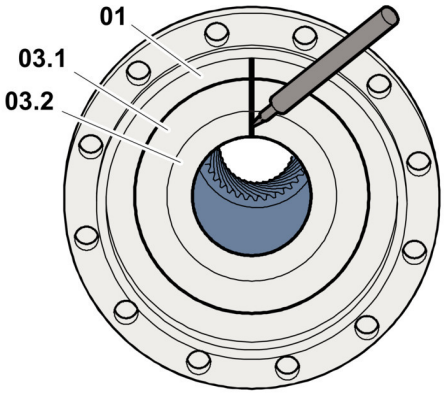
8. Using a pen, mark the position of the shaft relative to the piston, i.e. mark one of the shaft splines and the corresponding groove in the piston. See example in the following figure.




*Marking shaft-piston*

9. Unscrew the shaft all the way out of the housing.
10. Use a plastic drift and hammer to drive the piston (03.2) (including piston skirt (03.1)) out of the housing (01).

> ! ***NOTE:*** *Auxiliary marks must be made to ensure that the piston will be refitted in its correct position. For this to be possible, however, the piston must first be released fully from the ring gear. Hold the piston in this position and use a pen to mark the housing (01), piston skirt (03.1) and piston (03.2).*




*Marking housing-piston skirt-piston*

After marking, the piston can be removed from the housing. Exercise care to avoid damaging the piston and housing.

11. The piston and piston skirt need not be removed further unless it is suspected that the O-ring (210) may be damaged. If the O-ring (210) is to be changed mark the relative positions of the piston and piston skirt and then remove the wear rings (300 and 301). Press out the locking pins (100) and unscrew the piston from the piston skirt.

    Replace the O-ring (210) and reassemble piston and piston skirt.

12. Unscrew the grease nipples (111) and valves (112).
13. Remove all seals and bearings.

14. Clean all parts thoroughly and check them for wear.

> ***NOTE:*** *The minimum thickness of the wear rings (300, 301 and 302) should be 3.098 mm. The washers (304) should have a minimum thickness of 3.048 mm.*

## 10.7 Assembly of Rotary Actuator

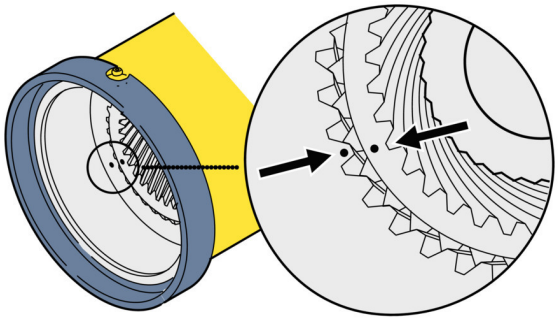
1. Thoroughly clean all parts and blow them dry with compressed air. Make sure that all position marks are still clearly visible.
2. Carefully inspect the threads on the shaft (02) and cover plate (04) and grind away any burrs with abrasive cloth.
3. Screw the cover on the shaft.
4. Lubricate all seals and contact surfaces with hydraulic oil.

> ***NOTE:*** *Always change the seals and bearings when assembling rotary actuators.*
>
> ***NOTE:*** *Never use sharp tools when fitting seals.*

5. Fit the wear rings (300 and 301) on the piston.

> ***NOTE:*** *Fitting the piston is the most difficult part of reassembling the rotary actuator. It may therefore be a good idea to practice this without any seals on the piston.*

6. Stand the housing (01) upright with the flange upwards. Fit the piston in the housing. Use the markings to make sure it is in the right position. Lay the housing down in a horizontal position when the piston has engaged with the ring gear and check at the other end of the housing that the position of the piston coincides with the permanent markings.

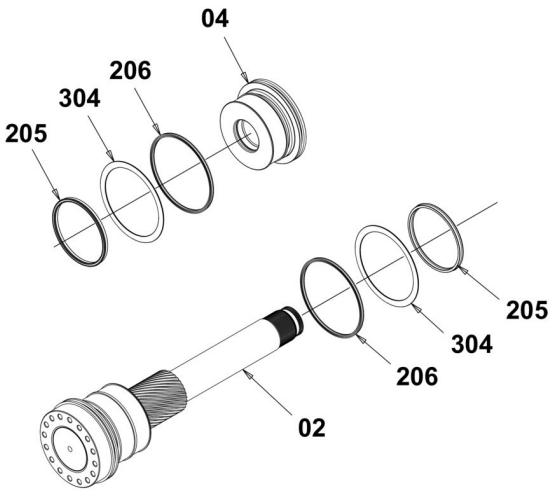


*Permanent markings piston-ring gear*

Screw the piston in fully so that the piston skirt bottoms against the ring gear.

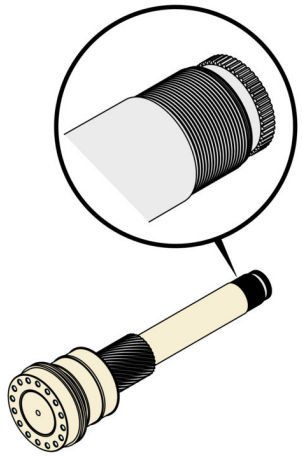
7. Grease the washers (304).

8. Fit a set consisting of washer (304) and seals (205) and (206) on the shaft (02) and another set on the cover (04).




*Fitting washers and seals*

9. Stick masking tape on the ring gear of the shaft so that the piston seals will not be damaged when the shaft (02) is fitted.



*Shaft ring gear and threads*

10. Fit the shaft in place so that its marking is opposite the piston skirt marking. Then remove the masking tape.
11. Apply thread paste to the threaded part of the cover (04) and screw it on the shaft. Tighten to a torque of 800-950 Nm.
12. Apply grease generously to the shaft ring gear. Also grease the bright metal surfaces of the cover.
13. Fit the retaining ring (05) on the shaft and try to find a position where its through hole comes opposite the threaded hole of the cover (04). It may be necessary to loosen or tighten the cover slightly to achieve this.
14. Apply Loctite 242 (or the equivalent) to the bolts (102) and tighten them to a torque of 116 Nm. Apply sealing compound to the plugs (105) and screw them flush into the retaining ring.
15. Pump grease into the grease nipples (111) to remove any impurities and to check that they are in working order. Wipe off surplus grease.

16. Screw the grease nipples (111) and valves (112) in place.
17. Fit the hydraulic connections and overcentre valve.

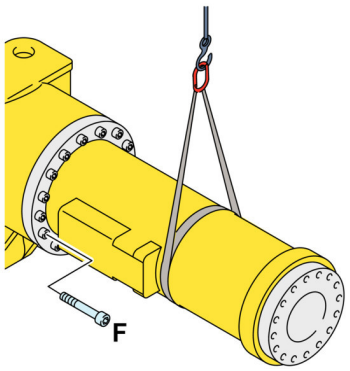
## 10.8 Action after Rotary Actuator Assembly

After mounting of the rotary actuator a check for oil leakage should be performed. If possible, connect up the rotary actuator in a hydraulic test bench and give it a trial run before fitting it on the boom.

1. Pressurize port P2 at 210 bar. No oil should leak out of port P1 or round the cover.
2. Pressurize port P1 with 210 bar. No oil should leak out at port P2 or round the shaft flange.
3. Pump grease into the grease nipples (111) until it comes out through the vales (112). Repeat this after having run the rotary actuator through a number of cycles.
4. Run at least 15 cycles and check that no oil leakage occurs.

## 10.9 Mounting of Rotary Actuator on Boom

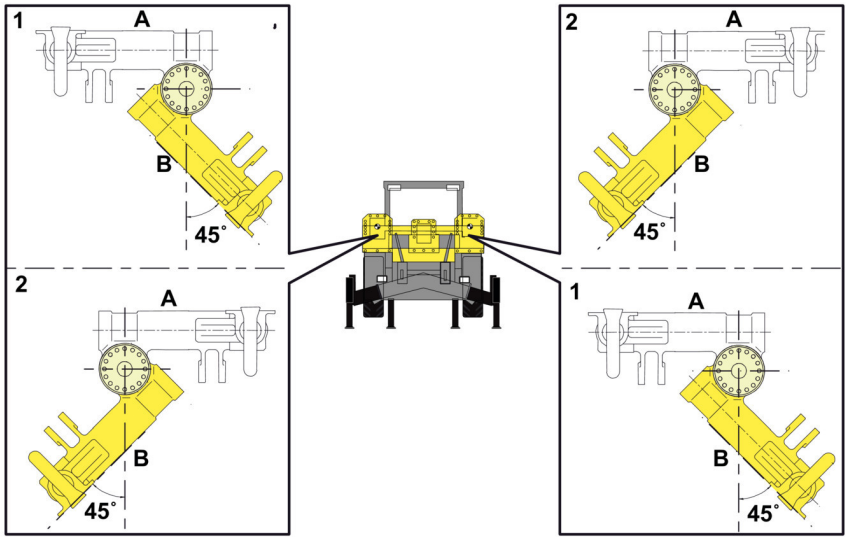
1. Apply slings round the rotary actuator and mount it on the boom head using the bolts (F).




*Mounting of rotary actuator on boom*

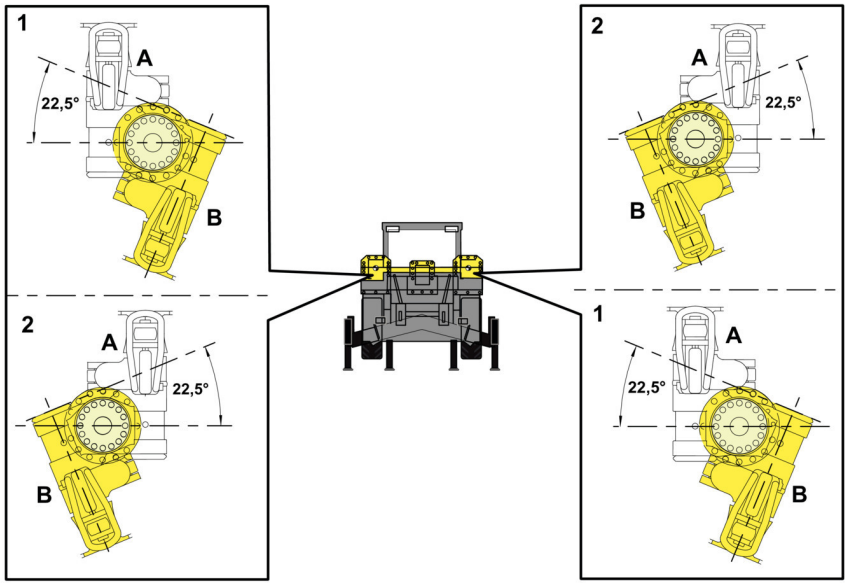
2. Connect the hydraulic hoses to the overcentre valve.

3. When mounting the bearing housing it is important to ensure that the stop position for feed rotation is correct.




*Stop position for feed rotation for side-mounted feeder*

| | | | |
|---|---|---|---|
| 1 | Boom with right-mounted feeder | 2 | Boom with left-mounted feeder |
| A | Bearing housing in horizontal position | B | Bearing housing rotated in under boom to stop position |



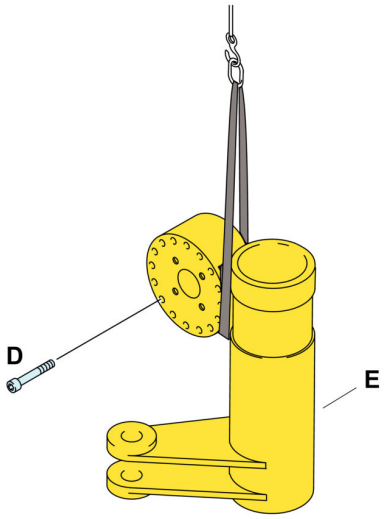

*Stop position for feed rotation for top-mounted feeder*

| | | | |
|---|---|---|---|
| 1 | Boom with right-mounted feeder | 2 | Boom with left-mounted feeder |
| A | Bearing housing in horizontal position | B | Bearing housing rotated in under boom to stop position |

a. Rotate the rotary actuator to the stop position.

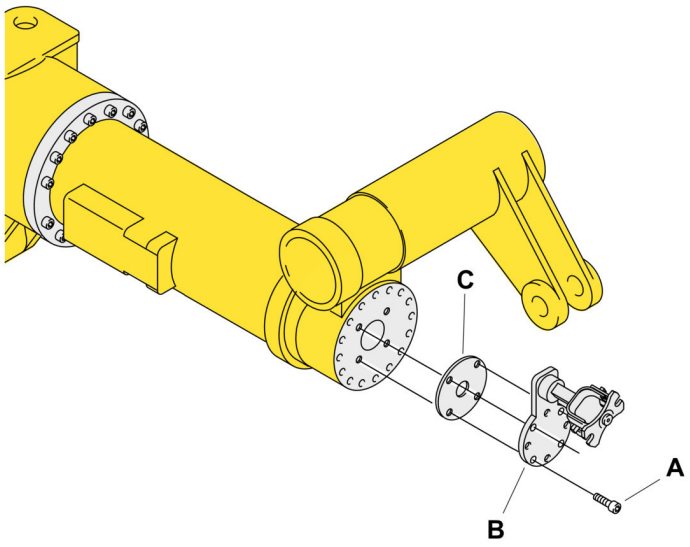
b. Then rotate it in the opposite direction so that the pattern of holes on the rotary actuator's shaft flange is displaced by two holes for side-mounted booms, and by one hole for top-mounted booms.

c. With the rotary actuator rotated to this position the bearing housing (E) can be mounted hanging vertically. Tighten the bolts (D) to a torque of 315 Nm.



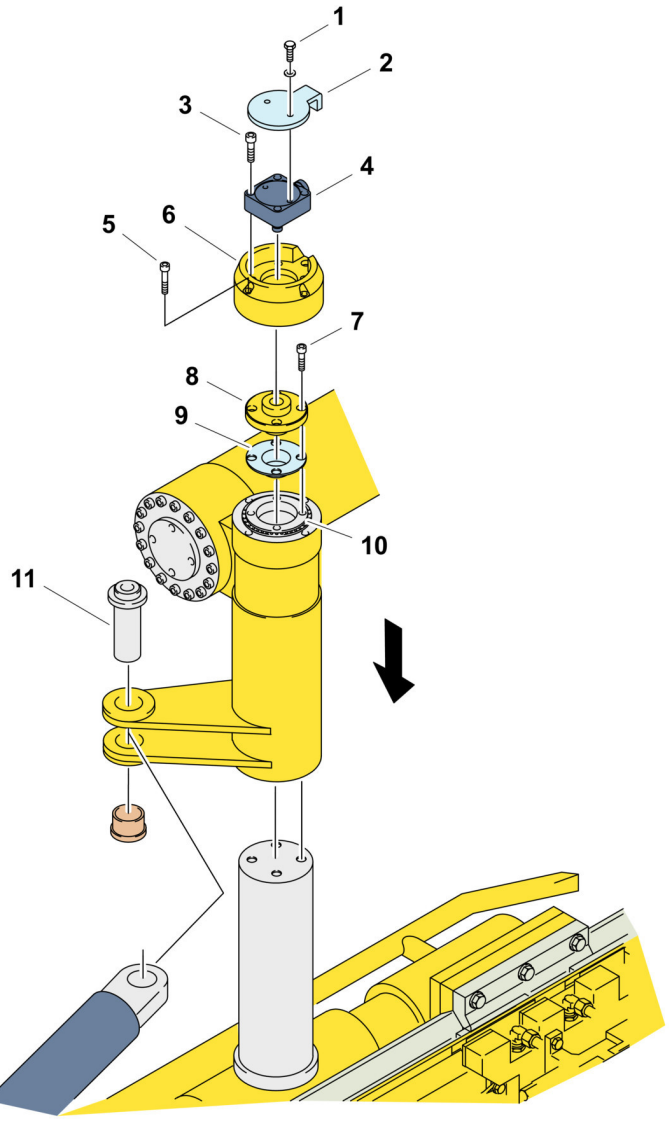

*Mounting the bearing housing*

4. Mount the cover (C) and hose retainer (B) using the bolts (A). Tighten the bolts (A) to a torque of 128 Nm.




*Mounting of cover and hose retainer*

5. Mount the feeder by rotating the bearing housing through 90°. Lower the boom straight down against the feed holder's attachment shaft (12). Take care to avoid damaging the sliding bearings (10) in the bearing housing.




*Mounting the feeder*

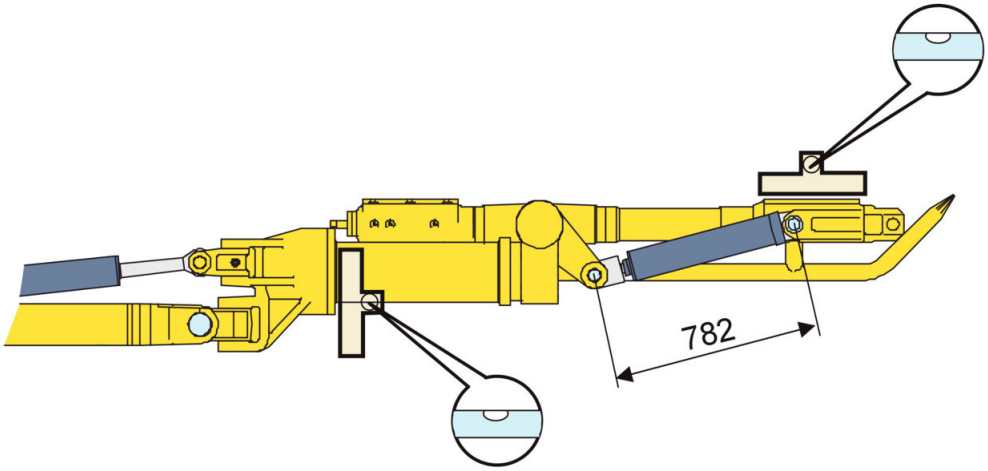
6. Mount shims (9) and inner cover (8). Tighten the bolts (7) to a torque of 128 Nm.
7. Mount the inner cover (6) using the bolts (5). Tighten the bolts (5) to a torque of 75 Nm.
8. Mount the sensor (4) using the bolts (3).

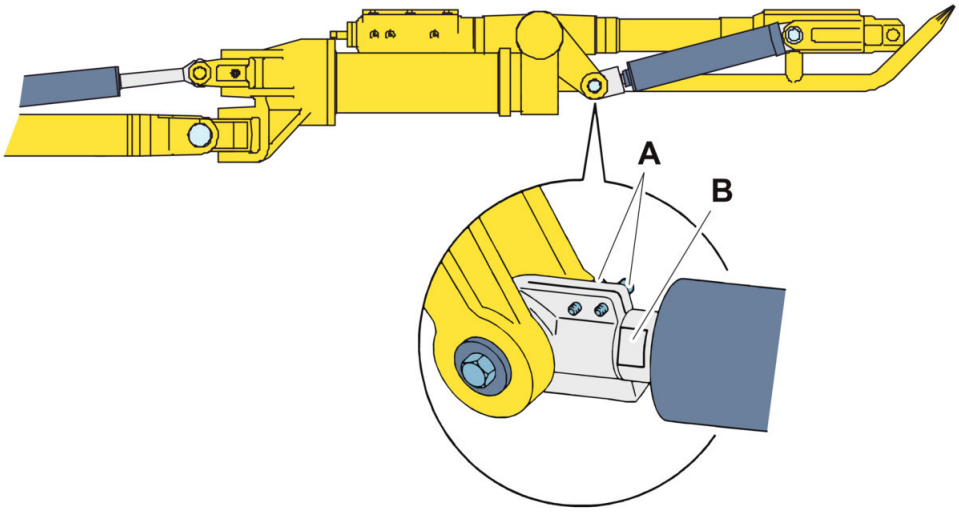
> **NOTE:** *This point applies only to rigs with the RCS electronic control system and one of the ABC Regular or ABC Total options.*

9. Mount the protection (2).
10. Mount the tilt cylinder with the aid of the expander shaft (11). Tighten the expander shaft (11) to a torque of 195 Nm.
11. Lift the boom and rotate the feeder through 90°. Refit the hydraulic hoses.

## 10.10 Adjusting the Tilt Cylinder

> ***NOTE:*** *When mounting the tilt cylinder, start from the basic setting of 782 mm (30.8 in) between the expander shaft centers. Then continue with fine adjustment of the tilt cylinder.*




1. Position the boom horizontally.
2. Position the rotary actuator bearing housing horizontally using a spirit level (placed vertically on the rotary actuator flange).
3. Operate the rotary actuator to bring the feed holder into a horizontal position.
4. When the boom is in this position, the feed holder can be tilted with the tilt cylinder. When the tilt cylinder piston rod is all the way inside the cylinder, the feed holder must be horizontal.
5. To adjust, loosen the locking screws (A) and screw the piston rod in or out using an open-end wrench on the piston rod flats (B) until the feed holder is horizontal.

# 11 Feed Unit

## 11.1 Safety Precautions before Working on Feed Unit

**WARNING**

**Disassembling and Assembling Components**

Can cause personal injury.

- ▶ Components that could move or fall down must be securely supported or strapped in place during service and maintenance work.

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

**WARNING**

**Moving Parts**

Can cause personal injury.

- ▶ Shut off the machine and lock the battery isolation switch before starting any work.
- ▶ Make sure that the hydraulic pump is off and that the system is depressurized before starting work.

## 11.2 Feed 6000-Series



The hydraulic feeds on the BMH/BMHT 6000 series are primarily intended for drift and tunnel drilling. They are fitted on hydraulic booms of type BUT 32, BUT 35, BUT 36, and BUT 45. The feeds are available in different versions depending on the drill that is installed on them. The different numbers are explained, for example, BMH 6818 and BMHT 6816/10.

The first number states the type of feed: 6 = 6000 series.

The second number states the type of drill for which the feed is intended:

- 3 = COP 1238
- 7 = COP MD20
- 8 = COP 1638/1838/2238
- 9 = COP 3038/4038

The third and fourth number state the length of drill rods in feet. For example, 16 = 16 feet.

The fifth and sixth number state the length of the short drill rods in feet and only apply to the telescopic feeds (BMHT).

## 11.3 Install Rock Drill

**WARNING**

**Disassembling and Assembling Components**

Can cause personal injury.

▶ Components that could move or fall down must be securely supported or strapped in place during service and maintenance work.

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

- Do not stand under the heavy object being lifted.
- Use adequate lifting device.

**WARNING**

**Moving Parts**

Can cause personal injury.

- Shut off the machine and lock the battery isolation switch before starting any work.
- Make sure that the hydraulic pump is off and that the system is depressurized before starting work.

**WARNING**

**Risk of Lifting the Rock Drill**

Incorrect handling can cause serious crushing injury or death.

- Use extreme caution when strapping and lifting heavy objects.
- Lifting must be done through the center of gravity.
- Only use straps that are intact and designed for the load they will carry.
- Do not approach a suspended load.

**CAUTION**

**Heavy Object**

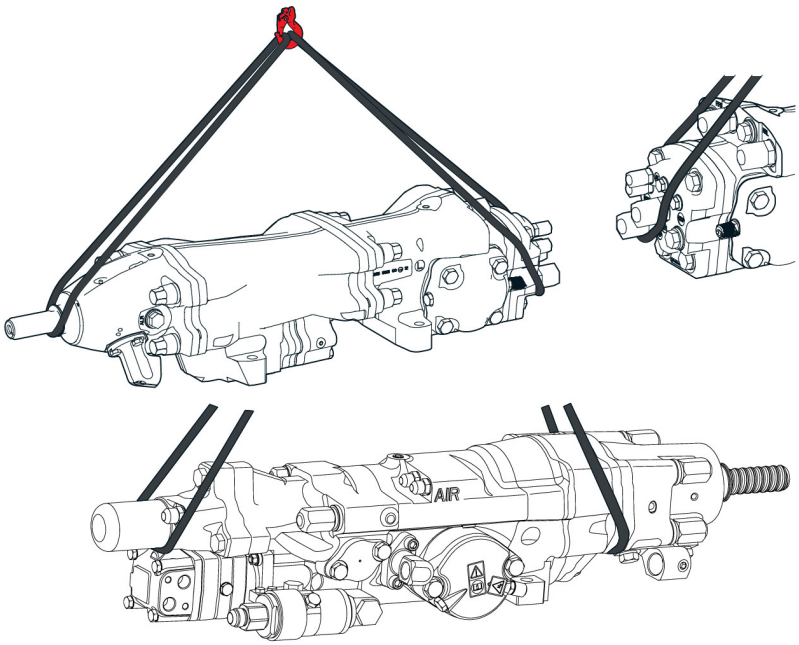
The rock drill is a heavy object and can cause serious injury if it tips over or fall down.

- Do not remove all attachment screws at the same time without having the rock drill supported.
- Do not leave the rock drill unsupported if it needs to be disassembled from the feeder.
- Mount the rock drill on a folding plate for stability when performing work.

! ***NOTE:*** *The procedure describes the installation of rock drill only but can also be applied to the rotation unit.*

1. Clean the corrosion inhibitor from the feed unit.
2. Remove burrs, paint, or coatings from the cradle and the contact surfaces on the rock drill.

3. Remove the attaching bolts from the cradle.
4. Position the rock drill with shims on the cradle and reinstall the bolts, and make sure that the rock drill is installed firmly in place.




5. Tighten the bolts alternately to the proper torque.
6. Connect and attach the hoses to the rock drill.
7. Adjust slide rails and hoses.
8. After four hours, perform a safety check of the rock drill or rotation unit installation.

| Tightening Torque |
| --- |
| 200 Nm (147.5 lbf.ft) |

| See Reference Documentation |
| --- |
| Rock drill instruction manual |

## 11.4 Location of Drill Hoses

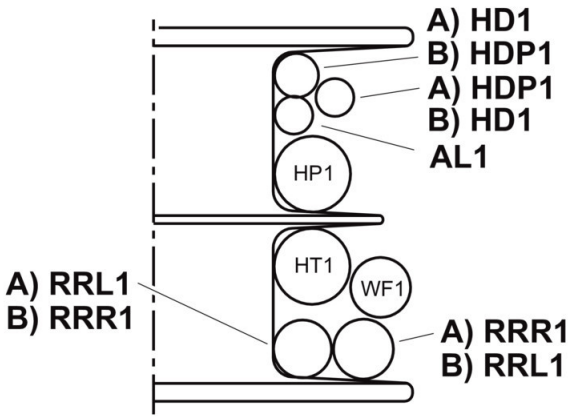
Depending on the drill that is fitted on the feed, the hoses must be positioned in the water hose drum and the feed hose retainer.

### Drill Hose Designations

| Hose Designations | Description |
| --- | --- |
| AL1 | Air lubrication |
| D1 | Drainage |
| HPD1 | Damper |

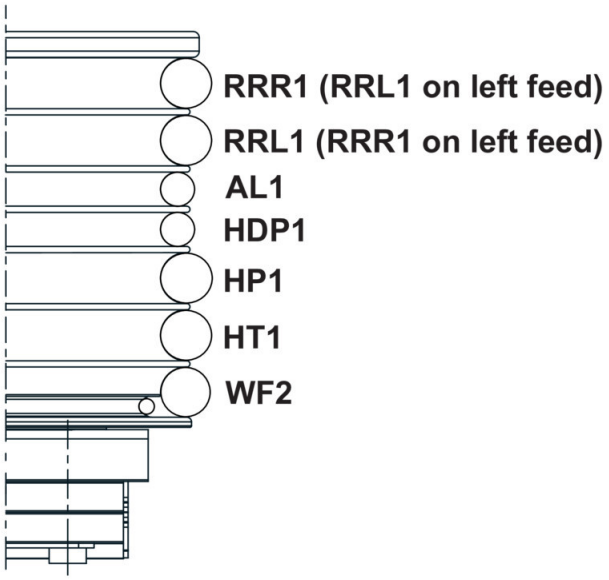
| Hose Designations | Description |
|---|---|
| HP1 | Hammer pressure |
| HT1 | Hammer tank |
| RRL1 | Rotation left |
| RRR1 | Rotation right |
| WF2 | Flushing |

Drill Hose Locations

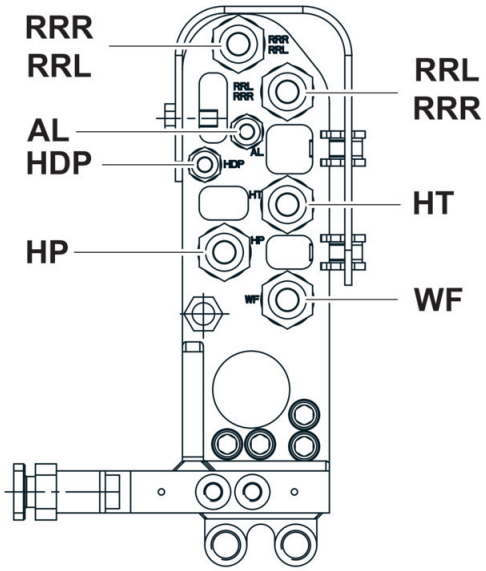



*Water-hose Drum for COP 3038*

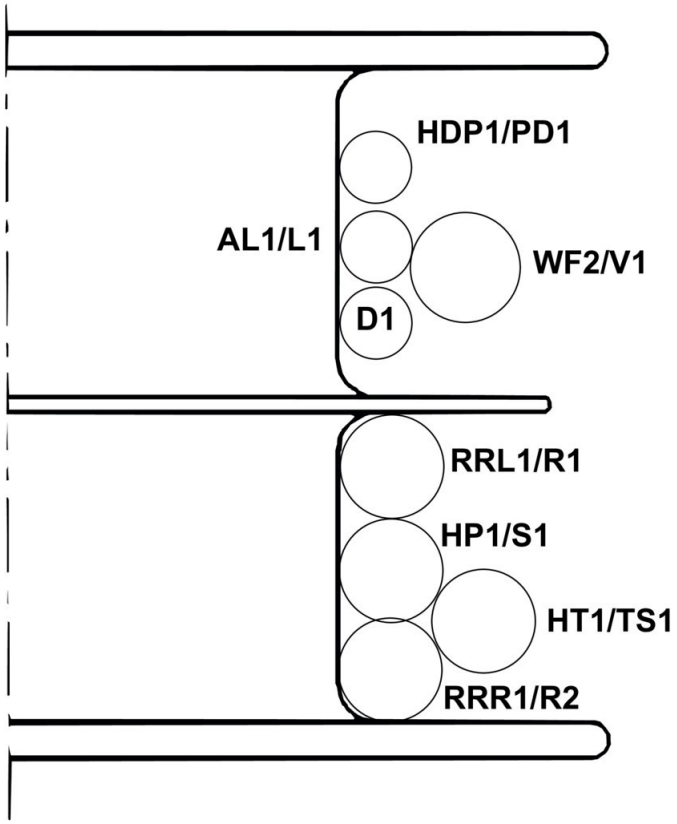
| | | | |
|---|---|---|---|
| A | Right side | B | Left side |



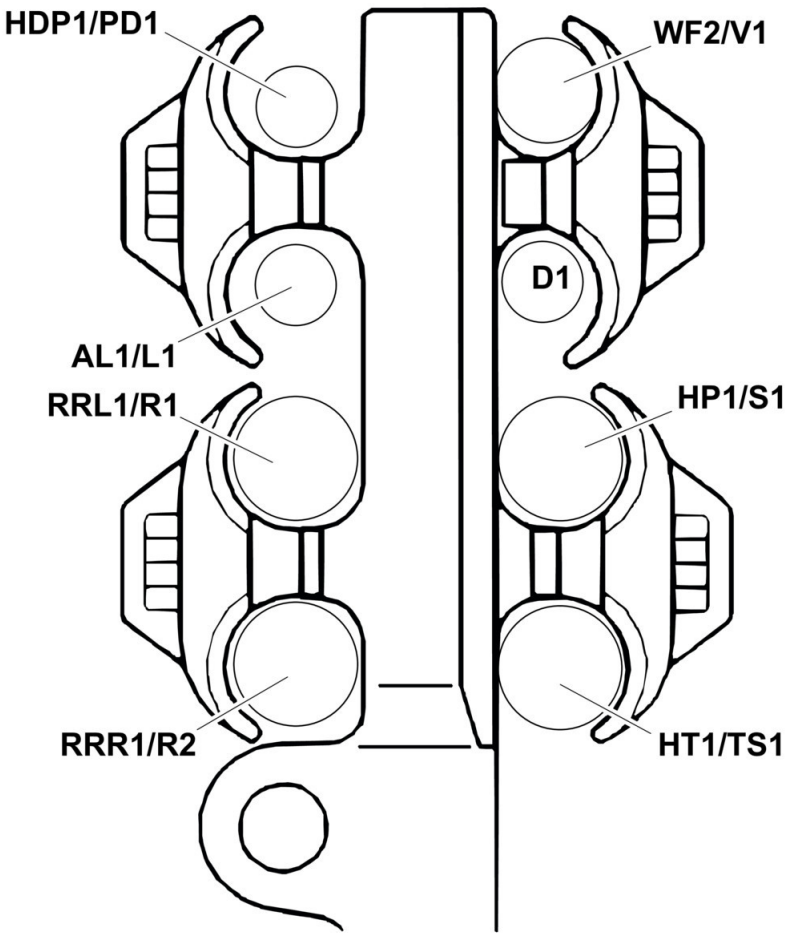

*Water Hose Drum COP MD20*



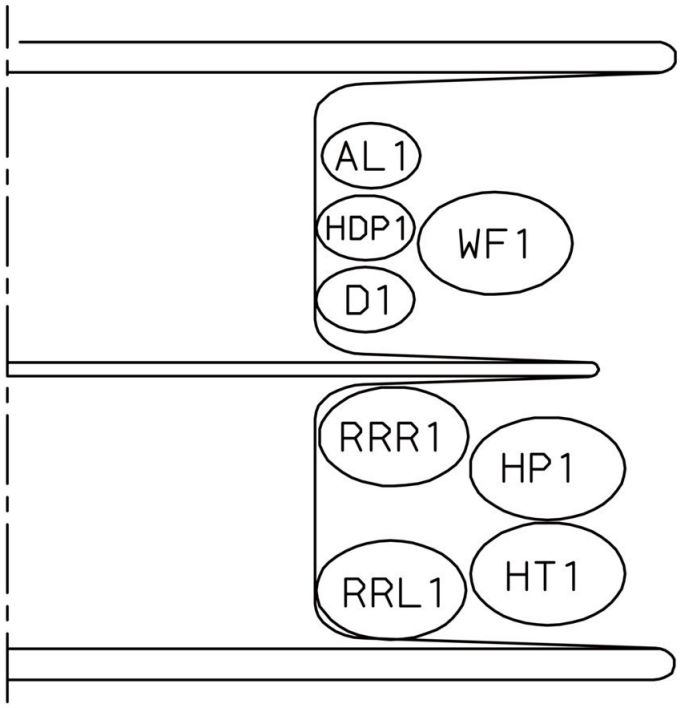

*Feed Hose Retainer COP MD 20*



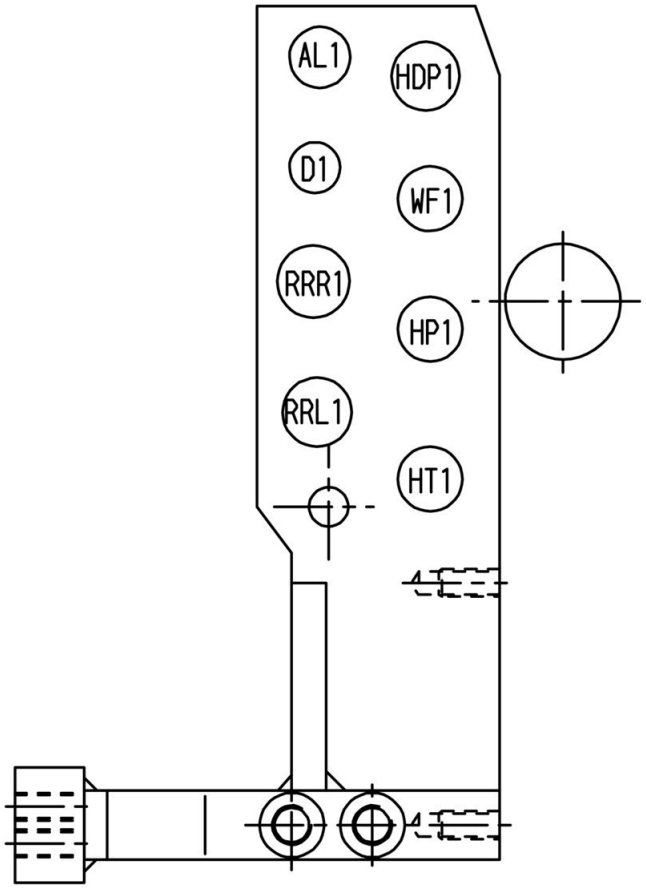

*Hose Drum COP 1838/1638/2238*




*Feed Hose Retainer COP 1838/1638/2238*

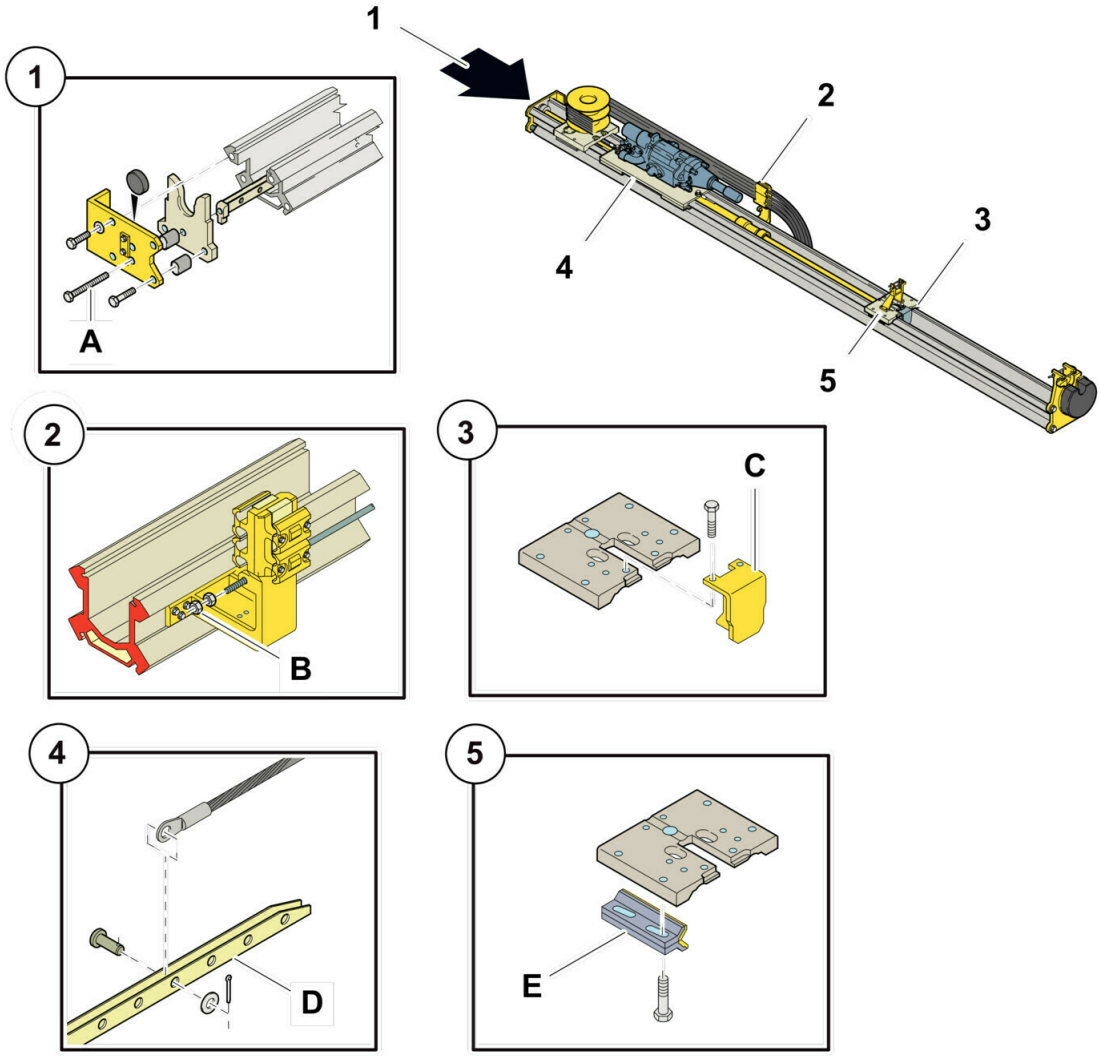



*Hose Drum COP 1838/1638/2238 (feed with bulkhead connection)*




*Feed Hose Retainer COP 1838/1638/2238 (feed with bulkhead connection)*

## 11.5 Locations of Haul and Return Ropes




*Locations*

| | | | |
|---|---|---|---|
| A | Adjustment for haul rope | B | Adjustment for return rope |
| C | Scraper plate | D | Haul rope tensioner |
| E | Holder for intermediate drill rod support | | |

## 11.6 Adjusting Hoses on Rock Drill

1. Loosen the bolts on the hose retainer slightly when adjusting and tensioning the hoses.
2. Tension the hoses and make sure that they are not crossed.

## 11.7 Check Pull and Return Rope on Feed

**WARNING**

**Disassembling and Assembling Components**

Can cause personal injury.

- ▶ Components that could move or fall down must be securely supported or strapped in place during service and maintenance work.

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

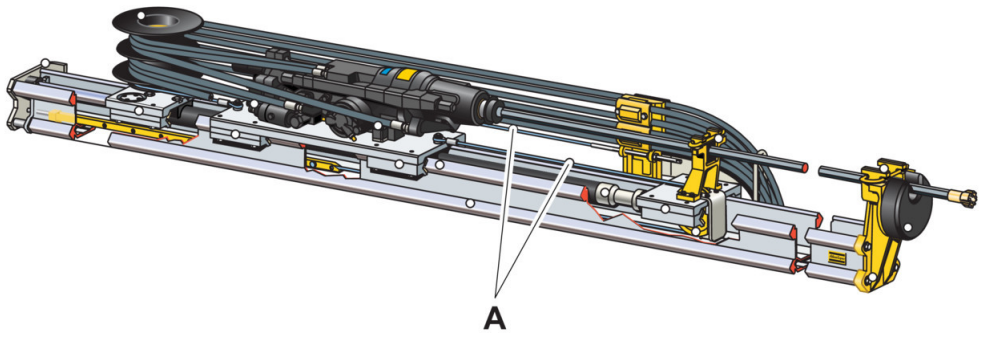
- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

**WARNING**

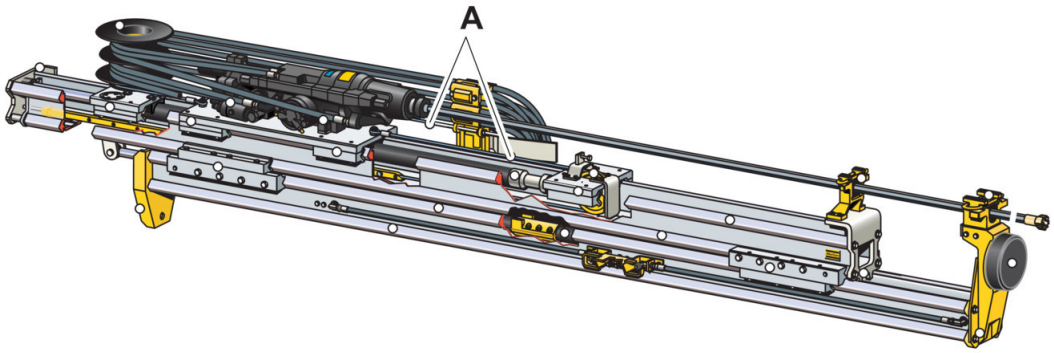
**Moving Parts**

Can cause personal injury.

- ▶ Shut off the machine and lock the battery isolation switch before starting any work.
- ▶ Make sure that the hydraulic pump is off and that the system is depressurized before starting work.



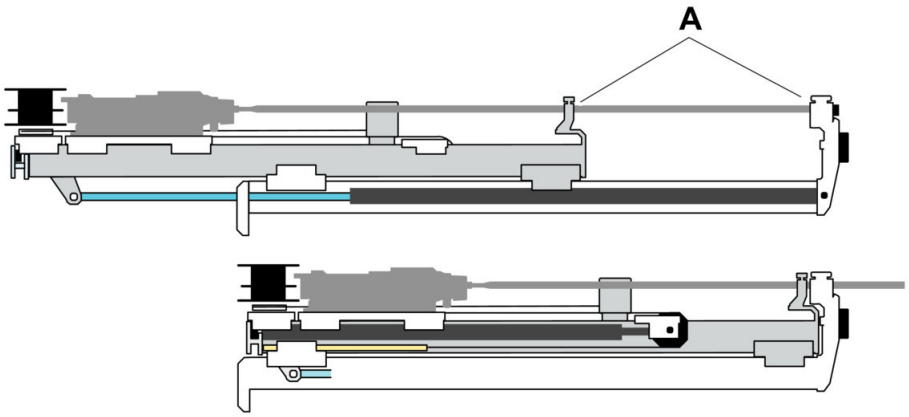

*Feed BMH*



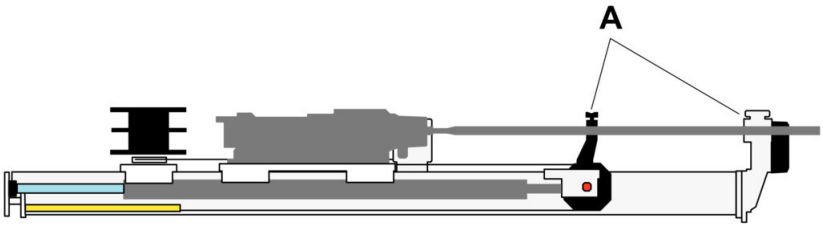

*Feed BMHT*

- Check wear and tension on pull and return rope (A).

## 11.8 Check Drill Rod Bushings on Feed




*Feed BMHT*




*Feed BMH, BMHE, BHMS*

- Check wear on drill rod bushings (A).

## 11.9 Check Slide Rails on Feed

**WARNING**

**Disassembling and Assembling Components**

Can cause personal injury.

- ▶ Components that could move or fall down must be securely supported or strapped in place during service and maintenance work.

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

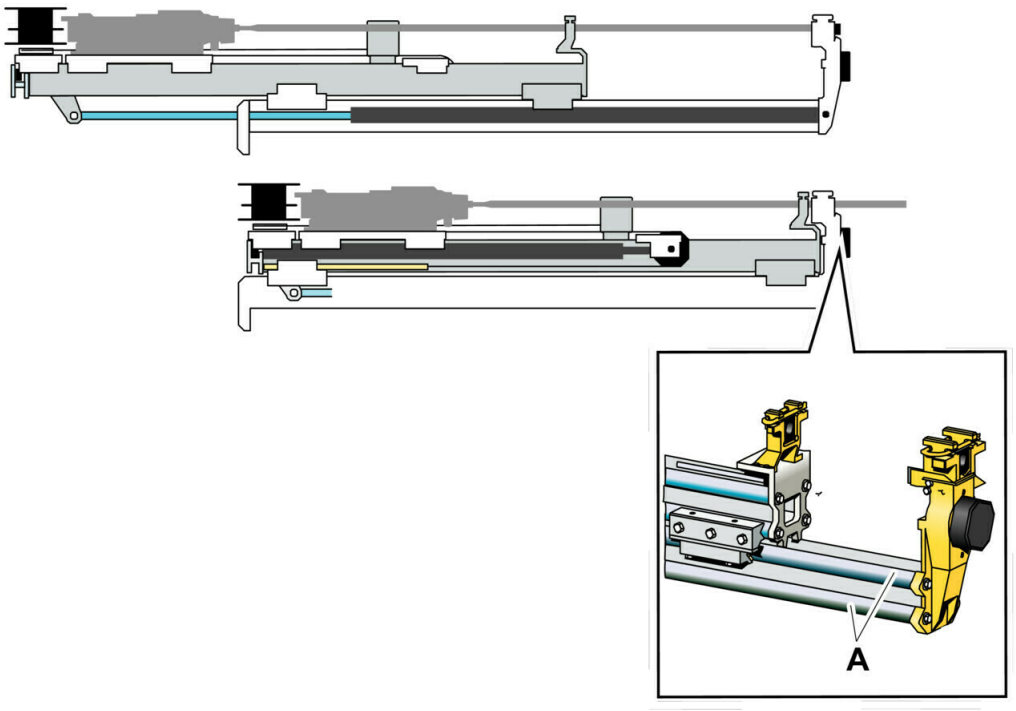
- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

**WARNING**

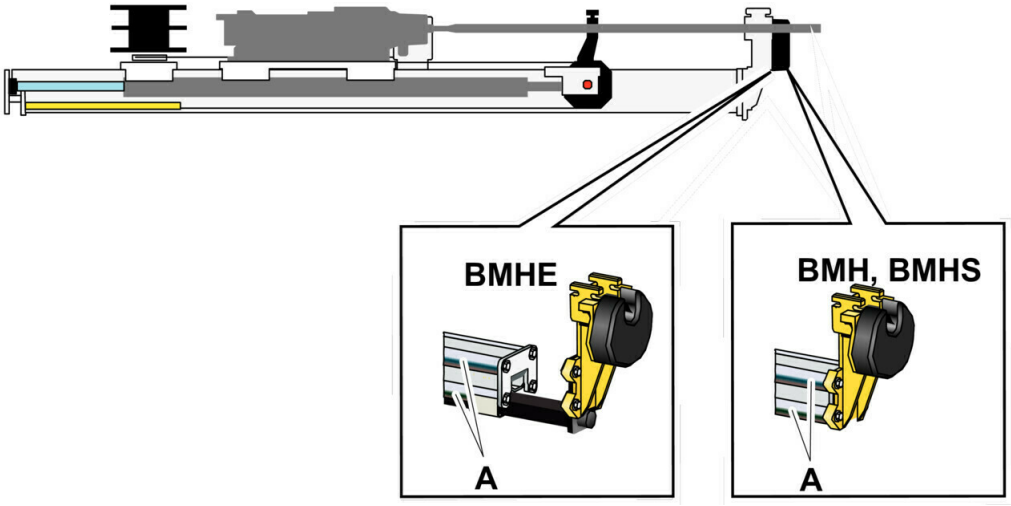
**Moving Parts**

Can cause personal injury.

- ▶ Shut off the machine and lock the battery isolation switch before starting any work.
- ▶ Make sure that the hydraulic pump is off and that the system is depressurized before starting work.



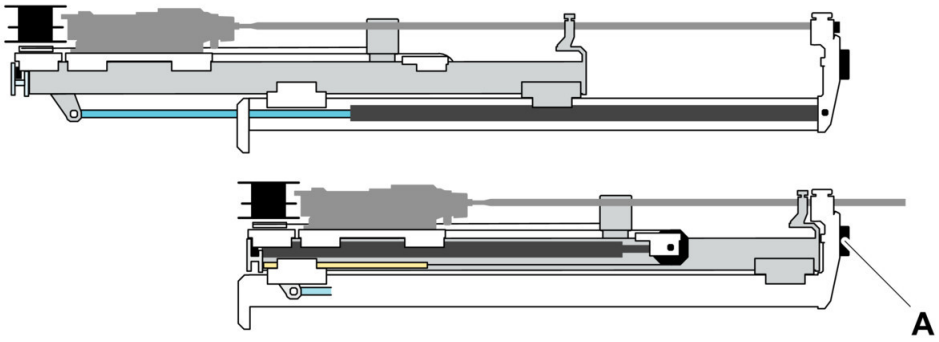

*Feed BMHT*



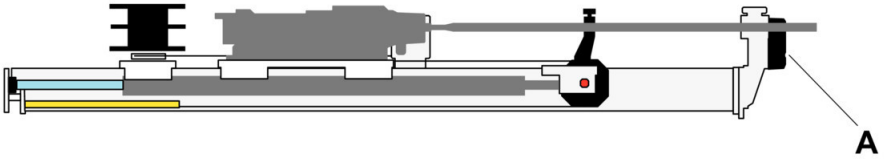

*Feed BMH, BMHE, BHMS*

- Check wear and damage on slide rails (A).

## 11.10 Check Wear on Dowel




*Feed BMHT*




*Feed BMH, BMHE, BHMS*

- ○ Check the wear on the dowel (A).

## 11.11 Check Wear on Slide Pieces on Feed

**WARNING**

**Disassembling and Assembling Components**

Can cause personal injury.

- ▶ Components that could move or fall down must be securely supported or strapped in place during service and maintenance work.

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

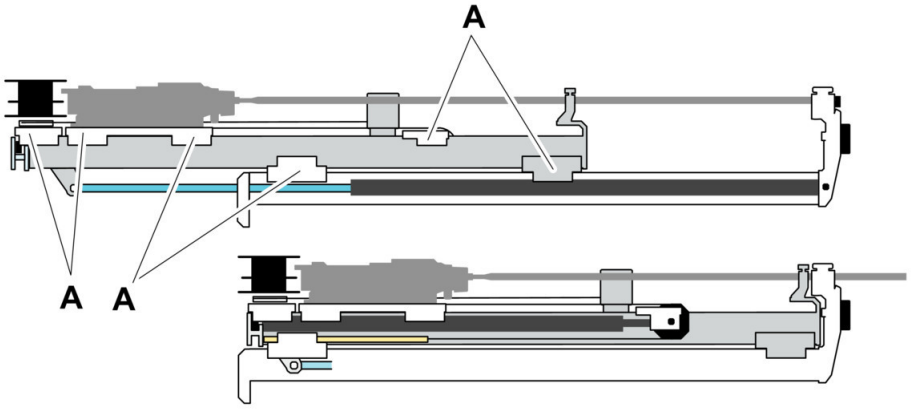
- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

**WARNING**

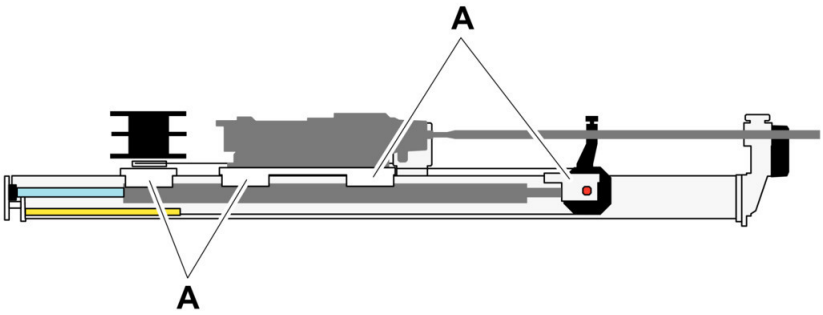
**Moving Parts**

Can cause personal injury.

- ▶ Shut off the machine and lock the battery isolation switch before starting any work.
- ▶ Make sure that the hydraulic pump is off and that the system is depressurized before starting work.




*Feed BMHT*




*Feed BMH, BMHE, BHMS*

- ○ Check the play and the wear on the slide pieces (A).

## 11.12 Check Tightening Torque on Feed

**WARNING**

**Disassembling and Assembling Components**

Can cause personal injury.

- ▶ Components that could move or fall down must be securely supported or strapped in place during service and maintenance work.

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

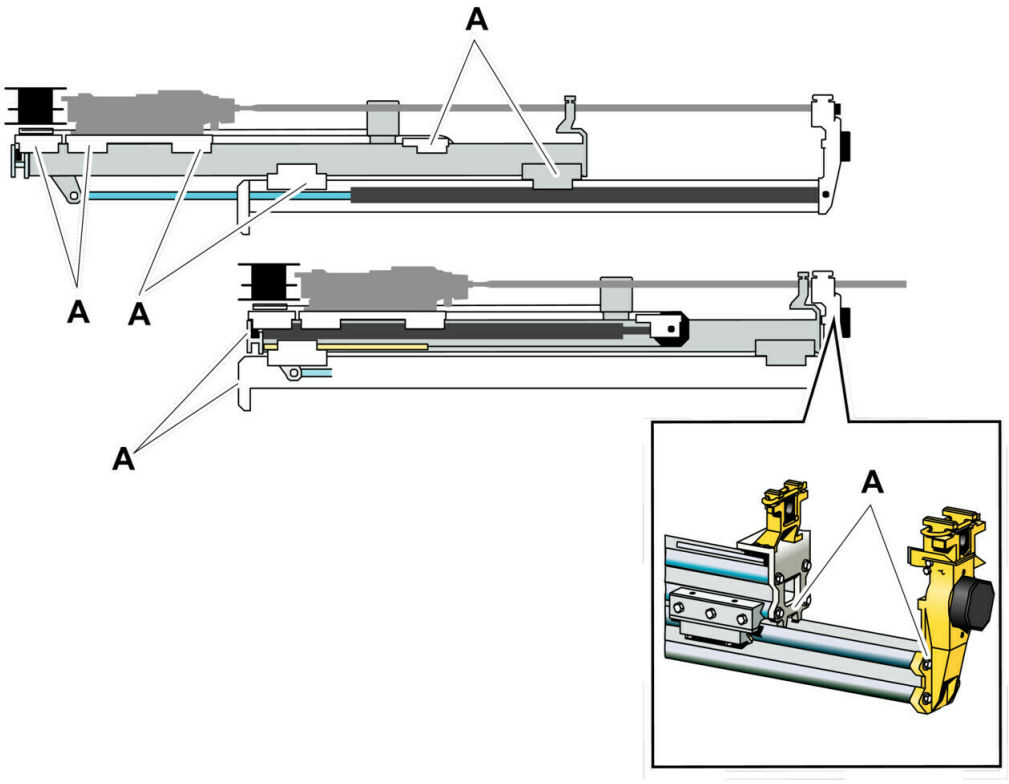
- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

**WARNING**

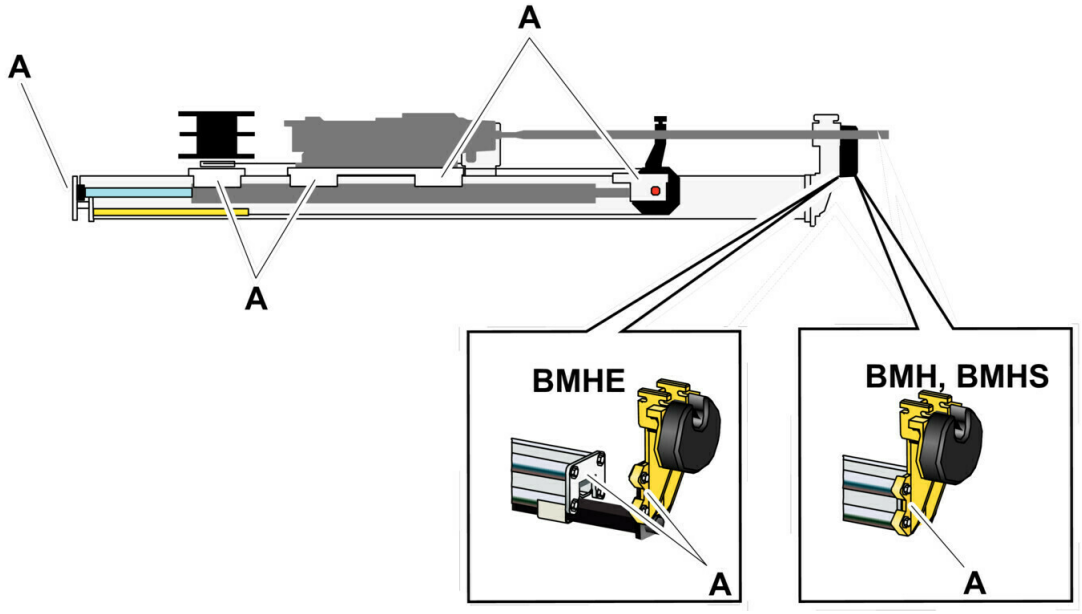
**Moving Parts**

Can cause personal injury.

- ▶ Shut off the machine and lock the battery isolation switch before starting any work.
- ▶ Make sure that the hydraulic pump is off and that the system is depressurized before starting work.




*Feed BMHT*




*Feed BMH, BMHE, BHMS*

- ○ Check tightness on bolted joints (A).

## 11.13 Clean Feed Unit

**WARNING**

**Disassembling and Assembling Components**

Can cause personal injury.

- ▶ Components that could move or fall down must be securely supported or strapped in place during service and maintenance work.

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

**WARNING**

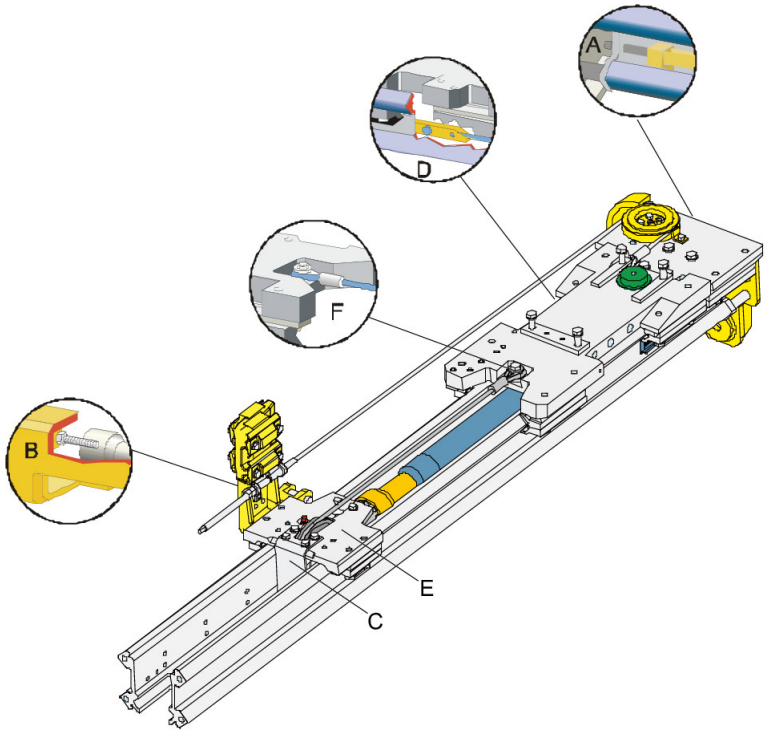
**Moving Parts**

Can cause personal injury.

- ▶ Shut off the machine and lock the battery isolation switch before starting any work.
- ▶ Make sure that the hydraulic pump is off and that the system is depressurized before starting work.

- ○ Clean the complete feed unit.

## 11.14 Replacing the Haul Rope




1. Operate the rock drill to about half its length of travel.
2. Slacken the tension on the ropes, bolt (A) and nut (B).
3. Remove the haul rope from its front attachment (F) on the rock drill cradle.
4. Remove the scraper plate (C) from the intermediate drill rod support.
5. Loosen the intermediate drill rod support holder (E) so that the intermediate drill rod support can be lifted.
6. Remove the rope from the rope tensioner (D) in the rear part of the beam.

! ***NOTE:*** *Make sure the new rope is fitted in the same hole as the old one.*

7. Fit the new rope and refit the scraper plate.
8. Adjust the ropes.

## 11.15 Replace Pull Rope

**WARNING**

**Disassembling and Assembling Components**

Can cause personal injury.

- Components that could move or fall down must be securely supported or strapped in place during service and maintenance work.

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

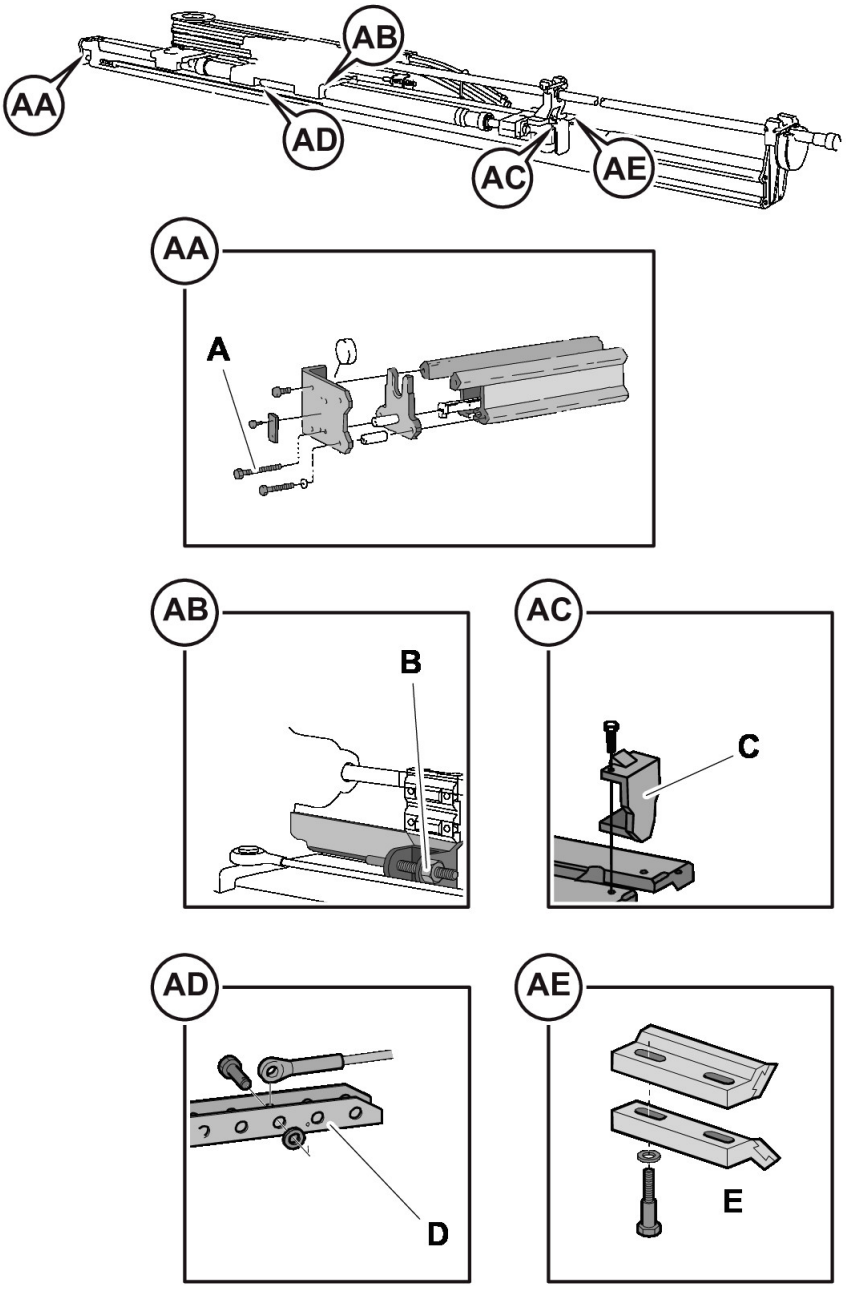
- Do not stand under the heavy object being lifted.
- Use adequate lifting device.

**WARNING**

**Moving Parts**

Can cause personal injury.

- Shut off the machine and lock the battery isolation switch before starting any work.
- Make sure that the hydraulic pump is off and that the system is depressurized before starting work.

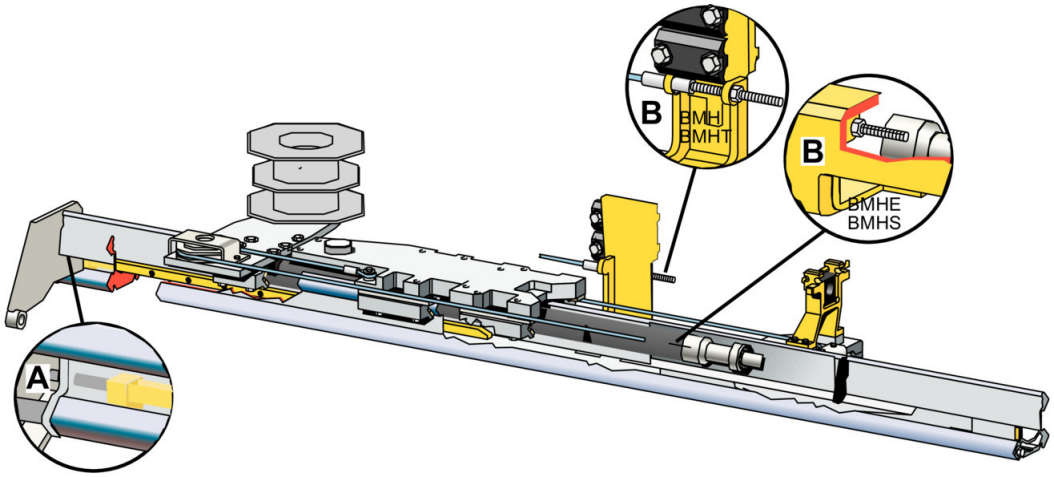



1. Operate the drill to about half its length of travel.
2. Slacken the tension on the ropes, bolt (A), and nut (B).
3. Remove the pull rope from its front attachment on the rock drill cradle.
4. Remove the scraper plate (C) from the intermediate drill steel support.
5. Loosen the intermediate drill steel support holder (E) so that the intermediate drill steel support can be lifted.
6. Remove the rope from the rope tensioner (D) in the rear part of the beam.

> ! ***NOTE:*** *Make sure that the new rope is fitted in the same hole as the old one.*

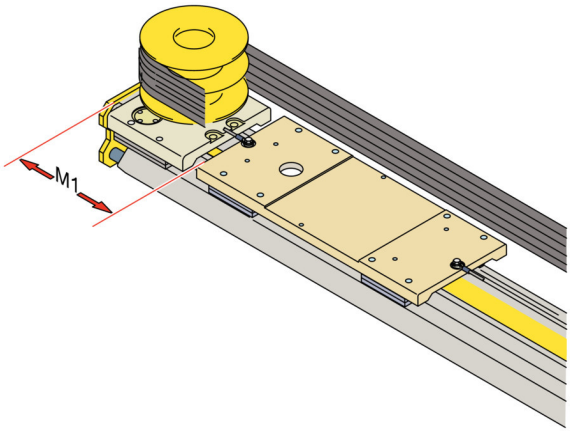
7. Install the new rope and reinstall the scraper plate.
8. Adjust the ropes.

## 11.16 Adjust Haul and Return Ropes




Precondition
- ✓ Cradle is put at the rear end of the feed beam.
- ✓ Drill rod with drill bit is fitted on the rock drill.

1. Adjust the haul rope with bolt (A) and the return rope with nut (B).
2. Adjust the ropes so that the bit is behind the spike.
3. Adjust the position measurement (M1).




Measurement for current feed unit is specified in the feed measurement drawing supplied in the machine documentation.

## 11.17 Adjust Tension of Return Rope

1. Position a plank between the rock drill cradle and the intermediate drill rod support.

2. Run the cradle forward until it stops against the plank and keep the feed force applied.
3. Tension the return rope so there is no risk that it jumps out of the cable drum.

> ! ***NOTE:*** *Do not tension the return rope too tightly.*

Step result ➔ There must be a couple of centimeters of slack remaining when the return rope is correctly tensioned.

## 11.18 Adjusting Cradle on Feed Beam

**⚠ WARNING**

**Disassembling and Assembling Components**

Can cause personal injury.

- ▶ Components that could move or fall down must be securely supported or strapped in place during service and maintenance work.

**⚠ WARNING**

**Heavy Objects**

Can cause crushing injury or death.

- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

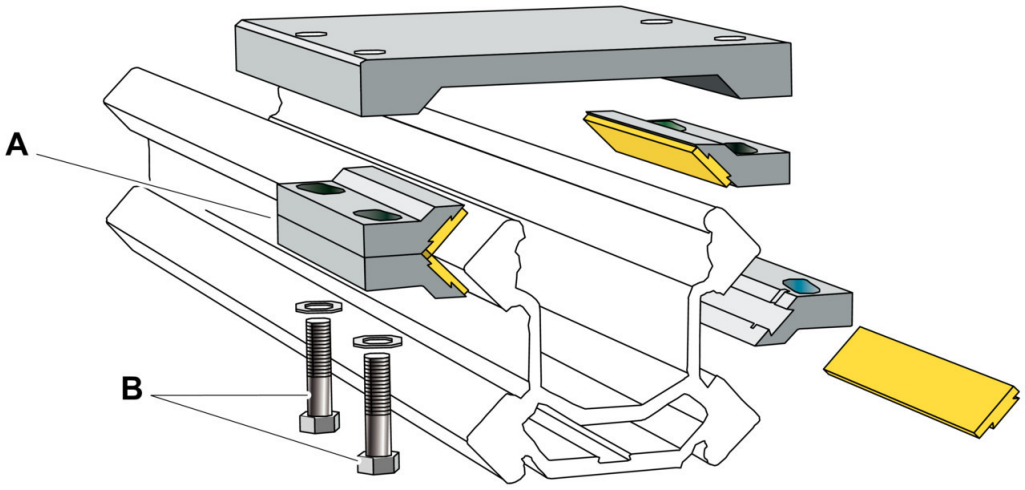
**⚠ WARNING**

**Moving Parts**

Can cause personal injury.

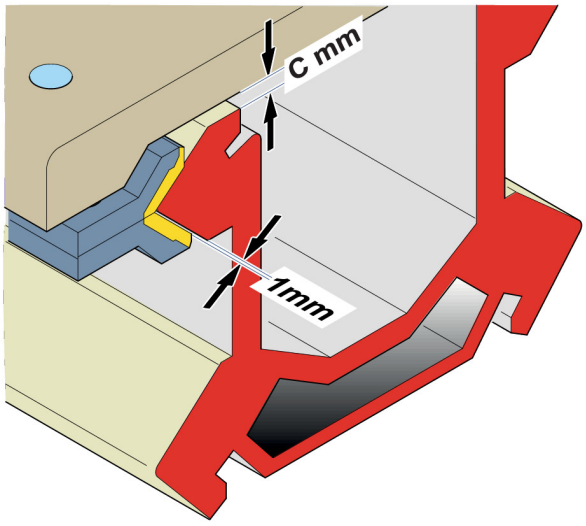
- ▶ Shut off the machine and lock the battery isolation switch before starting any work.
- ▶ Make sure that the hydraulic pump is off and that the system is depressurized before starting work.

The cradle plates for the rock drill, intermediate drill rod support, and water hose drum are guided along the feed beam by holder (A). Each pair of holders is locked in position with bolts (B). The bolt holes in the holders are in the form of angled grooves. The cradle can be adjusted on the feed beam by shifting the holders lengthways.




Precondition
- ✓ Feed is in the horizontal position and the drill rod is installed in the rock drill.
- ✓ Holders are turned the same way as in the illustration so that the outer part of the angled grooves is facing to the rear of the beam.

1. Remove the bolts (B).
2. Adjust the upper holders so the cradle is lying straight on the beam and is C mm above the beam. The measurement C depends on the drill unit.




| Drill Unit | C |
|---|---|
| 1838<br>2238<br>1638<br>MD20 | **4 mm** |
| 3038<br>4038 | **6 mm** |

Step result
- ➔ Shank adapter is set at the correct height.

3. Shift the lower holders lengthways until a clearance of 1 mm is attained between the lower holder and feed beam.
4. Install the bolts (B).
5. Check by running the cradle along the entire beam.

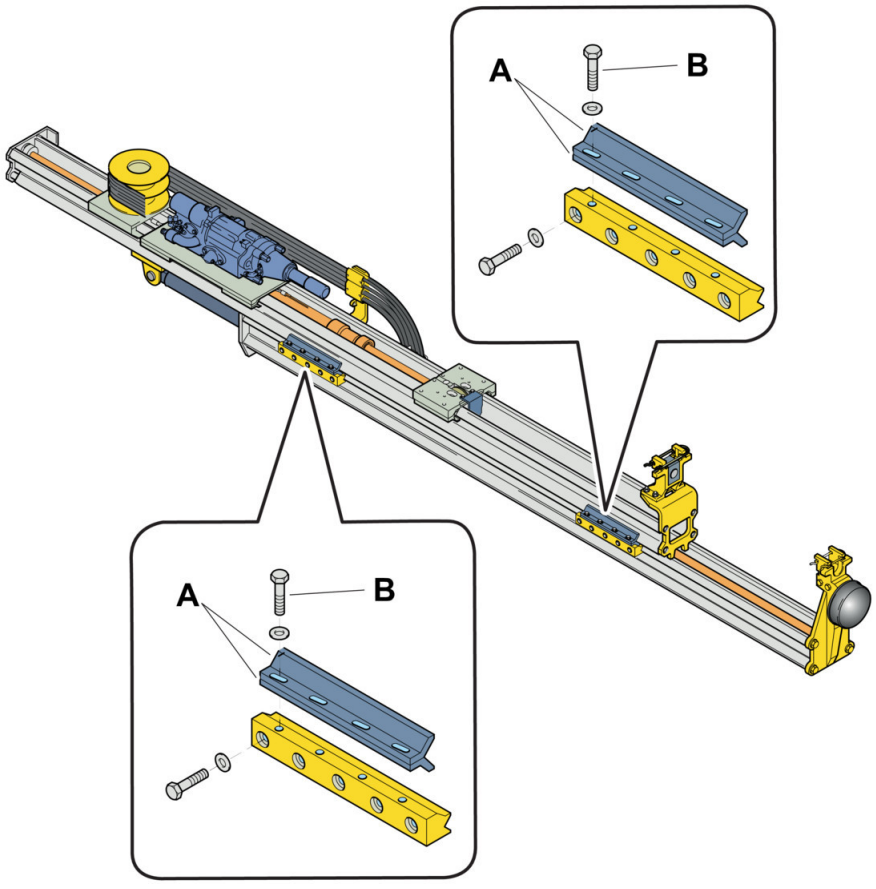
   The cradle runs forward within the maximum pressure with the hydraulic oil at operating temperature. If the pressure exceeds the maximum value, means that the holders are too tight and must be readjusted.
6. Install the rock drill straight on the cradle.
7. Replace damaged hoses and tighten leaking connections.

> ! ***NOTE:*** *The hoses are correctly adjusted as they do not hang down when the feeder is in the horizontal position.*

| | |
|---|---|
| Maximum Pressure | 30 bar (435 psi) |

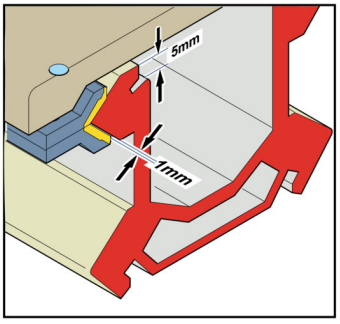
## 11.19 Adjust Feed Beam on Telescope Feed

The upper beam is guided on the lower beam by similar holders to the ones used for the cradle.



Precondition
- ✓ The holders are turned so that the outer part of the angled groove is facing to the rear.
- ✓ The feed is in the horizontal position.

1. Run the upper beam along the lower beam to about half its length of travel.
2. Remove the bolts (B) that attach the holders (A).
3. Adjust the upper holders so that the upper beam is positioned straight on the lower and the measurement is 5–7 mm (0.19–0.27 in.).
4. Shift the lower holders lengthways until a clearance of 1 mm (0.039 in.) is attained between the lower holder and feed beam.




5. Install the bolts (B).
6. Run the beam along its entire length of travel.

   The beam runs forward within the maximum pressure of 30 bar (435 psi) with the hydraulic oil at operating temperature. If the pressure exceeds maximum pressure, the holders are too tight and must be adjusted.

## 11.20 Replace Slide Pieces in the Holder

**WARNING**

**Disassembling and Assembling Components**

Can cause personal injury.

- ▶ Components that could move or fall down must be securely supported or strapped in place during service and maintenance work.

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

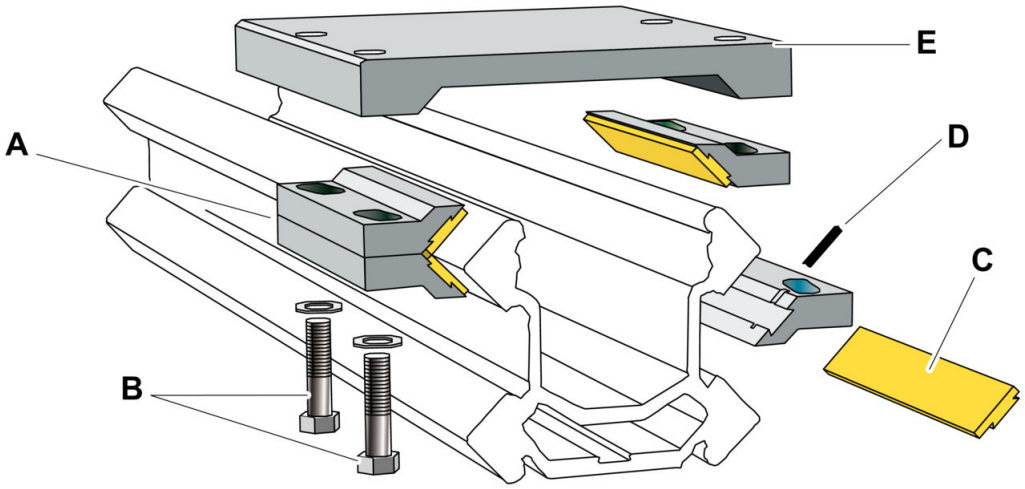
**WARNING**

**Moving Parts**

Can cause personal injury.

- ▶ Shut off the machine and lock the battery isolation switch before starting any work.
- ▶ Make sure that the hydraulic pump is off and that the system is depressurized before starting work.

***NOTE:*** *If the wear allowance for any of the slide pieces is less than 1 mm, replace all the slide pieces.*




1. Remove the bolts (B) to remove the holder (A) from the cradle (E).
2. Remove the keys (D).

   Each slide piece is kept in place by keys.
3. Remove the slide pieces (C) from the holder.
4. Slide a new slide piece into the holder track and install it to the holder.
5. Install new keys.
6. Adjust the cradle on the feed beam.

## 11.21 Replace Slide Rails

**WARNING**

**Disassembling and Assembling Components**

Can cause personal injury.

- ▶ Components that could move or fall down must be securely supported or strapped in place during service and maintenance work.

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

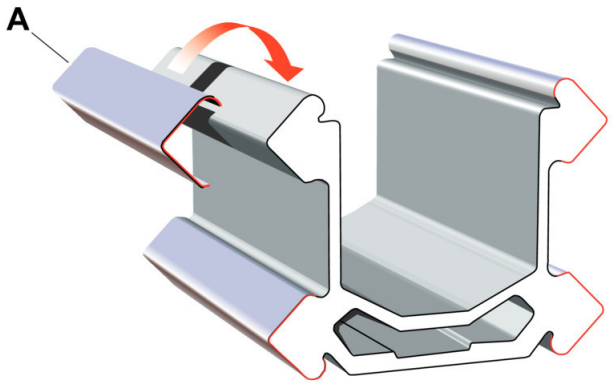
**WARNING**

**Moving Parts**

Can cause personal injury.

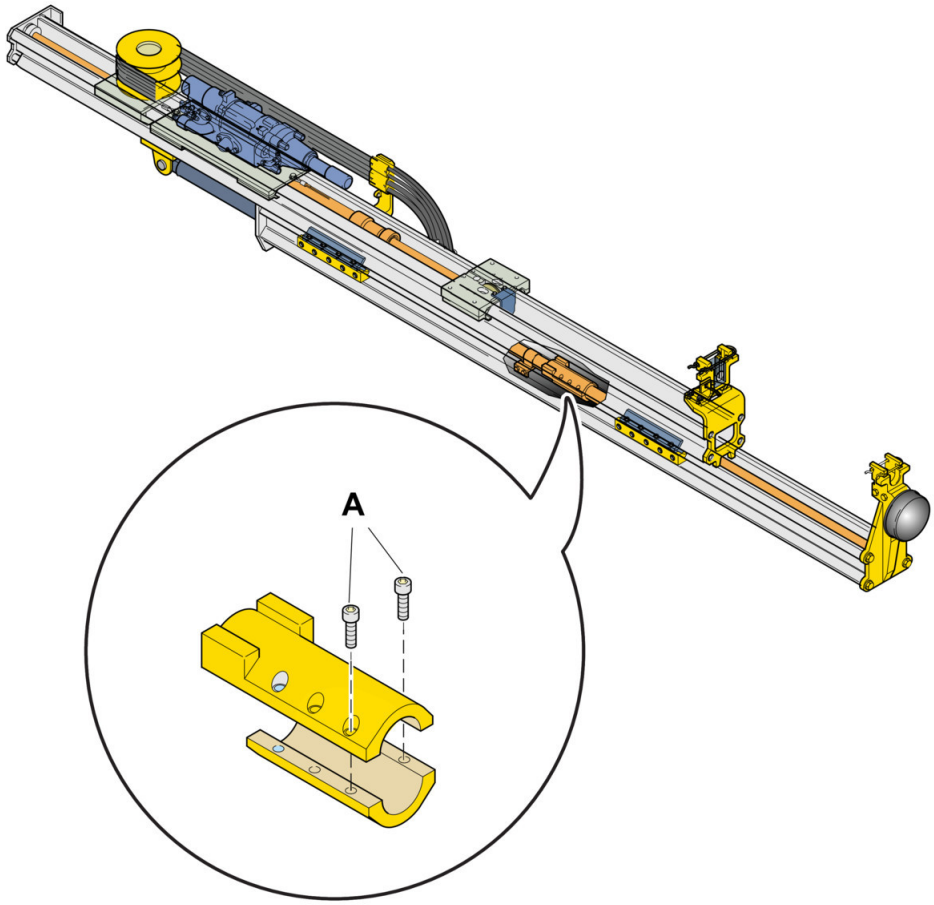
- ▶ Shut off the machine and lock the battery isolation switch before starting any work.
- ▶ Make sure that the hydraulic pump is off and that the system is depressurized before starting work.

***NOTE:*** *Replace side rails if they are worn or severely scratched.*




1. Remove the rock drill cradle, the intermediate drill rod support, and the water hose drum from the beam.
2. Remove the old slide rails (A). Press the lower edges of the bar outwards.
3. Clean the beam surfaces thoroughly.
4. Install the new slide rails with the larger edge on the slide rail facing upwards. The rails are pressed in a place by hand.
5. Reinstall the rock drill cradle, intermediate drill rod support, and the water hose drum.
6. Adjust the cradle on the feed beam.
7. Check the feed idling pressure.

## 11.22 Adjust Different Drill Rods Lengths for the Telescope Feed




The use of different drill rods lengths is made possible by moving a mechanical stop mechanism on the lower feed cylinder.

1. Operate the lower feed cylinder backwards towards the mechanical stop mechanism.
2. Remove socket head cap screws (A) and move one of the screws to the top of the mechanical stop mechanism.
3. Operate forward or backward to the correct drill rods length.

   The drill bit must be behind the rubber dowel.
4. Replace the socket head cap screws (A) to its original position and tighten the mechanical stop mechanism.

## 11.23 Disassemble Feed Cylinder

**WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

▶ Make sure that the system is de-pressurized before starting any work.

**WARNING**

**Hydraulic Oil and Water Pressure**

Can cause personal injury.

- ▶ Do not replace high-pressure hoses with hoses of lower quality than the originals.
- ▶ Do not replace high-pressure hoses with hoses that are installed with removable couplings.

**WARNING**

**Disassembling and Assembling Components**

Can cause personal injury.

- ▶ Components that could move or fall down must be securely supported or strapped in place during service and maintenance work.

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

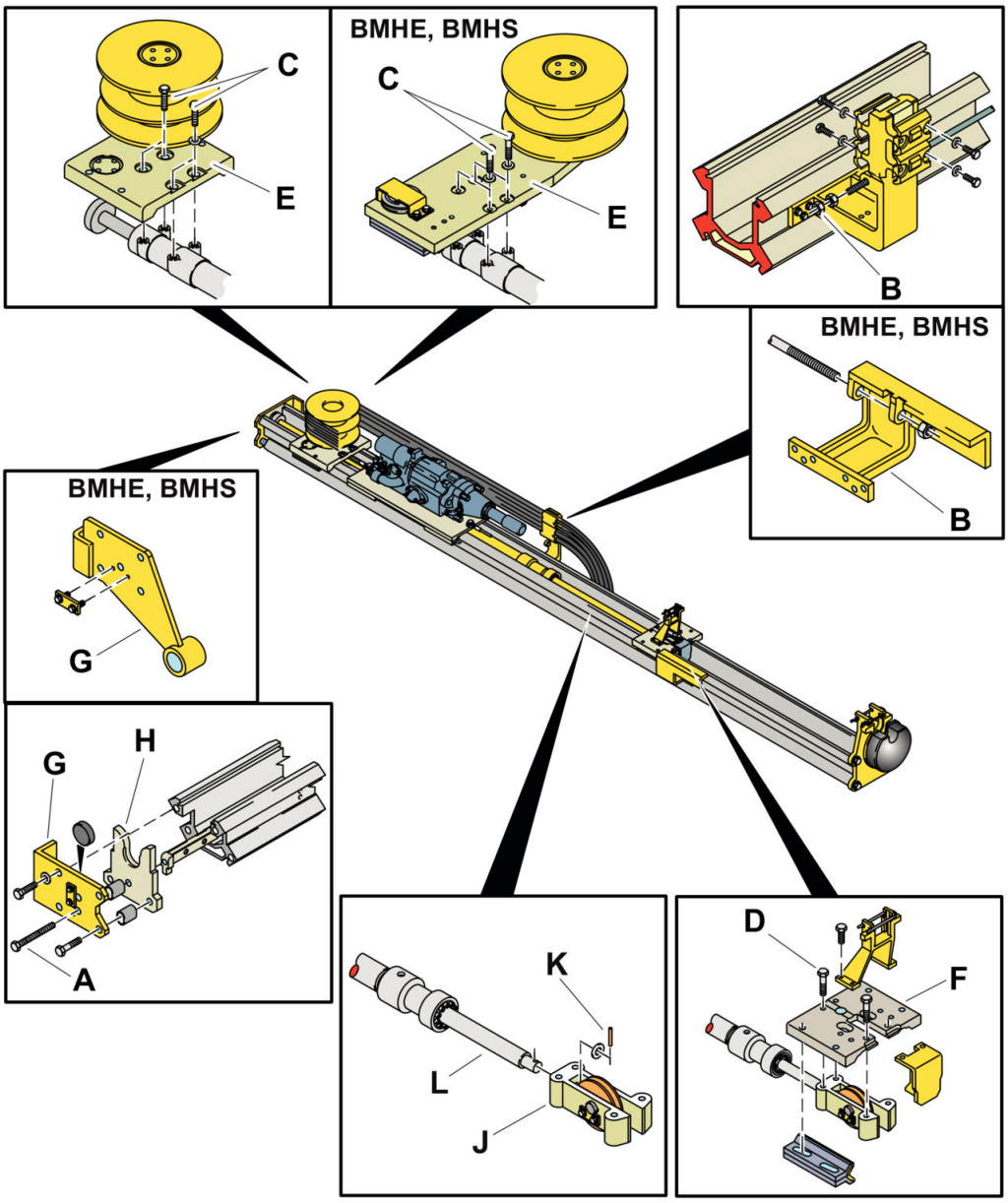
- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

**WARNING**

**Moving Parts**

Can cause personal injury.

- ▶ Shut off the machine and lock the battery isolation switch before starting any work.
- ▶ Make sure that the hydraulic pump is off and that the system is depressurized before starting work.




Precondition ✓ The hydraulic system is depressurized.

1. Operate the rock drill cradle to about half the feed length.
2. Relieve the tension from pull and return ropes with bolt (A) and nut (B).
3. Remove the bolts from the center of the water hose drum and lift the entire drum.
4. Disconnect the hoses at the hose retainer.
5. Loosen bolts (C) and (D) on cradle plates (E) and (F).
6. Remove bolt (A) from the end piece (G).
7. Remove the end plate (H).
8. Pull the cylinder and fork backwards, out of the beam.

9. Remove the pin (K).
10. Remove the fork (J) from the spacer (L).

> ***NOTE:*** *Avoid removing the spacer (L). If the spacer must be removed, first measure (SP) so the spacer can be replaced in the same position.*

> ***NOTE:*** *Measurement (SP) is specified in the Spare Parts Catalog.*

> ***NOTE:*** *Measurement SP = 492 mm (19.37 in.)*

> ***NOTE:*** *Measurement SP = 605 mm (23.8 in.)*

## 11.24 Disassemble Tension Bushing for Spacer

**WARNING**

**Disassembling and Assembling Components**

Can cause personal injury.

- ▶ Components that could move or fall down must be securely supported or strapped in place during service and maintenance work.

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

**WARNING**

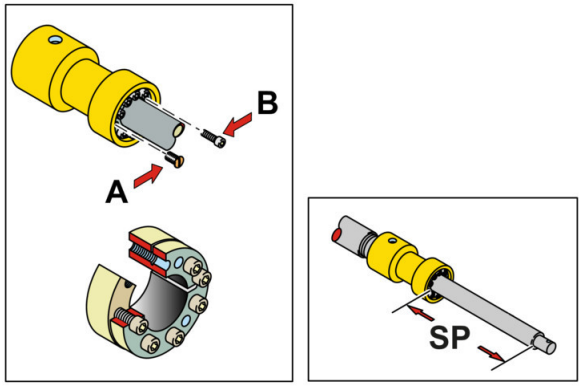
**Moving Parts**

Can cause personal injury.

- ▶ Shut off the machine and lock the battery isolation switch before starting any work.
- ▶ Make sure that the hydraulic pump is off and that the system is depressurized before starting work.

! ***NOTE:*** *Measurement (SP) is specified in the Spare Parts Catalog.*

The spacer at the front of the cylinder is held in place with an expanding bushing. In order for the feed to function correctly, the spacer measurement (SP) must be correct. This measurement varies depending on the feed length and type of feed.




Precondition ✓ Spacer measurement (SP) is noted, so the bushing can be replaced in the same position.

1. Remove the plastic plugs (A).
2. Remove the bolts (B) from the bushing.
3. Place the bolts (B) into the threaded holes and pull them alternately until the bushing are separated.

## 11.25 Assemble Tension Bushing for Spacer

**WARNING**

**Disassembling and Assembling Components**

Can cause personal injury.

▶ Components that could move or fall down must be securely supported or strapped in place during service and maintenance work.

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

▶ Do not stand under the heavy object being lifted.

▶ Use adequate lifting device.

**WARNING**

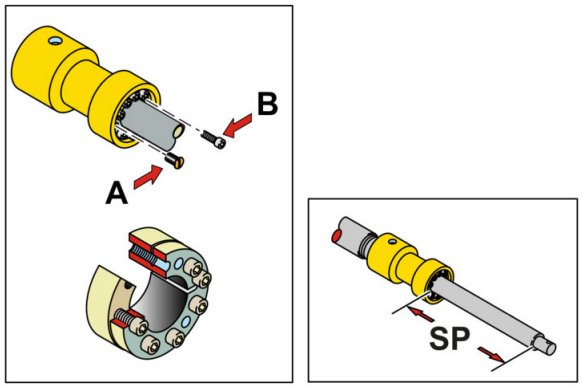
**Moving Parts**

Can cause personal injury.

- ▶ Shut off the machine and lock the battery isolation switch before starting any work.
- ▶ Make sure that the hydraulic pump is off and that the system is depressurized before starting work.

***NOTE:*** *The (SP) measurement is noted before disassembling and is also specified in the Spare Parts Catalog.*

The spacer at the front of the cylinder is held in place with an expanding bushing. For the feed to function correctly, the spacer measurement (SP) must be correct. This measurement varies depending on the feed length and type of feed.




1. Assemble the bushing and the bolts (B). Do not tighten the bolts (B).
2. Install the spacer and bushing into the sleeve.
3. Tightening the bolts (B) in circles from 1–8 until the bolts set.
4. Install the plastic plugs (A).

| Tightening Torque |
| --- |
| 28 Nm (20 lbf.ft) |

| Tightening Torque |
| --- |
| 18 Nm (13 lbf.ft) |

| Tightening Torque |
| --- |
| 38 Nm (28 lbf.ft) |

## 11.26 Replace Rock Drill Retaining Bolts

**WARNING**

**Disassembling and Assembling Components**

Can cause personal injury.

- ▶ Components that could move or fall down must be securely supported or strapped in place during service and maintenance work.

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

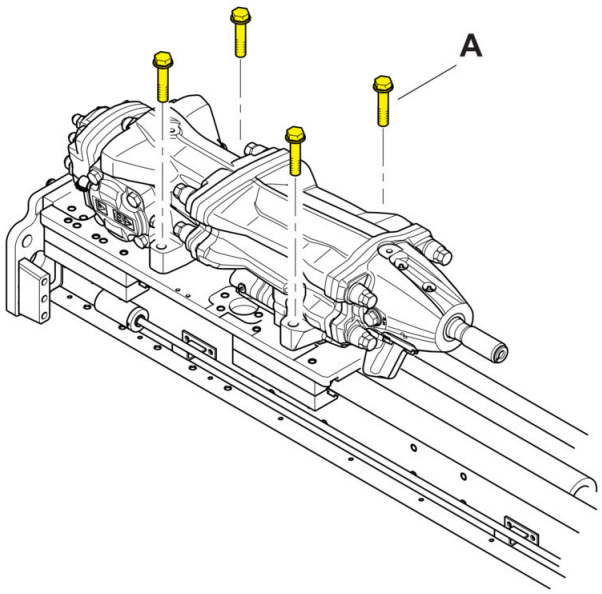
- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

**WARNING**

**Moving Parts**

Can cause personal injury.

- ▶ Shut off the machine and lock the battery isolation switch before starting any work.
- ▶ Make sure that the hydraulic pump is off and that the system is depressurized before starting work.




1. Position the feed horizontally with the rock drill upwards.

2. Remove and replace the retaining bolts (A) one at a time.
3. Torque-tighten the retaining bolts alternately.

**See Reference Documentation**

Rock drill instruction manual

## 11.27 Long-Term Storage

1. Clean the feed thoroughly.
2. Lubricate as directed.
3. Protect unpainted surfaces with corrosion inhibitor.
4. Store the feed in a dry and clean environment.

# 12 Diesel Engine

## 12.1 Safety Precautions before Working on Diesel Engine

**WARNING**

**Hot Surface**

Hot components can cause serious personal injury.

- Turn off the machine and allow the components to cool down before starting maintenance work.
- Use Personal Protective Equipment (PPE).
- Be careful when draining hot fluids.
- Do not handle flammable fluids near hot surfaces, sparks, or open flames.

## 12.2 Tightening Torques

### Tightening torques, Deutz TCD 2012, 2013 diesel engine

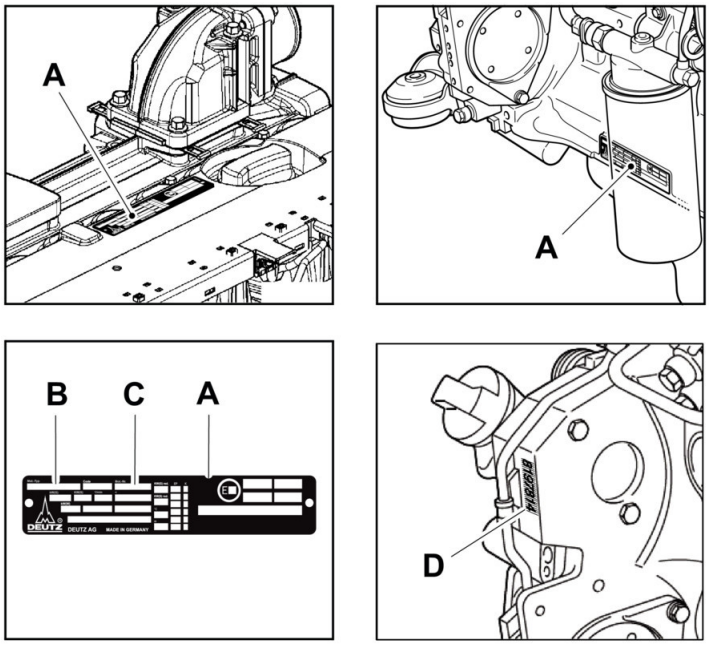
| Bolted joints | Tightening torque (Nm) | Comments |
|---|---|---|
| Valve cover | 9±1 | M6 |
| Set screw, rocker arm | 20±2 | |
| Engine mounting | 280<br>280 | M16 x 85-10.9<br>M16 x 40-10.9 |
| Oil drain plug | 55 | M18 x 1.5 with copper ring |
| Oil filter | approximately 10 | 3/4 turn (after contact) |
| Fuel filter | approximately 10 | 3/4 turn (after contact) |

### Tightening torques, Deutz TCD 4.1, TCD 6.1 diesel engines

| Bolted joints | Tightening torque (Nm) | Comments |
|---|---|---|
| Valve cover | 22 | |
| Oil drain plug | 100 | |
| Oil filter | 15-17 | |
| Fuel filter | 10-12 | |
| Preliminary fuel filter | 17-198 | |

| Bolted joints | Tightening torque (Nm) | Comments |
|---|---|---|
| Pre fuel filter drain plug | 1.6±0.3 | |
| Pre fuel filter bleed nipple | 6.5±1.3 | |

## 12.3 Diesel Engine Data Plate




| | | | |
|---|---|---|---|
| A | Type plate | B | Engine type |
| C | Engine number | D | Engine number stamped on the crank-case. |

> **NOTE:** *Engine type and engine number must be designated if ordering spare parts.*

## 12.4 Commissioning New or Overhauled Diesel Engine

The following maintenance must be done when commissioning a new diesel engine.

> **NOTE:** *To perform the following maintenance points, see respective maintenance instructions in the Maintenance manual.*

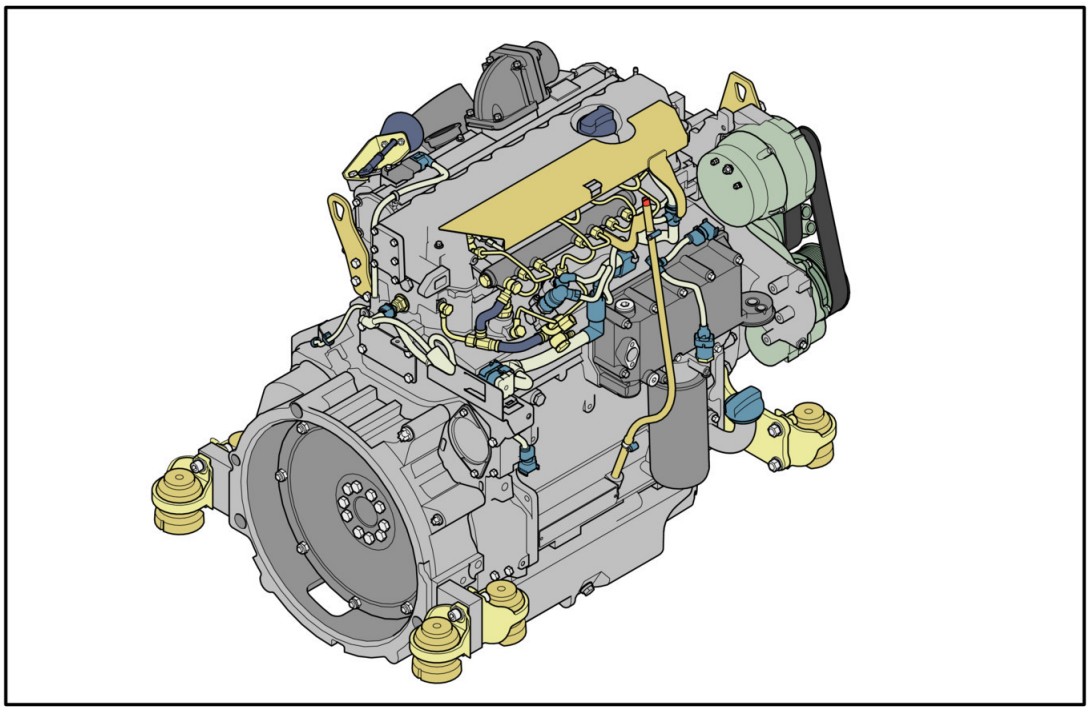
- Bleed the fuel system.
- Check the Pre fuel filter and secondary fuel filter and replace if necessary.
- Check diesel engine oil level.
- Check diesel engine oil quality.
- Check for engine oil leaks.

- Check the coolants concentration.
- Check coolant level and add if necessary.
- Replace diesel engine air filter cartridge and safety cartridge.
- Drain any condensation or oil from the charge air cooler.

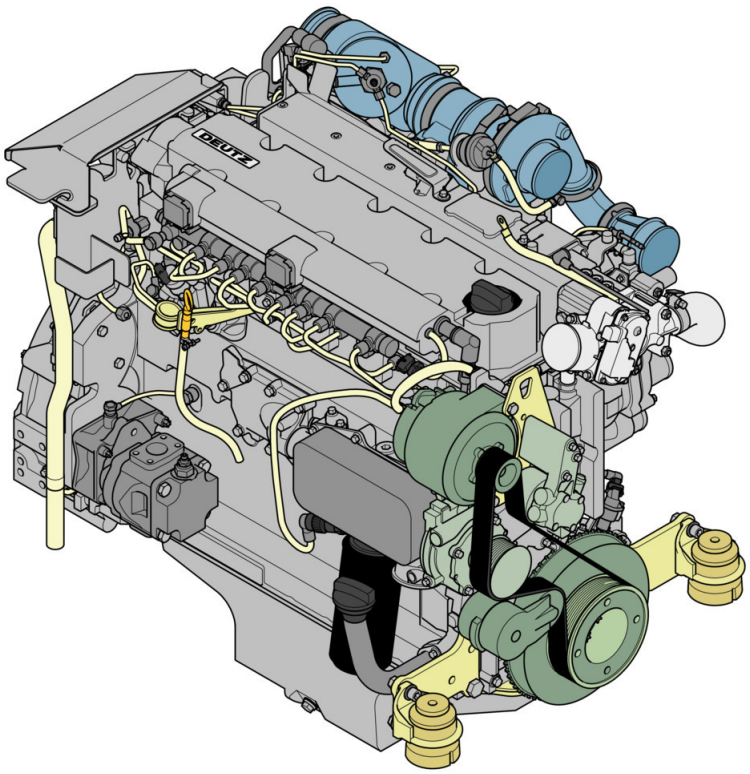
## 12.5 Overview of Diesel Engine

This chapter covers the following diesel engines.

- Deutz TCD 2012 L06
- Deutz TCD 2013 L04
- Deutz TCD 4.1
- Deutz TCD 6.1



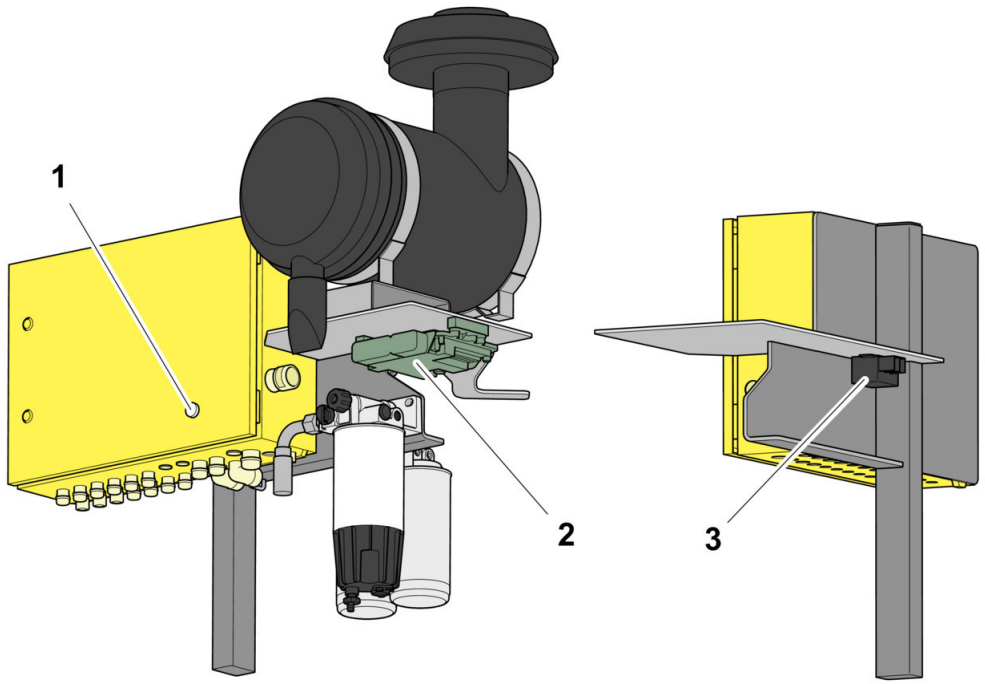
*Deutz TCD 2013 L04*




*Deutz TCD 6.1*

## 12.6 EMR

The engine is equipped with a control unit which is designated EMR. A number of sensors are connected to this which detect engine functions. In the event of a fault, one or more sensors signal to the EMR. These signals are also sent further to the summation alarm (H220) on the driving panel. In addition, the EMR ensures that the engine operates optimally from an environmental point of view.




*Section of the engine*

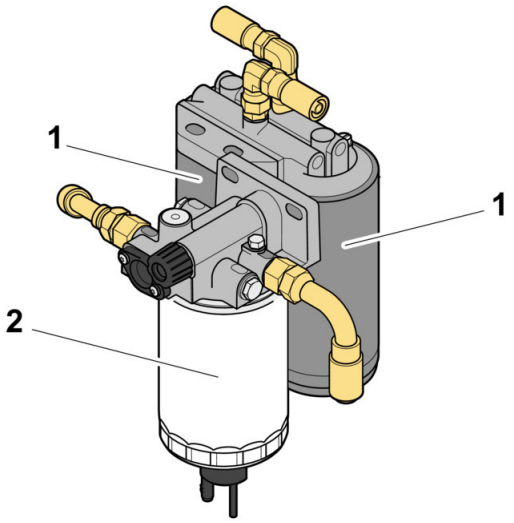
| | | | |
|---|---|---|---|
| 1 | Diagnostic socket (EMR) | 2 | EMR |
| 3 | Relay, preheater | | |

## 12.7 Check Engine Monitoring System

- ○ Check the engine monitoring system.

> ! ***NOTE:*** *Only an authorized specialist must carry out the checking.*

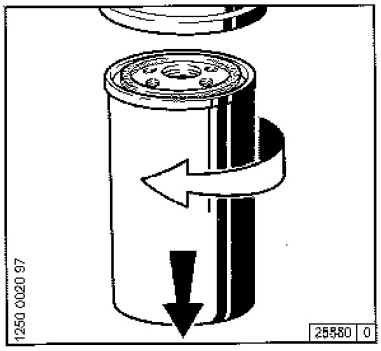
## 12.8 Changing Fuel Filter




*Fuel filter*

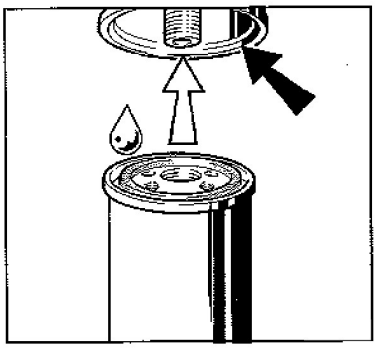
There are three fuel filters for the diesel engine, two diesel filters (1) and one prefilter (2).

1. Loosen the fuel filters (1) using a suitable tool and unscrew the filter.
2. Collect any residual fuel.




*Changing fuel filter*

3. Clean the filter holder sealing surface.
4. Lightly oil the new fuel filter rubber seal.
5. Screw in the filter by hand until the gasket is home.



*Changing fuel filter*

6. Tighten the filter a further 3/4 turn (10 Nm).
7. Bleed the fuel system.

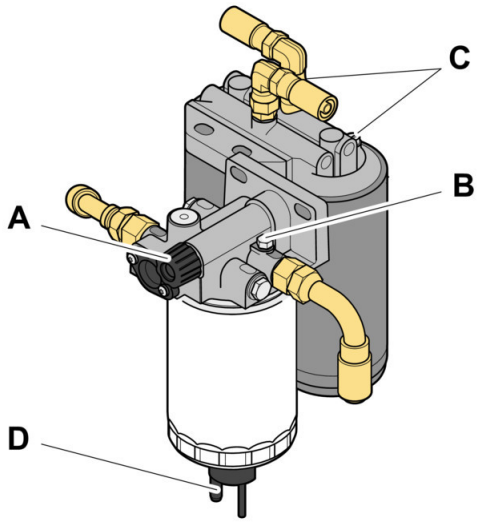
## 12.9 Change Pre Fuel Filter

1. Power off the diesel engine and turn off the ignition.
2. Place a suitable receptacle under the pre fuel filter.
3. Uncouple the electrical connection from the water level sensor.
4. Undo the drain plug and allow the fluid to drain from the filter.
5. Undo the filter insert.
6. Clean the rubber sealing on the new filter insert and filter holder.
7. Moisten the sealing surface lightly with fuel, screw the filter insert clockwise onto the filter holder and tighten.
8. Screw on the drain plug and tighten.

9. Couple the electrical connection for the water level sensor.
10. Bleed the fuel system.

## 12.10 Bleed the Fuel System

The fuel system must be bled when the engine is first taken into service or when the tank has completely run dry. It must also be bled if there is a suspicion that air has entered for any other reason. The ignition key must be on when bleeding the fuel system so that solenoid valve (Y226) on the fuel tank stays open.




*Prefilter and fuel filter*

| | |
|---|---|
| A | Hand fuel pump |
| B | Bleeder nipple prefilter |
| C | Bleeder nipple fuel filter |
| D | Drain cock for water |

1. Undo the manual fuel pump (A) bayonet connection by simultaneously pressing and turning anticlockwise.

> ! ***NOTE:*** *The ignition must be switched on for the fuel to flow.*

2. Bleed the prefilter by loosening the bleeder nipple (B) on the filter and then pump out fuel with the hand pump (A) until fuel without air mixed in flows out, close the bleeder nipple.
3. Bleed the fuel filters by loosening the bleeder nipple (C) on one of the filters and then pump out fuel with the hand pump (A) until fuel without air mixed in flows out, close the bleeder nipple. Repeat procedure with the second filter.
4. Tighten the manual fuel pump (A) bayonet connection by simultaneously pressing and turning clockwise.

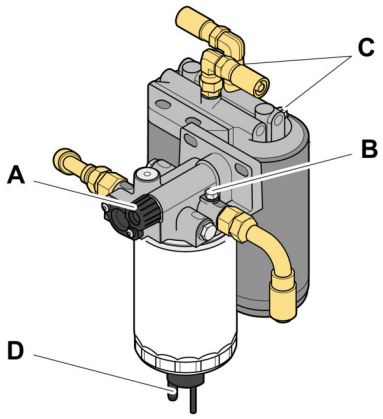
5. Start the engine and run it at idling speed or low load for approx. five minutes. Check the sealing integrity of the prefilter.

> ***NOTE:*** *The fuel nozzles should not be bled due to the high pressures that exist in the common rail system.*

## 12.11 Drain the Prefilter

Water needs to be drained from the prefilter regularly, otherwise the fuel system sustains damage, if water is not drained then the water sensor on the prefilter detects the water and activates the EMR lamp on the driving panel.

1. Drain water by undoing the drain plug (D) in the bottom of the prefilter and letting the water run out.




*Draining the water in the prefilter*

| | |
|---|---|
| D | Water drain plug |

2. Screw on the drain plug and tighten it to 1.6±0.3 Nm.

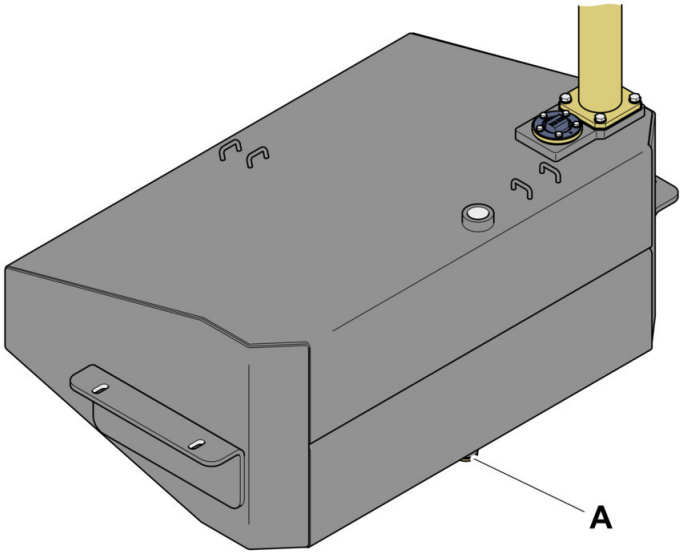
## 12.12 Drain Fuel Tank

**WARNING**

**Hot Surface**

Hot components can cause serious personal injury.

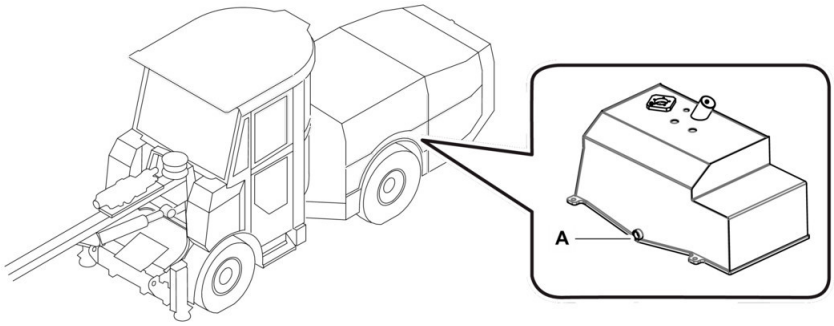
- ▶ Turn off the machine and allow the components to cool down before starting maintenance work.
- ▶ Use Personal Protective Equipment (PPE).
- ▶ Be careful when draining hot fluids.
- ▶ Do not handle flammable fluids near hot surfaces, sparks, or open flames.




1. Place a vessel under the drain plug (A).
2. Loosen the plug (A) about one turn and allow the fuel to run out.
3. Tighten the plug (A) to avoid fuel leakage.

## 12.13 Drain Condensate from Fuel Tank

> ***NOTE:*** *Always fill the fuel tank with clean diesel and fuel of the correct grade and temperature.*




1. Place a vessel under the drain plug (A).
2. Loosen the drain plug (A) about one turn and allow the water to run out.
3. Tighten the drain plug (A) to avoid fuel leakage.

## 12.14 Air System

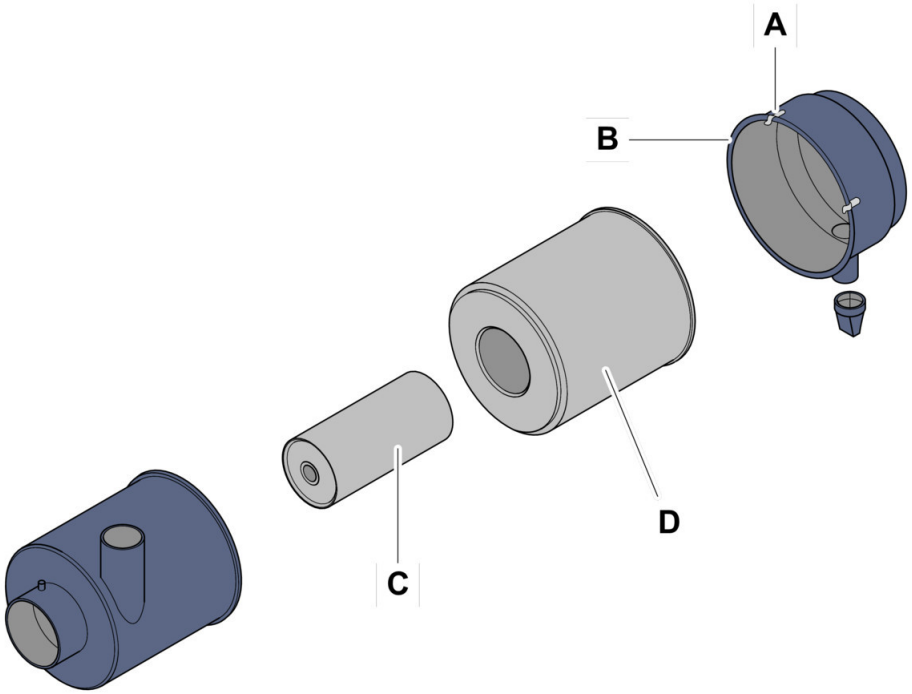
It is important to keep the air filter and air cleaner in good condition so that the exhaust gases are as clean as possible. Repeated dismantling and assembly can damage the gasket between the insert and the filter housing. Smoke and poor engine performance can be an indication of clogged filters.

- A clogged air filter is indicated on the driving panel. See operator's instructions Controls, operation.

### 12.14.1 Every Second Year Replacement of Air Filter Cartridge

> ***NOTE:*** *Replace air filter cartridge every second year irrespective of how many hours the diesel engine has been running.*

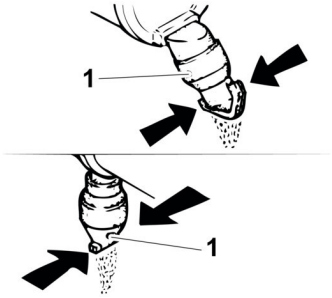
### 12.14.2 Replace Air Filter Cartridge




1. Remove the clamps (A).
2. Remove the cover (B).
3. Remove the filter insert (C).
4. Examine the adhesive gasket for cracks or other damage.
5. Install a new filter insert (C).
6. Do the following if the safety air filter needs replacement:
   a. Pull out the safety air filter (D).
   b. Install the new safety air filter in place.
7. Install the filter cover (B) and lock it with the clamps (A).

### 12.14.3 Clean the Dust Valve

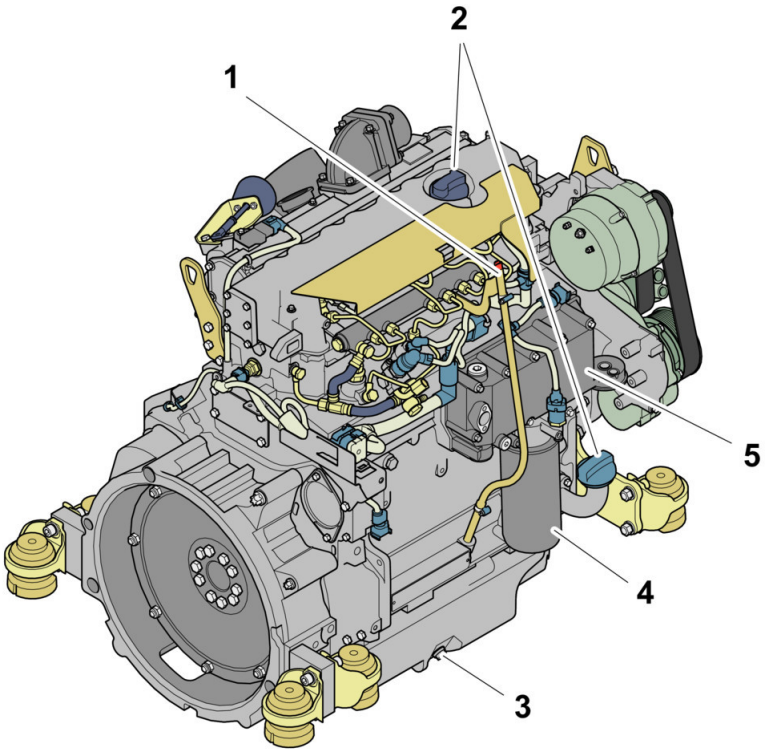
1. Empty the dust valve (1) by squeezing the slit together in the direction of the arrow.




*Cleaning the dust valve*

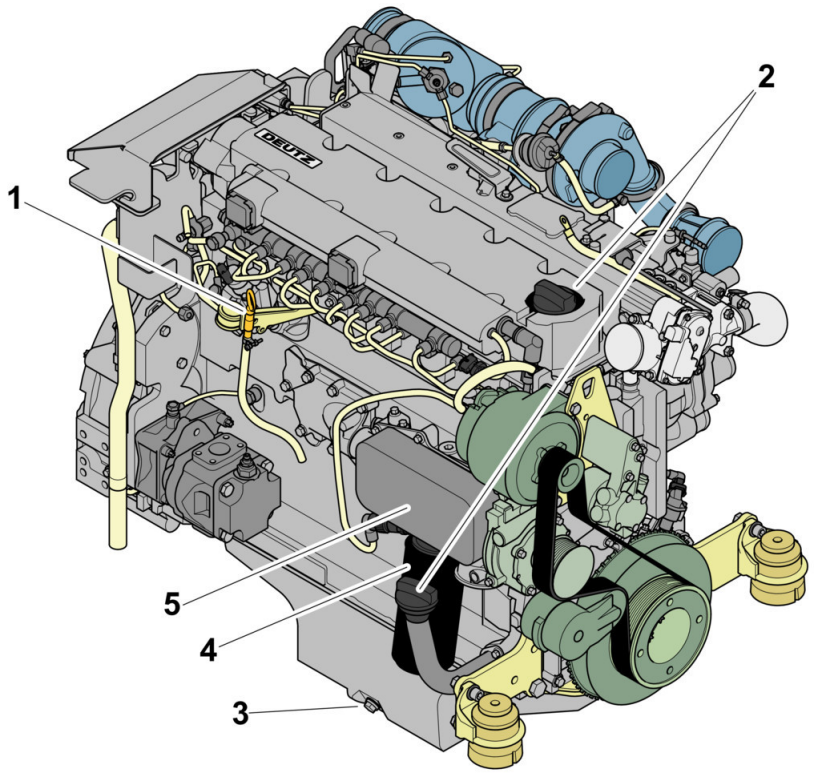
2. Clean the slit at regular intervals.
3. Remove any accumulation of dirt by squeezing the upper part of the valve.

## 12.15 Oil System




*Filling up and changing oil, Deutz TCD 2012 L06 and 2013 L04*

| | | | |
|---|---|---|---|
| 1 | Dipstick | 2 | Oil filling orifice |
| 3 | Oil drain plug | 4 | Oil filter |
| 5 | Oil cooler | | |




*Filling up and changing oil, Deutz TCD 4.1 and 6.1*

| | | | |
|---|---|---|---|
| 1 | Dipstick | 2 | Oil filling orifice |
| 3 | Oil drain plug | 4 | Oil filter |
| 5 | Oil cooler | | |

### 12.15.1 Engine Oil Quality

- Use only engine oil recommended by the engine manufacturer for the engine type and area of application.

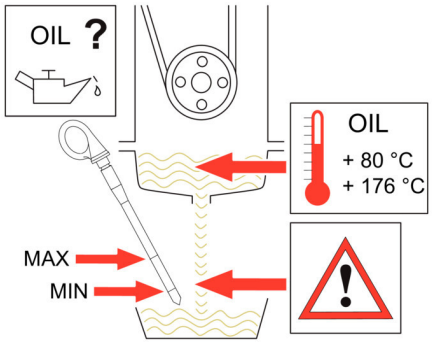
### 12.15.2 Fill Engine Oil

1. Add oil through the filler hole (2). See manual Fluids and greases.
2. Check the oil level on the dipstick (1).

### 12.15.3 Change the Motor Oil

1. Place the rig horizontally.
2. Warm up the engine. Oil temperature approx. 80 °C.
3. Stop the engine.
4. Place a receptacle under the drain plug.
5. Screw out the oil drain plug (3).

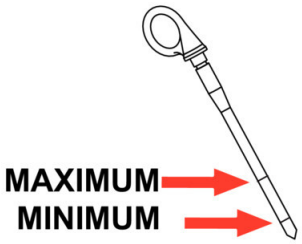
6. Drain the oil.




*Changing oil*

7. Screw in the oil drain plug (3) with a new gasket and tighten it.
8. Add oil to correct level through the filler pipe (2). See manual Fluids and greases.
9. Start the engine and allow it to idle for about two minutes.
10. Check the oil level.

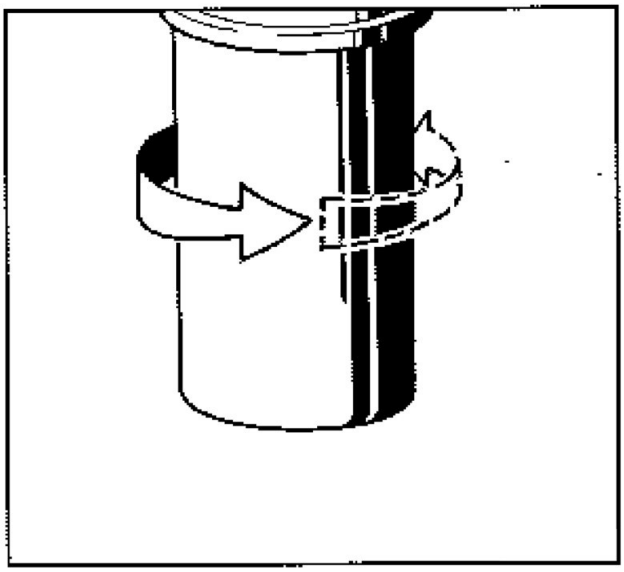
### 12.15.4 Check Engine Oil Level




Precondition ✓ The engine is OFF.

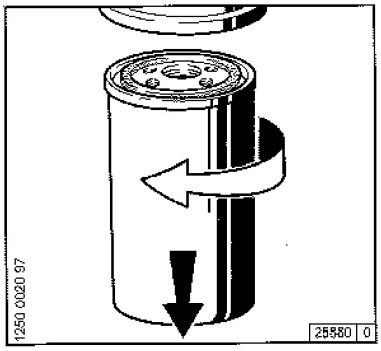
1. Check the oil level on the dipstick.
2. Top up with oil to the maximum mark, if necessary.

### 12.15.5 Changing Oil Filter



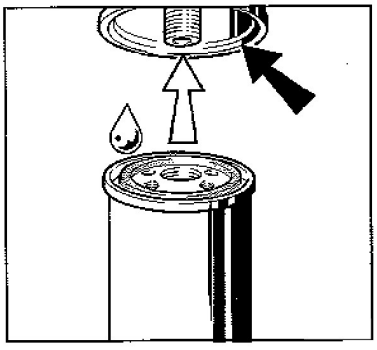
*Changing oil filter*

1. Loosen the oil filter using a suitable tool and unscrew it.
2. Collect the oil.




*Changing oil filter*

3. Clean the filter holder sealing surface.
4. Lightly oil the rubber gasket on the new oil filter.
5. Screw in the filter by hand until the gasket is home.



*Changing oil filter*

6. Tighten the filter 3/4 turn.
7. Check the oil level.
8. Check the oil pressure.
9. Make sure the oil filter does not leak.

## 12.16 Belts

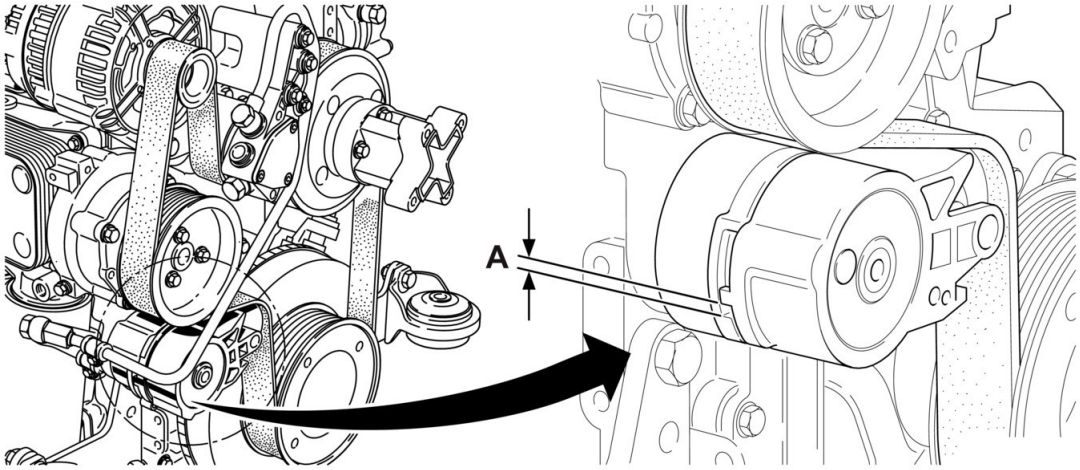
### 12.16.1 Check Belt Wear

**WARNING**

**Hot Surface**

Hot components can cause serious personal injury.

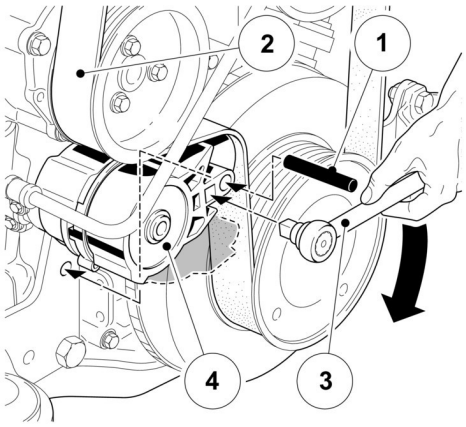
- Turn off the machine and allow the components to cool down before starting maintenance work.
- Use Personal Protective Equipment (PPE).
- Be careful when draining hot fluids.
- Do not handle flammable fluids near hot surfaces, sparks, or open flames.



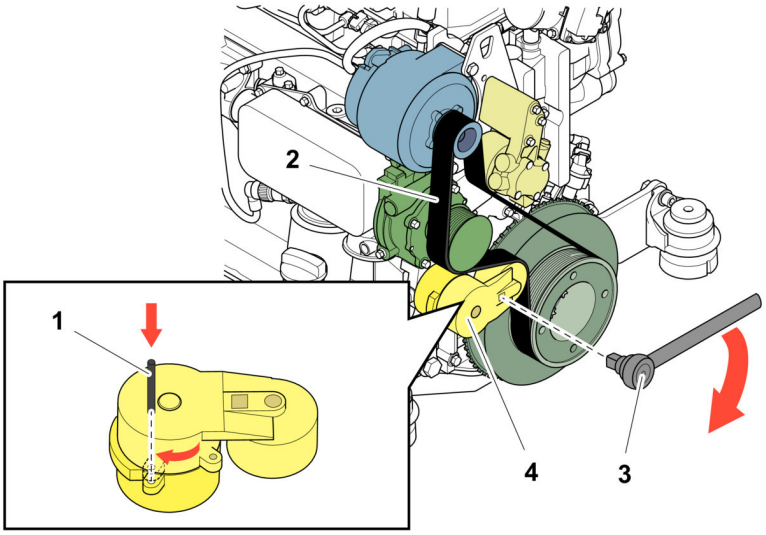

- Check belt wear by inspecting the wear indicator for the belt tensioner.
- Replace the belt if the distance (A) is less than 3 mm (0.11 in.).

### 12.16.2 Replace Belt

1. Press tension pulley (4) with key (3) in the direction of the arrow until the lock pin (1) can be secured in the mounting hole. The belt (2) is not yet tensioned.




*Drive belt replacement, Deutz TCD 2012 L06 and 2013 L04*




*Drive belt replacement, Deutz TCD 4.1 and 6.1*

2. First pull the belt off the smallest roller or from the tension pulley and then remove the entire belt.
3. Install the new belt.
4. Release the lock pin (1) by turning the wrench (3) in the direction of the arrow until the pin comes loose. Remove the pin and slowly lower the tension pulley back against the direction of the arrow until the belt is taut.
5. Make sure the belt is positioned correctly.

## 12.17 Change Engine Pads

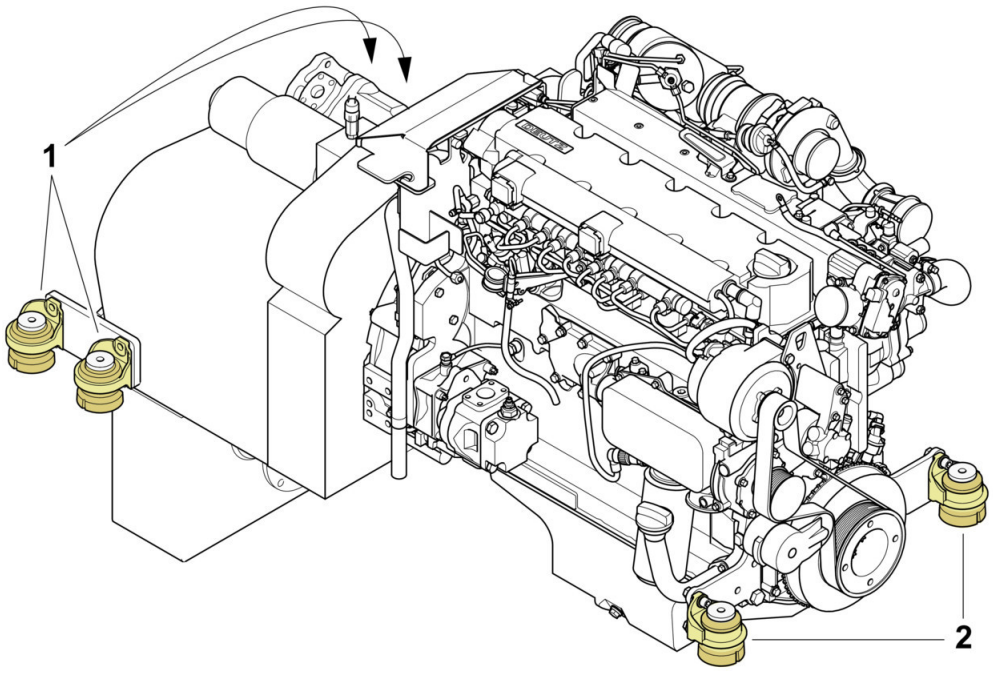
1. Secure the diesel engine/transmission with a suitable lifting device.
2. Loosen the bolts to the engine pad/pads to be changed.

3. Remove the old engine pad.

> ***NOTE:*** *If the engine pad is difficult to shift, the entire engine pad bracket can be dismantled and the engine pad then removed elsewhere.*

4. Put the new engine pad in place and lower the diesel engine/transmission.
5. Replace the bolt and tighten it to the prescribed torque, see chapter General, Tightening Torque in Bolted Joints.

## 12.18 Check Tightening Torque on Engine Suspension Bolts




*Engine suspension*

| | | | |
|---|---|---|---|
| 1 | Transmission brackets, two each side | 2 | Engine brackets, one each side |

1. Make sure the engine suspension bolts are tightened to the correct torque, see chapter General, Tightening Torques in Bolted Joints.

## 12.19 Check Heating Element

**WARNING**

**Hot Surface**

Hot components can cause serious personal injury.

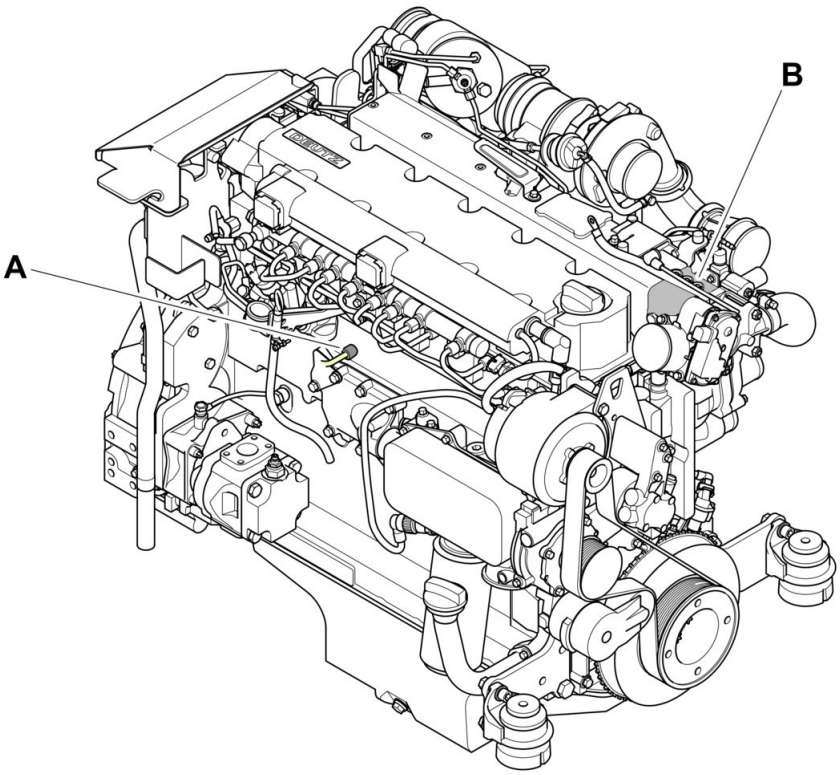
- ▶ Turn off the machine and allow the components to cool down before starting maintenance work.
- ▶ Use Personal Protective Equipment (PPE).
- ▶ Be careful when draining hot fluids.
- ▶ Do not handle flammable fluids near hot surfaces, sparks, or open flames.

**CAUTION**

**Hot Surfaces**

The heating element will get hot if preheating is on for too long which results in a risk of burn injuries.

- ▶ Check the heating element directly after preheating has been turned on.




Precondition ✓ The ignition is switched OFF.

1. Disconnect the connector (A) from the coolant temperature sensor.

2. Turn the ignition key to the preheating position.

Step result ➔ Heating element (B) starts to heat up. If the heating element does not heat up, it is defective and requires replacement.

