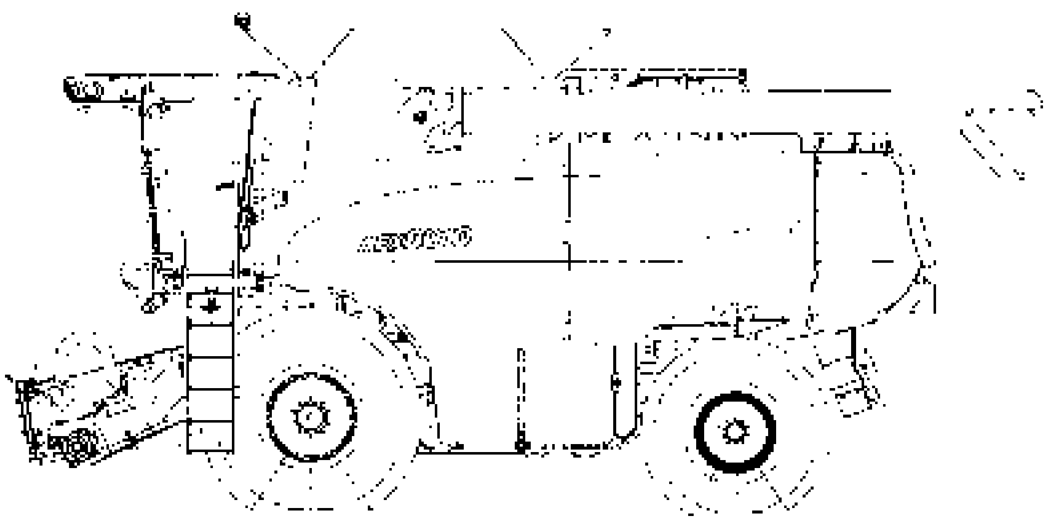
REPAIR MANUAL



AFX8010

Contents

INTRODUCTION

Contents

INTRODUCTION

Foreword (- A.10.A.40)

AFX8010

Technical Information

This manual has been produced by a new technical information system. This new system is designed to deliver technical information electronically through CDROM and in paper manuals. A coding system called ICE has been developed to link the technical information to other Product Support functions e.g. Warranty.

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

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

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

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

Every piece of technical information will have those 3 categories attached to it. You will be able to use any combination of those categories to find the right piece of technical information you need to resolve that customers concern on his machine.

That information could be:

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

How to Use this Manual

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

Each Chapter is divided into four Information types:

- Technical Data (specifications) for all the mechanical, electrical or hydraulic devices, components and, assemblies.
- Functional Data (how it works) for all the mechanical, electrical or hydraulic devices, components and assemblies.

- Diagnostic Data (fault codes, electrical and hydraulic troubleshooting) for all the mechanical, electrical or hydraulic devices, components and assemblies.
- Service data (remove disassembly, assemble, install) for all the mechanical, electrical or hydraulic devices, components and assemblies.

Sections

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

PRODUCT \ SECTION	A - Distribution Systems	B - Power Production	C - Power Train	D - Travelling	E - Body and Structure	F - Frame Positioning	G - Tool Positioning	H - Working Arm	J - Tools and Couplers	K - Crop Processing	L - Field Processing
Tractors	X	X	X	X	X	X		X	X		
Vehicles with working arms: backhoes, excavators, skid steers, ...	X	X	X	X	X	X	X	X	X		
Combines, forage harvesters, balers, ...	X	X	X	X	X	X	X	X	X	X	
Seeding, planting, floating, spraying equipment, ...	X	X	X	X	X	X	X		X		X
Mounted equipment and tools, ...					X	X	X		X		

This manual contains these Sections. The contents of each Section are explained over the following pages.

Contents

Section Contents

SECTION A, DISTRIBUTION SYSTEMS
This Section covers the main systems that interact with most of the functions of the product. It includes the central parts of the hydraulic, electrical, electronic, pneumatic, lighting and grease lubrication systems. The components that are dedicated to a specific function are listed in the Chapter where all the technical information for that function is included.

Contents of DISTRIBUTION SYSTEMS - A

SECTION B, POWER PRODUCTION
This Section covers all the functions related to the production of power to move the machine and to drive various devices.

Contents of POWER PRODUCTION - B

SECTION C, POWER TRAIN
This Section covers all the functions related to the transmission of power from the engine to the axles and to internal or external devices and additional Process Drive functions.

Contents of POWER TRAIN - C

SECTION D, TRAVELLING
This Section covers all the functions related to moving the machine, including tracks, wheels, steering and braking. It covers all the axles both driven axles and non-driven axles, including any axle suspension.

Contents of TRAVELLING - D

SECTION E, BODY AND STRUCTURE
This Section covers all the main functions and systems related to the structure and body of the machine. Including the frame, the shields, the operator's cab and the platform.

Contents of BODY AND STRUCTURE - E

SECTION G, TOOL POSITIONING
This Section covers all the functions related to the final and/or automatic positioning of the tool once the tool is positioned using the Working Arm or the machine frame.

Contents of TOOL POSITIONING- G

SECTION K, CROP PROCESSING
This Section covers all the functions related to crop processing.

Contents of CROP PROCESSING - K

Chapters

Each Chapter is identified by a letter and number combination e.g. Engine B.10.A The first letter is identical to the Section letter i.e. Chapter B.10 is inside Section B, Power Production.
CONTENTS
The Chapter Contents lists all the technical data (specifications), functional data (how it works), service data (remove, install adjust, etc..) and diagnostic data (fault codes and troubleshooting) that have been written in that Chapter for that function or system on the machine.

Contents

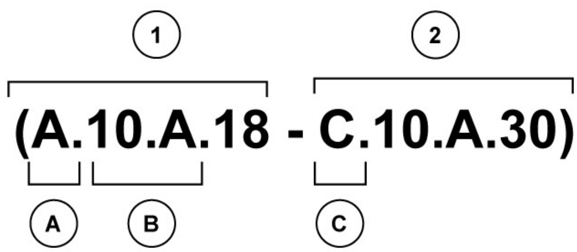
INDEX
The Chapter Index lists in alphabetical order all the types of information (called Information Units) that have been written in that Chapter for that function or system on the machine.

Index

Information Units and Information Search

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

example information unit	Stack valve - Sectional View (A.10.A.18 - C.10.A.30)				
Information Unit ICE code	A	10.A	18	C	10.A.30
ICE code classification	Distribution systems	Primary hydraulic power	Stack valve	Functional data	Sectional view



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

- **(1)** Function and **(2)** Information type.
- **(A)** corresponds to the sections of the repair manual.
  (B) corresponds to the chapters of the repair manual.
  (C) corresponds to the type of information listed in the chapter contents, Technical data, Functional Data, Diagnostic or Service.
  (A) and **(B)** are also shown in the page numbering on the page footer.
  THE REST OF THE CODING IS NOT LISTED IN ALPHA-NUMERIC ORDER IN THIS MANUAL.
- You will find a table of contents at the beginning and end of each section and chapter.
  You will find an alphabetical index at the end of each chapter.
- By referring to **(A)**, **(B)** and **(C)** of the coding, you can follow the contents or index (page numbers) and quickly find the information you are looking for.

Page Header and Footer

The page header will contain the following references:

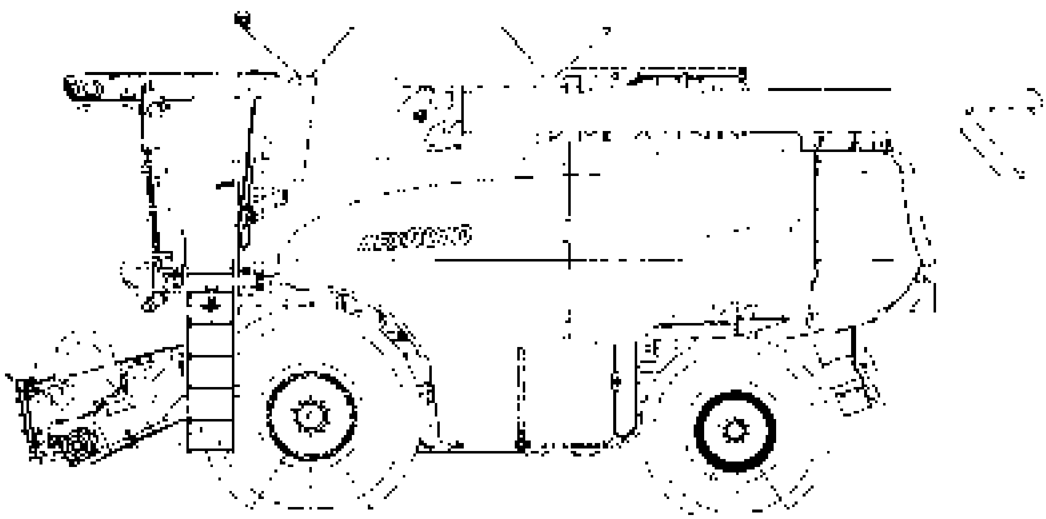
- Section and Chapter description

The page footer will contain the following references:

- Publication number for that Manual, Section or Chapter.
- Version reference for that publication.
- Publication date
- Section, chapter and page reference e.g. A.10.A / 9

REPAIR MANUAL

DISTRIBUTION SYSTEMS



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Contents

DISTRIBUTION SYSTEMS - A

DISTRIBUTION SYSTEMS - A

PRIMARY HYDRAULIC POWER SYSTEM - 10.A

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DISTRIBUTION SYSTEMS - A

PRIMARY HYDRAULIC POWER SYSTEM - 10.A

CONTENTS

FUNCTIONAL

DIAGNOSTIC

Signal valve

Sensing system

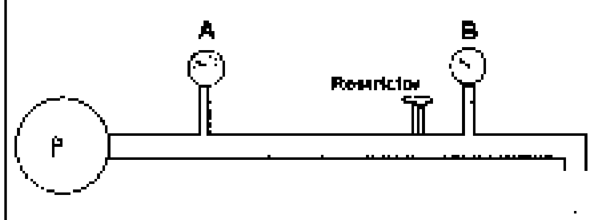
BASIC PRINCIPLES OF THE SYSTEM

Combines use a combination of Pressure Flow Compensated (PFC) and open-center hydraulics. In a **PFC** system, oil flow is minimal unless there is a hydraulic demand. In an **open-center** system, oil is constantly pumped through the system regardless of hydraulic demand.

Flow Across a Restriction

The hydraulic system of the combine uses the principle of flow across a restriction for some functions. It is important to understand this basic principle in order to understand how the system works, or more importantly, why the system may not be working.

1. When oil flows through an **unrestricted** passage, the pressure in this passage, if any, will remain constant as long as pump flow remains constant.



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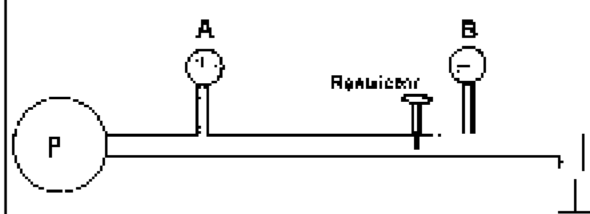
2. When oil in a passage **flows across a restriction**, the pressure after the restriction will be less than the pressure before that restriction. **Flow must exist for this to happen**. A restriction can occur by any component causing a resistance to flow.



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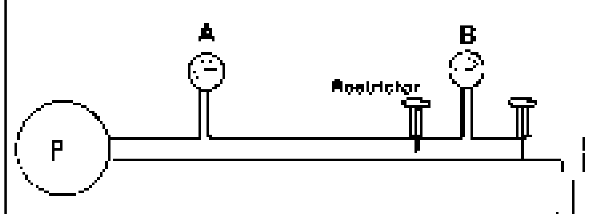
3. When oil in a passage is **fully restricted** from flow (no-flow), the pressure in the passage will build until it reaches the relief valve setting. This relief pressure will be maintained as long as the flow is blocked and the pump is functioning normally. This is true regardless of what component is blocking flow. No flow will create constant pressure in the passage based on the relief valve setting.



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BASIC PRINCIPLES OF THE SYSTEM

Pilot Operated Hydraulic System

1. Pilot-operated hydraulic system has two basic parts or sections: A pilot (also called primary) section, and a main (also called secondary) section.
2. When a pilot-operated system is actuated, the pilot (primary) **always** moves first. Once the pilot has operated, the main (secondary) section **always** moves last. This is true whether the system is being activated or deactivated.
3. The movement of the pilot (primary) controls a very small amount of oil flow (pilot flow). The movement of the main (secondary) controls the majority of the oil flow (main flow) and is responsible for actuating a given system.

The header raise/header lower and reel drive valve are three examples of a pilot operated system used on the combine.

GENERAL INFORMATION

The AFX Axial-Flow combines use a very extensive hydraulic system to operate machine functions that are normally associated with belts and chains, along with the normal hydraulic functions. This section will cover the basics of the hydraulic supply system, each actual function will be included with that function's sections.

This section will cover the reservoirs, filtration, gear pumps, PFC pump and cooling. Since the machine incorporates two reservoirs, the hydraulic system is easily broken into two separate systems.

1. Hydraulics: Operator control functions
2. Control Pressure: Hydrostatic drives, associated valves and clutches

HYDRAULICS Hydraulic Reservoir	CONTROL PRESSURE PTO Gearbox Reservoir
Steering	Ground Drive
Header Raise / Lower	Rotor Drive
Reel Fore / Aft, Raise, and Drive	Feeder Drive
Lateral Tilt	Chopper Clutch
Unloading Auger Swing	Unloader Clutch
Fan Drive	Lubrication
Spreader Drive	
Rotary Air Screen	
Parking Brake / Tow Valve	
Regulated Pressure	

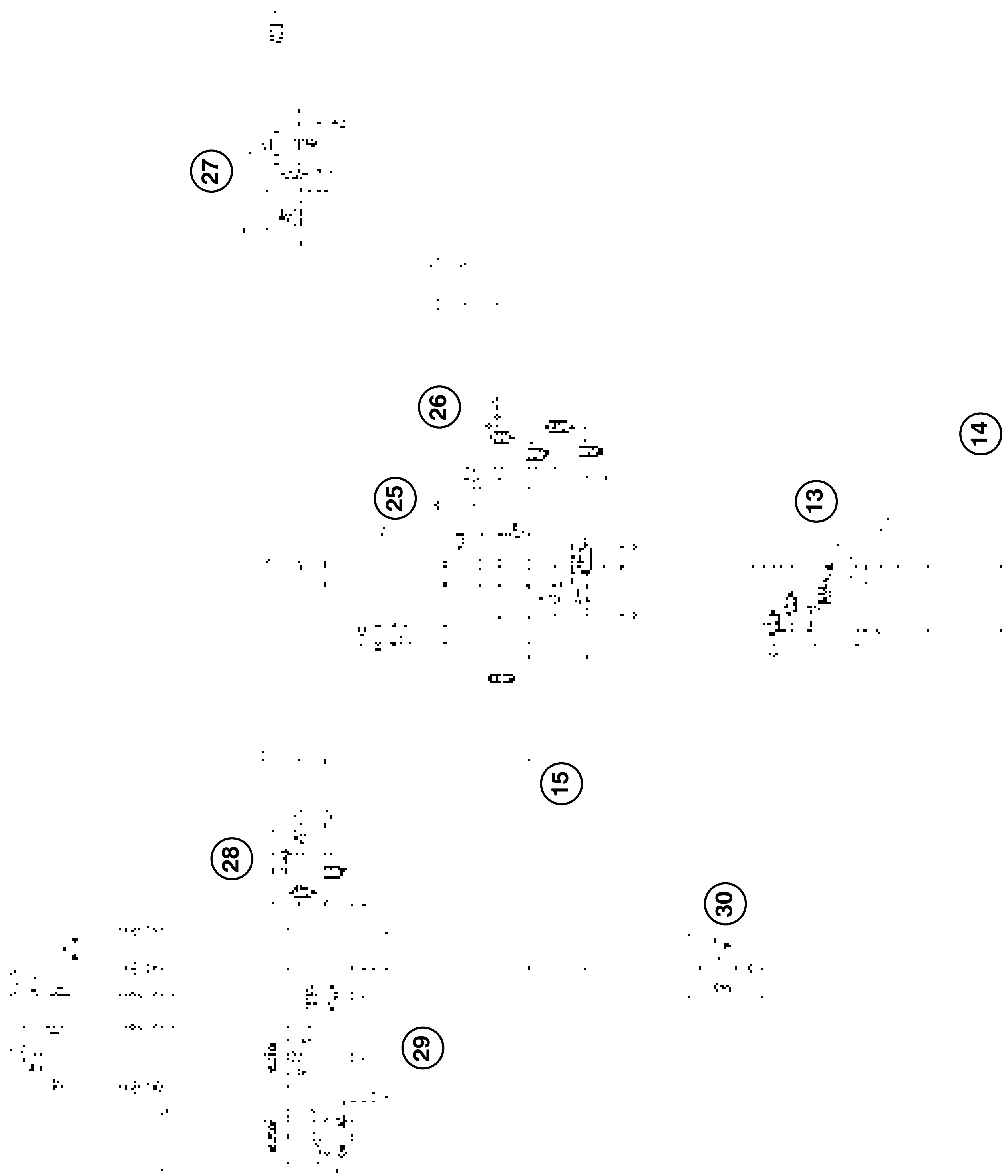
The two systems will incorporate several hydraulic pumps and motor to complete the required operations.

