

## Die-Lube



- STANDARD SYSTEM
- CYLINDRICAL SYSTEM
- DUAL SYSTEM
- PRESS MOUNT SYSTEM

# INTRODUCTION

## GENERAL DESCRIPTION

The Trabon Die-Lube System is an airless lubricant spray system designed for the metalworking industry. The Die-Lube system helps reduce lubricant consumption, increase productivity and increase die life. This is done by providing a clean, cost-effective method of applying controlled amounts of lubricant to areas that will benefit the most.

## TYPES OF SYSTEMS

There are four types of Die-Lube systems available to meet different die lubrication requirements. Anywhere from one to 16 pumps are available, depending on what system is ordered, to service up to 16 lubrication points. Each system is shipped with the necessary manifolds to support the pumps. The four systems are:

- **Standard System** - The standard system can be used for most lubrication requirements and is available in 5-, 15- and 30-gallon capacities.
- **Cylindrical System** - The cylindrical system holds up to 2-1/2 gallons (9.46 liters) of lubricant and is ideal for small and medium presses that require lubrication at only a few points.
- **Dual System** - The dual system offers two independently controlled groups of lubricant spray outputs for flexible lubrication application. Each group (referred to as Pump Bank A and Pump Bank B) can be equipped with up to four pumps for a total of eight pumps. The dual system is available in 15- and 30-gallon capacities.
- **Press Mount System** - The press mount system is designed to draw lubricant directly from a 55-gallon (208-liter) drum. This system is ideal for medium and large presses that require lubrication at many points in the metal forming process.

## BENEFITS AND FEATURES

Each of the Die-Lube systems offers many benefits and features:

- Each system can be field-modified - without factory assistance - to meet changing lubrication requirements.
- Each system can be used with a wide range of lubricant types and viscosities.
- Each system can be equipped with different electrical control modules to allow precise control of lubrication cycles.
- Individually adjustable pump volume controls eliminate over- and under-spraying at each lubrication point.
- Pump manifolds feature internally captured parts (spring and poppet) that will not fall out and get lost while changing pumps.
- Quick disconnect fittings can be installed on either side of the pump manifold to allow a choice of plumbing locations for “cleaner” spray tube plumbing.

## SYSTEM OVERVIEW

The block diagram in Figure 1, which uses the standard system as an example, illustrates how a typical system functions.

The Die-Lube system operates on 115 VAC, 60 Hz power. The control panel energizes the solenoid(s) at intervals determined by the control modules that are installed on the system. A control module may be a timer or counter. An external control source such as a limit switch, foot switch or machine PC may also be used.

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In the standard, dual and cylindrical systems, lubricant is supplied through the strainer to the inlet manifold by self-priming flooded suction (gravity feed). In the press mount system, lubricant is supplied through the suction line to the inlet manifold. In all systems, regulated shop air is also supplied to the inlet manifold through a filter-regulator-

lubricator (FRL) unit. From the inlet manifold, air and lubricant are supplied through separate ports to the pump manifolds. Each time the solenoid is energized, the pump is cycled and lubricant is pumped through tubing to the spray nozzles. For a detailed description on pump operation, refer to page 4.

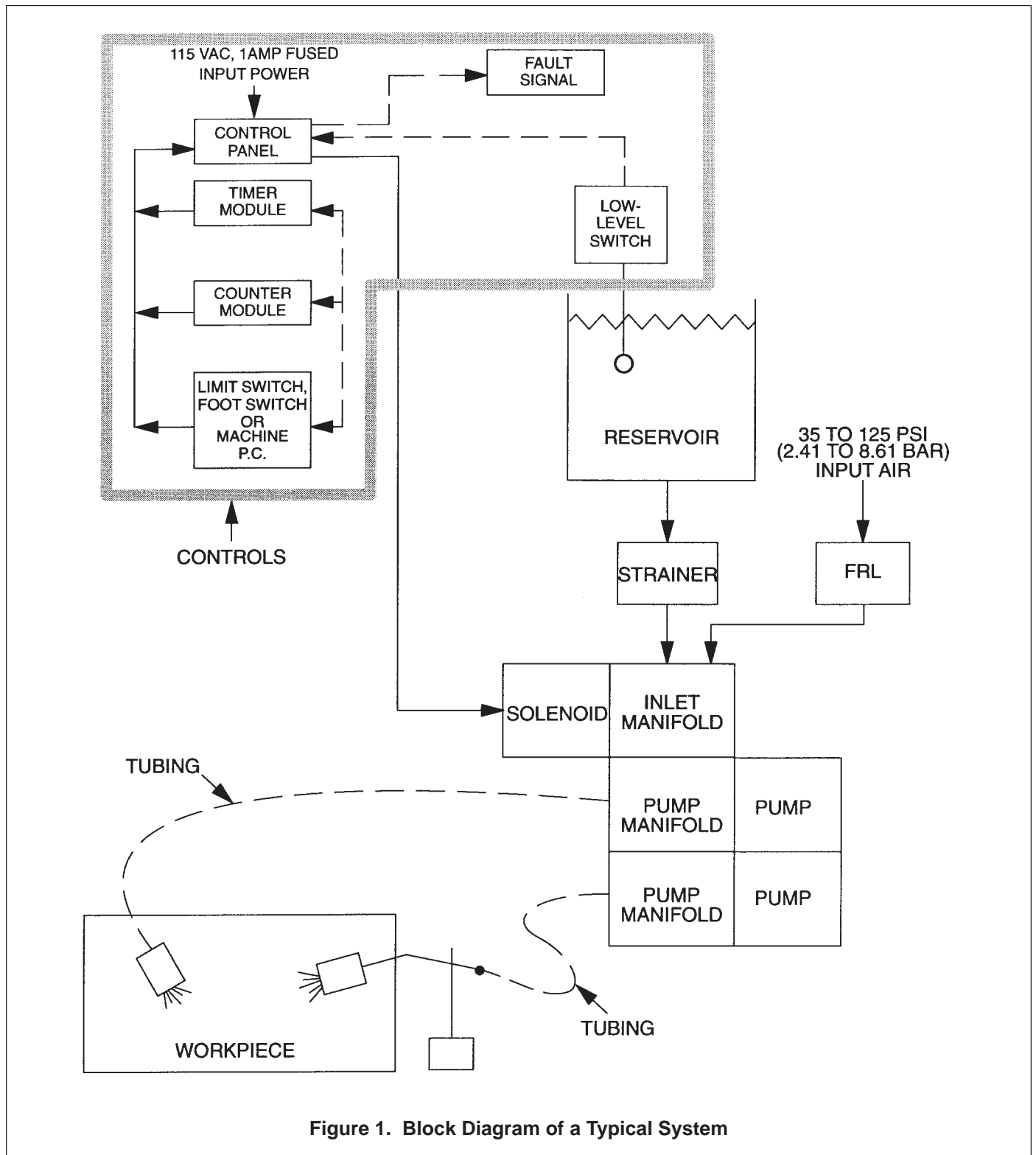


Figure 1. Block Diagram of a Typical System

## PUMPS

### DESCRIPTION

There are three types of pumps available for use on the Die-Lube systems:

- **Standard Pump** - The standard pump can be used for most applications with normal-viscosity lubricants. Refer to Comparison of Viscosity Classification Systems on page 24 for more information on lubricant viscosities.
- **High-Viscosity Pump** - The high-viscosity pump is capable of delivering high-viscosity lubricants for tough applications. Refer to Comparison of Viscosity Classification Systems on page 24 for more information on lubricant viscosities.
- **High-Volume Pump** - The high-volume pump delivers a higher volume of lubricant per stroke through a single nozzle. This is ideal for situations where only one nozzle can be used due to space limitations.

All pumps are constructed of stainless steel for increased dependability and longer life and include Viton seals throughout.

Figure 2 shows a standard pump. Table 1 lists pump data to help determine which pump is most suitable for a particular application.



**Figure 2. Pump (Standard Shown)**

### PUMP OPERATION

When the solenoid is deenergized, air under piston (1) (see Figure 3, View A) is exhausted through bottom manifold passage (2). At the same time, air flows from the air inlet through top manifold passage (3) forcing piston (1) downward.

When piston (1) is moving downward, a void is being created in chamber (4) (see Figure 3, View B). This void is filled by lubricant being forced in suction passageway (5) from the reservoir, which is at atmospheric pressure. The pressure on the lubricant in the reservoir is great enough to overcome the pressure of inlet check spring (6). Inlet valve poppet (7) then unseats and allows lubricant to flow freely into voided chamber (4).

When the solenoid is energized, the air on top of piston (1) (see Figure 3, View C) is exhausted through top manifold passage (3). At the same time, air flows from the inlet to bottom manifold passage (2). This air flow will cause piston (1) to move upward and apply a force to the lubricant in chamber (4). This force seats inlet valve poppet (7) and unseats outlet check ball (8). The pressurized lubricant in chamber (4) now flows out of the pump through Port 9 or 10 and applies its force to the lubricant already in the spray line. This force displaces lubricant through the spray nozzle.

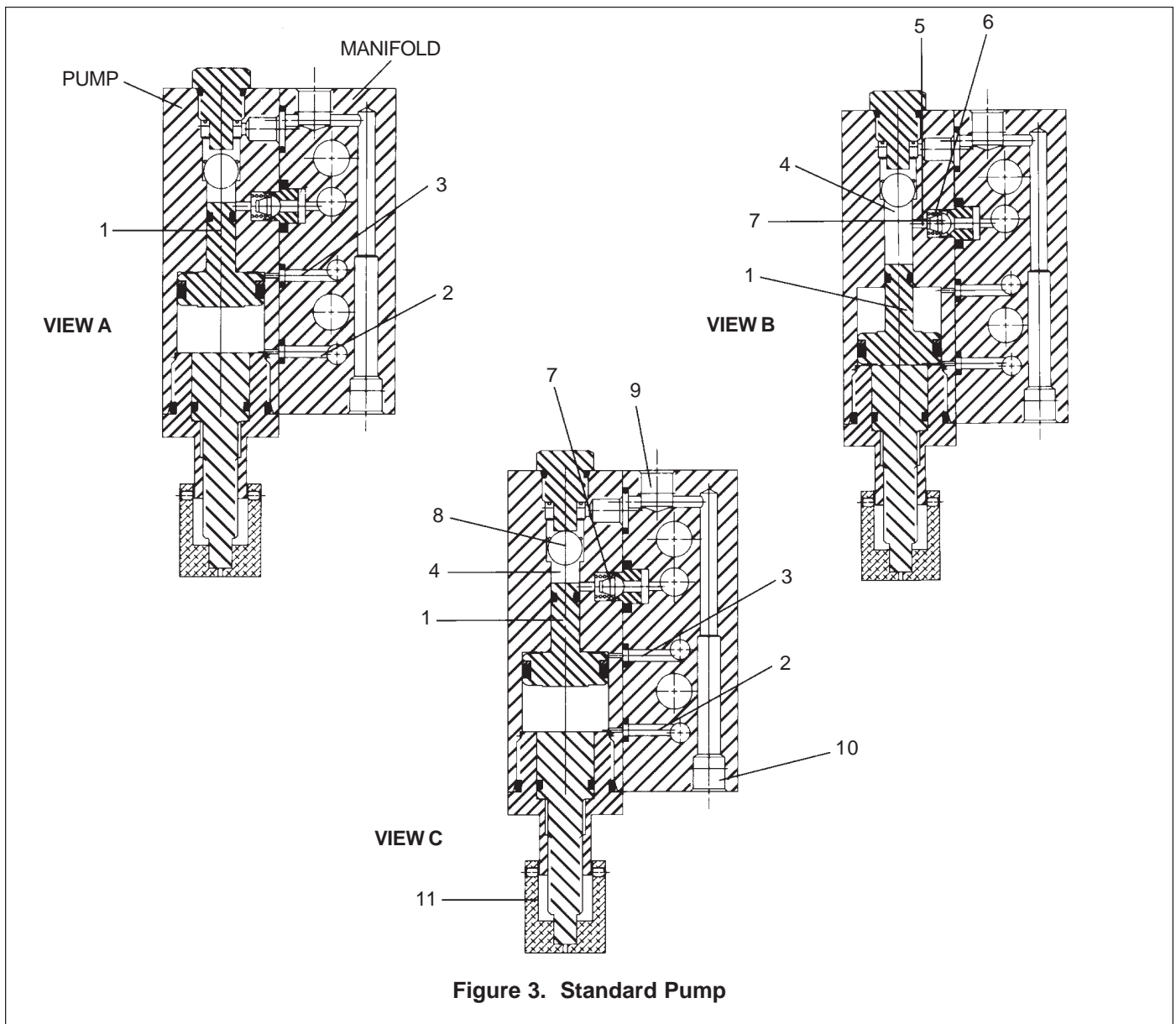
Lubricant volume to the spray nozzle is controlled by volume adjustment knob (11) (see Figure 3, View C) shown in the maximum volume position. When adjustment knob (11) is turned clockwise it will limit the stroke of piston (1), thus limiting the volume of lubricant in chamber (4). This allows each pump to be adjusted for the volume of lubricant required at a specific lubrication point.

