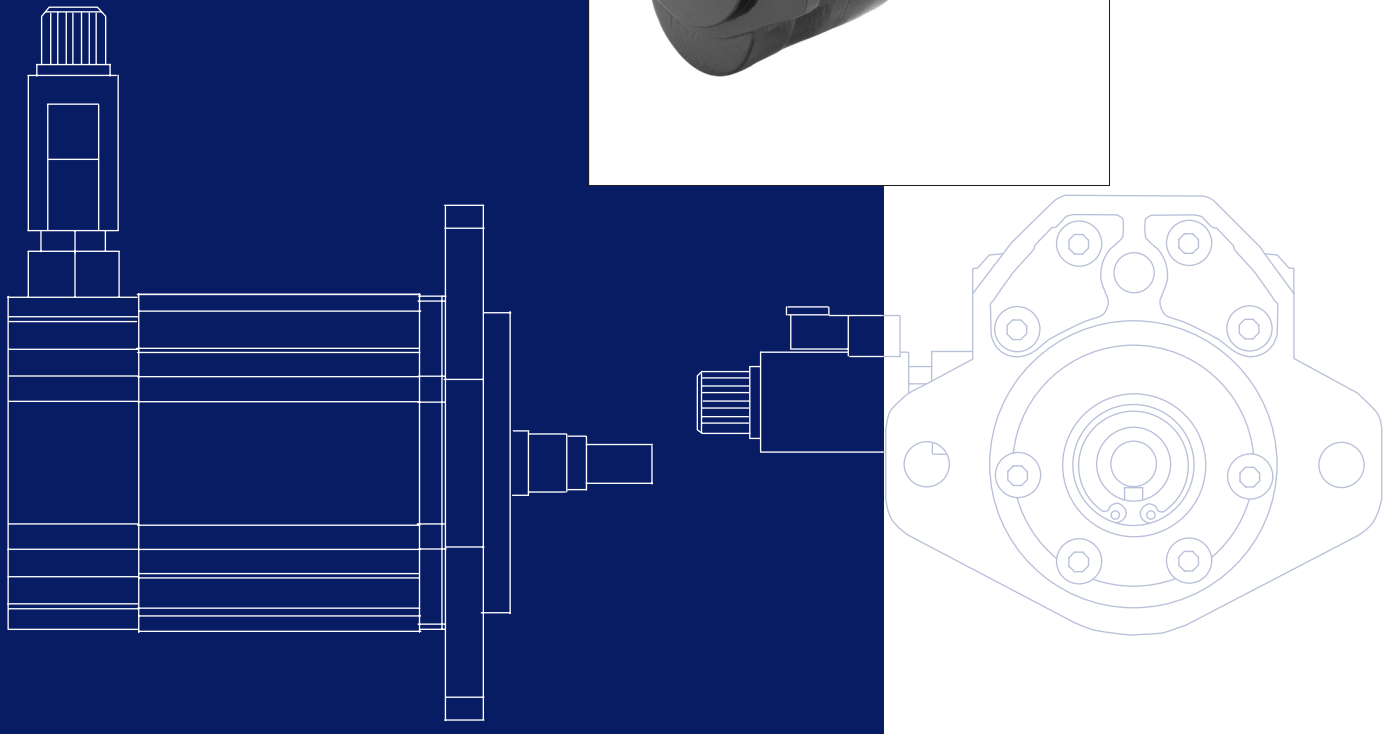
D Series
Gear Motors

Turolla OpenCircuitGear
MEMBER OF THE SAUER-DANFOSS GROUP

Service Manual



History of Revisions

Table of Revisions

Date	Page	Changed	Rev.
November 2010	all	Turolla colors	BB
March 2010	19	Added shaft seal kit number	AC
February 2010	last	Fix Osaka address	AB
April 2009	-	First edition	AA

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D Series Gear Motors
Service Manual
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D Series Gear Motors
Service Manual
Introduction

Overview

This manual includes instructions for the installation, maintenance, and minor repair of D Series Motors. It includes a description of the units and their individual components, troubleshooting information, and minor repair procedures.

A worldwide Authorized Service Center network is available for major repairs. Sauer-Danfoss Authorized Service Centers are trained by the factory and certified on a regular basis. You can locate your nearest Authorized Service Center using the distributor locator at www.sauer-danfoss.com.

Warranty

Performing installation, maintenance, and minor repairs according to the procedures in this manual does not affect your warranty. Major repairs requiring the removal of a unit's rear cover or front flange voids the warranty. Only a Sauer-Danfoss Authorized Service Center may perform major repairs. Sauer-Danfoss trains ASC and certifies their facilities on a regular basis.

Safety Precautions

Always consider safety precautions before beginning a service procedure. Protect yourself and others from injury. Take the following general precautions whenever servicing a hydraulic system.

Unintended Machine Movement

⚠ Warning

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

Flammable Cleaning Solvents

⚠ Warning

Some cleaning solvents are flammable. To avoid possible fire, do not use cleaning solvents in an area where a source of ignition may be present.

Fluid Under Pressure

⚠ Warning

Escaping hydraulic fluid under pressure can have sufficient force to penetrate your skin causing serious injury and/or infection. This fluid may also be hot enough to cause burns. Use caution when dealing with hydraulic fluid under pressure. Relieve pressure in the system before removing hoses, fittings, gauges, or components. Never use your hand or any other body part to check for leaks in a pressurized line. Seek medical attention immediately if you are cut by hydraulic fluid.

Personal Safety

⚠ Warning

Protect yourself from injury. Use proper safety equipment, including safety glasses, at all times.

Hazardous Material

⚠ Warning

Hydraulic fluid contains hazardous material. Avoid prolonged contact with hydraulic fluid. Always dispose of used hydraulic fluid according to state and federal environmental regulations.

