

Operation Manual-SCT II

SP 2000



Part# 98515456

Revision: 1.0

Date: 03/14/25



SCHWING
AMERICA INC.

5900 Centerville Road
St. Paul, MN 55127
1-888-SCHWING (724-9464)
www.schwing.com

**CALIFORNIA PROPOSITION 65 WARNING**

Breathing diesel engine exhaust exposes you to chemicals known to the State of California to cause cancer, birth defects, and other reproductive harm. Always start and operate the engine in a well-ventilated area. If in an enclosed area, vent the exhaust to the outside. Do not modify or tamper with the exhaust system. Do not idle the engine except as necessary. For more information go to www.P65warnings.ca.gov/diesel.



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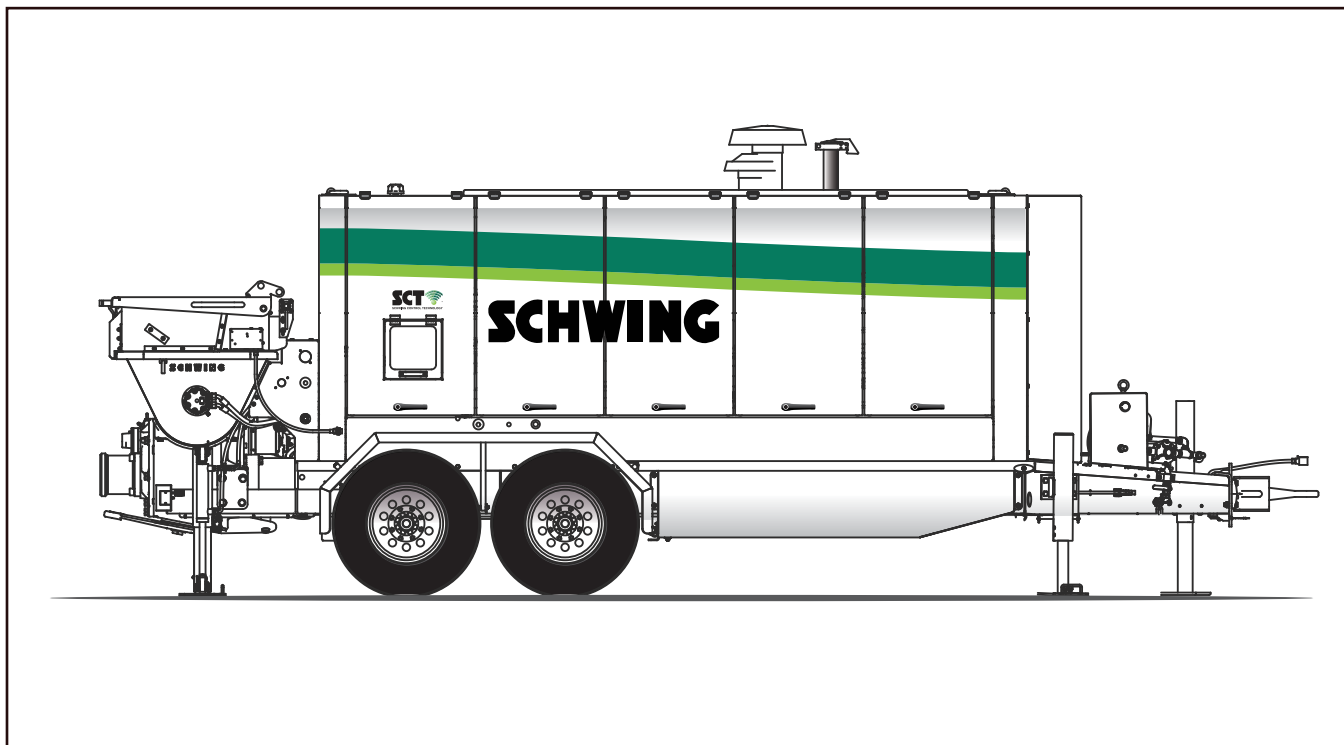
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Manufacturer's Statement

SCHWING America is a member of the SCHWING Group, a worldwide designer, manufacturer, and distributor of premium concrete production and handling equipment, headquartered in Herne, Germany. SCHWING is committed to supporting customer success, and excels in producing high quality concrete equipment used in the most demanding construction applications through innovative engineering, premiere manufacturing, and optimum after-sales support. SCHWING America, located in St. Paul, Minnesota, offers industry leading concrete pumps, truck conveyors, and genuine parts for distribution in North and Latin America.

The information contained in this operation manual is absolutely necessary for the setup, operation, maintenance, and servicing of your concrete pump. All operators should become familiar with the information in this manual as it will promote safety, efficiency of operation, and long life of the equipment. Keep this manual and all included literature in a safe and convenient location.

Read and understand this manual before operating, repairing, or adjusting your SCHWING concrete pump. Individuals who operate and maintain it must be trained and know the equipment. Death or severe injury can occur if this equipment is misused or poorly maintained.

Illustrations may look slightly different from the actual machine but only in ways that do not fundamentally change the information presented.

New editions of the operation manual will be created as technical modifications are made to this machine



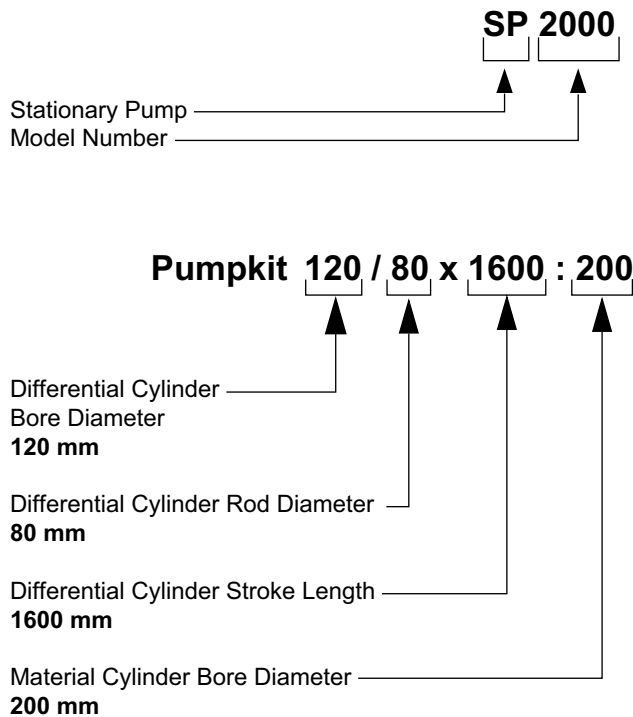
Concrete Pump Nomenclature



The complete model number of a SCHWING concrete pump is designated by the following code:

SP 2000
120/80 x 1600:200

The code is broken down as follows:



How to Reach Us

If you encounter a circumstance that is not covered by this manual, the SCHWING Service Center is more than happy to assist you with all of your parts and service needs.

- Service Center: **1-888-292-0262**
- Spare Parts: **1-800-328-9635**
- Spare Parts (Fax): **(651) 429-2112**
- Minnesota (Main Office): **(651) 429-0999**

To place an order for spare parts, go online to **Schwingparts.com**, or call the toll free spare parts line from anywhere in the continental United States. Hours are Monday through Friday from 6:00 am to 6:00 pm (Central time). Orders will also be accepted via fax 24 hours a day.

When contacting the Service Center please provide the concrete pump model and serial number. You can find the model and serial number on the ID tag (Figure 1) that is mounted to the subframe of the unit (Figure 2).

Identification Tag (ID Tag)

An ID tag (Figure 1) lists the model and serial number of the concrete pump. This tag also provides information on the pumpkit, weights, year of manufacture, and material and hydraulic system pressures.

ID tags and serial numbers shown in this manual are for "REFERENCE ONLY." Locate each of the tags on your own unit to determine specific information for your pump.

Schwing America 5900 Centerville Rd White Bear, MN 55127 Phone: 651-429-0999 www.schwing.com		SUBSIDIARY OF SUBSIDIARIA DE		Schwing GmbH Heerstrasse 8-27 D-44653 Herne / Germany Phone +49-2325-987-0 www.schwing.de	
This product is covered by one or more U.S. patents - see patent decal / Este producto está cubierto por una o más patentes de Estados Unidos-vea la etiqueta					
MODEL MODELO	SERIAL # # DE SERIE	YEAR AÑO	MAX SPM	HP kW	
WEIGHTS/LOADS/PESO/CARGA					
Total Weight Peso Total	LBS N	Tongue Weight Lengua De Peso	LBS N	Allowable Vertical Tongue Load Carga Vertical Permissible	LBS N
HYDRAULIC PRESSURES/PRESIONES HIDRAULICAS					
Concrete Pump / Bomba De Concreto	P.S.I. bar	Agitator El Agitador	P.S.I. bar	Accumulator El Acumulador	P.S.I. bar
MATERIAL PRESSURE/PRESIONES					
	P.S.I. bar	Auxiliary Auxiliar	P.S.I. bar	Material RS	PS PS

Figure 1
ID Tag

How to Order Missing Tags

If an ID tag is missing or has been removed, a new tag can be ordered through the SCHWING Service Center. Simply provide the concrete pump serial number, and a new ID tag will be created. The serial number is punched into the steel subframe near the ID Tag (Figure 2).

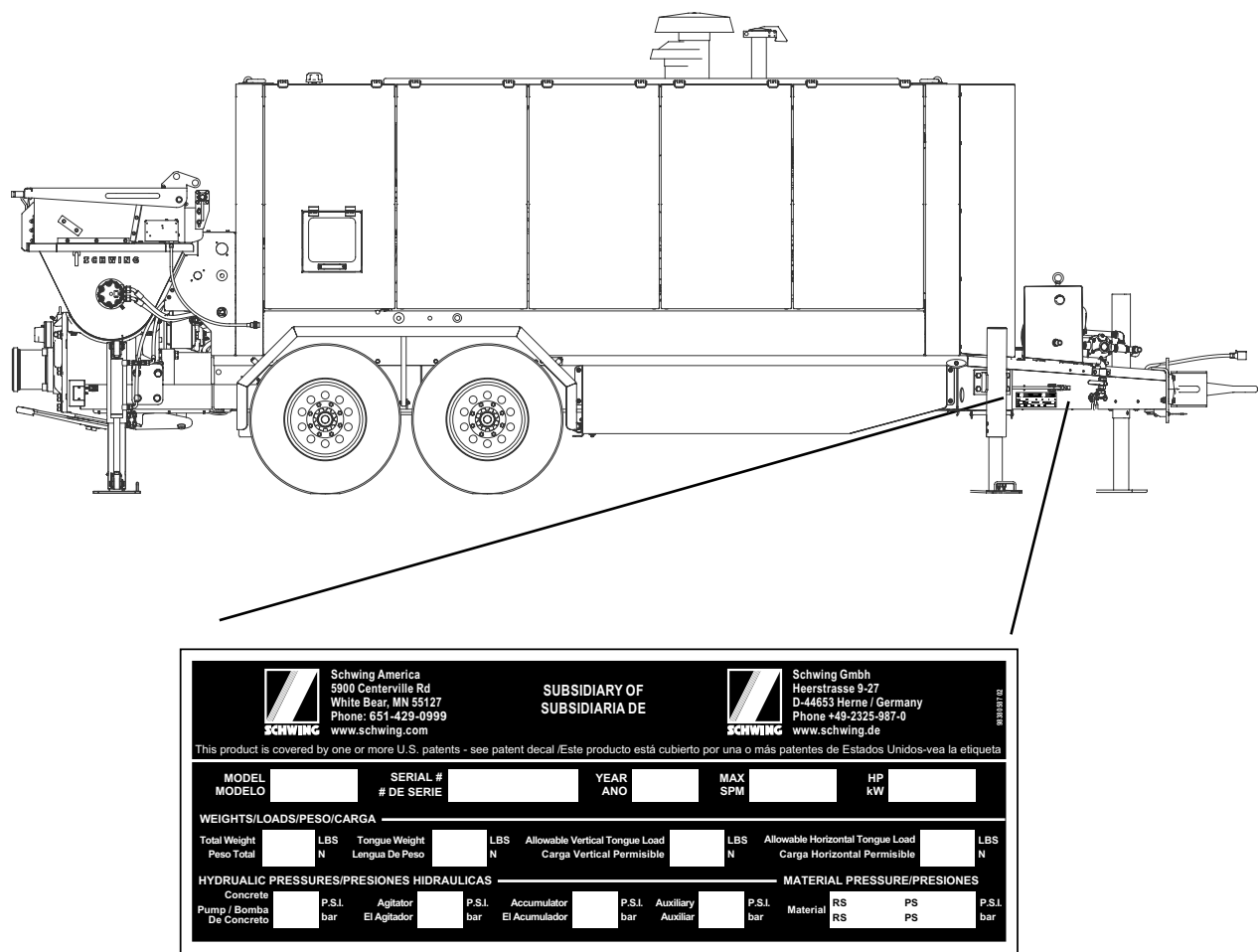
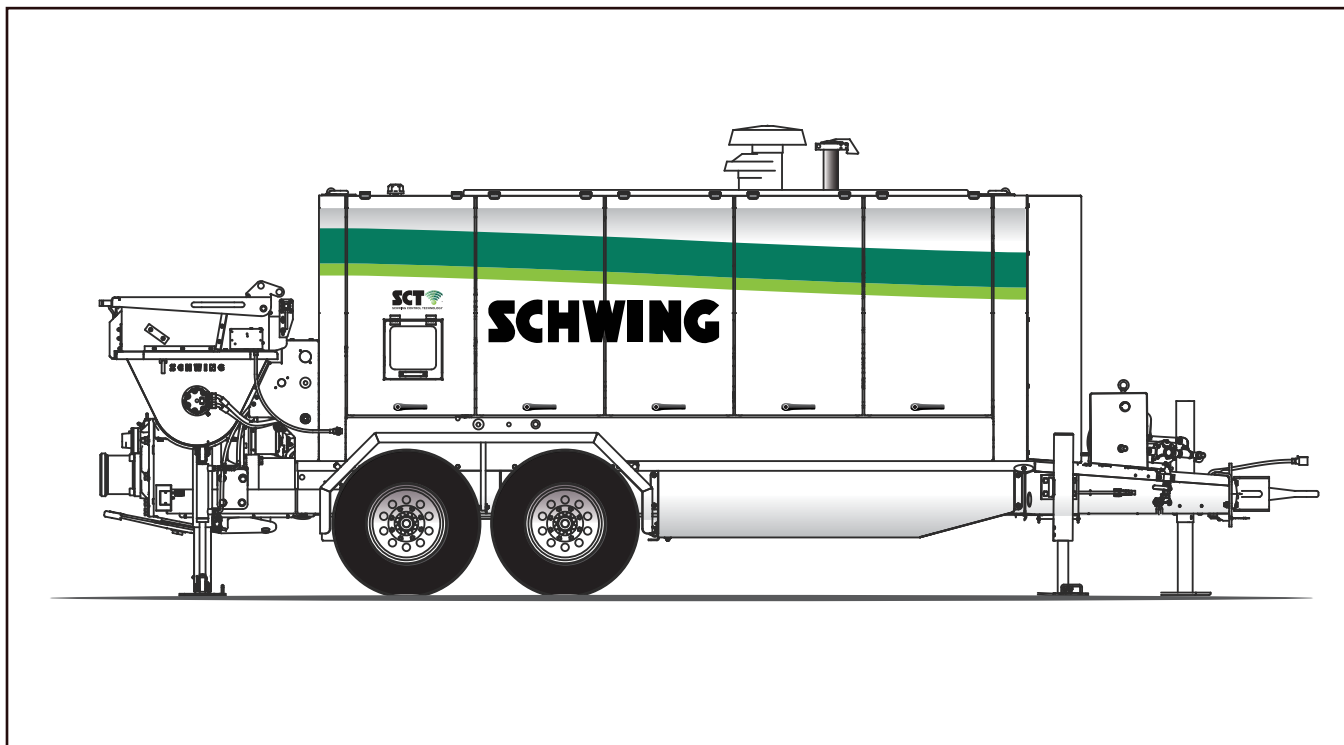


Figure 2
ID Tag Location



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Concrete Pump Specifications

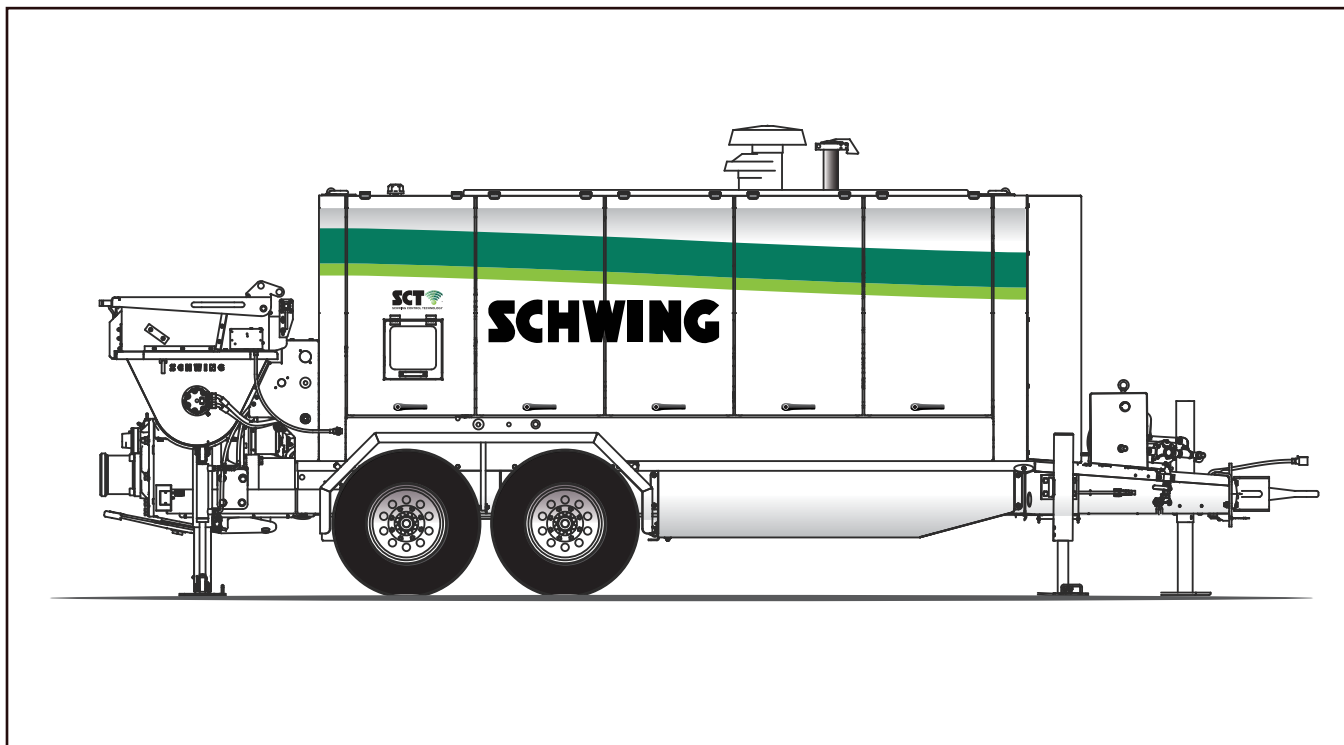
SP 2000

Concrete Pumpkit	120/80 x 1600:200			
Concrete Valve	M Rock			
	Rod	Piston	Rod	Piston
Maximum Strokes/Minute	30	23	30	23
Maximum Concrete Volume	118 yd³/hr	91 yd³/hr	91 m³/hr	70 m³/hr
Maximum Pressure on Concrete	870 psi	1566 psi	60 bar	108 bar
Differential Cylinder Diameter	3.14 in	4.72 in	80 mm	120 mm
Diesel Motor (C7.1 Tier 3)	174 hp		130 Kw	
Diesel Motor (C4.4 Tier 4 / Stage V)	174 hp		130 Kw	
Electric Motor	N/A		N/A	
Hydraulic Pumps RPM - Diesel	2200 rpm			
Hydraulic Pumps RPM - Electric	N/A			
Maximum Hydraulic Pressure	4350 psi		300 bar	
Maximum Aggregate Size	2.5 in		63.5 mm	
Concrete Cylinder Diameter	8 in		200 mm	
Concrete Cylinder Stroke Length	63 in		1600 mm	
Hopper Height	51 in		1294 mm	
Fuel Tank Capacity	53 gal		200 L	
Hydraulic Tank Capacity	112 gal		424 L	
Estimated Weight	13050 lbs		5919 kg	
Length	240 in		6096 mm	
Width	76 in		1930 mm	
Height	95 in		2410 mm	
Remote Control Cable Length	100 ft		30.5 m	

Max RPM of the hydraulic pumps is calculated while the pump is under a full load. Depending on the unit, it is acceptable for the max RPM to vary slightly from the published estimate.

