CRT60-74LX

Husqvarna, 2020-03-03

Workshop manual, EN

Dear customer,

Thank you for choosing a Husqvarna quality product. We hope that you will genuinely enjoy it.

Please note that the enclosed manual contains Wacker Neuson references.

The Husqvarna Group is vouching for the quality of this product.

If you have any questions, please do not hesitate to contact our local sales or service point, or visit www.husqvarnacp.com.

Husqvarna AB

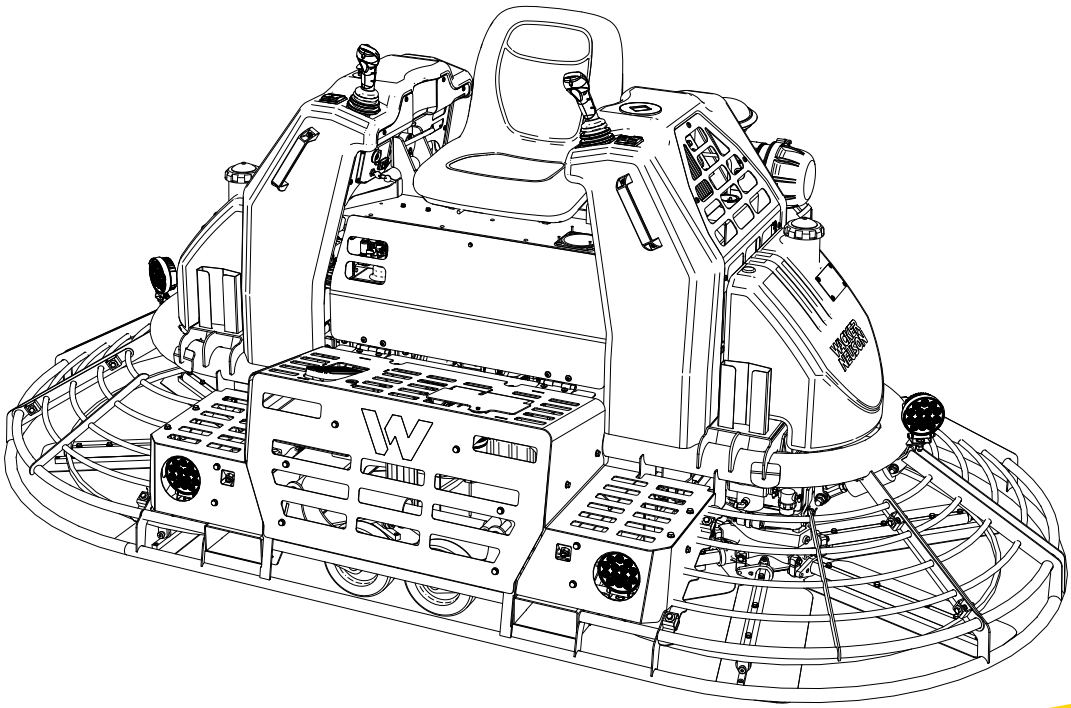
SE-561 82 Huskvarna, Sweden

1142314-26

WACKER NEUSON

all it takes!

CRT60-74LX
Ride-On Trowel
Service Manual



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www.wackerneuson.com

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Original instructions

This Manual presents the original instructions. The original language of this Manual is American English.

Foreword

General

This manual provides detailed information and procedures to safely repair and maintain the following: Wacker Neuson CRT60-74LX Ride-On Trowel.

This manual is intended to introduce and guide the user through the latest factory-approved troubleshooting and repair techniques and practices.

Before you attempt to troubleshoot or make repairs, you must be familiar with the operation of this machine. Refer to the operator's manual for specific information on these topics.

THE INFORMATION CONTAINED IN THIS MANUAL IS BASED ON MACHINES MANUFACTURED UP TO THE TIME OF PUBLICATION. WACKER NEUSON RESERVES THE RIGHT TO CHANGE ANY OF THIS INFORMATION WITHOUT NOTICE.

California Proposition 65 Warning

WARNING

Certain vehicle components contain or emit chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

Trademark Acknowledgment

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Lubriplate® is a trademark of Fiske Brothers Refining Co.
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How to Use This Manual

This manual is designed to provide multiple ways to locate and access repair information. Read each section in its entirety before beginning a procedure. Proper understanding of machine operation and components is the key to successful diagnostics and repair.

Make use of special information features within this manual in order to be better prepared to perform repairs. Always follow manual procedures and safety guidelines. Never take shortcuts.

Table of Contents

Major machine components or topics of interest are separated into specific chapters. Each manual lists these chapters in a main Table of Contents.

Chapter Table of Contents

Each chapter begins with a detailed Table of Contents related to the specific machine component or system. Use the Chapter Table of Contents to find specific component procedural information.

Index

An alphabetical Index is located at the back of the manual.
Use the Index to find specific components and related procedures.

Required Tools and Materials

Some procedures will require the use of specific tools and/or materials. These tools and/or materials will be listed for reference prior to beginning a procedure.

Specifications

Near the beginning of each chapter is a specifications list. This listing contains any specifications contained within the chapter.

Quick Reference Specifications

A list of all machine specifications can be found in Chapter 1, Specifications and General Information. This is a list of all specifications from each chapter, combined and listed in one place for easy reference.

Warnings and Cautions

Warning and Caution indicators are located throughout the manual at specific points of interest. These notices are given to prevent personal injury, death, and/or equipment damage. Always heed these notices, and practice common sense when performing any maintenance or repair procedure.

Notes

Special notes are given in order to draw attention to detailed instructions. These notes are intended to give

further important information regarding the machine and/or a step in a procedure.

Troubleshooting
Troubleshooting charts are provided in each chapter to aid in the diagnostic process. Use these suggestions to aid in identifying a potential mechanical or machine adjustment problem.

Safety

Introduction

Safety is the most important element of any repair procedure. Knowledge of the procedure to be performed and safe work habits are essential to preventing death, personal injury, or property damage. Use the following statements as a common-sense guide to proper work and tool-use habits.

Preparing for the Job

Preparation is essential to complete a procedure in a safe and efficient manner.

Service Training

- Read and understand the instructions contained in all manuals delivered with the machine.
- Familiarize yourself with the location and proper use of all controls and safety devices.
- Only trained personnel shall troubleshoot or repair problems occurring with the machine. Contact Wacker Neuson for additional training if necessary.
- Visit http://www.wackerneuson.us/en/support-usa/technical-training.html for more information.

Repair Person Qualifications

Work on the electric system, equipment on the undercarriage, and the steering and brake systems may be performed only by skilled individuals who have been specially trained for such work.

Personal Protective Equipment (PPE)

Wear the following Personal Protective Equipment (PPE) while servicing or maintaining this machine:

- Close-fitting work clothes that do not hinder movement.
- Safety glasses with side shields.
- Hearing protection.
- Safety-toed footwear.
- In addition, before servicing or maintaining the machine:
  - Tie back long hair.
  - Remove all jewelry (including rings).

Personal Safety Measures

- Follow the specific safety instructions in this manual.
- Block or support the machine parts that may move or fall prior to making repairs.
- Apply special care when working on the fuel system due to increased risk of fire.
- Engine block and muffler system become very hot during operation and require cool-down time after machine is shut off. Avoid contact with hot parts.
- Retainer pins can fly out or splinter when struck with force. Use a brass hammer or a suitable material between the hammer and pin.
- To reduce the risk of explosions, do not use starting fluid (for example, ether), especially in those cases in which a heater or glow plug (intake air pre-heating) is used at the same time.
- Always use specially designed or otherwise safety-oriented ladders and operating platforms to perform overhead assembly work. Never use machine parts or attachments/superstructures as a climbing aid.

Precautions

- Read and understand the service procedures before performing any service on the machine.
- Remain aware of the machine's moving parts. Keep hands, feet, and loose clothing away from the machine's moving parts.
- Reinstall the safety devices and guards after repair and maintenance procedures are complete.

Cleaning

- Ensure the machine is clean and free of debris such as leaves, paper, cartons, etc.
- Ensure all labels are legible.
- Do not clean the machine while it is running.
- Never use gasoline or other types of fuels or flammable solvents to clean the machine. Fumes from fuels and solvents can become explosive.

Preparing Machine for Maintenance

- Prior to performing assembly work on the machine, make sure no movable parts will roll away or start moving.
- Position on firm and level ground.
- Secure machine against unintentional movement.
- Stop engine unless maintenance or repair is required with engine running.
- Remove starting key and attach warning tag (Do Not Operate) to machine unless maintenance or repair is required with engine running.

- Disconnect the battery.
- Should maintenance or repair with the engine running be required:
  - Only work in groups of two.
  - One person must be positioned near starting key and maintain visual contact with the other person.
  - Always keep a safe distance from all rotating and moving parts, for example, fan blades, V-belt drives, etc.
- Prior to performing assembly work on the machine, stabilize the area under repair and use proper lifting and support devices.
- Special care must be taken with the electrical system when cleaning the machine with water/ detergents.
- To avoid the risk of accidents, parts and large assemblies being moved for replacement purposes must be carefully attached and secured to lifting gear. Use only certified lifting gear and suspension systems in a state of good repair with adequate load-bearing capacity.
- Stay clear of suspended loads.
- Have loads fastened and lift operators instructed by experienced persons only. The person giving the instructions to the operator must be within sight or sound of them.

General Maintenance Notes

- Make sure all tools and service center equipment are capable of performing the tasks prescribed. Do not use malfunctioning or broken tools. Use certified measuring devices that are routinely calibrated for accuracy (for example torque wrench, pressure gauge, or multimeter).
- Recycle scrapped parts and drained fluids according to environmental and hazardous material requirements. To avoid fire and health hazards, dispose of soiled shop towels by approved methods.
- Always retighten any screws, electrical connections, or hose connections that may have been loosened during maintenance and repair.
- Any safety devices removed for setup, maintenance, or repair purposes must be refitted and checked immediately upon completion of the maintenance and repair work.

Machine Modifications

- Do not defeat safety devices.
- Do not modify the machine without the express written approval of Wacker Neuson.
- Do not make any modifications, additions, or conversions to the machine and its superstructures or the machine's attachments without the approval of Wacker Neuson. Such modifications may affect safety and/or machine performance. This also applies to the installation and adjustment of safety devices, as well as to welding work on load-bearing parts. Use only accessories/attachments that are approved by Wacker Neuson.

Safety Symbols Found In This Manual

Throughout this manual, the following key safety words will be used to alert the reader of potential hazards. Become familiar with these words and their meaning. Take all precautions to avoid the hazards described.

DANGER

Indicates an imminently hazardous situation which, if not avoided, WILL result in death or serious injury.

WARNING

Indicates a potentially hazardous situation which, if not avoided, COULD result in death or serious injury.

CAUTION

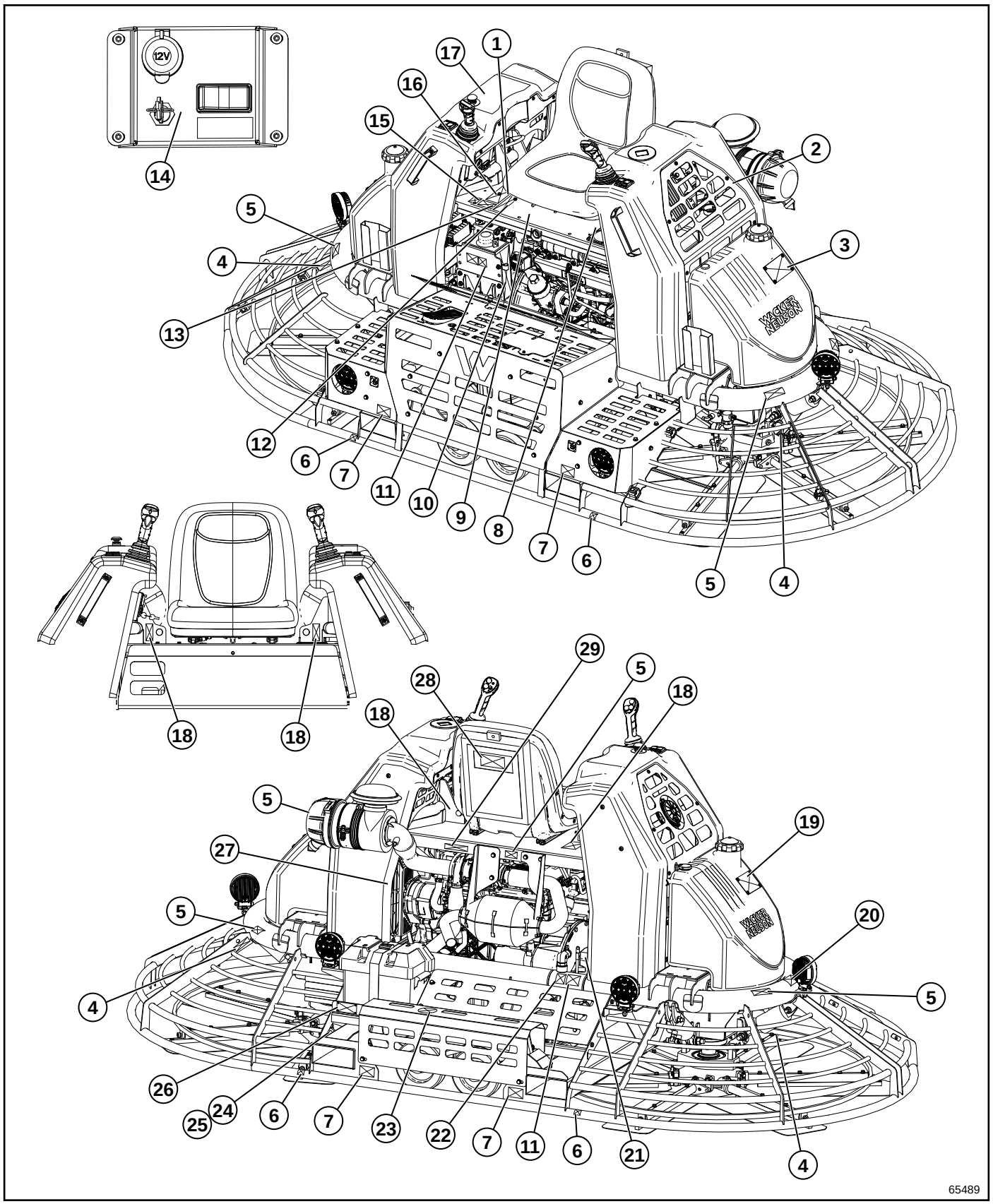
Indicates a potentially hazardous situation which, if not avoided, MAY result in minor or moderate injury and property damage. It may also be used to alert against unsafe practices.

NOTICE

Indicates a potentially hazardous situation which, if not avoided, MAY result in property damage. It may also be use to alert against unsafe practices.

Safety Label Locations

Become familiar with machine safety labels and locations. The following illustrations show safety label locations on the machine.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NOTICE

COLD WEATHER STARTING BELOW 40° F (4° C) : RUN ENGINE AT FULL THROTTLE FOR AT LEAST 5 MINUTES BEFORE DEPRESSING FOOT PEDAL. COLD RUNNING COULD RESULT IN HYDRAULIC DAMAGE NOT COVERED BY WARRANTY.

AVISO

PARA EL ARRANQUE EN CLIMA FRÍO POR DEBAJO DE 40°F (4°C): PONGA EN MARCHA EL MOTOR A ACELARACIÓN TOTAL AL MENOS DURANTE 5 MINUTOS ANTES DE OPRIMIR EL PEDAL. SI LA MÁQUINA FUNCIONA EN FRÍO PUEDE RESULTAR EN DAÑ AL SISTEMA HIDRÁULICO NO CUBIERTOS POR LA GARANTÍA.

AVIS

PAR TEMPS FROID SOUS 40°F (4°C): FAIRE FONCTIONNER LE MOTEUR À PLEIN GAZ PENDANT AU MOINS 5 MINUTES AVANT D'APPUYER SUR LA PÉDALE. LE FONCTIONNEMENT À RÉGIME FROID PEUT CAUSER DES DOMMAGES HYDRAULIQUES NON COUVERTS PAR LA GARANTIE.

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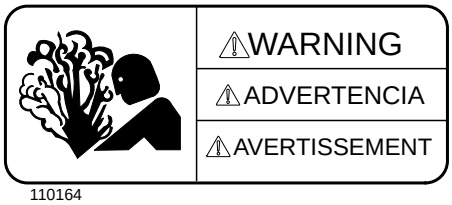

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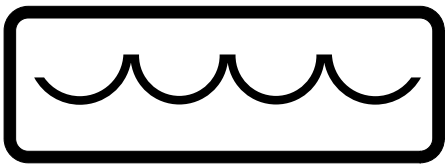

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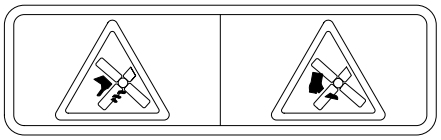

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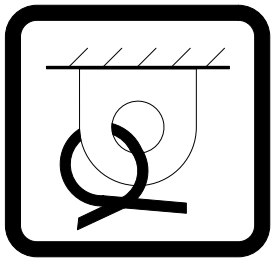

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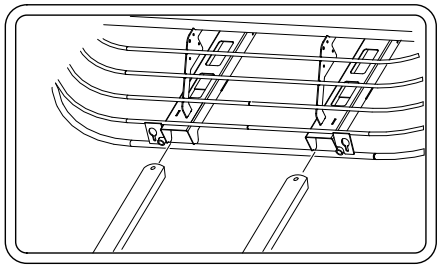

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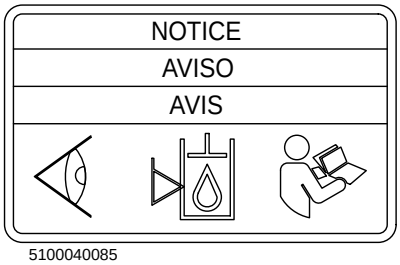

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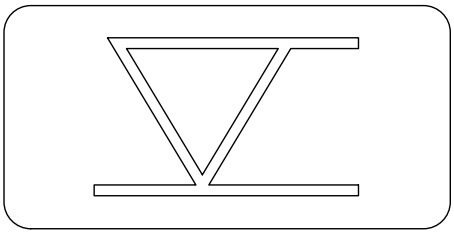

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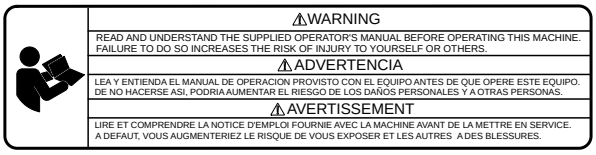

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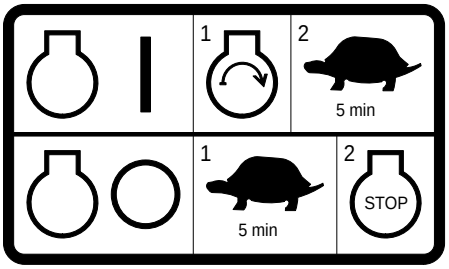

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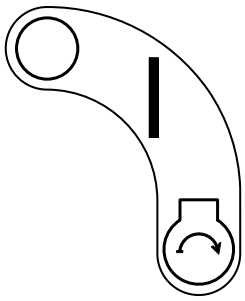

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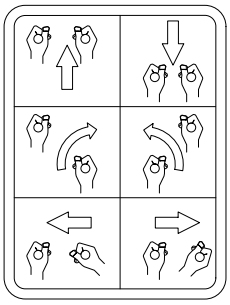

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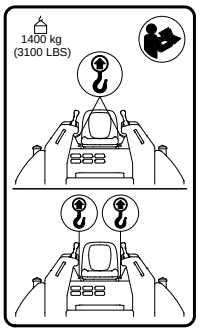

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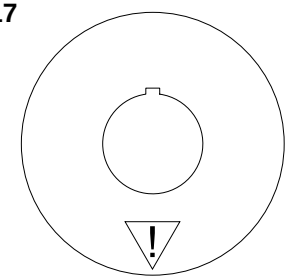

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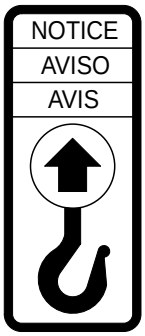

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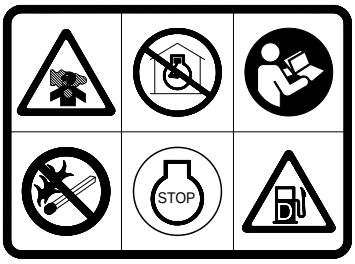

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ULTRA LOW SULFUR FUEL ONLY.
NUR ULTRANIEDRIGEN SCHWEFELKRAFTSTOFF.
SOLAMENTE COMBUSTIBLE DE ULTRABAJO CONTENIDO DE AZUFRE.
SEULEMENT CARBURANT DE SOUFRE ULTRA BAS.
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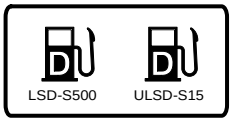

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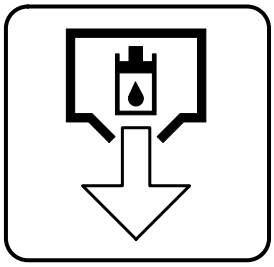

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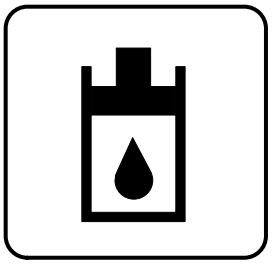

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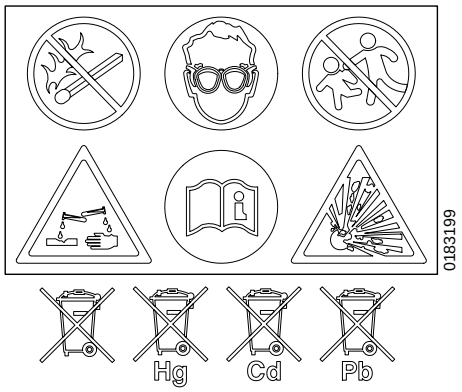

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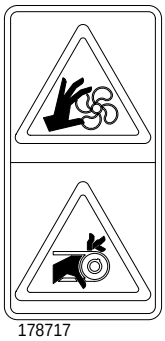
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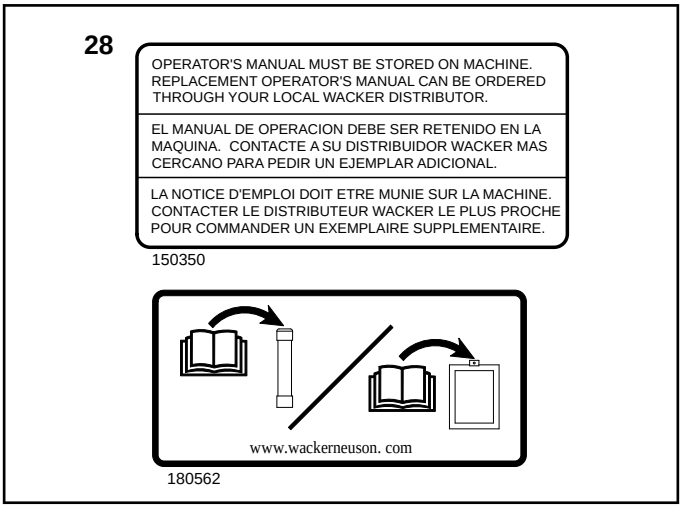
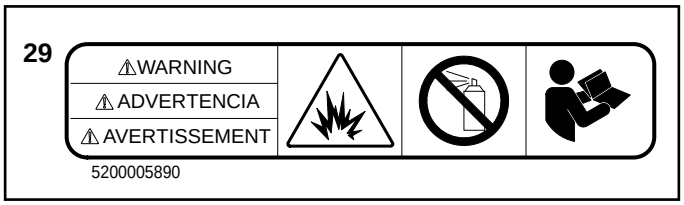




Safety Label Inspection

Safety labels are critical to the safe operation of the machine. Inspect the machine for any damaged, missing, or unreadable labels. Replace labels as needed before placing the machine back in service.

Keep Work Area Clean

A clean, organized, well-lit work area is important to promote safe working conditions.

- Keep floor clean of debris and clear of parts and tools.
- Clean up any spilled fuel, oil, and/or chemicals immediately.
- Store all air hoses and electrical cords properly when not in use.

Keep Work Area Well Ventilated

⚠ WARNING

Never operate the engine without proper ventilation. Exhaust fumes can be fatal if inhaled.

Certain test and adjustment procedures require the engine to be running. Be sure work area is well ventilated. Never run the engine in an enclosed area.

Use Proper Eye and Face Protection

⚠ WARNING

Always use approved personal protection equipment. Avoid workplace hazards by wearing properly maintained, approved eye and face protection. Failure to use appropriate protection equipment may result in serious injury or death.

Always wear eye protection while in a shop environment.

- Safety Glasses: Safety glasses offer a minimum level of protection from flying debris.
- Face Shields: Face shields are often used along with safety glasses to offer a higher level of protection when sparks and flying debris are present.
- Vented Goggles: Goggles offer side protection not offered by safety glasses alone.
- Unvented Goggles: Unvented goggles offer protection from chemical splashes and vapors.

Park Machine Safely

WARNING

When performing maintenance other than repairs that require engine to be running, remove starting key and attach warning tag to machine.

1. Park the machine on a solid, level surface.
2. Secure machine against unintentional movement.
3. Stop engine, unless maintenance or repair is required with engine running.
4. Remove starting key and attach **Do Not Operate** warning tag to machine.

Use Lifting Equipment Safely

WARNING

Always check the lifting capacity and condition of hoists, slings, cables, or chains before use. Using underrated or worn lifting components can result in death or serious injury.

- Always use a lifting device with a lifting capacity greater than the weight of the item being lifted.
- Secure the load to the lifting device using cables, chains, or slings rated to handle the load being lifted. Fasteners being used to connect lifting devices must be strong enough to handle the load. Be sure the mounting point of load is strong enough to handle the load.
- When using a lifting device, always connect the load so it is balanced.
- Always use a lifting device on a hard, level surface.
- Lower the lifting device to the lowest point before moving. Move the load slowly.
- Always support the load as soon as possible. Never leave a load suspended in mid-air.

Support Machine Securely

WARNING

- **Support the machine using properly rated jackstands. Never work under a machine supported only by a jack.**
- **Do not use wood or concrete blocks to support the machine. Failure to properly support the machine may result in death or serious injury.**

Use Compressed Air and Air Tools Safely

WARNING

Always wear approved eye and ear protection while using compressed air. Misuse of compressed air could result in death or serious injury.

- When using air nozzles, air pressure should not exceed 30 psi (206.8 kPa).
- Never direct air nozzles or tools at a person.
- Never point air nozzles directly at skin.
- Compressed air is a useful tool when used in a safe manner.
- Always use eye and ear protection while using compressed air and air tools.
- When using air tools, do not exceed the air pressure rating for the tool.
- When using an impact wrench, always use approved impact sockets. Never use standard sockets on an impact wrench.
- Disconnect the air supply before changing air tool attachments.
- Always properly maintain air tools.

Service Tires Safely

WARNING

An inflated tire contains explosive force. Use care when handling wheels and tires.

- Always wear safety glasses or goggles.
- Use proper lifting methods when working with wheels and tires.
- When working on an inflated tire, never position yourself directly over the work area.
- When dismounting or mounting tires, use a wheel holder or tire machine. Use proper tire mounting tools and equipment. Never use screwdrivers or makeshift tools to force a tire on or off of a wheel.
- Be sure tire irons and mounting tools are free of grease and oil. Grip them firmly.
- Inspect wheel parts for rust, damage, or distortion.
- Never use wheels that are out-of-round, rusted, or cracked.
- Never hammer on wheels with a steel hammer. Use rubber-covered hammers.
- When inflating tires, always use an inflation cage.
- Always stand away from the valve stem.
- Use accurate, tested inflation gauges to set air pressures.

Handle Fuel Safely

WARNING

- **Never remove the fuel cap from the fuel tank or add fuel when the engine is running or while the engine is hot.**
- **Do not smoke when handling fuel. Never fill or drain the fuel tank indoors.**
- **Do not spill fuel. Clean spilled fuel immediately.**
- **Never handle or store fuel containers near an open flame or any device that may create sparks and ignite the fuel or fuel vapors.**
- **Be sure to reinstall and tighten fuel cap securely.**
- **Use an approved container; the spout must fit inside the fuel filler neck. Avoid using cans and funnels to transfer fuel.**
- Store fuel according to local, state, or federal ordinances and recommendations from your fuel supplier.
- Never overfill or allow the tank to become empty.
- Use clean, fresh fuel.
- Do not fill above the fuel filler neck.

Store Volatile and Hazardous Materials Safely

Store volatile materials (for example, gasoline, diesel fuel, oil, etc.) in approved containers that are clearly marked. Containers should be stored in an approved safety cabinet away from possible sources of ignition. Storage areas and cabinets should be well ventilated to prevent the possible build-up of fumes.

Handle Chemical Products Safely

WARNING

Exposure to chemical products could result in serious injury. Handle chemical products with care.

Refer to the chemical manufacturer's Material Safety Data Sheet (MSDS) for information regarding health hazards, safe handling, and emergency response procedures.

Routine service often requires the use of various chemical products, including lubricants and cleaning solutions. Many of these chemicals are flammable and can pose health risks if not handled properly.

- Never mix chemicals. Mixing chemicals can produce toxic or explosive results.
- Follow the manufacture's recommendations for safe usage and handling of the product.
- Various materials may pose a health hazard if used incorrectly. An MSDS contains important information regarding proper handling and health hazards, as well as emergency response procedures. Contact the chemical manufacturer to obtain an MSDS for the chemical product.

Service Cooling System Safely

WARNING

Engine coolant is hot and under pressure! Allow the cooling system to cool completely before performing service. Rotate the filler cap 1/2-turn counterclockwise and allow pressure to vent before removing filler cap. Failure to follow appropriate safety precautions may result in death or serious injury.

WARNING

Contact with anti-freeze can damage your skin. Use gloves when working with anti-freeze. If you come in contact with anti-freeze, wash it off immediately.

Always dispose of used engine coolant properly. (See "**Service Cooling System Safely**" on **page 18**.)

Service Electrical Components Safely

WARNING

Always disconnect the negative terminal first and positive terminal last. Connect positive terminal first and negative terminal last. Use care when testing live circuits to prevent arcing. Arcing could result in death or serious injury.

- Make sure circuit breakers are open (off).
- Disconnect the battery negative (–) cable before removing or installing electrical components. Always connect the battery negative (–) cable last.
- Certain test and adjustment procedures must be performed with the battery connected. Use care to prevent arcing when working on live circuits or components. Arcing can cause component damage and could ignite flammable materials.

Dispose of Waste Materials Safely

Routine service can produce waste products such as used oil, coolant, grease, and batteries. If not handled properly, these materials can pose a threat to the environment. Collect fluids in well-marked, approved storage containers. Some waste fluids can react with certain types of plastics. Make sure the fluid to be stored is compatible with the storage container. Never use food or beverage containers to store waste fluids.

NOTICE

- **Dispose of waste fluids properly at approved local recycling centers. If recycling facilities are not available, contact your local community for the correct disposal procedure for waste fluids.**
- **Dispose of old batteries properly. Battery electrolyte contains sulfuric acid and other hazardous materials. Never place an old battery in the trash. Batteries must be disposed of in a manner consistent with EPA and/or local regulations.**

Table of Contents

Chapter 1

Specification and General Information

1

Standard Torque Values

Torque Values

1. Always use torque values listed in Table 1-1, Torque Limits - SAE Standard Fasteners and Table 1-2, Torque Values for Lubricated or Plated Metric Thread Fasteners when a maintenance procedure does not provide a specific torque value.
2. Unless otherwise indicated, standard torque tolerance shall be ±10 percent.
3. Torque values listed are based on clean, dry threads.

a. Reduce torque by 25 percent when engine oil is used as a lubricant.

b. Reduce torque by 25 percent if new plated cap screws are used.

4. If the maintenance procedures do not specify a tightening order, use the following guidelines:

a. Lubricate threads of fasteners as specified in work procedure or Table 2.

b. Tighten fasteners above 30 lb-ft (41 N•m) using torque pattern and tighten to 70 percent of final value.

c. Multiply final value by 0.7 and torque to specifications.

d. Use torque pattern to torque to final value.

e. Tighten circular patterns using **Figure 1-1**, Circular Torque Pattern.

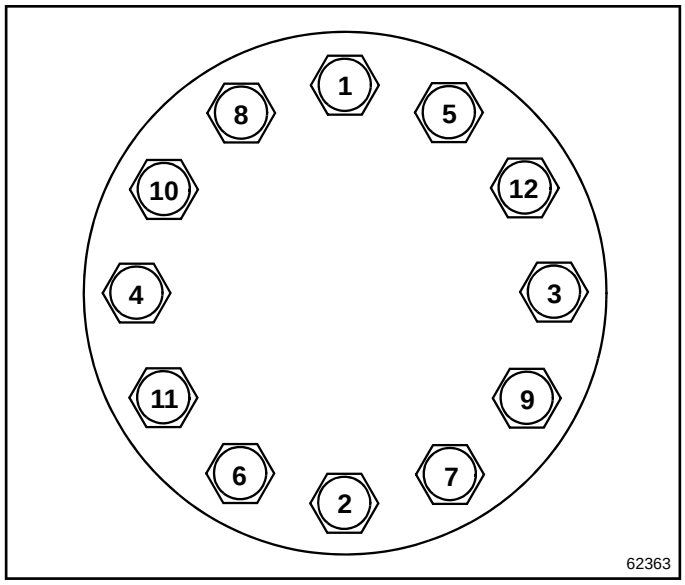


Figure 1-1: Circular Torque Pattern

f. Tighten straight patterns using **Figure 1-2**, Straight Torque Pattern.

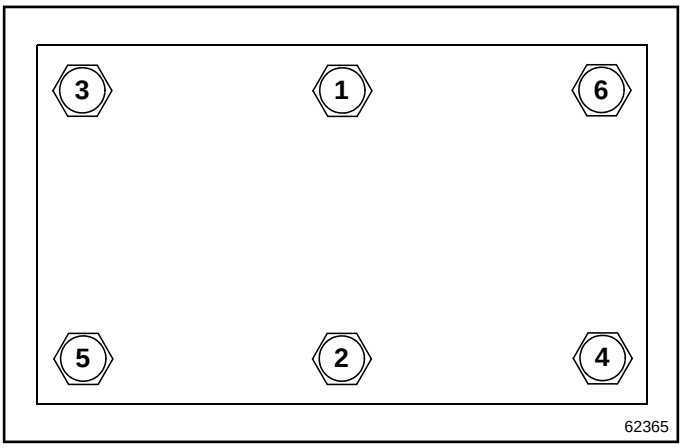


Figure 1-2: Straight Torque Pattern

SAE Standard Fasteners Torque Limits

CAUTION

If replacement cap screws are of a higher grade than originally supplied, use torque specifications for original cap screw. Failure to comply may result in damage to equipment.

Table 1-1. Torque Limits - SAE Standard Fasteners

Cap Screw Head Markings (Manufacturer's Marks May Vary)		TORQUE			
SIZE		SAE GRADE NO. 1 or 2 and General Hardware	SAE GRADE NO. 5	SAE GRADE NO. 6 or 7	SAE GRADE NO. 8
DIA. INCHES	THREADS PER INCH	lb-ft (N•m)	lb-ft (N•m)	lb-ft (N•m)	lb-ft (N•m)
1/4 1/4	20 28	5 (7) 6 (8)	8 (11) 10 (14)	10 (14) 12 (16)	12 (16) 14 (19)
5/16 5/16	18 24	11 (15) 12 (16)	17 (23) 19 (26)	21 (28) 24 (33)	25 (34)
3/8 3/8	16 24	20 (27) 23 (31)	30 (41) 35 (47)	40 (54) 45 (61)	45 (61) 50 (68)
7/16 7/16	14 20	30 (41) 35 (47)	50 (68) 55 (75)	60 (81) 70 (95)	70 (95) 80 (108)
1/2 1/2	13 20	50 (68) 55 (75)	75 (102) 90 (122)	95 (129) 100 (136)	110 (149) 120 (163)
9/16 9/16	12 18	65 (88) 75 (102)	110 (149) 120 (163)	135 (183) 150 (203)	150 (203) 170 (230)
5/8 5/8	11 18	90 (122) 100 (136)	150 (203) 180 (244)	190 (258) 210 (285)	220 (298) 240 (325)
3/4 3/4	10 16	160 (217) 180 (244)	260 (353) 300 (407)	320 (434) 360 (488)	380 (515) 420 (569)
7/8 7/8	9 14	140 (190) 155 (210)	400 (542) 440 (597)	520 (705) 580 (786)	600 (813) 660 (895)
1 1	8 12	220 (298) 240 (325)	580 (786) 640 (868)	800 (1085) 860 (1166)	900 (1220) 1000 (1356)
1-1/8 1-1/8	7 12	300 (407) 340 (461)	800 (1085) 880 (1193)	1120 (1519) 1260 (1708)	1280 (1735) 1440 (1952)
1-1/4 1-1/4	7 12	420 (569) 460 (624)	1120 (1519) 1240 (1681)	1580 (2142) 1760 (2386)	1820 (2468) 2000 (2712)
1-3/8 1-3/8	6 12	560 (759) 640 (868)	1460 (1980) 1680 (2278)	2080 (2820) 2380 (3227)	2380 (3227) 2720 (3688)
1-1/2 1-1/2	6 12	740 (1003) 840 (1139)	1940 (2630) 2200 (2983)	2780 (3769) 3100 (4203)	3160 (4285) 3560 (4827)

Metric Fasteners Torque Limits

Table 1-2. Torque Limits - Torque Values for Lubricated or Plated Metric Thread Fasteners

Cap Screw Head Markings (Manufacturer's Marks May Vary)	Class 8.8* or 9.8+	Class 10.9*	Class 12.9
Thread Diameter-Pitch	Torque: lb-ft (N•m)		
DIA. INCHES	lb-ft (N•m)	lb-ft (N•m)	lb-ft (N•m)
M6 M8 M8 X 1.25	5 (7) 12 (16) 13 (18)	7 (9) 17 (23) 18 (24)	12 (16) 30 (41) 29 (39)
M10 M10 X 1.25	24 (33) 27 (37)	34 (46) 38 (52)	70 (95) 60 (81)
M12 M12 X 1.5	42 (57) 43 (58)	60 (81) 62 (84)	120 (163)
M14 M14 X 1.5	66 (89) 72 (98)	95 (129) 103 (140)	190 (258)
M16 M16 X 1.5	103 (140) 110 (149)	148 (201) 157 (213)	300 (407)
M18 M18 X 1.5	147 (199) 165 (224)	203 (275) 320 (434)	410 (556)
M20 M20 X 1.5	208 (282) 213 (289)	288 (390) 320 (434)	580 (786)
M22 M22 X 1.5	283 (384) 315 (427)	392 (531) 431 (584)	800 (1085)
M24 M24 X 2	360 (488) 392 (531)	498 (675) 542 (735)	1000 (1356)
M27 M27 X 2	527 (715) 569 (771)	729 (988) 788 (1068)	1475 (2000)
M30 M30 X 2	715 (969) 792 (1074)	990 (1342) 1096 (1486)	2000 (2712)
M33	1300 (1763)	1850 (2508)	2150 (2915)
M36	2100 (2847)	3000 (4067)	3500 (4745)

*Coat plated and unplated fasteners with oil before installation.
+Use if bolt or nut is lubricated or plated (zinc-phosphate conversion-coated, cadmium-plated, or waxed).

Using a Torque Wrench Extension

Occasionally an extension, crowfoot, or other adapter is necessary to use with a torque wrench to torque a bolt or line fitting. Adding adapters or extensions will alter the torque on the fastener from what the torque wrench reads. Use the following formula to calculate the correct torque wrench setting to achieve a specific torque value.

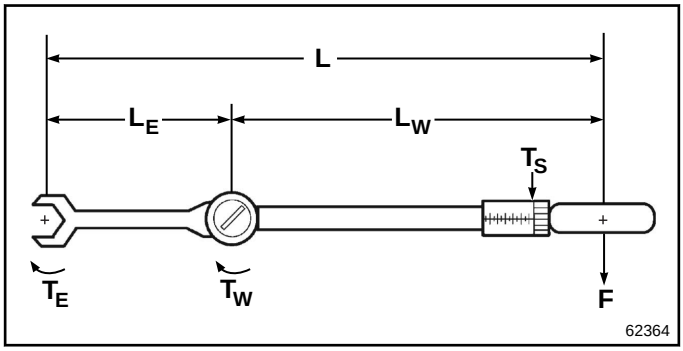


Figure 1-3: Torque Wrench and Extension

F - Force applied by technician

L - Total length through which force is applied to fastener

TW - Torque applied at end of torque wrench
TS = TE (LW / (LW + LE))

TS - Torque wrench setting

TE - Torque specified at fastener

LW - Length of torque wrench

LE - Length of extension
Example: A component requires a specified torque value of 65 lb-ft and a 6 inch extension is required to reach it. What should the torque wrench setting (TS) be to compensate for the extension?

Torque specified at fastener (TE) = 65 lb-ft

Length of torque wrench (LW) = 12 in.

Length of extension (LE) = 6 in.
TS = TE (LW / (LW + LE))
TS = 65 lb-ft (12 in. / (12 in. + 6 in.)
TS = 65 lb-ft (12 in. / (18 in.)
TS = 65 lb-ft (0.666)
TS = 43.33 lb-ft

Service Information

Service Schedule

	Hours					
	Daily	50	100	250	500	1000
Grease Trowel Arms	X					
Check Hydraulic Oil Level	X					
Inspect Air Filter	X					
Check External Hardware	X					
Pressure Wash All Surfaces	X					
Check Hoses and Connections For Leaks	X					
Lubricate Wheel Kit Cylinder		X				
Check Wiring and Electrical Connections		X				
Lubricate Steering Pivots		X				
Drain Water From Fuel/Water Separater			X			
Check For Leaks Around Radiator Hoses and Hose Clamps				X		
Inspect Air Intake Line				X		
Clean Air Cleaner Element[1]				X		
Remove Sediment from Fuel Tank					X	
Clean Radiator Filler Cap					X	
Replace Hydraulic Oil Filter[2][3][4]				X	X	
Replace Hydraulic Oil[3][4]				X	X	
Replace Fuel Line Hose						X
Replace Air Cleaner Element[1][5]						X
Change Radiator Coolant[6]						X

[1]Service more often in dusty conditions

[2]Perform initially after first 50 hours of operation

[3]In hot climates exceeding 90°F (32°C), replace fluid and filter every 250 hours

[4]In climates below 90°F (32°C), replace fluid and filter every 500 hours

[5]or 12 months if hours are not reached

[6]or 24 months if hours are not reached

General Specifications

General Specifications

Engine Model	CRT60-74LX
Engine Make	Kohler
Max Rated Power @ Rated Speed	74 hp (55 kW) @ 2,600 rpm
Displacement	152 in³ (2, 482 cm³)
Operating Speed	up to 2,600 rpm
Engine Speed-Idle	1,000 rpm
Battery	12V / BCI G 24
Fuel Type	Clean, filtered diesel
Fuel Tank Capacity	11.8 gal (44.7 L)
Fuel Consumption	3.3 gal/hr (12.5 L/hr)
Running Time	3.6 hours
Rotor Drive ControEngine Oil Capacity	Electronically variable hydrostatic
Engine Oil Capacity	9 qt (8.5 L)
Engine Lubrication	5W30, 10W40

Machine	CRT60-74LX
Operating Weight	2720 lb (1235 kg)
Dimensions (L x W x H)	127 x 64 x 57 in (3227 x 1637 x 1455 mm)
Rotor Speed (Range)	25-132 rpm
Blade Pitch (Range)	0-25 degrees
Rotor Drive	Tandem Hydro Pump Twin Radial Piston Motor
Hydraulic Oil	Synthetic ISO/VG 68 Blue Hydraulic Oil Available in 5-gallon Containers as Wacker Neuson Part Number 5100029012 Or 55-gallon Container As Wacker Neuson Part Number 5100029013
Hydraulic Oil Capacity	38 qt (36 L)

Operation	CRT60-74LX
Troweling Width with Pans (Non-Overlapping)	122 in (3,092 mm)
Troweling With without pans (Non-Overlapping)	120 in (3,049 mm)
Troweling Area with Pans (Non-Overlapping)	50 ft² (4.6 m²)
Troweling Area without Pans (Non-Overlapping)	48 in² (4.4 cm²)

Chapter 2

Engine

Specifications

General Specifications

Engine Model	CRT60-74LX
Engine Make	Kohler
Max Rated Power @ Rated Speed	74 hp (55 kW) @ 2,600 rpm
Displacement	152 in^3 (2, 482 cm^3)
Operating Speed	up to 2,600 rpm
Engine Speed-Idle	1,000 rpm
Battery	12V / BCI G 24
Fuel Type	Clean, filtered diesel
Fuel Tank Capacity	11.8 gal (44.7 L)
Fuel Consumption	3.3 gal/hr (12.5 L/hr)
Running Time	3.6 hours
Rotor Drive ControEngine Oil Capacity	Electronically variable hydrostatic
Engine Oil Capacity	9 qt (8.5 L)
Engine Lubrication	5W30, 10W40

Repair Specifications

Specification	
Muffler Nuts	26 lb-ft (35 N•m)
Muffler Bracket Bolts	18 lb-ft (24 N•m)
Ground Strap	18 lb-ft (24 N•m)
Motor Mount Nuts and Bolts	35 lb-ft (48 N•m)

Repair

Radiator Assembly

Removal and Installation

See **Figures 2-1** through **2-6**.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Support machine securely. (See "**Support Machine Securely**" on **page 16**.)

WARNING

Always disconnect the negative terminal first and positive terminal last. Connect positive terminal first and negative terminal last. Use care when testing live circuits to prevent arcing. Arcing could result in death or serious injury.

3. Open battery cover.
4. Disconnect negative battery cable at battery.

WARNING

Engine coolant is hot and under pressure! Allow the cooling system to cool completely before performing service. Rotate the filler cap 1/2-turn counterclockwise and allow pressure to vent before removing filler cap. Failure to follow appropriate safety precautions may result in death or serious injury.

5. Drain coolant.
6. Remove retardant tank. (See "**Retardant Tank**" on **page 5-3**.)
7. Disconnect the left joystick. (See "**Left Joystick**" on **page 3-81**.)
8. Remove left shell panel. (See "**Shell**" on **page 5-5**.)

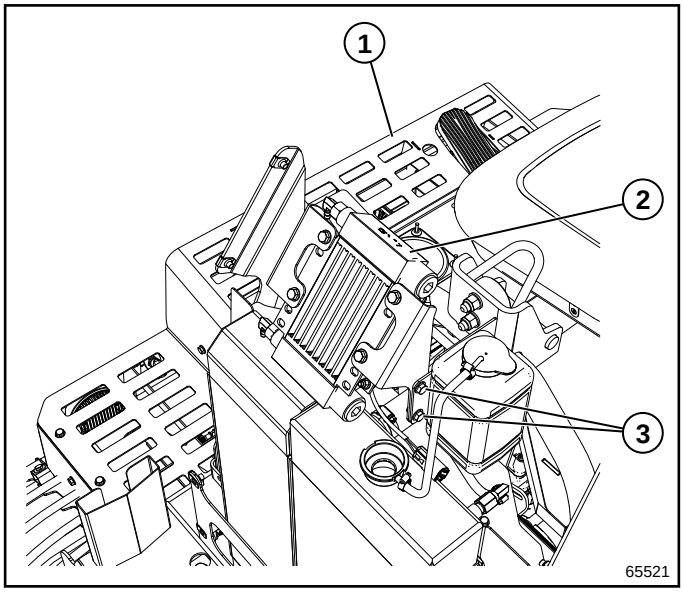


Figure 2-1: Fuel Cooler

9. Remove bolts (3) securing fuel cooler and brackets (2) to machine (1). Position fuel cooler and brackets out of the way.

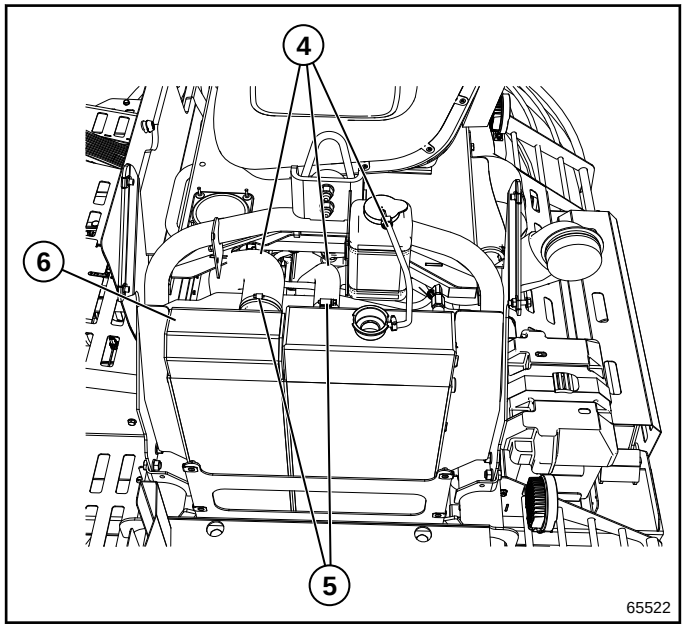


Figure 2-2: Upper Radiator Hoses

10. Loosen clamps (4) and remove upper hoses (4) from radiator assembly (6).

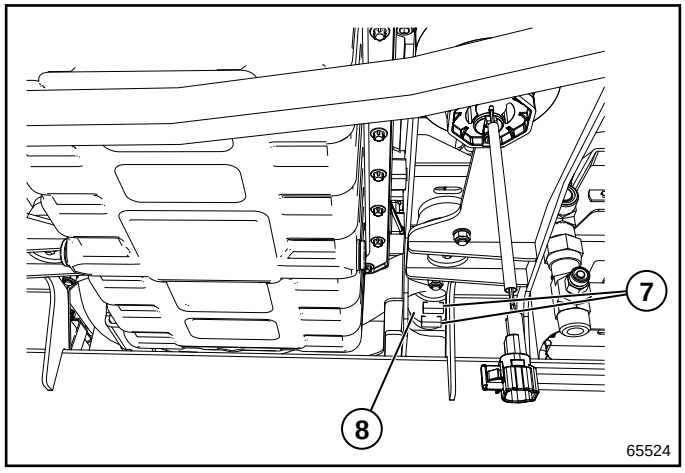


Figure 2-3: Lower Radiator Hoses

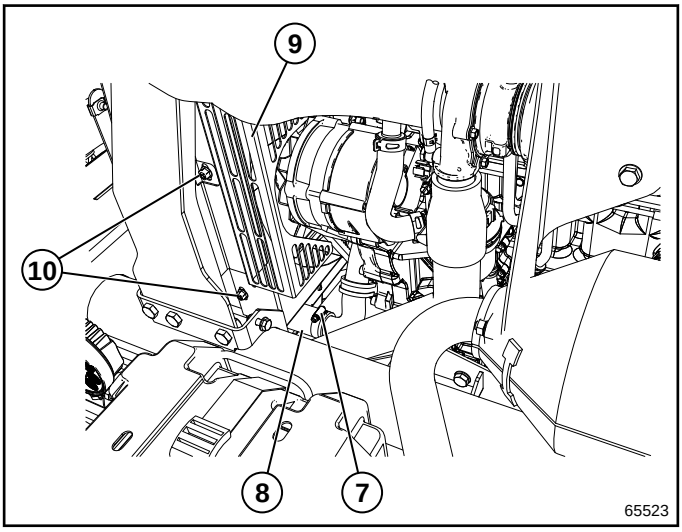


Figure 2-4: Lower Radiator Hoses and Fan Guard

11. Loosen clamps (7) and remove lower radiator hoses (8) from radiator assembly.
12. Remove bolts (10) securing fan guard (9) to radiator assembly (6). Position fan guard out of the way.

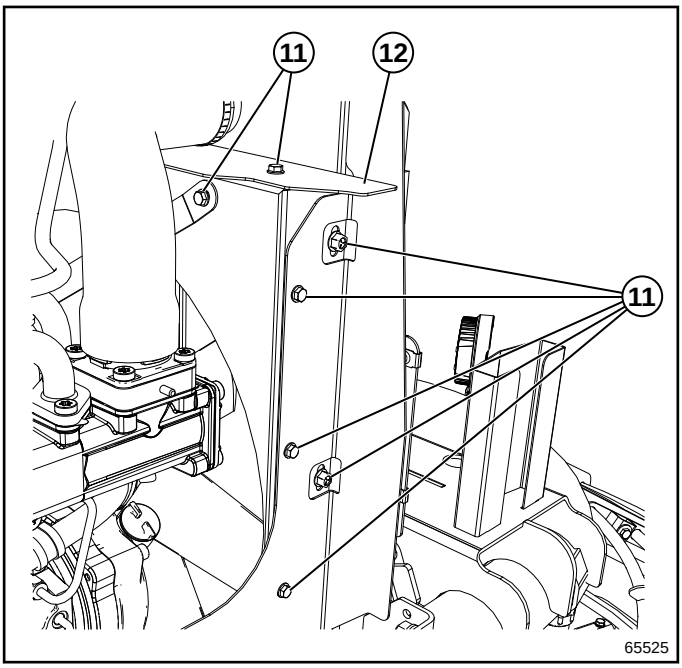


Figure 2-5: Fan Shroud

13. Remove bolts (11) securing fan shroud (12) to radiator assembly (6). Position fan shroud out of the way.

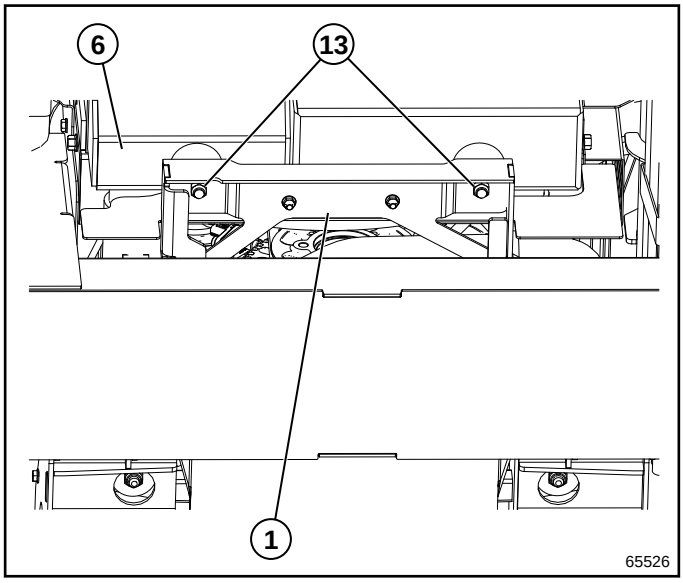


Figure 2-6: Radiator Removal and Installation

14. Remove nuts (13) securing radiator assembly (6) to machine (1). Remove radiator assembly.

Installation Notes

- *Install the radiator by reversing the order of removal.*

Diesel-Oxygenated Catalyst (DOC)

Removal and Installation

See **Figure 2-7**.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)

WARNING

Engine may be hot. Allow the engine to cool completely before performing service. Failure to follow appropriate safety precautions may result in death or serious injury.

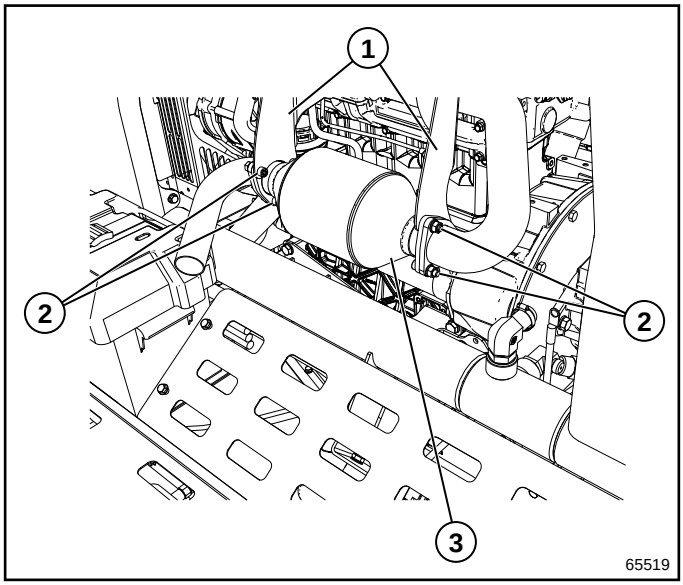


Figure 2-7: DOC Removal and Installation

2. Remove insulation wrap from DOC (3).
3. Remove nuts and bolts (2) securing DOC (3) to support brackets (1). Remove DOC from support brackets.

Installation Notes

- *Install the DOC by reversing the order of removal.*

Engine

Removal and Installation

See **Figures 2-8** through **2-13**.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Open battery cover.

WARNING

Always disconnect the negative terminal first and positive terminal last. Connect positive terminal first and negative terminal last. Use care when testing live circuits to prevent arcing. Arcing could result in death or serious injury.

3. Disconnect negative battery cable at battery.

WARNING

Prolonged contact with lubricating oil may cause skin rash. Remove saturated clothing immediately and thoroughly wash skin that comes in contact with lubricating oil. Failure to comply may result in injury or death to personnel.

NOTE

A separate engine manual, prepared by the engine manufacturer, is supplied with this machine. Refer to the engine manufacturer's manual for all engine-related service.

4. Drain engine oil.

WARNING

Engine coolant is hot and under pressure! Allow the cooling system to cool completely before performing service. Rotate the filler cap 1/2-turn counterclockwise and allow pressure to vent before removing filler cap. Failure to follow appropriate safety precautions may result in death or serious injury.

5. Drain coolant.
6. Remove fuel tank. (See "**Fuel Tank**" on **page 5-4**.)
7. Remove retardant tank. (See "**Retardant Tank**" on **page 5-3**.)

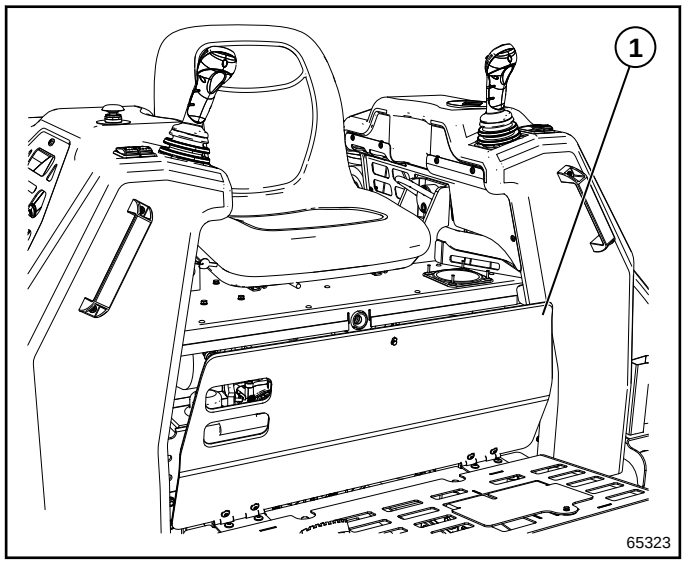


Figure 2-8: Access Panel

8. Unlatch and open access panel (1).
9. Remove right joystick. (See "**Right Joystick**" on **page 3-80**.)
10. Remove left joystick. (See "**Left Joystick**" on **page 3-81**.)
11. Remove left and right shell. (See "**Shell**" on **page 5-5**.)
12. Remove radiator assembly. (See "**Radiator Assembly**" on **page 2-3**.)
13. Remove Diesel-Oxygenated Catalyst (DOC). (See "**Diesel-Oxygenated Catalyst (DOC)**" on **page 2-5**.)
14. Disconnect hoses from hydraulic manifold. (See "**Manifold**" on **page 4-54**.)
15. Disconnect hoses from oil cooler. (See "**Oil Cooler**" on **page 4-49**.)
16. Cut any wire ties that connect engine wiring harness to the upper frame assembly and to the engine as needed.
17. Disconnect all electrical connectors connecting the wire harnes to the lower frame, such as:
    - Work lights
    - Retardant pump
    - Sensors

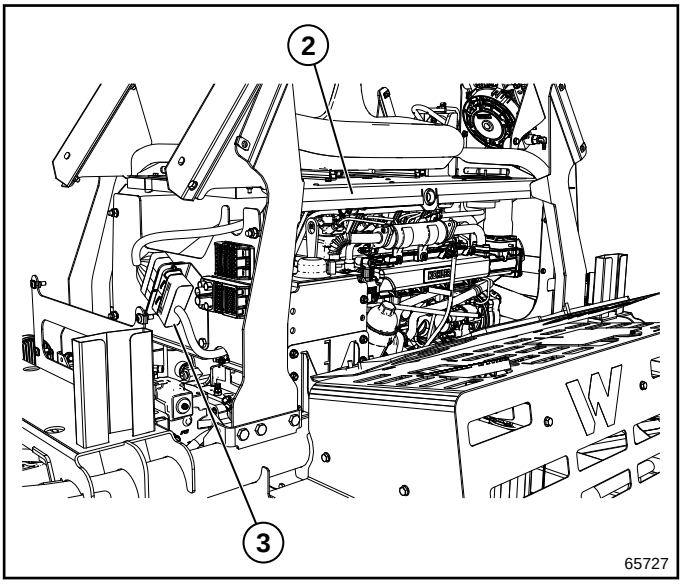


Figure 2-9: Engine Electrical Connector

18. Disconnect engine wiring (3) harness from machine (2).

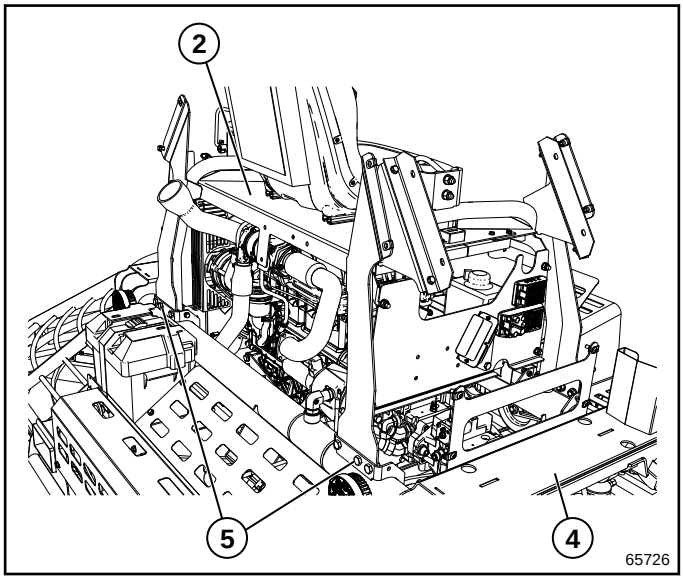


Figure 2-10: Upper Frame Assembly

Remove nuts and bolts (5) securing upper frame assembly (2) to machine (4).

19. Using an appropriate lifting device, remove upper frame assembly (2) from machine (4).

WARNING

Hydraulic system operates at high pressures and temperatures. Always allow hydraulic oil to cool and relieve pressure in hydraulic reservoir before working on hydraulic system. Wear eye protection and gloves to prevent injury. Open lines and hoses slowly and wait for any residual pressure to relieve before continuing to open lines and hoses. Failure to comply may result in injury or death to personnel.

WARNING

Prolonged contact with lubricating oil may cause skin rash. Remove saturated clothing immediately and wash skin thoroughly that comes in contact with lubricating oil. Failure to comply may result in injury or death to personnel.

WARNING

Spilled hydraulic oil is slippery and creates a hazardous condition. Clean up and properly dispose of hydraulic oil. Failure to comply may result in injury or death to personnel.

CAUTION

Wipe area clean around all fluid connections prior to removal. Cap and plug all hoses, lines, fittings, and ports during removal to prevent contamination of system components. System must be kept clean from contaminants. Failure to comply may result in damage to equipment.

NOTES

- *Position drain pan under hoses being removed.*
- *Tag and mark hoses and fittings prior to removal to ensure proper installation.*
- *Inspect O-rings upon removal for wear or damage and replace as necessary.*
- *Cap and plug hoses and fittings during removal.*

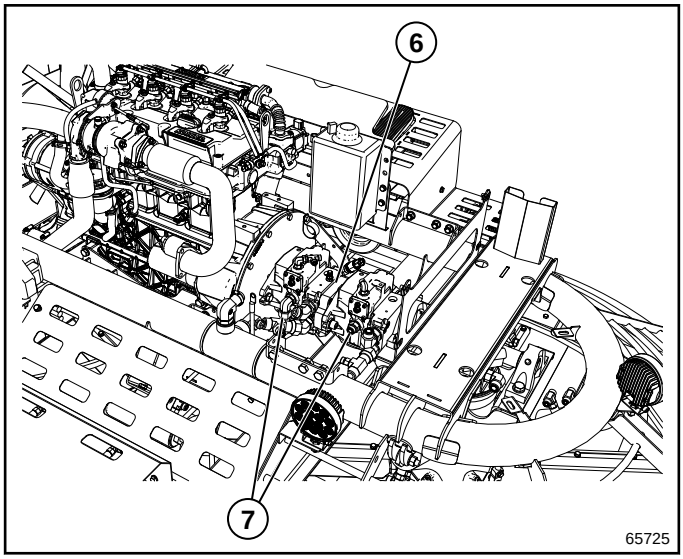


Figure 2-11: Tandem Pump Hoses

20. Mark and remove hoses (7) from tandem pump (6). (See "**Tandem Pump**" on **page 4-59**.

WARNING

Prolonged contact with lubricating oil may cause skin rash. Remove saturated clothing immediately and thoroughly wash skin that comes in contact with lubricating oil. Failure to comply may result in injury or death to personnel.

NOTE

A separate engine manual, prepared by the engine manufacturer, is supplied with this machine. Refer to the engine manufacturer's manual for all engine-related service.

Figure 2-12: Engine Wiring Harness Connectors

NOTE

Note location of tiedown straps during removal to ensure proper installation.

