

SERVICE MANUAL

CornMaster™ 9208-22

CornMaster™ 9212-20

CornMaster™ 9212-22

CornMaster™ 9216-20

CornMaster™ 9216-22

CornMaster™ 9218-20

CornMaster™ 9218-22

Corn Header



SERVICE MANUAL

**CornMaster™ 9208-22, CornMaster™ 9212-20, CornMaster™ 9212-22,
CornMaster™ 9216-20, CornMaster™ 9216-22, CornMaster™ 9218-20,
CornMaster™ 9218-22**

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INTRODUCTION

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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 NEW HOLLAND Sales and Service Networks.

Personal safety

Your machine may be equipped with special guarding or other devices in compliance with local legislation. Some of these require active use by the operator.

Therefore, check local legislation on the usage of this machine.

Hydraulic system safety

- Hydraulic oil leaking under pressure can penetrate the skin and cause infection or other injury. To prevent personal injury:
 - Relieve all pressure before disconnecting fluid lines.
 - Before applying pressure, make sure all connections are tight and components are in good condition.
 - Never use your hand to check for suspected leaks under pressure. Use a piece of cardboard or wood for this purpose.
 - If injured by leaking fluid, seek medical attention immediately.
- The hydraulic hoses and fittings on your machine meet engineering specifications for the particular function. When replacing damaged, blown or worn hoses or fittings, use only manufacture authorized service parts.
- Care in hydraulic hose installation is a must:
 - Make sure pressure is relieved before starting installation procedure.
 - DO NOT kink or twist a hose, failure may occur.
 - Properly route the hose.
 - Have a certified hydraulic technician install the hose.
 - Remove air from the hydraulic system after installing any hydraulic component.
- Periodically check hydraulic system for leaks or damage. check for:
 - Leaks at hose fitting or in hose.
 - Damaged hoses and/or fittings.
 - Kinked, crushed, flattened, hard blistered, heat cracked, charred, twisted, soft or loose covered hoses.
 - Corroded or damaged fittings.
 - Leaking ports.
 - Excessive dirt and debris around hoses and/or fittings.
 - Damaged or missing hose retaining clamps, guards, shields, etc.
- DO NOT stand on or use a hose as a step. DO NOT pull or apply external forces to the hose. The hose may fail and cause injury.
- Keep all persons away from the working area. Mechanisms controlled by fluid power can become hazardous if a hose fails. Lifted mechanisms can fall to the ground, machine steering may fail, etc.
- Stay clear of a pressurized hose assembly that has blown apart. Hose fittings can be thrown off at high speed and a loose hose can whip around with great force.
- Hydraulic fluid can reach high temperatures. Allow fluid to cool before servicing the system.
- Escaping fluid under pressure may form a mist or fine spray which can flash or explode upon contact with an ignition source.
- Vibration can reduce hose service life. Make sure all retaining clamps and/or devices are secured.
- Environmental conditions can cause hose and fittings to deteriorate. Inspect hydraulic hoses periodically. Replace worn or damaged hoses and fittings.

Safety requirements for fluid power systems and components - hydraulics (EUROPEAN STANDARD PR EN 982)

- Flexible hose assemblies must not be constructed from hoses which have been previously used as part of a hose assembly.

- Do not weld hydraulic piping.
- When flexible hoses or piping are damaged, replace them immediately.
- It is forbidden to modify a hydraulic accumulator by machining, welding or any other means.
- Before removing hydraulic accumulators for servicing, the liquid pressure in the accumulator must be reduced to zero.
- Pressure check on hydraulic accumulators shall be carried out by method recommended by the accumulator manufacturer.
- Care must be taken not to exceed the maximum allowable pressure of the accumulator. After any check of adjustment there must be no leakage of gas.

Safety precautions

Farm accidents can be prevented with your help.

No accident prevention program can be successful without the wholehearted cooperation of the person who is directly responsible for the operation of the equipment.

To read accident reports from all over the country is to be convinced that a large number of accidents can be prevented only by the operator anticipating the result before the accident is caused and doing something about it.

It is said that "The best kind of safety device is a careful operator who with care and mature consideration can save more lives and limbs than any accident prevention program which is not adhered to".

Further in this chapter you will find a list of the most important safety precautions.

Take time to read and follow the instructions and furthermore, be careful!

Some pictures in this manual may show the safety guarding open or removed to better illustrate a particular feature or adjustment.

Ensure to close or replace all guards before operating the machine.

General and operating safety

Most farm machinery accidents can be avoided by the observance of a few simple safety precautions.

- The machine must only be used by a skilled operator familiar with all the controls and harvesting techniques on cultivated land with slopes up to maximum **26% (15°)** uphill and downhill.
- Keep children away from and off the machine at all times.
- When driving on public roads, observe traffic regulations, adapt your speed to road and traffic conditions and ensure that all lights and other safety mechanisms on the machine (if they are required) are fitted and work properly.
- Before operating the machine ensure that all safety guards are installed.
- Do not enter the grain tank while the machine engine is running. With engine stopped, use a wooden clearing club should the grain tank unloading auger become bridged. Take utmost care not to be pulled into the grain tank in case unbridging is required.
- Do not attempt to clean, lubricate or carry out any adjustments on the machine while it is in motion or while the engine is running.
- Never leave the operator's platform without first disengaging the machine drive mechanism, lowering the header, stopping the engine, applying the park brake and removing the ignition key.
- Do not work under the machine header unless it is securely blocked and/or the header safety latch is engaged.
- Do not work around the machine in loose clothing that might catch in any of the moving parts.
- Keep hands away from moving parts of the machine.
- Keep the fire extinguisher within easy reach of the operator. Ensure to replace it by a similar type of extinguisher or have it checked or refilled after every usage and/or date of expiry.

Danger of death by electrocution!

Pay special attention to the overhead power lines. Make sure the machine has sufficient clearance to pass in all directions (also with raised or opened machine components). Also think of the radio aerial(s) or any other factory-fitted accessory or parts which may have been added afterwards.

Should a contact between the machine and an electric power line occur, then the following precautions must be taken: Stop the machine movement immediately, stop the engine and apply the hand brake.

Check if you can safely leave the cab or your actual position without direct contact with electric wires. If not, stay in your position and call for help. If you can leave your position without touching the lines, jump off the last step or support position to ensure that there is no contact between any part of your body and the ground at any time. Do not touch the machine afterwards until power to the lines has been shut off. When people approach the machine, warn them not to touch the machine but to ask the electric power supply company to shut off the power to the lines.

Fire and explosion prevention

- Due to the flammable nature of the crop materials encountered, fire risks are high. This risk can be minimized by frequent removal of accumulated crop material from the machine and checking for overheated machine components. If oil leaks appear, re-torque bolts or replace gaskets as necessary.
- Remove all trash or debris from the machine each day. Especially check the engine area and exhaust system.
- Sparks or flame can cause the hydrogen gas in a battery to explode. To prevent an explosion do the following:
 - Do not weld, grind or smoke near a battery.
- Sparks from the electrical system or engine exhaust can cause an explosion and fire. Before you operate this machine in an area with flammable dust or vapors, use good ventilation to remove the flammable dust or vapors.
- Use nonflammable cleaning solvent to clean parts.
- A fire can cause death or injury. Always have fire extinguisher near or on the machine. Make sure the fire extinguishers are serviced according to the manufacturers instructions.
- If a fire extinguisher has been used, always recharge or replace the fire extinguisher before operating the machine.
- Make sure that you DO NOT store oily rags or other flammable materials on the machine.
- If the machine has an oil, fuel or hydraulic leak, always repair the leak and clean the area before operating.
- Check the electrical system for loose connections or frayed insulation. Repair or replace the loose or damaged parts.
- Before welding or using a torch on the machine, clean the area to be repaired.

Safety rules

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 you will find the signal words DANGER, WARNING, and CAUTION followed by special instructions. These precautions are intended for the personal safety of you and those working with you.

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

 DANGER indicates a hazardous situation that, if not avoided, will result in death or serious injury.

 WARNING indicates a hazardous situation that, if not avoided, could result in death or serious injury.

 CAUTION indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

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

Machine safety

NOTICE: Notice indicates a situation that, if not avoided, could result in machine or property damage.

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: Note indicates additional information that 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 - Ecology and the environment

Soil, air, and water quality is important for all industries and life in general. When legislation does not yet rule the treatment of some of the substances that advanced technology requires, sound judgment should govern the use and disposal of products of a chemical and petrochemical nature.

Familiarize yourself with the relative legislation applicable to your country, and make sure that you understand this legislation. Where no legislation exists, obtain information from suppliers of oils, filters, batteries, fuels, anti-freeze, cleaning agents, etc., with regard to the effect of these substances on man and nature and how to safely store, use, and dispose of these substances.

Helpful hints

- Avoid the use of cans or other inappropriate pressurized fuel delivery systems to fill tanks. Such delivery systems may cause considerable spillage.
- In general, avoid skin contact with all fuels, oils, acids, solvents, etc. Most of these products contain substances that may be harmful to your health.
- Modern oils contain additives. Do not burn contaminated fuels and or waste oils in ordinary heating systems.
- Avoid spillage when you drain fluids such as used engine coolant mixtures, engine oil, hydraulic fluid, brake fluid, etc. Do not mix drained brake fluids or fuels with lubricants. Store all drained fluids safely until you can dispose of the fluids in a proper way that complies with all local legislation and available resources.
- Do not allow coolant mixtures to get into the soil. Collect and dispose of coolant mixtures properly.
- The air-conditioning system contains gases that should not be released into the atmosphere. Consult an air-conditioning specialist or use a special extractor to recharge the system properly.
- Repair any leaks or defects in the engine cooling system or hydraulic system immediately.
- Do not increase the pressure in a pressurized circuit as this may lead to a component failure.
- Protect hoses during welding. Penetrating weld splatter may burn a hole or weaken hoses, allowing the loss of oils, coolant, etc.

Battery recycling

Batteries and electric accumulators contain several substances that can have a harmful effect on the environment if the batteries are not properly recycled after use. Improper disposal of batteries can contaminate the soil, groundwater, and waterways. NEW HOLLAND strongly recommends that you return all used batteries to a NEW HOLLAND dealer, who will dispose of the used batteries or recycle the used batteries properly. In some countries, this is a legal requirement.



