SERVICE MANUAL

MOBILE ELEVATING WORK PLATFORM
T65D

EN - 9833/1400 - ISSUE 3 - 01/2026

This manual contains original instructions, verified by the manufacturer (or their authorized representative).

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Foreword

The Operator's Manual

⚠

You and others can be killed or seriously injured if you operate or maintain the machine without first studying the Operator's Manual. You must understand and follow the instructions in the Operator's Manual. If you do not understand anything, ask your employer or JCB dealer to explain it.

Do not operate the machine without an Operator's Manual, or if there is anything on the machine you do not understand.

Treat the Operator's Manual as part of the machine. Keep it clean and in good condition. Replace the Operator's Manual immediately if it is lost, damaged or becomes unreadable.

Contents

01 - Machine
06 - Body and Framework
15 - Engine
18 - Fuel and Exhaust System
21 - Cooling System
24 - Brake System
25 - Steering System
27 - Driveline
30 - Hydraulic System
33 - Electrical System
72 - Fasteners and Fixings
75 - Consumable Products
78 - After Sales

Notes:

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SERVICE MANUAL **Volume 1** **T65D** EN 9833/1400	**SERVICE MANUAL** **Volume 2** **T65D** EN 9833/1400
SERVICE MANUAL **Volume 3** **T65D** EN 9833/1400	**SERVICE MANUAL** **Volume 4** **T65D** EN 9833/1400

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Notes:

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01 - Machine

Contents **Page No.**

Acronyms Glossary 01-2

01-03 Safety
- 01-03-03 Safety - Yours and Others 01-3
- 01-03-06 Safety Warnings 01-4
- 01-03-09 General Safety 01-5
- 01-03-12 Maintenance Safety 01-6
- 01-03-18 Operating Safety 01-7
- 01-03-21 Worksite Safety 01-9
- 01-03-24 Risk Assessment 01-10
- 01-03-27 Maintenance Positions 01-11

01-06 About this Manual
- 01-06-03 Model and Serial Number 01-13
- 01-06-06 Using the Manual 01-14

01-09 Description
- 01-09-12 Main Component Locations 01-16
- 01-09-15 Service Point Locations 01-18

01-12 Operation
- 01-12-00 General 01-20

01-27 Lifting the Machine
- 01-27-00 General 01-35

01-33 Cleaning
- 01-33-00 General 01-37

01-48 Specifications
- 01-48-09 Static Dimensions 01-40
- 01-48-10 Weights 01-43
- 01-48-12 Lift Arm Dimensions and Performance 01-44

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Acronyms Glossary

CCV	Crankcase Ventilation
LED	Light Emitting Diode
PIL	Parts Identification List
PPE	Personal Protective Equipment
RPM	Revolutions Per Minute

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03 - Safety

03 - Safety - Yours and Others

Introduction

All machinery can be hazardous. When a machine is correctly operated and maintained, it is a safe machine to work with. When it is carelessly operated or poorly maintained it can become a danger to you (the operator) and others.

In this manual and on the machine you will find warning messages, you must read and understand them. They inform you of potential hazards and how to avoid them. If you do not fully understand the warning messages, ask your employer or JCB dealer to explain them.

Safety is not just a matter of responding to the warnings. All the time you are working on or with the machine you must be thinking of what hazards there might be and how to avoid them.

Do not work with the machine until you are sure that you can control it.

Do not start any work until you are sure that you and those around you will be safe.

If you are not sure of anything, about the machine or the work, ask someone who knows. Do not assume anything.

Remember:

- Be careful.
- Be alert.
- Be safe.

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06 - Safety Warnings

Introduction

In this manual there are safety notices. Each notice starts with a signal word. The signal word meanings are given below.

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

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

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

The signal word 'Notice' indicates a hazardous situation which, if not avoided, could result in machine damage.

The safety alert system symbol (shown) also helps to identify important safety messages in this manual. When you see this symbol your safety is involved, carefully read the message that follows.

Figure 1. The safety alert system symbol

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09 - General Safety

Introduction

Training

To operate the machine safely you must have received the appropriate training. The operator's manual instructs you on the machine, its controls and its safe operation; it is not a training manual. Ensure that you receive the correct training before operating the machine. Failure to do so will result in incorrect operation of the machine and you will be putting yourself and others at risk. You must abide by all local site regulations. Make sure that you and your machine comply with relevant local laws and jobsite requirements – it is your responsibility.

Clothing

You can be injured if you do not wear the correct clothing. Loose clothing can get caught in the machinery. Keep cuffs fastened. Do not wear a necktie or scarf. Keep long hair restrained. Remove rings, watches and personal jewellery.

Care and Alertness

All the time you are working with or on the machine, take care and stay alert.

Alcohol and Drugs

It is extremely dangerous to operate or work on machines when under the influence of drugs or alcohol. Do not consume alcoholic drinks or take drugs before or while operating any machinery. Medicines could reduce your ability to control the machine safely due to their possible side effects such as drowsiness, dizziness, loss of touch, blurred vision etc. This list is not totally exhaustive, consult your doctor if you are unsure.

Feeling Unwell

Do not attempt to operate the machine if you are feeling unwell. By doing so you could be a danger to yourself and those you work with. If you begin to feel unwell during operation stop using the machine immediately and seek help.

Mobile Phones

Switch off your mobile phone before entering an area with a potentially explosive atmosphere. Sparks in such an area could cause an explosion or fire resulting in death or serious injury.

Switch off and do not use your mobile phone when refuelling the machine.

Lifting Equipment

You can be injured if you use incorrect or faulty lifting equipment. You must identify the weight of the item to be lifted then choose lifting equipment that is strong enough and suitable for the job. Make sure that lifting equipment is in good condition and complies with all local regulations.

Raised Equipment

Never walk or work under raised equipment unless it is supported by a mechanical device. Equipment which is supported only by a hydraulic device can drop and injure you if the hydraulic system fails or if the control is operated (even with the engine stopped).

Make sure that no-one goes near the machine while you install or remove the mechanical device.

Raised Machine

Never position yourself or any part of your body under a raised machine which is not correctly supported. If the machine moves unexpectedly you could become trapped and suffer serious injury or be killed.

Lightning

Lightning can kill you. Do not use the machine if there is lightning in your area.

Machine Modifications

This machine is manufactured in compliance with prevailing legislative requirements. It must not be altered in any way which could affect or invalidate its compliance. For advice consult your JCB dealer.

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12 - Maintenance Safety

Introduction

Raised Machine

Never position yourself or any part of your body under a raised machine which is not correctly supported. If the machine moves unexpectedly you could become trapped and suffer serious injury or be killed.

Compressed Air

Compressed air is dangerous. Wear personal protective equipment. Never point a compressed air jet at yourself or others.

Springs

Always wear personal protective equipment when dismantling assemblies containing components under pressure from springs. This will protect against eye injury from components accidentally flying out.

Metal Splinters

You can be injured by flying metal splinters when driving metal pins in or out. Use a soft faced hammer or copper drift to remove and install metal pins. Always wear personal protective equipment.

Repairs

If your machine does not function correctly in any way, get it repaired straight away. Neglect of necessary repairs could result in an accident or affect your health. Do not try to do repairs or any other type of maintenance work you do not understand. To avoid injury and/or damage get the work done by a specialist engineer.

Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before connecting or removing any hydraulic hose, residual hydraulic pressure trapped in the service hose line must be vented. Make sure the hose service line has been vented before connecting or removing hoses. Make sure the engine cannot be started while the hoses are open.

'O' rings, Seals and Gaskets

Badly installed, damaged or rotted 'O' rings, seals and gaskets can cause leakages and possible accidents. Renew whenever disturbed unless otherwise instructed. Do not use Trichloroethane or paint thinners near 'O' rings and seals.

Counterweights

Your machine may be installed with counterweights. They are extremely heavy. Do not attempt to remove them.

Soft Ground

A machine can sink into soft ground, never work under or on a machine parked on soft ground.

Working Under the Machine

Make the machine safe. Make sure the park brake is engaged and machine is fully isolated. Remove the machine key switch, disconnect the battery. Use blocks to prevent unintentional movement of the wheels.

Lifting the Machine

Under no circumstances must the engine be run with the transmission in gear and only one driving wheel jacked clear of the ground, since the wheel on the ground will move the machine.

Chemicals

Certain seals and gaskets (e.g. crankshaft oil seal) on JCB machines contain fluoroelastomeric materials such as Viton®, FluorelTM and Technoflon®. Fluoroelastomeric materials subjected to high temperatures can produce highly corrosive hydrofluoric acid. This acid can severely burn. New fluoroelastomeric components at ambient temperature require no special safety precautions. Used fluoroelastomeric components whose temperatures have not exceeded 300°C (572 °F) require no special safety precautions. If evidence of decomposition (e.g. charring) is found, refer to the next paragraph for safety instructions. Do not touch component or surrounding area. Used fluoroelastomeric components subjected to temperatures greater than 300°C (572 °F) (e.g. engine fire) must be treated using the following safety procedure. Make sure that heavy duty gloves and special safety glasses are worn: Thoroughly wash contaminated area with 10% calcium hydroxide or other suitable alkali solution, if necessary use wire wool to remove burnt remains. Thoroughly wash contaminated area with detergent and water. Contain all removed material, gloves etc. used in this operation in sealed plastic bags and dispose of in accordance with Local Authority Regulations. Do not burn fluoroelastiometric materials.

Hydraulic Hoses

Never re-use hydraulic hose end crimps or use reusable hose end crimps.

Personal Protective Equipment

Use the appropriate personal protective equipment before performing maintenance on the machine, otherwise you could be injured.

Working at Height

Use appropriate access equipment such as ladders or a working platform if it is necessary to work at height to perform maintenance tasks on the machine. If you do not use suitable access equipment there is a risk of falling, resulting in personal injury or death.

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18 - Operating Safety

Introduction

Training

Make sure that you have had adequate training and that you are confident in your ability to operate the machine safely before you use it. Practice using the machine and its attachments until you are completely familiar with the controls and what they do. Where applicable you may be required to show competency to a national certification scheme. Ensure you comply with local legislation and jobsite rules. With a careful, well trained and experienced operator, your machine is a safe and efficient machine. With an inexperienced or careless operator, it can be dangerous. Do not put your life, or the lives of others, at risk by using the machine irresponsibly. Before you start to work, tell your colleagues what you will be doing and where you will be working. On a busy site, use a signalman.

Before doing any job not covered in this manual, find out the correct procedure. Your local JCB distributor will be glad to advise you.

Fuel

Fuel is flammable, keep naked flames away from the fuel system. Stop the engine immediately if a fuel leak is suspected. Do not smoke while refuelling or working on the fuel system. Do not refuel with the engine running. Completely wipe off any spilt fuel which could cause a fire. There could be a fire and injury if you do not follow these precautions.

Machine Condition

A defective machine can injure you or others. Do not operate a machine which is defective or has missing parts. Make sure the maintenance procedures in this manual are completed before using the machine.

Machine Limits

Operating the machine beyond its design limits can damage the machine, it can also be dangerous. Do not operate the machine outside its limits. Do not try to upgrade the machine performance with unapproved modifications or additional equipment.

Engine/Steering Failure

If the engine or steering fails, stop the machine as quickly as possible. Do not operate the machine until the fault has been corrected.

Exhaust Gases

Machine exhaust gases can harm and possibly kill you or bystanders if they are inhaled. Do not operate the machine in enclosed spaces without making sure there is good ventilation. If possible, install an exhaust extractor. If you begin to feel drowsy, stop the machine at once and get into fresh air.

Do not touch the exhaust or the water/steam coming out of the exhaust. Doing so may cause high-temperature burns. Never drink the water coming out of the exhaust.

Worksites

Worksites can be hazardous. Examine the site before working on it. You could be killed or injured if the ground gives way under your machine or if piled material collapses onto it. Check for potholes and hidden debris, logs, ironwork etc. Any of these could cause you to lose control of your machine. Check for utilities such as electric cables (overhead and underground), gas and water pipes etc. Mark the positions of the underground cables and pipes. Make sure that you have enough clearance beneath overhead cables and structures.

If the machine is used in coordination with other machines, vehicles and/or people on the jobsite the operator must follow jobsite organisation rules.

Communications

Bad communications can cause accidents. Keep people around you informed of what you will be doing. If you will be working with other people, make sure any hand signals that may be used are understood by everybody. Worksites can be noisy, do not rely on spoken commands.

You must stop the machine operation, isolate the controls and turn off the machine when persons are required to interact with it.

Parking

An incorrectly parked machine can move without an operator. Follow the instructions in the Operator's Manual to park the machine correctly.

Banks and Trenches

Banked material and trenches can collapse. Do not work or drive too close to banks and trenches where there is danger of collapse.

Safety Barriers

Unguarded machines in public places can be dangerous. In public places, or where your visibility is reduced, place barriers around the work area to keep people away.

Sparks

Explosions and fire can be caused by sparks from the exhaust or the electrical system. Do not use the machine in closed areas where there is flammable material, vapour or dust.

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Regulations

Obey all laws, worksite and local regulations which affect you and your machine.

Electrical Power Cables

You could be electrocuted or badly burned if you get the machine or its attachments too close to electrical power cables.

You are strongly advised to make sure that the safety arrangements on site comply with the local laws and regulations concerning work near electric power lines.

Before you start using the machine, check with your electricity supplier if there are any buried power cables on the site.

There is a minimum clearance required for working beneath overhead power cables. You must obtain details from your local electricity supplier.

Machine Safety

Stop work at once if a fault develops. Abnormal sounds and smells can be signs of trouble. Examine and repair before resuming work.

Hot Components

Touching hot surfaces can burn skin. The engine and machine components will be hot after the unit has been running. Allow the engine and components to cool before servicing the unit.

Travelling at High Speeds

Travelling at high speeds can cause accidents. Always travel at a safe speed to suit working conditions.

Hillsides

Operating the machine on hillsides can be dangerous if the correct precautions are not taken. Ground conditions can be changed by rain, snow, ice etc. Check the site carefully. When applicable, keep all attachments low to the ground.

Confined Areas

Pay extra attention to proximity hazards when operating in confined areas. Proximity hazards include buildings, traffic and bystanders.

Safe Working Loads

Overloading the machine can damage it and make it unstable. Study the specifications in the Operator's Manual before using the machine.

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21 - Worksite Safety

Introduction

"Workplace Inspection" will help operators to determine whether the workplace is suitable for operation. Operators must inspect the workplace before they move machines there. It is the operator's responsibility to understand and keep in mind the hazards in the workplace, He/she must pay attention and avoid these problems when moving, installing and operating the machine. Check for hazards such as but not limited to:

- Drop-offs, or potholes including those concealed by water mud, etc.
- Slopes.
- Bumps and floor obstructions.
- Debris.
- Over head obstructions and electrical conductors.
- Hazardous locations and atmospheres.
- Inadequate surface and support to withstand all load forces imposed by the platform in all operating configurations.
- Wind and weather conditions.
- Presence of unauthorized persons.
- Other possible unsafe conditions.
- Underground utilities and pipes.
- Overhanging objects, tree branches.

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24 - Risk Assessment

Introduction

It is the responsibility of the competent people that plan the work and operate the machine to make a judgement about the safe use of the machine, they must take into account the specific application and conditions of use at the time.

It is essential that a risk assessment of the work to be done is completed and that the operator obeys any safety precautions that the assessment identifies.

If you are unsure of the suitability of the machine for a specific task, contact your JCB dealer who will be pleased to advise you.

The following considerations are intended as suggestions of some of the factors to be taken into account when a risk assessment is made. Other factors may need to be considered.

A good risk assessment depends on the training and experience of the operator. Do not put your life or the lives of others at risk.

Personnel

- Are all persons who will take part in the operation sufficiently trained, experienced and competent? Are they fit and sufficiently rested? A sick or tired operator is a dangerous operator.
- Is supervision needed? Is the supervisor sufficiently trained and experienced?
- As well as the machine operator, are any assistants or lookouts needed?

The Machine

- Is it in good working order?
- Have any reported defects been corrected?
- Have the daily checks been carried out?
- Are the tyres in good condition?
- Is there sufficient fuel to complete the job?

Working Area

- Is it level?
- Is the ground solid? Will it support the weight of the machine when loaded?
- How rough is the ground? Are there any sharp projections which could cause damage, particularly to the tyres?
- Are there any obstacles or hazards in the area, for example, debris, excavations, manhole covers, power lines?
- Is the space sufficient for safe manoeuvring?
- Are any other machines or persons likely to be in or to enter the area while operations are in progress?

The Route to be Travelled

- How solid is the ground, will it provide sufficient traction and braking? Soft ground will affect the stability of the machine and this must be taken into account.
- How steep are any slopes, up/down/across? A cross slope is particularly hazardous, is it possible to detour to avoid them?

Weather

- How windy is it? High wind will adversely affect the stability of a loaded machine. For maximum allowable wind speed of your machine.
- Is it raining or is rain likely? The ground that was solid and smooth when dry will become uneven and slippery when wet, and it will not give the same conditions for traction, steering or braking.

Emergency Plan

Make sure that emergency rescue plan is in place and understood, It is important to make sure that those involved in the rescue plan are aware of the location of the lowering controls and how to operate the machine from platform controller at height.

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27 - Maintenance Positions

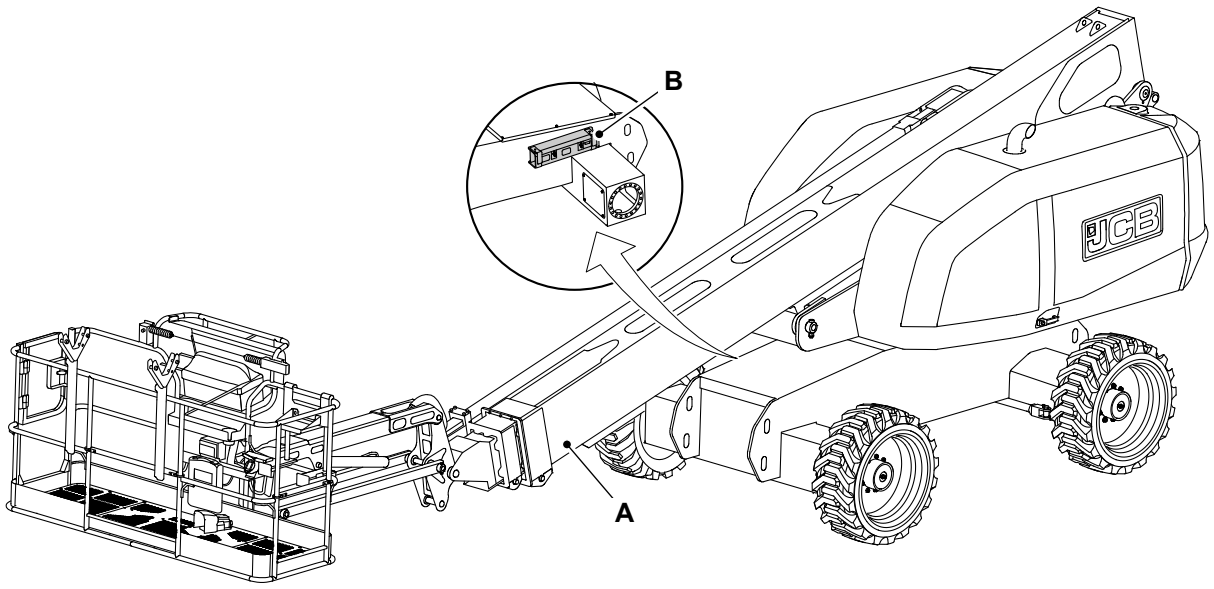
Introduction 01-11
Health and Safety 01-12

Introduction

Make the machine safe before you start any maintenance procedure.

1. Park the machine on firm, level ground.
2. Make sure that machine is in the stowed position.
3. Turn the ignition switch to the OFF position and remove the ignition key from the ignition switch.
4. Disconnect the battery to prevent accidental operation.
5. Put chocks at front and rear of all wheels.
6. Engage the turntable locking pin with the chassis.
7. The boom support safety strut should be used when it is required to work under the elevated boom

Figure 2. Platform Lowered Position



A Boom stowed position

B Safety strut

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Health and Safety

⚠ **WARNING** Maintenance must be done only by suitably qualified and competent persons.

Before doing any maintenance make sure the machine is safe, it must be correctly parked on firm, level ground.

To prevent anyone starting the engine, remove the ignition key. Disconnect the battery (by means of the battery isolator if installed) when you are not using electrical power. If you do not take these precautions you could be killed or injured.

WARNING Make the machine safe before getting beneath it. Make sure that any attachments on the machine are correctly attached. Engage the park brake, remove the ignition key, isolate the battery.

Make the machine safe before you start a maintenance procedure.

You can complete most of the maintenance procedures with the lift arm lowered. Unless a maintenance procedure instructs you differently, you must lower the lift arm.

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06 - About this Manual

03 - Model and Serial Number

Introduction

This manual provides information for the following model(s) in the JCB machine range:

Table 1.

Model	**VIN Prefix.** **Refer to: PIL 06-63-03.**
T65D [T4F]	RAJA3036

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06 - Using the Manual

Introduction

Information in this manual conforms to a standard JCB service manual format. The format uses section headings taken from a PIL (Parts Identification List). These headings are assigned numerical identification references.

Table 2.

Example	Section	Main Assembly / Heading	Component / Sub-heading
PIL reference	33	03	03
Heading	Electrical System	Battery	Isolator Switch

Information within each PIL reference is included under a set of standard headings such as Introduction, Health and Safety, Technical Data and Operation for example. Where additional relevant information is contained within another PIL reference a cross reference is provided.

The main systems information is contained in the manual as follows.

Table 3.

System	PIL Reference	Heading
Hydraulic System	PIL 30-00-50	Schematic Circuit
Electrical System	PIL 33-03-03	Battery - Isolator Switch
	PIL 33-09-00	Power Distribution (including fuses and relays)
	PIL 33-00-50	Schematic Circuit
Electronic Diagnostic	PIL 33-57-00	Electronic Diagnostic (including Servicemaster)

Machine Variants

Where information is different depending on machine variant, the applicable information sets are included within the same PIL reference. Headings are included to identify which information is for which variant. Make sure you use the correct information.

Routine Maintenance

A dedicated section for routine maintenance procedures is not included. Instead, procedures are included in the relevant PIL headings. For example, procedures for the engine oil filter are given in Engine, Oil Filter (PIL 15-21).

Routine maintenance must be carried out in accordance with the applicable maintenance schedule.
Refer to: PIL 78-24.

Diagnostics

Information in this manual can help you diagnose machine faults.

Before attempting to diagnose possible faults check the following.

- Make sure that the operator understands the machine controls, functions and use. Refer to the applicable Operator Manual.
- Check that the maintenance record complies with the applicable schedule for the operating environment.
- Check that the fluids in use comply with the standards specified.
- Make sure that the machine electronic set-up is applicable. Use the applicable Servicemaster vehicle set-up tool.
- Use the applicable Servicemaster diagnostics tools.

Remove and Install

Before removal of components or assemblies, clean the applicable parts of the machine. After removal cap open ports and hoses to prevent contamination.
Refer to: PIL 01-33-00.

Use new sealing elements such as gaskets and O-rings.

Do not install defective components or assemblies. if necessary replace them with new ones.

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Dismantle and Assemble

Before dismantling an assembly clean it.

After dismantling, clean the individual components and check them for wear and defects. If necessary replace them with new ones.

During assembly use new sealing elements such as gaskets and O-rings.

Torque Tightening

When you replace components, always tighten the applicable fixings to the correct torque value. Use the torque tightening values contained in the individual procedures (Remove and Install, Disassemble and Assemble etc.). If no torque values are specified, use the standard torque tightening values. For the torque setting to be effective, do the following before you install the fixings.
Refer to: PIL 72-00-00.

- Make sure that all the applicable component assemblies are correct.
- Make sure that the applicable fixings are to the correct specification. If necessary discard the original fixings and replace them with new ones. The relevant procedures indicate when this is necessary.
- Make sure that the applicable fixings and threaded holes are free from contamination. This includes dirt, debris, old sealants and compounds, fluids and lubricants.

Consumable Products

Some procedures require the use of consumable products such as lubricants, sealants, adhesives and locking fluids. Use the correct products. Where products are available from JCB the applicable part numbers are given in the procedures. A complete list of consumable products available from JCB is given in this manual.
Refer to: PIL 75-00.

After Sales

Some procedures require the use of equipment such as special tools and PPE (Personal Protective Equipment). Where special tools are available from JCB the applicable part numbers are given in the procedures. Full details about the applicable special tools are given in this manual. Refer to (PIL 78-00).

Use the correct PPE to comply with local and employer regulations.

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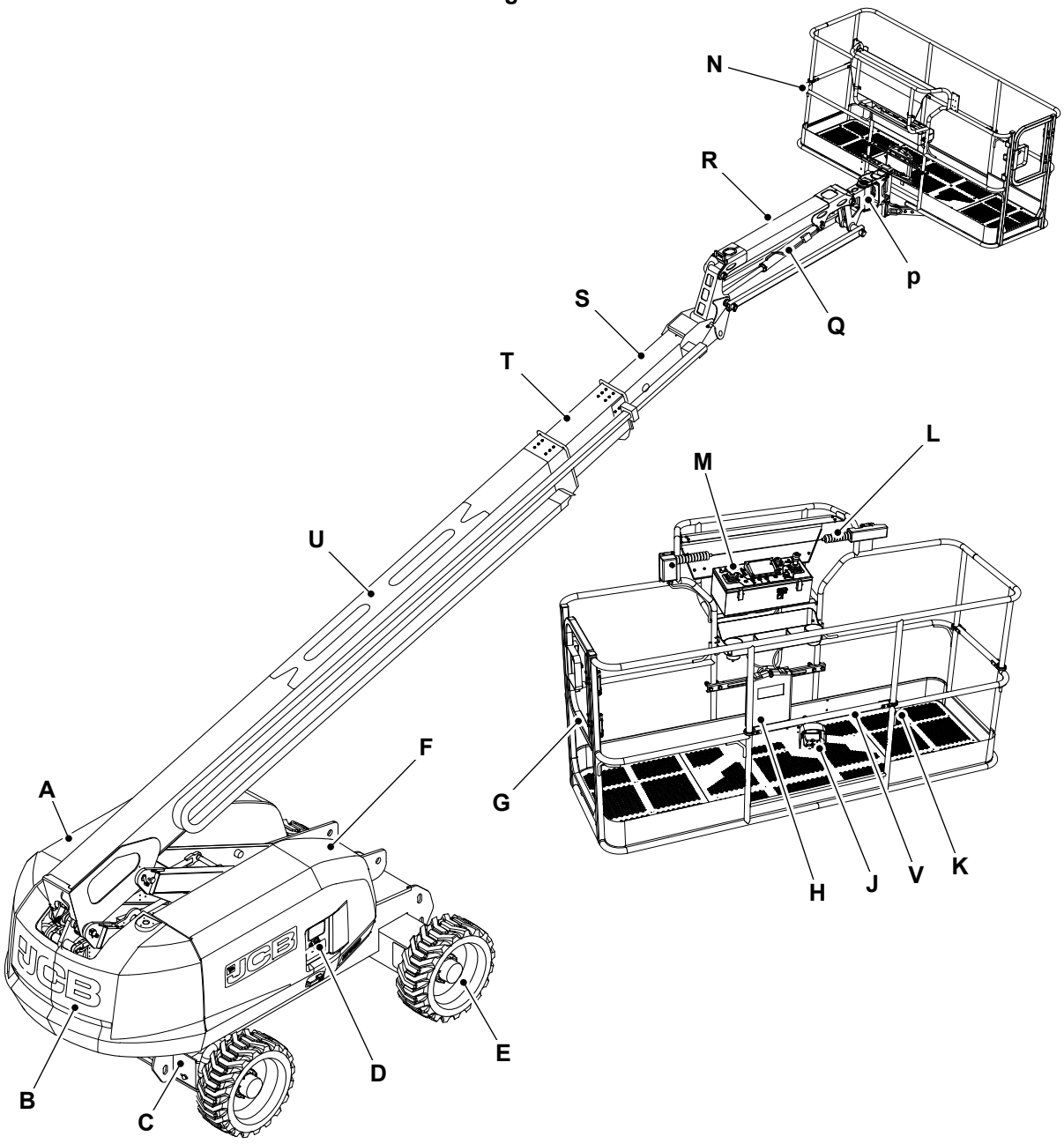
09 - Description

12 - Main Component Locations

Introduction

Figure 3.



A Engine canopy
B Counter weight
C Front axle
D Base controller

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E Wheel
F Control side canopy
G Platform entry door
H Operator manual's case
J Foot pedal switch
K Safety harness anchorage point
L Secondary guarding system
M Platform controller
N Work platform
P Rotary actuator
Q Jib lift cylinder
R Jib
S Telescopic boom (Stage 3)
T Telescopic boom (Stage 2)
U Telescopic boom (Stage 1)
V Platform entry slider

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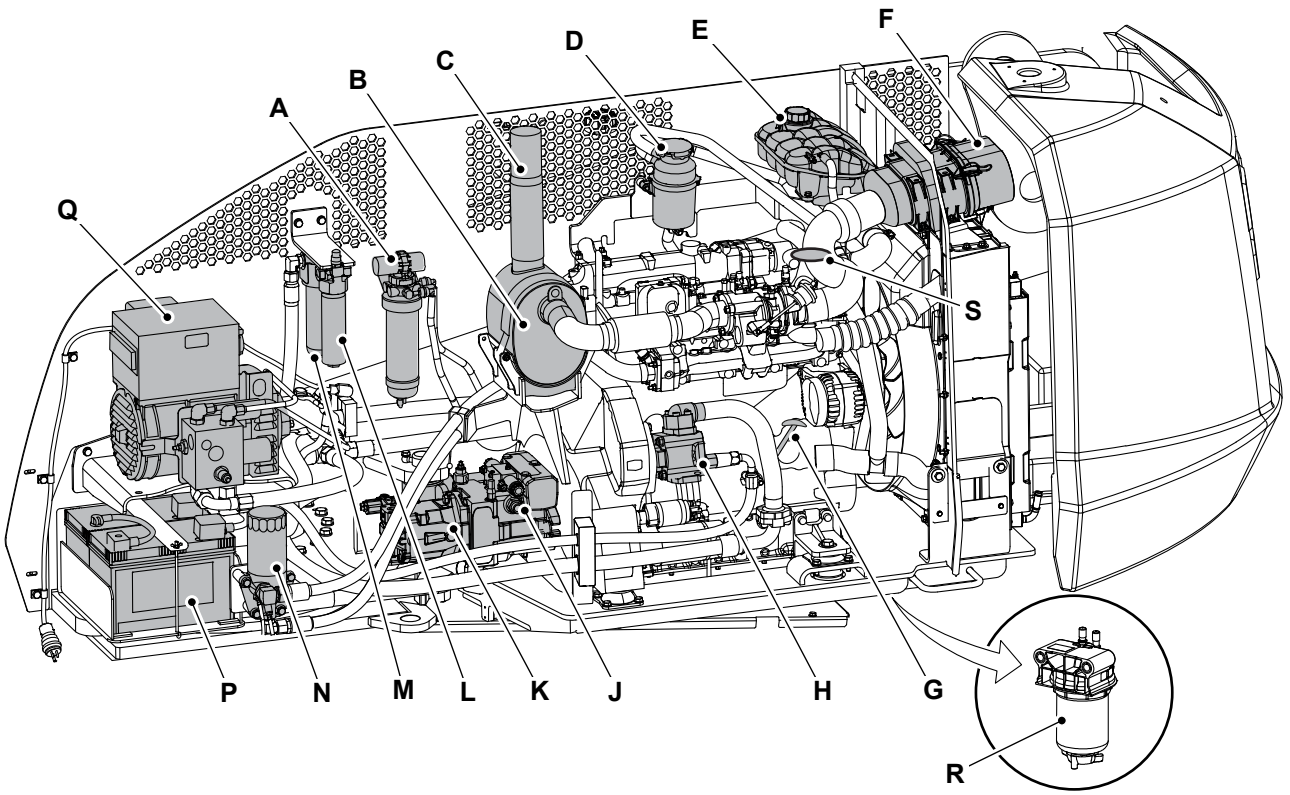
15 - Service Point Locations

Introduction

Figure 4.



A Primary fuel filter
B Engine exhaust
C Exhaust outlet pipe
D CCV (Crankcase Ventilation) unit
E Coolant expansion bottle
F Air cleaner
G Dipstick (engine oil)
H Engine PTO pump (optional fitment for generator option)
J Hydraulic transmission pump
K Hydraulic boom pump
L Hydraulic high pressure filter
M Hydraulic medium pressure filter
N Engine oil filter
P Batteries
Q Hydraulic generator
R Secondary fuel filter
S Engine oil fill point

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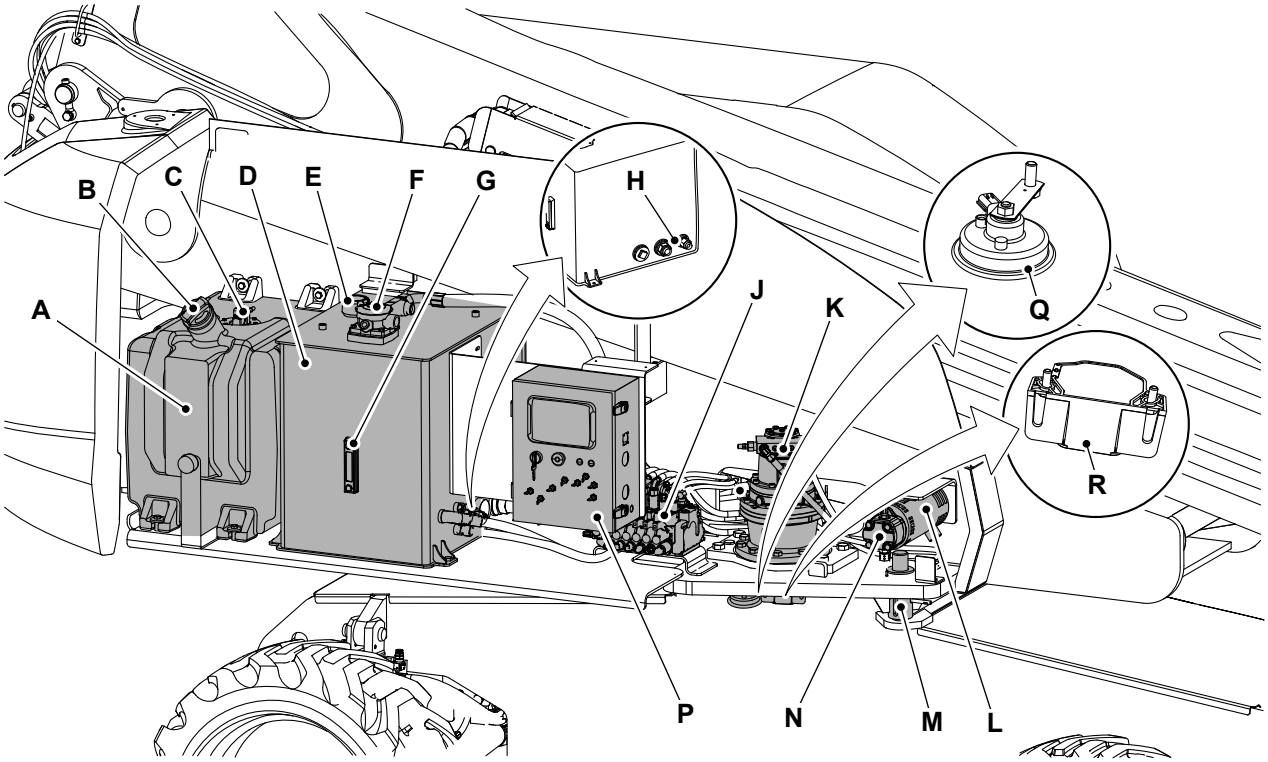
Figure 5.



A Fuel tank
B Fuel filler cap
C Fuel sender
D Hydraulic tank
E Filler / breather
F Return line filter
G Level gauge / oil temperature (hydraulic)
H Suction strainer
J Control valve block
K Slew drive motor
L Auxiliary motor
M Locking pin
N Auxiliary gear pump
P Base control panel
Q Horn
R White noise alarm

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12 - Operation

00 - General

Check (Operation) 01-20
Calibrate 01-21

Check (Operation)

You must check the machine and platform for correct operation at regular intervals.
Refer to: PIL 78-24-00.

Make a note of the following.

- The correct drive function is necessary for safe machine operation.
- The drive function must respond quickly and smoothly to operator control.
- The drive performance must be free of hesitation, jerking and unusual noise over the entire proportionally controlled speed range.
- Do this procedure with the machine on a firm, level surface that is free of obstructions.

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Calibrate

For Machine Serial Range up to '3499615'

If any component or part is changed on this machine, it is recommended to calibrate full machine in the specified sequence only, Refer to Table 4. and Refer to Table 5.

Table 4. Machine Calibration Sequence

Sequence	Check	Description
1	Calibrate and test the tilt sensor	Calibrate level sensor on 0° ground and test sensor on rated ramps. Refer to: Calibrate (PIL 33-84-60).
2	Setting of boom elevation and angle sensor	Set up boom length and angle sensor. Refer to: Calibrate (PIL 33-85-15).
3	Calibrate and test the weight sensor	On flat level ground. Refer 'Calibrating the Weight Sensor' section below. Refer to Table 5.
6	Parking brake test	Check the parking brake holds the machine on 40% ramp.
7	Gradeability test	Check the machine can drive on 40% ramp.
8	Check for base override	Switch the machine OFF. Press and hold base override switch. Switch the machine ON. Continue to press down and hold the 'base override' icon while pushing the boom function button. Clear the 'base override' icon. Refer to: Introduction (PIL 33-24-02).
9	Check for slew acknowledgement LED (Light Emitting Diode) and travel	Slew the turntable outside forward position (25°), check slew acknowledgement LED flashing and check the travel function is not enabled. Press foot pedal and slew acknowledgement button, check the LED turns solid and check the travel function enabled. Release the foot switch and check platform slew acknowledgement LED flashing. Slew inside forward position, check platform slew acknowledgement LED is off. Refer to: PIL 33-84-76. Refer to: PIL 27-00-00.
10	Secondary guarding check	Start the engine, press the secondary guarding cable. Refer to: PIL 06-97-00. Check the operator caution, LED flashes and buzzer beeps. Check drive, slew, raise and extend functions are disabled. Check main boom lower and telescopic boom retract are enabled. Operate platform levelling, function is disabled. Reset secondary guarding pull switch and check all the functions are enabled.
11	Check oscillating axle	For oscillating axle safety check. Refer to: PIL 27-20-01.

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Sequence	Check	Description
12	Alternator motor / hydraulic generator(if installed)	For PAT test, Refer to: PIL 30-07-00.
13	Hydraulic tank body/ joint seal	No leakage in the hydraulic tank body.

Table 5. Serial Number Range up to '3499615'

Software Version - V10.0	Calibration Options
NO	Existing calibration sequence: • Q-CAL kit. Or • Apply weights on the platform up to the rated load.
YES	Known load calibration sequence: • Q-CAL kit. Or • Apply weights on the platform.

Tilt Sensor Calibration

For tilt sensor calibration-
Refer to: Calibrate (PIL 33-84-60).

Boom Length and Angle Sensor Setting

For boom length and angle sensor calibration-
Refer to: Calibrate (PIL 33-85-15).

Calibrating the Weight Sensor

No Load Calibration

1. Take the machine to suitable testing area (flat ground).
2. Lower the platform to the stowed position.
3. Make sure that there is no load on the platform.
4. Turn the machine ON and make sure that both (base and platform) emergency switches are in released position.
5. Select the machine settings page of the display. For passcode, contact JCB dealer/JCB service for assistance.

   Refer to: PIL 33-24-02.
6. Select the load cell calibration option in the menu.
7. Select 'No Load' and press the 'Enter (tick)' button
8. Display will ask for confirmation.
9. Press the ' Enter (tick)' button again to confirm.
10. Once the calibration is done, the display will show the result of calibration.

Rated Load 1 Calibration

1. Take the machine to suitable testing area.
2. Lower the platform to the stowed position.
3. Put 300kg load on the platform.
4. Make sure that both (base and platform) emergency switches are in released position.
5. Turn the ignition switch to the ON position.
6. Select the machine settings page of the display. For passcode, contact JCB dealer/JCB service for assistance.

   Refer to: PIL 33-24-02.
7. Select the load cell calibration option in the menu.
8. Select 'Rated Load 1' and press the 'Enter (tick)' button
9. Display will ask for confirmation.
10. Press the ' Enter (tick)' button again to confirm.
11. Once the calibration is done, the display will show the result of calibration.

Table 6. Load Calibration Weights

Machine Model	Rated Load 1
T65D	300kg

Rated Load 2 Calibration

1. Take the machine to suitable testing area.
2. Lower the platform to the stowed position.
3. Put 454kg load on the platform.
4. Make sure that both (base and platform) emergency switches are in released position.

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5. Turn the ignition switch to the ON position.
6. Select the machine settings page of the display. For passcode, contact JCB dealer/JCB service for assistance.

   Refer to: PIL 33-24-02.
7. Select the load cell calibration option in the menu.
8. Select 'Rated Load 2' and press the 'Enter (tick)' button
9. Display will ask for confirmation.
10. Press the ' Enter (tick)' button again to confirm.
11. Once the calibration is done, the display will show the result of calibration.

Table 7. Load Calibration Weights

Machine Model	Rated Load 2
T65D	454kg

Raising and Lowering Speed

1. Make the machine safe.

   Refer to: PIL 01-03-27.
2. Test should be done on flat level ground.
3. Park the machine in a solid and even test free area from any overhead obstructions.
4. Make sure that both (base and platform) emergency switches are in released position.
5. Turn the ignition switch to the ON position.
6. Check the main boom lift cycle time as follows.
   - 6.1. Set the machine at 2200 RPM (Revolutions Per Minute).
   - 6.2. Raise the main boom.
   - 6.3. Make a note of the duration required for raising the main boom.
   - 6.4. Make sure that the cycle time is within the specified limits.

     Refer to: PIL 01-48-12.
   - 6.5. Lower the main boom to its fully stowed position.
   - 6.6. Make a note of the cycle time required for lowering the main boom.
   - 6.7. Make sure that the cycle time is within the specified limits.

     Refer to: PIL 01-48-12.
   - 6.8. If the main boom raising and lowering speeds are not within the range, adjust the maximum solenoid currents through service master.
7. Check the telescopic boom (extended / retracted) lift cycle time as follows.
   - 7.1. Set the machine at 1500 RPM.
   - 7.2. Extend the telescopic boom.
   - 7.3. Make a note of the duration required for extending the telescopic boom.
   - 7.4. Make sure that the cycle time is within the specified limits.

     Refer to: PIL 01-48-12.
   - 7.5. Retract the telescopic boom to its fully stowed position.
   - 7.6. Make a note of the cycle time required for retracting the telescopic boom.
   - 7.7. Make sure that the cycle time is within the specified limits.

     Refer to: PIL 01-48-12.
   - 7.8. Set the machine at 2200 RPM.
   - 7.9. Extend the telescopic boom.
   - 7.10. Make a note of the duration required for extending the telescopic boom.
   - 7.11. Make sure that the cycle time is within the specified limits.

     Refer to: PIL 01-48-12.
   - 7.12. Retract the telescopic boom to its fully stowed position.
   - 7.13. Make a note of the cycle time required for retracting the telescopic boom.
   - 7.14. Make sure that the cycle time is within the specified limits.

     Refer to: PIL 01-48-12.
   - 7.15. If the telescopic boom raising and lowering speeds are not within the range, adjust the maximum solenoid currents through service master.
8. Check the jib boom, telescopic boom lift cycle time as follows.
   - 8.1. Set the machine at 1500 RPM.
   - 8.2. Raise the jib boom.
   - 8.3. Make a note of the duration required for raising the jib boom.
   - 8.4. Make sure that the cycle time is within the specified limits.

     Refer to: PIL 01-48-12.
   - 8.5. Lower the jib boom to its fully stowed position.
   - 8.6. Make a note of the cycle time required for lowering the jib boom.

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8.7. Make sure that the cycle time is within the specified limits.

Refer to: PIL 01-48-12.

8.8. Set the machine at 2200 RPM.

8.9. Raise the jib boom.

8.10. Make a note of the duration required for raising the jib boom.

8.11. Make sure that the cycle time is within the specified limits.

Refer to: PIL 01-48-12.

8.12. Lower the jib boom to its fully stowed position.

8.13. Make a note of the cycle time required for lowering the jib boom.

8.14. Make sure that the cycle time is within the specified limits.

Refer to: PIL 01-48-12.

8.15. If the jib boom raising and lowering speeds are not within the range, adjust the maximum solenoid currents through service master.

9. Check the platform rotate cycle time as follows.

9.1. Set the machine at 1500RPM.

9.2. Rotate the platform clockwise.

9.3. Make a note of the duration required for rotating the platform.

9.4. Make sure that the cycle time is within the specified limits.

Refer to: PIL 01-48-12.

9.5. Set the machine at 2200 RPM.

9.6. Rotate the platform anti-clockwise.

9.7. Make a note of the duration required for rotating the platform.

9.8. Make sure that the cycle time is within the specified limits.

Refer to: PIL 01-48-12.

9.9. If the platform rotate clockwise and anti-clockwise speeds are not within the range, adjust the maximum solenoid currents through service master.

10. Check the slew- 90° cycle time as follows.

10.1. Set the machine at 1500 RPM.

10.2. Slew the machine at 90° to its fully stowed position.

10.3. Make a note of the duration required to slew- 90°.

10.4. Make sure that the cycle time is within the specified limits.

Refer to: PIL 01-48-12.

10.5. Slew the machine at 90° to its fully extended position.

10.6. Make a note of the cycle time required to slew- 90°.

10.7. Make sure that the cycle time is within the specified limits.

Refer to: PIL 01-48-12.

10.8. Set the machine at 2200 RPM.

10.9. Slew the machine at 90° to its fully stowed position.

10.10. Make a note of the duration required to slew- 90°.

10.11. Make sure that the cycle time is within the specified limits.

Refer to: PIL 01-48-12.

10.12. Slew the machine at 90° to its fully extended position.

10.13. Make a note of the cycle time required to slew- 90°.

10.14. Make sure that the cycle time is within the specified limits.

Refer to: PIL 01-48-12.

10.15. If the slew- 90° stowed and extended speed are not within the range, adjust the maximum solenoid currents through service master.

11. Check the platform levelling cylinder lift cycle time as follows.

11.1. Make sure that there is no one in platform and carry out the operation through base control panel.

11.2. Set the machine at 1500 RPM.

11.3. Raise the platform levelling cylinder.

11.4. Make a note of the duration required for raising the platform levelling cylinder.

11.5. Make sure that the cycle time is within the specified limits.

Refer to: PIL 01-48-12.

11.6. Lower the platform levelling cylinder to its fully stowed position.

11.7. Make a note of the cycle time required for lowering the platform levelling cylinder.

11.8. Make sure that the cycle time is within the specified limits.

Refer to: PIL 01-48-12.

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11.9. Set the machine at 2200 RPM.

11.10. Raise the platform levelling cylinder.

11.11. Make a note of the duration required for raising the platform levelling cylinder.

11.12. Make sure that the cycle time is within the specified limits.

Refer to: PIL 01-48-12.

11.13. Lower the platform levelling cylinder to its fully stowed position.

11.14. Make a note of the cycle time required for lowering the platform levelling cylinder.

11.15. Make sure that the cycle time is within the specified limits.

Refer to: PIL 01-48-12.

11.16. If the platform levelling cylinder raising and lowering speeds are not within the range, adjust the maximum solenoid currents through service master.

Machine Travel Speed Calibration

Make a note of the following.

- The correct drive function is necessary for safe machine operation.
- The drive function must respond quickly and smoothly to operator control.
- The drive performance must be free of hesitation, jerking and unusual noise over the entire proportionally controlled speed range.
- Do this procedure with the machine on a firm, level surface that is free of obstructions.

You must check the platform for correct operation in three different modes as follows.

At fast speed and platform in lowered position

1. Make the machine safe with the platform lowered.

   Refer to: PIL 01-03-27.

2. Put marks on the ground for start and finish lines. Make sure that the distance between the lines is as specified.

   Distance: 20m

3. Make sure that both (base and platform) emergency switches are in released position.

4. Turn the ignition switch to ON position.

5. Make a note of the point on the machine (contact patch of a tyre) as a visual reference when you cross the test line.

6. Make sure that the engine speed is in Hare mode, and the high torque setting is OFF.

7. Press and hold the foot pedal at the platform control position

8. Move the drive joystick in the forward direction.

9. Bring the machine to top drive speed before you reach the start line.

10. Start the timing when the selected reference point on the machine crosses the start line.

11. Continue at full speed and note the time when your reference point on the machine passes the finish line.

12. Make sure that the values are within the specified limits.

    Refer to: PIL 01-48-12.

At slow speed and platform in lowered position

1. Make the machine safe with platform lowered.

   Refer to: PIL 01-03-27.

2. Put marks on the ground for start and finish lines. Make sure that the distance between the lines is as specified.

   Distance: 20m

3. Make sure that both (base and platform) emergency switches are in released position.

4. Turn the ignition switch to ON position.

5. Make a note of the point on the machine (contact patch of a tyre) as a visual reference when you cross the test line.

6. Change the engine speed and high torque setting for required drive speed.

7. Press and hold the foot pedal at the platform control panel.

8. Move the drive joystick in the forward direction.

9. Bring the machine to top drive speed before you reach the start line.

10. Start the timing when the selected reference point on the machine crosses the start line.

11. Continue at full speed and note the time when your reference point on the machine passes the finish line.

12. Make sure that the values are within the specified limits.

    Refer to: PIL 01-48-12.

At platform in raised position

When the platform is raised, the machine automatically goes to the elevated speed mode.

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1. Make the machine safe.

   Refer to: PIL 01-03-27.

2. Put marks on the ground for start and finish lines. Make sure that the distance between the lines is as specified.

   Distance: 10m

3. Make sure that both (base and platform) emergency switches are in released position.
4. Turn the ignition switch to the ON position.
5. Extend the telescopic boom until the display shows the machine is in the raised position.

   Distance: 0.5m

6. Make a note of the point on the machine (contact patch of a tyre) as a visual reference when you cross the test line.
7. Make sure that the engine speed is in hare mode.
8. Press and hold the foot pedal at the platform control panel.
9. Move the drive joystick in the forward direction.
10. Bring the machine to top drive speed before you reach the start line.
11. Start the timing when the selected reference point on the machine crosses the start line.
12. Continue at full speed and note the time when your reference point on the machine passes the finish line.
13. Make sure that the speed is as specified limits.

    Refer to: PIL 01-48-12.

Brake Test

Make a note of the following.

- You must check the brakes for correct operation at regular intervals.
  Refer to: PIL 78-24.
- The correct brake function is necessary for safe machine operation.
- The brake function must operate smoothly, free of hesitation, jerking and unusual noise.
- Do this procedure with the machine on a firm, level surface that is free of obstructions.

1. Make the machine safe with the platform lowered.

   Refer to: PIL 01-03-27.

2. Put a mark on the ground to use as a test line.
3. Make sure that both (base and platform) emergency switches are in released position.
4. Turn the ignition switch to ON position.
5. Make a note of the point on the machine (contact patch of a tyre) as a visual reference when you cross the test line.
6. Press and hold the foot pedal at the platform control position
7. Move the drive joystick in the forward direction.
8. Bring the machine to top drive speed before you reach the test line.
9. Release the control lever when the selected reference point on the machine crosses the test line.
10. Measure the distance between the test line and the machine reference point.
11. Make sure that the braking distance is within the specified limits.

    Refer to: PIL 01-48-12.

12. Extend the telescopic boom.

    Distance: 0.5m

13. Do the steps 2 to 10 with the telescopic boom partly extended.
14. Make sure that the braking distance is within the specified limits.

    Refer to: PIL 01-48-12.

Gradeability Test

The brakes must be able to hold the machine upto 40% slope.
Refer to: PIL 78-24.

Make a note that the machine must be in high torque mode for the duration of this test.

1. Start the machine on specified slope ramp from base of the ramp and slowly drive up the ramp until both sets of wheels are on the ramp.

   Percentage: 40%

2. Hold/Park the machine on ramp for specified duration.

   Duration: 5s

   2.1. The machine should stop on ramp.

3. Drive the machine slowly down the slope. Stop while both sets of wheels are on the ramp.
4. Hold/Park the machine on ramp for specified duration.

   Duration: 5s

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4.1. The machine should stop on ramp.

Platform Pull Calibration (Q-CAL)

⚠ **DANGER** Ensure the shackles and the lifting slings are free from damage and have a valid load rating certificate, otherwise the load attachment could fail causing injury or death.

DANGER Ensure the load scale is calibrated every 12 months by an accredited calibration services provider. Do not perform this calibration procedure with a damaged load scale, a load scale with low batteries, an uncalibrated load scale or a load scale with an out of date calibration, otherwise the machine could tip over causing injury or death.

WARNING Ensure the safety struts are fitted to the jib and platform levelling hydraulic cylinders before standing under the platform. Failure to fit the safety struts will put you and others at risk of injury.

WARNING Do not operate the machine hydraulics during calibration or use them to apply the calibration load. Wear eye protection and exercise caution during load application. Operation of the machine hydraulics during calibration will put excessive load on the calibration kit, with potential failure and/or injury.

WARNING The platform must be completely empty during calibration, with no additional weights or accessories. If extra load is in the platform during calibration, the machine will be incorrectly calibrated which could pose a risk to machine stability when elevated.

WARNING Calibrate to the machine specific loads only, otherwise the machine will be incorrectly calibrated which could pose a risk to machine stability when elevated.

WARNING Do not overload the equipment or the platform carrier. Otherwise the machine will be incorrectly calibrated which could pose a risk to machine stability when elevated. There will also be a risk of equipment failure which can cause serious injury to the user.

An alternative method to achieve the rated load in the platform is to securely attach a load scale to the bottom of the platform and apply load using a lifting hoist. Make sure that the machine remains stable throughout the process and follow all relevant safety guidelines provided in this manual.

Use JCB Q-CAL kit 400/37260 to perform the task. For additional guidance or technical support, contact JCB Service. Only use the parts provided in this kit for platform calibration, no additional or substitute parts are to be used. If kit parts are damaged or the kit is incomplete, contact JCB Service.

Make sure that the platform load calibration is carried out by competent person(s) only.

Important: Handle the load scale carefully to avoid knocks or damage, as these can invalidate its calibration.

1. Make the machine safe.

   Refer to: PIL 01-03-27.

2. Locate a suitable low-level anchoring point that can support a shackle attachment and withstand the specified machine calibration load.

   Weight: 449kg

   2.1. The calibration loads are set 5kg lower than the platform's rated capacity to account for the combined weight of the load scale unit, sling and bow shackle.

   2.2. The attachment should be positioned as close to the ground as possible and connected using one of the slings provided in the kit.

3. Manoeuvre the machine or boom so that the center of the platform is directly above the low-level anchor point.

4. All operators must vacate the platform. Ensure the platform is empty of any additional weight/ attachment. Use the base controls to raise the platform to a 2m height from the ground level.

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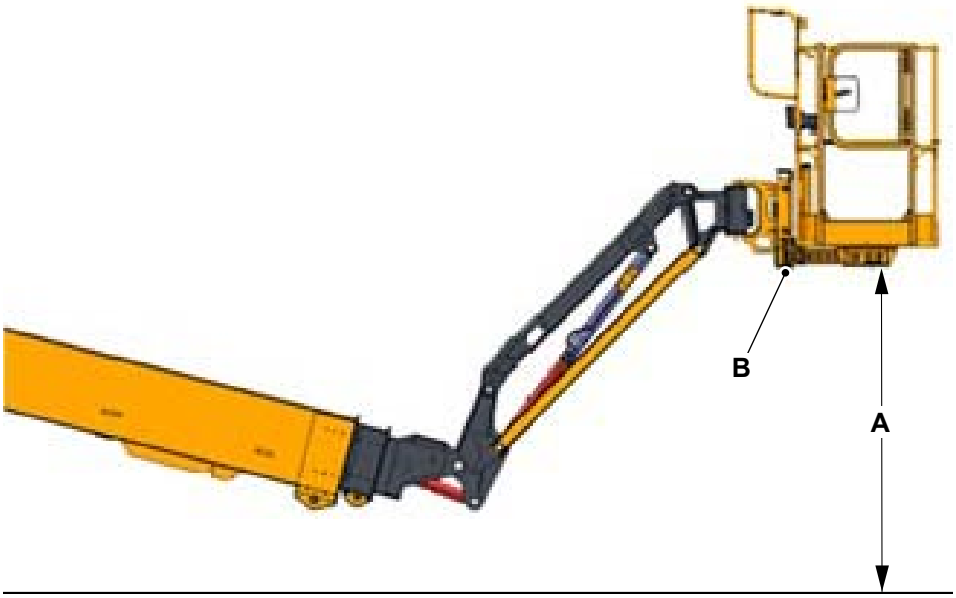
Figure 6.

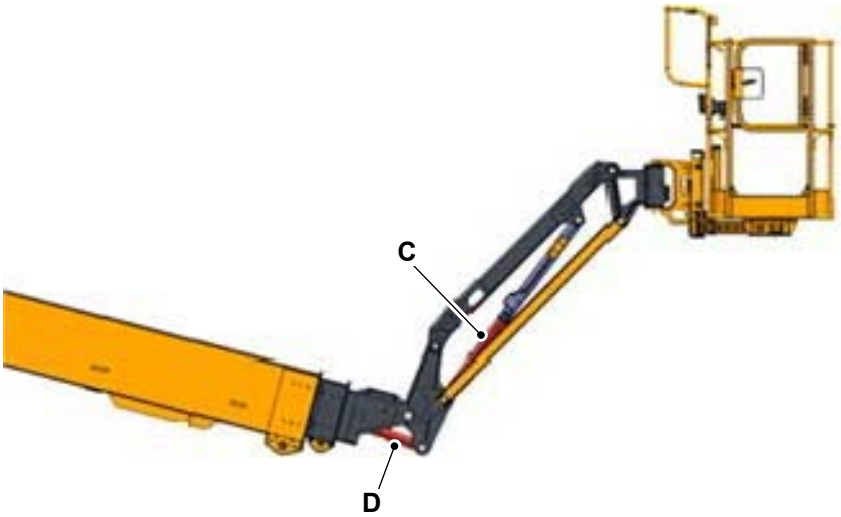


A Platform height

B Platform carrier

5. Make sure that the platform is central on its rotation axis and the platform floor is level to horizontal.

Figure 7.



C Jib cylinder strut

D Upper leveling cylinder strut

5.1. Fit the safety struts to the jib hydraulic cylinder and leveling hydraulic cylinder.

6. Do not attach any of the Q-Cal kit to the platform carrier at this point.

6.1. Ensure the engine is stopped.

7. Perform a no-load calibration procedure. Refer to the above section 'No Load Calibration' for more details.

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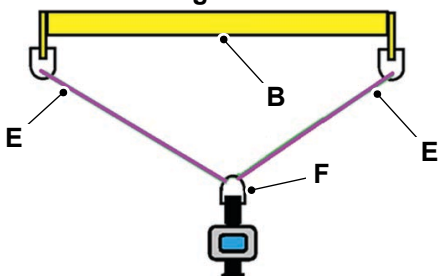
Figure 8.

8. Attach supplied sling (x2) to the apertures in the platform carrier using a choke hitch.

Figure 9.



B Platform carrier
E Sling (x2)
F Bow shackle

8.1. Once secured, join the hanging ends of both slings together with the supplied bow shackle.

8.2. Make sure not to attach the sling to any other part of the platform carrier or the platform basket.

9. Hang the load scale in the bow shackle as shown. Refer to Figure 10. Make sure that the load scale hook is at the bottom.

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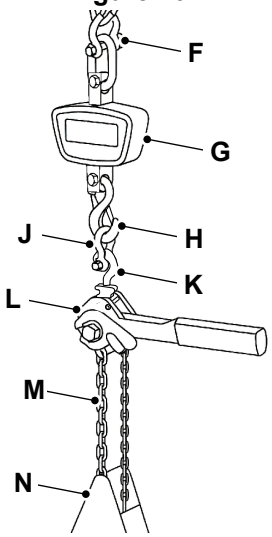
Figure 10.



F Bow shackle
G Load scale
H Load scale hook
J Bow shackle of the load scale
K Top hook of the lifting hoist
L Lifting hoist
M Lifting hoist chain
N Ground anchor point

9.1. Turn ON the load scale. Wait until the display initialises. Make sure to set the load scale to zero at this stage.

10. Attach the top hook of the lifting hoist to the bow shackle of the load scale located below the load scale. Refer to Figure 10.

11. Adjust the chain length so that the lower hook of the lifting hoist can be attached to the ground anchor point using the shackle. Make sure that the hook's safety catch is securely closed at the ground point. Refer to Figure 10.

12. Make sure that all hook safety catches are closed and all shackle pins are properly secured.

13. Make sure that the line of attachment from the platform carrier to the anchor point is aligned vertically when viewed from the rear and side of the platform. If necessary, adjust using the telescopic boom functions. Note: The line of attachment must remain vertical. Failure to maintain this alignment could invalidate the platform load calibration.

13.1. Make sure that there is no slack in the lifting sling and confirm that nothing is caught or snagged.

14. Use the ratchet handle to apply a tensile load. Gradually increase the load until the load scale readout falls within the specified range. Refer to Table 8.

14.1. Apply the load gradually and allow sufficient time for the system to stabilise. Once the readout value has settled, verify that it meets the specifications outlined in the table. Refer to Table 8.

14.2. If the readout is below the required value, apply additional load until the readout is within the specified range. Refer to Table 8.

15. Set the 'Rated Load' option on the base control display.

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Figure 11.

16. Make sure that the applied load has fully stabilised and falls within the specified range. Refer to Table 8.

    16.1. Once confirmed, select 'YES' on the calibration prompt displayed on the machine base control display.

17. Move the selector lever on the lifting hoist to the down position and use the handle to gradually release the load.

18. The platform load system is now calibrated.

19. Remove the safety strut from the jib cylinder and leveling hydraulic cylinder.

20. Use the base controls to lower the platform.

Table 8.

Loads	Calibration Range
Rated load	290.5→295kg
Rated load 2	444.5→449kg

For Machine Serial Range from '3499616'

Table 9. Serial Number Range from '3499616'

Software Version - V10.0	Calibration Options
YES	Known load calibration sequence: • Q-CAL kit. Or • Apply weights on the platform.

Known Load Calibration

The purpose of known load calibration is to allow a platform calibration using a known weight within the range specified for the machine's rated load.

Make sure that the known load calibration is carried out by trained service technician only.

The capacity of the platform may be reduced when the load sensing system is calibrated. For best performance, calibrate with a known weight of half of the machine capacity or more.

1. Make the machine safe.
   Refer to: PIL 01-03-27.

2. Navigate to 'Advanced Machine Settings' on the base control panel and select 'Load Cell Calibration'.

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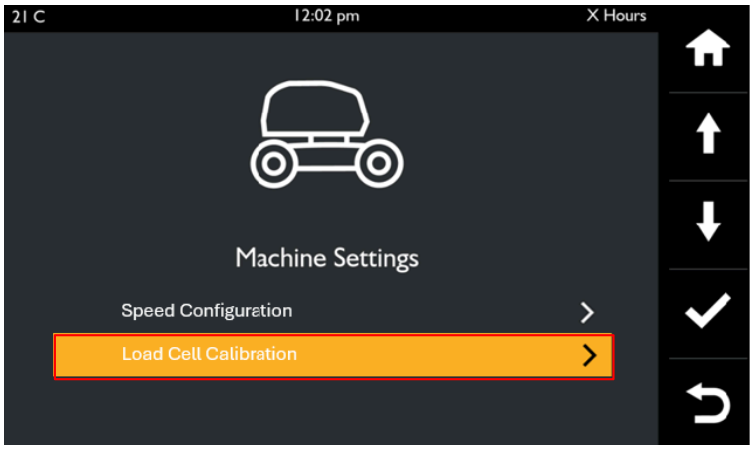
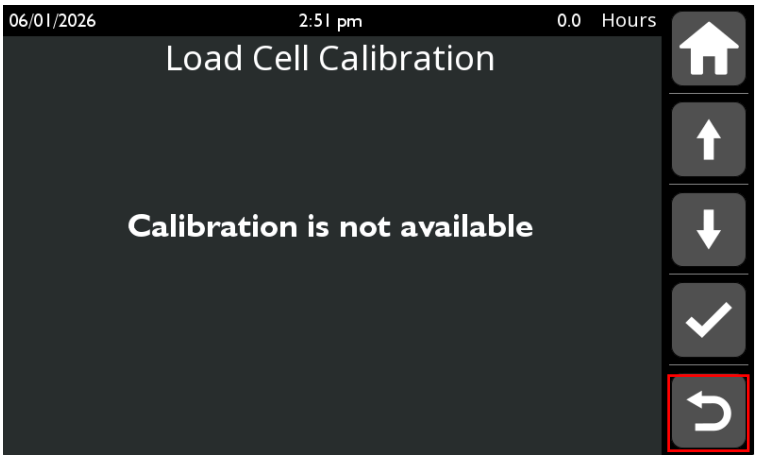
Figure 12.



3. Check the display for any message. If the message on the display is 'Calibration is not available', press 'Back' symbol to return to previous screen. Contact your JCB dealer for assistance. Refer to Figure 12.

Figure 13.



4. Make sure that the platform is empty, and all attachments or accessories are removed from the platform. Confirm this by pressing the 'Tick' symbol.

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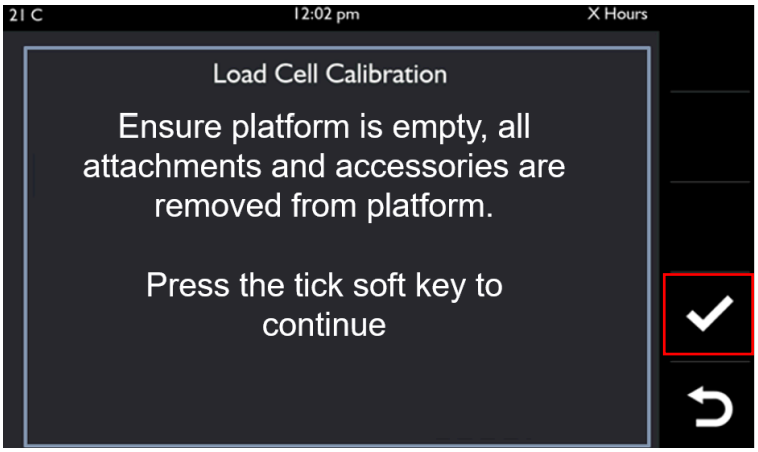
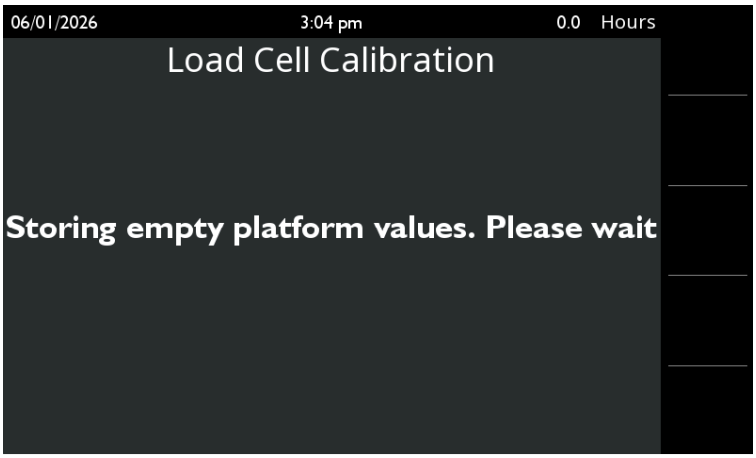
Figure 14.



5. Wait for the specified duration for the system to store the empty platform values.

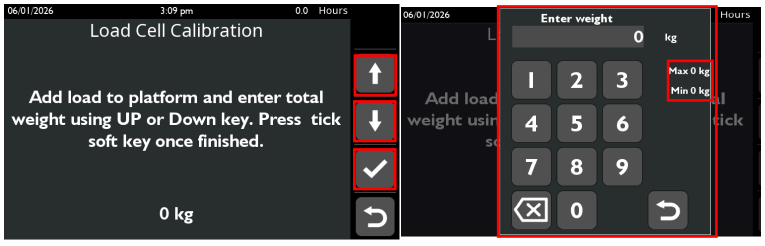
   Duration: 5s

Figure 15.



6. Add load to platform and enter total weight using 'UP' or 'Down' symbol. Press 'Tick' symbol once finished.

Figure 16.



   6.1. The minimum and maximum platform load values allowable for calibration (in kg/lbs) are displayed, and the keypad only accepts entries within this range.

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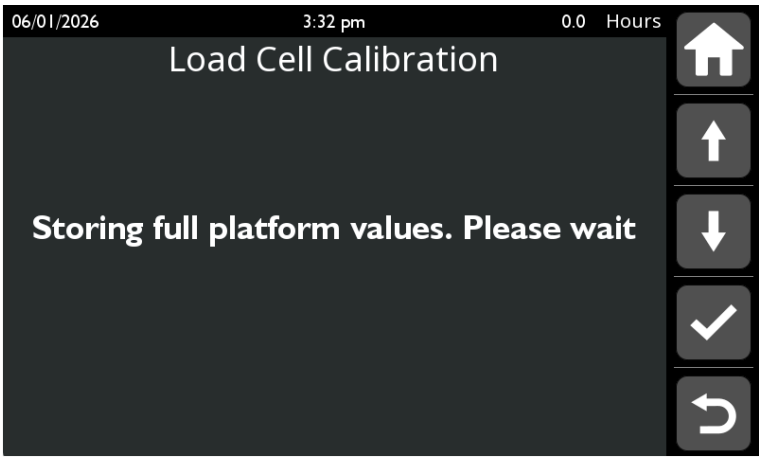
7. Wait for specified duration for the system to store the full platform values. Press the 'Tick' symbol to continue with the stored values.

   Duration: 5s

Figure 17.



8. When the weight entry is completed, the display shows the calibration process status.

Figure 18.

8.1. If the calibration is successful, a 'Calibration complete' message will appear on the display. To exit the display, press 'Back' or 'Home' to return to the main display.

8.2. If calibration fails or the process is exited early, a 'Calibration failed' message will appear on the display. To exit the display, press 'Back' or 'Home' to return to the main display. The previously stored calibration values will continue to be used. Restart the calibration procedure or contact your JCB dealer for assistance.

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27 - Lifting the Machine

00 - General

Introduction

1. Make the machine safe with the platform lowered.

   Refer to: PIL 01-03-27.

2. Remove any loose items from the machine.

3. Make sure all the access covers and canopies are securely shut.

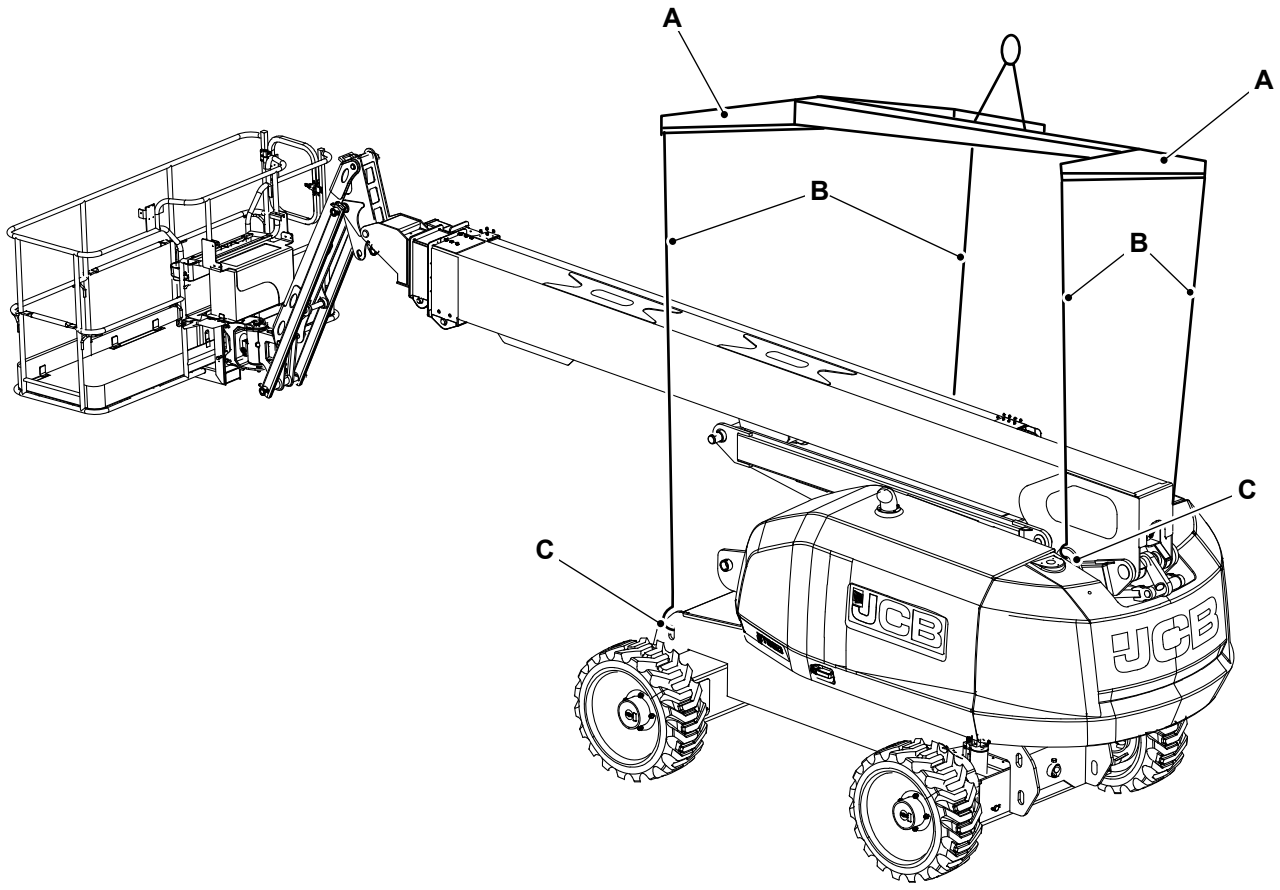
4. Use the correct length of hoisting rope to prevent damage to the platform base and guardrail.

5. Make sure the hoist rigging is in the correct position. Adjust the hoist rigging to prevent machine damage and keep the machine in the level position.

   5.1. You must consider the location of the centre of gravity on the machine, when you lift the machine.

   5.2. Use a foam to protect booms and counterweight at suitable contact points to avoid damage.

Figure 19.



A Spreader bars
B Lifting chains
C Lifting points

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Figure 20.

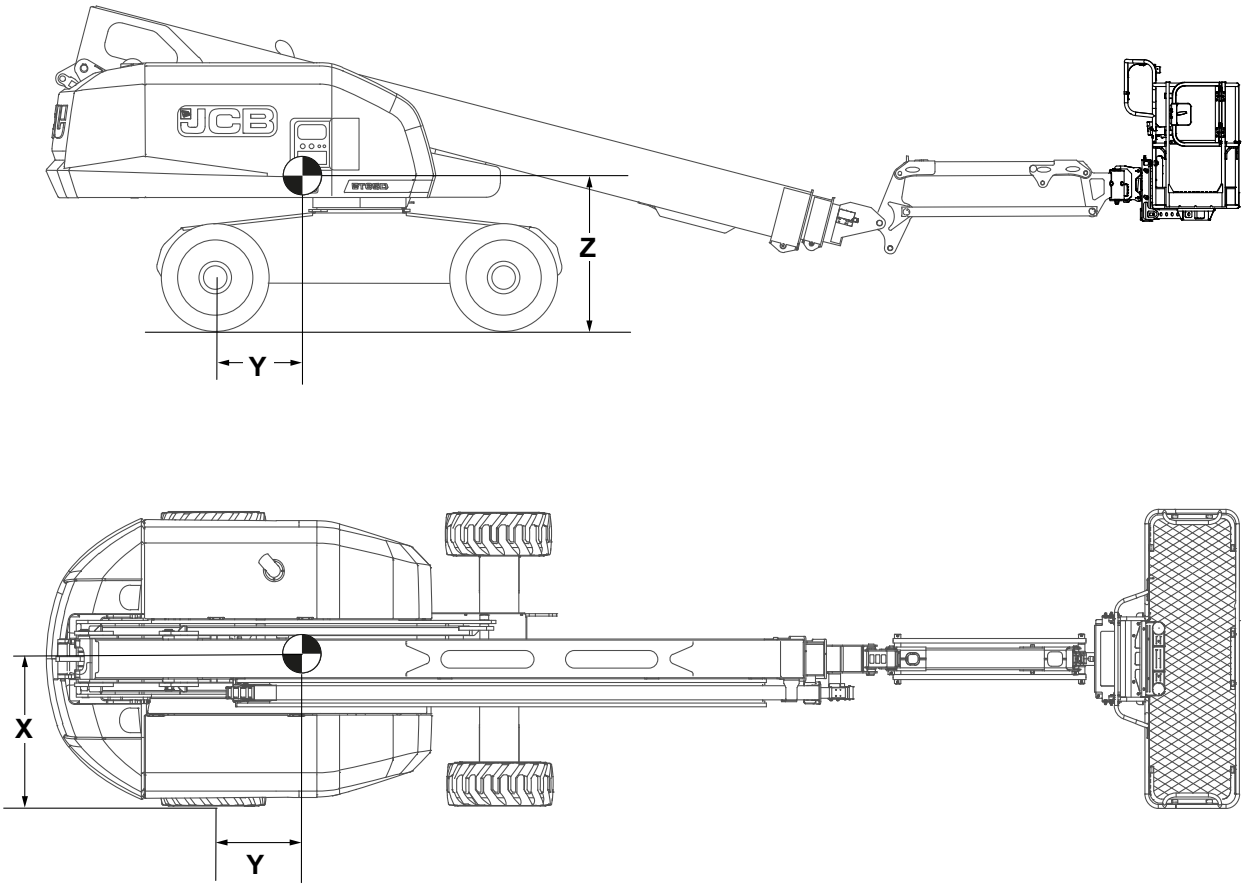

Table 10. Location of the Centre of Gravity

X- axis	Y- axis	Z- axis
1,221mm	802.6mm	1,305mm

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33 - Cleaning

00 - General

Introduction 01-37
Preparation 01-38
Clean 01-39

Introduction

⚠ **WARNING** When using cleaning agents, solvents or other chemicals, you must adhere to the manufacturer's instructions and safety precautions.

CAUTION To avoid burning, wear personal protective equipment when handling hot components. To protect your eyes, wear goggles when using a brush to clean components.

Notice: Cleaning metal parts with incorrect solvents can cause corrosion. Use only recommended cleaning agents and solvents.

Notice: The efficiency of the rams will be affected if they are not kept free of solidified dirt. Clean dirt from around the rams regularly. When leaving or parking the machine, close all rams if possible to reduce the risk of weather corrosion.

Notice: Never use water or steam to clean inside the battery compartment. The use of water or steam could damage the machine electrics and render the machine inoperable. Remove dirt using a brush or damp cloth.

Clean the product with water and/or steam. Do not let mud, debris etc. to collect on the product.

Before you do any service procedures that require components to be removed:

- The cleaning must be done in the area of components to be removed, or in the case of major work, the surrounding product must be cleaned.
- When cleaning is complete, move the product away from the wash area or alternatively, remove the material washed from the product.

When you remove components, be aware of exposure to dirt and debris. Cover any open ports and remove the deposits before proceeding.

Detergents

Do not use a full strength detergent. Always dilute the detergents as per the manufacturer's recommendations, or damage to the paint finish can occur.

Always obey the local regulations regarding the disposal of debris created from cleaning the product.

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Pressure Washing and Steam Cleaning

⚠ **CAUTION** When using a steam cleaner, wear safety glasses or a face shield as well as protective clothing. Steam can cause personal injury.

The electrical components could be damaged by high pressure washing systems. Special precautions must be taken if the machine is to be washed using a high pressure system. Make sure that the electrical components are shielded and not directly cleaned by the high pressure cleaning system. Do not aim the water jet directly at internal surface of the machine.

Use a low pressure water jet and brush to remove dried mud or dirt.

Use a pressure washer to remove soft dirt and oil.

The product must always be greased (if appropriate) after pressure washing or steam cleaning.

Table 11. Pressure Washing

Nozzle size	Distance	Water flow rate
6mm	2.5→3m	12.5L/min not exceeding 3

Preparation

1. Make the machine safe. Stop the machine and let it cool for at least one hour. Do not try to clean any part of the machine while it is running.
2. Make sure that all of the electrical connectors are correctly coupled.
3. If the connectors are open, attach the correct caps or seal with waterproof tape.

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Clean

⚠ **WARNING** When using cleaning agents, solvents or other chemicals, you must adhere to the manufacturer's instructions and safety precautions.

CAUTION To avoid burning, wear personal protective equipment when handling hot components. To protect your eyes, wear goggles when using a brush to clean components.

Notice: Cleaning metal parts with incorrect solvents can cause corrosion. Use only recommended cleaning agents and solvents.

Notice: The efficiency of the rams will be affected if they are not kept free of solidified dirt. Clean dirt from around the rams regularly. When leaving or parking the machine, close all rams if possible to reduce the risk of weather corrosion.

The following guidelines are for internal boom cleanliness for machines that are used in excessively dirty environments.

1. JCB recommends the use of the JCB kit to keep the internal portions of a boom cleaner and to help prevent dirt and debris from entering the boom. This package reduces the amount of contamination which can enter the boom but does not eliminate the need for more frequent inspections and maintenance when used in these types of environments.
2. JCB recommends you to follow all guidelines for servicing your equipment in accordance with the instructions outlined in the JCB Service Manual. Periodic maintenance and inspection is vitally important to the proper operation of the machine. The frequency of service and maintenance must be increased as environment severity and frequency of usage requires.
3. Debris and foreign matter inside of the boom can cause premature failure of components and should be removed. Methods to remove debris should always be done using all applicable safety precautions outlined in the JCB Operators Manual and JCB Service Manual.
4. The first attempt to remove the debris from inside the boom must be to utilise pressurised air to blow the debris towards the nearest exiting point from the boom. Make sure that all debris is removed before operating the machine.
5. If pressurised air cannot dislodge the debris, use water with mild solvents applied via a pressure washer. Wash the debris towards the nearest exiting point from the boom. Make sure that all debris is removed, Make sure that no puddles of water have occurred and the boom internal components are dry prior to operating the machine. The collection and disposal of wash water and debris should be in accordance with any local regulations.
6. If neither pressurised air nor washing of the boom dislodges and removes the debris, disassemble the boom in accordance to the instructions outlined in the JCB Service Manual to remove the debris.

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48 - Specifications

09 - Static Dimensions

Technical Data

Figure 21.

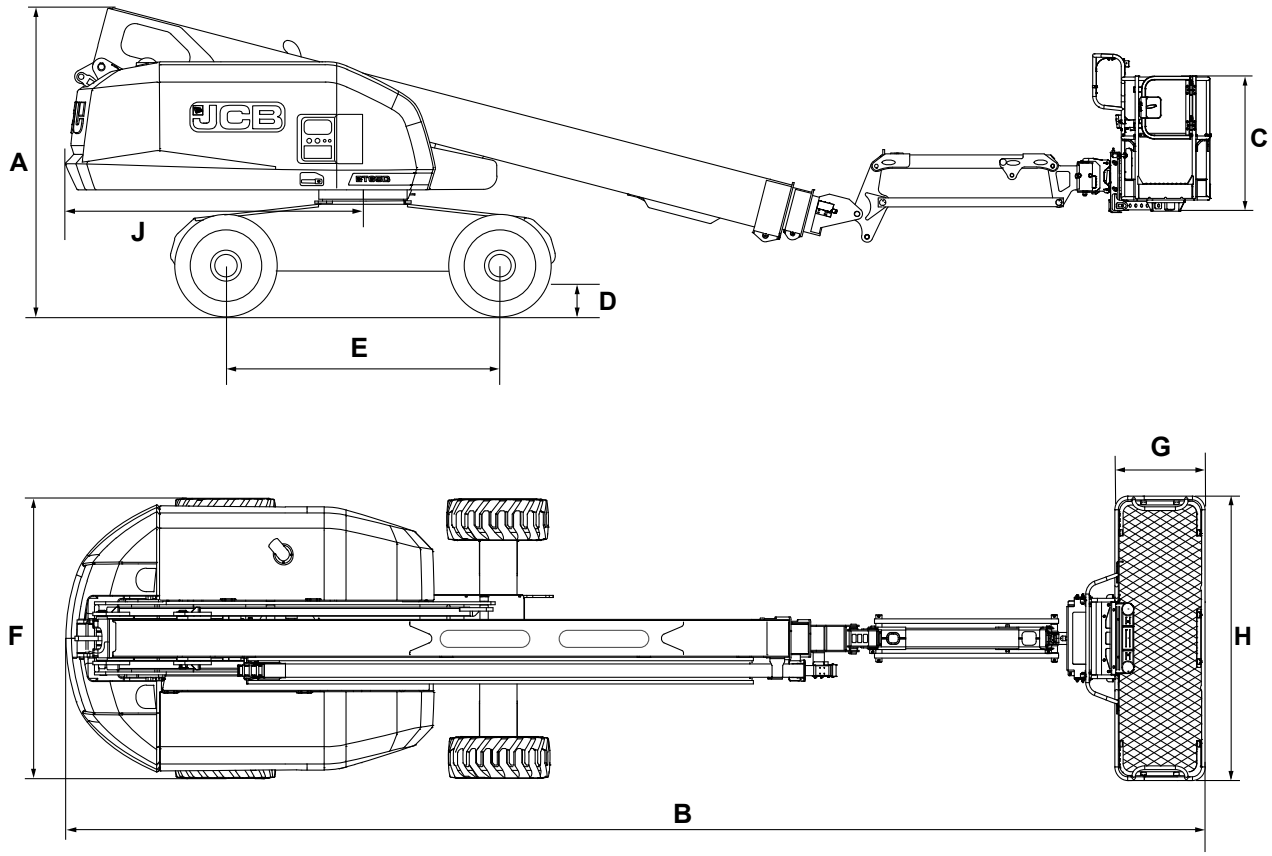

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Figure 22.

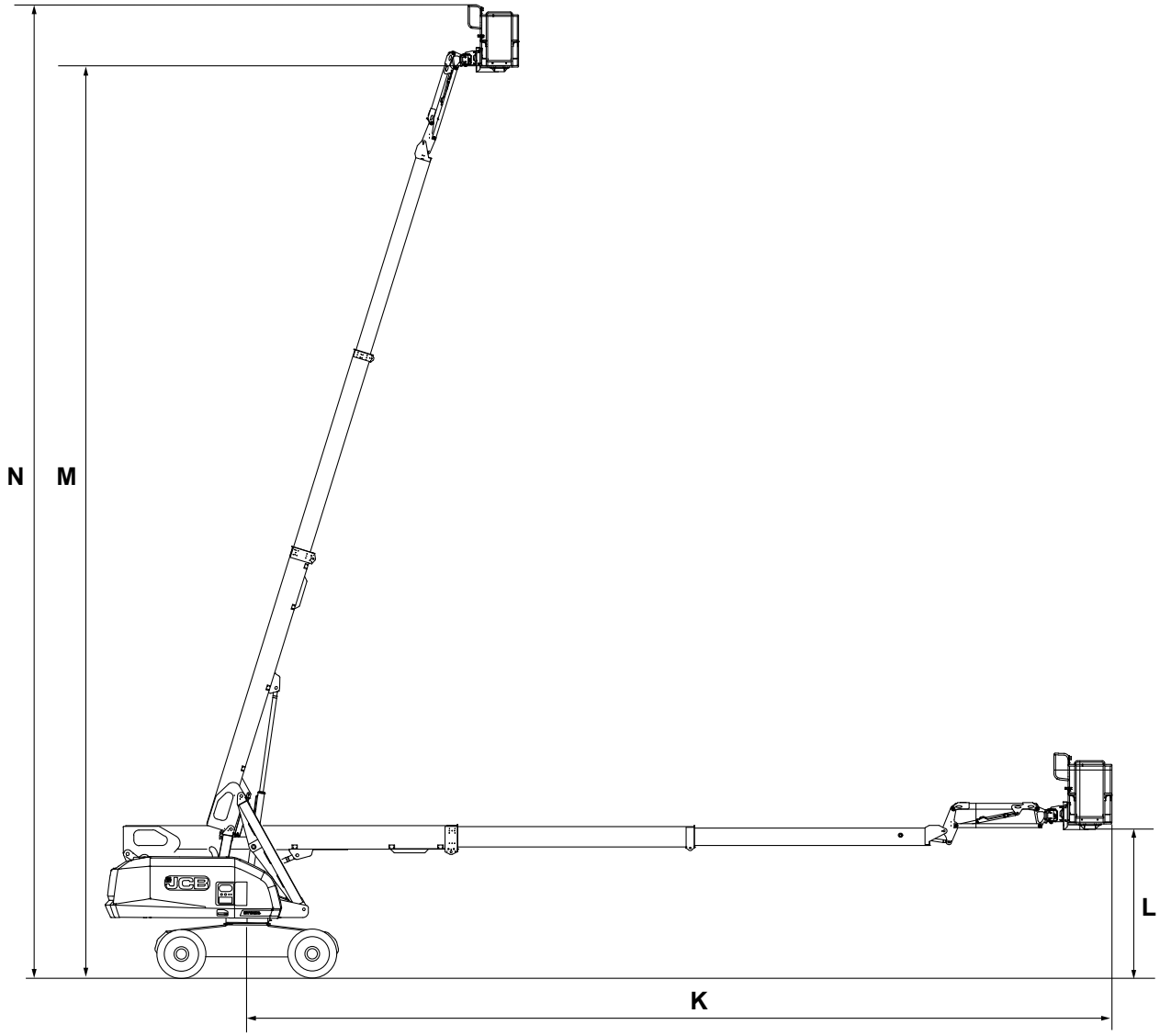

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Figure 23.

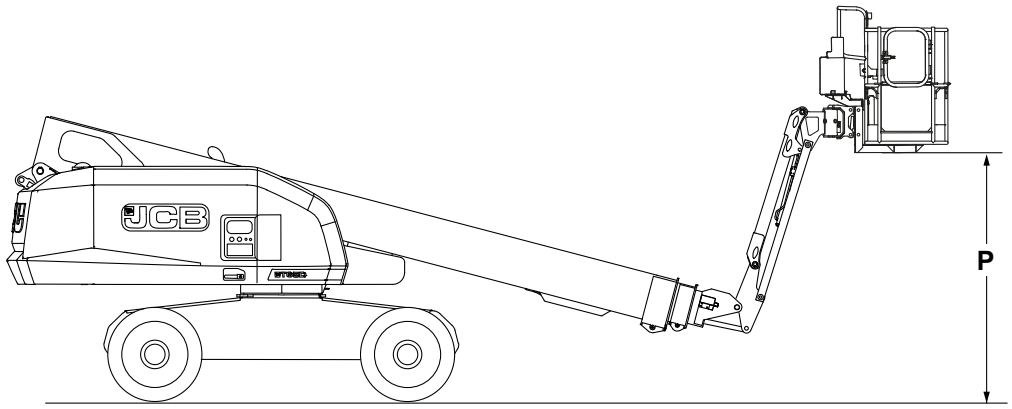

Table 12.

Items	Description	Length
A	Height- stowed	2.81m
B	Length- stowed	10.1m
C	Platform height	1.1m
D	Ground clearance	0.227m
E	Wheelbase	2.49m
F	Width	2.4m
G	Platform- width	0.84m
H	Platform-length	2.43m
J	Swing-radius	2.71m
K	Maximum horizontal reach	16.61m
L	Height at maximum horizontal reach	3.01m
M	Maximum platform height(2)	19.92m
N	Maximum working height	21.75m
P	Platform height	2.4m

(1) The maximum height that the basket can reach when the main telescopic boom is angled horizontally.
(2) Maximum working height adds 2m to the metric platform height, and adds 6ft to the imperial platform height, based on regional norms.

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10 - Weights

Technical Data

Table 13.

Description	Weight
Overall weight (approximate)	12,655kg
Load capacity	300kg(1)
	454kg(2)
Platform entry type and number	1 Gate and 2 slide bars
Platform occupancy	3 persons
Maximum manual force	400N
Maximum ground wheel load	5,352kg

(1) Capacity with 100% boom extension.
(2) Capacity with 80% boom extension.

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12 - Lift Arm Dimensions and Performance

Technical Data

Table 14. Drive Speed Checks

Description	Data
Maximum stowed drive speed	6km/h (3.7mph)
Engine at hare speed, wheel motor at low torque (20m)	10→12s
Engine at tortoise speed, wheel motor at low torque (20m)	17→21s
Engine at hare speed, wheel motor at high torque (20m)	30→34s
Engine at tortoise speed, wheel motor at high torque (20m)	45→49s
Maximum elevated drive speed (kph)	1km/h (0.6mph)
Elevated drive speed, engine at hare speed (10m)	35→38s
Elevated drive speed, engine at tortoise speed (10m)	38→41s
Maximum wind speed	12.5m/s
Stowed maximum inclination (front/ rear)	22°
Stowed maximum inclination (side)	14°
Raised inclination and gradeability	5°
Turning radius (outside)	5.1m
Turning radius (inside)	2.9m
Drive and steer	4WD, 2WS

Table 15. Operating Cycle Time

Description	Base Control Operation at 1500RPM (in Seconds)	Platform Control Operation at 1500RPM (in Seconds)	Platform Control Operation at 2200RPM (in Seconds)
Main boom- raise (Telescopic retract and fully telescopic extend)	60s ± 6s	60s ± 6s	60s ± 6s
Main boom- lower (Telescopic retract and fully telescopic extend)	60s ± 6s	60s ± 6s	60s ± 6s
Telescopic boom- extend	60s ± 6s	60s ± 6s	48s ± 6s
Telescopic boom- retract	48s ± 6s	48s ± 6s	48s ± 6s
Telescopic boom (Creep) - extend	NA	125s ± 15s	125s ± 15s
Telescopic boom (Creep) - retract	NA	90s ± 15s	90s ± 15s
Jib boom- raise	23s ± 3s	23s ± 3s	23s ± 3s
Jib boom- lower	17s ± 3s	17s ± 3s	17s ± 3s
Platform rotate (left to right)	15s ± 3s	15s ± 3s	15s ± 3s
Platform rotate (right to left)	15s ± 3s	15s ± 3s	15s ± 3s
Slew (Retracted) - 90° clockwise (left)	21s ± 3s	21s ± 3s	21s ± 3s

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Description	Base Control Operation at 1500RPM (in Seconds)	Platform Control Operation at 1500RPM (in Seconds)	Platform Control Operation at 2200RPM (in Seconds)
Slew (Retracted) - 90° anti-clockwise (right)	21s ± 3s	21s ± 3s	21s ± 3s
Slew (extended) - 90° clockwise (left)	39s ± 4s	39s ± 4s	39s ± 4s
Slew (extended) - 90° anti-clockwise (right)	39s ± 4s	39s ± 4s	39s ± 4s

Description	Base Control Operation at 1500RPM (in Seconds)	Platform Control Operation at 1500RPM (in Seconds)	Platform Control Operation at 2200RPM (in Seconds)
Slew (Creep) - 90° clockwise (left)	NA	150s ± 15s	150s ± 15s
Slew (Creep) - 90° anti-clockwise (right)	NA	150s ± 15s	150s ± 15s
Platform levelling-Up	55s ± 7s	NA	NA
Platform levelling-Down	55s ± 7s	NA	NA
Steer (left and right)	NA	5s ± 1s	5s ± 1s

Table 16. Speed and Braking Distance

Operation	Engine Speed (RPM)	POT	Speed (Kmph)	Braking Distance (m)
Stowed-forward	2200	100%	5.5 to 7	2.25
Stowed-reverse	2200	100%	5.5 to 7	2.25
Raised-forward	2200	100%	0.7 to 1	0.075
Raised-reverse	2200	100%	0.7 to 1	0.075

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Notes:

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06 - Body and Framework

Contents **Page No.**

Acronyms Glossary 06-2

06-00 Body and Framework
- 06-00-00 General 06-3

06-06 Moveable Panel and Cover
- 06-06-00 General 06-5
- 06-06-06 Engine Compartment 06-6
- 06-06-09 Hydraulic Compartment 06-8

06-17 Telescopic Boom
- 06-17-00 General 06-9
- 06-17-30 Wear Pads 06-21

06-24 Slew Ring
- 06-24-00 General 06-25

06-30 Pivot Pins
- 06-30-00 General 06-30

06-45 Gas Strut
- 06-45-15 Engine Compartment Cover 06-31
- 06-45-18 Hydraulic Compartment 06-32

06-57 Counterweight
- 06-57-00 General 06-33

06-63 Identification Label
- 06-63-00 General 06-36
- 06-63-03 Machine 06-37
- 06-63-06 Engine 06-39

06-70 Powertrack
- 06-70-00 General 06-41

06-73 Jib
- 06-73-00 General 06-44

06-93 Emergency Lower System
- 06-93-00 General 06-49

06-97 Platform
- 06-97-00 General 06-51

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Acronyms Glossary

ECU	Electronic Control Unit
PIN	Product Identification Number
VIN	Vehicle Identification Number

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00 - Body and Framework

00 - General

Introduction 06-3
Check (Condition) 06-4

Introduction

This machine mainly consists of chassis, turntable, counterweight, power system, boom linkages, main telescopic boom, jib and work platform.

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Check (Condition)

1. Make sure that all of the guards and protective devices are in position, secured by their locking devices and free from damage.
2. Inspect all the steelwork for damage. Include the following:
   2.1. Examine all the pivot point welds.
   2.2. Examine the condition of all pivot pins.
   2.3. Check the pivot pins are correctly in position and secured by their locking devices.
3. Check the guardrails are undamaged and not removable.
4. Check that all the safety and instructional labels are undamaged and in position. Install new labels where necessary.
5. Note any damaged paintwork for future repair.
6. Inspect the machine for broken or loose fasteners.

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06 - Moveable Panel and Cover

00 - General

Introduction

Access panels provide easy access to the machine major components test and service points and other parts which require routine testing, servicing, adjusting, replacement or repair.

Before you operate the machine, make sure that all of the access panels are in their operation position and secure.

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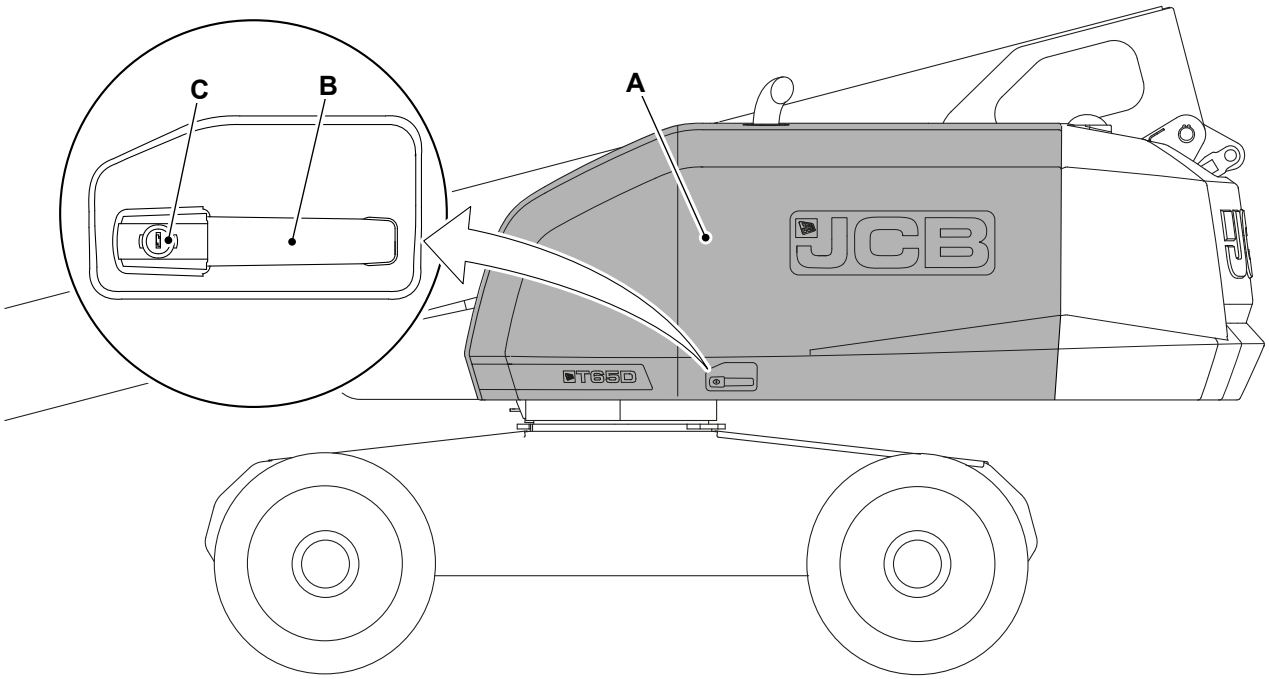
06 - Engine Compartment

Open and Close

To open the cover:

1. Unlock the right hand side body panel with the ignition key.
2. Push the button on the lock barrel.
3. Pull the handle to release the latch and open the cover.
4. The cover is supported by gas springs.

Figure 24.



A Engine compartment cover
B Handle
C Lock

To close the cover

1. Close the cover by pushing the handle firmly; it will latch itself.

Engine Access

Opening the engine tray allows access to the rear of the engine for troubleshooting items such as engine ECU (Electronic Control Unit).

To open the engine tray:

1. Remove the securing bolt with 24 mm A/F spanner.
2. Remove the locking pin from swivel side.
3. Pull the engine tray out.
4. Insert the locking pin to keep the engine tray in its locked position.

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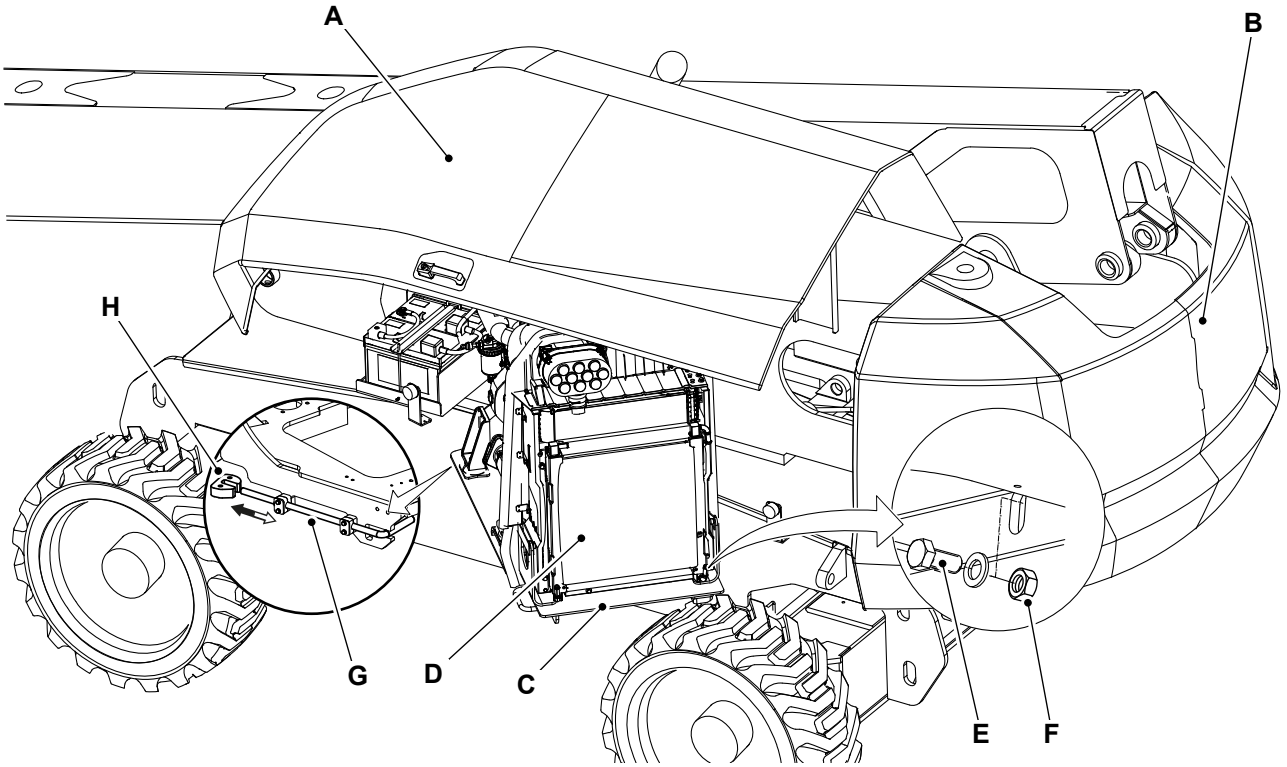
Figure 25.



A Engine compartment cover
B Counter weight
C Engine tray
D Engine
E Securing bolt
F Locking nut
G Locking pin
H Lock stop plate

To close the engine tray:

1. Remove the locking pin from the lock stop plate and push the tray inside.
2. Insert locking pin at swivel side.
3. Install and torque tighten the securing bolt with 24 mm A/F spanner to the specified torque value.

   Torque: 184N·m
4. Close the cover by pushing the handle firmly; it will latch itself.

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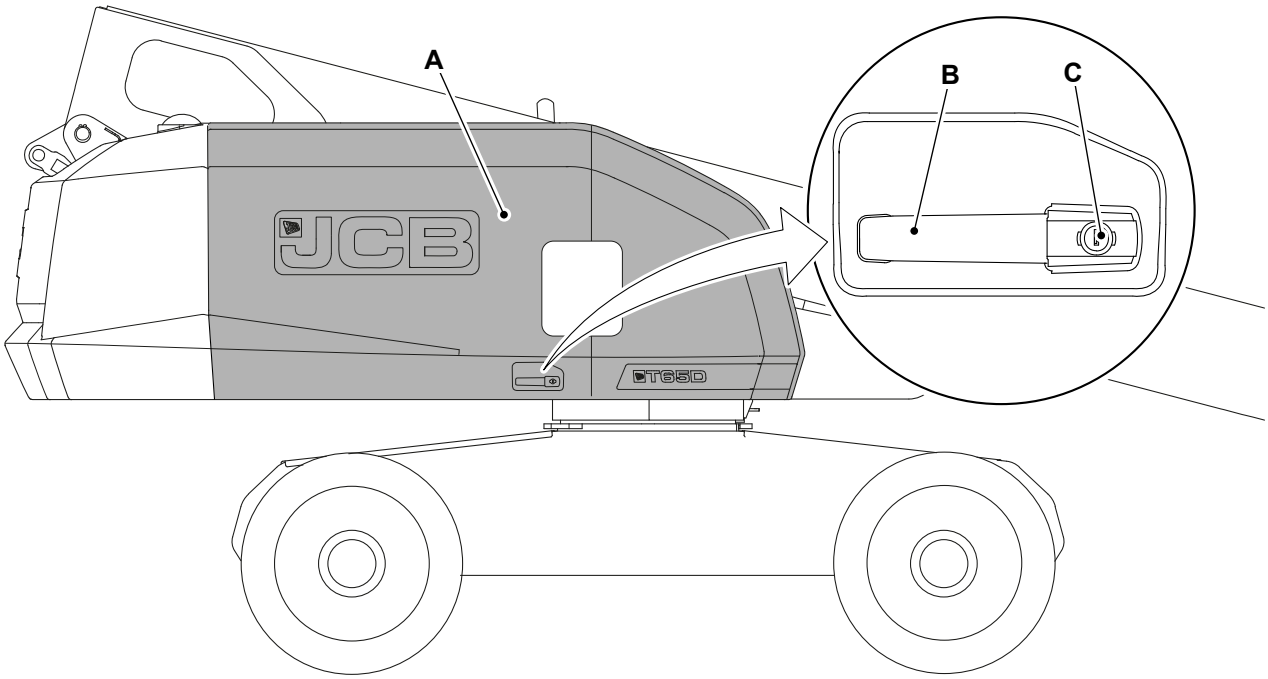
09 - Hydraulic Compartment

Open and Close

To open the cover:

1. Unlock the cover with the ignition key.
2. Push the button on the lock barrel.
3. Pull the handle to release the latch.

Figure 26.



A Body panel left side
B Handle
C Lock

To close the cover:

1. Close the cover by pushing the handle firmly; it will latch itself.

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17 - Telescopic Boom

00 - General

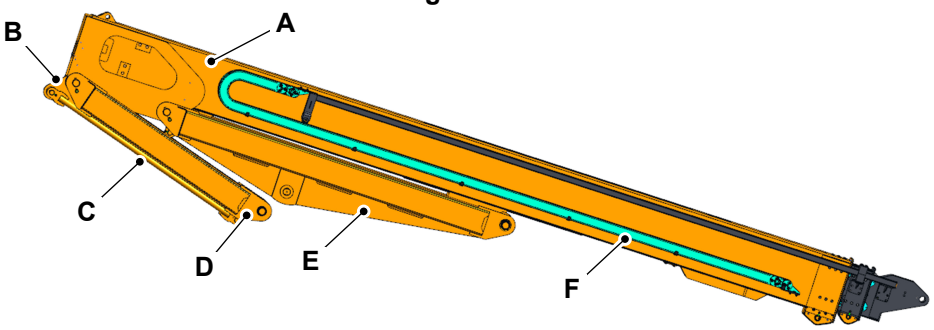
Introduction 06-9
Component Identification 06-10
Operation 06-11
Check (Condition) 06-12
Lubricate 06-13
Remove and Install 06-14
Disassemble and Assemble 06-17

Introduction

The telescopic boom mainly consist of 3 stage telescopic boom, connection bracket, linkage rods, folding arm, cylinder support arm and drag chain.

The 3 stage telescopic boom consists of inner, intermediate and outer boom.

Figure 27.



A Telescopic boom- 3 stage
B Connection bracket
C Linkage rods
D Folding arm
E Cylinder support arm
F Drain chain

Telescopic boom- 3 Stage

It houses all 3-stage boom (inner, intermediate and outer) within each other along with other supporting components which facilitate telescopic movement of the boom.

Connection Bracket

It provides linkage support between outer boom, linkage rods, folding arm and lower leveling cylinder.

Linkage Rods

These are used to support lower leveling cylinder and facilitates its opening and closing along with boom's vertical movement thereby keeping operator's platform aligned and horizontal with respect to ground.

Folding Arm

It acts as structural support to boom during lift and duty cycle operation.

Cylinder Support Arm

It acts as structural support to boom during lift and duty cycle operation. It also provide support to boom lift cylinder as it is mounted in the cylinder support arm.

Drag Chain

It supports electrical harnesses, cables and hydraulic hoses during telescopic movement of the boom.

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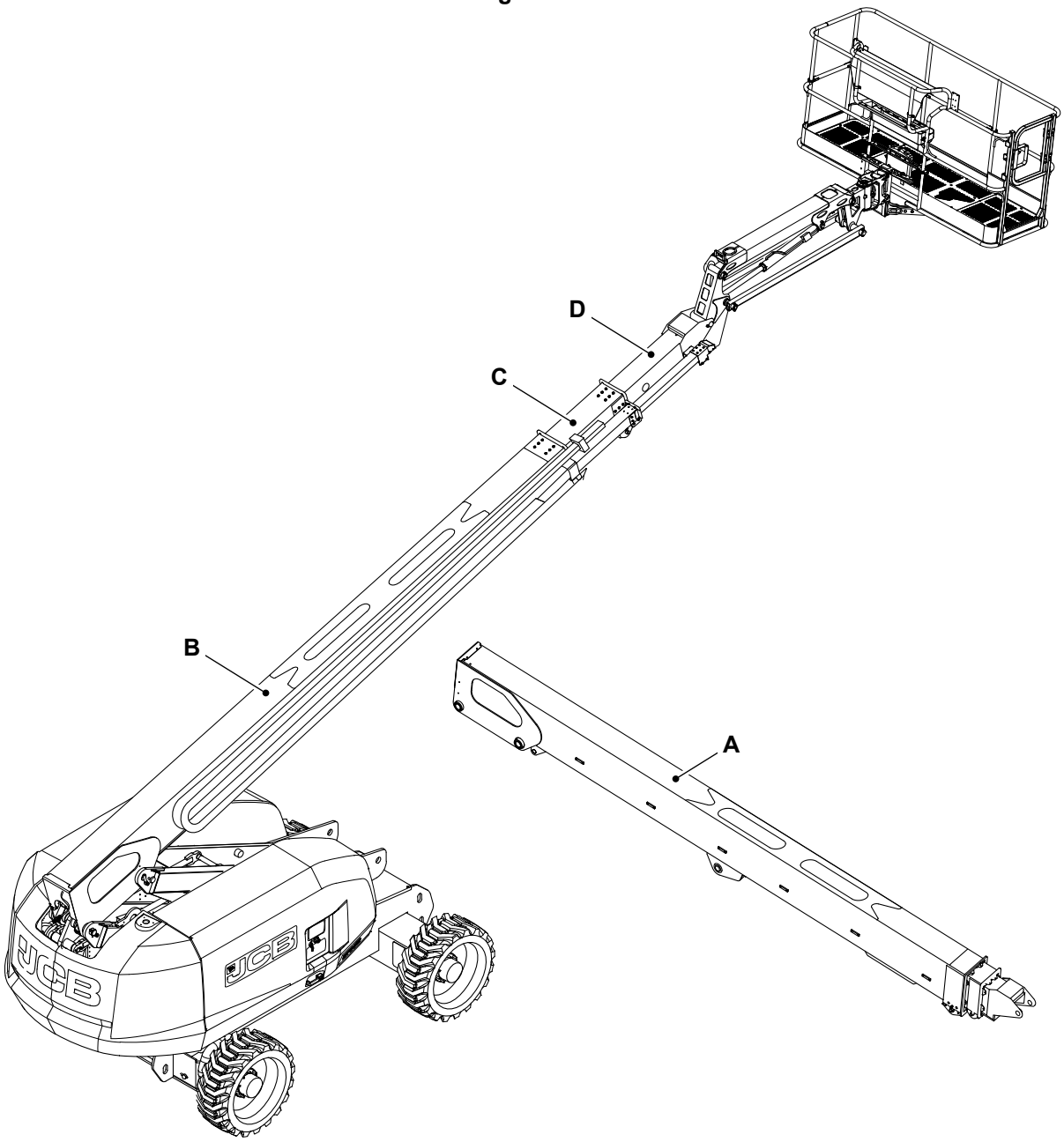
Component Identification

Figure 28.



A Telescopic boom
B Outer boom
C Intermediate boom
D Inner boom

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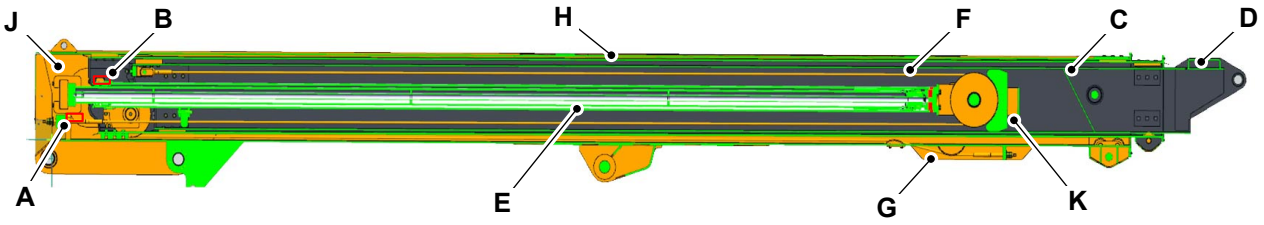
Operation

The main telescopic boom consists of inner, intermediate and outer boom. This assembly is supported by three rams.

- Lifting ram
- Levelling / lowering ram
- Telescopic ram.

Refer to: Component Identification (PIL 06-17-00).

Figure 29.



A Point A on the outer boom
B Point B on intermediate boom
C Intermediate boom
D Inner boom
E Boom extension cylinder
F Wire rope- extension cable (x2)
G Wire rope- retraction cable (x2)
H Telescopic boom
J Outer boom
K Head wheel pulley

Telescopic Boom - Interaction

1. Outer and intermediate booms are connected with boom extension cylinder which has stroke of 4358mm.
2. The rod end side of the ram is connected to 'Point A' on the outer boom and cylinder end side is connected to 'Point B' on intermediate boom. Refer to Figure 29.
3. The wire rope- extension cable (x2) are connected to the inner boom, then pass around the head wheel pulleys mounted to the telescopic extension cylinder and are connected at the outer boom.
4. The wire rope- retraction cable (x2) are anchored on the front of the outer boom, they pass around head wheel pulleys at the rear of the intermediate boom and are anchored close to the rear of the inner boom.
5. All the booms are supported on the wear pads and rollers which are self-lubricating in nature and facilitates smooth extension/retraction of the booms.

   Refer to: PIL 75-00-00.

Telescopic Boom - Actuation

1. As the boom extension cylinder is extended, the cylinder directly moves the intermediate boom.
2. The movement of the head wheel pulleys causes the inner boom to extend by the same distance relative to the intermediate boom.
3. The retraction of the boom also follows the same principal, through the wire rope- retraction cable (x2) and movement of the head wheel pulleys at the rear of the intermediate boom.

The close length of the telescopic boom is 6,971mm.

The open length of the telescopic boom is 15,687mm.

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Check (Condition)

⚠ **WARNING** If delayed movement is detected during wire rope operation, lower the platform to the stowed position, shut down the machine and have the wire ropes inspected/serviced by a qualified engineer. Loose or incorrectly adjusted wire ropes could result in serious injury or death.

CAUTION Wire rope can have sharp edges. Never handle wire rope with bare hands, otherwise you could be injured.

Wire Rope Maintenance

Before using the machine, make sure that telescopic boom is raised approximately horizontal, extend and retract the telescopic boom and check the wire ropes.

Inspection

1. Inspect the wire ropes for broken wires, particularly valley wire breaks and breaks at end terminations.

Figure 30.

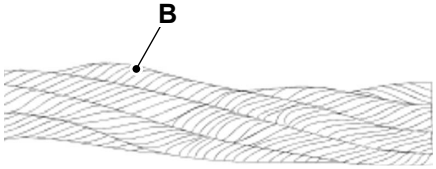
A Wire rope breaks

1.1. Note: Flexing a wire rope can often expose broken wires hidden in valleys between strands.

2. Inspect wire ropes for corrosion.

3. Inspect wire ropes for kinks or abuse (Note: Kink is caused by pulling down a loop in a slack line during improper handling, installation or operation).

Figure 31.



B Wire rope kink

4. Inspect the pulleys for condition of bearings / pins and flanges.

5. Wire ropes passing inspection must be lubricated with wire rope lubricant before reassembly.

Three Month Inspection

1. Remove boom covers and visually (with flashlight) inspect the ropes for rust, broken wires, frays, abuse or any signs of abnormalities.

2. Check wire rope tension by deflecting wire ropes by hand. Properly tensioned ropes should have little or no movements.

3. Additional inspection is required for below scenarios:

3.1. Machine is exposed to hostile environment or conditions.

3.2. If unpredictable boom operation or unusual noise exists.

3.3. Machine is idle for an extended period of time.

3.4. Telescopic boom is overloaded or sustained with shock load.

12 Years or 7000 Hours Inspection/Replacement

Wire ropes and pulleys must be replaced in sets.

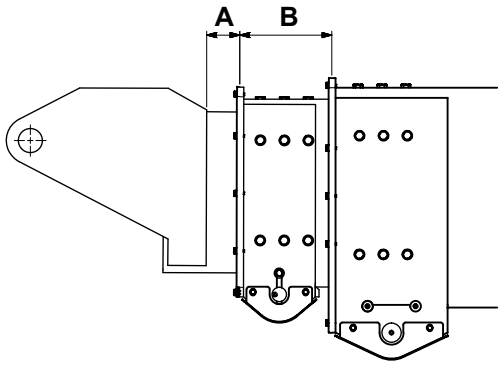
The additional replacement for wire rope must be done in below scenarios:

- Rusted or corroded wire ropes
- Kinked, 'bird caged', or crushed ropes
- Ropes at end of adjustment range
- Pulleys failing wear-out gauge inspection.
- Ropes with 6 total broken wires in one rope lay, 3 in one strand in one rope lay, 1 valley break, or 1 break at any end termination.

Wire Rope Service and Torquing Details

1. Make sure that the telescopic boom is in horizontal and retracted position.

Figure 32.



A 72 ± 5mm
B 190 ± 15mm

2. Extend the telescopic boom horizontally to the specified value.

Length: 1.5m

3. Counter hold both thread ends of the wire rope with the suitable tool to prevent twisting during torquing. Do not allow wire ropes to twist during torquing as it may damage the wire ropes.

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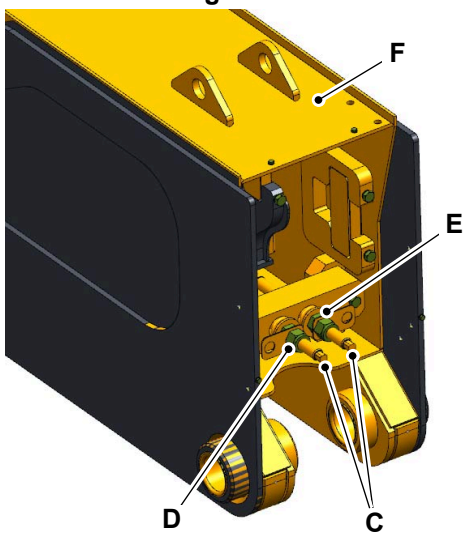
Figure 33.



C Thread ends (x2)
D Locknut (x2) 40N·m
E Nut (x2) 20N·m
F Telescopic boom

4. Tighten the retract rope adjustment nut (x2) to specified torque value. Refer to Figure 33.

   Torque: 20N·m

5. Retract the telescopic boom to the specified value.

   Length: 0.5m

6. Tighten the extend rope adjustment nut (x2) to the specified torque value.

   Torque: 20N·m

   6.1. Make sure that extend wire ropes do not twist during torquing.

7. Again, repeat the step 1 and step 6.

8. Finally, once all the adjustment nut (x2) are torqued, retract the telescopic boom fully and make sure that each boom section meets the dimension A and B values. Refer to Figure 32.

   8.1. If telescopic boom section doesn't meet the dimension A and B values, return to step 1.

9. Now, tighten the locknut (x2) to the specified torque value. Refer to Figure 33.

   Torque: 40N·m

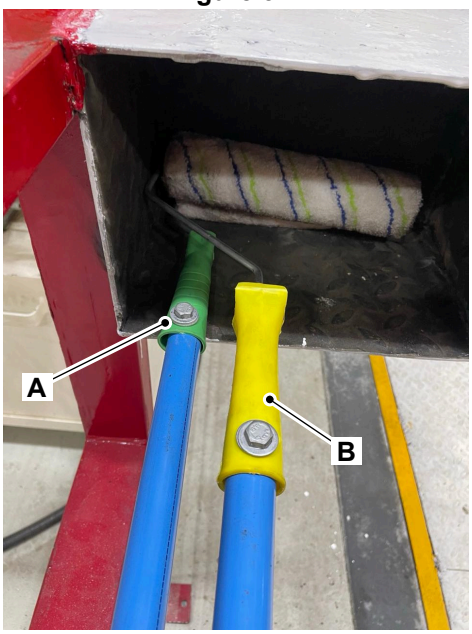
Lubricate

1. Before applying the grease, make sure that the surface is free from shots and metal emries.

2. Make sure that the thin layer of grease is distributed on surface equally.

3. Apply the grease inside bottom surface of inner boom with the help of green colour grease applicator. Refer to Figure 34.

Figure 34.



A Grease applicator - Green
B Grease applicator - Yellow

4. Apply the grease from the backside of the inner boom on the bottom surface of the inner boom.

   4.1. Make sure that the inner boom greasing length is 5100mm.

5. Apply the grease inside all the four surfaces of intermediate boom with the help of yellow colour grease applicator. Refer to Figure 34.

6. Apply the grease from the backside of the intermediate boom.

   6.1. Make sure that the intermediate boom greasing length is 4900mm.

7. Apply the grease inside all the four surfaces of the outer boom with the help of yellow colour grease applicator. Refer to Figure 34.

8. Apply the grease from the backside of the intermediate boom.

   8.1. Make sure that the outer boom greasing length is 4900mm.

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Remove and Install

Special Tools

Description	Part No.	Qty.
Slide Hammer Kit	993/68100	1

⚠ **CAUTION** This component is heavy. It must only be removed or handled using a suitable lifting method and device.

Notice: Do not allow dirt to enter the system. Before disconnecting any part of the system, thoroughly clean around the connection. When a component has been disconnected, always install protective caps and plugs to prevent dirt ingress.

Failure to follow these instructions will lead to dirt entering the system. Dirt in the system may seriously damage the systems components and could be expensive to repair.

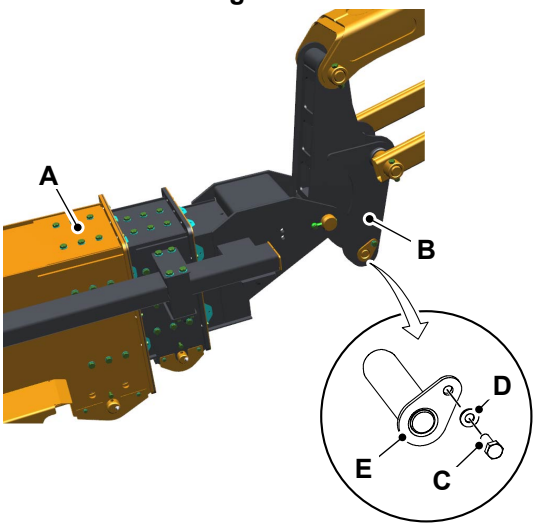
Telescopic Boom

The telescopic boom consists of the outer boom, intermediate boom and inner boom.

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Discharge the hydraulic pressure.
   Refer to: Discharge and Pressurise (PIL 30-00-00).
3. Disconnect the hydraulic hoses from the telescopic boom.
   3.1. Put a label on the hoses to help during installation.
   3.2. Plug all the open ports and hoses to prevent contamination.
4. Disconnect the required electrical harnesses.
5. Remove the platform.
   Refer to: Remove and Install (PIL 06-97-00).
6. Support the jib with the help of suitable lifting equipment.
7. Use suitable tool to extract the pivot pins from the telescopic boom.
   Special Tool: Slide Hammer Kit (Qty.: 1)
8. Remove the bolt, washer and pivot pin from the jib knuckle. Refer to Figure 35.

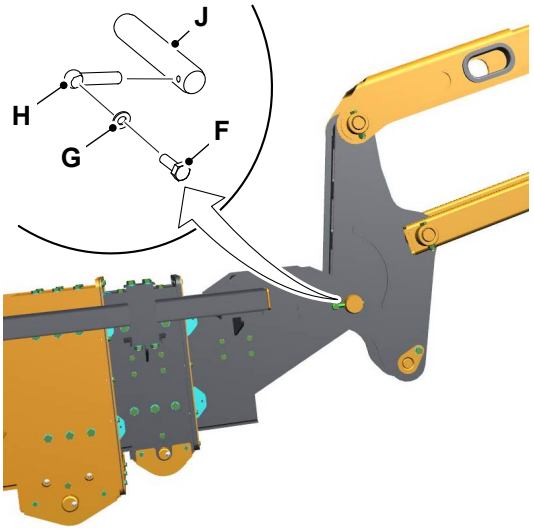
Figure 35.



A Outer boom
B Jib knuckle
C Bolt
D Washer
E Pivot pin

9. Remove the setscrew, washer 1 and lock pin from the pivot pin 1 located on the jib knuckle.

Figure 36.



F Setscrew
G Washer 1
H Lock pin
J Pivot pin 1

10. Remove the pivot pin 1 from the jib knuckle located on the inner boom. Refer to Figure 36.
11. Use suitable lifting equipment to move jib with platform away from the machine.
12. Support the telescopic boom with the help of suitable lifting equipment.

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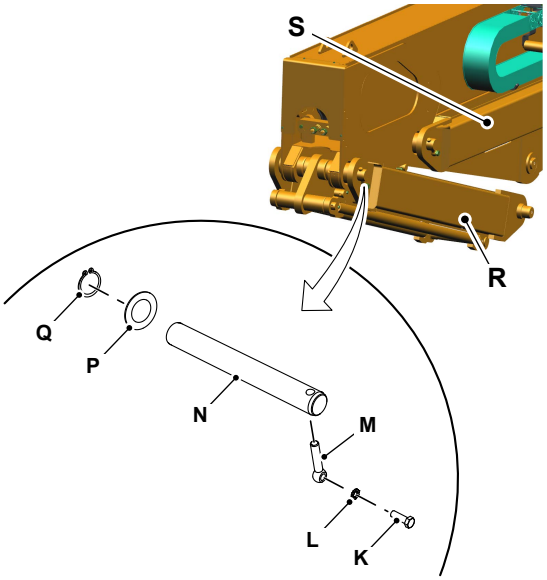
13. Remove the setscrew 1 (x2), washer 2 (x2) and lock pin 1 (x2) from the pivot pin 2 (x2) located on the outer boom.

Figure 37.



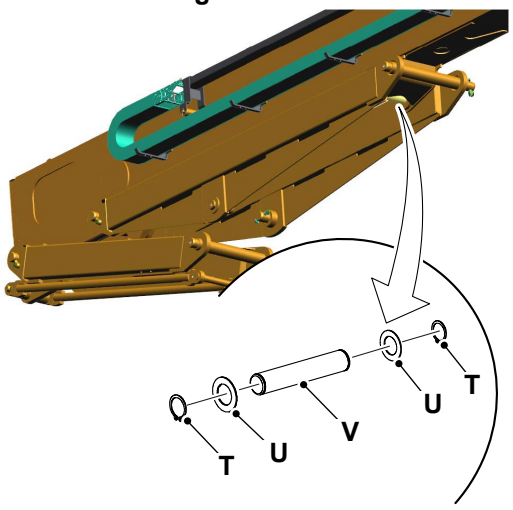
K Setscrew 1
L Washer 2
M Lock pin 1
N Pivot pin 2
P Washer 3
Q Circlip
R Folding arm
S Cylinder support arm

13.1. Remove the pivot pin 2 (x2), washer 3 (x2) and circlip (x2) from the folding arm and cylinder support arm.

14. Make sure that the boom is raised before removing the pivot pin 3.

15. Remove the circlip 1 (x2), washer 4 (x2) and pivot pin 3 from the boom lift cylinder rod end.

Figure 38.



T Circlip 1
U Washer 4 (x2)
V Pivot pin 3

16. Remove the telescopic boom from the cylinder support arm and folding arm.

16.1. Make sure that necessary lifting equipments are attached to the telescopic boom.

16.2. Make sure that the necessary precautions are followed during removal.

16.3. After removal, keep the telescopic boom on the workbench.

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

2. Tighten the setscrews and nuts to the correct torque value. Refer to Table 17.

Folding Arm, Linkage Rods and Cylinder Support Arm

Remove

1. Make sure that the telescopic boom is removed to proceed with the removal of folding arm, linkage rods and cylinder support arm.

2. Make sure that necessary lifting equipments are attached to the cylinder support arm.

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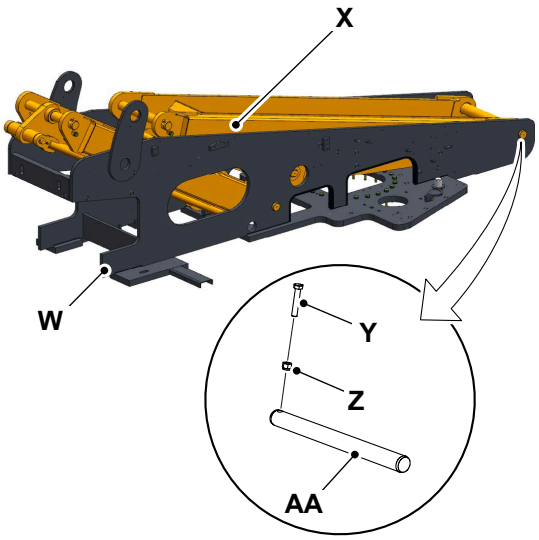
Figure 39.



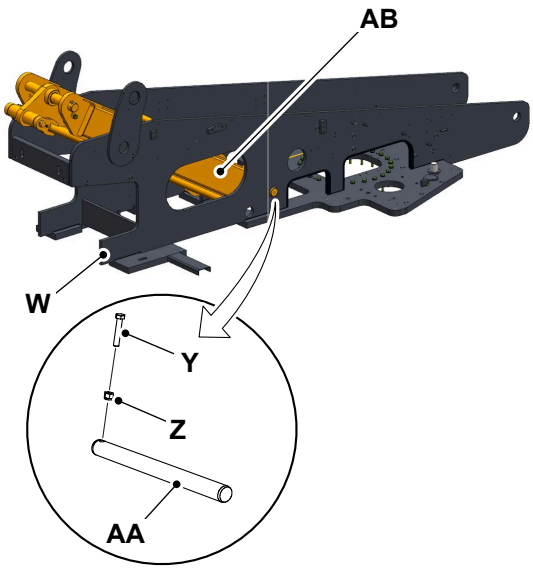
W Turntable structure
X Cylinder support arm
Y Bolt 1
Z Nut 1
AA Pivot pin 4

3. Remove the bolt1, nut 1 and the pivot pin 4 from the turntable structure connecting to the cylinder support arm.

   3.1. Make sure that the necessary precautions are followed during the removal.

4. Make sure that necessary lifting equipments are attached to the folding arm.

Figure 40.



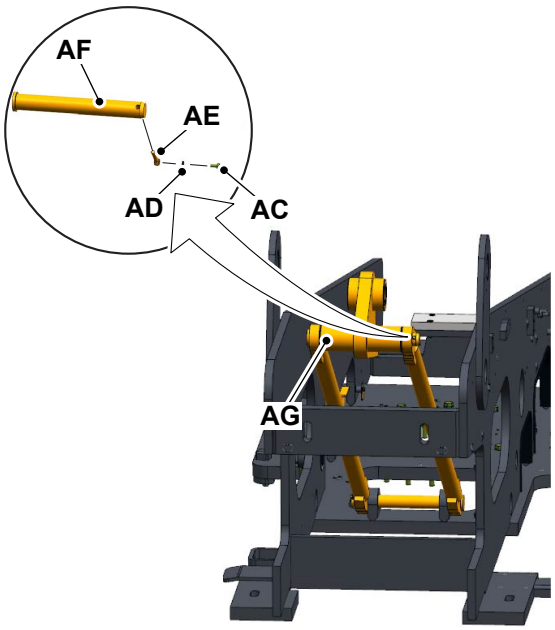
W Turntable structure
Y Bolt 1
Z Nut 1
AA Pivot pin 4
AB Folding arm

5. Remove the bolt1, nut 1 and the pivot pin 4 from the turntable structure connecting to the folding arm.

   5.1. Make sure that the necessary precautions are followed during the removal.

6. Remove the setscrew 2, washer 5, lock pin 2 and the pivot pin 5 from the connection bracket.

Figure 41.



AC Setscrew 2
AD Washer 5
AE Lock pin 2
AF Pivot pin 5
AG Connection bracket

   6.1. Make sure that the necessary precautions are followed during the removal.

7. Remove the setscrew 2, washer 8, lock pin 2 and the pivot pin 6 from the turntable structure connecting to the linkage rod (x2).

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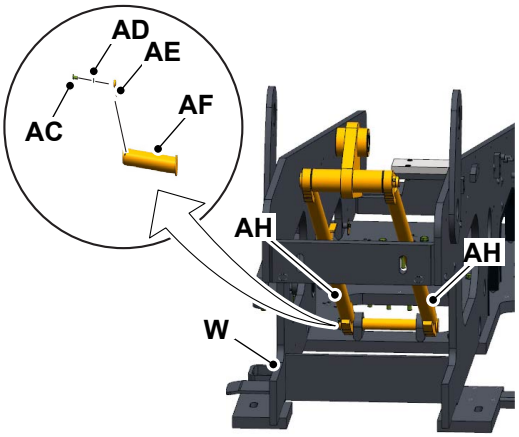
Figure 42.



W Turntable structure
AC Setscrew 2
AD Washer 5
AE Lock pin 2
AF Pivot pin 5
AH Linkage rod (x2)

7.1. Make sure that the necessary precautions are followed during the removal.

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Tighten the setscrews and nuts to the correct torque value. Refer to Table 17.

Table 17. Torque Values

Item	Nm
C	22
F	43
K	184
Y	150
AC	22

Disassemble and Assemble

⚠ **CAUTION** This component is heavy. It must only be removed or handled using a suitable lifting method and device.

Notice: Do not allow dirt to enter the system. Before disconnecting any part of the system, thoroughly clean around the connection. When a component has been disconnected, always install protective caps and plugs to prevent dirt ingress.

Failure to follow these instructions will lead to dirt entering the system. Dirt in the system may seriously damage the systems components and could be expensive to repair.

Disassemble

1. Remove the telescopic boom from the machine.
   Refer to: Remove and Install (PIL 06-17-00).
2. Remove the powertrack.
   Refer to: Remove and Install (PIL 06-70-00).
3. Remove the rear cover.
   Refer to: Remove and Install (PIL 30-15-07).
4. Remove the telescopic cylinder block (x2) and rope detection plate from the outer boom.
   Refer to: Remove and Install (PIL 30-15-07).
5. Remove the wear pads from the outer boom.
   Refer to: Remove and Install (PIL 06-17-30).
6. Remove the setscrew (x4) and washer (x4) from the roller assembly cover located on the outer boom.

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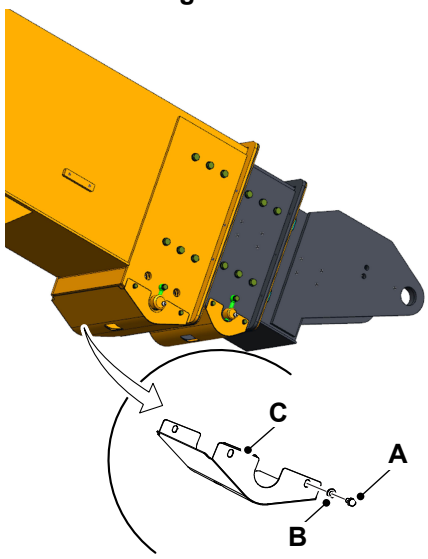
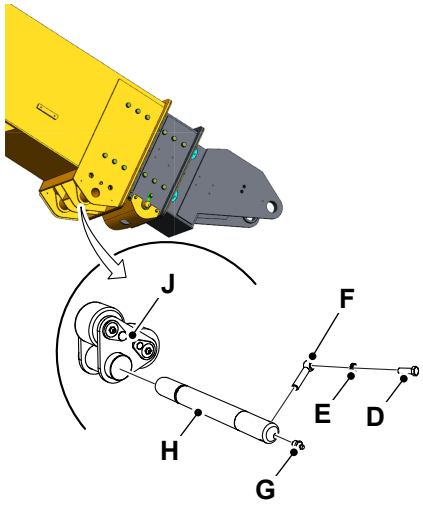
Figure 43.



A Setscrew (x4)
B Washer (x4)
C Roller assembly cover

7. Remove the grease nipple (x2) from the pivot pin 1.

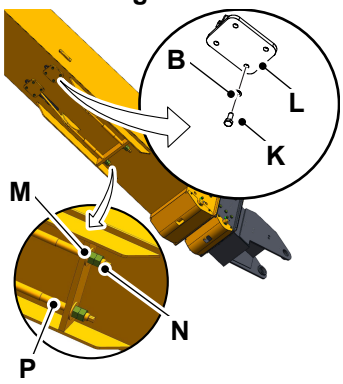
Figure 44.



D Setscrew 1
E Washer 1
F Lock pin 1
G Grease nipple
H Pivot pin 1
J Roller bearing (x2)

8. Remove the setscrew 1, washer 1 and lock pin 1 from the pivot pin 1 located on the outer boom. Refer to Figure 44.
9. Remove the roller bearing (x2) from the outer boom. Refer to Figure 44.
10. Remove the setscrew 2 (x8) and washer 2 (x8) from the rope guide (x2) located on the outer boom.

Figure 45.



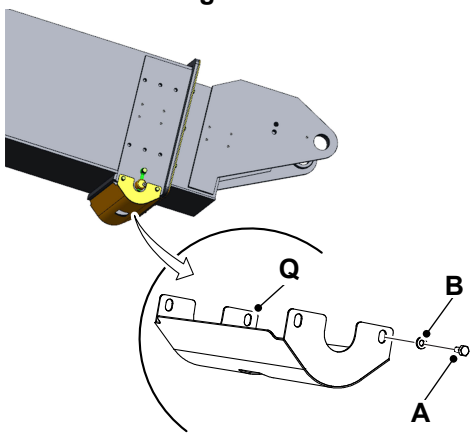
B Washer 2 (x8)
K Setscrew 2 (x8)
L Rope guide (x2)
M Nut (x4)
N Washer 3 (x2)
P Wire rope (Retract)

11. Remove the nut (x4), washer 3 (x2) from the wire rope (Retract) connector. Refer to Figure 45.
12. Slide and remove the intermediate boom from the outer boom with the help of suitable lifting equipment.
13. Remove the wear pads from the intermediate boom.

    Refer to: Remove and Install (PIL 06-17-30).
14. Remove the telescopic cylinder pressing block (x2) from the intermediate boom.

    Refer to: Remove and Install (PIL 06-17-30).
15. Remove the setscrew (x4) and washer (x4) from the wheel cover located on the intermediate boom.

Figure 46.



A Setscrew (x4)
B Washer (x4)
Q Wheel cover

16. Remove the grease nipple (x2) from the pivot pin 4 (x2).

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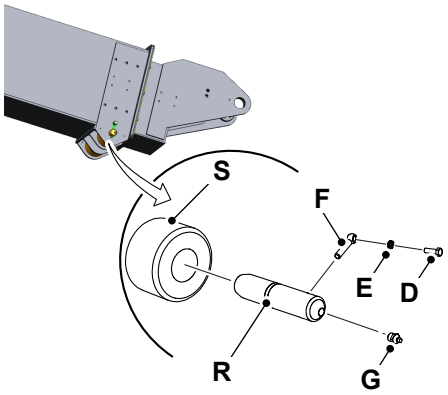
Figure 47.



D Setscrew 3 (x2)
E Washer 4 (x2)
F Lock pin 2 (x2)
G Grease nipple (x2)
R Pivot pin 2 (x2)
S Wheel (x2)

17. Remove the setscrew 3 (x2), washer 4 (x2) and lock pin 2 (x2) from the pivot pin 2 (x2) located on the intermediate boom. Refer to Figure 47.

18. Remove the wheel (x2) from the intermediate boom. Refer to Figure 47.

19. Remove the telescopic extension cylinder along with the upper wire rope bracket and wire rope (extend) from the intermediate boom.

    Refer to: Remove and Install (PIL 30-15-07).

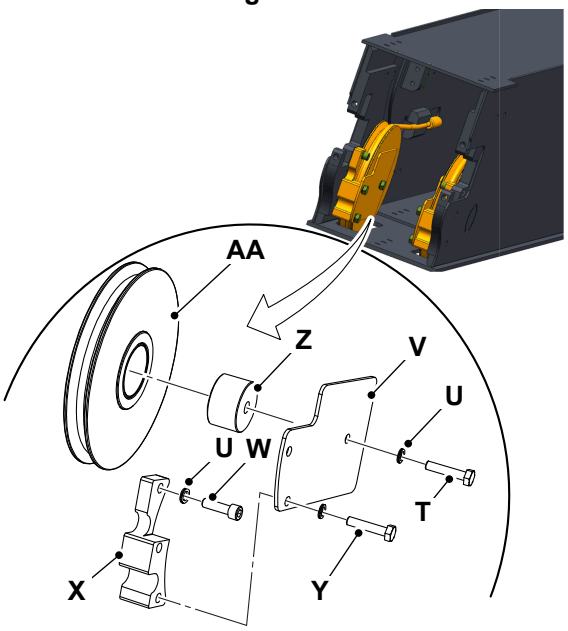
    19.1. Make sure that necessary lifting equipments are attached to the telescopic extension cylinder.

    19.2. Make sure that the necessary precautions are followed during the removal.

    19.3. After removal, keep the telescopic extension cylinder on the workbench.

20. Remove setscrew 4 (x2), bolt (x4) and washer 5 (x6) from the rope block bracket (x2) and remove the rope block bracket (x2).

Figure 48.



T Bolt (x4)
U Washer 5 (x8)
V Rope block bracket (x2)
W Capscrew (x2)
X Rope block (x2)
Y Setscrew 4 (x2)
Z Shaft sleeve (x2)
AA Pulley (x2)

21. Remove the capscrew (x2) and washer 5 (x2) from the rope block (x2). Refer to Figure 48.

22. Remove the rope block (x2) located on the left and right hand sides of the intermediate boom. Refer to Figure 48.

23. Slide and remove the wire rope (retract) from the inner boom to remove the pulley (x2) and shaft sleeve (x2) located on the intermediate boom.

24. Slide and remove the intermediate boom from the inner boom with the help of suitable lifting equipment.

Assemble

The assembly procedure is the opposite of the disassemble procedure. Additionally do the following steps.

1. Apply grease to the inner, intermediate and outer boom during assembly.

    1.1. Apply grease inside bottom surface of the inner boom with the help of green colour grease applicator.

    1.2. Apply grease on all the four sides of the intermediate and outer boom with the help of yellow colour grease applicator.

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2. Tighten the capscrews to the correct torque value.

   Refer to: PIL 72-03-00.

3. Tighten the setscrews to the specified torque value. Refer to Table 18.

Table 18. Torque Values

Item	Nm
A	9
D	43
T	43
Y	43

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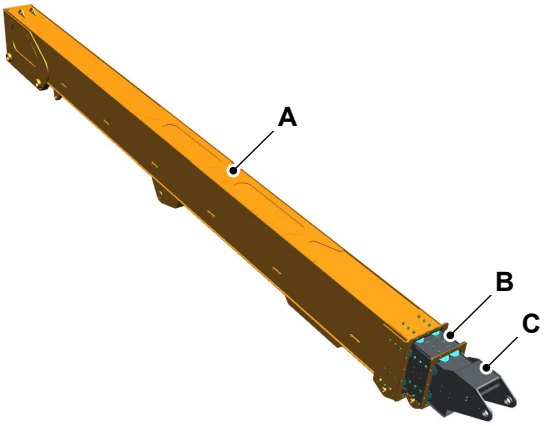
30 - Wear Pads

Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Lubricate all pins through the grease nipples before attempting to remove them. This will ease the removal procedure and reduce damage.
3. Remove the telescopic boom, if required.
   Refer to: Remove and Install (PIL 06-17-00).

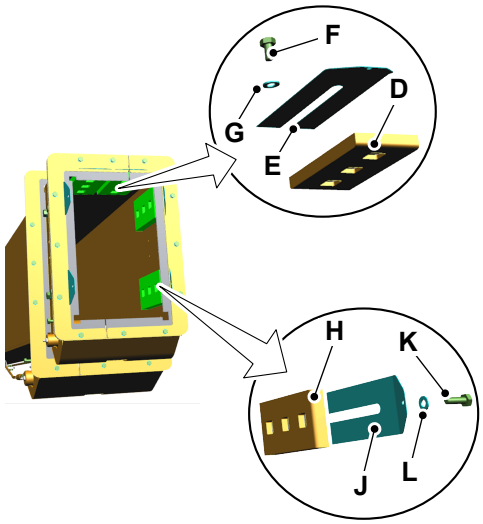
Figure 49.



A Outer boom
B Intermediate boom
C Inner boom

4. Get access to the wear pads on the telescopic boom.
5. Remove the wear pads from the intermediate boom as follows:

Figure 50. Intermediate boom wear pad



D Top wear pads (x2)
E Shim 1 (As required)
F Setscrew 1 (x6)
G Washer 1 (x6)
H Side wear pads (x4)
J Shim 2 (As required)
K Setscrew 2 (x12)
L Washer 2 (x12)

5.1. Remove the set screw 1 (x6), washer 1 (x6), top wear pads (x2) and shim 1.

5.2. Remove the set screw 2 (x12), washer 2 (x12), LH and RH side wear pads (x4) and shim 2. Refer to Figure 50.

6. Remove the wear pads from the inner boom as follows:

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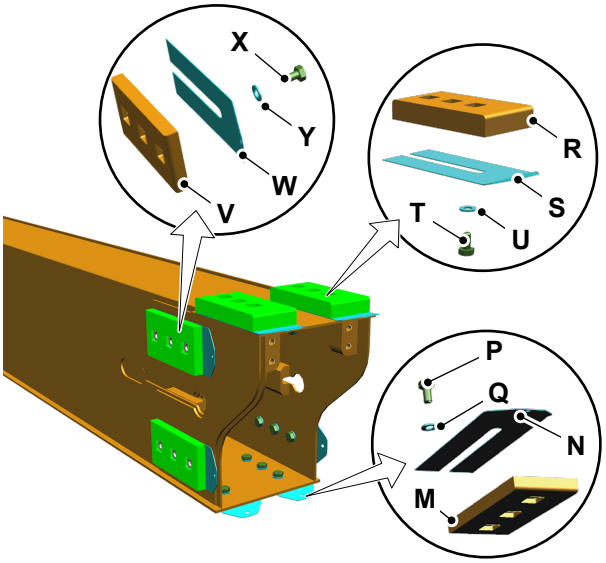
Figure 51. Inner boom wear pad



M Bottom wear pad (x2)
N Shim 3 (As required)
P Setscrew 3 (x6)
Q Washer 3 (x6)
R Top wear pads (x2)
S Shim 4 (As required)
T Setscrew 4 (x6)
U Washer 4 (x6)
V Side wear pads (x4)
W Shim 5 (As required)
X Setscrew 5 (x12)
Y Washer 5 (x12)

6.1. Remove the setscrew 4 (x6), washer 4 (x6), top wear pads (x2) and shim 4.

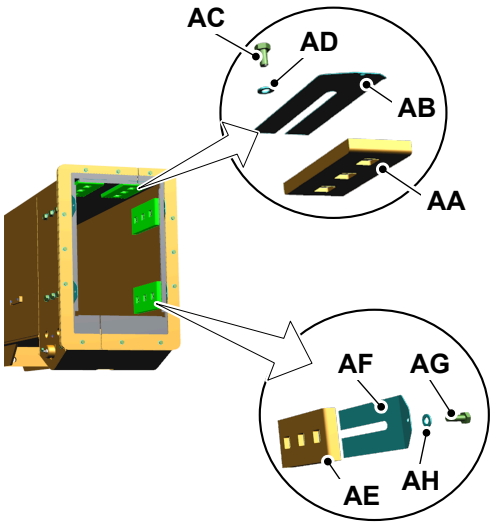
6.2. Remove the setscrew 3 (x6), washer 3 (x6), bottom wear pads (x2) and shim 3.

6.3. Remove the setscrew 5 (x12), washer 5 (x12), LH and RH side wear pads (x4) and shim 5. Refer to Figure 51.

7. Remove the inner boom from the intermediate boom with suitable lifting equipment.

8. Remove the wear pads from the outer boom as follows:

Figure 52. Outer boom wear pad



AA Top wear pad (x2)
AB Shim 6 (As required)
AC Setscrew 6 (x6)
AD Washer 6 (x6)
AE Side wear pad (x4)
AF Shim 7 (As required)
AG Setscrew 7 (x12)
AH Washer 7 (x12)

8.1. Remove the setscrew 6 (x6), washer 6 (x6), top wear pads (x2), and shim 6.

8.2. Remove the setscrew 7 (x12), washer 7 (x12), LH and RH side wear pads (x4) and shim 7. Refer to Figure 52.

9. Remove the wear pads from the intermediate boom as follows:

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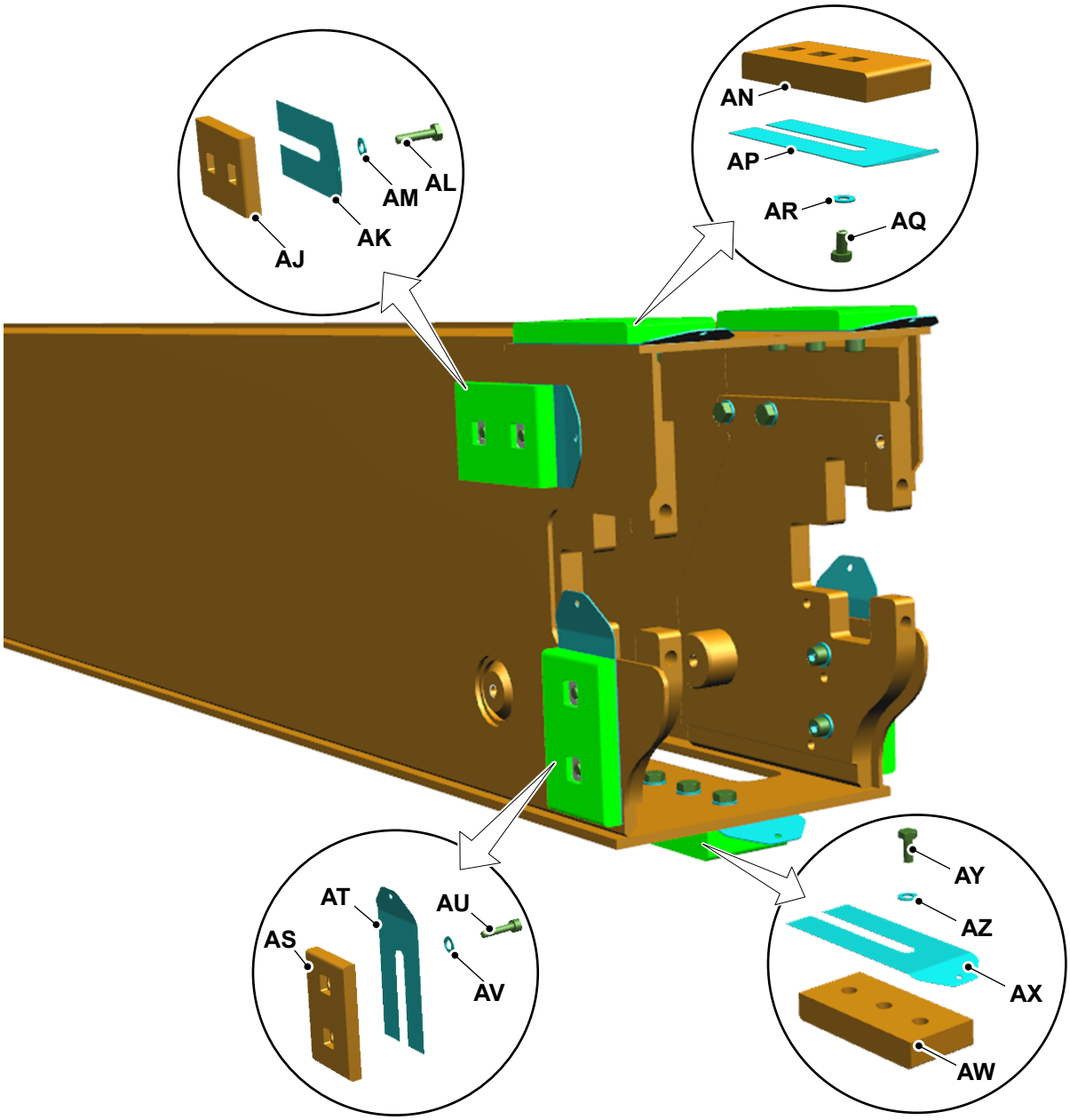
Figure 53. Intermediate boom wear pad



AJ Upper side wear pad (x2)
AL Setscrew 8 (x4)
AN Top wear pad (x2)
AQ Capscrew 1 (x6)
AS Lower side wear pad (x2)
AU Capscrew 2 (x4)
AW Bottom wear pad (x1)
AY Setscrew 9 (x3)
AK Shim 8 (As required)
AM Washer 8 (x4)
AP Shim 9 (As required)
AR Washer 9 (x6)
AT Shim 10 (As required)
AV Washer 10 (x4)
AX Shim 11 (As required)
AZ Washer 11 (x3)

9.1. Remove the capscrew 1 (x6), washer 9 (x6), top wear pads (x2), and shim 9.

9.2. Remove the setscrew 9 (x3), washer 11 (x3), bottom wear pads (x1) and shim 11.

9.3. Remove the setscrew 8 (x4), washer 8 (x4), LH and RH upper side wear pads (x2) and shim 8.

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9.4. Remove the capscrew 2 (x4), washer 10 (x4), LH and RH lower side wear pads (x2) and shim 10. Refer to Figure 53.

10. Remove the intermediate boom from the outer boom with the help of suitable lifting equipment.

Install

The installation procedure is opposite to the removal procedure. Additionally do the following steps.

1. Make sure that all the shims are fitted on side positions. Locate the intermediate and inner boom centrally in the outer boom respectively.
2. Maintain the clearance of 3 mm on LH and RH side with the wear pad along with the shims.
3. Make sure that bottom side of the boom will always rest on the rollers/wear pads by virtue of its gravity and hence no clearance will be observed. Clearance will be observed only on the top side.
4. Make sure that bolts/screws used for wear pad should not protude beyond insertion of wear pad by 1-2 mm.
5. Make sure that there is sufficient wear allowance approximately 3 mm for wear pads.
6. Apply JCB boom tec lubricant on the boom surface.

   Refer to: PIL 75-00-00.
7. Apply grease to the inner, intermediate and outer boom.
8. Before applying the grease, allow JCB boom tec lubricant to dry completely as per standard settling time on the boom surfaces. Do not apply grease when JCB boom tec is not dried or wet in nature.
9. Lubricate all pins before attempting to install them. This will make ease the installation procedure and reduce damage.
10. Make sure of the following points during installation.

    10.1. Proper alignment of cylinder inside the inner boom.

    10.2. After half insertion of the intermediate boom inside the outer boom, install the top wear pad, bottom wear pad and LH and RH wear pad on the outer boom.
11. Tighten the bolts to the specified torque value. Refer to Table 19.

Table 19. Torque Values

Item	Nm
F	43
K	43
P	43
T	43
X	43
AC	43
AG	43
AL	43
AY	43
AQ	72
AU	72

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24 - Slew Ring

00 - General

Introduction 06-25
Component Identification 06-26
Lubricate 06-26
Remove and Install 06-27

Introduction

The slew ring is a rotational rolling-element bearing that supports the heavy but slow-turning upper structure.

An inner and outer ring rotate on an integrated bearing. Gear teeth on the outer ring mesh with a slew motor pinion gear, which is used to drive the platform relative to the chassis.

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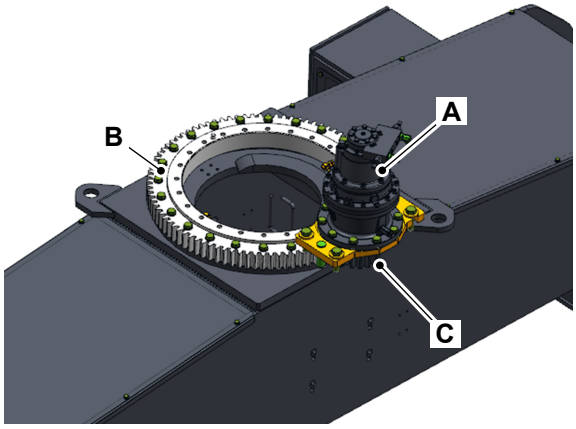
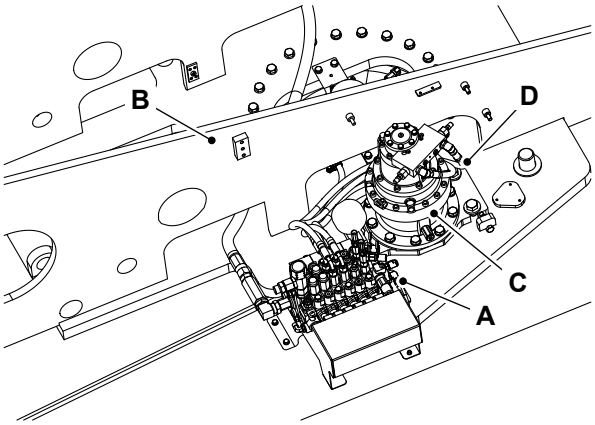
Component Identification

Figure 54.



