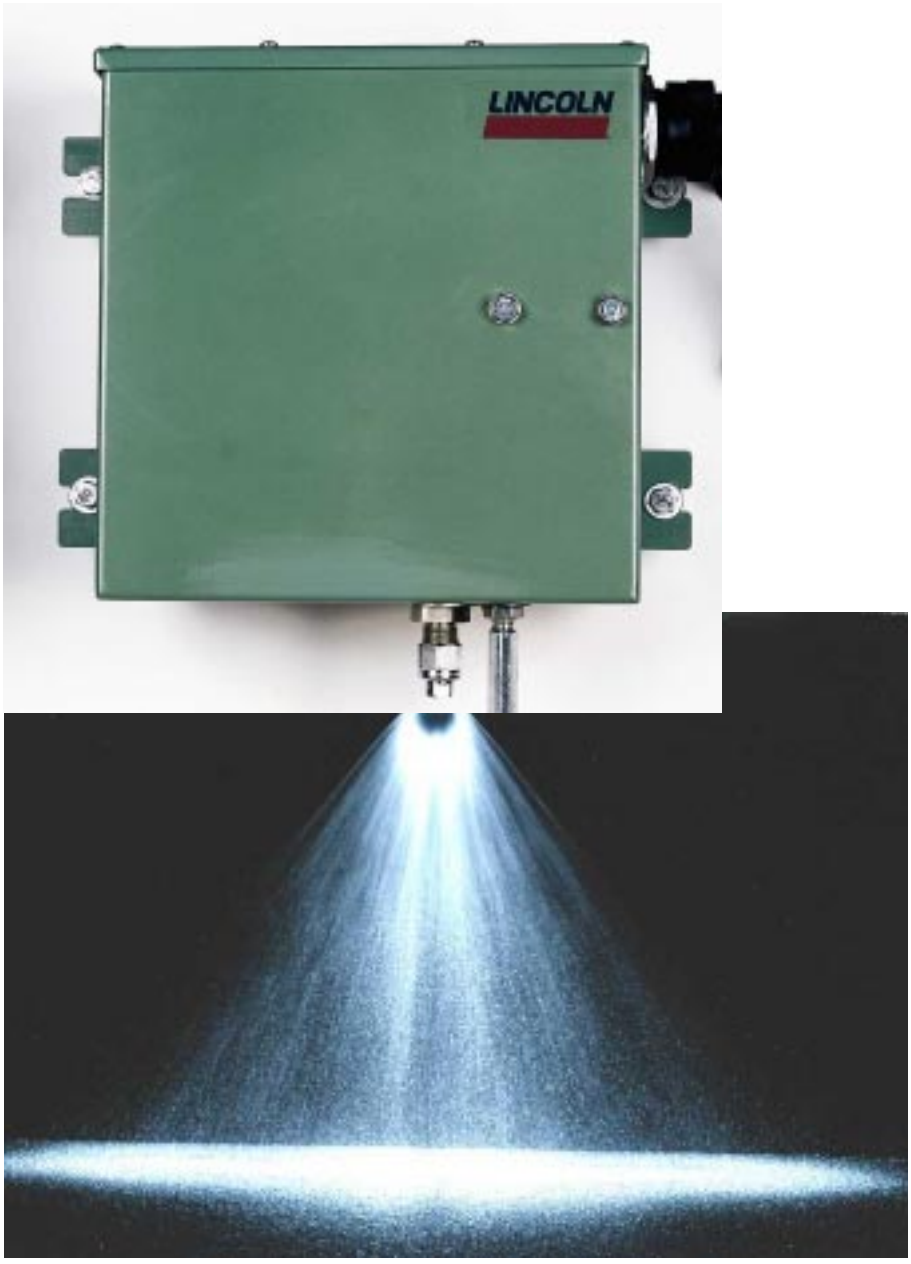
Lincoln Industrial



AIRLESS SPRAY GEAR LUBE DESIGN GUIDE

Table of Contents

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Open Gear Airless Spray
Application and Design Guide

I. Introduction

Proper lubrication of the open gear drive is critical for long and trouble free service life and operation of the equipment.

In the operation of the gears the line of contact between the gear and pinion is constantly changing. In the bearing, the same area of bearing surface is continually carrying the load and absorbing the heat, which is generated during the operation. In gear the load is changing as the teeth pass in and out of mesh.

As the teeth first began to mesh, a sliding motion predominates. As the teeth approach the pitch line contact, the sliding motion changes to a rolling motion and at the pitch line the motion is virtually all rolling. As the teeth pass out of mesh, sliding motion progressively increases with decrease in rolling motion. Although the teeth contact is commonly referred to as the “contact line”, in reality it is of an appreciable width. It could be as large as 3/16 inches or more in the bull gear contact pressure of 3,000 P.S.I. or more.

The Airless Spray system can eject the lubricant to reach the lowest points of the teeth contact line even below the pitch line to ensure lubrication of all contact area of the bull gear.

II. System components

The system consists of four major components:

1. Hydraulic Spray and Measuring block Model 85418
2. Duplex filter assembly panel Model 85419
3. Controller (see paragraph VIII for the model number)
4. Pump station (see paragraph VI for the model number)

Typical open gear Airless Spray lubrication system with air operated pump and dual spray nozzle is shown on Figure 1.