Table 1. Pump Data

Pump	Output (Per Stroke)	Power Ratio	*Cycle Rate	Air Pressure	**Air Consumption (at 80 psi)
Standard	0 - 0.036 in <sup>3</sup> 0 - 0.59 cm <sup>3</sup>	9:1	350 cpm	35 - 125 psi (2.41 - 8.62 bar)	0.0024 scfm per cycle/pump
High-Volume	0 - 0.070 in <sup>3</sup> 0 - 1.15 cm <sup>3</sup>	9:1	160 cpm	35 - 125 psi (2.41 - 8.62 bar)	0.0048 scfm per cycle/pump
High-Viscosity	0 - 0.026 in <sup>3</sup> 0 - 0.43 cm <sup>3</sup>	25:1	160 cpm	35 - 125 psi (2.41 - 8.62 bar)	0.0048 scfm per cycle/pump

\* Higher cycle rates possible at reduced output

\*\* To determine total scfm per cycle, multiply number of pumps x pump scfm + 0.0024 (for solenoid scfm). Dual systems have two solenoids, so use 2 x 0.0024.



## STANDARD SYSTEM

### DESCRIPTION

The standard system can be used for most lubrication requirements and can be equipped with different control options to allow precise control of lubrication cycles. The standard system supplies lubricant to the pumps by self-priming flooded suction (gravity feed). The standard system is available in 5-, 15- and 30-gallon capacities. The 5-gallon standard system accommodates up to six pumps, while the 15- and 30-gallon standard systems accommodate up to ten pumps each. Each of the standard systems is portable in that it can be transferred to active presses as required.

A 5-gallon standard system with six pumps and optional counter module, timer module with two-position switch, air agitator, ten-foot power cord, external source connector, and mounting legs is shown in Figure 4. A 15-gallon standard system with ten pumps and optional counter module, timer module with two-position switch, power cord, and external source connector is shown in Figure 5. A 30-gallon standard system with ten pumps and optional counter module, timer module with two-position switch, air agitator, ten-foot power cord, and external source connector is shown in Figure 6. The standard system control panel is shown in Figure 7.

### FEATURES

Each of the standard systems comes equipped with the following features:

- Power Switch and Pilot Light
- Low-Level Switch and Fault Pilot Light
- Manual Cycle Pushbutton
- Panel-Mounted 1 Amp System Fuse
- 100-Mesh, 140-Micron Pump Inlet Strainer
- Reservoir Level Sight Glass
- Inlet Manifold Lubrication Supply Shutoff Valve
- Solenoid Valve
- Petcock Drain Valve
- Return-to-Reservoir Port
- Filter-Regulator-Lubricator Unit

### AVAILABLE OPTIONS

There are many options available to each of the standard systems that can be ordered factory installed or ordered separately for field installation. Refer to pages 12 through 18 for a complete description of all available options. The following options are available to the standard system:

- Timer Module
- Timer Module With Two-Position Switch
- Counter Module
- Magnetic Base Limit Switch
- Foot Switch
- External Source Connector
- Ten-Foot Power Cord
- 230 VAC Transformer
- Fault Relay
- Air Agitator
- Auto Fill Valve
- Mounting Legs
- Four-Wheel Cart



Figure 4. 5-Gallon Standard System



Figure 5. 15-Gallon Standard System

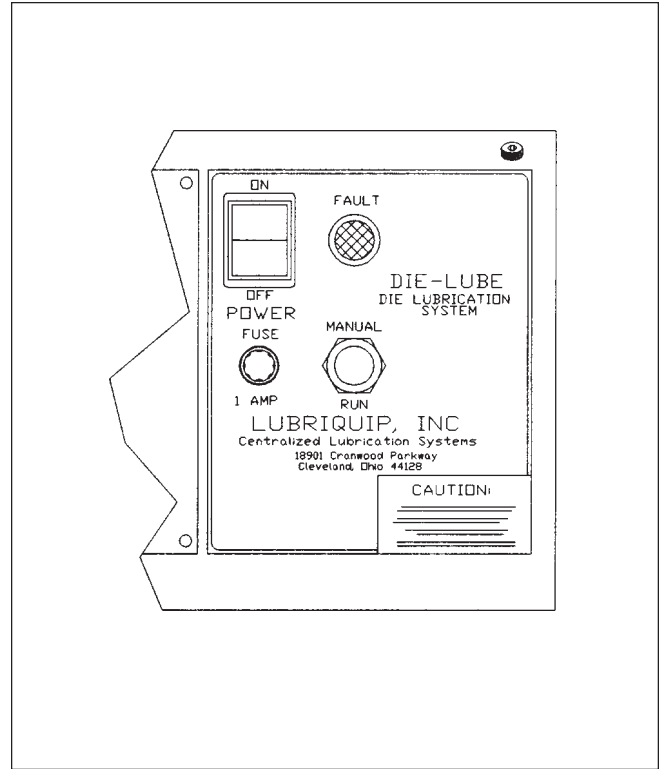


Figure 7. Standard System Control Panel

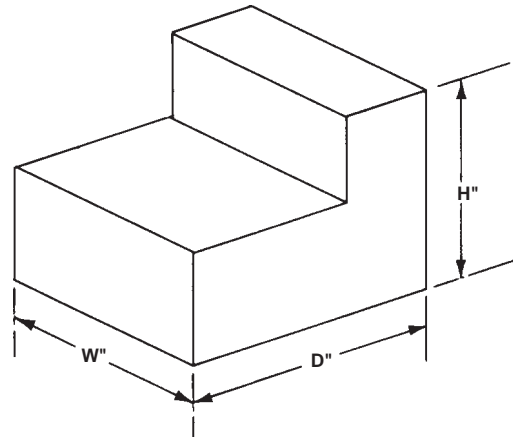


Figure 6. 30-Gallon Standard System

## SPECIFICATIONS

Standard system weights and dimensions are listed in Table 2. Utility requirements and material specifications are as follows:

- Reservoir Material - Stainless Steel
- Manifold Material - Aluminum Construction with Viton Seals Throughout
- Electrical - 115 VAC, 60 Hz, 1 amp
- Pneumatic - 35 psi (2.41 bar) Minimum to 125 psi (8.61 bar) Maximum



**Table 2. Standard System Weights and Dimensions**

Reservoir Capacity Gallons (l)	Width (W) Inches (mm)	Depth (D) Inches (mm)	Height (H) Inches (mm)	Weight* Pounds (kg)	Number of Pumps	Mounting Options	
						Wall	Leg
5 (18.9)	15 (381)	12.25 (311.1)	23 (584.2)	56 (25.5)	1 to 6	Std.	Yes
15 (56.8)	20 (508)	16.75 (425.4)	27 (685.8)	82 (37.3)	1 to 10	No	Yes
30 (113.6)	20 (508)	16.75 (425.4)	39 (990.6)	100 (45.5)	1 to 10	No	No

\* Dry weight with six pumps, no legs

## CYLINDRICAL SYSTEM

### DESCRIPTION

The cylindrical system holds up to 2-1/2 gallons (9.46 liters) of lubricant and is ideal for small and medium presses that require lubrication at only a few points. The cylindrical system supplies lubricant to the pumps by self-priming flooded suction (gravity feed). Up to four pumps can be installed on the cylindrical system.

The cylindrical system with two pumps and optional timer module is shown in Figure 8. Depending on the specific lubrication requirements, the cylindrical system can be ordered with one of three different control options. Refer to pages 13 and 14 for a complete description of all control options available to the cylindrical system.



Figure 8. Cylindrical System

### FEATURES

The cylindrical system comes equipped with the following features:

- Transparent Reservoir
- 40-Mesh, 420-Micron Reservoir Inlet Strainer
- Inlet Manifold Lubrication Supply Shutoff Valve
- Solenoid Valve
- Filter-Regulator-Lubricator Unit

### AVAILABLE OPTIONS

An optional low-level switch can be ordered factory installed or ordered separately for field installation. A manifold that accommodates up to two additional pumps can also be ordered. Refer to pages 12 through 15 for a complete description of all the available options.

### SPECIFICATIONS

Cylindrical system specifications are as follows:

- Dimensions - 7.25 inches (184.15 mm) wide x 18.63 inches (473.2 mm) high x 12 inches (304.8 mm) deep
- Weight - 15 pounds (6.8 kg)
- Reservoir Material - Extruded Butyrate
- Manifold Material - Aluminum Construction with Viton Seals Throughout
- Electrical - 115 VAC, 60 Hz, 1 amp
- Pneumatic - 35 psi (2.41 bar), Minimum to 125 psi (8.61 bar), Maximum

## DUAL SYSTEM

### DESCRIPTION

The dual system can be used for two different presses or two different parts of the same press. The dual system can be equipped with two timer module control options to allow precise control of lubrication cycles. The dual system supplies lubricant to the pumps by self-priming flooded suction (gravity feed). The dual system is available in 15- and 30-gallon capacities and each can accommodate up to eight pumps total. There are many pump configurations available to meet different application requirements. For example, Pump Bank A can include one pump (one manifold with the pump and a blanking plate) and Pump Bank B can include six pumps (three manifolds with two pumps each). Each of the dual systems is portable in that it can be transferred to active presses as required.

A 30-gallon dual system with eight pumps (four pumps for each output), two optional timer modules with ON OFF switch and ten-foot power cord is shown in Figure 9. The dual system control panel is the same as the standard system control panel shown in Figure 7, page 7.



Figure 9. 30-Gallon Dual System

### FEATURES

Each of the dual systems comes equipped with the following features:

- Power Switch and Pilot Light
- Low-Level Switch and Fault Pilot Light
- Manual Cycle Pushbutton
- Panel-Mounted 1 Amp System Fuse
- 100-Mesh, 140-Micron Pump Inlet Strainer
- Reservoir Level Sight Glass
- Inlet Manifold Lubrication Supply Shutoff Valve
- Two Solenoid Valves
- Petcock Drain Valve
- Return-to-Reservoir Port
- Filter-Regulator-Lubricator Unit

### AVAILABLE OPTIONS

Like the standard systems, there are many options available to each of the dual systems that can be ordered factory installed or ordered separately for field installation. Refer to pages 12 through 18 for a complete description of all available options. The following options are available to the dual system:

- Timer Module
- Ten-Foot Power Cord
- 230 VAC Transformer
- Fault Relay
- Air Agitator
- Auto Fill Valve
- Mounting Legs (for 15-gallon dual system only)
- Four-Wheel Cart

### SPECIFICATIONS

Specifications for the dual systems are identical to those of the standard systems. Refer to Table 2, page 8.