A Slew motor
B Slew ring
C Slew pinion gear

Figure 55.



A Main control valve
B Turntable
C Slew drive motor
D Hose - main control valve to slew drive motor

Lubricate

Consumables

Description	Part No.	Size
Special HP Grease	4003/2020	0.5kg
	4003/2017	0.4kg
	4003/2006	12.5kg
	4003/2005	50kg

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Grease the slew ring bearing until grease extrudes from under the seal around all of the circumference.
   Consumable: Special HP Grease

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Remove and Install

⚠ **CAUTION** You can be injured if you use incorrect or faulty lifting equipment. You must identify the weight of the item to be lifted then choose lifting equipment that is strong enough and suitable for the job. Make sure that lifting equipment is in good condition and complies with all local regulations.

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Discharge the hydraulic pressure.
   Refer to: PIL 30-00-00.
3. Remove the telescopic boom.
   Refer to: Remove and Install (PIL 06-17-00).
4. Put a mark on the turntable and chassis to aid correct alignment during installation.
5. Remove the slew motor.
   Refer to: PIL 30-39-00.
6. Remove the hydraulic hoses from the rotary coupling.
7. Remove the plate which prevents the rotary coupling reaction pin from rotating.
   7.1. Do not rotate the rotary coupling after the plate removal.
8. Attach suitable lifting equipment to the turntable.
9. Remove the bolts 1 (x24) that attach the turntable to the slew ring. Refer to Figure 56.
10. Lift the turntable above the machine.
    10.1. Be careful when you lift the turntable, not to foul the rotary coupling.
11. Remove the rotary coupling, if necessary.
    Refer to: PIL 30-24-00.
12. Remove the bolts 2 (x24) that attach the slew ring to the chassis. Refer to Figure 56.
13. Remove the slew ring from the machine.

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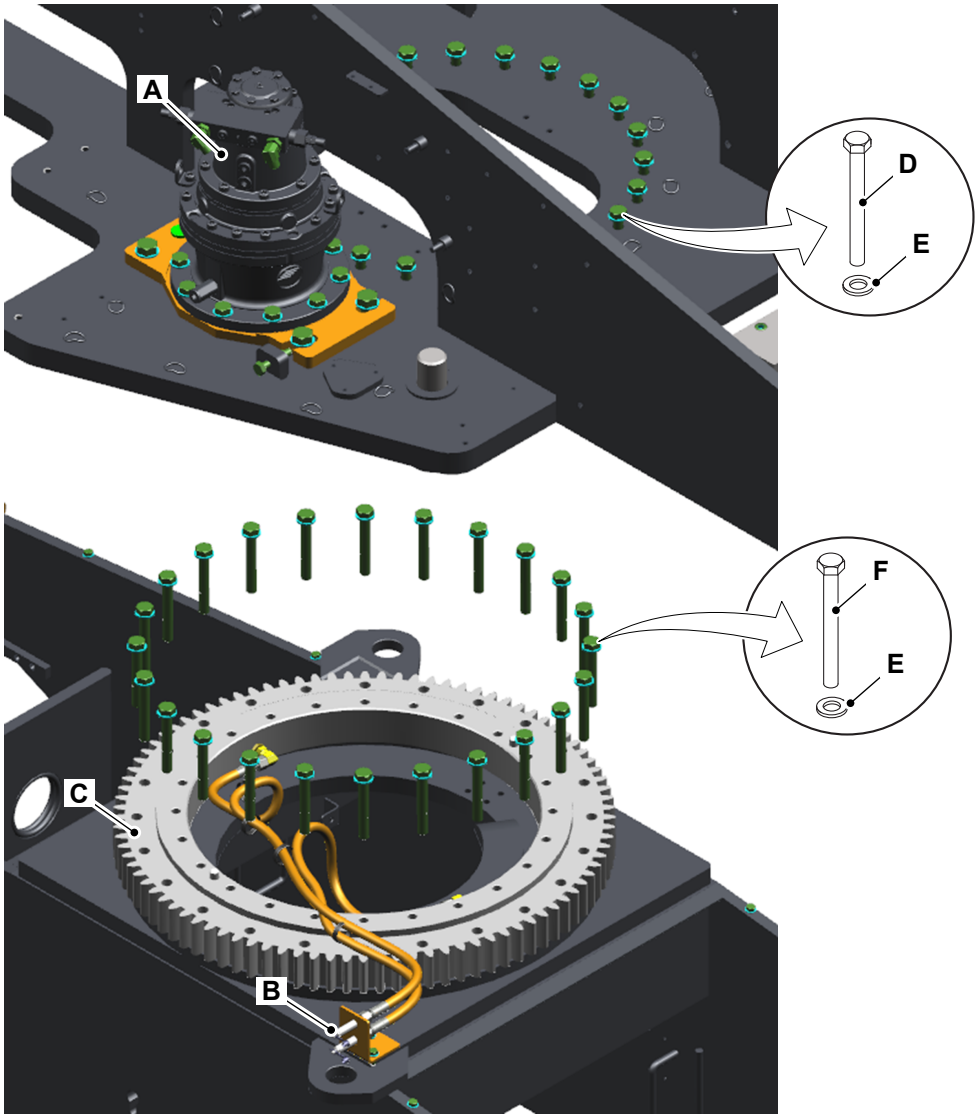
Figure 56.



A Slew motor
B Remote greasing
C Slew ring
D Bolts 1 (x24)
E Washer (x48)
F Bolts 2 (x24)

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

1. Tighten the bolts 1 (x24) to the specified torque value in the specified sequence that attaches the turntable structure to the slew bearing.Refer to Table 20.

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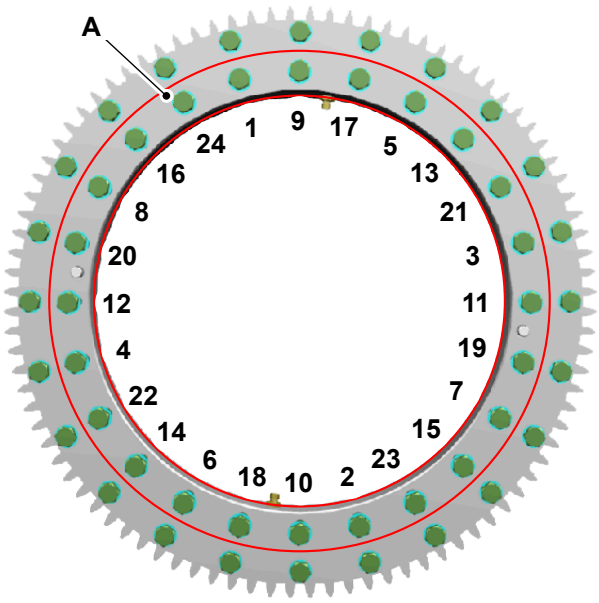
Figure 57.

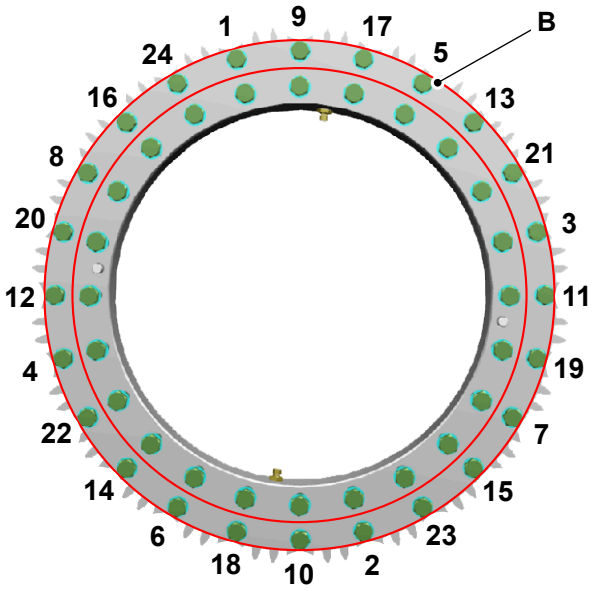


D Bolts 1 (x24)

1.1. Make sure that the sequence is diagonal and in the specified order. Refer to Figure 57.

2. Tighten the bolts 2 (x24) to the specified torque value in the specified sequence that attaches the slew bearing to the chassis. Refer to Table 20.

Figure 58.



F Bolts 2 (x24)

2.1. Make sure that the sequence is diagonal and in the specified order. Refer to Figure 58.

3. Check the operation of all the hydraulic services.

Table 20. Torque Values

Item	Nm
D	259
F	259

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30 - Pivot Pins

00 - General

Introduction

Pivot pins are a short shaft or pin that supports something that turns. Pivot pins are installed in numerous positions on the machine. There is usually a greasing point associated with the pivot pin. The pivot points are grease free on the machine.

The pivot pins installed on these machines do not require any special tool for removal. You must use a suitable hammer and drift tool to remove the pivot pins.

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45 - Gas Strut

15 - Engine Compartment Cover

Remove and Install

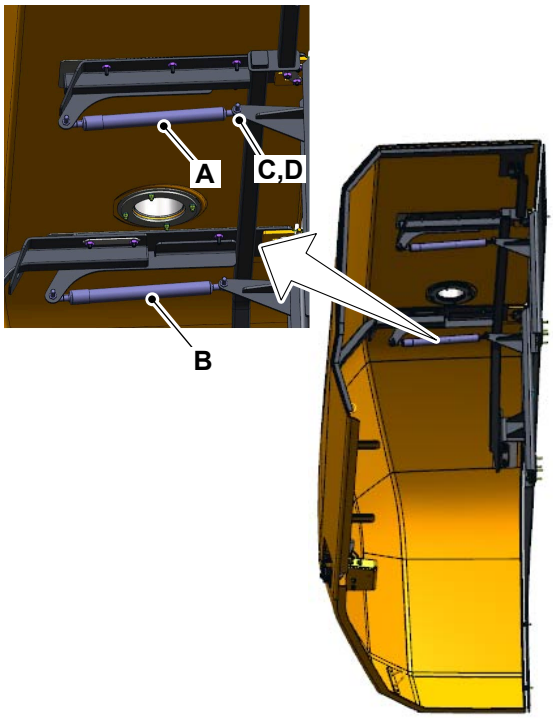
Remove

1. Make the machine safe with the platform lowered.

   Refer to: Introduction (PIL 01-03-27).

2. Get access to the LH and RH engine side gas strut.
3. Support the engine cover with suitable lifting equipment. Take care when you remove the gas strut, it is under load.
4. Remove the ball stud (x4) and washer (x4) from both the ends of the LH and RH engine side gas strut.
5. Remove the LH and RH engine side gas strut.

Figure 59.



A Gas strut - LH engine side
B Gas strut - RH engine side
C Ball stud (x4)
D Washer (x4)

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Tighten the bolt studs to the specified torque value.

   Torque: 35N·m

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18 - Hydraulic Compartment

Remove and Install

Remove

1. Make the machine safe with the platform lowered.

   Refer to: Introduction (PIL 01-03-27).

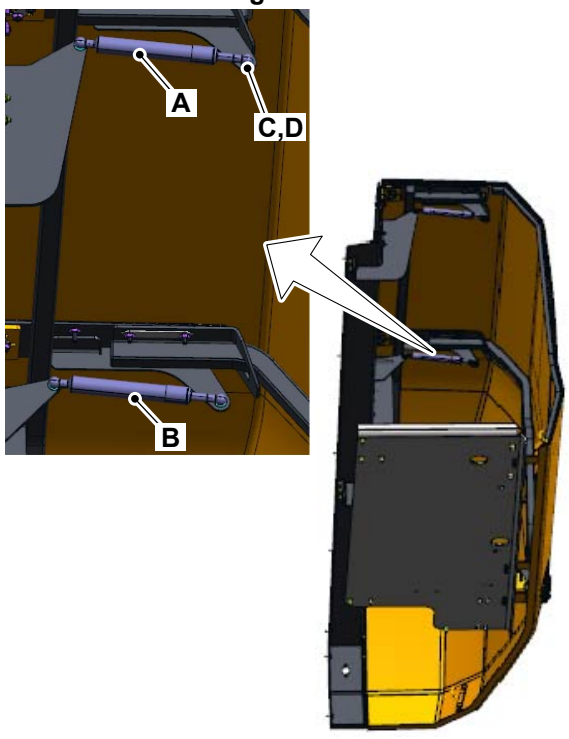
2. Get access to the LH and RH hydraulic compartment side gas strut.

3. Support the hydraulic compartment cover with suitable lifting equipment. Take care when you remove the gas strut, it is under load.

4. Remove the ball stud (x4) and washer (x4) from both the ends of the LH and RH hydraulic compartment side gas strut.

5. Remove the LH and RH hydraulic compartment side gas strut.

Figure 60.



A Gas strut - LH hydraulic compartment side
B Gas strut - RH hydraulic compartment side
C Ball stud (x4)
D Washer (x4)

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Tighten the bolt studs to the specified torque value.

   Torque: 35N·m

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57 - Counterweight

00 - General

Introduction 06-33
Remove and Install 06-34

Introduction

⚠ **WARNING** Make sure the machine cannot be used with the counterweight removed. Make sure the ignition key is removed and the battery is isolated.

WARNING Do not use the machine with the counterweights removed. The counterweights are critical to the stability of machine.

The counterweight is an equivalent counterbalancing weight installed to the machine to balance any load.

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Remove and Install

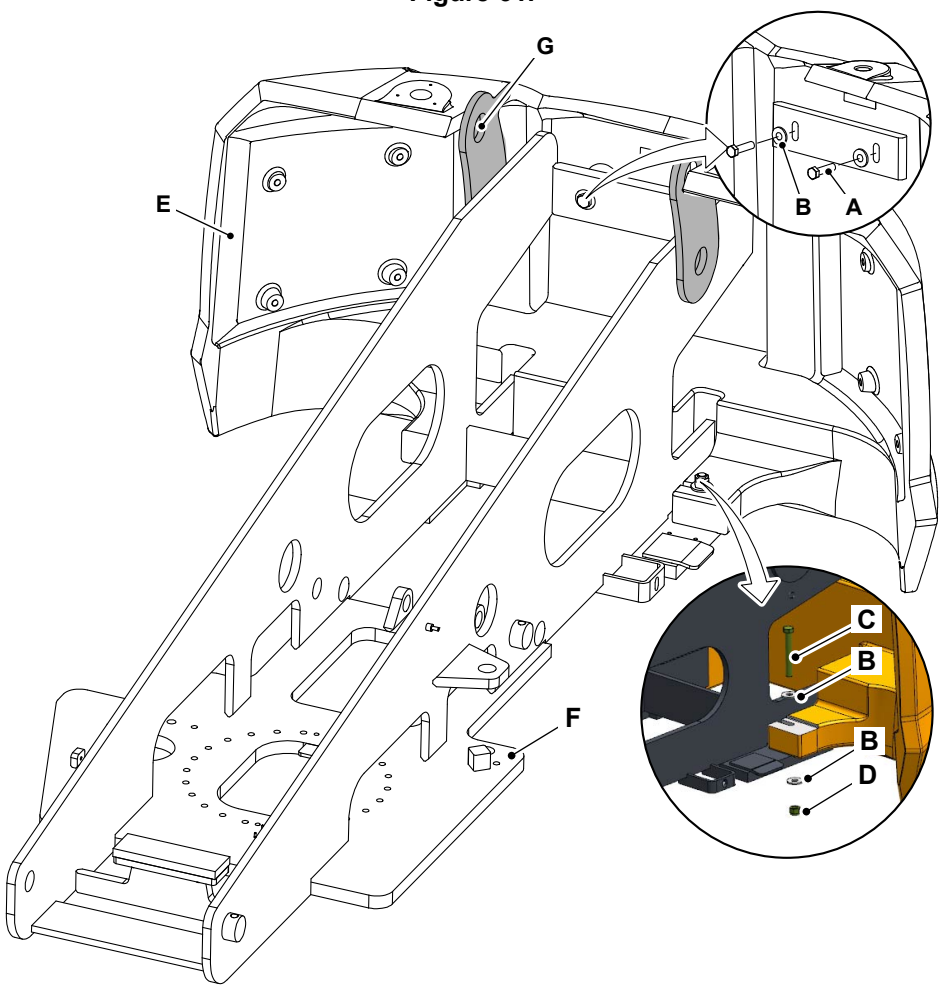
⚠ **CAUTION** This component is heavy. It must only be removed or handled using a suitable lifting method and device.

CAUTION You can be injured if you use incorrect or faulty lifting equipment. You must identify the weight of the item to be lifted then choose lifting equipment that is strong enough and suitable for the job. Make sure that lifting equipment is in good condition and complies with all local regulations.

WARNING Make sure the machine cannot be used with the counterweight removed. Make sure the ignition key is removed and the battery is isolated.

1. Make the machine safe.
   Refer to: Health and Safety (PIL 01-03-27).
2. Open the engine compartment to get access to the counterweight.
   Refer to: PIL 06-06-06.
3. Support the counterweight with the help of suitable lifting equipment.
4. Remove the bolt 1 (x2) and spacer (x2) from turntable horizontal plate.
5. Remove the bolt 2 (x2), spacer (x4) and locknut (x2) from the turntable.
6. Lift the counterweight away from the machine. Make sure that the counterweight does not swing or snag on any other components.
   Weight: 2,800kg

Figure 61.



A Bolt 1 (x2)
B Spacer (x6)
C Bolt 2 (x2)
D Locknut (x2)
E Counterweight
F Turntable

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G Lifting point (x2)

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

1. Apply the loctite to the bolt 1.
2. Tighten the bolts to the specified torque value. Refer to Table 21.

Table 21. Torque Values

Item	Nm
A	621
C	805

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63 - Identification Label

00 - General

Introduction

The machine has identification plates that contain important information relating to the specific machine details, for example VIN (Vehicle Identification Number) or PIN (Product Identification Number) and engine serial number. These serial numbers can help you identify exactly which equipment has been installed on the machine.

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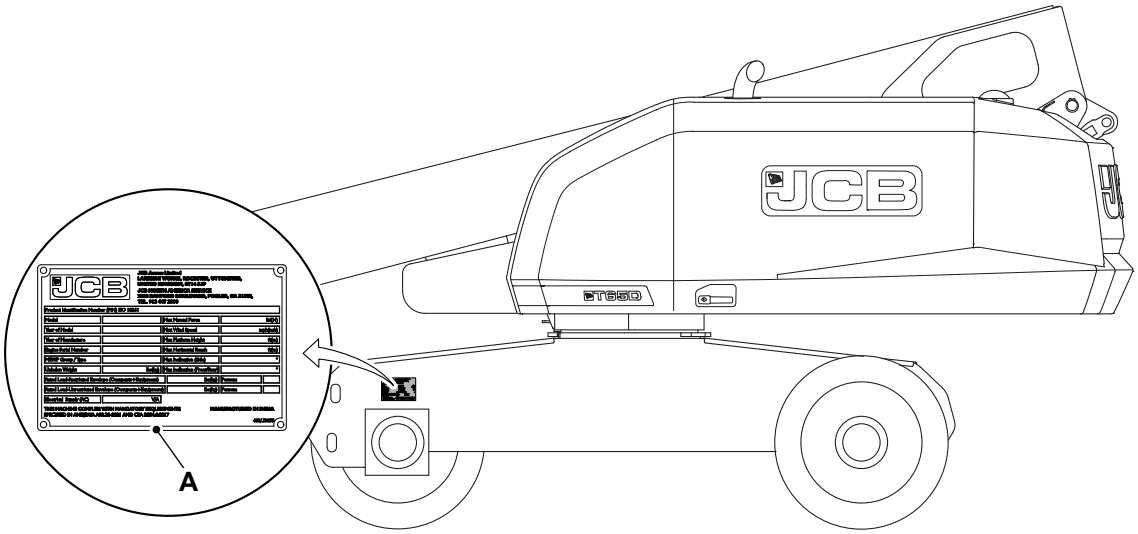
03 - Machine

Introduction

Your machine has an identification plate as shown.
Refer to Figure 62.

Figure 62.



A Machine identification plate

Explanation of Machine Identification Plate

Figure 63.

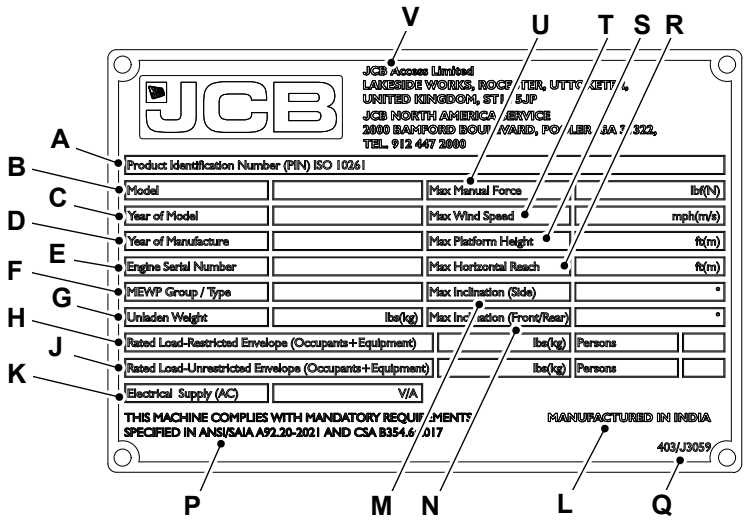


Table 22.

A	PIN (Product Identification Number) ISO10261
B	Model
C	Year of Model

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D	Year of Manufacture
E	Engine Serial Number
F	MEWP Group / Type
G	Unladen Weight
H	Rated Load-Restricted Envelope (Occupation+Equipment)
J	Rated Load-Unrestricted Envelope (Occupation+Equipment)
K	Electrical Supply (AC)
L	Build Location
M	Max Inclination (Side)
N	Max Inclination (Front/Rear)
P	Compliance
Q	Part Number
R	Max Horizontal Reach
S	Max Platform Height
T	Max Wind Speed
U	Max Manual Force
V	Manufacturers Address

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06 - Engine

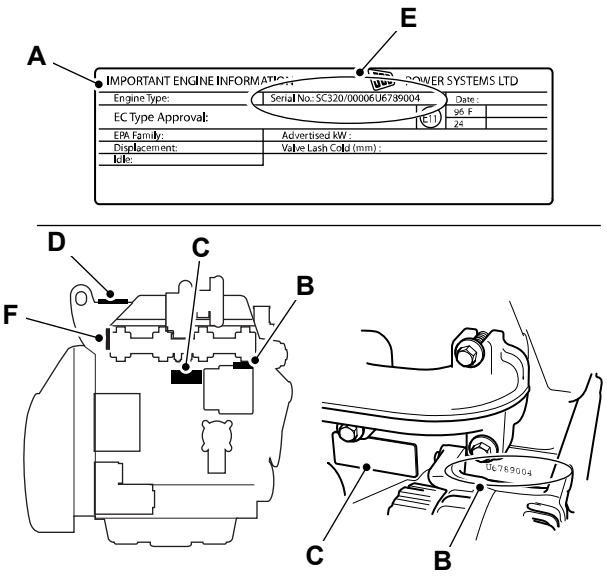
Introduction

The engine data labels are attached to the cylinder block and rocker cover as shown. Refer to Figure 64.

The data label contains important engine information and includes the engine identification number.

Injector codes are on a label on the rocker cover. Refer to Figure 64.

Figure 64.



A Engine data label
B Stamp
C Engine data label- cylinder block
D Engine data label- rocker cover
E Engine identification number
F Injector codes label

The data label includes the engine identification number.

Table 23. Example of the engine identification number

	SL	320/40001	U	00001	12
Digit	1-2	3-10	11	12-16	17-18

Table 24.

Digit 1-2	Engine Type
SL	4.4L turbocharged and aftercooled electronic common rail fuel injection (Tier 4F) < 55kW

Table 25. Explanation of the engine identification number

Digit	Explanation
3-10	Engine part number
11	Country of manufacture. U = United Kingdom
12-16	Engine serial number
17-18	Year of manufacture

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The country of manufacturer, engine serial number and year of manufacture of the engine are also stamped on the cylinder block. Refer to Figure 64.

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70 - Powertrack

00 - General

Introduction 06-41
Remove and Install 06-42

Introduction

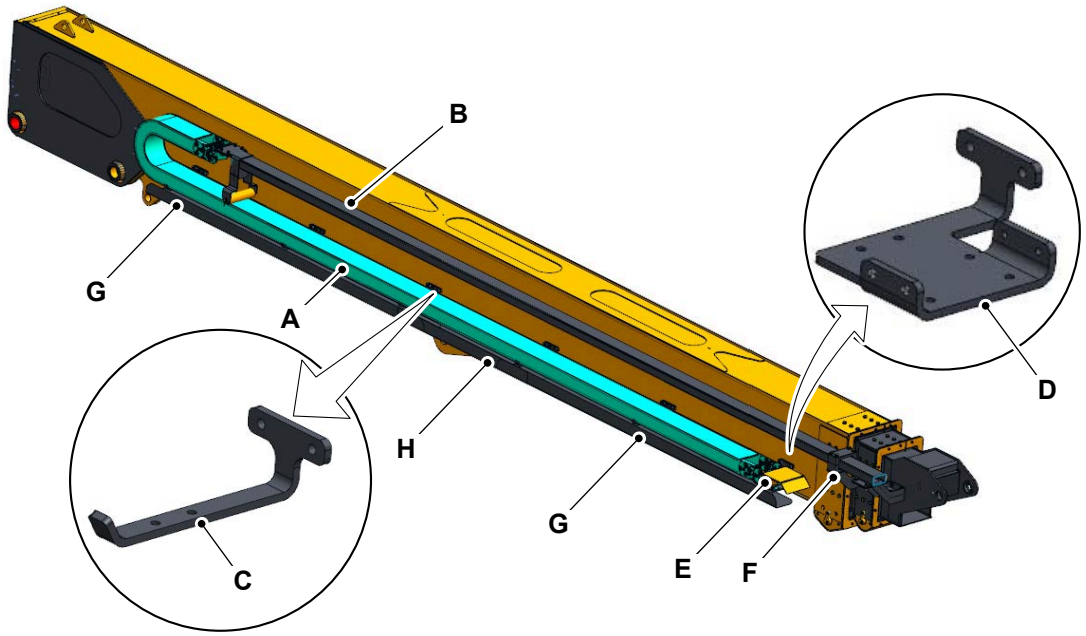
The drag chain is installed on the machine to support electrical harness, electrical cables and hydraulic hoses to the jib and platform.

It tends to expand and retract in line with the boom movement.

It is supported on outer, intermediate and inner boom in such a way that it facilitates smooth extension and retraction of the system.

The drag chain can be repaired without removing the cables and hoses.

Figure 65.



A Drag chain
B Towline catcher
C Drain chain hanger (x5)
D Drain chain end bracket
E Hose protection cover
F Drag chain wear pad
G Boom tray (long) (x2)
H Boom tray (short)

Drag Chain Maintenance

Drag chain comprises of components which can be serviced as required.

Before dismantling the drag chain, all electrical harnesses, cables and hoses should be completely removed from it. Similarly, before installing it back on the machine, all necessary connections should be removed from it first before final installation can be carried out.

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Remove and Install

Remove

1. Make the machine safe with the platform lowered.

   Refer to: PIL 01-03-27.

2. Discharge the hydraulic pressure.

   Refer to: PIL 30-00.

3. Disconnect the hydraulic hoses.

   Refer to: PIL 30-93.

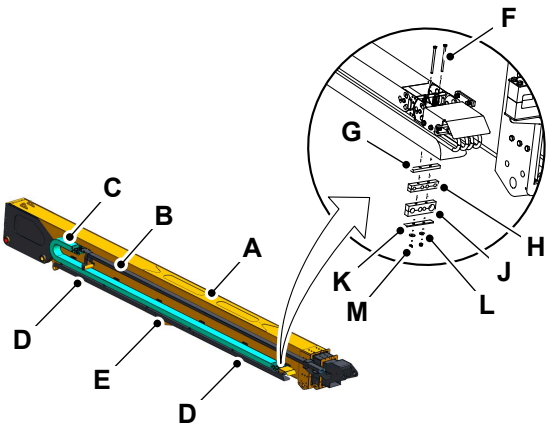
4. Put a label on the hoses to help installation.

5. Plug all the open ports and hoses to prevent contamination.

6. Disconnect the electrical connector.

7. Remove the bolt (x12), spacer plate 1 (x6), tube clamp (x6), spacer plate 2 (x6), washer (x12) and locknut (x12) from the boom tray (long) and boom tray (short). Refer to Figure 66.

Figure 66.



A Telescopic boom
B Towline catcher
C Drag chain
D Boom tray (long) (x2)
E Boom tray (short)
F Bolt (x12)
G Spacer plate 1 (x6)
H Tube clamp (x6)
J Harness clamp (for reference)
K Spacer plate 2 (x6)
L Washer (x12)
M Locknut (x12)

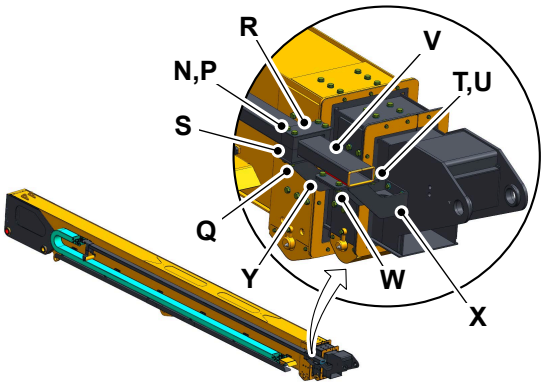
7.1. Remove the boom tray (long) and boom tray (short) from the drag chain.

8. Make sure that hoses and harness are not entangled during removal of towline catcher.

9. Support the towline catcher with the help of suitable lifting equipment.

10. Disconnect the towline catcher from the telescopic boom.

Figure 67.



N Bolt 1 (x4)
P Washer 1 (x8)
Q Nut (x4)
R Retainer plate
S Drag chain wear pad (x2)
T Setscrew (x4)
U Washer 2 (x4)
V Towline catcher bracket
W Nut 1 (x4)
X End support bracket
Y End support bracket - 2

10.1. Remove the bolt 1 (x4), washer 1 (x8), nut (x4) and retainer plate from the drag chain wear pad (x2) and end support bracket - 2. Refer to Figure 67.

10.2. Remove the setscrew (x4), washer 2 (x4) and nut 1 (x4) from the towline catcher bracket and end support bracket.

11. Disconnect drag chain from towline catcher. Refer to Figure 68.

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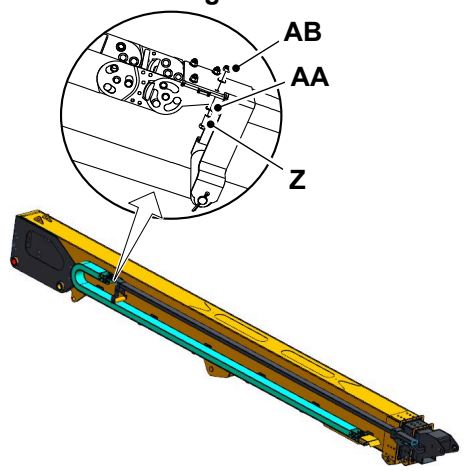
Figure 68.



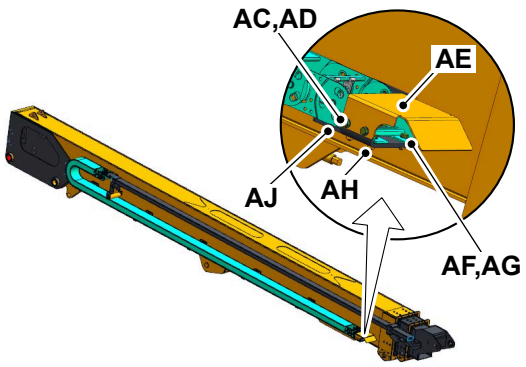
Z Setscrew 1 (x4)
AA Washer 3 (x8)
AB Locknut (x4)

11.1. Remove the setscrew 1 (x4), locknut (x4) and washer 3 (x8) from the drag chain.

12. Make sure that hoses and harness are not entangled during removal of drag chain.

13. Disconnect the drag chain from drag chain end bracket. Refer to Figure 69.

Figure 69.



AC Setscrew 2 (x4)
AD Washer 4 (x4)
AE Tube protection cover
AF Setscrew 3 (x4)
AG Washer 5 (x4)
AH Nut 2 (x4)
AJ Drag chain end bracket

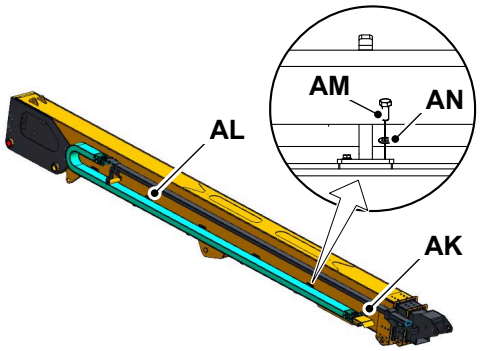
13.1. Remove the setscrew 2 (x4) and washer 4 (x4) from the tube protection cover located on the drag chain end bracket.

13.2. Remove the tube protection cover.

13.3. Remove the setscrew 2 (x4), washer 5 (x4) and nut 2 (x4) from the drag chain end bracket.

14. Remove the set screw 4 (x12) and washer 6 (x12) from the drag chain end bracket and drag chain hanger.Refer to Figure 70.

Figure 70.



AK Drag chain end bracket
AL Drag chain hanger (x5)
AM Setscrew 4 (x12)
AN Washer 6 (x12)

14.1. Remove drag chain end bracket, drag chain hanger (x5) from the telescopic boom.

15. Lock the two ends of the drag chain with suitable lifting equipment.

16. Lift the drag chain carefully and place it on the backstop with adequate capacity.

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

1. Make sure that the drag chain is parallel to the telescopic boom during assembly.

2. Use shim below the drain chain wear pad to bridge gap between end support bracket - 2 and drag chain wear pad.

3. Tighten the setscrews and bolts to the specified torque value. Refer to Table 26.

Table 26. Torque Values

Item	Nm
F	9
N	35
T	38
Z	21
AC	21
AG	21
AM	21

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73 - Jib

00 - General

Introduction 06-44
Component Identification 06-45
Check (Condition) 06-46
Remove and Install 06-46
Disassemble and Assemble 06-47

Introduction

These machines are installed with a jib.

The jib is an another articulation point for the platform to move up and down. The jib provides unequalled access up, over and around obstacles.

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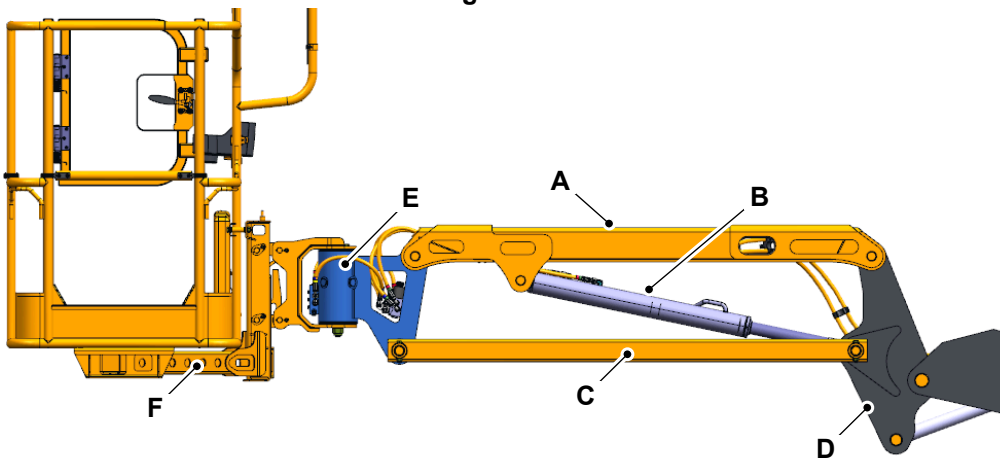
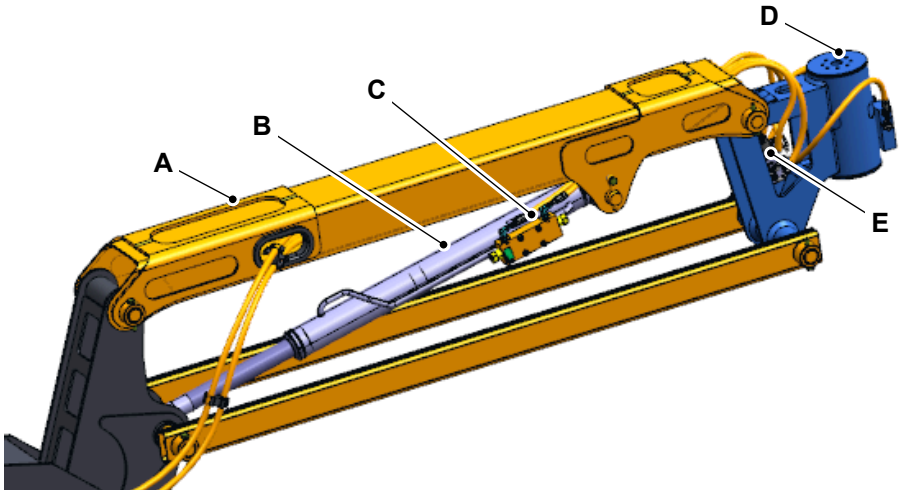
Component Identification

Figure 71.



A Fabricated jib arm
B Jib lift cylinder
C Jib level arm
D Jib knuckle
E Rotary actuator
F Platform carrier

Figure 72.



A Fabricated jib arm
B Jib lift cylinder
C Counter balance valve
D Rotary actuator
E Platform control valve

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Check (Condition)

1. Check condition of the jib boom pivot pin for wear, scoring, tapering, ovality or other damage. If necessary, replace the pivot pin.
2. Check condition of the jib boom pivot pin attach points for scoring, tapering, ovality, or other damage. If necessary, replace the pivot pin.
3. Check condition of the inner diameter of jib boom pivot bearings for scoring, distortion, wear or other damage. If necessary, replace the damaged bearing.
4. Check condition of the jib lift cylinder attach pin for wear, scoring, tapering, ovality or other damage.
   4.1. Make sure that the pin surfaces are protected prior to installation. If necessary, replace the pivot pin.
5. Check condition of the inner diameter of rotary actuator attach point bearings for scoring, distortion, wear or other damage. If necessary, replace the damaged components.
6. Check condition of all the threaded components for damage such as stretching, thread deformation or twisting. If necessary, replace the damaged components.
7. Check condition of the structural components of the boom assembly for bending, cracking, separation of welds or other damage. Repair the boom sections as required.

Remove and Install

⚠ **CAUTION** This component is heavy. It must only be removed or handled using a suitable lifting method and device.

Notice: Do not allow dirt to enter the system. Before disconnecting any part of the system, thoroughly clean around the connection. When a component has been disconnected, always install protective caps and plugs to prevent dirt ingress.

Failure to follow these instructions will lead to dirt entering the system. Dirt in the system may seriously damage the systems components and could be expensive to repair.

Remove

1. Make the machine safe with the platform lowered.
   Refer to: PIL 01-03-27.
2. Remove the platform.
   Refer to: PIL 06-97-00.
3. Remove the rotary actuator.
   Refer to: PIL 30-80-00.
4. Disconnect the hydraulic hoses from the jib boom.
   4.1. Put a label on the hoses to help during installation.
   4.2. Plug all the open ports and hoses to prevent contamination.
5. Disconnect the required electrical harnesses.
6. If required, remove the jib lifting cylinder.
   Refer to: Remove and Install (PIL 30-15-78).
7. Use suitable lifting equipment to support the jib boom.
8. Remove the bolt (x3) and locknut (x3) from the pivot pin 1 and pivot pin 2 located on the jib extension arm and jib level arm.
   8.1. Use a suitable brass drift and hammer to remove the jib extension arm and jib level arm pivot pins from the rotary actuator and jib knuckle.
9. Remove the setscrew and lock pivot pin from the pivot pin 3 located on the jib knuckle.
   9.1. Use a suitable brass drift and hammer to remove the jib knuckle from the inner boom.

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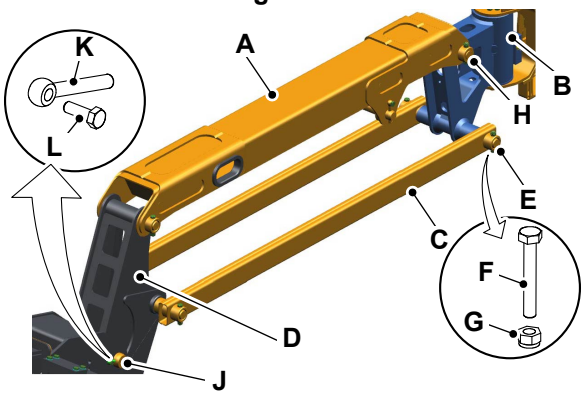
Figure 73.



A Jib extension arm
B Rotary actuator
C Jib level arm
D Jib knuckle
E Pivot pin 1
F Bolt (x3)
G Locknut (x3)
H Pivot pin 2
J Pivot pin 3
K Setscrew
L Lock pivot pin

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Tighten the setscrew and bolts to the correct torque value. Refer to Table 27.

Table 27. Torque Values

Item	Nm
F	43
L	22

Disassemble and Assemble

⚠ **CAUTION** This component is heavy. It must only be removed or handled using a suitable lifting method and device.

Notice: Do not allow dirt to enter the system. Before disconnecting any part of the system, thoroughly clean around the connection. When a component has been disconnected, always install protective caps and plugs to prevent dirt ingress.

Failure to follow these instructions will lead to dirt entering the system. Dirt in the system may seriously damage the systems components and could be expensive to repair.

Disassemble

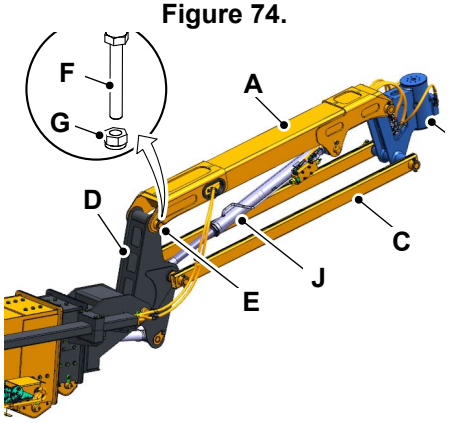
1. Remove the jib boom from the machine.

   Refer to: Service Manual (Machine) - T65D (T4F) (9833/1400) Remove and Install.
2. Use suitable lifting equipment to support the jib boom.
3. Remove the jib lifting cylinder.

   Refer to: Service Manual (Machine) - T65D (T4F) (9833/1400) Remove and Install.
4. Remove the bolt and locknut from the pivot pin located on the jib extension arm and jib knuckle.

   4.1. Use a suitable brass drift and hammer to remove the jib extension arm from the jib knuckle.

Figure 74.



A Jib extension arm
B Rotary actuator
C Jib level arm
D Jib knuckle
E Pivot pin
F Bolt
G Locknut

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Assemble

The assembly procedure is the opposite of the disassembly procedure. Additionally do the following steps.

1. Tighten the bolts to the correct torque value.Refer to Table 28.

Table 28. Torque Values

Item	Nm
F	43

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93 - Emergency Lower System

00 - General

Introduction 06-49
Component Identification 06-50

Introduction

In the event of no engine power available a hydraulic gear pump and electrical motor is used to lower the platform safely to the ground.

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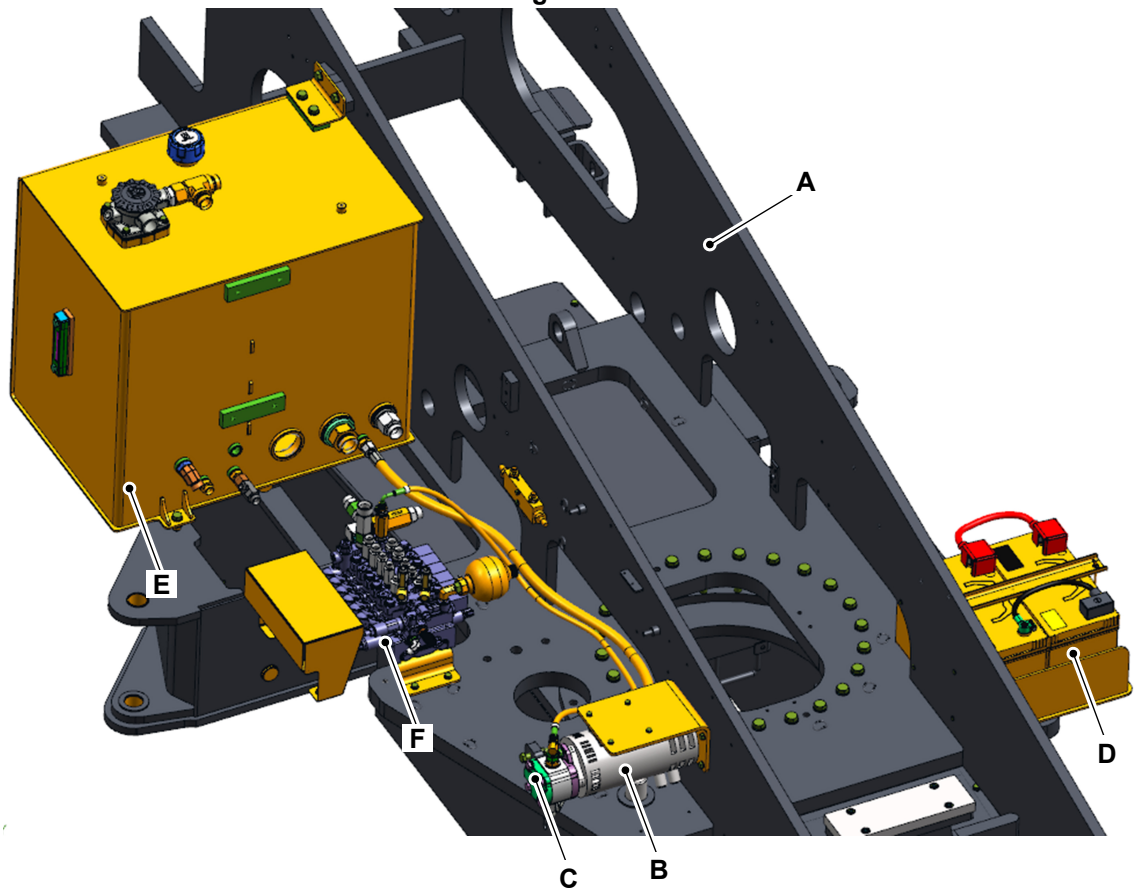
Component Identification

Figure 75.



A Turntable
B Electric motor
C Auxiliary pump
D Batteries
E Hydraulic tank
F Main control valve

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97 - Platform

00 - General

Introduction 06-51
Health and Safety 06-52
Component Identification 06-53
Remove and Install 06-54

Introduction

The platform is mounted on the platform carrier. The platform consists of the following parts:

- Platform floor
- Foot pedal
- Platform control panel
- Secondary guarding system
- Control shield
- Document box
- Tool tray
- Side gate
- Entrance tube
- Side entrance tube.

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Health and Safety

⚠ **WARNING** Control lever/switch action may vary on machines, instructional labels near the levers/switches show by symbols, which levers/switches cause what actions. Before operating control levers/switches check the instructional label to make sure you select the desired action.

WARNING To operate the machine safely you must have received the appropriate training. The operator's manual instructs you on the machine, its controls and its safe operation; it is not a training manual. Ensure that you receive the correct training before operating the machine. Failure to do so will result in incorrect operation of the machine and you will be putting yourself and others at risk. You must abide by all local site regulations. Make sure that you and your machine comply with relevant local laws and jobsite requirements – it is your responsibility.

WARNING Make sure it is clear overhead before raising the platform. Keep an adequate safe distance from all electrical power lines. Contact your local power company for safety procedures.

WARNING Notice boards or panels must not be installed on the platform because they will increase wind resistance.

WARNING Do not use the platform as a crane.

WARNING Do not extend the reach or height of the platform by the use of ladders or other equipment.

WARNING Do not use the platform when the wind speed exceeds the rated limit, stated in the operators manual.

WARNING Do not allow the machine to come in to contact with fixed objects, buildings etc.

WARNING Do not allow the machine to come in to contact with moving objects, vehicles, cranes etc.

WARNING Do not exceed the maximum rated load stated on the platform.

WARNING All operators must be adequately trained and authorised to use the machine.

WARNING All operators must make sure there is a restricted area under or around the platform to safeguard against falling objects injuring bystanders or colleagues.

WARNING All operators must use the correct safety harnesses when operating from the platform. Hard hats with chin straps must also be worn.

WARNING Do not operate the machine from the base controls with personnel in the platform, except when you need to lower the platform in an emergency using the procedure in the operators manual.

If the platform cannot be lowered by the use of the emergency controls, personnel must be removed using other means.

You must not work on the machine whilst personnel are in the platform.

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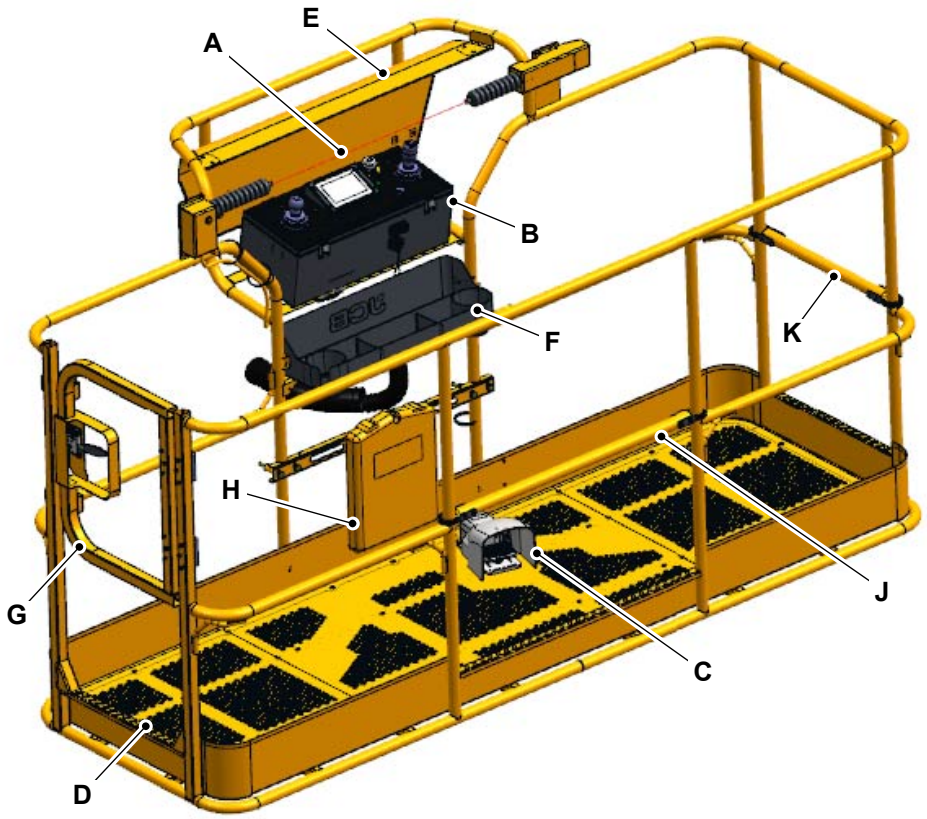
Component Identification

Figure 76.



A Secondary guarding system
B Platform control panel
C Foot pedal
D Platform floor
E Control shield
F Tool tray
G Side gate
H Document box
J Entrance tube
K Side entrance tube

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Remove and Install

⚠ **CAUTION** This component is heavy. It must only be removed or handled using a suitable lifting method and device.

Remove

1. Make the machine safe with the platform lowered.

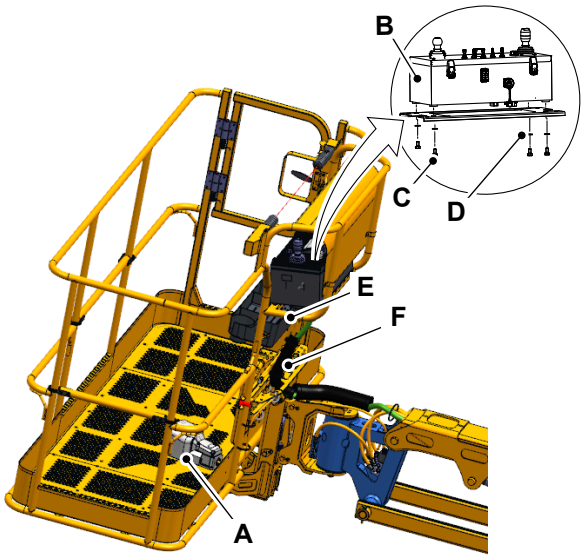
   Refer to: PIL 01-03-27.

2. Disconnect the electrical connectors from the foot pedal.
3. Remove the foot pedal.
4. Support the platform with suitable support equipment.
5. Disconnect the electrical connectors from the controller box.

   5.1. Put a label on the electrical connectors to help installation.

6. Remove the set screws (x4) and washers 1 (x4) of platform controller box. Refer to Figure 77.
7. Remove platform controller box.
8. Remove the bolts (x4), washers 2 (x8), spacer (x4) and locknut 1 (x4) from platform mounting. Refer to Figure 78.
9. Remove the setscrew (x4) and washers 3 (x4) from the platform.
10. Remove the platform from the machine.

Figure 77.



A Foot pedal
B Platform control
C Set screw (x4)
D Washer1 (x4)
E Electric connectors
F Platform mounting

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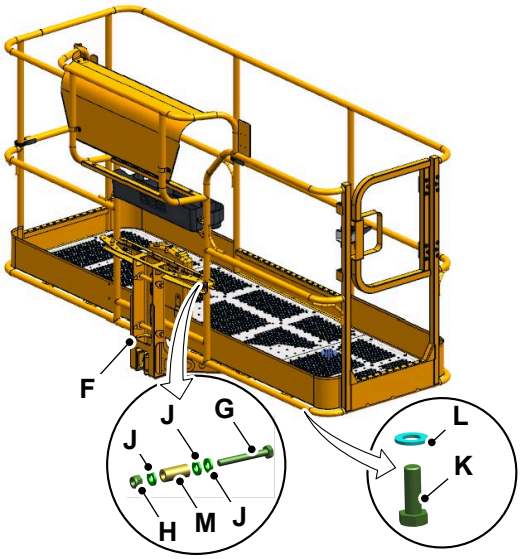
Figure 78.



F Platform mounting
G Bolts (x4)
H Locknut 1 (x4)
J Washer 2 (x8)
K Setscrew (x4)
L Washer 3 (x4)
M Spacer (x4)

Install

The installation procedure is the reverse of the removal procedure. Additionally do following steps.

1. Tighten the setscrews, bolts and locknuts to specified torque value. Refer to Table 29.

Pipe Cradle Post (Attachment)

⚠ **CAUTION** This component is heavy. It must only be removed or handled using a suitable lifting method and device.

It is important to ensure that precautions are taken and two service personnel are available during this procedure.

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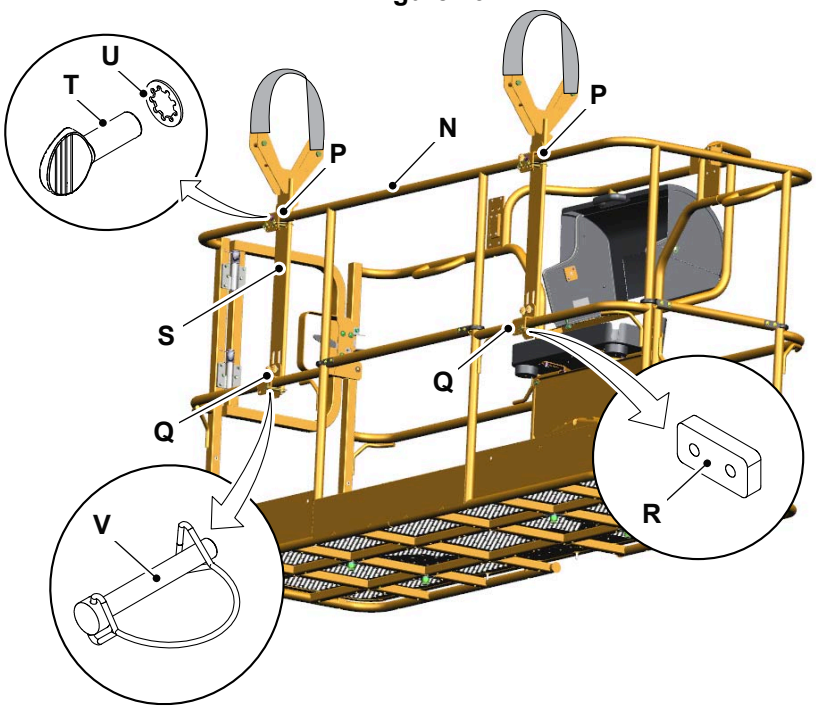
Figure 79.



N Guardrail
Q Bottom bracket (x2)
S Pipe cradle post (x2)
U Toothed lock washer (x6)
P Upper bracket (x2)
R Back plate (x2)
T Thumb screw (x6)
V Shaft locking pin (x8)

Install

1. Make the machine safe.

   Refer to: PIL 01-03-27.

2. Get access to the platform to install the pipe cradle post (x2) on the guardrails.

3. Safely hang the pipe cradle post (x2) on the guardrails with the upper bracket (x2). Refer to Figure 79.

4. Match the holes on the upper bracket (x2) with the holes on the guardrails and install the thumb screw (x2) and toothed lock washer (x2). Refer to Figure 79.

5. Use the thumb screw (x4) and toothed lock washer (x4) to install the bottom bracket (x2) and back plate (x2). Refer to Figure 79.

6. Install the shaft locking pin (x8) on the upper and bottom brackets of the pipe cradle post (x2). Refer to Figure 79.

Remove

1. The removal procedure is the reverse of the installation procedure. Additionally, do the following step.

2. Tighten the thumb screw (x6) to the specified torque value.

   Torque: 22N·m

Table 29. Torque Values

Item	Nm
C	43
G	43
K	74

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15 - Engine

Contents **Page No.**

Acronyms Glossary 15-2

15-00 Engine
15-00-00 General 15-3
15-21 Oil Filter
15-21-00 General 15-11
15-24 Air Filter
15-24-00 General 15-14

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Acronyms Glossary

IMV	Inlet Metering Valve
RPM	Revolutions Per Minute

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00 - Engine

00 - General

Introduction 15-3
Health and Safety 15-4
Technical Data 15-5
Drain and Fill 15-6
Remove and Install 15-8

Introduction

This machine is installed with "JCB 444-T4 55 kw 12V" diesel engine. Maintenance information related to this engine is available via stand-alone documents on JCB Service Pro.
Refer to: servicepro.jcb.com.

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Health and Safety

Hot Components

Touching hot surfaces can burn skin. The engine and machine components will be hot after the unit has been running. Allow the engine and components to cool before servicing the unit.

Turning the Engine

Do not try to turn the engine by pulling the fan or fan belt. This could cause injury or premature component failure.

Notice: *The engine and other components could be damaged by high pressure washing systems. Special precautions must be taken if the machine is to be washed using a high pressure system. Make sure that the alternator, starter motor and any other electrical components are shielded and not directly cleaned by the high pressure cleaning system. Do not aim the water jet directly at bearings, oil seals or the engine air induction system.*

WARNING! *To bleed the injectors you must turn the engine. When the engine is turning, there are parts rotating in the engine compartment. Before starting this job make sure that you have no loose clothing (cuffs, ties etc) which could get caught in rotating parts. When the engine is turning, keep clear of rotating parts.*

Notice: *Clean the engine before you start engine maintenance. Obey the correct procedures. Even very minor contamination of the fuel system will cause damage and possible failure of the engine.*

Notice: *Do not exceed the maximum level of engine oil in the sump. If the maximum is exceeded, the excess must be drained to the correct level. An excess of engine oil could cause the engine speed to increase rapidly without control.*

WARNING! *Hot oil and engine components can burn you. Make sure the engine and engine oil is cool before draining the engine oil. Used engine crankcase lubricants contain harmful contaminants. In laboratory tests it was shown that used engine oils can cause skin cancer.*

WARNING! *The engine has exposed rotating parts. Switch off the engine before working in the engine compartment. Do not use the machine with the engine cover open.*

Notice: *A drive belt that is loose can cause damage to itself and/or other engine parts.*

WARNING! *Do not open the high pressure fuel system with the engine running. Engine operation causes high fuel pressure. High pressure fuel spray can cause serious injury or death.*

CAUTION! *It is illegal to pollute drains, sewers or the ground. Clean up all spilt fluids and/or lubricants. Used fluids and/or lubricants, filters and contaminated materials must be disposed of in accordance with local regulations. Use authorised waste disposal sites.*

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Technical Data

Table 30.

Description	SL Engine
Engine Variant	Turbocharged with intercooler
Emission compliance	US-EPA Tier 4 Final, EU Stage IV
Rated speed	2200 RPM (Revolutions Per Minute)
Weight (Dry)	(Dry weight-No cooling fan drive) 496kg
Number of cylinders	4
Nominal bore size	103mm
Stroke	132mm
Cylinder arrangement	In line
Combustion Cycle	4-stroke
Firing order	1-3-4-2
Displacement	4.399L
Compression ratio	16.7: 1
Engine Compression	Compression variance between each cylinder should be no greater than 3.5bar (50.8psi)
Direction of rotation (viewed from front {crankshaft pulley} end)	Clockwise
Valves	4 per cylinder
Valve clearances measured at the tappet end of the rockers (measured cold)	
- Inlet	0.15→0.21mm
- Exhaust	0.43→0.49mm
Lubricating oil pressure (Dependent on engine temperature and speed)	1.6→6.5bar (23.2→94.3psi)
Filter type	Screw-on canister (with drain facility)*(2)*
Pressure to open by-pass valve	-
Oil pressure relief valve setting	6bar (87.0psi)
Oil pressure switch setting	0.6bar (8.7psi) falling
Oil pump*(1)*	Integral unit with relief valve
Combustion system	Common rail direct Injection
High pressure fuel pump	High pressure with electronically controlled fuel metering

(1) The oil pump is a non-serviceable part
(2) Some variants have ports for connection of a remote filter assembly.

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Drain and Fill

Special Tools

Description	Part No.	Qty.
Data Link Adaptor (DLA) Kit Data Link Adaptor (DLA 2.0) Kit	892/01174 728/H5409	1*
*Unless otherwise stated, you can use any of the tools shown.		

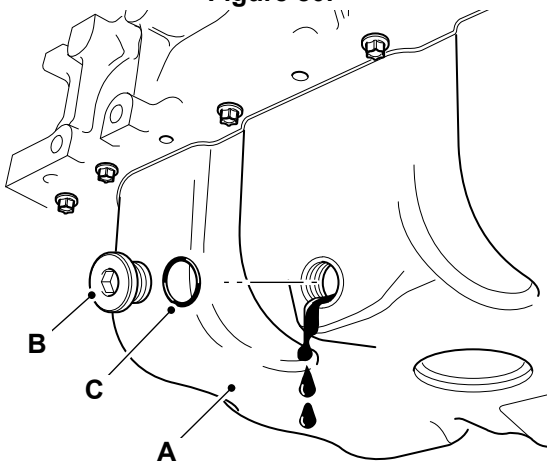
⚠ **CAUTION** Oil will gush from the hole when the drain plug is removed. Keep to one side when you remove the plug.

Drain

Drain the oil when the engine is warm as contaminants held in suspension will then be drained with the oil.

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Open the engine compartment cover.
   Refer to: PIL 06-06-06.
3. Get access to the engine oil pan.
4. Place a container of suitable size below the engine oil pan.

Figure 80.



A Engine oil pan
B Drain plug
C O-ring

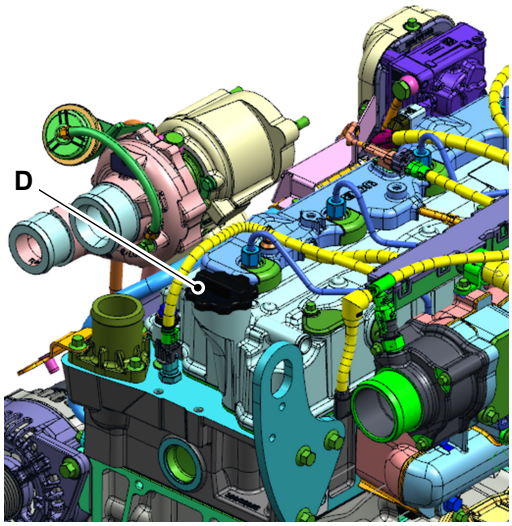
5. Remove the drain plug and O-ring.
   5.1. Make sure to discard the O-ring.
   5.2. Let the oil drain out from the engine oil pan.
   5.3. Check and install the drain plug along with a new O-ring, and replace if damaged.
   5.4. Tighten the drain plug to the specified torque value.
   Torque: 40N·m

Fill

Note: The engine has top oil filling option only.

1. Open the engine oil filling cap.

Figure 81.



D Engine oil filling cap

2. Use a funnel of specified diameter or smaller to fill the engine oil. Refer to Figure 82.
   Dimension: 200mm

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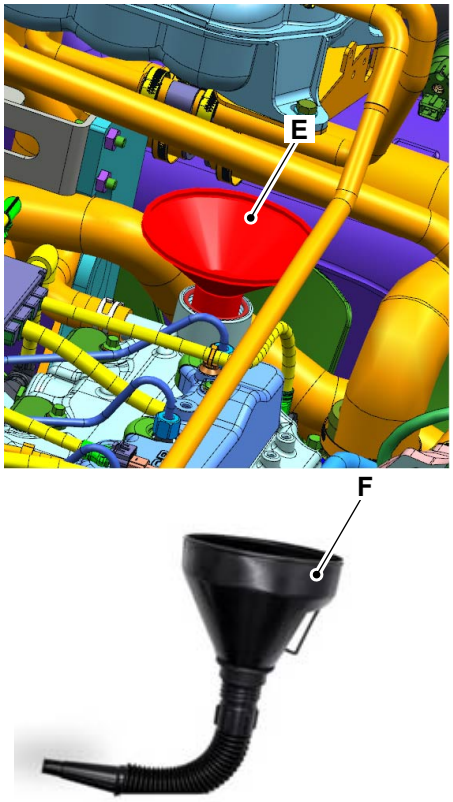
Figure 82.



E Funnel (200mm diameter or smaller)
F Funnel with extended flex pipe

2.1. If funnel of specified diameter as given in step 2 is not available, make sure to use the funnel with extended flex pipe to fill the engine oil. Refer to Figure 82.

3. Fill the engine with the recommended oil to the MAX mark on the dipstick.

   3.1. Clean the engine oil spillage, if any.

4. Install and close the engine oil filling cap correctly.

5. Do the steps that follow if the engine does not have a dead crank feature.

   5.1. Connect a laptop to the engine with a data link adaptor and open Servicemaster.

   Special Tool: Data Link Adaptor (DLA) Kit / Data Link Adaptor (DLA 2.0) Kit (Qty.: 1)

   5.2. Perform the IMV (Inlet Metering Valve) Override test.

   5.3. The IMV Override test will allow the engine to be cranked for a set time period without starting allowing sufficient time to prime the oil pressure.

   Duration: 10s

6. Operate the engine at idle and make sure that the oil pressure low warning light is extinguished immediately after the engine starts.

   6.1. If the oil pressure low warning light does not extinguish, stop the engine and investigate the cause.

7. Check for oil leakage.

   7.1. When the oil has cooled, check the oil level again.

   7.2. Top up with clean engine oil, if necessary.

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Remove and Install

Hot Components

Touching hot surfaces can burn skin. The engine will be hot after the unit has been running. Allow the engine to cool before servicing the unit.

Lifting Equipment

You can be injured if you use incorrect or faulty lifting equipment. You must identify the weight of the item to be lifted then choose lifting equipment that is strong enough and suitable for the job. Make sure that lifting equipment is in good condition and complies with all local regulations.

Remove

1. Park the machine on firm level ground.
2. Make the machine safe.
   Refer to: PIL 01-03.
3. Turn OFF the isolator switch.
4. Unlock and open engine canopy.
   Refer to: PIL 06-06-06.
5. Pull the engine tray out.
   Refer to: PIL 06-06-06.
6. Disconnect and remove the battery.
   Refer to: PIL 33-03-00.
7. Drain the engine oil and cooling system, if necessary.
   7.1. Place a suitable container to collect the oil and coolant.
8. Put labels on the coolant hoses for identification to help installation.
9. Disconnect the coolant hoses from the engine.
10. Remove the cooling pack along with fan guard.
11. Disconnect and remove the induction system.
12. Disconnect and remove the exhaust pipes from the engine.
    Refer to: PIL 18-24-00.
13. Discharge the hydraulic pressure.
    Refer to: PIL 30-00-00.
14. Drain the hydraulic tank.
    Refer to: PIL 30-03-00.
15. Disconnect the hydraulic pipes from the engine.
16. Put labels on the hydraulic hoses for identification to help installation.
17. Disconnect the wiring connections from the starter motor, alternator, engine sensors and actuators.
18. Disconnect the electrical connections from the engine.
19. Put labels on electrical connectors for identification to help installation.
20. Disconnect the fuel pipes from engine.
21. Put labels on the fuel pipes for identification to help installation.
22. Seal all open ends of fuel pipes with caps.
23. Seal all open ports of the engine with caps.
24. Disconnect the hydraulic pump from the engine.
25. Put labels on the hydraulic pump hoses for identification to help installation.
26. Remove the hydraulic pump.
    Refer to: PIL 30-12-00.
27. Attach a sling / chain to the engine lifting eyes.

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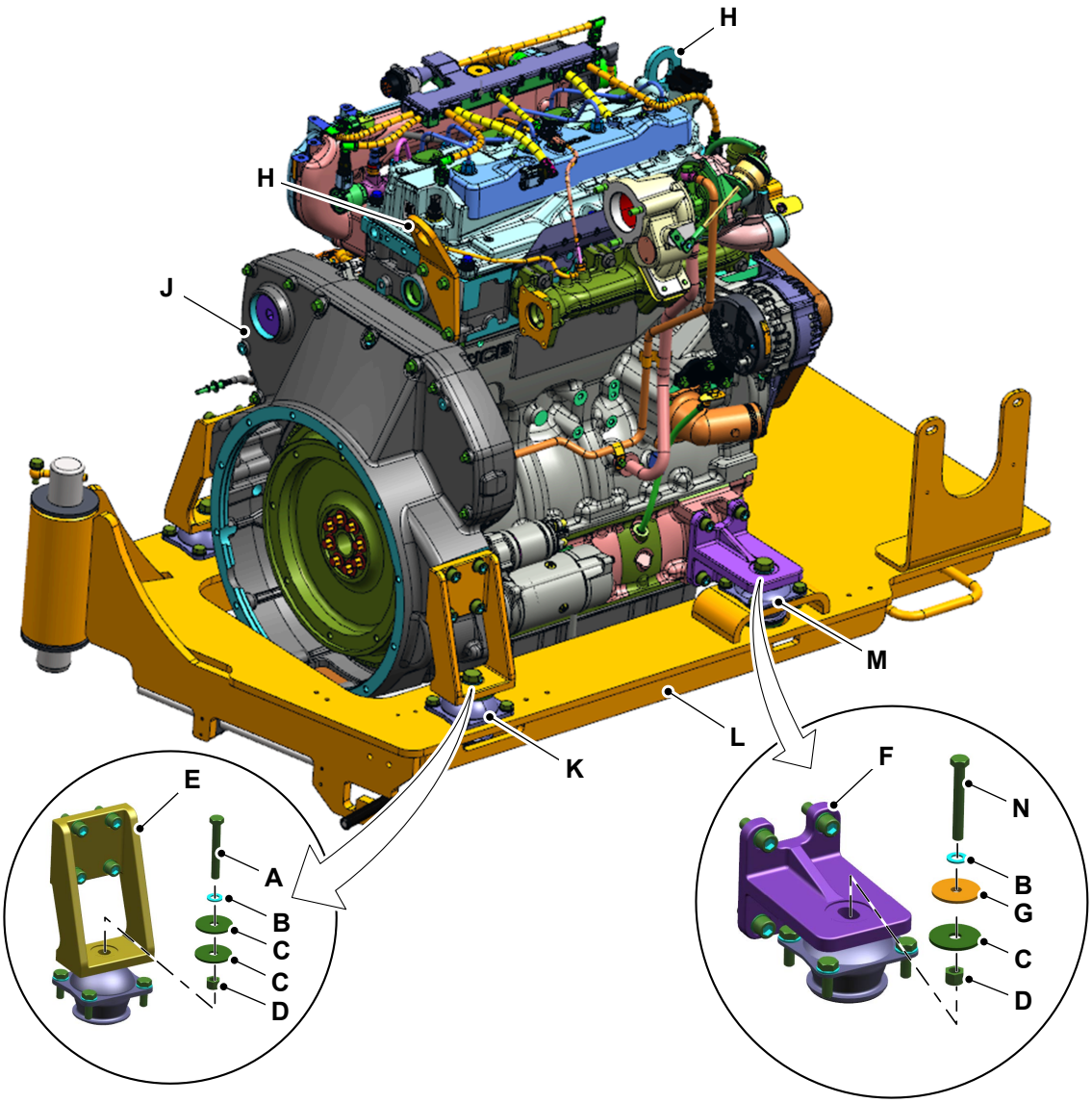
Figure 83.



A Bolt 1 (x2)
B Washer 1 (x4)
C Washer 2 (x6)
D Locknut (x4)
E Rear engine bracket (x2)
F Front engine bracket (x2)
G Step washer (x2)
H Lifting eye (x2)
J Engine
K Rear rubber mount (x2)
L Engine tray
M Front rubber mount (x2)
N Bolt 2 (x2)

28. Remove the bolt 1 (x2), washer 1 (x2), washer 2 (x4) and locknut (x2) from the rear engine bracket (x2) and rear rubber mount (x2).

29. Remove the bolt 2 (x2), washer 1 (x2), step washer(x2), washer 2 (x2) and locknut (x2) from the front engine bracket (x2) and front rubber mount (x2).

30. With suitable lifting equipment, lift and move the engine away from its position.

31. Put the engine on a suitable stand.

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

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1. Fill the cooling system with the specified coolant.
   Refer to: PIL 75-09-03.
2. Fill and check the hydraulic fluid, engine oil and coolant level.
3. Make sure no leakages from exhaust system pipe connections.
4. Make sure no leakages from fuel pipe connections.
5. Make sure that all the bolts are tighten to correct torque value. Refer to Table 31.

Table 31. Torque Values

Item	Nm
A	135
N	75

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21 - Oil Filter

00 - General

Introduction 15-11
Health and Safety 15-12
Remove and Install 15-12

Introduction

The oil filter is part of the engine's entire lube oil system.

It keeps the engine oil condition at the required level set for cleanliness, through the separation and retention of compact impurities from the oil in order to prevent damages to the engine.

The oil filter is remotely mounted on to the chassis.

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Health and Safety

Oil

Oil is toxic. If you swallow any oil, do not induce vomiting, seek medical advice. Used engine oil contains harmful contaminants which can cause skin cancer. Do not handle used engine oil more than necessary. Always use barrier cream or wear gloves to prevent skin contact. Wash skin contaminated with oil thoroughly in warm soapy water. Do not use petrol, diesel fuel or paraffin to clean your skin.

CAUTION! *It is illegal to pollute drains, sewers or the ground. Clean up all spilt fluids and/or lubricants. Used fluids and/or lubricants, filters and contaminated materials must be disposed of in accordance with local regulations. Use authorised waste disposal sites.*

CAUTION! *Oil will gush from the hole when the drain plug is removed. Keep to one side when you remove the plug.*

CAUTION! *The oil filter canister will contain some oil which could spill out when you remove the canister.*

Remove and Install

Special Tools

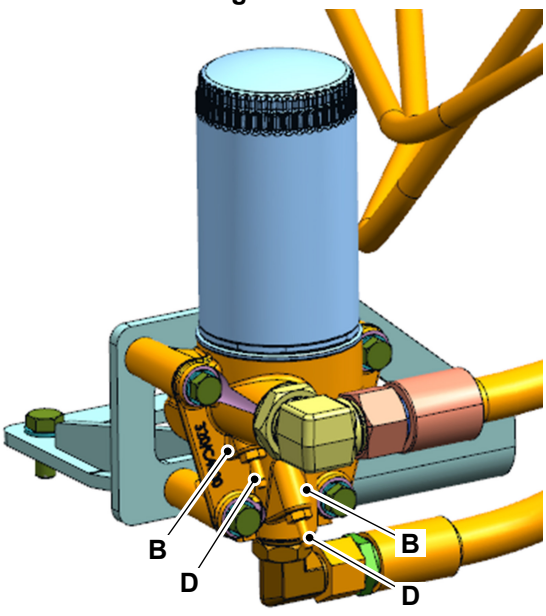
Description	Part No.	Qty.
Oil Filter Removal Tool	892/00292	1

⚠ **CAUTION** Oil will gush from the hole when the drain plug is removed. Keep to one side when you remove the plug.

Drain the oil when the engine is warm as contaminants held in suspension will then be drained with the oil.

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Get access to the engine compartment.
   Refer to: PIL 06-06-06.
3. Locate and access the remote oil filter.
4. If necessary, drain the engine oil from the engine oil pan.
5. Place a container of suitable size below the remote oil filter.
6. Loosen the bleed screw (x2) from the drain port (x2).

Figure 84.



B Drain port (x2)
D Bleed screw (x2)

7. Drain the 2 sides of the filter element (clean side and dirty side) from the drain port (x2). Refer to Figure 84.

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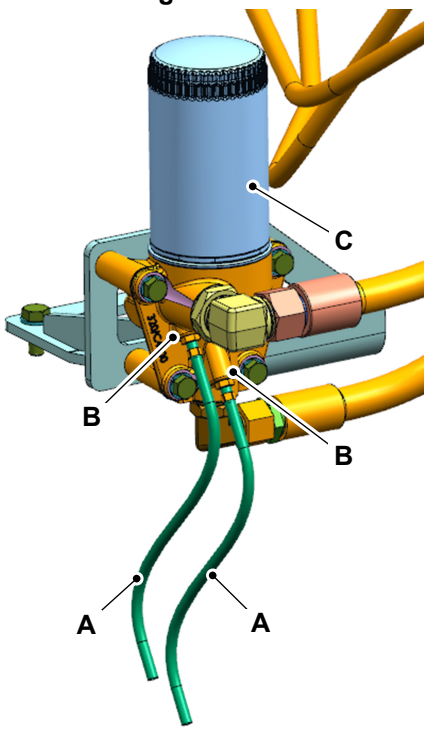
Figure 85.



A Vent hose (x2)
B Drain port (x2)
C Remote oil filter

8. Install the bleed screw (x2) onto the drain port (x2). Refer to Figure 84.
9. Loosen and remove the oil filter canister, use special tool if necessary.

   Special Tool: Oil Filter Removal Tool (Qty.: 1)
10. Clean the seal face of the filter head.
11. Smear the seal on the new filter canister with the clean engine oil.
12. Install and hand-tighten the new filter canister.
13. Tighten the filter until it contacts the filter housing and then tighten it an additional 3/4 of a turn.
14. Fill the engine oil.

    Refer to: Drain and Fill (PIL 15-00-00).
15. Operate the engine at idle and make sure that the oil pressure low warning light is extinguished immediately after the engine starts.

    15.1. If the oil pressure low warning light does not extinguish, stop the engine and investigate the cause.
16. Check for oil leakage.

    16.1. When the oil has cooled, check the oil level again.

    16.2. Top up with clean engine oil, if necessary.

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24 - Air Filter

00 - General

Introduction 15-14
Health and Safety 15-15
Remove and Install 15-16

Introduction

Engine performance and durability will be severely affected if the quality of the air intake is poor.

A dirty and blocked air filter will reduce the amount of air entering the combustion chamber which can cause engine misfiring, black smoke and low output power.

A dirty and blocked air filter can also lead to abrasion of the cylinder bores and valves (referred to as dusting). This will cause excessive oil consumption, black smoke, low output power and a reduced engine life.

This is a dry-type air filter with a replaceable paper filter cartridge.

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Health and Safety

⚠ **Notice:** Do not run the engine when the element has been removed.

Notice: The outer element must be renewed immediately if the warning light on the instrument panel illuminates.

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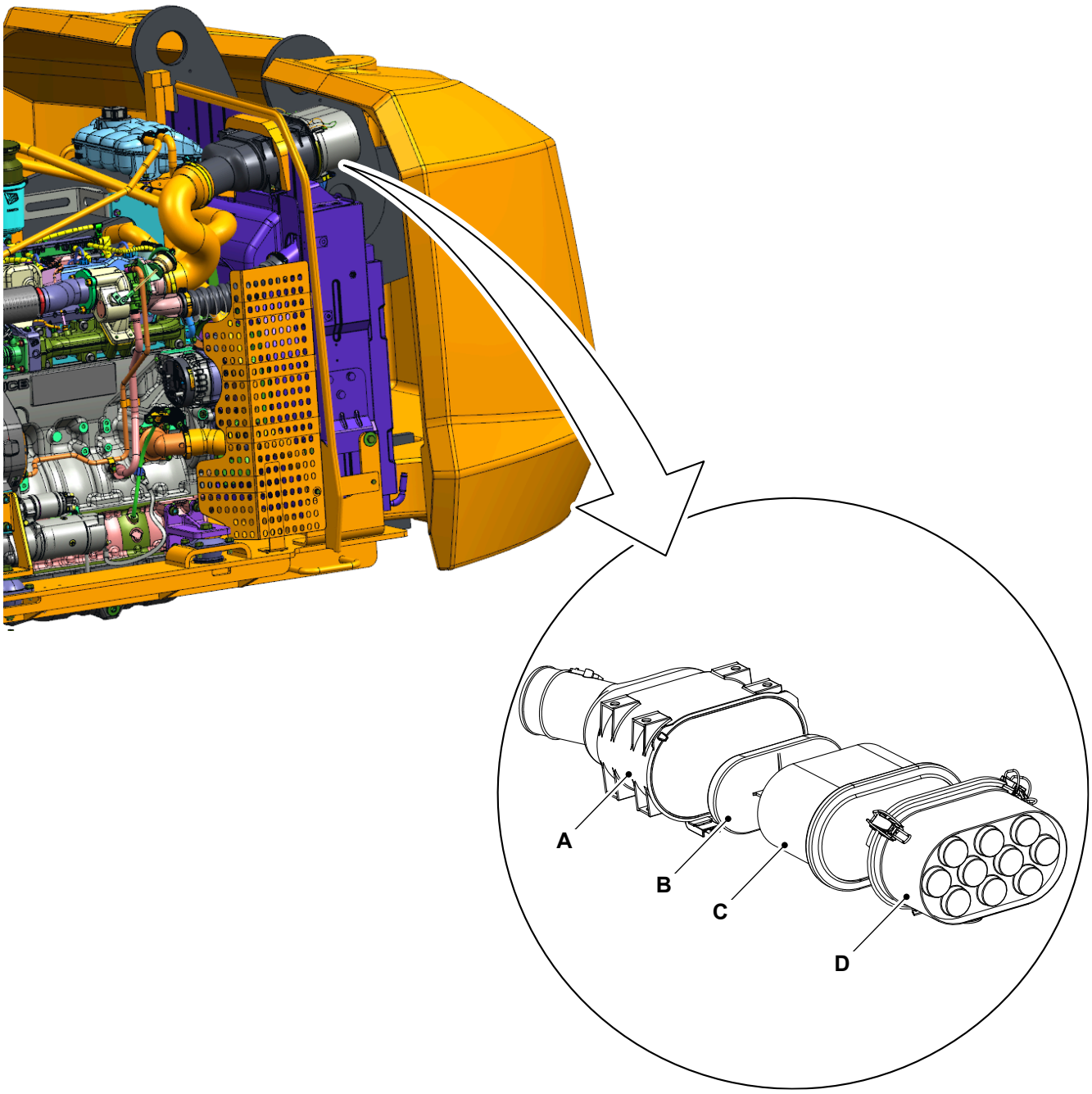
Remove and Install

⚠ **Notice:** The inner element of the engine air filter must be replaced with a new one. Do not attempt to clean or wash the old element.

Notice: Do not run the engine with the air filter element removed.

Figure 86.



A Housing induction filter
B Safety element
C Main element
D Filter - pre cleaner

1. A new inner element must be fitted at least every second time the outer element is changed. As a reminder, mark the inner element with a felt tipped pen each time the outer element is changed.

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2. Make the machine safe.
   Refer to: PIL 01-03-27.
3. Stop the engine and remove the starter key.
4. Open the engine compartment cover.
   Refer to: PIL 06-06-06.
5. Identify the air filter.
6. Remove outer element.
7. If necessary, remove the inner element.
   7.1. You must not tap or knock the element.
   7.2. Carefully insert the new inner element into the canister.
8. Clean the inside of cover and canister.
9. Make sure it seats correctly and check the seal is fully seated.
10. Insert a new outer element into the canister, check seal is fully seated.
11. Replace the cover and push firmly into the position, make sure it is secured.
12. Check all hoses for condition and tightness.
    12.1. Never try to replace hose with any other pipe/ hose. Contact JCB service dealer for details.

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Notes:

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18 - Fuel and Exhaust System

Contents **Page No.**

Acronyms Glossary 18-2

18-00 Fuel and Exhaust System
18-00-00 General 18-3
18-03 Tank
18-03-00 General 18-9
18-09 Filter
18-09-00 General 18-12
18-09-03 Filter Element 18-17
18-12 Water Separator
18-12-04 Water in Fuel Sensor 18-18
18-21 Fuel Pump
18-21-00 General 18-19
18-24 Exhaust
18-24-00 General 18-26

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Acronyms Glossary

DEF	Diesel Exhaust Fluid
ECM	Engine Control Module
EGR	Exhaust Gas Recirculation
NOx	Nitrogen Oxide
SCR	Selective Catalytic Reduction
WIF	Water in Fuel

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00 - Fuel and Exhaust System

00 - General

Introduction 18-3
Health and Safety 18-4
Component Identification 18-5
Clean 18-6
Check (Leaks) 18-8

Introduction

Maintenance information for some components pertaining to the fuel system is contained within the Manufacturer's engine manual and is available as a stand-alone document on JCB Service Pro.
Refer to: servicepro.jcb.com.

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Health and Safety

Fuel

Fuel is flammable, keep naked flames away from the fuel system. Stop the engine immediately if a fuel leak is suspected. Do not smoke while refuelling or working on the fuel system. Do not refuel with the engine running. Completely wipe off any spilt fuel which could cause a fire. There could be a fire and injury if you do not follow these precautions.

Fluid Under Pressure

Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of fluid under pressure and wear personal protective equipment. Hold a piece of cardboard close to suspected leaks and then examine the cardboard for signs of fluid. If fluid penetrates your skin, get medical help immediately.

WARNING! *Do not open the high pressure fuel system with the engine running. Engine operation causes high fuel pressure. High pressure fuel spray can cause serious injury or death.*

Notice: *Do not allow dirt or any other oil/liquid/ contamination to enter the fuel system. Before disconnecting any part of the fuel system, thoroughly clean around the connection. When a component has been disconnected, for example a fuel pipe, always install protective caps and plugs to prevent dirt ingress. Contamination in the fuel system will compromise the durability and safety of the system. It will seriously damage the fuel injection equipment and could be expensive to repair.*

Notice: *The high pressure fuel system is extremely susceptible to damage if it is contaminated. Always clean the engine using the correct procedures before carrying out maintenance. Contamination of the fuel system can cause catastrophic failure of the engine.*

Notice: *Running the engine with air in the system could damage the fuel injection pump. After maintenance, the system must be bled to remove any air.*

Notice: *Clean the engine before you start engine maintenance. Obey the correct procedures. Even very minor contamination of the fuel system will cause damage and possible failure of the engine.*

CAUTION! *It is illegal to pollute drains, sewers or the ground. Clean up all spilt fluids and/or lubricants. Used fluids and/or lubricants, filters and contaminated materials must be disposed of in accordance with local regulations. Use authorised waste disposal sites.*

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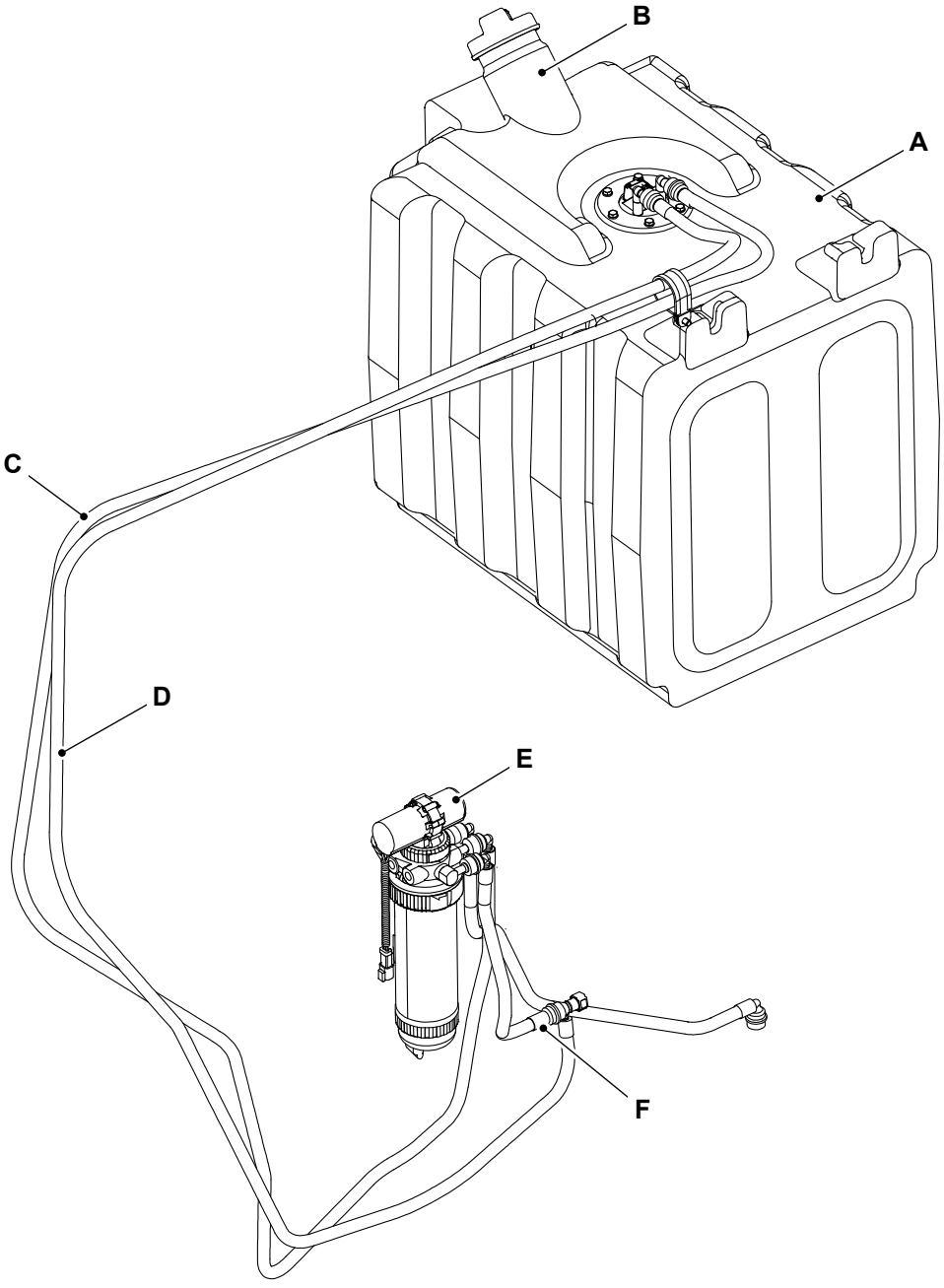
Component Identification

Figure 87.



A Fuel tank
B Fuel tank filler
C Hose- tank to feed pump
D Hose- return line
E Feed pump
F Hose- feed pump to T- connector

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Clean

Cleanliness Requirements

Important: Additional cleaning must be carried out prior to working on the high pressure fuel system. It is extremely important the high pressure fuel components and the adjacent parts of the engine are meticulously cleaned before any components are removed. Refer to: Effects of Contamination.

Before starting work on the high pressure fuel system, make sure that the working environment is suitable. Refer to: Maintenance Environment, Common Rail Fuel Injection.

1. Obey all fuel system health and safety information.
2. Clean the machine, prior to completing any maintenance work.
3. Clean the engine.
4. Remove the hoses, electrical harnesses and ancillaries to improve access and expose any remaining trapped dirt close to the relevant high pressure components.
5. Wash away any remaining dirt or debris and then dry the area using a compressed air jet. When the area is dry use a soft clean brush to remove sand or grit particles that remain.

Effects of Contamination

While the requirement for a good level of cleanliness is well known and common practice, the introduction of high pressure common rail fuel injection necessitates working to new levels of cleanliness.

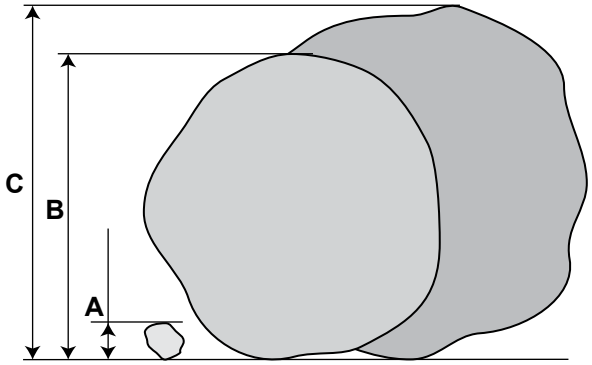
Once inside the system, fuel circuit contaminants greatly affect the performance and life of the fuel injection equipment. For example, contaminants in the fuel pump will develop internal wear to cause internal leakage and hence lower discharges. Use of poor quality fuels and poor maintenance could also lead to contaminants entering the fuel injectors. There is a possibility of catastrophic equipment failure if debris should prevent the injectors from fully closing. The main contaminants can be classified as follows:

- Solid Particles - sand, fibres, metallic particles, welding scale, sealing materials and wear particles etc.
- Liquid - usually water and incompatible oils and greases.
- Gases - Air, sulphur dioxide etc. which can create corrosive compounds if dissolved in the fluid.

These contaminants can appear during manufacture, assembly, operation and maintenance.

The fuel filter is rated at 5 micron = 0.005mm (0.0002in). Listed are a few typical comparisons of micron size:

Figure 88.



A 8 microns
B 70 microns
C 100 microns

- Red Blood Cell = 8 microns (0.008mm, 0.000315in).
- Human Hair = 70 microns (0.07mm, 0.00275in).
- Grain of Salt = 100 microns (0.1mm, 0.00394in).
- The smallest particle visible to the naked eye is 40 microns (0.00157in) approximately.

The fuel filter must be changed in accordance with the applicable service schedule and procedures. The water in fuel sensor must be maintained to make sure of correct operation at all times.

The potential for engine damage due to fuel contamination is much greater when using common rail injection technology than with mechanical injection systems. This is because common rail requires components with smaller manufacturing tolerances, especially the fuel injectors. In addition, common rail operates at much higher fuel pressures, over five times that of mechanical systems.

Similar pressures are used by commercial water jet cutting machines to cut metal. Fortunately clean diesel fuel has lubricating qualities that prevents erosion of components but it is obvious that contaminated fuel will cause serious damage at such high pressures.

Maintenance Environment, Common Rail Fuel Injection

Depending on circumstances engine maintenance may be required in various working environments. Obviously procedures are best carried out in a

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dedicated workshop equipped with a suitable clean room, but in practice this is not always possible.

Maintenance procedures requiring removal or replacement of fuel system components, particularly high pressure components, require special precautions to make the working environment suitable, reducing the risk of contamination to an absolute minimum.

Use the following guidelines to make sure you reduce the chances of fuel system contamination when working in different environments:

Worksite - Open to weather

This repair site is not an acceptable location. Only in extreme circumstances should a machine be repaired on an open site. Use the guidelines below:

- Clean the engine. If the machine is on hard standing, clean away the material washed from the engine.
- Place suitable clean boards on the ground around the machine.
- Erect clean plastic sheeting to shelter the engine from wind and rain.
- Wear a new disposable environmental type suit when working on the fuel system. If the suit becomes contaminated with mud, move away from the engine and change into a new suit.
- Use clean latex gloves (non-powdered).
- Before you start work make sure that all the required replacement parts and tools are on site. Make sure that the replacement parts are still sealed inside their packaging.
- Put caps on all exposed ports and orifices immediately. Do not leave them open.
- High pressure fuel pipes MUST BE RENEWED if any pipe joint is loosened or disconnected. DO NOT re-use the original pipe.

Worksite - Closed to weather from above

This repair site is the least acceptable condition, if possible move the machine to a more suitable environment. Use the guidelines below:

- Clean the engine. Clean the floor of all material washed from the engine.
- Place suitable clean boards on the ground around the machine.
- Erect clean plastic sheeting to shelter the engine from the wind and the possibility of debris such as dirt and dust falling from above.
- Wear a new disposable environmental type suit when working on the fuel system. If it becomes contaminated with mud, move away from the engine and change into a new suit.
- Use clean latex gloves (non-powdered).
- Before you start work make sure that all the required replacement parts and tools are on site. Make sure that the replacement parts are still sealed inside their packaging.
- Put caps on all exposed ports and orifices immediately. Do not leave them open.
- High pressure fuel pipes MUST BE RENEWED if any pipe joint is loosened or disconnected. DO NOT re-use the original pipe.

Vehicle Maintenance Workshop

Unless the workshop has a dedicated `sealable clean room' work bay, precautions must still be taken.

- Clean the engine. Clean the engine in the dedicated area and then move it to the workshop.
- Clean the floor area around the machine.
- Erect clean plastic sheeting to shelter the engine from any wind and the possibility of debris such as dirt and dust falling from above.
- Make sure that workshop doors to the outside are kept closed. A gust of wind through an open door will easily blow sand particles into the air.
- Make sure your work wear is clean, non-flocking and lint free. If in doubt wear a new disposable environmental type suit.
- Use clean latex gloves (non-powdered).
- Before you start work make sure that all the required replacement parts and tools are on site. Make sure that the replacement parts are still sealed inside their packaging.
- Put caps on all exposed ports and orifices immediately. Do not leave them open.
- High pressure fuel pipes MUST BE RENEWED if any pipe joint is loosened or disconnected. DO NOT re-use the original pipe.

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Check (Leaks)

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Open the engine compartment cover.
   Refer to: Open and Close (PIL 06-06-06).
3. Check the engine compartment, fuel pipes and the area below for leaks.
4. Start the engine.
5. While the engine is running, check the engine compartment, fuel lines and the area below for leaks.
6. If necessary, repair or replace any damaged components.

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03 - Tank

00 - General

Introduction 18-9
Clean 18-10
Remove and Install 18-11

Introduction

The fuel tank is a safe container for storing flammable fluids, from here the fuel is pumped into the engine.

There can be condensation in a partially filled fuel tank. Therefore, you must fill the fuel tank after you operate the engine.

Drain the water and sediment from any fuel storage tank at the recommended service intervals.

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Clean

The diesel tank must be drained if there is a chance the fuel is contaminated or it has been filled with the incorrect fuel.

1. Make the machine safe.

   Refer to: PIL 01-03.

2. Drain the diesel tank.
3. Drain the fuel from the low pressure fuel pipes.
4. Replace the fuel filters.
5. Refill the tank to the specified level with clean diesel.

   Percentage: 25%

6. Start the engine and leave it to run for the specified time period.

   Duration: 10min

7. Stop the engine.
8. Drain the water separator and the main fuel filter.
9. If there was any water or other liquid in the water separator, repeat 6 to 8.

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Remove and Install

Remove

1. Make the machine safe with the boom arm lowered.

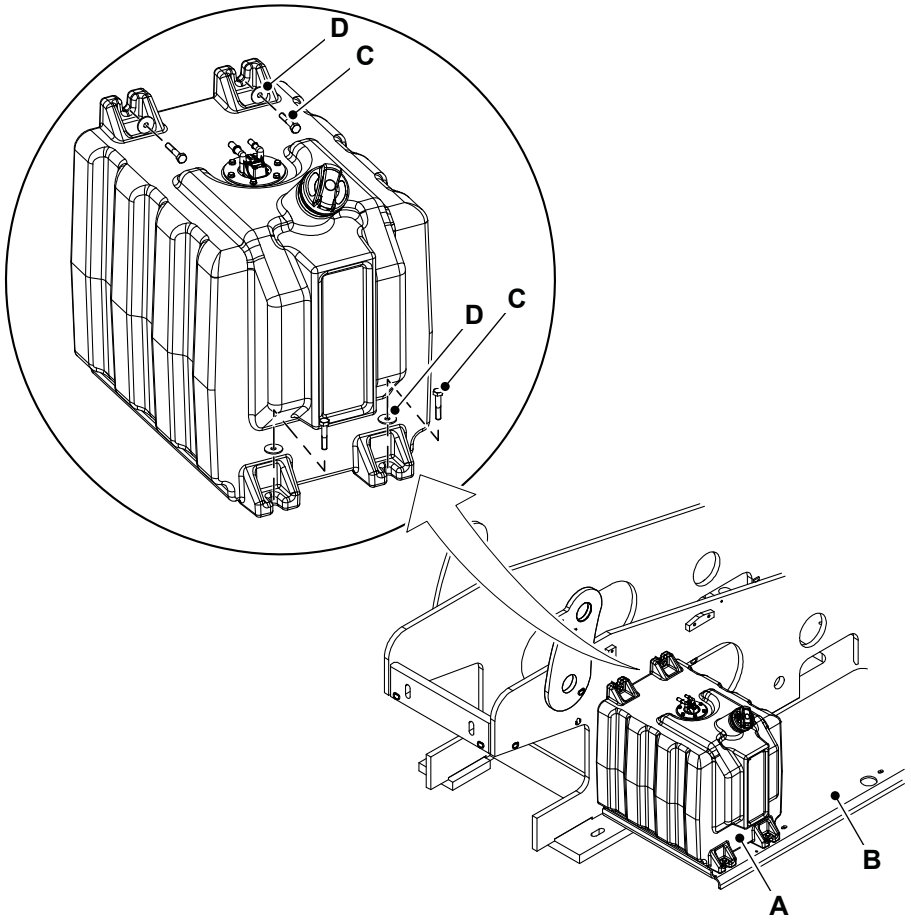
   Refer to: PIL 01-03-27.

2. Remove the feed and return fuel lines, and fuel pipes.
3. Put a label on the feed and return fuel lines, and fuel pipes to help installation.
4. Disconnect the fuel sensor plug connection.
5. Plug all the open ports and hoses to prevent contamination.
6. Place a container of suitable size below the machine.

   6.1. Remove the drain plug.

7. Remove the bolt (x4) and washer (x4) from the turntable.
8. Remove the fuel tank away from the machine.

Figure 89.



A Fuel tank
B Turntable
C Bolt (x4)
D Washer (x4)

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Check the fuel pipes for leaks.
3. Tighten the bolt (x4) to the correct torque value. Refer to Table 32.

Table 32. Torque Values

Item	Nm
C	35–40

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09 - Filter

00 - General

Introduction 18-12
Component Identification 18-13
Operation 18-13
Drain and Fill 18-14
Remove and Install 18-15

Introduction

The machine is equipped with JCB CEV Stage-IV 55kW engine. Manually navigate to the JCB Service Pro to view the engine service manual for the detailed information.

The fuel filter consists of a paper element folded in such a way as to give a very large surface area. It is most important that the fuel filter is changed regularly in accordance with the machine service schedule. Use only the correct specification filters.

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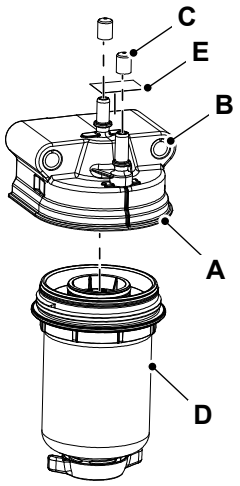
Component Identification

Figure 90.



A Filter cover
B Compression limiter
C Filter cap
D Filter element
E Label

Operation

The fuel pre-filter works under suction. The fuel is pulled through the filter media by the fuel lift pump where any dirt particles or water droplets are retained. Water droplets congeal and drop down into the integral water sediment bowl. The water can be drained off by means of a drain valve in the bottom of the water sediment bowl.

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Drain and Fill

1. Make the machine safe
   Refer to: PIL 01-03.
2. Drain off any water in the water separator bowl and filter element by turning the drain valve. Any fuel and water mix drained must be disposed of in accordance with local regulations. Do not reuse the drained fuel.

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Remove and Install

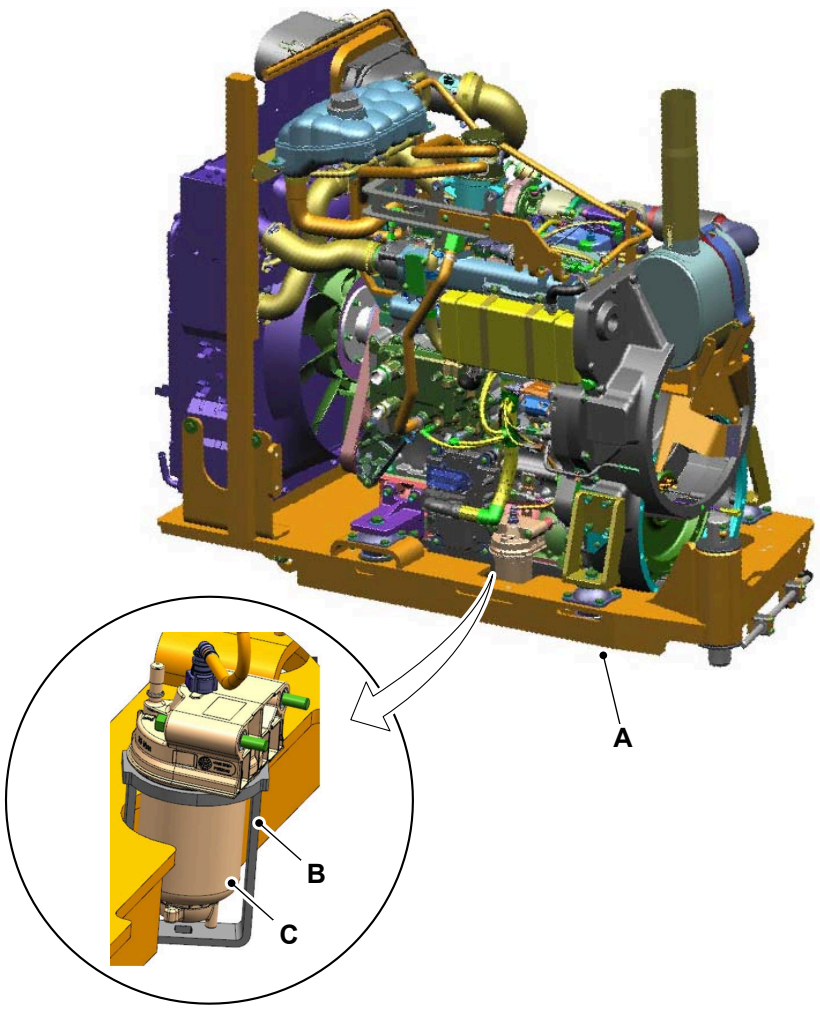
Special Tools

Description	Part No.	Qty.
Fuel Filter Removal Tool (4 cyl)	892/01383	1

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
3. Get access to the filter.
4. Make sure that you keep a suitable container to collect the fuel from the cartridge.
5. Note: The filter is accessible from bottom of the machine. Use suitable tool for servicing the filter element.
   Special Tool: Fuel Filter Removal Tool (4 cyl) (Qty.: 1)
   Refer to: Remove and Install (PIL 18-09-03).

Figure 91.



A Engine tray
B Fuel filter tool
C Fuel filter

6. Clean around the filter cover and housing.

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7. Loosen the drain nut and allow the water / fuel to drain into a suitable container.
8. Remove the filter and O-ring.
9. With suitable tool remove the cartridge from the filter housing.

   Special Tool: Fuel Filter Removal Tool (4 cyl) (Qty.: 1)

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Install a new O-ring into filter housing and lubricate with clean fuel.

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03 - Filter Element

Remove and Install

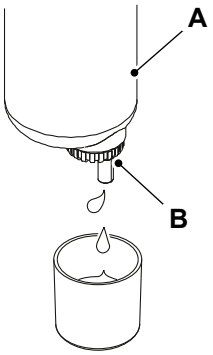
Special Tools

Description	Part No.	Qty.
Spanner - HP Fuel Filter	334/G5933	1
Fuel Filter Removal Tool (4 cyl)	892/01383	1

Before Removal

1. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
2. Get access to the filter.
   2.1. The filter is remotely located onto the machine.
3. Thoroughly clean the outside of the filter housing and around the filter head.
4. Loosen the drain tap and allow the water / fuel to drain into a suitable container.

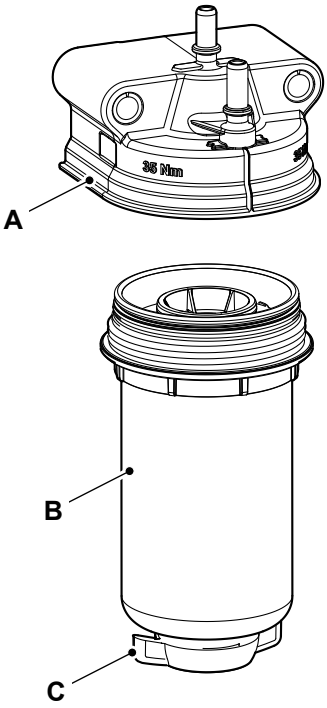
Figure 92.



A Fuel filter element
B Drain tap

Remove

Figure 93.



A Filter head
B Filter element
C Drain tap

1. Use the applicable service tool to unscrew the filter element from the filter head (anticlockwise).
   Special Tool: Fuel Filter Removal Tool (4 cyl) (Qty.: 1)
   Special Tool: Spanner - HP Fuel Filter (Qty.: 1)

Install

1. Lubricate the element seals with clean fuel and install a new filter element.
   1.1. Make sure that the filter flange touches the filter head.
   1.2. Use the applicable service tool to tighten to the correct torque value.
   Torque: 35N·m
   Special Tool: Fuel Filter Removal Tool (4 cyl) (Qty.: 1)
   Special Tool: Spanner - HP Fuel Filter (Qty.: 1)

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12 - Water Separator

04 - Water in Fuel Sensor

Introduction

The water in fuel sensor is installed in the fuel filter water bowl. A warning light will illuminate in the instrument panel to indicate that water has accumulated in the fuel filter water bowl and must be drained.

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21 - Fuel Pump

00 - General

Introduction 18-19
Technical Data 18-20
Operation 18-21
Check (Operation) 18-22
Remove and Install 18-24

Introduction

The fuel lift pumps function is to raise the level of fuel up through the system into the fuel injection system.

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Technical Data

Table 33.

Component	Value
Operating pressure	0.8bar (11.6psi)
Expected minimum free flow delivery	2.5L/min

Table 34. Expected electrical values

Machine Voltage V	Minimum Voltage V	Maximum Voltage V	Minimum Resistance Ohms	Maximum Resistance Ohms	Minimum Current Draw A	Maximum Current Draw A
12	8	16	0.8	1.5	4	8

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Operation

The pump draws fuel from the tank, through the water separator, pumping it through the fuel filter and into the fuel injection pump. The pump has a built in protection against running dry and will shut down after 2min if no fuel is present.

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Check (Operation)

Flow Test

If the fuel lift pump is suspect, measure the delivery flow rate.

1. Make the machine safe.
   Refer to: PIL 01-03.
2. Disconnect the fuel hose from the outlet of the pump/ filter assembly.
3. Connect a length of fuel hose from the pump outlet to a suitable fuel container.
   Volume: 5L
4. Activate the fuel pump. Do not attempt to start the engine.
5. Run the pump. The fuel flow must be equal to or greater than the value shown.
   Duration: 1min
   Flowrate: 2.5L/min

Fuel Lift Pump Test - Machines with Electronic Control Fuel Injection

When the ignition is set to ON the ECM (Engine Control Module) energises the fuel lift pump. If the engine is not started the pump is de-energised after a period of 24s. A fuel pump flow test can be carried out during this period of time. Minimum expected fuel flow. 1L in 24s.

Alternatively use Servicemaster to energise the fuel pump as follows.

1. Make the machine safe.
   Refer to: PIL 01-03.
2. Turn the ignition switch ON. Do not start the engine.
3. Allow the fuel pump priming to occur at key on before starting the test.
4. Put a container of suitable capacity to collect the fuel at the outlet port of the lift pump.
5. Select the fuel lift pump test using Servicemaster.
6. There is a delay of the specified duration before the test starts.
   Duration: 5s
7. The test will operate the lift pump for specified duration.
   Duration: 24s
8. Make sure that the fuel collected in the container is not more or less than the specified value.
   Volume: 1 ± 0.2L

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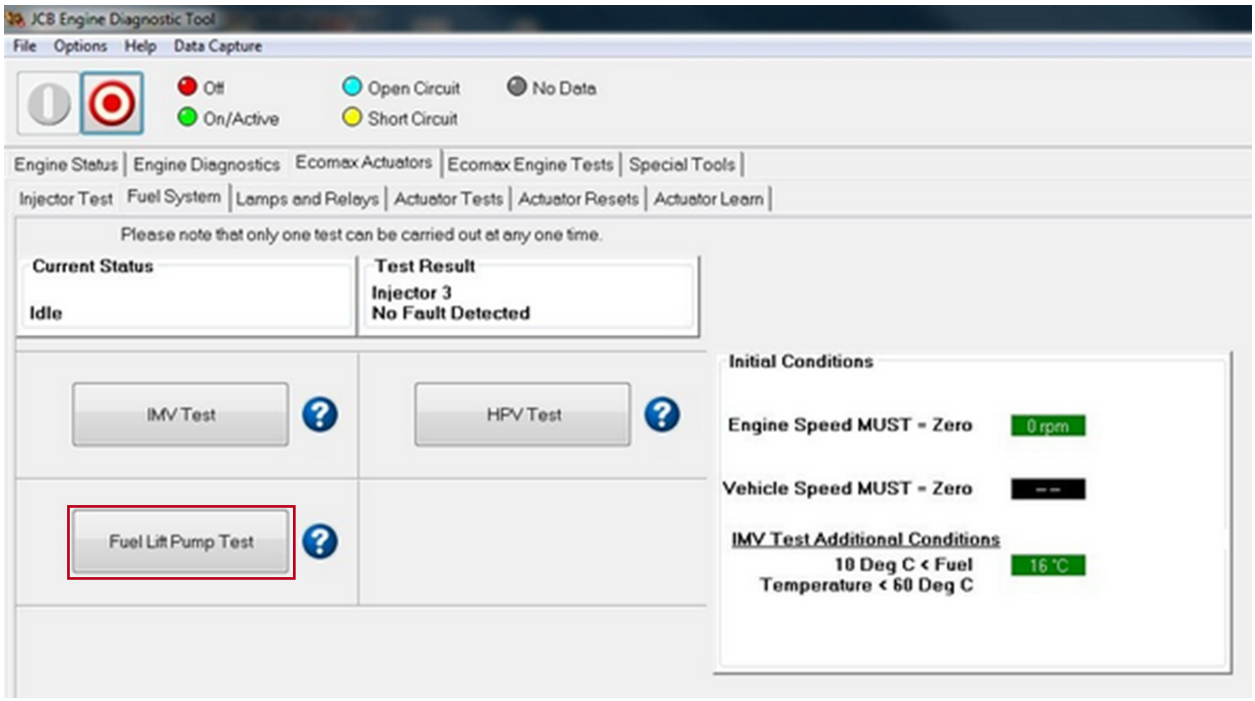
Figure 94. Servicemaster fuel lift pump test screen



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Remove and Install

The fuel lift pump assembly and the fuel pipe connections may vary slightly depending on the application. The removal and installation procedure will be similar.

Remove

1. Make the machine safe.
   Refer to: PIL 01-03.
2. Disconnect the battery.
3. Disconnect the fuel lift pump electrical connector.

Figure 95.

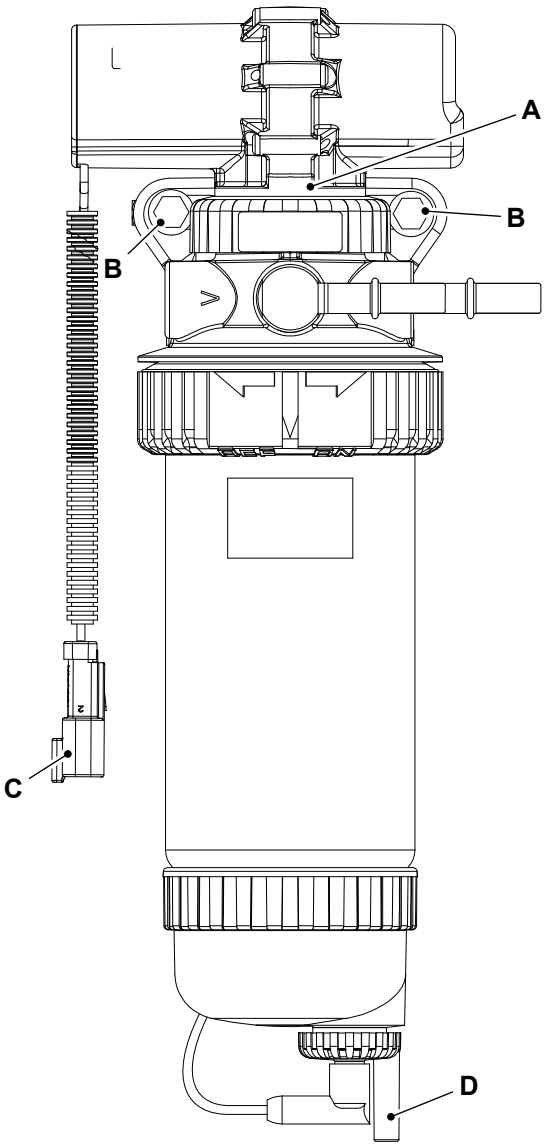
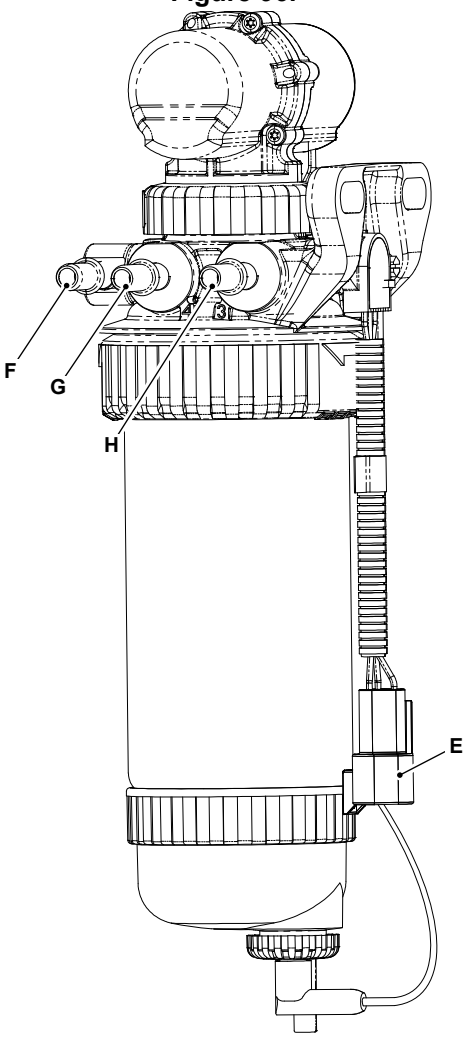


Figure 96.



A Fuel lift pump and pre-filter assembly
B Bolts (x2)
C Fuel lift pump electrical connector
D Water separator drain tap
E WIF (Water in Fuel) sensor electrical connector
F Fuel pipe - Air bleed (blue)
G Fuel pipe - Fuel inlet from tank (red)
H Fuel pipe - Fuel outlet (yellow)

4. Disconnect the WIF sensor electrical connector.
5. If necessary, put a label on the fuel pipes to aid installation.
6. Disconnect the fuel pipes at the fuel lift pump by means of the quick release connectors.
   6.1. Plug all open ports and hoses to prevent contamination.
7. If installed, disconnect the drain hose from the water separator drain tap.
8. Support the fuel lift pump and remove the bolts (x2).

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9. Remove the fuel lift pump and pre-filter assembly from the machine.

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Tighten the bolts to the correct torque value.
   Refer to: PIL 72-06.

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24 - Exhaust

00 - General

Introduction 18-26
Health and Safety 18-27
Check (Condition) 18-27
Remove and Install 18-28

Introduction

The machine is equipped with JCB CEV Stage-IV 55kW engine. Manually navigate to the JCB Service Pro to view the engine service manual for the detailed information.

The exhaust system is used to guide exhaust gases away from the controlled combustion inside the engine by means of an exhaust pipe. Depending on the machine design, the exhaust gas may flow through the following components:

- Cylinder head and exhaust manifold.
- Turbocharger to increase the engine power (if installed).
- A catalytic converter or EGR (Exhaust Gas Recirculation) system to reduce air pollution (if installed).
- SCR (Selective Catalytic Reduction) (if installed). In SCR system exhaust gases pass through the DEF (Diesel Exhaust Fluid) injection chamber to lower the NOx (Nitrogen Oxide) concentration in the exhaust gases.
- A silencer or muffler to reduce noise (if installed).

The exhaust pipe carries the toxic and noxious gases away from the users of the machine. Note machines or generators that work indoors can quickly fill an enclosed space with carbon monoxide or other poisonous exhaust gases if they are not properly vented to the outdoors.

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Health and Safety

Exhaust Gases

Machine exhaust gases can harm and possibly kill you or bystanders if they are inhaled. Do not operate the machine in enclosed spaces without making sure there is good ventilation. If possible, install an exhaust extractor. If you begin to feel drowsy, stop the machine at once and get into fresh air.

Do not touch the exhaust or the water/steam coming out of the exhaust. Doing so may cause high-temperature burns. Never drink the water coming out of the exhaust.

Sparks

Explosions and fire can be caused by sparks from the exhaust or the electrical system. Do not use the machine in closed areas where there is flammable material, vapour or dust.

Hazardous Atmospheres

This machine is designed for use in normal outdoor atmospheric conditions. It must not be used in an enclosed area without adequate ventilation. Do not use the machine in a potentially explosive atmosphere, i.e. combustible vapours, gas or dust, without first consulting your JCB dealer.

Hot Components

Touching hot surfaces can burn skin. The engine and machine components will be hot after the unit has been running. Allow the engine and components to cool before servicing the unit.

WARNING! *The engine has exposed rotating parts. Switch off the engine before working in the engine compartment. Do not use the machine with the engine cover open.*

Check (Condition)

Excessive smoke from the exhaust stack combined with a complaint of low power could be as a result of:

- Dirt or dust (unfiltered air) ingested directly into the engine, resulting in damage to the cylinder bores and/or turbocharger (if installed). There will also be a possible increase in oil consumption.
- Air leaks from the air hose connections.
- Exhaust manifold leaks.
- Dirty or partially blocked air filter.

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Remove and Install

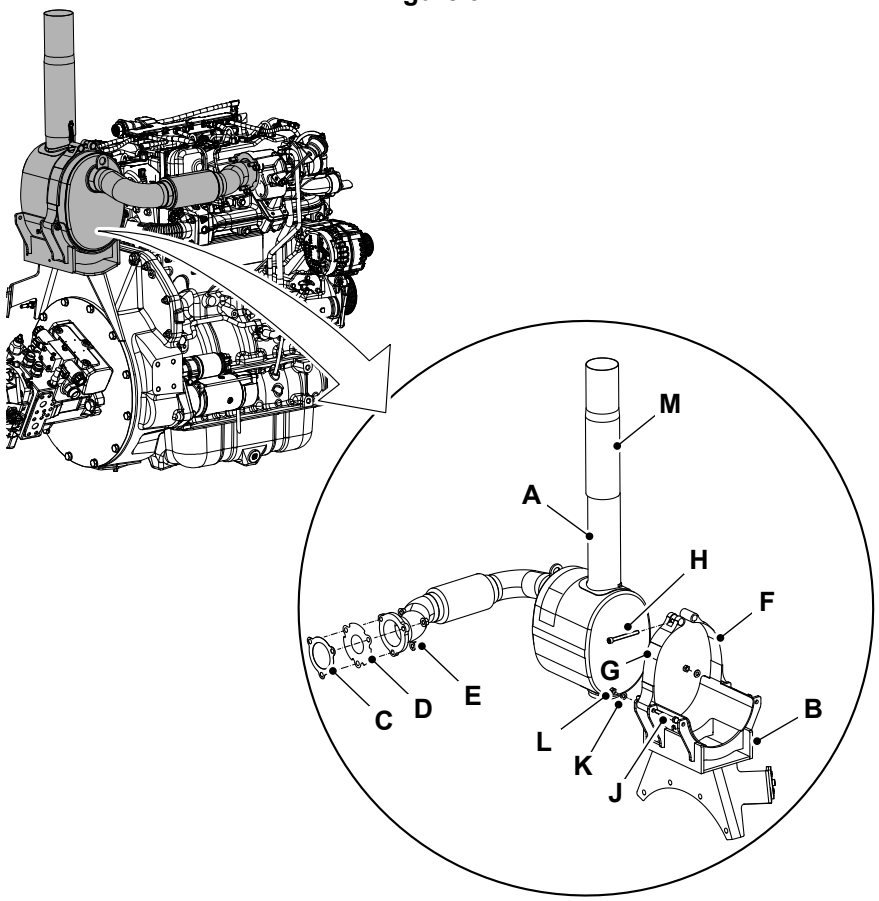
⚠ **CAUTION** The exhaust pipe becomes extremely hot when the engine is running and will remain so for some time after the engine is stopped. If you touch the hot pipe you could be severely burned.

CAUTION This component is heavy. It must only be removed or handled using a suitable lifting method and device.

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
3. Get access to the exhaust system.
4. Remove the manifold nut (x3), gasket and gasket plate from the engine.
5. Remove the capscrew from LH and RH band clamp.
6. Remove the bolt (x2), washer (x2) and nut (x2) from the exhaust support bracket.
7. Remove the exhaust silencer from the exhaust support bracket. If required, remove the exhaust extension.

Figure 97.



A Exhaust silencer
B Exhaust support bracket
C Gasket
D Gasket plate
E Manifold nut (x3)
F Band clamp- RH side
G Band clamp- LH side
H Capscrew
J Bolt (x2)
K Washer (x2)
L Nut (x2)
M Exhaust extension

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Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Tighten the nuts and capscrew to the specified torque value. Refer to Table 35.

Table 35. Torque Values

Item	Nm
E	22
H	22

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Notes:

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21 - Cooling System

Contents **Page No.**

Acronyms Glossary 21-2

21-00 Cooling System
21-00-00 General 21-3
21-03 Cooling Pack
21-03-00 General 21-8
21-06 Expansion Tank
21-06-00 General 21-12

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Acronyms Glossary

CAC	Charge Air Cooler

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00 - Cooling System

00 - General

Introduction 21-3
Health and Safety 21-4
Technical Data 21-4
Fault-Finding 21-5
Drain and Fill 21-7

Introduction

During the working cycle of the engine a great deal of heat is generated. It is important that the engine is kept at its normal operating temperature to achieve maximum efficiency. It is the function of the cooling system to allow the engine to reach this temperature quickly and then maintain it.

Maintenance information for some components pertaining to the cooling system is contained within the Manufacturer's engine manual and is available as a stand-alone document on JCB Service Pro.
Refer to: servicepro.jcb.com.

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Health and Safety

⚠ **CAUTION** The cooling system is pressurised when the coolant is hot. If you remove the cap, hot coolant can spray out and burn you. Make sure that the engine is cool before you work on the cooling system.

WARNING Coolant can be harmful and is restricted to professional users only. Obey the manufacturer's instructions when handling full strength or diluted coolant and always use appropriate PPE. Inappropriate coolant handling may damage fertility or the unborn child.

Technical Data

Table 36.

Radiator cap pressure setting	1bar (14.5psi)
Thermostat	Wax element with by-pass blanking
Thermostat operating temperature:	
- Nominal temperature	96°C (204.7°F)
- Start to open temperature	94→98°C (201.1→208.3°F)
- Full open temperature	110°C (229.8°F)
- Travel (fully open)	9mm
Cooling fan drive type	Engine driven belt
Coolant pump (non-serviceable part)	Bolt on, belt driven unit

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Fault-Finding

Fault

Coolant - Loss.	Table 37.	Page 21-5
Coolant - Over Temperature.	Table 38.	Page 21-5
Coolant - Under Temperature.	Table 39.	Page 21-6
Coolant - Contaminated.	Table 40.	Page 21-6

Table 37. Coolant - Loss.

Cause	Remedy
Incorrect coolant level.	Check the level.
Coolant leaking from engine radiator or cab heater.	Visually inspect the radiator heater, hoses and connection to locate the leak.
External engine coolant leak.	Visually inspect the engine and components for seal, gasket hose connection leaks. Make sure all hose clips are in good condition and torqued to the recommended figure. Make sure all spring band clamps are in good condition and apply sufficient pressure to the hoses.
Overheating or compression gases leaking, resulting in loss through the radiator overflow.	See Also: Table 38. Coolant - Over Temperature.
Lubricating oil cooler leak.	Check/replace the oil cooler. Check for coolant in the oil.
Cylinder head gasket leak.	Check/replace the head gasket.
Cylinder head cracked or porous.	Check/replace the cylinder head.
Crankcase coolant passages leaking.	Check/replace the crankcase.

Table 38. Coolant - Over Temperature.

Cause	Remedy
Incorrect coolant level (low).	Check the level. See Also: Table 37. Coolant - Loss.
External radiator matrix blocked with dirt or chaff.	Clean exterior or radiator matrix.
Air flow to the radiator inadequate or restricted.	Check/repair fan shroud, anti-recirculation sealing, shutters, fan sensors, fan speeds as required.
Coolant pump or fan drive belts loose.	Check/correct belt tension.
Radiator hose collapsed, restricted or leaking.	Check/replace hose.
Oil level overfilled.	Check oil level.
Cooling system pressure cap incorrect or faulty.	Replace cap with the correct rating for the system.
Over concentration of anti-freeze.	Remove part of the coolant from cooling system and replace with water.
Temperature sensor gauge faulty.	Verify that the gauge and temperature sensor are accurate.
Thermostat faulty, incorrect or missing.	Check/replace the thermostat.
Air or combustion gases in the cooling system.	Make sure the fill rate is not exceeded and the correct vented thermostat is installed. If aeration continued, check for a compression leak through the head gasket.
Coolant pump faulty.	Check/replace the coolant pump.

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Cause	Remedy
Vent line from engine and/or radiator blocked or incorrectly routed (sudden overheating).	Check routing and operation or vent line.
Leak between the top tank and the auxiliary tank (sudden overheating).	Check for coolant leakage between radiator auxiliary tank and radiator top tank.
Cooling passages in radiator, cylinder head, head gasket or crankcase blocked.	Flush the system and fill with clean coolant.

Table 39. Coolant - Under Temperature.

Cause	Remedy
Air flow across the radiator excessive.	Check/repair fan shroud, anti-recirculation sealing, shutters, fan sensors, fan speeds as required.
Temperature sensor gauge faulty.	Check the electronic fault codes. Verify that the gauge and temperature sensor are accurate.
Thermostat faulty, (open - not sealing).	Check/replace the thermostat.
Coolant not flowing by temperature sensor.	Check/clean coolant passages. A total coolant loss may result in the gauge showing low temperature initially. In which case, check the level.

Table 40. Coolant - Contaminated.

Cause	Remedy
Coolant rusty, operation without correct mixture of antifreeze and water.	Drain and flush the cooling system. Fill with correct mixture of antifreeze and water. Review the coolant change interval.
Engine oil cooler, or cooler housing allowing cross contamination of coolant with engine oil.	Remove the oil cooler assembly and check relevant sealing elements for damage.
Lubricating oil leaks from lubricating oil cooler, head gasket, head and crankcase.	See Also: Table 37. Coolant - Loss.

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Drain and Fill

Consumables

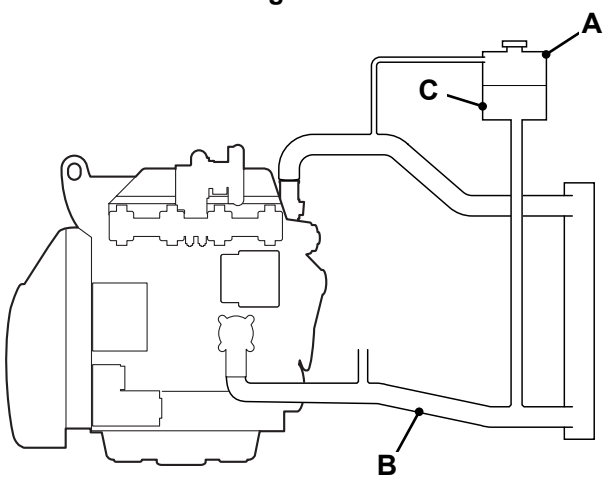
Description	Part No.	Size
Antifreeze HP/ Coolant ASTM D6210 Concentrate	4006/1101	5L
	4006/1120	20L
	4006/1103	200L

The graphic shows a typical engine cooling system, the system you are working on may look slightly different.

1. Make the machine safe. Refer to (PIL 01-03).
2. Stop the engine and let it cool down.
3. Get access to the engine.
4. Carefully loosen the cap just enough to let any pressure escape. Remove the cap when all pressure is released.
5. Disconnect the bottom radiator hose and allow the coolant to drain into a suitable container.
6. Flush the system by pouring clean water into the filler port.
7. Connect the bottom radiator hose.
8. Fill the expansion tank, using the necessary anti-freeze solution, to the level indicated.

   Consumable: Antifreeze HP/Coolant ASTM D6210 Concentrate
9. Run the engine for a while to raise the coolant to working temperature and pressure. Stop the engine and check for leaks. Check the level in the expansion tank and top up if necessary.

Figure 98.



A Cap
B Bottom radiator hose
C Expansion tank

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03 - Cooling Pack

00 - General

Introduction 21-8
Check (Condition) 21-9
Remove and Install 21-10

Introduction

The cooling pack is an assembly of air blast radiators. The assembly is carefully designed to ensure that there is sufficient air flow across the radiators for effective cooling of the applicable systems. Air is drawn across the radiators by a cooling fan. Baffles, seals and shrouds ensure that air is drawn from outside the machine. Typically the cooling pack assembly contains the following components.

- Cooling fan
- Engine coolant radiator
- Engine CAC (Charge Air Cooler) (if installed)
- Hydraulic oil cooler

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Check (Condition)

1. Make the machine safe. Refer to (PIL 01-03).
2. Let the engine cool.
3. Get access to the cooling pack. Refer to (PIL 21-03)
4. Check the hoses, radiator and fan for:
   - 4.1. Condition.
   - 4.2. Damage.
   - 4.3. Security.
5. If necessary, Replace the system hoses/radiator.

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Remove and Install

⚠ **WARNING** Never remove the radiator cap when the cooling system is hot - severe risk of scalding.

CAUTION The cooling system fans contain rotary parts. The rotating parts can cause injury.

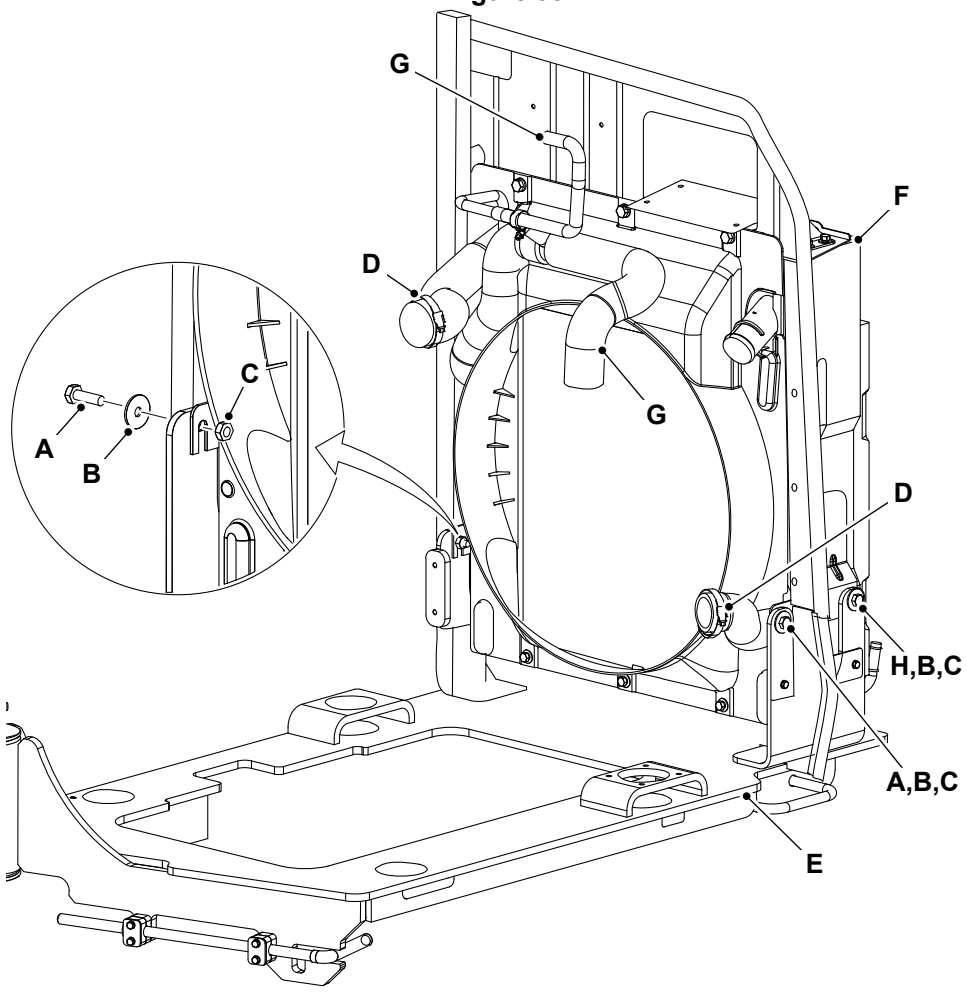
CAUTION The cooling system is hot when the machine is running. Allow the machine to cool down to perform the service tasks.

CAUTION The cooling system is pressurised when the coolant is hot. If you remove the cap, hot coolant can spray out and burn you. Make sure that the engine is cool before you work on the cooling system.

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Get access to the cooling system.
3. Disconnect the hydraulic cooler.
4. Drain the cooling system.
5. Loosen the clips and remove the required hoses from the cooling system. Refer to Figure 99.
6. Put a label on the hoses to help installation.
7. Remove the setscrew 1 (x2), setscrew 2 (x2), washer (x4) and nut (x4) from the cooling system mounting. Refer to Figure 99.
8. Remove the cooling pack from the engine tray.

Figure 99.



A Setscrew 1 (x2)
B Washer (x4)
C Nut (x4)
D Clip
E Engine tray
F Cooling system

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G Hoses

H Setscrew 2 (x2)

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Tighten the clips and fasteners to the correct torque value. Refer to Table 41.

   Refer to: PIL 72.
3. Fill the cooling system with the correct coolant type.

   Refer to: PIL 75.

Table 41. Torque Values

Item	Nm
A	43
H	22

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06 - Expansion Tank

00 - General

Introduction 21-12
Component Identification 21-13
Check (Level) 21-14
Remove and Install 21-15

Introduction

The expansion tank retains coolant that has been forced out of the machines radiator under pressure.

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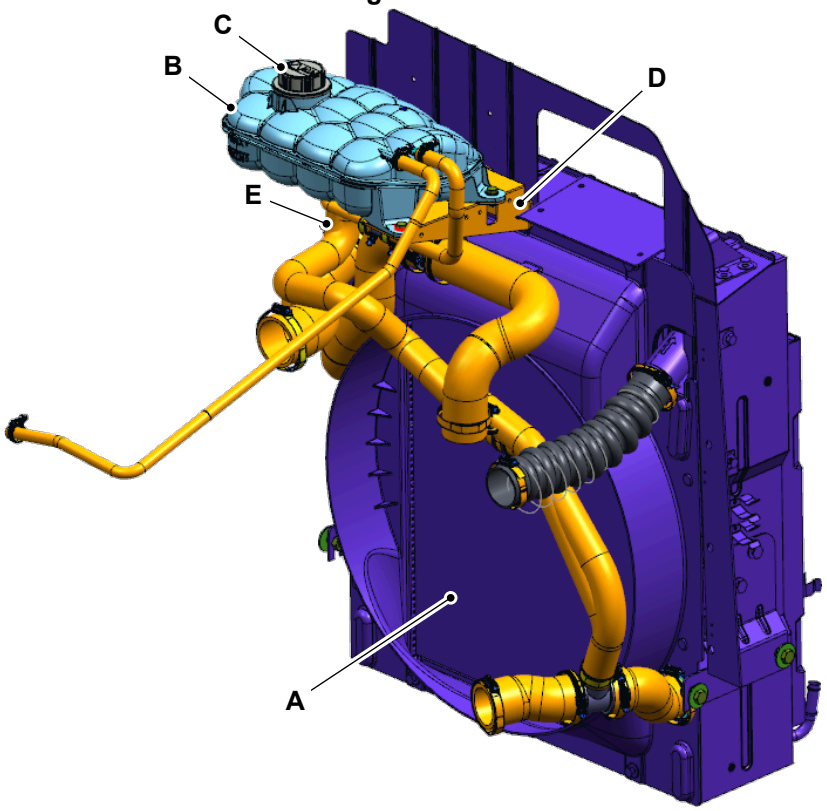
Component Identification

Figure 100.



A Cooling pack
B Expansion tank
C Filler cap
D Bracket
E Expansion tank hose

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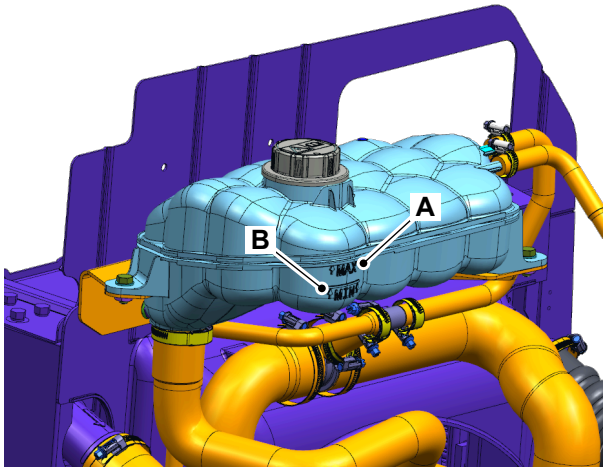
Check (Level)

⚠ **CAUTION** The cooling system is pressurised when the coolant is hot. If you remove the cap, hot coolant can spray out and burn you. Make sure that the engine is cool before you work on the cooling system.

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Let the engine cool.
3. Get access to the coolant expansion bottle.
   Refer to: PIL 06-06-06.
4. Check the fluid level in the expansion bottle, if the fluid level is low: Refer to Figure 101.

Figure 101.



A Maximum level
B Minimum level

   4.1. Carefully loosen the cap on the expansion bottle and let the pressure release from the system.
   Refer to: PIL 01-09-15.
   4.2. Remove the cap from the expansion bottle.
   4.3. Add the recommended coolant up to the maximum mark.
   Refer to: PIL 75-00-00.
   4.4. Manipulate the top radiator hose to make sure that there are no air locks in the system.
   4.5. Replace the cap.
5. Start the engine.
6. Operate the engine until the coolant reaches the specified temperature.
   Temperature: 96°C (204.7°F)
7. Stop the engine.
8. Remove the ignition key.
9. Let the engine cool.
10. Check the level of coolant in the expansion bottle. If necessary, add more coolant.

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Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
3. Open the engine compartment cover.
   Refer to: Open and Close (PIL 06-06-06).
4. Drain the cooling system.
5. Remove the hoses from the expansion tank.
   5.1. Put a label on the hoses to help during installation.
   5.2. Plug all the open ports and hoses to prevent contamination.
6. Remove the setscrew (x3) and washer (x3) from the expansion tank bracket.
7. Remove the expansion tank from the machine.
8. If required, remove the bolt (x2) from the cooling pack.
   8.1. Remove the expansion tank bracket along with expansion tank.

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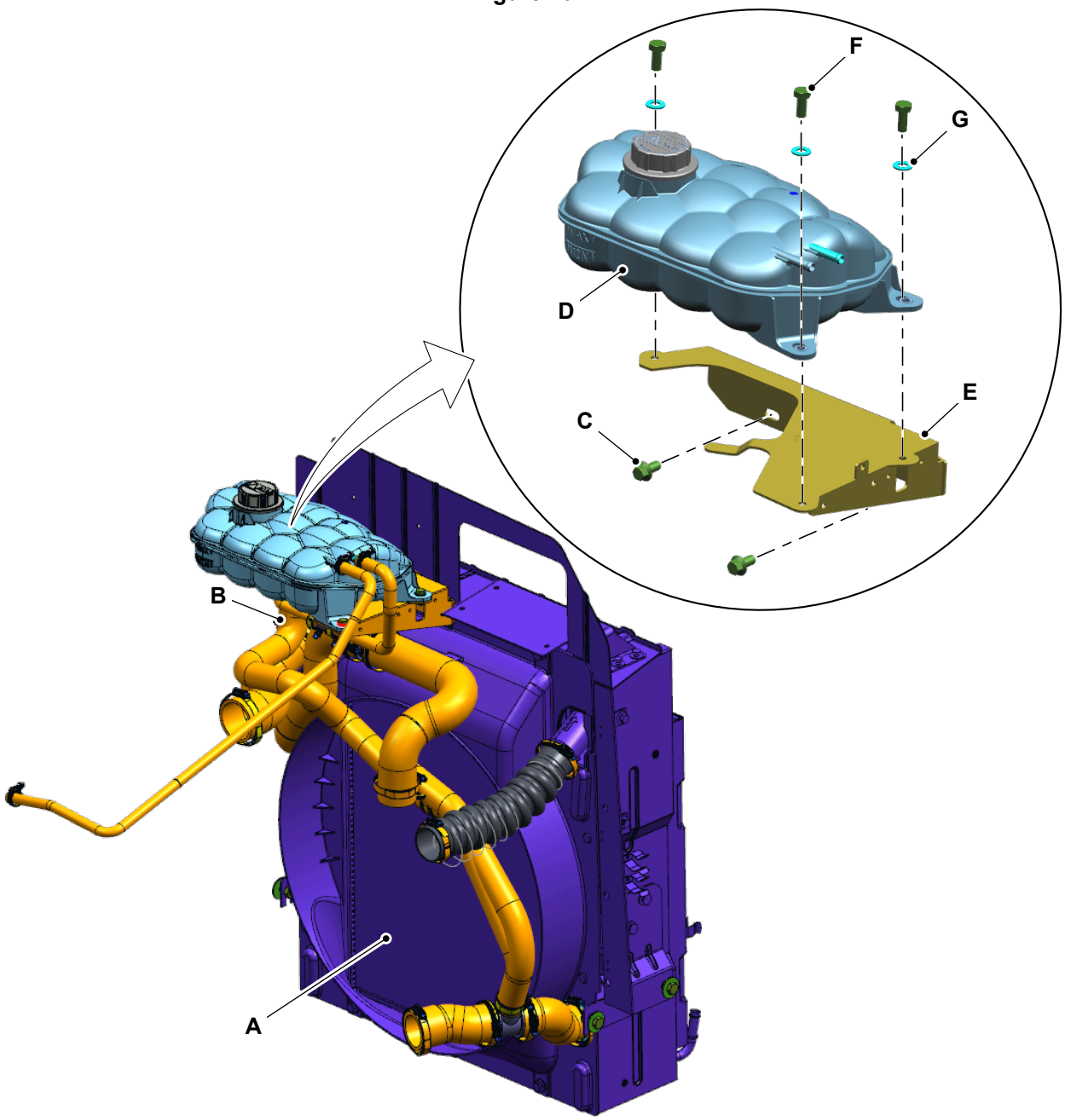
Figure 102.



A Cooling pack
B Hoses
C Bolt (x2)
D Expansion tank
E Expansion tank bracket
F Setscrew (x3)
G Washer (x3)

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Tighten the setscrew (x3) and bolt (x2) to the specified torque value. Refer to Table 42.
2. Tighten the clips and fasteners to the correct torque value.
3. Fill the expansion tank with the correct coolant to the level indicated.
4. Check the coolant level and top up to the correct level.

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Table 42. Torque Values

Item	Nm
C	18
G	12.7

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Notes:

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24 - Brake System

Contents **Page No.**

24-18 Park Brake
24-18-00 General 24-2

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18 - Park Brake

00 - General

Introduction 24-2
Health and Safety 24-3
Technical Data 24-4
Component Identification 24-5
Operation 24-6
Fault-Finding 24-7
Check (Pressure) 24-8

Introduction

The brakes are installed on the front and rear wheels of the machine and they are integral parts of the hub.

The brakes installed on the machine are park brake only, there are no service brakes installed.

The hydrostatic drive system accelerates and decelerates the machine.

The park brake will release during travel, when the park brake solenoid valve is signalled to open. The pressure from the transmission circuit causes the brakes to release.

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Health and Safety

Working Under the Machine

Make the machine safe. Make sure the park brake is engaged and machine is fully isolated. Remove the machine key switch, disconnect the battery. Use blocks to prevent unintentional movement of the wheels.

Springs

Always wear personal protective equipment when dismantling assemblies containing components under pressure from springs. This will protect against eye injury from components accidentally flying out.

WARNING! *Before working on the brake system, make sure that the machine is on solid level ground. Put blocks on all wheels to prevent the machine rolling.*

WARNING! *Before testing the park brake make sure the area around the machine is clear of people.*

WARNING! *Do not use a machine with a faulty park brake.*

WARNING! *Do not use the machine with any part of its brake system disconnected or inoperative. When the test has been completed, make sure all brake system components are installed and the system is operating correctly.*

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Technical Data

Table 43. Brake control valve

Description	Data
Flow rating	11L/min
System operating pressure	280bar (4,061.1psi)
Voltage	12V + 25% / --10% at 60°C
Current	Maximum 1.67A
	Normal 1.04A
Power	20W

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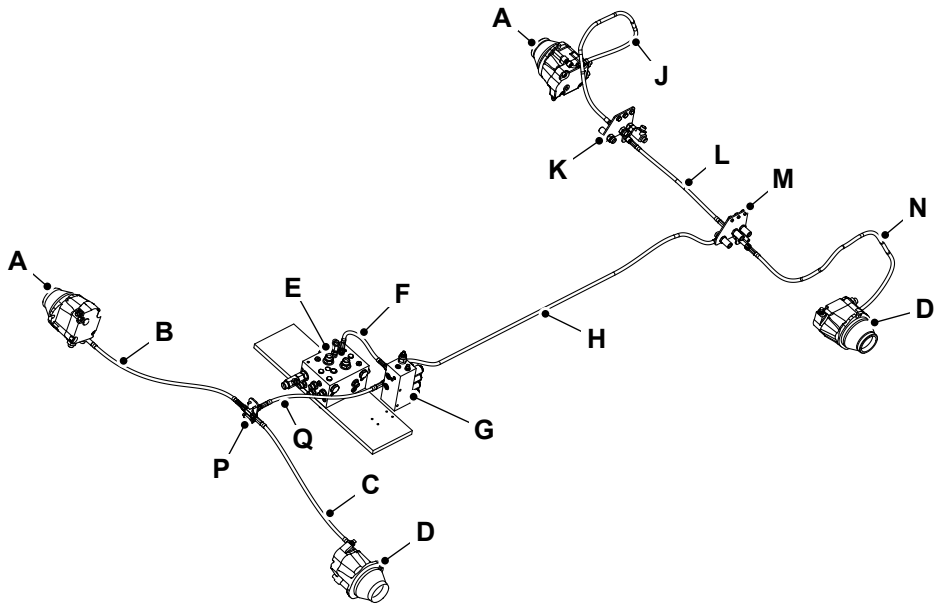
Component Identification

Figure 103.



A Left side drive motor

B Hose- rear bulkhead to left hand side motor (Red colour band)

C Hose- rear bulkhead to right hand side motor (Red colour band)

D Right side drive motor

E Transmission control valve

F Hose- brake valve to transmission valve (White colour band)

G Brake valve

H Hose- brake valve to right bulkhead (Blue colour band)

J Hose- left bulkhead to left hand side motor (Blue colour band)

K Left bulkhead connection

L Hose- right bulkhead to left bulkhead (Blue colour band)

M Right bulkhead connection

N Hose- right bulkhead to right hand side motor (Blue colour band)

P Rear bulkhead connection

Q Hose- brake valve to rear bulkhead (Red colour band)

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Operation

Manual Brake Deactivation

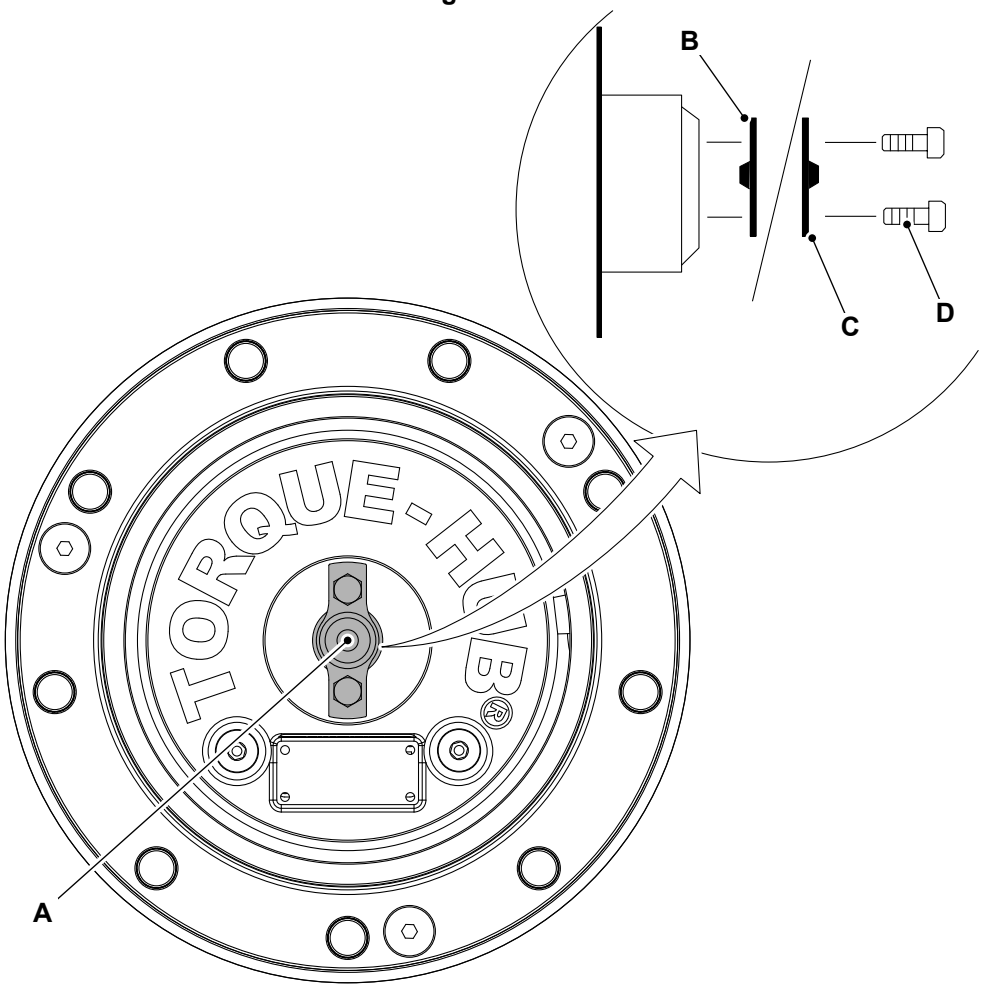
⚠ **WARNING** Do not keep the brake deactivated for a duration more that 30 minutes. Before towing the machine perform a risk assessment and make sure there is a safe method of stopping the machine since the machine brakes will not be available.

Manual brake deactivation is required when there is machine failure and machine needs to be towed to the safe maintenance site. Do not tow machine for a distance more than 200m. Before towing make sure that the oil level in the hub is appropriate.

Do not keep the brake deactivated for a duration more than 0.5h

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Remove the screw (x2).
3. Remove the disengage cap from the hub.
4. Flip the disengage cap and install to the hub.
5. Tighten the screw (x2).
6. Do the steps 1 to 5 to other hubs.
7. After towing operation install the disengage cap in its original position on all four hubs.

Figure 104.



A Disengage cap
B Disengage cap (brake disengaged position)
C Disengage cap (brake engaged position)
D Screw (x2)

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Fault-Finding

Fault

Brake slips	Table 44.	Page 24-7
Brake drags or runs hot	Table 45.	Page 24-7
Brake not releasing	Table 46.	Page 24-7

Table 44. Brake slips

Cause	Remedy
Excessive pressure in the hydraulic system	Check the filters, hose size, restrictions in other hydraulic components.
Oil in the brake (If designed for dry use)	Replace oil seal in the brake. Check motor seal and piston seals. Check and clean the internal components. If necessary, replace the damaged components.
Disc plates worn	Check the disc thickness.
Springs broken or have taken a permanent set	Check the release pressure. If necessary, replace the spring.

Table 45. Brake drags or runs hot

Cause	Remedy
Low actuation pressure	Connect the pressure gauge to the bleed port and check pressure with system ON.
Bearing failure	Replace the bearing.

Table 46. Brake not releasing

Cause	Remedy
Stuck or clogged valve	Connect the pressure gauge to the bleed port and check pressure with system ON. If necessary, replace the inoperative line or component.
Damaged O-rings	Replace the O-rings.
Discs frozen	Replace the disc.

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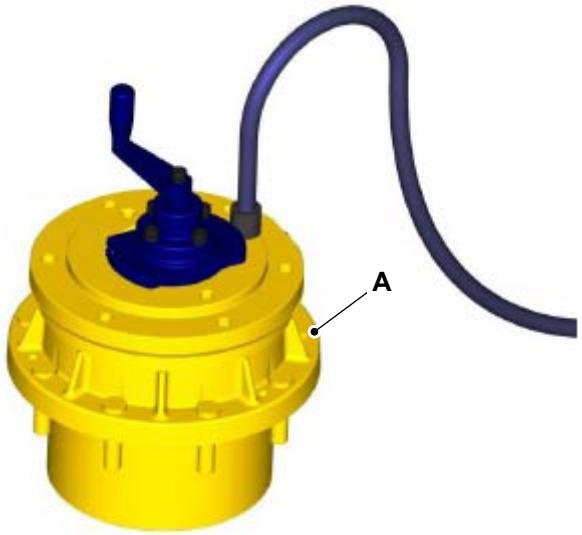
Check (Pressure)

⚠ **WARNING** Before testing the park brake make sure the area around the machine is clear of people.

1. Make the machine safe.
   Refer to: PIL 01-03.
2. Install a hydraulic hand pump with pressure gauge into the brake port.
3. Place the suitable tool into input coupling.

Figure 105.