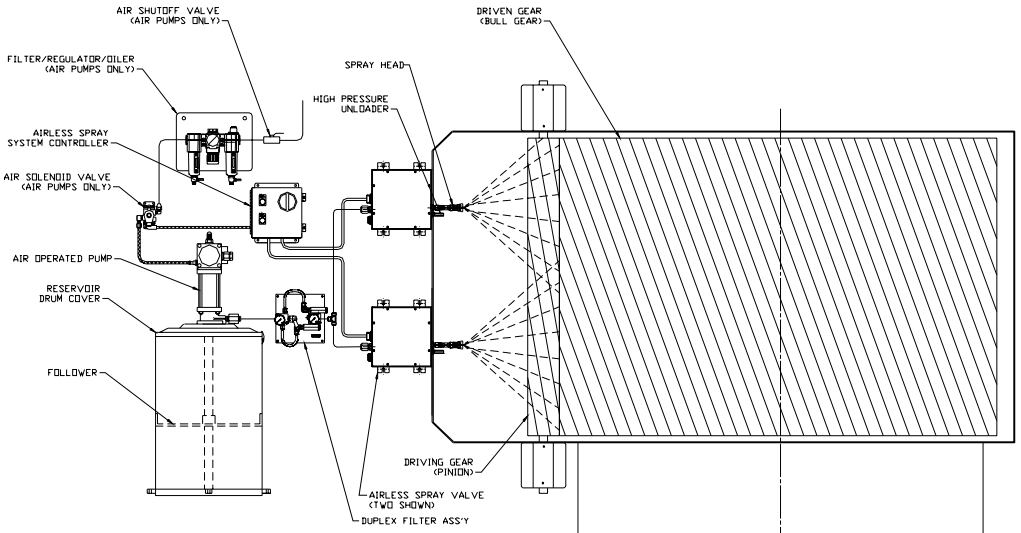

Figure 1

III. HOW THE AIRLESS SPRAY VALVE WORKS

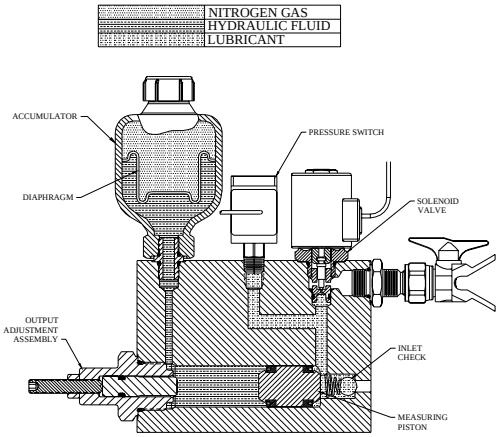

Figure 2: <u>STAGE 1.</u> Airless Spray Valve ready for charging with lubricant.

The airless spray valve in **Figure 2** is shown in **<u>STAGE 1</u>**, which is in the initial stage ready for lubricant. Nitrogen gas is in the top section of the accumulator, on the left, is pre-charged to 1500 PSI. Hydraulic fluid is on the bottom side of the accumulator diaphragm. The hydraulic fluid is pressurized to 2000 PSI. Lubricant, to be applied by the airless spray system, will be pumped into the airless spray valve on the right side of the measuring piston. The pressure switch indicates low pressure to the controller. The controller will signal for the pump to start and disable the spray solenoid valve.

<u>NOTE:</u> *This is the stage where output a djustments can be made, while there is minimum pressure on the output adjustment assembly.*

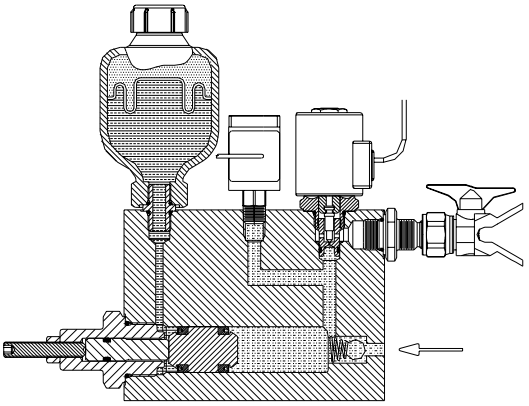

Figure 3: <u>STAGE 2.</u> Lubricant is pumped into the airless spray valve.

Figure 3 illustrates **<u>STAGE 2</u>** of the operating sequence. The lubricant is entering the system through the inlet check, and moves the measuring piston against the hydraulic fluid pressure, which in turn acts against the nitrogen gas pressure on the other side of the diaphragm in the accumulator. When the pressure reaches 3500 PSI the pressure switch changes state, turns off the pump, and enables the spray solenoid valve. The airless spray valve is now ready to spray.

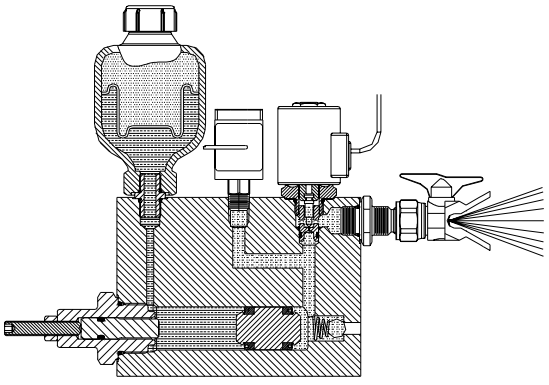

Figure 4: <u>STAGE 3</u> is the spray cycle.

Figure 4 illustrates **<u>STAGE 3</u>** of the spaying process. When a spray cycle is initiated, the spray solenoid valve is opened and the pressure in the accumulator causes the hydraulic fluid to act against the measuring piston which forces the lubricant out of through the spray solenoid valve and spray nozzle onto the surface to be lubricated. The pressure switch will change states, the spray time times out and the spray solenoid valve will close. Return to **<u>STAGE 1.</u>**

IV. PLANNING THE SYSTEM

1. LUBRICANT CONSIDERATIONS

The proper lubricant to use is recommended by the specifications provided by the machine manufacturer. The lubricant type will dictate where the lubricant is to be applied to the gears.

2. ASPHALTIC TYPE LUBRICANTS are lubricants with an asphaltic base diluted with a non-chlorinated solvent. The purpose of the solvent is to make the lubricant thin enough to spray, then the solvent flashes off or evaporates, leaving a film of lubricant behind to lubricate the gear mesh. Asphaltic lubricants are widely used in the Western Hemisphere.

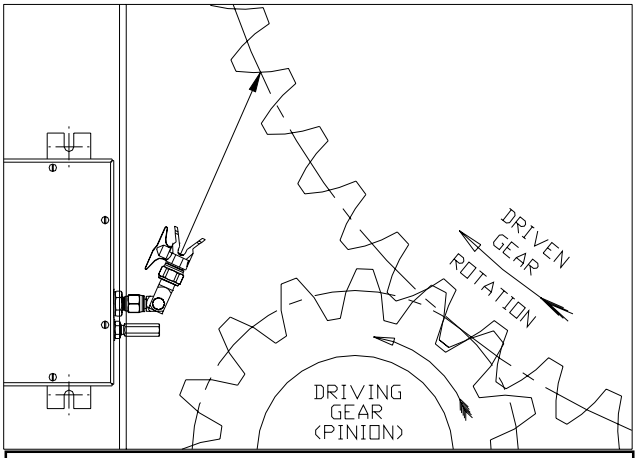

Figure 5: Illustrates the post-mesh application.