Optional Equipment

- Auto-Greaser - Rock Valve
- Auxillary Hydraulic Circuit - Triple Gear Pump
- Water Pump - Hydraulic-Hydro (7560 - 22 gpm at 300 psi)
- Air Compressor - (Max 24 CFM Max 150 psi)
- Auxillary Hydraulic Connection
- Hopper Mounted Vibrator (12v)
- Hydraulic Outrigger Legs - Protective Cover
- Skid Mount Frame - Flat Bottom w/Lifting Channels
- Work Light
- US Electric Motor and Panel (75hp-480v/3ph/60hz)
- Canadian Electric Motor and Panel (75hp-575v/3ph/60hz)
- EURO Electric Motor and Panel (55kw-380v/3ph/50hz)
- Hopper Grate Assembly (Round Bar for Fiber Reinforced Concrete)
- EURO Tow Ring Hitch Assembly
- Reflectors (for Canada only)
- Track Kit (Rubber) - Air, Water, RRC, Heater
- Folding Hopper Platform
- Slow Strokes Kit
- 2 5/16-inch Ball Hitch
- Heavy Duty Jack
- Manual Outriggers



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Safety Alert Symbols



The triangle with an exclamation point inside is used to alert you to an important safety point and is called a safety alert symbol. One of the following signal words will appear after the safety alert symbol:

- If the safety alert symbol is followed by the signal word **DANGER**, it indicates a hazardous situation which, if not avoided, **WILL** lead to **death or serious injury**.
- If the safety alert symbol is followed by the signal word **WARNING**, it indicates a potentially hazardous situation which, if not avoided, **COULD** result in **death or serious injury**.
- If the safety alert symbol is followed by the signal word **CAUTION**, it indicates a potentially hazardous situation which, if not avoided, **MAY** result in **minor to moderate injury**.
- The signal word **CAUTION** used without the safety alert symbol means the hazard **COULD** cause damage to **equipment or property**.

The keywords listed above will be displayed throughout the text of this manual in the form of information boxes like the ones shown in Figure 1.

The black text in the information box will describe the hazard to beware of and the consequences that can occur if that hazard is encountered.

All persons working near the concrete pump must be able to recognize hazardous situations. They must know how to avoid these situations and how to react quickly and appropriately whenever hazardous situations arise.

DANGER

Indicates a hazardous situation which, if not avoided, **WILL** lead to death or serious injury.

WARNING

Indicates a potentially hazardous situation which, if not avoided, **COULD** result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, **COULD** result in minor to moderate injury.

Figure 1
Safety Alert Information Boxes

Safety Manual

The Safety Manual is a separate document from the rest of this manual and has its own page numbering and formatting. This was done to allow the Safety Manual to be inserted in many different publications while appearing identical in all documents. The Safety Manual also has its own alphabetical index, which is found at the end of this section.

How to Order Additional Safety Manuals

To order additional Safety Manuals call the toll-free Spare Parts line from anywhere in the continental United States. Hours are Monday through Friday from 6:00 am to 6:00 pm (Central Time). Orders will also be accepted via fax 24 hours aday.

SCHWING America Phone Numbers:

- Service Center: **1-888-292-0262**
- Spare Parts: **1-800-328-9635**
- Spare Parts (Fax): **(651) 429-2112**
- Minnesota (Main Office): **(651) 429-0999**

We will ship one set of the following manuals free of charge for each unit that is listed with its serial number and current location:

Manual	Part Number
Safety Manual, English	30327535
Safety Manual, Spanish	30381024
Co-Worker Safety, laminated, English	30381022
Co-Worker Safety, Spanish	30381027
Small Line Safety Manual, English	30381680
Small Line Safety Manual, Spanish	30381841

Warning Labels (Decals)

Every concrete pump is equipped with a set of warning labels. Warning labels **MUST** be replaced if they are damaged, faded, missing, or unreadable. Ultraviolet radiation, rain, steam cleaning, and other factors cause these labels to fade over time. Re-apply warning labels to any parts or components that have been replaced.

For replacement labels, call the Spare Parts Department and provide your concrete pump serial number. Reference the Decal Location Guide (Figure 2) in the parts book for installation locations and part numbers. Complete sets or single labels can be ordered. Decal sets do not include metal ID Tags, which can be ordered separately.

Material-Nr./Part-No.:
98422064

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Version: 04

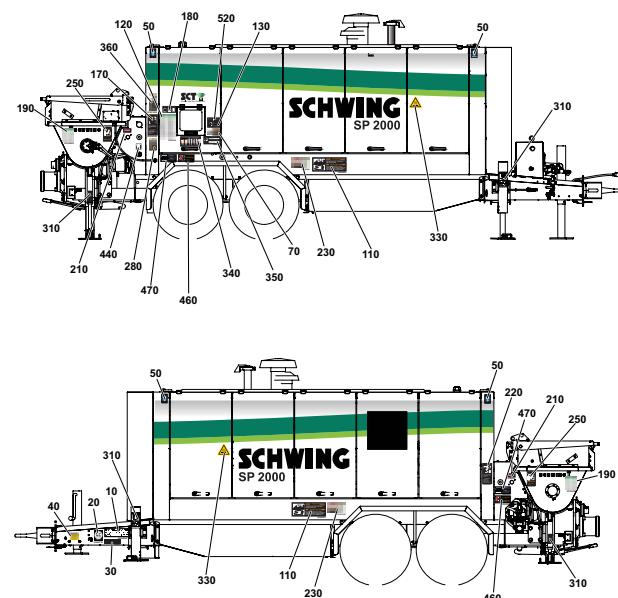


Figure 2
Sample Decal Location Guide

⚠ WARNING This equipment is equipped with a Cat Product Link communication device. When electric detonators are being used for blasting operations, radio frequency devices can cause interference with electric detonators for blasting operations which can result in serious injury or death. The Product Link communication device should be deactivated within the distance mandated under all applicable national or local regulatory requirements. In the absense of any regulatory requirements, Caterpillar recommends the end user perform their own risk assessment to determine safe operating distance.

SAFETY MANUAL

SAFETY MANUAL

A GUIDE FOR THE PREVENTION OF ACCIDENTS WHEN DRIVING, OPERATING, CLEANING, AND MAINTAINING CONCRETE LINE PUMPS AND RELATED EQUIPMENT

Introduction

Safety is one of the major concerns of every person involved in the concrete pumping industry. Although much of the responsibility for everyday safety rests upon the pump operator, it is vital that everyone involved makes safety the top priority. This includes the owners, the mechanics, the ready mix drivers, the placing crew, the concrete contractors, and the machine manufacturers.

Although this *Safety Manual* covers a great deal of information regarding the prevention of accidents while operating a concrete pump, it is unlikely that every conceivable circumstance has been covered. Regardless of how thorough a manual like this may be, there is always the unexpected. Please understand that there is no substitute for **common sense** and dedication to the idea that **you are responsible for your own safety**, and affect the safety of those around you. You have to know the rules first, but you

must keep your mind on the job if knowledge of the rules is going to keep you and your coworkers alive and well. No attempt has been made in this *Safety Manual* to provide the highly specialized knowledge of the workings of the individual machines that is also critical for safe and proper operation. For that, you must **read and understand the operation manual for the machine(s) that you operate!**

This *Safety Manual* is a guide for the prevention of accidents and is to be used in conjunction with **professional training**. The ACPA now has an Operator Training Program. Additional information and materials are available through the American Concrete Pumping Association, including, specifically, an Operator Certification Program. Make the commitment to be professional - get your certification!

Version 7.0.1

February 2015

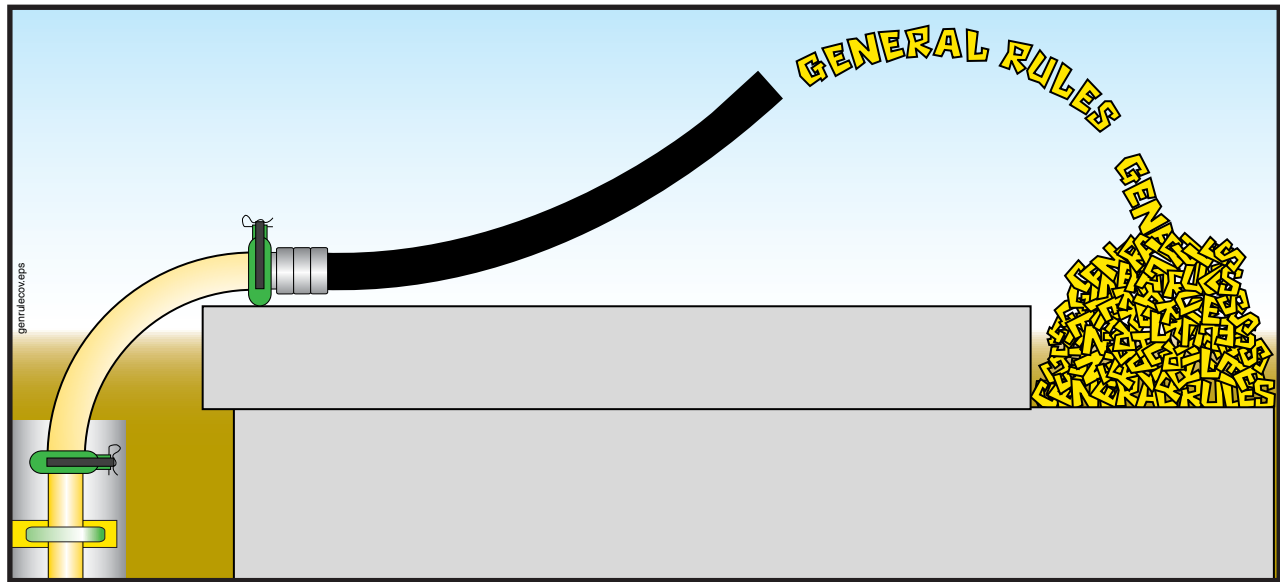
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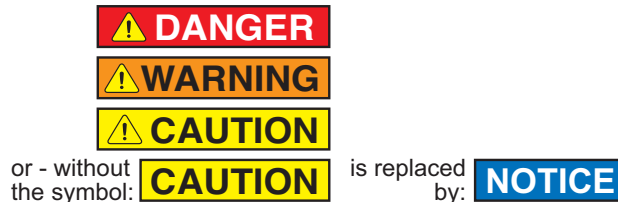
I. Before You Leave The Yard

1. Safety Alert Symbol And Signal Word Explanation

1.1



The triangle with the exclamation point inside is used to alert you to an important safety point, and is called a *Safety Alert Symbol*. One of the following color-coded signal words will appear after the safety alert symbol:



- If the safety alert symbol is followed by the signal word **DANGER** with white letters in a red box (), it indicates a hazardous situation which, if not avoided, **WILL** lead to **death or serious injury**.
- If the safety alert symbol is followed by the signal word **WARNING** with black letters in an orange box (), it indicates a potentially hazardous situation which, if not avoided, **COULD** result in **death or serious injury**.
- If the safety alert symbol is followed by the signal word **CAUTION** with black letters in a yellow box (), it indicates a potentially hazardous situation which, if not avoided, **COULD** result in **minor to moderate injury**.
- The signal word **CAUTION**, used in a yellow box, but **without the safety alert symbol** (), means the point addresses a hazard which, if not avoided, **COULD** cause **damage to equipment or property**.
- The signal word **NOTICE** (), now replaces the signal word caution (without the safety alert symbol), above.

2. What To Do Before You Arrive At Work

2.1

Get enough sleep to be ready for the day's work. Accidents can happen when the body is on the job, but the mind is not.

2.2

Dress in appropriate apparel and Personal Protective Equipment (P.P.E. or just PPE.) See Figure1. You should always wear these items when pumping concrete:

- hard hat;
- safety glasses or goggles (plus a full face shield, when shotcreting);
- snug-fitting clothes;
- gloves;
- steel-toed shoes;

In addition, you should wear:

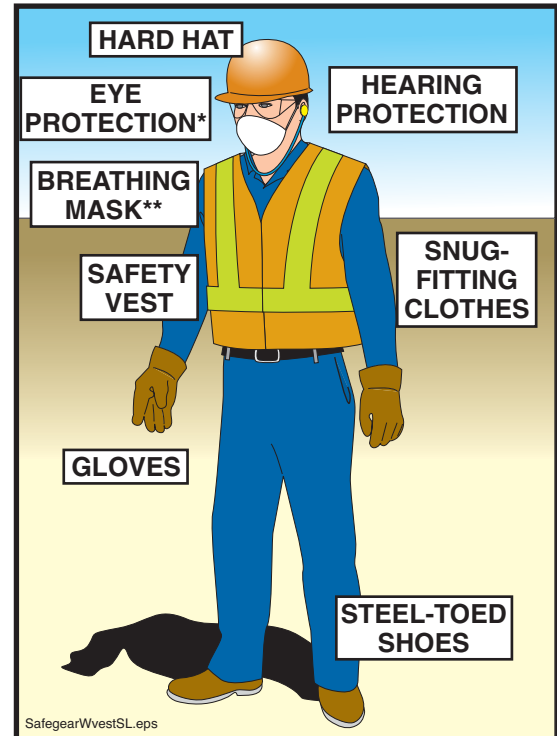
- hearing protection if you stand near the pump or any other source of noise;

- breathing mask whenever there is cement dust in the air;
- rubber gloves during cleanout or if you'll be touching wet concrete;
- rubber boots anytime you have to stand in concrete;
- full face-shield when shotcreting, or any time material is rebounding.

* Full face shield should be used in addition to safety glasses when shotcreting, or any time material is rebounding.

** Breathing mask needed when cement dust (or other toxic dust) is present in the air.

Figure 1
Personal Protective Equipment (PPE)



2.3

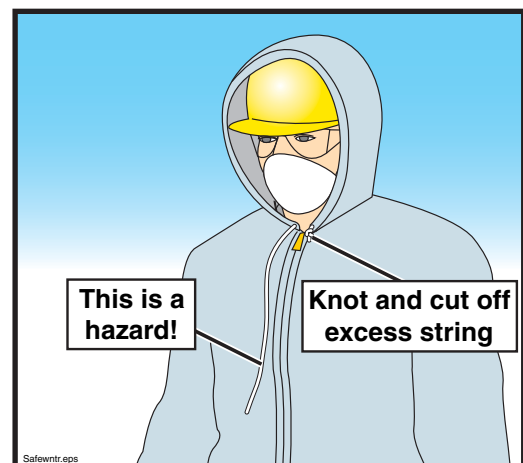
Jewelry, athletic shoes, sandals, and shorts are examples of clothing that should NOT be worn when pumping.

2.4



WARNING Be sure that any clothing you wear does not have strings, fringes, or other external tightening means that could be caught in moving parts (Figure 2).

Figure 2
No strings attached



SAFETY MANUAL

2.5 Arrive to work on time. Accidents can be caused by hurrying through procedures.

2.6 **⚠ WARNING** Never go to work on a construction site or work on, around or near a piece of machinery when under the influence of drugs or alcohol. Beware of prescription medications or over the counter drugs, many of which have specific warnings about operating machinery after taking the medication (Figure 3).



Figure 3
Your coworkers depend upon you for their safety

2.7 **⚠ WARNING** Don't bring your personal problems to work with you. In an office setting this may be annoying to coworkers, but on a construction site it can be deadly. The workers around you depend on you for their safety.

3. What To Check Before You Leave The Yard

3.1 **⚠ WARNING** Do not operate the machine until you read and understand the unit's operation manual. Lack of understanding of proper operating procedures could result in unsafe operation. Operation manuals are issued with each new unit. If you haven't seen it, ask your supervisor. Replacements are available from the manufacturer.

3.2 **⚠ WARNING** Inspect delivery pipes, concrete delivery hoses, and end hoses for wear. Never use a hose or pipe that is dented or worn out. **Know the maximum pressure that your machine can exert on the concrete, and be sure that the pipes, hoses and clamps are capable of handling the pressure.** Maximum pressure on concrete is stated in operation manuals, service manuals, and on the serial number plate of the machine. A chart showing the minimum wall thickness of pipeline versus maximum pressure is found on page 47 in the Appendix section of this *Safety Manual*.

3.3 **⚠ WARNING** If you will need to use compressed air to clean out the system pipeline, BE SURE that you have the proper training, equipment, and attachments to do this procedure safely! Proper attachments include:

- A blowout head with properly sized air discharge regulator valve and separate water/air inlet. The two openings should be spaced apart far enough that a blowout ball could not cover both openings at once.
- A *go-devil*, or a hard sponge ball. Regardless of which is used, it **must** fit into the pipeline tight enough that air cannot escape ahead of it.
- A ball or go-devil catcher that will catch the go-devil or ball when the line has been purged of all concrete, unless another method of controlling the outlet is used. There are two types of catchers (see paragraph 5.24 on page 13).
- A hose that is rated for the pressure of the air compressor you will use and that is able to connect with both the air compressor and the blowout head. The hose must be in good working condition and must be free of cracks, frays, tears or other damage. Do **NOT** improvise on this. **Make sure** you have the right part (Figure 4).

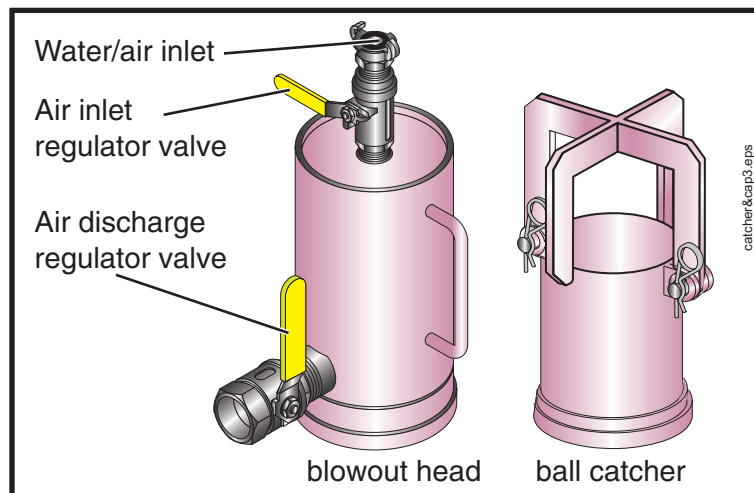


Figure 4
Compressed air accessories

- 3.4** **⚠ WARNING** Be sure that the unit is equipped with all the pipes, clamps, gaskets and hoses, blowout adapters, ball catchers, and other accessories that you will need for the day's work. Making do with inappropriate equipment could cause accidents.
- 3.5** On trailer-mounted units, check the oil and cooling system of the pump drive engine. Accidents could occur when lack of maintenance is causing a distraction while operating the equipment.
- 3.6** Be sure the battery has enough charge to start the pump drive engine. You will be rushed on the job if you have to do repair work before you can begin operation.
- 3.7** **⚠ WARNING** The operator is responsible for checking to see that the concrete pump, and delivery system are in safe and proper working condition. If an unsafe condition exists, **work must not begin** until necessary repairs have been completed, or until the machine can be operated safely.

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- 3.8** **⚠ WARNING** The operator is responsible for checking that all safety equipment and guards are in place and in good condition. If found to be missing, incomplete, or damaged, **work must not begin** until the situation has been made safe.
- 3.9** **⚠ WARNING** The operator is responsible for checking that all safety decals are in place and are in readable condition. If found to be missing or unreadable for any reason, steps should be taken to obtain replacements.
- 3.10** **⚠ WARNING** Inspect the tires and brakes on the truck. Never drive a truck with bald or cracked tires, or with weak or worn brakes. If you have air brakes, be sure that the air system is free from leaks and will maintain pressure when driving. Loss of air pressure will cause the brakes to be applied while driving. If driving continues after the brakes are applied, the resulting friction could cause enough heat to start a fire.
- 3.11** Drain moisture from the air tanks that supply the unit's brakes (if so equipped). This is especially important if weather conditions could cause the moisture to freeze. If you lose air pressure because of frozen moisture, the brakes will apply themselves, and you will have to stop driving until the unit is repaired.
- 3.12** **⚠ WARNING** (See Figure 5.) Mount or dismount the pump or truck using the *3-point Rule* (i.e. keep two hands and one foot or one hand and two feet in contact with a secure surface at ALL times).