A Roll check tool

4. Try to rotate the tool and keep increasing the pressure at the same time, until the brake releases.
   4.1. Make a note that the brake is released when the rotation is possible.
5. Make a note of the brake release pressure. Refer to Table 47.
   5.1. If the brake pressure is not within specified limit, check for visible leaks and perform leak check.
   Refer to: Check (Leaks) (PIL 27-27-00).
6. Increase the pressure to maximum and hold the pressure for specified time. Refer to Table 47.
   Duration: 1min
7. If brake loses pressure, perform leak check.
   Refer to: Check (Leaks) (PIL 27-27-00).
8. Roll check the unit for one revolution by rotating the tool.
9. Discharge the pressure.
10. Make a note of the pressure at which the brake locks up.
11. Clean the excess fluid from around brake port and install the pipe plug.

Table 47.

Description	Number of Spring	Initial Release Pressure	Full Release Pressure	Maximum Pressure	Torque Rating
Brake	14	7.24bar (105.0psi)	19.37bar (280.9psi)	68.95bar (1,000.0psi)	120N·m

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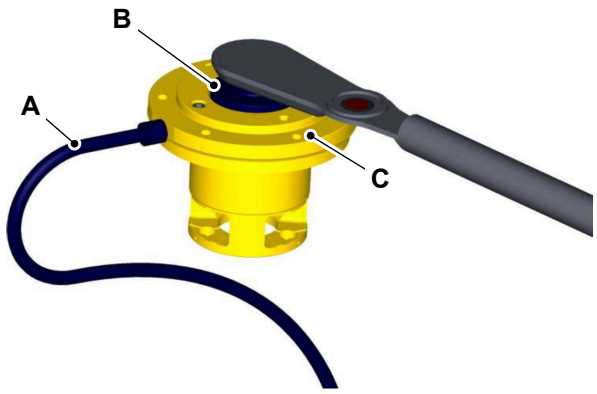
Figure 106.



A Pressure gauge pipe
B Roll check tool
C Spindle

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Notes:

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25 - Steering System

Contents **Page No.**

Acronyms Glossary 25-2

25-00 Steering System
25-00-00 General 25-3
25-33 Link Arm
25-33-00 General 25-7

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Acronyms Glossary

2WS	Two Wheel Steer

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00 - Steering System

00 - General

Introduction 25-3
Technical Data 25-4
Component Identification 25-5
Operation 25-6

Introduction

The steering is controlled by the hydraulic system and the service pump through the main control valve. There are two double acting steering cylinder rams installed on the front drive wheels.
Refer to: PIL 30-15-34.

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Technical Data

Table 48.

Description	Data
Type	2WS (Two Wheel Steer)
Inner wheel turning radius - Foam filled tyre	2.95m
Outer wheel turning radius - Foam filled tyre	5.1m

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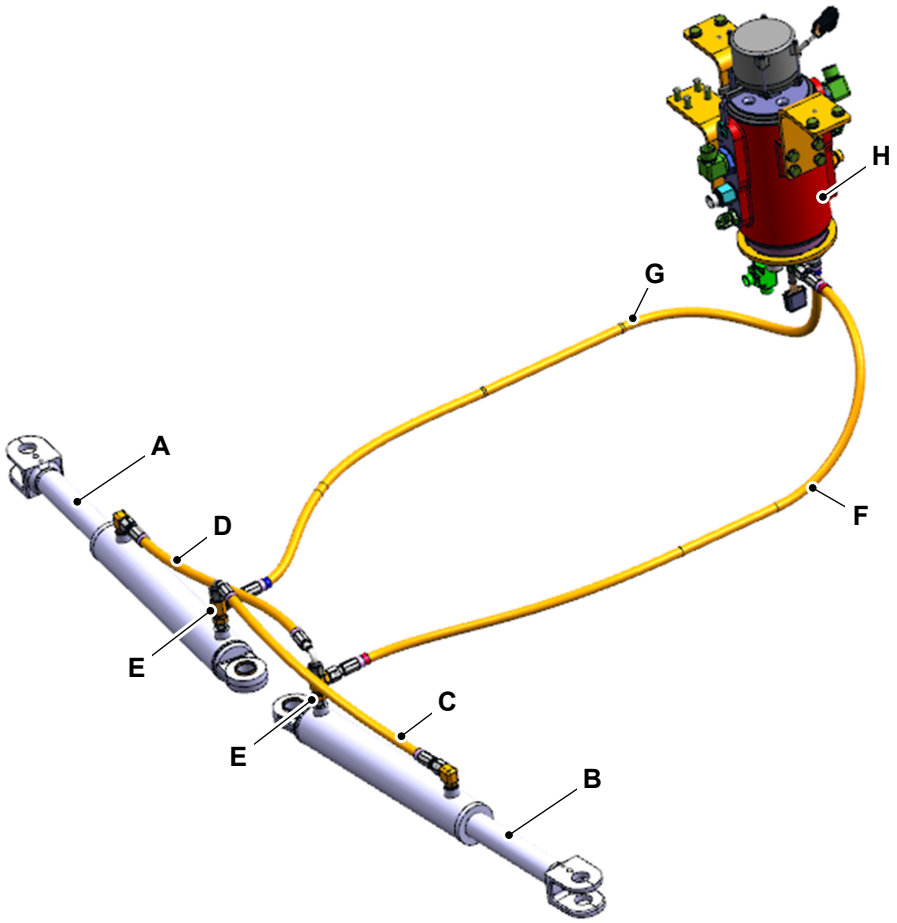
Component Identification

Figure 107.



A Steering ram right side
B Steering ram left side
C Hose- steering ram right side T- Adaptor to steering ram left side
D Hose- steering ram left side T- Adaptor to steering ram right side
E T - Adaptor
F Hose- center revolving joint to steering ram left side
G Hose- center revolving joint to steering ram right side
H Center revolving joint

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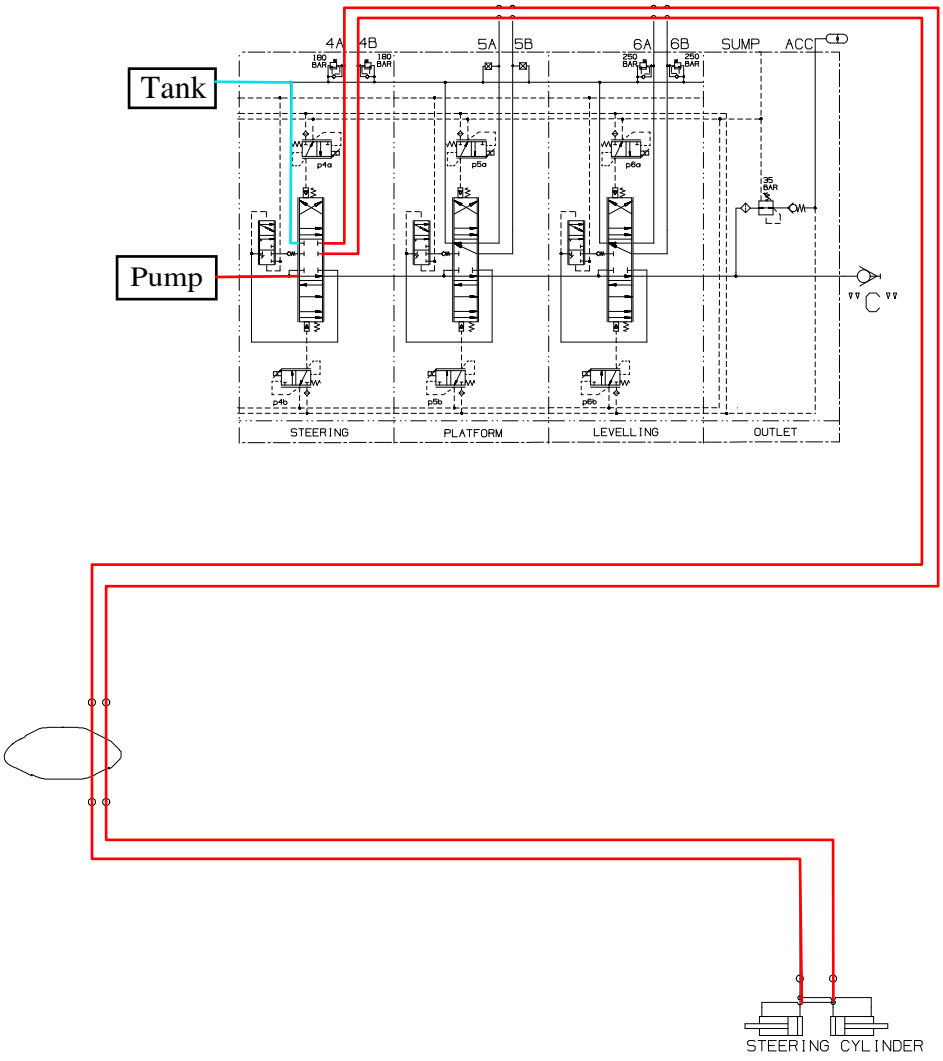
Operation

Steer Function

To operate from the platform, select travel function. Press the foot pedal and operate steer right or left button. The boom pump is driven at engine speed. The steer spool shifts across, hydraulic oil flows to the steer cylinder. Flow to cylinder steers the wheels at the speed commanded (controlled by MCV (4A, 4B)). The steer cylinder is driven in selected direction to turn the wheels.

Figure 108.



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33 - Link Arm

00 - General

Remove and Install

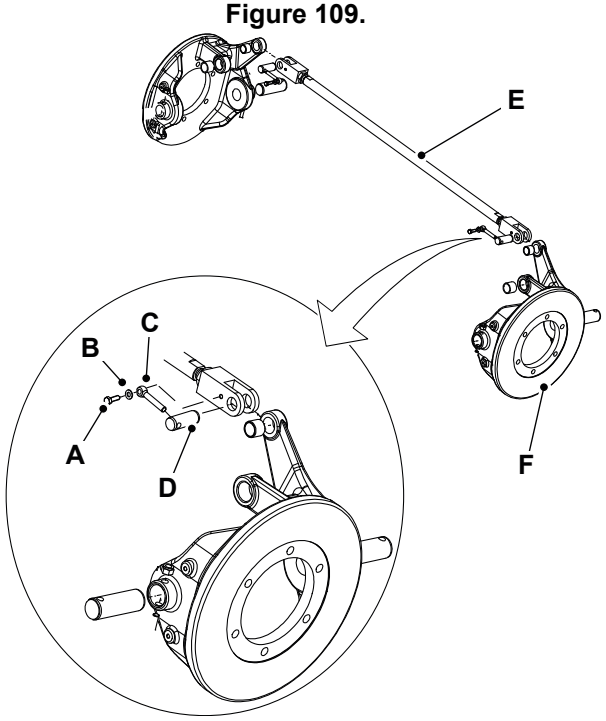
Remove

1. Make the machine safe with the platform lowered.

   Refer to: PIL 01-03-27.

2. Remove the bolt (x2) and washer (x2) from the pin (x2).
3. Remove the pin (x2).
4. Remove the pivot pin (x2) from the steering link rod.
5. Remove the steering link rod from the wheel hub.

Figure 109.



A Bolt
B Washer
C Pin
D Pivot pin
E Steering link rod
F Steering knuckle

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Tighten the bolt to the correct torque value.

Table 49. Torque Values

Item	Nm
A	22

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Notes:

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27 - Driveline

Contents **Page No.**

27-00 Driveline
27-00-00 General 27-2
27-20 Axle(s)
27-20-00 General 27-5
27-20-01 Axle Oscillation 27-8
27-27 Hub
27-27-00 General 27-12
27-29 Wheel
27-29-00 General 27-37
27-32 Wheel Drive Motor
27-32-00 General 27-41
27-32-46 Output Shaft Seal 27-48
27-33 Tyre
27-33-00 General 27-49

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00 - Driveline

00 - General

Introduction 27-2
Technical Data 27-3
Component Identification 27-4

Introduction

The driveline system installed on this machine is an electrically operated and a hydraulically driven system. It consists of the following components:

- Axle oscillation system.
  Refer to: PIL 27-20-01.
- Hub.
  Refer to: PIL 27-27-00.
- Wheel.
  Refer to: PIL 27-29-00.
- Wheel drive motor.
  Refer to: PIL 27-32-00.

Drive Orientation System

The drive orientation system is intended to indicate the operator conditions that could make the direction of movement of the chassis different than the direction of movement of the drive/steer control handle. The system indicates to the operator the need to match the yellow and white directional arrows on the platform control panel to the arrows on the chassis. The system uses a limit switch mounted on the underside of the turntable, an indicator light and an acknowledgment switch on the platform display panel.

The limit switch changes state approximately when the boom is swung past a rear tire. When the turntable is in the normal drive position with the boom between the rear tires, no indications or interlocks are made. When the machine is actively driving and the turntable is swung past the switch point, the system is ignored until drive/steer functions are returned to neutral. The operator must engage the drive orientation system is enabled, the DOS indicator will be illuminated continuously and a 3s enable timer will be started and will continue for 3s after the end the last drive/steer command. If the timer expires, the DOS override switch must be re-engaged to enable drive/steer.

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Technical Data

Table 50. Drive Motor

Description	Data
Motor type	Axial piston motor - variable displacement
Maximum working pressure	350bar (5,076.3psi)
Maximum brake release pressure	69bar (1,000.8psi)
Maximum displacement	38.2 cc/rev
Minimum displacement	14 cc/rev
Maximum flow at 38 cc/rev	134L/min
Rotation direction	Bi-directional
Shaft torque	213N·m

Table 51. Hub/Wheel gearbox

Description	Data
Gearbox ratio	57.49:1
Oil quantity	0.68L
Brake initial minimum release pressure	7.24bar (105.0psi)
Brake full release pressure	19.37bar (280.9psi)
Maximum operating pressure	68.95bar (1,000.0psi)
Static torque rating minimum	120N·m

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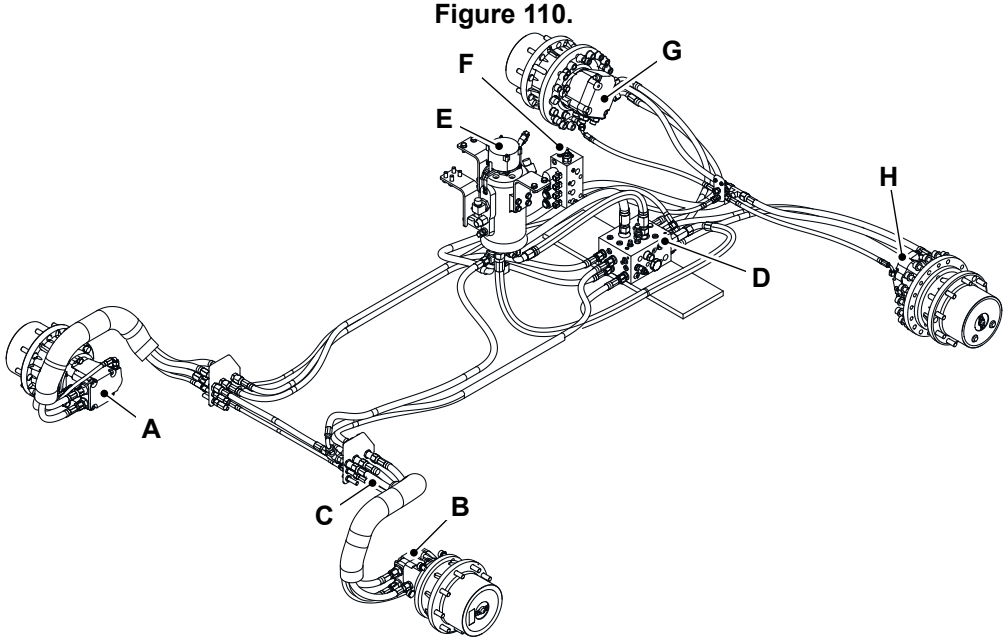
Component Identification

Figure 110.



A Front drive motor- right side
B Front drive motor- left side
C Drive circuit hoses
D Transmission control valve
E Center revolving joint
F Brake control valve
G Rear drive motor- right side
H Rear drive motor- left side

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20 - Axle(s)

00 - General

Introduction 27-5
Component Identification 27-6
Remove and Install 27-7

Introduction

The axles on this machine are structural components connecting the wheels to the chassis. The front axle is an oscillating axle. The rear axle is a fixed part of the chassis.

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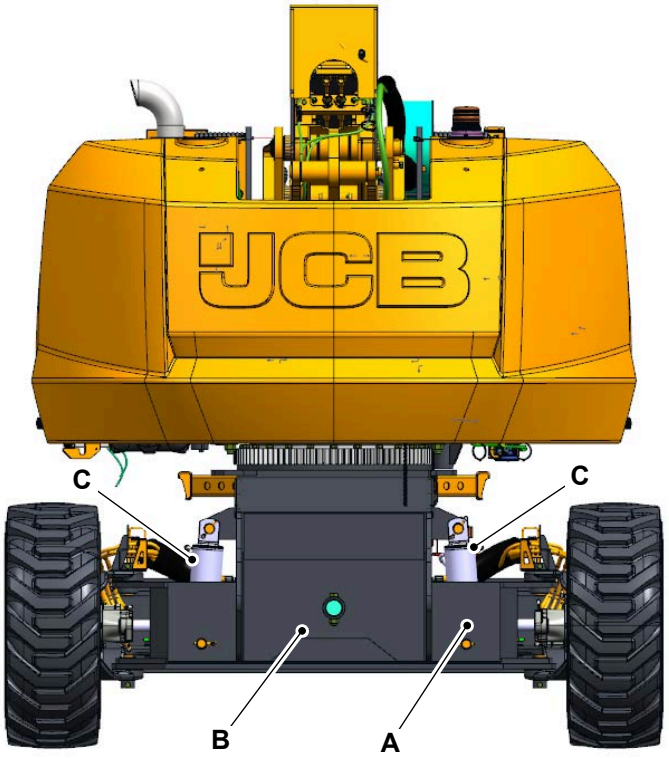
Component Identification

Figure 111.



A Front axle
B Chassis
C Oscillation cylinder(x2)

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Remove and Install

Working Under the Machine

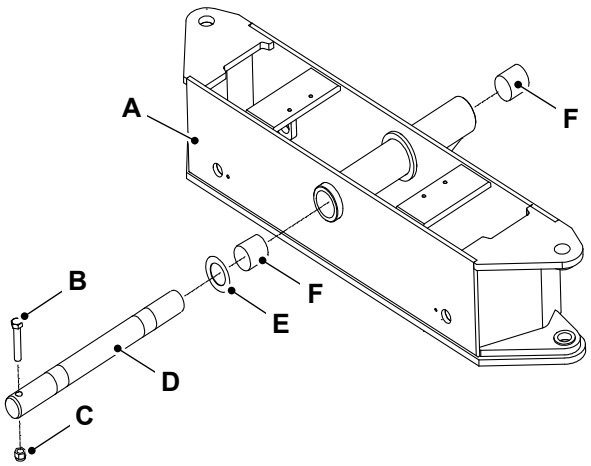
Make the machine safe. Make sure the machine is fully isolated. Remove the machine key switch, disconnect the battery. Use wheel chocks to prevent unintentional movement.

CAUTION! *This component is heavy. It must only be removed or handled using a suitable lifting method and device.*

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Discharge the hydraulic pressure.
   Refer to: Discharge and Pressurise (PIL 30-00-00).
3. Disconnect the hydraulic hoses from the wheel drive motor.
4. Put a label on the hoses to help installation.
5. Plug all the open ports and hoses to prevent contamination.
6. Use suitable lifting equipment to lift the machine, then use a stand to support its chassis.
7. Remove the wheels.
   Refer to: Remove and Install (PIL 27-29-00).
8. Remove the hub assemblies.
   Refer to: Remove and Install (PIL 27-27-00).
9. Remove the wheel motor assemblies.
   Refer to: Remove and Install (PIL 27-32-00).
10. Remove the oscillation axle rams.
    Refer to: Remove and Install (PIL 30-15-67).
11. Remove the bolt and lock nut from the front axle.
12. Remove the pivot pin, washer and self lubricating bearing (x2) from the front axle.
13. Use the suitable lifting equipment, remove the front axle from the machine.

Figure 112.



A Front axle
B Bolt
C Lock nut
D Pivot pin
E Washer
F Self lubricating bearing (x2)

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

1. Tighten the locknut to the correct torque value.
   Torque: 360N·m

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01 - Axle Oscillation

Introduction 27-8
Component Identification 27-9
Operation 27-10
Diagram 27-11

Introduction

The axle oscillation system allows the front axle to oscillate under certain conditions. The system consists of two oscillating axle cylinders, two pilot operated oscillating axle balance valves, and one solenoid operated flow control valve on the brake control valve.

The oscillating axle cylinders are installed on each side of the front axle and the two pilot operated oscillating axle balance valves are directly mounted to each cylinder. The pilot operated oscillating axle balance valve pilot lines are pressurised by the solenoid operated flow control valve on the brake control valve to enable the cylinders to move.

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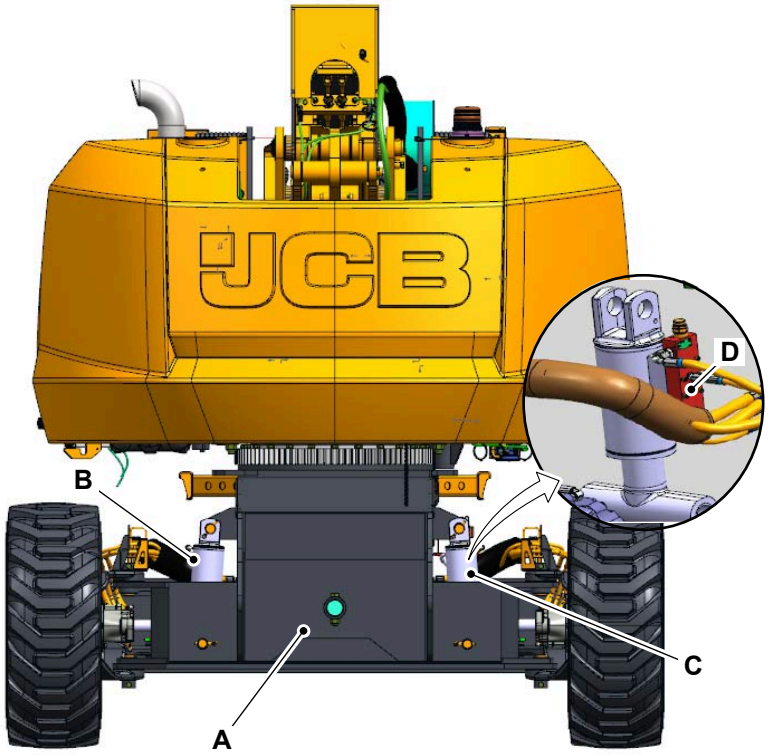
Component Identification

Figure 113.



A Front axle
B Axle lock cylinder - right side
C Axle lock cylinder - left side
D Axle lock balance valve

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Operation

The axle oscillation system enables the oscillating axle to be locked or unlocked according to boom position and drive requirements.

The oscillating axle system works in two ways:

1. It allows the axle to oscillate during travel on uneven ground with the platform in the stowed travel position.
2. It creates increased stability by locking the axle so it cannot pivot when the boom is rotated away from the standard travel position, or when the booms is raised or extended out of the stowed position.

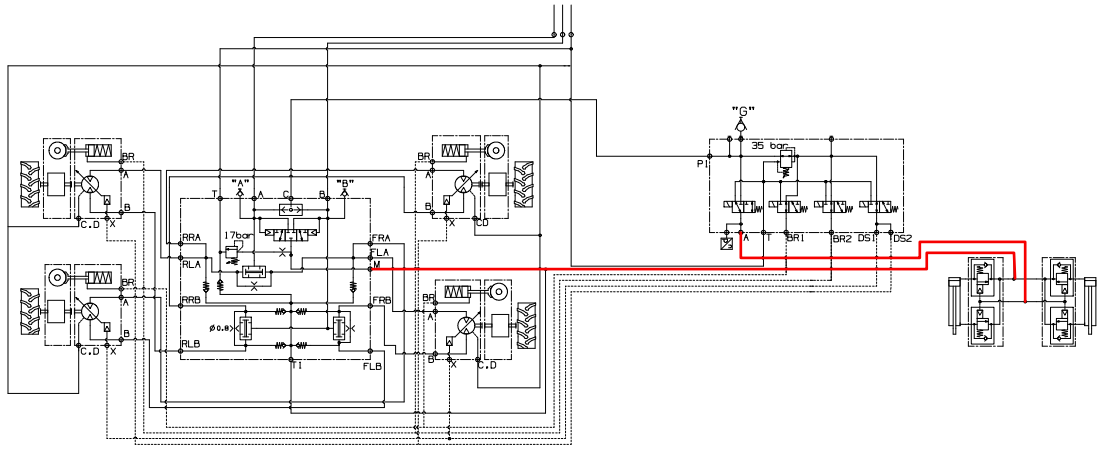
The front axle is attached to the frame by a pivot pin, which allows all four wheels to remain in contact with the ground when traveling over rough terrain.

The axle oscillation system also incorporates two hydraulic cylinders connected between the frame and the axle.

The hydraulic cylinders permit axle oscillation when the boom is in the transport position and drive is commanded. The hydraulic cylinders will lock and hold the axle when drive is not commanded or when the boom is outside the transport position.

The cylinders unlock when pilot pressure is applied to the oscillating axle balance valves and lock when pilot pressure is removed. Pilot pressure is available from the transmission circuit and is controlled by a solenoid operated valve mounted on the brake control valve in the chassis. To ensure the oscillating axle system is functioning correctly, a pressure transducer is mounted between the brake control valve and the balance valves.

Figure 114.



Oscillating Axle Lockout Test

The machine is installed with an oscillating front axle. The machine stability will be affected if the axle locking system is damaged.

1. Make the machine safe.
2. Make sure that the telescopic boom is in stowed position.
3. Start the engine from the platform control.
4. Drive the right front wheel up on the ramp of the specified height. The front axle should be free to tilt.

   Distance: 150mm
5. Make sure that the other three wheels are on the ground and are at a level position.
6. Extend the telescopic boom to the specified distance.

   Distance: 500mm
7. Drive the right front wheel down the ramp. The front axle should be locked.
8. Make sure that the axle remains locked relative to the chassis.

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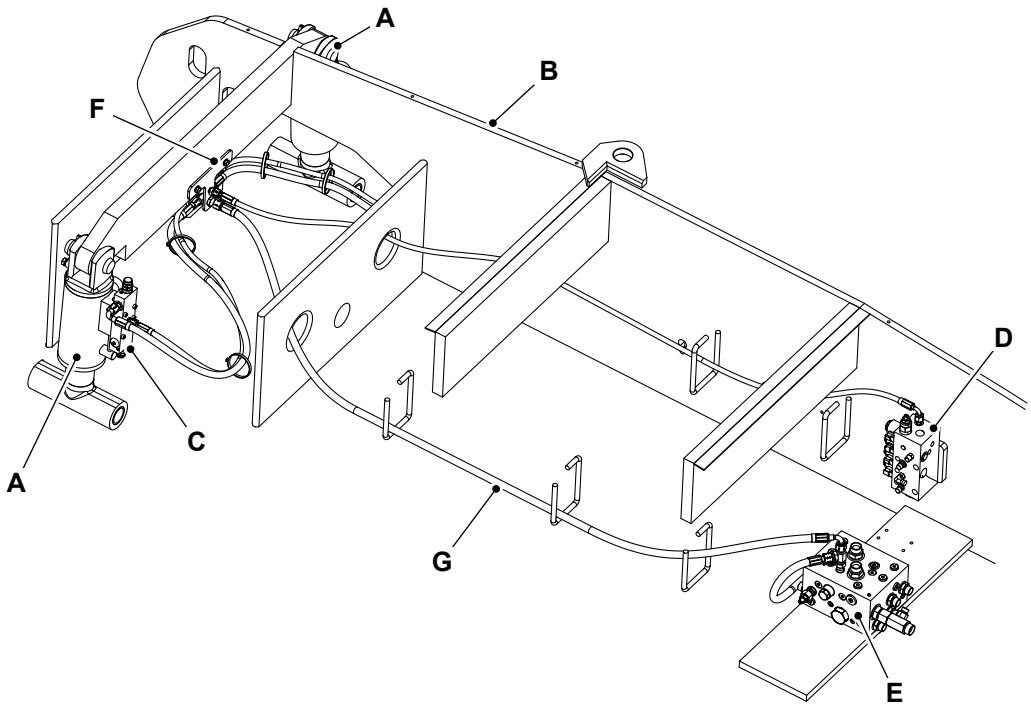
Diagram

Figure 115.



A Oscillation cylinder (x2)
B Chassis
C Counter balance valve (x2)
D Brake control valve
E Transmission control valve
F Front bulkhead connection
G Axle oscillation hoses

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27 - Hub

00 - General

Introduction 27-12
Drain and Fill 27-13
Check (Condition) 27-13
Check (Leaks) 27-14
Check (Level) 27-15
Remove and Install 27-16
Disassemble and Assemble 27-18

Introduction

The hub is the part of the axle where the wheel is mounted.

The hubs have reduction gearing installed and brakes incorporated.

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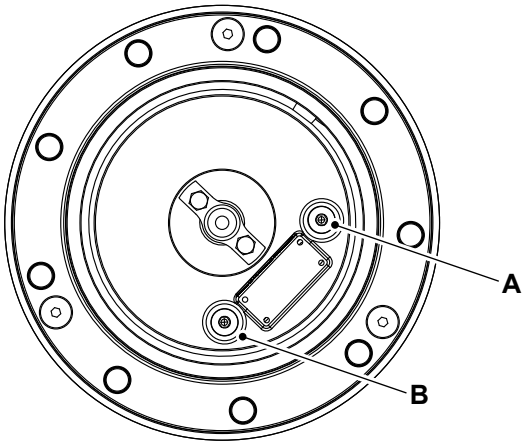
Drain and Fill

Make sure that you change the hub oil after correct intervals.
Refer to: PIL 78-24-10.

Drain

1. Make the machine safe.
   Refer to: PIL 01-03.
2. Park the machine on level ground.
3. Position the machine such that plugs are correctly oriented for each wheel one at a time.
4. Remove both the plugs.
5. Allow the oil to drain.
6. Make a note that, there will be a certain amount of residual oil that cannot be drained from the gearbox due to the internal configuration of the gearbox.

Figure 116.



A Oil level plug (horizontal position)
B Oil level plug (vertical position)

Fill

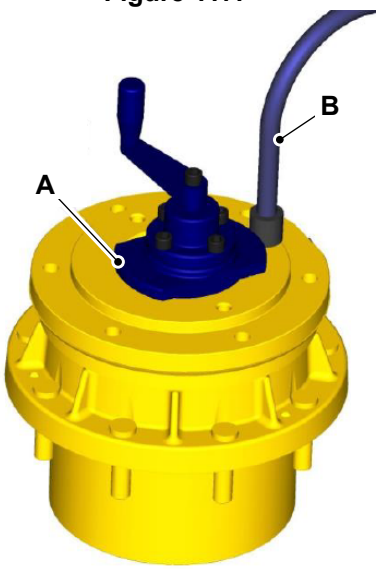
1. Fill the hubs with the correct axle oil through the plug in top vertical position.
   1.1. When gearbox is half filled, the oil will start spilling from the plug in horizontal position.
   1.2. The point of having two plug is so that the wheel does not need to be moved. Hub can be filled through the level plug
2. Clean and install both the cover pipe plugs.

Check (Condition)

The purpose of the roll test is to determine if the unit's gears are rotating consistently, easily and properly. If more drag is felt in the gears only at certain points, then the gears are not rolling consistently and easily and should be examined for improper installation or defects.

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Remove the gearbox from the machine.
3. Place it on a suitable workbench and install the roll test tool (Dana spicer part number T195650).
4. Rotate the gearbox both clockwise and counterclockwise the same number of turns as the ratio of the unit.
5. It should be able to rotate the gears in the unit applying constant force to the roll checker.
   5.1. If more drag is felt in the gears only at certain points, then the gears are not rolling consistently and easily and should be examined for improper installation or defects.
6. The brake must be released before performing the roll test.
   Refer to: Check (Leaks) (PIL 27-27-00).

Figure 117.



A Tool
B Pressure gauge pipe

Some gear packages roll with more difficulty than others. Do not be concerned if the gears in the unit seem to roll hard as long as they roll with consistency.

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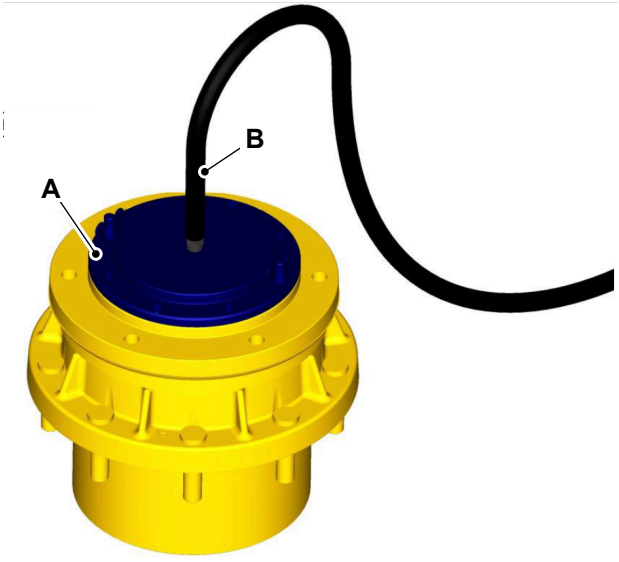
The gearbox ratio is the same number as the last three numbers on the ID tag.

Check (Leaks)

The purpose of the leak test is to make sure that the unit is air tight.

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Connect a suitable pressure gauge to the unit.
3. Pressurise the hub assembly to the specified pressure.
   Pressure: 0.69bar (10.0psi)
4. Wait for the specified duration.
   Duration: 20min
5. Check the reading on the pressure gauge.
   5.1. Make sure that the pressure in the hub assembly does not decrease.
6. If the pressure in the hub assembly decreases, do the following steps.
   6.1. Apply a solution of soap and water on to the pipe plug, main seal, O-rings and gasket.
   6.2. Check for signs of air bubbles.
   6.3. Replace the damaged parts.

Figure 118.



A Blanking plate
B Pressure gauge pipe

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Check (Level)

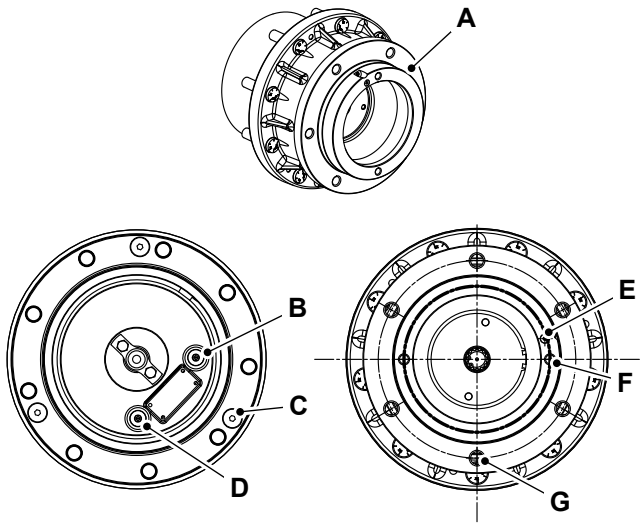
⚠ **Notice:** Never operate the machine with the low hub oil level, otherwise severe damage to the hub internal components can occur.

1. Make the machine safe.

   Refer to: PIL 01-03.

2. Drive the machine to rotate the hub until side plugs are located one in vertical and other in horizontal position.
3. Make sure that the oil level mark on the hub is horizontal.
4. Remove the oil plug and check oil level.
5. Make sure that the oil is in level with the bottom of the oil plug hole. If necessary, top up with the correct axle oil.
6. Clean, apply pipe thread sealant and install the oil plug.
7. Repeat this procedure for each torque hub.

Figure 119.



A Gearbox wheel
B Oil plug (Horizontal position)
C Shipping cap screw
D Oil plug (vertical position)
E Brake port
F Motor mounting holes
G Spindle mounting holes

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Remove and Install

Working Under the Machine

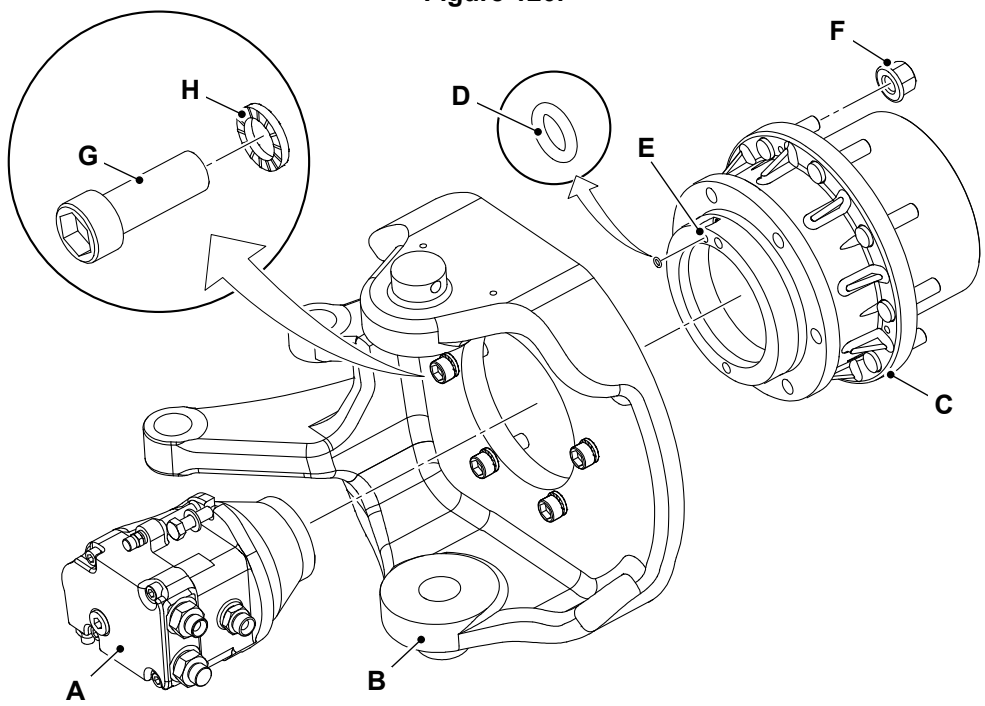
Make the machine safe. Make sure the machine is fully isolated. Remove the machine key switch, disconnect the battery. Use wheel chocks to prevent unintentional movement.

CAUTION! *This component is heavy. It must only be removed or handled using a suitable lifting method and device.*

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Discharge the hydraulic pressure.
   Refer to: Discharge and Pressurise (PIL 30-00-00).
3. If necessary, remove the wheel drive motor.
   Refer to: Remove and Install (PIL 27-32-00).
4. Disconnect the hydraulic hoses from the brake assembly.
5. Put a label on the hoses to help installation.
6. Remove and discard the O-rings.
7. Plug all the open ports and hoses to prevent contamination.
8. Place a jack under the hub assembly to support.
9. Remove the applicable wheel nut (x9) and remove the wheel from the machine.
   Refer to: Remove and Install (PIL 27-29-00).
10. Remove the capscrew (x6) and lock washer (x6).
11. Remove the hub assembly from the machine.

Figure 120.



A Wheel drive motor
B Steering knuckle
C Torque hub
D O-ring
E Brake port
F Wheel nut (x9)
G Capscrew (x6)
H Lock washer (x6)

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

1. Align the brake port of the hub assembly to the brake port of the wheel drive motor.
2. Tighten the capscrew (x6) and wheel nut (x9) to the specified torque value. Refer to Table 52.

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Table 52. Torque Values

Item	Nm
F	210
G	250

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Disassemble and Assemble

Special Tools

Description	Part No.	Qty.
Forklift Jack	334/F1285	1

Working Under the Machine

Make the machine safe. Make sure the machine is fully isolated. Remove the machine key switch, disconnect the battery. Use wheel chocks to prevent unintentional movement.

Disassembly

It is not necessary to remove the axle from the machine to disassemble the hub.

Main Disassembly

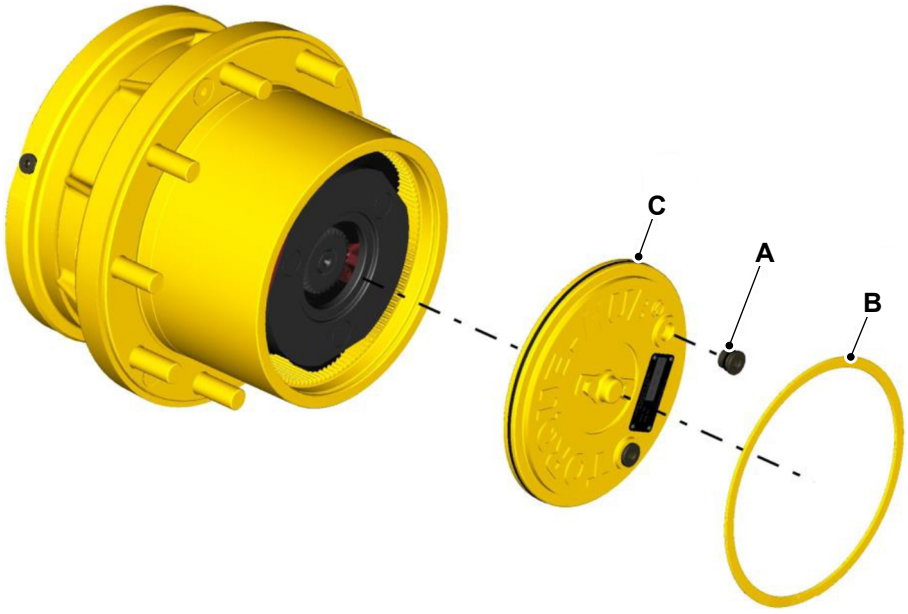
⚠ **WARNING** When working close to the machine with the machine running, protective clothing must be worn, i.e. Safety glasses, ear protection, gloves etc.

1. Make the machine safe.
2. Loosen the wheel nuts of the relevant wheel.
3. Jack up the machine so that the wheel is just clear of the ground.

   Special Tool: Forklift Jack (Qty.: 1)
4. Remove the wheel.
5. Remove the magnetic pipe plug (x2) and drain the oil out of the gearbox.

   5.1. Make sure to record the condition and volume of the oil.
6. Remove the retaining ring from the cover sub-assembly.
7. Lift the cover sub-assembly off the unit.

Figure 121.



A Magnetic pipe plug (x2)
B Retaining ring
C Cover sub-assembly

8. Remove the input sun gear (if applicable).

   8.1. Make a note that on units with a ratio of greater than 36:1, there will be no input sun gear. The teeth will be integrated into the input shaft.
9. Lift out the input carrier sub-assembly from the hub-spindle sub-assembly.
10. Remove the retaining ring from the second stage sun gear.
11. Remove the second stage sun gear.

    11.1. Make a note that on units with a ratio 48:1, the sun gear and the input shaft will need to be removed together.

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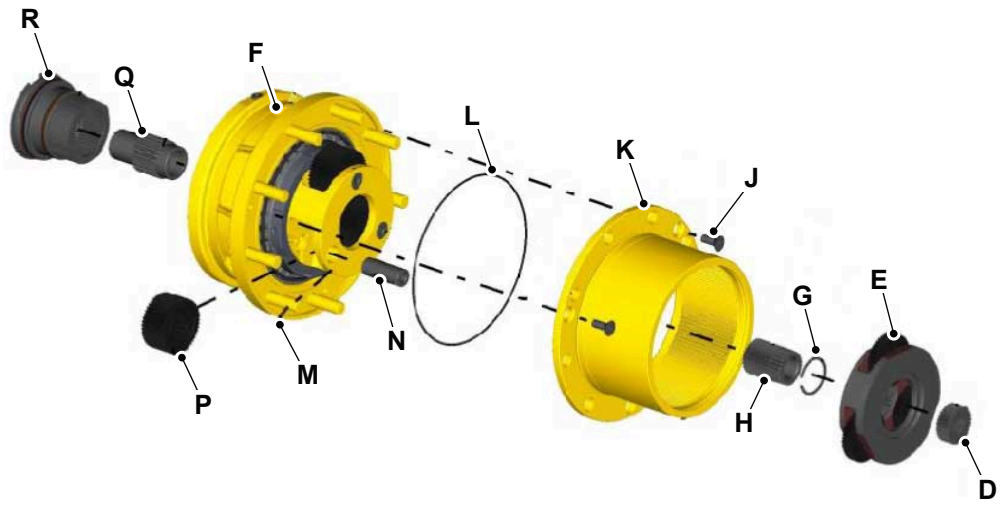
12. Remove the flat head bolt (x3) that retains the ring gear to the housing.
13. Lift the ring gear from the hub-spindle sub-assembly.
14. Remove and discard the O-ring between the housing and the ring rear.
15. Drive the roll pin into the planet shaft until it bottoms against the hub-spindle sub-assembly using a 1/8” diameter punch tool.
16. Hold the roll pin with needle-nosed pliers or some sort of hooked tool and pull the planet shaft out of the hub-spindle sub-assembly.
17. Drive the roll pin out of the planet shaft using a 1/8” diameter punch tool.
18. Slide the planet gear sub-assembly out of the hub-spindle sub-assembly.
    18.1. Carefully handle needle bearings to avoid damage.
19. Remove the input coupling sub-assembly from the hub-spindle sub-assembly.

Figure 122.



D Sun gear
E Carrier sub-assembly
F Hub-spindle sub-assembly
G Retaining ring
H Second stage sun gear
J Flat head bolt (x3)
K Ring gear
L O-ring
M Roll pin
N Planet shaft
P Planet gear sub-assembly
Q Input coupling sub-assembly
R Input brake sub-assembly

Output Planet Gear Disassembly

1. Remove the thrust washer (x4) from the planet gear.
2. Remove the needle roller (x28) from the planet gear.
3. Remove the thrust spacer from the planet gear.
4. Repeat steps 1 to 3 for the remaining planet gear (x2).

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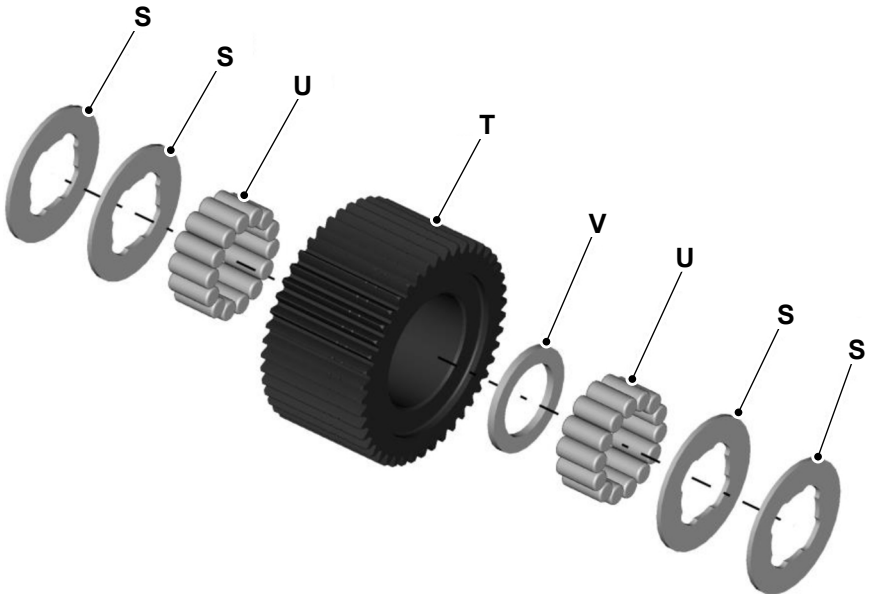
Figure 123.

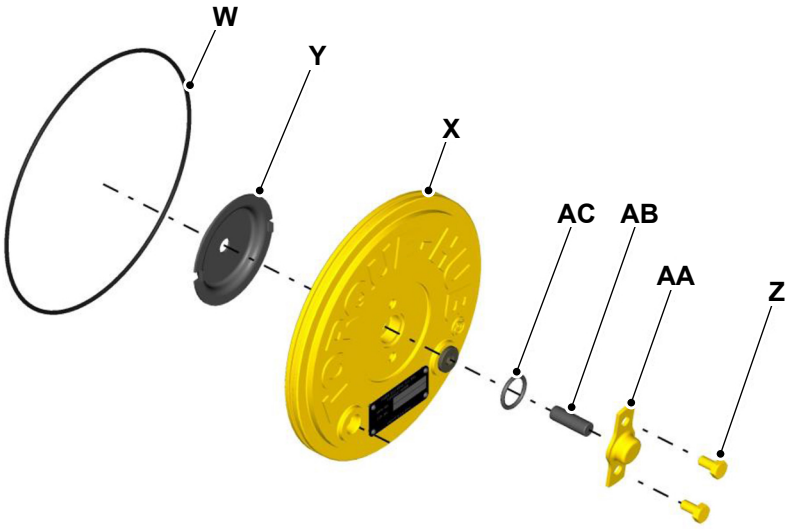


S Thrust washer (x4)
U Needle roller (x28)
T Planet gear
V Thrust spacer

Cover Disassembly

1. Remove and discard the O-ring 1 from the groove in the cover.
2. Remove the thrust washer from the cover.
3. Remove the hex head bolt (x2) from the disengage cap (if required).
4. Remove the disengage cap from the cover.
5. Pull the disengage rod out of the cover.
6. Remove and discard the O-ring 2 from the cover.

Figure 124.



W O-Ring 1
Y Thrust washer
X Cover
Z Hex head bolt (x2)

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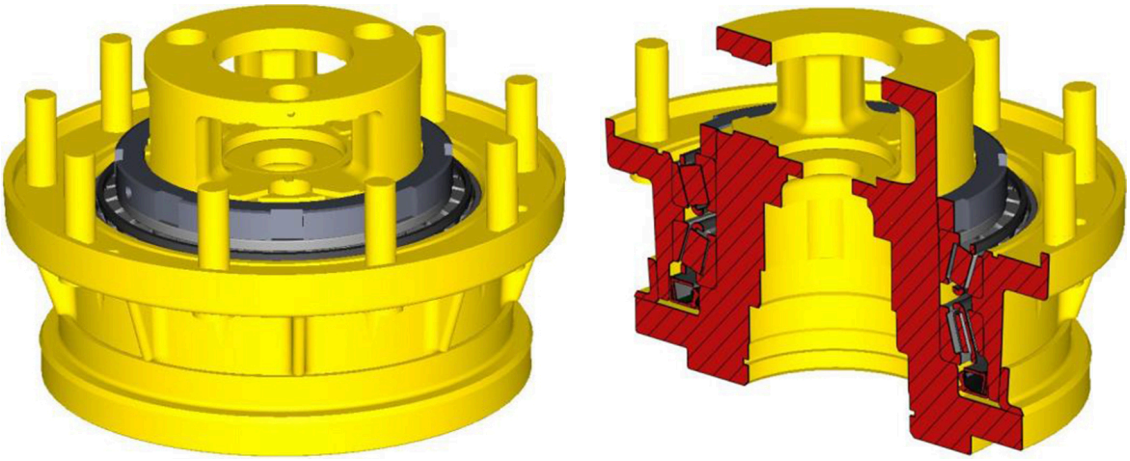
AA Disengage cap
AB Disengage rod
AC O-Ring 2

Housing-Spindle Disassembly

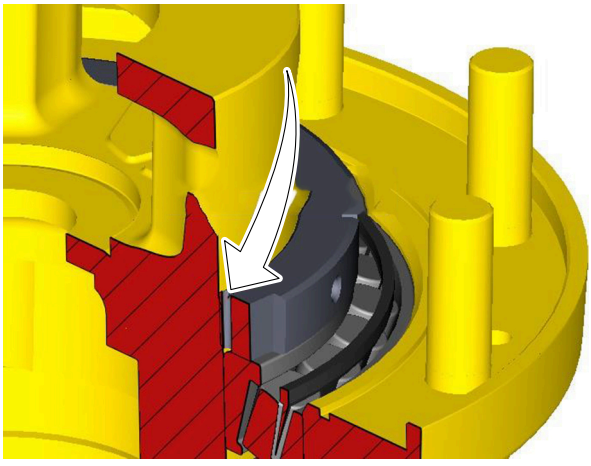
1. Place the unit on a bench so that the spindle flange is down.

Figure 125.



2. Use 1/8" drill bit to drill from the top of the bearing nut to the bottom. Refer to Figure 126.

Figure 126.



3. Use 5/16" drill bit to drill the bearing nut from the shoulder of the bearing nut to the bottom. Refer to Figure 127.

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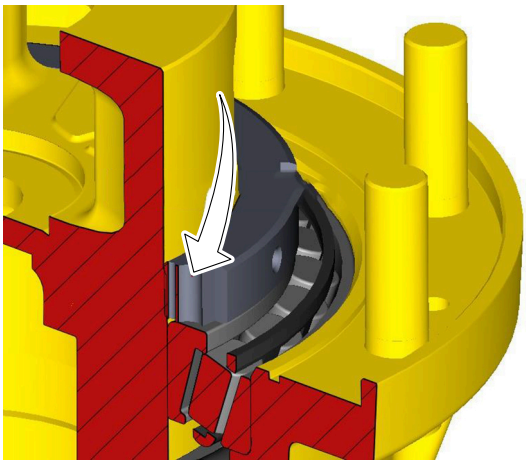
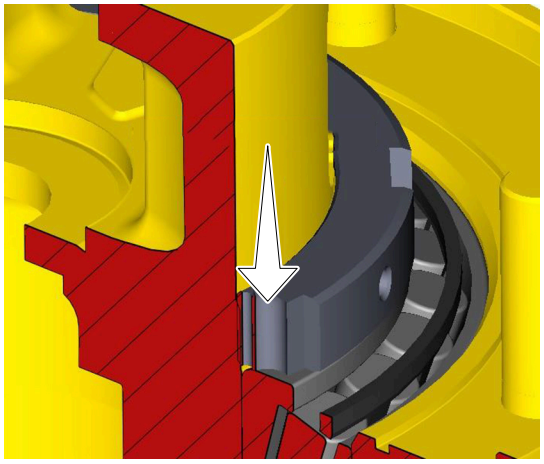
Figure 127.



4. Use chisel split to open the bearing nut through the larger drilled bore. Refer to Figure 128.

4.1. Make sure that the holes in the bearing nut for the setscrews were staked for retention of the setscrews. The holes will need to be cleaned up before removing the setscrews.

Figure 128.



5. Turn the unit over and carefully place the unit on a support base until the spindle rests on it.

5.1. Make sure there is enough gap to lower the housing down.

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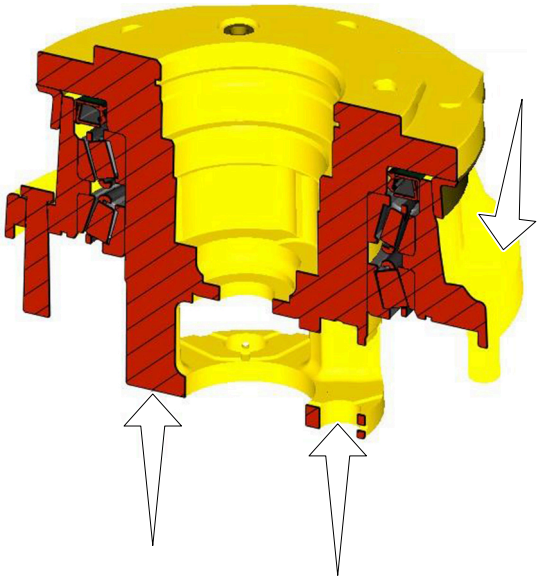
Figure 129.



6. Use a soft faced hammer on the housing flange to drive the inboard bearing cone off of the spindle.
7. Lift the spindle out of the housing.
8. If necessary, remove the boot seal.
9. Remove lip seal from housing.
10. Remove the bearing cone from the housing.
11. Drive the inboard bearing cup out of the housing using a hammer and punch.
    11.1. Make sure not to damage the counter bore in the housing.
12. Turn the housing over and drive the outboard bearing cup out of the housing.
    12.1. Make sure not to damage the counter bore in the housing.

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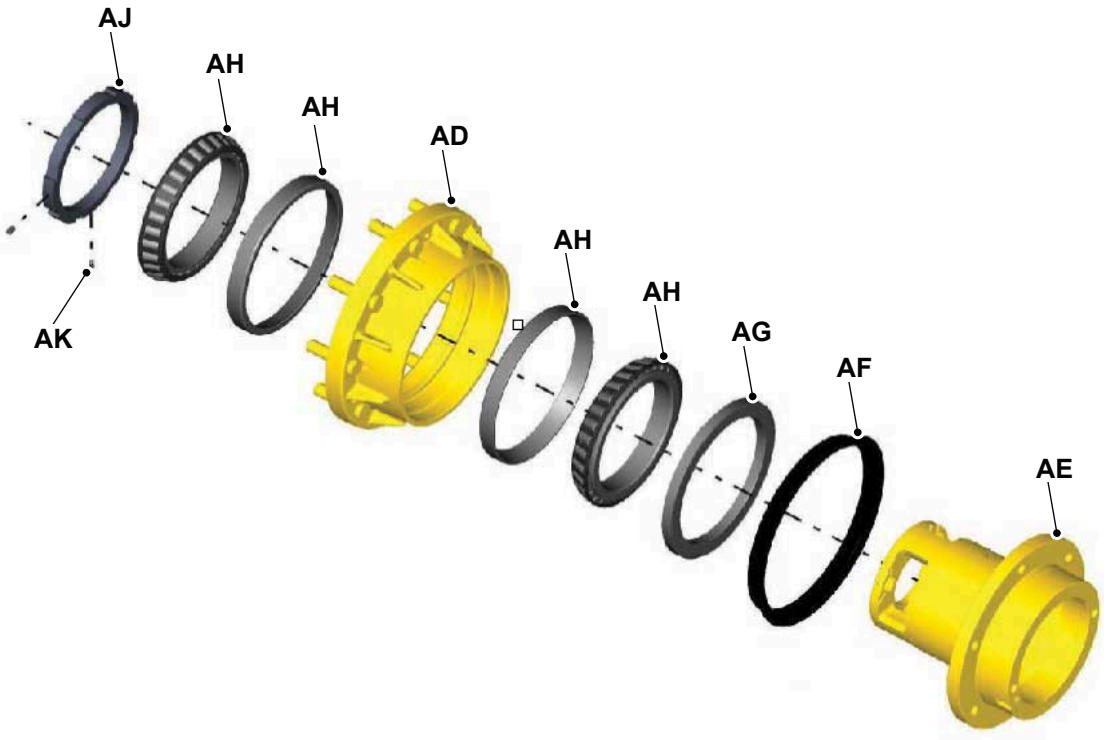
Figure 130.



AD Housing
AF Boot seal
AH Bearing cone (x4)
AK Nut
AE Spindle
AG Lip seal
AJ Setscrews

Input Brake Disassembly

1. Place the spindle such that the flange side is up.
2. Install socket head capscrews (x2) through the thrust plate into the brake piston and tighten incrementally to compress the brake springs and take pressure off of the retaining ring.
3. Remove the retaining ring from counter bore of the spindle.
4. Remove socket head capscrews (x2) from the brake piston incrementally to release the tension of the springs slowly.
5. Remove the brake thrust plate.
6. Remove the brake spring (x12) from the brake piston.
7. Remove the brake piston out of the spindle.
8. Remove the backup ring 1 and the O-ring 1 from grooves in the brake piston.
9. Remove the backup ring 2 and the O-ring 2 from grooves in the spindle.
10. Remove the stators and rotors from the spindle counter bore.
11. Remove plastic plug and pipe plug from spindle (if applicable).

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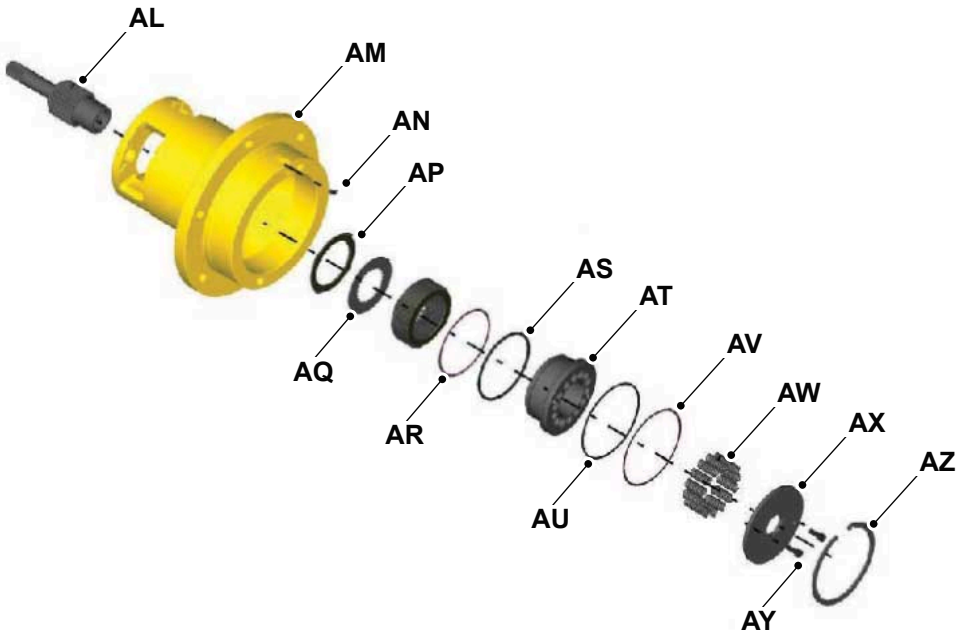
Figure 131.



AL Input coupling sub-assembly
AM Spindle
AN Plastic plug
AP Brake stator
AQ Brake rotor
AR Back-up ring 1
AS O-ring 1
AT Brake piston
AU O-ring 2
AV Back-up ring 2
AW Spring (x12)
AX Pressure plate
AY Socket head capscrew (x2)
AZ Retaining ring

Input Coupling Disassembly

1. Remove the retaining ring from the retaining ring groove of coupling.
2. Remove the input shaft from coupling.
3. Remove the spring from bore of coupling.
4. Remove the spacer from bore of coupling.
5. Remove the retaining ring from bore of coupling.

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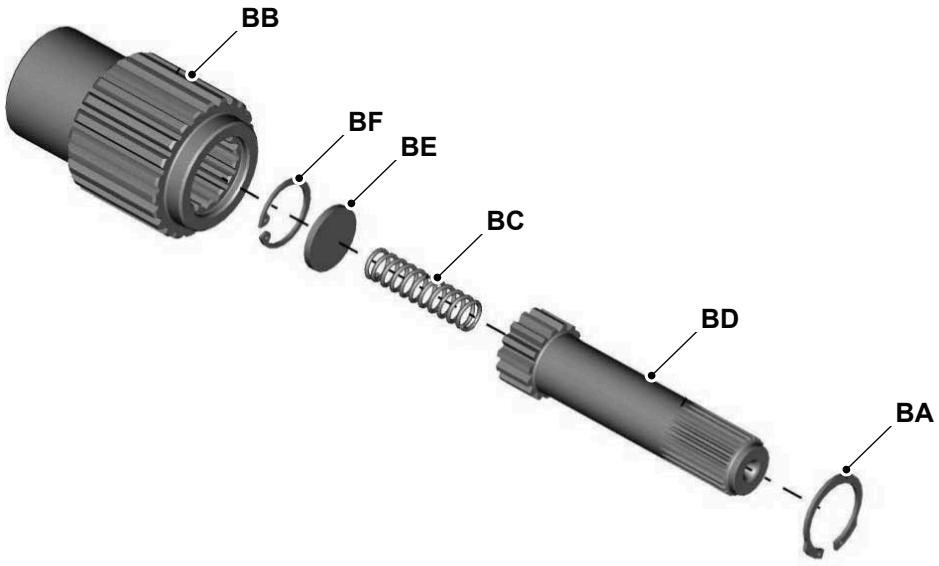
Figure 132.



BA Retaining ring
BC Spring
BE Thrust washer
BB Coupling
BD Input shaft
BF Retaining ring

Input Carrier Disassembly

1. Push the planet shaft out of the carrier pin holes, forcing the roll pin to shear off.
2. Hold on to the planet gear and push the planet shaft out of the carrier.
   2.1. The thrust washer (x2) will slide off the shaft as it is removed.
3. Push the roll pin out of the planet shaft and carrier using a hammer and punch tool.
4. Remove the needle bearings from the inside of the planet gear.
5. Repeat steps 1 to 4 for the remaining planet gear (x2).

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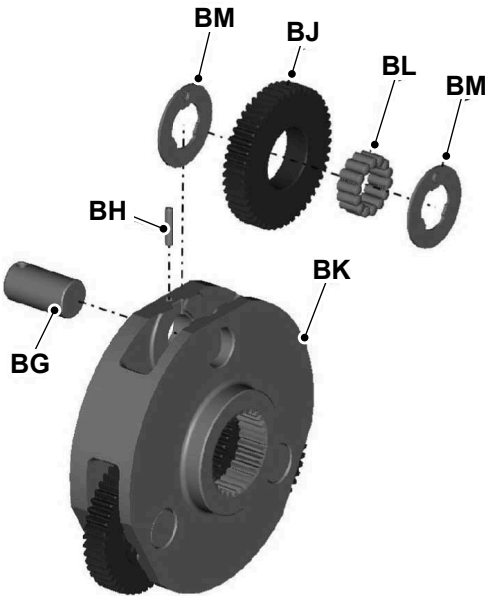
Figure 133.



BG Planet shaft
BJ Planet gear
BL Needle bearings
BH Roll pin
BK Carrier
BM Thrust washer (x2)

Assembly

Cover Sub-assembly

1. Install a magnetic pipe plug (x2) into the cover.
2. Grease the O-ring 1 and place it in the groove on the cover.
3. Grease the thrust washer and place it on the inner hub of the cover, keeping the two tangs aligned with the cast slots in the cover.
4. Grease the O-ring 2 and install it into the internal groove on the cover.
5. Attach the disengage cap to the cover using hex head bolt (x2).
   5.1. Tighten the bolts to the specified torque value.
   Torque: 8→9N·m
6. Turn the cover over and push the disengage rod until the disengage rod bottoms out on the disengage cap.

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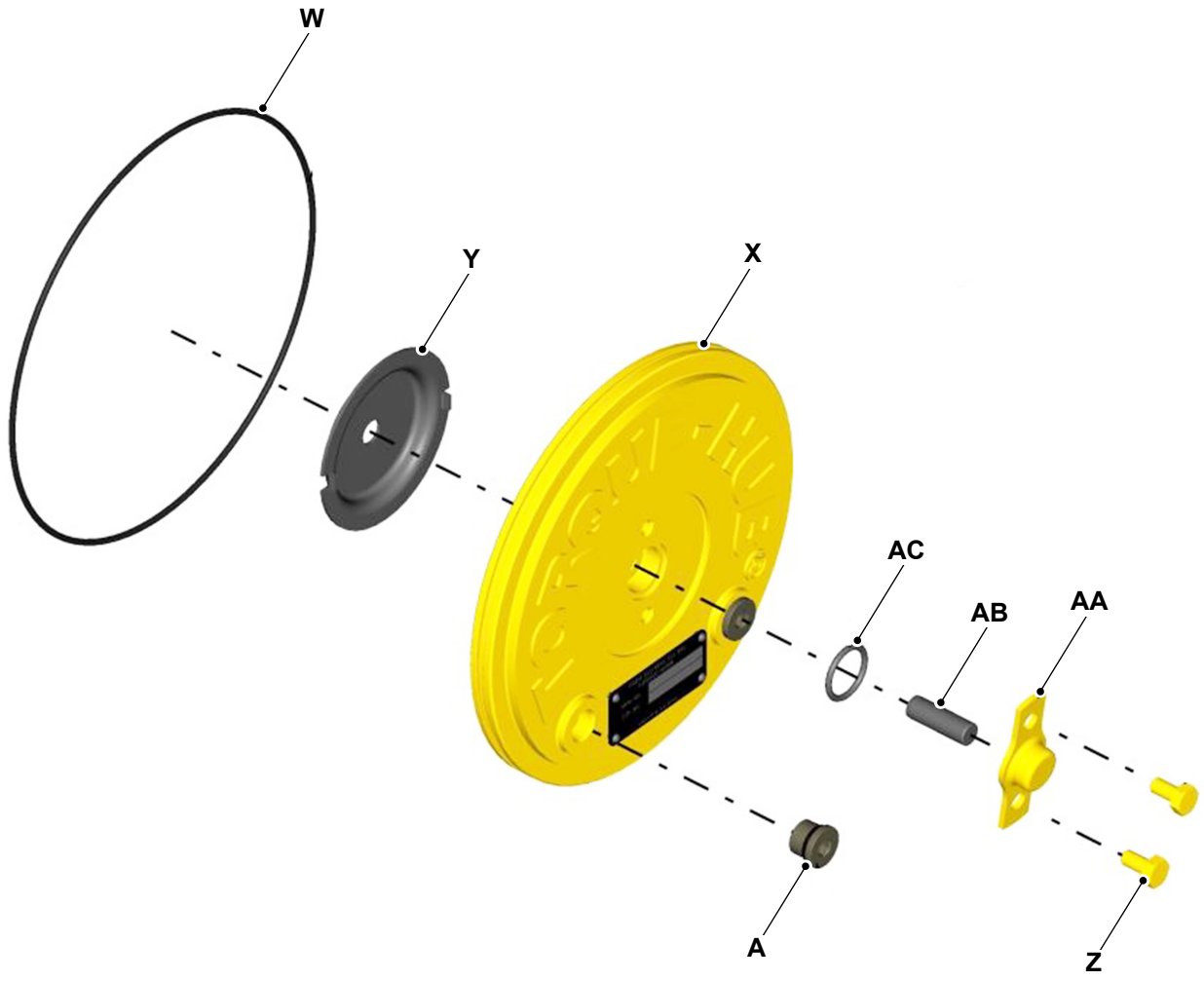
Figure 134.



A Magnetic pipe plug (x2)
X Cover
Z Hex head bolt (x2)
AB Disengage rod
W O-Ring 1
Y Thrust washer
AA Disengage cap
AC O-Ring 2

Input Carrier Sub-assembly

1. Apply a liberal coat of grease to the bore of the planet gear.
   1.1. This will enable the needle rollers to be held in place during assembly.
2. Install needle roller into the bore of the planet gears.
   2.1. Make sure the last roller installed must be installed end wise. That is, the end of the last roller must be placed in between the ends of the two rollers that form the space, and then slide parallel to the other rollers into place.
3. Place the carrier into the tool fixture so that one of the roll pin holes is straight up.
4. Start the planet shaft, with the end opposite roll pin hole first, through the planet shaft hole in the carrier.
   4.1. Make sure that the roll pin hole with the large chamfer in the planet shaft is straight up.
5. Using ample grease to hold them in position, slide thrust washer (x2) onto the planet shaft.
6. Place the planet gear into position and push the planet shaft through the planet gear without going all the way through the carrier.

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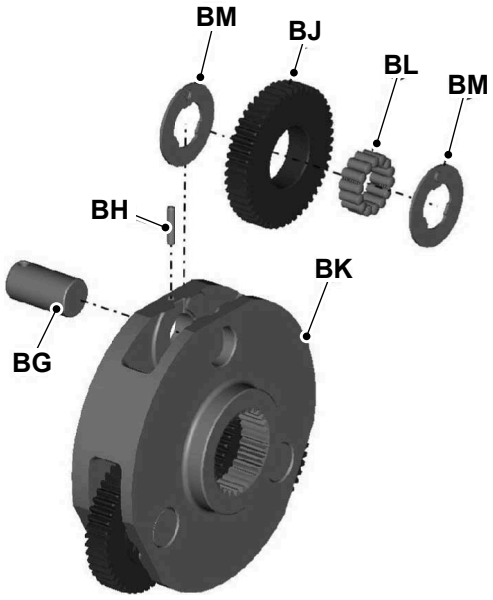
7. Push the planet shaft into the carrier until roll pin holes of the planet shaft and carrier are aligned. Align roll pin holes using a 1/8” diameter punch.

   7.1. Make sure the chamfer on the roll pin hole should be towards the roll pin hole in the carrier.

8. Push the roll pin into the roll pin hole in the carrier and the planet shaft until the end of the roll pin is flush with the outside diameter of the carrier.

9. Repeat steps 4 to 8 for the remaining planet gear (x2).

Figure 135.



BG Planet shaft
BJ Planet gear
BL Needle roller (x14)
BH Roll pin
BK Carrier
BM Thrust washer (x2)

Output Planet Gear Sub-assembly

1. Apply a liberal coat of grease to the bore of the planet gear.

   1.1. This will enable the needle rollers to be held in place during assembly.

2. Install one half of the inside of the planet gear with needle roller (x14).

   2.1. Make sure the last roller installed must be installed end wise. That is, the end of the last roller must be placed in between the ends of the two rollers that form the space, and then slide parallel to the other rollers into place.

3. Place the spacer on top of the needle rollers inside the planet gear.

4. Install the other half of the planet gear with needle roller (x14).

5. Apply grease to hold thrust washer (x2) together and onto the output planet gear counter bore.

   5.1. Do the same to the other side.

6. Repeat steps 1 to 5 complete the assembly of the remaining output planet gear (x2).

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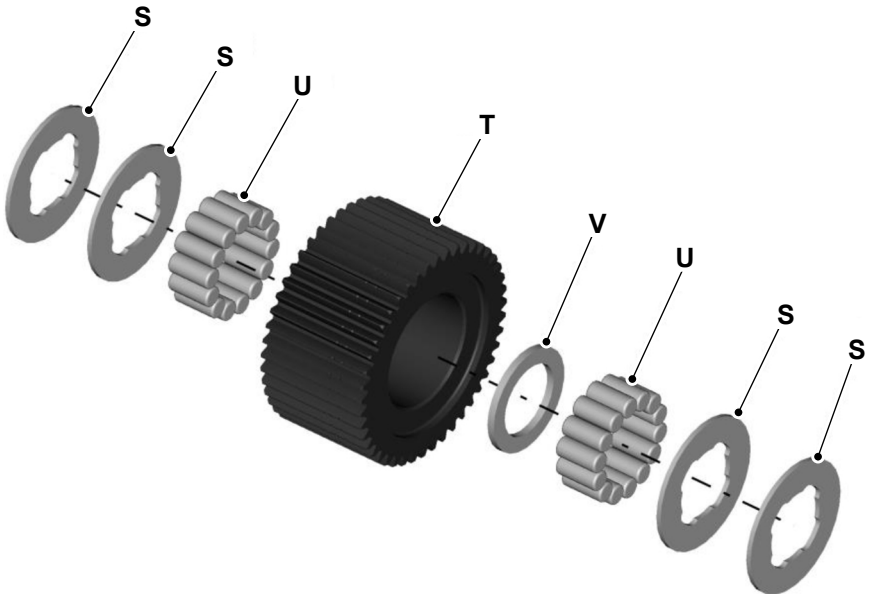
Figure 136.



S Thrust washer (x4)
U Needle roller (x28)
T Planet gear
V Thrust spacer

Input Coupling Sub-assembly

1. Install the retaining ring into coupling.
2. Install the spacer into the coupling.
3. Install the spring into the input coupling bore.
4. Slide the retaining ring onto input shaft.
5. Install the input shaft into the input coupling.
   5.1. Make sure that the splines are engaged.
6. Install the retaining ring into the retaining ring groove of the input coupling using the retaining ring installation tool.

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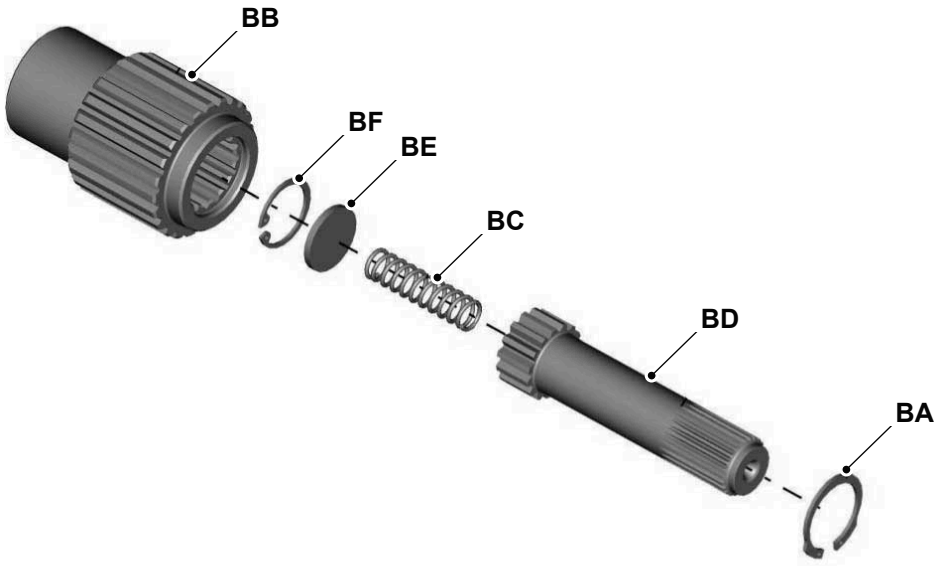
Figure 137.



BA Retaining ring
BC Spring
BE Thrust washer
BB Coupling
BD Input shaft
BF Retaining ring

Input Brake Sub-assembly

NOTE: Use an air gun to clean up the brake port and make sure there are no chips inside.

1. Place spindle such that the flange side is up.
2. Place stator into the spindle scallop cuts.
3. Place rotor on top of stator.
4. Repeat 2 and 3 until there are a total of 6 stators and 5 rotors installed.
   4.1. Make sure that there should always be a stator on the top and bottom of the stack.
5. Grease and install O-ring 1 into spindle O-ring groove.
6. Gradually feed back-up ring underneath O-ring 1.
   6.1. Using a small pick, push one end of the back-up ring to completely seat it in the groove.
   6.2. Make sure that the piston will not cut the back-up ring during assembly.
7. Install large back-up ring in groove on piston.
8. Grease and install large O-ring 2 in the large-diameter groove towards the small diameter end of piston on top of the large back-up ring.
9. Press the piston into spindle until the small end contacts the stator.
10. Insert appropriate number of spring (x12) into piston.
11. Place pressure plate on top of spring (x12).
12. Install the socket head capscrew (x2) through the pressure plate into piston.
    12.1. After springs have been compressed enough, install retaining ring into spindle groove.
    12.2. Remove the socket head capscrew (x2).
    12.3. Make sure that socket head capscrew (x2) are removed from the units when done, otherwise brake will not function.
13. Install the pressure plug into the spindle using appropriate tool.
14. Flip the spindle-motor sub-assembly over, with the brake pressurized.
15. Insert 7HP coupling sub-assembly through rotors.

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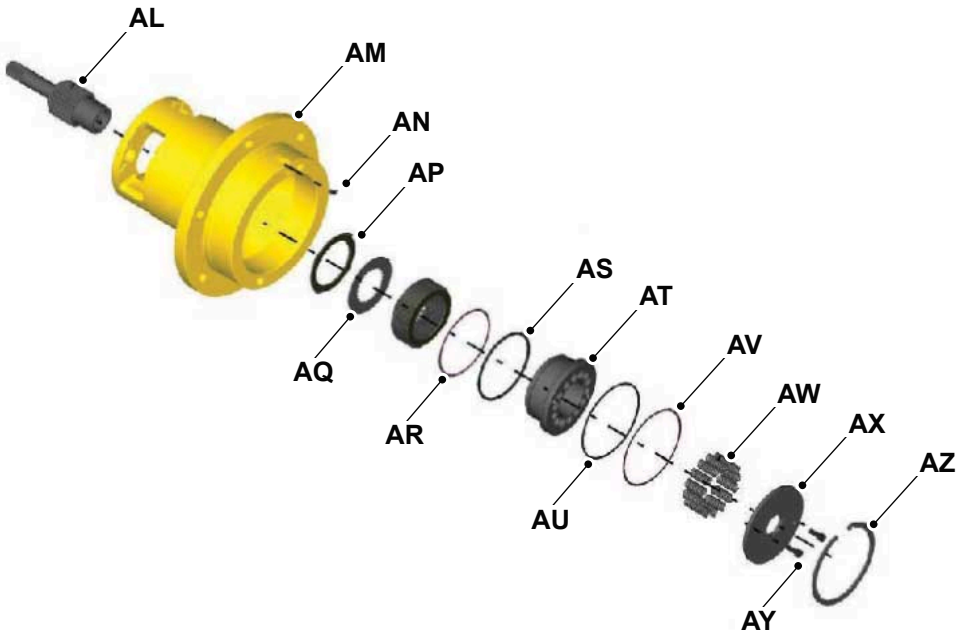
16. Pressurize the brake cavity and check for leaks.

Figure 138.



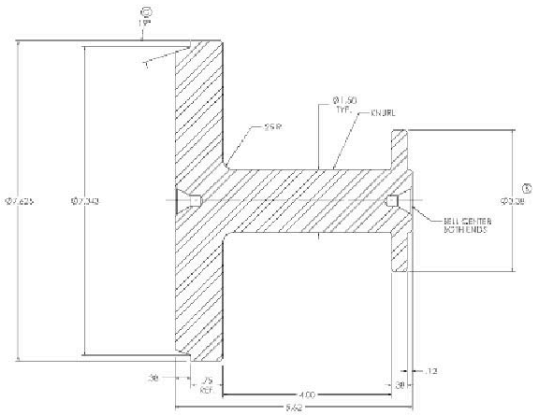
AL Input coupling sub-assembly
AM Spindle
AN Plastic plug
AP Brake stator
AQ Brake rotor
AR Back-up ring 1
AS O-ring 1
AT Brake piston
AU O-ring 2
AV Back-up ring 2
AW Spring (x12)
AX Pressure plate
AY Capscrew (x2)
AZ Retaining ring

Housing - Spindle Sub-assembly

NOTE: Spray a light film of oil on all components during assembly. Spray a generous amount of oil on bearings during installation.

1. Press one bearing cone into the bearing counter bore of the spindle end of housing until seated against the shoulder in housing with cup press tool. Refer to the dimensional details of the tool.

Figure 139. Cup Press Tool



2. Turn housing and press one bearing cup using cup press tool into bearing counter bore of cover end of the housing.

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2.1. Make sure that it is fully seated against the shoulder in the housing.

3. Place one bearing cone into the housing.

4. Spray the housing seal bore with alcohol, then wipe it with a clean rag. Make sure that there is no debris left in the bore.

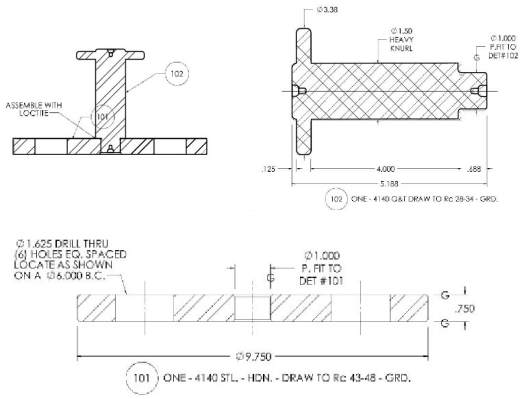
   4.1. Note that generally seals should not be reused.

5. Spray the outer diameter of the lip seal with alcohol and wipe with a clean rag.

   5.1. Place and visually align the lip seal with the spring side down into the housing seal bore.

   5.2. Press the seal into the housing using a seal press with a seal press tool.

Figure 140. Seal Press Tool



   5.3. When the seal press tool makes contact with the housing the seal is fully seated.

6. Spray the spindle seal diameter with alcohol and wipe with a clean rag.

   6.1. Apply a coat of grease to the spindle seal diameter with the brush.

7. If necessary, install a boot seal onto the housing.

8. Install the housing onto the spindle with seal side down.

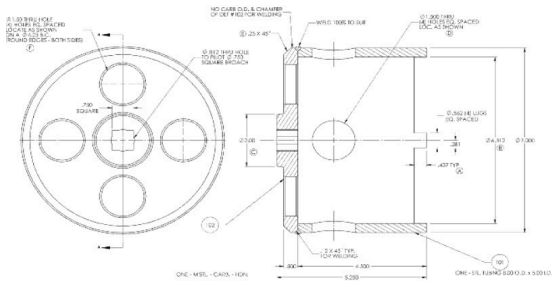
9. Place another bearing cone onto the spindle until it is seated in the bearing cup in housing and spray with a light coat of oil.

10. Apply Loctite 263 to the threads of the bearing nut and spindle.

11. Install bearing nut onto the spindle and tighten using locknut tool to the specified torque value.

    Torque: 17N·m

Figure 141. Locknut Tool



   11.1. Rotate housing in both directions and then torque bearing nut to the specified torque value.

   Torque: 17N·m

   11.2. Repeat step 11.1 until the bearing nut does not move when the specified torque value is applied.

   Torque: 17N·m

12. Apply Loctite 263 to setscrew (x2) and install them into bearing nut threaded holes.

   12.1. Make sure that the setscrew (x2) is driven into the spindle thread.

   12.2. Tighten the setscrew (x2) to damage the thread and stake the edge of the nut (x2) around the setscrew (x2) so the nut will not loosen.

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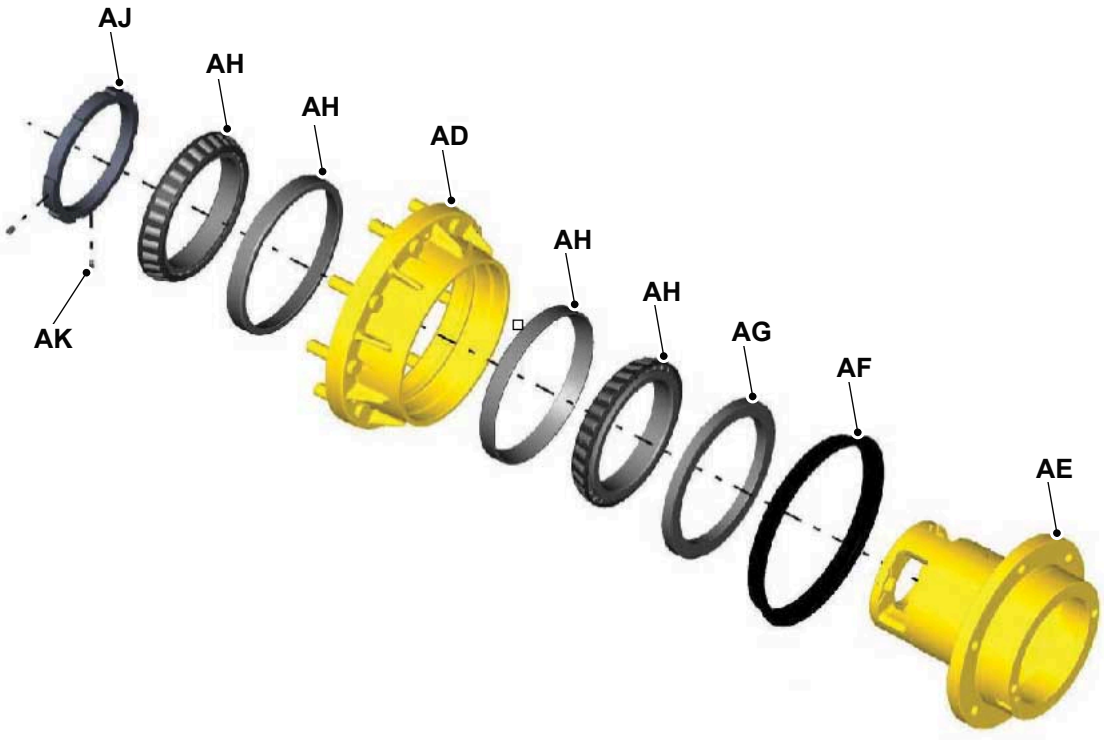
Figure 142.



AD Housing
AF Boot seal
AH Bearing cone (x4)
AK Nut (x2)
AE Spindle
AG Lip seal
AJ Setscrew (x2)

Main Assembly

NOTE: Spray components with a liberal amount of oil as they are being assembled.

1. Place hub-spindle sub-assembly with spindle flange side down.

   1.1. Make sure that on 7HP units with a ratio of greater than 36:1, install input coupling – input shaft and output sun gear sub-assembly before proceeding to 2.

2. Place output planet gear assembly into the windows of the spindle. The output planets must have their part number facing up. Align the planet gear holes with planet shaft holes.

3. Install planet shaft with pin hole side up into spindle. Make sure to align the pin hole in the planet shaft with the pin hole in the spindle during installation.

4. Use 1/8” diameter punch to drive the roll pin in the planet shaft. Make sure everything is aligned and push the planet shaft into the spindle until roll pin holes are aligned.

   4.1. Use an alignment punch or similar tool to align roll pin holes on the spindle and planet shaft.

5. Drive roll pin down into the aligned roll pin holes. The pin should be flush with the outer diameter of the spindle.

6. Install O-ring onto groove of housing.

7. Place ring gear onto the housing. Align the shipping capscrew holes on hub and ring gear.

8. Install shipping capscrew (x3) into ring gear and housing. Tighten them to the specified torque value.

   Torque: 1.7→2.26N·m

   8.1. Make sure that on 7HB units with a ratio of greater than 36:1, install output sun gear-input shaft assembly and proceed to step 11.

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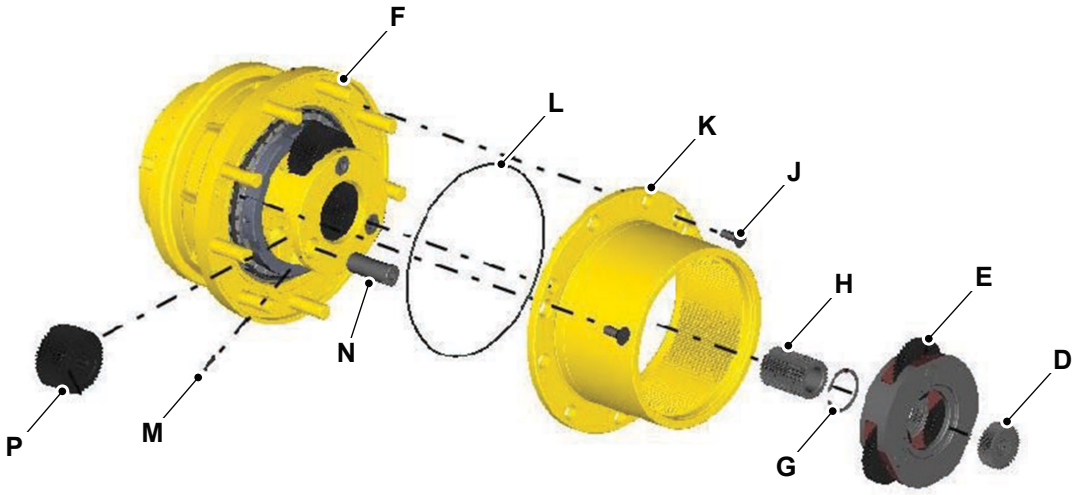
9. Install the retaining ring on the sun gear.
10. Install sun gear into output planet gear mesh with spline side up.
11. Install input carrier sub-assembly into ring gear and make sure that the splines of the sun gear are aligned with the splines of the input carrier sub-assembly.
12. Install input sun gear onto the input shaft, if applicable.

Figure 143.



D Sun gear
E Carrier sub-assembly
F Hub-spindle sub-assembly
G Retaining ring
H Second stage sun gear
J Capscrew (x3)
K Ring gear
L O-ring
M Roll pin
N Planet shaft
P Planet gear sub-assembly

13. Align magnetic pipe plug to the correct location and install cover sub-assembly to the housing using a retaining ring.

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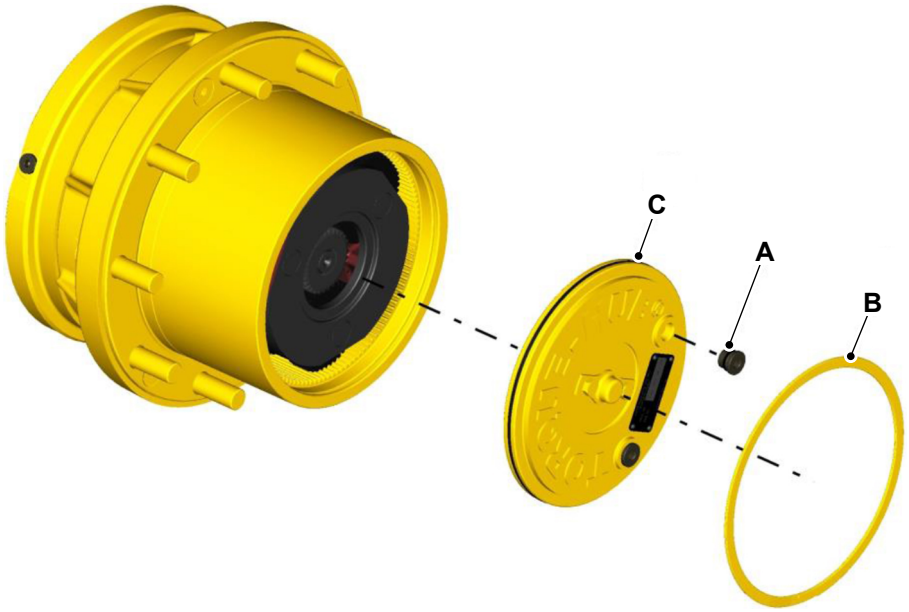
Figure 144.



A Magnetic pipe plug (x2)
B Retaining ring
C Cover sub-assembly

14. Install the wheel.

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29 - Wheel

00 - General

Introduction 27-37
Health and Safety 27-38
Remove and Install 27-39

Introduction

On new machines, and whenever a wheel has been removed, check the wheel nut torques every two hours until they stay correct. Every day, before starting work, check that the wheel nuts are tight. Tighten the wheel nuts (in a diagonal sequence) to the correct torque value, refer to Remove and Install.

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Health and Safety

⚠ **WARNING** If, for whatever reason, a wheel stud is renewed, all the studs for that wheel must be changed as a set, since the remaining studs may have been damaged.

WARNING Wheels and tyres are heavy. Take care when lifting or moving them. Store with care to ensure that they cannot fall and cause injury. Use suitable lifting equipment if necessary.

WARNING Do not install pneumatic tyres on a wheel made for a solid tyre. Do not install a solid tyre on a wheel made for a pneumatic tyre. If you are unsure of the correct specification for your machine, contact your local JCB dealer or a trained specialist.

This machine has only been stability tested with foam or solid-filled tyres. If semi-solid or inflated tyres are used the machine could be potentially unstable. Do not use tyres other than foam or solid-filled tyres.

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Remove and Install

⚠ **WARNING** A raised and badly supported machine can fall on you. Position the machine on a firm, level surface before raising one end. Ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it. Disconnect the battery, to prevent the machine being started while you are beneath it.

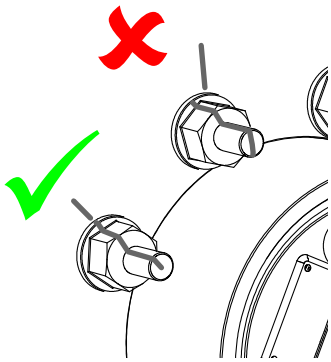
WARNING A machine can roll off jacks and crush you unless the wheels have been blocked. Always block the wheels at the opposite end of the machine that is to be jacked. Do not work underneath a machine supported only by jacks. Always support a jacked-up machine on axle stands before working underneath it.

WARNING Wheels and tyres are heavy. Take care when lifting or moving them. Store with care to ensure that they cannot fall and cause injury. Use suitable lifting equipment if necessary.

Daily Inspection

Prior to machine use, walk around machine and visually check the lug nut torque marks are in line with the markings on the wheel. If any of the marks are not aligned, then re-torque all the lug nuts. Remove and reapply the torque marks.

Figure 145.



Checking the Wheel Lug Nut Torques

⚠ **WARNING** You must check the lug nut torques:

- after the first 50 hours of operation.
- after removal and replacement of a wheel.
- if the lug nut torque marks are out of line.
- every 250 hours of operation.

If wheel/s are re-torqued then the existing marks must be removed and reapplied.

Changing a Wheel

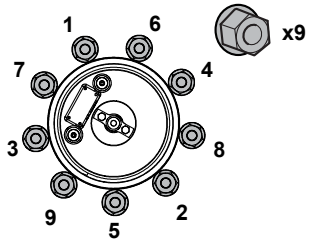
Removal

1. Make the machine safe.
   Refer to: Introduction (PIL 01-03-27).
2. Jack up the machine to gain access to the wheel to be changed. Ensure the tyre is not touching the ground.
3. Remove the lug nuts and then remove the wheel.

Replacement

1. Inspect the wheel for any damage, i.e. dents, elongated holes, corrosion etc.
2. Clean the wheel hub and wheel inner mounting face.
3. Ensure the wheel hub stud threads are free from oil and grease.
4. Position the wheel on to the hub centrally, ensuring the mating face on the rear of the wheel is fully pushed back and flush with the wheel hub; the tyre must not be touching the ground.
5. Tighten all lug nuts pushing the wheel back in to place.
6. Lower the machine to the ground.

Figure 146.



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7. Torque tighten the lug nuts in the sequence shown to 250Nm (184 ft lbs).
8. Remove and reapply the torque marks.

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32 - Wheel Drive Motor

00 - General

Introduction 27-41
Component Identification 27-42
Operation 27-43
Fault-Finding 27-44
Diagram 27-46
Remove and Install 27-46

Introduction

The wheel drive motors installed on each wheel of this machine are variable displacement axle piston motors with an integral servo piston.

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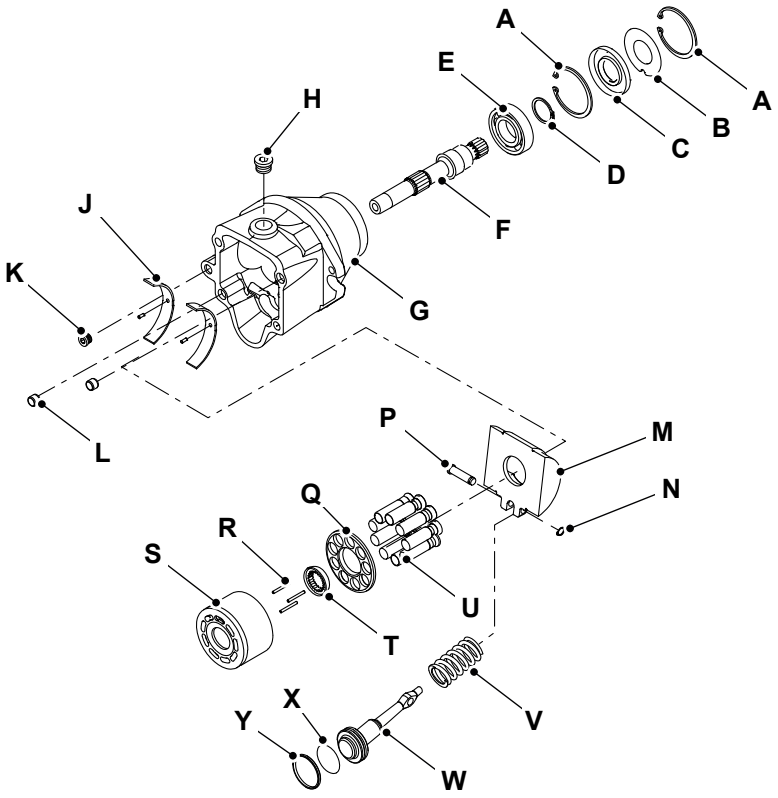
Component Identification

Figure 147.



A Retaining ring 1 (x2)
B Seal support washer
C Lip seal
D Retaining ring 2
E Ball bearing
F Shaft
G Motor housing
H Plug assembly 1
J Journal bearing kit (x2)
K Plug assembly 2
L Pin 1 (x2)
M Swashplate
N Retaining ring 3
P Pin 2
Q Slipper retainer
R Slipper hold down pin (x3)
S Cylinder block assembly
T Slipper retainer guide
U Piston assembly
V Spring
W Servo piston
X O-ring
Y Piston ring

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Operation

The integral servo piston controls the motor displacement.

The motor is spring biased to maximum displacement and hydraulically shifted to minimum displacement. The minimum and maximum displacement of the motor can be set with fixed internal stops. The large diameter servo piston allows smooth acceleration and deceleration with relatively large circuit orifices.

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Fault-Finding

Fault		
Unusual noises	Table 53.	Page 27-44
No or insufficient pressure	Table 54.	Page 27-44
Pressure/flow fluctuations	Table 55.	Page 27-44
Rotational speed or torque not achieved	Table 56.	Page 27-44
Oil heating	Table 57.	Page 27-45

Table 53. Unusual noises

Cause	Remedy
Insufficient bleeding of the hydraulic system.	Axial piston unit, suction line for the hydraulic pump and filling the reservoir.
	Completely air bleed axial piston unit and hydraulic system.
	Check correct installation position.
Output speed too high	Adjust the speed to the correct value.
Improper mounting of the axial piston unit.	Check the mounting of the axial piston unit. Tighten the fasteners to the correct torque value.
Attachment parts not installed correctly.	Install the attachment parts correctly. Tighten the fasteners to the correct torque value.
Mechanical damage to the motor.	Install new motor.

Table 54. No or insufficient pressure

Cause	Remedy
Insufficient bleeding of the hydraulic system.	Completely air bleed axial piston unit, suction line for the hydraulic pump and fill the reservoir with the correct hydraulic fluid.
Mechanical output drive is faulty.	Investigate and repair as necessary.
Drive power too low.	Investigate and repair as necessary.
Control device or controller of the axial piston unit faulty.	Investigate and repair as necessary.
Control of the control device faulty.	Investigate and repair as necessary.
Motor is worn.	Install new motor.
Drive unit defective.	Investigate and repair as necessary.

Table 55. Pressure/flow fluctuations

Cause	Remedy
Hydraulic system not or insufficiently air bled.	Completely air bleed the axial piston unit, suction line for the hydraulic pump and filling the reservoir with the correct hydraulic fluid.
	Check correct installation position.
Unstable control signal.	Investigate and repair as necessary.
Control device or controller faulty.	Investigate and repair as necessary.

Table 56. Rotational speed or torque not achieved

Cause	Remedy
Insufficient flow at hydraulic pump.	Check the function of the hydraulic pump.
Minimum or maximum displacement set incorrectly.	Investigate and repair as necessary.
Control of the control device faulty.	Check the control.
Pilot pressure or control pressure not sufficient.	Check pilot pressure or control pressure. Investigate and repair as necessary.

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Cause	Remedy
Control device or controller of the axial piston motor faulty.	Investigate and repair as necessary.
Hydraulic fluid not in optimum viscosity range.	Change the oil for one with the correct viscosity.
Motor is worn.	Install new motor.
Wrong direction of rotation.	Check function of the hydraulic pump. Make sure the connections are correct. Refer to (PIL 27-32).

Table 57. Oil heating

Cause	Remedy
Excessive inlet temperature at the motor.	Check the functioning of the cooler and repair if necessary.
	Check the hydraulic fluid level and top up if necessary.
Pressure control valve faulty.	Investigate and repair as necessary.
Output speed too high.	Investigate and repair as necessary.
Flushing valve faulty.	Investigate and repair as necessary.
Motor is worn.	Install new motor.

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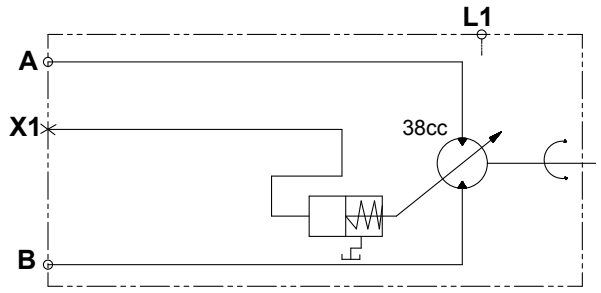
Diagram

Figure 148.



A System port A
B System port B
X1 Control port
L1 Drain port

Remove and Install

Working Under the Machine

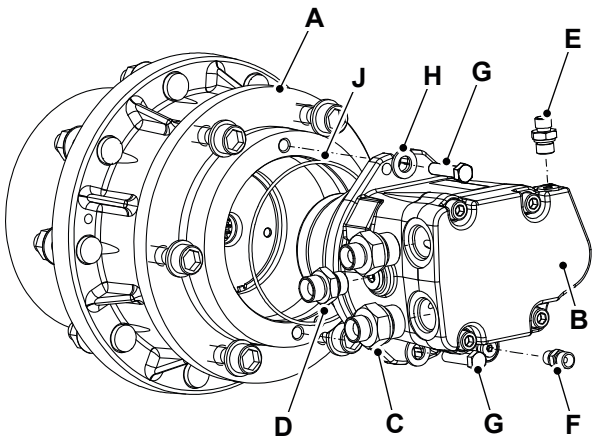
Make the machine safe. Make sure the machine is fully isolated. Remove the machine key switch, disconnect the battery. Use wheel chocks to prevent unintentional movement.

CAUTION! *This component is heavy. It must only be removed or handled using a suitable lifting method and device.*

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Discharge the hydraulic pressure.
   Refer to: Discharge and Pressurise (PIL 30-00-00).
3. Disconnect the hydraulic hoses from the wheel drive motor.
4. Put a label on the hoses to help installation.
5. Plug all the open ports and hoses to prevent contamination.
6. Support the wheel drive motor with a suitable stand.
7. Remove the adaptors.
8. Remove the bolt (x2) and washer (x2).
9. Remove and discard the O-ring.
10. Remove the wheel drive motor from the brake assembly and hub.

Figure 149.



A Hub/wheel gearbox
B Wheel drive motor
C Adaptor 1 (x2)
D Adaptor 2
E Adaptor 3

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F Adaptor 4
G Bolt (x2)
H Washer (x2)
J O-ring

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

1. Make sure that the brake port of the hydraulic motor is aligned with the brake port of the hub.
2. Renew the O-ring.
3. Tighten the bolts and adaptors to the specified torque value. Refer to Table 58.

Table 58. Torque Values

Item	Nm
C	170–187
D	70–77
E	35–39
F	20–22
G	65

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46 - Output Shaft Seal

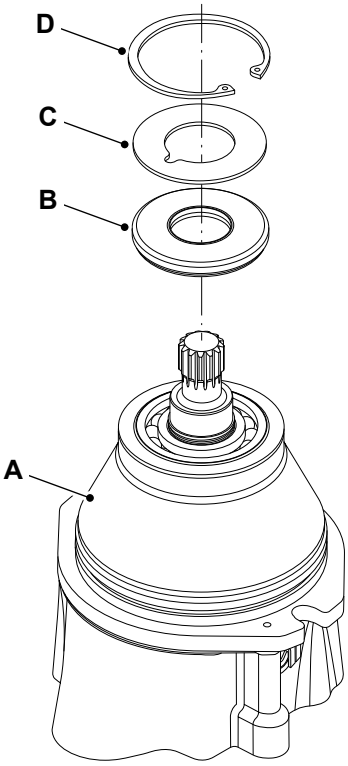
Remove and Install

Remove

Remove the output shaft seal if there is excessive leakage from the motor.

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Remove the wheel motor.
   Refer to: PIL 27-32-00.
3. Remove the retaining ring 1.
4. Remove the seal support washer.
5. Remove and discard the lip seal.
   5.1. To avoid damage to the shaft, install a large metal screw into the chuck of a slide hammer. Drive the screw into the seal surface and use the slide hammer to pull out the seal.

Figure 150.



A Motor housing
B Lip seal
C Seal support washer
D Retaining ring 1

Install

1. Check the condition of the output shaft and seal bore for rust, wear and contamination.
2. Cover the output shaft splines with an installation sleeve to protect the lip seal.
3. Install a new lip seal. Make sure that the cup side of the lip seal faces the motor.
4. Press the lip seal into the housing until it bottoms out. Press evenly to avoid binding and damaging the seal.
5. Install the seal support washer.
6. Install the retaining ring 1.
7. Remove the installation sleeve.

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33 - Tyre

00 - General

Introduction 27-49
Health and Safety 27-50
Technical Data 27-51

Introduction

Tyres provide a flexible cushion that absorb shocks, while keeping the wheel in close contact with the ground.

Tyre materials are usually synthetic rubber, natural rubber, fabric and wire, along with other compound chemicals. They consist of a tread and a body. The tread provides traction while the body ensures support.

Make sure that the tyres are kept in good condition.

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Health and Safety

⚠ **WARNING** Wheels and tyres are heavy. Take care when lifting or moving them. Store with care to ensure that they cannot fall and cause injury. Use suitable lifting equipment if necessary.

WARNING Running tyres outside recommended guidelines may result in failure of the tyres which at high speeds may endanger life.

WARNING Do not install pneumatic tyres on a wheel made for a solid tyre. Do not install a solid tyre on a wheel made for a pneumatic tyre. If you are unsure of the correct specification for your machine, contact your local JCB dealer or a trained specialist.

WARNING When ordering tyres, you must specify not only the tyre size but also the speed designation. The correct tyres for the machine are shown in the Operator's Manual. On no account should you use tyres of other designations without first gaining approval from the machine manufacturer.

This machine has been tested for stability with foam or solid tyres only. If the semi-solid or inflated tyres are used, the machine could be potentially unstable. Do not use any tyres other than JCB recommended foam or solid tyres. Refer to:
Refer to: Technical Data (PIL 27-33-00).

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Technical Data

Table 59.

Tyre Size (Description)	Type	Make	Tyre Width	Weight	Tyre Outer Diameter	Remark
24.5 X 11.75 - 25B	Foam filled-marking	Blacksmith	361.3mm	196.1kg	928mm	Standard
24.5 X 15 - 21	Foam filled-turf marking	Blacksmith	449.5mm	243.5kg	922mm	Option

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Notes:

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30 - Hydraulic System

Contents **Page No.**

Acronyms Glossary 30-3

30-00 General
- 30-00-00 General 30-4
- 30-00-49 Schematic Symbols 30-14
- 30-00-50 Schematic Circuit 30-18

30-03 Tank
- 30-03-00 General 30-24
- 30-03-24 Breather 30-28

30-04 Filter
- 30-04-00 General 30-30
- 30-04-03 Main 30-31
- 30-04-09 Return Line 30-34

30-07 Hydraulic Generator
- 30-07-00 General 30-37

30-11 Gear Pump
- 30-11-00 General 30-46

30-12 Variable Displacement Pump
- 30-12-00 General 30-51
- 30-12-50 Solenoid Control Valve 30-60
- 30-12-63 Charge Pressure Relief Valve 30-63
- 30-12-66 High Pressure Relief Valve 30-66

30-15 Cylinder / Ram
- 30-15-00 General 30-68
- 30-15-07 Lift Extension 30-74
- 30-15-17 Boom Lift 30-79
- 30-15-34 Steering 30-84
- 30-15-67 Axle Oscillation 30-87
- 30-15-78 Jib 30-90
- 30-15-82 Lower Levelling 30-95
- 30-15-83 Upper Levelling 30-99

30-18 Accumulator
- 30-18-00 General 30-103

30-24 Rotary Coupling
- 30-24-00 General 30-107

30-39 Slew Motor
- 30-39-00 General 30-110

30-56 Main Control Valve Block
- 30-56-00 General 30-118

30-57 Transmission Control Valve Block
- 30-57-00 General 30-124

30-60 Directional Control Valve
- 30-60-03 Brake 30-127
- 30-60-68 Platform 30-130

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30-93 Hose
30-93-00 General 30-133
30-96 Pipe
30-96-00 General 30-136
30-97 Connectors
30-97-00 General 30-137
30-97-09 Adaptor 30-141
30-80 Rotary Actuator
30-80-00 General 30-143

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Acronyms Glossary

ARV	Auxiliary Relief Valve
EDC	Electronic Displacement Control
HPRV	High Pressure Relief Valve
MRV	Main Relief Valve
PRV	Pressure Relief Valve
PTO	Power Take-Off
PWM	Pulse Width Modulation
QRC	Quick Release Coupling
RPM	Revolutions Per Minute
SPP	Service Parts Pro

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00 - General

00 - General

Introduction 30-4
Health and Safety 30-5
Technical Data 30-6
Fault-Finding 30-8
Discharge and Pressurise 30-10
Drain and Fill 30-10
Clean 30-11
Check (Leaks) 30-12
Check (Level) 30-13

Introduction

The hydraulic system is a power transmission system that uses the force of flowing liquids to transmit power to specific components in a machine.

To help you trace specific hydraulic problems to a faulty unit (valve, actuator, ram etc.), refer to Fault finding.
Refer to: PIL 30-00-00.

Once you have traced the faulty unit, refer to the relevant section for removal, disassembly and checking instructions.

To help identify circuits, valves, rams etc. mentioned in the fault finding procedures. Refer to the hydraulic schematic diagrams.
Refer to: PIL 30-00-50.

- Before you begin fault finding, read the Health and Safety Information.
  Refer to: PIL 30-00-00.
- Make simple checks before you remove or disassemble a major component.
- Make sure that the hydraulic fluid is at the correct working temperature 50°C (121.9°F).
- Whatever the fault, check the condition of the hydraulic fluid. Drain and replace if necessary. Refer to Hydraulic fluid quality in this procedure and Hydraulic System - Clean.
  Refer to: PIL 30-00-00.
- Make sure you remove ALL contamination and if possible identify its origin. It may be part of a component from elsewhere in the circuit.

Hydraulic Fluid Quality

This machine uses a large volume of fluid in the hydraulic system for power transmission, equipment lubrication, rust prevention and sealing. According to a survey conducted by a pump manufacturer, seventy per cent of the causes of problems in hydraulic equipment were attributable to inadequate maintenance of the quality of the hydraulic fluid. Therefore, it is obvious that control of the quality of the hydraulic fluid helps prevent hydraulic equipment problems and greatly improves safety and reliability. Furthermore from an economic angle it extends the life of the hydraulic fluid if quality is maintained.

Hydraulic Contamination

Once inside the system, hydraulic circuit contaminants greatly affect the performance and life

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of hydraulic equipment. For example, contaminants in a hydraulic pump develop internal wear to cause internal leakage and hence lower discharges. Wear particles generated will circulate with the hydraulic fluid to cause further deterioration in the performance of this and other equipment. Contaminants also enter principal sliding sections of the equipment causing temporary malfunction, scuffing, sticking and leakage and can lead to major problems. The main contaminants can be classified as follows:

1. Solid Particles - Sand, fibres, metallic particles, welding scale, sealing materials and wear particles etc.
2. Liquid - Usually water and incompatible oils and greases.
3. Gases - Air, sulphur dioxide etc. which can create corrosive compounds if dissolved in the fluid.

These contaminants can appear during manufacture, assembly and operation.

Health and Safety

Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before connecting or removing any hydraulic hose, residual hydraulic pressure trapped in the service hose line must be vented. Make sure the hose service line has been vented before connecting or removing hoses. Make sure the machine cannot be started while the hoses are open.

WARNING! *Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of pressurised fluid and wear protective glasses. If fluid penetrates your skin, get medical help immediately.*

WARNING! *Take care when disconnecting hydraulic hoses and fittings as the oil will be hot.*

WARNING! *Damaged hoses can cause fatal accidents. Examine the hoses regularly. Do not use the machine if a hose or hose fixture is damaged.*

Notice: *Using incorrect fluid could damage the system. See Fluids, Capacities and Lubricants for the correct fluid. The fluid can harm your skin. Wear rubber gloves. Cover cuts or grazes.*

Notice: *Do not allow dirt to enter the system. Before disconnecting any part of the system, thoroughly clean around the connection. When a component has been disconnected, always install protective caps and plugs to prevent dirt ingress. Failure to follow these instructions will lead to dirt entering the system. Dirt in the system may seriously damage the systems components and could be expensive to repair.*

CAUTION! *The temperature of the hydraulic oil will be high soon after stopping the machine. Wait until it cools before beginning maintenance.*

Notice: *Using incorrect fluid could damage the system. See Fluids, Capacities and Lubricants for the correct fluid. The fluid can harm your skin. Wear rubber gloves. Cover cuts or grazes.*

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Technical Data

Table 60.

Description	Details	Data
Hydraulic system	Hydraulic system capacity	165L
	Hydraulic main system pressure	350bar (5,076.3psi)
	Hydraulic transmission pressure	320bar (4,641.2psi)
Hydraulic tank	Capacity	205L
Return line filter	Maximum working pressure	10bar (145.0psi)
	Filter size	10 µ
	By pass valve pressure	3 +0.5 bar
High pressure filter	Maximum working pressure	400bar (5,801.5psi)
	Filter size	5 µ
	By pass valve pressure	7 +/-0.5 bar
Medium pressure filter	Maximum working pressure	63bar (913.7psi)
	Filter size	10 µ
	By pass valve pressure	7 +/-0.5 bar
Auxiliary pump	Type	Gear pump
	Displacement	4 cc
	Speed range	500-3500 RPM (Revolutions Per Minute)
	Maximum continuous pressure	250bar (3,625.9psi)
Slew drive	Type	Fixed displacement
	Maximum pressure	200 bar
Standard oil viscosity		ISO 46 CST at 40°C (103.9°F)
Main control valve	Maximum working pressure	235bar (3,408.4psi)
	Maximum flow	62L

Table 61. Pressure Specification

Description	Pressure
Steer left	180bar (2,610.7psi)
Steer right	180bar (2,610.7psi)
Drive forward	350bar (5,076.3psi)
Drive reverse	350bar (5,076.3psi)
Leveling rise	250bar (3,625.9psi)
Leveling lower	250bar (3,625.9psi)
Telescopic boom raise	235bar (3,408.4psi)
Telescopic boom lower	235bar (3,408.4psi)
Telescopic boom extend	235bar (3,408.4psi)
Telescopic boom retract	145bar (2,103.0psi)
Slew left	180bar (2,610.7psi)
Slew right	180bar (2,610.7psi)
Platform rotate left	235bar (3,408.4psi)
Platform rotate right	235bar (3,408.4psi)
Jib boom raise	235bar (3,408.4psi)
Jib boom lower	235bar (3,408.4psi)
Oscillating axles left hand side	200bar (2,900.8psi)
Oscillating axles right hand side	200bar (2,900.8psi)

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Description	Pressure
Oscillating axles ON / OFF	280bar (4,061.1psi)
Brakes front Brakes rear Drive motor speed	35bar (507.6psi)

Make a note that, these pressures are applicable for a hydraulic oil temperature of 40°C (103.9°F), and the values may vary per machine by +/-5% based on valve tolerances.

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Fault-Finding

Fault

Lack of power in all lifting functions	Table 62.	Page 30-8
All hydraulic cylinders slow to operate	Table 63.	Page 30-8
One hydraulic service fails to operate	Table 64.	Page 30-8
Engine tends to stall when hydraulics are under load	Table 65.	Page 30-8
Valve spool sticking	Table 66.	Page 30-9
Cylinder creep	Table 67.	Page 30-9
Hydraulic oil becomes too hot	Table 68.	Page 30-9
Boom judders when used while machine is moving	Table 69.	Page 30-9

Table 62. Lack of power in all lifting functions

Cause	Remedy
Insufficient hydraulic fluid	Check for leaks and top up as required
Hydraulic leaks in system	Check hoses, replace as required
Main relief valve (MRV) setting incorrect	Check and adjust as required
Pump flow	Check pump flow, if necessary service or replace pump
Auxiliary relief valve (ARV) setting incorrect	Check and adjust as required
Damaged cylinder seals	Check cylinder seals and replace as required

Table 63. All hydraulic cylinders slow to operate

Cause	Remedy
MRV (Main Relief Valve) setting incorrect	Check and adjust as required
Pump flow	Check pump flow, if necessary service or replace pump
Service pipe lines leaking, damaged, trapped or kinked	Check hoses and pipes, replace as required
ARV setting incorrect	Check and adjust as required
Hydraulic filter clogged	Replace filter element
Poor engine performance	Check engine performance

Table 64. One hydraulic service fails to operate

Cause	Remedy
Service pipe lines leaking, damaged, trapped or kinked	Check hoses and pipes, replace as required
Cylinder or pipe lines from cylinder leaking	Check and rectify as required
Valve spool not operating	Check for leaks, rectify as required. Make sure that valve spool is operating (check for faulty wiring, solenoid sticking, burr on spool, etc.). Make sure that associated load hold check valve is operating.
Valve spool not moving fully from neutral to full selection	Spool movement should be 5.5 mm (0.22 in). Check solenoid supply pressure is 35 bar minimum.
Valve spool leaking	Rectify, check for contamination
Electrical solenoid failure	Check solenoid is energised correctly. Replace solenoid or connections, if faulty

Table 65. Engine tends to stall when hydraulics are under load

Cause	Remedy
Main relief valve (MRV) setting incorrect	Check and adjust as required
Poor engine performance	Check engine performance
Pump failure	Check pump flow rate and pressures

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Table 66. Valve spool sticking

Cause	Remedy
Hydraulic fluid contaminated	Clean tank strainer. If strainer badly clogged, drain and flush hydraulic system then fill with clean hydraulic fluid. Replace all hydraulic filters
Valve housing twisted during installation	Loosen retaining bolts and tighten to correct torque
Bent spool	Disassemble control valve. Renew spool as necessary
Spool return spring broken	Renew as necessary

Table 67. Cylinder creep

Cause	Remedy
Piston rod bent	Replace piston rod. Check pressure setting of MRV, Check that associated pivot pins are adequately greased
Piston seal damaged	Check piston seal. Replace if faulty.
ARV (Auxiliary Relief Valve) pressure setting incorrect	Check ARV pressures. Adjust pressure setting or replace ARV if faulty
Load holding valve failure	Check Load holding valve settings. Check for oil contamination. Replace valve if required. Flush oil and replace filters if contamination present

Table 68. Hydraulic oil becomes too hot

Cause	Remedy
Hydraulic filter clogged	Change hydraulic filter
Charge filter by-pass valve leaking	Check condition of hydraulic filter, Check operation of by-pass valve
Air in hydraulic system	Bleed System
Oil temperature abnormally high	Check for correct fluid. Check for blockage or kinked hoses and lines

Table 69. Boom judders when used while machine is moving

Cause	Remedy
Boom pump flow low	Check flow rate
Service pipe lines leaking, damaged, trapped or kinked	Check hoses and pipes, replace as required

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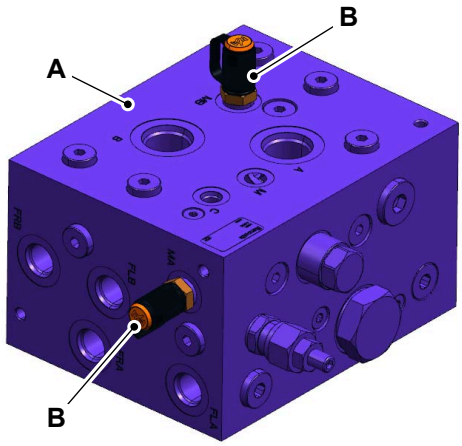
Discharge and Pressurise

Observe all the health and safety information.
Refer to: Health and Safety (PIL 30-00-00).

Discharge

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Discharge the hydraulic pressure for electrical and pilot operated services as follows:
   2.1. Turn the ignition key to the ON position. Do not start the engine.
   2.2. Lower and retract all the booms until they are stowed on their respective rests or fully supported. Then release the controls. All pressure should dissipated.
   2.3. Turn the ignition key to the OFF position.
3. Make sure there is no pressure in the hydraulic drive system.
   3.1. Check the pressure at the test point (x2) on the transmission valve block using a suitable pressure gauge.

Figure 151.

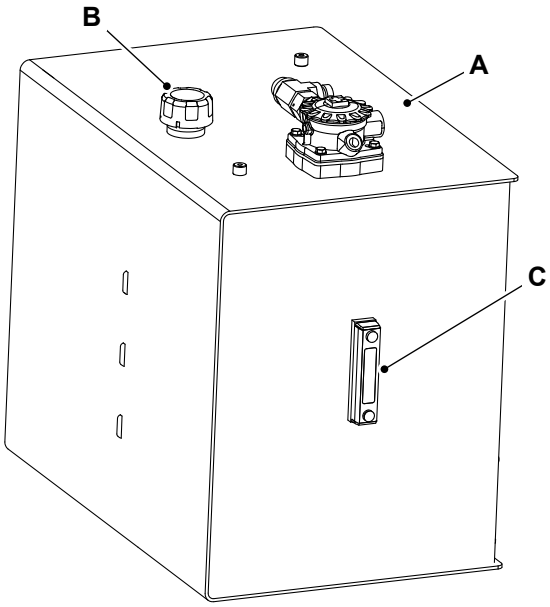


A Transmission valve block
B Test point (x2)

Drain and Fill

1. Make the machine safe with the platform lowered.
   Refer to: PIL 01-03-27.
2. Isolate the battery.
   Refer to: PIL 33-03-00.
3. Open the hydraulic compartment cover.
   Refer to: PIL 06-06-09.
4. Remove the filler cap from the hydraulic tank.
   4.1. Make sure that no foreign objects or contamination can enter the hydraulic tank.
5. Put a suitable container below the drain plug of the hydraulic tank.

Figure 152.



A Hydraulic tank
B Filler cap
C Check level plug

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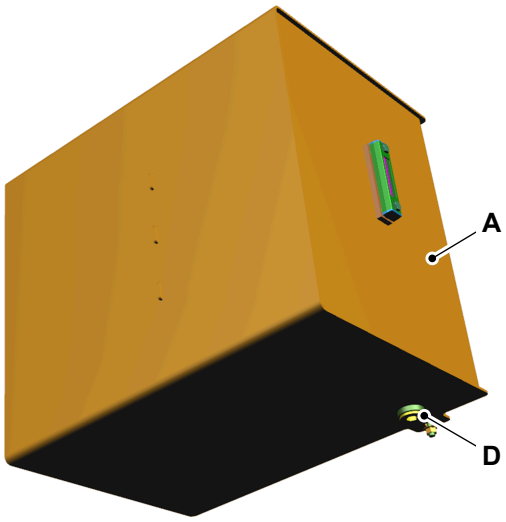
Figure 153.



A Hydraulic tank
D Drain plug

6. Remove the drain plug.
7. When the hydraulic tank is empty, check the drain plug.
   7.1. Clean the drain plug.
   7.2. Install the drain plug and tighten to specified torque value.
   Torque: 85→100N·m
   7.3. If the drain plug is damaged, replace it.
8. Fill the hydraulic tank with clean fluid through the filler neck.
9. Check the hydraulic oil level.
   Refer to: Check (Level) (PIL 30-00-00).
10. Install the filler cap.

Clean

Special Tools

Description	Part No.	Qty.
Hydraulic Flushing Rig	892/01255	1

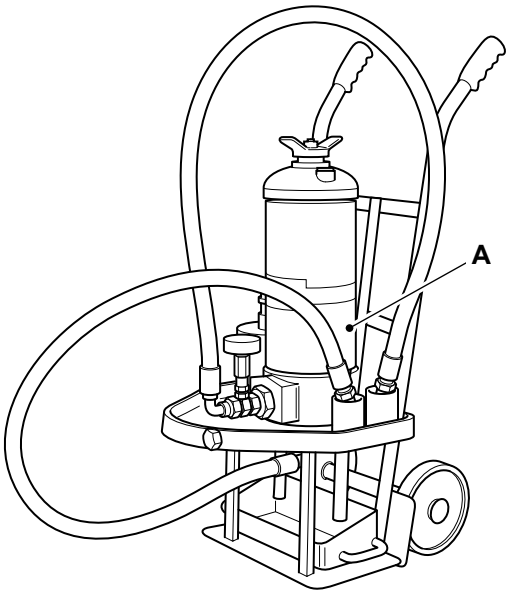
Cleaning Operation

The purpose of cleaning oil is to remove contaminants of all types and sludge by filtering hydraulic fluid through a cleaning unit. Follow the instructions in the Hydraulic flushing rig instruction manual.

Procedure

1. Connect the Hydraulic flushing rig in place of the hydraulic filter.
   Special Tool: Hydraulic Flushing Rig (Qty.: 1)
2. Run the system for sufficient time to pump all the hydraulic fluid through the unit.
3. Disconnect the cleaning unit and reconnect the filter.
4. Top up the system with clean hydraulic fluid as required.

Figure 154.



A Hydraulic flushing rig

Contaminant Standards

Dirt that damages your system is in many cases too small to be seen with the eye. The particle size is measured in microns (1 micron = 0.001 mm (0.0000394 in).

Listed below are a few typical comparisons:

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- Red Blood Cell = 8 microns (0.008 mm, 0.000315 in)
- Human Hair = 70 microns (0.07 mm, 0.00275 in)
- Grain of Salt = 100 microns (0.1 mm, 0.00394 in)

The smallest particle visible to the naked eye is 40 microns (0.00157) approximately. Standards will often be quoted to ISO (International Standards Organisation) for which literature can be obtained.

Check (Leaks)

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Open the access covers if required.
   Refer to: PIL 06-06.
3. Check the areas around the hydraulic components and hoses for traces of hydraulic oil.
4. Check the chassis and undershield for any traces of hydraulic oil.
5. Check all the hoses, connectors and fittings for any leaks.
6. If a leak is found, do the following.
   6.1. Clean the area around the leaking component, hose or fittings.
   6.2. Tighten the connectors to the correct torque value.
   6.3. If the leak is still present, disassemble the component to replace the O-rings and seals as applicable.

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Check (Level)

⚠ **Notice:** If the fluid is cloudy, then water or air has contaminated the system. This could damage the hydraulic pump. Contact your JCB dealer immediately.

1. Make the machine safe with the platform lowered.

   Refer to: PIL 01-03-27.

2. The machine must be level when the fluid level is checked to ensure that the measurement is correct.

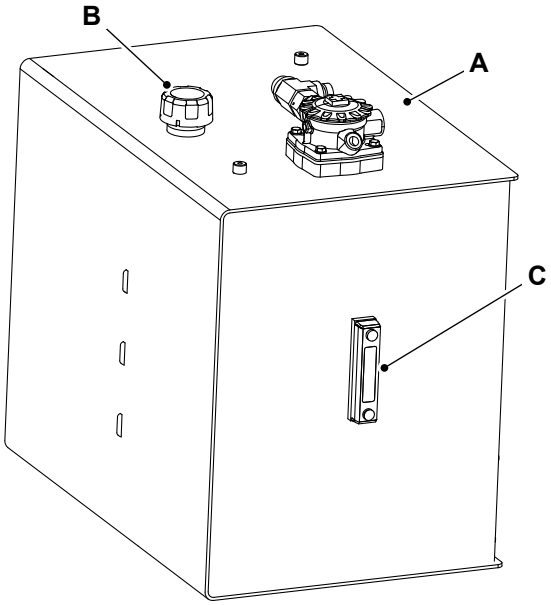
3. Make sure that the fluid is visible in the sight gauge.

4. Make sure that the fluid level is in between minimum and maximum mark.

5. If necessary, add the hydraulic fluid.

   Refer to: Drain and Fill (PIL 30-00-00).

Figure 155.



A Hydraulic tank
B Filler cap
C Level gauge with thermometer

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49 - Schematic Symbols

Introduction 30-14
Diagram 30-15

Introduction

Complex hydraulic components and circuits can be described to the engineer by using graphical symbols. The tables illustrate and give a brief description for some of the more common symbols used.

There are many symbols in use and it would be impossible to include them all here. However it should be noted that most are only variations or refinements on the basic principles explained here. If more detailed information is required you are recommended to obtain a copy of BS2917 or IS01219.

Once familiar with the symbols, the engineer can use hydraulic circuit diagrams as an aid to fault finding. It will be possible to see the complete hydraulic circuit and decipher the relationship between hydraulic components.

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Diagram

Table 70. General

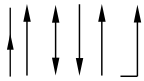
Symbol	Description
	Spring
	Flow restriction affected by viscosity
	Direction of flow
	Indication of rotation
	Indication of direction and paths of flow
	Variable control

Table 71. Cylinder Rams

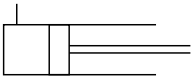
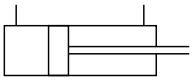
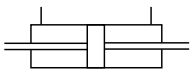
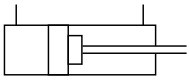
Symbol	Description
	Single acting
	Double acting
	Double ended
	Double acting with damping at rod area end

Table 72. Pumps and Motors

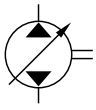
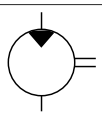
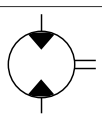
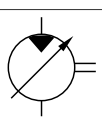
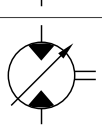
Symbol	Description
	Variable capacity pump two directions of flow
	Fixed capacity motor one direction of flow
	Fixed capacity motor two directions of flow
	Variable capacity motor one direction of flow
	Variable capacity motor two directions of flow

Table 73. Directional control valves

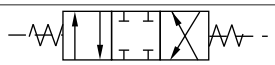
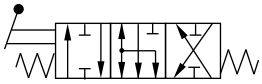
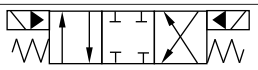
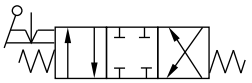
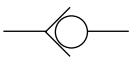
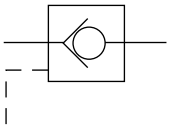
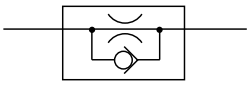
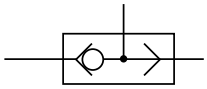
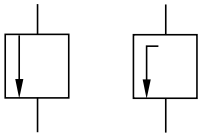
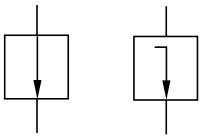
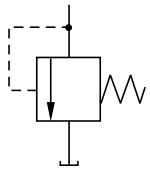
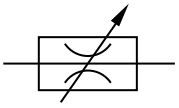
Symbol	Description
	Used to enclose several valves indicating they are supplied as one unit
	3-Position, 4-port spring centered pilot operated valve
	3-position, 6-port spring centered manually operated valve
	3-Position, 4-port spring centered solenoid & pilot pressure operated valve
	3-Position, 4-port spring centered detent hand operated valve
	Non-return valve
	Non-return valve with back pressure spring
	Pilot operated non-return valve
	One way restrictor
	High pressure selector (shuttle valve)
	Throttling orifice - normally closed
	Throttling orifice - normally open
	Relief valve
	Variable restrictor

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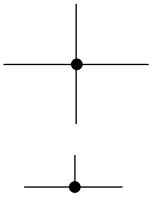
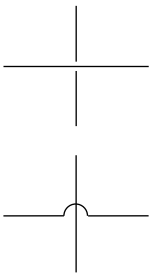
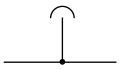
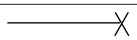
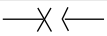
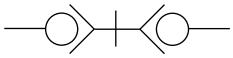
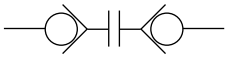
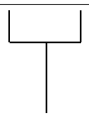
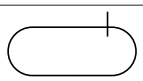
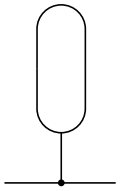
Table 74. Energy Transmissions and Conditioning

Symbol	Description
	Working line, return or feed
	Pilot control
	Drain lines
	Flexible pipe
	Line junction
	Crossing lines
	Air bleed
	Line plugged, also pressure test point
	Line plugged with take-off line
	QRC (Quick Release Coupling) - connected
	QRC - disconnected
	Tank - return line above fluid level
	Tank - return line below fluid level
	Header tank
	Pressure sealed tank
	Accumulator

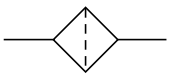
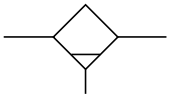
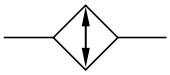
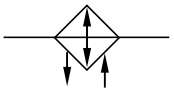
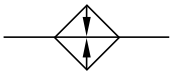
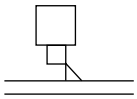
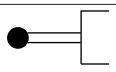
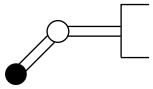
Symbol	Description
	Filter or strainer
	Water trap
	Cooler - with no indication of coolant flow
	Cooler - indicating direction of coolant flow
	Heater

Table 75. Control Mechanisms

Symbol	Description
	Rotating shaft - one direction
	Rotating shaft - two directions
	Detent
	Locking device
	Over centre device
	Simple linkage
	General control
	Push button operated
	Lever operated
	Pedal operated
	Stem operated
	Spring operated
	Roller operated
	Roller trip operated (one directional)
	Solenoid one winding
	Solenoid two windings

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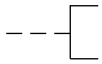
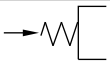
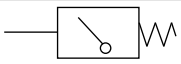
Symbol	Description
	Electric motor operated
	Internal pressure pilot operated
	External pressure pilot operated
	Pressure operated spring release
	Pilot operated by solenoid pilot valve
	Pilot operated by a solenoid or separate pilot valve
	Pressure gauge
	Pressure switch

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50 - Schematic Circuit

Introduction 30-18
Diagram 30-19

Introduction

A schematic diagram is a simplified pictorial representation of the machines hydraulic circuit. It shows the components of the circuit as simplified hydraulic symbols, and the connections between the different components. The schematic diagram is used to troubleshoot problems and to make sure that all the connections have been made and that everything is present. Detailed schematics for individual systems are given in the relevant PIL section.

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Diagram

Figure 156. 143/H0065 - 1 (Sheet 1 of 1) - Hydraulic Circuit.....Page 30-21

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Notes:

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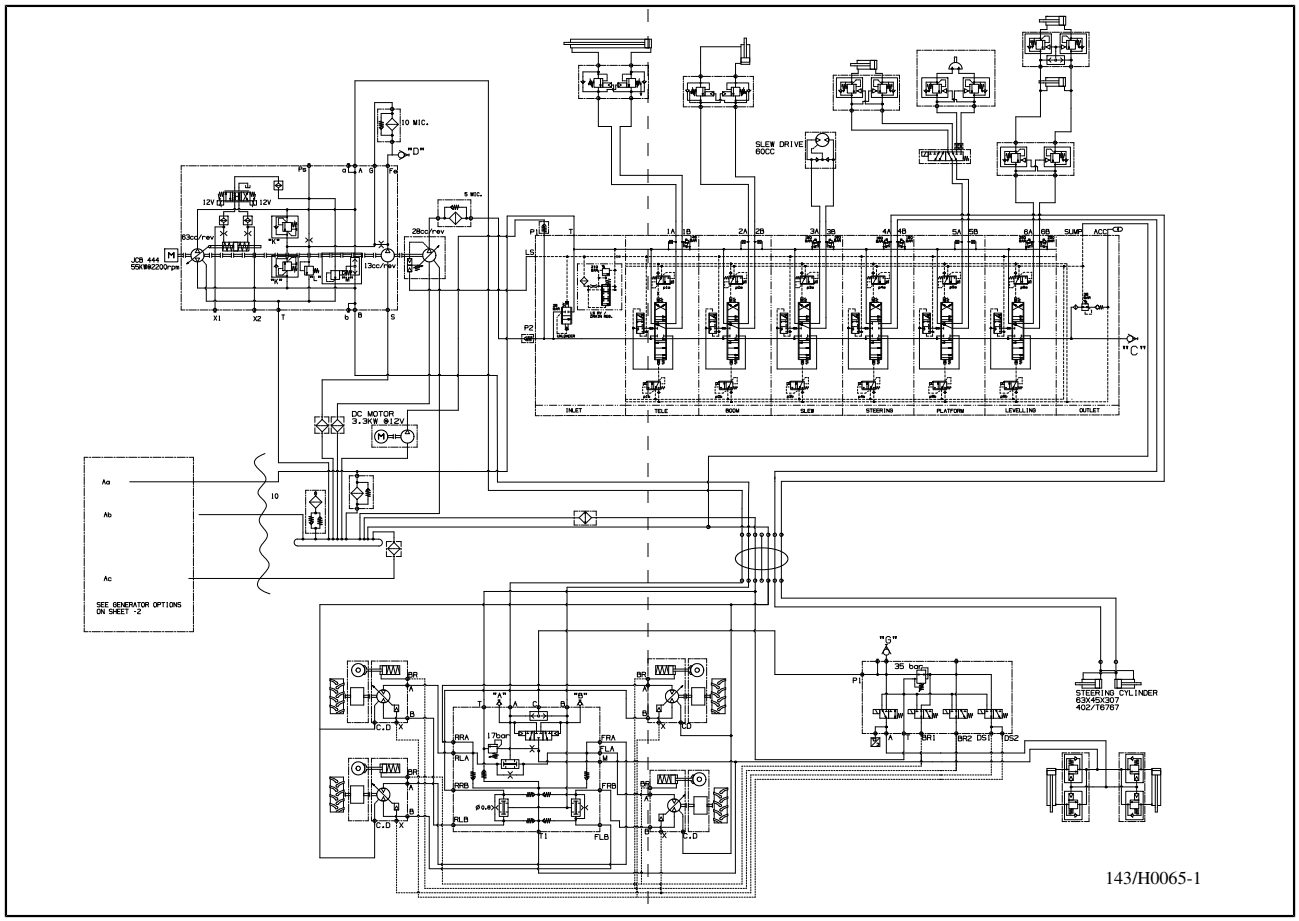
Page 30-22

Figure 156. 143/H0065 - 1
(Sheet 1 of 1) - Hydraulic Circuit

Page 30-23



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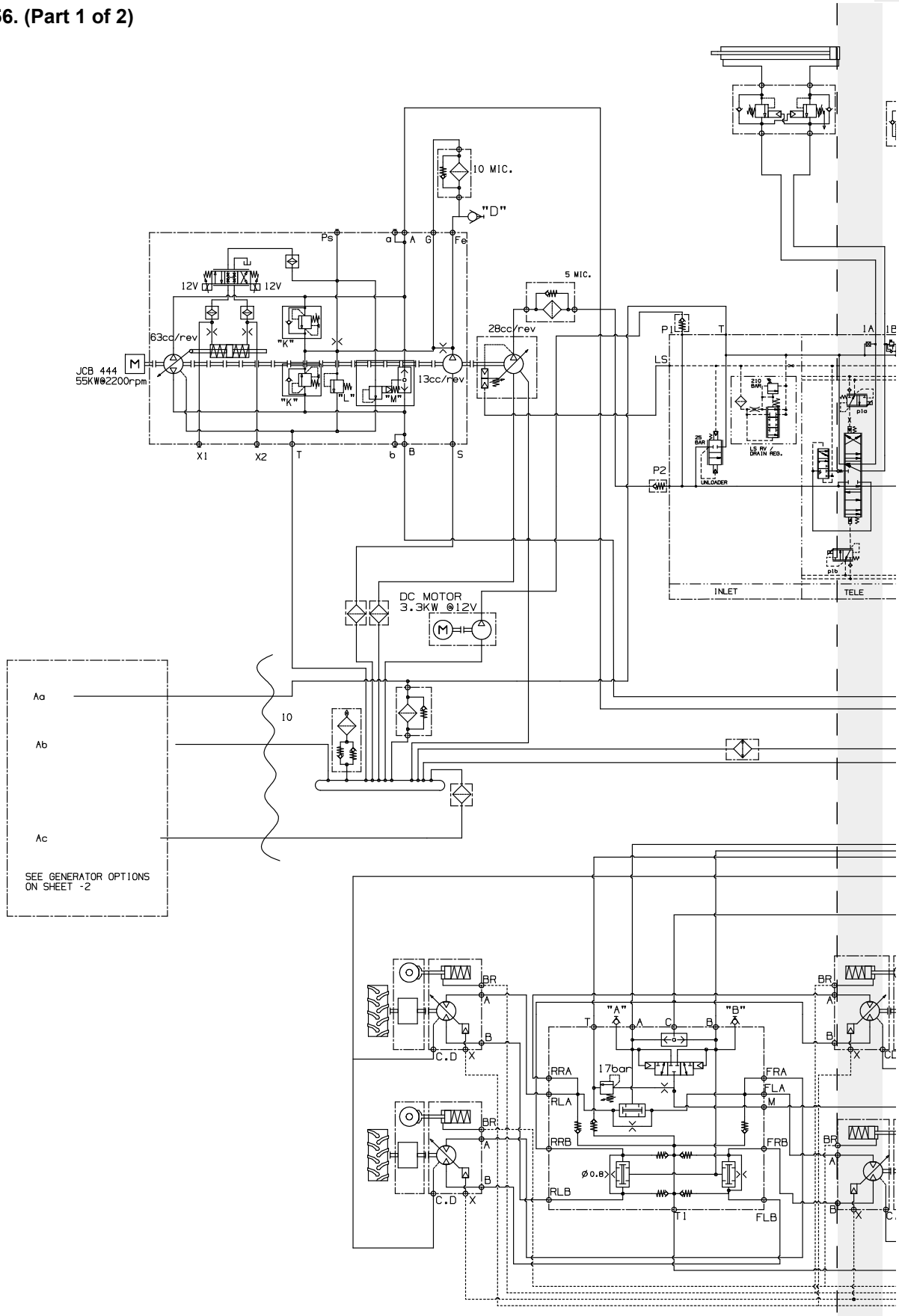
Page 30-22 Page 30-23

Figure 156. (Part 1 of 2)



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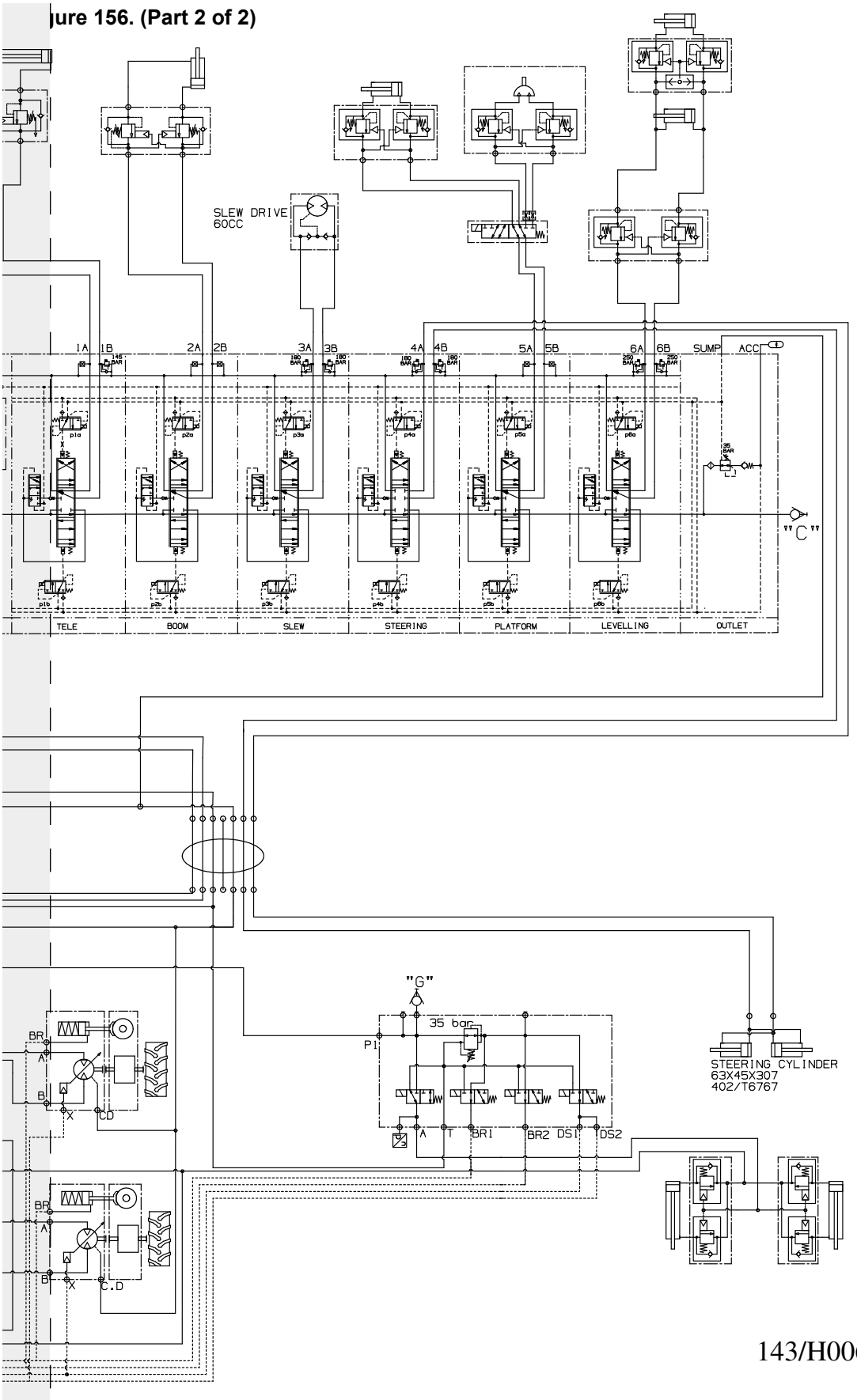
jure 156. (Part 2 of 2)



143/H0065-1

Page 30-22

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03 - Tank

00 - General

Introduction 30-24
Remove and Install 30-25

Introduction

The hydraulic tank holds excess hydraulic oil to accommodate volume changes due to the following:

- Cylinder ram extension and contraction.
- Temperature driven expansion and contraction.
- Hydraulic oil leaks.

The tank is designed to aid in the separation of air from the fluid.

The tank also houses filters or strainers that help to separate dirt and other particulates from the oil.

The cleanliness of this component is critical.
Refer to: Clean (PIL 30-00-00).

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Remove and Install

Remove

1. Make the machine safe.

   Refer to: PIL 01-03-27.

2. Open the side turntable cover of the base control panel.

3. Place a container of suitable size beneath the machine.

   Volume: 100L

   3.1. Remove the oil drain plug and discharge all the oil into the container.

4. Put a label on the hoses to help installation.

   4.1. Disconnect the oil suction hose attached to the cut-off valves of the hydraulic oil tank.

   4.2. Plug all the open ports and hoses to prevent contamination.

5. Put a label on the oil supply hoses to help installation.

   5.1. Disconnect the oil supply hoses for the auxiliary power unit.

   5.2. Plug all the open ports and hoses to prevent contamination.

6. Disconnect the hose from the hydraulic return filter.

   6.1. Plug all the open ports and hoses to prevent contamination.

7. Remove the setscrews (x4) and plain washers (x4) from the hydraulic oil tank and turntable.

8. Remove the bolts (x2) and nuts (x2) from the base plate.

9. Support the hydraulic oil tank with suitable lifting equipment.

10. Remove the hydraulic oil tank away from the machine.

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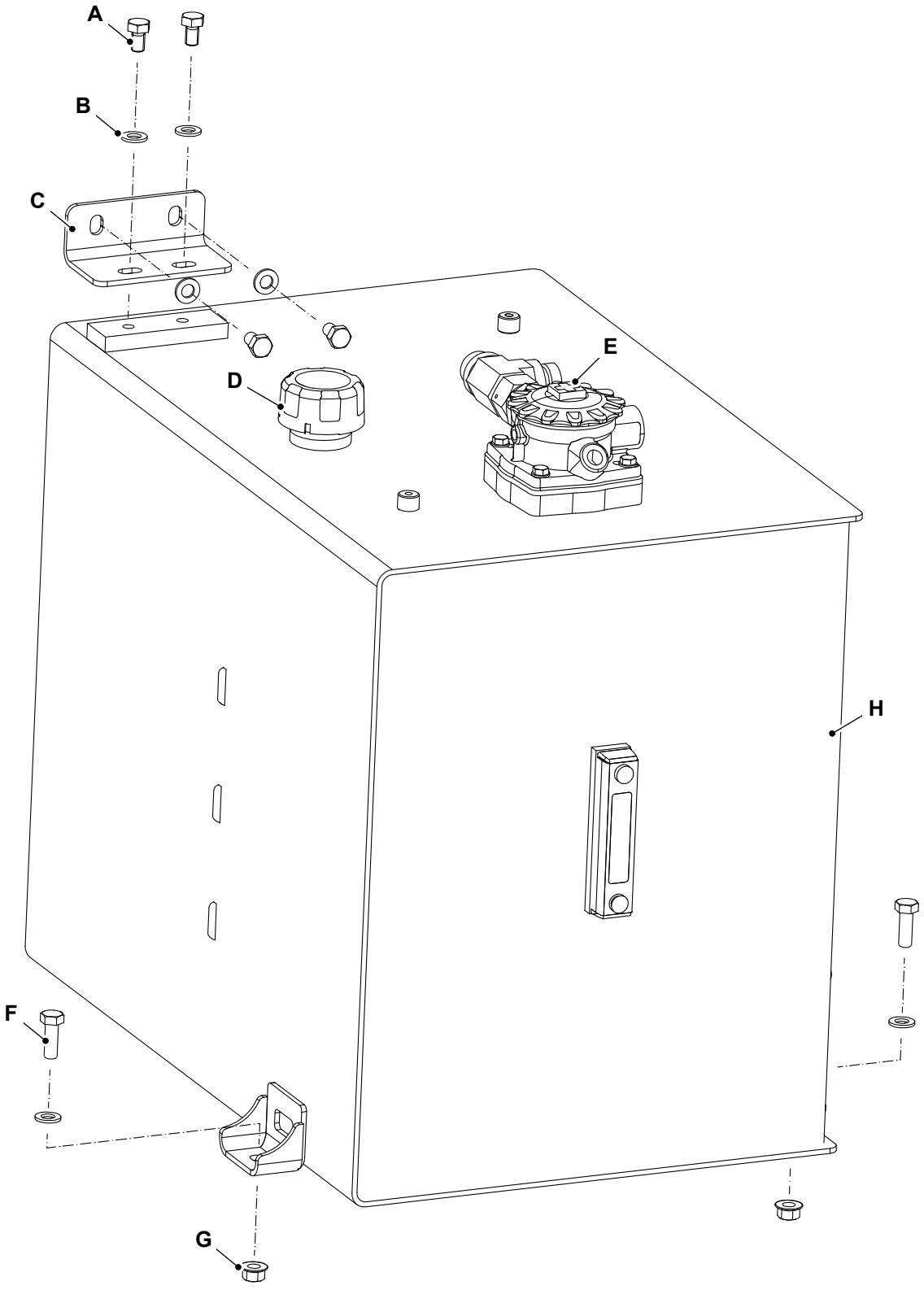
Figure 157.



A Setscrews (x4)
B Plain washers (x4)
C Tank clamp pad
D Filler cap
E Hydraulic return filter
F Bolts (x2)

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G Nuts (x2)

H Hydraulic tank

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Fill the tank with the correct, clean hydraulic oil through the filler neck.
2. Tighten the setscrews (x4) and bolts (x2) to the specified torque value. Refer to Table 76.

Table 76. Torque Values

Item	Nm
A	74
F	74

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24 - Breather

Introduction 30-28
Remove and Install 30-29

Introduction

The hydraulic tank breather allows air in and out of the tank. This smooths out the pressure fluctuations in the hydraulic tank as hydraulic fluid is rapidly drawn out from, or returned to the tank.

The breather also prevents contaminants like moisture and particles from entering the tank when air is drawn in. Contaminants can easily corrode, wear out or otherwise reduce the performance of a hydraulic system.

When air is expelled from the tank the breather prevents hydraulic fluid spillage.

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Remove and Install

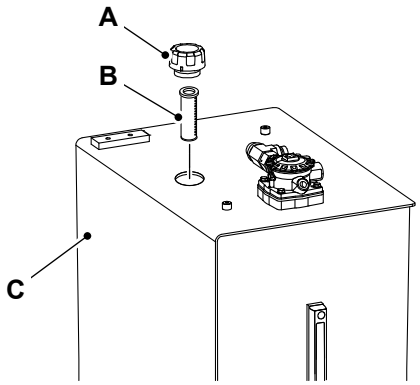
Special Tools

Description	Part No.	Qty.
Spanner	335/Y9489	1

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Get access to hydraulic tank.
   Refer to: PIL 06-06-09.
3. Use specified tool to remove the filler breather.
   Special Tool: Spanner (Qty.: 1)
4. If necessary, remove the strainer from the hydraulic tank.

Figure 158.



A Filler breather
B Strainer
C Hydraulic tank

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Tighten the filler breather to the specified torque value.
   Torque: 8 ± 2N·m

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04 - Filter

00 - General

Introduction

Hydraulic filters are an important part of the machines hydraulic system. Metal particles are continually produced by mechanical components and need to be removed along with other contaminants.

The hydraulic filter assemblies are designed to filter all the contamination that is generated through use to the required level of cleanliness.

Filters are positioned in many different locations. Refer to the relevant hydraulic filter for the location and removal procedure.

The filters must be serviced to the requirements of the machine maintenance schedules. To ensure optimum performance and reliability it is important that the machine's hydraulic system is serviced periodically in accordance with the manufacturers requirements.

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03 - Main

Introduction 30-31
Component Identification 30-32
Remove and Install 30-33

Introduction

This machine has two main hydraulic filters, one medium pressure filter of 10µ for the transmission drive circuit and the other high pressure filter of 5µ for the main valve block services.

Both the medium pressure filter and high pressure filter incorporates a bypass valve with 7bar (101.5psi) pressure capacity. If the filter becomes blocked, the bypass valve opens and allows fluid to bypass the filter. This prevents excessive back pressure which can damage the hydraulic system. The filter is not effective when the bypass valve is open.

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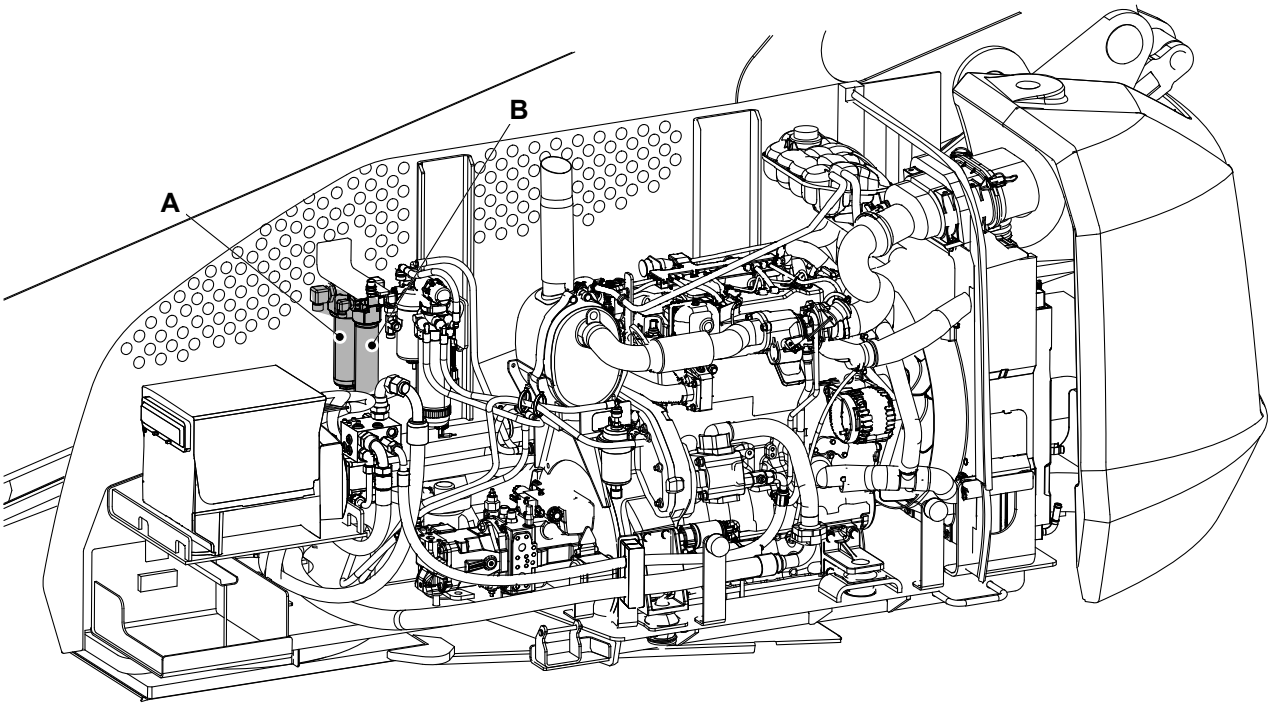
Component Identification

Figure 159.