3. Turn the ignition key to the OFF position.
4. Plug in the connector (A).

## 12.20 Alternator

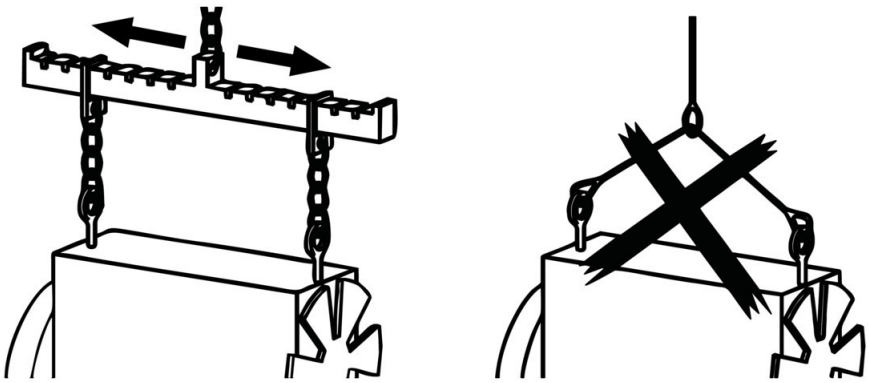
- Do not break connections between battery, alternator, and regulator when the engine is running.
- If the alternator must be started and run without the battery, the cable between the regulator and alternator must be disconnected before starting the engine.
- Do not mix up the battery connections.
- The charge lamp must be replaced immediately if it is broken.
- Do not spray water directly on the alternator when cleaning the engine. Run the engine warm afterward to evaporate excess water.
- The method of checking whether the alternator is energized by undoing one of the contacts and grounding it must not be used under any circumstances! Sparks can cause engine fires.
- When carrying out electric welding, connect the ground directly to the part being welded.

- Do not break connections between battery, alternator, and regulator when the engine is running.
- If the alternator must be started and run without the battery, the cable between the regulator and alternator must be disconnected before starting the engine.
- Do not mix up the battery connections.
- Do not spray water directly on the alternator when cleaning the engine. Run the engine warm afterward to evaporate excess water.
- The method of checking whether the alternator is energized by undoing one of the contacts and grounding it must not be used under any circumstances! Sparks can cause engine fires.
- When carrying out electric welding, connect the ground directly to the part being welded.

- Do not break connections between battery, alternator, and regulator when the motor is running.
- If the alternator must be started and run without the battery, the cable between the regulator and alternator must be disconnected before starting the motor.
- Do not mix up the battery connections.
- The charge lamp must be replaced immediately if it is broken.
- Do not spray water directly on the alternator when cleaning the motor. Run the motor warm afterward to evaporate excess water.

- The method of checking whether the alternator is energized by undoing one of the contacts and grounding it must not be used under any circumstances Sparks can cause motor fires.
- When carrying out electric welding, connect the ground directly to the part being welded.

## 12.21 Check Lifting Device



- Make sure that all connections to the engine have been disconnected.
- Use a suitable lifting device for repositioning the engine.
- The lifting device must be adjustable for the center of gravity of engine.
- Remove the lifting eyes before the engine is taken into operation again.

## 12.22 Check Hoses for Fuel and Air Intake Systems

**WARNING**

**Hot Surface**

Hot components can cause serious personal injury.

- ▶ Turn off the machine and allow the components to cool down before starting maintenance work.
- ▶ Use Personal Protective Equipment (PPE).
- ▶ Be careful when draining hot fluids.
- ▶ Do not handle flammable fluids near hot surfaces, sparks, or open flames.

- Check hoses and couplings for wear and leakage.

## 12.23 Engine Diagnostics

***NOTE:*** *Refer the Deutz instruction manual if further information on the engine is required. The instruction manual can be obtained via Epiroc. Contact Epiroc's local customer centre.*

# 13 Cooling System

## 13.1 Safety Precautions before Working on Cooling System

**WARNING**

**Burning Hazard**

Hot fluids can cause severe personal injury.

- ▶ Shut off the engine.
- ▶ Wait for the diesel engine to cool down before working on the cooling system.
- ▶ Use personal protective gear.

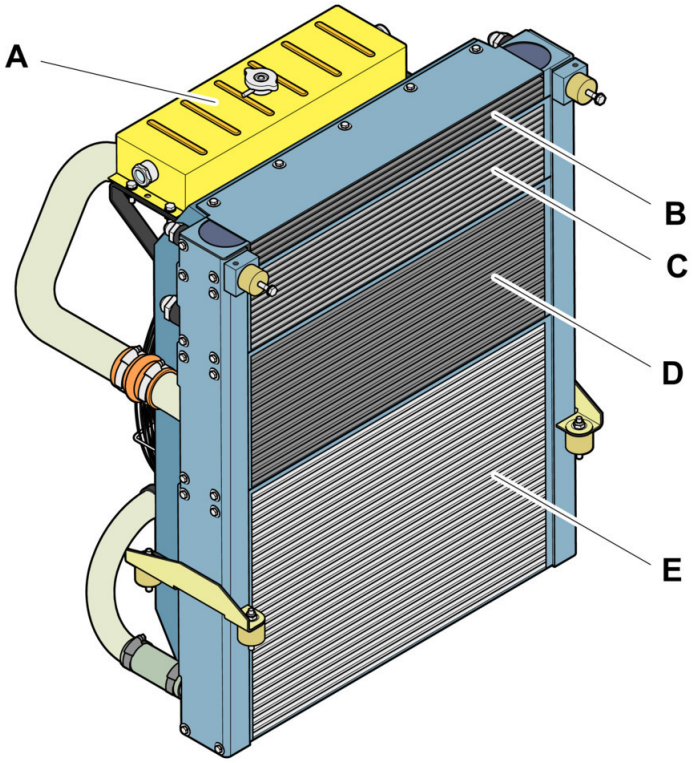
**WARNING**

**Burning Hazard**

The cooling elements may become hot during operation which can cause serious burn injury.

- ▶ Do not touch the elements until they have cooled down.
- ▶ Use personal protective gear.

## 13.2 Cooling System Overview

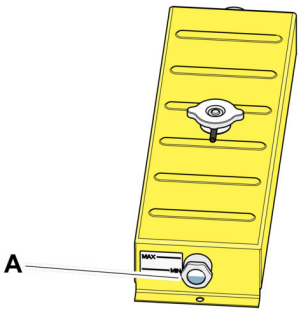



| | | | |
|---|---|---|---|
| A | Compensating reservoir | B | Hydraulic oil cooler |
| C | Transmission oil cooler | D | Aftercooler |
| E | Coolant radiator | | |

## 13.3 Check Coolant Level

The coolant level can be checked with the sight glass on the expansion vessel.

1. Check that the coolant level is between the MIN and MAX markings on the sight gauge (A).




*Compensating Reservoir*

2. Top up with coolant if necessary, see Top Up Coolant.

## 13.4 Clean Cooling System

**WARNING**

**Serious injury**

Risk of personal injury

- ▶ Uncouple the power source from the engine before cleaning

**WARNING**

**Serious injury**

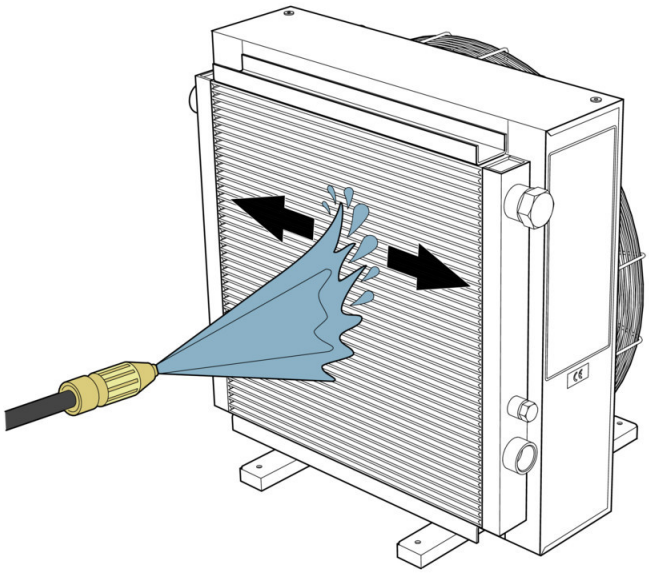
Danger of serious burns

- ▶ The air-oil cooler may become hot during operation. Do not touch the air-oil cooler until it has cooled down.

### 13.4.1 Air Oil Cooler

1. Remove all electrical connections.
2. Clean the outside of the radiator with water.

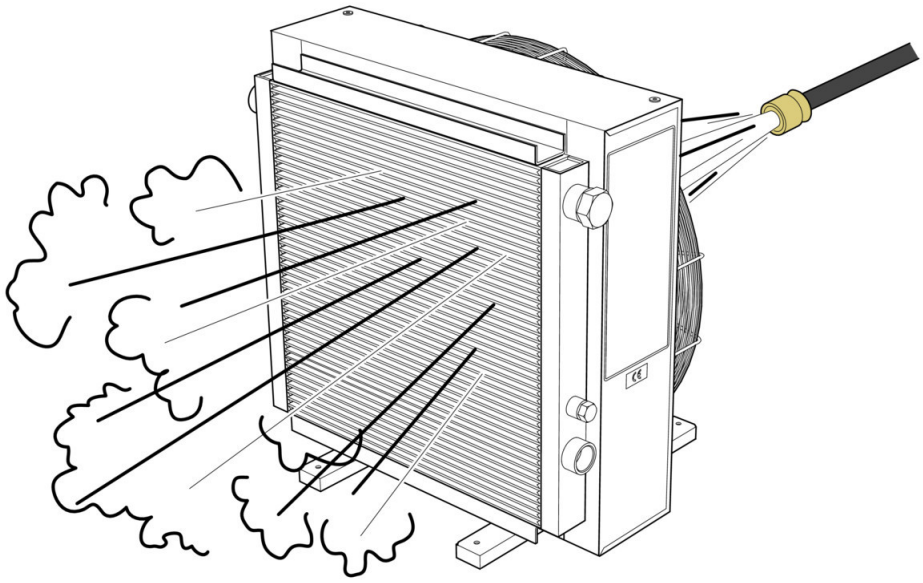
### 13.4.2 Cooling Element



*High-Pressure Jetting*

1. The cooling fins on the cooling element can be cleaned with compressed air.
2. If necessary, use a high-pressure washer with degreasing agent. The jet must be moved parallel to the fins when using a high-pressure washer.

### 13.4.3 Fan Housing



*High-pressure Jetting*

1. Disassemble the cooling element when cleaning the fan housing internally. See disassemble and Assemble the Fan Housing.
2. The inside of the fan housing can easily be cleaned with compressed air. Use degreasing agent whenever necessary.
3. Blow compressed air through the fan grille from the hydraulic motor side.

### 13.4.4 Dismantling/Assembling the Fan Housing

1. Turn off the system
2. Uncouple the power source to the engine
3. Ensure that the system is depressurized
4. Close the oil connections
5. Unscrew the cooling element from the fan housing
6. Lift away the cooling element
7. Assemble in reverse order
8. After assembly, check that:

   the cooler components are not damaged

   the cooler is connected correctly

   the fan is rotating freely

   all hydraulic couplings are tight

   the inside of the fan housing is free from objects that can be thrown out and cause personal injury or damage to property

   the direction of fan rotation and air flow agree with the indicator decal on the fan housing

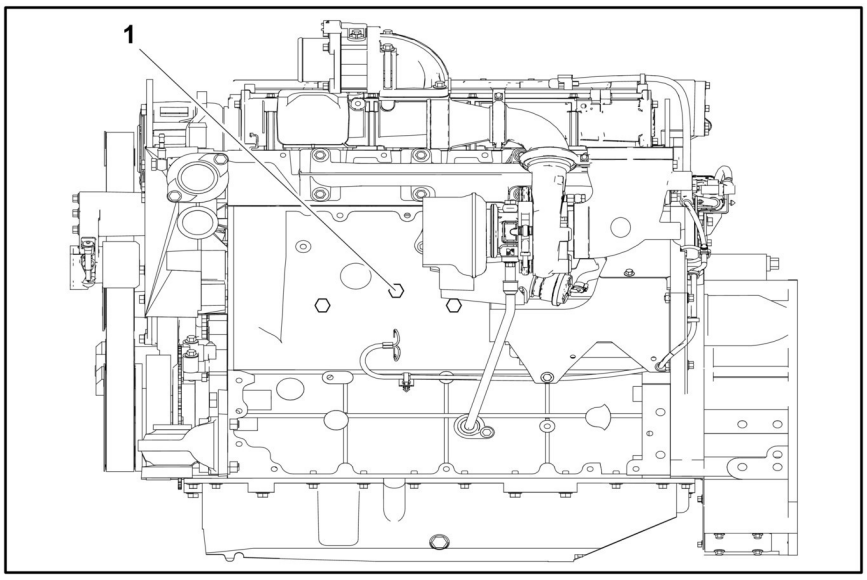
   there are no abnormal noise and vibrations

the cooler is not leaking

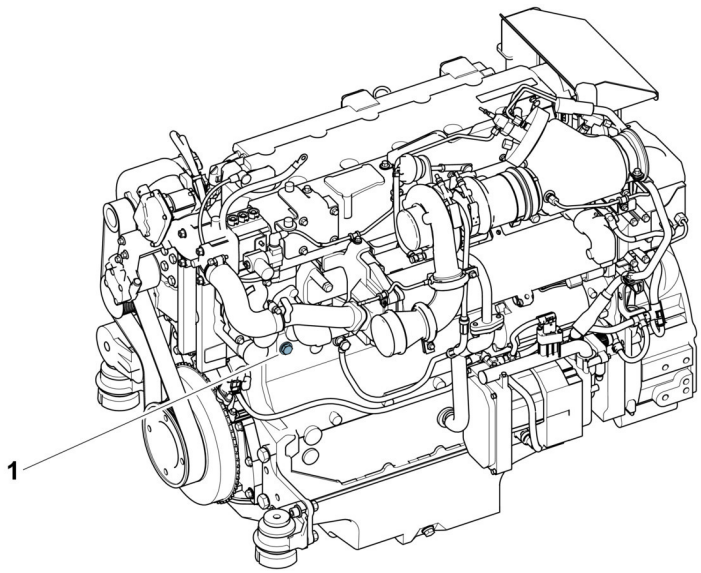
## 13.5 Drain the Coolant

> ***NOTE:*** *Take care when draining hot coolant. Risk of burns.*

1. Open the expansion tank lid.
2. Place a suitable receptacle under the drain plug (1).



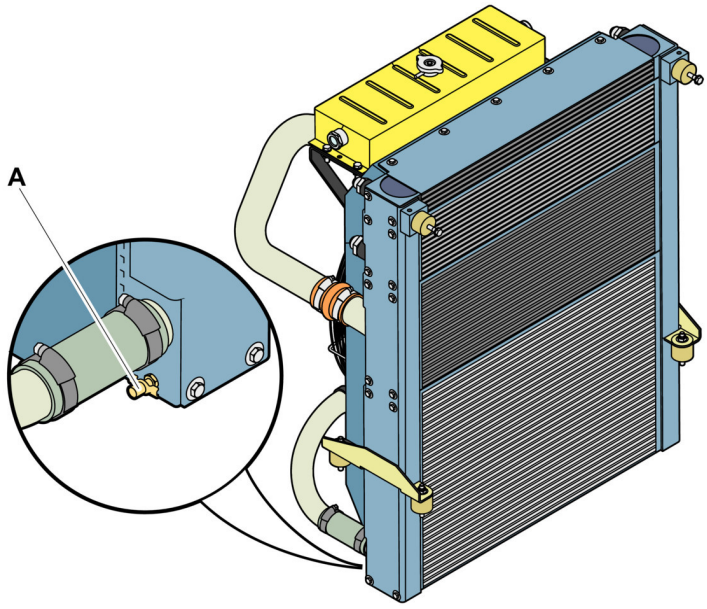

*Drain plug on crankcase, Deutz 2012 L06 and Deutz 2013 L04*




*Drain plug on crankcase, Deutz 4.1 and 6.1*

3. Unscrew the drain plug (1) on the crankcase completely.

4. Place a receptacle under the drainage tap (A).

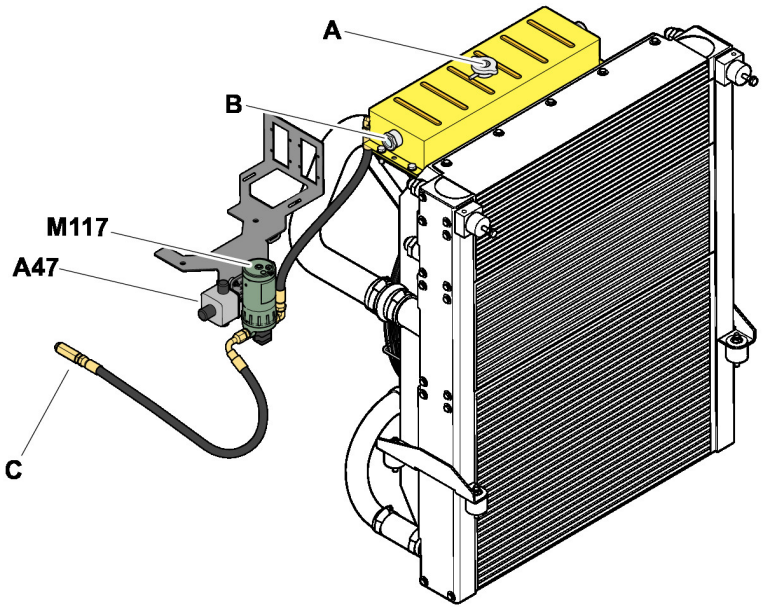



*Drainage tap on cooler*

5. Open the drainage tap (A).
6. Let all the coolant run out.
7. Tighten the drain plug (1) and close the drainage tap (A).

## 13.6 Top up Coolant

1. Make sure the cooler drainage tap is closed and the drain plug on the diesel engine and all hoses are tightened.




*Filling the coolant*

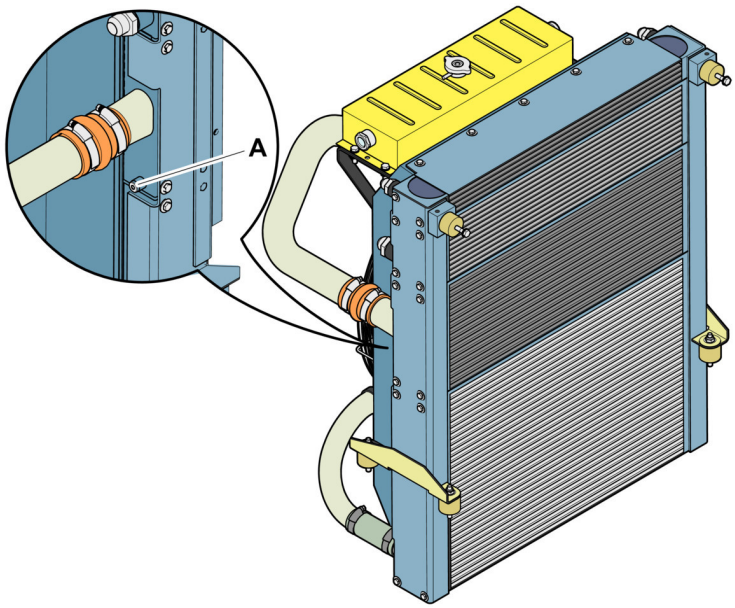
| | |
|---|---|
| A | Sight gauge |
| M117 | Filler pump |
| A47 | Control box |
| B | Filling hose |

2. Make sure the filler hose (B) is clean and then push it into the reservoir with new coolant.
3. Hold in the button on the control box (A47) to operate the filler pump (M117). Fill coolant until the level is approx. in the centre of the level glass (A).
4. Start the diesel engine and warm up until the thermostat opens, so the coolant begins to circulate through the system.
5. Switch off the diesel engine.
6. Check the coolant level with the engine cold and fill if necessary.

   Bleeding is performed automatically after filling.

## 13.7 Drain the After-cooler

1. Place a receptacle under the after-cooler drain plug (A).
2. Undo the drain plug (A).




*Drain the after-cooler*

3. Allow any condensation and lubricating oil to run out.
4. Screw back the drain plug.

# 14 Power Train

## 14.1 Safety Precautions before Working on Power Train

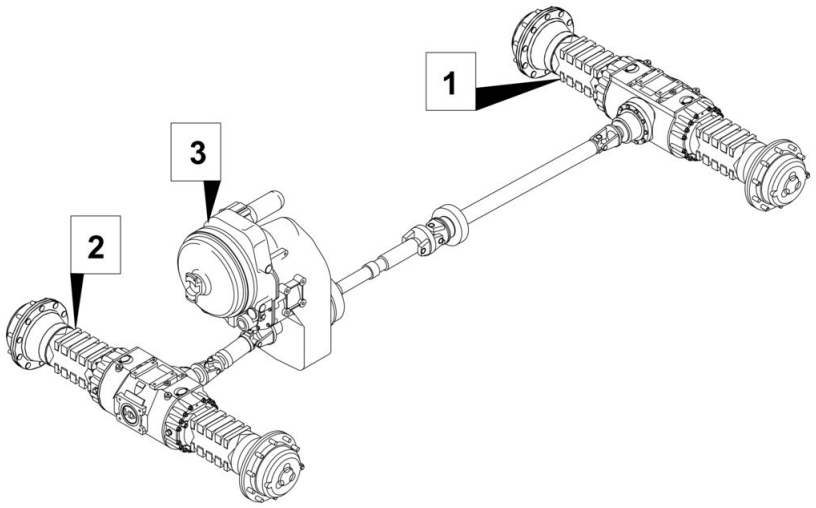
**WARNING**

**Hot Surface**

Hot components can cause serious personal injury.

- ▶ Turn off the machine and allow the components to cool down before starting maintenance work.
- ▶ Use Personal Protective Equipment (PPE).
- ▶ Be careful when draining hot fluids.
- ▶ Do not handle flammable fluids near hot surfaces, sparks, or open flames.

## 14.2 Power Train Overview




*Transmission*

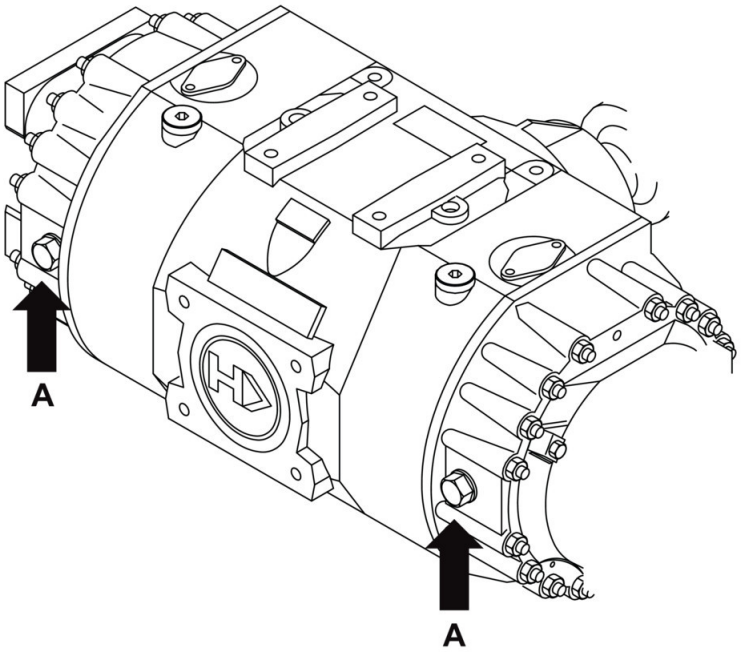
| | | | |
|---|---|---|---|
| 1 | Axle boom side Clark Hurt 176 | 2 | Axle Engine side Clark Hurt 176 |
| 3 | Transmission Clark 24000 long drop | | |

## 14.3 Replace Tyres and Wheels

- ○ The air pressure in the tires should be 10 bar (145 psi).
- ○ When changing wheels, the contact surface between hub and rim must be cleaned in order maintain tightening torque.
- ○ The wheel nuts must be torque-tightened to 350 Nm (258 lb-ft).

# 14.4 Drive Axles

## 14.4.1 Check Oil Level in Central Housing



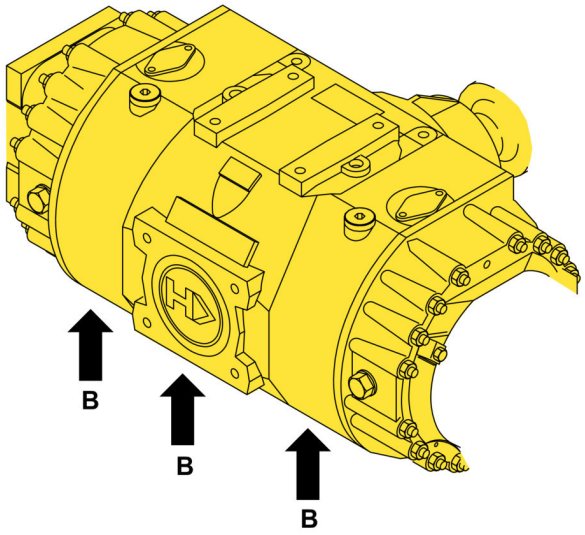

*The center of the axles*

1. Make sure that the machine is standing level.
2. Remove the plug (A) and check the oil level.
3. Fill the central housing with oil as necessary. See the specification in Fluids and Lubricating Greases manual.

## 14.4.2 Replace Oil in Central Housing

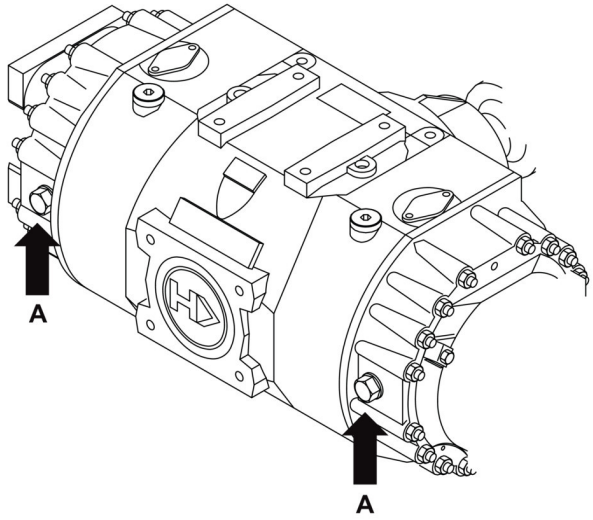
1. Oil should be changed after operating the machine, while the oil is still hot.

2. Unscrew the three plugs (B) and drain the oil.




*Changing oil*

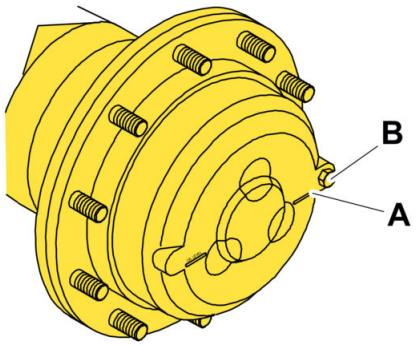
3. The oil will drain faster if plug (A) is also unscrewed




*The center of the axles*

4. Refit the plugs (B) and tighten them.
5. Fill with new oil through the hole for plug (A) until the oil reaches the hole.
6. Screw in and tighten plug (A).

### 14.4.3 Check Oil Level in Planetary Gear




1. Make sure the machine is standing level.
2. Rotate the wheel so that the two level markings (A) on the hub are horizontal.
3. Remove the screw (B) and check that the oil level.
4. Fill the planetary gear with oil as necessary. See the specification in Fluids and Lubricating Greases manual.

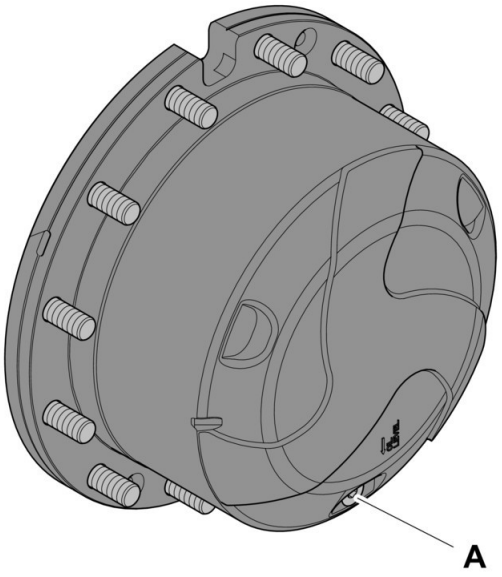
### 14.4.4 Replace Oil in Planetary Gear

**WARNING**

**Hot Surface**

Hot components can cause serious personal injury.

- ▶ Turn off the machine and allow the components to cool down before starting maintenance work.
- ▶ Use Personal Protective Equipment (PPE).
- ▶ Be careful when draining hot fluids.
- ▶ Do not handle flammable fluids near hot surfaces, sparks, or open flames.



Precondition
- ✓ The machine is parked on a flat and leveled surface.
- ✓ The oil is hot.

1. Rotate the gear until plug (A) is brought to its lowest position.
2. Remove the plug (A).
3. Drain the oil into a suitable vessel.
4. Rotate the gear until plug (A) is at level with the gear center.
5. Fill new oil through the hole for plug (A).
6. Check that the oil is at level with the hole.
7. Install plug (A) again and tighten.

**See Separate Manual**

Fluids and Greases

| Oil Volume for Planetary Gear on Wheel Axle, Dana 123 | Oil Volume for Planetary Gear on Wheel Axle, Dana 113 | Oil Volume for Planetary Gear on Wheel Axle, Dana 114 |
|---|---|---|
| 2.1 L (0.55 gallon) | 2.6 L (0.68 gallon) | 4.5 L (1.18 gallon) |

### 14.4.5 Check Tightening Torque on Bolted Joints on Wheel Axle

- ○ Check all bolts that hold the axle to the frame for damage.
- ○ Check no bolt is missing.
- ○ Check and tighten all bolted joints to frame.

## 14.5 Hydraulic Transmission

### 14.5.1 Safety Precautions before Working on Hydraulic Transmission of Power Train

**WARNING**

**Hot Engine and Components**

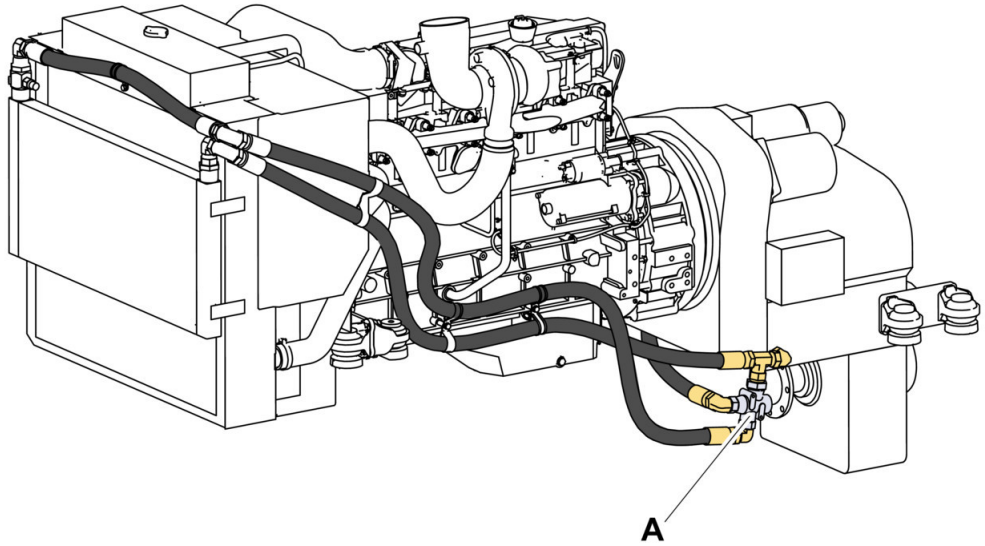
Can cause personal injury

- ▶ Make sure that the engine is switched off for all maintenance work.
- ▶ Take care when draining hot oil and fluids to avoid burns.

The oil must reach normal operating temperature 80−95 °C before the level is checked and the filter is replaced.

### 14.5.2 Cooling the Transmission Oil

Cooling of the transmission oil is controlled by a thermostat valve (A) which does not open the flow to the radiator before the oil has reached a temperature of 70 ºC.

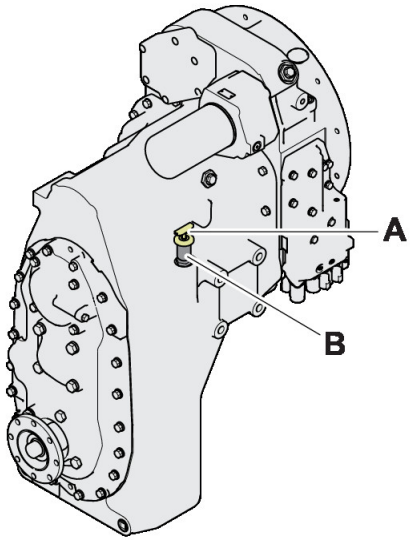



*Cooling the transmission oil*

> ***NOTE:*** *Thermostat valve (A) location may vary slightly depending on engine type.*

### 14.5.3 Check Oil Level Clark-24 000

First read: Safety Precautions before Working on Power Train [▶ 171]



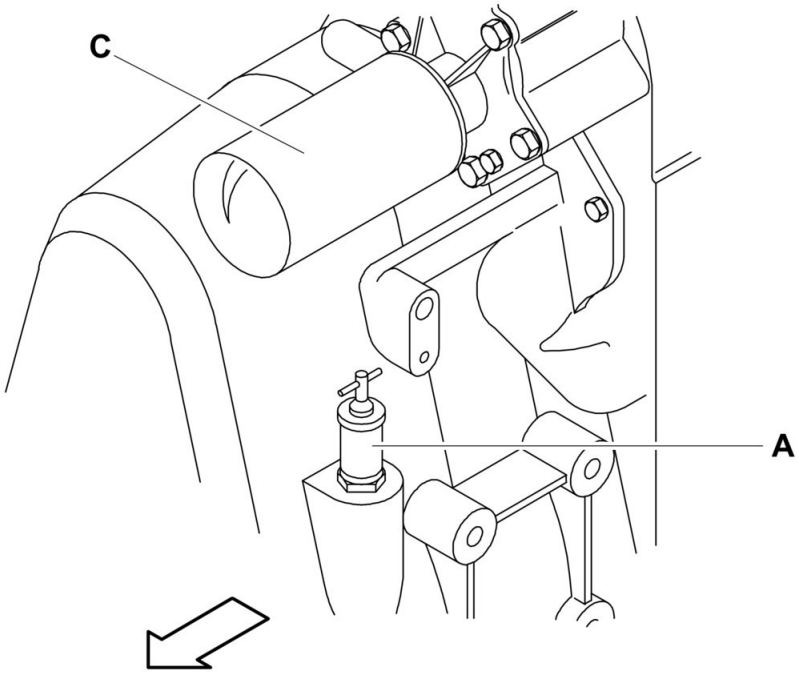

| | |
|---|---|
| Precondition | ✓ Oil is at operating temperature 80 °C to 95 °C (176 °F to 203 °F).<br>✓ Engine is idling at rpm. |

1. Check the oil with the dipstick (A).
2. Fill oil through the filler pipe (B) if necessary.

**See Separate Manual**

Fluids and Greases

### 14.5.4 Check Oil Level

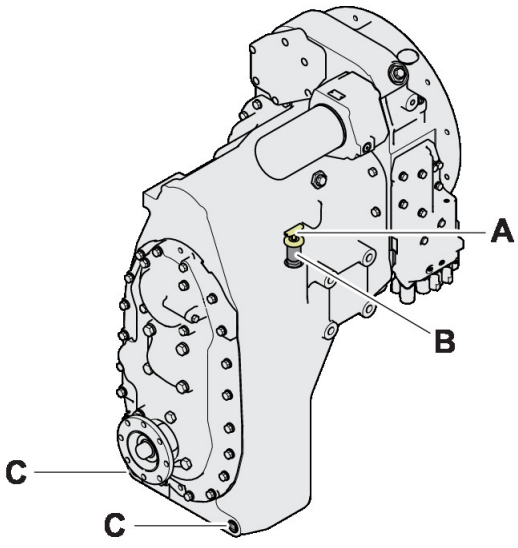



*Checking oil*

1. Check the oil with the dipstick (A) while the engine is idling, 750 - 800 rpm.
2. Top up as needed through the filler pipe (A) to the FULL mark on the dipstick. See maintenance instructions Lubricants, coolants and propellants.

### 14.5.5 Replace Oil Clark-24 000

First read: Safety Precautions before Working on Power Train [▶ 171]



Precondition
- ✓ Engine is switched off.
- ✓ Oil is at operating temperature, 80–95 ºC (176–203 ºF).

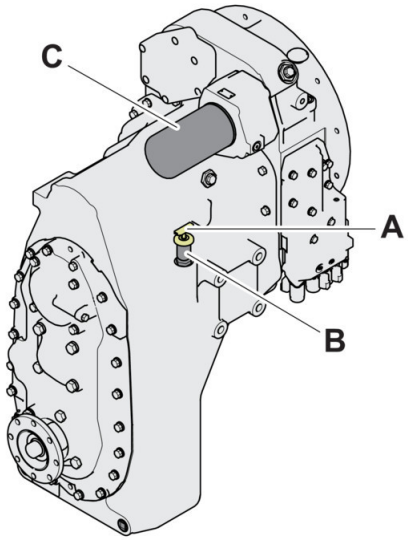
1. Place a vessel under the transmission.
2. Remove plug (C) to drain the oil from the transmission housing.
3. Install the plug.
4. Fill the transmission housing with oil through the filler pipe (B) up to the low mark on the dipstick (A).
5. Start the diesel engine and idle at rpm to fill up the torque converter and lines.
6. Check the oil level while the engine is idling and fill oil through the filler pipe (B) to the low mark on the dipstick (A).
7. Check the oil level after it has reached normal operating temperature.
8. Fill with oil up to the full mark on the dipstick (A).

| **See Separate Manual** |
| --- |
| Fluids and Greases |

| **Oil Volume for Hydraulic Transmission, Clark 24000** |
| --- |
| 21 L (5.54 gallon) |

### 14.5.6 Replace Filter Clark-24 000

First read: Safety Precautions before Working on Power Train [▶ 171]




Precondition
- ✓ Oil is at operating temperature 80 °C to 95 °C (176 °F to 203 °F).
- ✓ Engine is switched off.

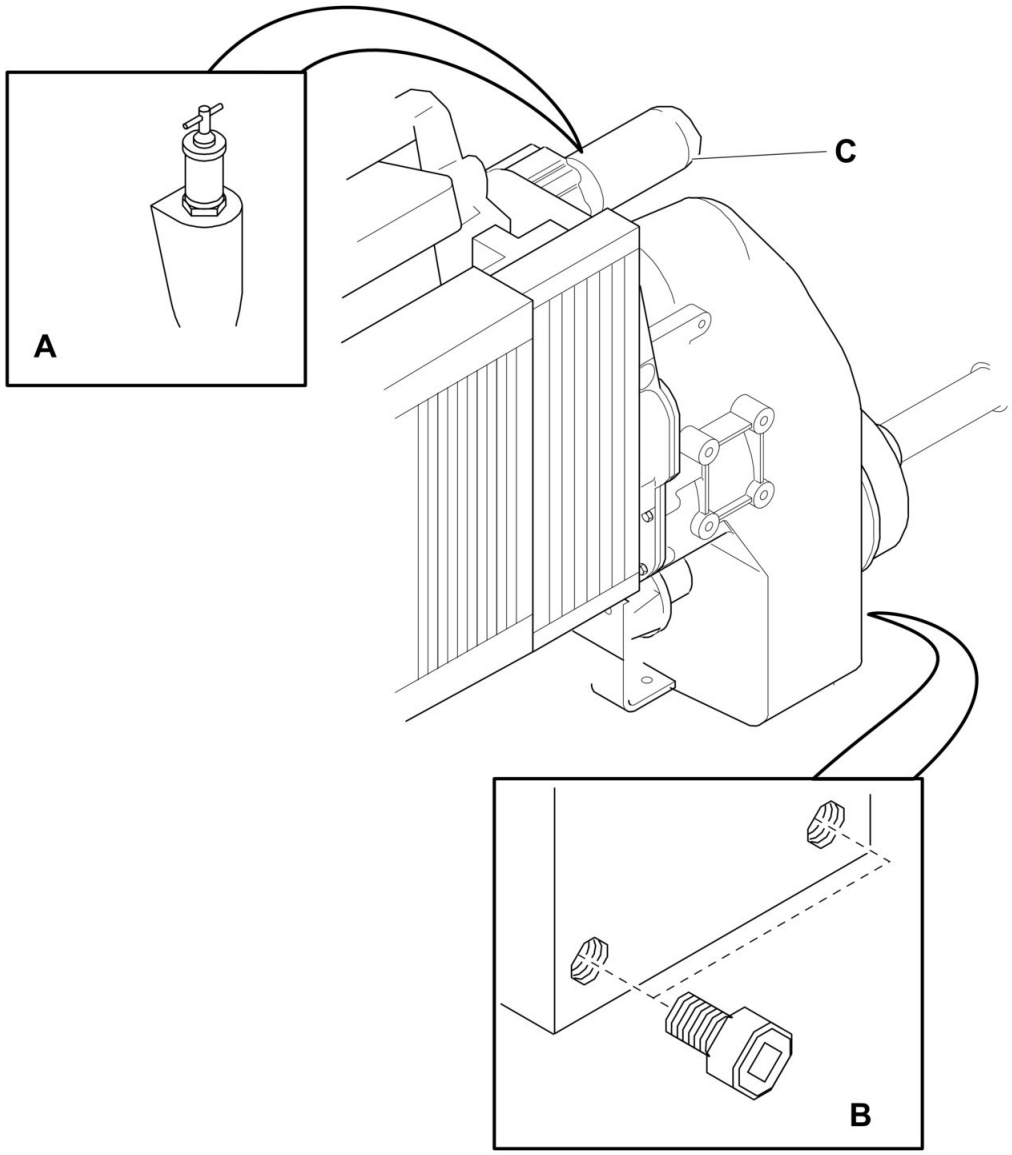
1. Remove the filter (C).
2. Replace the filter.
3. Start the diesel engine and idle at rpm to fill up the torque converter and lines with oil.
4. Check the oil level while the engine is idling and fill the oil through filler plug (B) to the low mark on the dipstick (A).
5. Check the oil level after it has reached normal operating temperature.
6. Fill with oil through filler plug (B) up to the full mark on the dipstick (A).

| **See Separate Manual** |
| --- |
| Fluids and Greases |

| **Oil Volume for Hydraulic Transmission, Clark 24000** |
| --- |
| 21 L (5.54 gallon) |

| **Oil Volume for Hydraulic Transmission, Clark 24000** |
| --- |
| 27 L (7.13 gallon) |

### 14.5.7 Replace Filter and Oil




*Changing oil in the transmission*

1. Drain the oil from the transmission housing when it has reached normal operating temperature by opening the plugs (B). Screw the plugs back in place
2. Remove filter (C) and fit a new one in its place.
3. Fill the transmission housing with oil through (A) up to the "LOW" mark on the dip-stick (A). See maintenance instructions Lubricants, coolants and propellants.
4. Start the diesel engine and let it idle, 750-800 rpm, to fill up the torque converter and lines.
5. Check the oil level again with the engine idling and top up to the "LOW" mark on the dipstick (A).
6. Check the oil again once it has reached normal operating temperature, 80-95 °C.
7. Fill with oil to the "FULL" mark on the dipstick.

# 14.6 Carrier

## 14.6.1 Check Carrier Central Lubrication

**WARNING**

**Hot Surface**

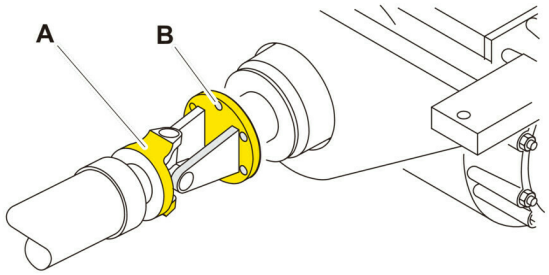
Hot components can cause serious personal injury.

- ▶ Turn off the machine and allow the components to cool down before starting maintenance work.
- ▶ Use Personal Protective Equipment (PPE).
- ▶ Be careful when draining hot fluids.
- ▶ Do not handle flammable fluids near hot surfaces, sparks, or open flames.

- ○ Check the central lubrication hoses and nipples for wear or other damage.
- ○ Fill the central lubrication with grease if necessary.

## 14.6.2 Lubricate Cardan Shafts

1. Pump grease into the grease nipples (A) in the center of the universal joints. Refer to Fluids and Lubricating Greases manual.

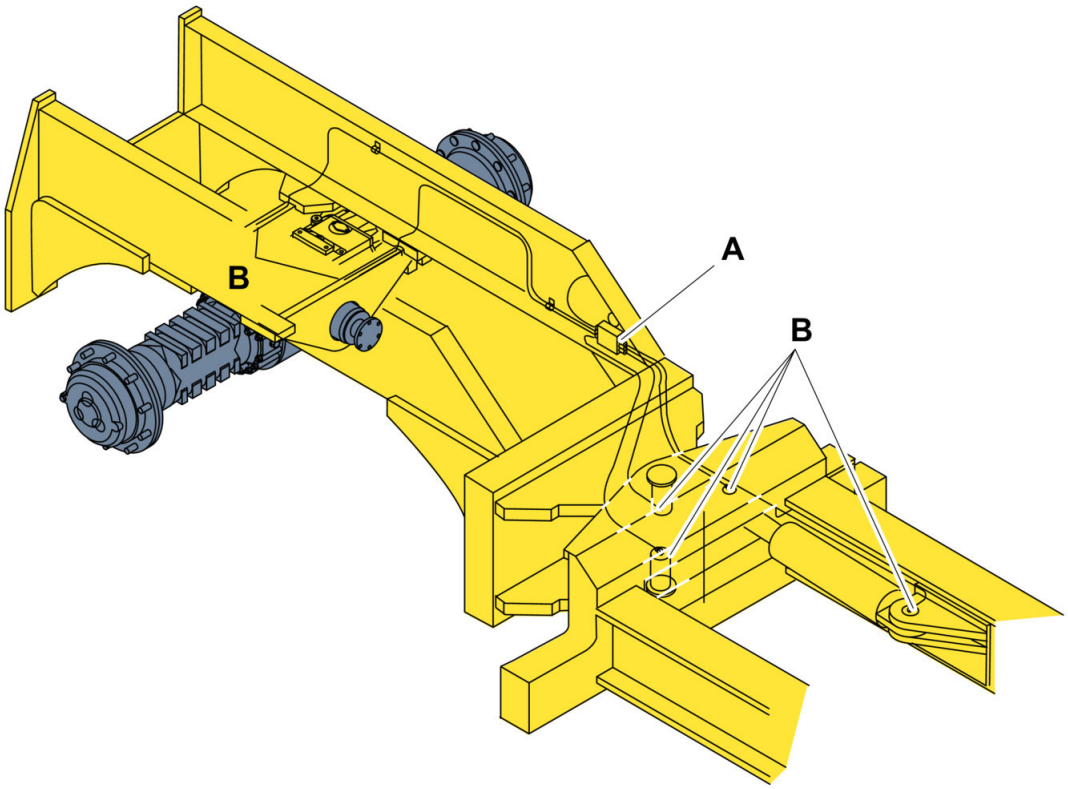



| | | | |
|---|---|---|---|
| A | Lubrication nipple | B | Bolted joints |

2. Make sure that the grease appears.

| See Reference Document |
|---|
| Fluids and Lubricating Greases |

### 14.6.3 Lubricate Central Chassis




*Central lubrication*

The chassis is equipped with a lubricating system that lubricates the rear axle's pendulum suspension from 2 nipples (B).

1. Press grease into the grease nipples (A). See manual Fluids and greases.
2. Make sure grease comes out at all positions (B).

## 14.7 Towing

### 14.7.1 Safety Precautions before Towing

**WARNING**

**Machine Movement**

The machine has no working brakes when it is being towed which can cause serious injury or death.

- ▶ Always attach a tow bar between the machine and the towing machine before releasing the brakes or removing the cardan shafts.
- ▶ Make sure that the towing machine and the tow bar are suitable to pull the load.

**NOTICE**

**Incorrect Towing**

Starting the machine when towing could damage the hydraulic transmission seriously.

- ▶ Do not start the machine by towing.

### 14.7.2 Preparing for Towing

First read: Safety Precautions before Towing [▶ 182]

Tow the carrier only if it is necessary.

Do not tow the carrier more than 1 km (0.621 mile) or at a speed greater than 5 km/h (3.10 miles/h).

***NOTE:*** *The brakes do not function while the machine is being towed.*

1. Connect a tow bar between the machine and the towing machine.
2. Disable the parking brake mechanically.
3. Disassemble the cardan shaft from the drive train.
4. If the diesel engine is not working, disconnect the steering cylinder.

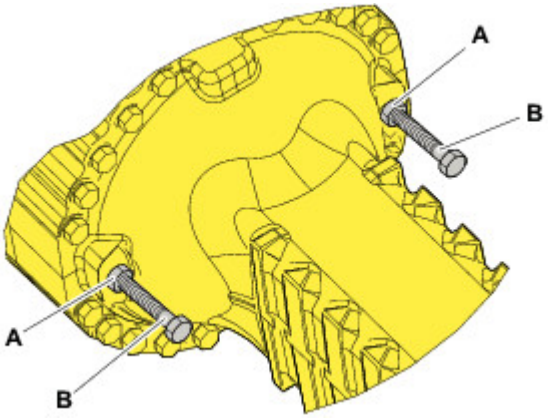
### 14.7.3 Disconnect Parking Brake Mechanically

**WARNING**

**Machine Movement**

The machine has no working brakes when it is being towed which can cause serious injury or death.

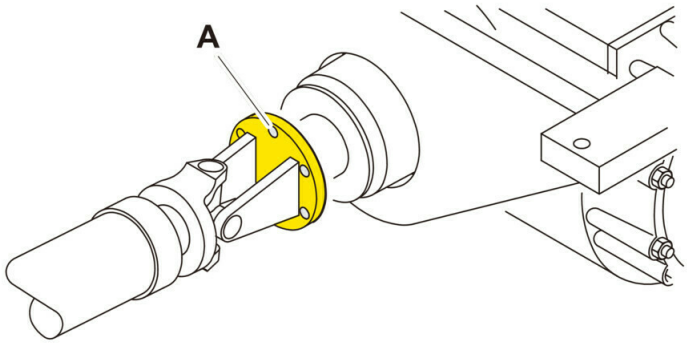
- ▶ Always attach a tow bar between the machine and the towing machine before releasing the brakes or removing the cardan shafts.
- ▶ Make sure that the towing machine and the tow bar are suitable to pull the load.



Precondition ✓ A tow bar is connected between the machine and the towing machine.

1. Loosen the lock nuts (A).
2. Tighten the bolts (B) alternately until the brake is released.
   Both the bolts must be tightened to the same extent.
3. Lock the bolts with the nuts.
4. Disable the brakes on both wheel axles.

### 14.7.4 Remove Cardan Shafts




1. Mark the flanges on the cardan shafts so they can be installed in the same way.
2. Remove the bolted joints (A) and remove the cardan shafts.

### 14.7.5 Disconnecting Steering Cylinder

First read: Safety Precautions before Towing [▶ 182]

If the diesel engine is not working during towing, the steering cylinder must be disconnected hydraulically.

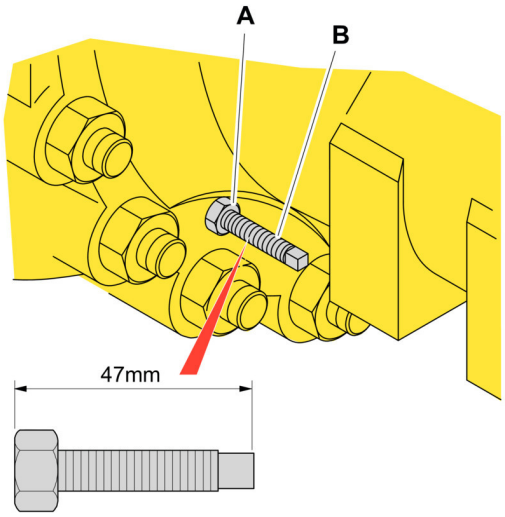
Precondition ✓ The unions on the cylinder are not plugged to allow oil to run out.
✓ The unions are protected from dirt.

1. Remove both hoses from the steering cylinder.
2. Plug the hoses.
3. Protect the steering cylinder against dirt.

### 14.7.6 Restoring after Towing

1. Refit the cardan shafts.
2. Connect the hoses to the steering cylinder.

3. Apply the brakes. Undo the lock nut (A) and unscrew the bolt until it protrudes 47 mm.




*Setting the brake screw*

4. Remove the drawbar between the chassis and the towing vehicle.
5. Check the brakes after towing. See maintenance instructions Brake system: Checking service brake pressure.

# 15 Brake System

## 15.1 Safety Precautions before Working on Brake System

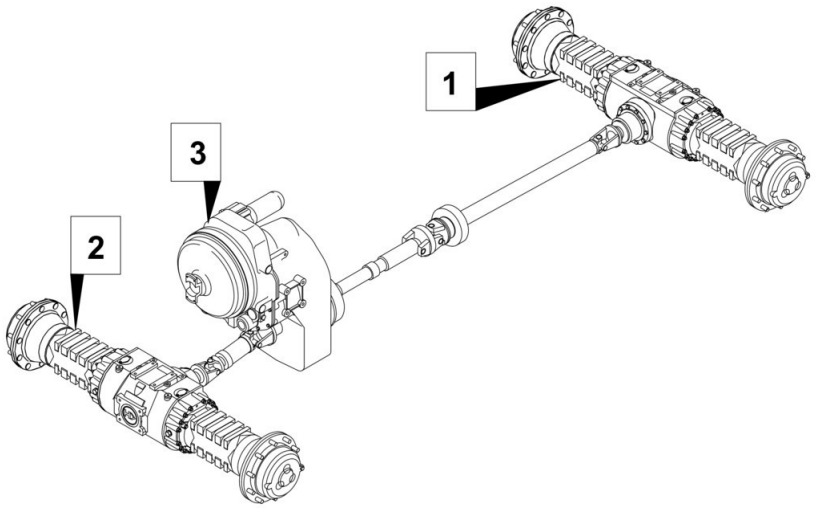
**WARNING**

**High Hydraulic Oil Pressure**

Can cause personal injury.

- ▶ Switch off the machine.
- ▶ Make sure that the system is de-pressurized before starting any work.
- ▶ Press the brake pedal repeatedly after the machine has been switched off to make sure that the system is de-pressurized.
- ▶ Check a pressure gauge on both brake system accumulators to make sure that the system is de-pressurized.

## 15.2 Brake System Overview




*Transmission*

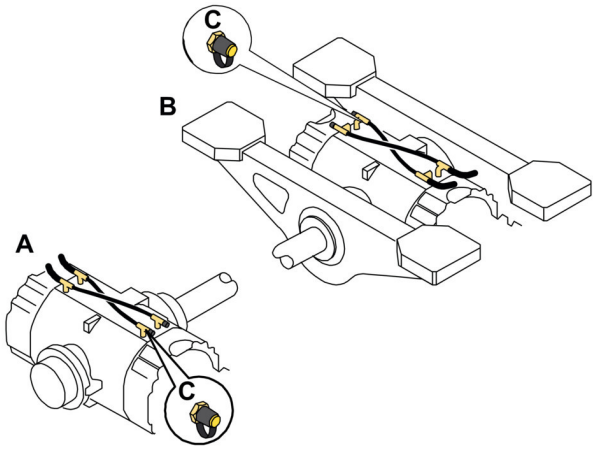
| | | | |
|---|---|---|---|
| 1 | Axle boom side Clark Hurt 176 | 2 | Axle engine side Clark Hurt 176 |
| 3 | Transmission Clark 24000 long drop | | |

## 15.3 Check Service Brake Pressure

**Preparation**

1. Ensure that the rig is on a level surface and that the parking brake is applied.

2. Connect a pressure gauge to the brake system pressure test outlet (C).




*Checking service brake pressure*

| | |
|---|---|
| A | Front axle |
| B | Rear axle |
| C | Test outlet |

**Check**

1. Start the diesel engine.
2. Depress the brake pedal and read off the pressure on the pressure gauge. It should read 80 +5/-0 bar.

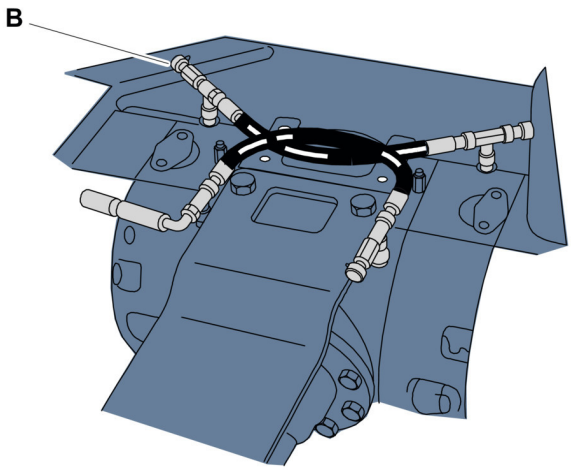
   The pressure is factory set and cannot be adjusted.
3. Stop the diesel engine.

**Finishing**

1. Disconnect the pressure gauge for the brake system test outlet (C).

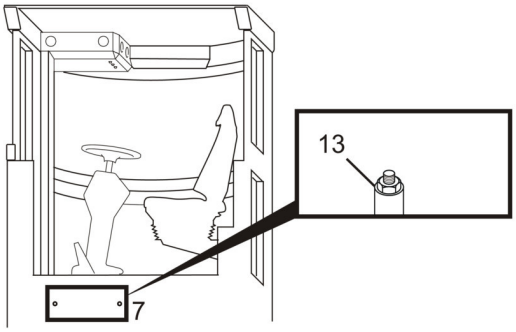
## 15.4 Check Parking Brake Pressure

1. Connect a pressure gauge to the brake system pressure test outlet (B).




*Checking parking brake pressure*

2. Start the diesel engine.
3. Release the parking brake while reading off the pressure on the pressure gauge. The pressure should be 35 bar. The pressure can be adjusted on the pressure regulator (13) under the control platform.




*Regulating parking brake pressure*

4. Stop the diesel engine and disconnect the pressure gauge from the pressure test outlet.

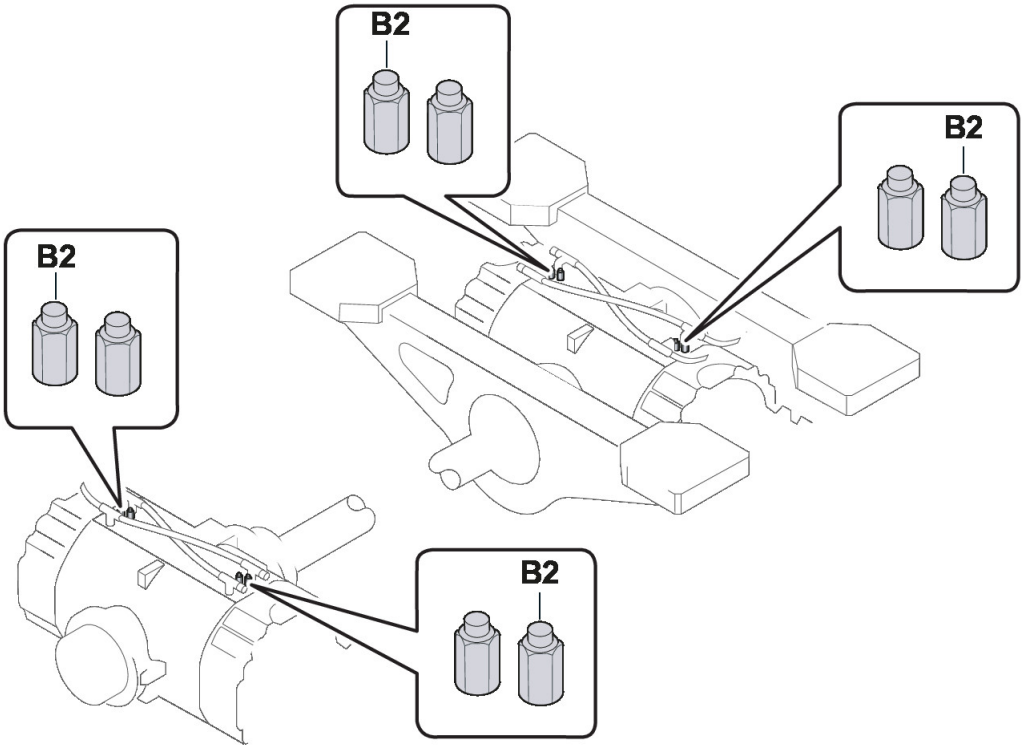
## 15.5 Bleeding Service Brake

**WARNING**

**Hydraulic Oil at High Pressure**

Thin jets of hydraulic oil under high pressure can penetrate the skin and cause permanent damage.

- ▶ Immediately consult a doctor if hydraulic oil has penetrated the skin.
- ▶ Never use your fingers to check for hydraulic fluid leaks.
- ▶ Keep your face away from any possible leaks.




Precondition
- ✓ The machine is parked on a flat and leveled surface.
- ✓ The jacks are extended and the wheels are suspended from ground.

1. Attach plastic hoses to the nipples ().
2. Start the diesel engine.
3. Press and hold the brake pedal.
4. Open the nipples (), about half a turn.
5. Use a vessel to collect the fluid residues.
6. Tighten the nipples when there is no air in the fluid.
7. Shut down the engine and turn on the ignition key.
8. Press the brake repeatedly.

   This must activate the once the pressure has dropped to 110 bar (1595 psi).
9. Press and hold the brake pedal completely and release.

   Repeat this four times.

   If the brake pressure drops below 90 bar (1305 psi) after this step is completed, repeat steps 1–6.

   Repair the brakes if the service brakes do not work.
10. Switch off the diesel engine.
11. Remove the plastic hoses.

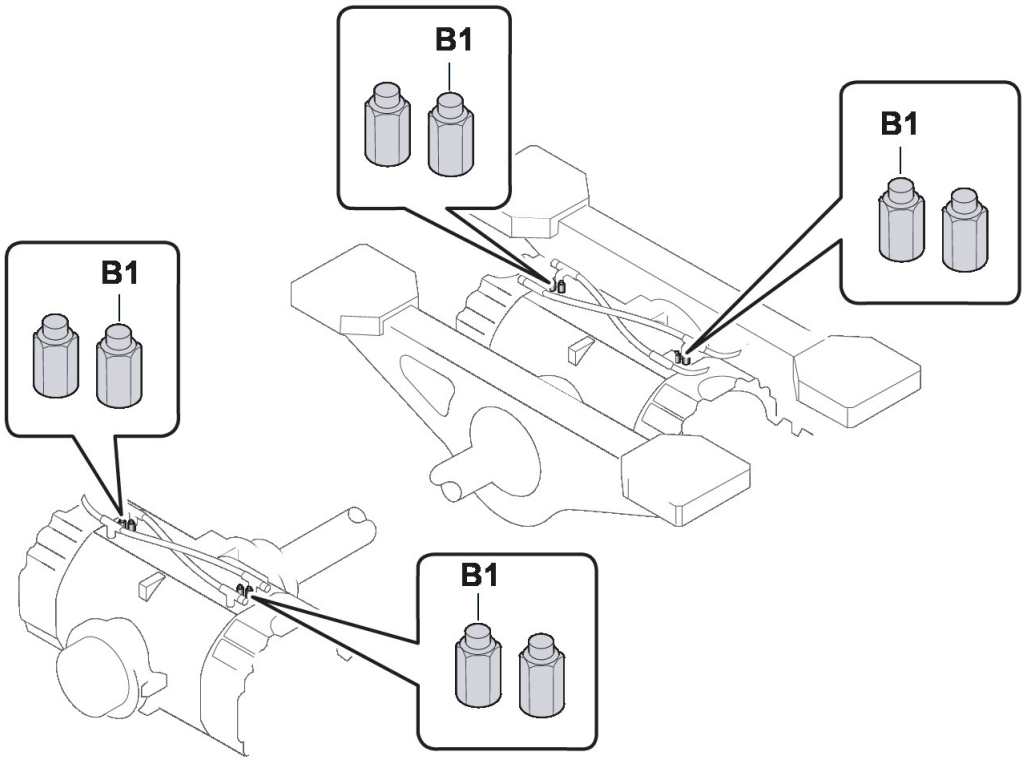
## 15.6 Bleeding Parking Brake

**WARNING**

**Pressurized System**

The parking brake is bled while the system is pressurized and the hydraulic oil in the system can cause personal injury.

- ▶ Never unscrew the bleeder nipples fully when bleeding the parking brakes.
- ▶ Follow the instructions carefully.




Precondition
- ✓ The machine is parked on a flat and leveled surface.
- ✓ The jacks are extended and the wheels are suspended from ground.

1. Attach the plastic hoses to the nipple ().
2. Start the diesel engine.
3. Release the parking brake.
4. Open the nipple (), about half a turn.
5. Use a vessel to collect the fluid residues.
6. Tighten the nipple when there is no air in the fluid.

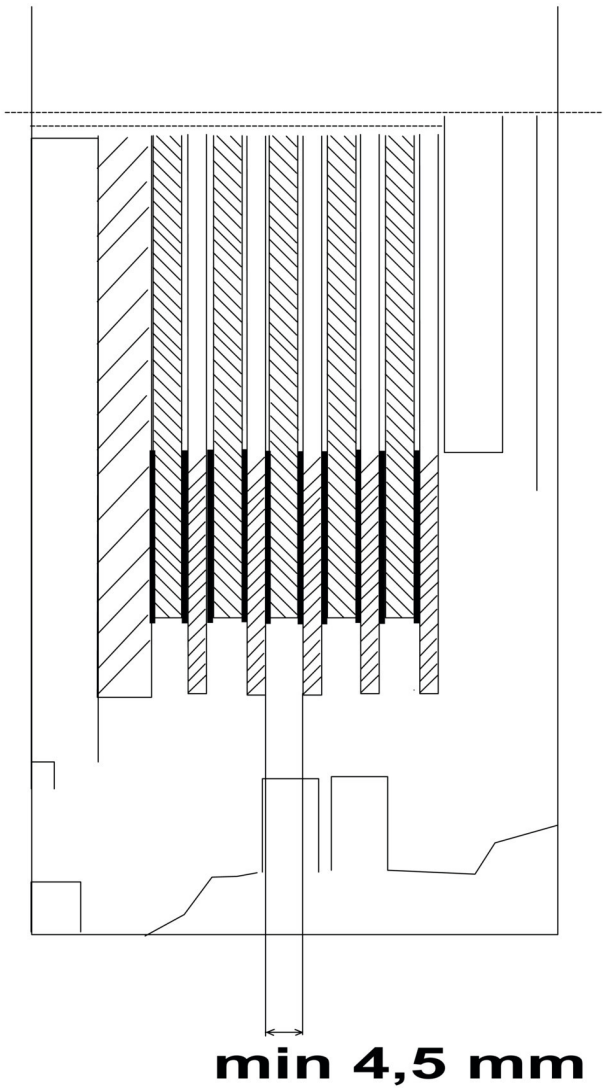
! ***NOTE:*** *Repeat bleeding several times to remove all the air from the system.*

7. Switch off the diesel engine.
8. Remove the plastic hoses.

## 15.7 Checking Brake System Wear

Precondition ✓ The brakes must be applied when checking brake disc wear. The discs can be checked in connection with changing oil in the final drive.

1. Remove the level plugs in the final drive, two for each brake.
2. Check the distance between the brake discs. Check the distance from both level plugs. Use a drift or similar tool with diameter 4.5 mm.




*Checking brake disc wear*

3. If the distance between the brake discs is less than 4.5 mm, they must be replaced. A new disc is 4.9 mm thick

## 15.8 Adjusting the Brakes

- The machine is equipped with self-adjusting brakes.

## 15.9 Checking Accumulator Charge Pressure

**WARNING**

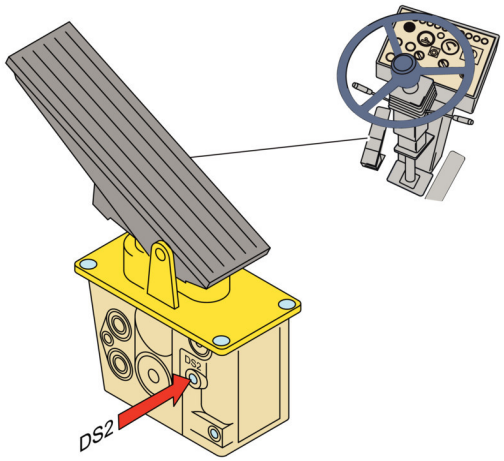
**Serious injury**

Hazardous hydraulic oil pressure

- ▶ Can cause personal injury
- ▶ There will be accumulated brake pressure of up to 210 bar in the brake circuit even after stopping the engine. If the system is opened without relieving this pressure, oil will spurt out at high pressure.

! ***NOTE:*** *The accumulator's charge pressure is specified on each accumulator's sign.*

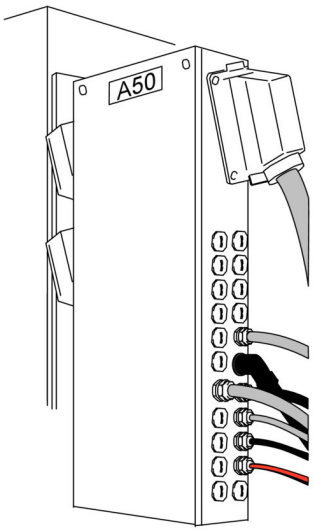
1. Connect a pressure gauge to a pressure gauge outlet at (DS2).




*Checking the service brakes*

2. Depressurise the system by depressing the brake pedal 30-40 times.

3. Disconnect fuse F112 in fuse box (A50) and crank the starter motor. The pressure gauge will indicate a rapid increase in pressure to the lowest pressure with which an accumulator is charged.

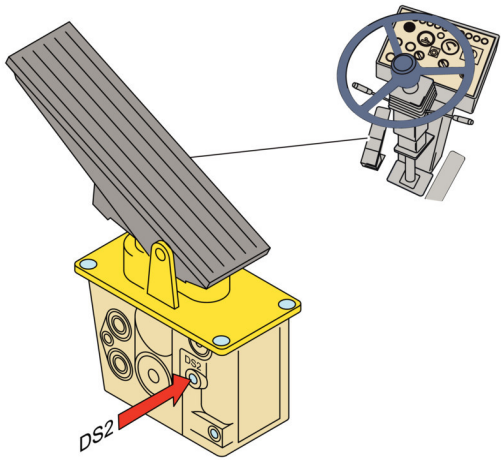



*Electric cabinet A50*

4. The pressure will subsequently rise very slowly. The accumulators are charged to 60-70 bar.
5. An accumulator with pre-charge pressure lower than 35 bar is faulty and must be replaced.
6. For identifying which accumulator to change, see section Checking the accumulators.

## 15.10 Checking Brake Pressure Control Valve

1. Connect a pressure gauge to the pressure test outlet at DS2.




*Checking brake pressure control valve*

2. Start the engine and let it run until max. brake pressure is attained.
3. Stop the diesel engine and brake repeatedly. The “low brake pressure” lamp should illuminate when the pressure has dropped to 110 bar.

4. Start the diesel engine and brake repeatedly with the engine idling. When the pressure has dropped to 125 bar, the brake system control valve should engage so the pressure rises again to max. for the brake system, 150 bar.
5. Stop the engine when max pressure is attained.
6. “Brake hard” four times, i.e. depress the pedal fully and release completely each time. If the brake pressure drops below 90 bar after braking hard four times, there is a fault in the brake system. This can be caused by:
   a. air in the brake lines.
   b. there is no charge pressure in an accumulator or the pressure is too low, e.g. due to a broken diaphragm, see section Checking accumulator charge pressure.
7. Continue to brake hard until the pressure drops below 80 bar, the parking brake should then be applied.
8. For identifying if an accumulator is uncharged and if so which one, see section Checking the accumulators.

## 15.11 Replacing Accumulator

**WARNING**

**High Hydraulic Oil Pressure**

Can cause personal injury.

- ▶ Switch off the machine.
- ▶ Make sure that the system is de-pressurized before starting any work.
- ▶ Press the brake pedal repeatedly after the machine has been switched off to make sure that the system is de-pressurized.
- ▶ Check a pressure gauge on both brake system accumulators to make sure that the system is de-pressurized.

**WARNING**

**Moving Cab**

A moving cab can cause serious personal injury.

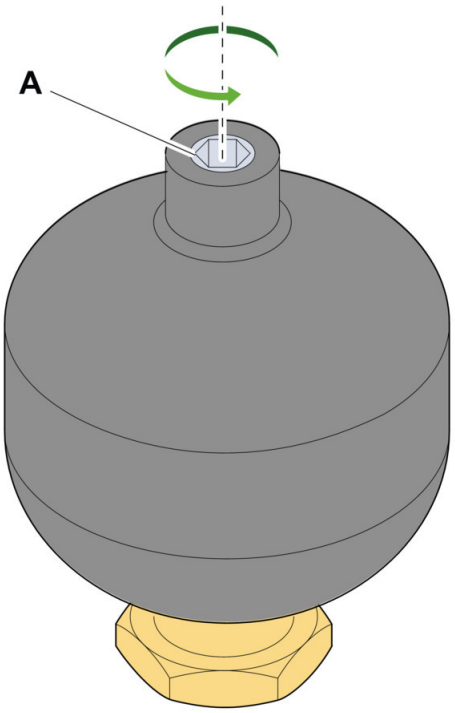
- ▶ Make sure that no personnel remain under the cab when it is operated.
- ▶ Make sure that the cab is secured with associated lockpins during all cab maintenance work.

**WARNING**

**Pressure Vessel**

Can cause personal injury.

- A discarded accumulator must be rendered harmless.
- A discarded accumulator that has not been punctured must be handled as a pressure vessel.
- Be careful when draining the accumulator.
- Work with pressure vessel must be carried out by personnel with prescribed training.




1. Remove the protective cap at the top of the accumulator.
2. Loosen the plug (A) with an Allen wrench, one turn at a time to release any pressure.
3. Disconnect the accumulator.

> ***NOTE:*** *A discarded accumulator that has not been punctured must be treated as a pressure vessel.*

4. Install a new accumulator.

## 15.12 Scrap an Accumulator

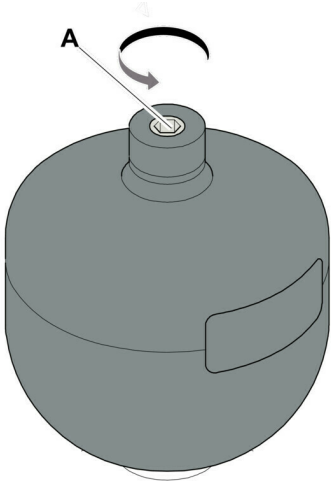
**WARNING**

**Pressure Vessel**

Can cause personal injury

- ▶ A discarded accumulator must be rendered harmless.
- ▶ A discarded accumulator that has not been punctured must be handled as a pressure vessel.
- ▶ Take care when draining the accumulator.

1. Remove the protective cap at the top to scrap the accumulator.
2. Remove the plug (A) carefully with a hex key wrench, one turn at a time to release any pressure.




## 15.13 Check after Working With Brake System

### 15.13.1 Check Service Brake

***NOTICE***

**Property Damage**

Risk of overheating the transmission system.

- ▶ Do not perform the brake test for longer than four seconds.

Precondition
- ✓ The machine is parked on a flat and level surface.
- ✓ The diesel engine is turned on.

1. Press and hold the brake pedal down.
2. Release the parking brake.
3. Engage second gear.
4. Gradually increase engine rpm to maximum.
5. Check the machine movement.

Step result

➔ If the machine moves, then the brakes must be repaired or replaced before operating the machine.

### 15.13.2 Check Parking Brake

**NOTICE**

**Property Damage**

Risk of overheating the transmission system.

▶ Do not perform the brake test for longer than four seconds.

Precondition

✓ The machine is parked on a flat and leveled surface.

✓ The parking brake is applied.

1. Start the diesel engine and engage second gear.
2. Gradually increase the engine rpm to maximum.
3. Check the machine movement.

   If the machine moves, then the brakes must be repaired or replaced before operating the machine.

# 16 Hydraulic System

## 16.1 Safety Precautions before Working on Hydraulic System

**WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

- ▶ Make sure that the system is de-pressurized before starting any work.

**WARNING**

**Hydraulic Oil and Water Pressure**

Can cause personal injury.

- ▶ Do not replace high-pressure hoses with hoses of lower quality than the originals.
- ▶ Do not replace high-pressure hoses with hoses that are installed with removable couplings.

## 16.2 About Working on Hydraulic Components

The hydraulic system is sensitive to contamination. The environment where the machine is used is usually an incorrect area for repairing hydraulic components. Avoid repairing hydraulic systems outside workshops.

Observe the following points to minimize interruptions in operation because of dirty hydraulic oil:

- Keep the machine clean.
- Use a degreasing additive for washing.
- Before opening any hydraulic connection, clean the area around it.
- Use clean tools and work with clean hands.
- Always plug hydraulic connections immediately after they are disengaged.
- Use clean protective plugs.
- Hydraulic components, like hoses, valves, and motors, must always be stored with applicable protective plugs installed.
- Spare parts for hydraulic components must always be kept in sealed plastic bags.
- Change filter cartridges when filters are clogged.

## 16.3 Hydraulic Workshops

Workshops that are used for the repair of hydraulic components must include:

- A clean environment to avoid dust and particles
- Applicable washing equipment for component repair
- Applicable tools for working on hydraulic systems
- Adequate ventilation system

## 16.4 Replace Hydraulic Hoses

**WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

▶ Make sure that the system is de-pressurized before starting any work.

**WARNING**

**Hydraulic Oil and Water Pressure**

Can cause personal injury.

▶ Do not replace high-pressure hoses with hoses of lower quality than the originals.

▶ Do not replace high-pressure hoses with hoses that are installed with removable couplings.

Load, vibration, and mechanical stresses have many requirements on hydraulic hoses. When replacing, check that replacement hoses have:

- The correct crimped couplings
- The correct quality class
- The correct dimensions

All pressurized components must be purchased from Epiroc. The grades and dimensions of hoses are specified in the Spare Part Catalog. Make sure that hose couplings are clean, undamaged, and correctly tightened.

## 16.5 Check Hydraulic Hoses and Couplings

**WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

▶ Make sure that the system is de-pressurized before starting any work.

**WARNING**

**Hydraulic Oil and Water Pressure**

Can cause personal injury.

- ▶ Do not replace high-pressure hoses with hoses of lower quality than the originals.
- ▶ Do not replace high-pressure hoses with hoses that are installed with removable couplings.

- ○ Inspect all hydraulic hoses and connections thoroughly with respect to cracking and swelling that indicates an external or internal leak. Inspect the hose location and clips.
- ○ Inspect the hose casing with respect to any swelling that indicates inner hose or cord breakage.
- ○ Inspect the hydraulic couplings with respect to leaks, indentations, and adapters. The couplings should be fastened securely if they have screw flanges. If there are any signs of connection leaks, replace the seals or the complete coupling.
- ○ Check that all hose attachments and clamps are intact.
- ○ Inspect all pressed couplings for signs of cracks or damage to compression sleeves. Replace any defective hoses with new ones.

## 16.6 Hydraulic Oil

### 16.6.1 Oil Sampling

An oil sample gives a good indication of how well the hydraulic system has been maintained.

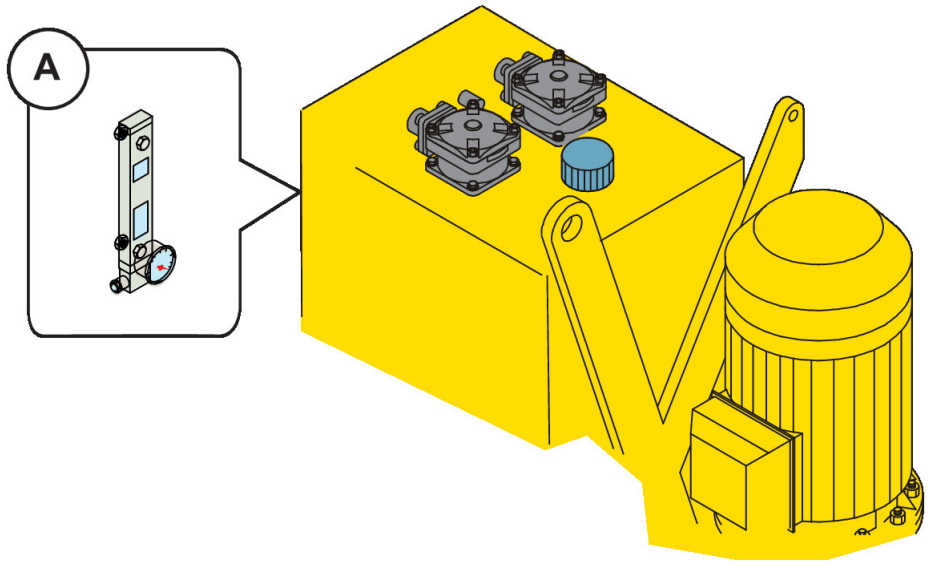
The system is equipped with nipples that are used together with special equipment to take oil samples. The nipples are on the delivery line from the hydraulic pumps. The nipples can also be used as pressure outlets for the pressure gauge.

### 16.6.2 Oil Monitoring

If the machine is equipped with oil monitoring, there are sensors that are installed for measuring moisture in the oil and the cleanliness of the oil. The sensors are connected to the RCS system to provide continuous information about the oil condition.

- The moisture sensor shows a percentage value relative to the oil saturation value. The oil begins to precipitate out water and is no longer able to bind moisture when the percentage value reaches 100%.
- Cleanliness measurement is made by obtaining the numbers of particles in the oil by passing the oil through a particle counter.

### 16.6.3 Check Oil Level in Carrier Hydraulic Tank




Precondition ✓ Service platform in transport position.

- ○ Check oil level through the sight glass (A).

### 16.6.4 Filling Hydraulic Oil

New oil must only be filled with the filler pump fitted on the machine. This is because the oil must be filtered before reaching the tank. This is achieved automatically if the filler pump is used.

!

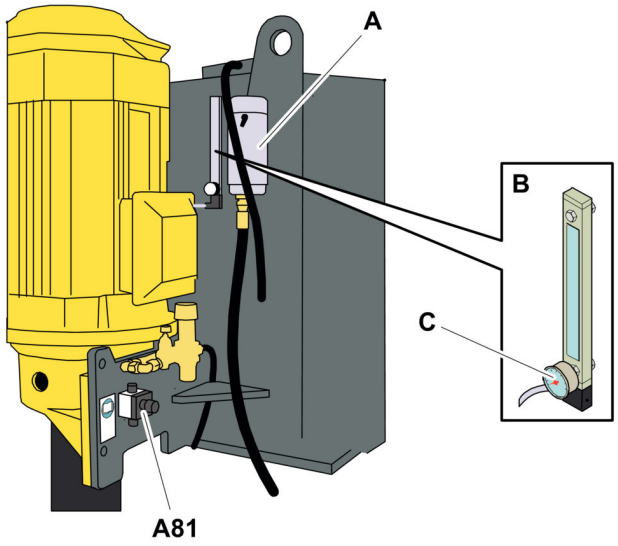
***NOTE:*** *Take into account that the position of the cylinders will affect the level in the tank. Make sure all the cylinders are retracted.*

***NOTE:*** *If the tank is overfilled, the breather filter will be destroyed. In this case, the filter must be changed. See section Filter: Breather filter.*

**Electric Hydraulic Oil filling**

1. Check the return oil filter, see section Filter: Return oil filter.
2. Make certain all connections and hoses that are used to fill oil are clean.

3. Press the button at (A81) to start pump (A).




*Electric filling, hydraulic oil tank*

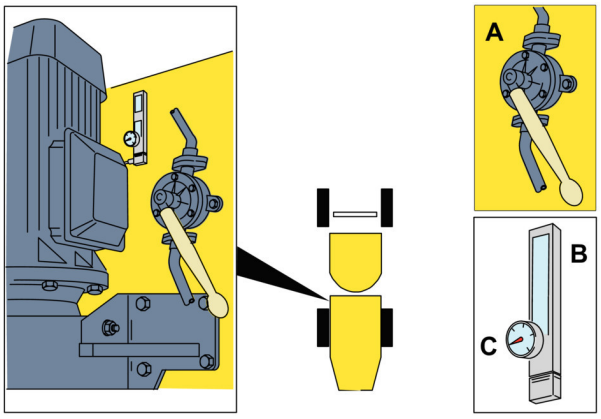
| | | | |
|---|---|---|---|
| A | Electric pump | B | Oil level glass / Oil level tube |
| C | Thermometer | A81 | Button, start electric pump |

4. Check the oil level on the level tube (B).
5. Release the button at (A81) when the correct level is attained.

   The correct level is obtained when oil becomes visible in the upper part of the oil level tube.

**Filling Hydraulic Oil Manually**

1. Check the return oil filter, see section, Filter: Breather filter.
2. Make certain all connections and hoses that are used to fill oil are clean.
3. Pump manually using hand pump (A).




*Hydraulic oil tank hand pump*

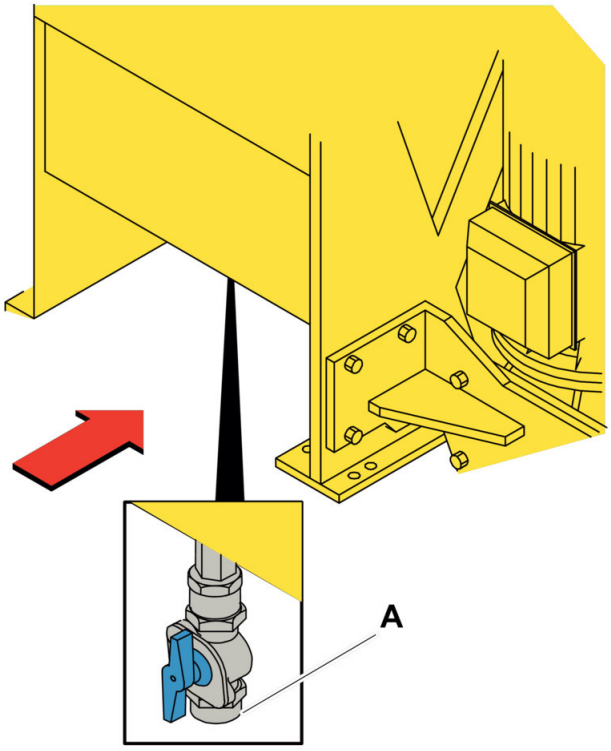
| | |
|---|---|
| A | Hand pump |
| B | Oil level glass |
| C | Thermometer |

4. Check the level in oil level glass (B).
5. Stop pumping when the correct level is attained. The correct level is obtained when oil becomes visible in the upper part of the oil level glass.

### 16.6.5 Drain Condensation from the Hydraulic Oil Tank

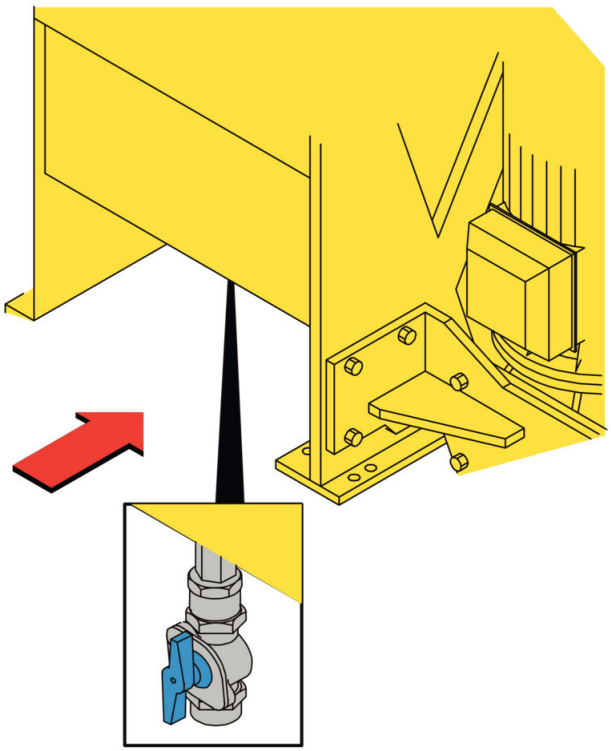
! ***NOTE:*** *Water in the hydraulic oil can seriously damage components in the hydraulic system and cause corrosion.*

! ***NOTE:*** *Before draining the hydraulic oil tank, the system must stay unused for approximately 12 hours so that any condensation has had time to sink to the bottom of the tank. The water can be drained off through the ball valve on the bottom of the tank.*




1. Remove the plug (A) from the valve.
2. Put a container below the ball valve.
3. Open the ball valve partially and allow the water to run out.
4. Close the ball valve when oil starts to drain.
5. Screw back the plug to protect the valve.

### 16.6.6 Emptying Hydraulic Oil Tank



1. Remove the plug on the ball valve that is below the hydraulic oil tank.
2. Connect a hose to the ball valve and place the other end of the hose into an empty oil drum.
3. Drain the oil from the tank by opening the ball valve.
4. Close the ball valve when the oil stops running out of the hose.
5. Disconnect the hose from the ball valve.
6. Insert the plug to protect the ball valve.

### 16.6.7 Clean Hydraulic Tank

**WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

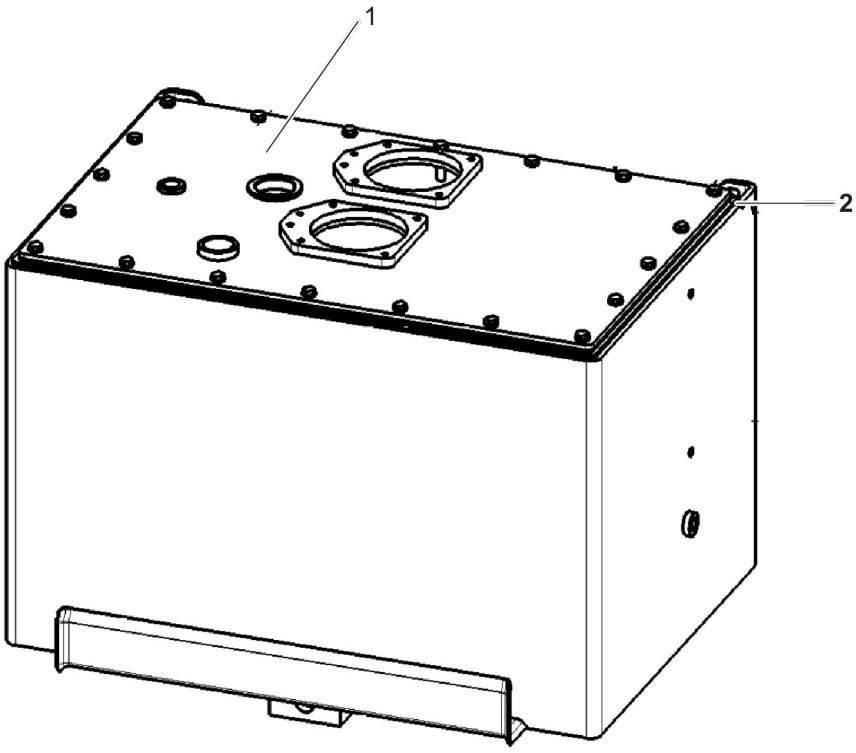
▶ Make sure that the system is de-pressurized before starting any work.

**WARNING**

**Hydraulic Oil and Water Pressure**

Can cause personal injury.

- ▶ Do not replace high-pressure hoses with hoses of lower quality than the originals.
- ▶ Do not replace high-pressure hoses with hoses installed with removable couplings.




| | |
|---|---|
| 1 | Top Plate |
| 2 | Gasket |

The hydraulic tank is cleaned manually through the top plate.

Precondition ✓ The oil is drained from hydraulic tank.

1. Remove the top plate.
2. Clean inside the tank completely.
3. Wipe all sides, the top, and the bottom of the tank using only lint-free rags.
   Clean thorough especially in corners, edges, and, around connecting holes.

> ***NOTE:*** *Make sure that no pieces of dirt or foreign body is stuck in suction hoses or left in the tank. It results in damage or failure of hydraulic pump.*

4. Reattach the top plate as fast as possible after cleaning to prevent any particles from entering.

> ***NOTE:*** *Make sure that the access hatch is closed tightly.*

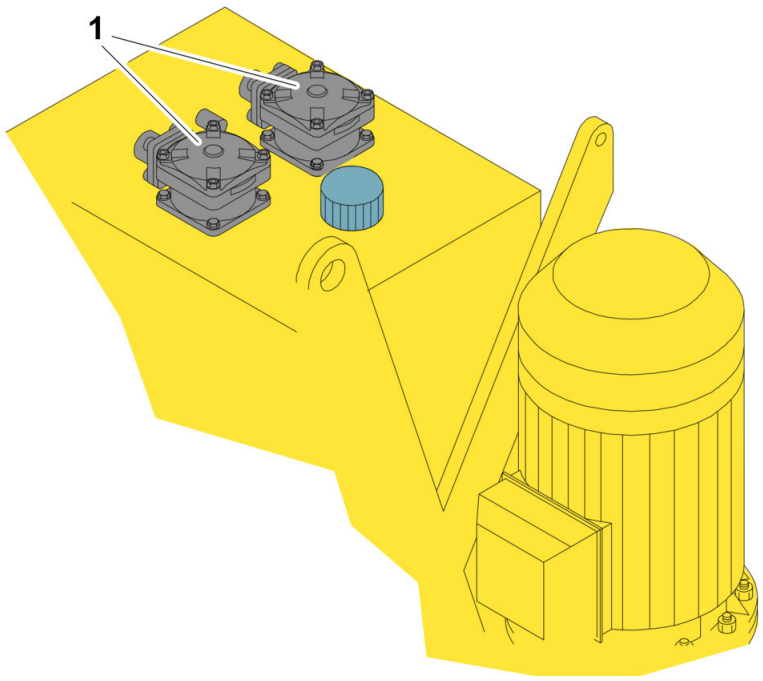
> ***NOTE:*** *Replace the tank gasket(2) if required.*

## 16.7 Hydraulic Filters

### 16.7.1 Check Return Oil Filter

The return oil filter cleans the oil before it is returned to the tank.

A return oil filter comprises a tube containing three filter inserts. The return oil filter is installed inside the hydraulic oil tank cover plate. The number of return oil filters on the tank vary.




*Location of Filter Inserts, Return Oil Filter*

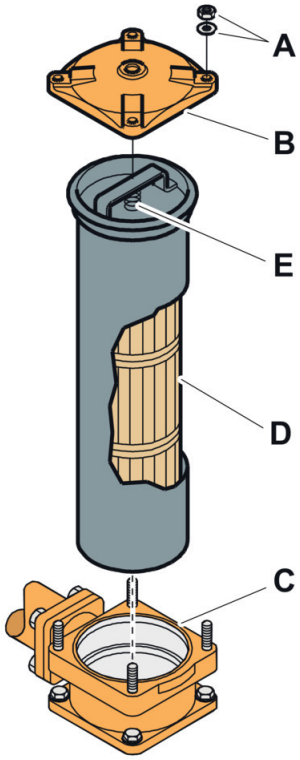
> ***NOTE:*** *The filter cartridges cannot be cleaned but must be replaced when they are clogged.*

- Check return oil filter.

  Replace the filter elements (1) according to the maintenance schedule but if the operator panel indicates clogged filter, replace all return oil filters immediately.

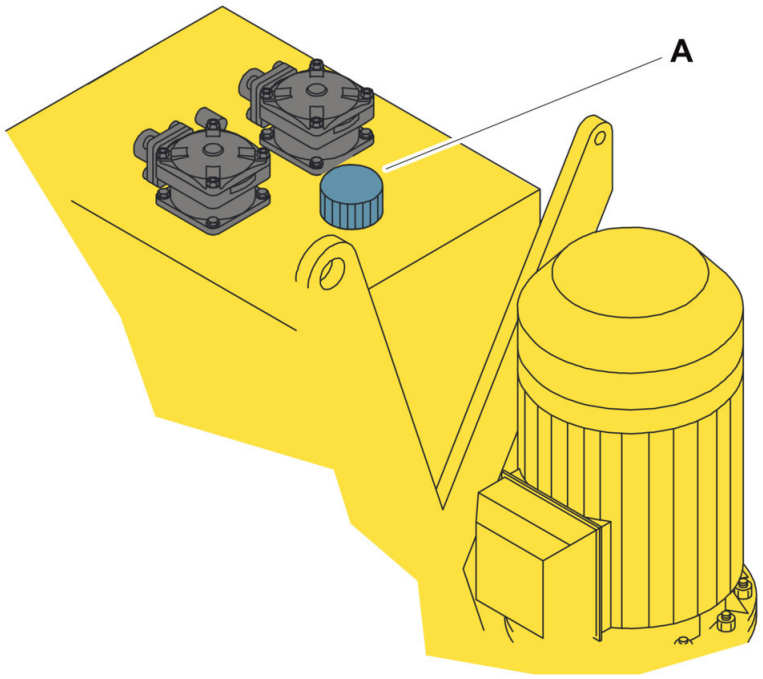
### 16.7.2 Replace Return Oil Filter

First read: Safety Precautions before Working on Hydraulic System [▶ 199]




1. Clean on and around the filter cap.
2. Remove the nuts and washers (A).
3. Remove cap (B).
4. Remove the filter canister by the handle.
5. Replace with a new O-ring (C).
6. Remove the overflow valve (E) by pressing down and turning the handle counterclockwise.
7. Replace the filter cartridges (D) with new ones.
8. Install the overflow valve and filter canister.
9. Install cap (B) with nuts and washers (A) and tighten.

### 16.7.3 Check Hydraulic Tank Breather Filter



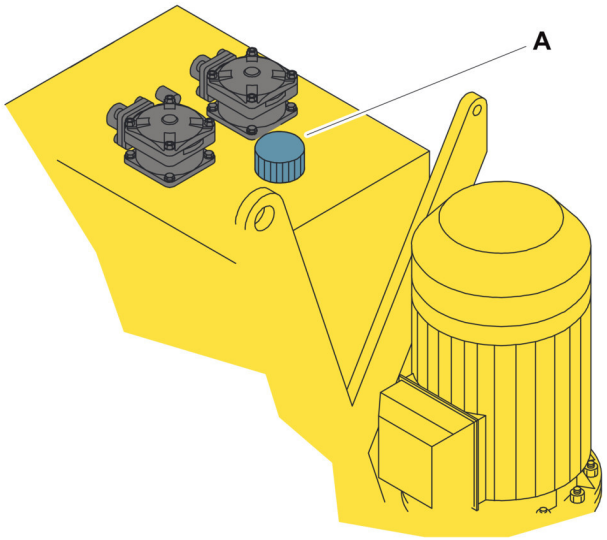

The breather filter equalizes the pressure differences in the tank that would otherwise arise when the level in the tank changes.

- ○ Check breather filter (A) for clogging.

> ***NOTE:*** *If the hydraulic tank is overfilled, hydraulic oil covers the breather filter and ruins it. Breather filter must be replaced if it is clogged or found contaminated.*

### 16.7.4 Replace Breather Filter

1. Wash clean on and around the filter (A).




*Breather filter*

2. Unscrew the old filter.

3. Fit a new filter.
4. Tighten the filter by hand.

### 16.7.5 Replace Water Separator Particle Filter

! ***NOTE:*** *The system is an option.*

**WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

▶ Make sure that the system is de-pressurized before starting any work.

**WARNING**

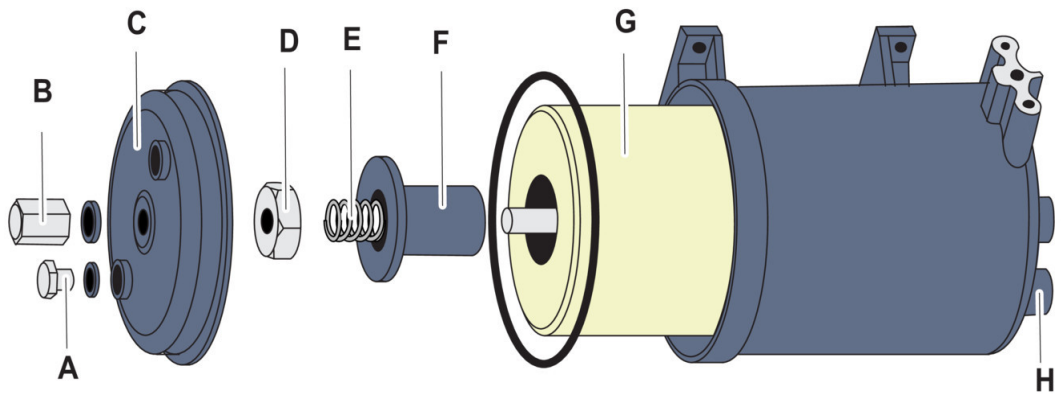
**Hydraulic Oil and Water Pressure**

Can cause personal injury.

▶ Do not replace high-pressure hoses with hoses of lower quality than the originals.

▶ Do not replace high-pressure hoses with hoses that are installed with removable couplings.

! ***NOTE:*** *The particle filter must be replaced according to the maintenance interval, and if the filter pressure is greater than 1.5 bar (22 psi). The pressure is read on the pressure gauge above the particle filter.*




Precondition ✓ The hydraulic pumps and water separator are switched off.

1. Drain the oil from the filter from the tap (H) into a suitable vessel.
2. Remove the bleed screw (A) to drain any pressure from the water separator.

3. Remove the lock nut (B) and lift away the cover plate (C).
4. Remove the filter nut (D) and lift away the spring (E) and filter holder (F).
5. Remove the old filter (G).
6. Clean the filter housing.
7. Replace with a new filter.
8. Install all disassembled components.

### 16.7.6 Bleeding Water Separator Particle Filter

This equipment is **optional**.

**WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

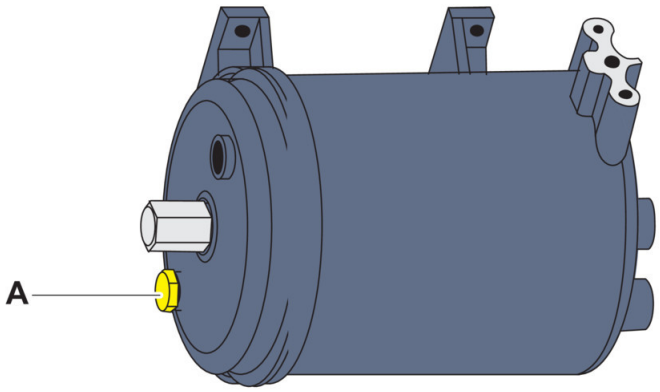
- ▶ Make sure that the system is de-pressurized before starting any work.

**WARNING**

**Hydraulic Oil and Water Pressure**

Can cause personal injury.

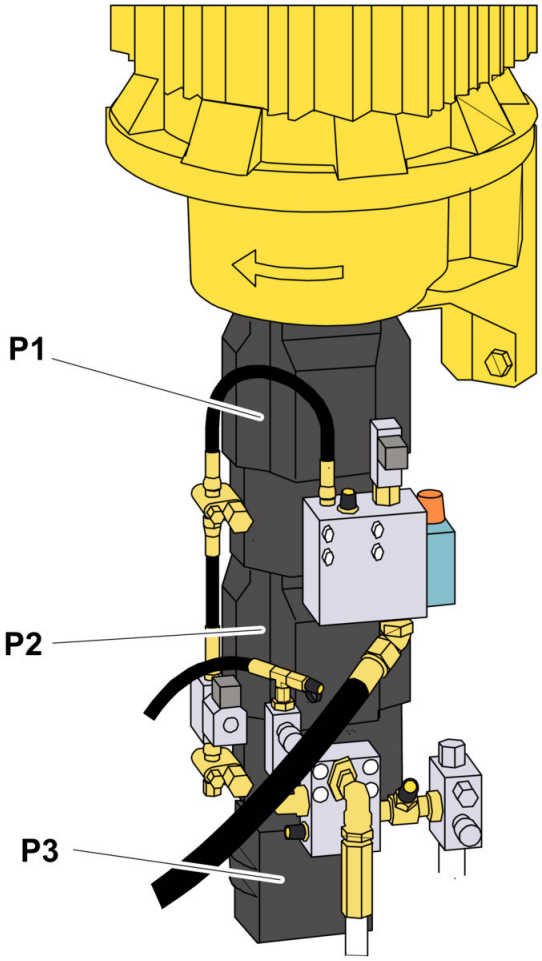
- ▶ Do not replace high-pressure hoses with hoses of lower quality than the originals.
- ▶ Do not replace high-pressure hoses with hoses that are installed with removable couplings.




1. Plug the pump to the electrical socket on the machine, or to an external electrical socket.
2. Loosen the bleed screw (A).
3. Start the pump to run until oil without air bubbles runs out.
4. Retighten the bleed screw (A).
5. Check for leaks.

# 16.8 Hydraulic Pumps

## 16.8.1 Overview of Power Unit Pumps




| | | | |
|---|---|---|---|
| P1 | Percussion pump | P2 | Positioning pump |
| P3 | Rotation pump | | |

## 16.8.2 Start New or Reconditioned Pump

**WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

▶ Make sure that the system is de-pressurized before starting any work.

**WARNING**

**Hydraulic Oil and Water Pressure**

Can cause personal injury.

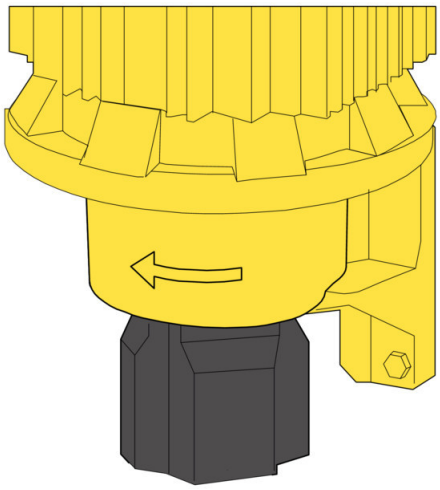
- ▶ Do not replace high-pressure hoses with hoses of lower quality than the originals.
- ▶ Do not replace high-pressure hoses with hoses that are installed with removable couplings.

! ***NOTE:*** *If a major intervention has been made in the system, such as replacing or reconditioning components in the hydraulic system, the system must be bled.*

1. Fill the pump housing with oil.
2. Bleed air from the pump housing.
3. Circulation-pump the system.

### 16.8.3 Checking Pump Rotation Direction

An arrow on the pump coupling housing indicates the correct direction of rotation.



*Pump rotation direction*

1. Start the pump and stop it again at once so that it rotates only a few turns. Check the direction in which the motor-pump coupling rotates.
2. If the pump rotates in the wrong direction, reverse two of the phase leads in the electric motor connection cable.

! ***NOTE:*** *This work is to be carried out by authorized electricians.*

### 16.8.4 Bleed Hydraulic Pump

**WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

- ▶ Make sure that the system is de-pressurized before starting any work.

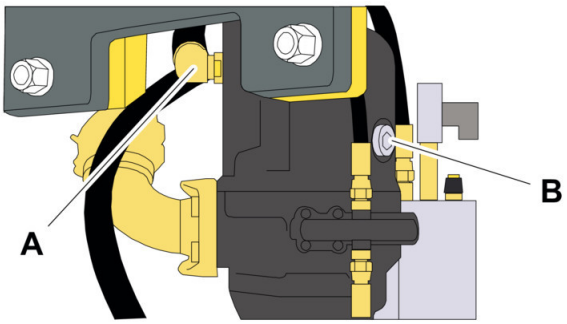
**WARNING**

**Hydraulic Oil and Water Pressure**

Can cause personal injury.

- ▶ Do not replace high-pressure hoses with hoses of lower quality than the originals.
- ▶ Do not replace high-pressure hoses with hoses that are installed with removable couplings.

! ***NOTE:*** *If a major intervention has been made in the system, such as replacing or reconditioning components in the hydraulic system, the system must be bled.*



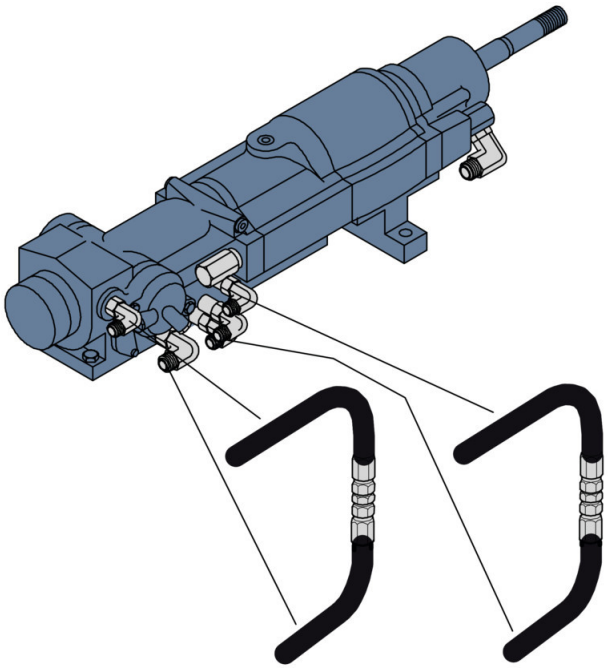

Precondition ✓ All hoses are connected to the pump.

1. Check the level of the hydraulic oil in the oil sight glass on the hydraulic oil tank. Top up if necessary.
2. Remove plug (B).
3. Install plug when oil starts to run out of the plug hole.
4. Loosen drain hose (A).
5. Tighten the drain hose (A) when clean oil with no air bubbles runs out.

### 16.8.5 Circulate the Pump

! ***NOTE:*** *The machine must be connected to water to prevent the oil temperature from rising too high.*

> ***NOTE:*** *Circulation pumping must be carried out to make sure that any contaminants are collected in the filter. This is done by connecting the delivery and return lines in the percussion, rotation and feed circuits, and allowing oil to be pumped through the system at no pressure for at least five minutes.*

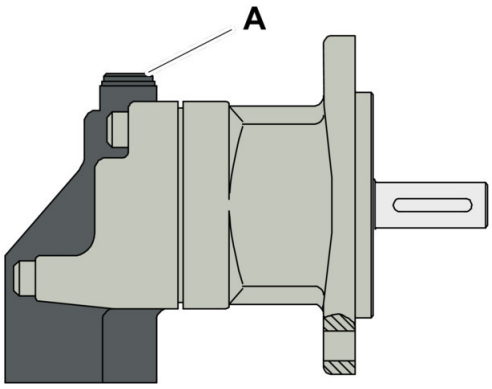


*Principles for Circulating the Pump*

1. Connect together the delivery and return hoses for the percussion unit with suitable coupling.
2. Connect together the delivery and return hoses for the rotation motor with suitable coupling.
3. Connect together the delivery and return hoses for the hydraulic cylinder of the feed with suitable coupling.
4. Start the hydraulic pump.
5. Start drilling.
6. Allow oil to circulate in the hoses for at least five minutes.
7. Stop the hydraulic pump.
8. Reconnect the hoses to their previous positions.

## 16.9 Start New or Reconditioned Motor

If the machine has been idle, or if a major intervention has been made in the system such as replacing or reconditioning components in the hydraulic system, carry out the following points:




1. Fill the hydraulic motor at the plug (A) with oil.
2. Operate the hydraulic motor for a few minutes.
3. Bleed the hydraulic motor by carefully opening the plug a few turns.
4. Close the plug when pure oil without air runs out from the plug.

   The hydraulic motor is filled with oil.

## 16.10 Settings

### 16.10.1 Pressure Settings and Rotation Speeds

Suitable rotation speeds for the rock drill, and suitable pressure for percussion and anti-jamming depend on:

- The state of the rock
- Type of drill bit
- Diameter of drill bit

Pressure and speed can therefore require adjustment if the drilling conditions change.

The feed pressure must also be adjusted according to:

- Dimension of drill rod
- Type of feed
- Percussion pressure

The feed pressure must be set so that the threaded joints of the drill rod equipment do not come loose, causing abnormal wear or damage. Nor must the pressure be set too high, subjecting the drill rod to abnormal loads or increasing the risk of jamming.

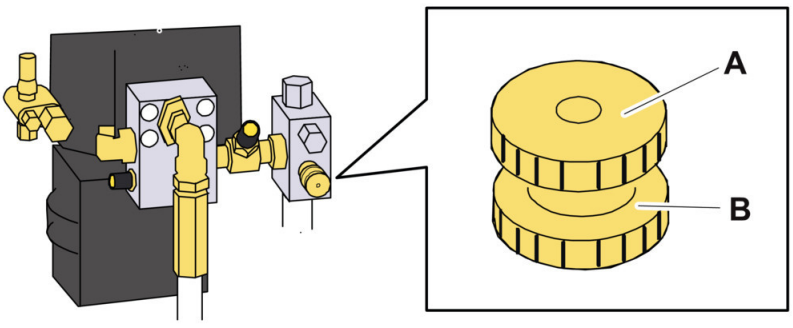
#### Recommended settings

| Setting | Value | Read from |
|---|---|---|
| Percussion pressure for collaring | 130–140 bar (1,885−2,031 psi) | Drill panel |
| Percussion pressure for full drilling | 180–230 bar (2,611− 3,336 psi) | Drill panel |
| Switching level, percussion | 55 bar (798 psi) | Drill panel |
| Positioning pressure | 210–230 bar (3,046−3,336 psi) | See hydraulic diagram, position 72 |

| Setting | Value | Read from |
|---|---|---|
| Rotation speed, small hole | Depends on type of drill bit and its diameter | Drill rod rev counter |
| Rotation speed, reaming hole | Depends on type of drill bit and its diameter | Drill rod rev counter |
| Rock drill damper pressure<br>Drilling system DCS 1800 | 40 bar (580 psi) | Drill panel |
| Max feed pressure for full drilling | 120 bar (1,740 psi) | Drill panel |
| Feed pressure for collaring | 40 bar (580 psi) | Drill panel |
| Feed pressure at full drilling, small hole | 65–120 bar (943 −1,740 psi) | Drill panel |
| Feed pressure at full drilling, reaming hole | 50–70 bar (725−1,015 psi) | Drill panel |
| Feed pressures reverse, telescope feed | 120 bar (1,740 psi) | See hydraulic diagram, position 30 |
| Pressure difference upper and lower feed cylinder, telescope feed | 30–35 bar (435−508 psi) | See hydraulic diagram, position 30 |
| Anti-jamming protection, RPCF | 20 bar (290 psi) above normal rotation pressure during drilling | Drill panel |
| Anti-jamming protection, feed return movement | 40 bar (580 psi) above normal rotation pressure during drilling | |

## 16.10.2 Rotation Pump

### Set Rotation Speed for Small Hole Bit




Precondition ✓ The lever for selecting small hole or reaming hole is in the position for small hole.

1. Start the pump.
2. Set the rotation lever to its forward position (rotary drilling).

3. Measure the rotation speed with a rev counter on the drill rod.

> ***NOTE:*** *Take the following measures if the rotation speed needs adjusting.*

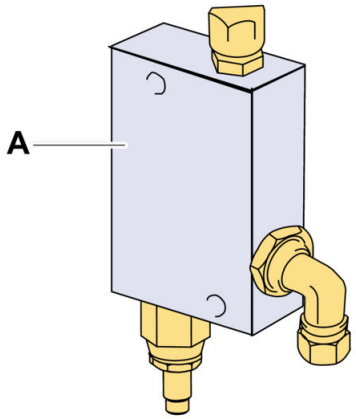
4. Loosen lock knob (B) on the valve for adjusting rotation speed, small hole at the hydraulic pump.
5. Set control knob (A) until the desired speed is attained.

   Screw in the screw to reduce the speed.
6. Tighten the lock knob (B).

### Set Rotation Speed for Reaming Hole Bit

The reaming hole kit is extra equipment that allows the rapid switch between settings for small hole and settings for reaming hole.

The set includes extra valves that allow the setting of individual reaming hole values for feed pressure and rotation speed.




Precondition ✓ The lever for selecting small hole or reaming hole is in the position for reaming hole.

1. Start the pump.
2. Set the rotation lever to its forward position (rotary drilling).
3. Check the rotation speed with a drill rod rev counter.

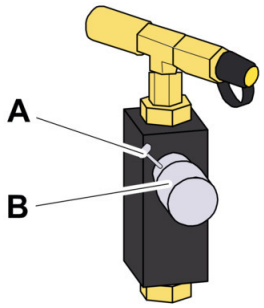
> ***NOTE:*** *Take the following measures if the speed needs adjusting.*

4. Remove the lock nut of the valve (A) for adjusting rotation speed, reaming hole.
5. Use a socket head cap screw to adjust the valve adjustment screw until the desired speed is attained, which can be read on the rev counter.

   Screwing the screw out reduces the speed.
6. Tighten the lock nut.

### 16.10.3 Adjust Rock Drill Damper Pressure

| | |
|---|---|
| ! | ***NOTE:*** *Only apply to machines with drill COP 1838 and COP 2238.* |




Precondition ✓ All the control levers on the operator panel are in neutral.

1. Start the pump.
2. Read the pressure from the damper pressure gauge on the operator panel.

   If the pressure is not 40 bar (580 psi), adjust it as follows:

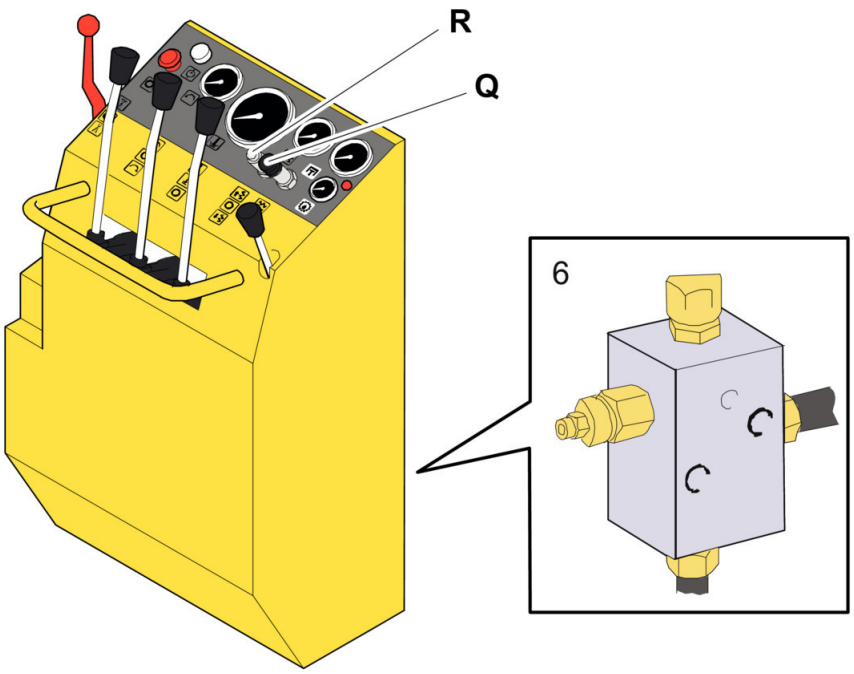
   a. Remove the lock screw (A) on the valve for damper pressure.

   b. Adjust the control knob (B) to the pressure of 40 bar (580 psi). Read the pressure from the damper pressure gauge on the operator panel.

   c. Tighten the locking screw (A).

## 16.10.4 Feed Pressure

### Drilling Valves, Blocks, and Sensors

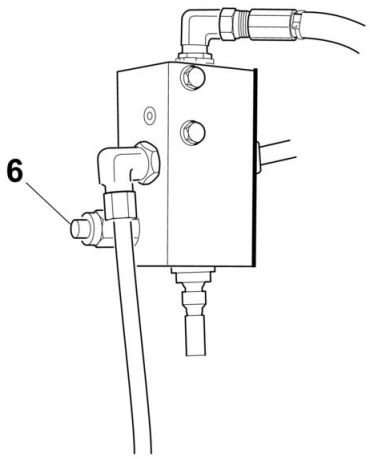



*Valves for feed pressure, operator panel*

| | |
|---|---|
| 6 | Max. feed pressure |
| R | Feed pressure, collaring |
| Q | Feed pressure, drilling |

### Adjust Maximum Feed Pressure

The pressure must **not** be adjusted when drilling.




*Valve for max. feed pressure*

1. Place a wooden block (10–20 cm wide) in the feed in front of the forward drill rod support so that the limit sensor will not be activated.
2. Make sure that all the control levers on the operator panel are in neutral.

3. Start the pump.
4. Maneuver the drill on towards the wooden block.
5. Screw valve (Q) clockwise as far as it goes to disengage the valve.
6. Remove the lock nut used for valve (6).
7. Adjust the set screw to 120 bar (1,740 psi).

   Read the pressure from the feed pressure gauge on the operator panel.
8. Tight the lock nut.
9. Reset the valve (Q).
10. Operate the drill back to its rear end position.
11. Stop the pump.
12. Remove the wooden block.

### Setting Feed Pressure for Collaring

1. The percussion lever must be at the middle position (low percussion pressure) and the feed lever must be at its forward position.
2. Adjust the pressure to 40 bar on the valve (R) on the operator panel.
3. Read the pressure from the feed pressure gauge located on the operator panel.

### Setting Feed Pressure for Full Drilling

! ***NOTE:*** *The feed pressure may often require manual adjustment while drilling is in progress. Consideration must be made of drill bit diameter, drill bit type, percussion pressure, rock conditions etc.*

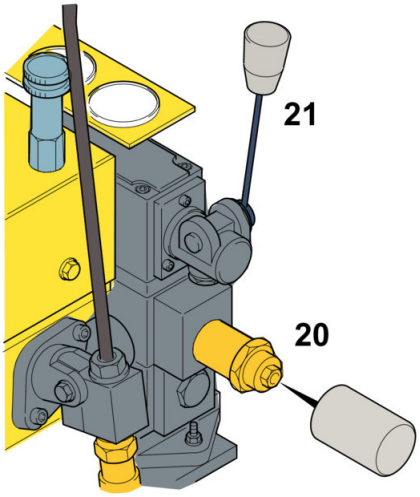
1. Undo the lock screw on the pressure control valve (Q).
2. Regulate the feed pressure on the pressure control valve (Q) to approx. 100 bar. A suitable feed pressure depends on the quality of the rock and is suitably adjusted during full drilling. Then set the feed pressure to a level where drilling can take place without more serious jamming tendencies.

   Turning the adjusting screw clockwise increases the feed pressure.
3. Read the pressure from the feed pressure gauge on the operator panel.

### Set Feed Pressure for Reaming Hole

The reaming hole kit is extra equipment that allows the rapid switch between settings for small hole and settings for reaming hole.

The set includes extra valves that allow the setting of individual reaming hole values for feed pressure and rotation speed.

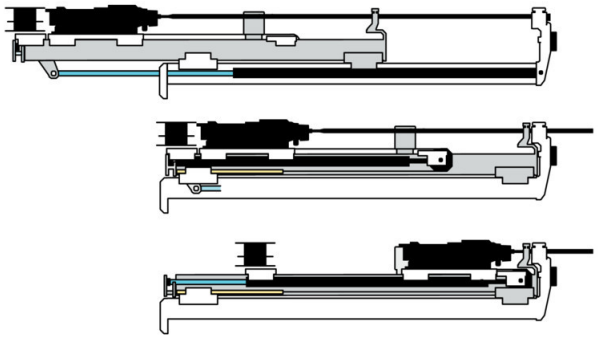



*Valve for setting the feed pressure, reaming hole*

1. Check that the lever for selecting small hole or reaming hole is in the position for reaming hole.
2. Use an hex key to adjust the feed pressure on valve (20) on the right-hand side of drill panel. The pressure must be 50−70 bar (725.2 psi−1,015.3 psi).

   Read the pressure from the feed pressure gauge on the drill panel.

### 16.10.5 Adjust the Feed Pressure for BMHT 6000 Series Feeder

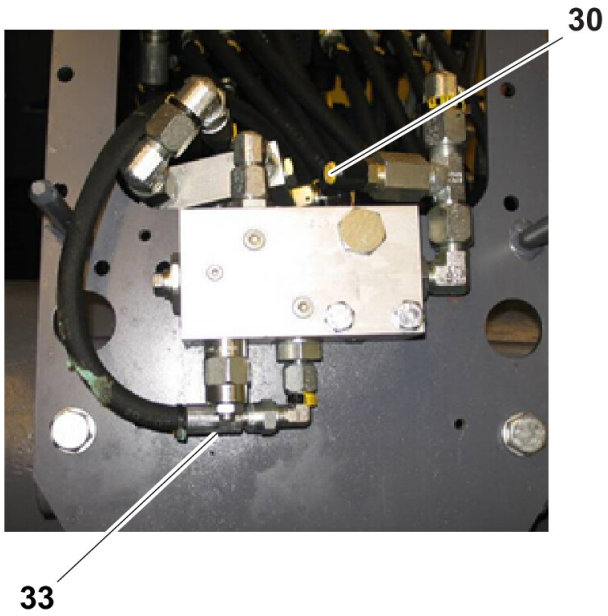


*Two step operation of telescope feed*

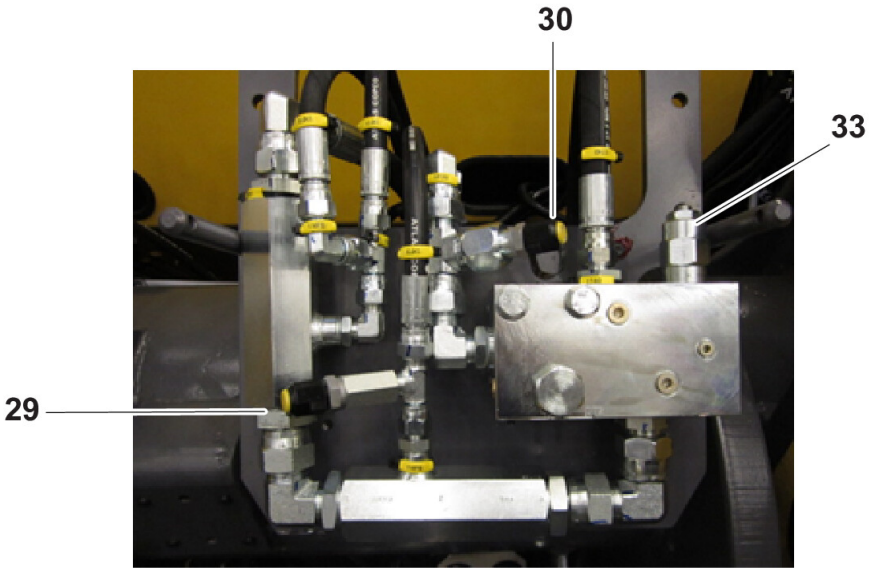
The telescope feed has two different designs to lock the beam cylinder:

- Either of the two, one-way restrictor
- One Lever

### Adjust Maximum Feed Pressure Reverse




*One-way restrictor*




*Lever*

1. BMHT-feeder with one-way restrictor for beam locking
   a. Fully open both the valves.

2. BMHT-feeder with lever for beam locking
   a. Set the lever in unlocked position.
3. Connect a pressure gauge to pressure test outlet (30) for lever, (34) for restrictors.
4. Screw out the adjustment screw on the pressure regulator (33) several turns.
5. Set the directional valve for feed in feed reverse position so that the rock drill cradle and telescope cylinder move to the rear position.
6. Set the return feed pressure on pressure regulator (33) to 120 bar, read on the pressure gauge connected to pressure test outlet (30).

### Adjust Maximum Feed Pressure

1. Place a wooden block in the feed beam behind the front drill rod support so that the limit position switch on the feeder is not activated.
2. Connect a pressure gauge to the telescope feed
   a. At one-way restrictor: pressure test outlet (30) Figure 1.
   b. At lever: pressure test outlet (29) Figure 2.
3. Screw in the pressure control valve (31) for the telescope feeder upper beam.
4. Set the directional valve on the drill panel for feed forward.
5. Increase the feed pressure on the pressure control valve for high feed pressure so that the telescope feed beam moves towards the wooden block.
6. Continue to increase the feed pressure, while observing the pressure gauge connected to the pressure test outlet (30) or (29) until maximum feed pressure 120 bar has been reached.

> ! ***NOTE:*** *If feed pressure is below or above maximum pressure, then the pressure regulator for maximum feed pressure must be adjusted to 120±3 bar.*

7. Check the setting by reversing the rock drill cradle and beam slightly. Loosen the pressure control valve for high feed pressure a couple of turns. Run the telescope feed beam towards the wooden block again and increase the feed pressure on the pressure control valve so that maximum pressure is reached. The pressure must stop at 120 bar, even if the pressure control valve is tightened further.
8. Screw out the pressure control valve for high feed pressure.

### Check the Idling Feed Pressure and Limit Valve on the Feeder

1. Screw out the pressure control valve (31) for the telescope feeder upper beam.
2. Reverse the rock drill cradle and the telescope step to the rear position.
3. Set the directional valve for feed on the drill panel forward.

4. Increase the feed pressure on the pressure control valve for high feed pressure until the rock drill cradle starts to move forward. Lower the pressure so that the rock drill cradle just moves. Allow the cradle to run along the whole feed beam. Check that the pressure on feed pressure gauge (GF) must not exceed 30 bar at any point.
5. Increase the feed pressure on the pressure control valve for high feed pressure until the telescope step starts to move forward. Then lower the pressure so that the telescope just moves and allow it to run along the whole feed beam. The pressure must not exceed 50 bar at any point.

> ! ***NOTE:*** *If any of the measured values is too high, the feed beam must be adjusted.*
>
> ***NOTE:*** *Normal play between cradles and beam is 1 mm on each side of the beam.*

### Adjust Feed Pressure of the Telescope Cylinder

1. Screw in the pressure control valve (31) for the telescope feeder upper beam.
2. Set the directional valve for feed on the drill panel forward.
3. Screw in the pressure control valve for high feed pressure so that the pressure on pressure gauge connected to pressure test outlet (29) or (30) shows 100±3 bar.
4. Open the pressure control valve (31) until the pressure on feed pressure gauge (GF) shows 70±2 bar.
5. Lock the pressure regulator (31).
6. Set the directional valve for the feed in neutral position.
7. Fully close both of the one-way restrictors (32) and (35) and check the telescope feed restrictors.
8. Set the directional valve for feed forward and allow the rock drill cradle and the telescope to move to their front positions.
9. Set the directional valve for the feed on the drill panel in reverse position.
10. The rock drill cradle should move backwards while the telescope should remain stationary.

### Check the Telescopic Feed Lever Locking

1. Move the lock lever to the Locked position.
2. Set the directional valve for feed forward and allow the rock drill cradle and the telescope to move to their front positions.
3. Set the directional valve for the feed on the drill panel in reverse position.

4. The rock drill cradle must move backwards while the telescope must remain stationary.

> ***NOTE:*** *The setting of the pressure control valve (31) might have to be adjusted during drilling to obtain smooth operation of the feed.*

## 16.10.6 Anti-Jamming Protection

There are two types of anti-jamming protection:

- RPCF (feed control)
- Feed return, commonly called anti-jamming protection

The anti-jamming protection is integrated and interacts. An example to show the occurrence and the result once the protection is activated.

If the drill bit tends to jam in the drill hole due to cracks in the rock or if the rotation pressure increases due to poor flushing of the drill hole:

- The feed pressure successively drops until it is almost non-existent.
- If the rotation pressure continues to rise, the feed changes direction and the rock drill returns. A damaged drill bit or low hydraulic oil temperature can give the same effect.
- The setting of when the RPCF valve is to start reducing the feed pressure must be made by trial and error during a period of drilling. This also applies to setting the feed return.
- If the valves are adjusted too low, the rock drill either does not move forward at all or move forward with low feed force.
- If the valve is adjusted too high, the anti-jamming protection does not work satisfactorily resulting in a risk of jamming.
- The anti-jamming protection must be set so it is possible to drill with both small hole and reaming hole bits.

### RPCF Feed Control

Rotation Pressure Controlled Feed (RPCF) is a type of anti-jamming protection that is activated by increased rotation pressure. The increasing rotation pressure have the following causes:

- The drill bit tends to jam in the rock.
- Broken or worn drill bit.
- Low hydraulic oil temperature.

When RPCF is activated, the feed pressure will gradually drop until it almost reaches zero.

### Feed Return Movement

If RPCF is activated but the rotation pressure still rises, then the second anti-jamming protection engages. This means that the feed changes direction so that the drill reverses.

### Anti-Jamming Protection Settings

To set the anti-jamming protection, make the following settings in the sequence:

1. Set RPCF.
2. Set the feed return movement.

There are two ways to proceed with RPCF setting:

- Setting RPCF during drilling: Provides better adaptation to the state of the local rock.
- Setting RPCF in a workshop: Option to be selected if it is impossible to drill but still want to set the RPCF valve or valves.

### Set RPCF During Drilling

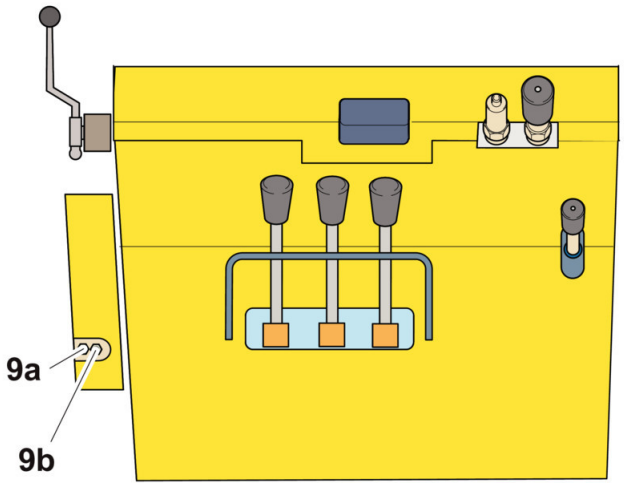
> ***NOTE:*** *The hydraulic oil must be at normal operating temperature before setting.*

> ***NOTE:*** *Normal rotation pressure setting for drilling is around 50 bar (725 psi) for small holes and 40–50 bar (580−725 psi) for reaming holes. If the pressure rises above the normal pressure, there is risk that the drill rod jams. The RPCF valve must be activated if the normal rotation pressure rises by about 20 bar (290 psi) during drilling.*

> ***NOTE:*** *If the machine is provided with a special reaming hole kit (option), the following settings are also to be made for reaming hole valve ().*

Valve () affects the rotation pressure at which the feed pressure will start to be reduced for a small hole bit.

Valve () affects the rotation pressure at which the feed pressure will start to be reduced for a reaming hole bit.




Precondition

- ✓ If the machine is equipped with a special reaming hole kit (option), make sure that the lever for selecting small hole or reaming hole is at the correct position.
- ✓ The lever must be in the small hole position to set the small hole valve ().
- ✓ The lever must be in the reaming hole position to set the reaming hole valve ().

1. Find some homogeneous rock in the area being drilled.
2. Screw in the adjustment screw used for the RPCF valve all the way.
3. Collar the hole firmly and proceed to full drilling at a suitable feed pressure.
4. Read the rotation pressure from the pressure gauge on the operator panel.

5. Screw out the adjustment screw used for the RPCF valve until the feed pressure starts to drop.
6. Screw in the adjustment screw used for the RPCF valve about one turn.

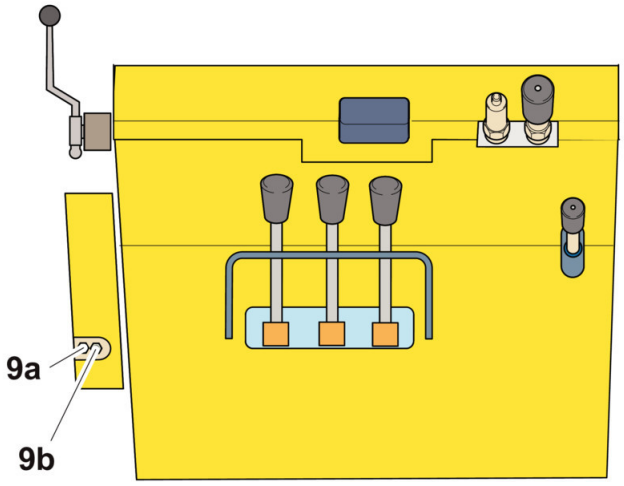
   One turn corresponds to about 20 bar (290 psi) of rotation pressure.

   In other words, a 20-bar (290 psi) increase in the normal rotation pressure is required during full drilling before the RPCF function will start to reduce the feed pressure.
7. Tighten the RPCF valve lock nut.

### Set RPCF in a Workshop

> ***NOTE:*** *The hydraulic oil must be at normal operating temperature before setting.*

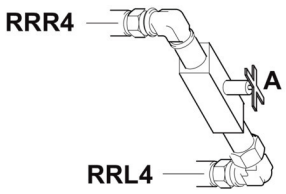
> ***NOTE:*** *Normal rotation pressure setting for drilling is around 50 bar (725 psi) for small holes and 40–50 bar (580−725 psi) for reaming holes. If the pressure rises above the normal pressure, there is risk that the drill rod jams. The RPCF valve must be activated if the normal rotation pressure rises by about 20 bar (290 psi) during drilling.*




Precondition
- ✓ If the machine is equipped with a special reaming hole kit (option), make sure that the lever is at the correct position.
- ✓ The lever must be in the small hole position to set the small hole valve ().
- ✓ The lever must be in the reaming hole position to set the reaming hole valve ().

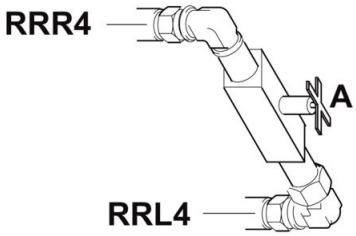
1. Read the normal rotation pressure during drilling from the rotation pressure gauge on the operator panel.
2. Operate the drill back to its rear position on the feed.
3. Screw out the adjustment screw all the way for the RPCF valve.
4. Jamming must be simulated when setting RPCF in a workshop.

   One way to simulate jamming is to disengage the drill rotation hoses (RRR4) and (RRL4), and connect the hoses together with a cock or needle valve (A).




5. Set the rotation lever to the forward position (rotary drilling).
6. Screw in needle valve (A) until the rotation pressure gauge on the operator panel reads 60 bar (870 psi).
7. Set the feed lever to its forward position (forward feed).
8. Screw in the adjustment screw on the RPCF valve until the rock drill cradle starts to move forward on the feed.
9. Screw out the adjustment screw used for the RPCF valve until the cradle stops.
10. Tighten the lock nut used for the RPCF valve.
11. Examine the function of the anti-jamming protection before making any further settings.

### Examine RPCF Function




Precondition ✓ If the machine is equipped with a special reaming hole kit (option), make sure that lever for selecting small hole or reaming hole is at the small hole position.

1. Open the needle valve (A) slowly.

Step result ➔ The rock drill must now start to move forward slowly while the rotation pressure starts to drop.

2. Close needle valve (A) slowly.

Step result ➔ The rock drill cradle must stop when the rotation pressure reaches about 70 bar.

3. Continue to close the needle valve (A) slowly.

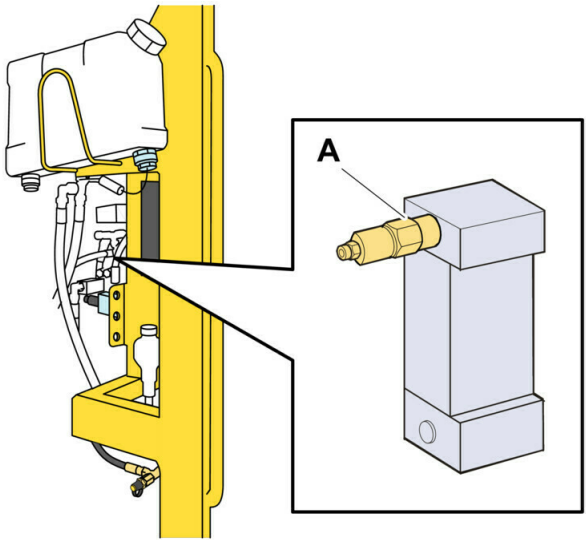
Step result ➔ The anti-jamming protection is to be activated and the rock drill cradle is to reverse direction when the rotation pressure reaches about 80 bar (1,160 psi).

4. Set the lever for selecting small hole or reaming hole in the reaming hole position and repeat steps 2−4.
5. Move the rotation lever and feed lever to their neutral positions.

### Set Feed Pressure to Return Movement

> ***NOTE:*** *The hydraulic oil must be at normal operating temperature before setting.*

The valve (A) for feed return on the valve pillar is to set at which rotation pressure the drill should change direction.

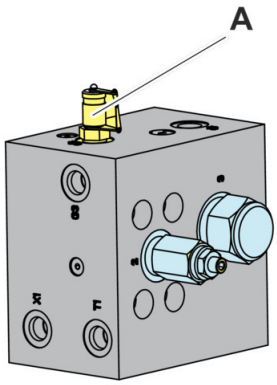



1. Check the rotation pressure during normal drilling. Read the rotation pressure from the pressure gauge on the operator panel.
2. Connect a pressure gauge to the pressure test outlet beside the valve (A).
3. Adjust to 30-40 bar (435−580 psi) above the normal rotation pressure approximately 90 bar (1,305 psi) on the valve (A).

> ***NOTE:*** *If the valve is adjusted too low, the drill will change direction too early.*
>
> ***NOTE:*** *If the valve is adjusted too high, the drill will not change direction and the risk of jamming will increase.*

## 16.10.7 Switch Percussion Pressure Level

Control the percussion pressure with the feed pressure. This function is termed FPCI (Feed Pressure Controlled Impact).