Symbols Used in Sauer-Danfoss literature


WARNING may result in injury


CAUTION may result in damage to product or property


Reusable part


Non-reusable part, use a new part


Non-removable item


Option – either part may exist


Superseded – parts are not interchangeable


Measurement required


Flatness specification


Parallelism specification


External hex head


Internal hex head


Torx head

O-ring boss port


Tip, helpful suggestion


Lubricate with clean hydraulic fluid


Apply grease/petroleum jelly


Apply locking compound


Inspect for wear or damage


Clean area or part


Be careful not to scratch or damage


Note correct orientation


Mark orientation for reinstallation


Torque specification


Press in – press fit


Pull out with tool – press fit


Cover splines with installation sleeve


Pressure measurement/gauge location or specification

The symbols above appear in the illustrations and text of this manual. They are intended to communicate helpful information at the point where it is most useful to the reader. In most instances, the appearance of the symbol itself denotes its meaning. The legend above defines each symbol and explains its purpose.

General Description

A Sauer-Danfoss electrohydraulic proportional fan drive system consists of a combination of fixed or variable displacement open circuit hydraulic pump and an D gear motor with or without proportional relief valve or standard relief valve and check valve to control fan speed. The engine control module or Sauer-Danfoss control module drives the proportional relief valve using a Pulse-Width Modulated (PWM) signal.

Sauer-Danfoss fan drives work with engines produced by all the major North American and European engine manufacturers.

The System Circuit

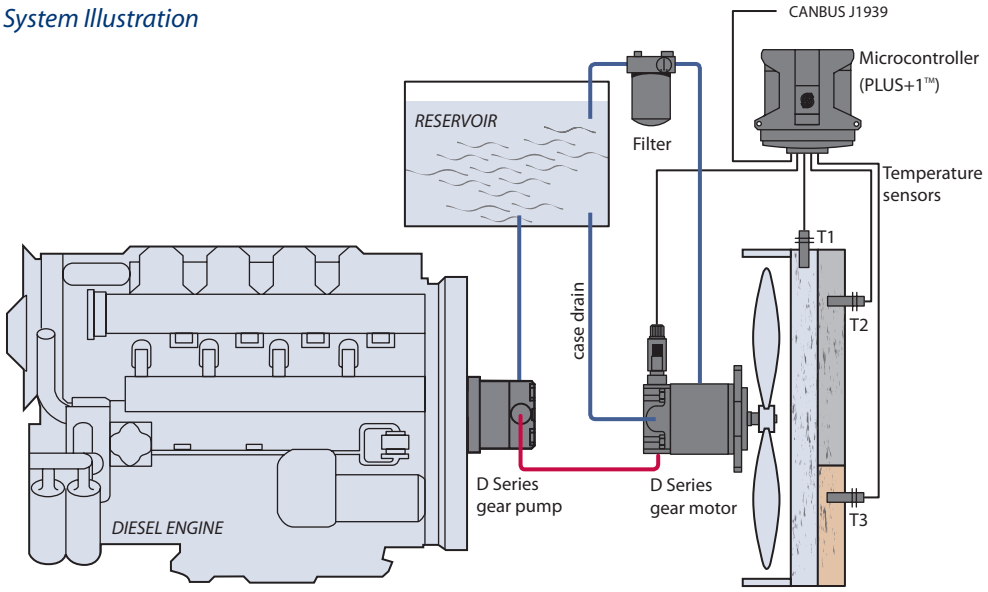
The pump receives fluid directly from the reservoir through the inlet line. The output of the pump is connected to a fixed displacement gear motor, which has an electrohydraulic proportional valve mounted in the motor's rear cover.

The valve setting determines the maximum pressure in the system by passing oil around the motor's gear set directly to the return port of the motor. The proportional valve is normally closed and requires the application of an electrical current to reduce the bypass pressure from a predetermined, customer selected, maximum pressure setting. In a hydraulic fan drive system, the predetermined maximum pressure setting determines the maximum pressure to the motor, and maximum trim speed of the fan.

Applying an electrical current to the valve allows the fan to run at speeds below its maximum trim speed, regardless of the flow supplied to the pump.

Oil exiting the motor is directed back to the reservoir through a filter and a heat exchanger. Oil returning to the reservoir must enter the reservoir well below the fluid level to minimize air entrainment. Baffles in the reservoir diffuse the oil to an acceptable level, mix it with the fluid in the reservoir, and prevent the oil from flowing immediately back to the pump inlet. The return oil remains in the reservoir long enough to allow any entrained air in the fluid to rise to the surface and dissipate.

System Illustration



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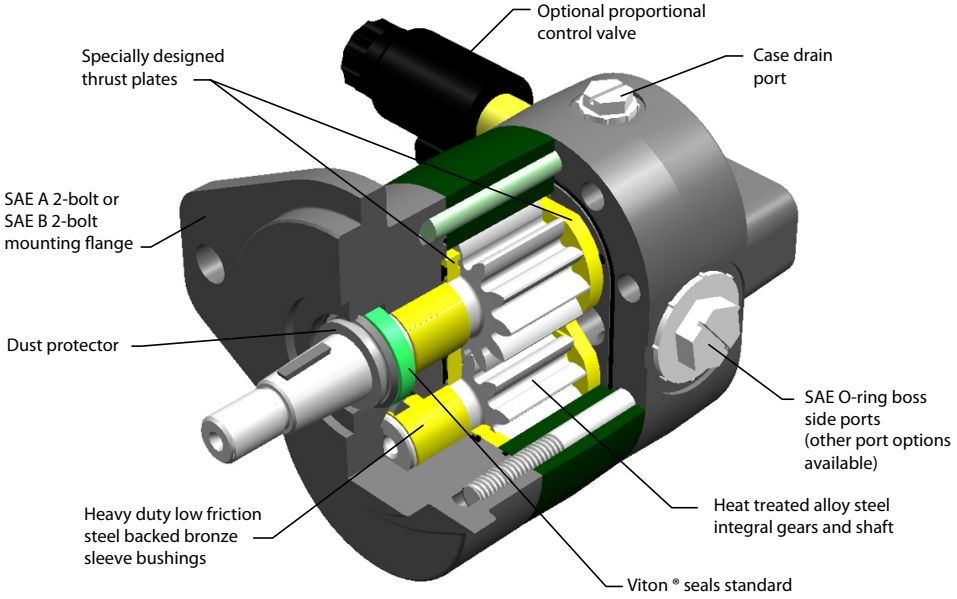
Design

Sauer-Danfoss fixed displacement open circuit gear motors convert hydraulic power into mechanical power. Supply flow determines shaft speed. Load torque results in system pressure between the pump and motor. Bushings at the front and rear of the motor support the shaft. The volume between the gear teeth and the pump body defines the displacement of the motor. A shaft seal and dust protector at the front of the motor prevents leakage where the shaft exits the motor housing.