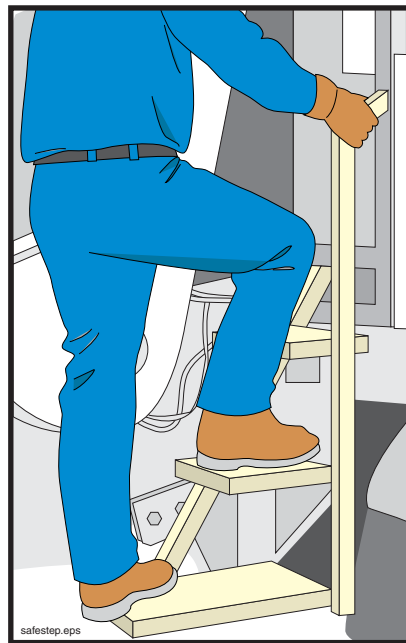
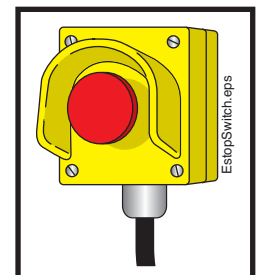


Figure 5
The 3-point Rule

- 3.13** **⚠ WARNING** Never mount or dismount the truck or pump while carrying objects that prevent you from using the 3-point Rule. Move the objects separately, if needed.

- 3.14** **⚠ WARNING** If applicable, be sure that outriggers are pinned and locked before traveling. If the locking device is damaged or worn, it should be repaired immediately and the unit **must not be driven until the outriggers can be positively locked** against accidental opening.
- 3.15** **⚠ WARNING** Be sure there is nothing in the cab of the truck (such as empty soda cans, loose tools, etc.) that could interfere with the operation of the vehicle.
- 3.16** Be sure that all road-related safety devices (warning signs, flares, fire extinguisher, etc.) are present and secured for travel.
- 3.17** Be sure all personal protective equipment (hard hat, safety goggles, rubber gloves, etc.) are secured for travel.
- 3.18** **⚠ WARNING** Be sure the windshield and mirrors are clean and free of frost or ice, and that the mirrors are properly adjusted.
- 3.19** **⚠ WARNING** Verify that head lights, tail lights, turn signals, brake lights, backup warning horn, and backup lights are operational.
- 3.20** In some cases you may be asked to operate a machine other than the one with which you are familiar. In these cases, be sure to:
- Know the weight, height, and width of the machine.
 - Have a copy of the operation manual with you.
 - Ask the machine's normal operator, the dispatcher, or your supervisor questions regarding any unusual or unique operational characteristics of the machine.
 - Familiarize yourself with the machine by setting it up in the yard and running the functions, and by familiarizing yourself with the operation manual. This is especially important if the new machine is significantly different than the one you normally operate. Your coworkers depend on you to know the machine.
- 3.21** **⚠ WARNING** Be certain that all loose items on the unit are secured for travel before driving.
- 3.22** **⚠ WARNING** Emergency stop switches (E-stops) should be periodically checked by activating the switch in the yard and confirming that none of the pump functions operate electrically or manually.

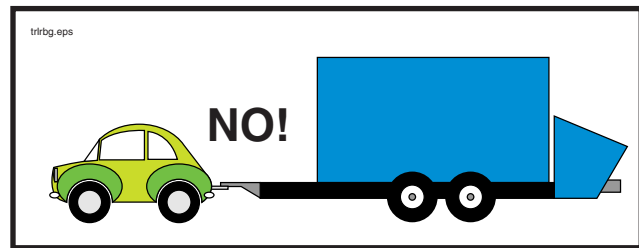
Figure 6
Periodically check your emergency stop switches (E-stops) for proper function



4. Safety Rules For Towing Trailer-Mounted Concrete Pumps

- 4.1 **WARNING** Be sure the towing vehicle is sized appropriately for the trailer. It must be heavy enough and have enough braking ability to maintain control at highway speeds and to stop—even on hills. If the trailer is heavier than the towing vehicle, braking distances will be greatly increased (Figure 7).

Figure 7
Do not under size the
towing vehicle



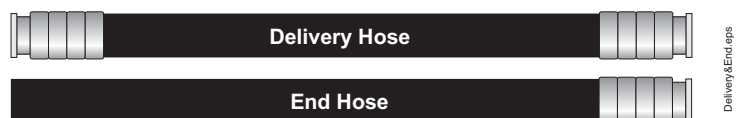
- 4.2 **WARNING** Never tow a trailer that has concrete in the hopper. The extra weight in the back of the machine will remove weight from the tongue and cause the trailer to fishtail.
- 4.3 **WARNING** Check the tires, tire pressure, and brakes on the trailer before towing. Never tow a vehicle with cracked or bald tires. A trailer tire blowout can cause loss of control in the towing vehicle.
- 4.4 **WARNING** Be especially careful on ice or slippery roads when towing a trailer. A skid that would normally be easily correctable can be multiplied by the trailer, causing loss of control.
- 4.5 **WARNING** Be sure the electrical connections between the towing vehicle and the trailer are sturdy and reliable, and that the lights on the towing vehicle and trailer are working.
- 4.6 **WARNING** Always use safety chains and break-away protection when towing a trailer.
- 4.7 **CAUTION** Be aware of local or state regulations regarding mirrors, lights and maximum speed when towing a trailer.
- 4.8 **WARNING** When towing a trailer, your stopping distance and turning radius are greatly increased. Be aware of this **at all times**.
- 4.9 **WARNING** When towing a trailer long distances, it is important to frequently check the hitch, hitch pins, couplers, safety clips, towing eyes, wiring, emergency breakaway switch, safety chains, and other accessories, as equipped.
- 4.10 **WARNING** Be aware of your length when towing a trailer. A common cause of trailer accidents is turning too close to curbs or objects.
- 4.11 **WARNING** Never back up a trailer without a guide.
- 4.12 **WARNING** Frequently observe the trailer and watch for unusual swerving or indications of problems, such as a flat tire.

II. On The Job Site - Safety Rules For Job Setup

5. Setting Up A Trailer-Mounted Pump and/or A Separate Pipeline

- 5.1 **The job setup phase sets the stage for most accidents.** Taking a few extra moments to correctly set up the job will improve your chances of having a safe, trouble free day.
- 5.2 **The operator is responsible for the safe operation of the machine.** Notify your employer, the job superintendent, and/or O.S.H.A. if you are being asked to set up in an unsafe manner. **You are never required to take a chance with safety.** You are the **only** person who can determine that the job circumstances under your control are safe.
- 5.3 **⚠ WARNING** Any power connections above 28 volts must be made by a **licensed electrician**. The supply power and appropriate disconnect boxes are the responsibility of the contractor.
- 5.4 **⚠ WARNING** Electrical power on the job site may be taken only from a **fused, grounded disconnect box with a disconnect switch that can be locked against activation**. If you will be making repairs to the concrete pump or separate placing boom, first lock out the power at the disconnect box.
- 5.5 **⚠ WARNING** On units equipped with electric motors, **check the power cables every day**. If they are frayed or have open spots in the insulation, replace the wire. If the connectors are worn or loose, have repairs made by a licensed electrician.
- 5.6 **⚠ WARNING** Consider the **safe approach and departure of the ready-mix trucks and adjust your setup accordingly**. Adjusting your setup position by a few degrees one way or another could mean the difference between a safe approach and an unsafe approach. Some examples of unsafe approaches are: too near an excavation or sticking out into traffic.
- 5.7 **⚠ WARNING** **Avoid collisions!** Secure the immediate area of the machine from public traffic in accordance with all applicable regulations (warning lights, safety cones, barricades with flashers, etc.).
- 5.8 **⚠ WARNING** Pipelines, end hoses, couplings, and all other **material delivery components must be able to withstand the maximum concrete pressure of the pump. Be sure** of it! Read and understand the minimum wall thickness chart found in the *Appendix* of this manual. If you don't understand the chart, contact the pipe manufacturer for assistance.
- 5.9 A *concrete delivery hose* is a flexible concrete hose that has two end couplings. An *end hose* is a flexible concrete hose that has one end coupling. See Figure 8.

Figure 8
End hose vs delivery hose



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5.10

⚠ WARNING Do not use a piece of pipeline, end hose, coupling, or any other material delivery component that is not in good condition. **Replace, do not repair damaged pipes and hoses.** Concrete pipeline system is subject to wear, and the rate of wear is affected by pumping pressure, concrete composition, pipeline material, and other factors. Read and understand the minimum wall thickness chart in the *Appendix* of this manual. **Bursting pipes and concrete escaping under pressure is a serious safety hazard (Figure 9)!**

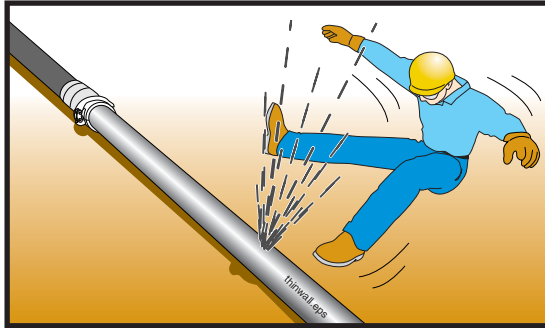


Figure 9
Delivery system components must be able to withstand maximum pump pressure

5.11

When laying out a pipeline, it is preferable to use an elbow instead of a hose to make direction changes. Elbows have less resistance to flow than hoses, and will therefore reduce the overall pressure required to push the concrete.

5.12

Always use the largest diameter pipeline that is practical, and use steel pipe instead of rubber hose. This will keep the pressure required to push the concrete to a minimum.

5.13

Support the delivery pipeline. Either an “S” transition pipe should be used to bring the pipe to ground level, or **each** section of the pipeline should be supported at the pump outlet level.

5.14

⚠ WARNING The sections of pipe nearest the pump are subjected to the highest pressure and the greatest wear. Because of this increase of pressure near the pump, you should install only thick-walled pipe, in like-new condition there. Read and understand the minimum wall thickness chart in the *Appendix* of this manual.

5.15

⚠ WARNING The maximum concrete pressure of the pump must be the only factor used to determine what thickness of pipe and what type of ends are needed. In the case of a rock jam or any other type of blockage, the maximum pressure of the pump will be exerted.

5.16

Grooved (Victaulic) ends are **not recommended** for concrete pumping. Read and understand the comparison between heavy duty raised, metric, and grooved ends in the *Appendix* of this manual.

5.17

⚠ WARNING If the pipeline remains on the job (as is the case when pumping a high-rise building), the operator is responsible for checking the pipeline for

dents, cracks, wear, and continuous connection each day before the pour begins.

5.18

⚠ WARNING In vertical runs, the weight of the vertical sections of pipe must be supported by a thrust block (often called a *deadman*, Figure 10) or other load-bearing device. **Each section of pipeline in a vertical run must be secured from lateral and horizontal movement.**

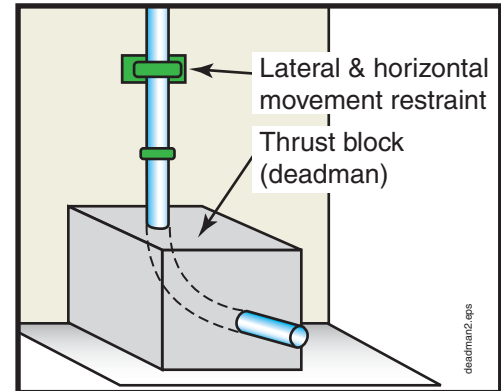


Figure 10
A thrust block (deadman)

5.19

⚠ WARNING If you will be unable to see the point of placement, establish a system of communications with the workmen who will be there. Arrange for radio communications, a system of visual or auditory signals (lights or bells), or a signalperson (Figure 11). If a signalperson is used, **agree on hand signals before beginning the pour!**

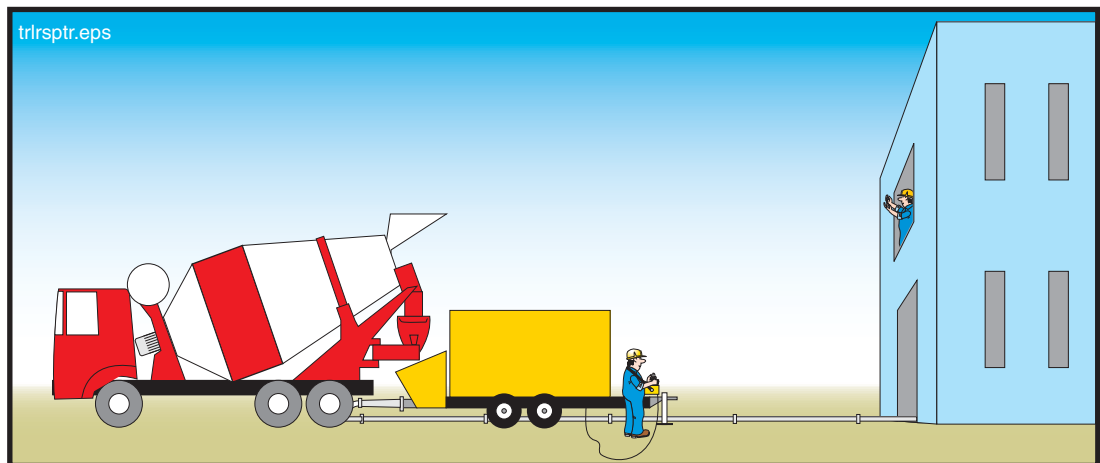


Figure 11
Arrange communications before starting

5.20

⚠ WARNING Never leave the machine unattended when it is running or ready to run. If you must leave the area, you must leave someone to monitor the unit. This is especially critical if there are children in the vicinity.

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5.21

⚠ WARNING Watch for children! It is possible for children to access the machine, but it is not safe for them to do so.

5.22

⚠ WARNING If spectators will be near the job, cordon off an area where they will be safe.

5.23

⚠ WARNING If you will be cleaning the pipeline with compressed air at the completion of the job, **be sure that you have all the necessary accessories to do the job safely.** If you don't have all of them, make arrangements to get them before you begin to pump. **Do not improvise on this. Make sure** you have the right parts. The minimum accessories include:

- A blowout head with properly sized air discharge regulator valve, and separate water/air inlet. The two openings must be spaced apart far enough that a blow-out ball could not cover both openings at once.
- A *go-devil*, or a hard sponge ball. Regardless of which is used, it **must** fit into the pipeline tight enough that air cannot escape ahead of it.
- A ball or go-devil catcher that will catch the go-devil or ball, or some other method of controlling the discharge while the line is being purged of material. There are two types of catchers (see paragraph 5.24).
- A hose that is rated for the pressure of the air compressor you will use and that is able to connect with both the air compressor and the blowout head. The hose must be in good working condition and must be free of cracks, frays, tears or other damage.
- If you will be cleaning the pipeline with compressed air at the completion of the job, be sure an adequate air compressor is available before starting the job.
- If you will be cleaning a vertical pipeline with compressed air at the completion of the job, you **must have a shutoff valve or switching valve installed at the bottom of the vertical run!**

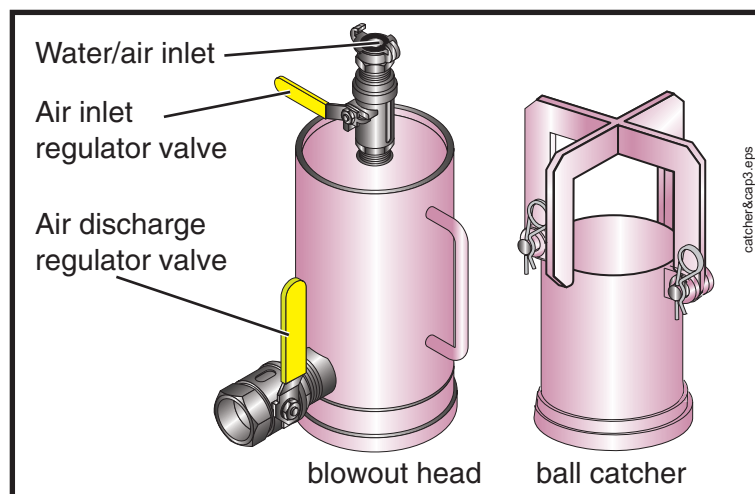


Figure 12
Ball catcher and blowout head

5.24

⚠ WARNING There are two types of ball catchers. Know which type of catcher you are using. You may need to adjust your cleanout procedure according to which type you have. The two types are as follows:

1. Catchers that stop the ball or go-devil before air can escape, and
2. Catchers that allow the air out of the pipeline after the ball or go-devil has reached the end.

Each type of catcher has advantages and disadvantages (Figure 13).

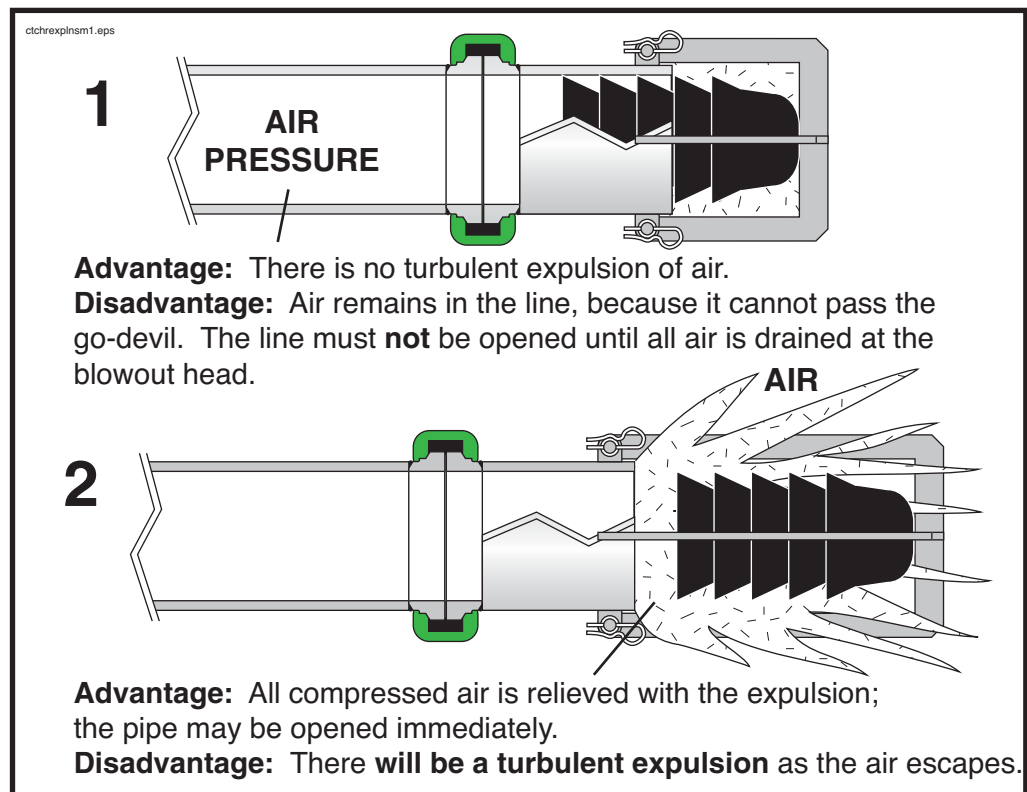


Figure 13
Types of catchers

With catcher type 1, the go-devil stops, but air is still trapped behind it. The advantage is prevention of the sometimes violent expulsion of air at the end of the pipe. The disadvantage is that the air must be drained from the blowout head before the pipe line is safe to open. The pipeline must be controlled; allow no one to open it until all compressed air is relieved.

Catcher type 2 is long enough that the compressed air escapes behind the go-devil. **Note!** This would happen with either catcher when used with a ball instead of a go-devil. The advantage of this is that once you hear the turbulent expulsion, there is no pressurized air remaining in the line, and the line may be opened immediately. The disadvantage is the expulsion itself. In this case, the end of the line must be controlled because flying concrete and aggregate pose a hazard.

Both catchers can be safely used if care is given to the hazards involved.

III. Concrete Pump Operation

6. Safety Rules For Pump Operators

6.1

⚠ WARNING Only qualified operators are allowed to operate the pump. A Qualified Operator is defined as someone who:

- has reached the age of 18 years (21 for interstate travel);
- is physically and mentally capable;
- has been trained in the operation and maintenance of the pump and the placing boom (if applicable);
- has demonstrated their capabilities to the employer in respect to the operation and maintenance of the pump and placing boom (if applicable); and
- can be expected to perform these duties, as assigned, in a reliable manner.

6.2

⚠ WARNING Because operators are responsible for the safe operation of the machine, it is crucial that they understand the proper operation of the machine and the safety rules that apply to the job at hand, so the course of action taken in unforeseen circumstances will be a safe one. Only thorough training and supervised job experience can supply the necessary understanding.