## PRESS MOUNT SYSTEM

### DESCRIPTION

The press mount system is designed to draw lubricant directly from a 55-gallon (208-liter) drum. This system is ideal for medium and large presses that require lubrication at many points in the metal forming process. Up to 16 pumps can be installed on the press mount system.

The press mount system with eight pumps and optional counter module, timer module with two-position switch, ten-foot power cord and external source connector is shown in Figure 10. The press mount system control panel is the same as the standard system control panel shown in Figure 7, page 7.



Figure 10. Press Mount System

### FEATURES

The press mount system comes equipped with the following features:

- Power Switch and Pilot Light
- Low-Level Fault Pilot Light
- Manual Cycle Pushbutton
- Panel-Mounted 1 Amp System Fuse
- 100-Mesh, 140-Micron Pump Inlet Strainer
- Inlet Manifold Lubrication Supply Shutoff Valve
- Solenoid Valve
- Filter-Regulator-Lubricator Unit
- Combination Suction/Low-Level Assembly (Shown in Figure 11)

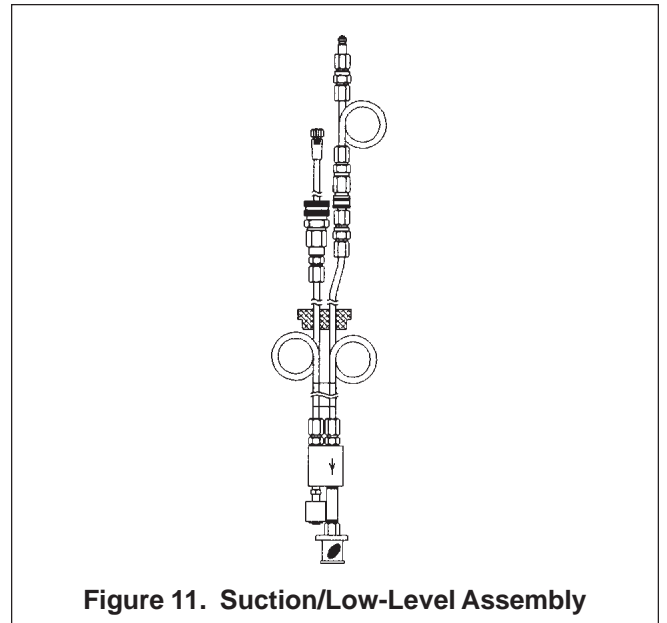


Figure 11. Suction/Low-Level Assembly

### AVAILABLE OPTIONS

Like the standard and dual systems, there are many options available to the press mount system that can be ordered factory installed or ordered separately for field installation. Refer to pages 12 through 18 for a complete description of all available options. The following options are available to the press mount system:

- Timer Module
- Timer Module With Two-Position Switch
- Counter Module
- Magnetic Base Limit Switch
- Foot Switch
- External Source Connector
- Ten-Foot Power Cord
- 230 VAC Transformer
- Fault Relay
- Power Prime Pump

### SPECIFICATIONS

Press mount system specifications are as follows:

- Dimensions - 25 inches (635.0 mm) wide x 16 inches (406.4 mm) high x 9 inches (230 mm) deep
- Weight - 50 pounds (22.7 kg)
- Mounting Bracket Material - Steel with powder coating
- Manifold Material - Aluminum Construction with Viton Seals Throughout
- Electrical - 115 VAC, 60 Hz, 1 amp
- Pneumatic - 35 psi (2.41 bar), Minimum to 125 psi (8.61 bar), Maximum

## CONTROL OPTIONS

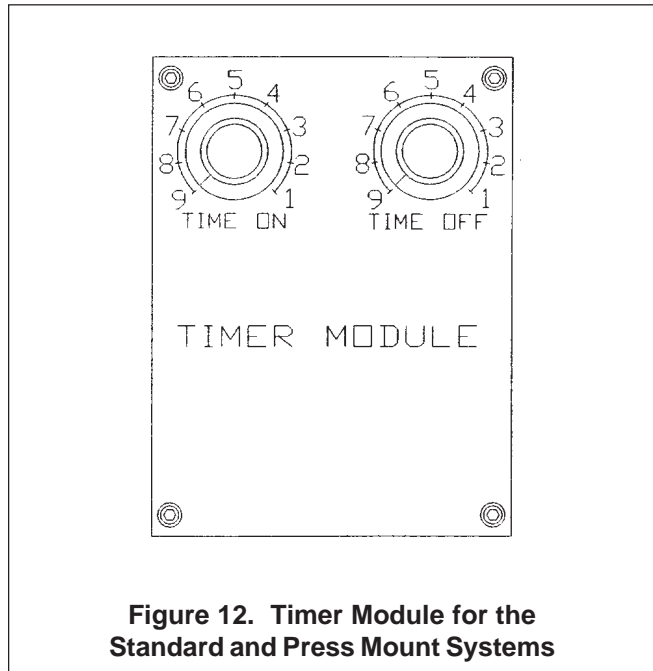
### TIMER MODULE FOR THE STANDARD AND PRESS MOUNT SYSTEMS. (See Figure 12.)

The timer module cycles the system based on time and is adjustable from 15 to 300 cycles per minute. The TIME ON dial controls the amount of time the solenoid is energized (lubricant discharging from pump chamber). The TIME OFF dial controls the amount of time the solenoid is deenergized (lubricant drawn into pump chamber). The combined total of the ON time and OFF time equals one cycle.

– Part Number 536-200-150, Option CT –

**NOTE**

When ordering the timer module for field installation to use with the counter module (if already installed), cable splitter kit, Part Number 536-200-130 must also be ordered.



**Figure 12. Timer Module for the Standard and Press Mount Systems**

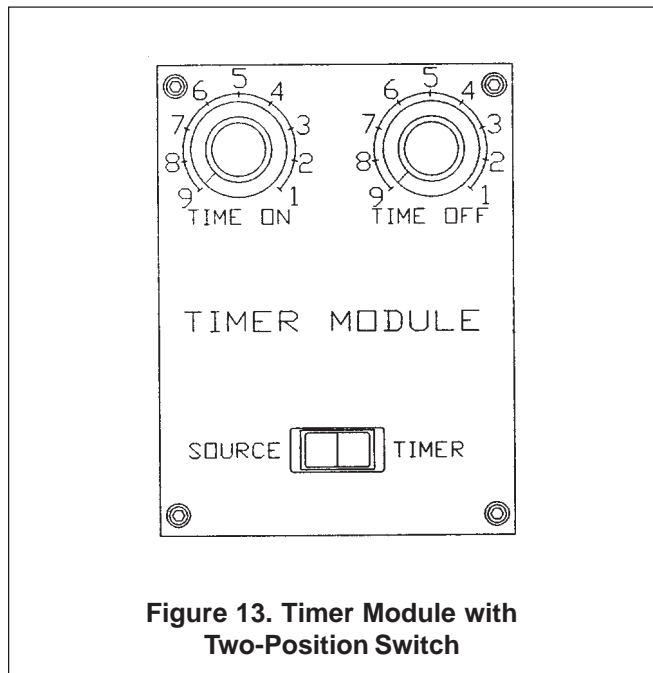
### TIMER MODULE WITH TWO-POSITION SWITCH FOR THE STANDARD AND PRESS MOUNT SYSTEMS. (See Figure 13.)

The timer module with two-position switch performs the same basic function as the timer module, Option CT, but can be operated in two modes. When the two-position switch is set to the SOURCE position the system will cycle once every time the limit or foot switch contacts (or other external dry contacts) close. When the switch is set to the TIMER position, the system will cycle at the rate set by the TIME ON and TIME OFF dials as long as the limit or foot switch contacts (or other external dry contacts) are closed.

– Part Number 536-200-170, Option CE –

**NOTE**

When ordering the timer module with two-position switch for field installation to use with the counter module (if already installed), cable splitter kit, Part Number 536-200-130 must also be ordered.



**Figure 13. Timer Module with Two-Position Switch**

### COUNTER MODULE AND TIMER MODULE.

The counter module and timer module can be ordered together as an option. This option allows either cycling method to be selected to meet different applications. However, only one cycling method (counter or timer) may be used at a time. When ordering this option, the external

source connector kit (Option ES) must also be ordered.

– Option CB –

**NOTE**

When ordering this option for field installation, cable splitter kit, Part Number 536-200-130 must also be ordered.

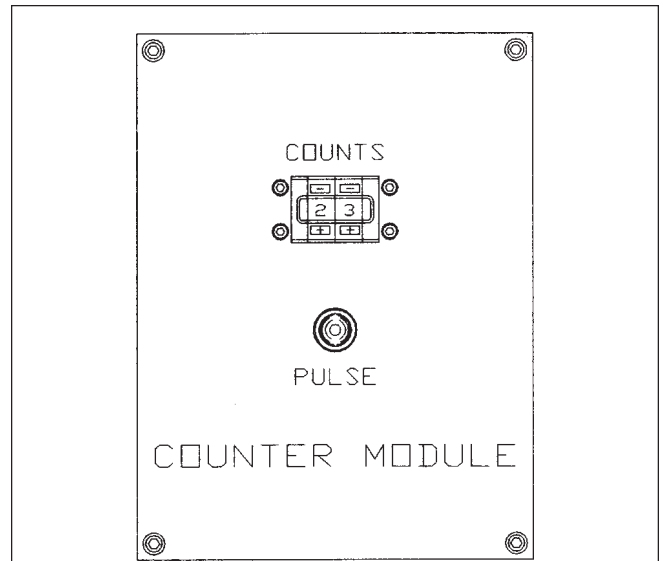
**COUNTER MODULE FOR THE STANDARD AND PRESS MOUNT SYSTEMS.** (See Figure 14.)

The counter module cycles the system using input signals from an external source such as a limit switch or press control relay (dry contact). The counter is adjustable from 1 to 99 counts. The system counts X amount of input signals (or pulses), then cycles the system one time (where X is whatever the counter is set to). When ordering the counter module, the external source connector kit (Option ES) must also be ordered.

– Part Number 536-200-160, Option CC –

**NOTE**

When ordering the counter module for field installation to use with either timer module (if already installed), cable splitter kit, Part Number 536-200-130 must also be ordered.

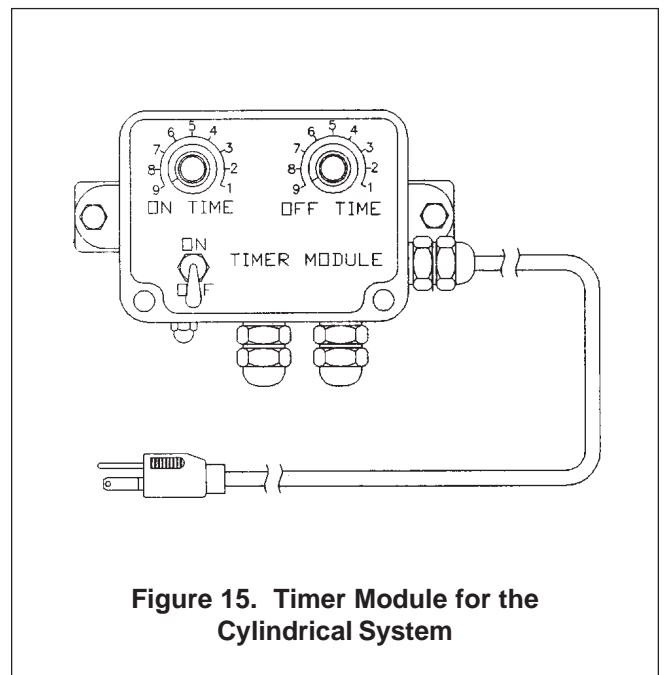


**Figure 14. Counter Module for the Standard and Press Mount Systems**

**TIMER MODULE FOR THE CYLINDRICAL SYSTEM.** (See Figure 15.)

The timer module cycles the system based on time and is adjustable from 15 to 300 cycles per minute. The TIME ON dial controls the amount of time the solenoid is energized (lubricant discharging from pump chamber). The TIME OFF dial controls the amount of time the solenoid is deenergized (lubricant drawn into pump chamber). The combined total of the ON time and OFF time equals one cycle. An external source such as a press control relay (dry contact) must be wired directly into the timer module. This allows multiple cycles upon contact closure at a rate determined by the timer setting. The timer module includes the electrical power switch and mounting bracket assembly.