Mandatory battery recycling

NOTE: The following requirements are mandatory in Brazil.

Batteries are made of lead plates and a sulfuric acid solution. Because batteries contain heavy metals such as lead, CONAMA Resolution 401/2008 requires you to return all used batteries to the battery dealer when you replace any batteries. Do not dispose of batteries in your household garbage.

Points of sale are obliged to:

- Accept the return of your used batteries
- Store the returned batteries in a suitable location
- Send the returned batteries to the battery manufacturer for recycling

Safety signs

Row Unit Drive and Chopper Drive

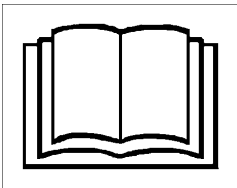
Signs shown are for a corn header with a row unit drive system.

The following safety signs are on your machine as a guide for your safety and for the safety of those working with you. Walk around the machine and note the content and the location of all safety signs before you operate your machine.

Keep safety signs clean and legible. Clean safety signs with a soft cloth, water, and a gentle detergent.

NOTICE: Do not use solvent, gasoline, or other harsh chemicals. Solvents, gasoline, and other harsh chemicals may damage or remove safety signs.

Replace all safety signs that are damaged, missing, painted over, or illegible. If a safety sign is on a part you or your dealer replaces, make sure that you or your NEW HOLLAND NEW HOLLANDdealer install the safety sign on the new part. See your NEW HOLLAND dealer for replacement safety signs.

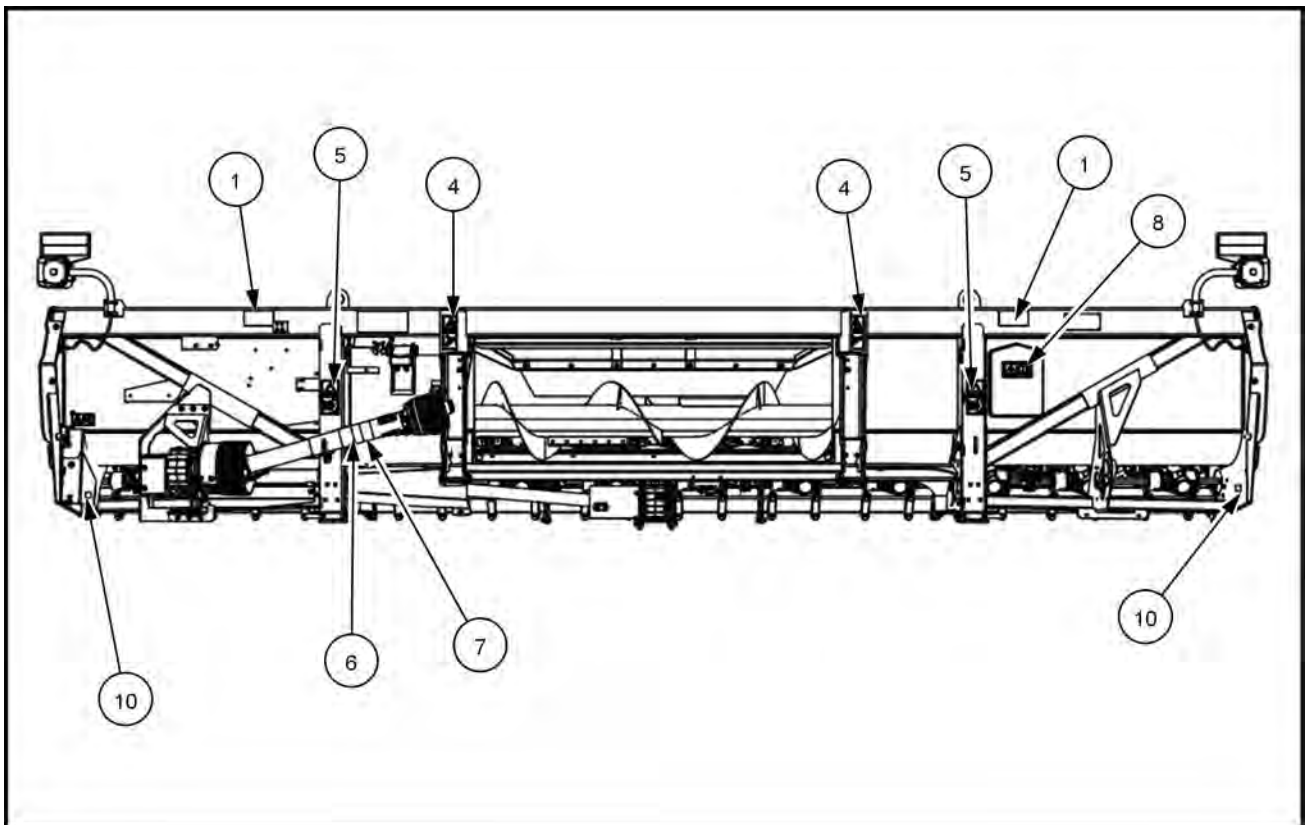


Safety signs that display the "Read Operator's Manual" symbol are intended to direct the operator to the operator's manual for further information regarding maintenance, adjustments, or procedures for particular areas of the machine. When a safety sign displays this symbol, refer to the appropriate page of the operator's manual.



Safety signs that display the "Read service manual" symbol direct you to the service manual. If you doubt your ability to perform service operations, contact your dealer.

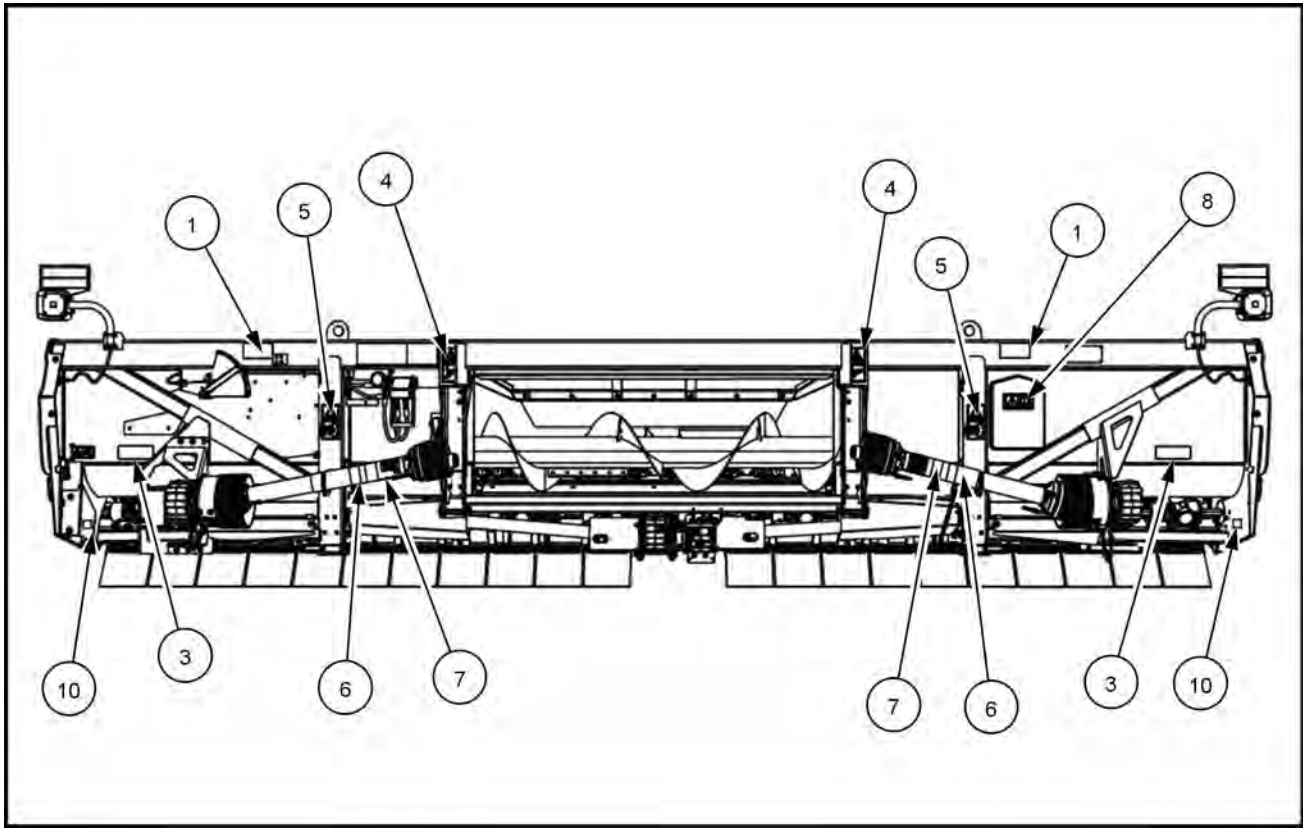
NOTE: Call outs on this page refer to decals as numbered on the following pages.



NHIL17MH00166AA 1

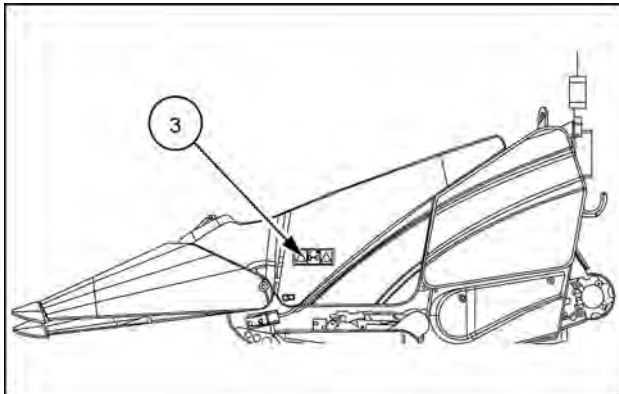
Rear – Non-chopping

NOTE: Call outs on this page refer to decals as numbered on the following pages.