Cutaway Drawing



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Technical Specifications

Technical data for D Motors

Ratings	Units	17	19	21	23	25	29	32	36	38	41	45
Displacement	cm^3/rev	17.0	19.0	20.5	22.5	25.4	29.0	31.8	36.1	38.0	41.0	45.0
	in^3/rev	1.04	1.16	1.25	1.37	1.55	1.77	1.94	2.20	2.32	2.50	2.75
Rated pressure	Bar	276	276	276	276	276	276	276	276	276	241	210
	psi	4000	4000	4000	4000	4000	4000	4000	4000	4000	3495	3045
Peak pressure	Bar	303	303	303	303	303	303	303	303	303	265	231
	psi	4400	4400	4400	4400	4400	4400	4400	4400	4400	3843	3350
Speed at rated pressure	maximum	3400	3400	3400	3400	3400	3400	3400	3400	3400	3000	3000
	minimum*	600	600	600	600	600	600	600	600	600	600	600
Start speed at 1000 PSI	rpm	400	400	400	400	400	400	400	400	400	400	400
Standard Weight	kg	8.53	8.66	8.80	8.94	9.07	9.38	9.53	9.84	9.93	10.16	10.43
	lb	18.8	19.1	19.4	19.7	20.0	20.7	21.0	21.7	21.9	22.4	23.0
Mass moment of inertia	$x10^{-6}$ kg•m²	127	138	146	156	172	191	206	228	239	255	276
	$x10^{-6}$ slug•ft²	94	102	107	115	127	141	152	168	176	188	204
Theoretical torque at rated pressure	N•m	65.7	73.4	79.2	87.0	98.2	112.1	122.9	139.6	146.9	138.4	132.4
	lbf•ft	48.5	54.2	58.4	64.2	72.4	82.7	90.7	102.9	108.3	102.1	97.6
Theoretical power at rated speed	kW	23.4	26.1	28.2	31.0	35.0	39.9	43.8	49.7	46.1	43.5	41.6
	hp	31.2	34.9	37.6	41.3	46.6	53.2	58.4	66.3	61.1	58.0	55.5
Case drain pressure (maximum)	Bar	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
	psi	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5

***** minimum speed at maximum pressure

Fluid Specifications

Ratings are based on operation with premium petroleum-based hydraulic fluids containing oxidation, rust, and foam inhibitors.

Parameter	Unit	Minimum	Continuous	Maximum
Viscosity	mm2/sec (cSt) [SUS]	8 [36]	10 - 100 [50 - 212]	1600 [7500]
Temperature	°C [°F]	-40 [-40]	110 [230]	115 [239]
Cleanliness		ISO 4406 Class 22/18/13 or better		
Filtration efficiency	charge filtration	$\beta_{15\text{-}20}=75(\beta_{10}\geq 10)$		

For detailed filtration information, see Sauer-Danfoss publication **520L0463** *Fluids and Filtration*. For information on biodegradable fluids see Sauer-Danfoss publication **520L0465** *Biodegradable Hydraulic Fluids*.

Overview

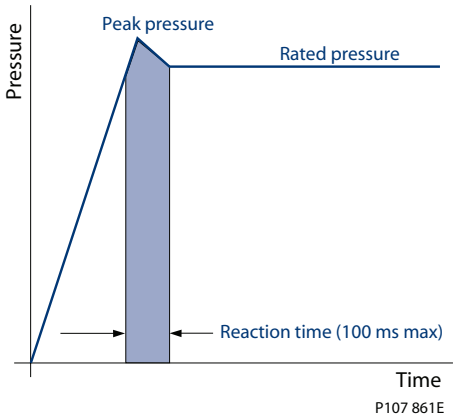
Definitions of the D Series motors operating parameters appear below. Consult Sauer-Danfoss technical support for applications running outside of these parameters.

Pressure

Peak pressure

Peak pressure is the highest intermittent pressure allowed. The relief valve overshoot (reaction time) determines peak pressure. It is assumed to occur for less than 100 ms. The illustration to the right shows peak pressure in relation to rated pressure and reaction time (100 ms maximum).

Pressure vs. time



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Rated pressure

Rated pressure is the average, regularly occurring operating inlet pressure that should yield satisfactory product life. The maximum machine load at the motor shaft determines rated pressure.

System pressure

System pressure is the differential between the inlet and outlet ports. It is a dominant operating variable affecting hydraulic unit life. High system pressure, resulting from high load at the motor shaft, reduces expected life. System pressure must remain at, or below, rated pressure during normal operation to achieve expected life.

Back pressure

Back pressure is the average, regularly occurring operating outlet pressure that should yield satisfactory motor life. The hydraulic load demand downstream of the motor determines the back pressure. The Fan Drive Gear Motor can work with back pressure up to 100% of the maximum rated inlet pressure.

Case drain pressure

Case drain pressure is the regularly occurring case drain line pressure that should yield satisfactory motor life. It is recommended to design the case drain piping connecting the case drain direct to the tank in order to keep the case drain pressure as low as possible. Maximum case drain pressure allowed is 5 bar [72.5 psi].

Temperature and Viscosity

Temperature and viscosity requirements must be concurrently satisfied.
Use petroleum/mineral-based fluids.

Temperature

High temperature limits apply at the inlet port of the motor. The motor should run at or below the maximum continuous temperature.

Cold oil, generally, doesn't affect the durability of motor components. It may affect the ability of oil to flow and transmit power. For this reason, keep the temperature at 16°C [60 °F] above the pour point of the hydraulic fluid.

Minimum (cold start) **temperature** relates to the physical properties of component materials.

Continuous temperature is the temperature at or below the temperature which normal motor life can be expected.

Maximum temperature is the highest temperature that is tolerable by the machine for a transient/limited time. (Duty cycle 1% or less)

Viscosity

Minimum viscosity occurs only during brief occasions of maximum fluid temperature and severe duty cycle operation. It's the minimum acceptable viscosity to guarantee the motor life. (Duty cycle 1% or less)

Maximum viscosity occurs only during cold start at very low temperatures. It is the upper limit of viscosity that allows the motor to start.

