DESIGN GUIDE



This manual contains important warnings and information. READ AND KEEP FOR REFERENCE.



309015

Rev. A

First choice when quality counts.™

Automatic Grease Lubrication Systems

For Mobile Mining Equipment

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Description

Graco Automatic Lubrication System

Refer to Fig. 1. Graco's single-line parallel automatic lubrication system offers positive displacement lubrication measurement for multiple lubrication points. This system was designed for use on mobile mining equipment, specifically haul trucks. At the heart of this system is the Graco Fireball pump, the most durable pump in the industry. The pump provides the lubricant pressure needed to activate the automatic lubrication system.

The entire system consists of a pump module, injectors and system controls. The pump module provides the system inherent pressurization and venting cycles to activate the injectors. The injectors measure precise amounts of grease to be dispensed to individual bearing points during an automatic lube cycle. The controls consist of a timer and a solenoid operated valve which turn the pump on at the required lubrication intervals.

This System Design Guide provides general system information to aid and assist the user in designing, installing and operation of an automatic lubrication system to meet the lubrication requirements of the designated equipment.

Description (cont.)



Product Warnings and Cautions

Warning Symbol

WARNING

This symbol alerts you to the possibility of serious injury or death if you do not follow the instructions.

Caution Symbol



This symbol alerts you to the possibility of damage to or destruction of equipment if you do not follow the instructions.

	EQUIPMENT MISUSE HAZARD
	Equipment misuse can cause the equipment to rupture or malfunction and result in serious injury.
INSTRUCTIONS	This equipment is for professional use only.
	• Read all instruction manuals, tags, and labels before operating the equipment.
	• Use the equipment only for its intended purpose. If you are uncertain about usage, call your Graco distributor.
	• Do not alter or modify this equipment. Use only genuine Graco parts and accessories.
	Check equipment daily. Repair or replace worn or damaged parts immediately.
	• Do not exceed the maximum working pressure of the lowest rated system component.
	• Use fluids and solvents which are compatible with the equipment wetted parts. Refer to the Tech-nical Data section of all equipment manuals. Read the fluid and solvent manufacturer's warnings.
	Handle hoses carefully. Do not use hoses to pull equipment.
	 Route hoses away from traffic areas, sharp edges, moving parts, and hot surfaces. Do not expose Graco hoses to temperatures above 82°C (180°F) or below –40°C (–40°F).
	Do not lift pressurized equipment.
	• Comply with all applicable local, state, and national fire, electrical, and safety regulations.

• Be sure breather is not plugged before filling reservoir.

Product Warnings and Cautions (cont.)

WARNING



INJECTION HAZARD

Fluid from the dispensing valve, leaks or ruptured components can inject fluid into your body and cause extremely serious injury, including the need for amputation. Fluid splashed in the eyes or on the skin can also cause serious injury.

- Fluid injected into the skin might look like just a cut, but it is a serious injury. Get immediate medical attention.
- Do not put your hand or fingers over the end of grease outlet.
- Do not stop or deflect leaks with your hand, body, glove or rag.
- Follow the **Pressure Relief Procedure** in your separate pump manual if the injector clogs and before you clean or service this equipment.
- Tighten all fluid connections before you operate this equipment.
- Check the hoses, tubes, and couplings daily. Replace worn or damaged parts immediately. Do not repair high pressure couplings; you must replace the entire hose.
- Fluid hoses must have spring guards on both ends to protect them from rupture caused by kinks or bends near the couplings.



TOXIC FLUID HAZARD

Hazardous fluid or toxic fumes can cause serious injury or death if splashed in the eyes or on the skin, inhaled, or swallowed.

- Know the specific hazards of the fluid you are using.
- Store hazardous fluid in an approved container. Dispose of hazardous fluid according to all local, state and national guidelines.
- Always wear protective eyewear, gloves, clothing and respirator as recommended by the fluid and solvent manufacturer.

Product Warnings and Cautions (cont.)

A WARNING



FIRE AND EXPLOSION HAZARD

Improper grounding, poor ventilation, open flames or sparks can cause a hazardous condition and result in a fire or explosion and serious injury.

- Ground the equipment and the object being dispensed to. See **Grounding** in your separate pump manual.
- If there is any static sparking or you feel an electric shock while using this equipment, **stop dispensing immediately.** Do not use the equipment until you identify and correct the problem.
- Provide fresh air ventilation to avoid the buildup of flammable fumes from solvents or the fluid being dispensed.
- Keep the dispensing area free of debris, including solvent, rags, and gasoline.
- Do not smoke in the dispensing area.