– Part Number 536-200-410, Option CT –



**Figure 15. Timer Module for the Cylindrical System**

**COUNTER MODULE AND TIMER MODULE WITH TWO-POSITION SWITCH.**

The counter module and timer module with two-position switch can be ordered together as an option. This option allows either cycling method to be selected to meet different applications. However, only one cycling method (counter or timer) may be used at a time. When ordering

this option, the external source connector kit (Option ES) must also be ordered.

– Option CS –

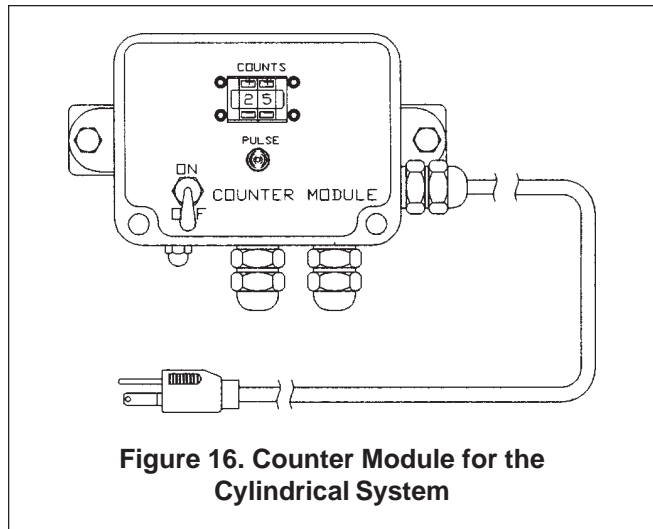
**NOTE**

When ordering this option for field installation, cable splitter kit, Part Number 536-200-130 must also be ordered.

**COUNTER MODULE FOR THE CYLINDRICAL SYSTEM.** (See Figure 16.)

The counter module cycles the system using input signals from an external source such as a press control relay (dry contact). The counter is adjustable from 1 to 99 counts. The system counts X amount of input signals (or pulses), then cycles the system one time (where X is whatever the counter is set to). The counter module includes the electrical power switch. The counter module includes a mounting bracket assembly.

- Part Number 536-200-420, Option CC -

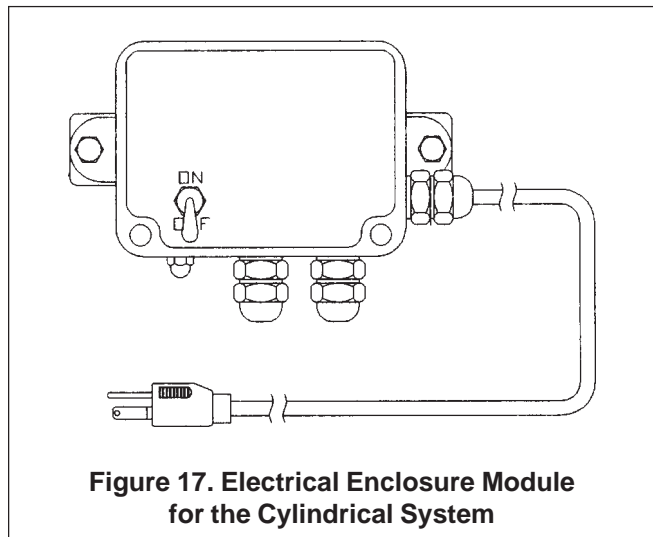


**Figure 16. Counter Module for the Cylindrical System**

**ELECTRICAL ENCLOSURE MODULE FOR THE CYLINDRICAL SYSTEM.** (See Figure 17.)

The electrical enclosure module includes a power switch and terminal strip for connecting an external source for cycling the system. An external source such as a press control relay (dry contact) must be used to cycle the system. The electrical enclosure module includes a mounting bracket assembly.

- Part Number 536-200-400, Option CE -

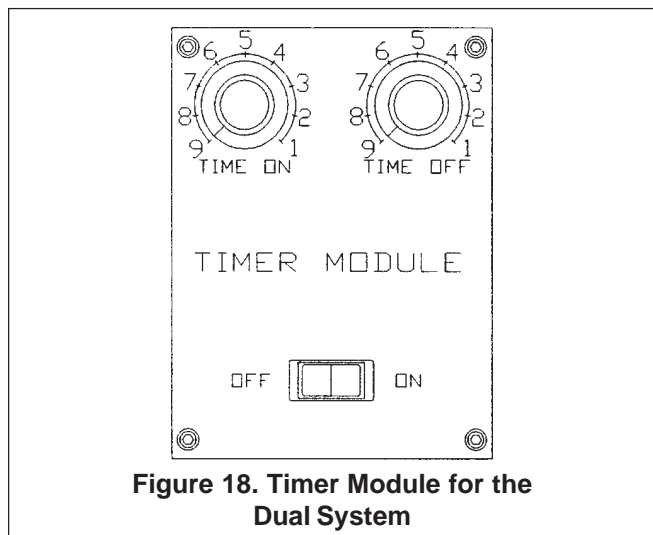


**Figure 17. Electrical Enclosure Module for the Cylindrical System**

**TIMER MODULE FOR THE DUAL SYSTEM.** (See Figure 18.)

Each pump bank on the dual system is controlled by its own timer module. Each timer module cycles its pumps based on time and is adjustable from 15 to 300 cycles per minute. The TIME ON dial controls the amount of time the solenoid is energized (lubricant discharging from pump chamber). The TIME OFF dial controls the amount of time the solenoid is deenergized (lubricant drawn into pump chamber). The combined total of the ON time and OFF time equals one cycle. Each timer module is independently controlled with its own ON/OFF switch.

- Part Number 536-200-390, Option CT -



**Figure 18. Timer Module for the Dual System**

## OTHER OPTIONS

### MAGNETIC BASE LIMIT SWITCH. (See Figure 19.)

The magnetic base limit switch can be mounted on a press so that the switch is tripped when a work piece is in position. The limit switch is connected to the external source connector (Option ES) to signal the counter module or timer module with two-position switch and cycle the system. The limit switch is mounted on a 200-lb. (90.5-kg) pull magnet with cam release and comes with a 12-foot (3.66-meter) cable and Brad Harrison connector. The magnetic base limit switch is available to the standard and press mount systems. The same limit switch is also available to the cylindrical system with two different connection options. Ring connectors or pre-stripped wire ends easily connect to the internal terminal strip in the control option.

- Part Number 536-200-200 (Brad Harrison Connector) -
- Part Number 536-200-470 (Ring Connectors - for cylindrical systems with counter or timer module) -
- Part Number 536-500-820 (Wire Ends - for cylindrical systems with electrical enclosure module) -

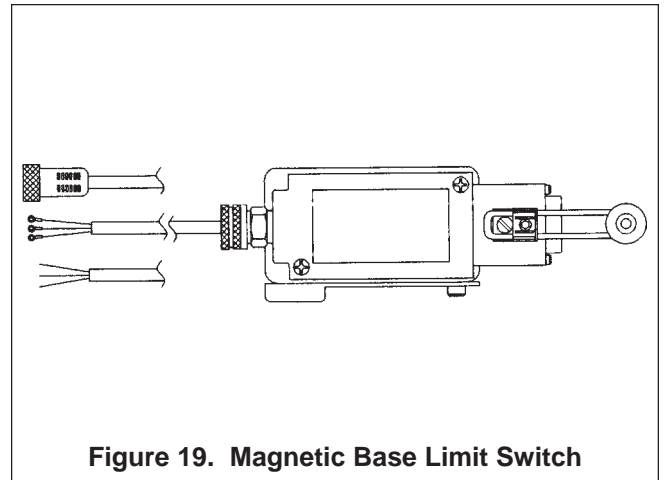


Figure 19. Magnetic Base Limit Switch

### FOOT SWITCH. (See Figure 20.)

The foot switch is used by the machine operator to cycle the system on demand. The foot switch is enclosed in a durable metal housing to prevent accidental actuation and comes with a 12-foot (3.66-meter) cable and Brad Harrison connector. The foot switch is available to the standard and press mount systems.

- Part Number 536-200-220 -

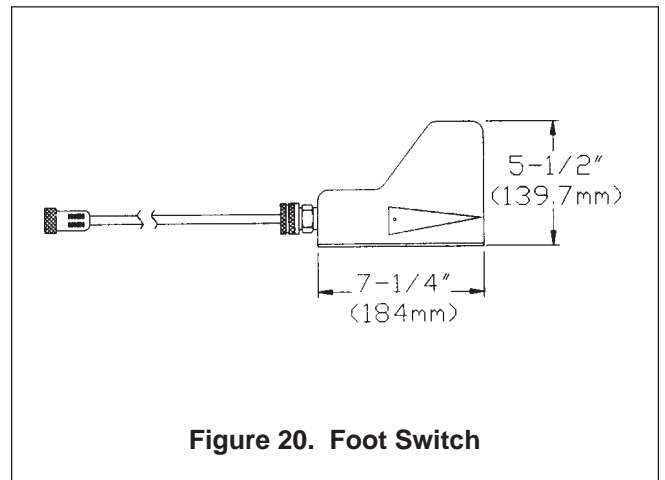


Figure 20. Foot Switch

### EXTERNAL SOURCE CONNECTOR KIT. (See Figure 21.)

The external source connector kit is a Brad Harrison female connector. The connector mounts on the side of the electrical enclosure and is wired to the terminal strip. The external source connector is used for connecting the magnetic base limit switch, foot switch or other actuating device with a Brad Harrison connector, to the counter module or to the timer with the two-position switch. The external source connector kit is available to the standard and press mount systems.

