W20F
Wheel Loader

SERVICE MANUAL

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CASE CONSTRUCTION

SERVICE MANUAL

W20F Standard model, with cab, Tier 3, made in Brazil
W20F Fertilizer model, with cab, Tier 3, made in Brazil

48096018A 18/05/2018

EN

Link Product / Engine

Product	Market Product	Engine
W20F Standard model, with cab, Tier 3, made in Brazil	Australia New Zealand	F4GE9684T*J601
W20F Standard model, with cab, Tier 3, made in Brazil	North America	F4GE9684T*J601
W20F Standard model, with cab, Tier 3, made in Brazil	Europe	F4GE9684T*J601
W20F Standard model, with cab, Tier 3, made in Brazil	Asia Pacific	F4GE9684T*J601
W20F Standard model, with cab, Tier 3, made in Brazil	Middle East Africa	F4GE9684T*J601
W20F Standard model, with cab, Tier 3, made in Brazil	Latin America	F4GE9684T*J601
W20F Fertilizer model, with cab, Tier 3, made in Brazil	Asia Pacific	F4GE9684T*J601
W20F Fertilizer model, with cab, Tier 3, made in Brazil	Australia New Zealand	F4GE9684T*J601
W20F Fertilizer model, with cab, Tier 3, made in Brazil	Europe	F4GE9684T*J601
W20F Fertilizer model, with cab, Tier 3, made in Brazil	Latin America	F4GE9684T*J601
W20F Fertilizer model, with cab, Tier 3, made in Brazil	North America	F4GE9684T*J601
W20F Fertilizer model, with cab, Tier 3, made in Brazil	Middle East Africa	F4GE9684T*J601

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INTRODUCTION

Foreword - Important notice regarding equipment servicing

All repair and maintenance work listed in this manual must be carried out only by qualified dealership personnel, strictly complying with the instructions given, and using, whenever possible, the special tools.

Anyone who performs repair and maintenance operations without complying with the procedures provided herein shall be responsible for any subsequent damages.

The manufacturer and all the organizations of its distribution chain, including - without limitation - national, regional, or local dealers, reject any responsibility for damages caused by parts and/or components not approved by the manufacturer, including those used for the servicing or repair of the product manufactured or marketed by the manufacturer. In any case, no warranty is given or attributed on the product manufactured or marketed by the manufacturer in case of damages caused by parts and/or components not approved by the manufacturer.

The manufacturer reserves the right to make improvements in design and changes in specifications at any time without notice and without incurring any obligation to install them on units previously sold. Specifications, descriptions, and illustrative material herein are as accurate as known at time of publication but are subject to change without notice.

In case of questions, refer to your CASE CONSTRUCTION Sales and Service Networks.

Foreword - How to use and navigate through this manual

This manual has been produced by a new technical information system. This new system is designed to deliver technical information electronically through web delivery (eTIM), DVD, and paper manuals. A coding system called SAP has been developed to link the technical information to other Product Support functions, e.g., Warranty.

Technical information is written to support the maintenance and service of the functions or systems on a customer's machine. When a customer has a concern on their machine it is usually because a function or system on their machine is not working at all, is not working efficiently, or is not responding correctly to their commands. When you refer to the technical information in this manual to resolve that customer's concern, you will find all the information classified using the SAP coding, according to the functions or systems on that machine. Once you have located the technical information for that function or system, you will then find all the mechanical, electrical or hydraulic devices, components, assemblies, and sub assemblies for that function or system. You will also find all the types of information that have been written for that function or system: the technical data (specifications), the functional data (how it works), the diagnostic data (fault codes and troubleshooting), and the service data (remove, install adjust, etc.).

By integrating SAP coding into technical information, you will be able to search and retrieve just the right piece of technical information you need to resolve that customer's concern on his machine. This is made possible by attaching 3 categories to each piece of technical information during the authoring process.

The first category is the Location, the second category is the Information Type and the third category is the Product:

- LOCATION - the component or function on the machine, that the piece of technical information is going to describe (e.g., Fuel tank).
- INFORMATION TYPE - the piece of technical information that has been written for a particular component or function on the machine (e.g., Capacity would be a type of Technical Data describing the amount of fuel held by the fuel tank).
- PRODUCT - the model for which the piece of technical information is written.

Every piece of technical information will have those three categories attached to it. You will be able to use any combination of those categories to find the right piece of technical information you need to resolve that customer's concern on their machine.

That information could be:

- the procedure for how to remove the cylinder head
- a table of specifications for a hydraulic pump
- a fault code
- a troubleshooting table
- a special tool

Manual content

This manual is divided into Sections. Each Section is then divided into Chapters. Contents pages are included at the beginning of the manual, then inside every Section and inside every Chapter. An alphabetical Index is included at the end of each Chapter. Page number references are included for every piece of technical information listed in the Chapter Contents or Chapter Index.

Each Chapter is divided into four Information types:

- Technical Data (specifications) for all the mechanical, electrical or hydraulic devices, components, assemblies or sub-assemblies.
- Functional Data (how it works) for all the mechanical, electrical or hydraulic devices, components, assemblies or sub-assemblies.
- Diagnostic Data (fault codes, electrical and hydraulic troubleshooting) for all the mechanical, electrical or hydraulic devices, components, assemblies or sub-assemblies.
- Service Data (remove disassemble, assemble, install) for all the mechanical, electrical or hydraulic devices, components, assemblies or sub-assemblies.

Sections

Sections are grouped according to the main functions or a systems on the machine. Each Section is identified by a number (00, 35, 55, etc.). The Sections included in the manual will depend on the type and function of the machine that the manual is written for. Each Section has a Contents page listed in alphabetic/numeric order. This table illustrates which Sections could be included in a manual for a particular product.

	PRODUCT				
	Tractors				
	Vehicles with working arms: backhoes, excavators, skid steers, ….				
	Combines, forage harvesters, balers, ….				
	Seeding, planting, floating, spraying equipment, ….				
SECTION	Mounted equipment and tools, ….				
00 - Maintenance	X	X	X	X	X
05 - Machine completion and equipment	X	X	X	X	X
10 - Engine	X	X	X	X	
14 - Main gearbox and drive	X	X	X	X	
18 - Clutch	X	X	X		
21 - Transmission	X	X	X	X	
23 - Four wheel drive (4WD) system	X	X	X	X	
25 - Front axle system	X	X	X	X	
27 - Rear axle system	X	X	X	X	
29 - Hydrostatic drive	X	X	X	X	
31 - Power Take-Off (PTO)	X		X		
33 - Brakes and controls	X	X	X	X	
35 - Hydraulic systems	X	X	X	X	
36 - Pneumatic system	X	X	X	X	
37 - Hitches, drawbars and implement couplings	X		X	X	
39 - Frames and ballasting	X	X	X	X	X
41 - Steering	X	X	X	X	
44 - Wheels	X	X	X	X	
46 - Steering clutches					
48 - Tracks and track suspension	X	X	X		
50 - Cab climate control	X	X	X	X	
55 - Electrical systems	X	X	X	X	X
56 - Grape harvester shaking					
58 - Attachments/headers			X		
60 - Product feeding			X		

61 - Metering system				X		
62 - Pressing - Bale formation			X			
63 - Chemical applicators				X		
64 - Chopping			X			
66 - Threshing			X			
68 - Tying/Wrapping/Twisting			X			
69 - Bale wagons						
70 - Ejection			X			
71 - Lubrication system	X	X	X	X	X	
72 - Separation			X			
73 - Residue handling			X			
74 - Cleaning			X			
75 - Soil preparation/Finishing						
76 - Secondary cleaning / Destemmer						
77 - Seeding				X		
78 - Spraying				X		
79 - Planting				X		
80 - Crop storage / Unloading			X			
82 - Front loader and bucket	X	X				
83 - Telescopic single arm	X	X				
84 - Booms, dippers and buckets	X	X				
86 - Dozer blade and arm	X	X				
88 - Accessories	X	X	X	X	X	
89 - Tools	X	X	X	X	X	
90 - Platform, cab, bodywork and decals	X	X	X	X		

Chapters

Each Chapter is identified by a number e.g. Engine - Engine and crankcase - 10.001. The first number is identical to the Section number i.e. Chapter 10.001 is inside Section 10, Engine. The second number is representative of the Chapter contained within the Section.

CONTENTS

The Chapter Contents lists all the technical data (specifications), functional data (how it works), diagnostic data (fault codes and troubleshooting), and service data (remove, install, adjust, etc.), that have been written in that Chapter for that function or system on the machine.

Contents

ENGINE

ENGINE - Engine and crankcase – 10.001

INDEX

The Chapter Index lists in alphabetical order all the types of information (called information units) that have been written in that Chapter for that function or system on the machine.

Index

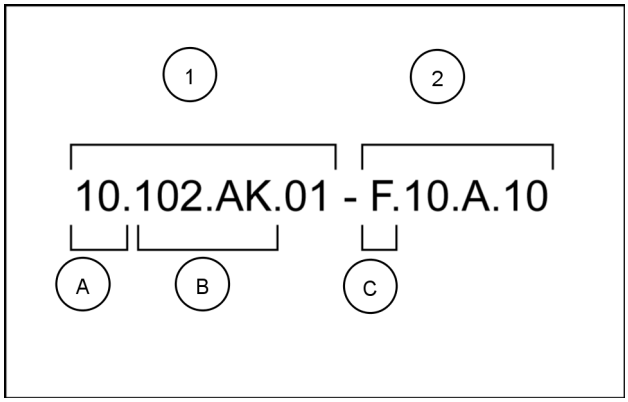
ENGINE - 10

ENGINE

Information units and information search

Each chapter is composed of information units. Each information unit has the SAP code shown in parentheses. This indicates the function and type of information in that information unit. Each information unit has a page reference within that Chapter. The information units provide a quick and easy way to find just the right piece of technical information you are looking for.