A High pressure filter

B Medium pressure filter

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Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Open the engine compartment cover.
   Refer to: PIL 06-06-06.
3. Place a suitable container under the high and medium pressure filter.
4. Remove the high and medium pressure filter with an oil filter wrench.
5. Remove and discard the gasket.
6. Remove and discard the high and medium pressure filter element.

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

1. Tighten the medium pressure filter to the specified torque value.
   Torque: 20→5N·m
2. For the high pressure filter, screw in bowl to filter head until it stops and then 1/6 turn back with the help of suitable spanner (A/F 36).
3. Check the system for hydraulic leaks.
   Refer to: Check (Leaks) (PIL 30-00-00).

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09 - Return Line

Introduction 30-34
Remove and Install 30-35

Introduction

This machine has one return line filter common for both drive circuit and service circuit, located in the main hydraulic return line inside the hydraulic tank.

This filter incorporate a bypass valve with pressure 3bar (43.5psi). If the filter becomes blocked, the bypass valve opens and allows fluid to bypass the filter. This prevents excessive back pressure which can damage the hydraulic system. The filter is not effective when the bypass valve is open.

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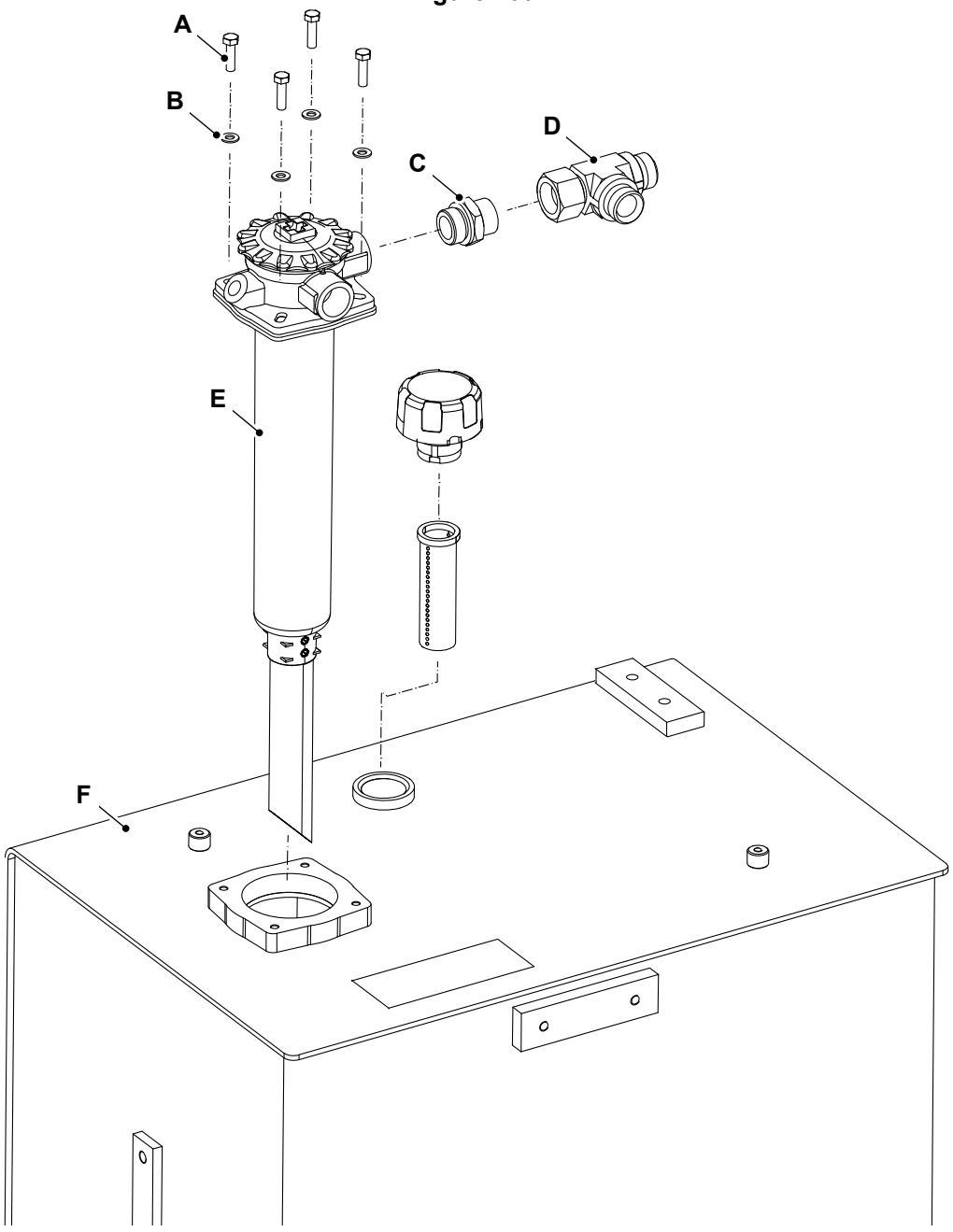
Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Discharge the hydraulic pressure.
   Refer to: Discharge and Pressurise (PIL 30-00-00).
3. Get access to the hydraulic tank.
   Refer to: PIL 06-06-09.
4. Remove the capscrew (x4) and plain washer (x4) from the return line filter.
5. Remove the return line filter from the hydraulic tank.

Figure 160.



A Capscrew (x4)

B Plain washer (x4)

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C Adaptor
D T - Adaptor
E Return line filter
F Hydraulic tank

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

1. Tighten the capscrew (x4) to the specified torque value.

   Torque: 21N·m

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07 - Hydraulic Generator

00 - General

Health and Safety 30-37
Introduction 30-38
Component Identification 30-39
Operation 30-40
Fault-Finding 30-41
Clean 30-43
Check (Condition) 30-43
Adjust 30-44
Remove and Install 30-45

Health and Safety

Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before connecting or removing any hydraulic hose, residual hydraulic pressure trapped in the service hose line must be vented. Make sure the hose service line has been vented before connecting or removing hoses. Make sure the machine cannot be started while the hoses are open.

WARNING! *Electric shock hazard. High voltage can cause serious injury or death. Make sure that all work is performed by qualified personnel. All cabling to the load must comply with the applicable laws and electrical standards.*

WARNING! *Suitable grounding of the product provides extra safety. The international electric code requires that the product is properly connected to an appropriate earth to help prevent electric shock. A suitable terminal is located on the generator for this purpose. For remote grounding connect a length of heavy gauge copper wire from the product terminal to a copper rod driven into the ground. Never operate electrical equipment with damaged or defective cables.*

WARNING! *Stop and wait for at least 30min for the electrical parts to completely discharge before you remove any covers, otherwise you could be electrocuted.*

CAUTION! *The temperature of the hydraulic oil will be high soon after stopping the machine. Wait until it cools before beginning maintenance.*

CAUTION! *To avoid burning, wear personal protective equipment when handling hot components. To protect your eyes, wear goggles when using a brush to clean components.*

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Introduction

The machine is installed with an alternator motor, also called a hydraulic generator.

The hydraulic generator is a compact and integrated all-in-one unit. The hydraulic generator uses a hydraulic power source to operate and produce electricity. This can be used to provide power to the platform when the machine is stationary. You must use equipment that is within the specified rated capacity of hydraulic generator. Refer to Table 77.

Table 77.

Description	Single Phase	Three Phase
Rated output	120V,60Hz	208V,60Hz
Rated power	7.5kW	

For operation of hydraulic generator from platform refer to:
Refer to: Operation (PIL 30-07-00).

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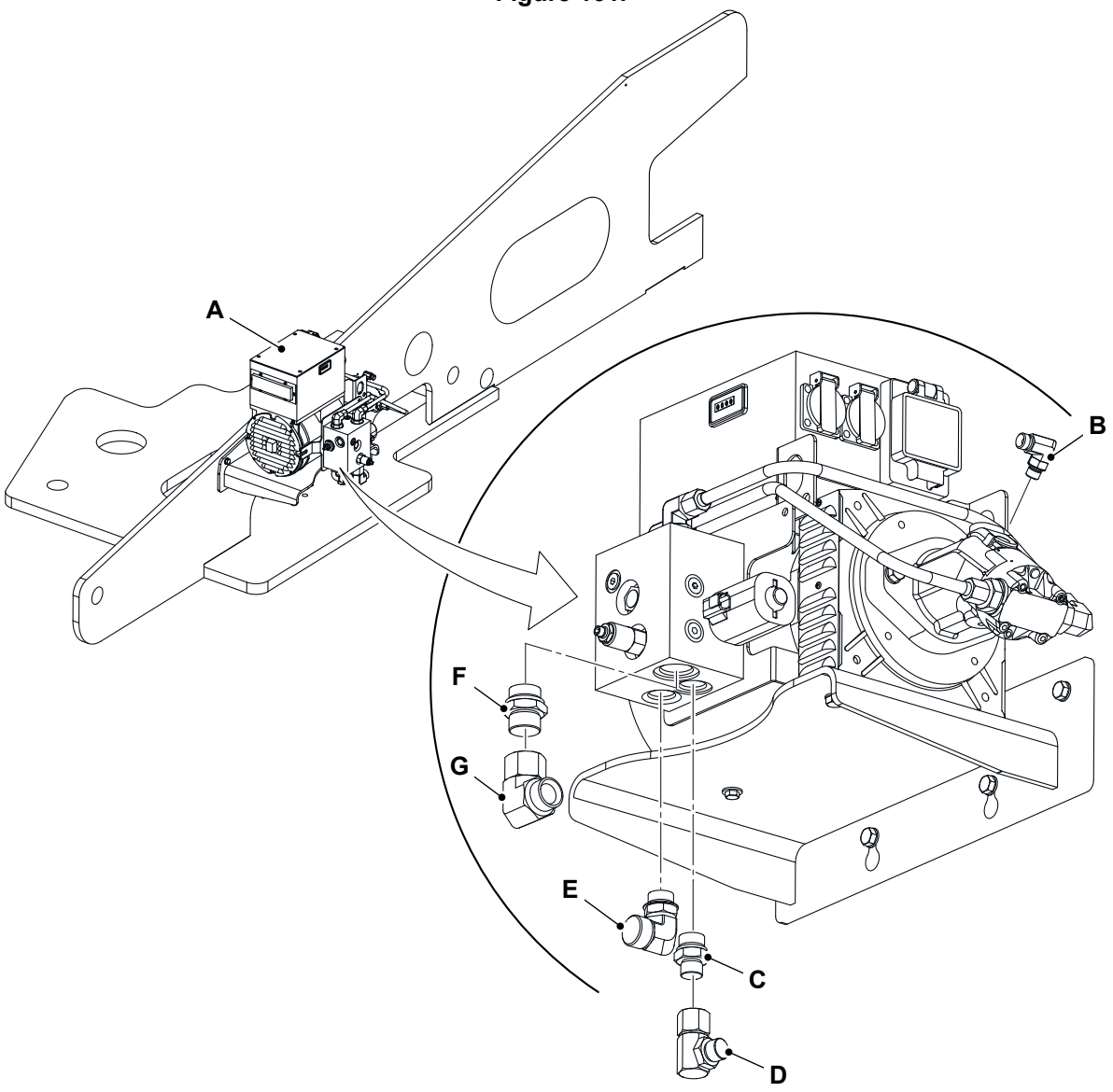
Component Identification

Figure 161.



A Generator
B Elbow adaptor 1
C Adaptor 1
D Elbow adaptor 2
E Elbow adaptor 3
F Adaptor 2
G Elbow adaptor 4

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Operation

⚠ **WARNING** Electric shock hazard. High voltage can cause serious injury or death. Make sure that all work is performed by qualified personnel. All cabling to the load must comply with the applicable laws and electrical standards.

Notice: Possibility of equipment damage. Proper sizing is critical to the operation and performance of the generator. Make sure that the load is sized correctly for the capacity of your generator and cables.

WARNING Working with equipment that runs on Alternating Current (AC) could be dangerous. Any maintenance work on such equipment should be done by an authorised electrical engineer or a suitably trained person. All maintenance work must comply with IEC 60204-1 in Europe.

1. Make the machine safe.

   Refer to: PIL 01-03-27.

2. Make sure that the emergency stop buttons are released.
3. Turn the ignition key to the position 1.
4. Push the engine start/stop button on the platform control panel to start the engine.
5. Grid heater icon will pop up on the display until the engine starts.
6. Make sure the hydraulic generator canopy door is closed and locked. The canopy door should not be opened unless the machine ignition and isolator are switched OFF. Make sure that machine or the generator is not operational when the canopy door is open.
7. The hydraulic generator may become hot after use. Allow the machine to cool down before service or inspection.
8. Daily or before use visually inspect connectors and wiring for damage. If any damage to the AC cable, please contact the JCB dealer.

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Fault-Finding

Fault		
Generator not rotating	Table 78.	Page 30-41
Frequency falls under load	Table 79.	Page 30-41
Generator does not excite	Table 80.	Page 30-41
High voltage at no load	Table 81.	Page 30-41
Low voltage at no load	Table 82.	Page 30-41
Proper no-load but low loaded voltage	Table 83.	Page 30-41
Voltage unstable	Table 84.	Page 30-41
Generator noisy	Table 85.	Page 30-42

Table 78. Generator not rotating

Cause	Remedy
Motor not turning	Check for proper hydraulic flow.
Broken drive coupling	Check and repair the coupling.

Table 79. Frequency falls under load

Cause	Remedy
Hydraulic flow to motor falling	Check flow to the motor is constant.
Bad motor	Replace the motor.

Table 80. Generator does not excite

Cause	Remedy
Low speed	Check and adjust the RPM (Revolutions Per Minute).
Faulty capacitor	Check and replace the capacitor.
Faulty windings	Check the winding resistance.

Table 81. High voltage at no load

Cause	Remedy
Excessive speed	Check and adjust the RPM.
High capacity of the capacitor	Check and replace the capacitor.

Table 82. Low voltage at no load

Cause	Remedy
Low speed	Check and adjust the RPM.
Faulty rotary diodes	Check and replace the rotary diodes.
Worn windings	Check the winding resistance
Low capacity of the capacitor	Check and replace the capacitor.

Table 83. Proper no-load but low loaded voltage

Cause	Remedy
Low speed in loaded condition	Check and adjust the RPM.
Excessive load	Check and repair the generator.
Short-circuited rotary diodes	Check and replace the rotary diodes.

Table 84. Voltage unstable

Cause	Remedy
Loose contacts	Check the connections.
Uneven rotation	Check for the uniform rotation speed.

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Table 85. Generator noisy

Cause	Remedy
Worn bearings	Replace the bearings.
Poor coupling	Check and repair the coupling.

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Clean

Compressed Air

Compressed air is dangerous. Wear personal protective equipment. Never point a compressed air jet at yourself or others.

The frequent cleaning of the alternator motor is critical for correct operation. Make sure that the alternator gets clean ventilation. Dusty conditions increase the wear of the components.

1. Remove the cover, side screen and diffuser.
2. Use compressed air to clean the fan, rotor, stator compartment and the alternator electrical component.
3. Clean the component thoroughly. Remove all dust, dirt, oil and grease deposits.
4. Check condition of all seals and gaskets. Replace them as required.
5. Install the cover, side screen and diffuser.

Check (Condition)

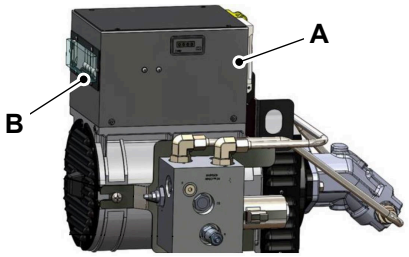
It is recommended to check the condition of the hydraulic generator at least once a month.

Make a note of the following:

- The alternator safety device can only be tested when the hydraulic generator is ON.
- When the test button is pressed the switch must be released immediately.
- Do not use the hydraulic generator with faulty safety equipment.
- If a fault condition trips the safety device, the fault has to be cleared before the switch can be set back up.
- Do not bypass or remove the safety device to clear the problem.

1. Push the test button to check the functionality of the device. If everything is in order, the switch releases.
2. Switch the reset switch back up to put the hydraulic generator is operational.

Figure 162.



A Hydraulic generator
B Reset switch

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Adjust

Do not adjust hydraulic generator when any appliance is connected to it. When you adjust the hydraulic generator, make sure that the hydraulic oil is at normal operating temperature.

1. Make the machine safe.

   Refer to: PIL 01-03-27.

2. Turn the ignition key to the ON position and operate the machine until the temperature reaches the specified value.

   Temperature: 40°C (103.9°F)

3. Turn the hydraulic generator ON/OFF button to the ON position.

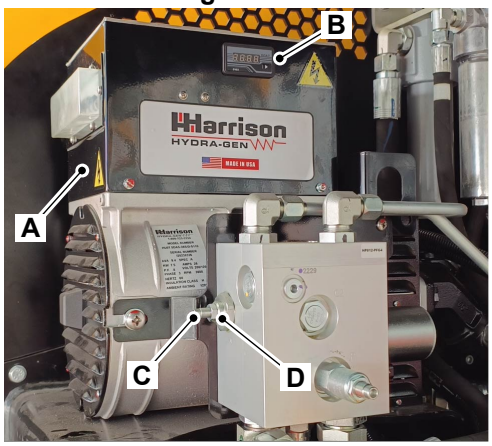
   Refer to: PIL 33-24-05.

   3.1. The hydraulic generator display shows the frequency.

4. Turn the hydraulic generator to the OFF position before adjusting the settings.

5. Loosen the check nut on the frequency setting knob.

Figure 163.



A Hydraulic generator
B Hydraulic generator display
C Frequency setting knob
D Check nut

6. Use the allen key to turn the frequency setting knob to change the frequency accordingly.

   6.1. Do not make more than a quarter of a turn at a time.

   6.2. Check the frequency by restarting the hydraulic generator.

   6.3. Make sure that the hydraulic generator display shows 59.4 Hz to 60.6 Hz frequency reading.

7. Tighten the check nut to the specified torque value. Refer to Table 86.

Table 86. Torque Values

Item	Nm
B	10

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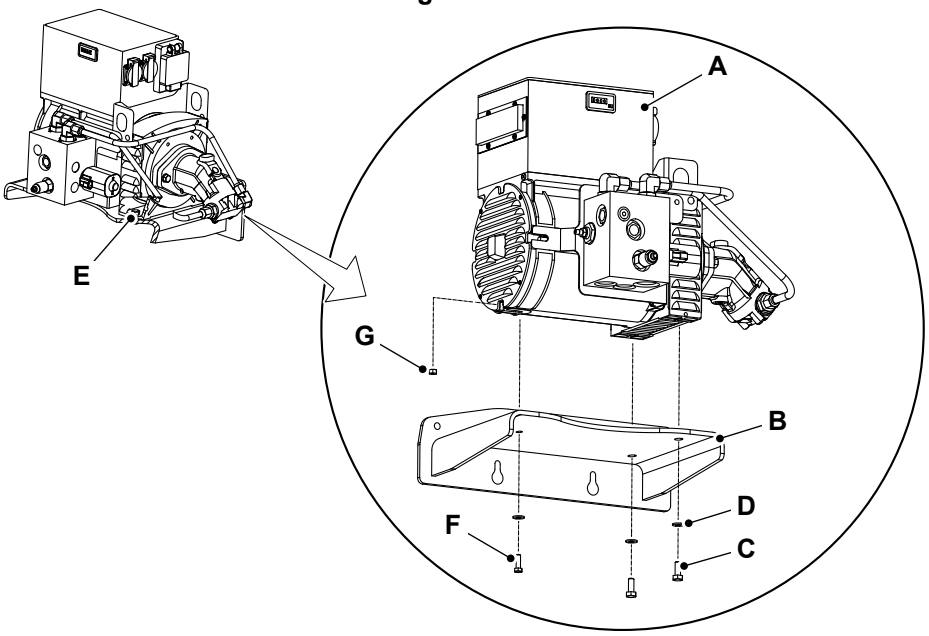
Remove and Install

⚠ **CAUTION** This component is heavy. It must only be removed or handled using a suitable lifting method and device.

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Discharge the hydraulic pressure.
   Refer to: PIL 30-00-00.
3. Remove the engine compartment cover.
   Refer to: PIL 06-06-06.
4. Put a label on the hydraulic hoses to help installation.
   4.1. Remove the hydraulic hoses from the hydraulic generator.
   4.2. Plug all the open ports and hoses to prevent contamination.
5. Disconnect the electrical connectors from hydraulic generator.
6. Remove the setscrew 1 (x2), setscrew 2 (x1), nut 1 (x2), nut 2 (x1) and washer (x3) from the hydraulic generator mounting bracket.
7. Carefully lift and remove the hydraulic generator from the machine.

Figure 164.



A Hydraulic generator
B Hydraulic generator mounting bracket
C Setscrew 1 (x2)
D Washer (x3)
E Nut 1 (x2)
F Setscrew 2 (x1)
G Nut 2 (x1)

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Tighten the setscrews to the specified torque value. Refer to Table 87.

Table 87. Torque Values

Item	Nm
C	43
F	22

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11 - Gear Pump

00 - General

Introduction 30-46
Check (Condition) 30-47
Remove and Install 30-48

Introduction

There are two gear pumps on the machine. One is mounted to Engine PTO (Power Take-Off). The other is mounted to the auxiliary motor to the left side of the turntable.

The gear pump consists of an end cover, a body, housing a matched gear pair, bushes and a mounting flange fixed together with bolts. The gear journals are supported in plain bearings within pressure balanced bushes to give high volumetric and mechanical efficiencies.

The direction of rotation of the pump is indicated by an arrow on the body near to the driveshaft.

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Check (Condition)

Each component should be thoroughly cleaned, carefully checked and assessed for possible re-use again. Use the guide below to check the various components and if any component is unserviceable, replace the complete pump assembly.

Body

Check the body bore cut-in on the inlet side where the gears touch the body. The body can only be re-used if the cut-in is bright and polished in appearance and the depth does not exceed 0.08mm. The body should not be scored, have a 'matt' appearance or show signs that the tip of the gears have dug in and torn away the surface material.

The body must be checked to make sure that there is no superficial damage, which may badly affect performance or sealing. Give particular attention to the port threads and the body O-ring seal recesses.

Mounting flange and end cover

The inner surfaces must be checked to make sure that there is no unusual wear or scoring in the area where the body O-rings and bush seals contact, which could result in external leakage.

Check the shaft seal recess for scoring or damage that could result in oil leakage around the outer diameter of the shaft seal. Shaft seals can be re-used with Loctite hydraulic sealant to overcome small damage in this area.

Bushes

The side faces, which abut the gears, should be perfectly flat, should not have any signs of scoring. Characteristically there are bright polished areas on this surface caused by loading against the gear side faces and is often more pronounced on the low pressure side.

Often there is a witness mark where the tips of the opposing gears have wiped an overlap resembling a half moon shape. There must be no noticeable wear step as it is critical that the bush side face is completely flat on the gear side face.

The bush bearing liners are acceptable for use unless they are not scored, have bronze appearing through the grey surface or show any prominent signs of wear.

Gears

The gear side faces should be checked for bruising or scoring. Often operation on contaminated fluid shows scoring between the root of the gear and the journal, which leaves a wear step. If a wear step can be felt coincident with the root diameter by drawing a fingernail across the surface from the journal outwards to the tip of the gear, then the gear is unserviceable.

The gear teeth must be carefully checked to make sure that there are no signs of scuffing or pitting on the involute face.

The journal bearing surfaces should be completely free from scoring or bruising. The surface should appear highly polished and smooth to the touch.

Make sure that the area where the shaft seal lips run on the driveshaft, this shows up as a polished ring or rings. If a noticeable groove can be felt or there is scoring the shaft is unserviceable.

If the driveshaft is not damaged from the drive coupling and the gears have not been harmed as described above, then the gears can be used again.

When pumps are disassembled, all the seals must be replaced. It is most important that genuine JCB parts are used.

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Remove and Install

Gear Pump Mounted to Auxiliary Pump

Remove

1. Make the machine safe.

   Refer to: PIL 01-03-27.

2. Discharge the hydraulic pressure.

   Refer to: Discharge and Pressurise (PIL 30-00-00).

3. Drain the hydraulic oil.

   Refer to: Drain and Fill (PIL 30-00-00).

4. Get access to the gear pump.

5. Put a label on the hydraulic hoses to help installation.

   5.1. Disconnect the hoses from the gear pump.

   5.2. Plug all the open ports and hoses to prevent contamination.

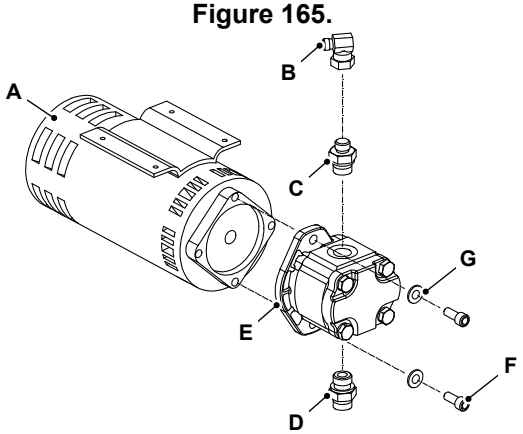
6. Support the gear pump suitably.

7. Remove the capscrew (x2) and washer (x2) from the gear pump.

8. Remove the gear pump from the machine.

9. If required, remove the adaptor 1, adaptor 2 and adaptor 3 from the gear pump.

Figure 165.



A Auxiliary pump electric motor
B Adaptor 1
C Adaptor 2
D Adaptor 3
E Gear pump
F Capscrew (x2)
G Washer (x2)

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

1. Tighten the capscrew (x2), adaptor 1, adaptor 2 and adaptor 3 to the specified torque value. Refer to Table 88.

Gear pump mounted to Engine PTO

Remove

1. Make the machine safe.

   Refer to: PIL 01-03-27.

2. Discharge the hydraulic pressure.

   Refer to: Discharge and Pressurise (PIL 30-00-00).

3. Drain the hydraulic oil.

   Refer to: Drain and Fill (PIL 30-00-00).

4. Get access to the gear pump.

5. Put a label on the hydraulic hoses to help installation.

   5.1. Disconnect the hoses from the gear pump.

   5.2. Plug all the open ports and hoses to prevent contamination.

6. Support the gear pump suitably.

7. Remove the capscrew (x4) and O-ring from the gear pump.

8. Remove the PTO pump suction pipe from the machine.

9. If required, remove the adaptor 4 and adaptor 5 from the gear pump.

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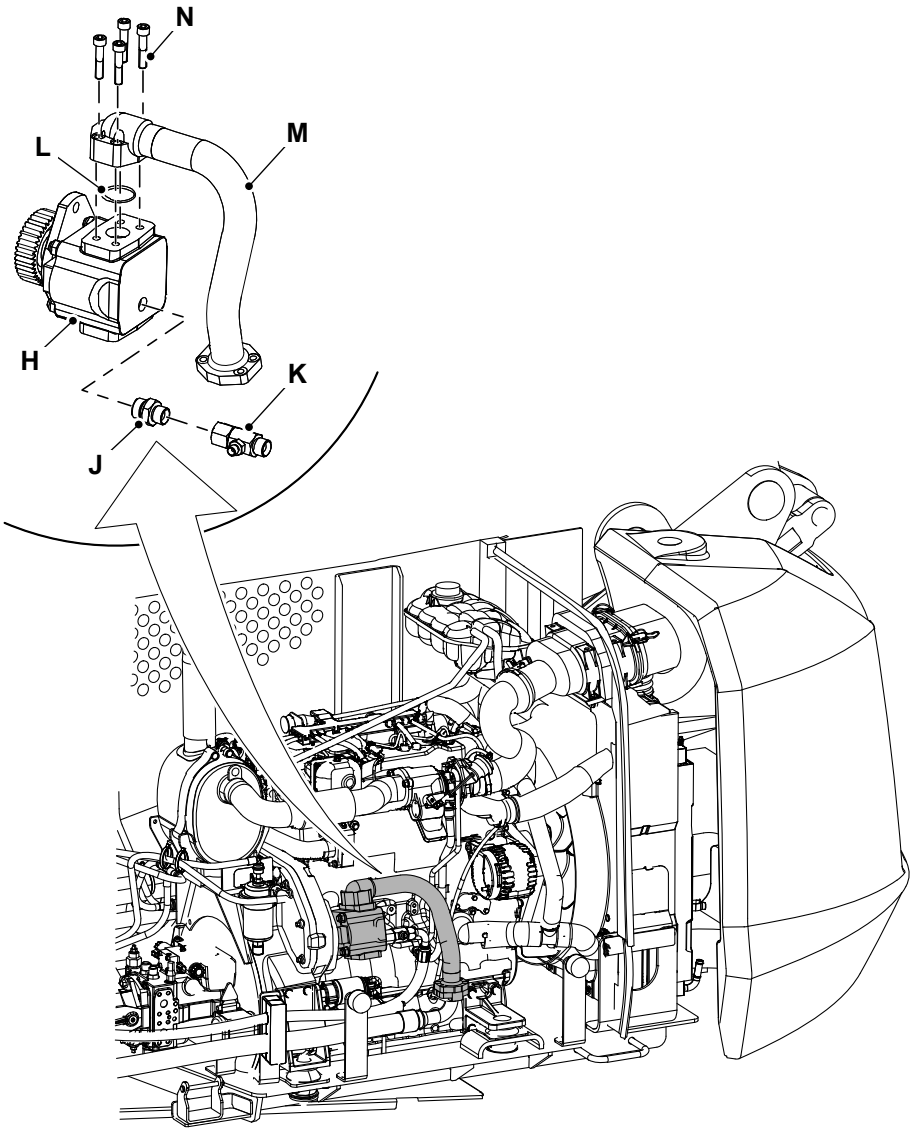
Figure 166.



H Gear pump
J Adaptor 4
K Adaptor 5
L O-ring
M PTO pump suction pipe
N Capscrew (x4)

10. Remove the setscrew (x2) and washer 1 (x2) from the gear pump.

11. Remove the gear pump from the engine.

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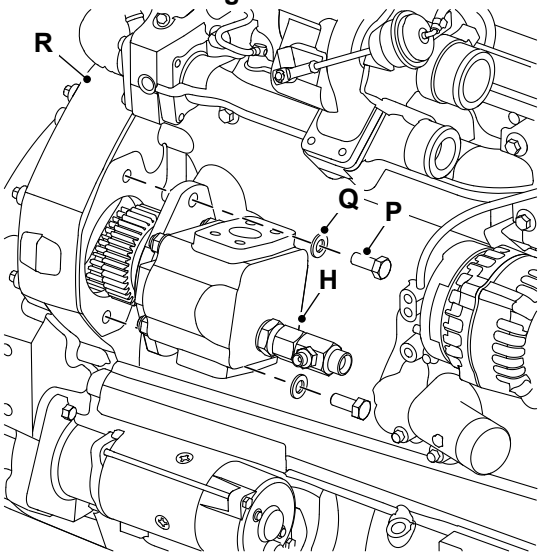
Figure 167.



H Gear pump
P Setscrew (x2)
Q Washer 1 (x2)
R Engine

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

1. Tighten the capscrew (x4), adaptor 4, adaptor 5 and setscrew (x2) to the correct torque value. Refer to Table 88.

Table 88. Torque Values

Item	Nm
B	35–39
C	65–71
D	65–71
F	20–23
J	170–187
K	120–130
N	72
P	74

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12 - Variable Displacement Pump

00 - General

Introduction 30-51
Component Identification 30-52
Fault-Finding 30-53
Diagram 30-55
Adjust 30-56
Remove and Install 30-57
Disassemble and Assemble 30-59

Introduction

The most common variable displacement pump used in vehicle technology is the axial piston pump. This pump has several pistons in cylinders arranged parallel to each other and rotating around a central shaft. A swashplate at one end is connected to the pistons. As the pistons rotate, the angle of the plate causes them to move in and out of their cylinders.

A rotary valve at the opposite end from the swashplate alternately connects each cylinder to the fluid supply and delivery lines. By changing the angle of the swashplate, the stroke of the pistons can be varied continuously. If the swashplate is perpendicular to the axis of rotation, no fluid will flow. If it is at a sharp angle, a large volume of fluid will be pumped.

Some pumps allow the swashplate to be moved in both directions from the zero position, pumping fluid in either direction without reversing the rotation of the pump.

Piston pumps can be made variable-displacement by inserting springs inline with the pistons. The displacement is not positively controlled, but decreases as the back-pressure increases.

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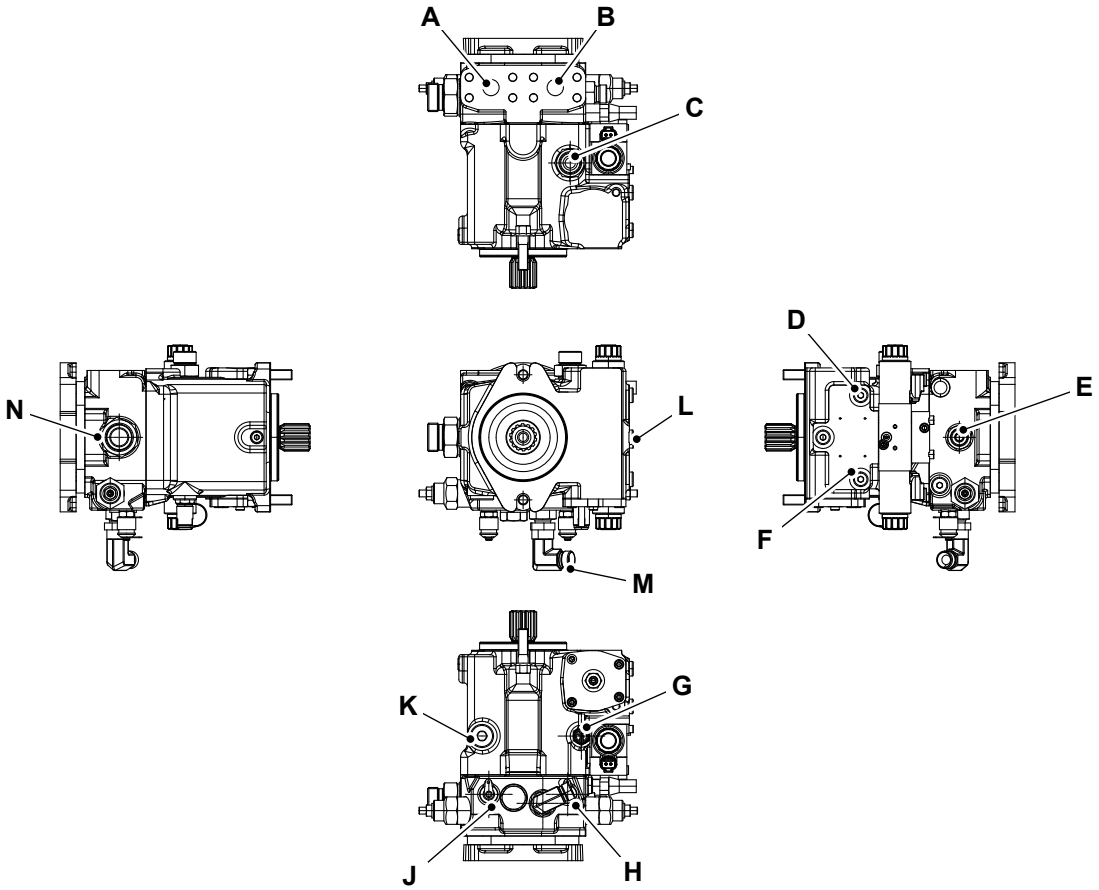
Component Identification

Figure 168.



A Service line port A
B Service line port B
C Case drain/ fill port T1
D Control pressure port X1
E Filter inlet
F Control pressure port X2
G Test point (control pressure supply)
H Operating pressure measuring point MB
J Operating pressure measuring point MA
K Case drain/fill port T2
L Air bleed port
M Boost pressure port
N Boost suction port

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Fault-Finding

Fault		
Unusual noises	Table 89.	Page 30-53
Increased, unusual vibration	Table 90.	Page 30-53
No or insufficient flow	Table 91.	Page 30-53
No or insufficient pressure	Table 92.	Page 30-54
Pressure/flow fluctuations or instabilities	Table 93.	Page 30-54
Excessively high temperature of hydraulic fluid and housing	Table 94.	Page 30-54

Table 89. Unusual noises

Cause	Remedy
Insufficient air bleeding of the hydraulic system	Fill the axial piston unit, suction line for the hydraulic pump and the reservoir. Completely air bleed the axial piston unit and hydraulic system. Check correct installation position.
Insufficient suction conditions, viscosity of the hydraulic fluid too high, suction pressure too low, foreign particles in the suction line, suction filter too small or blocked, etc.	Check the system, optimize inlet conditions, use suitable hydraulic fluid. Fill the suction line with hydraulic fluid. Remove foreign particles from the suction line. Check the filter system and change the filter as necessary.
Drive speed too high	Reduce drive speed. Contact JCB Service.
Wrong direction of rotation	Check correct direction of rotation. Contact JCB Service.
Improper mounting of the axial piston unit	Check the mounting of the axial piston unit according to the specifications of the machine/ system manufacturer (observe tightening torques).
Improper mounting of assembled parts, hydraulic lines or improper installation of the coupling	Mount assembled parts according to the information provided by the coupling fitting manufacturer.
Operate the pressure limit and control valves (boost-pressure relief valve, high-pressure relief valve, pressure cut-off, and pressure reducing valve) in the axial piston unit.	Air bleed the axial piston unit and hydraulic system. Optimize the setting of the pressure limitation and pressure control valve. Contact JCB Service.
Mechanical damage to the axial piston unit (e.g., bearing damage)	Replace axial piston unit. Contact JCB Service.

Table 90. Increased, unusual vibration

Cause	Remedy
Bearings worn	Contact JCB Service.

Table 91. No or insufficient flow

Cause	Remedy
Insufficient air bleeding of the hydraulic system	Fill the axial piston unit, suction line for the hydraulic pump and the reservoir. Completely air bleed the axial piston unit and hydraulic system.
Faulty mechanical drive (e.g. defective coupling)	Contact JCB Service.
Drive speed too low	Contact JCB Service.
Hydraulic fluid not in optimal viscosity range	Check temperature range and use the suitable hydraulic fluid.
Insufficient boost pressure	Check boost pressure. Contact JCB Service.
Insufficient pilot pressure or control pressure	Check pilot pressure or control pressure. Contact JCB Service.

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Cause	Remedy
Malfunction of the control device or controller of the axial piston unit	Contact JCB Service.
Control of the control device defective	Check control (contact machine/system manufacturer or JCB Service).
Wear or mechanical damage to the axial piston unit	Replace axial piston unit. Contact JCB Service.

Table 92. No or insufficient pressure

Cause	Remedy
Insufficient air bleeding of the hydraulic system	Fill the axial piston unit, suction line for the hydraulic pump and the reservoir. Completely air bleed the axial piston unit and hydraulic system. Check correct installation position.
Faulty mechanical drive (e.g. defective coupling)	Contact JCB Service.
Drive power too low	Contact JCB Service.
Hydraulic fluid not in optimal viscosity range	Check temperature range and use suitable hydraulic fluid. Contact JCB Service.
Insufficient boost pressure	Check boost pressure. Contact JCB Service.
Insufficient pilot pressure or control pressure	Check pilot pressure or control pressure. Contact JCB Service.
Malfunction of the control device or controller of the axial piston unit	Contact JCB Service.
Control of the control device defective	Check control (contact machine/system manufacturer or JCB Service)
Wear or mechanical damage to the axial piston unit	Replace axial piston unit. Contact JCB Service.
Output unit defective (e.g. hydraulic motor or cylinder)	Contact JCB Service.

Table 93. Pressure/flow fluctuations or instabilities

Cause	Remedy
Insufficient air bleeding of the hydraulic system	Fill the axial piston unit, suction line for the hydraulic pump and the reservoir. Completely air bleed the axial piston unit and hydraulic system. Check correct installation position
Operate the pressure limit and control valves (boost-pressure relief valve, high-pressure relief valve, pressure cut-off, and pressure reducing valve) in the axial piston unit.	Air bleed the axial piston unit and hydraulic system. Contact JCB Service.
Unstable control signal	Contact JCB Service.
Malfunction in the control devices or the controller	Contact JCB Service.

Table 94. Excessively high temperature of hydraulic fluid and housing

Cause	Remedy
Excessively high inlet temperature at the axial piston unit	Inspect system, e.g., malfunction in the cooler, insufficient hydraulic fluid in the reservoir. Contact JCB Service.
Wrong setting or malfunction of the pressure relief and pressure control valves (e.g., high pressure relief valve, pressure cut-off, pressure reducing valve)	Adjust the pressure limitation and pressure control valves of the axial piston unit and the pressure safe guarding in the hydraulic system. Contact JCB Service
Flushing flow of the flushing valve too low	Contact JCB Service.
Axial piston unit worn	Replace axial piston unit; contact JCB Service.

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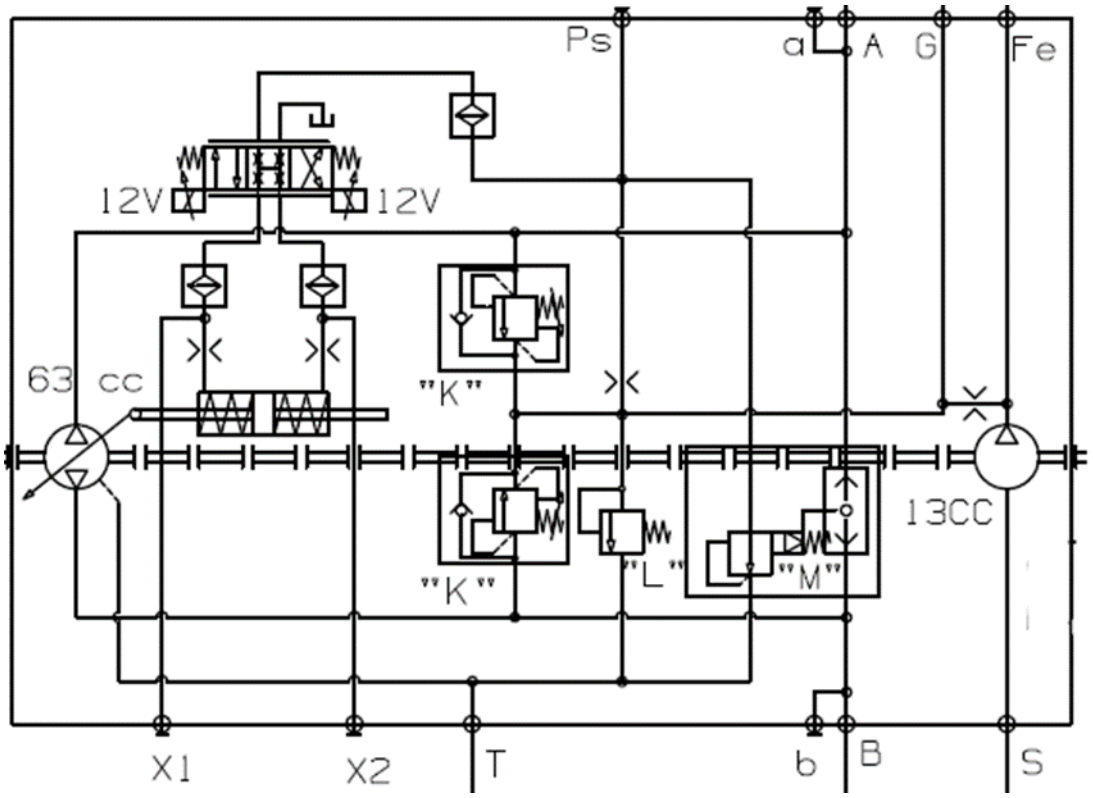
Diagram

Figure 169.



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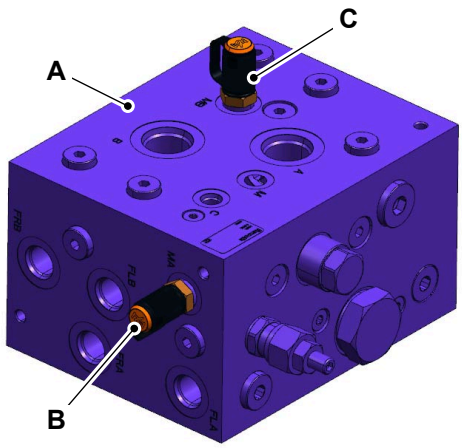
Adjust

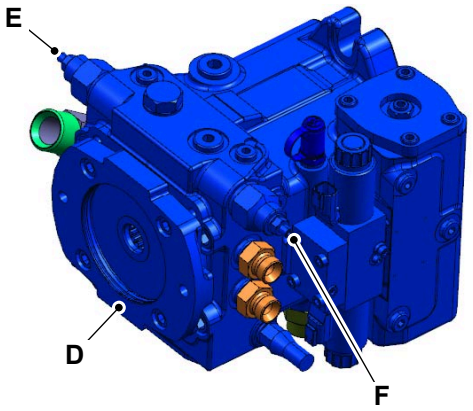
1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Remove the gauge port plugs from the ports MA and MB.
   2.1. Connect a suitable pressure gauge to each of the ports MA and MB.
   Pressure: 350bar (5,076.3psi)
3. Start the machine and operate at normal speed.
4. Check the reading on the pressure gauges.
   4.1. If necessary, adjust differential pressure by adjusting screw MA and MB.
   4.2. Tighten the locknut to the specified torque value.
   Torque: 24N·m
   4.3. Note that a maximum pressure differential of the specified value.
   Pressure: 325bar (4,713.7psi)
   4.4. Use the allen key of specified dimension for adjusting the pressure.
   Dimension: 4mm
   4.5. Use a internal hexagon wrench of the specified dimension to hold the adjusting screw stationary.
   Dimension: 13mm
5. Note that the adjustment of the EDC (Electronic Displacement Control) is very sensitive.

Figure 170.



A Transmission valve block
B Gauge port MA
C Gauge port MB

Figure 171.



D Variable displacement pump
E Adjusting screw MA
F Adjusting screw MB

6. Stop the charge pump.
7. Remove the pressure gauges.
   7.1. Install the gauge port plugs.
8. Connect the external control input.

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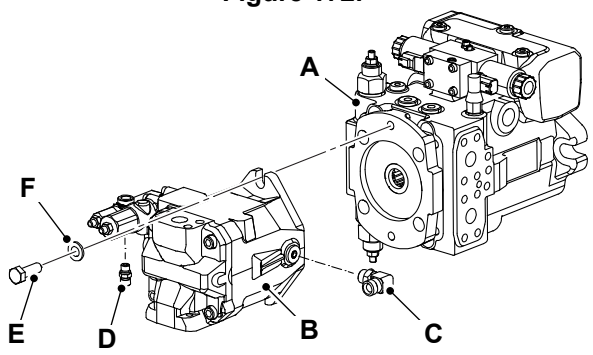
Remove and Install

⚠ **CAUTION** This component is heavy. It must only be removed or handled using a suitable lifting method and device.

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Discharge the hydraulic pressure.
   Refer to: Discharge and Pressurise (PIL 30-00-00).
3. Drain the hydraulic oil.
   Refer to: Drain and Fill (PIL 30-00-00).
4. Disconnect the electrical connectors.
5. Disconnect the hoses from the boom hydraulic pump.
   5.1. Put a label on the hoses to help installation.
   5.2. Plug all the open ports and hoses to prevent contamination.
6. Support the boom hydraulic pump with the help of suitable lifting equipment.

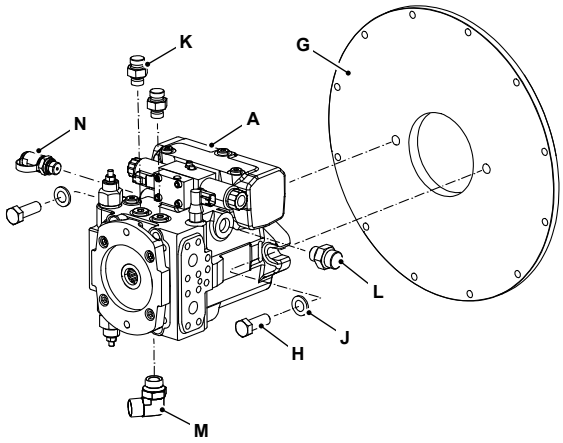
Figure 172.



A Transmission pump
B Boom hydraulic pump
C Elbow adaptor
D Adaptor
E Bolt (x2)
F Washer (x2)

7. Remove the bolt (x2) and washer (x2)) from the transmission pump. Refer to Figure 172.
8. Remove the boom hydraulic pump.
9. If required, remove the adaptor and elbow adaptor.
10. Support the transmission pump suitably.
11. Remove the bolt 1 (x2) and washer 1 (x2) from the engine pump mount plate. Refer to Figure 173.
12. Remove the transmission pump from the machine.
13. If required, remove the adaptor 1 (x2), adaptor 2, test point and elbow adaptor.

Figure 173.



A Transmission pump
G Engine pump mount plate

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H Bolt 1 (x2)
J Washer 1 (x2)
K Adaptor 1 (x2)
L Adaptor 2
M Elbow adaptor
N Test point

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

1. Tighten the bolt (x2), adaptor 1 (x2), adaptor 2, elbow adaptor and test point to the specified torque value. Refer to Table 95.

Table 95. Torque Values

Item	Nm
C	70–77
D	20–22
E	74
H	184
K	65–71
L	78–82
M	160–176
N	35–40

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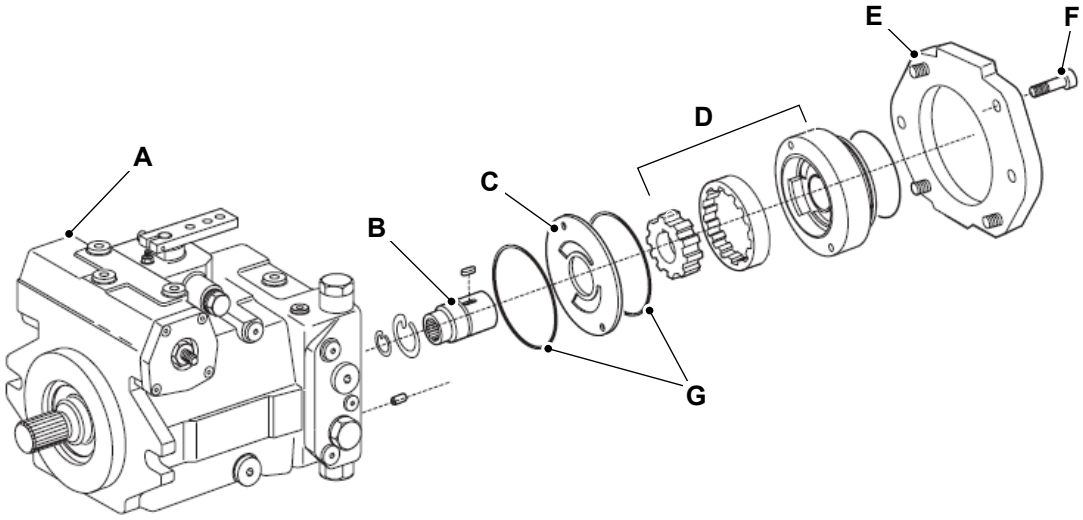
Disassemble and Assemble

Disassemble

1. Remove the piston pump and connecting shaft.
2. Place the pump on a clean workbench with the end cover facing upwards.
3. Use a suitable internal hexagon wrench to remove the screw (x4).
4. Remove the end cover.
5. Remove and discard the O-ring (x2).
6. Remove the coupling.
   6.1. If necessary, use a suitable hook to remove the coupling.
7. Remove the boost pump components.
8. Remove the wear plate.

Figure 174.



A Variable displacement pump
B Coupling
C Wear plate
D Boost pump components
E End cover
F Screw (x4)
G O-ring (x2)

Assemble

1. The assembly procedure is the opposite of the disassembly procedure. Additionally do the following steps.
2. Inspect the components for wear, scratches or pitting.
   2.1. If you find any wear, scratches or pitting, replace the damaged component.
3. Lubricate the new O-ring (x2).
4. Tighten the screw (x4) to the correct torque value.

   Refer to: PIL 72-03-00.

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50 - Solenoid Control Valve

Introduction 30-60
Operation 30-61
Remove and Install 30-62

Introduction

The swashplate position of the pump is controlled through the solenoid control valve. This system is called an EDC (Electronic Displacement Control) system.

Depending on the preselected current at the two proportional solenoids (a and b), the stroke cylinder of the pump is supplied with control pressure via the EP control unit. Thus the swash plate and the displacement are infinitely adjustable. One direction of through flow is assigned to each proportional solenoid.

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Operation

EDC Principle

This pump is installed with EDC (Electronic Displacement Control) system.

An EDC is a displacement (flow) control system of the pump. The pump swashplate position is proportional to the input command and therefore the machine speed, is dependent only on the prime mover speed or motor displacement.

The EDC consists of a pair of proportional solenoids on each side of a three-position, four-way porting spool. The proportional solenoid applies a force input to the spool, which ports hydraulic pressure to either side of a double acting servo piston. Differential pressure across the servo piston rotates the swashplate, changing the pump displacement from full displacement in one direction to full displacement in the opposite direction.

Under some circumstances, such as contamination, the control spool could stick and cause the pump to stay at some displacement. A serviceable 10 micron filter is located in the supply line immediately before the control porting spool.

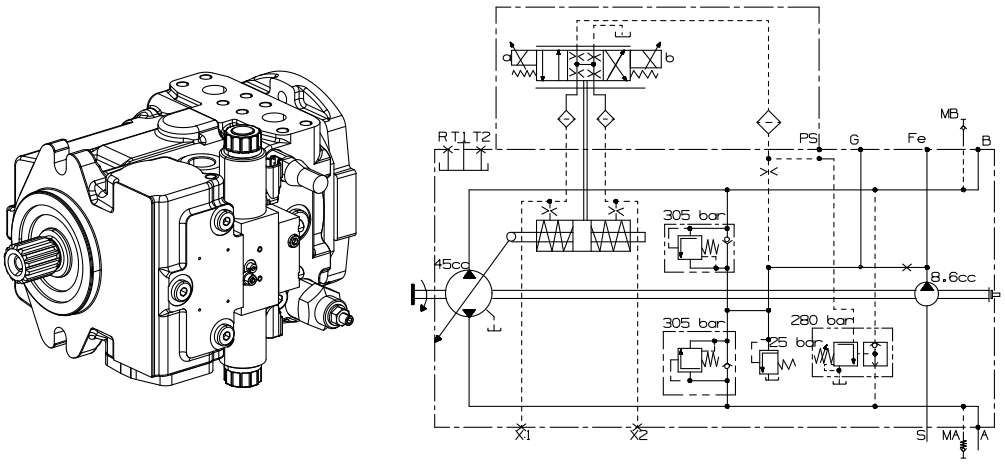
EDC Operation

The EDC is a current driven control that requires a PWM (Pulse Width Modulation) signal. The PWM allows more precise control of current to the solenoids. The PWM signal causes the solenoid pin to push against the porting spool, which pressurizes one end of the servo piston, while draining the other. The pressure differential across the servo piston moves the swashplate.

A swashplate feedback link, opposing control links, and a linear spring provide swashplate position force feedback to the solenoid. The control system reaches equilibrium when the position of the swashplate spring feedback force exactly balances the input command solenoid force from the operator. As hydraulic pressures in the operating loop change with load, the control assembly and servo/ swashplate system work constantly to maintain the commanded position of the swashplate.

The EDC incorporates a positive neutral deadband as a result of the control spool porting, pre-loads from the servo piston assembly, and the linear control spring. Once the neutral threshold current is reached, the swashplate is positioned directly proportional to the control current. To minimise the effect of the control neutral deadband. The neutral position of the control spool does provide a positive preload pressure to each end of the servo piston assembly. When the control input signal is either lost or removed, or if there is a loss of charge pressure, the spring loaded servo piston will automatically return the pump to the neutral position.

Figure 175.



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Remove and Install

Remove

1. Make the machine safe.

   Refer to: PIL 01-03-27.

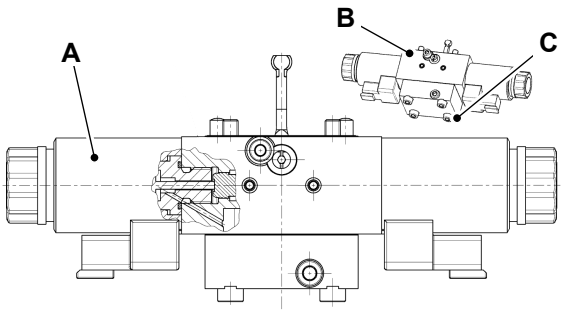
2. Disconnect the hydraulic and electrical connections.

   2.1. Plug all the open ports and hoses to prevent contamination.

3. Use a suitable internal hexagon wrench to remove the capscrew (x4).

4. Remove the control module.

Figure 176.



A Solenoid
B Control module
C Capscrew (x4)

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

2. Inspect the machined surfaces on the control module.

   2.1. If you find nicks or scratches, replace the damaged component.

3. Tighten the capscrew (x4) to the correct torque value.

   Refer to: PIL 72-03-00.

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63 - Charge Pressure Relief Valve

Introduction 30-63
Operation 30-64
Remove and Install 30-64

Introduction

The charge PRV (Pressure Relief Valve) is an integrated part of the pump. The charge PRV maintains the system pressure above the case pressure.

An internal charge relief valve regulates charge pressure. Charge pressure maintains a minimum pressure in the low side of the transmission loop

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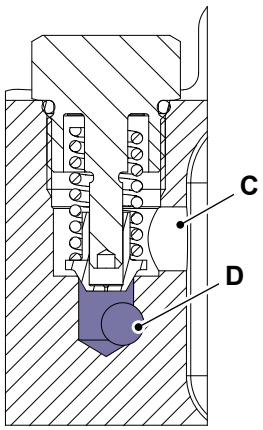
Operation

Charge Pressure Relief Valve

An internal charge PRV (Pressure Relief Valve) regulates the charge pressure within the hydraulic circuit. The charge PRV is a direct acting poppet valve that regulates charge pressure at a designated level above case pressure. The charge PRV is set at 25bar (362.6psi).

Figure 177.



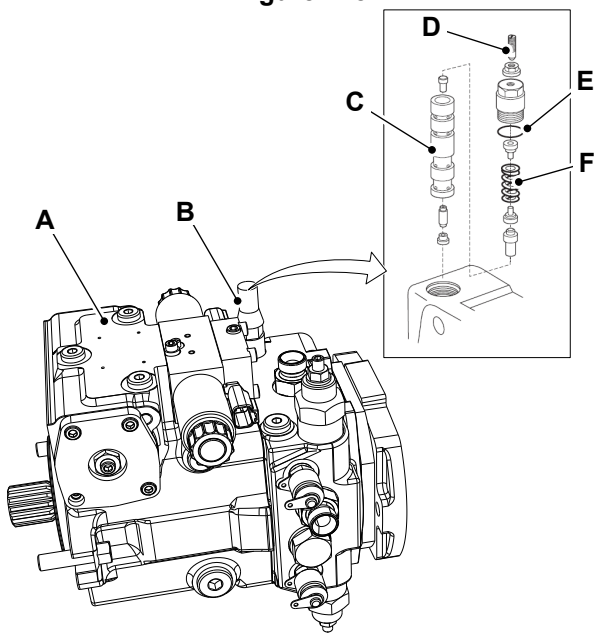
C Case drain
D Charge pressure

Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Use a suitable wrench to remove the pressure relief valve.
3. Remove and discard the O-ring.
4. Remove the adjusting screw,spring and control piston.

Figure 178.



A Transmission pump
B Pressure relief valve
C Control piston
D Adjusting screw
E O-ring
F Spring

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

1. Install the new O-ring.
2. Do an inspection of the pressure relief valve, control piston, spring and adjusting screw.
   2.1. If necessary, replace the damaged components.
3. Inspect the sealing surfaces of the pump for nicks or scratches.

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4. Make sure that all the components are tightened to the correct torque value as per JCB standard.

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66 - High Pressure Relief Valve

Introduction 30-66
Operation 30-67
Remove and Install 30-67

Introduction

The pumps are installed with HPRV (High Pressure Relief Valve). The purpose of the HPRV is to release the excess system pressure.

The HPRV is installed with an integrated charge check valve.

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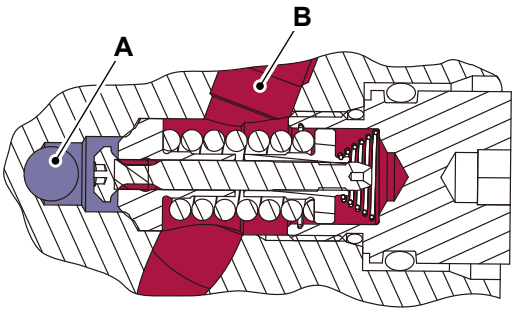
Operation

HPRV and Charge Check Valve

The pump is equipped with a combination HPRV (High Pressure Relief Valve) and charge check valve. The HPRV function is a dissipative (with heat generation) pressure control valve for the purpose of limiting excessive system pressures. The charge check function acts to replenish the low pressure side of the working loop with charge oil.

Each side of the transmission loop has a dedicated HPRV that is non-adjustable with a factory set pressure. When system pressure exceeds the factory setting of the valve, oil is passed from the high pressure system loop, into the charge gallery, and into the low pressure system loop through the charge check valve.

Figure 179.



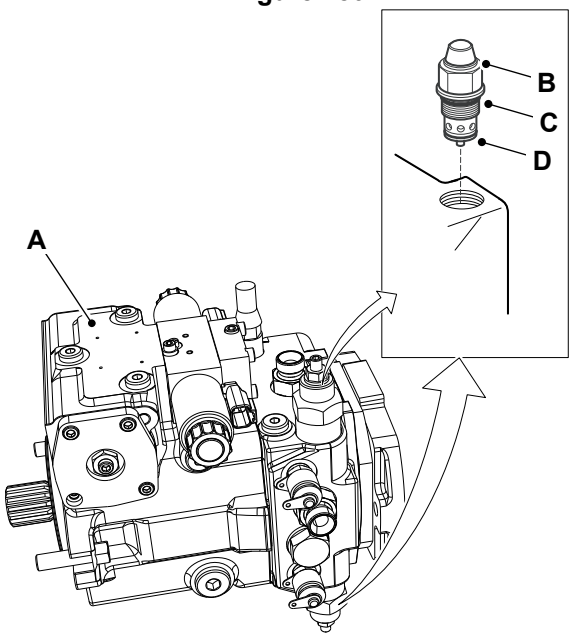
A Low pressure
B High pressure

Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Use a suitable spanner to remove the HPRV (High Pressure Relief Valve)s.
3. Remove and discard the O-rings and back-up rings.

Figure 180.



A Variable displacement pump
B HPRV
C O-ring
D Backup ring

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

1. Install the new O-ring and back-up rings.
2. Do an inspection of the HPRVs.
   2.1. If necessary, replace the damaged HPRVs.
3. Inspect the sealing surfaces of the pump for nicks or scratches.
4. Make sure that all the components are tightened to the correct torque value as per JCB standard.

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15 - Cylinder / Ram

00 - General

Introduction 30-68
Health and Safety 30-69
Technical Data 30-70
Component Identification 30-72
Check (Condition) 30-73
Check (Leaks) 30-73

Introduction

A hydraulic cylinder is a mechanical actuator that is used to give a directional force through a single action stroke. It is used in many applications, the cylinder gets the power from pressurised hydraulic oil. The hydraulic cylinder consists of a cylinder barrel, in which a piston connected to a piston rod moves back and forth.

A double acting cylinder alternates cycles of pressurised fluid to both sides of the piston and creates extend and retract forces to move the piston rod, permitting more control over the movement.

The barrel is closed on one end by the cylinder cap and the other end by the cylinder head where the piston rod comes out of the cylinder. The piston has sliding rings and seals. The piston divides the inside of the cylinder into two chambers, the bottom chamber (head end) and the piston rod side chamber (rod end).

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Health and Safety

Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before connecting or removing any hydraulic hose, residual hydraulic pressure trapped in the service hose line must be vented. Make sure the hose service line has been vented before connecting or removing hoses. Make sure the engine cannot be started while the hoses are open.

Lifting Equipment

You can be injured if you use incorrect or faulty lifting equipment. You must identify the weight of the item to be lifted then choose lifting equipment that is strong enough and suitable for the job. Make sure that lifting equipment is in good condition and complies with all local regulations.

WARNING! *A raised and badly supported machine can fall on you. Position the machine on a firm, level surface before raising one end. Ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it. Disconnect the battery, to prevent the machine being started while you are beneath it.*

Precautions for Installation

1. Precautions when installing the cylinder on the machine.
    1.1. When installing and removing from the machine, suspend the cylinder safely.
    1.2. Suspending the cylinder by the piping is not only dangerous, but can also cause damage to the cylinder.
    1.3. Secure the piston rod with a sling. It is very dangerous if the rod extends unexpectedly. Also, the rod can be damaged and become unusable.
2. Welding after installing the cylinder may result in damage.
    2.1. If electric welding is done even at a point away from the cylinder, there may be sparking inside the cylinder and it will become necessary to replace the cylinder with a new one.
3. When painting the machine, mask the cylinder. If paint adheres to the rod surface or to the wiper ring and the cylinder is operated, the wiper ring will not function properly and foreign matter and paint can easily enter the cylinder. This will cause damage to the seals, drastically shortening the life of the cylinder.
4. Install the ram only when it is clean.

Caution During Use

1. Use only under designated conditions.
    1.1. If hydraulic oil other than the designated oil is used, the seals quickly degenerate and become damaged. If the relief valve is set at a value higher than specified, it may cause cylinder damage and is dangerous.
    1.2. In high temperature environments (approx. 90°C and above) or low temperature environments (below -20°C), seals quickly become damaged. Special seal materials are necessary so check to see if the cylinder that you are using is suitable or not.
    1.3. The number one cause of cylinder oil leakage is rod damage. Be careful not to damage the rod.
2. Warm up sufficiently before beginning work.
    2.1. In cold conditions the rod seals may be frozen, so if the cylinder is operated at maximum pressure and maximum speed, the seals will be damaged.
    2.2. There is a large amount of air in a new cylinder or one which has been left for a long time, so the ram will not operate smoothly. Also, if pressure is applied suddenly without bleeding the air, high temperatures will be generated due to adiabatic compression and the seals may burn.
    2.3. Before beginning work, always move the cylinder at full stroke with no load and expel air from the cylinder.
3. When stopping or storing, do it at a safe and fixed position.
    3.1. The installed cylinder cannot maintain the same position for a long period of time, because the oil inside the cylinder may leak and the hydraulic oil volume decreases as it cools. Stop or store the machine in a safe and fixed position.

Maintenance, Inspection Points

1. Carry out daily maintenance and inspection.
    1.1. The key point for correct long-term cylinder function is daily maintenance and inspection. Carry out maintenance and inspection so that the cylinder functions fully at all times. Always remove any mud, water, dust or oil film adhering to the rod and keep it in normal condition. However, when cleaning the wiper ring and seals, do not get them wet with water but wipe clean with a rag. To prevent rust forming during storage,

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the amount of exposed cylinder piston rod should be kept to a minimum. If leaving for more than one week, apply a light coating of suitable grease or petroleum jelly to the exposed part of the cylinder piston rod.

2. Use genuine JCB parts when replacing parts.

   2.1. If parts other than genuine JCB parts are used, the desired results may not be obtained. Use only genuine JCB parts.

3. Caution during dismantling and reassembly.

   3.1. Dismantling the cylinder while it is still installed on the machine can be dangerous as unexpected movements of the machine can occur. Remove the cylinder from the machine and then dismantle.

   3.2. If reassembled with dirty hands, foreign matter can enter the cylinder causing a shorter life span and also the other hydraulic equipment may be damaged. Reassemble in a clean state.

   3.3. Follow the instructions in the diagrams regarding torque tightening for screwed parts. If the torque is too high or too low, it can cause damage.

Technical Data

Table 96.

Description	Details	Data
Jib lifting ram	Cylinder outer diameter	73mm
	Bore	63mm
	Rod	45mm
	Stroke	618mm
	Open length	1,535mm
	Closed length	917mm
	Cushion	Both ends
	Maximum operating pressure	235bar (3,408.4psi)
Lower levelling ram	Cylinder outer diameter	117mm
	Bore	100mm
	Rod	50mm
	Stroke	340mm
	Open length	995mm
	Closed length	655mm
	Maximum operating pressure	235bar (3,408.4psi)
Upper levelling ram	Cylinder outer diameter	117mm
	Bore	100mm
	Rod	50mm
	Stroke	351mm
	Open length	996mm
	Closed length	645mm
	Maximum operating pressure	235bar (3,408.4psi)
Steering ram	Cylinder outer diameter	73mm
	Bore	63mm
	Rod	45mm
	Stroke	305mm
	Open length	875mm
	Closed length	570mm
	Maximum operating pressure	235bar (3,408.4psi)
Front axle oscillation ram	Cylinder outer diameter	117mm
	Bore	100mm
	Rod	70mm
	Stroke	100mm
	Open length	485mm
	Closed length	385mm
	Maximum operating pressure	235bar (3,408.4psi)
Telescopic boom lift ram	Cylinder outer diameter	178mm

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Description	Details	Data
	Bore	150mm
	Rod	100mm
	Stroke	2,110mm
	Open length	3,530mm
	Closed length	1,420mm
	Cushion	Both ends
	Maximum operating pressure	235bar (3,408.4psi)
Telescopic boom extension ram	Cylinder outer diameter	130mm
	Bore	110mm
	Rod	90mm
	Stroke	4,358mm
	Open length	9,458mm
	Closed length	5,100mm
	Maximum operating pressure	235bar (3,408.4psi)

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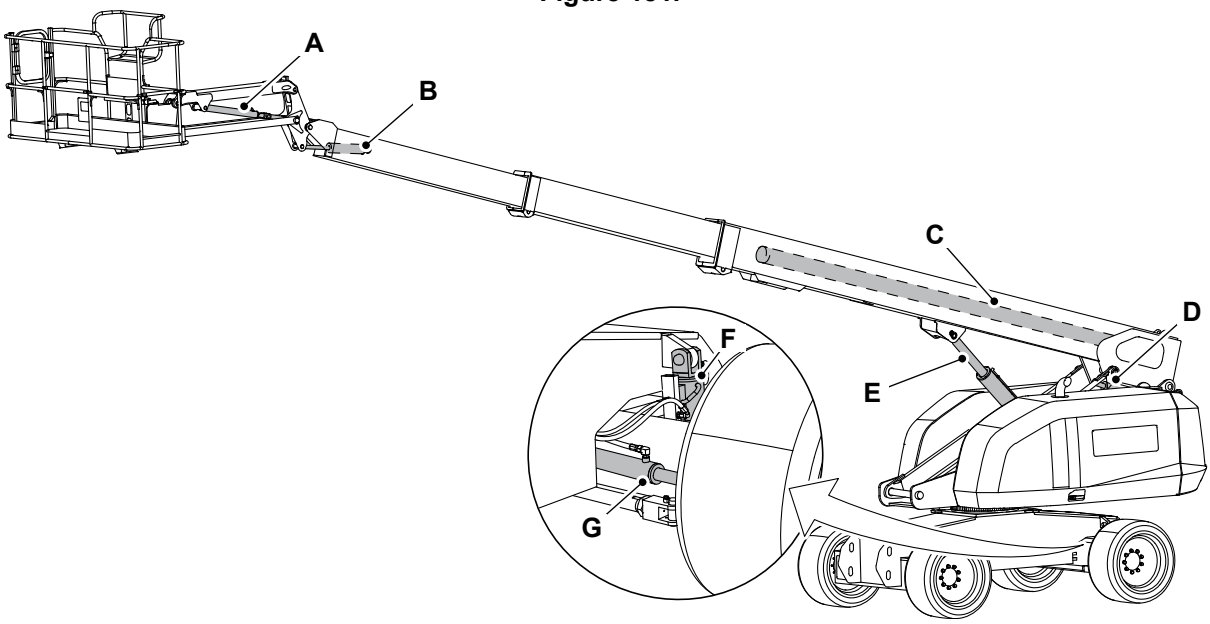
Component Identification

Figure 181.



A Jib cylinder
B Upper levelling cylinder
C Main boom telescopic cylinder
D Lower levelling cylinder
E Main boom lift cylinder
F Oscillating axle cylinder (x2)
G Steering cylinder (x2)

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Check (Condition)

Consumables

Description	Part No.	Size
Surface Cleaning Fluid	4103/1204	1L

1. Make the machine safe.

   Refer to: PIL 01-03-27.

2. Extend each ram fully.
3. Clean the piston, gland, piston rod and tube with cleaning solvent.

   Consumable: Surface Cleaning Fluid

4. Visually examine each ram for score marks, dents, leaks or similar defects.
5. Remove the ram from the machine, and disassemble it.
6. Check the condition of the tube as follows.

   6.1. Illuminate the inside of the tube.

   6.2. Inspect the inside of the tube for deep grooves and other damage. If damaged, replace the tube.

   6.3. Remove small scratches on the inside of the tube with a medium grain emery cloth. Use the emery cloth with a rotary motion.

   6.4. Inspect the gland end of the tube for sharp edges that will cut the gland O-ring.

   6.5. Remove the sharp edges from the tube as required.

7. Check the condition of the piston rod as follows.

   7.1. Inspect the piston for damage and wear.

   7.2. If the piston is damaged or worn, replace it.

   7.3. Make sure that the piston rod is straight.

   7.4. If the piston rod is not straight, install a new piston rod.

8. Check the condition of the gland as follows.

   8.1. Inspect the gland for rust.

   8.2. Remove rust and clean as required.

Check (Leaks)

Leakage in the ram hydraulic circuit causes cylinder creep.

Cylinder creep can be caused by a number of reasons:

- Cylinder / piston Leakage
- Spool leakage
- ARV leakage

If creep is suspected the following test procedures must be carried out to make sure the equipment is extended within tolerance limit.

This should be carried out in two conditions with specified rated load placed on platform. 300kg or454kg

- Maximum horizontal outreach condition.
- Maximum vertical height condition.

Creep Test

1. Operate the machine to bring the hydraulic oil to a normal working temperature.
2. Setup the machine for full load in platform at full boom angle and 80% boom extension for creep test setup.
3. Using a felt tip pen and ruler, make a mark at the suitable distance from the edge of the wiper seal on the piston rod.
4. Measure the actual movement of the piston rod over the specified time period.

   Duration: 24h

5. With 300 kg weight in platform take the machine to full height setup and record the values for boom extended length and boom angle from base display,platform height using measuring tape.
6. Let the machine run under creep for 24hrs and record again same values and the difference should be less than value specified in below table. Refer to Table 97.

Table 97. Creep Test Results for 24 hrs at 300 kg Load

Cylinder description	Change Measurement
Telescopic boom cylinder	8mm
Boom lift cylinder	2mm
Upper levelling cylinder	4.5mm

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07 - Lift Extension

Introduction 30-74
Operation 30-75
Remove and Install 30-76

Introduction

The telescopic boom cylinder is attached to the intermediate and outer sections of the main boom. The cylinder extends and retracts the telescopic boom. The cylinder is fitted with load holding counterbalance valves in case of a hose burst scenario.

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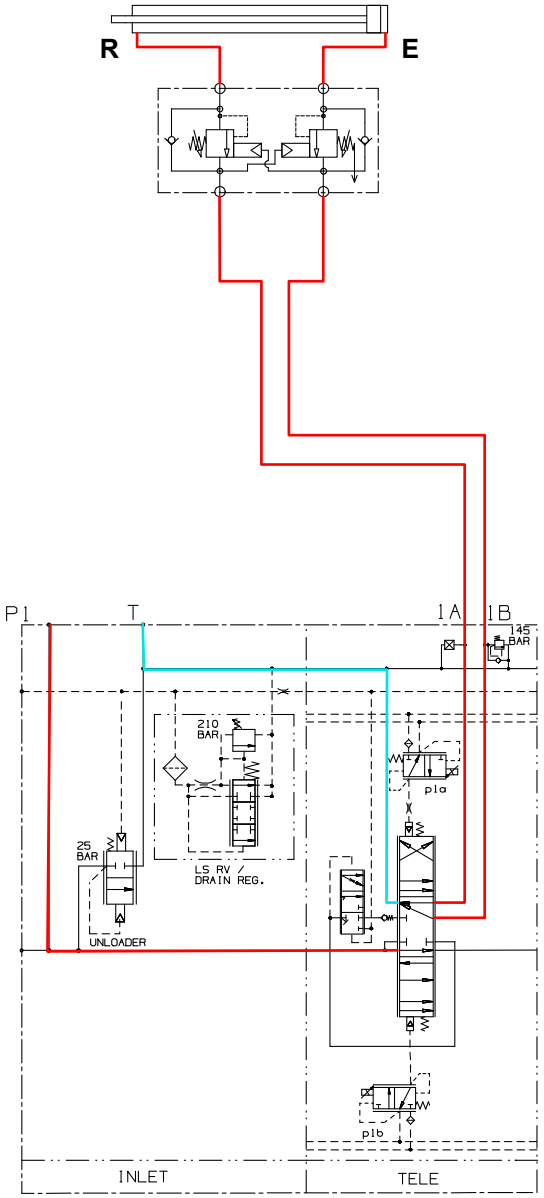
Operation

The telescopic boom cylinder is connected inside the boom assembly. When pressurised flow passes in cylinder from E, the telescopic cylinder will be extended. When pressurised flow passes in cylinder from R, the telescopic cylinder will be retracted. Telescopic operation is protected form overpressure by auxiliary relief valve of 145bar (2,103.0psi) on the telescopic extend.

When the extend / retract switch is operated, solenoids 1B and 1 A are energised respectively. When solenoid of port 1B is energized telescopic cylinder will extend and boom will come out. When solenoid of port 1A is energized telescopic cylinder will retract and boom will go in.

Figure 182.



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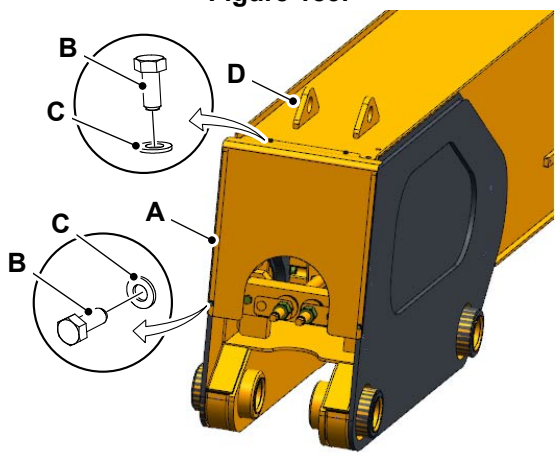
Remove and Install

Telescopic Extension Cylinder

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Discharge the hydraulic pressure.
   Refer to: PIL 30-00-00.
3. Remove the setscrew 1 (x4) and washer 1 (x4) from the rear cover.

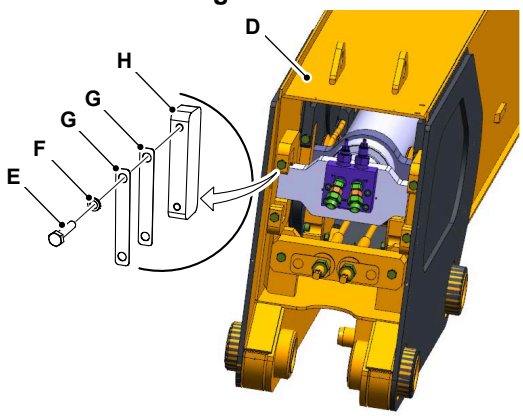
Figure 183.



A Rear cover
B Setscrew 1 (x4)
C Washer 1 (x4)
D Outer boom

4. Remove the rear cover from the outer boom.
5. Remove the hoses from the telescopic extension cylinder.
   5.1. Put a label on the hoses to help during installation.
   5.2. Plug all the open ports and hoses to prevent contamination.
6. Remove the setscrew 2 (x4), washer 2 (x4), shim 1 from the telescopic cylinder block (x2) located on the outer boom.

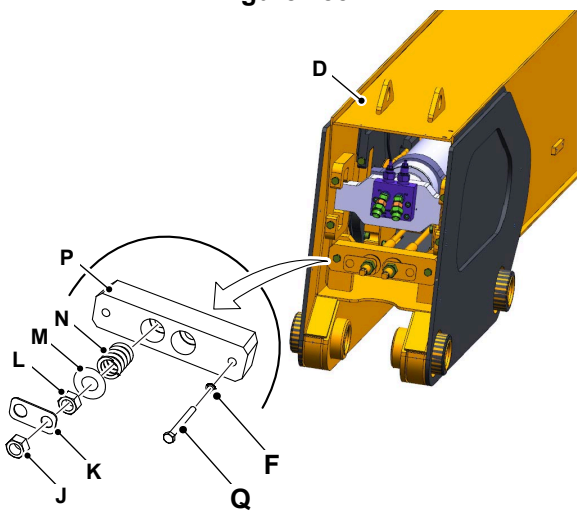
Figure 184.



D Outer boom
E Setscrew 2 (x4)
F Washer 2 (x4)
G Shim 1 (As required)
H Telescopic cylinder block (x2)

7. Remove the telescopic cylinder block (x2) from the outer boom.
8. Remove the locknut (x2), detection plate (x2), nut (x2), washer 3 (x2), spring (x2) from the rope detection plate.

Figure 185.



D Outer boom
F Washer 2 (x2)
J Locknut (x2)
K Detection plate (x2)
L Nut (x2)
M Washer 3 (x2)
N Spring (x2)
P Rope detection plate
Q Bolt (x2)

9. Remove the bolt (x2), washer 2 x2) from the rope detection plate. Refer to Figure 185.

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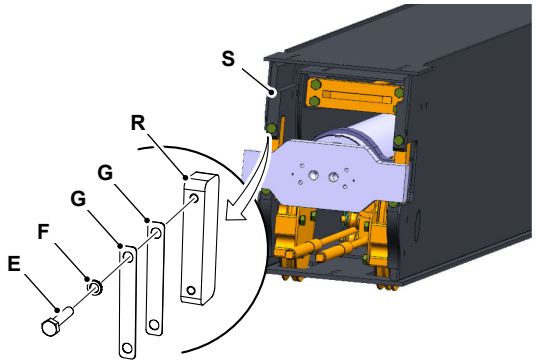
10. Remove the rope detection plate from the outer boom.

11. Remove the setscrew 2 (x4), washer 2 (x4), shim 1 from the telescopic cylinder pressing block (x2) located on the intermediate boom.

Figure 186.

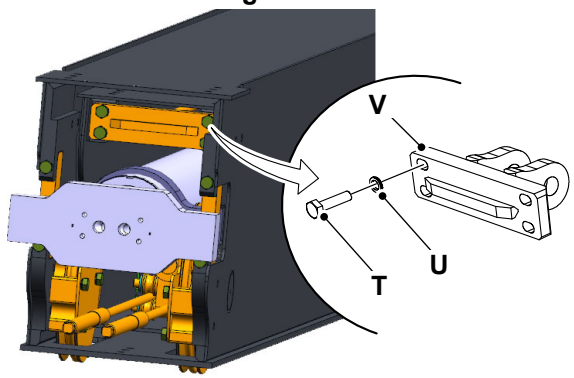


E Setscrew 2 (x4)
F Washer 2 (x4)
G Shim 1 (As required)
R Telescopic cylinder pressing block (x2)
S Intermediate boom

12. Remove the telescopic cylinder pressing block (x2) from the intermediate boom.

13. Remove the setscrew 3 (x4), washer 3 (x4) from the upper wire rope bracket located on the inner boom.

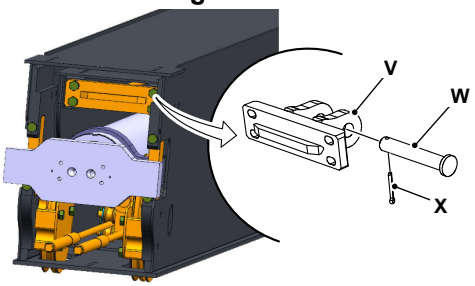
Figure 187.



T Setscrew 3 (x4)
U Washer 3 (x4)
V Upper wire rope bracket

14. Remove the pivot pin and split pin from the upper wire rope bracket.

Figure 188.



V Upper wire rope bracket
W Pivot pin
X Split pin

15. Pull out the telescopic extension cylinder along with the head wheel and extended cables from the inner boom.

    15.1. Make sure that extended cables are fixed with the cable ties to the telescopic extension cylinder so that they are removed from the inner boom together.

    15.2. Make sure that necessary lifting equipments are attached to the telescopic extension cylinder.

    15.3. Make sure that the necessary precautions are followed during the removal.

    15.4. After removal, keep the telescopic extension cylinder on the workbench.

16. Follow the below procedure to remove the telescopic extension cylinder from the head wheel.

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

1. Apply Loctite to the setscrew 3 (x4).
2. Tighten the capscrews and setscrews to the specified torque value. Refer to Table 98.

Head Wheel

Remove

1. Follow the above procedure to remove the telescopic extension cylinder.
2. Remove the setscrew 4 (x4) and washer 4 (x4) from the head wheel located on the telescopic extension cylinder.

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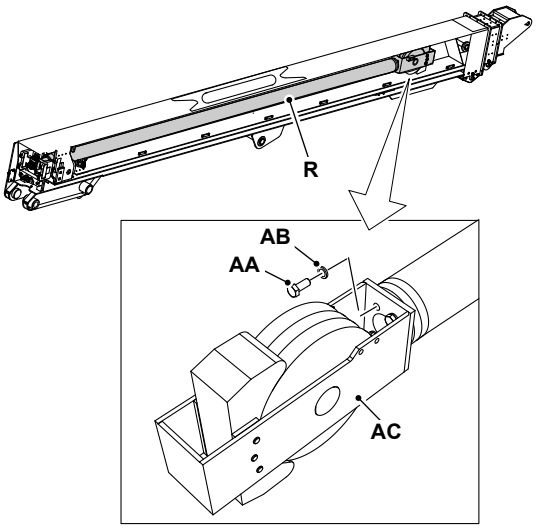
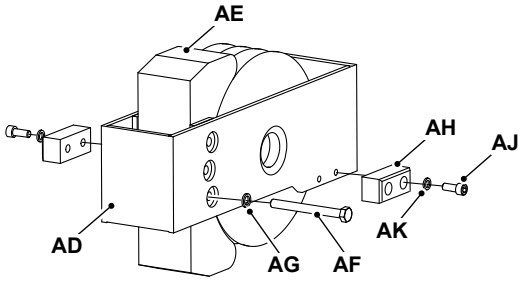
Figure 189.



Y Telescopic extension cylinder
Z Setscrew 4 (x4)
AA Washer 4 (x4)
AB Head wheel assembly

3. Remove the bolt 1 (x3) and washer 5 (x3) from the slider located on the head wheel frame.

Figure 190.

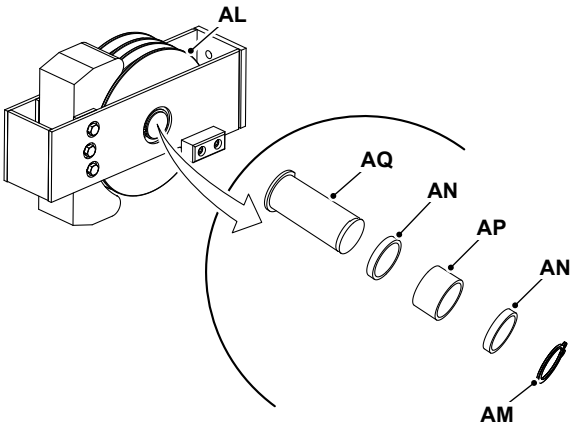


AC Head wheel frame
AD Slider
AE Bolt 1 (x3)
AF Washer 5 (x3)
AG Head wheel slider (x2)
AH Capscrew 1 (x4)
AJ Washer 6 (x4)
AK Shim 2 (As required)

4. If necessary, remove the capscrew 1 (x4),washer 6 (x4) and shim 2 from the head wheel slider (x2) located on the head wheel frame.

5. Remove the circlip 1, spacer (x2), spacer 1 and pivot pin 1 from the pulley (x2) located on the head wheel frame.

Figure 191.



AL Pulley (x2)
AM Circlip 1
AN Spacer (x2)
AP Spacer 1
AQ Pivot pin 1

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

1. Apply Loctite to the setscrew 4 (x4), bolt 1 (x3) and capscrew 1 (x4).

2. Tighten the capscrews and bolts to the specified torque value. Refer to Table 98.

Table 98. Torque Values

Item	Nm
B	5.2
E	43
J	40
L	40
Q	43
T	43
Z	167
AE	74
AH	35

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17 - Boom Lift

Introduction 30-79
Operation 30-80
Remove and Install 30-82

Introduction

The main boom lift cylinder is attached to the cylinder support arm and the main boom. The cylinder lifts and lowers the main boom. The cylinder is fitted with load holding counterbalance valves in case of a hose burst scenario.

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Operation

The boom lift cylinder is connected with linkages for the boom movements. When pressurised flow passes into the cylinder from E, boom lift cylinder will extend and the boom will raise. When pressurised flow passes into the cylinder from R, telescopic cylinder will retract and the boom will lower.

The boom operation joystick operates solenoids 2A and 2B on the main control valve. When solenoid of port 2B is energised the boom lift cylinder will extend and the boom will raise. When solenoid of port 2A is energised the boom lift cylinder will retract and the boom will lower.

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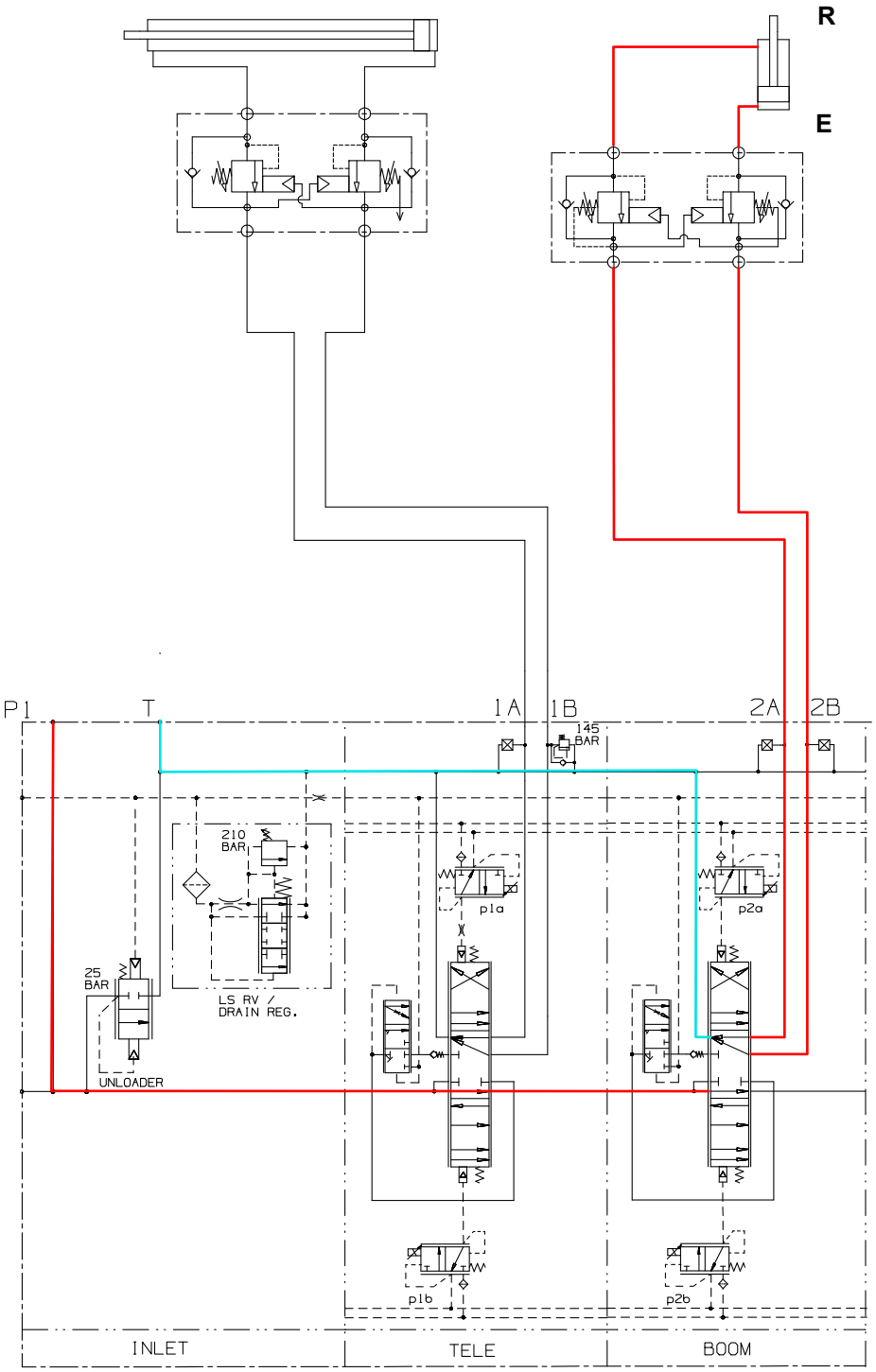
Figure 192.



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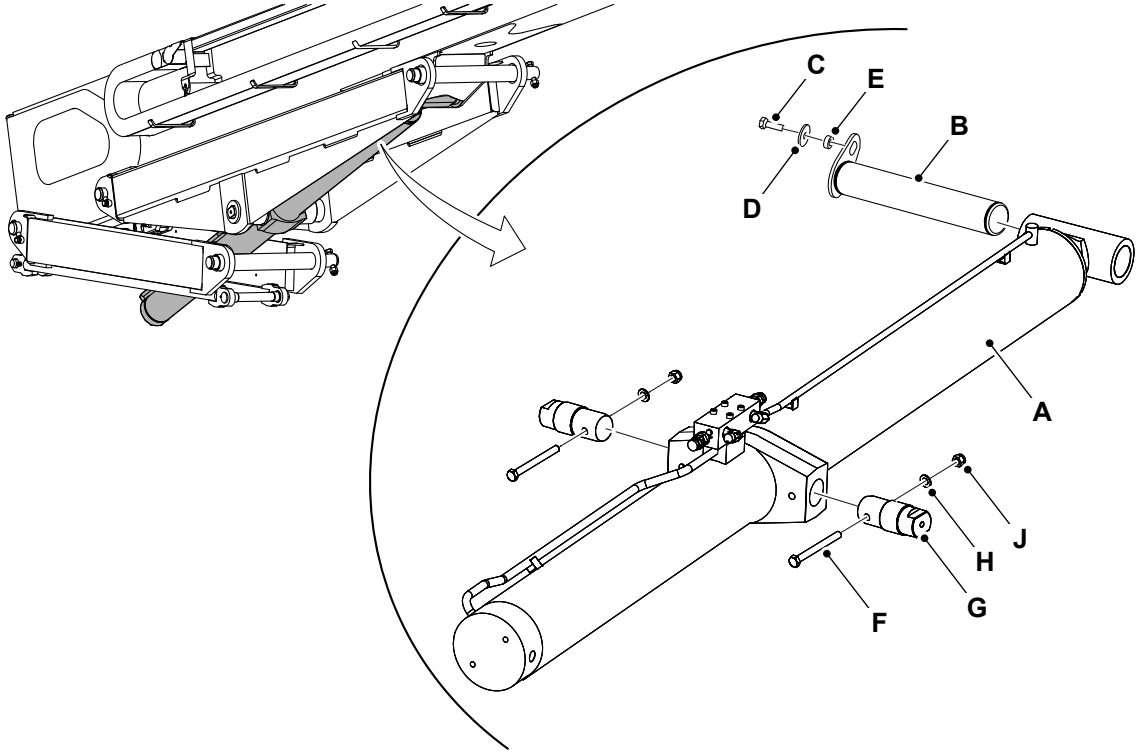
Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Discharge the hydraulic pressure.
   Refer to: PIL 30-00-00.
3. Get access to the boom lift cylinder.
4. Put a label on the hydraulic hoses to help installation.
   4.1. Remove the hoses from the boom lift cylinder.
   4.2. Plug all open ports and hoses to prevent contamination.
5. Support the boom lift cylinder with suitable lifting equipment.
6. From the cylinder mount side, remove the bolt 2 (x2), washer 2 (x2) and lock nut (x2) from the pivot pin 2 (x2).
   6.1. Remove the pivot pin 2 (x2).
7. From the rod side, remove the bolt 1, washer 1 and boss from the pivot pin 1.
   7.1. Remove the pivot pin 1.
8. Remove the boom lift cylinder from the machine.

Figure 193.



A Boom lift cylinder
B Pivot pin 1
C Bolt 1
D Washer 1
E Boss
F Bolt 2 (x2)
G Pivot pin 2 (x2)
H Washer 2 (x2)
J Locknut (x2)

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Tighten the bolt 1 and bolt 2 to the specified torque value. Refer to Table 99.

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Table 99. Torque Values

Item	Nm
C	43
F	119

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34 - Steering

Introduction 30-84
Remove and Install 30-85

Introduction

The steering cylinders are attached to the front axle and the front wheels. The cylinder turns the wheels to steer the machine.

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Remove and Install

The procedure given below is for the right steering cylinder. The procedure for the left steering cylinder is similar.

Remove

1. Make the machine safe with the platform lowered.

   Refer to: PIL 01-03-27.

2. Discharge the hydraulic pressure.

   Refer to: Discharge and Pressurise (PIL 30-00-00).

3. Disconnect the hydraulic hoses from the steering cylinder.

   3.1. Put a label on the hoses to help installation.

   3.2. Plug all the open ports and hoses to prevent contamination.

4. Remove the setscrew 1 and washer 1 from the lock pin 1.

5. Remove the pivot pin 1 and spacer (x2). Refer to Figure 194.

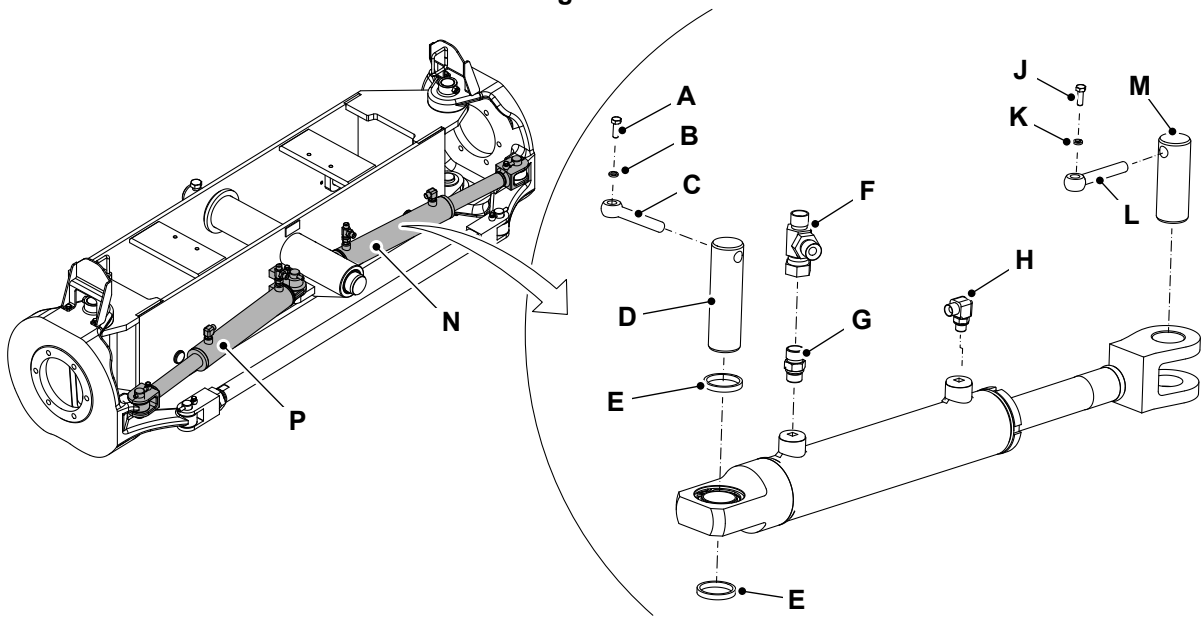
6. Remove the setscrew 2 and washer 2 from the lock pin 2.

7. Remove the pivot pin 2.Refer to Figure 194.

8. Remove the steering cylinder from the axle.

9. If required, remove the T-adaptor, adaptor 1 and elbow adaptor.

Figure 194.



A Setscrew 1
B Washer 1
C Lock pin 1
D Pivot pin 1
E Spacer (x2)
F T- adaptor
G Adaptor 1
H Elbow adaptor
J Setscrew 2
K Washer 2
L Lock pin 2
M Pivot pin 2
N Right steering cylinder
P Left steering cylinder

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Tighten the setscrews and adaptors to the specified torque value. Refer to Table 100.

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Table 100. Torque Values

Item	Nm
A	22
F	70–80
G	35–39
H	35–39
J	22

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67 - Axle Oscillation

Introduction 30-87
Remove and Install 30-88

Introduction

The axle oscillation cylinders are attached to the front axle and the chassis. The cylinders enable the front axle to pivot when the hydraulic circuit is unlocked in the forward and stowed driving condition. This enables all four wheels to maintain ground contact when driving over rough terrain. The cylinders are fitted with load holding counterbalance valves in case of a hose burst scenario. The cylinders also allow the axle to be locked to prevent oscillation relative to the chassis, when operating in the elevated mode.

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Remove and Install

The procedure given below is for the left axle oscillation cylinder. The procedure for the right axle oscillation cylinder is similar.

Remove

1. Make the machine safe with the platform lowered.

   Refer to: PIL 01-03-27.

2. Discharge the hydraulic pressure.

   Refer to: Discharge and Pressurise (PIL 30-00-00).

3. Disconnect the hydraulic hoses from the axle oscillation cylinder.

   3.1. Put a label on the hoses to help installation.

   3.2. Plug all the open ports and hoses to prevent contamination.

4. Support the axle suitably.

5. Remove the setscrew 2, washer 2 and lock pin 2 from the pivot pin 2.

6. Remove the pivot pin 2 from the lower end of the axle oscillation cylinder.

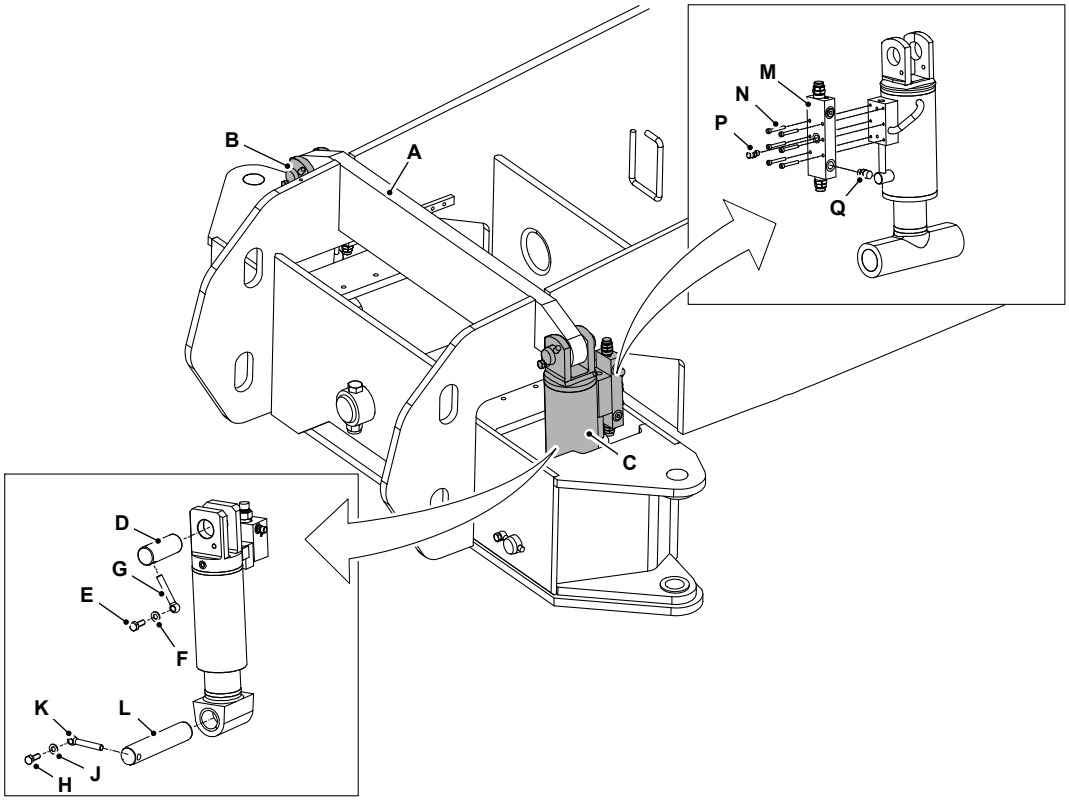
7. Support the axle oscillation cylinder suitably.

8. Remove the setscrew 1, washer 1 and lock pin 1 from the pivot pin 1.

9. Remove the pivot pin 1 from the upper end of the axle oscillation cylinder.

10. Remove the axle oscillation cylinder from the chassis.

Figure 195.



A Chassis
B Right axle oscillation cylinder
C Left axle oscillation cylinder
D Pivot pin 1
E Setscrew 1
F Washer 1
G Lock pin 1
H Setscrew 2
J Washer 2
K Lock pin 2
L Pivot pin 2
M Oscillation balance valve
N Capscrew (x6)
P Adaptor 1

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Q Adaptor 2

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Tighten the fasteners to the specified torque value. Refer to Table 101.

Table 101. Torque Values

Item	Nm
E	72
H	72
N	15
P	20–22
Q	31–37

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78 - Jib

Introduction 30-90
Operation 30-91
Remove and Install 30-93

Introduction

The jib cylinder is attached to the jib parallelogram. The cylinder lifts and lowers the jib, maintaining a constant angle of the platform. The cylinder is fitted with a load holding counterbalance valve in case of a hose burst scenario.

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Operation

Jib Lift

Select the base control enable switch from the base control panel and operate the jib boom function switch up / down or from the platform control panel, operate foot pedal and jib boom function switch up / down. The platform chooses main control valve spool shifts at 5A and 5B positions for its operations. The platform control jib spool shifts from function jib up / down. The main control valve spool 5A and 5B controls the speed and flow of the boom lift cylinder. When the oil passes through the platform control valve port C1 and Port C4 the jib operates.

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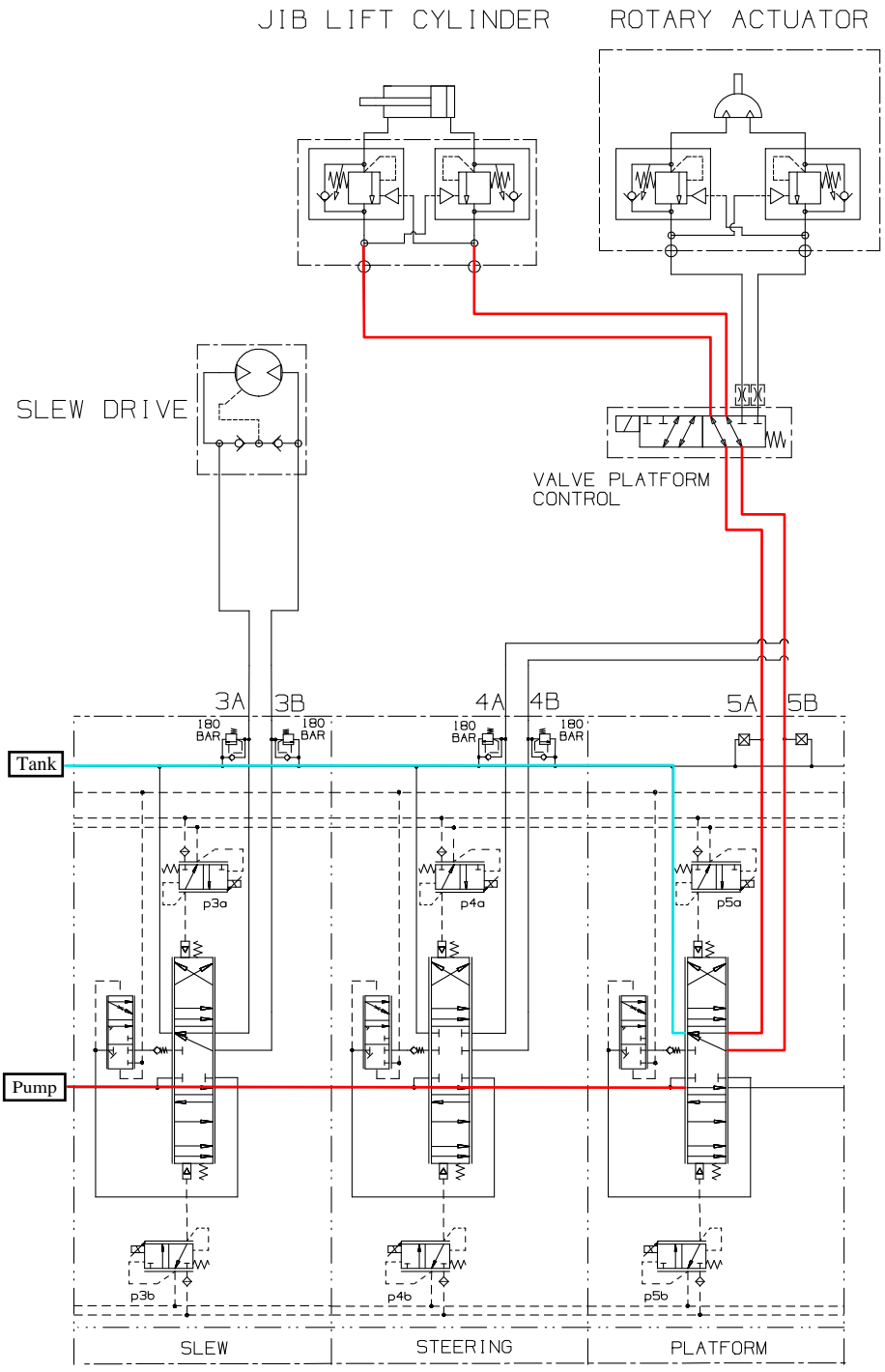
Figure 196.



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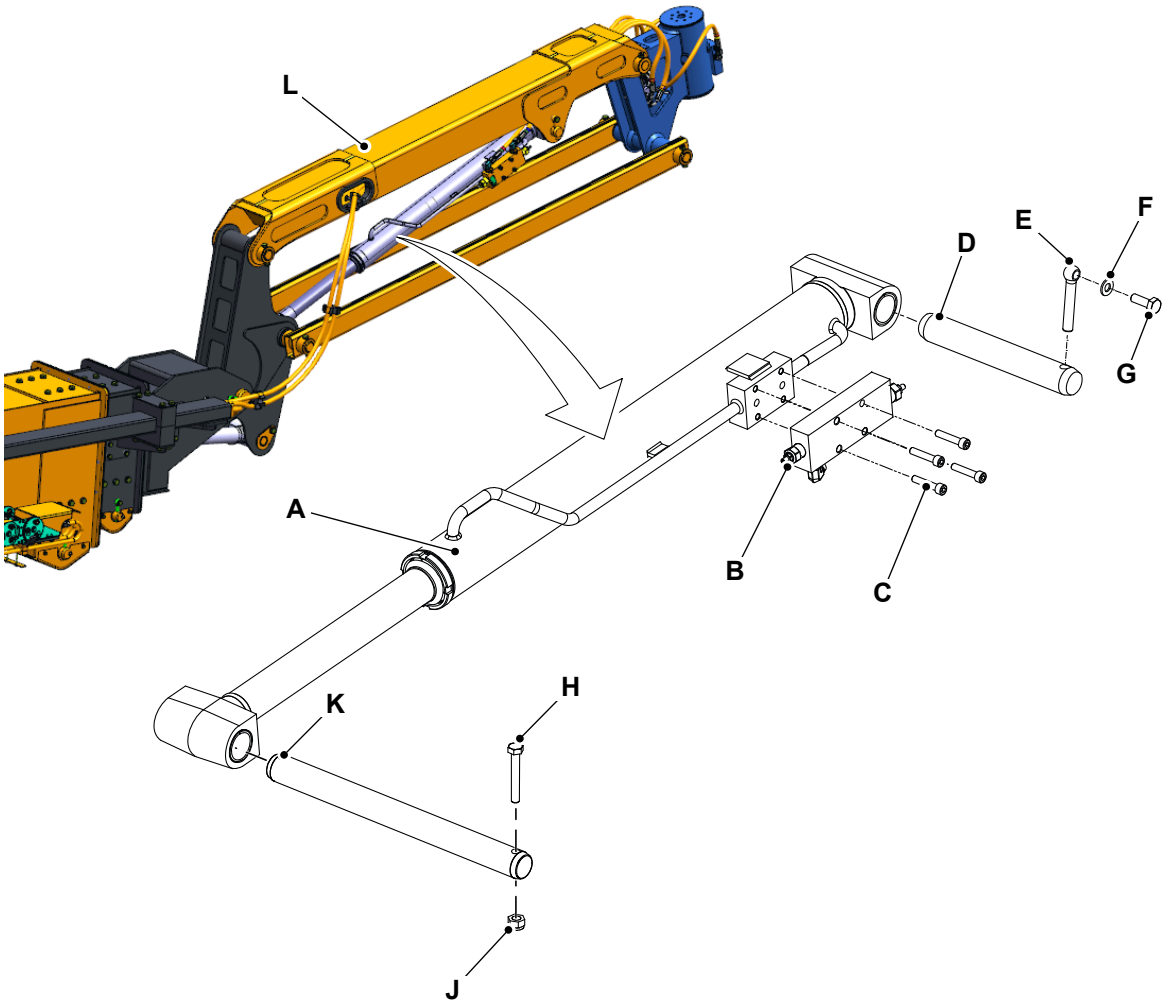
Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Discharge the hydraulic pressure.
   Refer to: Discharge and Pressurise (PIL 30-00-00).
3. Put a label on the hoses to help installation.
   3.1. Remove the hoses from the jib lifting cylinder.
   3.2. Plug all the open ports and hoses to prevent contamination.
4. Support the jib lifting cylinder with suitable lifting equipment.
5. From the cylinder end, remove the bolt 1 and washer.
   5.1. Remove the lock pivot pin and pivot pin 1.
6. From the rod end, remove the bolt 2 and locknut.
   6.1. Remove the pivot pin 2.
7. Support the platform with suitable lifting equipment.
   7.1. Support the lower booms of the jib with suitable lifting equipment.
8. Remove the jib lifting cylinder from the machine.

Figure 197.



A Jib lifting cylinder
B Jib counter balance valve
C Capscrew (x4)
D Pivot pin 1

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E Lock pivot pin
F Washer
G Bolt 1
H Bolt 2
J Locknut
K Pivot pin 2
L Jib boom

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Align the booms, jib lifting cylinder and jib knuckle.
2. Tighten the capscrews, bolt 1 and bolt 2 to the specified torque value. Refer to Table 102.

Table 102. Torque Values

Item	Nm
C	36
G	43
K	43

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82 - Lower Levelling

Introduction 30-95
Bleed 30-96
Remove and Install 30-97

Introduction

The lower levelling cylinder is attached to the connection bracket and the main boom. The cylinder acts as the master cylinder for the platform levelling circuit. The slave cylinder is the upper levelling cylinder. As the main boom lifts and lowers, the lower levelling cylinder extends and retracts, transferring pressure through a closed loop hydraulic system to the upper levelling cylinder, which then maintains the level of the platform.

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Bleed

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. From the base control panel, operate the platform levelling in both directions (start of motion) to ensure complete oil filling in the circuit.
3. Operate the boom lift upwards to achieve a boom angle of specified value. Refer to Figure 198.
   Angle: 10°

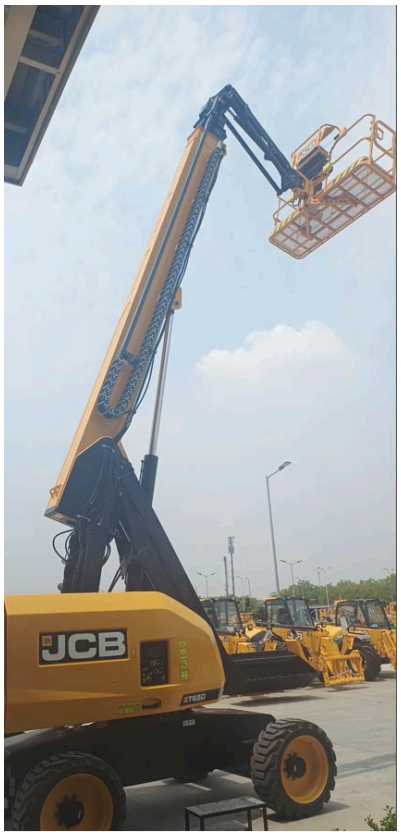
Figure 198. Boom Lift Upwards at 10° angle

4. In this position, operate the platform by leveling it down to create an extreme down position. Refer to Figure 199.

Figure 199. Platform Levelling Down

5. Operate the boom lift to its full extent to force the bleed leveling circuit in the desired direction. Refer to Figure 200.

Figure 200. Boom Lift - Full Extent



6. In this position, operate the platform leveling up to the end stroke. Refer to Figure 201.

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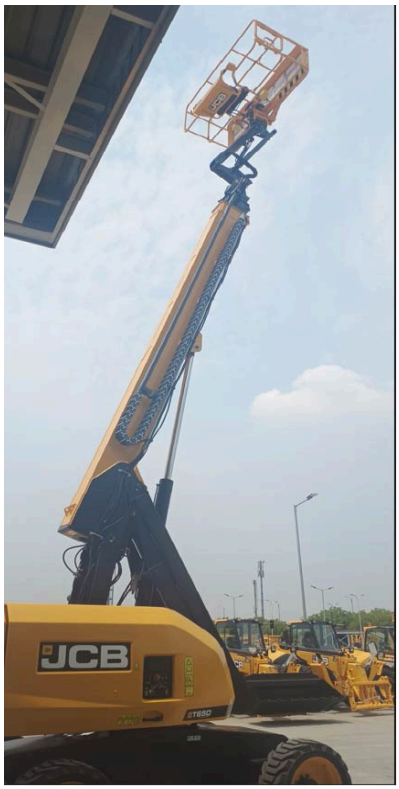
Figure 201. Platform Levelling - Up (End Stroke)



7. Now, operate the boom lift downwards to bring it to the initial position. Refer to step 3.
8. Repeat the step 3 and step 7 once again.
9. Operate the platform levelling down and up(start of motion) to fill empty hose and finish the process at specified boom lift angle position.

   Angle: 10°
10. The estimated time for bleeding the auto-levelling circuit.

    Duration: 12min

Remove and Install

Remove

1. Make the machine safe.

   Refer to: PIL 01-03-27.
2. Discharge the hydraulic pressure.

   Refer to: PIL 30-00-00.
3. Get access to the lower levelling cylinder.
4. Put a label on the hydraulic hoses to help installation.

   4.1. Remove the hoses from the lower levelling cylinder.

   4.2. Plug all open ports and hoses to prevent contamination.
5. Support the lower levelling cylinder with suitable lifting equipment.
6. Remove the setscrew (x2), washer (x2) and lock pin (x2) from the pivot pin (x2).
7. Remove the pivot pin (x2) from the rod and cylinder side of the lower levelling cylinder.
8. Remove the lower levelling cylinder from the machine.
9. If required, remove the adaptor 1, T-adaptor (x2), adaptor 2 (x2) and adaptor 3 from the lower levelling cylinder.

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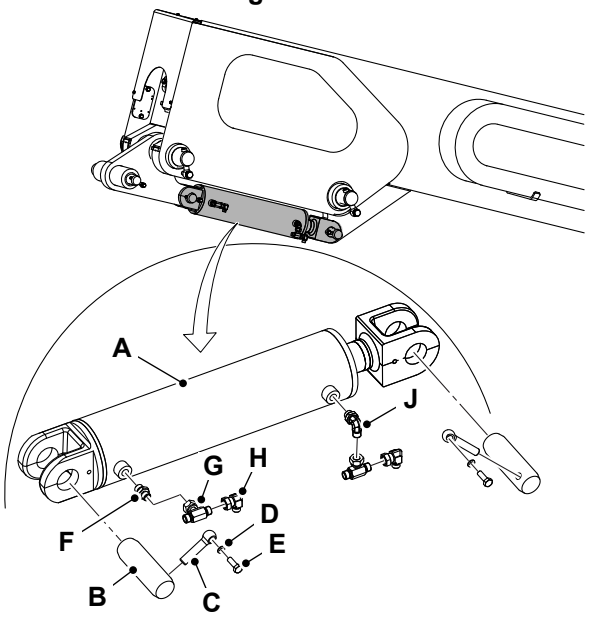
Figure 202.



A Lower levelling cylinder
B Pivot pin (x2)
C Lock pin (x2)
D Washer (x2)
E Setscrew (x2)
F Adaptor 1
G T- adaptor (x2)
H Adaptor 2 (x2)
J Adaptor 3

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Tighten the setscrews and adaptors to the specified torque value. Refer to Table 103.
2. Bleed the levelling ram circuit.

   Refer to: Bleed (PIL 30-15-82).

Table 103. Torque Values

Item	Nm
E	22
F	31–37
G	31–37
H	31–37
J	31–37

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83 - Upper Levelling

Introduction 30-99
Operation 30-100
Remove and Install 30-102

Introduction

The upper levelling cylinder is attached to the inner boom and the jib knuckle. The cylinder lifts and lowers the jib, causing the platform to rotate up and down to change or maintain the platform level. In combination with the lower levelling cylinder, the upper leveling cylinder acts as the slave cylinder in a master-slave hydraulic circuit, to keep the platform level with the chassis as the main boom lifts and lowers. The cylinder is fitted with a load holding counterbalance valve in case of a hose burst scenario.

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Operation

Platform Levelling

Platform levelling is an automatic function when the main boom is raised / lowered so that the platform remains at a constant angle relative to the chassis. It can also be a manual function to make adjustments to the angle of the platform.

For the automatic levelling function: When the main boom is raised / lowered, the master levelling cylinder is extended / retracted. This displaces oil into the slave levelling cylinder, which maintains the platform angle. When there is no manual adjustment of the platform level, the master and slave levelling cylinders are in a closed loop circuit.

For the manual levelling function: From the base control panel, select the base control enable switch and operate the platform levelling function switch up / down or from the platform control panel, operate foot pedal and platform levelling function switch up / down. The platform level spool shifts for level up / down function. Fluid flows to the cylinder to change the platform level at speed commanded (controlled by MCV (6A, 6B)).

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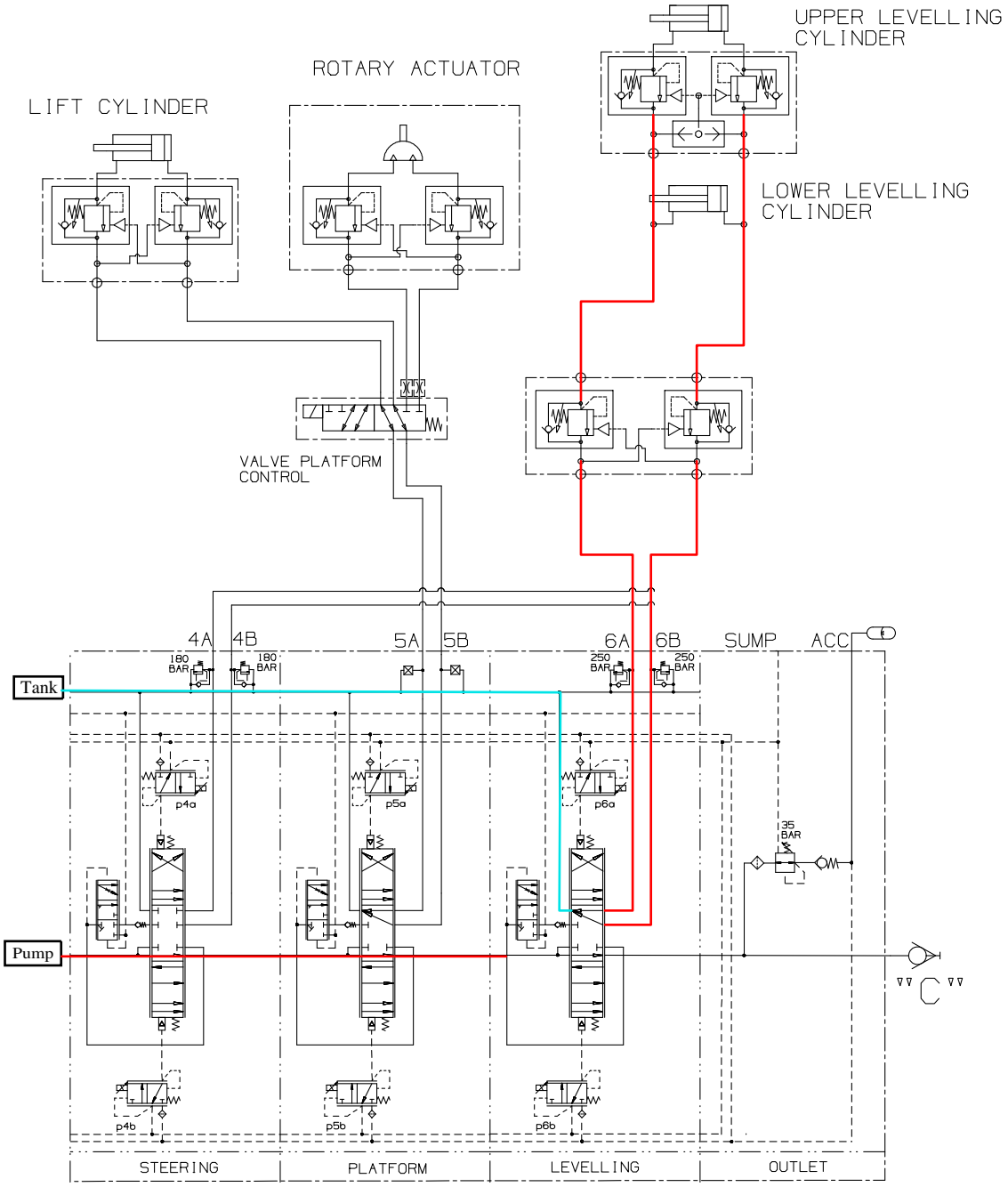
Figure 203.



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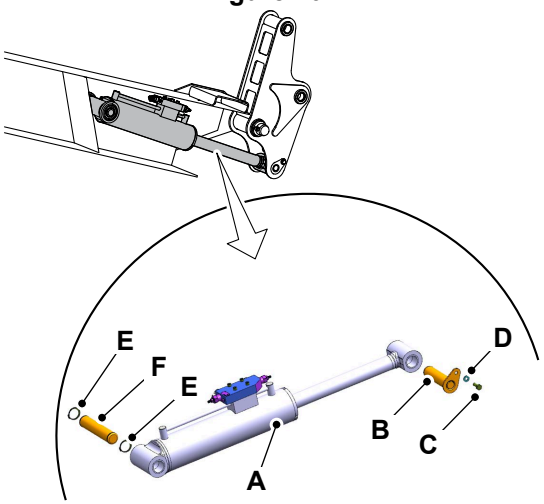
Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Extend the telescopic boom to get access to the upper levelling cylinder.
3. Discharge the hydraulic pressure.
   Refer to: PIL 30-00-00.
4. Remove the hoses from the upper levelling cylinder.
   4.1. Put a label on the hoses to help installation.
   4.2. Plug all the open ports and hoses to prevent contamination.
5. Support the upper levelling cylinder and platform with suitable lifting equipment.
6. From the cylinder end, remove the circlip (x2).
   6.1. Remove the pivot pin 2.
7. From the rod end, remove the bolt and washer.
   7.1. Remove the pivot pin 1.
8. Remove the upper levelling cylinder from the machine.

Figure 204.



A Upper levelling cylinder
B Pivot pin 1
C Bolt
D Washer
E Circlip (x2)
F Pivot pin 2

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Tighten the bolt to the specified torque value. Refer to Table 104.
2. Bleed the upper levelling cylinder circuit.
   Refer to: Bleed (PIL 30-15-82).

Table 104. Torque Values

Item	Nm
D	43

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18 - Accumulator

00 - General

Introduction 30-103
Health and Safety 30-104
Component Identification 30-104
Discharge and Pressurise 30-105

Introduction

A hydraulic accumulator is a pressure storage reservoir used to store hydraulic fluid, the non-compressible hydraulic fluid is held under pressure by a compressed nitrogen gas. It is designed to increase or relieve pressure in the hydraulic system.

Accumulators enable a hydraulic system to cope with extremes of demand using a less powerful pump, to respond more quickly to a temporary demand, and to smooth out pulsations.

It is not possible to disassemble the accumulators. The extent of permissible servicing is limited to checking the nitrogen gas pre-charge pressure. If an accumulator is suspected as being faulty it must be renewed as a complete assembly.

Make sure you have read and understood the Health and Safety implications.
Refer to: PIL 30-18-00.

There are three different types of accumulator installed on JCB machines:

- Diaphragm (sealed for life) - Non Rechargeable.
- Diaphragm (with gas valve) - Rechargeable.
- Piston Bladder - Rechargeable.

Although some accumulators are identical in appearance, the accumulators are charged to different pressures. When renewing an accumulator make sure you know the correct charge pressure, refer to the applicable Technical Data.

Upon installation of a new accumulator the correct label stating the charge pressure must be attached. The original label which states a zero charge must be removed.

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Health and Safety

⚠ **DANGER** Use only Nitrogen gas to charge accumulators. The use of any other gas can cause the accumulators to explode. Remember that although Nitrogen is not poisonous you can be killed by suffocation if it displaces the air in your workplace. Do not allow excessive quantities of Nitrogen to be discharged into the atmosphere.

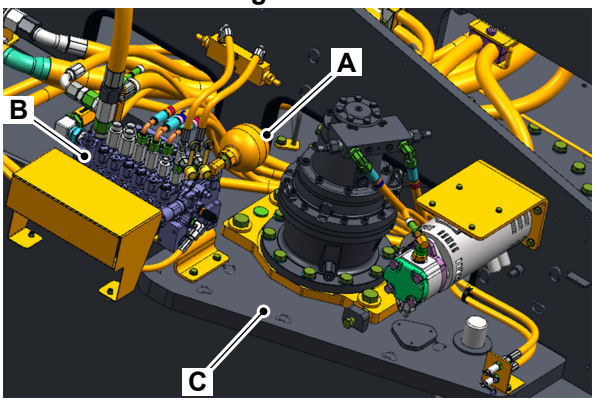
CAUTION To reduce pressure use the recommended charging tool or the charge valve could be damaged which may result in rapid discharge of the accumulator.

WARNING You must vent all the hydraulic pressure from the accumulators before disconnecting them from the hydraulic system.

Replacement accumulators will only be supplied in an uncharged, non pressurised condition to meet air freight hazardous good requirements (Health and Safety).

Component Identification

Figure 205.



A Accumulator
B Main control valve
C Turntable

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Discharge and Pressurise

Special Tools

Description	Part No.	Qty.
Accumulator Charging Kit (Diaphragm)	892/01042	1
Accumulator Charging Adaptor	892/01043	1

⚠ **WARNING** You must vent all the hydraulic pressure from the accumulators before disconnecting them from the hydraulic system.

DANGER Use only Nitrogen gas to charge accumulators. The use of any other gas can cause the accumulators to explode. Remember that although Nitrogen is not poisonous you can be killed by suffocation if it displaces the air in your workplace. Do not allow excessive quantities of Nitrogen to be discharged into the atmosphere.

Before removing accumulators make sure hydraulic pressure is released.

Even when the hydraulic pressure is released the accumulator still contains pressurised nitrogen gas. Do not attempt to discharge the gas pressure.

Do not transport accumulators charged with pressurised gas by air freight.

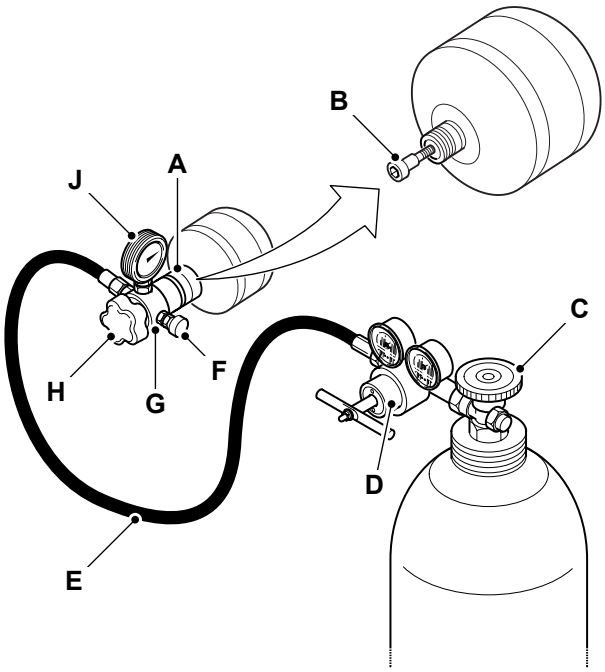
Charging

Important: The following charging procedure is only applicable to accumulators supplied in a discharged state.

Operating charge pressures: Accumulators are charged to different operating pressures depending on the application.
Refer to: PIL 30-18. for the correct charge pressure.

Charge the replacement accumulator with nitrogen as follows:

Figure 206.



A Adaptor
B Filler plug
C Gas bottle valve
D Pressure regulator
E Charging hose
F Discharge plug
G Charging unit
H Charging unit knob
J Pressure gauge

1. Hold the accumulator vertical and remove the plastic cap from the top of the accumulator.
2. Note: Some accumulators are supplied with a measured quantity of oil inside the gas chamber. Take care to prevent oil loss.
3. With a suitable allen key, slowly remove the filler plug.
   - 3.1. Remove the sealing washer and plug.
   - 3.2. Lightly oil the sealing washer.
   - 3.3. Install the new plug.
   - 3.4. Loosen the plug by 1/8 of a turn.
4. Connect the accumulator adaptor to the accumulator.
   Special Tool: Accumulator Charging Adaptor (Qty.: 1)
5. Connect the charging unit to the accumulator adaptor.
   Special Tool: Accumulator Charging Kit (Diaphragm) (Qty.: 1)

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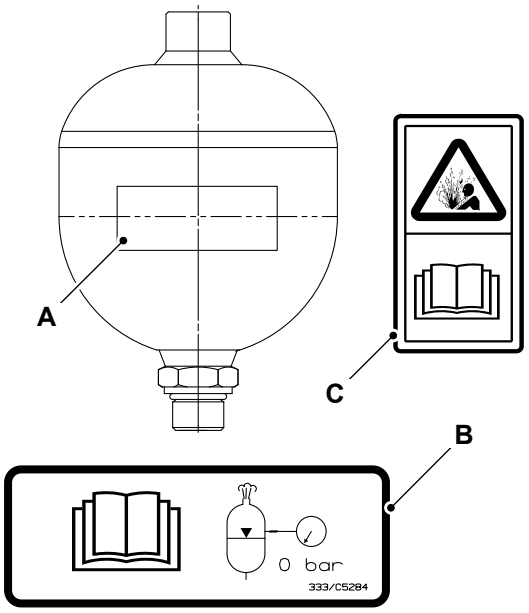
6. Connect the charging hose to the pressure regulator on the nitrogen gas bottle with the correct adaptor.
7. Set the pressure regulator on the gas bottle to the minimum pressure.
8. Turn the charging tool knob to open the filler plug by three turns.
9. Open the discharge valve on the charging unit.
10. Carefully open the nitrogen gas bottle valve and make sure that the nitrogen gas flows freely through the discharge valve.
11. Close the gas bottle valve and the discharge valve.
12. Carefully open the gas bottle valve.
13. Slowly increase the pressure using the gas bottle pressure regulator and watching the gauge on the charging unit, allow nitrogen to flow until the pressure reading reaches the specified value above the operating charge pressure.

    Pressure: 13bar (188.5psi)
14. Important: Do not exceed the maximum working pressure of the accumulator. The maximum working pressure is marked on the accumulator body.
15. Close the gas bottle valve.
16. Wait for the specified duration to dissipate the heat generated during charging.

    Duration: 10min
17. Carefully open and close the discharge valve to reduce the pressure in the accumulator to the specified operating charge pressure.
18. Turn the charging tool knob to close the filler plug and tighten to the correct torque value.

    Torque: 20N·m
19. Open the discharge valve to release the pressure from the charging hose.
20. Disconnect the charging unit and adaptor from the accumulator.
21. Pour oil around the filler plug to make sure that it is gas tight.
22. Replace the plastic cap.
23. Remove the discharged state label.
24. Attach the pressurised warning label on the accumulator at the position shown.

Figure 207.



A Label position
B Discharged state label
C Pressurised warning label

25. Install the accumulator and make sure the pressurised warning label is clearly visible.

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24 - Rotary Coupling

00 - General

Introduction 30-107
Check (Condition) 30-108
Remove and Install 30-109

Introduction

A rotary coupling also called a rotary joint or center revolving joint is a mechanism used to transfer hydraulic fluid under pressure from a stationary inlet to a rotating outlet.

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Check (Condition)

Inspect the rotary coupling components after disassembly:

1. Check the condition of the seals. If damaged, replace all O-rings and back-up rings with a new set.
2. Inspect the core and shell for wear. If worn, replace the complete rotary coupling.

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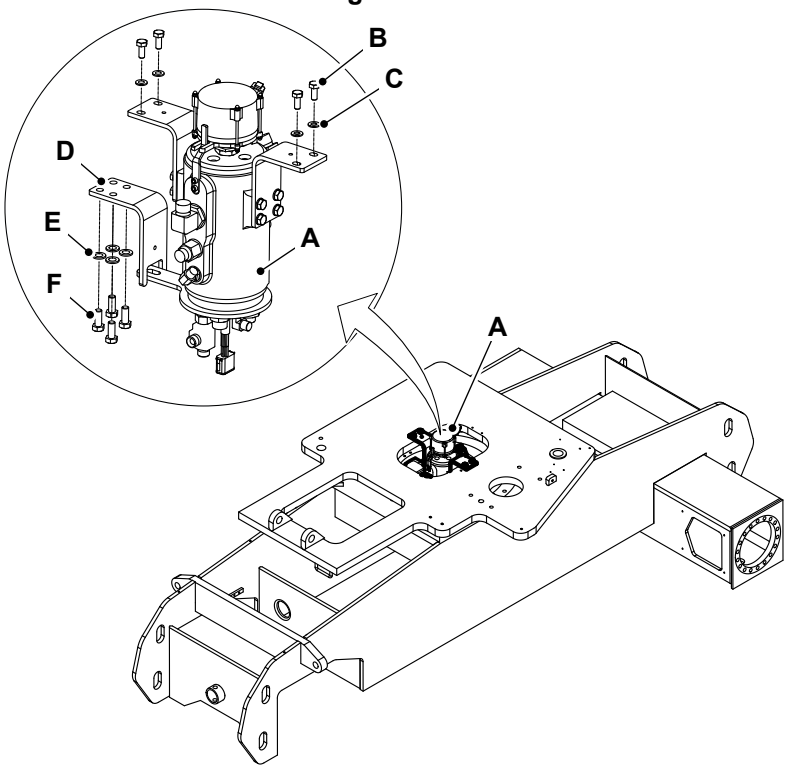
Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03.
2. Get access to the rotary coupling.
3. Remove the slew ring from the machine.
   Refer to: PIL 06-24-00.
4. Remove the hoses from the rotary coupling.
   4.1. Put caps on the open hoses and ports to prevent contamination.
   4.2. Put labels on the hydraulic hoses to aid identification for installation.
5. Remove the electrical connections from the machine.
6. Attach suitable lifting equipment to support the rotary coupling.
7. Remove the setscrew (x4) and washer 1 (x4) from the turntable structure. Refer to Figure 208.
8. Remove the bolt (x4) and washer 2 (x4) from the chassis. Refer to Figure 208.
9. Remove the rotary coupling from the chassis.

Figure 208.



A Rotary coupling
B Setscrew (x4)
C Washer 1 (x4)
D Revolving joint mount
E Washer 2 (x4)
F Bolt (x4)

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

1. Tighten the setscrews and bolts to the specified torque value. Refer to Table 105.

Table 105. Torque Values

Item	Nm
B	43
F	74

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39 - Slew Motor

00 - General

Introduction 30-110
Operation 30-111
Fault-Finding 30-113
Check (Condition) 30-114
Adjust 30-115
Remove and Install 30-116
Disassemble and Assemble 30-117

Introduction

The slew motor is a hydraulic orbital type motor that converts hydraulic flow supplied from the hydraulic pump into rotary motion.

The slew motor is controlled by hydraulic valves in the main valve block that consists of cross-line relief valves, which in conjunction with a double acting spool installed to the valve block, make sure that the inertia produced when the machine is stopped is absorbed through the cross-line relief valves. This in turn produces a smooth machine stop also preventing the hydraulic motor becoming overloaded.

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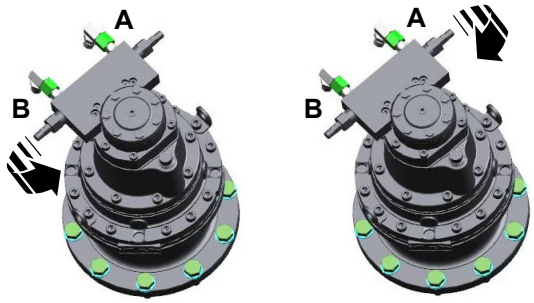
Operation

Slew drive is connected with a slew bearing on machine chassis. When pressurized flow passes in motor from port B to A, the machine will slew in right direction and when flow passes from port A to B, the machine will slew in left direction. Slew operation is protected from overpressure by auxiliary relief valve of 180bar (2,610.7psi).

Figure 209.



When slew switch or joy stick is operated port 3A, 3B of the slew spool is operated. When solenoid of port 3A is energised the machine is slewed in right direction and when port 3B is energised the machine is slewed in left direction.

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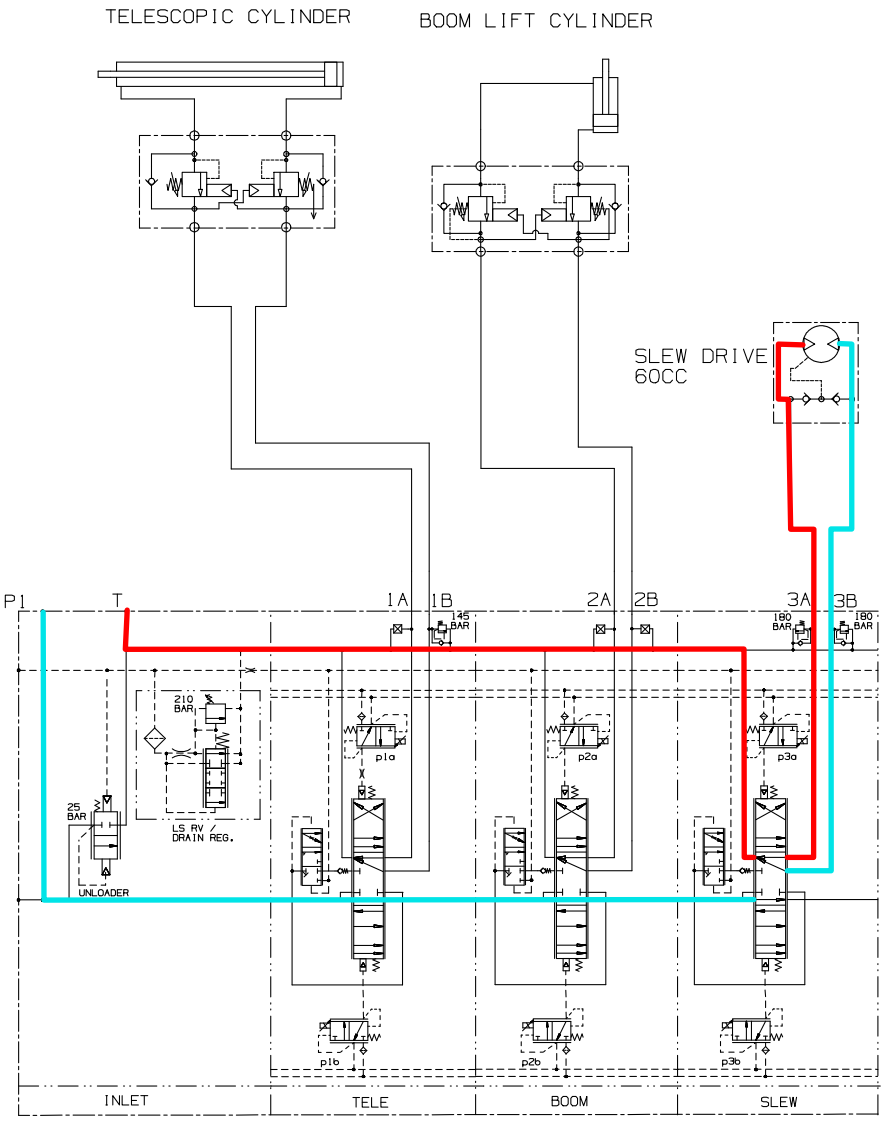
Figure 210.



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Fault-Finding

Fault		
Motor does not turn (The supplied pressure is correct)	Table 106.	Page 30-113
Insufficient torque	Table 107.	Page 30-113
Abnormal noise	Table 108.	Page 30-113
Oil leakage at housing joint face	Table 109.	Page 30-113
Oil leakage at pinion gear	Table 110.	Page 30-113
Delay in starting	Table 111.	Page 30-113
Excessive heat generation	Table 112.	Page 30-113

Table 106. Motor does not turn (The supplied pressure is correct)

Cause	Remedy
Relief valve pressure too low or faulty	Replace the relief valve
Motor has too much internal leakage	Replace the motor assembly
Reduction gears damaged	Replace the gears
Overload	Remove the overload

Table 107. Insufficient torque

Cause	Remedy
Relief valve pressure too low or faulty	Replace the relief valve
Motor has too much internal leakage	Replace the motor assembly
Reduction gears damaged	Replace the gears
Bearings damaged	Replace the bearings

Table 108. Abnormal noise

Cause	Remedy
Cavitation noise due to insufficient flow	Inspect the oil level and pipework
Motor has damaged sliding parts	Replace the motor assembly
Reduction gears damaged	Replace the gears
Bearings damaged	Replace the bearings
Pinion gear damaged	Replace the pinion

Table 109. Oil leakage at housing joint face

Cause	Remedy
Damaged O-rings	Replace the O-rings
Loose bolts	Tighten to the correct torque value

Table 110. Oil leakage at pinion gear

Cause	Remedy
Damaged oil seal	Replace the oil seal

Table 111. Delay in starting

Cause	Remedy
Relief valve pressure too low or faulty	Replace the relief valve
Check valve internal leakage	Replace the check valve

Table 112. Excessive heat generation

Cause	Remedy
Reduction gears damaged	Replace the gears
Bearings damaged	Replace the bearings

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Check (Condition)

Reduction Gear

Table 113.

Item	Item inspected for	Inspection	Repair
	Excessive wear of the surface	Pitting area is 5% or more of the gear surface	Replace the carrier kit
Ring	Damage to spline section	Visual check	Replace the carrier kit
S1 Gear, S2 Gear, B1 gear, B2 Gear	Excessive wear of the surface	Pitting area is 5% or more of the gear surface	Replace the carrier kit
	Excessive wear of the bearing surface	Visual check, pitting and flaking apparent	
Ring	Excessive wear of the bearing surface	Visual check, pitting and flaking apparent	Replace the carrier kit
Other (O ring, screw etc.)	Damage or excessive rust	-	Replace applicable part

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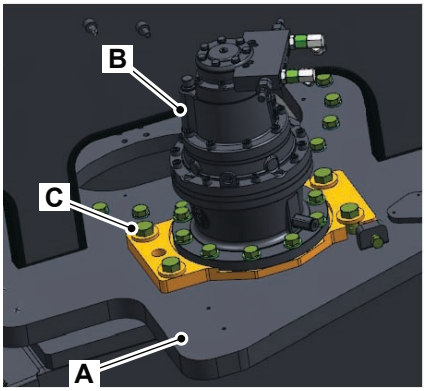
Adjust

1. Check the pinion tooth backlash with the help of filler gauge.
2. Make sure that the backlash is between the specified value. If not adjust the backlash. 3 to 5

   Dimension: 0.12→0.15mm
3. Loosen the bolt (x4), so that the slew drive moves parallel to the turntable without any vertical movement.

Figure 211.

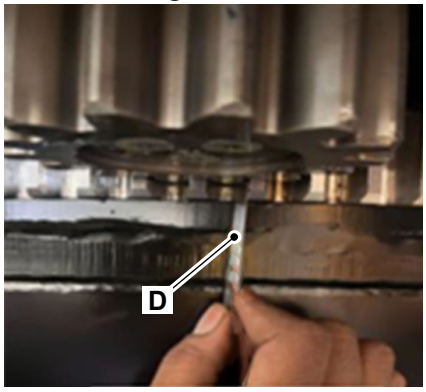


A Turntable
B Slew drive
C Bolt (x4)

4. Use the filler gauge with the specified value and check the space between the meshing gears.

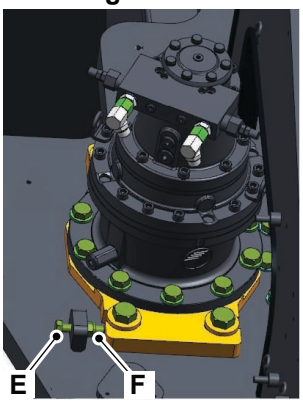
   Dimension: 0.12mm

Figure 212.



D Filler gauge

Figure 213.



E Setscrew
F Locknut

4.1. If the filler gauge easily passes through the gap of 0.12 mm, then tighten the adjustment setscrew to the specified torque value.

   Torque: 104N·m

4.2. Tighten the adjustment setscrew until it achieves a backlash of 0.12 to 0.15 mm, then secure the adjustment setscrew by tightening the locknut.

5. Tighten the bolt (x4) to the specified torque value to secure the slew drive position with the adjusted backlash.

   Torque: 360N·m

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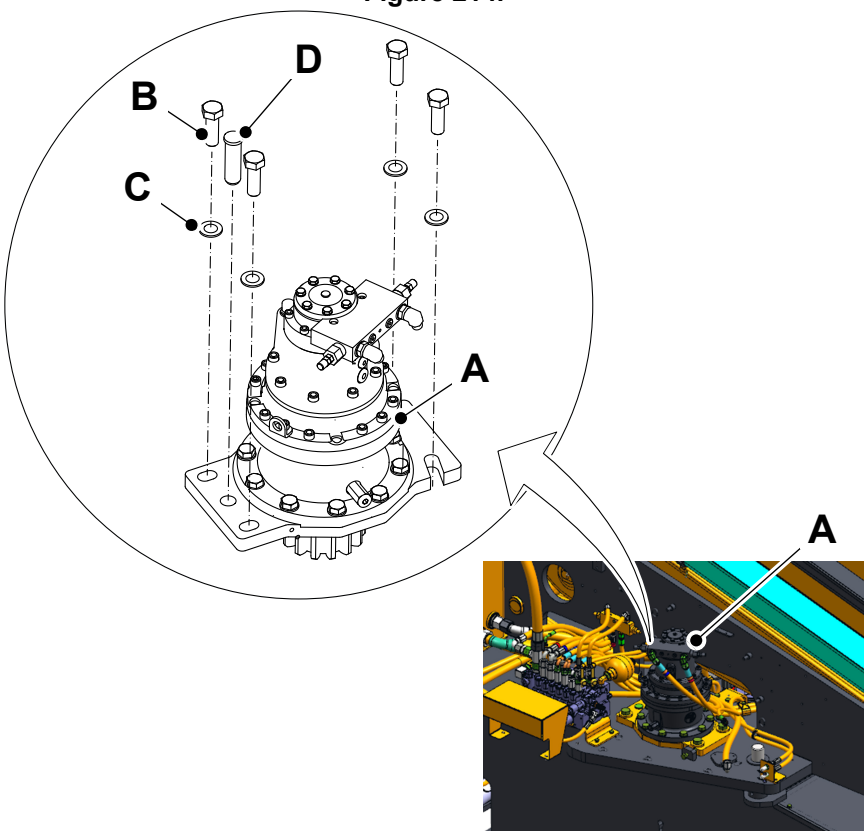
Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Discharge the hydraulic pressure.
   Refer to: Discharge and Pressurise (PIL 30-00-00).
3. Disconnect the hydraulic hoses from the slew drive motor.
   3.1. Put a label on the hoses to help installation.
   3.2. Plug all the open ports and hoses to prevent contamination.
4. Support the slew drive motor with suitable lifting equipment.
5. Slacken off the adjuster bolt (x4) and washer (x4) from the turntable structure.
6. Remove the headed pin.
7. Remove the slew drive motor from the machine.

Figure 214.



A Slew drive motor
B Bolt (x4)
C Washer (x4)
D Pin headed

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Tighten the bolt (x4) to correct torque value. Refer to Table 114.

Table 114. Torque Values

Item	Nm
B	360

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Disassemble and Assemble

Manually navigate to the JCB Service Pro to view the manufacturer's service manual for slew drive disassemble and assemble procedure.

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56 - Main Control Valve Block

00 - General

Introduction 30-118
Component Identification 30-119
Diagram 30-121
Check (Pressure) 30-122
Remove and Install 30-123

Introduction

The main control valve block controls the hydraulic functional elements of the slew, main boom lift, telescopic extension, flow to jib lift and platform rotate, platform levelling and steering.

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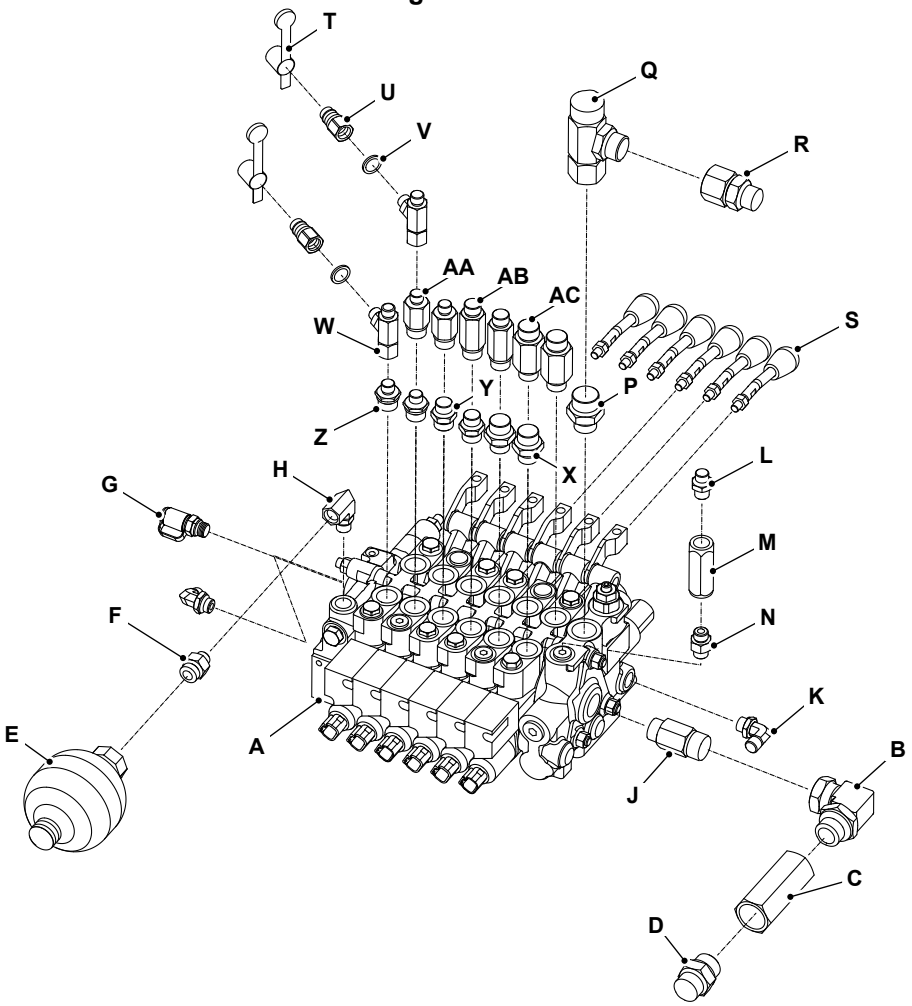
Component Identification

Figure 215.



A Main boom control valve
B Adaptor 1
C Check valve 1
D Adaptor 2
E Accumulator
F Adaptor 3
G Hydraulic test point adaptor
H Elbow- adaptor 1
J Adaptor 4
K Elbow- adaptor 2 (x2)
L Adaptor 5
M Check valve 2
N Adaptor 6
P Adaptor 7
Q T- adaptor
R Adaptor 8
S Lever handle control spool (x6)
T Q - R coupling cap (x2)
U Q / R male coupling (x2)
V Bonded washer (x2)
W Adaptor 9 (x2)
X Adaptor 10 (x2)
Y Adaptor 11 (x2)
Z Adaptor 12 (x2)
AA Adaptor 13 (x2)
AB Adaptor 14 (x2)
AC Adaptor 15 (x2)

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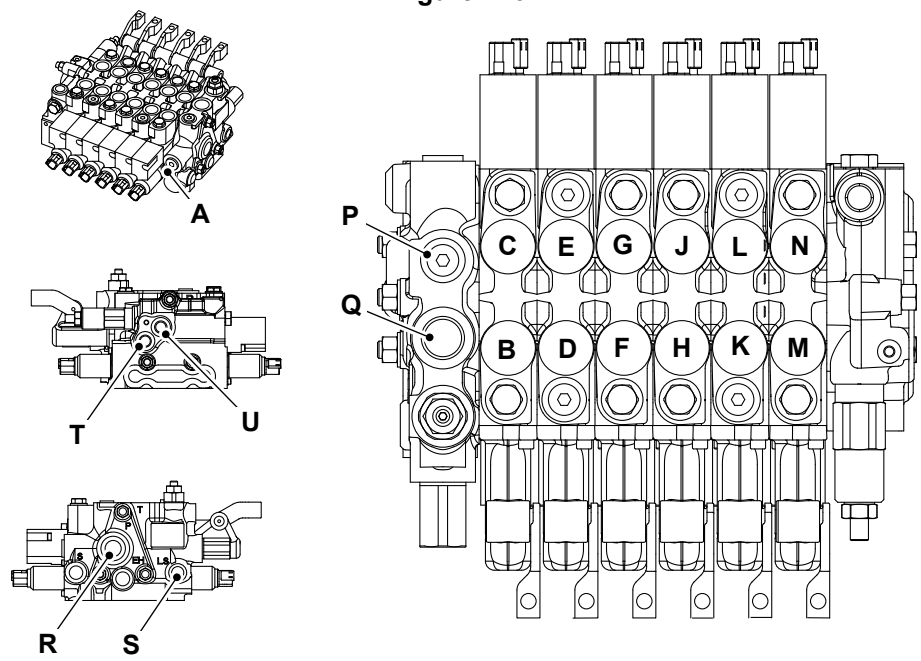
Figure 216.



A Main boom control valve
B Telescopic boom retraction
C Telescopic boom extension
D Main boom down
E Main boom up
F Slew motor clockwise rotation
G Slew motor anticlockwise rotation
H Steering (left)
J Steering (right)
K Jib and platform (down and right)
L Jib and platform (up and left)
M Levelling down
N Levelling up
P Pump gauge port
Q Tank port
R Pump port
S Load sense port
T Sump port
U Pump 2 port

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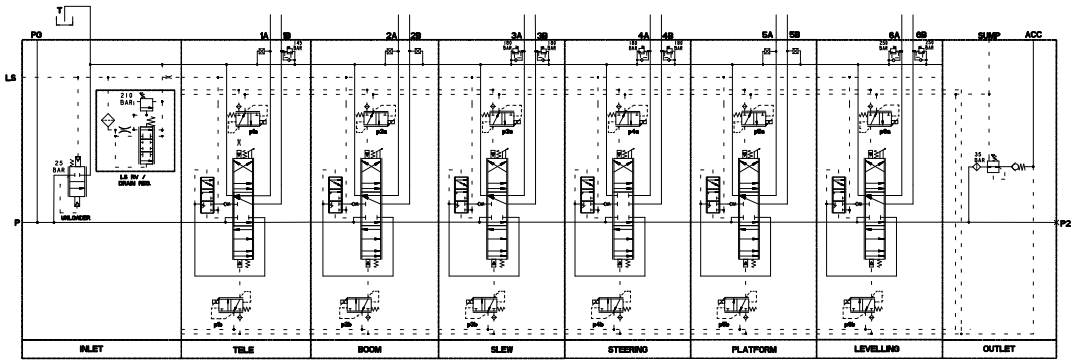
Diagram

Figure 217.