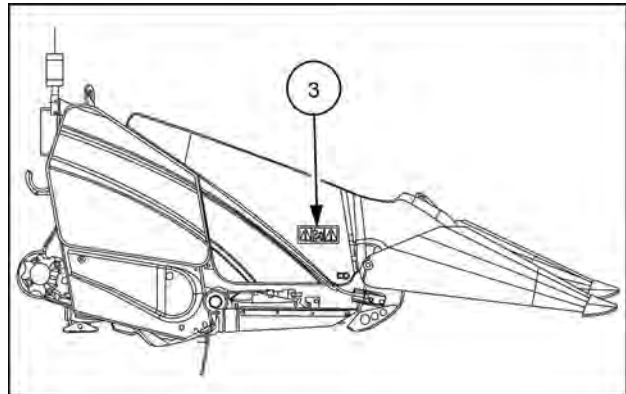
NHIL17MH00164AA 2

Rear – Chopping



NHIL16GH00061AA 3

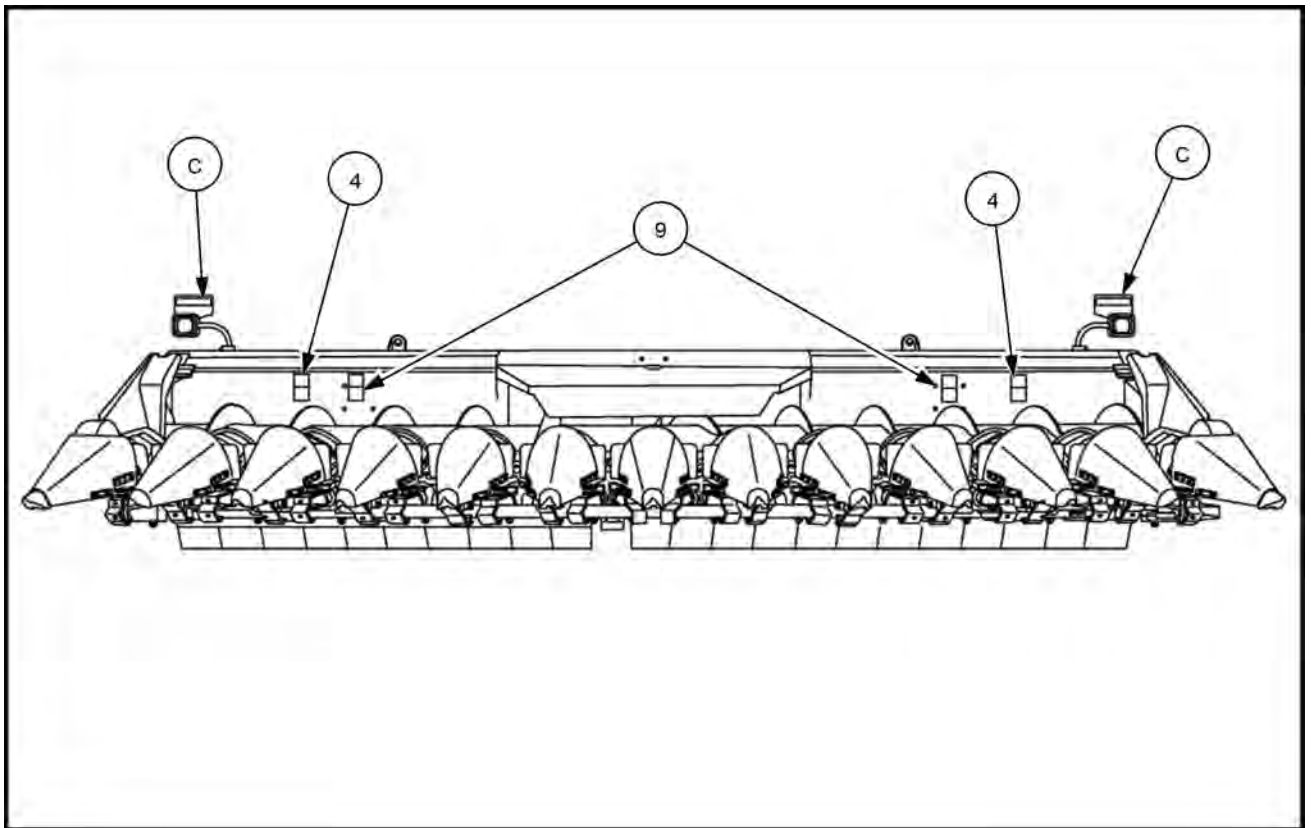
Left



NHIL16GH00069AA 4

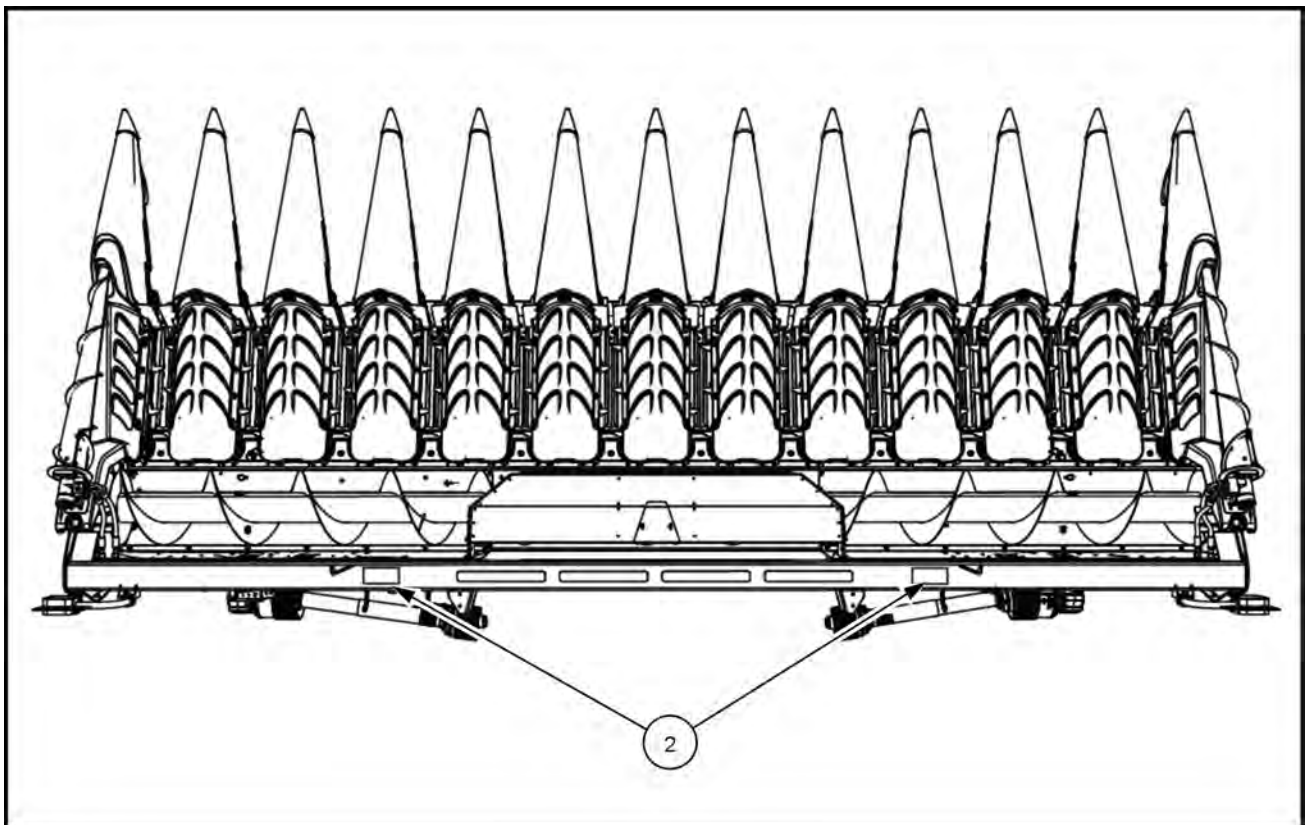
Right

NOTE: Call outs on this page refer to decals as numbered on the following pages.



NHIL17MH00038AA 5

Front



NHIL17MH00150AA 6

Top

WARNING

Overhead lifting hazard.

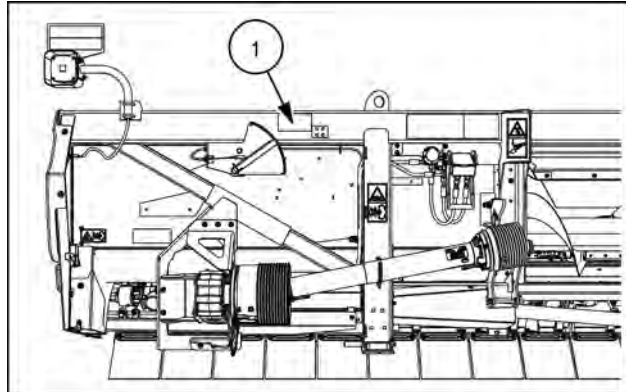
Lift and handle heavy components using lifting equipment with appropriate lifting capacity.
Ensure that units are supported by suitable slings and hooks.
Ensure that no persons or pets are in the vicinity of the load being lifted.
Failure to comply could result in death or serious injury.

Quantity: 2
84593097



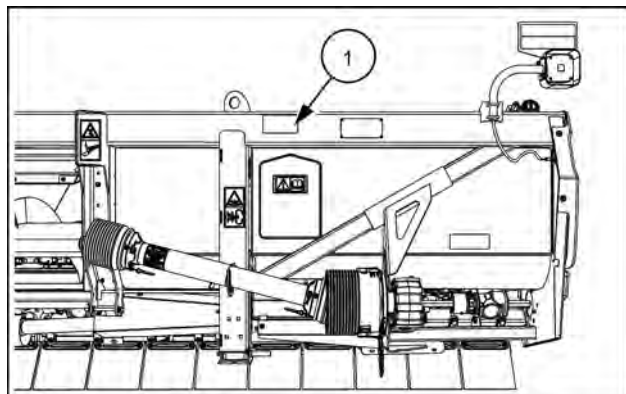
84593097 7

(1) Left-Hand (LH) side of the feeder house opening top beam.



NHIL17MH00167AA 8

(1) Right-Hand (RH) side of the feeder house opening top beam.



NHIL17MH00159AA 9

WARNING

Slippery surface.