21. Mark and disconnect engine wiring harness connectors (8) from engine.

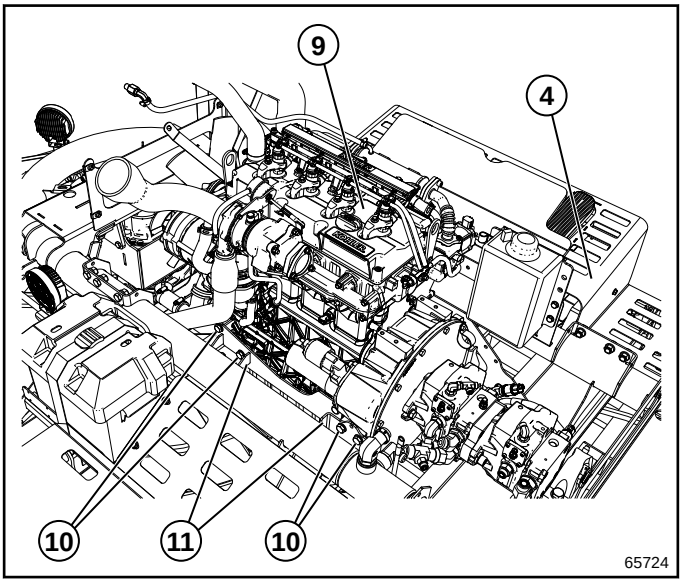


Figure 2-13: Engine

22. Remove nuts and bolts (10) from engine (9) and motor mounts (11).
23. Using an appropriate lifting device, remove engine (9) from machine (4).

Installation Notes

- *Install the engine by reversing the order of removal.*
- *Torque front motor mount nuts and bolts to 35 lb-ft (48 N•m).*
- *Torque muffler nuts to 25 lb-ft (35 N•m).*
- *Torque muffler bracket bolt to 18 lb-ft (24 N•m).*
- *Torque ground strap bolt to 18 lb-ft (24 N•m).*
- *Fill the radiator with a mixture of good quality ethylene glycol-base anti-freeze and clean, fresh water. The coolant mixture should have a freezing point of -34 °F (-37 °C).*
- *Replace engine oil filter.*
- *Fill engine with oil using approved engine oil.*
- *Start engine. Check engine for oil and coolant leaks. Repair as necessary.*
- *Check engine oil and add if necessary.*
- *Check engine coolant and add if necessary.*

Chapter 3

Electrical

Specifications

Test and Adjustment Specifications

Table 3-1. Steering Specification

Steering Mode	Joystick Movement				
	Reverse	Neutral	Forward	Left	Right
High resolution	0.5 VDC / 1.1 amp	2.5 VDC / 0 amp	4.5 VDC / 1.1 amp	0.5 VDC / 1.1 amp	4.5 VDC / 1.1 amp
High rate	0.5 VDC / 1.7 amp	2.5 VDC / 0 amp	4.5 VDC / 1.7 amp	0.5 VDC / 1.7 amp	4.5 VDC / 1.7 amp

Component Location

Component Location

See **Figures 3-1** and **3-2**.

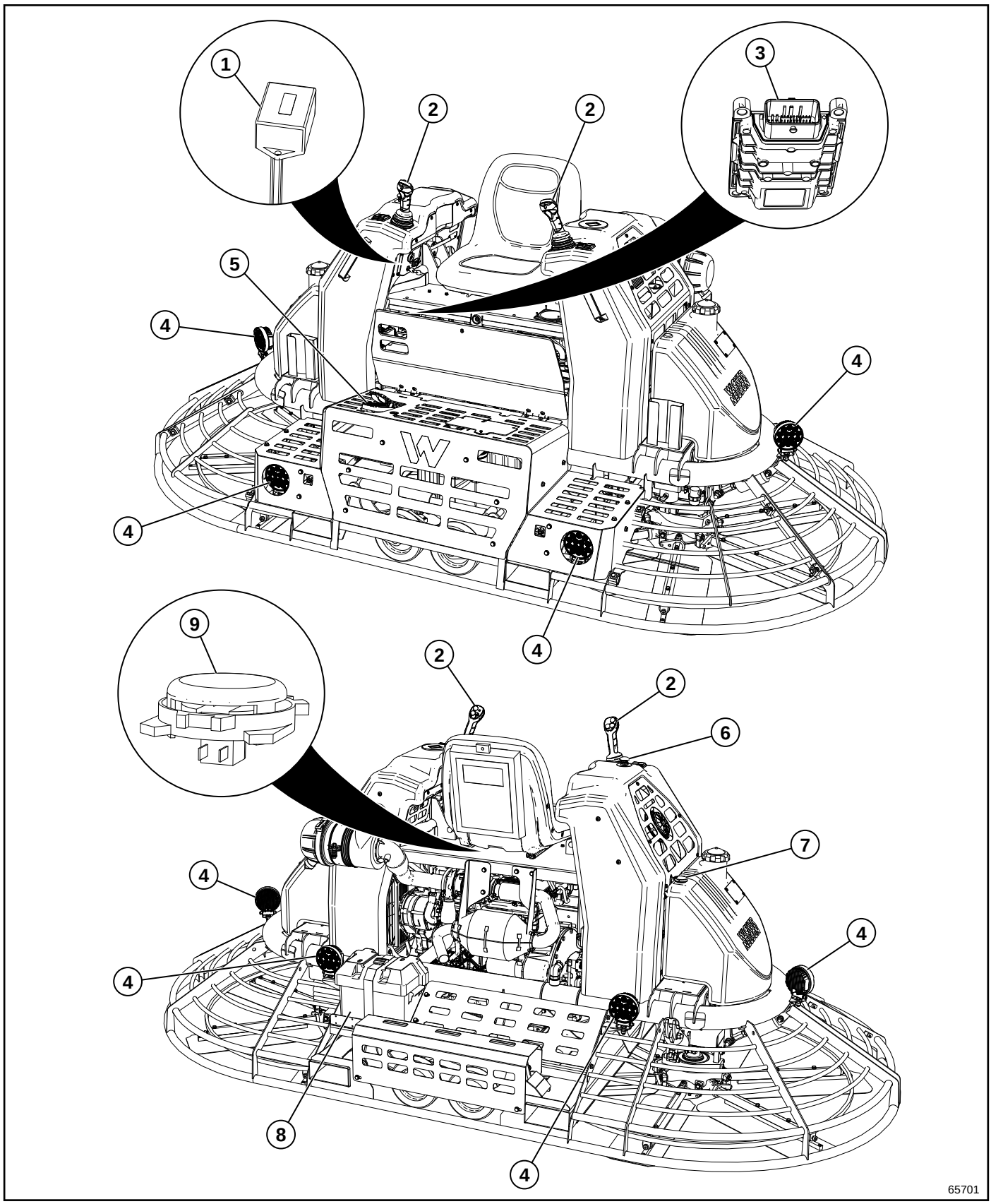
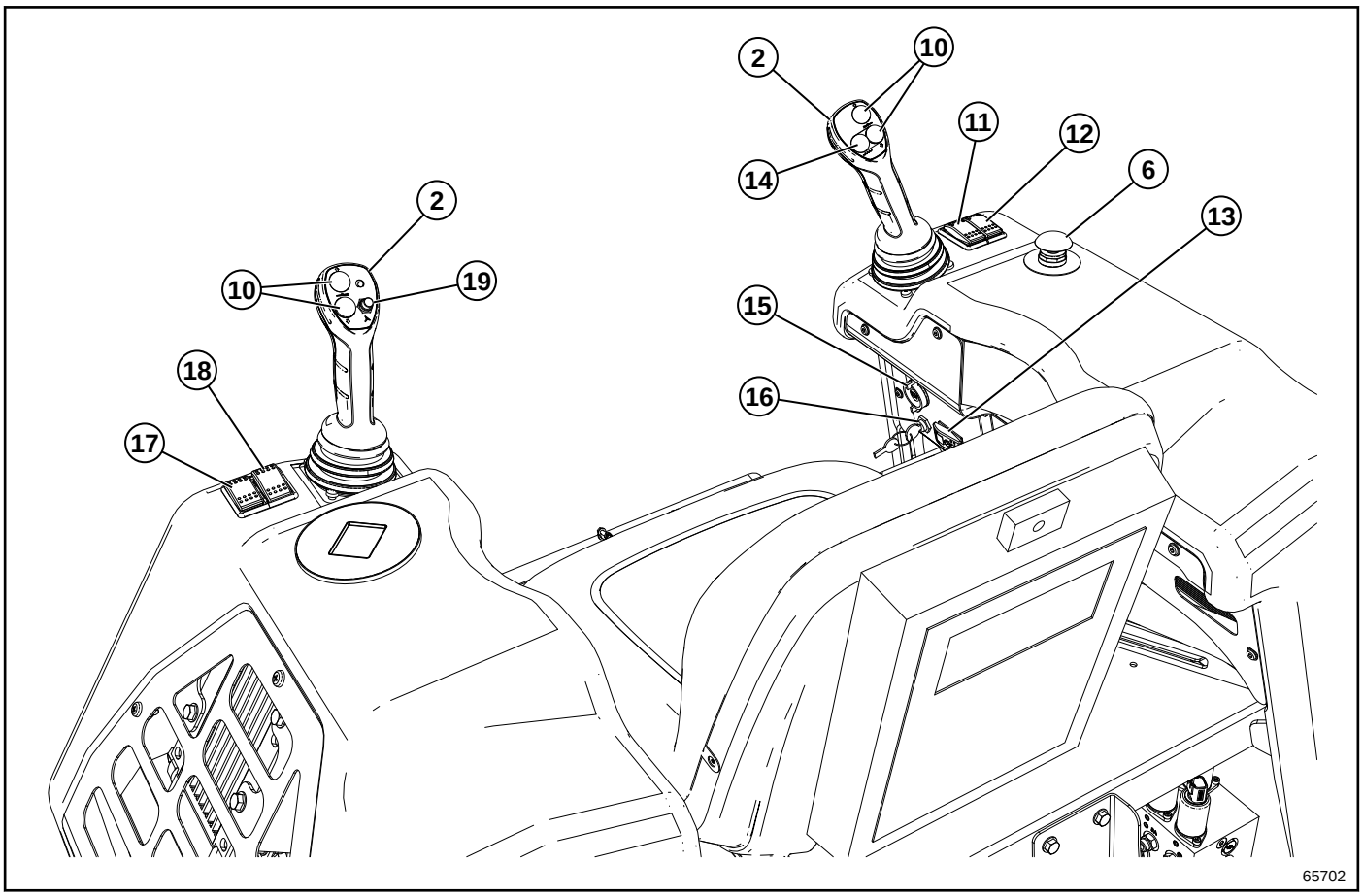


Figure 3-1: Ride-On Trowel Electrical Component Location



1. STEERING MODULE
2. JOYSTICK
3. MACHINE CONTROLLER
4. WORK LIGHTS
5. FOOT PEDAL
6. EMERGENCY STOP SWITCH
7. FUEL SENDING UNIT
8. BATTERY
9. SEAT SWITCH
10. PITCH CONTROL BUTTONS
11. THROTTLE SWITCH
12. CRUISE CONTROL SWITCH
13. GYROSCOPIC STEERING SWITCH
14. WATER SPRAY SWITCH
15. 12V POWER OUTLET
16. ENGINE KEYSWITCH
17. WHEEL KIT SWITCH
18. WORK LIGHT SWITCH
19. STEERING MODE SWITCH

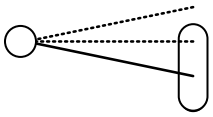
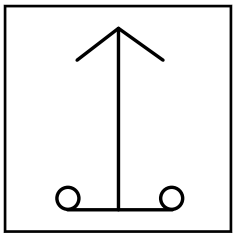
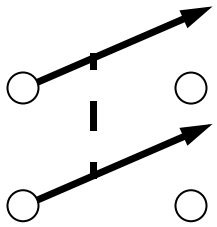
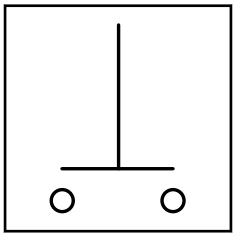
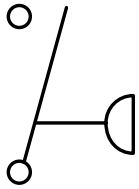
Figure 3-2: Operator Controls Component Location

Symbols/How to Read a Schematic

Electrical Component Symbols

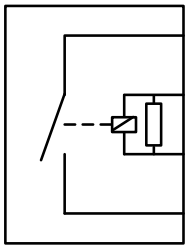
The following symbols are used in the electrical schematics to represent various electrical components.

Switches[1]

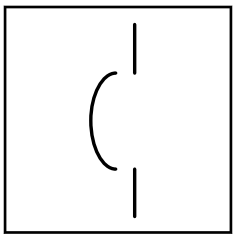
 Single Pole, Single Throw (SPST)	 Single Pole, Triple Throw (SPTT)
 Single Pole, Double Throw (SPDT)	 Normally Closed, Momentary
 Double Pole, Single Throw (DPST)	 Normally Open
 Pressure Switch	

[1] The sample switch symbols shown are just a few of the many switch configurations. Switches are designated by the number of “poles” (circuits controlled) and “throws” (actuator positions). Unless otherwise specified, switches are shown in the “Normally Open” (N.O.) position.

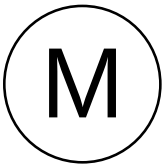
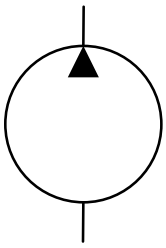
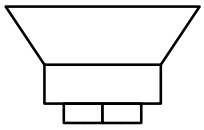
Switching Devices

 Relay	

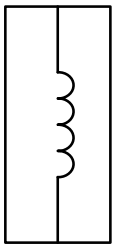
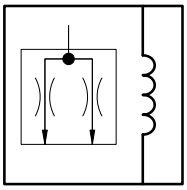
Circuit Protection Devices

 Fuse	 Circuit Breaker

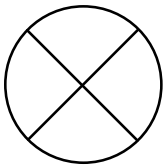
Motors and Generating Devices

 Electric Motor (may also include "AC" or "DC")	 Pump
 Loudspeaker	

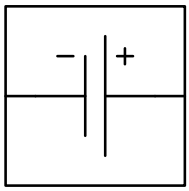
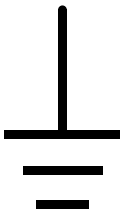
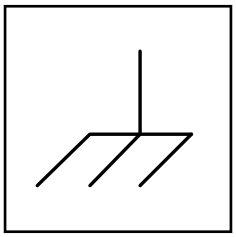
Actuating Devices

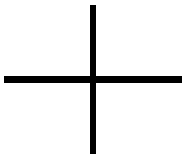
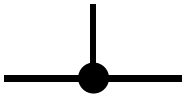
 Solenoid Valve	 Self-Level Valve

Lights

 Single-Element Light	

Miscellaneous Symbols

 Enclosure	 Battery
 Ground (to earth)	 Ground (to chassis)

 Resistor	 Diode
 Resistor	 Pin and Socket Connector
 Variable Resistor	 Wires (crossing but not connected)
 Coil	 Wiring Connections

Electrical Schematic Component Identification

Electrical Schematic Component Identification

Electrical components shown in the main schematic are identified with an alpha-numeric callout. All electrical components shown in the electrical schematic are listed below.

- B001—Fuel Sender (See "**Figure 3-6**" on **page 3-16**)
- B007—Hydraulic Temperature Sensor (See "**Figure 3-6**" on **page 3-16**)
- B054—Pedal (See "**Figure 3-6**" on **page 3-16**)
- B121—Hydraulic Charge Pressure Sensor (See "**Figure 3-6**" on **page 3-16**)
- B126—Gyro Module (See "**Figure 3-6**" on **page 3-16**)
- B127—Hydraulic Left Pressure Sensor (See "**Figure 3-6**" on **page 3-16**)
- B128—Hydraulic Right Pressure Sensor (See "**Figure 3-6**" on **page 3-16**)
- B129—Hydraulic Auxiliary Pressure Sensor (See "**Figure 3-6**" on **page 3-16**)
- E019—Work Light Side Left (See "**Figure 3-7**" on **page 3-17**)
- E020—Work Light Side Right (See "**Figure 3-7**" on **page 3-17**)
- E029—Work Light Rear Left (See "**Figure 3-7**" on **page 3-17**)
- E030—Work Light Rear Right (See "**Figure 3-7**" on **page 3-17**)
- E036—Work Light Front Left (See "**Figure 3-7**" on **page 3-17**)
- E037—Work Light Front Right (See "**Figure 3-7**" on **page 3-17**)
- E1C1—Engine to Vehicle Connection (250V 30 AMP) (See "**Figure 3-5**" on **page 3-15**)
- F001—Main Fuse (60 AMP) (See "**Figure 3-5**" on **page 3-15**)
- F002—Fuse (50 AMP) (See "**Figure 3-5**" on **page 3-15**)
- F003—EGR Signal Fuse (5 AMP) (See "**Figure 3-5**" on **page 3-15**)
- F004—Ignition Signal Fuse (5 AMP) (See"**Figure 3-5**" on **page 3-15**)
- F005—MCU Power Fuse (20 AMP) (See "**Figure 3-6**" on **page 3-16**)
- F006—Work Lights Fuse (25 AMP) (See "**Figure 3-7**" on **page 3-17**)
- F007—Wheel Kit Fuse (15 AMP) (See "**Figure 3-7**" on **page 3-17**)
- F008—Accessory Outlet Fuse (15 AMP) (See **Figure 3-7**)
- F009—Fuel Cooler Fan Fuse (15 AMP) (See "**Figure 3-7**" on **page 3-17**)
- F010—Hydraulic Oil Fan Fuse (30 AMP) (See "**Figure 3-7**" on **page 3-17**)
- F011—Grip Power Fuse (2 AMP)(See "**Figure 3-6**" on **page 3-16**)
- F012—Power Supply Signal Fuse (5 AMP) (See "**Figure 3-5**" on **page 3-15**)
- F013—Gyro Fuse (2 AMP) (See "**Figure 3-6**" on **page 3-16**)
- F014—ECU Power Fuse (20 AMP) (See "**Figure 3-5**" on **page 3-15**)
- F015—Starter CMD Fuse (15 AMP) (See "**Figure 3-5**" on **page 3-15**)
- F016—Kohler Diagnostics Fuse (3 AMP) (See **Figure 3-7**)
- F017—Pitch Power Fuse (10 AMP) (See "**Figure 3-6**" on **page 3-16**)
- F018—Spray Pump Fuse (15 AMP) (See "**Figure 3-6**" on **page 3-16**)
- F019—MCU Ignition Power Fuse (5 AMP) (See "**Figure 3-6**" on **page 3-16**)
- F020—Seat Switch Fuse (5 AMP) (See "**Figure 3-6**" on **page 3-16**)
- G001—Alternator (See "**Figure 3-5**" on **page 3-15**)
- G002—Battery (See "**Figure 3-5**" on **page 3-15**)
- G012—Accessory Outlet (See "**Figure 3-7**" on **page 3-17**)
- K001—12VDC Main Power Relay (See "**Figure 3-5**" on **page 3-15**)
- K053—Hydraulic Oil Cooler Relay (See "**Figure 3-7**" on **page 3-17**)
- K155—Starter Relay (See "**Figure 3-5**" on **page 3-15**)
- K156—Gird Heater Relay (See "**Figure 3-5**" on **page 3-15**)
- K157—Kohler ECU Power Relay (See "**Figure 3-5**" on **page 3-15**)
- K161—Left Pitch Up Relay (See "**Figure 3-6**" on **page 3-16**)
- K162—Left Pitch Down Relay (See "**Figure 3-6**" on **page 3-16**)
- K163—Right Pitch Up Relay (See "**Figure 3-6**" on **page 3-16**)
- K164—Right Pitch Down Relay (See "**Figure 3-6**" on **page 3-16**)

- K173—Spray Pump Relay (See "**Figure 3-6**" on **page 3-16**)
- M001—Starter (See "**Figure 3-5**" on **page 3-15**)
- M004—Fuel Cooler Fan (See "**Figure 3-7**" on **page 3-17**)
- M033—Hydraulic Oil Cooler Fan (See "**Figure 3-7**" on **page 3-17**)
- M039—Spray Pump (See "**Figure 3-6**" on **page 3-16**)
- R048—Grid Heater (See "**Figure 3-5**" on **page 3-15**)
- S004—Air Filter Restriction Switch (See "**Figure 3-7**" on **page 3-17**)
- S005—Hydraulic Filter Switch (See "**Figure 3-6**" on **page 3-16**)
- S016—Work Light Switch (See "**Figure 3-7**" on **page 3-17**)
- S047—Key Switch (See "**Figure 3-5**" on **page 3-15**)
- S058—Fuel/Water Separator (15 AMP) (See "**Figure 3-7**" on **page 3-17**)
- S097—Throttle Switch (See "**Figure 3-5**" on **page 3-15**)
- S104—Seat Switch (See "**Figure 3-6**" on **page 3-16**)
- S147—Cruise Switch (See **Figure 3-6**)
- S167—E-Stop (See "**Figure 3-5**" on **page 3-15**)
- S219—Gyro Switch (See "**Figure 3-6**" on **page 3-16**)
- S220—Wheel Kit Switch (See "**Figure 3-7**" on **page 3-17**)
- X003—Left Joystick (See "**Figure 3-6**" on **page 3-16**)
- X004—Right Joystick (See "**Figure 3-6**" on **page 3-16**)
- X005—Left Grip Buttons (See "**Figure 3-6**" on **page 3-16**)
- X006—Right Grip Buttons (See "**Figure 3-6**" on **page 3-16**)
- XA01—Display (See "**Figure 3-6**" on **page 3-16**)
- XE01—Kohler Diag Port (See "**Figure 3-7**" on **page 3-17**)
- XE02—Machine Diag Port (See "**Figure 3-7**" on **page 3-17**)
- Y171—2B Steer Valve (See "**Figure 3-6**" on **page 3-16**)
- Y172— 2A Steer Valve (See "**Figure 3-6**" on **page 3-16**)
- Y173—1B Steer Valve (See "**Figure 3-6**" on **page 3-16**)
- Y174—1A Steer Valve (See "**Figure 3-6**" on **page 3-16**)
- Y175—3B Steer Valve (See "**Figure 3-6**" on **page 3-16**)
- Y176—3A Steer Valve (See "**Figure 3-6**" on **page 3-16**)
- Y177—Left Up Pitch Valve (See "**Figure 3-6**" on **page 3-16**)
- Y178—Left Down Pitch Valve (See "**Figure 3-6**" on **page 3-16**)
- Y179—Right Up Pitch Valve (See "**Figure 3-6**" on **page 3-16**)
- Y180—Right Down Pitch Valve (See "**Figure 3-6**" on **page 3-16**)
- Y181—Wheel Kit Up Valve (See "**Figure 3-7**" on **page 3-17**)
- Y182—Wheel Kit Down Valve (See "**Figure 3-7**" on **page 3-17**)
- Y183—Drive Pump Control (HDC) Valve (See "**Figure 3-6**" on **page 3-16**)

Electrical Schematic

See **Figures 3-3** through **3-7**.

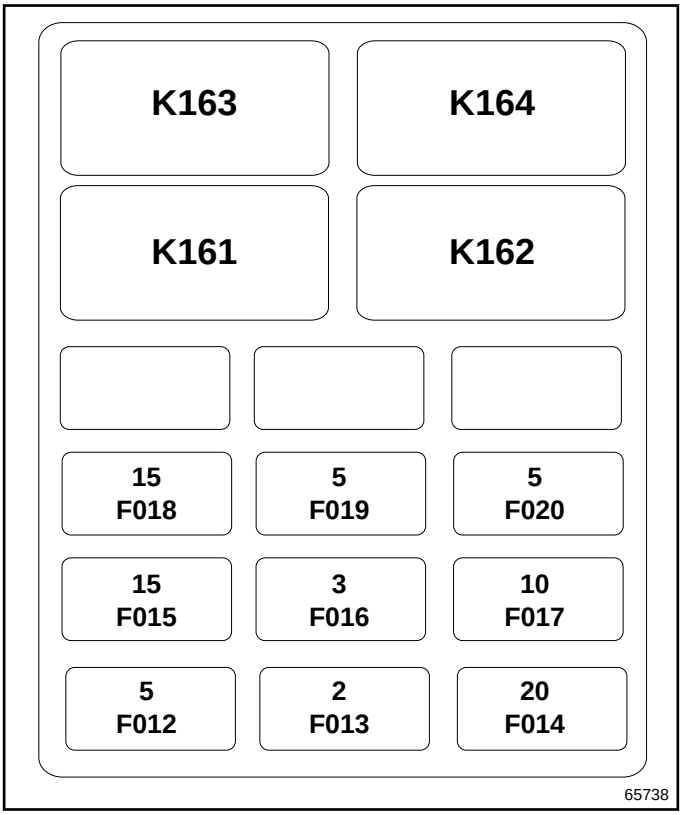


Figure 3-3: Relay Box 1

Fuse ID	Description
F012	5-amp power supply signal fuse
F013	2-amp gyroscopic steering assist fuse
F014	20-amp power relay (engine)
F015	15-amp starter command switch fuse
F016	3-amp engine diagnostic connection fuse
F017	10-amp pitch fuse
F018	15-amp water pump fuse
F019	5-amp ignition signal fuse
F020	5-amp operator presence switch
K161	Left pitch up relay
K162	Left pitch down relay
K163	Right pitch up relay
K164	Right pitch down relay

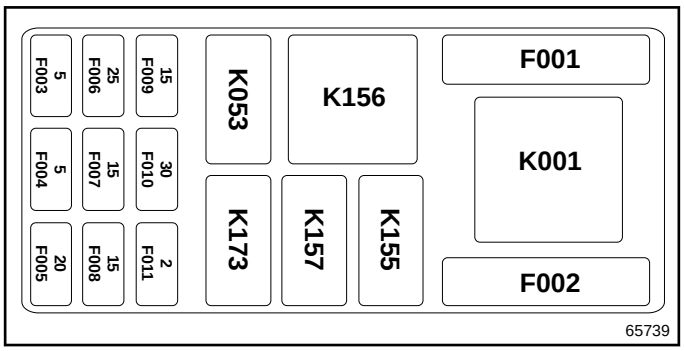


Figure 3-4: Fuse/Breaker Box

3

Fuse ID	Description
F001	60-amp power fuse
F002	50-amp grid fuse
F003	5-amp EGR signal fuse
F004	20-amp power supply for trowel machine control unit
F005	3-amp engine diagnostic connection fuse
F006	25-amp work lights fuse
F007	15-amp wheel kit fuse
F008	15-amp accessory outlet fuse
F009	15-amp fuel cooler fuse
F010	30-amp hydraulic oil cooler resetable breaker
F011	2-amp power supply for joystick buttons
K001	12V auxiliary power outlet relay
K053	Hydraulic oil cooling fan relay
K155	Starter relay
K156	Grid heaters relay
K157	Power supply for the engine control unit
K173	Water pump relay

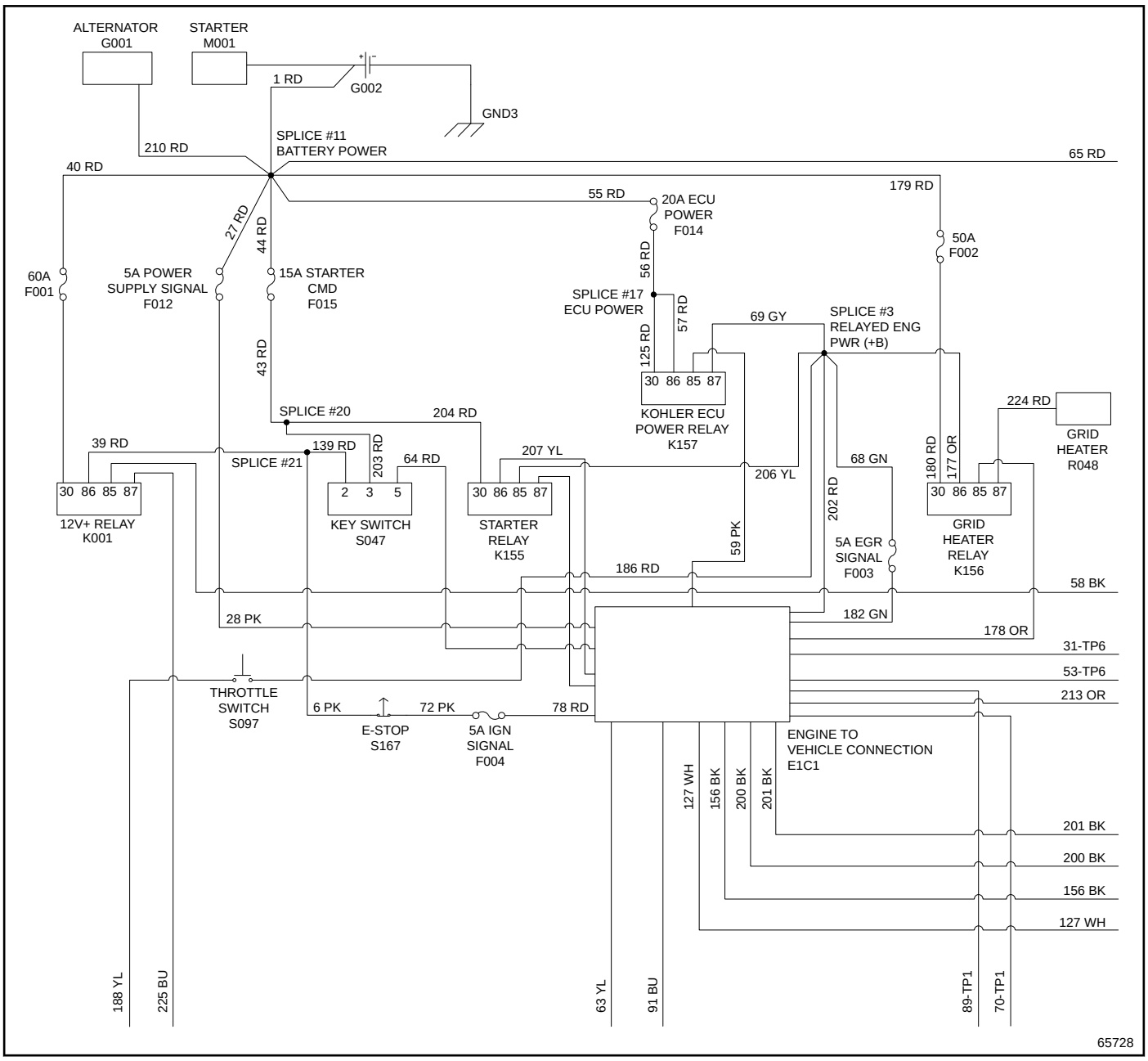


Figure 3-5: Electrical Schematic

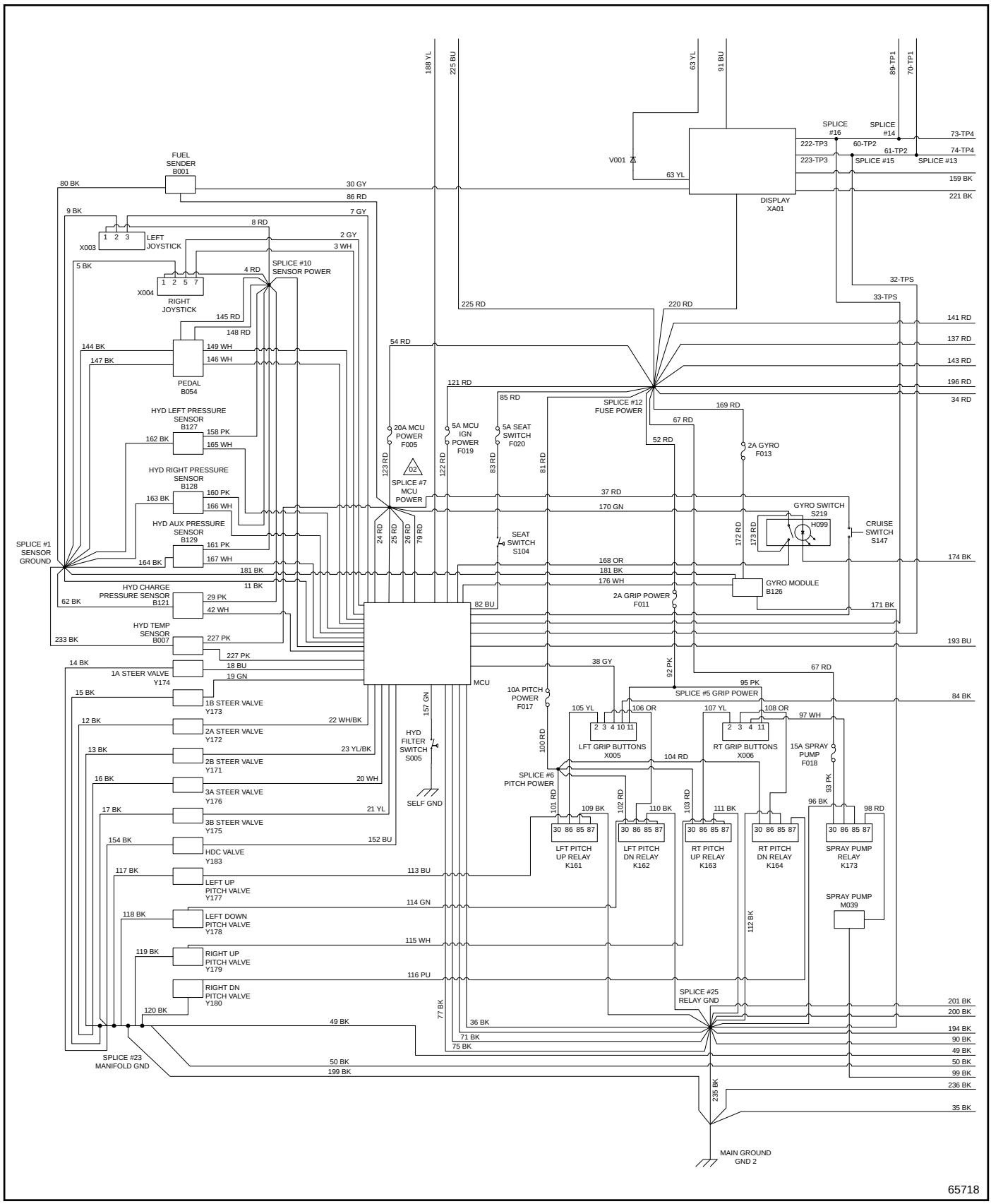


Figure 3-6: Electrical Schematic

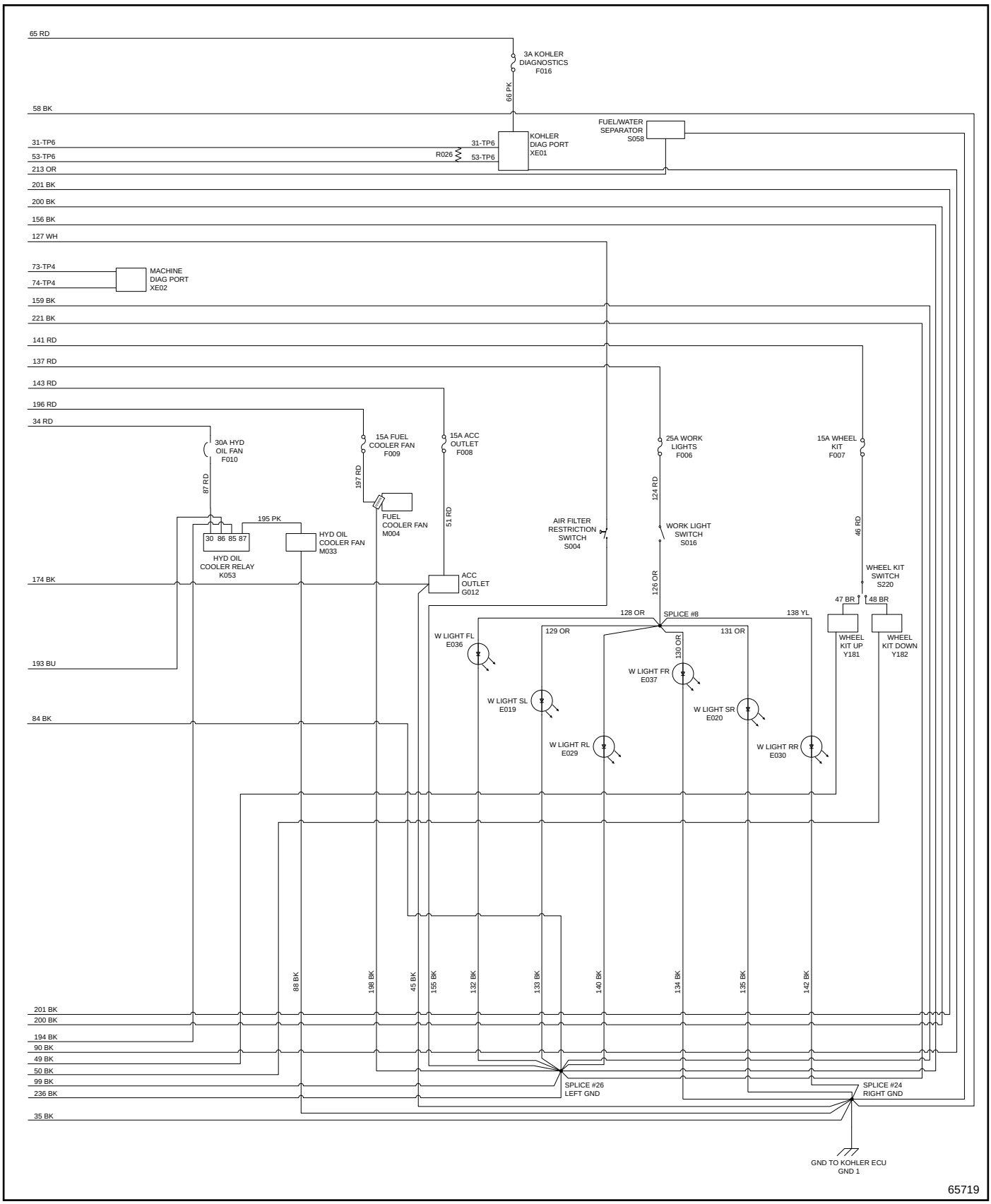


Figure 3-7: Electrical Schematic

Theory of Operation and Sub Circuit Schematics

Start Circuit—Theory of Operation

Unswitched Power

Unswitched power is provided from the battery positive terminal (G002) to the following:

- Starter (M001)
- 60-amp main fuse (F001)
- 5-amp power supply signal fuse (F012)
- 15-amp starter Command (CMD) fuse (F015)
- 20-amp Electronic Control Unit (ECU) power fuse (F014)
- 50-amp grid heater fuse (F002)

Unswitched power is provided from the 60-amp main fuse (F001) to the 12-VDC main power relay (K001) terminal 30.

Unswitched power is provided from the 5-amp power supply signal fuse (F012) to the engine to vehicle connection (E1C1).

Unswitched power is provided from the 15-amp starter CMD fuse (F015) to the key switch (S047) terminal 3 and the starter relay (K155) terminal 30.

Unswitched power is provided from the 20-amp ECU power fuse (F014) to the ECU power relay (K157) terminals 30 and 86.

Unswitched power is provided from the 50-amp grid heater fuse (F002) to the grid heater relay (K156) terminal 30.

Switched Power

Switched power is provided from the key switch (S047) terminal 2 to the 12-VDC main power relay (K001) terminal 86 and the E-stop (S167). Switched power is then provided from the 12-VDC main power relay (K001) terminal 87 to the 20-amp MCU power fuse (F005), the 5-amp MCU ignition power fuse (F019), and to the 5-amp seat switch fuse (F020). Switched power is provided from the E-stop (S167) to the 5-amp ignition signal fuse (F004).

Switched power is provided from the 20-amp Machine Control Unit (MCU) power fuse (F005) to the MCU. Switched power is provided from the 5-amp MCU ignition power fuse (F019) to the MCU. Switched power is provided from the 5-amp seat switch fuse (F020) to the seat switch (S104).

Start Circuit

Switched power is provided from the ECU power relay (K157) to the engine to vehicle connection (E1C1) and the 5-amp EGR signal fuse (F003).

Switched power is provided from the grid heater relay (K156) terminal 85 to the engine to vehicle connection (E1C1). Switched power is provided from the grid heater relay (K156) terminal 87 to the grid heater (R048).

When the key is in the start position, switched power is provided from the starter relay (K155) terminals 86 and 87 to the engine to vehicle connection (E1C1), starting the machine.

Start Circuit Schematic

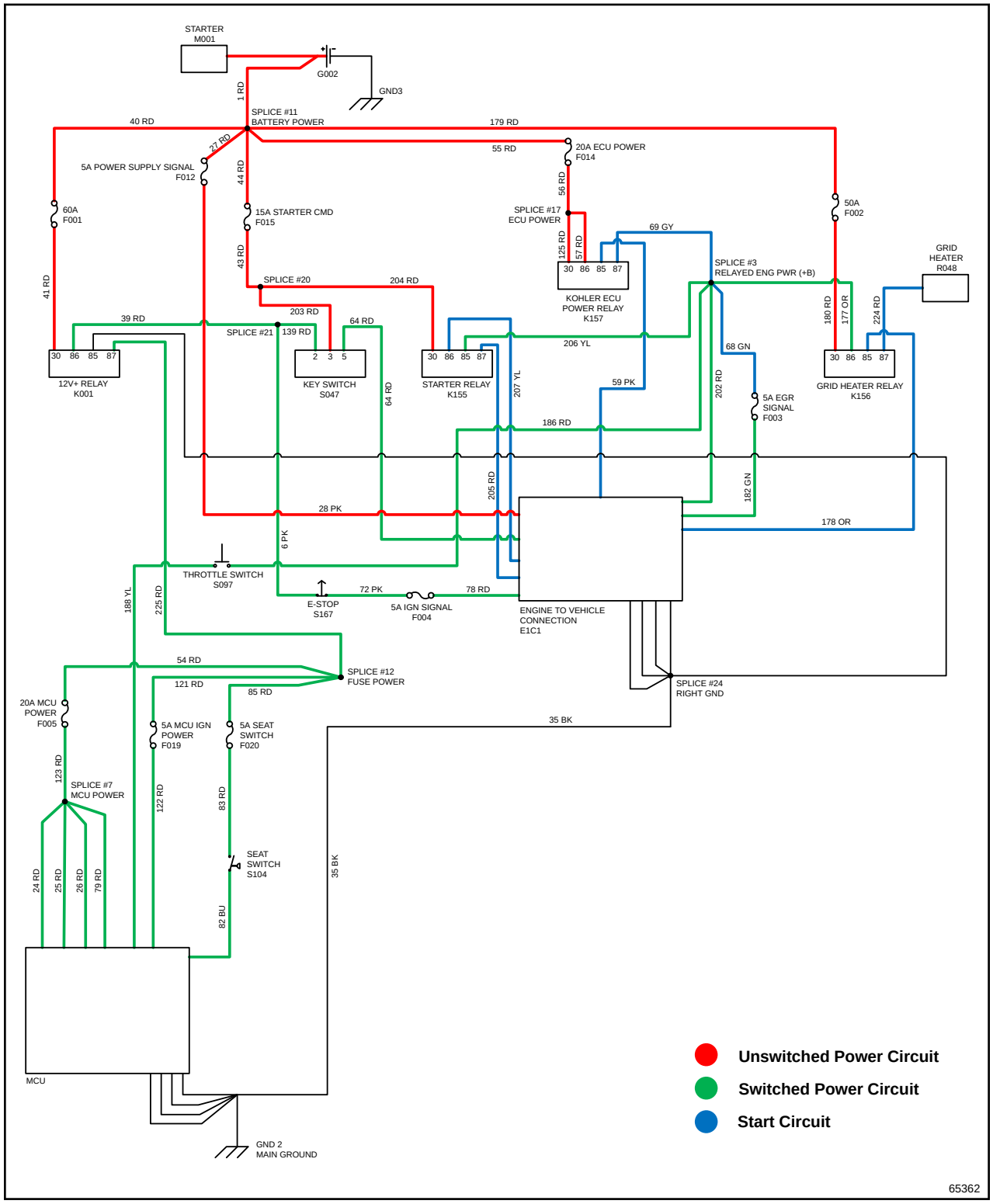


Figure 3-8

Run Circuit—Theory of Operation

Unswitched Power

Unswitched power is provided from the battery positive terminal (G002) to the following:

- Alternator (G001)
- Starter (M001)
- 60-amp main fuse (F001)
- 5-amp power supply signal fuse (F012)
- 15-amp starter Command (CMD) fuse (F015)
- 20-amp Electronic Control Unit (ECU) power fuse (F014)
- 50-amp grid heater fuse (F002)

Unswitched power is provided from the 60-amp main fuse (F001) to the 12-VDC main power relay (K001) terminal 30.

Unswitched power is provided from the 5-amp power supply signal fuse (F012) to the engine to vehicle connection (E1C1).

Unswitched power is provided from the 15-amp starter CMD fuse (F015) to the key switch (S047) terminal 3 and to the starter relay (K155) terminal 30.

Unswitched power is provided from the 20-amp ECU power fuse (F014) to the ECU power relay (K157) terminals 30 and 86.

Switched Power

Switched power is provided from the key switch (S047) terminal 2 to the 12-VDC main power relay (K001) terminal 86 and the E-stop (S167). Switched power is then provided from the 12-VDC main power relay (K001) terminal 87 to the 20-amp MCU power fuse (F005), the 5-amp MCU ignition power fuse (F019), and the 5-amp seat switch fuse (F020). Switched power is provided from the E-stop (S167) to the 5-amp ignition signal fuse (F004).

Switched power is provided from the 20-amp Machine Control Unit (MCU) power fuse (F005) to the MCU. Switched power is provided from the 5-amp MCU ignition power fuse (F019) to the MCU. Switched power is provided from the 5-amp seat switch fuse (F020) to the seat switch (S104).

Run Circuit

Switched power is provided from the starter relay (K155) terminals 86 and 87 to the engine to vehicle connection (E1C1).

Switched power is provided from the ECU power relay (K157) to the engine to vehicle connection (E1C1) and the 5-amp EGR signal fuse (F003).

Run Circuit Schematic

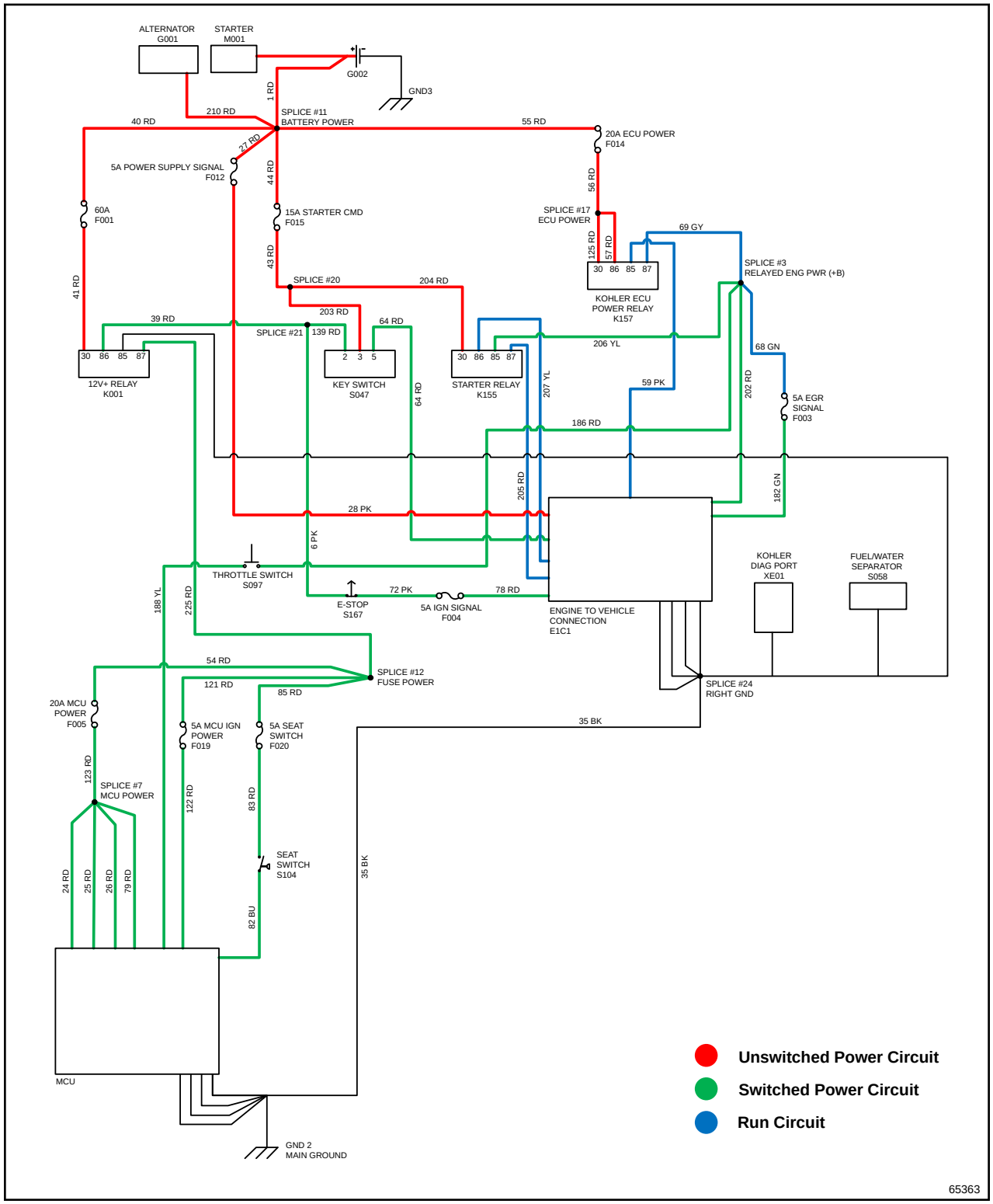


Figure 3-9

Wheel Kit Circuit—Theory of Operation

Unswitched Power

Unswitched power is provided from the battery positive terminal (G002) to the 60-amp main fuse (F001) and the 15-amp starter Command (CMD) fuse (F015).

Unswitched power is provided from the 60-amp main fuse (F001) to the 12-VDC main power relay (K001) terminal 30.

Unswitched power is provided from the 15-amp starter CMD fuse (F015) to the key switch (S047) terminal 3.

Switched Power

Switched power is provided from the key switch (S047) terminal 2 to the 12-VDC main power relay (K001) terminal 86. Switched power is then provided from the 12-VDC main power relay (K001) terminal 87 to the 15-amp wheel kit fuse (F007).

Wheel Kit Circuit

Switched power is provided from the 15-amp wheel kit fuse (F007) to the wheel kit switch (S220). When the wheel kit switch (S220) is in the down position, switched power is provided from the wheel kit switch (S220) to the wheel kit down solenoid (Y182), lowering the wheel kit.

Switched power is provided from the 15-amp wheel kit fuse (F007) to the wheel kit switch (S220). When the wheel kit switch (S220) is in the up position, switched power is provided from the wheel kit switch (S220) to the wheel kit up solenoid (Y181), raising wheel kit.

Wheel Kit Circuit Schematic

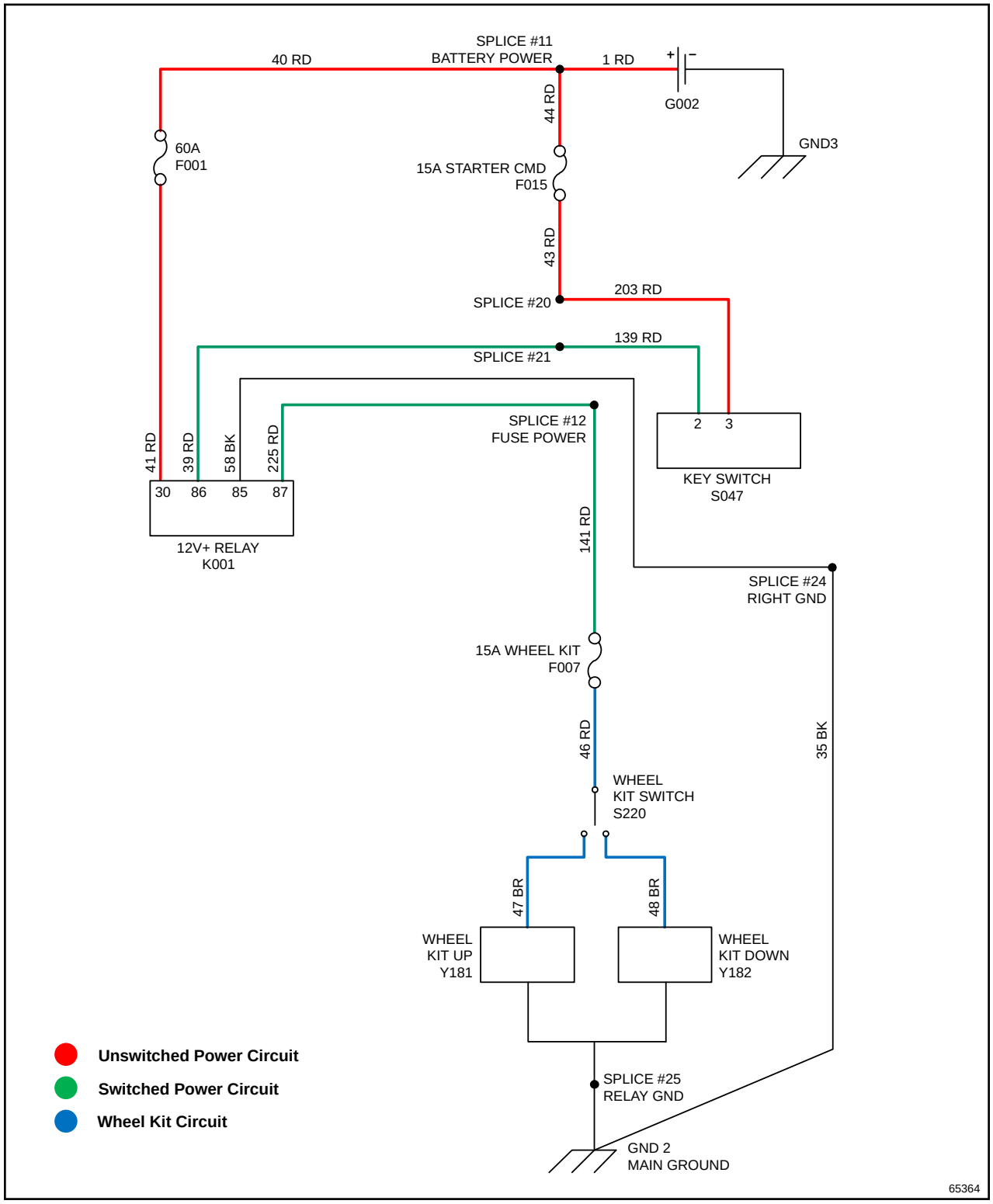


Figure 3-10

Steer Circuit—Theory of Operation

Unswitched Power

Unswitched power is provided from the battery positive terminal (G002) to the 60-amp main fuse (F001) and to 15-amp starter Command (CMD) fuse (F015).

Unswitched power is provided from the 60-amp main fuse (F001) to the 12-VDC main power relay (K001) terminal 30.

Unswitched power is provided from the 15-amp starter CMD fuse (F015) to the key switch (S047) terminal 3.

Switched Power

Switched power is provided from the key switch (S047) terminal 2 to the 12-VDC main power relay (K001) terminal 86. Switched power is then provided from the 12-VDC main power relay (K001) terminal 87 to the 20-amp Machine Control Unit (MCU) power fuse (F005) and to the 2-amp gyro fuse (F013).

Switched power is provided from the 20-amp MCU power fuse (F005) to the MCU and to the gyro switch (S219). Switched power is then provided from the MCU to the left joystick (X003) terminal 1 and the right joystick (X004) terminal 1.

Switched power is provided from the 2-amp gyro fuse (F013) to the gyro module (B126).

Steer Circuit

Switched power is provided from the left joystick (X003) terminal 5 and right joystick (X004) terminal 5 to the MCU.

Switched power is provided from the gyro module (B126) to the MCU.

Switched power is provided from the MCU to the 1A steer valve (Y174), 1B steer valve (Y173), 2A steer valve (Y172), 2B steer valve (Y171), 3A steer valve (Y176), and 3B steer valve (Y175) to change the direction of travel.

Steer Circuit Schematic

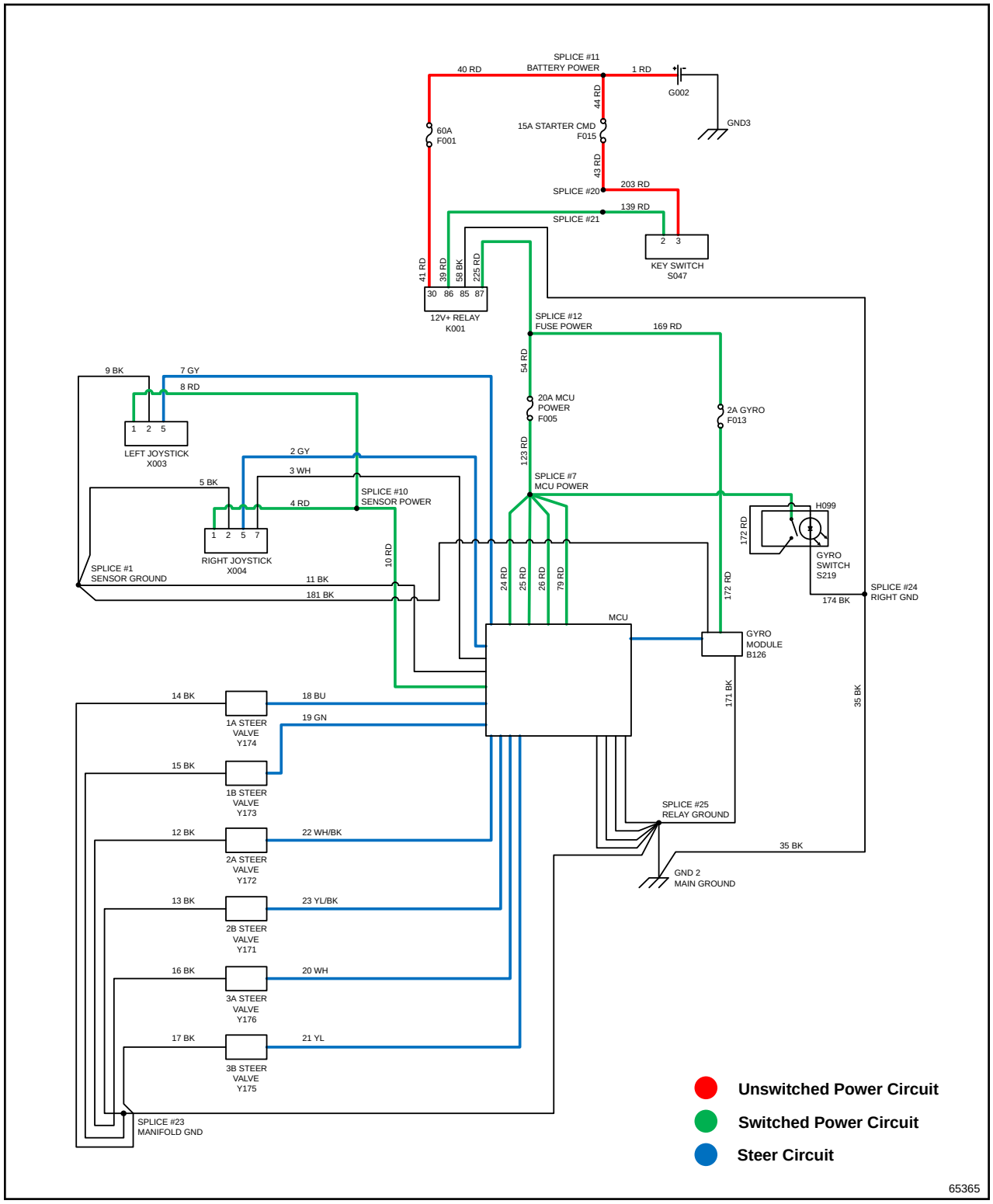


Figure 3-11

Pitch Control Circuit—Theory of Operation

Unswitched Power

Unswitched power is provided from the battery positive terminal (G002) to the 60-amp main fuse (F001) and to the 15-amp starter Command (CMD) fuse (F015).

Unswitched power is provided from the 60-amp main fuse (F001) to the 12-VDC main power relay (K001) terminal 30.

Unswitched power is provided from the 15-amp starter CMD fuse (F015) to the key switch (S047) terminal 3.

Switched Power

Switched power is provided from the key switch (S047) terminal 2 to 12-VDC main power relay (K001) terminal 86. Switched power is then provided from the 12-VDC main power relay (K001) terminal 87 to the 20-amp Machine Control Unit (MCU) power fuse (F005), the 10-amp pitch power fuse (F017), and the 2-amp grip power fuse (F011).

Switched power is provided from 10-amp pitch power fuse (F017) to the left pitch up relay (K161) terminal 30, left pitch down relay (K162) terminal 30, right pitch up relay (K163) terminal 30, and right pitch down relay (K164) terminal 30.

Switched power is provided from the 2-amp grip power fuse (F011) to the left grip buttons (X005) terminal 11 and the right grip buttons (X006) terminal 11.

Pitch Control Circuit

When the left grip pitch control buttons are engaged in the up position, switched power is provided from the left grip buttons (X005) terminal 2 to the left pitch up relay (K161) terminal 86. Switched power is then provided from the left pitch up relay (K161) terminal 87 to the left up pitch valve (Y177), increasing the left side pitch.

When the left grip pitch control buttons are engaged in the down position, switched power is provided from the left grip buttons (X005) terminal 3 to the left pitch down relay (K162) terminal 86. Switched power is then provided from the left pitch down relay (K162) terminal 87 to the left down pitch valve (Y178), decreasing the left side pitch.

When the right grip pitch control buttons are engaged in the up position, switched power is provided from the right grip buttons (X006) terminal 2 to the right pitch up relay (K163) terminal 86. Switched power is then provided from the right pitch up relay (K163) terminal 87 to the right up pitch valve (Y179), increasing the right side pitch.

When the right grip pitch control buttons are engaged in the down position, switched power is provided from the right grip buttons (X006) terminal 3 to right pitch down relay (K164) terminal 86. Switched power is then provided from the right pitch down relay (K164) terminal 87 to the right down pitch valve (Y180), decresing the right side pitch.

Pitch Control Circuit Schematic

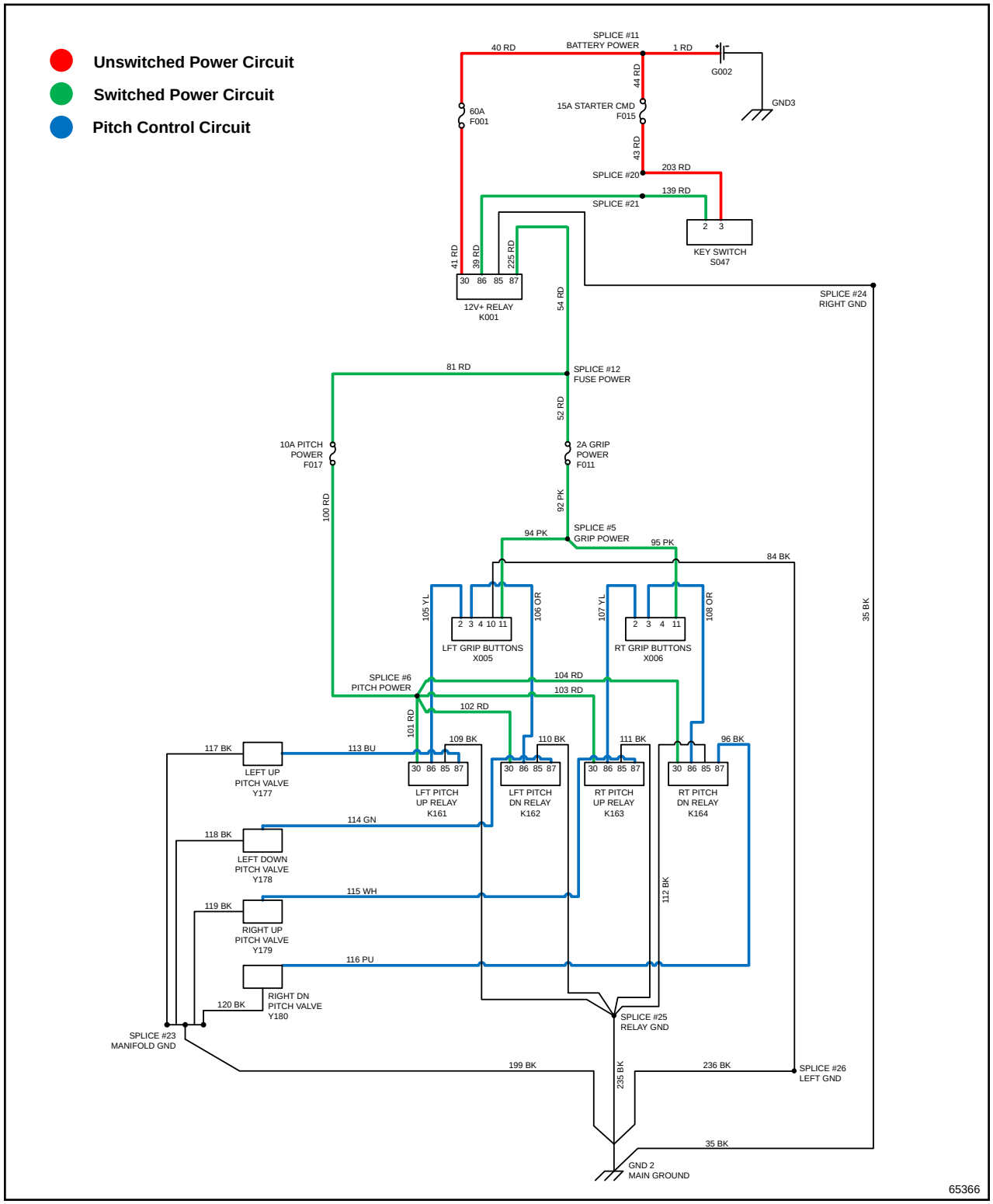


Figure 3-12

Blade Control Circuit—Theory of Operation

Unswitched Power

Unswitched power is provided from the battery positive terminal (G002) to the 60-amp main fuse (F001), 15-amp starter Command (CMD) fuse (F015), and the 20-amp Engine Control Unit (ECU) power fuse (F014).

Unswitched power is provided from the 60-amp main fuse (F001) to the 12-VDC main power relay (K001) terminal 30.

Unswitched power is provided from the 15-amp starter CMD fuse (F015) to the key switch (S047) terminal 3.

Unswitched power is provided from the 20-amp ECU power fuse (F014) to the ECU power relay (K157) terminals 30 and 86.

Switched Power

Switched power is provided from the key switch (S047) terminal 2 to the 12-VDC main power relay (K001) terminal 86. Switched power is then provided from the 12-VDC main power relay (K001) terminal 87 to the 20-amp Machine Control Unit (MCU) power fuse (F005) and the 5-amp seat switch fuse (F020).

Switched power is provided from the 20-amp MCU power fuse (F005) to the MCU, the hydraulic temperature sensor (B007), and the cruise switch (S147).

Switched power is provided from the MCU to the pedal (B054), the hydraulic left pressure sensor (B127), the hydraulic right pressure sensor (B128), the hydraulic charge pressure sensor (B121), and the hydraulic control valve (Y183).