Example information unit	Engine block cover - Front – Remove (10.102.AP.01 - F.10.A.10)					
Information Unit SAP code	10	102	AK	01	F	10.A.10
SAP code classification	Engine	Pan and covers	Engine block cover	Front	Service data	Remove



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Navigate to the correct information unit you are searching for by identifying the function and information type from the SAP code.

- **(1)** Location and **(2)** Information type.
- **(A)** corresponds to the sections of the service manual.
  (B) corresponds to the chapters of the service manual. After **(B)** there may be some additional information. In this case it shows ".01", which represents the "Front" block cover. These options may be front/rear, left/right, hydraulic/mechanical etc.
  (C) corresponds to the type of information listed in the chapter contents: Technical Data, Functional Data, Diagnostic, or Service.
  (A) and **(B)** are also shown in the page numbering on the page footer.
  THE REST OF THE CODING IS NOT LISTED IN ALPHANUMERIC ORDER IN THIS MANUAL.
- You will find a table of contents at the beginning and end of each section and chapter.
  You will find an alphabetical index at the end of each chapter.
- By referring to **(A)**, **(B)** and **(C)** of the coding, you can follow the contents or index (page numbers) and quickly find the information you are looking for.

Page header and footer

The page header will contain the following references:

- Section and Chapter description

The page footer will contain the following references:

- Publication number for that Manual.
- Version reference for that publication.
- Publication date
- Section, chapter, and page reference e.g. 10.102 / 9

Safety rules

Ecology and environment

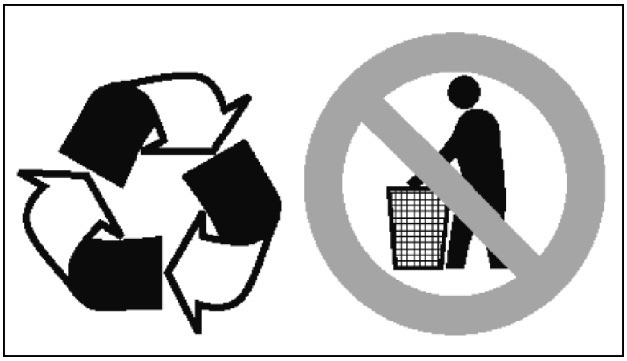
Soil, air and water are vital factors of life in general. Disposing of waste improperly represents a danger for the environment.

NOTE: *Some recommendations must be followed:*

- Obtain information about the correct methods to recycle or dispose of waste from local authorities, collection centers or your dealer.
- Do not dispose of waste onto the ground, into drains, or in water beds.
- Do not fill reservoirs using cans or inappropriate pressurized fluid delivery systems, as they may cause considerable spillage.
- Use sealed containers when draining the fluids. Do not use containers for food or beverages which may induce ingestion.
- The air conditioning system is under pressure, and contains gases that should not be released into the atmosphere. Do not disconnect or remove any component from the pressure line of the air conditioning system. If you need repairs to the air conditioning system, contact a dealer.
- Immediately repair any leaks or defects in the machine's engine cooling and hydraulic systems.
- Generally avoid skin contact with any fuels, oils, fluids, acids, solvents, etc. Most of them contain substances which may be harmful to your health.
- Avoid spills when draining fluid. Store them safely until they can be disposed of properly in compliance with local legislation.
- Protect hoses and pipes during welding works, because the sparks generated during the welding work can damage them, allowing the fluid to leak.

Mandatory recycling

The battery is essentially composed of lead plates and sulfuric acid solution. Because the battery contains heavy metals such as lead, resolution 401 de 2008 of CONAMA orders that all used batteries must be returned to the battery dealer at the time of replacement. Do not dispose of the battery in the garbage. Points of sale are obliged to accept the return of your used battery, and to store it in a suitable place and return it to the manufacturer for recycling.



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Improper disposal of batteries can contaminate the soil, groundwater and waterways. Consumption of contaminated water can cause serious health risks. Contact of the acid solution with the skin or eyes can cause serious injury and blindness. In case of accidental contact with the eyes or skin, immediately wash with running water and seek emergency medical care.

Safety rules (Signal word definitions)

Personal Safety

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible death or injury.

Throughout this manual and on machine safety signs, you will find the signal words DANGER, WARNING, and CAUTION followed by special instructions. These precautions are intended for your personal safety and for all those involved in the work activity during operation of the machine.

Read and understand all the safety messages in this manual before you operate or service the machine.

DANGER:

Indicates an immediate danger that, if not avoided, will cause death or serious injury. The color associated with Danger is RED.

WARNING:

Indicates a potential danger that, if not avoided, will cause serious injury. The color associated with Warning is ORANGE.

CAUTION:

Indicates a potential danger that, if not avoided, can cause minor or moderate injury. ORANGE also alerts the operator to unsafe practices. The color associated with Caution is YELLOW.

FAILURE TO FOLLOW DANGER, WARNING AND CAUTION MESSAGES COULD RESULT IN DEATH OR SERIOUS INJURY.

Machine safety

NOTICE: *Indicates a situation that, if not avoided, could result in machine or property damage. The color associated with Notice is BLUE.*

Throughout this manual you will find the signal word Notice followed by special instructions to prevent machine or property damage. The word Notice is used to address practices not related to personal safety.

Information

NOTE: *Indicates additional information which clarifies steps, procedures, or other information in this manual.*

Throughout this manual you will find the word NOTE followed by additional information about a step, procedure or other information in the manual. The word NOTE is not intended to address personal safety or property damage.

Safety rules

Standard safety precautions

Be informed and notify personnel of the laws in force regulating safety, and provide documentation available for consultation.

- Keep working areas as clean as possible.
- Ensure that working areas are provided with emergency boxes. They must be clearly visible and always contain adequate sanitary equipment.
- Fire extinguishers must be properly identified and always be clear of obstructions. Their efficiency must be checked on a regular basis and personnel must be trained on proper interventions and priorities.
- Keep all emergency exits free of obstructions and clearly marked.
- Smoking in working areas subject to fire danger must be strictly prohibited.

Prevention of injury

- Wear suitable work attire and safety glasses with no jewelry such as rings and chains when working close to engines and equipment in motion.
- Wear safety gloves and goggles when performing the following operations:
  - Topping off or changing lubrication oils.
  - Using compressed air or liquids at a pressure greater than **2 bar** (**29 psi**).
- Wear a safety helmet when working close to hanging loads or equipment working at head level.
- Always wear safety shoes and fitting clothes.
- Use protection cream for hands.
- Change wet clothes as soon as possible.
- In the presence of voltages exceeding **48 – 60 V**, verify the efficiency of the ground and mass electrical connections. Ensure that hands and feet are dry and use isolating foot boards. Workers should be properly trained to work with electricity.
- Do not smoke or start an open flame close to batteries and any fuel material.
- Place soiled rags with oil, diesel fuel or solvents in specially provided anti-fire containers.
- Do not use any tool or equipment for any use other than what it was originally intended for. Serious injury may occur.
- If running an engine indoors, make sure there is a sufficient exhaust fan in use to eliminate exhaust fumes.

During maintenance

- Never open the filler cap of the cooling system when the engine is hot. High temperature liquid at operating pressure could result in serious danger and risk of burn. Wait until the temperature decreases under **50 °C** (**122 °F**).
- Never add coolant to an overheated engine and use only appropriate liquids.
- Always work when the engine is turned off. Certain circumstances require maintenance on a running engine. Be aware of all the risks involved with such an operation.
- Always use adequate and safe containers for engine fluids and used oil.
- Keep engine clean of any spilled fluids such as oil, diesel fuel, and or chemical solvents.
- Use of solvents or detergents during maintenance may emit toxic vapors. Always keep working areas aerated. Wear a safety mask if necessary.
- Do not leave soiled rags that may contain any flammable substances close to the engine.
- Always use caution when starting an engine after any work has been performed. Be prepared to cut off intake air in case of engine runaway.
- Never disconnect the batteries while the engine is running.
- Disconnect the batteries prior to performing any work on the equipment.

- Disconnect the batteries to place a load on them with a load tester.
- After any work is performed, verify that the battery clamp polarity is correct and that the clamps are tight and safe from accidental short circuit and oxidation.
- Before disconnecting any pipelines (pneumatic, hydraulic, fuel pipes, etc.), verify that all pressure has been released. Take all necessary precautions bleeding and draining residual pressure. Always wear the proper safety equipment.
- Do not alter the lengths of any wires.
- Do not connect any electronic service tool to the engine electrical equipment unless specifically approved by CASE CONSTRUCTION.
- Do not modify the fuel system or hydraulic system unless approved by CASE CONSTRUCTION. Any unauthorized modification will compromise warranty assistance and may affect engine operation and life span.