Asphaltic lubricants use post mesh application where it is applied to the driven gear just <u>after</u> the gear mesh with the pinion or driving gear. The lubricant should be applied to the loaded tooth of the driven gear. The object is for the solvent to evaporate before the lubricated area of the gear reaches the driving pinion gear. The lubrication frequency is every 10-30 minutes. Figure 5 illustrates the recommended application point of asphaltic lubricants.

It should be noted that asphaltic type lubricants will have a tendency to dry over time, due to the evaporation of solvents in the drum. The use of a follower is recommended in the lubricant reservoir.

3. SYNTHETIC LUBRICANTS are made from a synthetic base material. Solvents are not required to make the lubricant sprayable. Some synthetic gear lubricants have been successfully applied with the Lincoln Airless Spray Gear Lube system. Contact Lincoln Industrial for more information concerning lubricants that have been tested in the Airless Spray Gear Lube System. Some of these lubricants may replace asphaltic type lubricants and may be applied with the post-mesh method.

Many hydrocarbon base and synthetic lubricating oils have added tackifiers which are used to increase the tenacity of the oil, or make it tacky so it will stick to the gear surfaces. ©This tacky property will not allow the lubricant to be applied with a spray system at normal temperatures (120°-150° F). Increasing the system temperature to 160° to 175° will enable many of these lubricants to be sprayed with the Lincoln Airless Spray System.

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4. SEMI-LIQUID GREASES

are commonly specified on European manufactured equipment. The European manufacturers often recommend applying the lubricant before the gear mesh, to the loaded tooth. (See figure 6) Semi-liquid greases have no solvents to evaporate, therefore may be applied directly to the mesh of the gear. The lubricant is applied in small quantities intermittently.

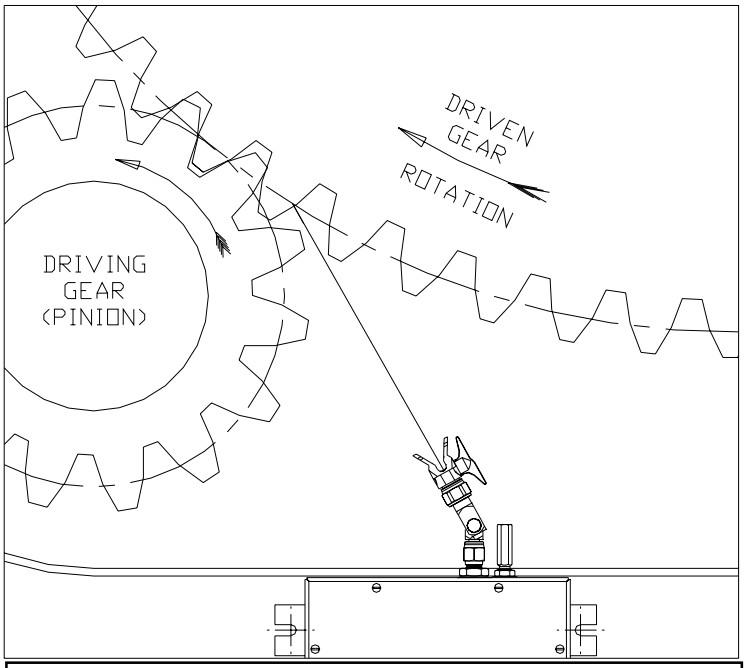


Figure 6: Illustrates the pre-mesh application position.

5. DETERMINE THE NUMBER OF SPRAY HEADS

Factors that determine the shape and size of the spray pattern are the tip angle, and spray distance. The tip angle is the included angle of the spray pattern as it comes out of the spray tip. The spray distance is the distance from the spray tip to the gear face or target surface. See figure 7, below. The distance between the spray tip and the target surface will determine the spray width and the force of impact. As the distance is increased, the spray pattern will get wider and the impact force will be reduced.

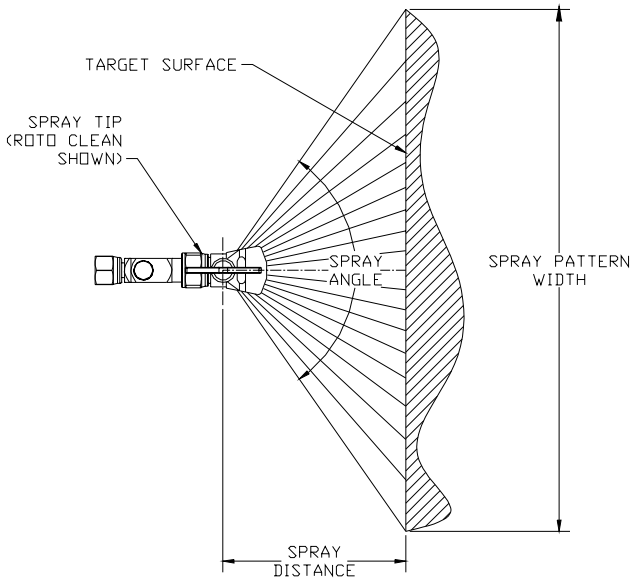


Figure 7: Spray pattern components

The distance from gear to spray tip will vary depending on the room available in the application. The distance from tip to gear face should not exceed about 18". Air turbulence from the moving gears may reduce the impact force of the lubricant on the gear face and cause unpredictable results. Reducing the tip to gear distance will reduce the pattern width. Smaller spray angle tips may become available for applications requiring a narrower spray pattern. Contact Lincoln Industrial for available tip options.

It should be noted that only one spray tip per airless spray valve is to be used. Adding two or more spray tips to an airless spray valve will not produce satisfactory results and is not recommended or supported by Lincoln.

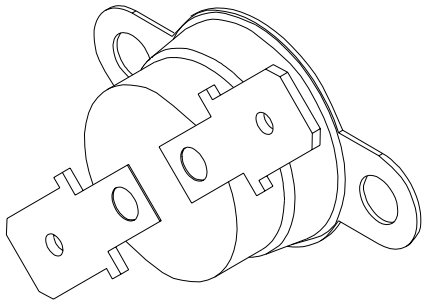
Spray Pattern Factors:

The spray pattern is greatly affected by the lubricant viscosity, specific gravity, type and temperature. Each lubricant should be tested to determine the proper spray temperature and tip required for the application.

To maintain a uniform spray pattern, the Airless Spray Gear Lube System is equipped with a heater to maintain the lubricant temperature, which in turn will control the lubricant viscosity in a wide range of atmospheric conditions. The lubricant is heated just prior to application, so that solvent evaporation does not occur. Heating of the lubricant in the drum is not normally required except in conditions where required for pumping in extremely cold conditions.