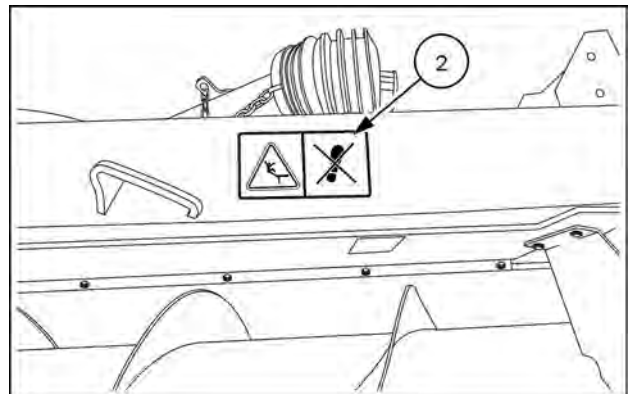
Do not use the area of the top beam outboard of these safety signs as a step or platform.
Failure to comply could result in death or serious injury.

Quantity: 2
87026533



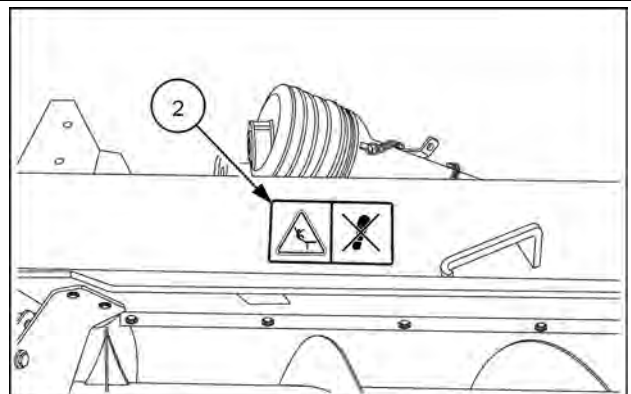
87026533_B 10

(2) LH side of the feeder opening on top of the top beam.



NHIL13GH00420AA 11

(2) RH side of the feeder opening on top of the top beam.



NHIL13GH00419AA 12

WARNING
Hidden knife.
Flying debris.

Stay clear of the machine while running.
Failure to comply could result in death or serious injury.

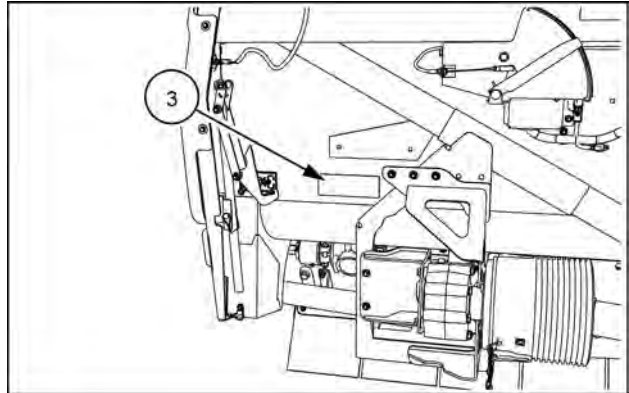
Quantity: 4

Only used on chopper equipped corn headers.
84586899



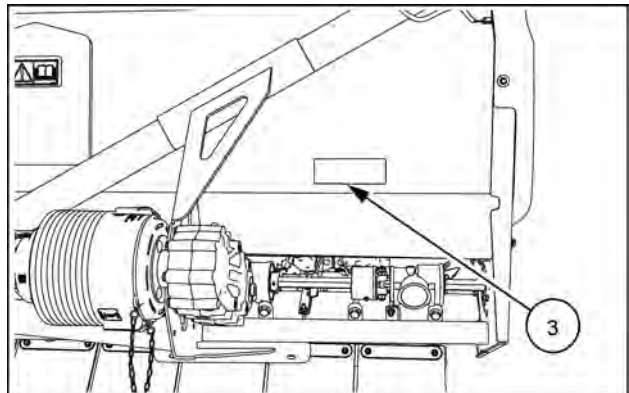
84586899 13

(3) LH side rear backsheet (Chopper equipped units only).



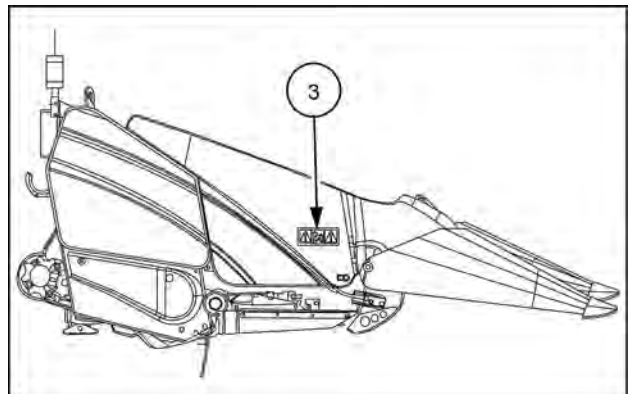
NHIL17MH00080AA 14

(3) RH side rear backsheet (Chopper equipped units only).



NHIL17MH00081AA 15

(3) On the RH outer hood.



NHIL16GH00069AA 16

WARNING

Hidden knife.

Flying debris.

Stay clear of the machine while running.
Failure to comply could result in death or serious injury.

Quantity: 4

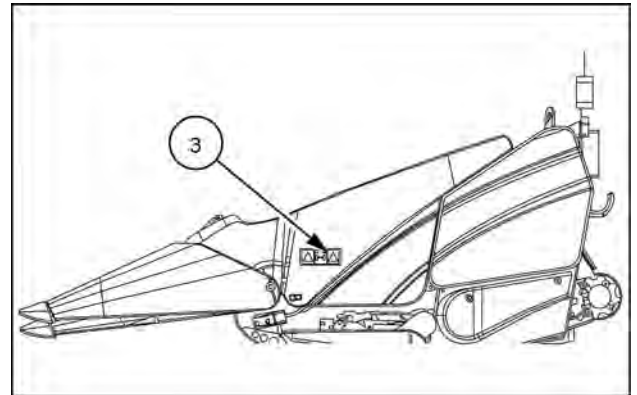
Only used on chopper equipped corn headers.

84586899



84586899 13

(3) On the LH outer hood.



NHIL16GH00061AA 17

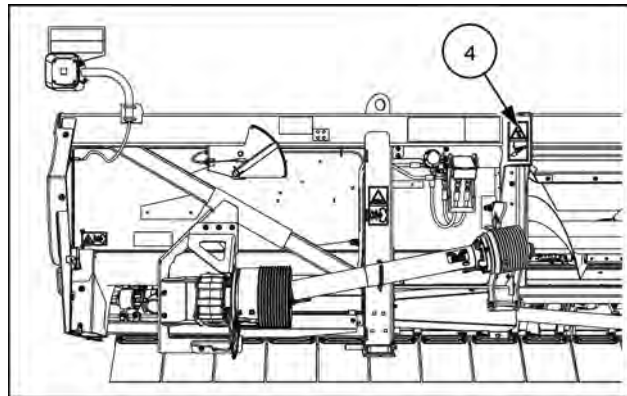
DANGER
Crush Hazard.
Engage safety latch before working under machine.
Failure to comply could result in death or serious injury.

Quantity: 4
144380A1



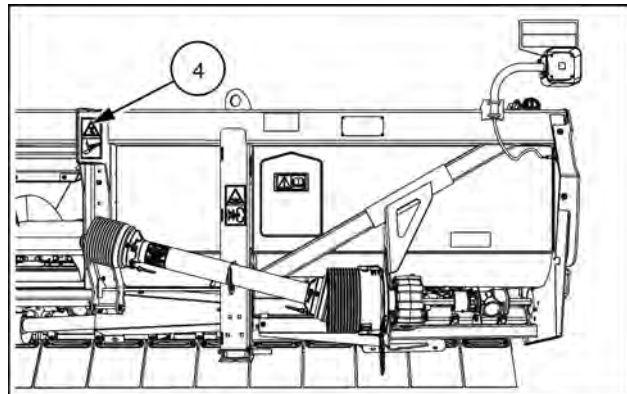
144380A1 18

(4) LH inboard vertical post.



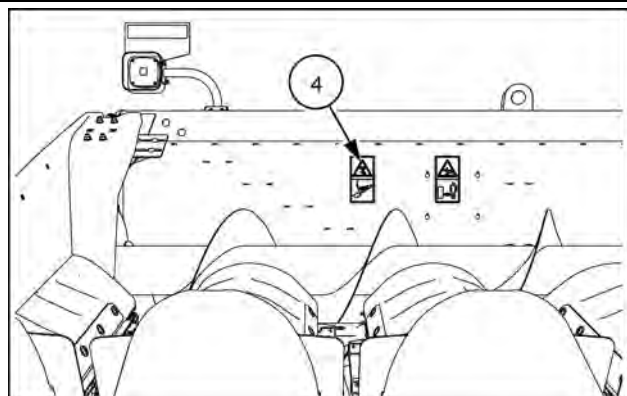
NHIL17MH00167AA 19

(4) RH side inboard vertical post.



NHIL17MH00159AA 20

(4) RH side of the front panel



NHIL17MH00044AA 21

DANGER

Crush Hazard.

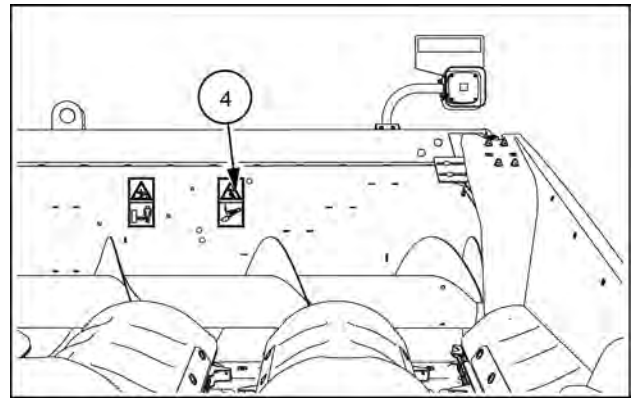
**Engage safety latch before working under machine.
Failure to comply could result in death or serious
injury.**

**Quantity: 4
144380A1**



144380A1 18

(4) LH side of the front panel



NHIL17MH00041AA 22

DANGER
Rotating Drive line.
Stand clear.