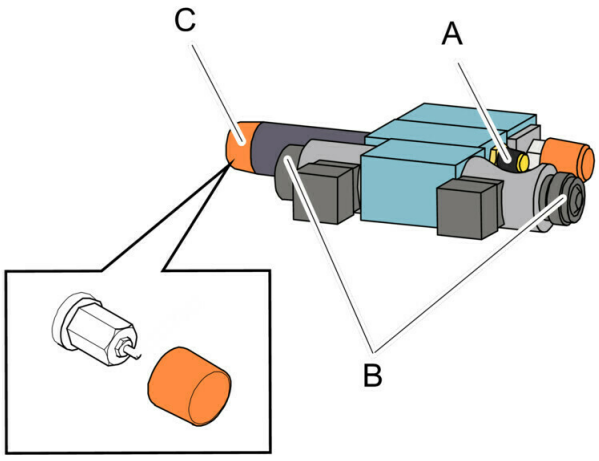



1. Connect a needle valve into the percussion circuit and open it 1/4 turn.
2. Place a wooden block (10–20 cm wide) in the feed behind the forward drill rod support so that the limit sensor will not be activated.
3. Maneuver the drill on towards the wooden block.
4. Activate rotation left, feed forward, and low percussion (collaring).
5. Set a rotation pressure of 30−40 bar (435−580 psi) with the needle valve in the rotation circuit.
6. Move the percussion lever to the high percussion position and lower the feed pressure slowly with the feed knob on the operator panel.

   Check the feed pressure on the feed pressure gauge of the operator panel. When feed pressure decreases to approximately 55 bar (797.7 psi), the percussion switches from high pressure to low. The switching level can be adjusted on valve ().

### 16.10.8 Adjust Maximum Pressure and Speed of Reeling Units

If it is not possible for the slip clutch on the reel gear to unwind the hose and cable, the reel hydraulic motor can be used for unwinding. The winding-in and winding-out speed can be adjusted by the restrictions beneath valve (Y414) for the cable reeling unit and (Y415) for the water hose reeling unit.




1. Connect a pressure gauge (250 bar) to pressure reducing valve (A).
2. Adjust the pressure to 150 bar (2,175.5 psi) with the pressure reducing set screw (C).

3. Start the reeling unit for winding-in and winding-out.
4. Adjust the winding-in and winding-out speed with the restrictions (B).

   The speed for **reeling in** can be adjusted 10–12 rpm ( **one revolution each 5–6 seconds**).

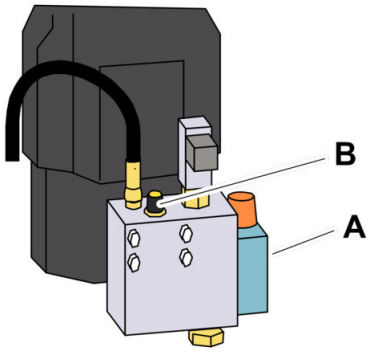
   The speed for **reeling out** can be adjusted 5–6 rpm ( **one revolution each 10–12 seconds**).

> ! ***NOTE:*** *During normal operation, the cable and water hose reels must not be operated hydraulically when being reeled out. The cable and hose must be pulled out by the gear friction coupling instead.*

## 16.10.9 Percussion Pump

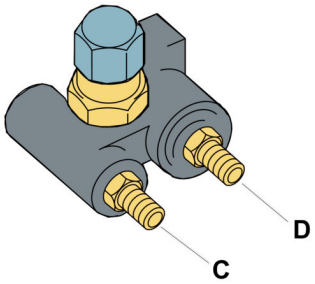
### Percussion Pump Stand-by Pressure and Sequence Valve

> ! ***NOTE:*** *The percussion pump has a pilot-controlled sequence valve (A) in the valve plate of the pump. The sequence valve makes sure that the stand-by pressure does not reach the hammer at the neutral position. It must be set to 70 bar (1,015.3 psi).*




1. Connect a pressure gauge to the pressure test outlet (B).
2. Connect a needle valve in the percussion circuit and make sure that the valve is open.
3. Set the percussion lever in rearmost position to make sure that the percussion is switched off.
4. Start the hydraulic pump and fully close the needle valve.

5. Adjust the pressure if necessary with the outer adjustment screw (C) on the control valve of the pump.




*Percussion pump control valve (S1)*

| | | | |
|---|---|---|---|
| C | Set the stand-by pressure | D | Set maximum pressure |

Step result ➔ The stand-by pressure on the pressure gauge is 18−25 bar (261−362.6 psi).

6. Set the percussion lever to collaring position (center position) and open the needle valve 1/8 turn.
7. Screw in the inner adjustment screw (D) on the control valve of the pump until the pressure gauge shows 70 bar (1,015 psi).
8. Screw in the adjustment screw on the sequence valve (A) so that it closes.

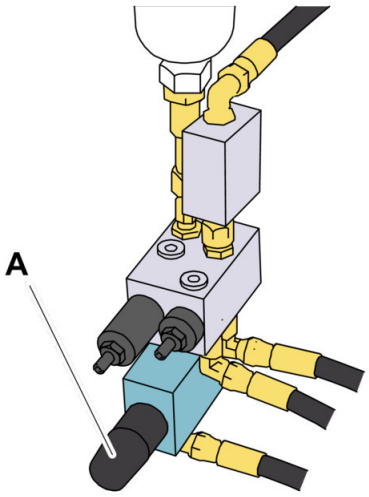
Step result ➔ The pressure on the pressure gauge should decrease to 0 bar.

9. Examine the function of the sequence valve by screwing in and out the adjustment screw (D) on the control valve of the pump.

Step result ➔ Adjust the sequence valve setting if necessary so that it closes at approximately 70 bar (1,015 psi).

### Set Percussion Pressure for Collaring

The pressure is best adjusted during collaring.



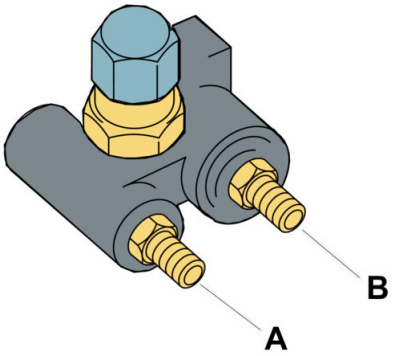

1. Remove the lock nut on valve (A) for adjusting percussion pressure collaring.
2. Start the pump.

3. Set the percussion unit lever to its middle position (collaring).
4. Adjust the set screw for valve (A) until the desired pressure of 130 bar (1,885.5 psi) is attained. Read the pressure from the percussion pressure gauge on the operator panel.

   Screw in the screw to increase the pressure.
5. Tighten the lock nut.
6. Cover the protective cap.

### Set Percussion Pressure for Full Drilling

The pressure is best adjusted during full drilling.




*Percussion pump control valve (S1)*

| | | | |
|---|---|---|---|
| A | Set the stand-by pressure | B | Set maximum pressure |

1. Set the percussion lever in its front position.
2. Read the pressure on the percussion pressure gauge on the operator panel.
3. Adjust to the desired pressure 180−230 bar (2,610−3,336 psi) with the setting screw (B) on the percussion pump control valve (S1).

   Screw in the screw to increase the pressure.

## 16.10.10 Positioning Pump

### Position Pump Stand-by Pressure

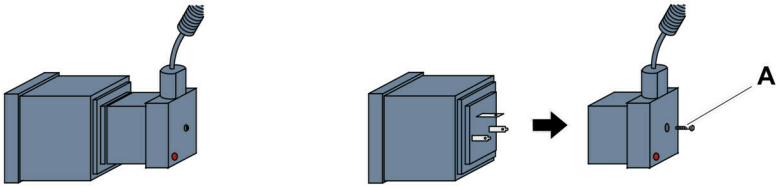
| | |
|---|---|
| ! | ***NOTE:*** *This is always set by the pump supplier.* |

Normally, the stand-by pressure need not be checked or adjusted. If you suspect that the pump is not supplying a sufficient flow to the system, check the stand-by pressure and adjust it if necessary.

1. Remove screw (A) and pull out the connector to disengage anti-inductive protection (Y172).

> ***NOTE:*** *Make sure that the gasket remains in place at the pin.*

> ***NOTE:*** *The anti-inductive protection (Y172) is an electrical connection to the valve. By removing the protection, the positioning pump is unloaded (stand-by mode).*



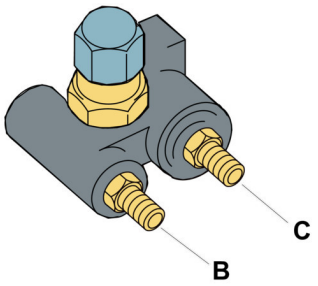

*The anti-inductive protection (Y172)*

2. Start the pump.
3. Connect a pressure gauge to the pressure test outlet.
4. Make sure the pressure stays in the interval 18–25 bar (261–362.6 psi).

> ***NOTE:*** *Take the following measures if the pressure needs adjusting.*

5. Remove the lock nut on valve (B) to adjust the socket head cap screw and read the pressure from the pressure gauge connected to the test outlet.

   Screw in the screw to increase the pressure.



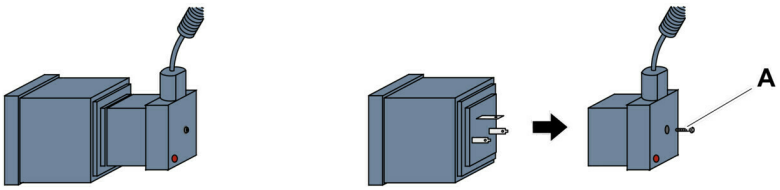

*Positioning pump control valve (S2)*

| | | | |
|---|---|---|---|
| B | Set the stand-by pressure | C | Set maximum pressure |

Step result ➔ The pressure gauge reads 18–25 bar (261–362.6 psi).

6. Tighten the lock nut.
7. Engage the anti-inductive protection (Y172) by connecting the connector.

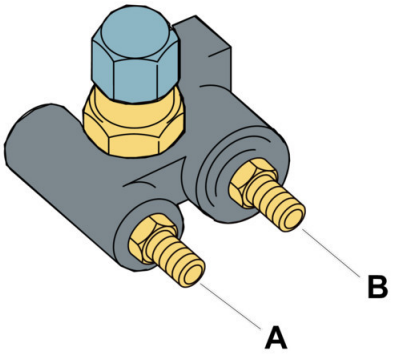
> ***NOTE:*** *Make sure that the gasket is in place.*




*The anti-inductive protection (Y172)*

8. Secure the anti-inductive protection (Y172) with the screw (A).

### Set Positioning Pump Pressure




*Positioning pump control valve (S2)*

| | | | |
|---|---|---|---|
| A | Set the stand-by pressure | B | Set maximum pressure |

Precondition ✓ All the control levers on the operator panel are in neutral position.

1. Connect a pressure gauge to the pressure test outlet (72).
2. Start the pump.
3. Remove the lock nut on valve (B) to adjust the socket head cap screw and read the pressure on the pressure gauge that is connected to the pressure test outlet (72).

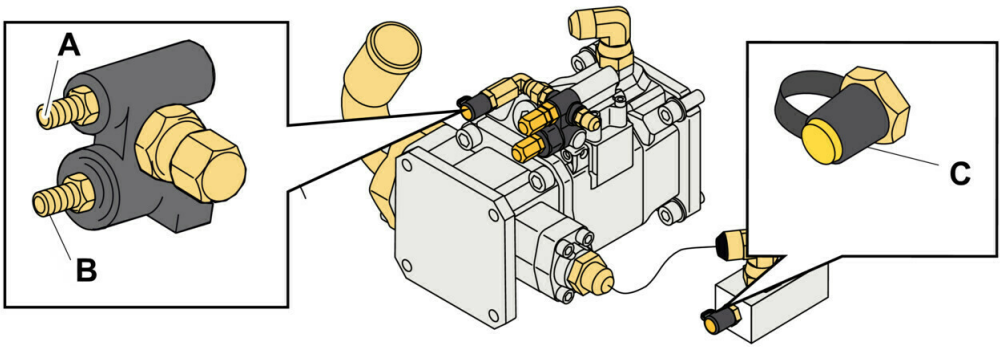
   Screw in the screw to increase the pressure.

Step result ➔ The pressure gauge reads 210−230 bar (3,045−3,335 psi).

4. Tighten the lock nut.

### Adjust Positioning Pressure with Diesel Power

! ***NOTE:*** *Setting the load-sensing diesel positioning pump must be carried out in accordance with the instructions below.*




1. Connect a pressure gauge (0−400 bar, 0−5,802 psi) at pressure test outlet (C).
2. Remove the protective caps to loosen the lock nuts on the pump actuators and fully loosen the two adjustment screws (A and B).
3. Deactivate the knob for diesel positioning pressure and start the diesel engine.Refer to chapter Tramming in operation manual.
4. Screw in adjustment screw (B) for diesel positioning pressure until the accumulators stop charging at approximately 150 bar (2,176 psi).

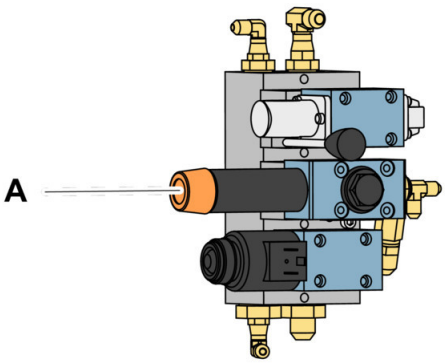
Step result ➔ The pressure falls on the pressure gauge at pressure test outlet (C) to approximately 0−5 bar (0−72.5 psi).

5. Set the standby pressure on the diesel positioning pump with adjustment screw (A) to 30 bar (435 psi) on the pressure gauge.
6. Activate the knob for diesel positioning pressure in the cab or canopy.
7. Adjust the diesel positioning pressure with adjustment screw (B).

Step result ➔ The pressure gauge reads 210 bar (3,045.8 psi).

8. Remove the pressure gauge from the test outlet.
9. Lock the adjustment screws and install the protective caps on the pump actuators.

## 16.10.11 Set the Pilot Pressure and Boom Positioning Pilot Pressure




1. Connect a pressure gauge to the pressure test outlet (). Read the pressure on the pressure gauge.

   If the pressure is not bar ( psi), do the following steps to adjust the pressure.

2. Remove the lock nut of the valve () for adjusting pilot pressure.

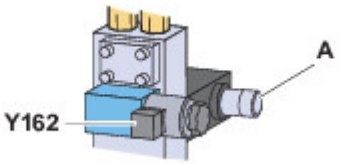
3. Adjust the set screw to provide bar ( psi). Read the pressure from the pressure gauge that is connected to pressure test outlet ().
4. Tighten the lock nut.

### 16.10.12 Set Water Pump Speed

1. Check that the maximum water pump speed reading is 3000 rpm. Read the speed from the tachometer on the water pump hydraulic motor coupling.

> ! ***NOTE:*** *Take the following measures if the speed needs adjusting.*

2. Adjust the water pump speed using flow valve (A) until the tachometer on the water pump hydraulic motor coupling reads 3000 rpm.

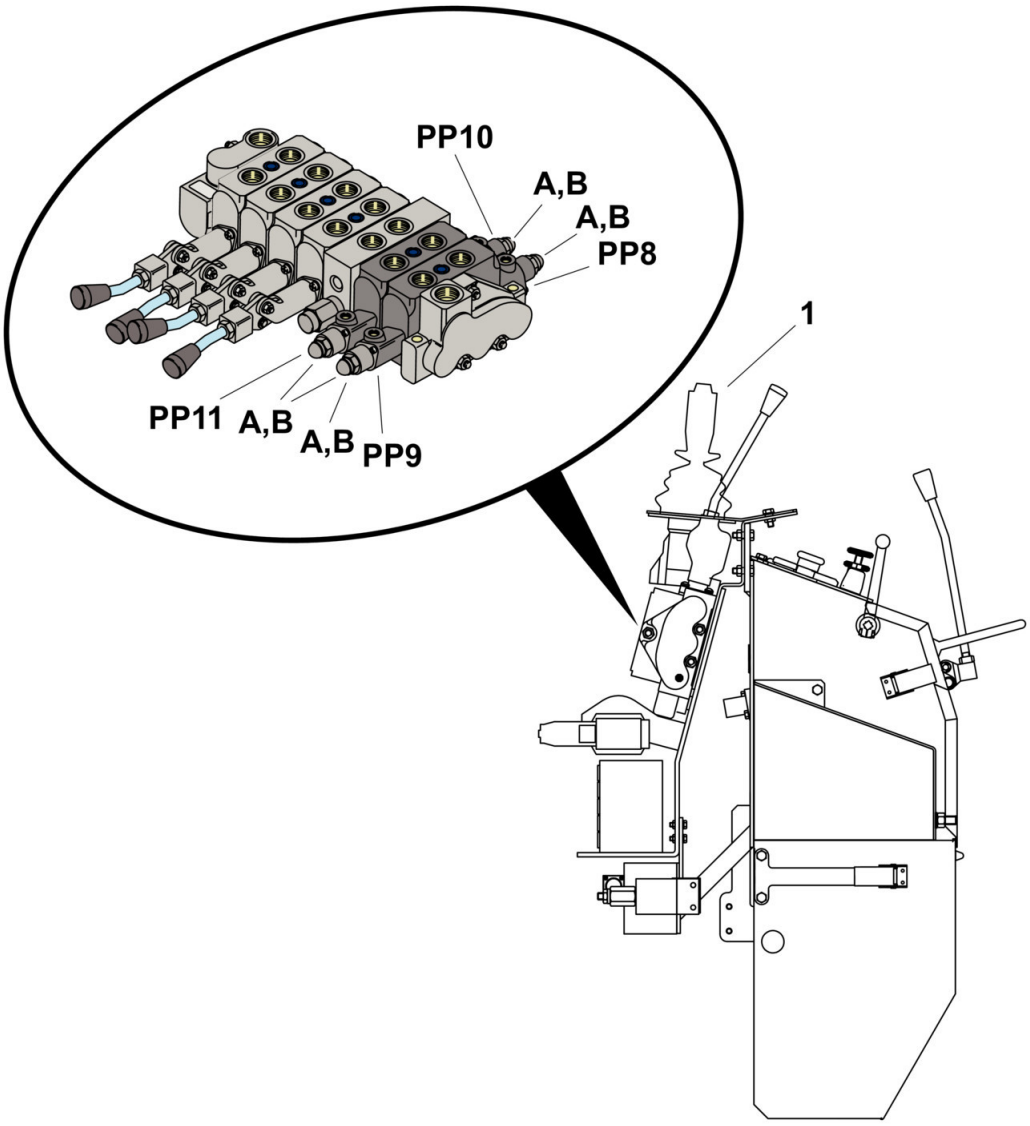



*Valve Section (Y162)*

> ! ***NOTE:*** *The output pressure varies with the input pressure.*

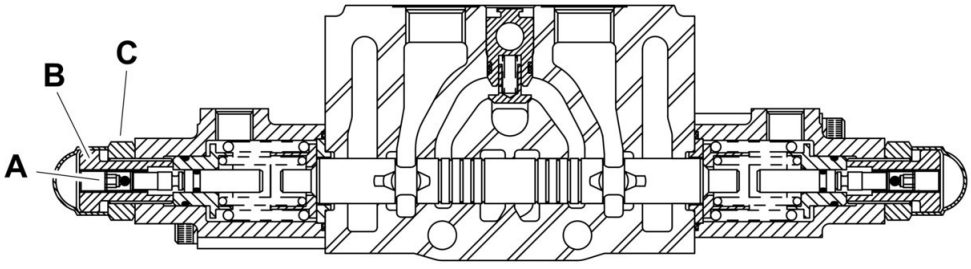
> ! ***NOTE:*** *The water pressure must not exceed 25 bar (363 psi) when drilling. If it does, the speed must be reduced.*

## 16.10.13 Adjusting the Positioning Valves for Front and Rear Boom




*Boom positioning valves and steering lever*

| | |
|---|---|
| 1 | Steering lever |
| A | Adjusting screws for boom speed and parallelism |
| B | Adjusting screws for valve opening pressure |
| PPxx | Hose marking |




*Cross-section of boom positioning valve*

| | |
|---|---|
| A | Socket head cap screw for adjusting boom speed and parallelism |
| B | Hexagon-headed screw for adjusting valve opening pressure |
| C | Lock nut |

### Checking and adjusting valve opening pressure

The opening pressure is the minimum pressure required from the steering lever in order that the boom shall move. The pressure must be adjusted to 4 - 4.5 bar.

! ***NOTE:*** *The boom extension cylinder must be fully extended.*

Connect pressure gauges (0-30 bar) to the lines PP8, PP9, PP10 and PP11 . Start the pump and move the steering lever in different directions, just enough for the boom to start moving. Read the pressure on the pressure gauges. It must be 4 - 4.5 bar.

If the pressure requires adjustment:

Adjust using the screws (B) at (PP8), (PP9), (PP10) and (PP11) so that the boom starts to move at approx. 4 bar pressure when the steering lever actuation is as small as possible.

Lock the settings with the lock nuts (C) but allow the pressure gauges to remain.

### Setting the boom's parallelism

When **lowering** the boom the valves at (PP8) and (PP11) are activated. Adjustment of parallelism must be made on the **opposite side** i.e. at (PP9) and (PP10).

Lower the boom **straight down** . If the boom pulls to the **right** instead of straight down: screw in the socket head cap screw (A) at (PP9).

If the boom pulls to the **left** instead of straight down: screw in the socket head cap screw (A) at (PP10).

When **lifting** the boom the valves at (PP9) and (PP10) are activated. Adjustment of parallelism must be made on the **opposite side** i.e. at (PP8) and (PP11).

Lift the boom **straight up**. If the boom pulls to the **right** instead of straight up: screw in the socket head cap screw (A) at (PP11).

If the boom pulls to the **left** instead of straight up: screw in the socket head cap screw (A) at (PP8).

! ***NOTE:*** *Adjust the valves max. 1/4 turn at a time.*

### Setting boom speed

Recommended speeds for both lifting and lowering:

- BUT 35: 3 m/20 s
- BUT 32: 3 m/15 s

When lowering the boom, adjust the speed by changing the setting on the socket head cap screws (A) at (PP9) and (PP10). Screw in the screws to reduce speed and screw out to increase speed

> ***NOTE:*** *Adjust the screws equally and max. 1/4 turn at a time.*

When lifting the boom, adjust the speed by changing the setting on the socket head cap screws (A) at (PP8) and (PP11). Screw in the screws to reduce speed and screw out to increase speed.

> ***NOTE:*** *Adjust the screws equally and max. 1/4 turn at a time.*

### Check Boom Movement

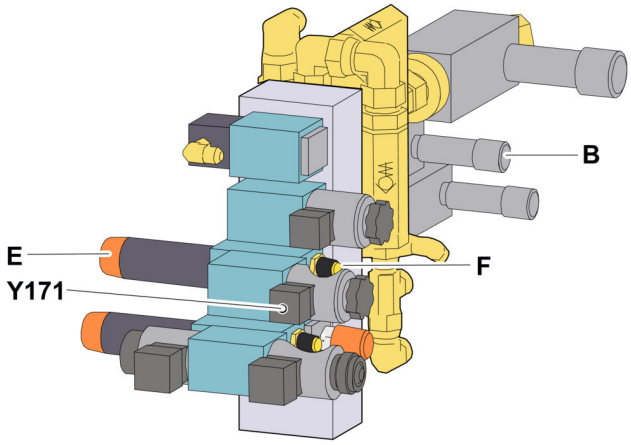
Check that boom movements are correct and that the opening pressure is still correct. Remove the pressure gauges from the lines.

## 16.10.14 Speed Control for Air Flow

1. Check that air pressure gauge on the operator panel reads 3 bar.

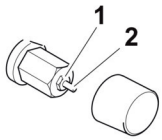
> ***NOTE:*** *Perform the following steps if the air pressure needs to be adjusted.*

2. Screw out adjusting knob (B) on the flow regulator all the way.




*Valve section (Y171)*

3. Remove protective cap (E).
4. Undo lock nut (1).



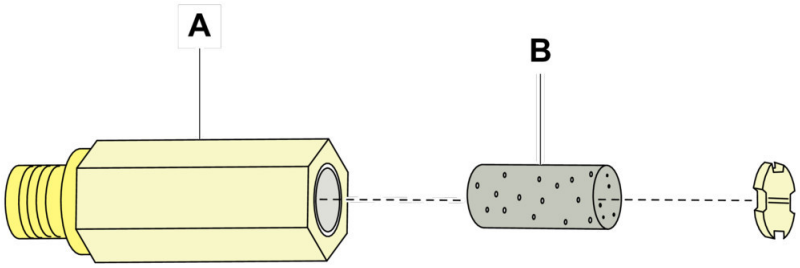

*Detail of valve*

5. Adjust setting screw (2) until the pressure gauge reads 3 bar.
6. Tighten lock nut (1).
7. Screw in flow regulator (B) until the pressure begins to drop.

8. Then open the flow regulator a half turn.
9. Refit protective cap (E).

## 16.11 Clean Strainer

There is a strainer on the line from the limit valve for rock drill stop. If the strainer that is connected to valve Y114, becomes clogged, rock drill stops to function after drilling a hole. The strainer must be cleaned.




1. Loosen the strainer housing (A) from the line.
2. Remove the strainer (B).
3. Blow compressed air to clean the strainer.
4. Install the strainer (B) again.

# 17 Pneumatic and Water Systems

## 17.1 Safety Precautions before Working on Pneumatic System

**WARNING**

**High System Pressure**

There is a risk of personal injury when working with pressurized systems.

- ▶ Do not perform maintenance work while the machine is operating.
- ▶ Check that the hydraulic, water, and air systems are depressurized and that the electrical system is de-energized before starting to work on these systems.

## 17.2 Safety Precautions before Working on Water System

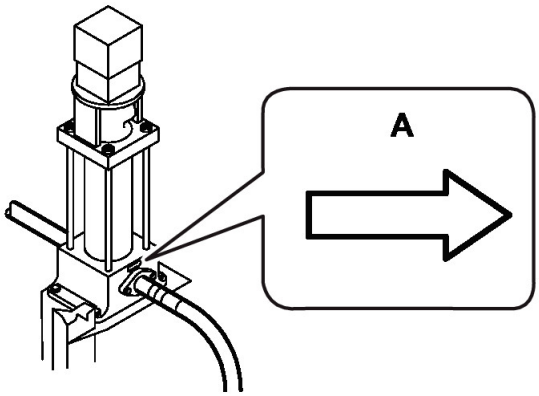
**WARNING**

**High System Pressure**

There is a risk of personal injury when working with pressurized systems.

- ▶ Do not perform maintenance work while the machine is operating.
- ▶ Check that the hydraulic, water, and air systems are depressurized and that the electrical system is de-energized before starting to work on these systems.

## 17.3 Check Water Pump Rotation Direction

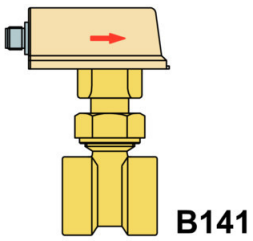



Precondition ✓ The rotation direction of the water pump is checked after working on the hydraulic circuit.

○ Check the rotation direction of the water pump corresponds with the arrow (A).

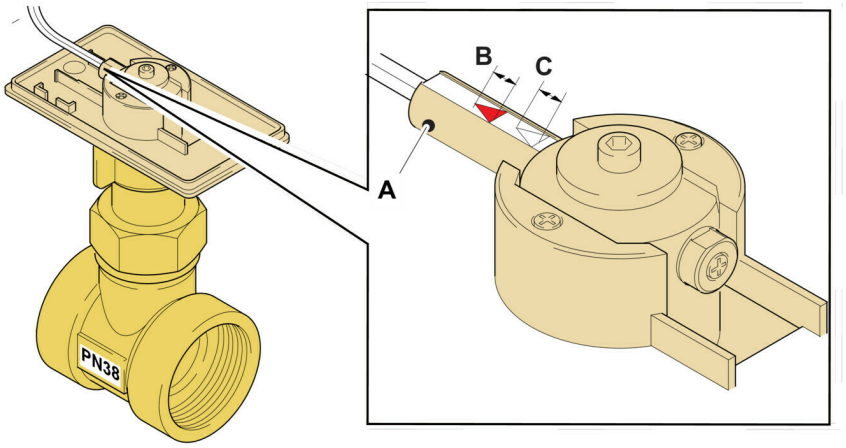
- Switch the delivery and return hoses on the motor and valve if the rotation direction of the pump is incorrect.

## 17.4 Setting Water Flow Switch




*Flow Switch*

1. Remove the black plastic cover from the guard.
2. Remove the screw on top of the switch.
3. Adjust sensor body (A).




4. Set the flow switch (B141) as a making contact (B).

   The filled red triangle (B) shows interval for making contact and white triangle (C) for breaking contact.
5. Adjust the water flow switch so that just the tip of the red triangle is visible.
6. Tighten the screw and install the plastic cover.
7. Check that desired function is reached by turning ON and OFF the flow.

Step result

➔ The flow switch (B141) senses the water flow during drilling. The adjustment of the sensor body determines the water flow value. If the flow is below the set value, the water pump stops and the drilling is interrupted.

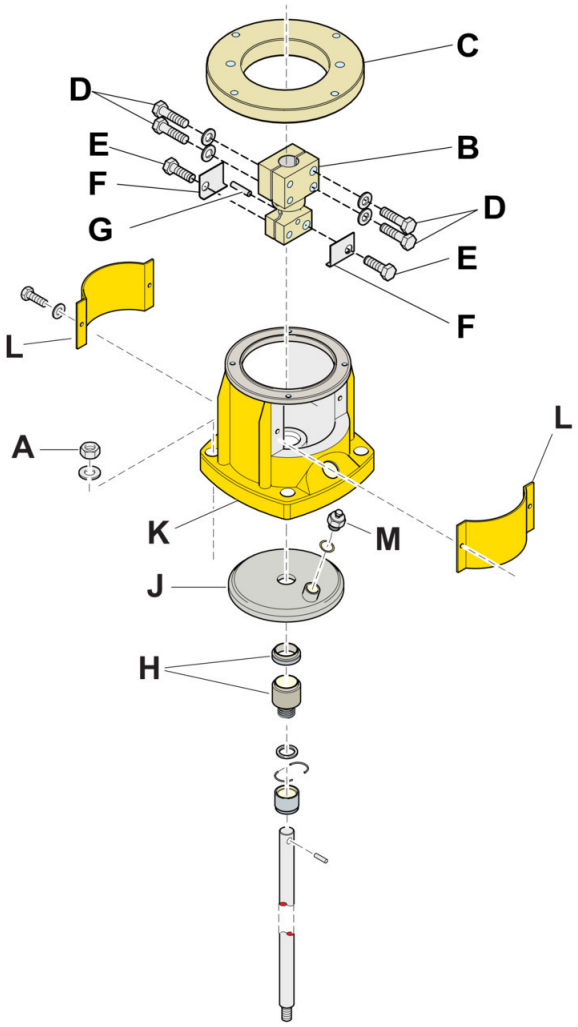
## 17.5 Replacing Water Pump Shaft Seal - Hydraulic Drive

**WARNING**

**High System Pressure**

There is a risk of personal injury when working with pressurized systems.

- ▶ Do not perform maintenance work while the machine is operating.
- ▶ Check that the hydraulic, water, and air systems are depressurized and that the electrical system is de-energized before starting to work on these systems.




Precondition ✓ The water pump is removed from the machine.

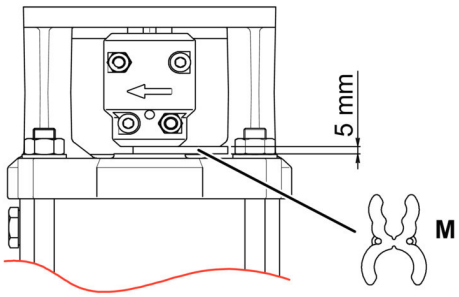
1. Remove the protection (L) from the lantern piece.
2. Remove the hub bolts (E) and associated lock tabs.
3. Remove the locking pin (G), which is inside the lock tabs (F).
4. Remove the bolts that attach the hydraulic motor in flange (C) and lift off the hydraulic motor together with the hub (B).

5. Remove the plug (M).
6. Remove the nuts (A) and the lift off the lantern piece (K).
7. Lift off the disk (J) and remove the upper part of the shaft seal (H) from the disk underside.
8. Wash the upper part of the new shaft seal with alcohol and install it in place on the disk.
9. Pull off the lower part of the old shaft seal from the shaft.
10. Wash the lower part of the new seal with alcohol and place on the shaft.
11. Install the disk (J) with the upper part of the shaft seal in place.
12. Install the lantern piece (K) with the nuts (A).

> ! ***NOTE:*** *The drawbar nuts (1) must be torque tightened to 25 Nm (18.43 lbf-ft) if they have M12 thread (PX4) and to 30 Nm (22.12 lbf-ft) of they have M14 thread (PX8, PX16).*

13. Press in the fork-shaped shim (M) on the shaft.

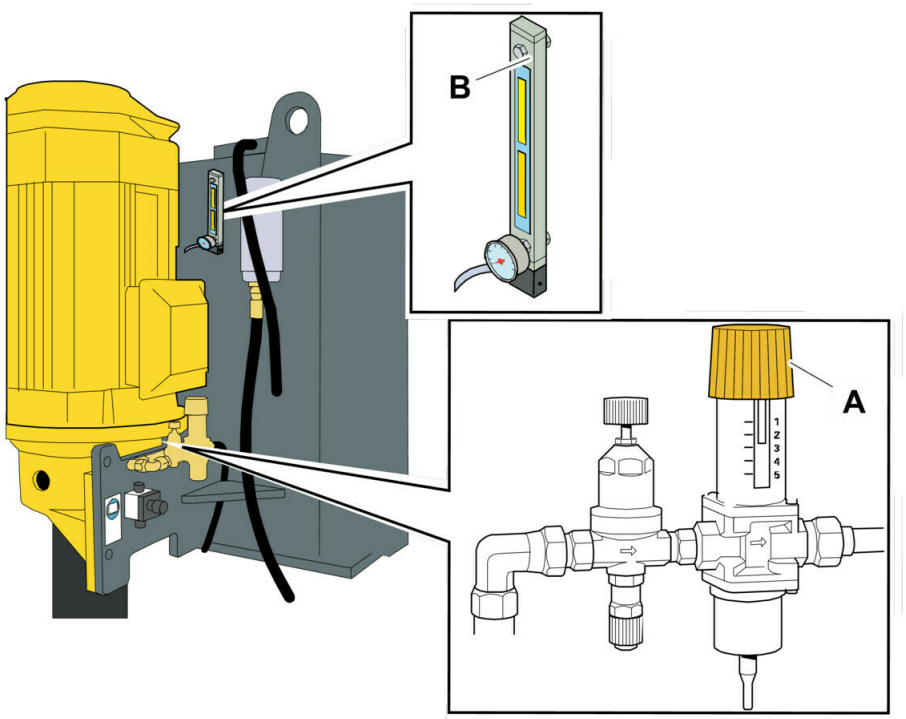
    If there is no shim, then a fitting piece of 5 ± 0.1 mm (0.196 ± 0.0039 in) can be used.




14. Lower the hub (B) over the shaft.
15. Attach the locking pin (G) in the shaft hole.
16. Install the lock tabs (F) and the hub bolts (E).
17. Install the hydraulic motor into the flange (C) on the lantern piece.
18. Remove the fork-shaped shim and fit the plate protection (L).

## 17.6 Adjust Thermostat

The hydraulic oil tank opens and releases water to increase the flow of water through the oil cooler when hydraulic oil temperature reaches 50 °C (122° F) in a thermostat.

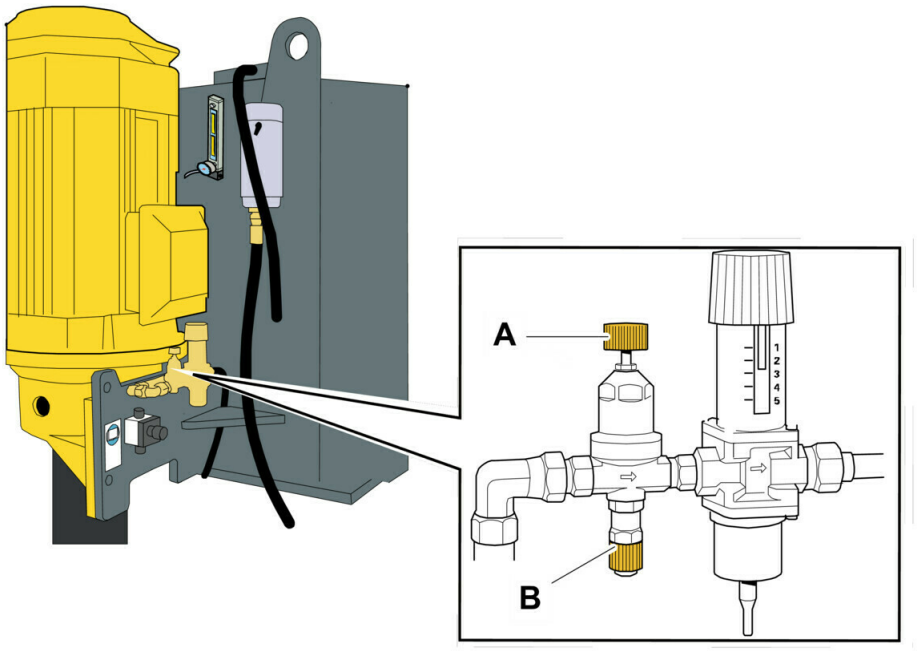



- Set the thermostat to 50° C (122° F) using the control knob (A).

> **NOTE:** *The thermostat has a scale graduated 1–5 value. The value 1 on the scale is equivalent to approximately 25° C (77° F) and the value 5 is equivalent to approximately 65° C (149° F).*

- Check the setting on the thermometer (B) on the hydraulic oil tank.

## 17.7 Adjust Water Pressure in Thermostat




- Check the input water pressure on pressure gauge that is connected to outlet (B).

- Adjusted the pressure using the reducing valve (A) to approximately 5 bar (72 psi) located near the hydraulic oil tank.

> ***NOTE:*** *Input water pressure must be maximum of 14 bar (203 psi).*

## 17.8 Clean Water Strainer

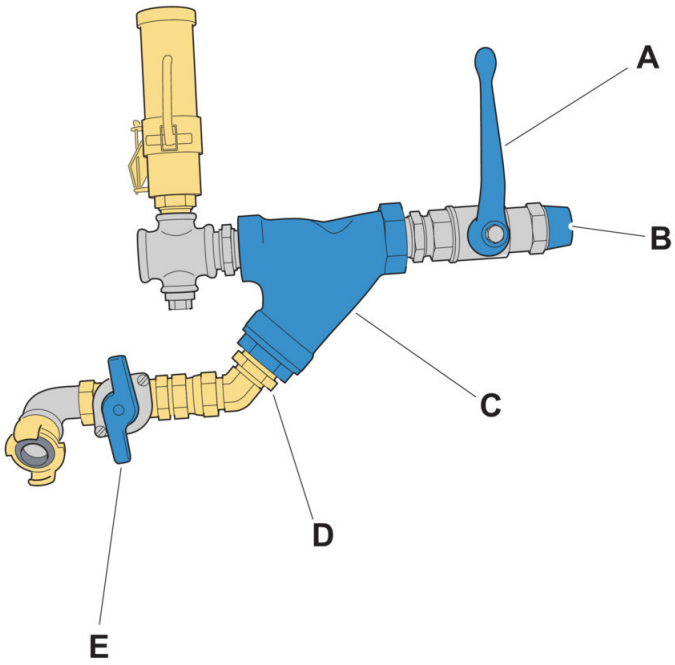
**WARNING**

**High System Pressure**

There is a risk of personal injury when working with pressurized systems.

- ▶ Do not perform maintenance work while the machine is operating.
- ▶ Check that the hydraulic, water, and air systems are depressurized and that the electrical system is de-energized before starting to work on these systems.

> ***NOTE:*** *Clean the strainer regularly to maintain the proper flow.*




Precondition
- ✓ The hose reeling unit is connected to the water supply if the machine is equipped with a water supply.
- ✓ The hose connection points are clean.

1. Connect a water supply to the water inlet (B) on the machine.
2. Open the main stop valve (A).

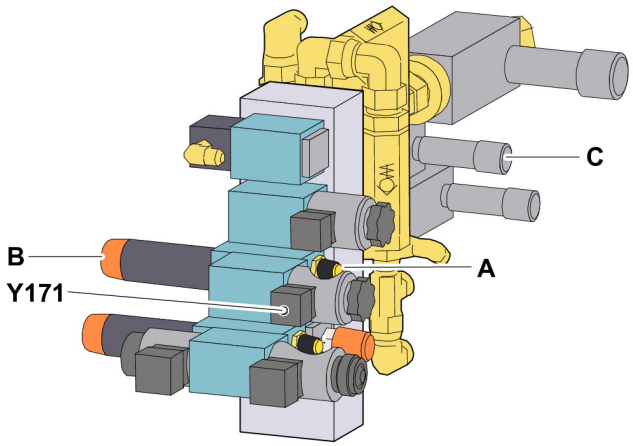
3. Open the valve (E) and let water run through the water strainer (C).
4. Remove the end piece (D) if the water strainer is damaged.
5. Remove the strainer drum.
6. Clean the strainer drum or replace with a new one if necessary.

## 17.9 Adjusting Compressor Speed GAR 5 for Machines Without Hole Blowing

If the machine lacks the hole blowing option, then the air is only used for drill lubrication. Compressor speed must be set so that lubricating air pressure is 3 bar (43 psi).

1. Mark the compressor pulley with reflective tape.
2. Measure the rotation speed using a tachometer.

   The rotation speed must be 3500–4000 rpm.
3. Remove the anti-inductive protection (Y171).




4. Connect a pressure gauge to the test outlet (A).

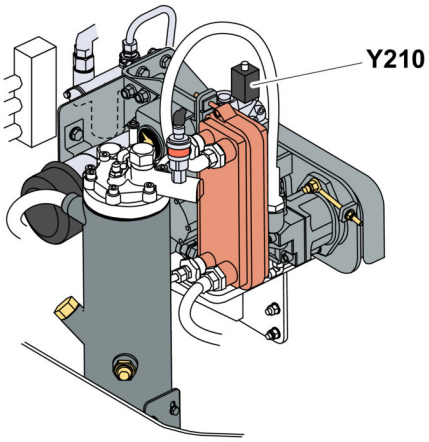
   The pressure must be 170 bar (2465 psi). If not, adjust the pressure on pressure reducing valve (B).
5. Adjust the rotation speed of the compressor using the flow regulator (C).
6. Attach the anti-inductive protection (Y171).

## 17.10 Adjusting Compressor Speed GAR 5 for Machines with Hole Blowing

1. Mark the compressor pulley with reflective tape.
2. Measure the rotation speed using a tachometer.

   The rotation speed must be 4000 rpm.

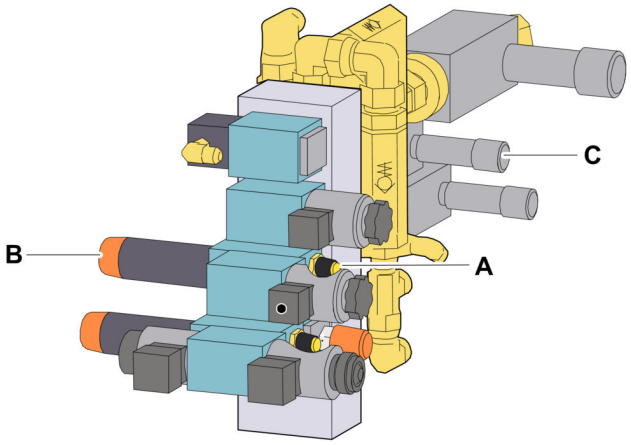
3. Remove the anti-inductive protection (Y210) from the relief valve of compressor.




*Anti-inductive Protection (Y210)*

4. Connect a pressure gauge to pressure test outlet (A).

   The pressure must be 220 bar (3190 psi). If not, adjust the pressure on pressure reducing valve (B).




*Valve Post*

5. Adjust the rotation speed of the compressor using the flow regulator (C).
6. Attach the anti-inductive protection (Y210) to the relief valve of compressor.

## 17.11 Adjusting Booster RPM Compressor Speed GAR 5

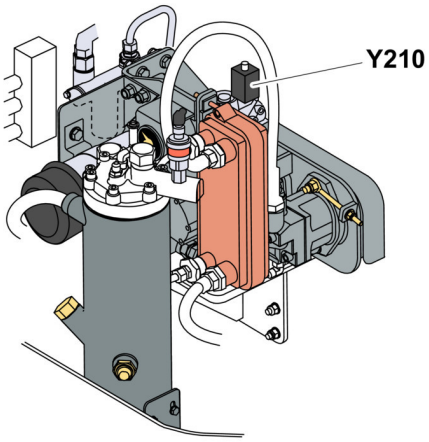
If the machine has the compressor boost function, then a higher rotation speed is activated using a lever at the operator station.

Adjust both the lower basic speed (4000 rpm) and the higher speed (7000 rpm).

1. Mark the compressor pulley with reflective tape.
2. Measure rotation speed using a tachometer.

   The rotation speed must be 4000 rpm.

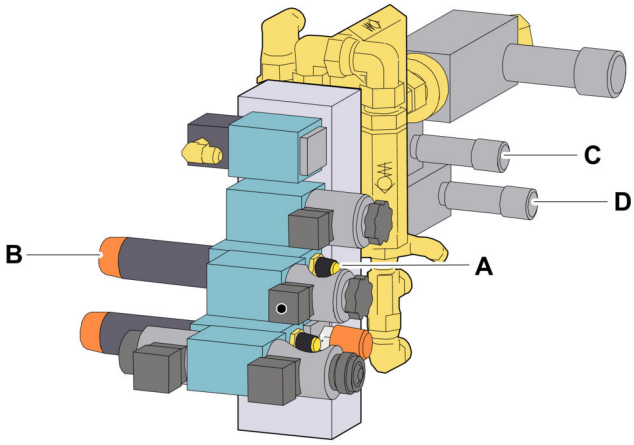
3. Remove the anti-inductive protection (Y210) from the compressor relief valve.




*Anti-inductive Protection (Y210)*

4. Connect a pressure gauge to pressure test outlet (A).

   The pressure must be 220 bar (3190 psi). If not, adjust the pressure on pressure reducing valve (B).




*Valve Post*

5. Adjust the rotation speed of compressor using the flow regulator (C).
6. Activate compressor boost using the lever at the operator station.
7. Measure the rotation speed on the tachometer.

   The rotation speed for compressor boost must be 7000 rpm. If not, adjust the rotation speed using the flow regulator (D).

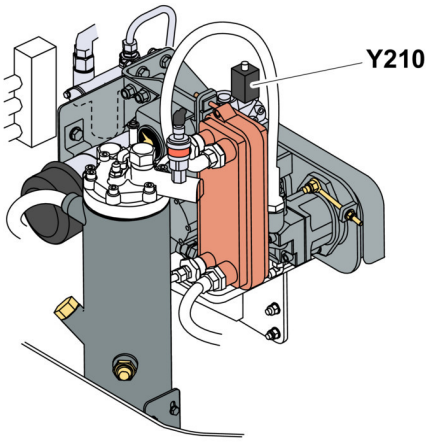
8. Attach the anti-inductive protection (Y210) to the relief valve of compressor.

## 17.12 Adjusting Compressor Speed GAR 30

1. Mark the compressor pulley with reflective tape.
2. Measure rotation speed using a tachometer.

   The rotation speed must be 4000 rpm.

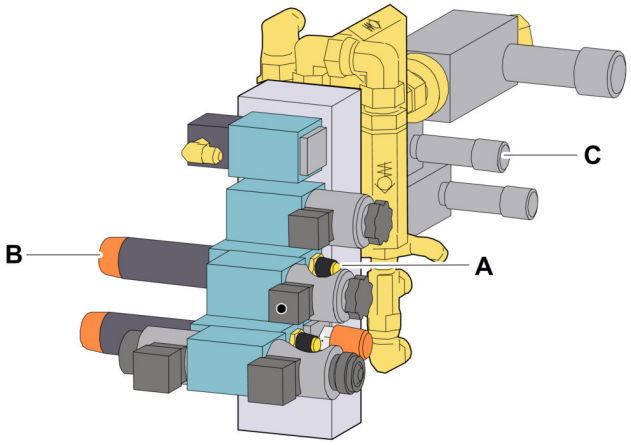
3. Remove the anti-inductive protection (Y210) from the compressor relief valve.




*Anti-inductive Protection (Y210)*

4. Connect a pressure gauge to pressure test outlet (A).

   The pressure must be 220 bar (3190 psi). If not, adjust the pressure on pressure reducing valve (B).




*Valve Post*

5. Adjust the rotation speed of compressor using the flow regulator (C).
6. Attach the anti-inductive protection (Y210) to the relief valve of compressor.

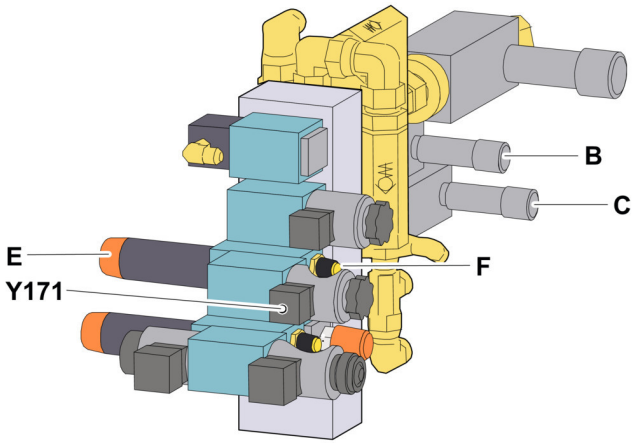
## 17.13 Adjusting Booster RPM Compressor Speed GAR 30

If the rig has the compressor boost function then a higher rotation speed is activated using a lever at the operator's station.

When adjusting, both the lower basic speed (approx. 1800 rpm) and the higher speed (approx. 4500 rpm) should be adjusted.

1. Mark with reflective tape on the compressor's pulley.
2. Remove the anti-inductive protection Y210 and Y171.

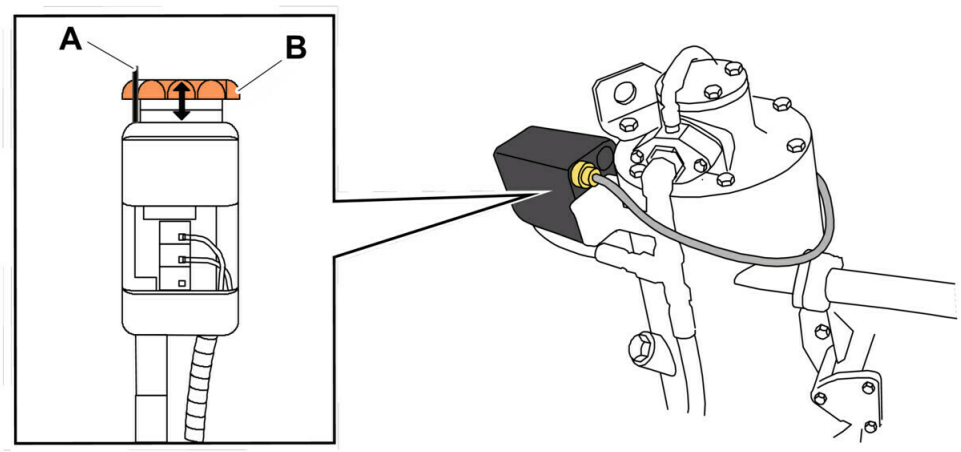
3. Connect a pressure gauge to pressure test outlet (F). The pressure should be approx. 200 bar.




If necessary, adjust the pressure on pressure reducing valve (E).

4. Refit the anti-inductive protection Y171.
5. Activate compressor boost using the lever on the operator's station.
6. Adjust the compressor's booster speed to approx. 4500 rpm using the flow regulator (C).
7. Switch off compressor boost with the lever at the operator's station.
8. Adjust the compressor's rotation speed to approx. 1800 rpm using the flow regulator (B).
9. Refit the anti-inductive protection (Y210) to the compressor's relief valve.

## 17.14 Load and Unloading the Compressor




! ***NOTE:*** *The compressor pressure switch (B188) must only be adjusted while the system is pressurized. If not, it can be damaged.*

1. Remove the locking pin (A).
2. Pull the setting knob (B) up to adjust the unloading pressure.

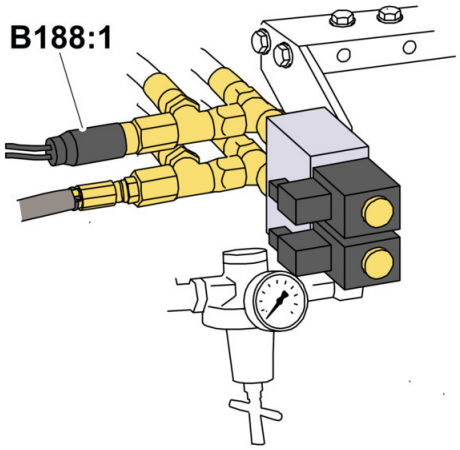
3. Check the air pressure on the operator panel pressure gauge.
4. Turn the adjuster knob (B) to set the unloading pressure to 8 bar (116 psi).

   Clockwise = Increase pressure

   Counterclockwise = Decrease pressure
5. Push the adjuster knob (B) down to adjust the difference between the unloading and loading pressures.
6. The pressure difference between the unloading and loading pressures must be 2 bar (29 psi).
7. Check the air pressure again on the operator panel pressure gauge.
8. Adjust the pressure so that the compressor loads at 6 bar (87 psi).
9. Install the locking pin (A).

## 17.15 Check Pressure Sensor B188:1

Pressure sensor B188:1 detects the pressure in the air circuit. If the pressure is too low, then drilling is stopped after a certain time to prevent damage to the drill due to deficient lubrication.




1. Check that the pressure sensor has the correct power supply +24 VDC and that it sends the correct output signal to the air-water system.

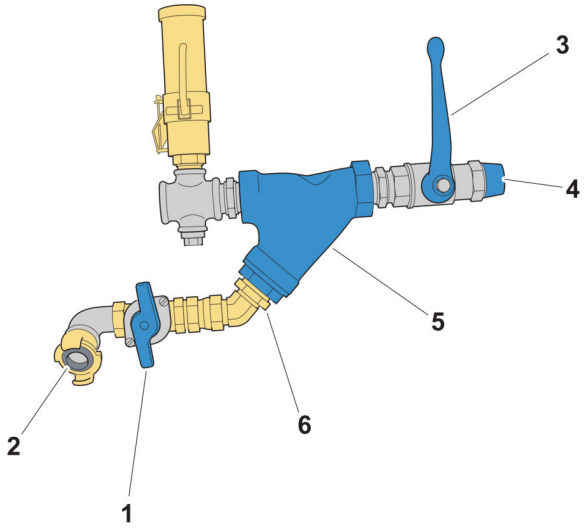
   ! ***NOTE:*** *The special terminal block that is included in the Epiroc service bag must be used to measure the voltage supply.*
2. Calibrate sensors after replacement. Refer to FAM (Feed Angle Measurement) manual.

## 17.16 Freeze Prevention Measures

! ***NOTE:*** *The water system must be drained at temperatures approaching or below 0 °C (32 °F).*

### 17.16.1 Draining Water System

1. Make sure the diesel engine and hydraulic pumps are turned off to avoid the risk of damaging the water pump.
2. Connect air to water inlet (2).



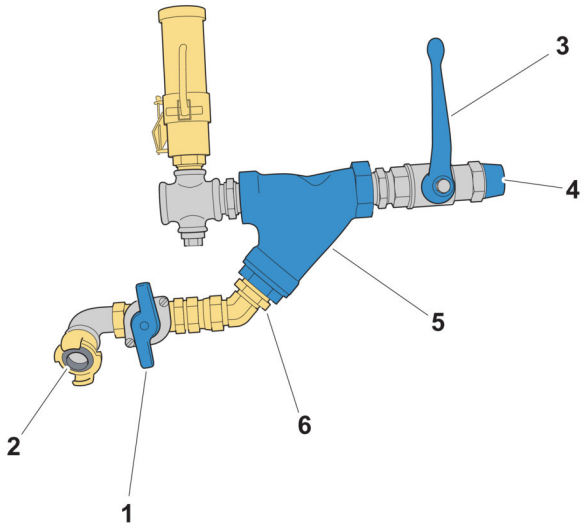

*Water inlet*

3. Open cocks (1) and (3) to blow the water out through the reeling unit.
4. Close cock (3).
5. Move the water/air flushing lever forward, so that the water valve opens and the compressed air expels the water through the system.
6. Repeat the above procedure for the other boom.

### 17.16.2 Draining Water Mist System

1. Disconnect the induction connector from the solenoid valve Y 162 and Y162:2 so that the water pumps do not start.

2. Connect air to water inlet (2).




*Water inlet*

3. Close cock (3).
4. Open cock (1).
5. Open both drain cocks in the system for water mist.
6. Close the drain cocks when only air is blown out.
7. Start the hydraulic pump and activate water mist. Deactivate it when only air is blown out from the rock drill. Switch off the hydraulic pump.
8. Repeat the above procedure for the other boom.
9. Open both drain cocks in the system for watermist.
10. Reconnect the induction connectors to the solenoid valves Y162 and Y162:2.

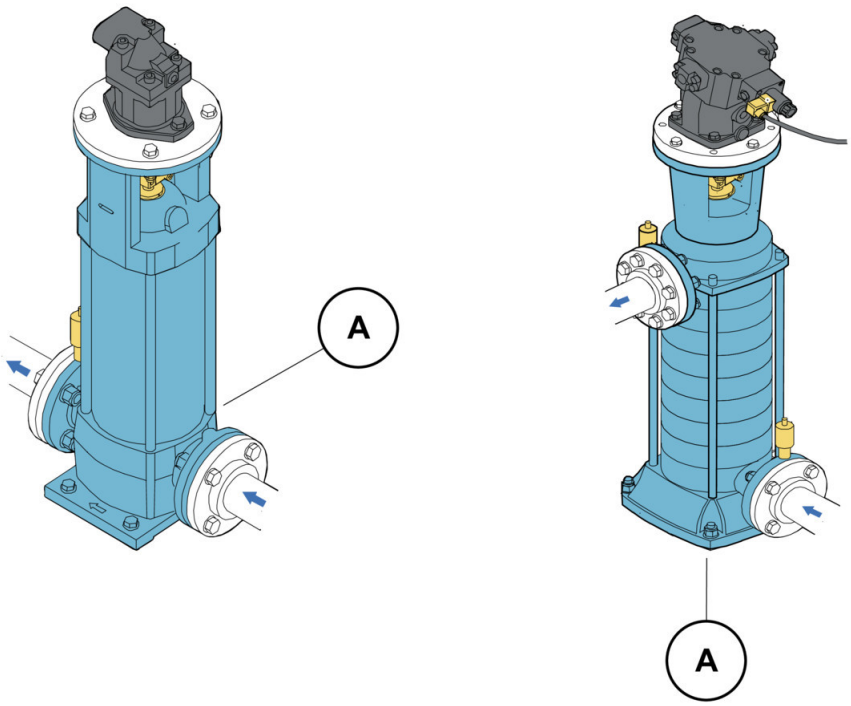
### 17.16.3 Drain Water Pump

**WARNING**

**High System Pressure**

There is a risk of personal injury when working with pressurized systems.

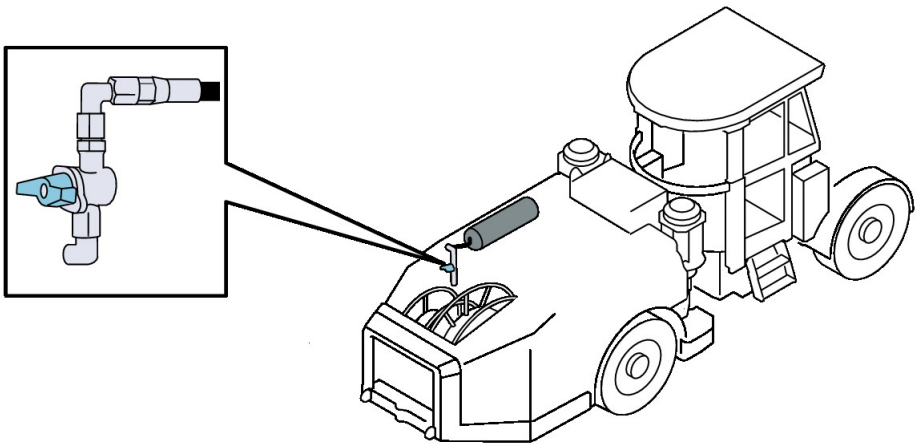
- ▶ Do not perform maintenance work while the machine is operating.
- ▶ Check that the hydraulic, water, and air systems are depressurized and that the electrical system is de-energized before starting to work on these systems.




1. Open the water pump drain plug (A).
2. When the flow of water stops, close the drain plug.

### 17.16.4 Draining Condensate from Air Tank

Air tank is installed on machine with the air flushing option.

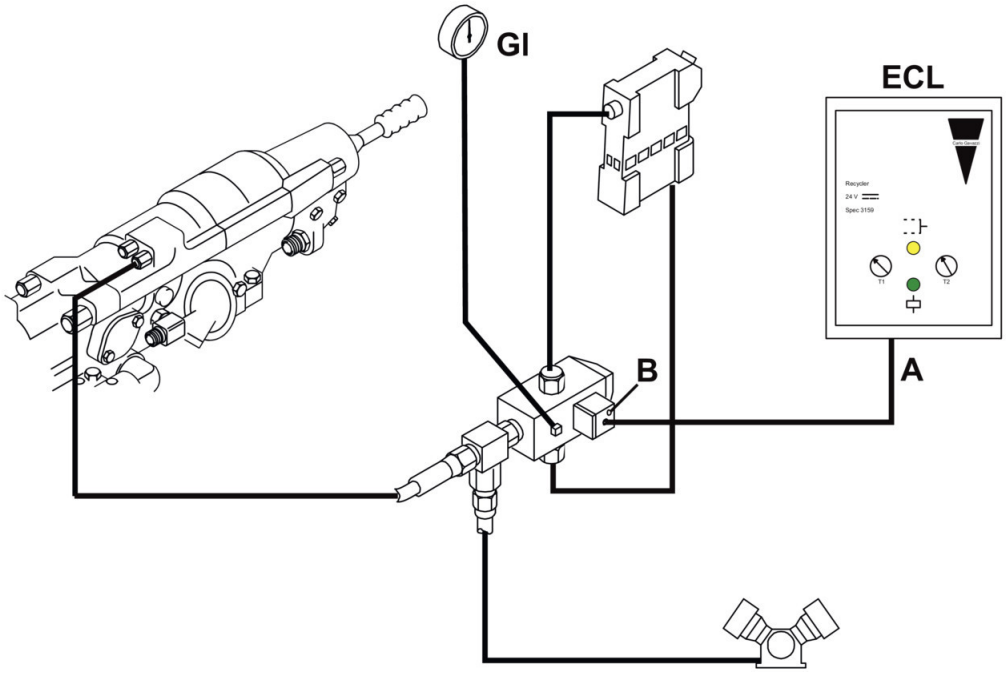


Precondition ✓ Machine is parked on a flat and level surface.

1. Open the drain tap on the air tank.
2. Close the drain tap when the flow of water stops.

# 17.17 ECL Lubricating System Adjustment

## 17.17.1 Metering Lubricating Oil

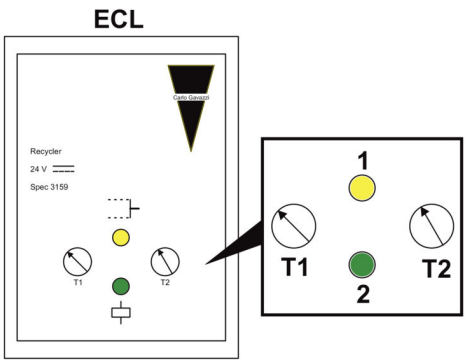



*ECL Lubrication System*

| | |
|---|---|
| ECL | Pulse relay |
| B | LED on lubrication pump anti-inductive protection |
| GI | Pressure gauge for lubricant pressure. Located on operator panel. |

1. Start the pump.
2. Check that the LED (2) on the pulse relay in the electric cabinet.

   It indicates that power is turned On.




*ECL Pulse Relay*

3. Adjust screw (T1) so that the LED (1) is on for approximately 0.5 second.
4. Set the correct lubricating oil dosage with screw (T2) including LED (1) to indicate 25 pulses/minute.

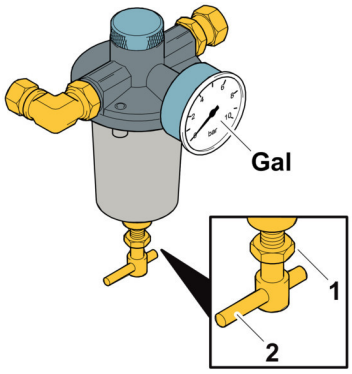
5. Check the lubrication pump LED (B) after each shift to confirm that the correct pulse frequency is obtained and that oil is emerging from the front section of the rock drill.

### 17.17.2 Lubricating Air Pressure for Rigs with Hole Blowing

Rigs equipped with hole blowing have a pressure regulator that limits the air pressure used for lubricating the drill adapter.

Pressure switch B188:1 monitors the lubricating air pressure. If the pressure falls below 2 bar then a warning lamp illuminates on the drill panel.

1. Undo lock nut (1).



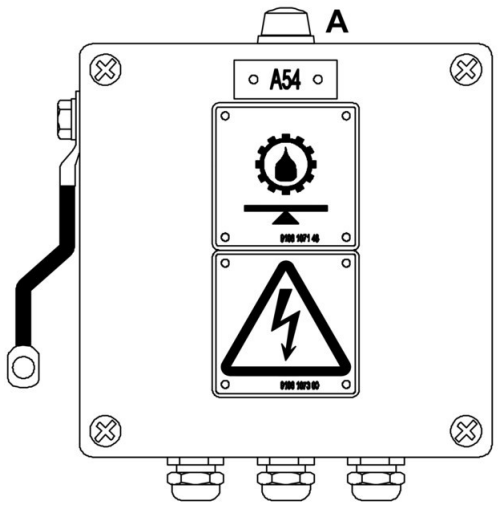

*Pressure regulator with pressure gauge used for lubricating air pressure*

2. Adjust the lubricating pressure to 3 bar using set screw (2). Read the value from pressure gauge (Gal).
3. Tight the lock nut.

### 17.17.3 Lubricant Level Monitor

The lubricant level monitor is extra equipment and is therefore not available on standard rigs.

The lubricant level monitor is located in the bottom of the lubricating oil tank. If the lubricant level is too low then a lamp (A) illuminates, located on the junction box at the operator's station.




*Junction box and indication*

The lubricant level monitor acts on time relay K107T which is set at 5 minutes. This means that if the lubricating oil tank is not filled within this time then the pumps will be switched off after five minutes.

If the pumps have stopped, it will suffice to fill the lube oil tank before the pumps are started again.

# 18 Electrical System, IEC

## 18.1 Safety Precautions before Working on Electrical System

**WARNING**

**Dangerous Voltage**

Can cause severe personal injury.

- ▶ Check that the electrical system is de-energized before starting to work.
- ▶ The electrical system must only be serviced by authorized electrician.

## 18.2 Safety Precautions before Working on Lighting

**WARNING**

**Xenon Bulbs**

Working with high voltage can cause serious personal injury.

- ▶ The supply voltage to the xenon bulb must be switched off before replacing the bulb or starting other work on the supply circuit.
- ▶ Only the authorized maintenance personnel can handle the xenon bulbs.

**CAUTION**

**Risk on Bulb Replacement**

Hot surfaces can cause burns while replacing a bulb. Dirt on bulb glass is burned in and shortens the life of the bulb.

- ▶ Do not touch the glass on a bulb with fingers.
- ▶ Always use a clean cloth when installing the bulb or hold the bulb at its base.
- ▶ Wait until the bulb has cooled before replacing it.

## 18.3 Cable Marking

All the cables are marked with cable numbers corresponding to the external connection diagram.

### 18.3.1 Power Supply Cable on Rigs with COP 1638

| Voltage (V) | Type | Dimension (mm²) | Diameter (mm) | Length (m) |
|---|---|---|---|---|
| 400 | H07RN-F | 4G150 | 67 | 60 |
| 440 | H07RN-F | 4G120 | 60 | 75 |
| 440 | Buflex | 3×150+3G25 | 52 | 100 |
| 460-500 | H07RN-F | 4G120 | 60 | 75 |
| 460-500 | Buflex | 3×150+3G25 | 52 | 100 |
| 500-550 | H07RN-F | 4G95 | 55 | 90 |
| 500-550 | Buflex | 3×120+3G25 | 46 | 135 |
| 660-700 | H07RN-F | 4G70 | 49 | 125 |
| 660-700 | Buflex | 3×95+3G16 | 42 | 150 |

### 18.3.2 Power Supply Cable on Rigs with COP 1838

| Voltage (V) | Type | Dimension (mm²) | Diameter (mm) | Length (m) |
|---|---|---|---|---|
| 400 | Buflex | 3x185+3G35 | 55 | 100 |
| 440-500 | Buflex | 3×150+3G25 | 52 | 110 |
| 550 | Buflex | 3×120+3G25 | 46 | 135 |
| 690 | Buflex | 3×95+3G16 | 42 | 150 |
| 1000 | Buflex | 3×50+3G10 | 32 | 250 |

### 18.3.3 Power Supply Cable on Rigs with COP 1838ME

| Voltage (V) | Type | Dimension (mm²) | Diameter (mm) | Length (m) |
|---|---|---|---|---|
| 400 | H07RN-F | 4G150 | 67 | 60 |
| 440 | H07RN-F | 4G120 | 60 | 75 |
| 440 | Buflex | 3×150+3G25 | 52 | 100 |
| 460-500 | H07RN-F | 4G120 | 60 | 75 |
| 460-500 | Buflex | 3×150+3G25 | 52 | 100 |
| 500-550 | H07RN-F | 4G95 | 55 | 90 |
| 500-550 | Buflex | 3×120+3G25 | 46 | 135 |
| 660-700 | H07RN-F | 4G70 | 49 | 125 |

| Voltage (V) | Type | Dimension (mm $^2$) | Diameter (mm) | Length (m) |
|---|---|---|---|---|
| 660-700 | Buflex | 3×95+3G16 | 42 | 150 |
| 1000 | Buflex | 3×50+3G10 | 32 | 250 |

## 18.4 Electrical Component Marking

When replacing a component, make sure the new component has the same Epiroc part number as the old one. Mark new components with the same marking as the ones they replace.

## 18.5 Low-Voltage Circuit

Low voltage refers to an alternating current circuit with a voltage greater than 50 V but less than or equal to 1000 V. The machines low-voltage circuit is a high-current circuit.

Low-voltage sources are:

- Cable on reeling unit and collector
- Electric cabinet
- Electric motors for hydraulic pumps
- Operating circuits
- Service outlet
- Battery charger for the carrier (also a source of extra low voltage)
- Indicator lamps on electric cabinet
- Electric motor for compressor
- Electric motor for water pump

## 18.6 Extra Low-Voltage Circuit

Extra low-voltage refers to an alternating current with a voltage less than or equal to 50 V or a direct current with a voltage less than or equal to 120 V.

Examples of extra low-voltage sources:

- Operating circuits
- Monitors in the system
- Battery charger for the carrier (also a source of low-voltage)
- Lighting
- Indicator lamps on electric cabinet
- RCS system

## 18.7 Checking Electrical System before Starting

- Check that all high-current connections in the electric cabinet, collector, and electric motors.
- Check that the plug is plugged in properly.

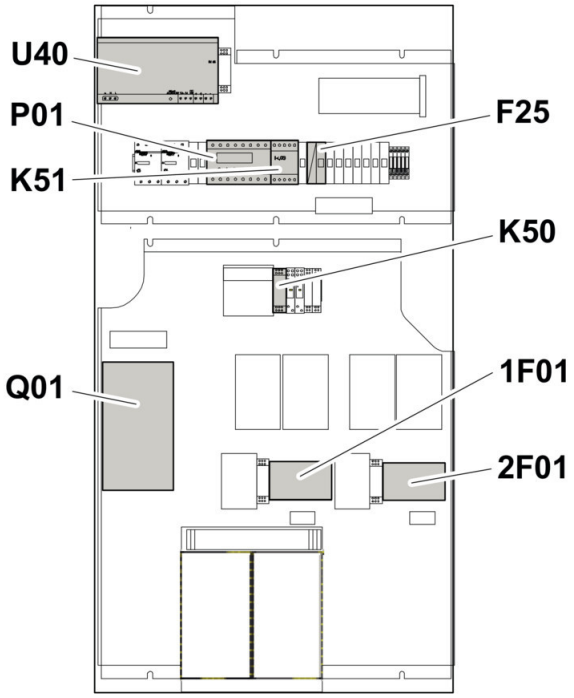
## 18.8 Before Troubleshooting Electrical System

Check the following before troubleshooting the electrical system:

- All fuses are intact and switched on.
- Correct power supply is connected (see voltmeter).
- All warning lamps on the electric cabinet are in working order (lamp test).

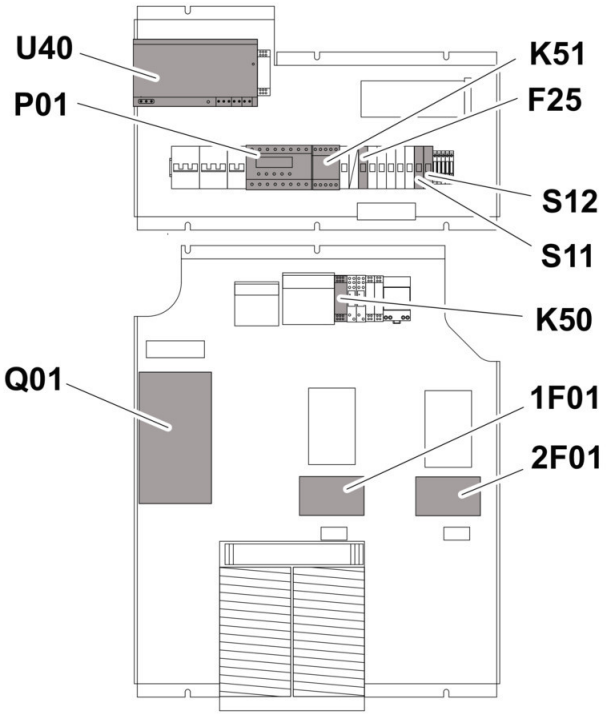
## 18.9 Electrical Distribution Cabinet, High-Current

### 18.9.1 Electrical Distribution Cabinet A10 Y/D-Start IEC (400–690 V)




| | | | |
|---|---|---|---|
| U40 | Battery charger | P01 | Voltmeter and Ammeter |
| K51 | Ground fault relay (fire protection) | F25 | Ground fault breaker (personal protection) |
| K50 | Phase sequence monitor | Q01 | Main power switch |
| F01 | Motor protection relay (one relay for each hydraulic pump motor) | | |

### 18.9.2 Electrical Distribution Cabinet A10 Direct Start IEC (1000 V)




*Electrical distribution cabinet A10, direct start (1000V)*

| | | | |
|---|---|---|---|
| U40 | Battery charger | P01 | Voltmeter and ammeter |
| Q01 | Main switch | K51 | Ground fault relay (fire protection) |
| F25 | Ground fault breaker (personal protection) | S11 | Motor switch |
| S12 | Motor switch | K50 | Phase sequence monitor |
| F01 | Motor protection relay (one for each hydraulic pump unit) | | |

### 18.9.3 Checking Voltage, Current, and Percussion Running Hours

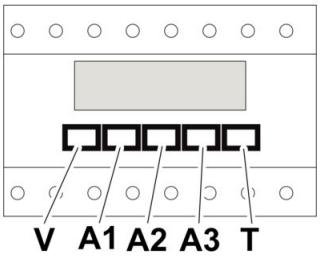
**WARNING**

**Dangerous Voltage**

Can cause severe personal injury.

- ▶ Check that the electrical system is de-energized before starting to work.
- ▶ The electrical system must only be serviced by authorized electrician.

The Meter (), on the electric cabinet, is a combined voltmeter, ammeter, and hour meter. The light under the buttons indicates if button is activated.




- Press button (V) to check that the input voltage to the machine complies with the rated voltage specified on the data plate of the machine.
- Check the current of the hydraulic pumps electric motors by pressing the buttons (A1, A2, A3). The number of buttons (A1, A2, A3) that are functional varies depending on number of hydraulic pump units on the machine.
- Check that the hydraulic pumps electric motors are not overloaded in operation by comparing the meter readings with the rated current specified on the data plates of the electric motor.
- Check the running hours of the percussion unit button (T).

  Does not apply for machines with RCS.

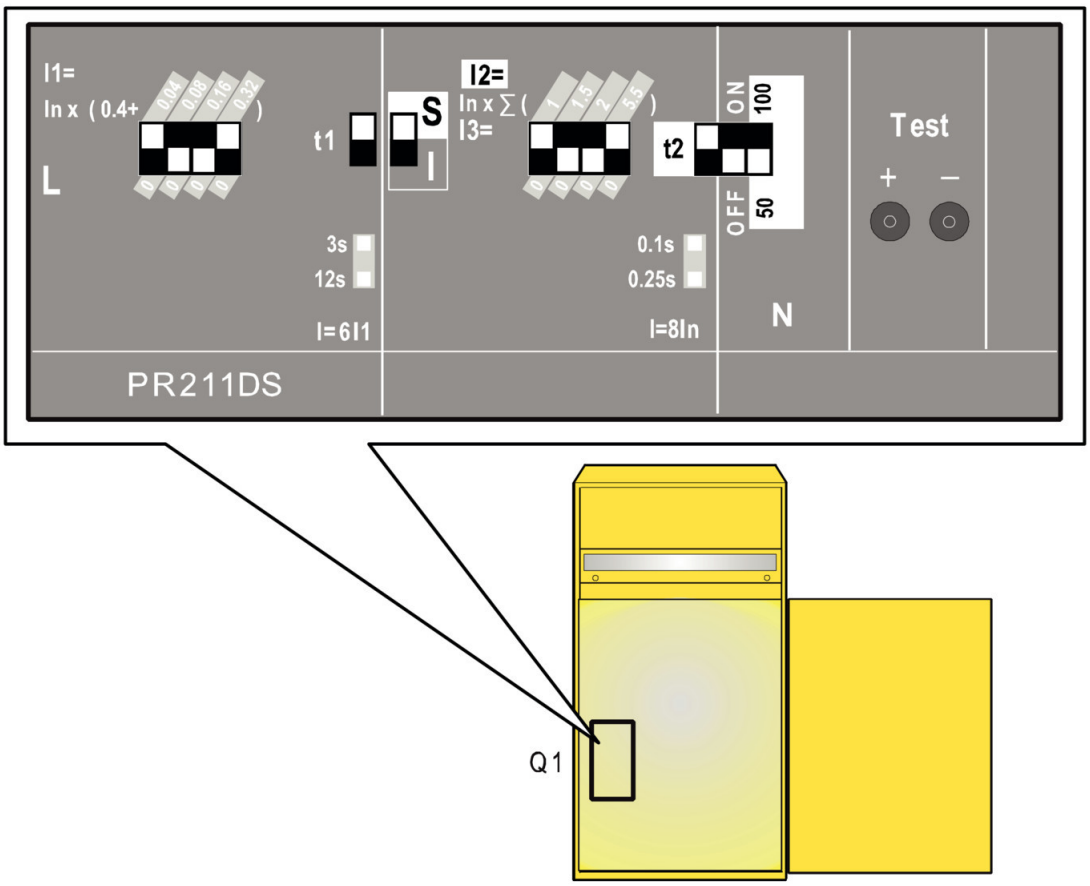
## 18.10 Electrical System Protection

### 18.10.1 Main Switch Q01

The main switch (Q01) is on the 3-phase circuit in the electric cabinet, and has built in protections. The main switch has a knob for on and off. If triggered by a protection, the switch can be reset by turning the knob to position 0 (OFF) and then back to position 1 (ON).

### 18.10.2 Setting Overload Protection IEC

First read: Safety Precautions before Working on Electrical System [▶ 261]




| | | | |
|---|---|---|---|
| I1 | Dip switches for setting overload protection | t1 | Dip switches for setting overload duration |
| t3 | Dip switches for setting short circuit protection | | |

The overload protection setting depends on the supply voltage and total electric motor output. The setting is made with DIP switches (I1) on the main power switch. Next to the DIP switches is a mark indicating the different setting alternatives.

Precondition ✓ The duration (t1) is set at 12 seconds.

○ Follow the table for correct settings.

| Supply Voltage | Electric Motor | Setting |
|---|---|---|
| 380–400 V | 2 x 55 kW | 0.6 x 400 A |
| 380–400 V | 2 x 75 kW | 0.8 x 400 A |
| 440 V | 2 x 55 kW | 0.5 x 400 A |
| 440 V | 2 x 75 kW | 0.7 x 400 A |
| 500 V | 2 x 55 kW | 0.5 x 400A |
| 500 V | 2 x 75 kW | 0.6 x 400A |

| Supply Voltage | Electric Motor | Setting |
|---|---|---|
| 550 V | 2 x 55 kW | 0.4 x 400 A |
| 550 V | 2 x 75 kW | 0.5 x 400 A |
| 660–690 V | 2 x 55 kW | 0.4 x 400 A |
| 660–690 V | 2 x 75 kW | 0.4 x 400 A |
| 660–690 V | 2 x 95 kW | 0.6 x 400 A |
| 1000 V | 2 x 55 kW | 0.4 x 250 A |
| 1000 V | 2 x 75 kW | 0.5 x 250 A |
| 1000 V | 2 x 95 kW | 0.7 x 250 A |

### 18.10.3 Set Short-Circuit Protection

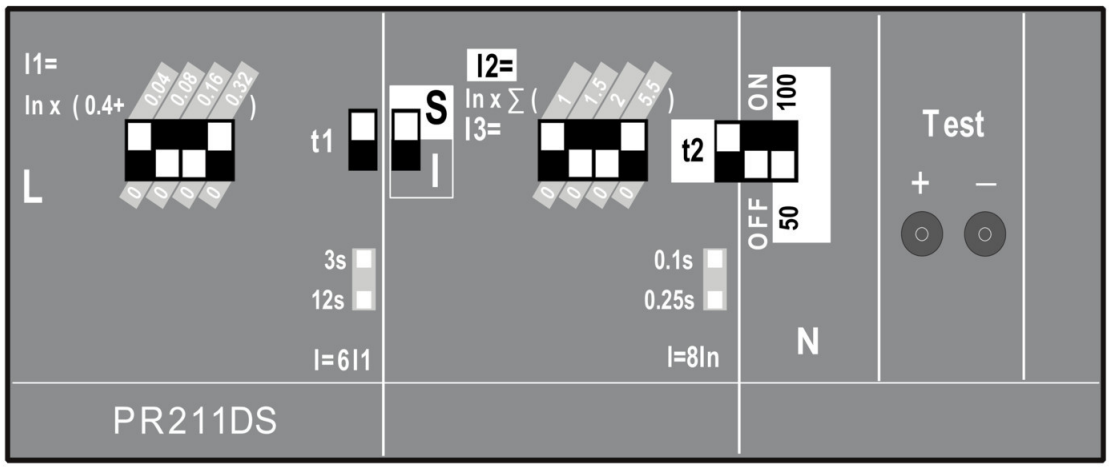
**WARNING**

**Dangerous Voltage**

Can cause severe personal injury.

- ▶ Check that the electrical system is de-energized before starting to work.
- ▶ The electrical system must only be serviced by authorized electrician.

The settings for the short-circuit protection depend on the method of starting. The setting is made with DIP switches (I3) on the main power switch. Next to the DIP switches is a mark, indicating the different setting alternatives.




*DIP Switches*

- ○ Set the short-circuit protection to 4.5 × the main power switch rated current (In) for Y/D start or soft start.
- ○ Set the short-circuit protection to 10 × the main power switch rated current (In) for direct start.

### 18.10.4 Resetting Phase Sequence Alarm

**WARNING**

**Dangerous Voltage**

Can cause severe personal injury.

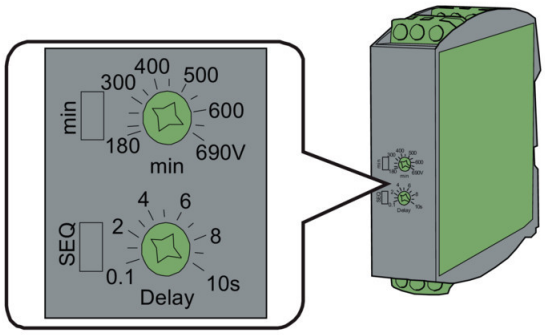
- ▶ Check that the electrical system is de-energized before starting to work.
- ▶ The electrical system must only be serviced by authorized electrician.

The electrical system has a phase sequence monitor () to prevent the electric motors from starting if the power supply has the wrong phase sequence. If there is a phase sequence problem, an indicator lamp on the electric cabinet comes on.

If the phase sequence fault indicator lamp comes on, a qualified electrician must take action.

1. Turn off the main power switch for the input cable and remove the plug.
2. Switch two of the phases in the consumer mains source.
3. Install the plug and turn on main power switch.

### 18.10.5 Setting Phase Sequence Relay




- ○ Set the minimum voltage to 180 V.
- ○ Set the delay to 10 seconds.

### 18.10.6 Ground Fault Equipment

**WARNING**

**Dangerous Voltage**

Can cause severe personal injury.

- ▶ Check that the electrical system is de-energized before starting to work.
- ▶ The electrical system must only be serviced by authorized electrician.

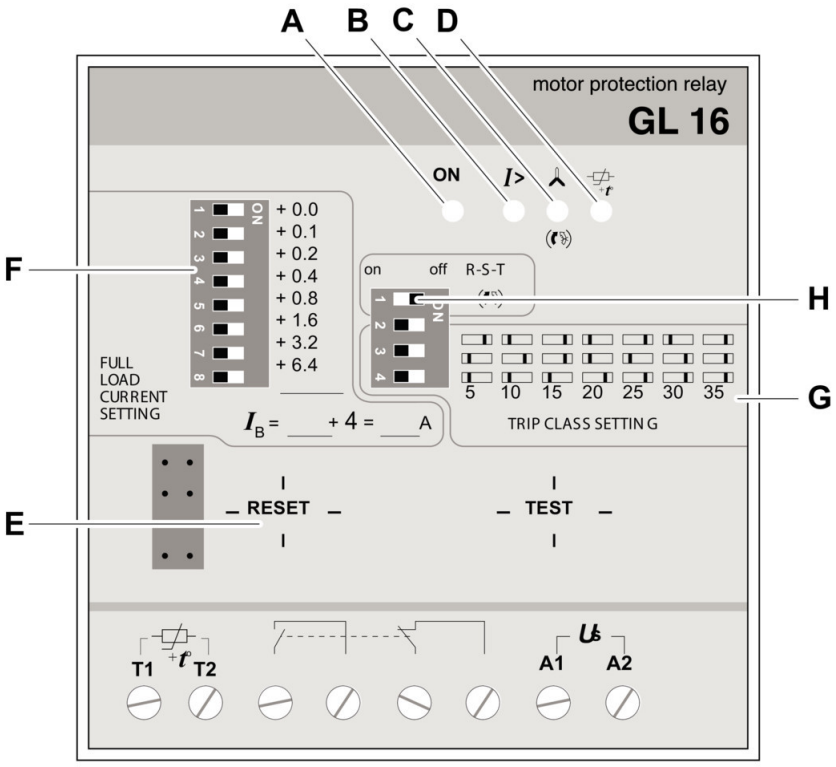
The electrical system has a ground fault relay () and a ground fault breaker ().

- The purpose of the ground fault relay is to protect against fires in the main circuits. This switch is set to 300 mA and 500 ms.
- The ground fault switch provides personal protection. When it trips, the supply to the transformer circuit for service outlet 230 VAC and to the battery charger is disconnected. This switch is set to 30 mA and maximum 40 ms.

A qualified electrician must test the ground fault equipment regularly. The ground fault equipment settings are checked before delivery and sealed.

## 18.10.7 Motor Protection

### Motor Protection Relay Epiroc




> ***NOTE:*** *The information applies to models GL 16, GL 40, GL 90 and GL 200. Appearance may vary between models.*

Each hydraulic pump motor has an electronic motor protection relay. The motor protection has a green lamp (A) that indicates that the power supply is on and that the output relay is in operating position. If the motor protection is triggered, the lamp goes off.

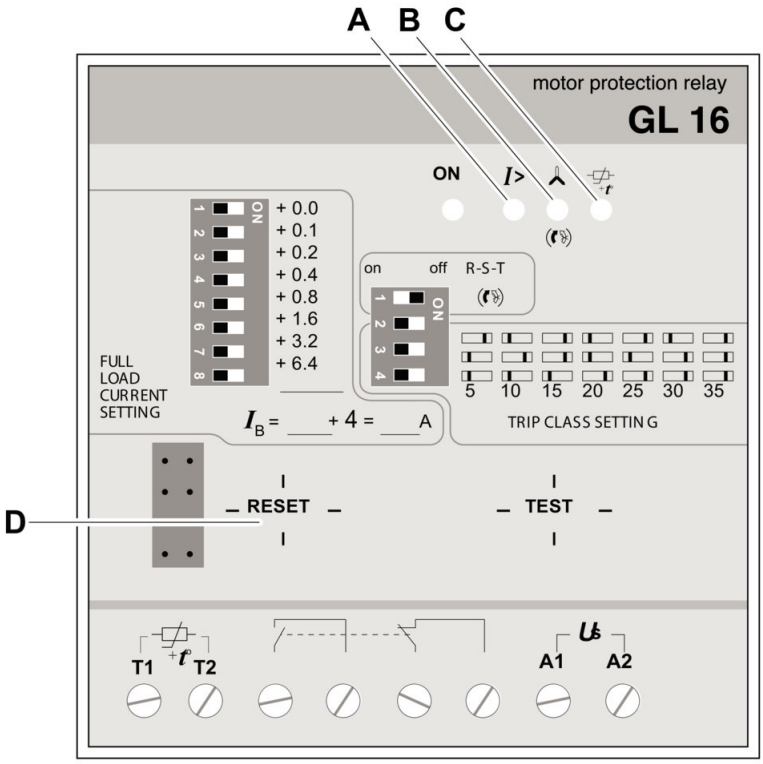
The motor protection has three lamps to indicate which type of fault has triggered the protection.

- Lamp (B) comes on if the permitted motor current is exceeded (over-current). Motor protection trips because the motor is overloaded (thermal overload).
- Lamp (C) comes on in the event of a phase loss or a phase error. The electric motor stops or cannot be started
- Lamp (D) comes on if the permitted motor temperature is exceeded (overheating). The electric motor stops.

The motor protection has a DIP switch for setting rated current (F) and a DIP switch for phase sequence monitoring (H). It is possible to set the trip class (G). It also has a reset button (E) to reset alarms.

### Check if Motor Protection is Triggered

First read: Safety Precautions before Working on Electrical System [▶ 261]




1. Check the lamp to analyze which protection is triggered.
   a. If lamp (A) is ON: The motor current exceeds the set rated current and that the motor protection has tripped.
   b. If lamp (B) is ON: Turn off the main power and pull out the plug from the wall socket. Check the cables in the electric motor circuit and the electric motor.
   c. If lamp (C) is ON: Check the electric motor is properly cooled or if it has been overloaded for a long time.
   d. Check the power supply complies with the rated voltage on the data plate. If the voltage is correct, check the electric motor circuit.
2. Reset the motor protection with button (D) after the fault is rectified.

### Setting Rated Current

First read: Safety Precautions before Working on Electrical System [▶ 261]

The motor protection must be set to the rated current of the motor unless the motor has a service factor (SF) higher than 1.0. The motor protection has a basic value of 4 A for GL 16, 15 A for GL 40, 40 A for GL 90 or 60 A for GL 200 that must be considered when setting. The value set for direct start must therefore be 4 A, 15 A, 40 A or 60 A lower than the

rated current for the motor. Alternatively 4 A, 15 A, 40 A or 60 A lower than the rated current for the motor times the service factor (1.15 or 1.3). For Y/D, start the value must be as above but times 0.58. Adjust settings using the DIP switches on the motor protection.

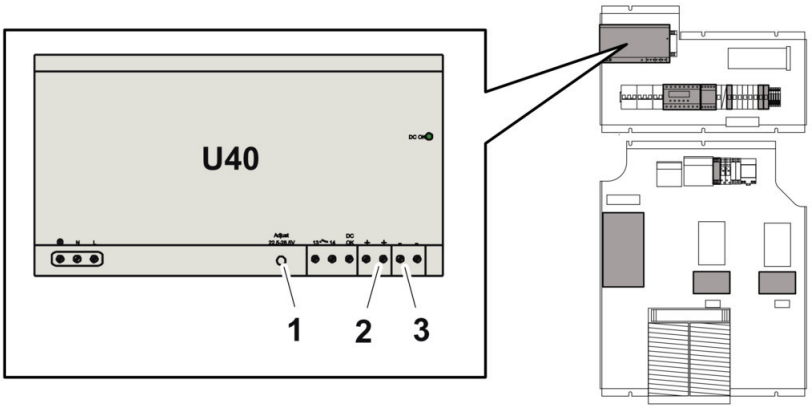
Precondition ✓ The rated current and service factor are specified on the electric motor data plate.

- If the service factor is 1.15, set the motor protection to a value 15% higher than the rated current.
- If the service factor is 1.3, set the motor protection to a value 30% higher than the rated current.
- Set Trip class to a value of 10.

## 18.11 Battery Charger

The battery charger (U40) supplies the rig's 24 V-system and is fitted integrated into the electrical distribution cabinet (A10).

The supply voltage to the battery charger must be 240 V AC, 45-65 Hz.




*Battery charger (U40)*

When replacing a battery charger the correct charging voltage must be set. The charging voltage is adjusted on screw (1) and must be set at 26.8V. Measure the set voltage between 2(+) and 3(-) using a voltmeter.

## 18.12 Before Troubleshooting Electrical System

Check the following before troubleshooting the electrical system:

- All fuses are intact and switched on.
- Correct power supply is connected (see voltmeter).
- All warning lamps on the electric cabinet are in working order (lamp test).

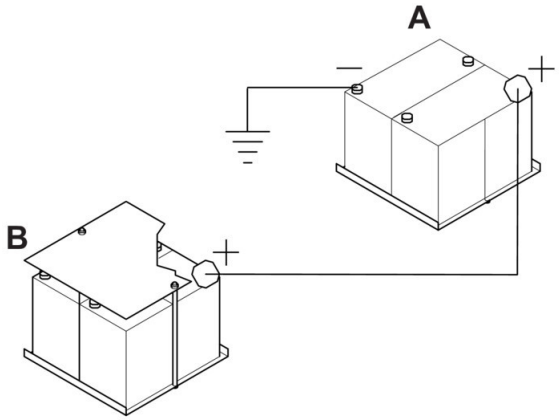
## 18.13 Starting with Auxiliary Battery

**WARNING**

**Risk of Explosion**

There is a risk of personal injury if a charged battery is connected to a discharged battery.

- ▶ Use a well ventilated area.
- ▶ Fire extinguisher must be close at hand.
- ▶ Use protective safety glasses.
- ▶ Use protective gloves.




Precondition

1. Check that the auxiliary batteries (A) have the same voltage as the chassis batteries (B).
2. Connect the positive terminal of the auxiliary batteries (A) to the positive terminal of the chassis batteries (B).
3. Connect the negative terminal of the auxiliary batteries (A) to ground on the chassis.

> ! ***NOTE:*** *Do not connect the negative terminal of the auxiliary batteries (A) to the chassis batteries (B) negative terminal.*

4. Disconnect the cable from the chassis ground when the engine starts.
5. Disconnect the cable from the negative terminal on the auxiliary batteries (A).
6. Disconnect the cable between the positive terminal of the chassis batteries (B) and the auxiliary batteries (A).

# 19 Swellex

## 19.1 Safety Precautions Before Working on Swellex

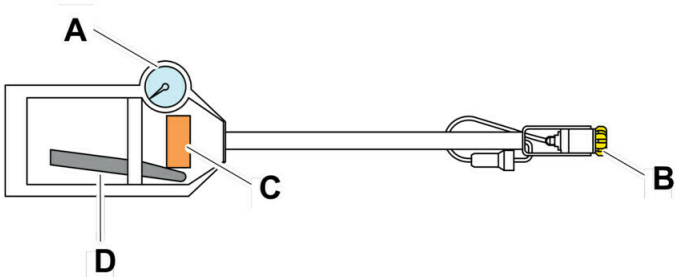
**WARNING**

**High Water Pressure**

The extremely high water pressure from the pump can cause personal injury.

- ▶ Immediately rectify leaks in high-pressure lines and couplings.
- ▶ Turn off the main circuit breaker before working on the pump.
- ▶ Check that the hydraulic system is depressurized before working on the pump.
- ▶ Activate the Swellex pump to check that the water system is depressurized before working on the pump.

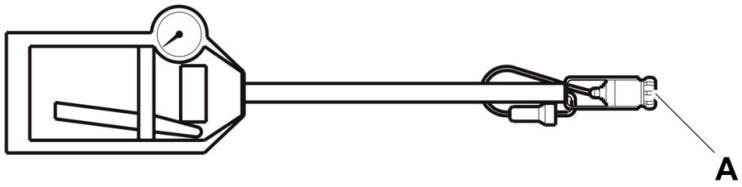
## 19.2 Swellex Arm




| | | | |
|---|---|---|---|
| A | Pressure gauge | B | Chuck |
| C | Three-way valve | D | Trigger |

## 19.3 Checking Swellex Arm

First read: Safety Precautions Before Working on Swellex [▶ 275]

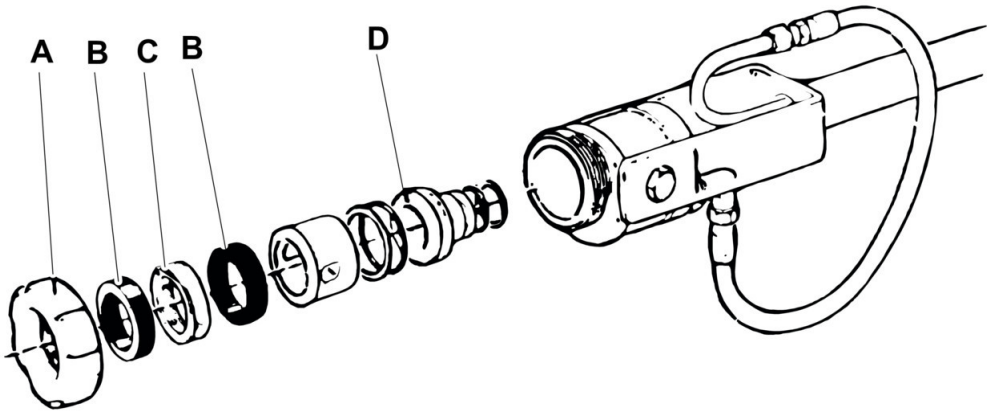



1. Check the equipment is not damaged.
2. Connect the hydraulics and water connections to the pump.
3. Check that all hoses are tightened and are not damaged.
4. Check the water pressure to the Swellex pump.

5. Check that the water strainer is clean.
6. Check that the gaskets in the chuck (A) are intact and the chuck is clean.

## 19.4 Replace Chuck Seals of Swellex Arm

First read: Safety Precautions Before Working on Swellex [▶ 275]

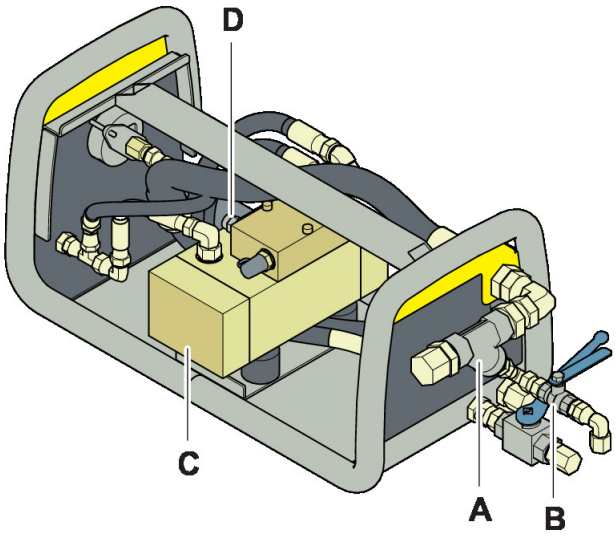



Chuck seals should be replaced if the chuck leaks while installing the bolts.

1. Remove nut (A).
2. Remove the seals (B) and the spacer ring (C).
3. Clean all parts.
4. Replace the seals (B), spacer ring (C), and also replace if any damaged parts.
5. Lubricate the plunger (D) with waterproof grease.
6. Install the chuck with the new seals.
7. Install and tighten the nut (A).

## 19.5 Swellex Pump H1

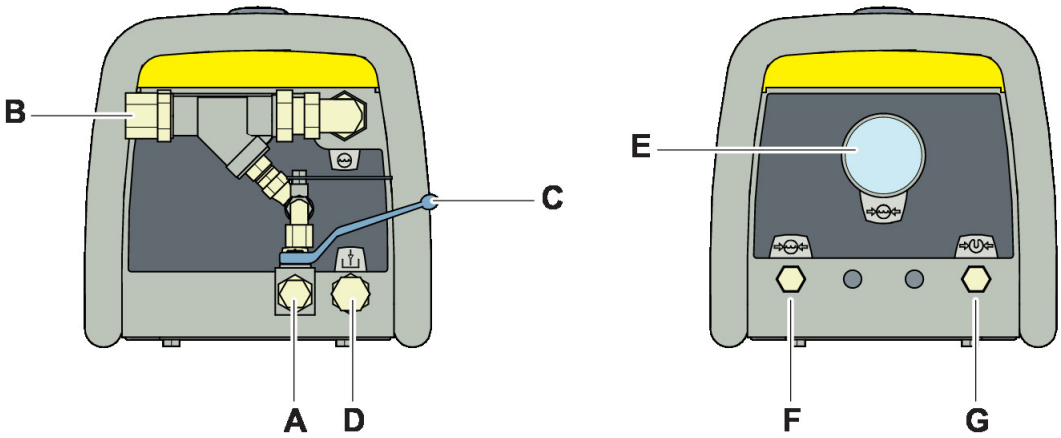
The swellex pump is **optional** equipment.




| | | | |
|---|---|---|---|
| A | Water Strainer | B | Draining Valve |
| C | Pump Unit | D | Pressure Regulator |

## 19.6 Swellex Pump Connections

The swellex pump is **optional** equipment.




> **NOTE:** *The swellex pump must be fitted at flat level. It must be possible to see whether water is leaking from the overflow hole under the pump.*

| Position | Function | Connection Dimension in inches | Comment |
|---|---|---|---|
| A | Oil pressure in | 3/8 | N/A |
| B | Water connection | 3/4 | N/A |
| C | Activating hydraulic pressure | 3/8 | N/A |
| D | Oil return | 1/2 | N/A |

| Position | Function | Connection Dimension in inches | Comment |
|---|---|---|---|
| E | Pressure gauge | NA | Water pressure 0–400 bar (0–5802 psi) |
| F | Drainage | 1/4 | N/A |
| G | Swellex chuck water | 1/4 | N/A |

## 19.7 Draining Swellex Pump

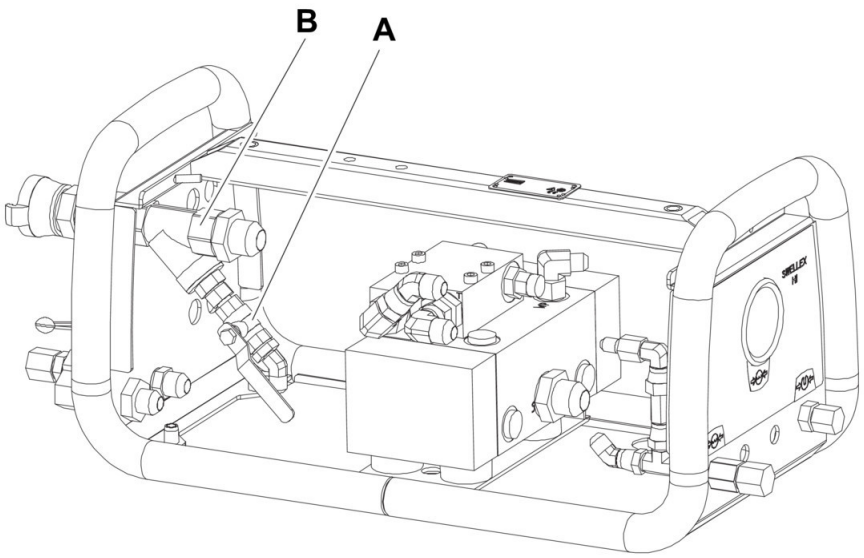
The swellex pump is **optional** equipment.

**WARNING**

**High Water Pressure**

The extremely high water pressure from the pump can cause personal injury.

- ▶ Immediately rectify leaks in high-pressure lines and couplings.
- ▶ Turn off the main circuit breaker before working on the pump.
- ▶ Check that the hydraulic system is depressurized before working on the pump.
- ▶ Activate the Swellex pump to check that the water system is depressurized before working on the pump.

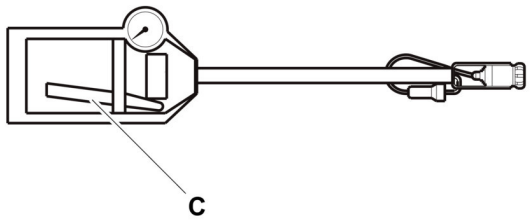



Drain the water system if the ambient air temperature around the pump is below the freezing point to prevent the pump freezing.

Protect the swellex pump against frost by storing it in a frost-free environment.

1. Remove the water hoses from the connections on the pump.
2. Connect compressed air to the swellex pump.

3. Press the swellex arm trigger (C) for ten seconds to run the pump, and then release it.




4. Turn off the compressed air and drain the water strainer (B) by the draining valve (A).

## 19.8 Clean Water Strainer on Swellex Pump

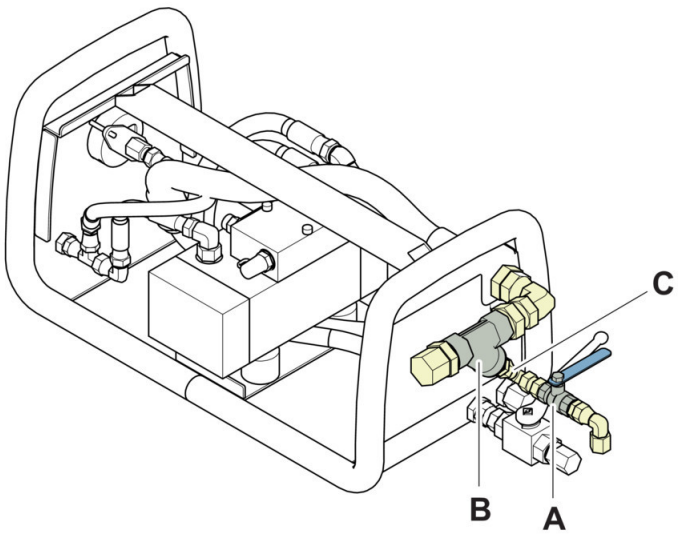
The swellex pump is **optional** equipment.

**WARNING**

**High Water Pressure**

The extremely high water pressure from the pump can cause personal injury.

- ▶ Immediately rectify leaks in high-pressure lines and couplings.
- ▶ Turn off the main circuit breaker before working on the pump.
- ▶ Check that the hydraulic system is depressurized before working on the pump.
- ▶ Activate the Swellex pump to check that the water system is depressurized before working on the pump.




1. Open the drain valve (A).
2. Clean the water strainer by flushing water through the strainer (B) for a few seconds.

3. Check the filter.

Alternative step
a. Remove the nipple (C) from the water strainer.

Alternative step
b. Pull the filter out from the water strainer.

Alternative step
c. Check that the filter is clean and intact.
Replace the filter with a new one if necessary.

Alternative step
d. Reinstall the filter.

Alternative step
e. Install the nipple (C) on the water strainer.

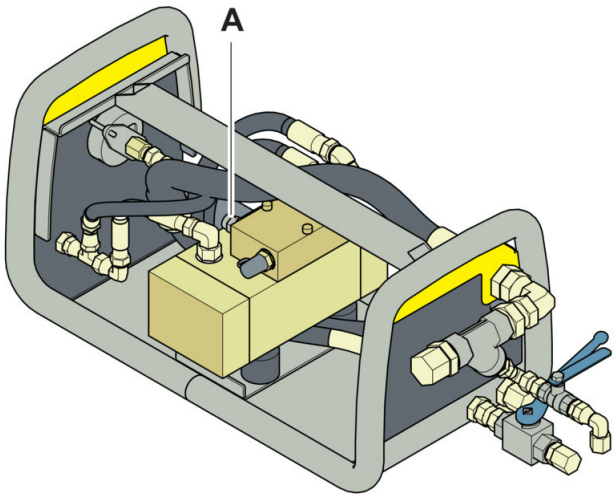
## 19.9 Preparing Swellex Pump for Long Time Storage

Starting a frozen pump can cause extensive damage.

1. Protect the pump with rust inhibitor.
2. Drain the pump before storage.
3. Store the pump in a frost-free place.

## 19.10 Adjusting Swellex Water Pressure

The swellex pump is **optional** equipment.




1. Start the Swellex pump.
2. Remove the protective cap from the pressure regulator (A).
3. Adjust the hydraulic pressure on the pressure regulator (A) to deliver the correct water pressure.

   Adjust the swellex water pressure according to the type of Swellex bolt that is used.

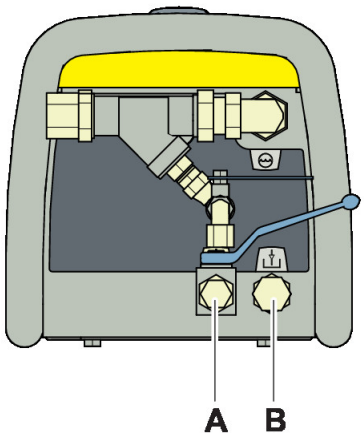
   Turn the pressure regulator clockwise to increases the pressure and turn counter-clockwise to decrease the pressure.

   Read the pressure on the pressure gauge in the swellex pump.

| 240 bar (3481 psi) | 300 bar (4351 psi) |
|---|---|
| Swellex Mn16 | Swellex Mn 12 |
| Swellex Pm 16 | Swellex Pm 12 |
| Midi Swellex | Swellex Mn 24 |
| | Swellex Pm 24 |
| | Standard Swellex |
| | Super Swellex |

## 19.11 Troubleshooting Swellex Pump

The swellex pump is **optional** equipment.




| Failure | Cause | Action |
|---|---|---|
| No water when activating the Swellex arm handle | Water not connected to the pump | Connect to water supply. |
| | No flow or low flow of hydraulic fluid | Adjust the hydraulic flow rate. |
| | Reverse flow of hydraulic fluid | Check the connection of the hydraulic hoses.<br>Install the delivery hose to connection (A) and the return to connection (B). |
| | Hydraulic pressure too low | Adjust the hydraulic pressure. |
| Water flow rate too low | Insufficient hydraulic flow or pressure | Adjust to the recommended hydraulic flow rates and pressure. |
| Water pressure too low | Insufficient hydraulic flow or pressure | Adjust to the recommended hydraulic flow rates and pressure. |
| | Leaking seals in the Swellex chuck | Replace seals. |

| Failure | Cause | Action |
|---|---|---|
| | Insufficient water flow | Check the hose and connections.<br>If possible, use pressurized supply of water. |
| Pulsing water pressure | The pump is cavitating because water hose diameter is too small. | Check the diameter of the hose and replace as necessary. |
| | The pump is cavitating due to the water connection drawing in air. | Check the water hose and rectify any faults. |
| Pump is not receiving water | The water hose is not connected or is leaking. | Check the hose and the connections. |
| | The water connection is clogged. | Check and clean the water strainer. |
| Leakage | Hydraulic oil leak | Check bolted joints, couplings, and seals. |
| | Water leak | Check bolted joints, couplings, and seals. |
| | The hydraulic oil or water is leaking from the overflow hole under the pump. | Replace the pump seals if it exceeds 10 drops per minute. |

# 20 Reeling Unit

## 20.1 Overview of Reeling Unit

The reeling unit is controlled by a hydraulic motor. Unwinding from the reel while tramming takes place allowing the clutch on the reel gear to slip. The unwinding control is left in neutral. Winding is done with the hydraulic motor. The slip clutch is adjusted so that it is able to wind up the cable or hose hydraulically but can slip when the cable is unwound during travel.

### 20.1.1 Cable Reeling Unit

**WARNING**

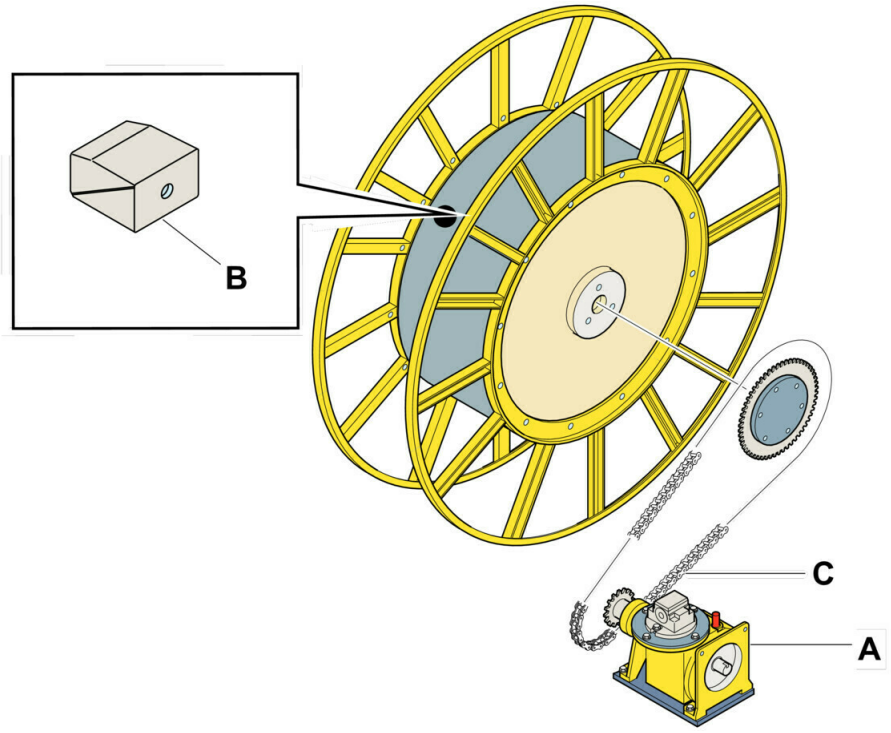
**Risk of Pulling Loose the Power Supply Cable**

Can cause serious injuries or death.

Can cause material damage.

Can make the machine and peripheral equipment live.

▶ Always make sure that the power supply cable is relieved of strain at both ends.




| | | | |
|---|---|---|---|
| A | Gear with motor | B | Collector |
| C | Drive chain | | |

### 20.1.2 Hose Reeling Unit

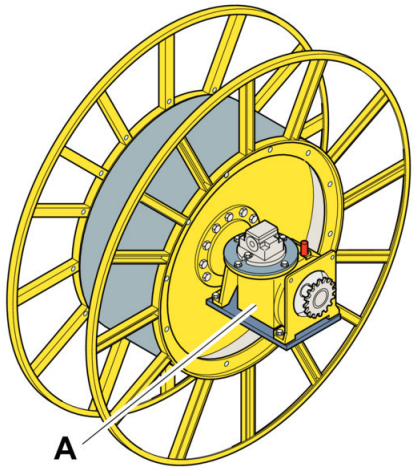
**NOTICE**

**Risk of Pulling Loose the Water Hose**

Can cause water leakage on the machine.

Can cause material damage.

- ▶ Make sure that the water hose is relieved of strain at the hose reel.




| | | | |
|---|---|---|---|
| A | Gear with motor | | |

## 20.2 Power Supply Cable

**⚠ WARNING**

**Risk of Short Circuit or Fire**

Can cause serious injuries or death.

Can cause material damage.

- ▶ Always use a cable with sufficient area for the current ambient temperature and power output of the machine.
- ▶ Make sure that the cable is intact before using the machine. Replace the cable in the event of damage, discoloration, or deformation.
- ▶ Make sure that the cable is routed on the tunnel floor so that it is protected from being driven over by other mobile machines.
- ▶ Unwind the whole cable for intensive operation.
- ▶ Make sure that the cable does not overheat during intensive use of the machine.

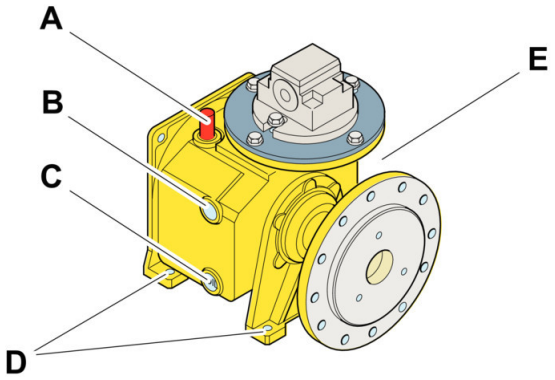
For intensive operation with short intervals for cooling down, there is a risk of the electrical cable overheating. For instance, during long drilling cycles with a short time between the cycles.

Many external factors affect the ability of the electrical cable to cool down. For example:

- The number of layers on the reel.
- The ambient temperature.
- The air exchange.
- The dirt accumulation.

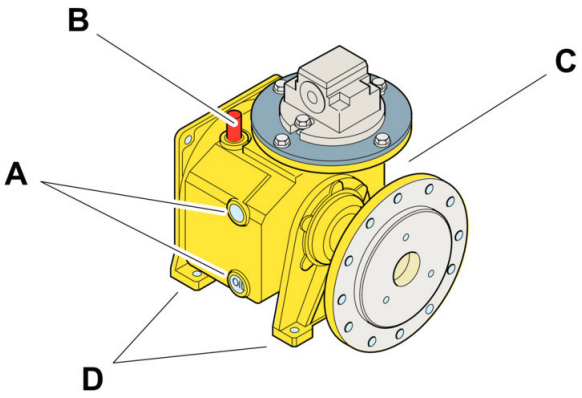
Therefore, make a habit of always unreeling the entire length of the electrical cable during operation.

## 20.3 Reeling-Unit-Gear Overview




| | | | |
|---|---|---|---|
| A | Key for adjusting reel torque, and oil filler hole | B | Upper sight glass |
| C | Lower sight glass, and drain plug | D | Attachment bolts |
| E | Screw for adjusting drive chain | | |

## 20.4 Adjust Reeling Unit Drive Chain




1. Undo the four bolts (D) that holds the gear.
2. Adjust the chain with the set screw (C). The chain slack should be 10–15 mm.
3. Tighten the four bolts (D).

## 20.5 Adjust Reeling Unit Slip Clutch

**NOTICE**

**Reeling Unit Gear and Chain**

The gear and chain of the reeling unit can be damaged.

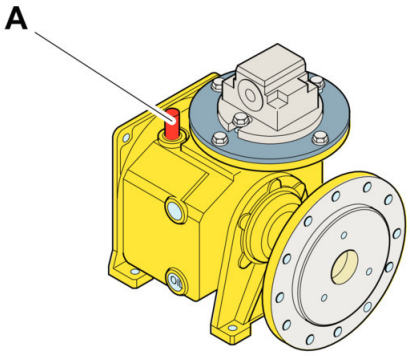
- ▶ Always turn off the hydraulics when not using the reeling unit.
- ▶ Do not adjust the winding torque too high.

Adjust the reeling unit slip clutch when necessary and according to maintenance interval.

The slip clutch is designed to slip when winding and unwinding the electric cable and water hose. The torque is transferred trough a clutch in the gear. The torque must be measured in operation while the clutch is slipping. The torque must only be adjusted hard enough to lift and wind the cable or hose without any slack.

Replace oil in the gear regularly, for fault-free operation and retained torque.

The torque setting is carried out by making small adjustments to the spring package, 1/6 of a turn at a time. After adjusting, test the operation and change the torque until it is correct.




1. Remove the set key (A).
2. Insert the set key upside down into the gear housing.
3. Rotate the drum slowly until the set key falls into locked position.

Step result ➔ The set torque increases if the drum is rotated clockwise and decreases if it is rotated counterclockwise.

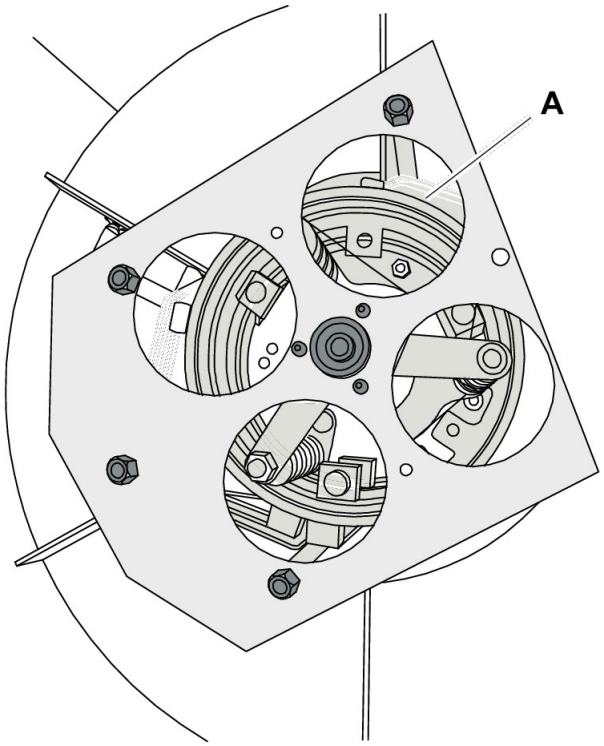
4. Remove the set key (A).
5. Insert the set key in the correct position.
6. Fasten the set key.
7. Check the torque.

Step result ➔ Repeat the procedure until the correct torque is obtained.

| Cable Reeling Unit | Hose Reeling Unit |
|---|---|
| Torque in operation on drum periphery: 25–30 kg (55–66 lb) (maximum 40–50 kg (88–110 lb)) | Torque in operation on drum periphery: 10–15 kg (22–33 lb) (maximum 15–20 kg (33–44 lb)) |

| Hose Reel for 150 m (492 ft) Hose |
|---|
| Torque in operation on drum periphery: 15–20 kg (33–44 lb) (maximum 20–25 kg (44–55 lb)) |

## 20.6 Cable Reeling Unit Collector F460/1 and K4122/1




| | | | |
|---|---|---|---|
| A | Collector | | |

## 20.7 Check Cable Reeling Unit Collector

**WARNING**

**Dangerous Voltage**

Can cause serious personal injury.

- ▶ Keep away from high-voltage cables.
- ▶ Check that the system is de-energized before starting any maintenance work.
- ▶ Only authorized electrician must service the electrical system.

The location of the collector depends on the type of machine. On some machine, the collector is located inside the cable reel unit and is protected by a cover plate that must be removed during inspection. On the other machines, the collector is located in a protective box that is attached on the outside of the reeling unit.

> ***NOTE:*** *Tighten the nuts on all the cable terminals on a new or reconditioned collector after about a week of use. The collector slip rings must be tightened according to the torque table.*

- Make sure that the collector housing and collector rings are dry, clean, and free from oil, copper deposits, and other impurities.
- Use a vacuum cleaner, clean cloth, and a brush for cleaning.

> ***NOTE:*** *Do not use water or compressed air.*

- Tighten the collector unions.
- Replace damaged components with new ones.
- Make sure that the protective cable stocking is installed properly.

## 20.8 Settings

Refer to chapter Hydraulic System for setting the speed of the reeling units.

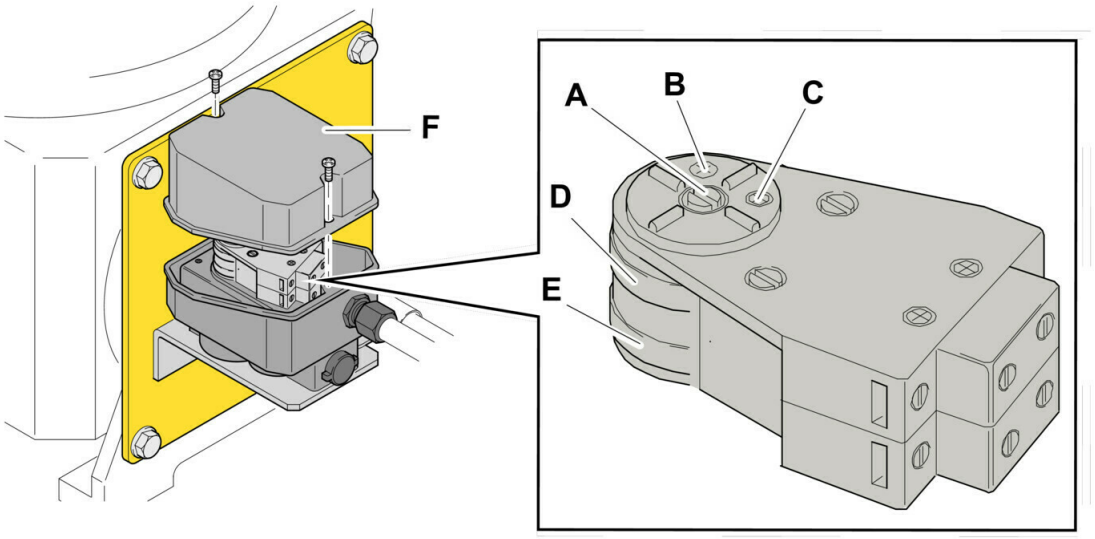
## 20.9 Limit Switch

Limit switch on reeling unit is an option. The limit switch is used to:

- Warn when there are only three turns left on the drum of the cable reeling unit.
- Activate the parking brake when there is one turn left on the drum of the cable reeling unit.

### 20.9.1 Adjust Limit Switch

Adjust the limit switch if the cable or cable reel has been changed, or of the limit switch setting has unintentionally been changed.




1. Remove the limit switch cover (F).
2. Loosen the lock screw (A).

3. Unwind the cable until three turns are left on the drum of the cable reeling unit.
4. Adjust the screw (C) until the contactor (D) activates the cable reel warning lamp on the control panel.
5. Unwind the cable reel unit until there is one turn on the drum.
6. Adjust the screw (B) until contactor (E) activates the parking brake.

Step result ➔ Parking brake lamp on the control panel comes on.

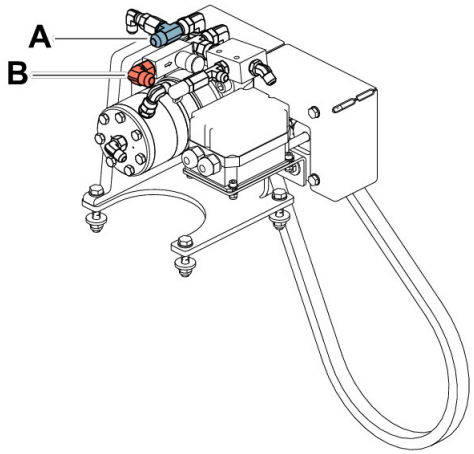
7. Check the adjustment by winding the cable in and out.

> ! ***NOTE:*** *Repeat the procedures if further adjustment is needed.*

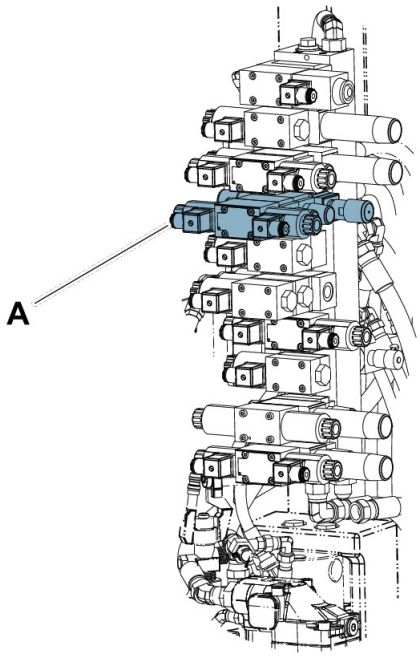
8. Tighten the locking screw (A).
9. Attach the limit switch cover (F).

## 20.10 Adjust Maximum Pressure and Speed of Reeling Units

If it is not possible for the slip clutch on the reel gear to unwind the hose and cable, the reel hydraulic motor can be used for unwinding. The winding-in and winding-out speed can be adjusted by the restrictions that are located beneath valve (Y414) for the cable reeling unit and (Y415) for the water hose reeling unit.




| | | | |
|---|---|---|---|
| A | CR1 | B | CR2 |




*Valve Stack*

| | | | |
|---|---|---|---|
| A | Cable reeling valve | | |

1. **Adjusting pressure setting**
   a. Plug the hoses CR1, CR2 with the measuring socket into the hydraulic motor.
   b. Start the diesel engine.
   c. Activate the diesel positioning with knob S141.
   d. Connect a P400 to CR1, CR2.
   e. On machines without gearbox, adjust the pressure regulator to 150 bar (2,175.5 psi) with the pressure reducing set screw.
   f. Drain the pressure by turning the diesel engine OFF, ignition ON, diesel pump ON and turn knob S248 or S143 until pressure is drained.

2. **Adjusting speed setting**
   a. Start the reeling unit for winding-in and winding-out.

> ! ***NOTE:*** *Start the cable winch for rolling the cable with knob S248 or S143.*

> ! ***NOTE:*** *Start the hose winch for rolling the waster hose with knob S249 or S144.*

   b. Adjust the winding-in and winding-out speed with the restrictions.

      The speed for **reeling in** can be adjusted 10–12 rpm (**1 rev each 5–7 seconds**).

      The speed for **reeling out** can be adjusted 5–6 rpm (**1 rev each 10–12 seconds**).

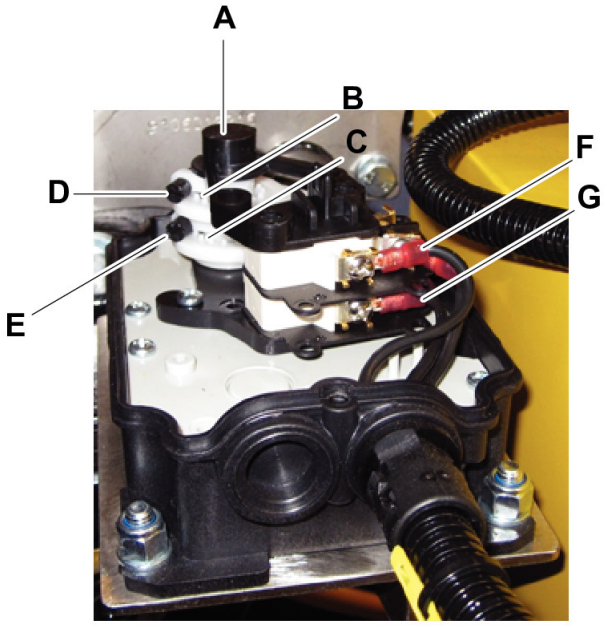
> ***NOTE:*** *Turn the knob counterclockwise for reeling in and clockwise to reeling out.*

> ***NOTE:*** *During normal operation, the cable and water hose reels must not be operated hydraulically when being reeled out. The cable and hose must be pulled out by the gear friction coupling instead.*

c. Stop the diesel engine.

## 20.11 Adjusting Limit Switch

Adjust the limit switch if the cable or cable reel has been changed, or if the limit switch setting has unintentionally been changed.




1. Check that cable is connected correctly with wire mesh hose and strain relieved.
2. Remove the limit switch cover.
3. Wind in one turn with cable on the reel.
4. Turn the adjustment screw (E) so the ride on the ridge wheel (C) is moving clock wise until the relay is clicking or buzzer / multi-meter activates over switch (G).
5. Turn the screw (D) so that the cam on the cam wheel (B) moves counterclockwise until the switch clicks or that a buzzer or multimeter activates over switch (F).

> ***NOTE:*** *If the screw is hard to adjust, then remove cover (A) and loosen that screw slightly until adjustment screw runs easily.*

6. Run the cable until three turns are left on the drum of the cable reeling unit.

7. Turn the screw (D) so that the cam on the cam wheel (B) moves counterclockwise until the switch clicks or that a buzzer or multimeter activates over switch (F).
8. Wind in one more turn on cable reel and connect a buzzer or multimeter (Ω) over switch (F).
9. Unwind and check that switch gives signal with three laps returning on cable reel.
10. Adjust if necessary and redo check.
11. Connect a buzzer or multimeter over switch (G).
12. Unwind and check that switch gives signal with one lap returning on cable reel.
13. Adjust if necessary and redo check.

## 20.12 Reeling Unit Operation Hints

**WARNING**

**Risk Due to Inexperience**

Inexperienced operator can cause personal injury.

▶ Start or operate the machine only if experienced with the machine operating system, system instruments, or controls.

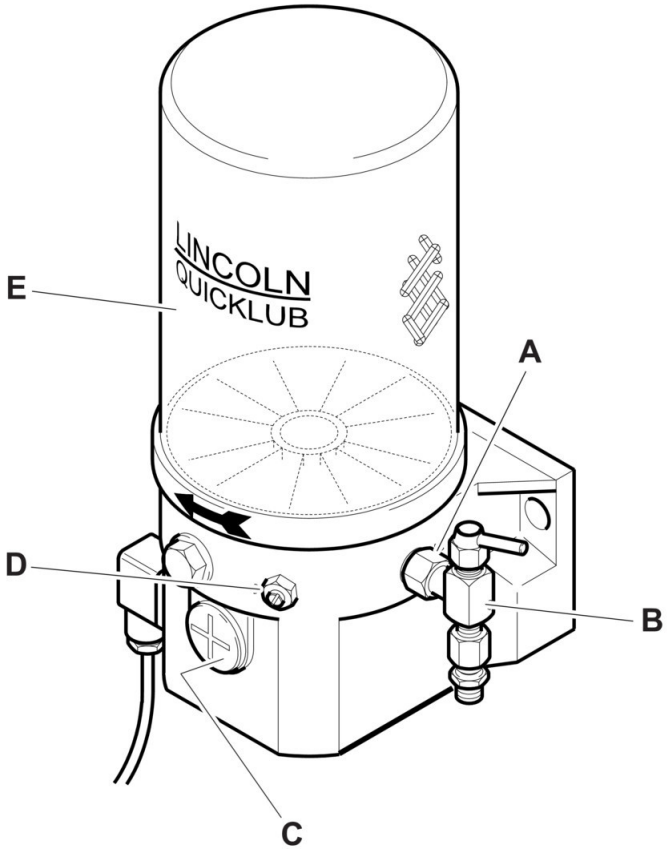
- Cable reel drive must be used at maximum speed 6 km/hr only on first gear forward and reverse.
- G39 is a pilot pressure for brake release, it must read more than 13–15 bar (188–217 psi) while reel in and reel out operation.
- Maximum continuous pressure for operating hydraulic motor is 175 bar (2538 psi).

! ***NOTE:*** *Do not set pressure relief valve at pressure more than 175 bar (2538 psi).*

# 21 Automatic Central Lubrication System CLS

## 21.1 Central Lubrication System

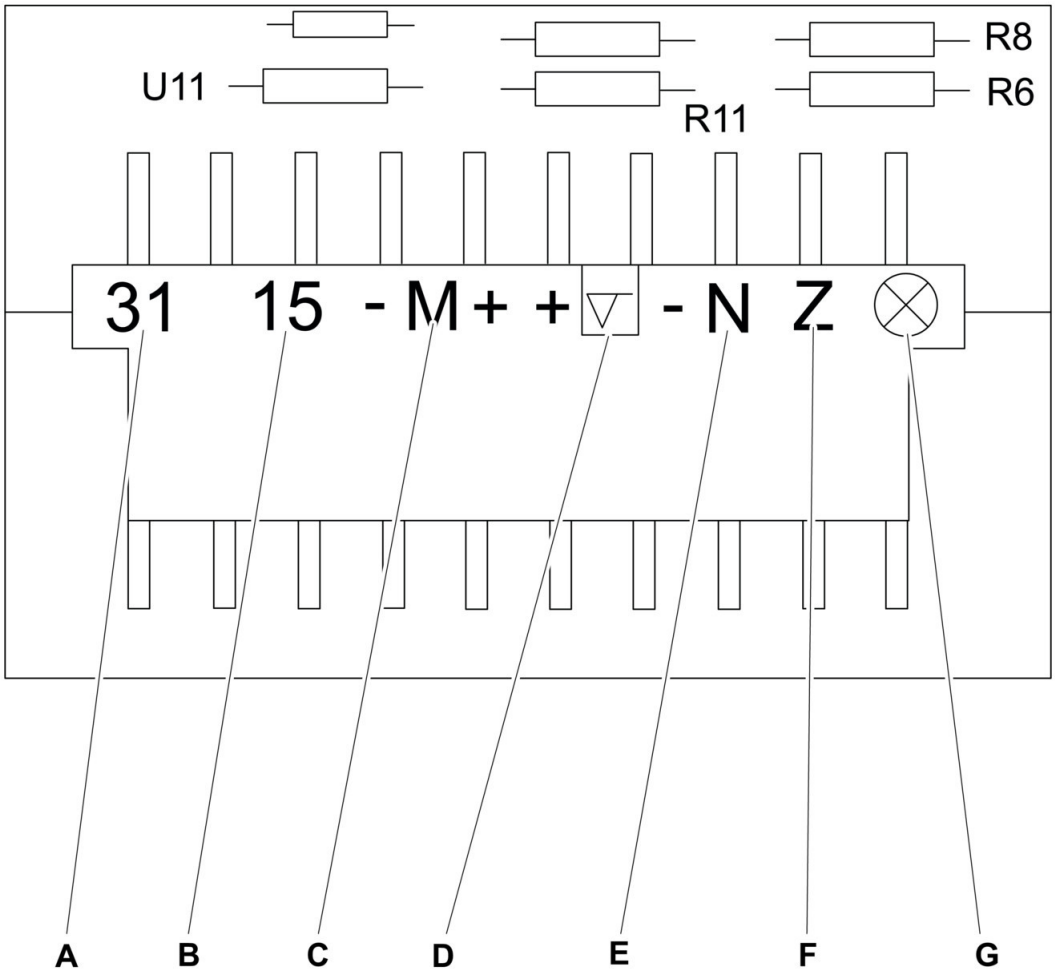
The CLS lubricates all joints in the rear boom body. The CLS is started by a pressure switch, B186, in the hydraulic positioning circuit.




*Lincoln Quicklub 203 Lubricating Pump*

| | | | |
|---|---|---|---|
| A | Pump element | B | Safety valve |
| C | Plug (Timer for pause and running time) | D | Filler nipple |
| E | Reservoir | | |

## 21.2 Central Lubrication System Power Supply

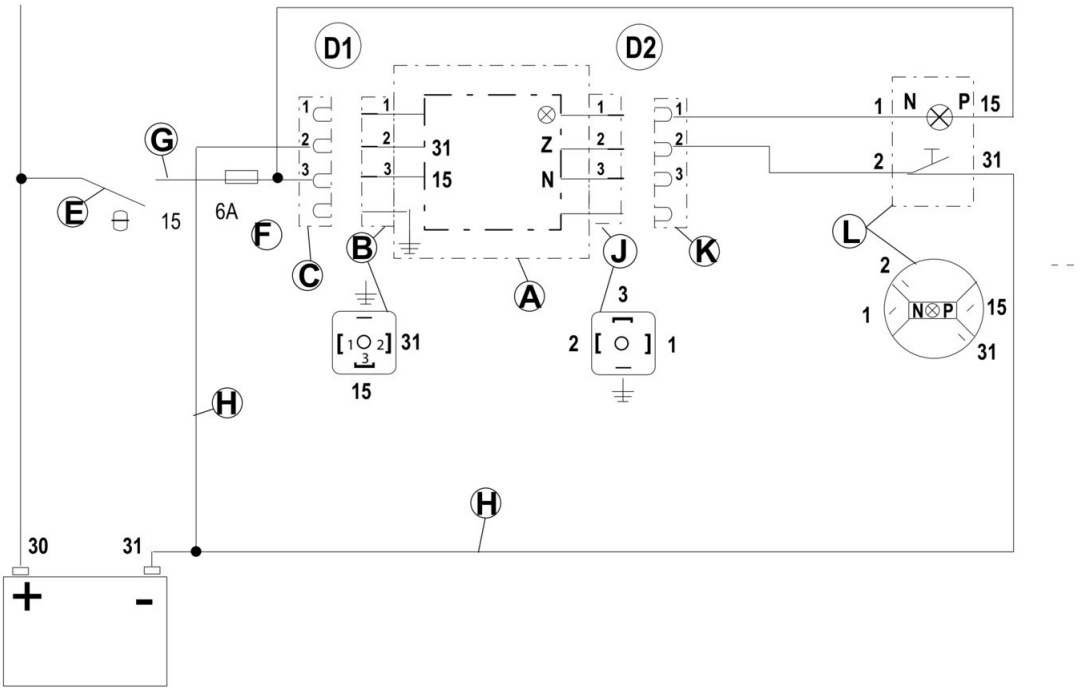



*Timer Terminal*

| | | | |
|---|---|---|---|
| A | Ground | B | Ignition switch |
| C | Motor | D | Low-Level Indication |
| E | Level indication | F | Extra lubrication |
| G | Lamp in push button | | |

- The timer receives power through the ignition switch and ground.
- Operating time and the lubrication system pause time are started and stopped when the electric motor is started and stopped.
- The system stores the time setting when the voltage is switched off.