Figure 8: is an actual photograph of the spray pattern produced by the airless spray gear lube system.

The Airless Spray Gear Lube System is supplied with a thermostat set to control the temperature of the lubricant from 120° F (49° C) to 150° F (66° C). The standard thermostat will be suitable for application of most asphaltic and petroleum based greases. Synthetic lubricant and some greases may require higher temperatures to obtain a suitable spray pattern.



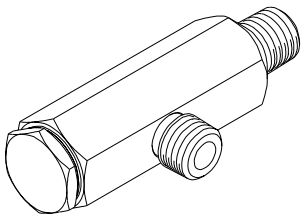
High Temperature Thermostat: An optional thermostat (shown at left) is available that will maintain a lubricant temperature from 160°F (71° C) to 175° F (79°C). The optional high temperature thermostat is **P/N: 272297**. The optional thermostat may be used by replacing the existing thermostat in the spray system enclosure. No other changes are necessary.

Consult the “Tested Lubricant List” Supplied with this manual for recommended spray temperatures and spray tips for a specific lubricant. This list represents a summary of lubricant that have been test sprayed by Lincoln.

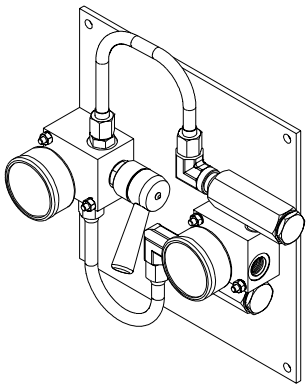
6. KEEPING THE LUBRICANT CLEAN

For trouble free operation, Lincoln recommends that the lubricant be filtered before entering the airless spray valves. Dirt and particulants in the lubricant can clog the spray valve and spray tips, requiring frequent attention to clear and service. Keeping lubricant clean in the

reservoir will help but will not prevent some contamination from entering the system. Lincoln Industrial offers two filter options for Airless Spray Gear Lube Systems.



Model 84004: (shown at left) is a single in line filter assembly that will filter the lubricant to 140 micron with a replaceable filter screen. See Owner's Manual section K1 page 6.

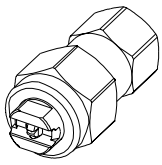


Model 85419: (shown at left) is a duplex filter assembly with filter element monitoring capability and the ability to change from a dirty to a clean filter while the system is operating. The filter elements are 140 micron and are replaceable. See Owner's Manual section K1 page 21.

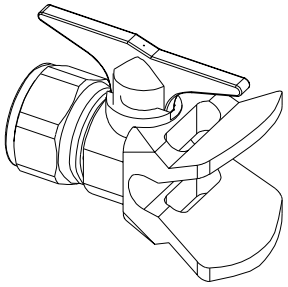
7. SPRAY NOZZLE OPTIONS

Lincoln Industrial currently offers two types of spray tips. All tips offered are tungsten carbide for long life. The tips provide a fan shaped or rectangular spray pattern.

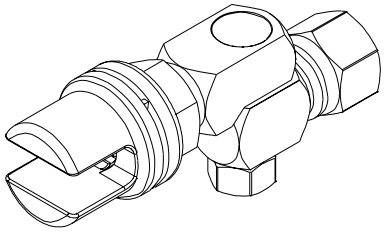
Standard Spray Tips: as shown on the right. See owner's manual **Section C8 Page 280** series for standard spray tip components and assembly sequence. The standard tip will attach directly to the outlet adapter on the side of the airless spray valve assembly. Standard tips are not recommended for any lubricant that may cause frequent clogging of the tip. Tools are required for changing and cleaning of the tip.



Roto Clean Tips: as shown on the right provide the user with the same long life of the standard tips, above, but also allow the user to clear clogs as well as clean and replace tips without the use of tools. See owner's manual **Section C8 Page 280** series for details on the Roto Clean. A clogged Roto Clean tip can be cleared by rotating the tip handle 180° and flushing out the tip with a lube cycle. Roto Clean tips can be attached directly to the outlet adapter on the airless spray valve or attached to the outlet end of the swivel assembly. Roto Clean tips are highly recommended for all lube applications where tip selection and room permits.



Tip Swivel Assembly: as shown on the right, can be used with standard or roto clean tips. The swivel assembly is used to direct the spray tip towards the target area without the need of aiming the entire airless spray valve assembly. See owner's manual **Section C8 Page 280** series for details on the swivel assembly. The swivel assembly can be locked in position after the spray has been directed to the desired target



point, by tightening the swivel lock nut. The swivel is recommended in all applications where room permits.

8. TIP ORDERING GUIDE

See the chart below for what is required to properly order tip components, which are sold separately from the airless spray valve assemblies.

	RETAINING NUT 252790	JET STABILIZER 252792	STD SPRAY TIP AS REQ'D 85423-SERIES	SWIVEL ASS'Y 271579	ROTO CLEAN ASS'Y 252831	HANDLE/ORIFICE AS REQ'D 85427-SERIES
STANDARD SPRAY TIP	X	OPT	X	OPT	NR	NR
STD TIP W/SWIVEL	NR	OPT	X	X	NR	NR
ROTO CLEAN TIP	NR	NR	NR	OPT	X	X
ROTO CLEAN TIP W/ SWIVEL *	NR	NR	NR	X	X	X

X=Required OPT=Optional NR=Not Required

* Discard tip retaining nut and protective cover, supplied with swivel assembly, when installing the roto clean tip on a swivel assembly.

V. System requirements

To properly lubricate open gear and pinion in bull gear applications using Airless Spray system follow these 7 steps, unless specified by the manufacturer of the machine.

1 Fluid Oz. = 1.805 Cu. In.

1. Determine the number of Airless Spray Valves (ASV) required to spray the gear face.

Use the spray tip chart on page 5 to make determination. The width figures given are close enough if proper tip is used for the lubricant to be applied. To approximate the spray width for a distance other than 12", use the following:

$$\text{TAN}\frac{Z}{2} \times D \times 1.5 = W$$

Where Z = Spray Angle
D = Spray Distance
W = Width of Spray (max)

2. Calculate the film thickness.

The proper amount of grease or oil is the amount of lubricant that will completely replenish the lubricant capacity of the gear in one hour. To calculate this, we must start with the film thickness of the lubricant. For oil, the film thickness (T) = .001" per hour; for grease T = .00025 per hour.