Do not operate without:

All drive line, tractor, and equipment shields in place.

Drive lines securely attached at both ends.

Drive line shields that turn freely on drive line.

Failure to comply will result in death or serious injury.

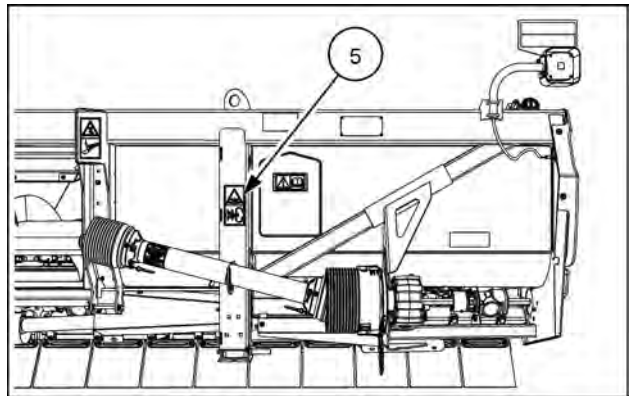
Quantity: 2

86999254



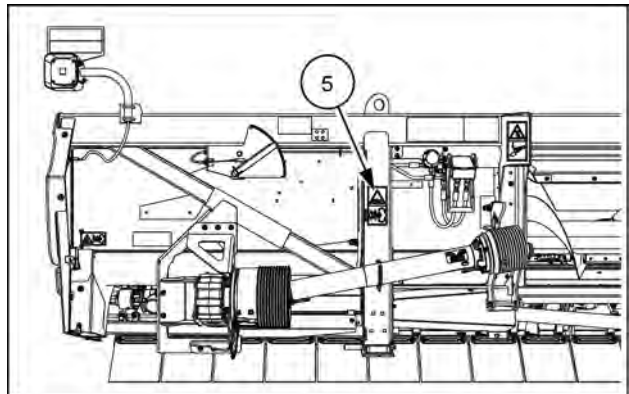
86999254 23

(5) RH side intermediate vertical post.



NHIL17MH00159AA 24

(5) LH side intermediate vertical post.



NHIL17MH00167AA 25

DANGER

Shield missing do not operate.
Replace shield before operating.
Failure to comply will result in death or serious injury.

Quantity: 1 per drive line

English: 849472

Portuguese: 47613650

Spanish: 9801256

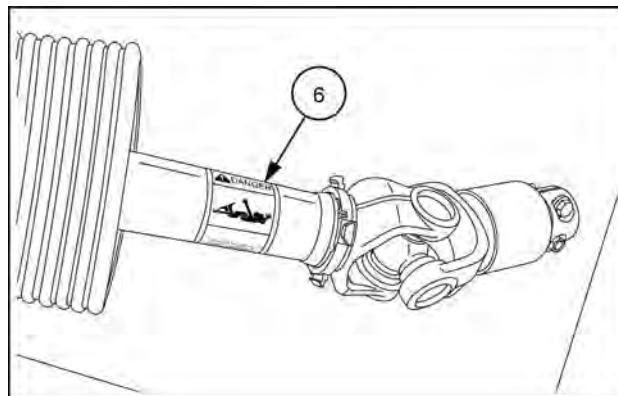
French: 849483

Chinese: 47467566



849472_H 26

(6) On the PTO shaft under the safety shielding.



NHIL17MH00065AA 27

DANGER

Rotating drive line

Do not operate without:

All drive line, tractor and equipment shields in place.

Drive lines securely attached at both ends.

Drive line shields that turn freely on drive line.

Failure to comply will result in death or serious injury.

Quantity: 1 per drive line

English: 849471

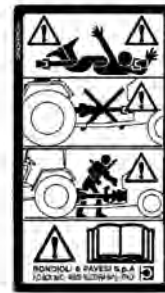
French: 849482

Spanish: 9801260



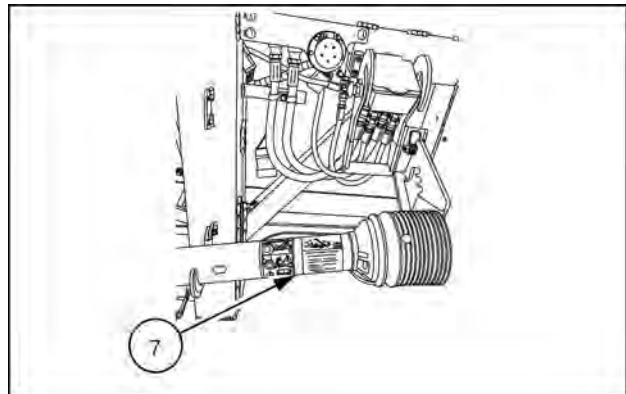
849471_E 28

86520950



86520950 29

(7) On the Power Take-Off (PTO) shaft safety cover.



NHIL17MH00059AA 30

WARNING

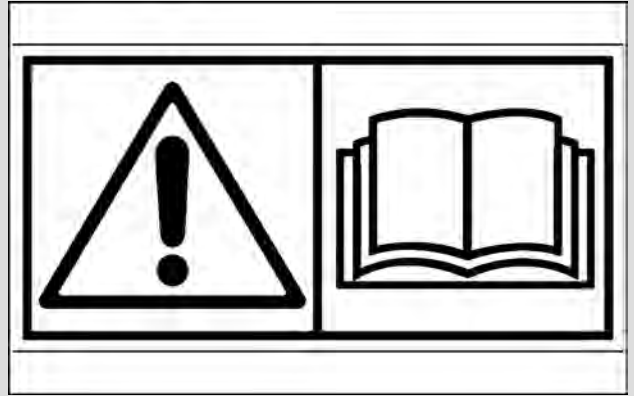
Before operating machine, read Operator's Manual and ALL SAFETY instructions.

If manual is missing, contact your dealer or service department.

1. Before starting engine or operation, clear area of bystanders.
2. Disengage drives including PTO. Stop engine, wait for all movement to stop before leaving operator's position.
3. Keep all shields in place. Keep hands, feet clothing and hair away from moving parts.
4. Keep riders off machines.
5. Use Slow Moving Vehicle (SMV) identification emblem and flashing warning lights when operating on highways, except when prohibited by law.
6. Never adjust, lubricate, clean or unplug machine with engine running.

Failure to comply could result in death or serious injury.

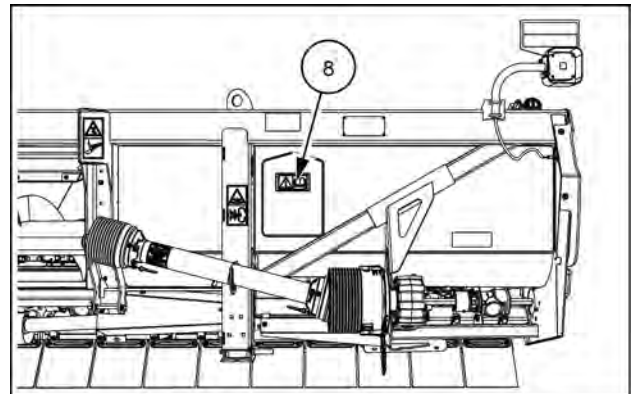
Quantity: 1
47358801



47358801A 31

(8) On the Operator's Manual storage container on the RH side of the feeder house opening rear panel.

NOTE: On 8 row units the Operator's Manual storage container will be located on the right-hand side of the header.



NHIL17MH00159AA 32

WARNING

Row unit entanglement hazard.

Operator should stay clear of the corn head when running.

Stop the corn head, shut off the engine, and remove the keys before attempting to unclog the corn head row unit.

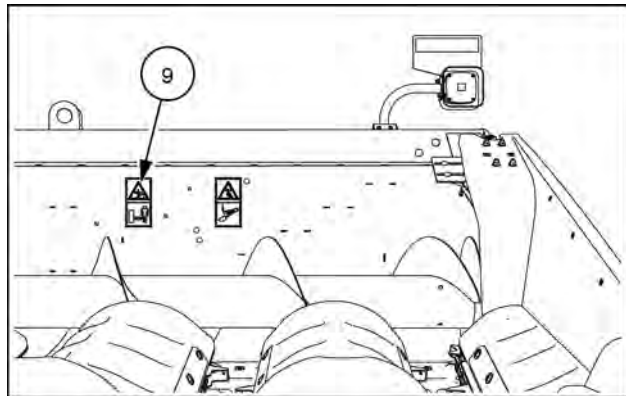
Failure to comply could result in death or serious injury.

**Quantity: 2
84400502**



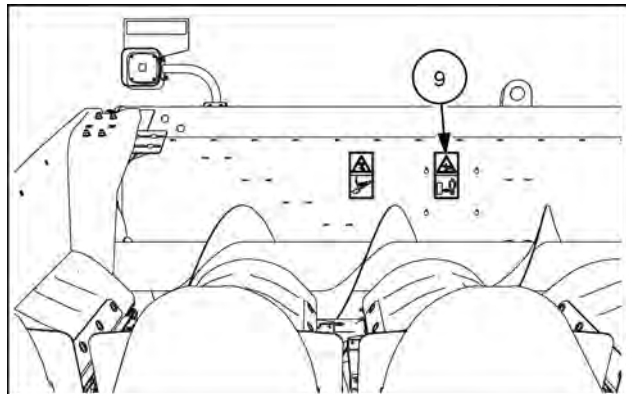
84400502 33

(9) LH side of the front panel.



NHIL17MH00041AA 34

(9) RH side of the front panel.



NHIL17MH00044AA 35

WARNING

Shield is open.
Stand clear.

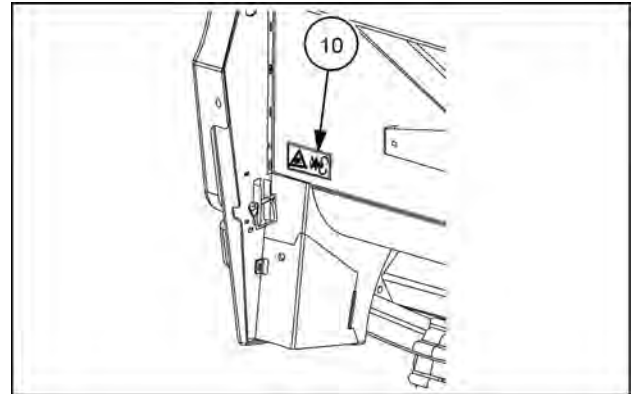
Replace or close shield before operating machine.
Failure to comply could result in death or serious injury.