HYDRAULICS Hydraulic Reservoir		HYDROSTATICS PTO Gearbox Reservoir	
PFC Pump	Steering Header Raise / Lower Lateral Tilt Unloading Auger Swing Reel Fore / Aft and Raise Reel Drive Park Brake / Tow Valve Regulated Pressure	Control Circuit Pump	Beater/Chopper Clutch Unloader Clutch Ground Drive Rotor Drive Feeder Drive
Fan Pump	Fan Drive Motor	Lube Pump	Lubrication
Spreader Pump	Spreader Drive Motor and Rotary Air Screen Motor		

SPECIFICATIONS

Component	Specification
Electrical	
Parking Brake / Regulated pressure sensor Control pressure sensor	0.0 PSI = 0.5V signal wire C Normal PSI = 3V signal wire C
Hydraulic filter restriction switch	N/O, Closes at 2.75 bar (40 PSID)
Control pressure filter restriction switch	N/O, Closes at 2.75 bar (40 PSID)
Hydraulic return oil temperature sensor Motor Temp. (Ground Drive) sensor	2500ohms @ room temperature 83 ohms @ 128°C (262°F)
Reservoir tank level switch	N/C, Closed with low oil 0.0 ohms
Hydraulic	
Spreader motor relief	210 bar (3000 PSI)
Rotary air screen motor relief	24 bar (350 PSI)
Fan motor relief	241 bar (3500 PSI)
Oil cooler by-pass (Hydraulic cooler)	7.6 bar (110 PSI)
Hydraulic filter by-pass	3.45 barD (50 PSID)
Regulated pressure	22-25 bar (320-360 PSI)
Control pressure filter by-pass	3.45 barD (50 PSID)
Control pressure relief	20-22 bar (290-320 PSI) Hot 23-25 bar (340-360 PSI) Cold
Lubrication pump / cooler relief	20 bar (290 PSI)
Lubrication system relief	3.5 bar (50 PSI)
PFC pump low pressure stand-by	26-28 bar (375-400 PSID)
PFC pump high pressure stand-by	207-214 bar (3000-3100 PSI)
Steering relief	183-190 bar (2650-2750 PSI)
Reel drive relief	138 bar (2000 PSI)
Header Tilt cushion relief	207 bar (3000 PSI)
Feeder lift cylinder thermal relief	276 bar (4000 PSI)
Spreader drive pump flow	63 l/m (16.5 GPM)
Fan drive pump flow	51 l/m (13.5 GPM)
PFC pump flow	152 l/m (42 GPM)
Control pressure pump flow	150 l/m (39.5 GPM)
Lubrication pump flow	92.7 l/m (23.5 GPM)

HYDRAULIC SYSTEM



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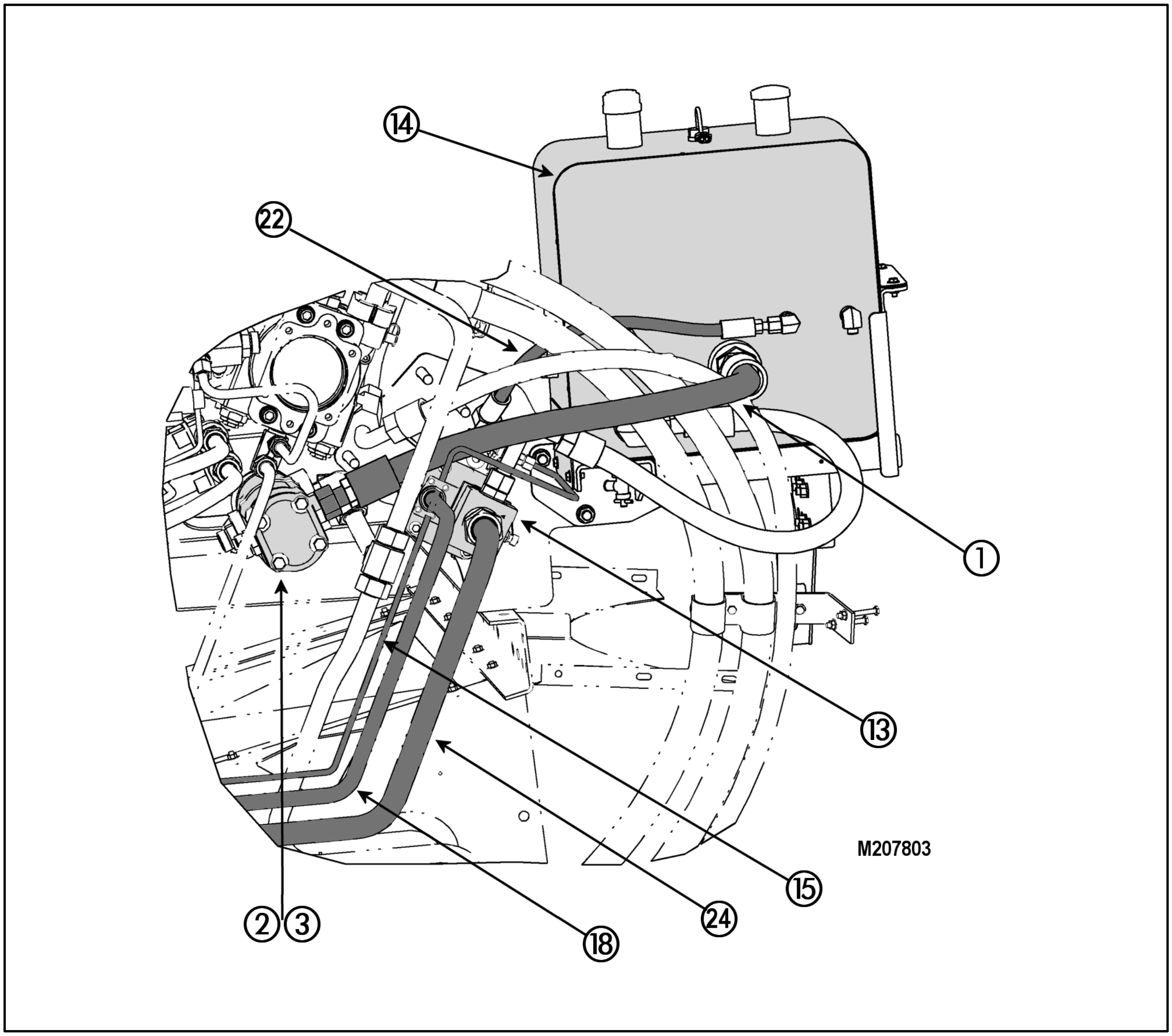
Hydraulic Component Locations



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1. Supply to Spreader and Fan Pumps
2&3. Gear Pump Assembly, Spreader and Fan Drive
13. PFC Piston Pump
14. Hydraulic Reservoir
15. Signal Line to Compensator
18. PFC Pump Discharge Line
22. PFC Pump Case Drain
24. PFC Pump Suctions
25. Main Valve Assembly
26. Header Lift Valve
27. Park Brake / Regulated Pressure Valve
28. Reel Drive Valve
29. Feeder Valve Assembly
30. Hydraulic Return Filter

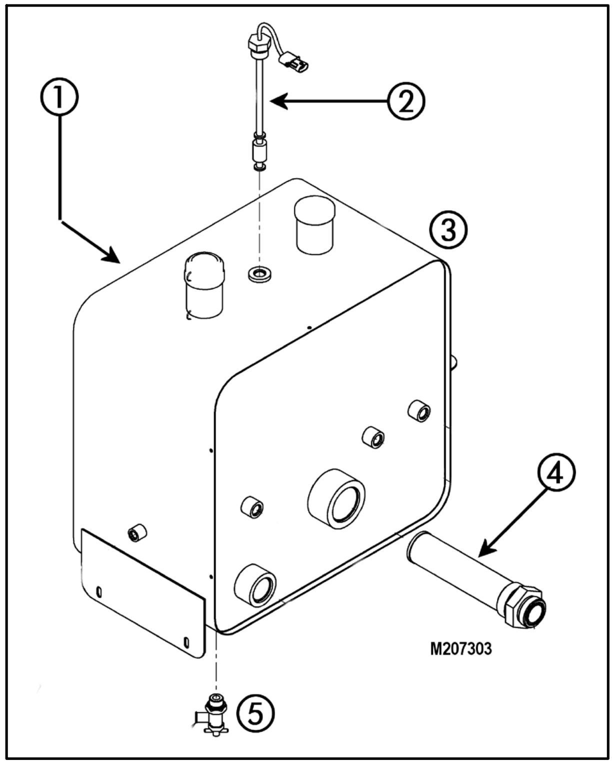
Oil Supply

1. Oil Level Sight Glass
2. Oil Level Sensor
3. Reservoir Tank
4. Outlet Strainer
5. Tank Drain

The hydraulic system is supplied with Hy-Tran Ultra from a central reservoir tank that is mounted behind the PTO gearbox. The tank contains approximately 57L (15 gal) of oil and should be changed out every 1000 hours of operation.

A float type gauge that is mounted in the top of the tanks monitors the proper oil level. The float provides an Open/Closed signal to the Universal Display Plus monitor. The switch is N.C. when held in the operating position, open when oil is present.

The tank incorporates a discharge port strainer and tank breather. The strainer is rated at 100 micron of protection and supplies the gear pumps.



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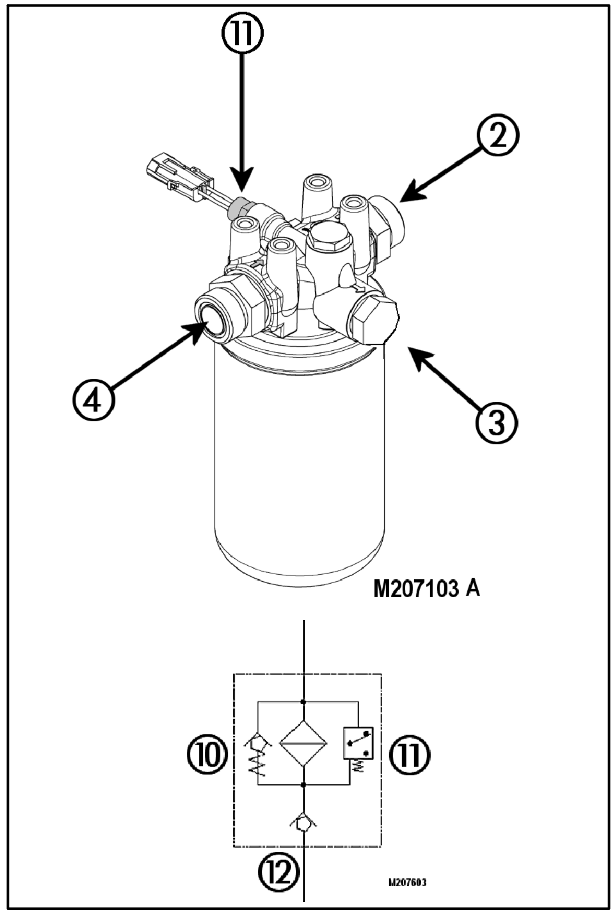
Filtration

2. Discharge Port
3. Not used on the hydraulic filter
4. Inlet Port
10. Filter By-Pass
11. Restrictions Indicator
12. Back Flow Check Valve

The hydraulic filter is on the return side of the hydraulic system, prevent trash from reaching the reservoir tank. It is imperative that only CLEAN Hy-Tran Ultra is placed in the tank. The filter base incorporates a filter restriction sensor (11) that monitors the condition of the filter element. If the restriction increases above 2.76 bar (40 PSID) differential pressure the sensor will CLOSE to create a signal to the Universal Display Plus monitor for operator warning. The filter base incorporates a filter by-pass valve that will open at 3.45 bar (50 PSID) differential pressure to prevent over pressuring the filter. The sensor is set to activate prior to the by-pass valve opening.



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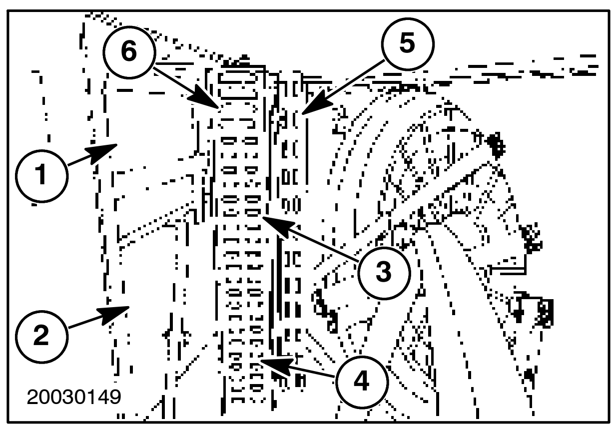
Cooling

1. Intercooler
2. Radiator
3. PTO Gearbox Oil Cooler
4. Hydraulic Oil Cooler
5. Air Conditioning Condenser
6. Fuel Cooler

The hydraulic cooler is mounted behind the rotary air screen and is the Lower third of the center cooler. There is a 7.6 bar (110 PSI) oil cooler by-pass valve mounted in the lower front corner to protect the cooler.



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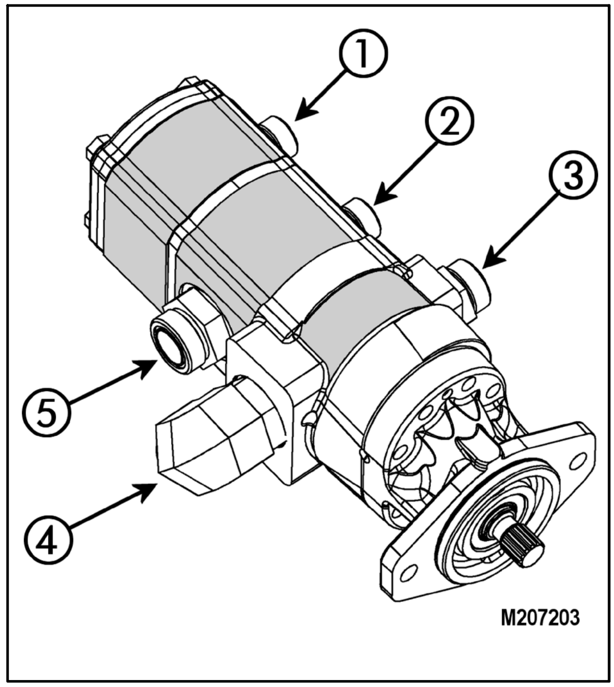
Gear Pumps