For engine equipped with an electronic control unit

- Do not weld on any part of the equipment without removing the control unit.
- Remove the in case of work requiring heating over **80 °C** (**176 °F**).
- Do not paint the components and the electronic connections.
- Do not alter any data filed in the electronic control unit driving the engine. Any manipulation or alteration of electronic components will void engine warranty assistance and may affect the correct working order and life span of the engine.

Respect of the Environment

- Respect of the environment should be of primary importance. Take all necessary precautions to ensure personnel's safety and health.
- Inform the personnel of the laws regarding the dispensing of used engine fluids.
- Handle batteries with care, storing them in a well ventilated environment and within anti-acid container.

Safety rules

General safety regulations

General Aspects

- Strictly follow repair and maintenance procedures.
- Do not wear rings, wrist watches, jewelry, accessories, unbuttoned items of clothing, unsecured clothing like ties, torn clothing, scarves, or open jackets or shirts with open zippers that could get caught in moving parts. Use approved safety clothing, such as anti-slip footwear, sleeves, protective goggles, helmets, etc.
- Wear safety goggles with side shields when cleaning parts using compressed air.
- Worn or damaged cables and chains are not reliable. Do not use these elements in lifting or towing operations.
- Use regulation safety equipment, such as approved eye protection, helmets, clothes, sleeves, and special footwear whenever you are welding. All individuals near the welding process must use regulation eye protection. Never look at the welding arc without using suitable eye protection.
- Never perform any repairs on the machine if there is someone in the operator seat, except when the person is a qualified operator who is helping with the service to be performed.
- Never operate the machine or use accessories from a place other than the operator seat or next to the machine when operating the fender switches.
- Never perform any operations on the machine with the engine running, except when specifically instructed to do so. Shut down the engine and release all the pressure from the hydraulic circuits before removing covers, cases, valves, etc.
- You must conduct all repair and maintenance operations with the utmost care and attention.
- Disconnect the batteries and put warning labels on all of the controls to warn that the machine is being repaired. Lock the machine and all the equipment that you remove.
- Never check or fill the fuel tank or batteries or use starting fluid when you are smoking or near a naked flame, because these fluids are flammable.
- The fuel filling gun must remain in contact with the filler neck. Maintain the contact until the fuel stops flowing into the tank in order to avoid sparks caused by static electricity build-up.
- To transport a faulty machine, use a trailer or a low loader platform trolley, if available.
- To load and unload the machine from the mode of transportation, choose a flat area that offers firm support for the wheels of the truck or trailer. Securely fasten the machine to the platform of the trailer or truck, in accordance with the transporter’s requirements.
- Always use hoist mechanisms with an appropriate capacity for lifting or moving heavy components.
- Chains must always be securely fastened. The fastening device must have sufficient capacity to support the intended load. It is prohibited for bystanders to be near the fastening position.
- The work area must always be clean and dry. Clean it immediately if any water or oil is spilled.
- Never use gasoline, diesel, or other flammable liquids for cleaning. Use only non-toxic solvents.
- Do not allow cloths soaked with oil or grease to accumulate because they can cause a fire risk. Always keep these cloths in a metal container.

Starting

- Never start the engine in enclosed spaces that are not equipped with a suitable exhaust system or gas-extraction system.
- Never bring your head, body, arms, legs, feet, hands, or fingers close to fans or rotating belts.

Engine

- Always loosen the radiator cap slowly before removing it, in order to dissipate the system pressure. You must top up the coolant with the engine stopped.
- Do not fill up the fuel tank when the engine is running.
- Never adjust the fuel injection pump when the machine is in motion.

- Never lubricate the machine when the engine is running.

Electrical systems

- If it is necessary to use auxiliary batteries, you must connect the cables on both sides as follows: (+) to (+) and (-) to (-). Avoid causing the terminals to short circuit. The gas that the batteries release is highly flammable. During charging, leave the battery compartment open to improve ventilation. Avoid sparks and naked flames near the battery. Do not smoke.
- Do not charge the batteries in enclosed spaces.
- Always disconnect the batteries before carrying out any type of servicing on the electrical system.

Hydraulic system

- A little fluid coming out of a small bore could be almost invisible, but strong enough to penetrate the skin. For this reason, never use your hands to check for leaks. Instead, use a piece of cardboard or wood. If any fluid penetrates your skin, seek medical assistance immediately. Failure to seek immediate medical assistance could result in serious infections or dermatitis.
- Always read the system pressure using suitable gauges.

Wheels and tires

- Make sure that the tires are correctly inflated at the pressure specified by the manufacturer. Inspect the rims and tires regularly for any damage.
- Remain next to the tire when filling it with air.
- Only check the pressure when the platform is unloaded and the tires are cold, in order to prevent inaccurate readings caused by overpressure.
- Never cut or weld a rim with a full tire fitted.
- To remove the wheels, lock both the front and rear wheels of the machine. Lift the machine. Install stable and secure supports under the machine, as per the legislation in force.
- Deflate the tire before removing any objects that may be caught in the tire tread.
- Never inflate tires using flammable gases, as they could cause explosions and injure bystanders.

Remove and install

- Lift and handle all heavy components using hoist devices of appropriate capacity. You must suspend the parts using suitable hooks and slings. Use the hoist eyes provided for this purpose. Be careful if there are any bystanders near the hoisted load.

Safety rules

Health and safety precautions

Many of the procedures involved in machine maintenance and repair services involve physical hazards and other health risks. This section lists some of these hazardous procedures and the materials and equipment associated with them.

Acids and alkalis

Avoid splashing into your eyes and nose, or onto your skin and clothing. Wear suitable sleeves and protective goggles. Irritate and corrode the skin, eyes, nose, and throat. Causes burns. Do not inhale the fumes.

Adhesives and sealants

These are highly flammable. You must store them in no smoking areas. Use applicators when possible or secondary containers. The containers must be labeled.

Resin-based adhesives/sealants

Skin contact could result in irritation, dermatitis, and the absorption of toxic or harmful chemicals through the skin. Splashes could cause eye injuries. Ensure that there is adequate ventilation and avoid contact with the skin and the eyes. Follow the manufacturer’s instructions.

Ensure that there is adequate ventilation as volatile harmful or toxic chemicals may be released.

Anti-freeze

These are highly flammable. You must store them in no smoking areas.

Anti-freeze can be absorbed through the skin in toxic or harmful quantities. Ingesting anti-freeze can cause death and you must seek medical assistance immediately.

Chemicals – General

You must always take care when using and handling chemicals such as solvents, sealants, adhesives, paints, foam resins, battery acids, anti-freeze, brake fluid, oils and greases. They may be harmful, toxic, corrosive, irritant, or highly flammable. They may also emit hazardous fumes or dust.

Do

Remove chemicals from skin and clothing as soon as possible after contact. Change very dirty clothes and make provision for cleaning them.

Read and strictly adhere to the safety recommendations on the chemical containers.

When working with chemicals, wash before breaks, and before eating, smoking, drinking, or using the bathroom. Keep work areas clean, organized, and free of spillages. Store according to local and national legislation. Keep chemicals out of the reach of children.

Do not

Do not mix chemicals, except in accordance with the manufacturer's instructions. Some substances could form other chemical substances that are toxic or harmful, emit toxic or harmful fumes, or become explosive after mixing. Do not spray chemicals, especially solvent-based chemicals, in enclosed spaces.

Do not apply heat or flames to chemicals, except in accordance with the manufacturer's instructions. Some are highly flammable or could release toxic or harmful fumes.

Do not leave containers open. The fumes emitted could accumulate in toxic, harmful, or explosive concentrations. Some fumes are heavier than air and will accumulate in confined areas, trenches, etc. Do not put chemicals in un-marked containers.

Do not clean your hands or clothes with chemicals. Chemicals, particularly solvents and fuels, dry out the skin and can cause irritation and dermatitis. Some can be absorbed through the skin in toxic or harmful quantities.

Do not use empty containers to store other chemicals, except when they have been cleaned under supervision. Do not attempt to sniff or inhale chemicals. Rapid exposure to high concentrations of fumes can be toxic or harmful.

Anti-corrosive protective material

These materials are varied and you must follow the manufacturers' instructions. They may contain solvents, resins, petroleum derivatives, etc. You must avoid contact with the skin and the eyes. You must carry out spraying with adequate ventilation and never in enclosed spaces.

Post

Dust, powders, or clouds may be irritant, harmful, or toxic. Avoid inhaling the chemical powders or dusts that result from dry abrasion services. Use respiratory protection if ventilation is not adequate.

Electric shock

Electric shocks result from the use of faulty electrical equipment or from incorrect use.

You must keep electrical equipment in good condition and test it frequently.

Electrical equipment must be protected by a fuse with an appropriate nominal capacity.

Use low-voltage equipment (**110 volt**) for work lights and inspection lights, wherever possible. Use pneumatic equipment instead of electrical equipment wherever possible.

In the event of electrocution:

- Turn off the electricity before approaching the victim.
- If that is not possible, push or pull the victim away from the source of the electricity using a dry, non-conductive material.
- If you have been trained, start giving first aid.
- Seek medical assistance.

Exhaust fumes

These fumes contain asphyxiating, toxic or harmful chemical substances. You must only run engines in adequate extraction or general ventilation conditions, and never in enclosed spaces.