Continuous viscosity: The viscosity range at which normal motor life can be expected.

Hydraulic Fluid

Ratings and data for gear motors are based on operation with premium hydraulic fluids containing oxidation, rust, and foam inhibitors. These fluids must possess good thermal and hydrolytic stability to prevent wear, erosion, and corrosion of internal components.

Use only clean fluid in the motor and hydraulic circuit.

! Caution
Never mix hydraulic fluids.

For more information on hydraulic fluid selection, see Sauer-Danfoss publications **520L0463** *Hydraulic Fluids and Lubricants, Technical Information*, and **520L465** *Experience with Biodegradable Hydraulic Fluids, Technical Information*.

Required Tools

You can perform the service procedures described in this manual using common mechanic's hand tools. Special tools, if required are shown. When testing system pressures, calibrate pressure gauges frequently to ensure accuracy. Use snubbers to protect gauges.

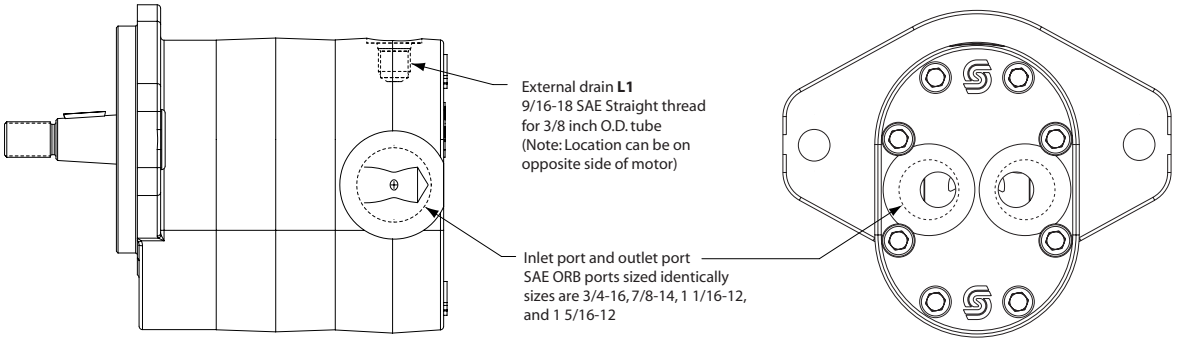
Port locations and Gauge Installation

For economical reasons, the motors do not contain any designated gauge installation ports. Use tee fittings to obtain pressure measurements. The table lists locations and gauge sizes.

D Series Motor

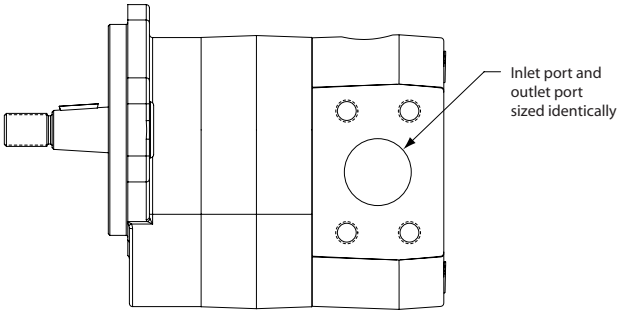
Port information

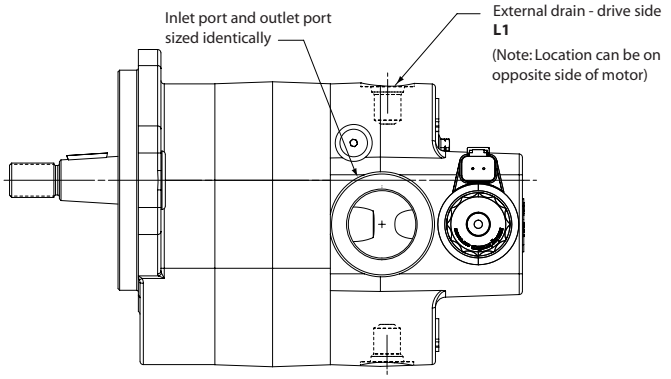
Port identifier	Size	Pressure obtained	Gauge size, bar [psi]
Inlet and outlet ports A and B	3/4-16 SAE J 1926/1 O-ring boss	System and return pressure	600 [10 000]
	7/8-14 SAE J 1926/1 O-ring boss		
	1 1/16-12 SAE J 1926/1 O-ring boss		
	1 5/16-12 SAE J 1926/1 O-ring boss		
	1 inch split flange		
	1 1/4 split flange		
Drain port L1	9/16-18 SAE	Case drain	10 [100]



Radial ports

Axial ports





Split flange ports

Fan drive ports

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Service Manual
Initial Start-Up Procedures

General

Follow this procedure when starting-up a new motor installation or when restarting an installation in which the motor has been removed.

Prior to installing the motor, inspect for damage incurred during shipping. Make certain all system components (reservoir, hoses, valves, fittings, heat exchanger, etc.) are clean prior to filling with fluid.

Start-Up Procedure

1. Ensure that the machine hydraulic oil and system components (reservoir, hoses, valves, fittings, and heat exchanger) are clean and free of any foreign material.

2. Install new system filter element(s) if necessary.

3. Install the gear motor.

4. Fill the reservoir with hydraulic fluid of the recommended type and viscosity. Use a 10-micron reservoir filler filter.

After start-up the oil level in the reservoir may drop due to filling of the system components. Check the oil level in the reservoir to maintain the full level throughout the start-up.

Caution

If reservoir is low, damage to hydraulic components may occur. Maintain sufficient oil in the reservoir at all times.

5. Use a common method to disable the engine to prevent the engine from starting. Crank the engine starter for several seconds. Do not to exceed the engine manufacturer's recommendation. Wait 30 seconds and then crank the engine a second time as stated above. This operation helps remove unwanted air from the pump outlet line and lubricates the gear motor prior to engine start up. Refill the reservoir to recommended full oil level.

6. Enable engine to start. Start the engine. Let the engine run for a minimum of 30 seconds at low idle to allow the air to work itself out of the system. Check for leaks at all line connections and listen for cavitation.

Caution

Cavitation damages hydraulic components. Take steps to avoid air entrainment in the system.