Switched power is provided from the 5-amp seat switch fuse (F020) to the seat switch (S104).

Switched power is provided from the ECU power relay (K157) terminal 87 to the throttle switch (S097).

Blade Control Circuit

Switched power is provided from the pedal (B054), the hydraulic charge pressure sensor (B121), the hydraulic temperature sensor (B007), the seat switch (S104), the cruise switch (S147), and the throttle switch (S097) to the MCU to control blade rotation speed.

Blade Control Circuit Schematic

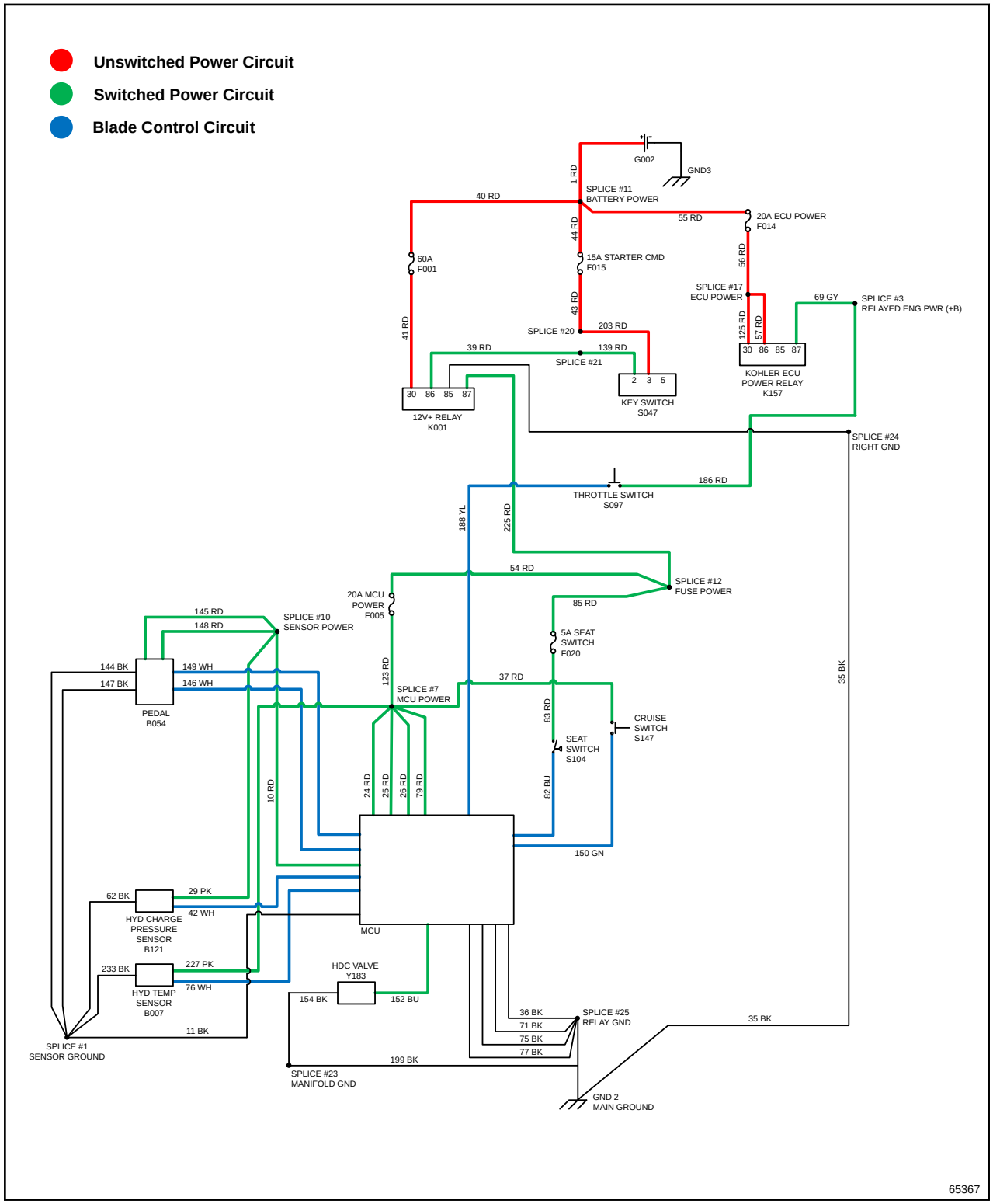


Figure 3-13

Hydraulic Oil Cooler Fan Circuit—Theory of Operation

Unswitched Power

Unswitched power is provided from the battery positive terminal (G002) to the 60-amp main fuse (F001) and the 15-amp starter Command (CMD) fuse (F015).

Unswitched power is provided from the 60-amp main fuse (F001) to the 12-VDC main power relay (K001) terminal 30.

Unswitched power is provided from the 15-amp starter CMD fuse (F015) to the key switch (S047) terminal 3.

Switched Power

Switched power is provided from the key switch (S047) terminal 2 to the 12-VDC main power relay (K001) terminal 86. Switched power is then provided from the 12-VDC main power relay (K001) terminal 87 to the 20-amp Machine Control Unit (MCU) power fuse (F005) and the 30-amp hydraulic oil fan circuit breaker (F010).

Switched power is provided from the 20-amp MCU power fuse (F005) to the MCU and the hydraulic temperature sensor (B007).

Switched power is provided from the MCU to the hydraulic oil cooler relay (K053) terminal 86.

Hydraulic Oil Cooler Fan Circuit

Switched power is provided from the hydraulic temperature sensor (B007) to the MCU.

Switched power is provided from 30-amp hydraulic oil fan circuit breaker (F010) to the hydraulic oil cooler relay (K053) terminal 30. Switched power is then provided from the hydraulic oil cooler relay (K053) terminal 87 to the hydraulic oil cooler fan (M033), allowing the hydraulic oil cooler fan to operate.

Hydraulic Oil Cooler Fan Circuit Schematic

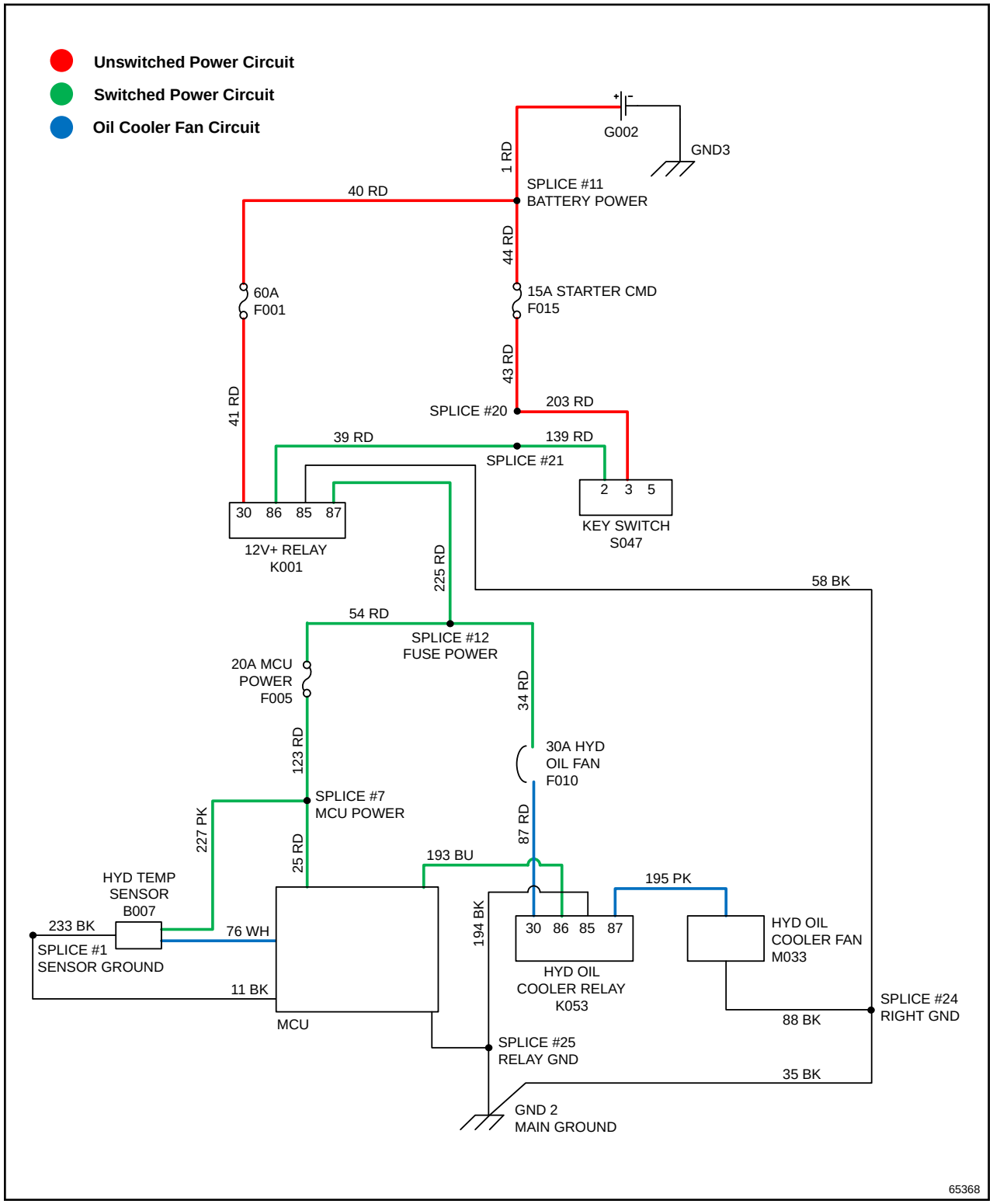


Figure 3-14

Retardant Spray Circuit—Theory of Operation

Unswitched Power

Unswitched power is provided from the battery positive terminal (G002) to the 60-amp main fuse (F001) and the 15-amp starter Command (CMD) fuse (F015).

Unswitched power is provided from the 60-amp main fuse (F001) to the 12-VDC main power relay (K001) terminal 30.

Unswitched power is provided from the 15-amp starter CMD fuse (F015) to the key switch (S047) terminal 3.

Switched Power

Switched power is provided from the key switch (S047) terminal 2 to the 12-VDC main power relay (K001) terminal 86. Switched power is then provided from the 12-VDC main power relay (K001) terminal 87 to the 2-amp grip power fuse (F011) and the 15-amp spray pump fuse (F018).

Switched power is provided from the 2-amp grip power fuse (F011) to the right grip buttons (X006) terminal 11.

Switched power is provided from the 15-amp spray pump fuse (F018) to the spray pump relay (K173) terminal 30.

Retardant Spray Circuit

Switched power is provided from the right grip buttons (X006) terminal 4 to the spray pump relay (K173) terminal 86. Switched power is then provided from the spray pump relay (K173) terminal 87 to the spray pump (M039), activating the spray pump.

Retardant Spray Circuit Schematic

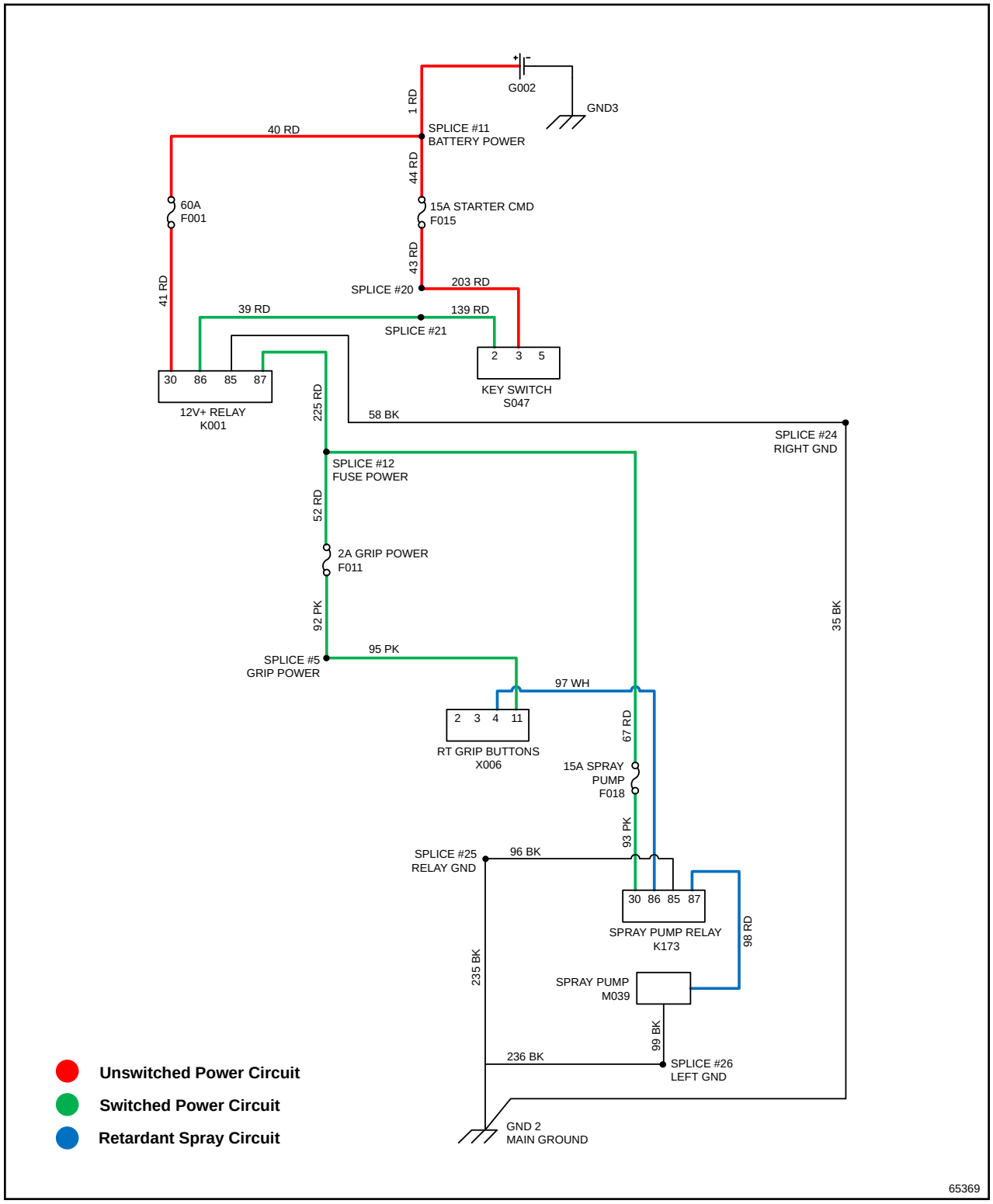


Figure 3-15

Work Lights Circuit—Theory of Operation

Unswitched Power

Unswitched power is provided from the battery positive terminal (G002) to the 60-amp main fuse (F001) and the 15-amp starter Command (CMD) fuse (F015).

Unswitched power is provided from the 60-amp main fuse (F001) to the 12-VDC main power relay (K001) terminal 30.

Unswitched power is provided from the 15-amp starter CMD fuse (F015) to the key switch (S047) terminal 3.

Switched Power

Switched power is provided from the key switch (S047) terminal 2 to the 12-VDC main power relay (K001) terminal 86. Switched power is then provided from the 12-VDC main power relay (K001) terminal 87 to the 25-amp work lights fuse (F006).

Switched power is provided from the 25-amp work lights fuse (F006) to the work light switch (S016).

Work Lights Circuit

When the work light switch (S016) is in the on position, switched power is provided form the work light switch (S016) to the front left work light (E036), side left work light (E019), rear left work light (E029), front right work light (E037), side right work light (E020), and rear right work light (E030), allowing the work lights to illuminate.

Work Lights Circuit Schematic

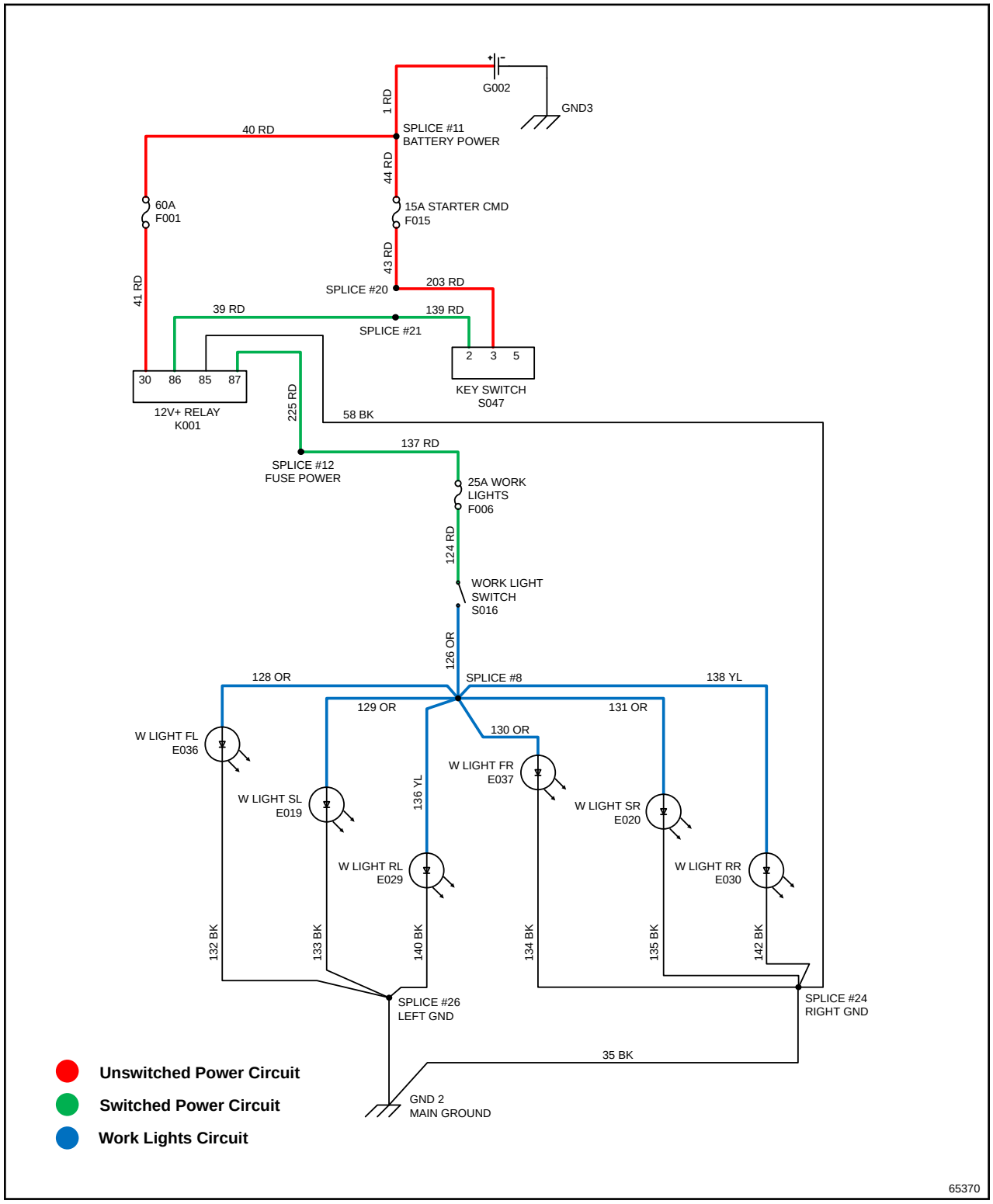


Figure 3-16

Accessory Outlet Circuit—Theory of Operation

Unswitched Power

Unswitched power is provided from the battery positive terminal (G002) to the 60-amp main fuse (F001) and the 15-amp starter Command (CMD) fuse (F015).

Unswitched power is provided from the 60-amp main fuse (F001) to the 12-VDC main power relay (K001) terminal 30.

Unswitched power is provided from the 15-amp starter CMD fuse (F015) to the key switch (S047) terminal 3.

Switched Power

Switched power is provided from the key switch (S047) terminal 2 to 12-VDC main power relay (K001) terminal 86. Switched power is then provided from the 12-VDC main power relay (K001) terminal 87 to the 15-amp accessory outlet fuse (F008).

Accesory Outlet Circuit

Switched power is provided from 15-amp accessory outlet fuse (F008) to the accessory outlet (G012).

Accessory Outlet Circuit Schematic

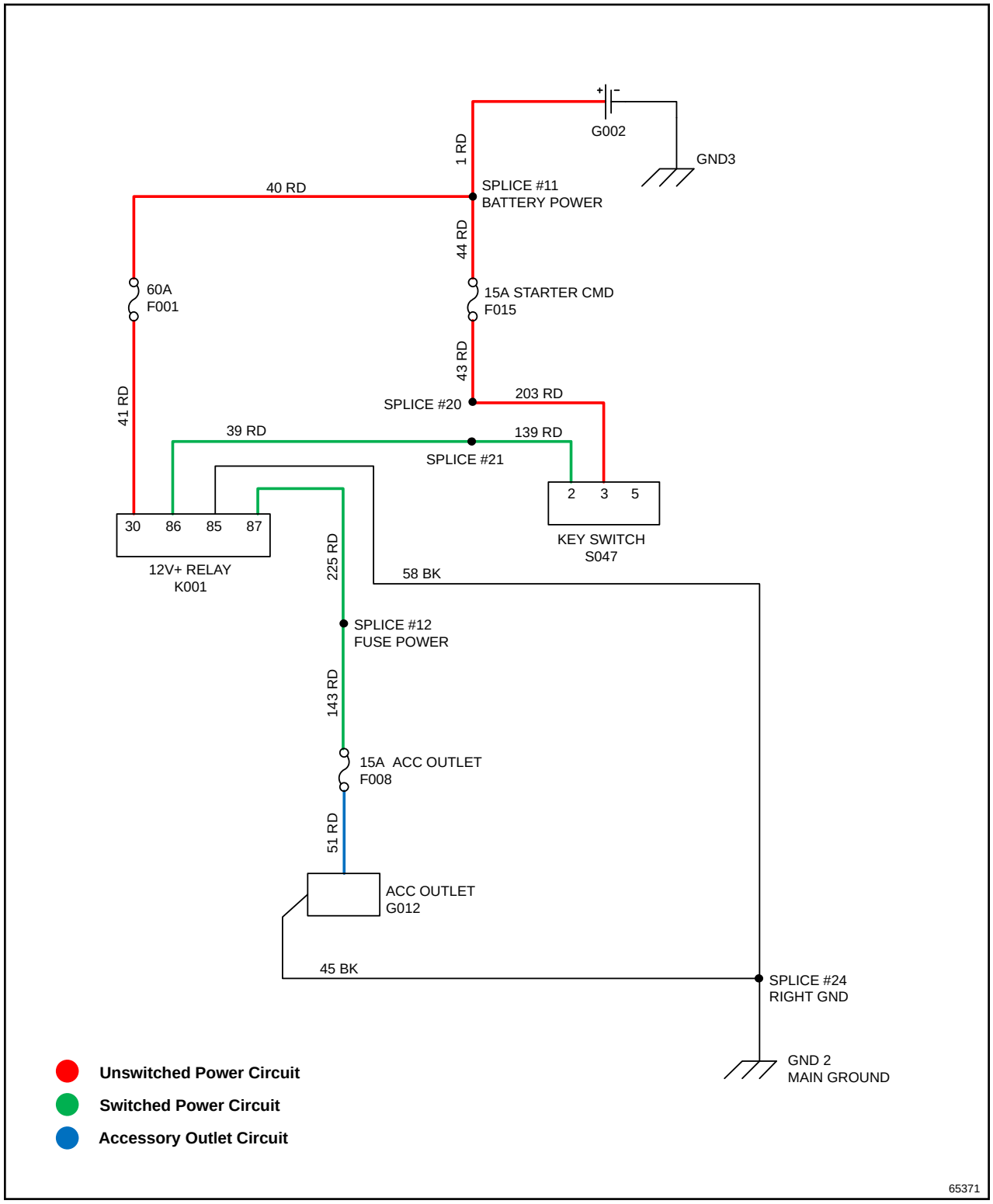


Figure 3-17

Instrumentation Circuit—Theory of Operation

Unswitched Power

Unswitched power is provided from the battery positive terminal (G002) to the 5-amp power supply signal fuse (F012) and the 15-amp starter Command (CMD) fuse (F015).

Unswitched power is provided from the 5-amp power supply signal fuse (F012) to the engine to vehicle connection (E1C1).

Unswitched power is provided from the 15-amp starter CMD fuse (F015) to the key switch (S047) terminal 3.

Switched Power

Switched power is provided from the key switch (S047) terminal 5 to the engine to vehicle connection (E1C1).

Instrumentation Circuit

Switched power is provided from the engine to vehicle connection (E1C1) to the fuel sender (B001), the fuel/water separator (S058), and the display (XA01).

Instrumentation Circuit Schematic

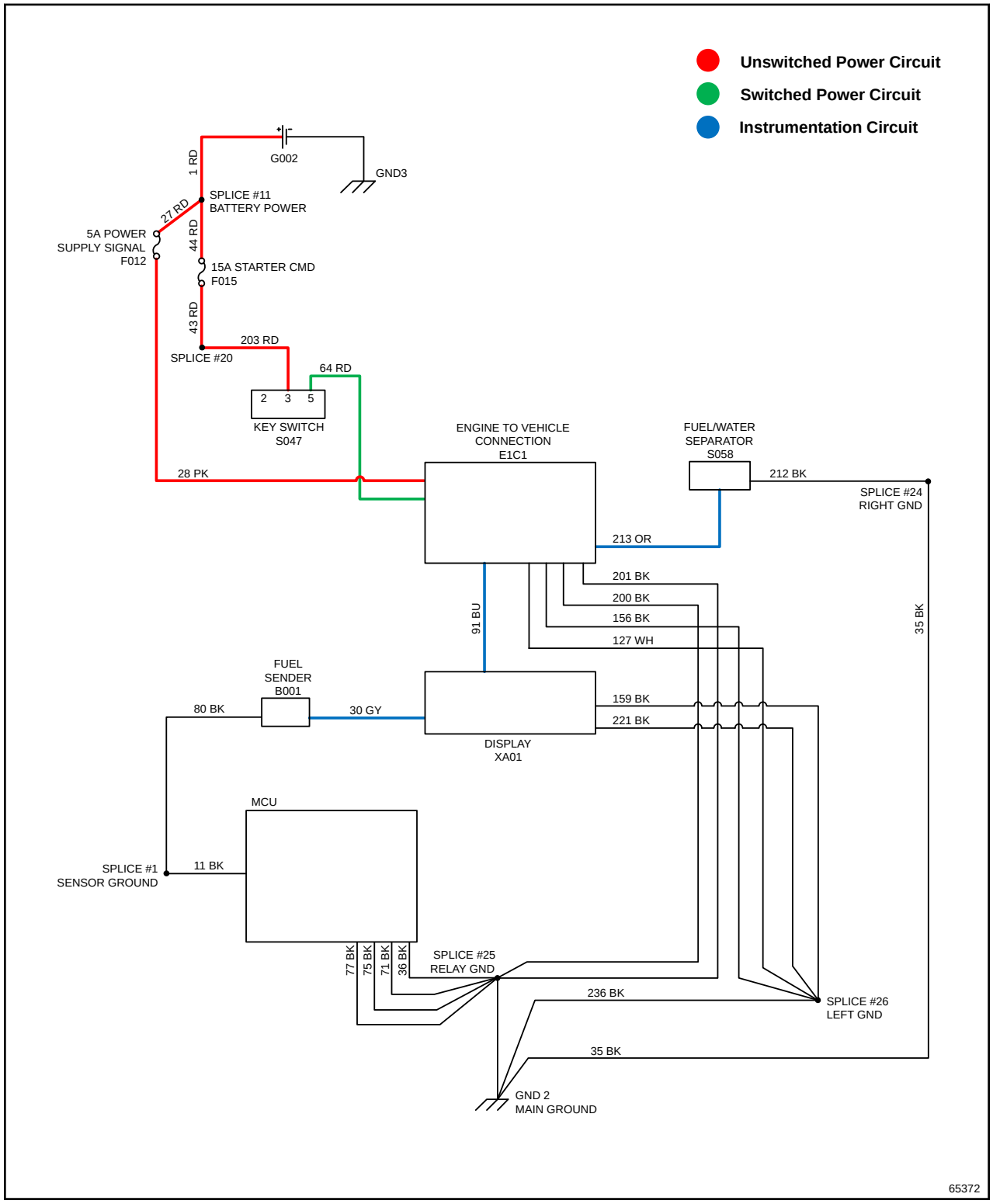


Figure 3-18

Controller Area Network (CAN)—Theory of Operation

CAN Circuit

The CAN system allows all controllers on the machine to communicate with each other. CAN HI and CAN LO wires carry messages between the controllers and are connected through terminating resistors in the display (XA01) and in the Engine Control Unit (ECU). CAN LO is connected to each controller through the engine to vehicle connection (E1C1) pin D2, the display (XA01) pin 23, and the Machine Control Unit (MCU) pin B2. CAN HI is connected to each controller through the engine to vehicle connection (E1C1) pin D1, the display (XA01) pin 24, and the MCU pin C2. The CAN system can also communicate with diagnostic software through the machine diagnostic port (XE02) pins G and F. Pin G of the machine diagnostic port (XE02) is CAN HI and pin F of the vehicle diagnostic port (XE02) is CAN LO.

Controller Area Network (CAN) Circuit Schematic

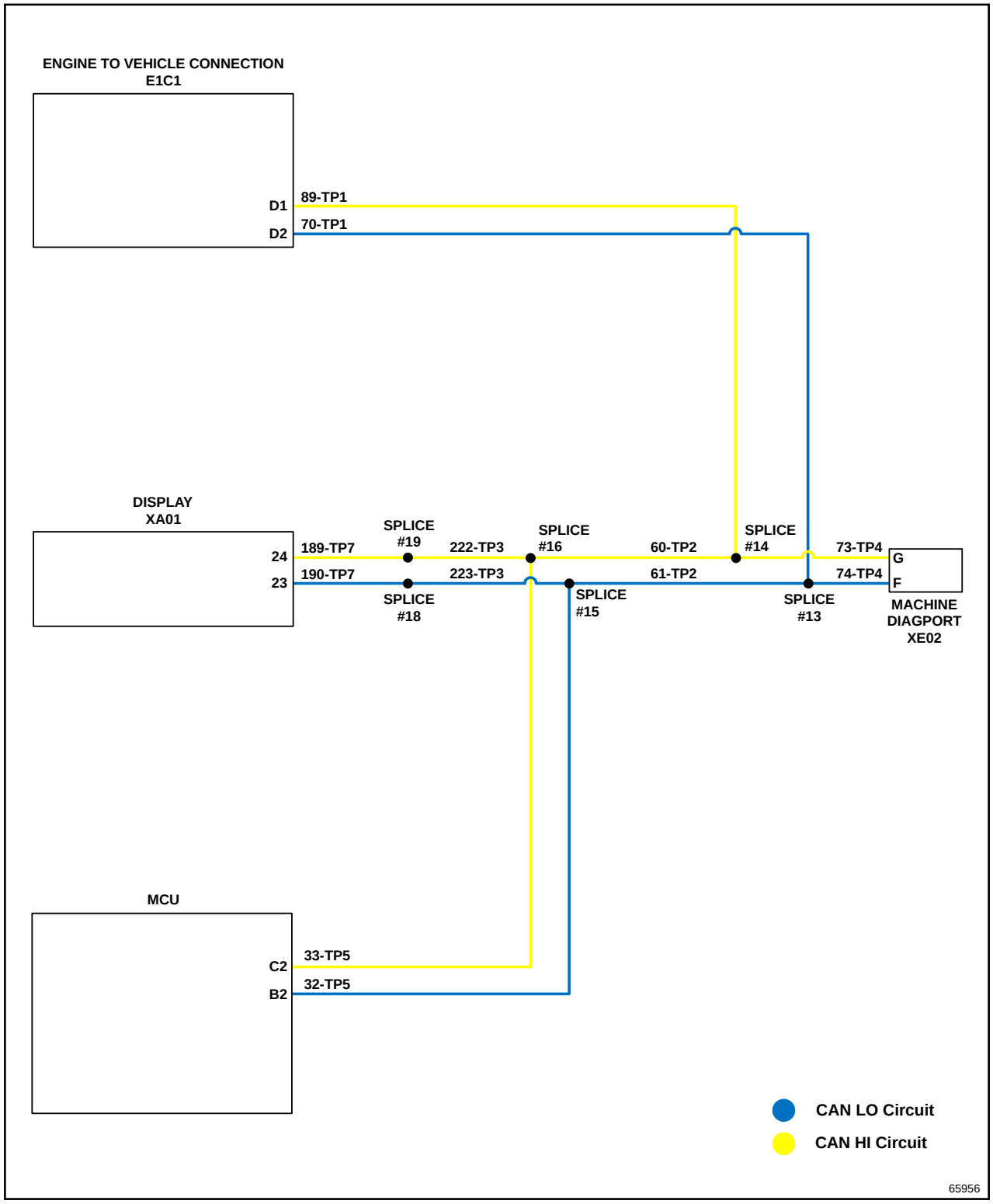


Figure 3-19

Troubleshooting

Start Circuit

Symptom: Machine Does Not Start

Probable Cause	Remedy
E-stop (S167) engaged	Disengage E-stop (S167).
Faulty or weak battery (G002)	Check battery state of charge.
Loose or corroded battery cable ends and/or chassis grounds	Check battery cable ends and/or chassis grounds for loose fit or corrosion.
Faulty key switch (S047)	Test key switch. (See "**Key Switch Test**" on **page 3-50**.)
Loose or corroded connectors at starter	Check for loose or corroded connectors at starter. Repair as needed.
Faulty start circuit	Test start circuit. (See "**Start Circuit Test**" on **page 3-57**.)
Faulty 15-amp starter Command (CMD) fuse (F015)	Test starter CMD fuse (F015).
Faulty starter (M001)	Replace starter. A separate engine manual, prepared by the engine manufacturer, is supplied with this machine. Refer to the engine manufacturer's manual for all engine related service.
Faulty starter relay (K155)	Test starter relay (See "**Relay Test**" on **page 3-55**.)
Faulty 50-amp fuse (F002)	Replace 50-amp fuse.
Faulty grid heater relay (K156)	Test grid heater relay (See "**Relay Test**" on **page 3-55**.)
Faulty grid heater (R048)	Replace grid heater. A separate engine manual, prepared by the engine manufacturer, is supplied with this machine. Refer to the engine manufacturer's manual for all engine-related service.

Throttle Circuit

Symptom: Throttle Does Not Work

Probable Cause	Remedy
Faulty 60-amp fuse (F001)	Replace 60-amp fuse (F001).
Faulty main power relay (K001)	Replace main power relay (K001).
Loose or corroded wiring	Check wiring from main power relay (K001) to MCU and pedal (B054).
Faulty Machine Control Unit (MCU)	Test MCU.
Faulty 20-amp MCU power fuse (F005)	Replace 20-amp MCU power fuse (F005).
Faulty pedal (B054)	Test pedal (B054). (See **Throttle Pedal Test**.)
Faulty throttle switch (S097)	Test throttle switch (S097). (See "**Throttle Switch Test**" on **page 3-51**.)
Faulty 20-amp Engine Control Unit (ECU) power fuse (F014)	Replace 20-amp ECU power fuse (F014).
Faulty ECU power relay (K157)	Test ECU power relay (K157). (See "**Relay Test**" on **page 3-55**.)

Wheel Kit Circuit

Symptom: Wheel Kit Will Not Raise

Probable Cause	Remedy
Faulty 60-amp fuse (F001)	Replace 60-amp fuse (F001).
Faulty main power relay (K001)	Replace main power relay (K001).
Loose or corroded wiring	Check wiring from main power relay (K001) to wheel kit up and wheel kit down valves.
Faulty 15-amp wheel kit fuse (F007)	Replace 15-amp wheel kit fuse (F007).
Faulty wheel kit switch (S220)	Test wheel kit switch (S220).
Faulty wheel kit up (Y181) valve	Test wheel kit up (Y181) valve.

Symptom: Wheel Kit Will Not Lower

Probable Cause	Remedy
Faulty 60-amp fuse (F001)	Replace 60-amp fuse (F001).
Faulty main power relay (K001)	Replace main power relay (K001).
Loose or corroded wiring	Check wiring from main power relay (K001) to wheel kit up and wheel kit down valves.
Faulty 15-amp wheel kit fuse (F007)	Replace 15-amp wheel kit fuse (F007).
Faulty wheel kit switch (S220)	Test wheel kit switch (S220).
Faulty wheel kit down (Y182) valve	Test wheel kit down (Y182) valve.

Work Lights Circuit

Symptom: Work Light(s) Will Not Turn On

Probable Cause	Remedy
Faulty 60-amp fuse (F001)	Replace 60-amp fuse (F001).
Faulty main power relay (K001)	Replace main power relay (K001).
Loose or corroded wiring	Check wiring from main power relay (K001) to wheel kit up and wheel kit down valves Y181 and Y182.
Faulty 25-amp work light fuse (F006)	Replace 25-amp work light fuse (F006).
Faulty work light switch (S016)	Test work light switch (S016). (See "**Work Lights Circuit Test**" on **page 3-71**.)
Faulty work light	Test work light. (See "**Work Lights Circuit Test**" on **page 3-71**.)

Steering Circuit

Symptom: Machine Will Not Steer

Probable Cause	Remedy
Faulty 60-amp fuse (F001)	Replace 60-amp fuse (F001).
Faulty main power relay (K001)	Replace main power relay (K001).
Loose or corroded wiring	Check wiring from main power relay (K001) to MCU and pedal (B054).
Faulty Machine Control Unit (MCU)	Test MCU.
Faulty 20-amp MCU power fuse (F005)	Replace 20-amp MCU power fuse (F005).
Faulty left joystick (X003) or right joystick (X004)	Test left joystick (X003) and right joystick (X004).
Faulty hydraulic manifold	Test hydraulic manifold.
Faulty steering valve	Test 1A steer valve (Y174), 1B steer valve (Y173), 2A steer valve (Y172), 2B steer valve (Y171), 3A steer valve (Y176), and 3B steer valve (Y175).

Oil Cooler Fan Circuit

Symptom: Oil Cooler Fan Will Not Turn On

Probable Cause	Remedy
Faulty 60-amp fuse (F001)	Replace 60-amp fuse (F001).
Faulty main power relay (K001)	Replace main power relay (K001).
Loose or corroded wiring	Check wiring from main power relay (K001) to wheel kit up and wheel kit down valves.
Tripped or faulty 30-amp hydraulic oil fan circuit breaker (F010)	Check 30-amp hydraulic oil fan circuit breaker (F010).
Faulty hydraulic oil cooler relay (K053)	Replace hydraulic oil cooler relay (K053).
Faulty hydraulic oil cooler fan (M033)	Test hydraulic oil cooler fan (M033). (See "**Hydraulic Oil Cooler Fan Test**" on **page 3-69**.)

Pitch Control Circuit

Symptom: Pitch Control Will Not Work

Probable Cause	Remedy
Faulty 60-amp fuse (F001)	Replace 60-amp fuse (F001).
Faulty main power relay (K001)	Replace main power relay (K001).
Loose or corroded wiring	Check wiring from main power relay (K001) to pitch control valves.
Faulty 10-amp pitch power fuse (F017)	Replace 10-amp pitch power fuse (F017).
Faulty 2-amp grip power fuse (F011)	Replace 2-amp grip power fuse (F005).
Faulty left grip buttons (X005) or right grip buttons (X006)	Test left grip buttons (X005) or right grip buttons (X006).
Faulty hydraulic manifold	Test hydraulic manifold.
Faulty pitch relay	Test left pitch up relay (K161), left pitch down relay (K162), right pitch up relay (K163), and right pitch down relay (K164). (See "**Pitch Control Test**" on **page 3-63**.)
Faulty pitch valve	Test left up pitch valve (Y177), left down pitch valve (Y178), right up pitch valve (Y179), and right down pitch valve (Y180). (See "**Pitch Control Test**" on **page 3-63**.)

Blades Circuit

Symptom: Blades Will Not Rotate

Probable Cause	Remedy
Faulty 60-amp fuse (F001)	Replace 60-amp fuse (F001).
Faulty main power relay (K001)	Replace main power relay (K001).
Loose or corroded wiring	Check wiring from main power relay (K001) to MCU and pedal (B054).
Faulty Machine Control Unit (MCU)	Test MCU.
Faulty 20-amp MCU power fuse (F005)	Replace 20-amp MCU power fuse (F005).
Faulty pedal (B054)	Repair or replace pedal (B054) as needed.
Faulty throttle switch (S097)	Test throttle switch (S097). (See "**Throttle Switch Test**" on **page 3-51**.)
Faulty 20-amp Engine Control Unit (ECU) power fuse (F014)	Replace 20-amp ECU power fuse (F014).
Faulty ECU power relay (K157)	Test ECU power relay (K157). (See "**Relay Test**" on **page 3-55**.)
Faulty 5-amp seat switch fuse (F020)	Replace 5-amp seat switch fuse (F020).
Faulty seat switch (S104)	Replace seat switch (S104).

Controller Area Network (CAN) Circuit

Symptom: CAN Does Not Communicate

Probable Cause	Remedy
Faulty Display (XA01)	Replace display. (See "**Display**" on **page 3-90**.)
Faulty Machine Control Unit (MCU)	Replace MCU. Contact Wacker Neuson customer service for further instructions.
Faulty CAN Circuit	Test CAN circuit. (See "**Controller Area Network (CAN) Test** " on **page 3-78**.)
Faulty Engine Control Unit (ECU)	Replace ECU. A separate engine manual, prepared by the engine manufacturer, is supplied with this machine. Refer to the engine manufacturer's manual for all engine-related service.

Component Testing

General Information

Repair of the electrical system is limited to replacement of defective component(s) or wiring. When replacing either electrical component(s) and/or wiring, be sure to apply dielectric grease to all connector terminals to prevent corrosion.

Electrical schematics are provided in this section for troubleshooting and/or testing the electrical system. Specific testing and replacement information, where applicable, is provided in this section. In addition, testing suspected faulty component(s) it may be necessary to check for shorts and/or breaks in wiring to component(s). A common method of testing wires and/or circuits is to perform a continuity test as described in the following tests.

When performing the following test to the electical system, it is assumed that the fault is caused by an electrical failure. In addition, when testing suspected faulty component(s) it is necessary to check for hydraulic and mechanical failures that may be causing the fault, prior to replacing any parts.

NOTE

Before performing any component or wiring tests, check for corrosion and/or loose and/or missing connections and pay special attention to all ground points.

If a component(s) (switch, relay, etc.) is removed for testing and/or replacement, make sure to identify and label all wires so component(s) can be installed correctly.

Continuity Test

Required Tools or Equipment
Digital Multimeter

1. Identify and locate wire(s) and/or component(s) to be checked using the electrical schematic(s).

NOTE

Some multimeters may have a continuity tester setting that uses an audible alert to indicate continuity. See the multimeter Operator's Manual for more information.

2. If using a multimeter, set to test ohms or set meter to continuity setting.
3. Disconnect the ends of the wire(s) being tested.
4. Touch multimeter leads to each end of the wire or to terminals of the component to be tested.

   Does multimeter display less than 0.5 ohm and/or does the audible alert sound?

   YES *Wire is good.*

   NO *Proceed to Step 5.*
5. Use a known good jumper wire of correct gauge to bypass the wire in question.
6. Test the function of the circuit.

   Does the circuit now operate properly?

   YES *Replace the wire.*

   NO *Continue testing other wire(s) and component(s) in the circuit.*

Resistance Test

Required Tools or Equipment
Digital Multimeter

1. Identify and locate wire(s) and/or component(s) to be checked using electrical schematic(s).
2. If using a multimeter, set to test amperage.
3. Isolate (disconnect) component(s) to be tested from the circuit to prevent false values through the circuit.

NOTE

Some digital multimeters are equiped with an amp clamp. Select an appropriate range for the component(s) being tested. Refer to specifications listed in the component(s) test procedure.

4. Connect multimeter leads to the terminals of the component being tested. Check the component test procedure for specifications and additional test conditions.

   Does the resistance through the component match specified value(s) listed in test procedure(s)?

   YES *Component is good.*

   NO *Replace component.*

Amperage Test

NOTE

The use of a standard digital multimeter is described in all amperage test. Some digital multimeters are equipped with a clamp-on ammeter. The use of stand alone clamp-on ammeter is also acceptable. When using a clamp-on ammeter, wiring and connectors may not need to be disconnected.

Required Tools or Equipment
Digital Multimeter

1. Identify and locate wire(s) and/or component(s) to be checked using electrical schematic(s).
2. If using a multimeter, set to test amperage.
3. Isolate (disconnect) component(s) to be tested from the circuit to prevent false values through the circuit.
4. Connect multimeter leads to the terminals of the component being tested. Check the component test procedure for specifications and additional test conditions.

   Does the amperage through the component match specified value(s) listed in test procedure(s)?

   YES *Component is good.*

   NO *Replace component.*

Key Switch Test

See **Figures 3-20** and **3-21**.

Required Tools or Equipment
Digital Multimeter

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Remove instrument panel to access key switch, but do not disconnect wires. (See "**Right Shell Removal and Installation**" on **page 5-5**.)

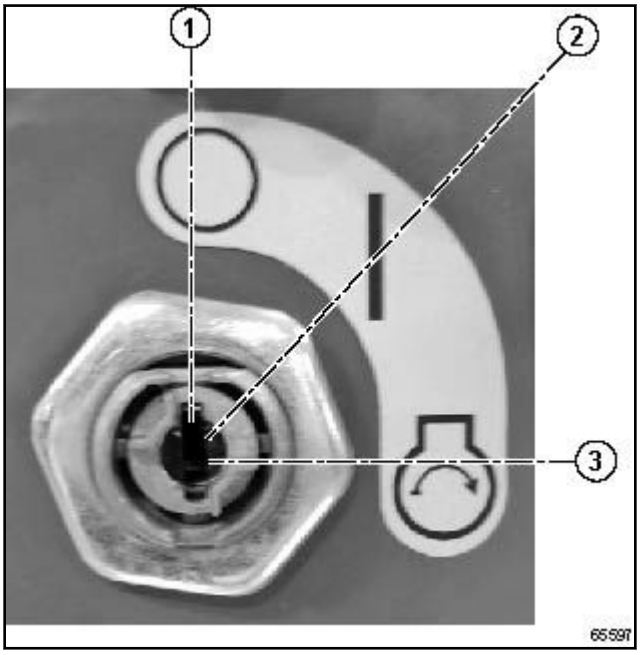


Figure 3-20: Key Switch (Front View)

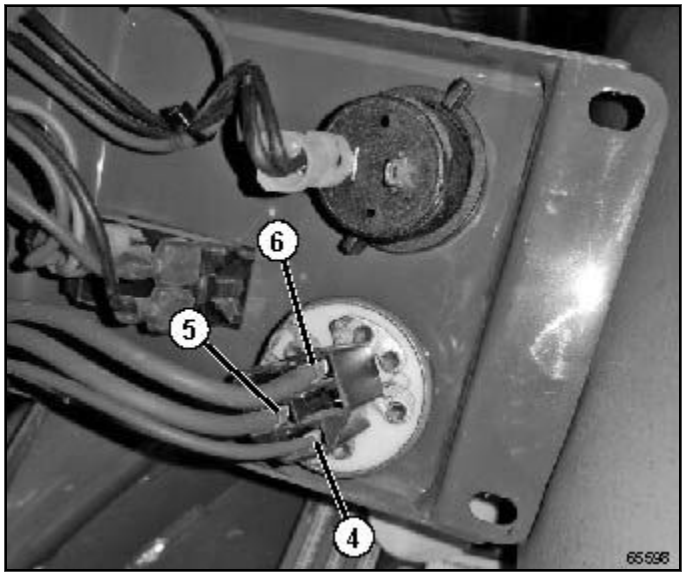


Figure 3-21: Key Switch (Rear View)

3. Check wiring (4, 5, and 6) and connections to key switch .

   Are all wires in good condition and tight?

   YES *Proceed to Step 4.*

   NO *Repair wires or tighten any loose connections.*

4. Set digital multimeter to test VDC.
5. Connect red test lead to wire 203 (5) and terminal on back of key switch.
6. Connect black test lead to known good ground.

7. Using digital multimeter, test for VDC with key switch in the off position (1).

   Are at least 10.5 VDC indicated?

   YES *Proceed to Step 8.*

   NO *Connection between wire 203 (5) and battery is faulty. Repare connection.*

8. Connect red test lead to wire 64 (4) and terminal on back of key switch.
9. Connect black test lead to known good ground.
10. Turn the key to the start position (3).

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 11.*

    NO *Key switch is faulty. Replace key switch.*

11. Connect red test lead to wire 139 (6) and terminal on back of key switch.
12. Connect black test lead to known good ground.
13. Turn the key to the on position (2).

    Are at least 10 VDC indicated?

    YES *Key switch is okay.*

    NO *Key switch is faulty. Replace key switch.*

Throttle Switch Test

See **Figure 3-22**.

Required Tools or Equipment
Digital Multimeter

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Remove throttle switch.

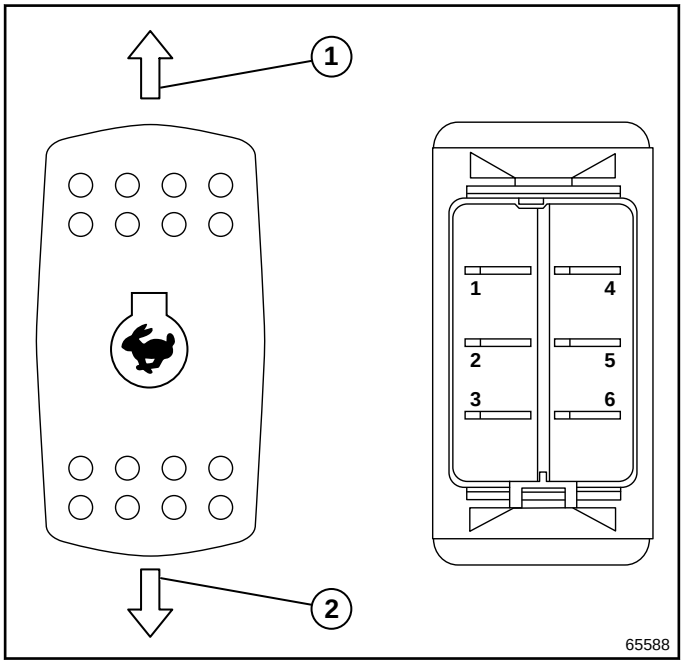


Figure 3-22: Throttle Switch

3. Set digital multimeter to test continuity.
4. Connect red test lead to terminal 2.
5. Connect black test lead to terminal 3.
6. Ensure throttle switch is in the normally open position (2).
7. Using digital multimeter, test for continuity.

   Is continuity indicated?

   YES *Throttle switch is faulty. Replace throttle switch.*

   NO *Proceed to Step 8.*

8. Connect red test lead to terminal 2.
9. Connect black test lead to terminal 3.
10. Depress park brake switch to engage (1) and hold.
11. Using digital multimeter, test for continuity.

    Is continuity indicated?

    YES *Throttle switch is good.*

    NO *Throttle switch is faulty. Replace throttle switch.*

Wheel Kit Switch Test

See **Figure 3-23**.

Required Tools or Equipment
Digital Multimeter

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Remove wheel kit switch.

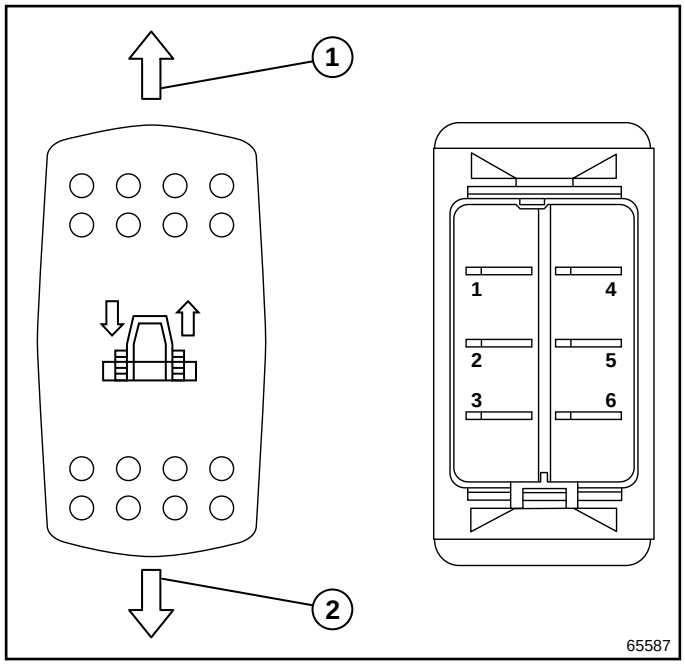


Figure 3-23: Wheel Kit Switch Test

3. Set digital multimeter to test continuity.
4. Connect red test lead to terminal 2.
5. Connect black test lead to terminal 3.
6. Press and hold wheel kit switch to the down position (2).
7. Using digital multimeter, test for continuity.

   Is continuity indicated?

   YES *Proceed to Step 8.*

   NO *Wheel kit switch is faulty. Replace wheel kit switch.*
8. Connect red test lead to terminal 2.
9. Connect black test lead to terminal 1.
10. Press and hold wheel kit switch to the up position (1).
11. Using digital multimeter, test for continuity.

Is continuity indicated?

YES *Wheel kit switch is okay.*

NO *Wheel kit switch is faulty. Replace wheel kit switch*

Work Lights Switch Test

See **Figure 3-24**.

Required Tools or Equipment
Digital Multimeter

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Remove work lights switch.

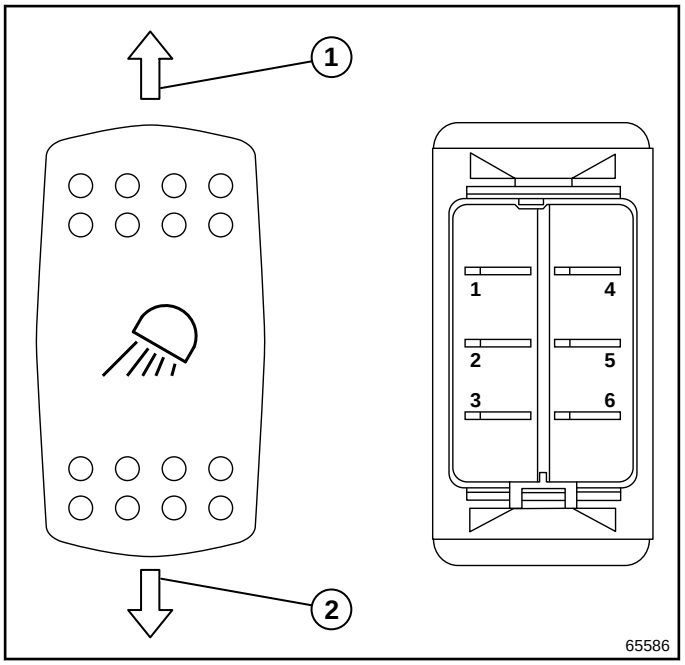


Figure 3-24: Work Lights Switch

3. Set digital multimeter to test continuity.
4. Connect red test lead to terminal 2.
5. Connect black test lead to terminal 3.
6. Depress work lights switch to on (1).
7. Using digital multimeter, test for continuity.

   Is continuity indicated?

   YES *Proceed to Step 8.*

   NO *Work lights switch is faulty. Replace beacon switch.*
8. Connect red test lead to terminal 2.
9. Connect black test lead to terminal 3.
10. Depress work lights switch to off (2).
11. Using digital multimeter, test for continuity.

    Is continuity indicated?

    YES *Work lights switch is faulty. Replace beacon switch.*

    NO *Work lights switch is okay.*

Gyroscopic Steering Switch Test

See **Figure 3-25**.

Required Tools or Equipment
Digital Multimeter

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Remove gyroscopic steering switch.

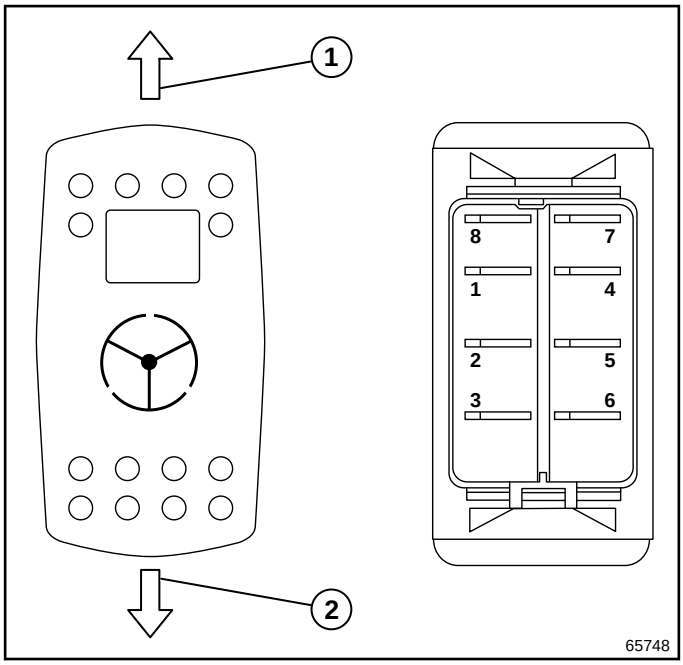


Figure 3-25: Gyroscopic Steering Switch

3. Set digital multimeter to test continuity.
4. Connect red test lead to terminal 2.
5. Connect black test lead to terminal 3.
6. Depress gyroscopic steering switch to on (1).
7. Using digital multimeter, test for continuity.

   Is continuity indicated?

   YES *Proceed to Step 8.*

   NO *Gyroscopic steering switch is faulty. Replace gyroscopic steering switch.*
8. Connect red test lead to terminal 2.
9. Connect black test lead to terminal 3.
10. Depress gyroscopic steering switch to off (2).

11. Using digital multimeter, test for continuity.

    Is continuity indicated?

    YES *Gyroscopic steering switch is faulty. Replace gyroscopic steering switch.*

    NO *Gyroscopic steering switch is okay.*

Emergency Stop Switch Test

See **Figures 3-26** and **3-27**.

Required Tools or Equipment
Digital Multimeter

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Remove side panel to gain access to emergency stop switch. (See "**Right Shell Removal and Installation**" on **page 5-5**.)

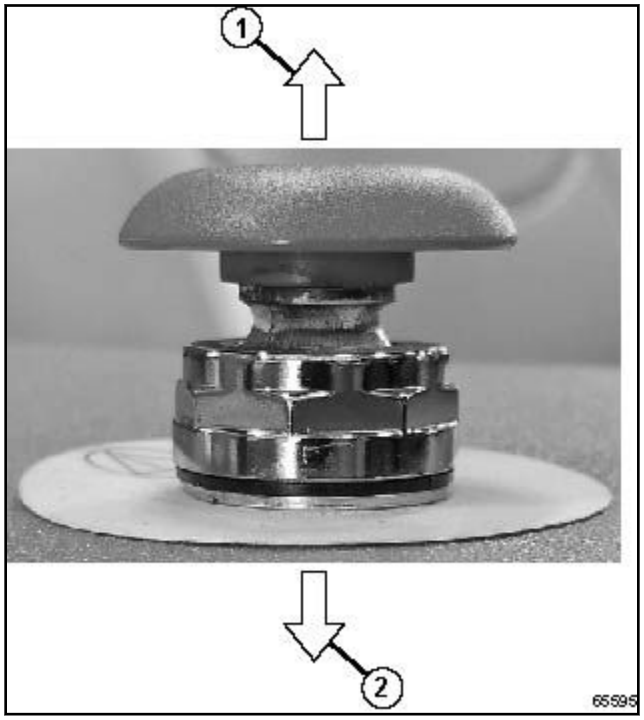


Figure 3-26: Emergency Stop Switch Top View

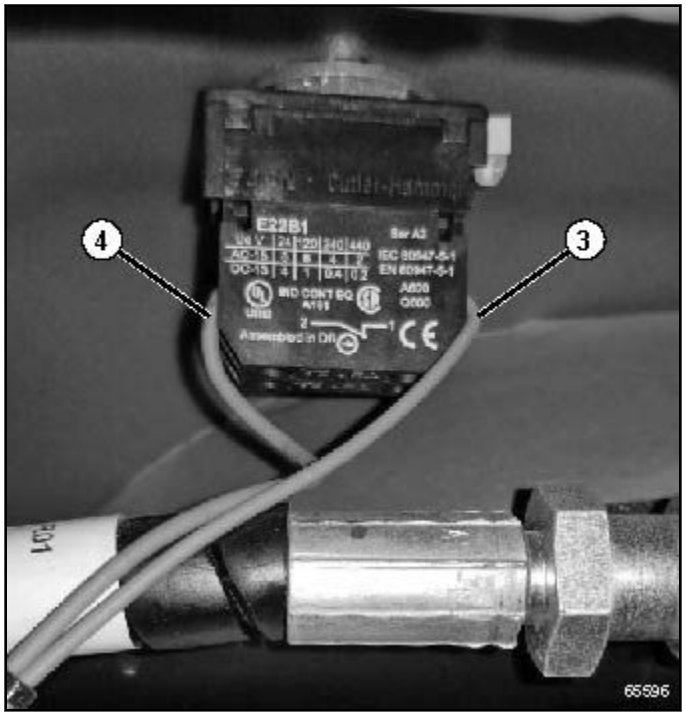


Figure 3-27: Emergency Stop Switch Terminal View

3. Make sure emergency stop switch is in the run position (1).
4. Turn key to on position.
5. Set digital multimeter to test for VDC.
6. Connect red test lead to wire 6 (4) and terminal on emergency stop switch.
7. Connect black test lead to known good ground.
8. Using digital multimeter, test for VDC.

   Are at least 10.5 VDC indicated?

   YES *Proceed to Step 9.*

   NO *Connection between wire 6 and battery is faulty. Repair connection.*

9. Connect red test lead to wire 72 (3) and terminal on emergency stop switch.
10. Connect black test lead to known good ground.
11. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 12.*

    NO *Emergency stop switch is faulty. Replace emergency stop switch.*

12. Make sure emergency stop switch is in the stop position (2).
13. Connect red test lead to wire 72 (3) and terminal on emergency stop switch.

14. Connect black test lead to known good ground.
15. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Emergency stop switch is faulty. Replace emergency stop switch.*

    NO *Emergency stop switch is okay.*

Fuel Level Sensor Test

See **Figure 3-28**.

Required Tools or Equipment
Digital Multimeter

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Remove fuel level sensor, but leave electrical connector connected.

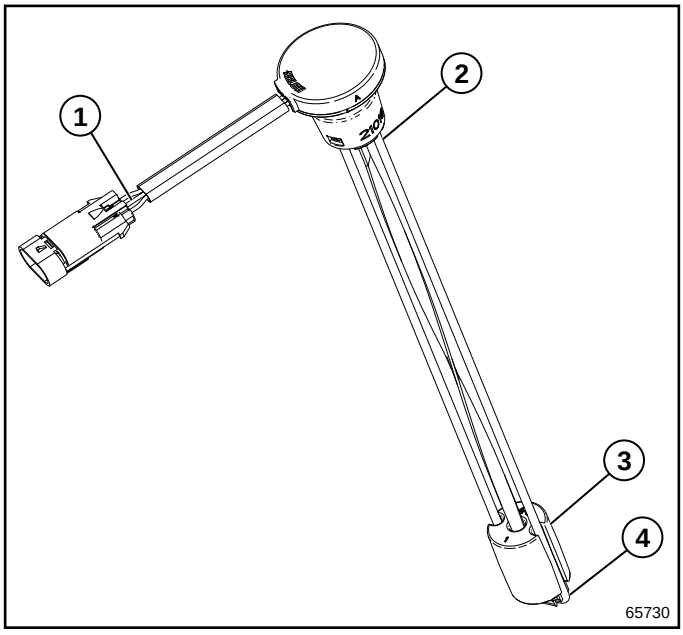


Figure 3-28: Fuel Level Sensor

NOTE

Float is shown in empty position.

3. Turn key to on position
4. Set digital multimeter to test VDC.
5. Using red test lead, backprobe wire 30 (1).
6. Move float (3) to full (2).
7. Using digital multimeter, test for VDC.

   Is 0.5 VDC indicated?

   YES *Proceed to Step 8.*

   NO *Fuel level sensor is faulty. Replace fuel level sensor.*

8. Move float (3) to empty (4).
9. Using red test lead, backprobe wire 30 (1).
10. Using digital multimeter, test for VDC.

    Are 4.5 VDC indicated?

    YES *Fuel level sensor is okay.*

    NO *Fuel level sensor is faulty. Replace fuel level sensor.*

Relay Test

See **Figure 3-29**.

Required Tools or Equipment
Digital Multimeter
1- Fused Jumper Wire
1- Jumper Wire

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Remove relay.

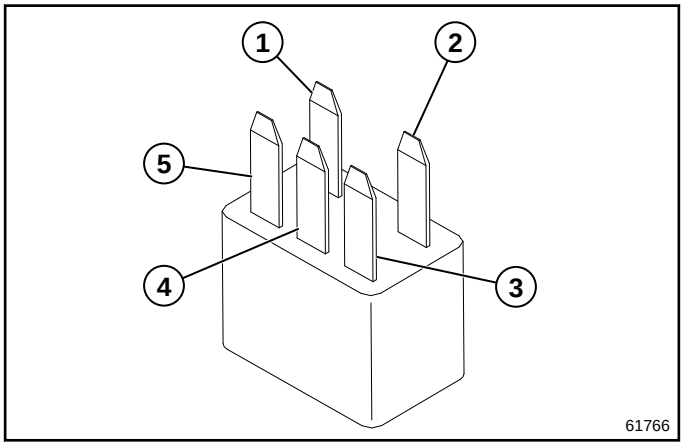


Figure 3-29: Relay Terminal View

3. Set digital multimeter to test for continuity.
4. Connect red test lead to terminal 1.
5. Connect black test lead to terminal 4.
6. Using digital multimeter, test for continuity.

   Is continuity indicated?

   YES *Proceed to Step 7.*

   NO *Relay is faulty. Replace relay.*

7. Connect red test lead to terminal 1.

8. Connect black test lead to terminal 3.
9. Using digital multimeter, test for continuity.

   Is continuity indicated?

   YES *Relay is faulty. Replace relay.*

   NO *Proceed to Step 10.*
10. Connect red test lead to terminal 2.
11. Connect black test lead to terminal 5.
12. Using digital multimeter, test for continuity.

    Is continuity indicated?