Fiber insulation

The fibrous nature of cut surfaces and edges can cause skin irritation. In general, the effect is physical and not chemical. You must take precautions to avoid excessive skin contact. Take care when organizing your work methods. Wear sleeves.

Fire

Many materials relating to vehicle repair are highly flammable. Some release toxic or harmful fumes when burned.

Scrupulously observe the fire prevention safety recommendations when storing and handling flammable materials or solvents, particularly in the vicinity of electrical equipment or welding processes.

Before using any electrical or welding equipment, ensure that there is no risk of fire. Always have an appropriate fire extinguisher nearby when using welding or heating equipment.

Foams – Polyurethane

See fire. Used for soundproofing. Cured foams used in seat cushions and finishes. Follow the manufacturer's instructions.

Components that have not reacted are irritants and could be harmful to the eyes and the skin. Wear sleeves and protective goggles. Individuals with chronic respiratory illnesses, asthma, bronchial problems, or a history of allergic illnesses must not work with or be in proximity to uncured materials.

Components, fumes, and aerosol clouds can cause irritation and sensitization reactions, and may be toxic or harmful. You must apply these materials with adequate respiratory protection and adequate ventilation. Do not remove the respirator when you have finished spraying. Keep the respirator on until the fumes and clouds disperse.

Burning uncured components and cured foams can generate toxic and harmful fumes. Do not permit smoking, the presence of naked flames, or the use of electrical equipment during the application of foam, and until the fumes/clouds have dispersed. The hot cutting of cured or partially cured foam must be performed in an environment with a ventilation system with extraction.

Kerosene (Paraffin)

Ingesting kerosene can cause irritation to the mouth and throat. The greatest danger from ingesting kerosene is the possibility of breathing it into the lungs. Liquid contact dries the skin and can cause irritation or dermatitis. Splashes on the skin and in the eyes cause mild irritation.

Avoid contact with the eyes and the skin as far as possible and ensure that there is adequate ventilation.

Fuel oil (diesel fuel)

When the quantities are large or the exposure period is long, skin contact with fuel oils with a high boiling point can cause serious skin diseases, including skin cancer.

Gas cylinders

See fire. In general, gases, such as oxygen, carbon dioxide, argon, and propane, are stored in cylinders with pressures of up to **140 bar** (**2000 lb/in2**). You need to take sufficient care when handling them to prevent physical damage to the cylinders and the valve accessories. The content of each cylinder must be clearly identified with suitable labels.

You must store the cylinders in a well-ventilated room, protected from ice, rain, and direct sunlight. You must not store combustible gases near to oxygen cylinders.

Be careful to prevent leaks from the cylinders and the gas lines, and to avoid ignition sources. Only qualified personnel may perform services using the cylinders.

General workshop equipment and tools

You must keep all equipment and tools in good condition and you must use the correct safety equipment whenever necessary.

Never use tools or equipment for any purpose other than that for which they are intended. Never overload equipment such as hoists, jacks, chassis bases and axles, or hoisting slings. The damage caused by overloading does not always appear immediately and could cause a fatal accident the next time that the equipment is used.

Do not use faulty or damaged equipment or tools, particularly high-speed equipment, such as emery wheels. A damaged emery wheel can disintegrate suddenly and cause serious injury. Use protective goggles whenever you use equipment for grinding, cutting, polishing, or sandblasting.

Oil test equipment, lubrication test equipment, and high-pressure air test equipment, in accordance with local legislation

Always keep high-pressure equipment in good condition and carry out regular maintenance, particularly on connections and fittings. Never point a high-pressure nozzle at the skin as the fluid can cause serious injuries.

Legal aspects

Various laws and regulations lay down the health and safety requirements for working with materials and equipment in workshops. Always observe the regulations and laws in force in the country in which you are working.

Workshops must comply with the relevant regulations and laws. Consult the local supervisory authorities or related government bodies if you are in any doubt.

Lubricants and greases

Avoid prolonged or recurrent contact with mineral oils, particularly used oils.

Thoroughly wash the skin after tasks using oil. Do not use gasoline, paraffin, or other solvents to remove oil from the skin. Lubricants and greases can cause mild eye irritation.

You must avoid repeated or prolonged skin contact by wearing protective clothing where necessary. Do not allow your work clothes to become contaminated with oil. Wash or dry clean work clothes regularly. Discard oil-soaked shoes.

Do not use used engine oil as a lubricant or for applications where it might come into contact with the skin.

Paints

You should preferably perform spraying in a ventilated cab with an exhaust system to remove the fumes and spray from the breathing area. Individuals working in cabs must use respiratory protection. Personnel carrying out small-scale repair work must use respirators with an air supply.

Solvents

Contact dries out the skin, and prolonged or recurrent contact can cause irritation and dermatitis. Some can be absorbed through the skin in toxic or harmful quantities. Splashes into the eyes can cause serious irritation and even lead to blindness.

Wear protective sleeves, protective goggles and protective clothing. Ensure that there is good ventilation during use, avoid inhaling smoke, fumes, and spray clouds, and keep containers securely closed. Do not use in enclosed spaces.

Do not apply heat or flame, except in accordance with specific and detailed instructions from the manufacturer.

Arc welding

This process emits a high level of ultraviolet radiation that can burn the eyes and skin of the welder and of other people nearby. Gas-protected welding processes are particularly dangerous in this respect. Personal protection is mandatory. Barriers to protect other people are also necessary. You also need to use suitable eye and skin protection because of metal splashes.

The heat of arc welding will produce gases and fumes from the metals that are being melted, and from the coatings applied to or contamination on the worked surfaces. These gases and fumes may be toxic and you must avoid inhaling them. You may need to use ventilation with extraction to remove smoke from the work area, particularly in cases where there is not enough general ventilation or in places where a considerable amount of welding is expected to take place. In extreme cases, where adequate ventilation cannot be guaranteed, you may need to use respirators with an air supply.

Safety rules (Weld works)

⚠ WARNING

Avoid injury!
When welding, always wear proper protective equipment and welding clothing. All persons in the work area must, at minimum, wear welding goggles. Never look directly at the welding arc without welding eye protection.
Failure to comply could result in death or serious injury.

W1178A

NOTICE: *Repair works with welding must be performed by a qualified and experienced welder. Appropriate safety regulations should be followed by the personnel involved in the work. The time to perform welding operations depends on the quality and precision of the work. Never make modifications on the machine.*

To perform welding operations on the machine (authorized and in accordance with CASE CONSTRUCTION recommendations), proceed as follows:

SP0064 1

- Identify all points of fracture or cracking, and the areas in which welding is required.
- Thoroughly clean the areas involved.
- Remove all paint. Inspect the parts with liquid penetrant or a magnetic tool for particles.
- Shut down the engine. Place the ignition key in the “OFF” position to shut down the engine.

  NOTICE: *After you shut down the machine, wait at least* ***8 min*** *to shut down the battery cables or the master switch (if equipped). This time is necessary so that the engine’s electronic system (if equipped) can store the settings data in the electronic module.*
- Disconnect the batteries and the wires from terminals D+ and B+ of the alternator.
- Disconnect the electrical wiring harnesses from the transmission control modules and from the engine.
- Connect the ground cable of the welding machine to the component to be welded.
- Always connect the welding equipment to the frame that is being welded.
- Never connect the welding equipment ground to a component of the hydraulic system.
- Avoid welding at low temperatures, e.g., below **16 °C**. If necessary, warm up the part involved prior to welding.
- Remove the paint from all surfaces before heating or welding. Painted surfaces can generate toxic gases when heated or welded.
- Use appropriate masks or protective goggles.
- Wear appropriate gloves and protective equipment.
- Disconnect the connectors from all control modules of the machine.

Heating lines containing pressurized fluid

NOTICE: *Flammable sprays can be generated by heating near lines containing pressurized fluid, resulting in severe burns to those doing the repair and to bystanders.*

- Do not cause heating by welding, or use open flames near the components containing pressurized fluid or other flammable materials.
- Install temporary fire protection to protect the lines and other components of the machine when you perform a welding procedure.

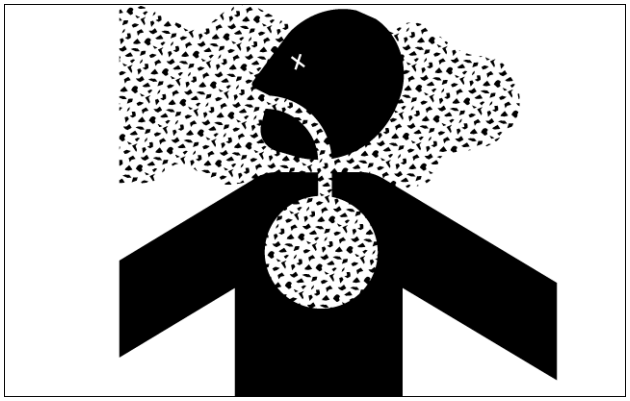
  NOTE: *Pressurized lines can be accidentally cut when the heat goes beyond the area of the flame.*
- Avoid heating lines containing flammable fluids
- Do not weld or torch cut lines that contain flammable fluids.
- Clean the lines to be welded or cut with non-flammable solvents before welding or cutting them.