7. After initial air removal and ensuring the hydraulic reservoir oil level is correct, raise the engine speed enough to increase fan speed to a moderate level but not enough to open the bypass relief valve.

8. With the engine at high rpm disconnect the PWM wire or a sensor to ensure the motor is going to full speed.

9. Check that the reservoir is full. The motor is now ready for operation.

Recommendations

Gear motors are manufactured using a process known as cut-in, during which the gears, motor body, and bearing blocks are allowed to establish a unique relationship to each other. Opening a motor and replacing components is not recommended. Removal or replacement of some internal components will modify their critical dimensions. Because motors are cut-in at a specific pressure to ensure maximum efficiency, removal or replacement of internal components may be detrimental to motor efficiency. Motor conversions are not allowed.

To ensure optimum life, perform regular maintenance of the fluid and filter. Contaminated fluid is the main cause of unit failure. Take care to maintain fluid cleanliness when servicing.

Check the reservoir daily for proper fluid level, the presence of water, and rancid fluid odor. Fluid contaminated by water may appear cloudy or milky or free water may settle in the bottom of the reservoir. Rancid odor indicates the fluid has been exposed to excessive heat. Change the fluid immediately if these conditions occur. Correct the problem immediately.

Inspect vehicle for leaks daily.

Change the fluid and filter per the vehicle/machine manufacturer's recommendations or at these intervals:

Fluid and filter change interval

Reservoir type	Recommended oil change interval
Sealed	2000 hours
Breather	500 hours

Change the fluid more frequently if it becomes contaminated with foreign matter (dirt, water, grease, etc.), or if the fluid is subjected to temperature levels greater than the recommended maximum.

Dispose of used hydraulic fluid properly. Never reuse hydraulic fluid.

Change filters whenever the fluid is changed or when the filter indicator shows that it is necessary to change the filter. Replace all fluid lost during filter change.

Fan Speed Locked High at High Engine Speed (cold conditions)

To determine minimum fan speed at high engine rpm, connect coil to battery voltage to lock coil in open position. Follow steps 1 - 3. If fan is still not operating properly, follow steps 4 - 5.

Item	Description	Action
1. Wire disconnected or shorted	Any wire on the controller, switches, or temperature sensors that is disconnected, cut, or shorted will lock the fan to full speed.	Re-connect wires or re-wire the wiring harness.
2. Faulty electronics	The control module is not sending a current signal to the solenoid. No feel of magnetics on proportional relief valve coil.	Replace the control module. Consult engine repair manual; verify 12 or 24 VDC is going to the coil.
3. Faulty input signal to control module (sensors, switches, PWM signal)	Sensors either not functioning properly or not properly engaged in mounting. Improper or No PWM signal from engine.	Replace or re-mount sensor. Determine why engine is sending faulty signal and fix. Verify 12 or 24VDC going to controller. Check for 5VDC across sensors.
4. Faulty valve	Valve is stuck in closed position.	Replace valve or complete motor assembly.
5. Faulty solenoid coil.	Coil is either shorted or open. No feel of magnetics on coil	Replace coil. Torque coil nut to 4 to 6 N•m [3 to 4.5 lbf•ft].

High Stand-by Fan Speed (cold conditions)

Item	Description	Action
Blockage in main valve flow passages	Blockage in valve flow passages will increase fan speed and system pressure.	Replace valve. Torque to 45 N•m [33 lbf•ft]. Torque coil nut to 4 N•m to 6 N•m [3 to 4.5 lbf•ft].
Faulty electronics, sensor bad or disconnected, PWM signal missing.	Controller is not sending full current signal to the solenoid. Sensor bad or disconnected, PWM signal missing	Replace bad sensor or connect wire. Determine reason for missing PWM signal. Replace the controller.
Faulty solenoid coil.	Coil is either shorted or open. No feel of magnetics on coil	Replace coil. Torque coil nut to 4 to 6 N•m [3 to 4.5 lbf•ft].

Fan Speed Not Controlled by Current to Coil

Item	Description	Action
Fan speed proportional to engine speed at all times	Blocked or stuck valve causes fan speed to be proportional to engine speed at all times.	Replace valve. Torque to 45 N•m [33 lbf•ft]. Torque coil nut to 4 N•m to 6 N•m [3 to 4.5 lbf•ft]

Fan Does Not Turn

Item	Description	Action
Not enough flow through motor.	If engine is left at idle at start-up of machine, there is not enough flow or pressure to turn fan motor.	Rev engine a couple times to get flow through motor. If the fan begins to turn, and continues to turn when the engine returns to idle, the pump and motor are OK.
Delta pressure across proportional valve too low	Delta pressure across motor ports should measure approximately 50 psi minimum at engine idle.	Measure delta pressure across motor ports. If it is greater than 150 psi and the motor does not turn, replace motor. If the delta pressure is between 50 psi and 150 psi and the motor does not turn, rev the engine a couple of times to get flow through the motor and check current to the solenoid. If current is greater than recommended maximum, adjust controller parameters to reduce the current. If increasing the engine rpm makes the fan turn, adjust controller parameters to reduce the current. Consult Sauer-Danfoss controller documentation. Consult engine service manual.
	Check motor case drain flow	Is motor case drain flow greater than 1.2 l/min [US 0.3 gal/min] **YES** - Replace motor. **NO** - Check proportional relief valve
	Check proportional relief valve	Is there 12 or 24 VDC to coil. **NO** - Find out why and repair. **YES** - Disconnect coil.
	Check fan speed	Did fan speed increase? **NO** - Replace proportional relief valve. **YES** - Check controller
	Replace proportional relief valve	After replacing proportional relief valve, is there adequate fan speed?
	Check pump	**YES** - System is OK. **NO** - With solenoid disconnected, measure and record system pressure and fan speed at increasing engine speed (i.e.700, 1200, 1500, 1800, full throttle).
	Check fan speed and system pressure	Is the fan speed and system pressure increasing with engine speed? **NO** - Replace pump.
Inadequate fan system flow coming from pump	If pump or motor lose efficiency, there may not be enough flow to move the motor	Disconnect a sensor wire or battery wire to controller, if the fan does not turn, check motor bearing flow out of motor case drain line (maximum 1.2 l/min [US 0.3 g/min]) and / or with the solenoid disconnected verify system pressures and fan speed while increasing engine speed. If the fan does not turn replace the pump, if it does turn, Repeat troubleshooting chart from the top of this chart. Check engine idle.
	System with Priority Flow Divider (PFD) for steering may be sending too much flow to steering	Check flow to steering unit. Replace pump.
Fan system flow coming from pump is bypassing the motor	Proportional relief valve in motor is stuck in open position	Disconnect solenoid coil. Fan should go to full speed. If fan does not go to full speed, replace relief valve.