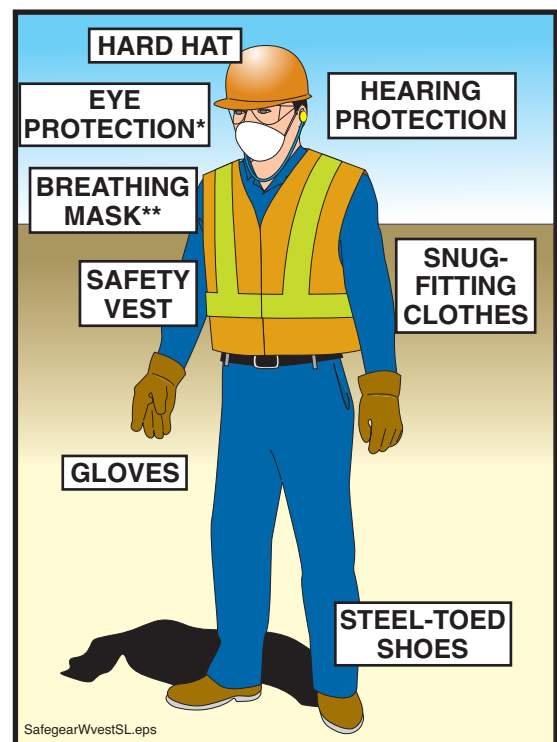
6.3

⚠ WARNING When operating the machine, **wear Personal Protective Equipment (P.P.E., or just PPE).** (Including *full face shield and/or ** breathing mask, when necessary, as shown in Figure 14.)

* Full face shield should be used in addition to safety glasses when shotcreting, or any time material is rebounding.

** Breathing mask needed when cement dust (or other toxic dust) is present in the air.

Figure 14
Wear Personal
Protective Equipment
(PPE)



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GENERAL RULES

- 6.4 **⚠ WARNING** All guards, covers, and service flaps must be secured in place during operation.
- 6.5 **⚠ WARNING** **Electrocution hazard!** If you are operating and lightning moves into the area, seek shelter until the lightning is gone.
- 6.6 **⚠ WARNING** **Crushing hazard! Never, ever** position yourself between a ready mix truck and the pump! Stand off to the side, so the ready mix driver can see you at all times (Figure 15).

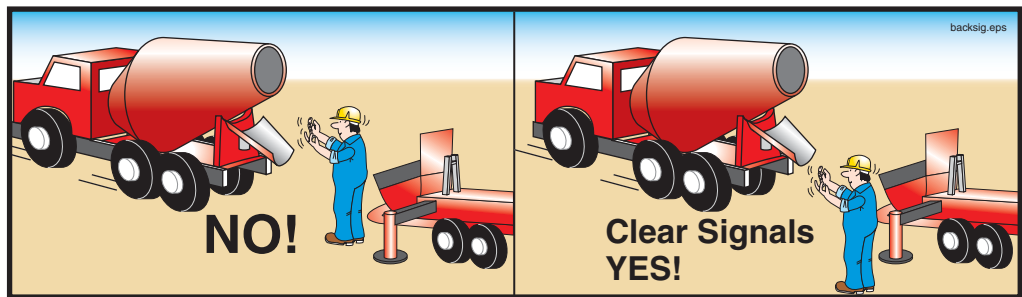


Figure 15
Never stand between the ready mix truck and the pump
Use clear and concise hand signals

- 6.7 **⚠ WARNING** When backing in ready mix trucks, use clear and concise hand signals (Figure 15).
- 6.8 **⚠ WARNING** If the job requires that you work above ground to operate your machine, an approved fall protection plan must be implemented.
- 6.9 **⚠ CAUTION** **Loss of hearing!** While standing near a working concrete pump, sound pressure levels may exceed O.S.H.A. standards for constant exposure (Figure 16).

PERMISSIBLE NOISE EXPOSURES*

*Under part 1910.95 Occupational Noise Exposure, (Dept. of Labor) of the Code of Federal Regulations, Chap. XVII of Title 29 (39 F.R. 7006).

DURATION per DAY in HOURS	Sound level in dB (A) Slow response
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4 or LESS	115



WEAR HEARING PROTECTION!

Figure 16
Noise level and exposure time limits

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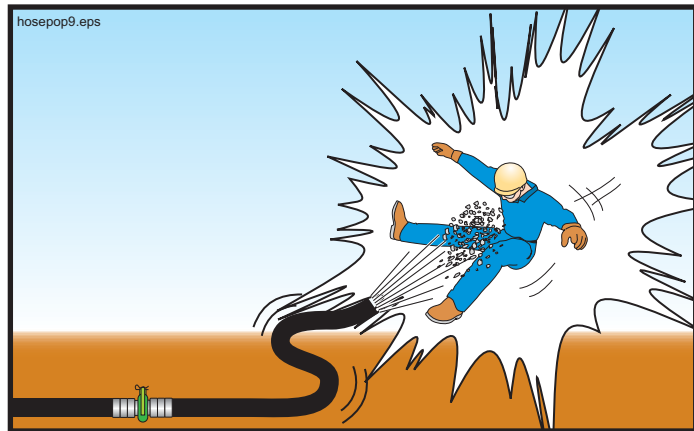
6.10

⚠ WARNING Do not let the concrete level in the hopper become low! If air is sucked into the material cylinders, the pump will compress the air. Compressed air always poses a hazard as it is expelled from the hopper or the delivery pipeline (Figure 17). If air is taken into the material cylinders, take the following steps to minimize the hazard:

1. Stop the pump immediately. Hit the emergency stop switch (E-Stop) if that is the quickest way to stop the pump. There will be an expulsion of compressed air the next time the concrete valve shifts, which can be safely absorbed by filling the hopper with concrete.
2. If possible, fill the hopper with concrete to just below the grate, then pump slowly in reverse for several strokes. This will not remove all the air, but it should minimize the amount left in the pipeline.
3. Persons standing at the discharge end or near the delivery line must be warned to move away until all of the air has been purged. Personnel should move a prudent and reasonable distance beyond the end-hose movement area or the point of discharge, and personal protective equipment (PPE) should be worn (Figure 17).
4. When the pump is restarted, pump forward slowly until **all** air is removed from the pipeline. Don't assume that the first little air bubble is the end of the compressed air.
5. Do not allow anyone near the discharge until concrete runs steadily from the end and there is no movement of the delivery system.

If workers are positioned in high or precarious places, warn them to expect a loud sound as the air escapes the pipeline. (Warn them even if they are well away from the discharge.) That way, we can prevent the worker from falling as a result of being startled by the noise.

Figure 17
Remove everyone from
the discharge area
whenever air is in the line



6.11

⚠ WARNING Air can be introduced into the delivery system in several ways besides being sucked in through the hopper.

For example:

- when initially priming the delivery system;
- when restarting after moving;

- when restarting after adding or removing delivery system;
- when attempting to remove a blockage by rocking the concrete;
- when opening the system to remove a blockage;
- when pumping is stopped and the pipeline is at a downward angle.

6.12

WARNING

When initially priming the delivery system, when restarting after moving, when restarting after adding or removing hoses, when attempting to remove a blockage by rocking the concrete, or whenever air has been introduced into the line, warn everyone to stay away from the discharge until material runs steadily. Personnel should move a prudent and reasonable distance beyond the end-hose movement area or the point of discharge, and personal protective equipment (PPE) should be worn (Figure 17).

6.13

WARNING

Blockages in the pump or delivery pipeline can create an unsafe condition. Blockages are caused by many different factors, as outlined below.

CAUSES OF BLOCKAGES

- **Faulty concrete mix design.** The concrete being supplied may not be a pumpable mix; for example there may be too much sand or too little cement. There may be bleeding or segregation. Some admixtures adversely affect pumpability (e.g., too much air entrainment). If the mix is not pumpable, no amount of operator expertise will make it so.
- **The line size may be inadequate.** The line size should always be at least 3 times larger than the largest aggregate being pumped, or blockages could occur.
- **Worn concrete valve parts.** Worn parts allow the finest material and water to escape back into the hopper when pressure is applied.
- **Pipeline and joint deficiencies.** This would include: dirty pipes (pipes that have not been cleaned properly); worn and leaking pipe joints that allow loss of concrete fines and water; pipes that haven't been properly primed before starting; and too many sections of rubber hose, which increases friction. These are all causes of blockages that can be controlled by the operator.
- **Pump inadequate for the application.** The pump selected for the job may not have enough pressure or horsepower available for the required duty.
- **Concrete setting up in the pipeline.** This may be caused by delays on site (e.g., repairing a broken form), or by attempting to pump old concrete (concrete that was batched hours before pumping and is being kept alive only by adding water and constant agitation). Weather conditions can also affect how quickly the concrete becomes hard. Companies should establish procedures for these situations. A good rule of thumb is: **If in doubt...wash out.**
- **Foreign matter in the concrete.** Pieces of old concrete that break away from mixer fins, unmixed clumps of cement, mixer fins, hammers, and furry mammals are examples of foreign matter that have caused blockages.
- **An inexperienced operator can cause blockages by setting up the job improperly.** For example, if the placing crew is forced to add hose or pipe to reach a far point after the pour is already in progress, there is a great chance of

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creating a blockage due to the dry conditions inside the pipe or hose. It is for this reason that the job should be set up so pipe or hose need only be removed (never added) as the day progresses. If dry pipe or hose must be added, it must be lubricated just like the rest of the pipe was lubricated when you first started.

- **An inexperienced or improperly trained placing crew can cause blockages by kinking the end hose.** This type of blockage can lead to serious accidents because the hose may unkink by the force of the pump.
- **The concrete becomes segregated in the hopper.**
 - a. If the concrete is too wet, the cement and fine material get washed from the stone and coarse sand. This mix will not pump. It is for this reason that you should cover the hopper as you wait out a passing storm, never allow a truck mixer to wash out in your hopper, and never add water to the mix.
 - b. If concrete is over vibrated, it will separate. Turn off the hopper vibrator when not actively pumping.

6.14

**WARNING**

Never try to remove a pipeline blockage by applying high pressure to it, because that will cause the blockage to become a plug. If you have a blockage, immediately stop the pump. Stroke the pump several times in reverse. Slowly stroke the pump in forward, and try to dislodge the blockage. If you are moving the blockage, continue to do so slowly and gently. While attempting to clear the blockage, remove all personnel from the discharge area, as air may be introduced into the placing line during this process. If you are unable to move the blockage after a couple of attempts, stop the pump. Continuing to apply high pressure could create a hazardous condition.

6.15

**WARNING**

If the pump or associated equipment develops a problem that creates an unsafe condition, you must stop pumping immediately! Do not restart until the unsafe condition has been remedied.

6.16

**WARNING**

The following points must be observed when locating a blockage.

- Pump in **reverse** for **at least two strokes**, then stop the pump. In the case of a mechanical pump (which cannot be reversed), it is important to carefully follow the manufacturer's instructions for relieving line pressure before any clamp is opened. **Do not allow anyone to open the pipeline** until the pressure is relieved (Figure 18).
- Wear personal protective equipment (PPE) when opening a blocked pipeline.
- Clear the area of nonessential personnel before opening the line.
- In all cases, the blockage must be removed before pumping again. Remember that air will be introduced when the system is taken apart, and keep personnel away from the discharge when restarting.
- Plugs will be found (in the order of likelihood): reducers, hoses, elbows, and pipe.
- If you are tapping the pipe to find the plug, the sound will be a dull thud (tik-tik) rather than a ringing sound (tong-tong) at the spot of the plug, because the

jammed material will keep the pipeline from vibrating. (This method won't find a plug in a hose.)

- To find a plug in a hose: with the pressure relieved, tap or step on the hose to locate the hard spot where the hose is plugged.

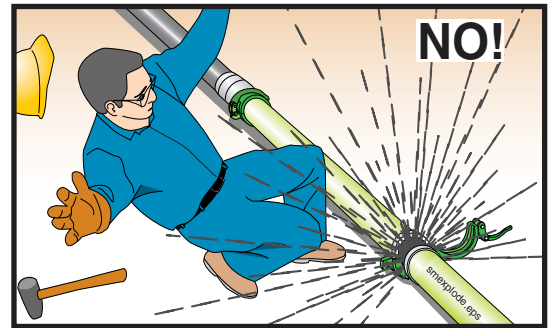


Figure 18
Never open a pressurized pipeline

6.17

⚠ WARNING It is possible that some pressure will remain in the pipeline after reversing the pump. Use a shovel or pry bar to open the clamps on a blocked pipeline. Wear face protection, and turn away from the pipeline when opening the clamp.

6.18

⚠ WARNING It would be better to let the pipe be ruined by setting concrete than to risk injury by ignoring safe procedures. Always use safe practices when cleaning pipe. Remember, pipeline is replaceable, you are not.

6.19

⚠ WARNING Do not kink hoses. Kinking will cause the pump to create maximum concrete pressure. The pump may unkink the hose with force! (See Figure 19.)

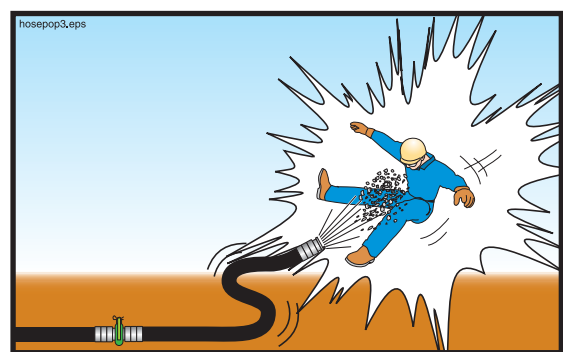
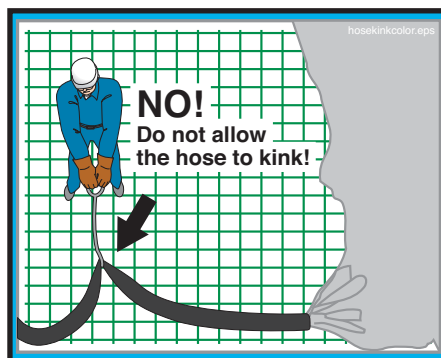


Figure 19
Kinking the hose creates a hazard

6.20

⚠ WARNING Never use compressed air to clear a blockage! It is unsafe and unnecessary. The pump can develop much more pressure than an air compressor. If the pump pressure cannot move it, air pressure won't either.

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6.21

⚠ WARNING Never stand on, sit on, or straddle a pipeline while it's in use, or whenever it is pressurized. Pipeline wears out with each stroke of the pump. If the pipe bursts, you want to be to the side of it, not on top of it (Figure 20).

Figure 20
Never straddle or sit on
a pressurized pipeline



6.22

⚠ WARNING Crushing/amputation hazard. Do not remove the water box covers or grates when the machine is stroking (Figure 21). If you must remove the water box cover (to add water, for example), and there is not a bolt-down grate over the water box, then stop the pump and activate the emergency stop (E-stop) so the pump cannot be restarted until you are finished and the covers are back in place. If a bolt-down grate is installed, you may simply stop the pump from stroking before removing the water box covers. Replace the covers before restarting the pump.

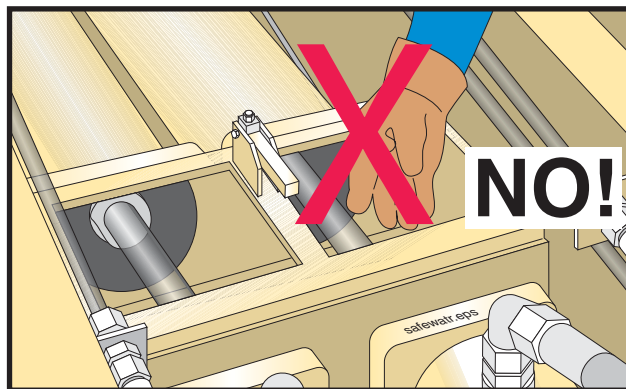


Figure 21
Keep your body out of the water box

6.23

⚠ WARNING Never leave the pump unattended! Before you leave a laborer, ready mix driver, or any other worker alone with the pump for any reason, make sure the worker who you leave with the pump knows:

- the safety rules for a person stationed at the pump (the rules are listed in this *Safety Manual*, beginning on page 35),

- how to stop the pump,
- the location of the emergency stop switches (E-stops),
- how to signal you.

6.24

⚠ WARNING To prevent any unintentional movements of the machine, **all** control devices on the operator's panel and the remote control box must be switched off before changing from remote control to local control, or vice-versa. Whenever you are connecting or disconnecting the remote cable, push in the emergency stop switch (E-stop).

6.25

⚠ WARNING Crushing/amputation hazard. Never put your hands, feet, or any other body part into the water box, concrete valve, or hopper when the hydraulic system is operational or ready to operate! (See Figure 22.)

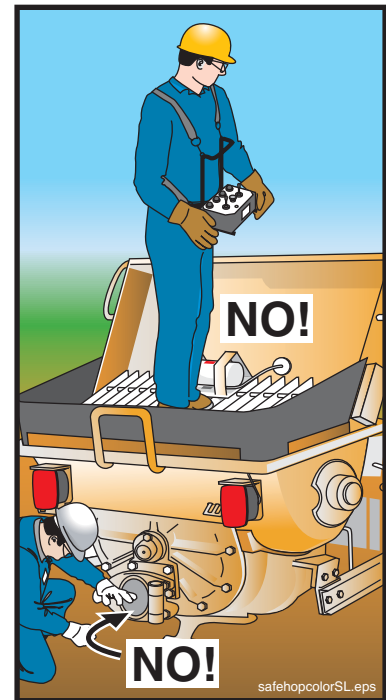


Figure 22
Don't put your body in the machine

6.26

⚠ WARNING Do not work on the hopper, water box, concrete valve, or the hydraulic system unless the drive engine is turned off and the accumulator pressure (if so equipped) has been released! On units with internal combustion engines, the key must be removed. If there is more than one key, you should tag the ignition. On units driven by electric motors, the main disconnect must be locked out according to applicable standards.

6.27

⚠ WARNING Never operate the pump blind. If you can't see the point of placement, you must establish a system of communications with the workmen who can see the point of placement. Arrange for radio communications, a system of visual or auditory signals (lights or bells), or a signalperson. If a signalperson is used, **agree on hand signals before beginning the pour!** (Use of the ACPA standardized hand signals is highly recommended.)

7. Safety Rules For Shotcreting

- 7.1** Keep the pump clean. A clean machine runs more efficiently. To enhance the cleaning of your pump, it will help to spray some type of bond breaker on the entire unit before each use (form oil or equivalent). Do not put oil on surfaces that will become hot, such as exhaust manifolds.

- 7.2** **⚠ WARNING** The nozzle person and nearby personnel should protect themselves by wearing appropriate safety gear, including a full face shield to prevent rebounding concrete from injuring their face and eyes (Figure 23).



Figure 23
Wear a full face shield for rebound protection

- 7.3** **⚠ WARNING** Direct the reducers away from the operator and the concrete mixer driver. The line pressures can be quite high during the shotcrete process (Figure 24).



Figure 24
Point reducers away from the operator and driver

- 7.4** **⚠ WARNING** When practical, the nozzle man and the pump operator should use radios to communicate to facilitate a fast shut-down in the event of a line plug.

- 7.5** **⚠ WARNING** If setting up on a city street or some other obstacle prevents you from directing the reducers away from your work station, it can be helpful to use rubber matting and bungee cords to cover the reducers and act as a protective cover to protect you and the mixer driver in the event of a line rupture (Figure 25).

Figure 25
Cover reducers and use
containment boxes for cleanout



7.6

⚠ WARNING Crushing/amputation hazard! Always keep the hopper grate in place (Figure 26). Never put your hands, feet, or any other body part into the concrete valve, hopper, or water box when the hydraulic system is operational or ready to operate! Never stand on the hopper grate! In addition, the grate can keep many items from entering the hopper that would become blockages in the line.



Figure 26
Never remove the hopper grate
while the pump is operating

7.7

⚠ CAUTION Overspray always presents a problem during the shotcrete process. Protect personnel and equipment in the area by providing overspray protection, even when you are shooting on the inside. The most commonly used protection is plastic sheeting. It is easy to work with and can be nailed or fastened to almost any surface. Canvas tarps can be used in the same manner, but need to be cleaned frequently. Masonite and plywood also work well in some instances. It can help to over-form the area where shotcrete is to be applied. For example, if a wall is to be six feet high, you can form it to eight feet creating a two-foot area of protection. The same would apply to the end of a wall.

7.8

⚠ WARNING Check forms and rebar for stability—both backward and forward—before shotcreting. The rebar cage needs to be tied to something—usually the back form. When the shotcrete wall is being built up, the placed shotcrete wants to sag forward, bringing the rebar with it. If the rebar moves, the form may also move.