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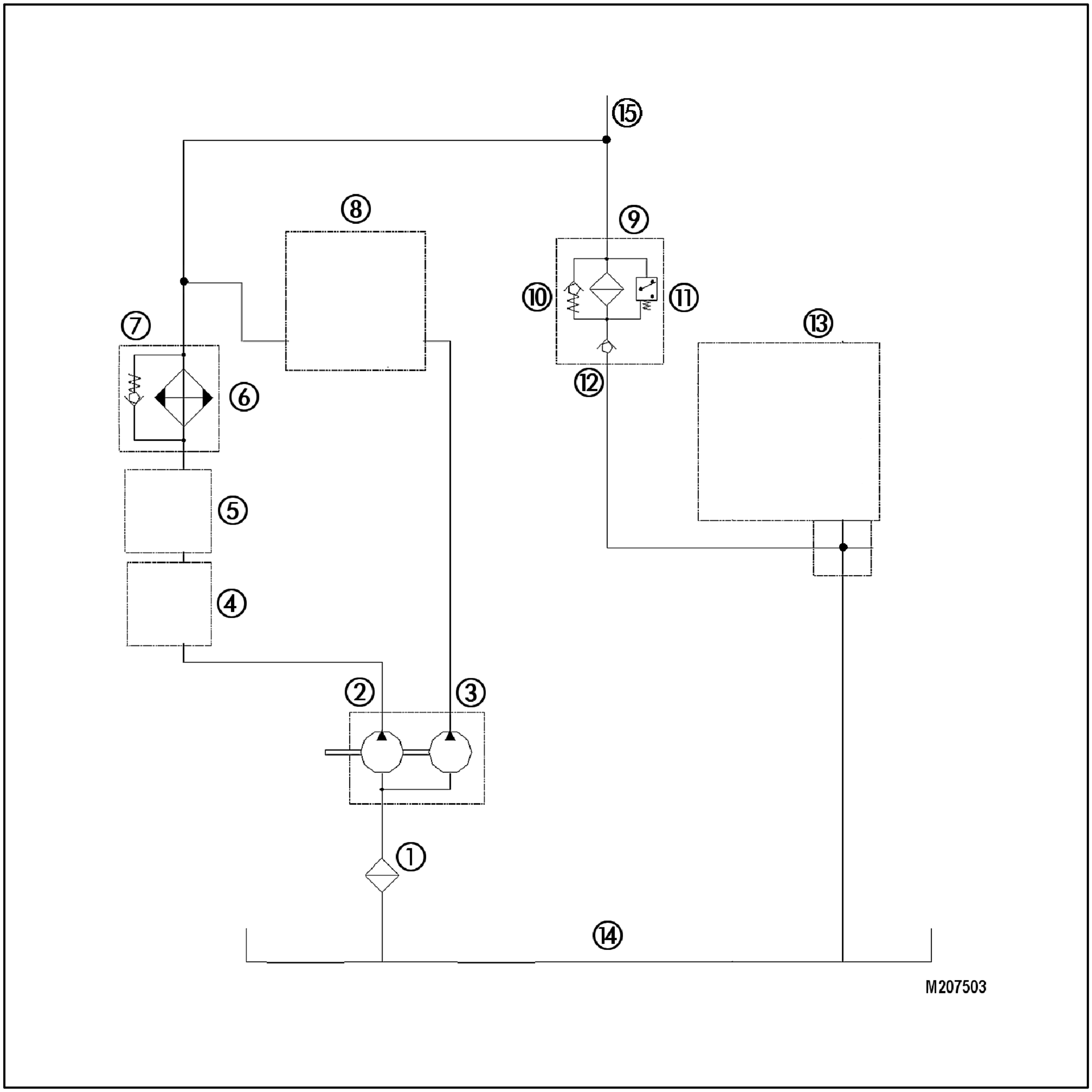
1. Fan Drive Output (rear pump)
2. Spreader and Rotary Air Screen Output (center pump)
3. Control Pressure Output (front pump)
4. Supply From PTO Gearbox, (for pump 3)
5. Supply From Hydraulic Reservoir, (for pumps 1 and 2)

The gear pump assembly is mounted in the PTO gearbox and incorporates three separate gear pumps.

- The **Control Pressure** pump, (pump 3, nearest to the drive shaft), is supplied oil from the **PTO gearbox** and all of its flow is returned to the PTO gearbox. See specification page.
- The **Spreader/Rotary Air Screen Drive** pump is supplied oil from the **hydraulic reservoir** and returns all of its flow back to the reservoir. See specification page.
- The **Fan Drive** pump is supplied oil from the **hydraulic reservoir** and returns all of its flow back to the reservoir. See specification page.

NOTE: *If the seal was to leak between the front and center pumps oil could transfer between reservoirs.*

Hydraulic Schematic



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1. Reservoir Strainer
2. Spreader/Rotary Air Screen Drive Pump
3. Fan Drive Pump
4. Spreader Drive Valve
5. Rotary Air Screen Valve
6. Oil Cooler
7. Oil Cooler By-Pass Valve
8. Fan Drive Valve
9. Return Filter Base
10. Filter By-Pass Valve
11. Filter Restriction Indicator Switch
12. Back Flow Check Valve
13. PFC Piston Pump
14. Reservoir Tank
15. Return From All Hydraulic Functions

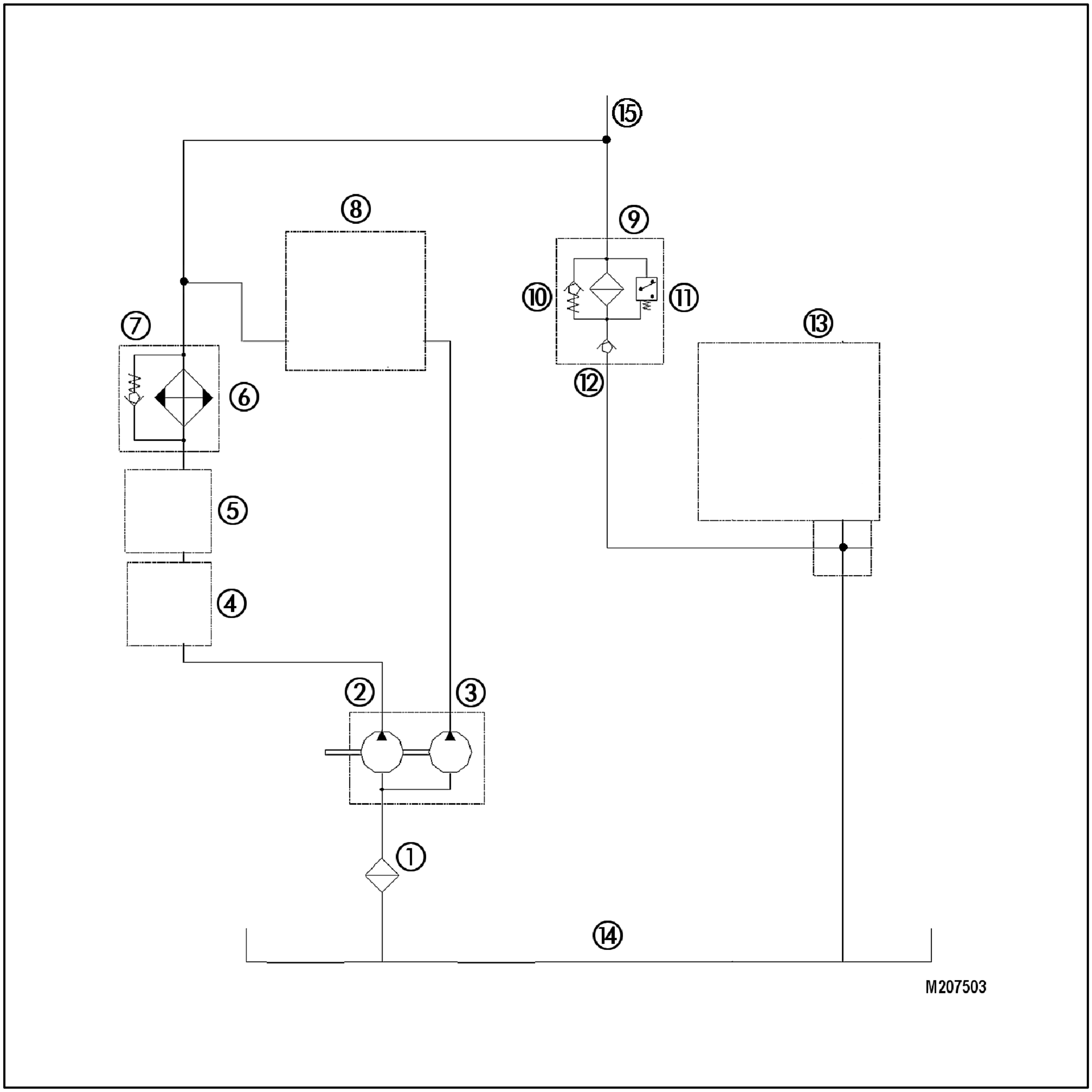
Hydraulic Schematic

Spreader Pump

The spreader pump (2) will pull oil from the hydraulic reservoir (14) and direct it to the spreader valve (4). The spreader valve will direct the full flow of pump on to the rotary air screen valve (5) once the spreader operation is completed. The rotary air screen valve will direct the full flow of pump on to the oil cooler (6) once the air screen operation is completed. In cold whether the cooler may cause excessive restriction so the by-pass valve (7) can direct the oil flow around the cooler the filter housing (9). The filter restriction is monitored by the filter sensor (11) and is protected by the by-pass valve (10). The filter directs the flow to the PFC pump inlet and the reservoir tank.

IMPORTANT: *The spreader pump being a gear pump is associated with an open center system. In an open center system the pump flow is constant and MUST be routed back to the reservoir at all times. It can not be deadheaded or serious failures can occur.*

Hydraulic Schematic



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1. Reservoir Strainer
2. Spreader/Rotary Air Screen Drive Pump
3. Fan Drive Pump
4. Spreader Drive Valve
5. Rotary Air Screen Drive Valve
6. Oil Cooler
7. Oil Cooler By-Pass Valve
8. Fan Drive Valve
9. Return Filter Base
10. Filter By-Pass Valve
11. Filter Restriction Indicator Switch
12. Back Flow Check Valve
13. PFC Piston Pump
14. Reservoir Tank
15. Return From All Hydraulic Functions

Hydraulic Schematic

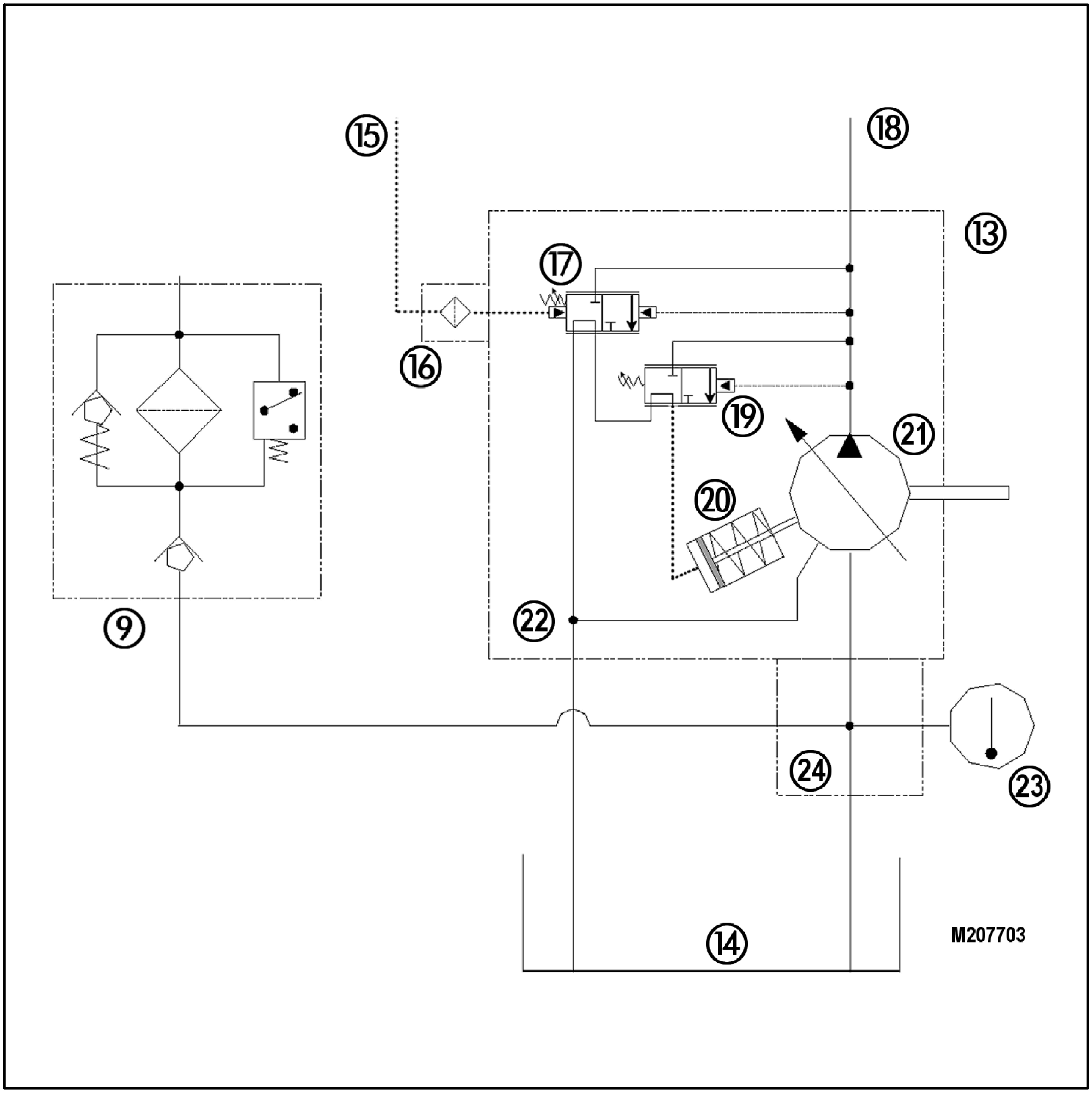
Fan Pump

The fan pump (3) will pull oil from the hydraulic reservoir (14) and direct it to the fan valve (8). The fan valve will direct the full flow of pump into the flow from the spreader pump headed to the filter base (9). The filter restriction is monitored by the filter sensor (11) and is protected by the by-pass valve (10). The filter directs the flow to the PFC pump inlet and the reservoir tank.

IMPORTANT: *The fan pump being a gear pump is associated with an open center system. In an open center system the pump flow is constant and MUST be routed back to the reservoir at all times. It can not be deadheaded or serious failures can occur.*

Pressure Flow Compensating (PFC) Pump Hydraulic System

PFC Pump Schematic



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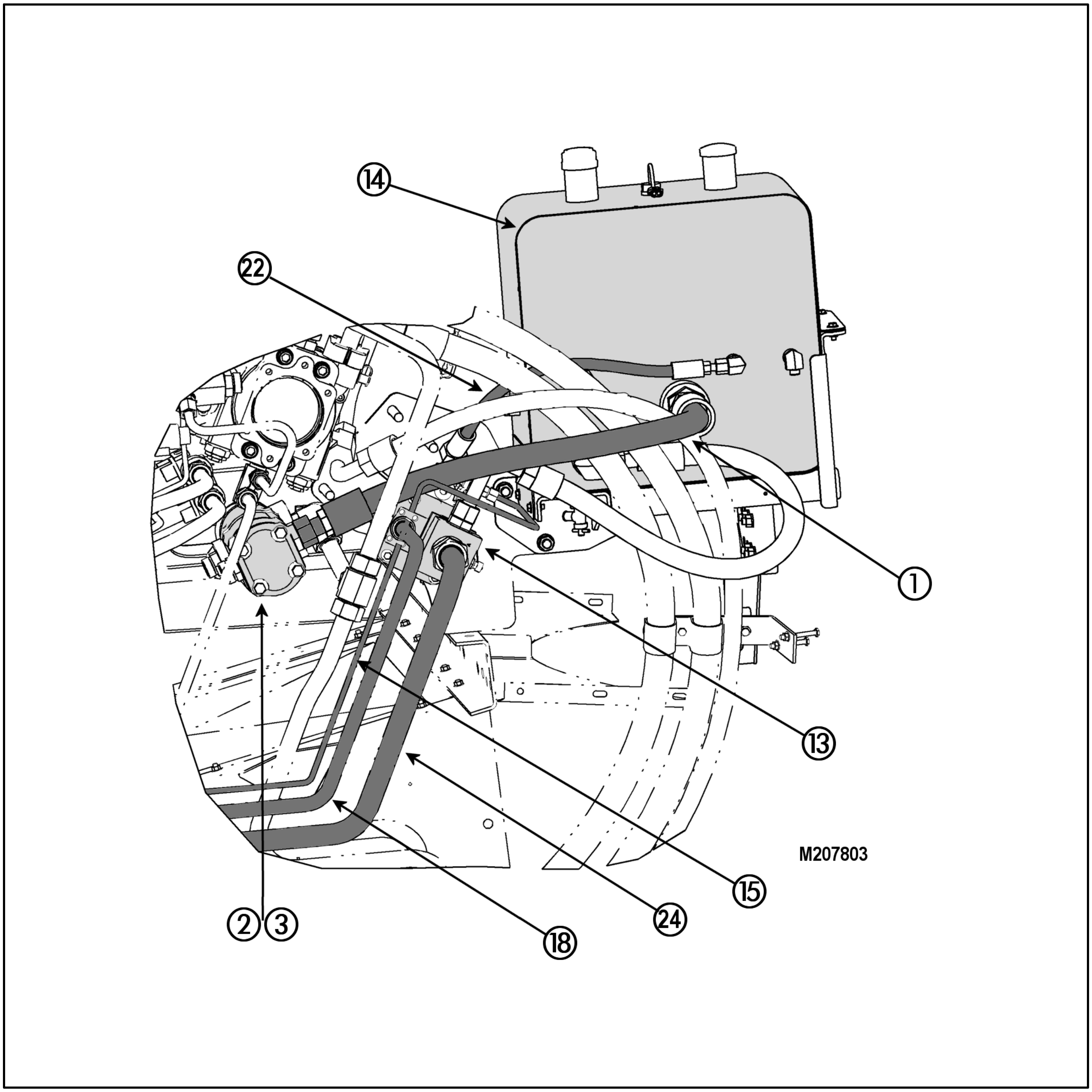
9. Return Filter Base
13. PFC Pump Assembly
14. Hydraulic Reservoir
15. Signal Line to Compensator
16. Signal Line Screen
17. Flow Control Spool
18. Pump Discharge Port
19. High Pressure Spool
20. Servo Piston (swashplate)
21. Rotating Assembly
22. Case Drain
23. Temperature Sensor
24. Supply Manifold