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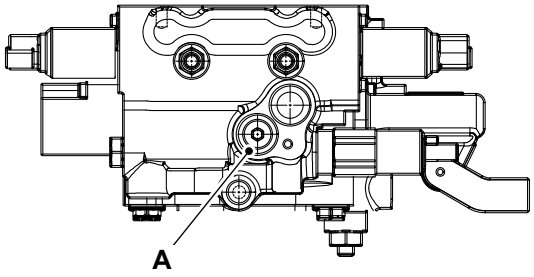
Check (Pressure)

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Remove the plug from the pump gauge port (P3).
   2.1. Connect a suitable pressure gauge to the pump gauge port (P3).
   Pressure: 250bar (3,625.9psi)
3. Start the engine.
4. Make sure that the pressure gauge displays specified idle pressure.
   Pressure: 15→18bar (217.6→261.1psi)
5. To check maximum pressure of hydraulic system for lower telescopic boom lift or telescopic retraction, continuously hold the operation switch from base control.
   5.1. The pressure gauge should show a specified value.
   Pressure: 230→240bar (3,335.9→3,480.9psi)
6. There are different relief pressure set for various boom operations. Refer to Table 115.

Figure 218.



A Pump gauge port (P3)

Table 115.

Boom Function	Auxiliary Relief Pressure
Steering right	180bar (2,610.7psi)
Steering left	180bar (2,610.7psi)
Platform levelling up	250bar (3,625.9psi)
Platform levelling down	250bar (3,625.9psi)
Platform jib up	235bar (3,408.4psi)
Platform jib down	235bar (3,408.4psi)
Platform rotate right	235bar (3,408.4psi)
Platform rotate left	235bar (3,408.4psi)
Telescopic boom extension	145bar (2,103.0psi)
Telescopic boom retract	235bar (3,408.4psi)
Main boom up	235bar (3,408.4psi)
Main boom down	235bar (3,408.4psi)
Slew right	180bar (2,610.7psi)
Slew left	180bar (2,610.7psi)

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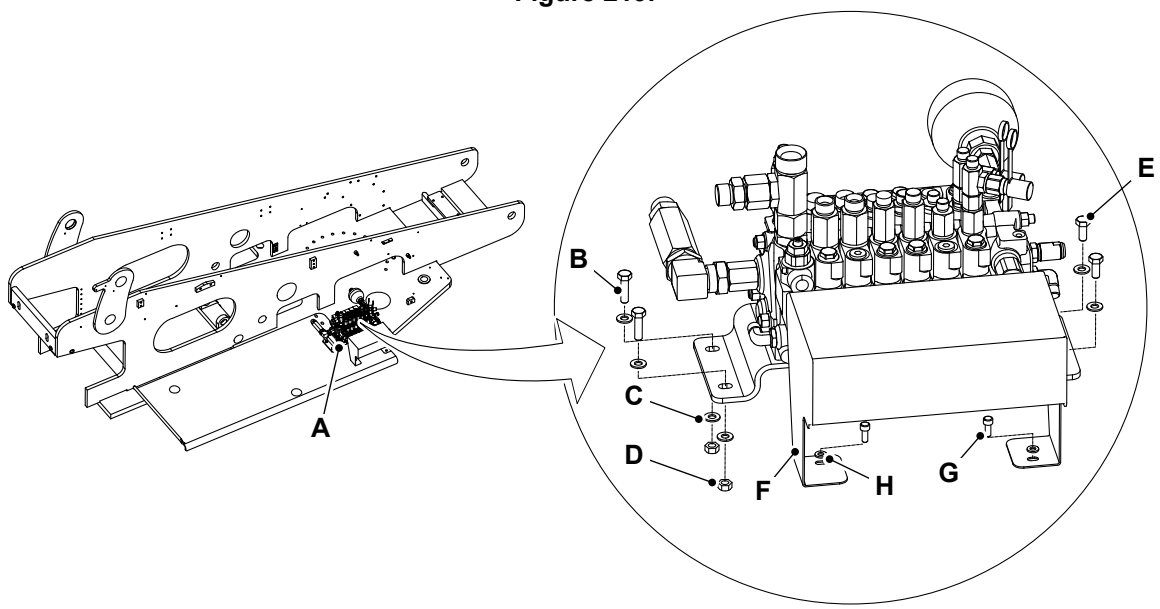
Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Discharge the hydraulic pressure.
   Refer to: PIL 30-00-00.
3. Get access to the main control valve block.
4. Put a label on the hoses to help installation.
   4.1. Disconnect the hydraulic hoses.
   4.2. Plug all the open ports and hoses to prevent contamination.
5. Support the main control valve block with suitable lifting equipment.
6. Remove the capscrew (x2), washer 2 (x2) from the base mounting plate.
7. Remove the lever cover plate from the base mounting plate.
8. Remove the bolt (x2), washer 1 (x6), nut (x2) and setscrew (x2) from the base mounting plate.
9. Remove the main control valve block with mounting bracket from the machine.

Figure 219.



A Main control valve block
B Bolt (x2)
C Washer 1 (x6)
D Nut (x2)
E Setscrew (x2)
F Levers cover plate
G Capscrew (x2)
H Washer 2 (x2)

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. After installation, check the operation of hydraulic services.
2. Tighten the bolt (x2), setscrew (x2) and capscrew (x2) to the correct torque value. Refer to Table 116.

Table 116. Torque Values

Item	Nm
B	22
E	22
G	15

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57 - Transmission Control Valve Block

00 - General

Introduction 30-124
Component Identification 30-125
Remove and Install 30-126

Introduction

The transmission control valve block directs the hydraulic flow to the wheel motors for forward and reverse drive.

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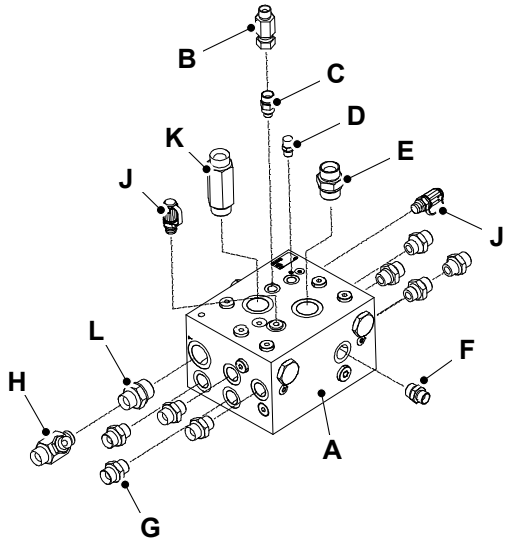
Component Identification

Figure 220.



A Transmission control valve
B T - adaptor 1
C Adaptor (x1) (port M)
D Adaptor (x1) (port C)
E Adaptor (x1) (port B)
F Adaptor (x1) (port T1)
G Adaptor (x8) (ports RRB, RRA, RLA, FRA, FRB and FLA)
H T - adaptor 2
J Test point adaptor (x2) (ports MA and MB)
K Adaptor (x1) (port A)
L Adaptor (x1) (port T)

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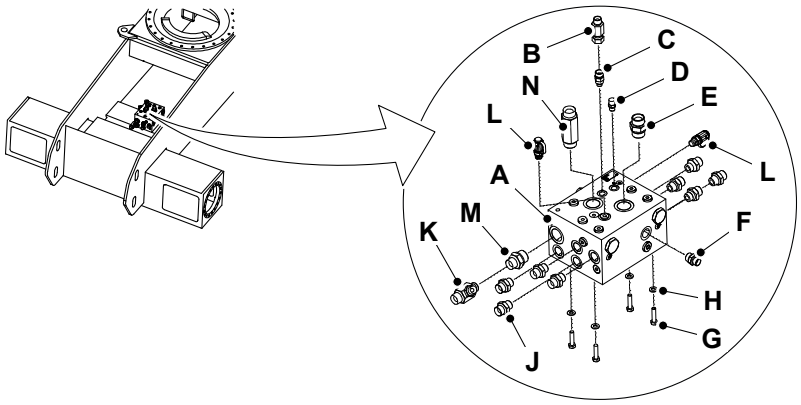
Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03.
2. Open the chassis cover.
3. Get access to the transmission control valve block.
4. Chock the wheels and switch the machine off to discharge the hydraulic pressure from the park brake and drive circuit.
5. Disconnect the hoses from the transmission control valve block.
   5.1. Put a label on the hoses to help installation.
   5.2. Plug all the open ports and hoses to prevent contamination.
6. Remove the setscrew (x4) and washer (x4).
7. Remove the transmission control valve block from the machine.
8. If required, remove T- adaptor 1, adaptor 1, adaptor 2, adaptor 3 (x3), adaptor 4, adaptor 5 (x8), T- adaptor 2, adaptor 6, adaptor 7 and hydraulic test point adaptor (x2).

Figure 221.



A Transmission control valve block
B T- Adaptor 1
C Adaptor 1
D Adaptor 2
E Adaptor 3
F Adaptor 4
G Setscrew (x4)
H Washer (x4)
J Adaptor 5 (x8)
K T- Adaptor 2
L Hydraulic test point adaptor (x2)
M Adaptor 6
N Adaptor 7

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Tighten the setscrews, adaptors and hydraulic test point adaptors to the specified torque value. Refer to Table 117.

Table 117. Torque Values

Item	Nm
B	45–50
C	20–22
D	20–22
E	95–108
F	45–50
J	45–50
K	95–108
L	35–39
M	95–108
N	95–108

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60 - Directional Control Valve

03 - Brake

Introduction 30-127
Component Identification 30-128
Remove and Install 30-129

Introduction

The brake control valve is fitted on the chassis. It controls the flow of direction and movement or rotation of hydraulic drives.

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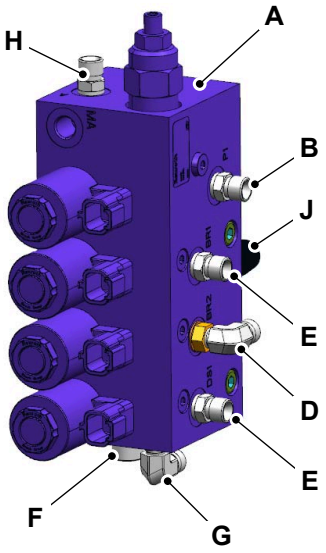
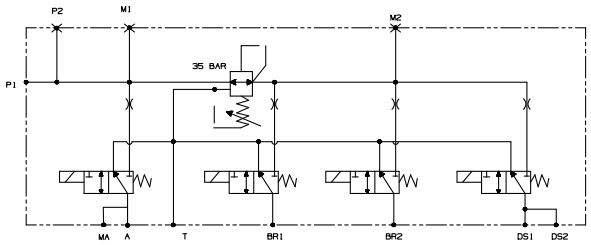
Component Identification

Figure 222.



A Brake control valve
B Port P1 - brake control valve to transmission control valve
C Port BR1 - brake control valve to front side drive motors
D Port BR2 - brake control valve to rear side drive motors
E Port DS1 - brake control valve to front side drive motors
F Port T - brake control valve to transmission control valve
G Port DS2 - brake control valve to rear adaptor bulkhead
H Port A - brake control valve to front adaptor bulkhead
J Hydraulic test point adaptor

Figure 223. Schematic Diagram



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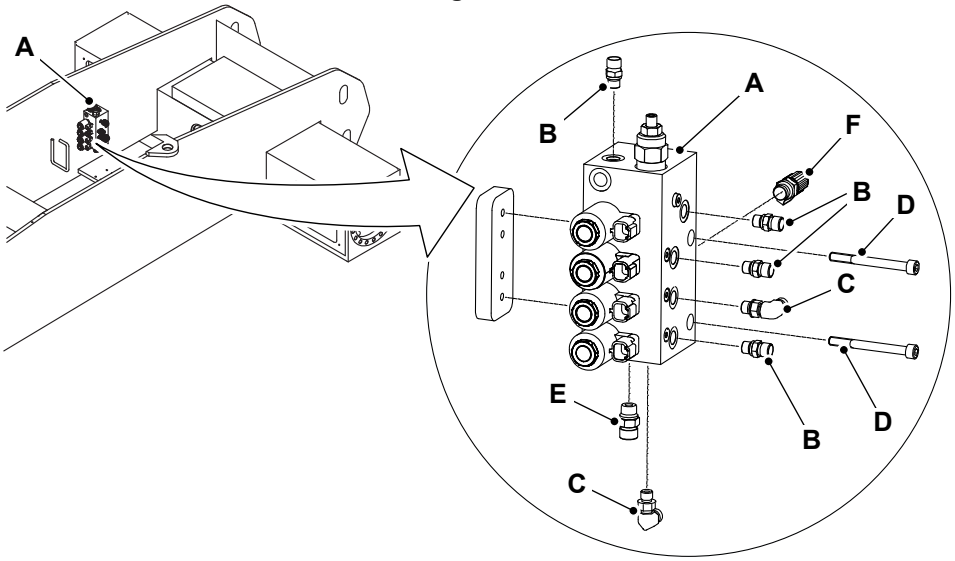
Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Get access to the brake control valve.
3. Disconnect the harness from the solenoid electrical connector.
4. Disconnect and plug the brake valve hoses to prevent the ingress of dirt.
   4.1. Label the hoses to help installation.
5. Remove the capscrew (x2) and lift the brake valve from the machine.

Figure 224.



A Brake control valve
B Adaptor 1 (x4)
C Elbow adaptor (x2)
D Capscrew (x2)
E Adaptor 2
F Hydraulic test point adaptor

Install

The installation is the opposite of the removal procedure. Additionally do the following the steps.

1. Check the hydraulic tank level.
2. Bleed the brake control valve system.
3. Tighten the capscrews, adaptors and hydraulic test point adaptor to the specified torque value. Refer to Table 118.

Table 118. Torque Values

Item	Nm
B	20–22
C	20–22
D	36
E	31–37
F	31–37

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68 - Platform

Introduction 30-130
Component Identification 30-131
Remove and Install 30-132

Introduction

The platform control valve is fitted on the jib knuckle. It receives flow from the platform or jib flow valve output of the main valve block (5A/5B). It consists of two solenoid controlled spools, two orifices of size 1.5mm platform rotate. The main function of the platform control valve is to raise and lower the jib, and to rotate the platform left and right.

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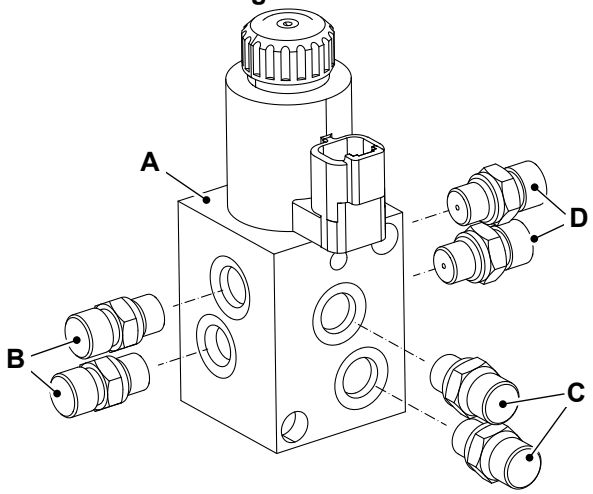
Component Identification

Figure 225.



A Platform control valve
B Adaptor
C Adaptor 1
D Restrictor

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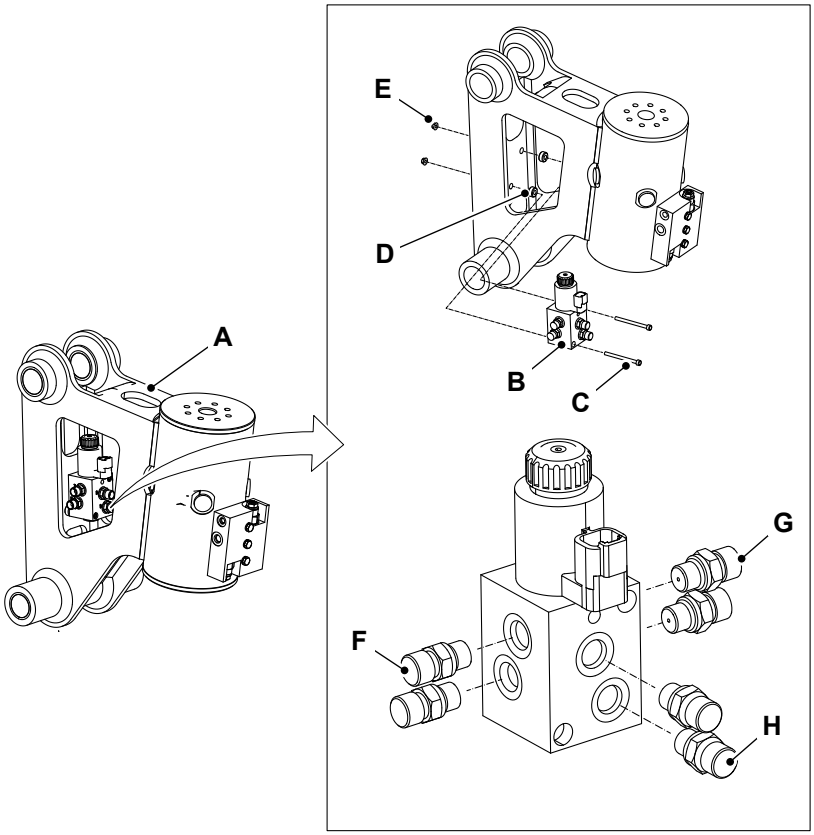
Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Get access to the rotary actuator.
3. Disconnect the hoses from the rotary actuator.
   3.1. Put a label on the hoses to help installation.
   3.2. Plug all the open ports and hoses to prevent contamination.
4. Remove the capscrew (x2), spacer (x2) and nut (x2) from the rotary actuator.
5. Remove the platform control valve from the machine.
6. If required, remove the adaptor (x2), restrictor (x2) and adaptor 1 (x2).

Figure 226.



A Rotary actuator
B Platform control valve
C Capscrew (x2)
D Spacer (x2)
E Nut (x2)
F Adaptor (x2)
G Restrictor (x2)
H Adaptor 1 (x2)

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Tighten the capscrews, adaptors and restrictor to the specified torque value. Refer to Table 119.

Table 119. Torque Values

Item	Nm
C	8.8
F	20–22
G	20–22
H	20–22

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93 - Hose

00 - General

Introduction 30-133
Disconnect and Connect 30-134
Check (Condition) 30-135

Introduction

Hydraulic hoses are used to connect different components in the hydraulic circuit. The hoses are graded by pressure, temperature, and fluid compatibility. Hoses are built up with rubber and steel layers. A rubber interior is surrounded by multiple layers of woven wire and rubber. The exterior is designed for abrasion resistance. The bend radius of a hydraulic hose is carefully designed for the machine, since hose failures can be deadly, and violating the hose's minimum bend radius will cause failure. Hydraulic hoses generally have steel fittings swaged on the ends.

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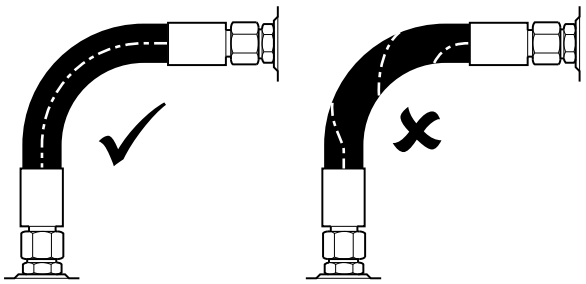
Disconnect and Connect

Some attachments are hydraulically powered. The following procedures show how to connect and disconnect the hydraulic hoses safely.

Connecting the Hydraulic Hoses

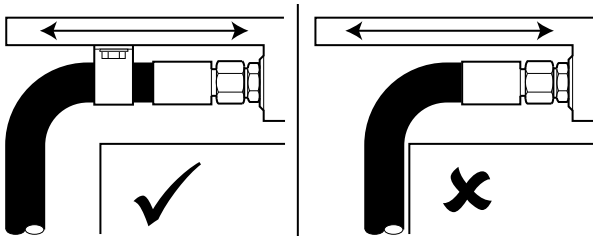
1. Make the machine safe.
2. Discharge the hydraulic system pressure.
3. Check the hoses and adaptors for damage.
4. Connect the hoses:
   - 4.1. Make sure that the hose is not twisted. Pressure applied to a twisted hose can cause the hose to fail or the connections to loosen.

Figure 227.



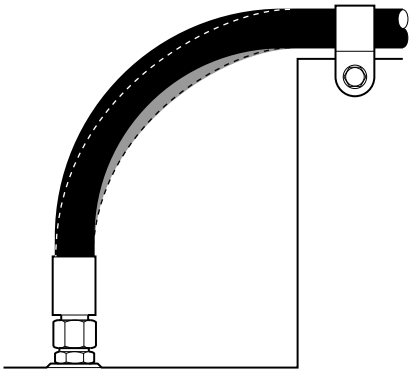
   - 4.2. Make sure that the hose does not touch hot parts. High ambient temperatures can cause the hose to fail.
   - 4.3. Make sure that the hose does not touch parts which can rub or cause abrasion.
   - 4.4. Use the hose clamps (where possible) to support long hose runs and keep the hoses away from moving parts, etc.

Figure 228.



   - 4.5. To allow for length changes when the hose is pressurised, do not clamp at the bend. The curve absorbs the change.

Figure 229.



5. Check for leaks:
   - 5.1. Start the machine.
   - 5.2. Operate the related controls to increase the pressure in the hydraulic system.
   - 5.3. Stop the machine then remove the key.
   - 5.4. Check for indications of leakage at the hose connections. Correct, as necessary.

Disconnecting the Hydraulic Hoses

1. Make the machine safe.
2. Discharge the hydraulic system pressure.
3. Disconnect the hoses.
4. Check the hoses and adaptors for damage.
5. If necessary, install the blanking caps.
6. Check for leaks:
   - 6.1. Start the machine.
   - 6.2. Operate the related controls to increase the pressure in the hydraulic system.
   - 6.3. Stop the machine then remove the key.
   - 6.4. Check for indications of leakage at the hose connections. Correct, as necessary.

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Check (Condition)

Hydraulic Hoses

⚠ **WARNING** Damaged hoses can cause fatal accidents. Examine the hoses regularly. Do not use the machine if a hose or hose fixture is damaged.

WARNING Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of fluid under pressure and wear personal protective equipment. Hold a piece of cardboard close to suspected leaks and then examine the cardboard for signs of fluid. If fluid penetrates your skin, get medical help immediately.

Examine the hoses for:

- Damaged hose ends
- Worn or cracked outer covers
- Ballooned outer covers
- Kinked or crushed hoses
- Exposed armouring in the outer covers
- Displaced hose end fittings.
- Worn cover sheathing or hose burst protection covering

Replace a damaged hose before you use the machine again.

The replacement hoses must be of the same size, standard and pressure rating. If necessary, for more information contact your JCB dealer.

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96 - Pipe

00 - General

Check (Condition)

The hydraulic system pipework comprises flexible hoses and steel hydraulic pipes.

1. Make the machine safe.

   Refer to: PIL 01-03-27.

2. Visually check the system pipework for the following defects:

   2.1. Hydraulic oil leaks.

   2.2. Security of ties and clamps.

   2.3. Security of connections.

   2.4. Crushed or kinked pipes and hoses.

   2.5. Chaffed pipes and hoses.

   2.6. Corroded steel pipes.

3. If one or more of the listed defects is identified, replace the applicable pipe/hose or retaining ties and clamps.

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97 - Connectors

00 - General

Technical Data

O-Ring Face Seal UNF Threads on the ORFS Fittings

Table 120. Torque Settings - ORFS

UNF Thread Size	Torque Value
inch x pitch	N·m
9/16 x 18	24→27N·m
11/16 x 16	40→44N·m
13/16 x 16	55→60N·m
1 x 14	60→66N·m
1 3/16 x 12	90→99N·m
1 5/16 x 12	115→126N·m
1 7/16 x 12	125→138N·m
1 11/16 x 12	170→187N·m
2 x 12	200→220N·m

Adaptors Connected into Valve Blocks

Table 121. Torque Settings - BSP Adaptors

BSP Adaptor Size	BSP Adaptor Size	Hexagon (A/F)	Torque Value
Inch	mm	mm	N·m
1/4	6.35	19mm	18N·m
3/8	9.525	22mm	31N·m
1/2	12.7	27mm	49N·m
5/8	15.875	30mm	60N·m
3/4	19.05	32mm	81N·m
1	25.4	38mm	129N·m
1 1/4	31.75	50mm	206N·m

Table 122. Torque Settings - SAE Connections

Dash Size	SAE Port Thread Size	Hexagon (A/F)	Torque Value
	inch x pitch	mm	N·m
4	7/16 x 20	15.9mm	20→28N·m
6	9/16 x 18	19.1mm	46→54N·m
8	3/4 x 16	22.2mm	95→105N·m
10	7/8 x 14	27mm	130→140N·m
12	1 1/16 x 12	31.8mm	190→210N·m
16	1 5/16 x 12	38.1mm	290→310N·m
20	1 5/8	47.6mm	280→380N·m

Table 123. Torque Settings - SAE UNF O-ring boss port adaptors; straight and phased (heavy duty S series)

SAE Thread Size	Adaptor Torque Into Aluminium Body	Adaptor Torque Into Ferrous Body	Plug Torque Into Ferrous Body
inch x pitch	N·m	N·m	N·m
3/8 x 24	10→12	10→12	20→22
7/16 x 20	20→22	20→22	35→39
1/2 x 20	25→27.5	25→27.5	40→44

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SAE Thread Size	Adaptor Torque Into Aluminium Body	Adaptor Torque Into Ferrous Body	Plug Torque Into Ferrous Body
inch x pitch	N·m	N·m	N·m
9/16 x 18	31→37	35→39	45→50
3/4 x 16	45→50	70→77	85→93
7/8 x 14	65→71	100→110	110→120
1-1/16 x 12	95→108	170→187	170→187
1-3/16 x 12	127→140	215→236	215→236
1-5/16 x 12	158→169	270→297	270→297
1-5/8 x 12	197→210	285→310	Contact JCB service
1-7/8 x 12	220→235	370→400	Contact JCB service

Table 124. Metric ports / adaptors with O-ring seal (light duty L series and heavy duty S series)

Metric thread	Adaptor Torque Into Aluminium Body (S&L series)	Adaptor Torque Into Ferrous Body (Light duty L series)	Adaptor Torque Into Ferrous Body (Heavy duty S series)	Plug Torque Into Ferrous Body (Heavy duty S series)
	N·m	N·m	N·m	N·m
M 8 x 1	6-8	8-9	10-11	10-11
M10 x 1	18-20	18-20	20-22	20-22
M12x 1,5	31-37	31-37	35-38	35-38
M14 x 1,5	35-40	35-40	45-49	45-49
M16 x 1,5	45-50	45-50	55-60	55-60
M18 x 1,5	65-71	65-71	70-77	70-77
M20 x 1,5	-	-	80-88	80-88
M 22 x 1,5	75-82	75-82	100-110	100-110
M 27 x 2	85-95	100-110	170-187	170-187
M30 x 2	95-108	130-143	215-236	215-236
M33 x 2	158-169	160-176	270-297	310-340
M 42 x 2	197-210	220-235	270-297	330-370
M48 x 2	220-235	220-235	270-297	330-370
M60 x 2	220-235	220-235	270-297	330-370

Table 125. Metric ports / adaptors with type E seal or O-ring with collar (heavy duty S series)

Metric thread	Adaptor Torque Into Aluminium Body	Adaptor Torque Into Ferrous Body
	N·m	N·m
M12 x 1,5	31-37	45-50
M14 x 1,5	35-40	60-66
M16 x 1,5	45-50	80-88
M18 x 1,5	55-60	100-110
M20 x 1,5	65-71	140-154
M22 x 1,5	75-82	150-165
M27 x 2	95-108	200-220
M33 x 2	158-169	380-418
M42 x 2	197-210	380-418
M48 x 2	220-235	380-418

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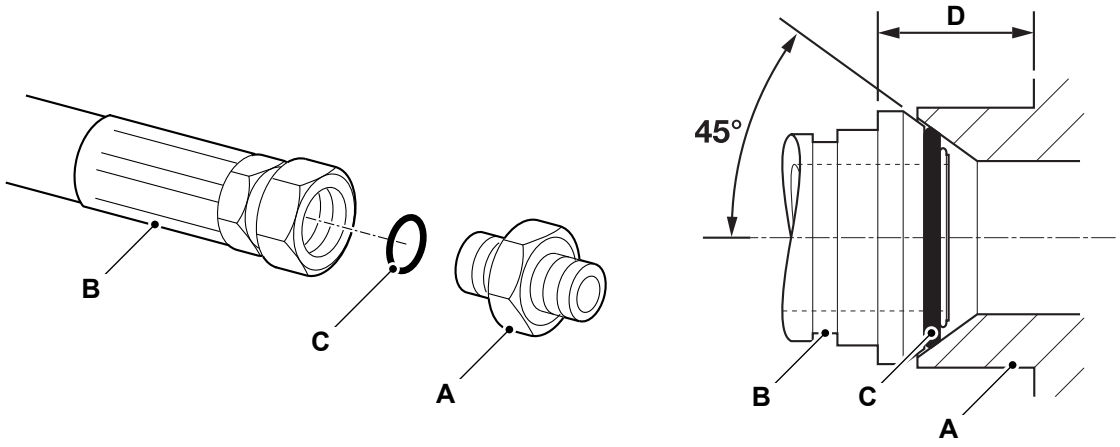
Hoses installed into Adaptors

Figure 230.



A Adaptor
B Hose
C O-ring
D Dimension will vary depending upon the torque applied.

Hoses installed into adaptors seal onto an `O' ring which is compressed into a 45° seat machined into the face of the adaptor port.

Table 126. BSP Hose - Torque Settings

BSP Hose Size	Hexagon (A/F)	Nm	kgf m	lbf ft
in	mm			
1/8	14.0	14.0 - 16.00	1.4 - 1.6	10.3 - 11.8
1/4	19.0	24.0 - 27.0	2.4 - 2.7	17.7 - 19.9
3/8	22.0	33.0 - 40.0	3.4 - 4.1	24.3 - 29.5
1/2	27.0	44.0 - 50.0	4.5 - 5.1	32.4 - 36.9
5/8	30.0	58.0 - 65.0	5.9 - 6.6	42.8 - 47.9
3/4	32.0	84.0 - 92.0	8.6 - 9.4	61.9 - 67.8
1	38.0	115.0 - 126.0	11.7 - 12.8	84.8 - 92.9
1 1/4	50.0	189.0 - 200.0	19.3 - 20.4	139.4 - 147.5
1 1/2	55.0	244.0 - 260.0	24.9 - 26.5	180.0 - 191.8

SAE Flange Connection Bolts

Table 127. Code 61 torques

Nominal size (DN)[1]	Screw torque[2]
13	32 →0/+3.2N·m
19	70 →0/+7N·m
25	70 →0/+7N·m
32	70 →0/+7N·m
38	130 →0/+13N·m
51	130 →0/+13N·m
64	130 →0/+13N·m
76	295 →0/+29.5N·m
89	295 →0/+29.5N·m
102	295 →0/+29.5N·m
127	295 →0/+29.5N·m

(1) Dimension Nominal
(2) These torque values (from ISO 6162 parts 1 and 2) are only a guide when using G10.9 metric phosphor-coated and lubricated screws with a coefficient of friction of 0,17; net tightening torque depends on many factors, including lubrication, coating, surface finish and material.

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Table 128. Code 62 torques

Nominal size (DN)[1]	Screw torque[2]
13	32 →0/+3.2N·m
19	70 →0/+7N·m
25	70 →0/+7N·m
32	70 →0/+7N·m
38	130 →0/+13N·m
51	130 →0/+13N·m
64	130 →0/+13N·m
76	295 →0/+29.5N·m

(1) Dimension Nominal
(2) These torque values (from ISO 6162 parts 1 and 2) are only a guide when using G10.9 metric phosphor-coated and lubricated screws with a coefficient of friction of 0,17; net tightening torque depends on many factors, including lubrication, coating, surface finish and material.

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09 - Adaptor

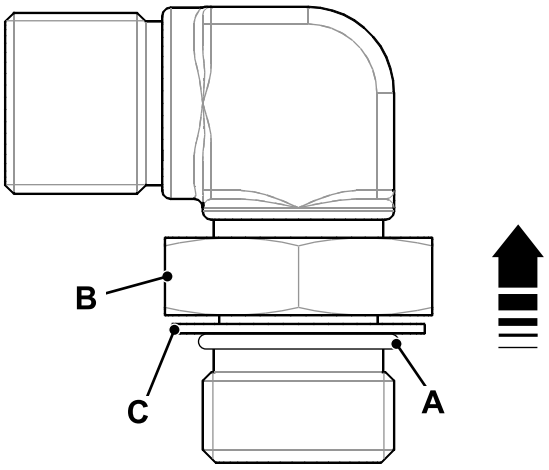
Introduction 30-141
Remove and Install 30-142

Introduction

On a typical machine, some hydraulic components may utilise Positional Type Hydraulic Adaptors. When you install a Positional Type Hydraulic Adaptor, it is important to adopt the Remove and Install procedure.
Refer to: Remove and Install (PIL 30-97-09).

If this procedure is not followed correctly, damage to the O-ring seal can occur which can result in oil leaks.

Figure 231.



A O-ring seal
B Locknut
C Washer

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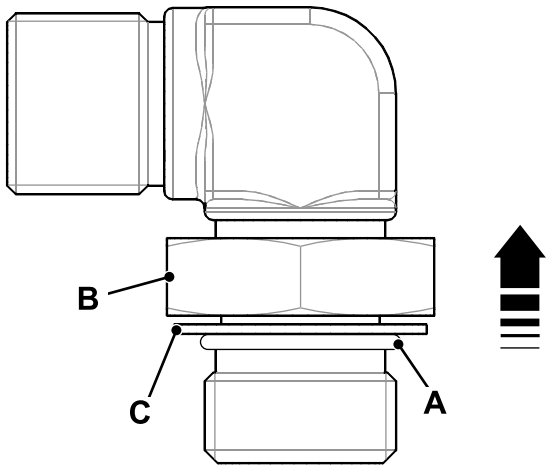
Remove and Install

1. Make sure that the locknut is screwed back on to the body of the adaptor as far as possible.
2. Check that the O-ring backing washer is a tight fit on the adaptor. Note that the washer should not move freely, if the washer is slack do not use the adaptor.
3. Check that the O-ring seal is installed and that it is free from damage or nicks. Before you install the adaptor, smear the O-ring with clean hydraulic fluid. The dimensions and shore hardness of the O-ring seal is critical. Should it become necessary to replace the O-ring seal, make sure you use JCB Genuine Parts.

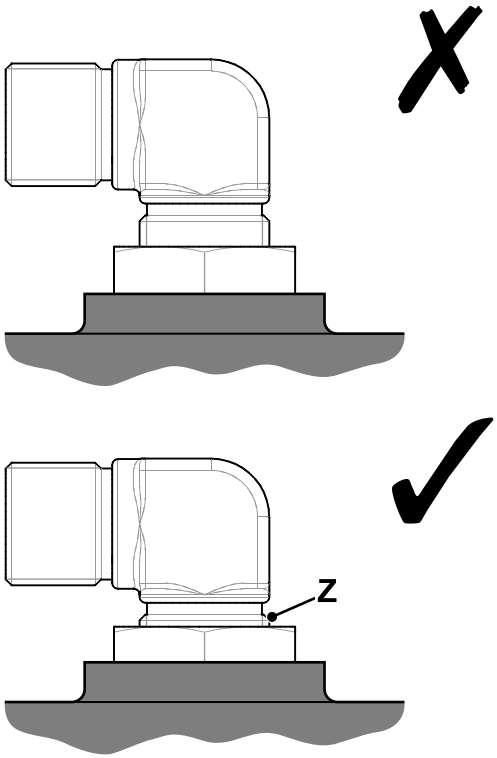
Figure 232.



A O-ring seal
B Locknut
C Backing washer

4. Screw the adaptor into the port of the hydraulic component as far as possible, so that all the threads engage and the O-ring seal is correctly seated against the sealing face.
5. Set the angular position of the adaptor as required, then secure by tightening the locknut. When installed correctly no more than one thread should be visible at Z as shown.

Figure 233.



Z Adaptor thread

6. Tighten the locknut to the correct torque value.

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80 - Rotary Actuator

00 - General

Introduction 30-143
Component Identification 30-144
Operation 30-145
Fault-Finding 30-147
Check (Condition) 30-148
Check (Leaks) 30-148
Bleed 30-149
Lubricate 30-150
Remove and Install 30-151
Disassemble and Assemble 30-153

Introduction

The rotator or rotary actuator is a hydro-mechanical component which converts axial piston motion into powerful shaft rotation. It works on the sliding spline concept.

The major components of a typical rotary actuator assembly are.

- Shaft
- Case
- Piston sleeve
- End cap

The rotary actuator installed on this machines can turn the platform through 180°.

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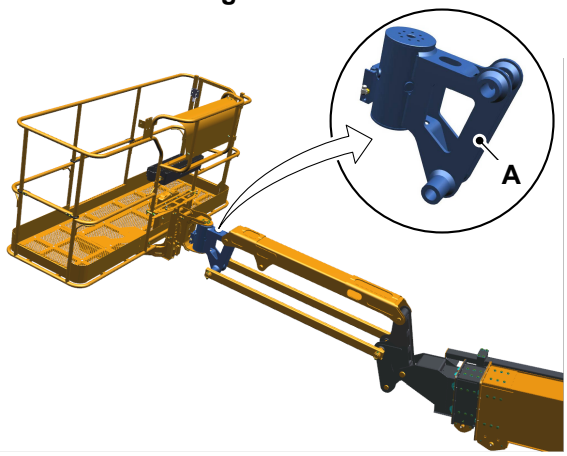
Component Identification

Figure 234.



A Rotary actuator

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Operation

The rotary actuator is a simple mechanism that uses the sliding spline operating concept to convert linear piston motion into powerful shaft rotation.

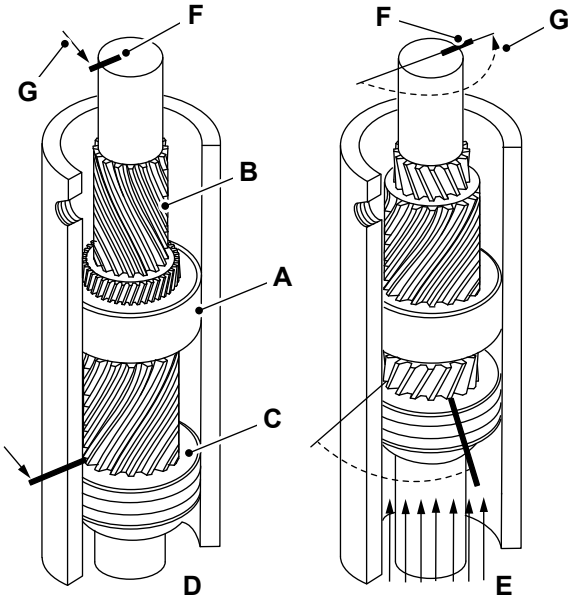
The rotary actuator has a case with integrated gear teeth, central shaft with integrated bearing tube, mounting flange and the annular piston sleeve.

The helical spline teeth machined on the shaft are engaged with matching splines on the inside diameter of the piston. The outside diameter of the piston carries a second set of splines, of opposite hand, which are engaged with matching splines in the case.

The shaft is supported radially by the large upper radial bearing and the lower radial bearing. The shaft is axially separated from the case by the upper and lower thrust washers. The end cap is adjusted for axial clearance and locked in position by set screws or pins.

When hydraulic pressure is applied, the piston is displaced axially within the case and the splines rotate the shaft. When the control valve is closed, oil is trapped inside the actuator, preventing piston movement and locking the shaft in position.

Figure 235.



A Case
B Shaft
C Annular piston sleeve
D Central position (Locked)
E Turned position (Hydraulic pressure is applied)
F Reference position of shaft
G Direction of rotation

Platform Rotation

From the base control panel, select the base control enable switch and operate the platform rotate function switch left / right or from the platform control panel, operate foot pedal and rotate function switch left / right. Platform select MCV spool shifts at 5A, 5B position for platform function. Platform control rotate spool shifts for platform rotate left / right function. Flow to the rotary actuator to rotate the platform at speed commanded (controlled by MCV (5A, 5B)).

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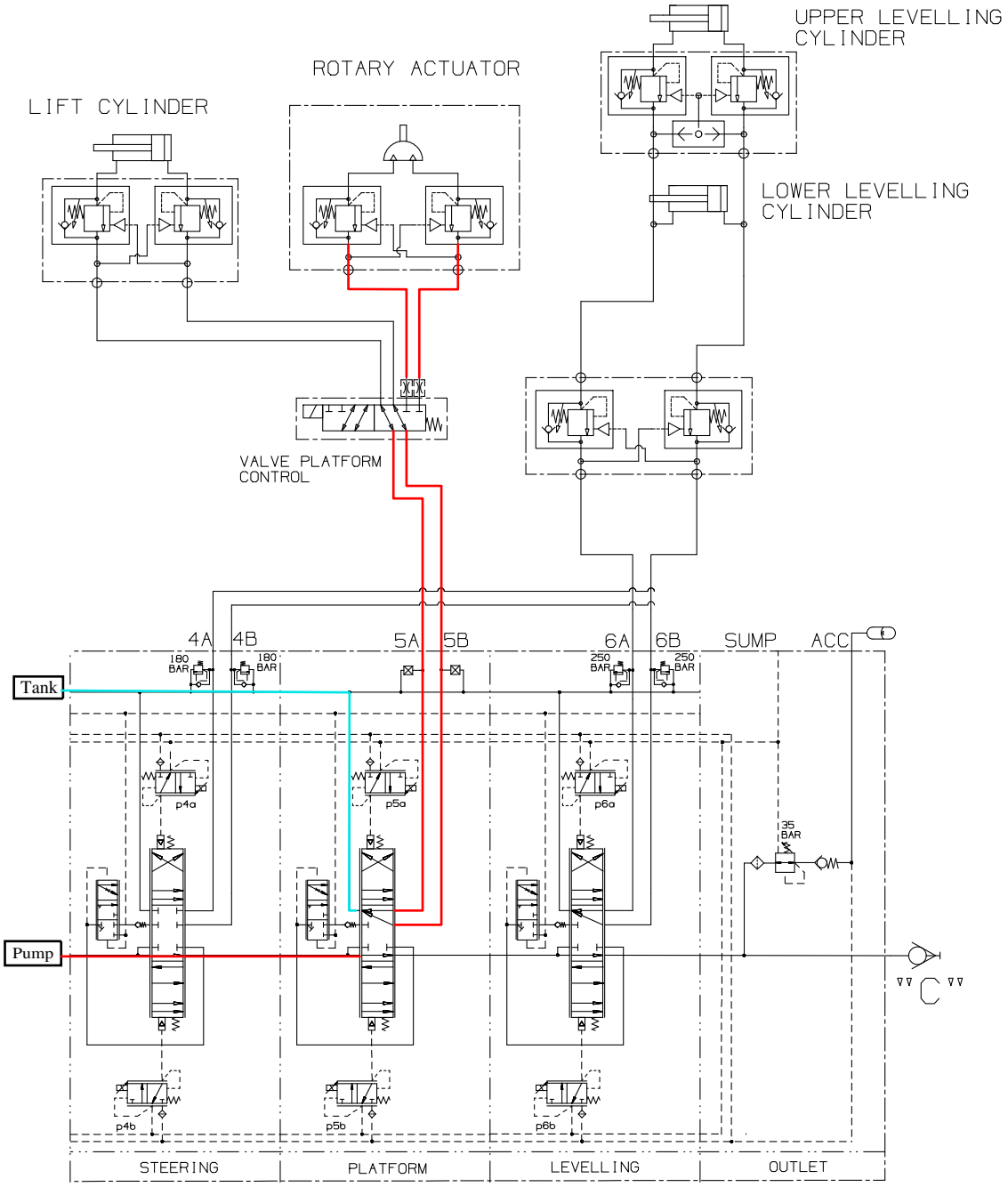
Figure 236.



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Fault-Finding

Fault

Slow or no shaft rotation	Table 129.	Page 30-147
Operation is erratic or not responsive	Table 130.	Page 30-147
Shaft will not fully rotate	Table 131.	Page 30-147
Selected position cannot be maintained	Table 132.	Page 30-147

Table 129. Slow or no shaft rotation

Cause	Remedy
Insufficient torque output	Check the correct operating hydraulic pressure. Check the load on the platform.
Low fluid flow rate	Check the condition of the ports for obstructions and hydraulic lines for restrictions and leaks.
Control or counterbalance valve leaking internally	Disconnect the hydraulic lines and bypass valve. Leave the valve ports open and operate the actuator through the case ports. The valve must be replaced if a steady flow of fluid is seen coming from the valve ports.
Piston and/or shaft seal leaking	Remove the plug and the case valve ports. Operate the actuator through the case ports. Check the rotator for leaks.
Corrosion buildup on the thrust surfaces	Disassemble the rotator. Remove all rust then polish. Replace the parts as required.
Swollen seals and composite bearings caused by incompatible hydraulic fluid	Disassemble the rotator. Replace the seals. Use correct fluid that is compatible with seals and bearings.

Table 130. Operation is erratic or not responsive

Cause	Remedy
Air in rotator	Bleed the rotator.

Table 131. Shaft will not fully rotate

Cause	Remedy
Twisted or chipped gear teeth	Check for gear binding. Rotator may not be able to be re-built and may need to be replaced. Damage could be a result of overload or shock.
Port fittings are obstructing the piston	Check thread length of port fittings. Fittings should during stroke not reach inside the housing bore.

Table 132. Selected position cannot be maintained

Cause	Remedy
Control or counterbalance valve leaking internally	Disconnect the hydraulic lines and bypass valve. Leave the valve ports open and operate the actuator through the case ports. The valve must be replaced if a steady flow of fluid is seen coming from the valve ports.
Piston and/or shaft seal leaking	Remove the plug and the case valve ports. Operate the actuator through the case ports. Check the rotator for leaks.
Air in rotator	Bleed the rotator.

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Check (Condition)

1. Clean all parts thoroughly.
2. Check condition of all parts for excessive wear, cracks and chips. If necessary, replace the parts.
   2.1. Make a note that a small amount of wear in the spline teeth will have little effect on the actuator strength.
   2.2. New spline sets are manufactured with a specified backlash per mating set.
   Dimension: 0.127mm
   2.3. After a long service, a specified backlash per set may still be acceptable, depending on the required accuracy of the application.
   Dimension: 0.381mm
3. Check condition of the ring gear for wear and weld damage to the pins.
4. Check condition of the cylinder bore for wear and scratches.

Check (Leaks)

1. Plug the ports of the counterbalance valve.
2. Connect the hydraulic hoses to the case ports.
3. Bleed all air from the actuator.
   Refer to: Bleed (PIL 30-80-00).
4. Rotate the shaft to the end of rotation at the specified pressure. Maintain the specified pressure.
   Pressure: 207bar (3,002.3psi)
5. Remove the hydraulic hoses from the non-pressurised side.
6. Continuous oil flow from the open case port indicates internal leakage across the piston.
7. Replace the hoses.
8. Rotate the shaft to the end of rotation in the opposite direction at the specified pressure. Maintain the specified pressure.
   Pressure: 207bar (3,002.3psi)
9. Continuous oil flow from the open case port indicates internal leakage across the piston.
10. If the internal leakage is found, disassemble and repair the rotary actuator.

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Bleed

It is necessary to bleed the rotary actuator, if excessive backlash is exhibited after the rotary actuator is connected to the hydraulic system.

1. Make the machine safe with the platform lowered.

   Refer to: PIL 01-03-27.

2. Connect a suitable hose to each bleed point.
3. Put a suitable container under the other end of the hose to collect the drained hydraulic fluid.
4. Loosen the bleed points by 1/4 turn.
5. Operate the platform control lever to rotate the platform until the end of rotation (either clockwise or anticlockwise).
6. Maintain the hydraulic pressure.

   6.1. Hydraulic oil with small air bubbles will be seen flowing through the hoses.

7. Allow the specified quantity of hydraulic oil to be purged from the rotary actuator.

   Volume: 1.9L

8. Keep the fittings open and rotate the platform in the opposite direction to the end position.
9. Maintain the hydraulic pressure until an additional specified quantity of hydraulic oil is pumped into the container.

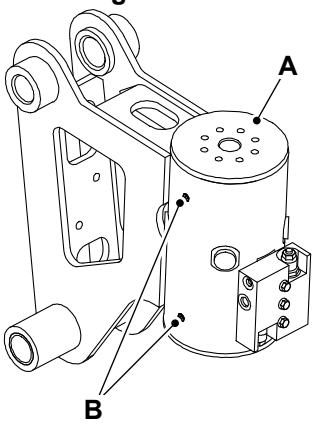
   Volume: 0.95L

10. Do the steps 5 to step 9 again.
11. Close both bleed points before rotating away from the end position.
12. Disconnect the hoses from the bleed points.
13. Check the hydraulic oil level and top up as required.

    Refer to: PIL 30-00-00.

    13.1. You can fill the hydraulic tank again with the drained hydraulic oil. Make sure that it is clean and free from contamination.

Figure 237.



A Rotary actuator
B Bleed points

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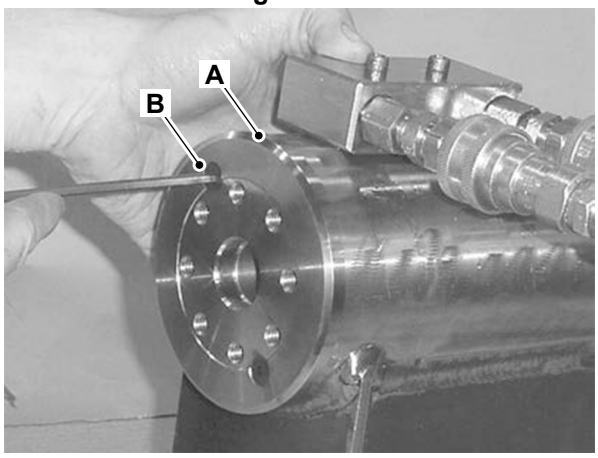
Lubricate

After the actuator is assembled but before it is put into service, you must lubricate the thrust washer area with lithium grease. There are two grease ports located on both the shaft flange and the end cap. The grease ports are plugged with capscrews.

1. Remove the capscrews.

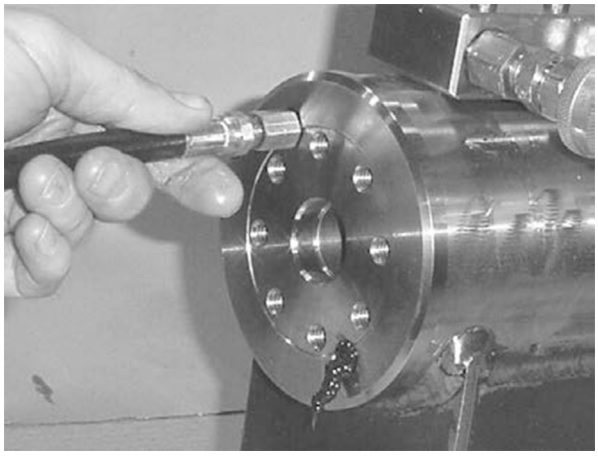
Figure 238.



A Rotary actuator
B Capscrews

2. Insert the tip of a grease gun into one port and apply grease to the shaft flange.
3. Continue to apply grease until it flows from the opposite port.

Figure 239.



4. Rotate the actuator five times.
   4.1. Open the pressure ports.
   4.2. Use a pry bar with capscrews inserted into the shaft flange to turn the shaft in the desired direction.
5. Apply the grease again.
6. Do the steps 1 to steps 5 on the end cap.
7. Install the capscrews into the grease ports.
8. Tighten the capscrews to the specified torque value. Refer to Table 133.

Table 133. Torque Values

Item	Nm
B	20

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Remove and Install

⚠ **CAUTION** This component is heavy. It must only be removed or handled using a suitable lifting method and device.

Remove

1. Make the machine safe.

   Refer to: PIL 01-03-27.

2. Discharge the hydraulic pressure.

   Refer to: Discharge and Pressurise (PIL 30-00-00).

3. Remove the platform from the machine.

   Refer to: PIL 06-97-00.

4. Remove the hoses from the rotary actuator.

   4.1. Put a label on the hoses to help during installation.

   4.2. Plug all the open ports and hoses to prevent contamination.

5. Remove the setscrew (x8) from the rotary actuator.

6. Remove the pivot pin, washer and nut from the rotary actuator.

7. Remove the kingpost from the rotary actuator.

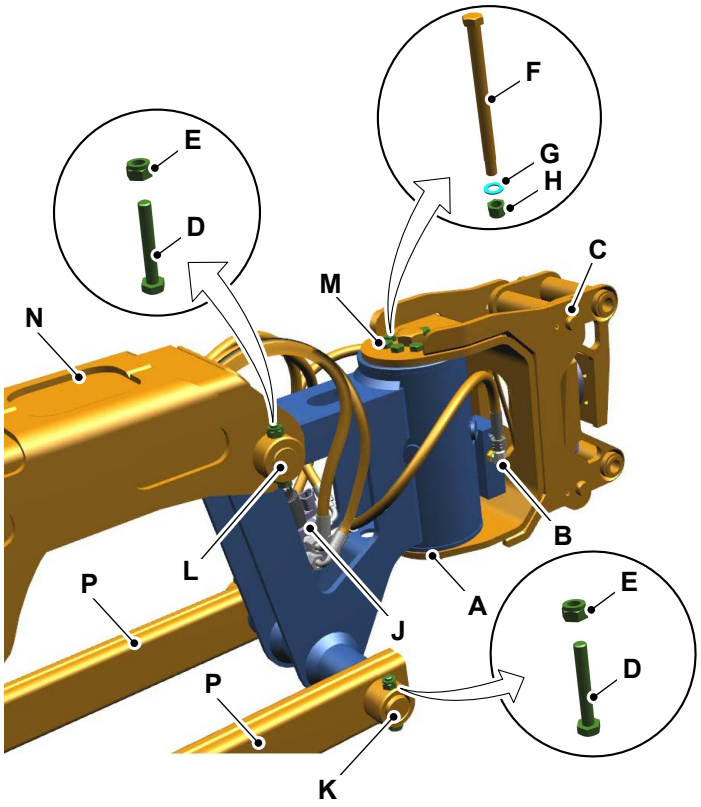
8. Remove the pivot pin 1, bolt (x2) and locknut (x2) from the jib level arm (x2).

9. Remove the pivot pin 2, bolt (x1) and locknut (x1) from the jib extension arm.

10. Remove the rotary actuator from the jib extension arm and jib level arm (x2).

11. If required, remove platform control valve from the rotary actuator.

Figure 240.



A Rotary actuator
B Hydraulic hose
C Kingpost
D Bolt (x3)
E Locknut (x3)
F Pivot pin
G Washer
H Nut
J Platform control valve
K Pivot pin 1

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L Pivot pin 2
N Jib extension arm
M Setscrew (x8)
P Jib level arm (x2)

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

1. Tighten the bolts, pivot pin and setscrews to the specified torque value. Refer to Table 134.

Table 134. Torque Values

Item	Nm
D	43
F	823
M	60

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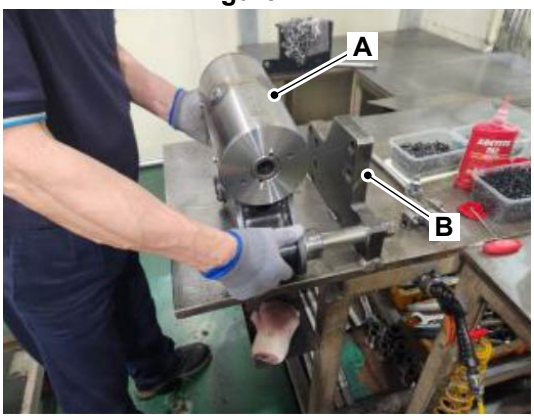
Disassemble and Assemble

The following procedure requires a replacement service parts kit. Make sure that you obtain the correct parts kit for replacement. Refer to SPP (Service Parts Pro) for details.

Disassemble

1. Remove the rotary actuator from the machine.
   Refer to: Remove and Install (PIL 30-80-00).
2. Fix the rotary actuator on the jig/vice.

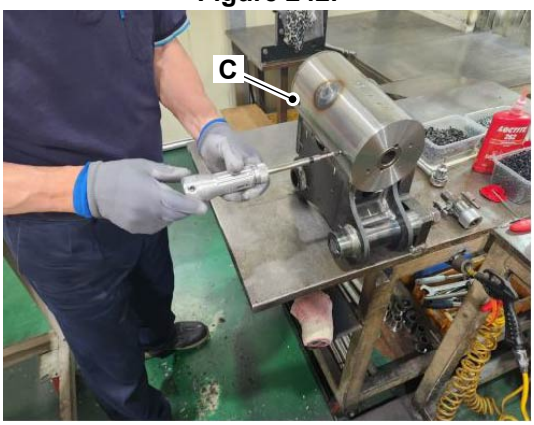
Figure 241.



A Rotary actuator
B Jig/vice

3. Remove the screw (x2) from the rotary actuator.

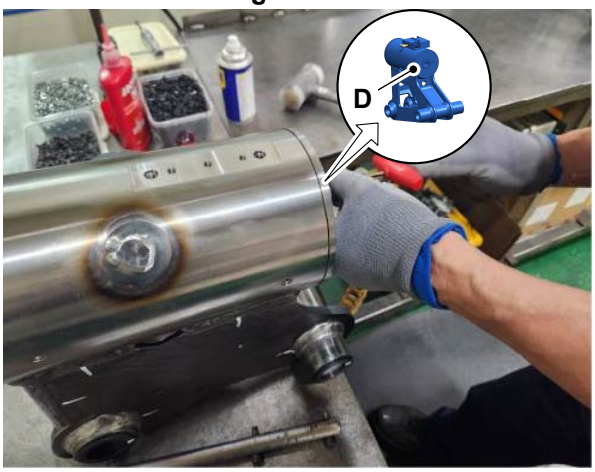
Figure 242.



C Screw (x2)

4. Remove the setscrew (x2) from the rotary actuator.

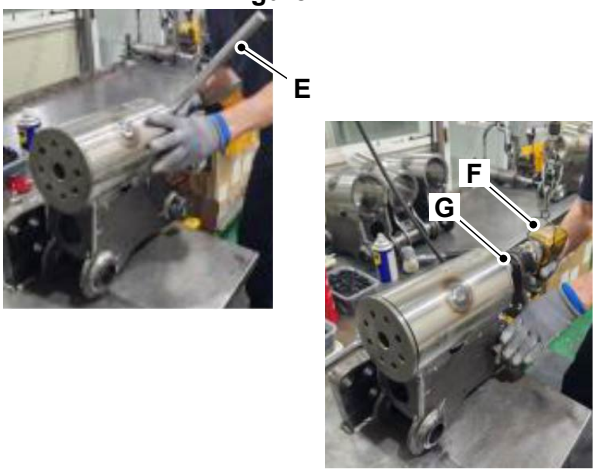
Figure 243.



D Setscrew (x2)

5. Remove the end cap.
   5.1. Use suitable angle stick and air assembly tool for end cap removal.

Figure 244.



E Angle stick
F Air assembly tool
G End cap

6. Remove the axle rod.
   6.1. Use suitable polyurethane hammer for axle rod removal.

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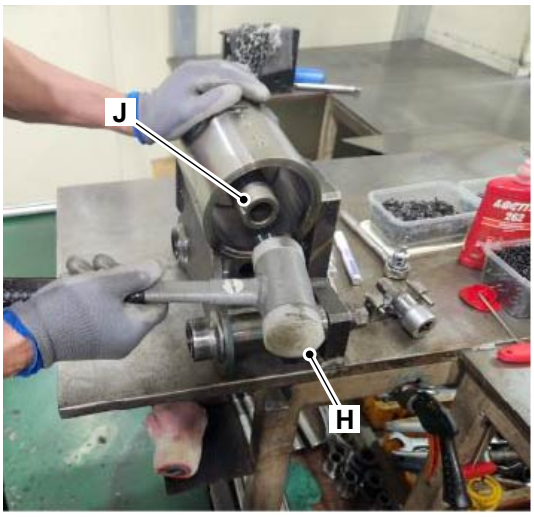
Figure 245.

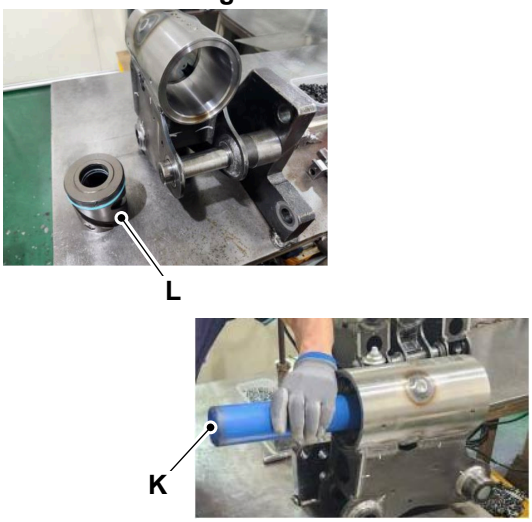


H Hammer
J Axle rod

7. Remove the piston.

   7.1. Use suitable polyurethane hammer and MC nylon bar for piston removal.

Figure 246.



K MC nylon bar
L Piston

Assemble

1. Check the condition of all parts.

   1.1. Clean all parts in a solvent tank.

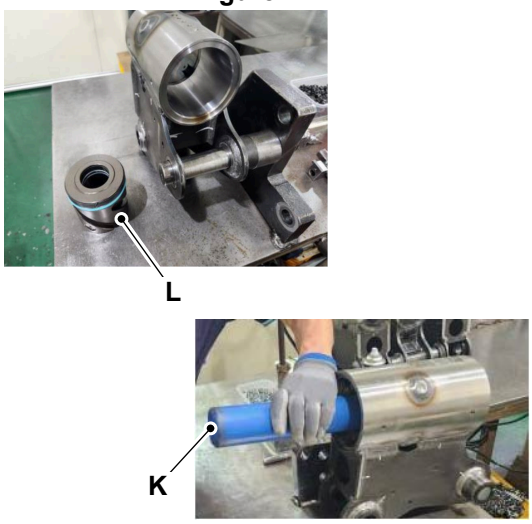
   1.2. Dry with compressed air.

   1.3. Check the condition of seal grooves, bearing grooves, thrust surfaces, shaft surface, housing bore and gear teeth for correct surface finish.

   1.4. Carefully polish small or minor surface scratches.

2. Fix the tube on the jig/vice.

Figure 247.



M Tube

3. Apply the hydraulic oil inside the inner surface of the tube after air blow.

4. Install the piston with the tube temporarily by hand after applying hydraulic oil to the piston seal assembly.

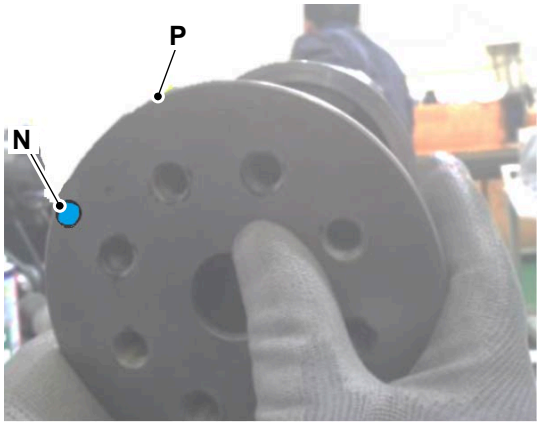
   4.1. Make sure that the pin inside the tube must be in gear with the helical groove on the piston.

5. Install the piston with the help of air press tool till the piston reaches the tube end.

6. Install the axle rod.

   6.1. Make sure that the timing mark and welding part are aligned correctly and then insert the axle rod into the piston by hand and angle stick.

Figure 248.



N Timing mark
P Welding

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7. Install the end cap with the tube assembly temporarily with the hand. Refer to Figure 244.
8. Execute complete assembly using the jig.
9. Set the assembly position of the setscrew after assembling the end cap completely.
10. Install the setscrew (x2) by wrench and apply loctite 262. Refer to Figure 243.
11. Center the timing mark using the angle stick.
12. Install the screw (x2) using the torque driver. Refer to Figure 242.
13. Tighten the screw (x2) to the specified torque value.

    Torque: 5 ± 0.5N·m

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Notes:

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33 - Electrical System

Contents **Page No.**

Acronyms Glossary 33-2

33-00 Electrical System
- 33-00-00 General 33-3
- 33-00-50 Schematic Circuit 33-6
- 33-00-90 Earth Point 33-78

33-03 Battery
- 33-03-00 General 33-79
- 33-03-03 Isolator Switch 33-90

33-09 Power Distribution
- 33-09-00 General 33-93
- 33-09-03 Fuse 33-95
- 33-09-06 Relay 33-98

33-10 Motor
- 33-10-00 General 33-100

33-12 Harness
- 33-12-00 General 33-106

33-15 Alarm
- 33-15-00 General 33-116

33-24 Instruments
- 33-24-02 Base Controller 33-117
- 33-24-05 Platform Controller 33-133

33-36 Horn
- 33-36-00 General 33-138

33-45 Control Module
- 33-45-00 General 33-140
- 33-45-30 LiveLink 33-143

33-57 Electronic Diagnostic
- 33-57-03 Servicemaster 33-145
- 33-57-05 Engine Diagnostic 33-156
- 33-57-90 Error Codes 33-158

33-84 Sensor
- 33-84-00 General 33-160
- 33-84-07 Hydraulic Pressure 33-165
- 33-84-60 Tilt 33-166
- 33-84-76 Slew 33-170
- 33-84-86 Platform Weight Limit 33-172

33-85 Limit Switch
- 33-85-05 Boom Lift 33-174
- 33-85-15 Boom Telescopic 33-175
- 33-85-20 Rope Switch 33-180

33-86 Solenoid
- 33-86-00 General 33-184

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Acronyms Glossary

CAN	Controller Area Network
DC	Direct Current
DLA	Data Link Adaptor
DTC	Diagnostic Trouble Code
ECM	Engine Control Module
ECU	Electronic Control Unit
EGR	Exhaust Gas Recirculation
HMI	Human- Machine Interface
LED	Light Emitting Diode
MIL	Malfunction Indicator Lamp
RPM	Revolutions Per Minute
SPP	Service Parts Pro
USB	Universal Serial Bus
VGT	Variable Geometry Turbocharger
WIF	Water in Fuel

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00 - Electrical System

00 - General

Introduction 33-3
Health and Safety 33-4
Technical Data 33-4
Operation 33-5
Check (Condition) 33-5

Introduction

It is important that the electrical system on the machine is in a sound state of repair.

Make sure that all the health and safety warnings in this section are followed. The machine must be safe with the battery isolated before you attempt to disconnect any electrical connections.

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Health and Safety

⚠ **CAUTION** Understand the electrical circuit before connecting or disconnecting an electrical component. A wrong connection can cause injury and/or damage.

Technical Data

Table 135.

Description	Data
Voltage	12V x2
Capacity	110Ah
Tilt sensor setting	5°
Auxiliary motor power	3.3kW

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Operation

The machine is controlled through electrical switches. The electrical switches give inputs to the controllers. The controllers gives outputs to solenoids on the valve blocks and transmission pump, which determines the direction of hydraulic oil flow.

There are a combination of proportional solenoids and ON/OFF solenoids on the machine. For the proportional solenoids, as the current increases, the hydraulic flow through the valve increases.

Check (Condition)

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Obey all electrical system health and safety information.
   Refer to: Health and Safety (PIL 33-00-00).
3. Isolate the battery.
   Refer to: PIL 33-03-00.
4. Check the condition of the following harnesses for burnt, chafed, corroded and loose wires.
   4.1. Engine harness.
   4.2. Base control panel harness.
   4.3. Turntable harness.
   4.4. Platform control panel harness.
   4.5. Platform harness.
   4.6. Boom harness.
   4.7. Rope harness.
   4.8. Wire reel harness.
5. Switch the isolator and turn the ignition key to ON position.
6. Turn the engine ON from the base control panel.
7. Check all control functions from the base control panel.
8. Check all control functions from the platform control panel.
9. Stop the engine.

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50 - Schematic Circuit

Introduction 33-6
Diagram 33-9

Introduction

A schematic wiring diagram is a simplified pictorial representation of the machines electrical circuit. It shows the components of the circuit as simplified electrical symbols, and the power and signal connections between the devices. The wiring diagram is used to troubleshoot problems and to make sure that all the connections have been made and that everything is present.

Use the schematics together with the correct electrical harness drawings to reference the connector pin details.

This section may contain more than one set of electrical schematics for different machine variants.

Understanding Electrical Schematics

Use the applicable schematic set to trace wires and connections between electrical devices. In most cases it will be necessary to trace wires across more than one schematic sheet.

The example identifies the information contained on the diagrams. It also shows how to follow wires from one diagram sheet to another.

The harness inter-connector codes and device harness connector codes are the same as used on the applicable harness drawings.

Splices are not normally accessible. Splices are inside the harness sheath and not visible on the outside. Wires are welded together at a splice, there are no individual connector components.

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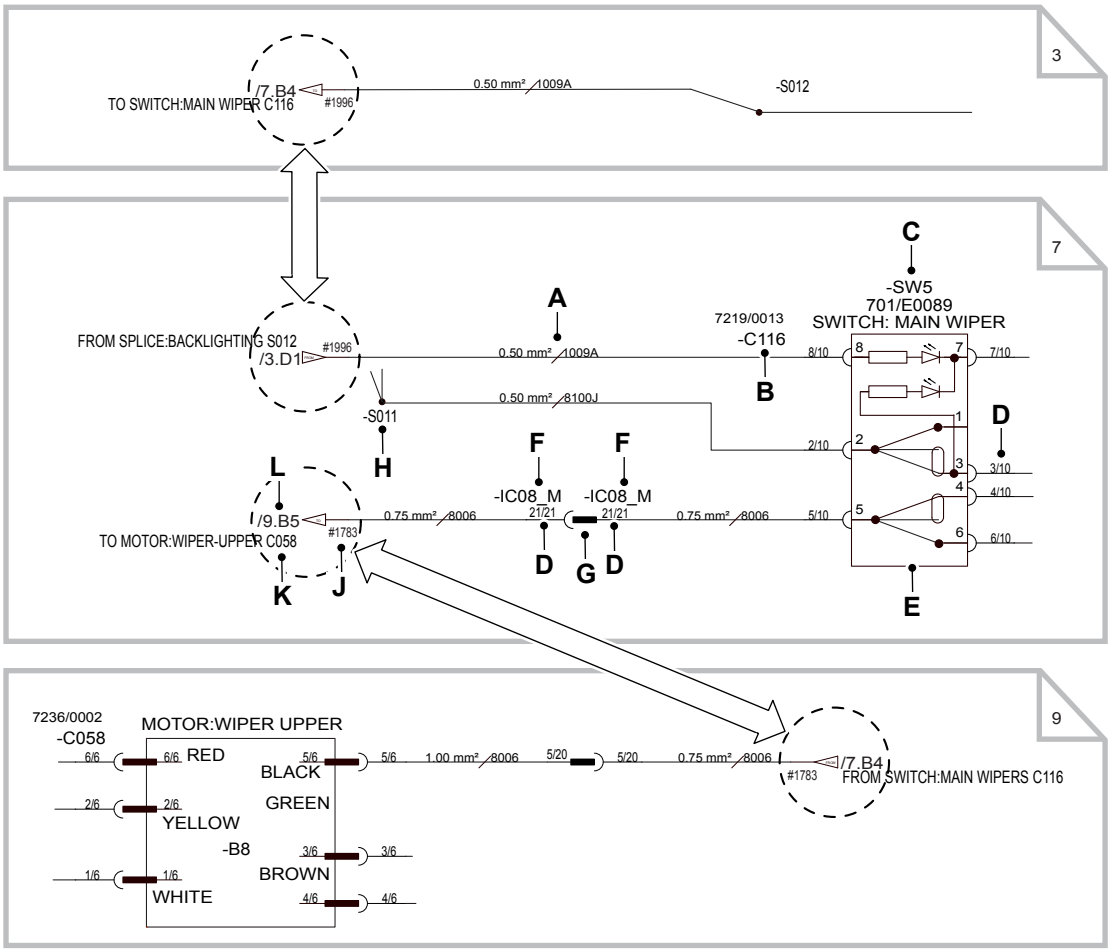
Figure 249.



A Wire size (area) and number
B Device harness connector code
C Device description
D Connector pin number (wire location / total)
E Device internal schematic
F Harness inter-connector codes
G Harness inter-connector symbol
H Splice code and symbol
J Destination reference number
K Destination (harness connector code)
L Destination (diagram sheet and grid)

To help locate a wire destination from other diagram sheets use the grid reference. This identifies the applicable location zone on the sheet in a similar way to a map reference.

Due to space limitations, the grid is sometimes omitted.

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Figure 250. Grid reference example (D4)

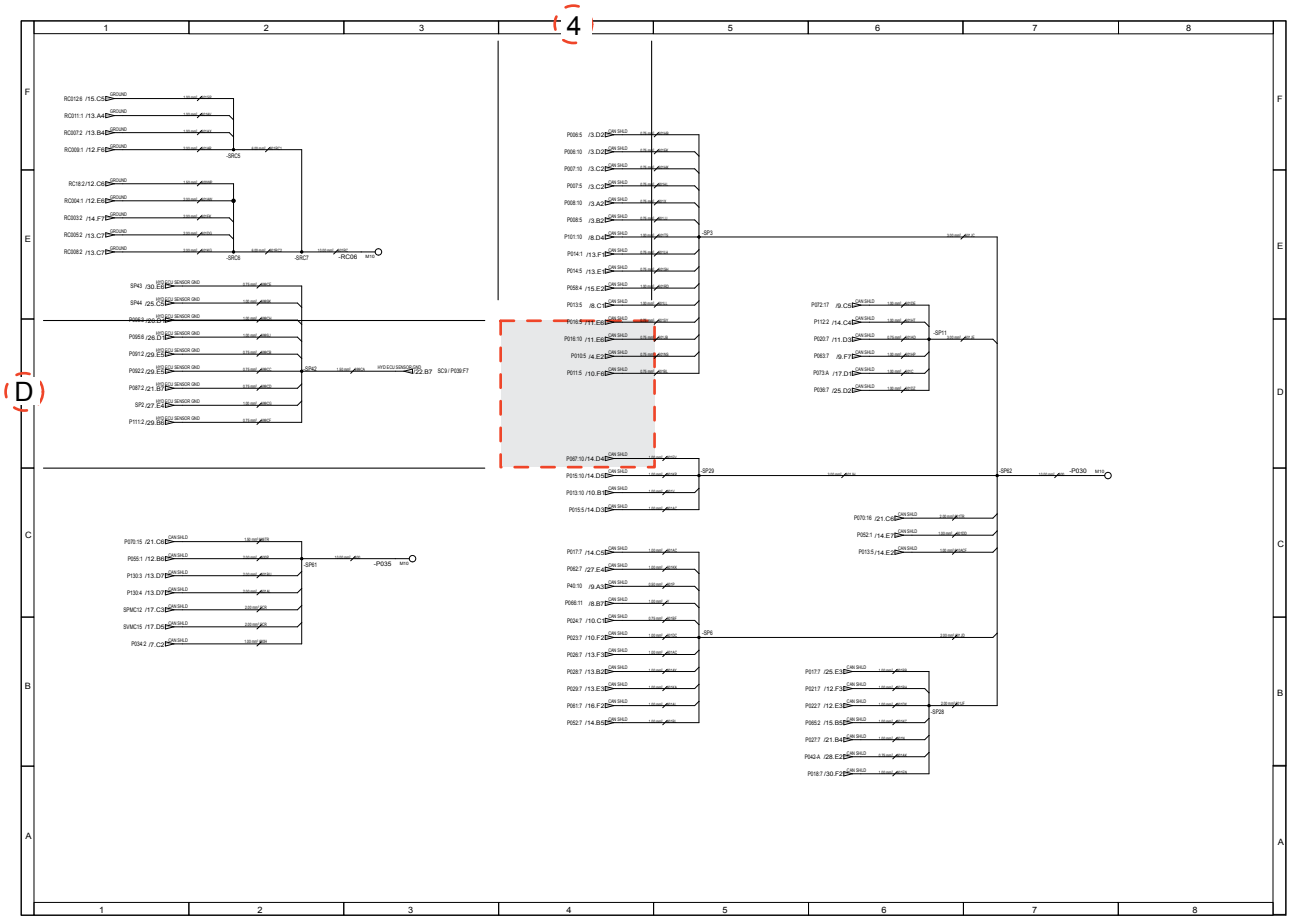

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Diagram

Figure 251. 402/R2361 Issue-7 (Sheet 3 of 20) - Battery Leads..... Page 33-11
Figure 252. 402/R2361 Issue-7 (Sheet 4 of 20) - Turntable Control Panel..... Page 33-15
Figure 253. 402/R2361 Issue-7 (Sheet 5 of 20) - Turntable Base Bosch ECU..... Page 33-19
Figure 254. 402/R2361 Issue-7 (Sheet 6 of 20) - Turntable Base Bosch ECU..... Page 33-23
Figure 255. 402/R2361 Issue-7 (Sheet 7 of 20) - Turntable Base Bosch ECU..... Page 33-27
Figure 256. 402/R2361 Issue-7 (Sheet 8 of 20) - Turntable Ground.....Page 33-31
Figure 257. 402/R2361 Issue-7 (Sheet 9 of 20) - Engine ECU.....Page 33-35
Figure 258. 402/R2361 Issue-7 (Sheet 10 of 20) - Engine ECU.....Page 33-39
Figure 259. 402/R2361 Issue-7 (Sheet 11 of 20) - LiveLink ECU..... Page 33-43
Figure 260. 402/R2361 Issue-7 (Sheet 12 of 20) - Platform Bosch ECU.....Page 33-47
Figure 261. 402/R2361 Issue-7 (Sheet 13 of 20) - Platform Bosch ECU.....Page 33-51
Figure 262. 402/R2361 Issue-7 (Sheet 14 of 20) - Platform Bosch ECU.....Page 33-55
Figure 263. 402/R2361 Issue-7 (Sheet 15 of 20) - CAN Network.....Page 33-59
Figure 264. 402/R2361 Issue-7 (Sheet 16 of 20) - CAN Network.....Page 33-63
Figure 265. 402/R2361 Issue-7 (Sheet 17 of 20) - 7.5kV Hyd Gen Cables..... Page 33-67
Figure 266. 402/R2361 Issue-7 (Sheet 18 of 20) - PWR To Plat US 110V..... Page 33-71
Figure 267. 402/R2361 Issue-7 (Sheet 19 of 20) - Spare Th- Platform Cable..... Page 33-75

Sheets 1 and 2 are not included as it only contains index and change summary.

Sheet 20 is not included as it only contains solenoids function.

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Notes:

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Page 33-12

Figure 251. 402/R2361 Issue-7
(Sheet 3 of 20) - Battery Leads

Page 33-13

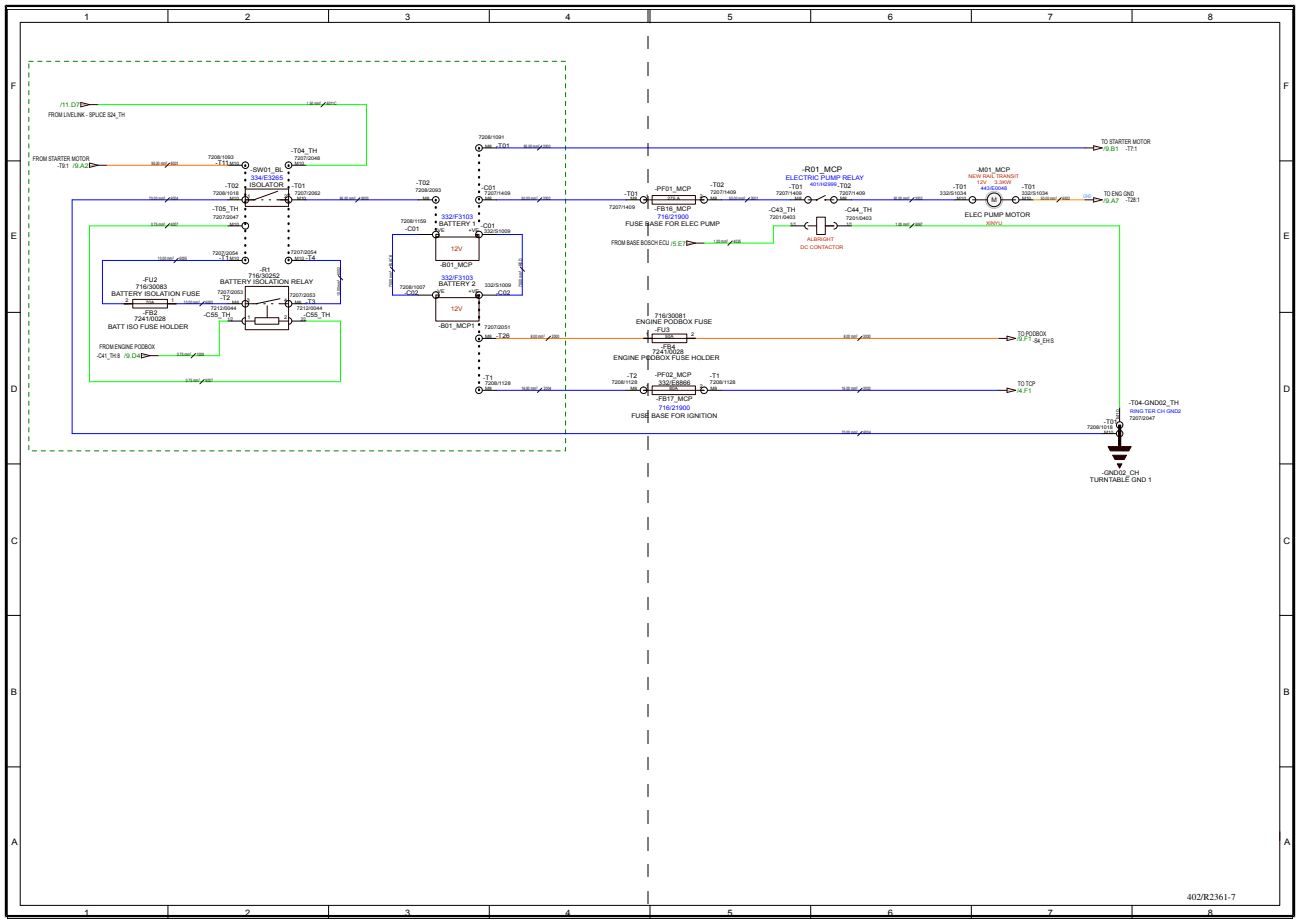

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Figure 251. (Part 1 of 2)

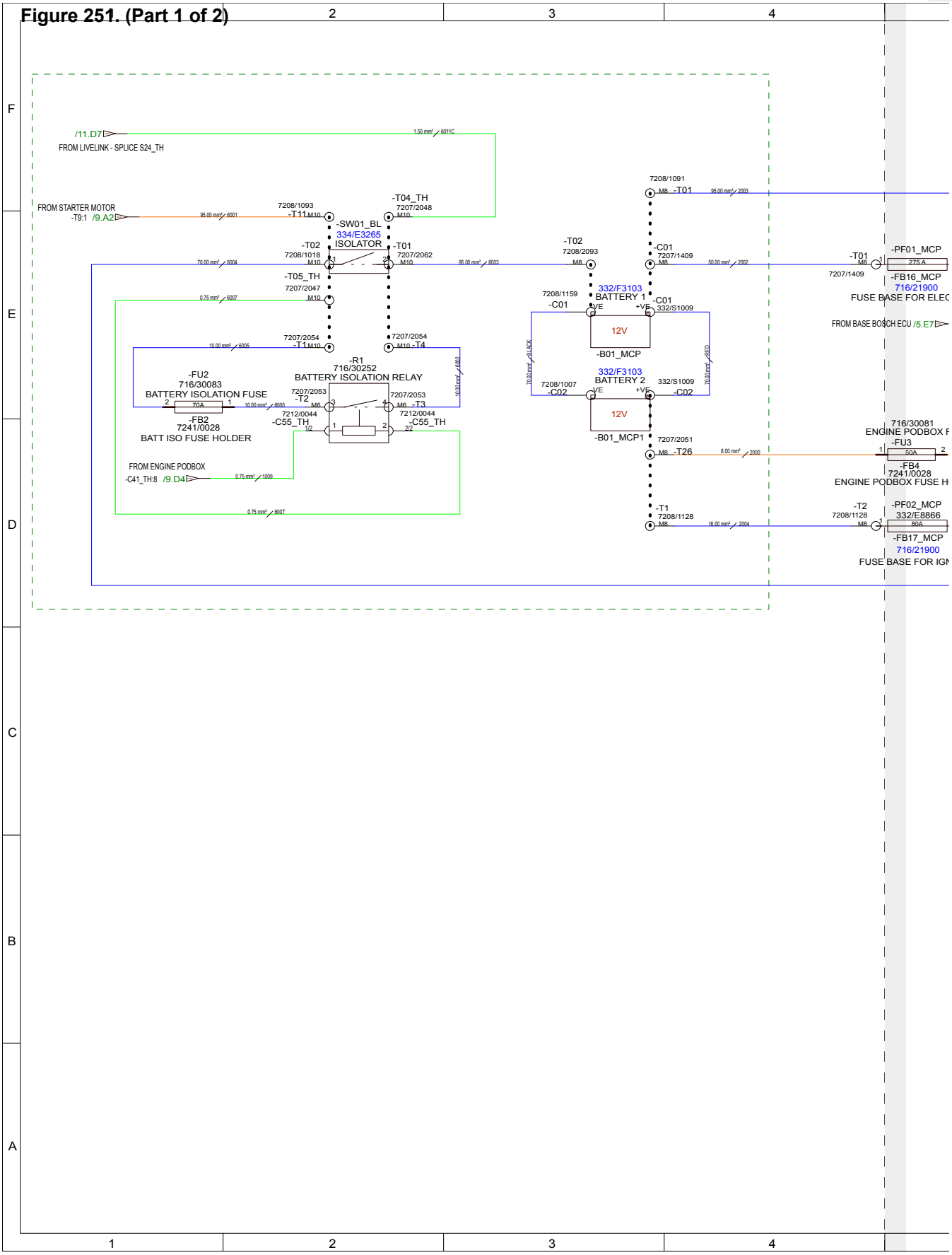

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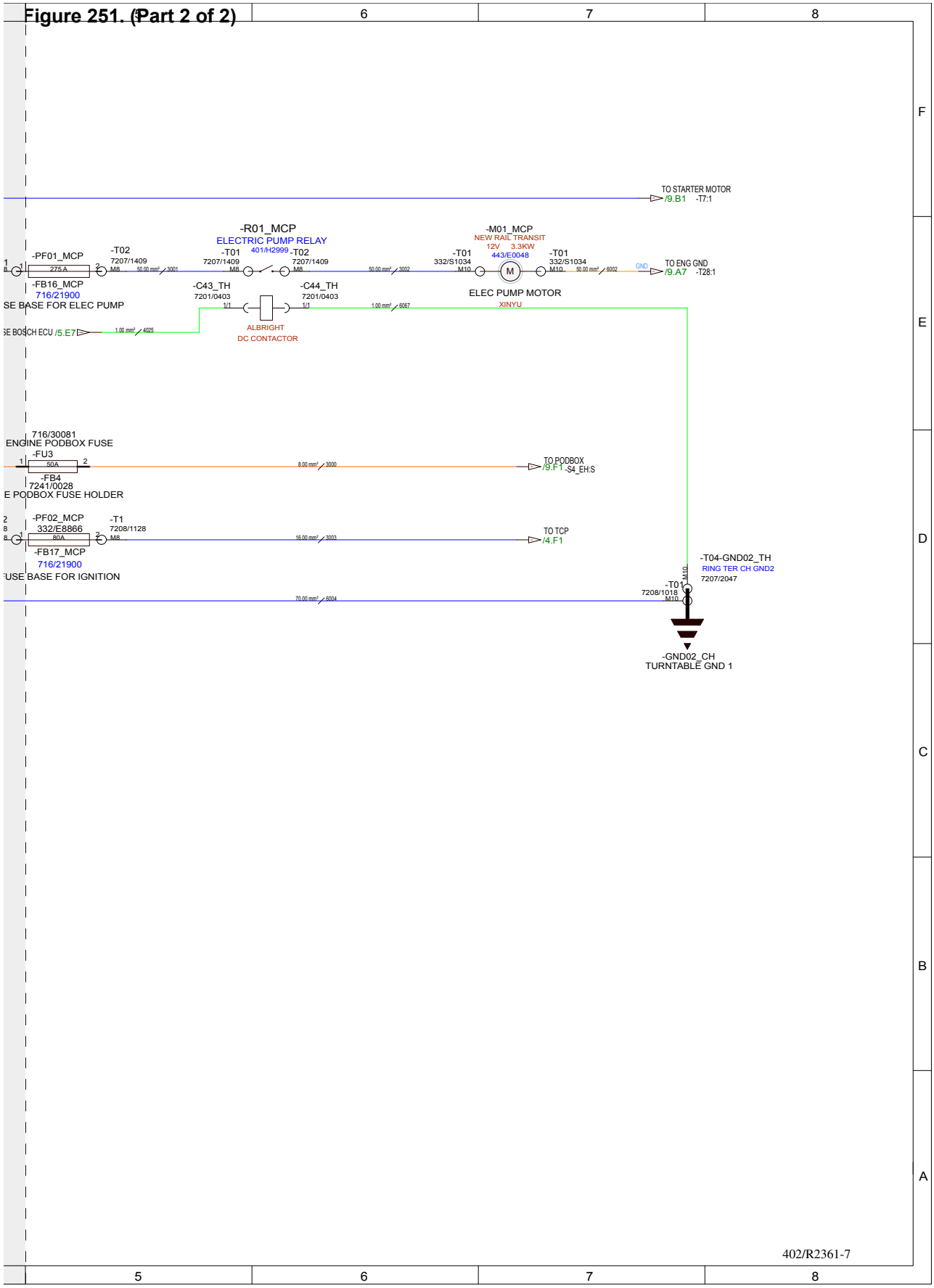
Figure 251. (Part 2 of 2)



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Page 33-16

Figure 252. 402/R2361 Issue-7 (Sheet 4 of 20) - Turntable Control Panel

Page 33-17

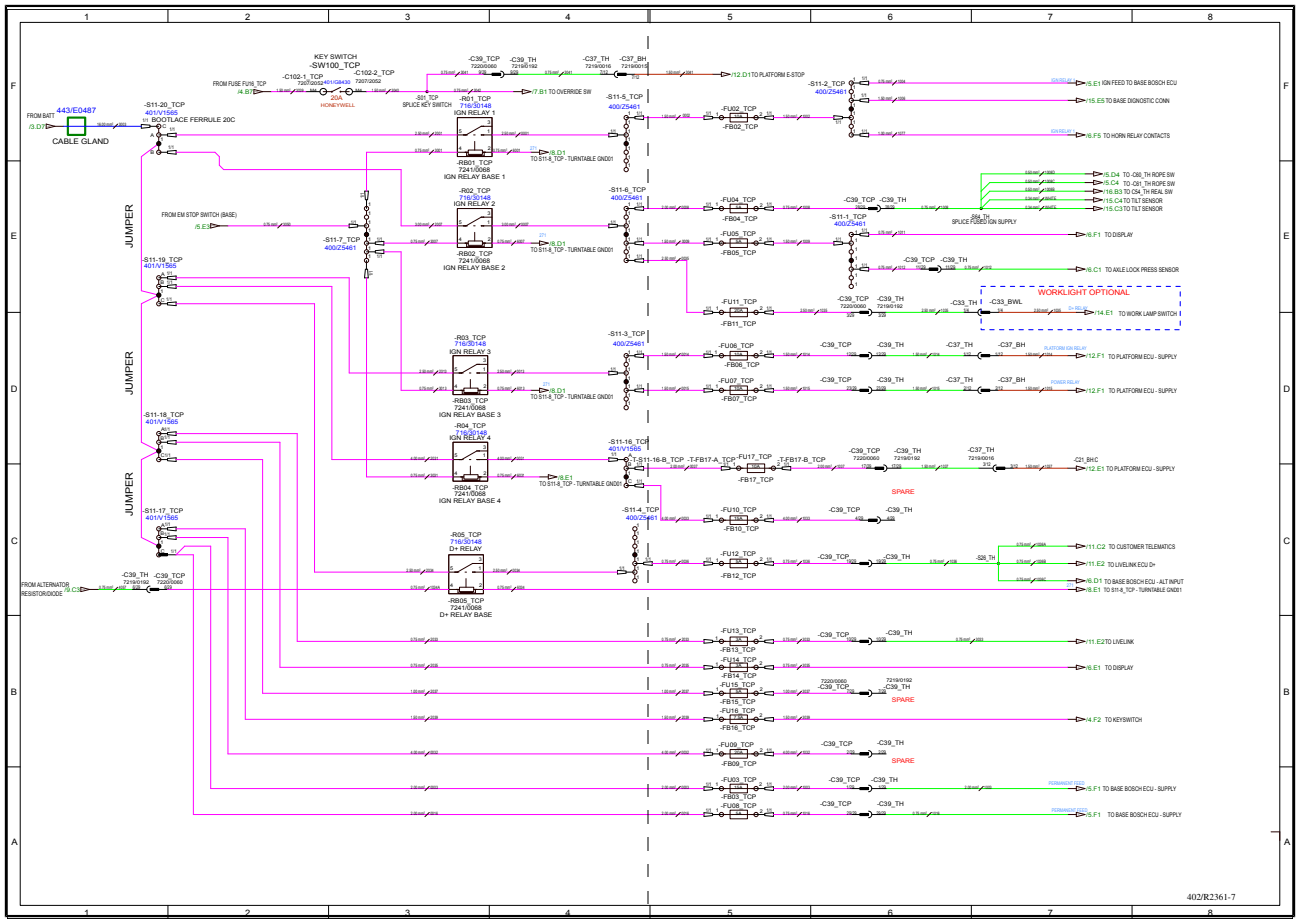

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Figure 252. (Part 1 of 2)

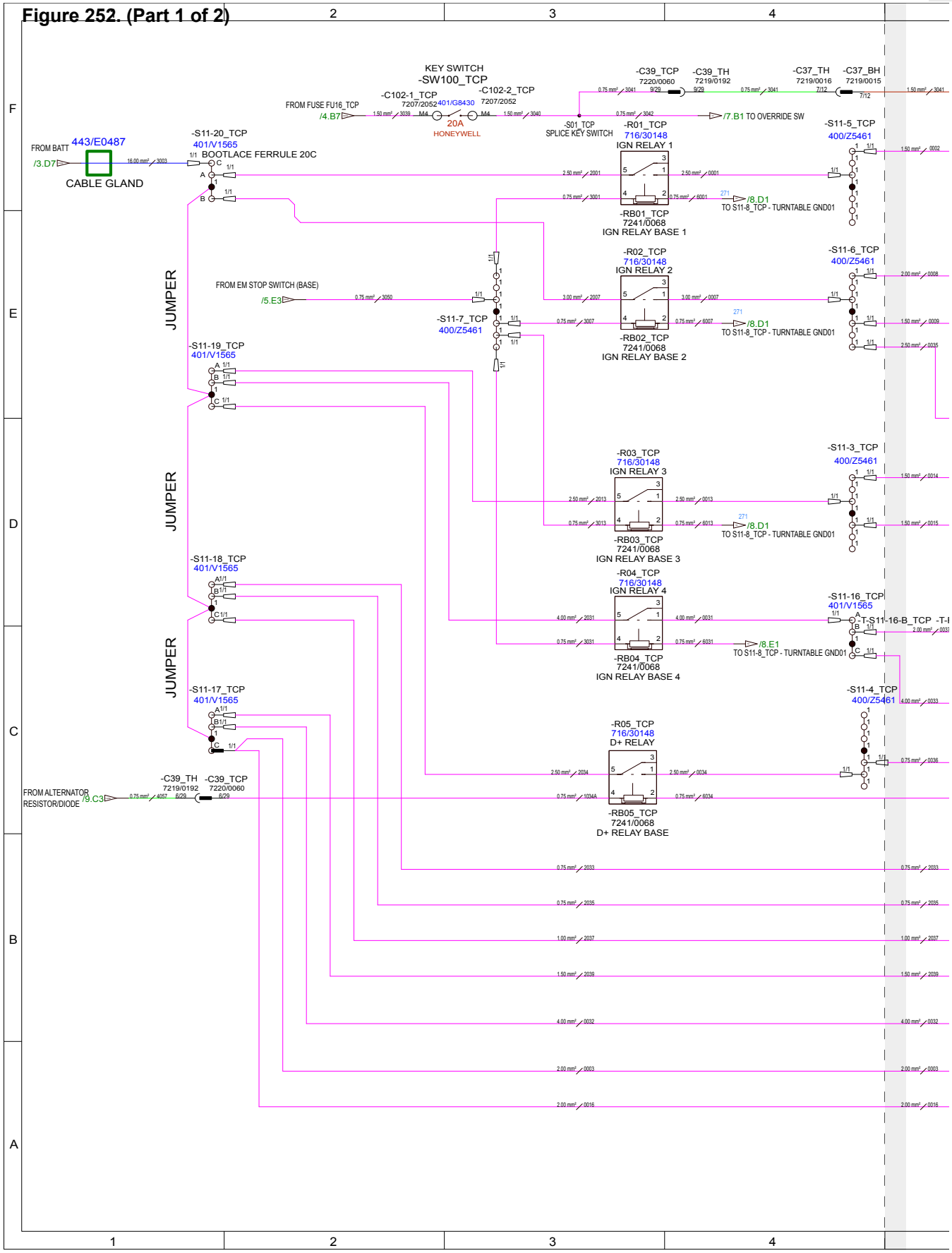

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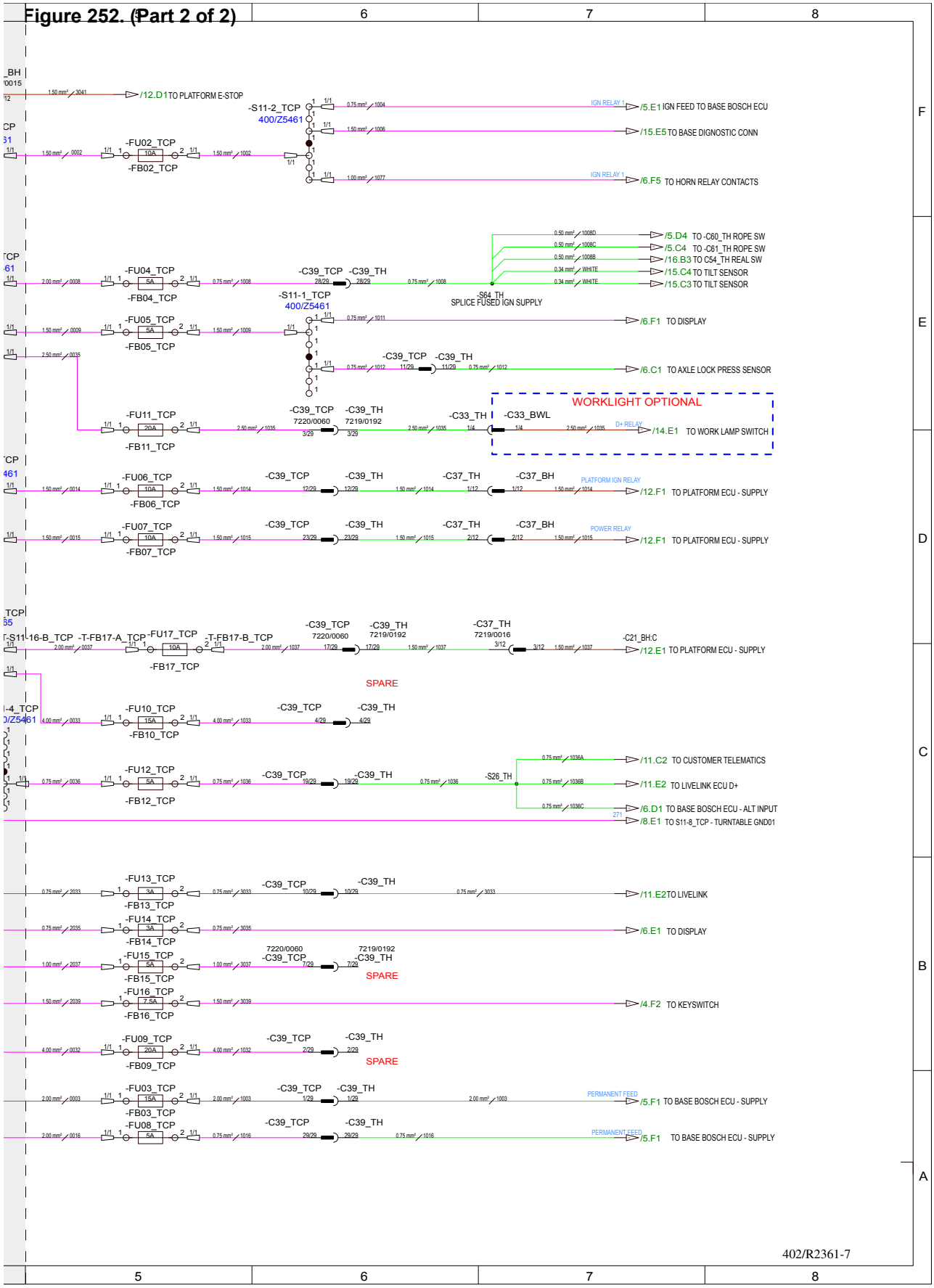
Figure 252. (Part 2 of 2)



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Page 33-20

Figure 253. 402/R2361 Issue-7 (Sheet 5 of 20) - Turntable Base Bosch ECU

Page 33-21

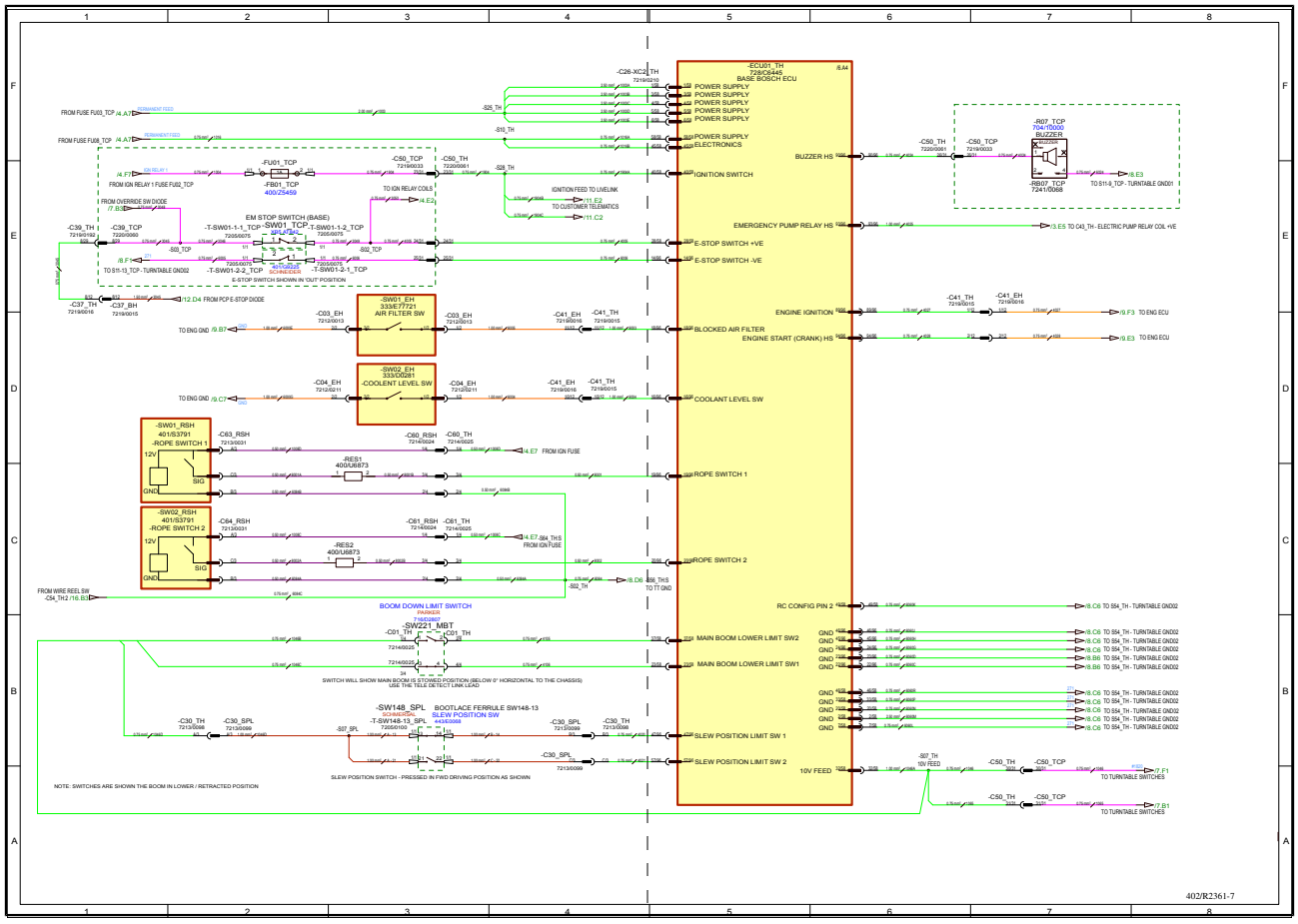

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Figure 253. (Part 1 of 2)

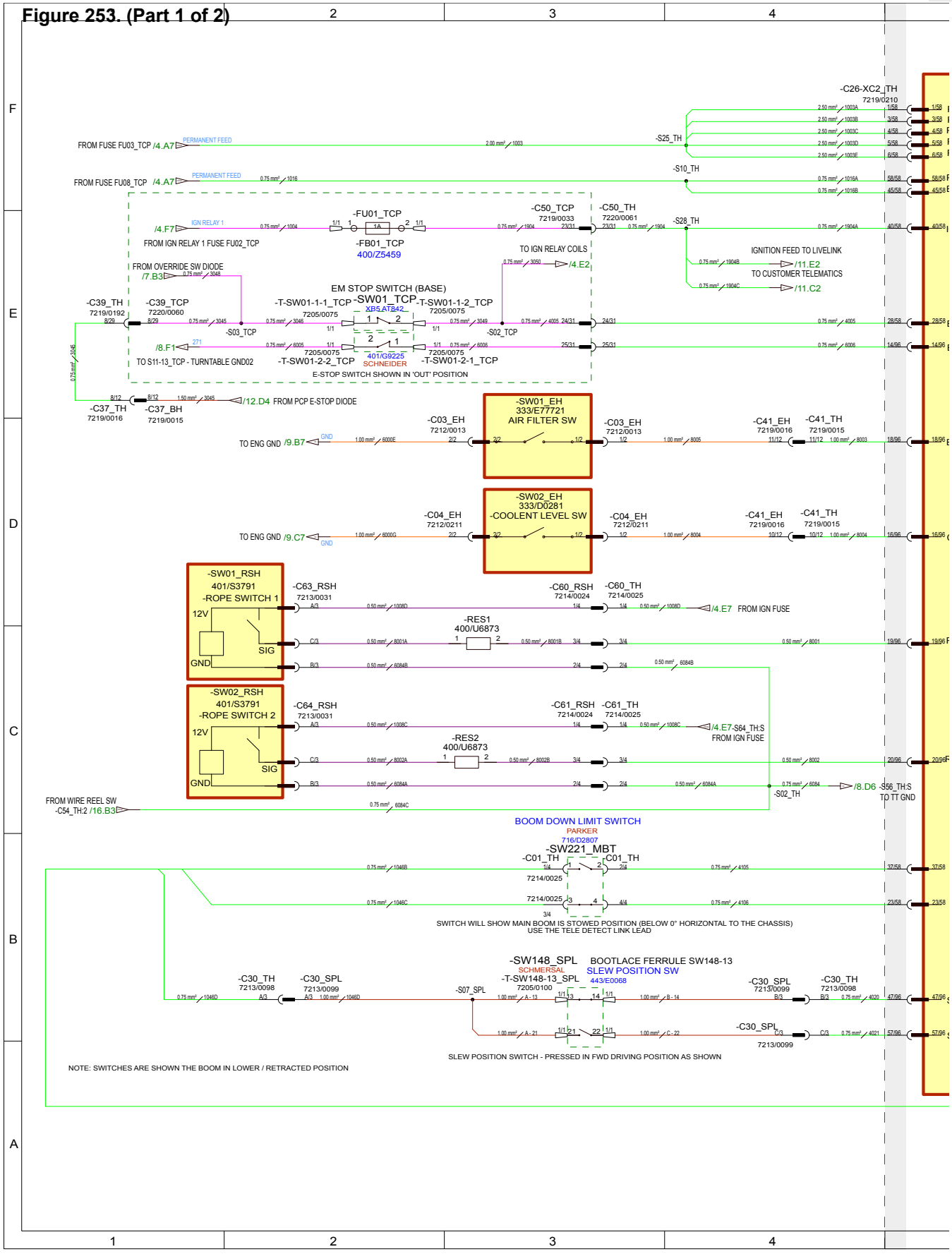

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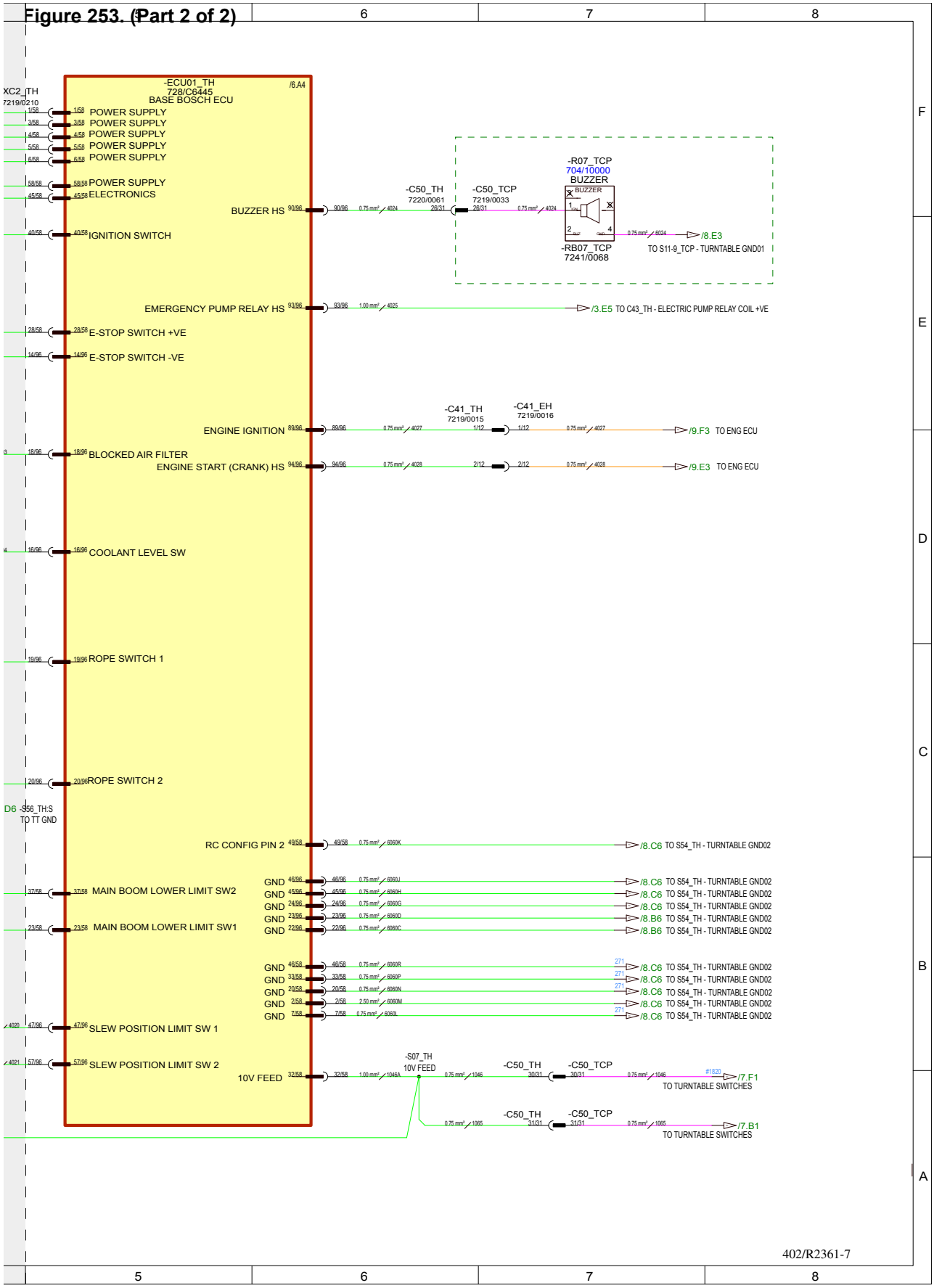
Figure 253. (Part 2 of 2)



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Page 33-24

Figure 254. 402/R2361 Issue-7 (Sheet 6 of 20) - Turntable Base Bosch ECU

Page 33-25

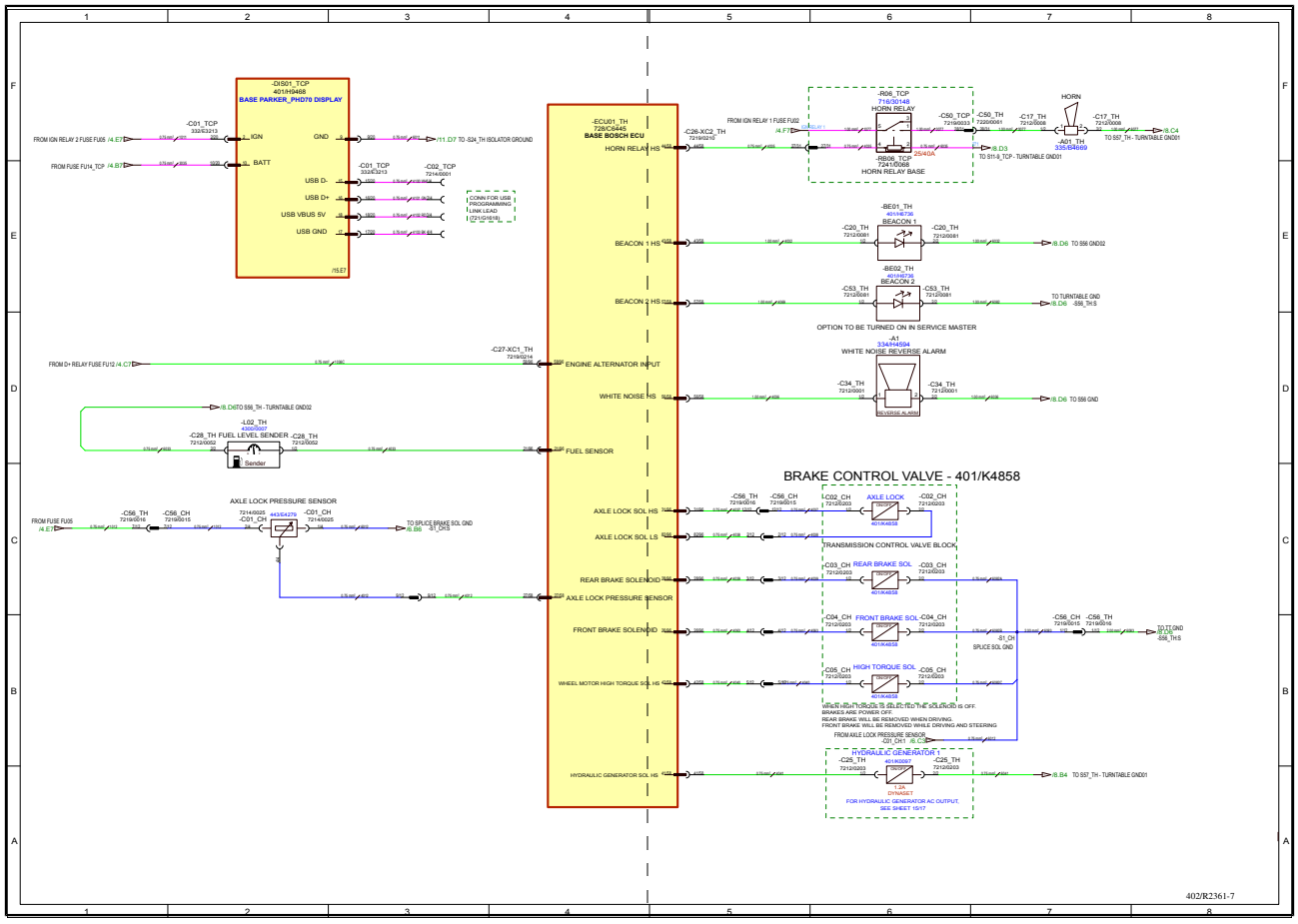

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Figure 254. (Part 1 of 2)

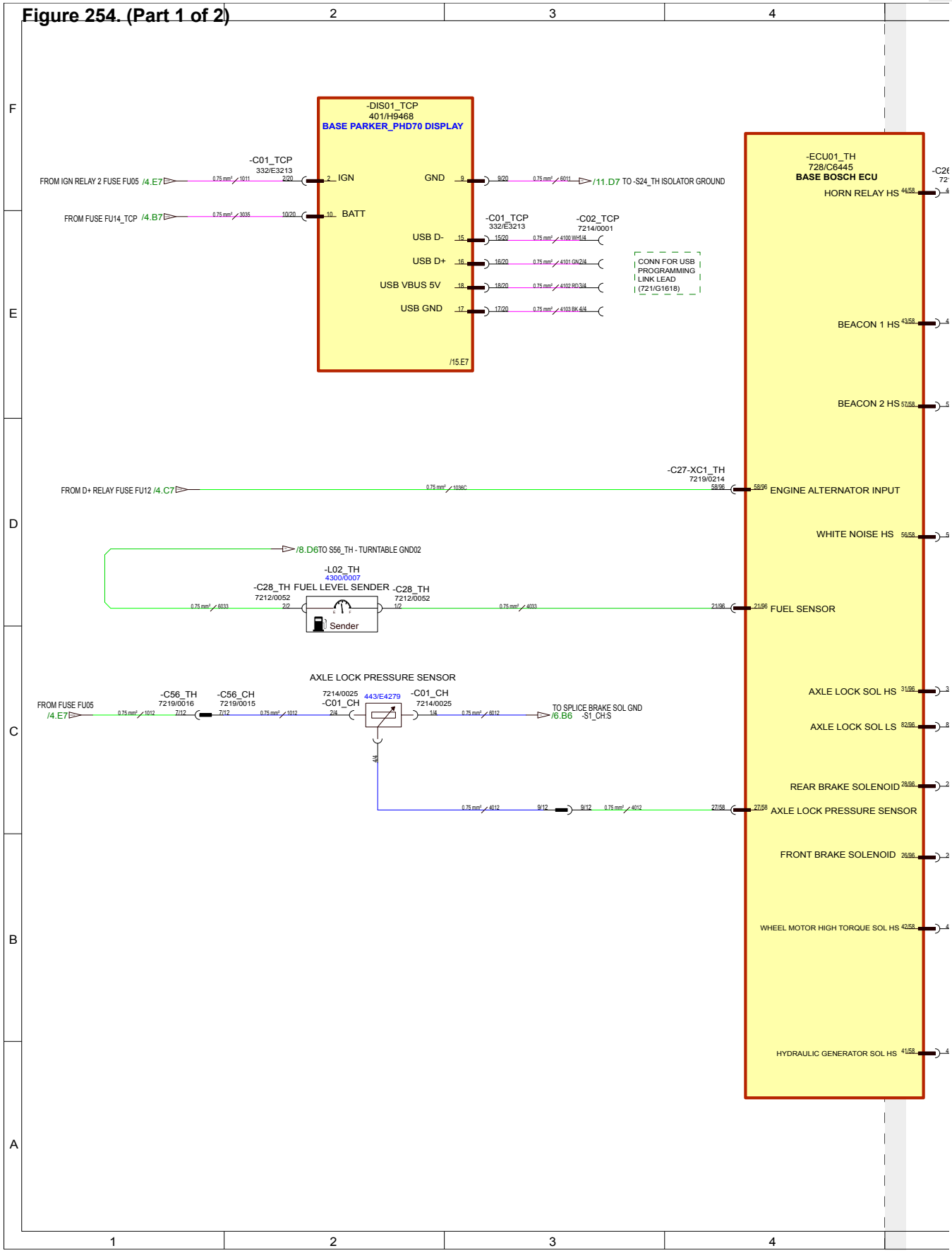

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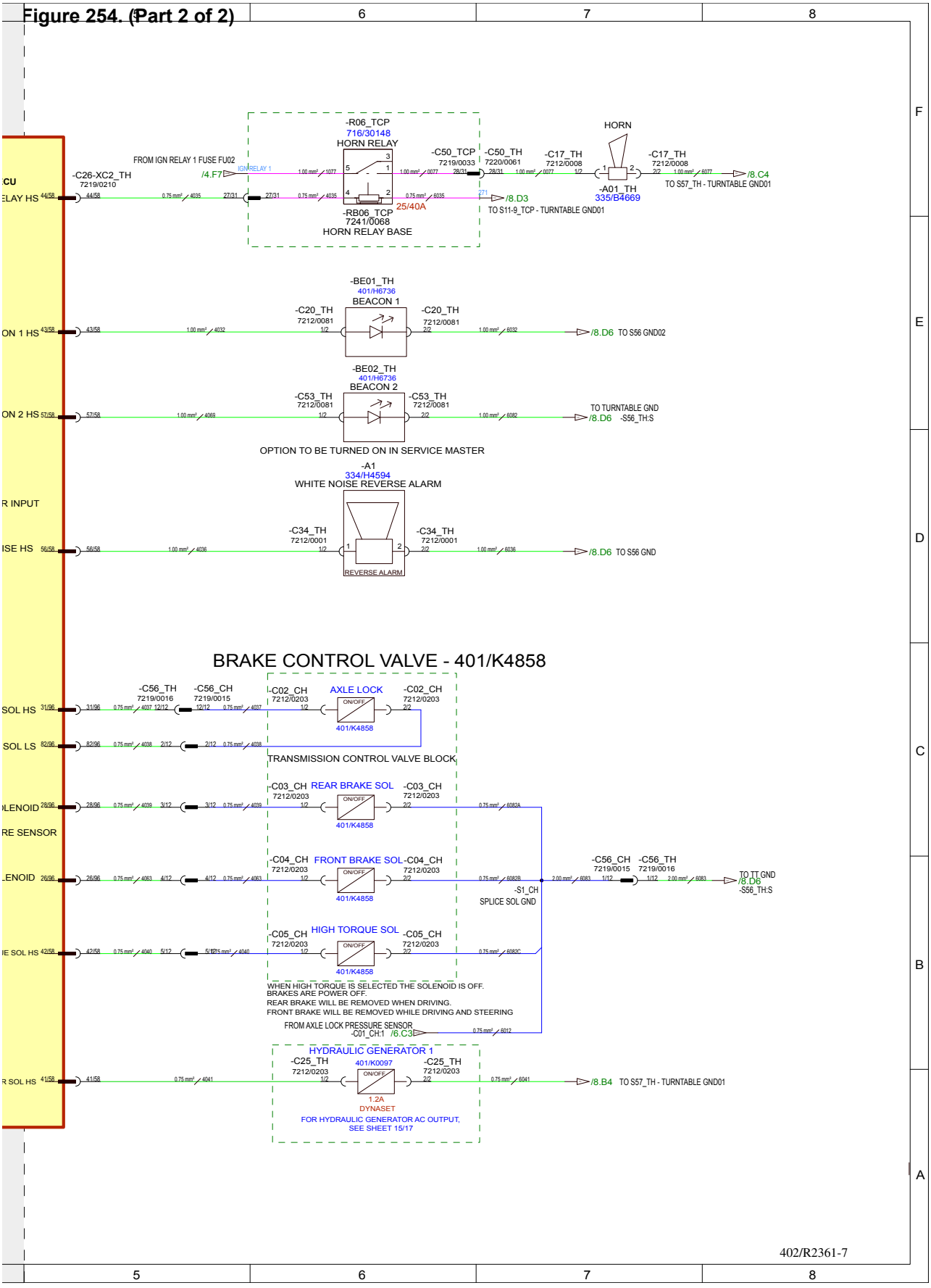
Figure 254. (Part 2 of 2)



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Page 33-28

Figure 255. 402/R2361 Issue-7 (Sheet 7 of 20) - Turntable Base Bosch ECU

Page 33-29

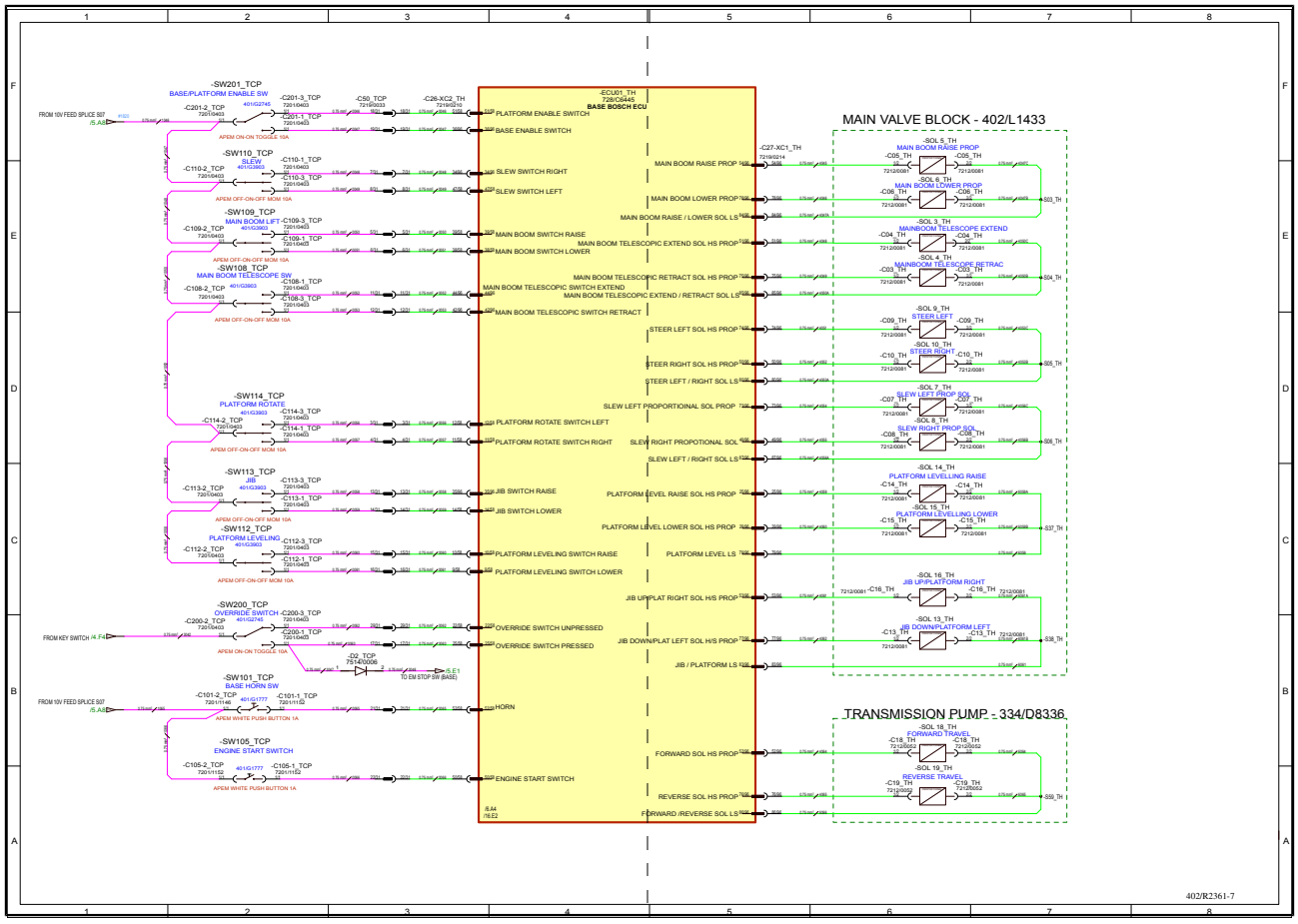

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Figure 255. (Part 1 of 2)

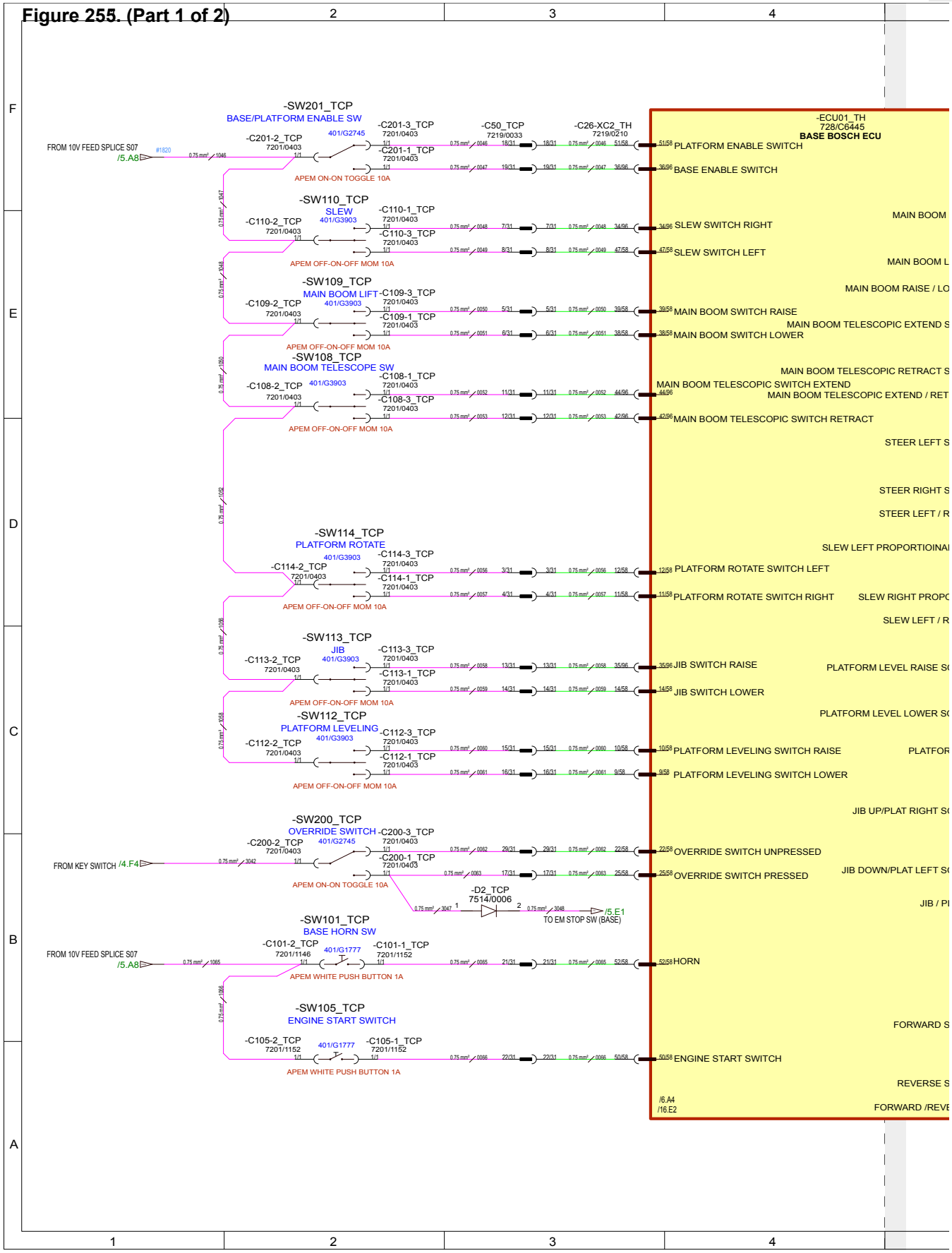

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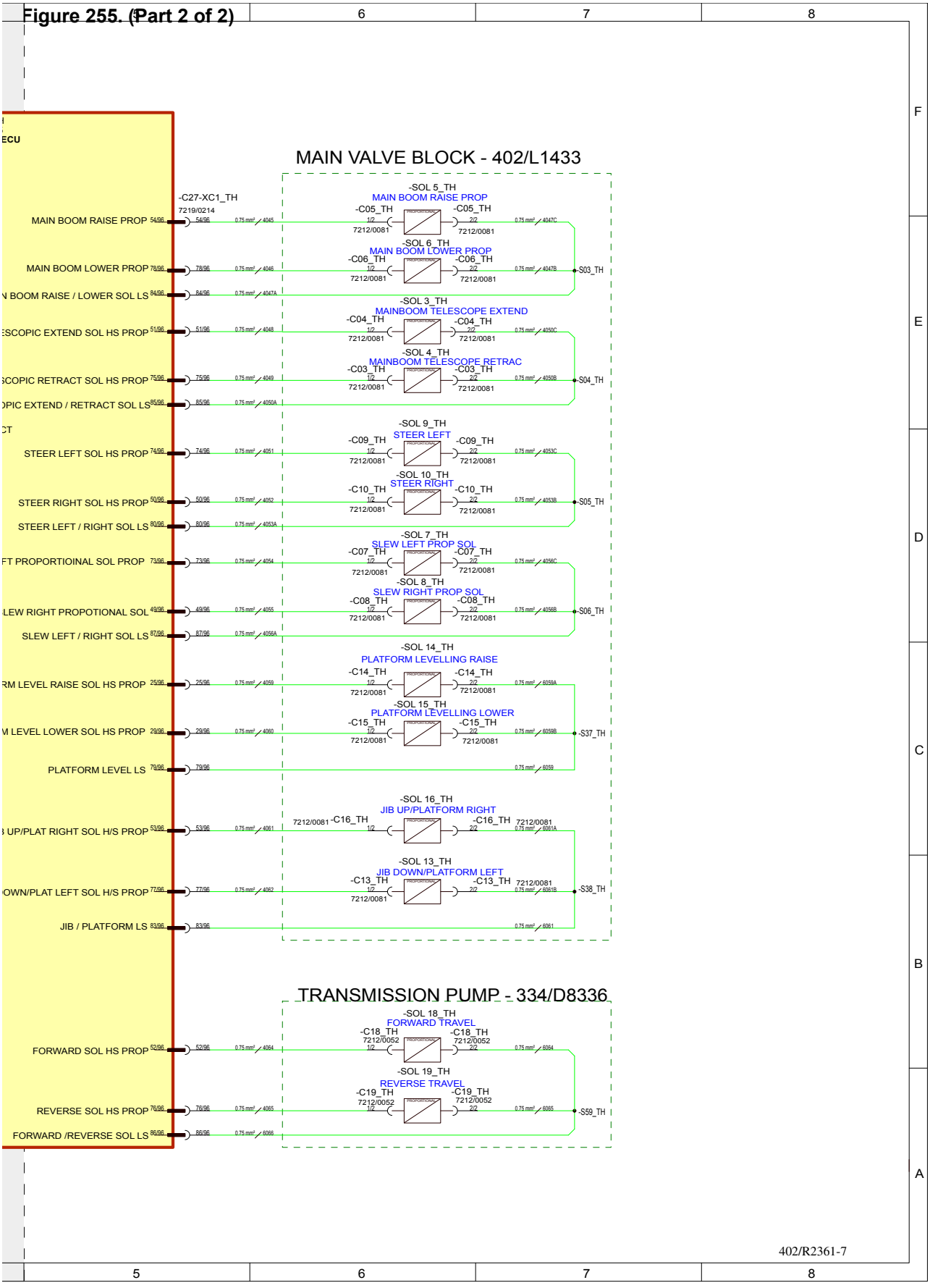
Figure 255. (Part 2 of 2)



Page 33-28

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Page 33-32

Figure 256. 402/R2361 Issue-7 (Sheet 8 of 20) - Turntable Ground

Page 33-33

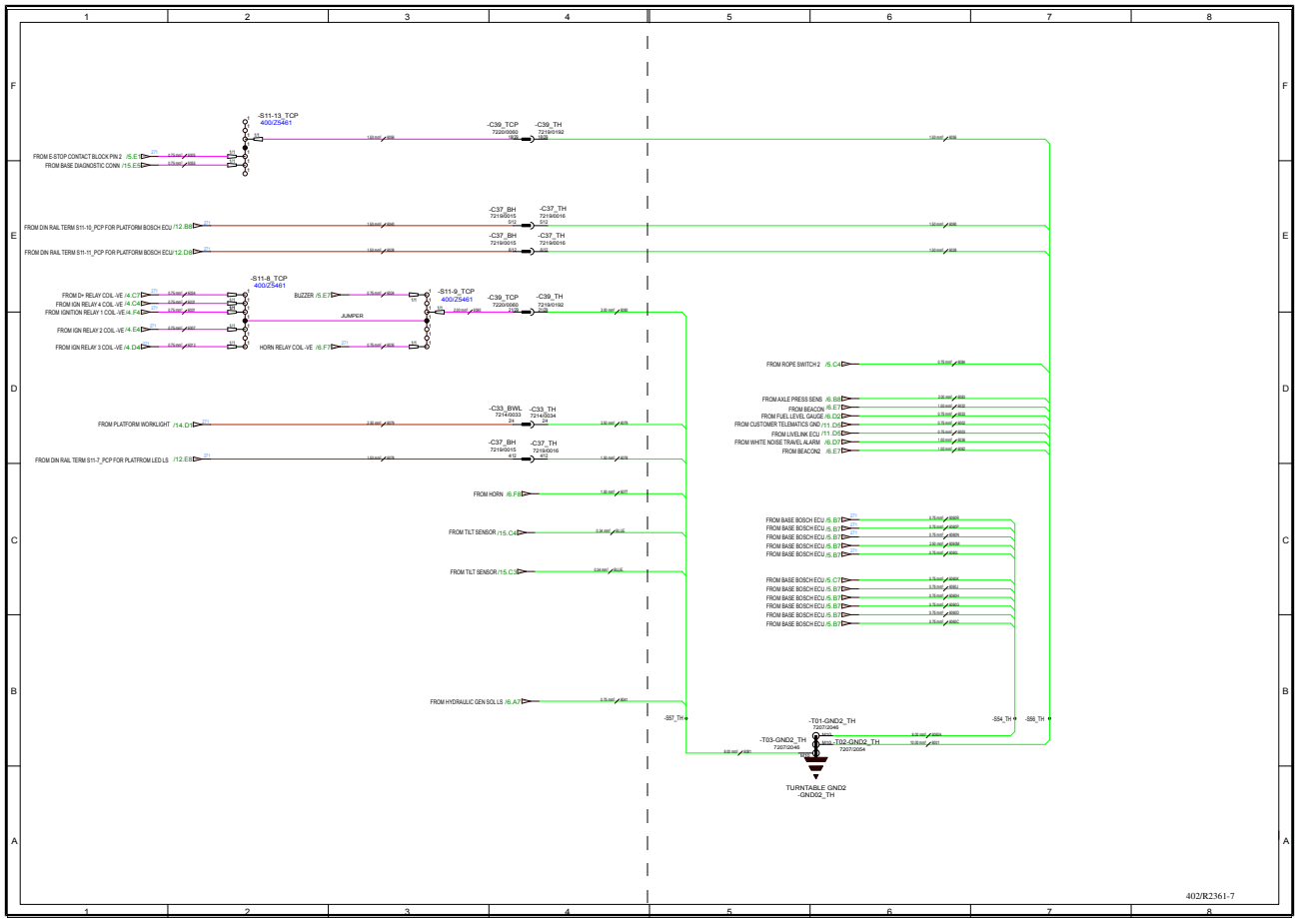

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Figure 256. (Part 1 of 2)

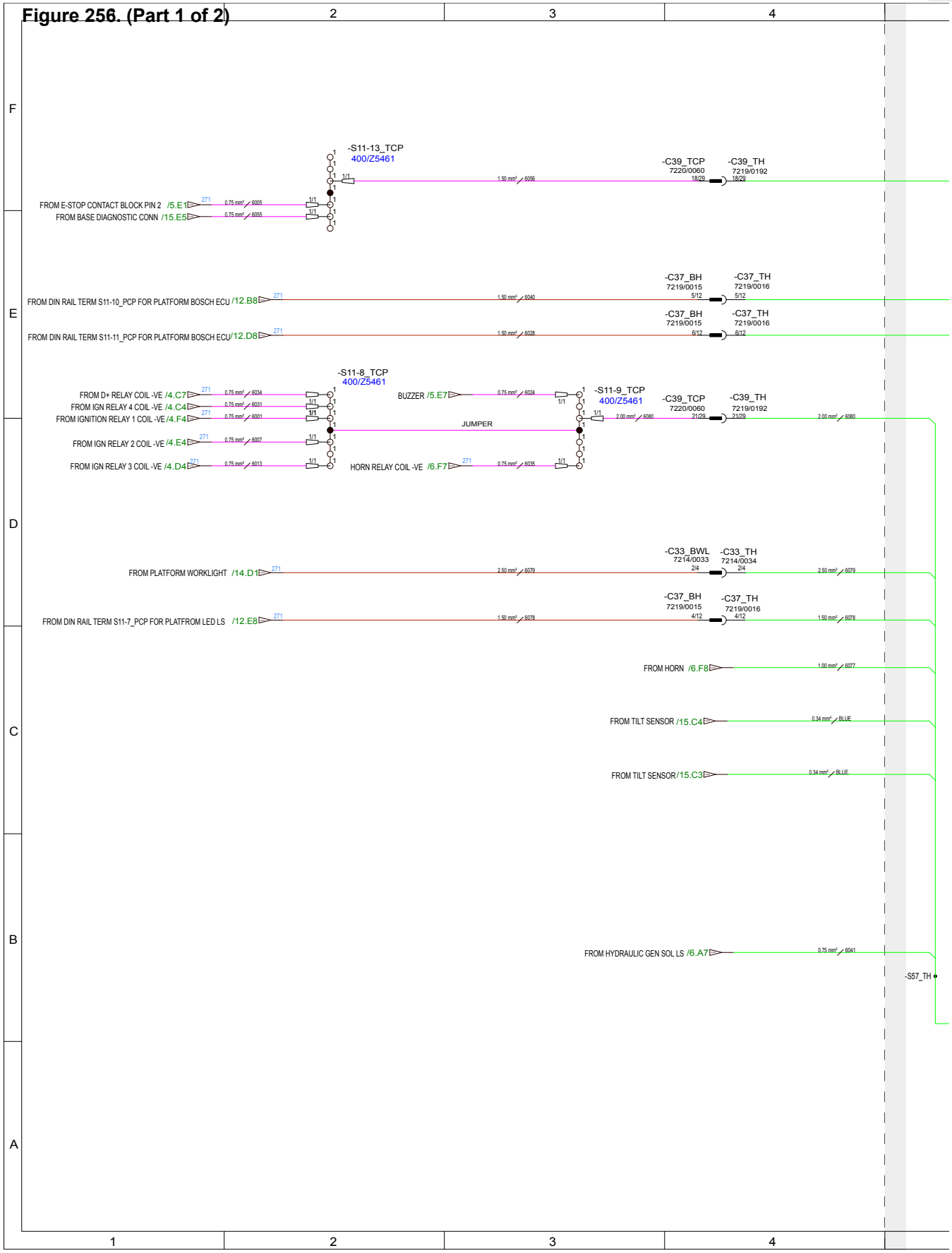

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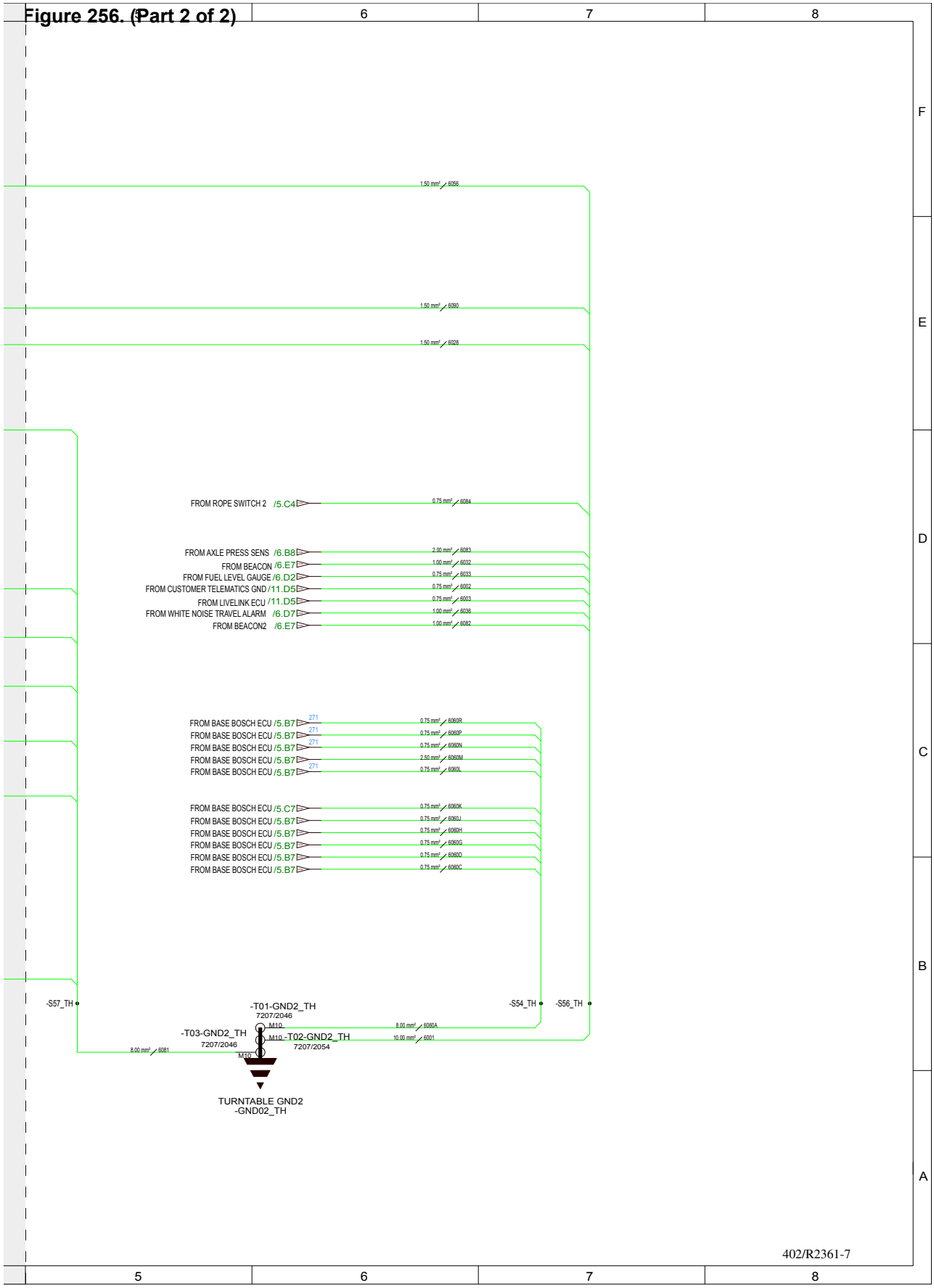
Figure 256. (Part 2 of 2)



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Page 33-36

Figure 257. 402/R2361 Issue-7 (Sheet 9 of 20) - Engine ECU

Page 33-37

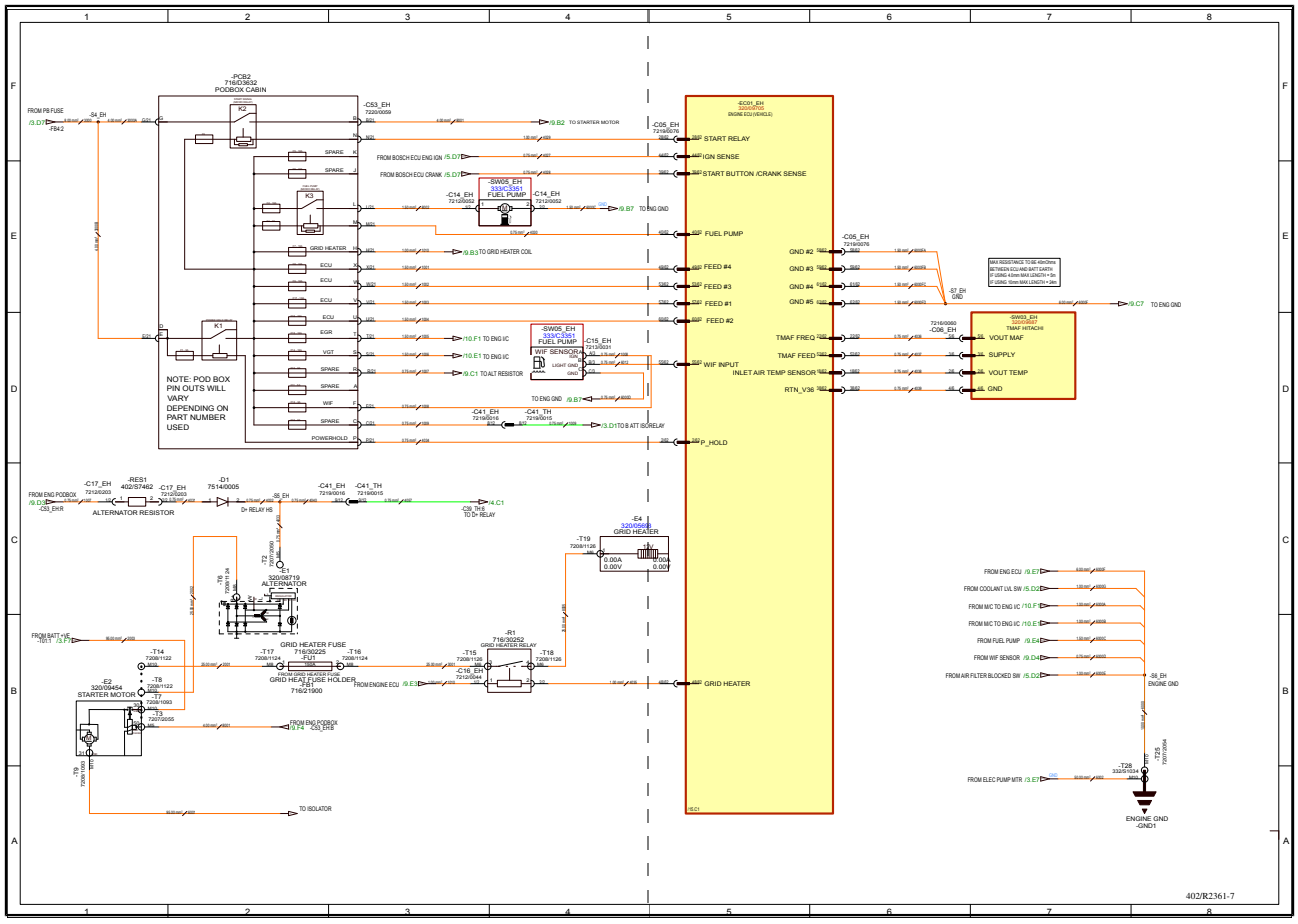

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Figure 257. (Part 1 of 2)

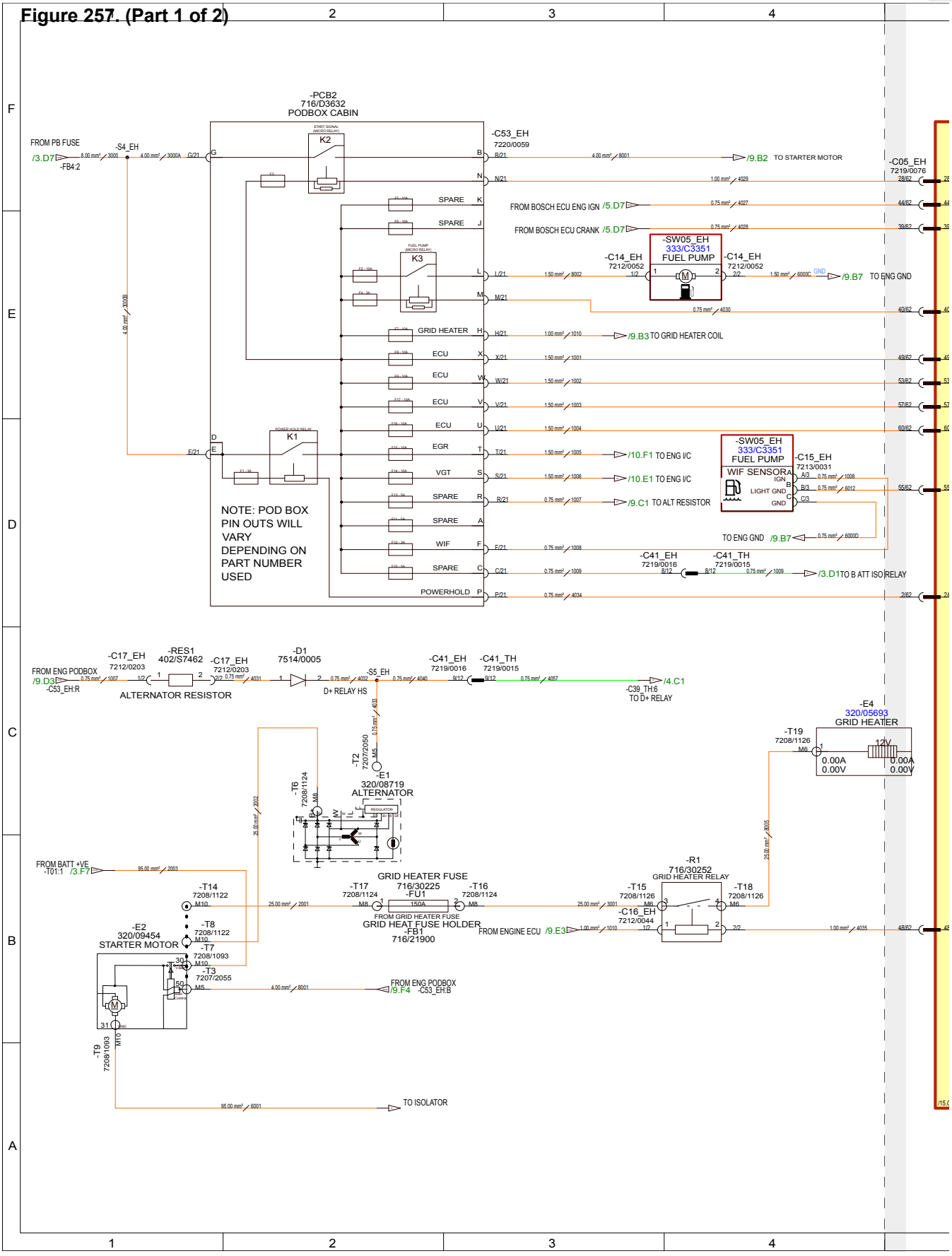

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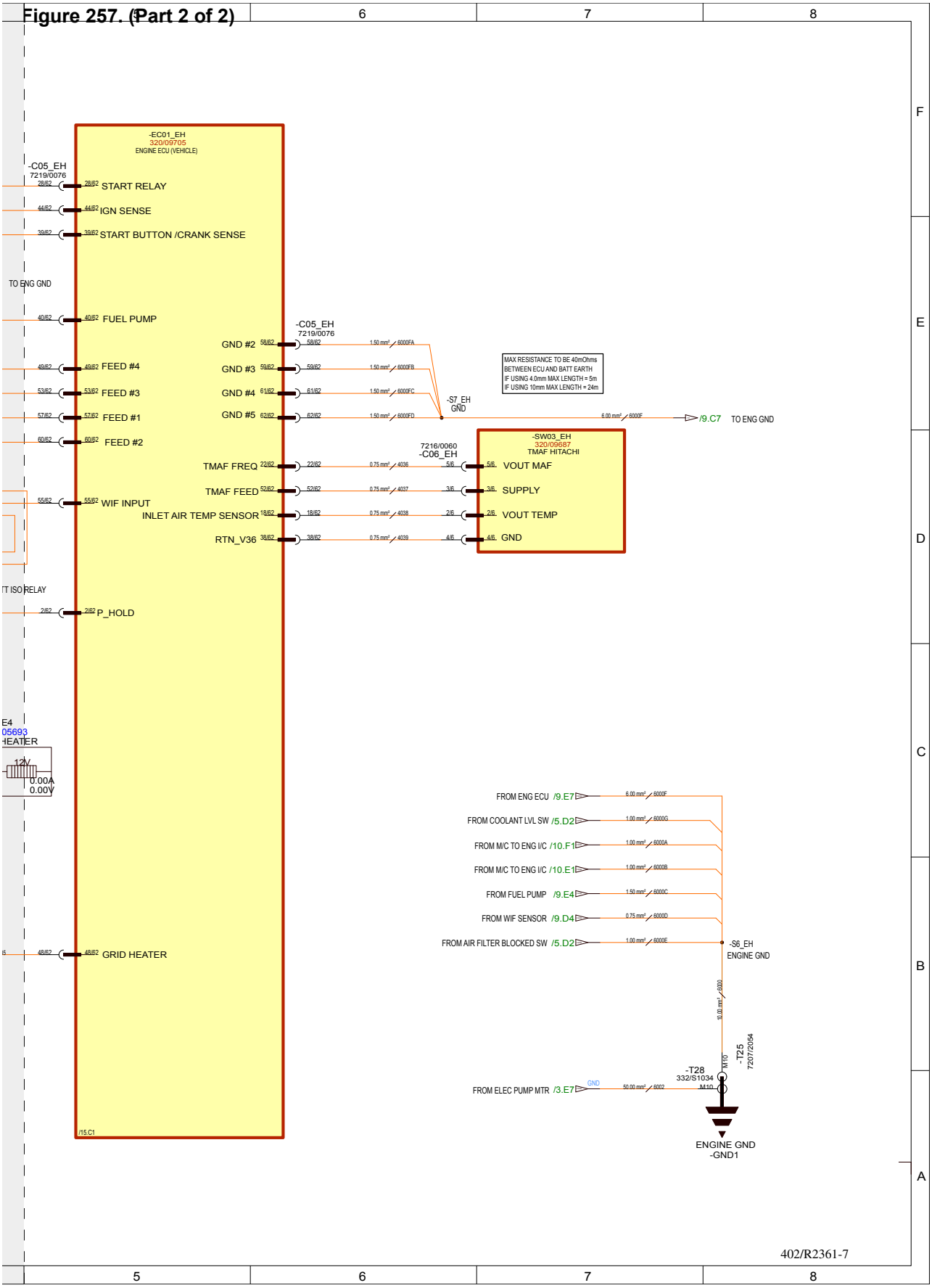
Figure 257. (Part 2 of 2)