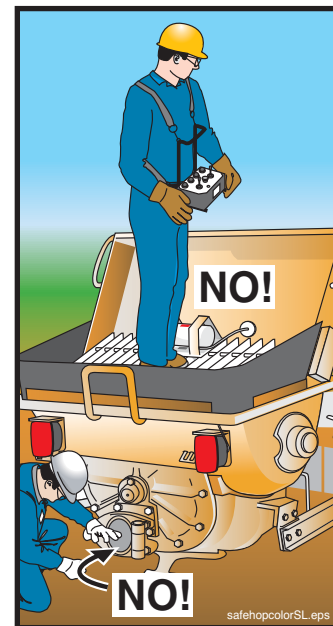
IV. Cleaning The Pump And System

8. Safety Rules For Cleaning The Concrete Valve And Hopper

8.1 **⚠ WARNING** Wear protective clothing and equipment when cleaning the concrete pump because the lime in concrete can burn your skin. Protect against concrete burns and concrete poisoning by wearing rubber boots and gloves during cleanout or any other time that you will be **in** contact with the concrete.

8.2 **⚠ WARNING** Crushing and amputation hazard! **Never put your hands or any other body part into the concrete valve.** Instead, use water jets and the supplied rake (Figure 27).

Figure 27
Keep your body parts
out of the machine



8.3 **⚠ WARNING** **Never put your hands or any other body part into the machine when the hydraulic system is operational.** If you must remove the grate to chip at hardened concrete, you must first disable the system by taking the transmission out of gear and locking the cab door, or stopping the engine, relieving pressure in the accumulator circuit (if so equipped) and securing the controls against unintended operation. Reinstall the grate before restarting the engine (Figure 27).

8.4 **⚠ WARNING** **Never put a bar or other solid tool into the hopper, water box, or other working system while the hydraulics are operational (Figure 28).**

9. Safety Rules For Cleaning The Water Box

9.1 **⚠ WARNING** Crushing and amputation hazard! Stop the concrete pump before removing the water box covers. If your unit has bolt-down guards, do not remove them for cleaning. If there is not a bolt-down guard over the water box, then stop the pump and activate the emergency stop (E-stop) so the pump cannot

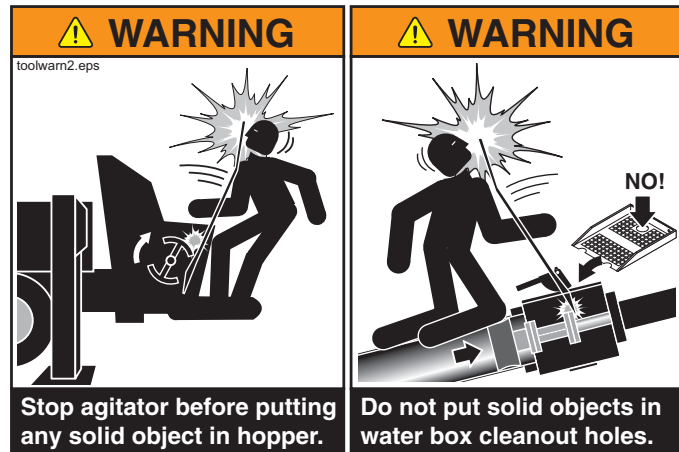


Figure 28
Don't put solid objects into working systems

be restarted until you are finished cleaning and the covers are back in place. If a bolt-down grate is installed, you may simply stop the pump from stroking before removing the water box covers. Replace the covers before restarting the pump.

9.2 **WARNING** Falling hazard! Be sure of your footing when cleaning the water box.

9.3 **WARNING** Crushing and amputation hazard! Do not remove the water box guards for cleaning. Clean the water box with water jets only. **Do not put your hands or any other body part into the water box for cleaning or at any other time when the hydraulic system is operational (Figure 29).**

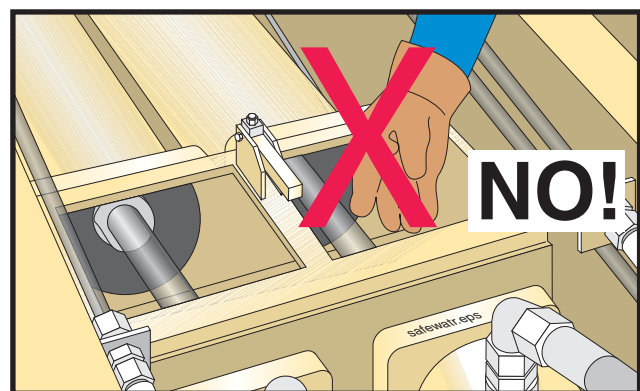


Figure 29
Keep your hands out of the water box

10. Safety Rules For Cleaning A Separately Laid Pipeline

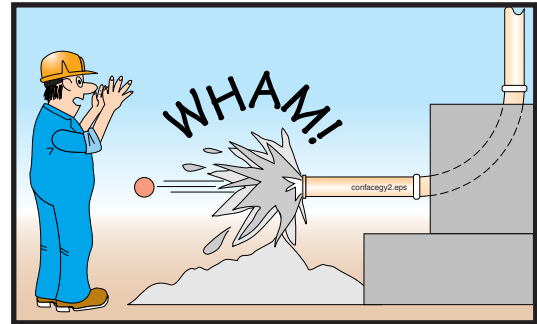
10.1 **WARNING** Flying particle hazard! Clear the discharge area of personnel and equipment before forcing a ball or go-devil through the pipeline, even if you are cleaning with water. Some air will be trapped in the pipeline, and the trapped air will become compressed before discharge.

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10.2 **⚠ WARNING** Using compressed air to clean the delivery system should only be done when no other method is practical, or as recommended by the manufacturer.

10.3 **⚠ WARNING** The point of discharge must be controlled. Use a ball catcher or some other containment device at the point of discharge, even when cleaning with water.

Figure 30
Cleaning with
compressed air can be
extremely hazardous if
you don't follow the
safety rules



10.4 **⚠ WARNING** If you have to use compressed air for cleaning the line you **must** have all of the necessary accessories. Read and understand the complete safety rules regarding cleaning out with compressed air in this section of this *Safety Manual* starting at paragraph 10.8 on page 26. Cleaning with compressed air should only be done by qualified people. See Figure 30.

10.5 **⚠ WARNING** If the ball or go-devil doesn't come out of the delivery system after applying compressed air, **you must relieve the pipe of air pressure before opening it.** If the bleed-off valve plugs when you are draining the air, the only safe way to proceed is to drill small holes into the pipeline, which will then allow the air to escape. Wear a full face shield when drilling the holes. Pipe you have drilled into is ruined and must be replaced. Drill the holes to relieve the air pressure even if the concrete has set up in the pipe. The pipe is hazardous until the pressure is relieved.

10.6 **⚠ WARNING** Exercise care when tapping on the pipeline to find the location of the cleanout ball. Applying too much force will dent a single wall pipe (making it weak and unsafe) and could break the carbide insert of double wall pipe.

10.7 **⚠ WARNING** It is better to let the pipe be ruined by setting concrete than to risk injury by ignoring safe procedures. Remember, pipeline is replaceable, you are not.

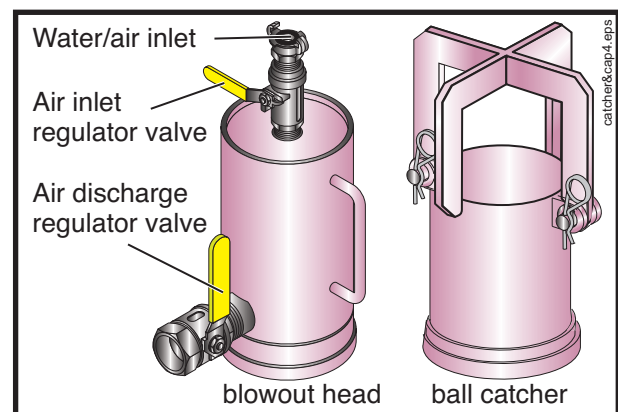
10.8 **⚠ WARNING** **Blowing out with compressed air creates potential hazards! Serious injury or death could result** if you do not adhere to these safety points.

- **Blowing out must be performed under the supervision of a qualified person.** (See the glossary for the definition of *qualified person*.)
- **Blowing out requires two people!** One trained person must be at the inlet end to operate the air insertion, and the other trained person must be near (but safely back from) the discharge point to monitor the discharge and to make sure that no one enters the hazard area.
- **No pipe bends or flexible delivery hoses may be connected to the end of the pipeline during the blowing out process,** unless there is a pre-planned

cleanout station erected to route the discharge into the ready mix truck.

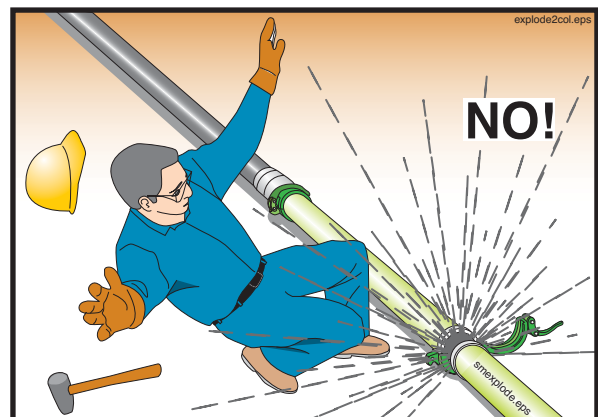
- **The point of discharge must be controlled. Clear the discharge area of personnel and equipment** before beginning the blowing out process. Do not allow anyone to enter the area during the blowout process. If a ball catcher is used, be aware of which type you have, and adjust your procedure accordingly. Ball catcher types are described in paragraph 5.24 on page 13.
- **The concrete outlet must be positioned high enough to permit easy discharge of the material.**
- If you are going to divert the discharge into a discharge pipe system, you must lubricate the discharge line with slurry, or a plug could occur.
- **The pipe cleaning blowout head must be equipped with a properly sized air discharge regulator valve and a separate water/air inlet.** The two openings should be spaced apart far enough that a blowout ball could not cover both openings at once (Figure 31).

Figure 31
Ball catcher and
blowout head



- The ball or go-devil must be large enough to prevent compressed air flow around and into the concrete.
- **The pipeline must not be disassembled until it has been completely relieved of air.** Be sure of this! (See Figure 32.)

Figure 32
Never open a
pressurized
pipeline



- **Do not use compressed air to blow out concrete delivery hose, single pipe sections and short pipelines up to a length of 40 feet.** Hoses will jump and

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move unpredictably; short pipelines don't have enough concrete to resist the force of the air, causing it to discharge too quickly, like a cannon (Figure 33).

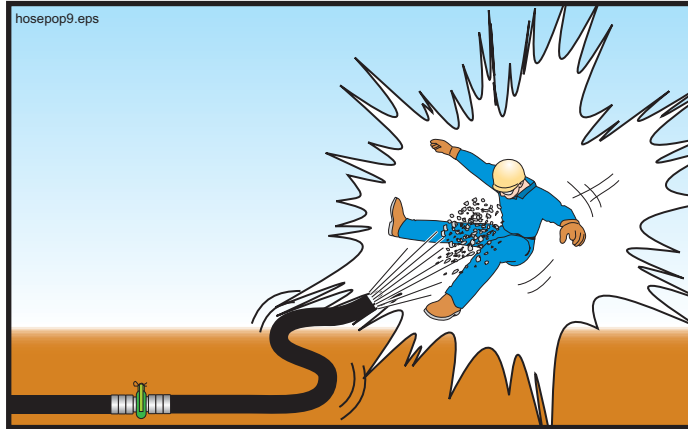


Figure 33
Never use air to blow out hoses or short pipelines

- **When air pressure begins to drop rapidly, shut off the air supply from the compressor, and immediately begin bleeding air out of the pipeline.** (The drop in pressure signifies that the pipeline is almost empty of concrete.)

10.9

⚠ WARNING When blowing out a vertical line, a shutoff valve is required to prevent the following scenario.

1. (See diagram A in Figure 34.) Without a shutoff valve installed, the pipeline is disconnected from the pump. Immediately, the concrete drains out of the vertical sections of pipe, leaving concrete in both horizontal sections, and air trapped in between.
2. (See diagram B in Figure 34.) The ball is inserted, and pushed with compressed air. This also compresses the air that is trapped in the vertical sections of pipe. The trapped air will be violently expelled when it reaches the end of the pipe, but the pipe will not yet be empty.

A shutoff valve installed at the bottom of the vertical run will prevent this hazardous situation. The shutoff valve must be capable of handling the maximum concrete pressure of the pump and, of course, must be installed before the pour begins. Several different styles are available, ranging from a manually operated flat gate that is put into place with a hammer to fully hydraulic types that will also divert the concrete to a different pipeline. With a shutoff valve installed, you can proceed as indicated below.

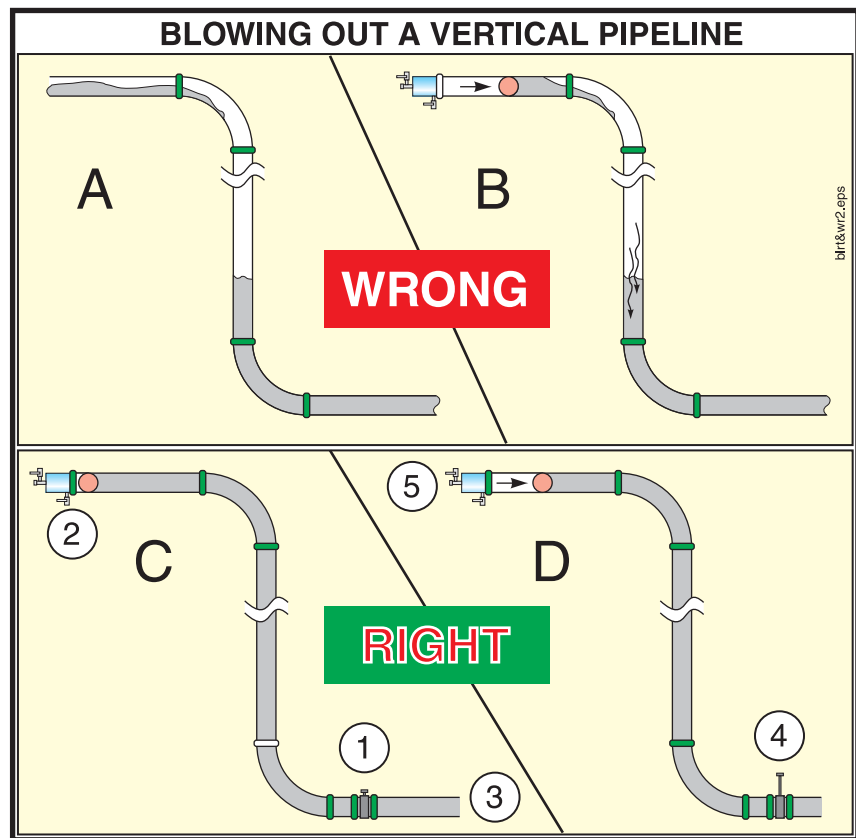


Figure 34
Blowout of a vertical line

10.10

⚠ WARNING Blowing out vertical sections of pipe (for example on a high-rise building) requires additional safety precautions.

1. **Know where the discharge area for blowing out will be before the pour begins.** Ready the area and accessories before the pour begins so you will not waste time when pumping is completed.
2. **Blowing out with compressed air requires two qualified persons.**
3. **The persons at both ends of the pipeline must be able to communicate without delays,** which means you must establish communications (for example, with a radio).
4. **When pumping is complete, close the shutoff valve before disconnecting the pipeline from the pump** (Item 1, Figure 34). Failure to do this will cause the concrete to fall out of the vertical sections of pipe, leaving concrete in the horizontal sections of pipe and an air pocket in the vertical sections. This does not apply if you are using a switching (diversion) valve.
5. **Install the ball(s) in the pipeline, secure the blowout head and hook up the air compressor. Do not apply the air yet!** (Item 2, Figure 34.)

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6. If you will be diverting the discharge to a cleanout area, lubricate the discharge line with slurry, or a plug could occur.
7. **Position the ready mix truck at the cleanout standpipe,** or install the ball catcher or other containment device at the end of the discharge line. (Item 3, Figure 34.)
8. **Clear the discharge area of personnel.** You must allow no one to enter the discharge area until the pipeline is depressurized.
9. **Divert the vertical pipe line to the cleanout area and secure the discharge (Figure 35), or open the shutoff valve in the delivery pipe line now.** Allow gravity to start the concrete moving through the discharge line. As the concrete falls from the vertical sections, it will take the ball with it, making it impossible to trap air in the line. (Item 4, Figure 34.)



Figure 35
Divert vertical pipeline to the cleanout area and be sure to secure the discharge before continuing

10. **Apply the compressed air to the pipeline.** Close communications must be maintained at this time. Add only enough air to keep the concrete moving. Do not allow the concrete to accelerate. (Item 5, Figure 34.)
11. **When concrete starts to accelerate, shut off the air supply from the compressor, and open the air regulator to bleed air from the line.** Rapidly accelerating concrete indicates that the pipeline is almost empty. After the ball has been expelled from the pipeline, leave the air regulator open to be sure that all air is removed from the system.
12. All the rules for blowing out found in Point 10.8 on page 26 also apply to blowing out a vertical pipe line. These rules are in addition to the general cleaning a pipeline with compressed air rules.

10.11

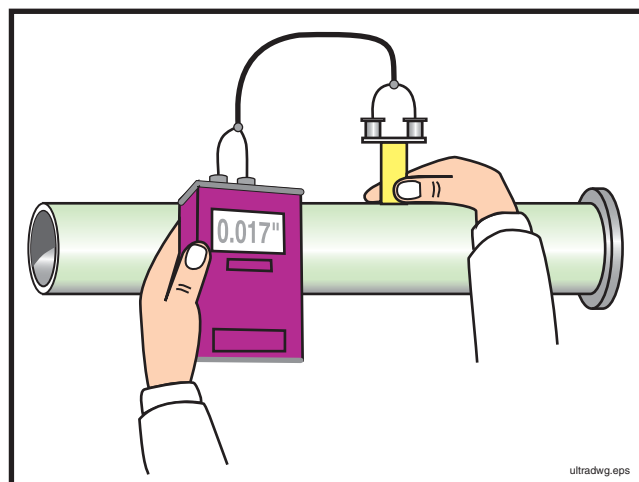


WARNING Never use compressed air to attempt to clear a blockage! It is unsafe and unnecessary. If the pump pressure can't move it, air pressure won't either.

V. Maintenance Of The Machinery

11. Safety Rules Regarding Inspection

- 11.1** **⚠ WARNING** Visually inspect your unit each day before it is put into operation. If any problem is found that will affect the safe operation of the pump, don't use the pump until it is repaired!
- 11.2** **⚠ WARNING** If safety decals are faded, missing, damaged, or otherwise unreadable, they must be replaced immediately. Contact the manufacturer of your unit to obtain replacements.
- 11.3** **⚠ WARNING** If safety devices or guards are removed for inspection purposes, they must be replaced before someone uses the machine.
- 11.4** **⚠ WARNING** Pay attention to the operation manual and manufacturers service bulletins regarding maintenance and inspection procedures and intervals.
- 11.5** **⚠ WARNING** If inspection reveals something that looks wrong, or even suspicious, report it to the manufacturer for consideration. Don't just assume that it's okay.
- 11.6** **⚠ WARNING** Visual inspection of the concrete pump circuits and safety devices should be done daily. Hands-on inspection and documentation of results should be done weekly, or at least when preventive maintenance is scheduled.
- 11.7** **⚠ WARNING** Do not neglect the delivery pipeline, clamps, or hoses. Check them often for wear, dents, and frays. Never send a unit to a job with a worn or damaged delivery system. For single wall pipes, ultrasonic thickness testers are more accurate than the tap method.



††

Figure 36
Check delivery system wall thickness with
an ultrasonic thickness tester

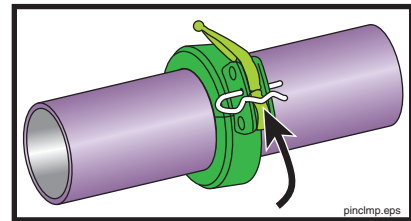
12. Safety Rules Regarding Scheduled Maintenance

12.1  **WARNING** Proper and timely maintenance is important to the safe operation of a concrete pump. The proper procedures are outlined in the operation manual supplied with the pump. Do not put it off. Do not treat it lightly. Do not fudge results. The lives of the operator, oiler, and workers on the job are depending on it.

12.2  **WARNING** Keep the machine clean! Oil spills, grease, loose tools, and displaced accessories are hazards.