PFC Component Locations



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- **1.** Supply to Spreader and Fan Pumps
- **2&3.** Gear Pump Assembly, Spreader and Fan Drive
- **13.** PFC Piston Pump
- **14.** Hydraulic Reservoir
- **15.** Signal Line to Compensator
- **18.** PFC Pump Discharge Line
- **22**. PFC Pump Case Drain
- **24.** PFC Pump Suctions

Hydraulic System

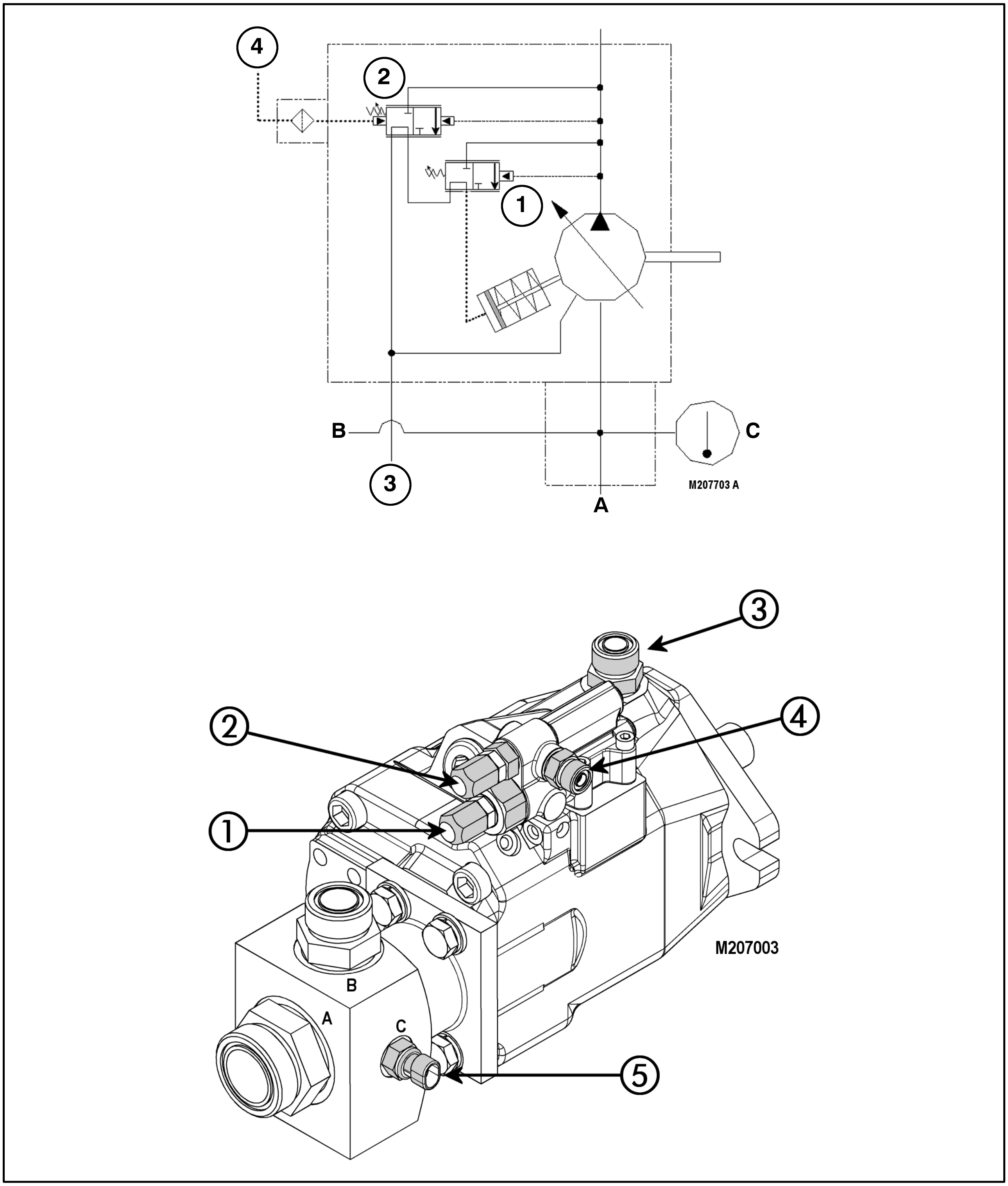
PFC Piston Pump

The PFC pump assembly is mounted to and driven by the PTO gearbox. The PFC pump will only produce the pressure and flow required meeting system demands when they occur. When discussing PFC hydraulics, it is important to realize that with the engine running the hydraulic system will always be in one of three modes:

- Low-pressure standby (could be thought of as neutral).
- Pressure and flow compensation (when the system is meeting the demand for oil).
- High-pressure standby (could be thought of as high-pressure relief).

The pump output is also directed to the parking brake / tow valve where a regulated pressure is created and maintained for the pilot operated valve assembles.

PFC Piston Pump



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1. High Pressure Spool Adjustment
2. Flow Control Spool Adjustment
3. Case Drain to Tank
4. Signal Line to Compensator
5. Temperature Switch

Hydraulic Systems

PFC Pump Operation

The PFC pump assembly is located directly in front of the reservoir. The PFC pump is an axial-piston type pump. When the drive shaft of the piston pump is rotated, the piston cylinder block, which is splined to the drive shaft, also turns. The piston block contains nine piston assemblies which have free swiveling slippers attached to the ball-end of the piston assembly. The slippers ride against the machined surface of the swash plate.

When the swash plate is tilted from neutral to its maximum angle by the swash plate control spring, the piston slippers follow the inclined surface of the swash plate and begin moving in and out of the piston block bore. Half of the piston assemblies are being pulled out of the piston block while the remaining half of the pistons are being pushed back into the piston block. As the pistons are pulled from the piston block, they draw oil into the piston block bores. This supply oil comes from the kidney shaped intake port. As the piston crosses over top dead center, the piston push the oil out of the piston block bores into a kidney shaped outlet pressure port. Each of the nine pistons completes this cycle for each revolution of the pump shaft. This causes a continuous even flow of oil from the pump.

The greater the swash plate angle, the greater the piston stroke. This increase in stroke causes more oil to be pulled into the pump and discharged out of the pressure port. When the engine is at high idle and the swash plate is at its maximum angle the pump output is approximately 152 l/m (40 GPM).

NOTE: *The pump is always engaged by the swash plate spring to its maximum output. The compensator is always reducing the pumps output.*

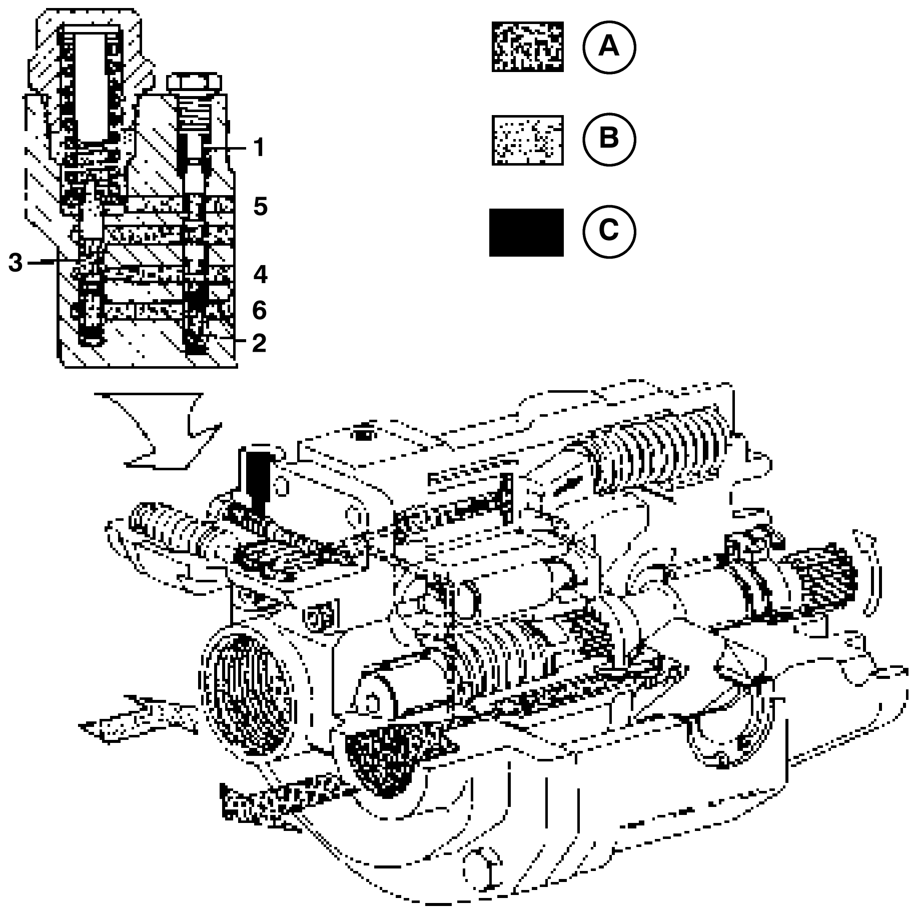
Pump Compensator

The pump compensator assembly controls the angle of the swash plate by directing oil to the swash plate control piston. The swash plate control piston will over come the swash plate control spring, placing the swash plate at the proper angle.

The main valve assembly, feeder valve assembly and steering hand pump each contain a signal port. The signal port and associated lines direct a signal pressure to the pump compensator. This signal pressure is equal to the system work pressure. The pump compensator will use this signal to place the piston pump swash plate at the proper angle to meet the system demand. The outlet pressure at the pump will be 27.6 bar (400 psi) higher than the signal line pressure due to the 27.6 bar (400 psi) spring in the compensator. The pump outlet pressure will continue to be 27.6 bar (400 psi) higher than signal line pressure until the high-pressure standby pressure is reached. After high pressure standby is reached, the pump outlet pressure and the signal line pressure will become equal.

Hydraulic Systems

Low Pressure Standby



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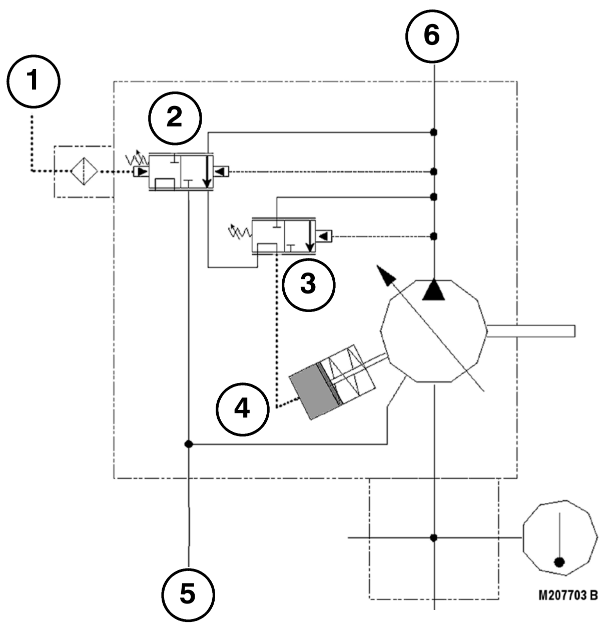
(Pump assembly is a representative drawing only.)



Hydraulic Systems

Low Pressure Standby

When there is no demand for oil flow, the pump will go into the low-pressure standby mode. Low-pressure standby means low pressure and minimal flow in the system. When the engine is not running, no pressure exists in any circuit. In this state, the swash plate control spring is holding the piston pump at full stroke. When the engine is started and the pump begins to rotate, it will momentarily try to pump oil. This creates outlet pressure at the pump. This pressure is directed to the flow compensator spool and the high-pressure spool through passages in the piston pump back plate. The two spools in the pump compensator are both spring biased. The flow compensator spool has a 27.6 bar (400 psi) spring while the high-pressure spool has a 186.3 bar (3050 psi) spring. The pump pressure is directed to the non-spring side of these two spools. As pressure builds, it will cause the flow compensator spool to shift against its 27.6 bar (400 psi) spring. When the spool shifts it allows pump oil to pass to the pump control piston. This piston will extend and cause the swash plate to move against the control spring. The swash plate will move to a nearly zero degree angle, de-stroking the pump. In this condition, the pump will only move enough oil to make up for internal leakage within the system and maintain 31-41.5 bar (450-600 psi). The pump will remain in this position until there is a demand for oil. In low-pressure standby mode the pump produces less heat and uses less horsepower than an open-center system. Low pressure standby also makes starting the engine easier.

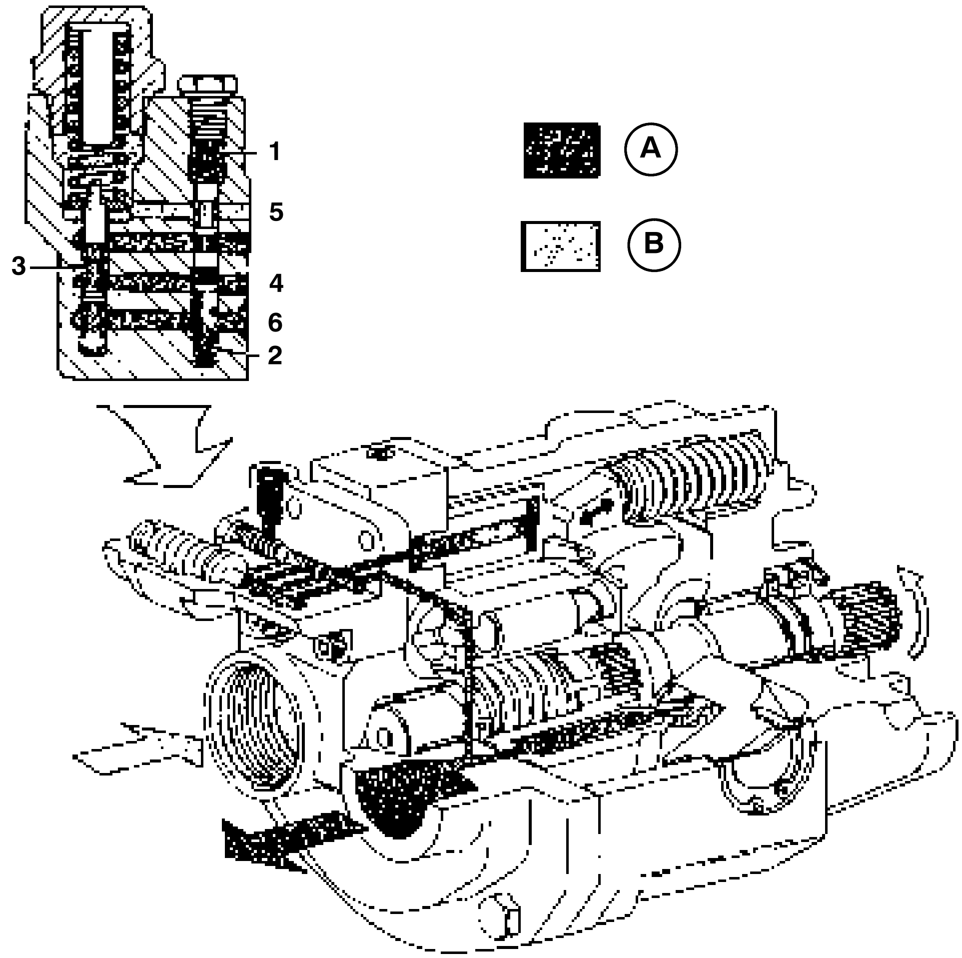
Minimum system pressure is 31-41.5 bar (450-600 psi) in the low-pressure standby mode. There is a 0.61 mm (0.024in) dynamic sensor orifice located in the steering priority spool. The dynamic sensor orifice connects the pump outlet port to the signal port of the pump compensator through the orifice check valve. If the oil in the signal line can flow through the steering hand pump too freely a 0.78 mm (0.031″) orifice in the steering hand pump signal passage provides back pressure in the signal line. This signal pressure of 3.45-10.3 bar (50-150 psi) is sent to the spring-end of the flow compensator spool. The spring pressure of 27.6 bar (400 psi) plus the signal line back pressure puts the pump into low pressure standby mode ranging from 31-41.5 bar (450-600 psi).