3. Calculate the area at the outside diameter of the gear the lubricant is applied to:

A = 3.14 x Diameter x Width of Gear Face.

4. Calculate the Gear Lubricant Capacity:

V = A x T

5. The Rotation Speed of the Gear must be considered as well as the spray time.

a) To calculate the time required for one revolution of the Gear, Time (R) = 60/RPM of gear.

b) The spray time is the duration of the actual spray pattern. Output adjustment, lubricant and spray tips used will determine the duration of the spray time.

6. Calculate the Gear Coverage area (with respect to the amount of rotation) with one spray cycle:

Coverage area (C) = Spray Time/R (Time of 1 revolution). Initally, set the spray time to 3 seconds. It will be set later when the system is fine tuned.

7. Determine the Pause Time between Spray Cycles.

Start with an output setting of 2 cu. in. per ASV. The output setting (Y) = 2 cu. in. for 1 ASV and 4 cu. in. for 2 ASV's. Good lubrication practice is to have at least three lubrication cycles per hour. N = no. of cycles/hour, V = Volume, Y = Output Setting.

$$N = V/Y$$

If N is less than 3, reduce the output setting Y and recalculate. When two ASV's are used, the outputs of each valve should be set the same.

NOTE: Changing the output will affect the spray time.

Calculate the pause time, correcting for coverage area and insuring that the spray cycle is out of sync with the gear rotation.

$$\text{Pause Time, } P = \frac{60}{N} - C\left(\frac{R}{60}\right)$$

Set up the system to operate with the intial settings you calculate here. Adjust the output volume of the ASV and set the controller for your initial settings.

After observing the system in operation, recalculate for the pause time based on actual spray time observed and make the necessary adjustments to the controller as outlined in Section IX.

S = Spray Time

Z = Spray Angle (of Spray Tip)

D = Spray Distance (inches)

W = Spray Pattern Width (in) = $\text{Tan}\frac{A}{2}$ X D X 1.5

T = Film Thickness (in) (.001" oil, .00025" grease)

A = Area of gear at Pitch Diameter (in²) = Outside Diameter x Width, Gear Face

V = Gear Lubricant Capacity (in³) = A x T

R = Time for one Revolution of Gear (second) = 60/RPM

C = Coverage Area of Gear = S/R

Y = ASV Output (Total) = 2.0 (1-ASV), 4.0 (2-ASV)

N = Number of Cycles per Hour = V/y

$$P = \text{Pause Time} = C \times \frac{60}{N} - C\left(\frac{R}{60}\right)$$

Example

Bull Gear rotating at 15 RPM
Outside Diameter = 30 Feet (360 in)
Width = 35"
Lubricant = Petron Gear Shield NC (Grease)
A Roto-Clean Nozzle is desired.

A survey of the machine revealed that with the Airless Spray Valve installed, a Roto-Clean tip and Swivel can be used and there will be 15" from Spray Tip to the loaded tooth of the Bull Gear.

1. Determine Number of ASVs.

$$W = \text{TAN}\frac{95}{2} \times 15 \times 1.5 = 24.5"$$

Two ASVs will be used with a total spray width of 49". The ASVs will be mounted so that there will be some spray overlap in the center and some over spray on the sides. A 95° tip will be used.

2. Film Thickness = .00025" (grease)

3. Gear Area = A = 3.14 x 360" x 35" = 39564 in²

4. Lubricant Capacity (1 hour) = V = 39564 x .00025 = 9.89 in^3

5a. Time required for 1 rotation of gear R = 60/15 = 4 sec.

5b. Spray Time = 3.0 seconds

6. Gear Coverage Area = 3.0 seconds/4 seconds = .75

7. Calculate the Pause Time

Start with an output (Y) of 4 cu. in. (2 cu. in. per ASV)

N = 9.89 in^3/4 in^3 = 2.47 cycles/hr. which is less than the desired 3 cycles/hr.

Reduce the output (Y) to 2 in^3 (1 in^3 for each ASV)
N = 9.89 in^3/2 in^3 = 4.95 cycles/hr. Round off to 5 cycles/hr.

The pause time will be:

$$P = \frac{60}{5} - .75\left(\frac{4}{60}\right) = 11.95 \text{ min}$$

Convert decimal minutes to seconds by multiplying the decimal only by 60:

.95 x 60 = 57 sec.

Both pause timers in the controller would be set to 11 min., 57 sec.

VI. Determine the pump and size of the supply lines

The pump should develop pressure of 3,500 P.S.I.G. at the connection to the Airless Spray to charge the system.

Determine the position of the pump and make the sketch of the system. Always position the pump as close to the Airless Spray system as possible. If pump location is close to the Airless Spray and spray lubricant is not viscous we recommend high pressure pump Model 83991 for 120 lb. drum or Model 83112 for 400 lb drum. Both pumps are 50:1 ratio. The recommended minimum air pressure should be 95 to 100 P.S.I.G..

Each pump assembly includes:

1. Model 83991
   - 82050 bare pump
   - 82989 drum cover and tie rod assembly
   - 84941 eye bolt kit
   - 815 air coupler
   - 11659 air nipple
   - 80202 volume elbow union

2. Model 83112:

- 83112-1 bare pump
- 83115 drum cover and tie rod assembly
- 815 air coupler
- 11659 air nipple
- 80202 volume elbow union

For larger output delivery and longer supply lines use Power Master series pumps:
Model 2008 for 120 lb drum or Model 2004 for 400 lb drum. The pumps are 75:1 ratio.
Minimum air pressure to operate these pumps should be 65 P.S.I.G. or higher.

VII. Pipe and hose selection requirements.

1. For compressed air supply use 3/8 ” inside diameter hose for Series 20 pumps and use at least ½ ” inside diameter hose compressed air supply for Power Master series pumps.

2. For supply lines use 5,000 P.S.I.G. minimum working pressure rate hose. Diameter of the hose for Series 20 pump should be ½ ” minimum. For Power Master series pumps ¾” diameter hose is recommended.

3. Use schedule 80 pipe for ½” and ¾” diameters and schedule 160 for pipe diameters 1.0” and larger.

4. Use high pressure components with minimum 5,000 P.S.I.G. of working pressure for shut off valves, elbows, tee, couplings, etc…

VIII. Controller selection

Lincoln Industrial offers three controller models:

- Model 254120 for single and dual Airless systems. Use this controller to operate the system and to program the lubrication time events. This controller will operate the system independently. See Section F40 page 33 series owner’s Manual.