MOVING PARTS HAZARD

Moving parts, such as the air motor piston, can pinch or amputate your fingers.

- Do not operate the pump with the air motor plates removed.
- Do not insert fingers in overflow port when filling reservoir.
- Keep clear of all moving parts when you start or operate the pump.
- Before you service this equipment, follow the **Pressure Relief Procedure** in your separate pump manual to prevent the equipment from starting unexpectedly.

Automatic Lubrication Definitions

Definitions

"Pump on" time

The duration that the pump has power supplied to it. This is controlled by the timer. All injectors must fully dispense within this time frame in a properly designed system.

"Pause interval" time

The duration between automatic lubrication cycles. This is also controlled by the timer. All injectors must fully vent within this time frame in a properly designed system.

Vented

The state of the injector after pressure is relieved at the inlet. It also means the measured amount of grease is fully transferred to the dispensing chamber of the injector.

Main supply line

The line that supplies lubricant from the pump module to the injector groups or banks.

Branch supply line

The line that branches off the main supply line to feed individual injector banks. The branch supply line prevents system venting problems in cold weather by minimizing the amount of grease vented through the injector manifolds.

Feed line

The line that supplies lubricant from the injectors to the bearings.

System Components

1. Controls

Timer



The timer is the "brain" of the automatic lube system. It requires a constant 24 volt power supply. Its function is to supply and remove power from the pump module via a solenoid valve, at predetermined time intervals. The timer must be programmed for "pump on" and "pause interval" settings.

Solenoid valve



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The solenoid valve is controlled by the timer. The function of the solenoid valve is to turn the power supply on for the pump module. The solenoid operates on a 24 volt signal received from the timer. The solenoid also has a manual override button to activate the pump module.

Pressure switch (optional)



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A pressure switch can be installed in an automatic lube system for additional system control and safety. A normally open pressure switch when properly connected to the timer and installed so that it monitors supply line pressure will turn the pump module off upon detection of a preset pressure, normally 2500 psi (172 bar, 17 MPa). Two advantages of a pressure switch are:

- It can monitor system for faults.
- It can turn the power supply to the pump off when a preset pressure has been reached.
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System Components

2. Pump Module



Pump

The pump provides the necessary lubricant pressure needed to operate the injectors.

Vent valve



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The vent valve relieves the lubricant pressure back to the reservoir at the end of each lubrication cycle.

Pressure relief



The pressure relief valve is a safety item to prevent over-pressurization of the system. **Never** operate your automatic lube system without a pressure relief valve. The pressure relief valve is factory set at 4000 psi and is nonadjustable.

Reservoir

The primary function of the reservoir is to contain the lubricant intended for later dispensing into the bearings. The reservoir has several features. The vent line is external to the reservoir to allow for trouble free follower plate operation. The fill port of the reservoir is at the bottom of the reservoir and is specifically designed such that it is impossible to fill the reservoir and later realize the follower plate is at the bottom of the reservoir instead of at the top where it belongs. The overflow port is located above the fill port and can be opened to determine when the reservoir is full during filling.

Follower plate

The function of the follower plate is to prevent grease tunneling and pump cavitation.

System Components (cont.)

3. Injectors

Injectors

The function of the injector is to measure a preset amount of lubricant for dispense into bearing points for each automatic lubrication cycle. Injector outputs can be combined for a common bearing point with a large grease requirement but the output for a single injector can not be split into multiple bearing points. The injectors come in various mounting configurations as shown below. For details of injector operation, refer to page 21.

Manifold mounted



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1 to 5 injectors mounted on a common inlet manifold. Up to 5 injector outputs can be combined for dispense to a common bearing point with a large grease requirement using a cross over kit.

Single Npt



Single injector with a 3/8" male npt fitting

Replacement



Single injector used for replacing old worn out injectors onto installed manifolds.

System Components (cont.)

4. Lubricant

Graco suggests the use of the following lubricant grades for the given temperature ranges.

NLGI #1 (0° F to +130° F) NLGI #0 (-40° F to +30° F)

5. Distribution Lines

Main supply line

Line that supplies lubricant from the pump module to the injector groups or banks.

Branch supply line

Line that branches off the main supply line to feed individual injector banks. Prevents system venting problems in cold weather by minimizing the amount of grease vented through the injector manifolds.

Feed line

Line that supplies lubricant from injectors to bearings.

System Design

Outlined below is a simple five step method for designing a single line parallel automatic lubrication system for a haul truck.