1. Signal Line-In
2. Flow Control Spool
3. High Pressure Spool
4. To Control Piston
5. Drain to Tank
6. Pump Output

- **A.** Low Pressure Standby Oil
- **B.** Drain Oil
- **C.** Trapped Oil

Hydraulic Systems

Pressure and Flow Compensation



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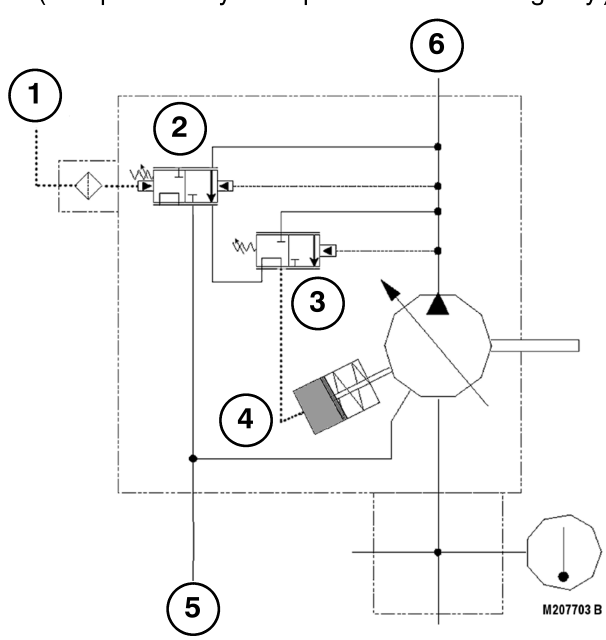
(Pump assembly is a representative drawing only.)



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Hydraulic Systems

Pressure and Flow Compensation

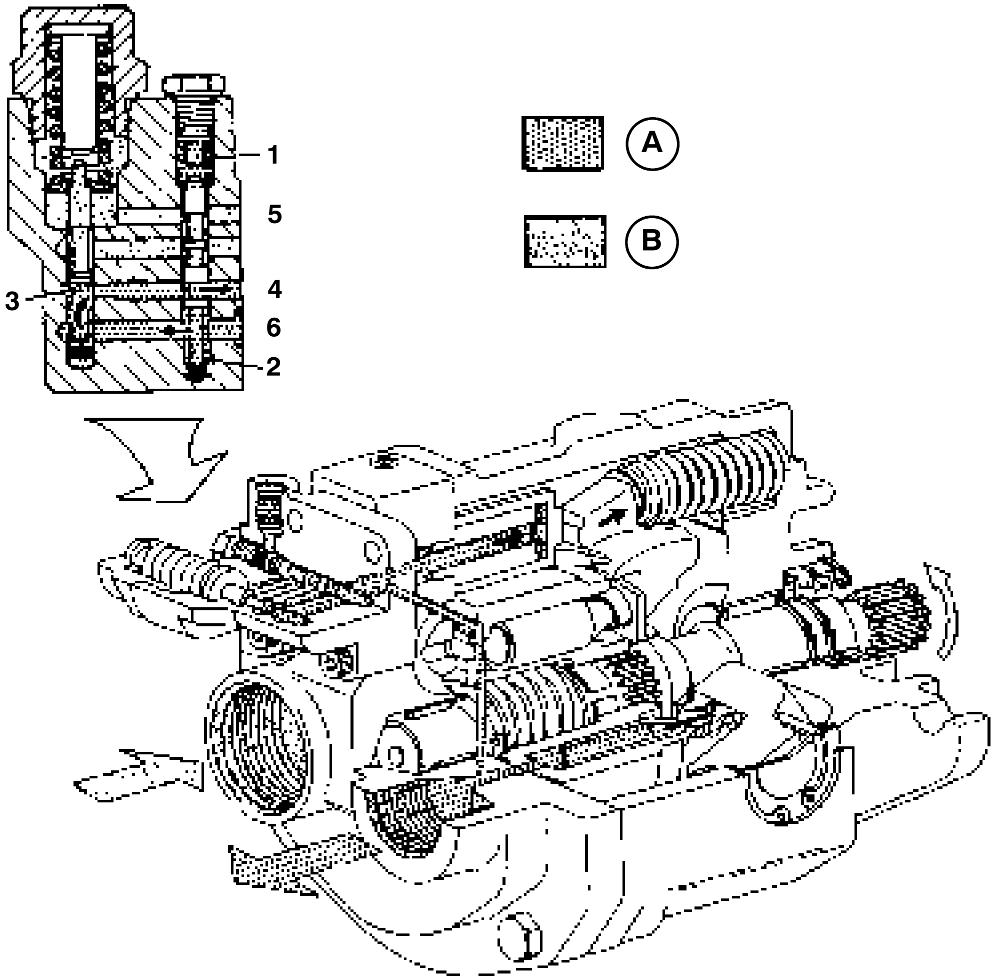
The flow of oil from the pump is controlled by the difference in pressure at opposite ends of the flow compensator spool. When a valve is opened to operate a function on the combine, the outlet pressure of the pump will drop. This drop in pressure is detected on the non-spring end of the flow compensator spool. The spring will now shift the spool and allow oil to drain from the pump control piston into the pump case. The swash plate control spring will tilt the swash plate, causing the pump to provide more oil flow. When the flow demand of the system is met, the swash plate will be tilted to provide only the flow required by the component(s) in use. The working pressure in the system is fed back to the spring-end of the flow compensator spool through the signal line. The pump must produce flow at a pressure equal to the working pressure desired, plus enough to overcome the 27.6 bar (400 psi) spring on the flow compensator spool. When the outlet pressure is high enough to overcome both the spring and work pressure, the flow compensator spool will shift allowing oil to flow to the control piston, causing the pump to destroke to match the demand.

1. Signal Line-In
2. Flow Control Spool
3. High Pressure Spool
4. To Control Piston
5. Drain to Tank
6. Pump Output

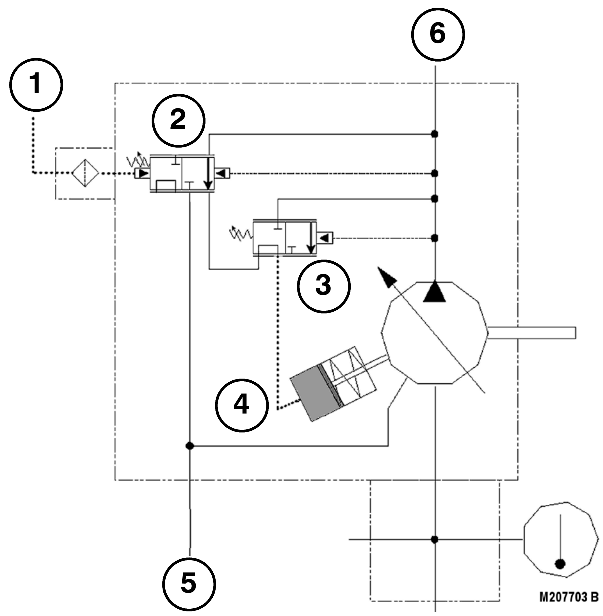
A. Pressurized Oil
B. Drain Oil

Hydraulic Systems

High Pressure Standby



(Pump assembly is a representative drawing only.)



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Hydraulic Systems

High Pressure Standby

Should the hydraulic system stall-out under a high load, or a cylinder reach the end of its stroke, the pump will go into high-pressure standby until the load is overcome or the valve is returned to neutral. When the system stalls-out, there will be no flow across the controlling valve. The pressure will then equalize on both ends of the flow compensator spool. The spring will then cause the flow compensator spool to shift. At the same time, the pressure will start to rise in the system until it is able to move the spring-loaded high-pressure spool. This spring is set at 182.85–189.75 bar (3050 psi). When the high-pressure compensator spool shifts, it directs oil to the swash plate control piston, de-stroking the pump.

The pump will remain in the high-pressure standby mode until the load is overcome or the valve is returned to neutral. When the valve is returned to neutral, pressure is no longer available to the signal line. The flow compensator spool will shift allowing oil to extend the control piston and destroke the pump. Signal line pressure is bled-off through a 0.5 mm (0.020″) signal orifice check valve threaded into the steering priory valve, a 0.89 mm (0.035″) dampening orifice located in the steering priority valve, a 0.78 mm (0.031″) orifice in the steering hand pump and then to the reservoir. When the signal pressure is bled-off, the flow compensator spool will return the system to low pressure standby.

1. Signal Line-In
2. Flow Control Spool
3. High Pressure Spool
4. To Control Piston
5. Drain to Tank
6. Pump Output

A. Maximum High Pressure Oil
B. Drain Oil

Signal Circuits

The signal circuit pressure may be generated from the following sources:

- Steering Circuit
- Header Raise Circuit
- Signal Valve Circuit
- Lateral Tilt Valve
- Reel Drive Valve

The steering, header raise, field tracker and reel drive circuits react differently than the reel raise, reel fore/aft and unloading auger swing circuits. This is due to the location of the signal line. The steering, reel drive, terrain tracker and header raise rates are variable by the operator, unlike the other functions, which are not adjustable. For example, the steering speed can be affected by how fast the operator turns the steering wheel. The header raise rate can be increased or decreased by changing the raise rate setting on the Universal Display Plus monitor. However, the adjustments for speed of reel raise, reel fore/aft and unloading auger swing are set by the size of the orifices in each valve.

The signal line for the variable control systems (steering, terrain tracker, reel drive and header raise) is located after each control valve, (monitoring the circuit work pressure). In this location, the signal line will sense actual working pressure in the cylinder(s).

The reel raise, reel fore/aft and unloading auger swing can NOT create a signal. When any of these functions are activated the jammer valve is also activated. The jammer valve is used to direct full pump pressure into the signal line, this causes the PFC pump to go the high pressure standby. A supply side orifice in each valve controls the speed at which these function operated.

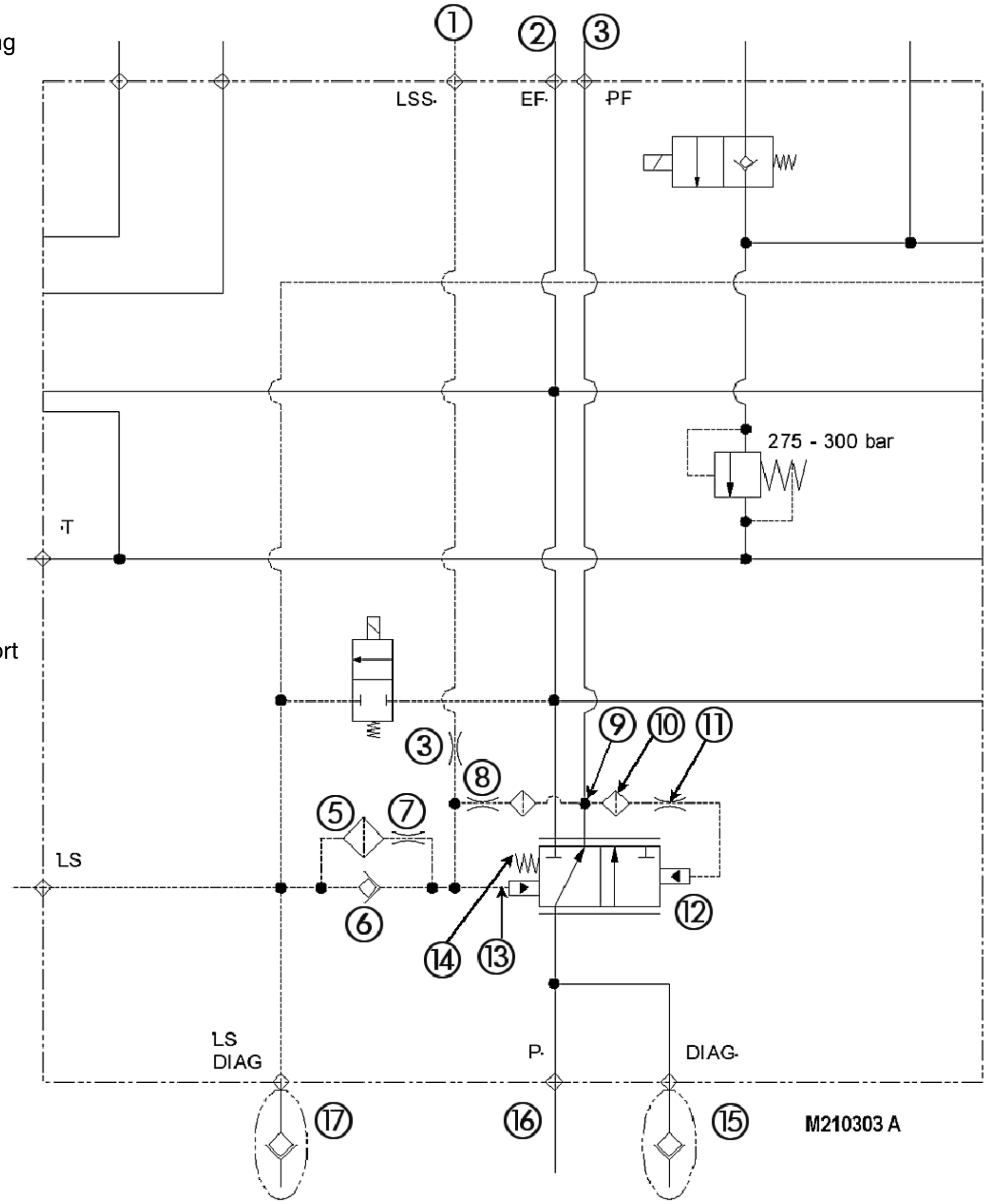
The jammer valve is connected before the orifices that control the actuation speed. As a result, the signal pressure sensed is not the actual working pressure at the cylinder(s), but full system pressure. In this case, no pressure drop is detected and the oil pressure on either side of the flow compensator spool will remain equal. This situation will cause the system to go on high-pressure standby whenever reel raise, reel fore/aft and unloading auger swing are operated.

Within the PFC system there are five checks valves located in the signal lines. One at the header valve, one at the steering priority valve, one in the reel drive valve and two in the lateral tilt valve. The purpose of these checks is to allow the highest signal line pressure to get back to the compensator. This will make sure that the component with the highest-pressure demand is satisfied.