- Part Number 536-200-340, Option ES -

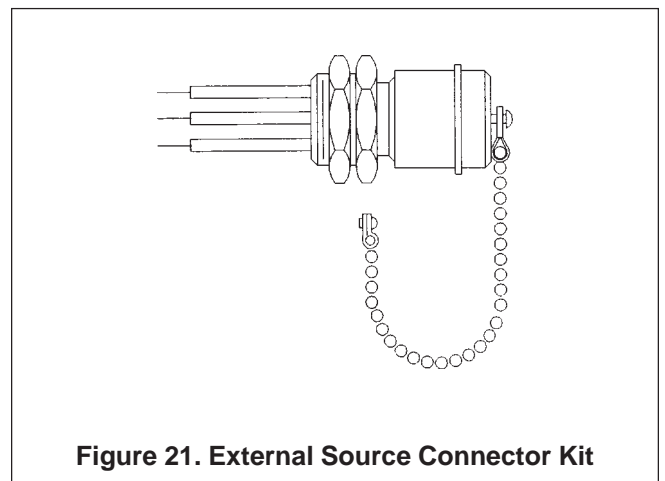
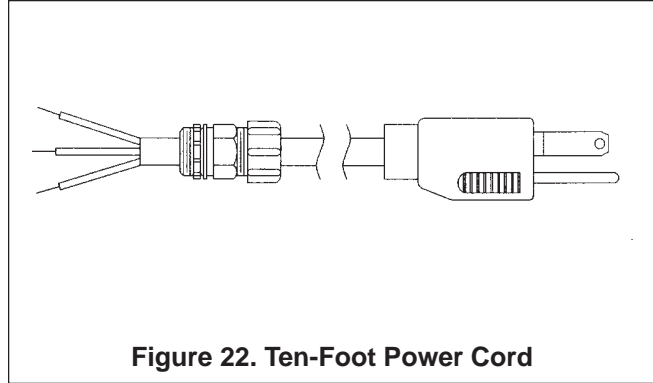


Figure 21. External Source Connector Kit

**TEN-FOOT POWER CORD.** (See Figure 22.)

The ten-foot (three-meter) power cord is used to provide 115 VAC power to electrical controls. The power cord can be installed in place of hard wiring if the lubrication system is to be moved around. The ten-foot power cord is available to the standard, dual and press mount systems. Each of the cylindrical system control options comes standard with the ten-foot power cord factory installed.

- Part Number 536-200-290, Option EP -

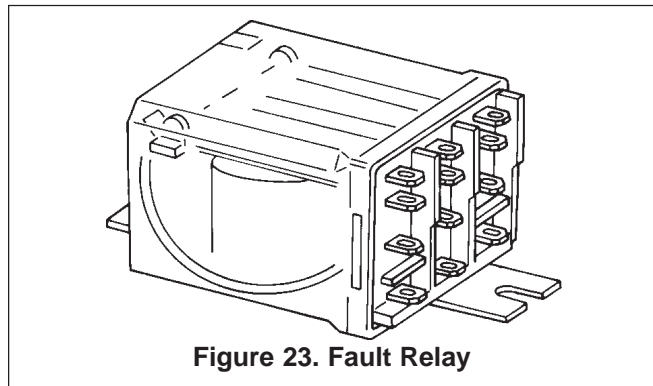


**Figure 22. Ten-Foot Power Cord**

**FAULT RELAY.** (See Figure 23.)

The fault relay is installed in the lubrication system electrical enclosure and wired to an external control device such as a machine controller. The relay will signal a lubrication low-level fault to allow press shutdown and prevent die damage. The relay has DPDT contacts rated for 15 amps at 250 VAC. This option is available to the standard, dual and press mount systems.

- Part Number 536-500-050, Option V2 -

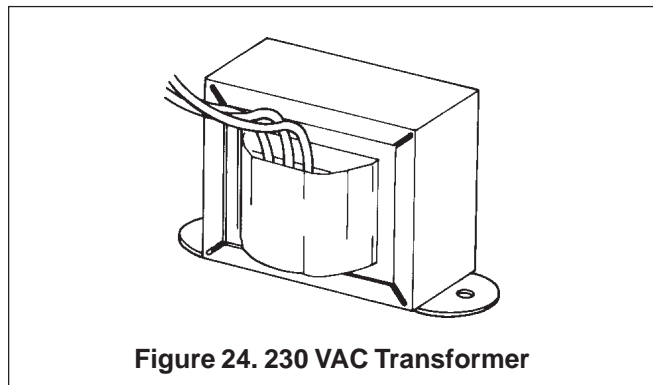


**Figure 23. Fault Relay**

**230 VAC TRANSFORMER.** (See Figure 24.)

The 230 VAC transformer converts 230 VAC incoming line voltage to 115 VAC. This option is available to the standard, dual and press mount systems.

- Part Number 536-500-090, Option V1 -



**Figure 24. 230 VAC Transformer**

**EXTERNAL SOURCE CONNECTOR KIT AND TEN-FOOT POWER CORD.**

The external source connector kit and ten-foot power cord can be ordered together as an option. This option is available to the standard and press mount systems only.

- Option EB -

**FAULT RELAY AND 230 VAC TRANSFORMER.**

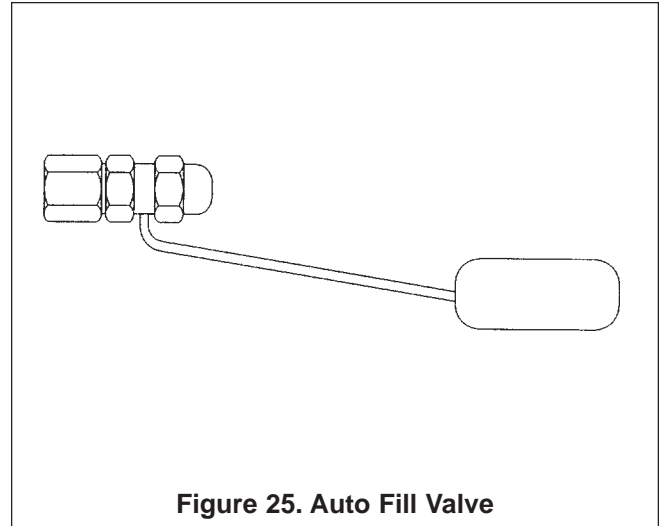
The fault relay and 230 VAC transformer can be ordered together as an option. This option is available to the standard, dual and press mount systems.

- Option V3 -

**AUTO FILL VALVE.** (See Figure 25.)

The auto fill valve is a float-actuated valve that allows the reservoir to be filled from a remote lubrication source. The valve is rated at 300 psi (20.68 bar) maximum. Flow rate is 3 gpm (11.36 lpm) at 100 psi (6.89 bar). The auto fill valve is available to the standard and dual systems.

- Part Number 536-500-040, Option A1 -

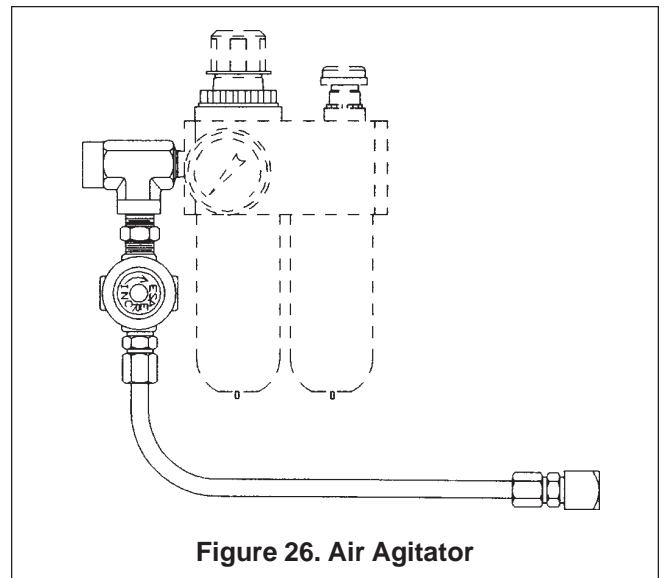


**Figure 25. Auto Fill Valve**

**AIR AGITATOR.** (See Figure 26.)

The air agitator connects to the pneumatic circuit. For lubricants that require occasional mixing, the agitator creates a mixing action in the reservoir by blowing pressurized air into the bottom of the reservoir. (NOTE: No mechanical moving components are involved.) The air agitator is available to the standard, dual and press mount systems.

- Part Number 536-500-031 (Standard and Dual Systems), Option B1 -
- Part Number 536-500-730 (Press Mount System), Option B1 -

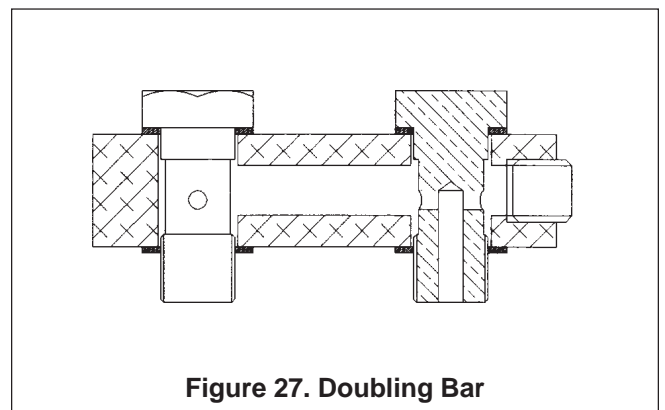


**Figure 26. Air Agitator**

**DOUBLING BAR.** (See Figure 27.)

The doubling bar connects two or more pump outputs at the manifold for higher volume requirements. The doubling bar is available to all lubrication systems.

- Part Number 536-500-000 -

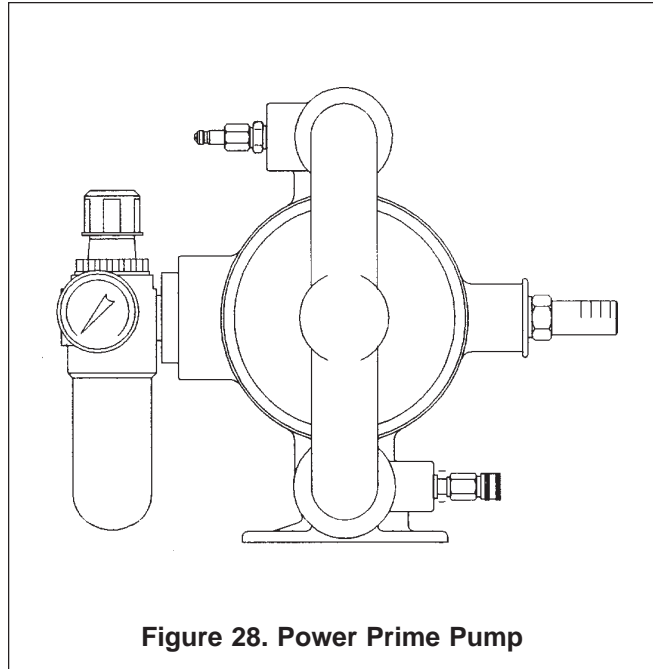


**Figure 27. Doubling Bar**

**POWER PRIME PUMP.** (See Figure 28.)

The power prime pump, available for the press mount system, is required when using lubricants with viscosities greater than 400 SUS, for any number of pumps.

- Part Number 536-500-740 -



**Figure 28. Power Prime Pump**

**MOUNTING LEG KIT.**

The mounting leg kit is available for supporting the standard and dual systems at 15 inches (381 mm) off the ground.

- Part Number 536-500-070 (5-Gallon), Option ML -
- Part Number 536-500-120 (15-Gallon), Option ML -

**FOUR-WHEEL CART.**

The four-wheel cart allows easy movement of the lubrication system from press to press. The cart is made of steel with rubber caster wheels and measures 18 x 24 x 5 inches (457.2 x 635 x 127 mm) deep. The four-wheel cart is available to the standard and dual systems.

- Part Number 536-200-020, Option MC -

**COMPONENTS AVAILABLE FOR INDIVIDUAL ORDERING**

Each of the components listed below can be ordered individually for field installation. Rebuild kits, also listed below, can be ordered for field repair.

Pump Assembly, Standard	536-500-510	Rebuild Kit, High-Viscosity Pump Assembly	536-500-500
Pump Assembly, High-Viscosity	536-500-570	Two-Pump Manifold	536-500-470
Pump Assembly, High-Volume	536-500-560	Blank Plate for Pump Manifold	536-500-080
Rebuild Kit, Standard Pump Assembly	536-500-500	Inlet Strainer	536-400-180
Rebuild Kit, High-Volume Pump Assembly	536-400-630		

## SPRAY ASSEMBLIES

**Basic Spray Assembly.** (See Figure 29.) The basic spray assembly consists of a ten-foot (three-meter) long, 1/4-inch (6.3 mm) O.D. nylon tubing with a male quick-connect plug at one end and the selected spray nozzle at the other end.