## 21.3 Central Lubrication System Circuit Diagram

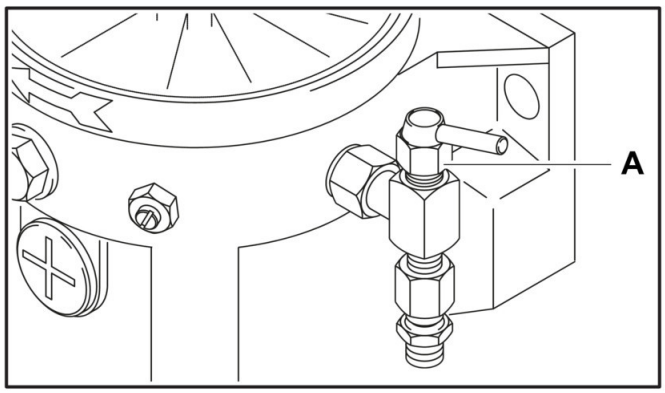



*Automatic Lubrication System Circuit Diagram with Two Versions*

| | | | |
|---|---|---|---|
| A | Pump housing | B | Terminal 1 |
| C | Cable contact 1 (Black) with 2-core cable | D1 | Pump without extra push button |
| D2 | Pump with extra push button | E | Ignition switch |
| F | Fuse 6A | G | Cable, black |
| H | Cable, brown | J | Terminal 2 |
| K | Cable contact 2 (Grey) with 3-core cable | L | Push button with lamp |

## 21.4 Lubrication Pump Safety Valve

This equipment is **optional**.

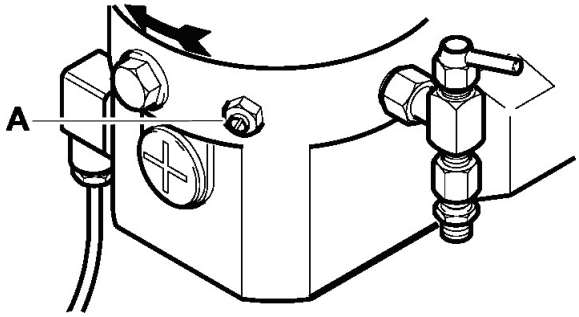



*Location of Safety Valve on Lubrication Pump*

The safety valve (A) is used to limit the pressure in the system. The valve opens at a pressure of 350 bar (5076 psi).

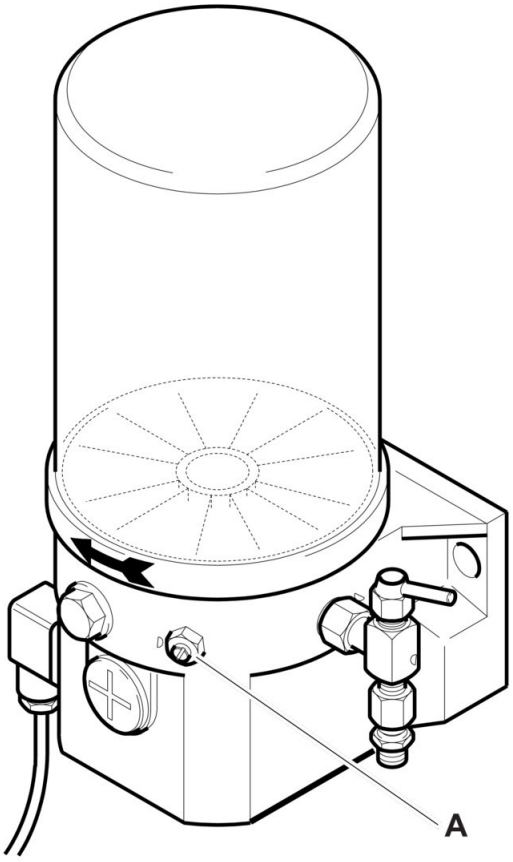
Grease that leaks out of the safety valve indicates that a hose, lubricating point, or nipple is blocked and that troubleshooting is required.

## 21.5 Lubrication Return Connection




Excess lubricant after dosage to the primary distributor must be routed back to the pump through the return connection (A).

## 21.6 Fill Lubricant




The container is transparent for visual inspection of the level. One filler nipple is located above the running lights on the left-hand side and one filler nipple is located directly on the pump.

| | |
|---|---|
| ! | ***NOTE:*** *Use a filler pump to fill the lubricant.* |

1. Remove the protective cover on the nipple (A).
2. Fill through the nipple (A) to the MAX marking on the container.

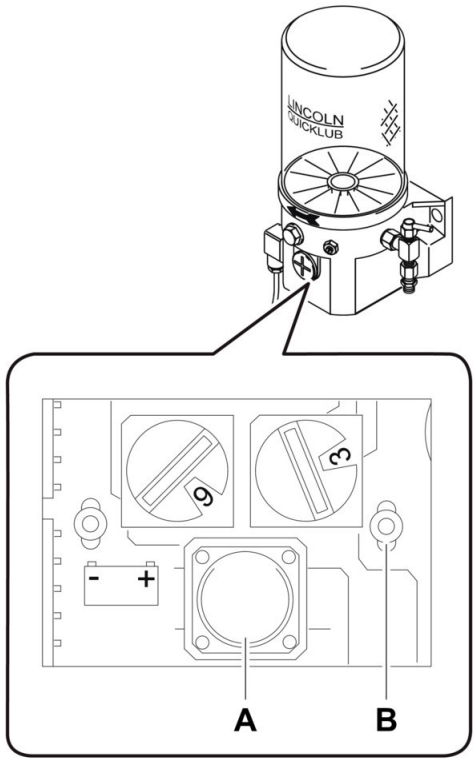
> ! ***NOTE:*** *Do not overfill.*

3. Reinstall the protective cover.

**See Separate Manual**

Fluids and Greases

## 21.7 Test Central Lubrication System




*Lubrication System Timer*

Precondition
- ✓ Battery isolation switch is ON.
- ✓ One of the hydraulic pumps is ON.

1. Press the pushbutton (A) for two seconds.

Step result
- ➔ The lubrication system starts.

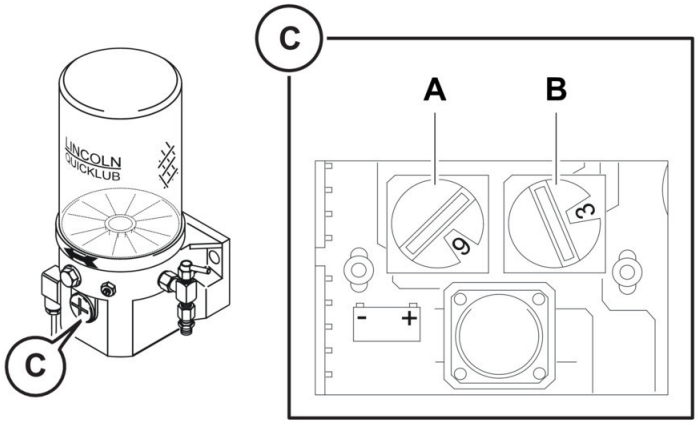
2. Check the indicator (B) to see if the lubrication pump follows the set pause time and the running time.

   Reset the pause time and running time if necessary.

3. Check that lubricant grease emerges from all lubrication points.

## 21.8 Setting Lubrication Pause and Running Time

Integrated in the lubrication pump is a timer which controls pause and running times. To access the timer, remove the plug from the lubrication pump.




Precondition
- ✓ The battery isolation switch is ON.
- ✓ One of the hydraulic pumps is ON.

- ○ Adjust the pause time in increments of 15 (1, 2, 3,.....15 hours) with the blue rotary switch (A).

> ! ***NOTE:*** *Pause time is preset at six hours.*

- ○ Adjust running time in increments of 15 (2, 4, 6,.....30 minutes) with the red rotary switch (B).

> ! ***NOTE:*** *Running time is preset at six minutes.*

# 22 Service Platform

## 22.1 Safety Precautions Before Working on Service Platform

**WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

- ▶ Make sure that the system is de-pressurized before starting any work.

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

## 22.2 Hoisting Service Platform

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

**WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

- ▶ Make sure that the system is de-pressurized before starting any work.

**WARNING**

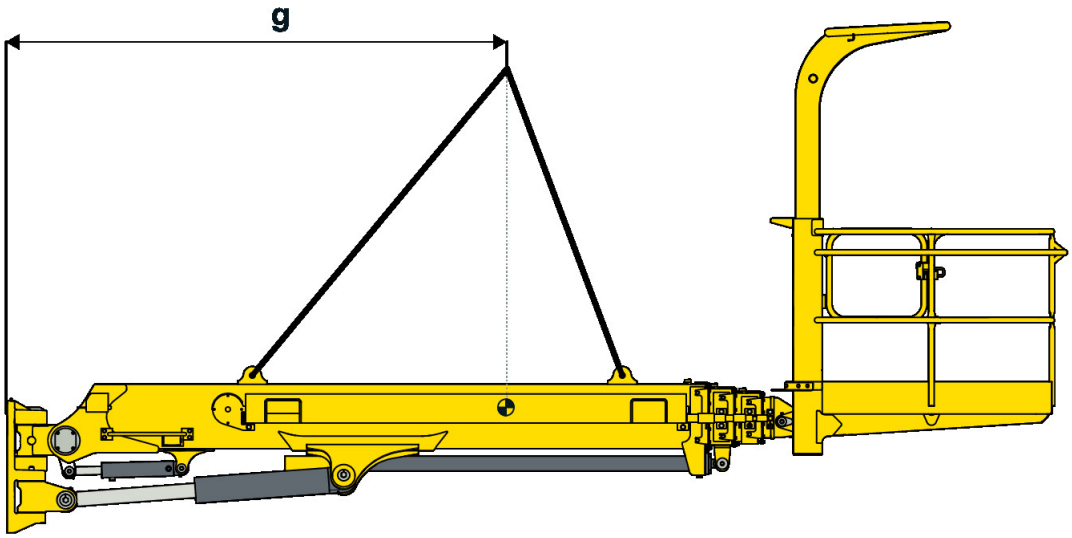
**Safety Message**

Service platform will not swing if the sling is damaged.

▶ Do not slip the sling as it can damage the sling.

***NOTE:*** *To avoid damage and accidents, it is important to be very careful when hoisting the service platform.*

- A new service platform is delivered in transport position.
- If it is not a new service platform, check the telescope is retracted and the service platform is in horizontal position.
- Lift directly above the center of gravity.
- Lift slowly and carefully.
- Check the slings.




*Distance to center of gravity from attachment plate (extension contracted)*

## Service Platform P2/P3

| Model | Distance to Center of Gravity from Attachment Plate |
|---|---|
| P2-NC-9.0 | 1941 mm (76 in) |
| P2-NCS-9.4 | 2106 mm (83 in) |
| P2-MO-9.4 | 1987 mm (78 in) |
| P2-MC-10.3 | 2179 mm (86 in) |
| P2-MCS-10.7 | 2376 mm (94 in) |
| P2-MC-11.8 | 2490 mm (98 in) |
| P2-MCS-12.2 | 2700 mm (106 in) |

| Model | Distance to Center of Gravity from Attachment Plate |
|---|---|
| P3-NC-13.9 | 2280 mm (90 in) |
| P3-NCS-14.3 | 2424 mm (95 in) |
| P3-MC-14.3 | 2290 mm (90 in) |
| P3-MCS-14.7 | 2460 mm (136 in) |

### Service Platform P2

| Model | Distance to Center of Gravity from Attachment Plate |
|---|---|
| P2-NC-9.0 | 1941 mm (76 in) |

### Service Platform P2

| Model | Distance to Center of Gravity from Attachment Plate (g) |
|---|---|
| P2-MD-10.3 | 2179 mm (86 in) |

## 22.3 Supporting Service Platform

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

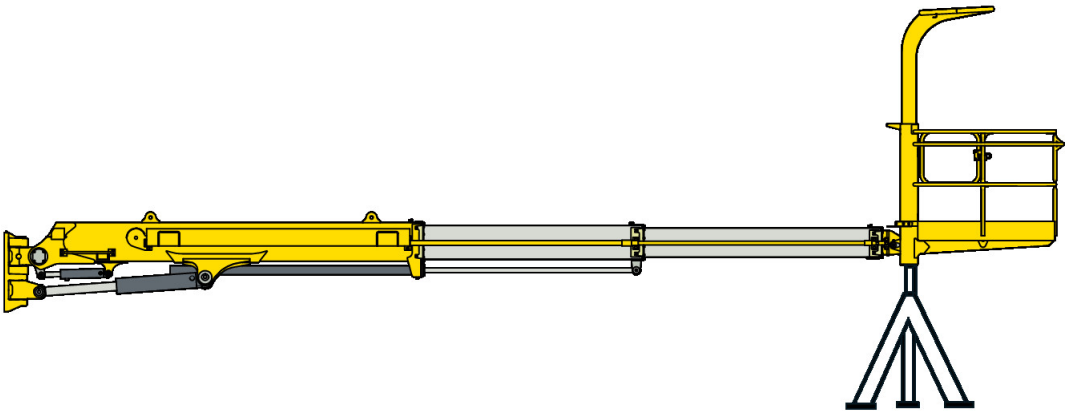
**WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

- ▶ Make sure that the system is de-pressurized before starting any work.

Always support the service platform on stands when performing service and maintenance work.



## 22.4 Checking New or Reconditioned Service Platform

***NOTE:*** *If a crack or other damage is detected on the service platform boom or another load-bearing component, the service platform must not be used before the damaged component has been replaced with a new original part from Epiroc! No repairs that are allowed.*

1. Check the service platform for transport damage.
2. Check threaded joints and hoses.

   Make sure the joints and the hoses are tight.
3. Check for oil leaks while performing all operative movements.
4. Check that the entire service boom movement pattern can be performed without any hoses getting jammed or pinched. All the hydraulic cylinders must be operated to their end positions.
5. Check lubrication.
6. Bleed the hydraulic system.

## 22.5 Check Service Platform

- Inspect the service platform thoroughly.

## 22.6 Check Bushings

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

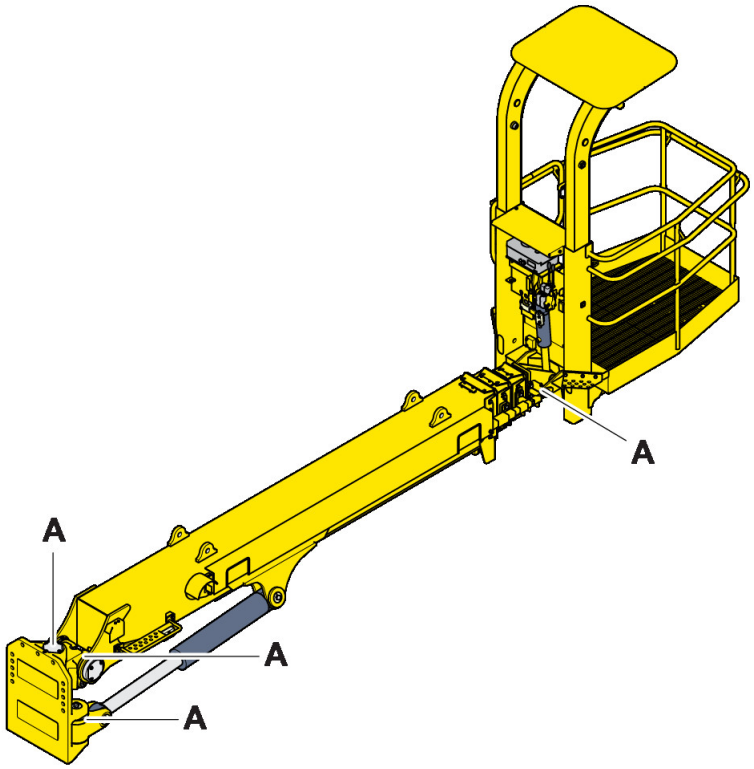
- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

**WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

- ▶ Make sure that the system is de-pressurized before starting any work.




1. Check the gap between axis and bushings (A).
2. Replace bushings if the gap is larger than half the wall thickness of the bushings.
   a. Check bearing seat for wear.
   b. Check axis for wear.

## 22.7 Check Bolted Joints

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

**WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

▶ Make sure that the system is de-pressurized before starting any work.

All bolted joints are tightened to the torque required by Epiroc Standard unless otherwise stated.

○ Check tightening torque on all bolted joints on service platform.

### 22.7.1 Special Tightening Torques for Service Platform P2/P3

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

▶ Do not stand under the heavy object being lifted.

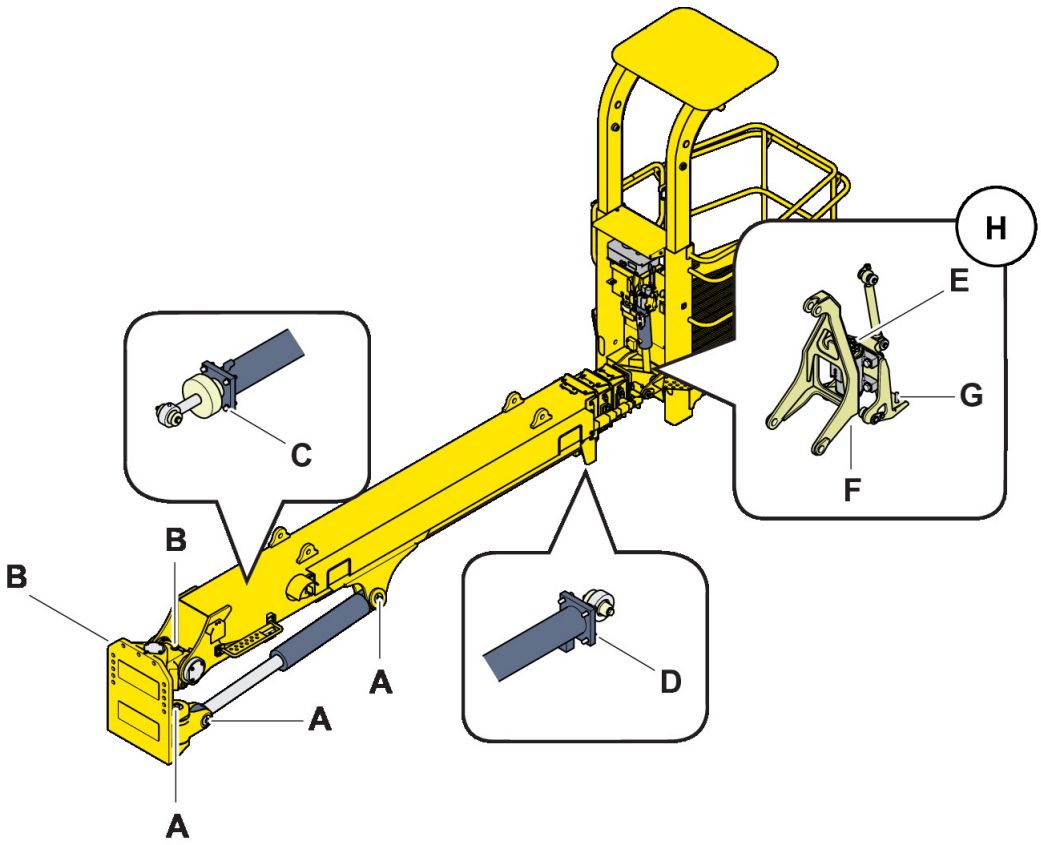
▶ Use adequate lifting device.

**WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

▶ Make sure that the system is de-pressurized before starting any work.




> ***NOTE:*** *(H) is only mounted if the service platform has cage swing.*

> ***NOTE:*** *The bolted joints must be lubricated with Molycote 1000 or corresponding thread grease with a coefficient of friction 0.11 µ.*

## Special Tightening Torques for Service Platform P2/P3

| Position | Bolt | Tightening Torque | Tolerance | Thread Locker |
|---|---|---|---|---|
| A, P2 | M16 | 195 Nm (143.8 lb-ft) | +/- 39 Nm (28.8 lb-ft) | |
| A, P3 | M20 | 290 Nm (213.9 lb-ft) | +/- 50 Nm (36.9 lb-ft) | |
| B | M20 | 365 Nm (269.2 lb-ft) | +/- 36 Nm (26.6 lb-ft) | |
| C | M12 | 81 Nm (59.7 lb-ft) | +/- 19 Nm (14 lb-ft) | Loctite 243 |
| D | M12 | 81 Nm (59.7 lb-ft) | +/- 19 Nm (14 lb-ft) | Loctite 243 |
| E | M12 | 107 Nm (78.9 lb-ft) | +/- 27 Nm (19.9 lb-ft) | Loctite 243 |

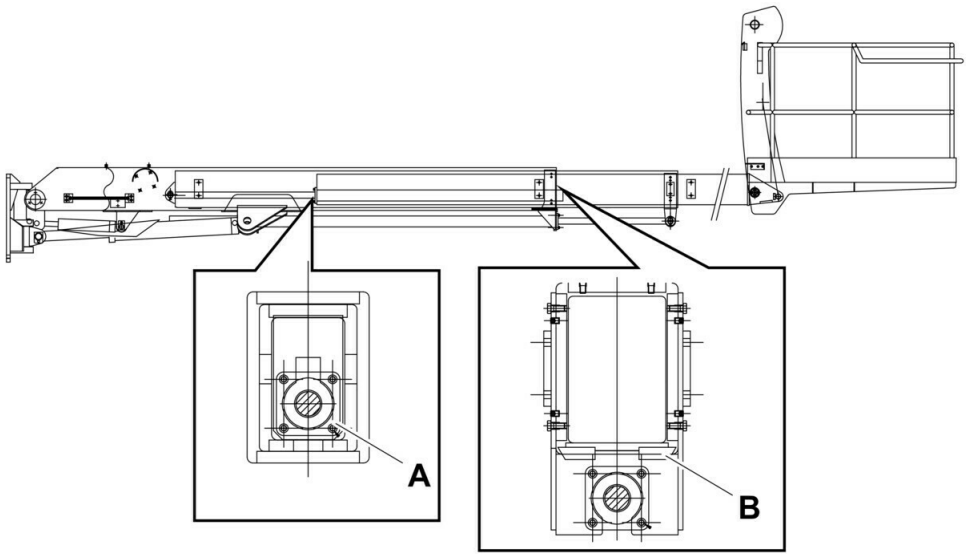
| Position | Bolt | Tightening Torque | Tolerance | Thread Locker |
|---|---|---|---|---|
| F | M24 | 860 Nm (634.3 lb-ft) | +/- 215 Nm (158.6 lb-ft) | |
| G | M16 | 156 Nm (115 lb-ft) | +/- 39 Nm (28.8 lb-ft) | Loctite 243 |

### Special tightening Torque for Attachment Plate Bolted Joints on Service Platform P2/P3

| Tightening Torque | Tolerance | Grade | Lubricant |
|---|---|---|---|
| 881 Nm (650 lb-ft) | +/-80 Nm (59 lb-ft) | 12.9 | Molycote 1000 or corresponding thread grease with a coefficient of friction 0.11 µ |

## 22.7.2 Lock Special Bolted Joints

For safety reasons, some of the platform's bolted joints should be locked with Loctite 243. See the figure below. It is also important that the joints are tightened with the specified tightening torque.




! ***NOTE:*** *Section (A) and section (B): Lock the four bolts with Loctite 243 and torque to 81 Nm (60 lb-ft).*

## 22.8 Attachment Plate Bolted Joints

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

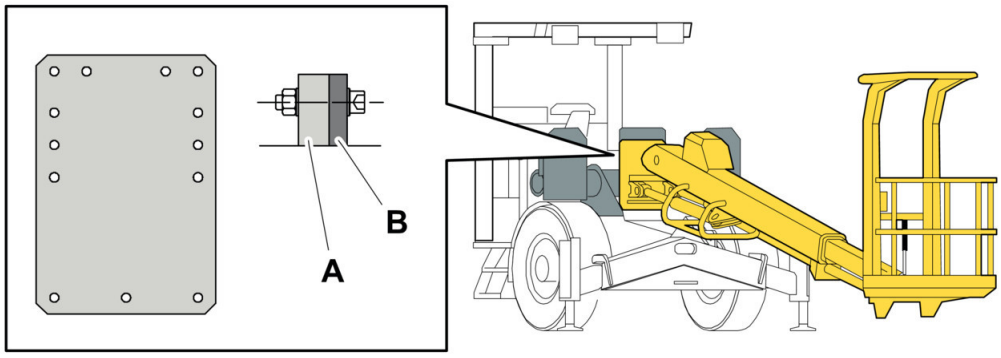
**WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

- ▶ Make sure that the system is de-pressurized before starting any work.

***NOTE:*** *If the service platform has been removed from the machine, all bolts in all joints must be replaced.*



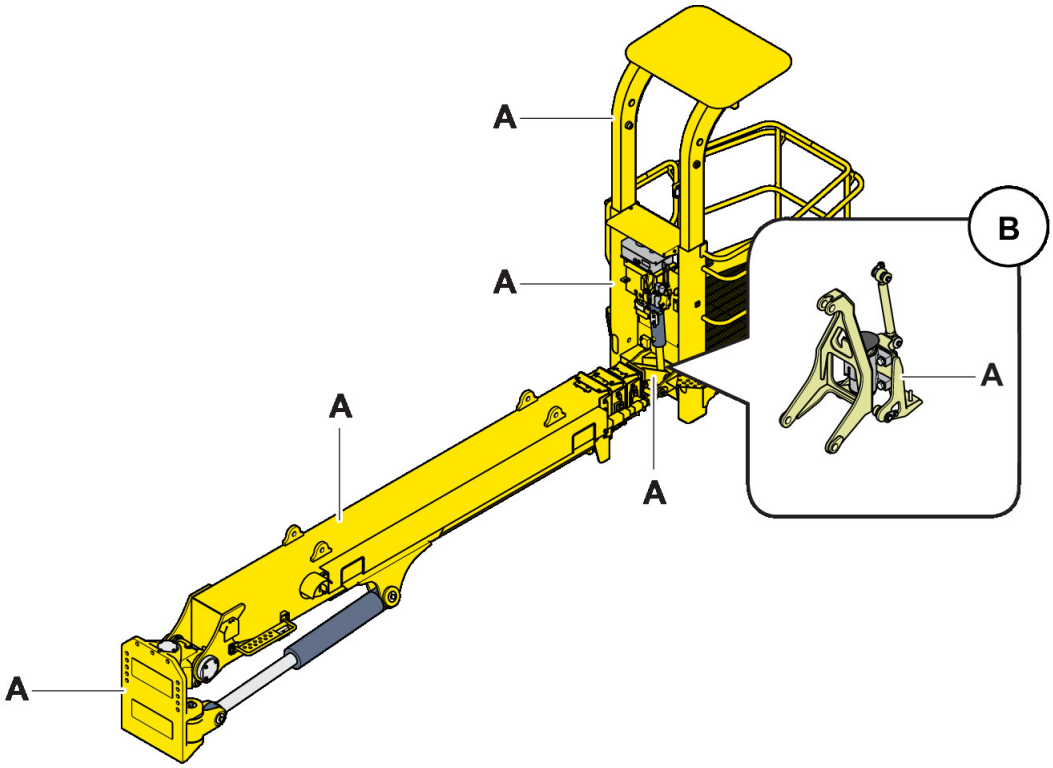

| | | | |
|---|---|---|---|
| A | Boom bracket | B | Service platform attachment plate |

### Special Tightening Torque for Attachment Plate Bolted Joints on Service Platform P2/P3

| Tightening Torque | Tolerance | Grade | Lubricant |
|---|---|---|---|
| 881 Nm (650 lb-ft) | +/-80 Nm (59 lb-ft) | 12.9 | Molycote 1000 or corresponding thread grease with a coefficient of friction 0.11 µ |

***NOTE:*** *With the bolts in all joints, use hardened washers and 12 Grade nut.*

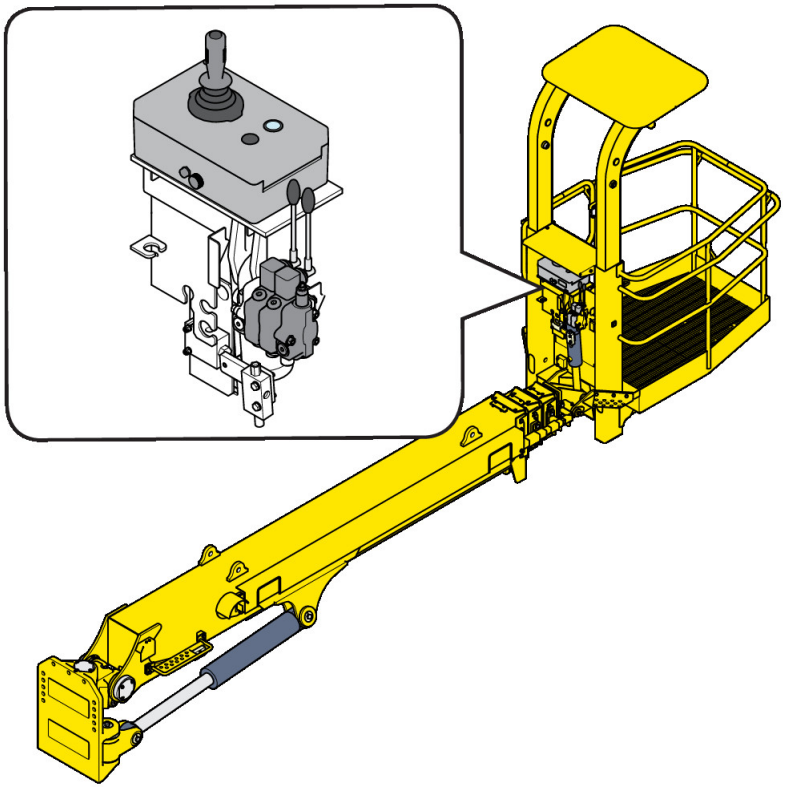
## 22.9 Check Structural Components




| | |
|---|---|
| ! | ***NOTE:*** *(B) is only mounted if the service platform has cage swing.* |

- Check structural components (A) for cracks and wear.

## 22.10 Check Control Levers



- ○ Check that levers move freely.
- ○ Check the levers for damage.

## 22.11 Adjust Play in Extension Tube Guide

**⚠ WARNING**

**Heavy Objects**

Can cause crushing injury or death.

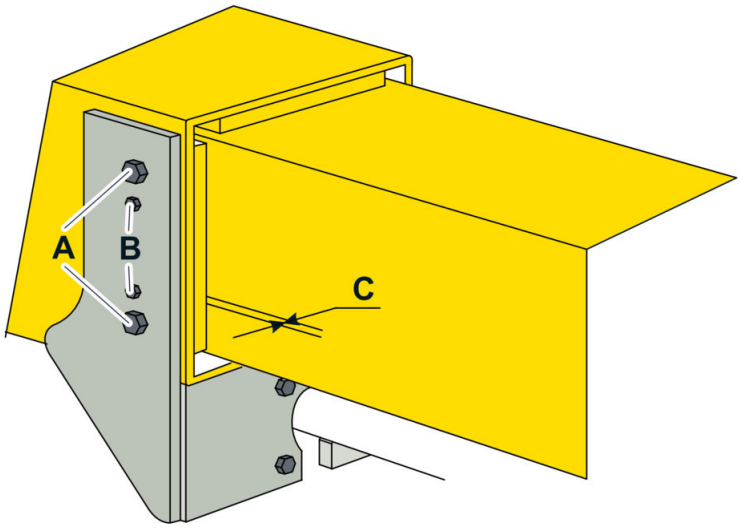
- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

**⚠ WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

- ▶ Make sure that the system is de-pressurized before starting any work.




1. Loosen bolts (A).
2. Adjust with set crews (B).

Step result ➔ The opening between the guide heel and extension tube (C) must be approximately 0.5 mm.

3. Tighten bolts (A).
4. Repeat the steps for the other side.

## 22.12 Lubricate Telescope Tube

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

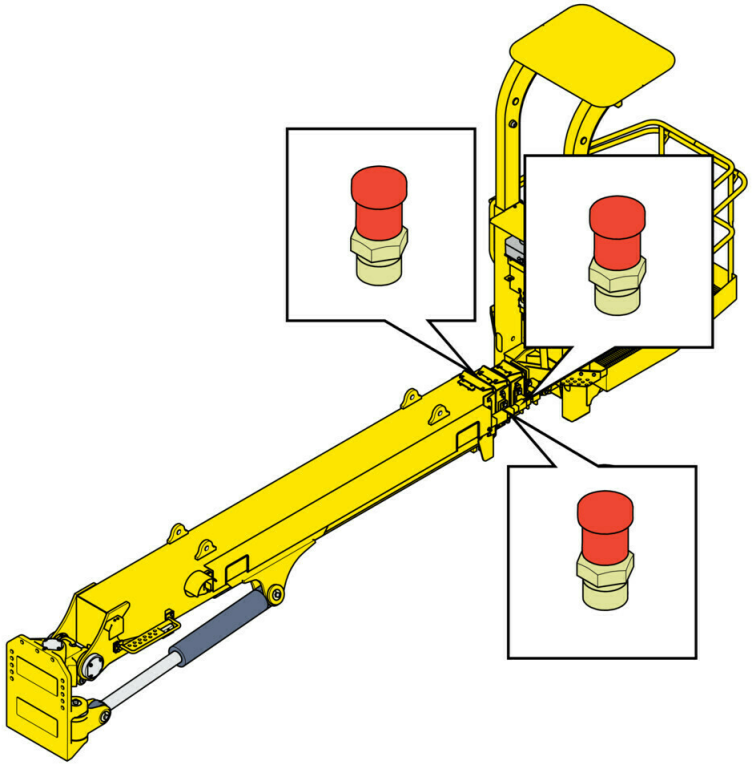
- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

**WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

- ▶ Make sure that the system is de-pressurized before starting any work.



○ Lubricate at all lubrication points on each side of the telescope tube.

## 22.13 Lubricate Hose Retainer

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

▶ Do not stand under the heavy object being lifted.

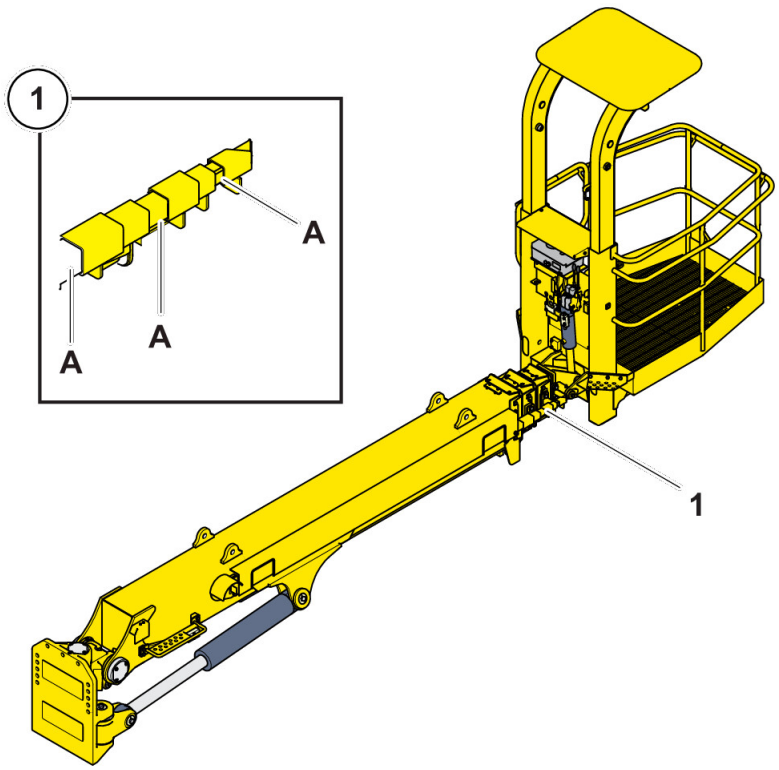
▶ Use adequate lifting device.

**WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

▶ Make sure that the system is de-pressurized before starting any work.




- Lubricate hose retainers (A).

| | |
|---|---|
| ! | ***NOTE:*** *Lubricate directly on the tube.* |

## 22.14 Lubricate Boom Attachment

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

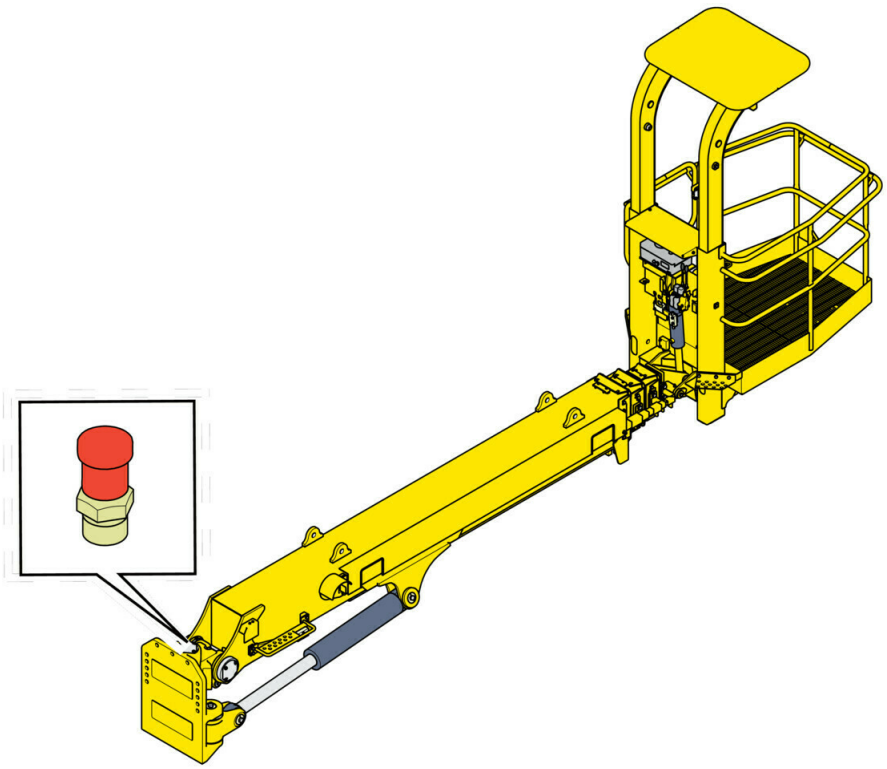
- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

**WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

- ▶ Make sure that the system is de-pressurized before starting any work.



- Lubricate boom attachment at lubrication points.

## 22.15 Lubricate Boom Links

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

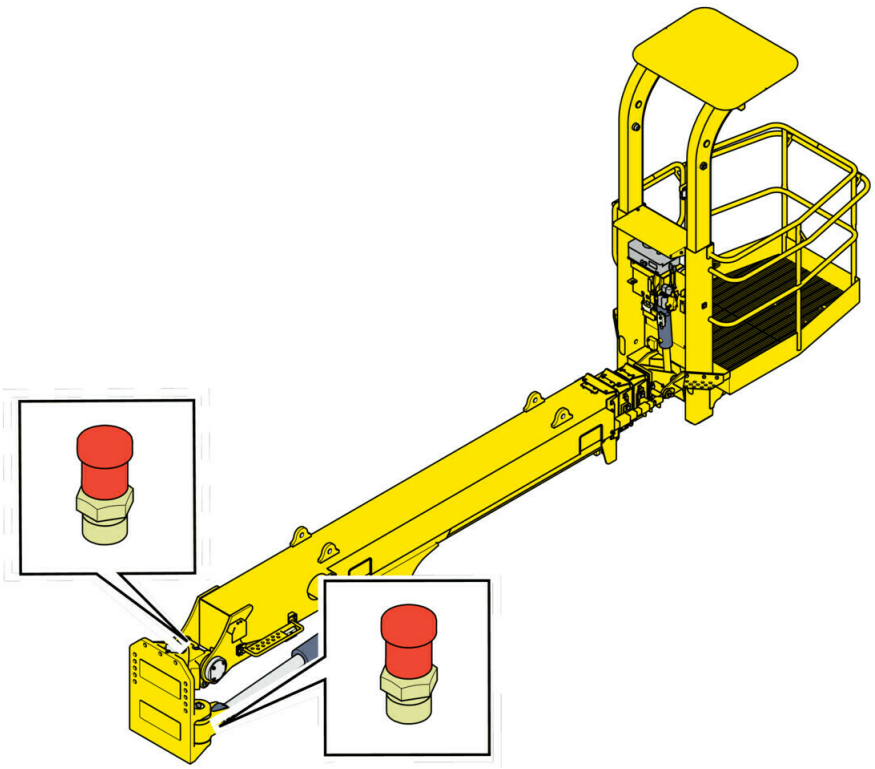
- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

**WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

- ▶ Make sure that the system is de-pressurized before starting any work.



1. Raise the service platform from the ground.
2. Lubricate at lubrication points.
3. Lower the service platform carefully to the ground to relieve the boom link.
4. Lubricate at the same lubrication points.

## 22.16 Lubricate Cylinder Bearings

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

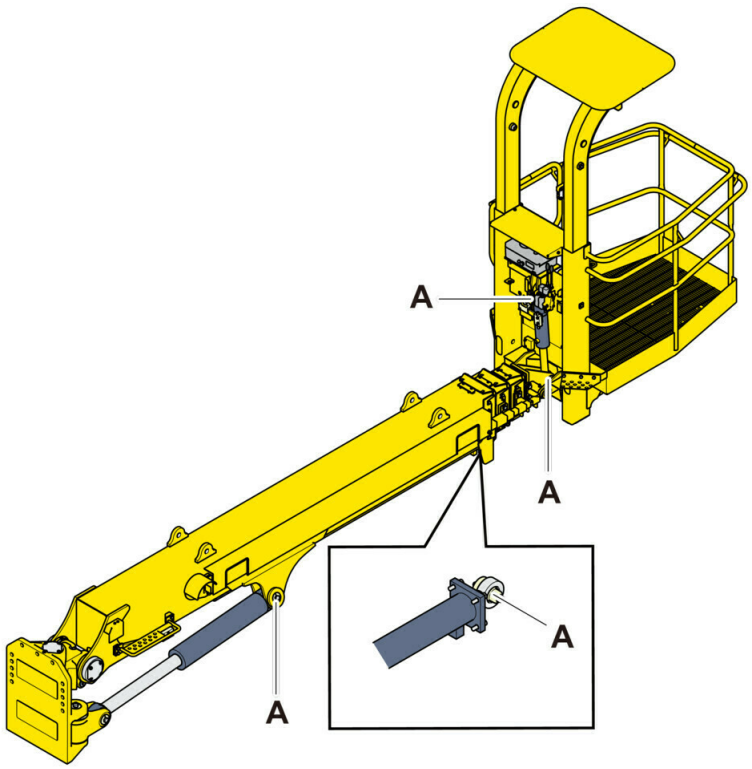
- ▶ Do not stand under the heavy object being lifted.
- ▶ Use adequate lifting device.

**WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

- ▶ Make sure that the system is de-pressurized before starting any work.




○ Lubricate cylinder bearings at lubrication point (A).

## 22.17 Lubricate Cage

**WARNING**

**Heavy Objects**

Can cause crushing injury or death.

▶ Do not stand under the heavy object being lifted.

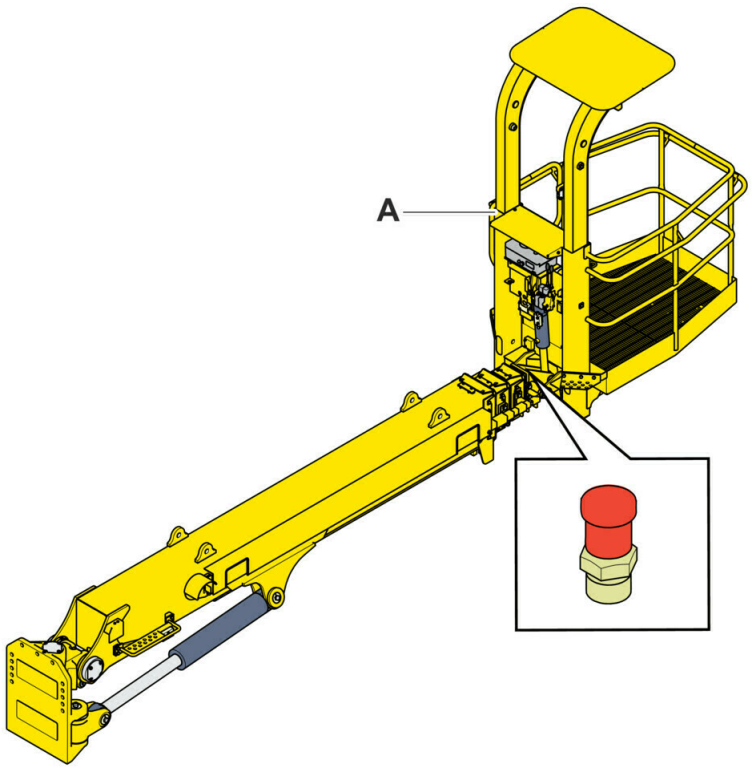
▶ Use adequate lifting device.

**WARNING**

**High Hydraulic Oil Pressure**

Working on the hydraulic system involves a high risk of personal injury.

▶ Make sure that the system is de-pressurized before starting any work.




- ○ Lubricate cage at lubrication point.
- ○ Apply grease to both roof posts (A).

## 22.18 Bleed Hydraulic System

| | |
|---|---|
| ! | ***NOTE:*** *Air in the hydraulic system can be detected if one or more hydraulic cylinders give or operate jerkily.* |

The hydraulic system must be bled if air enters the system.

1. Check the oil level in the hydraulic oil tank before bleeding.
2. Operate the cylinders several times between their end positions.

Step result ➔ It forces the aerated oil back to the hydraulic oil tank where the air can be separated.

## 22.19 Function Check

| | |
|---|---|
| ! | ***NOTE:*** *If a crack or other damage is detected on the service platform's boom or another load-bearing component then the service platform must not be used before the damaged component has been replaced with a new original part from Epiroc!*<br>***NOTE:*** *No repairs allowed!* |

1. Check the service platform for transport damage.
2. Make sure no threaded joints or hoses have been shaken loose.

3. Make sure there are no oil leaks while performing all operative movements.
4. Check that the entire service boom movement pattern can be performed (all the hydraulic cylinders should be operated to their end positions) without any hoses getting jammed or pinched.

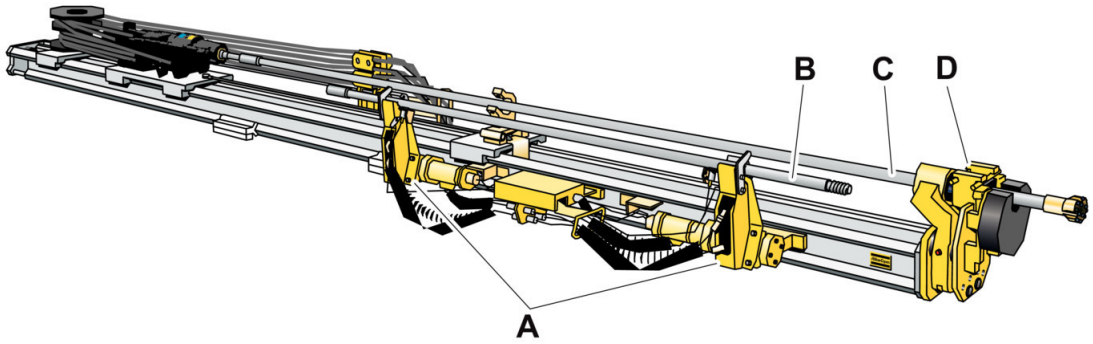
## 22.20 Long-term storage

If the service platform is not to be used for a long period, the following measures must be taken:

1. Clean the boom by spraying it with de-greasing agent. Then flush with warm water and blow dry with compressed air.
2. Lubricate according to the lubrication schedule.
3. Apply anti-rust oil on unpainted surfaces such as piston rods, sliding surfaces, etc.
4. Keep the service platform in a dry place.

# 23 RHS

## 23.1 RAS




*Rod handling equipment, RAS*

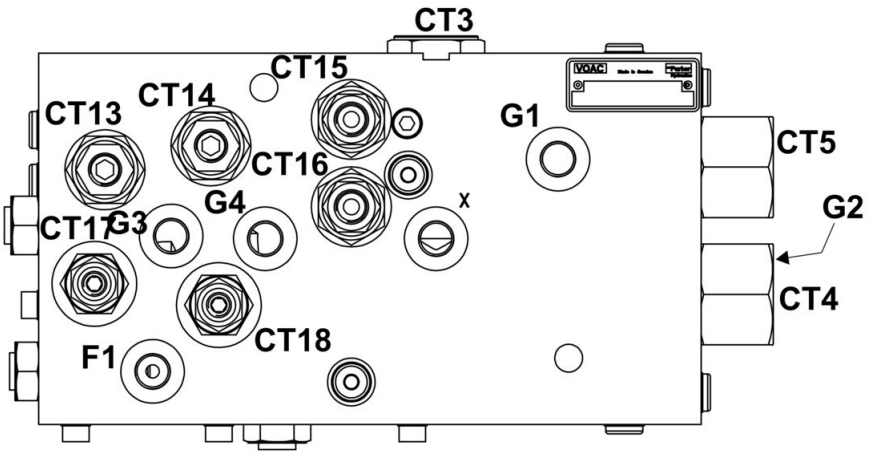
| | |
|---|---|
| A | RAS arms with gripper claws |
| B | Splicing rod |
| C | Drilling rod |
| D | Hydraulic drill steel support, BSH 110 |

The Rod Adding System (RAS) is a system for handling drill rods for extension drilling. The equipment comprises two arms with gripper claws mounted on the feed beam, and a hydraulic front drill-steel support.

The RAS arms can be positioned to two positions: parked position and drilling centre. The gripper claws can assume three positions: closed, guide position and open. The guide position means that the gripper claws hold the drill rod gently allowing the rod to rotate.

The drill-steel support can either be open or closed. These positions are adapted to the diameter of the drill rod (closed position) and the diameter of the rod joint (open position).

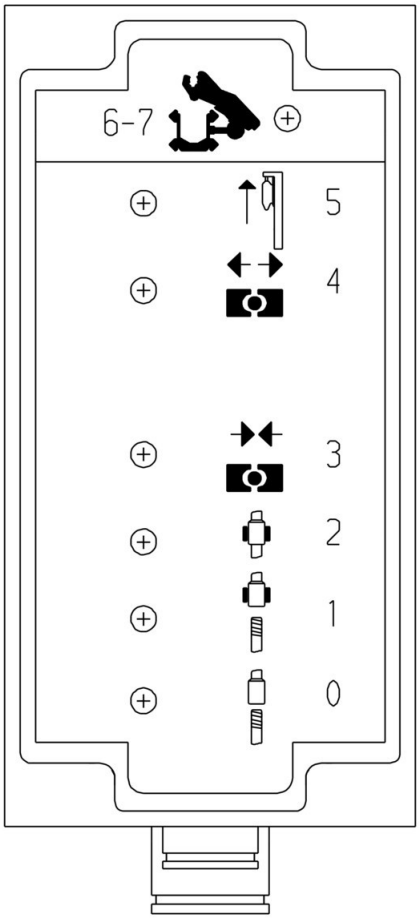
## 23.2 Settings, Valve Plate




*Detail of valve plate*

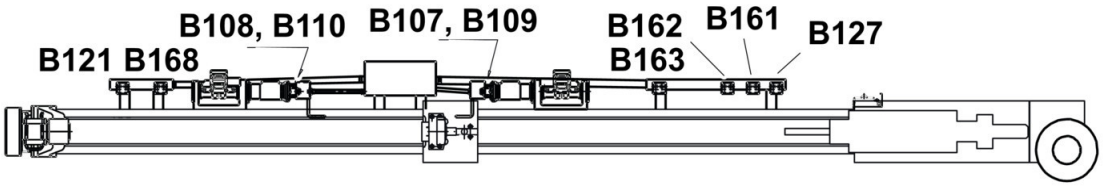
| | |
|---|---|
| G1 | Pressure gauge outlet, threading pressure at shank adapter |
| G2 | Pressure gauge outlet, unthreading pressure at rod joint |
| G3 | Pressure gauge outlet, feed pressure unthreading |
| G4 | Pressure gauge outlet, feed pressure threading |
| CT3 | Unthreading pressure shank adapter |
| CT4 | Directional valve |
| CT5 | Directional valve |
| CT13 | Rotation speed, threading |
| CT14 | Rotation speed unthreading |
| CT15 | Unthreading pressure rod joint |
| CT16 | Threading pressure shank adapter |
| CT17 | Thread feed pressure threading |
| CT18 | Thread feed pressure unthreading |

## 23.3 Inductive Switches, Position Indication for RAS




*Position indication for RAS on LED box*

| | |
|---|---|
| 0 | Rock drill shank adapter free from drill rod |
| 1 | Front join free |
| 2 | Drill rod joins in support |
| 3 | Drill-steel support can be closed |
| 4 | Drill-steel support must be opened |
| 5 | Rock drill in forward end position |
| 6-7 | RAS arms in drilling centre |




*Inductive switches on feeder*

| | |
|---|---|
| B127 | Splicing rod unthreaded at both ends |
| B161 | Splicing rod unthreaded at front |
| B162 | Sleeve in correct position drill-steel support |
| B163 | Drill-steel support can be closed |
| B168 | Drill-steel support opened |
| B121 | Front position rock drill |
| B108 | Front RAS arm in drill centre |
| B110 | Front RAS arm in parked position |
| B107 | Rear RAS arm in drill centre |
| B109 | Rear RAS arm in parked position |

# 24 Welding

## 24.1 About Welding

**WARNING**

**Risk of Poisoning**

When heated, the paint forms substances that can cause eczema, eye irritation, respiratory system difficulties, and in severe cases, asthma, or other health problems.

- ▶ Always use personal protection such as appropriate breathing apparatus, eye protection, and gloves.
- ▶ Always make sure that there is good ventilation when welding, grinding and other hot work that involves heating the paint.

**WARNING**

**Thermal Cracks**

Can cause severe personal injury.

- ▶ Follow the instructions.
- ▶ Do not weld on the booms.
- ▶ Do not weld on the framework of the cab or mountings.
- ▶ Pay attention to special certification for FOPS and ROPS.

***NOTE:*** *Unauthorized modification of the machine is not allowed.*

***NOTE:*** *Always keep a fire extinguisher for oil fires near during all types of welding, cutting, and grinding. Screen off the work area from flammable materials.*

***NOTE:*** *Do not weld machines with battery and TCU connections. Remove the three harness connectors (J1, J2, and J3) completely and ground (if applicable) from the TCU before welding to protect the TCU from high voltage and current. Disconnecting the battery is not sufficient to protect the TCU from voltage that is fed back through the cable.*

Contact Epiroc before repair welding on components or frames, approval of welding method and choice of electrodes.

- Qualified personnel must perform all welding.
- Turn off the current supply to the machine.

- Disconnect the cables from the alternator, the battery, the electronic modules, and the firefighting equipment.
- Grind off rust and paint from the area to be welded and carefully prepare the joint.
- Welding equipment must be grounded correctly.
- Weld in a dry area.
- If repair welding is necessary, damaged units must preferably be removed and repaired separately.
- Framework, brackets, and load-carrying structures are made of special materials. Any repair welding performed with incorrect materials or additives can weaken the structure.
- Avoid welding close to bearings and bushings.
- Do not weld on the boom, hydraulic tanks, hydraulic cylinders, valve blocks, compressed air tanks, or pressure lines.
- Do not weld on a FOPS and ROPS approved cab. The certification would then be invalid.
- Protect hoses, cables, and electrical components.
- If possible, grind the surface of the weld smooth and treat it with anti-corrosion paint.
- Follow safety precautions while working with RCS and battery related components.

## 24.2 Electrode Recommendations

Use only intact and clean electrodes that have been stored in a dry place. The generally recommended type of electrode is ESAB OK 48.00, ESAB OK 48.30 or the equivalent in accordance with the specified standard:

### Electrode Recommendations

| | |
|---|---|
| ISO | 2560 E51 5B 120 20 H |
| SS | 14 3211 H10 |
| DIN 1913 | E51 55 B10 |
| AWS | A/SFA 5.1 E 7018 |

The use of MIG welding equipment is perfectly acceptable. The generally recommended type of electrode is ESAB-OK Autorod 12.51 or equivalent in accordance with the following standard:

### MIG Electrodes

| | |
|---|---|
| SS | 14 3403 3423 |
| DIN 8559 | SG 2 |
| AWS | A/SFA 5.18 ER 70 S-6 |

If in any doubt, contact Epiroc for advice.

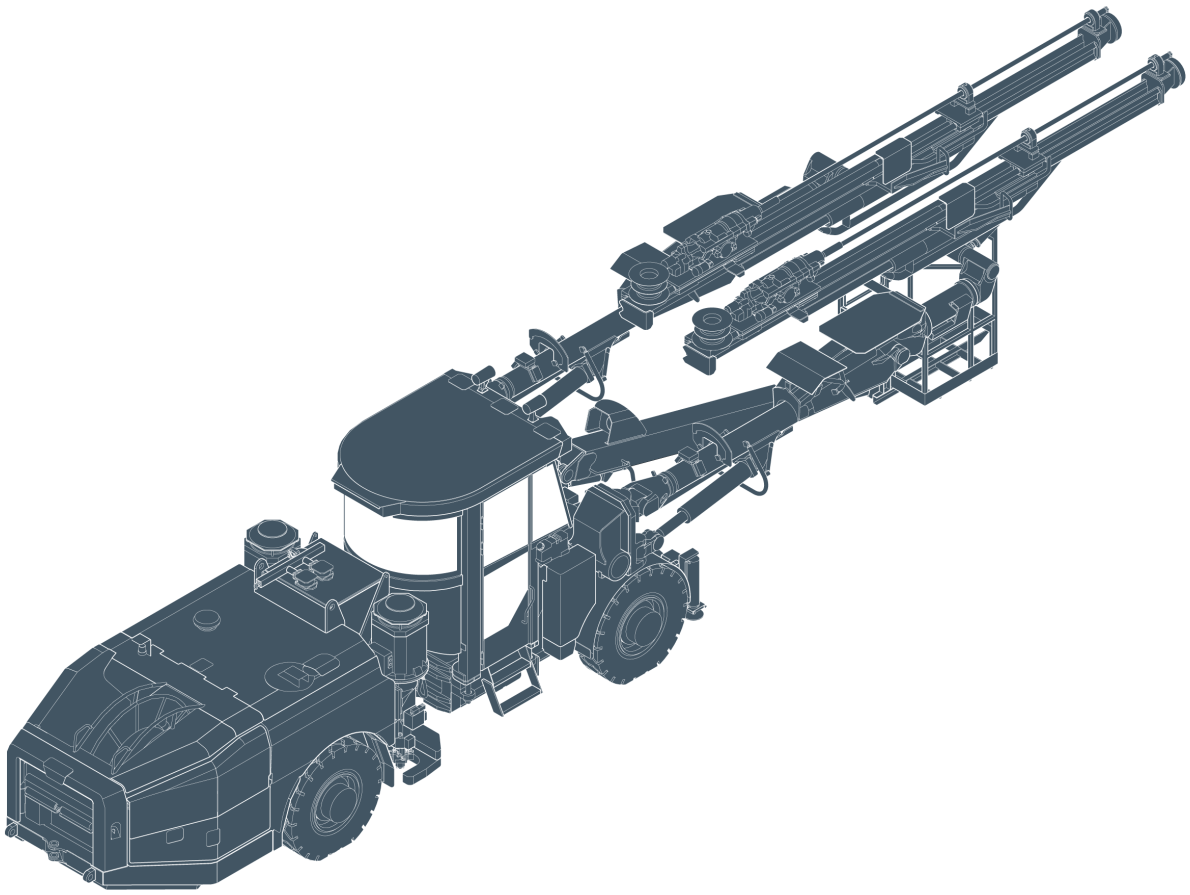
2020-02-14 | No: TIS0000977.002 en-US

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Diagrams and Drawings

# Boomer L2 D



**No. 8999 6511 00**
Rev. 001 |

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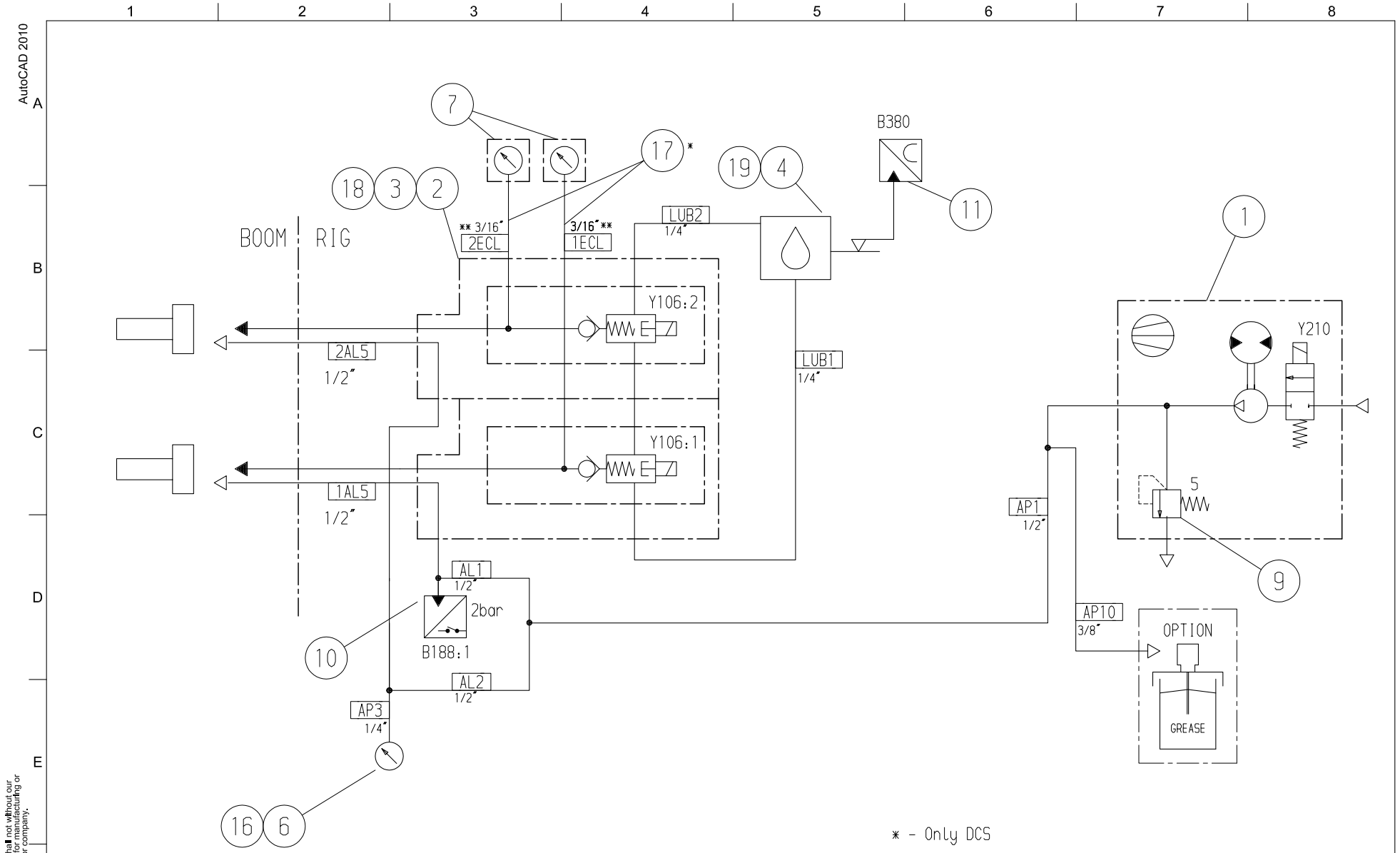
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|---|---|---|---|---|---|---|
| 009 | B3 | PCS included & notes added. TMG154865 | 2013-10-30 | tmgxrar | tmgbfk | tmgjsh |

Name: AIR SCHEDULE
AIR SYSTEM

Atlas Copco

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| Transf. fr. | Drawn UTU13/BF | Approver BF | Type DCS, 2-BOOM A3 |
| Confidentiality class acc. 1102 K Internal | Design chd. | Drawing owner TMG | Designation Sheet 1 ( 1 ) |
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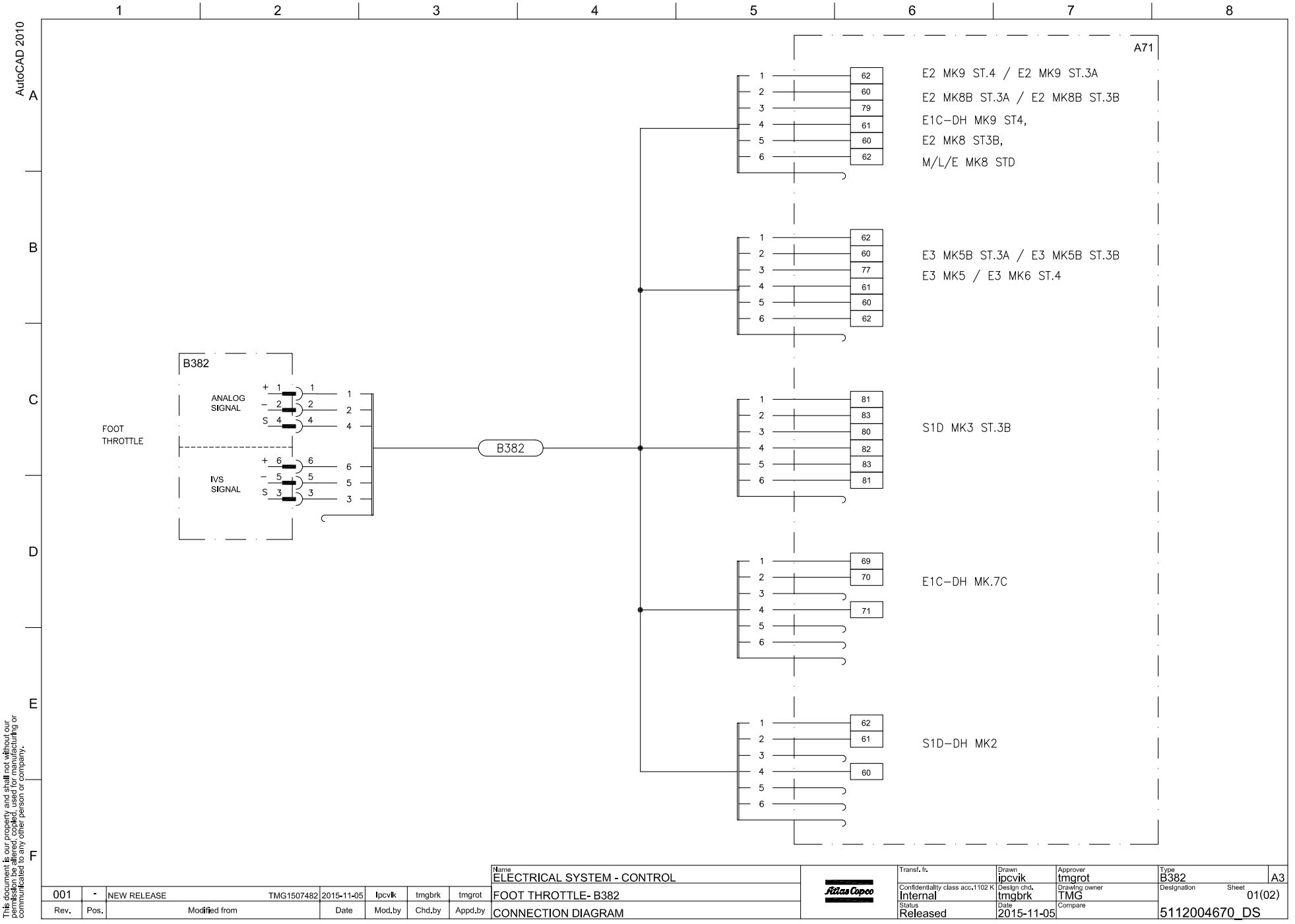


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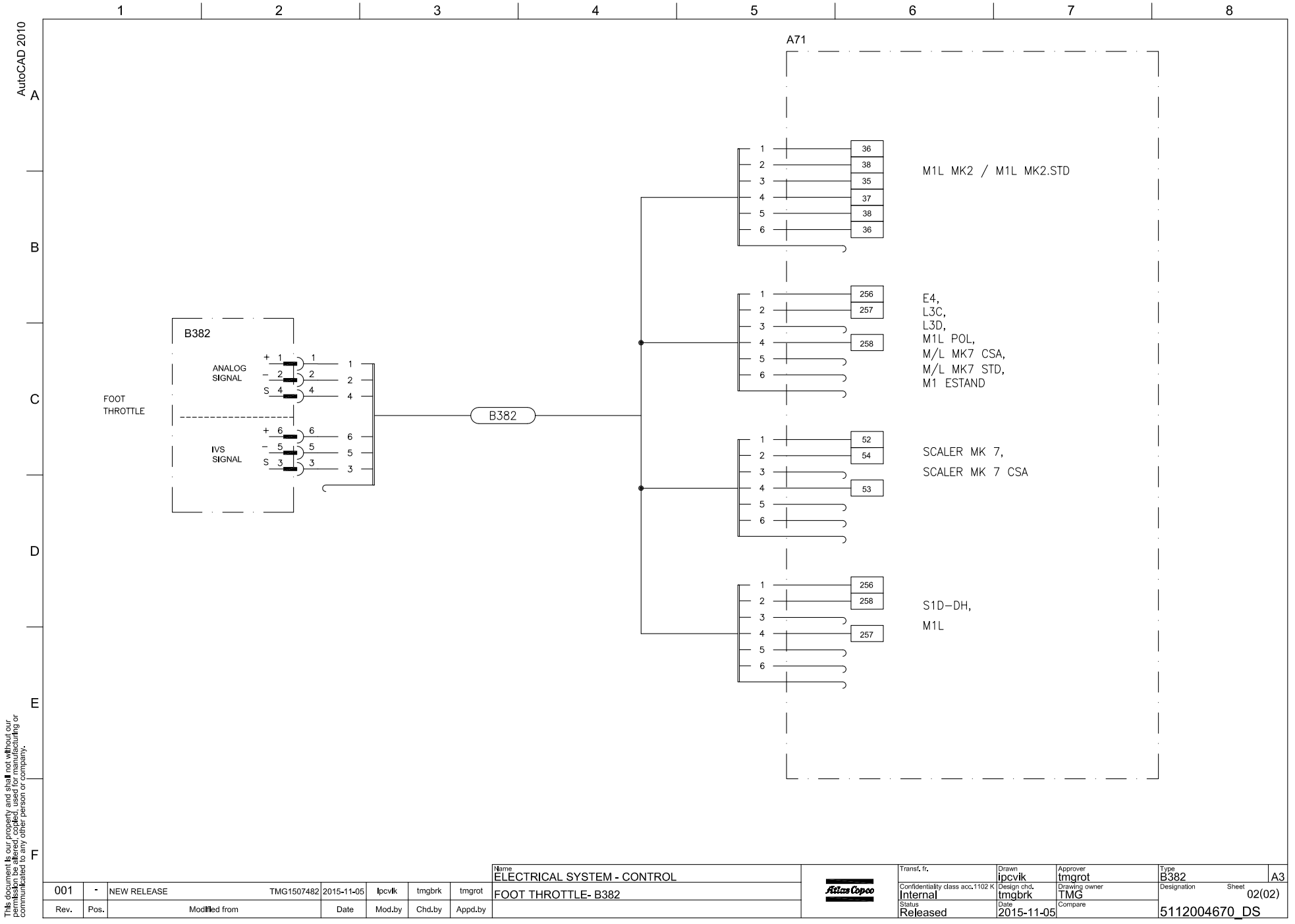

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| CONNECTION DIAGRAM | Status: Released | Date: 2015-11-05 | Compare | 5112004670_DS |



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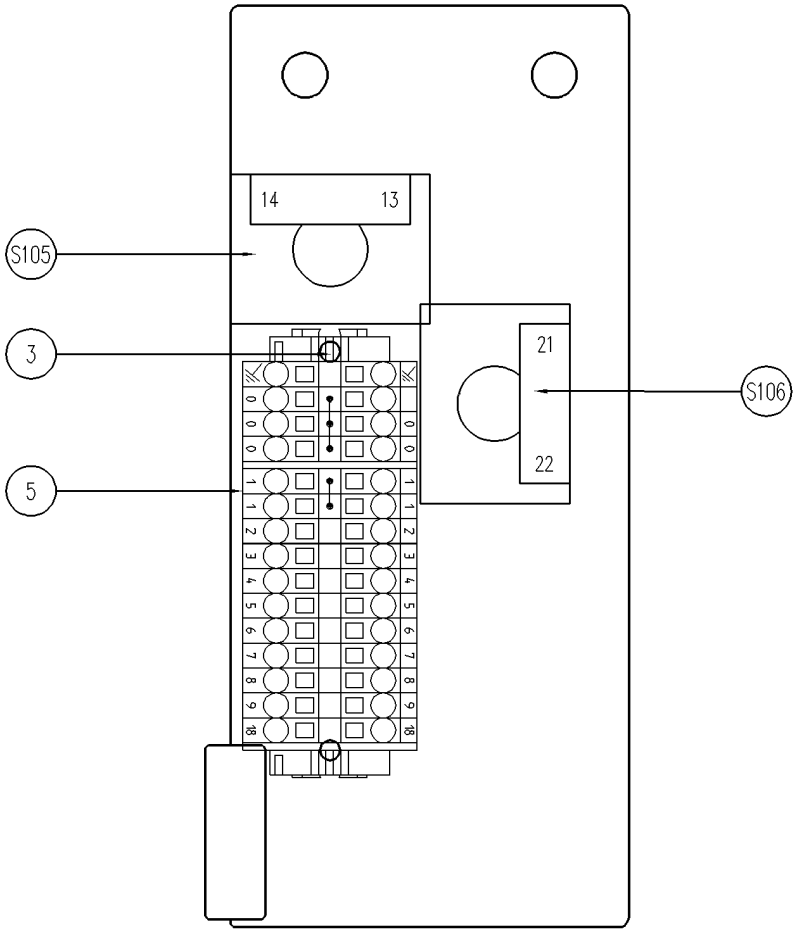
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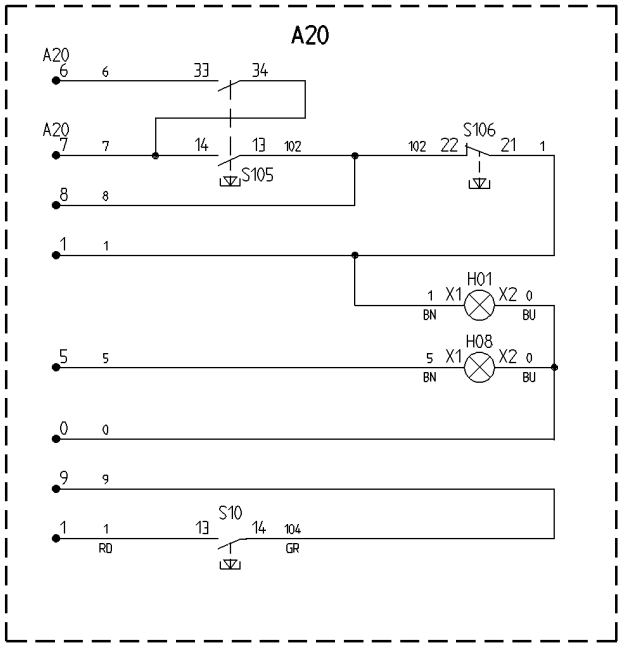
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| Tolerances, if not indicated, according to: | Machined surfaces | | | |
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| | L20 / M20 | | ACAD |

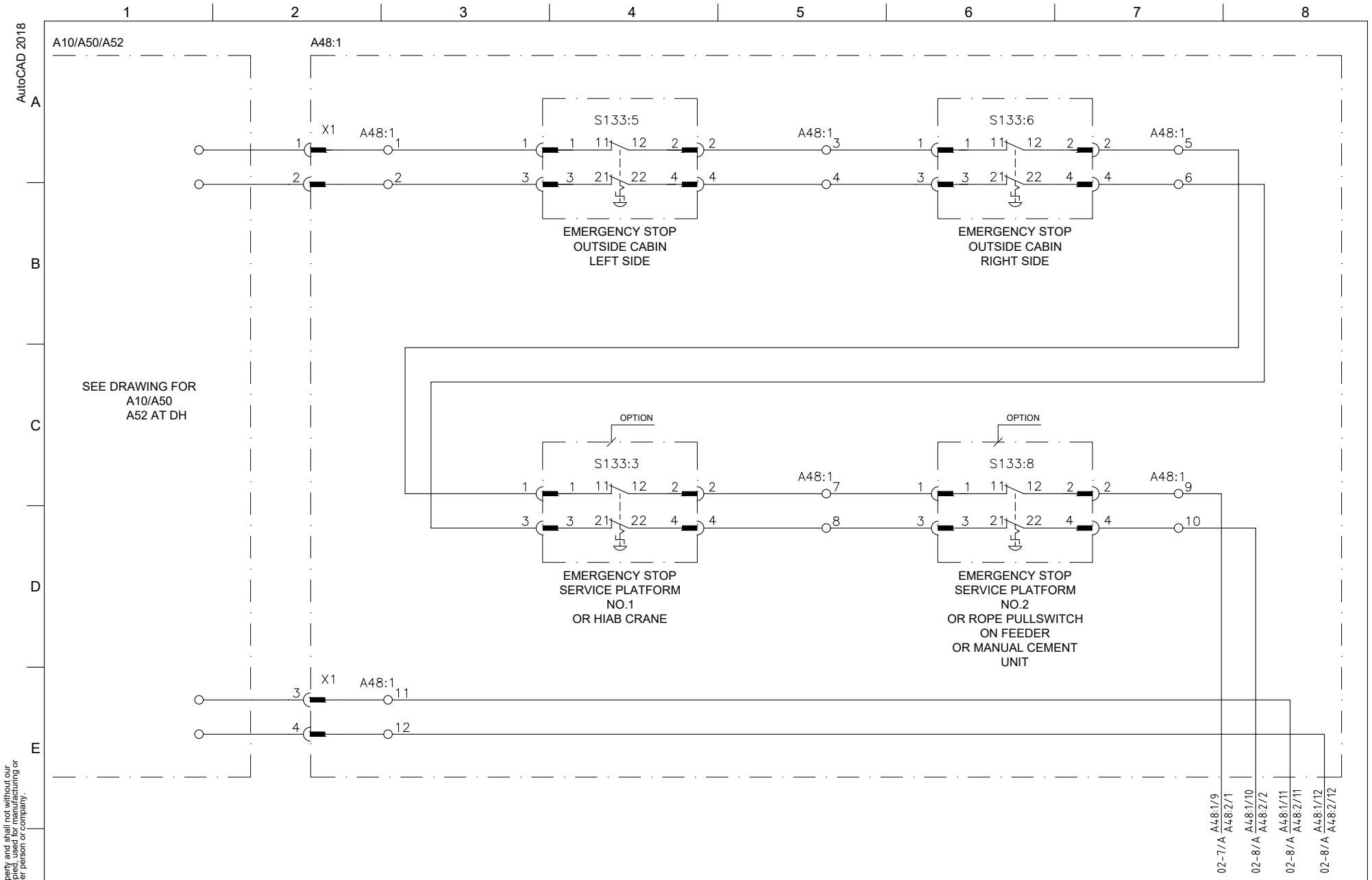
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| Transferred fr. | Std.chd. | Blk.wt. kg | Fin.wt. .kg | Designation | Sheet 1 ( 1 ) |
| . | Design chd. . | Prod.chd. . | Appd. LJ Date 2002-01-10 | 3217 8835 61 | |

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| 7 | | PLINTMODUL ÄNDRAD TMG090932 | 08-11-05 | LJ |
| 6 | | H08 INF.PLINTNR. JUST. TMG069070 | 06-11-16 | LJ |
| 5 | . | KONTAKTBLOCK & PLINT TILLK.TMG062146 | 06-03-08 | LJ |

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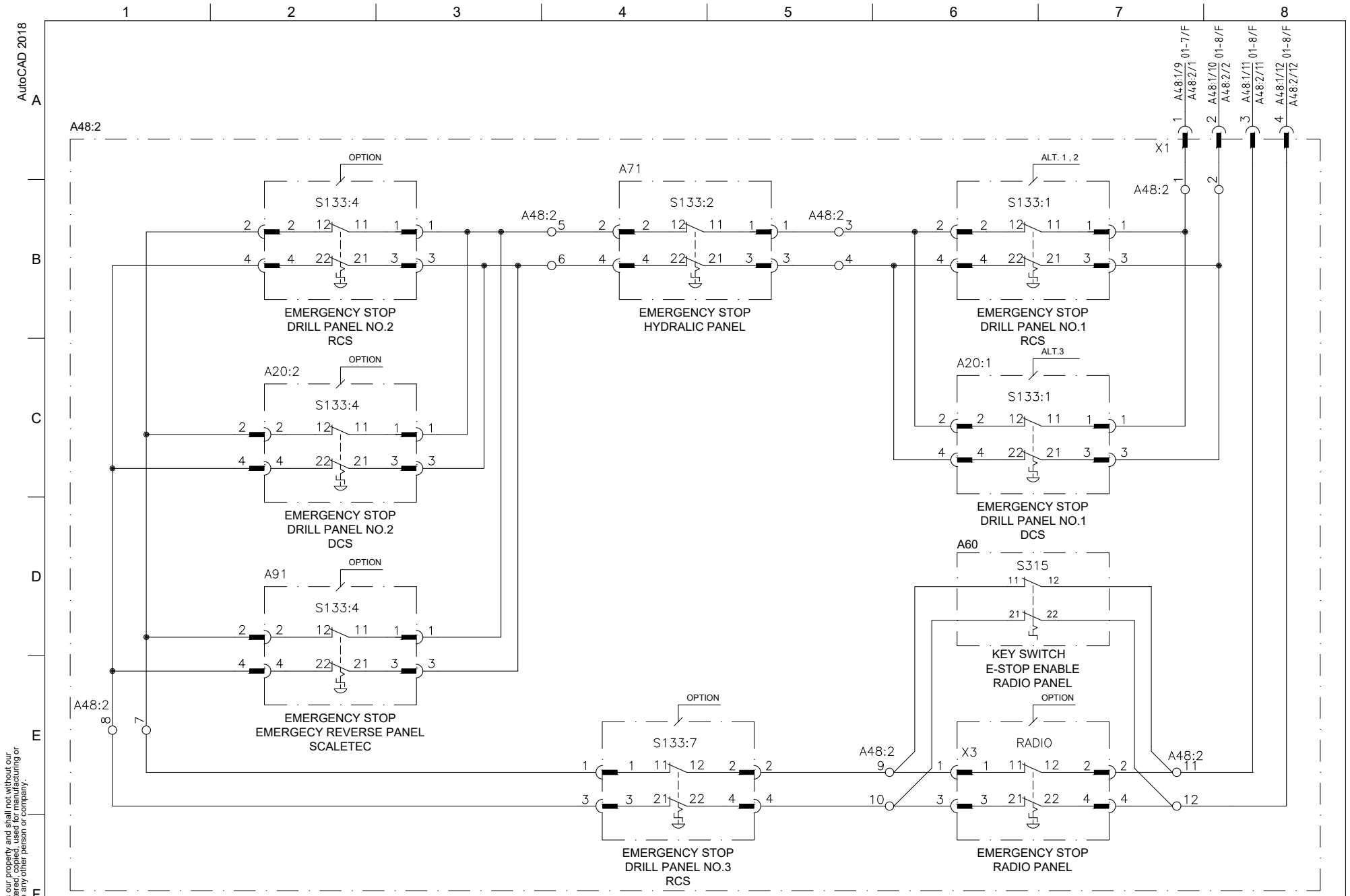
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| Status Released | Date 2012-10-31 | Compare | 5112013266 |



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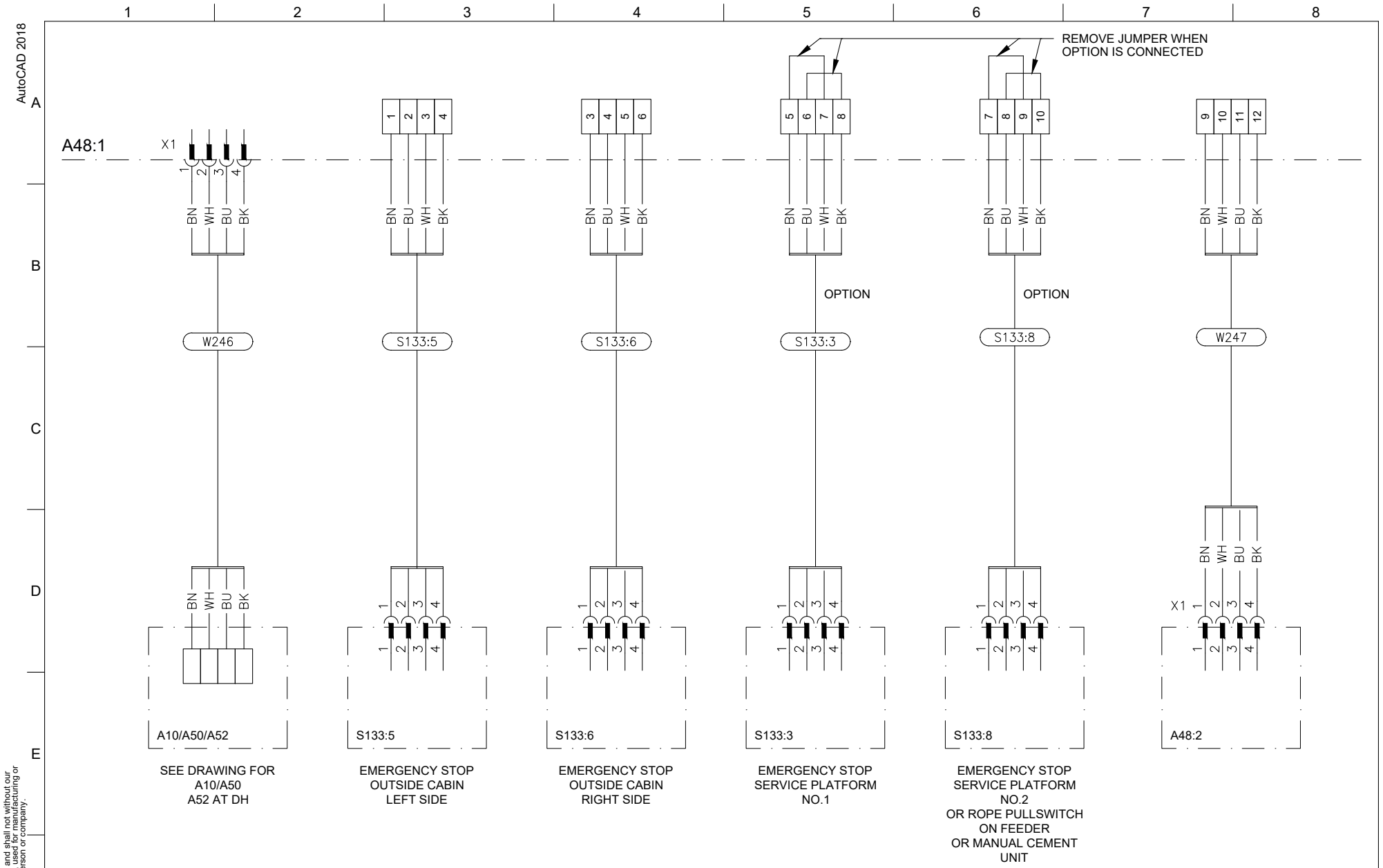
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Drawn: TMGXSIS
Design chd.
Date: 2012-10-31
Approver
Drawing owner: TMG
Compare

Type: EMERGENCYSTOP A3
Designation: 5112013266
Sheet: 02(05)



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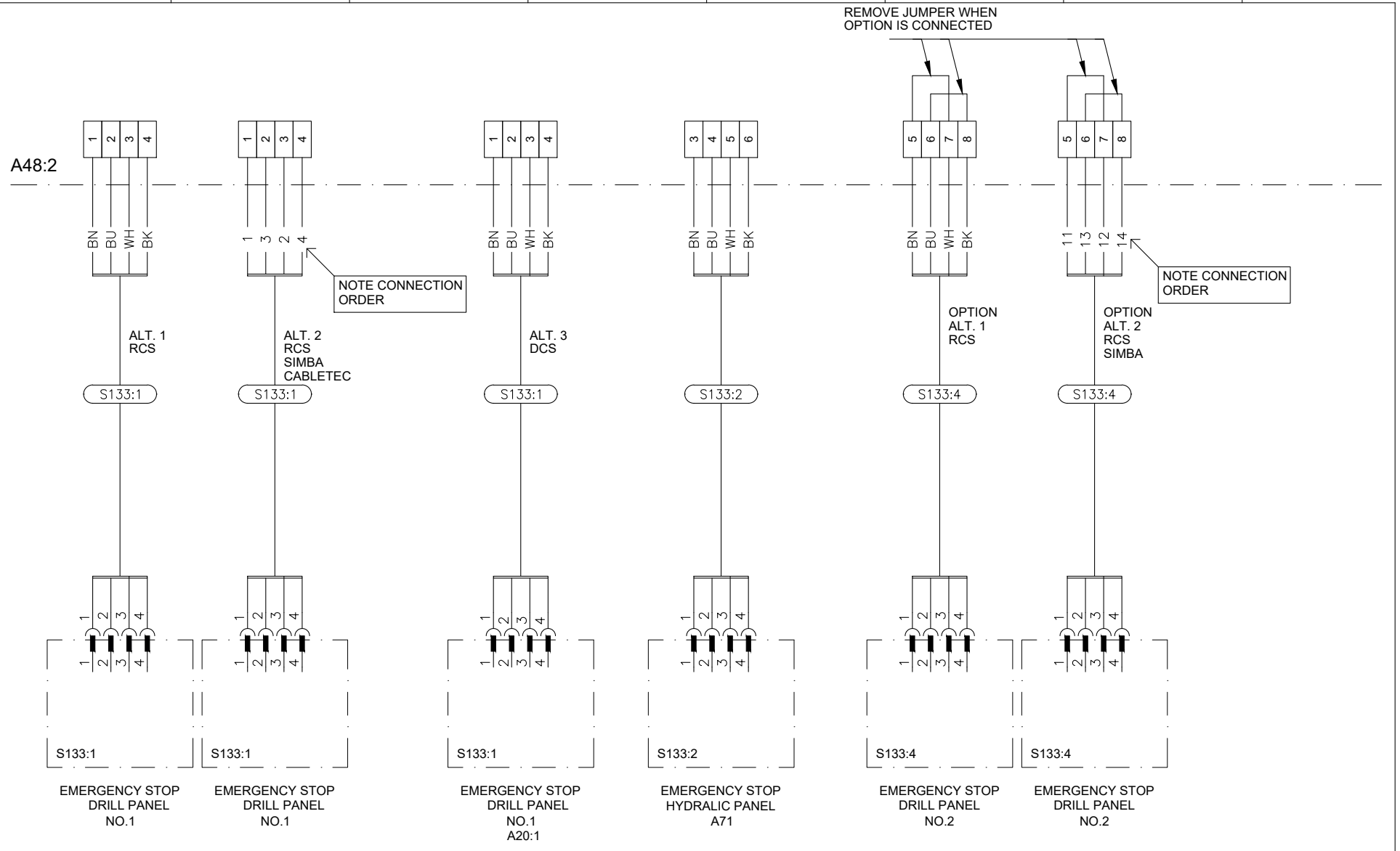
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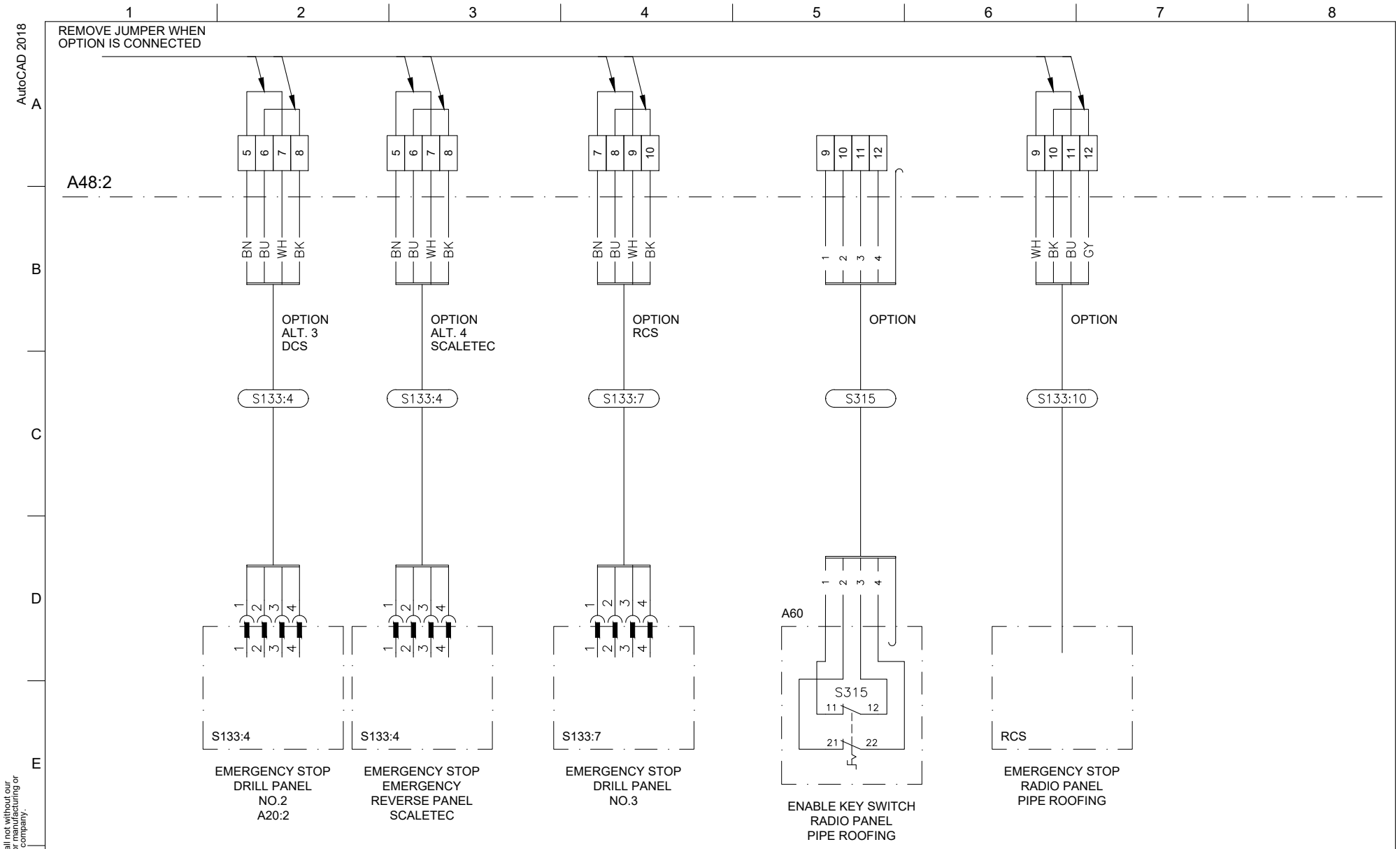
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CABIN / CANOPY A48:2

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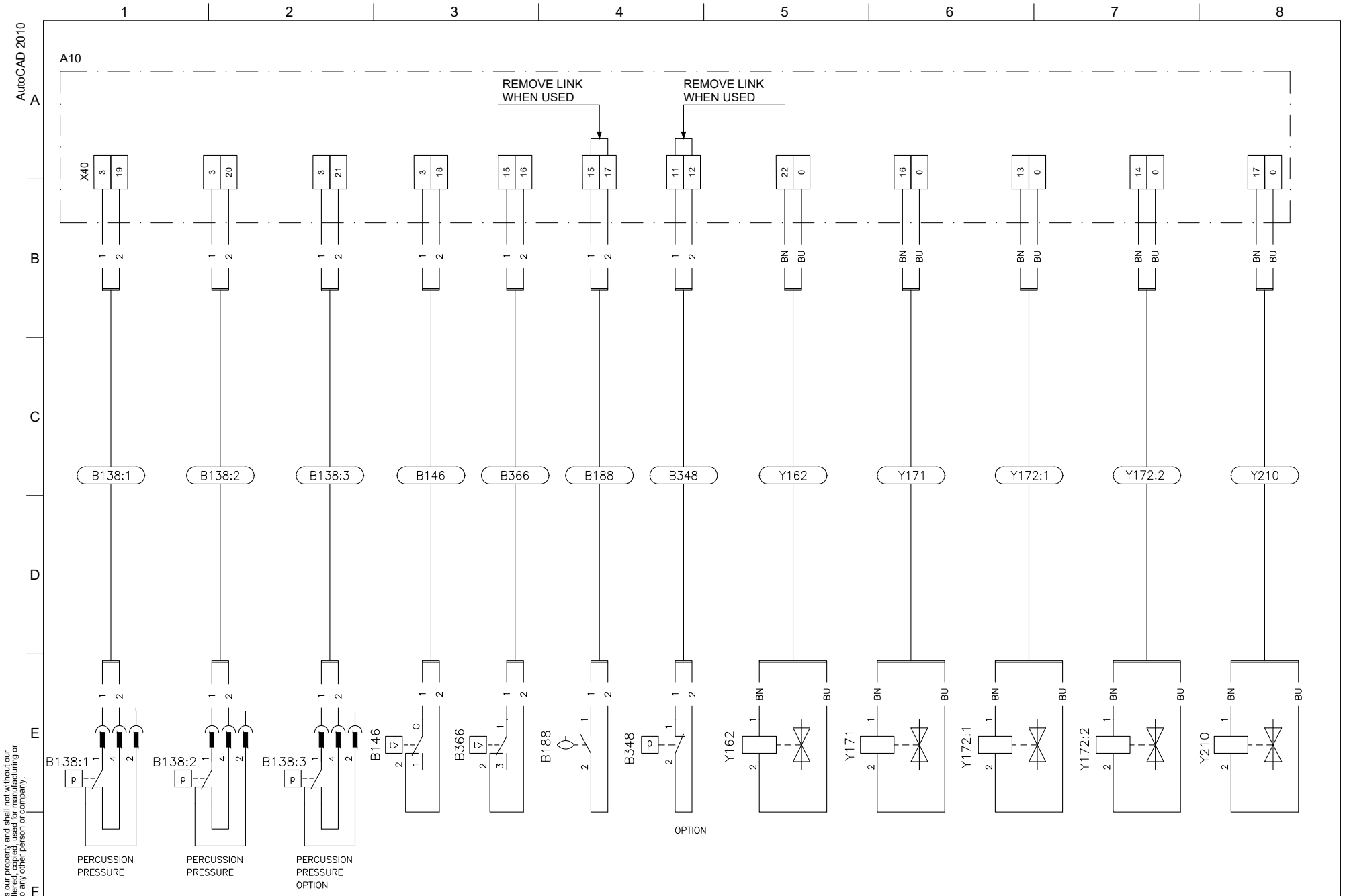
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| Confidentiality class acc.1102 K Internal | Design chd. | Drawing owner TMG | Designation Sheet 05(05) |
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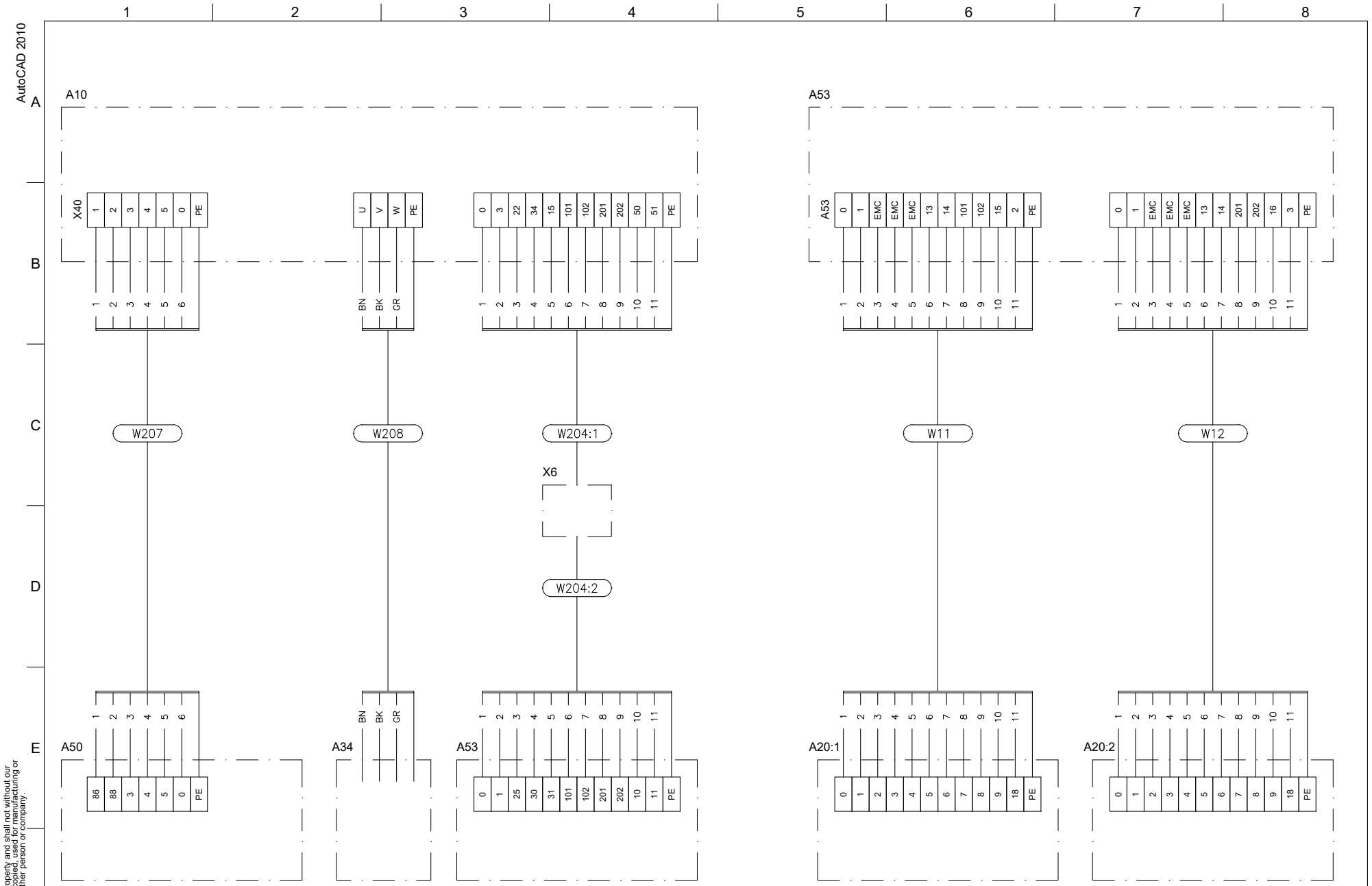
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External diagram - A10
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| Confidentiality class acc.1102 K: Internal | Design chd.: tmgheh | Drawing owner: TMG | Designation: 9106014834 — Sheet: 01(06) |
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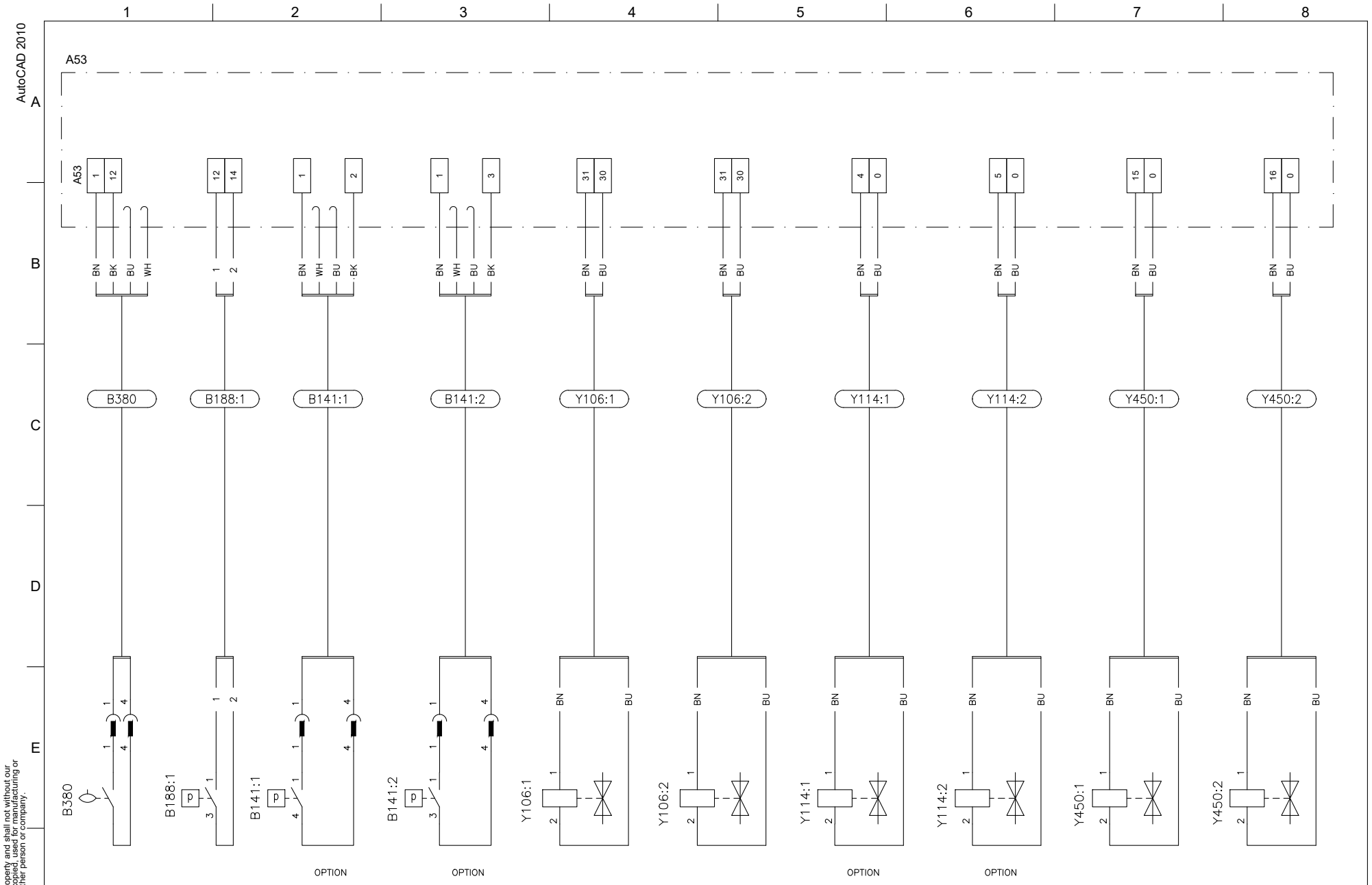
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External diagram - A10
DCS 400-690V Y/D-start IEC

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| Transf. fr. | Drawn: tmglj | Approver: tmgjml | Type: M/L/E — A3 |
| Confidentiality class acc.1102 K: Internal | Design chd.: tmgheh | Drawing owner: TMG | Designation: 9106014834 — Sheet: 02(06) |
| Status: Released | Date: 2014-10-24 | Compare | |



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| 007 | | New B138 with M12 TMG1805414 | 2018-06-27 | tmgheh | tmglj | tmglj |

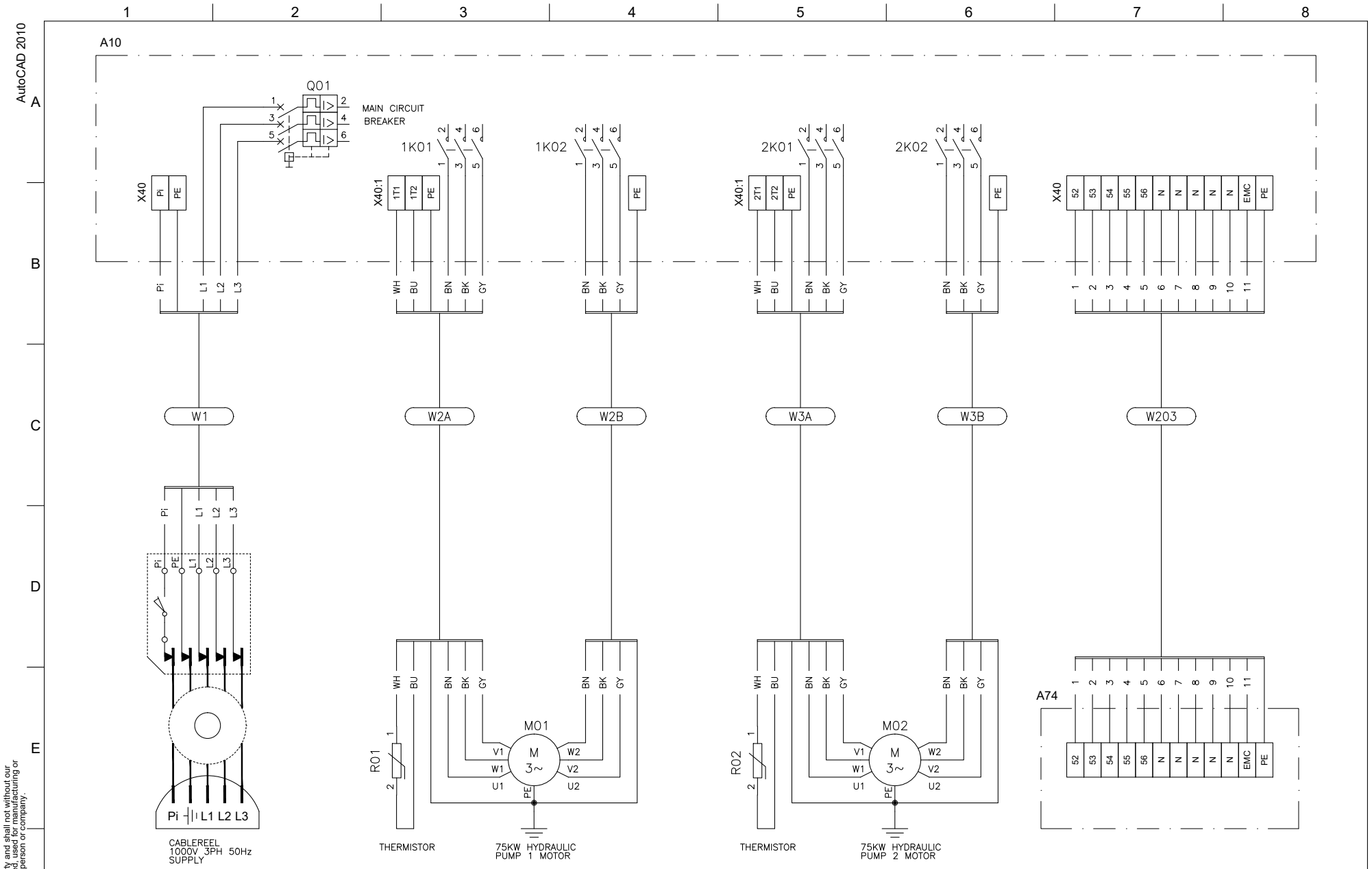
Name: Electrical system - Power
External diagram - A10
DCS 400-690V Y/D-start IEC

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| Transf. fr. | Drawn: tmglj | Approver: tmgjml | Type: M/L/E — A3 |
| Confidentiality class acc.1102 K: Internal | Design chd.: tmgheh | Drawing owner: TMG | Designation: 9106014834 — Sheet: 03(06) |
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| 007 | | New B138 with M12 TMG1805414 | 2018-06-27 | tmgheh | tmglj | tmglj |

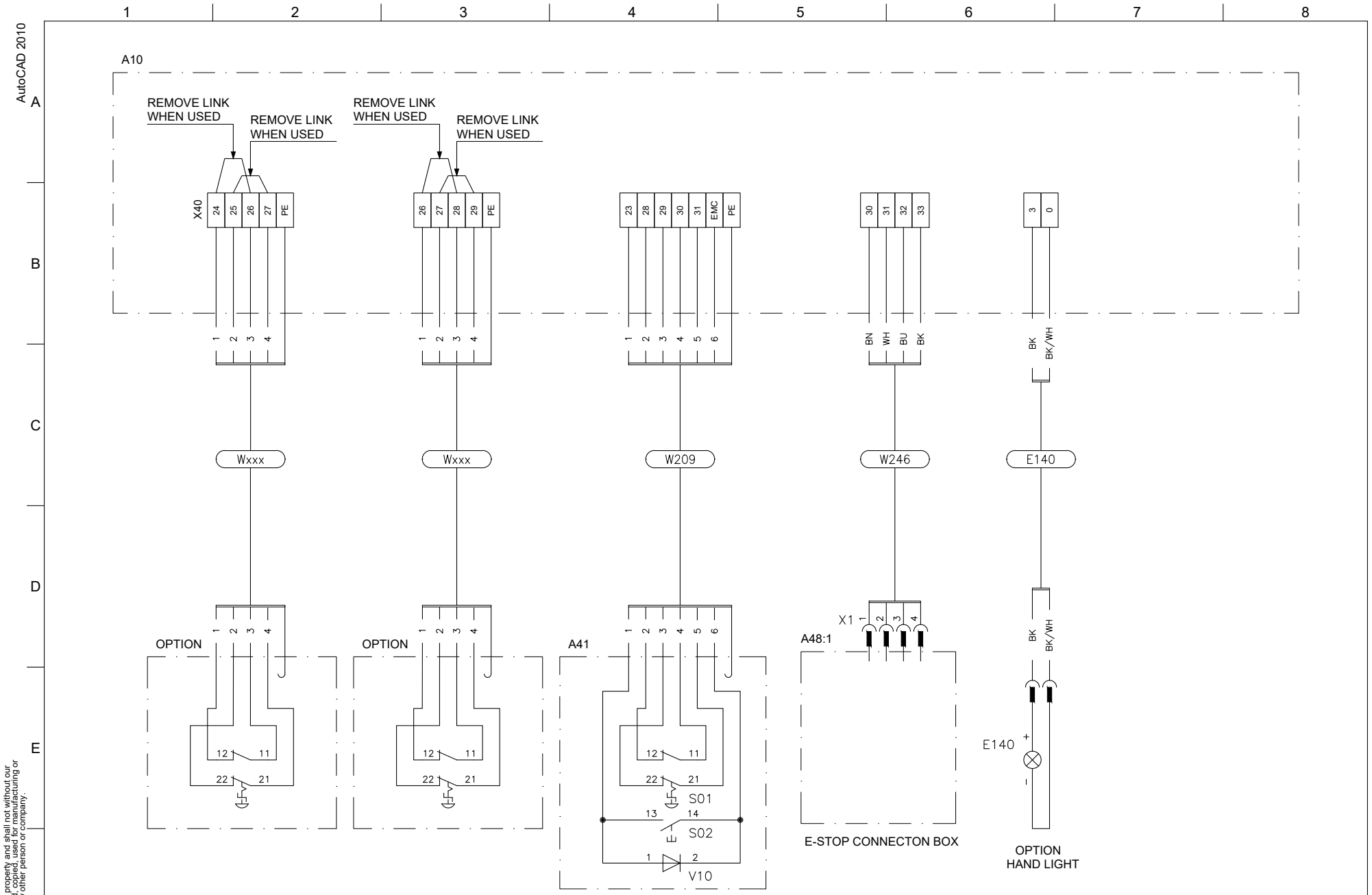
Name: Electrical system - Power
External diagram - A10
DCS 400-690V Y/D-start IEC

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| Transf. fr. | Drawn: tmglj | Approver: tmgjml | Type: M/L/E — A3 |
| Confidentiality class acc.1102 K: Internal | Design chd.: tmgheh | Drawing owner: TMG | Designation — Sheet: 04(06) |
| Status: Released | Date: 2014-10-24 | Compare | 9106014834 |



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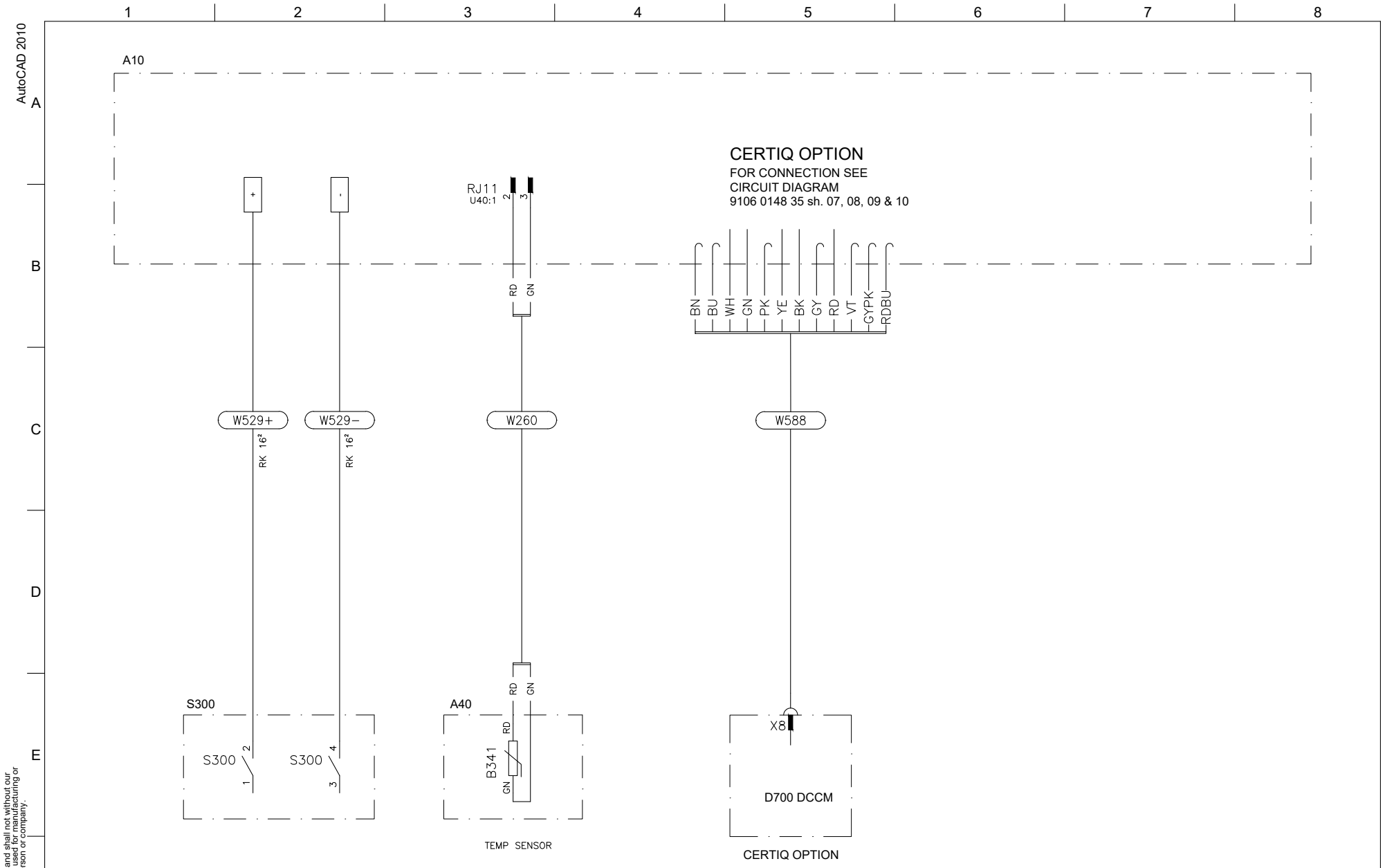

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| 007 | | New B138 with M12 TMG1805414 | 2018-06-27 | tmgheh | tmglj | tmglj |

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| Name: Electrical system - Power | Transf. fr. | Drawn: tmglj | Approver: tmgjml | Type: M/L/E | A3 |
| External diagram - A10 | Confidentiality class acc.1102 K: Internal | Design chd.: tmgheh | Drawing owner: TMG | Designation | Sheet: 05(06) |
| DCS 400-690V Y/D-start IEC | Status: Released | Date: 2014-10-24 | Compare | 9106014834 | |



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Name: Electrical system - Power
External diagram - A10
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| Transf. fr. | Drawn: tmglj | Approver: tmgjml | Type: M/L/E | A3 |
| Confidentiality class acc.1102 K: Internal | Design chd.: tmgheh | Drawing owner: TMG | Designation | Sheet: 06(06) |
| Status: Released | Date: 2014-10-24 | Compare | 9106014834 | |



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| DESIGN. | DESCRIPTION | LOC | INST | SHEET |
|---|---|---|---|---|
| A34 | EXTERNAL OUTLET MAIN VOLTAGE OR TRANSFORMER(OPTION) | A34 | | 03 |
| A41 | EMERGENCY STOP BOX WITH PILOTE TEST | A41 | | 11 |
| A48:1 | EMERGENCY STOP CONNECTION BOX | A48:1 | | 11 |
| A50 | MAIN CONNECTION BOX FOR CARRIER ELECTRICS | A50 | | 06 |
| A74 | CONNECTION PANEL IN CABIN OR CANOPY | A74 | | 04 |
| B138:1 | PERCUSSION PRESSURE SWITCH | B138:1 | | 07 |
| B138:2 | PERCUSSION PRESSURE SWITCH | B138:2 | | 07 |
| B138:3 | PERCUSSION PRESSURE SWITCH | B138:3 | | 07 |
| B141:1 | WATER FLOW GUARD | B141:1 | | 11 |
| B141:2 | WATER FLOW GUARD | B141:2 | | 11 |
| B146 | HYDRAULIC OIL TEMP GUARD | B146 | | 08 |
| B188 | PRESSURE SWITCH COMPRESSOR UNLOADING | B188 | | 08 |
| B188:1 | ECL AIR PRESSURE SWITCH | B188:1 | | 09 |
| B348 | PRESSURE SWITCH FIRE SUPRESSION SYSTEM | B348 | | 07 |
| B366 | COMPRESSOR OIL TEMP GUARD | B366 | | 08 |
| B380 | ECL OIL LEVEL SWITCH | B380 | | 09 |
| ECL | PULSE RELAY FOR ROCKDRILL LUBRICATION | A10 | | 08 |
| F02 | MOTOR PROTECTION CIRCUIT BREAKER FOR EXTERNAL OUTLET OR TRANSFORMER | A10 | | 03 |
| F03 | MOTOR PROTECTION CIRCUIT BREAKER FOR TRANSF. T04 23A | A10 | | 04 |
| F10 | MOTOR PROTECTION CIRCUIT BREAKER FOR TRANSF. T02 0,4A | A10 | | 03 |
| F14 | AUTOMATIC CIRCUIT BREAKER FOR CONTACTOR COILS 6A | A10 | | 04 |
| F15 | AUTOMATIC CIRCUIT BREAKER TO CABIN 10A | A10 | | 04 |
| F16 | AUTOMATIC CIRCUIT BREAKER TO CABIN 10A | A10 | | 04 |
| F17 | AUTOMATIC CIRCUIT BREAKER TO CABIN 10A | A10 | | 04 |
| F18 | AUTOMATIC CIRCUIT BREAKER TO CABIN 10A | A10 | | 04 |
| F19 | AUTOMATIC CIRCUIT BREAKER TO BATTERY CHARGER 10A | A10 | | 04 |
| F25 | GROUND FAULT CIRCUIT BREAKER 30MA FOR F15-F19 | A10 | | 04 |
| H01 | LIGHT IN DRILL PANEL | A20:1 | | 09 |
| H01 | LIGHT IN DRILL PANEL | A20:2 | | 10 |
| H02 | SIGNAL LAMP FOR ELECTRIC MOTOR OVERLOAD AND | A10 | | 08 |
| H03 | SIGNAL LAMP FOR WRONG PHASE SEQUENCE | A10 | | 08 |
| H04 | SIGNAL LAMP FOR LOW HYDRAULIC OIL LEVEL | A10 | | 08 |
| H05 | SIGNAL LAMP FOR HIGT HYDRAULIC OIL TEMP | A10 | | 08 |
| H06 | SIGNAL LAMP FOR MAIN VOLTAGE CONNECTED | A10 | | 08 |
| H08 | ROCKDRILL LUBRICATION WARNING LIGHT | A20:1 | | 09 |
| H08 | ROCKDRILL LUBRICATION WARNING LIGHT | A20:2 | | 10 |

| DESIGN. | DESCRIPTION | LOC | INST | SHEET |
|---|---|---|---|---|
| K107 | ROCKDRILL LUBRICATION WARNING RELAY | A53 | | 09 |
| K107T | ROCKDRILL LUBRICATION WARNING TIME RELAY | A53 | | 09 |
| K141:1 | RELAY FOR WATER PUMP START CIRCUIT | A53 | | 11 |
| K141:2 | RELAY FOR WATER PUMP START CIRCUIT | A53 | | 11 |
| K20 | RELAY FOR LOW HYDRALIC OIL LEVEL | A10 | | 06 |
| K21 | RELAY FOR HIGH HYDRAULIC OIL TEMP | A10 | | 08 |
| K50 | PHASE SEQUENCE RELAY | A10 | | 03 |
| K51 | GROUND FAULT RELAY 300MA AND 500MS | A10 | | 08 |
| K53 | EMERGENCY STOP RELAY | A10 | | 11 |
| M01 | ELECTRIC MOTOR PUMP 1 | M01 | | 05 |
| M02 | ELECTRIC MOTOR PUMP 2 | M02 | | 05 |
| M10 | COOLING FAN IN ELECTRICAL CABINET | A10 | | 04 |
| P01 | VOLT/AMPERE/HOUR-METER | A10 | | 07 |
| Q01 | MAIN CIRCUIT BREAKER | A10 | | 03 |
| Q01:1 | UNDERVOLTAGE COIL INSIDE MCCB | A10 | | 07 |
| S01 | EMERGENCY STOP BUTTON | A41 | | 11 |
| S02 | PILOTE TEST BUTTON | A41 | | 11 |
| S03 | LAMP TEST BUTTON | A10 | | 08 |
| S10 | ANTI PARALLELL PUSH BUTTON | A20:1 | | 09 |
| S10 | ANTI PARALLELL PUSH BUTTON | A20:2 | | 10 |
| S105 | PUMP START BUTTON IN DRILL PANEL | A20:1 | | 09 |
| S105 | PUMP START BUTTON IN DRILL PANEL | A20:2 | | 10 |
| S106 | PUMP STOP BUTTON IN DRILL PANEL | A20:1 | | 09 |
| S106 | PUMP STOP BUTTON IN DRILL PANEL | A20:2 | | 10 |
| S11 | CIRCUIT BREAKER CONTROL VOLTAGE ELECTRIC MOTOR | A10 | | 09 |
| S12 | CIRCUIT BREAKER CONTROL VOLTAGE ELECTRIC MOTOR | A10 | | 10 |
| S23 | DOOR LIMIT SWITCH | A10 | | 07 |
| S24 | DOOR LIMIT SWITCH | A10 | | 07 |
| T02 | TRANSFORMER 115V AC | A10 | | 03 |
| T04 | TRANSFORMER 115 AND 230V AC 8KVA | A10 | | 04 |
| T10 | CURRENT TRANSFORMER FOR K51 GROUND FAULT RELAY | A10 | | 03 |
| U40:1 | BATTERY CHARGER 60A | A10 | | 04 |
| U40:2 | BATTERY CHARGER 60A | A10 | | 04 |
| U41 | POWER SUPPLY UNIT 24V DC 1A | A10 | | 06 |
| V02 | DIOD UNIT FOR EMERGENCY STOP CIRCUIT | A10 | | 06 |
| V03 | DIODE UNIT FOR WATER PUMP START | A53 | | 11 |
| V10 | DIODE FOR PILOTE CIRCUIT | A41 | | 11 |

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Name: Electrical system - Power
Circuit diagram - A10
DCS 400-690V Y/D-start IEC

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| | tmglj | tmgjml | M/L/E | A3 |
| Confidentiality class acc.1102 K | Design chd. | Drawing owner | Designation | Sheet |
| Internal | tmgheh | TMG | | 1 (12) |
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| DESIGN. | DESCRIPTION | LOC | INST | SHEET |
|---|---|---|---|---|
| Y106:1 | ROCKDRILL LUBRICATION PUMP | Y106:1 | | 10 |
| Y106:2 | ROCKDRILL LUBRICATION PUMP | Y106:2 | | 10 |
| Y114:1 | VALVE FOR STOP DRILLING WHEN NO WATER FLOW | Y114:1 | | 11 |
| Y114:2 | VALVE FOR STOP DRILLING WHEN NO WATER FLOW | Y114:2 | | 11 |
| Y162 | WATERPUMP START VALVE | Y162 | | 11 |
| Y171 | COMPRESSOR START VALVE | Y171 | | 08 |
| Y172:1 | UNLOADING VALVE HYDRAULIC PUMP (POS PUMP) | Y172:1 | | 07 |
| Y172:2 | UNLOADING VALVE HYDRAULIC PUMP (POS PUMP) | Y172:2 | | 07 |
| Y210 | COMPRESSOR UNLOADING VALVE | Y210 | | 08 |
| Y450:1 | ANTIPARALLELL HOLDING VALVE | Y450:1 | | 09 |
| Y450:2 | ANTIPARALLELL HOLDING VALVE | Y450:2 | | 10 |
| 1F01 | ELECTRONIC OVERLOAD RELAY FOR ELECTRIC MOTOR | A10 | | 05 |
| 1K01 | MAIN CONTACTOR ELECTRIC MOTOR | A10 | | 09 |
| 1K01T | STAR/DELTA TIME RELAY | A10 | | 09 |
| 1K02 | DELTA CONTACTOR ELECTRIC MOTOR | A10 | | 09 |
| 1K03 | STAR CONTACTOR ELECTRIC MOTOR | A10 | | 09 |
| 1K11 | START RELAY ELECTRIC MOTOR | A10 | | 09 |
| 1R01 | THERMISTOR INSIDE ELECTRIC MOTOR | M01 | | 05 |
| 1T11 | CURRENT TRANSFORMER ELECTRIC MOTOR | A10 | | 05 |
| 2F01 | ELECTRONIC OVERLOAD RELAY FOR ELECTRIC MOTOR | A10 | | 05 |
| 2K01 | MAIN CONTACTOR ELECTRIC MOTOR | A10 | | 10 |
| 2K01T | STAR/DELTA TIME RELAY | A10 | | 10 |
| 2K02 | DELTA CONTACTOR ELECTRIC MOTOR | A10 | | 10 |
| 2K03 | STAR CONTACTOR ELECTRIC MOTOR | A10 | | 10 |
| 2K11 | START RELAY ELECTRIC MOTOR | A10 | | 10 |
| 2R01 | THERMISTOR INSIDE ELECTRIC MOTOR | M02 | | 05 |
| 2T11 | CURRENT TRANSFORMER ELECTRIC MOTOR | A10 | | 05 |