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Page 33-40

Figure 258. 402/R2361 Issue-7 (Sheet 10 of 20) - Engine ECU

Page 33-41

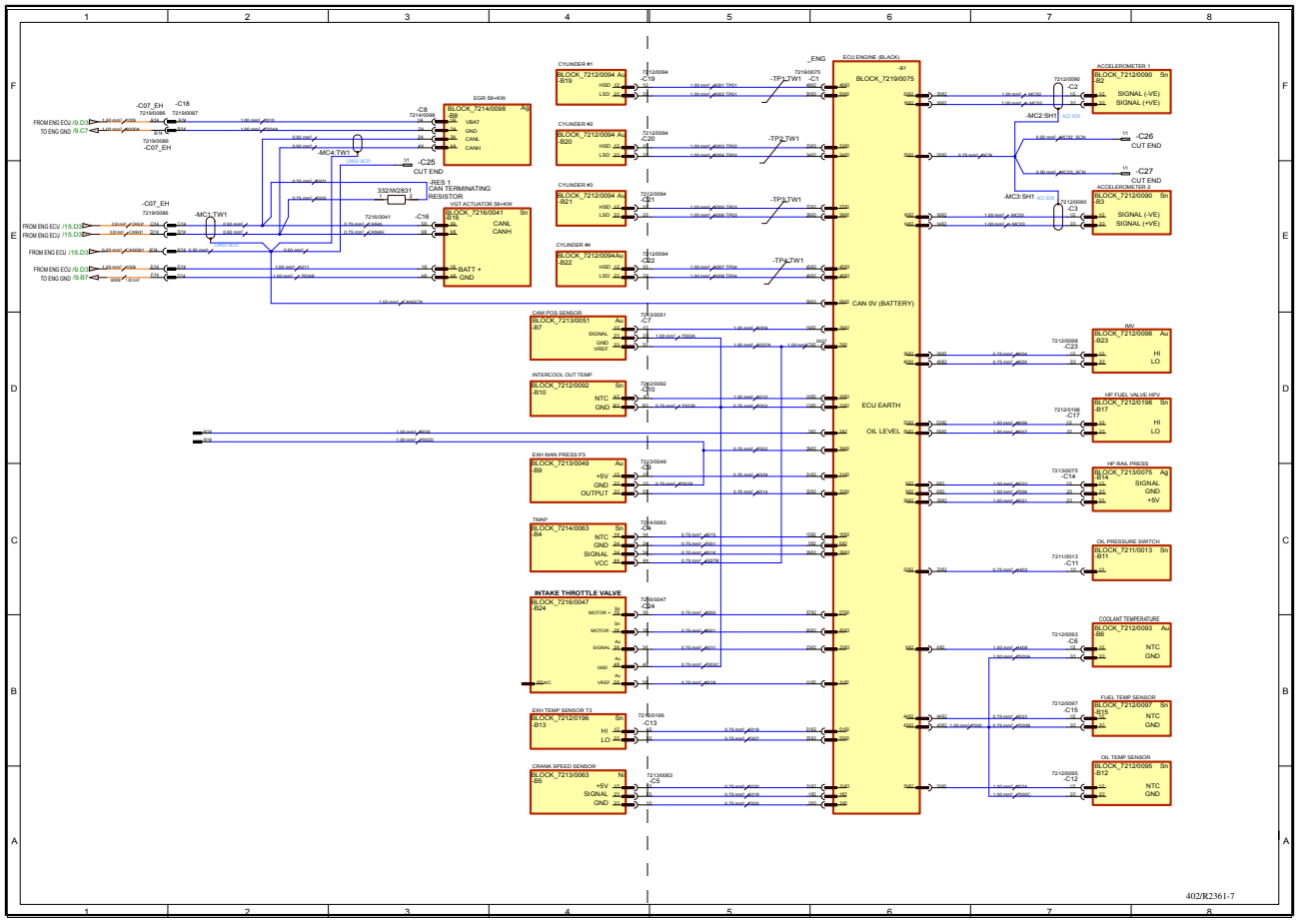

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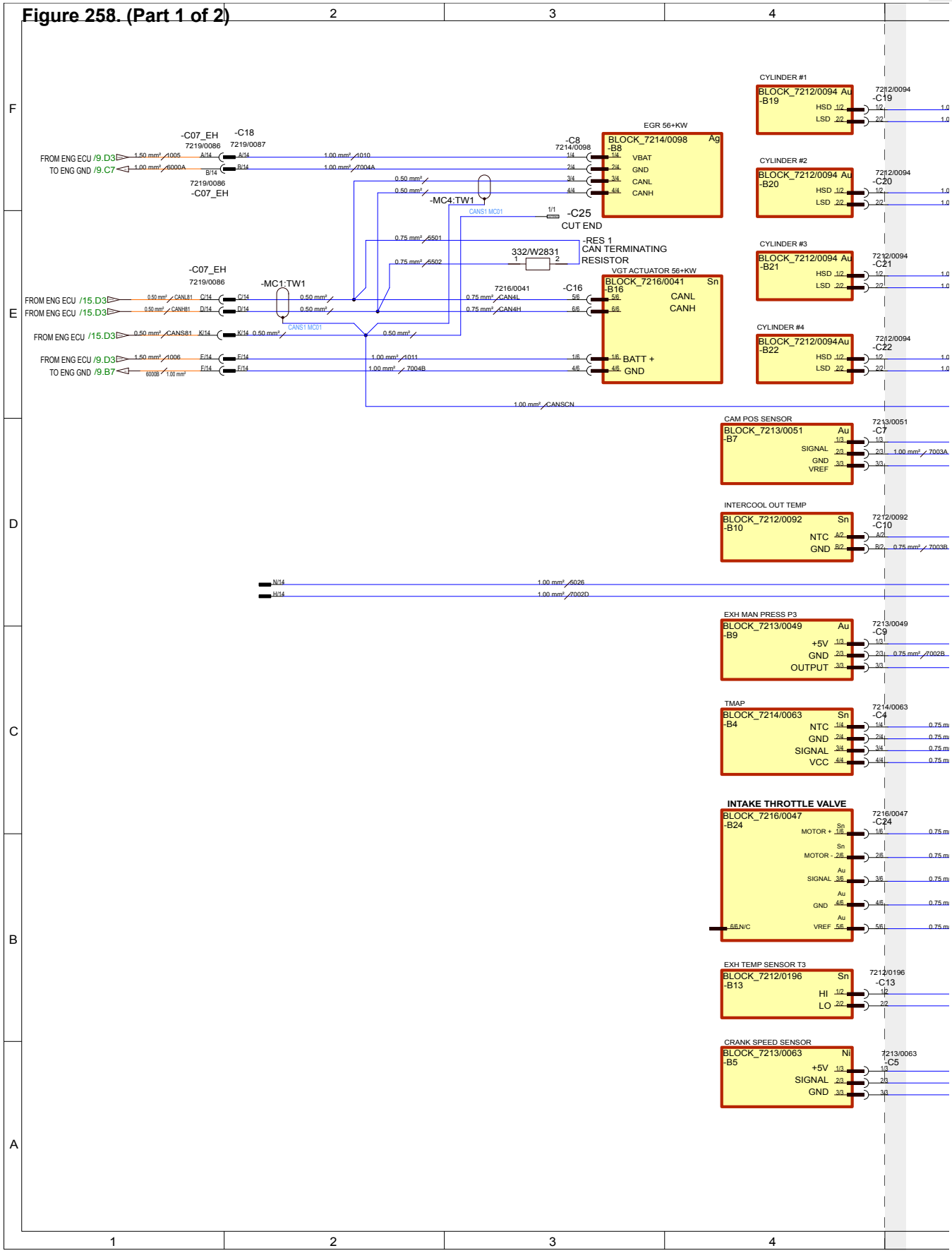
Figure 258. (Part 1 of 2)



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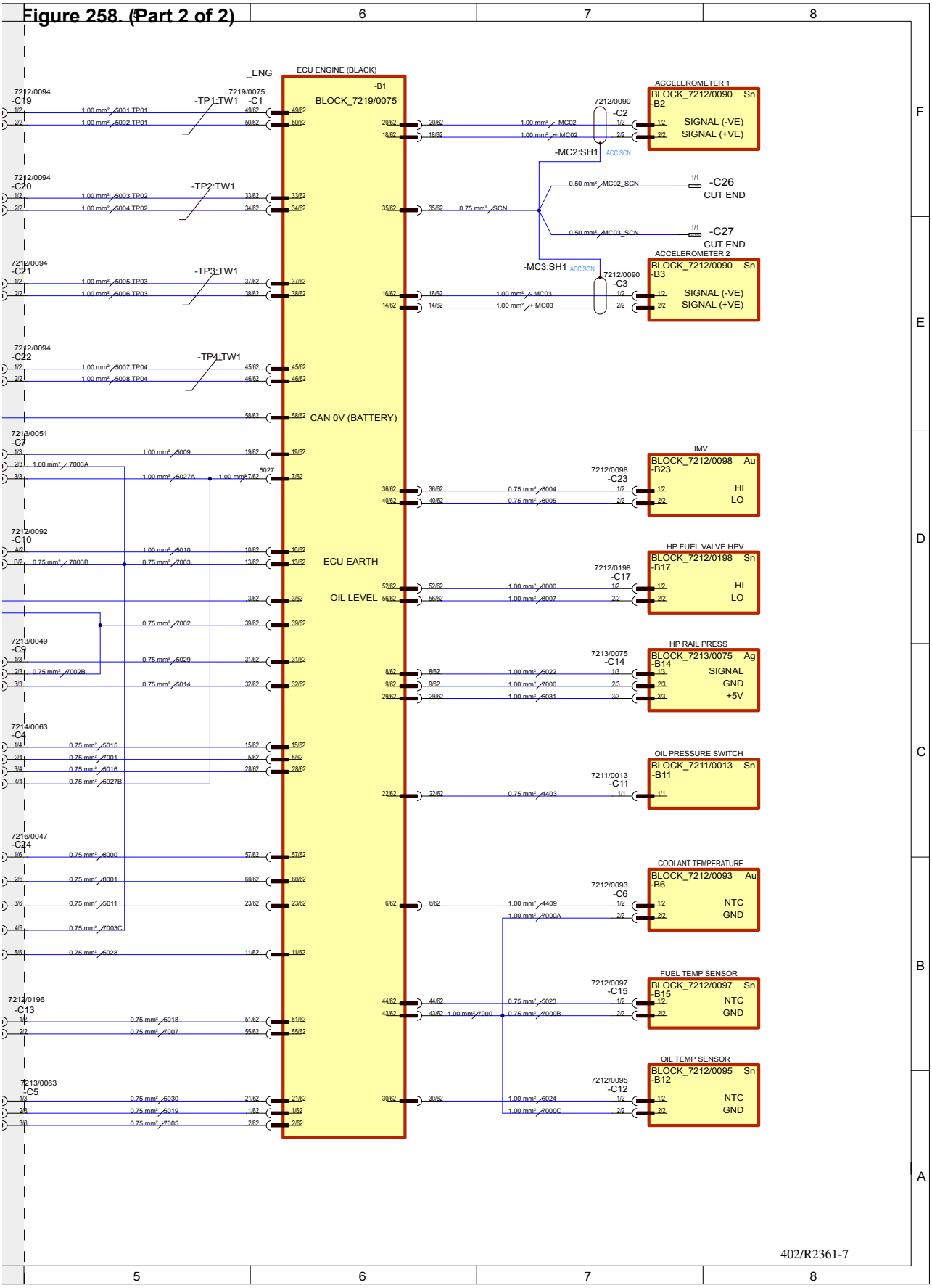
Page 33-40 Page 33-41

Figure 258. (Part 2 of 2)



Page 33-40

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Page 33-44

Figure 259. 402/R2361 Issue-7 (Sheet 11 of 20) - LiveLink ECU

Page 33-45

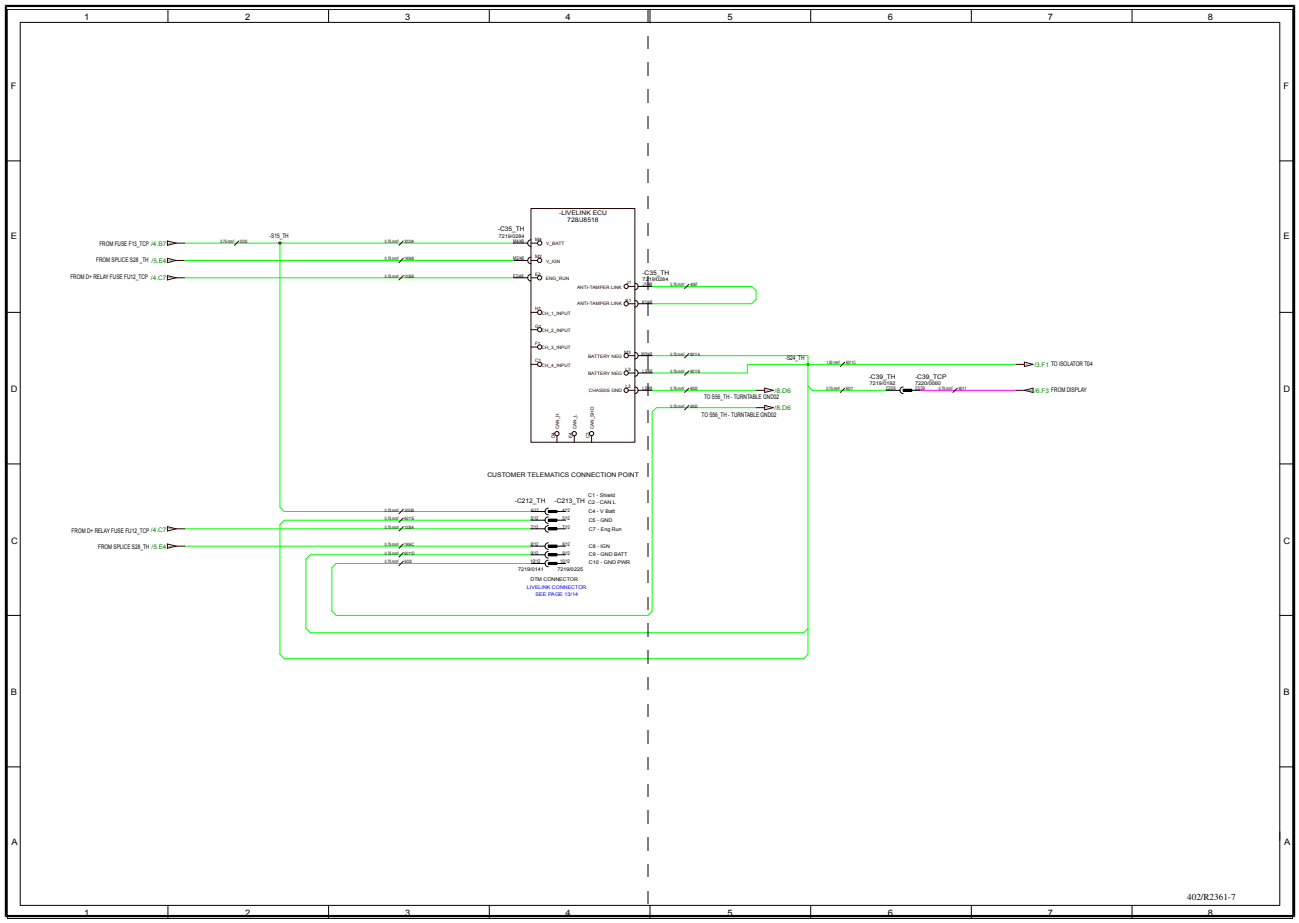

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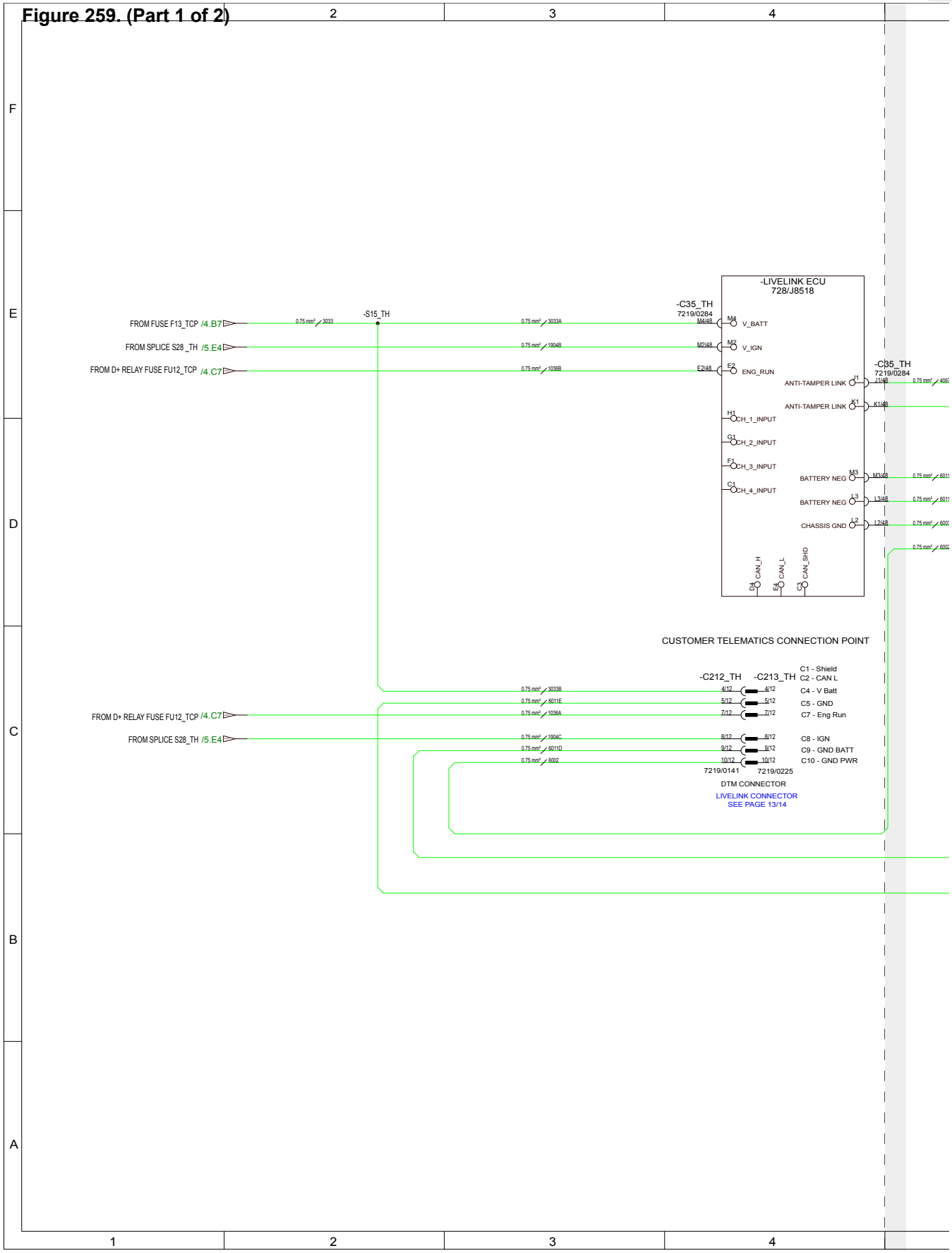
Figure 259. (Part 1 of 2)



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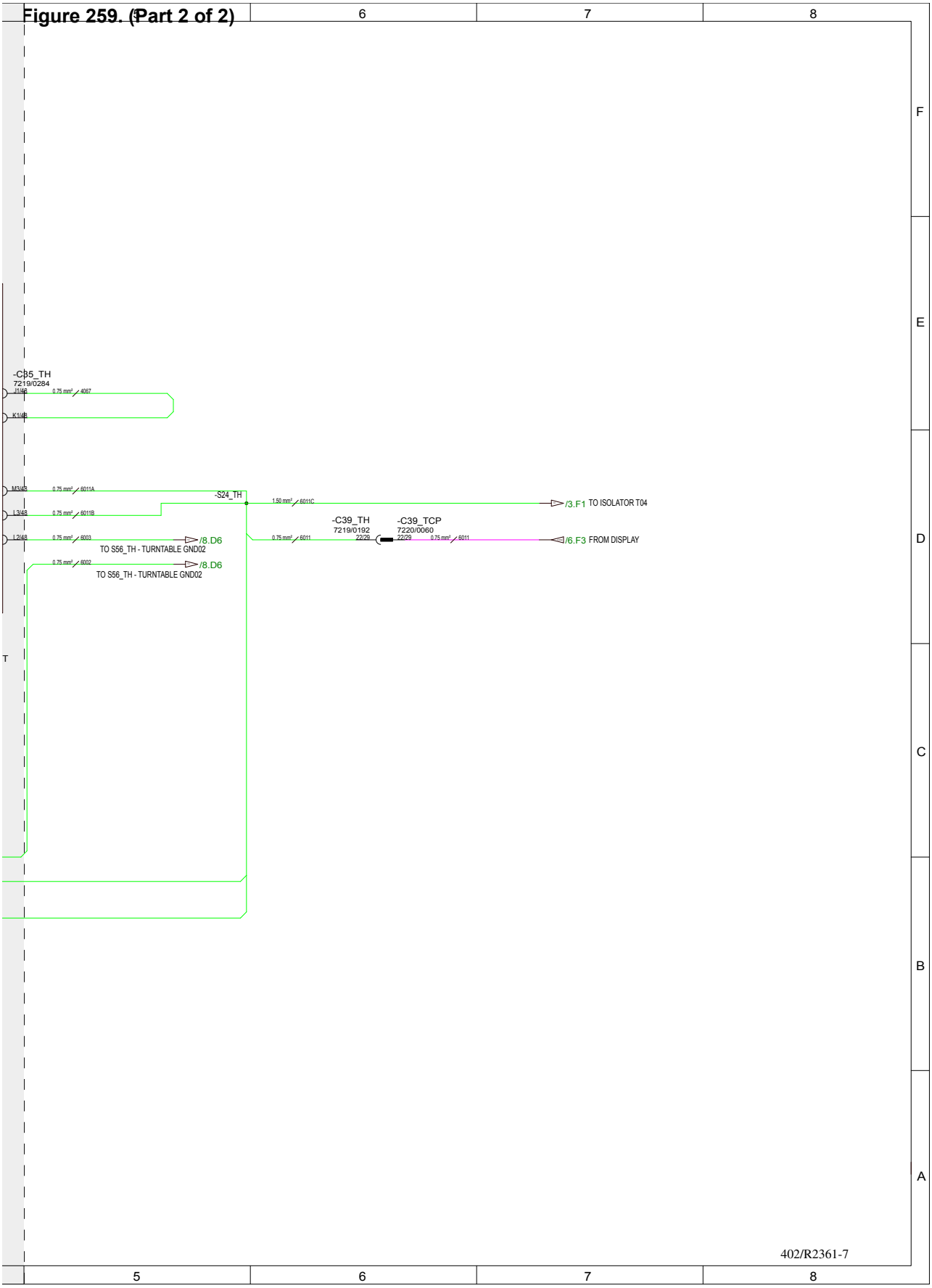
Page 33-44 Page 33-45

Figure 259. (Part 2 of 2)



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Page 33-48

Figure 260. 402/R2361 Issue-7 (Sheet 12 of 20) - Platform Bosch ECU

Page 33-49

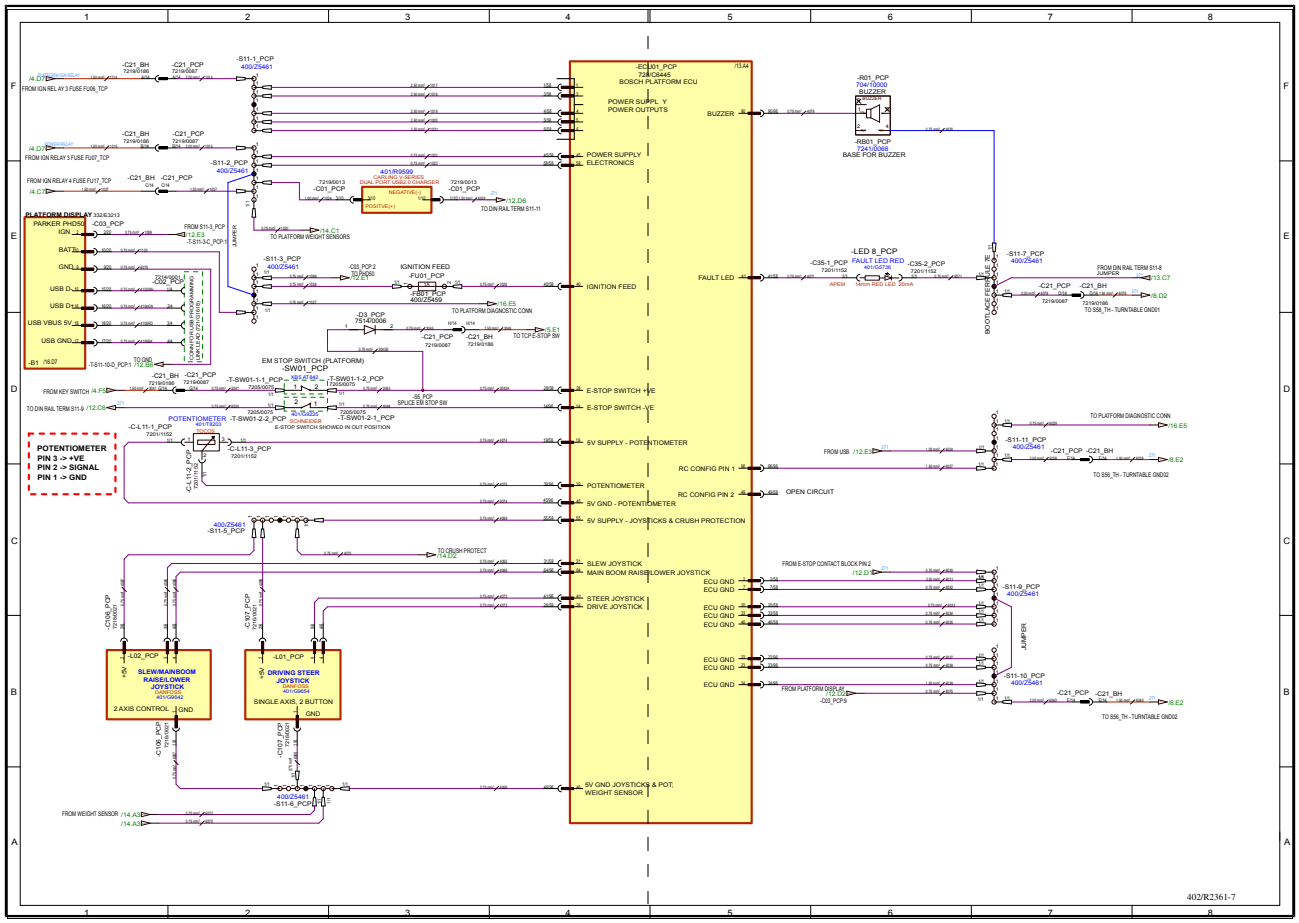

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Figure 260. (Part 1 of 2)

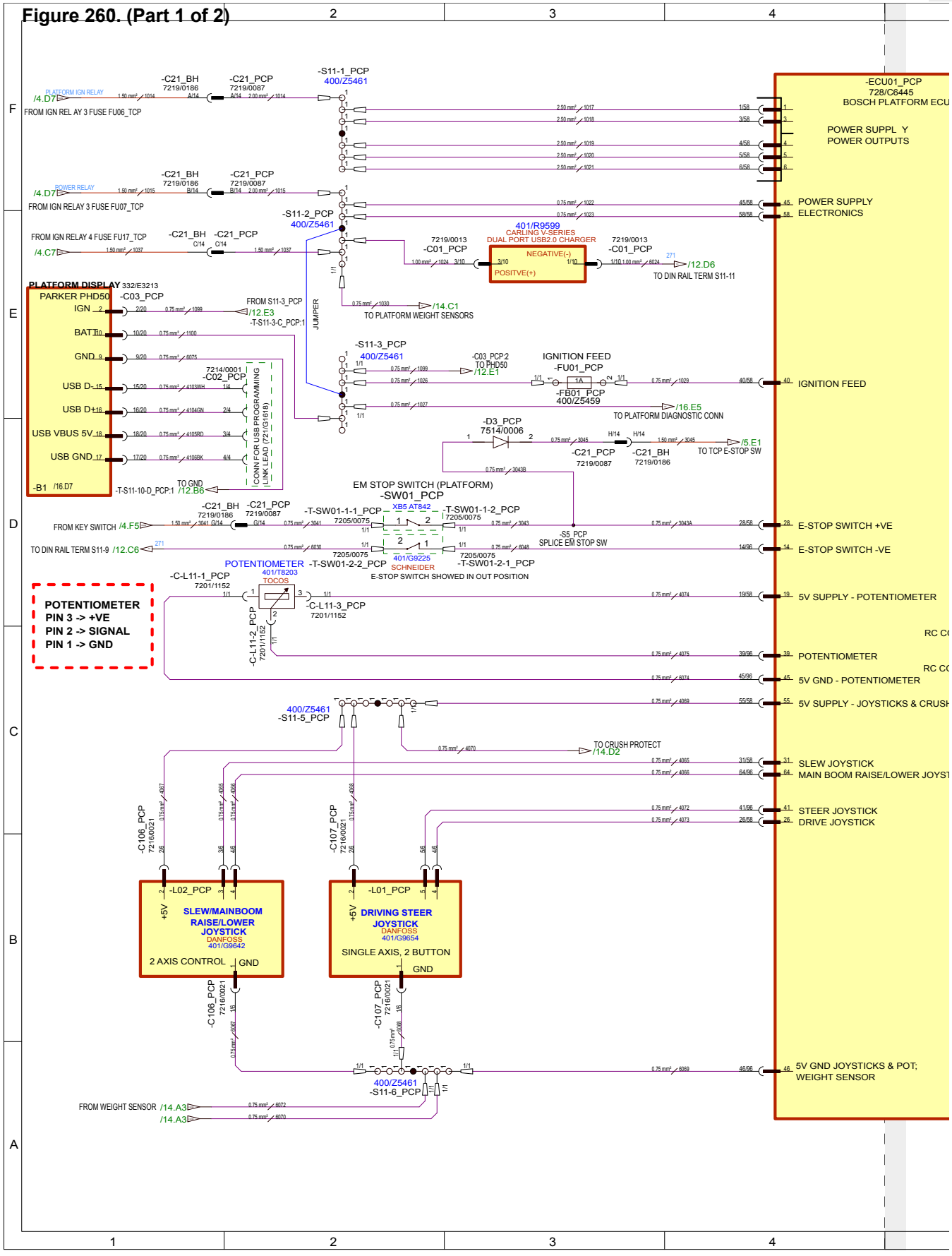

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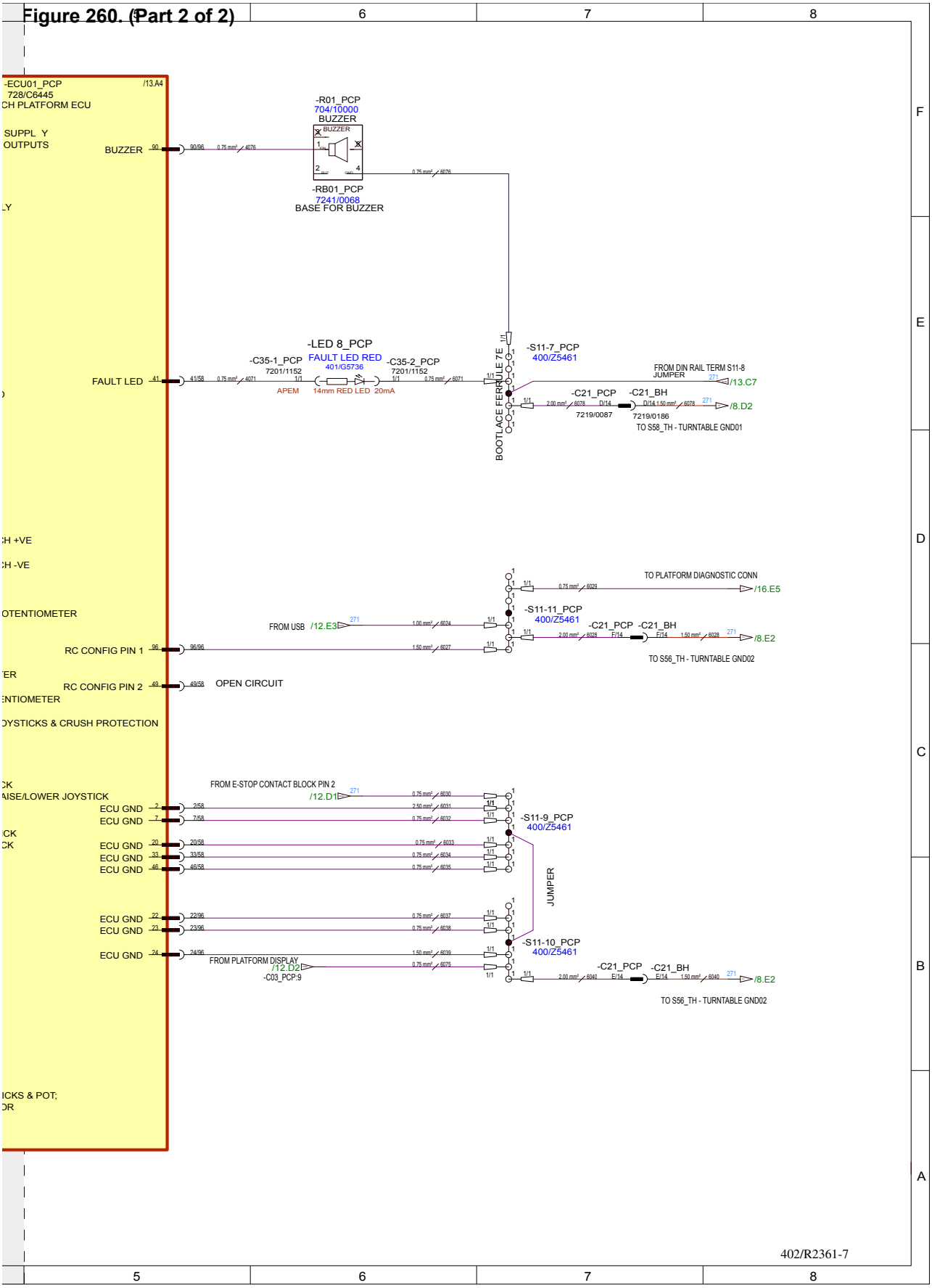
Figure 260. (Part 2 of 2)



Page 33-48

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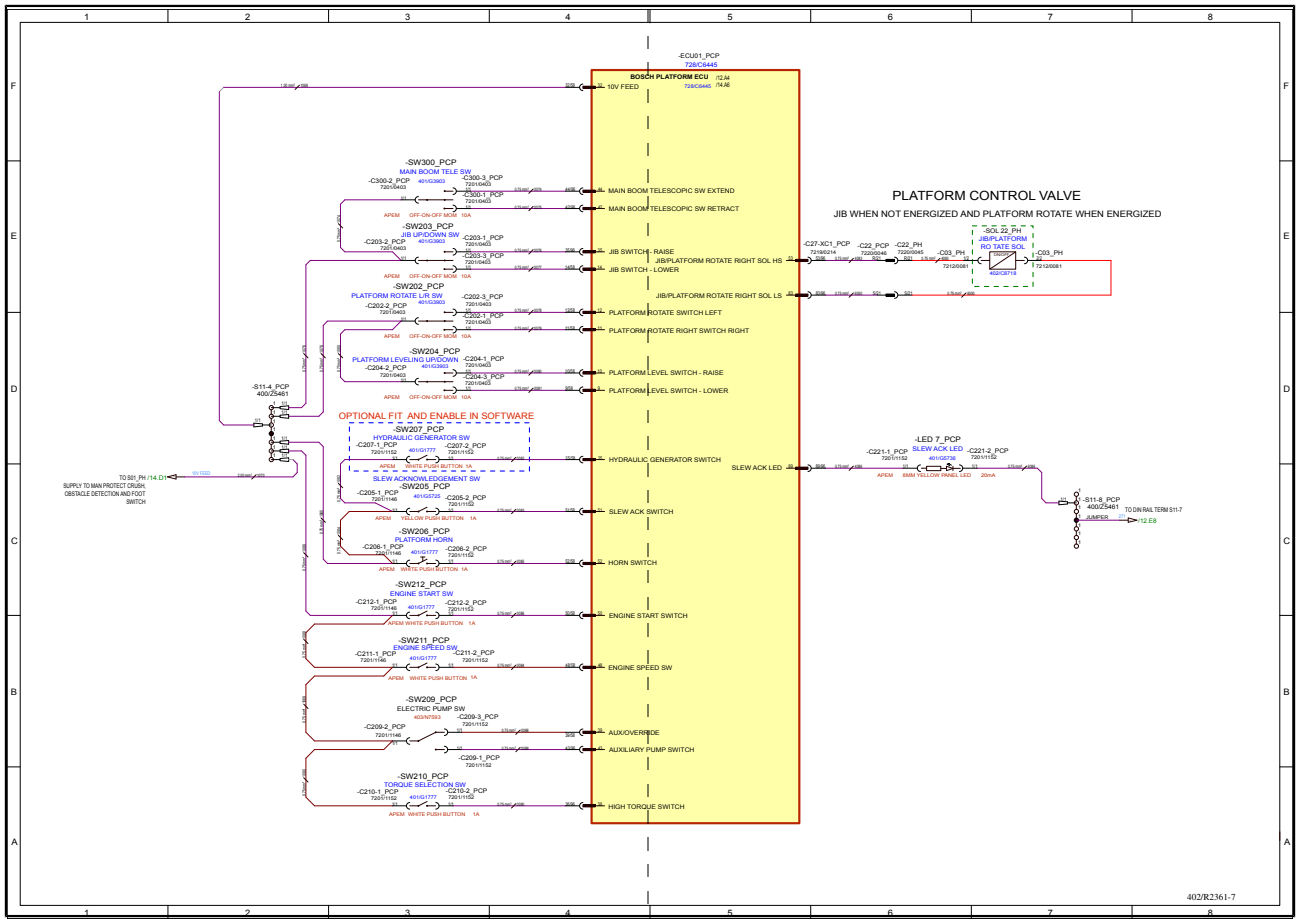
Page 33-52

Figure 261. 402/R2361 Issue-7 (Sheet 13 of 20) - Platform Bosch ECU

Page 33-53



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Page 33-52 Page 33-53

Figure 261. (Part 1 of 2)

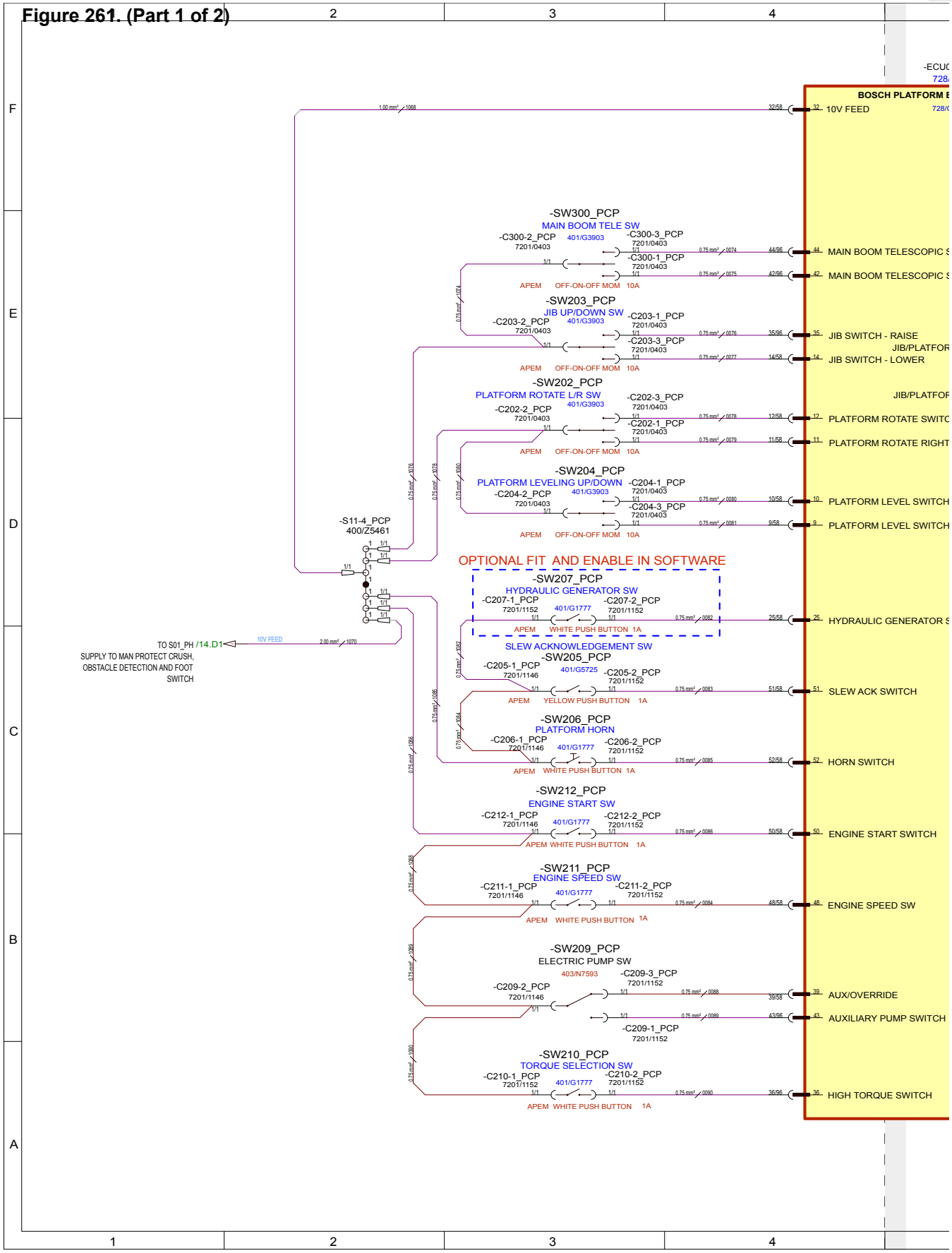

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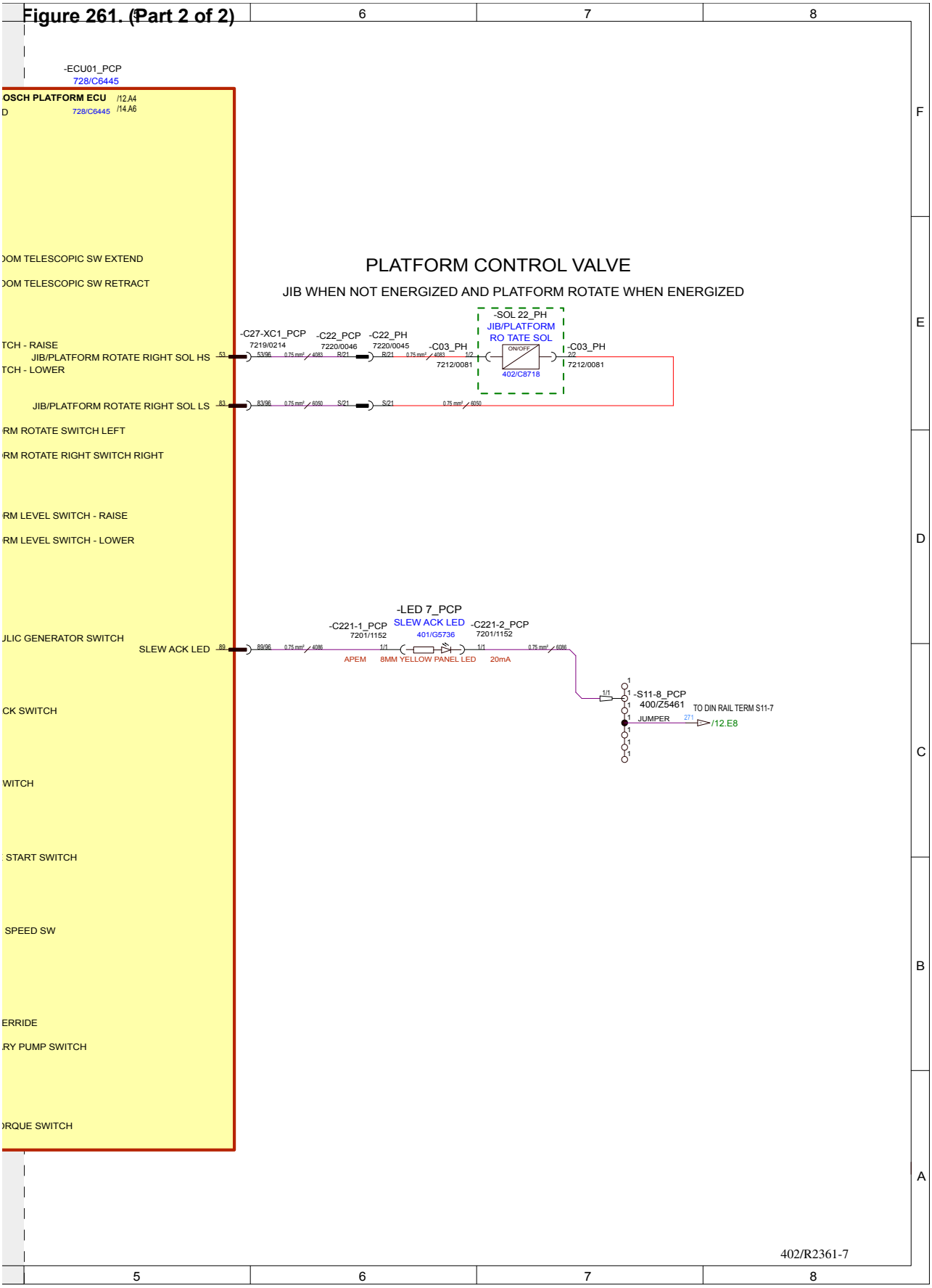
Figure 261. (Part 2 of 2)



Page 33-52

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Page 33-56

Figure 262. 402/R2361 Issue-7 (Sheet 14 of 20) - Platform Bosch ECU

Page 33-57

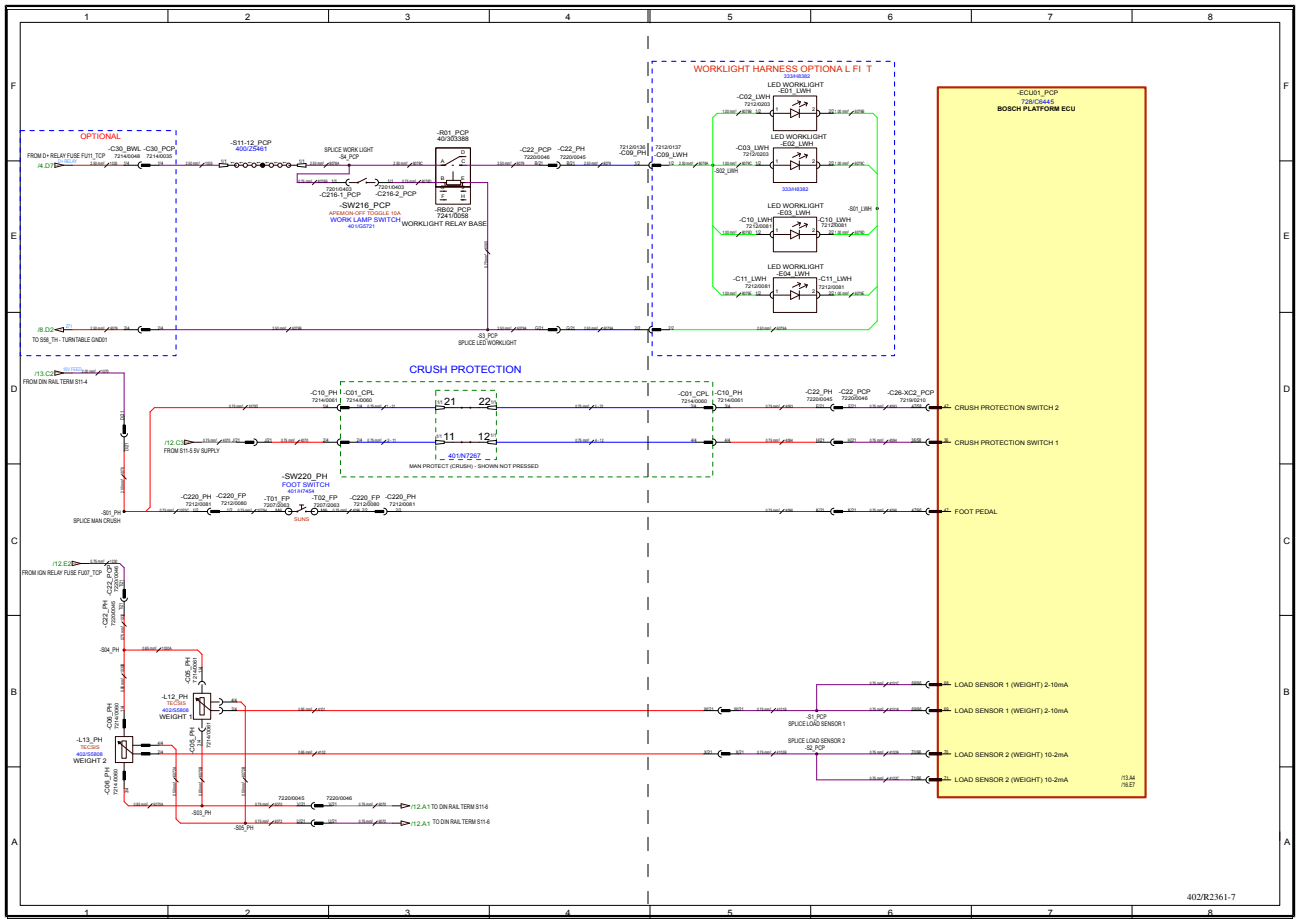

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Figure 262. (Part 1 of 2)

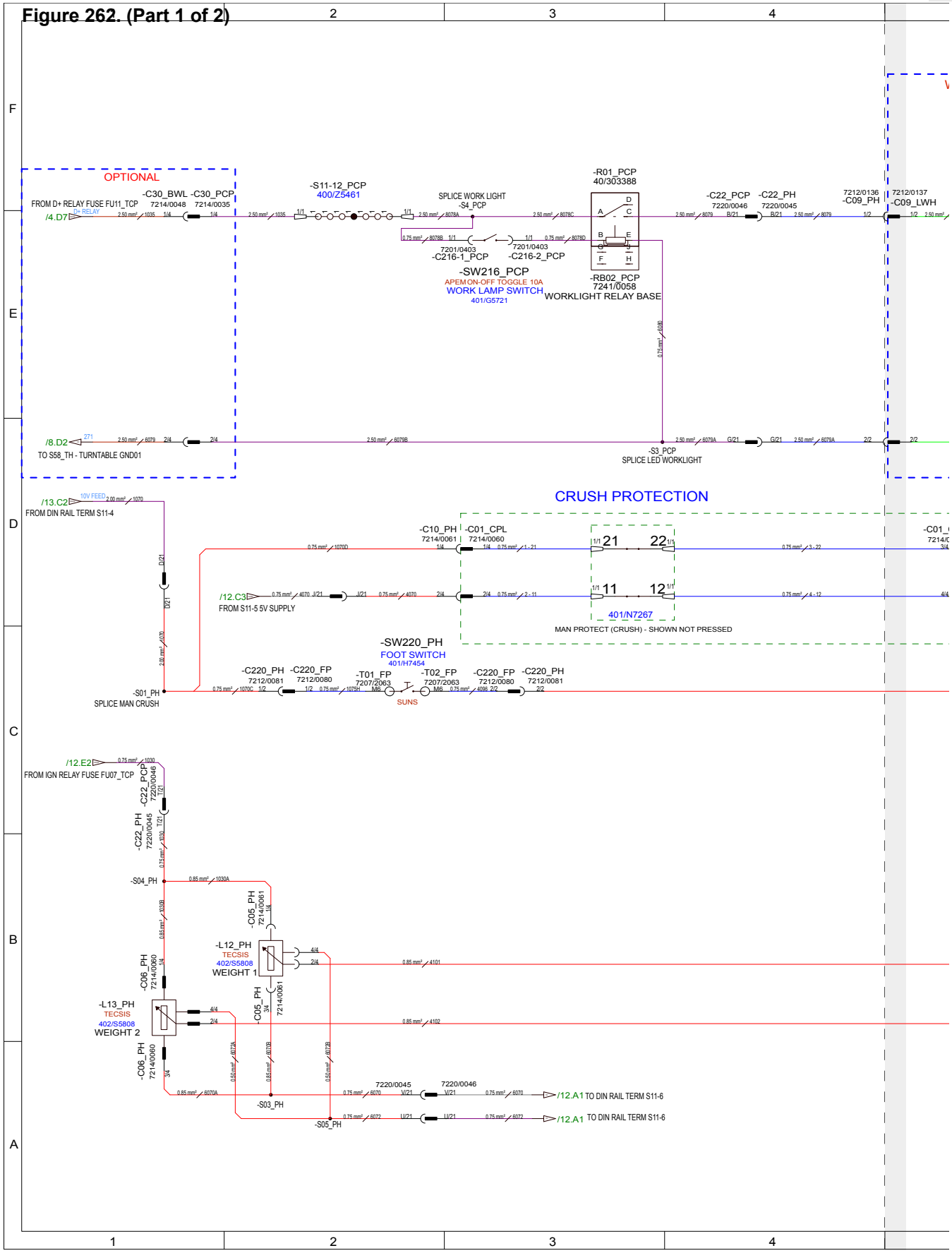

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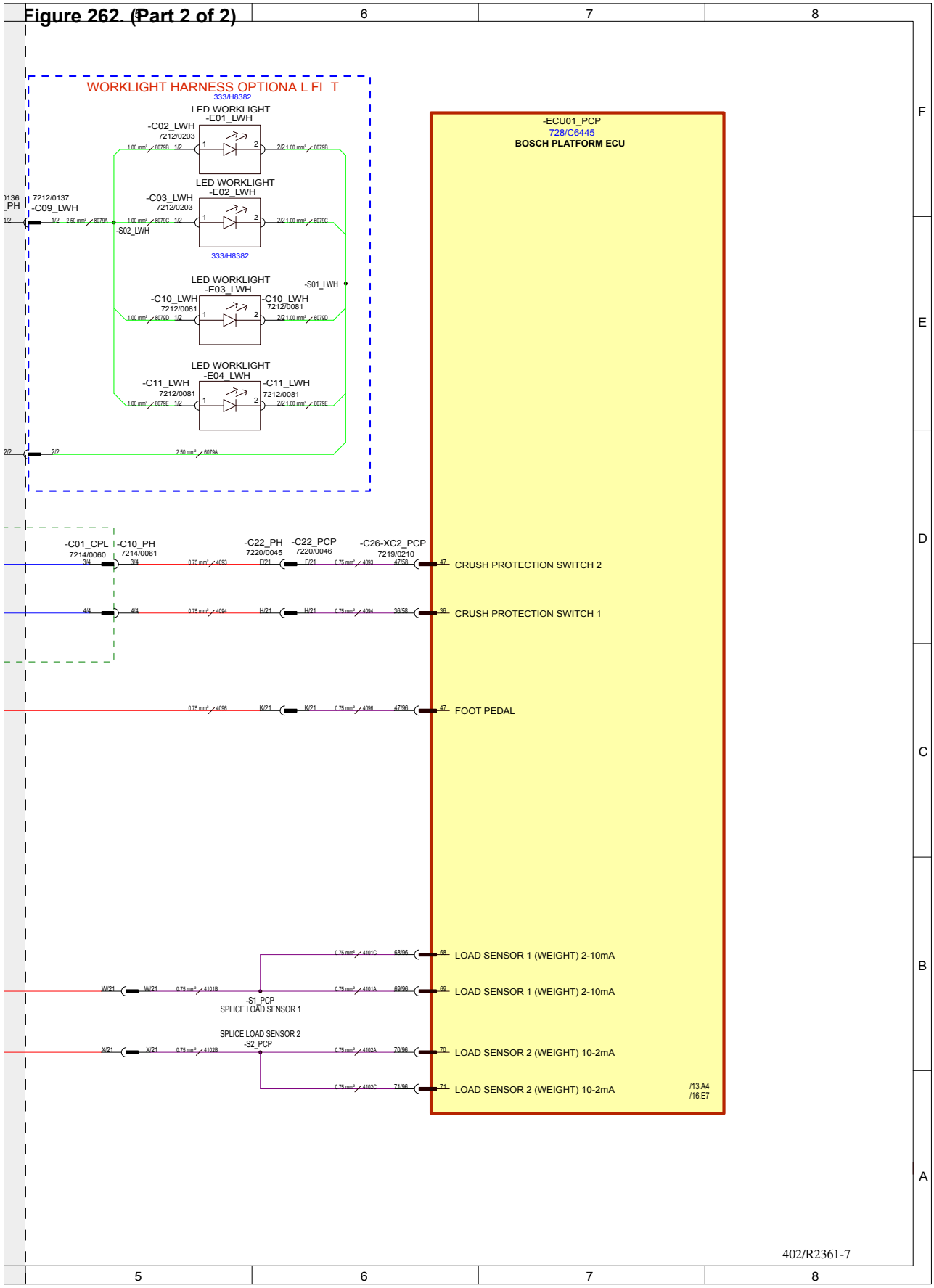
Figure 262. (Part 2 of 2)



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Page 33-60

Figure 263. 402/R2361 Issue-7
(Sheet 15 of 20) - CAN Network

Page 33-61

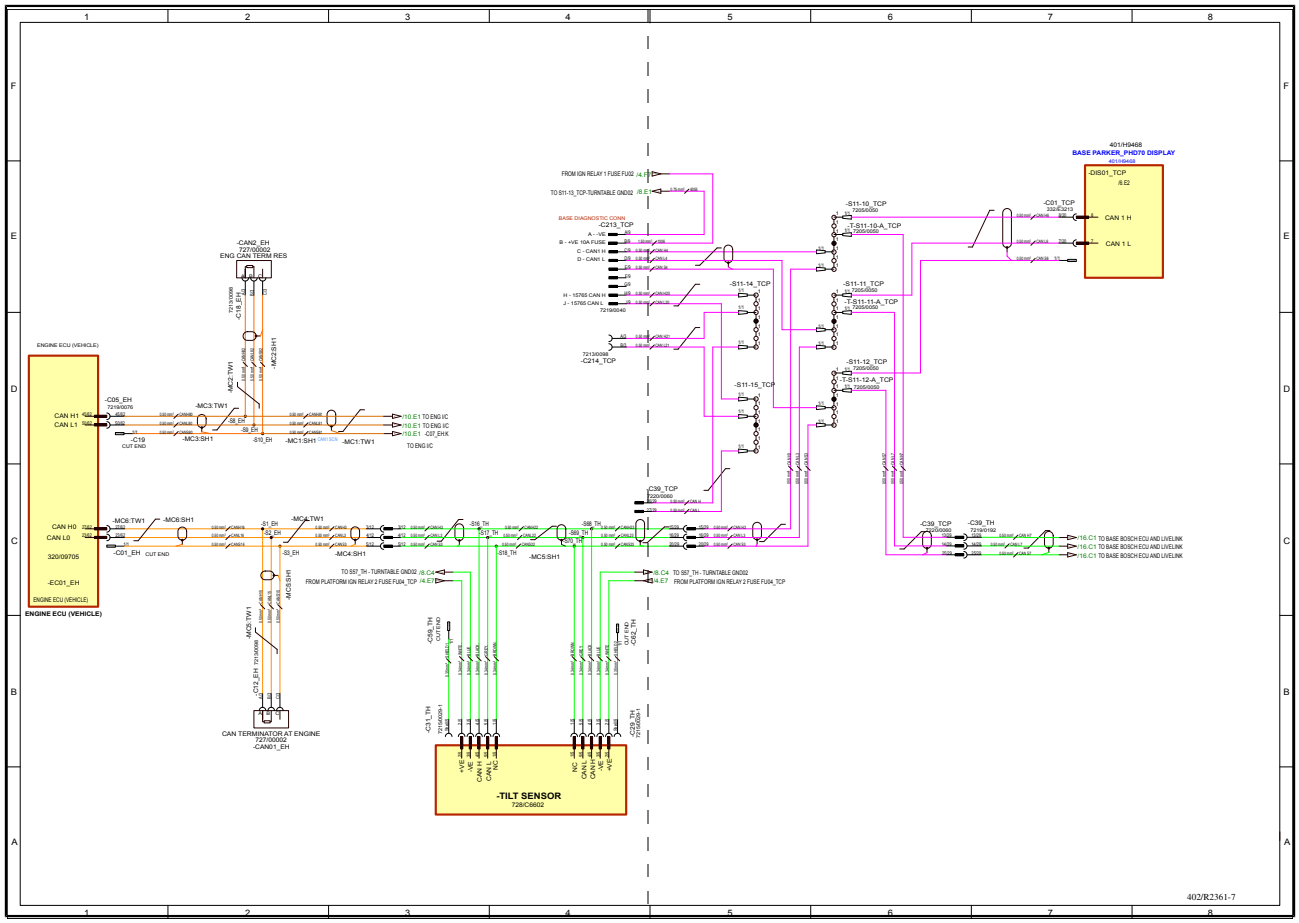

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Figure 263. (Part 1 of 2)

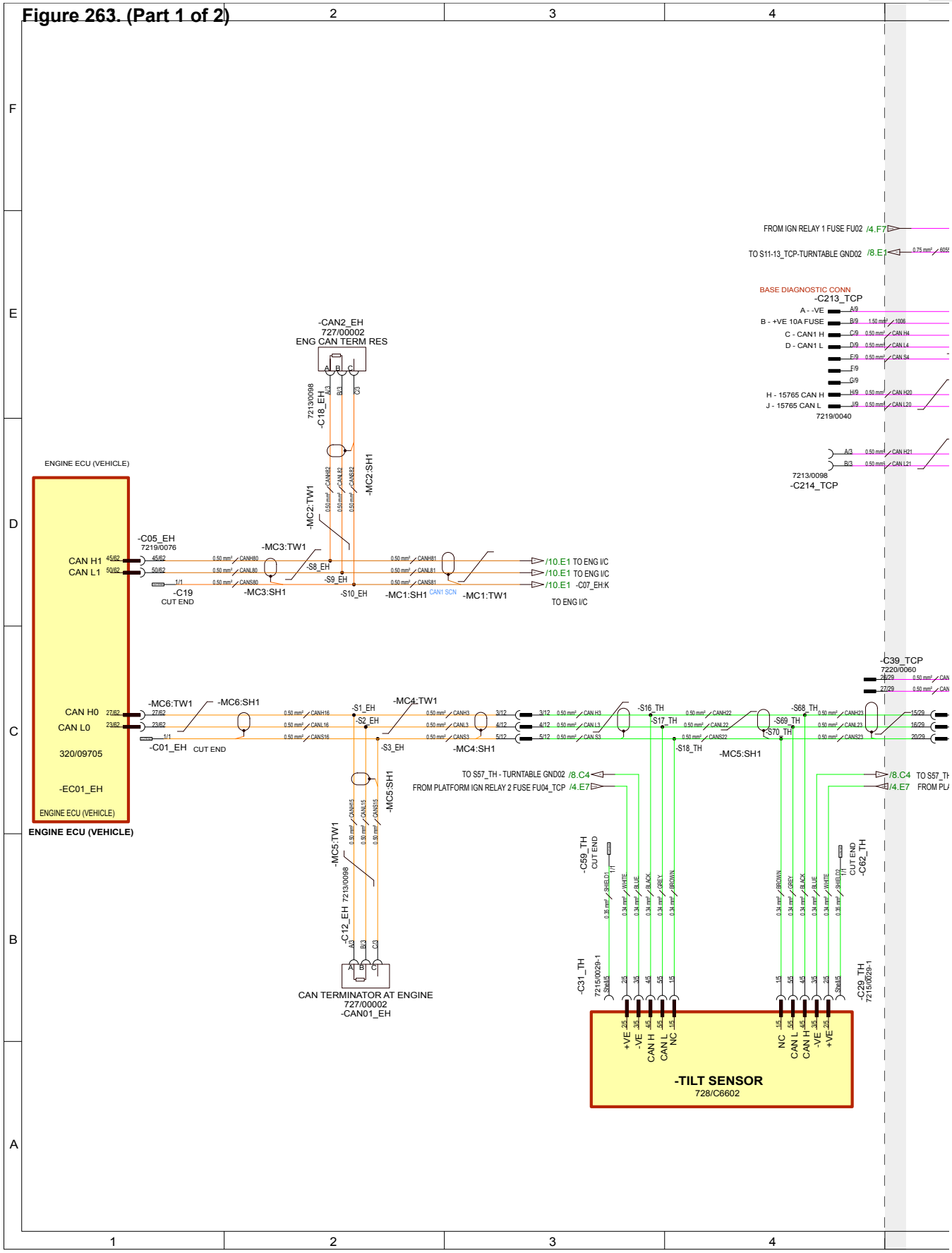

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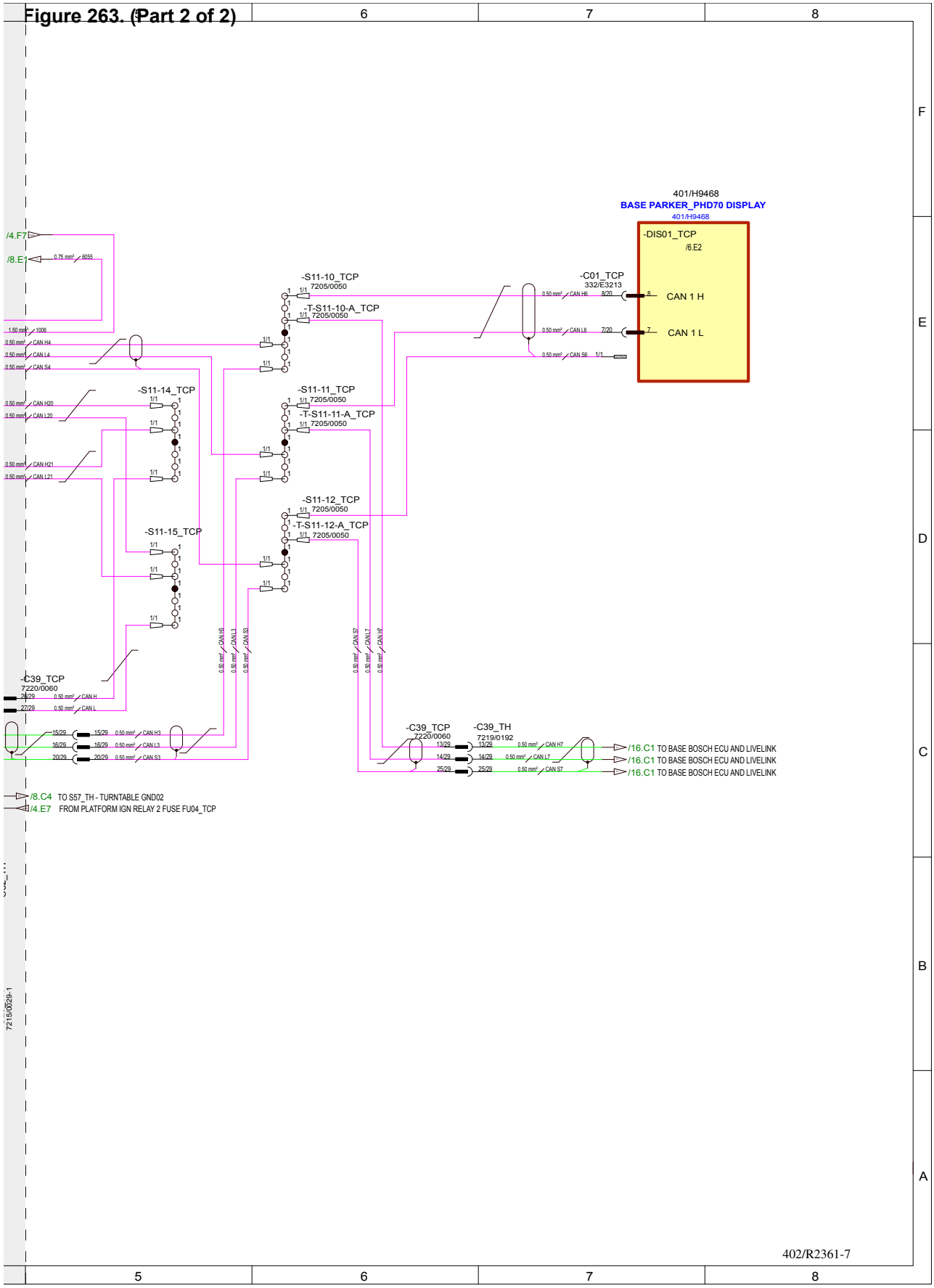
Figure 263. (Part 2 of 2)



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Page 33-64

Figure 264. 402/R2361 Issue-7
(Sheet 16 of 20) - CAN Network

Page 33-65

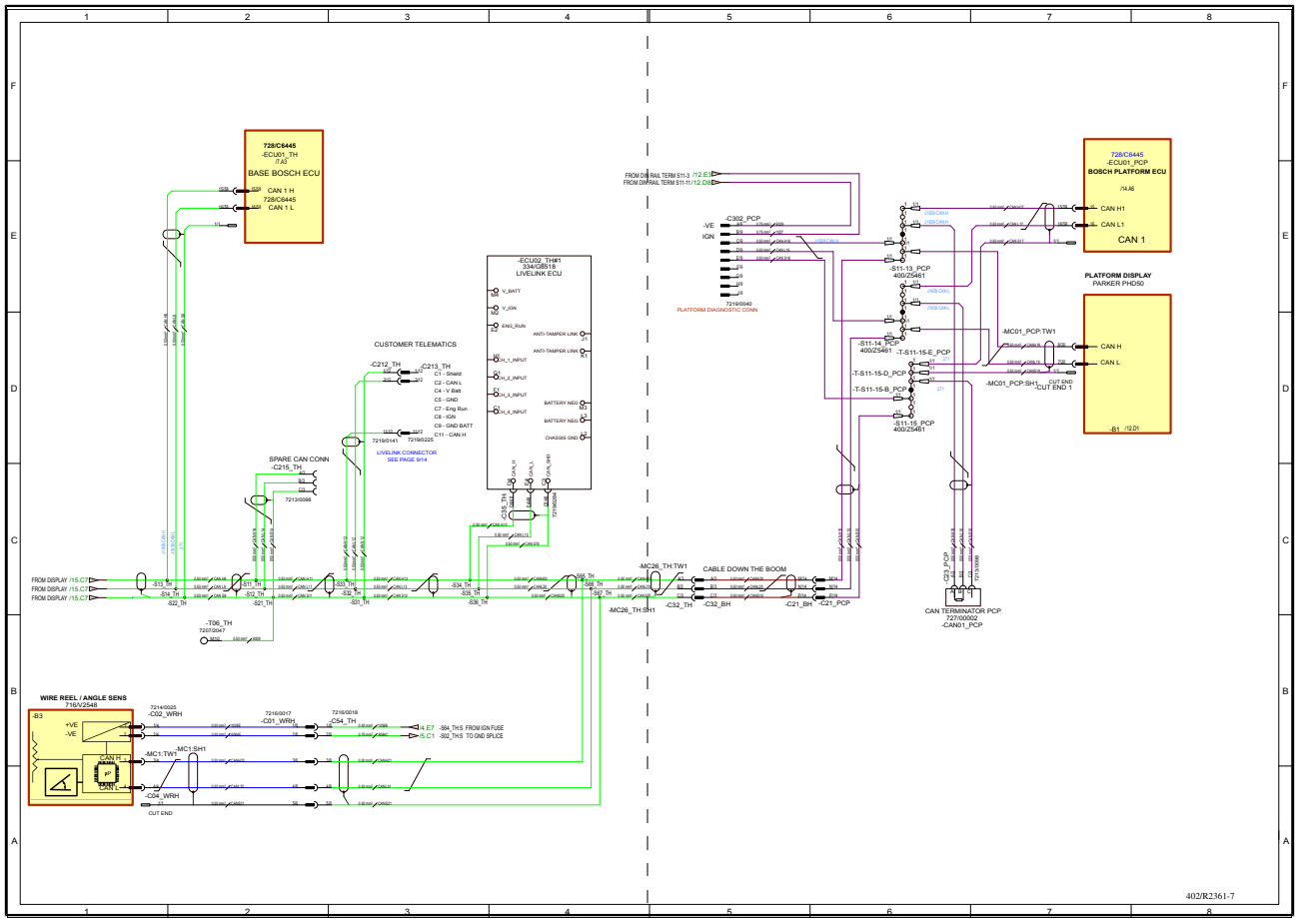

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Figure 264. (Part 1 of 2)

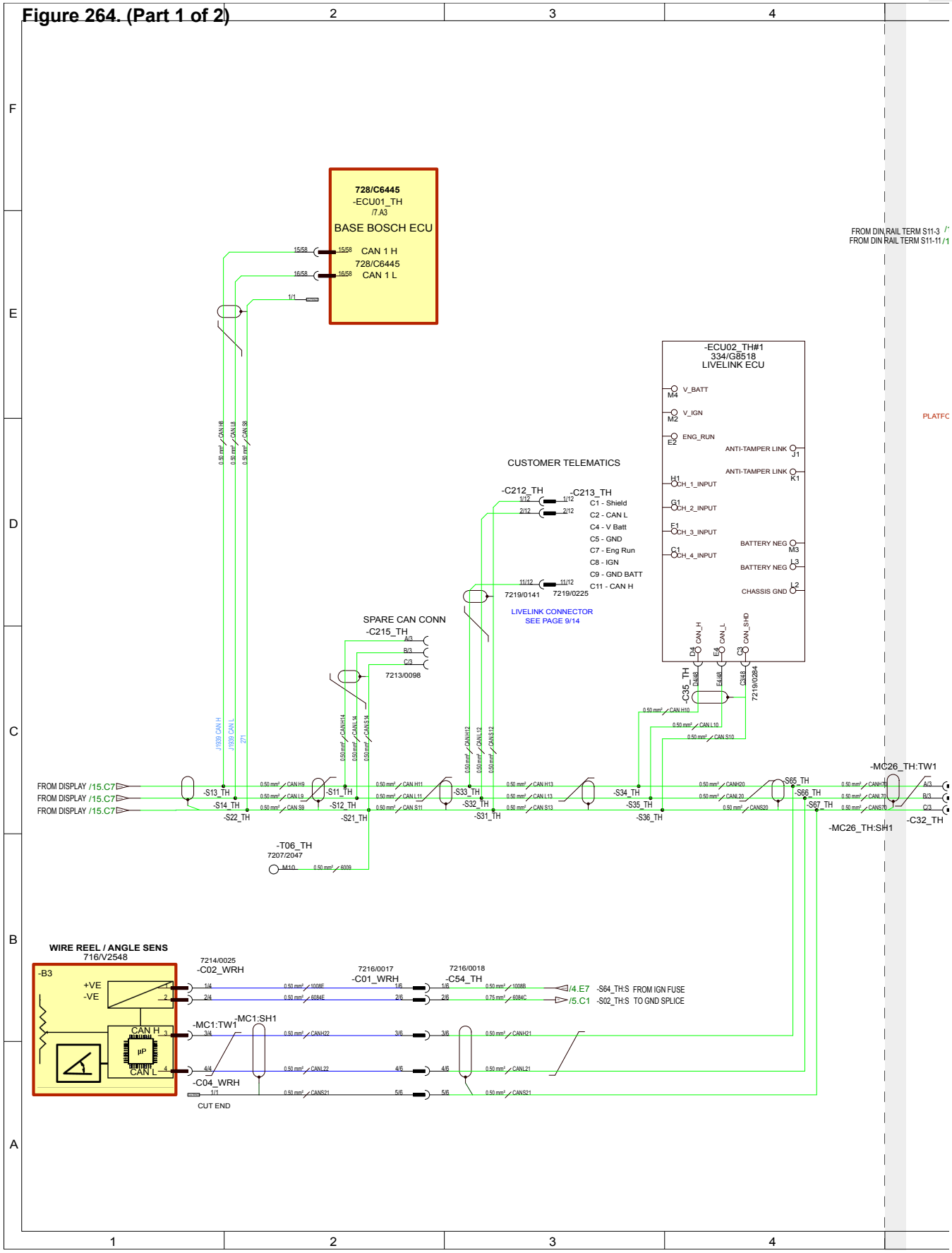

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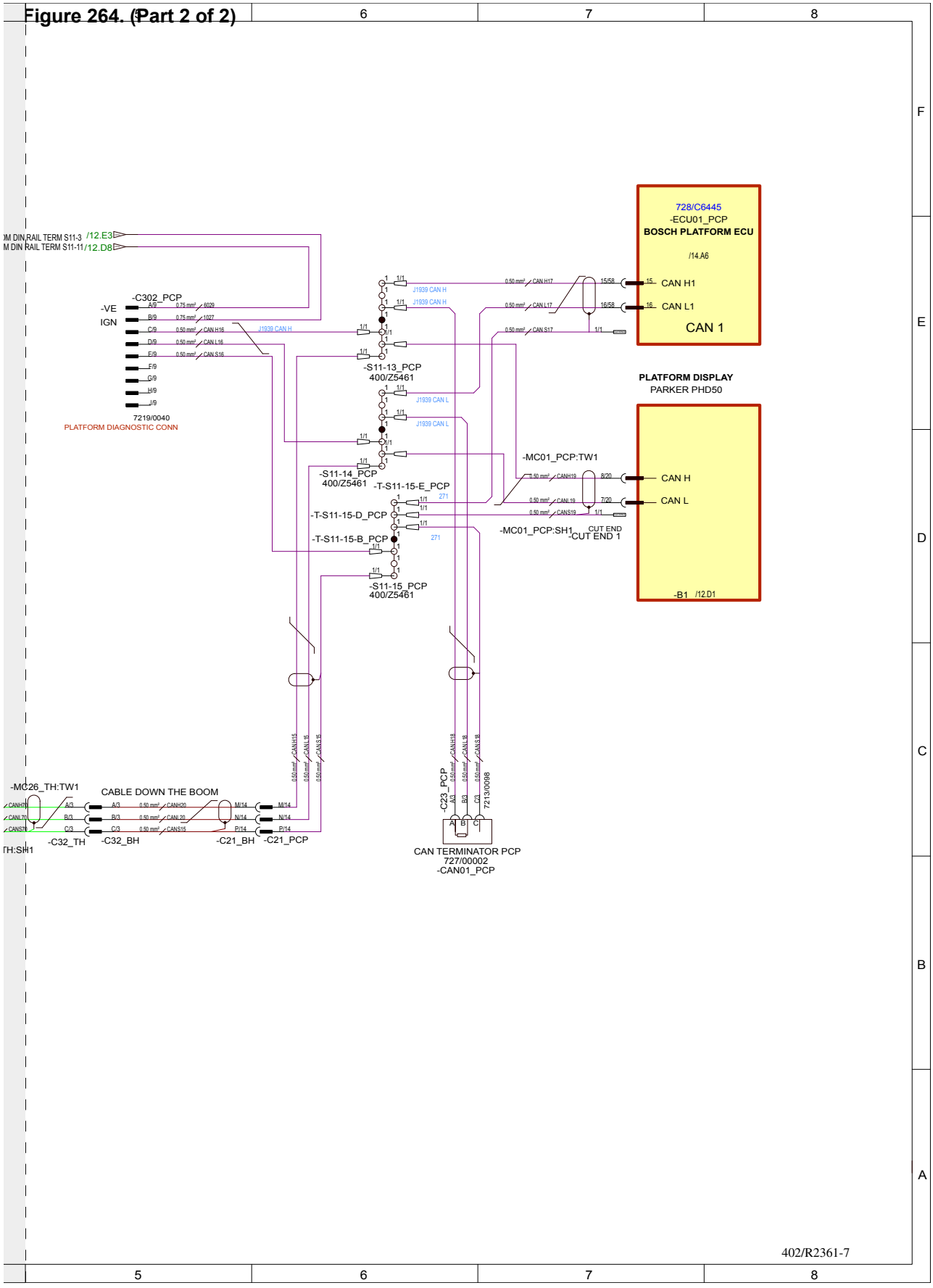
Figure 264. (Part 2 of 2)



Page 33-64

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Page 33-68

Figure 265. 402/R2361 Issue-7 (Sheet 17 of 20) - 7.5kV Hyd Gen Cables

Page 33-69

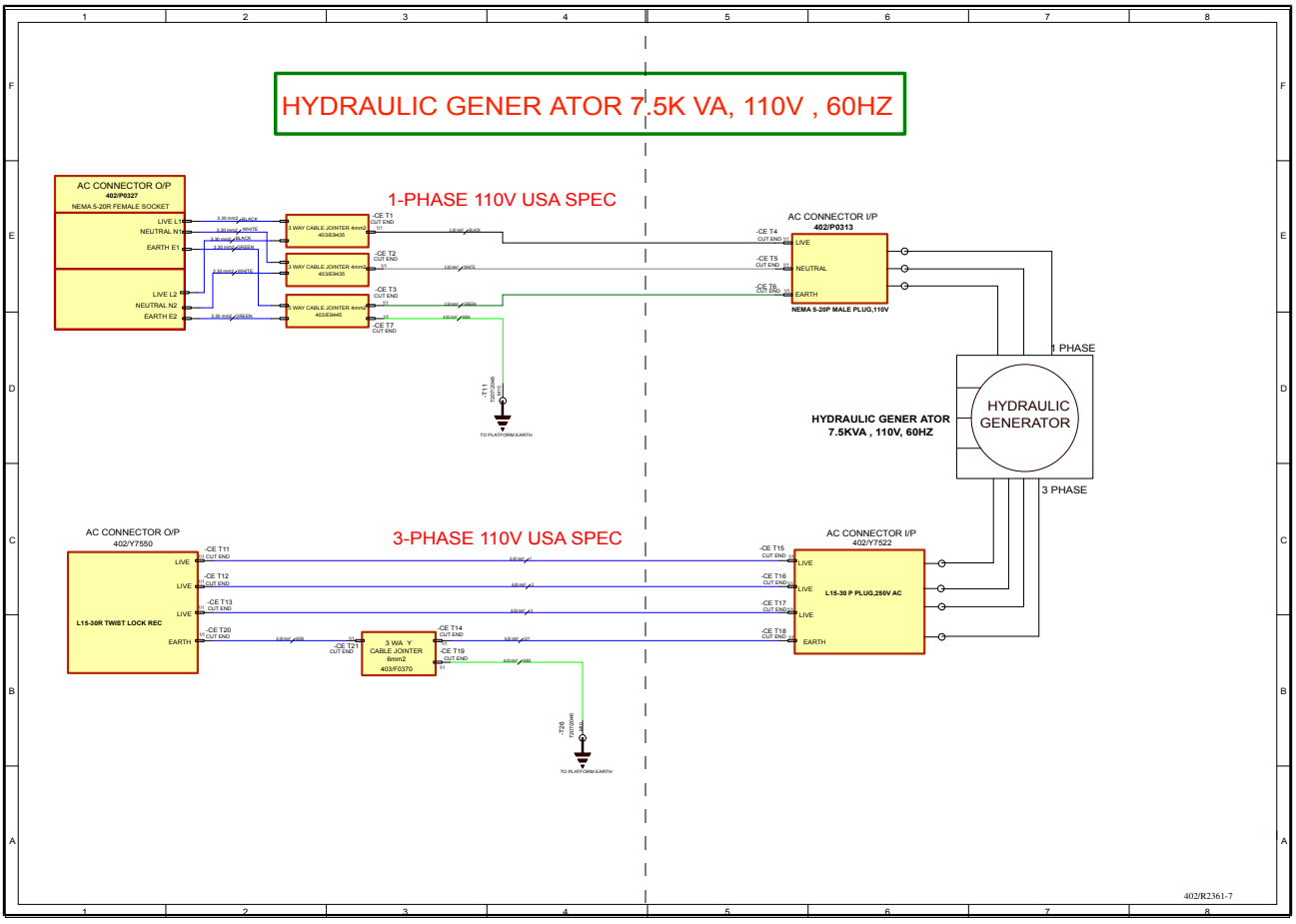

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Figure 265. (Part 1 of 2)

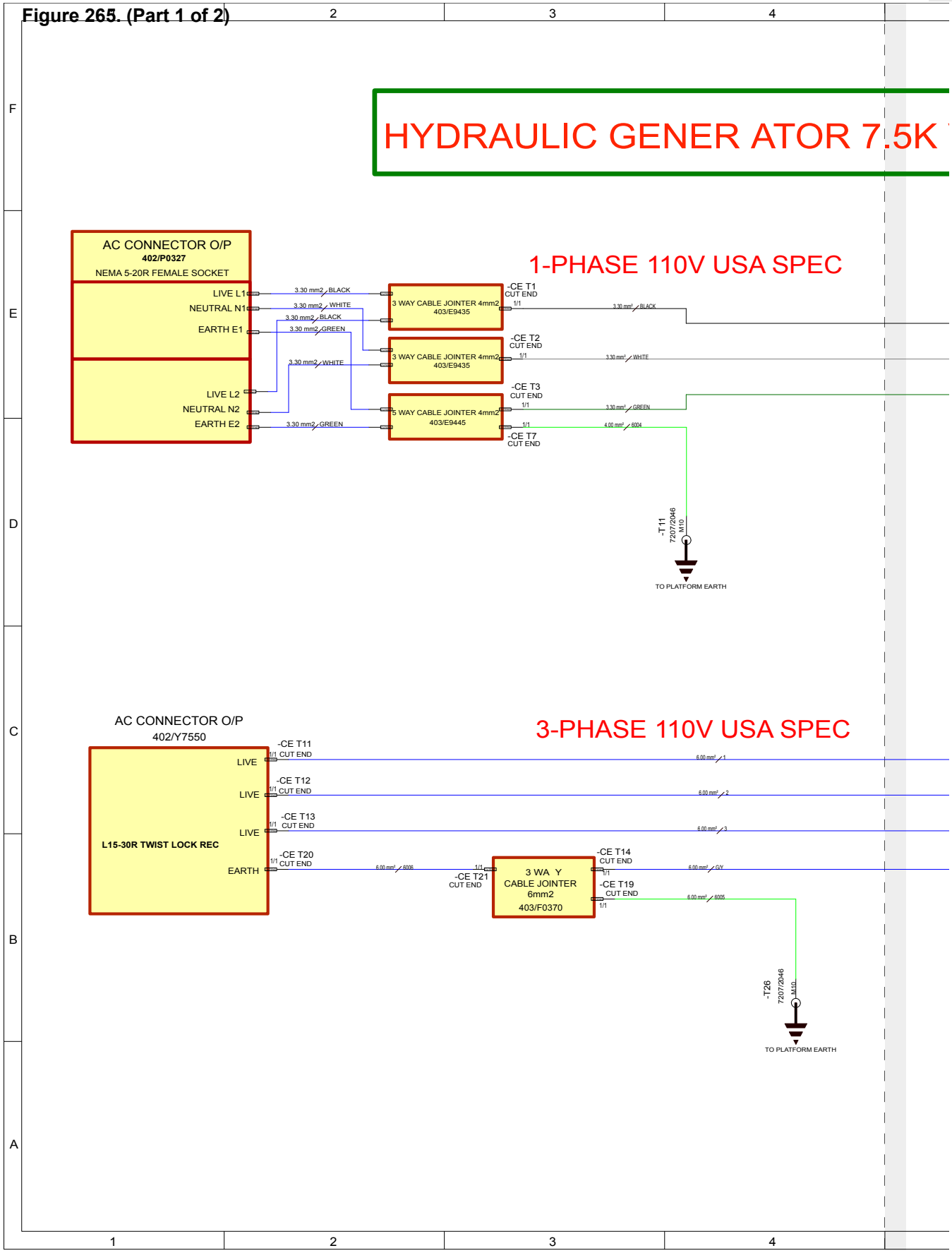

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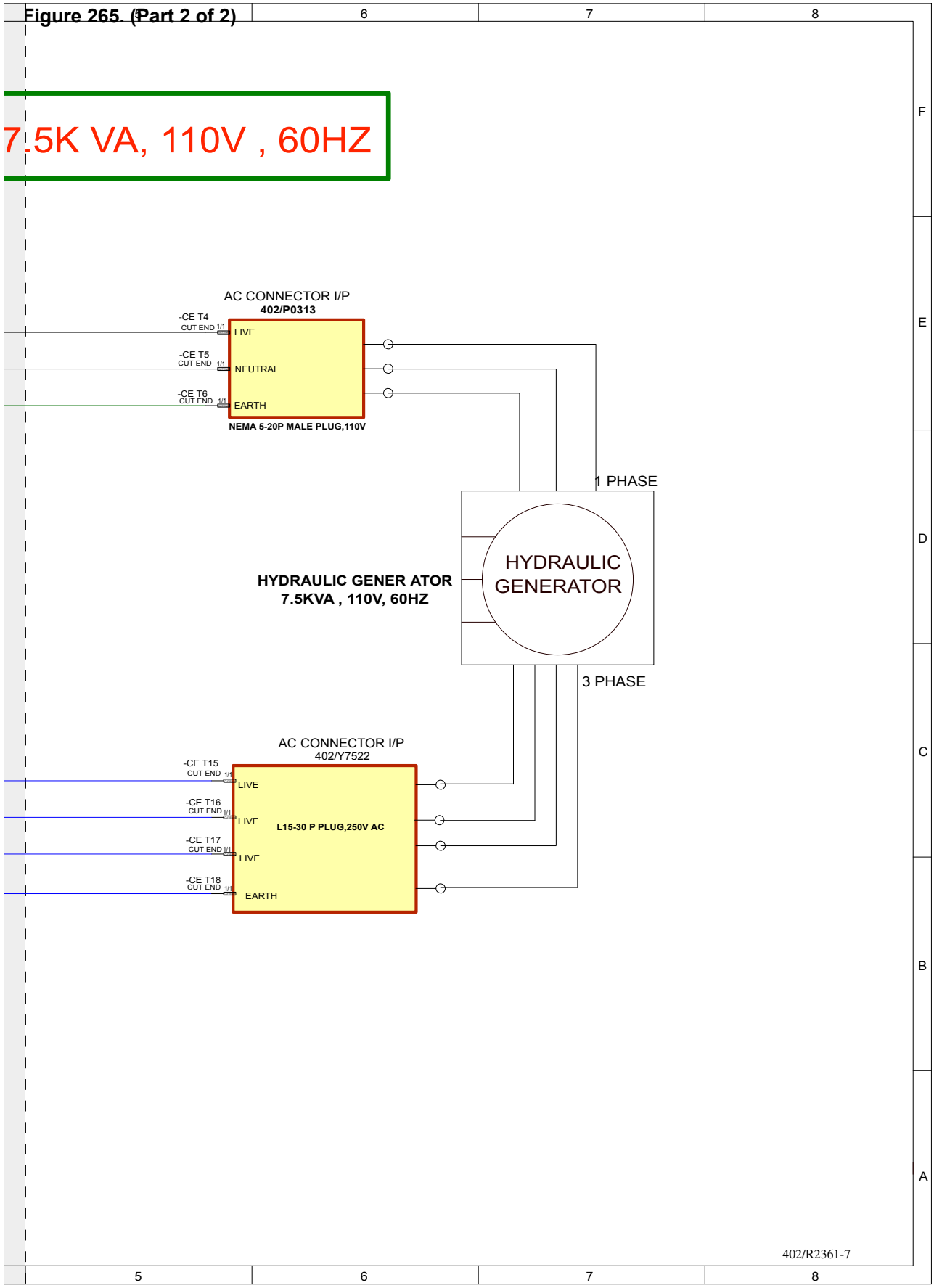
Figure 265. (Part 2 of 2)



Page 33-68

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Page 33-72

Figure 266. 402/R2361 Issue-7 (Sheet 18 of 20) - PWR To Plat US 110V

Page 33-73

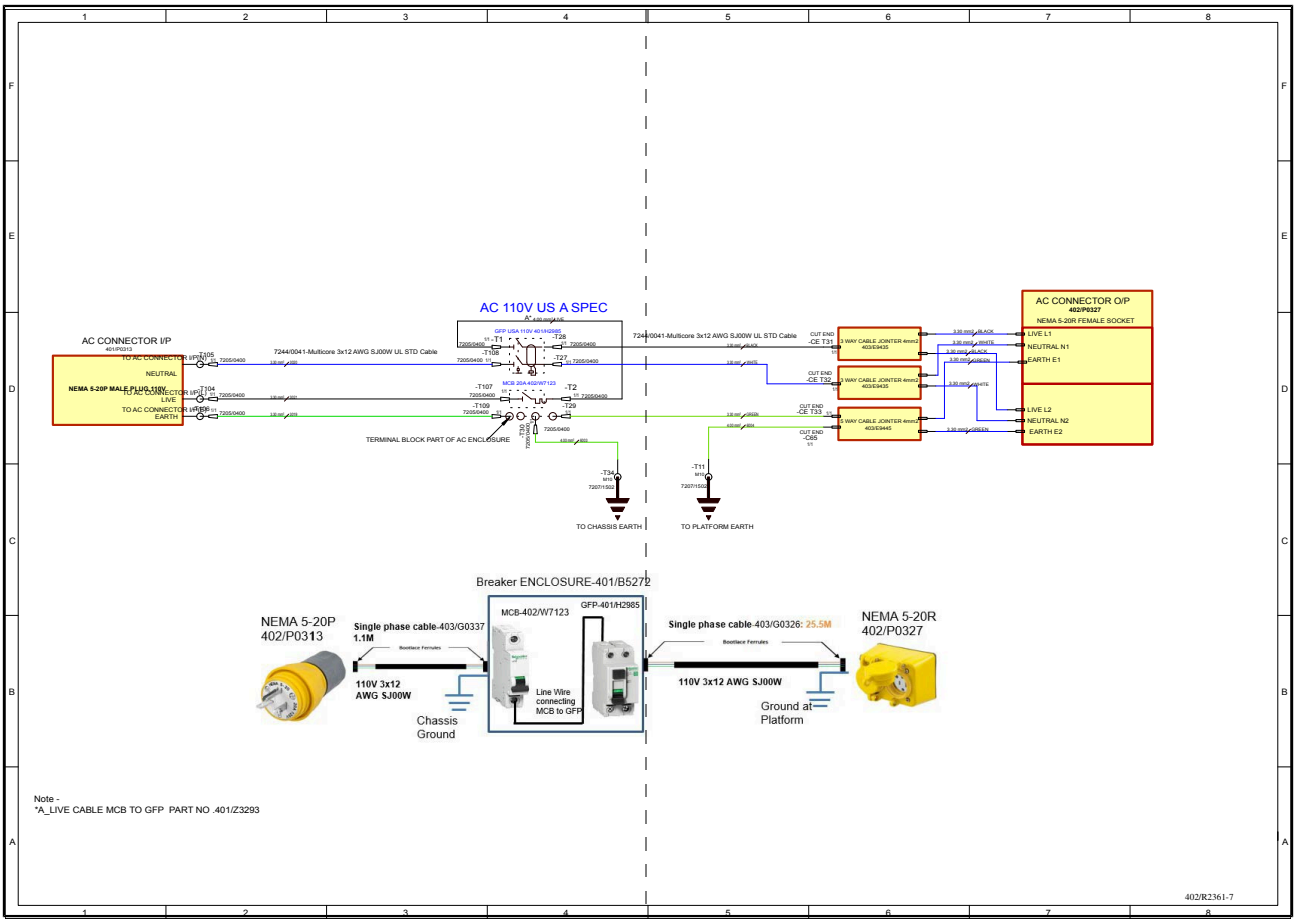

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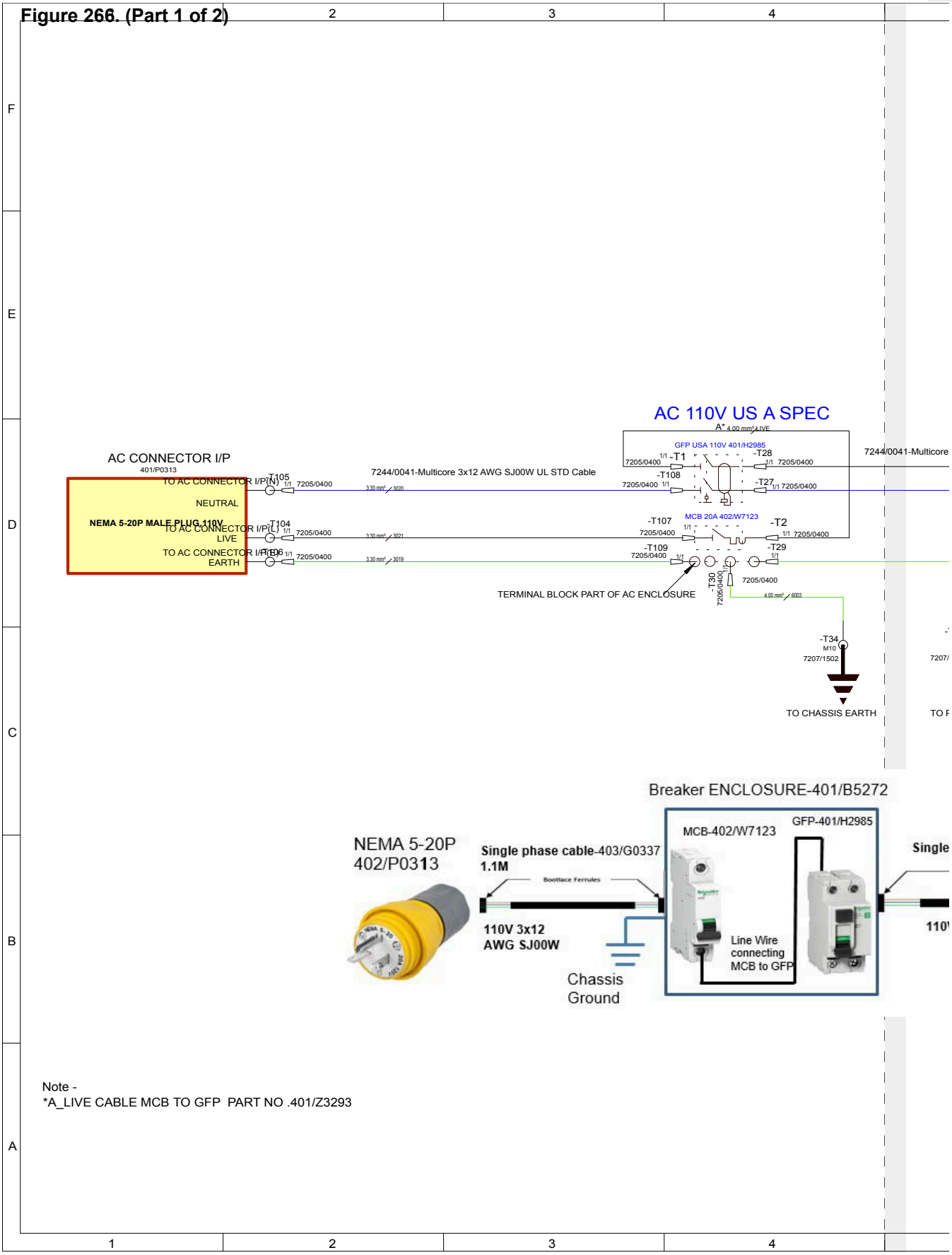
Figure 266. (Part 1 of 2)



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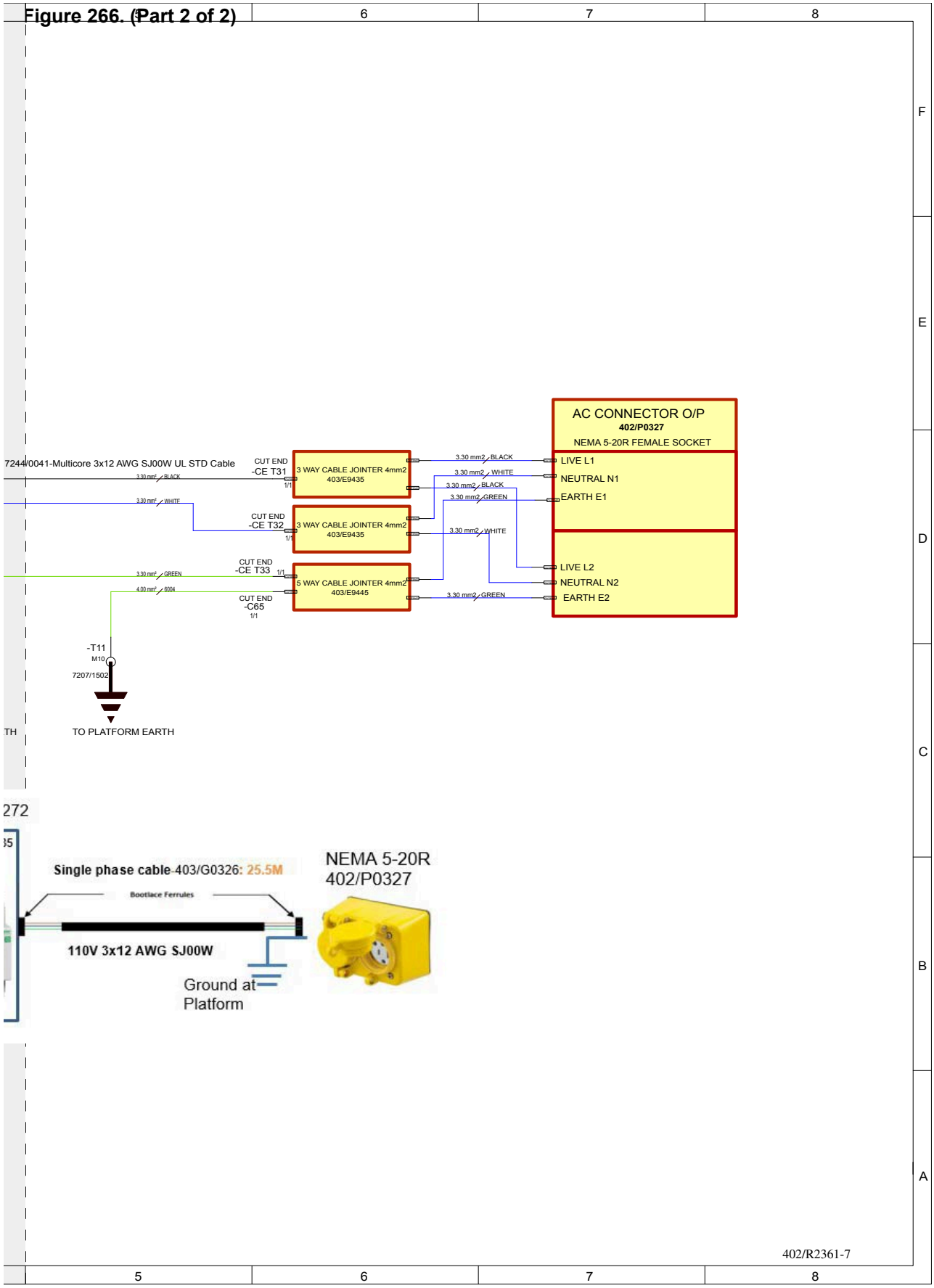
Page 33-72 Page 33-73

Figure 266. (Part 2 of 2)



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Page 33-76

Figure 267. 402/R2361 Issue-7 (Sheet 19 of 20) - Spare Th- Platform Cable

Page 33-77

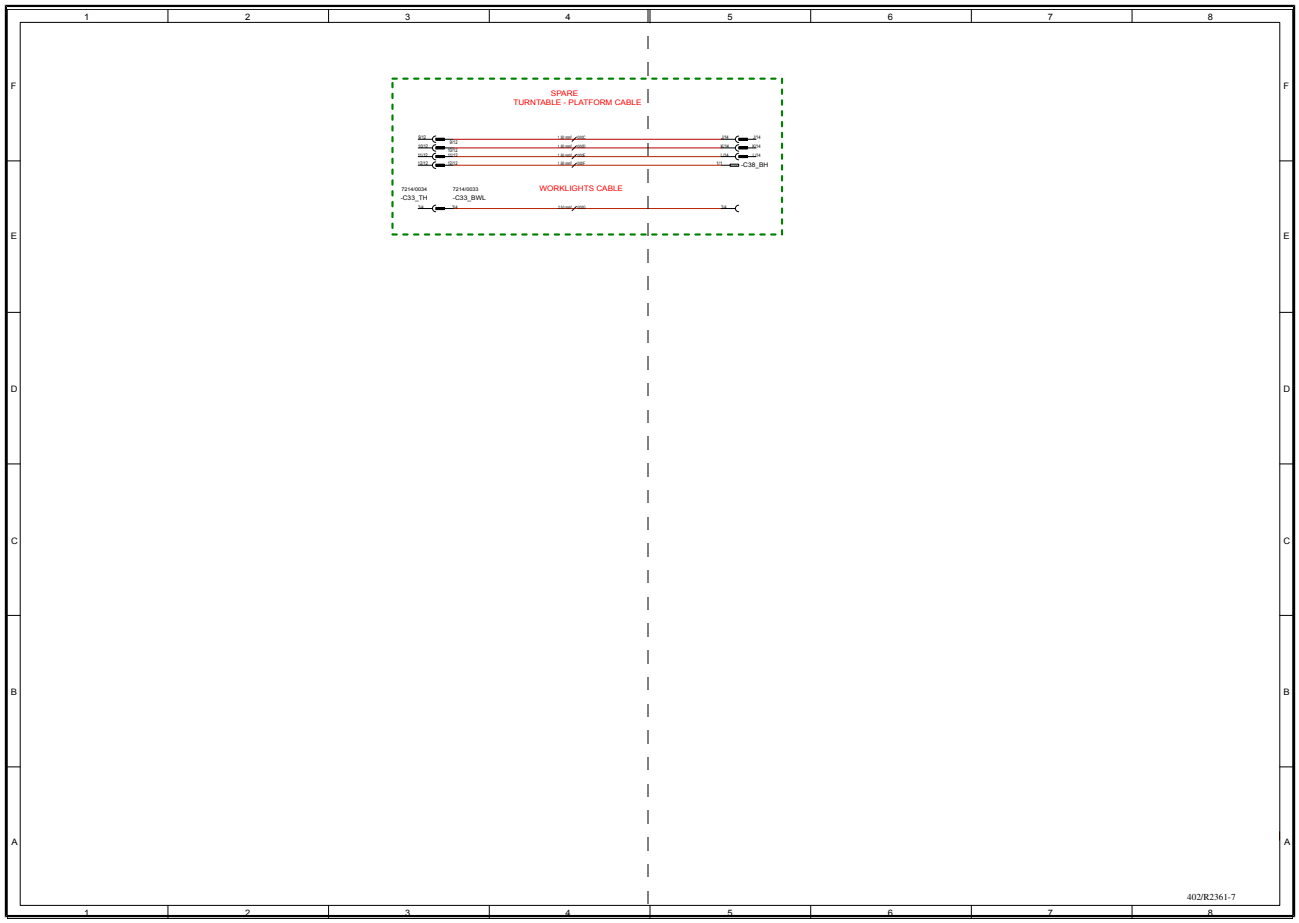

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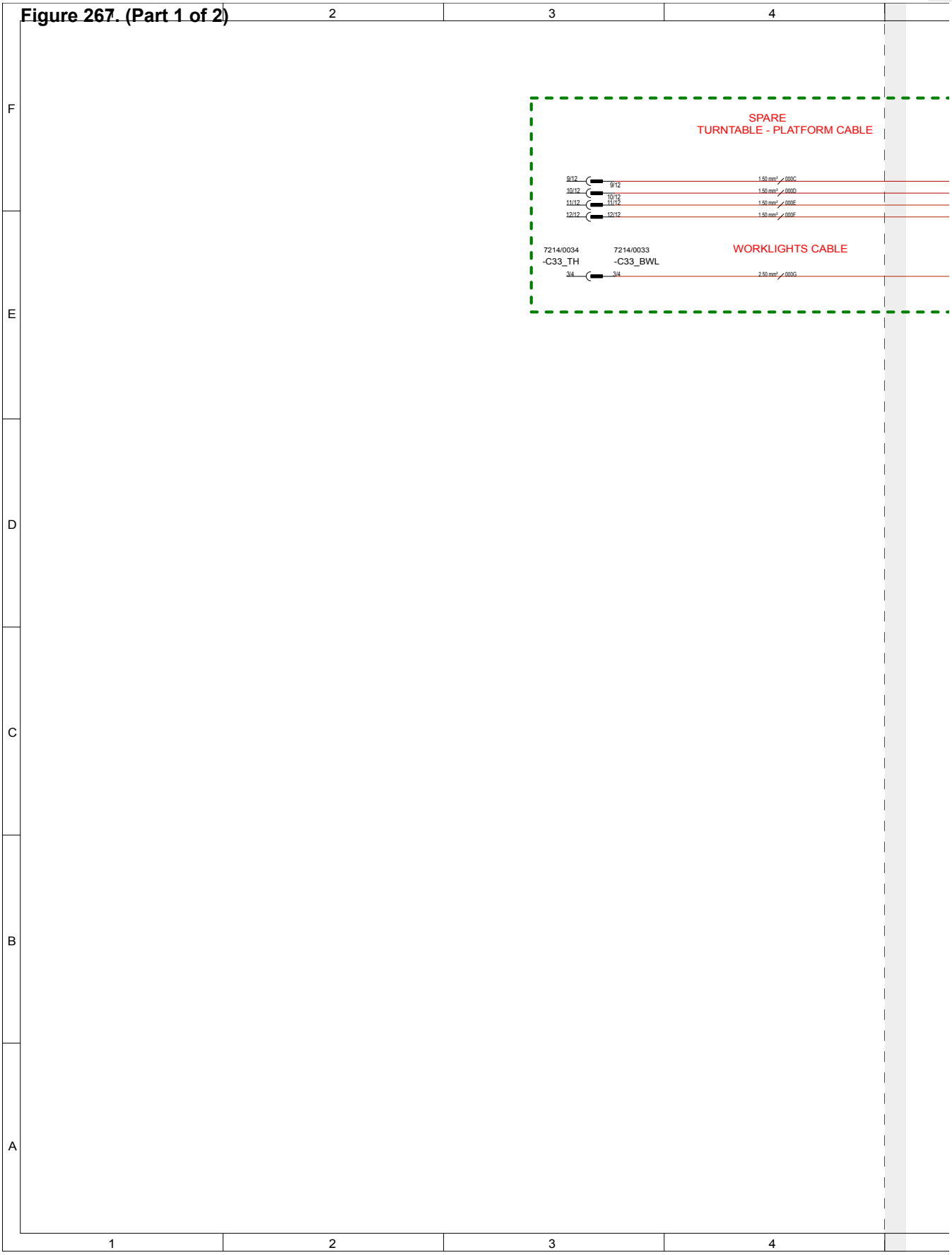
Figure 267. (Part 1 of 2)



Page 33-77

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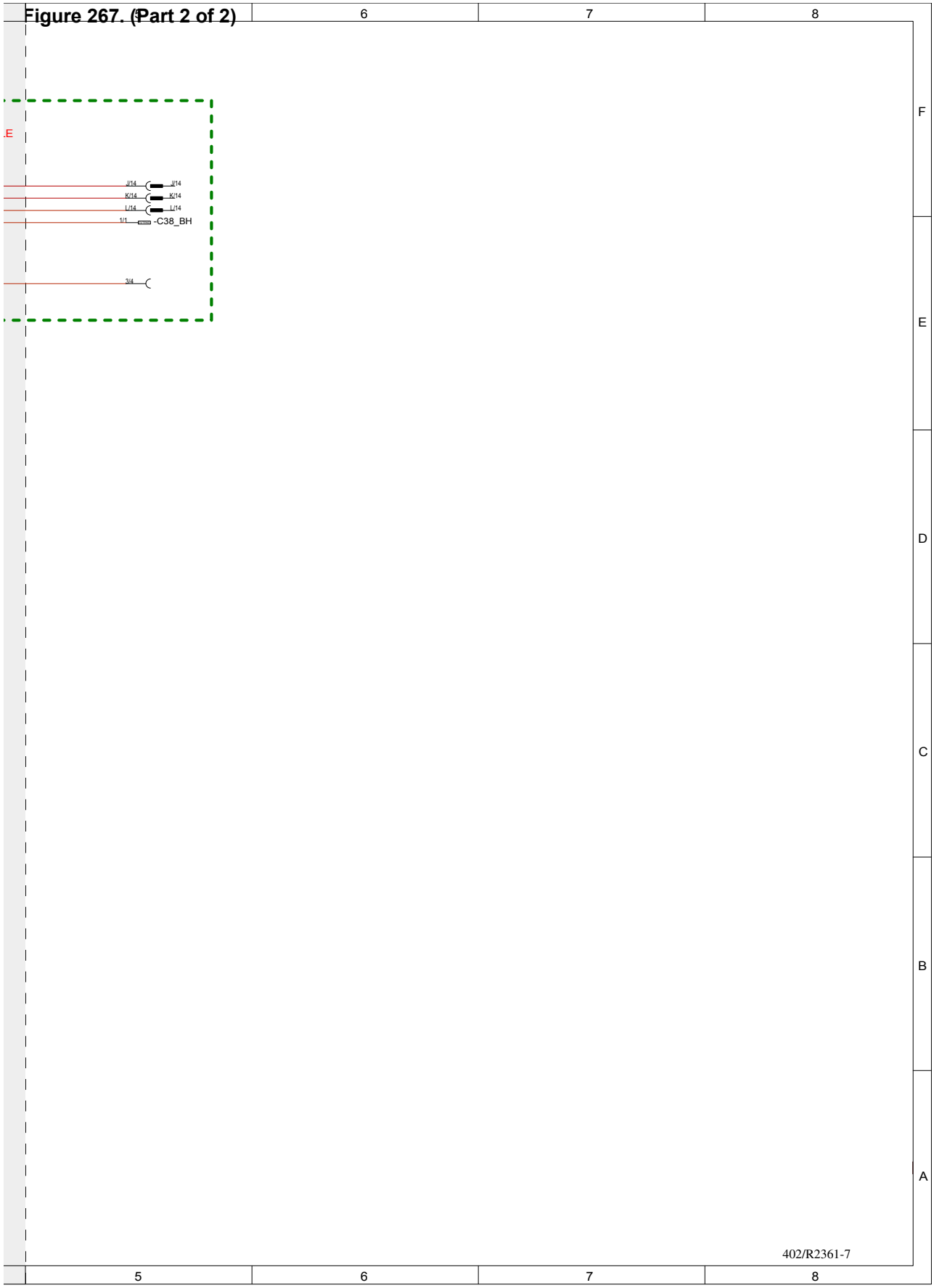
Page 33-76 Page 33-77

Figure 267. (Part 2 of 2)



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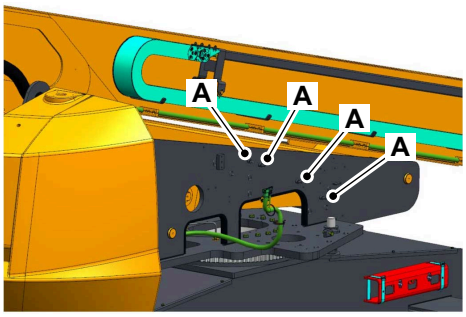
90 - Earth Point

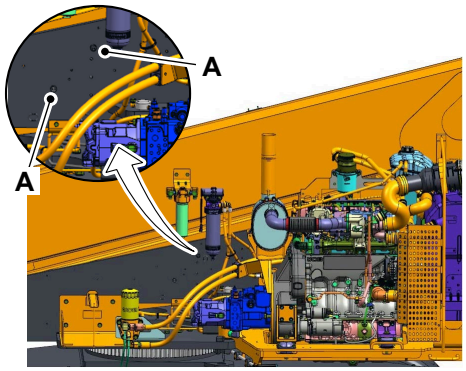
Component Identification

Figure 268. Earthing Points - Hydraulic Compartment Side



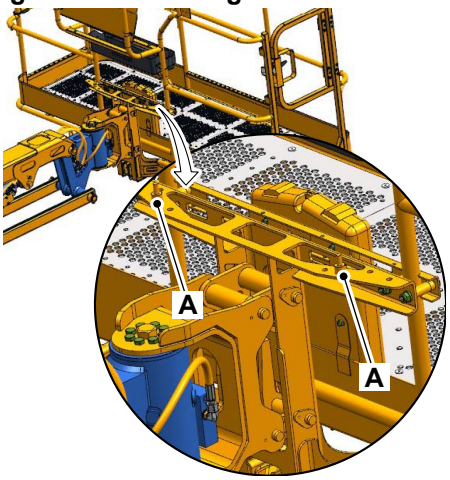
A Earthing point (x4)

Figure 269. Earth Points - Engine Compartment Side



A Earthing point (x2)

Figure 270. Earthing Points - Platform



A Earthing point (x2)

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03 - Battery

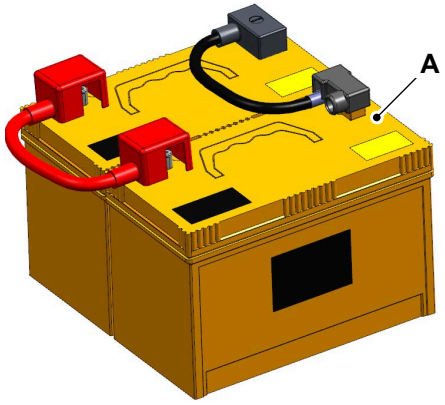
00 - General

Introduction 33-79
Health and Safety 33-81
Technical Data 33-82
Fault-Finding 33-82
Disconnect and Connect 33-82
Check (Condition) 33-84
Remove and Install 33-89

Introduction

This machine is installed with two 12V batteries, connected in parallel. These are low maintenance batteries. Just need periodic visual inspection of battery condition indicator.

Figure 271.



A Battery (x2)

Make a note that shorter maintenance intervals are required if the machine is operating at high ambient temperatures or continuously for long periods. The battery must be replaced immediately when you observe the sight glass changes to a white colour.

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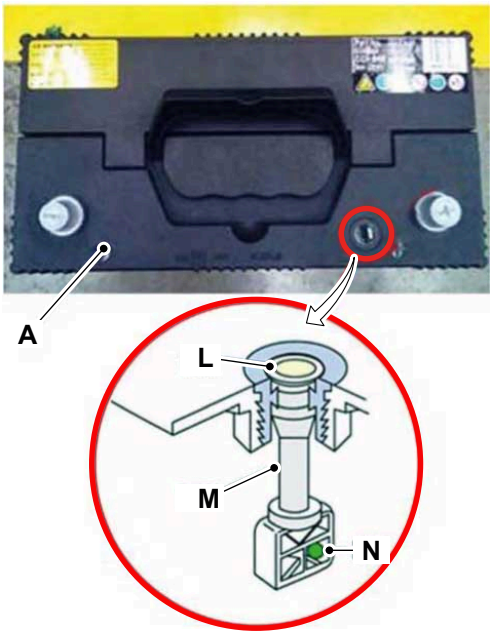
Figure 272.



A Battery
L Slight glass
M Plastic tube
N Green ball

The sight glass works on the same principle as a hydrometer with a small coloured ball on top of a prism. When the specific gravity is high the ball sits on top of the prism, as the gravity becomes lower then the ball slips down one of the sides of the prism. The colour is magnified up to the top glass dependant on the position of the ball.

Table 136. Sight Glass Colour Code

Colour	Symptom
Green	OK
Black	Battery requires charg-ing
White	Battery requires replace-ment

Maintenance

To make sure that the battery provides optimum performance the following steps should be observed:

- Make sure that the electrical connections are clean and tight. Smear petroleum jelly on connectors to prevent corrosion.
- When applicable - never allow the electrolyte level to fall below the recommended level of 6mm above the plates. Use only distilled water for topping up.
- Keep the battery at least three quarters charged, otherwise the plates may become sulphated (hardened) - this condition makes recharging the battery very difficult.

Extra precautions must be taken when bench charging maintenance free batteries, they are more prone to damage by overcharging than the standard type of battery:

- Never boost charge a maintenance free battery (if installed).
- Never charge a battery at a voltage in excess of 15.8V.
- Never continue to charge a battery after it begins to gas.

Quiescent Current Drain

If the machine has no permanently live circuits there should be zero quiescent current drain, when the key-switch is off and all the lights are switched off.

It should be noted that some permanently live circuits will place a quiescent drain on the battery. Typically the quiescent drain will be in the range of 10–20 mA. If the quiescent drain measures 40 mA or more, there is a problem with the wiring insulation or the accessories, if the fault is not rectified it will continue to drain the battery.

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Health and Safety

⚠ **DANGER** Batteries give off an explosive gas. Do not smoke when handling or working on the battery. Keep the battery away from sparks and flames.

Battery electrolyte contains sulphuric acid. It can burn you if it touches your skin or eyes. Wear goggles. Handle the battery carefully to prevent spillage. Keep metallic items (watches, rings, zips etc) away from the battery terminals. Such items could short the terminals and burn you.

Set all switches to off before disconnecting and connecting the battery. When disconnecting the battery, take off the earth (-) lead first.

Re-charge the battery away from the machine, in a well ventilated area. Switch the charging circuit off before connecting or disconnecting the battery. When you have installed the battery in the machine, wait 5min before connecting it up.

When reconnecting, attach the positive (+) lead first.

WARNING Keep metal watch straps and any metal fasteners on your clothes, clear of the positive (+) battery terminal. Such items can short between the terminal and nearby metal work. If it happens you can get burned.

WARNING Battery electrolyte is toxic and corrosive. Do not breathe the gases given off by the battery. Keep the electrolyte away from your clothes, skin, mouth and eyes. Wear safety glasses.

WARNING Do not top the battery up with acid. The electrolyte could boil out and burn you.

CAUTION Understand the electrical circuit before connecting or disconnecting an electrical component. A wrong connection can cause injury and/or damage.

Notice: Do not disconnect the battery while the engine is running, otherwise the electrical circuits may be damaged.

CAUTION The machine is negatively earthed. Always connect the negative pole of the battery to earth.

When connecting the battery, connect the earth (-) lead last.

When disconnecting the battery, disconnect the earth (-) lead first.

DANGER If you try to charge a frozen battery, or jump start and run the engine, the battery could explode. Do not use a battery if its electrolyte is frozen. To prevent the battery electrolyte from freezing, keep the battery at full charge.

CAUTION Damaged or spent batteries and any residue from fires or spillage must be put in a suitable closed receptacle and must be disposed of in accordance with local environmental waste regulations.

Notice: Before carrying out arc welding on the machine, disconnect the battery and alternator to protect the circuits and components. The battery must still be disconnected even if a battery isolator is installed.

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Technical Data

Table 137.

Item	Specification
Battery voltage	12V
Capacity	110 Ah
CCA (Cold Cranking Amps)	900
Quantity	2

Fault-Finding

The most obvious sign of a battery problem is a machine not being able to start. However, because the battery is part of a larger electrical system connected to other parts of the machine, a flat battery may indicate another problem.
If something else is going wrong in the electrical system, for example, a weak alternator, corrosion or loose connections, cold weather starting, electrical equipment being left on without the engine running, interrogate the cause of the problem.
The best way to test the condition of the battery is with an electronic battery tester. Refer to Battery-Check Condition.
When the machine is not in use, make sure that the electrical system is not causing a drain on the battery. On machines with electronically controlled engines check the operation of the power hold relay. Refer to PIL 33-09-06.

Disconnect and Connect

⚠ **Notice:** Before you install a pair of batteries to a machine, make sure you know the machines voltage. Some machines require two batteries but have a 12 V electrical system. This means the batteries need to be connected in parallel.

For 24 V machines, the batteries must be connected in series. Incorrect voltage may result in serious damage to the electrical system.

The illustrations show typical battery connections. The actual battery connections installed on your machine may look different.

Make sure you connect the batteries correctly for your machine.

Disconnect

1. Make the machine safe.

   Refer to: Introduction (PIL 01-03-27).

2. Get access to the battery or batteries (depending on the specification of your machine). The actual installation on your machine may vary from those shown below.
3. If the machine has a battery isolator, move the switch to the OFF position, then remove the key.
4. Disconnect the battery negative lead first.
5. Disconnect the battery positive lead and store away from the batteries.
6. Disconnect and remove the battery link lead or leads.

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Figure 273. Parallel and Series Connection (Example)

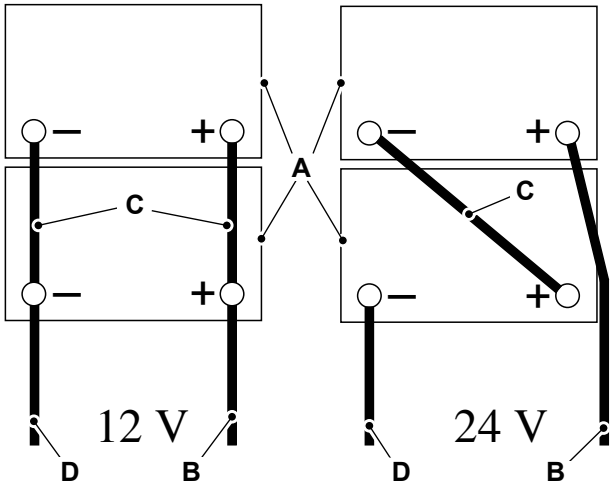
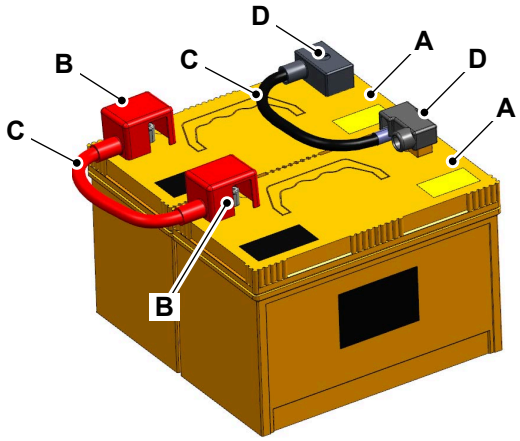


Figure 274. Twin Battery 12V Machines- Parallel Connection (Example)



A Battery
B Positive lead
C Battery link lead
D Negative lead

Connect

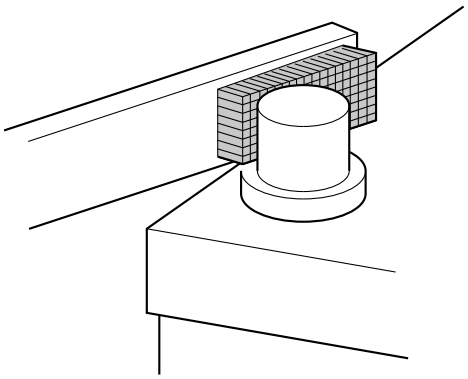
1. Check the battery as follows:

   1.1. If any terminals are dirty, clean them.

   1.2. If the terminal is corroded and has white powder, wash the terminal with hot water. Make sure the water does not enter the battery cells.

   1.3. If considerable corrosion is found, then clean with a wire brush or abrasive paper. Make sure you use eye and hand protection. Refer to Figure 275.

Figure 275.



   1.4. After cleaning, apply a thin coat of petroleum jelly to the terminals.

2. Connect the leads.

   2.1. For single battery machines, connect the positive lead then the negative lead.

   2.2. For twin battery machines, first connect the link lead or leads, then the positive terminal, and finally the negative terminal.

3. If the machine has a battery isolator, move the switch to the ON position.

4. Close and lock the access panels.

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Check (Condition)

Special Tools

Description	Part No.	Qty.
Battery Tester	400/G9956	1

Introduction

As of July 2019, this procedure must be used for all battery warranty claims. This procedure provides details on the new battery warranty claim criteria and details of how to test the batteries with the new battery tester kit.

To allow for the effective processing of battery warranty claims you must complete the battery test procedure specified in this document before you submit a warranty claim and in the event of claim submission, all the supporting criteria detailed in this procedure for approval should be made available.

Figure 276.

A Battery Tester Kit

Important Information.

- Any claims submitted without all the required criteria to support may be declined.
- All monthly test receipts and machine delivery test receipt should be kept with the machine or vehicle records and should be able to be evidenced in the event of a battery claim submission.

Battery Warranty Claim Adjudication.

Batteries are only warranted against the defects due to faulty workmanship or materials. Battery failures due to poor maintenance or a consequence of other electrical issues on the machine are not separately claimable.

Note that damaged and leaking batteries are not considered as warrantable defects as such defects do not arise from faulty materials or workmanship. Claims must not be submitted if those are the identified defects. Such claims will get declined.

Batteries must only be returned to JCB Service when requested by the warranty adjudicator.

Important: Any claims submitted without all the below criteria may get declined.

Battery Claim Criteria.

- Images of the machine and battery
- Images of the battery test receipt deeming a 'failed' battery
- Images of the battery test receipt at delivery
- Images of monthly stock check health receipts.

All the criteria should be compiled using the attachment to bulletin (W228) and the pdf attached to the claim.

Battery Maintenance.

Batteries in stock require periodic checking and maintenance, whether on the shelf or in stock.

Dealer Lay-up.

- Upon arrival at your dealership, all machines must have their battery condition checked. The battery must be tested as per this battery test procedure. On the printed test receipt, write the machine serial number, date and sign.
- Important: As best practice for all machines, as of July 2019, the battery test receipt at point of delivery should be retained, even after machine retail.
- Machines in stock must have their batteries tested on a monthly basis. The battery must be tested as per this procedure. On the printed test receipt, write the machine serial number, date and sign.
- If the result deems recharge is required, the battery should be recharged and retested to show successful recharge. Again, on the printed test receipt, write the machine serial number, date and sign.

Important: All monthly battery test receipts should be kept with the machine or vehicle records and should be able to be evidenced in the event of a battery claim submission.

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- If a battery is on a machine which is not going to be used for more than one month, it should be disconnected from the machine (Isolated or physically disconnected). Machines have electrical accessories which can slowly discharge the battery even when the ignition key has been removed.

Battery Stock Lay-up.

- Battery stock should be rotated (First in first out - FIFO) to make sure that the customer receives a good quality battery.
- The open circuit voltage of stock batteries should be checked every month (with the use of a digital voltmeter) and the voltage recorded on a ticket (date and voltage and signed) attached to the battery. The results of the test should be retained (by the dealer) upon battery retail for the duration of the battery warranty.
- If a stock battery has a voltage below 12.5V, a fresh recharge must be conducted.
- The battery condition must be checked before hand-over to the customer to make sure that its voltage is 12.5V or more.

Battery Test Procedure.

Note: All images are shown as examples. Some machines may require panels to be removed to get access to the battery. Refer to the respective service manual for information on the machine specific battery location to access.

All details on the battery test procedure can also be found in the battery test kit owner's manual. The engineer who completed this test must be familiar with the kit functionality and features.

The engineer who will carry out the procedure must have completed the JCB basic electrics training course to complete this procedure. They must be fully conversant in battery testing, a function of operation and battery lifting/handling.

1. Locate the negative terminal on the battery and identify the terminal by its symbol ('-'). Refer to Figure 277.

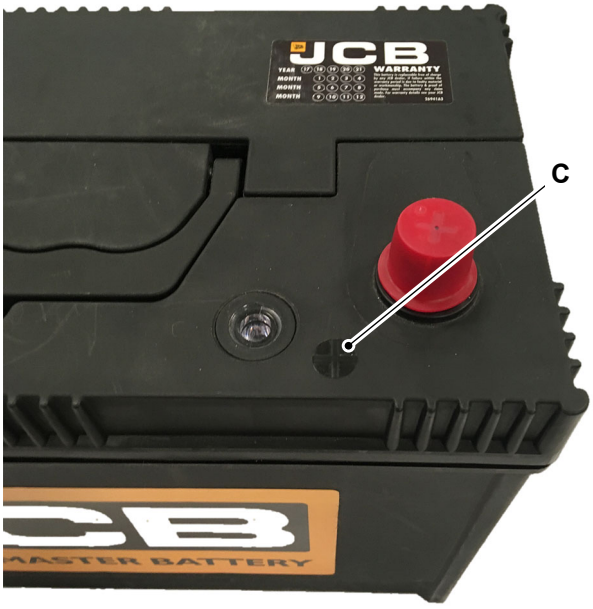
Figure 277.

B Negative battery-terminal identification

2. Connect the black clamp from the testing kit to the negative terminal. Make sure that the clamp is fully secured. Refer to Figure 279.

3. Locate the positive terminal on the battery and identify the terminal by its symbol ('+'). Refer to Figure 278.

Figure 278.



C Positive battery-terminal identification

4. Connect the red clamp from the testing kit to the positive terminal. Make sure that the clamp is fully secured. Refer to Figure 279.

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Special Tool: Battery Tester (Qty.: 1)

Figure 279.

D Black clamp
E Red clamp

5. The display of the battery tester will light up when both cables are connected to the battery.

   5.1. If the cables have not been connected to the battery correctly, the test kit will recognise this and ask you to reconnect. Refer to Figure 280. Refer to Figure 281.

Figure 280.

Figure 281.

6. Press the 'Forward' or 'Back' button to select 'BATTERY TEST'.Refer to Figure 282.

Figure 282.

7. Press the 'Enter' button to proceed. Refer to Figure 283.

Figure 283.

8. Select the machine battery type. The JCB batteries are ‘Flooded’. Move through the different types using the forward or back arrow buttons. Once selected press ‘Enter’. Note: This procedure does not apply to 48V electric machines.

9. Select 'SAE' for the rating option and press ‘Enter’.

Figure 284.

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10. Set the battery capacity. Refer to Figure 287. This can be found on the battery labelled as ‘CCA SAE’. Refer to Figure 285. Refer to Figure 286.

    10.1. Press and hold the ‘Forward’ button until the desired value is selected and press ‘Enter’.

Figure 285.

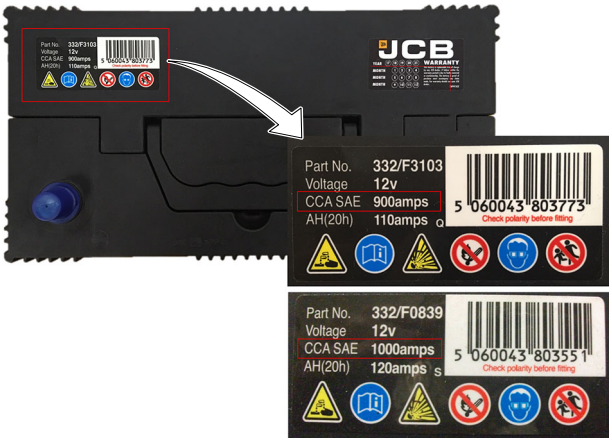


Figure 286.

Figure 287.

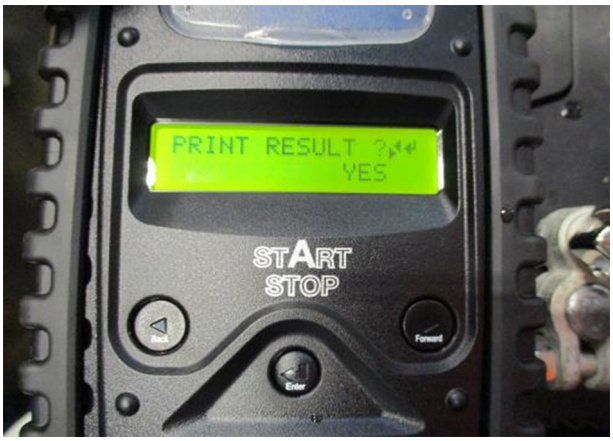
11. The battery tester will now perform the test. Once completed, the result will display on the screen. Refer to Table 138.

12. To print the test result, press the 'Enter' button. It will first display the battery resistance. Refer to Figure 288.

Figure 288.

13. Press 'Enter' again, and it will ask 'PRINT RESULT?'. Press the 'forward' button to display 'YES' and press 'Enter'. Refer to Figure 289.

Figure 289.



14. The battery tester should now print the test result. Refer to Figure 290.

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Figure 290.

Table 138.

Results	Description
GOOD and PASS	The battery is good and capable of holding charge.
GOOD and RECHARGE	The battery is good but needs to be recharged.
RECHARGE and RETEST	The battery is discharged. The battery condition cannot be determined until it is fully charged. Recharge and retest the battery.
BAD and REPLACE	The battery will not hold a charge. It should be replaced immediately.
BAD CELLS and REPLACE	The battery will not hold a charge. It should be replaced immediately.

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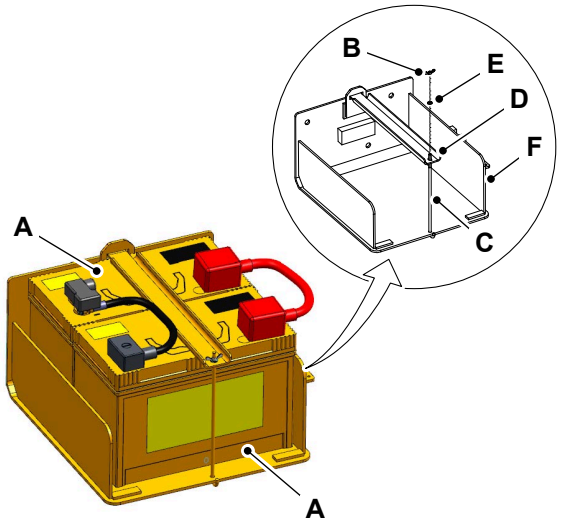
Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Obey all battery health and safety information.
   Refer to: Health and Safety (PIL 33-03-00).
3. Open the engine compartment cover.
   Refer to: PIL 06-06-06.
4. Disconnect the batteries.
   Refer to: Disconnect and Connect (PIL 33-03-00).
5. Remove the wing nut, washer and j-bolt from the support plate located on the battery box.
6. Remove the support plate from the battery box.
7. Carefully lift the batteries out of the machine.
   7.1. Never lift the batteries at the terminals, only lift the batteries at the handles.
8. If required, remove the battery isolator.
   Refer to: Remove and Install (PIL 33-03-03).

Figure 291.



A Batteries
B Wing nut
C J-bolt
D Support plate
E Washer
F Battery box

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

1. Connect the batteries in correct sequence.
   Refer to: Disconnect and Connect (PIL 33-03-00).
2. Tighten the fasteners to the correct torque values.
   Refer to: PIL 72-00.

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03 - Isolator Switch

Disconnect and Connect 33-90
Remove and Install 33-91

Disconnect and Connect

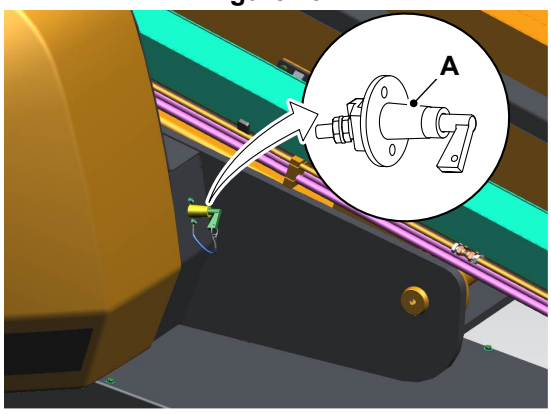
⚠ **Notice:** Before carrying out arc welding on the machine, disconnect the battery and alternator to protect the circuits and components. The battery must still be disconnected even if a battery isolator is installed.

Notice: Do not isolate the machine electrics when the engine is running, this may cause damage to the machine electrics.

To allow the engine ECU (Electronic Control Unit) to shutdown correctly, you must wait 30s before you isolate the battery. The 13s period starts when you turn the ignition OFF.

In the event of an incomplete power down an error will be displayed the next time the engine is started. To clear the errors, turn the ignition off and wait 30s, this should clear the error.

Figure 292.



A Battery isolator

Disconnect the Machine Electrics:

1. Turn the ignition key to the OFF position.
2. Wait for the engine ECU to shutdown correctly.
   Duration: 30s
3. Get access to the battery isolator switch.
4. Turn the battery isolator switch in a anticlockwise direction.

Connect the Machine Electrics:

1. Make sure the ignition is switched OFF.
2. Turn the battery isolator switch in the clockwise direction.

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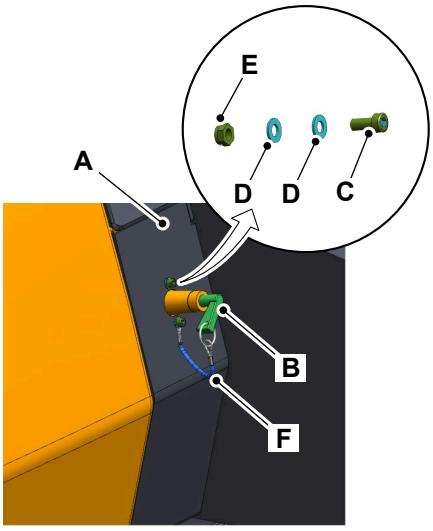
Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Open the hydraulic compartment cover.
   Refer to: PIL 06-06-09.
3. Disconnect the battery cables and turntable harness.
4. Remove the capscrew (x2), washer (x4),locknut(x2) and retaining rope from the hydraulic compartment cover.

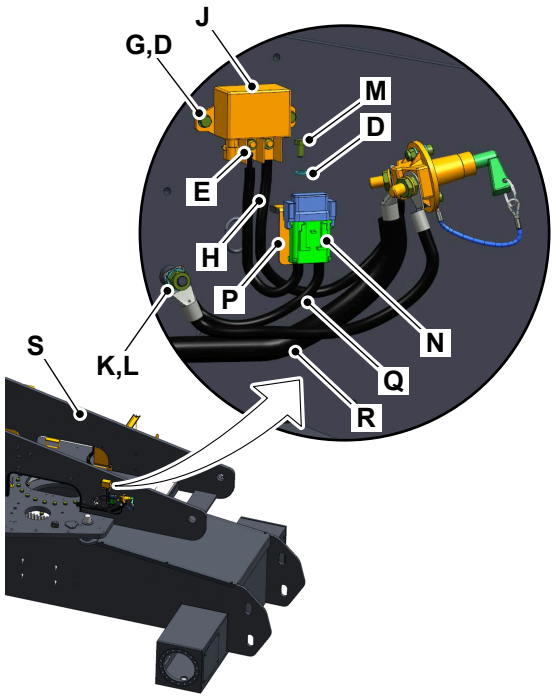
Figure 293.



A Hydraulic compartment cover
B Isolator switch
C Capscrew (x2)
D Washer (x4)
E Locknut (x2)
F Retaining rope

5. Remove the setscrew (x2), washer (x2) and locknut (x2) from the isolator relay located on the turntable.

Figure 294.



D Washer (x3)
E Locknut (x2)
G Setscrew (x2)
H Isolator relay harness
J Isolator relay
K Locknut 1
L Washer 1
M Setscrew 1
N Isolator fuse
P Mounting plate
Q Isolator fuse harness
R Battery cable
S Turntable

5.1. Remove the isolator relay from the turntable.

6. Remove the locknut 1 and washer 1 from the earthing point located on the turntable.
   Refer to: PIL 33-00-90.
7. Remove the setscrew 1 and washer from the mounting bracket. Refer to Figure 294.

   7.1. Remove the isolator fuse along with the mounting bracket.

8. Remove the isolator switch from the machine.

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

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1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Tighten the capscrew (x2), locknut(x4), setscrew (x2) and setscrew 1 to the specified torque values. Refer to Table 139.

Table 139. Torque Values

Item	Nm
C	15
E	5
G	9
M	12.5

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09 - Power Distribution

00 - General

Introduction 33-93
Health and Safety 33-94

Introduction

The electrical circuits are protected by fuses. If a fuse blows, find out why and rectify the fault before installing a new one.

A full up to date list of fuses and relays and their locations can be found in the relevant operator manual, maintenance section.

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Health and Safety

⚠ **Notice:** Always replace fuses with ones of correct ampere rating to avoid electrical system damage.

Notice: When installing auxiliary electrical components always ensure that the additional load rating is suitable for that particular circuit. It is unacceptable to simply increase the fuse rating as this can cause overloading and consequential failure of wiring, along with failure of integral circuit components, which the fuse is protecting.

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03 - Fuse

Technical Data

Primary Fuses

Table 140.

Fuse	Rating
Electric motor primary fuse	275A
Base control panel fuse	80A

Secondary Fuses

Figure 295. Base Control Fuses

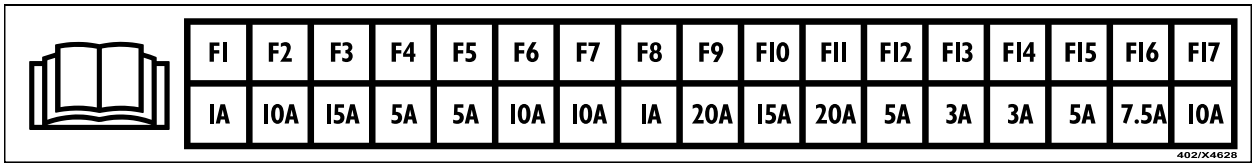

Table 141.

Fuse ID	Fuse	Rating
F1	Ignition fuse	1A
F2	Base E-stop, horn relay and diagnostic connector	10A
F3	Base ECU (Electronic Control Unit) supply	15A
F4	Wire reel, tilt sensor and rope switch	5A
F5	Display and axle lock pressure sensor	5A
F6	Platform ECU supply	10A
F7	Platform ECUsupply	10A
F8	Base ECU supply	1A
F9	Spare	20A
F10	Spare	15A
F11	Worklight	20A
F12	Engine run signal for telematics and Base ECU	5A
F13	Livelink	3A
F14	Display	3A
F15	Spare	5A
F16	Key switch	7.5A
F17	Platform ECU supply	10A

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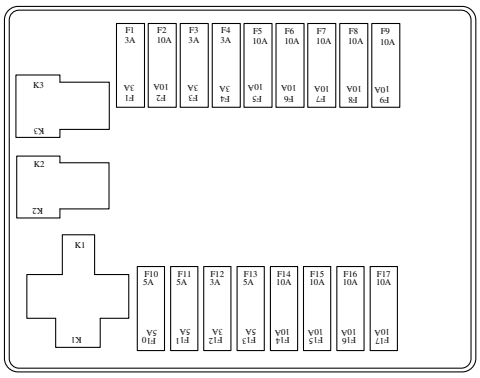
Figure 296. Podbox Fuses



400/R0760

Table 142.

Fuse ID	Fuse	Rating
F1	Engine ECU power hold	3A
F2	Fuel pump	10A
F3	Starter	3A
F4	Fuel pump	3A
F5	Spare	10A
F6	Spare	10A
F7	Grid heater	10A
F8	Engine ECU	10A
F9	Engine ECU	10A
F10	Battery Isolator relay	5A
F11	Spare	5A
F12	WIF (Water in Fuel)	3A
F13	Alternator resistor	5A
F14	VGT (Variable Geometry Turbocharger)	10A
F15	EGR (Exhaust Gas Recirculation)	10A
F16	Engine ECU	10A
F17	Engine ECU	10A

Figure 297. Platform Control Fuse

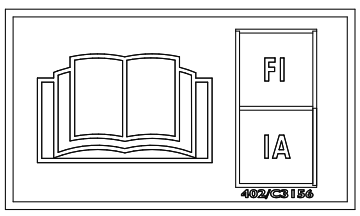


Table 143.

Fuse ID	Fuse	Rating
F1	Ignition feed fuse	1A

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Other Fuses

Table 144.

Fuse	Rating
Grid heater primary fuse	150A
Battery isolation fuse	70A
Engine podbox fuse	50A

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06 - Relay

Technical Data

Primary Relays

Table 145.

Description	Rating
Electric pump relay	180A
Grid heater relay	130A

Secondary Relays

Figure 298. Base Control Relays

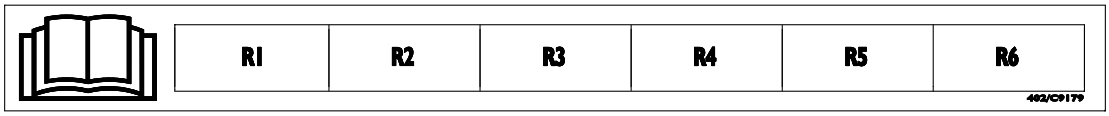
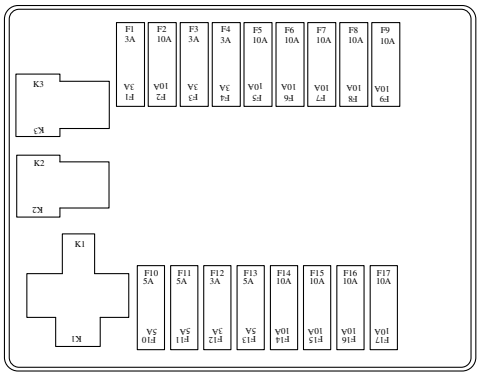


Table 146.

Relay ID	Description	Rating
R1	Ignition relay 1	40A
R2	Ignition relay 2	40A
R3	Ignition relay 3	40A
R4	Ignition relay 4	40A
R5	D+ relay	40A
R6	Horn relay	40A

Figure 299. Podbox Relays



400/R0760

Table 147.

Relay ID	Description	Rating
K1	Power hold relay	40A
K2	Starter relay	20A
K3	Fuel pump relay	20A

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Table 148.

Relay ID	Description	Rating
R1	Platform buzzer relay	12V

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10 - Motor

00 - General

Introduction 33-100
Technical Data 33-101
Component Identification 33-102
Remove and Install 33-103

Introduction

The electrical motor installed on this machine is a DC (Direct Current) motor. It is called the "Auxiliary motor" or "Pump motor". It is used for the emergency operation of the machine.

It is installed on the turntable structure under the hydraulic side canopy.

The pump motor rotates in a clockwise direction (viewed from shaft end).

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Technical Data

Table 149.

Description	Data
Power rating	3.3kW
Maximum voltage	24V
Rated current	180A
Rated speed	3050 RPM (Revolutions Per Minute)
Maximum speed	5600 RPM
Direction of rotation	Clockwise from the shaft end

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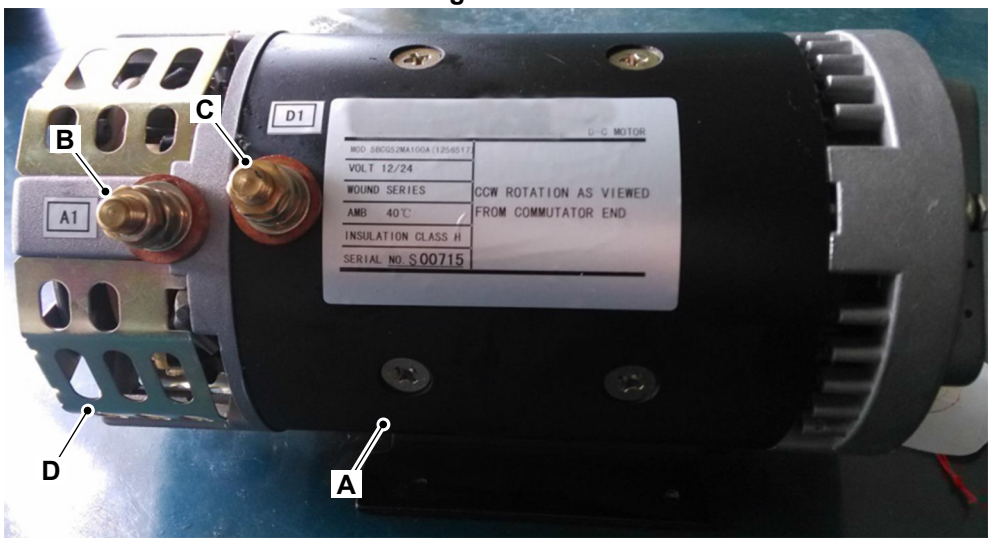
Component Identification

Figure 300.



A Pump motor
B A1 terminal (Positive binding)
C D1 terminal (Negative binding)
D Commutator end

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Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Isolate the machine.
3. Disconnect the electrical connections from the motor.
4. Disconnect the hydraulic hoses from the pump.
   4.1. Put a label on the hoses to help installation.
   4.2. Plug all the open ports and hoses to prevent contamination.
5. Remove the setscrew (x4) and washer (x4) from the motor mount bracket.
6. Remove the motor along with the gear pump from the machine.
7. Remove capscrew (x2) and washer 1 (x2) from the gear pump.
8. Remove the gear pump from the auxiliary motor.
9. If necessary, remove the adaptor 1, adaptor, bonded washer, adaptor 3 from the gear pump.

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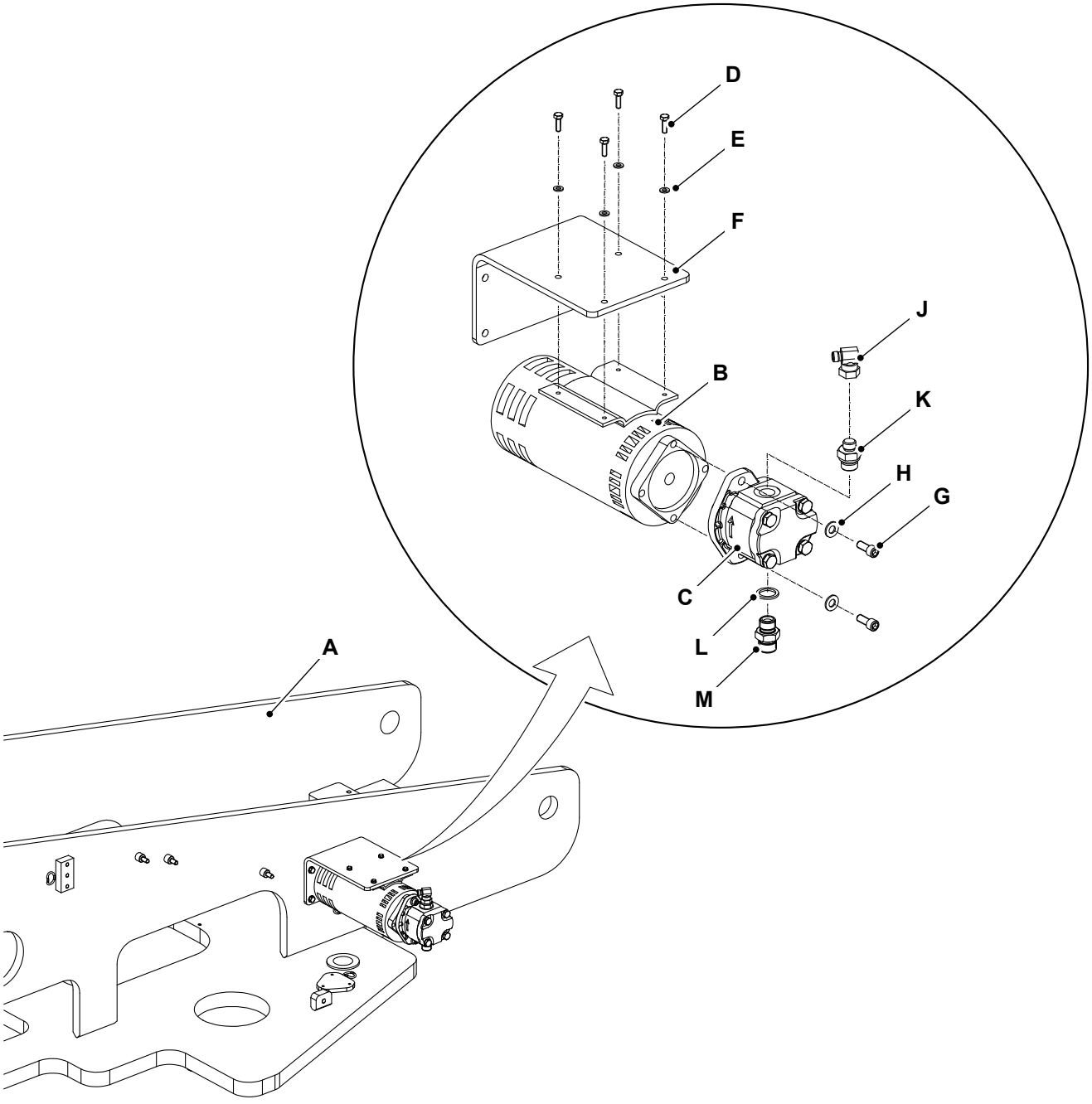
Figure 301.



A Turntable
B Auxiliary motor
C Gear pump
D Setscrew (x4)
E Washer (x4)
F Motor mount bracket
G Capscrew (x2)
H Washer 1 (x2)
J Adaptor 1
K Adaptor 2
L Bonded washer
M Adaptor 3

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Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Tighten the setscrew 1 (x4) and setscrew 2 (x4) to the specified torque value. Refer to Table 150.

Table 150. Torque Values

Item	Nm
D	9
G	20–23
J	35–39
K	65–71
M	65–71

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12 - Harness

00 - General

Introduction 33-106
Health and Safety 33-107
Component Identification 33-108
Diagram 33-110
Repair 33-110
Check (Condition) 33-113

Introduction

Harness Drawings

Drawings are reproduced from production electrical harness drawings. Each harness drawing includes tables showing wire connections and destinations for all the connectors on the harness. To identify the correct harness drawing for a particular machine refer to the relevant Harness Interconnection page for the machine serial number range.

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Health and Safety

⚠ **Notice:** When installing auxiliary electrical components always ensure that the additional load rating is suitable for that particular circuit. It is unacceptable to simply increase the fuse rating as this can cause overloading and consequential failure of wiring, along with failure of integral circuit components, which the fuse is protecting.

Harness Repair (Butane Heater)

⚠ **WARNING** In addition to the warnings incorporated into this procedure, extreme care should be taken when handling the gas heating tool to ensure that the flame does not damage or set fire to any items in the vicinity of the repair, i.e. other wires, floor panels, floor mats, sound proofing, paintwork, etc. This tool should not be used in any restricted location prohibiting the use of "Naked Flames" or where risk of explosive gas or similar safety parameters apply. No other heat source should be used to attempt a sealed joint.

CAUTION When the heater is in use, the reflector and the air coming out are extremely hot. Keep away to avoid accidental burns. Do not touch the reflector until it has had time to cool down after switching off. If flame reappears at the reflector when the heater is in use, the catalytic element is damaged or used up. Stop work immediately and replace the heater.

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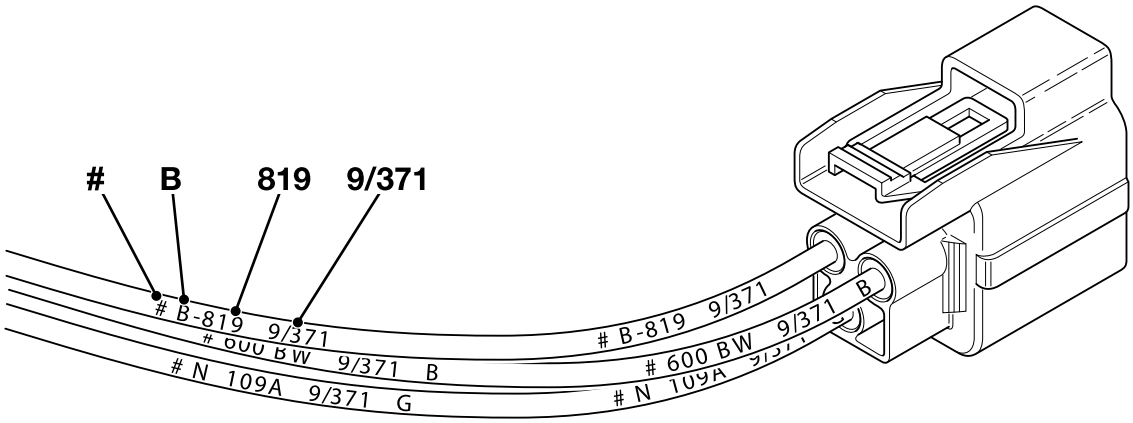
Component Identification

Wire and Harness Number Identification

This section details the allocation of wire numbers and the identification of wires in the wiring harness.

Figure 302.