- Step 1: Identify points for lubrication
- Step 2: Determine grease volume requirement for each bearing size
- Step 3: Determine number of injectors per point, injector setting and timer setting
- Step 4: Determine supply line and feed line plumbing requirements
- Step 5: Determine bill of material

Step 1: Identify points for lubrication.

First, make a rough sketch of the equipment being lubricated. Number the points to be lubricated and put these points into groups. The groups will be made up of a number of lubrication points where feed lines can be connected from a central location.

Hint: Group points with common locations together. Most haul truck systems have three groups of injectors. One at the rear of the truck for the shock absorber joints and box joints, and one on each side of the truck located near the front wheels. These groups typically lubricate the steering joints and front struts of the truck.

Enter the points on the System Worksheet (page 13) with the number and brief description. Indicate whether the bearing is a flat, journal, or roller bearing.

Step 2: Determine grease volume requirement for each bearing size

Enter the bearing dimensions on the System Worksheet. Use the appropriate Volume Chart (page 14) to determine the bearing lubricant volume for each point based on the bearing dimension. Record the volume on the System Worksheet.

NOTE: The Volume Charts use an assumption of a 0.002" film thickness of lubricant to calculate the bearing lubricant volume.

Step 3: Determine number of injectors per point, injector setting and timer setting

Using the Injector and Timer Setting Chart on page 15, place a check mark in the corresponding bearing volume for each lube point from the calculations in the System Worksheet. Round up to the next higher volume.

After you have recorded all of the points of lubrication on the Injector and Timer Setting Chart, you will be able to select a time setting. From the chart, notice that as you extend the timer pause interval you may need more than one injector for a single point of lubrication. Therefore, select a time setting where all the points can be serviced with the minimum number of injectors.

NOTE: If you have a few points that are far to the right on the chart, you can use more than one injector to lubricate each of those points. If you have a point that does not make the chart on the left side, you can set the injector to the minimum setting and slightly over-lubricate that point. Or, you may decide the point is so small that you do not include it in the system.

Once you have selected a time setting, record it on the System Worksheet. Based on the selected time setting, determine the number of injectors per point of lubrication and the injector setting. Record this information on the System Worksheet.

SYSTEM WORKSHEET

Fill out the worksheet below.

Use the appropriate Bearing Lubricant Volume Chart (page 14) to determine the bearing lubricant volume.

Use the Injector and Timer Setting Chart (page 15) to fill out the injector settings and timer settings.

Lube	Description	Jou	rnal	FI	at	Ro	ller	Results from Tables			
Pt		Length (in.)	Dia. (in.)	Length (in.)	Width (in.)	Shaft Dia. (in.)	No. of Rows	Vol- ume (cu. in)	No. of Inj.	Inj. Setting	
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											
31											
32											
33											
34											
35											

Fill in the pause interval here: _____ minutes.

JOURNAL BEARING LUBRICANT VOLUME CHART

NOTE: Tabulated values are in cubic in. (in.3)



D = Dia.												L = Len	gth (in.)										
(in.)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	0.01	0.01	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.06	0.07	0.08	0.08	0.09	0.09	0.10	0.11	0.11	0.12	0.13	0.13	0.14	0.14	0.15
2	0.01	0.03	0.04	0.05	0.06	0.08	0.09	0.10	0.11	0.13	0.14	0.15	0.16	0.18	0.19	0.20	0.21	0.23	0.24	0.25	0.26	0.28	0.29	0.30
3	0.02	0.04	0.06	0.08	0.09	0.11	0.13	0.15	0.17	0.19	0.21	0.23	0.25	0.26	0.28	0.30	0.32	0.34	0.36	0.38	0.40	0.41	0.43	0.45
4	0.03	0.05	0.08	0.10	0.13	0.15	0.18	0.20	0.23	0.25	0.28	0.30	0.33	0.35	0.38	0.40	0.43	0.45	0.48	0.50	0.53	0.55	0.58	0.60
5	0.03	0.06	0.09	0.13	0.16	0.19	0.22	0.25	0.28	0.31	0.35	0.38	0.41	0.44	0.47	0.50	0.53	0.57	0.60	0.63	0.66	0.69	0.72	0.75
6	0.04	0.08	0.11	0.15	0.19	0.23	0.26	0.30	0.34	0.38	0.41	0.45	0.49	0.53	0.57	0.60	0.64	0.68	0.72	0.75	0.79	0.83	0.87	0.90
7	0.04	0.09	0.13	0.18	0.22	0.26	0.31	0.35	0.40	0.44	0.48	0.53	0.57	0.62	0.66	0.70	0.75	0.79	0.84	0.88	0.92	0.97		
8	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.96					
9	0.06	0.11	0.17	0.23	0.28	0.34	0.40	0.45	0.51	0.57	0.62	0.68	0.74	0.79	0.85	0.90	0.96							
10	0.06	0.13	0.19	0.25	0.31	0.38	0.44	0.50	0.57	0.63	0.69	0.75	0.82	0.88	0.94									
11	0.07	0.14	0.21	0.28	0.35	0.41	0.48	0.55	0.62	0.69	0.76	0.83	0.90	0.97										
12	0.08	0.15	0.23	0.30	0.38	0.45	0.53	0.60	0.68	0.75	0.83	0.90	0.98											