12.3  **WARNING** Pins should be used on all delivery system clamps. Clamps that will hang over workers, and clamps used on system that will be dragged shall be pinned (Figure 37).

Figure 37
Pin the clamps



12.4  **WARNING** Be sure that you are installing the correct clamps for the types of pipe ends used. Never try to mate dissimilar pipe ends unless using a clamp specifically made for this purpose. See the comparison regarding weld-on ends on page 46 in the *Appendix* of this manual.

12.5  **WARNING** When using new pipe and/or hose on the machine, be sure that it is capable of handling the maximum concrete pressure of the pump.

12.6  **WARNING** If safety devices or guards are removed for servicing, they must be replaced before the machine is put back in service.

12.7  **WARNING** Do not change the maximum relief valve setting on any hydraulic circuit without permission from the manufacturer. **Never** change an accumulator circuit pressure setting without specific instructions from the manufacturer.

12.8  **WARNING** Never make unauthorized modifications to structural members or pressure circuits.

12.9  **WARNING** You must **replace, not repair** damaged hydraulic or concrete hoses or pipes.

12.10  **WARNING** Never try to repair a machine using worn, damaged, or defective components.

12.11  **NOTICE** **Never allow welding current to travel through bearings or hydraulic cylinders.** Keep the ground cable on the component that is being welded.

12.12

NOTICE Electronic components can be destroyed by welding current. Before welding on the unit, you must disconnect the battery cables, and unplug all radio remote control power wires. If in doubt, contact the Service Department of the manufacturer for instructions **before** proceeding.

13. Safety Rules When Servicing The Machinery

13.1

WARNING Repairs should be carried out by qualified workshop personnel. (See the glossary for the definition of *qualified personnel*.)

13.2

WARNING Read and understand the maintenance procedures in the operation manual **of the machine before attempting any repairs**. If in doubt, call the manufacturer. Incorrectly done repairs affect the safe use of the machine.

13.3

WARNING Burn hazard! **Never work on a hot hydraulic system**.

13.4

WARNING Falling hazard! If you cannot work at ground level, you must find and use a suitable work platform, a tie-off harness system, or otherwise secure yourself from falling.

13.5

WARNING If maintenance work requires that you use a crane, hoist, fork truck, or similar machine, read and understand the safety regulations for that equipment.

13.6

WARNING Only operators should operate the unit. If work on the machine requires that it be operated and you are not qualified as an operator, you must get someone who is qualified to assist you.

13.7

DANGER Electrocution hazard! **Repair work on electrical systems over 28 volts must be done by qualified electricians**.

13.8

WARNING Explosion hazard! **Be sure that you understand the potential danger of spring-loaded or compressed-gas components before you service them**. (Examples: nitrogen accumulators, gas springs for toolbox doors, tires, brake chambers.) If you don't know the dangers, call the manufacturer **before** beginning work!

13.9

WARNING If you will be working in a hidden area inside the machine, lock it out as follows.

- With a gas or diesel engine, remove the ignition key and place a *Do Not Operate* sign on the controls. Carry the key with you.
- With an electrically driven pump, lock out the main breaker and tag the controls.

The above rules are one simple Lock Out-Tag Out procedure. A procedure may also be provided in the operation manual for the unit and there may be state or local regulations that require a more advanced or stringent Lock Out-Tag Out program. Be aware of the regulations in your area.

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- 13.10** **⚠ WARNING** Never activate the system hydraulics without checking if another workman is in a hidden position. Always yell “clear” before starting the engine or electric motor, and allow time for response.
- 13.11** **⚠ WARNING** Never work on a pressurized hydraulic system. Stop the engine or electric motor, relieve the accumulator circuit and verify zero pressure on the gauge (if so equipped), and be sure that no hydraulic components are loaded, (i.e., outrigger supporting the unit) before you open the hydraulic system.
- 13.12** **⚠ WARNING** Never use gasoline or diesel fuel as a cleaning solvent. This is critical to remember when cleaning hydraulic oil reservoirs, because gas and diesel fuels are highly explosive and **traces left in the oil may ignite when compressed!**
- 13.13** **⚠ WARNING** Remember to mount and dismount the unit using the 3-point Rule. One hand and two feet or two hands and one foot are to be in contact with a secure surface at all times (Figure 38).

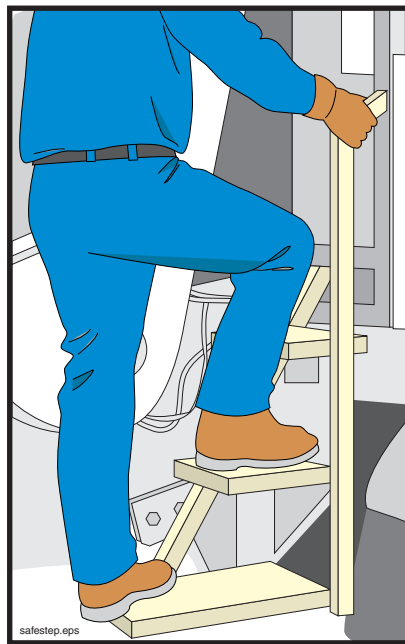


Figure 38
The 3-point Rule

- 13.14** **⚠ WARNING** Always use the correct tools for the job. Tools should be kept clean and in good condition.
- 13.15** **⚠ WARNING** If you see a coworker engaging in an unsafe practice, warn him about the dangers. Safety is always in the hands of those on the job!
- 13.16** **⚠ WARNING** After any repair is completed, test the function of the repaired part to be sure that repairs were done correctly.

VI. Coworker Safety

14. Safety Rules For Workers Assigned To The Pump.

14.1

⚠ WARNING You must know how to stop the pump. Have the operator show you the locations of the emergency stop switches (E-stops) (Figure 39).

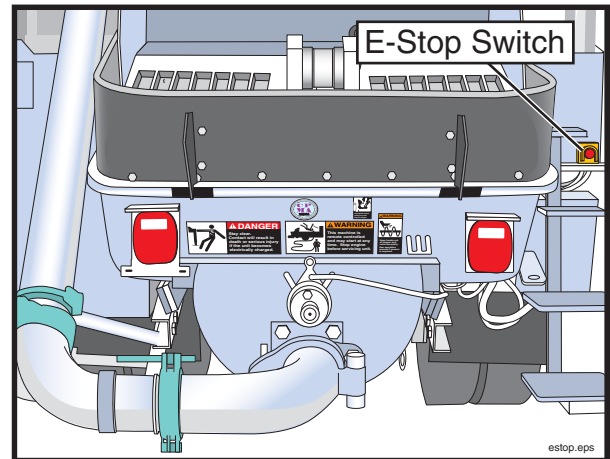


Figure 39
Know how to stop the unit in an emergency

14.2

⚠ DANGER You should wear the same personal protective equipment as the operator. Goggles, hard hat, ear protection, and rubber gloves are especially important when working near the hopper, (including *full face shield and/or **breathing mask, when necessary, as shown in Figure 40).

* Full face shield should be used in addition to safety glasses when shotcreting, or any time material is rebounding.

** Breathing mask needed when cement dust (or other toxic dust) is present in the air.

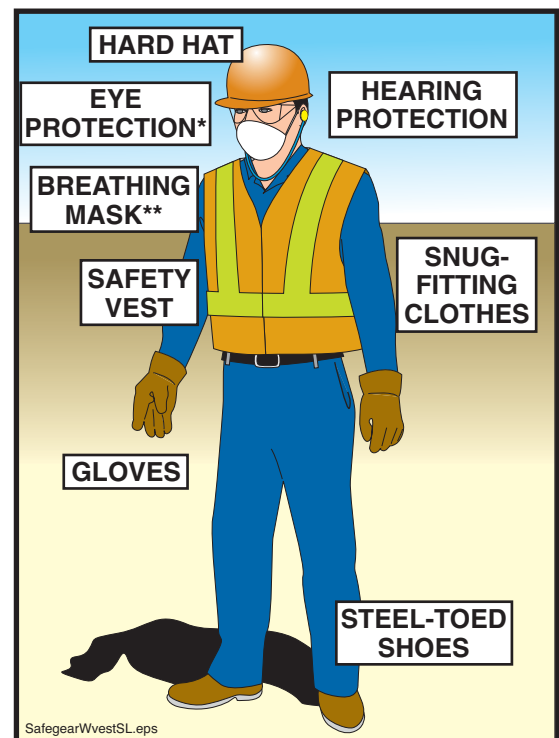


Figure 40
Wear the same personal protective equipment as the operator

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14.3

⚠ WARNING Crushing hazard. Never, ever position yourself between the ready mix truck and the pump! Stand to the side, where the driver can see you (Figure 41).



Figure 41
Never stand between the ready mix truck and the pump

14.4

⚠ WARNING When backing in ready mix trucks, use clear and concise hand signals (Figure 42).

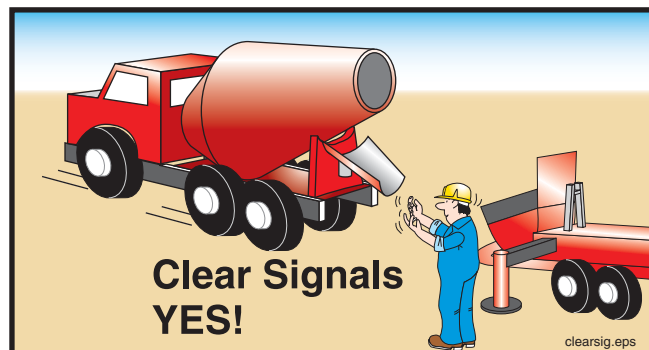


Figure 42
**Use clear, concise
hand signals**

14.5

⚠ WARNING If handling the chutes of a ready mix truck, keep your hands clear of the hinged areas.

14.6

⚠ WARNING Do not allow the ready mix driver to put concrete in the pump hopper until the pump operator gives him the 'okay.' Filling the hopper early can cause the pump to plug.

14.7

⚠ WARNING If you see foreign material that could create a blockage coming from the ready mix truck, alert the operator to stop the pump. Do not attempt to remove the material from the hopper or grate while the hydraulic system is ready to work. (See Point 14.16 on page 39.) If necessary, depress the E-stop button to stop the pump and alert the operator.

14.8

⚠ WARNING Never allow the ready mix driver to clean out in the hopper, because it can create a blockage. (Water will wash the cement and fine sand from the course aggregate causing segregation.)

14.9

⚠ WARNING Do not operate the pump unless you are also a trained operator and the regular operator has released the controls to you. **There must not be more than one operator at a time.** This does not apply to stopping the pump or boom if there is a need to do so.

14.10

⚠ WARNING Do not let the concrete level in the hopper become low! If air is sucked into the material cylinders, the pump will compress the air. Compressed air always poses a hazard as it is expelled from the hopper or the delivery pipeline (Figure 43). If air is taken into the material cylinders, take the following steps to minimize the hazard:

1. Stop the pump immediately. Hit the emergency stop switch (E-stop) if that is the quickest way to stop the pump. There will be an expulsion of compressed air the next time the concrete valve shifts. If possible, fill the hopper with concrete to help contain the expulsion. Do not put your face directly over the hopper.
 2. Alert the operator of the problem. It is the operator's job to know the procedures for safe removal of air from the pump and delivery system. These procedures include pumping in reverse for a couple of strokes.
 3. Persons standing at the discharge end or near the delivery line must be warned to move away until all of the air has been purged. Warn them to stay a reasonable and prudent distance beyond the reach of the end hose or point of discharge (Figure 43).
 4. When the pump is restarted, don't assume that the first little air bubble is the end of the compressed air.
 5. Do not allow anyone near the discharge until concrete runs steadily from the end and there is no movement of the delivery system.
- If workers are positioned in high or precarious places, warn them to expect a loud sound as the air escapes the pipeline. (Warn them even if they are well away from the discharge.) That way, we can prevent the worker from falling as a result of being startled by the noise.

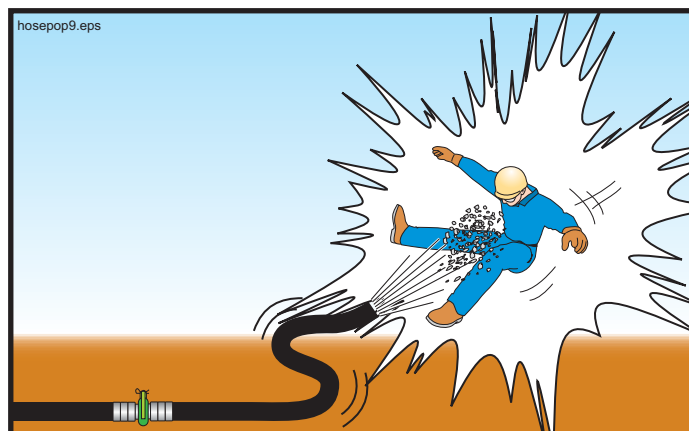


Figure 43
Remove everyone from the discharge area
whenever air has been introduced into the line

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14.11

⚠ WARNING When initially priming the delivery system, when restarting after moving, when restarting after adding or removing hoses, or whenever air has been introduced into the line, warn everyone to stay away from the discharge until concrete runs steadily and there is no movement of the delivery system. Personnel should stay back a reasonable and prudent distance beyond the reach of the end hose or point of discharge (Figure 43). Air will be in the line when first starting, when restarting after moving, when a blockage has been successfully removed by rocking the concrete, and after the line has been taken apart or opened for any reason.

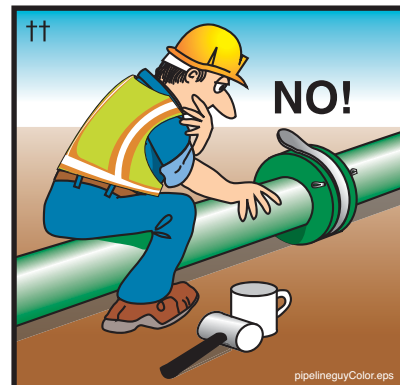
14.12

⚠ WARNING **Never use compressed air to clear a blockage!** The operator is responsible for knowing the safe blockage removal procedures. It is unsafe and unnecessary to use compressed air. If the pump pressure cannot move it, air pressure won't either.

14.13

⚠ WARNING Never stand on, sit on, or straddle a pipeline while it's in use, or whenever it is pressurized. Pipeline wears out with each stroke of the pump. If the pipe bursts, you want to be to the side of it, not on top of it (Figure 44).

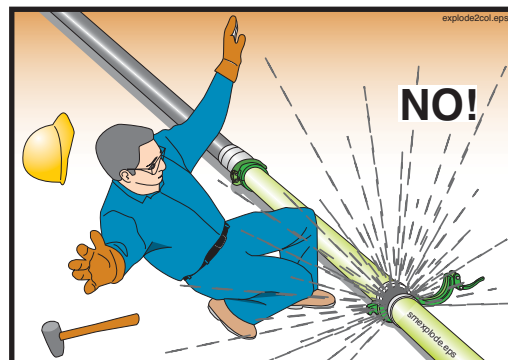
Figure 44
Never straddle or sit on a pressurized pipeline



14.14

⚠ WARNING Expulsion hazard! **Never open a pipeline that is under pressure** (Figure 45). The pump must be run in reverse for at least two strokes and then stopped before opening a pipeline. If the pipeline is pressurized with air, do not open it. The operator is responsible for knowing how to safely release the air pressure.

Figure 45
Never open a pressurized pipeline



14.15

⚠ WARNING Be careful when handling pipeline or any other heavy object. Learn how to lift without using your back. Get assistance if needed.

14.16

⚠ WARNING Crushing/amputation hazard! Never put your hands, feet, or any other body part into the water box, concrete valve, or hopper when the hydraulic system is operational or ready to operate! Never stand on the hopper grate! (See Figure 46.)

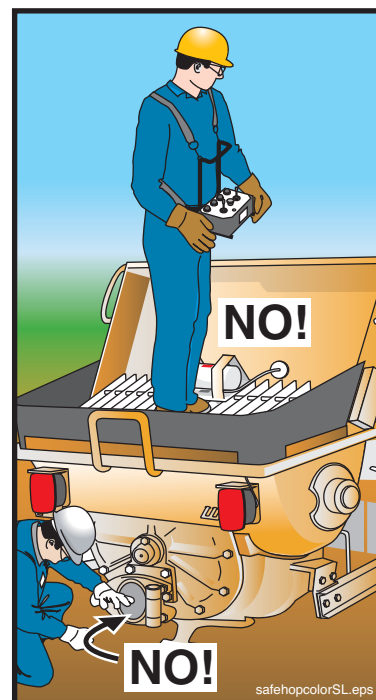


Figure 46
Never put your body in the machine!

14.17

⚠ WARNING Never lift or remove the hopper grate for any reason (Figure 47).



Figure 47
Lifting hopper grate exposes the agitator and the concrete valve

SAFETY MANUAL

14.18

⚠ WARNING Do not remove the water box covers or grates when the machine is stroking (Figure 48). Do not remove the water box cover (to add water, for example), until the operator has disabled the machine. Replace the covers before the operator restarts the pump.

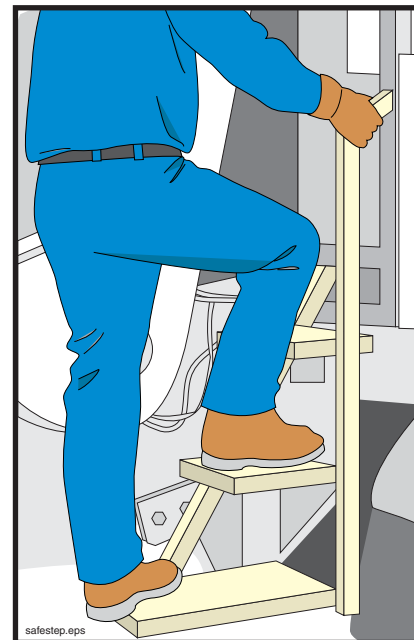
Figure 48
**Do not remove the water
box covers when the
machine is stroking**



14.19

⚠ WARNING Mount or dismount the pump or truck using the *3-point Rule*. One hand and two feet or two hands and one foot are to be in contact with a secure surface at all times (Figure 49).

Figure 49
The 3-point Rule



14.20

⚠ WARNING Keep unauthorized personnel off of the pump.

15. Safety Rules For The Placing Crew

15.1

⚠ WARNING Wear Personal Protective Equipment (P.P.E., or just PPE) when working around a concrete pump (Figure 50). The gloves should resist concrete lime burns. If you will be working **in** the concrete, protect your feet and hands with rubber boots and gloves (including *full face shield and/or ** breathing mask, when necessary, as shown below).

* Full face shield should be used in addition to safety glasses when shotcreting, or any time material is rebounding.

** Breathing mask needed when cement dust (or other toxic dust) is present in the air.

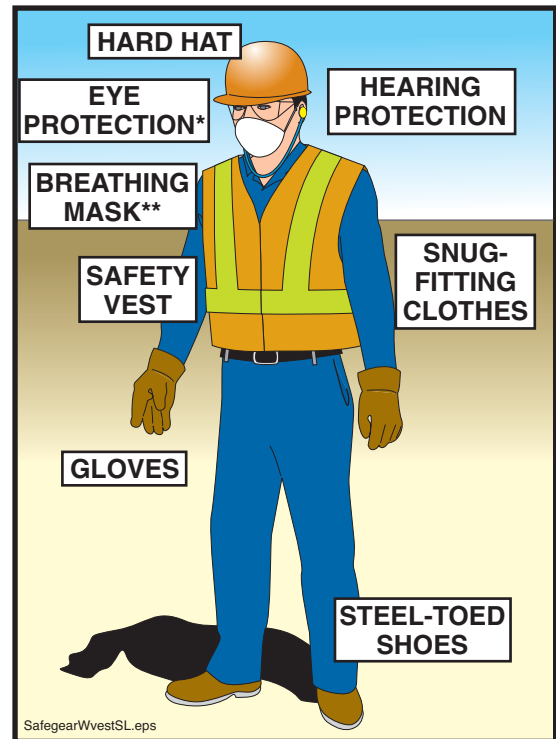


Figure 50
Wear Personal Protective Equipment (PPE)

15.2

⚠ WARNING When the operator is initially priming the delivery system, restarting after moving, restarting after adding or removing pipes or hoses, or any time that air has been introduced into the delivery system, stand a reasonable and prudent distance away from the tip hose or point of discharge. Do not get near the discharge until material runs steadily and there is no movement of the delivery system. (Figure 51). Compressed air in the line can cause rubber hose to move violently. If the operator tells you that air is coming in the delivery system, proceed as follows:

- Get to ground level (if in a high place) and remain well away from the discharge or at least take cover.
- Stay away from the discharge. Be sure that **all** the air is gone before getting near the point of discharge again. It is the operator's job to know when it's safe to go back to normal pumping.