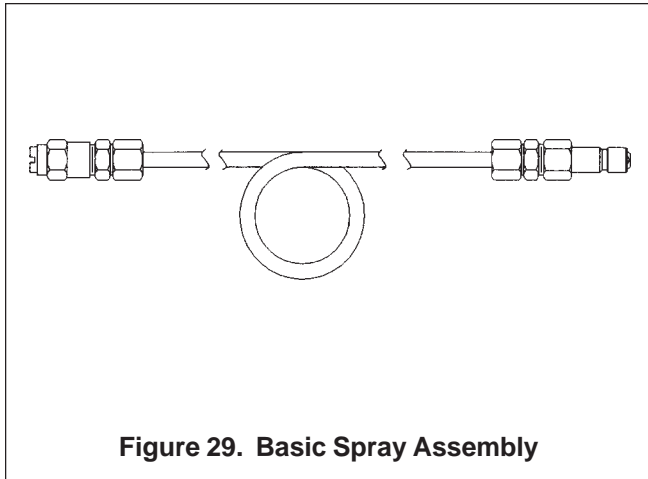


Figure 29. Basic Spray Assembly

**Magnetic Base Rigid Arm Spray Assembly.** (See Figure 30.) The magnetic base rigid arm spray assembly offers the advantage of quick setup time and flexible spray angle adjustment. This assembly consists of a 12-inch (304.8 mm) pole with a swivel clamp that holds the 11.75-inch long (298.5-mm) rigid spray tubing. The tubing has a 30 degree bend at the nozzle end. The tubing can be raised, lowered and pivoted about the pole by adjusting the clamp. The assembly comes with a 200-lb. (90.5-kg) pull magnet base with cam release and ten-foot (three-meter) long, 1/4-inch (6.3 mm) O.D. nylon tubing and male quick-connect plug.



Figure 30. Magnetic Base Rigid Arm Spray Assembly

**In-Die Spray Kits.** (See Figure 31.) An in-die spray kit can be mounted directly in the die to help reduce die change setup time. Each spray kit comes with a ten-foot (three-meter) long, 1/4-inch (6.3 mm) O.D. nylon tubing, male quick-connect plug and spray nozzle. The spray kit requires

a 1/8-inch (3.18-mm) diameter passage hole in the die with 11/32-inch (0.343 mm) diameter x 3/8 inch (9.53 mm) deep hole with 1/8-27 x 1/4 inch (6.35 mm) deep (minimum) tap at each end of the passage hole.

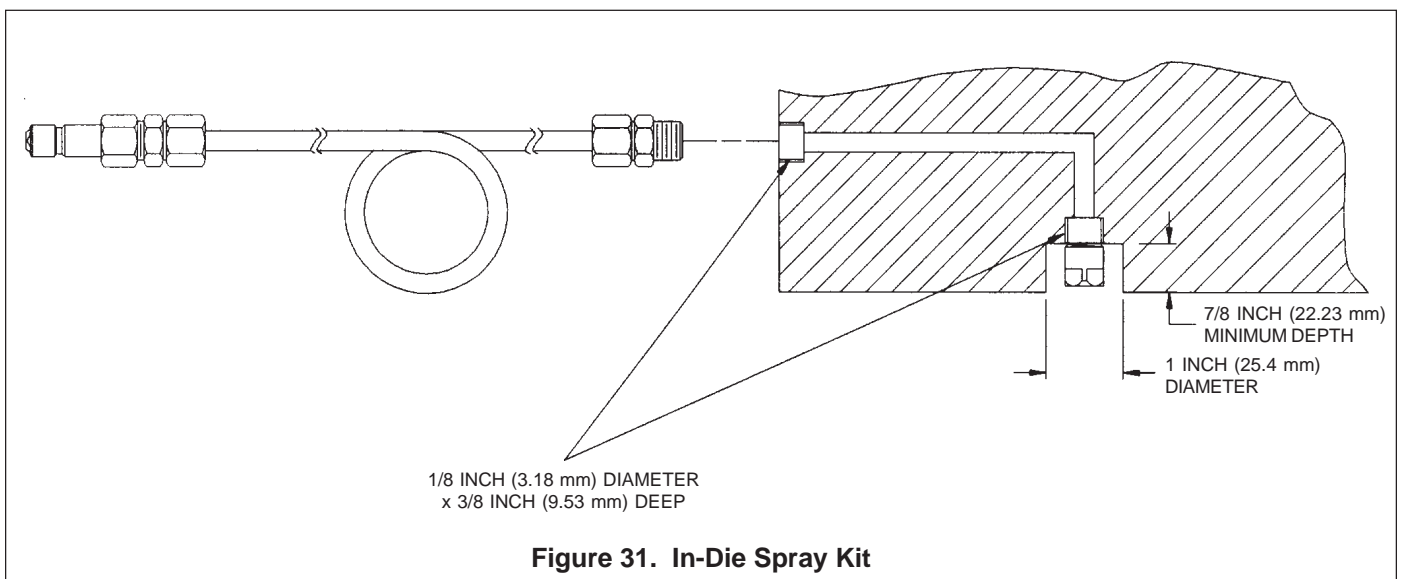


Figure 31. In-Die Spray Kit

## SPRAY APPLICATION COVERAGE

Figure 32, View A shows the spray patterns produced by the flat, round and deflector spray nozzles. Figure 32, View B shows how the spray pattern and coverage can be changed without changing the spray nozzle. In this ex-

ample, a round spray nozzle is used. For any given spray nozzle, spray displacement is adjustable at the associated pump.

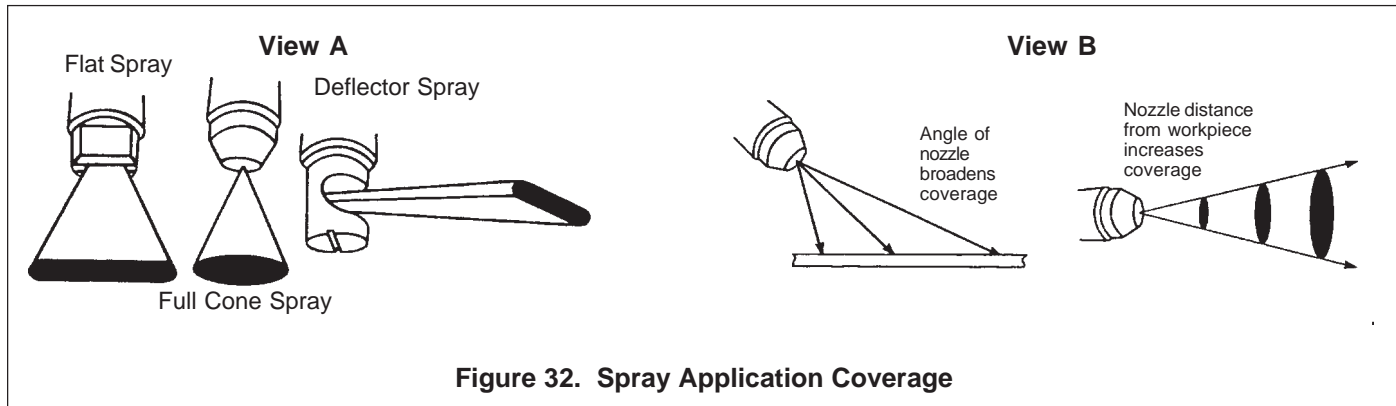


Figure 32. Spray Application Coverage

## SPRAY NOZZLE SELECTION GUIDE

To select a spray nozzle most suitable for a particular application, it is advisable to perform a test using the desired lubricant under field operating conditions. Table 3 shows the different spray patterns achieved for the standard and high-volume pumps during laboratory testing using the three spray nozzles and lubricants of various viscosities. Table 4 shows the spray pattern achieved for the high-viscosity pump using a flat spray nozzle. In both Tables 3 and 4 the spray nozzle column lists the number that appears on the spray nozzle portion of the assembly. The laboratory tests show that spray pattern quality decreases as the lubricant viscosity increases, starting with the lightest lubricants. Lubricants of similar viscosities may also have characteristics that affect the spray pattern.

Laboratory tests for the standard and high-volume pumps were performed under the following conditions:

- 9:1 Pump Ratio
- Full Output at 0.036 in<sup>3</sup> (0.09 cm<sup>3</sup>) for Standard Pump, 0.070 in<sup>3</sup> (0.18 cm<sup>3</sup>) for High-Volume Pump
- Pump Properly Bled
- System Air Pressure at 80 psi (5.51 bar)
- Spray Nozzle Positioned 6 Inches (152.4 millimeters) From Workpiece at 90 Degree Angle
- Ten-Foot (three-meter) Long, 1/4-Inch (6.35 mm) O.D. Nylon Tubing with 625 psi (43.07 bar) Working Pressure


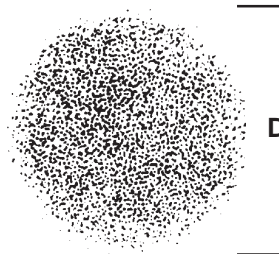

Laboratory tests for the high-viscosity pump were performed under the following conditions:

- 25:1 Pump Ratio
- Full Output at 0.026 in<sup>3</sup> (0.07 cm<sup>3</sup>)
- Pump Properly Bled
- System Air Pressure at 80 psi (5.51 bar)
- Spray Nozzle Positioned 6 Inches (152.4 mm) From Workpiece at 90 Degree Angle
- Ten-Foot (three-meter) Long, 1/4-Inch (6.35 mm) O.D. Rigid Tubing with 625 psi (43.07 bar) Working Pressure


In general, the flat spray nozzle operates under a wide range of lubricant viscosities, but the spray pattern tends to become more oval-shaped in the middle as the lubricant viscosity increases. The round spray nozzle is generally limited to water-soluble lubricants with viscosities of 50 SUS or less. The deflector spray nozzle is typically used where there is not sufficient space for mounting other nozzles. Deflector spray nozzle pattern quality is not as high as the flat spray nozzle pattern.

For any spray nozzle, better spray patterns can be achieved by using copper tubing (instead of nylon tubing) and/or keeping the tubing length as short as possible. Also, increasing the air pressure to the pumps (125 psi/8.61 bar maximum) will help improve spray pattern quality.