    YES *Proceed to Step 13.*

    NO *Relay is faulty. Replace relay.*
13. Connect red test lead to terminal 1.
14. Connect black test lead to terminal 3.
15. Connect one end of a fused jumper wire to a 12 VDC power source and the other end to terminal 2.
16. Connect one end of a jumper wire to terminal 5 and the other end to a good ground.
17. Using digital multimeter, test for continuity on terminals 1 and 3.

    Is continuity indicated?

    YES *Relay is good.*

    NO *Relay is faulty. Replace relay.*

Battery and Ground Circuit Test

See **Figures 3-30** and **3-31**.

Required Tools or Equipment
Digital Multimeter

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Check emergency stop switch.

   Is emergency stop switch in the run position?

   YES *Proceed to Step 3.*

   NO *Place emergency stop switch in the run position.*
3. Remove battery cover.

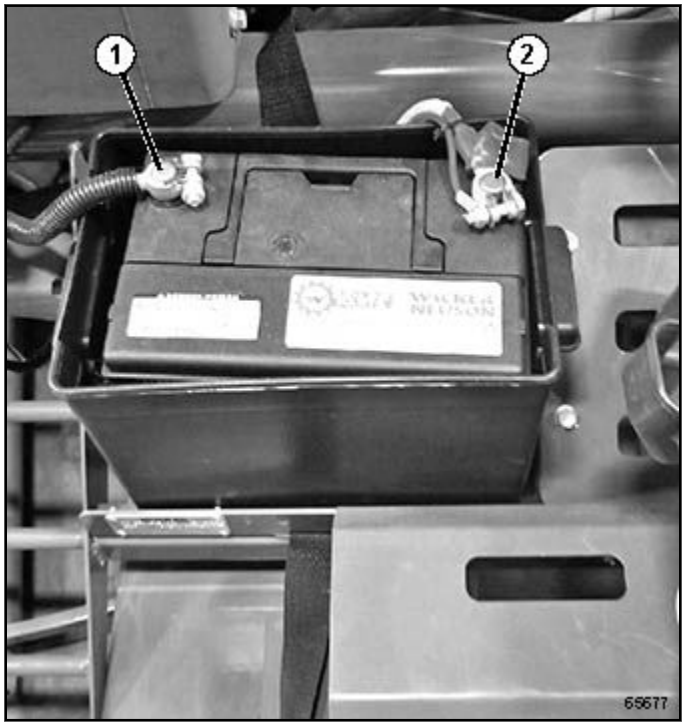


Figure 3-30: Battery Terminals

4. Set digital multimeter to test for VDC.
5. Connect red test lead to battery positive terminal (2).
6. Connect black test lead to battery negative terminal (1).
7. Using digital multimeter, test for VDC.

   Are at least 10.5 VDC indicated?

   YES *Proceed to Step 8.*

   NO *Battery is faulty. Charge or replace battery.*

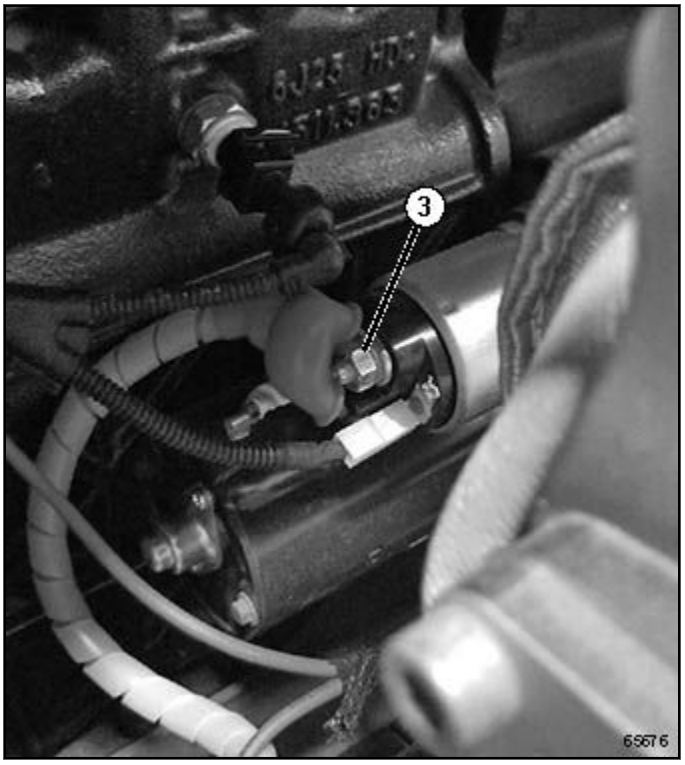


Figure 3-31: Starter Terminals

8. Connect red test lead to positive terminal on starter (3).
9. Connect black test lead to battery negative terminal (1).
10. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 11.*

    NO *Positive battery cable is faulty. Repair or replace positive battery cable.*
11. Connect red test lead to positive terminal on starter (3).
12. Connect black test lead to known good ground.
13. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 14.*

    NO *Negative battery cable is faulty. Repair or replace negative battery cable.*
14. Connect red test lead to battery positive terminal (2).
15. Connect black test lead to battery negative terminal (1).
16. Turn engine key to the start position.
17. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Battery and ground circuit is okay.*

    NO *Battery is faulty. Charge or replace battery.*

Start Circuit Test

See **Figures 3-32** through **3-34**.

Required Tools or Equipment
Digital Multimeter

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Check ignition signal fuse F004.

    Is ignition signal fuse F004 faulty?

    YES *Ignition signal fuse F004 is faulty. Replace fuse.*

    NO *Proceed to Step 3.*
3. Check starter relay K155. (See "**Relay Test**" on **page 3-55**.)

    Is starter relay K155 faulty?

    YES *Starter relay K155 is faulty. Replace relay.*

    NO *Proceed to Step 4.*

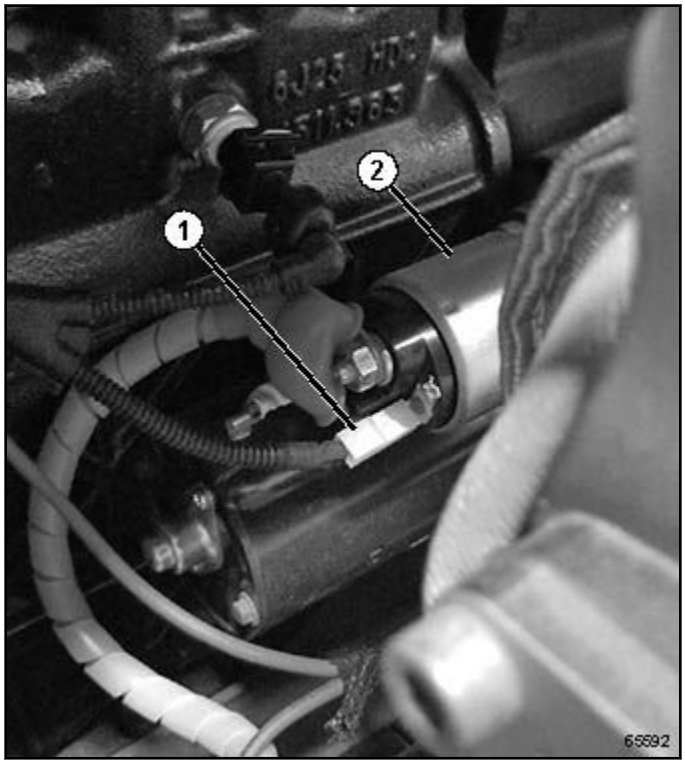


Figure 3-32: Starter Signal Wire

4. Disconnect signal wire (1) from starter solenoid (2).
5. Set digital multimeter to test for VDC.
6. Connect red test lead to signal wire (1).
7. Connect black test lead to known good ground.
8. Turn the key to the start position.
9. Using digital multimeter, test for VDC.

   Are at least 10.5 VDC indicated?

   YES *Starter is receiving power. A separate engine manual, prepared by the engine manufacturer, is supplied with this machine. Refer to the engine manufacturer's manual for all engine related service.*

   NO *Proceed to Step 10.*

10. Remove instrument panel to access key switch. (See "**Right Shell Removal and Installation**" on **page 5-5**.)

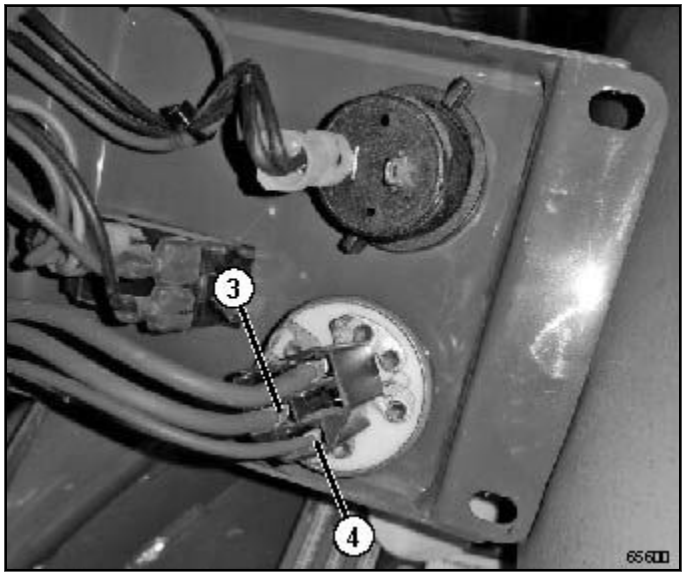


Figure 3-33: Key Switch Wires

11. Connect red test lead to wire 203 (3) and terminal on back of key switch.
12. Connect black test lead to known good ground.
13. Using digital multimeter, test for VDC.

    Are at least 10 VDC indicated?

    YES *Proceed to Step 14.*

    NO *Connection between wire 203 (3) and battery is faulty. Repair connection.*

14. Connect red test lead to wire 64 (4) and terminal on back of key switch.
15. Connect black test lead to known good ground.
16. Turn the key to the start position
17. Using digital multimeter, test for VDC.

    Are at least 10 VDC indicated?

    YES *Key switch is faulty. Replace Key switch.*

    NO *Proceed to Step 18.*

18. Remove side panel to gain access to emergency stop switch. (See "**Right Shell Removal and Installation**" on **page 5-5**.)
19. Make sure emergency stop switch is in the run position.
20. Turn key to on position.

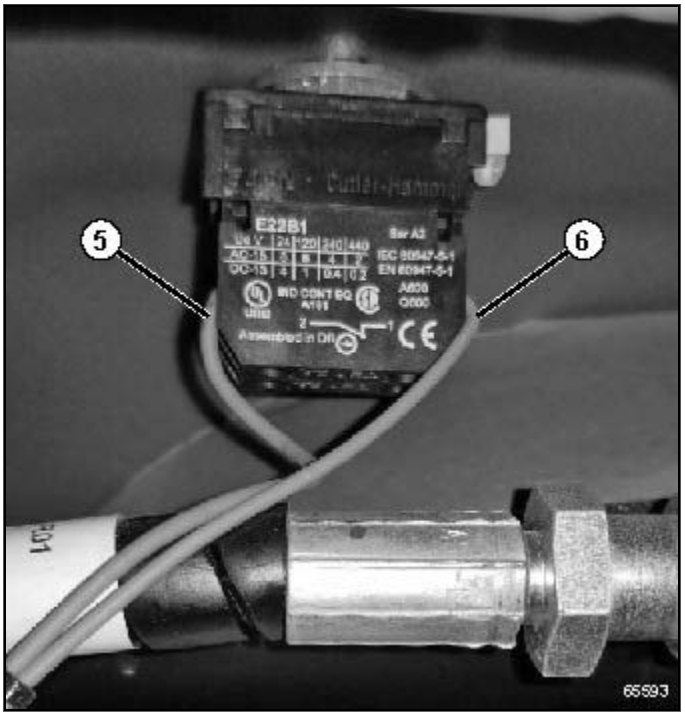


Figure 3-34: Emergency Stop Switch

21. Connect red test lead to wire 6 (5) and terminal on emergency stop switch.
22. Connect black test lead to known good ground.
23. Using digital multimeter, test for VDC.

    Are at least 10 VDC indicated?

    YES *Proceed to Step 24.*

    NO *Connection between wire 6 (5) and battery is faulty. Repair connection.*

24. Connect red test lead to wire 72 (6) and terminal on emergency stop switch.
25. Connect black test lead to known good ground.
26. Using digital multimeter, test for VDC.

    Are at least 10 VDC indicated?

    YES *Start circuit is faulty at engine. A separate engine manual, prepared by the engine manufacturer, is supplied with this machine. Refer to the engine manufacturer's manual for all engine related service.*

    NO *Emergency stop switch is faulty. Replace emergency stop switch.*

Steering System Test

NOTE

Valve 1A is described in this procedure. All steer circuits are tested in a similar manner. Refer to wiring schematic for wire numbers, fuses, relays, and coils of pitch control circuit being tested.

See **Figures 3-35** through **3-37**.

Required Tools or Equipment
Digital Multimeter
1- Fused Jumper Wire
1- Jumper Wire

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Locate the appropriate valve:
   - Valves 1A and 1B control forward and reverse movement of the right rotor
   - Valves 2A and 2B control forward and reverse movement of the left rotor
   - Valves 3A and 3B control left and right movement of the left rotor

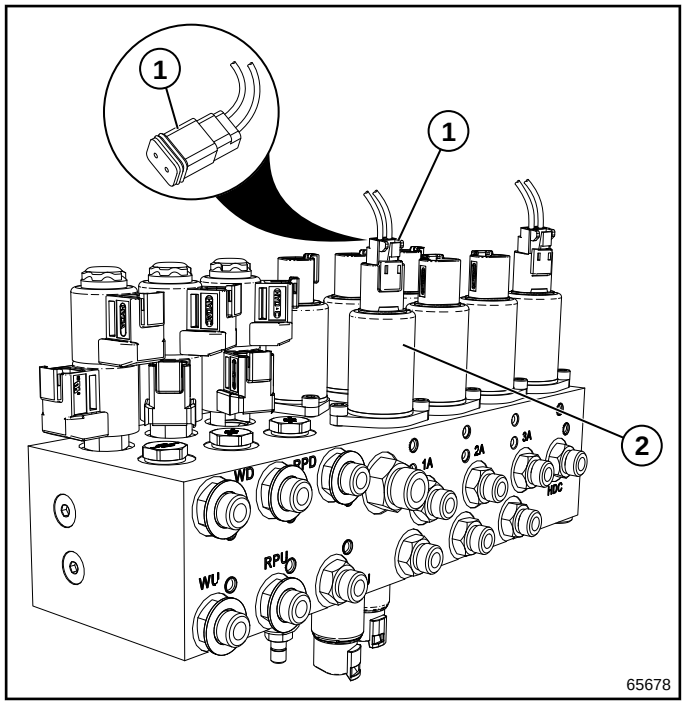


Figure 3-35: Valve 1A Electrical Connector

3. Make sure electrical connector (1) is properly connected at steer valve 1A (2).

   Is electrical connector (2) properly connected?

   YES *Proceed to Step 4.*

   NO *Electrical connector is not properly connected. Connect electrical connector.*

4. Disconnect electrical connector (1) from steering valve 1A (2).
5. Turn key switch to the on position.
6. Press the steering mode switch to high rate mode. (Light Emitting Diode [LED] is not illuminated.)

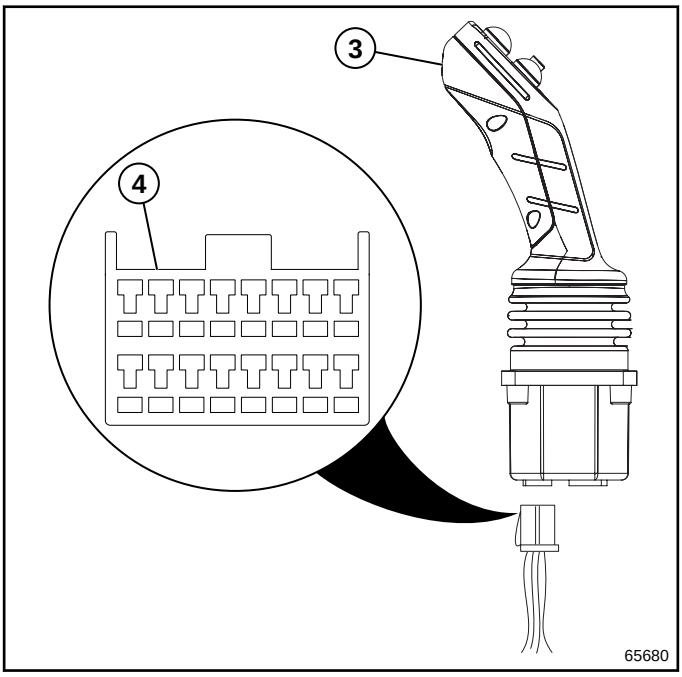


Figure 3-36: Joystick and Connector

7. Set digital multimeter to measure amperage.
8. Connect red test lead to power pin in steering valve 1A (2).
9. Connect black test lead to power pin in electrical connector (1).
10. Connect a jumper wire between ground pin of steering valve 1A (2) and electrical connector (1) wire 15.
11. Move joystick (3) to full extension.
12. Using digital multimeter, measure amperage.

    Are 1.7 amps indicated with joystick fully extended?

    YES *Steer circuit is okay.*

    NO *Proceed to Step 13.*

13. Press the steering mode switch to high resolution mode. (LED is illuminated.)
14. Set digital multimeter to measure amperage.

15. Connect red test lead to power pin in steering valve 1A (2).
16. Connect a jumper wire between ground pin of steering valve 1A (2) and electrical connector (1) wire 15.
17. Move joystick (3) to full extension.
18. Using multimeter, measure amperage.

    Are 1.1 amps indicated with joystick fully extended forward?

    YES *Steer circuit is okay.*

    NO *Proceed to Step 19.*

NOTE

Machine controller may be removed if needed to gain access to wiring harness.

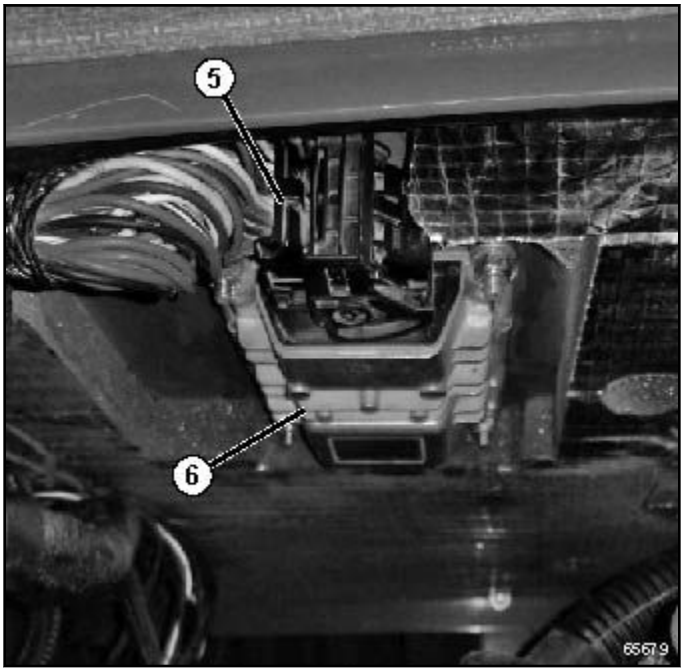


Figure 3-37: Machine Controller and Connector

19. Connect electrical connector (1) to steering valve 1A (2).
20. Set digital multimeter to measure VDC.
21. Using red test lead, backprobe wire 10 in electrical connector (5).
22. Connect black test lead to a known good ground.
23. Using digital multimeter, test for VDC at wire 10.

    Are at least 5 VDC indicated?

    YES *Proceed to Step 24.*

    NO *Wire 10 is faulty. Repair or replace wire 10.*

24. Disconnect electrical connector (5) from machine controller (6).
25. Connect red test lead to wire 24 in electrical connector (5).
26. Connect black test lead to a known good ground.
27. Using digital multimeter, test for VDC at wire 24.

    Is 10.5 VDC indicated?

    YES *Proceed to Step 28.*

    NO *Wire 24 is faulty. Repair or replace wire 24.*

28. Connect red test lead to wire 25 in electrical connector (5).
29. Connect black test lead to a known good ground.
30. Using digital multimeter, test for VDC at wire 25.

    Is 10.5 VDC indicated?

    YES *Proceed to Step 31.*

    NO *Wire 25 is faulty. Repair or replace wire 25.*

31. Connect red test lead to wire 26 in electrical connector (5).
32. Connect black test lead to a known good ground.
33. Using digital multimeter, test for VDC at wire 26.

    Is 10.5 VDC indicated?

    YES *Proceed to Step 34.*

    NO *Wire 26 is faulty. Repair or replace wire 26.*

34. Connect red test lead to wire 79 in electrical connector (5).
35. Connect black test lead to a known good ground.
36. Using digital multimeter, test for VDC at wire 79.

    Is 10.5 VDC indicated?

    YES *Proceed to Step 37.*

    NO *Wire 79 is faulty. Repair or replace wire 79.*

NOTE

*Left joystick will need to be disconnected if testing left steering functions. (See "**Left Joystick**" on **page 3-81**.)*

37. Disconnect electrical connector (4) from right joystick (3). (See "**Right Joystick**" on **page 3-80**.)
38. Set digital multimeter to continuity.

39. Connect red test lead to wire 11 in electrical connector (5).
40. Connect black test lead to wire 5 in electrical connector (4).
41. Using digital multimeter, test for continuity.

    Is continuity indicated?

    YES *Proceed to Step 42.*

    NO *Wire 5 is faulty. Repair or replace wire 5.*
42. Connect electrical connector (5) machine controller (6).
43. Set digital multimeter to measure VDC.
44. Connect red test lead to wire 4 in electrical connector (4).
45. Connect black test lead to known good ground.
46. Using digital multimeter, test for VDC.

    Are at least 5 VDC indicated?

    YES *Proceed to Step 47.*

    NO *Wire 4 is faulty. Repair or replace wire 4.*
47. Connect electrical connector (4) to right joystick (3).

NOTE

Machine controller may be removed if needed to gain access to wiring harness.

48. Using red test lead, backprobe wire 2 in electrical connector (5).
49. Connect black test lead to a known good ground.
50. Using digital multimeter, test for VDC at wire 2 with right joystick (3) in neutral position.

    Is 5 VDC indicated with right joystick (3) in the neutral position?

    YES *Proceed to Step 51.*

    NO *Right joystick (3) is faulty. Repair or replace right joystick. (See "**Right Joystick**" on **page 3-80**.)*
51. Using red test lead backprobe wire 2 in electrical connector (5).
52. Connect black test lead to a known good ground.
53. Using digital multimeter, test for VDC at wire 2 with right joystick (3) in forward position.

    Is 4.5 VDC indicated with joystick in the forward position?

    YES *Proceed to Step 54.*

    NO *Right joystick (3) is faulty. Repair or replace right joystick. (See "**Right Joystick**" on **page 3-80**.)*
54. Using red test lead, backprobe wire 2 in electrical connector (5).
55. Connect black test lead to a known good ground.
56. Using digital multimeter (3), test for VDC at wire 2 with right joystick (3) in reverse position.

    Is 0.5 VDC indicated with joystick in the reverse position?

    YES *Possible faulty Steering controller. Contact Wacker Neuson Customer support for further instructions.*

    NO *Right joystick (3) is faulty. Repair or replace right joystick. (See "**Right Joystick**" on **page 3-80**.)*

Pitch Control Test

NOTE

The right pitch up circuit is described in this procedure. All pitch circuits are tested in a similar manner. Refer to wiring schematic for wire numbers, fuses, relays, and coils of pitch control circuit being tested.

See **Figures 3-38** through **3-41**.

Required Tools or Equipment
Digital Multimeter
1- Fused Jumper Wire
1- Jumper Wire

1. Park the machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Check pitch control fuse F017.

   Is pitch control fuse F017 faulty?

   YES *Pitch control fuse F017 is faulty. Replace fuse.*

   NO *Proceed to Step 3.*
3. Check right up pitch relay K163. (See "**Relay Test**" on **page 3-55**.)

   Are one or more pitch relay K163 faulty?

   YES *Pitch relay K163 is faulty. Replace relay.*

   NO *Proceed to Step 4.*

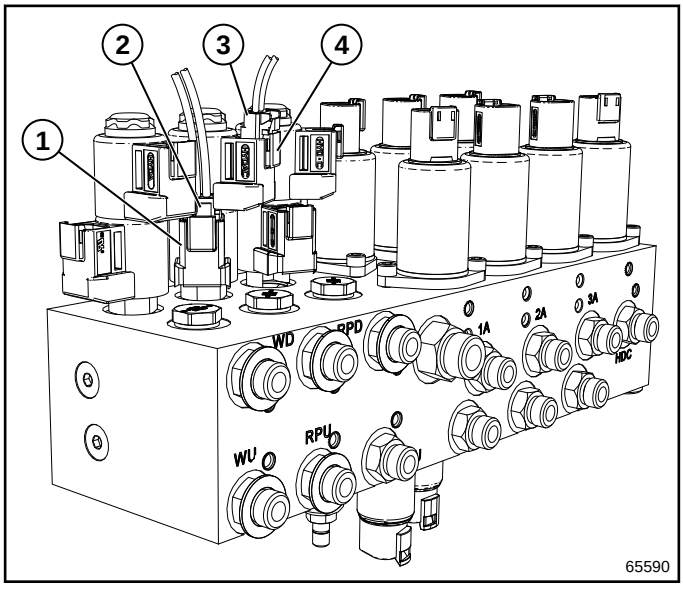


Figure 3-38: Valve Y179 and Electrical Connector

4. Make sure electrical connector (2) is properly connected at right pitch up valve Y179 (1).

   Is electrical connector properly connected?

   YES *Proceed to Step 5.*

   NO *Electrical connector is not properly connected. Connect electrical connector.*
5. Disconnect electrical connector (2) from right pitch up valve Y179 (1).
6. Disconnect electrical connector (3) from right pitch down valve Y180 (4).
7. Connect electrical connector (2) to right pitch down vlavle Y180 (4).
8. Start engine.
9. Attempt to operate the right pitch up function.

   Does the right pitch up controll cause the right pitch down?

   YES *Proceed to Step 10.*

   NO *The right pitch up valve Y179 (1) is faulty. Replace the right pitch up valve.*

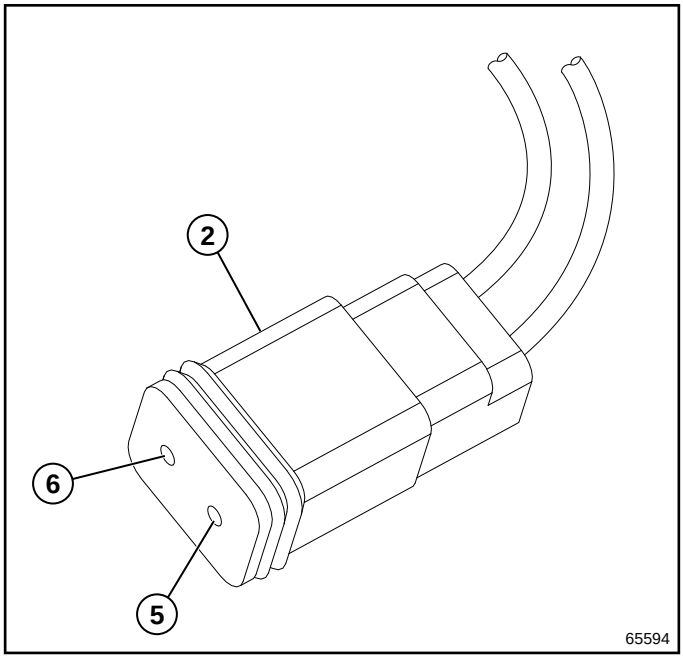


Figure 3-39: Valve Y179 Connector View

10. Turn off engine.
11. Disconnect electrical connector (2) from right pitch up valve Y179 (1).
12. Start engine.
13. Set digital multimeter to measure VDC.
14. Press and hold pitch control button.

15. Connect red test lead to wire 115 (5) in electrical connector (2).
16. Connect black test lead to a known good ground.
17. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 18.*

    NO *Proceed to Step 22.*
18. Press and hold pitch control button.
19. Connect red test lead to wire 115 (5) in electrical connector (2).
20. Connect black test lead to wire 119 (6) in electrical connector (2).
21. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Right pitch up valve is faulty. Replace right pitch up valve.*

    NO *Wire 119 (6) is faulty. Repair or replace wire 119.*

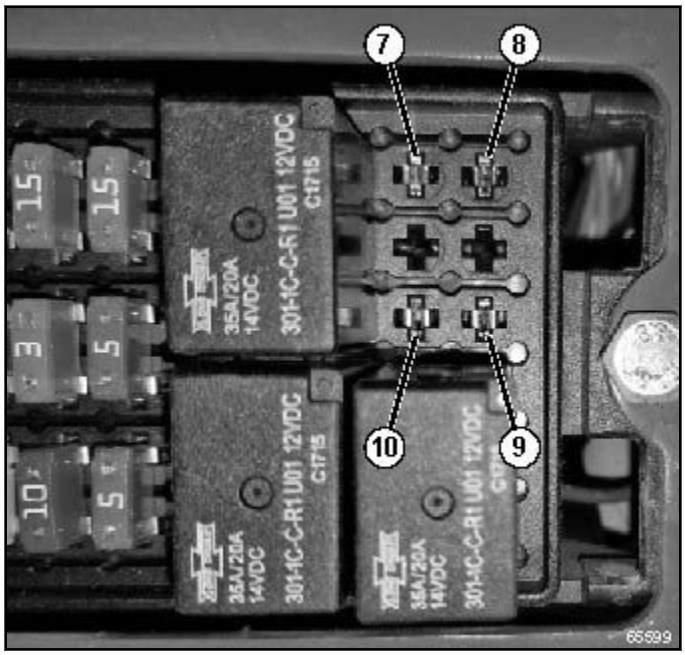


Figure 3-40: Pitch relay K163 Connector View

22. Turn machine off.
23. Turn key switch to the on position.
24. Remove relay K163.
25. Connect red test lead to wire 103 (7) in fuse panel.
26. Connect black test lead to a known good ground.
27. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 22.*

    NO *Wire 103 (7) is faulty. Repair or replace wire 103.*
28. Connect red test lead to wire 103 (7) in fuse panel.
29. Connect black test lead to wire 111 (8) in fuse panel.
30. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 25.*

    NO *Wire 111 (8) is faulty. Repair or replace wire 111.*
31. Press and hold pitch control button.
32. Connect red test lead to wire 107 (10) in fuse panel.
33. Connect black test lead to a known good ground.
34. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Wire 115 is faulty. Repair or replace wire 115.*

    NO *Proceed to Step 29.*

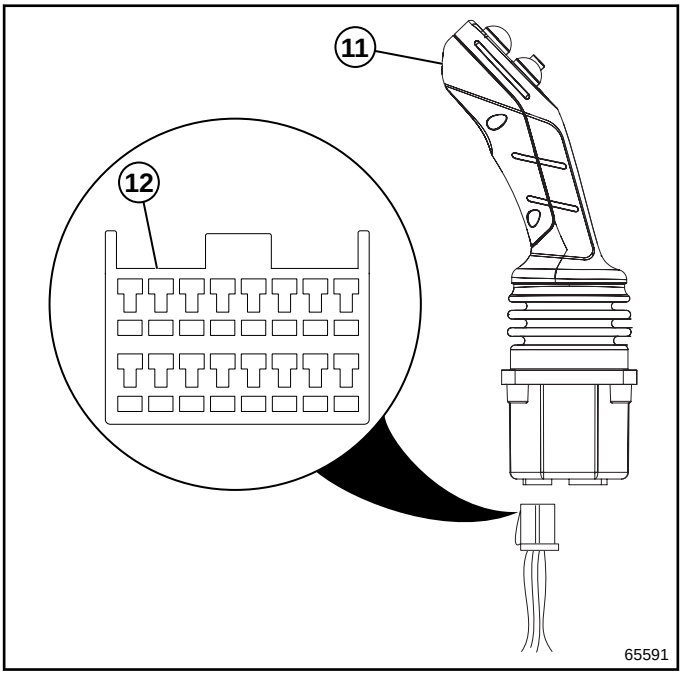


Figure 3-41: Right Joystick and Connector

NOTE

*Left joystick will need to be disconnected if testing left pitch circuit. (See "**Left Joystick**" on **page 3-81**.)*

35. Disconnect electrical connector (12) from right joystick (11). (See "**Right Joystick**" on **page 3-80**.)

36. Set digital multimeter to test continuity.
37. Connect black test lead to electrical connector (12) terminal 2.
38. Connect red test lead to wire 107 (9) in fuse panel.
39. Using digital multimeter, test for continuity.

    Is continuity indicated?

    YES *Pitch switch is faulty. Replace pitch control button. (See "**Pitch Control Buttons**" on **page 3-82**.)*

    NO *Wire 107 (9) is faulty. Repair or replace wire 107.*

Blade Rotation System Test

NOTE

Only perform this procedure if error codes on display and/or in WANDA diagnostic software indicate an electrical problem.

See **Figures 3-42** through **3-45**.

Required Tools or Equipment
Digital Multimeter
1- Fused Jumper Wire
1- Jumper Wire

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)

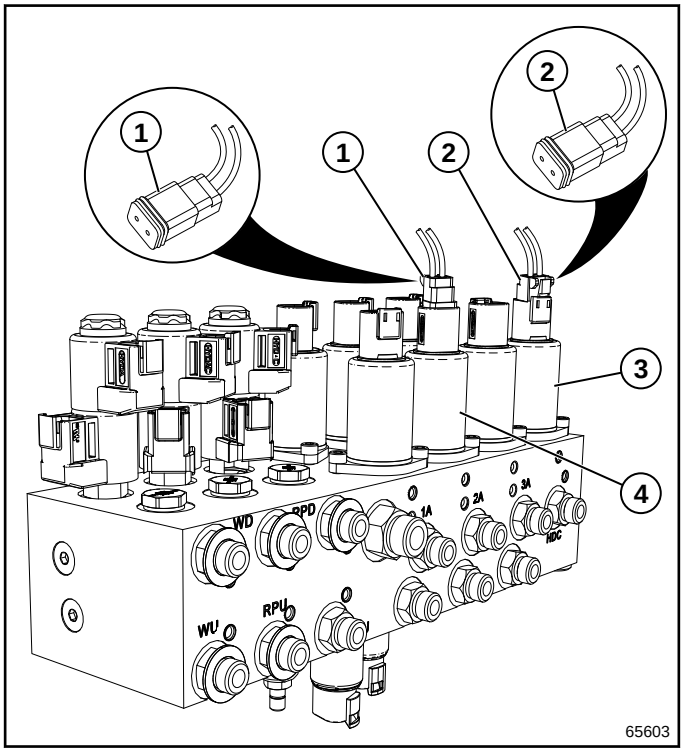


Figure 3-42: HDC and Steer Valves

2. Make sure electrical connector (2) is properly connected at Hydraulic Control (HDC) valve Y183 (3).

   Is electrical connector properly connected?

   YES *Proceed to Step 5.*

   NO *Electrical connector is not properly connected. Connect electrical connector.*

3. Disconnect electrical connector (2) from HDC valve Y183 (3).
4. Remove HDC valve Y183 (3).
5. Disconnect electrical connector (1) from a known working steer valve (4).
6. Remove known working steer valve (4).
7. Install known working steer valve (4) in HDC valve Y183 location.
8. Install HDC valve Y183 (3) in steer valve location.
9. Connect electrical connectors (1 and 2)
10. Start machine.
11. Attempt to operate machine.

    Does machine function properly?

    YES *HDC valve Y183 is faulty. Replace HDC valve Y183.*

    NO *Proceed to Step 12.*

12. Turn machine off.
13. Turn key switch to the on position.

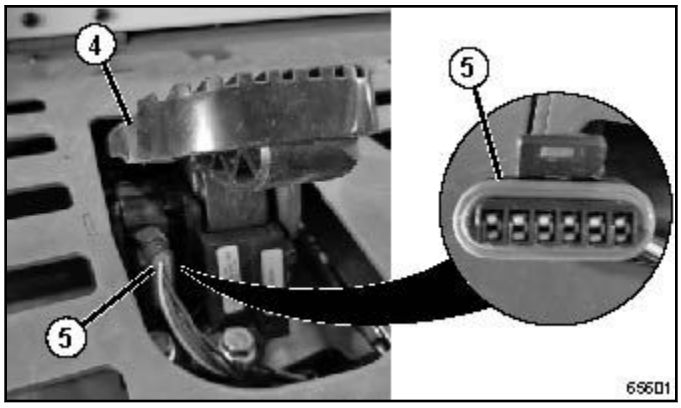


Figure 3-43: Foot Pedal and Electrical Connector

14. Disconnect electrical connector (5) from foot pedal (4).
15. Set digital multimeter to measure VDC.
16. Connect red test lead to wire 145 in electrical connector (5).
17. Connect black test lead to known good ground.
18. Using digital multimeter, test for VDC.

    Are at least 5 VDC indicated?

    YES *Proceed to Step 19.*

    NO *Possible faulty steering controller. Contact Wacker Neuson customer service for further instruction.*

19. Connect red test lead to wire 148 in electrical connector (5).
20. Connect black test lead to known good ground.
21. Using digital multimeter, test for VDC.

    Are at least 5 VDC indicated?

    YES *Proceed to Step 22.*

    NO *Possible faulty steering controller. Contact Wacker Neuson customer service for further instruction.*

22. Connect electrical connector (5) to foot pedal (4).

NOTE

Machine controller may be removed if needed to gain access to wiring harness.

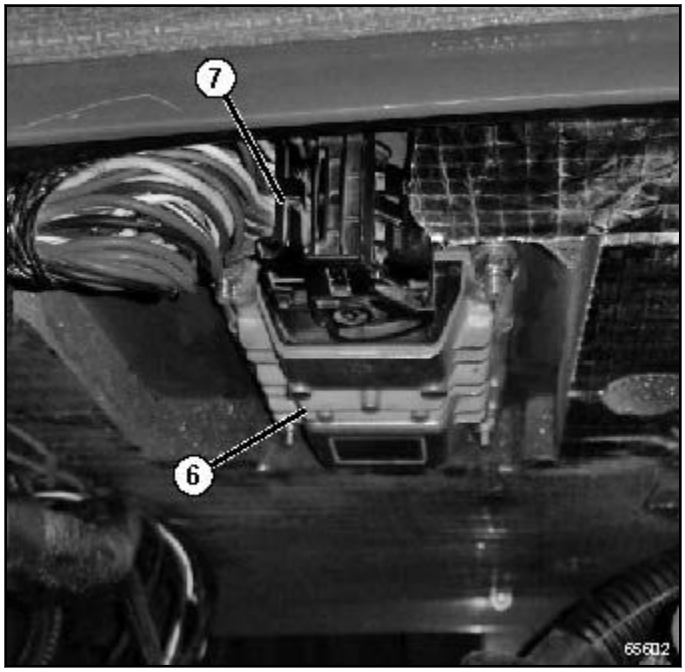


Figure 3-44: Machine Controller and Electrical Connector

23. Using red test lead, backprobe wire 146 at electrical connector (7) connected to machine controller (6).
24. Connect black test lead to a known good ground.
25. Using digital multimeter, test for VDC while slowly depressing foot pedal (4).

    Are 0 VDC indicated at rest and 5 VDC indicated with pedal (5) fully depressed?

    YES *Proceed to Step 26.*

    NO *Foot pedal (4) is faulty. Replace foot pedal.*

26. Using red test lead, backprobe wire 149 at electrical connector (7) connected to machine controller (6).
27. Connect black test lead to a known good ground.
28. Using digital multimeter, test for VDC whiles slowly depressing foot pedal (4).

    Are 0 VDC indicated at rest and 5 VDC indicated with pedal (5) fully depressed?

    YES *Proceed to Step 29.*

    NO *Foot pedal (4) is faulty. Replace foot pedal.*

NOTE

Only perform the following steps if the display and/or WANDA is displaying an error indocating the engine rpm is incorrect.

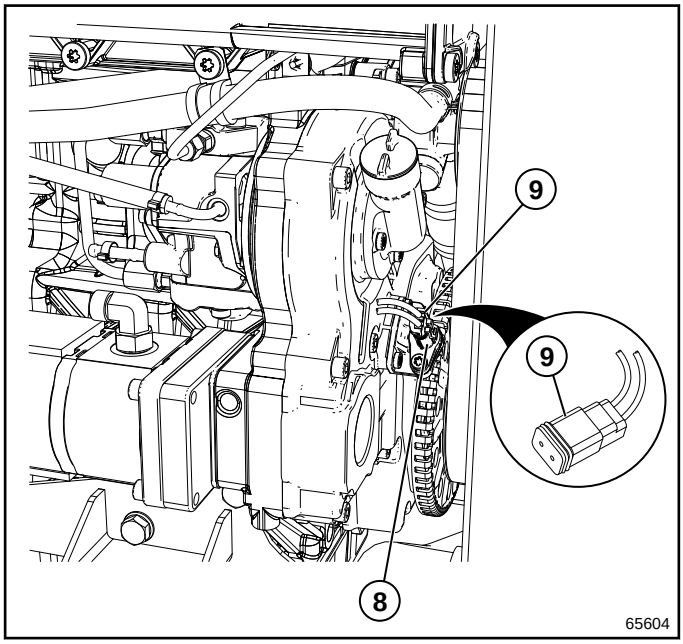


Figure 3-45: Speed Sensor and Electrical Connector

29. Disconnect electrical connector (9) from engine speed sensor (8).
30. Connect red test lead to wire 148 at electrical connector (9).
31. Connect black test lead to known good ground.
32. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 33.*

    NO *Wire 148 is faulty. Repair or replace wire 148.*
33. Connect electrical connector (9) to speed sensor (8).
34. Start engine.
35. Raise idle to fast idle.
36. Using red test lead, backprobe wire 149 at electrical connector (7) connected to machine controller (6).
37. Connect black test lead to a known good ground.
38. Using digital multimeter, test for VDC.

    Are 4.5 VDC indicated?

    YES *Proceed to Step 39.*

    NO *Speed sensor (8) is faulty. Replace speed sensor.*
39. Disconnect electrical connector (2) from HDC valve Y183 (3).
40. Set digital multimeter to measure amperage.
41. Disconnect electrical connector (1) from a known working steer valve (4).
42. Connect red test lead to power pin in known working steer valve (4).
43. Connect black test lead to electrical connector (2) wire 152.
44. Connect a jumper wire between ground pin of known working steer valve (4) and electrical connector (2) wire 12.
45. Start machine.
46. Run machine at fast idle.
47. Depress foot pedal (4).
48. Using digital multimeter, measure amperage.

    Is 1.6 amps indicated with foot pedal (4) fully depressed?

    YES *Blade rotation circuit is okay.*

    NO *Possible faulty steering controller. Contact Wacker Neuson customer service for further instruction.*

Retardant Spray System Test

See **Figures 3-46** through **3-48**.

Required Tools or Equipment
Digital Multimeter

1. Park the machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Check water pump fuse F018.

   Is water pump fuse F018 faulty?

   YES *Water pump fuse F018 is faulty. Replace fuse.*

   NO *Proceed to Step 3.*
3. Check water pump relay K173. (See "**Relay Test**" on **page 3-55**.)

   Is water pump relay K173 faulty?

   YES *Water pump relay K173 is faulty. Replace relay.*

   NO *Proceed to Step 4.*
4. Turn key to the on position.
5. Set digital multimeter to test for VDC.
6. Connect red test lead to water pump fuse F018.
7. Connect black test lead to a known good ground.

8. Using digital multimeter, test for VDC at water pump fuse F018.

   Are at least 10.5 VDC indicated?

   YES *Wire 67 is faulty. Repair or replace wire 67.*

   NO *Proceed to Step 9.*

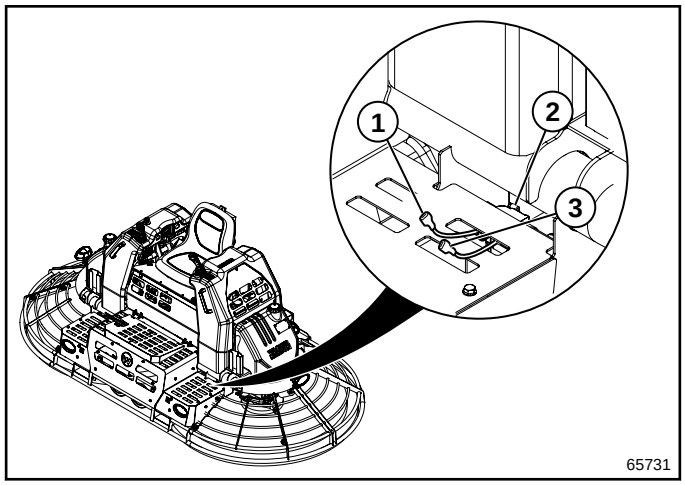


Figure 3-46: Retardant Spray Pump and Wires

9. Disconnect wires (1 and 3) from water pump (2).
10. Depress retardant spray button on right joystick.
11. Connect red test lead to wire 98 (1).
12. Connect black test lead to wire 99 (3).
13. Using digital multimeter, test for VDC with retardant spray button depressed.

    Are at least 10.5 VDC indicated?

    YES *Water pump is faulty. Repair or replace water pump as needed.*

    NO *Proceed to Step 14.*

14. Turn key to the off position.
15. Connect red test lead to the batteries positive terminal.
16. Connect black test lead to wire 99 (3).
17. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 18.*

    NO *Wire 99 (3) is faulty. Repair or replace wire 99.*

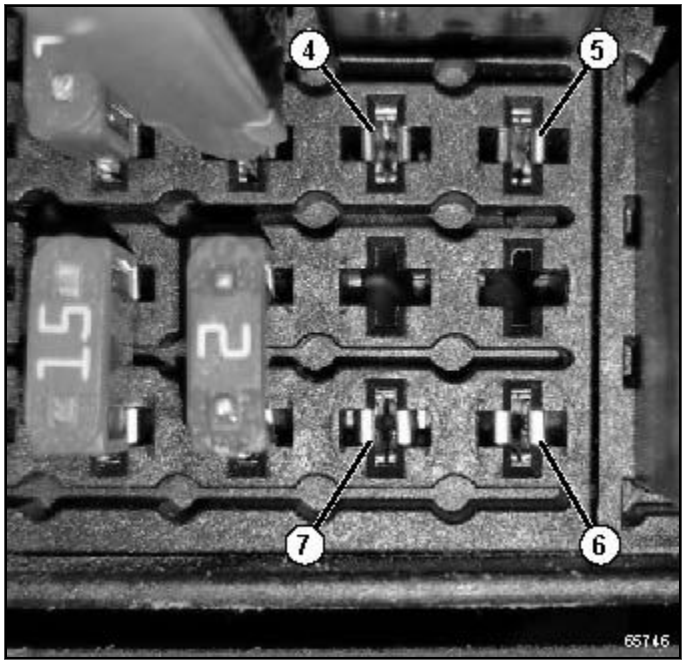


Figure 3-47: Water Pump Relay Connector View

18. Remove water pump relay K173.
19. Connect red test lead to wire 93 (4) in fuse panel.
20. Connect black test lead to known good ground.
21. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 22.*

    NO *Wire 93 (4) is faulty. Repair or replace wire 93.*

22. Connect red test lead to wire 93 (4) in fuse panel.
23. Connect black test lead to wire 96 (6) in fuse panel.
24. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 25.*

    NO *Wire 96 (6) is faulty. Repair or replace wire 96.*

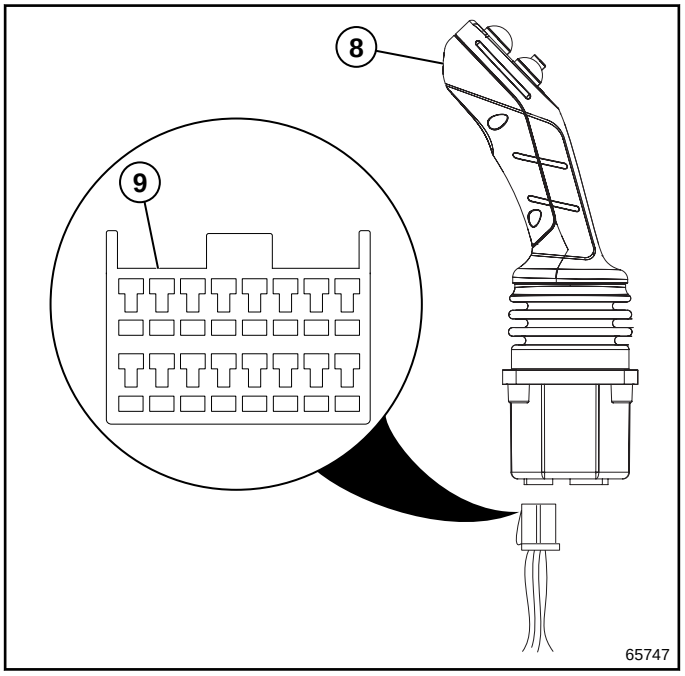


Figure 3-48: Joystick Connector View

25. Disconnect electrical connector (9) from right joystick (8). (See"**Right Joystick**" on **page 3-80**.)
26. Connect red test lead to electrical connector (9) terminal 11.
27. Connect black test lead to a known good ground.
28. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 29.*

    NO *Wire 95 is faulty. Repair or replace wire 95.*
29. Set digital multimeter to test for continuity.
30. Connect red test lead to electrical connector (9) terminal 4.
31. Connect black test lead to wire 97 (7) in fuse panel.
32. Using digital multimeter, test for continuity.

    Is continuity indicated?

    YES *Proceed to Step 33.*

    NO *Wire 97 (9) is faulty. Repair or replace wire 97.*
33. Connect red test lead to wire 98 (6) in fuse panel.
34. Connect black test lead to wire 98 (1) at water pump (2).
35. Using digital multimeter, test for continuity.

    Is continuity indicated?

    YES *Proceed to Step 36.*

    NO *Wire 98 (1) is faulty. Repair or replace wire 98.*
36. Set digital multimeter to test for VDC.
37. Connect red test lead to wire 97 (7) in fuse panel.
38. Connect black test lead to a known good ground.
39. Depress retardant spray button on right joystick.
40. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated with retardant spray button depressed?

    YES *Retardant spray system is OK.*

    NO *Retardant spray button is faulty. Repair or replace retardant spray button. (See "**Retardant Spray Button**" on **page 3-84**.)*

Hydraulic Oil Cooler Fan Test

See **Figures 3-49** through **3-51**.

Required Tools or Equipment
Digital Multimeter

1. Park the machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Check hydraulic oil cooler fan resetable breaker F010.

   Is hydraulic oil cooler fan resetable breaker F010 faulty?

   YES *Hydraulic oil cooler fan resetable breaker F010 is faulty. Replace hydraulic oil cooler fan resetable breaker F010.*

   NO *Proceed to Step 3.*
3. Check hydraulic oil cooler fan relay K053. (See "**Relay Test**" on **page 3-55**.)

   Is hydraulic oil cooler fan relay K053 faulty?

   YES *Hydraulic oil cooler fan relay K053 is faulty. Replace hydraulic oil cooler fan relay K053.*

   NO *Proceed to Step 4.*

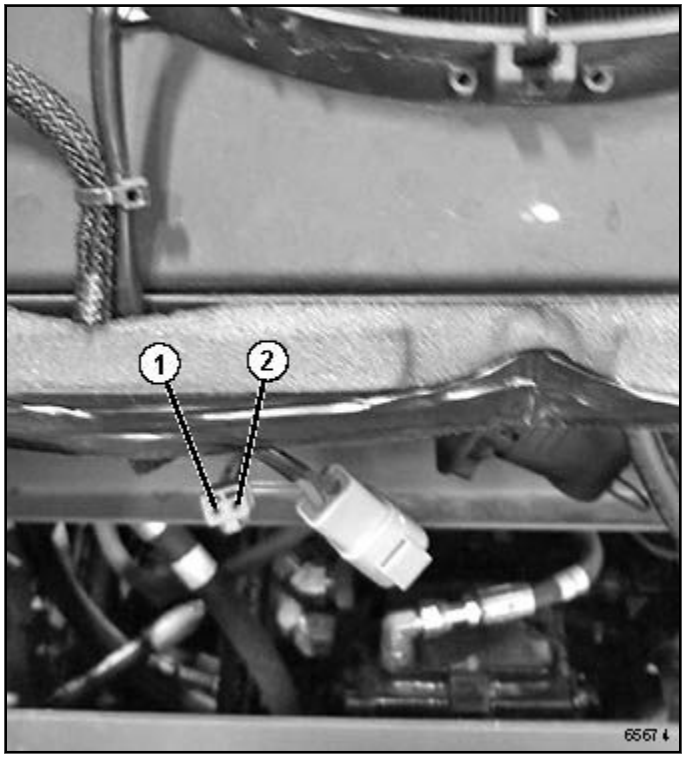


Figure 3-49: Hydraulic Oil Cooler Electrical Connector View

4. Disconnect hydraulic oil cooler fan electrical connector. (See "**Oil Cooler**" on **page 4-49**.)
5. Turn key switch to the on position.
6. Set digital multimeter to measure VDC.
7. Connect red test lead to wire 195 (1) in connector.
8. Connect black test lead to wire 88 (2) in connector.
9. Using digital multimeter, test for VDC.

   Are at least 10.5 VDC indicated?

   YES *Hydraulic oil cooler fan is faulty. Repair or replace oil cooler fan. (See "**Oil Cooler**" on **page 4-49**.)*

   NO *Proceed to Step 10.*
10. Connect red test lead to wire to battery positive terminal.
11. Connect black test lead to wire 88 (2) in connector.
12. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 13.*

    NO *Wire 88 (2) is faulty. Repair or replace wire 88.*

NOTE

Machine controller may be removed if needed to gain access to gain access to wiring harness,

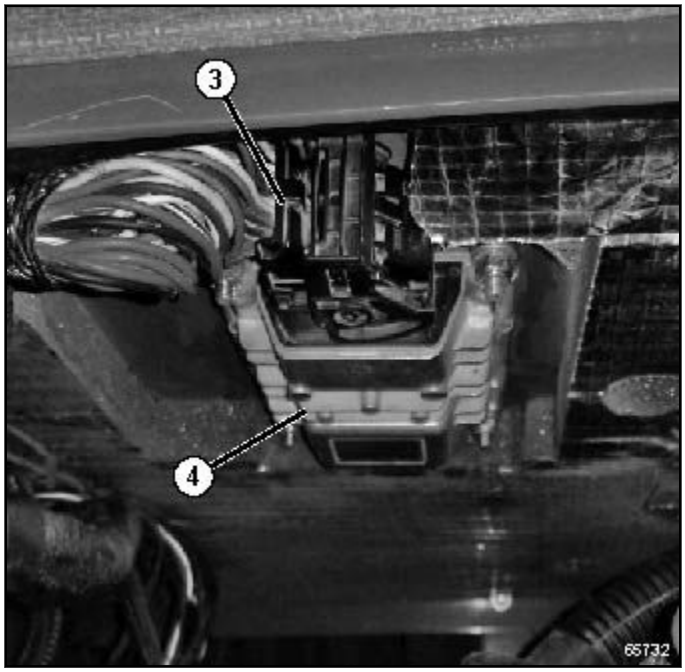


Figure 3-50: Machine Controller

13. Using red test lead, backprobe wire 193 at electrical connector connected (3) to machine controller (4).
14. Connect black test lead to known good ground.
15. Using digital multimeter, test for test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 10.*

    NO *Possible faulty machine controller. Contact Wacker Neuson customer service for further instruction.*

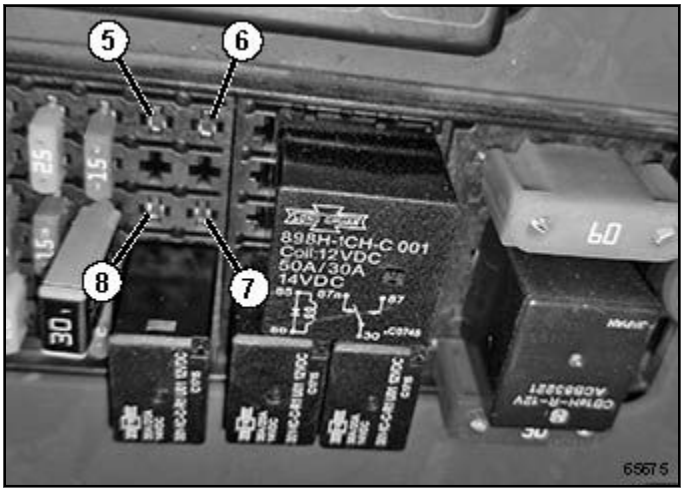


Figure 3-51: Hydraulic Oil Cooler Fan Relay Connector View

16. Set digital multimeter to measure VDC.
17. Connect red test lead to wire 87 (5) in fuse panel.
18. Connect black test lead to wire known good ground.
19. Using digital multimeter, test for test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 20.*

    NO *Wire 87 (5) is faulty. Repair or replace wire 87 .*

20. Set digital multimeter to measure VDC.
21. Connect red test lead to wire 87 (5) in fuse panel.
22. Connect black test lead to wire 194 (6) in fuse panel.
23. Using digital multimeter, test for test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 10.*

    NO *Wire 194 (6) faulty. Repair or replace wire 194.*

24. Set digital multimeter to measure VDC.
25. Connect red test lead to wire 193 (8) in fuse panel.
26. Connect black test lead to wire 194 (6) in fuse panel.
27. Using digital multimeter, test for test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 10.*

    NO *Wire 193 (8) is faulty. Repair or replace wire 193.*

28. Set digital multimeter to measure continuity.
29. Connect red test lead to wire 195 (7) in fuse panel.
30. Connect black test lead to wire 195 (1) in hydraulic oil cooler fan electrical connector.
31. Using digital multimeter, test for test for continuity.

    Is continuity indicated?

    YES *Hydraulic oil cooler fan circuit is okay.*

    NO *Wire 195 (1 and 7) is faulty. Repair or replace wire 195.*

Work Lights Circuit Test

NOTE

The front right work light circuit is described in this procedure. All work light circuits are tested in a similar manner. Refer to wiring schematic for wire numbers, fuses, and s of work light circuit being tested.

See **Figure 3-52**.

Required Tools or Equipment
Digital Multimeter

1. Park the machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Check work lights fuse F006.

   Is work lights fuse F006 faulty?

   YES *Work lights fuse F006 is faulty. Replace work lights fuse F006.*

   NO *Proceed to Step 3.*

3. Check work light switch. (See "**Work Lights Switch Test**" on **page 3-53**.)

   Is work light switch faulty?

   YES *Hydraulic work light switch is faulty. Replace work light switch.*

   NO *Proceed to Step 4.*

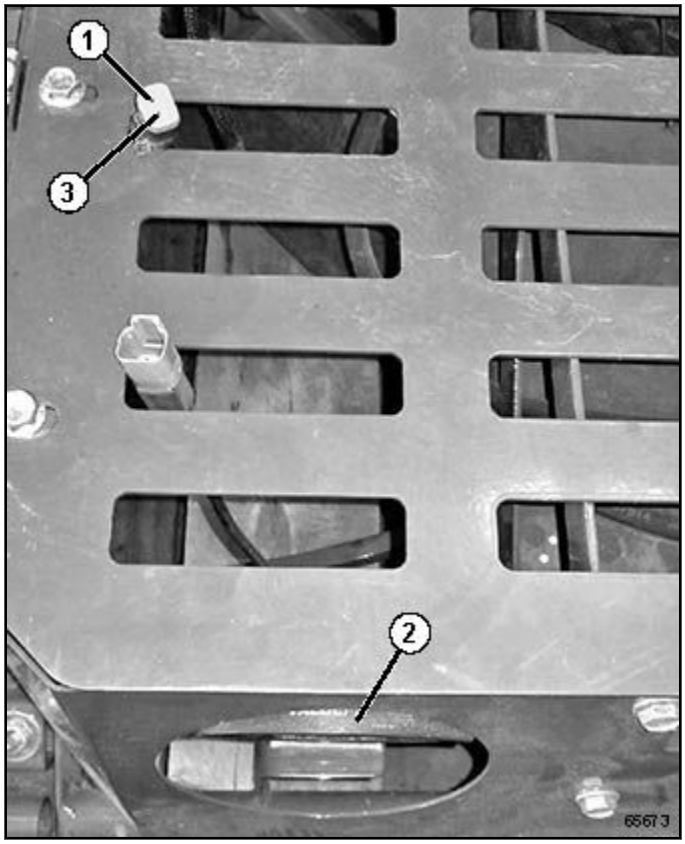


Figure 3-52: Work Light Wiring

4. Disconnect front work (2) light electrical connector.
5. Turn key switch to the on position.
6. Turn work light switch to the on position.
7. Set digital multimeter to measure VDC.
8. Connect red test lead to wire 130 (1) in connector.
9. Connect black test lead to wire 134 (3) in connector.
10. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Work light is faulty. Replace work light.*

    NO *Proceed to Step 11.*
11. Set digital multimeter to measure VDC.
12. Connect red test lead to wire 130 (1) in connector.
13. Connect black test lead to known good ground.
14. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 15.*

    NO *Wire 130 (1) is faulty. Repair or replace wire 130.*
15. Set digital multimeter to measure VDC.
16. Connect red test lead to wire positive battery terminal.
17. Connect black test lead to wire 134 (2).
18. Using digital multimeter, test for test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Front right work light circuit is okay.*

    NO *Wire 134 (2) is faulty. Repair or replace wire 134.*

Accessory Outlet Test

See **Figure 3-53**.

Required Tools or Equipment
Digital Multimeter

1. Park the machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Check accessory outlet fuse F008.

    Is accessory outlet fuse F008 faulty?

    YES *Accessory outlet fuse F008 is faulty. Replace accessory outlet fuse fuse F008.*

    NO *Proceed to Step 3.*
3. Remove instrument panel. (See "**Right Shell Removal and Installation**" on **page 5-5**.)

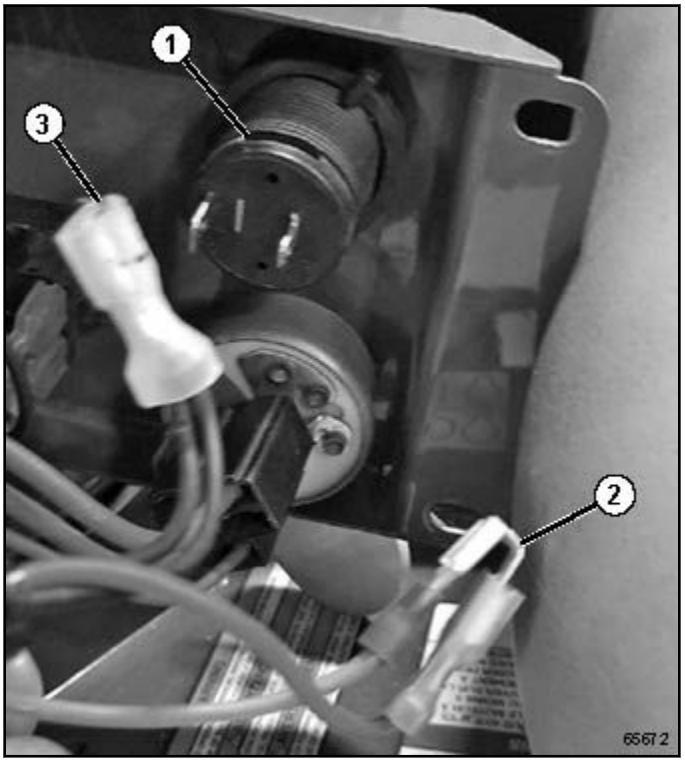


Figure 3-53: Accessory Outlet Terminal View

4. Disconnect electrical connectors from accessory outlet (1).
5. Turn key switch to the on position.
6. Turn work light switch to the on position.
7. Set digital multimeter to measure VDC.
8. Connect red test lead to wire 51 (2).
9. Connect black test lead to wire 45 (3).
10. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Accessory outlet is faulty. Replace accessory outlet is.*

    NO *Proceed to Step 11.*
11. Set digital multimeter to measure VDC.
12. Connect red test lead to wire 51 (2).
13. Connect black test lead to known good ground.
14. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 15.*

    NO *Wire 45 is faulty. Repair or replace wire 45.*
15. Set digital multimeter to measure VDC.
16. Connect red test lead to wire positive battery terminal.
17. Connect black test lead to wire 45 (3).
18. Using digital multimeter, test for test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Accessory outlet circuit is okay.*

    NO *Wire 51 faulty. Repair or replace wire 51.*

Wheel Kit Circuit Test

See **Figure 3-54**.

Required Tools or Equipment
Digital Multimeter

1. Park the machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Check wheel kit fuse F007.

   Is wheel kit fuse F007 faulty?

   YES *Wheel kit fuse F007 is faulty. Replace wheel kit fuse F007.*

   NO *Proceed to Step 3.*
3. Check wheel kit switch.

   Is wheel kit switch faulty?

   YES *Wheel kit switch is faulty. Replace wheel kit switch.*

   NO *Proceed to Step 4.*

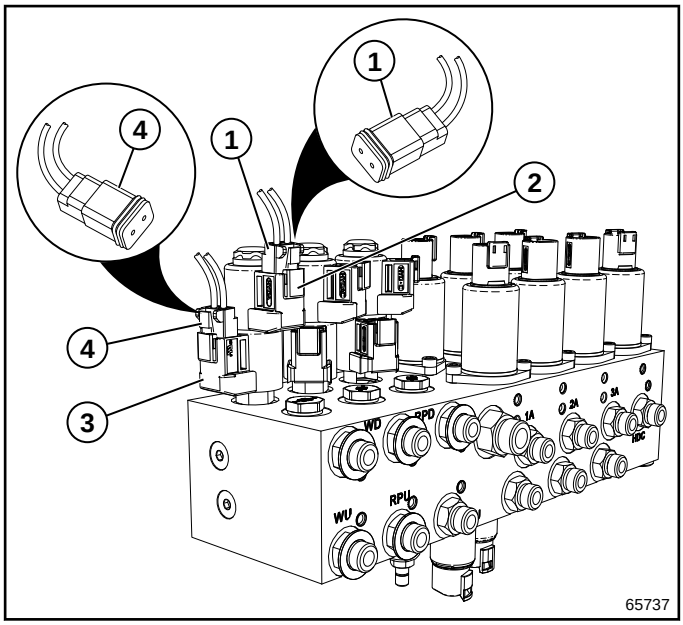


Figure 3-54: Wheel Kit Solenoids

4. Make sure electrical connector (1) is properly connected at wheel kit up solenoid Y181 (2).

   Is electrical connector (1) properly connected?