FLAT BEARING LUBRICANT VOLUME CHART

NOTE: Tabulated values are in cubic in. (in.3)



W = Width		L. = Length (in.)																						
(in.)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.05	0.05
2	0.00	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.04	0.05	0.05	0.06	0.06	0.06	0.07	0.07	0.08	0.08	0.08	0.09	0.09	0.10
3	0.01	0.01	0.02	0.02	0.03	0.04	0.04	0.05	0.05	0.06	0.07	0.07	0.08	0.08	0.09	0.10	0.10	0.11	0.11	0.12	0.13	0.13	0.14	0.14
4	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.06	0.07	0.08	0.09	0.10	0.10	0.11	0.12	0.13	0.14	0.14	0.15	0.16	0.17	0.18	0.18	0.19
5	0.01	0.02	0.03	0.04	0.05	0.06	0.07	80.0	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.24
6	0.01	0.02	0.04	0.05	0.06	0.07	0.08	0.10	0.11	0.12	0.13	0.14	0.16	0.17	0.18	0.19	0.20	0.22	0.23	0.24	0.25	0.26	0.28	0.29
7	0.01	0.03	0.04	0.06	0.07	0.08	0.10	0.11	0.13	0.14	0.15	0.17	0.18	0.20	0.21	0.22	0.24	0.25	0.27	0.28	0.29	0.31	0.32	0.34
8	0.02	0.03	0.05	0.06	0.08	0.10	0.11	0.13	0.14	0.16	0.18	0.19	0.21	0.22	0.24	0.26	0.27	0.29	0.30	0.32	0.34	0.35	0.37	0.38
9	0.02	0.04	0.05	0.07	0.09	0.11	0.13	0.14	0.16	0.18	0.20	0.22	0.23	0.25	0.27	0.29	0.31	0.32	0.34	0.36	0.38	0.40	0.41	0.43
10	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.30	0.32	0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.48
11	0.02	0.04	0.07	0.09	0.11	0.13	0.15	0.18	0.20	0.22	0.24	0.26	0.29	0.31	0.33	0.35	0.37	0.40	0.42	0.44	0.46	0.48	0.51	0.53
12	0.02	0.05	0.07	0.10	0.12	0.14	0.17	0.19	0.22	0.24	0.26	0.29	0.31	0.34	0.36	0.38	0.41	0.43	0.46	0.48	0.50	0.53	0.55	0.58

ROLLER BEARING LUBRICANT VOLUME CHART

NOTE: Tabulated values are in cubic in. (in.3)



No. of Rows											D = \$	Shaft D	iameter	' (in.)										
	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5
1	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.10	0.11	0.13	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.29	0.31	0.34	0.36
2	0.02	0.03	0.04	0.05	0.06	0.08	0.10	0.12	0.14	0.17	0.20	0.23	0.26	0.29	0.32	0.36	0.40	0.44	0.48	0.53	0.58	0.63	0.68	0.73

INJECTOR AND TIMER SETTING CHART

NOTE: Place a check mark for each lube point in the appropriate bearing volume column.

	Lube Point	Bearing Volume (cu. in.)																			
		0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00
	1																				
	2																				
	3																				
	4																				
	5																				
	6																				
	7																				
	8																				
	9																				
	10																				
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	28																				
	29																				
	30																				
	31																				
	32																				
	33																				
	34																				
	35																				
Timer Pause Interval	* Injectors = ne ** Turns = num	umber of t	of injecto turns fro	ors. m maxir	num set	ting.															
15 Minutos	Injectors*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WIIIIU(65	Turns**	8	8	7	7	7	6	6	6	5	5	5	4	4	4	3	3	3	2	2	1
20 Minutes	Injectors*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
	Turns**	8	8	7	7	6	6	5	5	4	4	3	3	2	2	2	1	1	0	0	4
30 Minutes	Injectors*	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
	Turns**	8	7	6	6	5	4	4	3	2	2	1	0	4	4	3	3	3	2	2	1
40 minutes	Injectors*	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	3
	Turns**	8	7	6	5	4	3	2	1	0	4	3	3	2	2	2	1	1	0	0	2
60 minutes	Injectors*	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3	3	4
	Turns**	7	6	4	3	2	0	4	3	2	2	1	0	2	2	2	1	1	0	0	1