Steering Priority Valve

Main Machine Stack Valve

1. Signal from Steering
2. Supply to Feeder Valve
3. Supply to Steering Hand pump
4. Not indicated
5. Screen
6. Steering Signal Check Valve
7. Signal Bleed Off Orifice
8. Dynamic Orifice
9. Not indicated
10. Screen
11. Damping Orifice
12. Pump PSI
13. Signal PSI
14. Spring
15. DIAG Test Port
16. From PFC Pump
17. Signal Line Test Port



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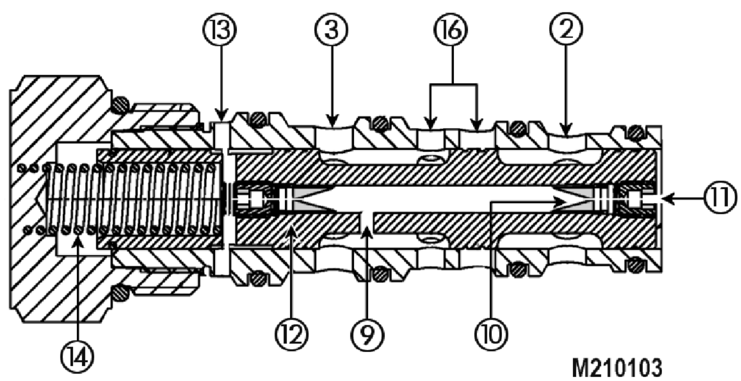

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STEERING CIRCUIT

Steering Priority Valve

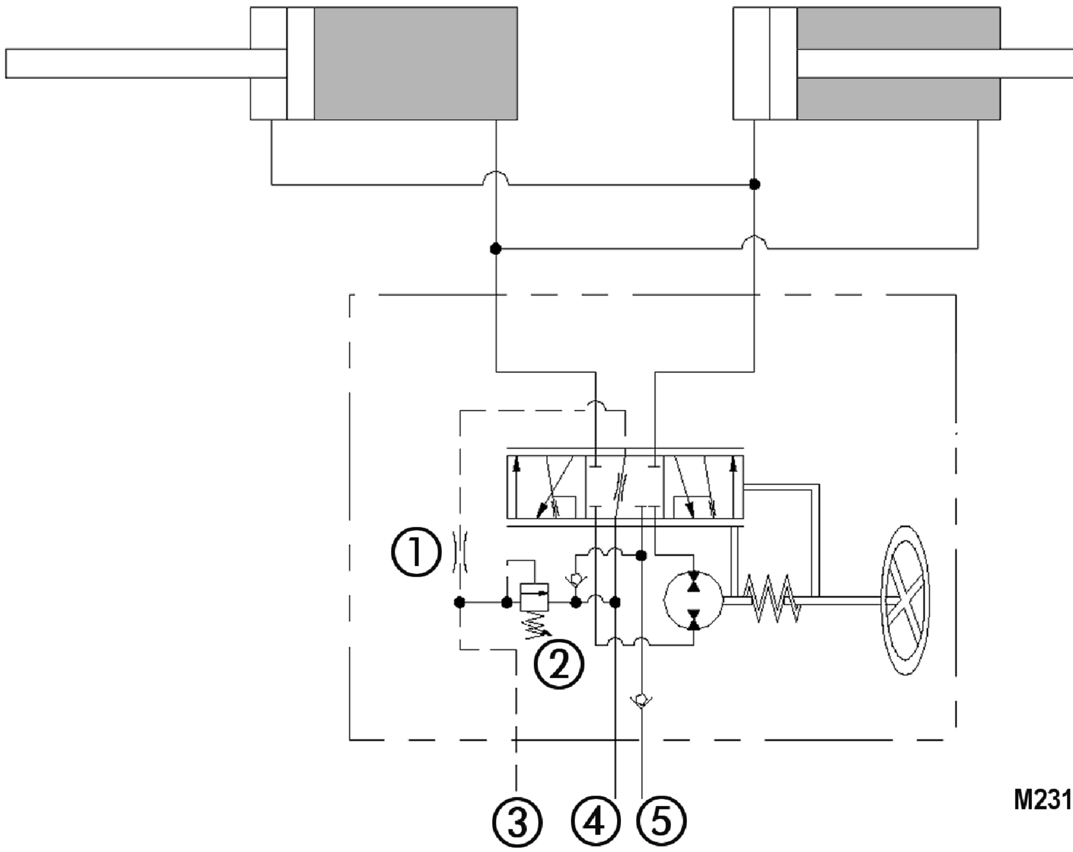
The steering priority valve is integral with the main stack valve on the left side of the combine. The primary function of the steering priority valve is to maintain a priority flow of oil to the steering system. Oil from the PFC pump is directed to the inlet of the steering priority valve. Inside the valve is the priority spool, which is spring biased. The spring will position the spool so incoming oil will to go to the steering hand pump first.

When steering is not being used, pressure will increase due to the closed-center steering hand pump. This build-up of pressure is directed to the non-spring end (12) of the priority spool through a screened 0.79 mm (0.031 in) damping orifice (11). At the same time, a screened 0.64 mm (0.025 in) dynamic sensor orifice (8) directs oil to the spring-end of the priority spool and to the signal line. The dynamic sensor orifice keeps the signal line filled with oil to keep the steering responsive. At the same time this oil is allowed to drain to the reservoir through the orifice in the steering hand pump spool. If the oil in the signal line can flow through the steering hand pump too freely, the 0.79 mm (0.031 in) orifice in the steering hand pump will create a back pressure of 10.3 bar (50–150 psi) in the signal line. This pressure in the signal line plus the 27.6 bar (400 psi) springs in the compensator act together to put the system at low pressure standby. With the oil on the spring-side (13) of the priority spool draining to the reservoir, and the increased pressure on the opposite end, the spool will shift against the spring. The priority spool will meter just enough oil to the steering circuit to make-up for the oil being bled-off through the 0.79 mm (0.031 in) orifice in the steering hand pump during low pressure standby. On the spring-end of the steering priority spool is an orifice (8) fitting that connects the steering hand pump signal line to the steering priority valve. This orifice fitting has a 0.79 mm (0.031 in) orifice in it, which serves as a dampening orifice to control priority spool movement.

The steering hand pump circuit is opened when steering is required. This will cause a pressure drop on the non-spring end of the priority spool. The spring will shift the priority spool to direct oil out to the steering hand pump. The PFC pump will stroke to meet the steering demand. When steering demand is satisfied, pressure will start to build on the non-spring end of the priority spool. The pressure will overcome the spring, shifting the priority spool, thus allowing excess oil to be supplied to the main valve assembly if required.

Threaded into the steering priority valve is a screened 0.50–mm (0.020in) orifice check. This orifice check allows oil pressure to get to the compensator when in low-pressure standby mode and when steering the combine. It also allows signal line pressure, once a function has been completed, to bleed from the compensator to reservoir through the steering hand pump, which de-strokes the pump.

Steering Hand Pump



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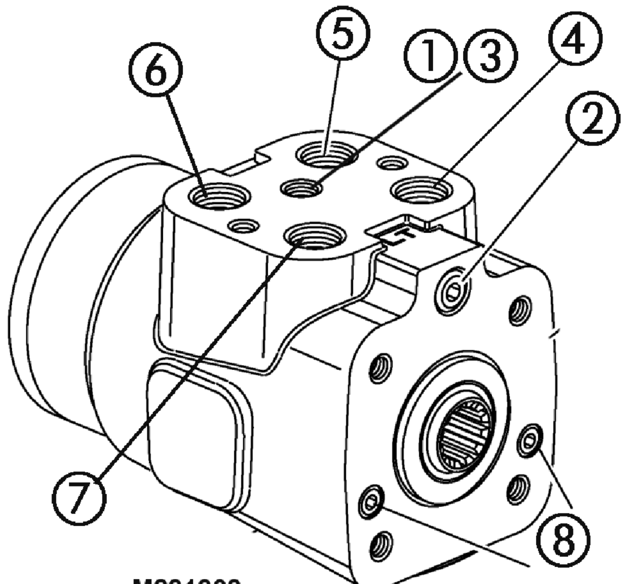

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STEERING CIRCUIT

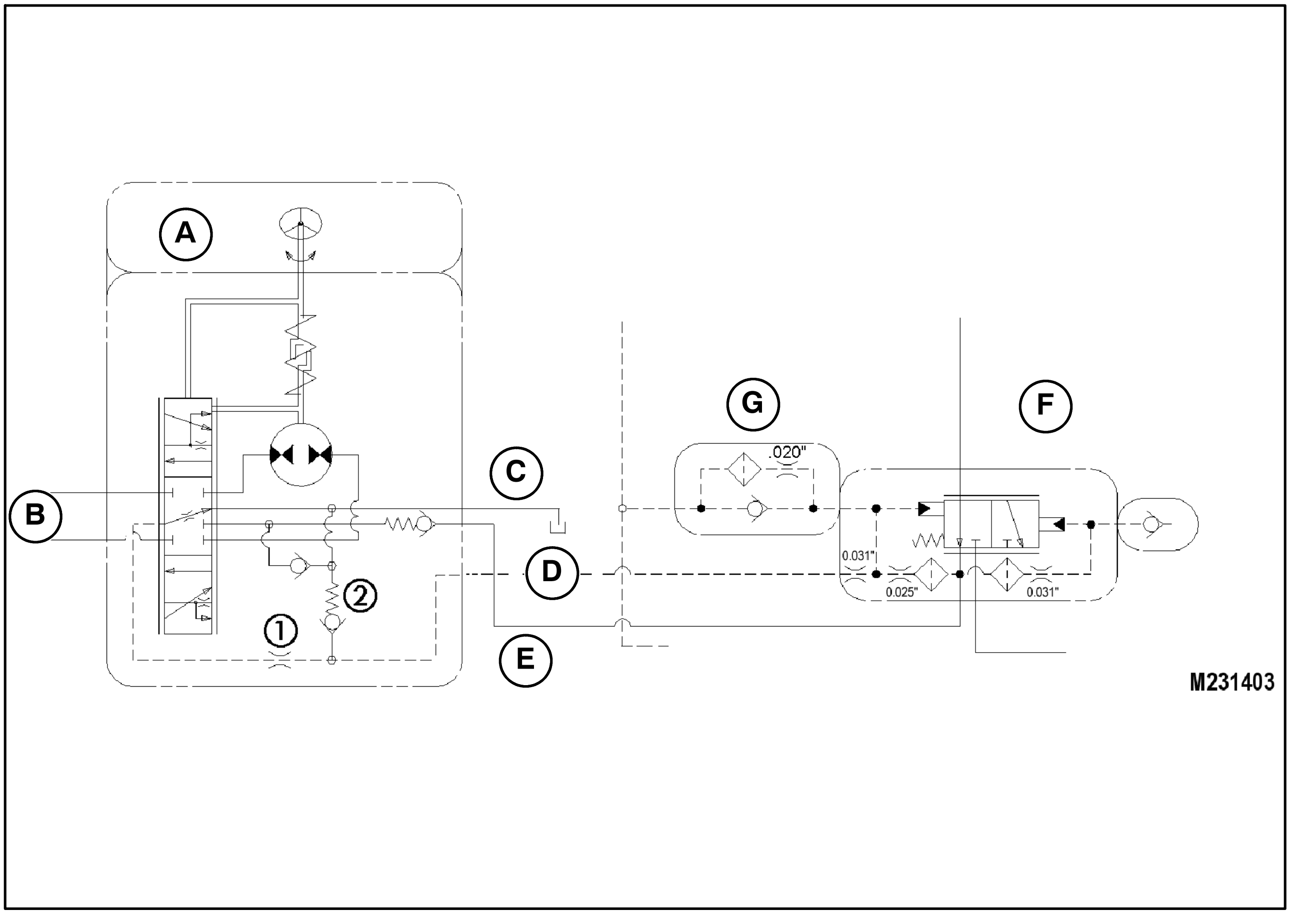
Steering Hand Pump
AFX Series Combines use an Eaton steering hand pump. This hand pump is a closed-center, load-sensing design to minimize horsepower consumption and heat generation. The NA unit is 328 cc with 4.5 turns lock to lock and the EUR unit is 320 cc with 4.7 turns lock to lock. Two 2.25″ X 13.4″ cylinders are used to turn the wheels.

Steering Neutral
When there is no demand for steering, the spring-centered main spool and sleeve block the oil inlet port and the ports to the steering cylinder. At the same time the main spool and sleeve open a passage so the signal line can drain to the reservoir. The 0.64 mm (0.025 in) dynamic sensor orifice directs oil to the spring-end of the priority spool and to the signal line. The dynamic sensor orifice keeps the signal line filled with oil to keep the steering responsive. At the same time this oil is allowed to drain to the reservoir through the orifice (1) in the steering hand pump. The orifice in the steering hand pump will create a back pressure of 10.3 bar (50–150 psi) in the signal line. This pressure in the signal line plus the 27.6 bar (400 psi) spring in the compensator act together to put the system at low pressure standby. The internal check valve between the supply and return passages is closed at this time.

Power Turn (left or right)
Oil from the PFC pump enters the steering hand pump at the supply port. This opens the spring-loaded check valve and seats the recirculation check. As the steering wheel is rotated (left or right), the main spool will move within the sleeve. This movement will direct oil to the metering section as well as to the signal line. The metering section begins to rotate with the rotation of the steering wheel. This moves oil from the PFC pump to the rod-end or the base end of the cylinder depending on the direction of rotation. At this point the oil pressure going to the cylinders is also transmitted back to the compensator by way of the signal line.

Oil returning from the cylinder is directed back to the main spool and sleeve, then out the return port of the steering hand pump to the oil filter. When rotation of the steering wheel is stopped, the spring-centered main spool and sleeve return to the neutral position. This stops oil flow to the metering section and traps oil in the cylinder.

Steering Relief Valve



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A. Steering Handpump
B. To Steering Cylinders
C. Return Line
D. Signal Line
E. Supply Line
F. Steering Priority Valve
G. Check Valve

STEERING RELIEF VALVE

If the steering wheels are turned to their stops, or the wheels can no longer be turned, the steering system pressure increases until it goes on relief. When the pressure increases above 182.7-189.6 bar (2650-2750 psi), a simple relief valve (2) located in the steering hand pump signal line will open. An orifice (1) is located in the hand pump to limit the amount of oil that is being feed into the signal line, so that the relief valve can limit the pressure in the signal line. This will limit the signal pressure available to the steering priority valve and the compensator. The purpose of this relief valve is to limit the maximum pressure available to the spring-side of the priority spool, thus allowing oil to flow to the main valve assembly. If the steering relief pressure is set too close to the high-pressure stand-by pressure, the oil flow to the main valve assembly may be cut off when the steering relief valve opens. This relief valve is factory set to provide a pump supply pressure between 182.7-189.6 bar (2650-2750 psi).

Manual Steering

The steering circuit will permit manual steering control of the combine in the event of a dead engine; however, steering effort is more demanding. Manual steering uses the existing oil in the steering circuit for the oil supply, and the operator turning the steering wheel as input power. In manual steering operation, the metering section (turned by the operator) is used as the pump to supply oil to the steering cylinder.

Manual Turn (left or right)

As the operator rotates the steering wheel, the centering springs compress and the main spool changes relationship to the sleeve. Since there is no supply of hydraulic oil from the PFC pump, the inlet check valve will be held on its seat by the spring. At this point, the recirculation check ball will not be seated due to the fact there is no incoming oil. This allows oil from the return port to be drawn past the recirculation check, through the main spool and sleeve, to supply the metering section, which is now acting as the pump. The metering section controls the amount of oil being directed to the cylinder based on the rotation speed of the steering wheel. Oil flow from the metering section is then directed to the spool and sleeve, then out to the steering cylinder.

Oil returning from the steering cylinder is directed back to the main spool and sleeve, then to the return port. Since return port oil is now the supply to the metering section, and the recirculation ball is off its seat, the oil can again be directed to the metering section for a continuous supply.

When the rotation of the steering wheel is stopped, the centering springs return the main spool and sleeve to a neutral position.

HYDRAULIC SYSTEM

Electrical Monitoring Circuits
The system uses a number of sensors to monitor the systems operations.

HYDRAULIC FILTER RESTRICTIONS SWITCH

Reference Material:
Electrical schematic frames #10

Key Components:
Hydraulic Filter Restriction Switch S-32, CCM1, ground (1)

The filter restriction switch is used to monitor the condition of the filter. The switch is a N/O switch. When the pressure differential on the filter exceeds the specifications the switch piston will shuttle over connecting the power wire to the filter base, providing a ground. The filter restriction indicator should illuminate prior to the filter by-pass opening, providing the operator time to replace the filter.

Power is supplied to the sensor from the CCM1 connector X019 terminal J2-34 to the sensor terminal B. The sensor terminal A is directed to the chassis ground (1).

HYDRAULIC OIL TEMPERATURE SENSOR

Reference Material:
Electrical schematic frames #10

Key Components:
Hydraulic Oil Temperature Sensor B-18, CCM1

Located:
In the PFC pump inlet manifold

The reservoir tank temperature sensor monitors the oil temperature in the reservoir tank. If the temperature should climb above 128ºC (260ºF), the resistance of the sensor will be reduced to a point at which enough current will flow through it providing the CCM1 with a signal. At room temperature the sensor reads approximately 2500 ohms and reduces as the temperature increases.

Power is supplied to the sensor from the CCM1 connector X019 terminal J2-24 to the sensor terminal B. The sensor terminal A is directed back to the CCM1 connector X019 terminal J2-14.

NOTE: *The diagnostic screen on the Universal Display Plus monitor monitors the supply wire B.*

RESERVOIR TANK LEVEL SWITCH

Reference Material:
Electrical schematic frames #10

Key Components:
Hydraulic Oil Level Switch S-33, CCM2, ground (1)

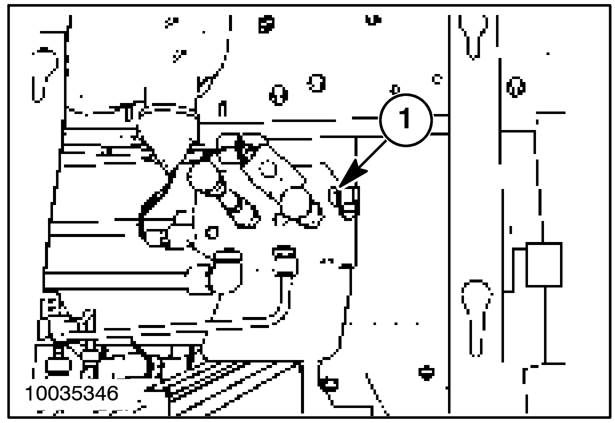
The reservoir tank level sensor monitors the oil level in the reservoir tank. If the level should fall too low the sensor will close, providing a complete circuit.