SP0059 2

Remove the paint before welding or heating

NOTICE: *Hazardous fumes can be generated when the paint is heated by the welding arc or torch flame. If inhaled, these fumes may be harmful to your health.*

- Do not breath in potentially toxic fumes and dust.
- Do all such work outside or in a well-ventilated area.
- Handle and dispose of waste from paints or solvents in accordance with environmental regulations, laws, and government codes.
- Remove the paint from the part to be welded before welding or heating operations.
- When sanding or grinding the paint, avoid breathing in the dust.
- Wear an approved respirator.
- If you use solvent or paint stripper, remove the stripper with soap and water before welding operations.
- Remove solvent or paint stripper containers and other flammable material from area.
- Allow the fumes to disperse for at least **15 min** before welding or heating operations.



SP0060 3

Safety rules - (Machine service)

NOTICE: *Carefully read the Operation and Maintenance Manual before you turn on, operate, perform maintenance, fuel, or repair the machine in any way.*

Safe maintenance

- Unexpected machine movement can cause serious injury.
- Place a “Do Not Operate” tag on the ignition key before you start any maintenance procedure on the machine.
- Observe, understand, and follow the instructions on all safety decals on the machine. If you have any questions, see the “Safety Decals” section in this manual.
- Keeps all safety signs and decals clean and legible.

NOTE: *Replace decals that are unreadable, damaged, or missing, as required.*

147783A1_B 1

- Never allow unauthorized persons without training or knowledge of the machine to perform maintenance tasks.
- Follow all of the recommended maintenance and service procedures.
- Do not leave the operator's seat if the operation requires that the engine remains on. If necessary, call another person to assist you in the verification procedure with the machine in operation.
- Keep all machine components in good condition and installed correctly.
- Immediately repair any fault.
- Replace worn or failed components.
- Remove grease, oil, and accumulated debris.

SP0039 2

Moving parts

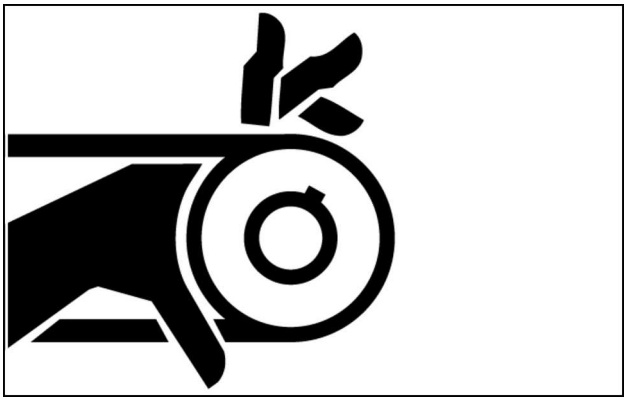
- Keep hands and clothing away from moving parts.
- Do not wear rings, wrist watches, jewellery, loose or hanging garments, such as ties, torn clothing, scarves, unbuttoned or unzipped jackets that can get caught by movements of rotating components.

SP0041 3

Maintenance with the engine in operation

- Do not perform any maintenance operation with the engine running.
- Contact with moving parts can cause serious injuries.
- Stop the engine and wait for it to cool off prior to performing maintenance operations.

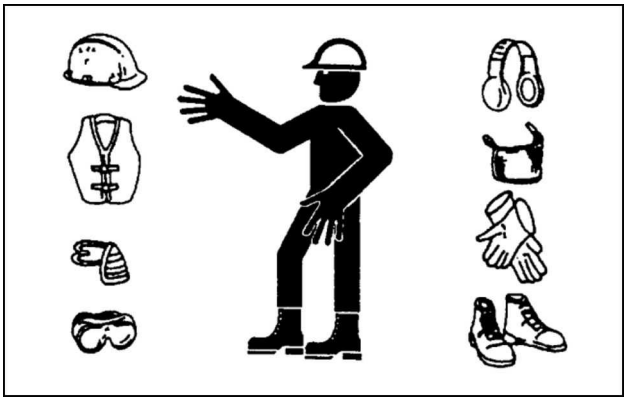
NOTE: *If the engine must be on to make certain adjustments, first place the transmission into neutral. Apply the parking brake. Place the implement in a safe position. Securely block the wheels. Use extreme caution.*



SP0042 4

Protective equipment

- Familiarize yourself with the safety and protection regulations.
- Always wear certified safety equipment such as: hard hat, no-slip footwear, protective gloves (to handle chains and cables), ear protection, protective goggles, reflector vests, and respirators when required.



SP0005 5

Support cradles

- Do not use the control levers or hydraulic hoses as supports.
- The hydraulic hoses and the control levers are movable parts. The hydraulic hoses and the control levers do not provide solid support. Also, the control levers can be moved inadvertently and cause unexpected movement of the machine or its attachments.
- Do not jump on or off the machine. Always maintain at least three points of support between the steps and the handrails.
- Always keep the operator's compartment, steps, handrails and control handles clean and clear of foreign objects, oil, grease, mud or snow to reduce the risk of slipping or stumbling.
- Remove mud or grease from your shoes before entering the cab to operate the machine.

Support, block, and protect the machine properly

SP0040 6

- Do not perform maintenance work on a machine that is not properly supported.
- Always support the implement on the ground before starting the maintenance work.
- If it is necessary to perform maintenance on a machine with the implement raised, make sure to support it firmly.
- Do not support the machine on bricks, boards or other material that could collapse under load.
- Do not perform maintenance work on a machine that is supported solely by a jack.
- Lock the machine components that must be raised for maintenance using appropriate lifting equipment.
- Always lock all moving components or parts of the machine that should be lifted for maintenance purposes using adequate external lifting equipment as required by local regulations.
- Do not allow anyone to pass or remain near or below a raised attachment.

  NOTE: *Never move or stop the bucket above people or a cab of another machine or truck.*

- When the maintenance to be performed requires access to areas that cannot be reached from the ground, use a ladder or scaffolding.
- Workshop maintenance or field scaffolding should be manufactured and maintained in accordance with the safety regulations.

  NOTE: *If a ladder or scaffolding are not available, use the machine handrails and steps.*

- Perform any maintenance work with the greatest care and attention.
- Do not place your head, body, limbs, hands, feet, or fingers near the articulated cutting edges without the necessary protection.
- Securely block the machine or any component that may fall before working on the machine or component. If possible, also use an auxiliary or backup blocking device.

  NOTE: *To prevent unexpected movement, securely block the working elements whenever you service or replace working tool parts such as cutting edges.*

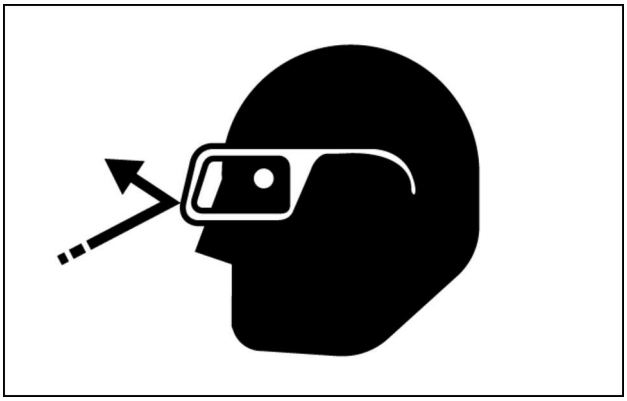
Safe storage of accessories

- Accessories such as buckets, hydraulic brakes and blades stored incorrectly can fall and cause serious injury or death.
- Store accessories and implements safely to prevent falling.
- Keep accessories and implements stored in safe locations without the circulation of people.

SP0054 7

Be careful with any debris that comes off

- Serious injury may occur if your eyes or any other part of the body are struck by flying debris.
- Protect yourself from injury caused by parts or debris that may be thrown; use protective goggles or a face shield.
- Keep people away from the work area before you perform any maintenance on the machine.

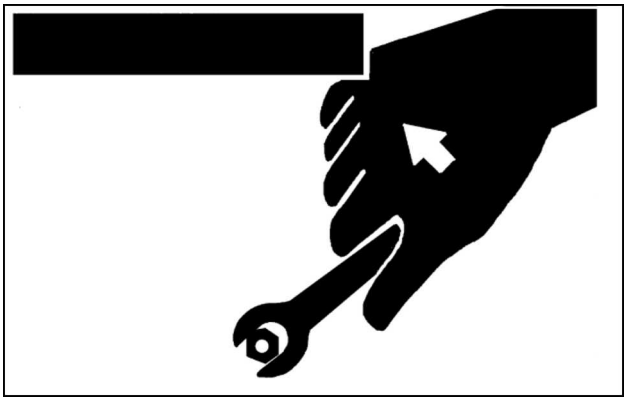


SP0056 8

Use appropriate tools

- Use tools appropriate for the work to be performed.
- Inappropriate tools, parts and procedures may create dangerous conditions.
- Use tools of correct dimensions in the fastening elements.