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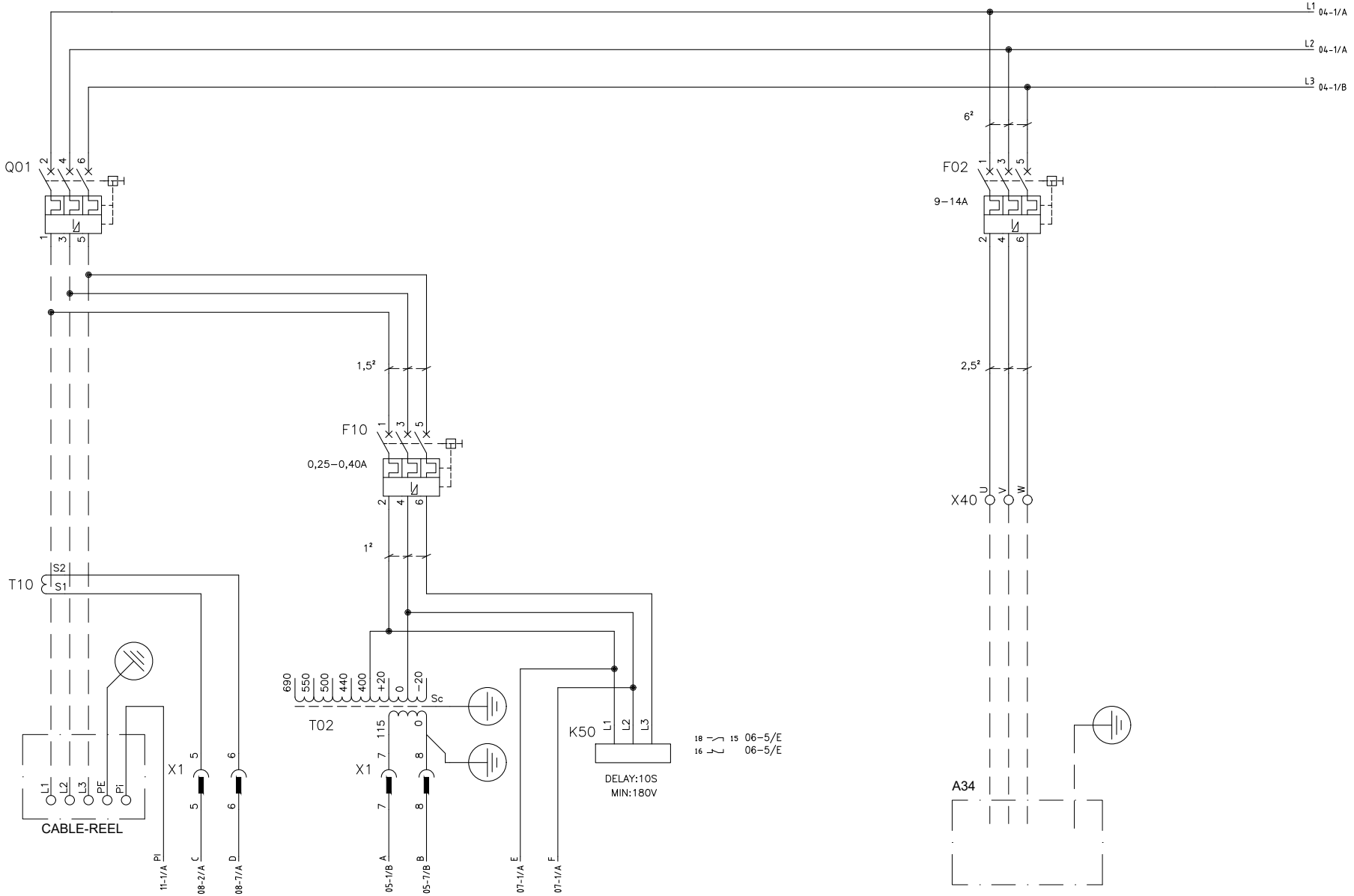
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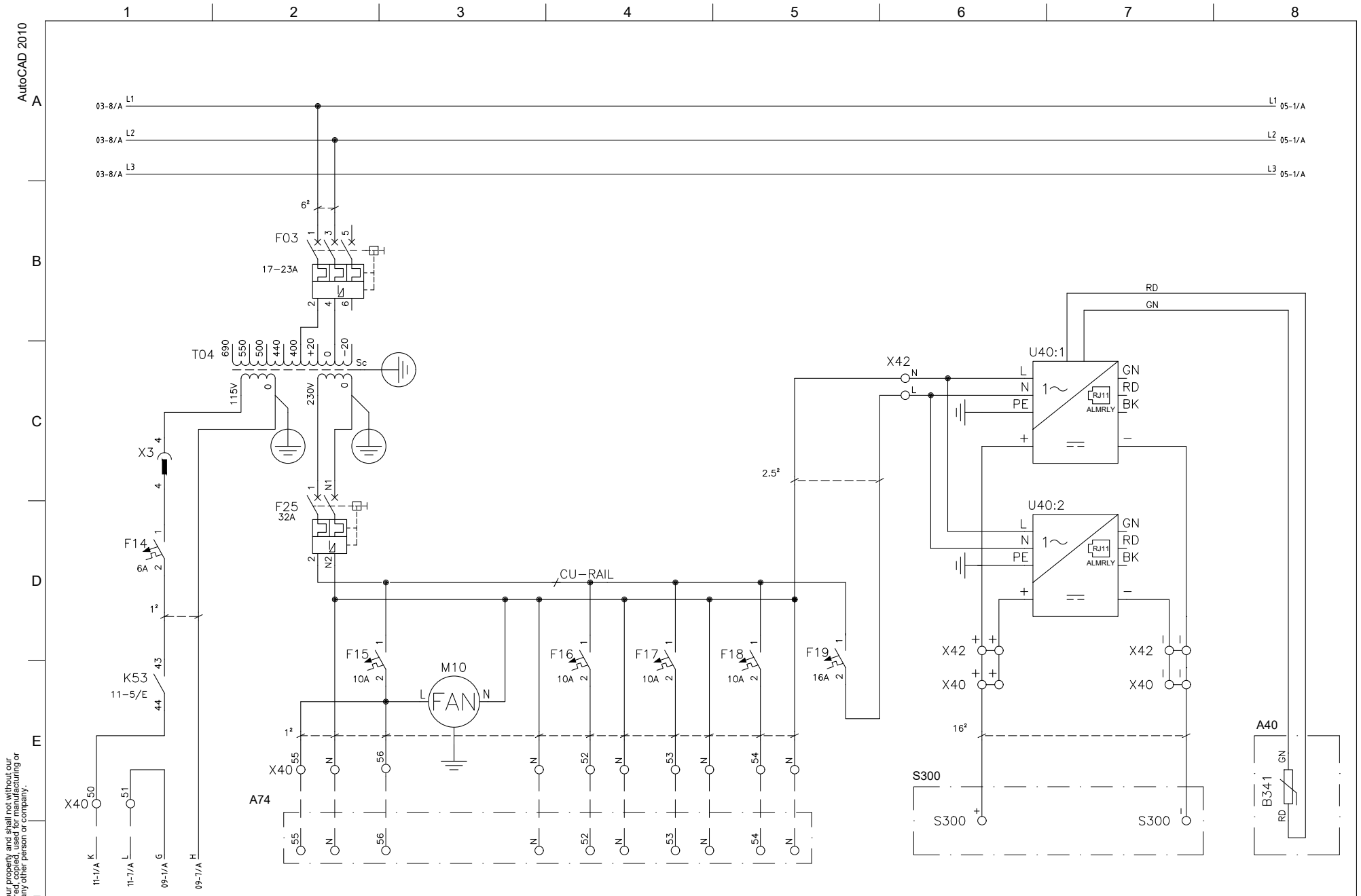
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| Confidentiality class acc.1102 K: Internal | Design chd.: tmgheh | Drawing owner: TMG | Designation | Sheet: 3 (12) |
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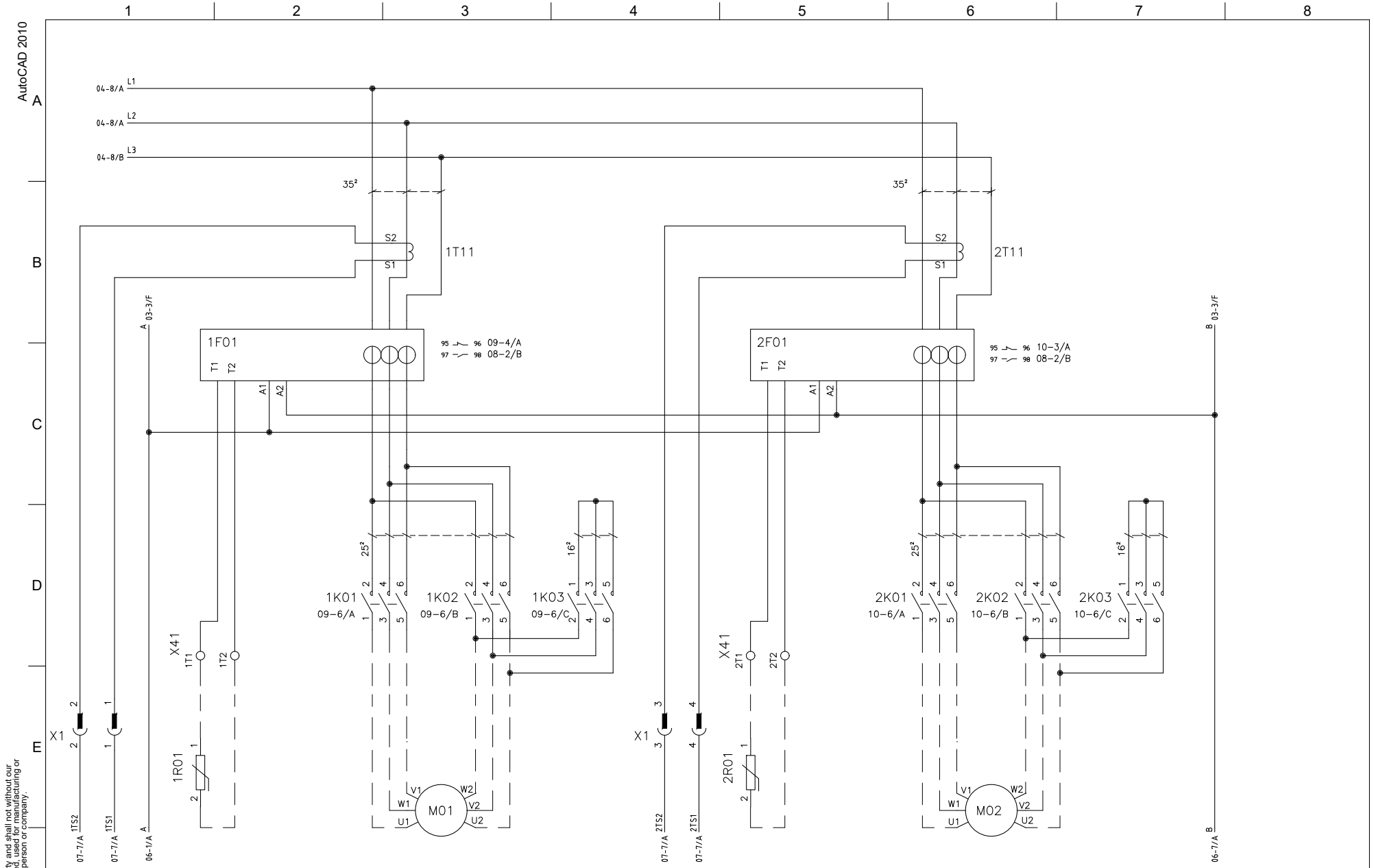
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| Confidentiality class acc.1102 K | Design chd. | Drawing owner | Designation | Sheet |
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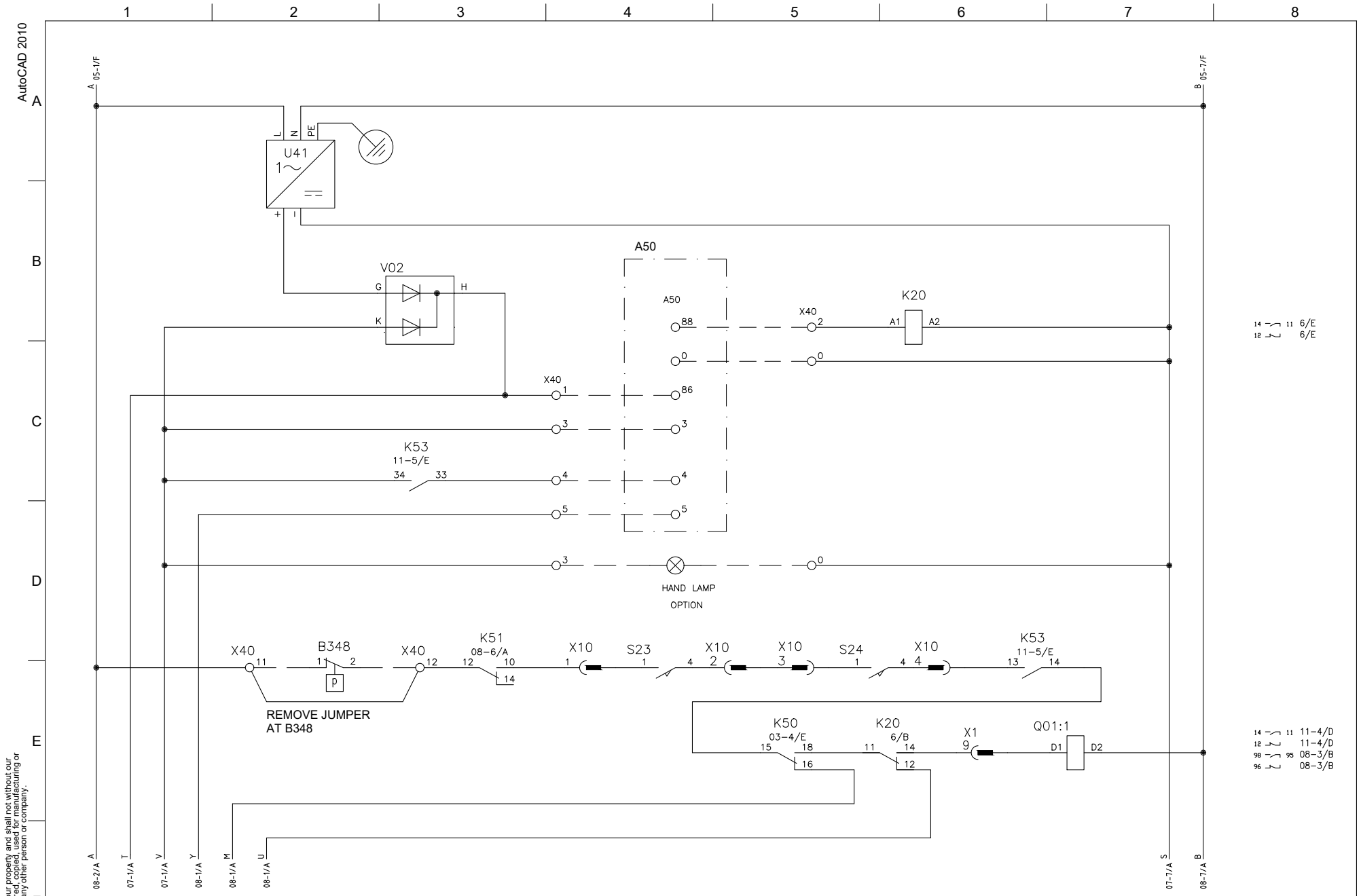
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| Name: Electrical system - Power | Transf. fr. | Drawn: tmglj | Approver: tmgjml | Type: M/L/E | A3 |
| Circuit diagram - A10 | Confidentiality class acc.1102 K: Internal | Design chd.: tmgheh | Drawing owner: TMG | Designation | Sheet: 5 (12) |
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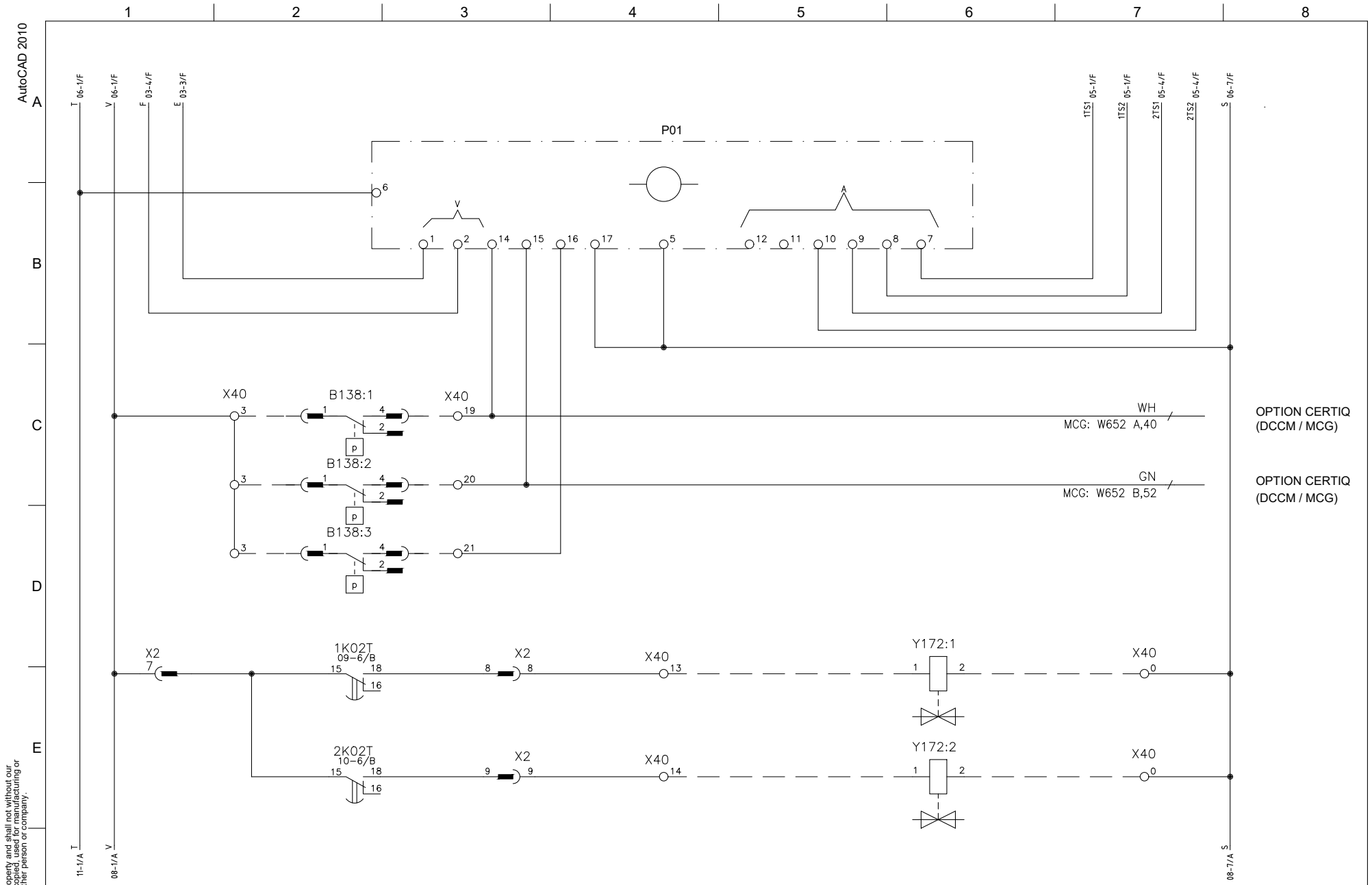
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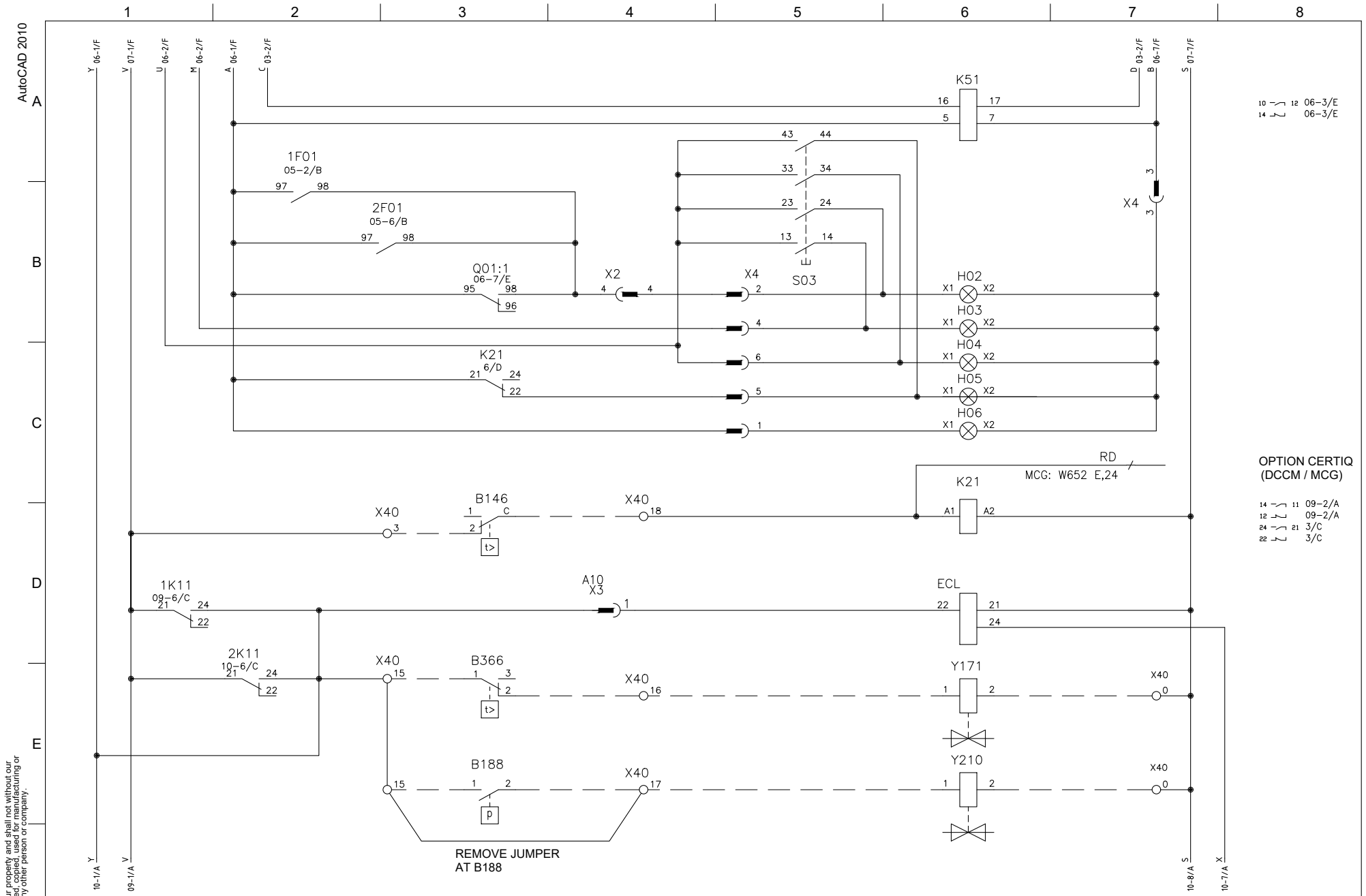
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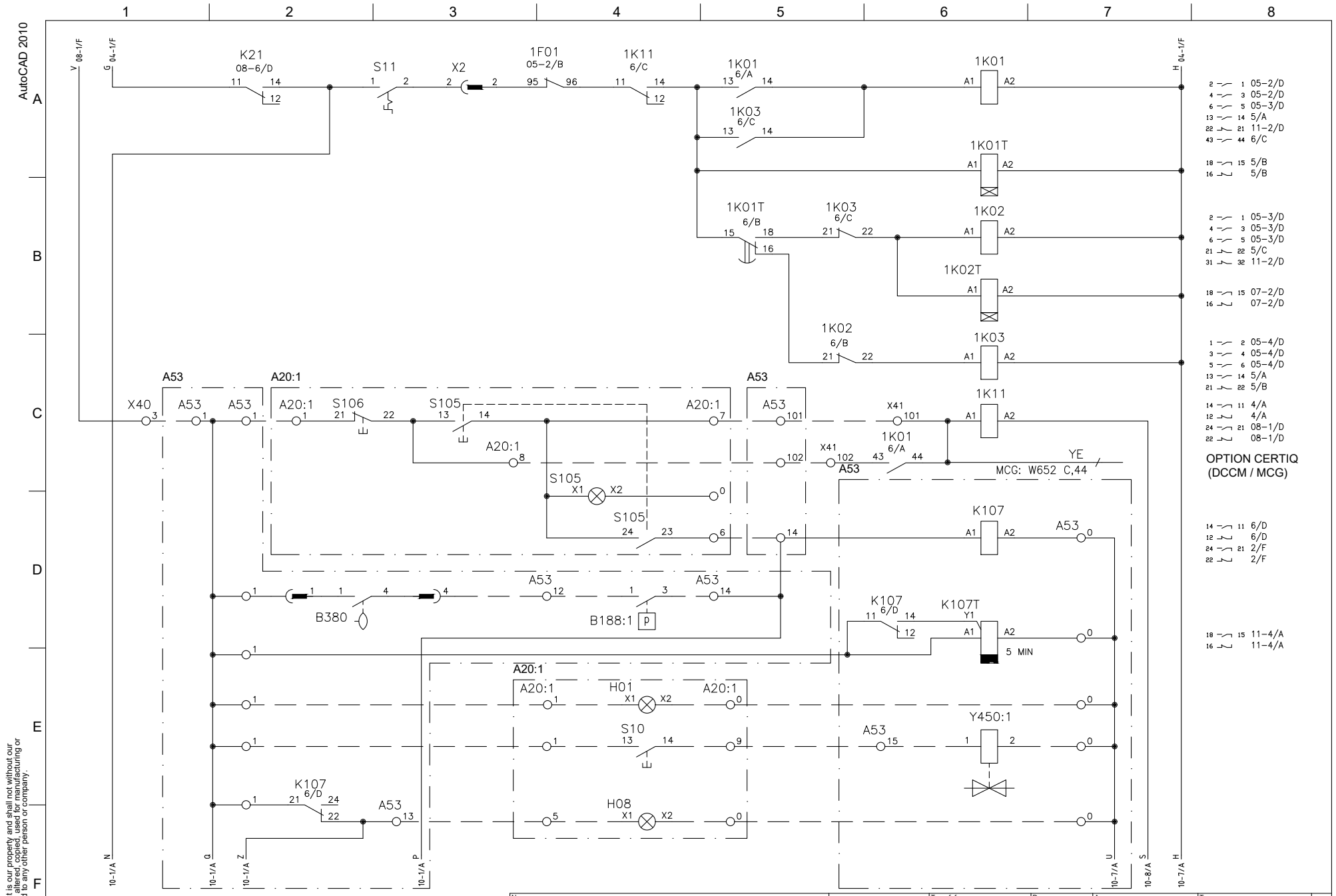
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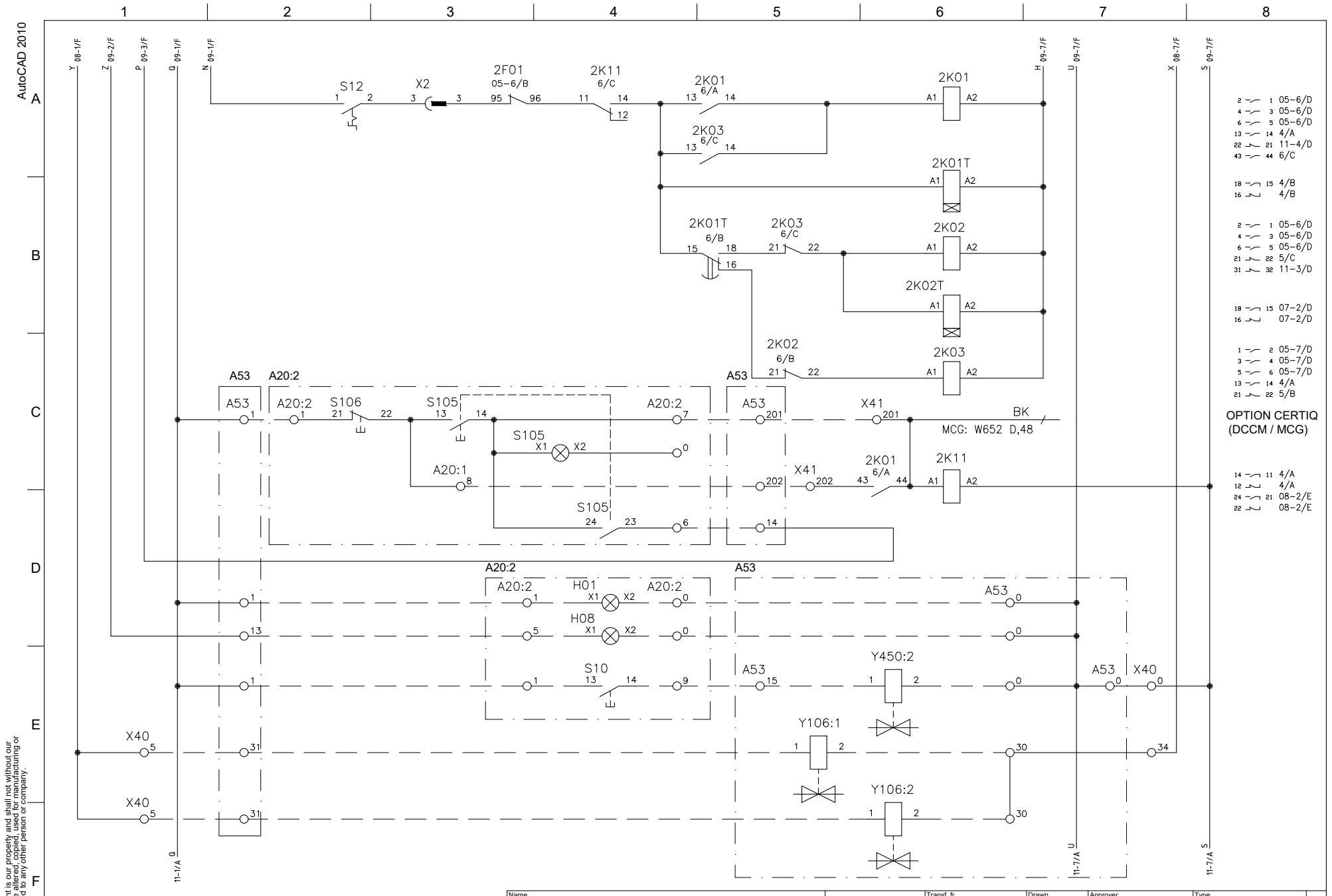
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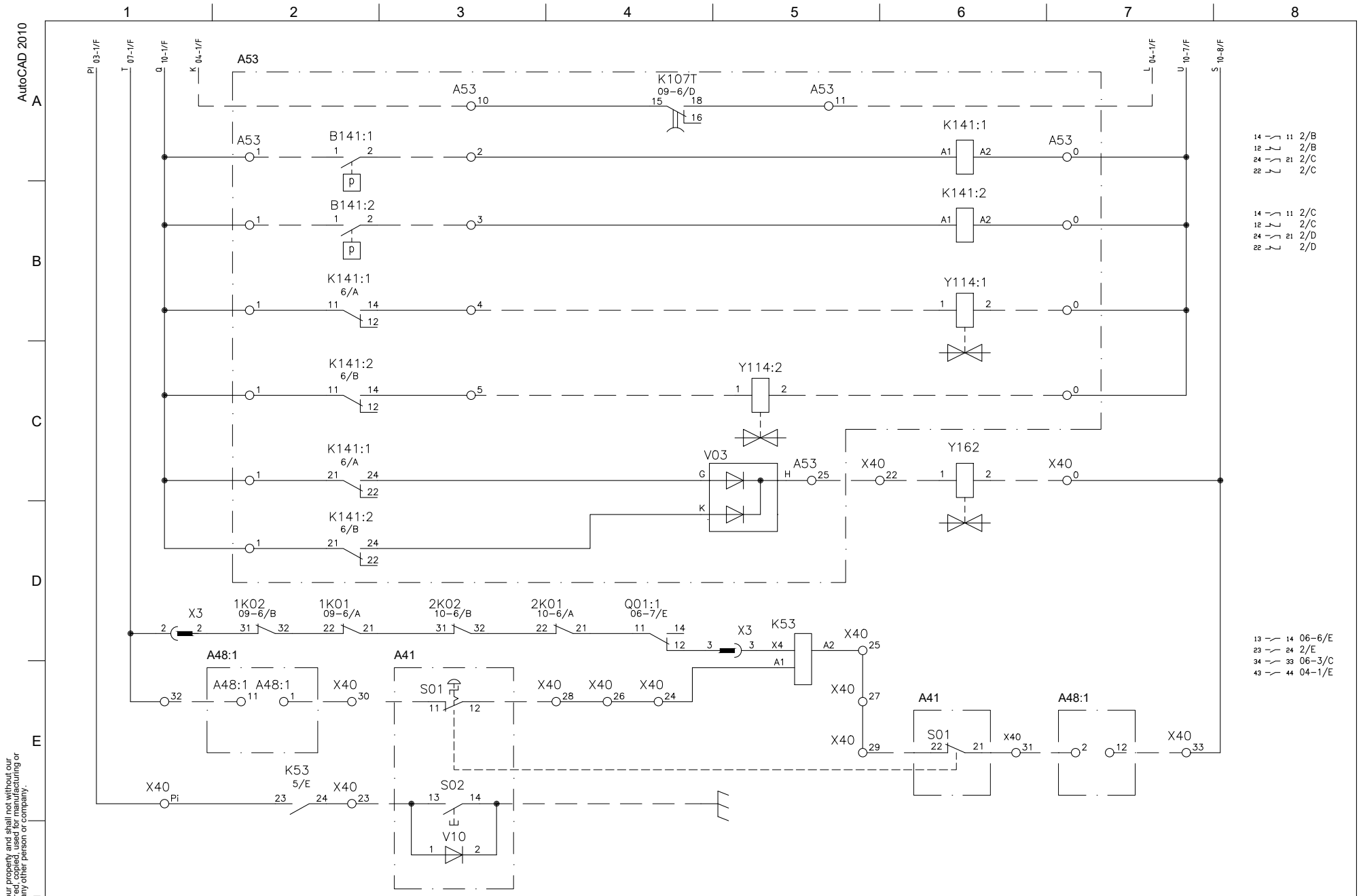
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| Released | 2014-10-24 | | 9106014835 | |



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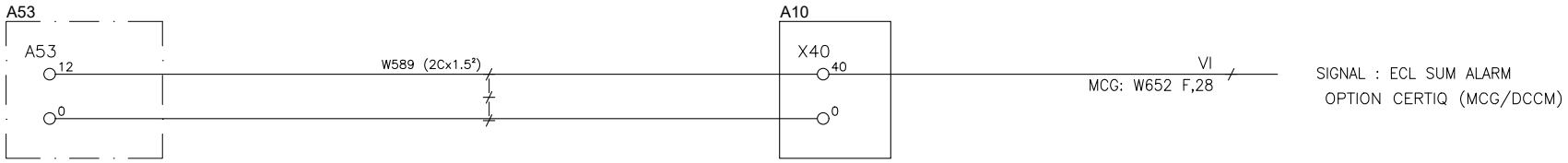
| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 014 | - | -- | 2022-08-02 | mhnpta | mhnds | mhnds |

| | | | | | |
|---|---|---|---|---|---|
| Name: Electrical system - Power | Transf. fr. | Drawn: tmglj | Approver: tmgjml | Type: M/L/E | A3 |
| Circuit diagram - A10 | Confidentiality class acc.1102 K: Internal | Design chd.: tmgheh | Drawing owner: TMG | Designation | Sheet: 11(12) |
| DCS 400-690V Y/D-start IEC | Status: Released | Date: 2014-10-24 | Compare | 9106014835 | |

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CABLE W589 FROM A53 TO A10 CABINET
& TERMINAL X40:40 ADDED IN A10 CABINET FOR CERTIQ OPTION.

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| 014 | - | -- | 2022-08-02 | mhnpta | mhnds | mhnds |

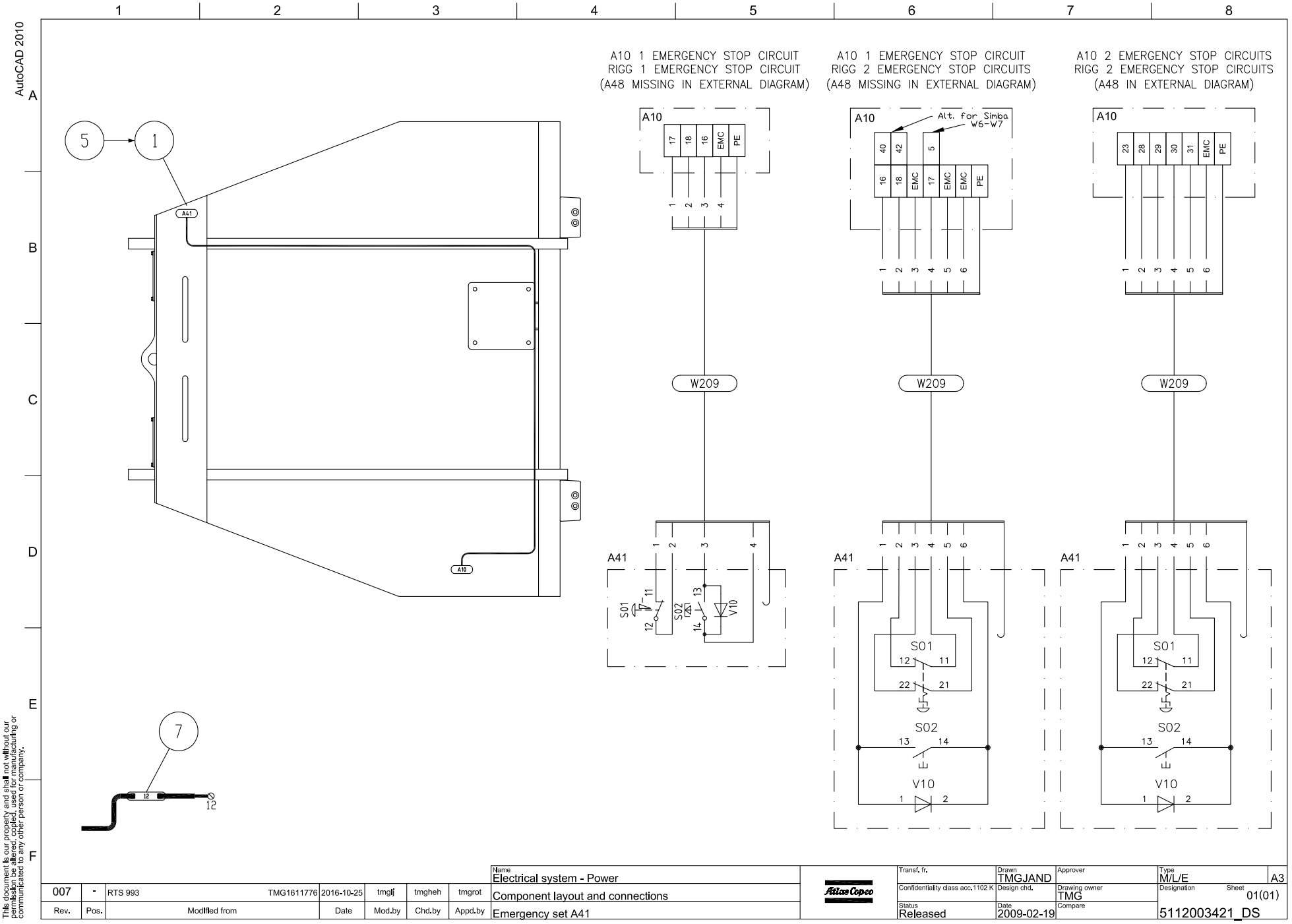
Name: Electrical system - Power
Circuit diagram - A10
DCS 400-690V Y/D-start IEC

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| Transf. fr. | Drawn | Approver | Type | |
|---|---|---|---|---|
| | tmglj | tmgjml | M/L/E | A3 |
| Confidentiality class acc.1102 K | Design chd. | Drawing owner | Designation | Sheet |
| Internal | tmgheh | TMG | 9106014835 | 12(12) |
| Status | Date | Compare | | |
| Released | 2014-10-24 | | | |



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| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 007 | - | RTS 993 TMG1611776 | 2016-10-25 | tmglj | tmgheh | tmgrot |

| | | | |
|---|---|---|---|
| Name: Electrical system - Power | Transf. fr. | Drawn: TMGJAND | Approver |
| Component layout and connections | Confidentiality class acc.1102 K | Design chd. | Drawing owner: TMG |
| Emergency set A41 | Status: Released | Date: 2009-02-19 | Compare |

| | |
|---|---|
| Type: M/L/E | A3 |
| Designation: 5112003421_DS | Sheet: 01(01) |



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| DESIGN. | DESCRIPTION | SHEET |
|---|---|---|
| A10 | ELECTRICAL CABINET | 09,26 |
| A40 | APPARATUS CABINET | 05,10,24,28 |
| A47 | CONTROL BOX COOLANT FILLING PUMP | 23 |
| A50 | CONTROL BOX CARRIER | |
| A51 | CONNECTION BOX BOOM FRAME | 08,15 |
| A52 | CONNECTION BOX REAR FRAME | |
| A54 | FORCED LUBRICATION PUMP | 22 |
| A55 | JUNCTION BOX BRAKE SYSTEM | |
| A57 | MANOUVRE BOX REELS | 14 |
| A58 | CONTROL BOX AIR CONDITION | 21 |
| A61:1;A61:2 | SWELLEX | 22 |
| A65 | FAM | 21 |
| A71 | MANOUVRE PANEL | 11,15,17,19 |
| A72 | PANEL AIR CONDITION | 15,27 |
| A74 | WORKING LIGHT PANEL | 24 |
| A76 | CONTROL UNIT SPOT LIGHT | 10,20 |
| A81 | CONTROL BOX OIL FILLING PUMP | 23 |
| A87 | HIAB CRANE BOX (EASER MACHINE) | 11 |
| A89 | REEL SWING | 24 |
| A90 | MANOUVRE BOX GUIDING REELS | 15 |
| A98 | PAN/TILT CONTROL BOX (WATER CANNON) | 10 |
| A100 | FUSE BOX | 05 |
| A107 | FORM OIL PUMP | 23 |
| B143 | HYDRAULIC OIL LEVEL SWITCH | 09 |
| B186 | LUBRICATION PRESSURE SWITCH | 22 |
| B229 | REVERSE CAMERA | 12 |
| B334 | WATER LEVEL SWITCH FUEL FILTER | 07 |
| B341 | CHARGER TEMP.SENSOR | 05 |
| B348:2 | FIRE SUPPRESSION PRESSURE SWITCH | 05 |
| B350 | BRAKE OIL PRESSURE SWITCH | 09 |
| B351 | PARKING BRAKE PRESSURE SWITCH | 13 |
| B352 | FUEL LEVEL SWITCH | 09 |
| B353 | ENGINE OIL PRESSURE SWITCH | 08 |
| B355 | TRANSMISSION OIL PRESSURE INDICATION SWITCH | 13 |
| B356 | TRANSMISSION OIL PRESSURE INTERLOCK SWITCH | 11 |
| B357 | TRANSMISSION OIL TEMP SWITCH | 13 |
| B358 | CABLE REEL LIMIT SWITCH | 11,13 |
| B360 | AIR FILTER PRESSURE SWITCH | 13 |

| DESIGN. | DESCRIPTION | SHEET |
|---|---|---|
| B361 | COOLANT LEVEL SWITCH | 13 |
| B364 | BRAKE LIGHT PRESSURE SWITCH | 08 |
| B381 | AIR CONDITION PRESSURE SWITCH | 21 |
| B382 | ELECTRICAL FOOT THROTTLE | 07 |
| B383 | PARTICULATE FILTER FULL WARNING SWITCH | 08 |
| B392R | GULLWING DOOR SWITCH RIGHT | 25 |
| B392L | GULLWING DOOR SWITCH LEFT | 25 |
| D700 | CERTIQ DCCM OPTION DCS | 07, 08, 09, 13 |
| D717 | PROFILER OPTION | 10 |
| D721 | ROUTER RCS4 | 10 |
| D771 | WIRELESS BRIDGE | 08 |
| EMR | DIESEL ENGINE CONTROL UNIT | 07 |
| E101 | TRAMMING LIGHT FRAME REAR | 16 |
| E102 | TRAMMING LIGHT FRAME FRONT | 16 |
| E103 | TRAMMING LIGHT ROOF FRONT | 16 |
| E104 | TRAMMING LIGHT ROOF REAR | 16 |
| E105 | STAIR LIGHT LEFT | 15 |
| E106 | STAIR LIGHT RIGHT | 15 |
| E107 | EXTRA LIGHT | 15 |
| E108 | FULL & LOW BEAM | 16 |
| E109 | SPOTLIGHT LEFT | 20 |
| E110 | SPOTLIGHT RIGHT | 20 |
| E111 | CABIN LIGHT | 20 |
| E113 | RADIO/MEDIA-PLAYER | 19 |
| E114 | REMOTE SPOTLIGHT LEFT | 20 |
| E116 | REMOTE SPOTLIGHT RIGHT | 20 |
| E122 | WORKING LIGHT LEFT | 27 |
| E123 | WORKING LIGHT RIGHT | 27 |
| E127 | POSITION LIGHT FRONT | 10 |
| E128 | POSTION LIGHT REAR | 25 |
| E134 | POS. LASER LEFT | 11 |
| E135 | POS. LASER RIGHT | 11 |
| E136 | CABIN HEATER | 26 |
| E137 | LASER UPWARDS | 11 |
| E140 | HAND LAMP | 24 |
| E141:1 | TRAMMING LIGHT RIGHT | 15 |

NOTE:
USE RK 1.5mm² UNLESS OTHERWISE STATED,
IN ENCLOSURE, INTERNAL CONNECTION.

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| 027 | - | | 2022-08-02 | mhnpta | mhnds | mhnds |

Name: ELECTRICAL SYSTEM - CONTROL
CIRCUIT DIAGRAM

Epiroc

| Transf. fr. | Drawn | Approver | Type | |
|---|---|---|---|---|
| | ipcvik | tmgrot | M/E MK9 TIER3A | A3 |
| Confidentiality class acc.1102 K | Design chd. | Drawing owner | Designation | Sheet |
| Internal | tmgbrk | TMG | | 1 (30) |
| Status | Date | Compare | 5112015081 | |
| Released | 2014-10-09 | | | |

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AutoCAD 2010



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| DESIGN. | DESCRIPTION | SHEET |
|---|---|---|
| E141:2 | TRAMMING LIGHT LEFT | 15 |
| E148 | CRANE LAMP | 27 |
| E152 | BOLT CAMERA LAMP | 27 |
| EH/DH | OPTION EH/DH | 6,7,9,11 |
| EH/DH | OPTION EH/DH | 12,13 |
| EH/DH | OPTION EH/DH | 26,27,29 |
| F100-F106 | RCS FUSE | 25 |
| F108 | FUSE MANOEUVRE EL. SYSTEM | 05 |
| F111 | FUSE PREE HEATING | 05 |
| F112 | FUSE MANOEUVRE | 06 |
| F113 | FUSE MANOEUVRE | 06 |
| F114 | FUSE OIL FILLING PUMP | 06 |
| F115 | FUSE AIR CONDITION | 06 |
| F116 | FUSE MANOEUVRE | 06 |
| F117 | FUSE TRAMMING LIGHT | 06 |
| F118 | FUSE TRAMMING LIGHT | 06 |
| F119 | FUSE MANOEUVRE | 06 |
| F124 | FUSE RCS SYSTEM | 05 |
| F125 | FUSE WORKING LIGHT LEFT (OPTION EH/DH) | 06 |
| F126 | FUSE WORKING LIGHT RIGHT (OPTION EH/DH) | 06 |
| F131 | FUSE EMR | 05 |
| F132 | FUSE HYDRAULIC OIL AIR COOLING | 06 |
| F135 | MCB A40 | 05 |
| F136 | MCB A50 | 05 |
| F137 | MCB SCR | 05 |
| F141 | FUSE SMALL BAT. CHARGER OPTION | 10 |
| F150 | MAIN FUSE CARRIER | 05 |
| F156 | FUSE CHARGING EQUIPMENT OPTION | 06 |
| F160 | FUSE PROFILER OPTION | 06 |
| F162 | FUSE MANOEUVRE | 05 |
| F766 | FUSE DRILLSTOP OPTION (DCS) | 06 |
| G100 | MAIN BATTERY | 05 |
| G101 | ALTERNATOR | 08 |
| H101 | EXHAUST EMISSION FILTER CONTROL INDICATION | 08 |
| H121 | REVERSE ALARM + PRE. START WARNING | 09 |
| H186 | HORN | 10 |
| H200 | PRE HEATING INDICATION | 07 |
| H201 | CHARGING INDICATION | 08 |
| H202 | ENGINE OIL PRESSURE INDICATION | 13 |

| DESIGN. | DESCRIPTION | SHEET |
|---|---|---|
| H203 | HYDRAULIC OIL LEVEL INDICATION | 13 |
| H204 | ENGINE TEMP INDICATION | 07 |
| H205 | TRANSMISSION OIL TEMP. INDICATION | 13 |
| H206 | BRAKE OIL PRESSURE INDICATION | 13 |
| H207 | AIR FILTER INDICATION | 13 |
| H208 | PARKING BRAKE INDICATION | 13 |
| H209 | CABLE REEL INDICATION | 13 |
| H210 | COOLANT LEVEL INDICATION | 13 |
| H211 | TURN SIGNAL INDICATION LEFT | 17 |
| H212 | TURN SIGNAL INDICATION RIGHT | 17 |
| H215 | WARNING LIGHT (BEACON) | 11 |
| H217 | TAIL, BRAKE, TURN LIGHT | 10,17 |
| H219 | TRANSMISSION OIL PRESSURE INDICATION | 13 |
| H220 | ENGINE ALARM | 07 |
| H245 | DIESEL POSITIONING PRESSURE | 14 |
| K16 | RCS POWER RELAY | 10 |
| K101 | START RELAY | 09 |
| K102 | HYDRAULIC OIL LEVEL RELAY | 09 |
| K104 | MASTER RELAY | 09 |
| K105 | ENGINE OIL PRESSURE RELAY | 08 |
| K106 | PARKING BRAKE INTERLOCK RELAY | 11 |
| K111 | EMERGENCY LIGHT RELAY | 09 |
| K112 | RELAY WIPER ON DELAY | 19 |
| K113 | REAR WIPER OFF DELAY RELAY | 19 |
| K114 | RCS SYSTEM SHUT-DOWN RELAY | 28 |
| K115 | REVERSE ALARM RELAY | 12 |
| K116 | TRAMMING LIGHT RELAY ROOF FRONT | 12 |
| K117 | TRAMMING LIGHT RELAY ROOF REAR | 12 |
| K118 | CONDENSOR FAN RELAY | 21 |
| k119 | RCS ON/OFF | 10 |
| K120 | COOLANT LEVEL RELAY (OPTION EH/DH) | 13 |
| K121 | TRAMMING LIGHT RELAY FRAME FRONT | 12 |
| K122 | TRAMMING LIGHT RELAY FRAME REAR | 12 |
| K123 | NEUTRAL GEAR RELAY (EH/DH OPTION) | 12 |
| K131 | WIPER FRONT RELAY | 19 |
| K133 | RCS PARK BRAKE INTERLOCK | 28 |
| K135 | MAIN RELAY | 05 |
| K136 | EMR POWER ON | 05 |
| K136B | EMR POWER SUPPLY RELAY | 07 |

| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 027 | - | | 2022-08-02 | mhnpta | mhnds | mhnds |

Name: ELECTRICAL SYSTEM - CONTROL
CIRCUIT DIAGRAM

Epiroc

| | | | | |
|---|---|---|---|---|
| Transf. fr. | Drawn: ipcvik | Approver: tmgrot | Type: M/E MK9 TIER3A | A3 |
| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation | Sheet: 2 (30) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015081 | |

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| DESIGN. | DESCRIPTION | SHEET |
|---|---|---|
| K137 | FULL & LOW BEAM RELAY | 17 |
| K138 | TURN SIGNAL RELAY (LEFT) | 17 |
| K139 | TURN SIGNAL RELAY (RIGHT) | 17 |
| K145 | AIRFILTER RELAY (OPTION EH/DH) | 13 |
| K148 | TIME RELAY DIESEL ENGINE START | 09 |
| K151 | EMR OFF DELAY | 05 |
| K152 | RELAY BRAKE OIL PRESSURE | 09 |
| K153 | RELAY BRAKE OIL PRESSURE | 09 |
| K157 | CABIN HEATER RELAY | 24 |
| K171 | COOLING FAN RELAY | 28 |
| K173 | WORKING LIGHT RELAY | 27 |
| K174 | WORKING LIGHT RELAY | 27 |
| K176 | RELAY GULLWING DOOR | 25 |
| K186 | SIGNAL HORN RELAY | 10 |
| K205 | EMR IGNITION SIGNAL RELAY | 09 |
| K209 | FRONT WASHER PUMP RELAY | 19 |
| M101 | STARTER | 08 |
| M102 | OIL FILLING PUMP | 23 |
| M103 | FRONT WIPER | 19 |
| M104 | FRONT WASHER PUMP | 19 |
| M107 | CONDENSOR FAN | 21 |
| M108 | REAR WIPER | 19 |
| M109 | REAR WASHER PUMP | 19 |
| M115 | HYDRAULIC OIL AIR COOLER FAN | 23 |
| M117 | COOLANT FILLING PUMP | 23 |
| M119 | FAN AIR SYSTEM WITH DEHUMIDIFICATION | 23 |
| M122 | FORM OIL PUMP AND CONCRETE REMOVER | 23 |
| N101 | PRE HEATING | 08 |
| N106 | AIR CONDITION CONTROL UNIT | 21 |
| N110 | CHAIR | 10 |
| N111 | BOLT UNIT CAMERA DISPLAY | 10 |
| P110 | HOUR METER DIESEL ENGINE | 08 |
| P111 | FUEL LEVEL METER | 09 |
| P248 | DEUTZ ENGINE DISPLAY | 07 |
| RCS | RIG CONTROL SYSTEM | 28,29 |
| R101 | PRE HEATING ELEMENT | 08 |
| R104 | END RESISTANCE RCS | 07 |

| DESIGN. | DESCRIPTION | SHEET |
|---|---|---|
| R200 | RESISTOR PRE-HEATING INDICATON | 07 |
| R201 | RESISTOR CHARGING INDICATION | 08 |
| R202 | RESISTOR ENGINE OIL PRESSURE INDICATION | 13 |
| R203 | HYDRAULIC OIL LEVEL INDICATION | 13 |
| R204 | RESISTOR ENGINE TEMP INDICATION | 07 |
| R205 | RESISTOR TRANSMISSION OIL TEMP. INDICATION | 13 |
| R206 | RESISTOR BRAKE OIL PRESSURE INDICATION | 13 |
| R207 | RESISTOR AIR FILTER INDICATION | 13 |
| R208 | RESISTOR PARKING BRAKE INDICATION | 13 |
| R209 | RESISTOR CABLE REEL INDICATION | 13 |
| R210 | RESISTOR COOLANT LEVEL INDICATION | 13 |
| R219 | RESISTOR TRANSMISSION OIL PRESSURE INDICATION | 13 |
| R220 | RESISTOR ENGINE ALARM INDICATION | 07 |
| R245 | RESISTOR DIESEL POSITIONING PRESSURE | 14 |
| S130 | DRILLING/TRAMMING SWITCH | 11 |
| S136 | BY PASS BUTTON LIMIT SWITCH | 11 |
| S137 | GEAR CHANGER SWITCH | 12 |
| S138 | PARKING BRAKE SWITCH | 11 |
| S139 | STARTER KEY | 09 |
| S141 | DIESEL POS. SWITCH | 14 |
| S143 | DUAL CONTROL CABLE REEL SWITCH | 14 |
| S144 | DUAL CONTROL WATER REEL SWITCH | 14 |
| S145 | FRONT WIPER/WASHER SWITCH | 19 |
| S147 | STAIR LIGHT SWITCH | 15 |
| S150 | CABIN HEATER SWITCH | 24 |
| S151 | WORKING LIGHT LEFT SWITCH | 27 |
| S157 | TEST BUTTON PARKING BRAKE | 11 |
| S178 | LAMP TEST BUTTON | 13 |
| S186 | HORN BUTTON | 10 |
| S195 | OIL FILLING BUTTON | 23 |
| S196 | CABIN LIGHT SWITCH | 20 |
| S207 | EXTENSION LEFT FRONT JACK SWITCH | 18 |
| S209 | REAR JACKS SWITCH | 18 |
| S210 | FRONT JACKS LEFT SWITCH | 18 |
| S211 | FRONT JACKS RIGHT SWITCH | 18 |
| S219 | COOLANT FILLING PUMP SWITCH | 23 |

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Name: ELECTRICAL SYSTEM - CIRCUIT DIAGRAM

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| | | | | |
|---|---|---|---|---|
| Transf. fr. | Drawn: ipcvik | Approver: tmgrot | Type: M/E MK9 TIER3A | A3 |
| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation | Sheet: 3 (30) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015081 | |



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| DESIGN. | DESCRIPTION | SHEET |
|---|---|---|
| S248 | CABLE REEL SWITCH | 14 |
| S249 | WATER REEL SWITCH | 14 |
| S274 | REAR WIPER/WASHER SWITCH | 19 |
| S286 | CONCRETE SPRAY PUMP | 23 |
| S300 | BATTERY SWITCH | 05 |
| S301 | MAIN RELAY SWITCH | 05 |
| S305 | HAND ACCELERATOR | 07 |
| S307 | TRAMMING LIGHT SWITCH ROOF | 12 |
| S308 | TRAMMING LIGHT SWITCH FRAME | 12 |
| S309 | LASER SWITCH | 11 |
| S311 | RCS SYSTEM ON BUTTON | 10 |
| S312 | CABLE REEL GUIDING SWITCH | 15 |
| S313 | WATER REEL GUIDING SWITCH | 15 |
| S314 | STAIRS/PLATFORM IN/OUT | 18 |
| S316 | FULL & LOW BEAM, TURN SIGNAL SWITCH | 17 |
| S319 | CABLE REEL SWING | 24 |
| S320 | WATER REEL SWING | 24 |
| S323 | LUBRICATION PUMP FORCED ON | 22 |
| S500 | PROTECTION ROOF | 18 |
| T102 | DC CONVERTER 12V OUTLET | 24 |
| T103 | DC CONVERTER 24V/24V PROFILER | 10 |
| U42:1 | 230VAC/48VDC CONVERTER | 27 |
| U42:2 | 230VAC/48VDC CONVERTER | 27 |
| U100 | BATTERY CHARGER(REMOTE CONTROL) | 10 |
| V100 | DIODE UNIT LAMP TEST | 07,13 |
| V103 | DIODE UNIT EMERGENCY LIGHT | 12 |
| V104 | DIODE UNIT EMERGENCY LIGHT | 12 |
| V105 | DIODE UNIT HORN | 10 |
| V106 | DIODE UNIT PREE START WARNING | 09 |
| V113 | DIODE UNIT EMR ON FROM RCS | 07 |
| V128 | DIODE UNIT WIPER FRONT | 19 |
| V129 | DIODE UNIT WASHER FRONT | 19 |
| V130 | DIODE UNIT GEAR IN NEUTRAL | 12 |
| XA | CHARGING EQUIPMENT | 08 |
| X11 | CHASSI GROUND CU-RAIL | 05 |
| X23 | CONNECTION DEVICE DIESEL PRE-HEAT RELAY | 08 |

| DESIGN. | DESCRIPTION | SHEET |
|---|---|---|
| X130:1 | 230 /110V AC OUTLET | 26 |
| X130:2 | 230 /110V AC OUTLET | 26 |
| X131:1 | 12V OUTLET | 24 |
| X131:2 | 12V OUTLET FOR MINE RADIO | 24 |
| X139 | DIAGNOSIS OUTLET EMR | 07 |
| X766 | DRILL STOP DCS | 08 |
| Y117:1 | LUBRICATION AIR, SHUT-OFF VALVE | 23 |
| Y117:2 | VENTILATION MEMBRANE DRYER, SHUT-OFF VALVE | 23 |
| Y156 | AIR CONDITION COMPRESSOR VALVE | 21 |
| Y203 | DIESEL POS. VALVE | 14 |
| Y204 | CABLE REEL SWING | 24 |
| Y205 | WATER REEL SWING | 24 |
| Y216 | PARKING BRAKE VALVE | 11 |
| Y217 | GEAR VALVE | 12 |
| Y218 | GEAR VALVE | 12 |
| Y219 | GEAR VALVE REVERSE | 12 |
| Y220 | GEAR VALVE FORWARD | 12 |
| Y226 | FUEL SHUT DOWN | 11 |
| Y230 | CABLE REEL GUIDING VALVE | 15 |
| Y231 | WATER REEL GUIDING VALVE | 15 |
| Y410 | REAR JACKS VALVE | 18 |
| Y411 | FRONT JACKS LEFT VALVE | 18 |
| Y412 | FRONT JACKS RIGHT VALVE | 18,22 |
| Y414 | CABLE REEL VALVE | 14,15,18 |
| Y415 | WATER REEL VALVE | 14,15 |
| Y423 | EXTENSION JACK FRONT | 18 |
| Y436 | PROTECTION ROOF | 18 |
| Y531 | SWELLEX | 22 |
| Y608 | STAIRS/PLATFORM IN/OUT | 18 |

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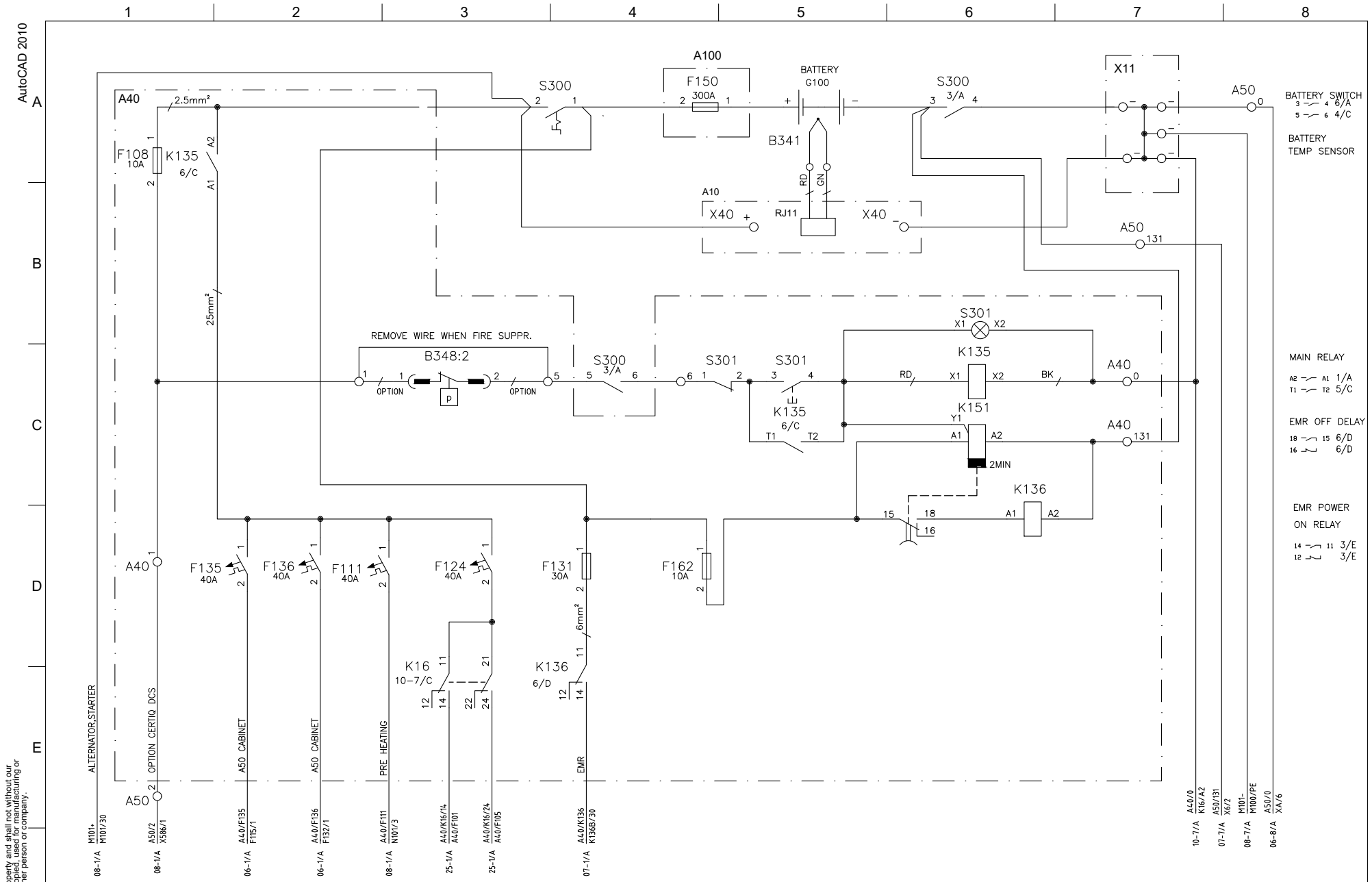
Name: ELECTRICAL SYSTEM - CONTROL
CIRCUIT DIAGRAM

Epiroc

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|---|---|---|---|---|
| Transf. fr. | Drawn: ipcvik | Approver: tmgrot | Type: M/E MK9 TIER3A | A3 |
| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation | Sheet: 4 (30) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015081 | |



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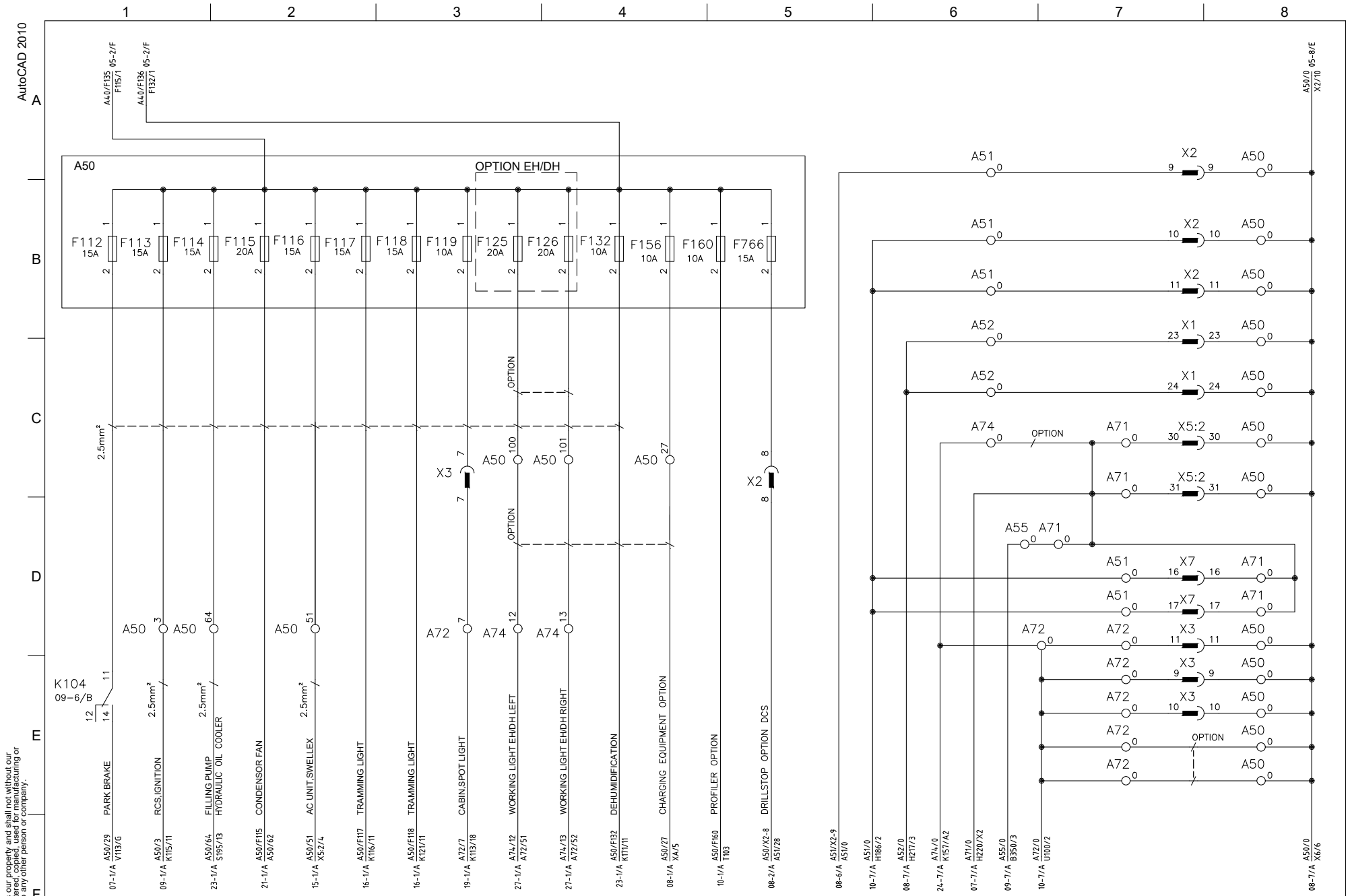
Name: ELECTRICAL SYSTEM - CONTROL
CIRCUIT DIAGRAM

Epiroc

| | | | |
|---|---|---|---|
| Transf. fr. | Drawn: ipcvik | Approver: tmgrot | Type: M/E MK9 TIER3A A3 |
| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation Sheet: 5 (30) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015081 |



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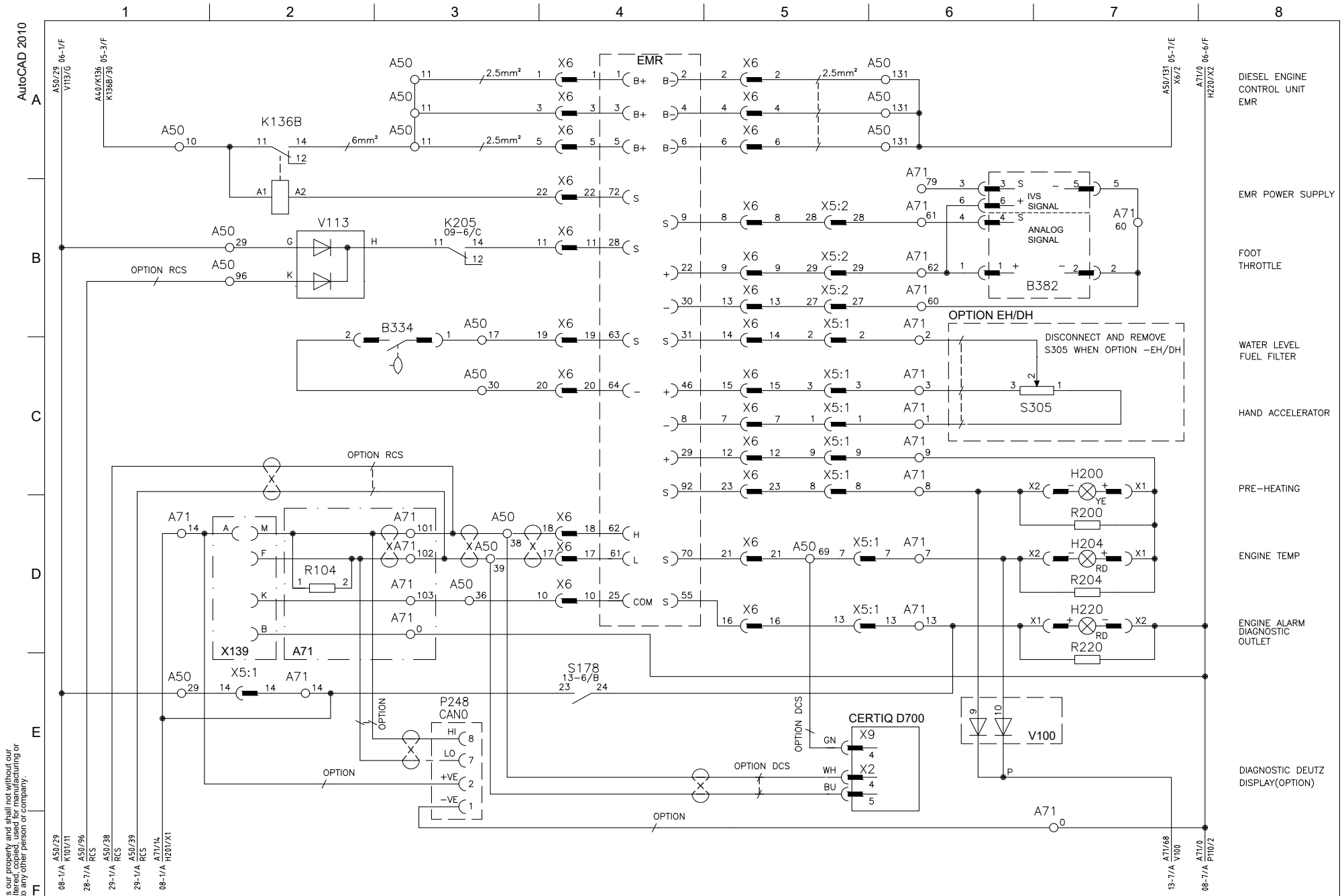
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CIRCUIT DIAGRAM

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| Transf. fr. | Drawn: ipcvik | Approver: tmgrot | Type: M/E MK9 TIER3A A3 |
| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation Sheet: 6 (30) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015081 |



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| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 027 | - | | 2022-08-02 | mhnpta | mhnds | mhnds |

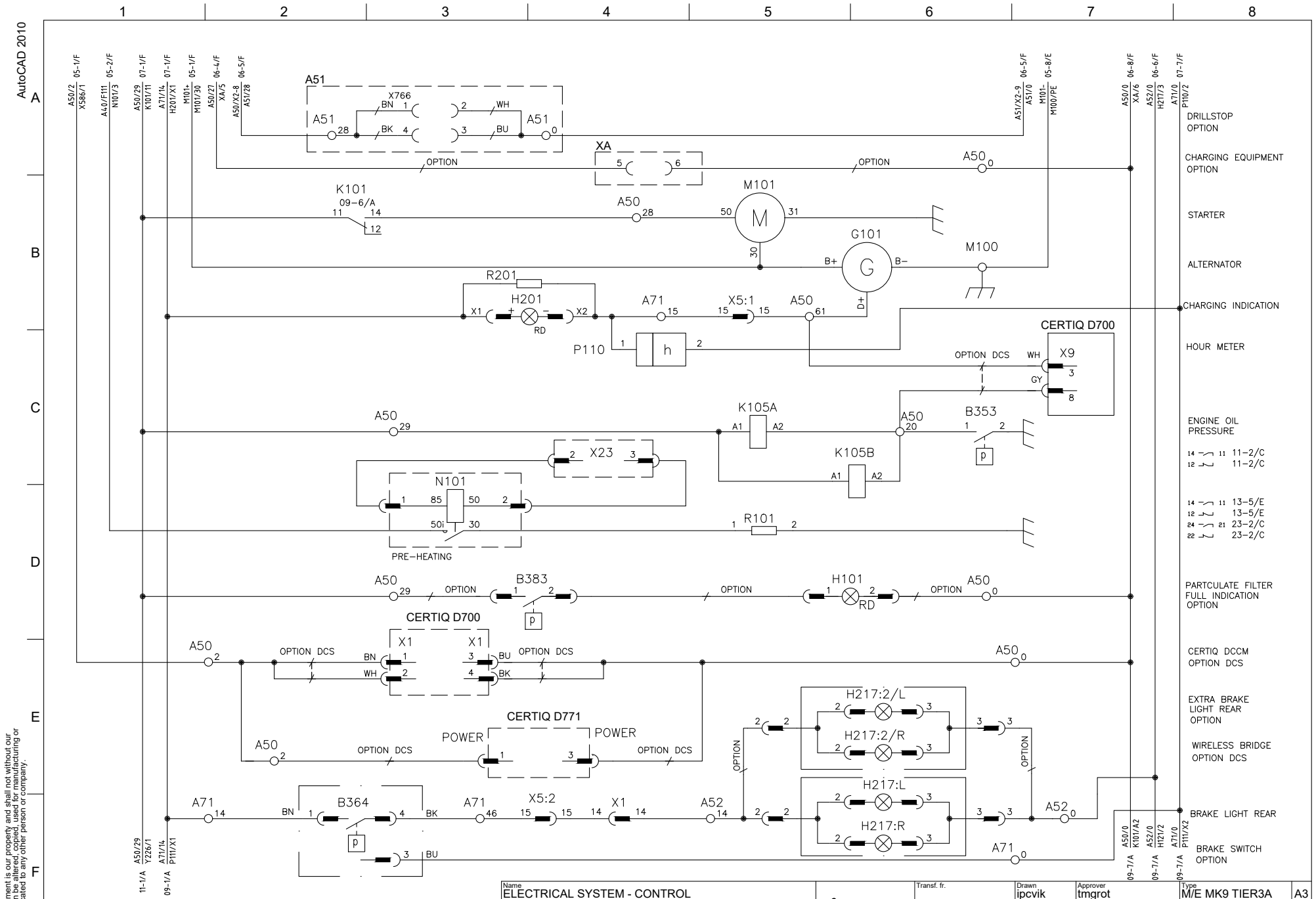
Name: ELECTRICAL SYSTEM - CONTROL
CIRCUIT DIAGRAM

Epiroc

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| Transf. fr. | Drawn: ipcvik | Approver: tmgrot | Type: M/E MK9 TIER3A — A3 |
| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation — Sheet: 7(30) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015081 |

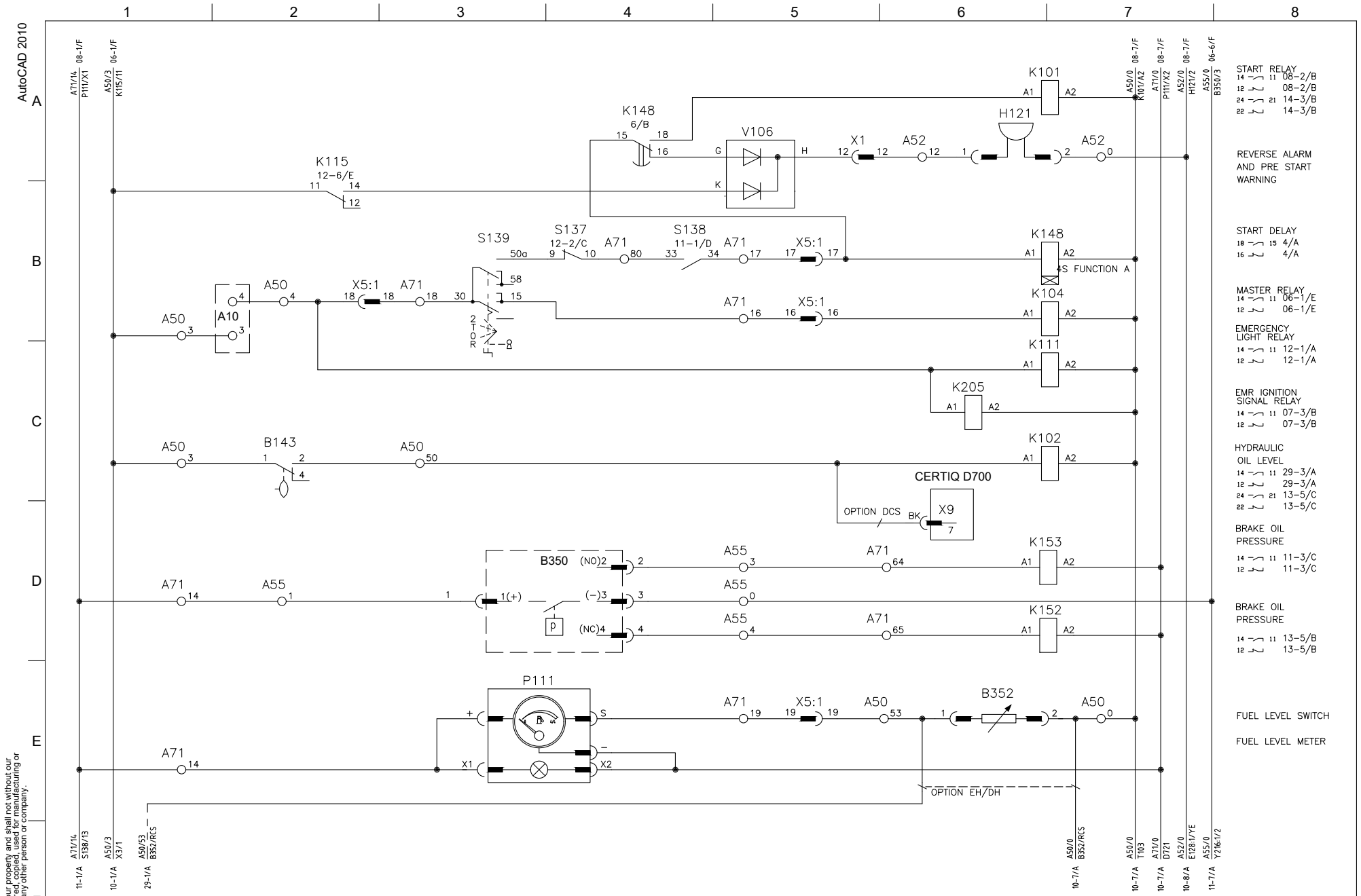


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|---|---|---|---|---|---|---|
| 027 | - | | 2022-08-02 | mhnpta | mhnds | mhnds |

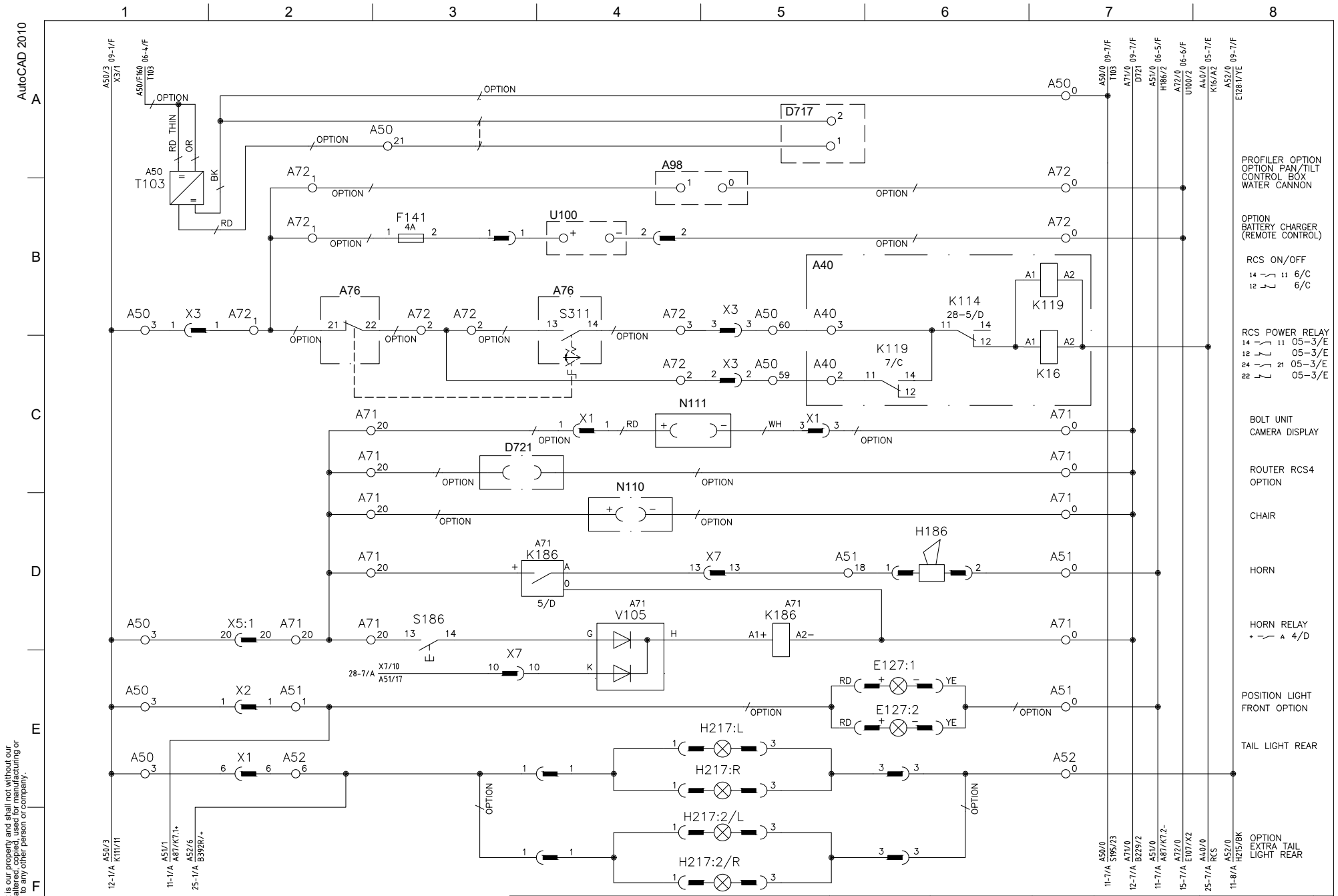
Name: ELECTRICAL SYSTEM - CONTROL
CIRCUIT DIAGRAM

Epiroc

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| Transf. fr. | Drawn: ipcvik | Approver: tmgrot | Type: M/E MK9 TIER3A — A3 |
| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation — Sheet: 9 (30) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015081 |



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| 027 | - | | 2022-08-02 | mhnpta | mhnds | mhnds |

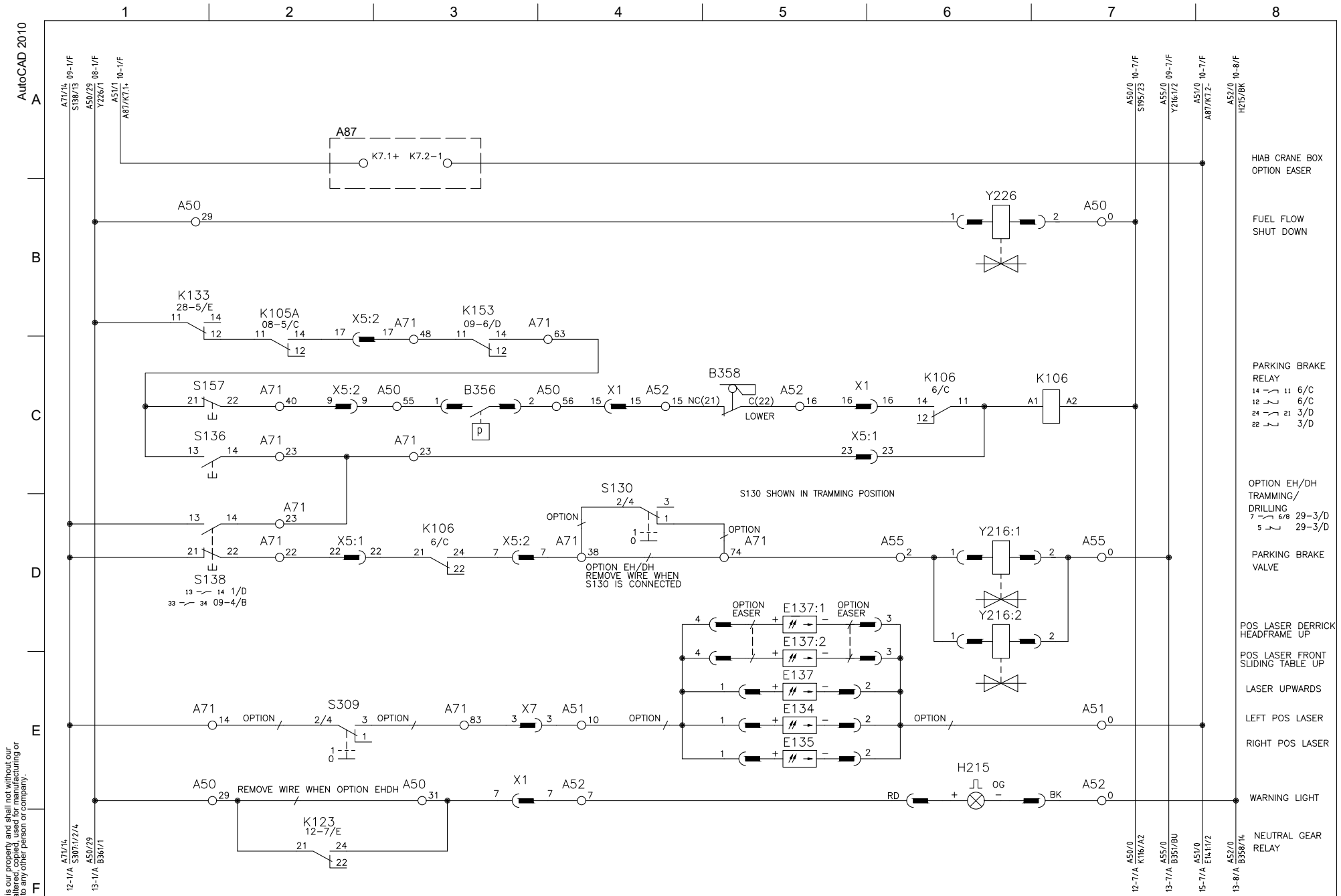
Name: ELECTRICAL SYSTEM - CONTROL
CIRCUIT DIAGRAM

Epiroc

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| Transf. fr. | Drawn: ipcvik | Approver: tmgrot | Type: M/E MK9 TIER3A A3 |
| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation Sheet: 10(30) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015081 |



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|---|---|---|---|---|---|---|
| 027 | - | | 2022-08-02 | mhnpta | mhnds | mhnds |

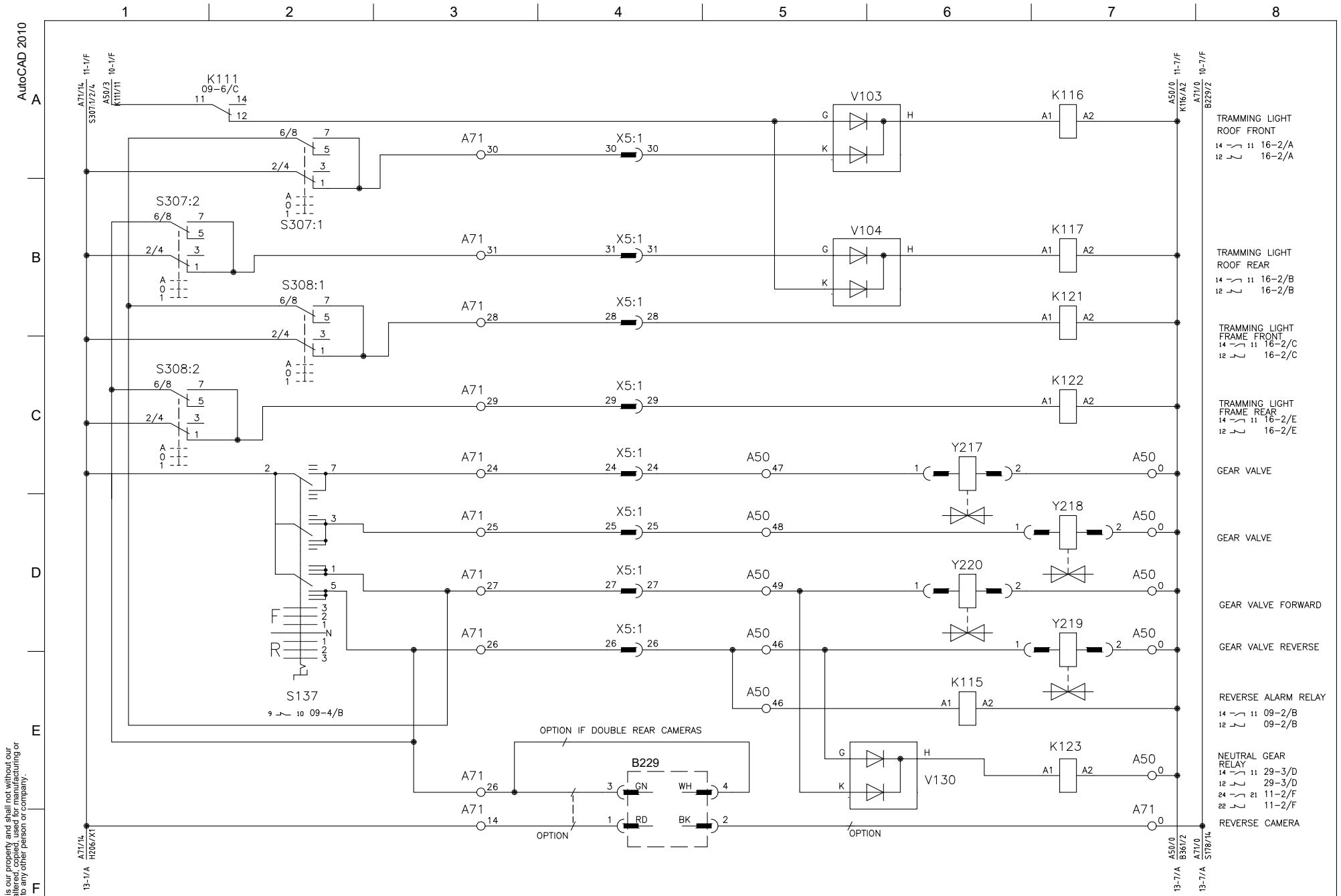
Name: ELECTRICAL SYSTEM - CIRCUIT DIAGRAM

Epiroc

| Transf. fr. | Drawn | Approver | Type | |
|---|---|---|---|---|
| | ipcvik | tmgrot | M/E MK9 TIER3A | A3 |
| Confidentiality class acc.1102 K: Internal | Design chd. tmgbrk | Drawing owner TMG | Designation | Sheet 11(30) |
| Status: Released | Date 2014-10-09 | Compare | 5112015081 | |



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| 027 | - | | 2022-08-02 | mhnpta | mhnds | mhnds |

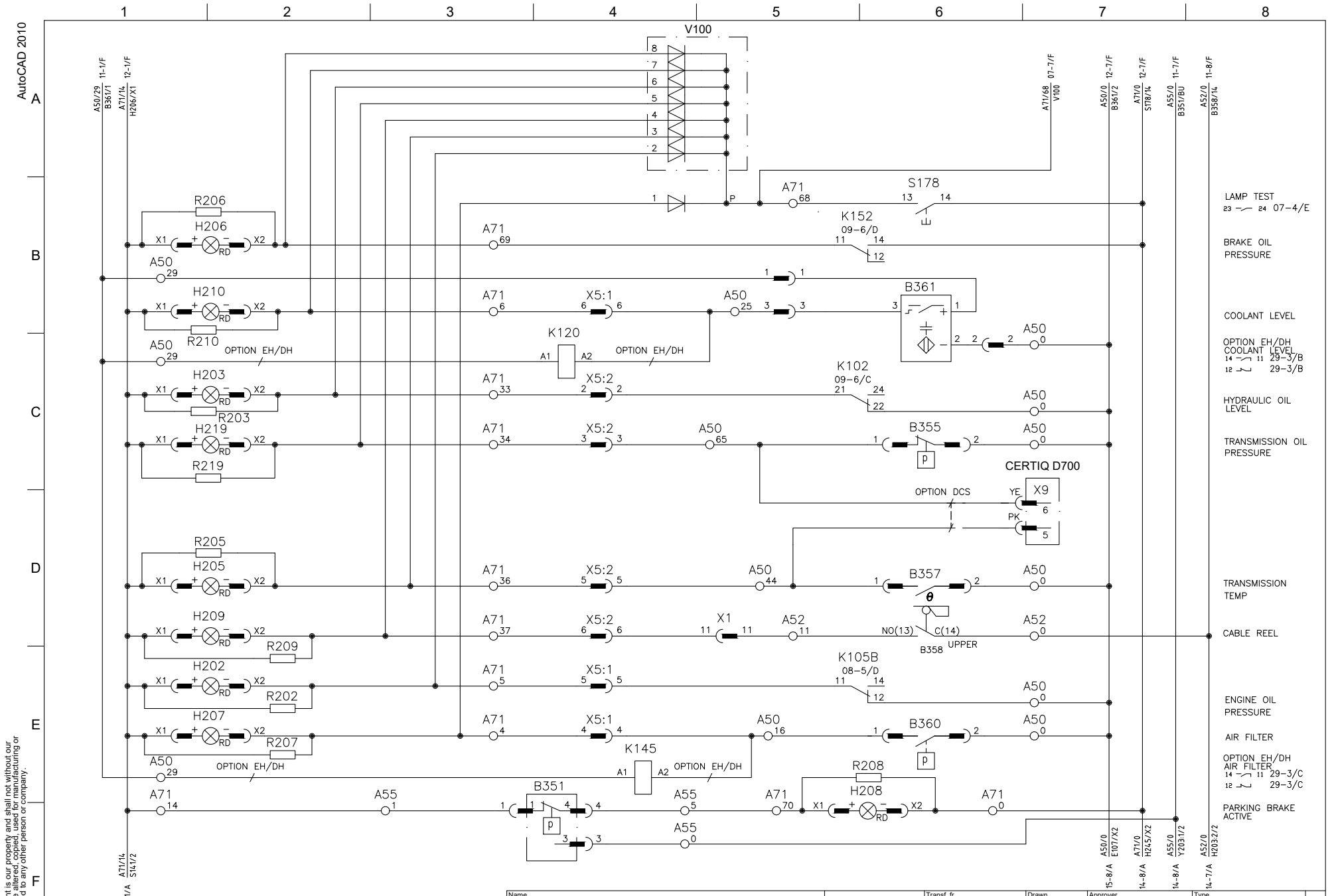
Name: ELECTRICAL SYSTEM - CONTROL
CIRCUIT DIAGRAM

Epiroc

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| Transf. fr. | Drawn: ipcvik | Approver: tmgrot | Type: M/E MK9 TIER3A A3 |
| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation Sheet: 12(30) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015081 |



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|---|---|---|---|---|---|---|
| 027 | - | | 2022-08-02 | mhnpta | mhnds | mhnds |

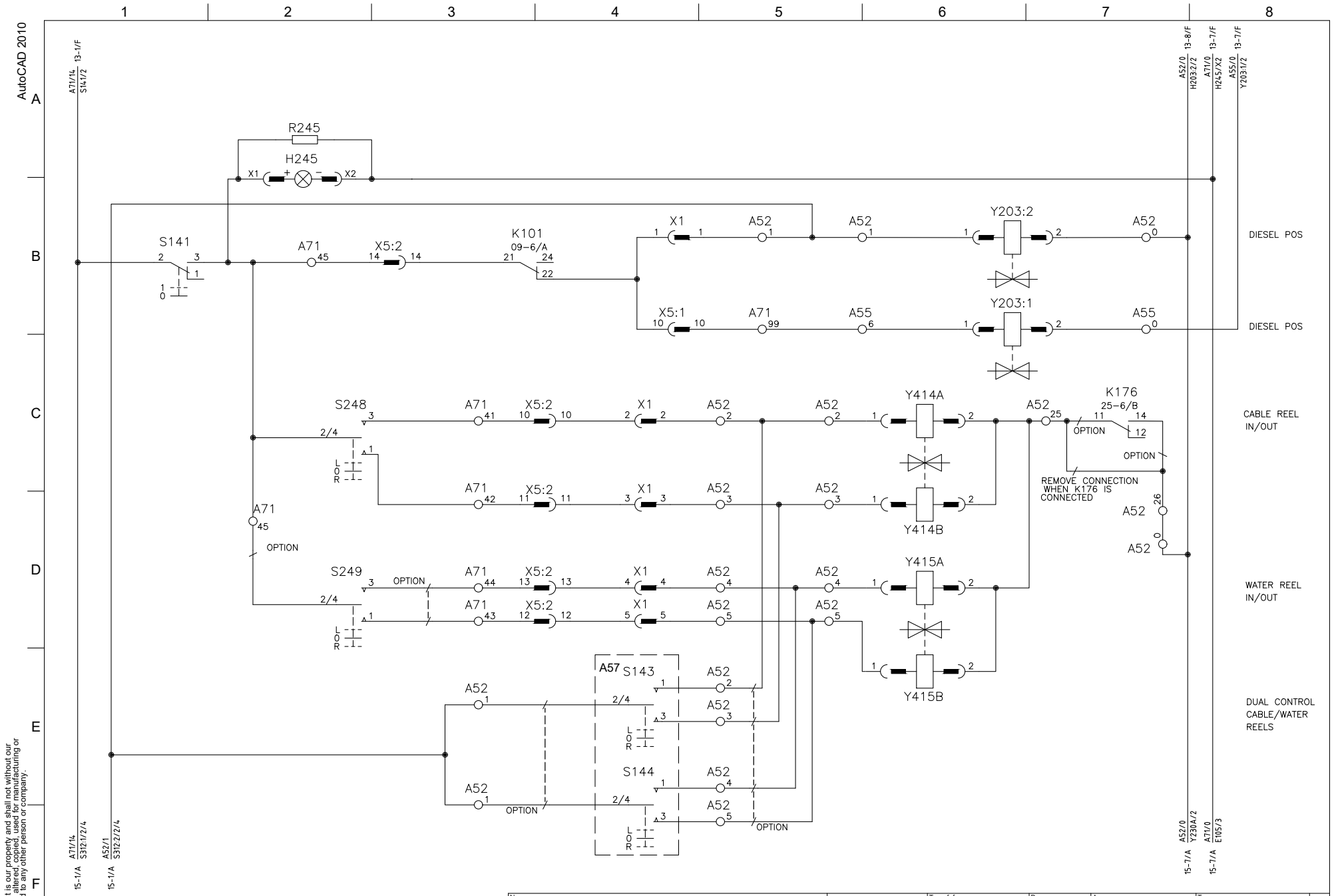
Name: ELECTRICAL SYSTEM - CONTROL
CIRCUIT DIAGRAM

Epiroc

| Transf. fr. | Drawn | Approver | Type | |
|---|---|---|---|---|
| | ipcvik | tmgrot | M/E MK9 TIER3A | A3 |
| Confidentiality class acc.1102 K | Design chd. | Drawing owner | Designation | Sheet |
| Internal | tmgbrk | TMG | | 13(30) |
| Status | Date | Compare | | |
| Released | 2014-10-09 | | 5112015081 | |



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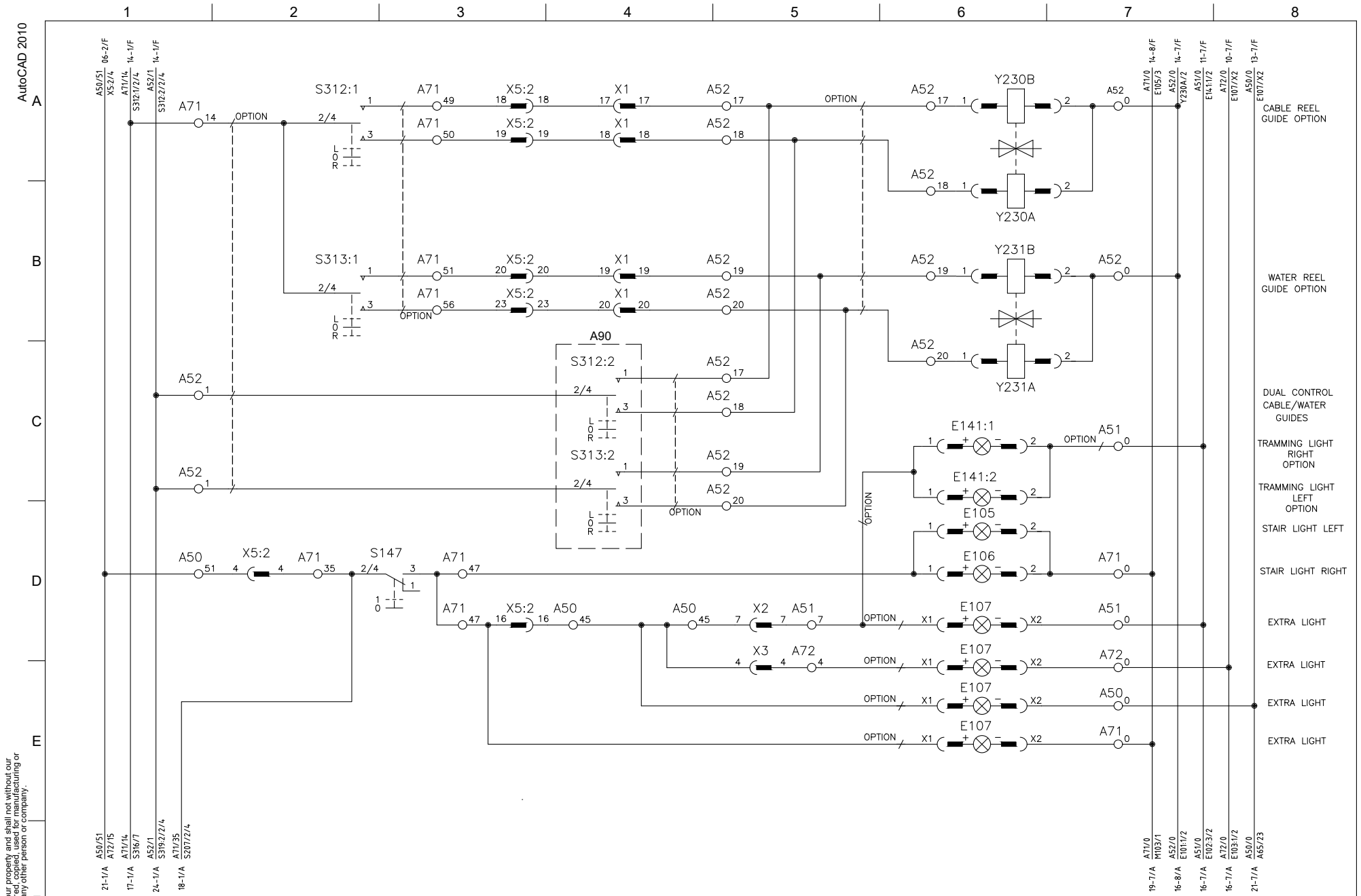
Name: ELECTRICAL SYSTEM - CIRCUIT DIAGRAM

Epiroc

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| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation Sheet: 14(30) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015081 |



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| 027 | - | | 2022-08-02 | mhnpta | mhnds | mhnds |

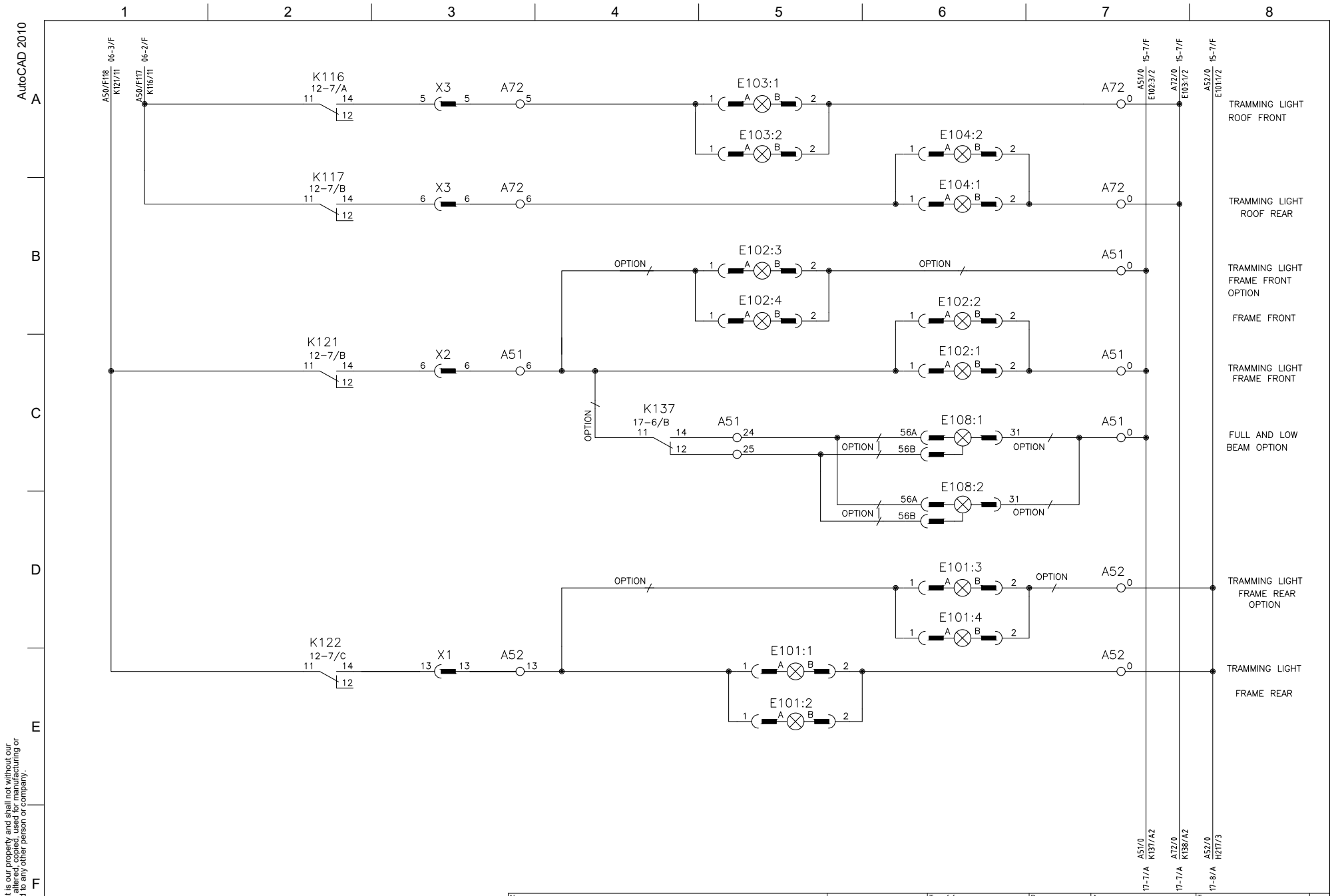
Name: ELECTRICAL SYSTEM - CONTROL
CIRCUIT DIAGRAM

Epiroc

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| Transf. fr. | Drawn: ipcvik | Approver: tmgrot | Type: M/E MK9 TIER3A A3 |
| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation Sheet: 15(30) |
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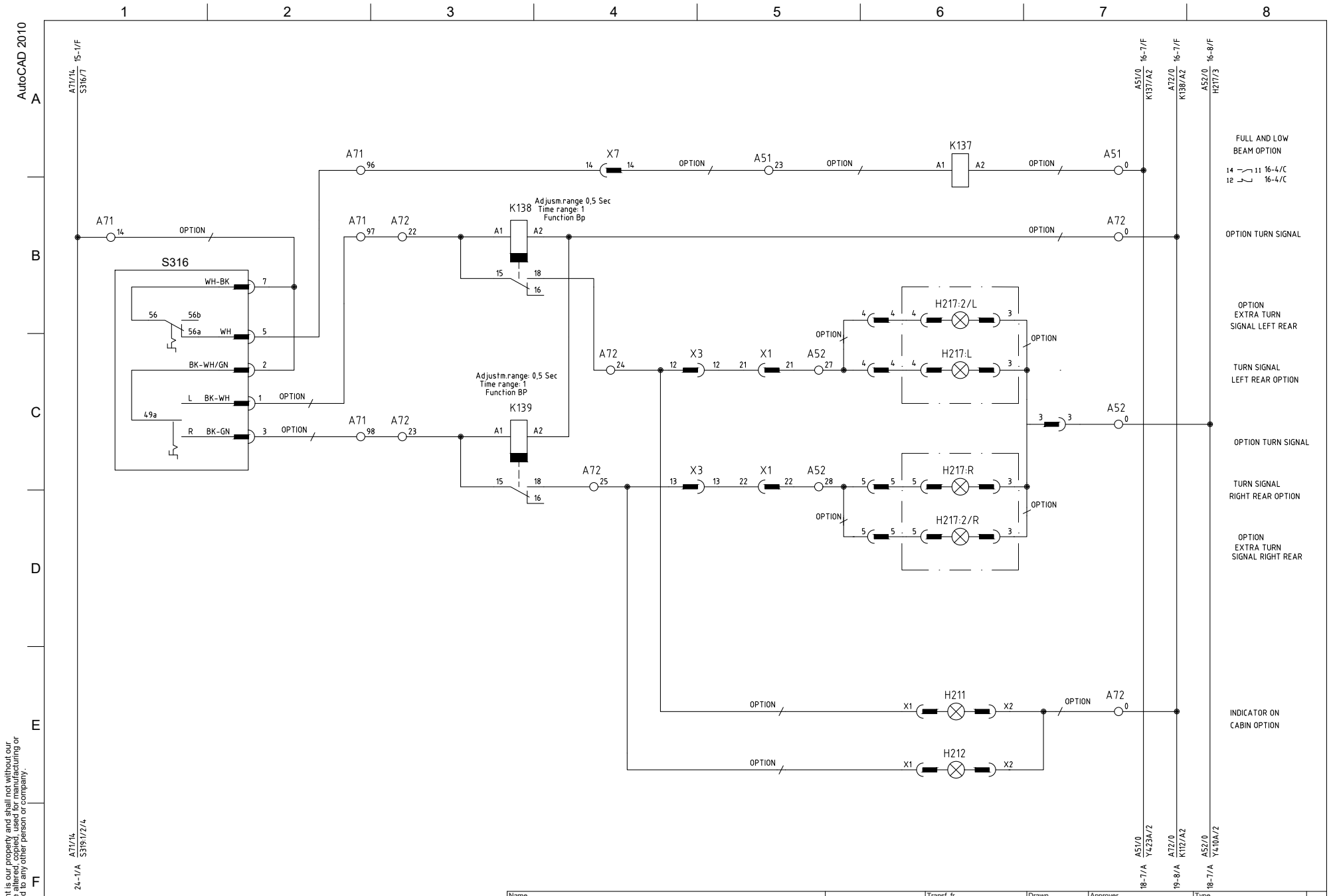


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| 027 | - | | 2022-08-02 | mhnpta | mhnds | mhnds |

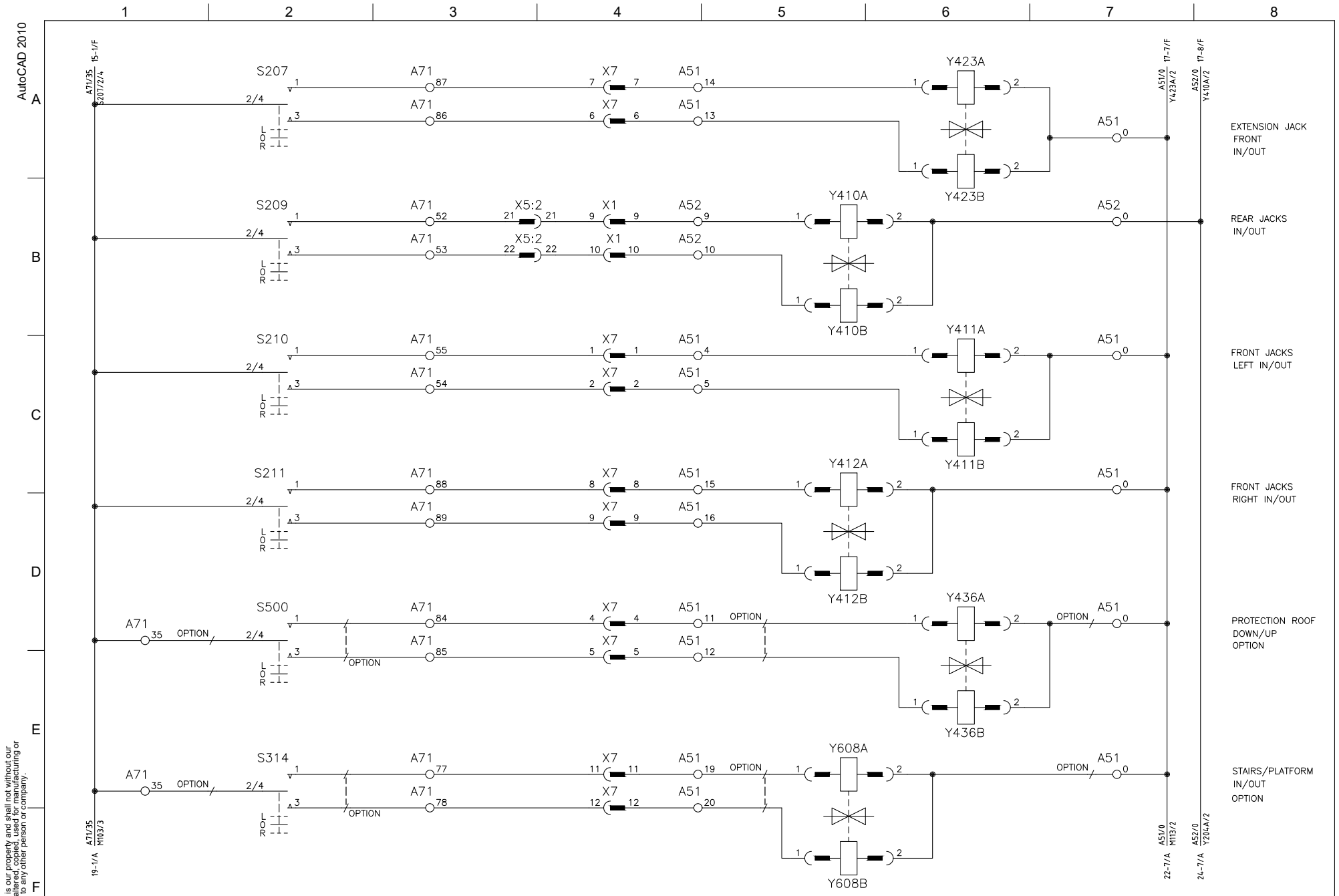
Name: ELECTRICAL SYSTEM - CONTROL
CIRCUIT DIAGRAM

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| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation Sheet: 17(30) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015081 |



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| 027 | - | | 2022-08-02 | mhnpta | mhnds | mhnds |

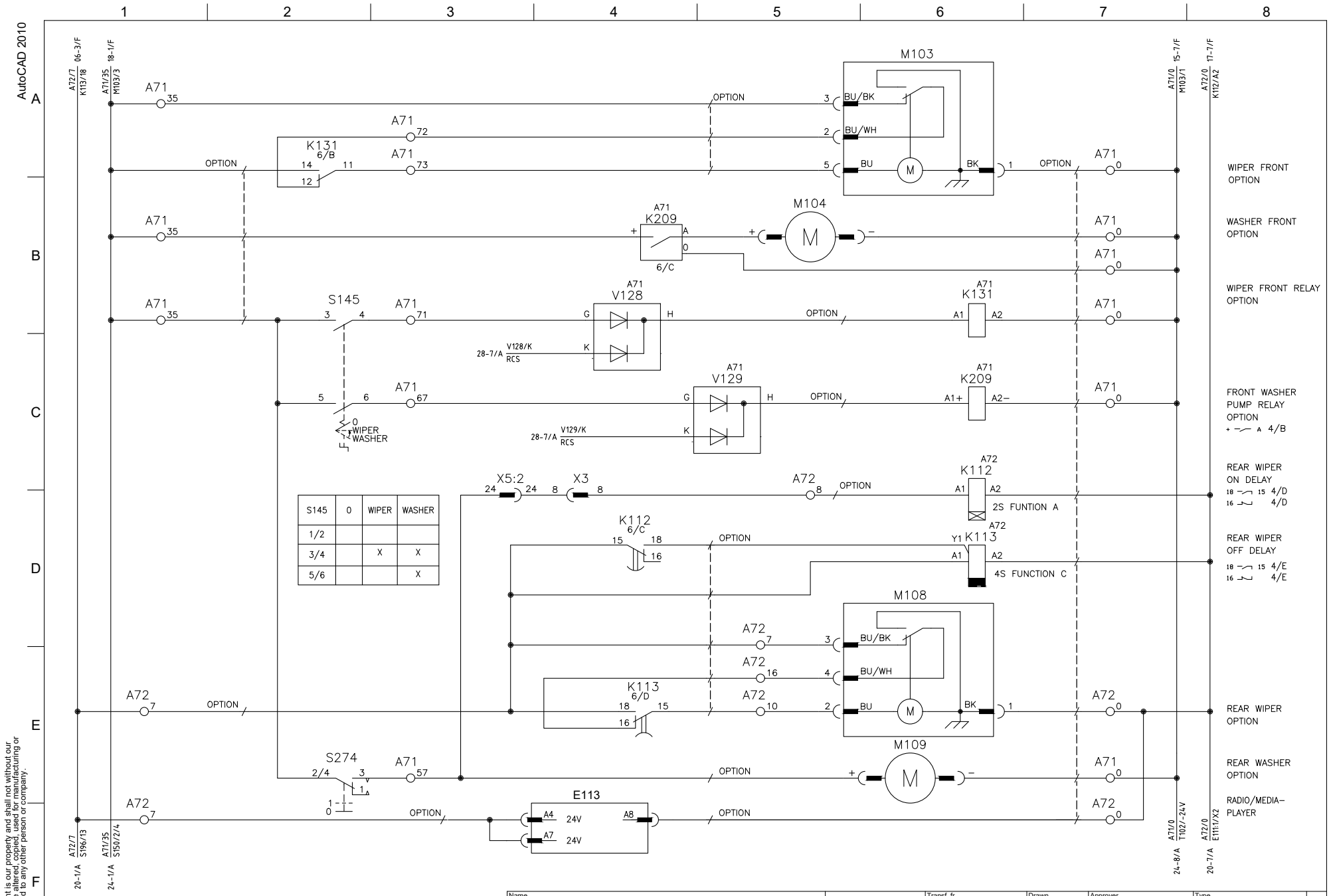
Name: ELECTRICAL SYSTEM - CIRCUIT DIAGRAM

Epiroc

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|---|---|---|---|---|
| | ipcvik | tmgrot | M/E MK9 TIER3A | A3 |
| Confidentiality class acc.1102 K | Design chd. | Drawing owner | Designation | Sheet |
| Internal | tmgbrk | TMG | | 18(30) |
| Status | Date | Compare | | |
| Released | 2014-10-09 | | 5112015081 | |



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| 027 | - | | 2022-08-02 | mhnpta | mhnds | mhnds |

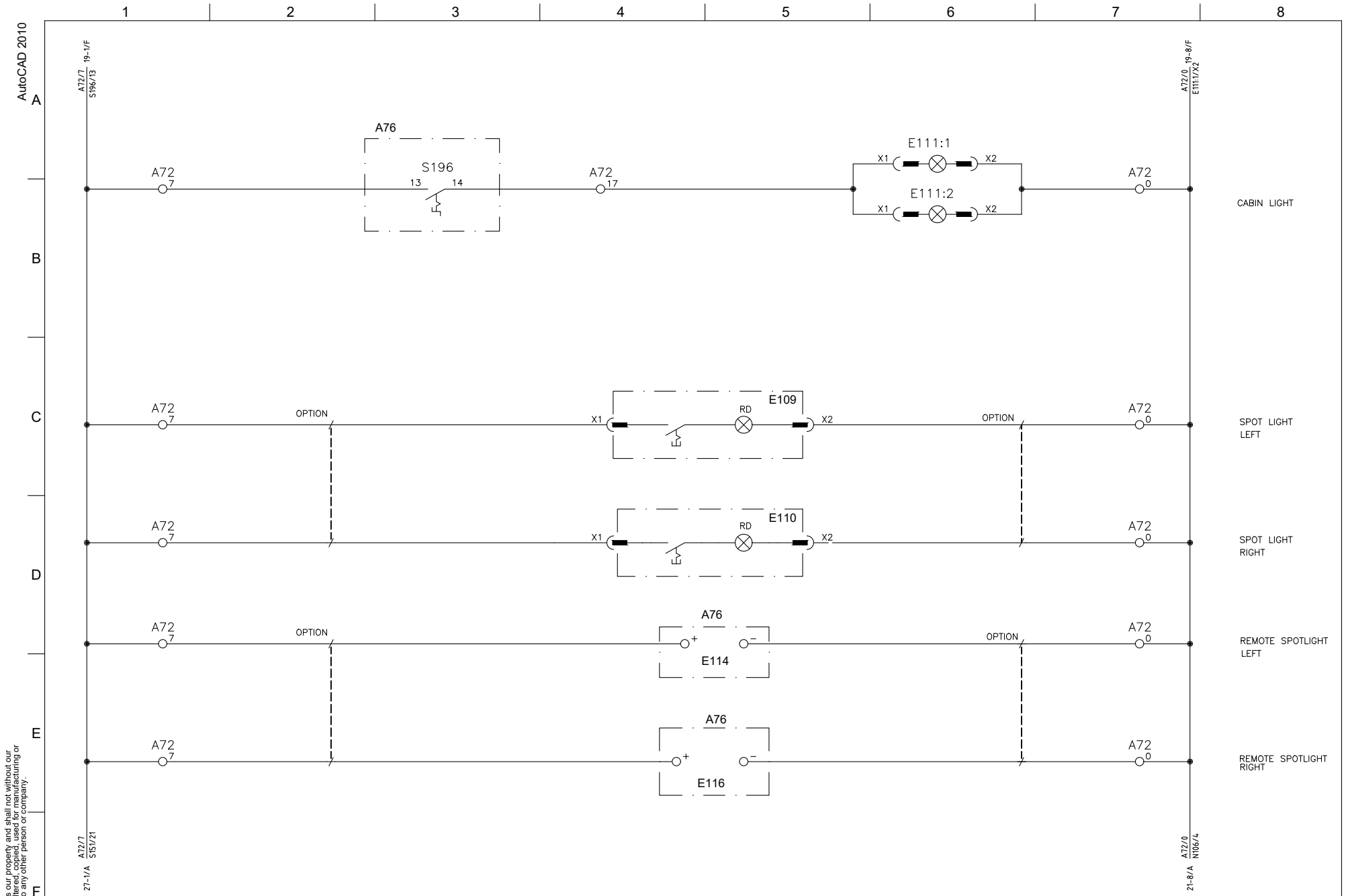
Name: ELECTRICAL SYSTEM - CIRCUIT DIAGRAM

Epiroc

| Transf. fr. | Drawn | Approver | Type | |
|---|---|---|---|---|
| | ipcvik | tmgrot | M/E MK9 TIER3A | A3 |
| Confidentiality class acc.1102 K: Internal | Design chd. tmgbrk | Drawing owner TMG | Designation | Sheet 19(30) |
| Status: Released | Date 2014-10-09 | Compare | 5112015081 | |



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| 027 | - | | 2022-08-02 | mhnpta | mhnds | mhnds |

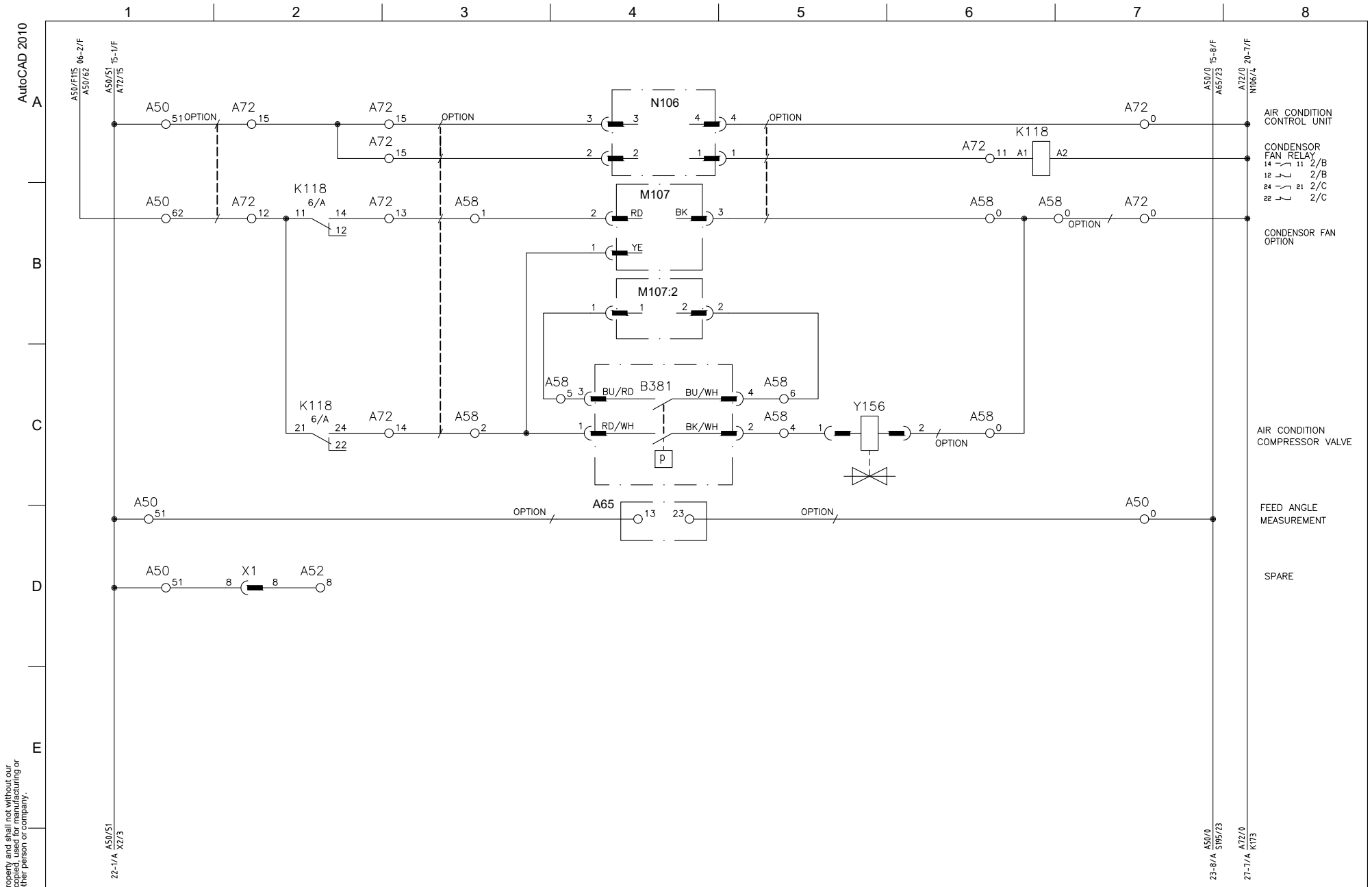
Name: ELECTRICAL SYSTEM - CONTROL
CIRCUIT DIAGRAM

Epiroc

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| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation — Sheet: 20(30) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015081 |



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| 027 | - | | 2022-08-02 | mhnpta | mhnds | mhnds |

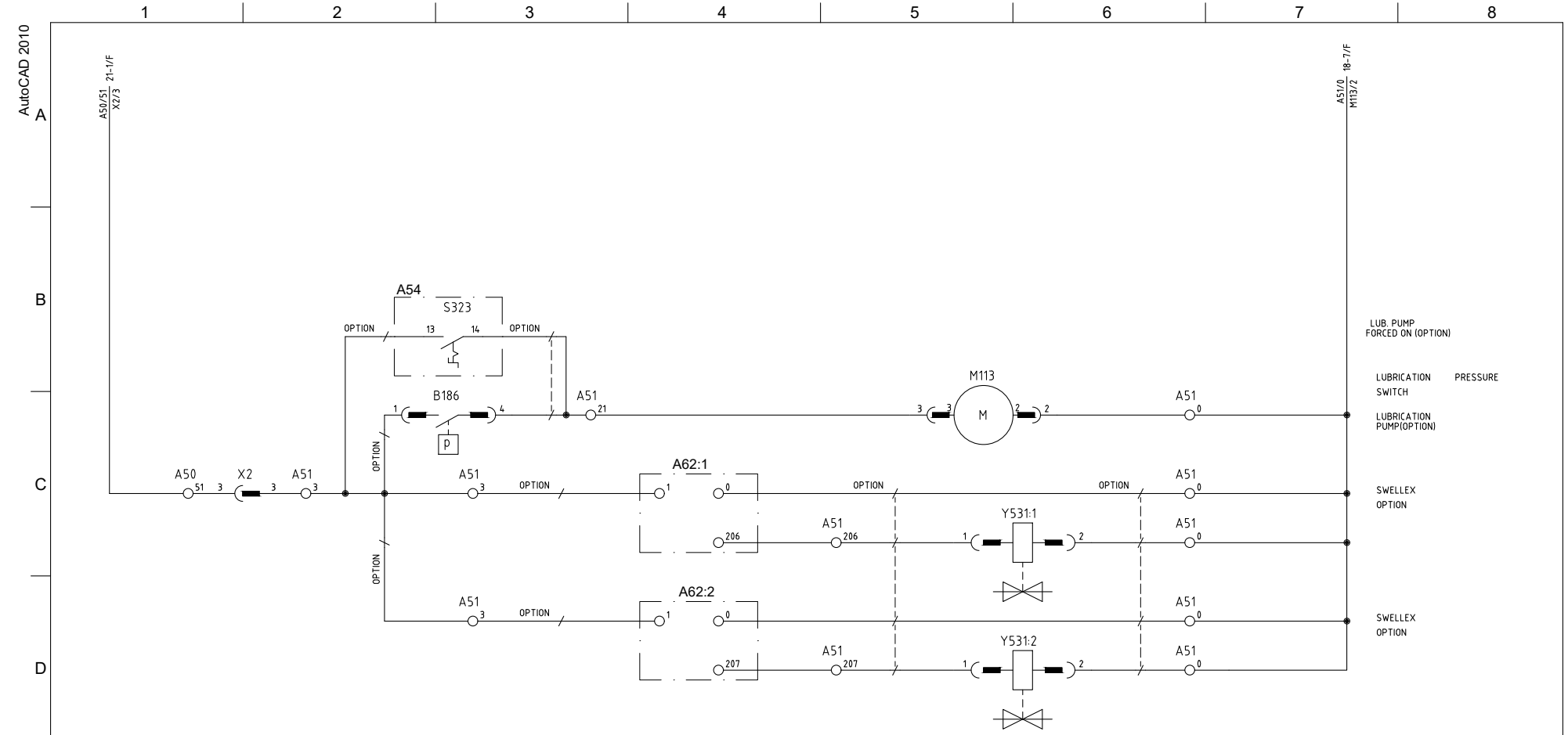
Name: ELECTRICAL SYSTEM - CIRCUIT DIAGRAM

Epiroc

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| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation Sheet: 21(30) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015081 |



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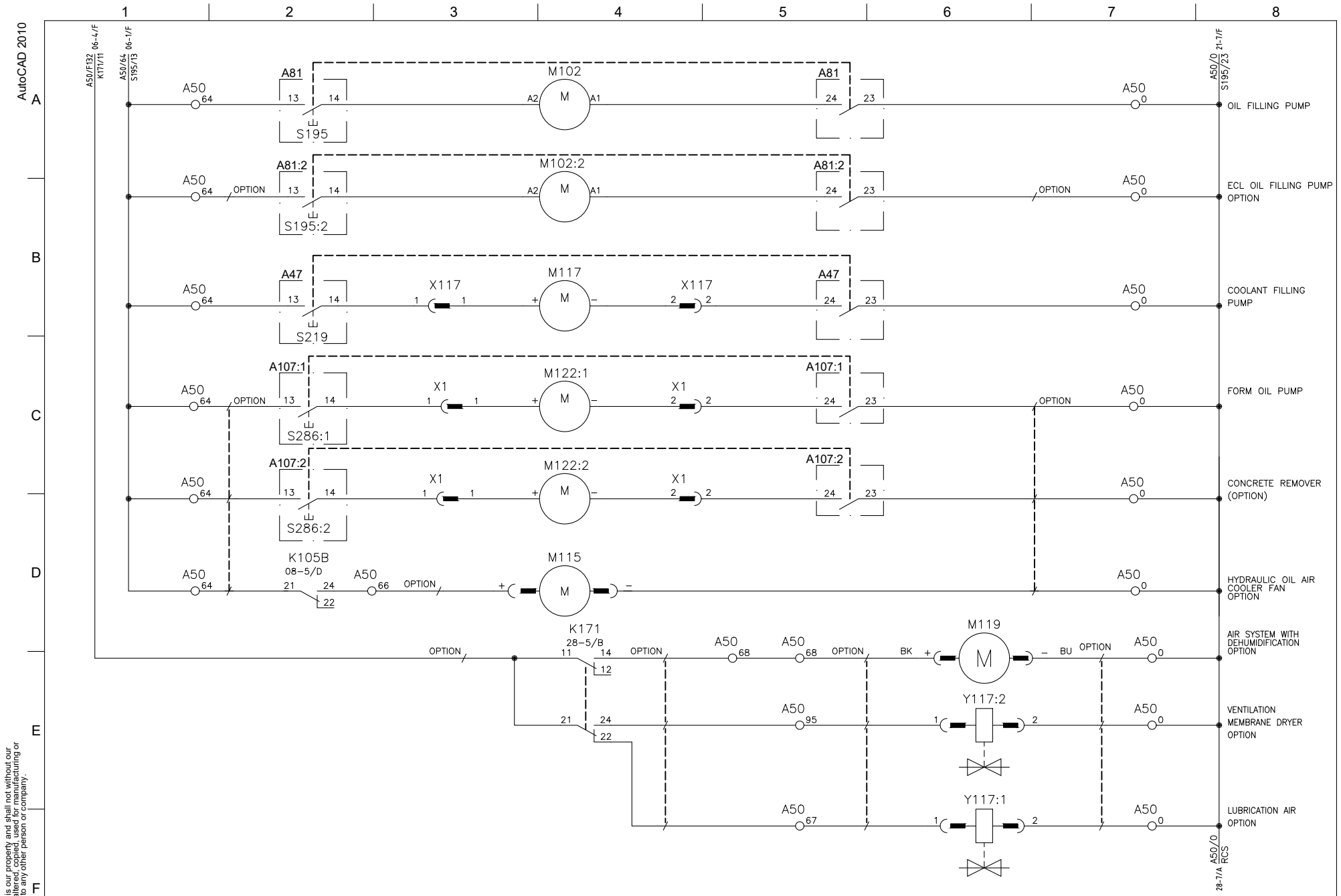
Name: ELECTRICAL SYSTEM - CONTROL
CIRCUIT DIAGRAM

Epiroc

| Transf. fr. | Drawn | Approver | Type | |
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| Confidentiality class acc.1102 K | Design chd. | Drawing owner | Designation | Sheet |
| Internal | tmgbrk | TMG | | 22(30) |
| Status | Date | Compare | | |
| Released | 2014-10-09 | | 5112015081 | |



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| 027 | - | | 2022-08-02 | mhnpta | mhnds | mhnds |

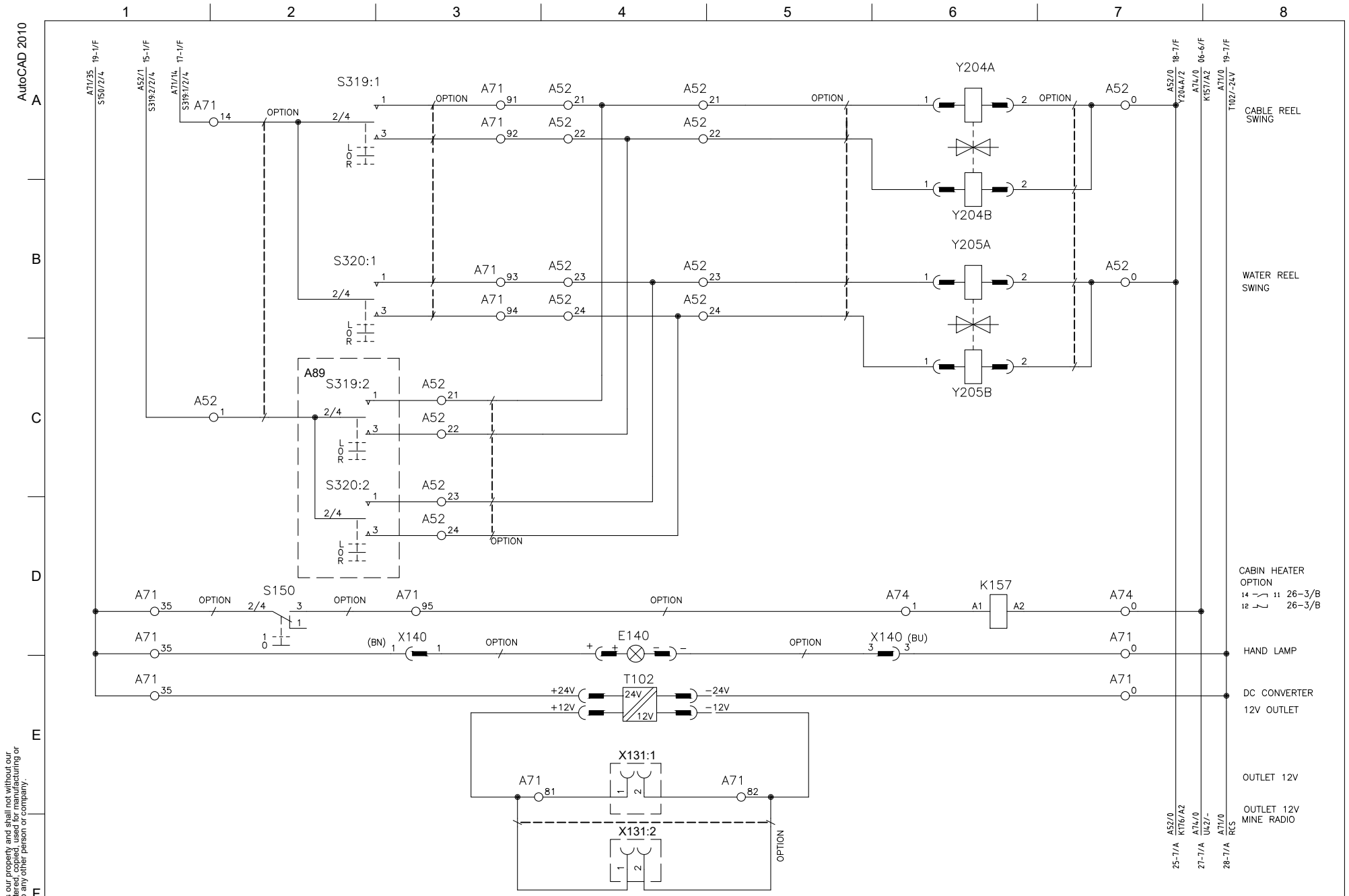
Name: ELECTRICAL SYSTEM - CONTROL
CIRCUIT DIAGRAM

Epiroc

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|---|---|---|---|
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| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation Sheet: 23(30) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015081 |



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| 027 | - | | 2022-08-02 | mhnpta | mhnds | mhnds |

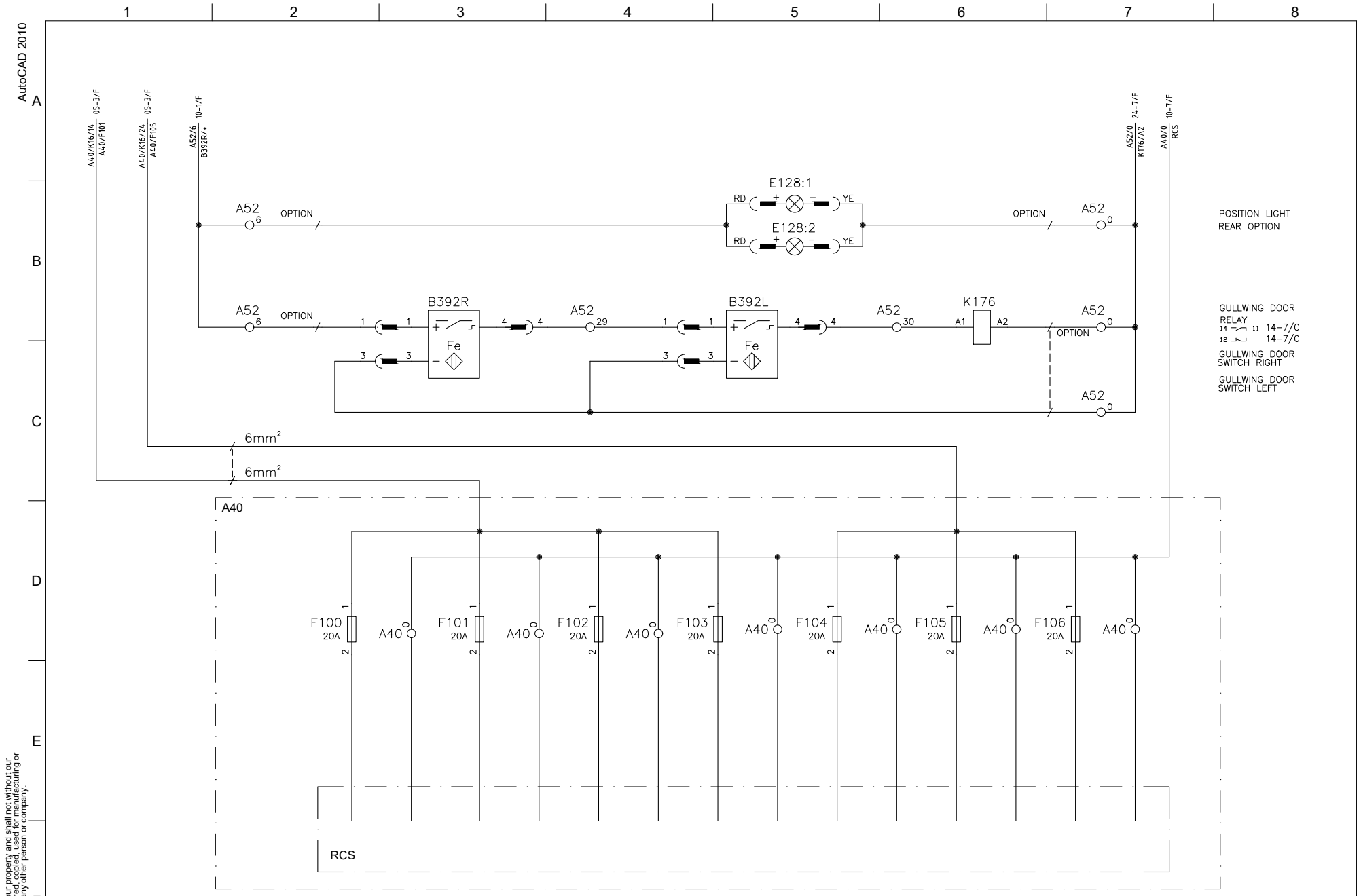
Name: ELECTRICAL SYSTEM - CONTROL
CIRCUIT DIAGRAM

Epiroc

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| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation Sheet: 24(30) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015081 |



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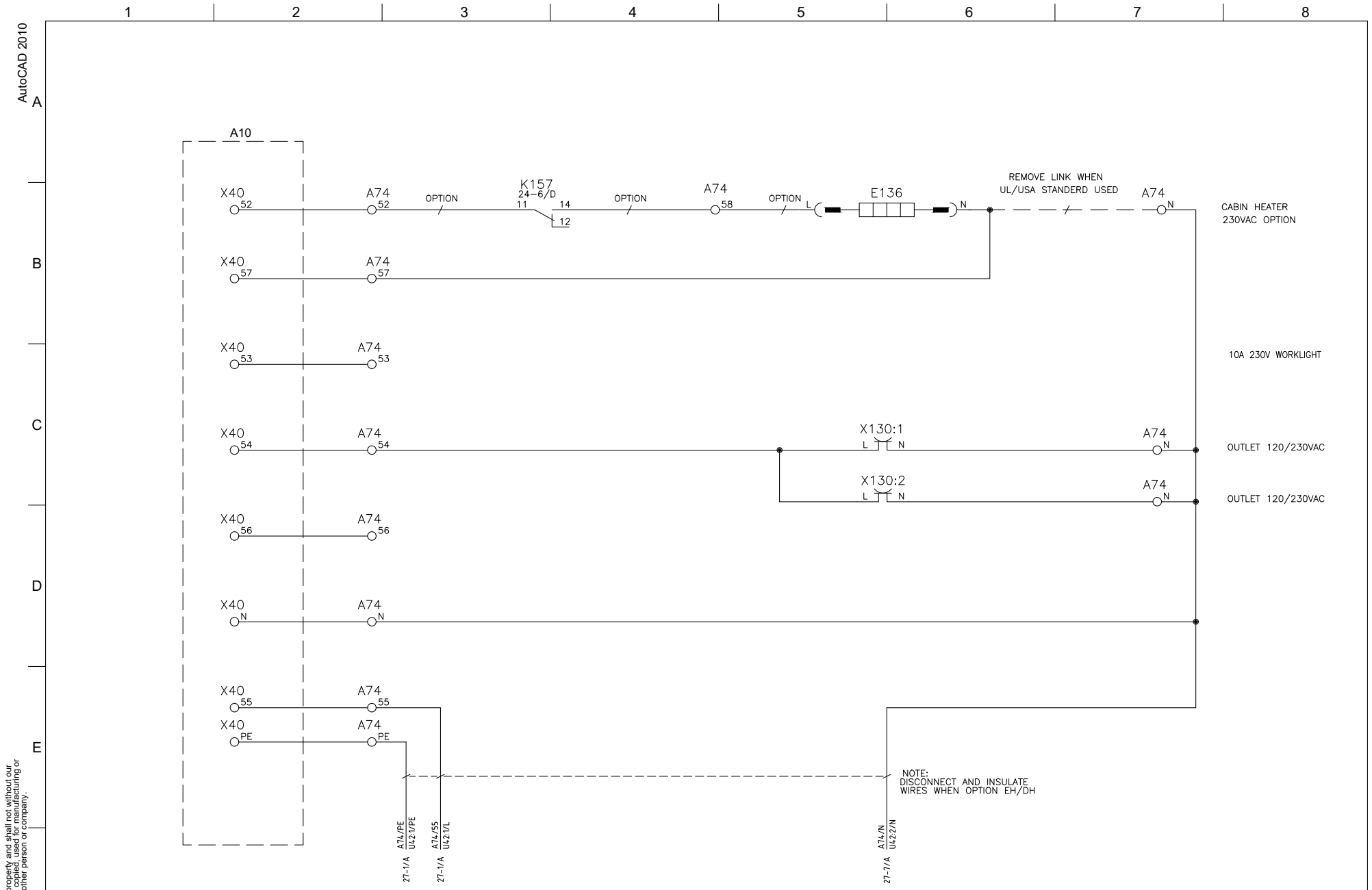
Name: ELECTRICAL SYSTEM - CIRCUIT DIAGRAM

Epiroc

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| Transf. fr. | Drawn: ipcvik | Approver: tmgrot | Type: M/E MK9 TIER3A — A3 |
| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation — Sheet: 25(30) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015081 |



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| 027 | - | | 2022-08-02 | mhnpta | mhnds | mhnds |