Power is supplied to the sensor from the CCM2 connector X016 terminal J2-39 to the sensor terminal B. The sensor terminal A is directed to the chassis ground (1).

REGULATED PRESSURE

Park Brake / Regulated Pressure Valve

1. Park Brake/Regulated Pressure Assembly



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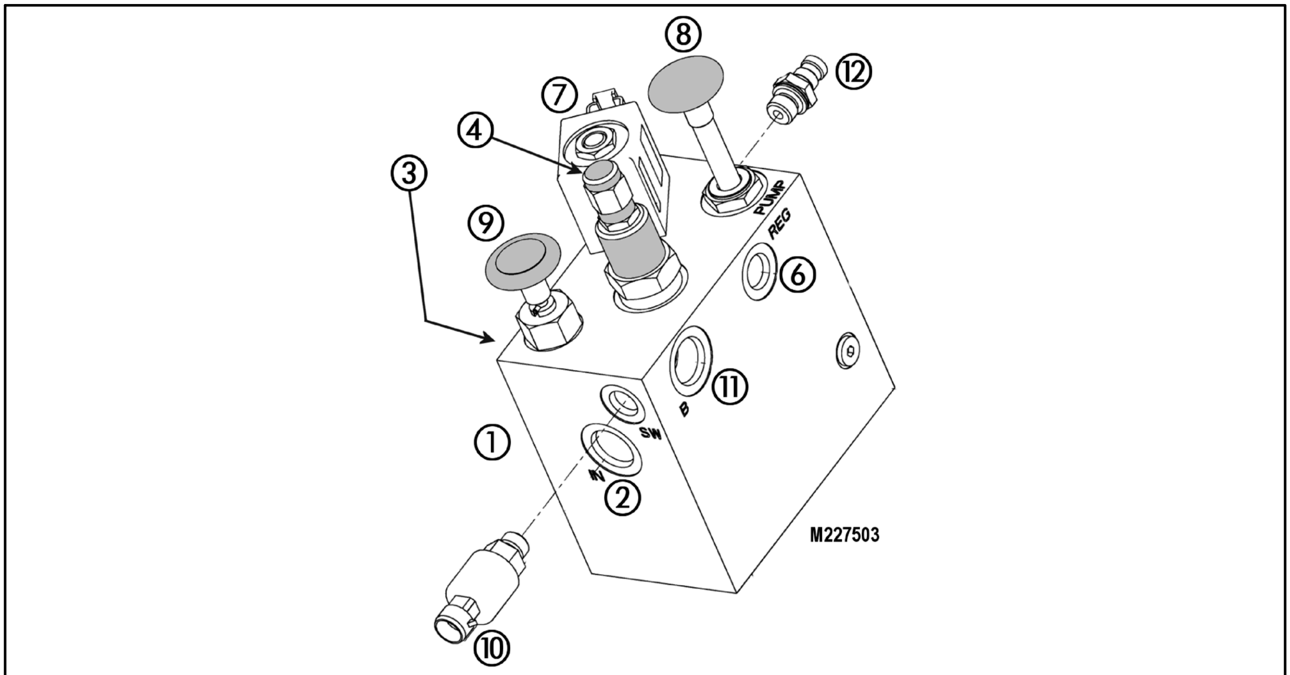
Park Brake / Regulated Pressure Valve
Regulated pressure is used for two functions:

1. To control the secondary portion of pilot operated valve assembles, Header Raise / Lower and Reel Drive valve. The primary spool uses regulated pressure to control the position of the secondary spool, the secondary spools will be controlling the operating flow from the PFC pump.
2. To release the Parking Brake and provide oil for the tow valve assembly.

Component Location



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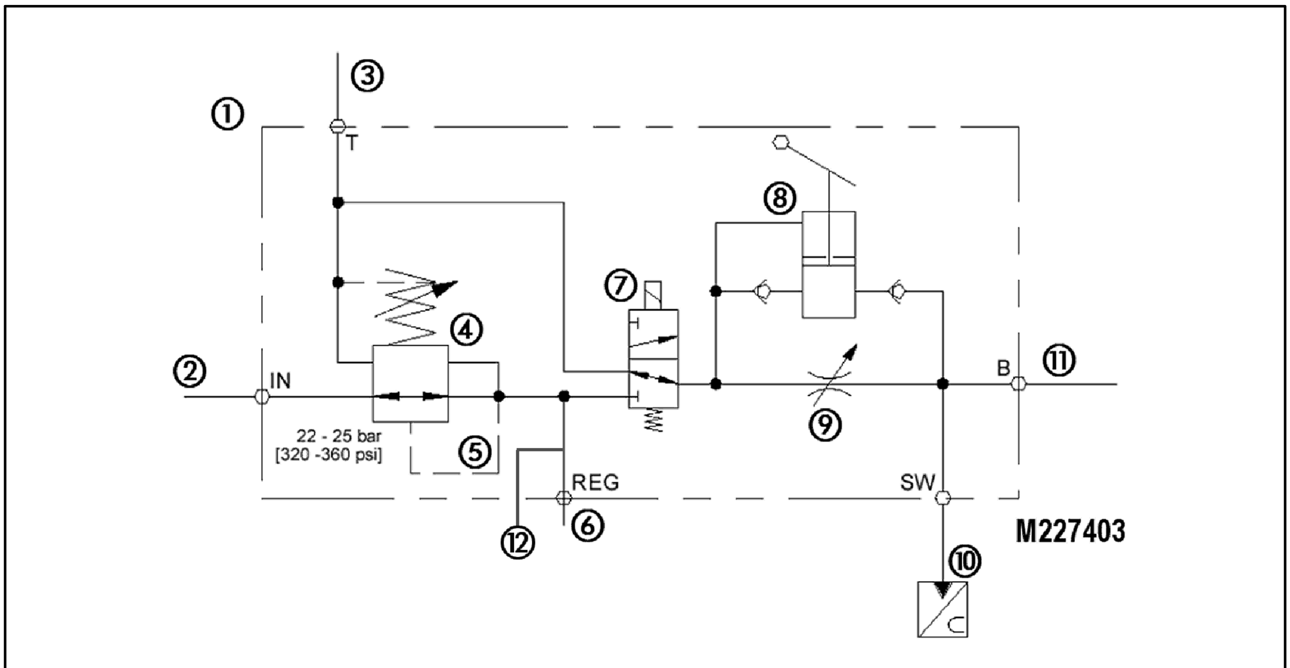
Regulated Pressure Schematic



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1. Park Brake/Reg. Valve Assembly
2. Supply From PFC Pump
3. Return to Tank
4. Regulated Pressure Valve
5. Pilot Line
6. To Regulated Circuits
7. Park Brake Valve
8. Tow Valve (Hand Pump)
9. Isolation Valve (Tow Operations)
10. Regulated Pressure Sensor
11. Park Brake Release
12. Regulated Test Port

Regulated Pressure Valve Operation

Reference Material:
Hydraulic Schematic

Key Components:
Regulated/Park Brake/Tow Valve Assembly

Regulated Pressure
The Regulating /Park Brake valve is teed into the hydraulic supply line from the PFC pump so when the PFC pump is operating, regardless of output pressure, the valve is receiving pump working pressure. PFC pump low pressure stand-by may vary between 31-41 bar (450-600 PSI) so it is the job of the regulated valve to maintain a regulated pressure of 22-25 bar (320-360 PSI) for the complete regulated circuit.

PFC is supplied at port (2) and is directed to the regulated valve assembly. All regulated functions are closed circuit operations, meaning they don’t require large volumes of oil BUT demand constant pressure. Since there is no real flow of oil through the circuits the pressure will stabilize at the current PFC working pressure which is to high. The regulating valve, through the pilot line (5), is monitoring the regulated pressure AFTER the valve. As the regulated pressure increase the pressure is also directed to the non-spring end of the regulating valve and shuttles it against the spring, restricting the inflow of oil into the regulated circuit, maintaining the circuit pressure.

Regulated pressure may be tested at the test port (12).

Electrical Monitoring Circuits

Park Brake Pressure Sensor

Reference Material:
Electrical schematic frames #9, #27

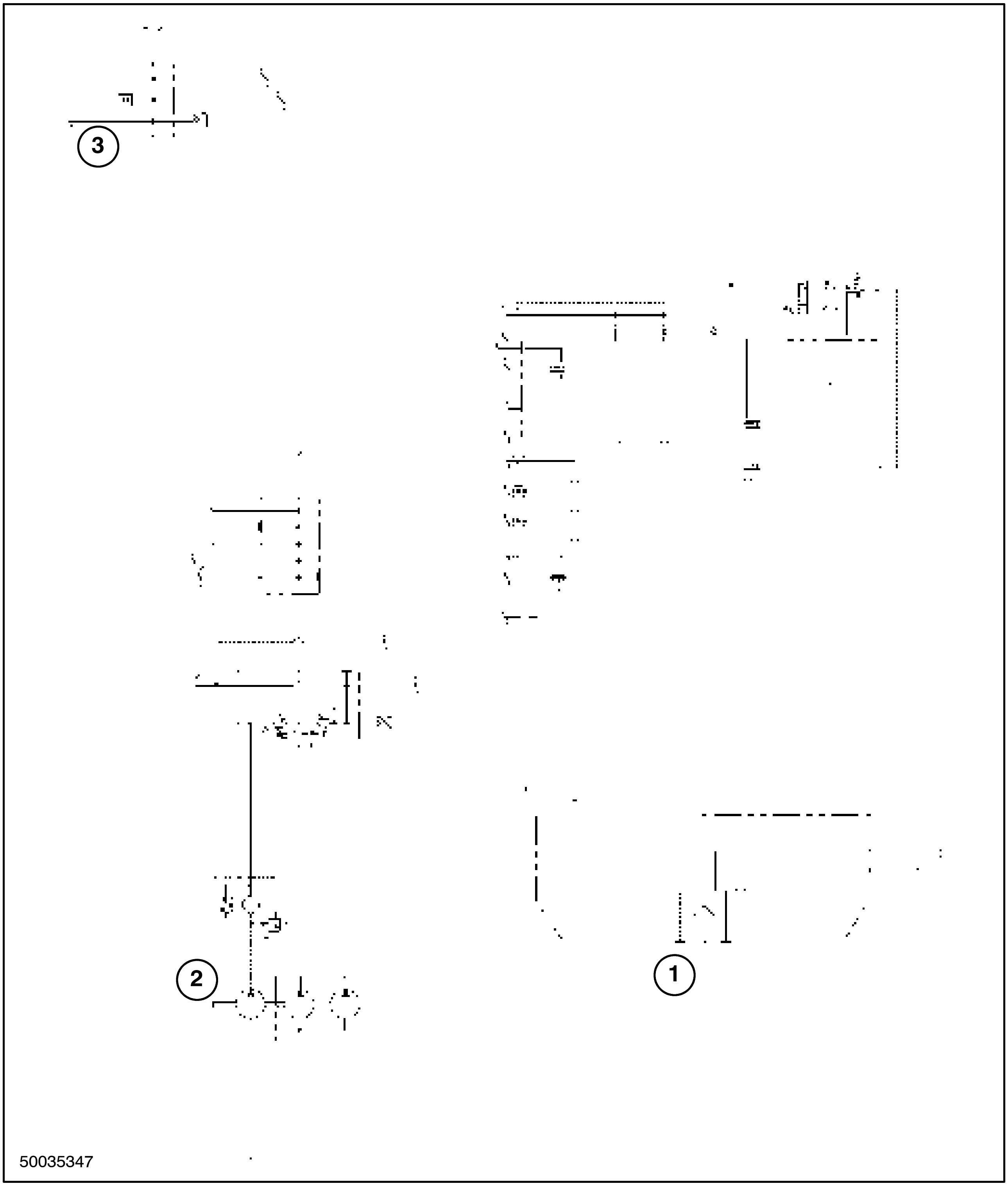
Key Components:
Park Brake Sensor B-53, CCM2

A pressure sensor is used to monitor the parking brake release pressure, in turn monitoring the regulated pressure. The sensor provides a constant voltage reading to the CCM2, and the CCM2 places a message on the data bus for the Universal Display Plus monitor. If the pressure falls below specification the park brake indicator lamp will illuminate warning to the operator. The sensor is a variable resistance sensor.

A 5V power is supplied to the sensor from the CCM2 connector X017 terminal J3-26 to the sensor terminal B. The sensor terminal A is directed back to the CCM2 connector X0016 terminal J2-14. The sensor terminal C is providing a variable signal voltage to the CCM2 connector X017 terminal J3-34.

NOTE: *The diagnostic screen on the Universal Display Plus monitor is monitoring the signal wire C.*

Control Pressure



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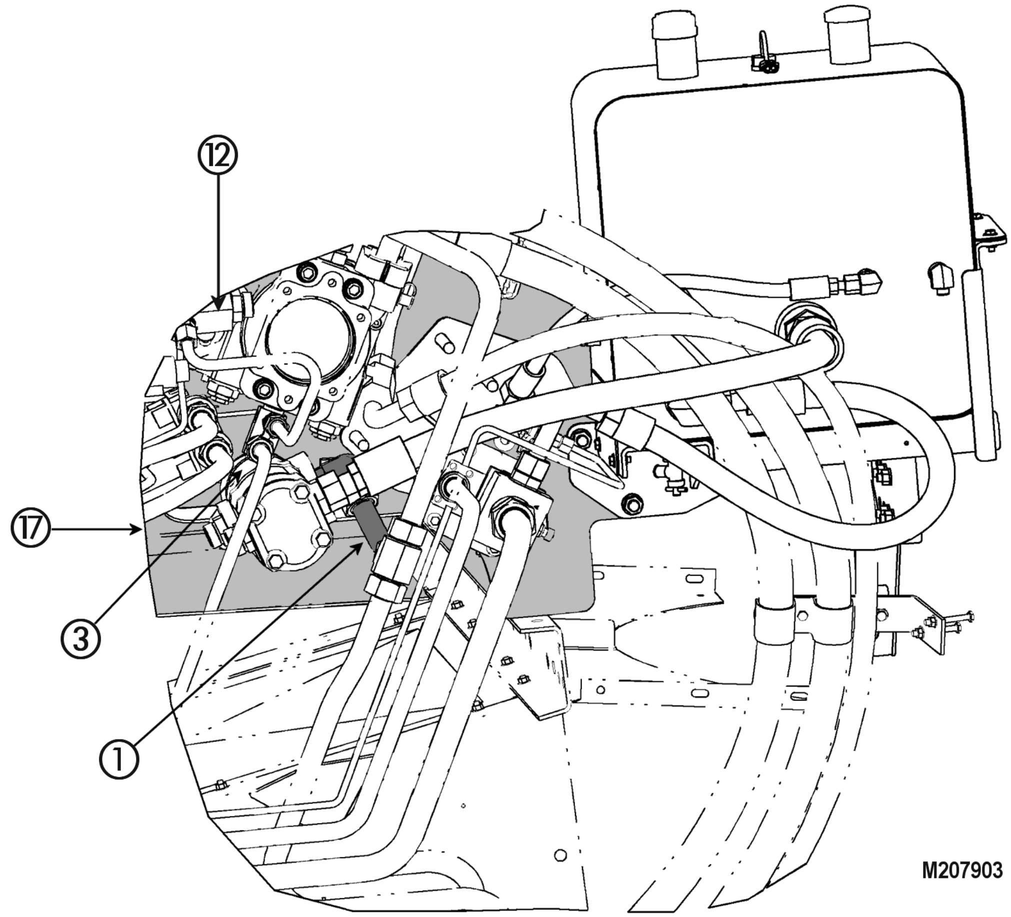
1. Supply from PTO Gearbox
2. Control Pressure Pump
3. Control Pressure Manifold and Sensor

CONTROL PRESSURE SYSTEM

On the AFX combines there are three individual hydrostatic drives, they all share common components. In the past we were accustomed to having a charge pump and filtering system for each hydrostatic drive, this system will use a common charge pump and filter for all drives. We would normally have call this the CHARGE pump and filter for the hydrostatic drive, it is now the CONTROL PRESSURE circuit.

Normally the hydrostatic drive charge pump is mounted inside the hydrostatic pump end cover, not so on the AFX combine. Since the control pump will be supplying all three hydrostatic drives a larger pump is required. The control pump is the largest gear pump section of the gear pump assembly. The customary charge pump that is incorporated into the ground drive hydrostatic pump assembly will be used ONLY for PTO gearbox cooling lubrication.