Quantity: 1 or 2
84011345



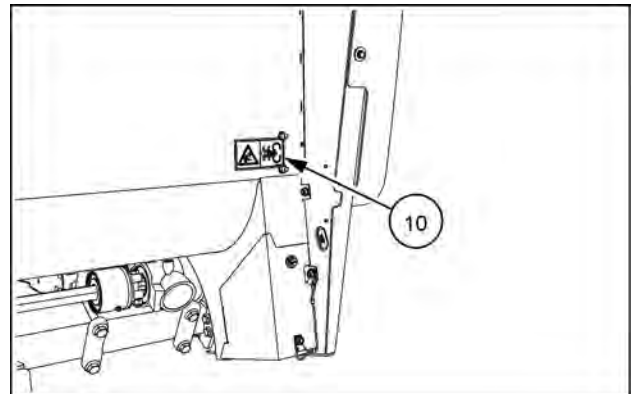
84011345_A 36

(10) LH backsheet above the auger drive shield.



NHIL16GH00074AA 37

(10) RH backsheet above the auger drive shield
(Headers with split auger drive only).



NHIL17MH00052AA 38

WARNING

Knife tip path

Keep hands and feet away.

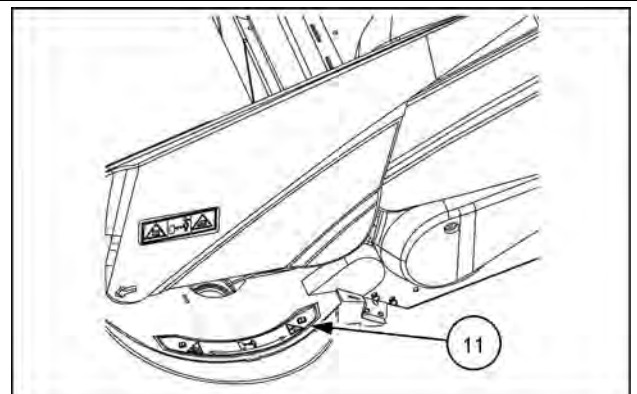
Failure to comply could result in death or serious injury.

Quantity: 1
84593097



84593097 39

(11) On the outer LH side chopper guard



NHIL16GH00070AA 40

Basic instructions - Shop and assembly

Shimming

For each adjustment operation, select adjusting shims and measure the adjusting shims individually using a micrometer, then add up the recorded values. Do not rely on measuring the entire shimming set, which may be incorrect, or the rated value shown on each shim.

Rotating shaft seals

For correct rotating shaft seal installation, proceed as follows:

1. Before assembly, allow the seal to soak in the oil it will be sealing for at least thirty minutes.
2. Thoroughly clean the shaft and check that the working surface on the shaft is not damaged.
3. Position the sealing lip facing the fluid.

NOTE: *With hydrodynamic lips, take into consideration the shaft rotation direction and position the grooves so that they will move the fluid towards the inner side of the seal.*

4. Coat the sealing lip with a thin layer of lubricant (use oil rather than grease). Fill the gap between the sealing lip and the dust lip on double lip seals with grease.
5. Insert the seal in its seat and press down using a flat punch or seal installation tool. Do not tap the seal with a hammer or mallet.
6. While you insert the seal, check that the seal is perpendicular to the seat. When the seal settles, make sure that the seal makes contact with the thrust element, if required.
7. To prevent damage to the seal lip on the shaft, position a protective guard during installation operations.

O-ring seals

Lubricate the O-ring seals before you insert them in the seats. This will prevent the O-ring seals from overturning and twisting, which would jeopardize sealing efficiency.

Sealing compounds

Apply a sealing compound on the mating surfaces when specified by the procedure. Before you apply the sealing compound, prepare the surfaces as directed by the product container.

Spare parts

Only use CNH Original Parts or NEW HOLLAND Original Parts.

Only genuine spare parts guarantee the same quality, duration, and safety as original parts, as they are the same parts that are assembled during standard production. Only CNH Original Parts or NEW HOLLAND Original Parts can offer this guarantee.

When ordering spare parts, always provide the following information:

- Machine model (commercial name) and Product Identification Number (PIN)
- Part number of the ordered part, which can be found in the parts catalog

Protecting the electronic and/or electrical systems during charging and welding

To avoid damage to the electronic and/or electrical systems, always observe the following practices:

1. Never make or break any of the charging circuit connections when the engine is running, including the battery connections.
2. Never short any of the charging components to ground.
3. Always disconnect the ground cable from the battery before arc welding on the machine or on any machine attachment.
 - Position the welder ground clamp as close to the welding area as possible.
 - If you weld in close proximity to a computer module, then you should remove the module from the machine.
 - Never allow welding cables to lie on, near, or across any electrical wiring or electronic component while you weld.
4. Always disconnect the negative cable from the battery when charging the battery in the machine with a battery charger.

NOTICE: *If you must weld on the unit, you must disconnect the battery ground cable from the machine battery. The electronic monitoring system and charging system will be damaged if this is not done.*

5. Remove the battery ground cable. Reconnect the cable when you complete welding.

WARNING

Battery acid causes burns. Batteries contain sulfuric acid.

Avoid contact with skin, eyes or clothing. Antidote (external): Flush with water. Antidote (eyes): flush with water for 15 minutes and seek medical attention immediately. Antidote (internal): Drink large quantities of water or milk. Do not induce vomiting. Seek medical attention immediately.

Failure to comply could result in death or serious injury.

W0111A

Special tools

The special tools that NEW HOLLAND suggests and illustrate in this manual have been specifically researched and designed for use with NEW HOLLAND machines. The special tools are essential for reliable repair operations. The special tools are accurately built and rigorously tested to offer efficient and long-lasting operation.

By using these tools, repair personnel will benefit from:

- Operating in optimal technical conditions
- Obtaining the best results
- Saving time and effort
- Working in safe conditions

Torque - Minimum tightening torques for normal assembly

NOTE: In the metric tables, nominal sizes M4 through M8 hardware torque specifications are shown as a Newton meters (pound-inches) numerical value.

Nominal sizes M10 through M24 hardware torque specifications are shown as a Newton meters (pound-feet) numerical value.

Metric non-flanged hardware

Plain (PLN) an unplated hardware finish with residual manufacturing oils

Zinc-dichromate (ZND) – a yellow colored chemical plating formula yellow applied to the hardware

Nominal size	Class (CL) 8.8 bolt and Class (CL) 8 nut	Class (CL) 10.9 bolt and Class (CL) 10 nut	Locknut CL 8 w/CL 8.8 bolt	Locknut CL 10 w/CL 10.9 bolt
	PLN and ZND	PLN and ZND	ZND	ZND
	N·m (lb in)	N·m (lb in)	N·m (lb in)	N·m (lb in)
M4	2.9 (26)	4.2 (37)	2 (18)	2.9 (26)
M5	5.9 (52)	8.5 (75)	4 (36)	5.8 (51)
M6	10.1 (89)	14.5 (128)	6.8 (60)	10 (89)
M8	24.5 (217)	35.1 (311)	17 (151)	24 (212)
	N·m (lb ft)	N·m (lb ft)	N·m (lb ft)	N·m (lb ft)
M10	48.7 (36)	69.5 (90)	33 (25)	48 (35)
M12	85 (63)	121 (67)	58 (43)	83 (61)
M14	135 (100)	193 (142)	92 (68)	132 (97)
M16	210 (155)	301 (222)	143 (106)	205 (151)
M18	299 (221)	414 (305)	203 (150)	281 (207)
M20	425 (313)	587 (433)	290 (214)	400 (295)
M24	735 (542)	1016 (749)	501 (370)	693 (510)

Metric flanged hardware

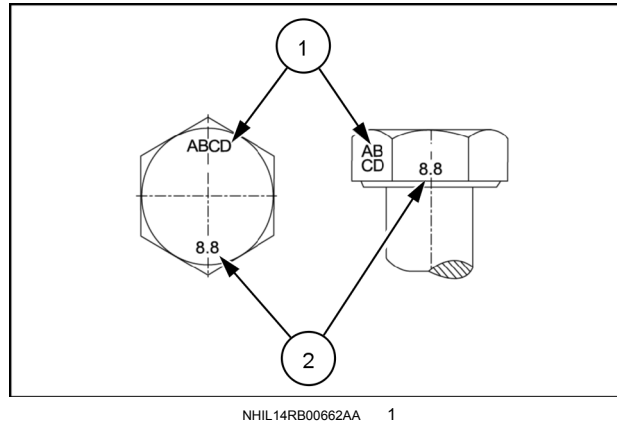
Plain (PLN) – an unplated hardware finish with residual manufacturing oils

Zinc-dichromate (ZND) – a yellow colored chemical plating formula yellow applied to the hardware

Nominal size	Class (CL) 8.8 bolt and Class (CL) 8 nut	Class (CL) 10.9 bolt and Class (CL) 10 nut	Locknut CL 8 w/CL 8.8 bolt	Locknut CL 10 w/CL 10.9 bolt
	PLN and ZND	PLN and ZND	ZND	ZND
	N·m (lb ft)	N·m (lb ft)	N·m (lb ft)	N·m (lb ft)
M4	3.2 (28)	4.6 (41)	2.2 (19)	3.1 (27)
M5	6.5 (58)	9.4 (83)	4.4 (39)	6.4 (57)
M6	11.1 (98)	15.9 (141)	7.5 (66)	11 (96)
M8	27 (239)	39 (345)	18 (163)	27 (240)
	N·m (lb ft)	N·m (lb ft)	N·m (lb ft)	N·m (lb ft)
M10	53.6 (40)	76.5 (56)	37 (27)	53 (39)
M12	93 (69)	134 (98)	63 (47)	91 (67)
M14	148 (109)	213 (157)	101 (75)	145 (107)
M16	231 (171)	331 (244)	158 (116)	226 (167)
M18	329 (243)	455 (336)	223 (165)	309 (228)
M20	467 (345)	645 (476)	318 (235)	440 (325)
M24	809 (597)	1118 (824)	552 (407)	