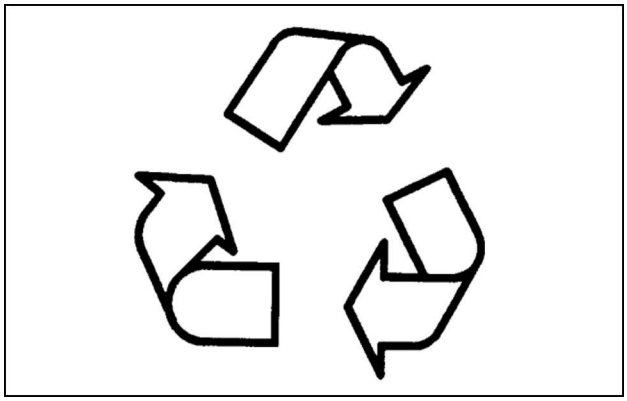
  NOTE: *Avoid injuries caused by an improper wrench.*
- Do not use tools sized in inches with metric bolts and nuts, or vice-versa.
- Only use genuine parts (See the Parts Catalog).



SP0063 9

Dispose of waste correctly

- Disposing of waste improperly represents a danger for the environment.
- Potentially dangerous material used in the machines includes lubricants, fuel, coolant, brake fluid, filters, and batteries.
- Use sealed containers when draining the fluids.
- Do not use containers for food or beverages which may induce ingestion.
- Do not dispose of waste onto the ground, into drains, or in water beds.
- Obtain information about the correct methods to recycle or dispose of waste from local authorities, collection centers or your dealer.
- Keep the maintenance area clean and dry at all times.
- Clean all spills of water, fluid or fuel immediately.
- Do not pile up rags soiled with fluid or grease. This is a fire hazard. Store soiled rags in closed metal containers.
- Rust and corrosion inhibitors are volatile and flammable.
- Prepare parts in well-ventilated areas.
- Keep flames away. Do not smoke.
- Store containers of fluids in cool and well-ventilated areas where they cannot be reached by unauthorized people.



SP0044 10

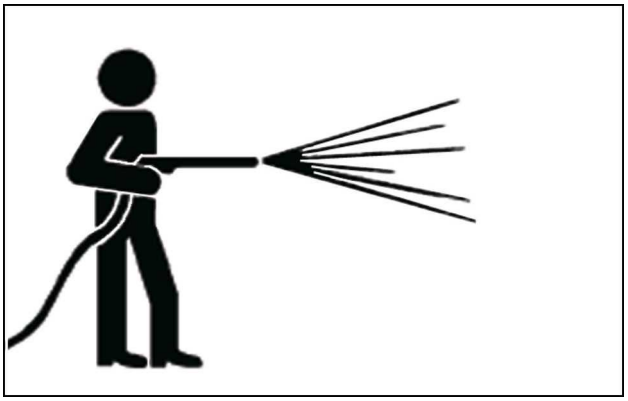
Properly light the work area

- Properly and safely light the working area.
- Use portable safety lights to work inside and under the machine.
- Make sure that the bulb is protected by a cage.
- The incandescent filament of the bulb can accidentally cause a fire if it comes into contact with fuel or oil.

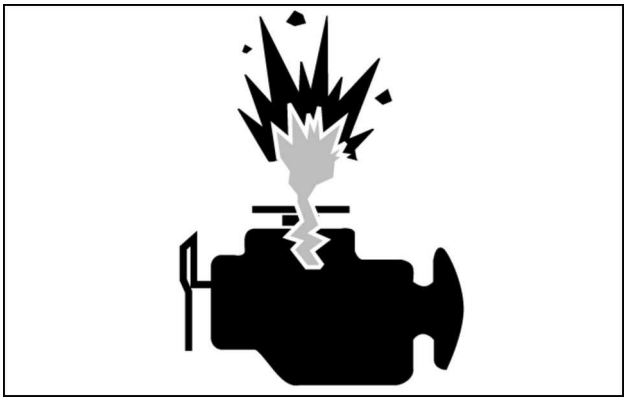
SP0045 11

Keep the machine clean

- Keep the machine clean and free of debris, excess lubricants, and spilled fuel and fluids.
- Do not spray water or steam inside the cab.
- Use approved solvents, detergents and water to clean the machine and its components on a regular basis.
- Keep the engine compartment, air conditioning condenser, radiator, batteries, hydraulic lines, fuel tank, and operator's cab clean.
- After shutting down the engine, the engine compartment temperature can rise rapidly.
- Be careful with possible fires.
- Open the access doors to speed up the engine cooling process and clean the compartment.



SP0053 12



SP0050 13

Battery maintenance precautions

- Disconnect the batteries before you perform any type of service on the electrical system.

  NOTE: *Familiarize yourself with the battery cable disconnection sequence and the disconnection sequence of other electrical and electronic components before you start the service procedure.*

- The sulfuric acid contained in the battery is poisonous. The acid is strong enough to scald the skin, corrode clothes and cause blindness if it comes into contact with the eyes.

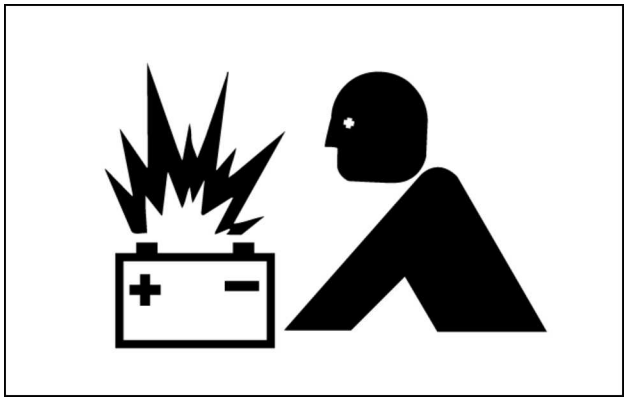
  NOTE: *Wash your eyes with water for* ***15 min*** *in the event of contact. See a doctor immediately.*

- Always top up the battery electrolyte level in ventilated areas.
- Wear eye protections and rubber gloves.
- Avoid breathing the electrolyte vapors when topping up the electrolyte level.
- Avoid spilling or splashing the machine with the electrolyte.
- Use the correct emergency start-up method.
- In case of contact with the acid, thoroughly wash the affected part with water. Place baking soda or clay on the area to help neutralize the acid.

SP0055 14

Avoid a battery explosion

- The gas released by the batteries can be flammable and may explode.
- Keep sparks, matches and flames away from the batteries.
- Never short-circuit the battery terminals to check their charge. Use a voltmeter.
- Do not charge a frozen battery, as it may explode.
- Warm the battery to **16.0 °C** (**60.8 °F**) before you charge the battery.
- Battery electrolyte is poisonous.
- If the battery explodes, the electrolyte can reach the eyes with consequent risk of blindness.
- Be sure to wear eye protection.



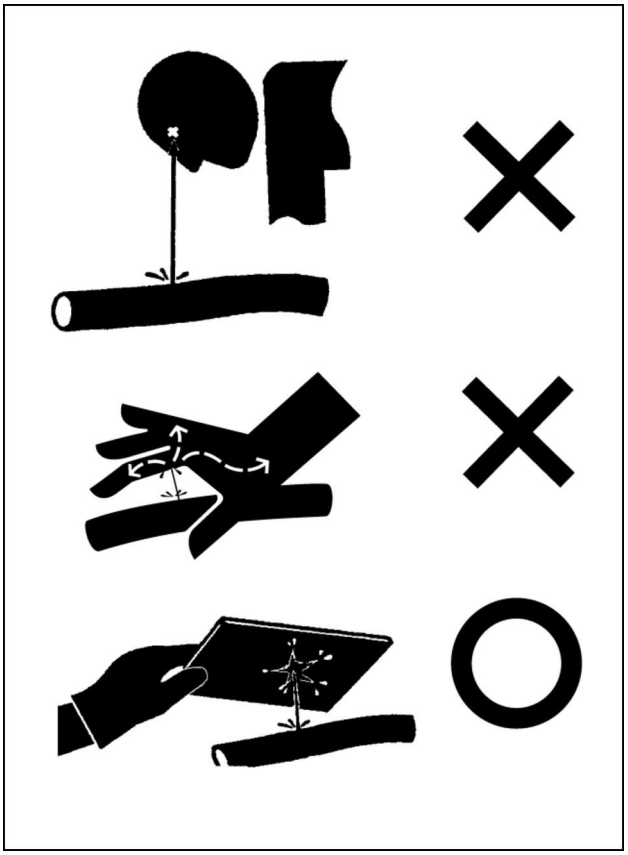
SP0052 15

Avoid burns

- After machine operation, the engine coolant is hot and under pressure.
- The engine, radiator, and cooling system lines contain hot water and steam.
- Skin contact with hot water or steam can cause severe burns.
- Avoid possible burns that may be caused by hot water or steam under pressure.
- Do not remove the radiator cap until the engine is cool.
- After the engine has cooled, turn the cap slowly to allow all the pressure to be released. We advise you to wear safety goggles and gloves to perform this operation.
- After the pressure is released, remove the cap completely.
- The hydraulic fluid reservoir is under pressure.
- Be sure to release all pressure before removing the cap.
- Engine oil, reducer oil and hydraulic fluid also become hot during operation.
- Like the engine, the pressure lines and lubrication system components are also heated during machine operation.
- In case of maintenance in any of these components, wait until the system completely cools.
- Wait until all the fluids and components cool before starting any maintenance work.