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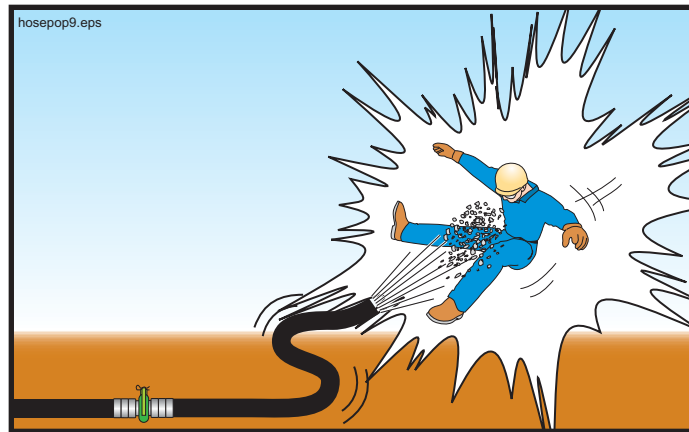


Figure 51
Stay away from the point of discharge when starting or restarting, and when there's air in the pipeline

- 15.3** **WARNING** Never use compressed air to clear a blockage! It is unsafe and unnecessary. If the pump pressure cannot move it, air pressure won't either. Stand away from the discharge and the line if anyone attempts to use compressed air in this manner.
- 15.4** **WARNING** Do not look into the end of a plugged hose or pipe!
- 15.5** **WARNING** When the pump crew is using compressed air to clean the boom or system pipeline, stay away from the discharge area. **Never try to hold down a pipe or hose that is being cleaned with air.**
- 15.6** **WARNING** Never open a pressurized pipeline (Figure 52). The pump operator must release the pressure before you open the line. If the line is pressurized with compressed air, let the operator release the pressure and verify that the air has escaped before you proceed.

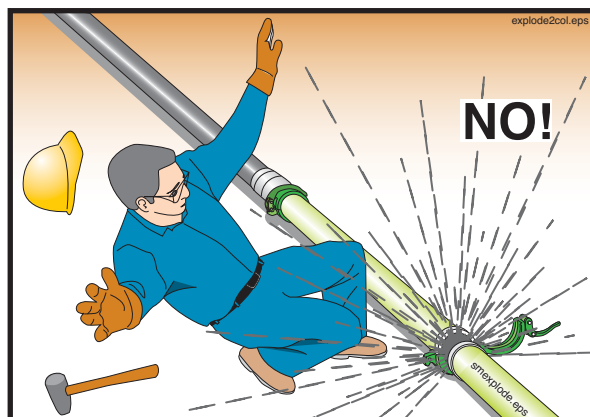


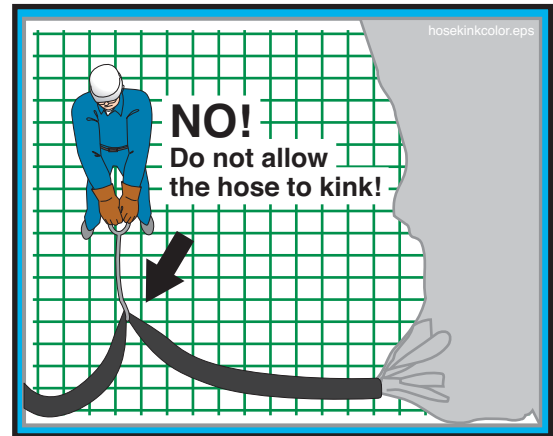
Figure 52
Never open a pressurized pipeline

- 15.7** **WARNING** After removing pipe sections you must **reassemble using gaskets and clamps**. Pipelines assembled without gaskets will leak cement and water, which can cause a blockage.

15.8 **⚠ WARNING** Concrete is being moved through the delivery system by pressure. Failure of a pipe, clamp, hose, or elbow is possible. For this reason, spend as little time as possible standing near the pipeline, and wear protective clothing.

15.9 **⚠ WARNING** Do not kink the end hose. Kinking will cause the pump to create maximum concrete pressure. The pump may unkink the hose by force! (See Figure 53.)

Figure 53
Never kink the hose;
Never hold the hose with your shoulder



15.10 **⚠ CAUTION** Be careful when handling pipeline or any other heavy object. Learn how to lift without using your back. Get assistance if needed.

15.11 **⚠ WARNING** Falling hazard! When pouring columns, slabs, or walls above ground, secure yourself from falling.

15.12 **⚠ WARNING** Never stand on, sit on, or straddle a pipeline while it's in use, or whenever it is pressurized (Figure 54). Pipeline wears out with each stroke of the pump. If the pipe bursts, you want to be to the side of it, not on top of it.

Figure 54
Never straddle or sit on a pressurized pipeline



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15.13

⚠ WARNING To avoid confusion and conflicting signals, only one person should act as a signalperson (give operational signals to the pump operator). However, the operator is trained to obey a stop signal from anyone and everyone.

15.14

⚠ WARNING Before the pour begins, the hose person, the signalperson, and the operator should agree on the hand signals (Figure 55).

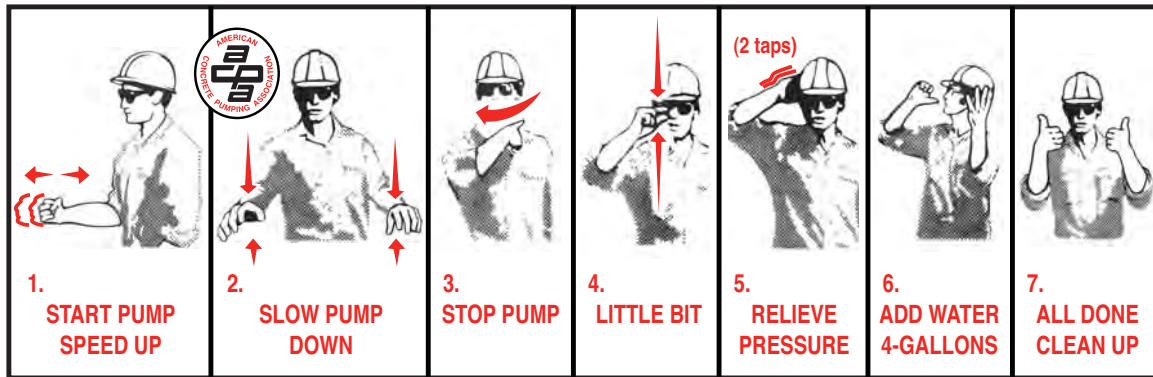
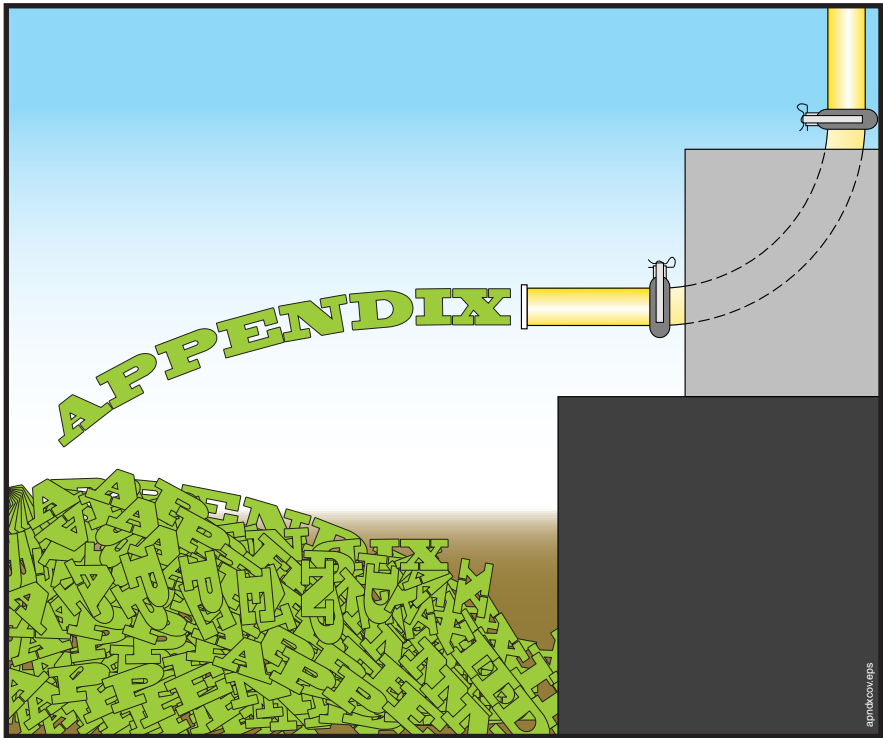


Figure 55
Recommended ACPA hand signals



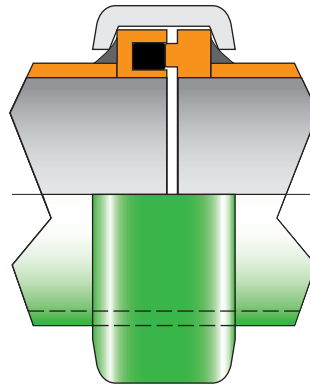
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VII. Weld-On Ends/Coupling Comparison

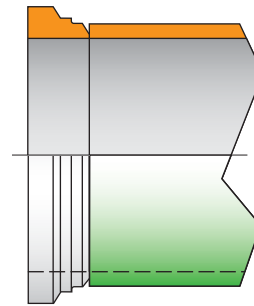
Shown is a comparison among commonly used ends/couplings. No two ends shown can be joined without the use of an adapter pipe or a special adapter clamp. Clamps and pipe strength must also be considered when determining proper system requirements. The ratios shown in the text below represent the safety factor from burst:working pressures.

1. Male/female o-ring type couplings have the highest pressure rating of the ends commonly used for concrete pumping. They can withstand 4350 PSI @ a 2:1 safety factor. They are self-aligning and waterproof when used with o-rings in good condition. Typically not used on booms because of their weight. Pipes equipped with this style coupling cannot be swapped end-for-end.



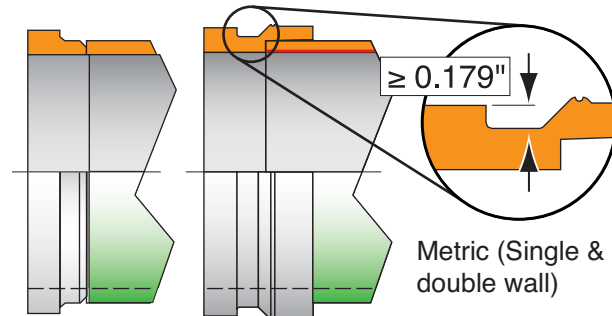
Male / Female
O-Ring
(shown with clamp)

2. Heavy-Duty couplings are designed for pressures up to 2250 PSI @ 2:1. They have 20% more contact area than metric couplings, and a tapered face that draws the pipe sections together during assembly. Both the ends and clamps weigh more than metric style, and therefore should not be used on booms without consulting the manufacturer.



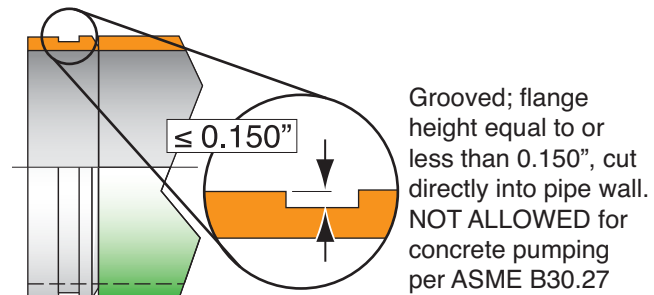
Heavy-Duty

3. Metric couplings are designed for pressures up to 1400 PSI @ 2:1. They have 85% more contact area than grooved couplings. The face is flat and will not draw pipe together. Although they have a raised edge, they are not compatible with Heavy-Duty couplings unless a special clamp or an adapter pipe is used to change from one style to the other. Metric connections are standard equipment on booms because of the weight savings compared with other styles.



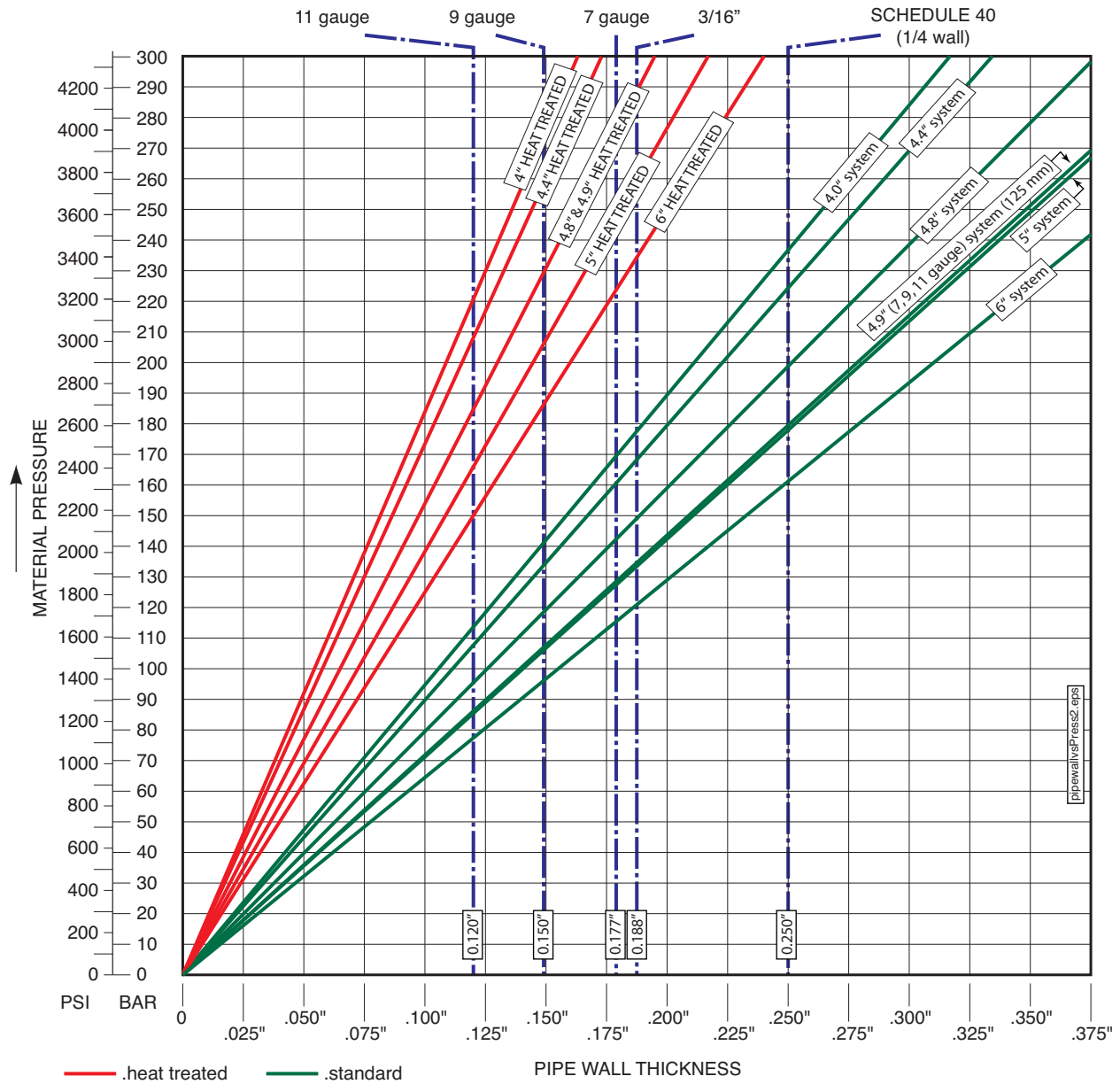
Metric (Single &
double wall)

4. Grooved (Victaulic) couplings (lip height of 0.15" or less) are designed for pressures only up to 750 PSI @ 2:1. The recessed groove is hard to clean when changing pipe on a job. The weld-on end fails before the pipe because the groove is cut into the pipe thickness, making it the weakest spot. Grooved couplings are not recommended for concrete pumping applications.



NOTE: All pressure ratings listed refer to 5-inch (125mm) diameters in like-new condition. Other pressures would apply to other diameters.

VIII. Minimum Pipe Wall Thickness Chart



1. This chart assumes a safety factor of 2:1. Higher safety factors may be required in some circumstances.
2. Wear reduces wall thickness. Thickness must be checked on a regular basis.
3. Pressures may be limited even more by clamp style or pipe end used.
4. The chart is based on 62,000 PSI tensile strength. Heat-treated calculations are based on 120,000 PSI tensile strength.
5. The chart is for pressure calculations ONLY. There is no allowance for mechanical forces other than pressure, and thicker walls may be needed for mechanical strength because of support or restraint considerations.
6. The chart does not take into account metal fatigue caused by pressure cycles.

Note! This chart is intended as a guide for concrete pumping applications and is subject to the notes, assumptions, and conditions listed above. Any other use of this chart is not recommended.

This chart does not apply to double-wall pipe. Double-wall pipe can be checked by inspecting the inside of the pipe. If the insert is intact, the pipe is okay. If the insert is worn through, the pipe must be replaced. Contact your pipe supplier for the pressure capacity of your double-wall pipe.

IX. Glossary Of Terms

Accumulator

A hydraulic device that stores fluid power energy in much the same way that a battery stores electrical energy. Because an accumulator will store energy, it **MUST** be drained and depressurized before work begins on an accumulator-equipped actuator or hydraulic system.

Agitator

A device that sits in the concrete hopper to keep concrete moving, preventing it from setting. It is typically a rotating shaft to which several paddles have been mounted. *See Also:* Hopper Grate

ASME B30.27

A safety standard for material placement systems (concrete pumps and material placement conveyors) that has been accepted by ANSI as an American National Standard.

Blanking Plate

Also known as a blanking plug or end cap. Its purpose is to prevent material from falling out of the delivery system when moving a boom with a full pipeline over personnel or property.

Blockage

Simply put, if the pump is pushing and concrete fails to come out at the point of discharge, it is called a blockage. Blockages can be removed with pump pressure, by rocking the pump between forward and reverse, or some other remedial measure. If the blockage cannot be removed in such a manner, it's called a plug. *See Also:* Plug, Rock Jam. The causes of blockages are detailed in Section 6.12 of this manual. In all cases, blockages create a hazard by causing high concrete pressure, combined with the sometimes uncoordinated efforts of untrained workmen to remedy the problem.

Bulk Density

The mass of a substance per volume. For example, one cubic foot of air weighs much less than one cubic foot of water. One cubic foot of lightweight concrete weighs less than one cubic foot of steel-entrained concrete. We could say that steel-entrained concrete has a higher bulk density than lightweight concrete. All calculations for the operation manuals and specifications of concrete pumps are based upon 150 pounds per cubic foot, which is the approximate mass of hard rock (normal) concrete.

Certified Operator

An operator that has been issued a certification card by the American Concrete Pumping Association. There are several classes of certification, each relating to a different category of pump. For an operator to become certified, he (she) must: pass the written tests regarding operation, setup, and cleanout for each category of pump; pass the safety rules test which is common to all certification categories; meet the experience requirements set forth for each category; and maintain a safe and clean driving record. The certification card only certifies that the operator has passed a written test administered by an ACPA certification proctor and does not attest to their ability to operate a concrete pump. *See Also:* Qualified Person, Qualified Operator.

Concrete Delivery Hose

A flexible concrete hose that has two end couplings.

Concrete Pressure

The force per square area that is exerted on the concrete. The concrete pressure will always be a ratio in direct proportion to the hydraulic oil pressure on the concrete pump circuit. *See Also:* Maximum Pressure

Decibels

One tenth of a bel. Abbreviated dB. It is a measurement of sound volume. As it applies to concrete pumps, it is a measurement of the sound pressure level one meter away from a noise source. O.S.H.A. has developed guidelines for time limits on exposure to sound at different volume levels. The chart can be found on page 15 of this manual.

Drive Engine

The primary source of power for a hydraulic system. Typically, the word “engine” denotes an internal combustion device, whereas the word “motor” denotes an electrical device.

End Hose

A flexible concrete hose that has one end coupling.

Foreign Material

Material that was never intended to be pumped, which ends up in the concrete hopper. Examples of foreign material include: small animals; hammers; ready mix truck fins; unmixed clumps of cement; hardened concrete that breaks away from ready mix truck fins; and soda pop cans. These items could create a blockage if pumped.