- Model 256228 for single Airless system with external initiate contacts. Use this controller to operate the system with some external input to initiate the spray cycle. See Section C8 Page 288 series Owner’s Manual for details.

- Model 254815 for dual Airless system with external initiate contacts. Use this controller to operate the system with some external input to initiate the spray cycle. See Section C8 Page 287 series Owner’s Manual for details.

All three models have capabilities to program the alarm time and duration of the spray time.

IX. STARTING THE SYSTEM

1. PURGING THE SYSTEM OF AIR

Tighten all lubricant connections, except as noted below. All filters should be installed, spray tips installed and tight. The pump should be complete with follower and drum cover. The controller should be connected to the airless spray valve(s), pump and power supply. Hose

connections to the airless spray valve can be removed and placed into a suitable container to catch lubricant as the pump and hoses are purged of air.

Turn on the controller and the pump. [The machine will have to be running if the controller is properly wired into the machine controls, as stated above.] The pump should begin to operate and begin pumping lubricant into the hoses and filter assemblies. Operate the pump until air free lubricant begins flowing from the supply hoses. Turn off the system controller. Reconnect the supply hoses to the airless spray valves, and tighten securely.

Turn on the system controller. The pump should restart. The pump should be set to deliver a minimum of 3500 P.S.I. at the airless spray valves. [Pressure at the pump may have to be set higher to allow for pressure drop through the hoses.] Adjust pressure regulators, or control valves as required to obtain the required pressure and flow. The pump should turn off when pressure inside the airless spray valve reaches 3500 P.S.I.

The ready light on the controller will not turn on immediately, when the system is initially turned on, a time delay has been added to allow time for the lubricant and the airless spray valve to warm up to operating temperature.

WARNING! : Do not point spray nozzle at any person. Keep hands and other body parts away from spray nozzles. Injury from injection of lubricant under the skin is possible if this warning is not followed.

Make sure that the nozzles on the airless spray valves are pointed towards the target spray area. The system may be cycled manually by pressing the green manual lube button. This should initiate a lube cycle by spraying lubricant onto the target surface. [The first shot or two will have some air entrained in the lubricant and may be spotty.] The pump should restart and recharge the airless spray valves for another lube cycle, again, turning off when pressure is reached. Repeat the manual lube cycle again until the sprayed lubricant is free of air.

2. SETTING THE OUTPUT

The volume of lubricant should have been determined in Section V “System Requirements” . See the Owner’s Manual for the airless spray valve for details on output setting adjustment. To set the output, start with the full output setting on the airless spray valve. Each clockwise turn of the output setting screw will reduce the output from full by .06 cu. In. (.033 oz.). Set the output to the setting as calculated in Section V.

3. SETTING THE CONTROLLER

See the Owner’s Manual for the spray system controller for the details on properly setting the controller. The pause timers, spray timers, and any alarm functions are set on the controller. The desired pause time interval should be determined in Section V “System Requirements” and set in the controller. If controlling a system with two airless spray valves, all settings should be adjusted to the same value for both airless spray valves.

Spray timers in the controller are used to reduce to a minimum; any post spray dribbling from

the spray nozzle after the pressure from the airless spray valve has dissipated to the point where a good spray pattern is no longer possible. The spray timer is not used to set the output volume of the airless spray system. The output adjustment on the airless spray valve is used to set output. See “Setting the Output”.

Initially set the spray on timer for about 6 seconds or more. After the system has warmed up observe the spray pattern, giving the system sufficient time (1 minute or more) to warm the lubricant between spray cycles. The spray timer should be set to turn off the spray solenoid valve just as the spray pattern changes from a well deined fan pattern into a solid lubricant stream. Use a stopwatch or use trial and error to determine the final setting for the spray timer. Verify the setting by observing several spray cycles.

A change in the spray volume will require an adjustment in the spray time.

4. FINE TUNE THE LOCATION OF THE SPRAY PATTERN

Adjust the position and angle of the spray head to position the spray pattern onto the loaded tooth of the desired gear. The long axis of the spray fan should be parallel with the gear teeth. The spray fan should be centered on the face of the gear so that it covers the entire gear face when the spray pattern is at its widest pattern width.

5. FINE TUNE THE PAUSE TIME INTERVAL

After the lube system has been in service for a few hours, the gear train should be checked for proper lubrication. See the machine manufacturer’s recommendations for confirming proper lubrication. Adjust the pause time, or time between lube cycles accordingly. A minimum of 1 minute should be allowed between lube cycles to allow the lubricant to be warmed by the system heater.

In most applications the Airless Spray Gear Lube System will not cover the entire face of a gear in one rotation. In these situations the lubricant can be spread out to cover the entire surface of the gear by selecting a frequency time setting that will be out of sync with the rotating gear. The Pause Time calculation in Section V will account for Desyncronization of the Spray system.

X. TROUBLE SHOOTING

CONTROLLER ALARMS

See owner’s manual of the controller for alarm functions. An alarm indication means that the system has failed to properly perform a lube cycle. In a system using only one airless spray valve, finding the fault is somewhat simpler than with a system using two. The controller will indicate which system has failed when two systems are in use. The method used to indicate failure is the pressure switch inside the airless spray valve. Should the pressure switch fail to change states within a prescribed period of time, the controller will go into alarm mode.

Possible causes for an alarm indication would be as follows:

- Clogged spray tip
- Low lubricant level in reservoir
- Clogged filter

- Low or no air pressure to pump (air pumps)
- Pump failure
- Supply line leak

When the system controller goes into the alarm mode, the system controller will still attempt to operate the system. When a tip has clogged, it should be noted that the controller would hold open the solenoid valve. **Always turn off the power to the spray system controller before servicing the spray tips.**

PRESSURE UNLOADER ON AIRLESS SPRAY VALVE

A pressure unloader is mounted near the spray tip adapter on the airless spray valve. When the airless spray valve is installed provisions must be made for the unloader. The area around the unloader valve must be kept clear so that lubricant from the unloader is free to flow from it.

The purpose of the valve is to prevent an over pressurization of the airless spray valve, causing damage to spray valve components. Under certain conditions it can be considered normal for the valve to open and discharge lubricant.