Name: ELECTRICAL SYSTEM - CONTROL

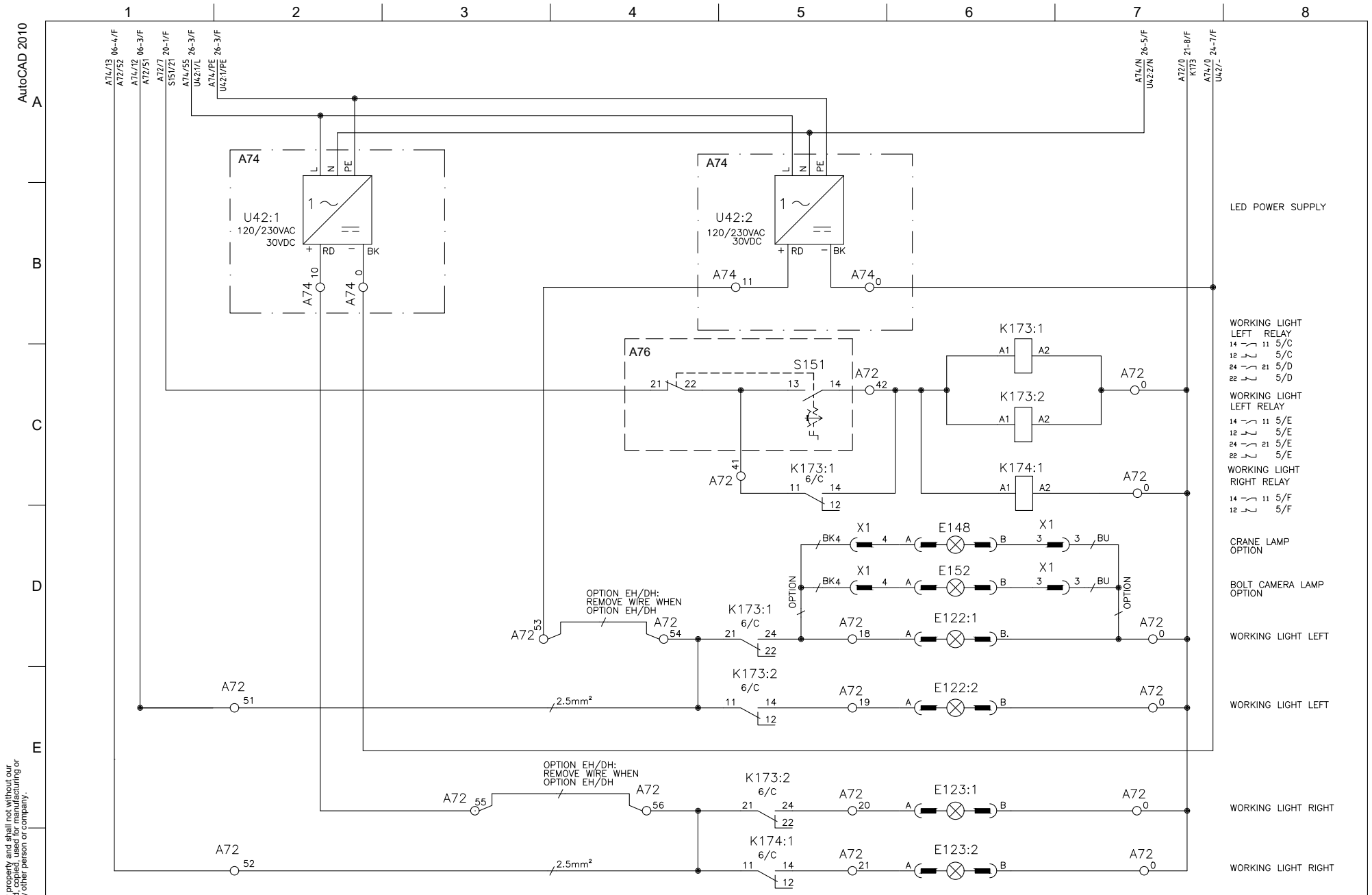
CIRCUIT DIAGRAM

Epiroc

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| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation | Sheet: 26(30) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015081 | |



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| 027 | - | | 2022-08-02 | mhnpta | mhnds | mhnds |

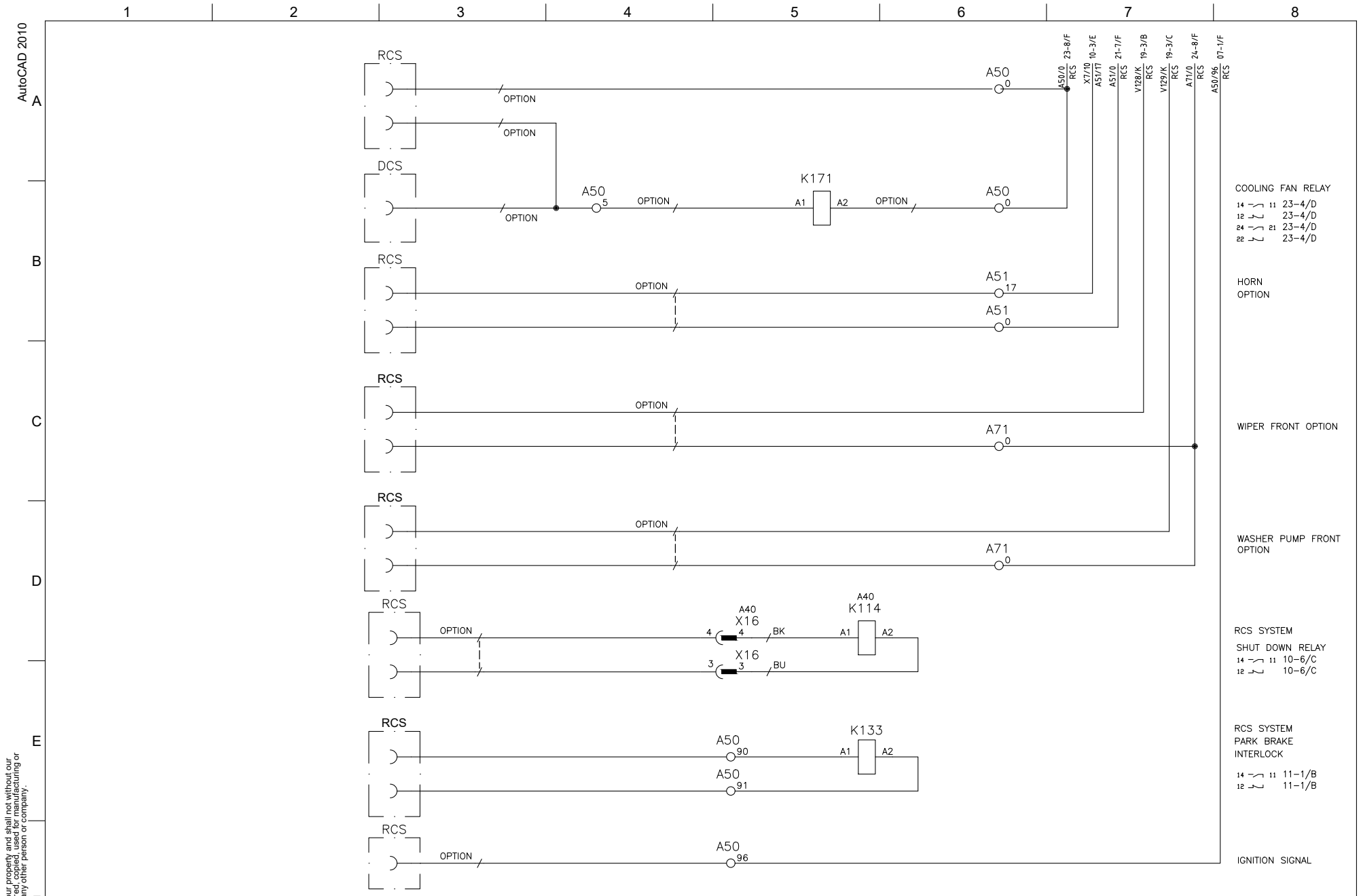
Name: ELECTRICAL SYSTEM - CONTROL
CIRCUIT DIAGRAM

Epiroc

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| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation — Sheet: 27(30) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015081 |



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AutoCAD 2010

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| 027 | - | | 2022-08-02 | mhnpta | mhnds | mhnds |

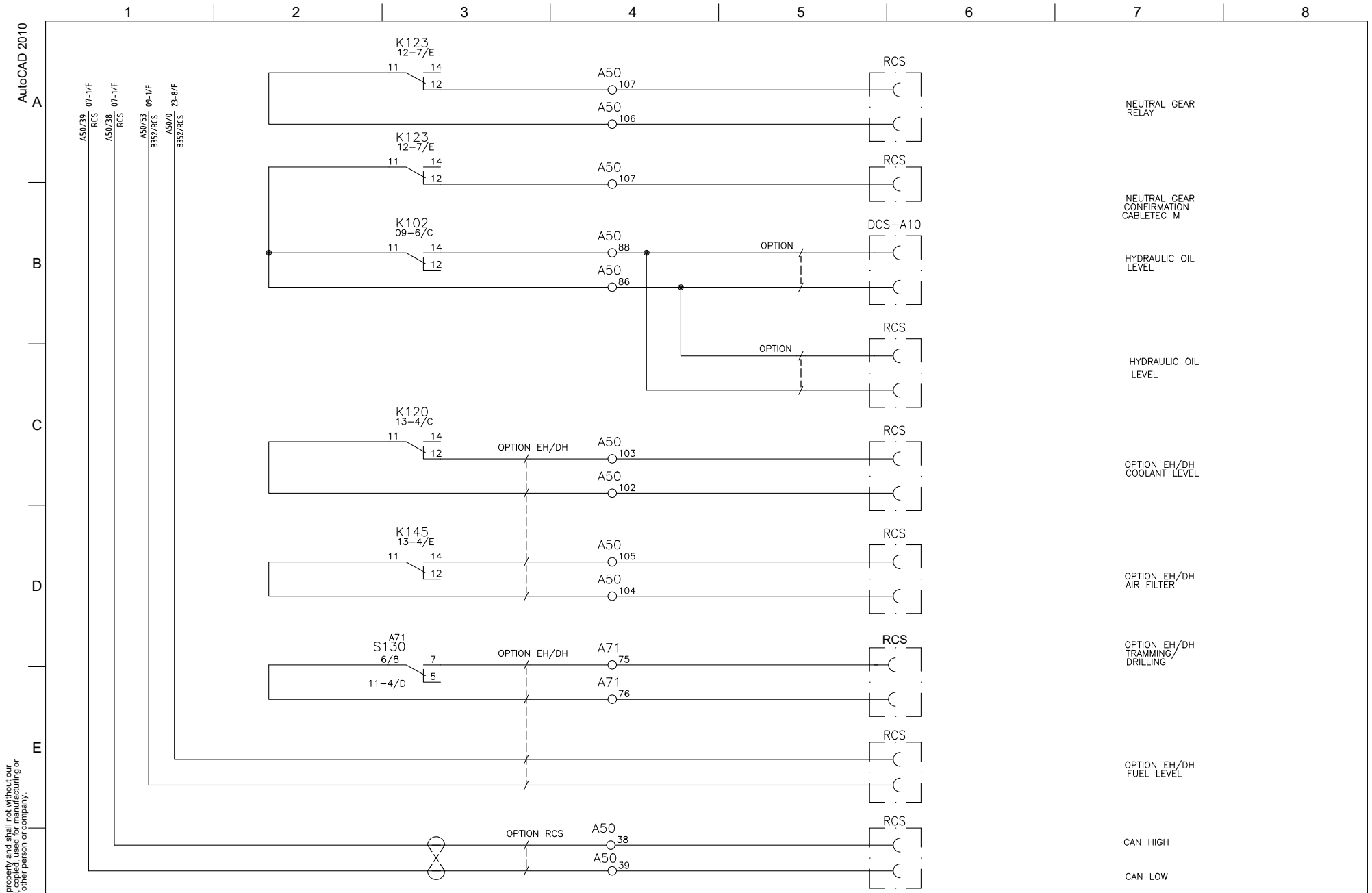
Name: ELECTRICAL SYSTEM - CONTROL
CIRCUIT DIAGRAM

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| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation Sheet: 28(30) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015081 |



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|---|---|---|---|---|---|---|
| 027 | - | | 2022-08-02 | mhnpta | mhnds | mhnds |

Name: ELECTRICAL SYSTEM - CONTROL

CIRCUIT DIAGRAM

Epiroc

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|---|---|---|---|---|
| Transf. fr. | Drawn: ipcvik | Approver: tmgrot | Type: M/E MK9 TIER3A | A3 |
| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation | Sheet: 29(30) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015081 | |



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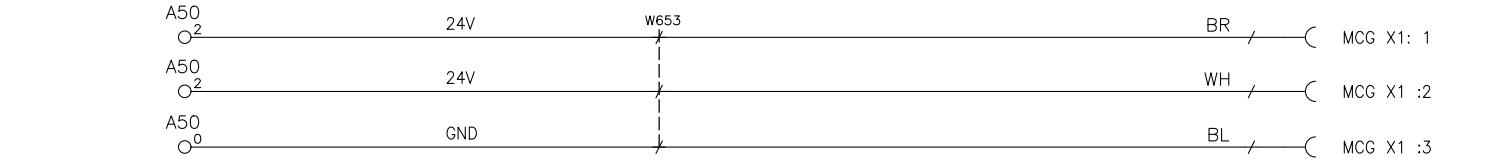
AutoCAD 2010

# OPTION CERTIQ (MCG) A50 CABINET CONNECTION DETAILS

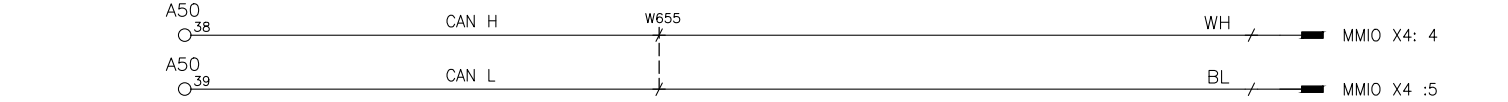
## HARNESS W652 CONNECTIONS




## HARNESS W653 CONNECTIONS




## HARNESS W655 CONNECTIONS




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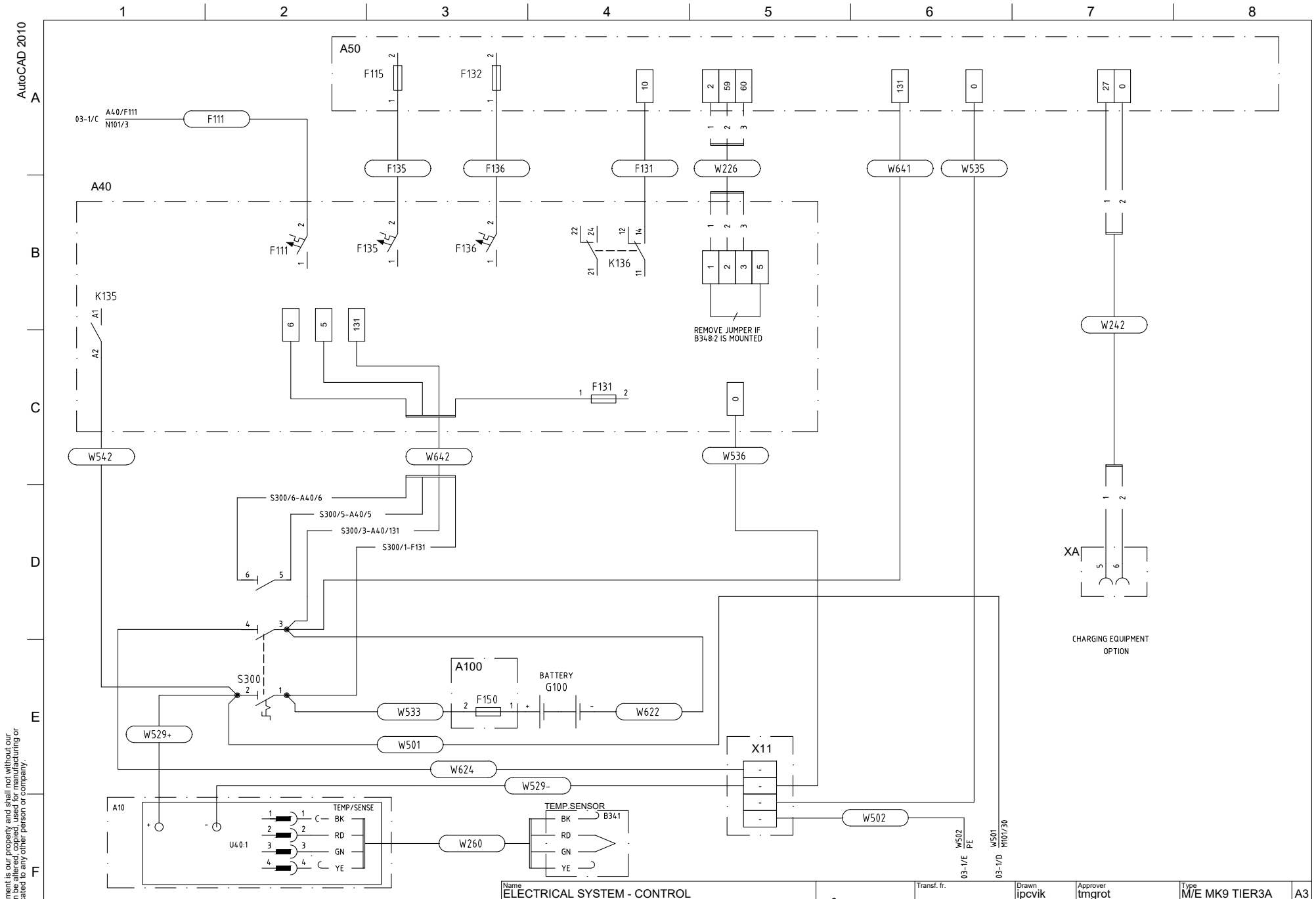
Name: ELECTRICAL SYSTEM - CONTROL
CIRCUIT DIAGRAM

Epiroc

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| Status: Released | Date: 2014-10-09 | Compare | 5112015081 |



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| 024 | - | See part change notes | 2019-07-02 | tmgjlt | tmgxdapi | tmgrot |

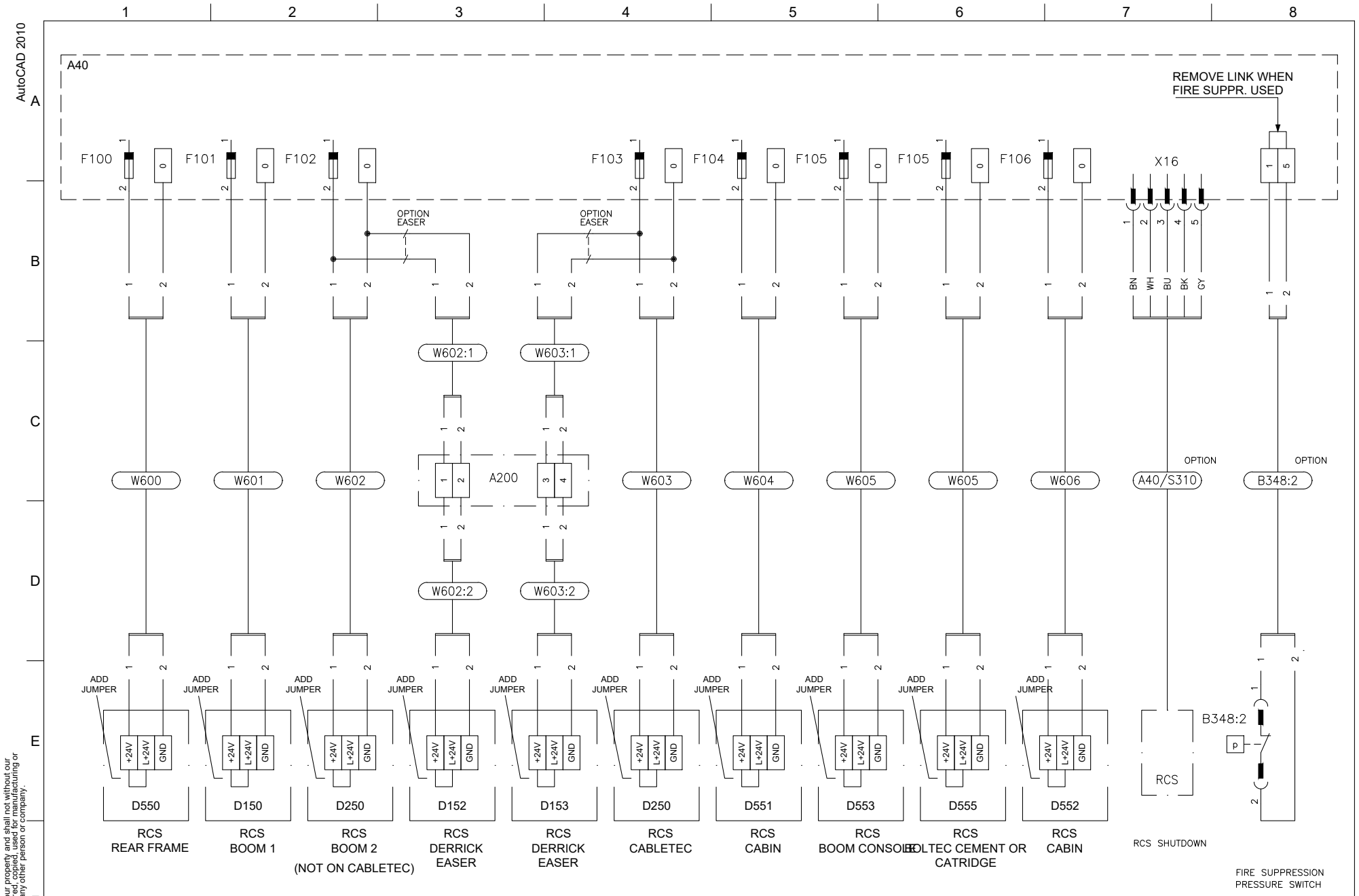
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

Epiroc

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| Status: Released | Date: 2014-10-09 | Compare | 5112015082 |



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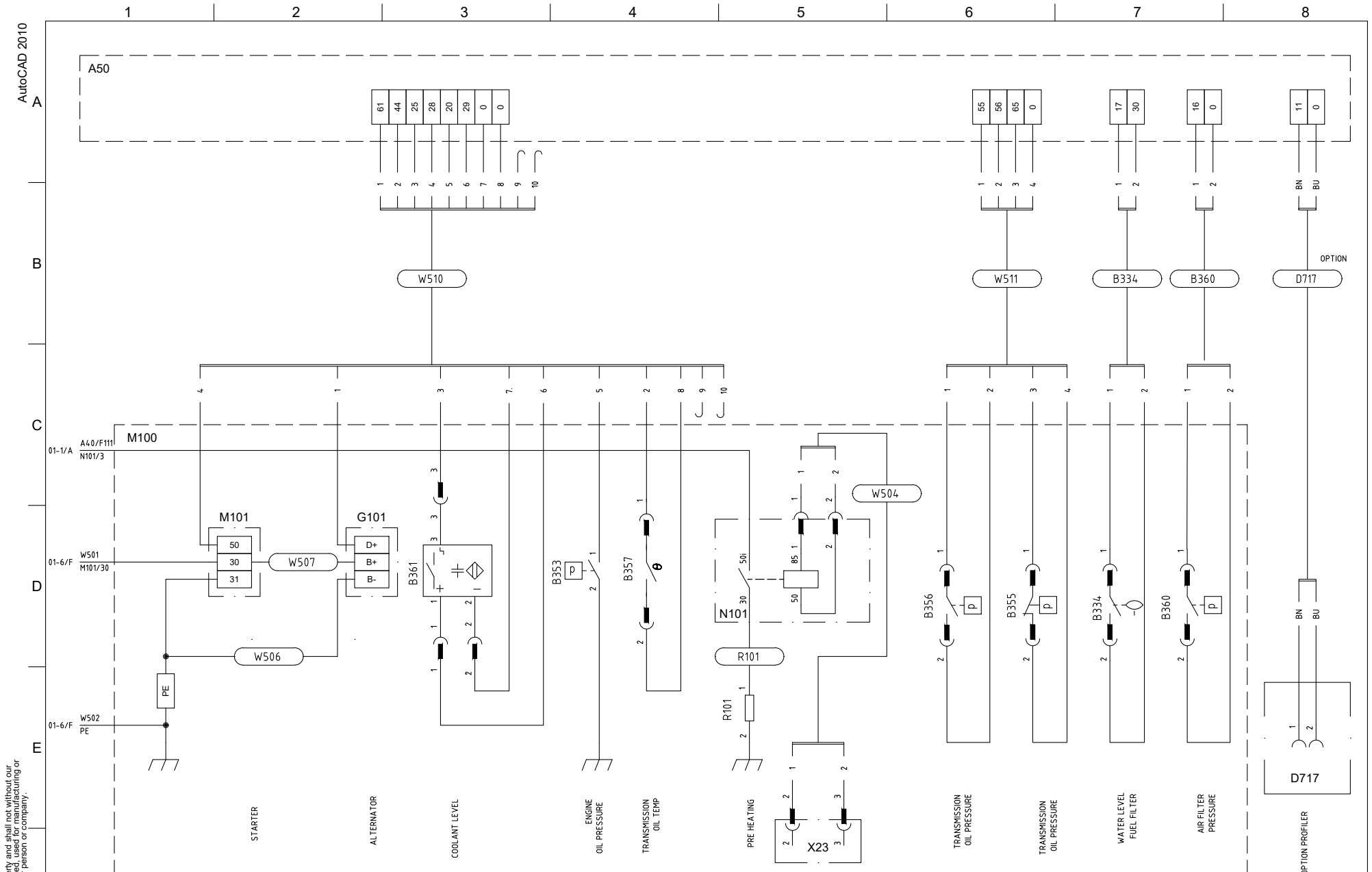
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

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| Status: Released | Date: 2014-10-09 | Compare | 5112015082 |



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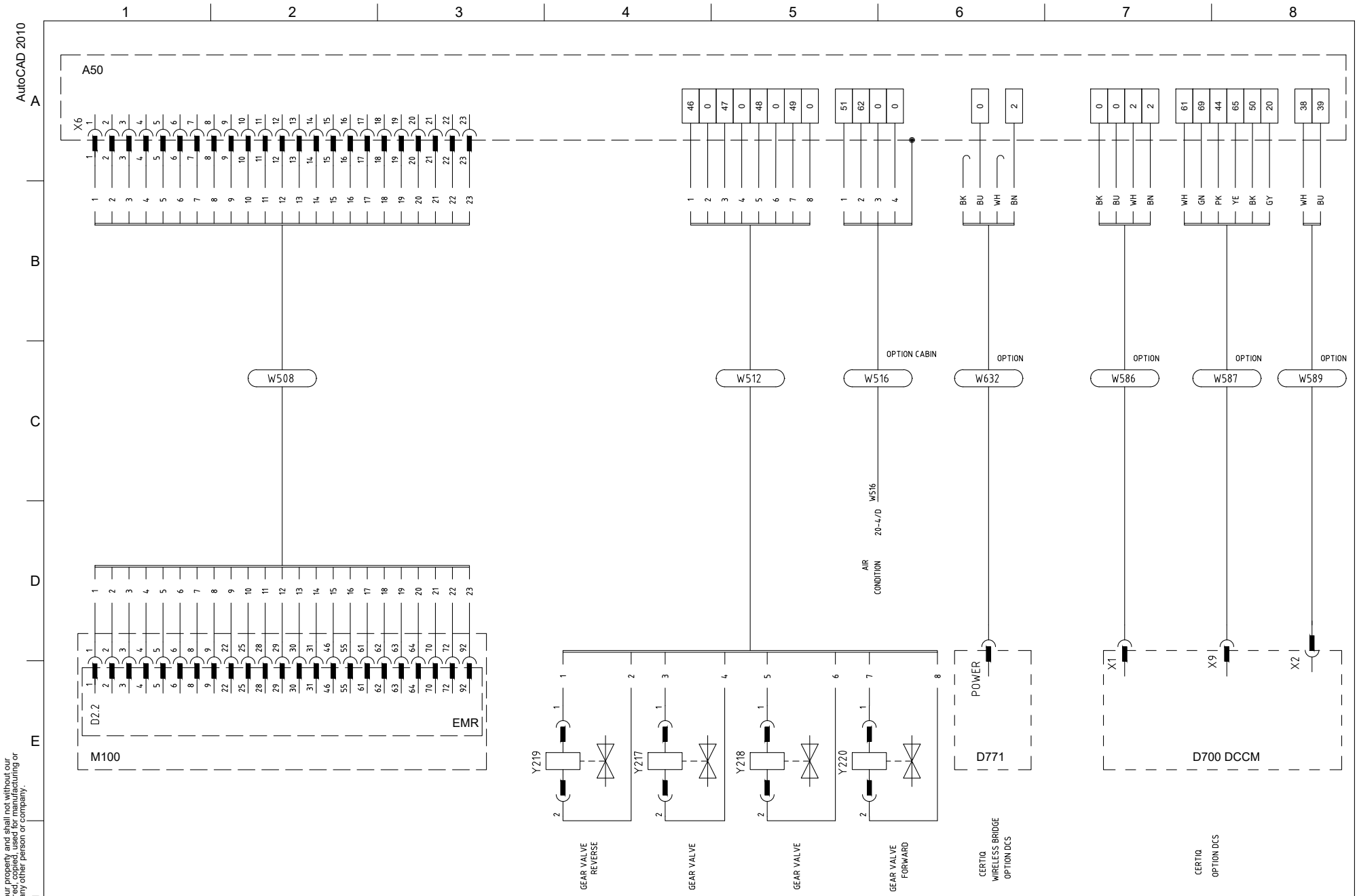
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

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| Status: Released | Date: 2014-10-09 | Compare | 5112015082 |



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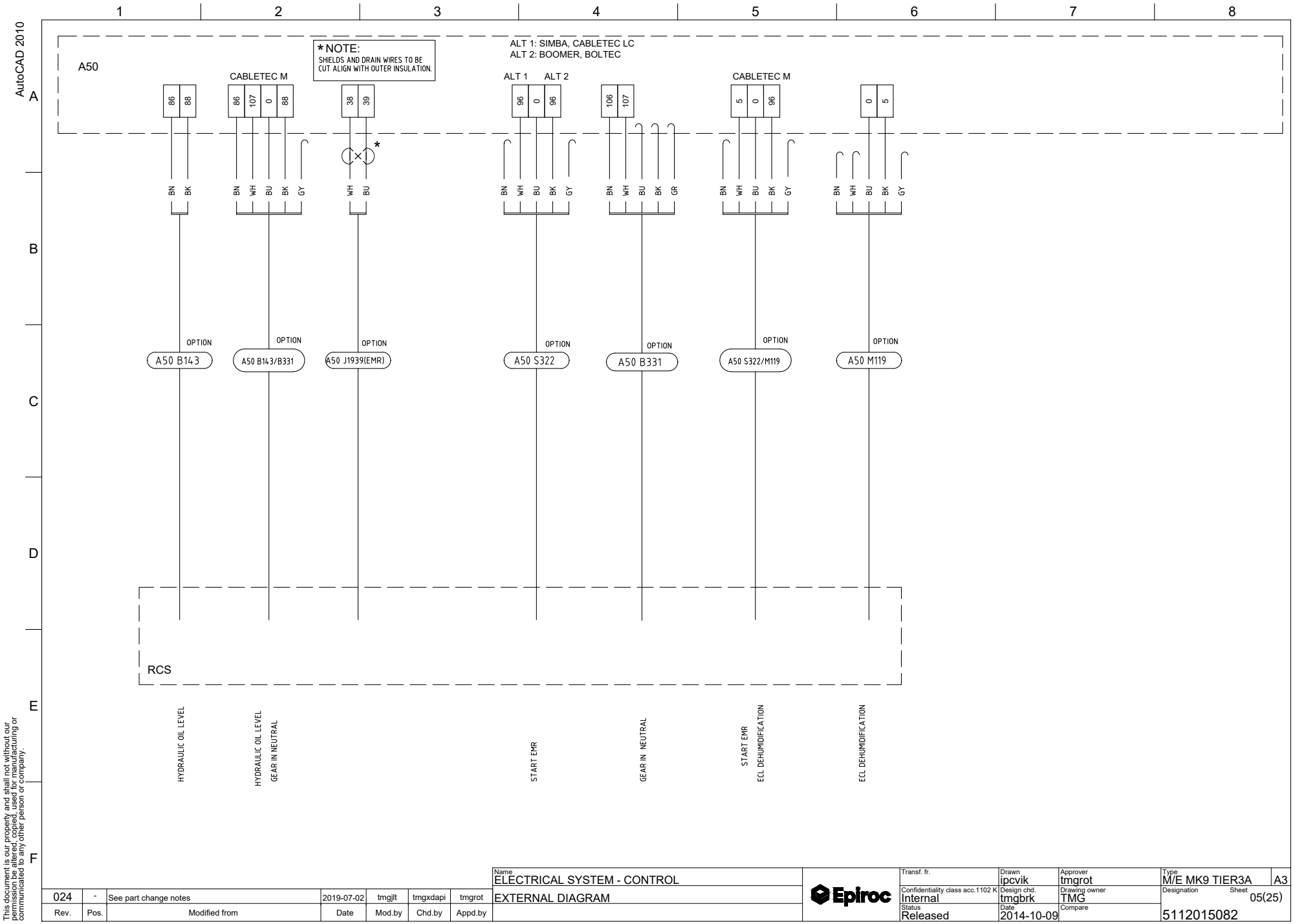
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

Epiroc

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| Status: Released | Date: 2014-10-09 | Compare | 5112015082 |



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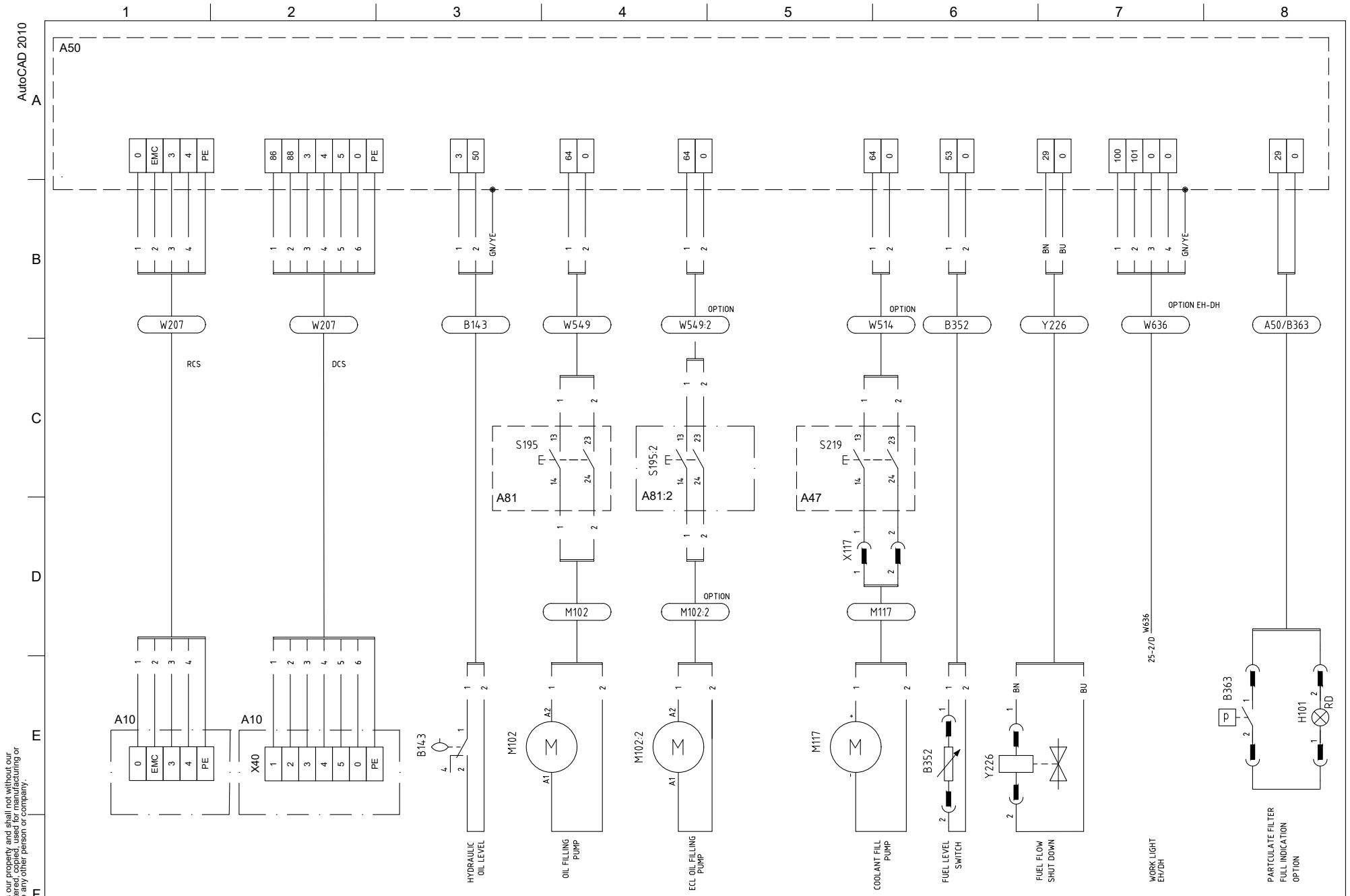
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

Epiroc

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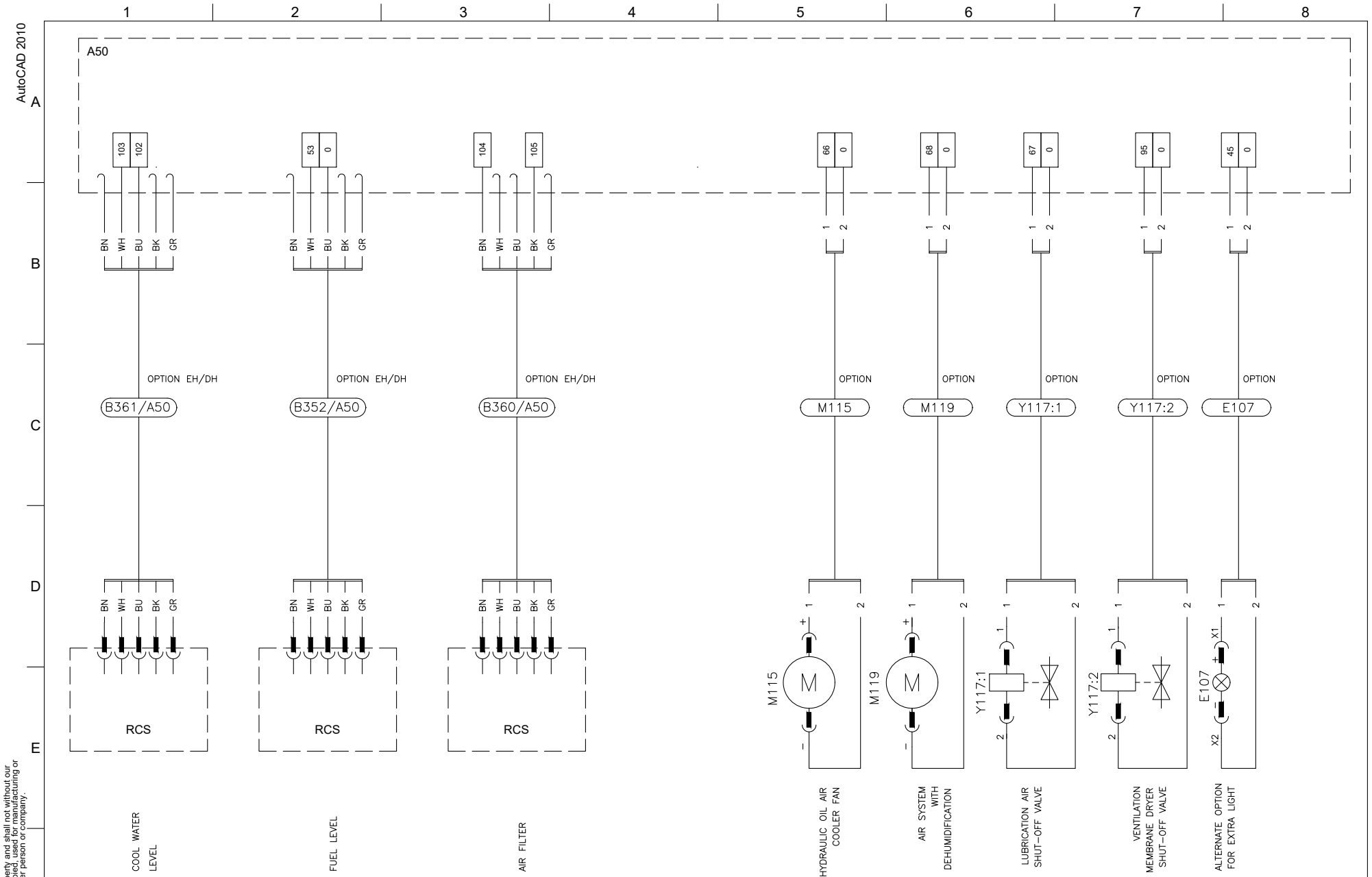
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

Epiroc

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| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation Sheet: 06(25) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015082 |



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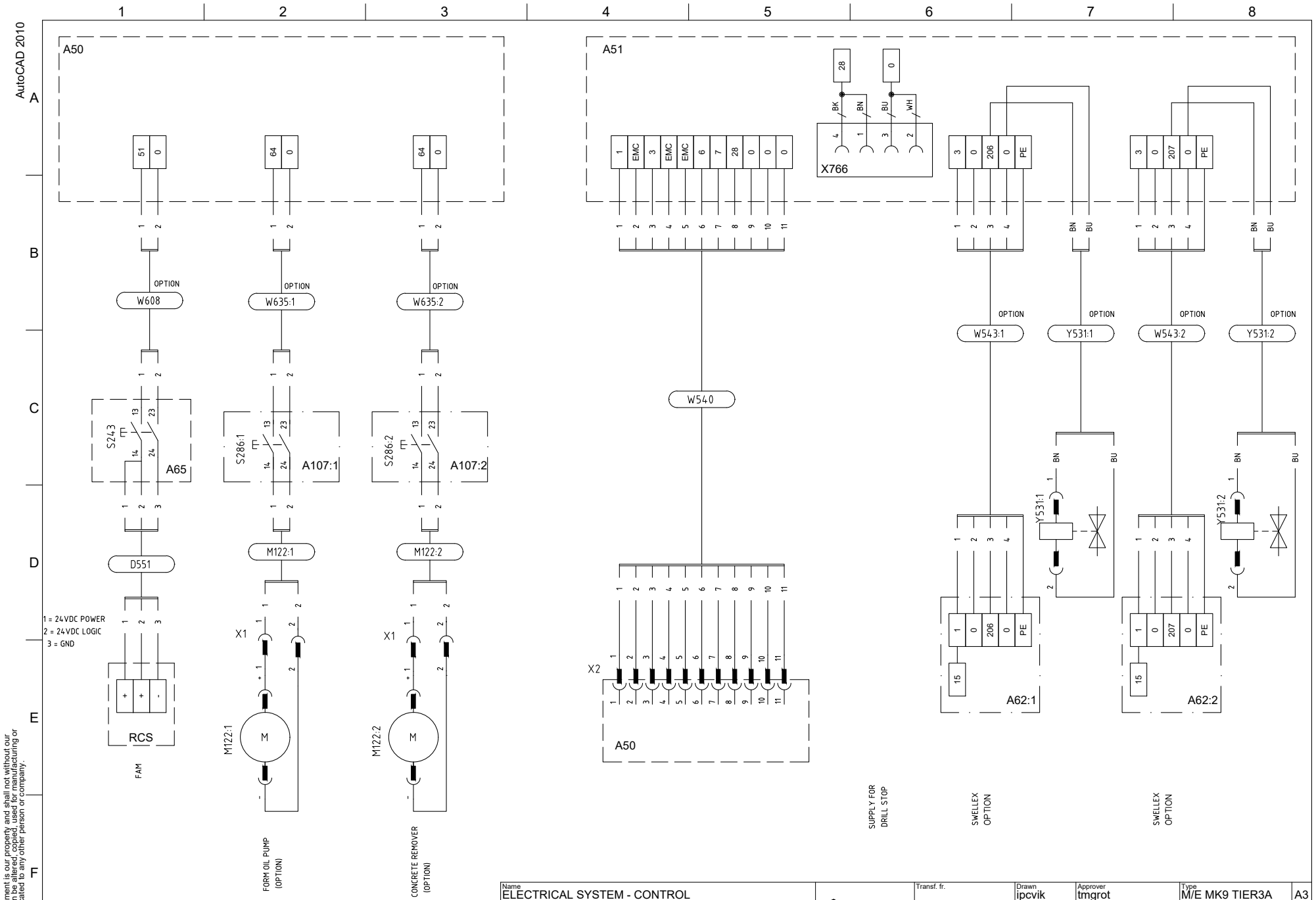
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

Epiroc

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| Status: Released | Date 2014-10-09 | Compare | 5112015082 | |



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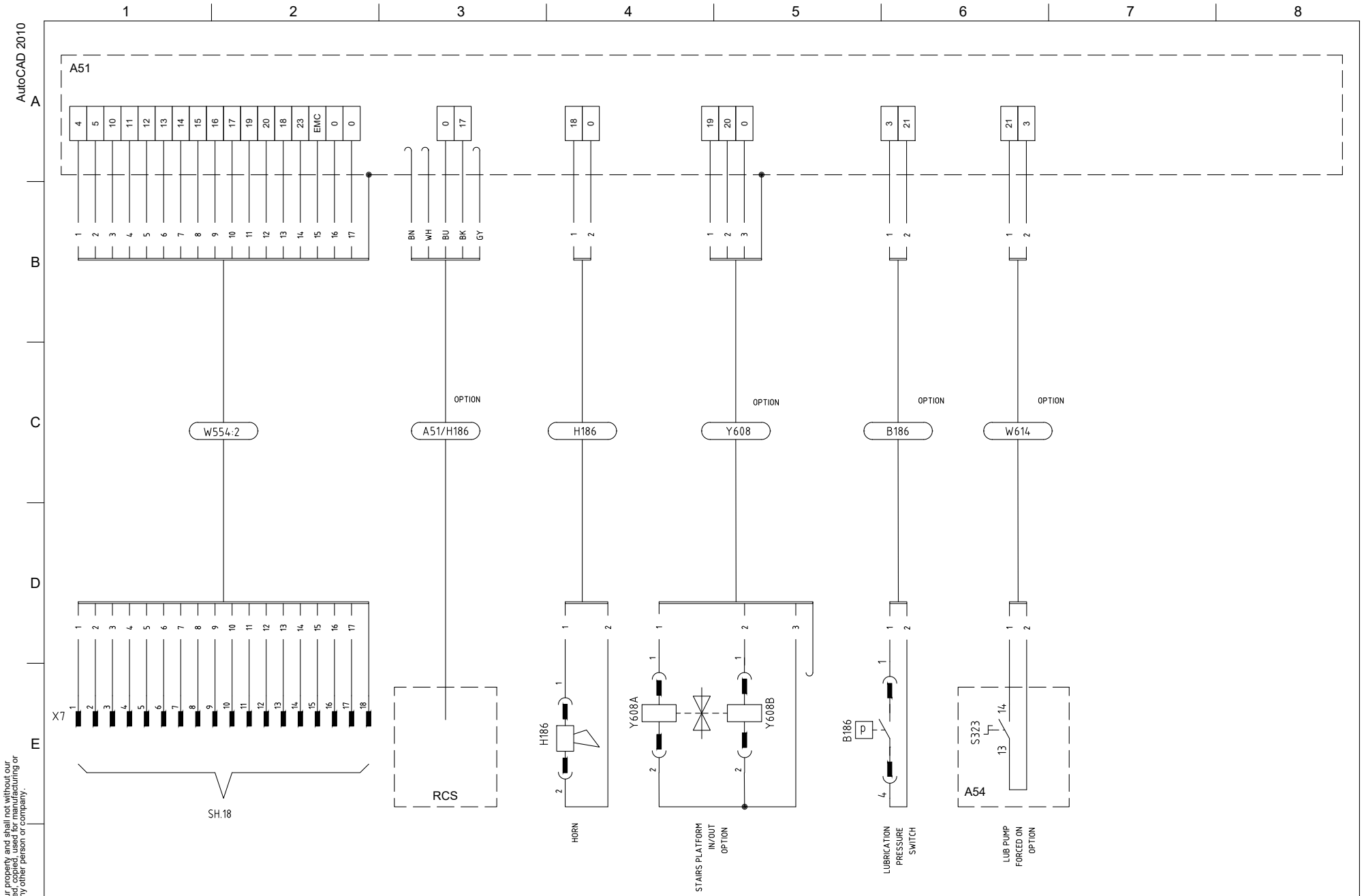
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

Epiroc

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| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation Sheet: 08(25) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015082 |



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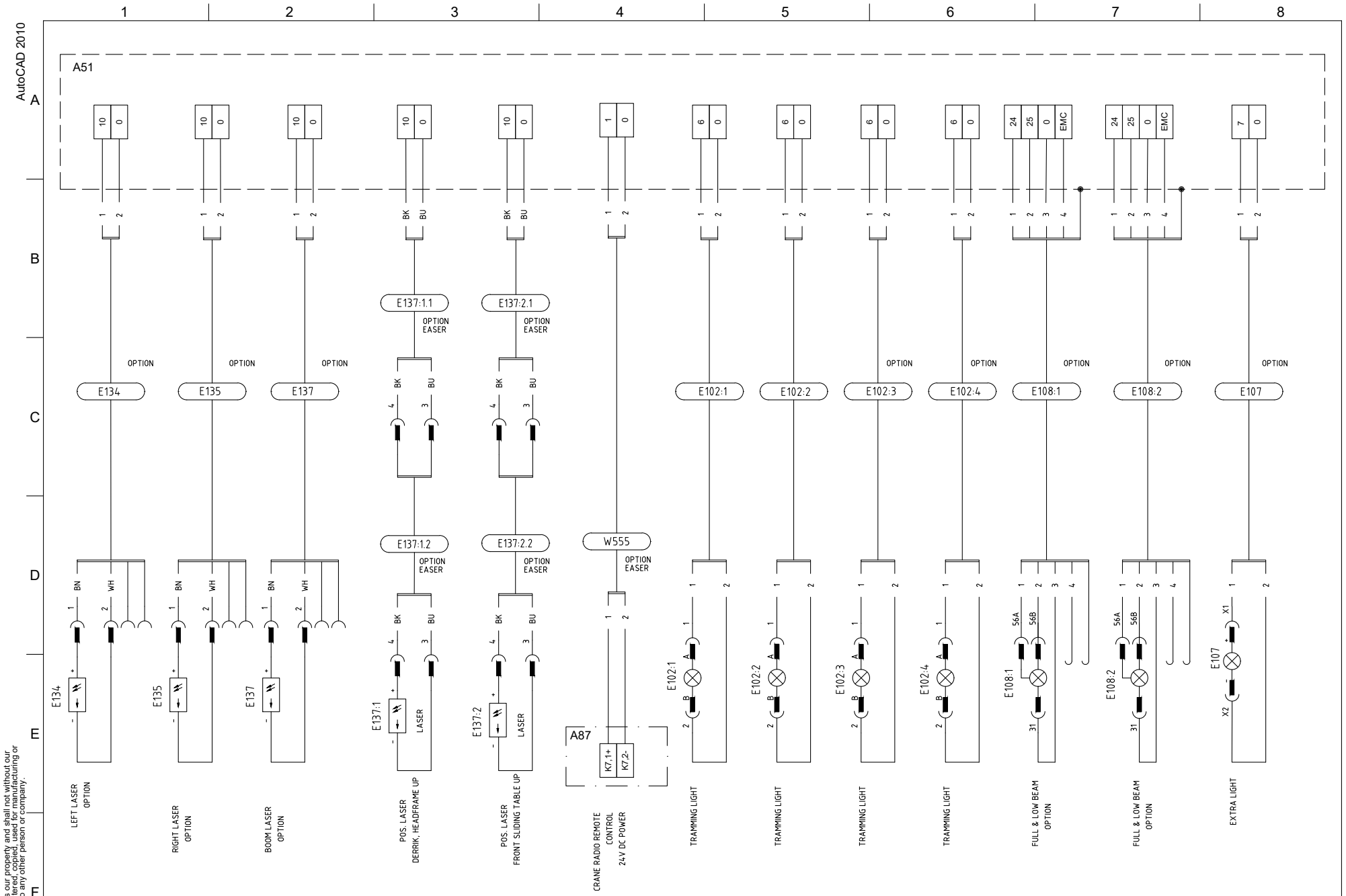
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

Epiroc

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| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation — Sheet: 09(25) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015082 |



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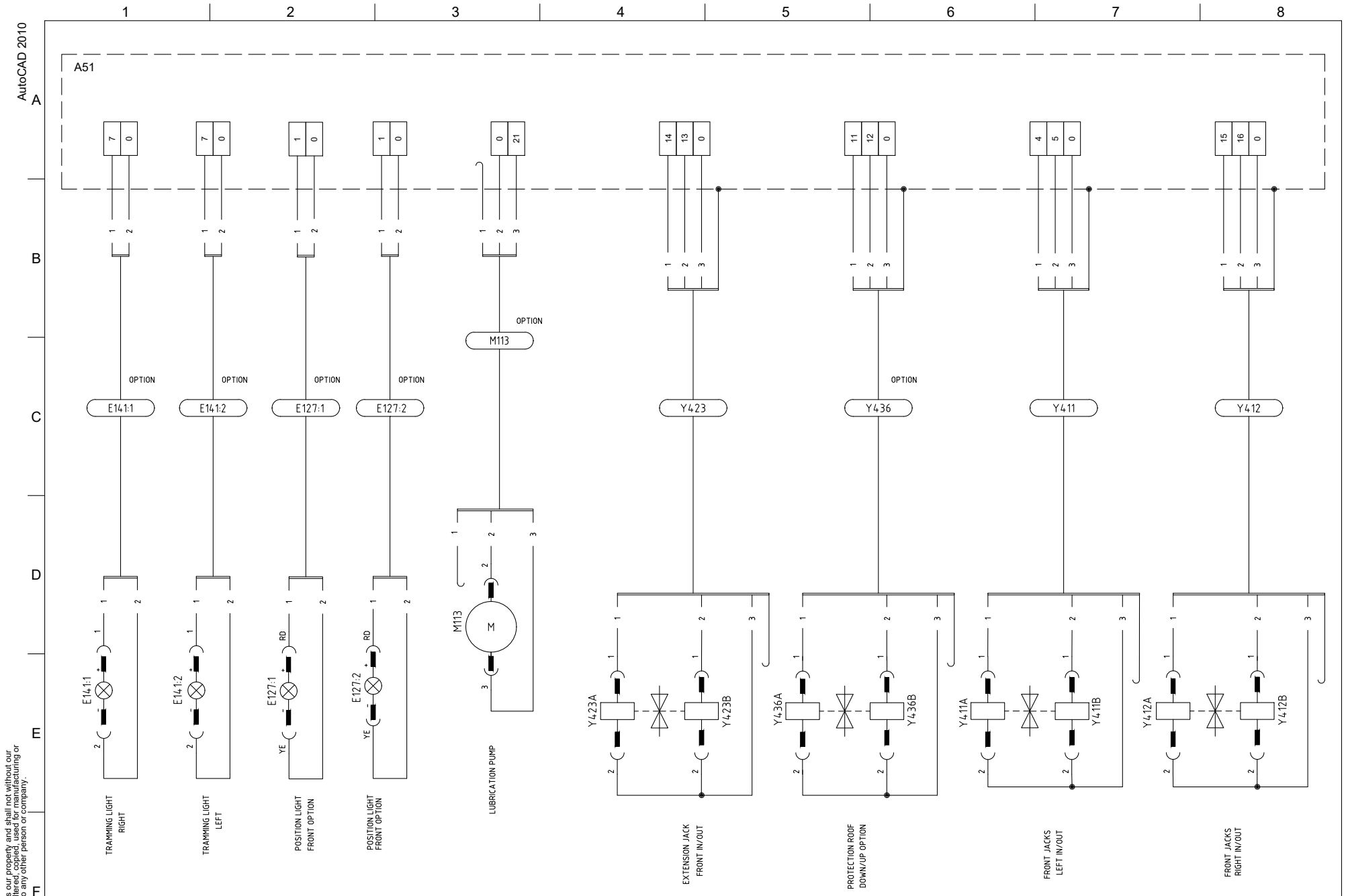
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

Epiroc

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| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation — Sheet: 10(25) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015082 |



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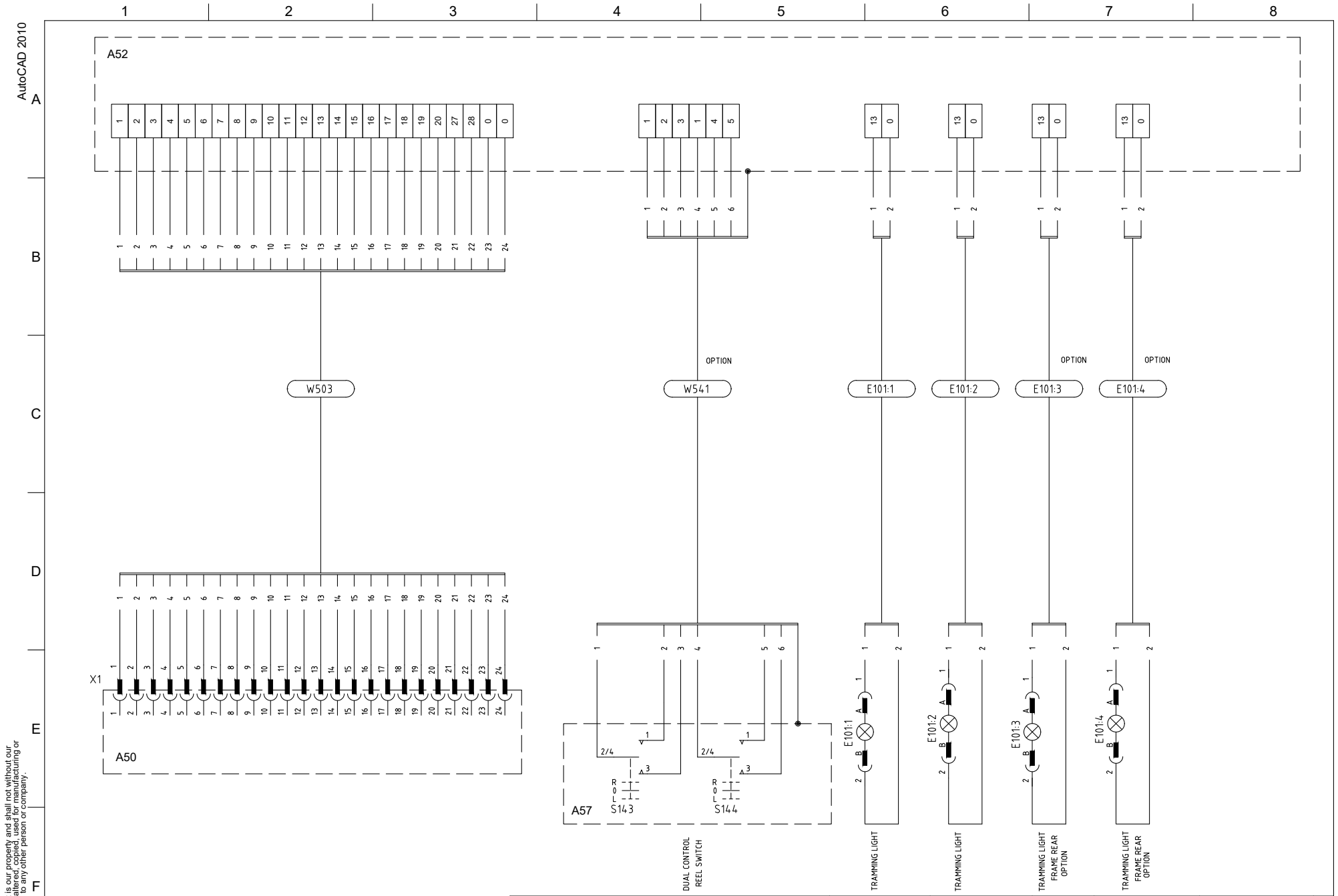
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

Epiroc

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| Status: Released | Date: 2014-10-09 | Compare | 5112015082 |



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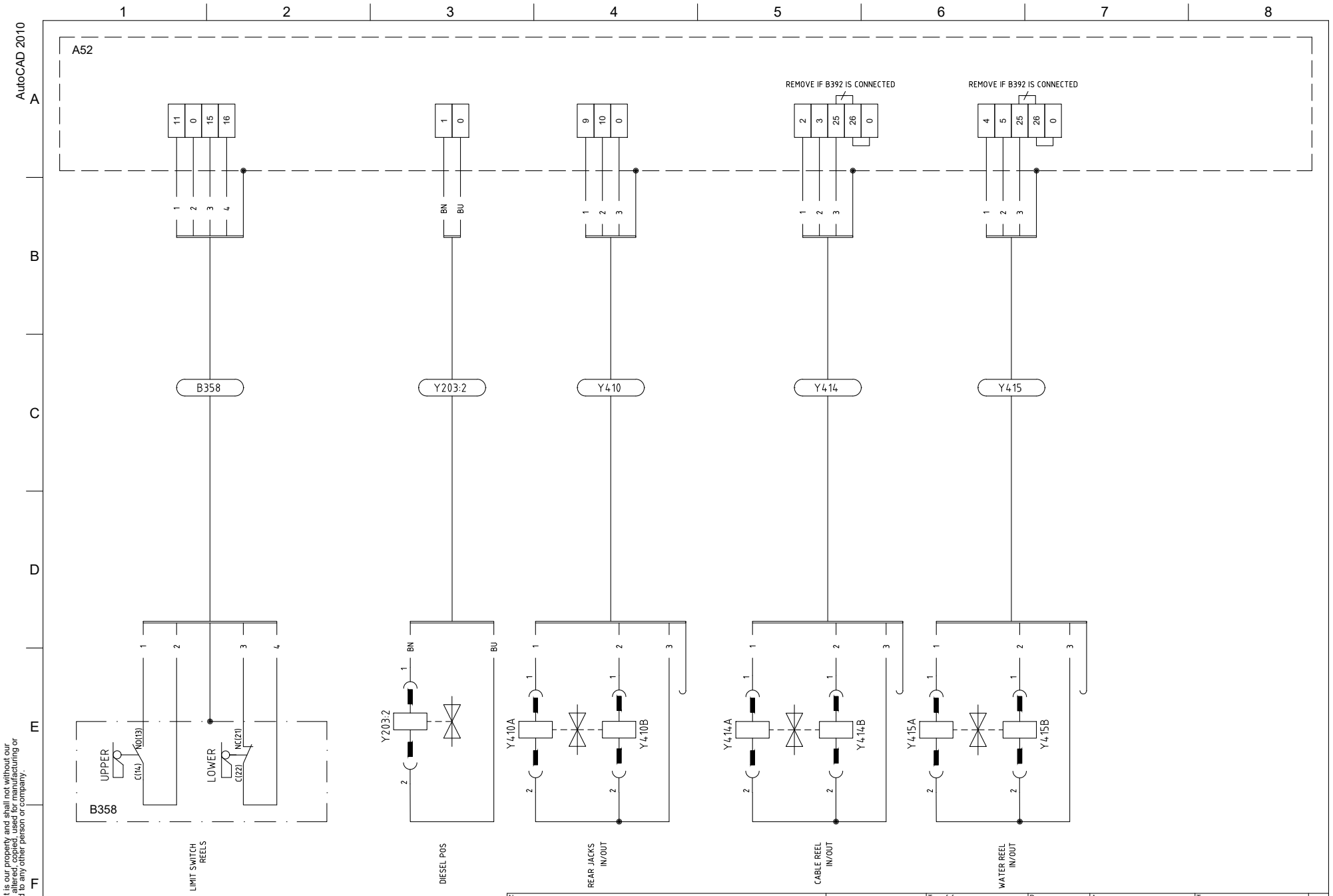
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

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| Status: Released | Date: 2014-10-09 | Compare | 5112015082 |



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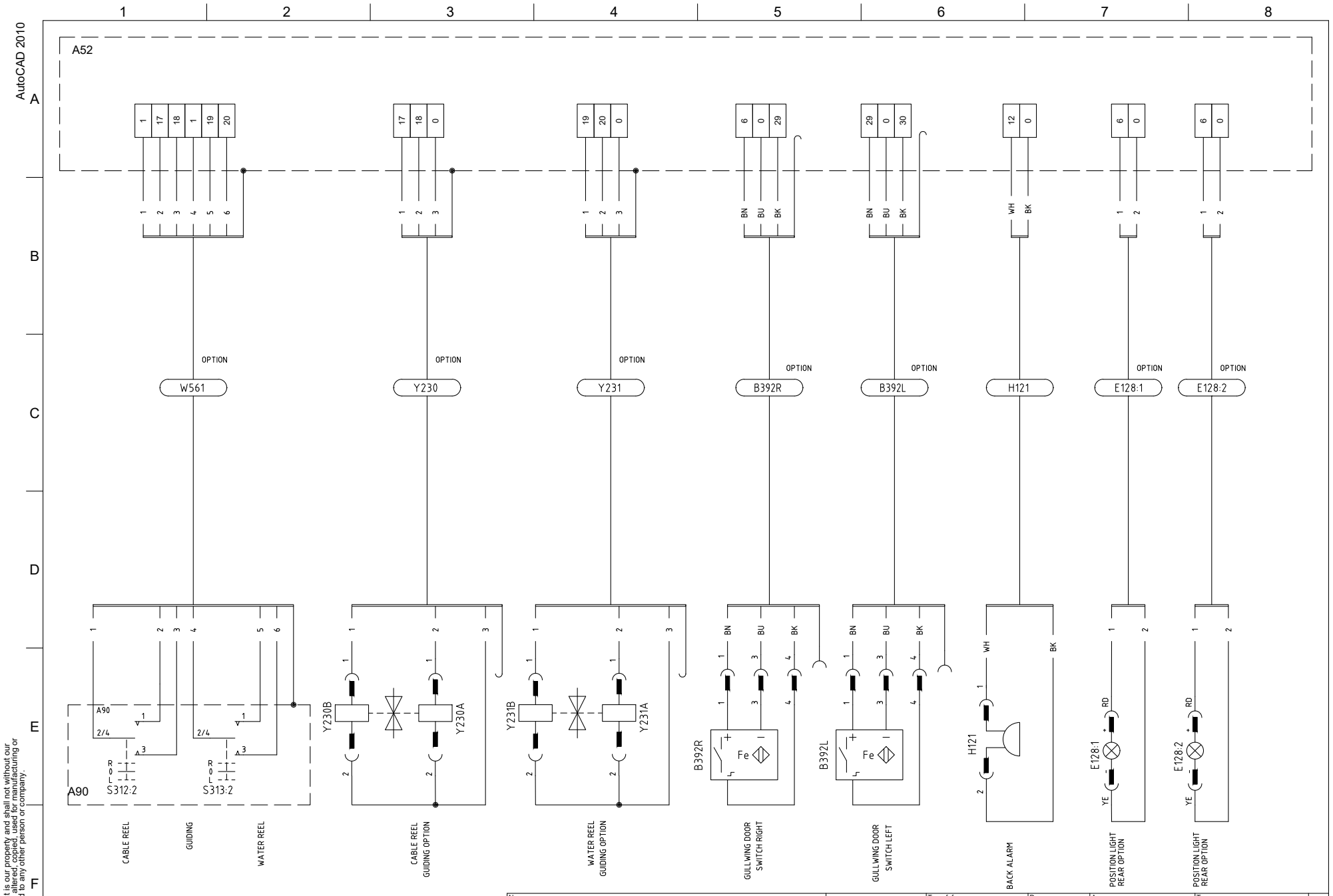
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

Epiroc

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| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation — Sheet: 13(25) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015082 |



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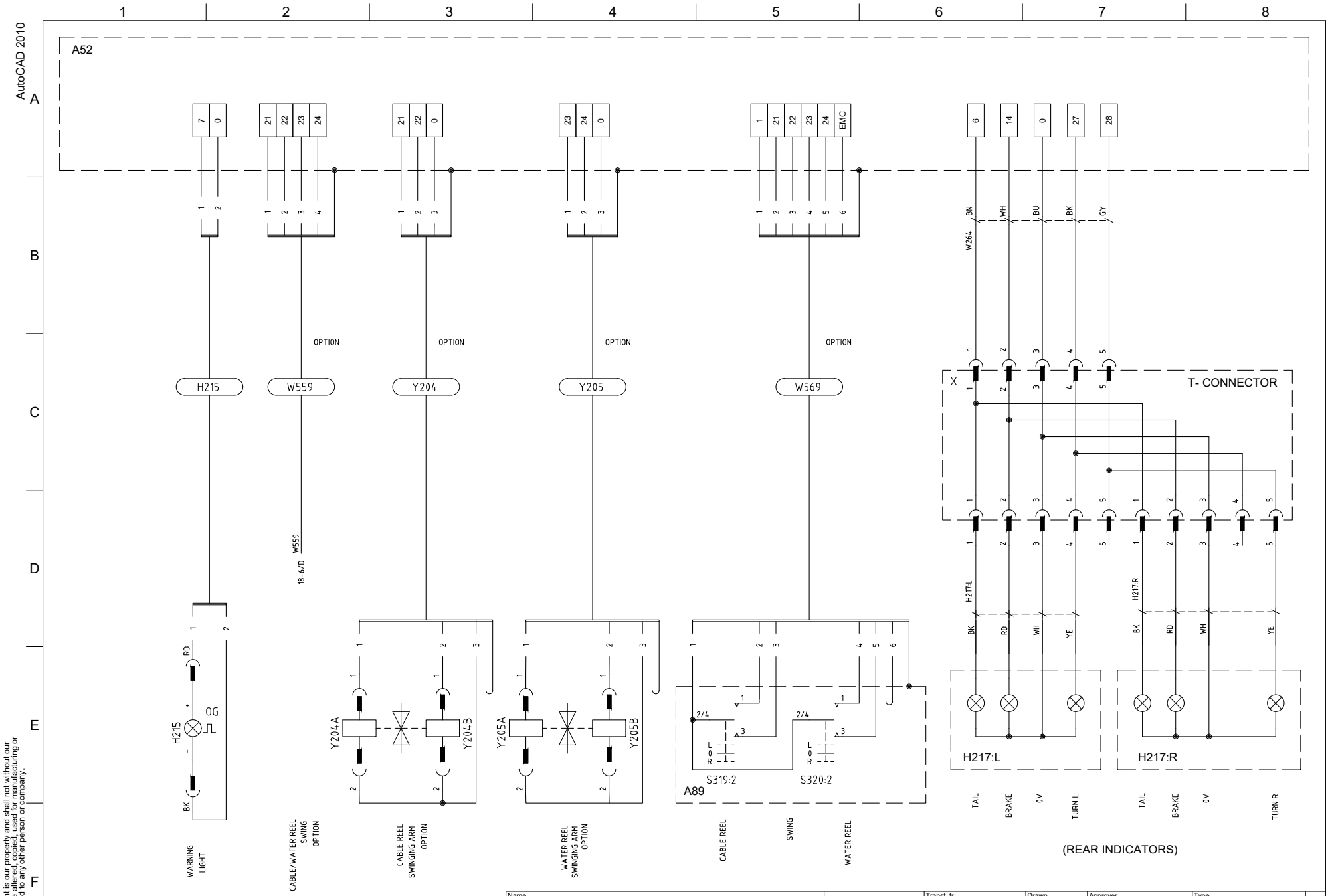
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

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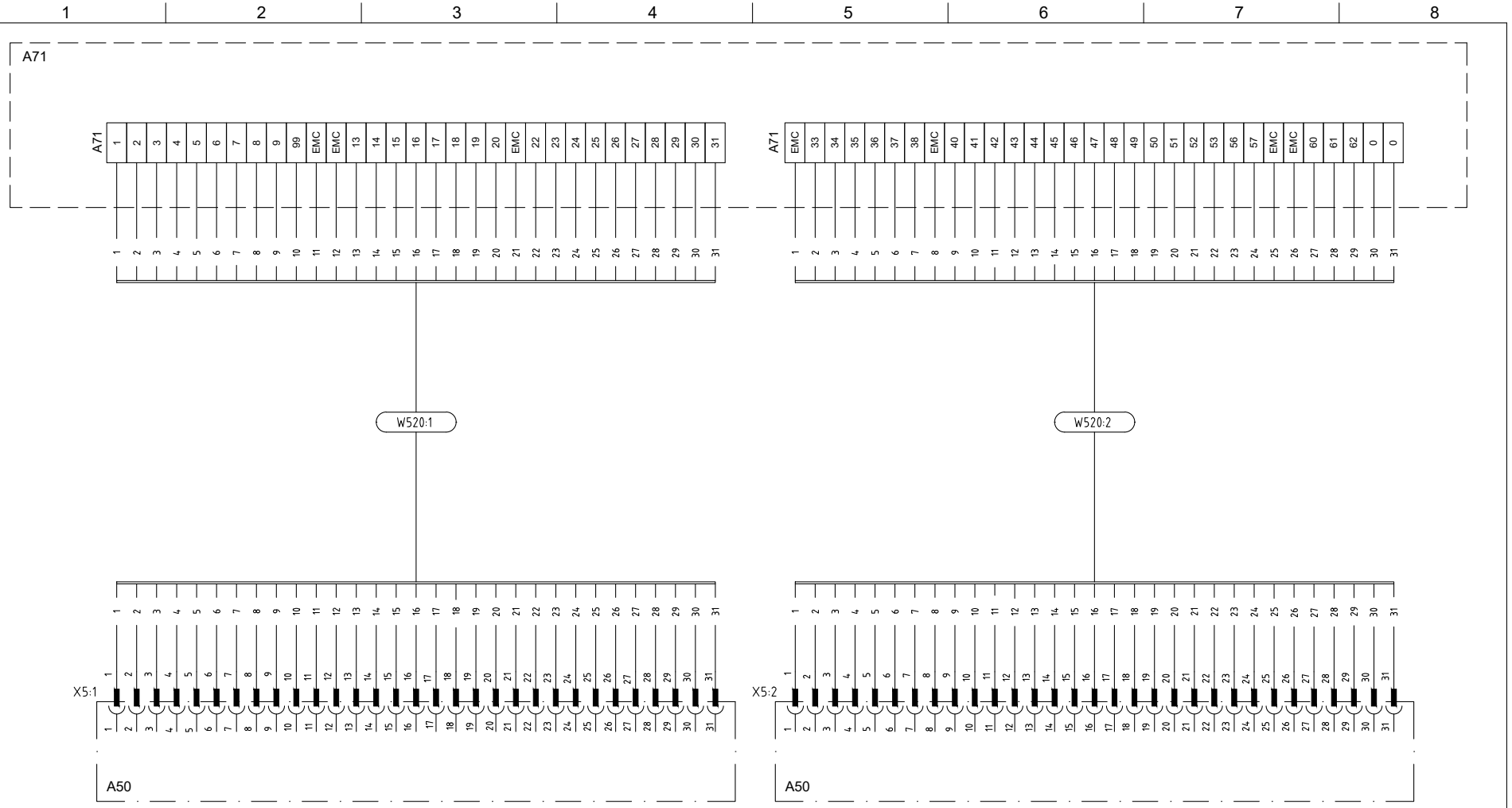
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

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| Status: Released | Date: 2014-10-09 | Compare | 5112015082 |



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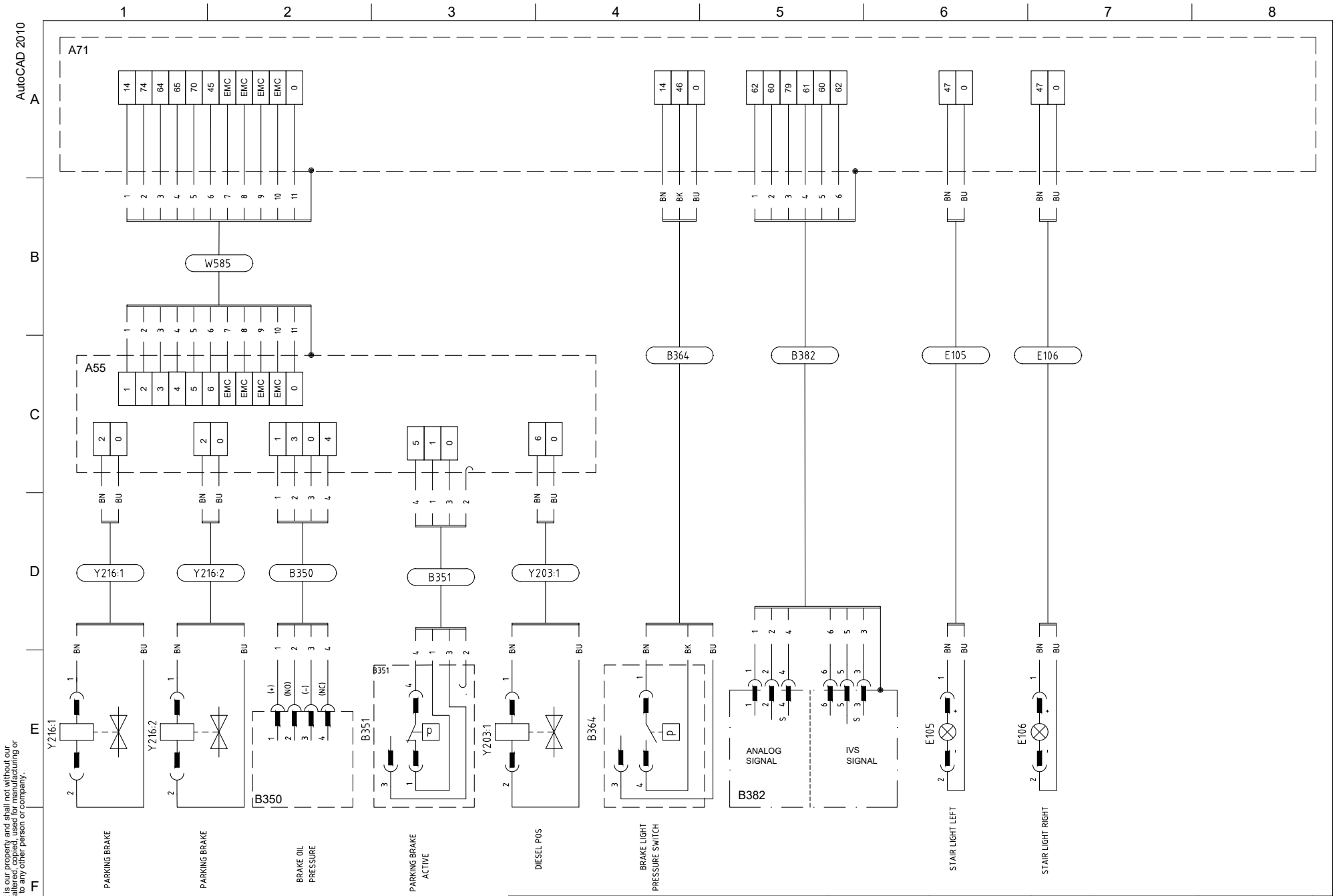
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

Epiroc

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| Status: Released | Date: 2014-10-09 | Compare | 5112015082 |



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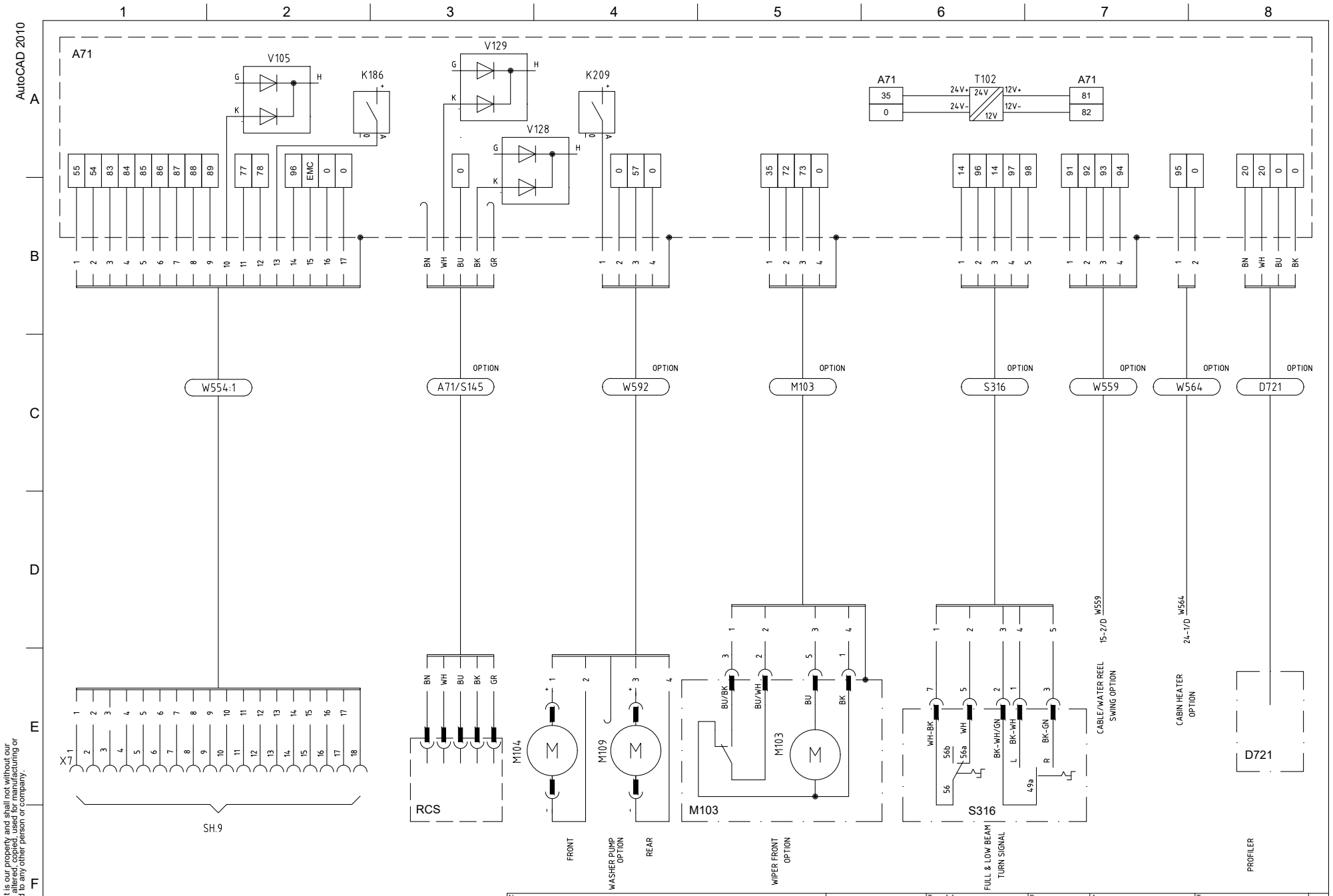
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

Epiroc

| Transf. fr. | Drawn | Approver | Type | |
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| Confidentiality class acc.1102 K | Design chd. | Drawing owner | Designation | Sheet |
| Internal | tmgbrk | TMG | | 17(25) |
| Status | Date | Compare | | |
| Released | 2014-10-09 | | 5112015082 | |



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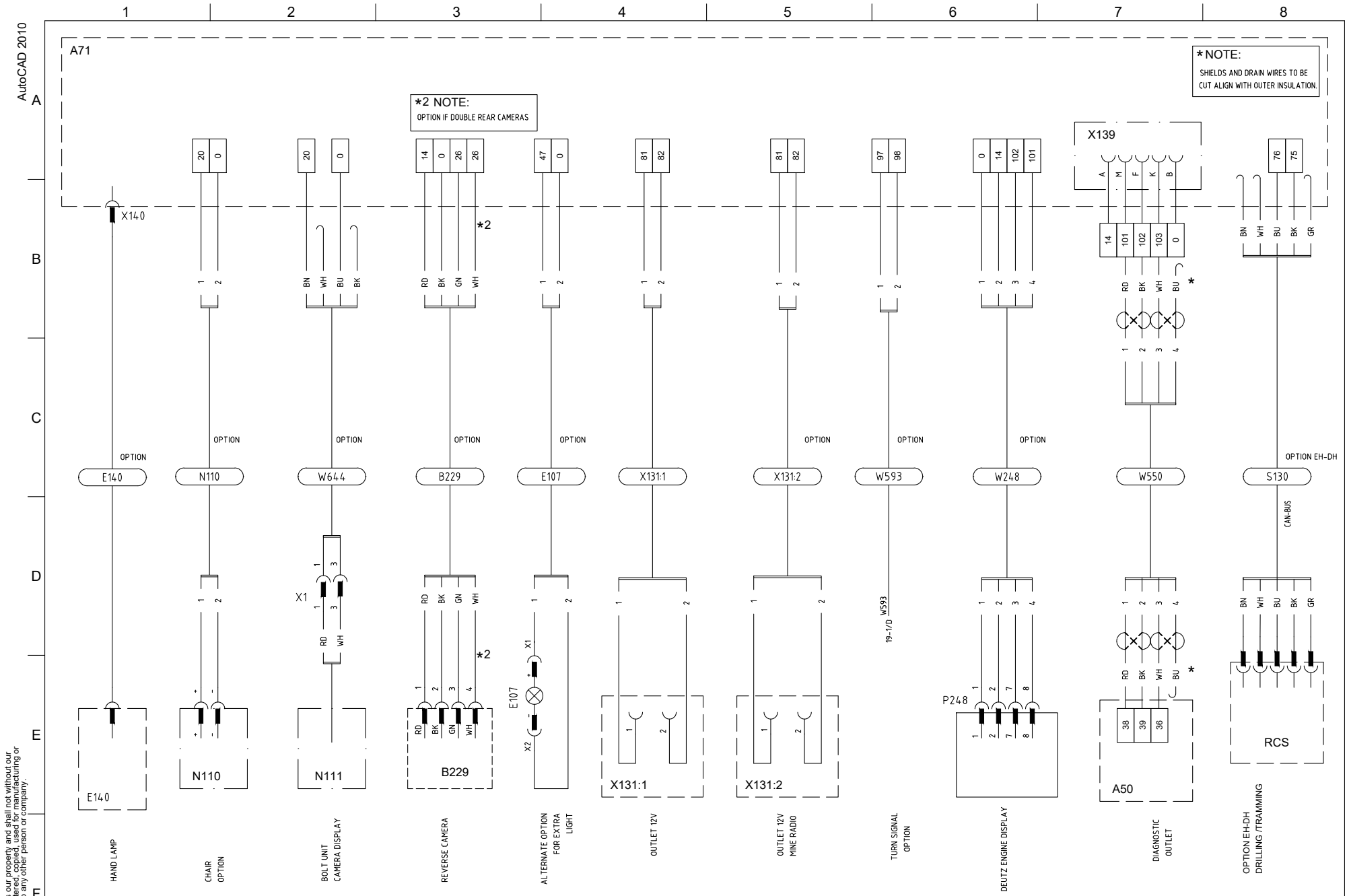
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

Epiroc

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| 024 | - | See part change notes | 2019-07-02 | tmgjlt | tmgxdapi | tmgrot |

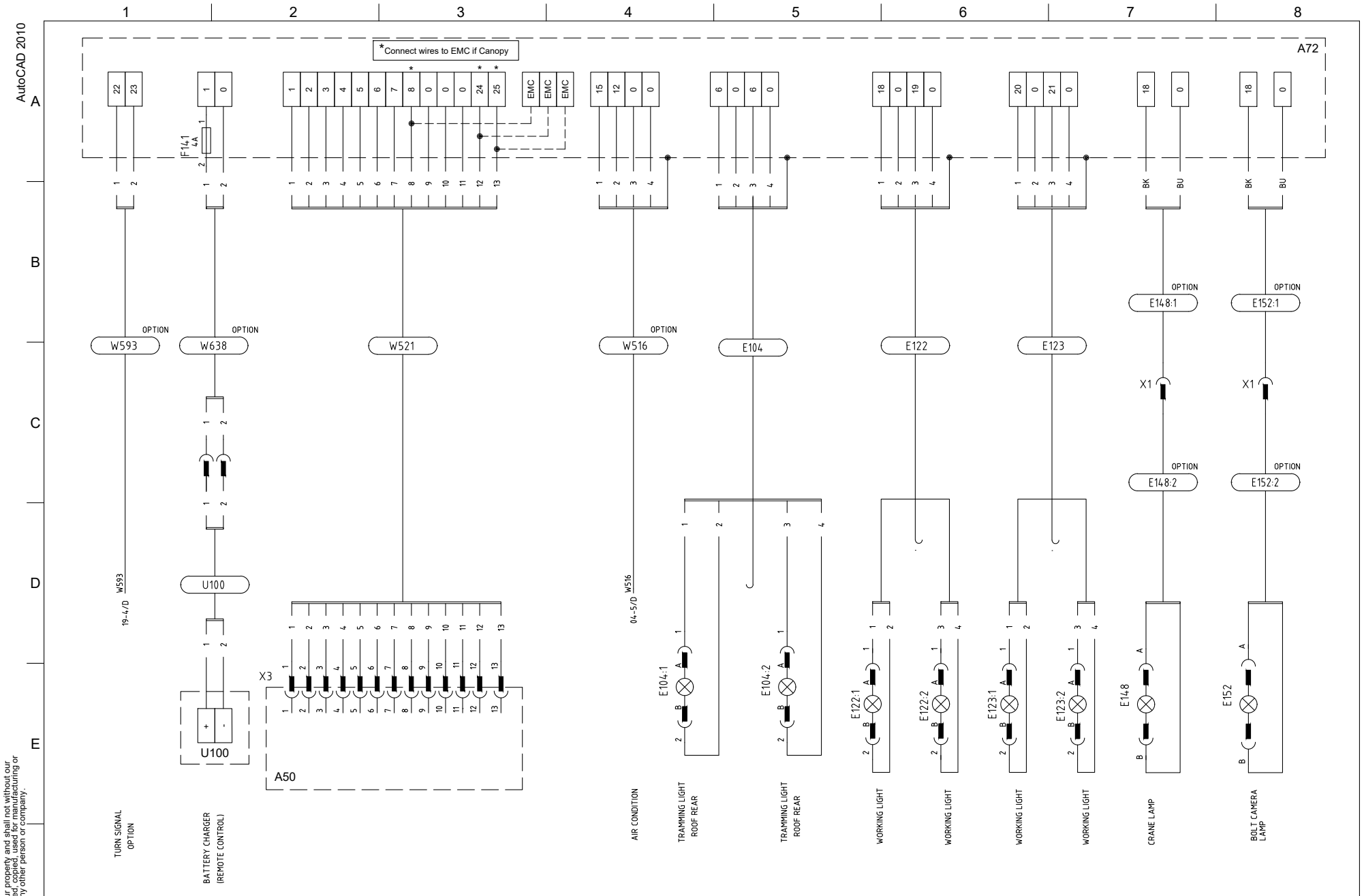
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

Epiroc

| | | | |
|---|---|---|---|
| Transf. fr. | Drawn: ipcvik | Approver: tmgrot | Type: M/E MK9 TIER3A — A3 |
| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation — Sheet: 19(25) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015082 |



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| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 024 | - | See part change notes | 2019-07-02 | tmgjlt | tmgxdapi | tmgrot |

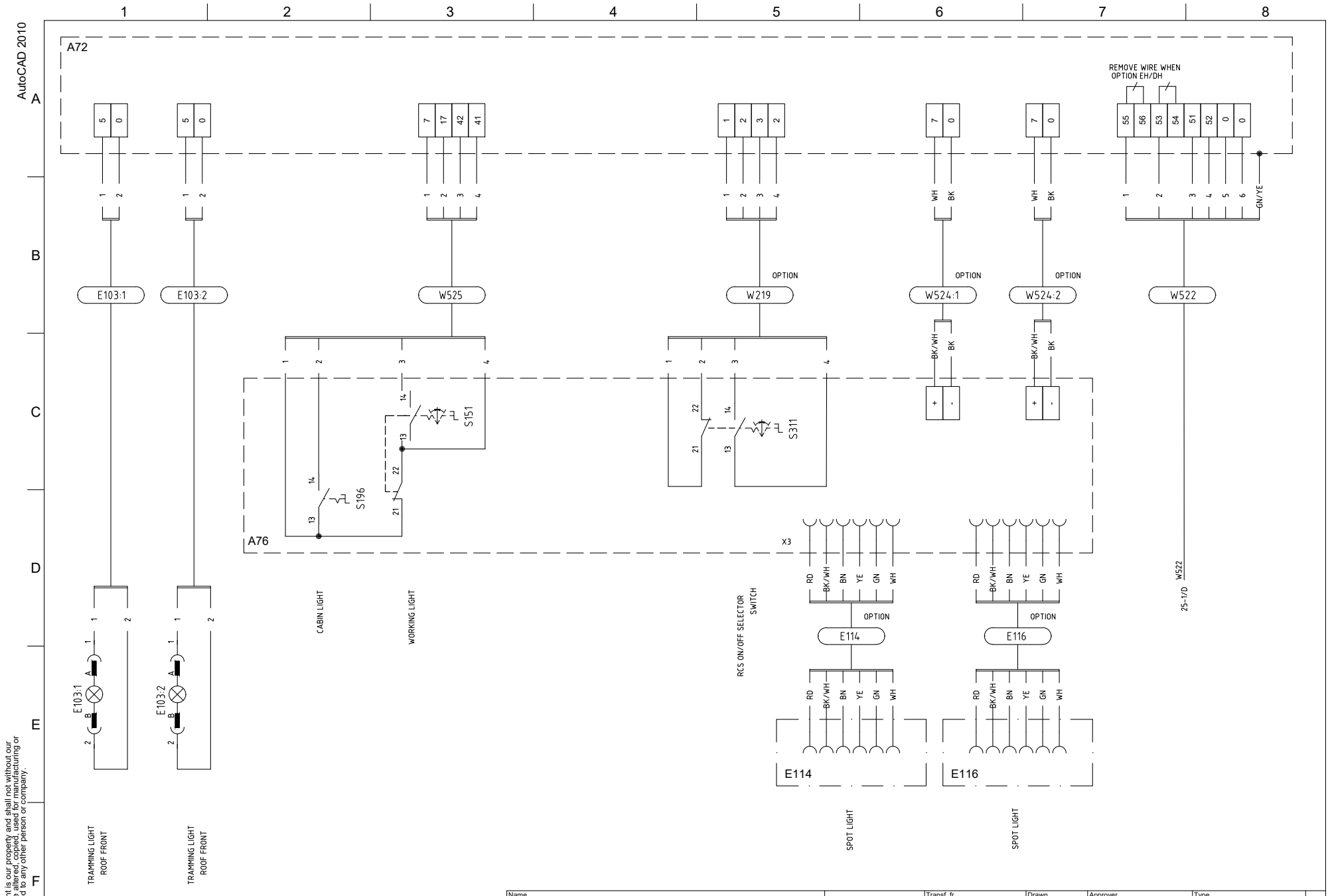
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

Epiroc

| | | | |
|---|---|---|---|
| Transf. fr. | Drawn: ipcvik | Approver: tmgrot | Type: M/E MK9 TIER3A — A3 |
| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation — Sheet: 20(25) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015082 |



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| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 024 | - | See part change notes | 2019-07-02 | tmgjlt | tmgxdapi | tmgrot |

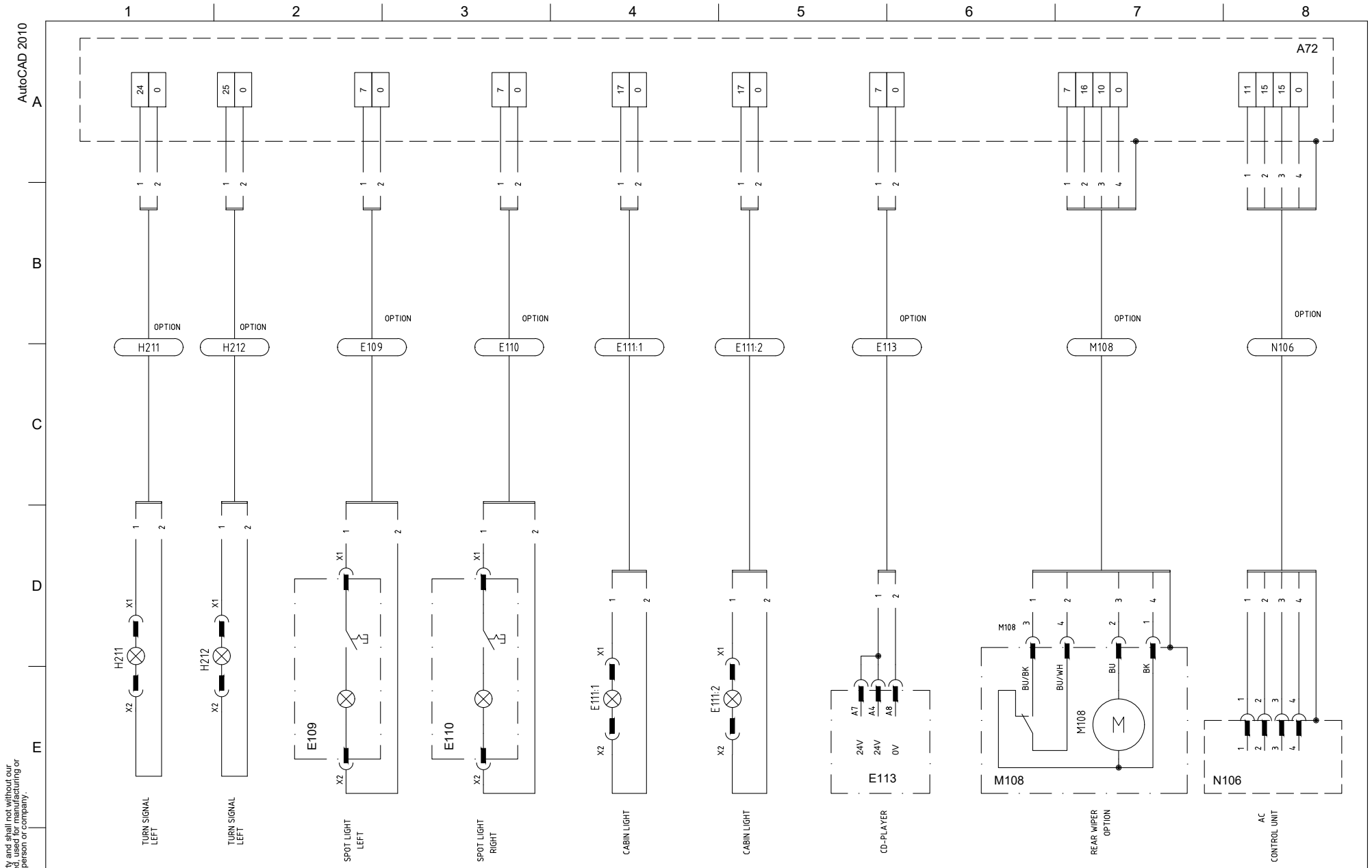
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

Epiroc

| Transf. fr. | Drawn | Approver | Type | |
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| Confidentiality class acc.1102 K: Internal | Design chd. tmgbrk | Drawing owner TMG | Designation | Sheet 21(25) |
| Status: Released | Date 2014-10-09 | Compare | 5112015082 | |



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| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 024 | - | See part change notes | 2019-07-02 | tmgjlt | tmgxdapi | tmgrot |

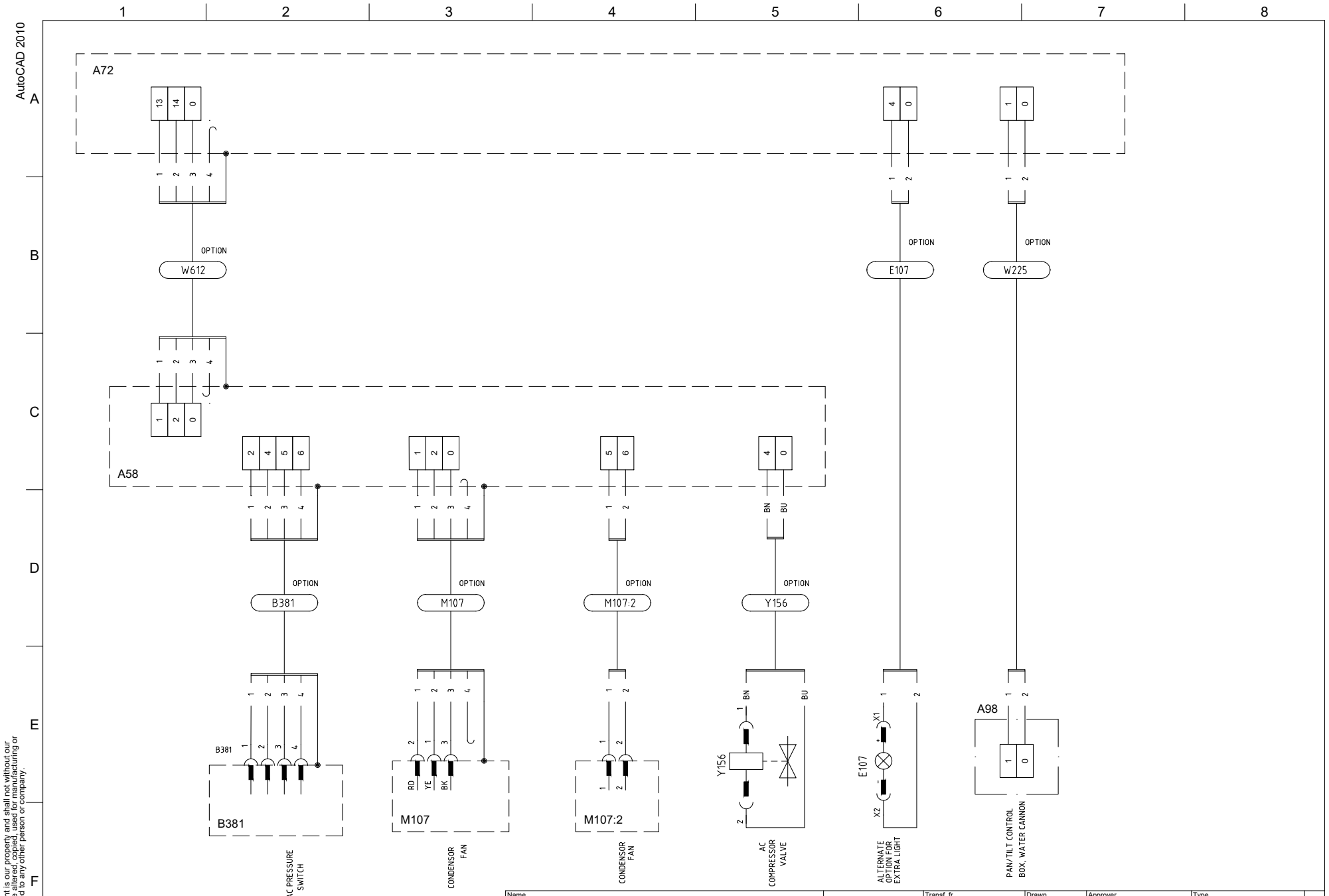
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

Epiroc

| | | | |
|---|---|---|---|
| Transf. fr. | Drawn: ipcvik | Approver: tmgrot | Type: M/E MK9 TIER3A — A3 |
| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation — Sheet: 22(25) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015082 |



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| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 024 | - | See part change notes | 2019-07-02 | tmgjlt | tmgxdapi | tmgrot |

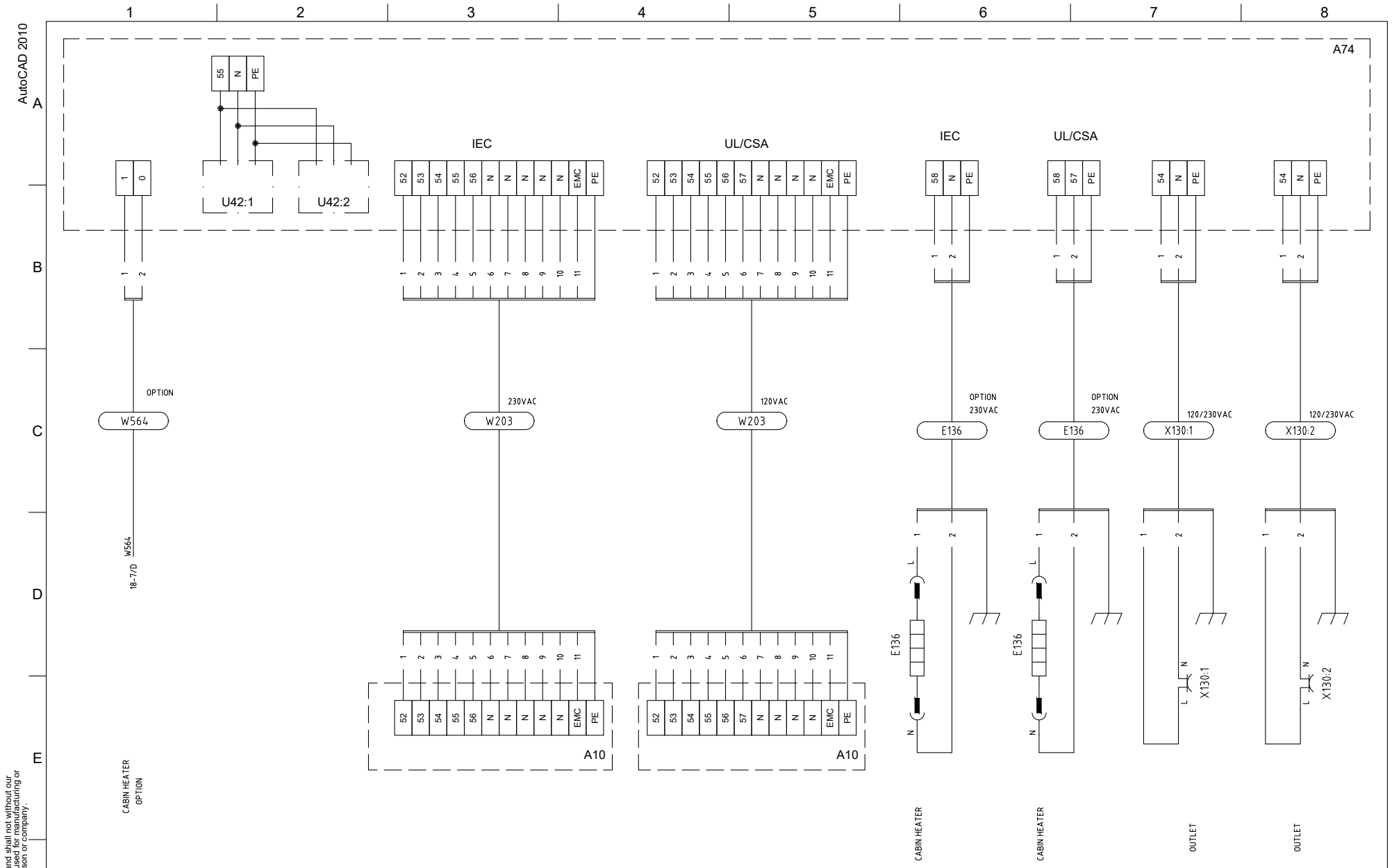
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

Epiroc

| | | | |
|---|---|---|---|
| Transf. fr. | Drawn: ipcvik | Approver: tmgrot | Type: M/E MK9 TIER3A — A3 |
| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation — Sheet: 23(25) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015082 |



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| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
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| 024 | - | See part change notes | 2019-07-02 | tmgjlt | tmgxdapi | tmgrot |

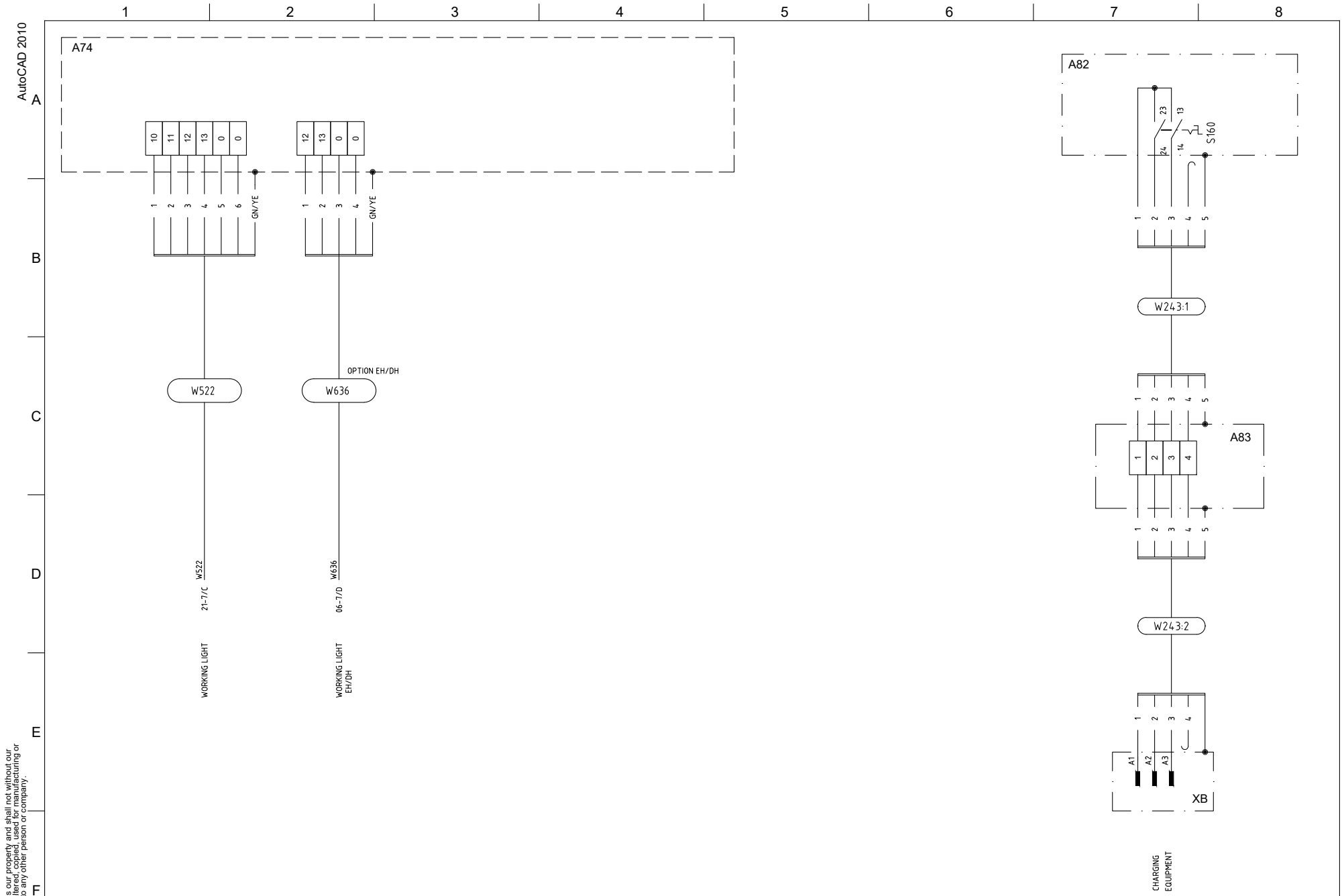
Name: ELECTRICAL SYSTEM - CONTROL
EXTERNAL DIAGRAM

Epiroc

| Transf. fr. | Drawn | Approver | Type | |
|---|---|---|---|---|
| | ipcvik | tmgrot | M/E MK9 TIER3A | A3 |
| Confidentiality class acc.1102 K | Design chd. | Drawing owner | Designation | Sheet |
| Internal | tmgbrk | TMG | | 24(25) |
| Status | Date | Compare | | |
| Released | 2014-10-09 | | 5112015082 | |



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| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 024 | - | See part change notes | 2019-07-02 | tmgjlt | tmgxdapi | tmgrot |

Name: ELECTRICAL SYSTEM - CONTROL

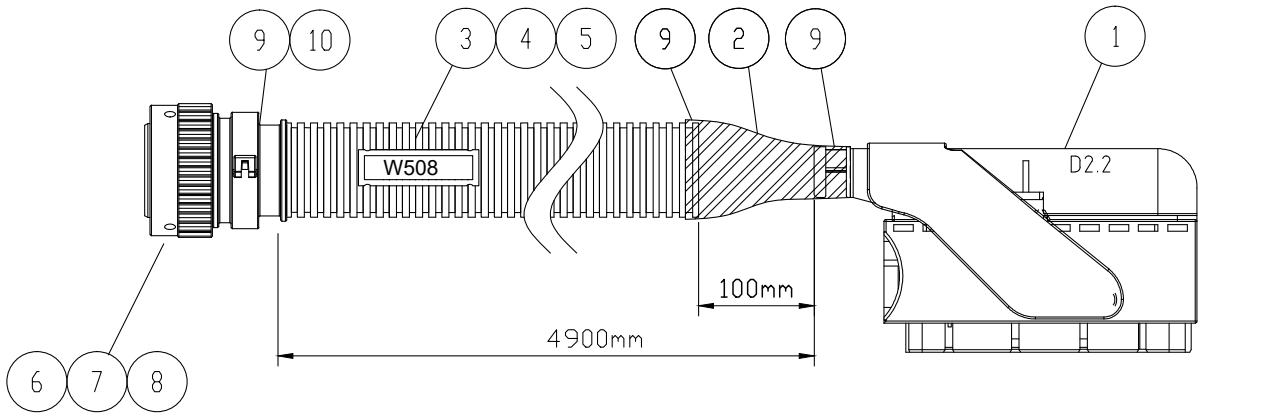
EXTERNAL DIAGRAM

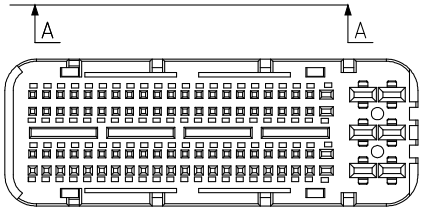
Epiroc

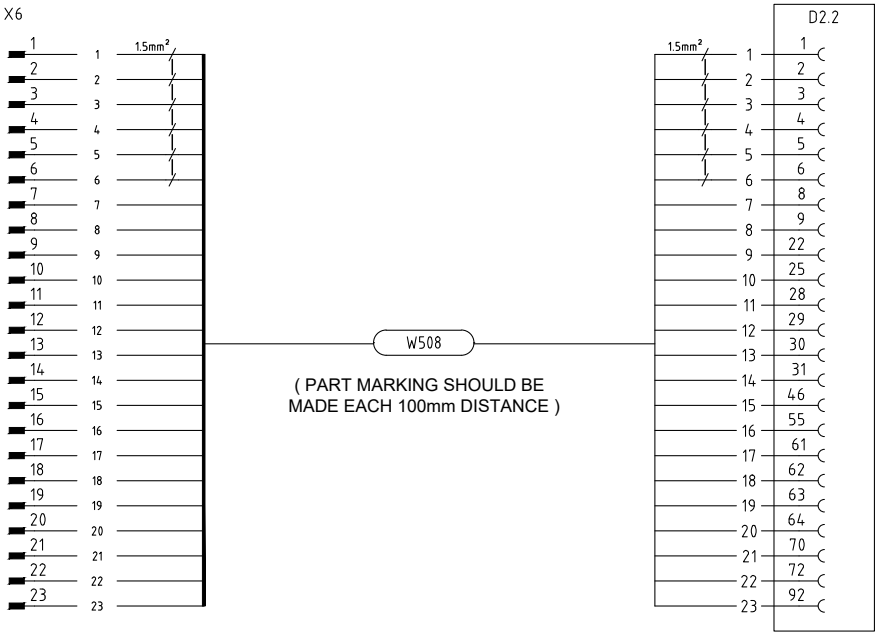
| | | | |
|---|---|---|---|
| Transf. fr. | Drawn: ipcvik | Approver: tmgrot | Type: M/E MK9 TIER3A — A3 |
| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbrk | Drawing owner: TMG | Designation — Sheet: 25(25) |
| Status: Released | Date: 2014-10-09 | Compare | 5112015082 |



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| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 002 | - | -D2.2 rotated, prot.hose measure added | 2018-06-15 | tmgjlt | tmgjms | tmgrot |

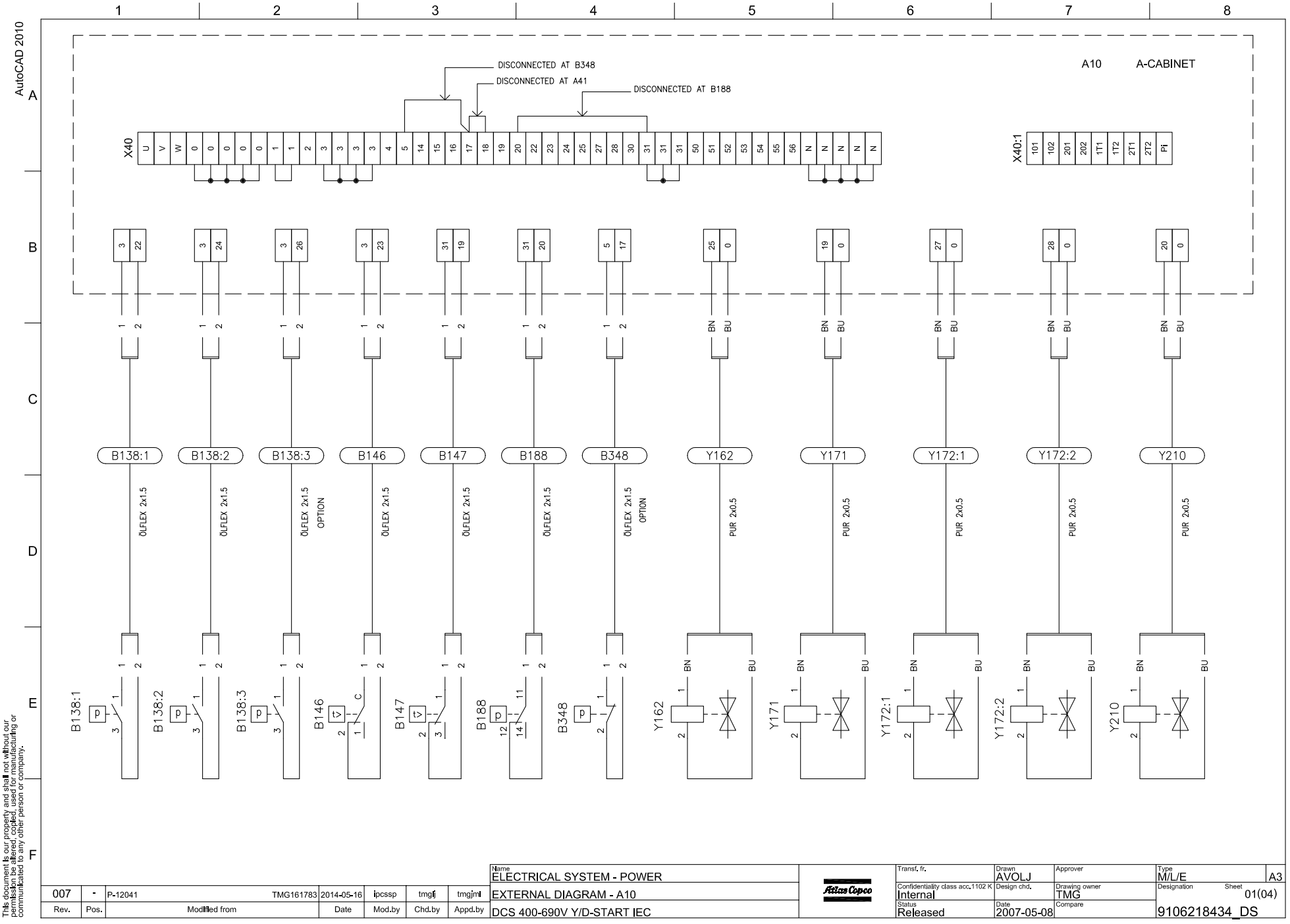
Name: ELECTRICAL SYSTEM - CONTROL
CABLE COMPLETE A50-EMR
STRUCTURE - 5112 0046 57

Epiroc

| Transf. fr. | Drawn | Approver | Type | |
|---|---|---|---|---|
| | ipcvik | tmgrot | W508 E2 MK9 ST.3A | A3 |
| Confidentiality class acc.1102 K | Design chd. | Drawing owner | Designation | Sheet |
| Internal | tmgbrk | TMG | 5112004660 | 01(01) |
| Status | Date | Compare | | |
| Released | 2015-10-19 | | | |



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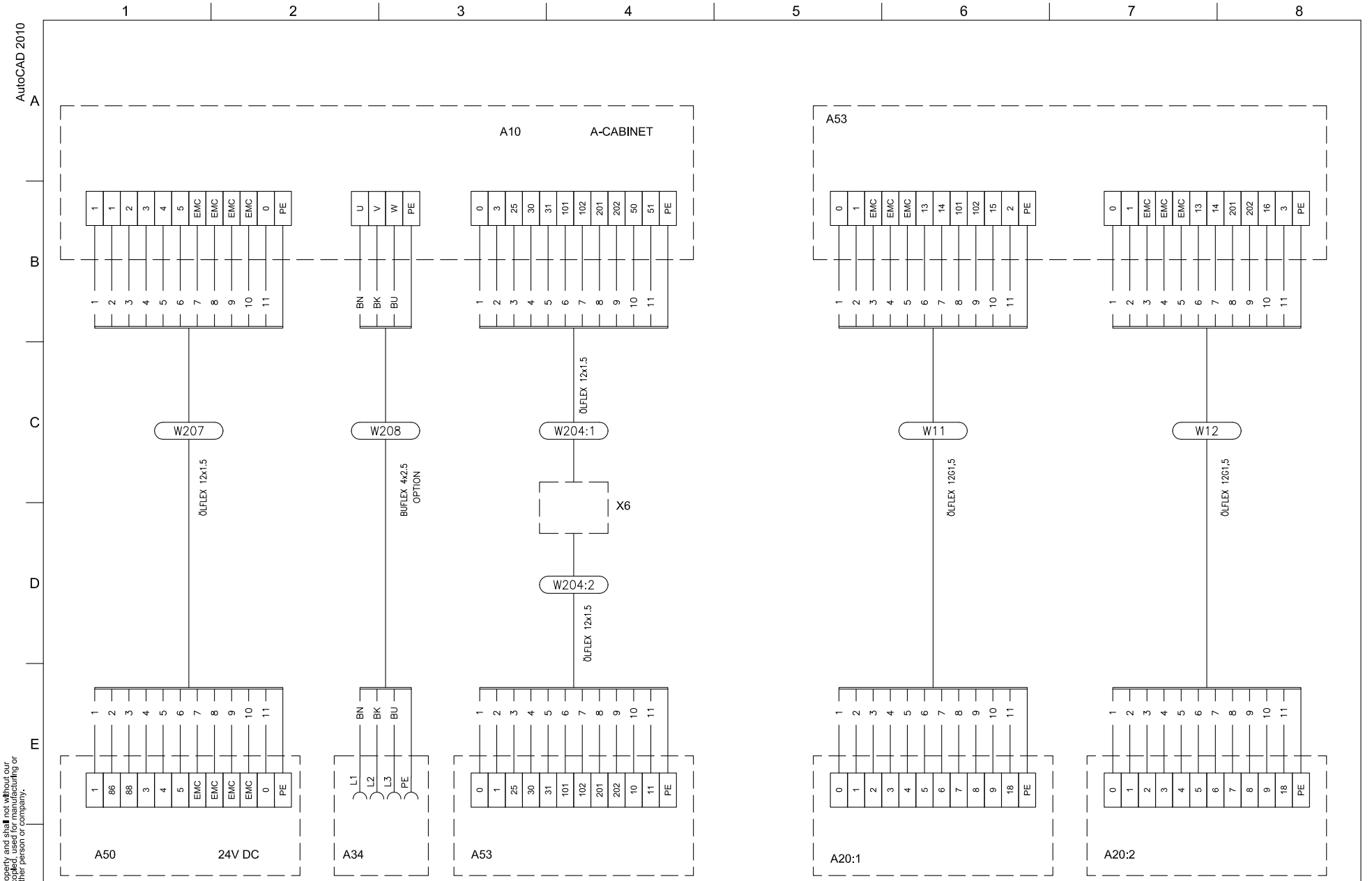

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| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 007 | - | P-12041 TMG161783 | 2014-05-16 | ipcssp | tmgfj | tmgjnl |

| | | | | | |
|---|---|---|---|---|---|
| Name: ELECTRICAL SYSTEM - POWER | Transf. fr. | Drawn: AVOLJ | Approver | Type: M/L/E | A3 |
| EXTERNAL DIAGRAM - A10 | Confidentiality class acc.1102 K: Internal | Design chd. | Drawing owner: TMG | Designation | Sheet: 01(04) |
| DCS 400-690V Y/D-START IEC | Status: Released | Date: 2007-05-08 | Compare | 9106218434_DS | |



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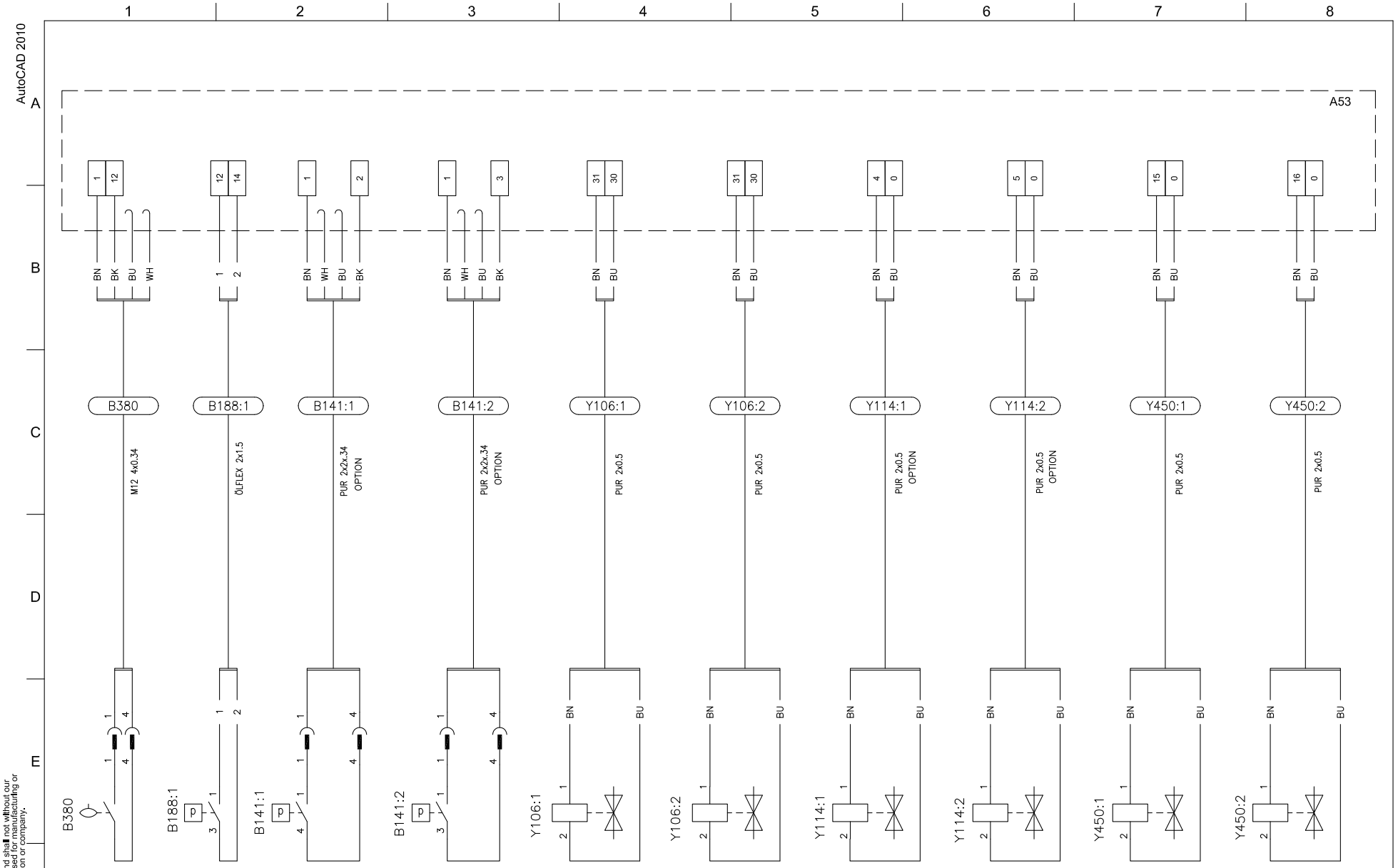

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| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 007 | - | P-12041 TMG161783 | 2014-05-16 | ipcssp | tmgfj | tmgjml |

| | | | | | |
|---|---|---|---|---|---|
| Name: ELECTRICAL SYSTEM - POWER | Transf. fr. | Drawn: AVOLJ | Approver | Type: M/L/E | A3 |
| EXTERNAL DIAGRAM - A10 | Confidentiality class acc.1102 K: Internal | Design chd. | Drawing owner: TMG | Designation | Sheet: 02(04) |
| DCS 400-690V Y/D-START IEC | Status: Released | Date: 2007-05-08 | Compare | 9106218434_DS | |



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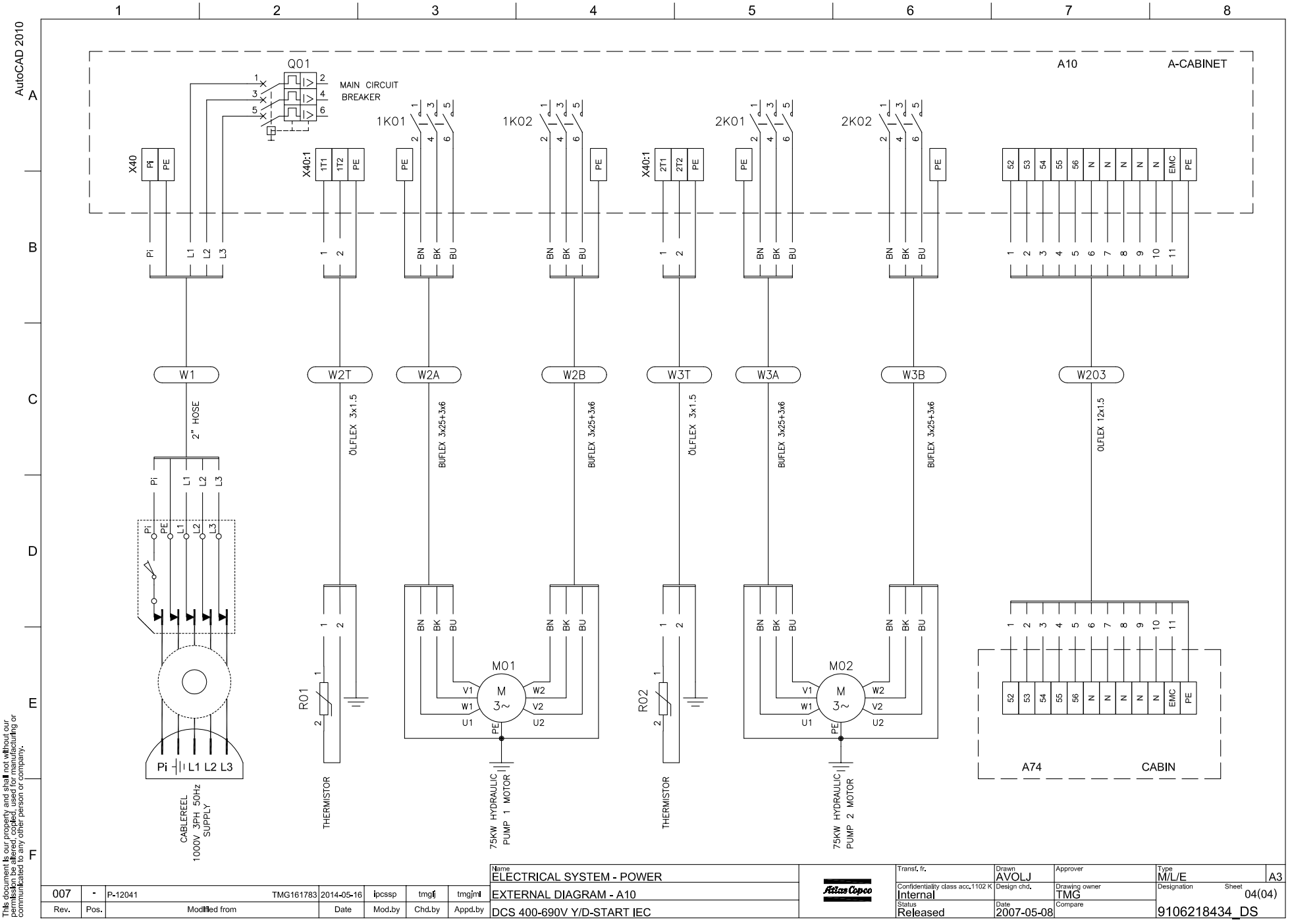

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| Rev. | Pos. | Modified from | | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|---|
| 007 | - | P-12041 | TMG161783 | 2014-05-16 | ipcssp | tmgfj | tmgjml |

| | | | | | |
|---|---|---|---|---|---|
| Name: ELECTRICAL SYSTEM - POWER | Transf. fr. | Drawn: AVOLJ | Approver | Type: M/L/E | A3 |
| EXTERNAL DIAGRAM - A10 | Confidentiality class acc.1102 K: Internal | Design chd. | Drawing owner: TMG | Designation | Sheet: 03(04) |
| DCS 400-690V Y/D-START IEC | Status: Released | Date: 2007-05-08 | Compare | 9106218434_DS | |



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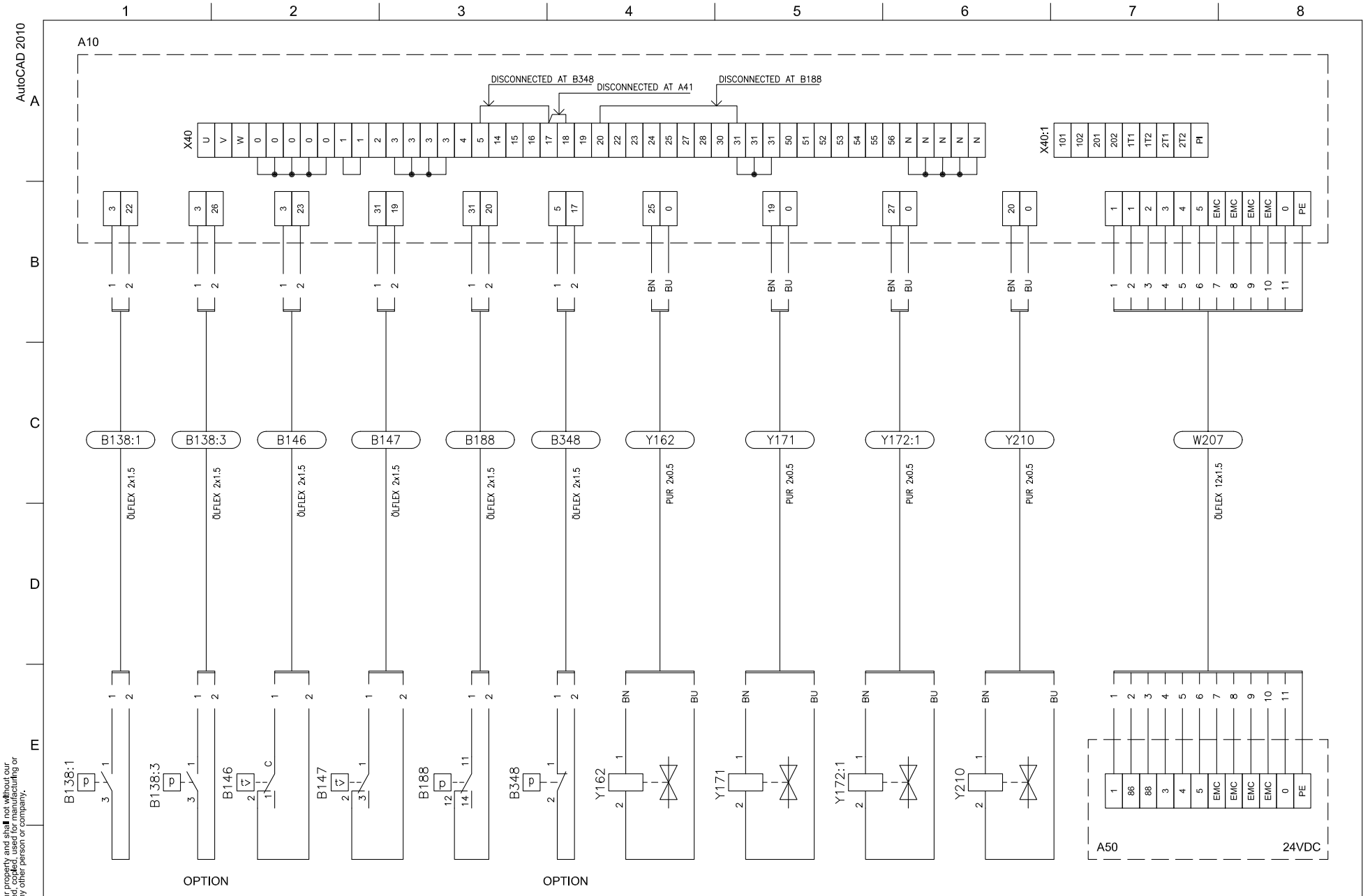

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| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 007 | - | P-12041 TMG161783 | 2014-05-16 | ipcssp | tmgfj | tmgjml |

| | | | | |
|---|---|---|---|---|
| Name: ELECTRICAL SYSTEM - POWER | Transf. fr. | Drawn: AVOLJ | Approver | Type: M/L/E A3 |
| EXTERNAL DIAGRAM - A10 | Confidentiality class acc.1102 K: Internal | Design chd. | Drawing owner: TMG | Designation Sheet: 04(04) |
| DCS 400-690V Y/D-START IEC | Status: Released | Date: 2007-05-08 | Compare | 9106218434_DS |



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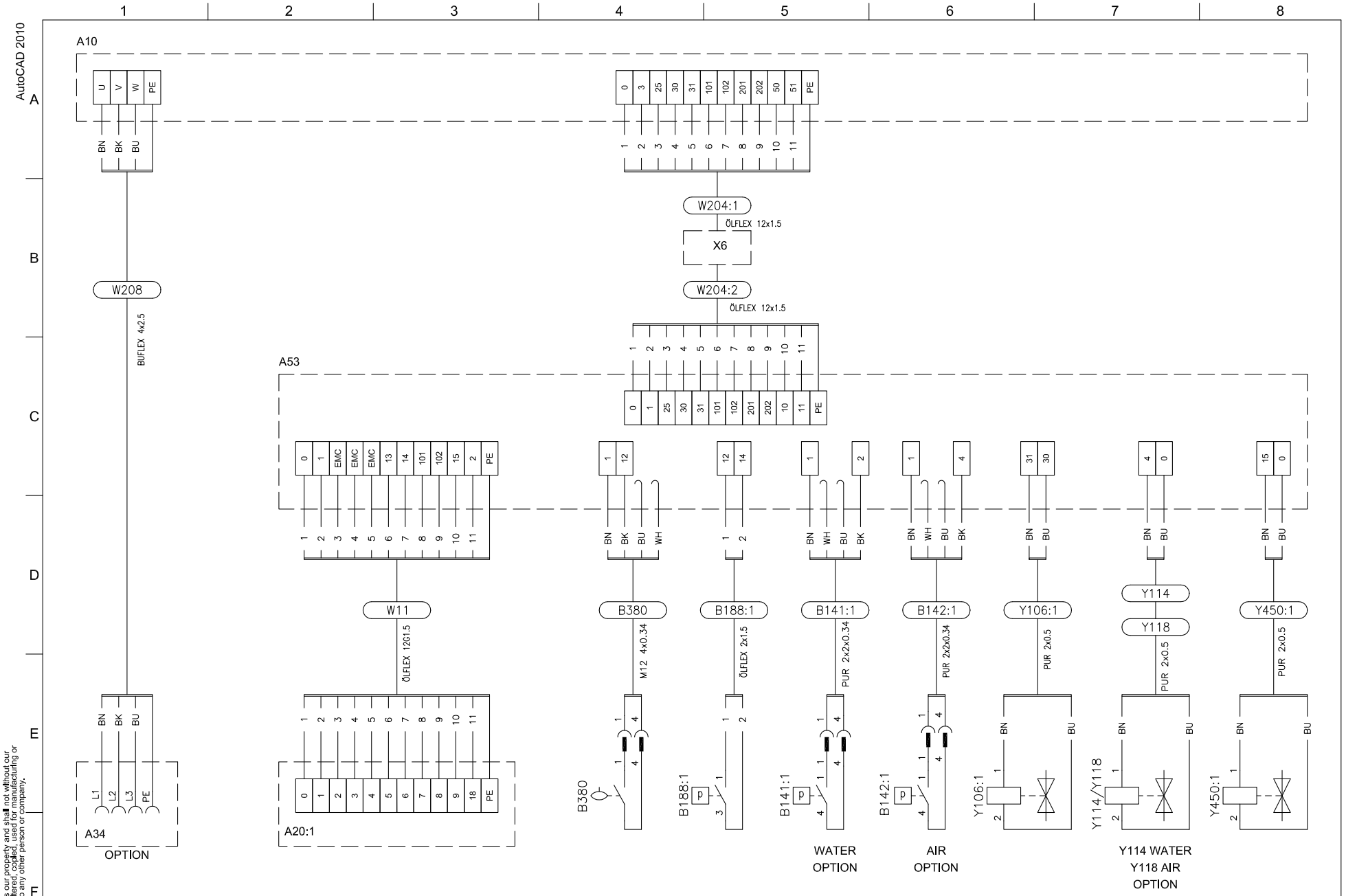

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| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 009 | - | PSM P-12041 TMG161783 | 2014-05-16 | ipcssp | tmgfj | tmgjml |

| | |
|---|---|
| Name | ELECTRICAL SYSTEM - POWER |
| | EXTERNAL DIAGRAM - A10 |
| | DCS 400-690V Y/D-START IEC |
| Transf. fr. | |
| Drawn | AVOLJ |
| Approver | |
| Type | M/L/E A3 |
| Confidentiality class acc. 1102 K | Internal |
| Design chd. | |
| Drawing owner | TMG |
| Designation | 9106218534_DS |
| Sheet | 01(03) |
| Status | Released |
| Date | 2008-01-28 |
| Compare | |



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| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 009 | - | PSM P-12041 TMG161783 | 2014-05-16 | ipcssp | tmgfj | tmgjml |

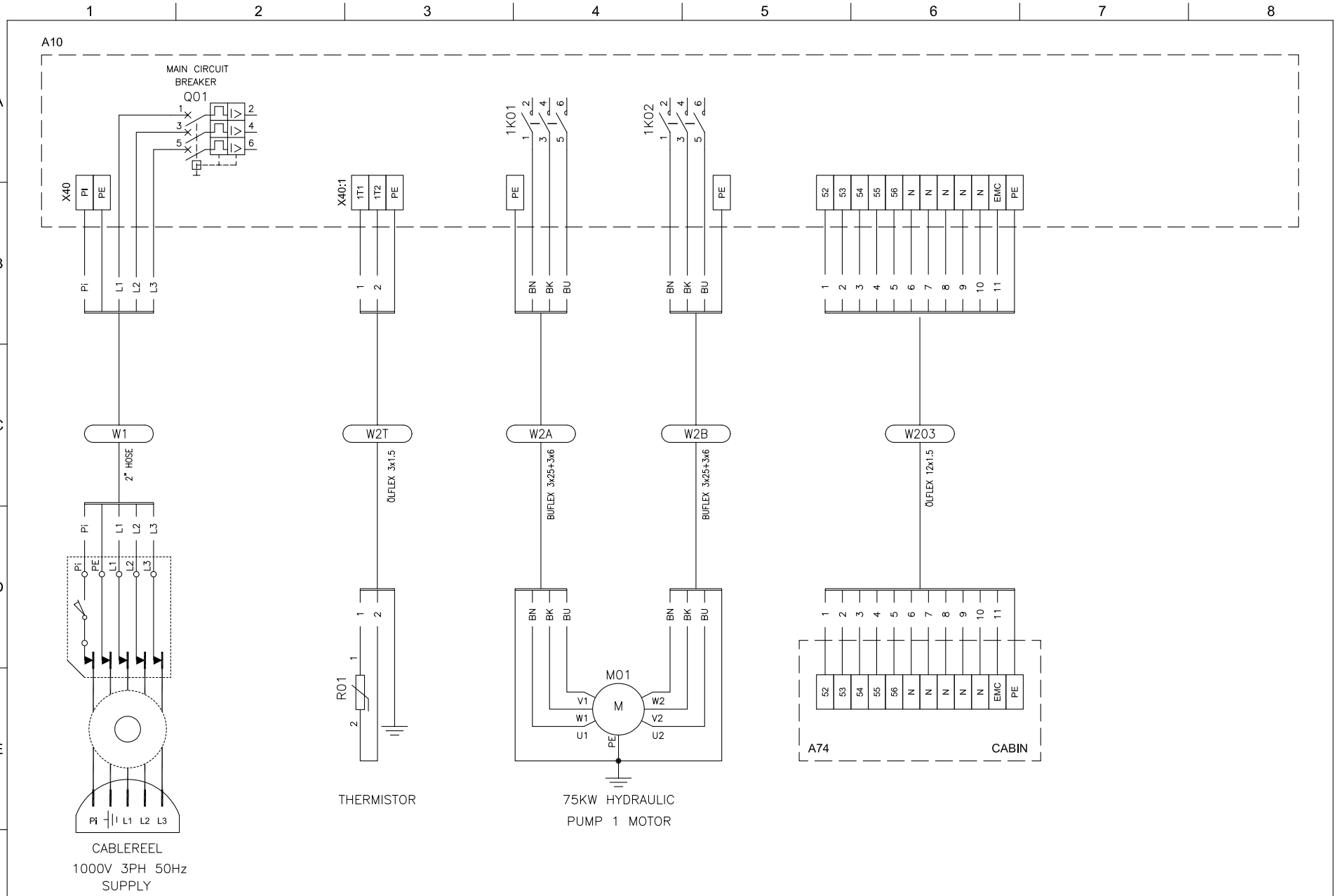
Name: ELECTRICAL SYSTEM - POWER
EXTERNAL DIAGRAM - A10
DCS 400-690V Y/D-START IEC

Atlas Copco

| Transf. fr. | Drawn | Approver | Type | |
|---|---|---|---|---|
| | AVOLJ | | M/L/E | A3 |
| Confidentiality class acc.1102 K | Design chd. | Drawing owner | Designation | Sheet |
| Internal | | TMG | | 02(03) |
| Status | Date | Compare | | |
| Released | 2008-01-28 | | 9106218534_DS | |



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| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 009 | - | PSM P-12041 TMG161783 | 2014-05-16 | lpcssp | tmgfj | tmgjml |

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|---|---|
| Name | ELECTRICAL SYSTEM - POWER |
| | EXTERNAL DIAGRAM - A10 |
| | DCS 400-690V Y/D-START IEC |
| Transf. fr. | |
| Confidentiality class acc.1102 K | Internal |
| Status | Released |
| Drawn | AVOLJ |
| Design chd. | |
| Date | 2008-01-28 |
| Approver | |
| Drawing owner | TMG |
| Compare | |
| Type | M/L/E |
| Designation | 9106218534_DS |
| Sheet | 03(03) |
| | A3 |

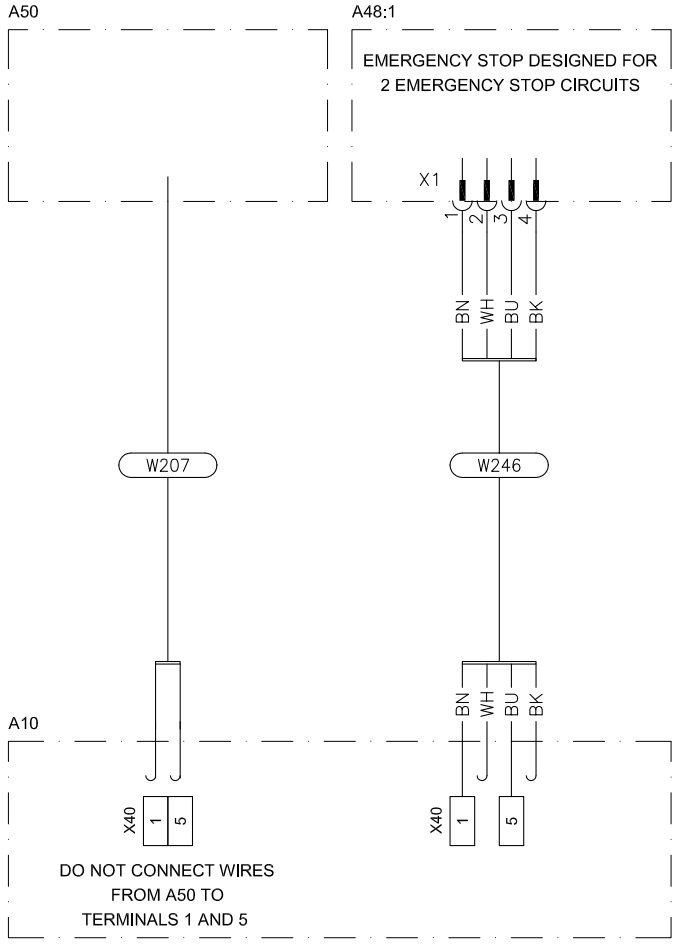


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AutoCAD 2010

A B C D E F

USE THIS EXTERNAL DIAGRAM WHEN EMERGENCY STOPS ARE DESIGNED FOR TWO CIRCUITS
AND A10 ARE DESIGNED FOR ONE CIRCUIT (A48 MISSING IN EXTERNAL DIAGRAM FOR A10)




A10 DESIGNED FOR
1 EMERGENCY STOP CIRCUIT (A48 MISSING IN EXTERNAL DIAGRAM)

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| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 004 | | Connection in W246 changed TMG147995 | 2013-04-16 | tmglj | tmgheh | tmgjml |

| | | | | | | |
|---|---|---|---|---|---|---|
| Name: ELECTRICAL SYSTEM - POWER | Transf. fr. | Drawn: tmgheh | Approver: tmgjml | Type: NODSTOPP | A3 |
| EXTERNAL DIAGRAM - A10 | Confidentiality class acc.1102 K: Internal | Design chd.: tmglj | Drawing owner: TMG | Designation | Sheet: 01(01) |
| EMERGENCY STOP | Status: Released | Date: 2013-01-21 | Compare | 5112013448_DS | |



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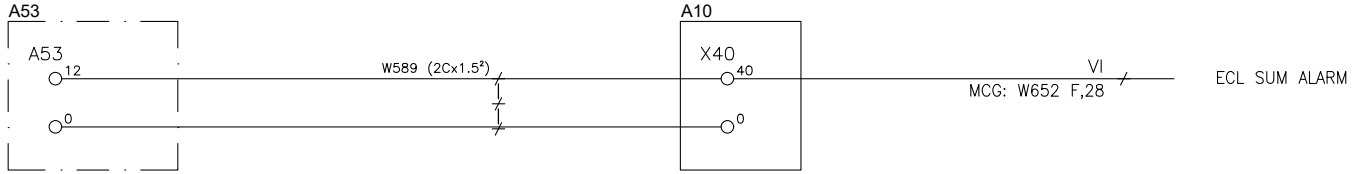
AutoCAD 2010

# OPTION CERTIQ (MCG) A10 CABINET CONNECTION DETAILS

## HARNESS W652 CONNECTIONS




## CABLE W589 CONNECTIONS




CABLE W589 FROM A53 TO A10 CABINET
& TERMINAL X40:40 ADDED IN A10 CABINET FOR CERTIQ OPTION.