Identification markings

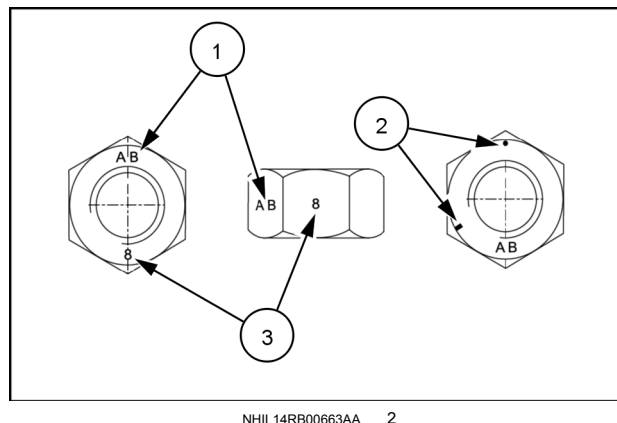
Metric hex head, flange hex head and carriage bolts, Classes (CL) 5.6 and upward



Metric bolt identification markings

1. Manufacturer's identification
2. Property class

Metric hex nuts and locknuts, Classes (CL) 05 and upward



Metric hex nut identification markings

- (1) – Manufacturer's identification
- (3) – Property class
- (2) – Clockwise type markings indicate property class and may include manufacturer identification (if applied), Example: property marks **240°** apart (shown) at the eight o'clock position indicate a Class 8 property, and marks **300°** apart at the ten o'clock position indicate a Class 10 property.

NOTE: In the Imperial units tables, the nominal sizes, **1/4 (0.25) in (inch)** and **5/16 (0.3125) in (inch)** hardware torque specifications are shown as a Newton meters (pound-inches) numerical value.
Nominal sizes **3/8 (0.375) in (inch)** through **1 (1.0) in (inch)** hardware torque specifications are shown as a Newton meters (pound-feet) numerical value.

Inch non-flanged hardware

Plain (PLN) – an unplated hardware finish with residual manufacturing oils

Zinc-dichromate (ZND) – a yellow colored chemical plating formula yellow applied to the hardware

Nominal size	SAE Grade (GR) 5 bolt and nut	SAE Grade (GR) 8 bolt and nut	Flange locknut GR F w/ GR 5 bolt	Flange locknut GR G w/ GR 8 bolt
	PLN and ZND	PLN and ZND	ZND	ZND
	N·m (lb in)	N·m (lb in)	N·m (lb in)	N·m (lb in)
1/4 (0.25) in	11 (97)	16 (142)	8.5 (75)	12.2 (109)
5/16 (0.3125) in	23 (204)	32 (283)	17.5 (155)	25 (220)
	N·m (lb ft)	N·m (lb ft)	N·m (lb ft)	N·m (lb ft)
3/8 (0.375) in	40 (30)	57 (42)	31 (23)	44 (33)
7/16 (0.4375) in	65 (48)	91 (67)	50 (37)	71 (53)
1/2 (0.50) in	98 (73)	139 (103)	76 (56)	108 (80)
9/16 (0.5625) in	142 (105)	201 (148)	111 (82)	156 (115)
5/8 (0.625) in	196 (145)	277 (204)	153 (113)	215 (159)
3/4 (0.75) in	348 (257)	491 (362)	271 (200)	383 (282)
7/8 (0.875) in	561 (413)	791 (584)	437 (323)	617 (455)
1 (1.0) in	841 (620)	1187 (875)	654 (483)	924 (681)

Inch flanged hardware

Plain (PLN) – an unplated hardware finish with residual manufacturing oils

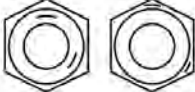
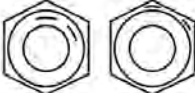
Zinc-dichromate (ZND) – a yellow colored chemical plating formula yellow applied to the hardware

Nominal size	SAE Grade (GR) 5 bolt and nut	SAE Grade (GR) 8 bolt and nut	Flange locknut GR F w/ GR 5 bolt	Flange locknut GR G w/ GR 8 bolt
	PLN and ZND	PLN and ZND	ZND	ZND
	N·m (lb ft)	N·m (lb ft)	N·m (lb ft)	N·m (lb ft)
1/4 (0.25) in	12 (106)	17 (150)	8 (71)	12 (106)
5/16 (0.3125) in	25 (221)	35 (310)	17 (150)	24 (212)
	N·m (lb ft)	N·m (lb ft)	N·m (lb ft)	N·m (lb ft)
3/8 (0.375) in	44 (33)	63 (46)	30 (22)	43 (32)
7/16 (0.4375) in	71 (52)	100 (74)	48 (35)	68 (50)
1/2 (0.50) in	108 (90)	153 (113)	74 (55)	104 (77)
9/16 (0.5625) in	156 (115)	221 (163)	106 (78)	157 (116)
5/8 (0.625) in	216 (159)	304 (225)	147 (108)	207 (153)
3/4 (0.75) in	383 (282)	541 (399)	261 (193)	369 (272)
7/8 (0.875) in	617 (455)	871 (642)	421 (311)	594 (438)
1 (1.0) in	925 (682)	1305 (963)	631 (465)	890 (656)

Identification marking

Grades of inch bolts and free-spinning nuts

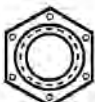
SAE (J995) bolt head and nut grade identification

Grade identification marking	Grade Marking description
	Grade 2 No line marks
	Grade 5 Three line marks
	Grade 8 Six line marks
	Grade 2 No circumferential line marks
	Grade 5 Two circumferential line marks located 120° apart
	Grade 2 Two circumferential line marks located 60° apart
	Grade 2 No circumferential line marks
	Grade 5 Two circumferential line marks located 120° apart
	Grade 8 Two circumferential line marks located 60° apart

Grades of inch prevailing torque locknuts, all metal (three common marking methods)

On prevailing torque locknuts, the grade of nut is identified by one of three different sets of markings that denote the strength level and manufacturer.

Common prevailing torque locknut grade identification markings

Grade identification marking	Grade Marking description
	Grade A No marks
	Grade B (hex nut) and Grade F (flange nut) Three raised or indented dot marks (Marks do not have to be in corners.)
	Grade C (hex nut) and Grade F (flange nut) Six raised or indented dot marks (Marks do not have to be in corners.)
	Grade A No letter mark on side flat
	Grade B Letter B on side flat
	Grade C Letter C on side flat
	Grade A No notches
	Grade B One circumferential notch on all six corners
	Grade C Two circumferential notches on all six corners

Torque - Standard torque data for hydraulics

Installation of adjustable fittings in straight thread O-ring bosses

NOTICE: O-ring boss fittings can be used multiple times. Always inspect the O-ring for damage and lubricate the O-ring with clean hydraulic oil or petroleum jelly at installation. Damaged O-rings will cause leakage and affect performance.

Nonadjustable O-ring boss fittings

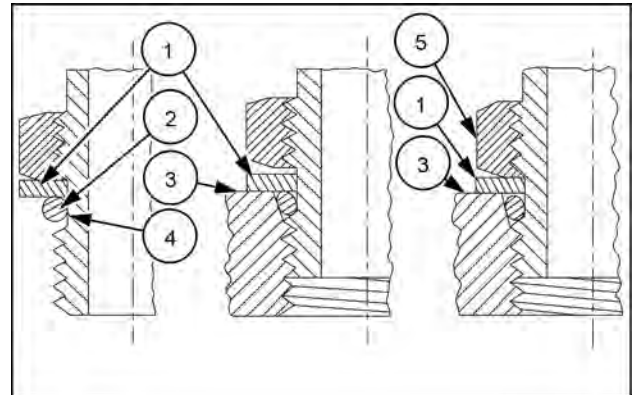
1. Inspect the components and make sure the port, O-ring, sealing surfaces, and threads are clean, and free of damage.
2. Install the O-ring if needed. Take special care not to cut the O-ring on the threads.

NOTE: Apply electrical tape over the threads to prevent O-ring damage if installing the O-ring, and then remove the tape.

3. Lubricate the threads and O-ring with clean hydraulic oil or petroleum jelly.
4. Install the O-ring (2) in the groove (4) adjacent to the metal backup washer (1) which is assembled at the extreme end of the groove.
5. Install the fitting into the **SAE** straight thread boss and hand tighten until the metal backup washer (1) contacts the face of the boss (3).

NOTICE: Do not over tighten and distort the metal backup washer.

6. Using the proper size wrenches, holding the head end of the fitting with a wrench, and then torque the locknut (5) and washer (1) against the face of the boss (3) to the proper specified torque value.



NHIL14RB00661AA 1

Adjustable (swivel) O-ring boss fittings

1. Inspect the components and make sure the port, O-ring, sealing surfaces, and threads are clean, and free of damage.
2. Install the O-ring if needed. Take special care not to cut the O-ring on the threads.

NOTE: Apply electrical tape over the threads to prevent O-ring damage if installing the O-ring, and then remove the tape.

3. Lubricate the threads and O-ring with clean hydraulic oil or petroleum jelly.
4. Install the O-ring (2) in the groove (4) adjacent to the metal backup washer which is assembled at the extreme end of the groove.
5. Completely back-off the locknut (5) and washer (1) .
6. Install the fitting into the **SAE** straight thread boss and hand tighten until the metal backup washer (1) contacts the face of the boss (3).

NOTICE: Do not over tighten and distort the metal backup washer.

7. Position the fitting as needed by turning the head of the fitting counterclockwise up to a maximum of one turn.
8. Using the proper size wrenches, hold the head end of the fitting with a wrench, and then torque the locknut (5) and washer (1) against the face of the boss (3) to the proper specified torque value.

Standard torque data for hydraulic tubes and fittings

NOTICE: These torques are not recommended for tubes of **12.7 mm (1/2 in)** Outer Diameter (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.