Fan Too Slow at High Engine rpm

Disconnect coil to send fan to maximum speed at high engine rpm. If problem remains, follow steps 1 thru 8 below. If fan attains maximum speed, follow step 9 .

Item	Description	Action
1. Low oil level in reservoir	Not enough oil to maintain full system flow.	Fill reservoir to recommended level. Consult operator's manual.
2. PRV set to wrong crack pressure	PRV may be holding pressure below specifications. The PRV controls the maximum speed of the motor.	Replace PRV with one set to appropriate crack pressure. Pressure setting is not externally adjustable.
3. Faulty PRV	Fan runs at low engine speed at all times	Replace valve. Torque to 45 N•m [33 lbf•ft] Torque coil nut to 4 N•m to 6 N•m [3 to 4.5 lbf•ft]
4. Hydraulic oil temperature too high	High oil temperature decreases viscosity and affects efficiency.	Maintain hydraulic oil at normal operating temperatures (110°C [230°F] max). Ensure cooler is operating properly. High oil temperature can also be caused by aeration (see below).
5. Aeration of oil	Air in system decreases efficiency of units and controls. Noise, foaming, and hot oil are signs of aeration.	Find location where air is entering into the system and fix. Check inlet line to pump and repair any leaks. Fill reservoir to recommended level. Consult operator's manual.
6. Damaged motor, low system pressure	Proportional relief valve spool sticking open may prevent full flow from going through motor. Not enough flow from pump.	Measure system pressure between pump and motor. Vary engine speed low to high. Does system pressure change? Check motor case drain flow. Should be maximum 1.2 l/min [US 0.3 gal/min]. If case drain flow exceeds limits, replace motor.
7. Inadequate fan system flow coming from pump.	If pump loses efficiency, it may not produce enough flow to turn the motor. A damaged pump may provide flow when oil is cold and viscous but may not when oil warms up. Systems equipped with steering PFD may be sending too much flow to steering. May be sending too much flow to steering.	Compare performance when oil is hot and cold. Measure flow entering motor. Measure steering flow. Replace pump if flow is insufficient.
8. Inadequate flow coming from the reservoir due to restrictions	Restriction in inlet of the pump, Strainer or filter in the reservoir plugged.	Clean strainer or replace filter in reservoir. Check inlet vacuum at pump inlet. Maximum Inlet vacuum 0.7 bar absolute [10 inches Mercury vacuum]
9. Faulty electronic control module.	The control module is sending too high of a current signal to the solenoid.	Readjust or replace the control module. Verify control module is working properly. Troubleshoot control module according to manufacturers instructions. Replace control module if necessary.

Improper Modulation of Control Module

Item	Description	Action
Faulty input signal to control module (sensors, switches, PWM signal)	Sensors either not functioning properly or not engaged into mounting properly. Improper PWM signal from engine.	Replace or re-mount sensor. Determine why engine is sending faulty PWM signal and fix.
Faulty electronic control module	Control module sending improper current to solenoid.	Consult engine service manual. Replace the control module.
Faulty proportional relief valve	Valve not shifting properly with current signal from control module. Verify proper current signal to valve.	Replace valve assembly. Torque to 45 N•m [33 lbf•ft]. Torque coil nut to 4 N•m to 6 N•m [3 to 4.5 lbf•ft].

System Noise

Item	Description	Action
Aeration of the oil	Low oil in reservoir Air in system decreases efficiency of units and controls. Air in system is indicated by excessive noise in pump, foaming in oil, and hot oil.	Find location where air is entering into the system and fix. Problem is often found in inlet line to pump. Fill reservoir
Cold oil	Low oil temperature increases viscosity and can cause cavitation, resulting in system noise.	Allow the oil to warm up to its normal operating temperature with engine at idle speed.
Fan hitting shroud.	Check fan shroud and hydraulic motor mountings.	Consult owner's manual for proper fastener torques.

Hydraulic System Operating Hot

Item	Description	Action
Low oil level in reservoir and low supply to pump.	Insufficient amount of hydraulic fluid will not meet the cooling demands of the system.	Fill the reservoir to the proper level.
Faulty or blocked heat exchanger (if equipped).	If the heat exchanger fails, or becomes obstructed, it may not meet the cooling demands of the system.	Ensure that heat exchanger is receiving adequate air flow and that the heat exchanger is in good operating condition. Repair or replace as necessary.
Faulty PRV	If a system relief valve becomes unseated for an extended period of time or fails for any other reason, the system could become overheated.	Replace malfunctioning relief valves and verify that the loads on the machine are not excessive. Torque to 45 N•m [33] Torque coil nut to 4 N•m to 6 N•m [3 to 4.5 lbf•ft]
Fan system flow coming from pump is bypassing the motor	Proportional relief valve in motor is stuck in open position	Disconnect solenoid coil. Fan should go to full speed. If fan does not go to full speed, replace relief valve.
	Proportional valve installed into end cover supply port.	Install valve into endcover port on return side of motor

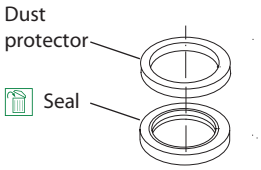
Leaking Motor Shaft Seal

Item	Description	Action
Excessive pressure in case drain line.	Case drain line (from rear of motor) restricted. No other return lines are tied into motor case drain.	Verify case drain line is routed directly to reservoir with no restrictions. Maximum case pressure limit is 5 bar [72 psi]. Replace motor.