SP0049 16

Be careful with pressurized fluids



SP0046 17

- Fuel or hydraulic fluid under pressure can penetrate the skin or eyes, causing serious injuries, blindness, or death.
- Avoid this hazard by releasing the pressure from the systems before disconnecting the hydraulic or fuel lines.
- Tighten all connections before pressurizing the systems.
- Search for leaks with a piece of cardboard or wood, taking care to protect the hands and body from high pressure fluids.
- Wear a face shield or protective goggles to protect the eyes.
- If an accident occurs, see a doctor immediately.
- Any fluid injected into the skin must be treated quickly to avoid major health problems.
- Never perform repairs on pressurized components until the pressure has been released.
- Use extreme caution when you remove the radiator, the expansion tank or the covers, the drain plugs, the grease fittings, or other pressure components.
- Park the machine and let it cool before opening a pressurized tank.
- Release all pressure before you work on systems with an accumulator.
- Hydraulic fluid or diesel fuel that leaks under pressure can penetrate the skin and cause infection or other injuries.

  NOTE: *To prevent personal injury, relieve all pressure before disconnecting fluid lines or performing work on the hydraulic system.*
- Before applying pressure, make certain all connections are tight and components are in good condition.
- Use a piece of cardboard, newspaper, or wood to check for any pressurized leaks to prevent fluid penetrating the skin.
- Unexpected movement of the machine could occur.

Torque

Non-flanged metric fasteners

Nominal size	Bolt 8.8 Class and nut class 8		Bolt 10.9 Class and nut class 10		Jam nut CL 0.8 with bolt CL 8.8	Jam nut CL 0.10 with bolt CL 10.9
	Unplated	Zinc- and chrome-plated	Unplated	Zinc- and chrome-plated		
M4	**2.2 N·m (19 lb in)**	**2.9 N·m (26 lb in)**	**3.2 N·m (28 lb in)**	**4.2 N·m (37 lb in)**	**2 N·m (18 lb in)**	**2.9 N·m (26 lb in)**
M5	**4.5 N·m (40 lb in)**	**5.9 N·m (52 lb in)**	**6.4 N·m (57 lb in)**	**8.5 N·m (75 lb in)**	**4 N·m (36 lb in)**	**5.8 N·m (51 lb in)**
M6	**7.5 N·m (66 lb in)**	**10 N·m (89 lb in)**	**11 N·m (96 lb in)**	**15 N·m (128 lb in)**	**6.8 N·m (60 lb in)**	**10 N·m (89 lb in)**
M8	**18 N·m (163 lb in)**	**25 N·m (217 lb in)**	**26 N·m (234 lb in)**	**35 N·m (311 lb in)**	**17 N·m (151 lb in)**	**24 N·m (212 lb in)**
M10	**37 N·m (27 lb ft)**	**49 N·m (36 lb ft)**	**52 N·m (38 lb ft)**	**70 N·m (51 lb ft)**	**33 N·m (25 lb ft)**	**48 N·m (35 lb ft)**
M12	**64 N·m (47 lb ft)**	**85 N·m (63 lb ft)**	**91 N·m (67 lb ft)**	**121 N·m (90 lb ft)**	**58 N·m (43 lb ft)**	**83 N·m (61 lb ft)**
M16	**158 N·m (116 lb ft)**	**210 N·m (155 lb ft)**	**225 N·m (166 lb ft)**	**301 N·m (222 lb ft)**	**143 N·m (106 lb ft)**	**205 N·m (151 lb ft)**
M20	**319 N·m (235 lb ft)**	**425 N·m (313 lb ft)**	**440 N·m (325 lb ft)**	**587 N·m (433 lb ft)**	**290 N·m (214 lb ft)**	**400 N·m (295 lb ft)**
M24	**551 N·m (410 lb ft)**	**735 N·m (500 lb ft)**	**762 N·m (560 lb ft)**	**1016 N·m (750 lb ft)**	**501 N·m (370 lb ft)**	**693 N·m (510 lb ft)**

NOTE: *The torque specifications in English units for M4 to M8 fastening elements are shown in pounds-inches. The torque specifications in English units for M10 to M24 fastening elements are shown in pounds-feet.*

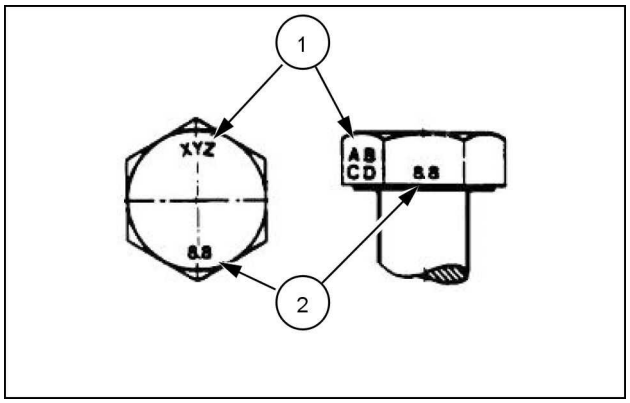
Flanged metric fasteners

Nominal size	Bolt 8.8 Class and nut class 8		Bolt 10.9 Class and nut class 10		Jam nut CL 0.8 with bolt CL 8.8	Jam nut CL 0.10 with bolt CL 10.9
	Unplated	Zinc- and chrome-plated	Unplated	Zinc- and chrome-plated		
M4	**2.4 N·m (21 lb in)**	**3.2 N·m (28 lb in)**	**3.5 N·m (31 lb in)**	**4.6 N·m (41 lb in)**	**2.2 N·m (19 lb in)**	**3.1 N·m (27 lb in)**
M5	**4.9 N·m (43 lb in)**	**6.5 N·m (58 lb in)**	**7.0 N·m (62 lb in)**	**9.4 N·m (83 lb in)**	**4.4 N·m (39 lb in)**	**6.4 N·m (57 lb in)**
M6	**8.3 N·m (73 lb in)**	**11 N·m (96 lb in)**	**12 N·m (105 lb in)**	**16 N·m (141 lb in)**	**7.5 N·m (66 lb in)**	**11 N·m (96 lb in)**
M8	**20 N·m (179 lb in)**	**27 N·m (240 lb in)**	**29 N·m (257 lb in)**	**39 N·m (343 lb in)**	**18 N·m (163 lb in)**	**27 N·m (240 lb in)**
M10	**40 N·m (30 lb ft)**	**54 N·m (40 lb ft)**	**57 N·m (42 lb ft)**	**77 N·m (56 lb ft)**	**37 N·m (27 lb ft)**	**53 N·m (39 lb ft)**
M12	**70 N·m (52 lb ft)**	**93 N·m (69 lb ft)**	**100 N·m (74 lb ft)**	**134 N·m (98 lb ft)**	**63 N·m (47 lb ft)**	**91 N·m (67 lb ft)**
M16	**174 N·m (128 lb ft)**	**231 N·m (171 lb ft)**	**248 N·m (183 lb ft)**	**331 N·m (244 lb ft)**	**158 N·m (116 lb ft)**	**226 N·m (167 lb ft)**
M20	**350 N·m (259 lb ft)**	**467 N·m (345 lb ft)**	**484 N·m (357 lb ft)**	**645 N·m (476 lb ft)**	**318 N·m (235 lb ft)**	**440 N·m (325 lb ft)**
M24	**607 N·m (447 lb ft)**	**809 N·m (597 lb ft)**	**838 N·m (618 lb ft)**	**1118 N·m (824 lb ft)**	**552 N·m (407 lb ft)**	

Metric hexagonal bolts, classes 5.6 and higher

(1) Manufacturer's Identification

(2) Property Class



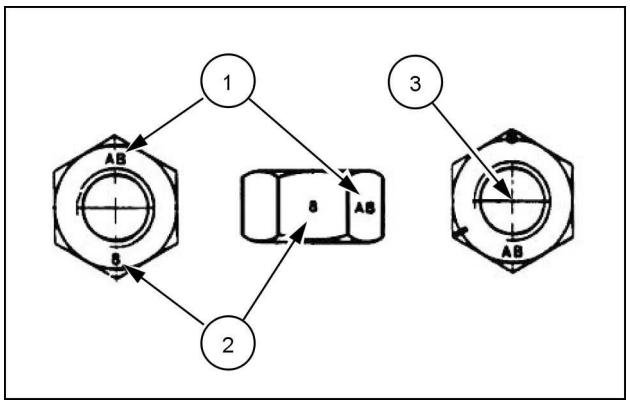
COIL14DOZ0004AA 1

Metric hexagonal nuts and jam nuts, classes 05 and up

(1) Manufacturer's Identification

(2) Property Class

(3) Clock marking of property class and manufacturer's identification (optional), i.e. marks **60°** apart indicate Class 10 properties and marks **120°** apart indicate Class 8.