   YES *Proceed to Step 5.*

   NO *Electrical connector is not properly connected. Connect electrical connector.*

5. Disconnect electrical connector (1) from wheel kit up solenoid Y181 (2).
6. Turn key switch to the on position.
7. Depress wheel kit switch to the up position.
8. Set digital multimeter to measure VDC.
9. Connect red test lead to wire 47 in connector (1).
10. Connect black test lead to wire 49 in connector (1).
11. Using digital multimeter, test for VDC with wheel kit switch depressed.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 20.*

    NO *Proceed to Step 12.*

12. Depress wheel kit switch to the up position.
13. Connect red test lead to wire 47 in connector (1).
14. Connect black test lead to known good ground.
15. Using digital multimeter, test for VDC with wheel kit switch depressed.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 16.*

    NO *Wire 49 is faulty. Repair or replace wire 49.*

16. Depress wheel kit switch to the up position.
17. Connect red test lead to positive battery terminal.
18. Connect black test lead to wire 49 in connector (1).
19. Using digital multimeter, test for VDC with wheel kit switch depressed.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 20.*

    NO *Wire wire 47 faulty. Repair or replace wire wire 47.*

20. Make sure electrical connector (4) is properly connected at wheel kit down solenoid Y182 (3).

    Is all electrical connector (4) properly connected?

    YES *Proceed to Step 21.*

    NO *Electrical connector is not properly connected. Connect electrical connector.*

21. Depress wheel kit switch to the down position.
22. Connect red test lead to wire 48 in connector (4).
23. Connect black test lead to wire 50 in connector (4).
24. Using digital multimeter, test for VDC with wheel kit switch depressed.

    Are at least 10.5 VDC indicated?

    YES *Wheel kit circuit is okay.*

    NO *Proceed to Step 25.*

25. Depress wheel kit switch to the down position.
26. Set digital multimeter to measure VDC.
27. Connect red test lead to wire 48 in connector (4).
28. Connect black test lead to known good ground.
29. Using digital multimeter, test for VDC with wheel kit switch depressed.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 30.*

    NO *Wire 50 is faulty. Repair or replace wire 50.*

30. Depress wheel kit switch to the down position.
31. Connect red test lead to positive battery terminal.
32. Connect black test lead to wire 50 in connector (4).
33. Using digital multimeter, test for VDC with wheel kit switch depressed.

    Are at least 10.5 VDC indicated?

    YES *Wheel kit circuit is okay.*

    NO *Wire 48 faulty. Repair or replace wire 48.*

Gyroscopic Steering Circuit Test

See **Figure 3-57**.

Required Tools or Equipment
Digital Multimeter

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Check gyro fuse F013.

   Is gyro fuse F013 faulty?

   YES *Gyro fuse F013 is faulty. Replace gyro fuse F013.*

   NO *Proceed to Step 3.*

3. Check gyroscopic steering switch. (See "**Gyroscopic Steering Switch Test**" on **page 3-53**.)

   Is gyroscopic steering switch faulty?

   YES *Gyroscopic steering switch is faulty. Replace gyroscopic steering switch.*

   NO *Proceed to Step 4.*

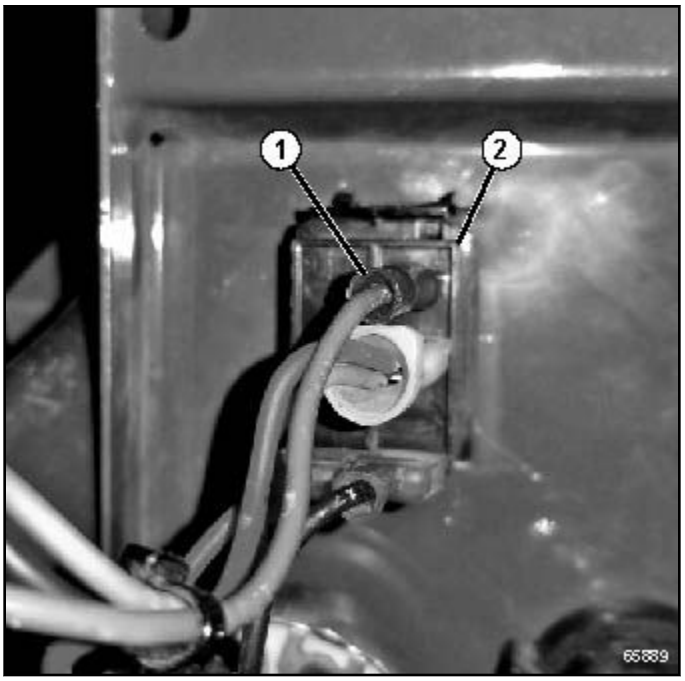


Figure 3-55: Gyroscopic Steering Switch Terminal View

4. Remove control panel. (See **Right Shell Removal and Installation**.)
5. Turn key switch to the on position.
6. Press gyroscoppic steering switch to on position
7. Set digital multimeter to measure VDC.
8. Connect red test lead to wire 170 (1) on gyroscopic steering switch (2).
9. Connect black test lead to a known good ground.
10. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 11.*

    NO *Wire 170 (1) is faulty. Repair or replace wire 170 (1).*

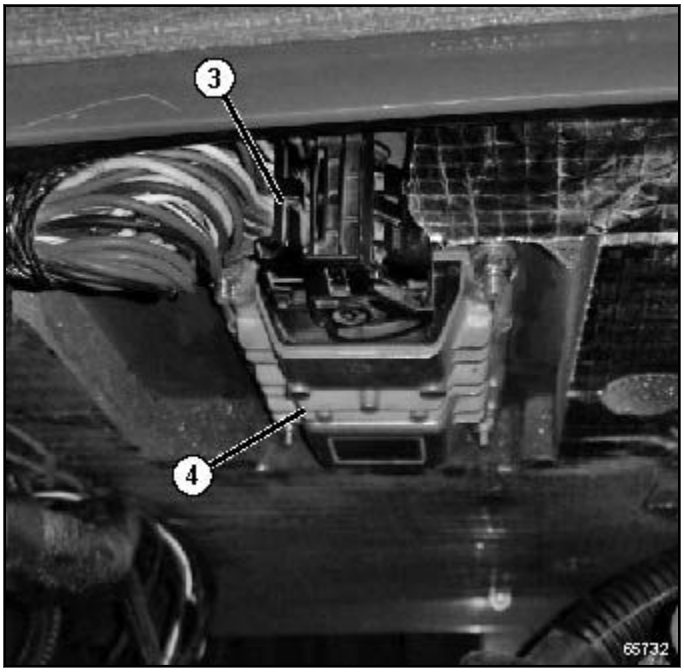


Figure 3-56: Machine Controller and Electrical Connector

11. Using red test lead, backprobe wire 168 in electrical connector (3) on machine controller (4).
12. Connect black test lead to a known good ground.
13. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Wire 168 is faulty. Repair or replace wire 168.*

    NO *Proceed to Step 14.*

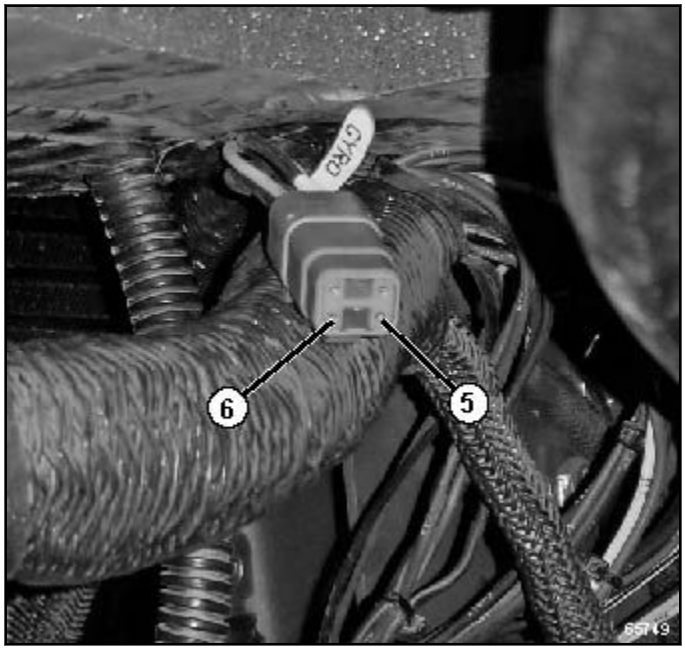


Figure 3-57: Steering Controller Terminal View

14. Disconnect gyro module electrical connector.
15. Connect red test lead to wire 172 (5) in connector.
16. Connect black test lead to wire 171 (6) in connector.
17. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Possible faulty gyro module. Contact Wacker Nueson support for further instructions.*

    NO *Proceed to Step 10.*
18. Connect red test lead to wire 172 (5) in connector.
19. Connect black test lead to known good ground.
20. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 14.*

    NO *Wire 171 (6) is faulty. Repair or replace wire 171 (6).*
21. Connect red test lead to positive battery terminal.
22. Connect black test lead to wire 171 (6) in connector.
23. Using digital multimeter, test for test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 18.*

    NO *Wire 172 (5) faulty. Repair or replace wire 172 (5).*

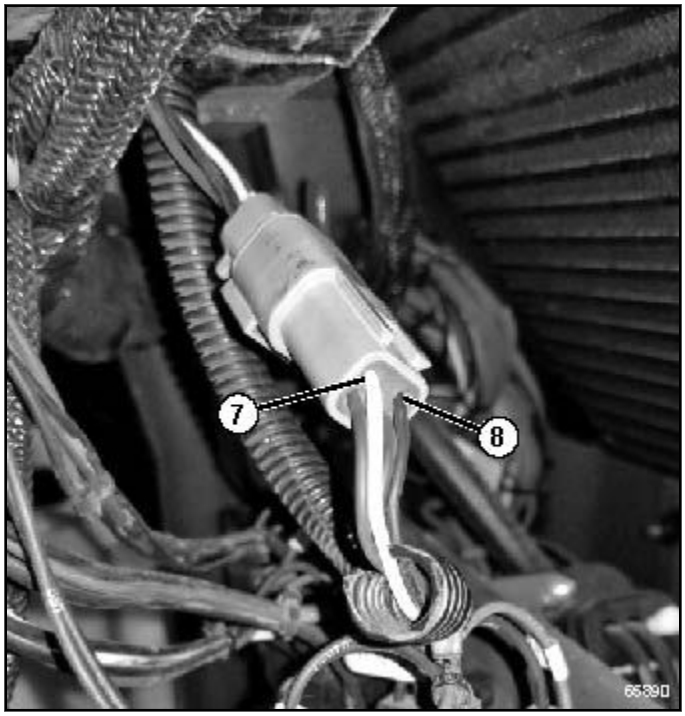


Figure 3-58: Steering Controller Terminal View

24. Connect gyro module electrical connector.
25. Using red test lead, backprobe wire 176 (7) in connector.
26. Connect black test lead to known good ground .
27. Using digital multimeter, test for test for VDC.

    Are at least 0.5 VDC indicated?

    YES *Proceed to Step 28.*

    NO *Wire 176 (7) faulty. Repair or replace wire 176 (7).*
28. Set digital multimeter to measure VDC.
29. Using red test lead, backprobe wire 176 (7) in connector.
30. Using black test lead, backprobe wire 181 (8) in connector.
31. Using digital multimeter, test for test for VDC.

    Are at least 0.5 VDC indicated?

    YES *Gyroscopic steering circuit is okay.*

    NO *Wire 181 (8) faulty. Repair or replace wire 181 (8).*

Fuel Cooler Fan Test

See **Figure 3-59**.

Required Tools or Equipment
Digital Multimeter

1. Park the machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Check fuel cooler fan fuse F009.

   Is fuel cooler fan fuse F009 faulty?

   YES *Fuel cooler fan fuse F009 is faulty. Replace fuel cooler fan fuse F009.*

   NO *Proceed to Step 3.*

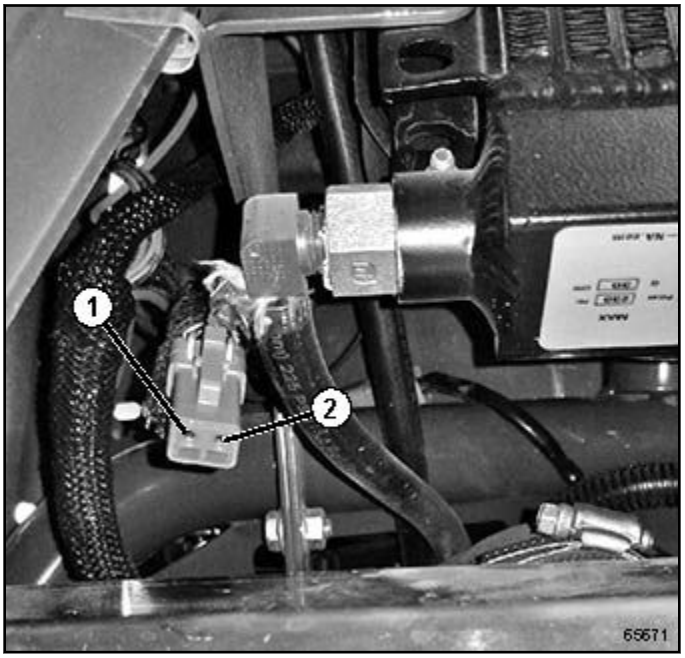


Figure 3-59: Fuel Cooler Fan Electrical Connector

3. Disconnect fuel cooler fan electrical connector. (See "**Oil Cooler**" on **page 4-49**.)
4. Turn key switch to the on position.
5. Set digital multimeter to measure VDC.
6. Connect red test lead to wire 197 (1) in connector.
7. Connect black test lead to wire 198 (2) in connector.
8. Using digital multimeter, test for VDC.

   Are at least 10.5 VDC indicated?

   YES *Fuel cooler fan is faulty. Repair or replace fuel cooler fan.*

   NO *Proceed to Step 9.*

9. Set digital multimeter to measure VDC.
10. Connect red test lead to wire to battery positive terminal.
11. Connect black test lead to wire 198 (2) in connector.
12. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Proceed to Step 13.*

    NO *Wire 198 is faulty. Repair or replace wire 198 (2).*

13. Set digital multimeter to measure VDC.
14. Connect red test lead to wire to wire 197 (1) in connector.
15. Connect black test lead to known good ground.
16. Using digital multimeter, test for VDC.

    Are at least 10.5 VDC indicated?

    YES *Fuel cooler fan is faulty. Repair or replace fuel cooler fan.*

    NO *Wire 197 is faulty. Repair or replace wire 197 (1).*

Controller Area Network (CAN) Test

See **Figures 3-60** through **3-63**.

Required Tools or Equipment
Digital Multimeter

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)

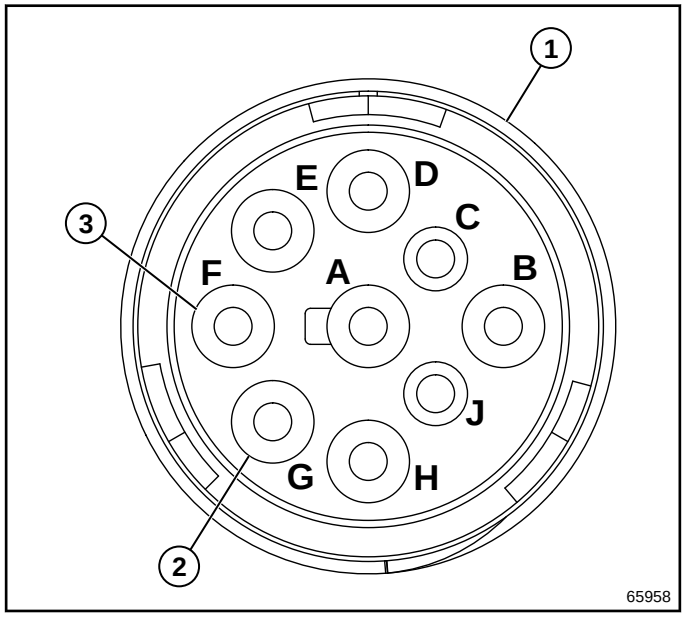


Figure 3-60: Diagnostic Connector

2. Set digital multimeter to measure ohms.
3. Connect red test lead to pin G (2) in diagnostic connector (1).
4. Connect black test lead to pin F (3) in diagnostic connector (1).
5. Using digital multimeter, test for ohms.

   Are approximately 60 ohms indicated?

   YES *CAN circuit is okay.*

   NO *Proceed to Step 6.*

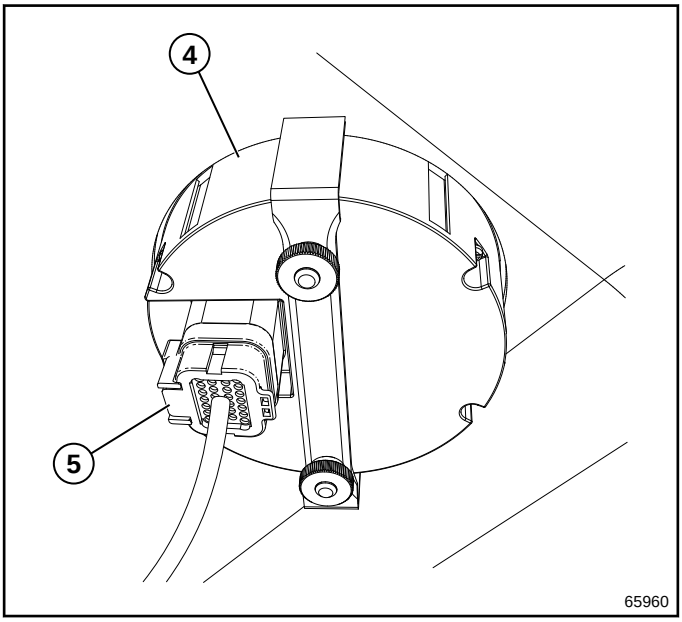


Figure 3-61: Display (Bottom View)

6. Disconnect display electrical connector (5) from display (4). (See "**Display**" on **page 3-90**.)
7. Connect red test lead to pin 23 of display (4).
8. Connect black test lead to pin 24 of display (4).
9. Using digital multimeter, test for ohms.

   Are approximately 120 ohms indicated?

   YES *Proceed to Step 10.*

   NO *Display is faulty. Replace display. (See "**Display**" on **page 3-90**.)*

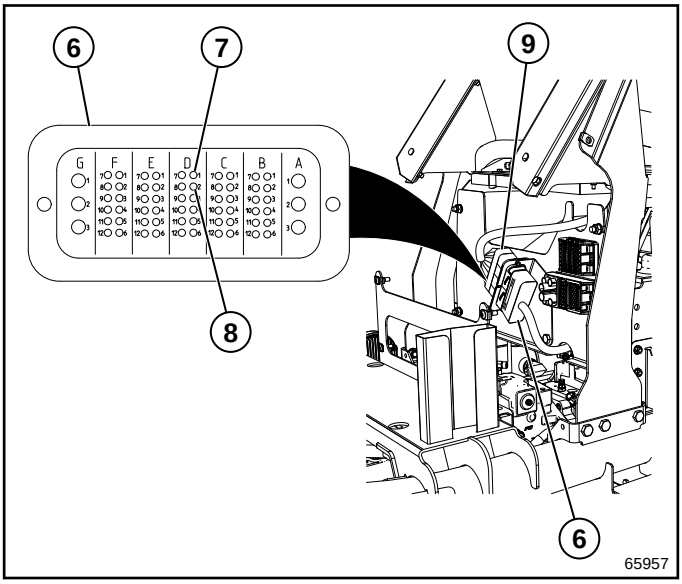


Figure 3-62: Machine Harness Electrical Connector and Engine Harness

10. Disconnect machine harness electrical connector (9) from engine harness (6).
11. Connect red test lead to pin D1 (7) of engine harness (6).
12. Connect black test lead to pin D2 (8) of engine harness (6).
13. Using digital multimeter, test for ohms.

    Are approximately 120 ohms indicated?

    YES *Proceed to Step 14.*

    NO *Possible faulty Engine Control Unit. A separate engine manual, prepared by the engine manufacturer, is supplied with this machine. Refer to the engine manufacturer's manual for all engine-related service.*

NOTE

Machine controller may be removed if needed to gain access to wiring harness.

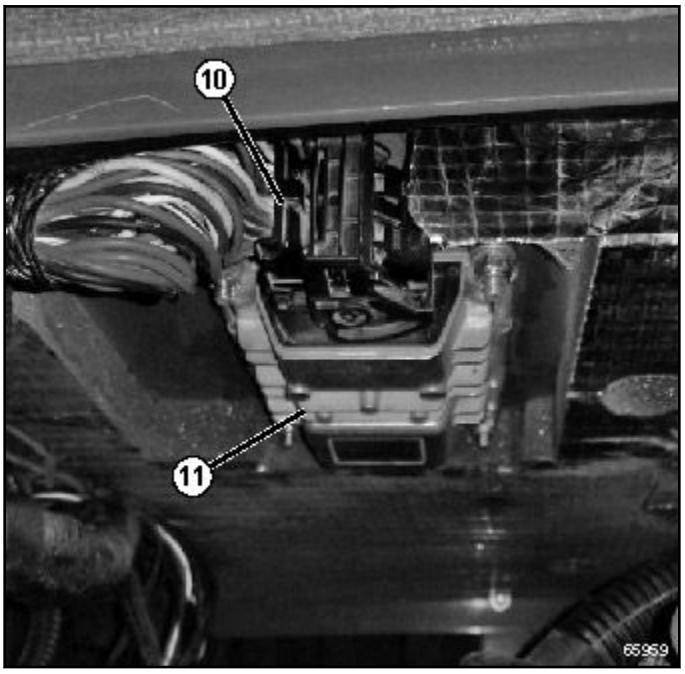


Figure 3-63: Machine Controller and Electrical Connector

14. Disconnect machine controller electrical connector (10) from machine controller (11). (See "**Engine**" on **page 2-5**.)
15. Connect red test lead to wire 73-TP4 in diagnostic connector (1).
16. Connect black test lead to wire 89-TP1 of machine harness electrical connector (9).
17. Using digital multimeter, test for continuity.

    Is continuity indicated?

    YES *Proceed to Step 18.*

    NO *Wire 73-TP4 or 89-TP1 are faulty. Repair or replace wires 73-TP4 and/or 89-TP1.*

18. Connect red test lead to wire 74-TP4 in diagnostic connector (1).
19. Connect black test lead to wire 70-TP1 in machine harness electrical connector (9).
20. Using digital multimeter, test for continuity.

    Is continuity indicated?

    YES *Proceed to Step 21.*

    NO *Wire 74-TP4 and/or 70-TP1 are faulty. Repair or replace wires 74-TP4 and/or 70-TP1.*

21. Connect red test lead to wire 73-TP4 in diagnostic connector (1).
22. Connect black test lead to wire 189-TP7 in display electrical connector (5).
23. Using digital multimeter, test for continuity.

    Is continuity indicated?

    YES *Proceed to Step 24.*

    NO *Wires 60-TP2, 222-TP3, and/or 189-TP7 are faulty. Repair or replace wires 60-TP2, 222-TP3, and/or 189-TP7.*

24. Connect red test lead to wire 74-TP4 in diagnostic connector (1).
25. Connect black test lead to wire 190-TP7 in display electrical connector (5).
26. Using digital multimeter, test for continuity.

    Is continuity indicated?

    YES *Proceed to Step 27.*

    NO *Wires 61-TP2, 223-TP3, and/or 190-TP7 are faulty. Repair or replace wires 61-TP2, 223-TP3, and/or 190-TP7.*

27. Connect red test lead to wire 73-TP4 in diagnostic connector (1).
28. Connect black test lead to wire 33-TP5 in machine controller electrical connector (10).
29. Using digital multimeter, test for continuity.

    Is continuity indicated?

    YES *Proceed to Step 30.*

    NO *Wire 33-TP5 is faulty. Repair or replace wire 33-TP5.*

30. Connect red test lead to wire 74-TP4 in diagnostic connector (1).
31. Connect black test lead to wire 32-TP5 in machine controller electrical connector (10).
32. Using digital multimeter, test for continuity.

    Is continuity indicated?

    YES *CAN circuit is okay.*

    NO *Wire 32-TP5 is faulty. Repair or replace wire 32-TP5.*

Repair

Right Joystick

Removal and Installation

See **Figures 3-64** through **3-66**.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Open battery cover.

WARNING

Always disconnect the negative terminal first and positive terminal last. Connect positive terminal first and negative terminal last. Use care when testing live circuits to prevent arcing. Arcing could result in death or serious injury.

3. Disconnect negative battery cable at battery.

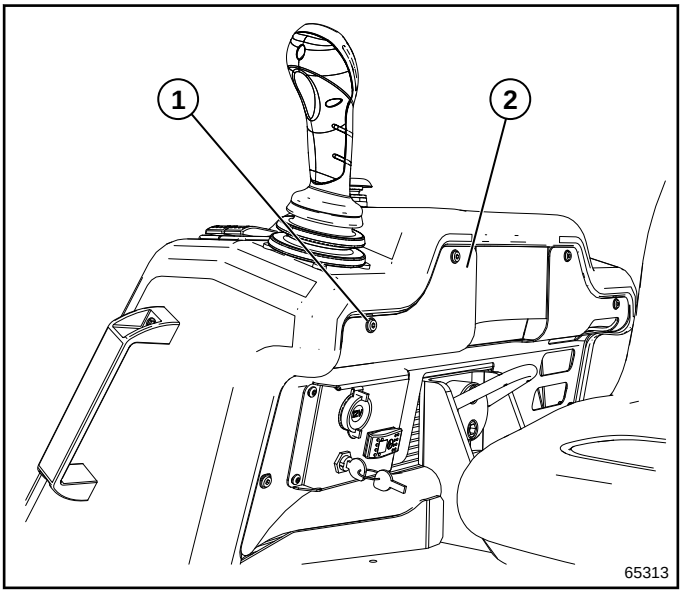


Figure 3-64: Panel Removal and Installation

4. Remove screws (1) from panel (2) and position panel (2) aside.

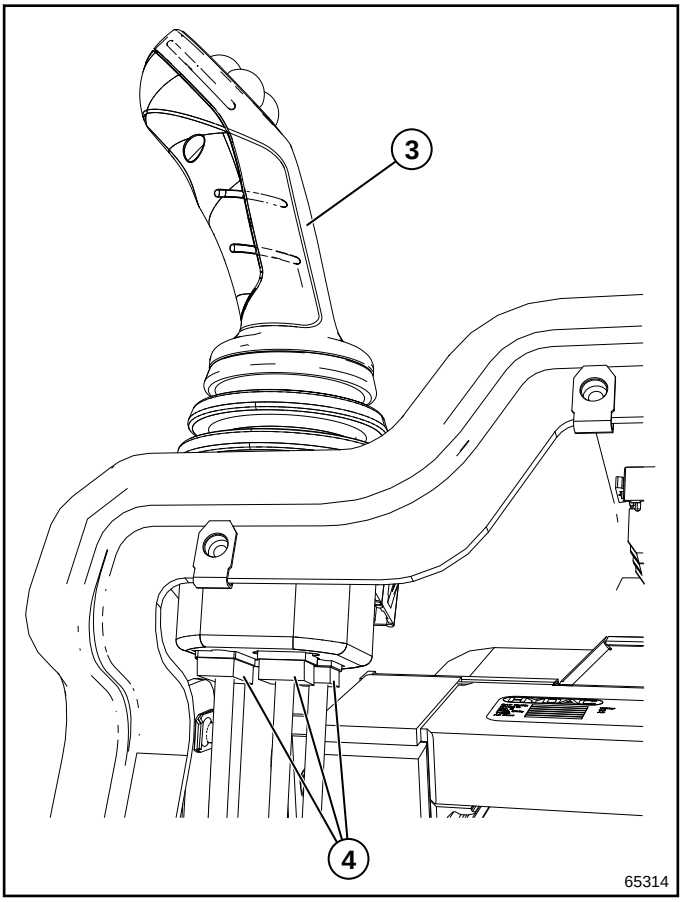


Figure 3-65: Connector Removal and Installation

5. Disconnect electrical connectors (4) from right joystick (3)

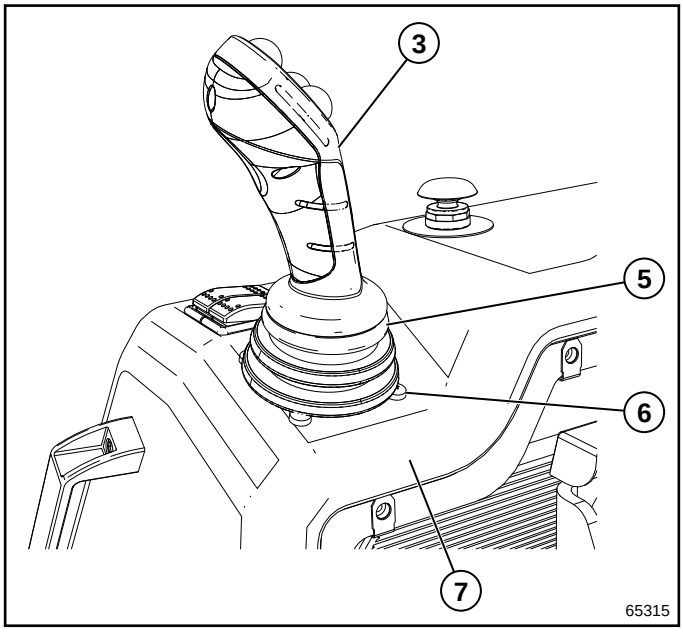


Figure 3-66: Right Joystick Removal and Installation

6. Pull back boot (5) and remove screws (6) and right joystick (3) from machine (7).

Installation Notes

- *Install right joystick by reversing the order of removal.*

Left Joystick

Removal and Installation

See **Figures 3-67** through **3-69**.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Open battery cover.

⚠ WARNING

Always disconnect the negative terminal first and positive terminal last. Connect positive terminal first and negative terminal last. Use care when testing live circuits to prevent arcing. Arcing could result in death or serious injury.

3. Disconnect negative battery cable at battery.

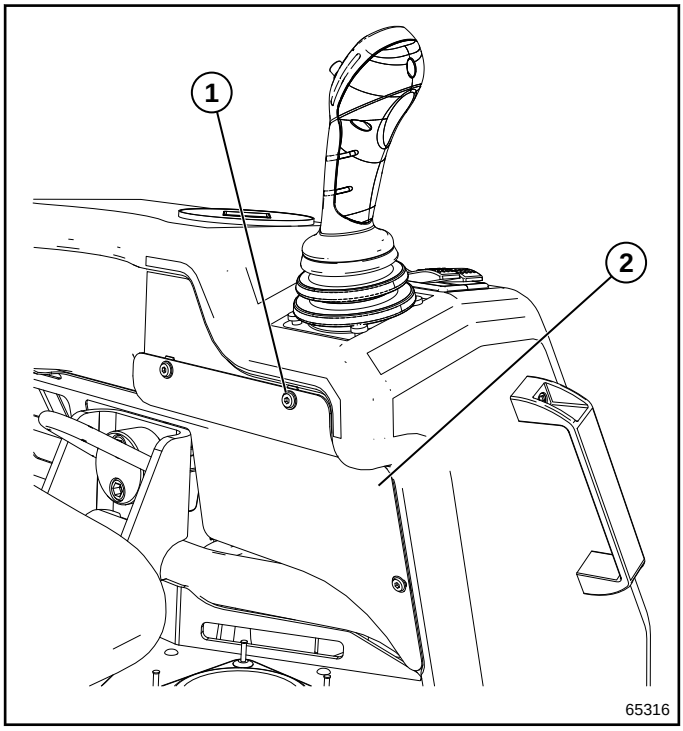


Figure 3-67: Panel Removal and Installation

4. Remove screws (1) from panel (2) and position panel (2) aside.

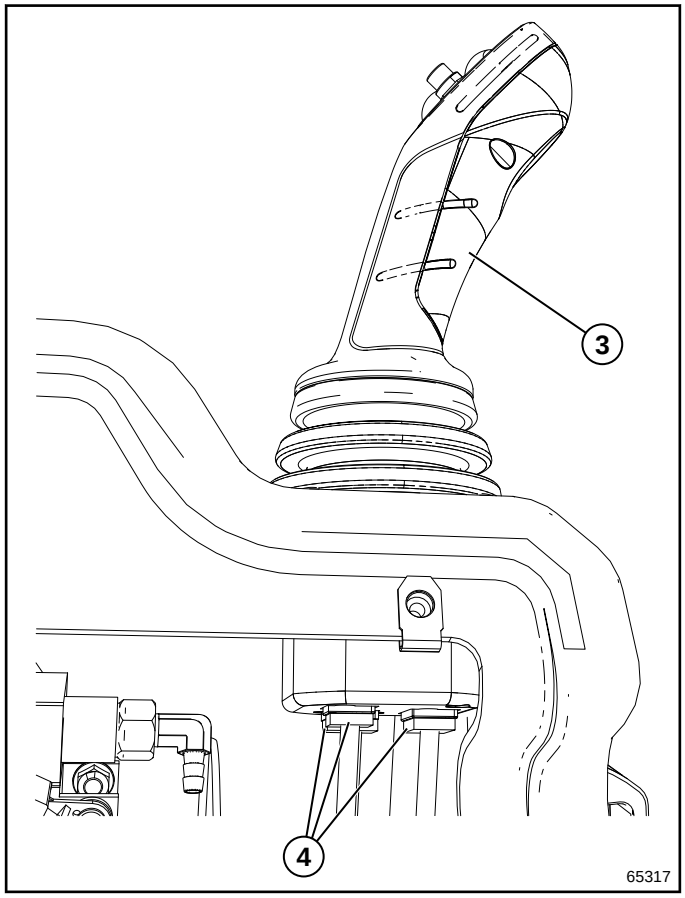


Figure 3-68: Connector Removal and Installation

5. Disconnect electrical connectors (4) from left joystick (3).

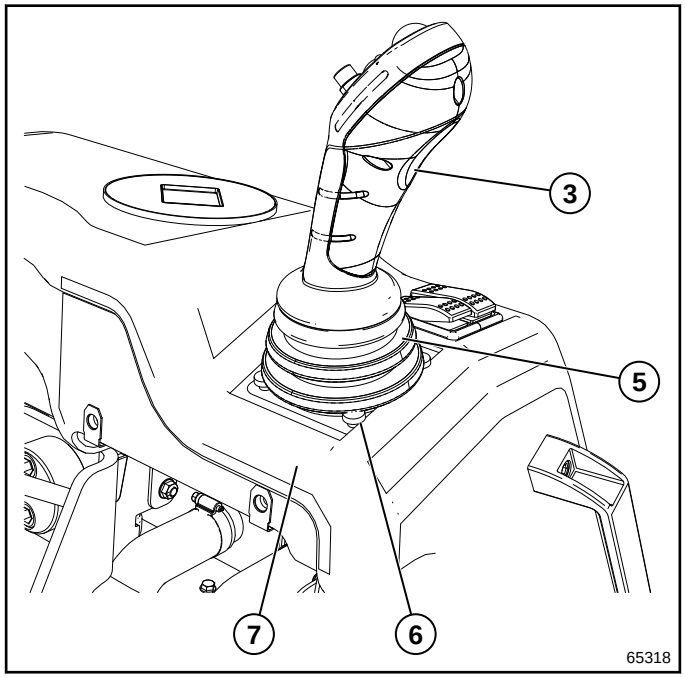


Figure 3-69: Left Joystick Removal and Installation

6. Pull back boot (5) and remove screws (6) and left joystick (3) from machine (7).

Installation Notes

- *Install left joystick by reversing the order of removal.*

Pitch Control Buttons

Removal and Installation

See **Figures 3-70** and **3-71**.

NOTE

Both sets of pitch control buttons are removed from each joystick the same way. Left joystick pitch control buttons are shown.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Open battery cover.

WARNING

Always disconnect the negative terminal first and positive terminal last. Connect positive terminal first and negative terminal last. Use care when testing live circuits to prevent arcing. Arcing could result in death or serious injury.

3. Disconnect negative battery cable at battery.

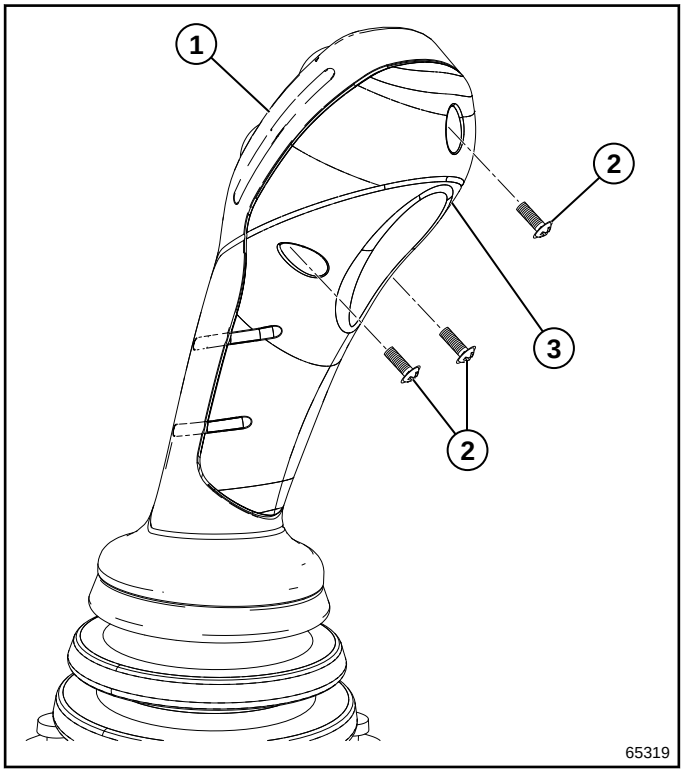


Figure 3-70: Joystick Cover Removal and Installation

4. Remove screws (2) and joystick cover (3) from joystick (1).

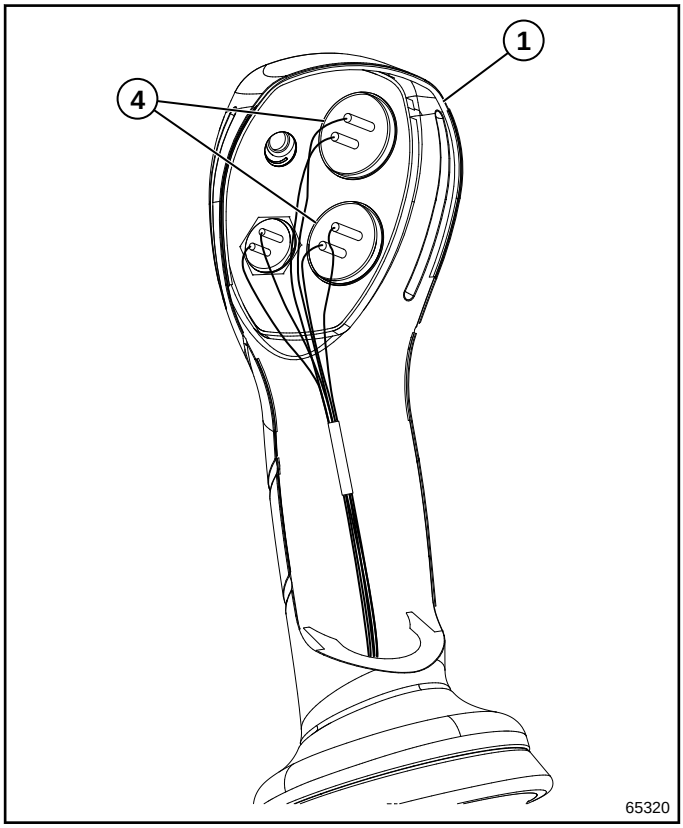


Figure 3-71: Pitch Control Buttons Removal and Installation

NOTE

Label all wires before disconnecting to ensure correct installation.

5. Cut wires at pitch control buttons (4).
6. Remove nuts and pitch control buttons (4) from joystick (1).

Installation Notes

- *Install pitch control buttons by reversing the order of removal.*
- *Solder wires as noted prior to removal.*
- *Seal solder joints with shrink tubing.*

Steering Mode Switch

Removal and Installation

See **Figures 3-72** and **3-73**.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Open battery cover.

WARNING

Always disconnect the negative terminal first and positive terminal last. Connect positive terminal first and negative terminal last. Use care when testing live circuits to prevent arcing. Arcing could result in death or serious injury.

3. Disconnect negative battery cable at battery.

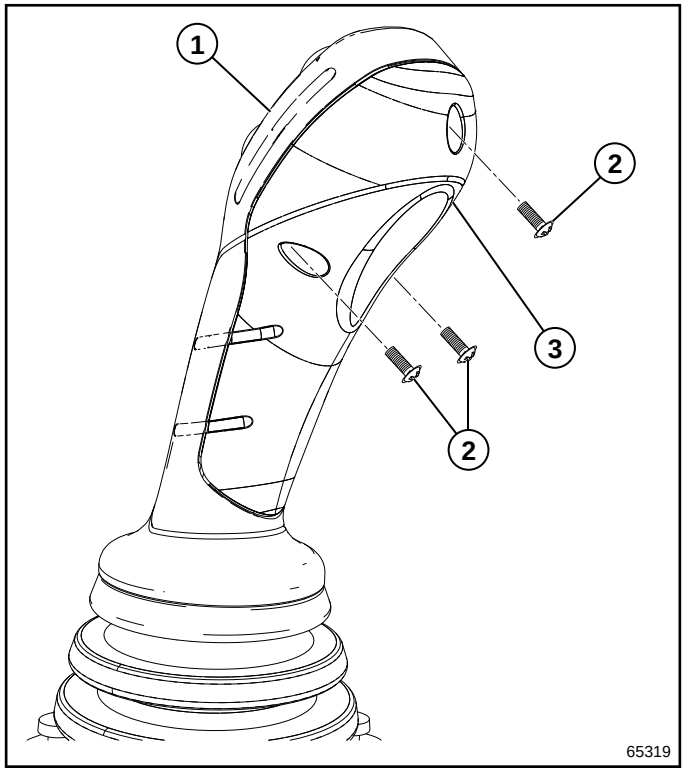


Figure 3-72: Joystick Cover Removal and Installation

4. Remove screws (2) and joystick cover (3) from left joystick (1).

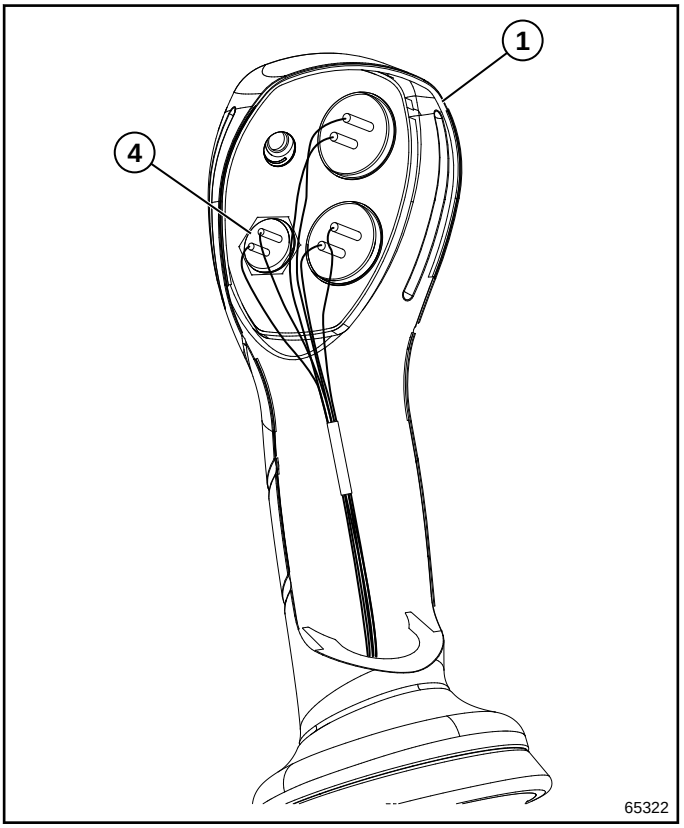


Figure 3-73: Steering Mode Switch Removal and Installation

NOTE

Label all wires before disconnecting to ensure correct installation.

5. Cut wires at steering mode switch (4).
6. Remove nut and steering mode switch (4) from left joystick (1).

Installation Notes

- *Install steering mode switch by reversing the order of removal.*
- *Solder wires as noted prior to removal.*
- *Seal solder joints with shrink tubing.*

Retardant Spray Button

Removal and Installation

See **Figures 3-74** and **3-75**.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Open battery cover.

WARNING

Always disconnect the negative terminal first and positive terminal last. Connect positive terminal first and negative terminal last. Use care when testing live circuits to prevent arcing. Arcing could result in death or serious injury.

3. Disconnect negative battery cable at battery.

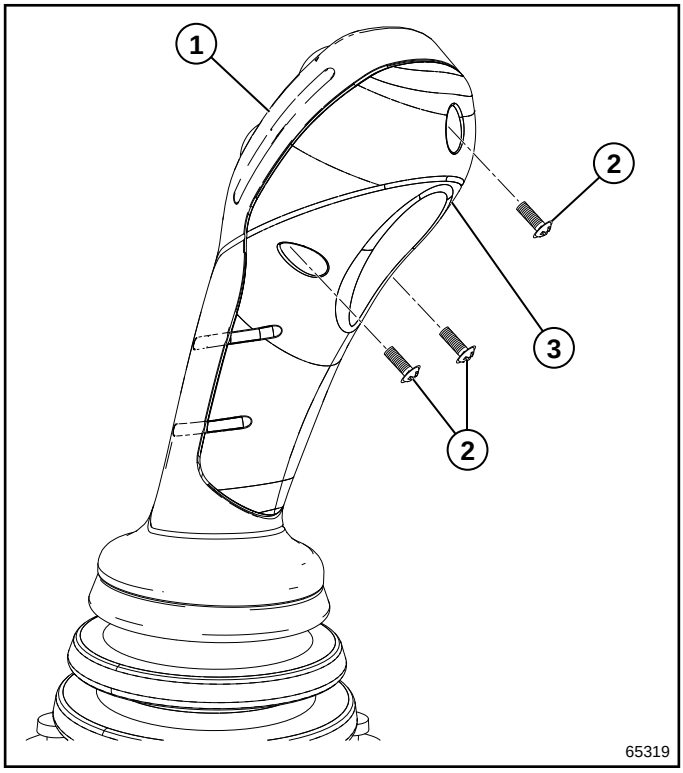


Figure 3-74: Joystick Cover Removal and Installation

4. Remove screws (2) and joystick cover (3) from right joystick (1).

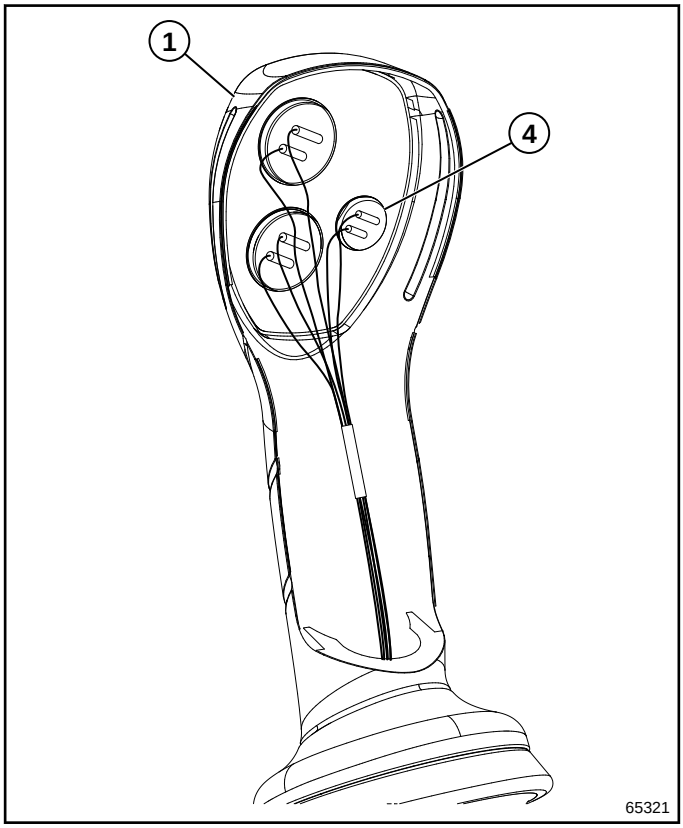


Figure 3-75: Retardant Spray Button Removal and Installation

NOTE

Label all wires before disconnecting to ensure correct installation.

5. Cut wires at retardant spray button (4).
6. Remove nut and retardant spray button (4) from right joystick (1).

Installation Notes

- *Install retardant spray button by reversing the order of removal.*
- *Solder wires as noted prior to removal.*
- *Seal solder joints with shrink tubing.*

Rocker Switch

Removal and Installation

NOTE

All rocker switches are removed the same way. Throttle rocker switch is shown.

See **Figure 3-76**.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Open battery cover.

WARNING

Always disconnect the negative terminal first and positive terminal last. Connect positive terminal first and negative terminal last. Use care when testing live circuits to prevent arcing. Arcing could result in death or serious injury.

3. Disconnect negative battery cable at battery.
4. Remove right joystick. (See "**Right Joystick**" on **page 3-80**.)

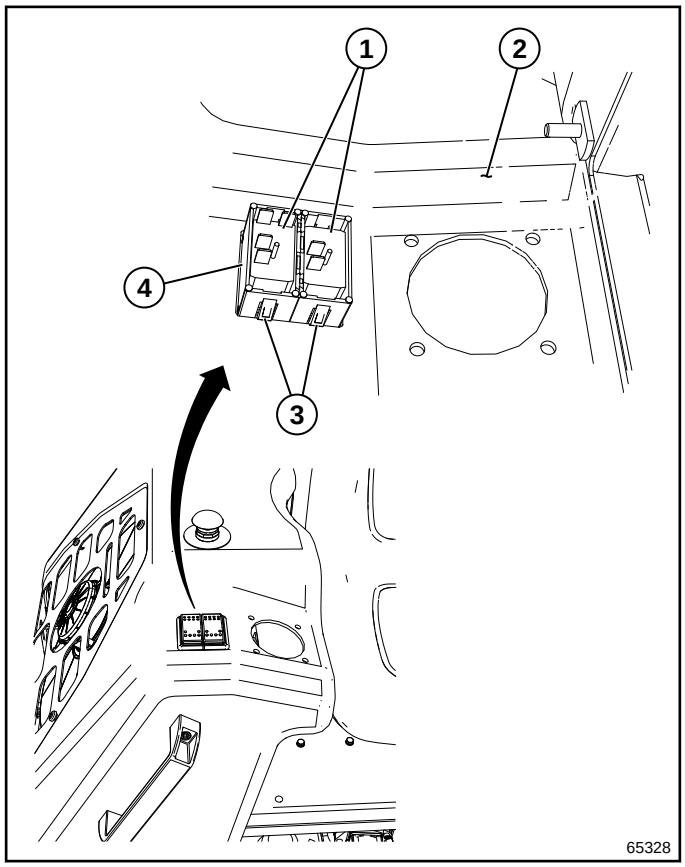


Figure 3-76: Throttle Switch Removal and Installation

NOTE

Label all connectors before disconnecting to ensure correct installation.

5. Disconnect electrical connectors (1) from rocker switch (4).
6. Depress tabs (3) and remove rocker switch (4) from machine (2).

Installation Note

Install rocker switch by reversing the order of removal.

Seat and Seat Switch

Removal and Installation

See **Figures 3-77** through **3-79**.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Open battery cover.

WARNING

Always disconnect the negative terminal first and positive terminal last. Connect positive terminal first and negative terminal last. Use care when testing live circuits to prevent arcing. Arcing could result in death or serious injury.

3. Disconnect negative battery cable at battery.

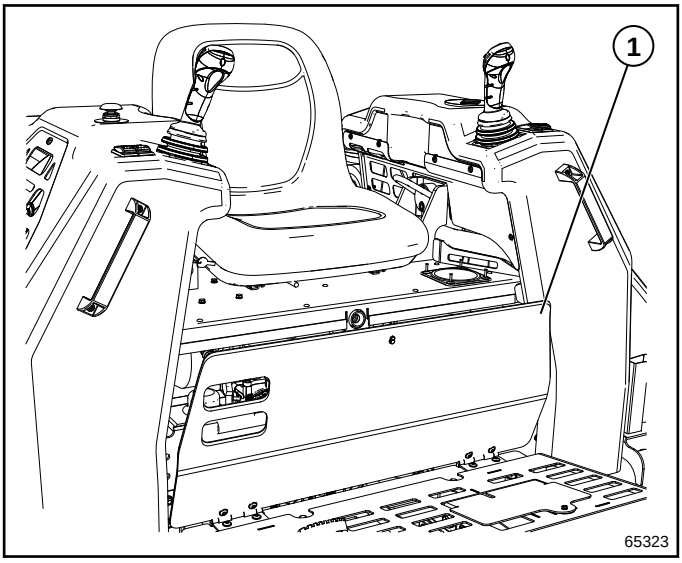


Figure 3-77: Access Panel

4. Unlatch and open access panel (1).

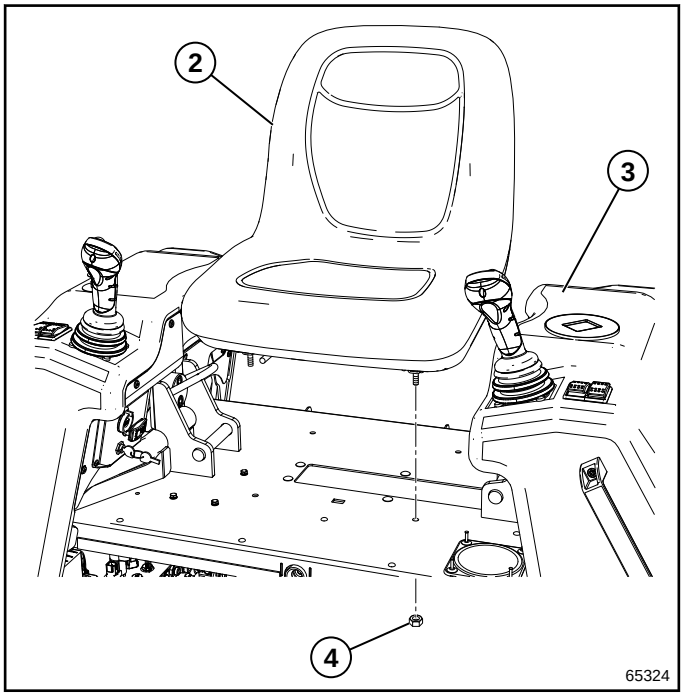


Figure 3-78: Seat Removal and Installation

5. Remove nuts (4) and seat (2) from machine (3).

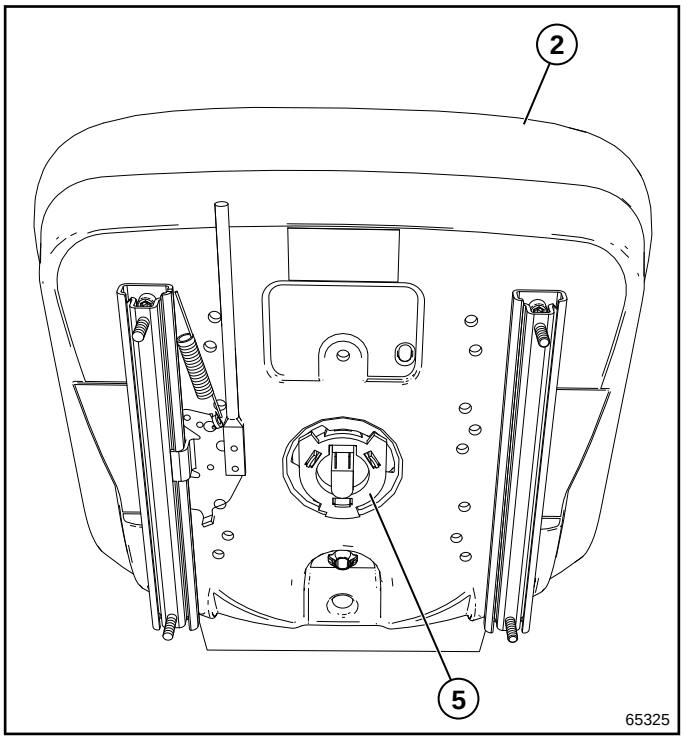


Figure 3-79: Seat Switch Removal and Installation

6. Disconnect electrical connector from seat switch (5).
7. Rotate and remove seat switch (5) from seat (2).

Installation Notes

- *Install seat and seat switch by reversing the order of removal.*
- *Torque seat screws to 13 lb-ft (18 N•m).*

Foot Pedal

Removal and Installation

See **Figures 3-80** and **3-81**.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Open battery cover.

WARNING

Always disconnect the negative terminal first and positive terminal last. Connect positive terminal first and negative terminal last. Use care when testing live circuits to prevent arcing. Arcing could result in death or serious injury.

3. Disconnect negative battery cable at battery.

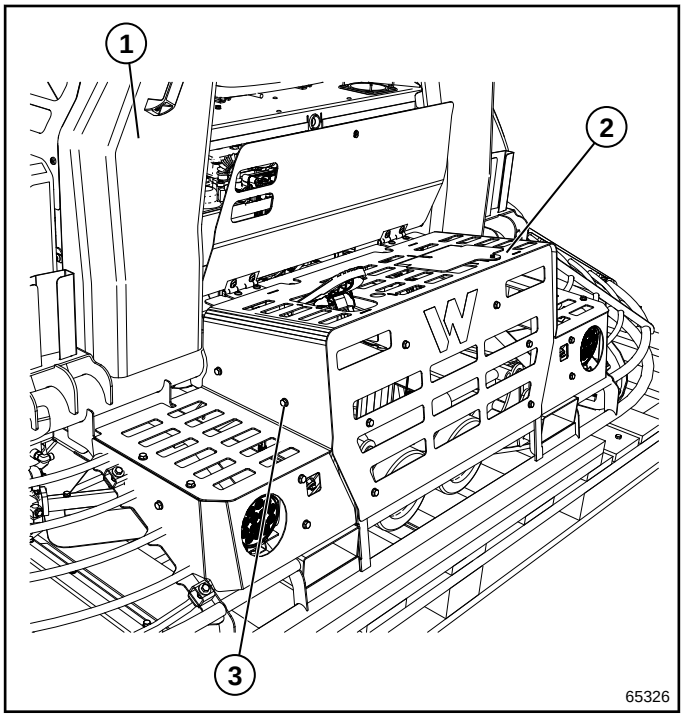


Figure 3-80: Foot Plate Removal and Installation

4. Remove screws (3) and foot plate (2) from machine (1).

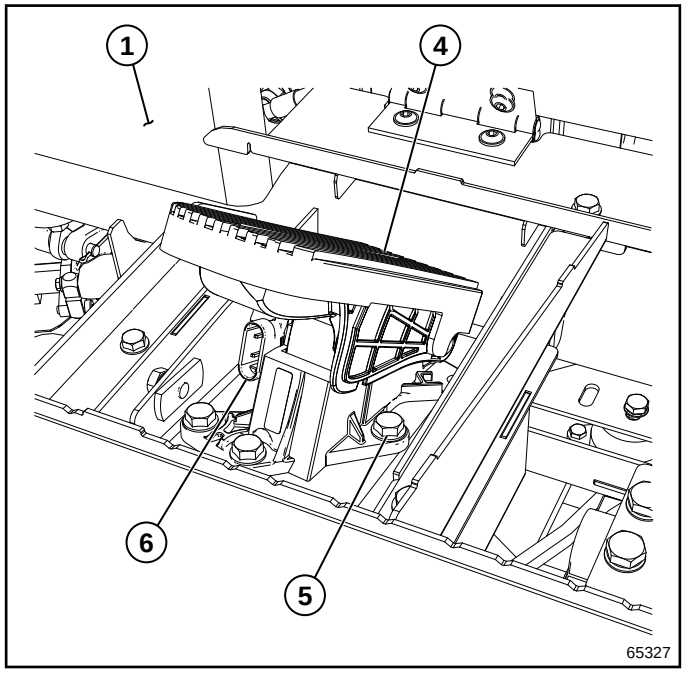


Figure 3-81: Foot Pedal Removal and Installation

5. Disconnect electrical connector (6) from foot pedal (4).
6. Remove screws and nuts (5) and foot pedal (4) from machine (1).

Installation Notes

- *Install foot pedal by reversing the order of removal.*
- *Torque screws and nuts (5) to 7 lb-ft (10 N•m).*
- *Torque screws (3) to 18 lb-ft (24 N•m).*

Emergency Stop Switch

Removal and Installation

See **Figures 3-82** through **3-84**.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Open battery cover.

WARNING

Always disconnect the negative terminal first and positive terminal last. Connect positive terminal first and negative terminal last. Use care when testing live circuits to prevent arcing. Arcing could result in death or serious injury.

3. Disconnect negative battery cable at battery.

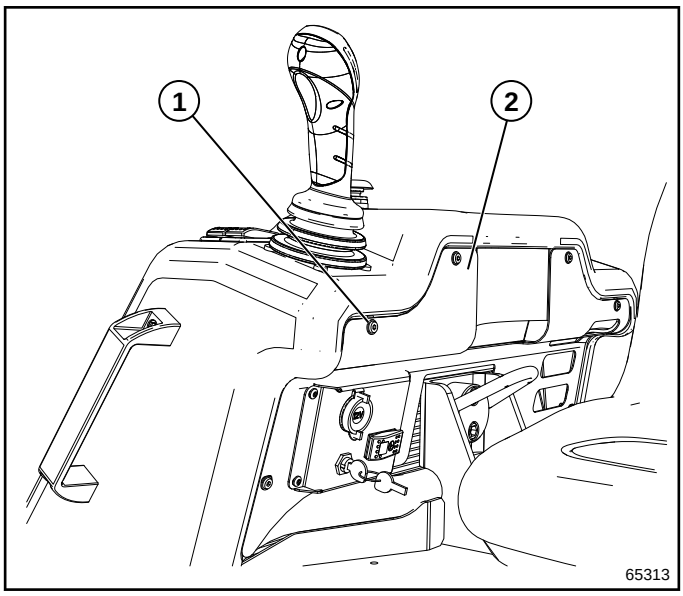


Figure 3-82: Panel Removal and Installation

4. Remove screws (1) from panel (2) and position panel (2) aside.

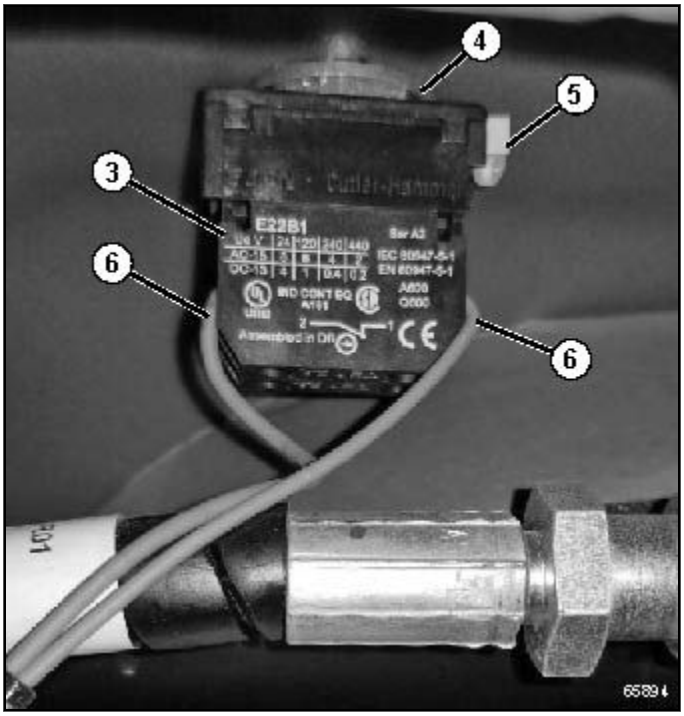


Figure 3-83: Emergency Stop Switch Bottom View

Figure 3-84: Emergency Stop Switch Top View

5. Disconnect wires (6) emergency stop switch body (3)
6. Pull back on release (5) and separate the emergency stop switch knob (7) from the emergency stop switch body (3). Remove emergency stop switch body.
7. Remove nut (4) securing emergency stop switch knob (7) to machine. Remove emergency stop switch knob.

Installation Notes

- *Install emergency stop switch by reversing the order of removal.*

Display

Removal and Installation

See **Figures 3-85** and **3-86**.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Open battery cover.

WARNING

Always disconnect the negative terminal first and positive terminal last. Connect positive terminal first and negative terminal last. Use care when testing live circuits to prevent arcing. Arcing could result in death or serious injury.

3. Disconnect negative battery cable at battery.

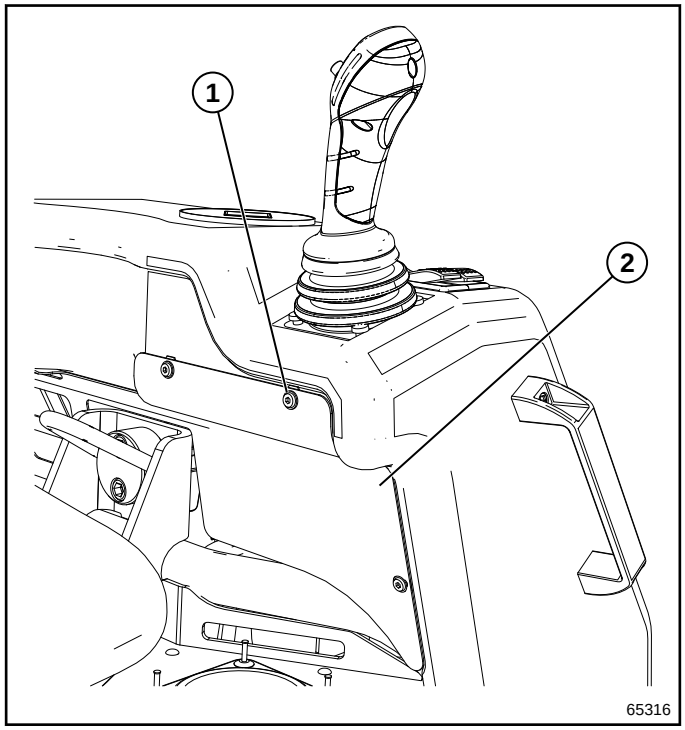


Figure 3-85: Panel Removal and Installation

4. Remove screws (1) from panel (2) and position panel (2) aside.

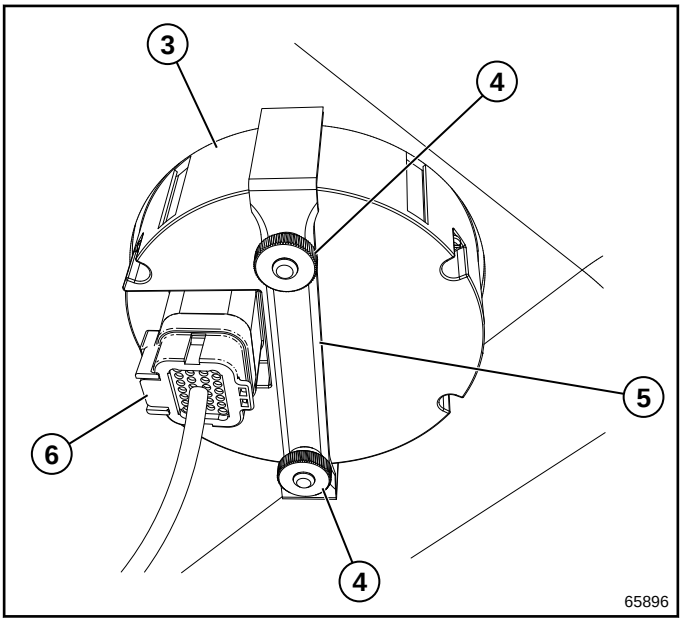


Figure 3-86: Display Removal and Installation

5. Disconnect electrical connector (6) from display (3).
6. Remove thumb nuts (4) and bracket (5) securing display (3) to macnine. remove display.