If the unloader should leak or discharge lubricant on a regular basis the cause should be investigated before placing the airless spray valve back into service. The unloader valve is not a serviceable assembly and should be replaced. **UNDER NO CIRCUMSTANCES** should the valve be replaced with a plug. The unloader valve should only be replaced by an assembly with the same pressure rating as the valve supplied. Using a valve with a pressure rating other than the one supplied may result in system damage or unsatisfactory results. Do not attempt to adjust the screw setting of the valve.

XI. MAINTENANCE

Once installed and fine tuned to the application, the only regular maintenance required to the system will be to the filters and spray tips. For system maintenance and repair see the owners manuals for the respective system components.

1. SPRAY TIP MAINTENANCE:

Clean, well-filtered lubricant will reduce tip and system maintenance to an occasional tip cleaning. Lubricant, contaminated with dust and dirt, will cause frequent tip clogging and possible spray valve clogging. Whenever handling the spray tips it is ***IMPORTANT*** to turn **OFF** the power to the spray system controller. This precaution should always be observed to prevent an unanticipated spray of lubricant. When the system is in alarm, the spray solenoid valve is open and clearing a clogged tip while the system is on will result in an unexpected spray cycle.

Standard Spray Tips: require disassembly to clean. See the owner's manual for tip assembly sequence and parts. If the tip clogs, turn off the power to the spray system controller before any work is done with the tip. The tip will still be under pressure, which must be dissipated before any attempt is made to remove the tip. Slowly loosen the tip retaining nut and let the pressure under the tip dissipate before removing any tip components.

To clean the tip, soak the tip components in a suitable solvent to soften any dried lubricant. Clean with a brush to remove any buildup. Blow clean with compressed air. A stubborn clog may require passing a fine wire into the tip opening to dislodge the clog. Replace the tip gasket if it shows any signs of wear or damage.

Roto Clean Tips: in most cases will not require disassembly to clear a clogged tip. Before clearing a clogged tip, turn off the power to the spray system controller. To clear a clogged tip, simply rotate the handle clockwise (when looking down on the handle) on the orifice assembly 180°. The arrow on the tip should point opposite from the direction of spray. Turn on the power to the spray controller and initiate a lube cycle. This process will flush most contaminate out of the spray tip. Turn off the power to the controller again and rotate the handle back, with the arrow pointing towards the target surface, to resume normal spray. Turn on the power to the spray system controller.

In some instances, this method will not clear a stubborn clog. In such cases, removal of the tip is necessary. To remove the tip, turn the handle 90° to the spray direction and pull it from the Roto Clean body. See the cleaning procedure for standard tips above.

2. TIP WEAR AND REPLACEMENT

Many factors will affect the spray pattern. Temperature, viscosity, pressure, and tip wear will all cause the spray pattern to change. If the spray pattern fails to fan out and sprays out in a solid stream any of the above factors may be at fault. Make sure the tip is clean and free of any clogging or buildup of any dried lubricant. Installing a known good tip is a good test. If the pattern does not improve, look into one of the other factors. See the Owner's Manual for trouble shooting the airless spray valve.
When replacing the Roto Clean spray tip handle orifice assembly, the seals in the Roto Clean body should be replaced at the same time. New seals are supplied with every handle/orifice assembly.

Lincoln Industrial has tested the tungsten carbide tips that are used on the Airless Spray Gear Lube System for hundreds of thousands of cycles with some of the harshest gear lubricants with no noticeable wear to the tip. If a tip has been in use for several hundred thousand cycles, and the other factors above are known to be good, the tip is likely due for replacement. Some lubricants will wear the tips out faster; others may not wear them at all.

3. FILTER MAINTENANCE:

The system filters must be kept clean. A clogged filter will result in filter bypass, thus allowing dirt and debris to enter the system. In extreme cases the filter element can burst, causing filter media to enter the system along with the dirt that will be allowed to enter.

Keeping the lubricant clean in the reservoir will reduce the filter maintenance. The use of a follower and tight fitting drum cover with no openings to allow dirt to enter the reservoir should be used.

When replacing lubricant drums, use a lift or hoist to remove the pump from the drum and hold it. Do not lay the pump tube down on a dirty floor. The lubricant will attract dirt onto the pump tube, which will be carried on into the drum, thus contaminating the lubricant. Keep the pump

tube and follower clean.

MODEL 85419 DUPLEX FILTER: The duplex filter assembly allows the user to monitor the condition of the filter elements while the system is in use. See Owner's Manual **Section K1, Page 21** for details on use and maintenance of the duplex filter.

MODEL 84004, SINGLE FILTER: See Owner's Manual, **Section K1, Page 6**, for details on maintenance of the single filter assembly

4. PRECAUTIONS FOR PROLONGED SHUTDOWN:

When the system is not to be in use for short time periods of over a weekend or holidays, in most cases no precautions are necessary. Be sure that the heaters in the Airless Spray Gear Lube System are turned off when the system is not in use. When the machine is restarted observe the spray pattern. Clean the spray tips if necessary.

If the machine that the Airless Spray Gear Lube System is installed on is to be shut down for a prolonged period of time, of <u>two weeks or less,</u> the tips should be cleaned in solvent after shutdown, for best results.

When an Asphaltic type lubricant or any other type of lubricant that uses solvents and is intended to dry, the lubricant should not be allowed to dry in the system. Severe system damage may result if a high solvent-based lubricant is allowed to dry in the system. If the Airless Spray Gear Lube System is to be shutdown for more than 2 weeks, the system should be flushed with a mixture of suitable solvent and oil until all the lubricant is removed from the system.