Shaft Seal Replacement

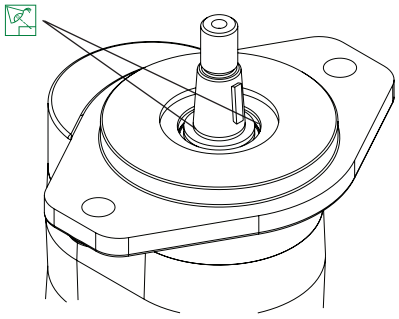
Tools needed; snap ring pliers, hammer, awl, (2) sheet metal screws, (2) wire cutting pliers, installation sleeve (PVC tube approximately 0.5 mm [0.02 in] smaller than flange hole diameter), wide cellophane packaging tape, and grease.

Replacing the shaft seal



Remove the shaft seal

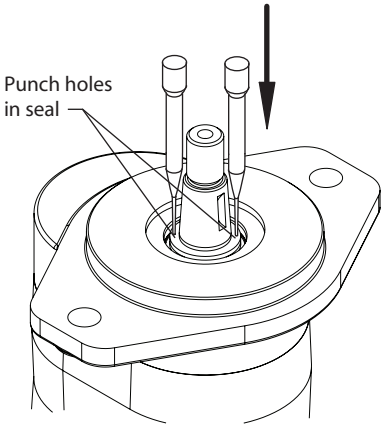
1. Remove key from shaft.
2. Clean shaft area of all rust, dirt and grime.
3. Use a needle nose pliers or sharp screwdriver to remove the dust protector.


E101 262

Use the following instructions to carefully pry out the shaft seal.

4. Using a sharp punch or awl, punch two holes in the shaft seal.

Do not drill holes. Drilling holes produces contamination.



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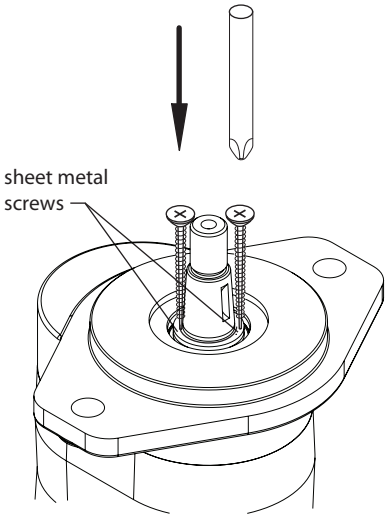
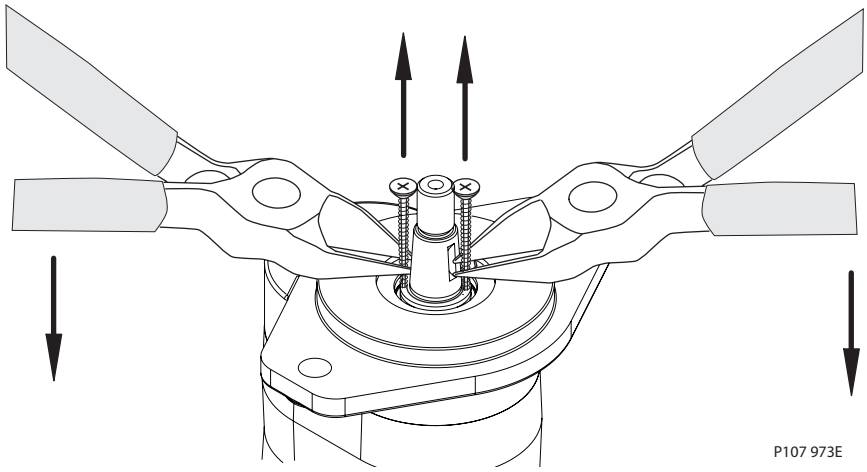
5. Turn two sheet metal screws, one or two turns, into the seal.



Shaft Seal Replacement (continued)



6. Using side cutting wire pliers, remove the seal by prying it out as shown. Take care not to damage the shaft.

7. Discard the seal.

Inspect the components

Inspect the new seal, the motor housing seal bore, and the sealing area on the shaft for rust, wear, and contamination. Polish the shaft and clean the housing if necessary, being careful not to allow contamination to fall into the motor.

Install the new shaft seal

Seal Kit

Kit P/N	11078459

1. Cover the shaft keyway and exposed threads with a shaft cover or packaging tape to protect the shaft and seal during installation.

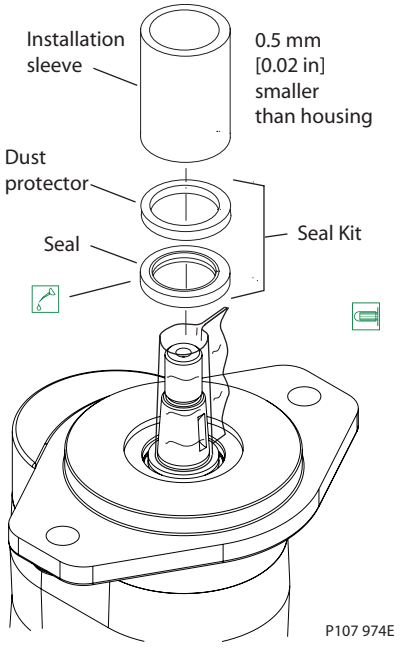
2. Lubricate the inside of the seal.

3. Start the shaft seal into the housing with the cupped side of the seal facing the motor.

4. Use an installation sleeve to press the seal slowly in place.

5. Stop when the seal is seated..

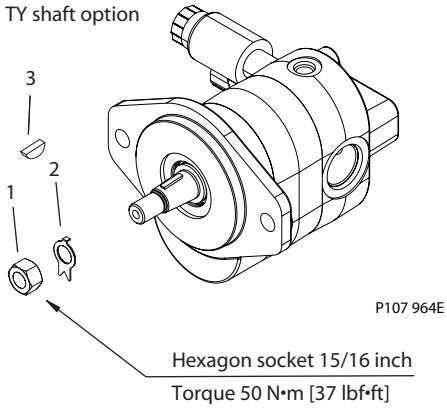
6. Using the installation sleeve, install the dust protector until it is flush with the motor.



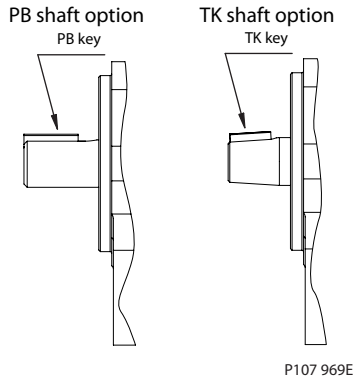
7. Re-install the key into the shaft. Ensure the top of the key does not interfere with the bottom of the keyway in the fan hub when the fan is installed.