Installation Notes

- *Install display by reversing the order of removal.*
- *Align bracket on plastic posts.*
- *Gently finger tighten thumb nuts.*

Chapter 4

Hydraulics

Specifications

Test and Adjustment Specifications

Table 4-1. Test and Adjustment Specifications

Wheel Kit Operating Pressure	750 psi (52 bar)
Auxiliary Pump Flow	6 gpm (23 L/min)
Steering System Operating Pressure	750 psi (52 bar)
Charge Pump Flow	10.7 gpm (40.5 L/min)
Pitch Control System Operating Pressure	750 psi (52 bar)
Charge Pump Operating Pressure	150 - 350 psi (10 - 24 bar)
Drive Pump Operating Pressure	1500 - 4500 psi (103 - 310 bar)
Charge Pressure Adjustment	305 psi (21 bar)

Repair Specifications

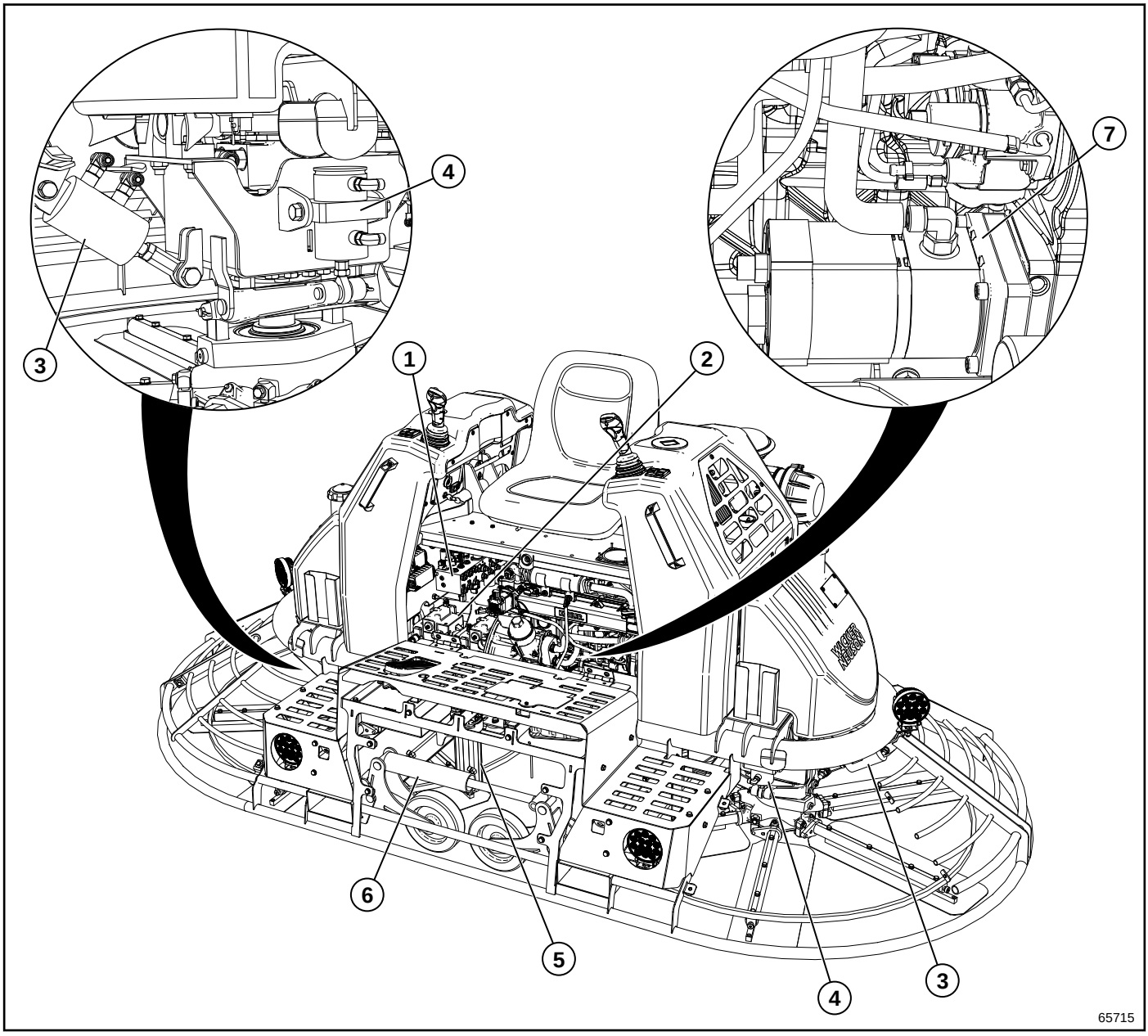
Table 4-2. Repair Specifications

Pitch Cylinder Fasteners	27 lb-ft (36 N•m)
Manifold Fasteners	36 lb-ft (49 N•m)
Blade Guard Fasteners	18 lb-ft (25 N•m)
Drive Motor Housing Fasteners	89 lb-ft (120 N•m)
Pitch Link Fasteners	63 lb-ft (85 N•m)
Drive Motor Shaft Fasteners	35 lb-ft (45 N•m)
Pivot Lever Fasteners	73 lb-ft (99 N•m)
Spider Assembly Fasteners	99 lb-ft (134 N•m)
Tandem Pump Fasteners	46 lb-ft (63 N•m)

Component Location

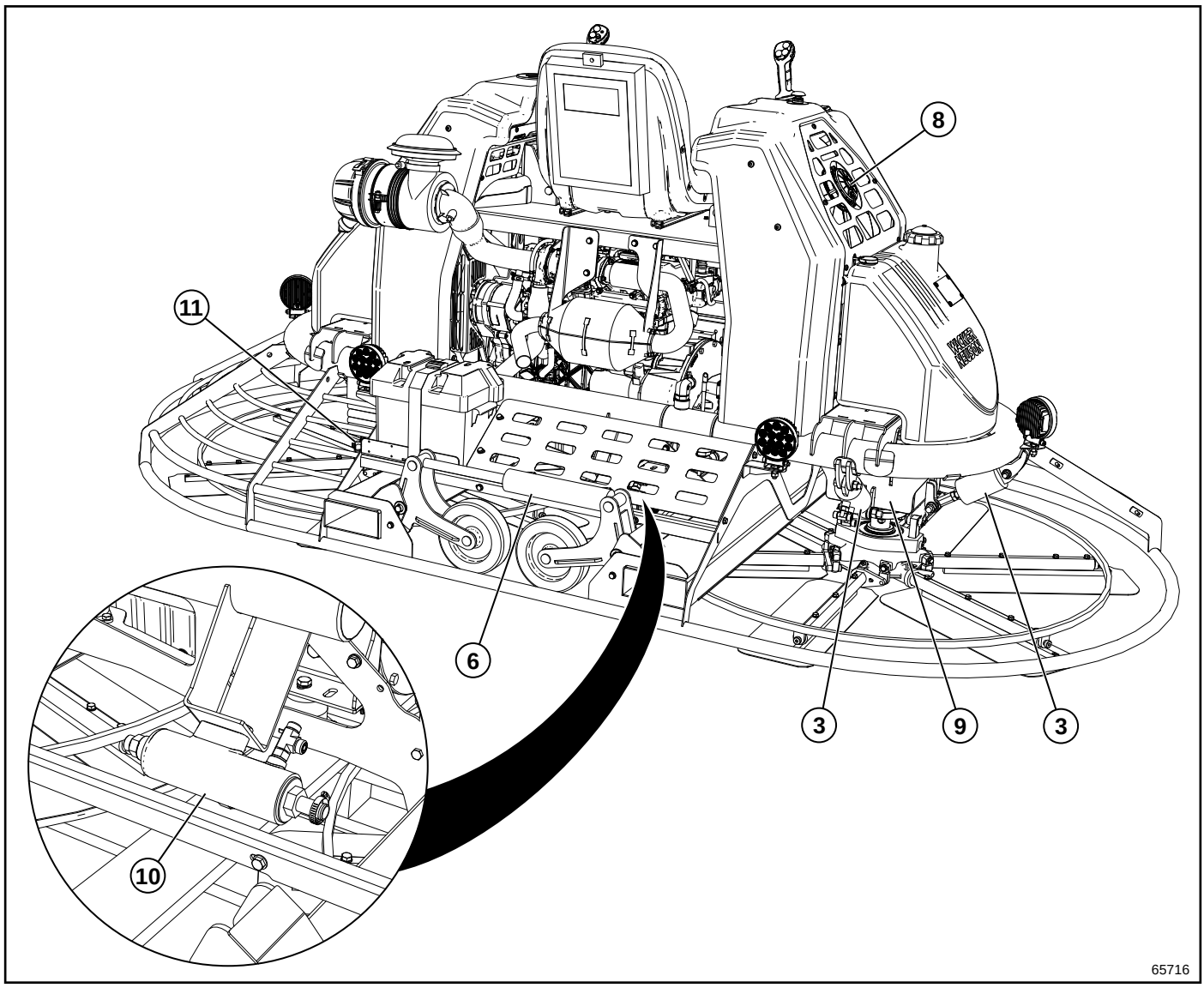
Component Location

See **Figures 4-1** and **4-2**.



1. MANIFOLD
2. TANDEM PUMP
3. STEER CYLINDER
4. PITCH CYLINDER
5. FILTER
6. WHEEL KIT CYLINDER
7. GEAR PUMP

Figure 4-1: Front Ride-On Trowel Hydraulic Component Location



3. STEER CYLINDER
6. WHEEL KIT CYLINDER
8. OIL COOLER
9. DRIVE MOTOR
10. DRAIN COLLECTOR/STRAINER
11. ROTOR ASSEMBLY

Figure 4-2: Rear Ride-On Trowel Hydraulic Component Location

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Hydraulic Schematics

Hydraulic Schematics

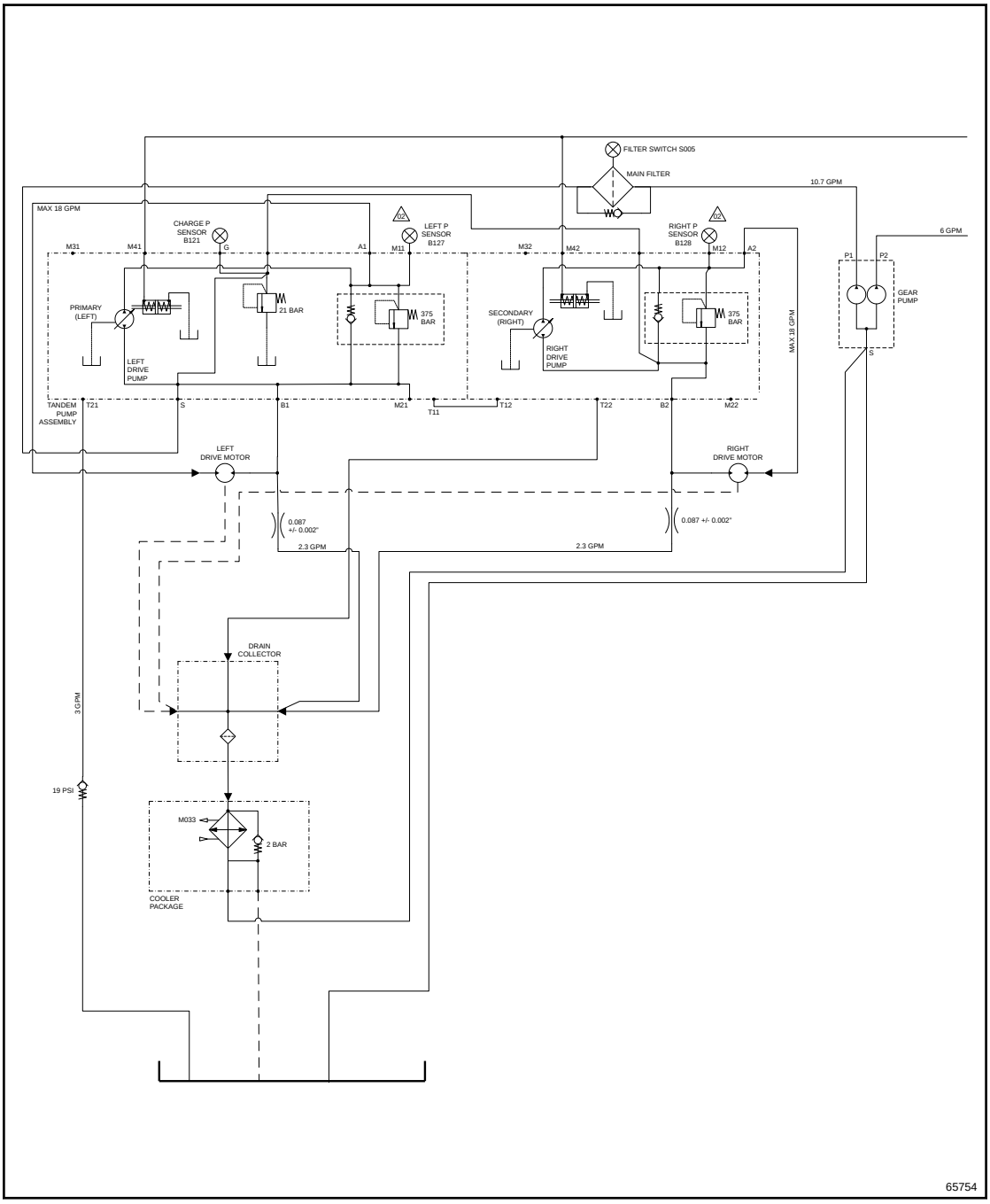

Figure 4-3: Hydraulic Schematic

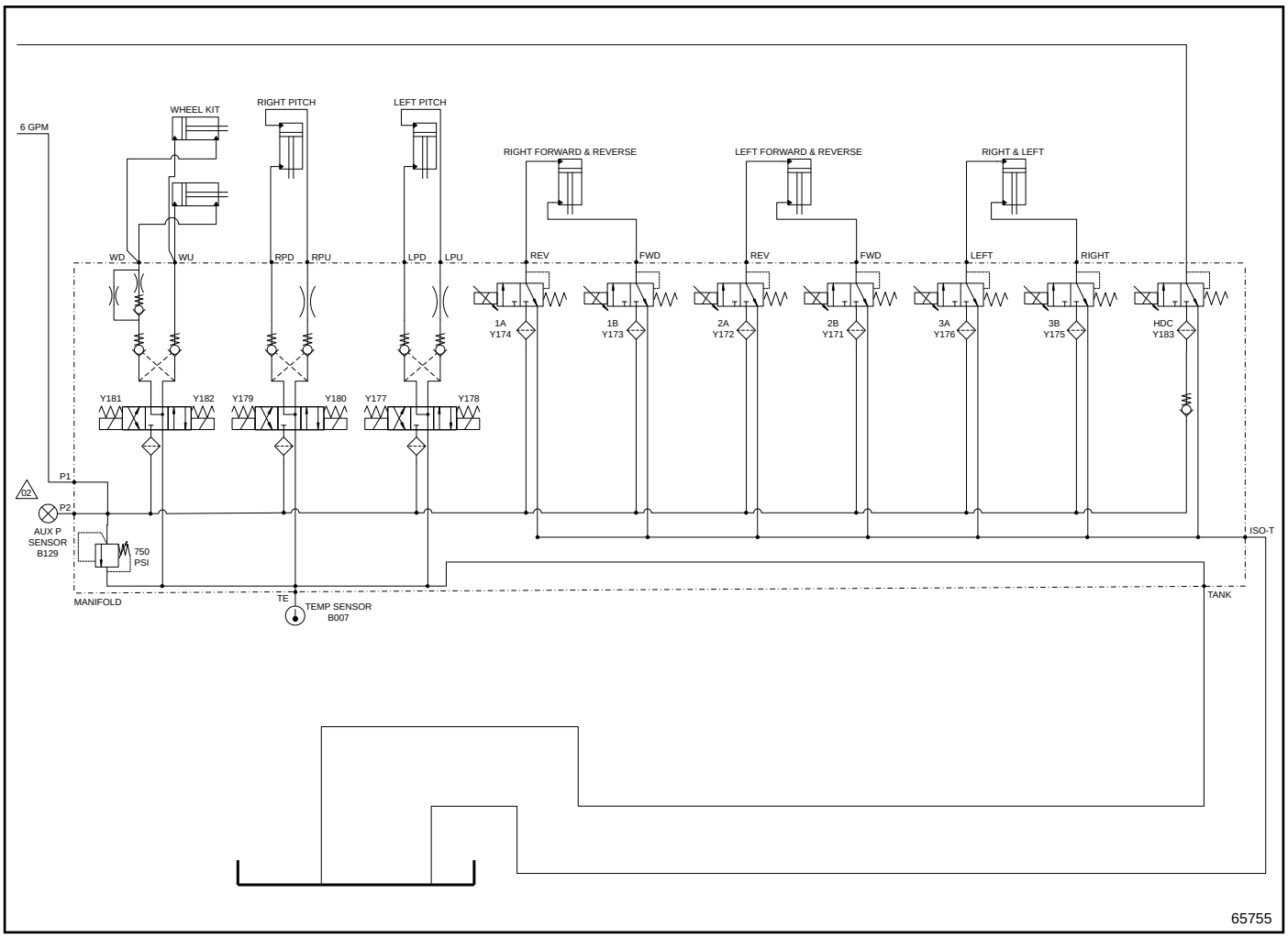

Figure 4-4: Hydraulic Schematic

Theory of Operation and Diagnostic Information

Wheel Kit Up Circuit—Theory of Operation

System Conditions:

- Engine running for a minimum of 5 minutes

Oil Supply to Manifold

The gear pump is driven by the engine. Oil is drawn from the hydraulic oil tank into port S of the gear pump where it is charged. Operating pressure oil is then routed from port P2 of the gear pump to port P1 of the manifold.

Wheel Kit Up Circuit

When the wheel kit switch is depressed to the up position, the wheel kit up solenoid is energized, shifting the wheel kit spool. Operating pressure oil is routed through the manifold from port P1 to the wheel kit spool, through a check valve, and out of port WU of the manifold. Operating oil pressure is then routed from the manifold WU port to the piston side of the wheel kit cylinders, causing the wheel kits to raise.

Return oil is forced from the rod side of the wheel kit cylinders and is routed to port WD of the manifold. Return oil is then routed from port WD of the manifold through the wheel kit spool, out port TANK of the manifold, and then returned to the hydraulic oil tank.

Circuit Relief

The wheel kit up circuit is protected by the 750 psi (52 bar) main system relief valve. If pressure on the operating pressure oil circuit of the relief valve reaches 750 psi (52 bar), the valve will open. Operating pressure oil exits at port TANK of the manifold and returns to the hydraulic oil tank.

Wheel Kit Up Circuit Schematic

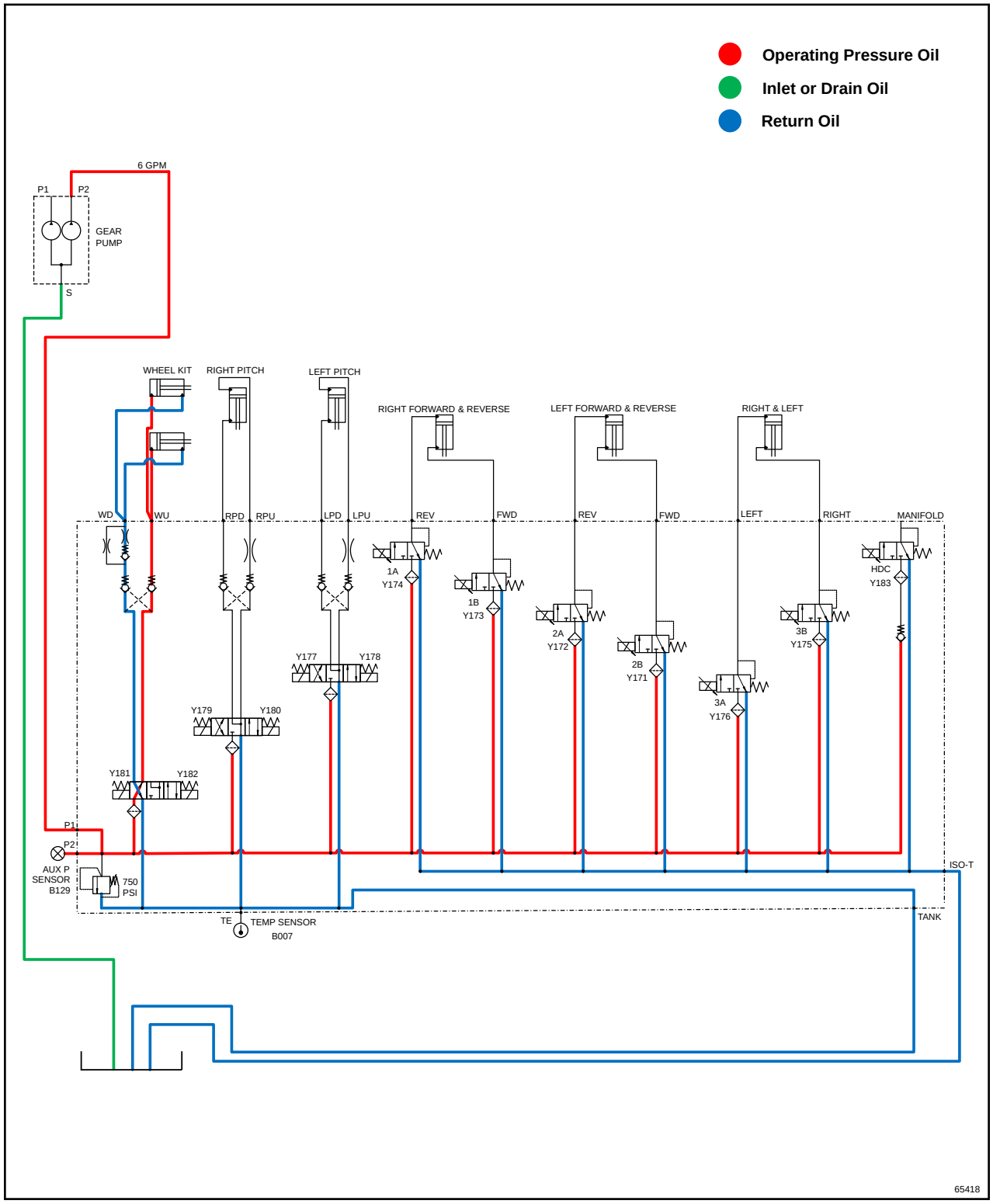

Figure 4-5

Wheel Kit Down Circuit—Theory of Operation

System Conditions:

- Engine running for a minimum of 5 minutes

Oil Supply to Manifold

The gear pump is driven by the engine. Oil is drawn from the hydraulic oil tank into port S of the gear pump where it is charged. Operating pressure oil is then routed from port P2 of the gear pump to port P1 of the manifold.

Wheel Kit Down Circuit

When the wheel kit switch is depressed to the down position, the wheel kit down solenoid is energized, shifting the wheel kit spool. Operating pressure oil is routed through the manifold from port P1 to the wheel kit spool, through a check valve, and out of port WD of the manifold. Operating oil pressure is then routed from port WD of the the manifold to the rod side of the wheel kit cylinders, causing the wheel kits to lower.

Return oil is forced from the piston side of the wheel kit cylinders and is routed to port WU of the manifold. Return oil is then routed from port WU of the manifold through the wheel kit spool, out port TANK of the manifold, and then returned to the hydraulic oil tank.

Circuit Relief

The wheel kit down circuit is protected by the 750 psi (52 bar) main system relief valve. If pressure on the operating pressure oil circuit of the relief valve reaches 750 psi (52 bar), the valve will open. Operating pressure oil exits at port TANK of the manifold and returns to the hydraulic oil tank.

Wheel Kit Down Circuit Schematic

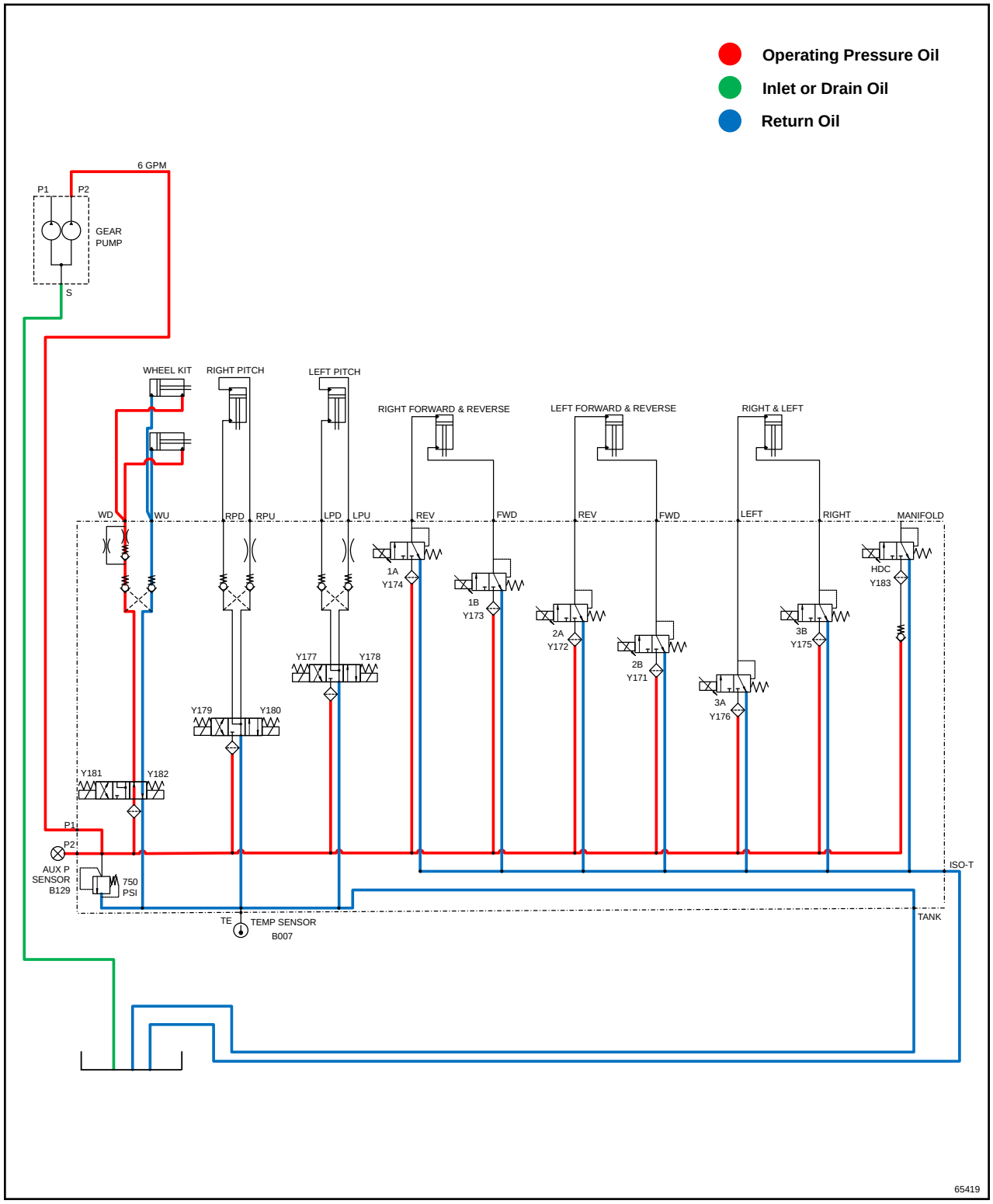

Figure 4-6

Strafe Right Circuit—Theory of Operation

System Conditions:

- Engine running for a minimum of 5 minutes

Oil Supply to Manifold

The gear pump is driven by the engine. Oil is drawn from the hydraulic oil tank into port S of the gear pump where it is charged. Operating pressure oil is then routed from port P2 of the gear pump to port P1 of the manifold.

Strafe Right Circuit

When the right joystick is moved to the straight right position, the 3B steer valve solenoid is energized, shifting the 3B steer spool. Operating pressure oil is routed through the manifold from port P1 to the 3B steer spool and out of the port RIGHT of the manifold. Operating oil pressure is then routed from port RIGHT of the manifold to the rod side of the right and left steer cylinder, causing the machine to strafe right.

Return oil is forced from the piston side of the right and left steer cylinder and is routed to port LEFT of the manifold. Return oil is then routed from port LEFT of the manifold, through the 3A steer spool, out port ISO-T of the manifold, and then returned to the hydraulic oil tank.

Circuit Relief

The strafe right circuit is protected by the 750 psi (52 bar) main system relief valve. If pressure on the operating pressure oil circuit of the relief valve reaches 750 psi (52 bar), the valve will open. Operating pressure oil exits at port TANK of the manifold and returns to the hydraulic oil tank.

Strafe Right Circuit Schematic

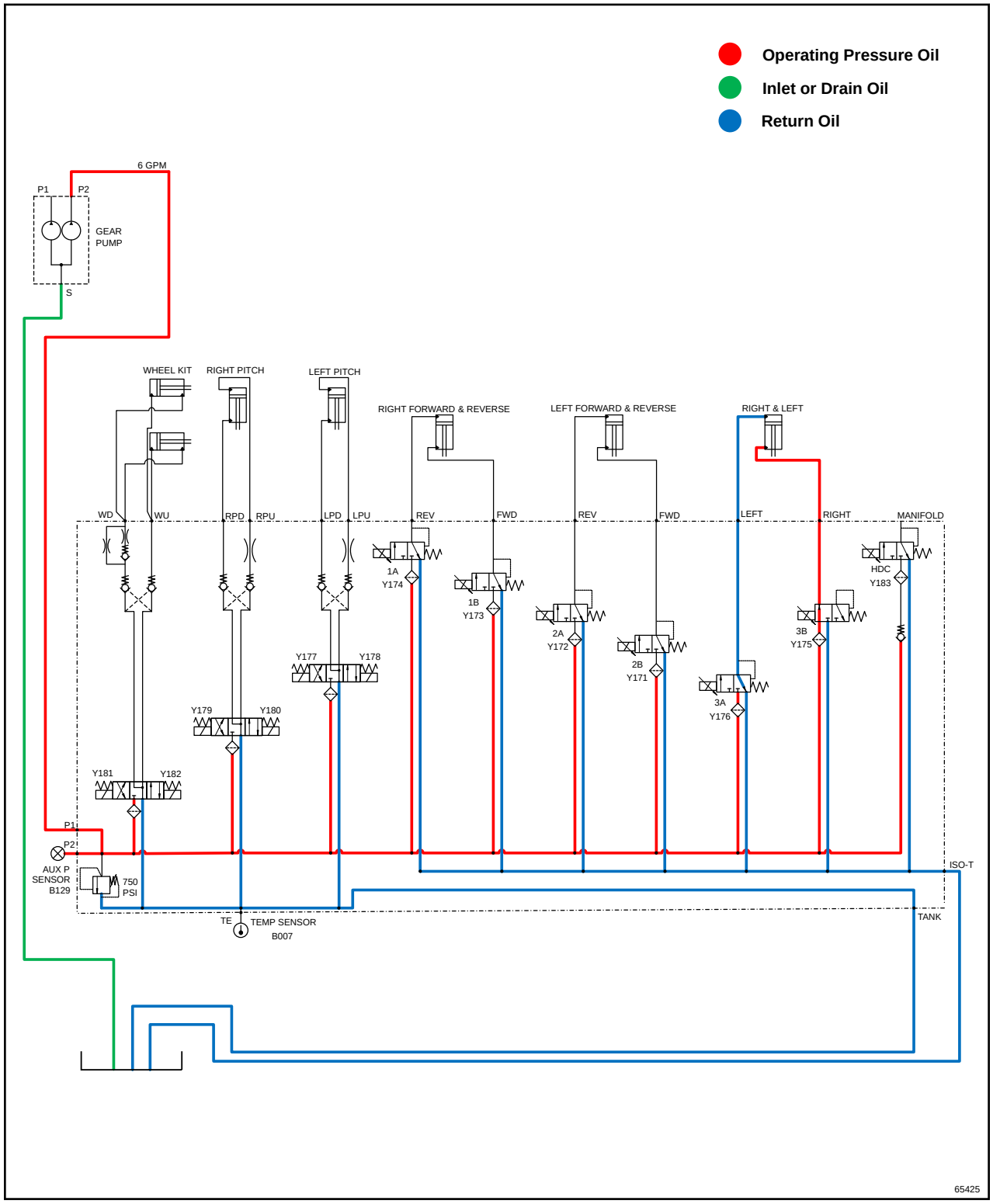

Figure 4-7

Strafe Left Circuit—Theory of Operation

System Conditions:

- Engine running for a minimum of 5 minutes

Oil Supply to Manifold

The gear pump is driven by the engine. Oil is drawn from the hydraulic oil tank into port S of the gear pump where it is charged. Operating pressure oil is then routed from port P2 of the gear pump to port P1 of the manifold.

Strafe Left Circuit

When the right joystick is moved to the straight left position, the 3A steer valve solenoid is energized, shifting the 3A steer spool. Operating pressure oil is routed through the manifold from port P1, to the 3A steer spool, and out port LEFT of the manifold. Operating oil pressure is then routed from port LEFT of the manifold to the piston side of the right and left steer cylinder, causing the machine to strafe left.

Return oil is forced from the rod side of the right and left steer cylinder and is routed to port RIGHT of the manifold. Return oil is then routed from port RIGHT of the manifold, through the 3B steer spool, out port ISO-T of the manifold, and then returned to the hydraulic oil tank.

Circuit Relief

The strafe left circuit is protected by the 750 psi (52 bar) main system relief valve. If pressure on the operating pressure oil circuit of the relief valve reaches 750 psi (52 bar), the valve will open. Operating pressure oil exits at port TANK of the manifold and returns to the hydraulic oil tank.

Strafe Left Circuit Schematic

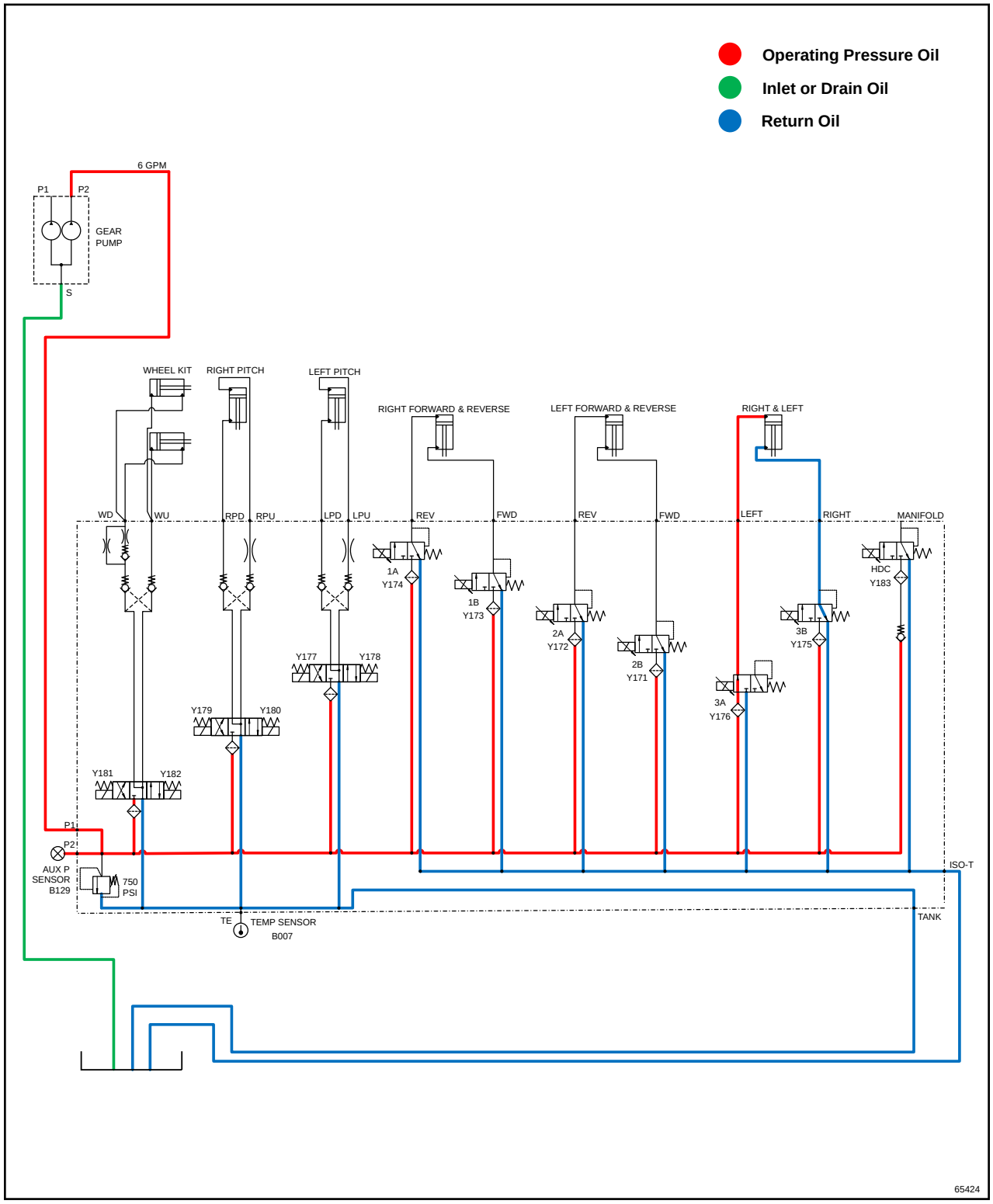

Figure 4-8

Forward Circuit—Theory of Operation

System Conditions:

- Engine running for a minimum of 5 minutes

Oil Supply to Manifold

The gear pump is driven by the engine. Oil is drawn from the hydraulic oil tank into port S of the gear pump where it is charged. Operating pressure oil is then routed from port P2 of the gear pump to port P1 of the manifold.

Forward Circuit

When both joysticks are moved to the straight forward position, the 1B and 2B steer valve solenoids are energized, shifting the 1B and 2B steer spools. Operating pressure oil is routed through the manifold from port P1 to the 1B and 2B steer spools and out of the two FWD ports of the manifold. Operating oil pressure is then routed from the two FWD ports of the manifold to the rod side of the right and left forward and reverse steer cylinders, causing the machine to move forward.

Return oil is forced from the piston side of the right and left forward and reverse steer cylinders and is routed to the two REV ports of the manifold. Return oil is then routed from the two REV ports of the manifold, through the 1A and 2A steer spools, out of the ISO-T port of the manifold, and then returned to the hydraulic oil tank.

Circuit Relief

The forward circuit is protected by the 750 psi (52 bar) main system relief valve. If pressure on the operating pressure oil circuit of the relief valve reaches 750 psi (52 bar), the valve will open. Operating pressure oil exits at port TANK of the manifold and returns to the hydraulic oil tank.

Forward Circuit Schematic

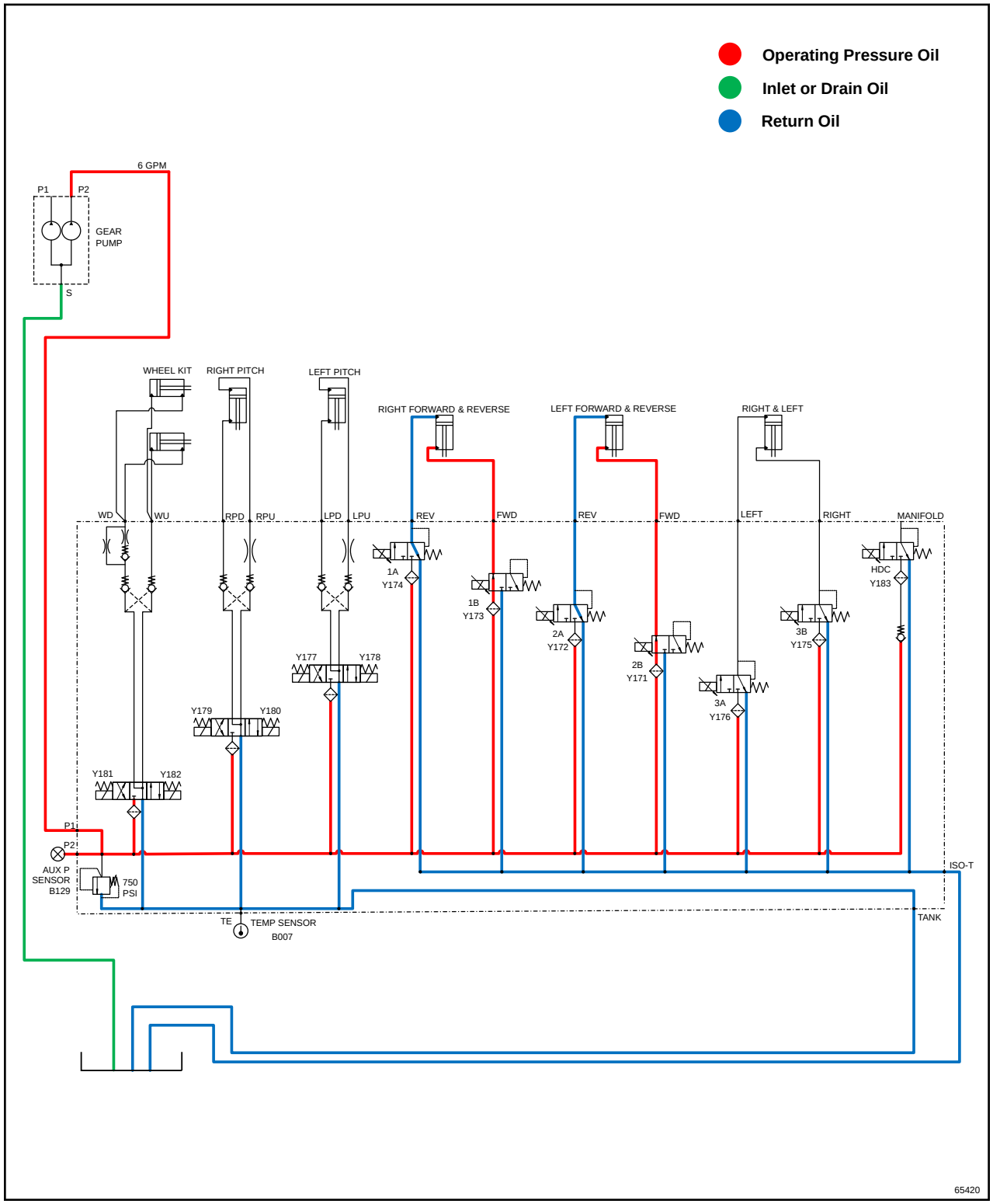

Figure 4-9

Reverse Circuit—Theory of Operation

System Conditions:

- Engine running for a minimum of 5 minutes

Oil Supply to Manifold

The gear pump is driven by the engine. Oil is drawn from the hydraulic oil tank into port S of the gear pump where it is charged. Operating pressure oil is then routed from port P2 of the gear pump to port P1 of the manifold.

Reverse Circuit

When both joysticks are moved to the straight back position, the 1A and 2A steer valve solenoids are energized, shifting the 1A and 2A steer spools. Operating pressure oil is routed through the manifold from port P1 to the 1A and 2A steer spools and out of the two REV ports of the manifold. Operating oil pressure is then routed from the two REV ports of the manifold to the piston side of the right and left forward and reverse steer cylinders, causing the macine to move backward.

Return oil is forced from the rod side of the right and left forward and reverse steer cylinders and is routed to the two FWD ports of the manifold. Return oil is then routed from the two FWD ports of the manifold, through the 1B and 2B steer spools, out port ISO-T of the manifold, and then returned to the hydraulic oil tank.

Circuit Relief

The reverse circuit is protected by the 750 psi (52 bar) main system relief valve. If pressure on the operating pressure oil circuit of the relief valve reaches 750 psi (52 bar), the valve will open. Operating pressure oil exits at port TANK of the manifold and returns to the hydraulic oil tank.

Reverse Circuit Schematic

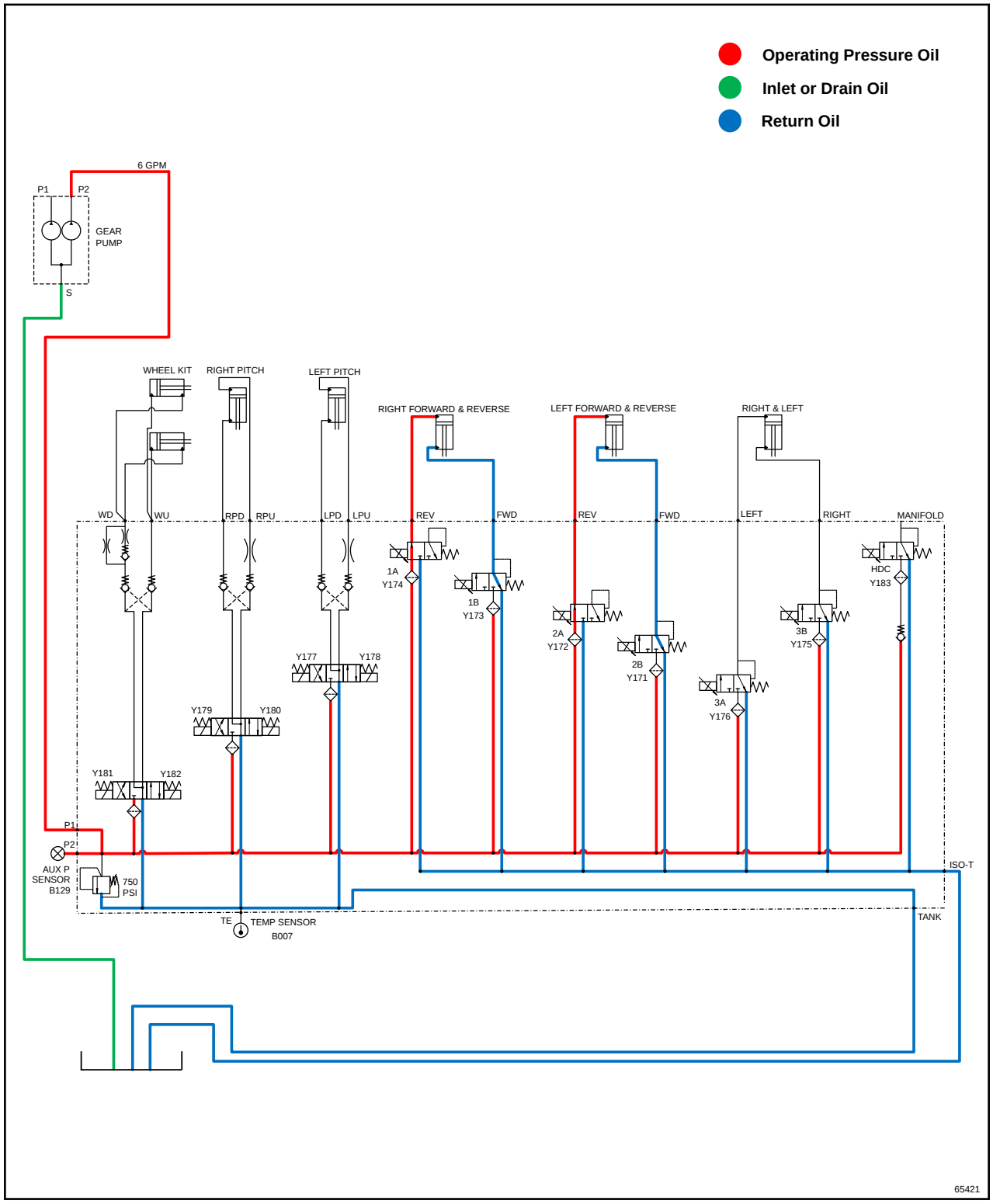

Figure 4-10

Rotate Counterclockwise Circuit—Theory of Operation

System Conditions:

- Engine running for a minimum of 5 minutes

Oil Supply to Manifold

The gear pump is driven by the engine. Oil is drawn from the hydraulic oil tank into port S of the gear pump where it is charged. Operating pressure oil is then routed from port P2 of the gear pump to port P1 of the manifold.

Rotate Counterclockwise Circuit

When the right joystick is moved to the straight forward position and the left joystick is moved to the straight back position, the 1B and 2A steer valve solenoids are energized, shifting the 1B and 2A steer spools. Operating pressure oil is routed through the manifold from port P1 to the 1B and 2A steer spools and out of the right FWD port and left REV port of the manifold. Operating oil pressure is then routed from right FWD port of the manifold to the rod side of the right forward and reverse steer cylinder and from the left REV port of the manifold to the piston side of the left forward and reverse steer cylinder, causing the machine to rotate counterclockwise.

Return oil is forced from the piston side of the right forward and reverse steer cylinder and is routed to the right REV port of the manifold. Return oil is forced from the rod side of the left forward and reverse steer cylinder and is routed to the left FWD port of the manifold. Return oil is then routed from the right REV port and left FWD port of the manifold, through the 1A and 2B steer spools, out port ISO-T of the manifold, and then returned to the hydraulic oil tank.

Circuit Relief

The rotate counterclockwise circuit is protected by the 750 psi (52 bar) main system relief valve. If pressure on the operating pressure oil circuit of the relief valve reaches 750 psi (52 bar), the valve will open. Operating pressure oil exits at port TANK of the manifold and returns to the hydraulic oil tank.

Rotate Counterclockwise Circuit Schematic

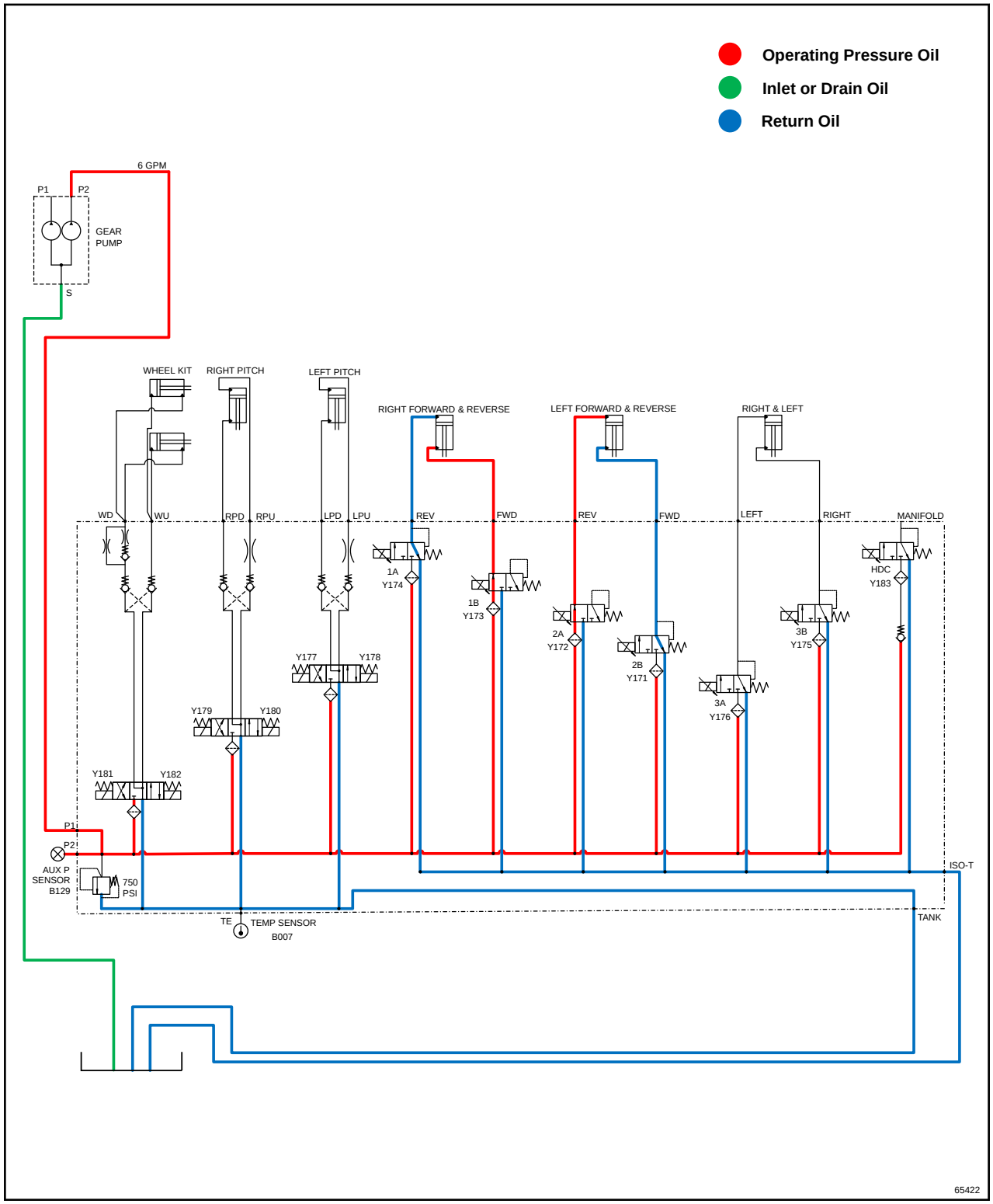

Figure 4-11

Rotate Clockwise Circuit—Theory of Operation

System Conditions:

- Engine running for a minimum of 5 minutes

Oil Supply to Manifold

The gear pump is driven by the engine. Oil is drawn from the hydraulic oil tank into port S of the gear pump where it is charged. Operating pressure oil is then routed from port P2 of the gear pump to port P1 of the manifold.

Rotate Clockwise Circuit

When the left joystick is moved to the straight forward position and the right joystick is moved to the straight back position, the 1A and 2B steer valve solenoids are energized, shifting the 1A and 2B steer spools. Operating pressure oil is routed through the manifold from port P1 to the 1A and 2B steer spools and out of the right REV port and left FWD port of the manifold. Operating oil pressure is then routed from the right REV port of the manifold to the piston side of the right forward and reverse steer cylinder and from the left FWD port of the manifold to the rod side of the left forward and reverse steer cylinder, causing the machine to rotate clockwise.

Return oil is forced from the rod side of the right forward and reverse steer cylinder and is routed to the right FWD port of the manifold. Return oil is forced from the piston side of the left forward and reverse steer cylinder and is routed to the left REV port of the manifold. Return oil is then routed from the right FWD port and left REV port of the manifold, through the 1B and 2A steer spools, out port ISO-T of the manifold, and then returned to the hydraulic oil tank.

Circuit Relief

The rotate clockwise circuit is protected by the 750 psi (52 bar) main system relief valve. If pressure on the operating pressure oil circuit of the relief valve reaches 750 psi (52 bar), the valve will open. Operating pressure oil exits at port TANK of the manifold and returns to the hydraulic oil tank.

Rotate Clockwise Circuit Schematic

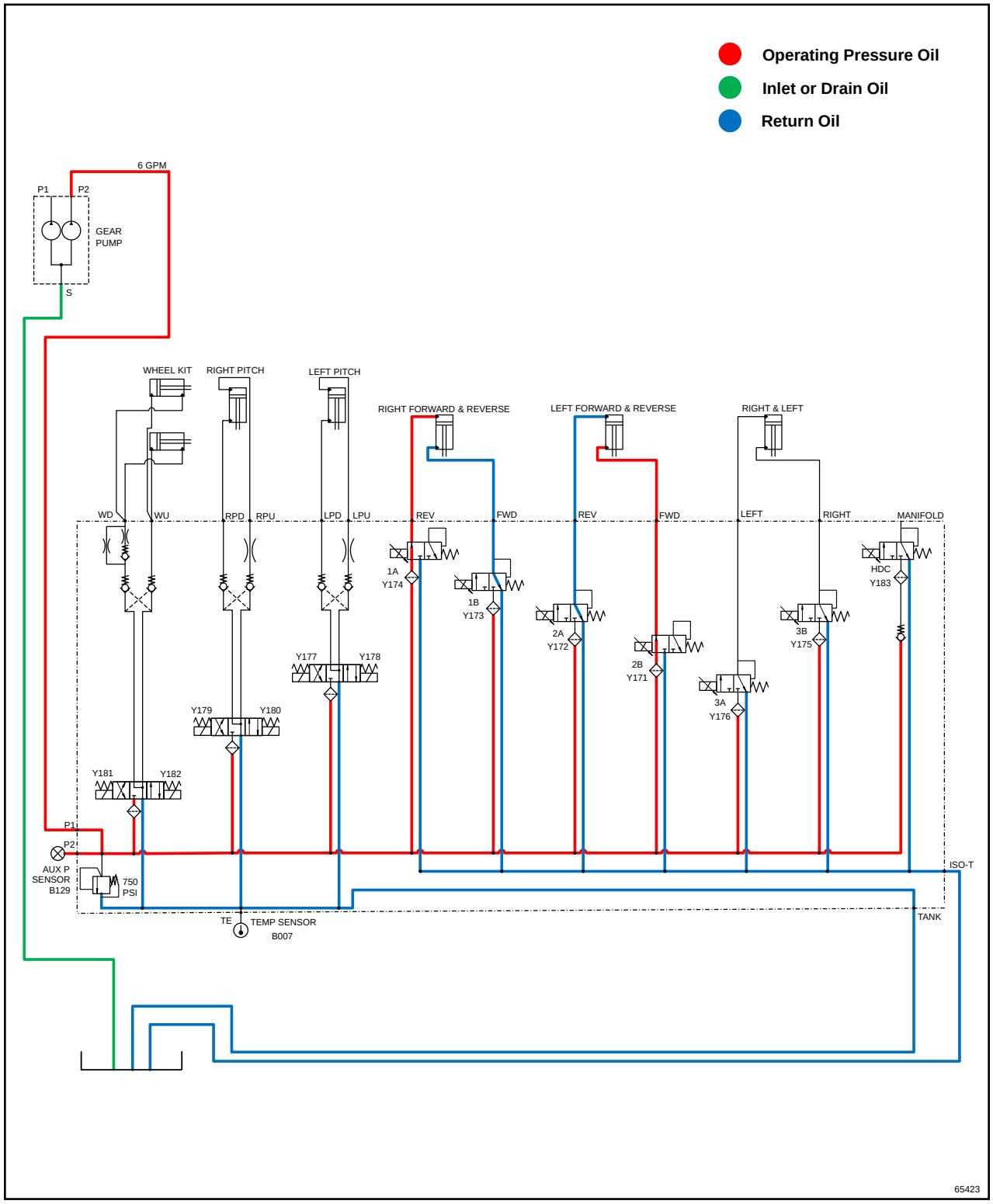

Figure 4-12

Increase Pitch Circuit—Theory of Operation

System Conditions:

- Engine running for a minimum of 5 minutes

Oil Supply to Manifold

The gear pump is driven by the engine. Oil is drawn from the hydraulic oil tank into port S of the gear pump where it is charged. Operating pressure oil is then routed from port P2 of the gear pump to port P1 of the manifold.

Increase Pitch Circuit

When the right and left pitch control buttons are depressed to the up position, the right and left pitch solenoids are energized, shifting the right and left pitch spools. Operating pressure oil is routed through the manifold from port P1 to the right and left pitch spools, through a check valve, and out of ports RPU and LPU of the manifold. Operating oil pressure is then routed from ports RPU and LPU of the manifold to the piston side of the right and left pitch cylinders, causing an increase in blade pitch.

Return oil is forced from the rod side of the right and left pitch cylinders and is routed to ports RPD and LPD of the manifold. Return oil is then routed from ports RPD and LPD of the manifold, through the right and left pitch spools, out port TANK of the manifold, and then returned to the hydraulic oil tank.

Circuit Relief

The increase pitch circuit is protected by the 750 psi (52 bar) main system relief valve. If pressure on the operating pressure oil circuit of the relief valve reaches 750 psi (52 bar), the valve will open. Operating pressure oil exits at port TANK of the manifold and returns to the hydraulic oil tank.

Increase Pitch Circuit Schematic

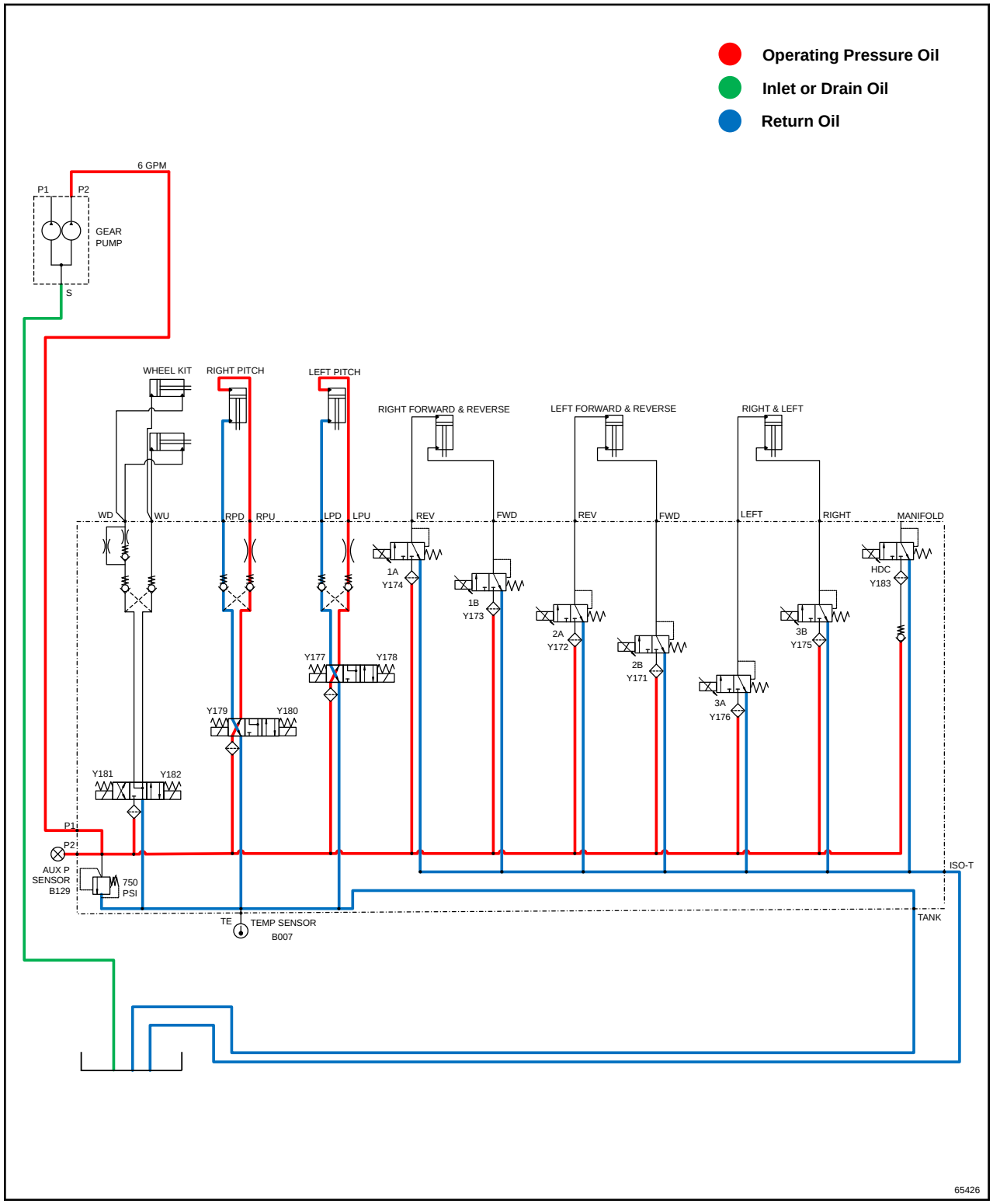

Figure 4-13

Decrease Pitch Circuit—Theory of Operation

System Conditions:

- Engine running for a minimum of 5 minutes

Oil Supply to Manifold

The gear pump is driven by the engine. Oil is drawn from the hydraulic oil tank into port S of the gear pump where it is charged. Operating pressure oil is then routed from port P2 of the gear pump to port P1 of the manifold.

Decrease Pitch Circuit

When the right and left pitch control buttons are depressed to the down position, the right and left pitch solenoids are energized, shifting the right and left pitch spools. Operating pressure oil is routed through the manifold from port P1 to the right and left pitch spools, through a check valve, and out of ports RPD and LPD of the manifold. Operating oil pressure is then routed from ports RPD and LPD of the manifold to the rod side of the right and left pitch cylinders, causing a decrease in blade pitch.

Return oil is forced from the piston side of the right and left pitch cylinders and is routed to ports RPU and LPU of the manifold. Return oil is then routed from ports RPU and LPU of the manifold, through the right and left pitch spools, out port TANK of the manifold, and then returned to the hydraulic oil tank.

Circuit Relief

The decrease pitch circuit is protected by the 750 psi (52 bar) main system relief valve. If pressure on the operating pressure oil circuit of the relief valve reaches 750 psi (52 bar), the valve will open. Operating pressure oil exits at port TANK of the manifold and returns to the hydraulic oil tank.