**Table 3. Spray Nozzle Selection Guide for Standard and High-Volume Pumps**

SUS @ 100 °F (37.8 °C)						
Pattern	Basic Spray Assembly ----- Rigid Spray Assembly	Spray Nozzle	Water Soluble <50 SUS inches (mm)	158 SUS inches (mm)	206 SUS inches (mm)	355 SUS inches (mm)
Flat  	536-450-100 ----- 536-450-500	25015	A X B 1.25 X 5 (31.75 x 127)	A X B 1 X 3.5 (25.4 x 88.9)	A X B 0.5 X 3.5 (12.7 x 88.9)	A X B 0.5 X 3 (12.7 x 76.2)
	536-450-120 ----- 536-450-520	50015	1.5 X 8 (38.1 x 203.2)	1 X 6.5 (25.4 x 165.1)	0.5 X 6.5 (12.7 x 165.1)	0.5 X 5.5 (12.7 x 139.7)
	536-450-140 ----- 536-450-540	80015	1 X 9 (25.4 x 228.6)	1 X 9 (25.4 x 228.6)	1 X 9 (25.4 x 228.6)	0.75 X 9 (19 x 228.6)
	536-450-150 ----- 536-450-550	110015	1 X 12 (25.4 x 304.8)	1 X 12 (25.4 x 304.8)	1 X 12 (25.4 x 304.8)	1 X 12 (25.4 x 304.8)
Round  	536-450-190 ----- 536-450-590	TG 2	D 5.5 (139.7)	D 2 (50.8)	D 1.5 (38.1)	D SQUIRT
	536-450-200 ----- 536-450-600	TG 1	5 (127)	2 (50.8)	1.5 (38.1)	SQUIRT
	536-450-210 ----- 536-450-610	TGO .7	4.5 (114.3)	2 (50.8)	1 (25.4)	SQUIRT
	536-450-220 ----- 536-450-620	TGO .5	4 (101.6)	2 (50.8)	0.75 (19)	SQUIRT
	536-450-230 ----- 536-450-630	TGO .3	4 (101.6)	1.75 (44.45)	0.75 (19)	SQUIRT
Deflector  	536-450-240 ----- 536-450-640	TK 1	A X B 1 X 15 (25.4 x 381)	A X B 2.5 X 18 (63.5 x 457.2)	—	—

**Table 4. Spray Nozzle Selection Guide for the High-Viscosity Pump**

SUS @ 100 °F (37.8 °C)			
Pattern	Basic Spray Assembly ----- Rigid Spray Assembly	Spray Nozzle	522 SUS inches (mm)
Flat  	536-450-420 ----- 536-450-800	500017	A X B 0.75 X 3.5 (19 x 88.9)
	536-450-430 ----- 536-450-810	650017	0.75 X 4.5 (19 x 114.3)
	536-450-440 ----- 536-450-820	11001	1.25 X 10 (31.75 x 250.4)

## APPLICATION RATE GUIDELINES

There are two mathematical methods that can be used to help determine how much lubricant is required for a particular application. The exact lubricant volume may also be determined empirically. Once the application rate is determined, the number of pumps and spray nozzles required can be determined. Refer to the Spray Nozzle Selection Guide on page 20. Some common fluid conversion factors that will be required for calculations are as follows:

- 1 drop (of lubricant) = 0.0025 in<sup>3</sup>
- 1 cubic centimeter (cc) = 0.061 in<sup>3</sup>
- 1 milliliter (ml) = 0.061 in<sup>3</sup>
- 1 teaspoon (tsp) = 0.3 in<sup>3</sup>
- 1 tablespoon (tbs) = 0.9 in<sup>3</sup>
- 1 fluid ounce (fl.oz.) = 1.8 in<sup>3</sup>

### Method 1

Method 1 is based on directly measuring the amount of lubricant required to produce a quality part. If the application amount can be measured, it can be converted to cubic inches (in<sup>3</sup>).

Example - A given application requires 0.5 ml of lubricant to produce a quality part. Convert 0.5 ml to in<sup>3</sup> as follows:

$$0.5 \times 0.061 = 0.030$$

0.030 in<sup>3</sup> of lubricant is required for this given application.

### Method 2

Method 2 uses observation and/or calculation, along with trial tests as required, to determine the proper application rate. This method is based on lube film thickness formulas over a known surface area to be covered. Given that a coat of oil is typically about 0.001 inch thick (a typical piece of writing/copy paper is 0.004 inch thick), the following formula is used:

$$V = A \times T$$

Where V = Volume (in<sup>3</sup>) of lubricant required, A = Surface Area (in<sup>2</sup>) of workpiece and T = Film Thickness (inches).

Example - A workpiece has surface area of 3 x 8 inches or 24 in<sup>2</sup>. Using the formula, the amount of lubricant required can be calculated as follows:

$$V = A \times T$$

$$V = 24 \text{ in}^2 \times 0.001 \text{ inch}$$

$$V = 0.024 \text{ in}^3$$

## VISCOSITY BLENDING CHART

When blending two lubricants of different viscosities, use the viscosity blending chart in Figure 33 to determine the blended viscosity as outlined in the following four steps:

1. Draw a line to connect the lower viscosity value (2 cst in this example) on the left side of the chart to the higher viscosity value (200 cst in this example) on the right side of the chart. (See Figure 33, STEP 1.)
2. Draw a vertical line from the percentage of the higher viscosity component (30% in this example) to intersect the line drawn in Step 1. (See Figure 33, STEP 2.)
3. Draw a horizontal line from the intersection point of the first two lines to either the lower or higher viscosity value scale on either side of the chart. This is the approximate blended viscosity (5 cst in this example). (See Figure 33, STEP 3.)

4. To determine the lubricant dilution rate, calculate using the following formula:

$$\begin{aligned} \text{\% (by volume) Dilution} &= \frac{\text{Compound}}{\text{Dilution Compound} + \text{Compound}} \\ &= \frac{1 \text{ Part Oil}}{1 \text{ Part Water} + 1 \text{ Part Oil}} \\ &= 1/2 = 50\% \text{ (or } 1 : 1) \end{aligned}$$

Some typical dilution rates are as follows:

- 1:1 = 50%    4:1 = 20%
- 2:1 = 33%    9:1 = 10%
- 3:1 = 25%

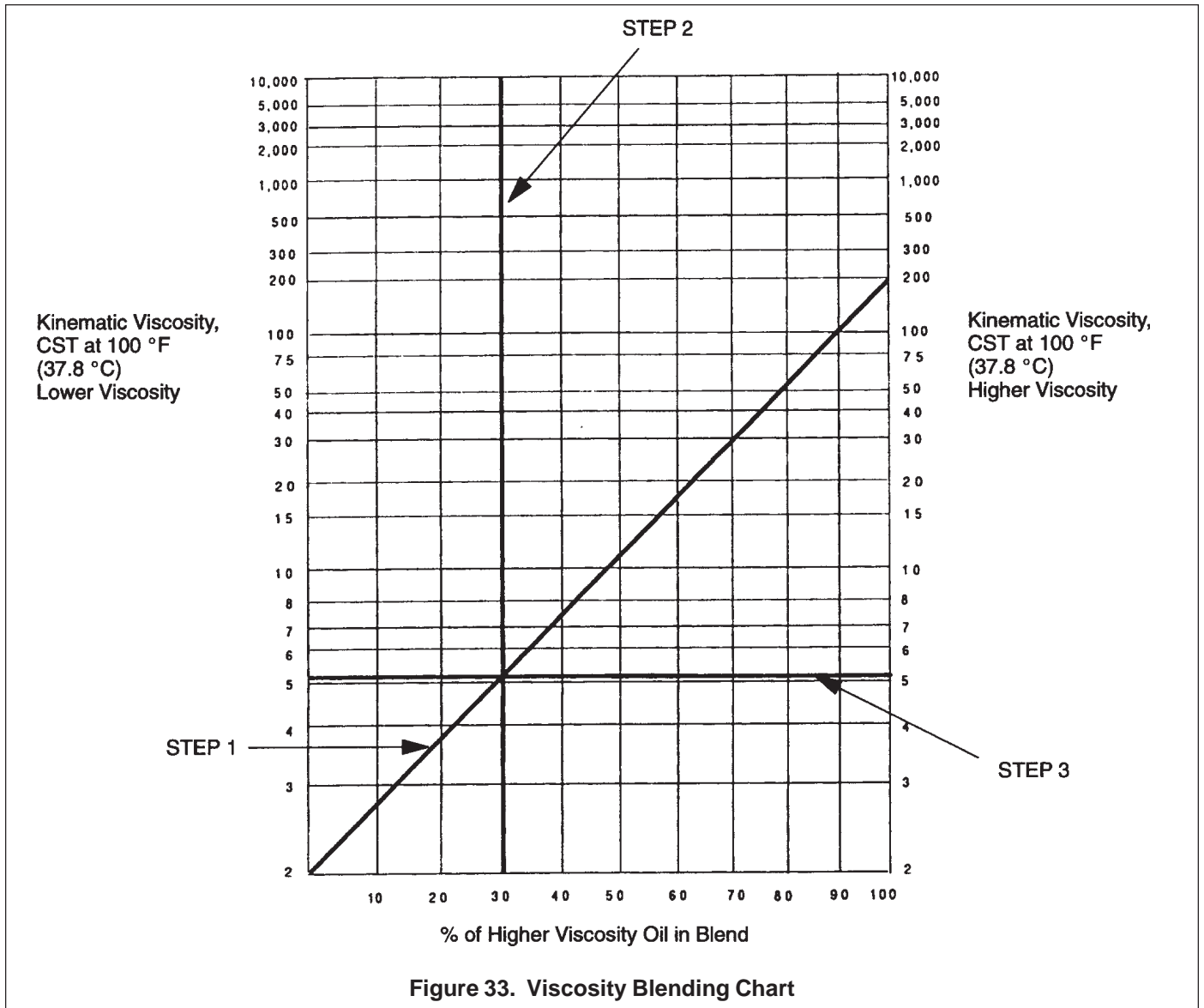


Figure 33. Viscosity Blending Chart

# COMPARISON OF VISCOSITY CLASSIFICATION SYSTEMS

The chart in Figure 34 gives a comparison of viscosity classification systems. Viscosities can be compared horizontally only and are based on 95 VI single-grade oils. The following temperature specifications apply:

- ASTM and AGMA specified at 100 °F (37.8 °C)
- SAE 5W, 10W, 75W, 80W and 85W specified at 0 °F (-17.8 °C)
- SAE 20 to 50 and 90 to 250 specified at 210 °F (98.9 °C)
- ISO Grades specified at 104 °F (40 °C)
- Equivalent viscosities for 100 and 210 °F (37.8 and 98.9 °C) shown