NOTE: *The Charge pressure is identified as "Control Pressure."*



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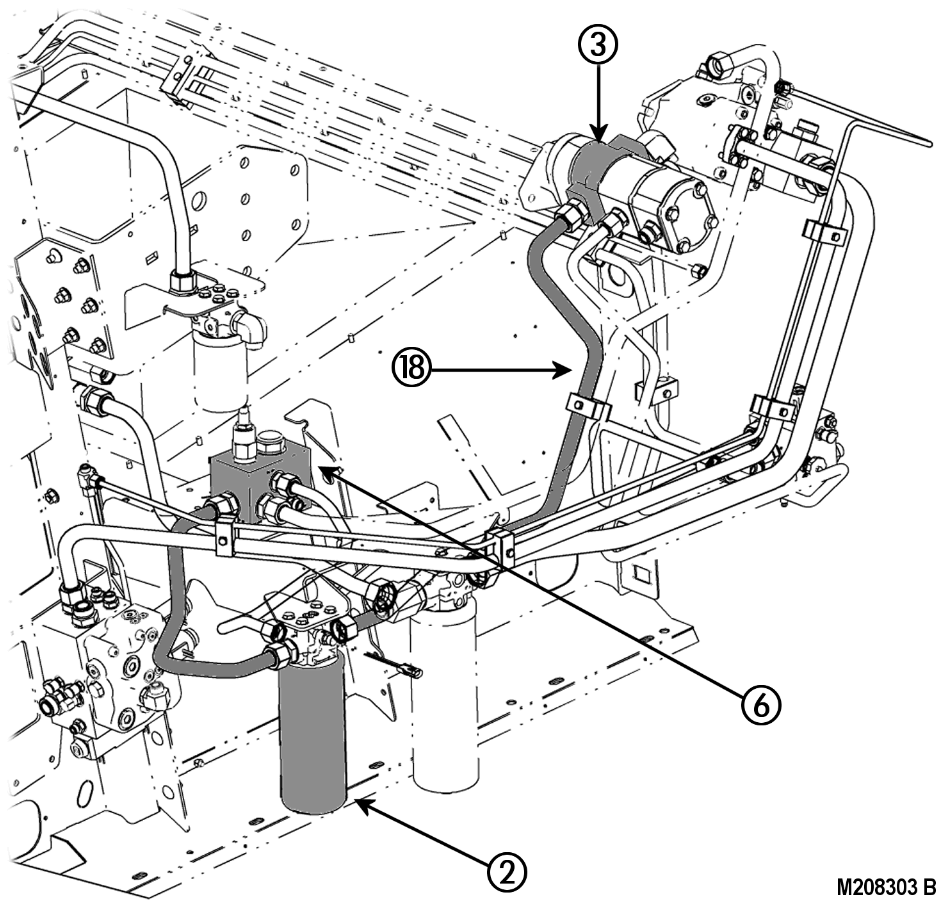
1. Supply From PTO Gearbox
3. Control Pressure Pump
12. Control Pressure Test Port and Sensor
17. PTO Gearbox



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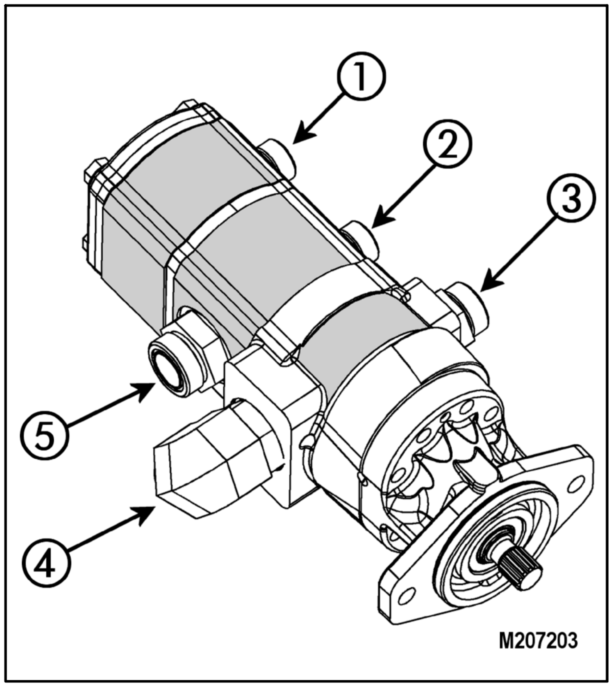
2. Control Circuit Filter
3. Gear Pump Assembly
6. Control / Lube Pressure Regulating Valve
18. Pump to Filter Line

Control Pressure Pump



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1. Fan Drive Output (rear pump)
2. Spreader and Rotary Air Screen Output (center pump)
3. Control Pressure Output (front pump)
4. Supply From PTO Gearbox, (for pump 3)
5. Supply From Hydraulic Reservoir, (for pumps 1 and 2)

The gear pump assembly is mounted in the PTO gearbox and incorporates three separate gear pumps.

The **Control Pressure** pump, (pump 3, nearest to the drive shaft), is supplied oil from the **PTO gearbox** and all of its flow is returned to the PTO gearbox. See specification page.

The **Spreader**/**Rotary Air Screen Drive** pump is supplied oil from the **hydraulic reservoir** and returns all of its flow back to the reservoir. See specification page.

The **Fan Drive** pump is supplied oil from the **hydraulic reservoir** and returns all of its flow back to the reservoir. See specification page.

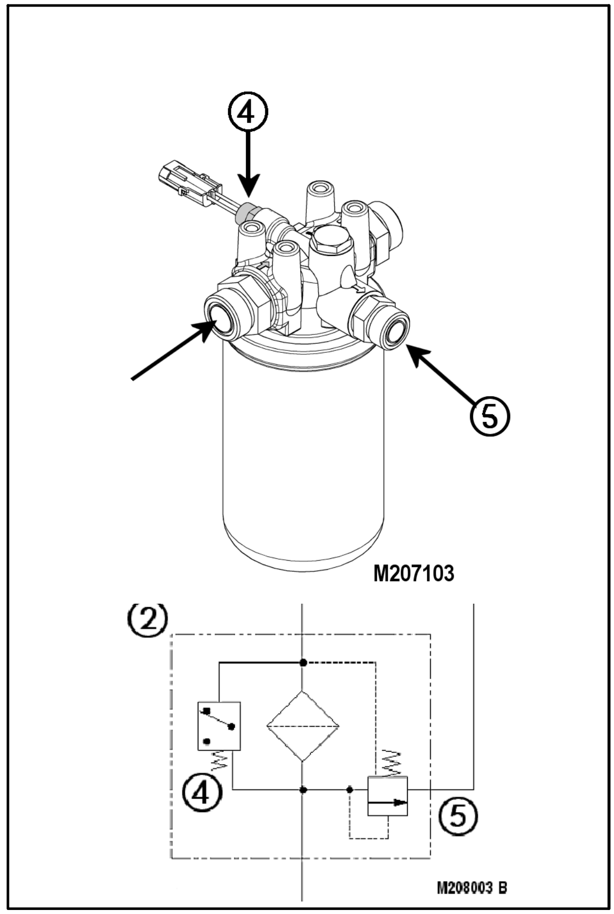
NOTE: *If the seal was to leak between the front and center pumps oil could transfer between reservoirs.*

Filtration

2. Filter Base
4. Restrictions Indicator
5. Filter By-Pass Port

The control pressure filter is on the supply side of the control pressure circuits, the filter is a pressure filter. The filter base incorporates a filter restriction sensor (4) that monitors the condition of the filter element. If the restriction increases above 2.76 bar (40 PSID) differential pressure the sensor will CLOSE to create a signal to the Universal Display Plus monitor for operator warning.

The filter base incorporates a filter by-pass valve that will open at 3.45 bar (50 PSID) differential pressure to prevent over pressuring the filter. Since the flow is supplying the hydrostatic pumps and motor the filter by-pass does NOT permit dirty oil to flow through the filter base down stream. The filter base directs the by-pass out port (5) to the return manifold. The sensor is set to activate prior to the by-pass valve opening.



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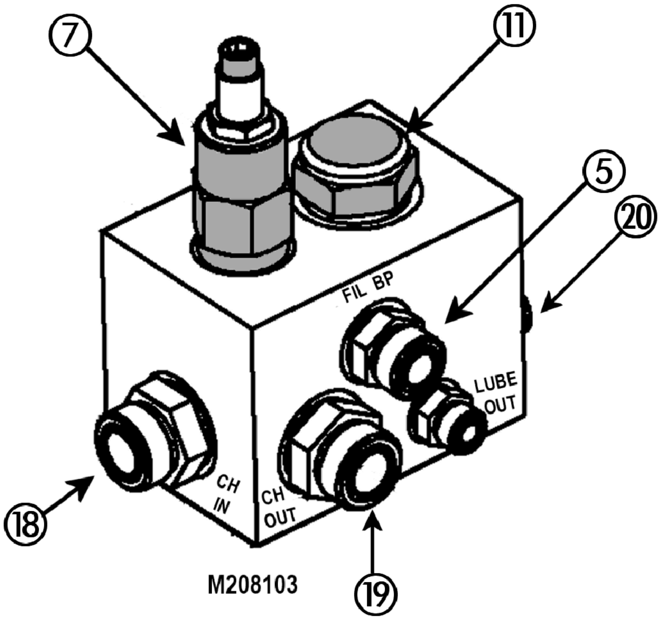
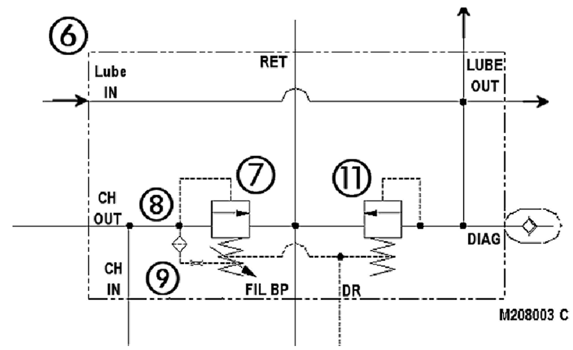
Control / Lubrication Pressure Valve





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5. Filter Base By-Pass IN Port
6. Valve Body
7. Control Pressure Regulating Valve
8. Screen
9. Orifice
11. Lubrication Pressure Regulating Valve
18. Control Pressure Supply
19. Control Pressure OUT Port
20. Lubrication Pressure Switch

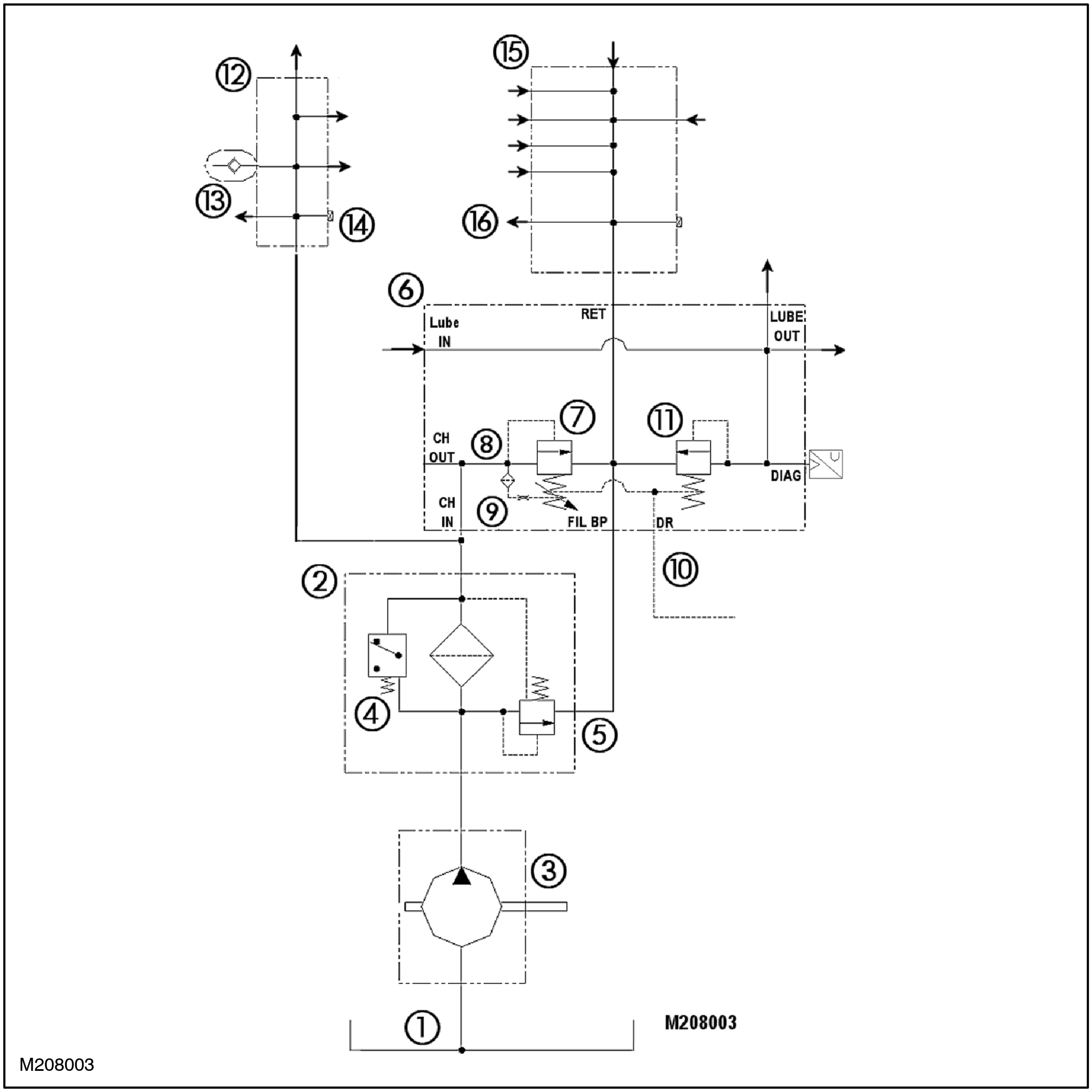
The Control/Lube pressure control valve regulates both the control pressure and lube pressure. The valve is supplied oil from the control pressure pump at port (18) and is exposed to the regulator (7). The regulator is adjustable to maintain a control pressure of 20-22 bar (290-320 PSI). If the pressure exceeds the spring setting the valve will shuttle and direct the flow to the return port (RET).

The valve body also receives the filter by-pass oil at port (5) and combines it with the oil from both pressure regulators. The combined oil is directed out the return port (RET) to the return filter and back to the PTO reservoir or the lubrication pump.

The lubrication pressure is checked at the diagnostic test port (20). The lubrication oil is supplied from the lubrication pump, which discussed later in this section.

NOTE: *The screen and orifice provide for an air bleed on initial start up at the plant or if the system is drained completely. If the orifice was plugged the control pressure pump could have problems priming. It will bleed approximately 1.9 L/m (0.5 GPM) to the PTO gearbox.*

Control Pressure Schematic



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1. PTO Reservoir
2. Control Pressure Circuit Filter
3. Control Circuit Pump
4. Filter Restriction Switch
5. Filter By-Pass Port
6. Control / Lubrication Pres. Reg. Valve
7. Control Pressure Valve
8. Screen
9. Orifice
10. Drain
11. Lubrication Pressure Valve
12. Control Pressure Distribution Manifold
13. Control Pressure Test Port
14. Control Pressure Sensor
15. Return Manifold
16. To The Lubrication Pump / Tank

Control Pressure Schematic

The control circuit pump is used to supply the ground, rotor, and feeder drive hydrostatics and their associated control valves, the unloading auger and chopper/separator clutches. Excess oil is bypassed through the control valve and is returned to the return manifold. All the oil from the return manifold is directed to the lubrication pump inlet, then to the control pump inlet. These two pumps will consume all the return flow and still need more oil to pump. The control circuit pump will receive the remaining oil from the PTO gearbox reservoir/sump.

1. The control circuit pump pulls oil from the return manifold and the PTO gearbox and directs it to the control circuit filter base
2. The filter base monitors the filter restriction and by-pass the oil if needed and directs the oil to the Control/Lube Pressure regulating valve.
3. The control pressure is regulated by an adjustable relief valve and directed out to the distribution manifold. All excess oil that is bleed off by the regulating valve is directed to the return manifold and sent to the PTO gearbox and charge the lubrication and control circuit pump.
4. The distribution manifold contains a pressure sensor to monitor the Control Pressure, sending a signal to the Universal Display Plus monitor for operator information.