Decrease Pitch Circuit Schematic

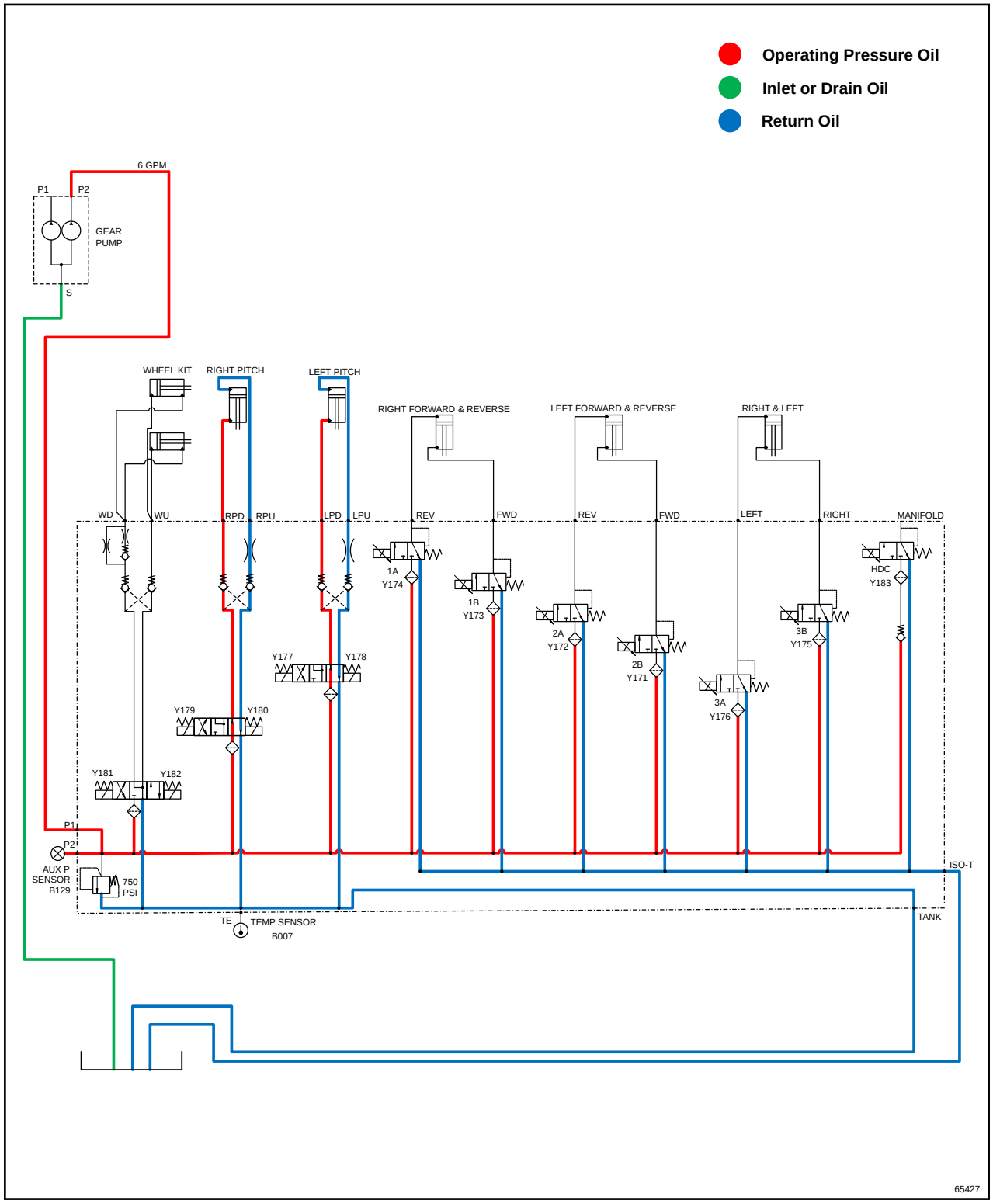

Figure 4-14

Blade Control Circuit—Theory of Operation

System Conditions:

- Engine running for a minimum of 5 minutes

Oil Supply to Manifold and Tandem Pump Assembly

The tandem pump and gear pump are driven by the engine. Oil is drawn from the hydraulic oil tank and cooler package into port S of the gear pump where it is charged. Operating pressure oil is then routed from port P2 of the gear pump to port P1 of the manifold. Charge oil pressure is routed from port P1 of the gear pump through the main filter. The filtered oil enters port S of the tandem pump assembly and is routed to the inlet of the left and right drive pumps.

Blade Control Circuit

When the pedal is depressed, the hydraulic control valve solenoid is energized, shifting the hydraulic control valve spool. Operating pressure oil is routed through the manifold from port P1 through a check valve and through the hydraulic control valve spool. Operating oil pressure is then routed from the hydraulic control valve spool to ports M41 and M42 of the tandem pump assembly. Operating oil pressure is then routed from the ports M41 and M42 of the tandem pump assembly to the left and right drive pump swashplate valves. As pressure increases in the swashplate valves, the displacement of the left and right drive pumps increases. Drive pressure oil is routed from the left and right drive pump outlets to ports A1 and A2 of the tandem pump assembly. Drive pressure oil is directed from ports A1 and A2 of the tandem pump assembly and then routed to the left and right drive motors, causing the blades to rotate.

Charge pressure oil is forced from the swashplate valves of the left and right drive pumps and the outlets of the left and right drive motors. Most of the charge pressure oil is routed from the outlets of the left and right drive motor back to the tandem pump through ports B1 and B2, creating a closed loop system. Some of the charge pressure oil that exits the drive motor becomes drain oil and is routed to the drain collector. Return oil is then routed from the drain collector, through the cooler package, and to the hydraulic oil tank and port S of the gear pump.

Return oil is forced from ports T21 and T22 of the tandem pump assembly to the hydraulic oil tank.

Return oil is forced from port TANK of the manifold to the hydraulic oil tank.

Circuit Relief

The blade control circuit is protected by the 750 psi (52 bar) main system relief valve. If pressure on the operating pressure oil circuit of the relief valve reaches 750 psi (52 bar), the valve will open. Operating pressure oil exits at port TANK of the manifold and returns to the hydraulic oil tank.

The charge pressure oil circuit is protected by the 305 psi (21 bar) pressure relief valve within the tandem pump assembly. If pressure on the charge pressure oil circuit of the relief valve reaches 305 psi (21 bar), the valve will open. Charge oil pressure exits the relief valve and returns to the hydraulic oil tank.

The drive pressure oil circuit is protected by the 5,439 psi (375 bar) pressure relief valves within the tandem pump assembly. Once the drive pressure oil reaches 5,439 psi (375 bar), the oil is cycled back into the closed loop system.

Blade Control Circuit Schematic

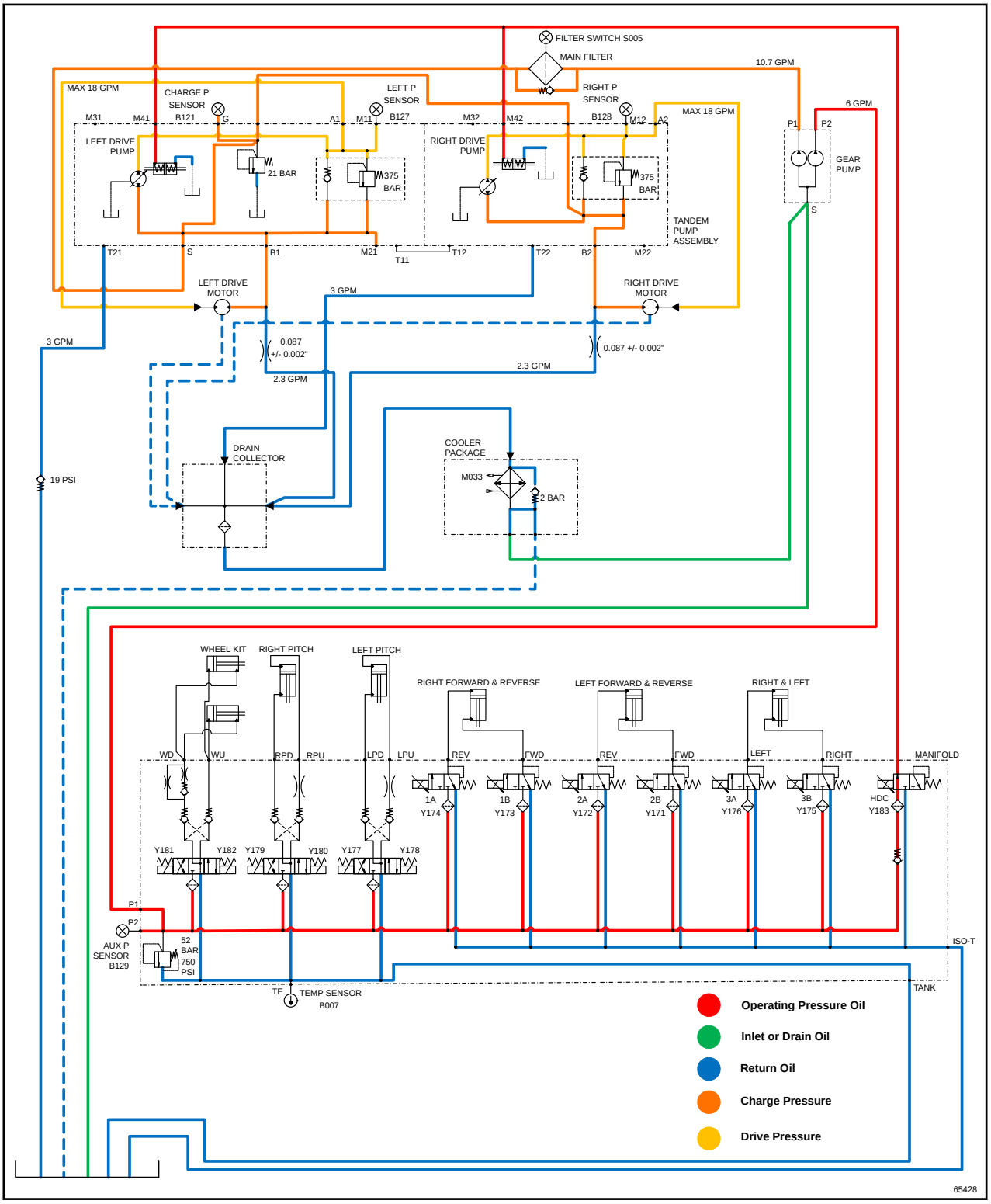

Figure 4-15

Troubleshooting

Wheel Kit

Symptom: Wheel Kit Will Not Raise / Lower

Probable Cause	Remedy
Hydraulic oil not at correct level in hydraulic oil tank	Fill hydraulic oil tank to correct level.
Hydraulic oil cold	Warm hydraulic oil to operating temperature.
Possible electrical system failure	See "**Wheel Kit Circuit**" on **page 3-44**.
Faulty wheel kit valve coil	Test wheel kit valve coil. (See "**Wheel Kit Test**" on **page 4-34**.)
Faulty relief valve	Test relief valve. (See "**Wheel Kit Test**" on **page 4-34**.)
Faulty gear pump	Test gear pump pressure. (See "**Wheel Kit Test**" on **page 4-34**.)
Faulty wheel kit spool	Test wheel kit spool. (See "**Wheel Kit Test**" on **page 4-34**.)
Worn or faulty wheel kit check/shuttle valve	Test wheel kit check/shuttle valve. (See "**Wheel Kit Test**" on **page 4-34**.)
Faulty wheel kit cylinder	Inspect cylinder for leakage or damage. Replace if necessary.

Steering Circuit

Symptom: Machine Will Not Steer

Probable Cause	Remedy
Hydraulic oil not at correct level in hydraulic oil tank	Fill hydraulic oil tank to correct level.
Hydraulic oil cold	Warm hydraulic oil to operating temperature.
Possible electrical system failure	See "**Steering Circuit**" on **page 3-45**.
Faulty steering valve coil	Test steering valve coil. (See "**Steering System Test**" on **page 4-37**.)
Faulty relief valve	Test relief valve. (See "**Steering System Test**" on **page 4-37**.)
Faulty gear pump	Test gear pump pressure. (See "**Steering System Test**" on **page 4-37**.)
Faulty steering spool	Test steering spool. (See "**Steering System Test**" on **page 4-37**.)
Worn or faulty steering check/shuttle valve	Test wheel kit check/shuttle valve. (See "**Steering System Test**" on **page 4-37**.)
Faulty steering cylinder	Inspect cylinder for leakage or damage. Replace if necessary.

Pitch Control Circuit

Symptom: Pitch Control Will Not Work

Probable Cause	Remedy
Hydraulic oil not at correct level in hydraulic oil tank	Fill hydraulic oil tank to correct level.
Hydraulic oil cold	Warm hydraulic oil to operating temperature.
Possible electrical system failure	See "**Pitch Control Circuit**" on **page 3-46**.
Faulty pitch control solenoid valve coil	Test pitch control valve coil. (See "**Pitch Control System Test**" on **page 4-40**.)
Faulty relief valve	Test relief valve. (See "**Pitch Control System Test**" on **page 4-40**.)
Faulty gear pump	Test gear pump pressure. (See "**Pitch Control System Test**" on **page 4-40**.)
Faulty pitch control spool	Test pitch control spool. (See "**Pitch Control System Test**" on **page 4-40**.)
Worn or faulty pitch control check/shuttle valve	Test pitch control check/shuttle valve. (See "**Pitch Control System Test**" on **page 4-40**.)
Faulty pitch cylinder	Inspect cylinder for leakage or damaged. Replace if necessary.

Blade Rotation Circuit

Symptom: Blades Will Not Rotate

Probable Cause	Remedy
Hydraulic oil not at correct level in hydraulic oil tank	Fill hydraulic oil tank to correct level.
Hydraulic oil cold	Warm hydraulic oil to operating temperature.
Possible electrical system failure	See "**Blades Circuit**" on **page 3-47**.
Possible mechanical problem	Repair mechanical problem. Faulty rotor key is likely.
Faulty hydro valve coil	Test hydro valve coil. (See "**Blade Rotation System Test**" on **page 4-43**.)
Faulty hydro valve	Test hydro valve. (See "**Blade Rotation System Test**" on **page 4-43**.)
Charge pump relief valve not adjusted properly or faulty.	Adjust charge pressure setting. (See "**Charge Pressure Adjustment**" on **page 4-47**.) Replace as necessary.
Faulty tandem pump	Test tandem pump. (See "**Blade Rotation System Test**" on **page 4-43**.)
Faulty drive motor	Test drive motor. (See "**Blade Rotation System Test**" on **page 4-43**.)

Tests and Adjustments

Test Procedures Overview

The following tests are specifically designed to approach hydraulic testing on a system level. The test results will help the technician decide which repairs will best remedy the performance issue experienced by the machine user.

Basic troubleshooting should be performed before any instrument test is performed. (See "**Troubleshooting**" on **page 4-32**.)

Preliminary checks should always be performed before any instrument test is performed. (See "**Preliminary Checks**" on **page 4-34**.)

If the complaint cannot be resolved through troubleshooting and preliminary checks, a manifold relief valve and gear pump test must first be performed to rule out a faulty manifold relief valve or gear pump. Operate the wheel kit or pitch controls to determine if the manifold relief valve or gear pump are functioning properly. Correct any problem with the manifold relief valve and gear pump before performing the following test procedures.

Preliminary Checks

Perform the following checks prior to beginning any tests:

1. Check machine for any active or inactive Diagnostic Trouble Codes (DTCs).
2. Check the hydraulic oil tank for proper fluid level and the presence or air, water, or unusual odor.
3. Check all lines and fittings for leaks. Tighten as needed.
4. Check all hydraulic cylinders for external leaks.
5. Check for clogged or damaged hydraulic filter.
6. Inspect cooling assembly for the following:
   - Obstructed air flow
   - Improper plumbing
   - Kinked or damaged hoses
7. Eliminate all mechanical issues prior to starting hydraulic tests.

Wheel Kit Test

See **Figures 4-16** through **4-19**.

WARNING

Hydraulic system operates at high pressures and temperatures. Always allow hydraulic oil to cool and relieve pressure in hydraulic reservoir before working on hydraulic system. Wear eye protection and gloves to prevent injury. Open lines and hoses slowly and wait for any residual pressure to relieve before continuing to open lines and hoses. Failure to comply may result in injury or death to personnel.

WARNING

Prolonged contact with lubricating oil may cause skin rash. Remove saturated clothing immediately and thoroughly wash skin that comes in contact with lubricating oil. Failure to comply may result in injury or death to personnel.

WARNING

Spilled hydraulic oil is slippery and creates a hazardous condition. Clean up and properly dispose of hydraulic oil. Failure to comply may result in injury or death to personnel.

CAUTION

Wipe clean area around all fluid connections prior to removal. Cap and plug all hoses, lines, fittings, and ports during removal to prevent contamination of system components. System must be kept clean from contaminants. Failure to comply may result in damage to equipment.

NOTE

All hydraulic cylinders are pressure-tested the same way.

Required Tools or Equipment
• Digital Multimeter

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)

2. Start machine.

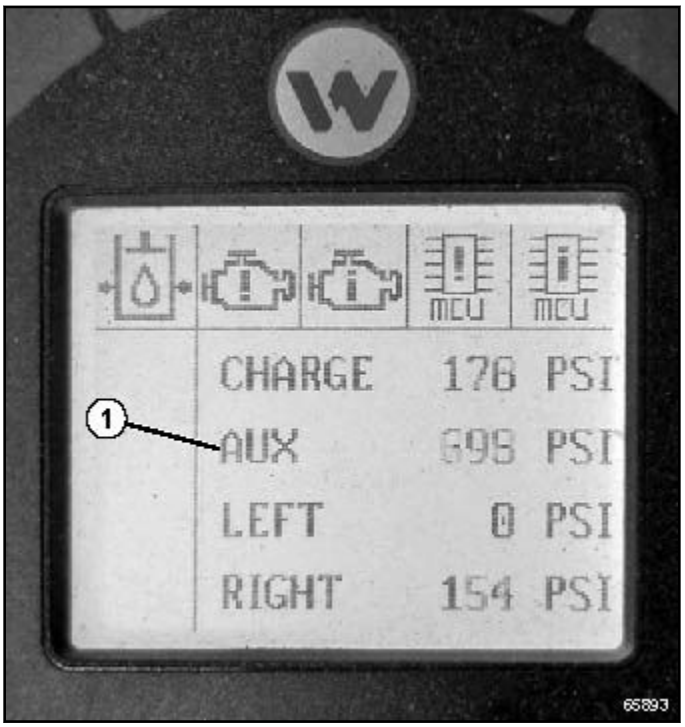

Figure 4-16: Display

3. Using the display monitor Aux hydraulic pressure.

   Does pressure read 750 psi (52 bar)?

   YES *Relief valve is okay. Proceed to Step 9.*

   NO *Relief valve may be clogged. Turn off machine. Remove and clean relief valve and retest. If condition still exists, proceed to Step 9.*

4. Using the display monitor Aux hydraulic pressure while operating wheel kit system (pressing wheel kit up or down button on joystick).

   Does pressure read 750 psi (52 bar)?

   YES *Relief valve is okay. Proceed to Step 14.*

   NO *Relief valve is faulty. Replace relief valve.*

5. Turn off machine.

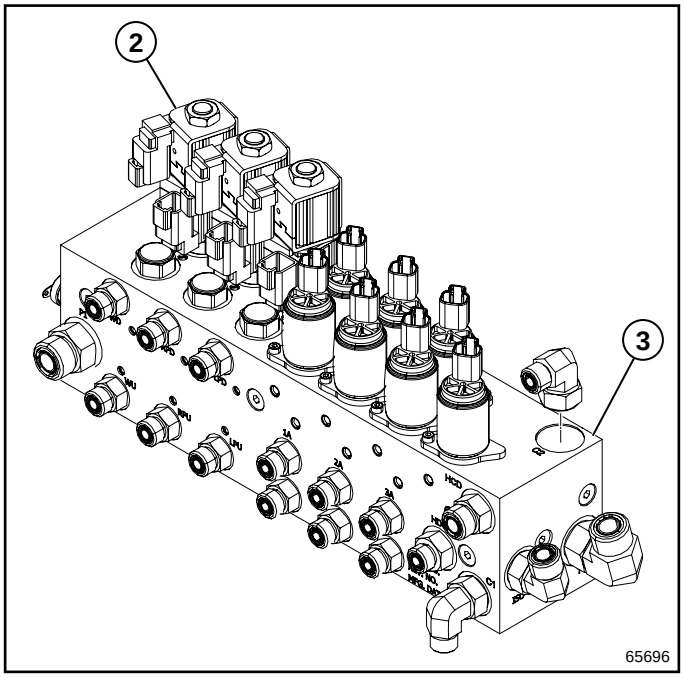

Figure 4-17: Wheel Kit Valve

6. Locate wheel kit valve (2) on manifold (3).

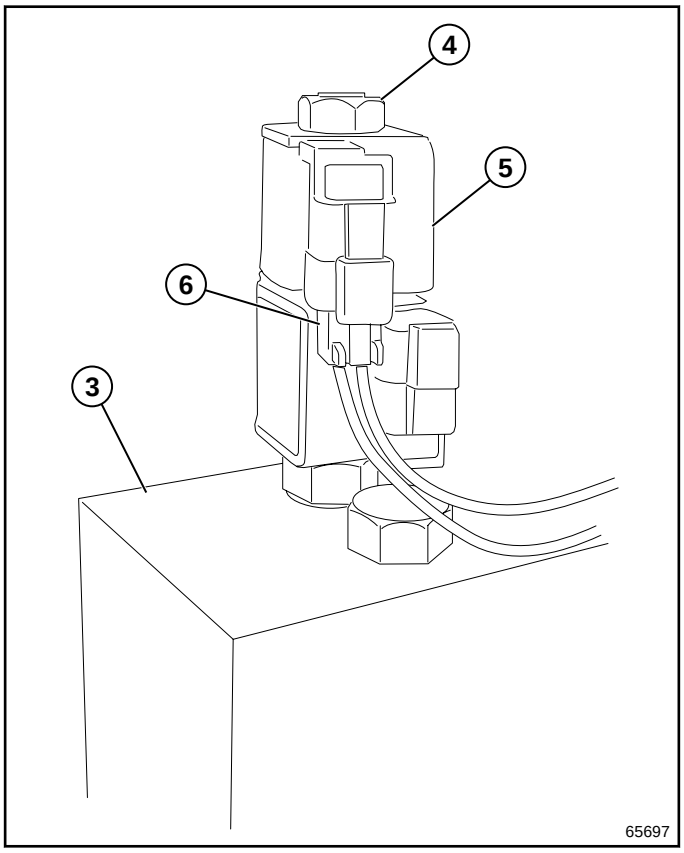

Figure 4-18: Coil Disconnect

7. Disconnect electrical connector (6).
8. Remove nut (4) and coil (5) from manifold (3).

9. Using multimeter, measure resistance of coil (4).

   Does coil measure 6.8 - 8.3 ohms?

   YES *Coil is okay. Proceed to Step 10.*

   NO *Coil is faulty. Replace coil.*

10. Remove wheel kit spool from manifold.
11. Install working pitch control spool to manifold in place of wheel kit spool.
12. Start machine.
13. Attempt operation of wheel kit system.

    Does wheel kit system function properly?

    YES *Wheel kit spool is faulty. Replace wheel kit spool.*

    NO *Wheel kit spool is okay. Turn off machine, reinstall wheel kit spool and pitch control spool to original locations, and proceed to Step 16.*

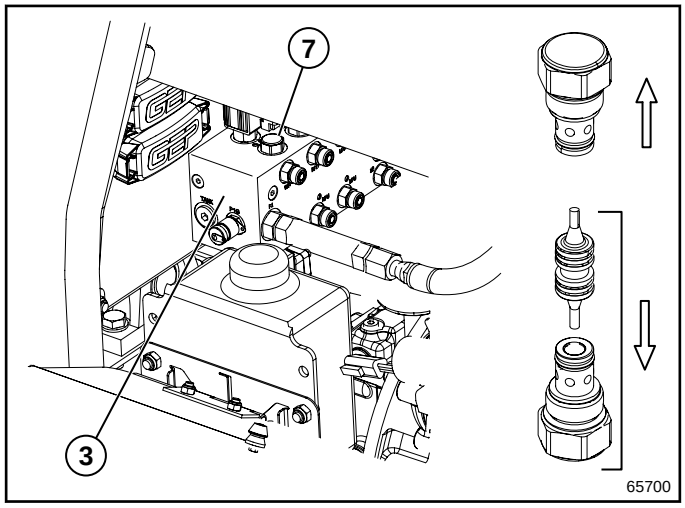

Figure 4-19: Wheel Kit Check/Shuttle Valve

14. Remove wheel kit check/shuttle valve (7) from manifold (3).
15. Clean wheel kit check/shuttle valve and replace all damaged O-rings. Reinstall wheel kit check/shuttle valve and retry operation. If system does not function properly, wheel kit check/shuttle valve has failed. Replace wheel kit check/shuttle valve.
16. Remove hose connected to WD fitting.
17. Remove WD (8) fitting.
18. Inspect orifice plate.

    Is orifice plate bound?

    YES *Orifice plate is faulty, repair or replace orifice plate as needed.*

    NO *Proceed to Step 19.*

19. Check orifice diamiters.

    Does one orifice measure 1.9 mm and the other 1.0 mm?

    YES *Orifice plate is faulty, repair or replace orifice plate as needed.*

    NO *Install WD fitting (8) and hose. Proceed to Step 20.*

20. Check each wheel kit cylinder for blow-by (leakage). Connect flowmeter to load side of wheel kit cylinder. Start machine and check for leakage. If steady stream of hydraulic oil flows past wheel kit cylinder seals, wheel kit cylinder has failed. Replace wheel kit cylinder.
21. Disconnect and remove test equipment. Install all hoses and fittings as noted prior to removal.
22. Install and connect all components as noted prior to test.
23. Check hydraulic oil level. Add oil as needed.

Steering System Test

See **Figures 4-20** through **4-22**.

WARNING

Hydraulic system operates at high pressures and temperatures. Always allow hydraulic oil to cool and relieve pressure in hydraulic reservoir before working on hydraulic system. Wear eye protection and gloves to prevent injury. Open lines and hoses slowly and wait for any residual pressure to relieve before continuing to open lines and hoses. Failure to comply may result in injury or death to personnel.

WARNING

Prolonged contact with lubricating oil may cause skin rash. Remove saturated clothing immediately and thoroughly wash skin that comes in contact with lubricating oil. Failure to comply may result in injury or death to personnel.

WARNING

Spilled hydraulic oil is slippery and creates a hazardous condition. Clean up and properly dispose of hydraulic oil. Failure to comply may result in injury or death to personnel.

CAUTION

Wipe clean area around all fluid connections prior to removal. Cap and plug all hoses, lines, fittings, and ports during removal to prevent contamination of system components. System must be kept clean from contaminants. Failure to comply may result in damage to equipment.

NOTE

All hydraulic cylinders are pressure-tested the same way.

Required Tools or Equipment
• Digital Multimeter

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Start machine.

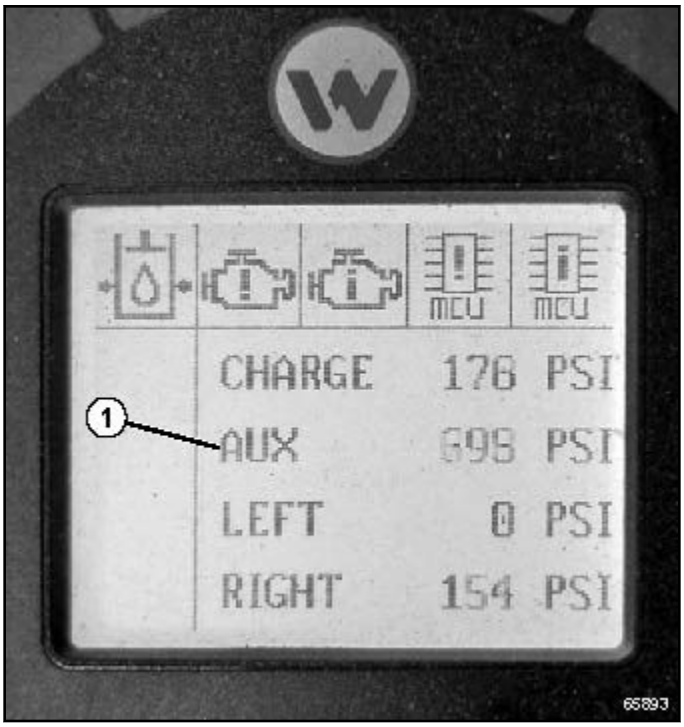

Figure 4-20: Display

3. Using the display monitor Aux hydraulic pressure (1).

   Does pressure gauge read 750 psi (52 bar)?

   YES *Relief valve is okay. Proceed to Step 4.*

   NO *Relief valve may be clogged. Turn off machine. Remove and clean relief valve and retest. If condition still exists, proceed to Step 4.*

4. Using the display monitor Aux hydraulic pressure (1) while operating the pitch control system (pressing pitch control up or down button on joystick).

   Does pressure read 750 psi (52 bar)?

   YES *Relief valve is okay. Proceed to Step 5.*

   NO *Relief valve is faulty. Replace relief valve.*

5. Turn off machine.

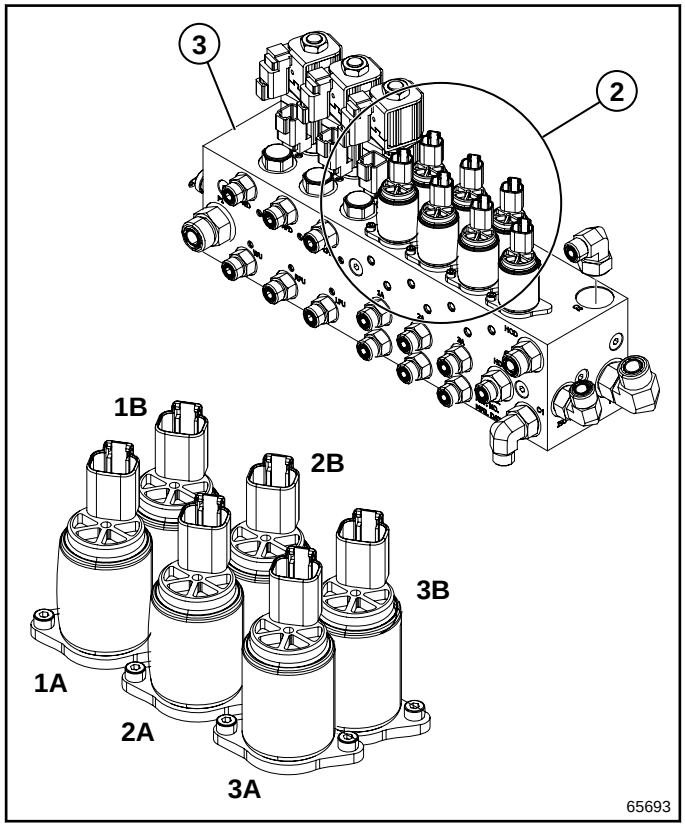

Figure 4-21: Steering Valves Location

6. Locate appropriate valves (2) on manifold (3). Valves 1A and 1B control forward and reverse movement of the right rotor, valves 2A and 2B control forward and reverse movement of the left rotor, and valves 3A and 3B control left and right movement of the right rotor.

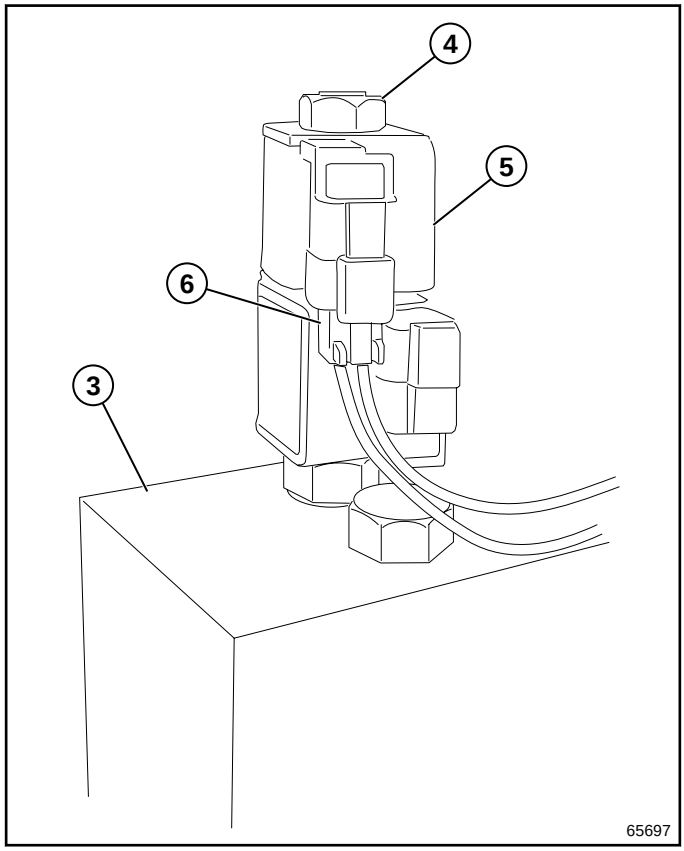

Figure 4-22: Coil Disconnect

7. Determine suspected faulty valve and disconnect electrical connector (6).
8. Remove nut (4) and coil (5) from manifold (3).
9. Using digital multimeter, measure resistance of coil (5).

   Does coil measure 5.0 - 5.5 ohms?

   YES *Coil is okay. Proceed to Step 10.*

   NO *Coil is faulty. Replace coil.*

10. Remove suspected faulty valve from manifold.
11. Install working valve to manifold in place of suspected faulty valve and install suspected faulty valve to manifold in place of working valve.
12. Start machine.
13. Attempt operation of steering system.

    Does steering system function properly?

    YES *Steering system valve is faulty. Replace steering system valve.*

    NO *Steering system valve is okay. Turn off machine, reinstall suspected faulty valve, and working valve to original locations, and proceed to Step 14.*

14. Check each steering cylinder for blow-by (leakage). Connect flowmeter to load side of steering cylinder. Start machine and check for leakage. If steady stream of hydraulic oil flows past steering cylinder seals, steering cylinder has failed. Replace steering cylinder.
15. Disconnect and remove test equipment. Install all hoses and fittings as noted prior to removal.
16. Install and connect all components as noted prior to test.
17. Check hydraulic oil level. Add oil as needed.

Pitch Control System Test

See **Figures 4-23** through **4-26**.

WARNING

Hydraulic system operates at high pressures and temperatures. Always allow hydraulic oil to cool and relieve pressure in hydraulic reservoir before working on hydraulic system. Wear eye protection and gloves to prevent injury. Open lines and hoses slowly and wait for any residual pressure to relieve before continuing to open lines and hoses. Failure to comply may result in injury or death to personnel.

WARNING

Prolonged contact with lubricating oil may cause skin rash. Remove saturated clothing immediately and thoroughly wash skin that comes in contact with lubricating oil. Failure to comply may result in injury or death to personnel.

WARNING

Spilled hydraulic oil is slippery and creates a hazardous condition. Clean up and properly dispose of hydraulic oil. Failure to comply may result in injury or death to personnel.

CAUTION

Wipe clean area around all fluid connections prior to removal. Cap and plug all hoses, lines, fittings, and ports during removal to prevent contamination of system components. System must be kept clean from contaminants. Failure to comply may result in damage to equipment.

NOTE

All hydraulic cylinders are pressure-tested the same way.

Required Tools or Equipment
• Digital Multimeter

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Start machine.

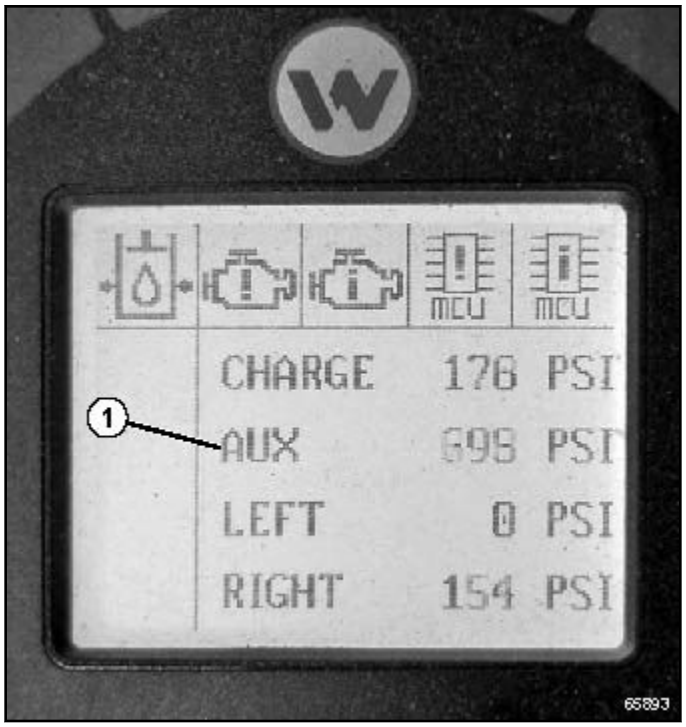

Figure 4-23: Display

3. Using the display monitor Aux hydraulic pressure (1).

   Does pressure read 750 psi (52 bar)?

   YES *Relief valve is okay. Proceed to step 4.*

   NO *Relief valve may be clogged. Turn off machine. Remove and clean relief valve and retest. If condition still exists, proceed to step 4.*

4. Using the display monitor Aux hydraulic (1) pressure while operating the pitch control system (pressing pitch control up or down button on joystick).

   Does pressure read 750 psi (52 bar)?

   YES *Relief valve is okay. Proceed to step 5.*

   NO *Relief valve is faulty. Replace relief valve.*

5. Turn off machine.

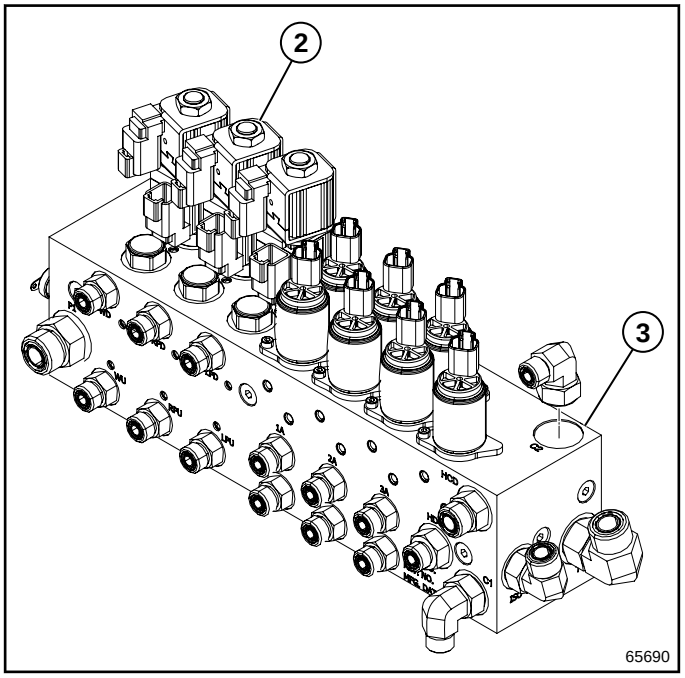

Figure 4-24: Pitch Control Solenoid

6. Locate pitch control solenoid valve (2) on manifold (3).

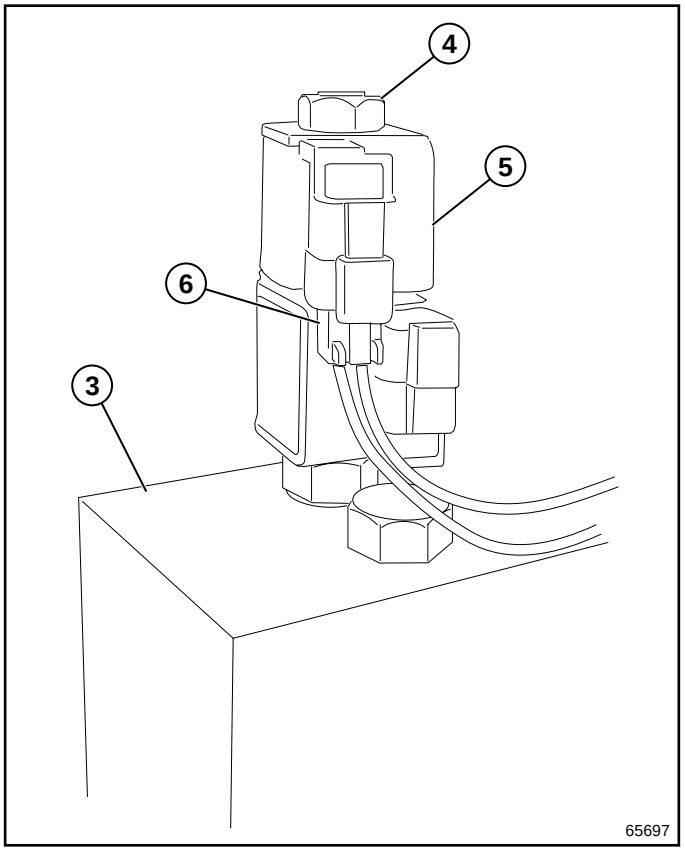

Figure 4-25: Coil Disconnect

7. Disconnect electrical connector (6).
8. Remove nut (4) and coil (5) from manifold (3).
9. Using multimeter, measure resistance of coil (5).

   Does coil measure 6.8 - 8.3 Ohms?

   YES *Coil is okay. If wheel kit is not functioning properly, proceed to step 10.*

   NO *Coil is faulty. Replace coil.*

10. Remove pitch control spool from manifold.
11. Install working wheel kit spool to manifold in place of pitch control spool and install pitch control spool to manifold in place of wheel kit spool.
12. Start machine.
13. Attempt operation of pitch control system.

    Does pitch control function properly?

    YES *Pitch control spool is faulty. Replace pitch control spool.*

    NO *Pitch control spool is okay. Turn off machine, reinstall wheel kit spool and pitch control spool to original locations, and proceed to step 14.*

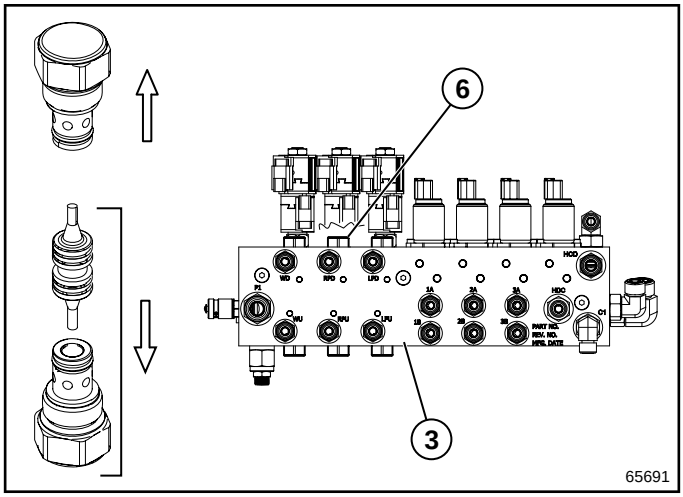

Figure 4-26: Pitch Control Check/Shuttle Valve

14. Remove pitch control check/shuttle valve (6) from manifold (3).
15. Clean pitch control check/shuttle valve and replace all damaged O-rings. Reinstall wheel kit check/shuttle valve and retry operation. If system does not function properly, wheel kit check/shuttle valve has failed. Replace wheel kit check/shuttle valve.
16. Check each pitch cylinder for blow-by (leakage). Connect flowmeter to load side of pitch cylinder. Start machine and check for leakage. If steady stream of hydraulic oil flows past pitch cylinder seals, pitch cylinder has failed. Replace pitch cylinder.

17. Disconnect and remove test equipment. Install all hoses and fittings as noted prior to removal.
18. Install and connect all components as noted prior to test.
19. Check hydraulic oil level. Add oil as needed.

Blade Rotation System Test

See **Figures 4-27** through **4-32**.

WARNING

Hydraulic system operates at high pressures and temperatures. Always allow hydraulic oil to cool and relieve pressure in hydraulic reservoir before working on hydraulic system. Wear eye protection and gloves to prevent injury. Open lines and hoses slowly and wait for any residual pressure to relieve before continuing to open lines and hoses. Failure to comply may result in injury or death to personnel.

WARNING

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WARNING

Spilled hydraulic oil is slippery and creates a hazardous condition. Clean up and properly dispose of hydraulic oil. Failure to comply may result in injury or death to personnel.

CAUTION

Wipe clean area around all fluid connections prior to removal. Cap and plug all hoses, lines, fittings, and ports during removal to prevent contamination of system components. System must be kept clean from contaminants. Failure to comply may result in damage to equipment.

CAUTION

Do not operate rotor motors when there is no resistance to blade movement, for example, when blades are lifted off work surface by activating wheel kit. Operating rotor motors without resistance will damage rotor motors

Required Tools or Equipment
• Pressure Gauge 0-1000 psi (0-69 bar) • Digital Multimeter

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Start machine and determine which set of blades is not rotating.
3. Start machine.

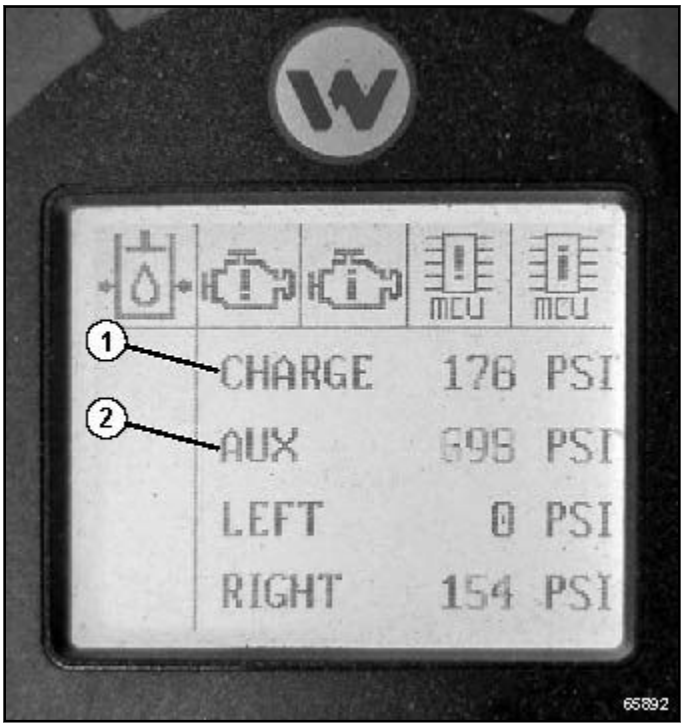


Figure 4-27: Display

4. Using the display monitor Aux (2) hydraulic pressure.

   Does pressure gauge read 750 psi (52 bar)?

   YES *Relief valve is okay. Proceed to Step 5.*

   NO *Relief valve may be clogged. Turn off machine. Remove and clean relief valve and retest. If condition still exists, proceed to Step 9.*

5. Using the display monitor Charge (1) hydraulic pressure.

   Does pressure gauge read at least 150 psi (10 bar)?

   YES *Proceed to Step 6.*

   NO *Adjust charge pressure. (See "**Charge Pressure Adjustment**" on **page 4-47**.)*

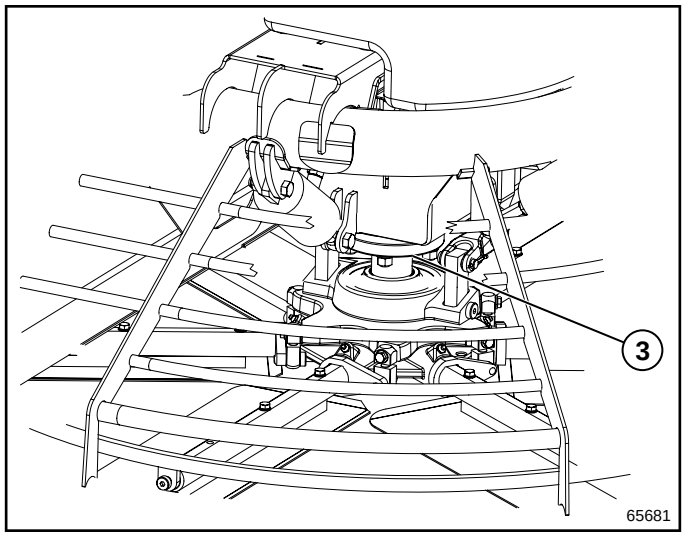


Figure 4-28: Rotor

6. Observe rotor (3).

   Does motor output and stub shaft spin while blades are stationary?

   YES *A mechanical problem exists. Turn machine off and repair mechanical failure.*

   NO *Turn off machine and proceed to Step 7.*

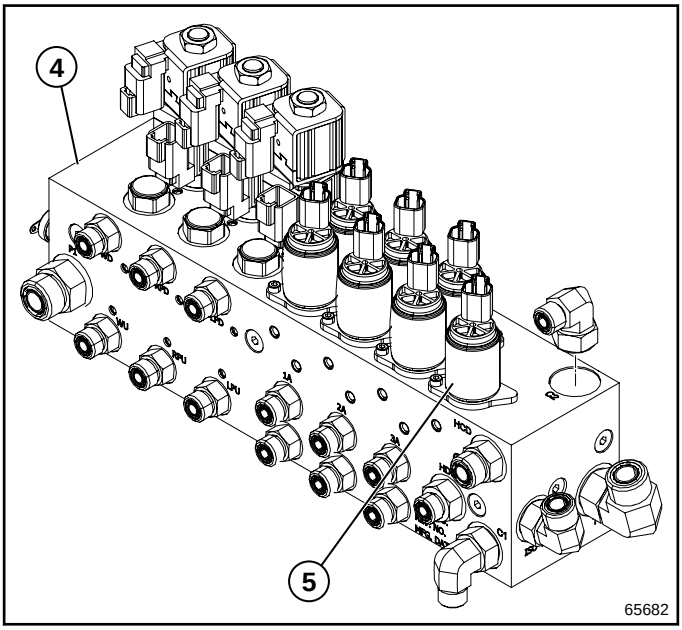


Figure 4-29: Hydro Valve

7. Locate hydro valve (5) on manifold (4).
8. Disconnect hydro valve electrical connector.
9. Using multimeter, measure resistance of hydro valve coil.

   Does coil measure 5.0 - 5.5 ohms?

   YES *Coil is okay. Proceed to Step 10.*

   NO *Coil is faulty. Replace coil.*

10. Remove hydro valve (5) from manifold (4).
11. Install steering valve to manifold (4) in place of hydro valve (5), and install hydro valve to manifold in place of steering valve.
12. Start machine.
13. Attempt operation of blade control system.

    Does blade control system function properly?

    YES *Hydro valve is faulty. Turn off machine, and replace hydro valve (5).*

    NO *Hydro valve is okay. Turn off machine, reinstall hydro valve and steering valve to original locations, and proceed to Step 14.*

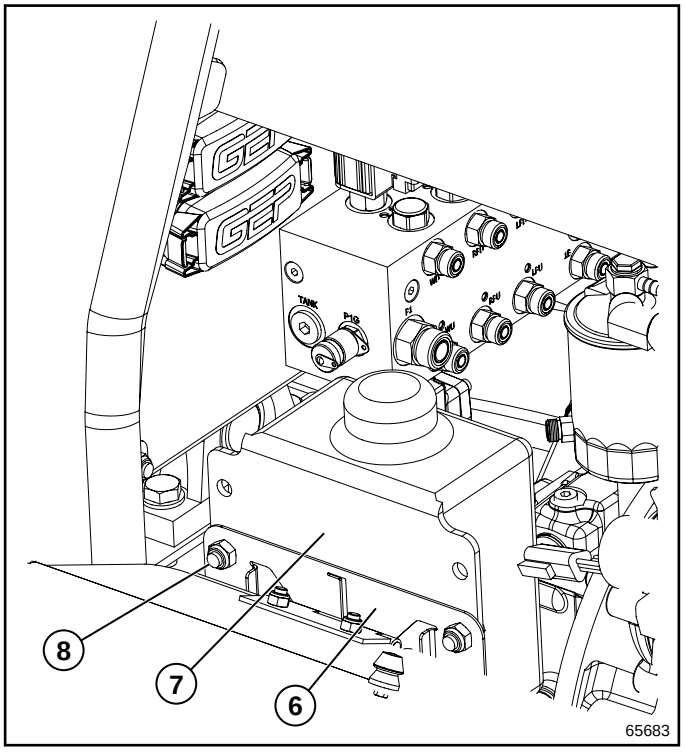


Figure 4-30: Oveflow Bottle

14. Remove bolts (8) securing overflow bottle (7) to machine (6). Position overflow bottle out of the way.
15. Start machine and run at FAST throttle.
16. Using the display check hydraulic pressure.

    Does pressure gauge read 150 - 350 psi (10 - 24 bar)?

    YES *Charge pump relief valve is okay. Proceed to Step 17.*

    NO *Either charge pump relief valve is not set correctly, charge pump relief valve is faulty, or charge pump is faulty. Turn off machine. Adjust or replace charge pump relief valve and retest system. If pressure is still low, chare pump is faulty. Rebuild or replace tandem pump assembly. (See "**Tandem Pump**" on **page 4-59**.)*

17. Turn off machine.

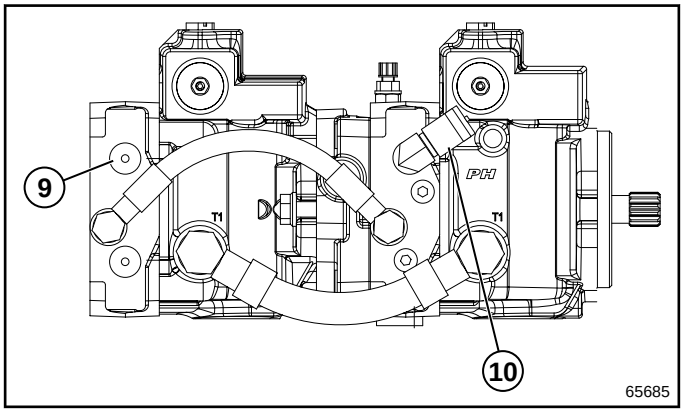


Figure 4-31: Tandem Pump

NOTE

Left rotor motor is driven by front pump (10) (pump closest to engine) and right rotor motor is driven by rear pump (9).

18. Start machine and run at FAST throttle.
19. Press and hold foot pedal, and measure hydraulic pressure.

    Does pressure guage read between 1500 - 4500 psi (103 - 310 bar)?

    YES *Pump is okay. Proceed to Step 20.*

    NO *If pressure is over 4500 psi (310 bar), drive motor is faulty. Replace drive motor. (See "**Drive Motor**" on **page 4-57**.) If pressure is below 1500 psi (103 bar), pump failure is possible. Proceed to Step 20.*

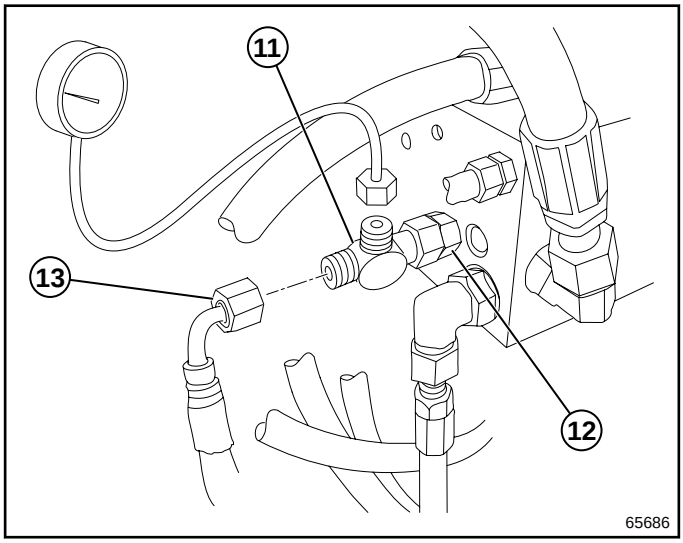


Figure 4-32: HDC Hose Test Connection

20. Connect tee-fitting (11) between manifold (12) and Hydraulic Control (HDC) hose (13).
21. Connect 0-1000 psi (0-70 bar) pressure gauge to tee-fitting (11).
22. Start machine and run at FAST throttle.
23. Press and hold foot pedal, and measure hydraulic pressure.

    Does pressure gauge read 480 psi (33 bar)?

    YES *Tandem pump may be faulty. Contact Wacker Nueson support for further instructions.*

    NO *Hydro valve is faulty. Turn machine off and replace hydro valve.*
24. Disconnect and remove test equipment. Install all hoses and fittings as noted prior to removal.
25. Install and connect all components as noted prior to test.
26. Check hydraulic oil level. Add oil as needed.

Charge Pressure Adjustment

See **Figures 4-33** and **4-34**.

WARNING

Hydraulic system operates at high pressures and temperatures. Always allow hydraulic oil to cool and relieve pressure in hydraulic reservoir before working on hydraulic system. Wear eye protection and gloves to prevent injury. Open lines and hoses slowly and wait for any residual pressure to relieve before continuing to open lines and hoses. Failure to comply may result in injury or death to personnel.

WARNING

Prolonged contact with lubricating oil may cause skin rash. Remove saturated clothing immediately and thoroughly wash skin that comes in contact with lubricating oil. Failure to comply may result in injury or death to personnel.

WARNING

Spilled hydraulic oil is slippery and creates a hazardous condition. Clean up and properly dispose of hydraulic oil. Failure to comply may result in injury or death to personnel.

CAUTION

Wipe clean area around all fluid connections prior to removal. Cap and plug all hoses, lines, fittings, and ports during removal to prevent contamination of system components. System must be kept clean from contaminants. Failure to comply may result in damage to equipment.

Required Tools or Equipment
• Pressure Gauge 0-1000 psi (0-70 bar)

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Start machine and idle for at least 5 minutes. Hydraulic oil must be at least 100°F (38°C).

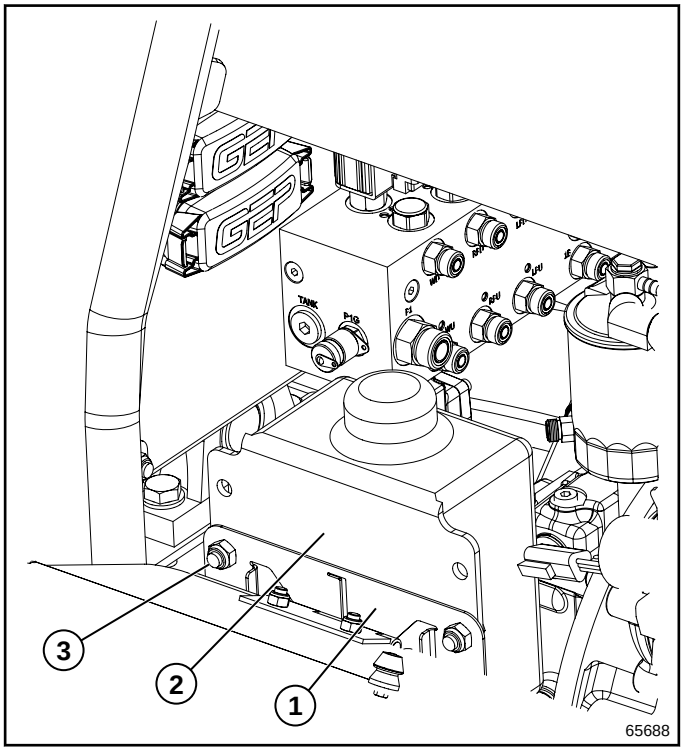


Figure 4-33: Overflow Bottle

3. Remove bolts (3) securing overflow bottle (2) to machine (1). Position overflow bottle out of the way.

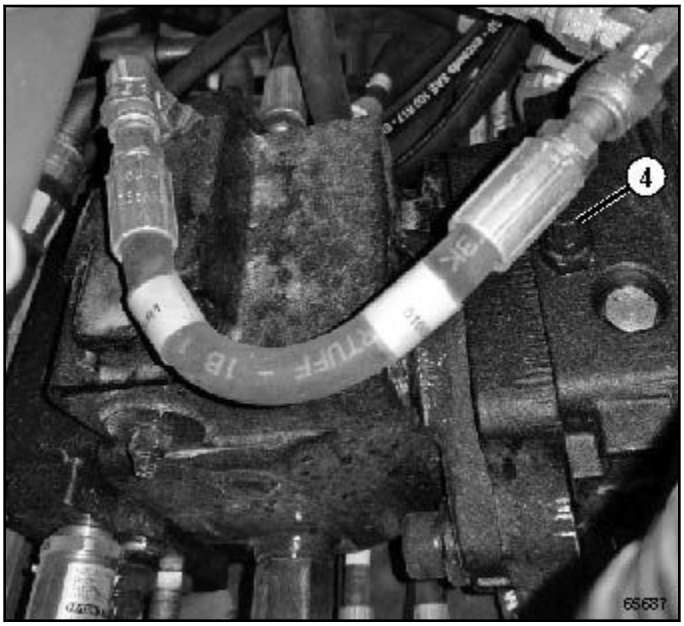


Figure 4-34: Charge Pressure Adjusting Screw

4. Locate charge pressure adjusting screw (4).
5. Start machine and run at FAST throttle.

NOTICE

Do not set charge pressure to more than 300 psi 300 psi (20.6 bar) or damage to oil cooler may occur.

6. Observe charge pressure on the display and adjust charge pressure to 300 psi (20.6 bar). Rotate adjusting screw clockwise to increase pressure and counterclockwise to decrease pressure.
7. Turn off machine.
8. Disconnect and remove test equipment. Install all hoses and fittings as noted prior to removal.
9. Install and connect all components as noted prior to test.
10. Check hydraulic oil level. Add oil as needed.

Repair

Oil Cooler

Removal and Installation

See **Figure 4-35**.

WARNING

Hydraulic system operates at high pressures and temperatures. Always allow hydraulic oil to cool and relieve pressure in hydraulic reservoir before working on hydraulic system. Wear eye protection and gloves to prevent injury. Open lines and hoses slowly and wait for any residual pressure to relieve before continuing to open lines and hoses. Failure to comply may result in injury or death to personnel.

WARNING

Prolonged contact with lubricating oil may cause skin rash. Remove saturated clothing immediately and wash skin thoroughly that comes in contact with lubricating oil. Failure to comply may result in injury or death to personnel.

WARNING

Spilled hydraulic oil is slippery and creates a hazardous condition. Clean up and properly dispose of hydraulic oil. Failure to comply may result in injury or death to personnel.

CAUTION

Wipe area clean around all fluid connections prior to removal. Cap and plug all hoses, lines, fittings, and ports during removal to prevent contamination of system components. System must be kept clean from contaminants. Failure to comply may result in damage to equipment.

NOTES

- *Position drain pan under hoses being removed.*
- *Tag and mark hoses and fittings prior to removal to ensure proper installation.*
- *Inspect O-rings upon removal for wear or damage and replace as necessary.*
- *Cap and plug hoses and fittings during removal.*

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Open battery cover.

WARNING

Always disconnect the negative terminal first and positive terminal last. Connect positive terminal first and negative terminal last. Use care when testing live circuits to prevent arcing. Arcing could result in death or serious injury.

3. Disconnect negative battery cable at battery.
4. Remove right side shell. (See "**Right Shell Removal and Installation**" on **page 5-5**.)

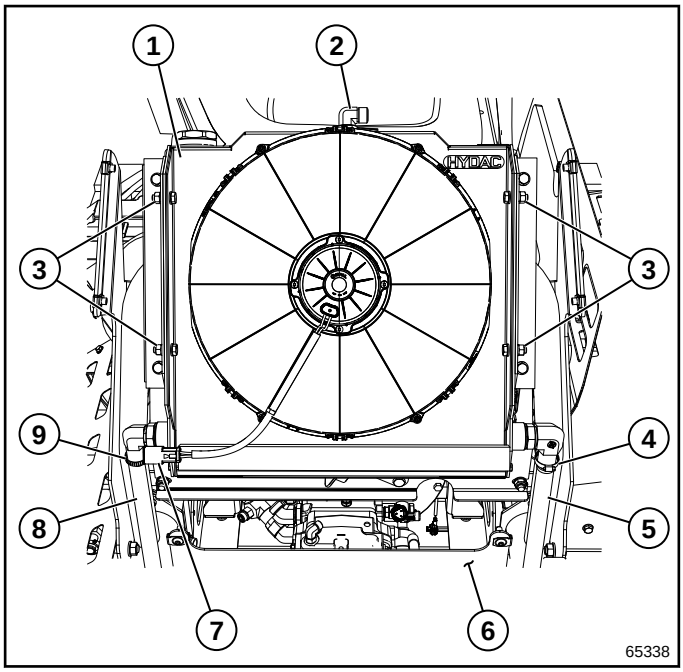


Figure 4-35: Oil Cooler Removal and Installation

5. Disconnect electrical connector (7) from oil cooler (1).
6. Remove clamp (4) and hose (5) from oil cooler (1) and allow oil cooler (1) to completely drain into drain pan.
7. Remove clamp (9) and hose (8) from oil cooler (1).
8. Remove hose (2) from oil cooler (1).

9. Remove bolts, nuts, washers (3), and oil cooler (1) from machine (6).

Installation Notes

- *Install oil cooler by reversing the order of removal.*
- *Remove caps and plugs as hoses and fittings are installed.*
- *Install hoses and fittings as noted prior to removal.*
- *Replace hydraulic oil filter.*
- *Refill hydraulic oil.*
- *Start engine. Check hydraulic system for leaks and repair as necessary.*
- *Check hydraulic level and add if necessary.*

Gear Pump

Removal and Installation

See **Figures 4-36** and **4-37**.

WARNING

Hydraulic system operates at high pressures and temperatures. Always allow hydraulic oil to cool and relieve pressure in hydraulic reservoir before working on hydraulic system. Wear eye protection and gloves to prevent injury. Open lines and hoses slowly and wait for any residual pressure to relieve before continuing to open lines and hoses. Failure to comply may result in injury or death to personnel.

WARNING

Prolonged contact with lubricating oil may cause skin rash. Remove saturated clothing immediately and wash skin thoroughly that comes in contact with lubricating oil. Failure to comply may result in injury or death to personnel.

WARNING

Spilled hydraulic oil is slippery and creates a hazardous condition. Clean up and properly dispose of hydraulic oil. Failure to comply may result in injury or death to personnel.

CAUTION

Wipe area clean around all fluid connections prior to removal. Cap and plug all hoses, lines, fittings, and ports during removal to prevent contamination of system components. System must be kept clean from contaminants. Failure to comply may result in damage to equipment.