Step 4: Determine supply line and feed line plumbing requirements

When connecting the supply line to several groups of injectors, use a branch supply line that comes off the main supply line to prevent having to vent through a number of injector manifolds. Use the same size lines for the main supply line and branch supply lines with these systems.

NOTE: Per JIC standards, copper tubing should not be used in lubricant systems.

Supply line recommendations:

- Up to 40 ft in any one direction from the pump to the furthest injector bank.
 3500 psi minimum working pressure.
 1/2 in. ID hose or 1/2 in. steel tubing (.049 wall thickness) or 3/8 in. Schedule 40 pipe.
- Up to 70 ft in any one direction from the pump to the furthest injector bank.
 3500 psi minimum working pressure.
 5/8 in. ID hose or 5/8 in. steel tubing (.049 wall thickness) or 1/2 in. Schedule 40 pipe.
- Steel tubing must be soft annealed D.O.M. welded or seamless hydraulic fluid line tubing.

Feed line recommendations:

- Up to 17 ft maximum hose length 3000 psi minimum working pressure. 1/4 in. ID hose.
- Up to 26 ft maximum hose length 3000 psi minimum working pressure. 3/8 in. ID hose.

Step 5: Determine bill of material

From the original layout sketch determine how many injectors will be required in each group. Make sure to allow for additional injectors for those lubrication points that require more than one injector. Determine the number of injector manifold assemblies required for each bank of injectors and total. Include injector accessories such as cover caps and outlet adapter kits.

Select the proper pump and reservoir assembly, timer, solenoid and necessary controls. The final step is to calculate the supply line, feed line tubing, fittings and connectors for a complete system. As a rule, you can calculate 15 ft per point for the bulk feed line hose which is cut to length and assembled during installation.

System Installation

System Installation

Timer

Refer to Instruction Manual 308950.



Solenoid valve (air valve shown)



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Install in power supply line to pump module.

Connect leads to timer output. Do not ground leads on Graco timer 115123 (refer to manual 308950). Connect either lead to the + output on timer and the other lead to the – output on timer.

Pressure switch (optional)

For pressure shutoff systems. Can be installed in grease supply line for using higher pump pressures. Refer to instruction manual 308950 for electrical hookup.



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System Installation

Pump module (air-powered shown)

Refer to instruction manual 308955 for air-powered systems and manual 309098 for hydraulic-powered systems.



System Installation

Supply lines; 3500 psi (241 bar, 24 MPa) rating or better

Install to vent valve outlet on pump module. Secure to framework to prevent abuse and abrasion. Use branch lines to connect to injector banks and groups.

NOTE: Per JIC standards, copper tubing should not be used in lubricant systems.

Supply line recommendations:

- Up to 40 ft in any one direction from the pump to the furthest injector bank.
 3500 psi minimum working pressure.
 1/2 in. ID hose or steel tubing (.049 wall thickness) or 3/8 in. Schedule 40 pipe.
- Up to 70 ft in any one direction from the pump to the furthest injector bank.
 3500 psi minimum working pressure.
 5/8 in. ID hose or steel tubing (.049 wall thickness) or 1/2 in. Schedule 40 pipe.

Branch lines; 3500 psi (241 bar, 24 MPa) rating or better

Limit line length as short as possible. Connect to injector inlet (3/8" npt).

Injectors



Group injectors (typical haul truck has 3 groups, right side for right side steering points, left side for left side steering points and rear for shocks and box joints).

Use branch lines to feed injector groups, no more than 15 injectors per branch line. Install zerk and cap fitting into either injector outlet (1/8" npt).

Feed lines; 3000 psi (207 bar, 21 MPa) rating or better

Connect to either injector outlet (1/8" npt). No more than one feed line per injector. Allow hose slack for moving points. Secure to framework to prevent abuse and abrasion.

Feed line recommendations:

- Up to 17 ft maximum hose length 3000 psi minimum working pressure. 1/4 in. ID hose.
- Up to 26 ft maximum hose length 3000 psi minimum working pressure. 3/8 in. ID hose.