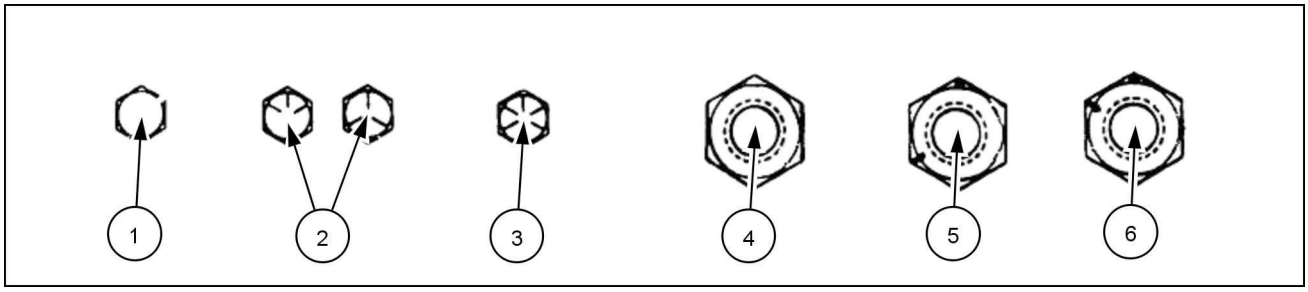


COIL14DOZ0005AA 2

Non-flanged fasteners in inches

Nominal size	Bolt and nut class SAE 5		Bolt and nut class SAE 8		Jam nut GrB with bolt Gr5	Jam nut GrC with bolt Gr8
	Unplated or silver-plated	Gold-, Zinc- and Chrome-plated	Unplated or silver-plated	Gold-, Zinc- and Chrome-plated		
1/4	**8 N·m (71 lb in)**	**11 N·m (97 lb in)**	**12 N·m (106 lb in)**	**16 N·m (142 lb in)**	**8.5 N·m (75 lb in)**	**12.2 N·m (109 lb in)**
5/16	**17 N·m (150 lb in)**	**23 N·m (204 lb in)**	**24 N·m (212 lb in)**	**32 N·m (283 lb in)**	**17.5 N·m (155 lb in)**	**25 N·m (220 lb in)**
3/8	**30 N·m (22 lb ft)**	**40 N·m (30 lb ft)**	**43 N·m (31 lb ft)**	**57 N·m (42 lb ft)**	**31 N·m (23 lb ft)**	**44 N·m (33 lb ft)**
7/16	**48 N·m (36 lb ft)**	**65 N·m (48 lb ft)**	**68 N·m (50 lb ft)**	**91 N·m (67 lb ft)**	**50 N·m (37 lb ft)**	**71 N·m (53 lb ft)**
1/2	**74 N·m (54 lb ft)**	**98 N·m (73 lb ft)**	**104 N·m (77 lb ft)**	**139 N·m (103 lb ft)**	**76 N·m (56 lb ft)**	**108 N·m (80 lb ft)**
9/16	**107 N·m (79 lb ft)**	**142 N·m (105 lb ft)**	**150 N·m (111 lb ft)**	**201 N·m (148 lb ft)**	**111 N·m (82 lb ft)**	**156 N·m (115 lb ft)**
5/8	**147 N·m (108 lb ft)**	**196 N·m (145 lb ft)**	**208 N·m (153 lb ft)**	**277 N·m (204 lb ft)**	**153 N·m (113 lb ft)**	**215 N·m (159 lb ft)**
3/4	**261 N·m (193 lb ft)**	**348 N·m (257 lb ft)**	**369 N·m (272 lb ft)**	**491 N·m (362 lb ft)**	**271 N·m (200 lb ft)**	**383 N·m (282 lb ft)**
7/8	**420 N·m (310 lb ft)**	**561 N·m (413 lb ft)**	**594 N·m (438 lb ft)**	**791 N·m (584 lb ft)**	**437 N·m (323 lb ft)**	**617 N·m (455 lb ft)**
1	**630 N·m (465 lb ft)**	**841 N·m (620 lb ft)**	**890 N·m (656 lb ft)**	**1187 N·m (875 lb ft)**	**654 N·m (483 lb ft)**	**924 N·m (681 lb ft)**

Bolts in inches and self-locking nuts (Class SAE)



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(1) Class 2 bolt - No Marks

(2) Class 5 bolt - Three marks

(3) Class 8 bolt - Five marks

(4) Class 2 nut - No Marks

(5) Class 5 Nut - Marks **120°** apart

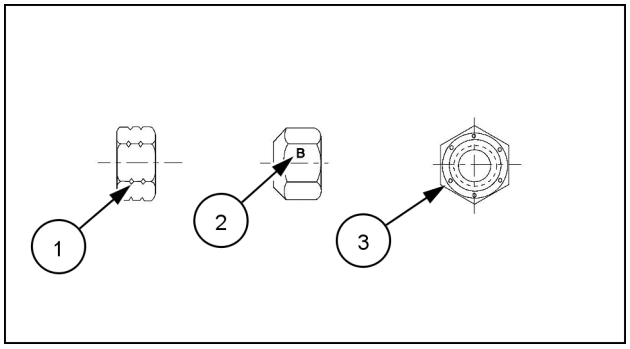
(6) Class 8 Nut - Marks **60°** apart

Self-locking nuts in inches, all-metal (three optional methods)

Grade A
(1) Corner marking method: No notches
(2) Flats marking method: No marks
(3) Clock marking method: No marks

Grade B
(1) Corner marking method: One circumferential notch
(2) Flats marking method: Letter B
(3) Clock marking method: Three marks

Grade C
(1) Corner marking method: Two circumferential notches
(2) Flats marking method: Letter C
(3) Clock marking method: Six marks



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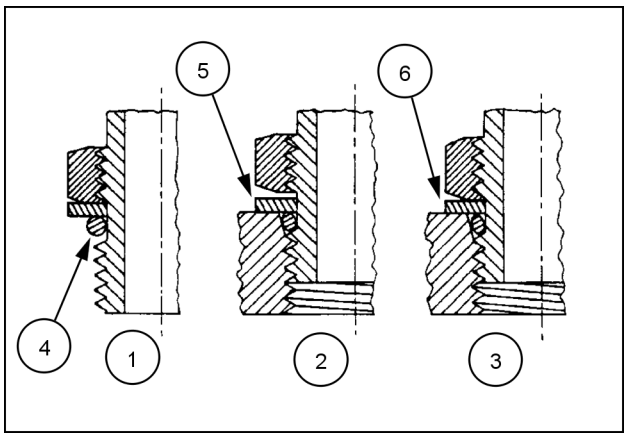
Torque - Standard torque data for hydraulics

Installation of adjustable fittings in straight thread O-ring bosses



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1. Lubricate the O-ring by coating it with a light oil or petroleum. Install the O-ring in the groove adjacent to the metal backup washer which is assembled at the extreme end of the groove **(4)**.
2. Install the fitting into the SAE straight thread boss until the metal backup washer contacts the face of the boss **(5)**.

   NOTE: *Do not over tighten and distort the metal backup washer.*
3. Position the fitting by turning out (counterclockwise) up to a maximum of one turn. Holding the pad of the fitting with a wrench, tighten the locknut and washer against the face of the boss **(6)**.

Standard torque data for hydraulic tubes and fittings

Tube nuts for 37° flared fittings				O-ring boss plugs adjustable fitting locknuts, swivel JIC-37° seats
Size	**Tubing OD**	**Thread size**	**Torque**	**Torque**
4	**6.4 mm** (**1/4 in**)	7/16-20	**12 – 16 N·m** (**9 – 12 lb ft**)	**8 – 14 N·m** (**6 – 10 lb ft**)
5	**7.9 mm** (**5/16 in**)	1/2-20	**16 – 20 N·m** (**12 – 15 lb ft**)	**14 – 20 N·m** (**10 – 15 lb ft**)
6	**9.5 mm** (**3/8 in**)	9/16-18	**29 – 33 N·m** (**21 – 24 lb ft**)	**20 – 27 N·m** (**15 – 20 lb ft**)
8	**12.7 mm** (**1/2 in**)	3/4-16	**47 – 54 N·m** (**35 – 40 lb ft**)	**34 – 41 N·m** (**25 – 30 lb ft**)
10	**15.9 mm** (**5/8 in**)	7/8-14	**72 – 79 N·m** (**53 – 58 lb ft**)	**47 – 54 N·m** (**35 – 40 lb ft**)
12	**19.1 mm** (**3/4 in**)	1-1/16-12	**104 – 111 N·m** (**77 – 82 lb ft**)	**81 – 95 N·m** (**60 – 70 lb ft**)
14	**22.2 mm** (**7/8 in**)	1-3/16-12	**122 – 136 N·m** (**90 – 100 lb ft**)	**95 – 109 N·m** (**70 – 80 lb ft**)
16	**25.4 mm** (**1 in**)	1-5/16-12	**149 – 163 N·m** (**110 – 120 lb ft**)	**108 – 122 N·m** (**80 – 90 lb ft**)
20	**31.8 mm** (**1-1/4 in**)	1-5/8-12	**190 – 204 N·m** (**140 – 150 lb ft**)	**129 – 158 N·m** (**95 – 115 lb ft**)
24	**38.1 mm** (**1-1/2 in**)	1-7/8-12	**217 – 237 N·m** (**160 – 175 lb ft**)	**163 – 190 N·m** (**120 – 140 lb ft**)
32	**50.8 mm** (**2 in**)	2-1/2-12	**305 – 325 N·m** (**225 – 240 lb ft**)	**339 – 407 N·m** (**250 – 300 lb ft**)

These torques are not recommended for tubes of **12.7 mm** (**1/2 in**) OD and larger with wall thickness of **0.889 mm** (**0.035 in**) or less. The torque is specified for **0.889 mm** (**0.035 in**) wall tubes on each application individually.

Before installing and torquing **37°** flared fittings, clean the face of the flare and threads with a clean solvent or Loctite cleaner and apply hydraulic sealant **LOCTITE® 569™** to the **37°** flare and the threads.

Install fitting and torque to specified torque, loosen fitting and retorque to specifications.