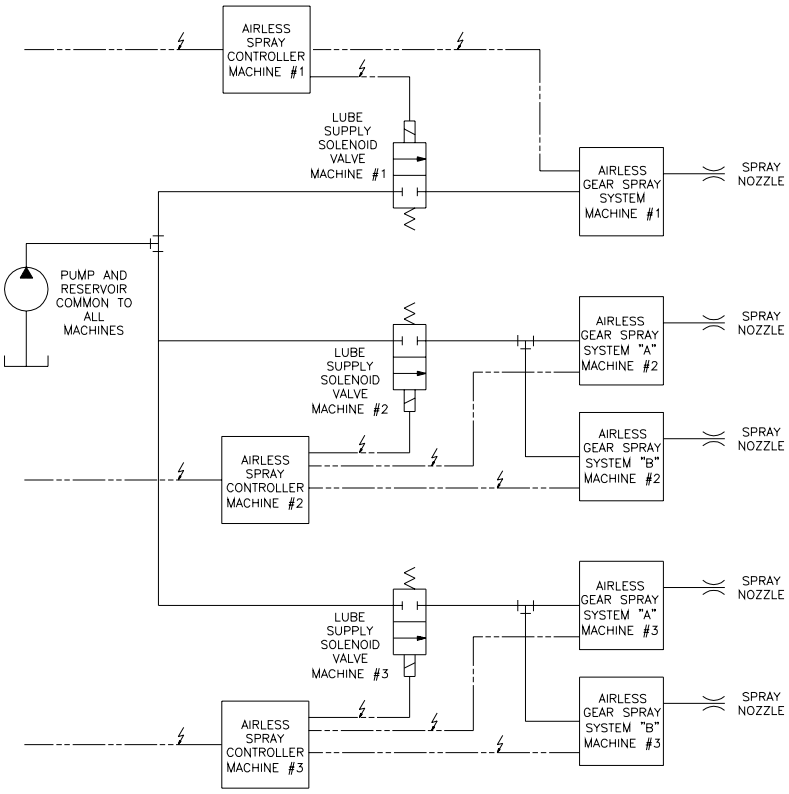
When restarting the system, purge out the solvent/oil mixture and replace with fresh lubricant. Asphaltic lubricants will dry and change viscosity as the solvent evaporates from the lubricant. This evaporation of the solvent may render the lubricant unusable. If the spray pattern fails to form properly, the lubricant should be suspected.

5. AIRLESS SPRAY VALVE MAINTENANCE:

Refer to the Owner's Manual for the airless spray valve before attempting any service on the airless spray valve. Follow and understand the discharge and disassembly procedure before attempting any service on any of the airless spray system components.

<u>WARNING!</u> The airless spray valve is always under pressure. Disconnecting all supply lines from the unit will not relieve the internal pressure within the airless spray valve. Follow the discharge procedure, exactly, as outlined in the Owner's Manual before any disassembly or service is attempted. Failure to follow the outlined procedure may result in severe personal injury or death.

XII. MULTIPLE MACHINE INSTALLATIONS



Where more than one machine is to be lubricated using the Airless Spray Gear Lube System it may be more economical to supply the lubricant from one pump and reservoir to all gear spray systems. The diagram at left illustrates a typical multi-machine installation where all airless spray systems are supplied with lubricant from one pump and reservoir.

Each machine must have it's own airless spray controller. A fluid solenoid valve is used to connect each airless spray system to the common pump and reservoir system. One fluid solenoid valve is required for each airless spray controller.

The pump and reservoir must be used to supply the same lubricant to all airless spray systems. Using the common pump with another type of lube system, such as Centro-Matic or Modular Lube, is *NOT RECOMMENDED*.

With the above multiple machine installation, each airless spray system can be operated independently of other machines. Spray cycles times and spray duration times may be independently tailored to each machines' requirement. Individual machines may be shut down for service without affecting the lubrication of the other machined in the lube system. Lubricant is not wasted lubricating a machine that is not operating.

OPERATION:

The operation of the multiple installation will be similar to the single installations. See **Section III** and Diagram above.

Stage 1. The pump will pressurize the lubricant supply header lines for all the fluid solenoid valves to full system pressure. When the Machine #1 airless spray system pressure switch sensed a low pressure condition, it will signal the airless spray system controller for Machine #1 to turn open the *fluid solenoid valve* for Machine #1. Lubricant form the pump will flow through the lube supply header lines and begin to charge the airless spray valve with lubricant.

Stage 2. When the pressure reaches 3500 PSI in the Machine #1 airless spray system, the pressure switch signals the Machine #1 airless spray controller to turn off the *fluid solenoid valve* on the inlet to the airless spray system for Machine #1.

Stage 3. When the spray cycle is initiated on Machine #1, the spray solenoid valve for Machine #1 will open, and the *fluid solenoid valve* for Machine #1 will remain closed. When the pressure switch on the Machine #1 airless spray system senses low pressure, the cycle repeats, after the spray solenoid valve closes.

The operation of the airless spray systems for Machines #2 and #3 will be the same as for Machine #1. All airless spray systems will operate independently as their needs dictate, without affecting the other systems.

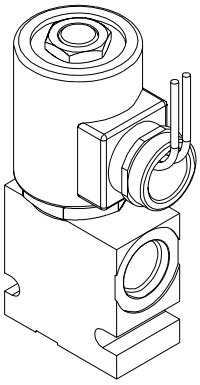
The fluid solenoid valves are required in the system to isolate each airless spray valve from the rest of the system. If the valves were not used, the accumulator effect of the header supply system would affect the volume of lubricant supplied by each spray system. Without a fluid solenoid valve for each airless spray system controller, one airless spray valve could effectively drain the system, leaving the other spray systems on the supply header short on lubricant and increasing the time required to recycle each system between sprays.

INSTALLATION:

Installation of the multiple machine system will be similar to single machine installations as illustrated previously in this manual. Supply line and hose recommendations are as stated previously. The airless spray systems and controllers should be installed on their respective machines. Install the **2-WAY FLUID SOLENOID, MODEL 272285**, at the inlet of each airless gear spray system, as indicated above. The fluid solenoid valve will be connected to the *"PUMP"* connections inside of the airless spray controller. One fluid solenoid valve is required for each airless spray controller.

IMPORTANT: Do not connect the fluid solenoid valve directly to an airless spray system. Use an 18"-24" length of ½" ID high-pressure hose between the solenoid valve and the airless spray valve enclosure.

Where an airless spray system for one machine is using two airless spray valve enclosures, a single 2-way fluid solenoid valve will be used to supply the lubricant to both airless spray valves, as shown above. The use of hoses and tee fittings is recommended. Mount the fluid solenoid valve on a surface near the airless spray valve enclosure suitable for supporting the solenoid valve.



Model 272285 2-Way Fluid Solenoid Valve (shown at left) is a 2-way fluid solenoid valve for use with the Airless Gear Spray lubrication systems. This valve is intended for use as a lubricant supply valve in applications where one common pump is used to supply lubricant to two or more airless spray systems, which are operating from two or more controllers. See Owner's Manual **Section C8 Page 294** for details and specifications.

The common pump used to supply lubricant to the system should be operated without an air solenoid valve, as recommended with the single systems. An air valve is recommended in the airline for the pump for service purposes. The pump should be allowed to stall against pressure in the system. The pump should develope enough pressure in the system so that all airless spray systems will see a minimum of 3500 PSI at the lube inlets.

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