System Operation

System Operation

Pump Module

The pump module provides pressure and pressure relief function necessary for injector operation according to timer programming.

- 1. Fill and prime pump module reservoir per instruction manual 308955 for air-powered systems and manual 309098 for hydraulic-powered systems.
- 2. Bleed supply lines.

Run the primed pump at reduced output pressure to slowly fill the supply lines with lubricant. Remove the fitting at the end of each branch line to allow air to escape from the line.

- 3. Bleed feed lines (two methods).
 - a. Disconnect the line from the bearing and cycle the automatic lubrication system until lubricant has filled all the lines.
 - b. Disconnect the line from the bearing. Using a grease gun and the zerk fitting on the injector, fill the lines with lubricant.
- 4. Set timer according to system requirements. See Instruction Manual 308950.

System Operation

Basic Injector Operation

Refer to Fig. 2.

Stage 1

At stage 1, the injector's discharge chamber contains lubricant from the preceding cycle. This lubricant is not under pressure, and the piston is at rest.

As the next cycle begins, pressurized lubricant enters the injector and starts to open the slide valve, which compresses the injector spring.

Stage 2

Pressurized lubricant pushes the slide valve upward, opening a path which allows the lubricant to flow into the measuring chamber above the piston. This pressure forces the piston down, pushing the lubricant from the discharge chamber, through the outlet, to the bearing.

Stage 3

At the bottom of its stroke, the piston pushes the slide valve downward, closing off the path to the measuring chamber. The piston and slide valve hold this position as long as the inlet lubricant remains under pressure.

Stage 4

As the lubricant inlet pressure is relieved, the slide valve moves down and the injector spring expands. The slide valve opens a port between the lubricant path and the discharge chamber.

As the spring continues to expand, it forces the piston upward, which pushes the lubricant out of the measuring chamber, back down the path, through the slide valve port, and into the discharge chamber.



Troubleshooting

Problem	Cause	Solution
System does not build sufficient pressure	Pump malfunction	Refer to pump manual 308955 or 309098
	Pump turned off too soon	Increase timer "pump on" setting
	Solenoid valve malfunction	Repair or replace
	Too low or no power supply	Turn power supply pressure up or supply on
	Vent valve seal failure	Replace seal
	Vent valve needle/seat failure	Replace needle and seat
	Reservoir out of grease	Fill reservoir
	Broken or leaky supply/branch line	Tighten connections and/or replace line(s)
Injectors do not dispense to bear-	Feed line blocked	Replace line
	Bearing plugged	Flush and clean bearing
	Feed line leaks or is broken off	Tighten connections and/or replace line
	System does not build sufficient pres- sure	See "System does not build sufficient pressure", above.
	Air trapped in supply/branch/feed line	Bleed air from line
	Injector failure	Repair or replace injector
Injector indicator pin does not	Injector failure	Repair or replace injector
pressure	Feed line blocked	Replace line
·	Bearing plugged	Flush and clean bearing
Bearing receives too much lubri- cant	Improper injector setting	Adjust injector setting by turning down the adjustment screw
	Injector failure	Repair or replace injector
System does not vent properly	Vent valve malfunction	Repair or replace vent valve
	Injector malfunction	Repair or replace injector
	Too many injectors on branch line	Reconfigure branch line to correct
	Supply line too small	Install supply line with larger diameter
	Grease too viscous	Use lighter grease, NLGI #0 or lighter for cold temperatures
	Vent line on pump module blocked	Remove obstruction or replace line
	Timer pause interval too short	Increase pause interval
Lubricant dispensed from pres- sure relief valve	System pressure set too high	Decrease power supply pressure to pump

Troubleshooting (cont.)

Problem	Cause	Solution
Pump runs too fast	Reservoir out of lubricant	Fill reservoir
	Lubricant cavitation	Install a follower plate
	Leak in system	Repair leak
Pump runs without building pres-	Leak in distribution system	Repair leak
sure	Faulty vent valve seat	Replace needle and seat
Lubricant coming out of breather	Reservoir overfilled	Drain lubricant until overflow stops
Pump will not start	No air or hydraulic supply	Turn on air or hydraulic supply
	Solenoid valve malfunction	Replace solenoid valve
	No electrical supply to timer	Turn on electrical supply
	Timer malfunction	Refer to Timer Manual 308950
	Pump malfunction	Refer to Pump Manual 308955 or 309098

Graco Phone Number

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PRINTED IN USA 309015 January 2000