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|---|---|---|---|---|---|---|
| 001 | - | | 2022-08-02 | mhnpta | mhnds | mhnds |

Name: ELECTRICAL SYSTEM - CONTROL
CIRCUIT DIAGRAM - MCG CONNECTIONS

Epiroc

| | | | | |
|---|---|---|---|---|
| Transf. fr. | Drawn: mhnpta | Approver: mhnds | Type: DIAGRAM,CIRCUIT | A3 |
| Confidentiality class acc.1102 K: Internal | Design chd.: mhnds | Drawing owner: TMG | Designation | Sheet: 1 ( 2 ) |
| Status: Released | Date: 2022-08-02 | Compare | 9900459564 | |



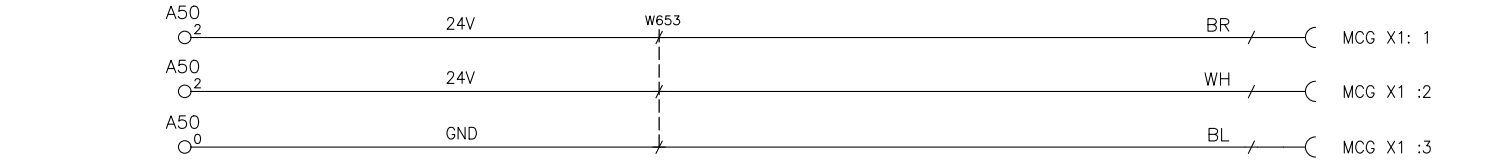
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# OPTION CERTIQ (MCG) A50 CABINET CONNECTION DETAILS

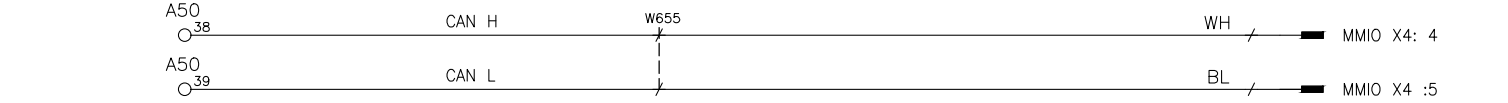
## HARNESS W652 CONNECTIONS




## CABLE W653 CONNECTIONS




## CABLE W655 CONNECTIONS




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| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 001 | - | | 2022-08-02 | mhnpta | mhnds | mhnds |

Name: ELECTRICAL SYSTEM - CONTROL
CIRCUIT DIAGRAM- MCG CONNECTIONS

Epiroc

| Transf. fr. | Drawn | Approver | Type | |
|---|---|---|---|---|
| | mhnpta | mhnds | DIAGRAM,CIRCUIT | A3 |
| Confidentiality class acc.1102 K: Internal | Design chd. mhnds | Drawing owner TMG | Designation | Sheet 2 ( 2 ) |
| Status: Released | Date 2022-08-02 | Compare | 9900459564 | |



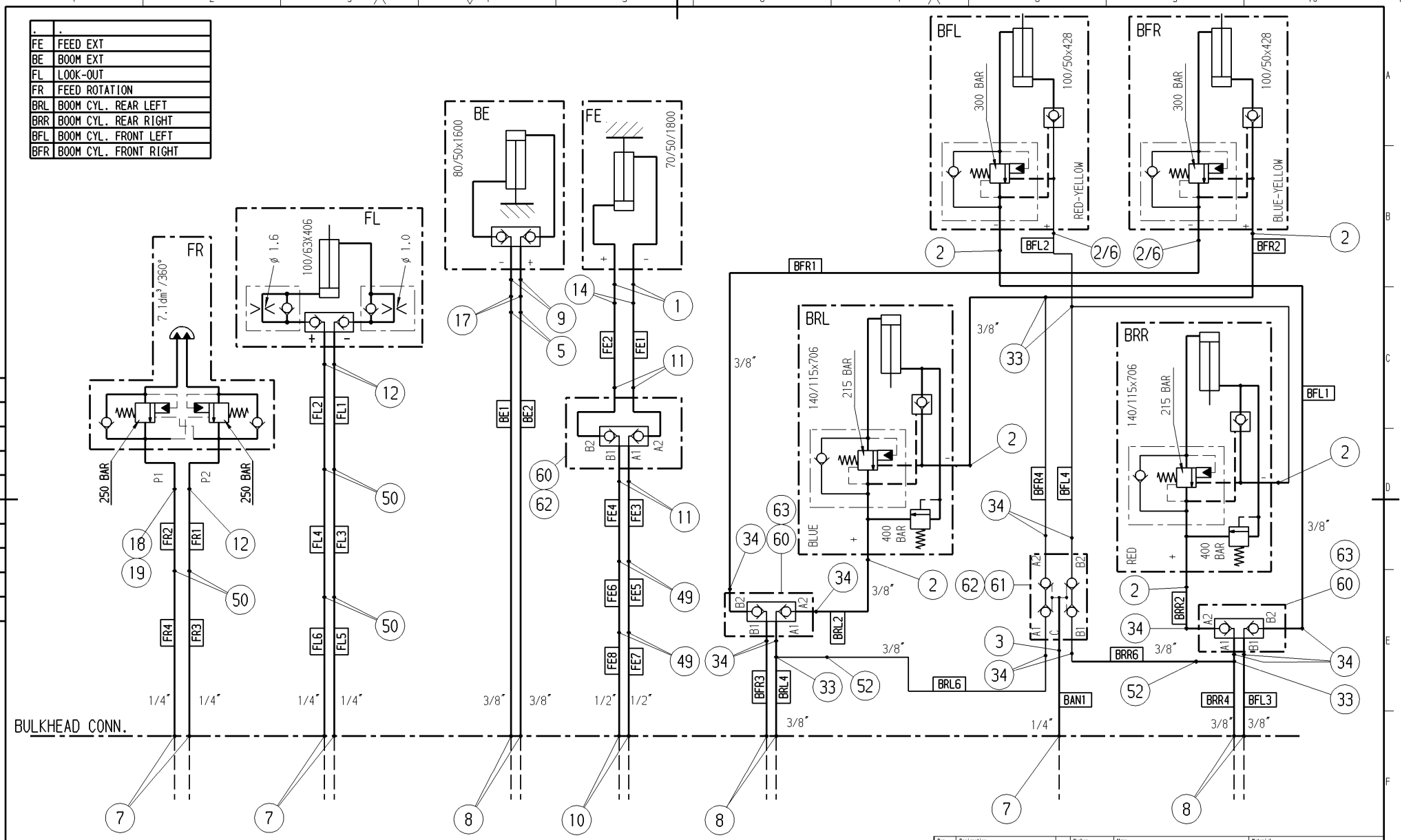
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## Hydraulic Diagram

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| 3150001461 | HYDR. DIAGRAM | SERVICE PLATFORM | 104 |
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| 9106129972 | HYDR. SCHEDULE | DRILLING SYSTEM | 111 |
| 3217883541 | HYDR. SCHEDULE | CONTROL PANEL BOOMPOS. | 112 |
| 3217883569 | HYDR. SCHEDULE | DRILLING PANEL DCS-1800 | 113 |
| 3217896931 | HYDR. SCHEDULE | REAMER | 114 |
| 9106246101 | HYDR. SCHEDULE | PROTECTION ROOF | 115 |
| 9106143725 | HYDR. SCHEDULE | COMPRESSOR OIL COOLED | 116 |
| 3217781659 | HYDR. SCHEDULE | WATER PUMP | 117 |
| 3217898830 | HYDR. SCHEDULE | WATER FLOW SENSOR | 118 |
| 9106150983 | HYDR. SCHEDULE | CABLE REEL | 119 |

| . | . |
|---|---|
| FE | FEED EXT |
| BE | BOOM EXT |
| FL | LOOK-OUT |
| FR | FEED ROTATION |
| BRL | BOOM CYL. REAR LEFT |
| BRR | BOOM CYL. REAR RIGHT |
| BFL | BOOM CYL. FRONT LEFT |
| BFR | BOOM CYL. FRONT RIGHT |




| Pos. | Designation | Number | Name | Material |
|---|---|---|---|---|
| Tolerances, if not indicated, according to: ATLAS COPCO STANDARD / Class | | Machined surfaces 1350 K / . | | |
| Name: HYDRAULSCHEMA | | | BUT 35 G | Secrecy class 1102 K/ . |
| Material: HYDR. SCHEDULE BOOM | | | | CAD |
| Scale 1:1 | Fam . | 2 | Compare . | Org.owner. TMG |
| Drawn UTUK/NÖ | Blank . | | Replaces . | |
| Std.chd. . | Blk.wt. . kg | Fin.wt. kg | Designation 3128 3102 48 | Sheet 1 ( 1 ) |
| Transferred from . | Design chd. | Prod.chd. UTUK/NÖ | Appd. . | Date 00-10-05 |

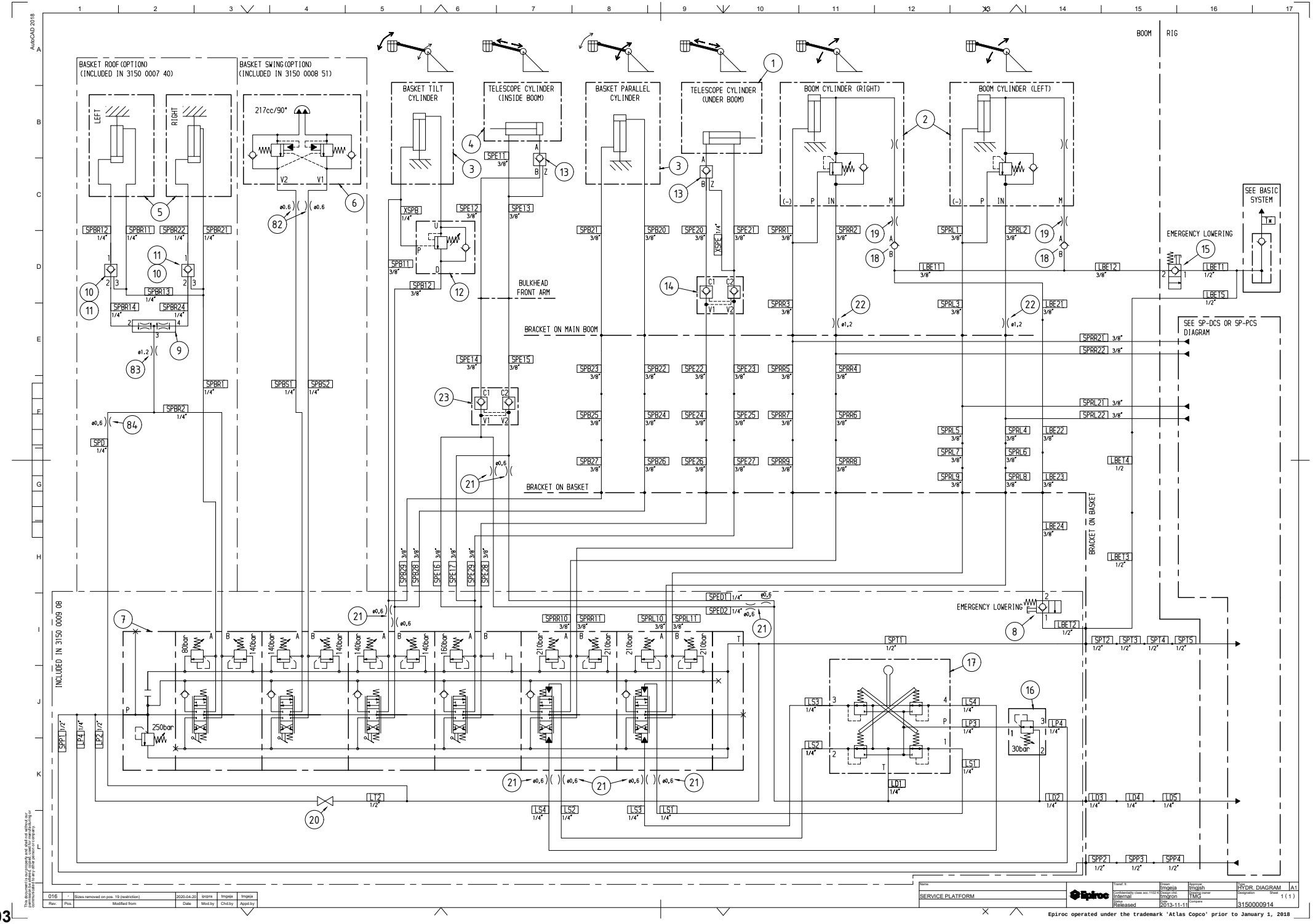
| Note | Position | Modified from | Date | Intr. |
|---|---|---|---|---|
| 2 | 2D | POS 4 removed, 18, 19 added TMG064250 | 060518 | UTUFU |
| 1 | . | Text justerad. TMG 012152 | 1-05-31 | KL |

. . Appurtenant drawings and documents

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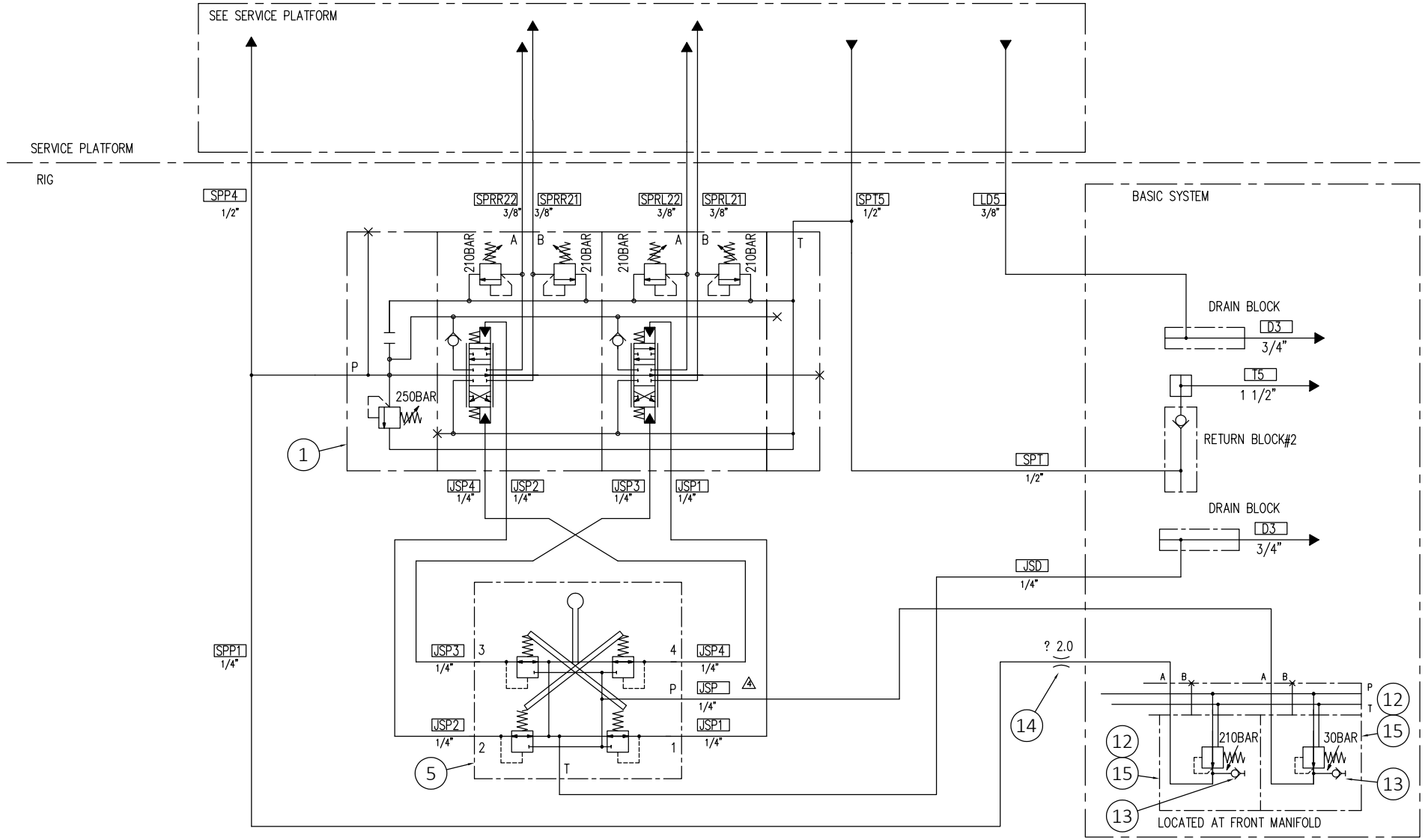


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Epiroc operated under the trademark 'Atlas Copco' prior to January 1, 2018



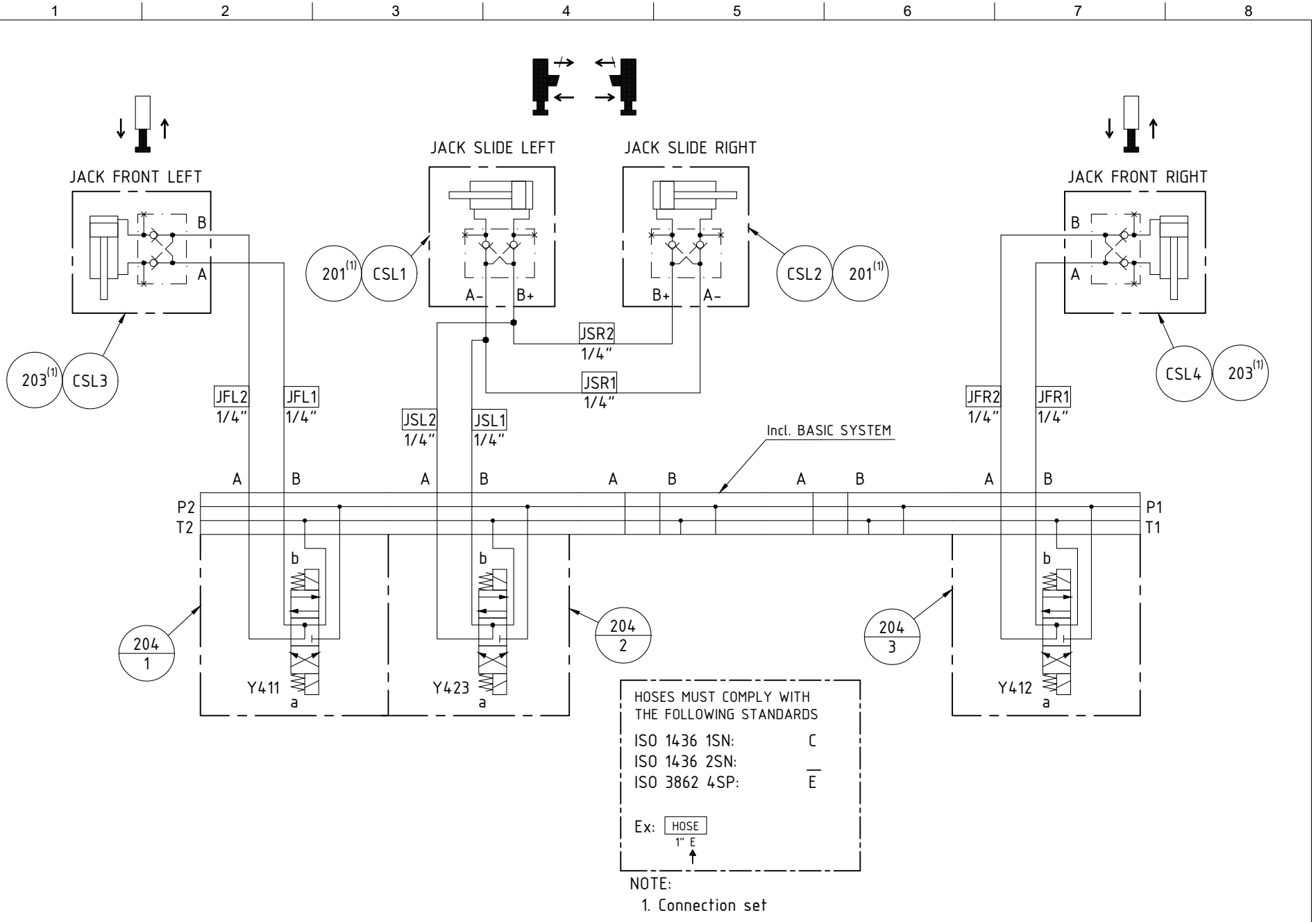

| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 04 | 00 | As per PSM282 updated joystick conn hose size & tag. | 2019-01-04 | MHNVW | MHNDS | MHNMJ |

| | | | | | |
|---|---|---|---|---|---|
| Name: HYDRAULIC_DIAGRAM | Epiroc | Transf. fr.: - | Drawn: TMGEJA | Approver: TMGJSH | Type: HYDR.SCHEDULE A2 |
| SERVICE_PLATFORM | | Confidentiality class acc.1102 K: SEC | Design chd.: TMGRON | Drawing owner: TMG | Designation Sheet: 1(1) |
| L2_PCS_REMOTE_CONTROL | WD_TB EPIROC | Status: - | Date: 2013-12-13 | Compare: 14:29 | 3150001461 |

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| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 007 | | Refer CN. | 2021-02-16 | ipcamds | tmgmay | tmgmay |

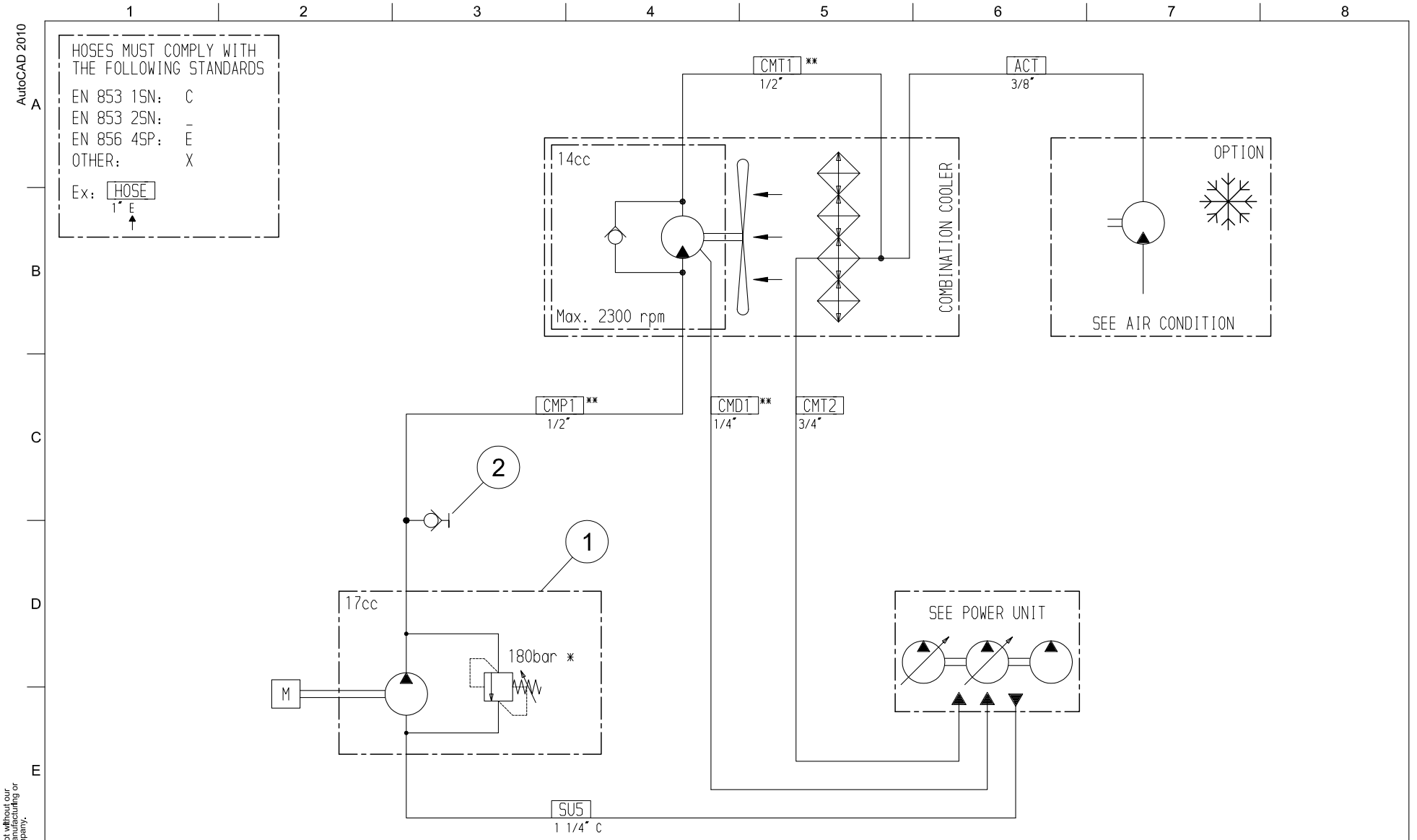
Name: Hydraulic Diagram
Front jacks

Epiroc

| | | | | |
|---|---|---|---|---|
| Transf. fr. | Drawn SIMETL | Approver | Type MLE | A3 |
| Confidentiality class acc.1102 K Internal | Design chd. | Drawing owner TMG | Designation 9106111853 | Sheet 1 ( 1 ) |
| Status Released | Date 1996-02-05 | Compare | | |



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| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 003 | A6 | Hose ACT changed to 3/8" | 2015-03-20 | tmgtzt | tmgron | tmgpekn |

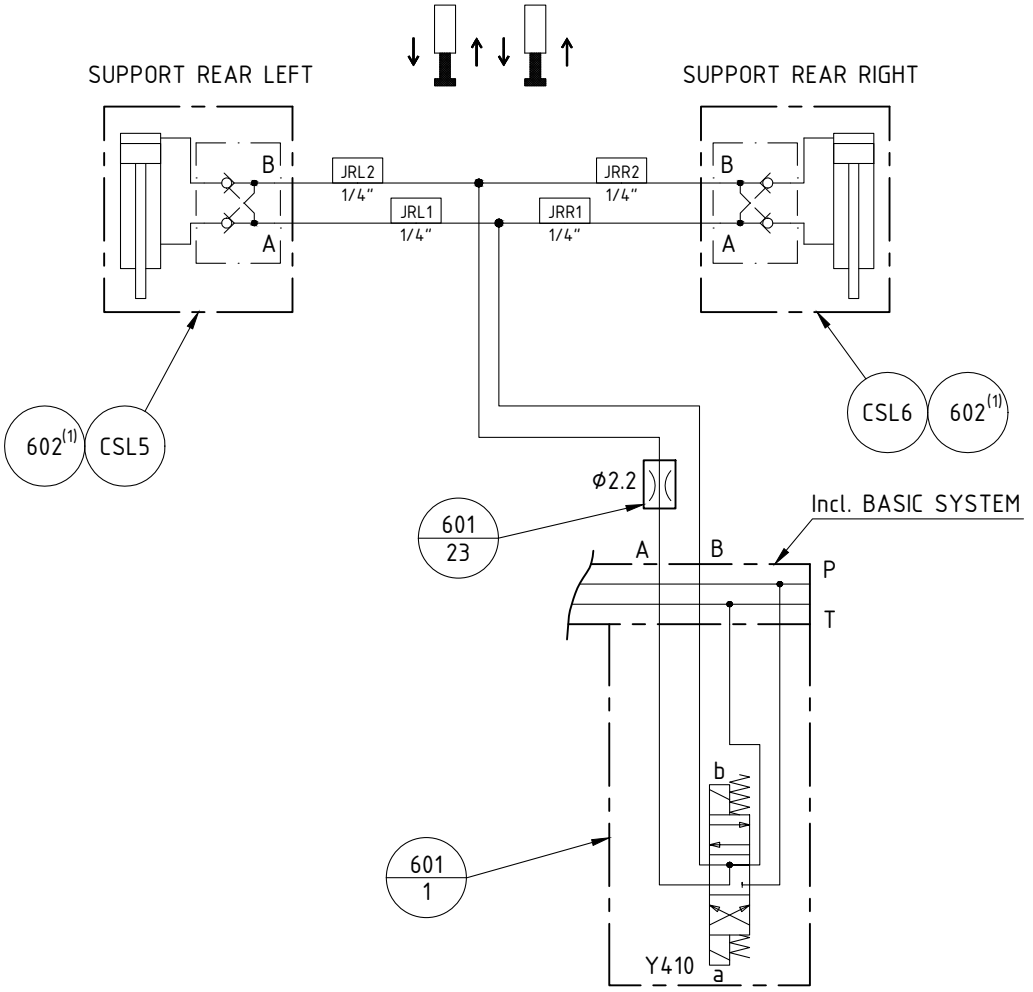
Name: HYDRAULIC DIAGRAM
FAN DRIVE
STANDARD MK9

Atlas Copco

| Transf. fr. | Drawn | Approver | Type | |
|---|---|---|---|---|
| | tmgtzt | tmgpekn | M/L/E | A3 |
| Confidentiality class acc.1102 K | Design chd. | Drawing owner | Designation | Sheet |
| Internal | tmgron | TMG | | ( 1 ) |
| Status | Date | Compare | | |
| Released | 2014-02-28 | | 5112287958_DS | |



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HOSES MUST COMPLY WITH THE FOLLOWING STANDARDS

| | |
|---|---|
| ISO 1436 1SN: | C |
| ISO 1436 2SN: | |
| ISO 3862 4SP: | E |
| ISO 3862 R13: | F |

Ex: HOSE 1" E

1. Connection set

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| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 003 | | "Incl. BASIC SYSTEM" Note added | 2021-03-05 | ipcamds | tmgmay | tmgmay |

Name: Hydraulic Diagram
Rear Jacks

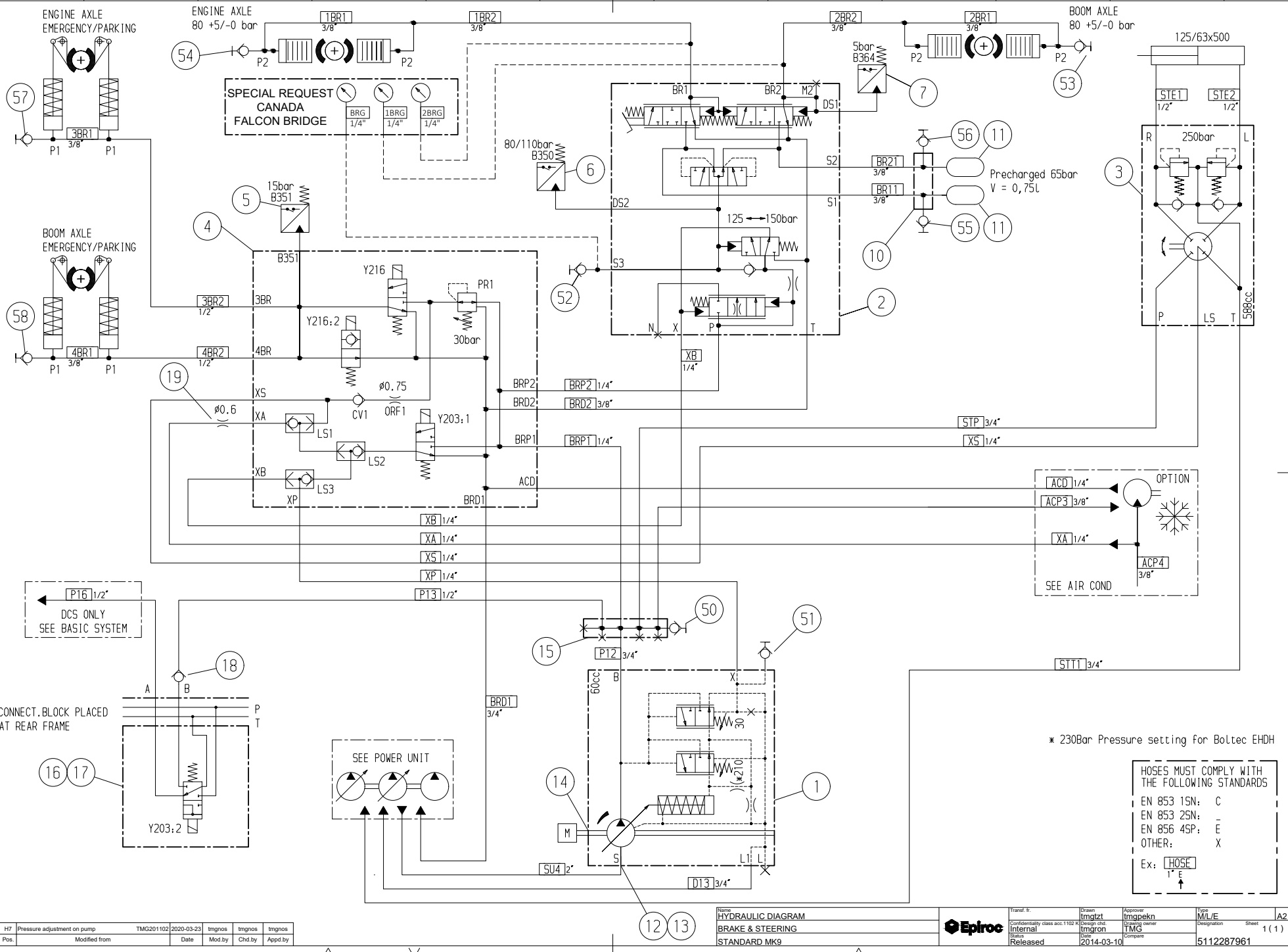
Epiroc

| | | | |
|---|---|---|---|
| Transf. fr. | Drawn: ipcram | Approver: tmgbfk | Type: MLE |
| Confidentiality class acc.1102 K: Internal | Design chd.: tmgbfk | Drawing owner: TMG | Designation: 9106000762 |
| Status: Released | Date: 2015-10-01 | Compare | Sheet: 1 ( 1 ) |

A3



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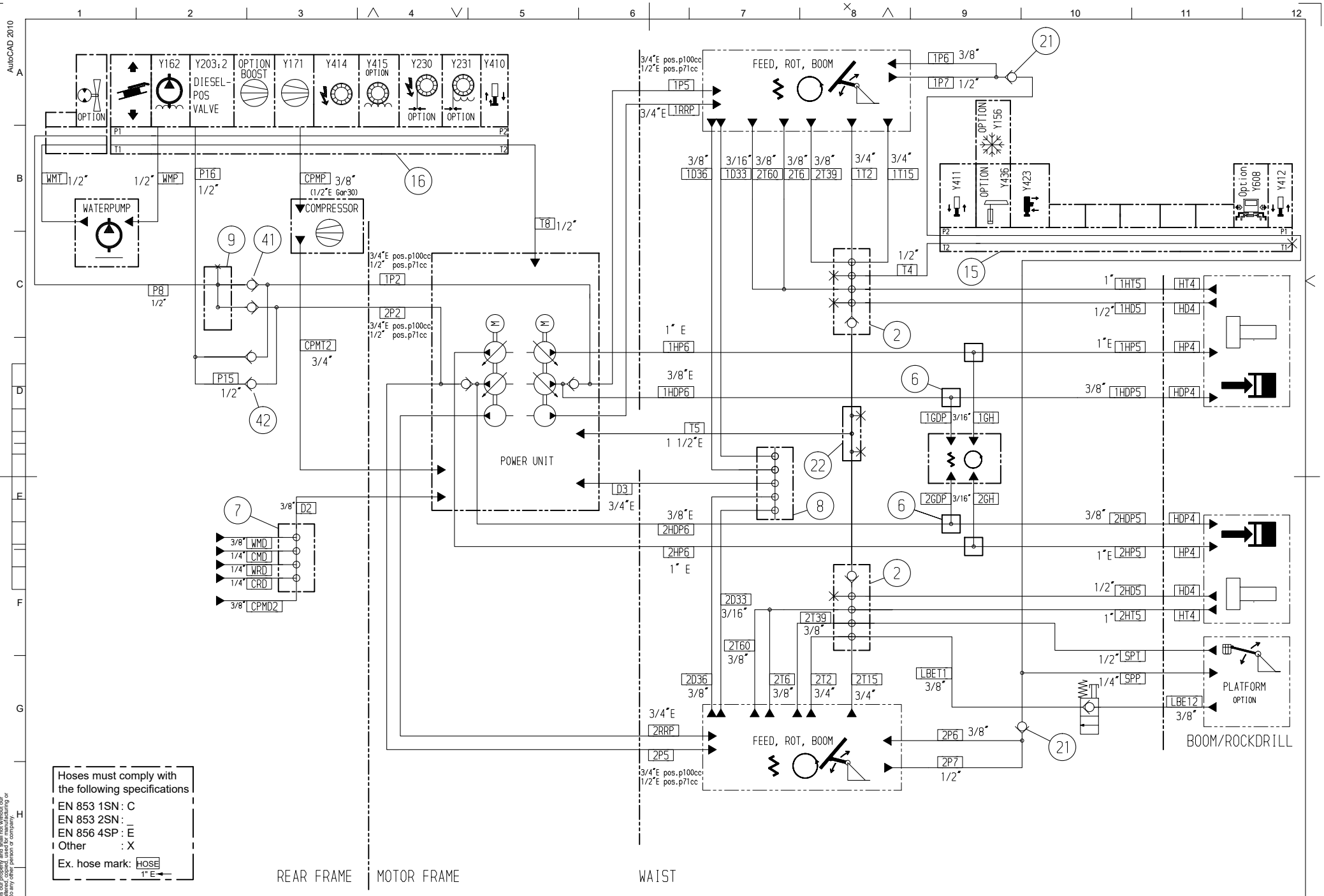

| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 005 | H7 | Pressure adjustment on pump TMG201102 | 2020-03-23 | tmgnos | tmgnos | tmgnos |

| | | | | | |
|---|---|---|---|---|---|
| Name: HYDRAULIC DIAGRAM | Transf. fr. | Drawn: tmgtzt | Approver: tmgpekn | Type: M/L/E | A2 |
| BRAKE & STEERING | Confidentiality class acc.1102 K: Internal | Design chd.: tmgron | Drawing owner: TMG | Designation | Sheet: 1(1) |
| STANDARD MK9 | Status: Released | Date: 2014-03-10 | Compare | 5112287961 | |

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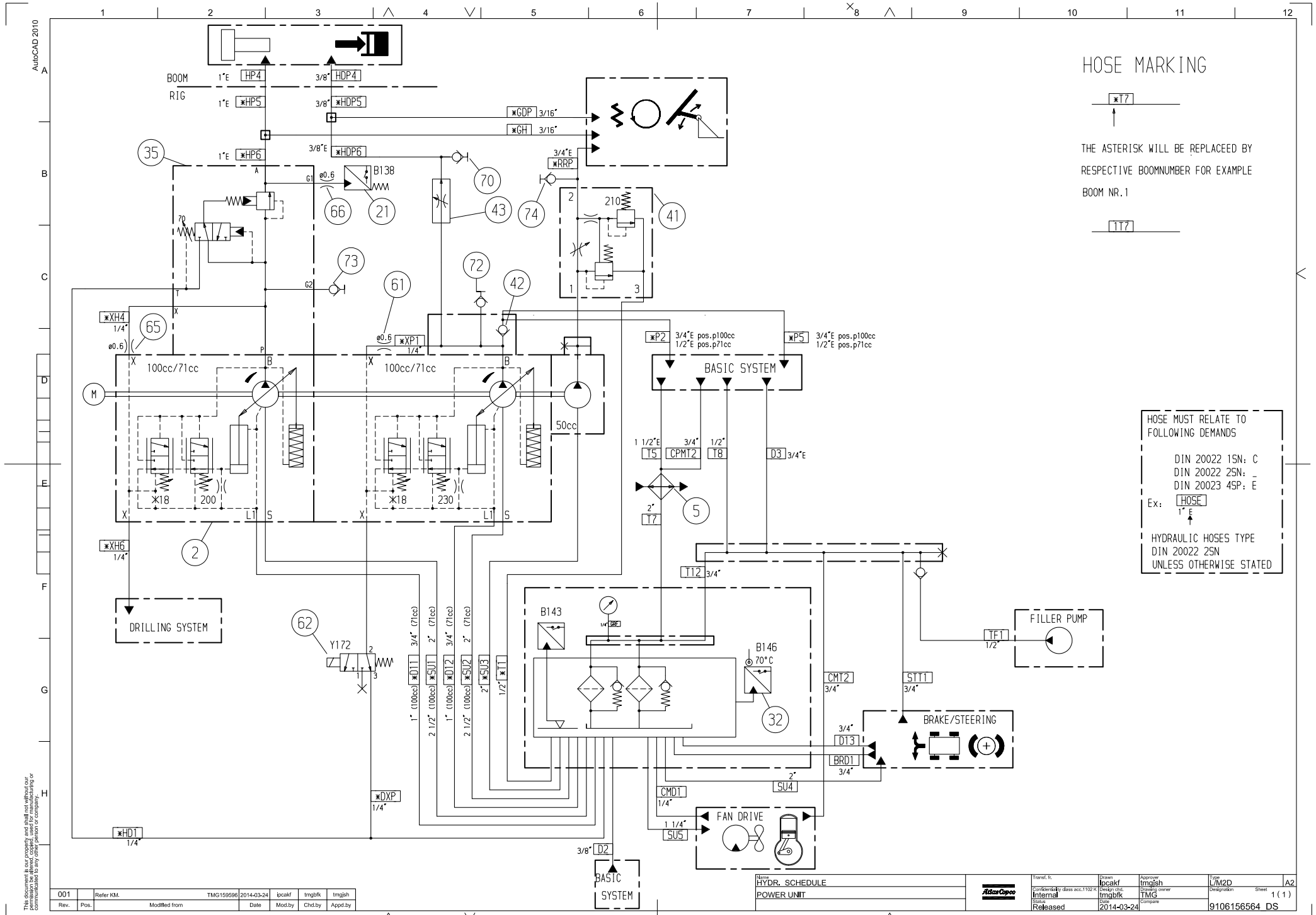

| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 005 | - | Pos.15 block updated. TMG1803825 | 2018-06-08 | ipcbasr | tmgbfk | tmgbfk |

| | | | | | |
|---|---|---|---|---|---|
| Name: Hydraulic schedule | Transf. fr. | Drawn: ipcakf | Approver: tmgjsh | Type: HYDR. SCHEDULE | A2 |
| Basic system roof and cab | Confidentiality class acc.1102 K: Internal | Design chd.: tmgbfk | Drawing owner: TMG | Designation | Sheet: 1 ( 1 ) |
| Epiroc | Status: Released | Date: 2014-03-24 | Compare | 9106130103 | |

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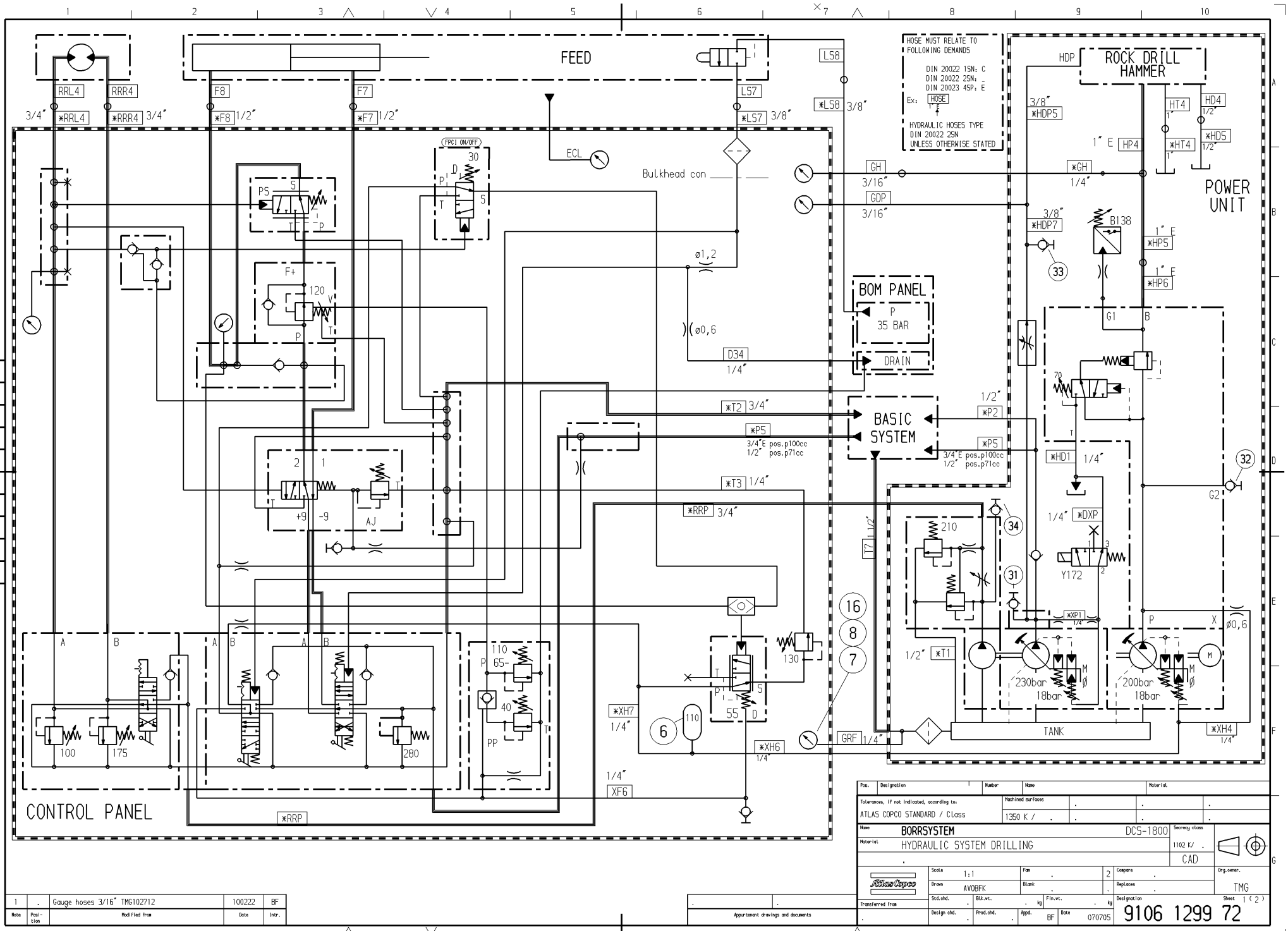


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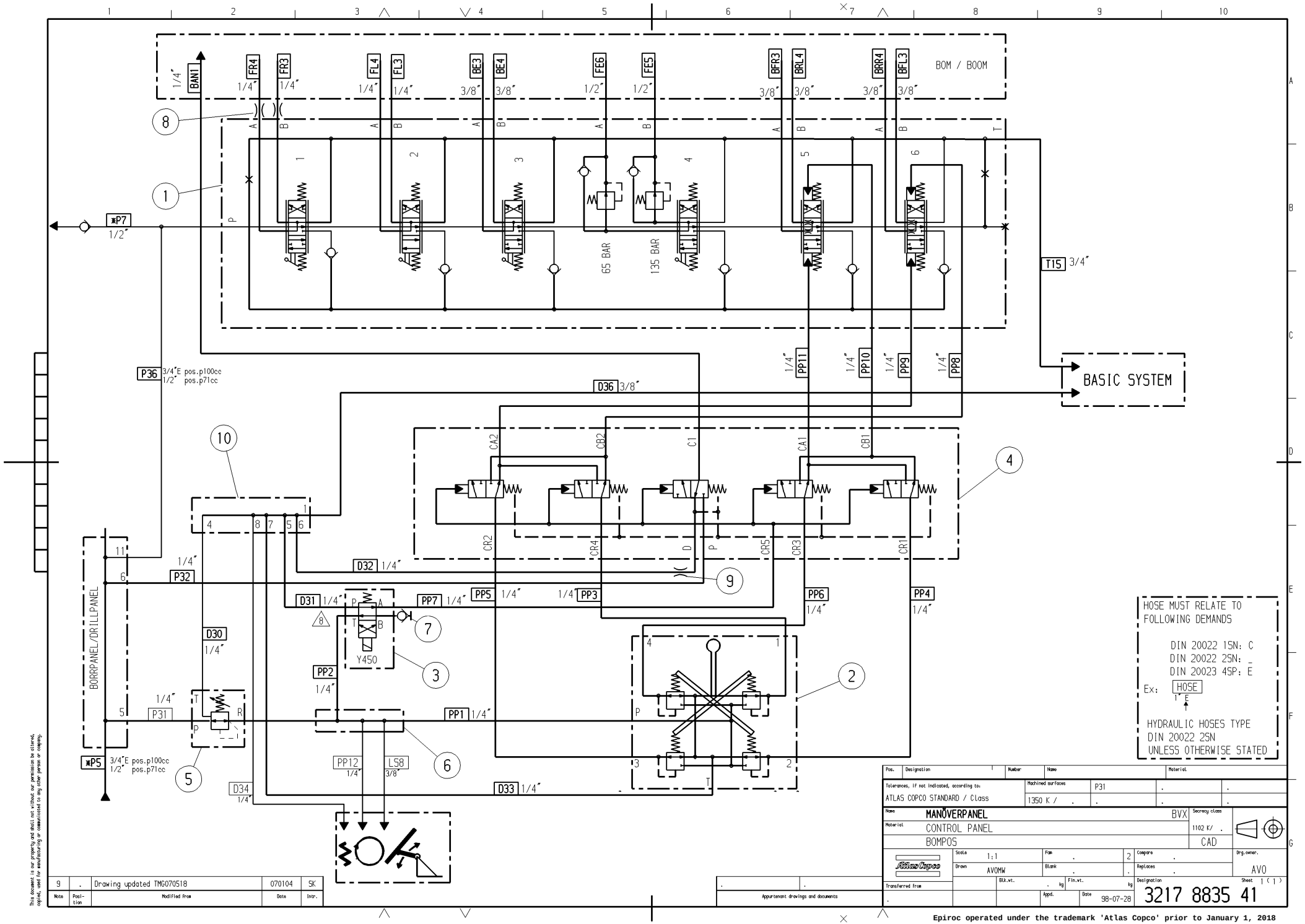

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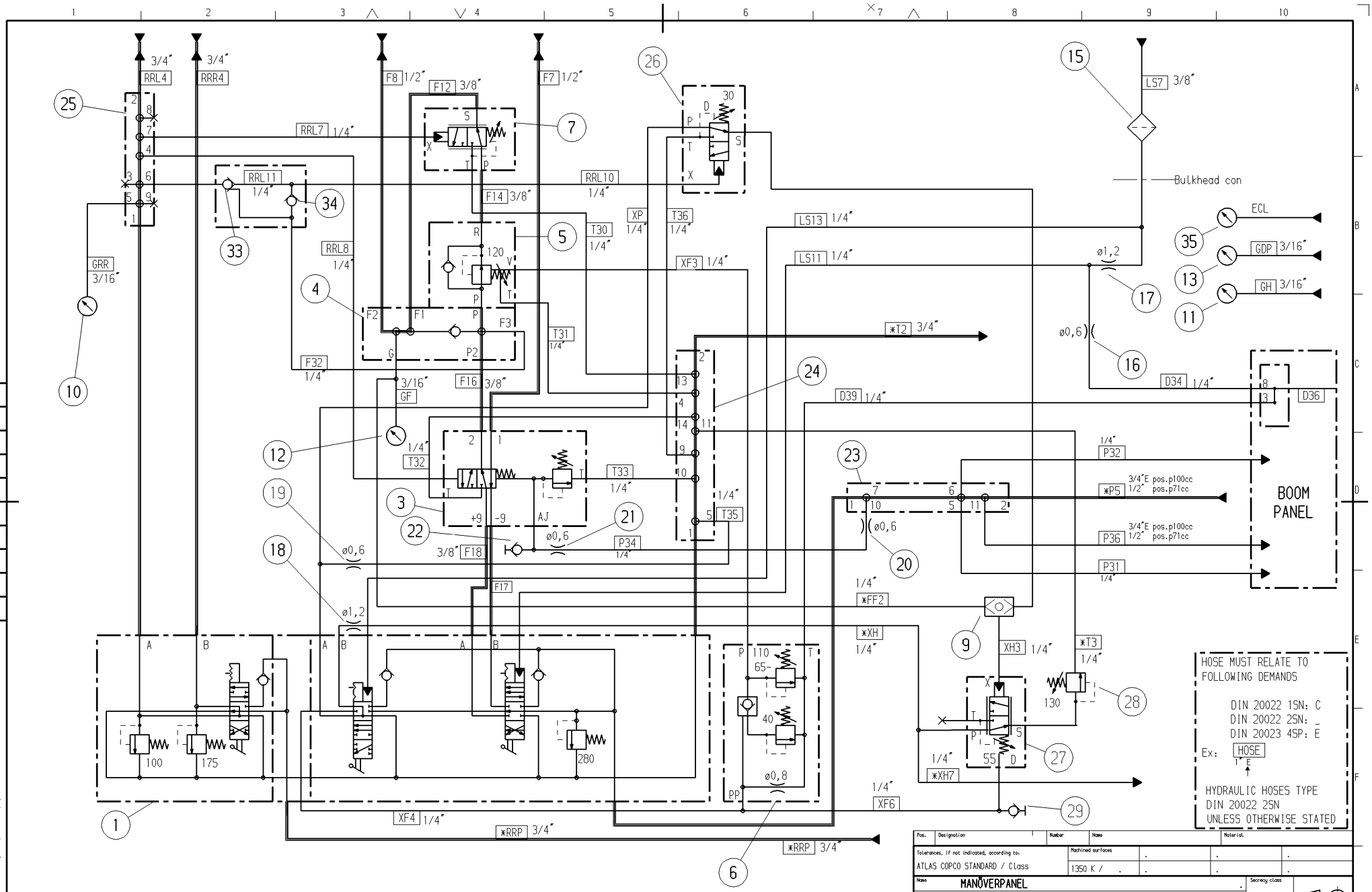
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| Pos. | Designation | Number | Name | Material |
|---|---|---|---|---|
| Tolerances, if not indicated, according to: ATLAS COPCO STANDARD / Class | | Machined surfaces 1350 K / | | |
| Name | MANÖVERPANEL | | | Secrecy class 1102 K/ |
| Material | CONTROL PANEL DCS-1800 | | | CAD |
| Atlas Copco | Scale 1:1 | Fam | 2 | Compare |
| | Drawn AVOBFK | Blank | | Replaces |
| Transferred from | Std.chd. | Blk.wt. kg | Fin.wt. kg | Org.owner. TMG |
| | Design chd. | Prod.chd. | Appd. BF Date 070705 | Designation 3217 8835 69 Sheet 1 ( 1 ) |

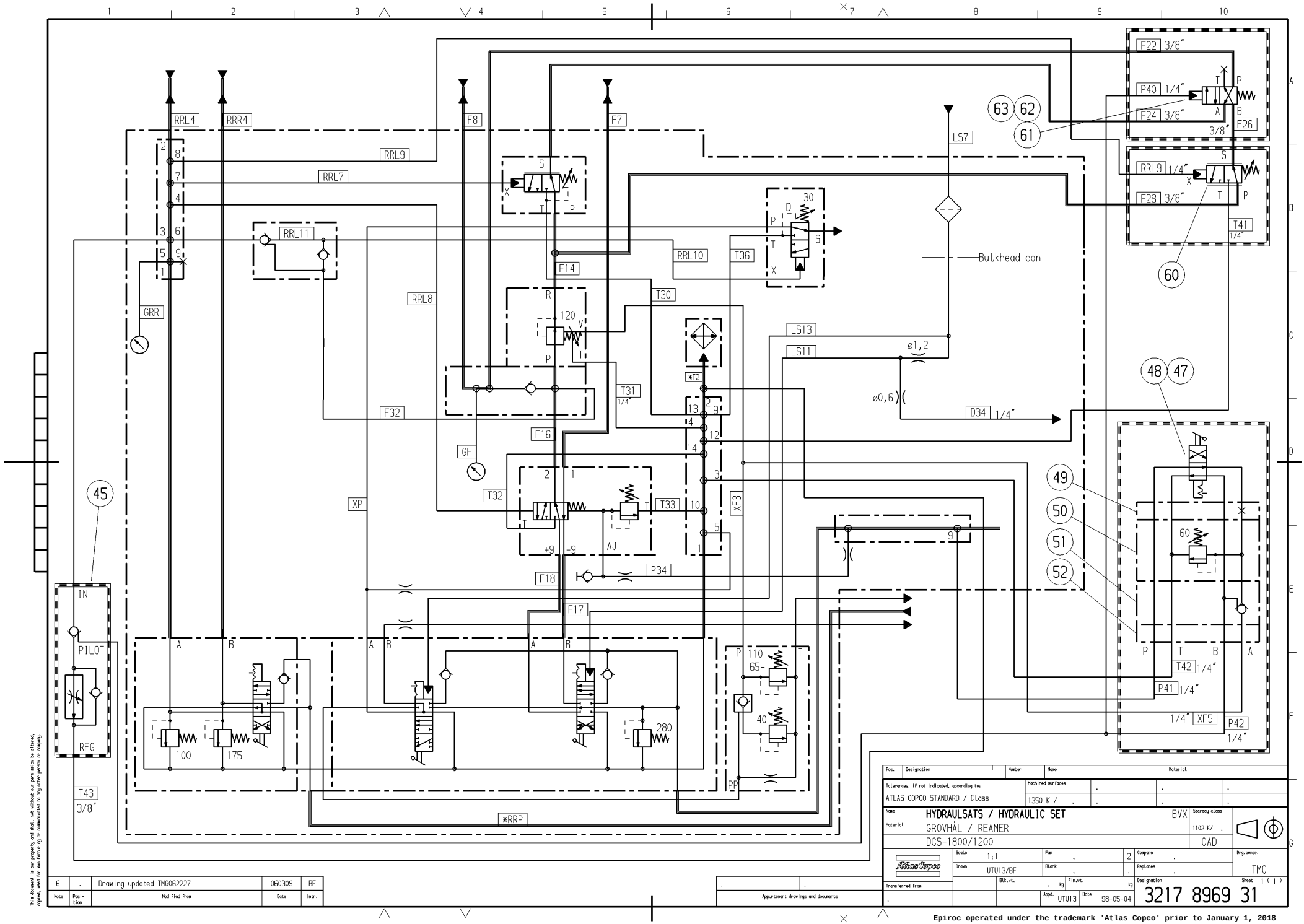
| Note | Position | Modified From | Date | Intr. |
|---|---|---|---|---|
| 1 | . | Gauge hoses 3/16" TMG102712 | 100222 | BF |

Appurtenant drawings and documents

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| Pos. | Designation | Number | Name | Material |
|---|---|---|---|---|
| | | | | |

Tolerances, if not indicated, according to: ATLAS COPCO STANDARD / Class — Machined surfaces: 1350 K / .

Name: HYDRAULSATS / HYDRAULIC SET — BVX — Secrecy class: 1102 K/ .

Material: GROVHÅL / REAMER — DCS-1800/1200 — CAD

Scale 1:1 — Drawn UTU13/BF — Fam . — Blank . — 2 — Compare . — Replaces . — Org.owner: TMG

Blk.wt. . kg — Fin.wt. kg — Transferred from . — Appd. UTU13 — Date 98-05-04

Designation: 3217 8969 31 — Sheet 1 ( 1 )

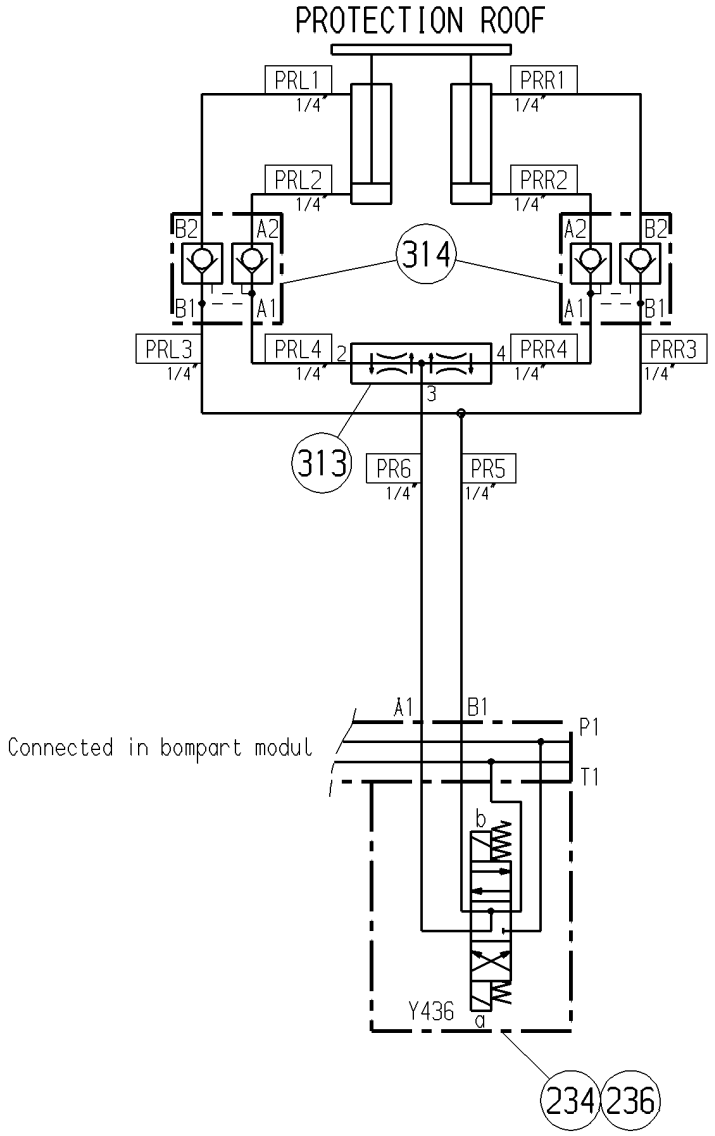
| Note | Position | Modified from | Date | Intr. |
|---|---|---|---|---|
| 6 | . | Drawing updated TMG062227 | 060309 | BF |

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| Pos. | Designation | Number | Name | Material |
|---|---|---|---|---|
| | | | | |

| Tolerances, If not indicated, according to: | Machined surfaces | | | |
|---|---|---|---|---|
| ATLAS COPCO STANDARD / Class | 1350 K / . | . | . | . |

| Name | HYDRAULIC SHEDULE | BOLTEC DH | Secrecy class |
|---|---|---|---|
| Material | PROTECTIV ROOF | | 1102 K/ . |
| . | | | CAD |

| Scale | 1:1 | Fam | . | 3 | Compare | . | Drg.owner. |
|---|---|---|---|---|---|---|---|
| Drawn | UTUZN | Blank | . | . | Replaces | . | TMG |
| Std.chd. | . | Blk.wt. | . kg | Fin.wt. | . kg | Designation | Sheet 1 ( 1 ) |
| Transferred from | | Design chd. | . | Prod.chd. | . | Appd. UTUZN | Date 091028 | 9106 2461 01 |

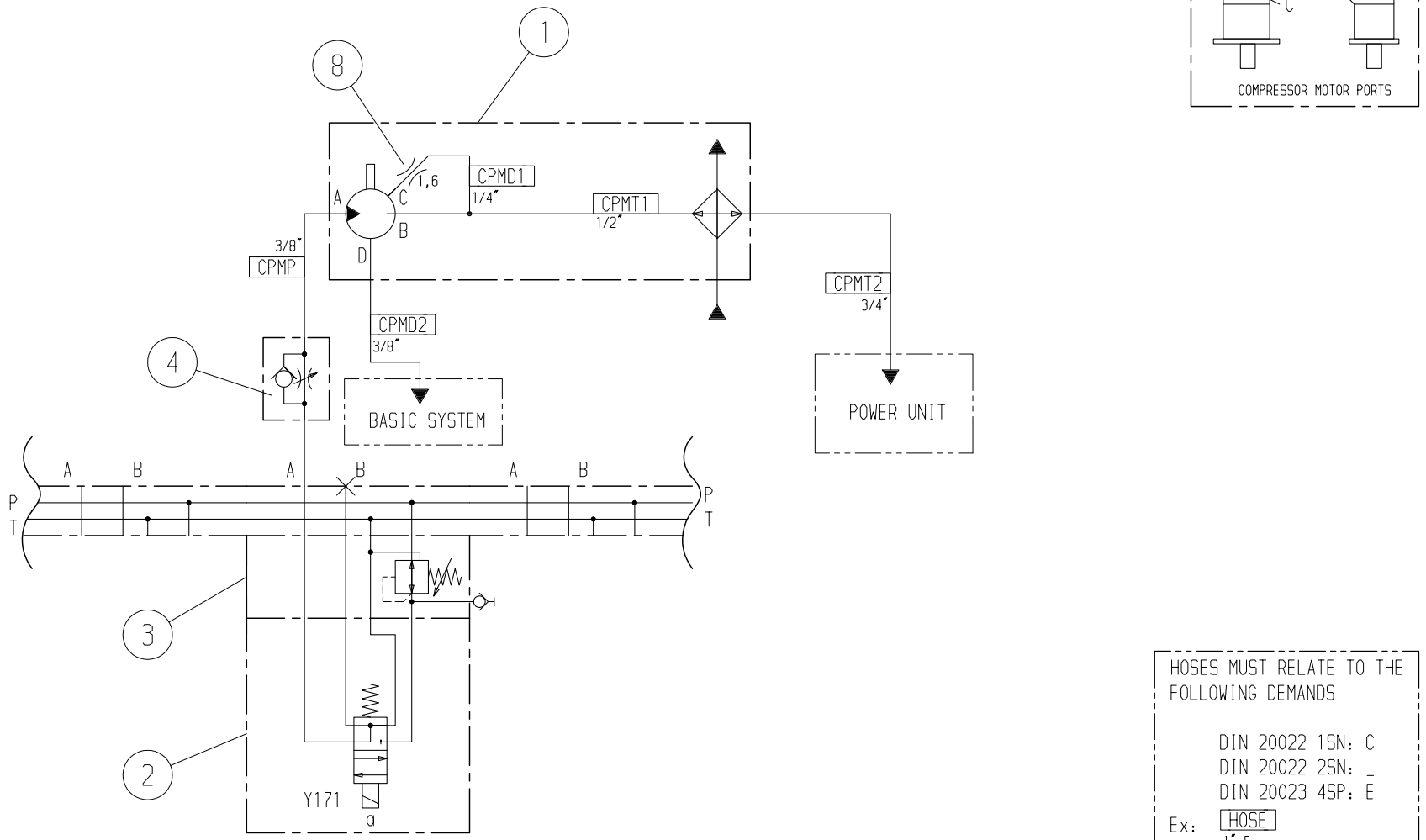
| Note | Posi-tion | Modified from | Date | Intr. |
|---|---|---|---|---|
| 0 | . | . | . | . |

| Appurtenant drawings and documents |
|---|
| . |

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HOSES MUST RELATE TO THE FOLLOWING DEMANDS

DIN 20022 1SN: C
DIN 20022 2SN: _
DIN 20023 4SP: E

Ex: HOSE 1" E

HYDRAULIC HOSES TYPE
DIN 20022 2SN
UNLESS OTHERWISE STATED

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| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 006 | | Drawing updated: PSM P-0832. TMG148584 | 2013-05-07 | ipcram | tmgbfk | tmgjsh |

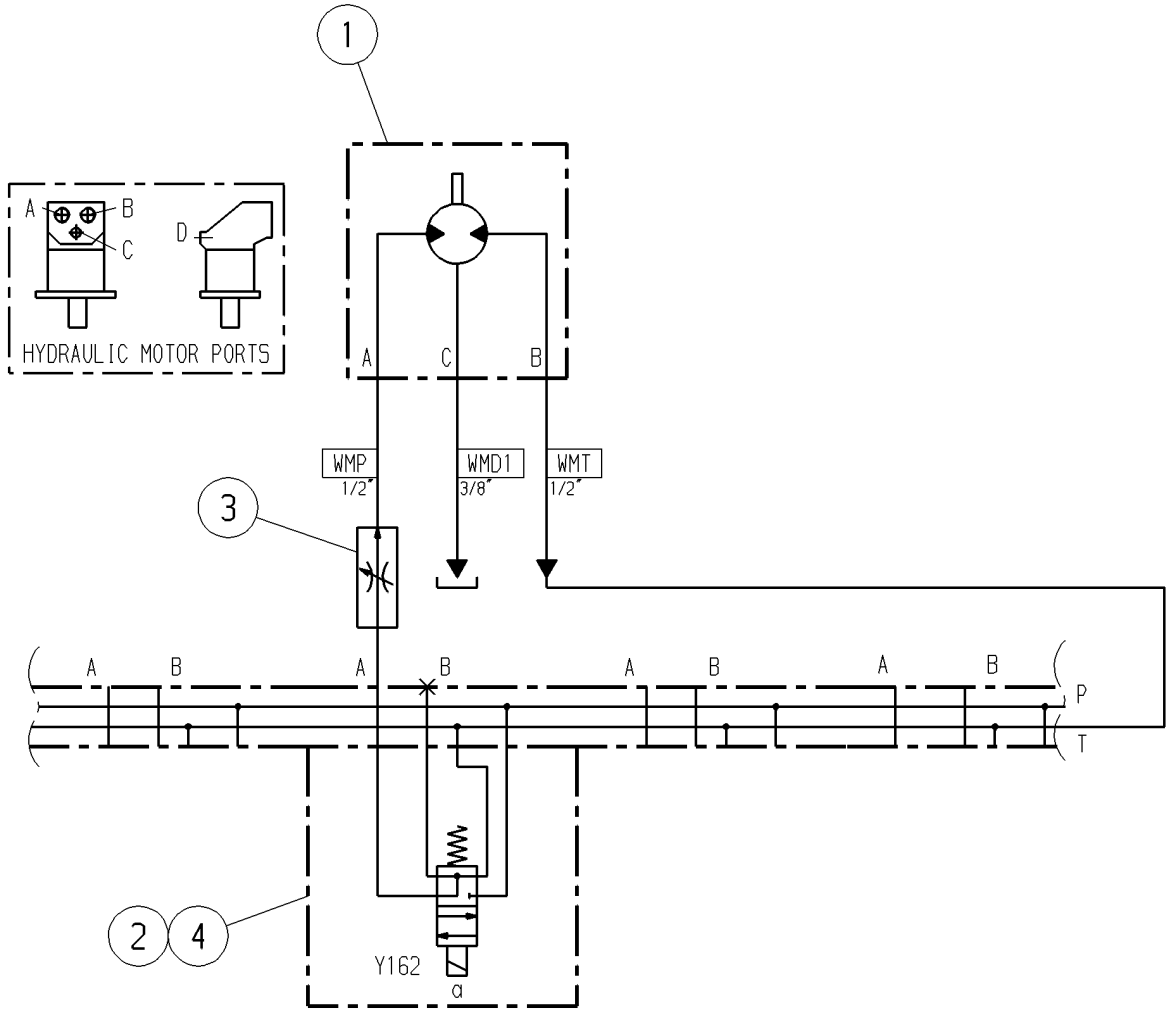
Name: HYDRAULIC SCHEDULE
COMPRESSOR
OIL COOLED

Atlas Copco

| Transf. fr. | Drawn | Approver | Type | |
|---|---|---|---|---|
| | AVOSNK | UTU13 | L2D/M2D | A3 |
| Confidentiality class acc.1102 K | Design chd. | Drawing owner | Designation | Sheet |
| Internal | | TMG | | ( 1 ) |
| Status | Date | Compare | 9106143725_DS | |
| Released | 1999-10-13 | | | |



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HOSES MUST RELATE TO THE FOLLOWING DEMANDS

DIN 20022 1SN: C
DIN 20022 2SN: _
DIN 20023 4SP: E

Ex: HOSE 1" E

HYDRAULIC HOSES TYPE
DIN 20022 2SN
UNLESS OTHERWISE STATED

| Pos. | Designation | Number | Name | Material |
|---|---|---|---|---|
| | | | | |

Tolerances, if not indicated, according to: ATLAS COPCO STANDARD / Class
Machined surfaces: 1350 K /

Name: HYDRAULSCHEMA/ HYDRAULIC SCHEDULE
Material: VATTENPUMP/ WATER PUMP
Secrecy class: 1102 K/
CAD

Scale: 1:1
Drawn: AVOBFK
Fam: .
Blank: .
3
Compare: .
Replaces: .
Drg.owner: TMG
Std.chd: .
Blk.wt: . kg
Fin.wt: . kg
Transferred from: .
Design chd: .
Prod.chd: .
Appd: .
Date: 070929
Designation: 3217 7816 59
Sheet 1 ( 1 )

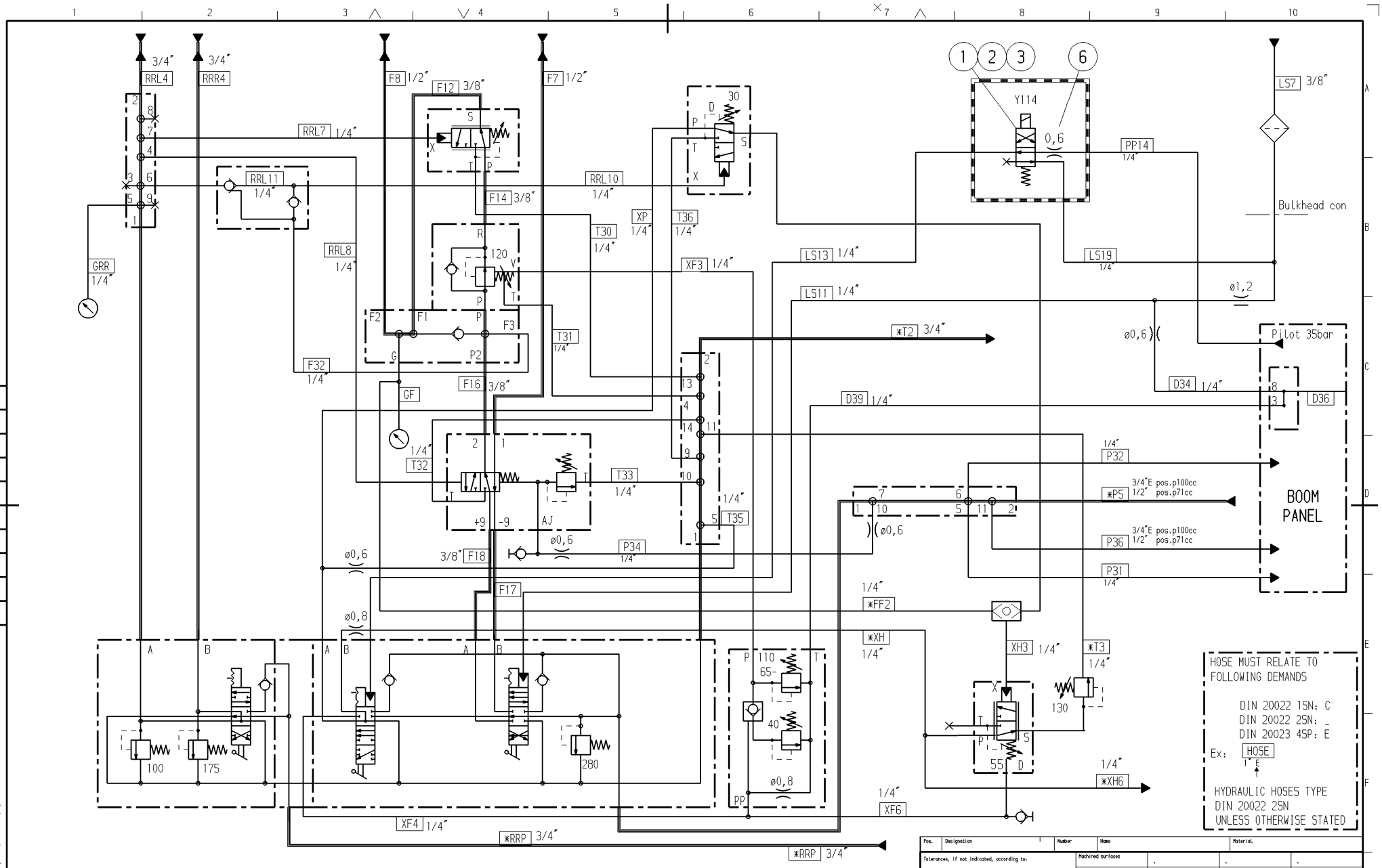
| Note | Position | Modified from | Date | Intr. |
|---|---|---|---|---|
| 0 | . | . | . | . |

Appurtenant drawings and documents: . .

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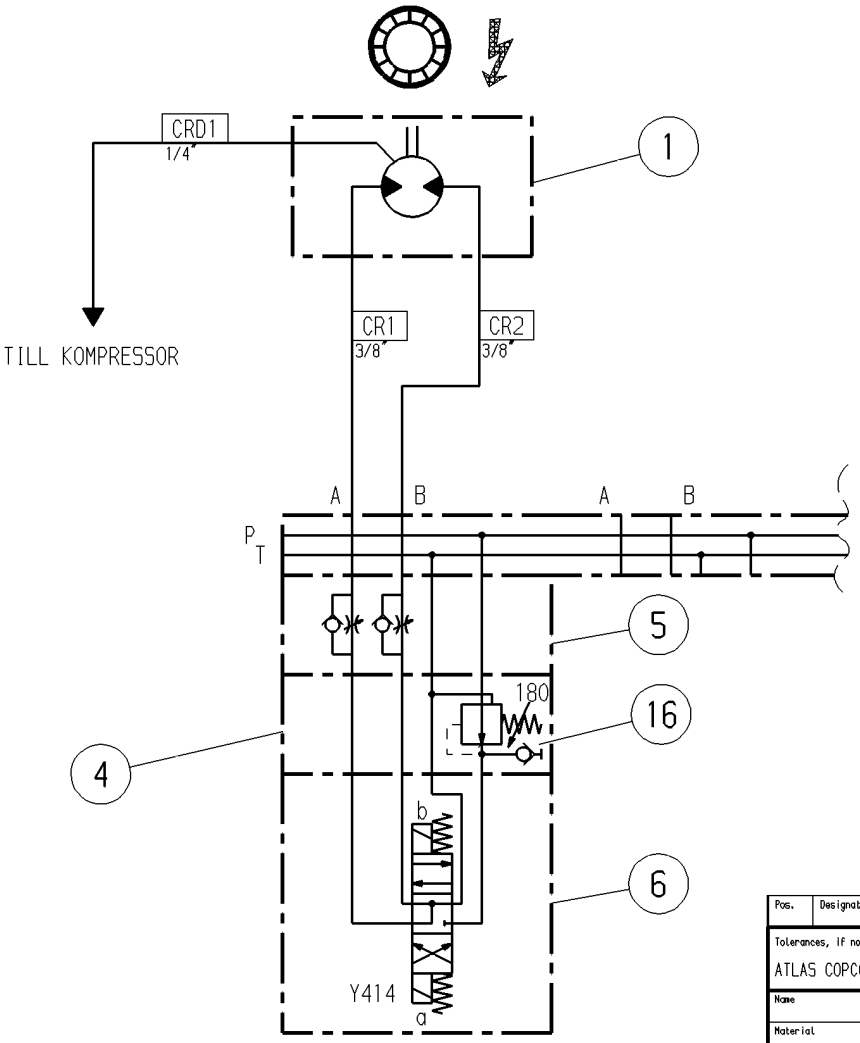


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| Pos. | Designation | Number | Name | Material |
|---|---|---|---|---|
| | | | | |

| Tolerances, if not indicated, according to: | Machined surfaces | | | |
|---|---|---|---|---|
| ATLAS COPCO STANDARD / Class | 1350 K / . | . | . | . |

| Name | HYDRAULSCHEMA / HYDR. SCHEDULE | Secrecy class |
|---|---|---|
| Material | KABELVINDA / CABLE REEL | 1102 K/ . |
| | | CAD |

| Scale | 1:1 | Fam | . | 3 | Compare | . | Drg.owner. |
|---|---|---|---|---|---|---|---|
| Drawn | AVOSNK | BLank | . | . | Replaces | . | TMG |
| Transferred from | | Blk.wt. | . kg | Fin.wt. | kg | Designation | Sheet 1 ( 1 ) |
| . | | | Appd. | Date 99-08-02 | | 9106 1509 83 | |

| Note | Position | Modified from | Date | Intr. |
|---|---|---|---|---|
| 1 | . | TEXT INLAGD TMG 035476 | 03-10-02 | Å.H. |

| . | Appurtenant drawings and documents |
|---|---|
| . | . |

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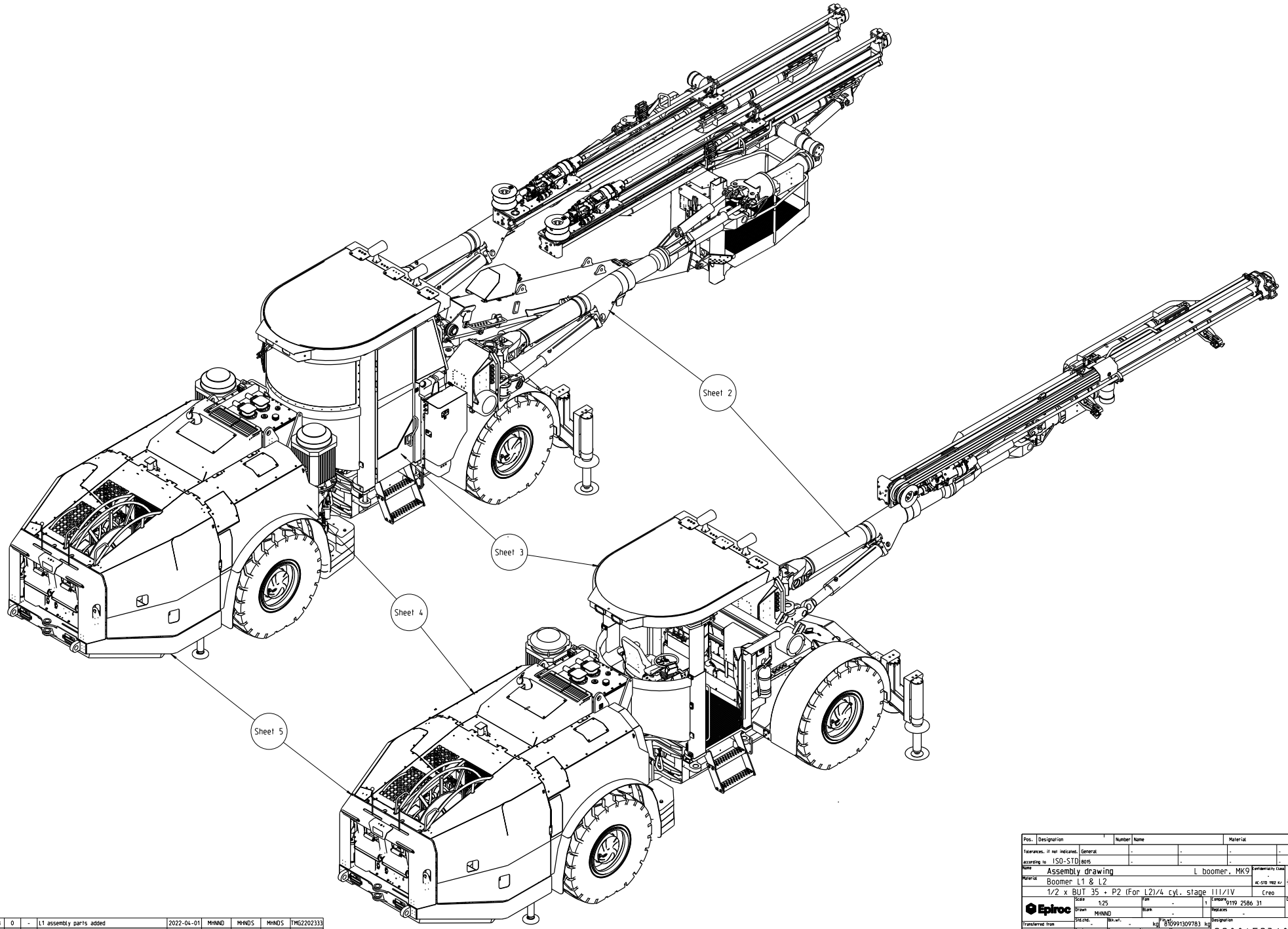


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## Mechanical - Overview

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| 9119255021 | RISK AREA DWG | RISK AREA TRANSPORT | 131 |
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| 5112330237 | DRAWING | WHEEL TORQUE | 134 |




| Rev. | Ver. | Position | Modified from | Date | Mod.by | Chd.by | Appd.by | CN id |
|---|---|---|---|---|---|---|---|---|
| 003 | 0 | - | L1 assembly parts added | 2022-04-01 | MHNND | MHNDS | MHNDS | TMG2202333 |

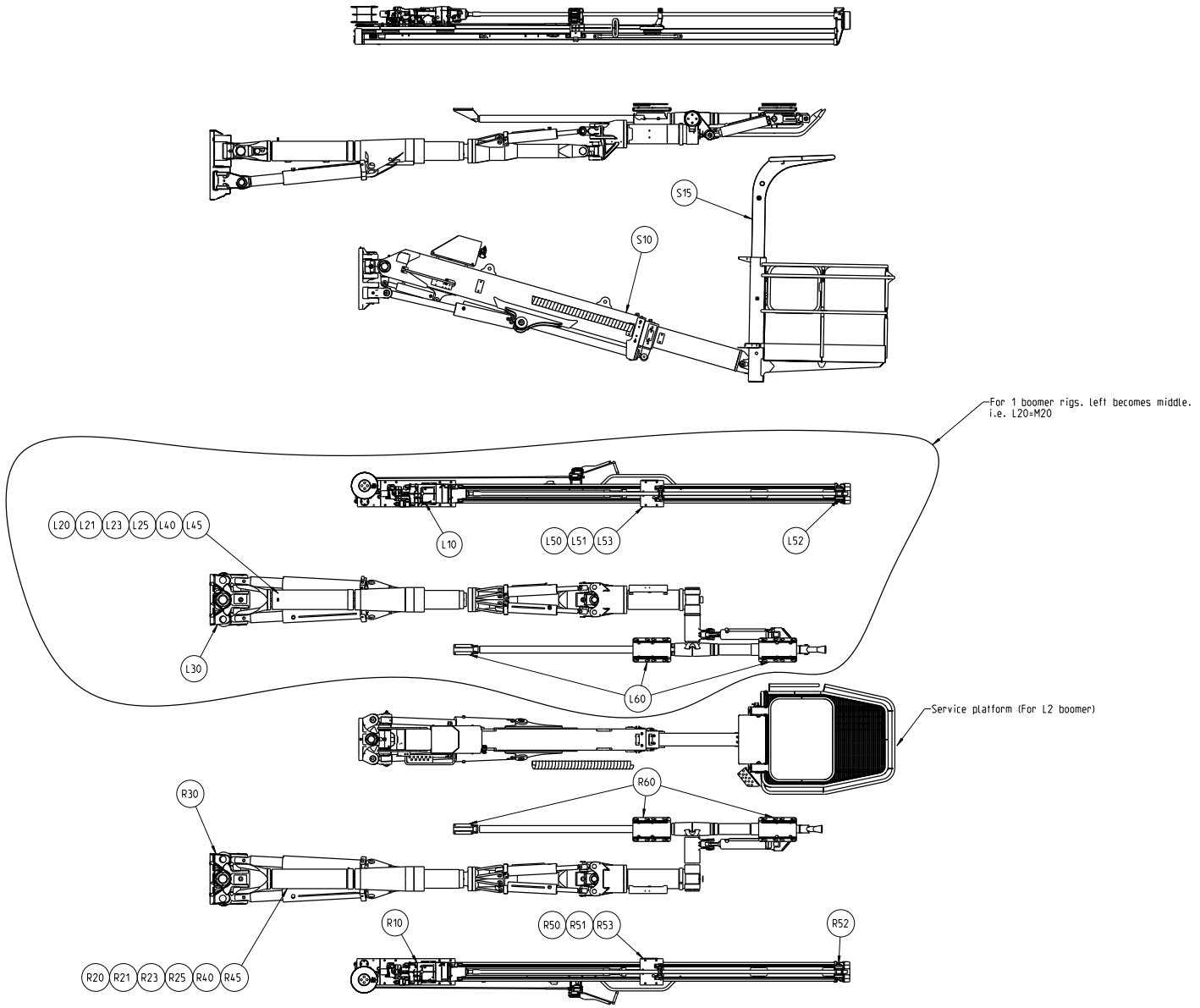
| Pos. | Designation | Number | Name | Material |
|---|---|---|---|---|
| Tolerances, if not indicated, according to ISO-STD 8015 | General | - | - | - |

Name: Assembly drawing — L boomer, MK9
Material: Boomer L1 & L2
1/2 x BUT 35 + P2 (For L2)/4 cyl. stage III/IV
Confidentiality Class: - (AC-STD 1902 4)
Creo
Epiroc
Scale: 1:25 | Form: - | Qty: 1 | Company: 9119 2586 31 | Org.owner: TMG
Drawn: MHNND | Blank: - | Replaces: -
Std.chd: - | Bln.wt.: - | Part kg: 8109991309783 kg | Designation | Sheet: 1(5)
Transferred from
Design chd.: MHNDS | Prod.chd.: - | Appd.: MHNMJ | Date: 2019-05-23
9900459360

Compare with the original structure in PLM System

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| Pos. | Designation | Number | Name | Material |
|---|---|---|---|---|
| Tolerances, if not indicated, according to ISO-STD | General 8015 | - | - | - |
| Name | Assembly drawing | L boomer, MK9 | | Confidentiality Class - AC-STD 1902 4/ |
| Material | Boomer L1 & L2 | | | |
| | 1/2 x BUT 35 + P2 (For L2)/4 cyl. stage III/IV | | | Creo |

Epiroc

| Scale | Fam | Qty | Company | Org.owner |
|---|---|---|---|---|
| 1:25 | - | 1 | 9119 2586 31 | TMG |
| Drawn MHNND | Blank - | | Replaces - | |
| Std.chd. - | Bln.wt. - | | Part mass kg 81099309783 kg | Designation |
| Design chd. MHNDS | Prod.chd. - | Appd. MHNMJ | Date 2019-05-23 | 9900459360 |

Transferred from

Sheet 2(5)

| Rev. | Ver. | Position | Modified from | Date | Mod.by | Chd.by | Appd.by | CN id |
|---|---|---|---|---|---|---|---|---|
| 003 | 0 | - | L1 assembly parts added | 2022-04-01 | MHNND | MHNDS | MHNDS | TMG2202333 |

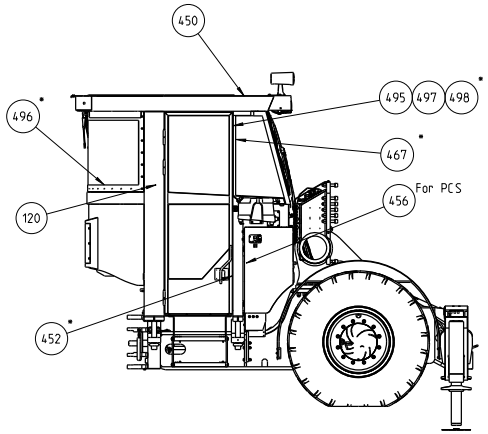
Only for Epiroc internal Use
Model name 9900459255_PLA
Rev 003
Ver 0

Compare with the original structure in PLM System

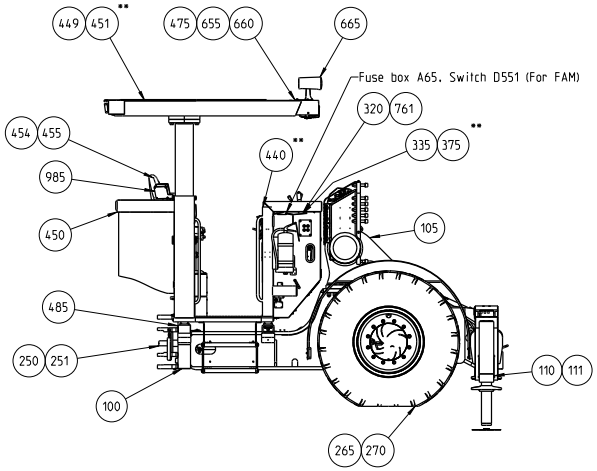
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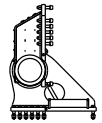
Cabin (PCS)



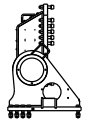

Protective roof with platform (DCS/PCS)

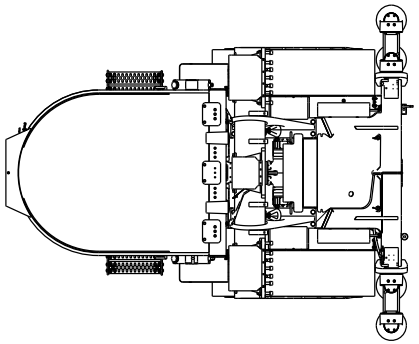


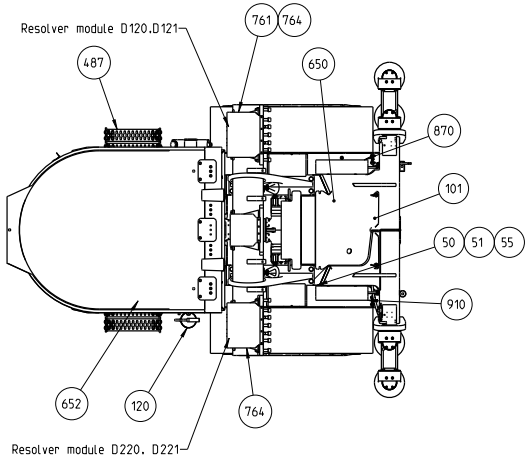

2 booms console

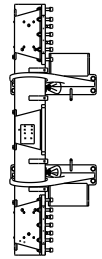


1 boom console

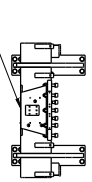






L2




L1

* Only used for rigs with Cabin
** Only used for rigs with platform

Remaining parts are common for both

| Rev. | Ver. | Position | Modified from | Date | Mod.by | Chd.by | Appd.by | CN id |
|---|---|---|---|---|---|---|---|---|
| 003 | 0 | - | L1 assembly parts added | 2022-04-01 | MHNND | MHNDS | MHNDS | TMG2202333 |

| Pos. | Designation | Number | Name | Material |
|---|---|---|---|---|
| Tolerances, if not indicated, according to ISO-STD 8015 | General | - | - | - |
| | | - | - | - |
| | | - | - | - |

Name: Assembly drawing — L boomer, MK9
Material: Boomer L1 & L2
1/2 x BUT 35 + P2 (For L2)/4 cyl. stage III/IV
Confidentiality Class: - (AC-STD 1902.4)
Creo
Epiroc
Scale: 1:25
Drawn: MHNND
Std.chd: -
Design chd: MHNDS
Blk.wt: -
Prod.chd: -
Fam: -
Blank: -
Appd: MHNMJ
Date: 2019-05-23
Compare: 9119 2586 31
Replaces: -
Part kg: 81099309783 kg
Designation: 9900459360
Org.owner: TMG
Sheet: 3(5)
Transferred from:

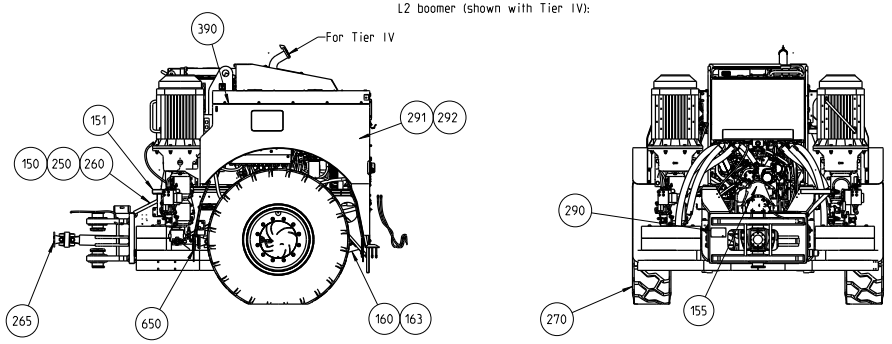
Compare with the original structure in PLM System

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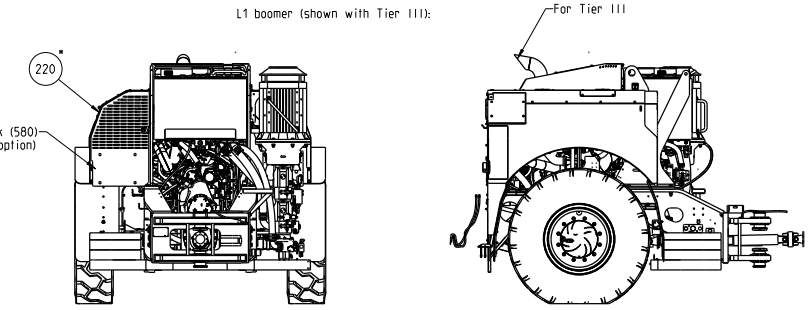
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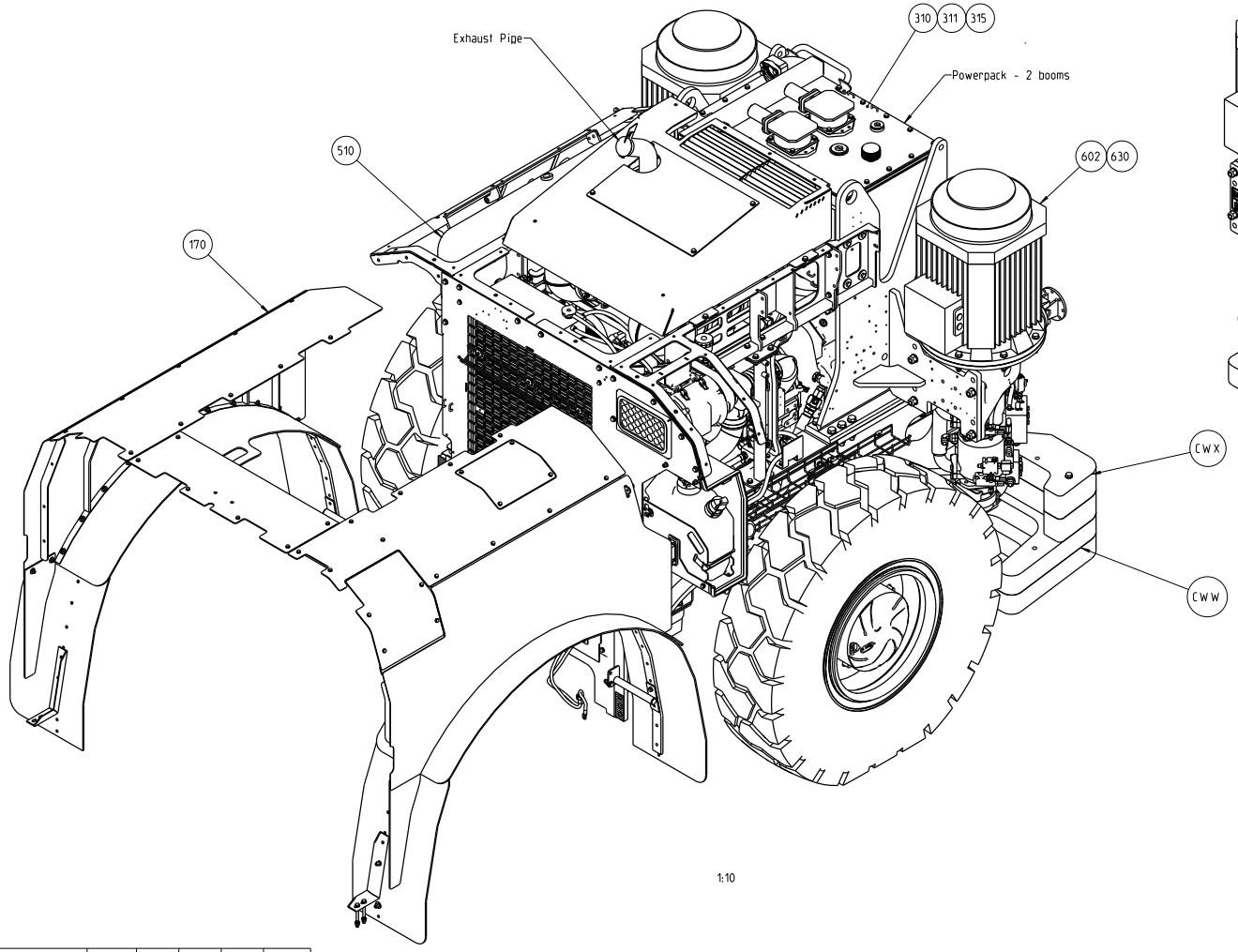
Only for Epiroc Internal Use
Obj | 9900459255_PLA | 001 | -
Model name | Rev | Ver

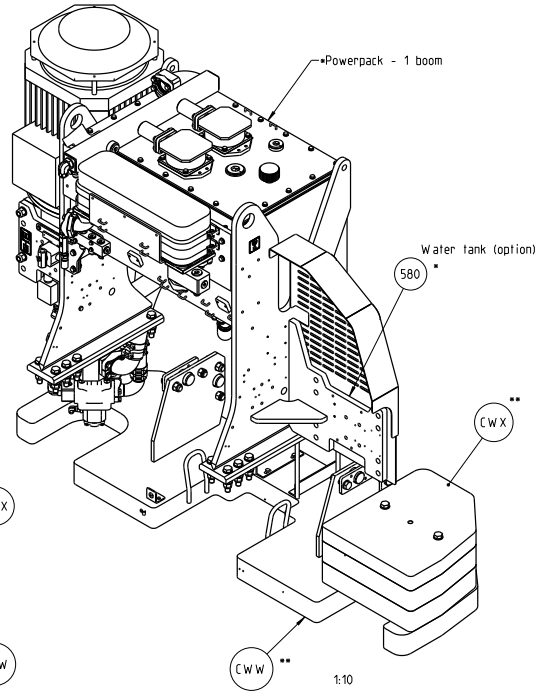
L2 boomer (shown with Tier IV):




L1 boomer (shown with Tier III):




Notes:
* - Only for L1 rig
** - Different in L1 rig
Remaining are same

| Pos. | Designation | Number | Name | Material |
|---|---|---|---|---|
| Tolerances, if not indicated, according to | General ISO-STD 8015 | - | - | - |
| Name | Assembly drawing L boomer, MK9 | Confidentiality Class: - AC-STD 1902 4/ | | |
| Material | Boomer L1 & L2 1/2 x BUT 35 + P2 (For L2)/4 cyl. stage III/IV | Creo | | |
| Epiroc | Scale 1:25 | Form - | Qty 1 | Compare 9119 2586 31 |
| | Drawn MHNND | Blank - | | Replaces - |
| Transferred from | Std.chd. - | Blk.wt. - | Part mass kg 8099309783 kg | Designation |
| | Design chd. MHNDS | Prod.chd. - | Appd. MHNMJ | Date 2019-05-23 |

Org.owner: TMG
Sheet 4(5)
9900459360

Compare with the original structure in PLM System

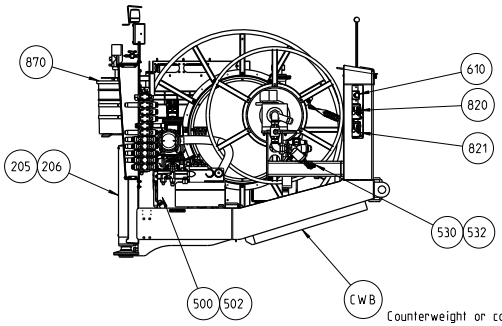
| Rev. | Ver. | Position | Modified from | Date | Mod.by | Chd.by | Appd.by | CN id |
|---|---|---|---|---|---|---|---|---|
| 003 | 0 | - | L1 assembly parts added | 2022-04-01 | MHNND | MHNDS | MHNDS | TMG2202333 |

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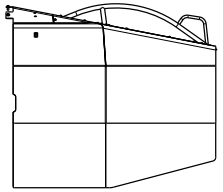
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Only for Epiroc Internal Use
Model name
Obj 9900459255_PLA 001 -
Rev Ver

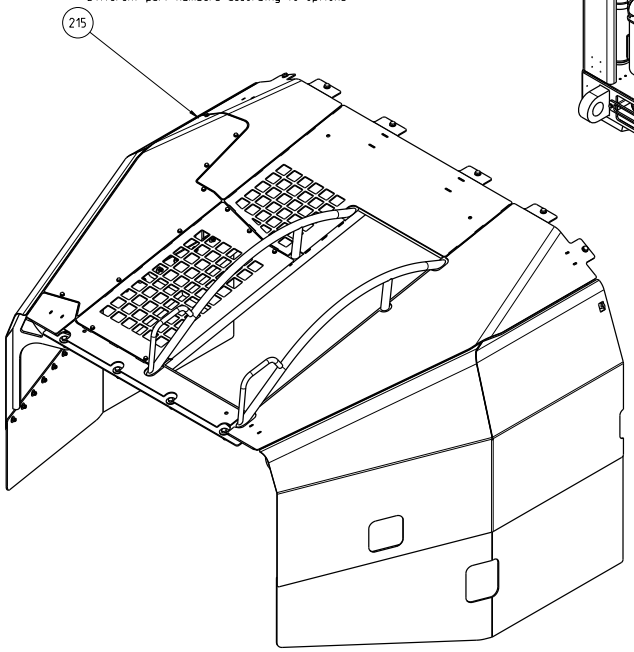



Counterweight or cover plate

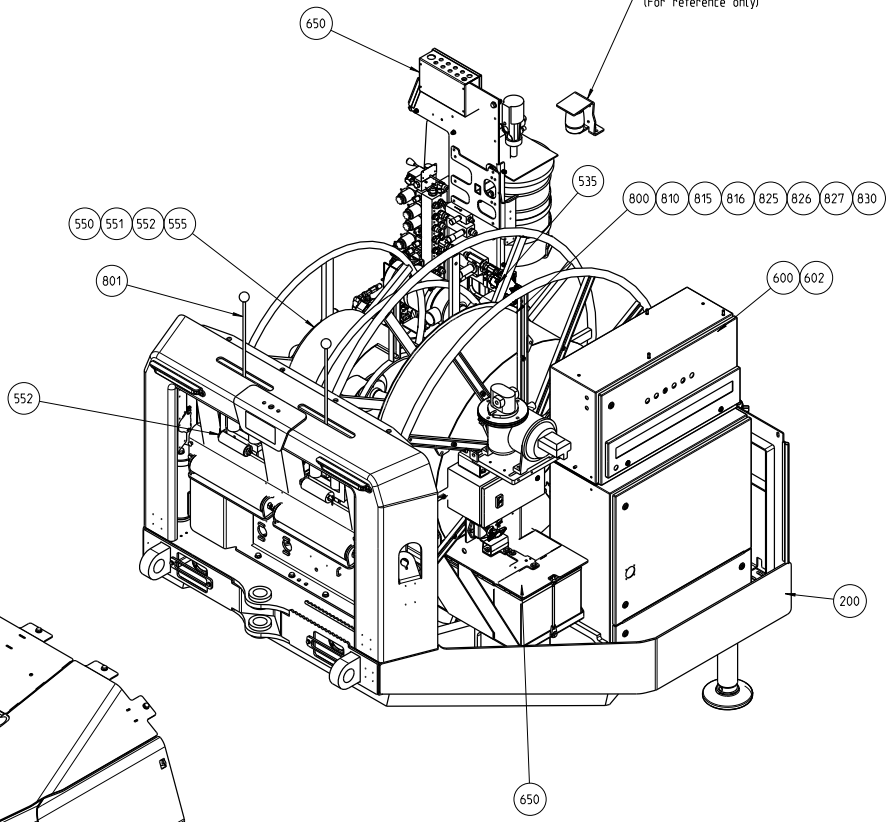
1:20



Different part numbers according to options




Mounting of flash light is on motor frame
(For reference only)




1:10

| Rev. | Ver. | Position | Modified from | Date | Mod.by | Chd.by | Appd.by | CN id |
|---|---|---|---|---|---|---|---|---|
| 003 | 0 | - | L1 assembly parts added | 2022-04-01 | MHNND | MHNDS | MHNDS | TMG2202333 |

| Pos. | Designation | Number | Name | Material |
|---|---|---|---|---|
| Tolerances, if not indicated, according to ISO-STD 8015 | General | - | - | - |
| Name | Assembly drawing L boomer, MK9 | | | Confidentiality Class: - AC-STD 1902 4/ |
| Material | Boomer L1 & L2 | | | |
| | 1/2 x BUT 35 + P2 (For L2)/4 cyl. stage III/IV | | | Creo |

Epiroc

| | | | |
|---|---|---|---|
| Scale 1:25 | Fam - | Compare 9119 2586 31 | Org.owner. |
| Drawn MHNND | Blank - | Replaces - | TMG |
| Std.chd. - | Blk.wt. - | Part mass kg 8199309783 kg | Designation Sheet 5(5) |
| Design chd. MHNDS | Prod.chd. - | Appr. MHNMJ Date 2019-05-23 | 9900459360 |

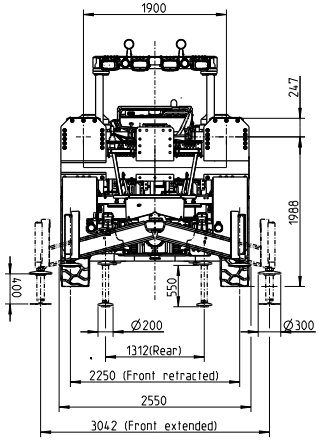
Transferred from

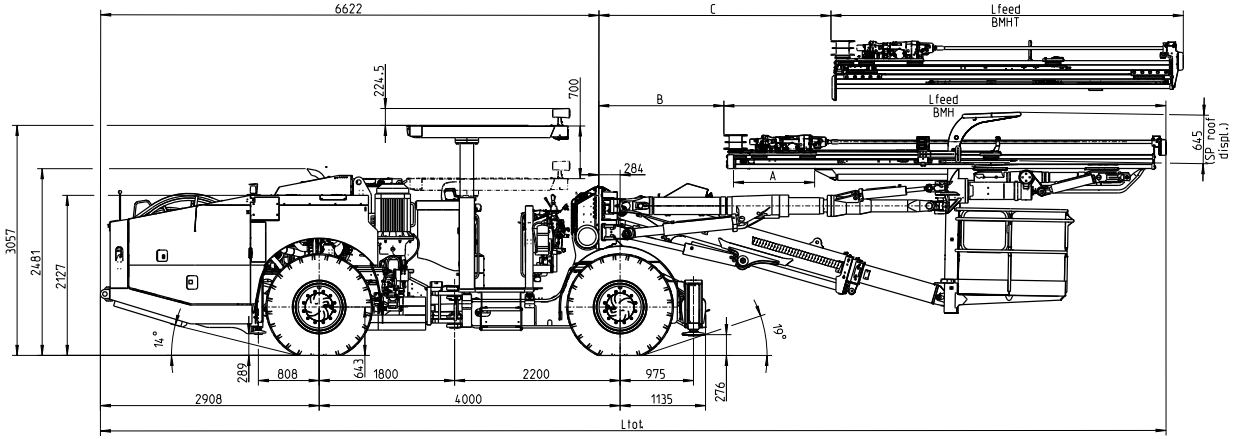
Compare with the original structure in PLM System

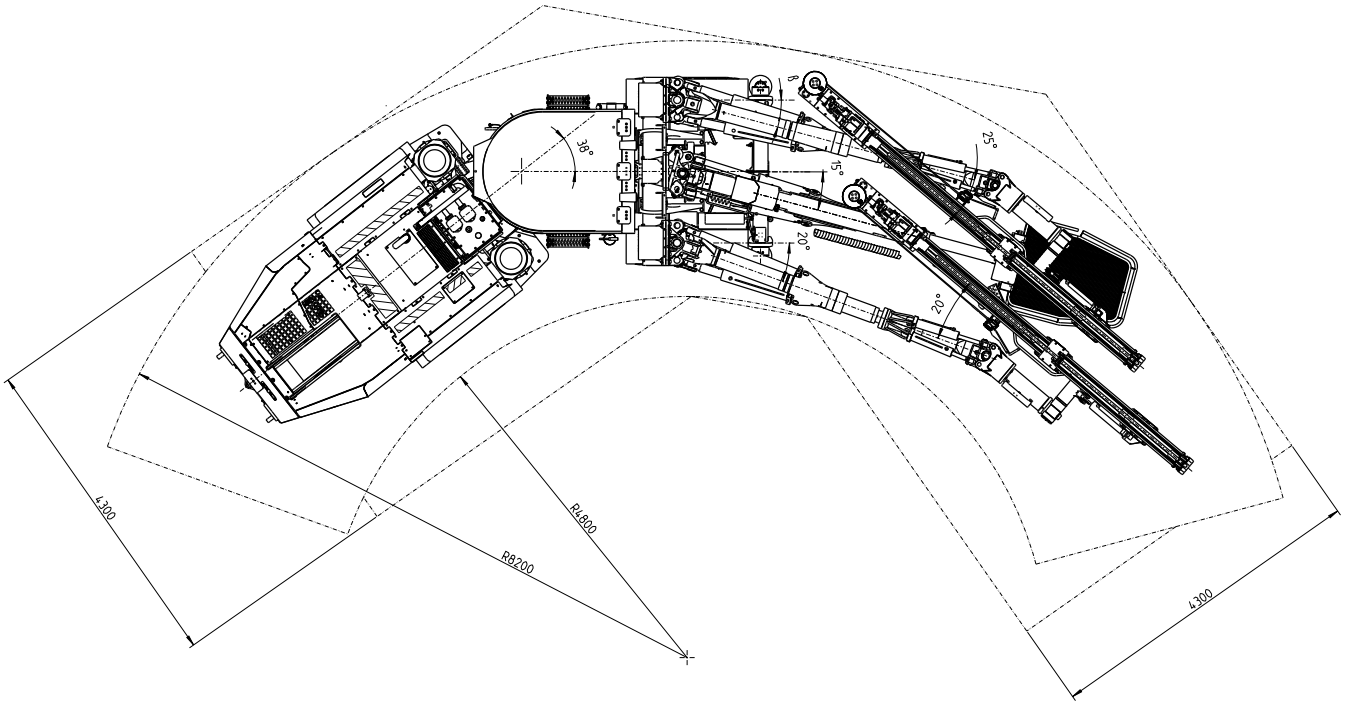
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L2 boomer with DCS & Protective roof




| Feed | Ltot | Lfeed (Max/Min) | A | B | C | Max feed extention | ß |
|---|---|---|---|---|---|---|---|
| BMH 6812 | 14369 | 5287 | 265 | 2462 | - | 1800 | 15° |
| BMH 6814 | 14164 | 5882 | 1065 | 1662 | - | 1800 | 15° |
| BMH 6816 | 14574 | 6492 | 1265 | 1462 | - | 1800 | 15° |
| BMH 6818 | 15184 | 7102 | 1265 | 1462 | - | 1800 | 15° |
| BMH 6820 | 15759 | 7677 | 1265 | 1462 | - | 1800 | 15° |
| BMHT 6814/08 | 13968 | 5903/4088 | - | - | 3258 | 1627 | 20° |
| BMHT 6816/10 | 14385 | 6503/4678 | - | - | 3085 | 1800 | 20° |
| BMHT 6818/10 | 14385 | 7123/4678 | - | - | 3085 | 1800 | 20° |

For rigs equipped with BSH110, dimensions Ltot and Lfeed are increased by 84 mm.
For rigs with Australian centralizers (AC), dimensions Ltot and Lfeed are increased by 80 mm.
For rigs with BUT 35L, dimensions Ltot, B and C are increased by 700 mm.
Service platform P2 is shown without roof for tramming (Top view), lower the roof while tramming the rig.

| Rev. | Ver. | Position | Modified from | Date | Mod.by | Chd.by | Appd.by | CN id |
|---|---|---|---|---|---|---|---|---|
| 001 | 0 | - | NEW RELEASED | - | - | - | - | - |

| Pos. | Designation | Number | Name | Material |
|---|---|---|---|---|
| Tolerances, if not indicated, according to AC-STD: | Machined surfaces 1950 K - - | - - | - - | - - |

Name: DIMENSION DRAWING L2 MK9
Material: BOOMER L2 - PCS & DCS
2 x BUT 35 + P2 / 4 cyl. diesel engine Stage 4F
Confidentiality Class: - AC-STD 1902 4J
Creo

Epiroc
Scale 3:100 | Pos - | Compare - | Org.owner TMG
Drawn MHNND | Blank - | Replaces -
Std.chd. - | Blk.wt. - | Prod.chd. - | Appd. MHNDS | Date 2019-02-20
Transferred from
Design chd. MHNDS
Weight 81177.3987710 kg
Designation 9900459246
Sheet 1(2)

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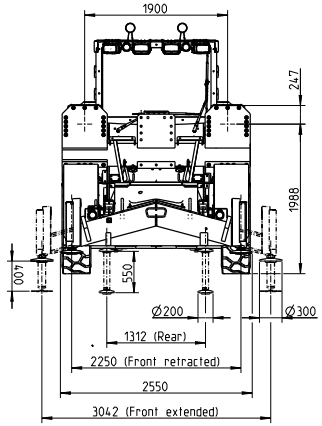
Compare with the original structure in PLM System

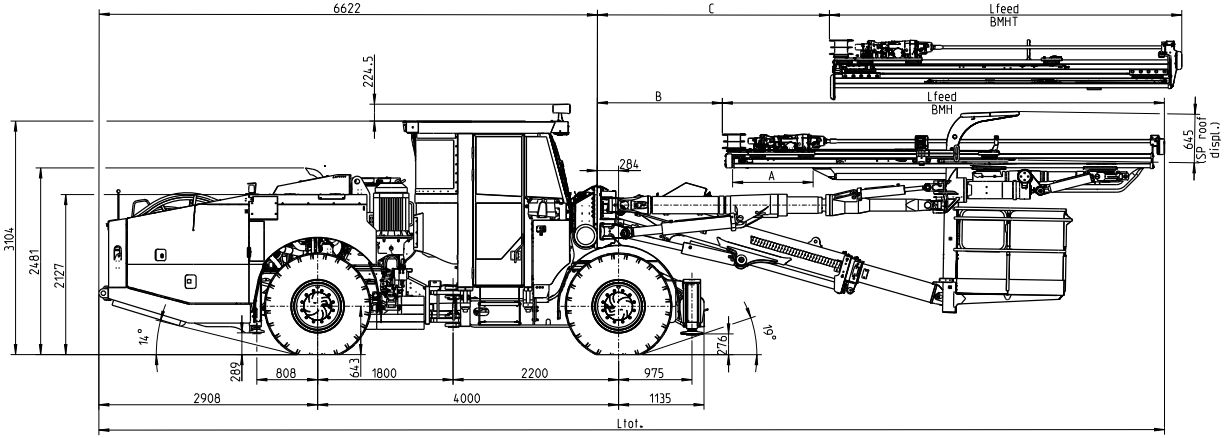
Dwg. for Epiroc internal Use | Model name 9900459246 | Dwl | Rev | Ver | 001 | -

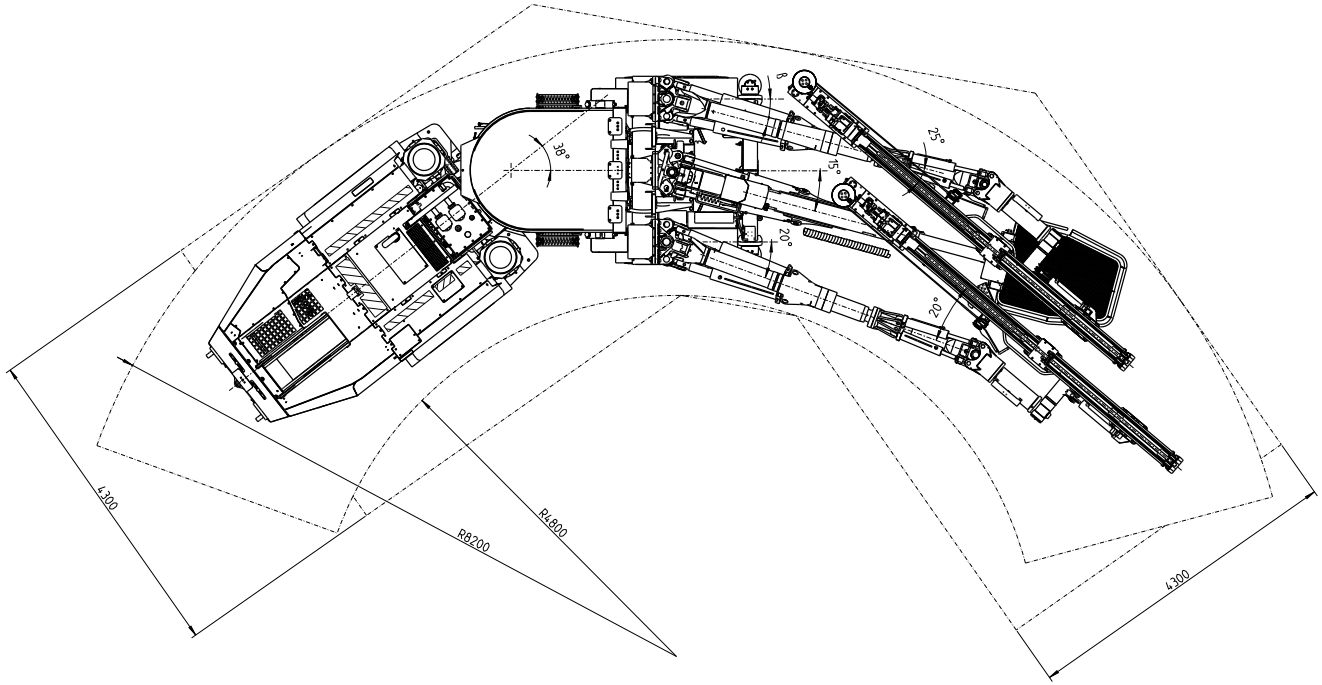
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Doc. for Epiroc internal Use
Model name
Obj. 9900459246
Rev. Ver. 001 -

L2 boomer with PCS & cabin




| Feed | Ltot | Lfeed (Max/Min) | A | B | C | Max feed extention | β |
|---|---|---|---|---|---|---|---|
| BMH 6812 | 14369 | 5287 | 265 | 2462 | - | 1800 | 15° |
| BMH 6814 | 14164 | 5882 | 1065 | 1662 | - | 1800 | 15° |
| BMH 6816 | 14574 | 6492 | 1265 | 1462 | - | 1800 | 15° |
| BMH 6818 | 15184 | 7102 | 1265 | 1462 | - | 1800 | 15° |
| BMH 6820 | 15759 | 7677 | 1265 | 1462 | - | 1800 | 15° |
| BMHT 6814/08 | 13968 | 5903/4088 | - | - | 3258 | 1627 | 20° |
| BMHT 6816/10 | 14385 | 6503/4678 | - | - | 3085 | 1800 | 20° |
| BMHT 6818/10 | 14385 | 7123/4678 | - | - | 3085 | 1800 | 20° |

For rigs equipped with BSH110, dimensions Ltot and Lfeed are increased by 84 mm.
For rigs with Australian centralizers (AC), dimensions Ltot and Lfeed are increased by 80 mm.
For rigs with BUT 35L, dimensions Ltot, B and C are increased by 700 mm.
Service platform P2 is shown without roof for tramming (Top view), lower the roof while tramming the rig.