The illustration shows a typical connector and wires. Each wire has an individual identification number permanently marked on it, at regular intervals along it's length. The number stamped on the wire identifies the following:

Table 151. Wire and Harness Number Identification

Identification Number	Description
#	The # indicates the start of the identification number. It is always printed to the left of the identification number.
B	If applicable - The colour of the flying lead that the harness wire should mate with. For instance, if wire 819 from harness 719/37100 mated with a flying lead coloured black (colour code B) then the number printed on the wire would be B-819 9/371.
819	The wire's unique identification number. The wire functions and numbers allocated to them are consistent through out the JCB range of products. Refer to Wire Numbers and Functions.
9/371	If applicable - The part number of the harness that the wire originates from. If the harness part number is 719/37100, the number printed on the harness wires will be 9/371 (71 and 00 are common numbers and therefore deleted).

Wire Numbers and Functions

Table 152. Wires 000-199, 1000-1999 (These numbers are reserved for ignition feeds, heater start circuits and start circuits)

Wire Number	Description
Wires 000 - 099	Unfused ignition feeds
Wires 100 - 199 and 1000 -1999	Fused ignition feeds (feeds via ignition relays are also classed as ignition feeds). Power supplies output by a control module.

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Table 153. Wires 200-399, 2000-3999 (These numbers are reserved for battery feeds)

Wire Number	Description
Wires 200-299 and 2000-2999	Unfused battery feeds. Power supplies output by a control module.
Wires 300-399 and 3000-3999	Fused battery feeds. Power supplies output by a control module.

Table 154. Wires 400-599, 4000-5999

Wire Number	Description
Wires 400-599 and 4000-5999	These numbers are reserved for instruments, sensors and variable input/output signal wires used in electronic systems. CAN wires also use numbers in this series.

Table 155. Wires 600-799, 6000-7999

Wire Number	Description
Wires 600-799 and 6000-7999	These numbers are used for earth wires. When the number is printed on to a wire it is prefixed by the Earth symbol. This symbol is printed onto the wire, it may however be omitted from harness drawings. Where a load is switched negative, the wire number from the load to the switch shall be different to that of the wire from the switch to the earth.

Figure 303.

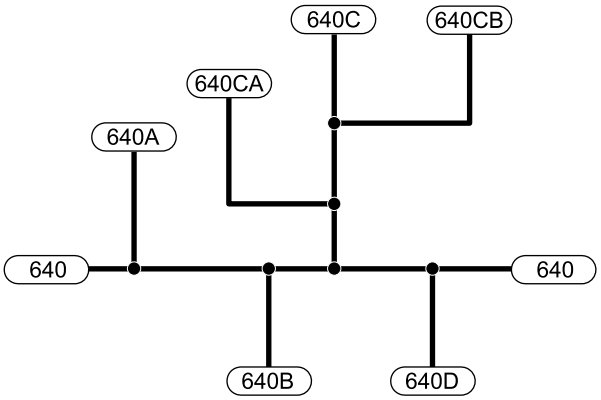
Table 156. Wires 800-999, 8000-9999

Wire Number	Description
Wires 800-999 and 8000-9999	These numbers are reserved for switched supplies to electrical loads, i.e. to lights, etc. Power supplies output by a control module.

Table 157. Wires In Splices

Wire Number	Description
Various	The main input wire is allocated with a wire number and a suitable description, i.e. Wire 640 earth splice to earth. The additional wires in the splice are allocated the same wire number and a postfix, i.e. 640A, 640B, etc.

Figure 304.



General Points

1. Wires continue to have the same number even after passing through a connector block to another harness.
2. The descriptions are applicable to JCB specification wiring harnesses. The machine may be installed with some wiring that does not conform to the JCB specifications, typically when it is part of equipment supplied by other manufacturers.

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Diagram

A full set of harness drawings are available. Refer to: servicepro.jcb.com.

Repair

Special Tools

Description	Part No.	Qty.
Wiring Crimp Tool	892/00349	1
Butane Heater	892/00350	1

Consumables

Description	Part No.	Size
Wiring Splice (0.5-1.5mm Red, contains 50 off)	892/00351	-
Wiring Splice (1.5-2.5mm Blue, contains 50 off)	892/00352	-
Wiring Splice (3-6mm Yellow, contains 50 off)	892/00353	-
Wiring Splice-Bootlace (1mm Red)	7205/0100	-
Wiring Splice-Bootlace (2.5mm Grey)	7205/0250	-

Instances occur where it is necessary to incorporate auxiliary electrical components into existing electrical circuits and although unlikely with present wiring harnesses, repair or replace specific individual wires within a harness. This will also apply to other machines in addition to those of manufacture.

To make sure that either the inclusion of an auxiliary electrical component or a repair within a harness is completed to an acceptable standard it is strongly recommended that the following tools, equipment and procedures are always used.

The sheath covering of the recommended splice is heat shrunk onto the original wire insulation. This results in a seal and corresponding joint to IP 67 specifications.

Procedure 1

1. Cut the wire and remove the protective insulation for a suitable distance dependent upon the size of wire and splice to be used.

   Special Tool: Wiring Crimp Tool (Qty.: 1)

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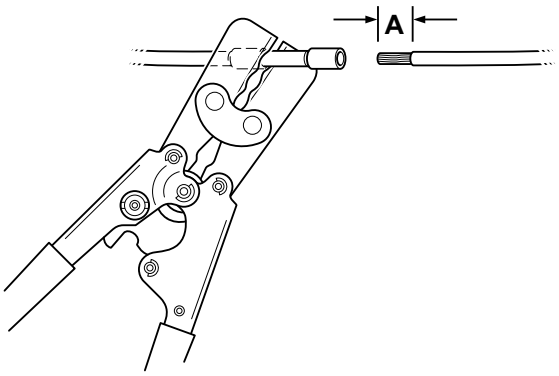
Figure 305.



A Distance for splice (check size)

2. Using the correct sized splice, attach the new section of wire required or auxiliary flying lead to the existing harness and secure using the crimp tool. Note that each of the splices detailed is colour-coded to make size and range readily visible. They are secured using the corresponding size and matching colour-coded jaws of the crimp tool to ensure joint security. This tool also incorporates a ratchet closing mechanism which will not release until the splice is fully closed to the correct compression size.

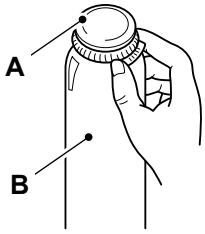
   Consumable: Wiring Splice (0.5-1.5mm Red, contains 50 off)
   Consumable: Wiring Splice (1.5-2.5mm Blue, contains 50 off)
   Consumable: Wiring Splice (3-6mm Yellow, contains 50 off)

3. With the Butane heater assembly, seal the connection.

   Special Tool: Butane Heater (Qty.: 1)

   3.1. Remove the cap from the end of the disposable gas cartridge.

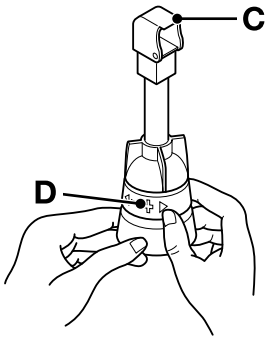
Figure 306.



A Cap
B Gas cartridge

   3.2. Before assembling the gas cartridge to the reflector element, turn the red ring to the left, (in the direction of the minus sign marked on the ring).

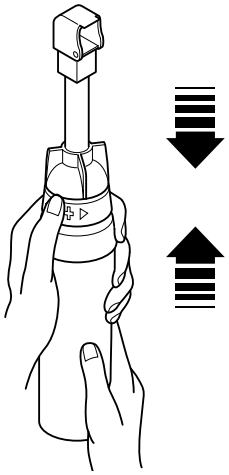
Figure 307.



C Reflector element
D Red ring

   3.3. Position the tube hanging down from inside the reflector assembly into the hole at the top of the gas cartridge. Then press the gas cartridge up into the reflector assembly as far as possible until the two elements are clasped firmly together. An audible click will be heard.

Figure 308.



   3.4. Turn the small ring so that the air holes are completely closed.

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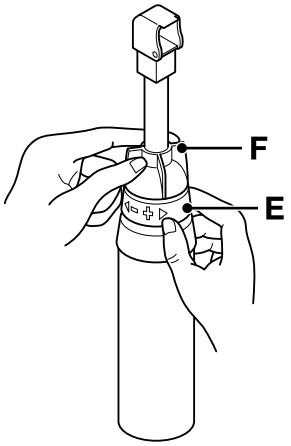
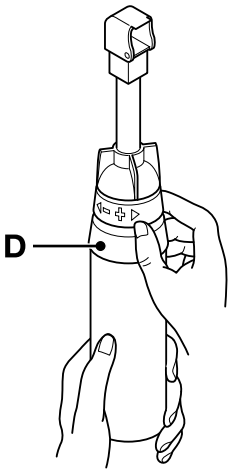
Figure 309.



E Small ring
F Air holes

3.5. Turn the red ring to the right (in the direction of the plus sign) in order to turn on the gas. Important: Before turning the heater on, make sure that the cartridge is not hotter than the reflector element. This may occur if the cartridge is held in the hand for a long time. The temperature difference between the cartridge and the reflector element may cause long yellow flames to appear on ignition.

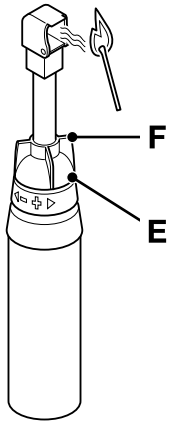
Figure 310.



D Red ring

3.6. Hold the heater vertically and, using a match or cigarette lighter, light the gas as shown. Hold the heater vertically for 1 to 2 minutes until the catalytic reaction occurs. This is indicated when the blue flame fades and the ceramic element glows red. Then turn the small ring until the air holes at are completely open. The tool is ready for use. Note: The fact that the sound of liquid cannot be heard when the cartridge is shaken does not mean it is empty. No sound will be heard even when the cartridge is full.

Figure 311.

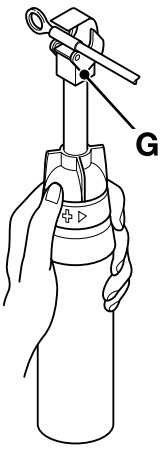


E Small ring
F Air holes

3.7. The heater can be used in two modes:

3.8. Side wings down, reflector head completely open. In this mode the infra-red heat waves are dominant (recommended for the light coloured plastic splices).

Figure 312.



G Side wings

3.9. Side wings up, reflector head opening reduced. In this mode the heating is done only by the hot gas (use for dark coloured plastic splices).

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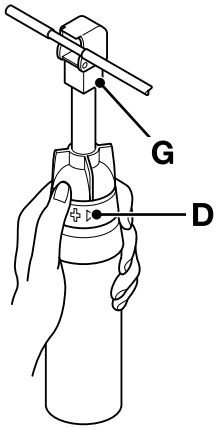
Figure 313.



D Red ring
G Side wings

Procedure 2

1. Cut the wire and remove the protective insulation for a suitable distance.
2. Install the suitable bootlace ferrule on the wires.

   Consumable: Wiring Splice-Bootlace (1mm Red)
   Consumable: Wiring Splice-Bootlace (2.5mm Grey)
3. Use a suitable bootlace ferrule tool to crimp the terminals. Refer to Figure 314.

Figure 314.

Check (Condition)

This section describes how to use electrical measuring devices that are used in electrical fault finding.

Use of Multimeters

In order to obtain the maximum benefit from the fault finding information contained in the Electrical Section, it is important that the technician fully understands the approach to fault finding and the use of the recommended test equipment, in this case a digital multimeter, or a moving pointer analogue multimeter. The approach is based on a fault finding check list. In tracing the fault from the symptoms displayed you will be directed to make measurements using a multimeter. These instructions are intended to cover the use of the recommended meters.

1. Make sure that the test leads are plugged into the correct sockets. The black test lead should be plugged into the black socket (sometimes, this socket is also marked by a -, or E or marked as COMMON or COM). The red test lead should be plugged into the red socket marked with +, V or Ω.
2. When you make a measurement, make sure that the test probes have a good clean contact with bare metal, free from grease, dirt, and corrosion as these can cause a false reading.
3. When you measure a voltage, make sure that the correct range is selected, that it is set to the selector value equal to or greater than that you are about to measure. e.g. If asked to measure 12 Volts, set the selector to the 12V range. If there is no 12V range, set the selector to the next range higher, 20V for instance. If the meter is set to a range that is too low, it may be damaged. e.g. setting to the 2V range to measure 12V.

Measuring DC Voltage

1. Select the correct range on the multimeter.

   1.1. On the digital multimeter, turn the switch to position B.

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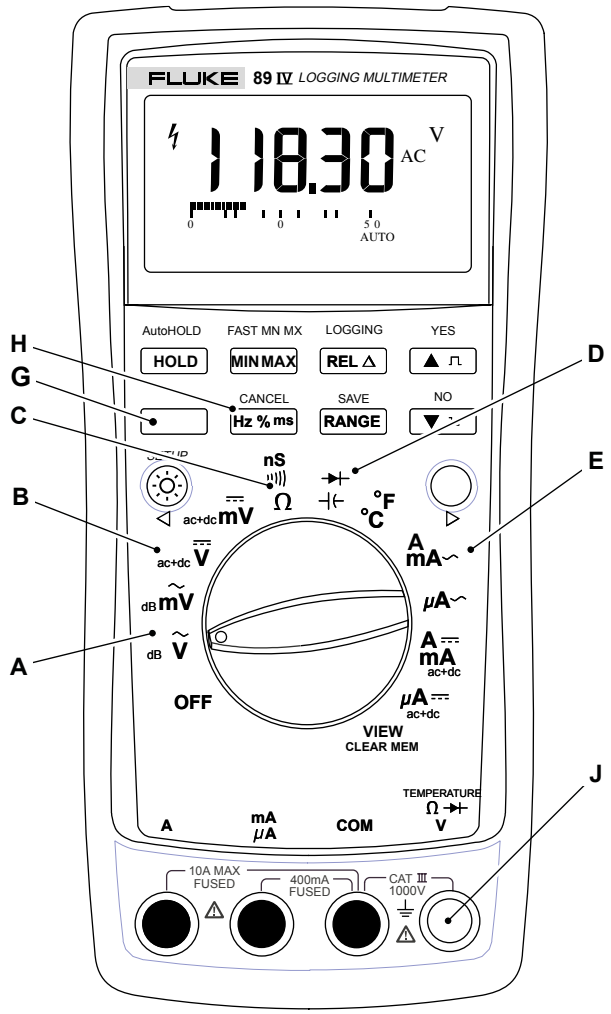
Figure 315. Typical Digital Multimeter



2. Connect the black probe to the nearest available suitable earth point, usually this will be the starter motor earth, the battery negative, or the chassis. Connect the red probe to the wire or contact from which you are measuring the voltage.

Measuring Resistance

1. Make sure that there is no power to the part of the circuit you are about to measure.
2. Connect one probe at one end of the component or wire to be checked and the other probe at the other end. It does not matter which way round the two probes are placed.
3. Select the correct range on the multimeter.
   3.1. Turn the switch to position C and check that the W sign at the right hand side of the display window is on. If the F sign is on instead, press the blue button G to change the reading to Ω. Touch the meter lead probes together and press the REL3 key on the meter to eliminate the lead resistance from the meter reading.

Measuring Continuity

1. Make sure that there is no power to the part of the circuit you are checking for continuity.
2. Connect one probe to one end of the component or wire to be checked and the other probe to the other end. It does not matter which way round the two probes are placed.
3. Select the correct range on the multimeter.
   3.1. On the digital multimeter, turn the switch to position C and check that the beeper symbol appears at the left hand side of the display window. If the F sign is on instead, press the button labelled F. If there is continuity in the circuit, the beeper will sound. If there is no continuity (open circuit), the beeper will not sound.

Measuring Frequency

1. Insert the black plug into the COM socket on the meter and attach the probe to the nearest suitable earth point on the chassis, for example, the battery negative terminal.
2. Insert the red probe into socket J.
3. Turn the selector switch to position A and depress G repeatedly until F is highlighted on the top row of the display.
4. Press button H once.
5. Touch or connect the red probe to the frequency source to be measured. Press and hold the button if an average reading is required.

Testing a Diode or a Diode Wire

A diode wire is a diode with male connector installed on one end and a female connector installed on the other end. The diode is sealed in heatshrink sleeving. To test a Diode or a Diode Wire.

1. On the digital multimeter:
   1.1. Turn the switch to position D.
   1.2. Press the HOLD button and check that the H sign appears at the top right hand side of the display window.
   1.3. Connect the black probe to the end of the diode with a band or to the male connector of the diode wire. Connect the red probe to the other end of the diode or diode wire. If the beeper does not sound the diode or diode wire is faulty.

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1.4. Connect the red probe to the end of the diode marked with a band, or to the male connector of the diode wire, the black probe should be connected to the other end of the diode or diode wire. If the beeper sounds or the meter does not read O.L., the diode or diode wire is faulty.

1.5. Press the HOLD button and check that the H sign disappears from the right hand side of the display window.

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15 - Alarm

00 - General

Check (Operation)

Alarms are installed to alert operators and ground personnel of machine proximity and motion.

The alarm package includes:

- Travel alarm
- Flashing beacon.
- Platform buzzer
- Base buzzer
- Base display warning icons
- Platform display warning icons.

You must check the alarms for correct operation at regular intervals. Refer to
Refer to: PIL 78-24.

Travel Alarm and Flashing Beacon

To check the travel alarm and flashing beacon do the following steps.

1. The alarms will operate with the engine running or not running.
2. Turn the ignition switch to the ON position.
3. Pull out the base emergency stop button to the ON position.
4. Pull out the platform emergency stop button to the ON position.
5. Move the base or platform selector switch to the base position.
   - 5.1. Activate the main boom lower, telescopic boom retract and slew left or right toggle switches to energise the travel alarm.
   - 5.2. The travel alarm should sound when the switch is pressed.

Platform Buzzer

To check the platform buzzer do the following steps.

1. Turn the ignition switch to the ON position.
2. Make sure that the base and platform emergency stop buttons are released.

The platform buzzer should beep 3 times at start-up.

Base Buzzer

To check the base buzzer do the following steps.

1. Turn the ignition switch to the ON position.
2. Make sure that the base and platform emergency stop buttons are released.

The base buzzer should beep 3 times at start-up.

Platform and Base Display Warning Icons

To check platform and base warning display icons, refer to-
Refer to: PIL 33-24.

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24 - Instruments

02 - Base Controller

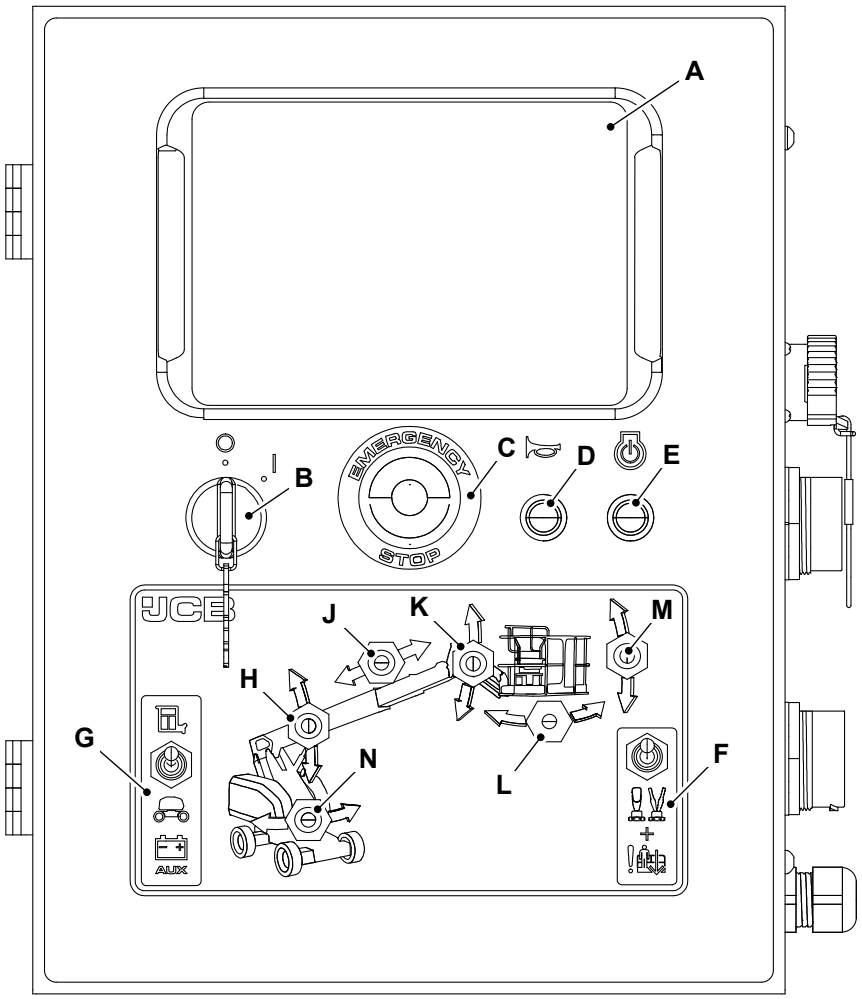
Introduction 33-117
Check (Operation) 33-132
Remove and Install 33-132

Introduction

Base Control Panel

⚠ **WARNING** Do not operate the machine with the base control when there are personnel in the platform except in an emergency.

Figure 316.



A Base control panel display
B Key switch
C Emergency stop button
D Horn button
E Engine start/stop button
F Base emergency override switch
G Base control enable switch
H Main boom raise/lower switch
J Telescopic boom extend/retract switch
K Jib raise/lower switch
L Platform rotate switch
M Platform level switch
N Slew left/right switch

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Base Control Panel Display

Figure 317.

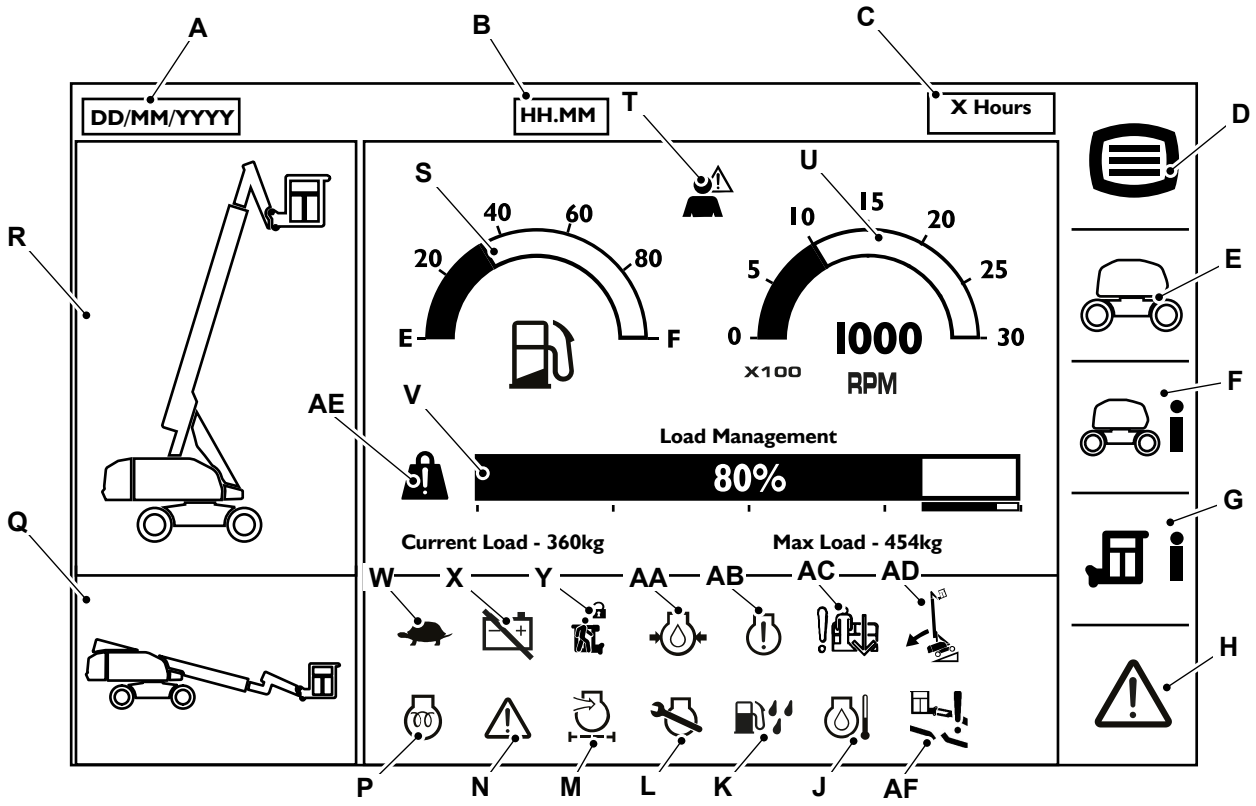

Table 158.

Callout	Indicator	Description
A	Date	Displays current date.
B	Time	Displays current time.
C	Machine hours	Displays machine running hours.
D	Machine control settings	Displays settings of the machine control.
E	Machine control setup	Displays locked screen for new settings of machine.
F	Base information	Displays base information of machine like input, output and machine information.
G	Platform information	Displays platform input / output information.
H	Alarm information	Displays live and historic faults.
J	Coolant temperature	Displays when coolant temperature is high.
K	Water in fuel	Displays if moisture is detected in fuel.
L	Service Lamp	Displays when the engine service is due.
M	Blocked air filter	Displays when the engine air filter is blocked.
N	Fault indicator	Displays when there is a fault on the machine.
P	Engine pre-heater	Applicable for machines fitted with grid heater. Indicates wait to heat in cold conditions.
Q	Machine stowed position	Displays when machine is in stowed position.
R	Machine raised position	Displays when machine is in raised position.

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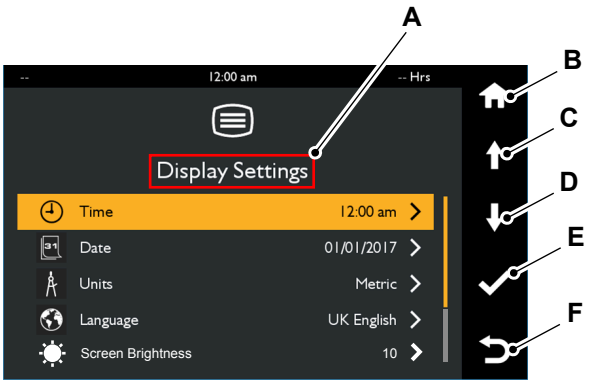
Callout	Indicator	Description
S	Fuel level indicator	Displays the level of diesel fuel in the tank. Do not let the tank run dry which will allow air will to enter the fuel system. Do not run the engine, if the indicator needle goes into the red area. First segment of fuel gauge blinks to show reserve capacity.
T	Operator error or caution alarm	Displays when there is error in the operation and requires operator's attention.
U	Engine speed indicator	Indicates the engine RPM (Revolutions Per Minute).
V	Load management indicator	Displays the amount of load machine is carrying in percentage.
W	Travel speed	Indicates machine operation is in slow / high or tortoise / hare mode.
X	Alternator lamp	Displays if there is a battery charging circuit fault while the engine is running.
Y	Secondary guarding	Displays when the platform secondary guarding is in active condition.
AA	Engine oil pressure	Displays if the engine oil pressure is too low. Stop the engine. The light should go out after the engine is started.
AB	Engine warning lamp	Displays during fault state of engine.
AC	Emergency mode used	Indicates when emergency override has been activated.
AD	Tilt limit exceeded	Displays when machine tilt limit is exceeded. Solid lamp if the machine is stowed. Flashing lamp if the machine is raised.
AE	Overload lamp	Displays when the platform load limit is exceeded. Solid lamp illuminates, if the load is approaching the limit. Flashing lamp illuminates, if the load is above the limit.
AF	Wire rope break alarm	The icon flashes red and an audible alarm sounds when the wire rope is loose or broken, or when the boom sensor or wire rope is not correctly positioned.

Display the Settings

Figure 318.



A Display Settings
B Home page icon
C Up scroll icon
D Down scroll icon
E Select icon
F Return icon

Setting the Time

1. On the machine home page, select 'Machine control settings' to open 'Display Settings'. Refer to Figure 317.
2. Use the Up/Down scroll icon to choose 'Time' in the menu, and click select icon. Refer to Figure 318.
3. The 'Set Time format' menu will appear on the screen.
   3.1. Select either 12h or 24h format.

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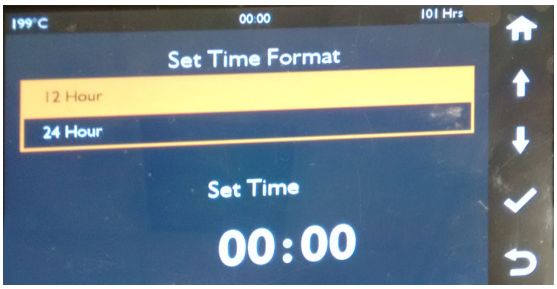
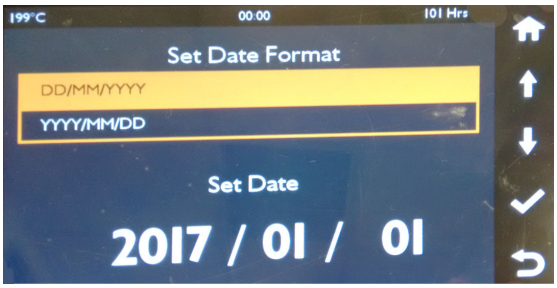
Figure 319.



Setting the Date

1. On the machine home page, select 'Machine control settings' to open 'Display Settings'. Refer to Figure 317.
2. Use the Up/Down scroll icon to choose 'Date' in the menu, and click select icon. Refer to Figure 318.
3. The 'Set Date format' menu will appear on the screen.

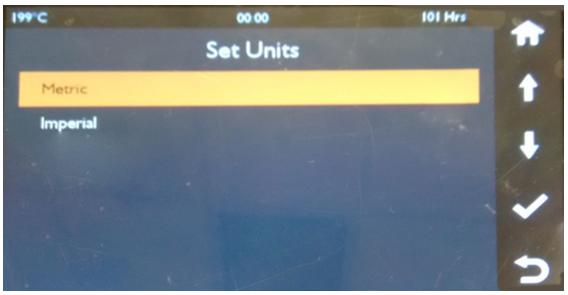
Figure 320.



Setting the Units

1. On the machine home page, select 'Machine control settings' to open 'Display Settings'. Refer to Figure 317.
2. Use the Up/Down scroll icon to choose 'Unit' in the menu, and click select icon. Refer to Figure 318.
3. The 'Set Units' menu will appear on the screen.

Figure 321.

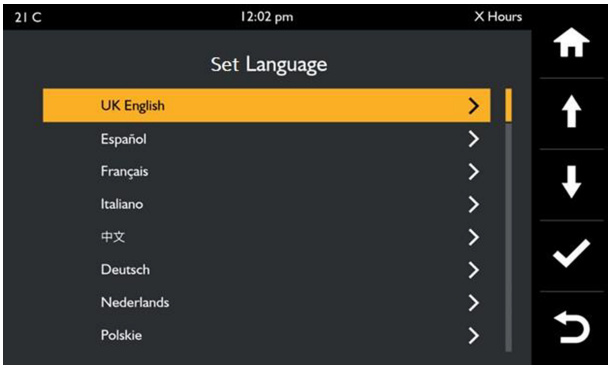


3.1. Select the units in 'Metric' or 'Imperial' format.

Setting the Language

1. On the machine home page, select 'Machine control settings' to open 'Display Settings'. Refer to Figure 317.
2. Use the Up/Down scroll icon to choose 'Language' in the menu, and click select icon. Refer to Figure 318.
3. The 'Set Language' menu will appear on the screen.

Figure 322.



3.1. Use the 'Up/Down scroll icon' to choose 'Language' from the drop-down list.

4. Use the select icon to confirm and save the desired setting.

Setting the Brightness

1. On the machine home page, select 'Machine control settings' to open 'Display Settings'. Refer to Figure 317.
2. Use the Up/Down scroll icon to choose 'Brightness' in the menu, and click select icon. Refer to Figure 318.
3. Use the Up/Down scroll icon to increase or decrease the brightness.

Figure 323.

4. Press select icon for desired brightness.

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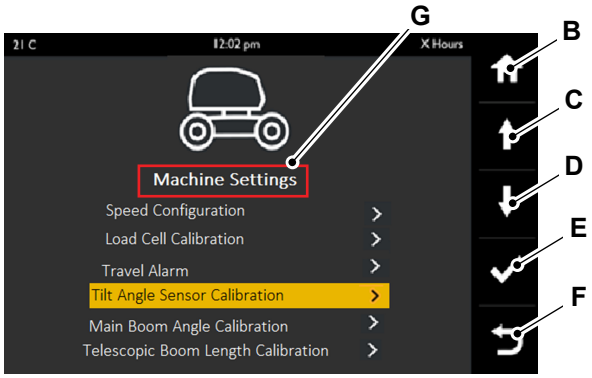
Machine Settings

Figure 324.

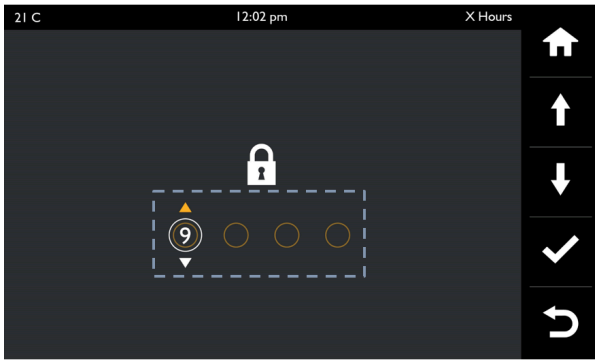


B Home page icon
C Up scroll icon
D Down scroll icon
E Select icon
F Return icon
G Machine settings

Machine Settings Pin

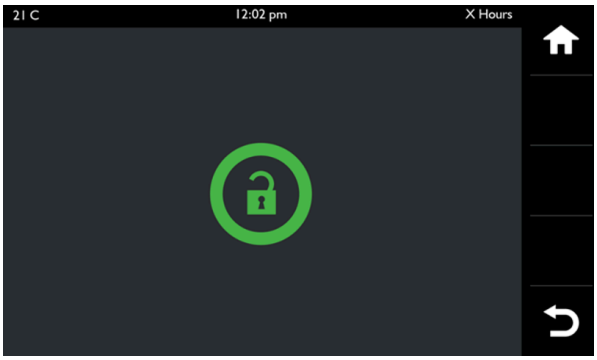
1. On the machine home page, select 'Machine control setup' to open 'Machine Settings'. Refer to Figure 317.
2. Enter the machine pin as '1930' (Default pin). Refer to Figure 325.
   2.1. Verify the pin in JCB Servicemaster, if necessary.
3. Use Up/Down scroll icon to toggle from 0-9 on the selected box, and click select icon.

Figure 325.



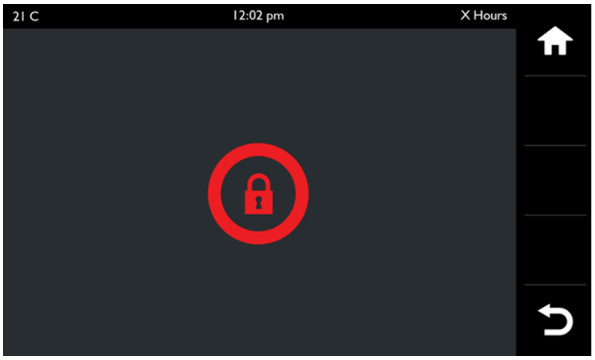
4. If pin entered is correct, 'Machine settings unlocked' will appear on the screen.

Figure 326.



5. If pin entered is incorrect, 'Machine setting incorrect pin' will appear on the screen.

Figure 327.



Speed Configuration

The machine will be set at 100% initially, but may be slowed down for new operators or even block a function. For example, if you do not want to allow slew, the slew function can be set to 0%.

1. On the machine home page, select 'Machine control setup' to open 'Machine Settings'. Refer to Figure 317.
2. Use the Up/Down scroll icon to choose 'Speed Configuration' in the menu, and click select icon. Refer to Figure 324.
3. Use the Up/Down scroll icon to navigate to the desired function for example 'Travel', and click select icon to select.

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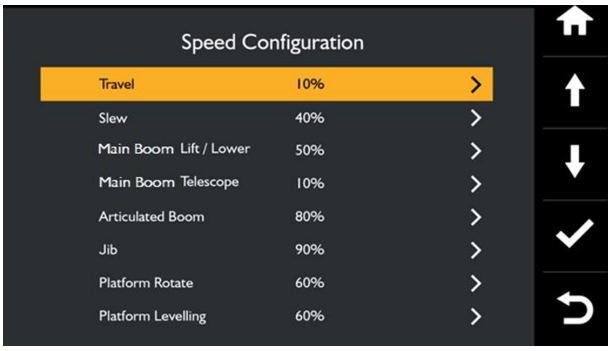
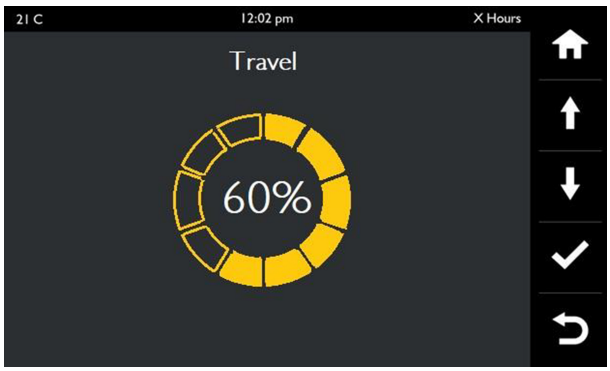
Figure 328.



4. The 'Travel' menu appears on the screen.

Figure 329.



4.1. Use the Up/Down scroll icon to adjust the speed.

5. Use the select icon to confirm and save the desired setting.

Setting the Load Cell Calibration

1. On the machine home page, select 'Machine control setup' to open 'Machine Settings'. Refer to Figure 317.
2. Use the Up/Down scroll icon to choose 'Load Cell Calibration' in the menu, and click select icon. Refer to Figure 324.
3. Use the Up/Down scroll icon and select the 'No load' or 'Rated load' depending on the calibration to be carried out. Refer to Figure 330.

Figure 330.

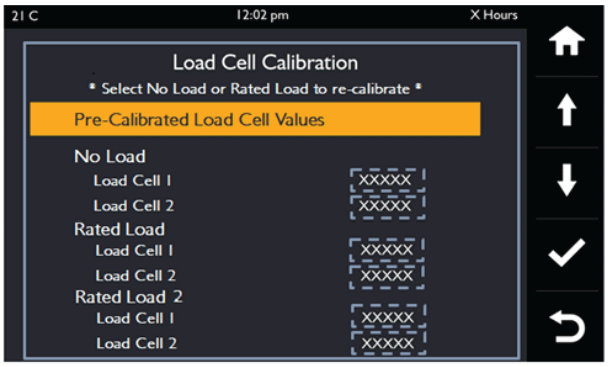


Figure 331.

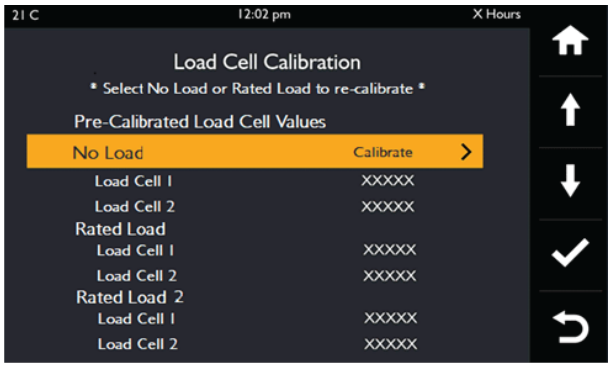


Figure 332.

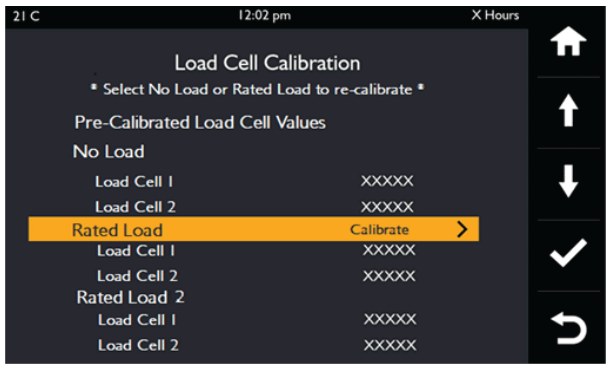
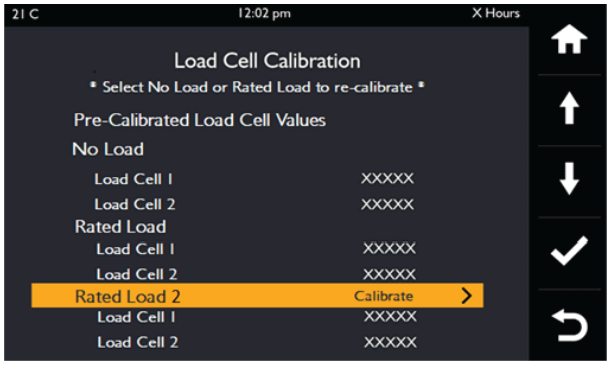


Figure 333.



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3.1. Make sure that there is no load at the platform when you select 'No Load' calibration. Refer to Figure 331.

3.2. Make sure that load of specified weight is placed on the platform when you select 'Rated Load' calibration. Refer to Figure 332.

Weight: 300kg

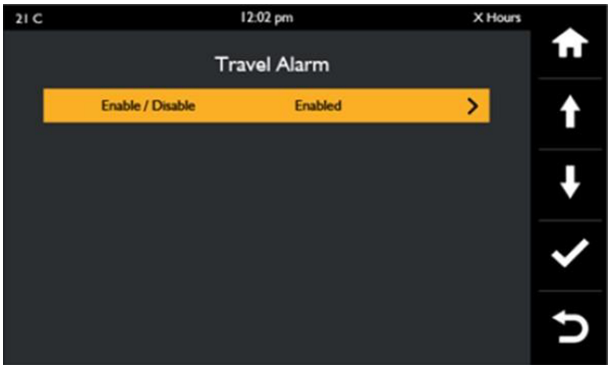
3.3. Make sure that load of specified weight is placed on the platform when you select 'Rated Load 2' calibration. Refer to Figure 333.

Weight: 450kg

Setting the Travel Alarm

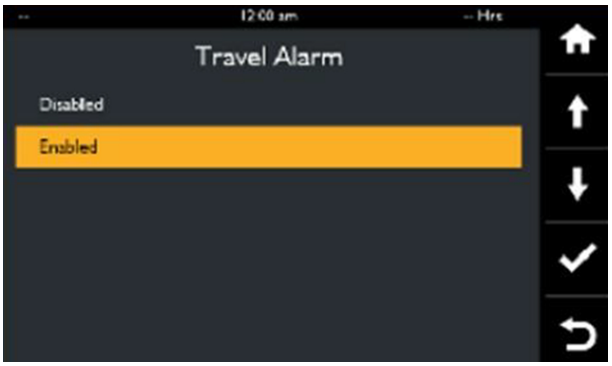
1. On the machine home page, select 'Machine control setup' to open 'Machine Settings'. Refer to Figure 317.
2. Use the Up/Down scroll icon to choose 'Travel alarm' in the menu, and click select icon. Refer to Figure 324.
3. Use the Up/Down scroll icon to enable or disable the travel alarm.

Figure 334.



4. Use the select icon to confirm and save the desired setting.

Figure 335.

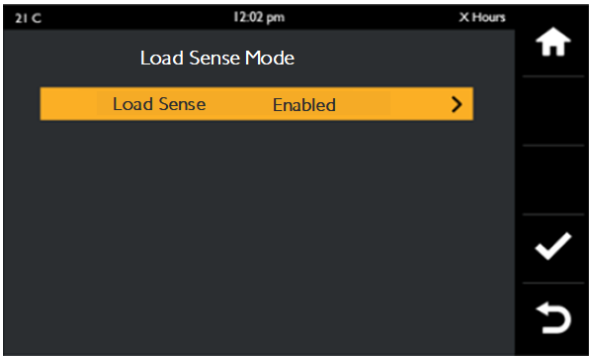


Setting the Load Sense Mode

Note: The load sense mode is only to be used to carry out structural overload testing, with no operators in the platform.

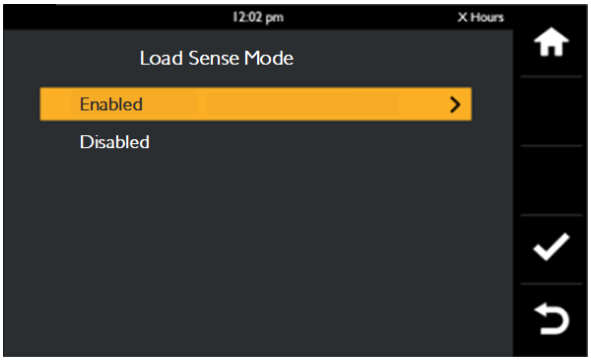
1. On the machine home page, select 'Machine control setup' to open 'Machine Settings'. Refer to Figure 317.
2. Use the Up/Down scroll icon to choose 'Load sense mode' in the menu, and click select icon. Refer to Figure 324.

Figure 336.



3. Use the Up/Down scroll icon to enable or disable the load sense mode.

Figure 337.



4. Use the select icon to confirm and save the desired setting.
5. When 'Disabled' is selected, 'Load Sense Disabled' will be displayed on the screen.

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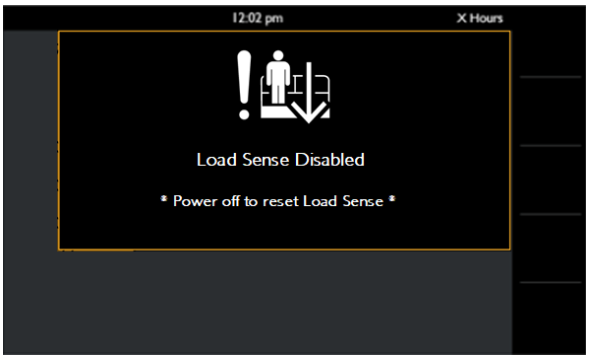
Figure 338.



Setting the Emergency Override Reset

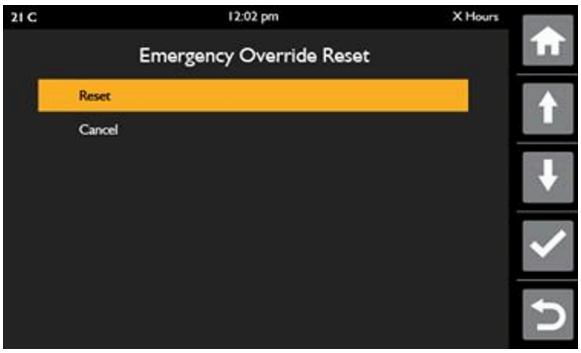
1. On the machine home page, select 'Machine control setup' to open 'Machine Settings'. Refer to Figure 317.
2. Use the Up/Down scroll icon to choose 'Emergency override reset' in the menu, and click select icon. Refer to Figure 324.
3. Use the Up/Down scroll icon to select 'Required' or 'Not Required' status.

Figure 339.

Figure 340.

4. Use the select icon to confirm and save the desired setting.

Figure 341.

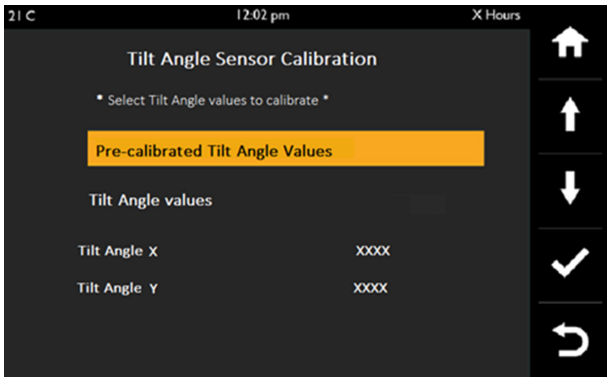


Tilt Angle Sensor Calibration

1. Park the machine on firm, level ground in specified angle for each required direction.

   Angle: 0°
2. On the machine home page, select 'Machine control setup' to open 'Machine Settings'. Refer to Figure 317.
3. Use the Up/Down scroll icon to choose 'Tilt Angle Sensor Calibration' in the menu, and click select icon. Refer to Figure 324.
4. The 'Tilt Angle Sensor Calibration' screen appears which displays the 'Pre-calibrated Tilt Angle Values'.

Figure 342.



   4.1. The specified preset values for 'Tilt Angle X' and 'Tilt Angle Y' will appear on the screen.

   Angle: 0°
5. Select 'Calibrate' from the drop-down menu of the 'Tilt Angle values' field.

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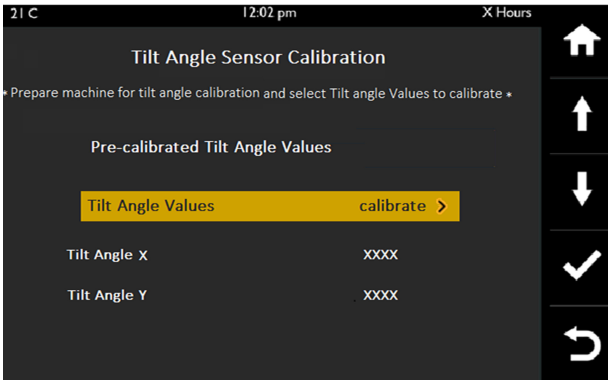
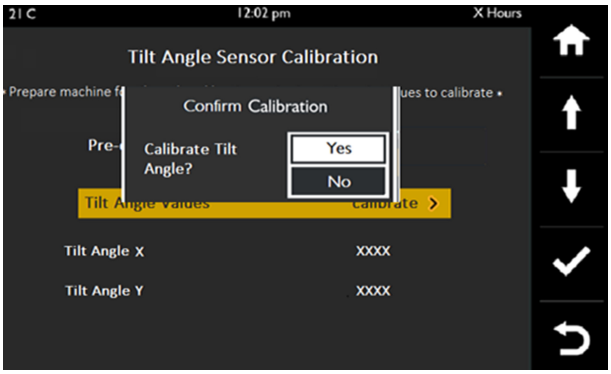
Figure 343.



6. The 'Confirm Calibration' screen appears.

Figure 344.

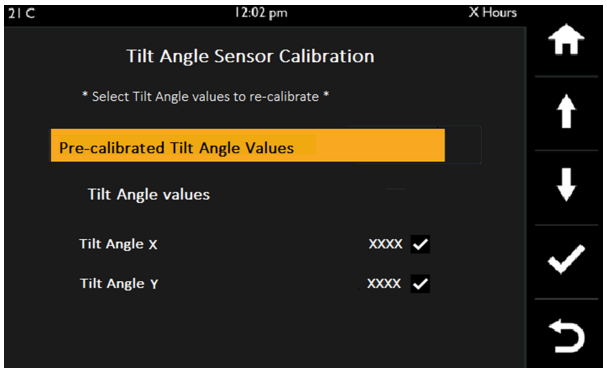


6.1. If the operator selects 'Yes' for 'Calibrate Tilt Angle?' field, it will save the live values of the 'Tilt Angle X' and 'Tilt Angle Y' in order to proceed with the calibration and go to step 7.

6.2. If the operator selects 'No' for 'Calibrate Tilt Angle?' field, the screen will return to 'Pre-calibrated Tilt Angle Values'. Refer to step4

7. The newly set 'Tilt Angle X' and 'Tilt Angle Y' values will appear on the screen with the 'Tick' mark.

Figure 345.



8. If the tilt angle calibrated set acknowledge message is not received within the specified duration, then the display shows 'Cross' mark.

   Duration: 4s

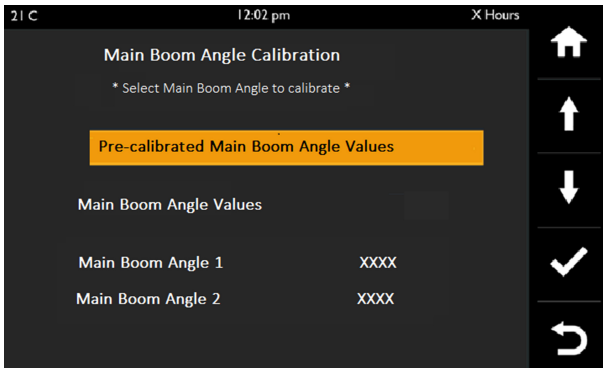
Main Boom Angle Sensor Calibration

1. On the machine home page, select 'Machine control setup' to open 'Machine Settings'. Refer to Figure 317.

2. Use the Up/Down scroll icon to choose 'Main Boom Angle Calibration' in the menu, and click select icon. Refer to Figure 324.

3. The 'Main Boom Angle Sensor Calibration' screen appears which displays the 'Pre-calibrated Main Boom Angle Values'.

Figure 346.

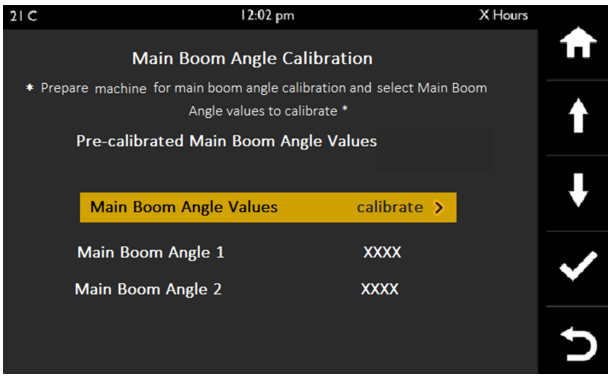


3.1. The specified preset values for 'Main Boom Angle 1' and 'Main Boom Angle 2' will appear on the screen.

   Angle: 0°

4. Select 'Calibrate' from the drop-down menu of the 'Main Boom Angle values' field.

Figure 347.



5. The 'Confirm Calibration' screen appears.

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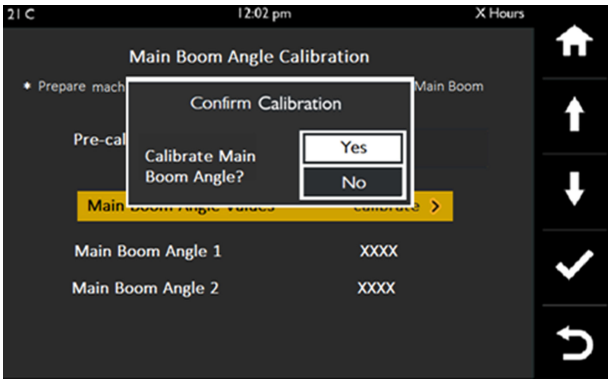
Figure 348.

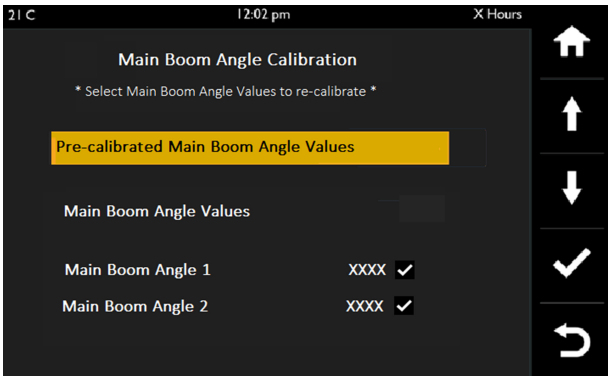


5.1. If the operator selects 'Yes' for 'Calibrate Main Boom Angle?' field, it will save the live values of the 'Main Boom Angle 1' and 'Main Boom Angle 2' in order to proceed with the calibration and go to step 6

5.2. If the operator selects 'No' for 'Calibrate Main Boom Angle?' field, the screen will return to 'Pre-calibrated Main Boom Angle Values'. Refer to step 3.

6. The newly set 'Main Boom Angle 1' and 'Main Boom Angle 2' values will appear on the screen with the 'Tick' mark.

Figure 349.



7. If the main boom angle calibrated set acknowledge message is not received within the specified duration, then the display shows 'Cross' mark.

   Duration: 4s

Telescopic Boom Length Calibration

Telescopic Boom Length Calibration - Retract

1. On the machine home page, select 'Machine control setup' to open 'Machine Settings'. Refer to Figure 317.

2. Use the Up/Down scroll icon to choose 'Telescopic Boom Length Calibration' in the menu, and click select icon. Refer to Figure 324.

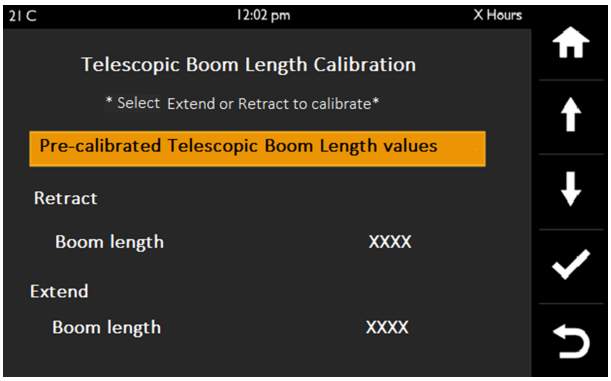
3. The 'Telescopic Boom Length Calibration' screen appears which displays the 'Pre-calibrated telescopic boom length Values'.

   3.1. The specified preset values for 'Telescopic Boom Length Retracted' and 'Telescopic Boom Length Extended' will appear on the screen.

   Angle: 0°

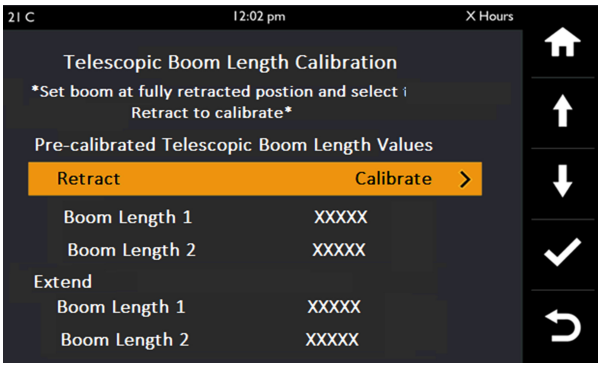
4. Select 'Calibrate' from the drop-down menu of the 'Retract' field.

Figure 350.



5. The 'Confirm Calibration' screen appears.

Figure 351.



5.1. If the operator selects 'Yes' for 'Calibrate Tele. boom length?' field, it will save the live values of the 'Tele. boom length 1' and 'Tele. boom length 2' in order to proceed with the calibration and go to step 6.

5.2. If the operator selects 'No' for 'Calibrate Tele. boom length?' field, the screen will return to 'Pre-calibrated Telescopic Boom Length Values'. Refer to step 3.

6. The newly set 'Tele. boom length 1' and 'Tele. boom length 2' values for telescopic boom length retract will appear on the screen with the 'Tick' mark.

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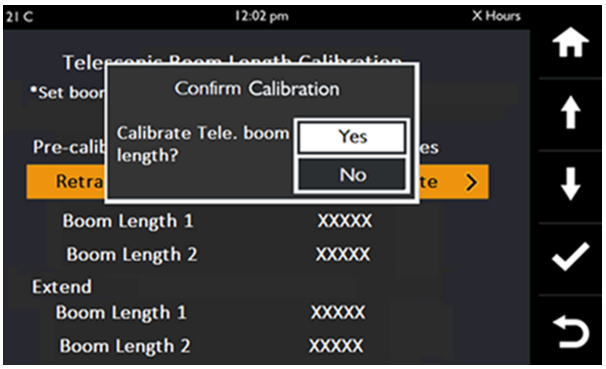
Figure 352.



7. If the telescopic boom length calibrated set acknowledge message is not received within the specified duration, then the display shows 'Cross' mark.

   Duration: 4s

Telescopic Boom Length Calibration - Extend

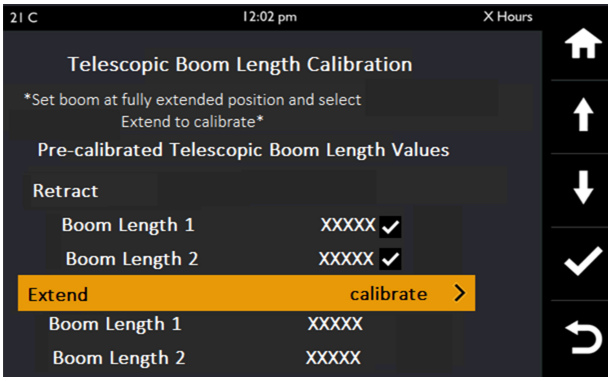
1. On the machine home page, select 'Machine control setup' to open 'Machine Settings'. Refer to Figure 317.
2. Use the Up/Down scroll icon to choose 'Telescopic Boom Length Calibration' in the menu, and click select icon. Refer to Figure 324.
3. The 'Telescopic Boom Length Calibration' screen appears which displays the 'Pre-calibrated telescopic boom length Values'.

   3.1. The specified preset values for 'Telescopic Boom Length Retracted' and 'Telescopic Boom Length Extended' will appear on the screen.

   Angle: 0°

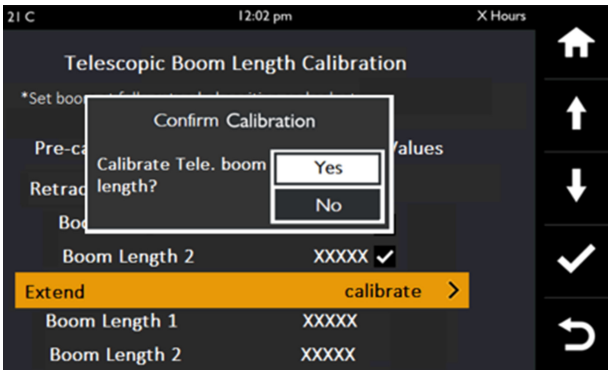
4. Select 'Calibrate' from the drop-down menu of the 'Extend' field.

Figure 353.



5. The 'Confirm Calibration' screen appears.

Figure 354.

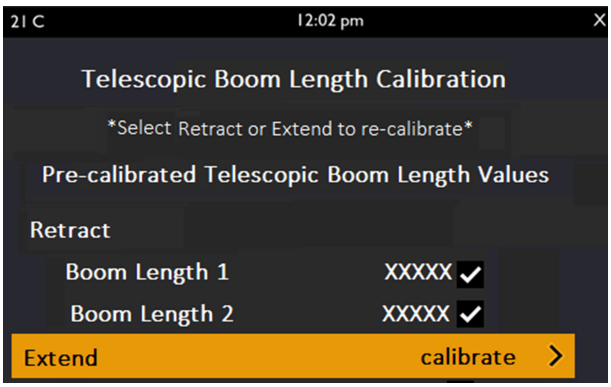


   5.1. If the operator selects 'Yes' for 'Calibrate Tele. boom length?' field, it will save the live values of the 'Tele. boom length 1' and 'Tele. boom length 2' in order to proceed with the calibration and go to step 6.

   5.2. If the operator selects 'No' for 'Calibrate Tele. boom length?' field, the screen will return to 'Pre-calibrated Telescopic Boom Length Values'. Refer to step 3.

6. The newly set 'Tele. boom length 1' and 'Tele. boom length 2' values for telescopic boom length extend will appear on the screen with the 'Tick' mark.

Figure 355.



7. If the telescopic boom length calibrated set acknowledge message is not received within the specified duration, then the display shows 'Cross' mark.

   Duration: 4s

Base Information

The base information menu will allow the user to diagnose the potential faults using the help file or contact remote technical support. Refer to Figure 317.

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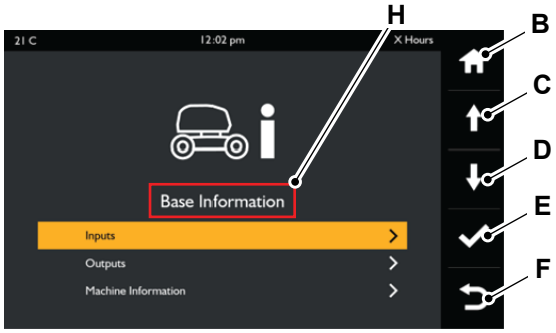
1. On the machine home page, select 'Base information' to open base information menu. Refer to Figure 317.

2. Use the Up/Down scroll icon to choose the desired settings, and click select icon.

Figure 356.



B Home page icon
C Up scroll icon
D Down scroll icon
E Select icon
F Return icon
H Base information

Base Inputs

The 'Base Inputs' menu provides information about all the function and sensor inputs to the base ECU (Electronic Control Unit).

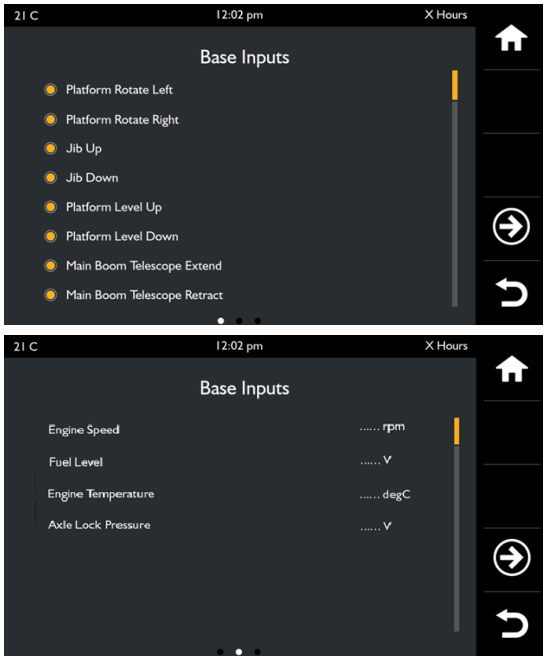
If selected, a solid bullet is shown.

If not selected, an empty bullet is shown.

The items that are shown on the display screen are as follows:

- Platform rotate left
- Platform rotate right
- Jib up
- Jib down
- Platform level up
- Platform level down
- Main boom telescopic extend
- Main boom telescopic retract
- Main boom up
- Main boom down
- Slew left switch
- Slew right switch
- Platform enable switch
- Base enable switch
- Emergency stop positive
- Emergency stop negative
- Engine start
- Horn
- Override un-pressed contact
- Override pressed contact
- Main boom lower limit switch - 1
- Main boom lower limit switch - 2
- Slew position limit switch - 1
- Slew position limit switch - 2
- Blocked air filter sensor
- Axle lock pressure
- Tilt sensor
- Engine alternator
- Engine speed (RPM)
- Fuel level
- Engine temperature
- Axle lock pressure (V)
- Water in fuel
- Coolant level switch
- Main boom angle filtered 1 (CAN signal)
- Main boom angle filtered 2 (CAN signal)
- Telescopic boom length filtered retracted (CAN signal)
- Telescopic boom length filtered extended (CAN signal)
- Rope switch 1 (digital i/p)
- Rope switch 2 (digital i/p)
- Tilt angle filtered X (CAN signal)
- Tilt angle filtered Y (CAN signal)

Figure 357.



Base Outputs

The 'Base Outputs' menu provides information about all the function outputs to the base ECU.

If selected, a solid JCB yellow indicator will represent all the states of the machine functions.

If not selected, a blank or empty indicator will represent all the states of the machine functions.

The items that are shown on the display screen are as follows:

- Public

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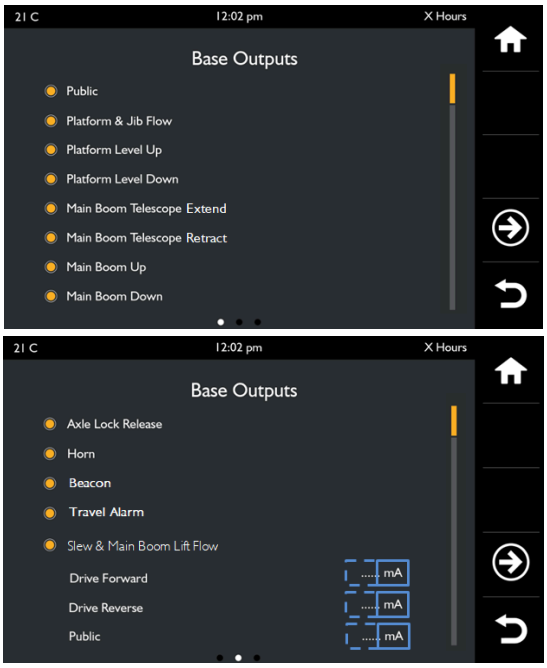
- Jib up and platform rotate right flow
- Jib down and platform rotate left flow
- Platform and jib flow
- Platform level up
- Platform level down
- Main boom telescope extend
- Main boom telescope retract
- Main boom up
- Main boom down
- Slew left
- Slew right
- Drive forward
- Drive reverse
- Steer left
- Steer right
- Auxiliary pump
- Hydraulic generator
- Engine ignition
- Base buzzer
- Engine crank
- High / Low drive torque
- Front brake release
- Rear brake release
- Axle lock release
- Horn
- Beacon
- Beacon - 2
- Travel alarm
- Slew left (mA)
- Slew right (mA)
- Drive forward (mA)
- Drive reverse (mA)
- Main boom raise (mA)
- Main boom lower (mA)
- Powertrain ignition
- Glow plug
- Front brake outputs
- Rear brake outputs

Figure 358.

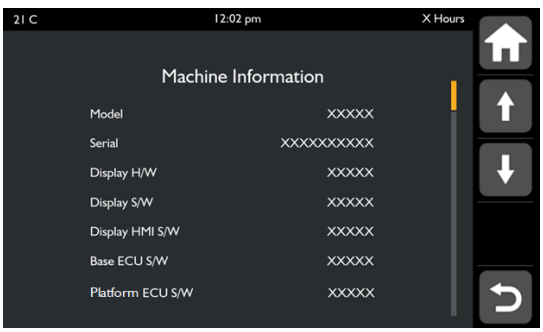


Machine Information

The 'Machine Information' screen displays following information:

- Machine model
- Machine VIN (serial) number
- Base display hardware revision
- Base display software revision
- Base display HMI (Human- Machine Interface) software
- Platform display hardware revision
- Platform display software revision
- Base ECU software version
- Platform ECU software
- Engine ECU software
- Machine hours
- Engine hours

Figure 359.



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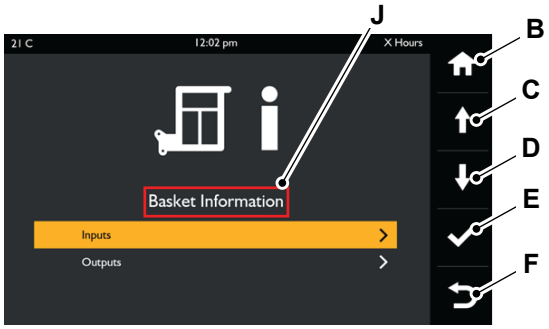
Platform Information

The platform information menu allows the user to diagnose the potential faults using the help file or contact remote technical support.

1. On the machine home page, select 'Platform information' to open 'Basket Information' menu. Refer to Figure 317.

2. Use the Up/Down scroll icon to choose the desired settings for 'Basket Information', and click select icon.

Figure 360.



B Home page icon
C Up scroll icon
D Down scroll icon
E Select icon
F Return icon
J Basket information

Platform Inputs

The 'Platform Inputs' menu provides information about all the function and sensor inputs to the platform ECU.

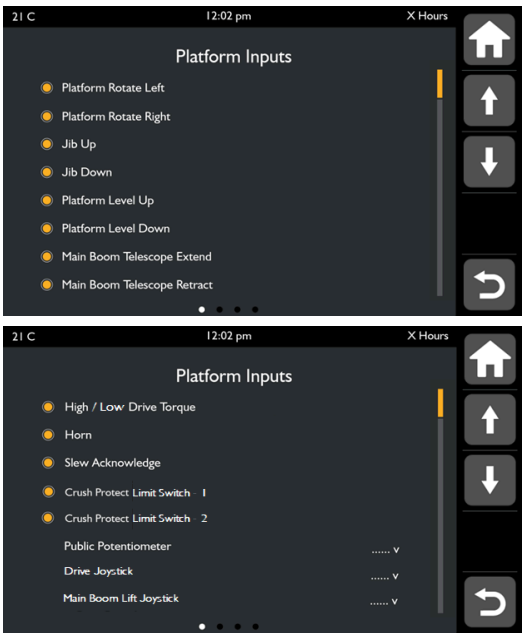
If selected, a solid bullet is shown.

If not selected, an empty bullet is shown.

The items that are shown on the display screen are as follows:

- Platform rotate left
- Platform rotate right
- Jib up
- Jib down
- Platform level up
- Platform level down
- Main boom telescope extend
- Main boom telescope retract
- Main boom up
- Main boom down
- Slew left
- Slew right
- Foot pedal
- Auxiliary pump
- Drive forward (Digital)
- Drive reverse (Digital)
- Steer left
- Steer right
- Emergency stop positive
- Emergency stop negative
- Engine start
- High engine speed
- Horn
- Slew acknowledge
- Crush protection limit switch - 1
- Crush protection limit switch - 2
- Speed potentiometer
- Drive joystick
- Main boom lift joystick
- Slew joystick
- Load sensor channel 1 (mA)
- Load sensor channel 1 (%)
- Load sensor channel 2 (mA)
- Load sensor channel 2 (%)

Figure 361.



Platform Outputs

The 'Platform Outputs' menu provides information about all the function outputs to the platform ECU.

If selected, a solid bullet is shown.

If not selected, an empty bullet is shown.

The items that are shown on the display screen are as follows:

- Platform rotate
- Fault light
- Tilt alarm light
- Overload alarm light
- Low fuel light
- Slew acknowledge light
- Platform buzzer

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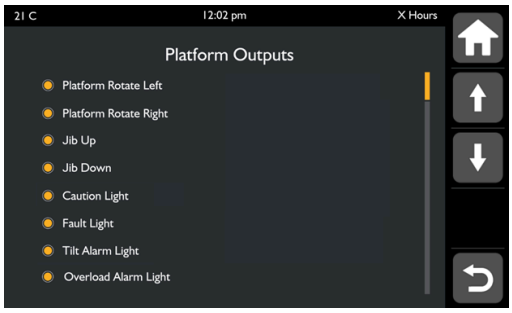
- Glow plug

Figure 362.

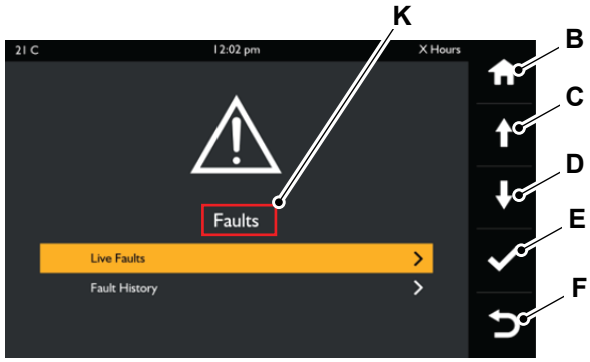


Alarm Information

The 'Alarm Information' menu contains details of any faults, present or historical that has occur on the machine.

1. On the machine home page, select 'Alarm information' to open the faults menu. Refer to Figure 317.
2. Use the Up/Down scroll icon to choose the desired settings for 'Faults', and click select icon.

Figure 363.



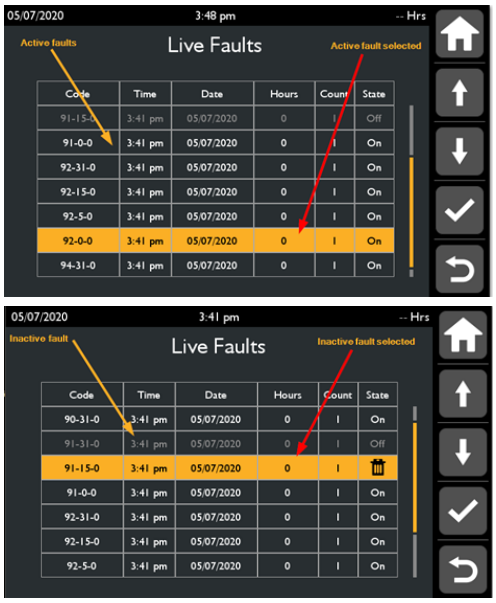
B Home page icon
C Up scroll icon
D Down scroll icon
E Select icon
F Return icon
K Faults

Live Faults

The 'Live Faults' menu shows all the live faults flagged by the base control unit in the current key cycle.

- JCB fault code
- Time
- Date
- Machine hours
- Count
- State

Figure 364.



An active fault entry should be created when a DTC (Diagnostic Trouble Code) listed in the application fault table becomes active.

It is possible for the operator to remove previously active faults from the active fault list by selecting the fault and pressing the enter.

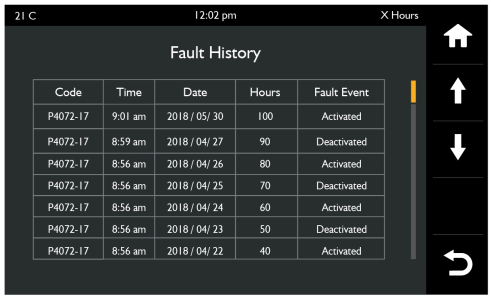
If the number of faults exceeds what can be shown on a single screen, the user shall have the ability to scroll through the faults.

Fault History

The fault history menu will display all the historic faults flagged by the base control unit.

- JCB fault code
- Time
- Date
- Machine hours
- Fault event (Activated / Deactivated)

Figure 365.



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Check (Operation)

Base Control Functional Test

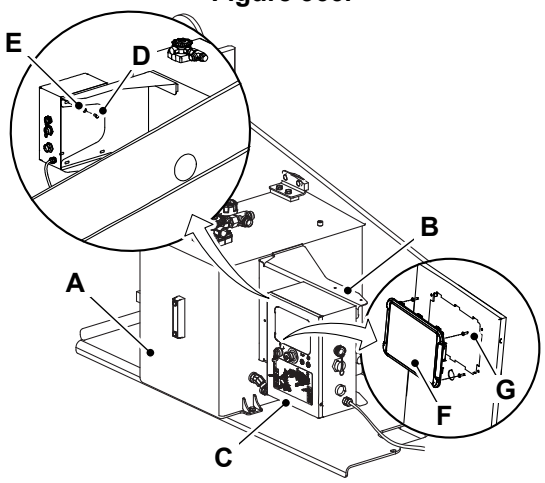
1. Make the machine safe with the platform lowered.
   Refer to: PIL 01-03-27.
2. Release the platform emergency stop switch.
3. Release the base emergency stop switch.
4. Turn the ignition key to ON position and do the following.
   4.1. Make sure that all the base controls operate normally. Refer to Operator's manual.
5. Turn the ignition key to the OFF position.

Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Get access to the base control panel.
3. Disconnect the wiring harnesses and connector.
4. Remove the washer (x4) and setscrew (x4) from the control panel support plate.
5. Remove the base control panel.
6. Remove the head screw (x4).
7. Remove the turntable display from the base control panel.

Figure 366.



A Hydraulic tank
B Control panel support plate
C Base control panel
D Washer (x4)
E Setscrew (x4)
F Turntable display
G Head screw (x4)

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Tighten the setscrew (x4) and head screw (x4) to the specified torque value. Refer to Table 159.

Table 159. Torque Values

Item	Nm
E	43
G	1.5

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05 - Platform Controller

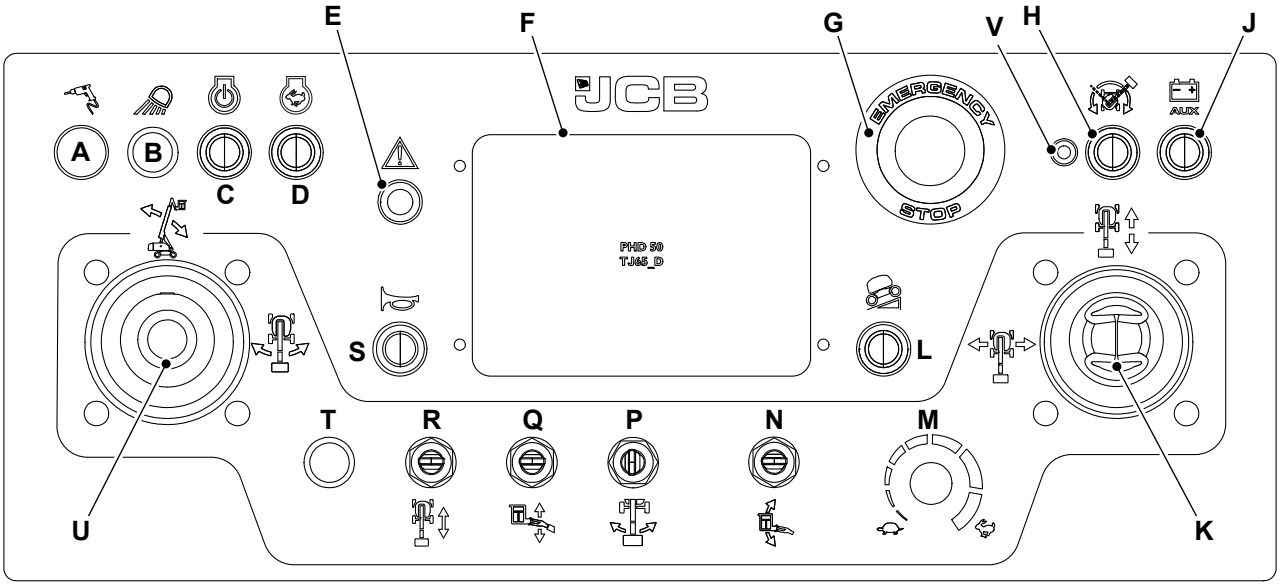
Introduction 33-133
Check (Operation) 33-136
Remove and Install 33-136

Introduction

Platform Control Panel

⚠ **WARNING** Do not drive the machine with the platform raised except on smooth, firm and level surface free of obstructions and pot holes.

Figure 367.



A Hydraulic generator ON/OFF button (if installed)
B Work lights ON/OFF switch (if installed)
C Engine start/stop button
D Engine high/low speed select button
E Error indicator
F Display
G Emergency stop button
H Slew acknowledgement button
J Auxiliary power button
K Drive and steer joystick
L High torque button
M Potentiometer
N Manual platform level switch
P Platform rotate switch
Q Jib boom up/down switch
R Telescope in/out function switch
S Horn button
T Spare
U Main boom lift and slew joystick
V Slew acknowledge LED (Light Emitting Diode) indicator

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Platform Control Display

Figure 368.

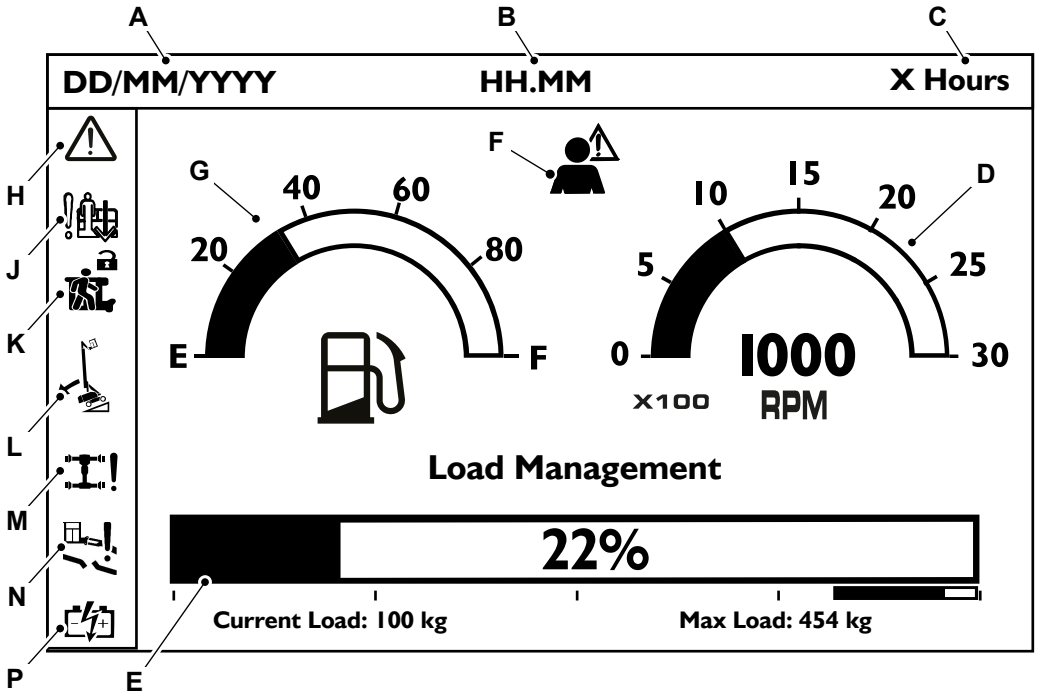

Table 160.

Callout	Indicator	Description
A	Date	Displays current date.
B	Time	Displays current time.
C	Machine hours	Displays machine running hours.
D	Engine speed indicator	Displays the engine RPM (Revolutions Per Minute).
E	Load management indicator	Displays the amount of load machine is carrying in percentage.
F	Operator error or caution alarm	Appears when machine is operated outside the limits.
G	Battery charging level indicator	Displays the battery level in percentage.
H	Fault indicator	Displays when there is a fault on the machine.
J	Emergency override	Displays when emergency override has been activated.
K	Secondary guarding	Displays when the platform secondary guarding is in active condition.
L	Tilt limit exceeded	Displays when machine tilt limit is exceeded. Solid lamp if the machine is stowed. Flashing lamp if the machine is raised.
M	Powertrain fault lamp	Displays when there is a fault on the powertrain.
N	Wire rope break alarm	The icon flashes red and an audible alarm sounds when the wire rope is loose or broken, or when the boom sensor or wire rope is not correctly positioned.
P	Battery voltage warning	Displays when battery voltage is high/low.

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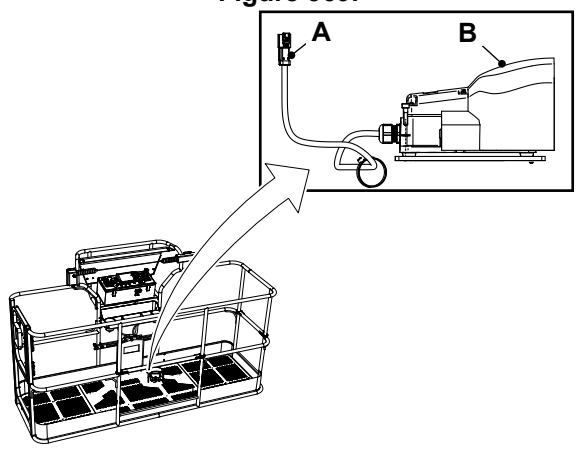
Foot Pedal

The foot pedal is located on the platform floor. When depressed and held, it activates the controls on the platform control console.

The platform control panel will deactivate if the foot pedal is held down for 10 seconds without using any of the controls. To reactivate the controls, release the foot pedal and press it down again.

Figure 369.



A Electrical connector
B Foot pedal

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Check (Operation)

Platform Control Functional Test

1. Make the machine safe with the platform lowered.
   Refer to: PIL 01-03-27.
2. Release the base and platform emergency stop buttons.
3. Turn the ignition key to the ON position and do the following.
   3.1. Make sure that all the platform controls operate normally. Refer to Operator's manual.
4. Turn the ignition key to the OFF position.

Foot Pedal Operation

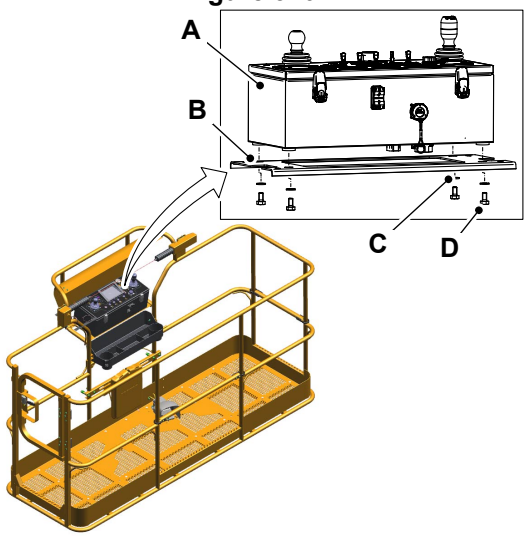
1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Turn the ignition key to the ON position.
3. Pull out the base and platform emergency stop buttons.
4. Press and hold the foot pedal.
5. Press the engine start/stop button and make sure that the engine does not start.
6. Release the foot pedal.
7. Start the engine.
8. Do not press down the foot pedal and operate the machine functions. Make sure that the machine functions are not performed.
9. Press and hold the foot pedal.
10. Operate the machine. Make sure that all the functions are performed normally.

Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Disconnect the electrical connector.
3. Remove the setscrew (x4) and washer (x4) from the mounting panel.
4. Remove the platform control panel from the platform.

Figure 370.



A Platform control panel
B Mounting panel
C Washer (x4)
D Setscrew (x4)

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Tighten the setscrew (x4) to the correct torque value.
   Torque: 43N·m

Foot Pedal

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Disconnect the electrical connector.
3. Remove the setscrew (x3) and nut (x3).
4. Remove the foot pedal from the platform.

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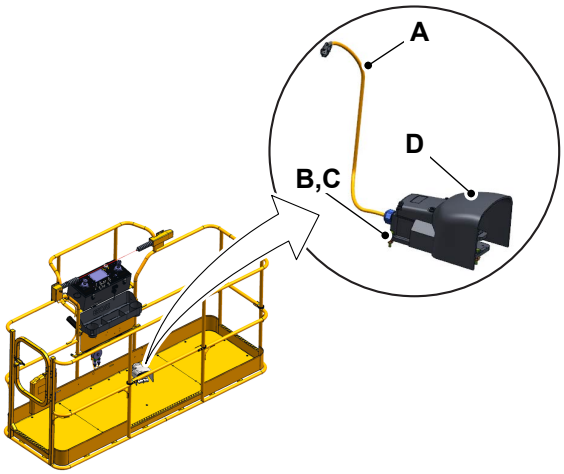
Figure 371.



A Electrical connector
B Setscrew (x3)
C Nut (x3)
D Foot pedal

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Tighten the setscrew (x3) to the specified torque value.

   Torque: 9N·m

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36 - Horn

00 - General

Introduction 33-138
Check (Operation) 33-139
Remove and Install 33-139

Introduction

The horn must be working correctly for safe machine operation.

The horn can be operated from the platform and base control panel. The horn is located under the turntable. An improperly functioning horn may prevent the operator from alerting the ground personnel of hazards or unsafe conditions.

Use the horn wherever necessary, particularly at blind corners.

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Check (Operation)

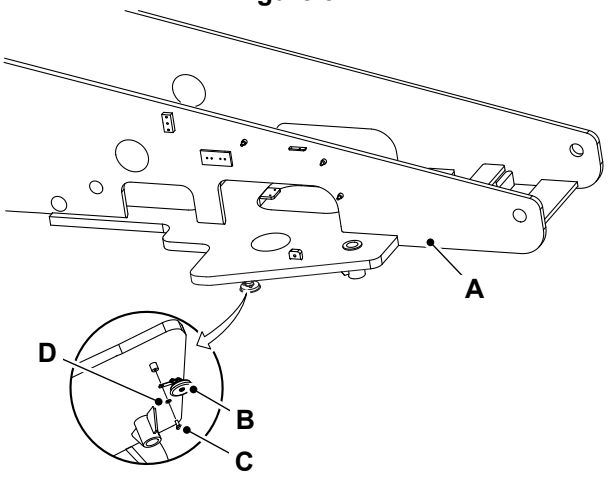
1. Pull out the red 'Emergency Stop button' to the ON position at both the base and platform control panel and turn the ignition key to the ON position.
2. Push down the horn button at the platform control panel. The horn should sound.
3. If the horn fails to sound, investigate further. Check the fuse, check the wiring, make sure that the horn is repaired or replaced before the machine is used again.

Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Isolate the battery.
   Refer to: PIL 33-03-00.
3. Open the hydraulic compartment cover.
   Refer to: PIL 06-06-09.
4. Disconnect the electrical connectors from the horn.
5. Remove the setscrew and washer from the turntable.
6. Remove the horn from the machine.

Figure 372.



A Turntable
B Horn
C Setscrew
D Washer

Install

1. The installation procedure is the opposite of the removal procedure.
2. Tighten the setscrew to the correct torque value.
   Torque: 43N·m

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45 - Control Module

00 - General

Introduction 33-140
Remove and Install 33-142

Introduction

Modern machines use ECU (Electronic Control Unit) to control machine systems such as hydraulics, transmission and engine. In much the same way as office computers can be ‘networked’ to communicate with each other the machine ECU’s can be ‘networked’. Some advantages of networking are:

- Improved more intelligent control systems.
- Service software tools can be used for fault finding and machine control set up.

The ECM (Engine Control Module) can communicate with other machine ECU using a CANbus network system.

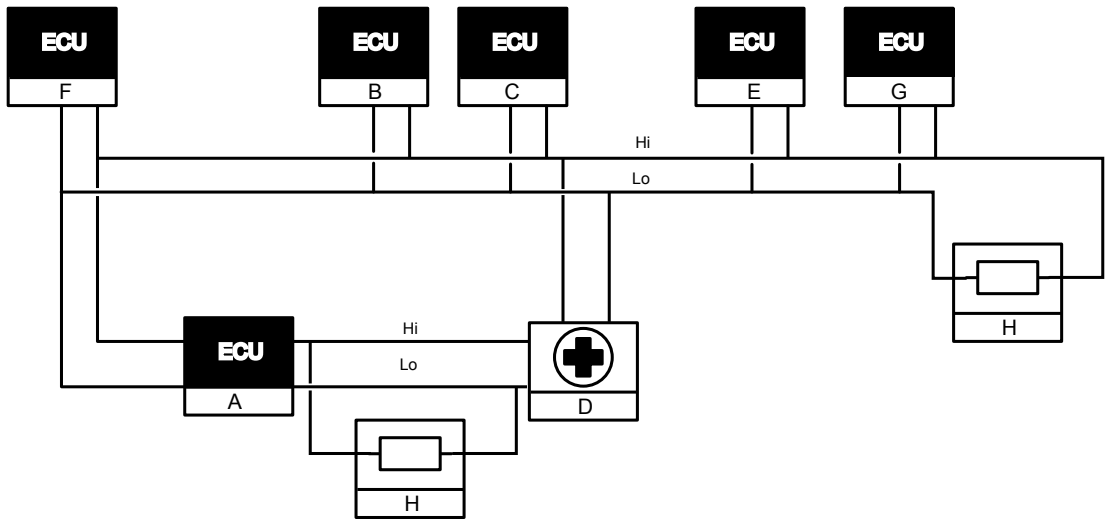
CANbus Communications System

CAN (Controller Area Network) is an electronic communications system that connects all the machine ECU to one pair of data wires, this is called the CANbus. Coded data is sent to and from the ECU on the CANbus. By connecting Servicemaster diagnostic software to the CANbus, data is seen and decoded for use by a service engineer.

CANbus System Schematic

A typical CANbus system architecture is shown for illustration purposes only below: Refer to Figure 373.

Figure 373. Typical CANbus architecture



The CAN architecture may differ on your machine. Refer to: PIL 33-00-50.

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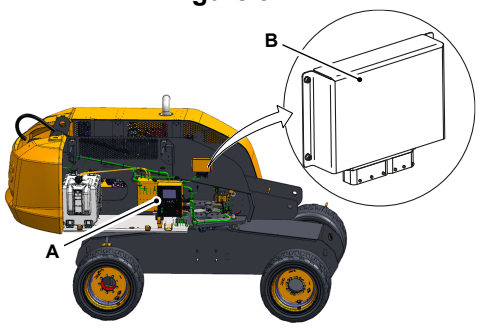
This machine is fitted with base control and platform control ECU's.

Base Control ECU

The base control ECU is fitted at machine base behind base control panel. Refer to Figure 374.

Figure 374.

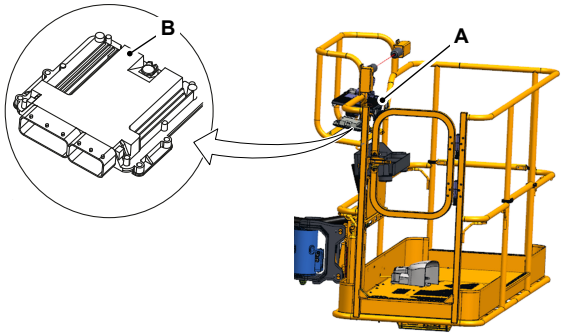


A Base control panel
B Base control ECU

Platform Control ECU

Platform control ECU is fitted at platform control panel. Refer to Figure 375.

Figure 375.



A Platform control panel
B Platform control ECU

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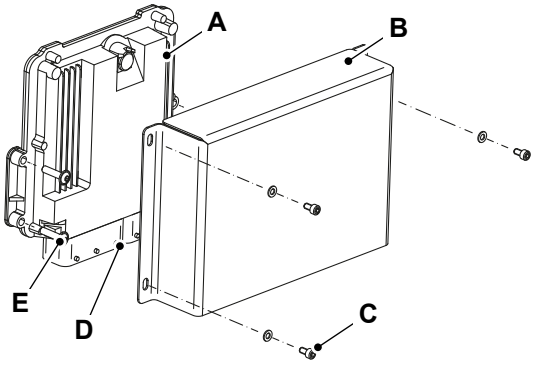
Remove and Install

Base Control ECU

Remove

1. Make the machine safe.
   Refer to: PIL 01-03.
2. Disconnect the battery.
3. Remove the cap screws (x3) and ECU (Electronic Control Unit) cover.
4. Disconnect the electrical connectors.
5. Remove screws (x4).
6. Remove the base control ECU.

Figure 376. Base Control ECU



A Base control ECU
B ECU cover
C Cap screws (x3)
D Electric connector point
E Screws (x4)

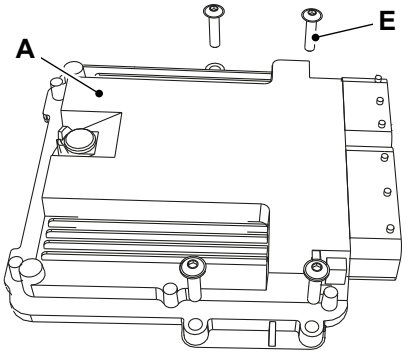
Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following step.
2. Make sure that the base control ECU is configured correctly before you operate the machine. Use the correct Servicemaster set-up tool.
3. Torque tighten the cap screws and screws to specified torque values. Refer to Table 161.

Platform Control ECU

1. Make the machine safe.
   Refer to: PIL 01-03.
2. Disconnect the battery.
3. Remove the platform control cover plate.
4. Disconnect the electrical connectors.
5. Remove screws (x4).
6. Remove the platform control ECU.

Figure 377. Platform Control ECU



A Platform control ECU
E Screws (x4)

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following step.
2. Make sure that the platform control ECU is configured correctly before you operate the machine. Use the correct Servicemaster set-up tool.
3. Torque tighten the cap screws and screws to specified torque values. Refer to Table 161.

Table 161. Torque Values

Item	Nm
C	8.8
E	9

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30 - LiveLink

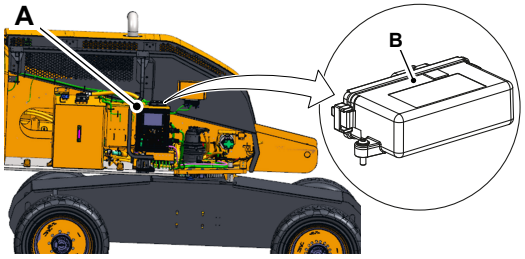
Introduction 33-143
Remove and Install 33-144

Introduction

Optional

The Livelink ECU (Electronic Control Unit) is located on panel mounting bracket behind base control panel.

Figure 378.



A Base control panel
B LiveLink ECU

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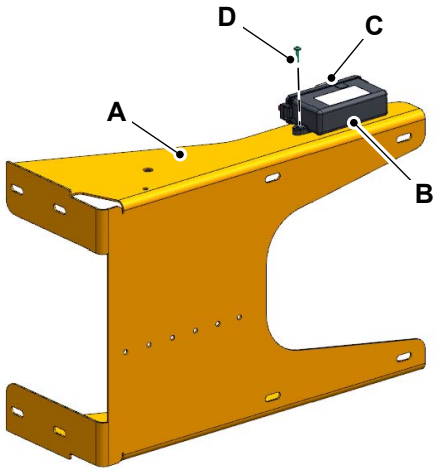
Remove and Install

Optional

Remove

1. Make the machine safe.
2. Disconnect the battery with the isolator switch.
3. Access the LiveLink ECU (Electronic Control Unit).
4. Disconnect the electrical connectors from the LiveLink ECU.

Figure 379.



A Control panel support plate
B LiveLink ECU
C Electrical connection port
D Screws (x2)

5. Remove the screw (x2) from the control panel support plate.
6. Remove the LiveLink ECU.

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Make sure that the LiveLink ECU is configured correctly before you operate the machine. Use the correct Servicemaster set-up tool.
3. Tighten the screws to specified torque value.

   Torque: 2N·m

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57 - Electronic Diagnostic

03 - Servicemaster

Introduction 33-145
Technical Data 33-148
Preparation 33-148
Disconnect and Connect 33-155

Introduction

JCB Servicemaster is an application to allow engineers to diagnose and setup the various electronic control units within the JCB product range. The tools comprise of a front end generic user interface that allows the user to select the machine which they wish to work on as well as a number of various tools which allow:

- Programming electronic control units
- Diagnosing electronic issues
- Setup of various options
- Checking the service history of the machine.

JCB Servicemaster is updated on a monthly basis by incorporating Web Update. This is a program which works alongside Servicemaster to let the user know and allow them to download an update as and when it becomes available.

JCB Servicemaster software is for use with Microsoft Windows and a laptop personal computer. The laptop computer is connected to the machine diagnostic socket using special cables and an adaptor commonly referred to as DLA (Data Link Adaptor). A second generation DLA 2.0 has been launched and operates in essentially the same way as the original DLA. There are a couple of slight differences to the DLA 2.0. Refer to system information bulletin SI044 for more details.

Use Servicemaster software to:

- Display data from a machine ECU (Electronic Control Unit)
- Change data stored in a ECU

Servicemaster software communicates with the machine ECM (Engine Control Module) using the CAN (Controller Area Network)bus, refer to Control Modules (PIL 33-45).

Diagnostics Tool - User Guide

Introduction

The diagnostics software tool is part of the JCB Servicemaster software suite. The diagnostics software is designed to be an easy to use fault finding tool.

Connecting the Diagnostics

To use Diagnostics your laptop computer must be connected to the machine CAN bus.

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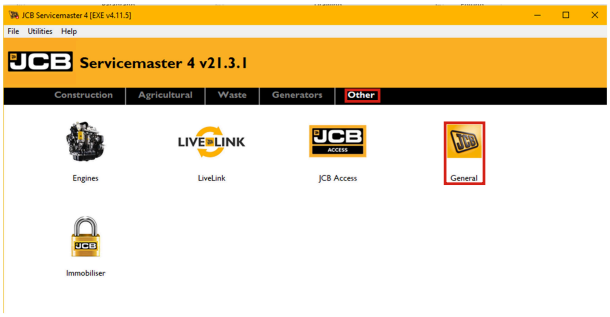
Starting the Diagnostics

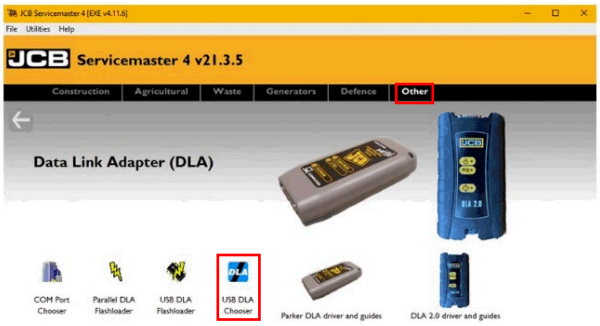
1. Turn ON the machine ignition and additionally start the engine if required (taking normal precautions).
2. Run JCB Servicemaster as administrator on the laptop computer.

Figure 380.



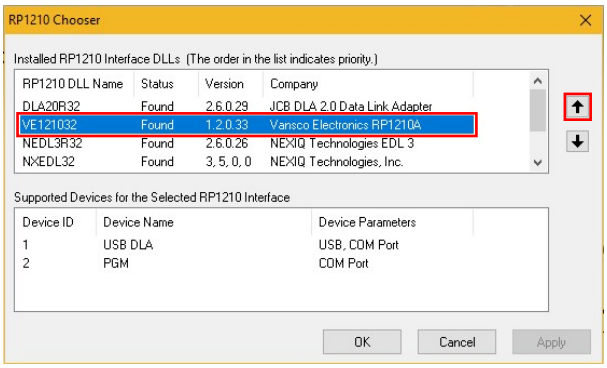
3. In Servicemaster go to “Other>General>DLA”.
   3.1. Left click on “USB DLA Chooser”.

Figure 381.



4. A new window will open. Refer to Figure 382.
   4.1. Make sure the sequence is correct based on the DLA you are using to plug in. The driver for the DLA in use should be on the top.
   4.2. Use arrows on the right side of the window to move the desired driver to move at the top.
   4.3. Click “Apply” and then click on “Ok”.

Figure 382.



Flashloader Tool-User Guide

The Flashloader software tool is part of the JCB Servicemaster software suite. If the ECU is replaced and the data file in its flash memory is not applicable it will be necessary to flash the ECU memory with the correct data file. The Flashloader software tool can be used to access the data file name currently loaded in the ECU memory and is necessary upload a new data file to the ECU.

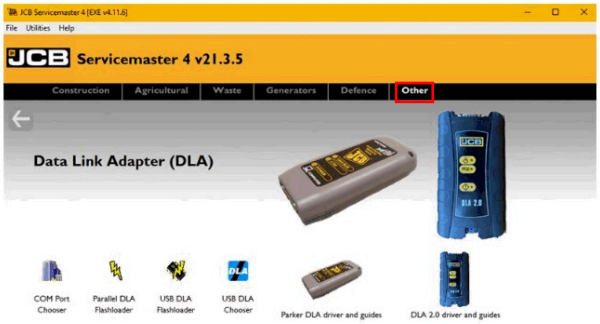
Connecting Flash Loader

To use Flashloader your laptop computer must be connected to the machine CANbus.

Starting Flashloader

1. Turn ON the machine ignition but DO NOT start the engine.
2. Start JCB Servicemaster on the laptop computer.

Figure 383.



3. Make sure that the correct DLA is selected in the chooser. Go to Other>General>DLA>USB DLA Chooser. The DLA Chooser window opens. Make sure the sequence is correct based on the DLA you are using to plug in. The driver for the DLA in use should be on the top. Use arrows on the right side of the window to move the desired driver to move at the top.

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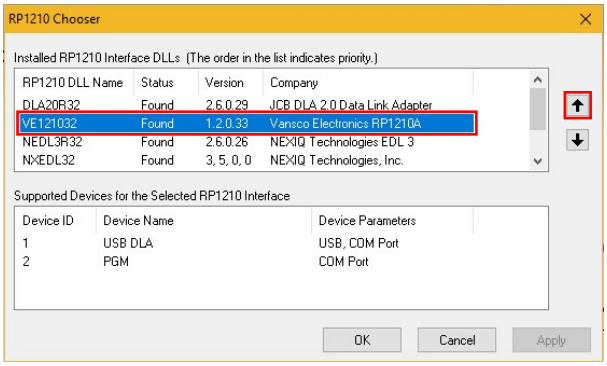
4. Click “Apply” and then click on “Ok”. Refer to Figure 384.

Figure 384.



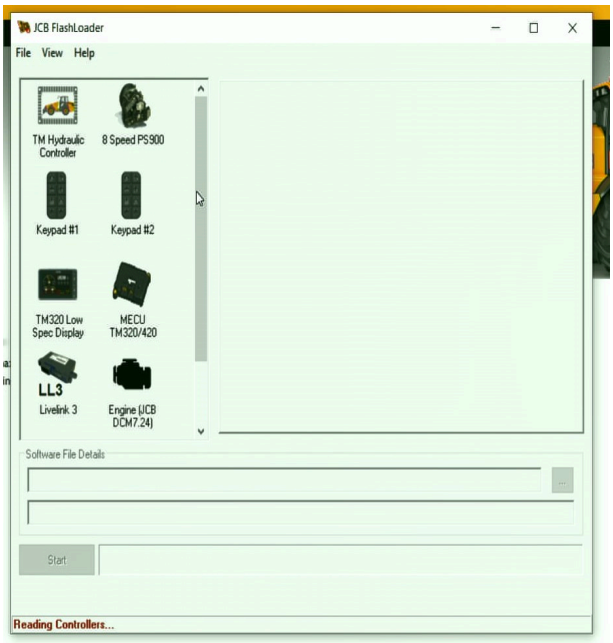
Using Flashloader

1. Make sure that the machine ignition switch is set to ON but do not start the engine.
2. Click on the flashloader icon. Refer to Figure 385.

Figure 385.

3. Click on the ECU icon.
4. Click on the Browse button and select the correct data file. Click Open.

Figure 386. Typical



5. Click on the Start button. A confirmation window will appear. Click on the Yes to start the reprogramming of the ECU. The progress bar is displayed.
6. When the programming is complete, switch the machine ignition to the OFF position.
7. Before starting the machine make sure that the machine setup data is correct. You must check that all other relevant machine settings are correctly configured. Use the setup software tool.

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Technical Data

Refer to Electrical System, Electronic Diagnostic, Fault Codes.
Refer to: PIL 33-57-90.

Preparation

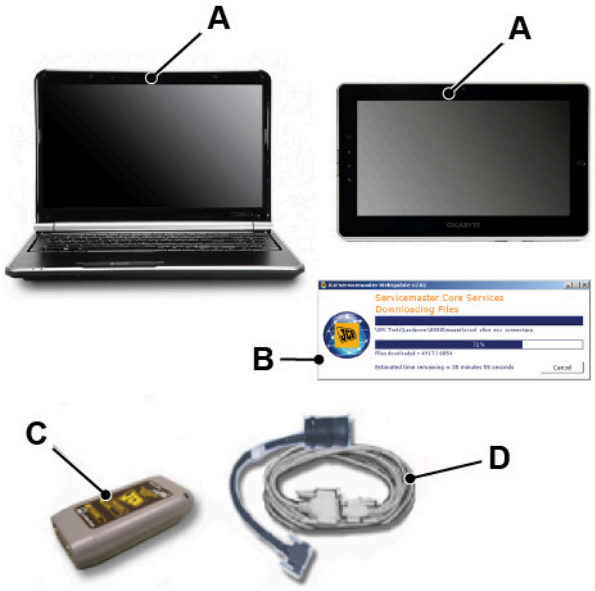
Set-up Servicemaster

The procedures below describe how to set up Servicemaster for USB (Universal Serial Bus) compatible equipment. There are other procedures and options. These are described in detail in the Servicemaster help files.

Before you start Servicemaster set up procedure make sure that you have the following:

1 A Microsoft Windows compatible laptop computer with a USB port. Refer to Figure 387.
   a Make a note that Servicemaster can be tested on Windows 10 only.
2 The latest Servicemaster software (internet connection for web updates). Refer to Figure 387.
3 A JCB compatible DLA (Data Link Adaptor). Refer to Figure 387.
4 The correct connection cables. Refer to Figure 387.
   a Do not connect any cables to the laptop, DLA or machine at this time.

Figure 387.



A Laptop computer
B Servicemaster software
C DLA
D Connection cables

JCB Servicemaster Web Update - New Installation

Once you install JCB Servicemaster on your laptop/PC you will need to keep it updated. JCB

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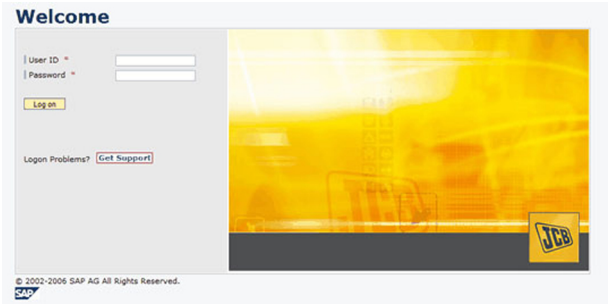
Servicemaster is updated through the "JCB Web Update" program. Do the below steps to download and install the JCB web update.

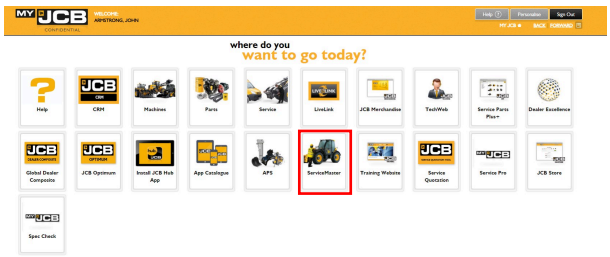
1. Use the web address www.business.jcb.com to install JCB web update.
2. A web page will open on the screen. Refer to Figure 388.

Figure 388.



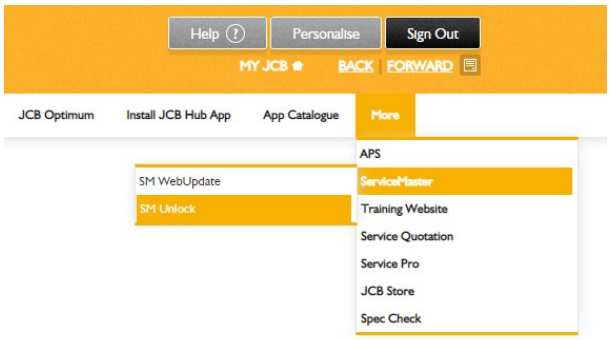
3. If you do not already have a User ID and Password, click the "Get Support" option.
   3.1. Apply for an account to get access to JDS (JCB Distribution System) and SPP (Service Parts Pro).
4. Once you are logged in, you will find Servicemaster icon on the screen.
   4.1. Click the "Servicemaster" icon.

Figure 389.



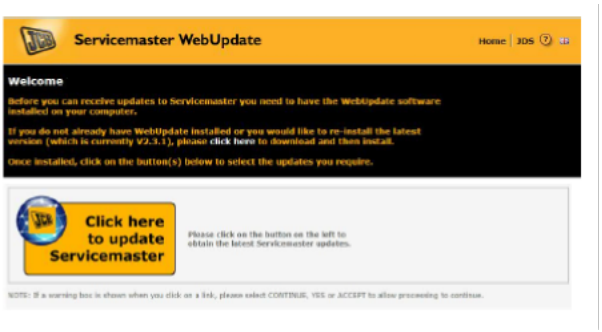
5. Go to More>ServiceMaster>SM WebUpdate.

Figure 390.



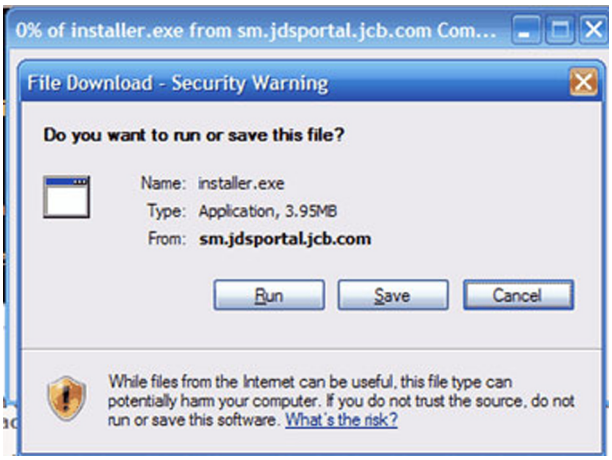
6. A new "Servicemaster Web Update" screen will open. Refer to Figure 391.

Figure 391.



   6.1. Click the "click here" link which is the orange colour text sentence to download JCB web update.
7. A new "File Download - Security Warning" window will appear on the screen. Refer to Figure 392.
   7.1. Click the "Run" option to start download.

Figure 392.



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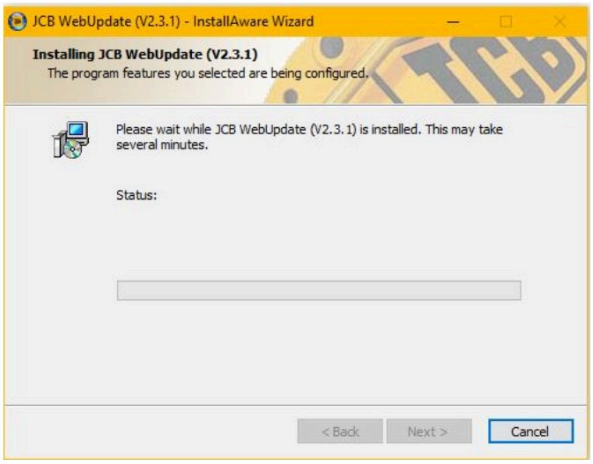
8. Due to the computer system firewall, you may get warning window "Internet Explorer - Security Warning".

   8.1. Click the "Run" option to proceed.

9. A new "JCB Web Update (V2.3.1) Installation Wizard" window will open. Refer to Figure 393.

   9.1. Once the download is finished, it will automatically run.

Figure 393.



10. The"JCB Web Update" program shortcut will be created on the computer desktop. Refer to Figure 394.

Figure 394.

11. Refer to the below section "Servicemaster Update" program to update Servicemaster.

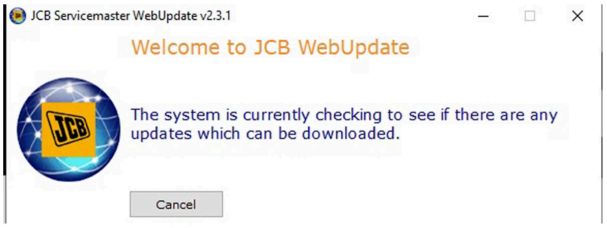
Servicemaster Updates - "JCB Web Update" Program

The updates for Servicemaster is downloaded through the "JCB Web Update" program on a laptop/ PC. Refer to the below steps.

1. Run the "JCB WebUpdate" program either by using desktop shortcut or "Help" menu within Servicemaster, to do a Servicemaster update.

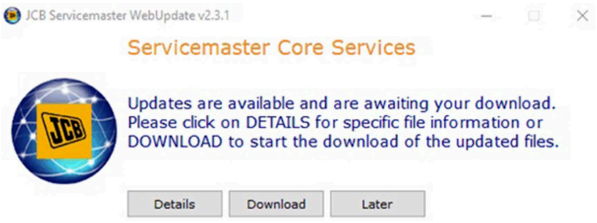
2. The "JCB WebUpdate" program will check for updates. Refer to Figure 395.

Figure 395.



3. The "JCB WebUpdate" program will inform you if there is any to download. Refer to Figure 396.

Figure 396.



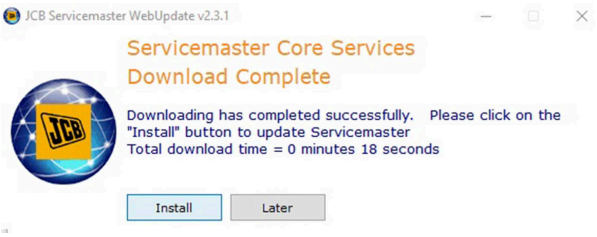
   3.1. You may click the "Details" option to check which files have been changed, added or removed.

   3.2. Click the "Download" option to download the updates.

4. Once the updates are downloaded, the "JCB Web Update" will give the option to install them. Refer to Figure 397.

   4.1. You may select options to install the updates immediately or at a later date.

Figure 397.



DLA Driver Software - Installation

When you use Servicemaster for the first time on your laptop/PC (which is newly installed with Servicemaster software), the DLA driver software is necessary to install first. Do the below steps to install the DLA driver software.

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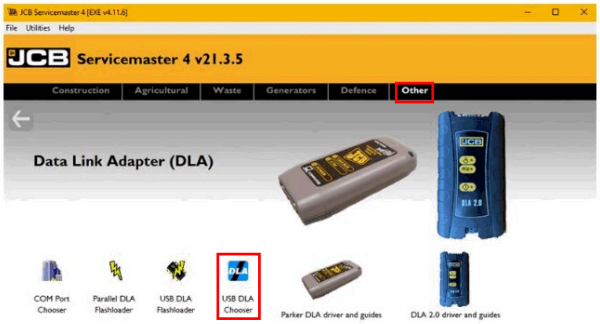
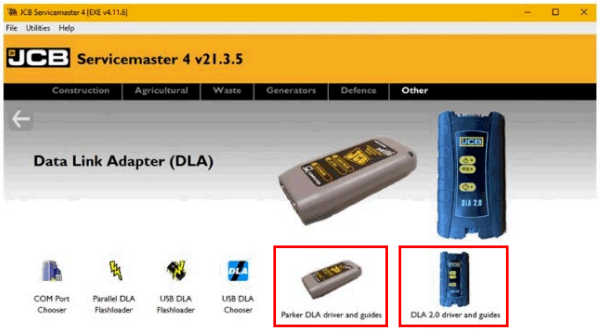
1. Once you complete the DLA driver software installation procedure, it will not require to be done again on your laptop/PC.
2. Do not connect the DLA or cables to the machine or laptop/PC before you install the DLA driver software.
3. Open Servicemaster on your laptop computer.
4. Click the "Other" tab to get access to the "General" icon.
5. Click the "General" icon to get access to the "DLA" icon.
6. Click the "DLA" icon. Refer to Figure 398.

Figure 398.



7. Click on DLA driver and guides icon. Refer to Figure 399.

Figure 399.

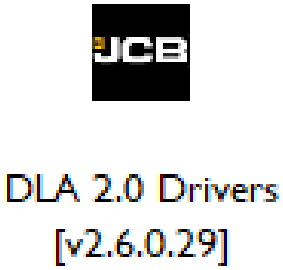


8. Based upon the driver you want to install. Refer to Figure 399. Select the appropriate version of DLA.
9. Select V1.10 USB DLA. Refer to Figure 400.
   9.1. Obey the window instructions to complete the DLA driver software installation.

Figure 400.

10. Select DLA 2.0 Drivers [v2.6.0.29]. Refer to Figure 401.
    10.1. Obey the window instructions to complete the DLA driver software installation.

Figure 401.



Switch between Parker and DLA 2.0

Switch from Parker DLA to DLA 2.0

1. On your laptop/PC go to “C: \JCB_Servicemaster_2”.
   1.1. Right click on “Servicemaster.exe” file and select “Run as Administrator”.

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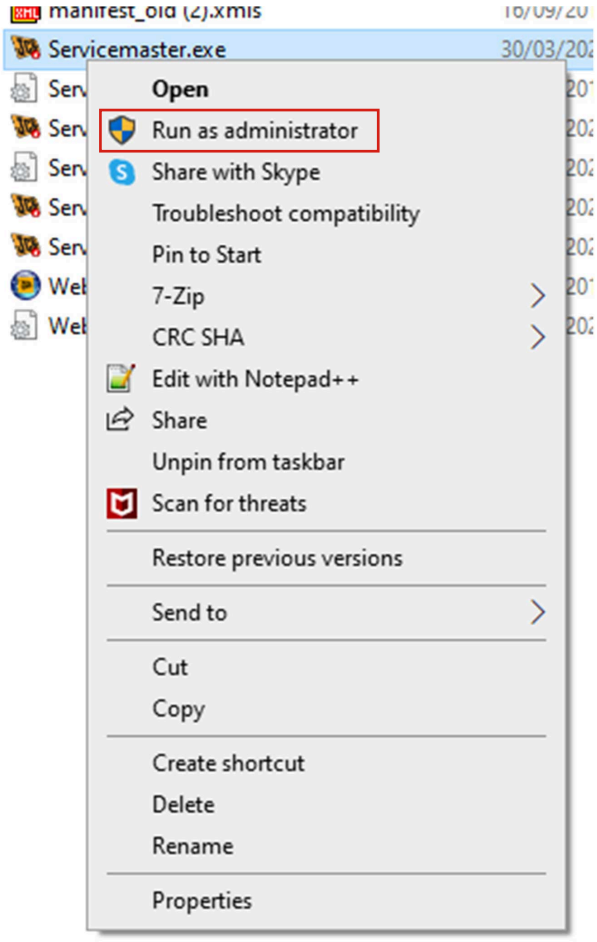
Figure 402.



2. In Servicemaster go to “Other>General>DLA”.

   2.1. Left click on “USB DLA Chooser”.

Figure 403.

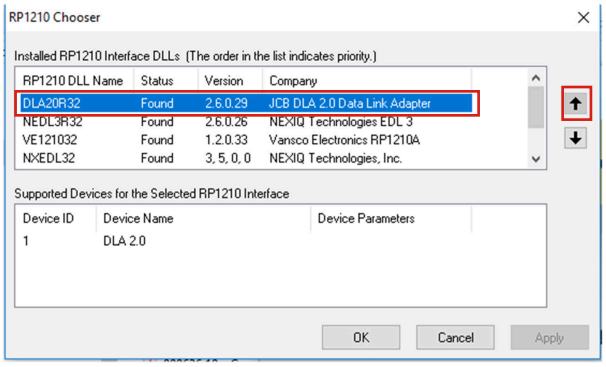
3. A new window will open.

   3.1. Select the “DLA20R32” item and move it to the top of the box with the highlighted arrow on the right side.

   3.2. Click “Apply” and then click on “Ok”.

   3.3. The DLA 2.0 is now ready to use.

Figure 404.

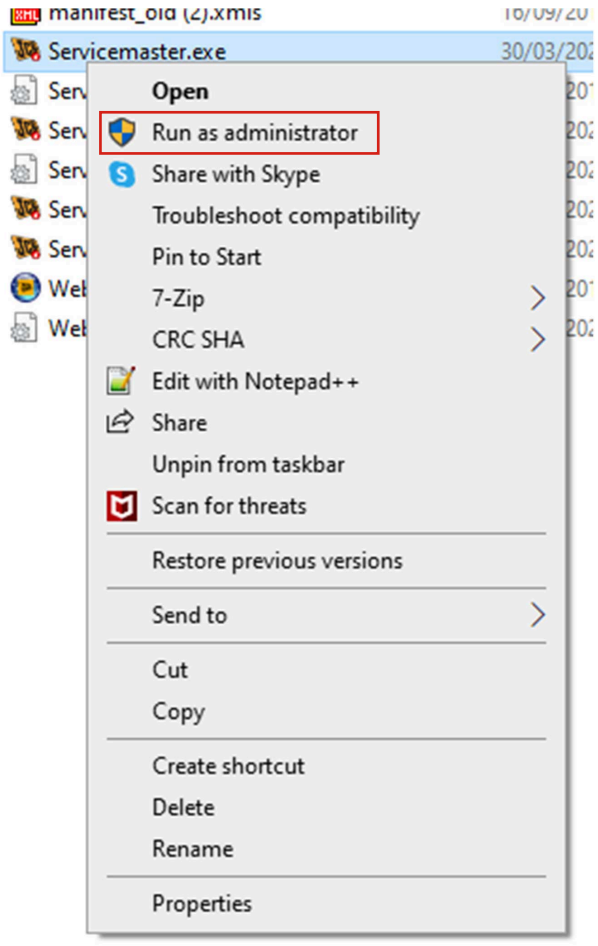


Switch from DLA 2.0 to Parker DLA

1. On your laptop/PC go to “C:\JCB_Servicemaster_2”.

   1.1. Right click on “Servicemaster.exe” file and select “Run as Administrator”.

Figure 405.



2. In Servicemaster go to “Other>General>DLA”.

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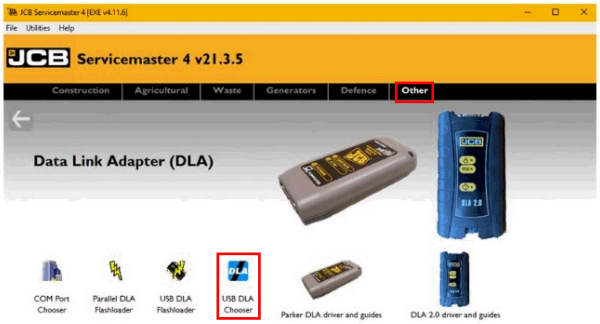
2.1. Left click on “USB DLA Chooser”.

Figure 406.



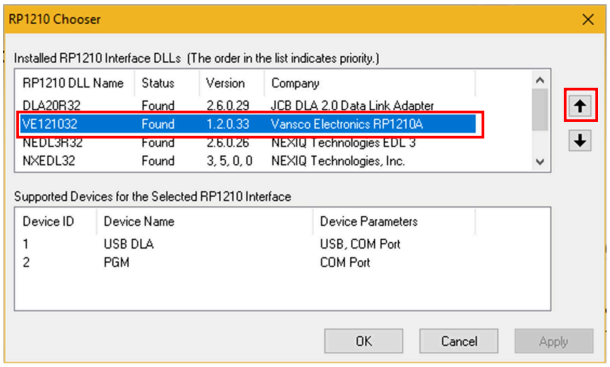
3. A new window will open. Refer to Figure 407.

   3.1. Select the “VE121032” item and move it to the top of the box with the highlighted arrow on the right side.

   3.2. Click “Apply” and then click on “Ok”.

   3.3. The Parker DLA is now ready to use.

Figure 407.



DLA Type and Communications Port - Configuration

When you use Servicemaster for the first time on your laptop/PC (which is newly installed with Servicemaster software) make sure that the correct DLA and laptop/PC port is selected to communicate with the DLA. Do the below steps to configure the DLA with the laptop/PC.

1. Once you complete the DLA configuration, it will not require to be done again on your laptop/PC.
2. Open Servicemaster on your laptop computer.
3. Click the "Other" tab to get access to the "General" icon.
4. Click the "General" icon to get access to the "DLA" icon.
5. Click the "DLA" icon.
6. Select and open the "COM Port Chooser" icon. Refer to Figure 408.

Figure 408.

7. A new "DLA Com Port Chooser" window will open.

   7.1. Select the "USB /Serial DLA" device and click the "Apply" option to confirm.

   7.2. Make a note that the older DLA and laptop computers may not be compatible with the USB ports. Select the "Parallel/Serial DLA" device in the DLA chooser.

DLA Firmware File - Check

Upon plugin of the DLA 2.0 from laptop to a machine and powered ON, the driver will update the Firmware on the device (DLA"2). Upon Servicemaster updates the latest DLA 2 Driver will also update. If update is needed the system will prompt an 'update required' message. If user selects 'OK' update happens automatically.

The DLA has software embedded in its own flash memory. This file must be replaced with a new one when new firmware is released. You will only have to Check the DLA firmware file version if you receive a new Servicemaster version or use a different DLA.

1. Make sure that the DLA is connected to the laptop computer.
2. Open Servicemaster on your laptop computer.
3. Click the "Other" tab to get access to the "General" icon.
4. Click the "General" icon to get access to the "DLA" icon.
5. Click the "DLA" icon.
6. Select and open the "USB DLA Flashloader" icon. Refer to Figure 409.

   6.1. Make a note that the older DLA and laptop computers may not be compatible with the USB ports. Select and open the "Flashloader for Serial/Parallel DLA" icon.

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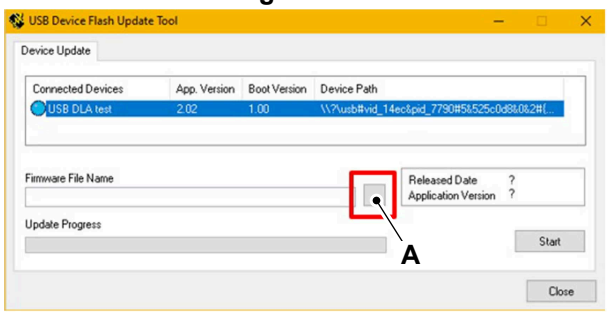
Figure 409.

7. A window "USB Device Flash Update Tool" will open. Refer to Figure 410.

   7.1. The firmware details in the DLA are displayed with the application version (for example - 1.04). Refer to Figure 410.

Figure 410.



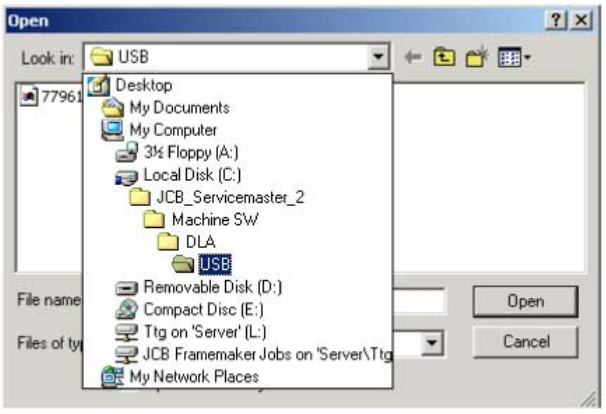
A Browse option

8. Check for a new firmware file.

   8.1. Click the "Browse" option and find the file stored within the JCB Servicemaster directory on your laptop hard drive. Refer to Figure 411.

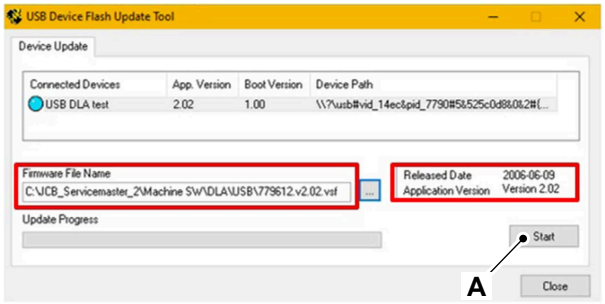
   8.2. Select the file and click the "Open" option.

Figure 411.



   8.3. The selected file appears in the "firmware file name" field together with its release date and application version (for example - 2.01). Refer to Figure 412.

Figure 412.



A Start option

9. Load a new firmware file.

   9.1. If the firmware in the DLA is not up to date, load the new file.

10. Click the "Start" option and obey the on-screen instructions.

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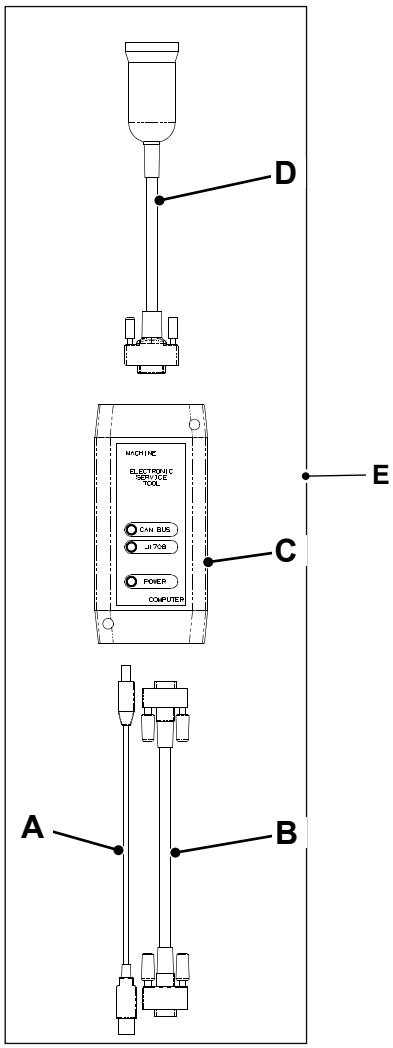
Disconnect and Connect

Special Tools

Description	Part No.	Qty.
Data Link Adaptor (DLA) Kit Data Link Adaptor (DLA 2.0) Kit	892/01174 728/H5409	1*
*Unless otherwise stated, you can use any of the tools shown.		

To use Servicemaster, connect your laptop computer to the machine CAN (Controller Area Network) bus. Connection is made using the DLA (Data Link Adaptor) and the applicable cables.

Figure 413.



A USB PC Cable - 718/20235
B Serial PC Cable - 718/20236
C USB DLA - 728/26500
D Machine Cable - 718/20237
E Kit - 892/01174 (contains items A, B, C and D)

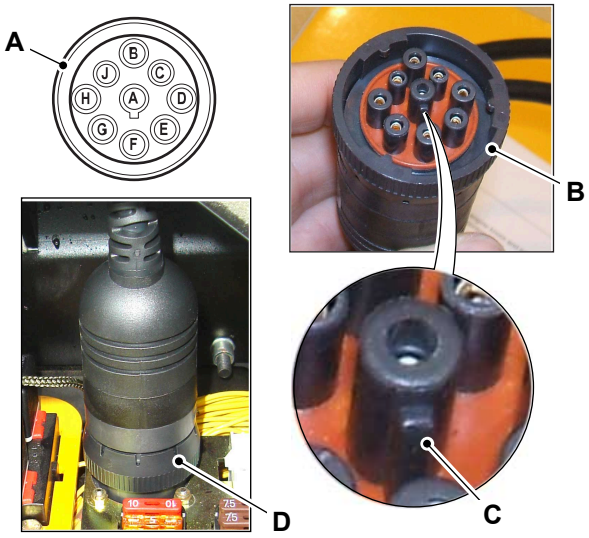
Note: Connect the USB cable directly to the laptop computer. Do not connect the cable via a USB hub.

Note: Older DLA and laptop computers may not be compatible with USB ports. Use the serial PC cable to connect the DLA to the laptop serial port.

1. Make sure the machine ignition system is OFF.
2. To use the Servicemaster diagnostic tool, connect the laptop computer to the machine.

   Special Tool: Data Link Adaptor (DLA) Kit / Data Link Adaptor (DLA 2.0) Kit (Qty.: 1)
3. Connect the USB PC Cable to the DLA and a free port on the laptop computer.
4. Connect the Machine Cable to the DLA. The Machine Cable has a 15-way D-type connector on one end and a 9-way CAN connector on the other. Plug the 15-way connector into the DLA and tighten the thumb screws.

Figure 414.



A USB PC Cable
B Serial PC cable
C Centre pin location tab
D Locking ring

5. Connect the 9-way CAN connector into the machines Diagnostics Connector as follows:

   5.1. Position the CAN connector to align the centre pin location tab with the diagnostics connector.

   5.2. Couple the connectors. Turn the locking ring clockwise to secure the connectors.

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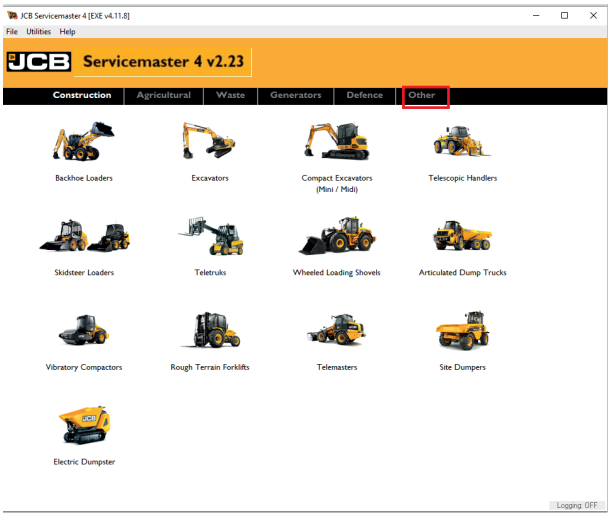
05 - Engine Diagnostic

Introduction

Engine setup:

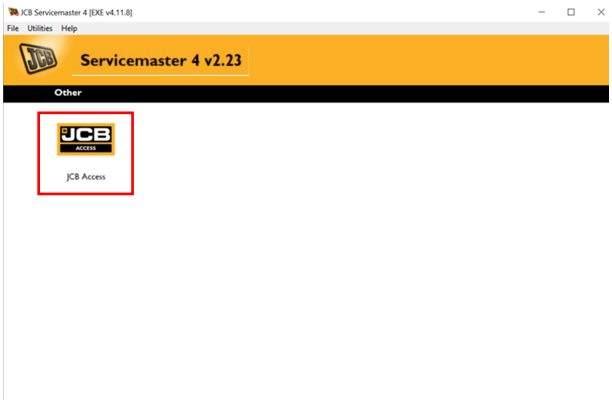
1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Connect the Servicemaster tool.
   Refer to: PIL 33-57-03.
3. In the Servicemaster, click and select 'Other'.

Figure 415.



4. Click on 'JCB Access'.

Figure 416.



5. Click on 'JCB Telescopic Booms'.

Figure 417.

6. Click on 'T65 Diesel'.

Figure 418.

7. Click on 'JCB Ecomax 444/448 Engine (DCM3.3+)'.

Figure 419.

8. Click on 'JCB Ecomax 444/448 Engine Setup - IPU' for engine setup.

Figure 420.

9. Click on 'Restore Default' to activate the fuel pump and other components.

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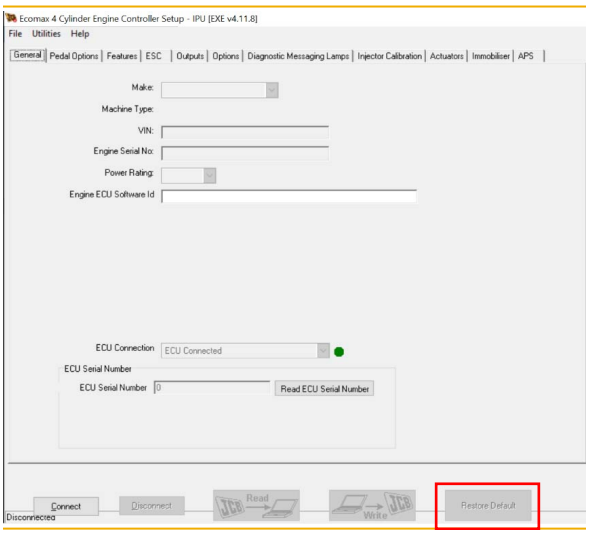
Figure 421.



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90 - Error Codes

Introduction

Should faults occur related to an ECU (Electronic Control Unit) or devices connected to it, the electronic system will generate the applicable fault codes.

Detailed fault code information can be found within the applicable HelpFiles located on JCB Service Pro and JCB ServiceMaster.

Fault Code Structure

The structure of fault codes, otherwise known as DTC (Diagnostic Trouble Code)'s has been standardised to a 7 digit code for all on and off-highway machine and vehicle applications. The standard (referred to as J2012) requires all fault codes to conform to the following structure.

- 1st character - defines the system on the vehicle (e.g. P = Powertrain, C= Chassis, U = Network).
- 2nd and 3rd characters - defines the sub-system (e.g. transmission, CAN (Controller Area Network) network, brakes etc).
- 4th and 5th characters - specifies the particular component, circuit or fault (e.g. starter relay).
- 6th and 7th characters - referred to as the 'Failure Type Byte' (FTB) which indicates the particular failure (e.g. 11 = short circuit to ground). See FTB Numbers below for a full list.

Some specific fault codes are defined by international standard, while other codes may be defined by individual vehicle manufacturers.

Fault Code Log Display Systems

Depending on the machine specification fault codes recorded by the machine electronic control system can be accessed and displayed in several ways:

CAN Enabled Display

The machine may be equipped with a CAN enabled instrument display. Such a display will be capable of displaying all recorded codes, for example P0047. All logged codes will be displayed. The operator may also have a facility to erase the fault code log. Refer to the relevant instrument panel operation information.

CAN BUS Connected Computer

Fault codes logged can be accessed via a suitable laptop computer running the applicable diagnostics software, JCB 444 Engine Diagnostics for example. The computer must be connected to the machine CAN using the relevant service cables and adaptors. Once connected all recorded codes can be displayed. The engineer also has a facility to erase the fault code log.

Failure Type Byte (FTB) Numbers

Table 162.

Number	Failure Type Byte (FTB) Description
0	No sub-type information.
2	General signal failure.
4	System internal failure.
5	System programming failure.
7	Mechanical failure.
9	Component failure.
11	Short Circuit To Ground (SC2G).
12	Short Circuit To Battery (SC2V-BAT).
13	Open Circuit (OC).
16	Circuit voltage below threshold.
17	Circuit voltage above threshold.
18	Circuit current below threshold.
19	Circuit current above threshold.
1A	Circuit resistance above threshold.
1B	Circuit resistance below threshold.
1C	Circuit voltage out of range.
1F	Circuit intermittent.
23	Signal stuck low.
24	Signal stuck high.
26	Signal rate of change below threshold.
27	Signal rate of change above threshold.
29	Signal invalid.
2F	Signal erratic.
31	No Signal (lost/missing).
36	Signal frequency too low.
37	Signal frequency too high.
38	Signal frequency incorrect.
45	Program memory failure.
46	Calibration / Parameter memory failure.
47	Watchdog / micro-controller / microprocessor failure.
4B	Over temperature.
62	Signal compare failure.
64	Signal plausibility failure.
71	Actuator stuck.
72	Actuator stuck open.
73	Actuator stuck closed.

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Number	Failure Type Byte (FTB) Description
85	Signal above allowable range.
86	CAN signal invalid.
92	Performance or incorrect operation.
98	Component or system over temperature.

Malfunction Indicator Light (MIL)

Figure 422.

Amber/Red light. The MIL (Malfunction Indicator Lamp) light comes on to show that a system error has been detected. Refer to Figure 422.

- Red light. The light comes ON (and a continuous audible alarm sounds) to indicate faults that may result in serious damage to the machine or make the machine dangerous to operate. This is known as a ‘STOP NOW’ fault.

- Amber light. The light comes ON (and an audible alarm sounds for one second) to indicate faults that may result in reduced machine performance but are not dangerous. They are unlikely to damage the machine. This is known as a ‘SERVICE’ fault.

When the MIL light comes ON another applicable system warning may display. These lights can show a blink code. Refer to Blink Codes.

Blink Codes

Some machine systems are equipped with a dedicated indicator light. If there is a system fault the light can display fault codes as a series of blinks.

For example code E127 can be displayed as a series of blinks as follows:

Table 163.

1	Blink						
2 Second delay							
2	Blink	Blink					
2 Second delay							
7	Blink	Blink	Blink	Blink	Blink	Blink	Blink

The light will be ON for approximately 1s and OFF for approximately 0.5s. There is an OFF time of approximately 2s between the code digits.

When a blink code is displayed the MIL light can also come ON. Refer to Malfunction Indicator Light (MIL).

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84 - Sensor

00 - General

Introduction 33-160
Component Identification 33-161
Check (Condition) 33-164

Introduction

There are 6 types of sensors installed on these machines.

- Mechanical limit switch
- Boom sensor
- Tilt sensor
- Weight sensor
- Pressure sensor
- Boom down limit switch
- Wire rope switch

Mechanical Limit Switch

The mechanical limit switch is activated by moving the switch probe with the machine parts to monitor their position. The following are the mechanical limit switches.

- Slew position limit switch

Boom Sensor

It is used to measure boom length and angle of the boom.

Tilt Sensor

The tilt sensor measures the slope of the chassis in two planes.

Weight Sensor

The weight sensor monitors the weight in the platform to detect if the platform is loaded with more than the rated load.

- Platform weight sensor

Pressure Sensor

The pressure sensor monitors the control system of the oscillating axle, to check that the axle is locked to stabilise the machine.

- Oscillating axle pressure sensor

Wire Rope Switch

The wire rope switch senses the broken wire rope, by detecting the gap between the sensor and the broken rope anchor plate.

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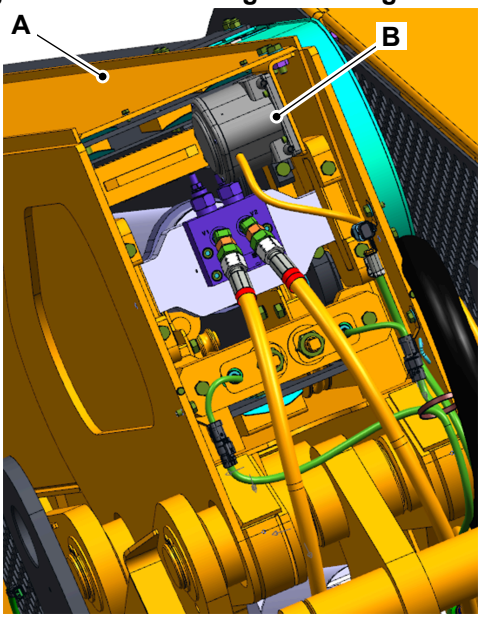
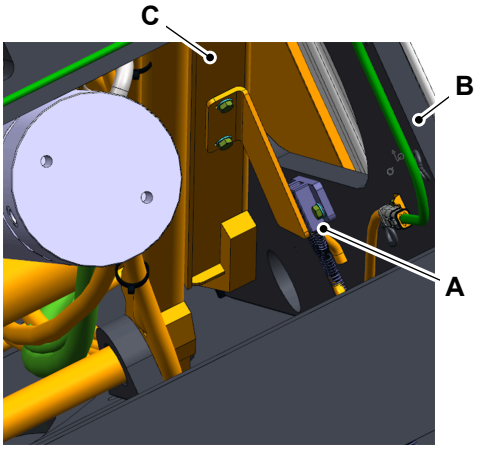
Component Identification

Figure 423. Boom Length and Angle Sensor



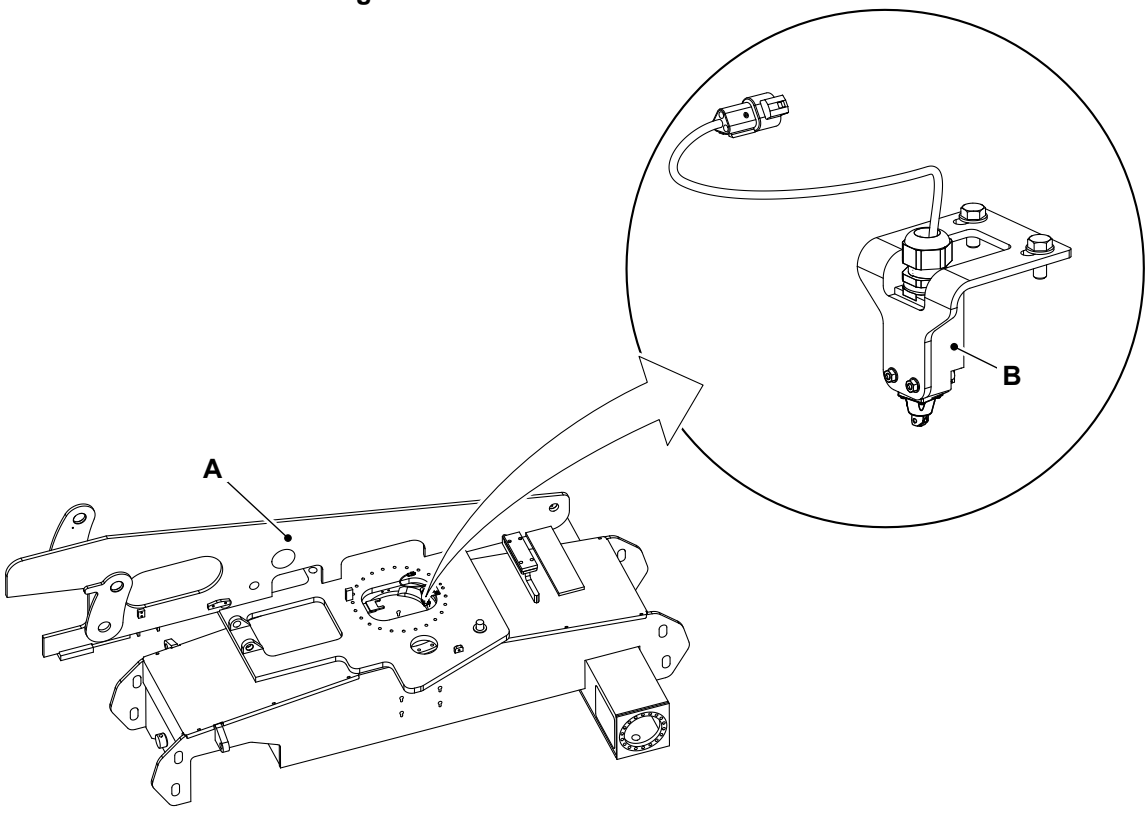
A Telescopic boom
B Boom length and angle sensor

Figure 424. Boom Down Limit Switch



A Boom down limit switch
B Turntable structure
C Folding arm

Figure 425. Slew Position Limit Switch



A Turntable structure

B Slew position limit switch

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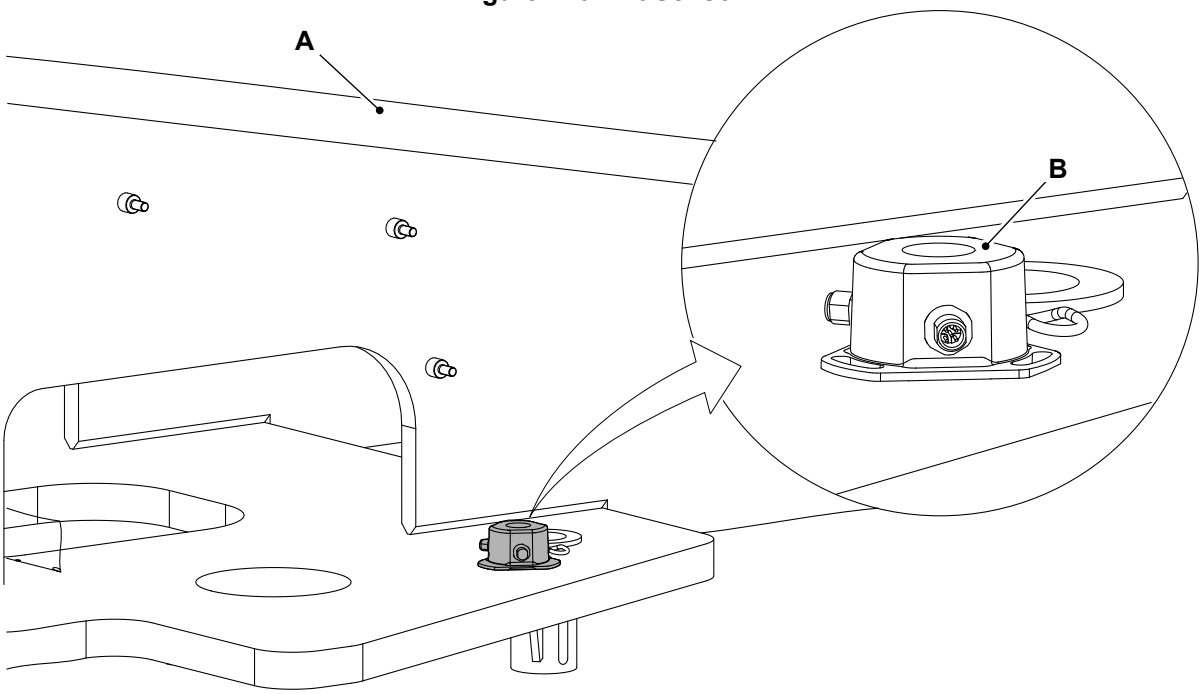
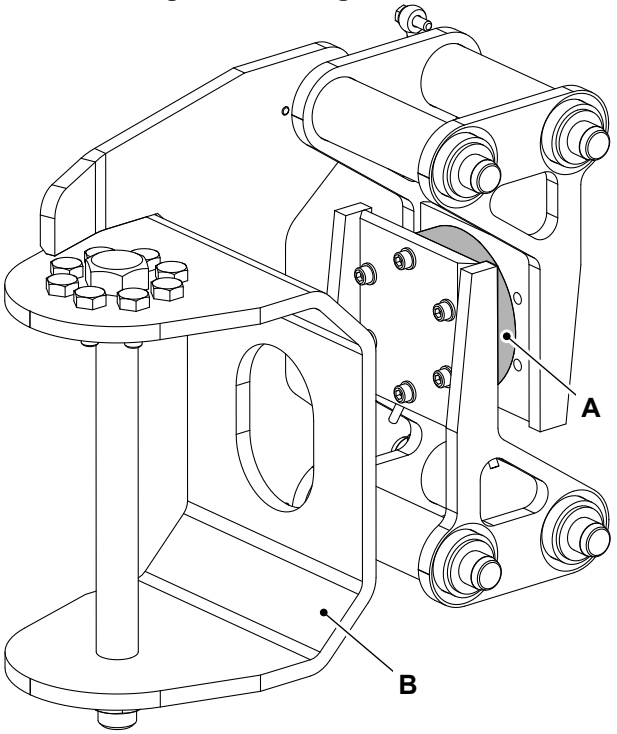
Figure 426. Tilt Sensor



A Turntable structure

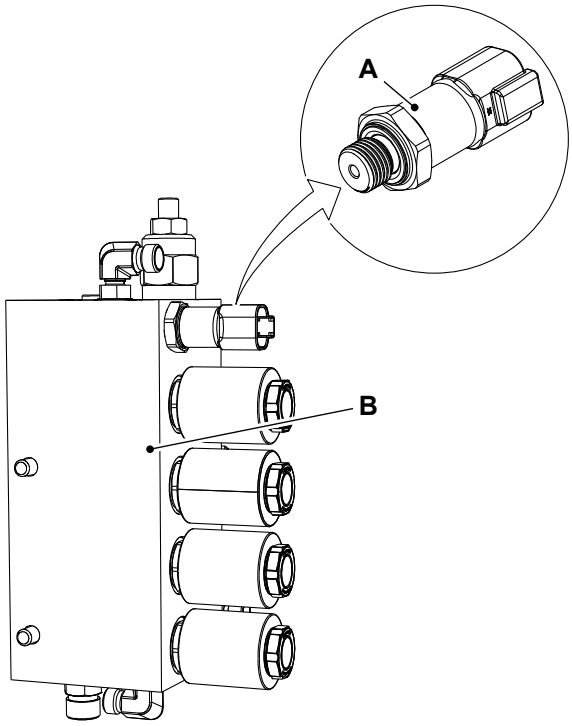
B Tilt sensor

Figure 427. Weight Sensor



A Weight sensor
B Kingpost

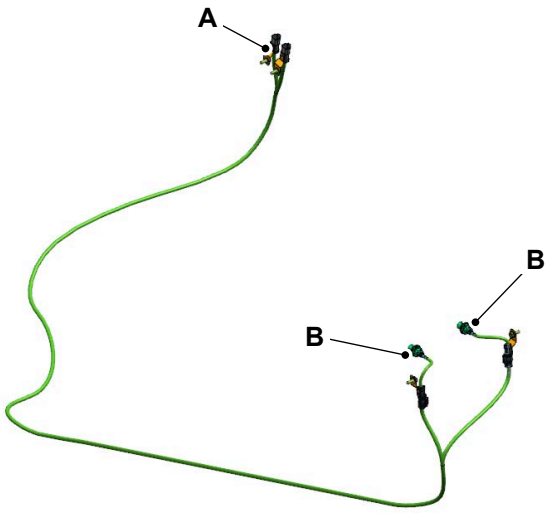
Figure 428. Pressure Sensor



A Pressure sensor
B Brake valve

JCB © CONNOR STANMORE - 13/03/2026 07:44.

Figure 429.



A Link lead rope switch
B Proximity sensor (x2)

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Check (Condition)

Mechanical Limit Switch

1. Activate the limit switch manually.
   1.1. Make sure that the limit switch moves optionally and resets automatically.
   1.2. Make sure that an audible click sound is heard.
2. Release the limit switch.
3. Use a multimeter to test the resistance between the switch joints. Make sure that it forms a closed circuit.
4. Activate the limit switch manually.

Proximity Switch

1. Use a multimeter to test the resistance between the switch joints. Make sure that it forms a closed circuit.
2. Find the magnetic area of the switch.
3. Place a magnetic metal block in front of the magnetic area within the specified distance.

   Distance: 12.7mm
4. Use a multimeter to test the resistance between the switch joints. Make sure that it forms a closed circuit.
5. Move the magnetic metal block away from the magnetic area.