NOTES

- *Position drain pan under hoses being removed.*
- *Tag and mark hoses and fittings prior to removal to ensure proper installation.*
- *Inspect O-rings upon removal for wear or damage and replace as necessary.*
- *Cap and plug hoses and fittings during removal.*

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)

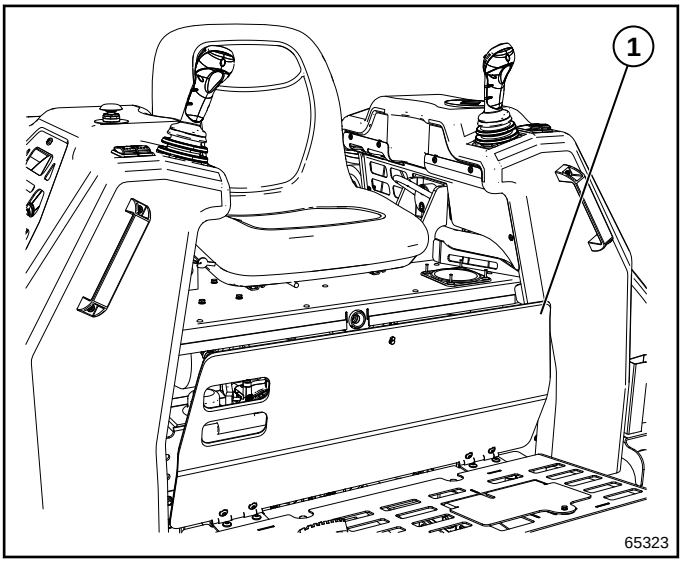


Figure 4-36: Access Panel

2. Unlatch and open access panel (1).

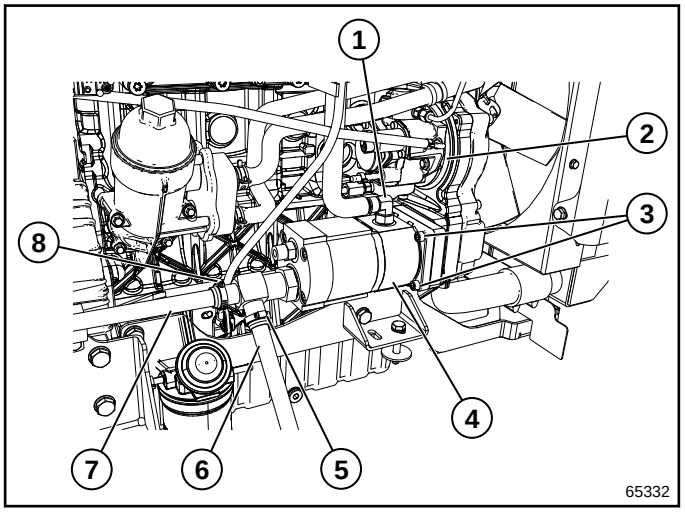


Figure 4-37: Gear Pump Removal and Installation

3. Remove clamp (8) and hose (7) from gear pump (4).
4. Remove clamp (5) and hose (6) from gear pump (4).
5. Remove hose (1) from gear pump (4).
6. Remove bolts, washers (3), and gear pump (4) from engine (2).

Installation Notes

- *Install gear pump by reversing the order of removal.*
- *Remove caps and plugs as hoses and fittings are installed.*
- *Install hoses and fittings as noted prior to removal.*
- *Start engine. Check hydraulic system for leaks and repair as necessary.*
- *Check hydraulic level and add if necessary.*

Steering Cylinder

Removal and Installation

See **Figures 4-38** and **4-39**.

WARNING

Hydraulic system operates at high pressures and temperatures. Always allow hydraulic oil to cool and relieve pressure in hydraulic reservoir before working on hydraulic system. Wear eye protection and gloves to prevent injury. Open lines and hoses slowly and wait for any residual pressure to relieve before continuing to open lines and hoses. Failure to comply may result in injury or death to personnel.

WARNING

Prolonged contact with lubricating oil may cause skin rash. Remove saturated clothing immediately and wash skin thoroughly that comes in contact with lubricating oil. Failure to comply may result in injury or death to personnel.

WARNING

Spilled hydraulic oil is slippery and creates a hazardous condition. Clean up and properly dispose of hydraulic oil. Failure to comply may result in injury or death to personnel.

CAUTION

Wipe area clean around all fluid connections prior to removal. Cap and plug all hoses, lines, fittings, and ports during removal to prevent contamination of system components. System must be kept clean from contaminants. Failure to comply may result in damage to equipment.

NOTES

- *Position drain pan under hoses being removed.*
- *Tag and mark hoses and fittings prior to removal to ensure proper installation.*
- *Inspect O-rings upon removal for wear or damage and replace as necessary.*
- *Cap and plug hoses and fittings during removal.*

NOTE

All steering cylinders are removed similarly. One steering cylinder is shown.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Ensure blades are flat on ground.

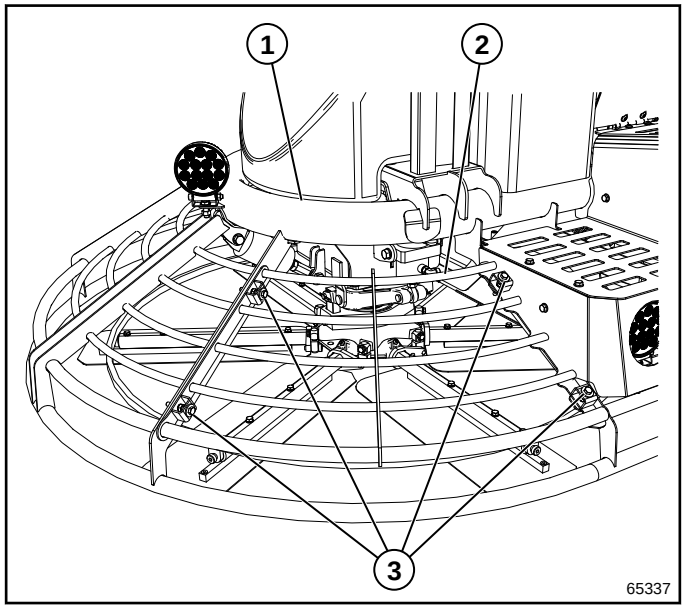


Figure 4-38: Safety Cage Removal and Installation

3. Remove nuts, bolts, washers (3), and safety cage (2) from machine (1).

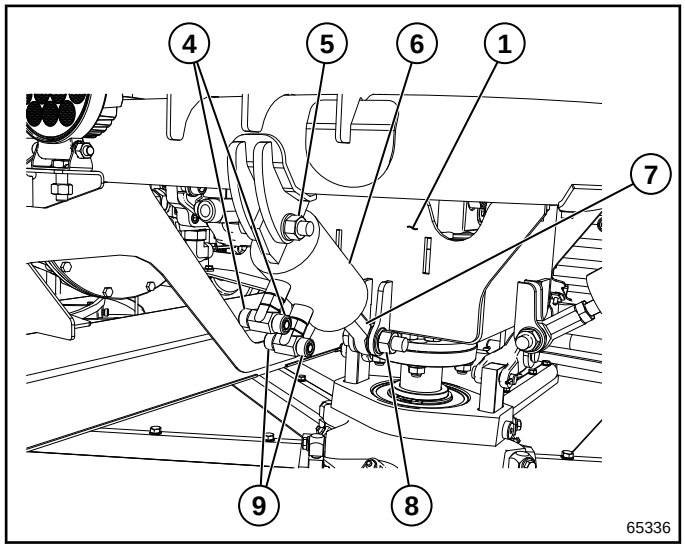


Figure 4-39: Steering Cylinder Removal and Installation

4. Remove hoses (4) from steering cylinder (6).
5. Remove hoses (9) from steering cylinder (6).
6. Remove nut, washers, and bolt (8) from steering cylinder piston (7).
7. Remove nut, washers, bolt (5), and steering cylinder (6) from machine (1).

Installation Notes

- *Install steering cylinder by reversing the order of removal.*
- *Piston head should be centered in cylinder before installing. Turn rod end to fit piston to correct length.*
- *Torque nut, washer, and bolt (5) to 88 lb-ft (119 N•m).*
- *Loosen lock nut on steering cylinder piston (7) to fit nut, washer, and bolt (8) to machine, and torque nut, washer, and bolt (8) to 112 lb-ft (152 N•m).*
- *Remove caps and plugs as hoses and fittings are installed.*
- *Install hoses and fittings as noted prior to removal.*
- *Start engine. Check hydraulic system for leaks and repair as necessary.*
- *Check hydraulic level and add if necessary.*

Pitch Cylinder

Removal and Installation

See **Figures 4-40** and **4-41**.

WARNING

Hydraulic system operates at high pressures and temperatures. Always allow hydraulic oil to cool and relieve pressure in hydraulic reservoir before working on hydraulic system. Wear eye protection and gloves to prevent injury. Open lines and hoses slowly and wait for any residual pressure to relieve before continuing to open lines and hoses. Failure to comply may result in injury or death to personnel.

WARNING

Prolonged contact with lubricating oil may cause skin rash. Remove saturated clothing immediately and wash skin thoroughly that comes in contact with lubricating oil. Failure to comply may result in injury or death to personnel.

WARNING

Spilled hydraulic oil is slippery and creates a hazardous condition. Clean up and properly dispose of hydraulic oil. Failure to comply may result in injury or death to personnel.

CAUTION

Wipe area clean around all fluid connections prior to removal. Cap and plug all hoses, lines, fittings, and ports during removal to prevent contamination of system components. System must be kept clean from contaminants. Failure to comply may result in damage to equipment.

NOTES

- *Position drain pan under hoses being removed.*
- *Tag and mark hoses and fittings prior to removal to ensure proper installation.*
- *Inspect O-rings upon removal for wear or damage and replace as necessary.*
- *Cap and plug hoses and fittings during removal.*

NOTE

Both pitch cylinders are removed similarly. One pitch cylinder is shown.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Ensure blades are flat on ground.

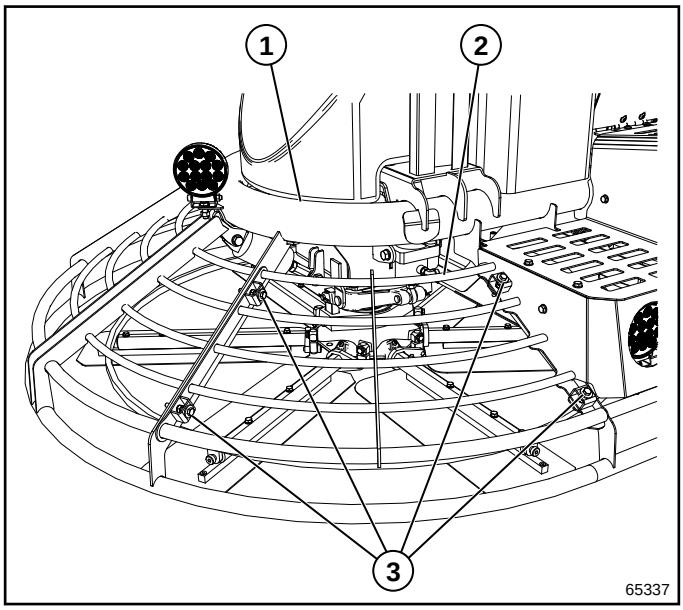


Figure 4-40: Safety Cage Removal and Installation

3. Remove nuts, bolts, washers (3), and safety cage (2) from machine (1).

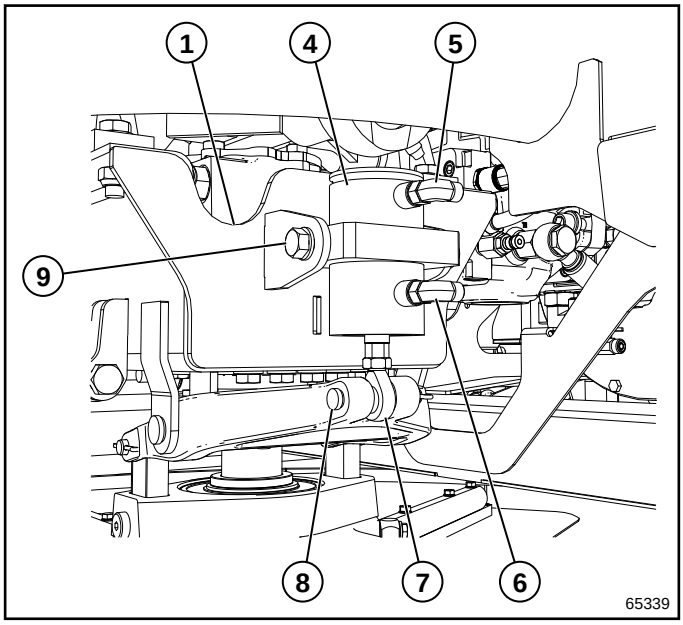


Figure 4-41: Pitch Cylinder Removal and Installation

4. Remove hose (5) from pitch cylinder (4).
5. Remove hose (6) from pitch cylinder (4).
6. Remove cotter and clevis pin (8) from pitch cylinder piston (7).
7. Remove bolts, washers (9), and pitch cylinder (4) from machine (1).

Installation Notes

- *Install pitch cylinder by reversing the order of removal.*
- *Torque bolts and washers (9) to 27 lb-ft (37 N•m).*
- *Loosen lock nut on pitch cylinder piston (7) to install cotter and clevis pin (8). Ensure pitch cylinder (4) connects to pitch cylinder piston (7) at midpoint.*
- *Remove caps and plugs as hoses and fittings are installed.*
- *Install hoses and fittings as noted prior to removal.*
- *Start engine. Check hydraulic system for leaks and repair as necessary.*
- *Check hydraulic level and add if necessary.*

Manifold

Removal and Installation

See **Figure 4-42**.

WARNING

Hydraulic system operates at high pressures and temperatures. Always allow hydraulic oil to cool and relieve pressure in hydraulic reservoir before working on hydraulic system. Wear eye protection and gloves to prevent injury. Open lines and hoses slowly and wait for any residual pressure to relieve before continuing to open lines and hoses. Failure to comply may result in injury or death to personnel.

WARNING

Prolonged contact with lubricating oil may cause skin rash. Remove saturated clothing immediately and wash skin thoroughly that comes in contact with lubricating oil. Failure to comply may result in injury or death to personnel.

WARNING

Spilled hydraulic oil is slippery and creates a hazardous condition. Clean up and properly dispose of hydraulic oil. Failure to comply may result in injury or death to personnel.

CAUTION

Wipe area clean around all fluid connections prior to removal. Cap and plug all hoses, lines, fittings, and ports during removal to prevent contamination of system components. System must be kept clean from contaminants. Failure to comply may result in damage to equipment.

NOTES

- *Position drain pan under hoses being removed.*
- *Tag and mark hoses and fittings prior to removal to ensure proper installation.*
- *Inspect O-rings upon removal for wear or damage and replace as necessary.*
- *Cap and plug hoses and fittings during removal.*

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Open battery cover.

WARNING

Always disconnect the negative terminal first and positive terminal last. Connect positive terminal first and negative terminal last. Use care when testing live circuits to prevent arcing. Arcing could result in death or serious injury.

3. Disconnect negative battery cable at battery.
4. Remove right shell. (See "**Right Shell Removal and Installation**" on **page 5-5**.)

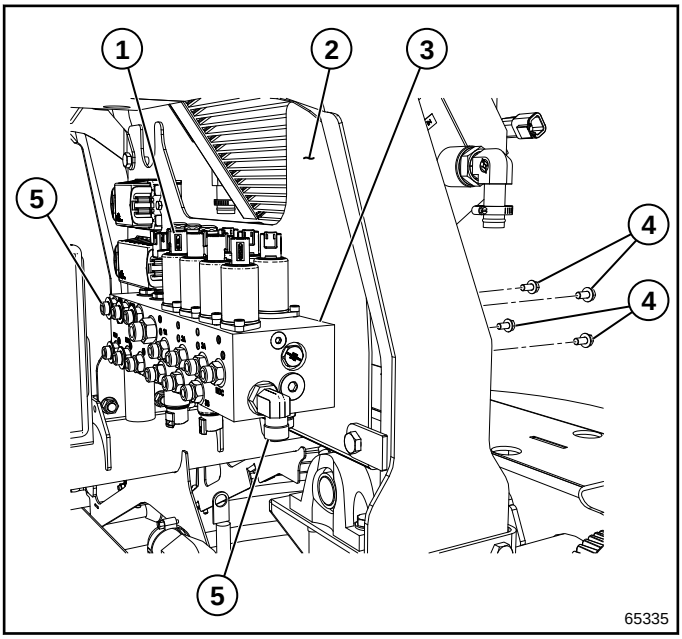


Figure 4-42: Manifold Removal and Installation

5. Remove hoses (5) from manifold (3).
6. Remove electrical connectors (1) from manifold (3).
7. Remove bolts (4) and manifold (3) from machine (2).

Installation Notes

- *Install manifold by reversing the order of removal.*
- *Torque bolts (4) to 36 lb-ft (49 N•m).*
- *Remove caps and plugs as hoses and fittings are installed.*
- *Install hoses and fittings as noted prior to removal.*
- *Start engine. Check hydraulic system for leaks and repair as necessary.*
- *Check hydraulic level and add if necessary.*

Wheel Kit Cylinder

Removal and Installation

See **Figures 4-43** and **4-44**.

WARNING

Hydraulic system operates at high pressures and temperatures. Always allow hydraulic oil to cool and relieve pressure in hydraulic reservoir before working on hydraulic system. Wear eye protection and gloves to prevent injury. Open lines and hoses slowly and wait for any residual pressure to relieve before continuing to open lines and hoses. Failure to comply may result in injury or death to personnel.

WARNING

Prolonged contact with lubricating oil may cause skin rash. Remove saturated clothing immediately and wash skin thoroughly that comes in contact with lubricating oil. Failure to comply may result in injury or death to personnel.

WARNING

Spilled hydraulic oil is slippery and creates a hazardous condition. Clean up and properly dispose of hydraulic oil. Failure to comply may result in injury or death to personnel.

CAUTION

Wipe area clean around all fluid connections prior to removal. Cap and plug all hoses, lines, fittings, and ports during removal to prevent contamination of system components. System must be kept clean from contaminants. Failure to comply may result in damage to equipment.

NOTES

- *Position drain pan under hoses being removed.*
- *Tag and mark hoses and fittings prior to removal to ensure proper installation.*
- *Inspect O-rings upon removal for wear or damage and replace as necessary.*
- *Cap and plug hoses and fittings during removal.*

NOTE

Both wheel kit cylinders are removed similarly. Front wheel kit cylinder is shown.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)

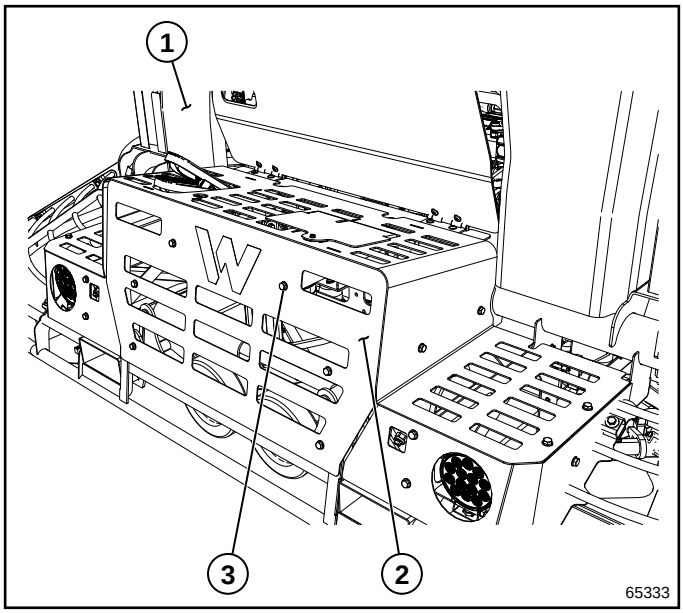


Figure 4-43: Wheel Kit Plate Removal and Installation

2. Remove bolts, washers (3), and wheel kit plate (2) from machine (1).

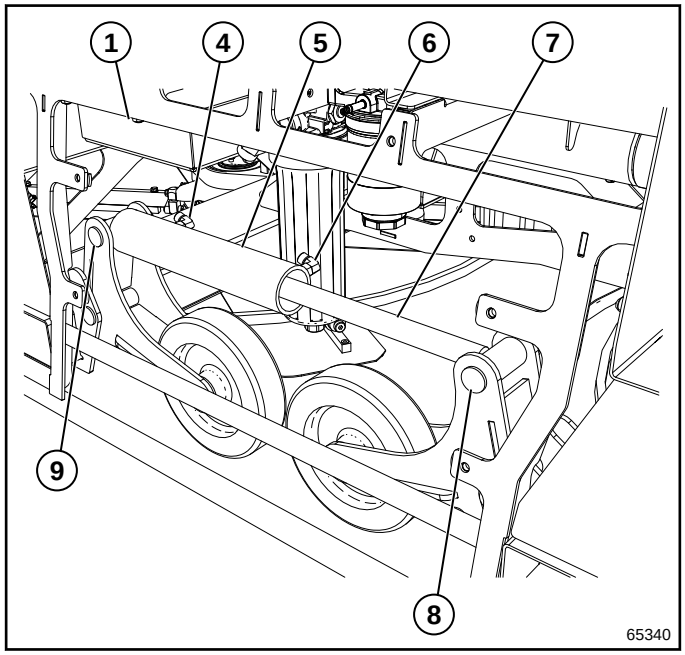


Figure 4-44: Wheel Kit Cylinder Removal and Installation

3. Remove hose (4) from wheel kit cylinder (5).
4. Remove hose (6) from wheel kit cylinder (5).
5. Remove cotter and clevis pin (8) from wheel kit cylinder piston (7).
6. Remove cotter, clevis pin (9), and wheel kit cylinder (5) from machine (1).

Installation Notes

- *Install wheel kit cylinder by reversing the order of removal.*
- *Remove caps and plugs as hoses and fittings are installed.*
- *Install hoses and fittings as noted prior to removal.*
- *Start engine. Check hydraulic system for leaks and repair as necessary.*
- *Check hydraulic level and add if necessary.*
- *Torque bolts (3) to 18 lb-ft (24 N•m).*

Rotor Assembly

Removal and Installation

See **Figure 4-45**.

WARNING

Always check the lifting capacity and condition of hoists, slings, cables, or chains before use. Using underrated or worn lifting components can result in death or serious injury.

WARNING

Support the machine using properly rated jackstands. Never work under a machine supported only by a jack.

- **Do not use wood or concrete blocks to support the machine. Failure to properly support the machine may result in death or serious injury.**

WARNING

Hydraulic system operates at high pressures and temperatures. Always allow hydraulic oil to cool and relieve pressure in hydraulic reservoir before working on hydraulic system. Wear eye protection and gloves to prevent injury. Open lines and hoses slowly and wait for any residual pressure to relieve before continuing to open lines and hoses. Failure to comply may result in injury or death to personnel.

WARNING

Prolonged contact with lubricating oil may cause skin rash. Remove saturated clothing immediately and wash skin thoroughly that comes in contact with lubricating oil. Failure to comply may result in injury or death to personnel.

WARNING

Spilled hydraulic oil is slippery and creates a hazardous condition. Clean up and properly dispose of hydraulic oil. Failure to comply may result in injury or death to personnel.

CAUTION

Wipe area clean around all fluid connections prior to removal. Cap and plug all hoses, lines, fittings, and ports during removal to prevent contamination of system components. System must be kept clean from contaminants. Failure to comply may result in damage to equipment.

NOTES

- *Position drain pan under hoses being removed.*
- *Tag and mark hoses and fittings prior to removal to ensure proper installation.*
- *Inspect O-rings upon removal for wear or damage and replace as necessary.*
- *Cap and plug hoses and fittings during removal.*

NOTE

Both rotor assemblies are removed similarly. Right rotor assembly is shown.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Remove retardant tank and/or fuel tank. (See "**Retardant Tank**" on **page 5-3** and/or "**Fuel Tank**" on **page 5-4**.)
3. Remove steering cylinder(s). (See "**Steering Cylinder**" on **page 4-51**.)

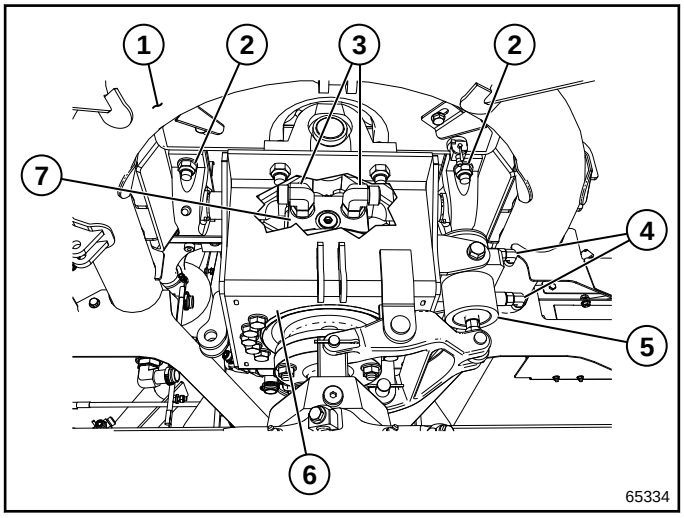


Figure 4-45: Rotor Assembly Removal and Installation

4. Remove hoses (4) from pitch cylinder (5).
5. Remove hoses (3) from drive motor (7).
6. Remove nuts, washers, and bolts (2) from rotor assembly (6) and machine (1).
7. Using suitable lifting device, lift machine (1) off of rotor assembly (6).

Installation Notes

- *Install rotor assembly by reversing the order of removal.*
- *Remove caps and plugs as hoses and fittings are installed.*
- *Install hoses and fittings as noted prior to removal.*
- *Start engine. Check hydraulic system for leaks and repair as necessary.*
- *Check hydraulic level and add if necessary.*

Drive Motor

Removal and Installation

See **Figures 4-46** and **4-47**.

WARNING

Always check the lifting capacity and condition of hoists, slings, cables, or chains before use. Using underrated or worn lifting components can result in death or serious injury.

WARNING

Support the machine using properly rated jackstands. Never work under a machine supported only by a jack.

- **Do not use wood or concrete blocks to support the machine. Failure to properly support the machine may result in death or serious injury.**

WARNING

Hydraulic system operates at high pressures and temperatures. Always allow hydraulic oil to cool and relieve pressure in hydraulic reservoir before working on hydraulic system. Wear eye protection and gloves to prevent injury. Open lines and hoses slowly and wait for any residual pressure to relieve before continuing to open lines and hoses. Failure to comply may result in injury or death to personnel.

WARNING

Prolonged contact with lubricating oil may cause skin rash. Remove saturated clothing immediately and wash skin thoroughly that comes in contact with lubricating oil. Failure to comply may result in injury or death to personnel.

WARNING

Spilled hydraulic oil is slippery and creates a hazardous condition. Clean up and properly dispose of hydraulic oil. Failure to comply may result in injury or death to personnel.

CAUTION

Wipe area clean around all fluid connections prior to removal. Cap and plug all hoses, lines, fittings, and ports during removal to prevent contamination of system components. System must be kept clean from contaminants. Failure to comply may result in damage to equipment.

NOTES

- *Position drain pan under hoses being removed.*
- *Tag and mark hoses and fittings prior to removal to ensure proper installation.*
- *Inspect O-rings upon removal for wear or damage and replace as necessary.*
- *Cap and plug hoses and fittings during removal.*

NOTE

Both drive motors are removed similarly. Right drive motor is shown.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Remove rotor assembly. (See "**Rotor Assembly**" on **page 4-56**.)

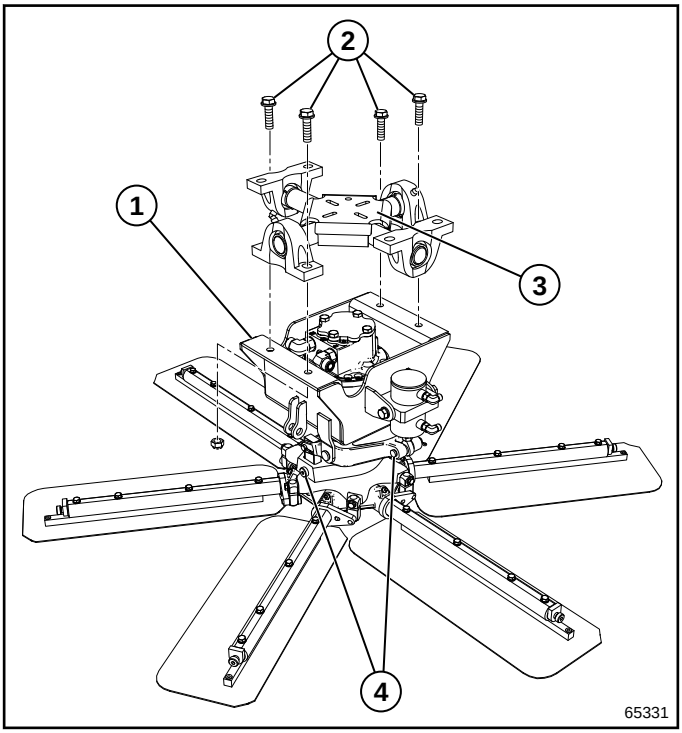


Figure 4-46: Cross Removal and Installation

3. Remove nuts, washers, bolts (2), and cross (3) from rotor assembly (1).

4. Remove clevis and cotter pins (4) from rotor assembly (1).

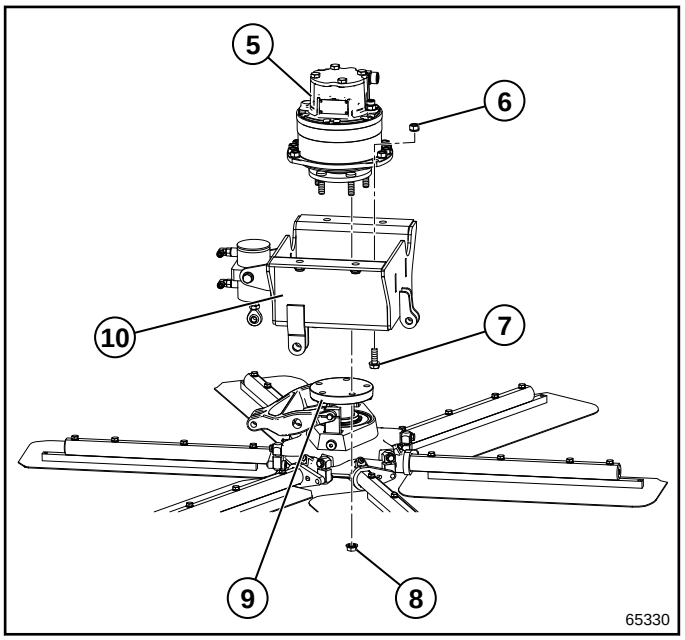


Figure 4-47: Drive Motor Removal and Installation

5. Using suitable lifting device, support weight of drive motor housing (10).
6. Mark position of rotor (9) and drive motor (5).
7. Remove nuts and washers (8) from rotor (9) and drive motor (5).
8. Using suitable lifting device, remove drive motor housing (10) from rotor (9) and place on ground.
9. Mark position of drive motor (5) and drive motor housing (10).
10. Using suitable lifting device, support weight of drive motor (5).
11. Remove nuts (6), bolts, and washers (7) from drive motor (5).
12. Using suitable lifting device, lift drive motor (5) out of drive motor housing (10).

Installation Notes

- *Install drive motor by reversing the order of removal.*
- *Fill drive motor with approximately 24 oz (710 ml) of hydraulic oil through case drain port.*
- *Install drive motor (5) to drive motor housing (10) as marked during removal and torque nuts (6), bolts, and washers (7) to 89 lb-ft (121 N•m).*
- *Apply blue loctite to nuts (8) and torque to 35 lb-ft (47 N•m).*
- *Torque nuts (8) to 73 lb-ft (99 N•m).*
- *Remove caps and plugs as hoses and fittings are installed.*
- *Install hoses and fittings as noted prior to removal.*
- *Start engine. Check hydraulic system for leaks and repair as necessary.*
- *Check hydraulic level and add if necessary.*

Tandem Pump

Removal and Installation

See **Figure 4-48**.

WARNING

Always check the lifting capacity and condition of hoists, slings, cables, or chains before use. Using underrated or worn lifting components can result in death or serious injury.

WARNING

Support the machine using properly rated jackstands. Never work under a machine supported only by a jack.

- **Do not use wood or concrete blocks to support the machine. Failure to properly support the machine may result in death or serious injury.**

WARNING

Hydraulic system operates at high pressures and temperatures. Always allow hydraulic oil to cool and relieve pressure in hydraulic reservoir before working on hydraulic system. Wear eye protection and gloves to prevent injury. Open lines and hoses slowly and wait for any residual pressure to relieve before continuing to open lines and hoses. Failure to comply may result in injury or death to personnel.

WARNING

Prolonged contact with lubricating oil may cause skin rash. Remove saturated clothing immediately and wash skin thoroughly that comes in contact with lubricating oil. Failure to comply may result in injury or death to personnel.

⚠ WARNING

Spilled hydraulic oil is slippery and creates a hazardous condition. Clean up and properly dispose of hydraulic oil. Failure to comply may result in injury or death to personnel.

⚠ CAUTION

Wipe area clean around all fluid connections prior to removal. Cap and plug all hoses, lines, fittings, and ports during removal to prevent contamination of system components. System must be kept clean from contaminants. Failure to comply may result in damage to equipment.

NOTES

- *Position drain pan under hoses being removed.*
- *Tag and mark hoses and fittings prior to removal to ensure proper installation.*
- *Inspect O-rings upon removal for wear or damage and replace as necessary.*
- *Cap and plug hoses and fittings during removal.*

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Remove right rotor assembly. (See "**Rotor Assembly**" on **page 4-56**.)

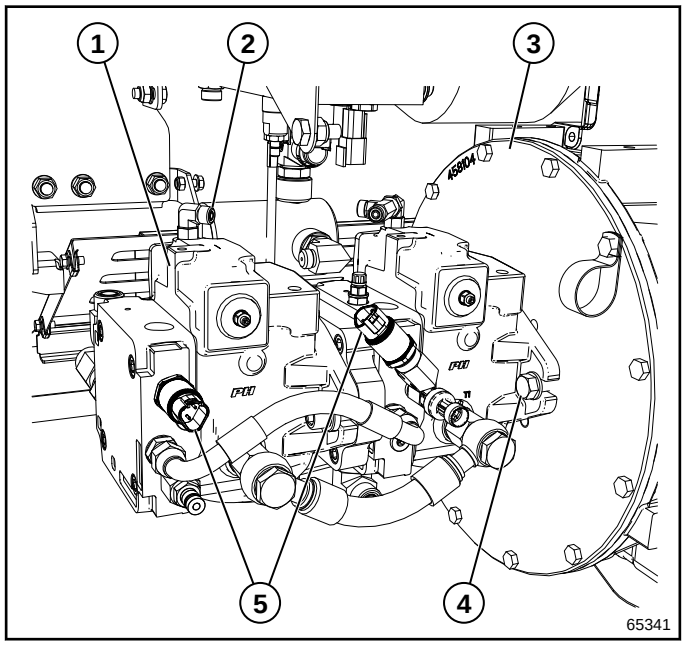


Figure 4-48: Tandem Pump Removal and Installation

3. Remove hoses (2) from tandem pump (1).
4. Remove electrical connectors (5) from tandem pump (1).
5. Support weight of tandem pump (1) with suitable lifting device.
6. Remove bolts, washers (4), and tandem pump (1) from engine (3).
7. Using suitable lifting device, lower tandem pump (1) to ground.

Installation Notes

- *Install tandem pump by reversing the order of removal.*
- *Fill tandem pump (1) with 12 oz (355 ml) 10W30 hydraulic oil through case drain.*
- *Torque bolts and washers (4) to 46 lb-ft (62 N•m).*
- *Remove caps and plugs as hoses and fittings are installed.*
- *Install hoses and fittings as noted prior to removal.*
- *Start engine. Check hydraulic system for leaks and repair as necessary.*
- *Check hydraulic oil level and add if necessary.*

Chapter 5

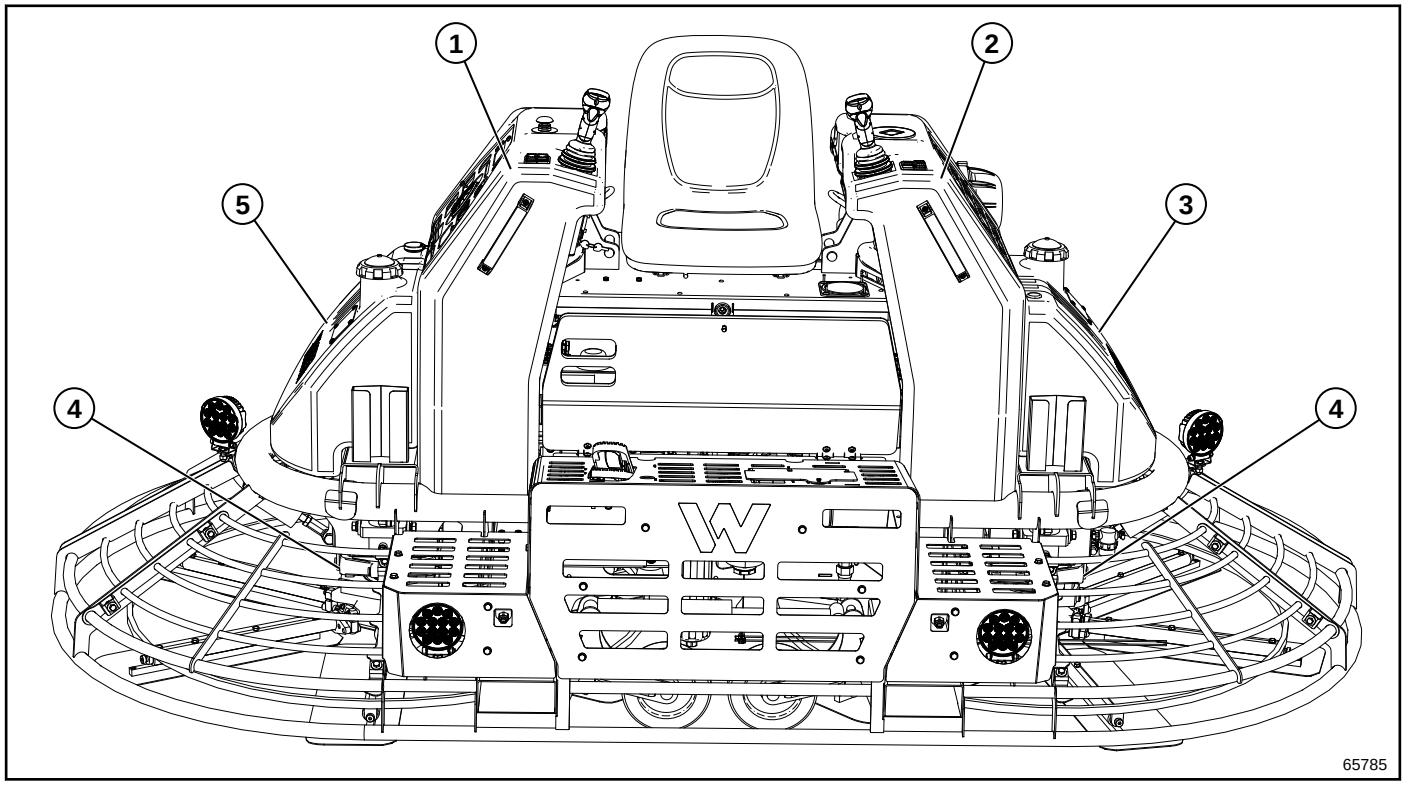
Frame and Misc

5

Component Location

Component Location

See **Figure 5-1**.



1. RIGHT SHELL
2. LEFT SHELL
3. RETARDANT TANK
4. SPIDER ASSEMBLY
5. FUEL TANK

Figure 5-1: Ride-On Trowel Frame Component Location

Specifications

Test and Adjustment Specifications

Table 5-1. Test and Adjustment Specifications

Blade Adjustment	Within 0.050 in (1.25 mm) of the average blade height

Repair

Retardant Tank

Removal and Installation

See **Figures 5-2** and **5-3**.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)

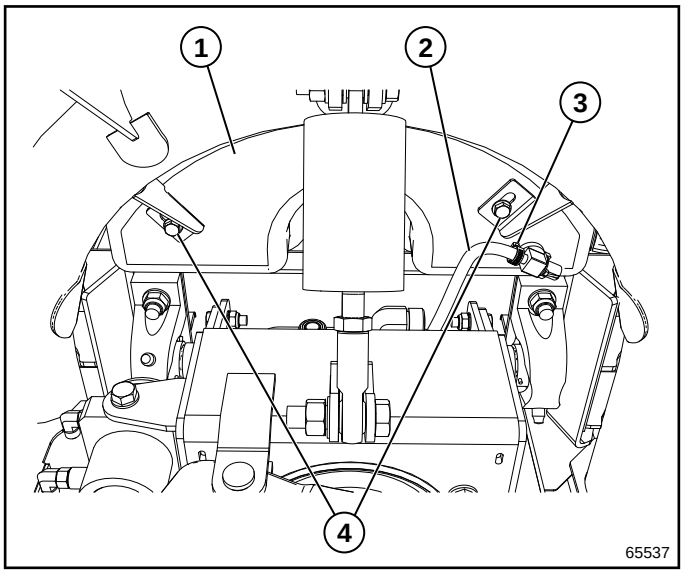


Figure 5-2: Hose Removal and Installation

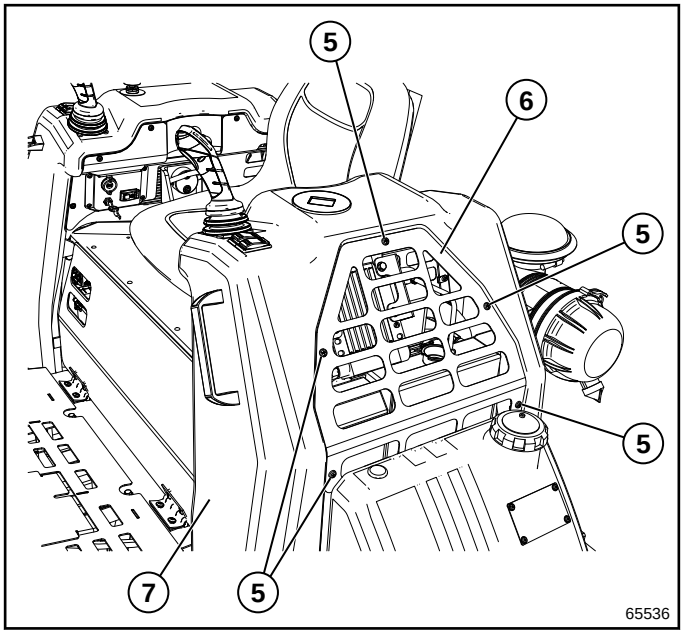


Figure 5-3: Retardant Tank Removal and Installation

2. Remove screws (5) securing side panel (6) to machine (7). Remove side panel.
3. Remove bolts (4) securing retardant tank (1) to machine (7).

NOTE

Before retardant line is removed, ensure a drain pan large enough to hold the retardant remaining in retardant tank is placed under the hose.

4. Loosen clamp (3) and remove retardant line (2) from retardant tank (1).
5. Drain retardant tank.
6. Remove retardant tank (1) from machine (7).

Installation Notes

- *Install the retardant tank by reversing the order of removal.*

Fuel Tank

Removal and Installation

See **Figures 5-4** through **5-7**.

WARNING

- **Never remove the fuel cap from the fuel tank or add fuel when the engine is running or while the engine is hot.**
- **Do not smoke when handling fuel. Never fill or drain the fuel tank indoors.**
- **Do not spill fuel. Clean spilled fuel immediately.**
- **Never handle or store fuel containers near an open flame or any device that may create sparks and ignite the fuel or fuel vapors.**
- **Be sure to reinstall and tighten fuel cap securely.**
- **Use an approved container; the spout must fit inside the fuel filler neck. Avoid using cans and funnels to transfer fuel.**

CAUTION

Dispose of fuel properly. Contact the local environmental department for instructions on disposing of unwanted fuel products.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)

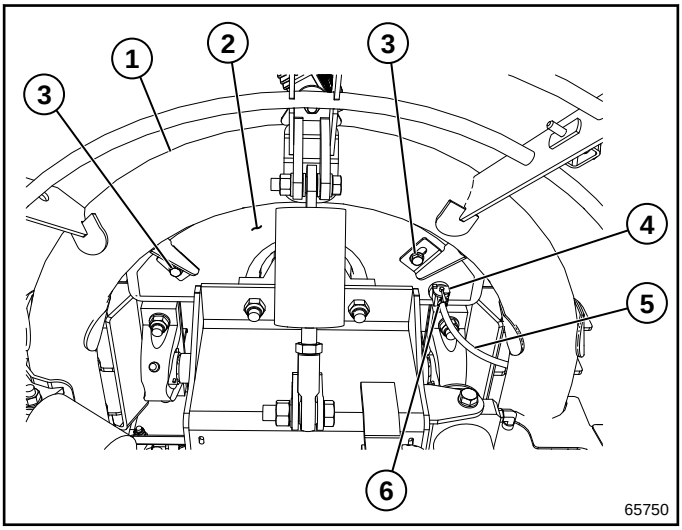


Figure 5-4: Hose Removal and Installation

2. Shut off shutoff valve (4).

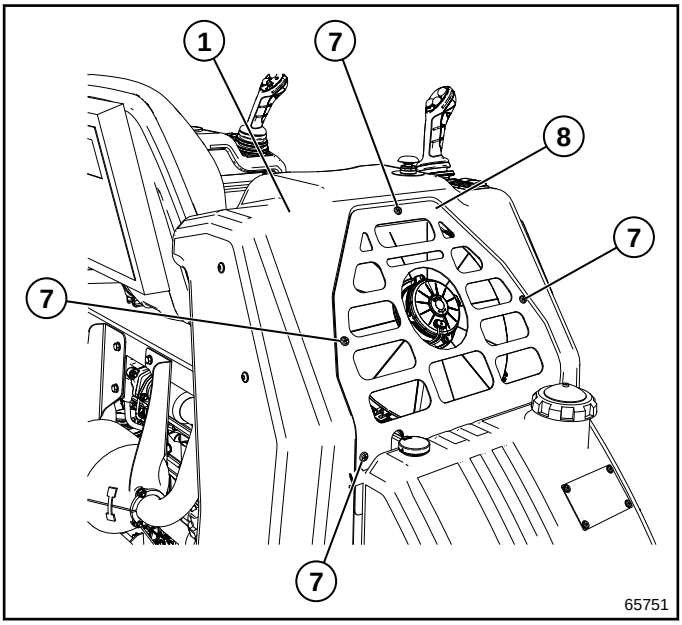


Figure 5-5: Side Panel Removal and Installation

3. Remove screws (7) securing side panel (8) to machine (1). Remove side panel.
4. Remove bolts (3) securing fuel tank (2) to machine (1).
5. Loosen clamp (6) and remove fuel line (5) from shutoff valve (4).

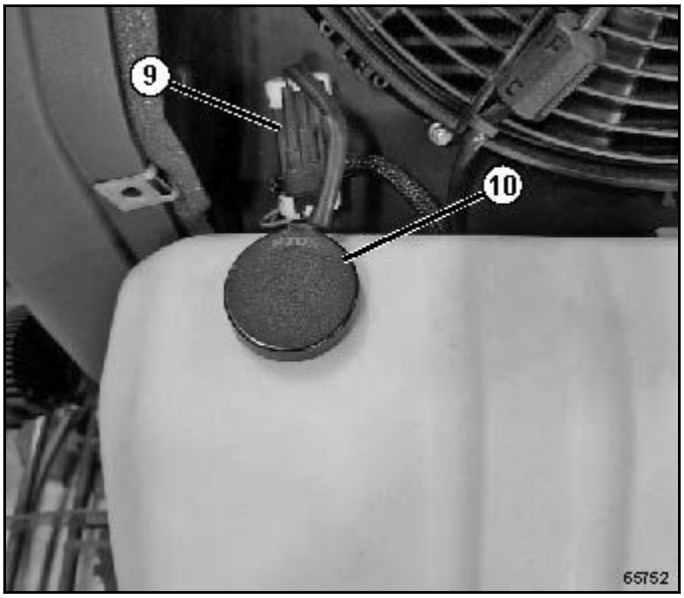


Figure 5-6: Fuel Level Sending Unit Removal and Installation

6. Disconnect electrical connetor (9) from fuel level sending unit (10).

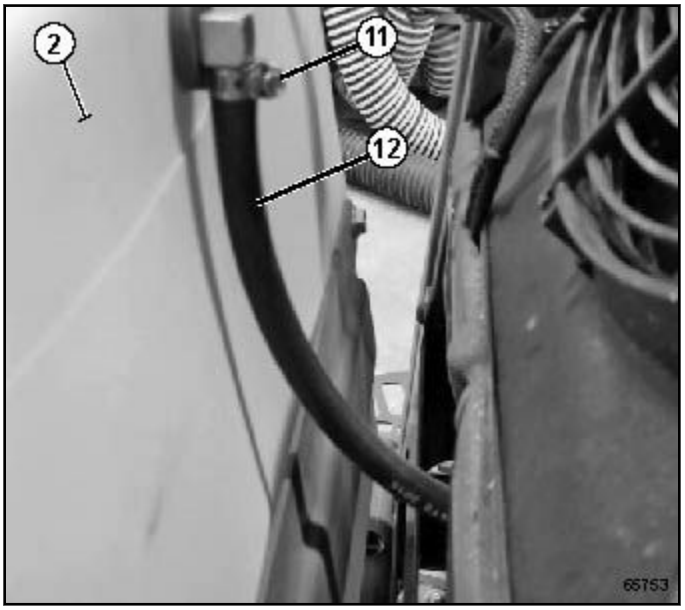


Figure 5-7: Fuel Tank Removal and Installation

7. Lift up on fuel tank (2) to seperate fuel tank from machine (1). This will allow access to fuel line (12).
8. Loosen clamp (11) and remove fuel line (12) from fuel tank (2).
9. Remove fuel tank (2) from machine (1).

Installation Notes

- *Install the fuel tank by reversing the order of removal.*

Shell

Right Shell Removal and Installation

See **Figures 5-8** through **5-11**.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Remove fuel tank. (See "**Fuel Tank**" on **page 5-4**.)
3. Remove right joystick. (See "**Right Joystick**" on **page 3-80**.)

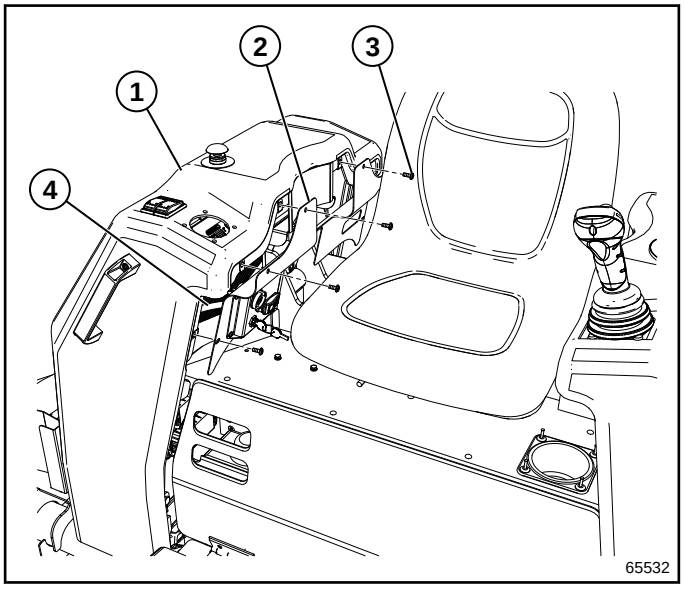


Figure 5-8: Control Panel Removal and Installation

4. Remove screws (3) securing control panel (2) to right shell (1). Remove control panel.

NOTE

Tag and mark electrical connectors and wiring prior to removal to ensure proper installation.

5. Disconnect electrical connectors (4) from control panel (2).

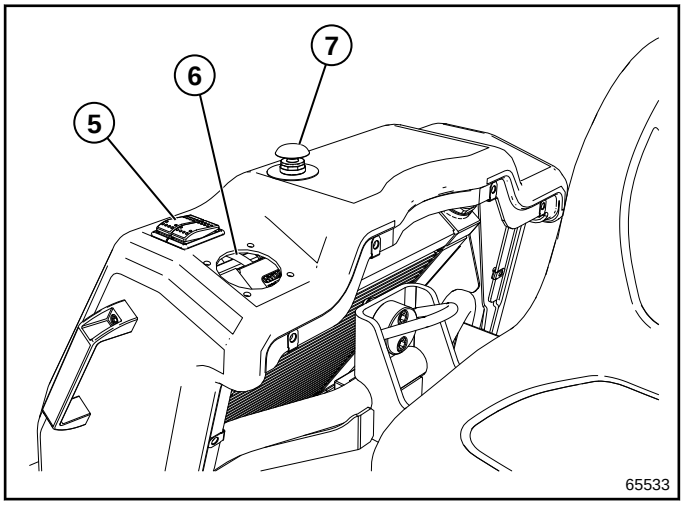


Figure 5-9: Wiring Removal and Installation

6. Disconnect electrical connectors (6) from switches (5) and emergency shutoff switch (7).

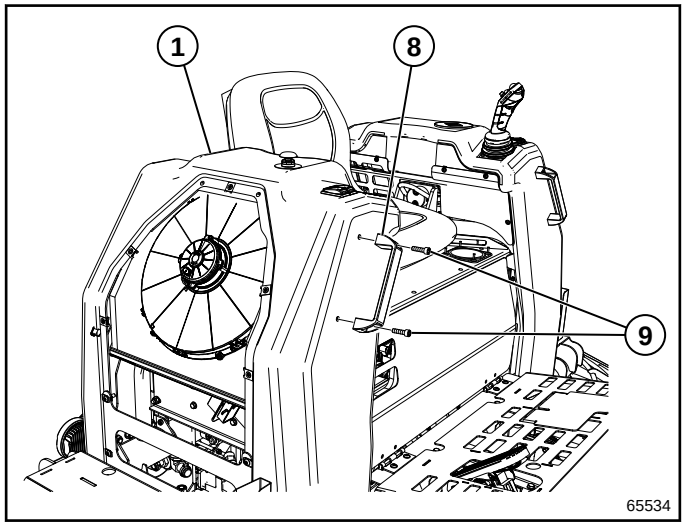


Figure 5-10: Handle Removal and Installation

7. Remove screws (9) securing handle (8) to right shell (1). Remove handle.

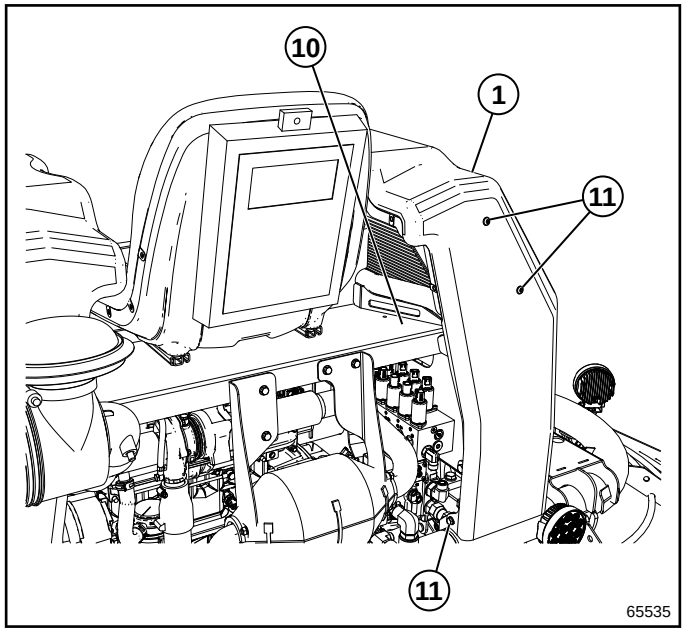


Figure 5-11: Enclosure Removal and Installation

8. Remove remaining screws (11) securing right shell (1) to machine (10). Remove right shell.

Installation Notes

- *Install the right shell by reversing the order of removal.*

Left Shell Removal and Installation

See **Figures 5-12** through **5-16**.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Remove retardant tank. (See "**Retardant Tank**" on **page 5-3**.)
3. Remove left joystick. (See "**Left Joystick**" on **page 3-81**.)

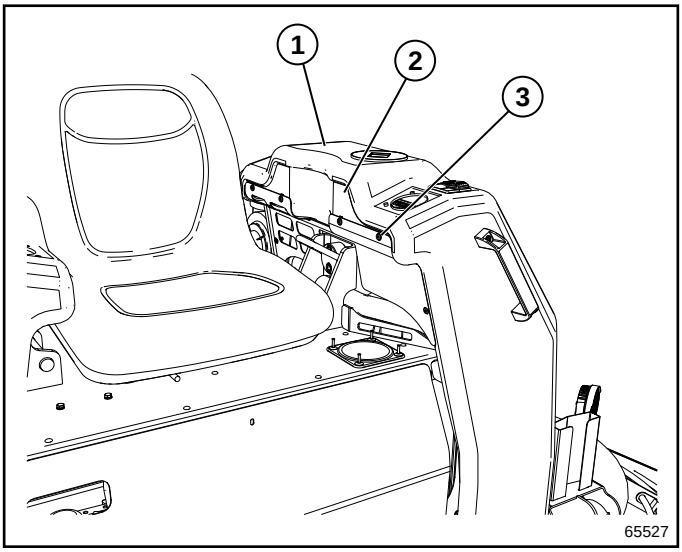


Figure 5-12: Panel Removal and Installation

4. Remove screws (3) securing panel (2) to left shell (1). Remove panel.

NOTE

Tag and mark electrical connectors and wiring prior to removal to ensure proper installation.

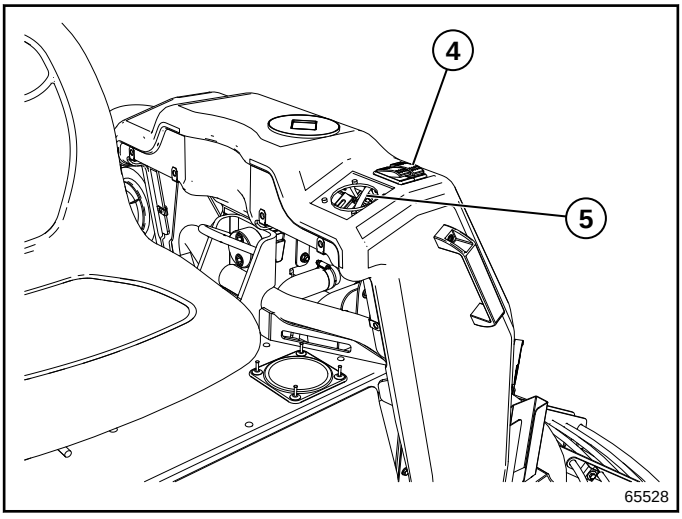


Figure 5-13: Wiring Removal and Installation

5. Disconnect electrical connectors (5) from switches (4).

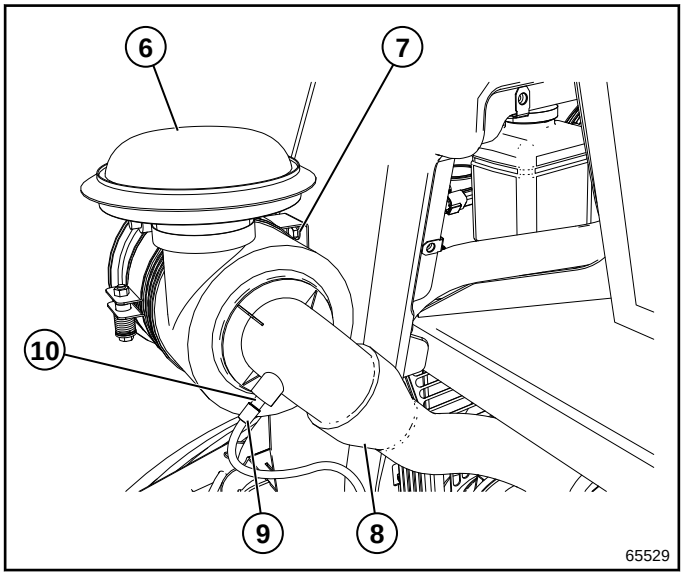


Figure 5-14: Air Filter Housing Removal and Installation

6. Disconnect hose (8) from air filter housing (6).
7. Disconnect electrical connector (9) from air filter restriction sensor (10).
8. Remove bolts (7) securing air filter housing (6) to left shell (1). Remove air filter housing.

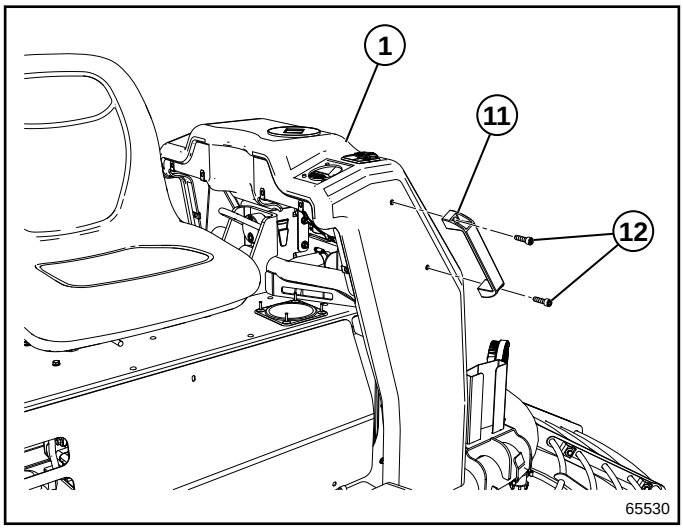


Figure 5-15: Handle Removal and Installation

9. Remove screws (12) securing handle (11) to left shell (1). Remove handle.

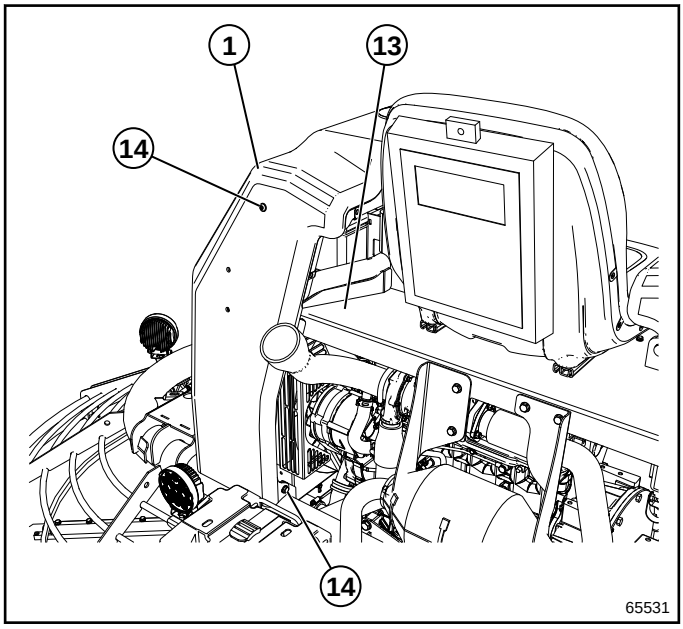


Figure 5-16: Left Shell Removal and Installation

10. Remove remaining screws (14) securing left shell (1) to machine (13). Remove left shell.

Installation Notes

- *Install the left shell by reversing the order of removal.*

Spider Assembly

Removal and Installation

See **Figure 5-17**.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Support machine securely. (See "**Support Machine Securely**" on **page 16**.)

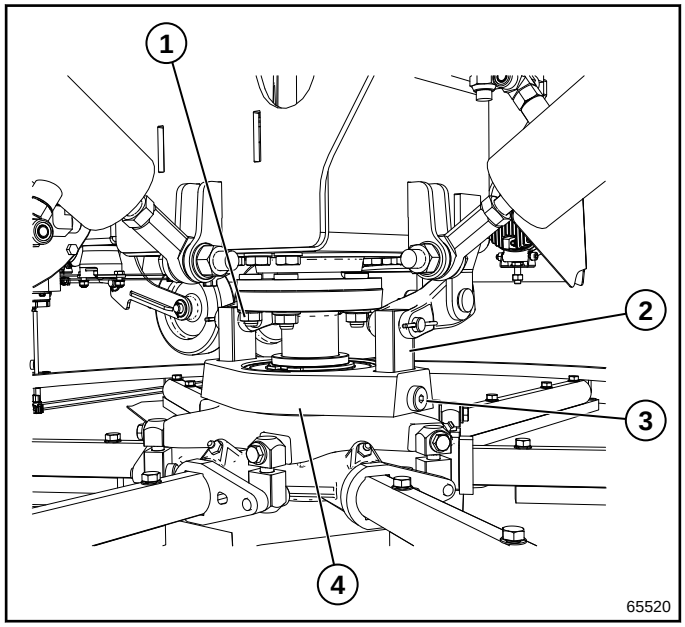


Figure 5-17: Spider Assembly Removal and Installation

3. Remove nuts and bolts (1) securing the spider assembly to the drive motor.
4. Mark the pitch link (2) and the motor housing (4) to aid in re-assembly.
5. Remove bolts (3) securing pitch link (2) to the motor housing (4) and remove spider assembly from machine.

Installation Notes

- *Install theSpider Assembly by reversing the order of removal.*

Blade Adjustment

See **Figure 5-18**.

1. Park machine safely. (See "**Park Machine Safely**" on **page 16**.)
2. Support machine securely. (See "**Support Machine Securely**" on **page 16**.) Ensure the blades do not contact the ground at full pitch
3. Turn key on.

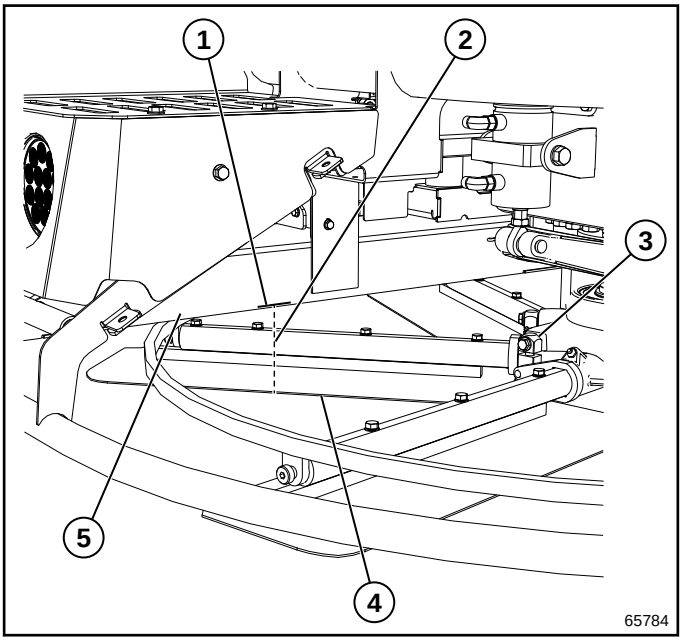


Figure 5-18: Blade Adjustment

4. Set blades (4) to half pitch using the pitch control buttons.

NOTE

There is small amount of play in the connection between the blade arm and the spider assembly. This will allow the blade to be positioned to proper location by hand.

5. Position each blade by hand, so that the lower end of each blade (4) is at the lowest point possible.
6. Position blade (4) beneath fork pocket (5).
7. Mark bottom of fork pocket (1), so that all blades (4) can be measured (2) at the same location.
8. Measure the distance from the bottom of the fork pocket to the bottom edge of the blade (2). Note measurement.
9. Repeat Steps 1 though 8 for remaining blades.
10. Determine the average measurement of all blades.
11. Loosen or tighten pitch links (3) so that all blades measure within 0.050 in (1.25 mm) of the average.

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