8. Thoroughly inspect the operation of the motor after it is installed to ensure no leakage occurs.

Shaft Repair Parts



Item	Description	Part number
1	Shaft nut (5/8-18 UNF)	163M2013
2	Locking washer	163M2428
3	Key	29620-17



Description	Part number
PB Key	163M4001
TK Key	163M4007

Coil Replacement

Refer to the valve drawings on the following pages for wrench sizes and torque specifications.

Remove the coil

1. Disconnect the electrical connection from the coil.
2. Remove the plastic nut holding the coil to the valve.
3. Remove the O-ring and coil.

Install the coil

1. Install new coil.
2. Install O-ring on the valve stem.
3. Install the plastic nut. Torque coil nut to 4 N•m to 6 N•m (3 to 4.5 lbf•ft)

⚠ Warning

Do not overtorque plastic nut. Overtoruque will damage valve.

4. Install the wire connector to the coil.

Valve Replacement

Remove the valve

Remove the valve from the motor.

Install the valve

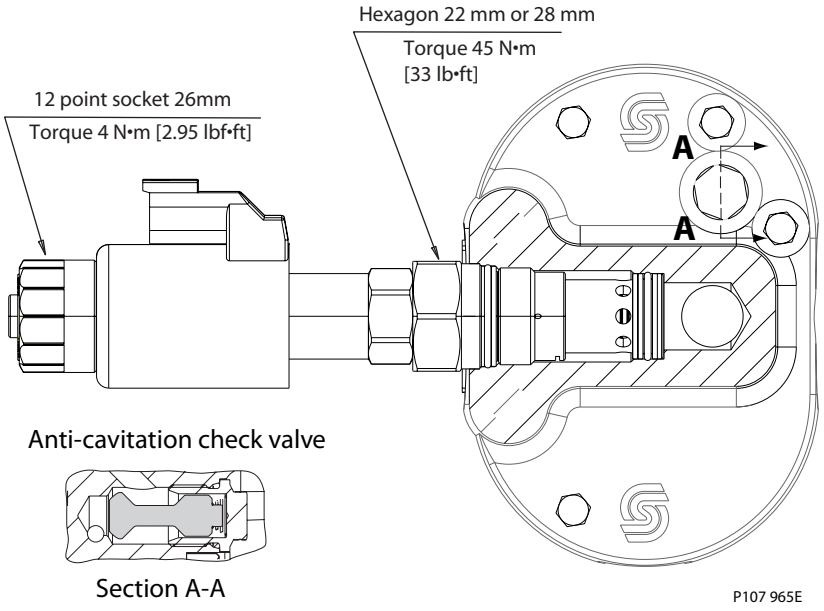
Install new valve into motor. Torque to 45 N•m [33 lbf•ft].

⚠ Warning

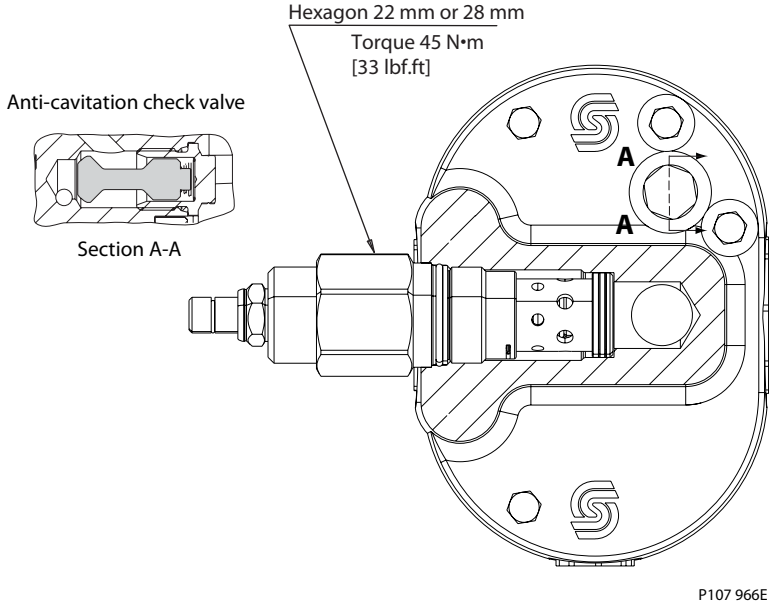
Do not overtorque valve. Overtoruque will damage valve.

Valves

Proportional Relief Valve

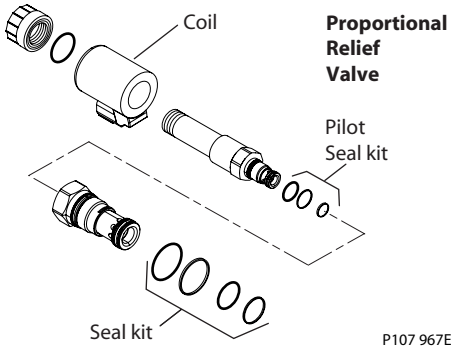


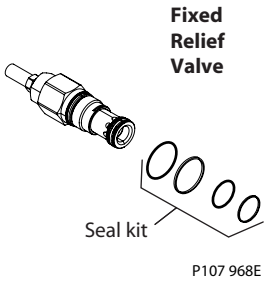
Fixed Relief Valve



Valves (continued)

Valve Repair Parts





Description	Part number
Coil 12 VDC, **P1**, **P2**	11057054
Coil 24 VDC, **P3**, **P4**	11057053
Seal Kit, **P2**, **P4**	11057060
Seal Kit, **P1**, **P3**	11057061
Pilot seal kit	11057166

Description	Part number
Seal Kit, **F**	11057062
Seal Kit, **G**	11057063

Model Code example:

Fan drive motor:

A, **B**, **C**, **D**, **E** *12 VDC proportional relief valve, 25 GPM or less at 172 Bar curve,* **F**.

A	B1	B2	C	D1	D2	E1	E2	F	G	J	K
□□□□–	□□□□–	□□–	□□□□–	P	1	□□–	□□□□–	□□□□–	□□–	□□□

Above example shows a 12 volt proportional relief valve (P1) in the E1 position of the model code.

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