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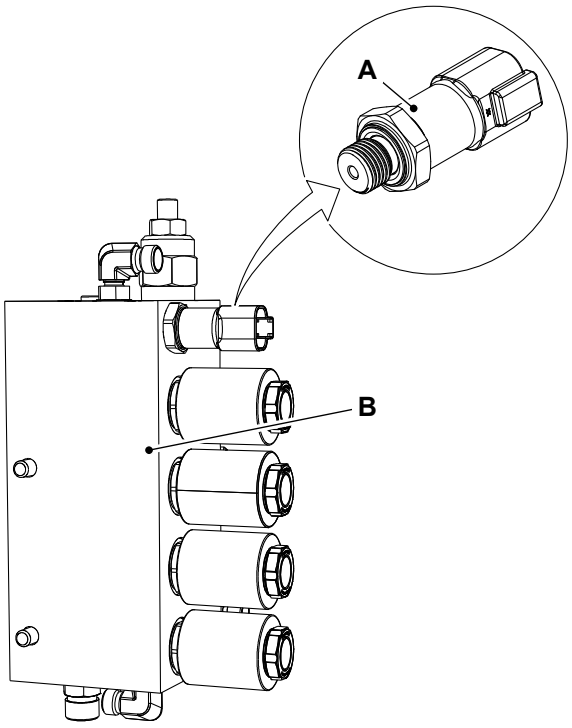
07 - Hydraulic Pressure

Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Discharge the hydraulic pressure.
3. Remove the chassis panel.
4. Get access to the brake control valve.
5. Disconnect the electrical connections from the sensor.
6. Place a suitable tray to collect the oil.
7. Remove the pressure sensor from the brake control valve.

Figure 430.



A Pressure sensor
B Brake valve

Install

1. The installation procedure is the opposite of the removal procedure.

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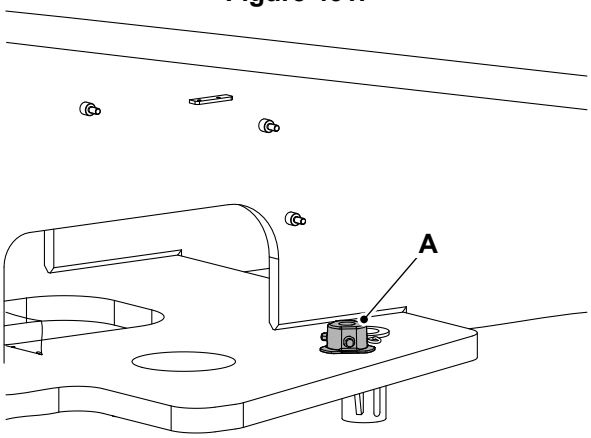
60 - Tilt

Calibrate 33-166
Remove and Install 33-169

Calibrate

Figure 431.



A Tilt sensor

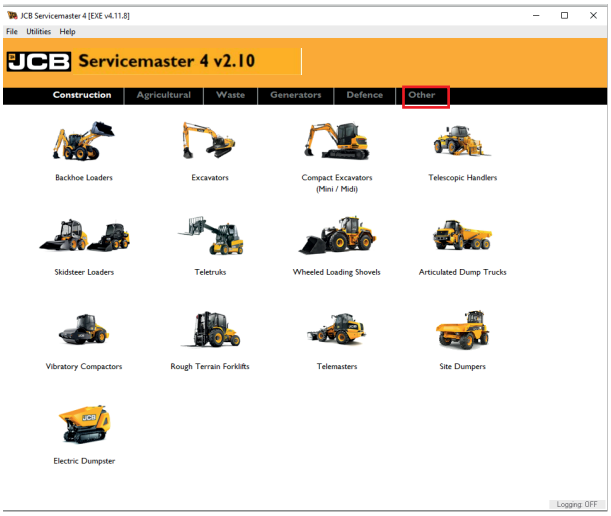
Tilt Sensor Calibration through Machine Display

For tilt sensor calibration through machine display, refer to
Refer to: Introduction (PIL 33-24-02).

Tilt Sensor Calibration through Servicemaster

1. Park the machine on flat, level ground.
2. Make the machine safe.
   Refer to: PIL 01-03-27.
3. Connect the Servicemaster tool.
   Refer to: PIL 33-57-03.
4. In the Servicemaster, click and select 'Other'.

Figure 432.



5. Click on 'JCB Access'.

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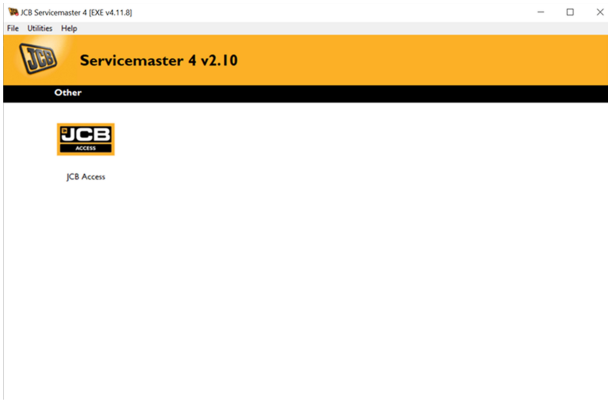
Figure 433.

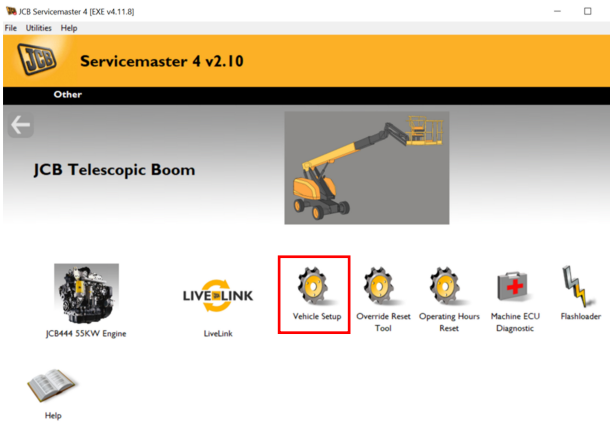


6. Click on 'JCB Telescopic Booms'.

Figure 434.

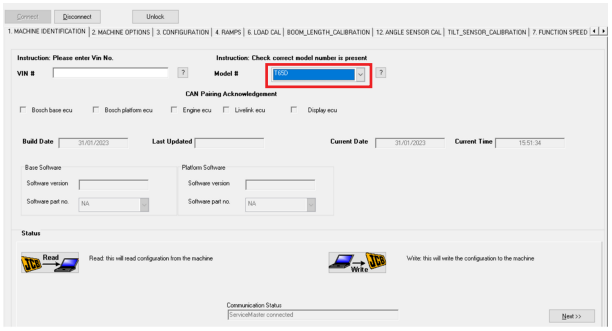
7. Click on 'Vehicle Setup'.

Figure 435.



8. Select 'T65D' in the drop-down menu of 'Model #'.

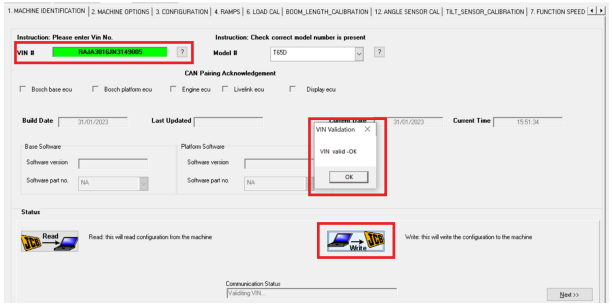
Figure 436.



9. Enter valid VIN, for e.g 'RAJA3016JN3149005' in 'VIN #' field and then click on 'Write' to flash the VIN. Refer to Figure 437.

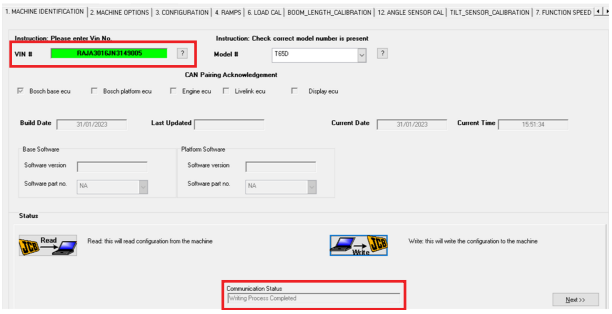
10. Click 'OK' once the VIN Validation pop up 'VIN Valid – OK' appears.

Figure 437.



11. Wait for the communication status field to display 'Writing Process Completed' to make sure that the VIN has been successfully written.

Figure 438.



12. Clear the 'VIN #' field and then click on 'Read' to read back the VIN written.

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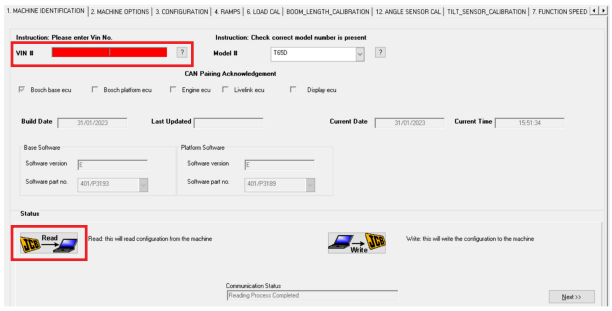
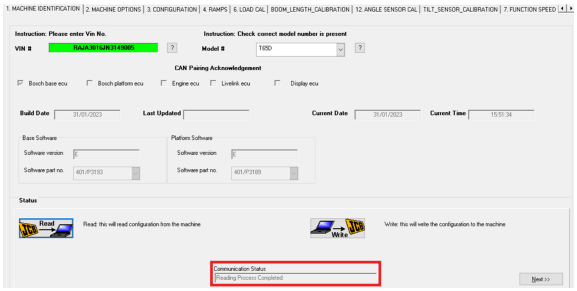
Figure 439.



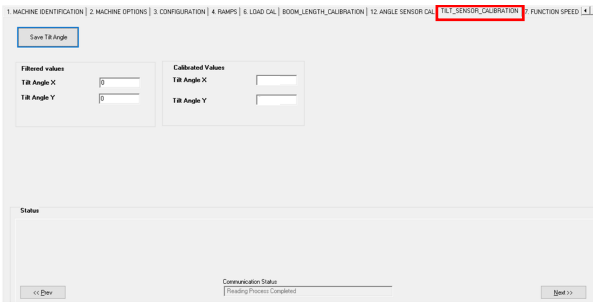
13. Wait for the communication status field to display 'Reading Process Completed'.

Figure 440.



14. Click on 'TILT SENSOR CALIBRATION'.

Figure 441.



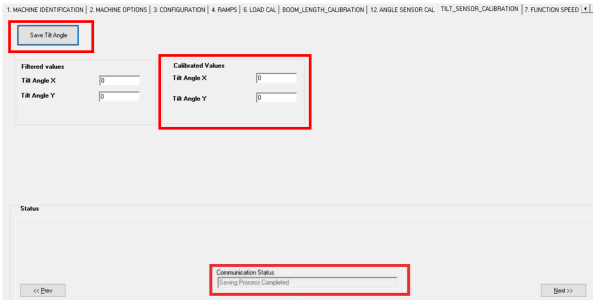
15. Make sure that the telescopic boom is fully retracted and main boom is fully lowered.

16. Make sure that the machine is parked on flat ground so that the 'Filtered Values' comes in range of zero.

Figure 442.

17. Now calibrate the tilt angle by clicking on 'Save Tilt Angle', so that the calibrated values appear in the 'Calibrated Values' tab.

Figure 443.



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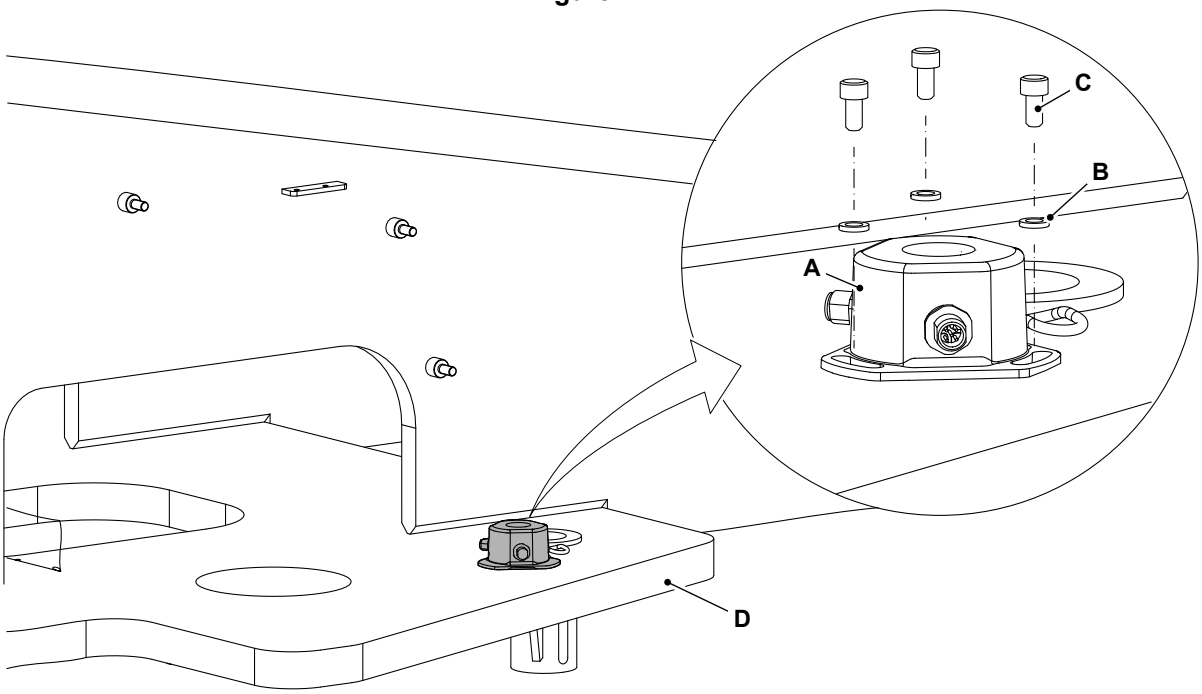
Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Disconnect the electrical connections from the sensor.
3. Remove the capscrew (x3) and lock washer (x3).
4. Remove the tilt sensor from the turntable assembly.

Figure 444.



A Tilt sensor
B Lock washer (x3)
C Capscrew (x3)
D Turntable assembly

Install

1. The installation procedure is the opposite of the removal procedure.
2. Torque tighten the capscrew (x3) to correct torque value.
   Torque: 15N·m
3. Calibrate the tilt sensor.
   Refer to: PIL 33-84-60.

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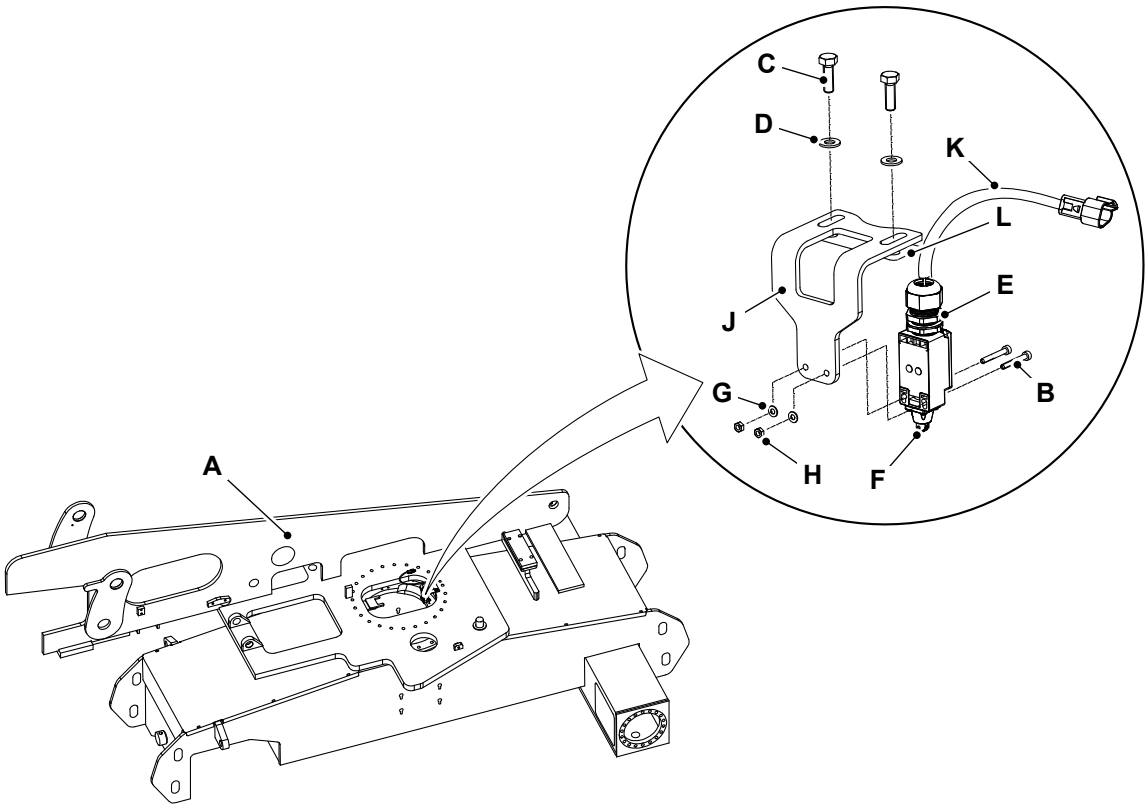
76 - Slew

Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Disconnect the electrical connections from the sensor.
3. Remove the setscrew (x2) and washer 1 (x2) from the mounting plate.
4. Remove the switch mounting plate from the machine.
5. Remove the cap screw (x2), washer 2 (x2) and nut (x2) from the mounting plate.
6. Remove the slew limit switch.

Figure 445.



A Turntable structure
B Capscrew (x2)
C Setscrew (x2)
D Washer 1 (x2)
E Cable gland
F Slew limit switch
G Washer 2 (x2)
H Nut (x2)
J Mounting plate
K Electric connector
L Shim

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

1. Install the shim of specified dimension to adjust the slew limit switch height as necessary.
   Length/Dimension/Distance: 1mm
2. Tighten the capscrew (x2) and setscrew (x2) to the specified torque value. Refer to Table 164.

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Table 164. Torque Values

Item	Nm
B	4.4
C	22

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86 - Platform Weight Limit

Calibrate 33-172
Remove and Install 33-173

Calibrate

To calibrate platform weight sensor-
Refer to: Calibrate (PIL 01-12-00).

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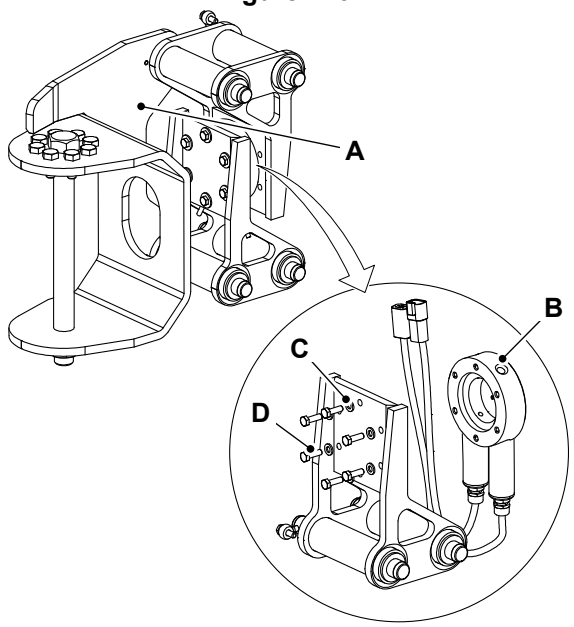
Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Make sure the platform weight is supported, so that the weight sensor is not in compression.
3. Disconnect the electrical connections from the weight sensor.
4. Remove the setscrew (x6) and washer (x6) from the weight sensor.
5. Remove the weight sensor from the kingpost assembly.

Figure 446.



A Kingpost assembly
B Weight sensor
C Washer (x6)
D Setscrew (x6)

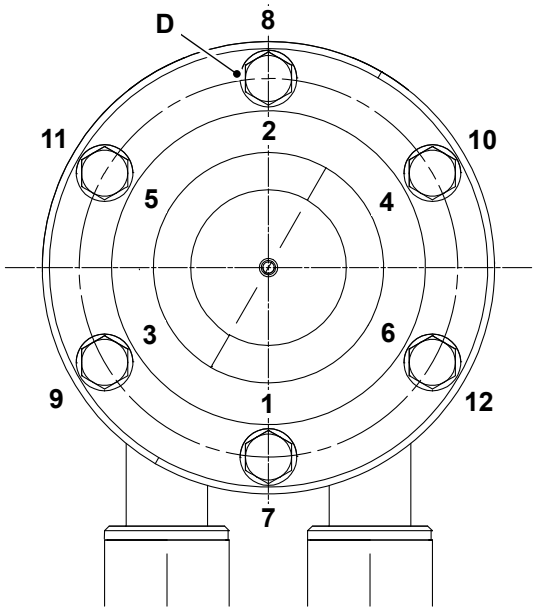
Install

The mounting surface must be free of paint and have a machined finish.

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

1. Do the steps that follow to tighten the setscrew (x6).

Figure 447.



D Setscrew (x6)

1.1. Make sure that the tightening sequence is diagonal and in the specified order. Refer to Figure 447.

1.2. Torque the setscrew (x6) to 4.5 to 8.1Nm in the tightening sequence 1-6. Refer to Figure 447.

1.3. Again, torque the setscrew (x6) to 9Nm in the tightening sequence 7-12. Refer to Figure 447.

2. Calibrate the weight sensor.
   Refer to: Calibrate (PIL 33-84-86).

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85 - Limit Switch

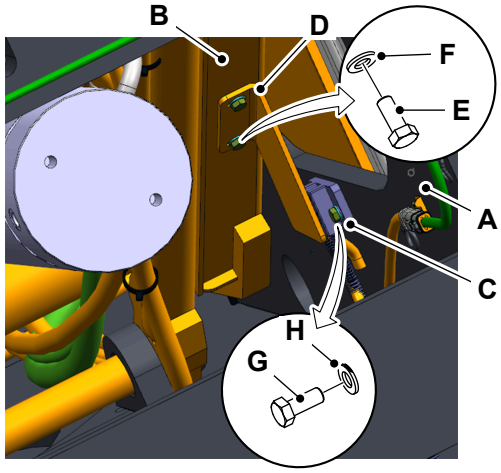
05 - Boom Lift

Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Get access to the main boom limit down sensor.
3. Disconnect the electrical connections from the sensor.
4. Remove the setscrew 1 (x2), washer 1 (x2) from the boom down limit switch plate
5. Remove the setscrew 2 (x2), washer 2 (x2) from the turntable structure.
6. Remove the main boom limit down sensor.

Figure 448.



A Turntable structure
B Folding arm
C Main boom limit down sensor
D Boom down limit switch plate
E Setscrew 1 (x2)
F Washer 1 (x2)
G Setscrew 2 (x2)
H Washer 2 (x2)

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

1. Tighten the setscrews to the specified torque value. Refer to Table 165.

Table 165. Torque Values

Item	Nm
E	22
G	30

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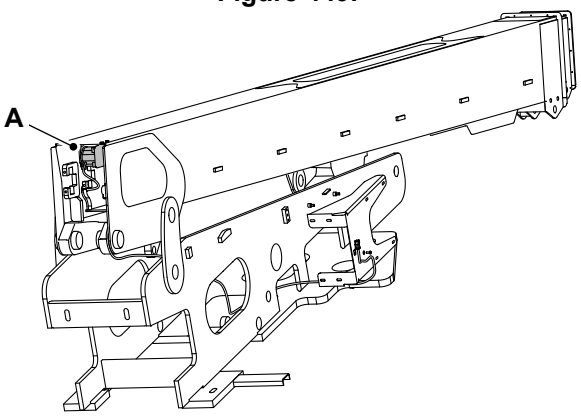
15 - Boom Telescopic

Calibrate 33-175
Remove and Install 33-179

Calibrate

Figure 449.

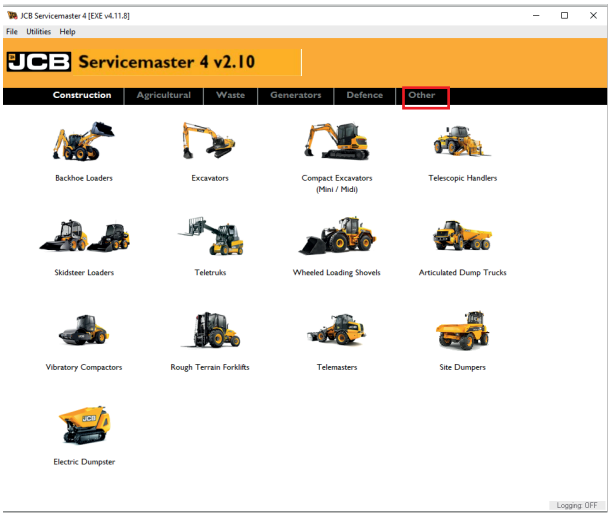


A Boom length and angle sensor

Boom length and angle sensor calibration:

1. Park the machine on flat, level ground.
2. Make the machine safe.
   Refer to: PIL 01-03-27.
3. Connect the Servicemaster tool.
   Refer to: PIL 33-57-03.
4. In the Servicemaster, click and select 'Other'.

Figure 450.



5. Click on 'JCB Access'.

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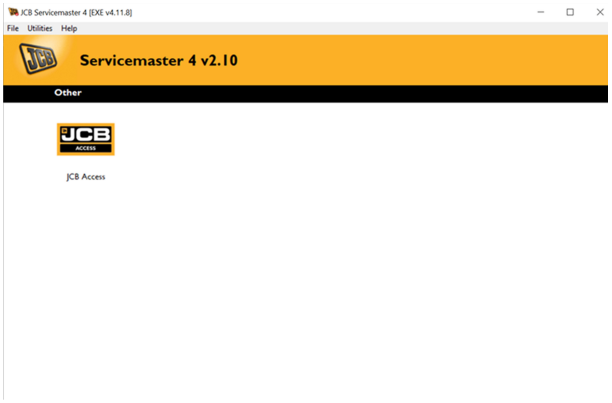
Figure 451.

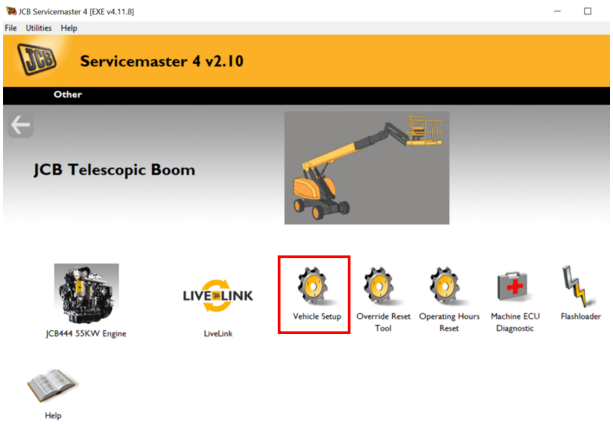


6. Click on 'JCB Telescopic Booms'.

Figure 452.

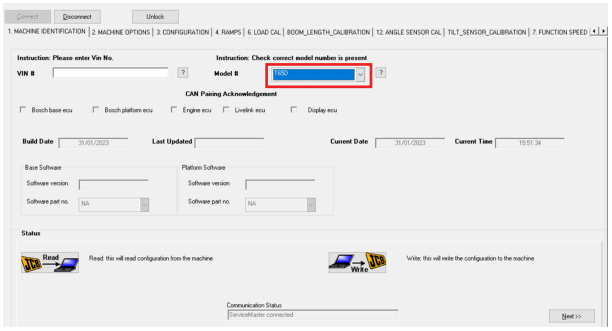
7. Click on 'Vehicle Setup'.

Figure 453.



8. Select 'T65D' in the drop-down menu of 'Model #'.

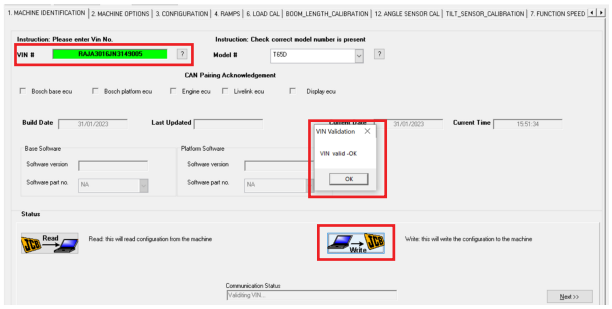
Figure 454.



9. Enter valid VIN 'RAJA3016JN3149005' in 'VIN #' field and then click on 'Write' to flash the VIN. Refer to Figure 455.

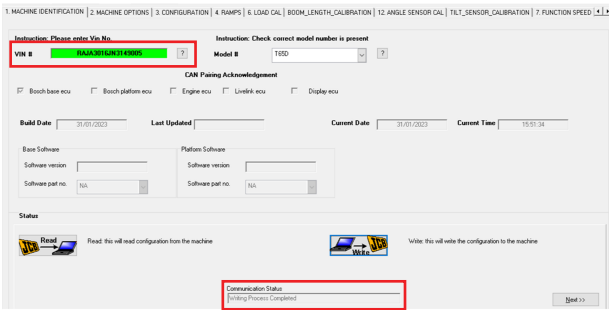
10. Click 'OK' once the VIN Validation pop up 'VIN Valid – OK' appears.

Figure 455.



11. Wait for the communication status field to display 'Writing Process Completed' to make sure that the VIN has been successfully written.

Figure 456.



12. Clear the 'VIN #' field and then click on 'Read' to read back the VIN written.

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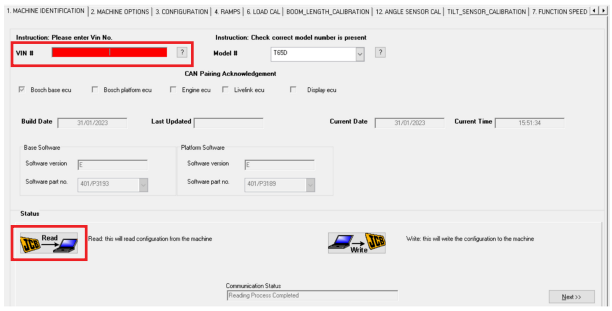
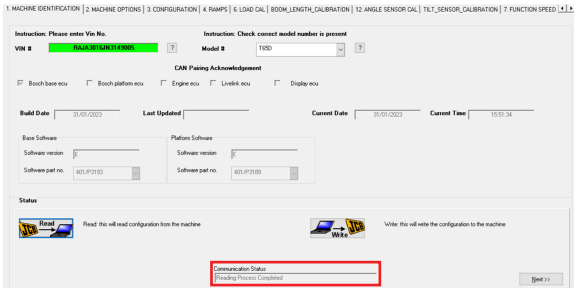
Figure 457.



13. Wait for the communication status field to display 'Reading Process Completed'.

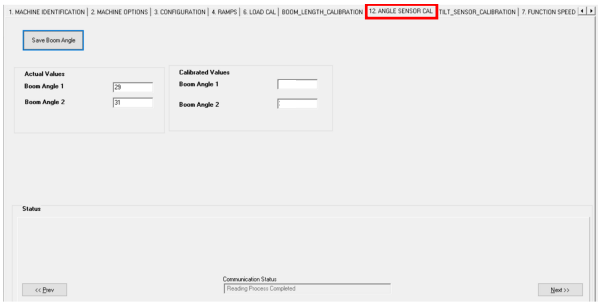
Figure 458.



Angle Sensor Calibration

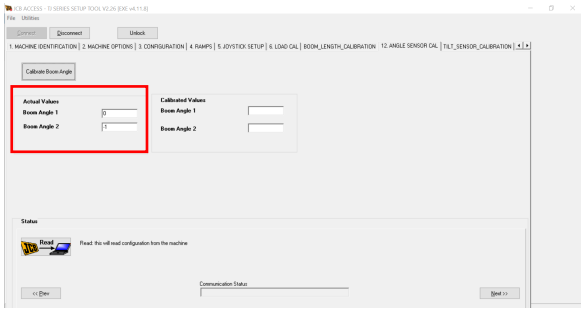
1. Click on 'ANGLE SENSOR CAL'.

Figure 459.



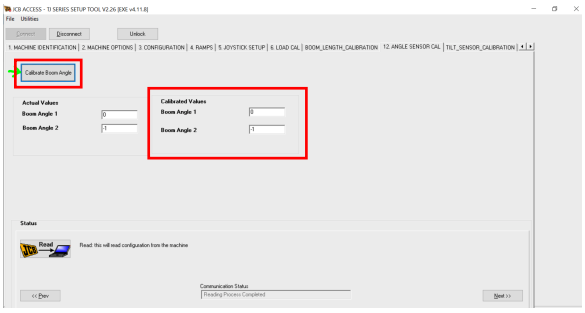
2. Make sure that the telescopic boom is fully retracted and main boom is fully horizontal, so that the actual values must come in the range of zero.

Figure 460.



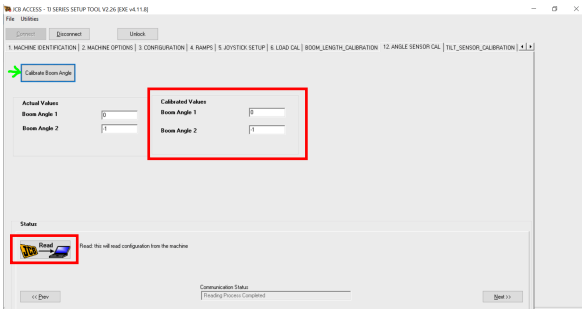
3. Click on 'Calibrate Boom Angle' tab so that the calibrated values appear in the 'Calibrated values' tab.

Figure 461.



4. Click on 'Read' tab and ensure that the calibrated values are correct or not.

Figure 462.



Boom Length Calibration

1. Click on 'BOOM LENGTH CALIBRATION'.

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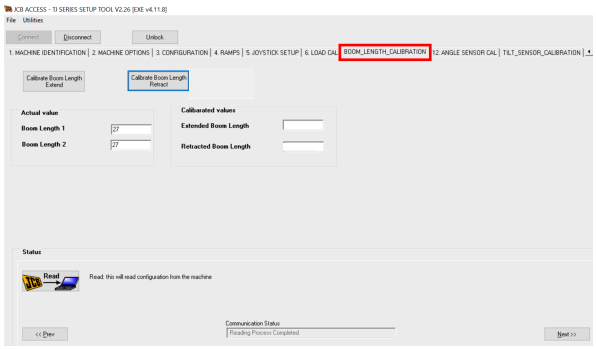
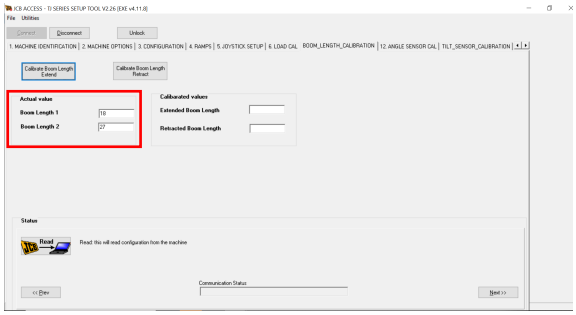
Figure 463.



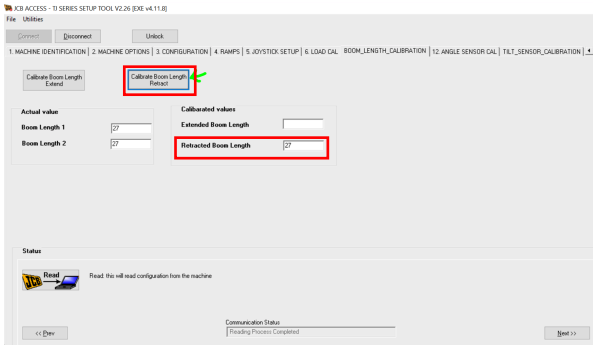
2. Make sure that the telescopic boom is fully retracted.

Figure 464.



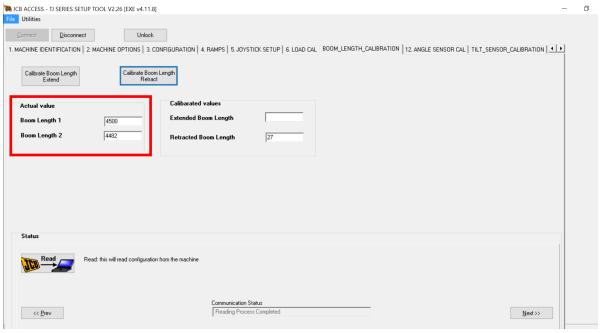
3. Click on 'Calibrate Boom Length Retract' tab so that the calibrated values appear in the 'Calibrated value' tab.

Figure 465.



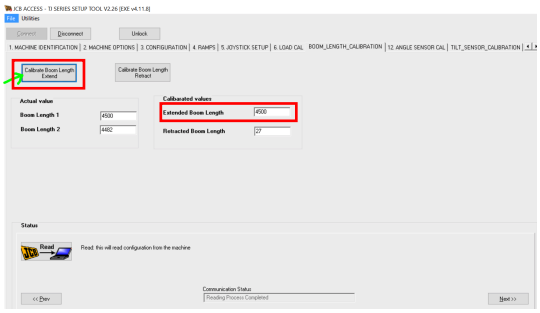
4. Now, extend telescopic boom upto full length and make sure that the telescopic boom is fully horizontal and extended.

Figure 466.



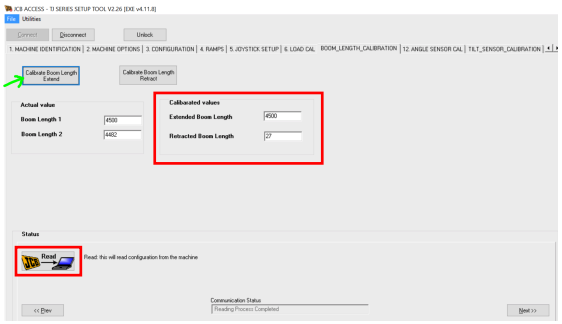
5. Click on 'Calibrate Boom Length Extend' tab so that the calibrated values appear in the 'Calibrated value' tab.

Figure 467.



6. Click on 'Read' tab and ensure that the calibrated values are correct or not.

Figure 468.



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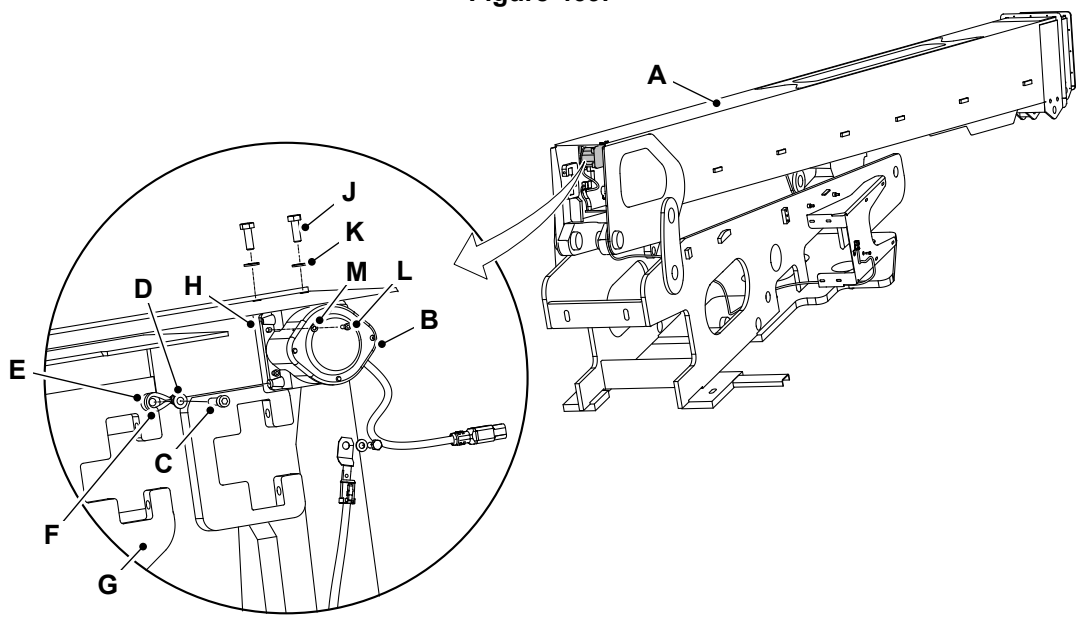
Remove and Install

Remove

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Get access to the boom length and angle sensor.
3. Disconnect the electrical connections from the sensor.
4. Remove the capscrew 1, washer 1 and spacer from the intermediate boom..
5. Remove the string pot cable end.
6. Remove the setscrew (x2) and washer 2 (x2) from the telescopic boom.
   6.1. Remove the string pot mounting plate along with the boom length and angle sensor.
7. If required, remove the capscrew 2 (x4) and washer 3 (x4) from the string pot mounting plate.
   7.1. Remove the boom length and angle sensor.

Figure 469.



A Telescopic boom
B Boom length and angle sensor
C Capscrew 1
D Washer 1
E Spacer
F String pot cable end
G Intermediate boom
H String pot mounting plate
J Setscrew (x2)
K Washer 2 (x2)
L Capscrew 2 (x4)
M Washer 3 (x4)

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

1. Make sure that the string pot cable end should be fixed over the washer 1.
2. Tighten the capscrews and setscrews to the specified torque value. Refer to Table 166.
3. Calibrate the boom length and angle sensor.
   Refer to: Calibrate (PIL 33-85-15).

Table 166. Torque Values

Item	Nm
C	72
J	60
L	8.8

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20 - Rope Switch

Introduction 33-180
Technical Data 33-181
Operation 33-182
Adjust 33-182
Remove and Install 33-183

Introduction

The function of the wire rope switch is to sense a broken wire rope, by detecting the gap between the sensor and the broken rope anchor plate. The wire rope switch is mounted to the wire rope termination threads with a plate.

It is installed near extend wire rope anchors.

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Technical Data

Table 167.

Specification	Technical Value
Contact type	Normally open
Sensing distance	8mm + / -10%
Residual output voltage	2V
Degree of protection	IP67

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Operation

1. Make the machine safe.
   Refer to: PIL 01-03-27.
2. Make sure that the proximity sensors are installed on the correct position.
3. Check the condition of the proximity sensors for tightness and damage to the harness wires.
4. If the gap between the proximity sensors and broken rope detection plate is between the specified value.
   Distance: 0→6.4mm
   4.1. The proximity sensor LED (Light Emitting Diode) turns ON.
5. If the gap between the proximity sensors and broken rope detection plate has increased or is more than the specified value.
   Distance: 8mm
   5.1. In this case proximity sensor LED doesn't illuminate and there is possibility of wire rope broken or elongated.
6. The proximity sensor senses and sends the signal to base ECU (Electronic Control Unit). The base ECU shows the warning or fault errors on the display.
7. If the sensor detects a large gap, indicating a broken wire, main boom raise and extend will not be allowed. Main boom lower and retract will be allowed to bring the platform to the ground position.

Adjust

If the gap goes to >8mm then LEDs at back side of both the proximity sensors will go OFF.

The base display will show raise mode and two error codes will come for both the proximity sensors.

1. To set the proximity sensor within the limit, perform the following step:
   1.1. Set the distance between proximity sensors and broken rope detection plate between the specified value, so that the LED (Light Emitting Diode) start blowing.
   Distance: 0→6.4mm

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Remove and Install

Remove

1. Make the machine safe.

   Refer to: PIL 01-03-27.

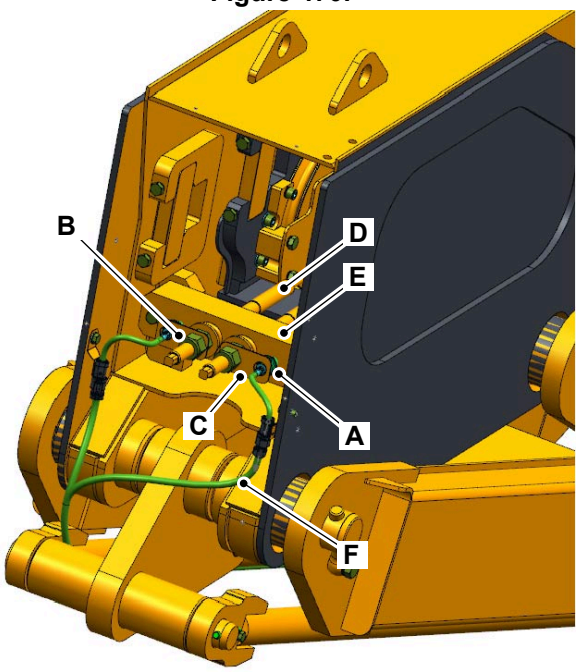
2. Obey all the precautions related to electrical system.

3. Disconnect the electrical connector from the proximity sensor (x2).

4. Loosen and remove the lock nut (x2) and detection plate (x2) from the wire rope extension (x2).

5. Remove the proximity sensor (x2) from the detection plate (x2).

Figure 470.



A Proximity sensor (x2)
B Locknut (x2)
C Detection plate (x2)
D Wire rope extension (x2)
E Broken rope detection plate
F Rope switch harness

Install

The installation procedure is the opposite of the removal procedure. Additionally do the following step.

1. Tighten the locknut (x2) to the specified torque value.

   Torque: 40N·m

2. Adjust the gap between proximity sensor and broken rope detection plate to the specified value.

   Distance: 0→0.64mm

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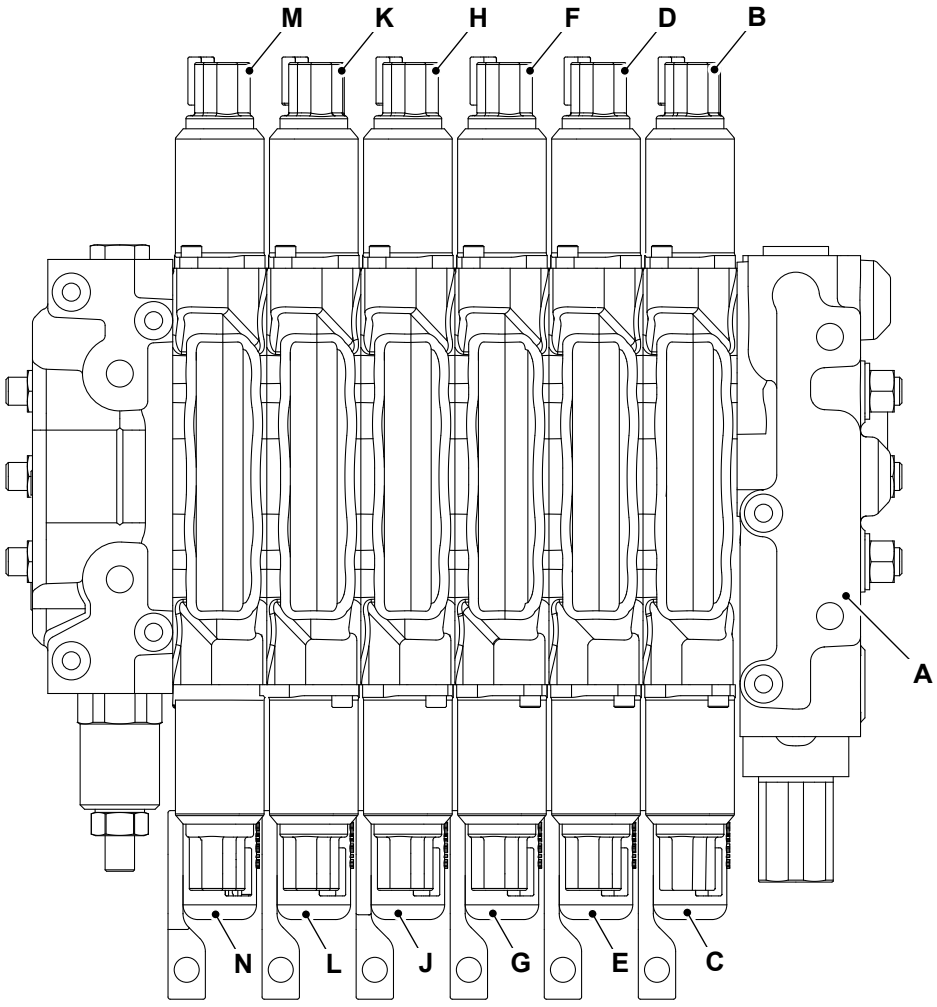
86 - Solenoid

00 - General

Component Identification

Figure 471. Main Boom Control Valve



A Main boom control valve
B Telescopic boom extend solenoid
C Telescopic boom retract solenoid
D Main boom up solenoid
E Main boom down solenoid
F Slew (left) solenoid
G Slew (right) solenoid
H Steering (right) solenoid
J Steering (left) solenoid
K Jib and platfrom (up and left) solenoid
L Jib and platfrom (down and right) solenoid
M Levelling up solenoid
N Levelling down solenoid

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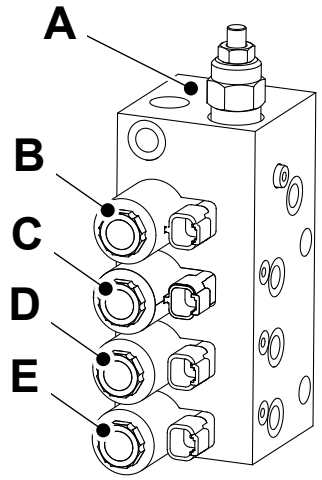
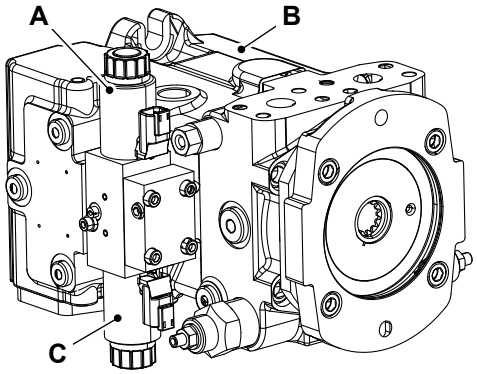
Figure 472. Brake Control Valve



A Brake control valve
B Axle oscillation solenoid
C Front brake solenoid
D Rear brake solenoid
E Travel speed control solenoid

Figure 473. Transmission Pump



A Reverse drive control solenoid
B Transmission pump
C Forward drive control solenoid

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Notes:

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72 - Fasteners and Fixings

Contents **Page No.**

72-00 Fasteners and Fixings
72-00-00 General 72-2
72-03 Screws
72-03-00 General 72-4
72-06 Bolts
72-06-00 General 72-6
72-21 Clips
72-21-03 Worm Drive 72-10

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00 - Fasteners and Fixings

00 - General

Introduction

JCB Fasteners (Before September 2017)

Some external fasteners on JCB machines are manufactured using an improved type of corrosion resistant finish. This type of finish is called Dacromet and replaces the original Zinc and Yellow Plating used on earlier machines. The two types of fasteners can be readily identified by colour and part number suffix. Refer to Table 1. Fastener Types.

Table 168.

Fastener Type	Colour	Part Number Suffix
Zinc and Yellow	Golden Finish	Z (e.g. 1315/3712Z)
Dacromet	Mottled Silver Finish	D (e.g. 1315/3712D)

Note: As the Dacromet fasteners have a lower torque setting than the Zinc and Yellow fasteners, the torque figures used must be relevant to the type of fastener.

A Dacromet bolt should not be used in conjunction with a Zinc or Yellow plated nut, as this could change the torque characteristics of the torque setting further. For the same reason, a Dacromet nut should not be used with a Zinc or Yellow plated bolt.

All bolts used on JCB machines are high tensile and must not be replaced by bolts of a lesser tensile specification.

Dacromet bolts, due to their high corrosion resistance are used in areas where rust could occur. Dacromet bolts are only used for external applications. They are not used in applications such as gearbox or engine joint seams or internal applications.

JCB Fasteners (After September 2017)

Table 169.

Fastener Type	Colour	Part Number Suffix
Zinc flake-silver	White aluminium (silver-grey), Dull	D (e.g. 1315/3712D)
Zinc and heavy trivalent passivated with seal	Silver (Bright iridescent)	V (e.g. 1315/3712V)
Zinc Nickel - silver/grey	Dark, dull silver grey	Not assigned
Zinc Nickel - black	Black, chalky texture	N (e.g. 1315/3712N)
Zinc flake - black	Black, slight gloss	B (e.g. 1315/3712B)

Torque and Angle Tightening

Insufficient pre-load of a bolted joint can cause major problems, such as cylinder head warp, leaking gasket joints etc. There are several methods of achieving an accurate pre-load of a bolted joint, the two main methods used on the JCB engine are:

- Torque Control Tightening - Using a torque meter to control the torque is the most popular means of controlling pre-load, and in the majority of instances this method is adequate. It should be noted that with this process, the majority of the torque is used to overcome friction, therefore slight variations in the frictional conditions can lead to large changes in the bolt pre-load.
- Angle Control Tightening - Where a more precise pre-load is required, the torque and angle tightening method is used. The bolt is tightened to a predetermined torque (this may be done in stages), and then as a final sequence, the bolt is tightened to a predetermined angle - this method of tightening the bolts results in a smaller variation in the final pre-load. It is critical that the predetermined tightening angle is accurately achieved, failure to tighten accurately to the specified angle could result in the bolt pre-load being incorrect - this will lead to eventual failures. It is good practice to replace all bolts that have been tightened using the torque + angle procedure.

Tightening Method

The following example explains the recommended torque and angle procedure. A torque angle gauge

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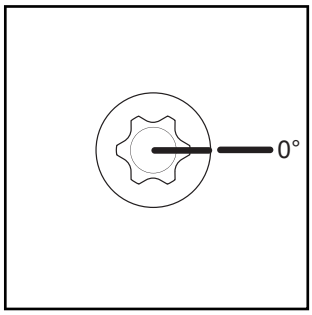
should be used for accuracy, but as a visual check, the bolts can be match marked as described below.

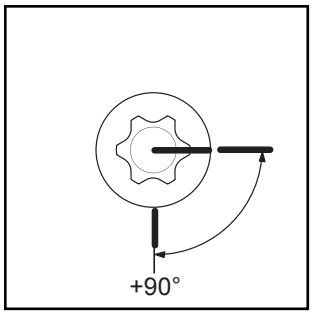
1. Tighten the bolt to the specified torque (specified torque values will be detailed in the relevant PIL sections).
2. Mark a line across the centre of the bolt, and a second line on the part to be clamped - the two lines should be aligned. Refer to Figure 474.

Figure 474.



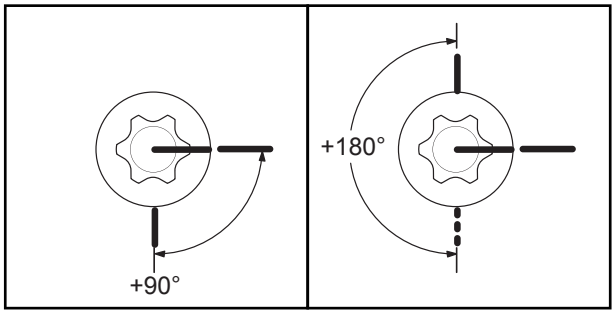
3. Mark a third line at the specified torque angle - in this instance the additional torque angle is 90°. This line must be marked the specified angle in a clockwise direction (to further tighten the bolt). Refer to Figure 475.

Figure 475.



4. In some instances, angle torque tightening can be specified in two stages, for instance in this example, the first angle quoted is 90° and then a second angle of 180°. The additional 180° angle is from the LAST tightened position. Refer to Figure 476.

Figure 476.



5. Tighten the bolt so that the line on the bolt aligns with the angle(s) marked on the item to be clamped - remember, to ensure complete accuracy an angle gauge should be used.

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03 - Screws

00 - General

Introduction 72-4
Technical Data 72-5

Introduction

Use the torque setting tables (Technical Data) only where no torque setting is specified in the text. Note: Dacromet fasteners are lubricated as part of the plating process, do not lubricate. Torque settings are given for the following conditions:

Table 170. Up to September 2017

Type	Condition 1	Condition 2
no coating	Unlubricated fasteners	Zinc flake silver (Dacromet) fasteners.
2 (obsolete from September 2017).	Zinc fasteners	Lubricated zinc and yellow plated fasteners.
3, 4 (obsolete from September 2017).	Yellow plated fasteners	Where there is a natural lubrication. For example, cast iron components.

Table 171. From September 2017

Type (suffix)	Condition 1	Condition 2
no coating	Unlubricated fasteners	Where there is a natural lubrication. For example, cast iron components
1 (D)		Zinc flake silver (Dacromet, Geomet) fasteners.
5 (V or Z)		Zinc and heavy trivalent with seal
7 (G)(1)		Zinc nickel - silver
8 (N)(1)		Zinc nickel - black
9 (B)(1)		Zinc flake - black

(1) With integrated torque control lubricant.

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Technical Data

Table 172. Torque Settings - Internal Hexagon Headed Capscrews (Zinc)

Bolt Size	
mm	**N·m**
3	2
4	6
5	11
6	19
8	46
10	91
12	159
16	395
18	550
20	770
24	1,332

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06 - Bolts

00 - General

Introduction 72-6
Technical Data 72-7

Introduction

Use the torque setting tables (Technical Data) only where no torque setting is specified in the text. Note: Dacromet fasteners are lubricated as part of the plating process, do not lubricate. Torque settings are given for the following conditions:

Table 173. Up to September 2017

Type	Condition 1	Condition 2
no coating	Unlubricated fasteners	Zinc flake silver (Dacromet) fasteners.
2 (obsolete from September 2017).	Zinc fasteners	Lubricated zinc and yellow plated fasteners.
3, 4 (obsolete from September 2017).	Yellow plated fasteners	Where there is a natural lubrication. For example, cast iron components.

Table 174. From September 2017

Type (suffix)	Condition 1	Condition 2
no coating	Unlubricated fasteners	Where there is a natural lubrication. For example, cast iron components
1 (D)		Zinc flake silver (Dacromet, Geomet) fasteners.
5 (V or Z)		Zinc and heavy trivalent with seal
7 (G)(1)		Zinc nickel - silver
8 (N)(1)		Zinc nickel - black
9 (B)(1)		Zinc flake - black

(1) With integrated torque control lubricant.

Verbus-Ripp Bolts

Torque settings for these bolts are determined by the application. Refer to the relevant procedure for the required settings.

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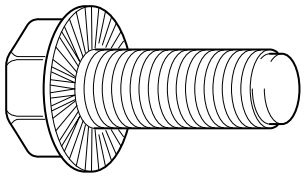
Figure 477.



Technical Data

From JCB standard STD00019 issue 07.

1. This information does not apply to:-
   1.1. Hydraulic fittings (i.e. BSP, SAE O-ring boss, UNF, four bolt split flange and JIC).
   1.2. Locking type fasteners (those with a nylon insert, or with distorted thread nuts such as Cleveloc).
2. For information on fastener conditions, refer to fasteners and fixings, bolts, general, introduction.

Table 175. Torque Settings - UNF S Fasteners

Bolt Size	Treads per Inch	Hexagon (A/F)	Condition 1	Condition 2
in	in	in	N·m	N·m
(1/4 in)	28	7/16	11.2	10
(5/16 in)	24	1/2	22.3	20
(3/8 in)	24	9/16	40	36
(7/16 in)	20	5/8	64	57
(1/2 in)	20	3/4	98	88
(9/16 in)	18	13/16	140	126
(5/8 in)	18	15/16	196	177
(3/4 in)	16	1 1/8	343	309
(7/8 in)	14	1 15/16	547	492
(1 in)	12	1 1/2	814	732
(1 1/8 in)	12	1 7/8	1,181	1,063
(1 1/4 in)	12	2 1/4	1,646	1,481

Table 176. Torque Settings - UNF X Fasteners

Bolt Size	Treads per Inch	Hexagon (A/F)	Condition 1	Condition 2
in	in	in	N·m	N·m
(1/4 in)	28	7/16	17.6	15.9
(5/16 in)	24	1/2	35.2	31.6
(3/8 in)	24	9/16	64	57
(7/16 in)	20	5/8	101	91
(1/2 in)	20	3/4	155	139
(9/16 in)	18	13/16	221	199
(5/8 in)	18	15/16	310	279
(3/4 in)	16	1 1/8	542	488
(7/8 in)	14	1 15/16	864	777
(1 in)	12	1 1/2	1,285	1,156
(1 1/8 in)	12	1 7/8	1,865	1,679
(1 1/4 in)	12	2 1/4	2,598	2,339

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Table 177. Torque Settings - Coarse Metric Grade 8.8 Fasteners

Bolt Size	Tread Pitch	Hexagon (A/F)	Condition 1	Condition 2
mm	mm	mm	N·m	N·m
4	0.7	7	2.9	2.6
5	0.8	8	5.8	5.2
6	1	10	9.9	9
8	1.25	13	24	22
10	1.5	17	47	43
12	1.75	19	83	74
14	2	22	132	119
16	2	24	205	184
20	2.5	30	400	360
24	3	36	690	621
30	3.5	46	1,372	1,235
36	4	55	2,399	2,159

Table 178. Torque Settings - Coarse Metric Grade 10.9 Fasteners

Bolt Size	Thread Pitch	Hexagon (A/F)	Condition 1	Condition 2
mm	mm	mm	N·m	N·m
4	0.7	7	4	3.6
5	0.8	8	8.1	7.3
6	1	10	13.9	12.5
8	1.25	13	34	30
10	1.5	17	67	60
12	1.75	19	116	104
14	2	22	185	167
16	2	24	288	259
20	2.5	30	562	506
24	3	36	971	874
30	3.5	46	1,930	1,737
36	4	55	3,374	3,036

Table 179. Torque Settings - Coarse Metric Grade 12.9 Fasteners

Bolt Size	Thread Pitch	Hexagon (A/F)	Condition 1	Condition 2
mm	mm	mm	N·m	N·m
4	0.7	7	4.8	4.4
5	0.8	8	9.8	8.8
6	1	10	16.6	15
8	1.25	13	40	36
10	1.5	17	80	72
12	1.75	19	139	125
14	2	22	223	200
16	2	24	345	311
20	2.5	30	674	607
24	3	36	1,165	1,048
30	3.5	46	2,316	2,084
36	4	55	4,049	3,644

Table 180. Torque Settings - Fine Metric Grade 8.8 Fasteners

Bolt Size	Tread Pitch	Nominal Stress Area	Proof Load	Preload (75% Proof Load)	Torque
mm	mm	mm²	kN	kN	N·m
8	1	39.2	22.7	17.025	21
10	1.25	61.2	33.5	25.125	38
12	1.25	92.1	53.5	40.125	74
14	1.5	125	72.5	54.375	116
16	1.5	167	96.9	72.675	178
18	1.5	216	130	97.5	268
20	1.5	272	163	122.25	374
22	1.5	333	200	150	505
24	2	384	230	172.5	633

Table 181. Torque Settings - Fine Metric Grade 10.9 Fasteners

Bolt Size	Tread Pitch	Nominal Stress Area	Proof Load	Preload (75% Proof Load)	Torque
mm	mm	mm²	kN	kN	N·m
8	1	39.2	32.5	24.4	30
10	1.25	61.2	50.8	38.1	58
12	1.25	92.1	76.3	57.2	105
14	1.5	125	104	93.8	201
16	1.5	167	139	104.3	255
18	1.5	216	179	134	370
20	1.5	272	226	169.5	519
22	1.5	333	276	207	698
24	2	384	319	239.3	879

Table 182. Torque Settings - Fine Metric Grade 12.9 Fasteners

Bolt Size	Tread Pitch	Nominal Stress Area	Proof Load	Preload (75% Proof Load)	Torque
mm	mm	mm²	kN	kN	N·m
8	1	39.2	38	28.5	35
10	1.25	61.2	59.4	44.5	68

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Bolt Size	Tread Pitch	Nominal Stress Area	Proof Load	Preload (75% Proof Load)	Torque
mm	mm	mm²	kN	kN	N·m
12	1.25	92.1	89.3	67	123
14	1.5	125	121	90.75	195
16	1.5	167	162	121.5	297
18	1.5	216	210	157.5	434
20	1.5	272	264	198	606
22	1.5	333	323	242	733
24	2	384	372	279	1,025

Table 183. Torque Settings - Rivet Nuts / Bolts

Bolt Size	
mm	N·m
3	1.2
4	3
5	6
6	10
8	24
10	48
12	82

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21 - Clips

03 - Worm Drive

Introduction 72-10
Technical Data 72-11
Component Identification 72-14

Introduction

Plain Worm Drive Clips

There are three types of plain worm drive clips.

- Standard worm drive clip
- Heavy duty worm drive clip
- Spring assisted worm drive clip

Spring assisted worm drive clip contains a spring insert on the inside of the band to provide compensation against hose compression set.

Use the torque setting tables (Technical Data) only where no torque setting is specified in the text.

Constant Torque Worm Drive Clips

Your machine may be installed with constant torque worm drive clips.

Use the torque setting tables (Technical Data) only where no torque setting is specified in the text.

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Technical Data

Dimensions

Figure 478. Spring assisted Worm Drive Clips

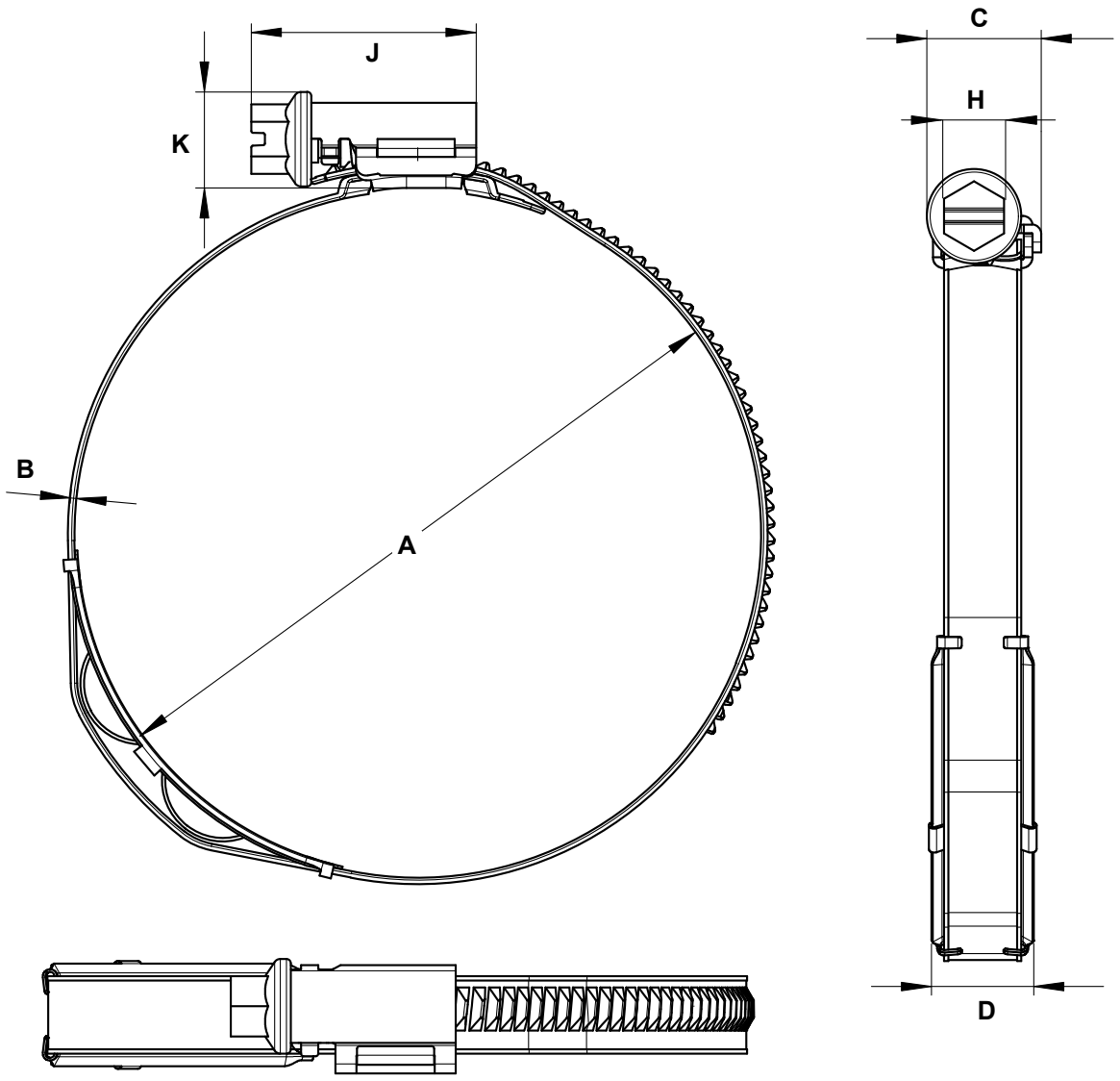

Table 184.

A	B	C	D	H	J	K
Clamping range	**Band thick-ness**	**Housing width**	**Band width**	**Hex size across flats**	**Bolt and housing length**	**Bolt and housing overall height**
Spring assisted worm drive clips						
10→16mm	0.65mm	13mm	9mm	7mm	21mm	11mm
12→22mm					24mm	

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A	B	C	D	H	J	K
Clamping range	**Band thick-ness**	**Housing width**	**Band width**	**Hex size across flats**	**Bolt and housing length**	**Bolt and housing overall height**
16→27mm up to 60→80mm	0.8mm	14.6mm	12mm		30mm	12.5mm
70→90mm up to 160→180mm					36mm	
Heavy duty worm drive clips						
172→206mm	0.7mm	23.1mm	16mm	7mm	37mm	13mm

Figure 479. Constant Torque Worm Drive Clips

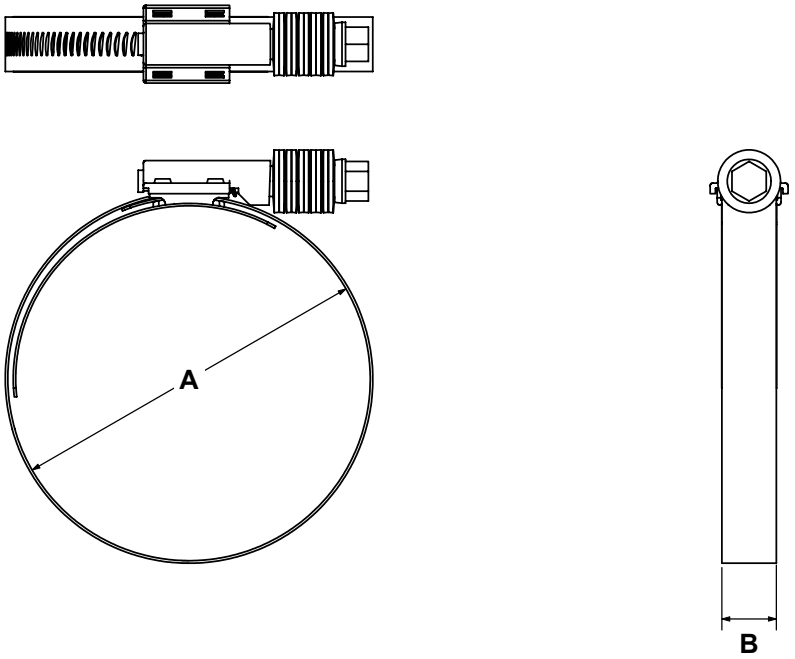

Table 185.

A	B
Clamping range	**Band Width**
14→27mm	14.2mm
25→45mm	15.7mm
32→54mm	15.7mm
45→67mm	15.7mm
54→79mm	15.7mm
70→92mm	15.7mm
83→105mm	15.7mm
95→118mm	15.7mm

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Torque Values

Table 186. Heavy Duty Worm Drive Clip

Clamping range	Part number	Torque values
172→194mm	2201/0022	10 →0/+0.5N·m
184→206mm	2201/0023	10 →0/+0.5N·m

Table 187. Spring Assisted Worm Drive Clip

Clamping range	Part number	Torque values
10→16mm	2206/0816	2 →0/+0.5N·m
12→22mm	2206/1222	3 →0/+0.5N·m
16→27mm	2206/1627	5 →0/+0.5N·m
20→32mm	2206/2032	5 →0/+0.5N·m
25→40mm	2206/2540	5 →0/+0.5N·m
30→45mm	2206/3045	5 →0/+0.5N·m
35→50mm	2206/3550	5 →0/+0.5N·m
40→60mm	2206/4060	5 →0/+0.5N·m
50→70mm	2206/5070	5 →0/+0.5N·m
60→80mm	2206/6080	5 →0/+0.5N·m
70→90mm	2206/7090	5 →0/+0.5N·m
80→100mm	2206/8010	5 →0/+0.5N·m
90→110mm	2206/9011	5 →0/+0.5N·m
100→120mm	2206/1012	5 →0/+0.5N·m
110→130mm	2206/1113	5 →0/+0.5N·m
120→140mm	2206/1214	5 →0/+0.5N·m
130→150mm	2206/1315	5 →0/+0.5N·m
140→160mm	2206/1416	5 →0/+0.5N·m
150→170mm	2206/1517	5 →0/+0.5N·m
160→180mm	2206/1618	5 →0/+0.5N·m
170→190mm	2206/1719	5 →0/+0.5N·m
180→200mm	2206/1820	5 →0/+0.5N·m
190→210mm	2206/1921	5 →0/+0.5N·m

Table 188. Constant Torque Worm Drive Clips

Clamping range	Part number	Torque values
14→27mm	334/J4514	5N·m
25→45mm	334/J9549	10N·m
32→54mm	333/K2259 OR 400/P2870	10N·m
45→67mm	821/10236	10N·m
54→79mm	821/10191	10N·m
70→92mm	821/10192	10N·m
83→105mm	332/K3479	10N·m
95→118mm	332/S8033	10N·m

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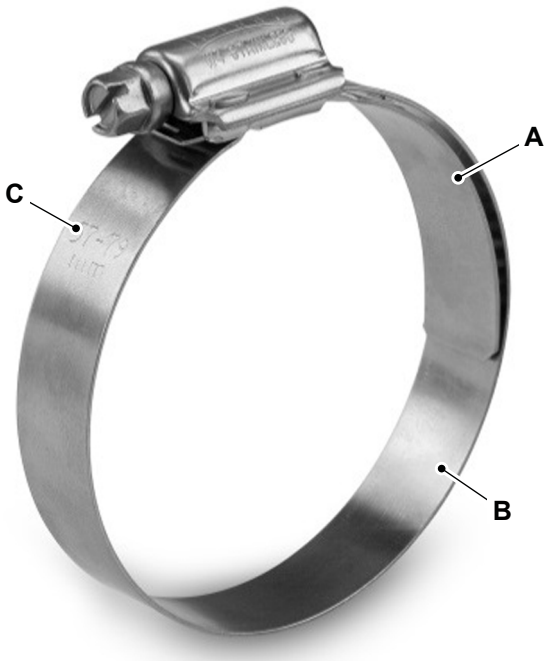
Component Identification

Figure 480. Standard Worm Drive Clip

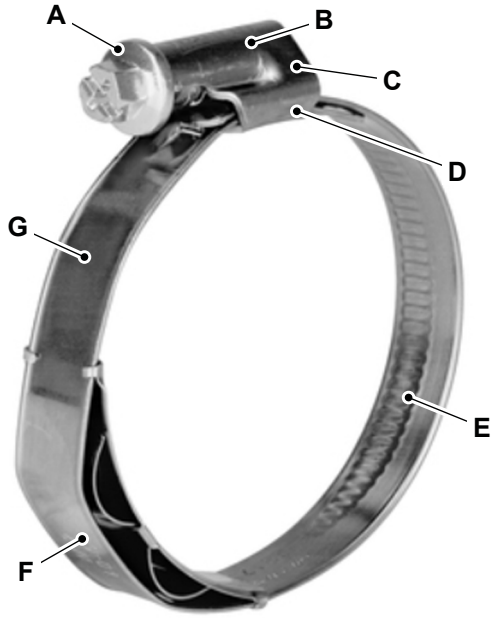
A Screw support flange
B Asymmetric housing
C Asymmetric extension
D Short housing saddle
E Stamped inside
F Identification of material/clamping range

Figure 481. Heavy Duty Worm Drive Clip



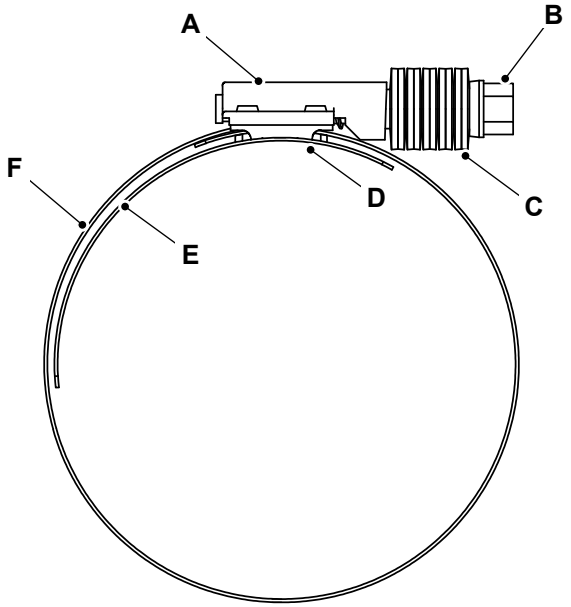
A Extended bridge
B Band width (16mm)
C Identification of clamping range

Figure 482. Spring Assisted Worm Drive Clip



A Screw support flange
B Asymmetric housing
C Asymmetric extension
D Short housing saddle
E Stamped inside
F Spring insert
G Identification of material/clamping range

Figure 483. Constant Torque Worm Drive Clips



A Housing
B Screw
C Belleville spring
D Saddle
E Liner
F Band

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75 - Consumable Products

Contents **Page No.**

Acronyms Glossary 75-2

75-00 Consumable Products
- 75-00-00 General 75-3
- 75-00-03 Parts List 75-7

75-03 Oil
- 75-03-00 General 75-8

75-06 Grease
- 75-06-00 General 75-9

75-09 Fluids
- 75-09-00 General 75-12
- 75-09-03 Antifreeze 75-13

75-10 Locking Fluids
- 75-10-00 General 75-15

75-14 Solvents and Primers
- 75-14-00 General 75-18

75-15 Adhesive
- 75-15-00 General 75-21

75-16 Sealant
- 75-16-00 General 75-26

75-18 Fuel
- 75-18-00 General 75-32

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Acronyms Glossary

PTFE	Polytetrafluoroethylene

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00 - Consumable Products

00 - General

Introduction 75-3
Health and Safety 75-4
Technical Data 75-6

Introduction

JCB recommend that you use the JCB lubricants shown as they have been verified by JCB for use on JCB machines. However, you could use other lubricants that are equivalent to the JCB standards and quality or offer the same machine component protection.

Before you start work, make sure that:

- All safety precautions are observed in accordance with the information contained within the relevant support documentation.
- The consumables are used in accordance with the manufacturer's recommendations.
- The consumables shown are available in the correct quantity.

Consumables other than those listed may be required. It is expected that general consumables will be available in any well equipped workshop or be available locally.

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Health and Safety

Oil

Oil is toxic. If you swallow any oil, do not induce vomiting, seek medical advice. Used engine oil contains harmful contaminants which can cause skin cancer. Do not handle used engine oil more than necessary. Always use barrier cream or wear gloves to prevent skin contact. Wash skin contaminated with oil thoroughly in warm soapy water. Do not use petrol, diesel fuel or paraffin to clean your skin.

Fluid Under Pressure

Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of fluid under pressure and wear personal protective equipment. Hold a piece of cardboard close to suspected leaks and then examine the cardboard for signs of fluid. If fluid penetrates your skin, get medical help immediately.

Fuel

Fuel is flammable, keep naked flames away from the fuel system. Stop the engine immediately if a fuel leak is suspected. Do not smoke while refuelling or working on the fuel system. Do not refuel with the engine running. Completely wipe off any spilt fuel which could cause a fire. There could be a fire and injury if you do not follow these precautions.

Hygiene

JCB lubricants are not a health risk when used correctly for their intended purposes.

However, excessive or prolonged skin contact can remove the natural fats from your skin, causing dryness and irritation.

Low viscosity oils are more likely to do this, so take special care when handling used oils, which might be diluted with fuel contamination.

Whenever you are handling oil products you must maintain good standards of care and personal and plant hygiene. For details of these precautions we advise you to read the relevant publications issued by your local health authority, plus the following.

Storage

Always keep lubricants out of the reach of children.

Never store lubricants in open or unlabelled containers.

Waste Disposal

⚠ **CAUTION** It is illegal to pollute drains, sewers or the ground. Clean up all spilt fluids and/or lubricants.

Used fluids and/or lubricants, filters and contaminated materials must be disposed of in accordance with local regulations. Use authorised waste disposal sites.

CAUTION Damaged or spent batteries and any residue from fires or spillage must be put in a suitable closed receptacle and must be disposed of in accordance with local environmental waste regulations.

All waste products must be disposed of in accordance with all the relevant regulations.

The collection and disposal of used oil must be in accordance with any local regulations. Never pour used engine oil into sewers, drains or on the ground.

Handling

⚠ **CAUTION** The temperature of the hydraulic oil will be high soon after stopping the machine. Wait until it cools before beginning maintenance.

New Oil

There are no special precautions needed for the handling or use of new oil, beside the normal care and hygiene practices.

Used Oil

Used engine crankcase lubricants contain harmful contaminants.

Here are precautions to protect your health when handling used engine oil:

- Avoid prolonged, excessive or repeated skin contact with used oil
- Apply a barrier cream to the skin before handling used oil. Note the following when removing engine oil from skin:
  - Wash your skin thoroughly with soap and water
  - Using a nail brush will help
  - Use special hand cleansers to help clean dirty hands
  - Never use petrol, diesel fuel, or paraffin for washing
- Avoid skin contact with oil soaked clothing
- Don't keep oily rags in pockets
- Wash dirty clothing before re-use
- Throw away oil-soaked shoes

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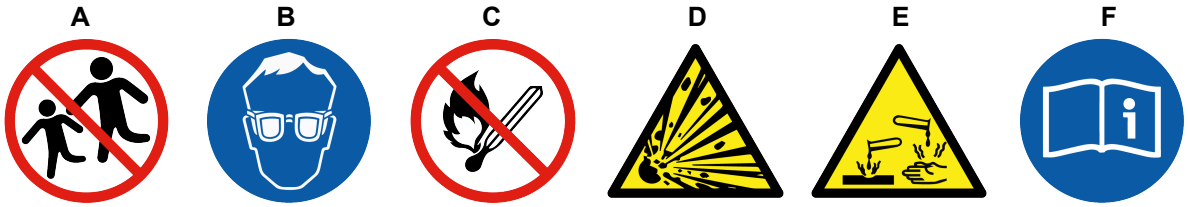
Battery

Warning Symbols

The following warning symbols may be found on the battery.

Figure 484.



A Keep away from children
B Shield eyes
C No smoking, no naked flames, no sparks
D Explosive gas
E Battery acid
F Note operating instructions

First Aid - Oil

Eyes

In the case of eye contact, flush with water for 15min. If irritation persists, get medical attention.

Swallowing

If oil is swallowed do not induce vomiting. Get medical advice.

Skin

In the case of excessive skin contact, wash with soap and water.

Spillage

Absorb with sand or a locally approved brand of absorbent granules. Scrape up and remove to a chemical disposal area.

Fires

⚠ **WARNING** Do not use water to put out an oil fire. This will only spread it because oil floats on water.

Extinguish oil and lubricant fires with carbon dioxide, dry chemical or foam.

First Aid - Electrolyte

Eyes

In the case of eye contact, flush with water for 15min. always get medical attention.

Swallowing

Do not induce vomiting. Drink large quantities of water or milk. Then drink milk of magnesia, beaten egg or vegetable oil. Get medical help.

Skin

Flush with water, remove affected clothing. Cover burns with a sterile dressing then get medical help.

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Technical Data

JCB recommend that you use the JCB lubricants shown as they have been verified by JCB for use on JCB machines. However, you could use other lubricants that are equivalent to the JCB standards and quality or offer the same machine component protection.

Table 189. Fluids, Lubricants and Capacities

Item	Capacity	Fluid/Lubricant	JCB Part Number	Container Size [1]	Specification
Fuel Tank	125L	Diesel Oil	-		
Engine Oil	16L	-20°C (-4°F) to 45°C (112.9°F) JCB High performance 5W40	4001/2705	20L	CH-4 or higher
Engine coolant (inorganic)[2]	25L	JCB Antifreeze HP/ Coolant/Water	4006/1120	20L	ASTM D6210
Engine OAT (organic acid technology)[2]	25L	JCB OAT Coolant	4006/1805	20L	ASTM D6210
Hydraulic System	System: 165L	-20°C (-4.0°F) to 46°C (114.7°F): JCB Hydraulic oil HP 32	4002/1025	20L	VG32 Grade oil: Cold climate region
	Tank: 200L	0°C (32.0°F) to 55°C (130.9°F): HVI Hydraulic oil	4002/3000		VG46 Grade oil: Hot climate region
Slew Ring Bearings	As required	JCB HP Grease	4003/2017	0.4kg	
Slew Ring Gear Teeth	As required	JCB Special Slew Pinion Grease	4003/1619	0.4kg	
Slew Gearbox	2.3L	Gear oil (slew) 80W90	4000/4500 or 4000/3400		Hot climate range: 0→51°C (32.0→123.7°F) Temperate climate range: -20→46°C (-4.0→114.7°F)
Transmission/Hub Oil	0.68L	Gear oil (slew) 80W90	4000/4500 or 4000/3400		Hot climate range: 0→51°C (32.0→123.7°F) Temperate climate range: -20→46°C (-4.0→114.7°F)
All Other Grease	As required	JCB MPL-EP Grease	4003/1501	0.4kg	
Boom wear pad greasing	As required	PTFE high temperature grease	4003/4405	As required	

(1) For information about the different container sizes that are available (and their part numbers), contact your local JCB dealer. Transmission oil required - 2.8L (4000/4900).
(2) Check which coolant type is installed in the machine before topping up the coolant. Mixing of different coolant types is not recommended and may result in invalidation of the warranty offered by JCB. In the event of mixing or if the coolant type is to be changed, the coolant circuit should be completely drained and flushed twice with clean water before re-filling with fresh coolant.

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03 - Parts List

Introduction

Consumables

Description	Part No.	Size
Antifreeze HP/Coolant ASTM D6210 Concentrate	4006/1101	5L
	4006/1120	20L
	4006/1103	200L
EP Hammer Grease	4003/2107	0.4kg
	4003/2106	12.5kg
Extreme Performance Moly Grease	4003/1327	0.4kg
	4003/1326	12.5kg
JCB Autogrease	4003/2305	0.5kg
Special HP Grease	4003/2020	0.5kg
	4003/2017	0.4kg
	4003/2006	12.5kg
	4003/2005	50kg
Special Hammer Grease	4003/1119	0.4kg
Special MPL-EP Grease	4003/1501	0.4kg
	4003/1506	12.5kg
	4003/1510	50kg
Special Slew Pinion Grease	4003/9999	0.4kg
Surface Cleaning Fluid	4103/1204	1L
Wiring Splice (0.5-1.5mm Red, contains 50 off)	892/00351	-
Wiring Splice (1.5-2.5mm Blue, contains 50 off)	892/00352	-
Wiring Splice (3-6mm Yellow, contains 50 off)	892/00353	-
Wiring Splice-Bootlace (1mm Red)	7205/0100	-
Wiring Splice-Bootlace (2.5mm Grey)	7205/0250	-

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03 - Oil

00 - General

Introduction

New Oil

There are no special precautions needed for the handling or use of new oil, besides the normal health and safety practices mentioned in the relevant section of this service manual.

Used Oil

Used engine crankcase lubricants contain harmful contaminants. Here are precautions to protect your health when handling used engine oil:

1. Avoid prolonged, excessive or repeated skin contact with used oil.
2. Apply a barrier cream to the skin before handling used oil.
3. Note the following when removing engine oil from skin:
   - 3.1. Wash your skin thoroughly with soap and water.
   - 3.2. Using a nail brush will help.
   - 3.3. Use special hand cleansers to help clean dirty hands.
   - 3.4. Never use petrol, diesel fuel, or paraffin for washing.
4. Avoid skin contact with oil soaked clothing.
5. Don't keep oily rags in pockets.
6. Wash dirty clothing before re-use.
7. Throw away oil-soaked shoes.

First Aid

EYES - In the case of eye contact, flush with water for 15 minutes. If irritation persists, get medical attention.

SWALLOWING - If oil is swallowed do not induce vomiting. Get medical advice.

SKIN - In the case of excessive skin contact, wash with soap and water.

SPILLAGE - Absorb on sand or a locally approved brand of absorbent granules. Scrape up and remove to a chemical disposal area.

FIRES - Extinguish with carbon dioxide, dry chemical or foam. Firefighters should use self-contained breathing apparatus.

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06 - Grease

00 - General

Introduction

Special Tools

Description	Part No.	Qty.
Grease Gun Attachment	892/00913	1
Grease Gun	992/11300	1

Consumables

Description	Part No.	Size
EP Hammer Grease	4003/2107	0.4kg
	4003/2106	12.5kg
Extreme Performance Moly Grease	4003/1327	0.4kg
	4003/1326	12.5kg
JCB Autogrease	4003/2305	0.5kg
Special HP Grease	4003/2020	0.5kg
	4003/2017	0.4kg
	4003/2006	12.5kg
	4003/2005	50kg
Special Hammer Grease	4003/1119	0.4kg
Special MPL-EP Grease	4003/1501	0.4kg
	4003/1506	12.5kg
	4003/1510	50kg
Special Slew Pinion Grease	4003/9999	0.4kg

There are various greasing points on the machine. You must grease the machine regularly to keep it working efficiently. Regular greasing will also lengthen the machine's working life. You must grease the machine as stated in the maintenance schedule. Refer to: PIL 78-24.

JCB grease is manufactured to provide significant load protection for your machine. It is recommended to use only JCB grease on your machine because they are specifically designed for the particular application. The list of JCB greases comprises:

1. JCB Special HP Grease
   Consumable: Special HP Grease
2. JCB Special MPL-EP Grease
   Consumable: Special MPL-EP Grease
3. JCB Extreme Performance Moly Grease
   Consumable: Extreme Performance Moly Grease
4. JCB Autogrease
   Consumable: JCB Autogrease
5. JCB EP Hammer Grease
   Consumable: EP Hammer Grease
6. JCB Special Hammer Grease
   Consumable: Special Hammer Grease
7. JCB Special Slew Pinion Grease
   Consumable: Special Slew Pinion Grease

Greasing Procedure

1. Make the machine safe.
   Refer to: PIL 01-03.
2. Make a note of the following:
   2.1. The machine must always be greased after pressure washing or steam cleaning.
   2.2. Greasing must be done with a grease gun. Normally, two strokes of the gun should be sufficient.
   Special Tool: Grease Gun (Qty.: 1)
   Special Tool: Grease Gun Attachment (Qty.: 1)
   2.3. Stop greasing when fresh grease appears at the joint.
   2.4. Use only the recommended type of grease.
   2.5. Do not mix different types of grease, keep them separate.
3. Count off the grease points as you grease each one.
4. Install the dust caps after greasing (if installed).

JCB Special HP Grease

JCB Special HP grease is a premium quality, extreme pressure grease. It is recommended for use in arduous operating conditions, such as high temperatures, excessive loading and extensive exposure to water. The sophisticated additive package combines with excellent adhesive properties to give high performance protection to your machine.

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Table 190. JCB Special HP Grease Properties

Description	Data
Colour	Blue
Soap type	Lithium complex
Drop point	245°C (472.7°F)
Working temperature range	-20→150°C (-4.0→301.8°F)

JCB Special MPL-EP Grease

JCB Special MPL-EP grease is a true multipurpose grease. It is recommended for a wide range of lubricating applications, such as pivot pins and wheel bearings, where excellent anti wear and anti rust performance is required. Its EP additive makes it particularly suitable for the shock load and vibrating conditions found on machines.

Table 191. JCB Special MPL-EP Grease Properties

Description	Data
Colour	Brown
Soap type	Lithium
Drop point	180°C (355.7°F)
Working temperature range	-20→130°C (-4.0→265.8°F)

JCB Extreme Performance Moly Grease

JCB Extreme Performance Moly grease is an advanced performance, multipurpose grease. It is recommended for heavily loaded bearing surfaces and in particular where limited or oscillating motion causes fretting. The addition of molybdenum disulphide provides extra protection against scoring and wear. This grease is ideal for automotive, industrial, agricultural and earthmoving equipment.

Table 192. JCB Extreme Performance Moly Grease Properties

Description	Data
Colour	Grey Black
Soap type	Lithium
Drop point	185°C (364.7°F)
Working temperature range	-20→120°C (-4.0→247.8°F)

JCB Autogrease

JCB Autogrease is for use with the automatic greasing system. It is a mineral oil based paste. It contains an aluminium complex soap and solid lubricants. It is suitable for use under water or in high ambient temperatures. The specially designed cartridges screw into the automatic greasing system installed on the machine.

The clear cartridge allows the operator to easily monitor the grease usage from inside of the operator station.

Table 193. JCB Autogrease

Description	Data
Colour	Black
Soap type	Aluminium complex, solid lubricants
Drop point	260°C (499.6°F)
Working temperature range	-20→110°C (-4.0→229.8°F)

JCB EP Hammer Grease

JCB EP Hammer grease is a unique formulation aluminium complex grease for use where extremes of pressure and temperature are likely to be encountered. It is suitable for the hammer applications where resistance to water washing and migration may be critical.

Table 194. JCB EP Hammer Grease

Description	Data
Colour	Black
Soap type	Aluminium complex
Drop point	250°C (481.6°F)
Working temperature range	-20→160°C (-4.0→319.8°F)

JCB Special Hammer Grease

JCB Special Hammer grease provides a highly effective lubricant on slow moving slides and an excellent corrosion resistant property. It combines the self healing action of oils and the resistance to drip of viscous compounds.

Table 195. JCB Special Hammer Grease

Description	Data
Colour	Dark grey
Soap type	Lithium
Drop point	185°C (364.7°F)
Working temperature range	-15→120°C (5.0→247.8°F)

JCB Special Slew Pinion Grease

JCB Special Slew Pinion grease is a soft, black and tenacious grease. It is designed specifically for the lubrication of large and heavy duty open gears. It has an excellent corrosion protection and load carrying properties throughout a large temperature range.

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Table 196. JCB Special Slew Pinion Grease

Description	Data
Colour	Black
Soap type	Organically modified clay
Working temperature range	-40→100°C (-39.9→211.9°F)

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09 - Fluids

00 - General

Introduction

It is most important that you read and understand this information and the publications referred to. Make sure all your colleagues who are concerned with lubricants read it too.

Hygiene

JCB lubricants are not a health risk when used properly for their intended purposes.

However, excessive or prolonged skin contact can remove the natural fats from your skin, causing dryness and irritation.

Low viscosity oils are more likely to do this, so take special care when handling used oils, which might be diluted with fuel contamination.

Whenever you are handling oil products you should maintain good standards of care and personal and plant hygiene. For details of these precautions we advise you to read the relevant publications issued by your local health authority, plus the following.

Storage

Always keep lubricants out of the reach of children. Never store lubricants in open or unlabelled containers.

Waste Disposal

All waste products should be disposed of in accordance with all the relevant regulations.

The collection and disposal of used oil should be in accordance with any local regulations. Never pour used engine oil into sewers, drains or on the ground.

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03 - Antifreeze

Introduction 75-13
Health and Safety 75-14

Introduction

⚠ **WARNING** Coolant can be harmful and is restricted to professional users only. Obey the manufacturer's instructions when handling full strength or diluted coolant and always use appropriate PPE. Inappropriate coolant handling may damage fertility or the unborn child.

Notice: Check which coolant type is installed in the machine before topping up the coolant. Mixing of different coolant types is not recommended and may result in invalidation of the warranty offered by JCB. In the event of mixing or if the coolant type is to be changed, the coolant circuit should be completely drained and flushed twice with clean water before re-filling with fresh coolant.

Check the strength of the coolant mixture at least once a year, preferably at the start of the cold period.

Replace the coolant mixture according to the intervals shown in the machine's Service Schedule.

You must dilute full strength coolant with clean water before use. You must dilute full strength coolant with distilled or de-ionized water.

The correct concentration of coolant protects the engine against frost damage in winter and provides year round protection against corrosion.

Table 197.

Concentration	Level of protection
50% (Standard)	Protects against damage down to -40°C (-40°F)
60% (Extreme Conditions Only)	Protects against damage down to -56°C (-69°F)

Do not exceed a 60% concentration, as the freezing protection provided reduces beyond this point.

- Make sure that the coolant complies with specification in this manual.
- Always read and understand the manufacturer's instructions.
- Make sure that a corrosion inhibitor is included. Serious damage to the cooling system can occur if corrosion inhibitors are not used.
- Care should be taken to not mix coolant types. Mixing coolant will have a detrimental effect on the performance of the coolant.

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Health and Safety

⚠ **CAUTION** The cooling system is pressurised when the coolant is hot. If you remove the cap, hot coolant can spray out and burn you. Make sure that the engine is cool before you work on the cooling system.

WARNING Coolant can be harmful and is restricted to professional users only. Obey the manufacturer's instructions when handling full strength or diluted coolant and always use appropriate PPE. Inappropriate coolant handling may damage fertility or the unborn child.

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10 - Locking Fluids

00 - General

Introduction 75-15
Technical Data 75-16

Introduction

All locking fluids should be used at all times in line with the manufacturer's recommendations.

Locking fluids are used for the locking of threaded fasteners and for the retention of ball & roller bearings and similar cylindrical items on to shafts and into housings. These fluids consist of an anaerobic resin in a liquid form which hardens when confined between closely fitting metal to metal and many metal to non-metal surfaces.

The fluids available possess a wide span of break-loose strengths, viscosities and gap filling properties and are marketed for a variety of locking and retaining purposes requiring different strength grades. Some of the sealants in use in JCB are also of anaerobic resin type and only differ from the locking fluids in respect of viscosity and other technical details.

Strength grades

Various strength grades of fluid are available, the highest strength type for permanent locking where disassembly is unlikely, medium strength for permanent locking but allowing disassembly with ordinary tools and low strength for locking of components where frequent adjustment or easy dismantling is required.

It is recommended that trials be carried out before scheduling locking fluids for any new type of application that has not been already proved as satisfactory in production or when use at elevated temperatures is intended.

Additional technical information is normally available from the product manufacturers.

Approved locking fluids

The table shown in Technical Data shows the approved locking fluids available to use on JCB machines. The table also provides basic details to help with selection of locking fluids. More up to date information can be found on the manufacturer's website.

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Technical Data

Table 198. Locking Fluids Approved Product Information

Subsection	Commercial name	Product Number	Colour	Shelf life	Strength	Comments
High strength	Loctite 270(1)	4101/0100	Green fluorescent	365d	80→120bar (1,160.3→1,740.5psi) breakaway strength	For the retention of threads up to M20 diameter where disassembly is unlikely and for locking bearings etc. onto shafts and into housing. Has a maximum gap fill of 0.05mm.
	R.A.S. threadlock for studs(1)		Red			
High strength	Loctite 638	4101/1400	Green, UV fluorescent	365d	More than 250bar (3,625.9psi) compressive shear strength	Maximum gap fill of 0.25mm. Maximum strength at room temperature.
High strength	Permabond A115(1)	4101/0500	Red, fluorescent	365d	100→150bar (1,450.4→2,175.6psi) prevailing strength	Fast curing (10→15min) thread locking up to M36, especially for use on oily surfaces, plated and clean parts.
	Loctite 262					
High strength	Loctite 648(1)	4101/0600	Green, fluorescent	365d	More than 250bar (3,625.9psi) compressive shear strength	Designed for holding gears and sprockets onto gearbox shafts and rotors on electric motor shafts.
	Permabond A118					
High strength	Loctite 2701	4101/1700	Green	365d	260→500bar (3,771.0→7,251.9psi) breakaway torque	Designed for permanent locking and sealing of threaded fasteners. Particularly suited for use on inactive substrates and/or where maximum resistance to hot oil is required.
Medium to high	Loctite 243	4101/1100	Blue	365d	140→340bar (2,030.5→4,931.3psi) breakaway torque	Suitable for all nuts, bolts, screws up to M36.
Medium strength	Permabond A119(1)	4101/0900	Blue	365d	80→120bar (1,160.3→1,740.5psi) static shear strength	Maximum gap fill of 0.25mm. Handling strength in 10→15min.
Medium strength	Loctite 640	4101/1200	Green, fluorescent	365d	150→330bar (2,175.6→4,786.2psi) static shear strength	Product has a slow cure rate, used on parts that need to be disassembled.
Medium strength	Loctite 242(1)	4101/0200	Blue, fluorescent	365d	80→120bar (1,160.3→1,740.5psi) static shear strength	Suitable for all nuts, bolts and screws up to M36 and hydraulic fittings up to 25mm in diameter. Permabond A113 and A1042 are the preferred choices. The difference between A113 and A1042 is timing for handling and working strength. A113 handling time 10→25min, working strength 1h. A1042 handling time 5→10min, working strength 30min.
	Permabond A1042					
	Permabond A113					

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Subsection	Commercial name	Product Number	Colour	Shelf life	Strength	Comments
Low strength	Loctite 222	4101/0300	Purple, fluorescent	365d	15→40bar (217.6→580.2psi)	For screwed fasteners up to M20 that require easy disassembly or frequent adjustment. Maximum gap fill of 0.05mm. Achieves handling strength in 10→30min.
Low strength	Permabond A1098	4101/1500	Blue	365d	120bar (1,740.5psi) shear strength	Allows dismantling of parts for maintenance. Suitable for sealing small hydraulic and pneumatic fittings. Handling strength in 5→10min.
Low strength	Loctite 567	4101/1600	Off-white	365d	17bar (246.6psi) breakaway torque	For the locking and sealing of metal tapered threads and fittings. High lubricating properties prevent galling on stainless steel, aluminium and all other metal pipe threads and fittings.
Very low strength	Loctite 932[1] Permabond A011	4101/0400	Brown/red	365d	7→18bar (101.5→261.1psi) average shear strength	Can be disassembled with hand tools. 10→30min cure time for handling strength. Used on large diameter screw threads bigger than 50mm.

(1) This is a non preferred product.

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14 - Solvents and Primers

00 - General

Introduction 75-18
Technical Data 75-19

Introduction

This section contains information on primers, solvents, cleaning solutions etc. that are in use at JCB.

All primers and solvents should be used at all times in line with the manufacturer's recommendations.

Approved primers and solvents

The table shown in Technical Data shows the approved primers and solvents available to use on JCB machines. The table also provides basic details to help with the selection of primers and solvents. More up to date information can be found on the manufacturer's website.

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Technical Data

Table 199. Primers and Solvents Approved Product Information

Subsection	Commercial name	Product Number	Colour	Shelf life	Drying Time	Comments
Activator/Primer	Loctite 770	332/U7901	Colourless	365d	Less than 5s	Used to make low energy surfaces suitable for bonding with cyanocrylate adhesives. It is recommended for polyethylene, polypropylene, PTFE and thermoplastic rubber materials. Can be used with Loctite 406 (332/U7899).
Activator	Loctite 7455	4104/1700	Clear amber	730d	Apply and leave to dry for 30s before applying adhesive	HIGHLY FLAMMABLE. Organic accelerator, non CFC solvent based surface activator. Designed to promote the speed of cure of cyanoacrylic adhesives.
Activator	Loctite 7471[(1)] Permabond A905	4104/0200	Colourless	365d	1→3min	Used with anaerobic products it increases cure speed. Recommended for inert surfaces and large bond gaps.
Water proofing	Loctite water proofing	4104/0500	-	-	-	A water proofing solution for protecting joints made using cyanoacrylate adhesive. Apply to Loctite 495 (4103/0900).
Solvent	Loctite 7063[(1)]	4104/1500	Colourless	365d	1min at 20°C (68.0°F)	HIGHLY FLAMMABLE, cleaner and degreaser. Removes grease, oil and dirt from electrical parts, tools and precision equipment.
Cleaning fluid	Loctite 7070	4101/2200	Colourless	365d	No wipe 5→10min, post wipe 1→2min	Cleaning treatment to remove most greases, oils, lubrication fluids and metal cuttings
Cleaning fluid	Simple green extreme	332/E9240	Colourless	365d	-	An all purpose cleaner and degreaser used diluted in water for direct, spray and dip tank procedures.
Application fluid	A4G-BCJCB	4104/3300	Blue	730d	-	Vinyl labels application fluid for use with the insignia/livery labels.
Gasket cleaner	Loctite 7200	4104/3200	Colourless	730d	Allow 10→15min for gasket, 30min for silicone gasket.	This is a product to aid the removal of cured chemical gaskets. Apply for time specified and remove gasket with soft scraper.
Hand cleaner	Loctite 7855	4104/3100	Light grey	540d	-	Is a heavy duty hand cleaner, specially formulated for the most difficult to remove soils like polyurethane, paints, primers, adhesives etc. The product is free from silicone and harsh solvents. Can be used without water.
Hand cleaner	Sika hand cleaner	4104/1300	Off white	-	-	A non-abrasive hand cleaner for use when using direct glazing materials.

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Subsection	Commercial name	Product Number	Colour	Shelf life	Drying Time	Comments
Direct glazing	Sika activator	4104/2100	Clear	365d	10min minimum drying time	HIGHLY FLAMMABLE. A cleaning and activating agent specifically formulated for the treatment of bonded faces in direct glazing applications prior to applying the direct glazing adhesive.
Direct glazing	Sika remover 208 (use 4104/3600)	4104/1900 (1)	Transparent	-	-	A cleaning agent for removing contaminates on painted surfaces and glass.
Direct glazing	Sika cleaner 205 (use 4104/3600)	4104/1200 (1)	Clear	-	-	A cleaning agent for removing contaminates on painted surfaces and glass.
Direct glazing	Sika primer 209 (use 4104/3500)	4104/2300 (1)	Black	270d	-	Used to prepare painted surfaces and plastic substrates prior to bonding with Sikaflex products.
Direct glazing	Sika aktivator	4104/2400	Clear	365d	10min at more than 15°C (59.0°F) or 30min at less than 15°C (59.0°F)	Used to clean and give improved adhesion on glass, ceramic-coated glass, the cut face of old polyurethane adhesive beads, polyurethane coated windows glass and paints.
Active wipe for surface	Terostat 8560 AC-25	4104/3400	Colourless	270d	Minimum 30s and maximum 1h	Applied with a clean cloth to the surface, the adhesive may then be applied after the drying time. Applied to glass or ceramic coating but only in the bonding area.
Direct glazing	Terostat 8519 P	4102/3500	Black	365→540d	Approx. 2min	Used to promote adhesion in direct glazing to glass and glass ceramics.
Cleaner	Teroson FL cleaner	4104/3600	Clear	730d	Depending on conditions between 2→10min.	Used for degreasing and cleaning of substrates prior to application of adhesives and sealants.
Adhesion promoter	3M AP III	4104/3700	-	-	-	Used to prepare a painted surface before adhering (LDL) door seals (to increase adhesion of 3M 5337A) before installation of the cab.

(1) This is a non preferred product.

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15 - Adhesive

00 - General

Introduction 75-21
Technical Data 75-22

Introduction

All adhesives should be used at all times in line with the manufacturer's recommendations.

Adhesives are used for the bonding of a number of engineering materials used in production at JCB. Many types are available on the market but in the interests of variety reduction and economy only a limited selection is purchased for regular use.

Types of adhesive

Various types of adhesive are covered by JCB Standards:

1. General purpose adhesives for bonding laminated plastics, wood, rubber etc. to themselves and to each other.
2. The more expensive cyanoacrylate adhesives for use where high strength, resistance to many chemicals and fast cure times are required.
3. Adhesives specially developed for bonding of foam rubber to painted metal surfaces.

Additional health and safety for cyanoacrylates

These adhesives require very careful handling on account of their exceptional properties. They bond together strongly and rapidly to most surfaces including body tissue, the curing process being initiated by surface moisture. For further information on cyanoacrylates refer to the Manufacturer's recommendations.

Approved adhesives

The tables shown in Technical Data are the approved adhesives available to use on JCB machines. The tables also provide basic details to help with the selection of adhesives. More up to date information can be found on the manufacturer's website.

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Technical Data

Table 200. Adhesives Approved Product Information

Subsection	Commercial name	Product Number	Colour	Shelf life	Technical data	Comments
High strength	Permabond 5002	4103/3100	Mixed grey	730d	3→5min for handling strength	Two part adhesive mixed in equal parts. A toughened adhesive system which bonds metals, plastics, wood, glass, ceramics and composites; even plated or coated surfaces can be securely fastened.
High strength	Loctite 601	4103/1000	Green fluorescent	365d	160→300bar (2,320.6→4,351psi) static shear strength	This product is a single component anaerobic adhesive. Used to bond cylindrical fitting parts, particularly where low viscosity is required. Maximum gap fill is 0.15mm.
Cyanoacrylate	Loctite 424	4103/3500	Colourless to straw	-	180→260bar (2,610.7→3,771psi) shear strength	Suitable for most materials including plastics and rubber. Takes 30s to cure to working strength.
Cyanoacrylate	Loctite 401	4103/2300	Colourless	180d	180→260bar (2,610.7→3,771psi) tensile strength	Designed for general purpose use. For use on inert and porous surfaces, reaching handling strength in seconds. Materials include plated metals, composite materials, wood, cork, foam, leather and paper.
Cyanoacrylate	Loctite 406	332/U7899	Colourless	180d	180→260bar (2,610.7→3,771psi) lap shear strength	Designed for bonding of plastics and elastomers materials where very fast fixturing is required. Can be used with Loctite 770 as a primer (332/U7901)
Cyanoacrylate	Loctite 410	4103/2400	Black	120d	220bar (3,190.8psi) lap shear strength	0.2mm, gap fill. A rubber toughened ethyl cyanoacrylate adhesive with enhanced resistance to peel and shock. Bonds rubber, metals and plastics for use in difficult conditions.
Cyanoacrylate	Loctite 480	4103/3800	Black	-	220→300bar (3,190.8→4,351psi) lap shear strength	A rubber toughened adhesive with increased flexibility and peel strength along with enhanced resistance to shock.
Cyanoacrylate	Loctite 495[1] / Permabond C2	4103/0900	Colourless	270d	12h maximum cure time	High speed bonding, suitable for rubber to itself and other materials reaching handling strength in a matter of seconds. Joint must be waterproofed with Loctite water proofing (4104/0500).
Low strength	Dunlop 1727 / British vita company VB 165	4103/1100	Clear to light straw	90d	-	Sprayable adhesive, non-structural applications. For the bonding of flexible foam to themselves, wood, painted metal, chipboard, fibreglass, hessian, felt etc.
Acrylic foam strip adhesive	3M 4941P	4103/3900	Dark grey	730d	Peel adhesion 350N/100mm	High bond acrylic double sided foam tape. Its allows more complete bond contact area when bonding rigid or irregular materials due to its conformability. Its core adhesive composition makes the product well suited to many paints and primers.

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Subsection	Commercial name	Product Number	Colour	Shelf life	Technical data	Comments
General purpose gap filling material	Araldite XD 580	4103/1400	Clear / cream	730d	560bar (8,122.1psi) flexural strength	Two part, equal parts by weight. Wear pad fixing to castings and telescopic components, alignments of fixings pads without expensive machining. This product is a general purpose gap-filling material. Cure time 2h at 25°C (77.0°F).
Methacrylate	Loctite Speedbonder H3151	4103/3600	Cream to light yellow	-	-	This is a sag resistant, two component, equal parts, methacrylate adhesive system formulated to bond automotive grade cold rolled steel without the use of an external primer. Suitable for bonding a wide variety of plastic and metal substrates. Provides a long open time (40→60min) for correct aligning of parts.
Methacrylate	Plexus MA420	4103/3700	Off-white or blue	365d	-	Two part methacrylate adhesive for structural bonding of thermoplastic, metal and composite assemblies. Combined at 10:1 ratio. It has a working time of 4→6min.
Structural plastic	Scotch-weld DP-8005	332/S7420	Black	180d	-	Two part acrylic based adhesive (10:1 ratio by vol.) that can bond many low surface energy plastics, including many grades of polypropylene, polyethylene and TPO's without special surface preparation.
General purpose adhesive	Evo-Stick 528 *(1)*	4103/0800	-	365d	HIGHLY FLAMMABLE	A thin even film of adhesive should be applied to both surfaces being bonded and allowed to become touch dry. This is a contact adhesive and coated surfaces cannot therefore be slid into position since the bond forms on contact. It is often convenient to align the parts along an edge and then bring the two areas into contact.
Direct glazing	Sika 250PC Sikattack Ultrafast (use 4103/4000 or 4102/4900) *(1)*	4103/2100	Black	-	-	A one component polyurethane pre-polymer based adhesive. A mastic adhesive which reacts with atmospheric moisture to form a rubber like solid.
Direct glazing	Sika 255FC (use 4102/5000) *(1)*	4103/2200	Black	-	-	For bonding glass to cab frames. A mastic adhesive which reacts with atmospheric moisture to form a rubber like solid. When using this product ensure both surfaces are clean and dry. Use Sika cleaner 205 (4104/1200).
Direct glazing	Sikaflex 552 (use 4102/5000) *(1)*	4103/3200	Black	-	-	A high performance, elastic, gap, filling one part structural adhesive cures on exposure to atmospheric moisture to form a durable elastomer. Contains no isocyanate.

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Subsection	Commercial name	Product Number	Colour	Shelf life	Technical data	Comments
Industrial grade epoxy adhesive	Loctite Hysol E-214 HP	333/Y7062	Light Grey Paste	-	307bar (4,452.7psi) tensile strength	Single component, heat activated formulation develops tough, strong, structural bonds which provide excellent peel resistance and impact strength. When fully cured, the product offers superior thermal shock resistance, excellent mechanical and electrical resistance properties and withstands exposure to a wide variety of solvents and chemicals. Bonds to a wide variety of materials, including metals, glass, ceramics and plastics. Cure at 120°C (247.8°F) or above until completely firm. Heat up to 150°C (301.8°F) for 2h, to maximize properties.
Anaerobic adhesive (Dimethacrylate)	Scotchweld RT-20	333/L9575	Green	365d	-	Single component anaerobic adhesives designed to secure cylindrical metal assemblies such as bearings on shafts, bushings, sleeves, housings, and keyways. Help prevent loosening, corrosion and leakage caused by shock and vibration. Full cure time 24h. Temperature range = -54°C (129.1°F) to 450°C (841.4°F). Not recommended for use on most plastics due to potential cracking of plastic parts.
Direct glazing	Teroson 939CT / Terostat MS939	4102/5000	Black	365d in original packaging	-	Skin formation time: approx. 10min. Cure rate: approx. 3mm/24h.
Direct glazing	Terostat 8900 HV	4103/4000	Black	180d	80bar (1,160.3psi) tensile strength	One component, pumpable adhesive/sealant based on polyurethane, which cures by reaction with moisture to an elastic rubber. The skin formation and curing time are dependent on humidity, temperature and depth of joint. High temperature and high moisture reduces curing time. Sag resistant, temperature range of -40°C (103.9°F) to 90°C (193.9°F).
Direct glazing	Terostat 8594 HMLC	4103/4100	Black	270d	85bar (1,232.8psi) tensile strength	Single component, moisture curing, adhesive/sealant for repair. Product with high shear modulus and low conductivity. Suitable for all applications that require very high electrical insulation of the adhesive used for the bonding of windows. Sag resistant.

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Subsection	Commercial name	Product Number	Colour	Shelf life	Technical data	Comments
Direct glazing	Terostat 8900 LV	4103/4200	Black	365d in cartridges. 180d in sausage pack. 180d in hobbocks and drums	80bar (1,160.3psi) tensile strength	One component, pumpable adhesive/sealant based on polyurethane, which cures by reaction with moisture to an elastic rubber. The skin formation and curing time are dependent on humidity, temperature and depth of joint. High temperature and high moisture reduces curing time. Sag resistant, temperature range of -40°C (103.9°F) to 90°C (193.9°F) short exposure (up to 1h) of 130°C (265.8°F).
Direct glazing	Sikaflex 295 UV	4103/4300	Black, white	365d	-	Direct glazing adhesive for plastic glazing panels. One component polyurethane adhesive of paste like consistency. 60min tack free time, 1d cure time (4mm at 23°C (73.4°F)). Good UV, fresh water and seawater resistance. Do not apply below temperatures of 10°C (50.0°F) or above 35°C (95.0°F).
High strength retainer	Loctite 603	4103/2500	-	-	-	Used for bearings.
Direct glazing	Teroson MS 660	4103/5000	Clear	365d	-	Area must be clean, dry, oil and grease free and not be in permanent contact with water. Provides a long open time approximately 15min for correct aligning of parts.
Medium strength threadlocker	Loctite 2400	4103/5100	Blue	-	-	Can be used in place of Loctite 243.
Direct glazing	Terostat 8910 (also known as Teroson PU 8910)	4103/5200	Black	-	Cure rate 3.5mm/24h	component with high viscosity, pumpable adhesive / sealant cures by reaction with moisture, humidity and temperature. Provides a long open time approximately 10min for correct aligning of parts.
Flange adhesive	Teroson RB 5100	320/B4113	Greyish black	90d	-	Thermosetting component, solvent free, reactive rubber based flange adhesive
Structural adhesive	AK 348	4103/5300	-	-	-	Used as structural adhesive.
Structural adhesive	Loctite V1315	4103/5400	Cream, Off white	365d	-	Used for bonding powder coated glazing strips onto the powder coated cab welded assemblies.

(1) This is a non preferred product.

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16 - Sealant

00 - General

Introduction 75-26
Technical Data 75-27

Introduction

All sealants should be used at all times in line with the manufacturer's recommendations. Sealants are used mainly for the sealing of screwed joints, sealing flanges and flat surfaces and where gap filling properties are required.

Types of Sealant

Various types of sealant are specified in JCB Standards:

1. Those for the sealing of screwed joints.
2. Sealants for joining flanges and flat surfaces. (Flange size and likelihood of dismantling require consideration when selecting this type of sealant).
3. Sealants for use where gap filling properties are required. (The gap dimensions, joint movement if any, type of materials being joined and aesthetic appearance require consideration when selecting this type of sealant).

Approved Sealants

The table shown in Technical Data are the approved sealants available to use on JCB machines. The table also provides basic details to help with selection of sealants. More up to date information can be found on the manufacturer's website.

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Technical Data

Table 201. Sealants Approved Product Information

Subsection	Commercial name	Product Number	Colour	Shelf life	Technical data	Comments
High strength	Loctite 275(1) / Permabond A140	4102/0500	Green	730d	250bar (3,625.9psi) torque strength (on M8)	Non drip formulation, used on larger fittings, coarse threads.
High strength	Forgeway 240FC(1)	4102/3100	Yellow	270d	25bar (362.6psi) breaking strength	Can be painted over with some 2 pack paint. Maximum width of joint =35mm, minimum width =2mm, minimum depth =2mm. Recommended depth of joint = width of joint.
Medium to high strength	Loctite 620	4102/3500	Green	-	More than 241bar (3,495.4psi) shear strength	Used for locating pins in radiator assemblies, sleeves into pump housings and bearings in auto transmissions. Not suitable for plastics. Diametrical clearance: up to 0.2mm
Medium strength	Loctite 518 Gasket Eliminator	4102/2000	Red, fluorescent	365d	90bar (1,305.3psi) tensile strength	Typically used as form-in-place gasket on rigid flanged connections.
Medium strength	Loctite 5182	4102/4100	Red gel, fluorescent	-	80bar (1,160.3psi) shear strength	It is manufactured to minimise air bubbles in the package. Used to seal gaskets, housings, cases and covers. It can also be used to repair and replace cut gaskets (up to 0.08mm in thickness).
Medium strength	Loctite 595	4102/2500	Clear	365d	6mm gap filling	Formulated to withstand weathering and extreme temperature cycling. Used for potting, coating and sealing. Can be applied horizontal, vertical and overhead.
Medium strength	Loctite 577(1) / Permabond A1044	4102/1900	Yellow	365d	170bar (2,465.6psi) breakaway torque	A fast curing thread sealant used on coarse threads and pipe fittings up to 75mm thread size. Clearance for gap filling 0.8mm.
Medium strength	Loctite 2431	4102/2700	Blue	365d	140→340bar (2,030.5→4,931.3psi) breakaway torque	Taper thread sealant, non-fluorescing to see oil leaks. Suitable for all taper fittings up to M36.
Low strength	Clayton Dewandre air brake sealant SC1252	4102/2200	White opaque	12h full cure	Maximum seal pressure 29bar (420.6psi)	Seals pipes and plugs against leakage of air, fuels, lubricants and coolants. Hardens to a tough seal resistant to shock and vibration. Easily dismantled.
Low strength	Red Hermetite	4102/0800	Red	-	Resistant to oil	Non-hardening paste jointing for joints regularly opened for servicing.

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Subsection	Commercial name	Product Number	Colour	Shelf life	Technical data	Comments
Low strength	Loctite 572	4102/1100	White opaque	730d	40→100bar (580.2→1,450.4psi) breakaway torque	Used where slow cure is required to permit component alignment. PTFE (Polytetrafluoroethylene) filler.
Gasketing medium strength	Loctite 509 Gasket Eliminator Flange Sealant	4102/3200	Blue to green	-	72h full strength on steel	Easy disassembly, used as form-in-place gasket. 0.2mm gap filling.
Gasketing medium strength	Loctite 574[(1)]	4102/1200	Red	730d	2h working strength	Does not creep or relax after curing, no bolt re-tightening is required. Oil resistant. Ideal for formed in-situ gaskets.
	Permabond A136					
Sealant for gaskets	Loctite FAG 2 / Loctite 5922	4102/2600	Black	365d	Resists pressures up to 345bar (5,003.8psi)	Used to dress new or worn gaskets. Dries slowly, sets to pliable film for easy dismantling.
Rubber jointing compound	Dow corning 781	4102/0900	Clear or translucent	270d	16.7bar (242.2psi) tensile strength	A synthetic rubber joint sealant suitable for joints between non-porous surfaces such as glass and metal, metal and metal where relatively large gap filling properties are required. Suitable for vertical and overhead applications under normal atmospheric conditions. Joint movement approx.+/-12.5%. Cure time to 6mm depth in 24h.
	Loctite superflex clear RTV3					
	EVOstick standard industrial clear silicone sealant					
	Dunlop high modulus silicone sealant DP2205					
Epoxy resin	Loctite fast epoxy sealant	4102/2400	Slightly coloured / transparent	-	-	0.05L container requires special bi-mixer (gun) so it is mixed as dispensed, 0.024L is mixed by hand.
Room temperature vulcanising	Loctite 5910, Flange sealant, RTV Silicon	4102/3400	Metallic black paste	-	Dry to touch in 40min	Designed for flange sealing, good resistance to oils and allows high joint movement.

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Subsection	Commercial name	Product Number	Colour	Shelf life	Technical data	Comments
Room temperature vulcanising	Loctite 5970	4102/4200	Black	730d	18bar (261.1psi) tensile strength	Used for gaskets. Excellent resistance to engine oils. Typical applications include stamped sheet metal covers (timing covers and oil sumps) where good oil resistance and the ability to withstand high joint-movement are required.
Room temperature vulcanising	Loctite superflex black silicone	4102/2900	Black	270d	16bar (232.1psi) tensile strength	Thixotropic allowing easy application, horizontal, vertical and overhead. Seals against water and many solvents.
Room temperature vulcanising	Loctite 5901	4102/3700	Grey	730d	14bar (203.1psi) shear strength	Designed specifically for on line, low pressure tests carried out before product begins to cure. Product exhibits excellent resistance to automotive engine oils. Primarily for flange sealing, it withstands high joint-movement requirements.
Room temperature vulcanising	Loctite 5368	4102/3900	Black paste	730d	20bar (290.1psi) tensile strength	Generally used for sealing applications, but also for bonding and for high temperature protection.
Room temperature vulcanising	Loctite 5366	4102/4000	Clear paste	730d	20bar (290.1psi) shear strength	Designed specifically for use as a bonding agent to ensure perfect sealing, as well as bonding and protection. Examples are sealing side windows in trains, sealing heat sources (heat exchangers and water heaters) and for protection/insulation of electrical boxes.
Room temperature vulcanising	Hylomar 607	332/D5695	Black paste	540d	40bar (580.2psi) tensile strength	A special purpose adhesive and sealant that can be used for a variety of applications. It has good resistance to oils and aqueous anti-freeze agents, and is particularly suitable for high strength applications in odour sensitive environments.
Joining oil pan to bedplate	Loctite 5900	4102/3800	Black paste	730d	14bar (203.1psi) shear strength	JCB Service ONLY. Introduced for joining the oil pan to the bedplate face during service. High resistance to engine oils. The joint should be clamped to spread the adhesive and allowed to cure for 7d before heavy service duty.
Anti-corrosive	To military spec TT-P-1757B 1CY	4102/4300	Yellow	-	Type 1 Class C	Used to coat surfaces of dissimilar metals prior to assembly to prevent corrosion. Zinc chromate containing substance ideal for application to joints between aluminium and steel to prevent corrosion and seizure. FOR USE ON MILITARY VEHICLES ONLY.
Gasketing medium strength	Bondloc B555	4102/4500	Clear/ Opaque	-	Full cure time 24h. 50bar (725.2psi) tensile strength	B555 is an anaerobic gasket sealant. It seals close fitting joints between rigid metal faces and flanges. Tensile strength to ISO 6922.

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Subsection	Commercial name	Product Number	Colour	Shelf life	Technical data	Comments
Seam sealant	Terolan 3412 AA-25	4102/4600	Light grey	90d	-	Serves as a seam sealant between sheet metal butt and overlap joints (interior seems) on vehicle bodies. Can be cured at temperatures of minimum 140°C (283.8°F) (effective metal temperature) for 15min. The material is applied to electro-dip coated steel sheets.
Direct glazing	Sikaflex 221 (use 4102/4800)	4102/2800	Yellow	-	-	Direct glazing one component polyurethane based adhesive and sealant compound. Tack free time of 50min.
Direct glazing	Sikaflex 252 (use 4102/4700)(1)	4102/2300	Black	-	-	A one component polyurethane pre-polymer based sealant. For sealing glass to frames. A mastic sealant which reacts with atmospheric moisture to form a rubber like solid.
Direct glazing	Teroson PU92 CT	4102/4700	-	365d in original packaging	-	The substrates must be clean, dry, oil and grease free. Skin formation time: approx. 20min Cure rate: approx. 4mm/24h
Direct glazing	930 JCB Branded yellow CT	4102/4800	Yellow	365d in original packaging	-	The substrates must be clean, dry, oil and grease free. It can be necessary to roughen the surface or to use a primer/adhesion promoter to provide optimum adhesion. When manufacturing of plastics, external release agents are often used; these agents must be absolutely removed prior. Skin formation time : approx. 20min Cure rate : approx. 4mm/24h
Direct glazing	Terostat 8597 CT	4102/4900	Black	540d in original package	-	Isocyanate free solution. Designed for use without primer or activator. When you use this sealant on operator station, it should be used with Teroson PU 8519P black primer (and Teroson 450 clear adhesion promoter when specified specially). Cross compatible with all OEM / OES / AAM DGX sealants, including MS and PU chemistry (any remaining bead must be fully cured before application).
Silicone sealant - Heat resistant	Sika/Everbuild Heat Mate	4102/5100	Black	-	-	High modulus permanently flexible 100% silicone. Temperature resistant up to 300°C (571.6°F). Ideal for sealing industrial and high performance gaskets, oven doors etc.
Gasket and sealing	Loctite 510	4102/6100	Opaque pink	-	-	Introduced for Heavy products India (swing motor/ gearbox face).

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Subsection	Commercial name	Product Number	Colour	Shelf life	Technical data	Comments
Polymer sealant	Terostat MS 930	4102/5200	White	-	-	Silane modified polymer sealant. used on roof panels of power products.
Silicon sealant	Rainbow - RAL coloured silicone	4102/5300	Yellow	-	-	Contains fungicide. used on roof panels of power products.

(1) This is a non preferred product.

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18 - Fuel

00 - General

Health and Safety

Fuel

Fuel is flammable, keep naked flames away from the fuel system. Stop the engine immediately if a fuel leak is suspected. Do not smoke while refuelling or working on the fuel system. Do not refuel with the engine running. Completely wipe off any spilt fuel which could cause a fire. There could be a fire and injury if you do not follow these precautions.

WARNING! *Do not use petrol in this machine. Do not mix petrol with the diesel fuel. In storage tanks the petrol will form flammable vapours.*

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78 - After Sales

Contents **Page No.**

Acronyms Glossary 78-2

78-24 Maintenance Schedules
- 78-24-00 General 78-3
- 78-24-03 Maintenance Intervals 78-4
- 78-24-07 Operator Maintenance Tasks 78-5
- 78-24-10 Service Engineer Maintenance Tasks 78-7

78-81 Clothing and Personal Protective Equipment (PPE)
- 78-81-00 General 78-11

78-93 Special Tools
- 78-93-00 General 78-12
- 78-93-03 Parts List 78-13

78-96 Units of Measurement
- 78-96-00 General 78-21

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Acronyms Glossary

AC	Alternating Current
CCV	Crankcase Ventilation
RCBO	Residual Current Breaker with Over-Current

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24 - Maintenance Schedules

00 - General

Introduction

The schedules show the service tasks which must be done and their intervals.

The services must be done at either the hourly interval or the calendar equivalent, whichever occurs first.

The intervals given in the schedules must not be exceeded. If the machine is operated under severe conditions (high temperature, dust, water, etc.) shorten the intervals. Where local regulations require more frequent checks, the local regulations intervals should be followed.

Table 202.

O	Service task can be completed by a competent operator. Details of how to complete the service task are given in the Operator's Manual.
□	We recommend that a Service Engineer completes the service task. Details of how to complete the service task are given in the Service Manual.

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03 - Maintenance Intervals

Introduction

Table 203.

Interval (h)	Calendar Equivalent
10	Daily
50	Weekly
250	6 months
500	Yearly
1000	Two years
2000	Two years

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07 - Operator Maintenance Tasks

Introduction

Table 204.

Component	Task	Daily	Weekly
Engine			
Engine compartment hose	Check condition/security	O	O
Engine oil	Check (level)	O	O
Engine oil	Check (leaks)	O	O
Engine coolant	Check (level)	O	O
Engine coolant	Check (leaks)	O	O
Cooling pack	Check/clean	O	O
Front end drive belt	Check (condition)		O
Air filter	Check (condition)	O	O
Air filter dust valve	Check operation/Clean		O
Engine fuel	Check (leaks)	O	O
Water Separator/fuel filter	Clean/Drain	O	O
Fuel tank cap- vent	Check (condition)	O	O
Exhaust system	Check (condition)	O	O
Hydraulics			
Hydraulic hoses	Check (condition)	O	O
Hydraulic oil	Check (level)	O	O
Hydraulic oil	Check (leaks)	O	O
Boom			
Boom wire rope	Check (Condition)	O	O
Boom wire rope-Tension	Check	O	O
Cylindrical wear pad	Check	O	O
Electrics			
Hydraulic generator (If installed)	Check (operation)	O	O
Hydraulic generator- wiring and connectors (If installed)	Check	O	O
AC (Alternating Current) power to platform cables	Check (operation)	O	O
Batteries terminal	Clean	O	O
Battery leads	Check (condition)	O	O
All electrical cables and conductors	Check (condition)	O	O
Base controller			
Emergency stop	Check (operation)	O	O
Platform raise and lower functions	Check (operation)	O	O
Electric pump	Check (operation)	O	O
Ignition switch	Check (operation)	O	O

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Component	Task	Daily	Weekly
Ground control emergency override	Check (operation)	O	O
Engine start	Check (operation)	O	O
Engine speed (1500RPM)	Check (operation)	O	O
Horn	Check (operation)	O	O
Emergency override switch	Check (operation)	O	O
Platform controller			
Emergency stop	Check (operation)	O	O
Platform raise and lower functions	Check (operation)	O	O
Foot pedal switch	Check (operation)	O	O
Steering	Check (operation)	O	O
Drive and brake	Check (operation)	O	O
Worklight (if installed)	Check (operation)	O	O
Power to platform (if power tool installed)	Check (operation)	O	O
Horn	Check (operation)	O	O
Engine speed (1500RPM/22000RPM)	Check (operation)	O	O
Electric pump	Check (operation)	O	O
General			
Limited driving speed (with platform lifted and stowed)	Check (operation)	O	O
Tilt sensor	Check (operation)	O	O
Proximity, String pod, Boom raise and lower sensor	Check (operation)	O	O
Axle oscillation lock	Check (operation)	O	O
Platform levelling	Check (operation)	O	O
Travel alarm	Check (operation)	O	O
Platform secondary guarding system	Check (operation)	O	O
Miscellaneous			
Operator's Manual	Check (condition)	O	O
Canopy and latches	Check (condition)	O	O
Safety Labels	Check (condition)	O	O
Welds	Check (condition)	O	O
Machine damage, missing parts	Check (condition)	O	O
Fasteners	Check (condition)	O	O
Platform guard rail	Check (condition)	O	O
Tyres and wheels	Check (condition)	O	O
Wheel lug nuts[1]	Check (torque)		O

(1) First 50 hours only.

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10 - Service Engineer Maintenance Tasks

Introduction

Table 205.

Component	Task	250h	500h	1000h	2000h
Engine					
Engine compartment	Check security	☐	☐	☐	☐
Engine compartment hose	Check condition/security	☐	☐	☐	☐
Engine oil	Check (level)	☐	☐	☐	☐
Engine oil	Check (leaks)	☐	☐	☐	☐
Engine oil	Replace		☐	☐	☐
Engine oil filter	Replace		☐	☐	☐
Engine coolant	Check (level)	☐	☐	☐	☐
Engine coolant	Check (condition)	☐	☐	☐	☐
CCV (Crankcase Ventilation)[7]	Replace				
Coolant (inorganic)[5]	Replace				☐
Coolant (OAT - organic acid technology)[4, 5]	Replace				
Engine coolant	Check (leaks)	☐	☐	☐	☐
Engine radiator	Check (condition)	☐	☐	☐	☐
Cooling pack	Check/clean	☐	☐	☐	☐
Cooling hoses[3]	Replace				
Front end drive belt	Check (condition)	☐	☐	☐	☐
Front end drive belt[3]	Replace				
Air filter	Check (condition)	☐	☐	☐	☐
Air filter element (outer)[2]	Replace		☐	☐	☐
Air filter element (inner)[2]	Replace				☐
Air filter dust valve	Check operation/Clean	☐	☐	☐	☐
Intake manifold hose[3]	Replace				
Engine fuel	Check (leaks)	☐	☐	☐	☐
Lubricity filter (if fitted)	Replace	☐	☐	☐	☐
Water Separator/fuel filter	Clean/Drain	☐	☐	☐	☐
Water Separator/fuel filter element	Replace		☐	☐	☐
Engine fuel filter element	Replace		☐	☐	☐
Fuel tank cap- vent	Check (condition)	☐	☐	☐	☐
Exhaust system	Check (condition)	☐	☐	☐	☐
Hydraulics					
Hydraulic hoses	Check (condition)	☐	☐	☐	☐
Hydraulic oil	Check (level)	☐	☐	☐	☐

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Component	Task	250h	500h	1000h	2000h
Hydraulic oil	Check (leaks)	☐	☐	☐	☐
Hydraulic oil	Replace				☐
Hydraulic return filter element	Replace		☐	☐	☐
Suction strainer	Replace				☐
Charge pump filter element	Replace		☐	☐	☐
High pressure filter element	Replace		☐	☐	☐
Vent filter - hydraulic tank	Replace				☐
Hydraulic system pressure	Check (settings)	☐	☐	☐	☐
Hydraulic system functional test	Check (operation)	☐	☐	☐	☐
Boom					
Boom wire rope	Check (Condition)	☐	☐	☐	☐
Boom wire rope - Tension	Check/ Adjust	☐	☐	☐	☐
Cylindrical wear pad	Check (condition)	☐	☐	☐	☐
Cylindrical wear pad	Grease	☐	☐	☐	☐
Electrics					
Batteries terminal	Clean	☐	☐	☐	☐
All electrical cables and conductors	Check (condition)	☐	☐	☐	☐
Hydraulic generator (If installed)	Check (operation)	☐	☐	☐	☐
Hydraulic generator- wiring and connectors (If installed)	Check	☐	☐	☐	☐
RCBO (Residual Current Breaker with Over-Current)	Check (operation)	☐	☐	☐	☐
AC (Alternating Current) power to platform cables	Visual inspection	☐	☐	☐	☐
AC power to platform cables	Check (operation)	☐	☐	☐	☐
Battery leads	Check (condition)	☐	☐	☐	☐
Ground controller					
Emergency stop	Check (operation)	☐	☐	☐	☐
Platform raise and lower functions	Check (operation)	☐	☐	☐	☐
Electric pump	Check (operation)	☐	☐	☐	☐
Ignition switch	Check (operation)	☐	☐	☐	☐
Ground control emergency override	Check (operation)	☐	☐	☐	☐
Engine start	Check (operation)	☐	☐	☐	☐
Engine speed	Check (operation)	☐	☐	☐	☐
Horn	Check (operation)	☐	☐	☐	☐
Emergency override switch	Check (operation)	☐	☐	☐	☐
Platform controller					
Emergency stop	Check (operation)	☐	☐	☐	☐
Platform raise and lower functions	Check (operation)	☐	☐	☐	☐
Foot pedal switch	Check (operation)	☐	☐	☐	☐
Steering	Check (operation)	☐	☐	☐	☐

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Component	Task	250h	500h	1000h	2000h
Drive and brake	Check (operation)	☐	☐	☐	☐
Worklight (if installed)	Check (operation)	☐	☐	☐	☐
Power to platform (if power tool installed)	Check (operation)	☐	☐	☐	☐
Horn	Check (operation)	☐	☐	☐	☐
Engine speed	Check (operation)	☐	☐	☐	☐
Electric pump	Check (operation)	☐	☐	☐	☐
General					
Limited driving speed (with platform lifted and stowed)	Check (operation)	☐	☐	☐	☐
Tilt sensor	Check (operation)	☐	☐	☐	☐
Proximity, String pod, Boom raise and lower sensor	Check (operation)	☐	☐	☐	☐
Axle oscillation lock	Check (operation)	☐	☐	☐	☐
Platform levelling	Check (operation)	☐	☐	☐	☐
Overload System	Check (operation)	☐	☐	☐	☐
Overload test	Check (operation)	☐	☐	☐	☐
Engine speed selection	Check (operation)	☐	☐	☐	☐
Travel alarm	Check (operation)	☐	☐	☐	☐
Buzzers	Check (operation)	☐	☐	☐	☐
Drive speed	Check	☐	☐	☐	☐
Boom and slew speed	Check	☐	☐	☐	☐
Platform secondary guarding system	Check (operation)	☐	☐	☐	☐
Miscellaneous					
Operator's Manual	Check (condition)	☐	☐	☐	☐
Canopy and latches	Check (condition)	☐	☐	☐	☐
Safety Labels	Check (condition)	☐	☐	☐	☐
Welds	Check (condition)	☐	☐	☐	☐
Machine damage, missing parts	Check (condition)	☐	☐	☐	☐
Fasteners	Check (condition)	☐	☐	☐	☐
Platform guard rail	Check (condition)	☐	☐	☐	☐
Steer pivots	Grease	☐	☐	☐	☐
Tyres and wheels	Check (condition)	☐	☐	☐	☐
Wheel lug nuts	Check (torque)	☐	☐	☐	☐
Hub oil	Check (level)	☐	☐	☐	☐
Hub oil[1]	Replace			☐	☐
Slew gearbox oil	Check (level)	☐	☐	☐	☐
Slew gearbox oil[9]	Replace		☐	☐	☐
Slew bearing	Check (condition)		☐	☐	☐
Wire ropes (Tension)[8]	Check (condition)				
Wire ropes (Wear)[6]	Check (condition)				

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Component	Task	250h	500h	1000h	2000h
Capscrews - front axle to wheel hub	Check (torque)	☐	☐	☐	☐
Capscrews - rear axle to wheel hub	Check (torque)	☐	☐	☐	☐
Setscrews - platform to carrier underside	Check (torque)	☐	☐	☐	☐
Pivot pin with locknut - rotary actuator	Check (torque)	☐	☐	☐	☐
Setscrew - rotary actuator top ring	Check (torque)	☐	☐	☐	☐
Slew bearing bolts (top and bottom sets)	Check (torque)	☐	☐	☐	☐
Counterweight bolts	Check (torque)	☐	☐	☐	☐

(1) An initial hub oil replacement should be made after the first 50 hours of operations. Subsequent oil changes should be made at 1000 hours or annually, which ever comes first.
(2) The period of time that must elapse before checking the filter element depends on the environment in which the engine operates. The air filter must be cleaned and replaced more frequently under very dusty conditions.
(3) At every 8000 hours.
(4) At every 4000 hours or 4 years, whichever is first.
(5) Check which coolant type is installed in the machine before topping up the coolant. Mixing of different coolant types is likely to impair corrosion inhibiting performance and may result in invalidation of the warranty offered by JCB. In the event of mixing or if the coolant type is to be changed, the coolant circuit should be completely drained and flushed with clean water before re-filling with fresh coolant.
(6) Wire ropes must be inspected as per the guidelines defined in the service manual at every 7000 hours / 12 Years and should be replaced if found damaged.
(7) At every 1500 hours.
(8) At every 150 hours.
(9) Slew gearbox oil replacement should be made at first 250 hours service and then at regular 1000 hours intervals.

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81 - Clothing and Personal Protective Equipment (PPE)

00 - General

Introduction

Do not wear loose clothing or jewellery that can get caught on controls or moving parts. Wear protective clothing and personal safety equipment issued or called for by the job conditions, local regulations or as specified by your employer.

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93 - Special Tools

00 - General

Introduction

The tools shown are the special tools required for completing the procedures described in this manual. These tools are available from JCB Service or in some instances can be manufactured locally.

The tools are divided into three categories:

- Special Tool = Only available from JCB.
- Recommended Tool = Available from JCB but other tool manufacturers/suppliers may offer a tool with the same characteristics.
- General Tool = A tool which is widely available.

Tools other than those listed will be required. It is expected that such general tools will be available in any well equipped workshop or be available locally from any good tool supplier.

Before you start work, make sure that all safety precautions are observed in accordance with the information contained within the relevant support documentation.

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03 - Parts List

Introduction

Introduction 78-13
Component Identification 78-15

06 - Body and Framework

Tool Category	Part No.	Description	Qty.	Comments
Special Tool	993/68100	Slide Hammer Kit	1	

15 - Engine

Tool Category	Part No.	Description	Qty.	Comments
Special Tool	892/00292	Oil Filter Removal Tool	1	
Special Tool	892/01174 728/H5409	Data Link Adaptor (DLA) Kit Data Link Adaptor (DLA 2.0) Kit	1	Unless otherwise stated, you can use any of the tools shown.

18 - Fuel and Exhaust System

Tool Category	Part No.	Description	Qty.	Comments
Special Tool	334/G5933	Spanner - HP Fuel Filter	1	
Special Tool	892/01383	Fuel Filter Removal Tool (4 cyl)	1	

27 - Driveline

Tool Category	Part No.	Description	Qty.	Comments
General Tool	334/F1285	Forklift Jack	1	

30 - Hydraulic System

Tool Category	Part No.	Description	Qty.	Comments
Special Tool	335/Y9489	Spanner	1	
Special Tool	892/01042	Accumulator Charging Kit (Diaphragm)	1	
Special Tool	892/01043	Accumulator Charging Adaptor	1	
Special Tool	892/01255	Hydraulic Flushing Rig	1	

33 - Electrical System

Tool Category	Part No.	Description	Qty.	Comments
General Tool	400/G9956	Battery Tester	1	
General Tool	892/00349	Wiring Crimp Tool	1	
General Tool	892/00350	Butane Heater	1	
Special Tool	892/01174 728/H5409	Data Link Adaptor (DLA) Kit	1	Unless otherwise stated, you can use any of the tools shown.

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Tool Category	Part No.	Description	Qty.	Comments
		Data Link Adaptor (DLA 2.0) Kit		

75 - Consumable Products

Tool Category	Part No.	Description	Qty.	Comments
Recommended Tool	892/00913	Grease Gun Attachment	1	
General Tool	992/11300	Grease Gun	1	

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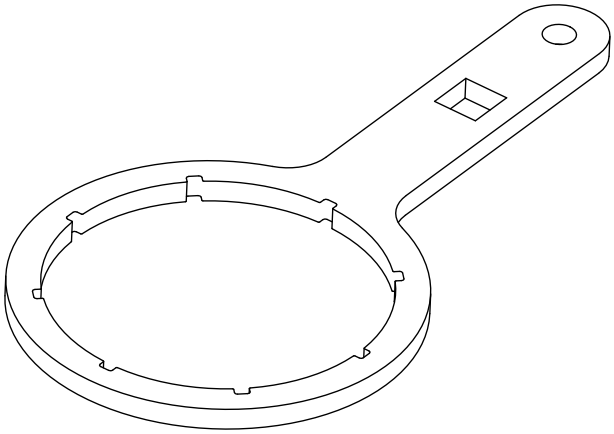
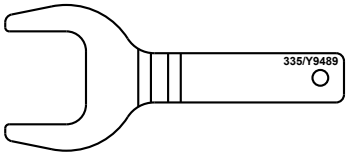
Component Identification

General Tool - 334/F1285 - Forklift Jack

Special Tool - 334/G5933 - Spanner - HP Fuel Filter



Special Tool - 335/Y9489 - Spanner



This tool is used to remove the hydraulic tank filler cap installed on your machine. This tool is supplied with machine as a part of standard tool kit.

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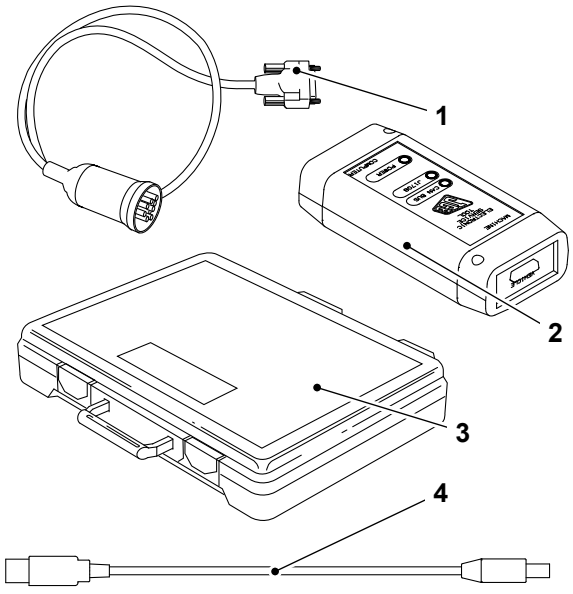
General Tool - 400/G9956 - Battery Tester

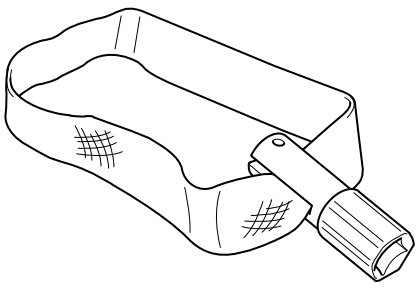
Special Tool - 728/H5409 - Data Link Adaptor (DLA 2.0) Kit



Item	Part No.	Description	Qty.
1		Interconnecting cable, DLA to machine ECU diagnostics socket.	1
2		Data Link Adaptor (DLA 2.0), enables data exchange between the machine ECU (Electronic Control Unit) and a laptop PC loaded with the applicable diagnostics software.	1
3		Kit carrying case.	1
4		Interconnecting cable, DLA to laptop PC.	1

Special Tool - 892/00292 - Oil Filter Removal Tool

Use to remove and install spin-on filter canister.



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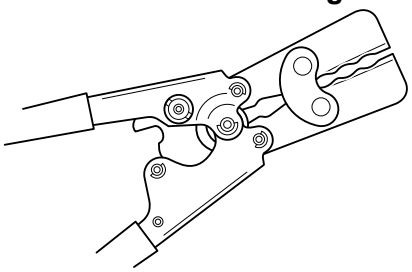
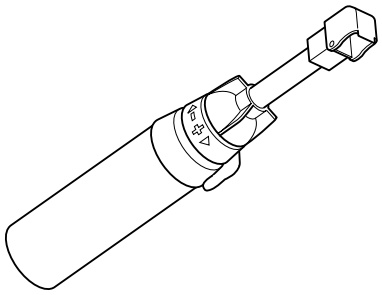
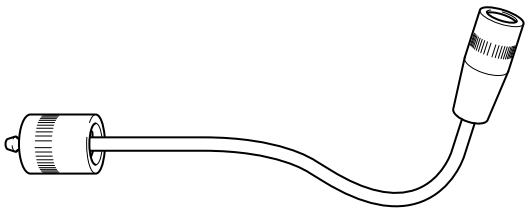
General Tool - 892/00349 - Wiring Crimp Tool



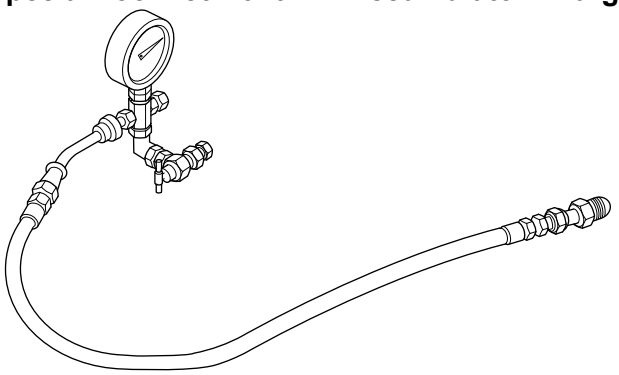
General Tool - 892/00350 - Butane Heater



Recommended Tool - 892/00913 - Grease Gun Attachment



Special Tool - 892/01042 - Accumulator Charging Kit (Diaphragm)



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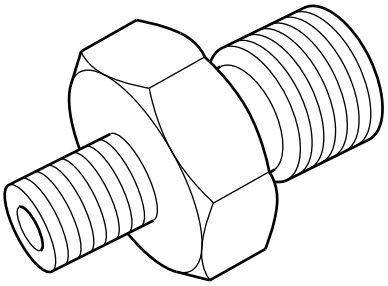
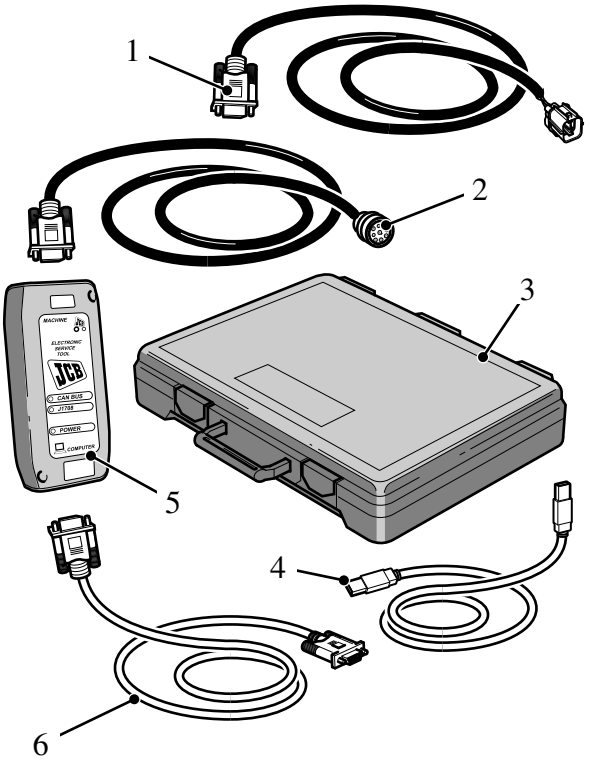
Special Tool - 892/01043 - Accumulator Charging Adaptor



Special Tool - 892/01174 - Data Link Adaptor (DLA) Kit



No longer available to order.
Replaced by special tool 728/H5409 (Data Link Adaptor (DLA 2.0) Kit)

Item	Part No.	Description	Qty.
1		Interconnecting cable, DLA to machine ECU diagnostics socket.	1
2		Interconnecting cable, DLA to machine ECU diagnostics socket.	1
3		Kit carrying case.	1
4		Interconnecting cable, DLA to laptop PC.	1
5		Data Link Adaptor (DLA), enables data exchange between the machine ECU (Electronic Control Unit) and a laptop PC loaded with the applicable diagnostics software.	1
6		Interconnecting cable, DLA to laptop PC.	1

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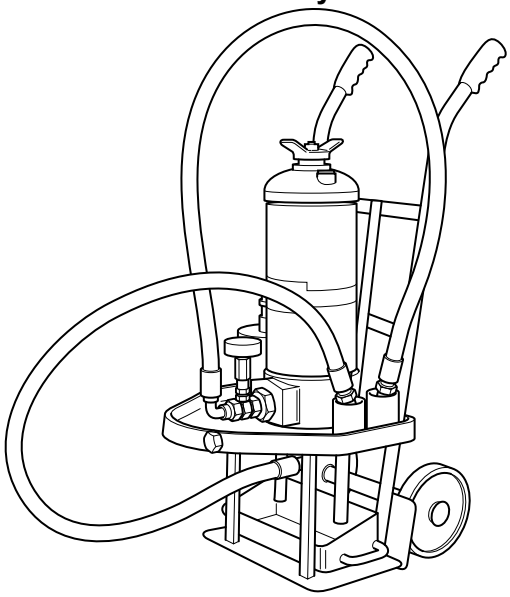
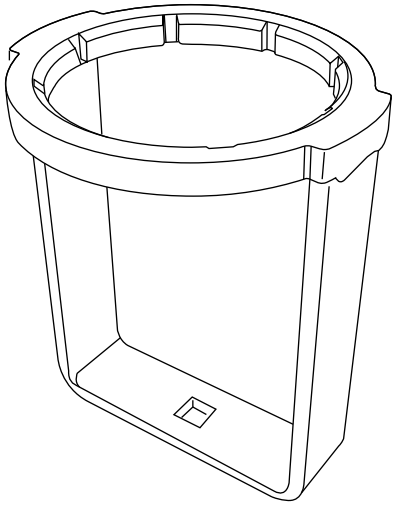
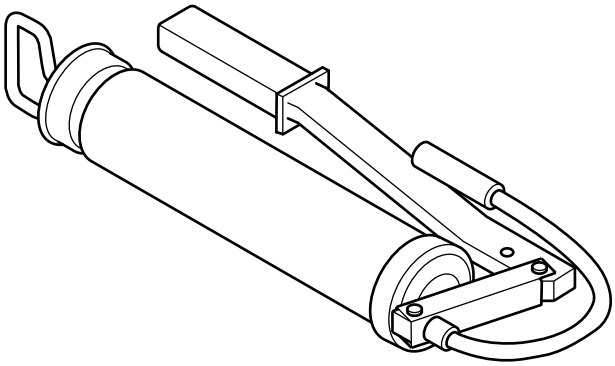
Special Tool - 892/01255 - Hydraulic Flushing Rig



Special Tool - 892/01383 - Fuel Filter Removal Tool (4 cyl)



General Tool - 992/11300 - Grease Gun



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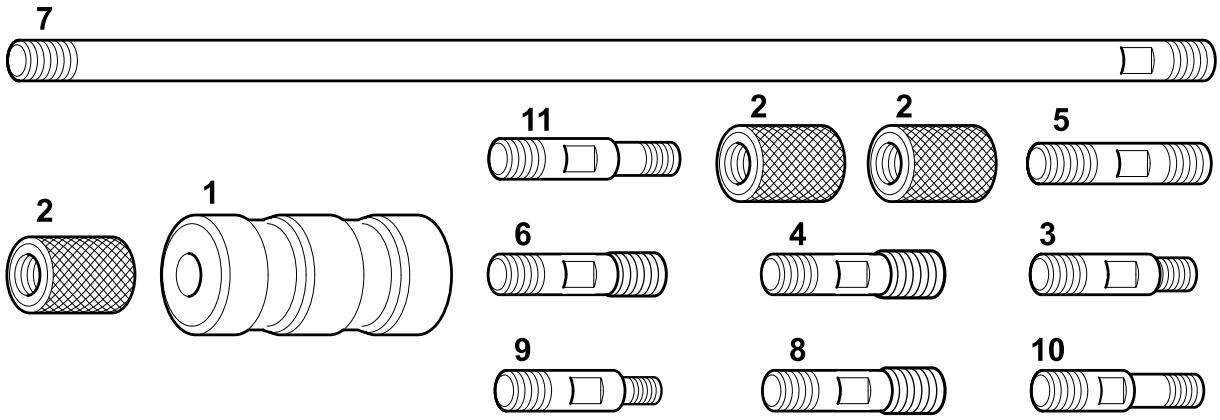
Special Tool - 993/68100 - Slide Hammer Kit



Item	Part No.	Description	Qty.
1	993/68101	Slide hammer	1
2	993/68102	End Stops	3
3	993/68103	Adaptor (M20 x 5/8" UNF)	1
4	993/68104	Adaptor (M20 x 1" UNF)	1
5	993/68105	Adaptor (M20 x M20)	1
6	993/68106	Adaptor (M20 x M24)	1
7	993/68107	Bar (M20 x M20 X 800mm)	1
8	993/68108	Adaptor (M20 x 7/8" UNF)	1
9	993/68109	Adaptor (M20 x M12)	1
10	993/68110	Adaptor (M20 x 5/8" UNF - Shoulder)	1
11	993/68111	Adaptor (M20 x 1/2" UNF)	1

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96 - Units of Measurement

00 - General

Technical Data

The standard units of measurement used by JCB are listed below together with the formula for conversion for countries using non metric standards.

Standard Units

Table 206. Force

Measurement (unit)	Convert to	Multiply by
Newton (N)	Kilogram force (kgf)	0.102
	Pound force (lbf)	0.225

Table 207. Length

Measurement (unit)	Convert to	Multiply by
Millimetre (mm)	Inch (in)	0.0394
Metre (m)	Feet (ft)	3.281
	Yard (yd)	1.094
Kilometre (km)	Mile (mile)	0.621

Table 208. Mass

Measurement (unit)	Convert to	Multiply by
Gram (g)	Ounce (oz)	0.035
Kilogram (kg)	Pound (lb)	2.205
Tonne	Ton	0.984

Table 209. Speed

Measurement (unit)	Convert to	Multiply by
Kilometre/Hour (km/h)	mile/hour (mph)	0.621
Metre/Second (m/s)	feet/second (ft/s)	3.281

Table 210. Volume

Measurement (unit)	Convert to	Multiply by
Cubic Centimetre (cm^3)	Cubic Inch (in^3)	0.061
Cubic Metre (m^3)	Cubic Foot (ft^3)	35.315
	Cubic Yard (yd^3)	1.308
Millilitre (ml)	Fluid ounce (fl oz)	0.035
Litre (l)	UK Gallon	0.220
	US Gallon	0.264

Table 211. Flow

Measurement (unit)	Convert to	Multiply by
Litre/Minute (L/m)	UK Gallon/Minute	0.220
	US Gallon/Minute	0.264

Table 212. Area

Measurement (unit)	Convert to	Multiply by
Square Millimetre (mm^2)	Square Inch (in^2)	0.0015
Square Metre (m^2)	Square Foot (ft^2)	10.764
	Square Yard (yd^2)	1.196

Table 213. Torque

Measurement (unit)	Convert to	Multiply by
Newton metre (Nm)	Pound force foot (lb f ft)	0.7376

Table 214. Pressure

Measurement (unit)	Convert to	Multiply by
Bar	Pound force/inch² (psi)	14.5

Table 215. Fuel Consumption

Measurement (unit)	Convert to	Multiply by
Kilometre/Litre (km/l)	Miles/Gallon (mpg)	2.825
	Miles/ US Gallon	2.352

Table 216. Temperature

Measurement (unit)	Convert to	Formula
Degrees Celsius (°C)	Degrees Fahrenheit (°F)	Multiply by 9, Divide by 5, Add 32

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Table 217. Power

Measurement (unit)	Convert to	Multiply by
KiloWatt (kW)	Horsepower (hp)	1.341

Table 218. Time

Measurement (unit)
Second (s)
Minute (min)
Hour (h)

Table 219. Current

Measurement (unit)
Ampere (A)

Table 220. Voltage

Measurement (unit)
Volt (V)

Table 221. Noise Levels

Measurement (unit)
Sound pressure level (LpA)
Sound power level (LwA)

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