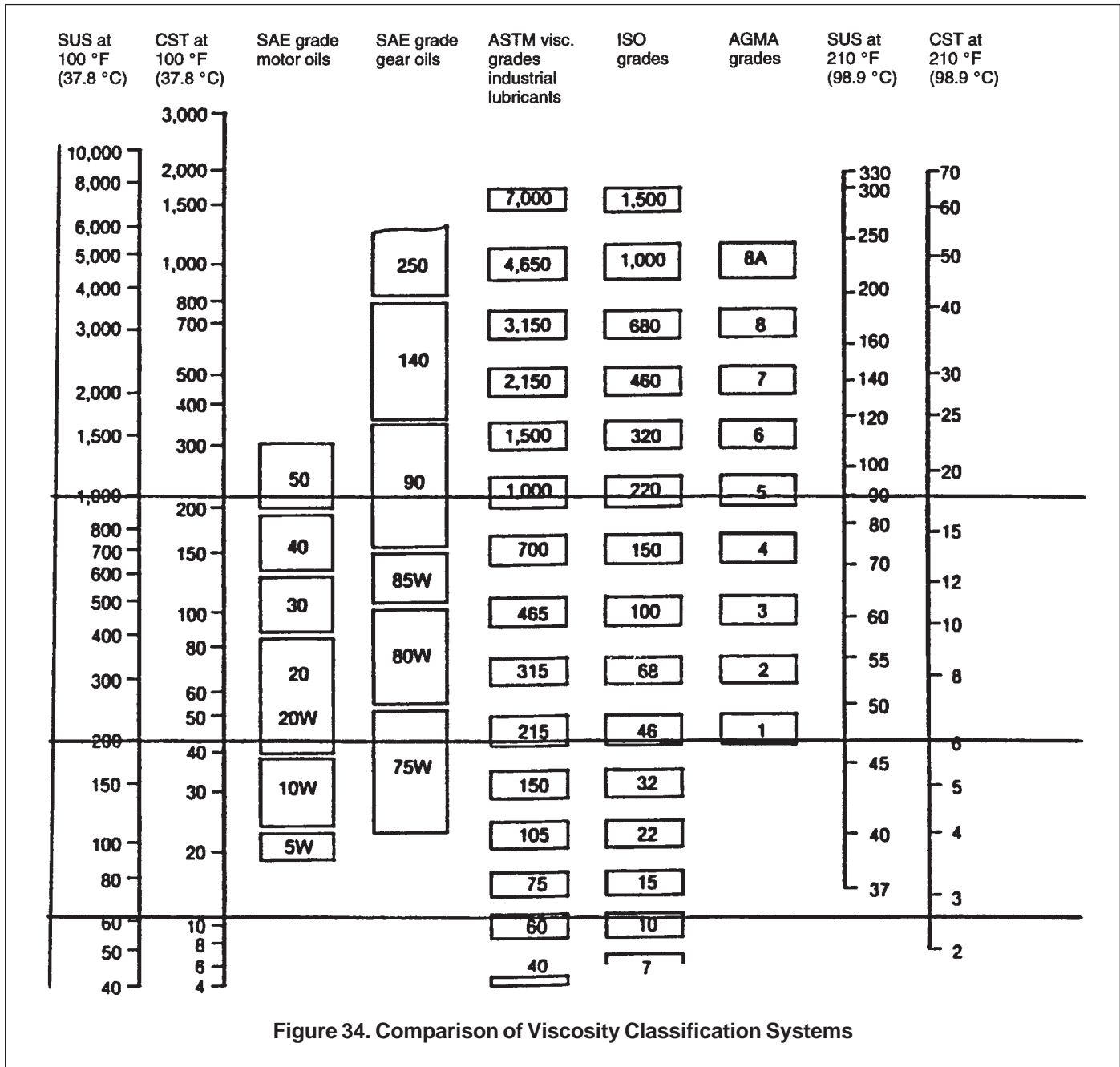


Figure 34. Comparison of Viscosity Classification Systems

## ORDERING MENU FOR STANDARD SYSTEM

LXX - XX - X - XX - XX - XX - XX - XX - XX

**RESERVOIR CAPACITY:** \_\_\_\_\_

- L5 - 5-GALLON RESERVOIR
- L15 - 15-GALLON RESERVOIR
- L30 - 30-GALLON RESERVOIR

**PUMP QUANTITY:** \_\_\_\_\_

- P1 - 1 PUMP } \_\_\_\_\_
  - P2 - 2 PUMPS } \_\_\_\_\_
  - P3 - 3 PUMPS } \_\_\_\_\_
  - P4 - 4 PUMPS } \_\_\_\_\_
  - P5 - 5 PUMPS } \_\_\_\_\_
  - P6 - 6 PUMPS } \_\_\_\_\_
  - P7 - 7 PUMPS } \_\_\_\_\_
  - P8 - 8 PUMPS } \_\_\_\_\_
  - P9 - 9 PUMPS } \_\_\_\_\_
  - P10 - 10 PUMPS } \_\_\_\_\_
- UP TO SIX PUMPS AVAILABLE  
ON ALL RESERVOIRS
- AVAILABLE ON 15- AND 30-  
GALLON RESERVOIRS

**PUMP TYPE:** \_\_\_\_\_

- S - STANDARD
- H - HIGH-VOLUME
- V - HIGH-VISCOSITY

**CONTROL OPTION:** \_\_\_\_\_

- CO - CONTROL PANEL ONLY
- CT - CONTROL PANEL WITH TIMER MODULE
- CC - CONTROL PANEL WITH COUNTER MODULE
- CB - CONTROL PANEL WITH TIMER AND COUNTER MODULES
- \*\*CE - CONTROL PANEL WITH TIMER MODULE AND TWO-POSITION SWITCH
- \*\*CS - CONTROL PANEL WITH COUNTER MODULE AND TIMER MODULE  
WITH TWO-POSITION SWITCH

**MOUNTING OPTION\*:** \_\_\_\_\_

- ML - MOUNTING LEGS - FOR 5- AND 15-GALLON RESERVOIRS ONLY
- MC - FOUR-WHEEL CART - ALL RESERVOIRS

**CONNECTION OPTION\*:** \_\_\_\_\_

- EP - TEN-FOOT POWER CORD (FOR 115 VAC ONLY)
- ES - EXTERNAL SOURCE CONNECTOR
- EB - TEN-FOOT POWER CORD AND EXTERNAL SOURCE CONNECTOR  
(FOR 115 VAC ONLY)

**AIR AGITATOR OPTION\*:** \_\_\_\_\_

- B1 - AIR AGITATOR

**ELECTRICAL OPTIONS\*:** \_\_\_\_\_

- V1 - 230 VAC TRANSFORMER
- V2 - FAULT RELAY OPTION
- V3 - 230 VAC TRANSFORMER AND FAULT RELAY

**AUTO FILL VALVE OPTION\*:** \_\_\_\_\_

- A1 - AUTO FILL VALVE

\* OMIT IF NOT REQUIRED

\*\*WHEN ORDERING THIS OPTION YOU MUST ALSO ORDER OPTION ES OR EB

# ORDERING MENU FOR CYLINDRICAL SYSTEM

LDL - R2 - XX - X - XX - XX

**PUMP OPTION (SEE NOTE 1):** \_\_\_\_\_

- P1 - 1 PUMP
- P2 - 2 PUMPS

**PUMP TYPE:** \_\_\_\_\_

- S - STANDARD
- H - HIGH-VOLUME
- V - HIGH-VISCOSITY

**CONTROL OPTION \*(SEE NOTE 2):** \_\_\_\_\_

- CE - ELECTRICAL ENCLOSURE MODULE ONLY
- CT - TIMER MODULE ONLY
- CC - COUNTER MODULE ONLY

**LOW LEVEL OPTION\*:** \_\_\_\_\_

- L2 - LOW-LEVEL SWITCH

\* OMIT IF NOT REQUIRED

### NOTES

1. FOR ADDITIONAL PUMPS, ORDER MANIFOLD KIT PART NUMBER 536-500-470 AND PUMP KIT PART NUMBER 536-500-510 (ONE PUMP PER KIT). A MAXIMUM OF FOUR PUMPS MAY BE USED ON THE CYLINDRICAL SYSTEM (INCLUDING THE TWO PUMPS AVAILABLE STANDARD FROM THE FACTORY).
2. TIMER AND COUNTER MODULES INCLUDE WIRING BETWEEN THE SOLENOID VALVE AND POWER CORD. BOTH MODULES ARE ALSO SUPPLIED WITH A CABLE CONNECTOR FOR EXTERNAL SOURCE CONNECTIONS. THE ELECTRICAL ENCLOSURE MODULE OPTION IS SUPPLIED WITHOUT A POWER CORD.
3. ABOVE ASSEMBLY IS FOR 115 VAC ONLY.

## ORDERING MENU FOR DUAL SYSTEM

DLXX - XXX - XXX - X - XXX - XXX - XX - XX - XX - XX - XX

**RESERVOIR CAPACITY:** \_\_\_\_\_

DL15 - 15-GALLON RESERVOIR ASSEMBLY  
DL30 - 30-GALLON RESERVOIR ASSEMBLY

**PUMP QUANTITY, PUMP BANK A\*\*:** \_\_\_\_\_

PA1 - 1 PUMP  
PA2 - 2 PUMPS  
PA3 - 3 PUMPS  
PA4 - 4 PUMPS  
PA5 - 5 PUMPS  
PA6 - 6 PUMPS

**PUMP QUANTITY, PUMP BANK B\*\*:** \_\_\_\_\_

PB1 - 1 PUMP  
PB2 - 2 PUMPS  
PB3 - 3 PUMPS  
PB4 - 4 PUMPS  
PB5 - 5 PUMPS  
PB6 - 6 PUMPS

**PUMP TYPE:** \_\_\_\_\_

S - STANDARD  
H - HIGH-VOLUME  
V - HIGH-VISCOSITY

**CONTROL OPTION, PUMP BANK A:** \_\_\_\_\_

COA - CONTROL PANEL ONLY  
CTA - CONTROL PANEL WITH TIMER MODULE

**CONTROL OPTION, PUMP BANK B:** \_\_\_\_\_

COB - CONTROL PANEL ONLY  
CTB - CONTROL PANEL WITH TIMER MODULE

**MOUNTING OPTION\*:** \_\_\_\_\_

ML - MOUNTING LEGS - FOR 15-GALLON RESERVOIR ONLY  
MC - FOUR-WHEEL CART

**CONNECTION OPTION\*:** \_\_\_\_\_

EP - TEN-FOOT POWER CORD (FOR 115 VAC ONLY)

**AIR AGITATOR OPTION\*:** \_\_\_\_\_

B1 - AIR AGITATOR

**ELECTRICAL OPTIONS\*:** \_\_\_\_\_

V1 - 230 VAC TRANSFORMER  
V2 - FAULT RELAY OPTION  
V3 - 230 VAC TRANSFORMER AND FAULT RELAY

**AUTO FILL VALVE OPTION\*:** \_\_\_\_\_

A1 - AUTO FILL VALVE

\* OMIT IF NOT REQUIRED

\*\* THE MAXIMUM AMOUNT OF PUMPS THAT CAN BE INSTALLED ON BOTH PUMP BANKS A AND B IS EIGHT. IF SIX PUMPS ARE ORDERED FOR PUMP BANK A (PA6), THEN ONLY ONE OR TWO PUMPS CAN BE ORDERED FOR PUMP BANK B (PB1 OR PB2). A MINIMUM OF ONE PUMP MUST BE ORDERED FOR EACH PUMP BANK (PA1 AND PB1).

# ORDERING MENU FOR PRESS MOUNT SYSTEM

DDM - XX - X - XX - XX - XX - XX - XX

**PUMP QUANTITY:** \_\_\_\_\_

- P2 - 2 PUMPS
- P4 - 4 PUMPS
- P6 - 6 PUMPS
- P8 - 8 PUMPS
- P10 - 10 PUMPS
- P12 - 12 PUMPS
- P14 - 14 PUMPS
- P16 - 16 PUMPS

**PUMP TYPE:** \_\_\_\_\_

- S - STANDARD
- H - HIGH-VOLUME
- V - HIGH-VISCOSITY

**CONTROL OPTION:** \_\_\_\_\_

- CO - CONTROL PANEL ONLY
- CT - CONTROL PANEL WITH TIMER MODULE
- CC - CONTROL PANEL WITH COUNTER MODULE
- CB - CONTROL PANEL WITH TIMER AND COUNTER MODULES
- \*\*CE - CONTROL PANEL WITH TIMER MODULE AND TWO-POSITION SWITCH
- \*\*CS - CONTROL PANEL WITH COUNTER MODULE AND TIMER MODULE WITH TWO-POSITION SWITCH

**CONNECTION OPTION\*:** \_\_\_\_\_

- EP - TEN-FOOT POWER CORD (FOR 115 VAC ONLY)
- ES - EXTERNAL SOURCE CONNECTOR KIT
- EB - TEN-FOOT POWER CORD AND EXTERNAL SOURCE CONNECTOR KIT (FOR 115 VAC ONLY)

**AIR AGITATOR OPTION\*:** \_\_\_\_\_

- B1 - AIR AGITATOR

**ELECTRICAL OPTIONS\*:** \_\_\_\_\_

- V1 - 230 VAC TRANSFORMER
- V2 - FAULT RELAY OPTION
- V3 - 230 VAC TRANSFORMER AND FAULT RELAY

**POWER PRIME PUMP OPTION\*:** \_\_\_\_\_

- FP - POWER PRIME PUMP

\* OMIT IF NOT REQUIRED

\*\*WHEN ORDERING THIS OPTION YOU MUST ALSO ORDER OPTION ES OR EB

All written and visual data contained in this document are based on the latest product information available at the time of publication. Graco reserves the right to make changes at any time without notice

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