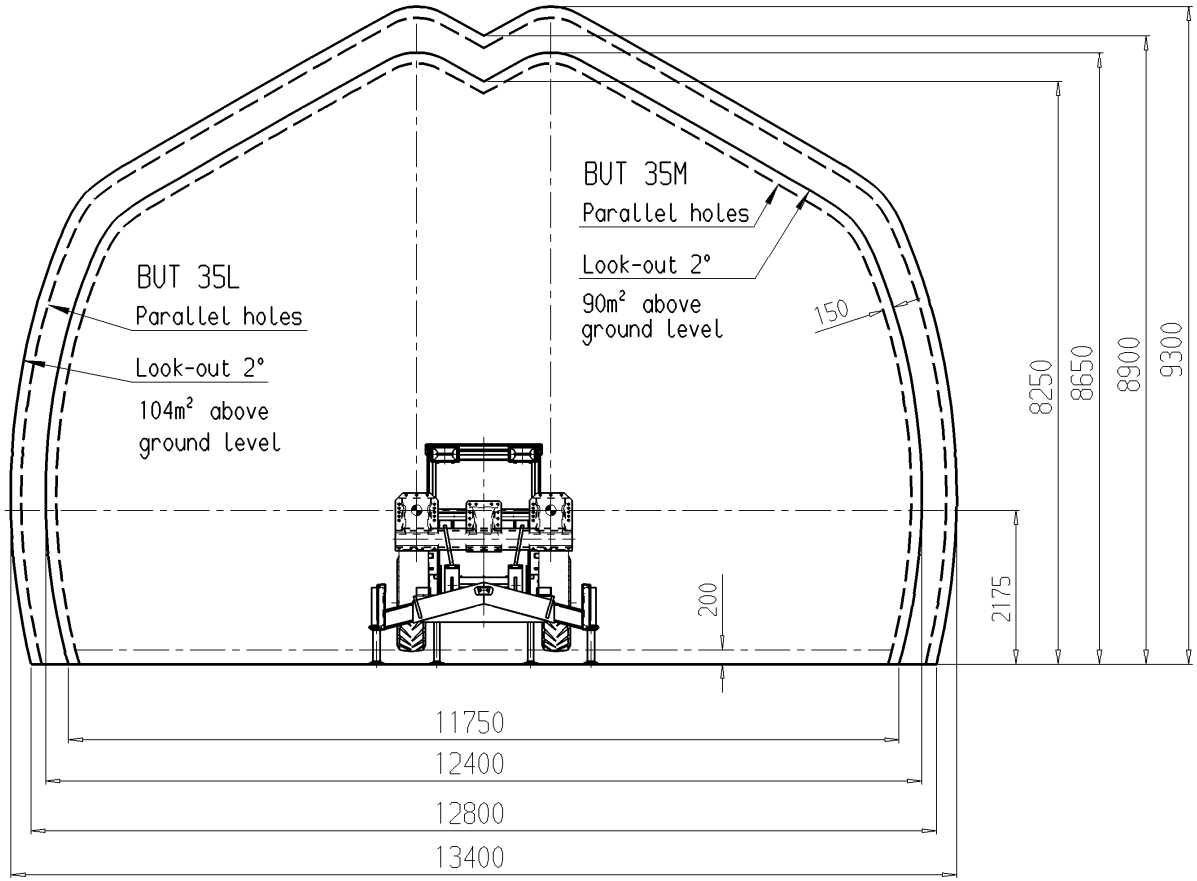
| Rev. | Ver. | Position | Modified from | Date | Mod.by | Chd.by | Appd.by | CN id |
|---|---|---|---|---|---|---|---|---|
| 001 | 0 | - | NEW RELEASED | - | - | - | - | - |

| Pos. | Designation | Number | Name | Material |
|---|---|---|---|---|
| Tolerances, if not indicated, according to AC-STD: | Machined surfaces 1950 K - - | - | - | - |
| Name | DIMENSION DRAWING | | L2 MK9 | Confidentiality Class - AC-STD 1902 A/ |
| Material | BOOMER L2 - PCS & DCS | | | |
| | 2 x BUT 35 + P2 / 4 cyl. diesel engine Stage 4F | | Creo | |
| Epiroc | Scale 3:100 | Fam - | Compare - | Org.owner. |
| | Drawn MHNND | Blank - | Replaces - | TMG |
| Transferred from | Std.chd. - | Bla.wt. - kg | Prod.wt. 81177387710 kg | Designation Sheet 2(2) |
| | Design chd. MHNDS | Prod.chd. - | Appd. MHNDS Date 2019-02-20 | 9900459246 |

Compare with the original structure in PLM System

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COVERAGE AREA
MEASURES INCLUDE LOOK-OUT 2°

**BOOMER L2**
2xBUT35M/L G
COP1432/1440/1838
BMH6XXX

Atlas Copco

| Pos. | Designation | Number | Name | Material |
|---|---|---|---|---|
| Tolerances, if not indicated, according to: ATLAS COPCO STANDARD / Class | | Machined surfaces 1350 K / . | | |
| Name: COVERAGE AREA | | BOOMER L2 | Secrecy class 1102 K/ . | |
| Material: 2X BUT 35M/L G / BMH 6000 | | | CAD | |
| Scale 1:50 | Fam . | 2 | Compare 5112 3070 03 | Org.owner. |
| Drawn AVOANH | Blank . | | Replaces . | TMG |
| Std.chd. . | Blk.wt. . kg | Fin.wt. . kg | Designation 9119 2538 01 | Sheet 1 ( 1 ) |
| Transferred from . | Design chd. . | Prod.chd. . | Appd. UTUM Date 2002-01-16 | |

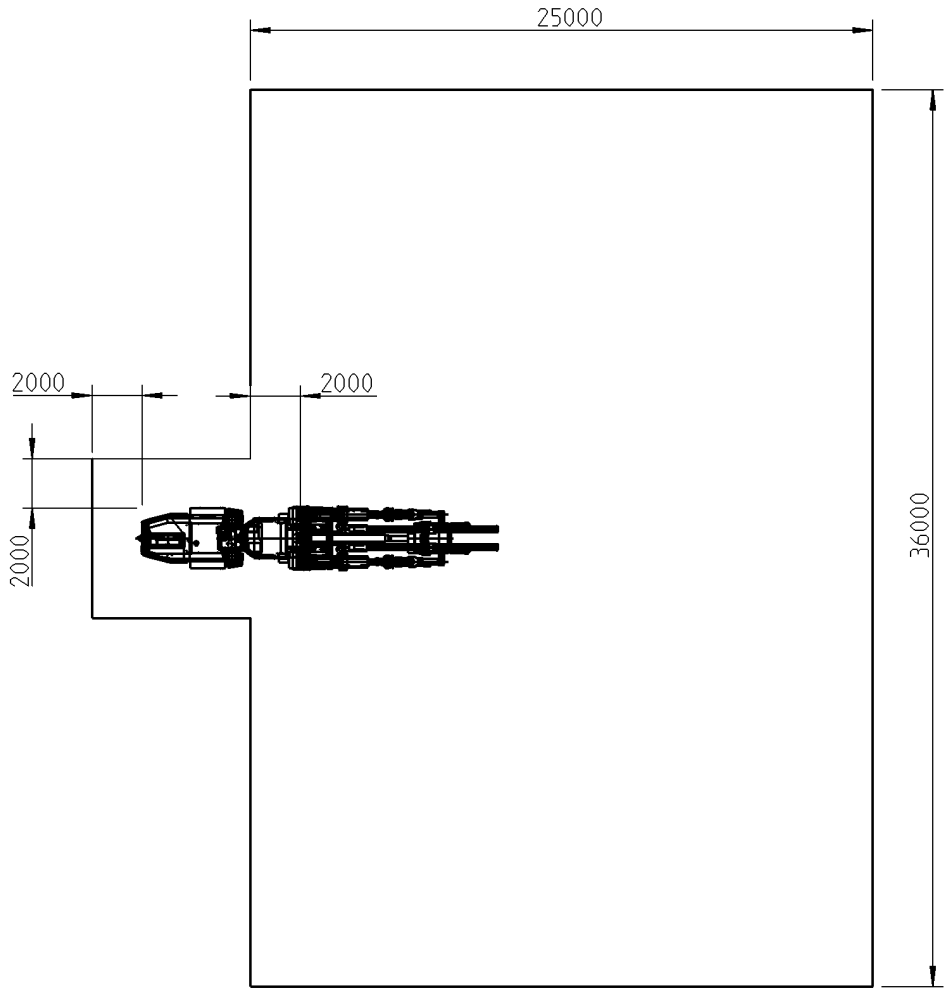
| Note | Position | Modified From | Date | Intr. |
|---|---|---|---|---|
| 0 | . | . | . | . |

. . Appurtenant drawings and documents

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| Model name | Rev | Ver |
|---|---|---|
| 9119255020 | 4 | 0 |

Obj

| Tolerances. if not indicated. | Machined surfaces | - | - | - | - |
|---|---|---|---|---|---|
| according to AC-STD: | 1350 K / - | - | - | - | - |

| | | | | | |
|---|---|---|---|---|---|
| Name | Risk Area | Boomer M2 / L2 / E2 | | Secrecy class | |
| Material | Working | | | AC-STD 1102 K/ | |
| - | | | | Pro/E | |

| | | | | | |
|---|---|---|---|---|---|
| Atlas Copco | Scale 1:200 | Fam | 3 | Compare - | Drg.owner. TMG |
| | Drawn AVOAFN | Blank | - | Replaces | |
| Transferred from | Std.chd. | Blk.wt. kg | Fin.wt. 0.0 kg | Designation | Sheet 1(1) |
| | Design chd. | Prod.chd. | Appd. P Roth Date 2003-10-17 | 9119255020 | |

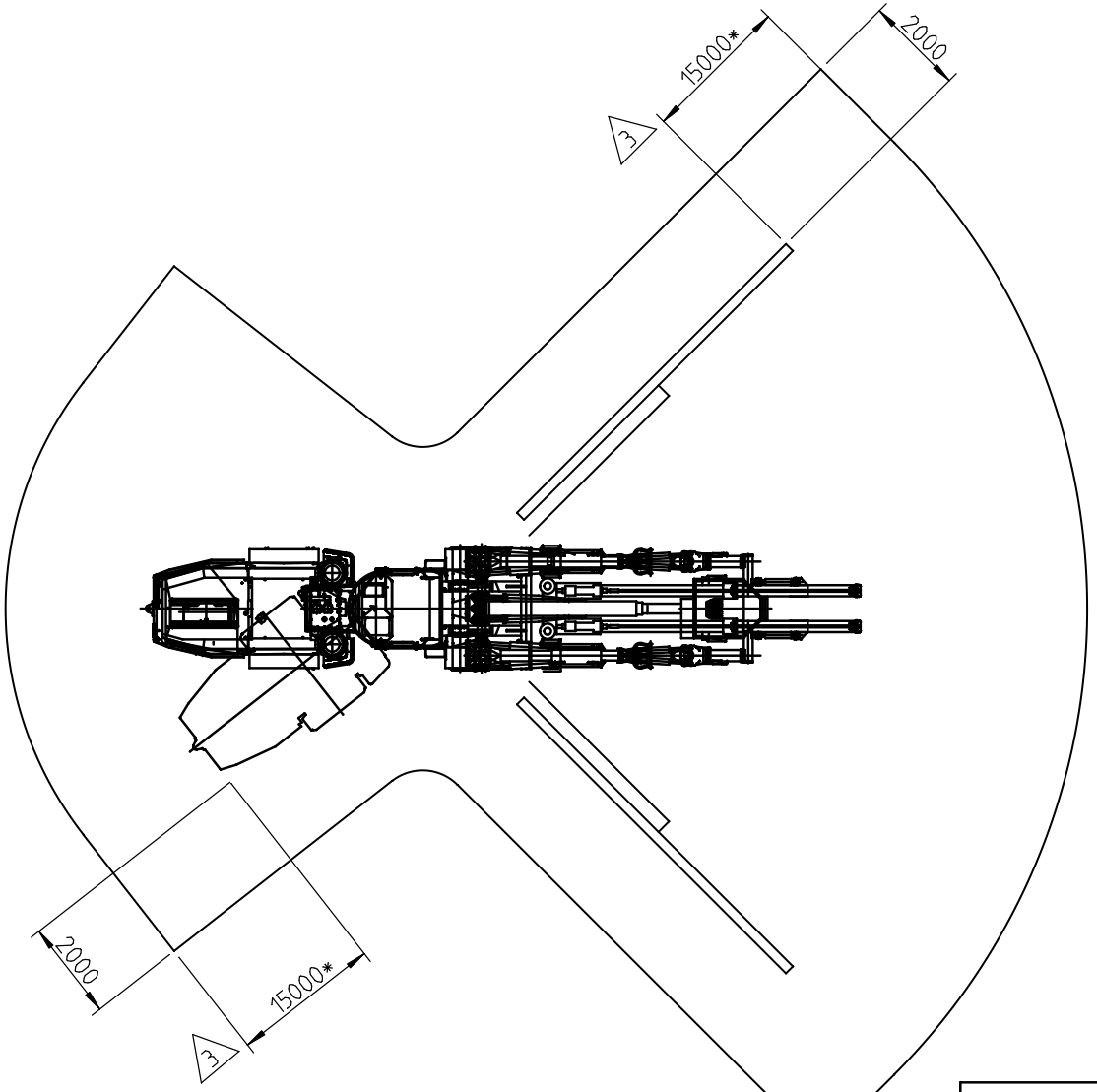
| Rev. | Ver. | Posi-tion | Modified from | Date | Intr. | DN no. |
|---|---|---|---|---|---|---|
| 4 | 0 | | Type changed to Boomer M2 / L2 / E2. | 2012-06-25 | ABr | TMG136382 |

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Only for Atlas Copco Internal Use
Model name
Obj 9119255021
Rev 3
Ver 0




3
*Note : For a machine that is started but not moving the hazard zones are 2m in each direction.

| Rev. | Ver. | Position | Modified from | Date | Mod.by | Chd.by | Appd.by | CN Id |
|---|---|---|---|---|---|---|---|---|
| 3 | 0 | - | Note added & Dim.15000 was 2000. | 2016-06-30 | IPCARP | IPCLH | TMGMSK | - |

| | | | | | |
|---|---|---|---|---|---|
| Tolerances. if not indicated. | Machined surfaces | - | - | - | - |
| according to AC-STD: | 1350 K / - | - | - | - | - |

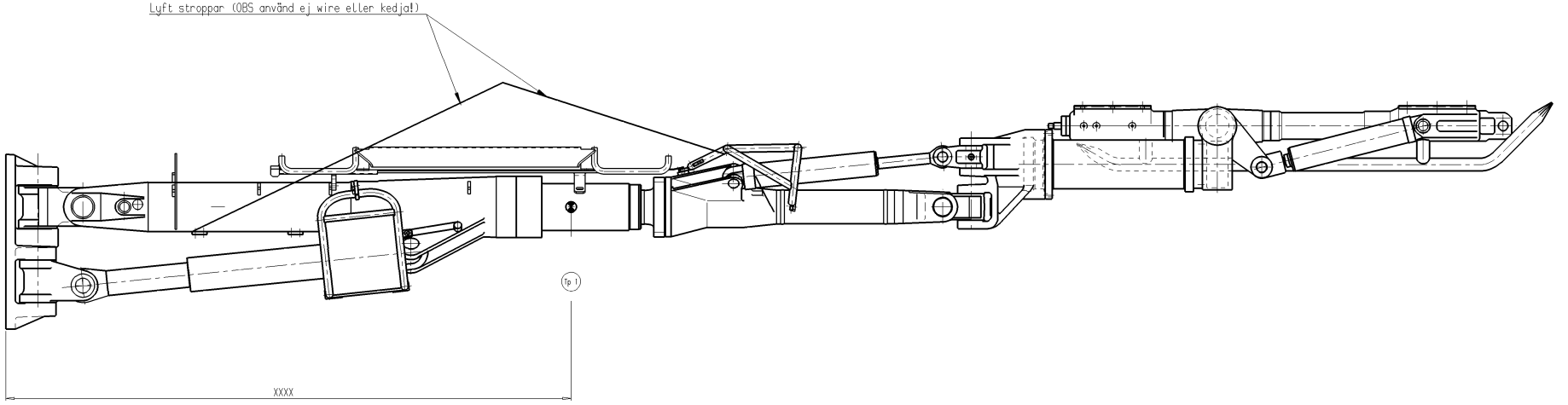
Name: **Risk area** — Boomer M2 / L2 / E2
Material: Transport
Confidentiality Class: Internal AC-STD 1102 K/
Pro/E

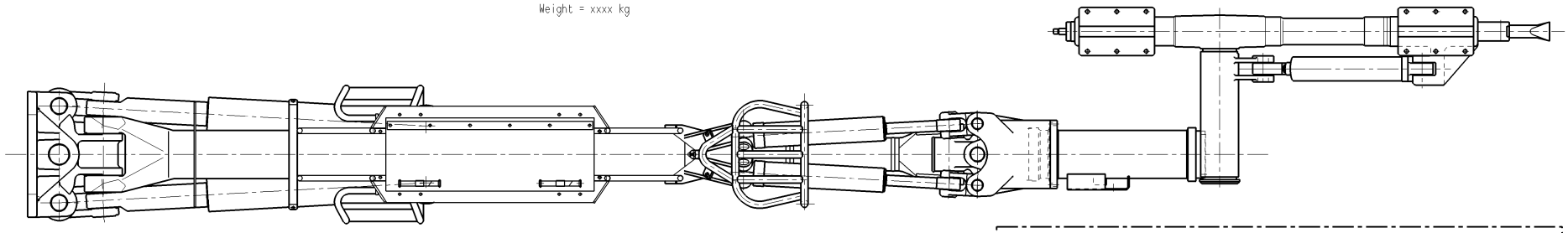
| | | | | | |
|---|---|---|---|---|---|
| Scale 1:100 | Fam - | 3 | Compare - | | Drg.owner. TMG |
| Drawn AVOAFN | Blank - | . | Replaces - | | |
| Transferred from | Std.chd. - | Blk.wt. - kg | Fin.wt. 0.0 kg | Designation 9119255021 | Sheet 1(1) |
| | Design chd. - | Prod.chd. - | Appd. P Roth | Date 2003-10-17 | |

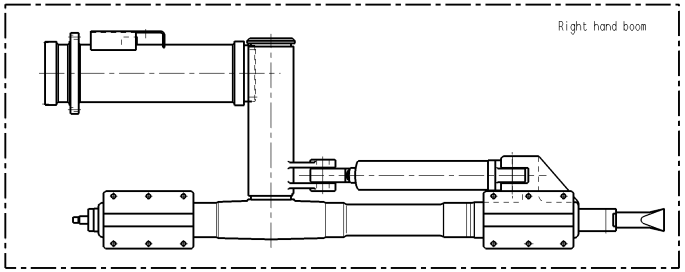
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Boom weight = MMMM kg incl. rock drill hoses but excl.

assembly set, feed and rock drill

(Tp1) = C.o.G with the telescopic tube at in position.

| Pos. | Designation | Number | Name | Material |
|---|---|---|---|---|
| Tolerances, if not indicated, according to: | | Machined surfaces | | |
| STROP INSTR. | | 1350 K / | | |
| Name: Stroppnings instruktion | | BUT 35 M L/R VER G | Sealing class: 1102 K/ | |
| Material: | | | CAD | |
| Atlas Copco | Scale: 1:10 | Free | Compare | Org.owner: |
| | Drawn: UTUU | Blank | Replaces | TMG |
| Transferred from | Std.chd. | Bla.wt. kg | Fin.wt. kg | Designation: 3128 3120 14 |
| | Design chd. | Prod.chd. | Appd. | Date: 02-02-12 |

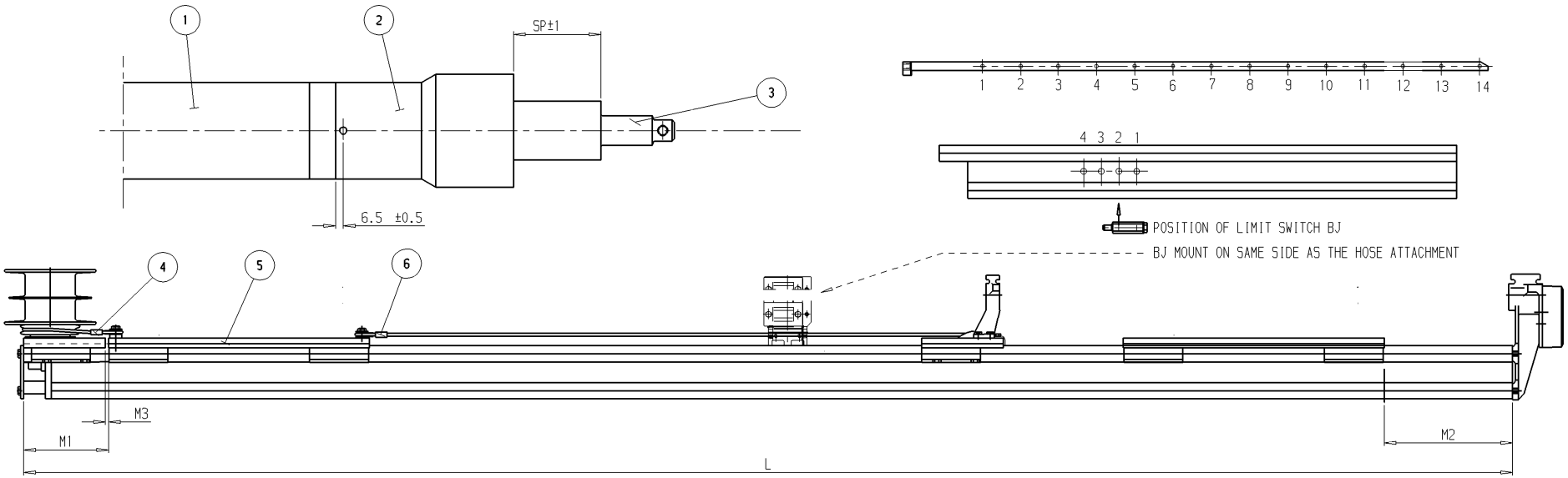
| Note | Position | Modified from | Date | Distr. |
|---|---|---|---|---|
| 0 | . | . | . | . |

Separament drawings and documents

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| FEED | MEAS. SP | MEAS. M1/M3 | MEAS. M2 | CYLINDER POS 1 | SPACER SLEEVE POS 2 | SPACER POS 3 | RETURN ROPE POS4 | CRADLE POS 5 | POSITION OF PULL ROPE 6 | MEASURE L | POS OF BJ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BMH 6312/COP 1238 | 0 | 287 / 10 | 435 | 3128 3142 54 | 3128 0785 71 | 3128 0785 70 | 3128 0784 13 | 3128 0784 44 | 3128 0784 11 | 7 | 5050 | 3 , 4 | . |
| BMH 6812/COP 1838 | 0 | 287 / 10 | 435 | 3128 3142 54 | 3128 0785 71 | 3128 0785 70 | 3128 0784 13 | 3128 0784 44 | 3128 0784 11 | 7 | 5050 | 3 , 4 | . |
| BMH 6314/COP 1238 | 178 | 279 / 2 | 435 | 3128 3142 54 | 3128 0784 09 | 3128 0784 06 | 3128 0784 14 | 3128 0784 44 | 3128 0784 11 | 11 | 5645 | 3 , 4 | . |
| BMH 6814/COP 1838 | 178 | 279 / 2 | 435 | 3128 3142 54 | 3128 0784 09 | 3128 0784 06 | 3128 0784 14 | 3128 0784 44 | 3128 0784 11 | 11 | 5645 | 3 , 4 | . |
| BMH 6316/COP 1238 New design | 484,5 | 279 / 2 | 436 | 3128 3142 54 | 3128 0784 09 | 3128 0784 08 | 3128 0784 14 | 3128 0784 44 | 3128 0784 12 | 4 | 6255 | 3 , 4 | . |
| BMH 6816/COP 1838 New design | 484,5 | 279 / 2 | 436 | 3128 3142 54 | 3128 0784 09 | 3128 0784 08 | 3128 0784 14 | 3128 0784 44 | 3128 0784 12 | 4 | 6255 | 3 , 4 | . |
| BMH 6318/COP 1238 | 333 | 279 / 2 | 435 | 3128 3142 55 | 3128 0784 09 | 3128 0784 07 | 3128 0784 14 | 3128 0784 44 | 3128 0784 12 | 9 | 6865 | 3 , 4 | . |
| BMH 6818/COP 1838 | 333 | 279 / 2 | 435 | 3128 3142 55 | 3128 0784 09 | 3128 0784 07 | 3128 0784 14 | 3128 0784 44 | 3128 0784 12 | 9 | 6865 | 3 , 4 | . |
| BMH 6320/COP 1238 Older design | 620 | 279 / 2 | 436 | 3128 3142 55 | 3128 0784 09 | 3128 0784 08 | 3128 0784 14 | 3128 0784 44 | 3128 0784 12 | 13 | 7440 | 3 , 4 | . |
| BMH 6820/COP 1838 Older design | 620 | 279 / 2 | 436 | 3128 3142 55 | 3128 0784 09 | 3128 0784 08 | 3128 0784 14 | 3128 0784 44 | 3128 0784 12 | 13 | 7440 | 3 , 4 | . |
| BMH 6320/COP 1238 New design | 86 | 279 / 2 | 436 | 3128 3142 56 | 3128 0785 71 | 3128 0785 70 | 3128 0784 14 | 3128 0784 44 | 3128 0784 12 | 13 | 7440 | 3 , 4 | . |
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| BMH 6816/COP 1838 Older design | 30 | 279 / 2 | 437 | 3128 3142 55 | 3128 0784 09 | 3128 0785 70 | 3128 0784 14 | 3128 0784 44 | 3128 0784 12 | 4 | 6255 | 3 , 4 | . |

| Note | Position | Modified from | Date | Intr. |
|---|---|---|---|---|
| 12 | F1 | BMH 6816 and BMH 6316 older design added | 061025 | BES |
| 11 | F2 | Feeds with nev design added | 061024 | BES |
| 10 | . | RITNING UPPDATERAD | 060612 | BES |
| 9 | D10 | NYA CYLINDERNUMMER INFÖRDA | 041026 | BES |
| 8 | E1 | BMH 68XX/COP 1838 TILLKOMMER | 98-12-03 | BES |
| 7 | D10 | NY MATARCYLINDER INFÖRD | 96-06-24 | BES |
| 6 | E6 | DISTANS 3128 0785 70 VAR 3128 0784 06 | 95-10-31 | BES |
| 5 | E8 | 13 VAR 12 | 94-06-03 | BES |
| 4 | E3,E9 | MÅTT SP=620 VAR 638,7440 VAR 7475 | 94-05-11 | BES |
| 3 | D9 | HÅLPLACERING 7 VAR 8 | 89-09-29 | BES |
| 2 | E9 | ÄNDRAD PLACERING AV IMPULSGIVARE | 89-08-30 | BES |
| 1 | E3 | MÅTT SP = 28 VAR 33 | 89-08-16 | BES |
| 13 | F2 | Measurement 30 was 86, 437 was 435 | 070531 | BES |

. . Appurtenant drawings and documents

| Pos. | Designation | Number | Name | Material |
|---|---|---|---|---|
| | | | | |

Tolerances, if not indicated, according to: ATLAS COPCO STANDARD / Class
Machined surfaces: 1350 K / .

Name: BMH 6XXX
Material: MOUNTING DRAWING
Secrecy class: 1102 K / .
CAD

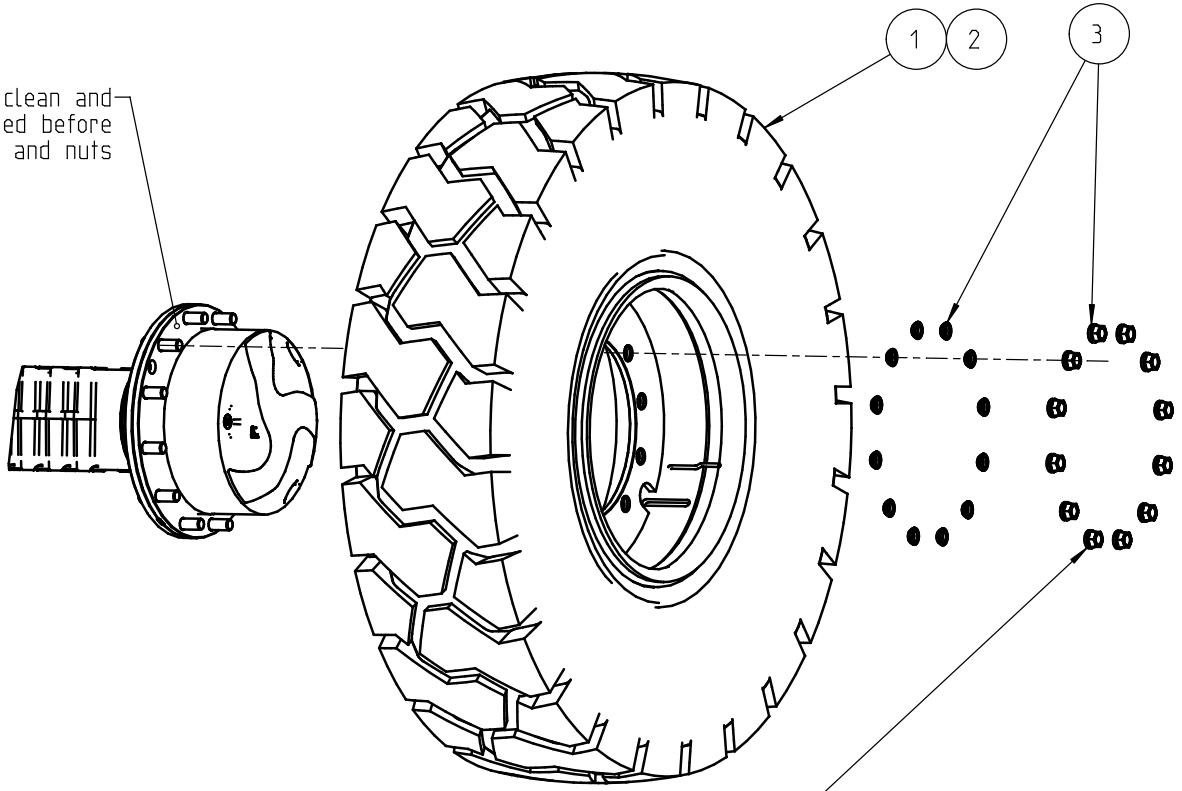
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Fam: .
2
Compare: .
Drawn: XTATBA/BES
Blank: .
Replaces: .
Org.owner: AVO
Std.chd: . Blk.wt: . kg Fin.wt: kg
Transferred from: .
Design chd: Prod.chd: Appd: Date: 89-08-08
Designation: 3128 0783 15
Sheet 1 ( 1 )

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Only for Atlas Copco Internal Use
Model name
Obj 5112330237
Rev 4
Ver 0




It is ESSENTIAL that the wheel nuts are tightened to the recommended torque and in the correct sequence.
The installation and tightening sequence for wheel nuts is in pairs on either side of the bolt pattern in a north, south, east, west sequence.
Never install and tighten bolts adjacent to each other in a clockwise or anti- clockwise sequence.

4
Note:

Wheel nuts to be tightening dry to 550 Nm (24x).

| Rev. | Ver. | Position | Modified from | Date | Mod.by | Chd.by | Appd.by | DN no. |
|---|---|---|---|---|---|---|---|---|
| 4 | 0 | - | Wheel nuts tightening torque upd., refer DN. | 2013-10-30 | UTX194 | UTTSPH | UTTSPF | TMG154955 |

| | | | | | |
|---|---|---|---|---|---|
| Tolerances. if not indicated. | Machined surfaces | - | - | - | - |
| according to AC-STD: | 1350 K - - | - | - | - | - |

Name **Drawing** Carrier of drill rigg
Material –
–
Secrecy class Internal AC-STD 1102 K/
Pro/E

| | | | | | |
|---|---|---|---|---|---|
| Scale 1:10 | Fam – | 3 | Compare – | Drg.owner. TMG | |
| Drawn UTUMK/TK | Blank – | – | Replaces – | | |
| Transferred from | Std.chd. – | Blk.wt. – kg | Fin.wt. 0.0 kg | Designation 5112330237 | Sheet 1(1) |
| | Design chd. – | Prod.chd. – | Appd. RA | Date 2009-01-08 | |

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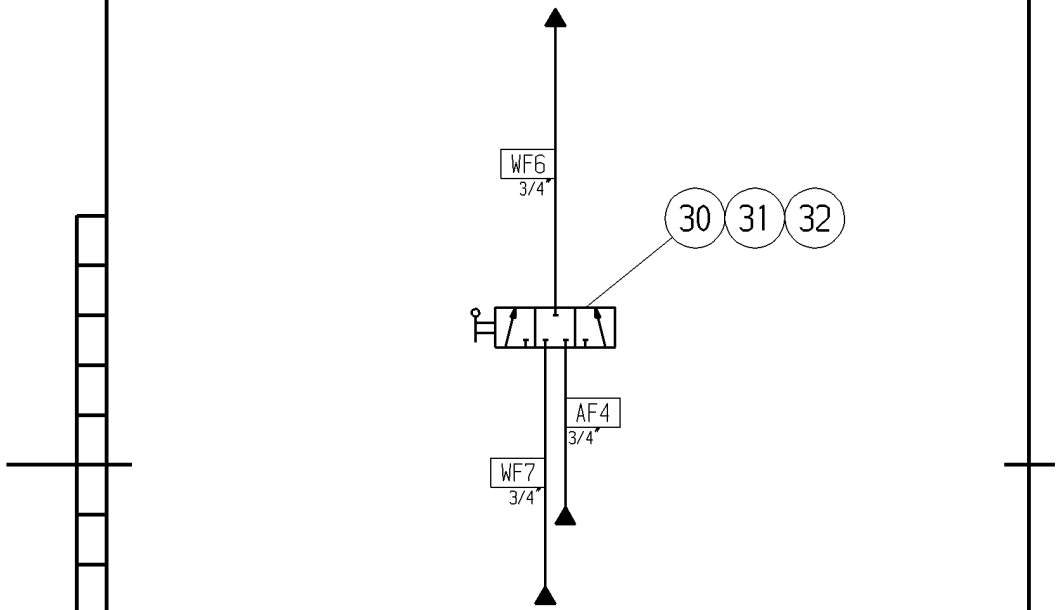


## Water Diagram

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| 9106078198 | WATER SCHEMATIC | WATER SCHEDULE | 139 |

| Note | Modified from | Date | Intr. | Note | Modified from | Date | Intr. |
|---|---|---|---|---|---|---|---|
| 1 | HOSE MARK WF ADDED AND CHANGED | 980911 | SK | . | . | . | . |




| Pos. | Designation | Number | Name | Material |
|---|---|---|---|---|
| | | | | |

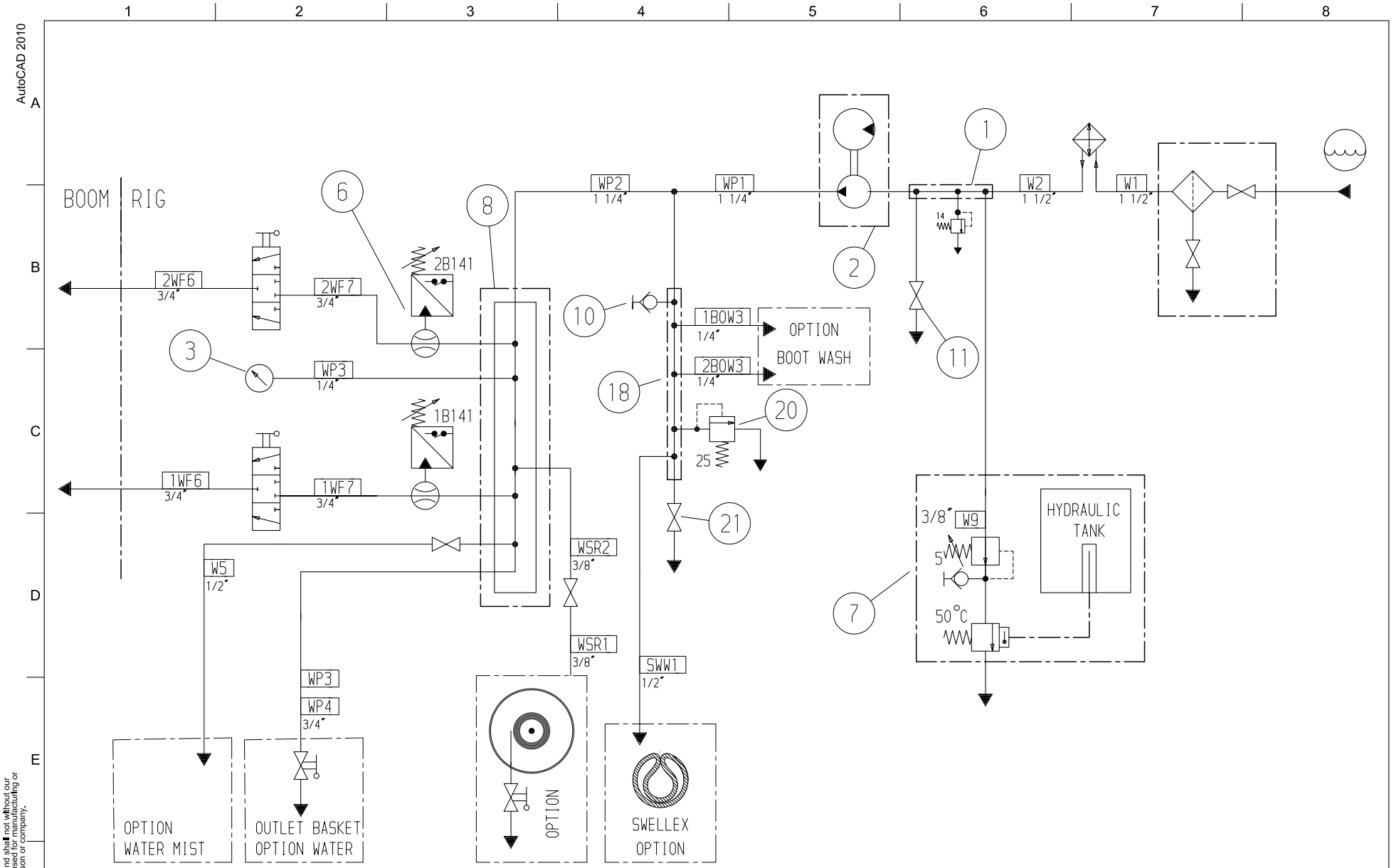
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|---|---|---|---|---|
| ATLAS COPCO STANDARD / Class | 1350 K / . | . | . | . |

| | | | | | |
|---|---|---|---|---|---|
| Name | WATER SCHEDULE | BVX-DCS | Secrecy class | | |
| Material | CONTROL PANEL | | 1102 K/ . | | |
| | DCS-1800 | | CAD | | |
| Scale . | Fam . | 4 | Compare . | Drg.owner. | |
| Drawn UTU13/BF | Blank . | . | Replaces . | TMG | |
| Transferred from | Blk.wt. . kg | Fin.wt. kg | Designation 9106 0779 31 | Sheet 1 ( 1 ) | |
| . | Appd. BF | Date 98-08-27 | | | |

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| Rev. | Pos. | Modified from | Date | Mod.by | Chd.by | Appd.by |
|---|---|---|---|---|---|---|
| 002 | | Pos No:20 added. TMG159744 | 2014-03-24 | lpcakf | tmgbfk | tmgjsh |

Name: WATER SCHEDULE
WATER SYSTEM

Atlas Copco

| | | | |
|---|---|---|---|
| Transf. fr. | Drawn AVOBFK | Approver | Type L/M2D A3 |
| Confidentiality class acc.1102 K Internal | Design chd. | Drawing owner TMG | Designation Sheet 1 ( 1 ) |
| Status Released | Date 2012-11-13 | Compare | 9106078198_DS |



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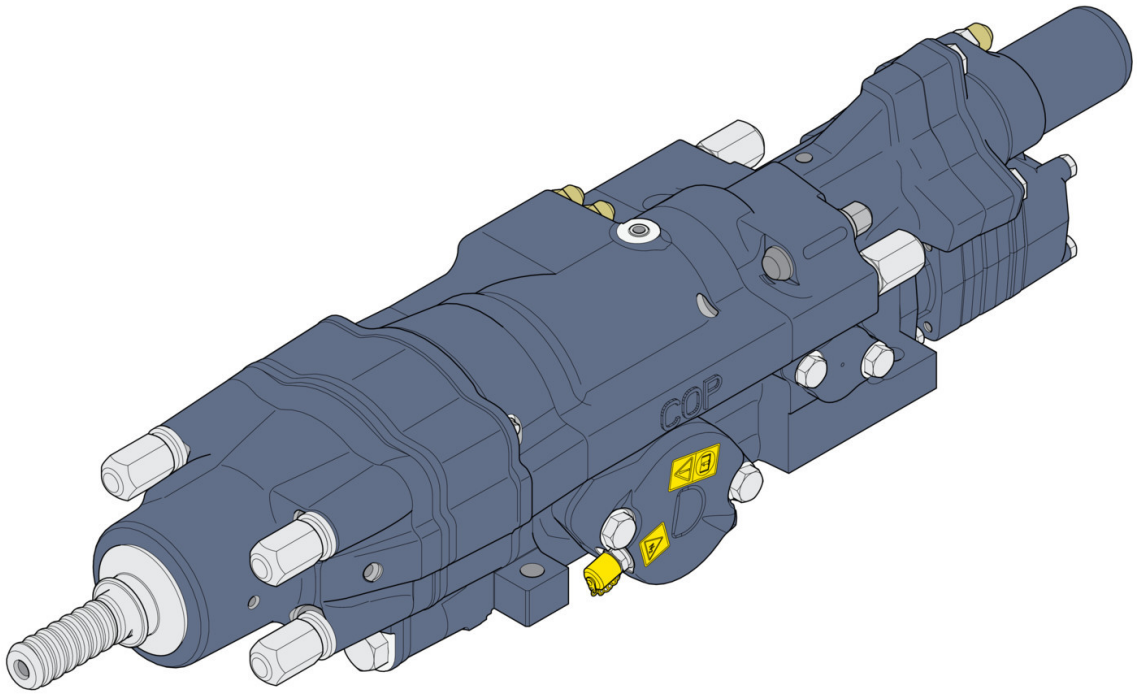
epiroc.com



Maintenance

# COP 1838HD+ Ver. F

## Hydraulic Rock Drill




**Original Instructions**
2021-10-18 | No: 9852 2943 01k. en-US

Epiroc

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# 1 Introduction

## 1.1 Safety first

**WARNING**

**Serious injury**

Risk of personal injury!

- Never operate the Rock Drill in any explosive environment.
- Always read the machine Safety Manual before start maintenance work on the Rock Drill.
- Always observe local regulations.
- Always let the Rock Drill to cool down before maintenance work.
- Always carry out a documented risk analysis and take the necessary precautions before maintenance work.
- Only use clean, calibrated tools in good condition.
- Only use approved handling and working equipment in good condition.
- Always use personal protective equipment.
- During maintenance work, the equipment should be shut down, in service mode, and the main switch turned off and locked.
- Attach WORK IN PROGRESS signs according to local regulations, or at least at the main switch and operator's station.

**WARNING**

**Serious injury or death**

Serious danger when working on the hydraulic system!

- Ensure that the air, water and hydraulic system is depressurised before starting work.
- Adjacent moving units should always be anchored before working on a system part.
- Always stop work if there is an unforeseen or suspected risk.

## 1.2 The Purpose of This Publication

The objective of these instructions is to detect and rectify faults at an early stage so that breakdowns, costly secondary damage and accidents can be prevented. Regular maintenance is a precondition for planning necessary interruptions in operation such as reconditioning and repairs. This allows work to be carried out when it's most suitable with regard to production instead of causing complete breakdown.

## 1.3 Target Group

> ***NOTE:*** *This instruction is an example of workflow during maintenance.*

The maintenance instructions are intended for use by maintenance and service personnel. Persons working to these instructions must have completed relevant Epiroc training for the Rock Drill.

## 1.4 Feedback and Contact Information

Epiroc works actively to develop and continuously improve its products and associated documentation. Provide your feedback on products and documentation by contacting your local supplier at http://www.epiroc.com, under 'CONTACT US'.

Epiroc values customer feedback and we do our best to promptly answer questions.

**Postal Address:**

Epiroc Rock Drills AB

SE-701 91 Örebro

Sweden

# 2 General Information

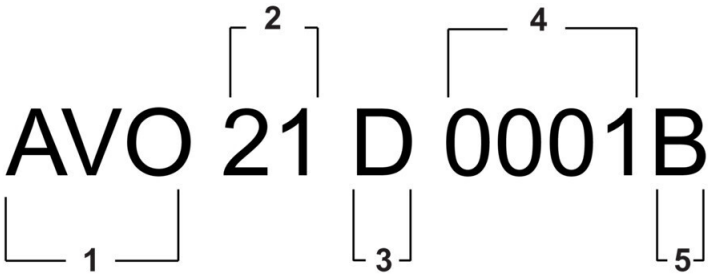
## 2.1 Component Replacement

Use original Epiroc Spare Parts to guarantee the safety and reliability of the rock drill function and design.

Use original Epiroc Rock Drills Overhaul Kits to optimize the performance and secure the availability of your rock drill.

## 2.2 Manufacturing Number

All Rock Drills are given a manufacturing number depending on place of Manufacture, Year, Family, and Version. The stamped manufacturing number location varies on the Rock Drill depending on the model.




1. Factory code for manufactured unit:
   AVO = Epiroc Rock Drills AB
2. Year that the product was produced.
3. Family letter that identifies the number series:
   D = Hydraulic Rock Drills
   P = Pneumatic Rock Drills
   T = Rotation Units
4. Serial number in the family group.
5. Version letter for the product, shows which Manual and Spare part list that is relevant.

## 2.3 Cleaning

### 2.3.1 Safety Precautions Before Cleaning

**WARNING**

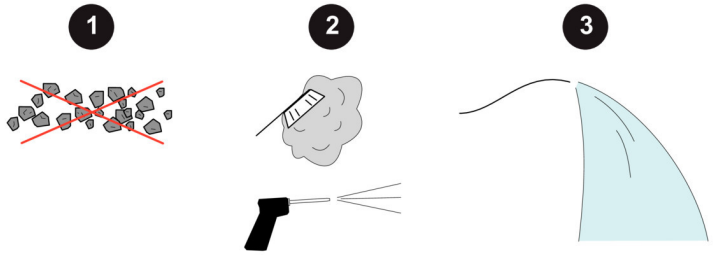
**Serious Injury**

Risk of personal injury

- Always read general safety regulations before starting maintenance work. Refer to Safety manual.
- Always turn off the equipment and the main switch before cleaning and maintenance work is carried out. Set up WORK IN PROGRESS warning signs at the main switch and control positions.
- Be aware of the units kinetic energy due to accumulated hydraulic pressure. Relieve pressure in hydraulic, water, and compressed air systems and always secure moving units.

### 2.3.2 Cleaning

1. Clean the Rock Drill frequently from rock fragments, drill cuttings and accumulations of dust.




2. Clear away fragments of rock and other objects from air, water and hydraulic hoses and cables frequently to avoid the risk of chafing on sharp edges.
3. Rinse the Rock Drill with water after every work shift. Use only rinsing pressure and avoid spraying directly at seals. Wipe away any accumulations of water.

## 2.4 Hydraulic Components

### 2.4.1 General

The hydraulic system is sensitive to contamination. The environment where the machine is normally used is generally an unsuitable place for repairing hydraulic components. Intervention in hydraulic systems in workplaces must be limited. Components must be repaired in an adapted environment, refer to Hydraulic Workshops.

Observe the following points to avoid breakdowns and interruptions in operation due to fouled hydraulic oil:

- Keep the machine clean. Hose it down at regular intervals using a degreasing additive.
- Before opening any connection, clean the area around it.
- Use clean tools and work with clean hands.
- Always plug hydraulic connections immediately after they have been detached. Use clean protective plugs.
- Hydraulic components like hoses, valves, engines must always be stored with suitable protective plugs fitted in place.

### 2.4.2 Hydraulic Workshops

Workshops that are used for the repair of hydraulic components must:

- Be separate from activities which generate dust and particles, such as welding, grinding, and transportation of machines.
- Have their own suitable washing equipment necessary for repairing the components.
- Use only tools from a hydraulic workshop consisting of standard and special tools.
- Have a ventilation system that does not allow dust into the premises.
- Use trained mechanics.

### 2.4.3 Hydraulic Hoses

**WARNING**

**Serious injury**

Risk of serious injury to the eyes, hands and skin.

▶ Never work on the lubrication system when it is pressurized. Lubrication air and oil may spray out.

▶ Never use hands or fingers to locate a leakage.

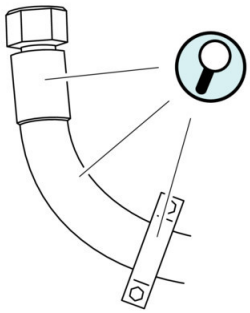
▶ Always use gloves and eye protection.

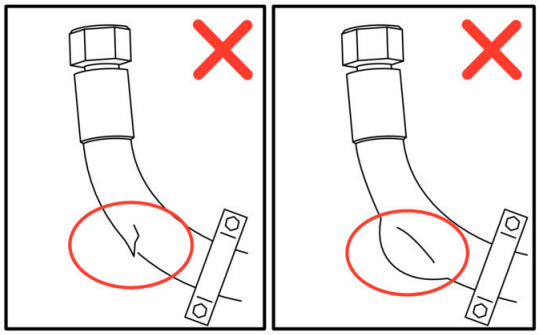
**WARNING**

**Serious Injury**

Risk of abrasions and crushing injuries.

▶ Always change damaged hoses and couplings.





- Wet areas around hoses and connections is a sign for leaks that can cause spurting oil or burst hoses if the leak worsens.
- The hose casing must be intact without any swelling (sign of inner hose or cord breakage).
- Couplings must not have indentations or cracks and must make a secure connection. Retighten or feel the coupling connection manually if a leak is suspected.
- Check that all hose attachments and clamps are intact. Loose attachments means that hoses are damaged or get jammed during angle adjustment or when lowering the machine.
- Replace or rectify in the event of any faults.

### 2.4.4 Hydraulic Hose Replacement

Hose requirements are according to ISO 4413:2010.

High pressure system with alternating pressure levels and high peaks.

Load, vibration, and other mechanical stresses place high demands on hydraulic hoses.

When replacing hydraulic hoses, check that they are replaced with hydraulic hoses:

- With the correct pressure rating according to rig manual
- With the correct crimped couplings
- Of the correct quality class
- Of the correct dimensions

Always make sure that hose couplings are clean, not damaged and properly tightened.

All pressurized hoses have pressed couplings and can therefore be purchased ready made from Epiroc. Grades and dimensions of hoses are specified in the spare part catalog for the machine in question.

## 2.5 Welding

- All welding on the Rock Drill is forbidden.

## 2.6 Prepare for Long Period of Storage or Marine Transportation

Action must be taken to protect the equipment from corrosion and storage damage if storage expected to last longer than three months or it will be exposed to marine environment.

- Wash the equipment and thoroughly wipe it dry. Use compressed air to blow any accumulated water out of cavities and pockets.
- Store the equipment in a temperature-, and humidity-controlled environment. Recommended storage environments maintain a temperature of 10-20 °C and max 20–50% humidity.
- Purge the flushing system with dry air. Add lubrication oil (COP Oil) to the air to protect against corrosion.
- Purge the lubrication system (ECL) with dry air. Add extra lubrication oil (COP Oil) and increase the number of lubrication pulses for (minimum) five minutes.
- Apply corrosive prevention compound to the shank adapter. Make sure that the area for flushing air and flushing water is also protected.
- Apply corrosive prevention compound to untreated machine surfaces.
- Clean old grease away from lubrication points to prevent residue buildup. Pump fresh grease into each lubrication nipple. Make sure that you use the correct quantity and type of grease for each point.

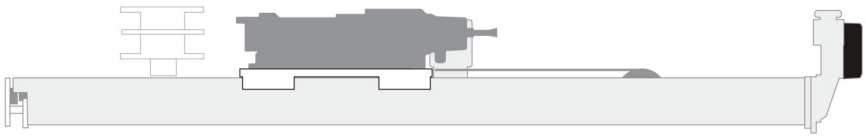
- Hoses and rubber parts can be packed in airtight plastic to reduce desiccation. Make sure that the components are dry before packing.

## 2.7 After Long Period of Storage

- Front Head, see chapter Front Head:
  - Remove the front head and the shank adapter.
  - Inspect the shank adapter for rust. If possible polish the rust away otherwise replace the shank adapter.
  - Inspect the cup seals, replace all damaged.
  - Inspect the impact piston surface and the rotation chuck bushing contact surfaces. If any visible damage, send the rock drill to Epiroc workshop for further inspection.
  - Lubricate the cup seals, grease the cup seal area on the shank adapter, and install the front head and the shank adapter.
- Accumulator, see chapter Accumulator:
  - Inspect and charge the accumulators.
- Lubrication, see chapter Lubrication:
  - Inspect the ECL-system. Clean / blow all nozzles and channels with compressed air. Make sure that the ECL-system is not blocked.

# 3 Service Positioning

1. Position the rock drill in a service position that enables a safe working environment.
2. Position the feed beam horizontal to make sure that the rock drill does not slip or tilt during service.



*Schematic picture*

# 4 Maintenance Tables

Overhaul period may vary based on local condition. Maintenance should be carried out at appropriate time intervals based on local conditions. The condition of the rock has a major affect on the amount wear and need of servicing the rock drill.

Epiroc Rock Drills Overhaul Kits are designed to optimize the performance and service life of the rock drill. Use original Epiroc Rock Drills Overhaul Kits when overhauling your rock drill. Information about the overhaul kits and part numbers are available in the spare parts catalog for each rock drill.

## 4.1 New or Overhauled Rock Drill

| Maintenance Task | | Work Shift First Service |
|---|---|---|
| 6.1 | Connect Hoses | Before |
| 9.8 | Charge Accumulators | Before |
| 12.2 | Check Rock Drill Lubricant Oil (ECL) | Before |
| 12.3 | Lubricate Gear Housing | Before |
| 13.1 | Set ECL Lubrication System | Before |
| 13.2 | Set Damper Pressure Idling | Before |
| 13.5 | Check Rotation Direction | Before |
| 13.6 | Set Rotation Speed | Before |
| 12.4 | Check Air Lubrication Oil | During |
| 8.1 | Tighten All Threaded Unions | After |
| 8.2 | Tighten Nipples | After |
| 8.3 | Re-tighten Side Bolts | After |

## 4.2 Work Shift

| Maintenance Task | | Work Shift |
|---|---|---|
| 11.7 | Inspect Shank Adapter Threads | Before |
| 13.2 | Set Damper Pressure Idling | Before |
| 6.2 | Check Hydraulic Hoses | During |
| 11.8 | Check for Leaks During Drilling | During |
| 12.4 | Check Air Lubrication Oil | During |
| 13.3 | Check Damper Pressure During Drilling | During |

## 4.3 Percussion Hours

| Maintenance Task | | Percussion Hours |
|---|---|---|
| 8.1 | Tighten All Threaded Unions | 40 |
| 8.2 | Tighten Nipples | 40 |
| 8.3 | Re-tighten Side Bolts | 40 |
| 9.1 | Check Accumulator Warning Signs | 40 |
| 9.2 | Check Accumulator Pressure | 40 |
| 12.3 | Lubricate Gear Housing | 40 |
| 14.2 | Remove Rock Drill for Overhaul | 600 |

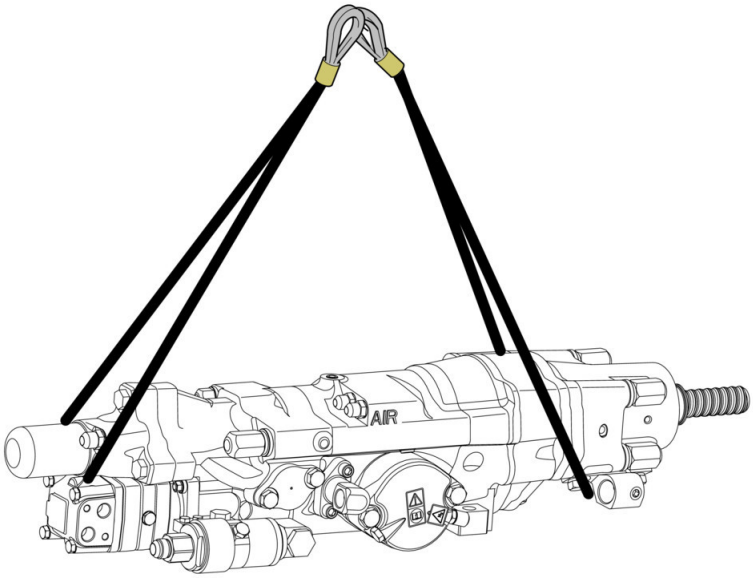
# 5 Lift Rock Drill

**WARNING**

**Risk of Lifting the Rock Drill**

Incorrect handling can cause serious crushing injury or death.

- Use extreme caution when strapping and lifting heavy objects.
- Lifting must be done through the center of gravity.
- Only use straps that are intact and designed for the load they will carry.
- Do not approach a suspended load.




1. Attach the two straps to the intended lifting points according to the figure.
2. Lift the Rock Drill carefully through the center of gravity. Make sure the Rock Drill is balanced and the two straps do not slip.

| Rock Drill | Weight |
|---|---|
| COP 1838HD+ Ver. F | 185 kg (408 lbs) |

# 6 Hose Connections

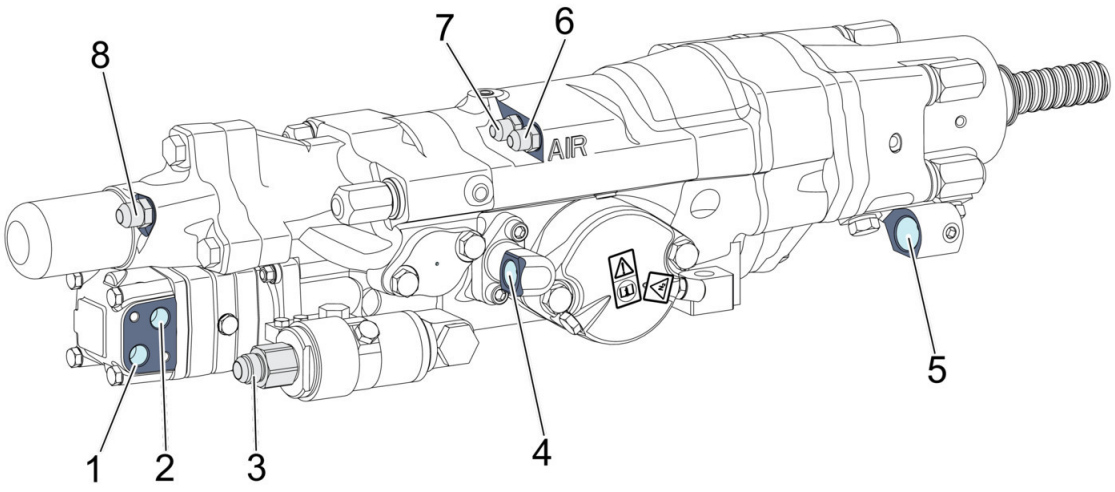
## 6.1 Connect Hoses

**WARNING**

**Pressurized Systems**

Can cause serious injury to eyes and skin.

- Always de-pressurize hydraulic, lubrication, and flushing system before any maintenance work.
- High pressure system with alternating pressure levels and high peaks.
- Never replace new hoses with hoses of lower grade or quality.
- Always use gloves and eye protection.
- Never use hands or fingers to locate a leakage.




| | |
|---|---|
| 1 | Rotation intake (RRL) |
| 2 | Rotation return (RRR) |
| 3 | Percussion, return (HT) |
| 4 | Percussion, intake (HP) |
| 5 | Flushing (F) |
| 6 | Lubricating air (ECL)* |
| 7 | Damper, intake (HDP) |
| 8 | Percussion drainage (HD) |

Precondition ✓ Always clean the rock drills hose connections before removing the protective caps.

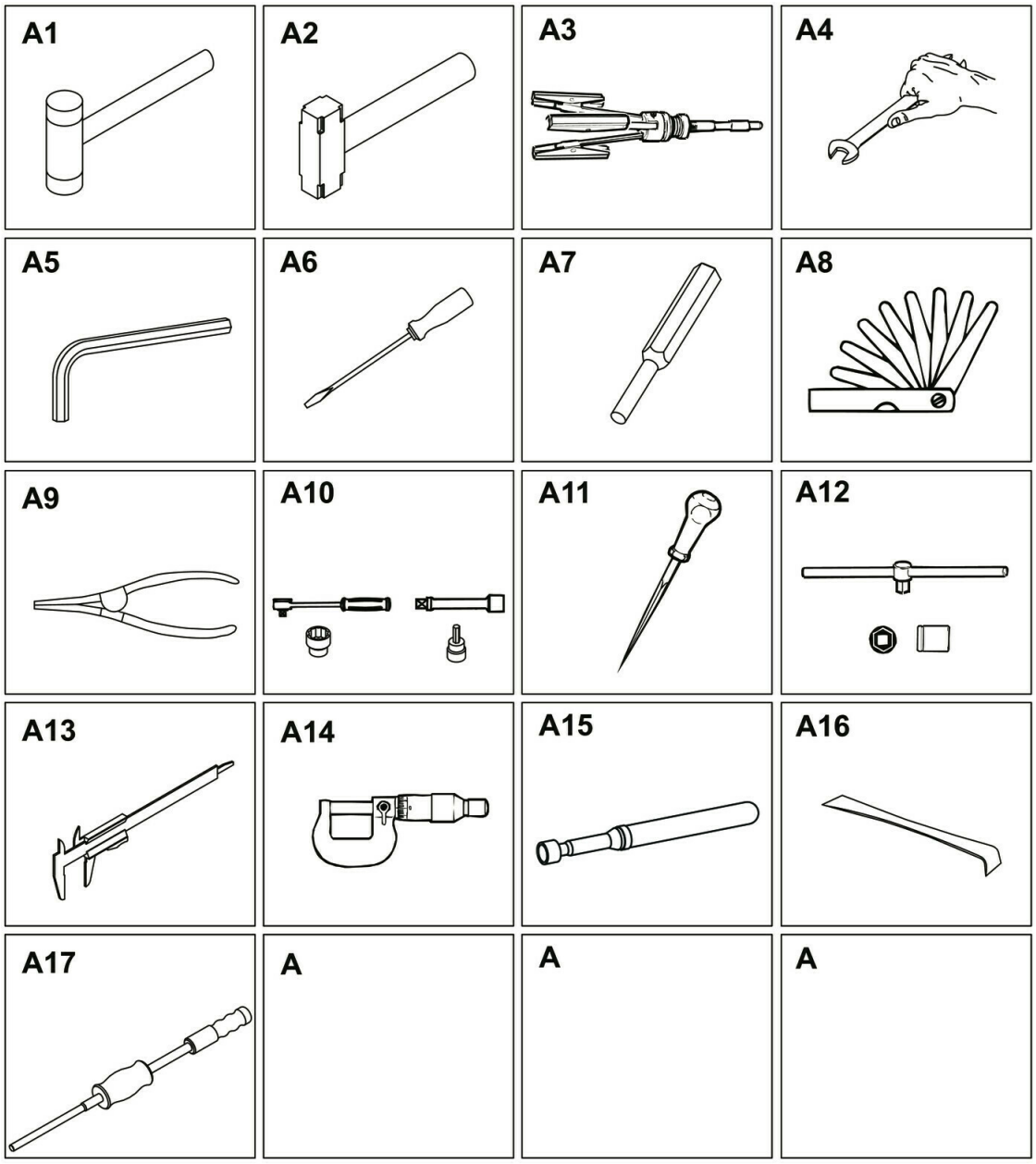
- *Cut the inner tube so it ends inside the hose, see chapter Lubrication.

## 6.2 Check Hydraulic Hoses

- If the hydraulic hoses vibrates hard, check the accumulator pressure. See chapter Accumulators.

# 7 Tools

## 7.1 Standard Tools

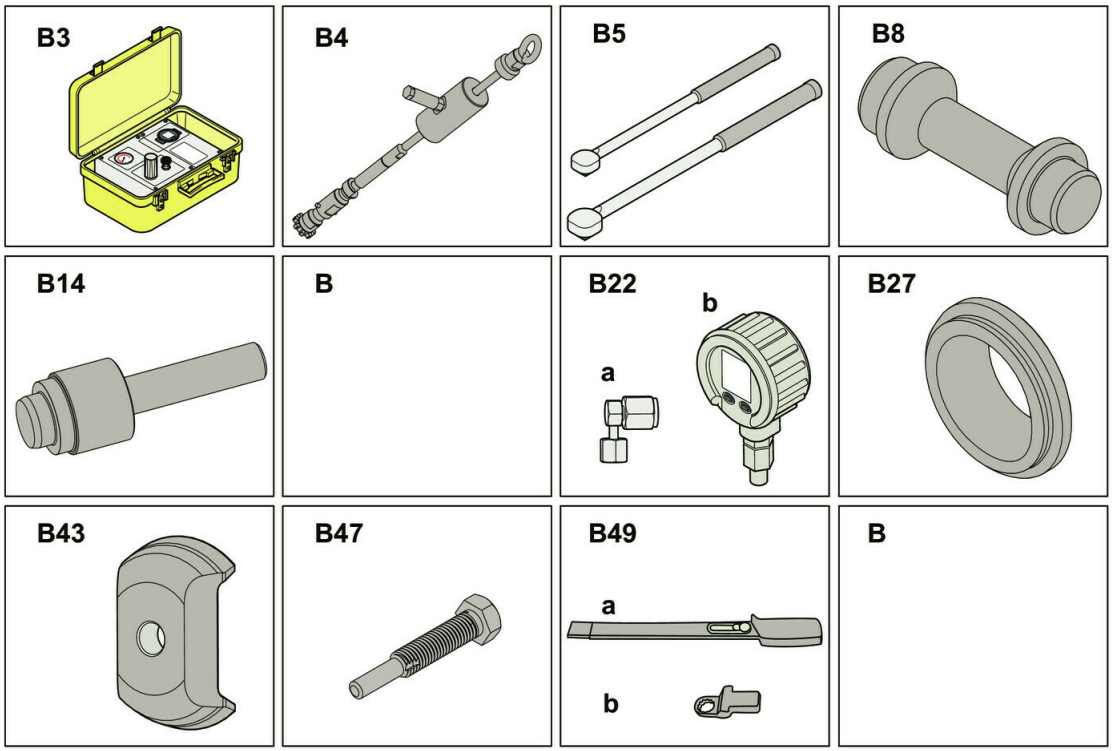



Standard tools

| Ref. No. | Tools |
|---|---|
| A1 | Plastic mallet |
| A2 | Sledge hammer |
| A3 | Honing tool 19–70 mm |
| A4 | Open-end wrenches 10–32 mm, 46 mm |

| Ref. No. | Tools |
|---|---|
| A5 | Allen keys 4–10 mm |
| A6 | Screwdriver |
| A7 | Mandrel 2–10 mm, brass mandrel 20x250 mm |
| A8 | Feeler gauge 0.05-1.00 mm with 0.05-mm intervals |
| A9 | Internal lock ring pliers |
| A10 | Socket wrench set 10–32 mm for external hexagon<br>Socket wrench set 4–10 mm for internal hexagon |
| A11 | Small pointed tool |
| A12 | T-handle with 3/4" connection bracket, power socket 32 mm |
| A13 | Vernier caliper |
| A14 | Micrometer 0-25 mm |
| A15 | Magnet |
| A16 | Pry bar |
| A17 | Slide hammer |

## 7.2 Special Tools



Special tools

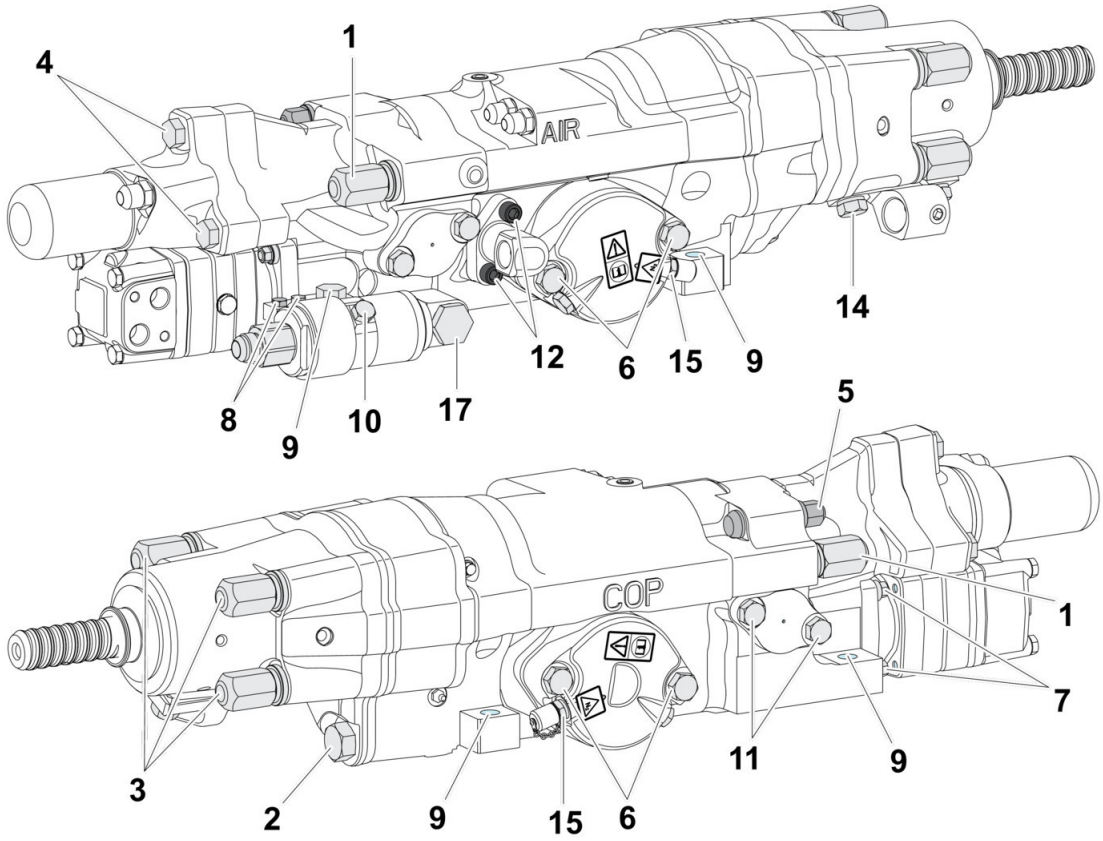
| Ref. No. | Tools | Part Number |
|---|---|---|
| B3 | Charging device | 3115 6001 92 |
| B4 | Disassembly tool | 3115 2724 80 |
| B5 | ½" Torque wrench, torque range 20–100 Nm<br>½" Torque wrench, torque range 80–420 Nm | 9106 1015 40<br>9106 1015 41 |
| B8 | Mandrel | 3115 1019 00 |
| B14 | Mandrel | 3115 0314 00 |
| B22a<br>B22b | Adapter, discharging accumulators<br>Pressure gauge | 3115 5748 00<br>3115 3799 80 |
| B27 | Mandrel | 3115 1899 00 |
| B43 | Disassembly tool | 3115 5255 00 |
| B47 | Extractor tool | 3115 3804 00 |
| B49a+b<br>B49b | Torque Wrench incl. 3 sockets<br>Socket 13 mm<br>Socket 15 mm<br>Socket 18 mm | 3115 6010 08<br>3115 6010 10<br>3115 6010 11<br>3115 6010 12 |

# 8 Tightening Torques

## 8.1 Tighten All Threaded Unions

**A calibrated torque wrench must be used for tightening.**

**Always tighten the side bolts and front side bolts in numerical order as in shown in the table (ref. no. 1, 2 and 3).**




Torque

| Ref. No. | Quantity | Check Point | Torque Nm | Lubricant | Instructions |
|---|---|---|---|---|---|
| 1 | 2 | Side bolts | 300 Nm (221 lbf-ft) | Anti-seize paste | Tighten the screws alternately to full torque.<br>Re-tightening, see instruction Re-tighten Side Bolts |
| 2 | 1 | Front bolt | 300 Nm (221 lbf-ft) | Anti-seize paste | Tighten the dome nuts alternately to full torque<br>Re-tightening, see instruction Re-tighten Side Bolts |
| 3 | 4 | Front studs | 350 Nm (221 lbf-ft) | Anti-seize paste | Tighten the dome nuts alternately to full torque |

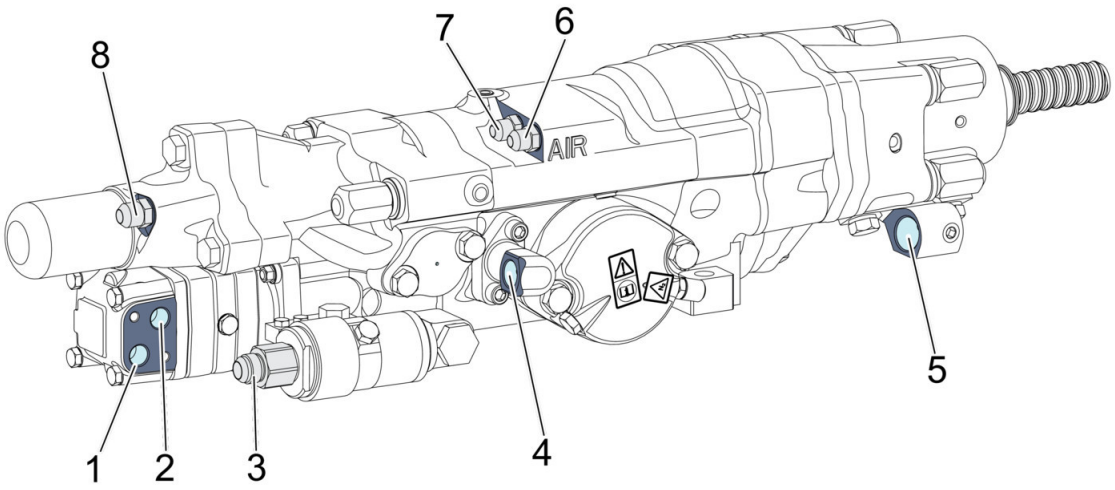
| Ref. No. | Quantity | Check Point | Torque Nm | Lubricant | Instructions |
|---|---|---|---|---|---|
| | | | | | Re-tightening, see instruction Re-tighten Side Bolts |
| 4 | 3 | Back head | 220 Nm (162 lbf-ft) | Oil | Tighten the nuts alternately to full torque, **top bolt last** |
| 5 | 1 | Regulating plug | 80 Nm (59 lbf-ft) | Oil | |
| 6 | 4 | Accumulators | 220 Nm (162 lbf-ft) | Oil | Tighten the screws alternately to full torque |
| 7 | 4 | Hydraulic motor | 65 Nm (48 lbf-ft) | Oil | Tighten the screws alternately |
| 8 | 2 | Clamping bracket, return accumulator | 30 Nm (21 lbf-ft) | Oil | |
| 9 | 4 | Rock Drill attachment (Steel Cradle) | 250 Nm (185 lbf-ft) | Oil | Tighten the screws alternately to full torque |
| 9 | 4 | Rock Drill attachment (Aluminum Cradle) | 180 Nm (133 lbf-ft) | Oil | Tighten the screws alternately to full torque |
| 10 | 1 | Plug, return accumulator | 30 Nm (21 lbf-ft) | Oil | |
| 11 | 4 | Valve covers | 145 Nm (107 lbf-ft) | Oil | Tighten the screws alternately to full torque |
| 12 | 2 | Connecting plate | 120 Nm (88 lbf-ft) | Oil | Tighten the screws alternately to full torque |
| 14 | 2 | Connecting plate, bolts | 220 Nm (162 lbf-ft) | Oil | |
| 15 | 2 | Filler nipple, accumulator | 45 Nm (33 lbf-ft) | Oil | |
| 16 | 2 | Plug, accumulator | 30 Nm (21 lbf-ft) | Oil | |
| 17 | 1 | Banjo bolt, return accumulator | 170 Nm (125 lbf-ft) | Oil | |

| Recommended Oil |
|---|
| Hydraulic oil or Motor oil |

| Recommended Anti-Seize Paste |
|---|
| Loctite LB 8009 or corresponding thread lubricant |

## 8.2 Tighten Nipples

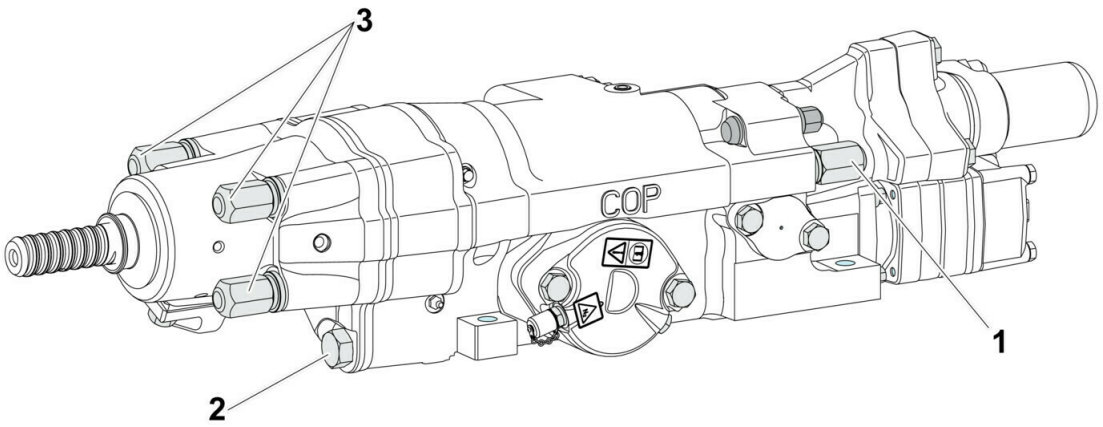
**A calibrated torque wrench must be used for tightening.**




Torque

| Ref. No. | Definition | Check Point | Torque Nm | Instructions |
|---|---|---|---|---|
| 1 | RRL | Rotation, intake | 85 Nm (63 lbf-ft) | |
| 2 | RRR | Rotation, return | 85 Nm (63 lbf-ft) | |
| 3 | HT | Percussion, return | 170 Nm (125 lbf-ft) | |
| 4 | HP | Percussion, intake | 170 Nm (125 lbf-ft) | |
| 5 | F | Flushing | 300 Nm (221 lbf-ft) | |
| 6 | ECL | Lubrication air | 70 Nm (52 lbf-ft) | |
| 7 | HDP | Damper, Intake | 70 Nm (52 lbf-ft) | |
| 8 | HD | Percussion, drain | 70 Nm (52 lbf-ft) | |

## 8.3 Re-tighten Side Bolts



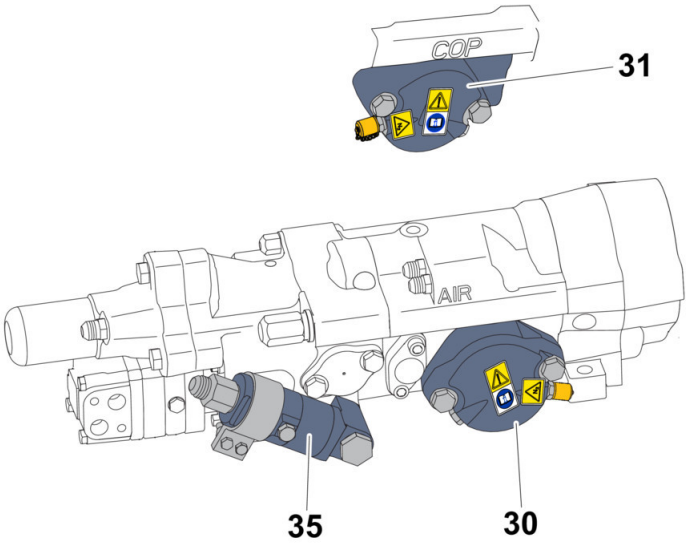
Precondition ✓ A calibrated torque wrench must be used for tightening.

1. Undo the front nuts (3) and side bolt (2) to release tension.
2. Release the rear dome nuts (1) one-quarter turn.
3. Check the side bolts, nuts or washers for cracks, scratches or rust. Replace damaged side bolts, nuts, and washers.
4. Lubricate threads and contact surfaces of the side bolt (2), nuts, and washers with anti-seize paste.
5. Ensure that the front nuts (3) not are in contact with the washers or front head, as it affects the torque on the rear nuts.
6. Tighten the side bolts rear dome nuts (1) alternately to 300 Nm (221 lbf-ft).
7. Tighten the front side bolt (2) to 300 Nm (221 lbf-ft).
8. Tighten the front nuts (3) alternately to 350 Nm (221 lbf-ft).

| Recommended Anti-Seize Paste |
| --- |
| Loctite LB 8009 or corresponding thread lubricant |

# 9 Accumulators

## 9.1 Check Accumulator Warning Signs




1. Check signs for correct location, clean, and fully legible on the machine, replace damage signs.

   Warning signs

| Symbol | Description |
|---|---|
|  | **Warning sign**<br>• Read the instruction manual thoroughly before performing service or replacement |
|  | **Warning sign**<br>• Charge only with nitrogen gas |

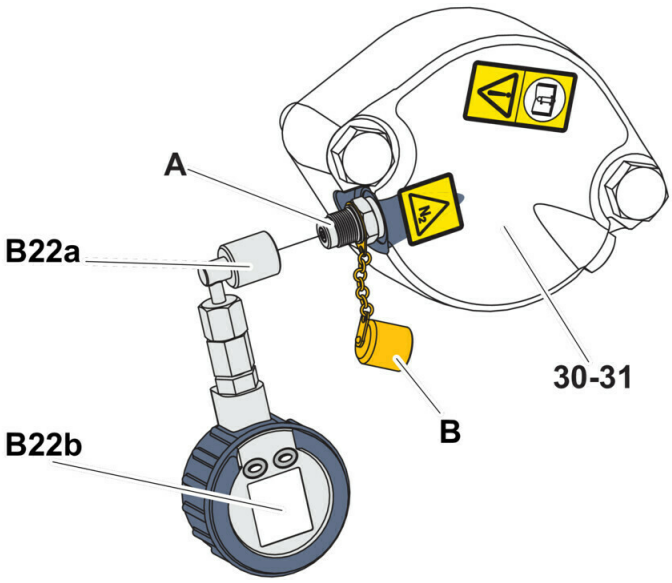
## 9.2 Check Accumulator Pressure

**WARNING**

**Explosion Risk**

Usage of wrong gas causes risk of personal injury or death.

▶ Only use dry nitrogen (N2).



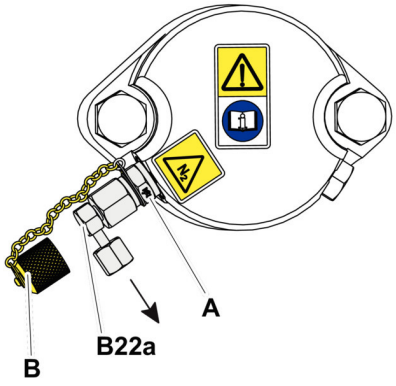

1. Remove the accumulators charging valve (A) protective cap (B).
2. Install the pressure gauge (B22b) with adapter (B22a) to the charging valve (A), use manual force when tighten.
3. Read the pressure gauge and check the values for correct accumulator pressure.
   a. Damper accumulator (31): 20–25 bar.
   b. Intake accumulator (30) **Recommended Base setting**: 90 bar. **Max setting** 100 bar.

> ! ***NOTE:*** *Intake accumulator (30): 30–40 bar under collaring pressure, max. 100 bar.*

4. Remove the pressure gauge (B22b) with adapter (B22a).
5. Charge the accumulators with nitrogen gas ($N_2$) if necessary. See chapter Charge Accumulators.
6. Install the charging valves (A) protective cap (B), use manual force when tighten.

## 9.3 Discharge Accumulator

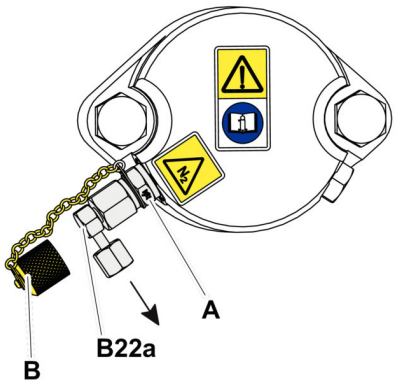
1. Remove the charging valves (A) protective cap (B).



2. Aim the connection adapter (B22a) so there is no risk for personal injury when the gas is released.
3. Tighten the connection adapter to the charging valve to release the nitrogen gas ($N_2$) from the accumulator.
4. Remove the connection adapter (B22a) and install the charging valve protective cap (B).

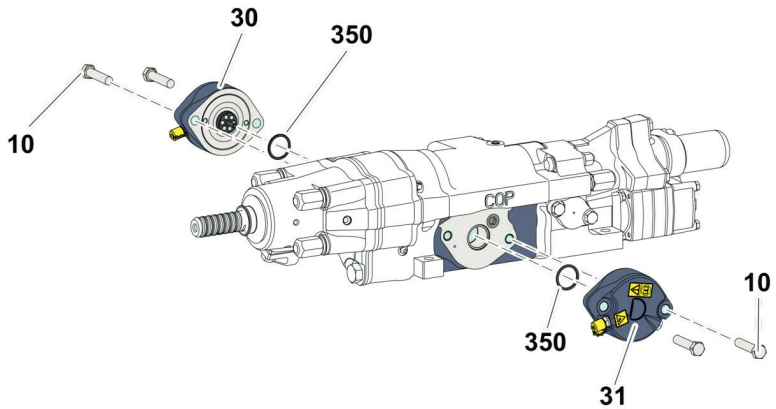
## 9.4 Remove Intake and Damper Accumulators

1. Remove the charging valve (A) protective cap (B).




   a. Aim the connection adapter (B22a) so there is no risk for personal injury when the gas is released.
   b. Tighten the connection adapter (B22a) to the charging valve to release the nitrogen gas ($N_2$).
   c. Remove the connection adapter (B22a) and install the protective cap (B).

2. Undo the screws (10) and remove the accumulators (30,31) with seal rings (350).

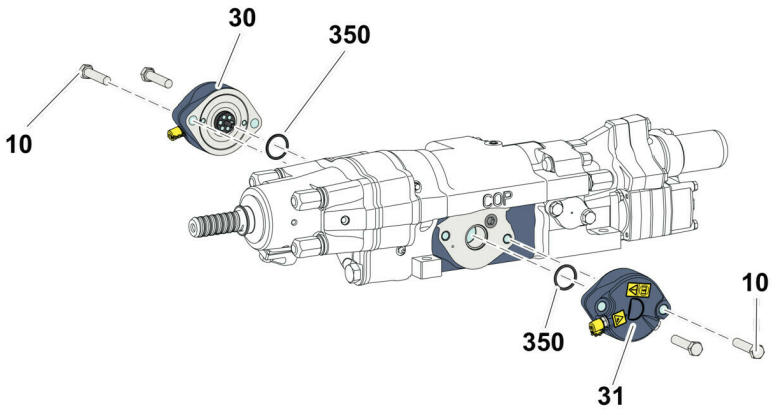



| ! | ***NOTE:** Always replace both the accumulator screws (10) if the accumulator diaphragm has broken and the gas has leaked out.* |
|---|---|

## 9.5 Install Intake and Damper Accumulators

Precondition ✓ All parts must be clean, dry, and free of oil before installation.

1. Position the seal rings (350) in the grooves on the intermediate segment (302).




a. Apply oil on two undamaged original accumulator screws (10) with correct length.

> ! ***NOTE:*** *Each accumulator must have screws of the correct length. Always replace bolts in pairs, even if only one bolt is corroded or otherwise damaged.*

b. Install the intake accumulator (30) on the right-hand side of the rock drill.

c. Tighten the screws alternately to 220 Nm (162 lbf-ft).

d. Apply oil on two undamaged original accumulator screws (10) with correct length.

> ! ***NOTE:*** *Each accumulator must have screws of the correct length. Always replace bolts in pairs, even if only one bolt is corroded or otherwise damaged.*

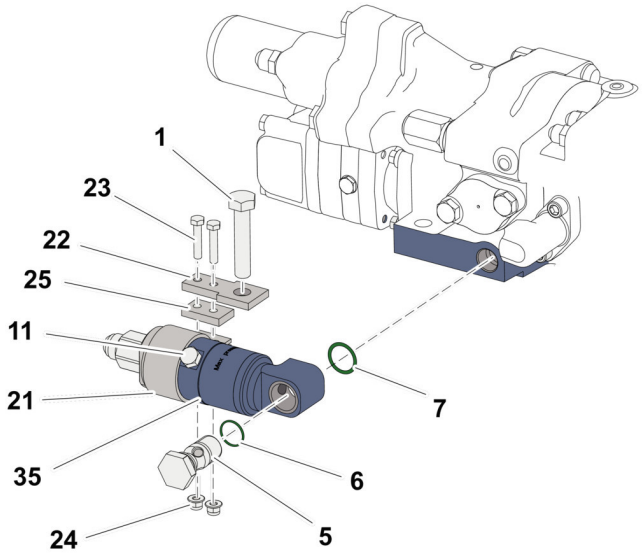
e. Install the damper accumulator (31) with two undamaged original screws (10) on the left-hand side of the rock drill.

f. Tighten the screws alternately to 220 Nm (162 lbf-ft).

| **Recommended Oil** |
| --- |
| Hydraulic oil or Motor oil |

## 9.6 Remove Return Accumulator

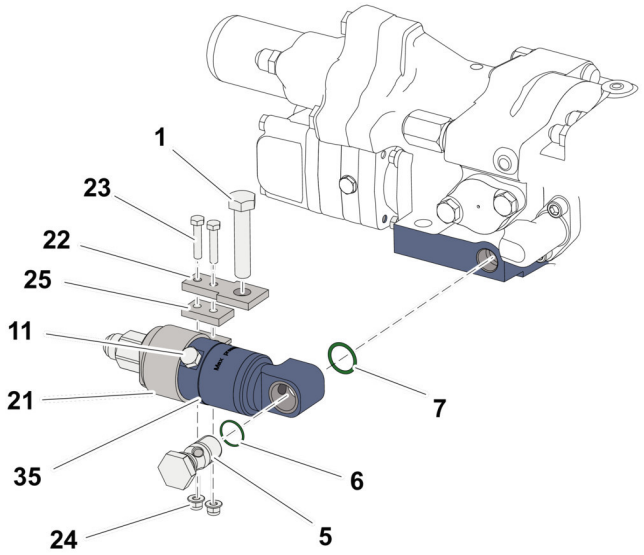
1. Mark and remove the hydraulic hose from the return accumulator (35).




2. Remove the return accumulator (35) by removing the nuts (24), the bolts (23), the bolt (1), the holder (22), and the pressure screw (5).
3. Open up the clip (21) and remove the accumulator.

## 9.7 Install Return Accumulator

1. Install the pressure screw (5) with o-ring (6) to the return accumulator (35).




2. Install the o-ring (7) in the groove on the pressure screw (5).

3. Install the return accumulator (35) with pressure screw (5) and o-rings (6, 7) loosely to the cylinder. Do not to damage the o-ring (7) during installation.

> ***NOTE:*** *Make sure that the plug (11) remains accessible for checking the accumulator diaphragm.*

4. Thread on the clamp (21) and install the holder (22) with the bolts (1, 23) and nuts (24).
   a. Tighten the bolt (23) to 30 Nm (21 lbf-ft).
5. Tighten the bolt (1) to
   a. Steel Cradle: 250 Nm (185 lbf-ft).
   b. Aluminum Cradle: 180 Nm (133 lbf-ft).
6. Tighten the pressure screw (5) to 170 Nm (125 lbf-ft).

## 9.8 Charge Accumulators

**WARNING**

**Explosion Risk**

Usage of wrong gas causes risk of personal injury or death.

▶ Only use dry nitrogen (N2).

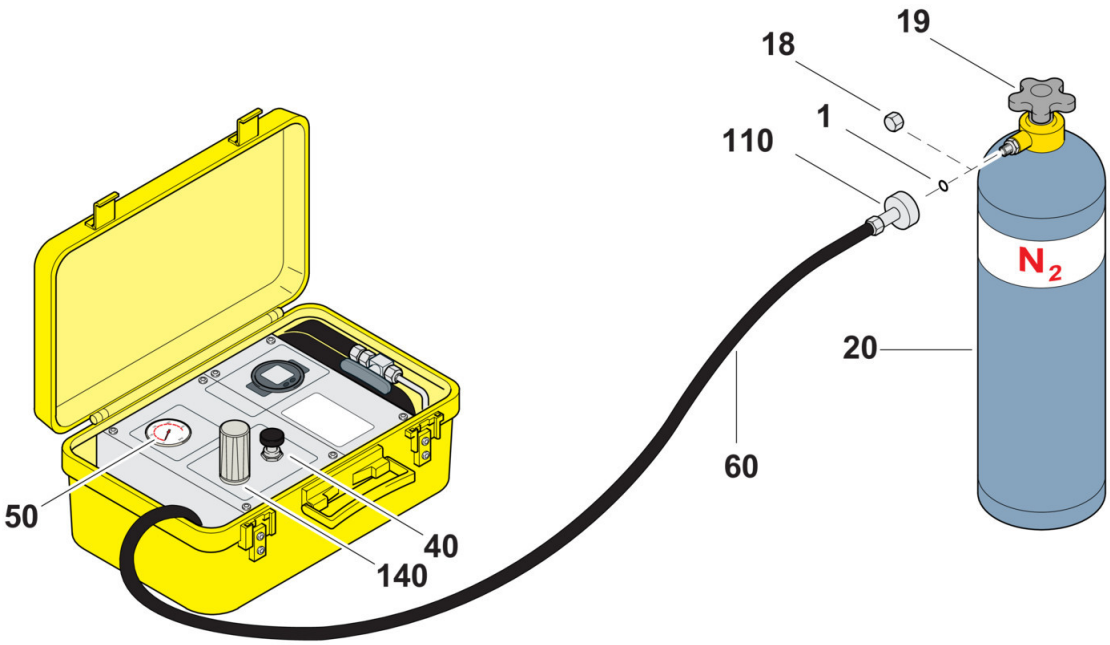
### 9.8.1 Connect Accumulator Charger to Gas Cylinder

**WARNING**

**Explosion Risk**

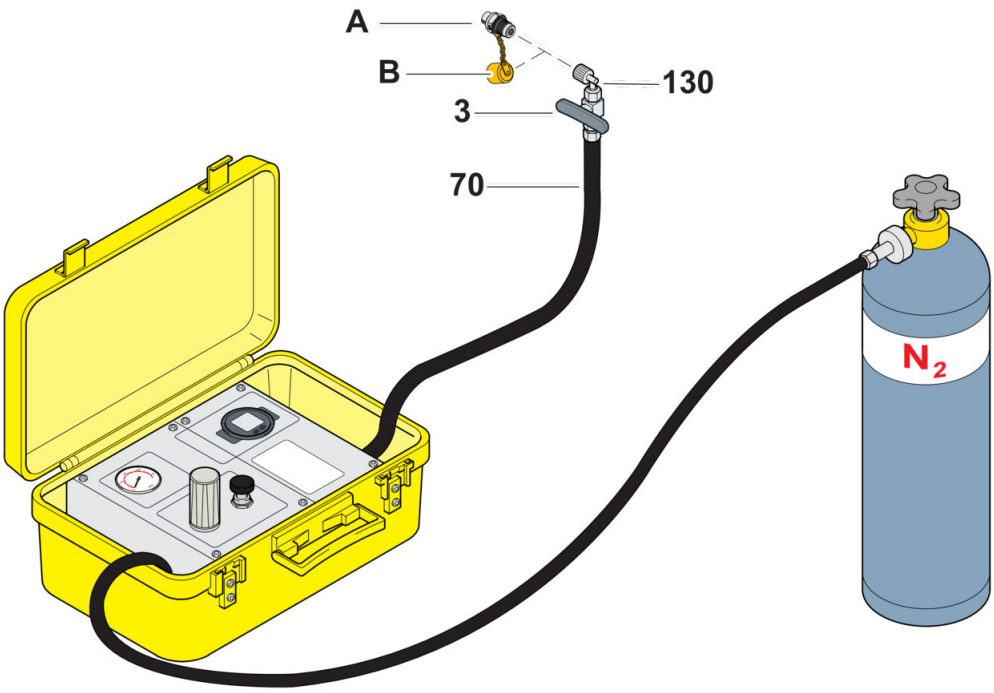
Usage of wrong gas causes risk of personal injury or death.

▶ Only use dry nitrogen (N2).



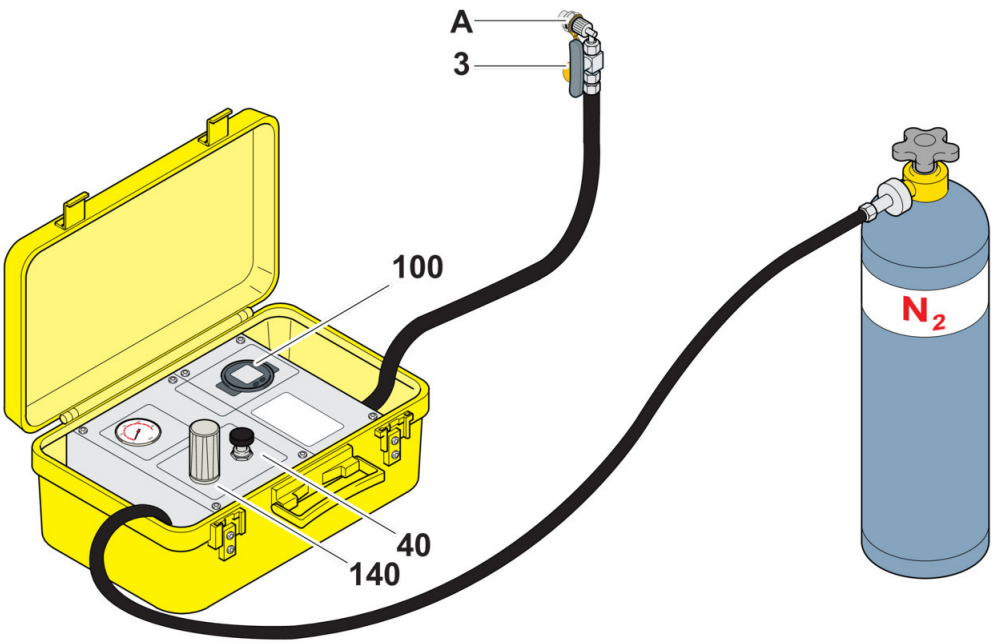

1. Check that the gas cylinder (20) contains Nitrogen ($N_2$) gas.
2. Secure the gas cylinder (20) so that it cannot fall over and cause damage.
3. Check that the gas cylinder valve (19) is closed.
4. Remove protective nut (18) from the gas cylinder valve and check that the gas cylinder valve threads are undamaged and clean.
5. Check that the bottle connection (110) and the o-ring (1) are undamaged and clean.
6. Connect the hose connection (110) to the gas cylinder valve (19) hand tight. Check that the hose (60) is not twisted or stretched.
7. Check that the pressure regulator (140) is closed.
8. Check that the needle valve (40) is closed.
9. Open the gas cylinder valve (19) slowly by turning it counterclockwise and check that the high-pressure gauge (50) shows full pressure reading.

### 9.8.2 Connect Accumulator Charger to Accumulator



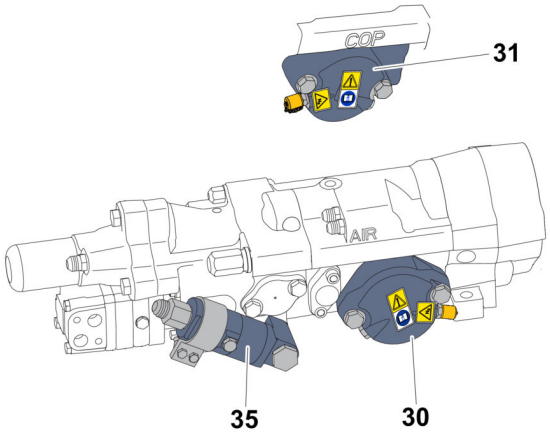

1. Remove the protective cap (B) from the accumulator valve (A).
2. Check that the threads of the accumulator valve (A) are undamaged and clean.
3. Close the ball valve (3) by turning it clockwise.
4. Connect the hose connection (130) to the accumulator valve (A) hand tight. Check that the hose (70) is not twisted or stretched.

### 9.8.3 Charge Accumulator



> ***NOTE:*** *Charge the accumulator in normal room temperature.*
>
> ***NOTE:*** *If the gas cylinder or rock drill are at a considerable lower temperature (approx. -5°C) the charging should be checked and re-done after reaching working temperature.*

1. Turn on the manometer (100).
2. Open hose valve (3) by turning it counterclockwise.
3. Charge the accumulators to the correct pressure as follows:




   a. Return accumulator (35) **DO NOT charge with N2!**

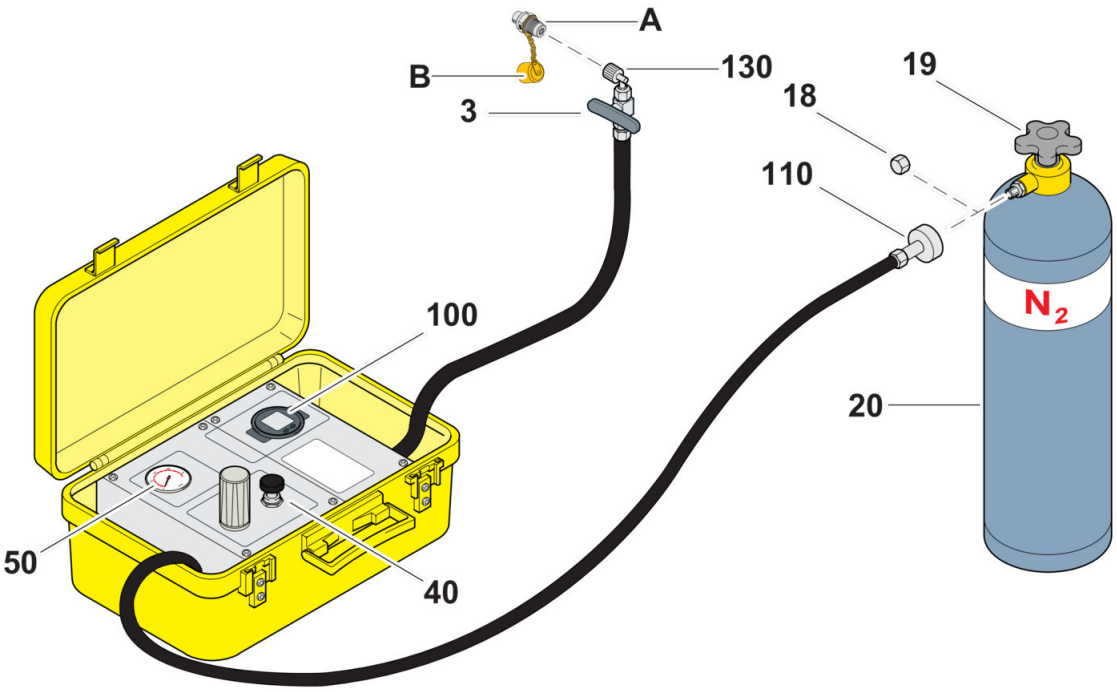
   b. Intake accumulator (30) **Recommended Base setting:** 90 **bar. Max setting** 100 **bar.**

   > ***NOTE:*** *Charge intake accumulator (30): 30–40 bar under collaring pressure, max. 100 bar.*

   c. Damper accumulator (31)**:** 20–25 **bar.**

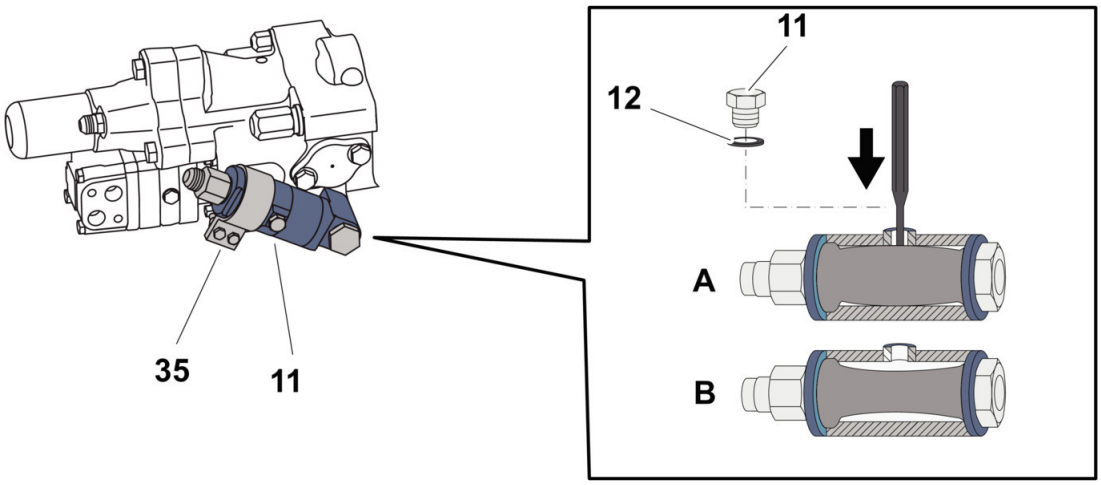
4. Open the pressure regulator (140) slowly by turning the knob clockwise while monitoring the manometer (100) until correct filling pressure is achieved.
5. Close the hose valve (3) by turning it clockwise.

### 9.8.4 Disconnect Accumulator Charger




1. Check that ball valve (3) is closed.
2. Close the gas cylinder valve (19).
3. Open needle valve (40) to evacuate the gas, check that the manometers (50) and (100) drops to 0.
4. Disconnect hose connection (130) from the accumulator valve (A).
5. Install protection cap (B) on the accumulator valve (A).
6. Disconnect hose connection (110) from the gas cylinder valve (19).
7. Install protection cap (18) in the gas cylinder valve (19).
8. Transport the gas cylinder (20) to the designated location and secure it.

### 9.8.5 Charge Return Accumulator




1. Place the rock drill horizontally, remove the plug (11) with o-ring (12). If oil escapes, then the diaphragm is damaged or the accumulator has been overcharged.
2. Replace the accumulator diaphragm and the plug (11) if they are damaged.
3. If the diaphragm lies against the outer tube:
   a. Press on the diaphragm with a mandrel (7–9 mm) See figure A
   b. The correct position of the diaphragm is: See figure B.
4. Charge the accumulator by admitting air at atmospheric pressure into the accumulator.
5. Reinstall the plug (11) with o-ring (12).
   a. Tighten the plug to 30 Nm (21 lbf-ft).

# 10 Hydraulic Motor

## 10.1 Remove Hydraulic Motor

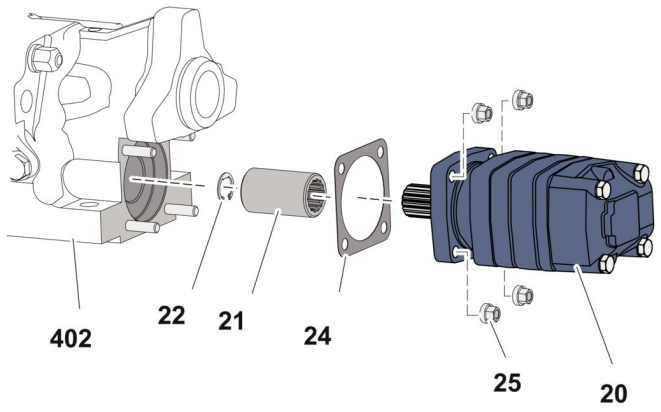
**WARNING**

**Pressurized Systems**

Can cause serious injury to eyes and skin.

- Always de-pressurize hydraulic, lubrication, and flushing system before any maintenance work.
- High pressure system with alternating pressure levels and high peaks.
- Never replace new hoses with hoses of lower grade or quality.
- Always use gloves and eye protection.
- Never use hands or fingers to locate a leakage.

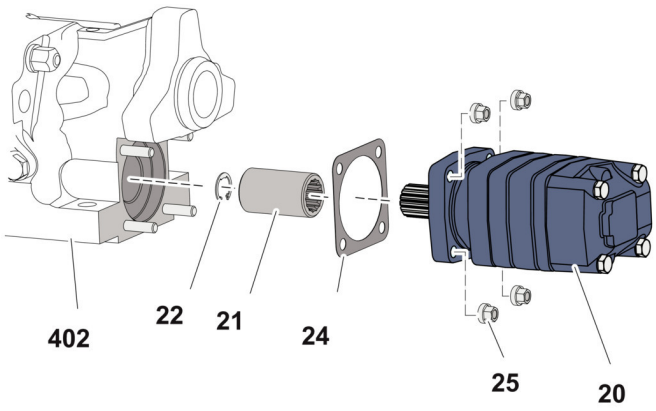
1. Mark, remove and plug the hydraulic hoses.
2. Use tool (B49) to undo the nuts (25) and remove the hydraulic motor (20).




3. Remove the gasket (24).
4. Remove the coupling (21) and remove the circlip (22) from the coupling.

## 10.2 Install Hydraulic Motor

1. Install a new circlip (22) in the coupling (21).




   a. Lubricate the coupling splines with grease and install the coupling onto the hydraulic motor (20).

   b. Use a new gasket (24) and install the hydraulic motor to the cylinder (402).

   c. Use tool (B49), apply oil, install, and tighten the hydraulic motor nuts (25) alternately to full torque 65 Nm (48 lbf-ft).

2. Install the hydraulic hoses according to the marks.

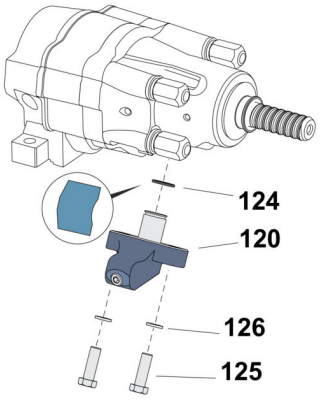
> ! ***NOTE:*** *After change of the hydraulic motor, check the rotation direction and speed according to Rig instruction.*

| Recommended Oil |
| --- |
| Hydraulic oil or Motor oil |

# 11 Front Head

## 11.1 Disassemble Front Head

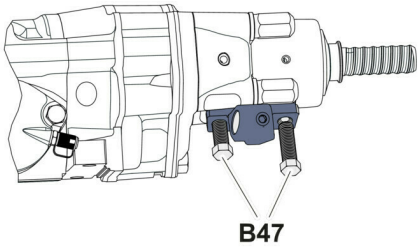
1. Plug and remove the flushing hose.




   a. Undo screws (125) and washers (126) and remove the connecting plate.

   b. Remove seal (124) from the flushing head.

2. If the connecting plate is stuck, insert tools (B47) according to the picture.



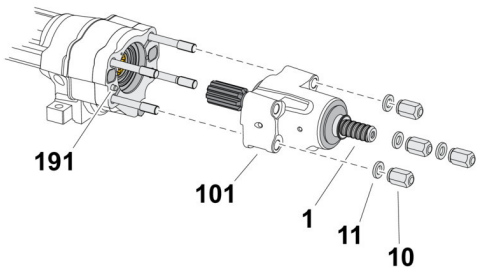

   a. Tighten the tools (B47) alternately to loosen the connecting plate.

   b. Remove the connecting plate from the front head.

   c. Remove the tools from the connecting plate.

   d. Remove seal (124) from the flushing head.

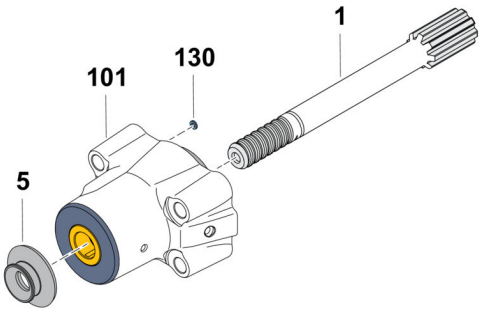
3. Remove front dome nuts (10) with washers (11).



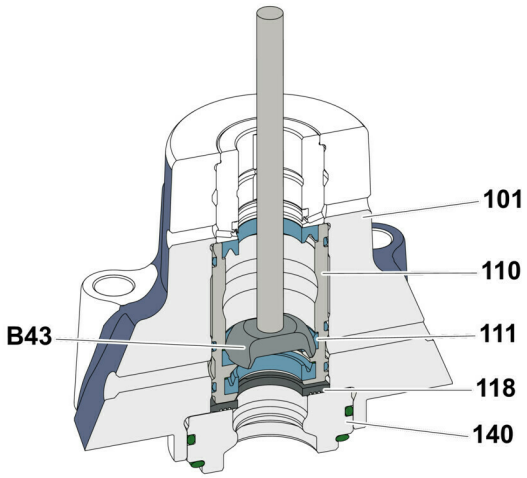

   a. Remove the front head (101) by pulling the shank adapter (1).

b. Tap with a plastic mallet if the front head is stuck.

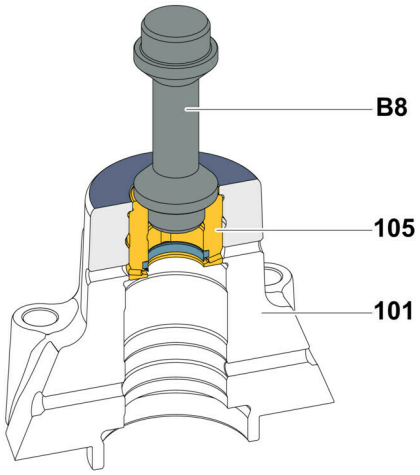
4. Remove the shank adapter (1) and the drill collar (5) from the front head (101).




5. Place the tool (B43) in the cup seal (111). Use a mandrel and plastic mallet to remove the stop ring (140), the washer (118), and the flushing head (110).

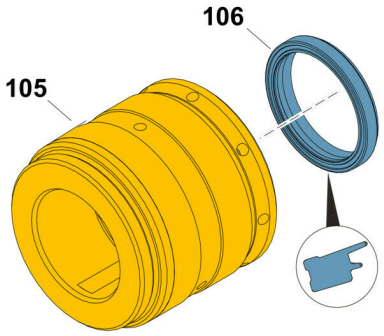



6. Use tool (B8) to press out the guide (105) from the front head (101).

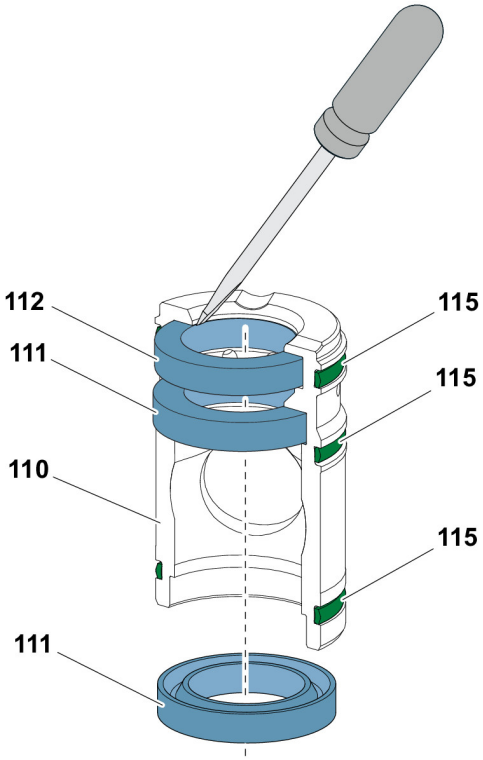


## 11.2 Disassemble Front Head Parts Seals and O-Rings

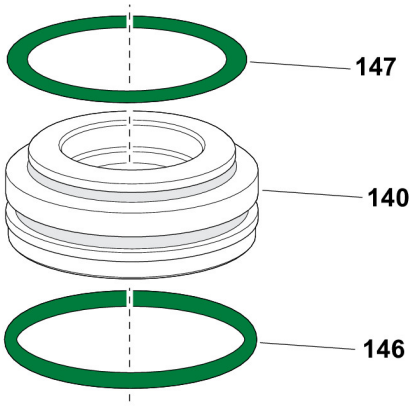
1. Use a pointed tool to carefully remove the wiper (106) from the guide (105).




2. Remove the cup seals (111, 112) and o-rings (115) with a pointed tool, carefully so that the sealing grooves in the flushing head (110) are not damaged.



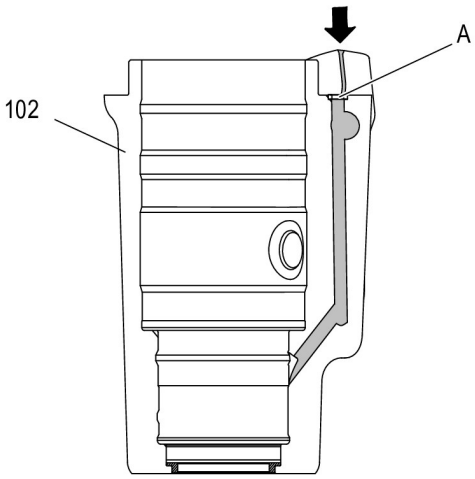
3. Remove the o-rings (146, 147) with a pointed tool, carefully so that the sealing groove in the rear stop ring (140) are not damaged.



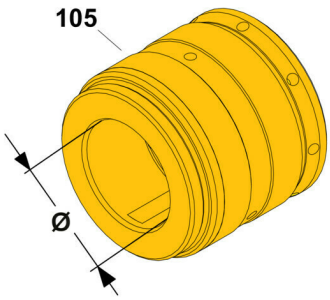

## 11.3 Inspect and Replace Front Head Parts

Precondition ✓ The parts must be washed with grease solvent before the inspection.

1. Use compressed air to inspect that the restriction (A) is open and the lubrication channels are clean.

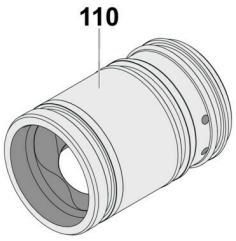



2. Replace the guide (105) if the inside diameter exceeds 39 mm (max. dimension).

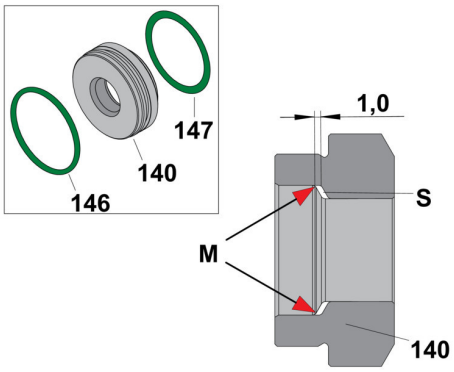



a. Check the lubrication ducts with compressed air.

3. Replace the flushing head if any sign of cracks or heavily corroded.

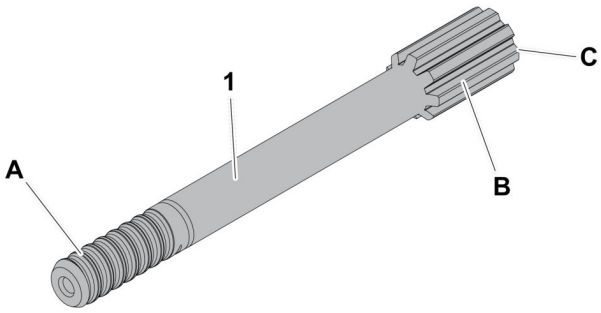



4. Replace the stop ring (140) if:
   a. Any point within the wear surface (S) is worn more than 1 mm, compare with a new stop ring.
   b. Any cracks or signs of breakage are found.
   c. The wear surface (S) is uneven.




| | |
|---|---|
| M | Measurement surface |
| S | Wear surface |

5. Replace the shank adapter (1) if:



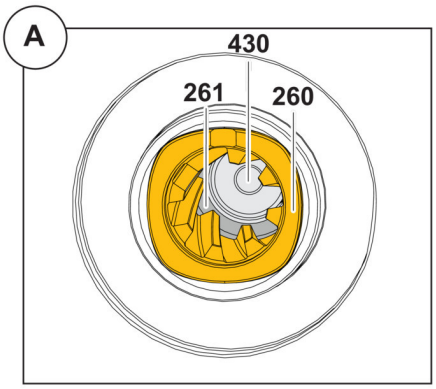

   a. The thread (A) is worn out.
   b. The front or rear end surfaces of the splines (B) are worn.
   c. The impact surface (C) is crushed or chipped.

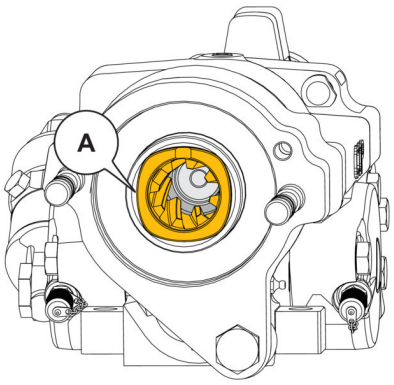
# 11.4 Replace Driver and Rotation Chuck Bushing

## 11.4.1 Inspect Driver, Rotation Chuck Bushing, and Impact Piston

Precondition ✓ The parts must be washed with grease solvent before the inspection.

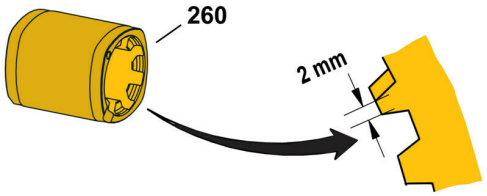
1. Look inside the gear housing and check the splines on the driver (260), rotation chuck bushing (261), and impact piston (430).




   a. If any part looks damaged or worn, send the rock drill for overhaul.

   b. If the splines are less than 2 mm in width, the driver (260) must be replaced.



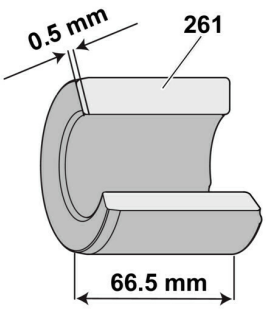

2. Send the rock drill to a workshop for inspection if:

   a. the impact pistons impact surface is damaged in any way

   b. the rotation chuck bushing (261) is scored or cracked.

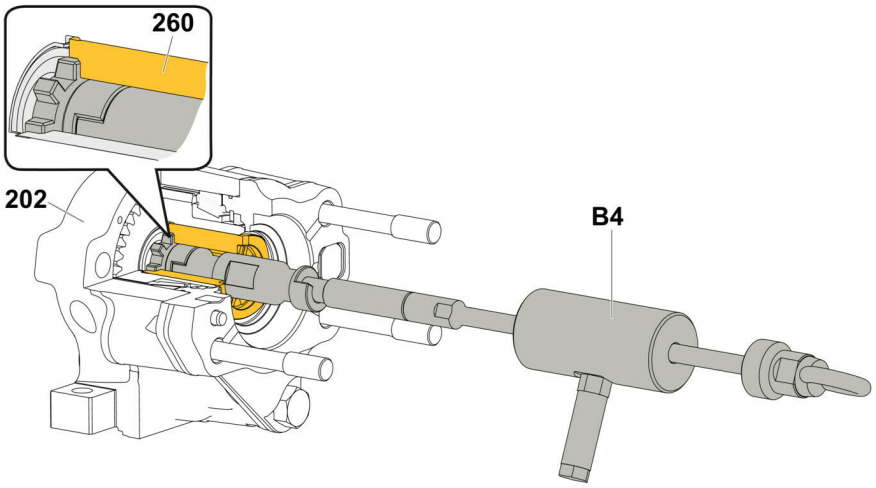
   c. marks (wave type) or splines are visible on the rotation chuck bushing.

   d. the rotation chuck bushings surface against the adapter is worn by more than 0.5 mm (min total length 66.5 mm).



### 11.4.2 Remove Driver and Rotation Chuck Bushing

1. Use the disassembly tool (B4) to remove the driver.




   a. Press the disassembly tool (B4) into the gear housing (202) until it moves to the stop, the tool splines section must have passed the driver (260) splines.

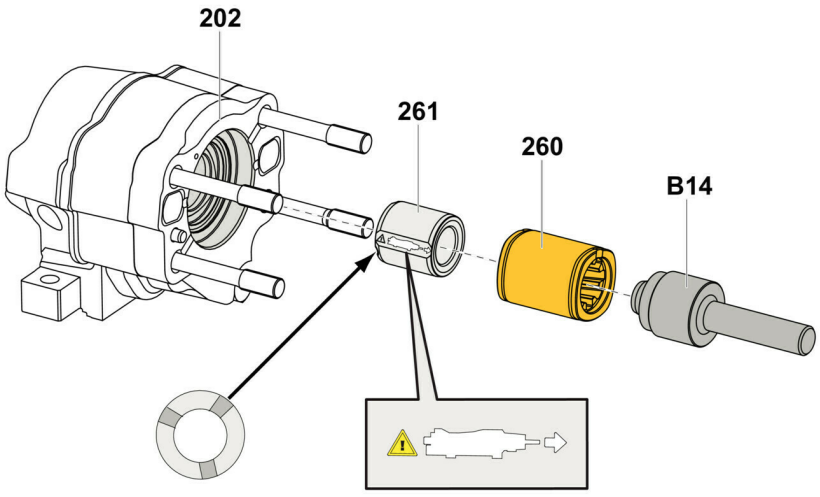
   b. Turn the disassembly tool (B4) clockwise slightly.

   c. Use the slide hammer to remove the driver (260).

2. Usually the rotation chuck bushing follows when removing the driver. Use a puller and an expander to remove it if it is stuck.

### 11.4.3 Install Driver, Rotation Chuck Bushing

1. If the rotation chuck bushing (261) has been removed, use a plastic mallet and mandrel to install it.

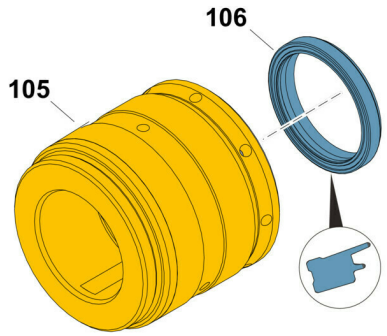



   a. Install the rotation chuck bushing with the lubricating grooves directed towards the damper piston. See symbol.

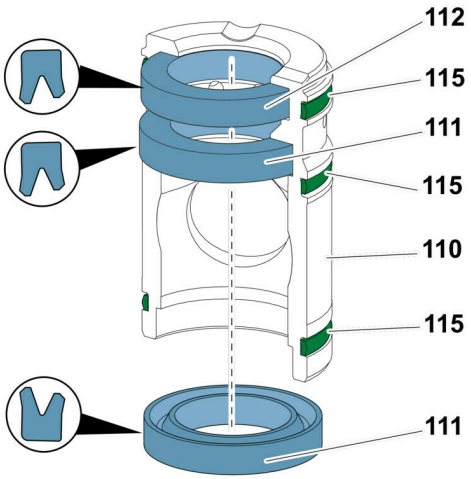
b. Use mandrel (B14) and a plastic mallet to tap the driver (260) into the rotation chuck in the gear housing (202).

## 11.5 Assemble Front Head Parts Seals and O-Rings

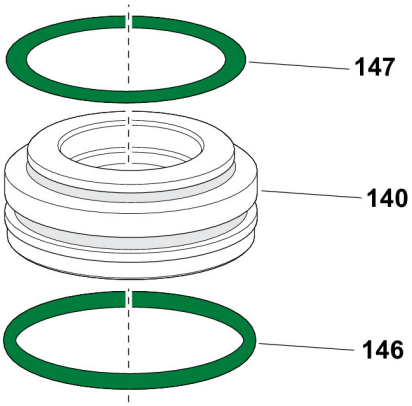
1. Install the new wiper (106) into the guide (105).




2. install new cup seals (111, 112) and o-rings (115) into the flushing head (110).

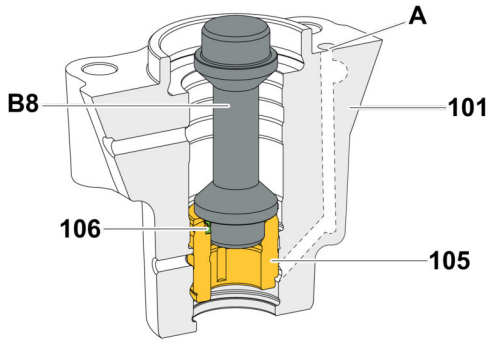



3. Install new o-rings (146, 147) to the rear stop ring (140).



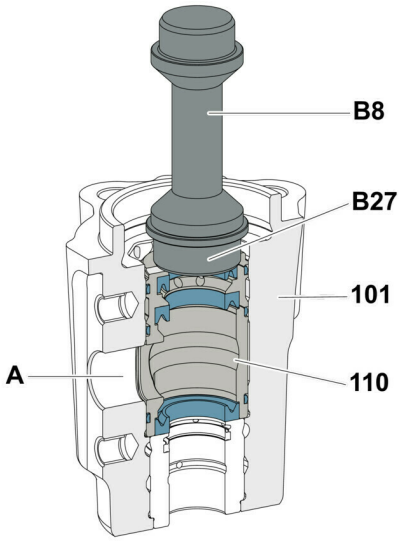
## 11.6 Assemble Front Head

1. Use tool (B8) to press in the guide (105) with the wiper (106).



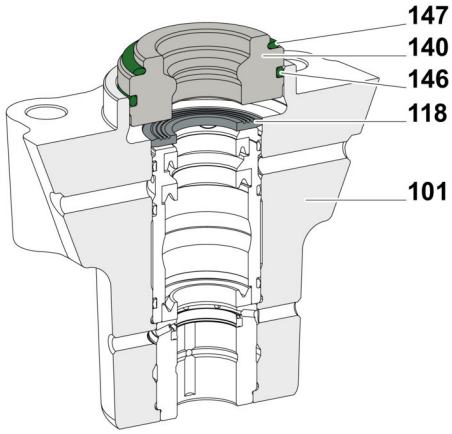

   a. After the guide installation, use compressed air to check that the guide lubricant duct is open.

2. Install the flushing head with the lubricating grooves turned upwards, align the flushing head (A) with the front head hole (A).

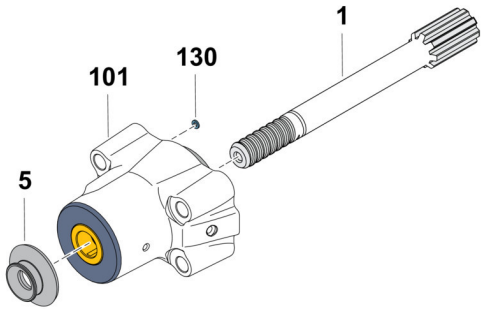



   a. Use tools (B8, B27) to press in the flushing head (110) into the front head (101). Check that the flushing head hole aligns with the front head hole (A).

3. Install the stop ring (140) with the o-rings into the front head (101).



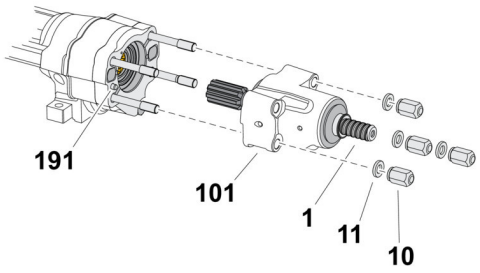

4. Install the shank adapter (1) into the front head (101).




   a. Install the drill collar (5) to the shank adapter.

5. Lubricate the side bolts and contact surfaces of the nuts (10) and the washers (11) with anti-seize paste.

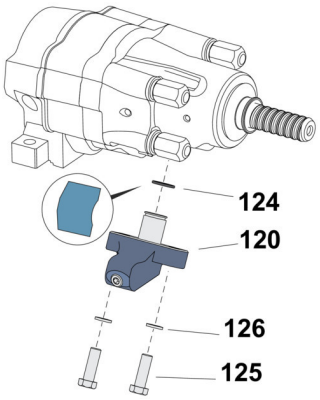
6. Check that the seal ring (130) and the pin (191) are installed before the front head (101) is aligned to the side bolts (221).




   a. Install the washers (11) and the dome nuts (10) to the side bolts (221).

   b. Tighten the front nuts (10) alternately to 350 Nm (258 lbf-ft).

7. Install the seal (124) into the flushing head.




   a. Install the connecting plate with the screws (125) and the washers (126) to the front head.
   b. Tighten the screws (125) alternately to 90 Nm (66 lbf-ft).
   c. Connect the flushing hose.

| Recommended Anti-Seize Paste |
| --- |
| Loctite LB 8009 or corresponding thread lubricant |

| Recommended Oil |
| --- |
| Hydraulic oil or Motor oil |

## 11.7 Inspect Shank Adapter Threads

1. Replace the shank adapter if the thread is worn out. See chapter Front Head.
2. When replacing the shank adapter, inspect internal components. See chapter Inspect and Replace Front Head.

## 11.8 Check for Leaks During Drilling

- If the flushing media leaks from the flushing head replace the cup seals and o-rings. See chapter Front Head.
- If oil leaks from the front head, shut of the percussion and activate the damper only to determine if it is percussion or damper leakage. Remove the Rock Drill for overhaul, see chapter Rock Drill Overhaul

# 12 Lubrication

## 12.1 Hydraulic and Lubricant Recommendations

### 12.1.1 Hydraulic Fluid

The hydraulic fluid of rock drill, in addition to containing decent lubrication properties, should provide superior protection against wear, rust and oxidation, as well as good antifoaming, water resistance, and air separation properties. For a hydraulic fluid, it is essential to have high shear stability, to ensure that viscosity and viscosity index remain constant, even at high-pressure drops over sealing gaps and valves. The use of an appropriate hydraulic fluid with proper viscosity, guarantee minimum energy losses in hydraulic systems.

There are various hydraulic fluids to fulfil all limit values of viscosity as required for different operating conditions and ambient temperatures. Various types of oils across these ranges, may differ from mineral to synthetic based. Epiroc recommends the use of hydraulic fluids, which conform to standards ISO 11158 HM, DIN 51524 HLP/HVLP and ISO 15380 (for environmentally friendly hydraulic fluids and biodegradable options).

Hydraulic fluids shall be chosen in relation to operational requirements and varying temperature ranges. It is important to select a hydraulic fluid of the correct viscosity (VG), suited to your operating temperature and environment. Viscosity is highly affected by temperature. A high viscosity index (VI), reduces the effect of temperature on the hydraulic fluid. The following table can be used to choose an appropriate viscosity grade (VG) and viscosity index (VI), based on your needs:

| **Normal Operating Temp °C**<br>**Viscosity 25-50 cSt** | **Min. Start Temp °C** | **Max. Operating Temp °C** | **Viscosity Grade VG**<br>**ISO 3448** | **Viscosity Index VI** |
|---|---|---|---|---|
| +50 to +70 | +5 | +80 | ISO VG 100 | Min. 100 |
| +45 to +60 | -5 | +75 | ISO VG 68 | Min. 100 |
| +35 to +50 | -10 | +65 | ISO VG 46 | Min. 100 |
| +25 to +40 | -15 | +55 | ISO VG 32 | Min. 100 |
| +10 to +25 | -25 | +35 | ISO VG 15 | Min. 100 |

! ***NOTE:*** *In compliance with ISO 4406, the hydraulic fluid must be filtered to the purity class of 20/18/15.*

**If viscosity is too low:**

- The hydraulic fluid may not form a lubricating layer between surfaces, thus increasing the risk of wear.
- The hydraulic fluid can leak past seals more easily in the rock drill, causing fluid losses and increasing energy requirements.

**If viscosity is too high:**

- Flow losses in the hydraulic lines are increased. The high flow losses amplify energy consumption and pressure levels, and put increased strain on seals.
- The risk of cavitation increases, which leads to the risk of damage to the rock drill and hydraulic pumps.

**The hydraulic fluid must be changed at regular intervals**

Oil viscosity changes during the period that the hydraulic fluid is used. In general, viscosity will drop with increased operating hours. To ensure that the viscosity of the fluid does not drop to a critical level before the recommended service interval, a hydraulic fluid of sufficient stability must be used. In compliance with DIN 51350-6, viscosity of suitable hydraulic fluids shall drop a maximum of 25% when tested at 100 ºC for shear stability.

Factors influencing the interval between changes are:

- Viscous stability of the hydraulic fluid as specified above. The hydraulic fluid must be changed before the viscosity drops to a critical level.
- Contamination with water. If the hydraulic fluid becomes cloudy and light grey, the water content has become such that the hydraulic fluid must be changed.
- Deterioration of properties such as oxidation inhibition and anti-foaming.

### 12.1.2 Pneumatic Tool Oil

Pneumatic tool oil is used for cooling and lubricating your rock drill. Depending on ambient temperature, the oil should have the following viscosity grades if the viscosity index (VI) is about 100:

| Ambient Temperature C° | Viscosity |
|---|---|
| -30 to ±0 | VG 32-68 |
| -10 to +20 | VG 68-100 |
| +10 to +50 | VG 100-150 |

The tool oil must have an EP additive which covers the following load-bearing properties:

| Referenced Standard | Load-Bearing Property |
|---|---|
| ASTM D 2783 | Min. 250 kg |
| ASTM D 4172 (40 kg) | Max. 0.5 mm |

The tool oil should also have the following properties:

- The oil must have good lubricating properties, intended for compressed air tools.
- The oil must have good adhesion capacity.
- The oil must have additives that prevent foam formation.

Epiroc recommends the use of Epiroc COP OIL which has been specially developed for our hydraulic rock drills. COP OIL is an environmentally friendly, biodegradable oil, which can be used in ambient temperatures between -25 ºC and +50 ºC. COP OIL can be ordered with the following part numbers:

| 1 Can of 4 litres | 1 Can of 20 litres | 24 Can of 20 litres | 1 Barrel of 208 litres |
|---|---|---|---|
| 3115 3125 02 | 3115 3125 01 | 3115 3126 01 | 3115 3127 00 |

### 12.1.3 Grease

Considering the high operating temperature in the rock drill gear housing, always use a high-temperature grease with lithium complex soap based on a synthetic base fluid (polyalphaolefin/synthetic ester) with EP additive, and additives that protect against oxidation, corrosion and wear at high loads. The grease should meet the specifications, specified in the table below:

| NLGI Number | Drop Point | Base Oil Viscosity | Operating Temp |
|---|---|---|---|
| 2 | 260 °C | 220 cSt at 40 °C | -15 to +150 °C |

! ***NOTE:*** *Molybdenum (Molybdenum disulfide) grease is harmful for seals and shall be avoided.*

Epiroc recommends the use of Epiroc COP GREASE, which has been specially developed for our hydraulic rock drills, and is suitable to be used in both gear housing and flushing seals. COP Grease withstands temperatures between -40ºC to +150ºC, and temperatures of up to 220ºC during shorter periods. COP Grease is developed to be implemented in both arctic and tropical conditions, and can be ordered with the following part numbers:

| Grease | Tube 0.4 kg | Can 18 kg |
|---|---|---|
| COP Grease | 3115 3422 00 | 3115 3423 00 |

## 12.2 Check Rock Drill Lubricant Oil (ECL)

**⚠ WARNING**

**Serious injury**

Risk of serious injury to the eyes, hands, and skin.

- ▶ Never work on the hydraulic system when it is pressurized.
- ▶ Never use hands or fingers to locate a leakage.
- ▶ Always use gloves and eye protection.

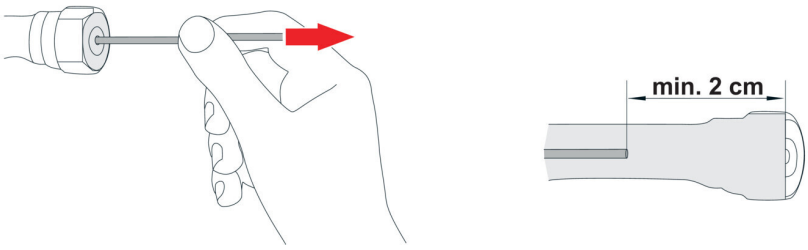
! ***NOTE:*** *Certain moving parts in the Rock Drill are lubricated with pneumatic tool oil mixed with compressed air. It is important that these parts receive good lubrication. Use the recommended lubrication air pressure and lubricant.*

1. Check the level in the lubrication tank at every shift. Exercise cleanliness and fill with the right grade oil. See chapter: Lubrication.
2. If the lubrication system is drained of oil, bleeding must take place after filling oil. See the appropriate Rig manuals for instructions.

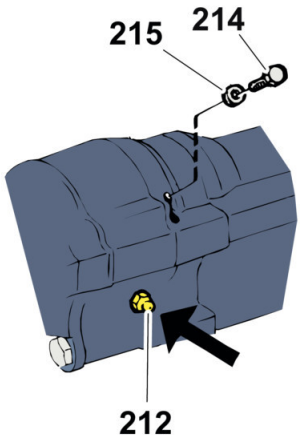
3. If the ECL-hose has been changed, make sure that the inner tube has correct length.

> ***NOTE:*** *The inner tube must end inside the ECL-hose.*

a. Pull out the inner tube and cut off 3–6 cm so that it ends minimum 2 cm inside the ECL-hose.




## 12.3 Lubricate Gear Housing




Precondition ✓ A manual grease gun must be used.

1. Remove the bleed plug (214) with gasket (215).

> ***NOTE:*** *The bleed plug must be removed before lubrication starts.*

2. Use a manual grease gun and lubricate with heat-resistant grease through the nipple (212) until new grease is visible in the hole for the bleed plug.

> ***NOTE:*** *Extremely important not to overfill, or fill with too high flow or pressure.*

Recommended lubricant: See chapter Lubrication.

3. Tighten the bleed plug (214) with gasket (215).

## 12.4 Check Air Lubrication Oil

- After a few minutes of drilling and regularly during the shift, check that air and lubricating oil escapes under the front head.

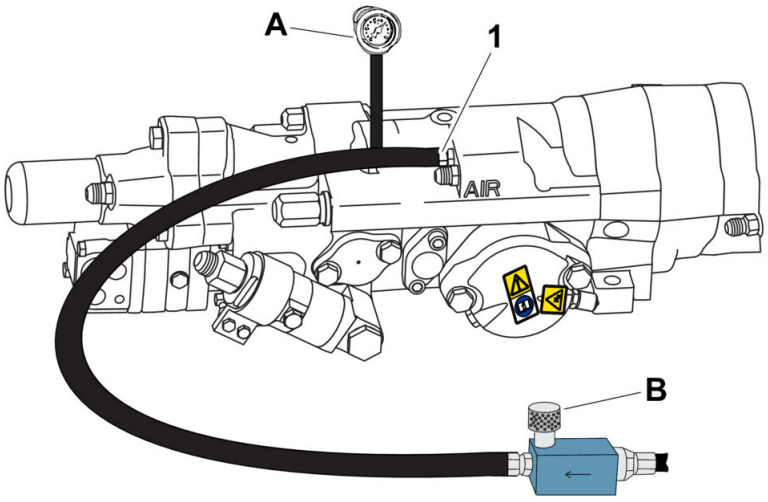
# 13 Settings

## 13.1 Set ECL Lubrication System

Precondition ✓ Configure Rock Drill lubrication to local conditions.

1. Start the lubrication system.
2. Recommended lubricating air pressure is 2–3 bar at the Rock Drill, use a pressure gauge to check the pressure.
3. If the pressure is too low, clean the restriction or increase the diameter of the restriction in the air supply system of the drill rig.
4. Set the correct lubricating oil dose:
   a. "New pump" (3217 8667 52): 20–25 pulses/min
   b. "Old pump" (3217 8667 50): 35–40 pulses/min
5. Check that the correct pulse frequency has been obtained.
6. Check that air and lubricating oil is emerging from the front.

## 13.2 Set Damper Pressure Idling




! ***NOTE:*** *Configure rock drill settings at normal operating temperature for the hydraulic oil.*

1. Close the constant flow valve on the rig.
2. Connect a pressure gauge (A), calibrated for 0-60 bar, between the hose and the damper nipple (1).
3. Open the flow valve and pressurize the damper circuit.
4. Check that the shank adapter is unloaded and in the forward position.

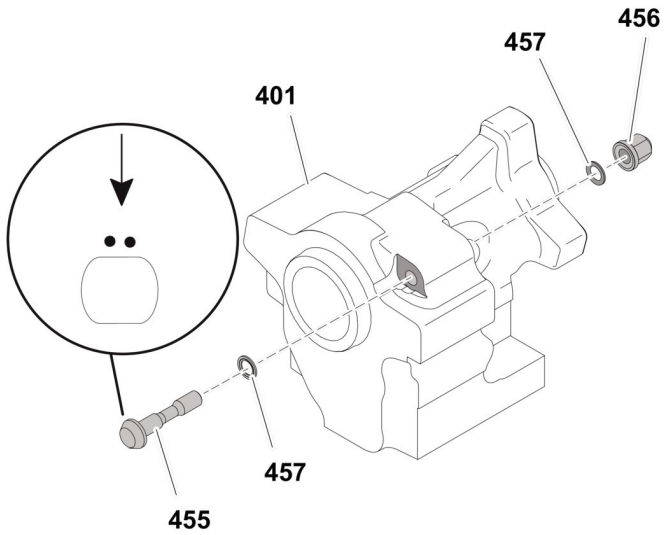
5. Adjust the constant flow valve (B) until the pressure gauge (A) shows 35 bar (Operator panel shows approximately 40 bar).
6. Disconnect the pressure gauge (A) and connect the hose to the damper nipple (1).

## 13.3 Check Damper Pressure During Drilling

- Check that the drill rig damper pressure gauge shows normal values during drilling. In the event of deviation adjust the damper pressure. See chapter Settings.

## 13.4 Set Stroke Length Settings 2

1. The regulating plug (455) is installed on the cylinder (401) turning the plug changes the stroke length of the piston.




2. There is one position shown on the regulating plug (455) by punched dots.
3. Basic setting: two dots are shown forward for setting 2.

## 13.5 Check Rotation Direction

- Check that correct rotation direction is obtained.

## 13.6 Set Rotation Speed

- Check that the rotation speed is stable according to the Setting Document.

# 14 Rock Drill Overhaul

## 14.1 Install Rock Drill After Overhaul

**WARNING**

**Pressurized Systems**

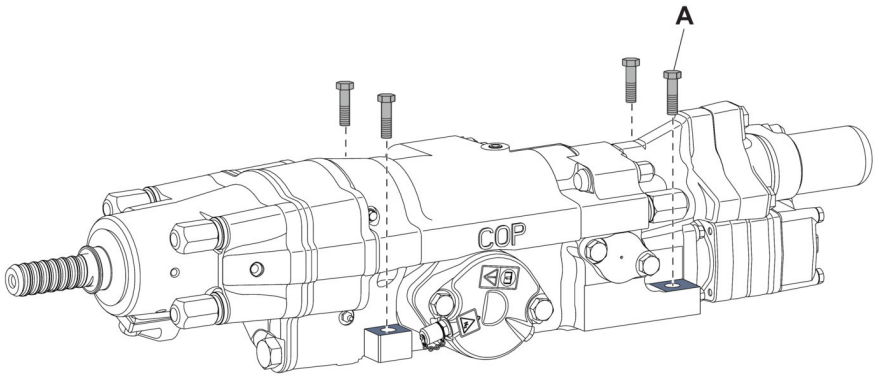
Can cause serious injury to eyes and skin.

- Always de-pressurize hydraulic, lubrication, and flushing system before any maintenance work.
- High pressure system with alternating pressure levels and high peaks.
- Never replace new hoses with hoses of lower grade or quality.
- Always use gloves and eye protection.
- Never use hands or fingers to locate a leakage.

Precondition ✓ Clean the contact surfaces between the rock drill and the cradle, metal to metal contact is required.

1. Sling and lift the rock drill according to chapter Lift Rock Drill.
2. Lubricate the four screws (A) with oil and install them.

> ***NOTE:*** *Never use washers.*




3. Tighten the screws (A) alternately to:
   a. Steel Cradle 250 Nm (185 lbf-ft)
   b. Aluminum Cradle 180 Nm (133 lbf-ft)
4. Remove all protective caps from the connections.
5. Install the hoses according to chapter Hose Connections.
6. Check the rock drill, see chapter Maintenance Tables.

| Recommended Oil |
| --- |
| Hydraulic oil or Motor oil |

## 14.2 Remove Rock Drill for Overhaul

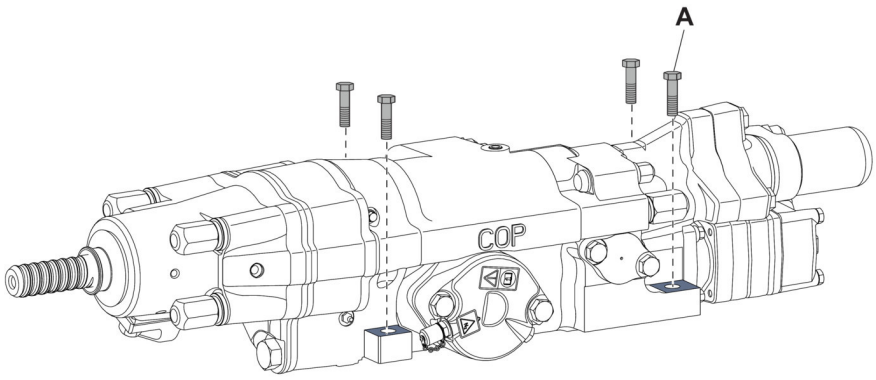
**WARNING**

**Pressurized Systems**

Can cause serious injury to eyes and skin.

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- Never replace new hoses with hoses of lower grade or quality.
- Always use gloves and eye protection.
- Never use hands or fingers to locate a leakage.

1. Discharge the accumulator, see chapter Discharge Accumulator.
2. Mark, remove and plug the hoses from the rock drill.
3. Install protective caps on all connections on the rock drill.
4. Undo and remove the four screws (A).




5. Sling and lift the rock drill according to chapter Lift Rock Drill.
6. Send the rock drill to the workshop for overhaul. Make sure that it is securely anchored for transportation.

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