NOTE: Acronyms in the following table, Joint Industry Council (JIC), Outer Diameter (OD).

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

Installing and torquing 37° flared fittings;

1. Clean the face of the flare and threads with **LOCTITE® ODC-FREE CLEANER AND DEGREASER** cleaning solvent or equivalent cleaning solvent.
2. Allow the cleaning the cleaning solvent to completely dry before application sealant.
3. Apply **LOCTITE® 569™** hydraulic sealant to the 37° flare and the threads.
4. Install the fitting, and then torque to the specified torque.
5. Loosen the fitting, and then torque once more to the specified torque.

Pipe thread fitting torque

Thread Size (inch)	Torque (Maximum) N·m (lb ft)
1/8–27	13 (10)
1/4–18	16 (12)
3/8–18	22 (16)
1/2–14	41 (30)
3/4–14	54 (40)

Before installing and torquing pipe fittings;

1. Clean the threads with **LOCTITE® ODC-FREE CLEANER AND DEGREASER** cleaning solvent or an equivalent cleaning solvent.
2. Allow the cleaning the cleaning solvent to completely dry before application sealant.
3. Apply **LOCTITE® 567™ PST PIPE SEALANT** for all fittings, including stainless steel or **LOCTITE® 565™ PST** sealant for most other metal fittings.

NOTICE: For high filtration/zero contamination systems use **LOCTITE® 545™** sealant.

Hydraulic contamination

Contamination in the hydraulic system is a major cause of the malfunction of hydraulic components. Contamination is any foreign material in the hydraulic oil.

Contamination can enter the hydraulic system in several ways:

- When you drain the oil or disconnect any line
- When you disassemble a component
- From normal wear of the hydraulic components
- From damaged seals or worn seals
- From a damaged component in the hydraulic system

All hydraulic systems operate with some contamination. The design of the components in this hydraulic system permits efficient operation with a small amount of contamination. An increase in this amount of contamination can cause problems in the hydraulic system.

The following list includes some of these problems:

- Cylinder rod seals that leak
- Control valve spools that do not return to neutral
- Movement of control valve spools is difficult
- Hydraulic oil that becomes too hot
- Pump gears, housing, and other parts that wear rapidly
- Relief valves or check valves held open by dirt
- Quick failure of components that have been repaired
- Slow cycle times are slow. The machine does not have enough power.

If your machine has any of these problems, check the hydraulic oil for contamination.

There are two types of contamination: microscopic and visible.

Microscopic contamination occurs when very fine particles of foreign material are suspended in the hydraulic oil. These particles are too small to see or feel. Microscopic contamination can be found by identification of the following problems or by testing in a laboratory.

Examples of problems caused by microscopic contamination:

- Cylinder rod seals that leak
- Control valve spools that do not return to neutral
- The hydraulic system has a high operating temperature

Visible contamination is foreign material that can be found by sight, touch, or odor. Visible contamination can cause a sudden failure of components.

Examples of problems caused by visible contamination:

- Particles of metal or dirt in the oil
- Air in the oil
- Dark or thick oil
- Oil with an odor of burned oil
- Water in the oil

If you find contamination, use a portable filter to clean the hydraulic system.

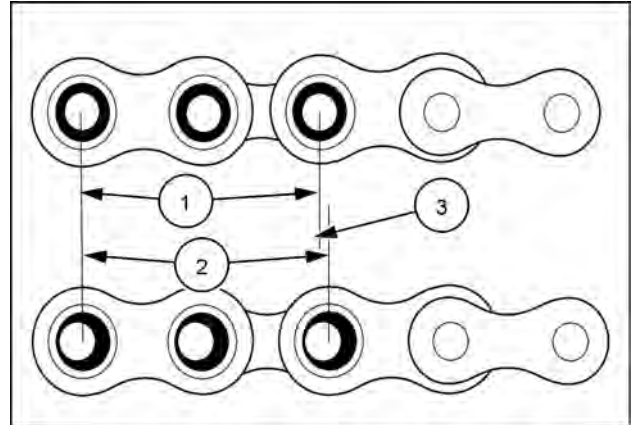
Basic instructions - Chain Wear Tables - Roller Chains

Chain wear

The individual joints in a roller chain articulate as they enter and leave the sprockets. This articulation results in wear on the pins and bushings. Material that is worn away from these surfaces will cause the chain to gradually elongate. Chains do not stretch. Material is removed from pin and bushing.

Critical dimensions of the chain are as follows:

- **(1)** 2X pitch
- **(2)** Wear plus 2X pitch
- **(3)** Elongation due to pin and bushing wear

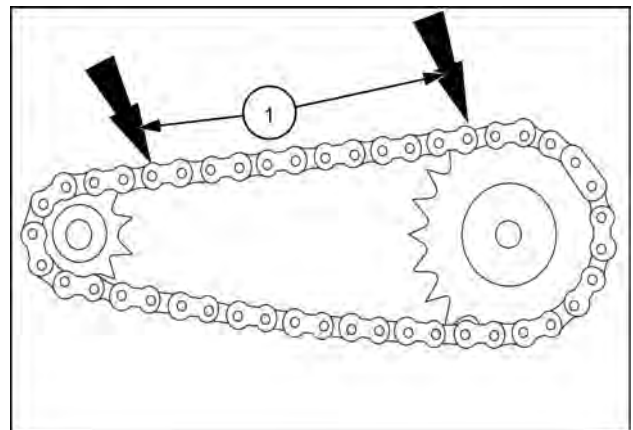


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Elongation is normal and may be minimized by proper lubrication and drive maintenance. The rate of wear is dependent upon: the relationship between the load and the amount of bearing area between pin and bushing, the material and surface condition of the bearing surfaces, the adequacy of lubrication, and the frequency and degree of articulation between pins and bushings. The latter is determined by the quantity of sprockets in the drive, their speeds, the number of teeth and the length of the chain in pitches.

An accurate wear measurement **(1)** can be made by using the above illustration. Measure as closely as possible from the center of one pin to the center of another. The more pitches (pins) contained within the measurement increase the accuracy. If the measured value exceeds the nominal by more than the allowable percentage the chain should be replaced. The maximum allowable wear elongation is approximately **3%** for most industrial applications, based upon sprocket design. The allowable chain wear in percent can be calculated using the relationship: $200/(N)$, where **(N)** is the number of teeth in the large sprocket. This relationship is often useful since the normal maximum allowable chain wear elongation of **3%** is valid only up to 67 teeth in the large sprocket. In drives having fixed center distances, chains running in parallel or where smoother operation is required, wear should be limited to approximately **1.5%**.

For example, if 12 pitches (12 pins) of a #80 chain were measured and the result was **313.944 mm (12.360 in)** or greater (using **3%** as the maximum allowable wear), the chain should be replaced. Anything less than **313.944 mm (12.360 in)** would still be acceptable by most industrial standards.



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WEAR LIMITS ON ROLLER CHAIN

Strand Length in Pitches	No. 40 Chain (08A)		No. 50 Chain (10A)		No. 60 Chain (12A)		No. 80 Chain (16A)	
	New	Replace	New	Replace	New	Replace	New	Replace
40P	508 mm (20.0 in)	523 mm (20.591 in)	635 mm (25.0 in)	654 mm (25.748 in)	762 mm (30.0 in)	787 mm (31.0 in)	1016 mm (40.0 in)	1047 mm (41.220 in)
50P	635 mm (25.0 in)	654 mm (25.748 in)	793 mm (31.220 in)	817 mm (32.165 in)	952 mm (37.480 in)	981 mm (38.622 in)	1270 mm (50.0 in)	1308 mm (51.496 in)
60P	762 mm (30.0 in)	784 mm (30.866 in)	952 mm (37.480 in)	981 mm (38.622 in)	1143 mm (45.0 in)	1177 mm (46.339 in)	1524 mm (60.0 in)	1568 mm (61.732 in)
70P	889 mm (35.0 in)	914 mm (36.0 in)	1111 mm (43.740 in)	1144 mm (45.039 in)	1333 mm (52.480 in)	1371 mm (54.0 in)	1778 mm (70.0 in)	1828 mm (72.0 in)
80P	1016 mm (40.0 in)	1047 mm (41.220 in)	1270 mm (50.0 in)	1308 mm (51.496 in)	1524 mm (60.0 in)	1568 mm (61.732 in)	2032 mm (80.0 in)	2095 mm (82.480 in)
90P	1143 mm (45.0 in)	1177 mm (46.339 in)	1428 mm (56.220 in)	1473 mm (58.0 in)	1714 mm (67.480 in)	1765 mm (69.488 in)	2286 mm (90.0 in)	2355 mm (92.717 in)
100P	1270 mm (50.0 in)	1308 mm (51.496 in)	1578 mm (62.126 in)	1635 mm (64.370 in)	1905 mm (75.0 in)	1962 mm (77.244 in)	2540 mm (100.0 in)	2616 mm (103.0 in)

STANDARD ROLLER CHAIN SIZES - NEW CHAINS

Chain No.	150 Chain No.	Pitch	Width	Roller Diameter
40	08A	12.7 mm (0.5 in)	7.9 mm (0.311 in)	7.9 mm (0.311 in)
50	10A	15.8 mm (0.622 in)	9.5 mm (0.374 in)	10.1 mm (0.398 in)
60	12A	19 mm (0.748 in)	12.7 mm (0.500 in)	11.9 mm (0.469 in)
80	16A	25.4 mm (1.000 in)	15.8 mm (0.622 in)	15.8 mm (0.622 in)
100	20A	31.7 mm (1.248 in)	19 mm (0.748 in)	19 mm (0.748 in)
120	24A	38.1 mm (1.500 in)	25.4 mm (1.000 in)	22.2 mm (0.874 in)
140	28A	44.4 mm (1.748 in)	25.4 mm (1.000 in)	25.4 mm (1.000 in)
160	32A	50.8 mm (2.000 in)	31.7 mm (1.248 in)	28.5 mm (1.122 in)
180	*	57.1 mm (2.248 in)	35.7 mm (1.406 in)	35.7 mm (1.406 in)
200	40A	63.4 mm (2.496 in)	38.1 mm (1.500 in)	39.6 mm (1.559 in)

* No. 150 Number does not exist.

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