Go-devil

A plug made from a rubber composite, usually with several fins that expand to seal when pressure is applied. They are intended to be inserted in a steel delivery pipeline and pushed with water or compressed air for the purpose of cleaning the pipe. *See Also:* Sponge Ball

Guide

An assistant brought in to help in backing up a truck or trailer, or to help in other circumstances where the driver cannot see enough to assure safety. *See Also:* Signperson

High Voltage

For the purposes of this manual, anything over 28 volts is to be considered high voltage. In the U.S., electrically driven concrete pumps normally operate the motors at 480 volts AC (high voltage) and the controls at 24 volt DC (low voltage).

Hopper Grate

A meshwork placed over the concrete hopper, typically made from steel bars. It serves the functions of keeping human body parts away from the agitator (when left in its proper position) and keeping large foreign objects from falling into the hopper, which could cause blockages if they were pumped.

Jacking the Outriggers

Adjustment of the outriggers in the vertical direction.

Licensed Electrician

A qualified electrician licensed by the state, county or municipality where the connections are to be made. In some locations electricians are not required to be licensed, and in these cases the work should still be carried out by competent professionals. Under no circumstances should high-voltage connections be made by a concrete pump operator or related personnel.

Maintenance

All procedures for service, inspection, and repair of concrete pumps and related equipment and devices. Maintenance and inspection are methods of *maintaining* the desired state of the equipment. Repair is the method of *restoring* the desired state of the equipment.

Maximum Pressure

When talking about a hydraulic system, maximum pressure refers to the highest pressure that can be achieved with the settings of the circuit relief valves. When discussing concrete output, maximum pressure refers to the pressure that will be developed if the hydraulic system pressure

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reaches the relief valve setting. Concrete pressure is the force at which the differential cylinders are moving, divided by the cross sectional area of the concrete cylinder. Maximum concrete pressure, then, is developed when the differential cylinders are moving with maximum force, which is determined by the hydraulic system relief valve setting. *See Also:* Concrete Pressure.

Minimum Safety Distance

In this manual, the term “minimum safety distance” refers to the closest distance that you are allowed to approach an object, electrical wires, etc. and still leave room for errors in human judgement or machine malfunction. With electrical wires in the U.S., this distance is 20 feet from the wires (50 feet above 350 Kv), as recommended by the American Concrete Pumping Association. This distance may have other values in different locations. It is up to the operator to know the value for the place of operation.

Operational Area

The area around a working piece of equipment or point of discharge where hazards can be encountered due to the nature of the machinery or process in use.

O.S.H.A.

Occupational Safety and Health Administration. A branch of the United States federal government that deals with job safety. It establishes and enforces safety regulations for industry and business. Among the areas over which it has authority are construction job sites and work shops.

Personal Protective Equipment (P.P.E. or just PPE)

Things you can wear to protect yourself from potential dangers in a concrete placing environment. Examples are:

- Snug-fitting work clothes
- Steel-toed work boots
- Lime-resistant gloves
- Safety glasses
- Ear muffs or ear plugs
- Rubber boots when you have to stand in concrete
- Hard hat
- Breathing mask when working with cement dust

Plug

A plug is a blockage that cannot be removed with the pump pressure, or by other remedial measures. A plug must be removed manually. *See Also:* Blockage.

Point of Discharge

Also known as the point of placement. The location of concrete expulsion from a delivery system. This can be the point of placement (the actual form that is being filled with concrete) or the cleanout area after completion of the job.

Pour

Used by the concrete pumping industry and in this manual as a noun. It is the specific job for the pump during any given time period. (e.g. “We’ll grab lunch right after the pour.”)

Qualified Person

As used in this *Safety Manual*, a *qualified person* is defined as: a person who, by possession of a recognized degree of certificate of professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter and work. Other qualified persons may include master mechanics and after-sales service technicians of the manufacturer. *See Also:* Certified Operator

Qualified Operator

Operators shall be considered qualified when they have completed a program of training and supervised operation of concrete pumps and have passed a practical operating examination of their ability to operate a specific model and type of equipment as well as their understanding of the controls and operating procedures. Furthermore, the operator must meet the knowledge and physical requirement sections of the concrete pumping safety standard.

Qualified Personnel

A generic term used to describe a person who is qualified in the area of application. For example, having your boom repairs inspected by “qualified personnel” before use would refer to inspection by a certified welder or certified welding inspector. Having repairs to your hydraulic system done by “qualified personnel” would refer to repairs made by qualified workshop personnel.

Qualified Workshop Personnel

An individual who:

- has reached the age of 18 years,
- is physically and mentally capable,
- has been trained in proper repair, maintenance, and inspection procedures plus the pertinent safety rules for concrete pumps and related equipment,
- has demonstrated their capabilities to their company in regards to the above mentioned procedures and rules, and
- can be expected to perform these duties, as assigned, in a reliable manner.

Rock Jam

A specific type of blockage caused when the cement and fines of the concrete are not present in sufficient quantity to fully coat the larger aggregates and the walls of the delivery system. In these cases, the rock (larger aggregates of the mix) will form a wedge inside of the pipe. Resistance to movement then becomes overpowering and the concrete stops. *See Also:* Blockage.

Separate Pipeline

A pipeline that is laid between the concrete pump and the point of discharge, other than the placing boom pipeline.

Shutoff Valve

In hydraulics: a valve with the ability to stop the flow or pressure of hydraulic oil. It must be able to withstand the maximum pressure of the hydraulic circuit that it controls.

In concrete: A manually or hydraulically operated valve that will prevent the flow of concrete in either direction. The shutoff valve must be able to withstand the maximum pressure on the concrete of which the pump is capable of exerting.

Signalperson

A person positioned at a vantage point where both the point of discharge and the pump operator can be seen and who relays operational signals to the operator.

Soil Pressure

The force per square area that is exerted on the ground by the outrigger legs. The amount of pressure that the soil will support varies with the composition and compaction of the soil. To make a determination on the stability of the soil.

Sponge Ball

A medium to hard sponge formed into a sphere and used to clean the inside of delivery pipelines. *See Also:* Go-devil

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Spotter

A person positioned at a vantage point where the distance between a hazard and the pump can be clearly seen and evaluated and the pump operator can be alerted if a predetermined safety distance is compromised. *See Also:* Guide

Sucking Back

The act of putting the concrete pump into the reverse mode for any of several reasons.

Thrust Block

Also known as a “dead man”. This is a large block of poured concrete, usually with one or more sweep elbows cast inside, placed at the bottom of a vertical run for the purpose of supporting the weight of the vertical run and for lateral stabilization of the pipeline. It stabilizes and supports the vertical run by virtue of its enormous mass (normally one cubic yard or larger).

Towing Vehicle

In this manual, *Towing Vehicle* applies only to vehicles that tow trailer-mounted concrete pumps. It is the vehicle that you will use to tow the trailer on the road, on the job site, or in the yard. See the safety rules regarding this subject on page 8 of this *Safety Manual*.

Transport Position

This relates to the position of the machinery when you will be driving or towing the unit. For example, the travel position of the engine hood is the position of the hood when it is completely lowered and latched into place.

Unauthorized

Without authority, without permission. Examples: Unauthorized operation of the boom could be operation by a passer-by, unauthorized repairs to the boom could be repairs designed without the manufacturer’s knowledge.

Unintentional Movement

Movement of the pump, boom or related equipment without a specific intentional command by the operator. An example of an unintentional movement would be if an operator fell while walking with the remote control box and accidentally hit a joystick, causing a boom movement.

Vertical Run

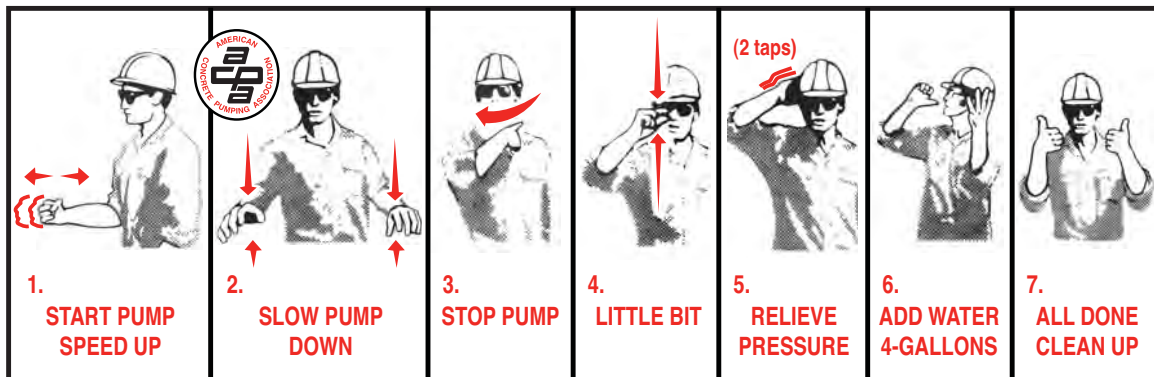
Sections of concrete delivery pipeline that are running in an up (or down) direction. Vertical runs have very specific procedures and rules for installation, support, cleaning, and inspection. Concrete pumping personnel should, therefore, have specific training in these procedures and rules before attempting to use them in a job setting.

Water Jet

The actual stream of water that comes out of the end of a water hose or pressure washer. This is the only part of the water system that needs to go into the hopper, concrete valve, or water box for cleaning.

X. Recommended ACPA Hand Signals

The American Concrete Pumping Association (ACPA) recommends using the following hand signals as standard procedure.



ACPAhandsignsmallline2.eps

XI. Bibliography

Further information regarding concrete pumping is available from the sources listed below. Information for this book was gathered from several different sources, including the following books:

PUMPING CONCRETE AND CONCRETE PUMPS © F. W. Schwing, GmbH

CONCRETE PUMP OPERATOR'S GUIDE TO SAFETY © British Concrete Pumping Association

The MANUAL and ADVISORY SAFETY CODE of PRACTICE for CONCRETE PUMPING © British Concrete Pumping Association

SAFETY STANDARD FOR CONCRETE PUMPS, PLACING BOOMS, AND DELIVERY SYSTEM by the Concrete Pump Manufacturers Bureau

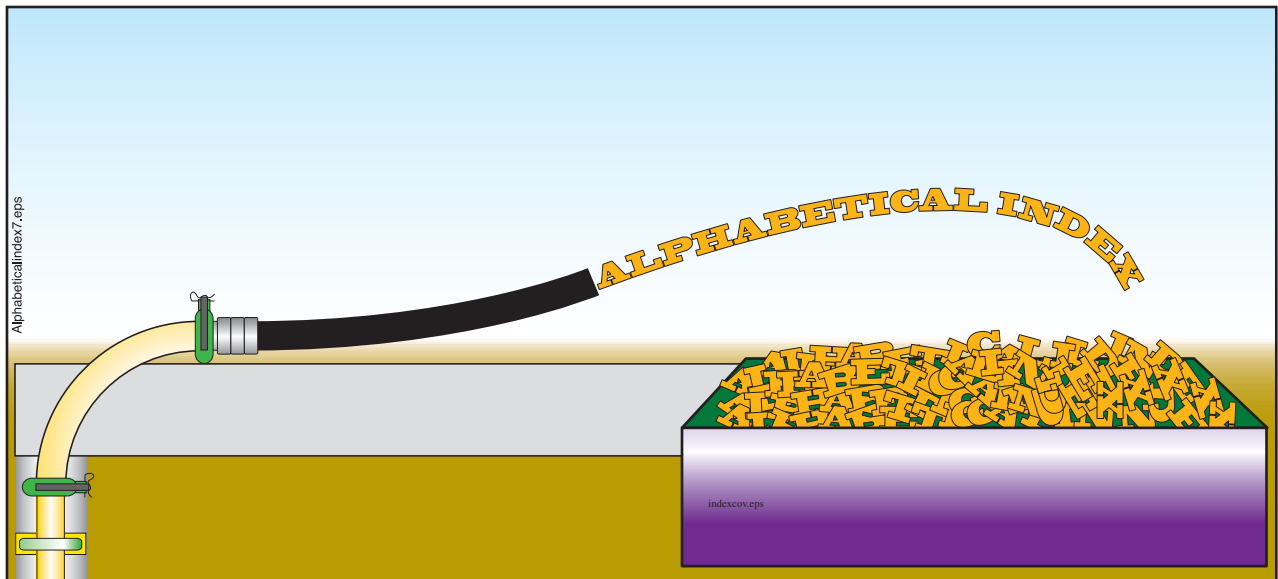
Additional technical information and/or graphic were supplied by:

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The American Concrete Pumping Association

Some cartoons were scanned from the book CONCRETE PUMP OPERATOR'S GUIDE TO SAFETY © British Concrete Pumping Association. Used by Permission.

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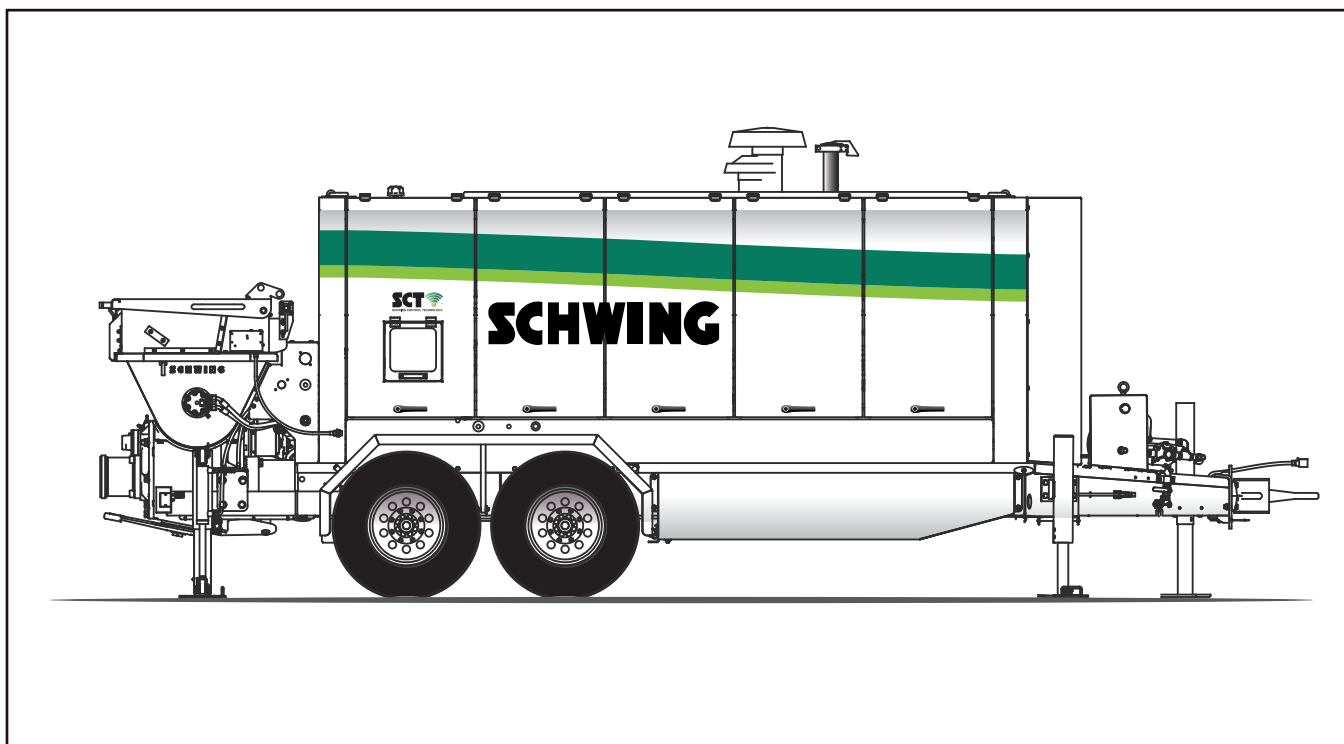
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This section provides an overview of the safety devices, machine components, and SCT 2 controller of the stationary pump. It is recommended that you read this section of the manual while you are near the stationary pump so that you can identify the components as they are described.

This section is not intended to be used for information on operating the pump. Operating procedures, along with their applicable warnings and cautions, are contained in the Operation section of this manual.

Concrete Pump Circuit Overview

The SCHWING concrete pump has a fully hydraulic, twin-cylinder, reciprocating design. The pumpkit consists of:

- Two differential hydraulic cylinders
- Waterbox
- Two material cylinders
- Concrete valve (rock valve) and slewing cylinder

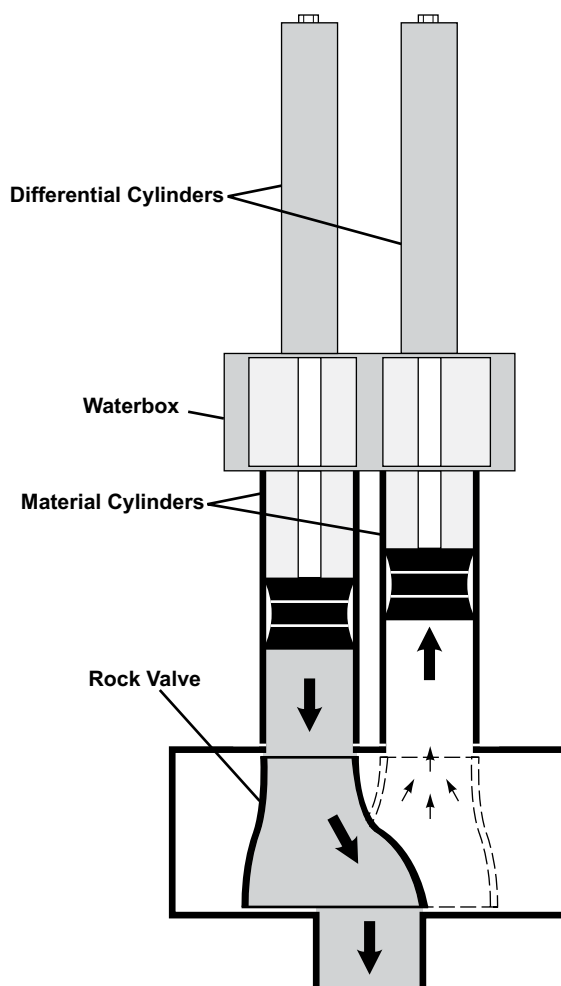
The waterbox acts as a mounting structure for the differential cylinders and as a container to hold flushing water. The concrete valve directs the flow of concrete from the hopper to the outlet piping.

During operation, the two hydraulic cylinders move back and forth in perfect synchronization. When one hydraulic cylinder reaches the end of its stroke both cylinders then shift direction, and the cylinder that had been pushing the concrete now begins to suck concrete from the hopper. The cylinder that had been sucking concrete from the hopper now begins to push it into the pipeline. When the machine runs in reverse mode, concrete is sucked from the pipeline and pushed into the hopper.

It is the job of the rock valve to shift the direction of the two hydraulic cylinders. These cylinders are connected via hydraulic plumbing and share hydraulic oil on one side of their pistons. This shared oil, called rocking oil, keeps the two cylinders moving. Another hydraulic cylinder (the rock valve slewing cylinder) cycles the rock valve back and forth.

The hydraulic pumps that supply oil to the concrete pumpkit adjust the amount of oil they deliver by internal pressure-sensing devices and by external valves (the stroke limiter and the damper valves).

Each hydraulic cylinder has an area difference referred to as an “area differential” between the two sides of the piston. This area differential exists because the rod extends from only one side of the piston. This is in contrast to a cylinder which has a rod extending from both sides of the piston, and, therefore, has the same area on both sides of the piston.



Rod-Side Versus Piston-Side Pumping

The hydraulic system for the SP 2000 concrete pump can be configured for rod-side or piston-side pumping (Figure 1).

Rod-side pumping allows maximum yards per hour output while piston-side pumping allows maximum pressure to be exerted on the concrete.

Piston-side operation dramatically raises the maximum pressure on the concrete. For this reason, it is crucial that your entire material delivery system is rated to handle the available pressure and kept in “like new” condition; remember that pipe wears with each yard pumped, and inspect the wall thickness regularly. The maximum material pressure available on piston-side pumping depends on which differential and material cylinders you purchased with your unit and is stamped on the main ID tag.

When configured on the rod-side, the hydraulic oil is routed from the S2 valve to the differential cylinders at the port on the rod end (the end from where the rod protrudes). The rocking oil loop hose is connected from one cylinder to the other via tubes in front of the waterbox.

When configured on the piston-side, the hydraulic oil is routed from the S2 valve to the differential cylinders at the port that is on the piston end (the end away from where the rod protrudes). The rocking oil loop is connected from one cylinder to the other on the rod end.

Note that the rods are moving the same direction in both examples shown, whether they are configured for rod side or piston side pumping.

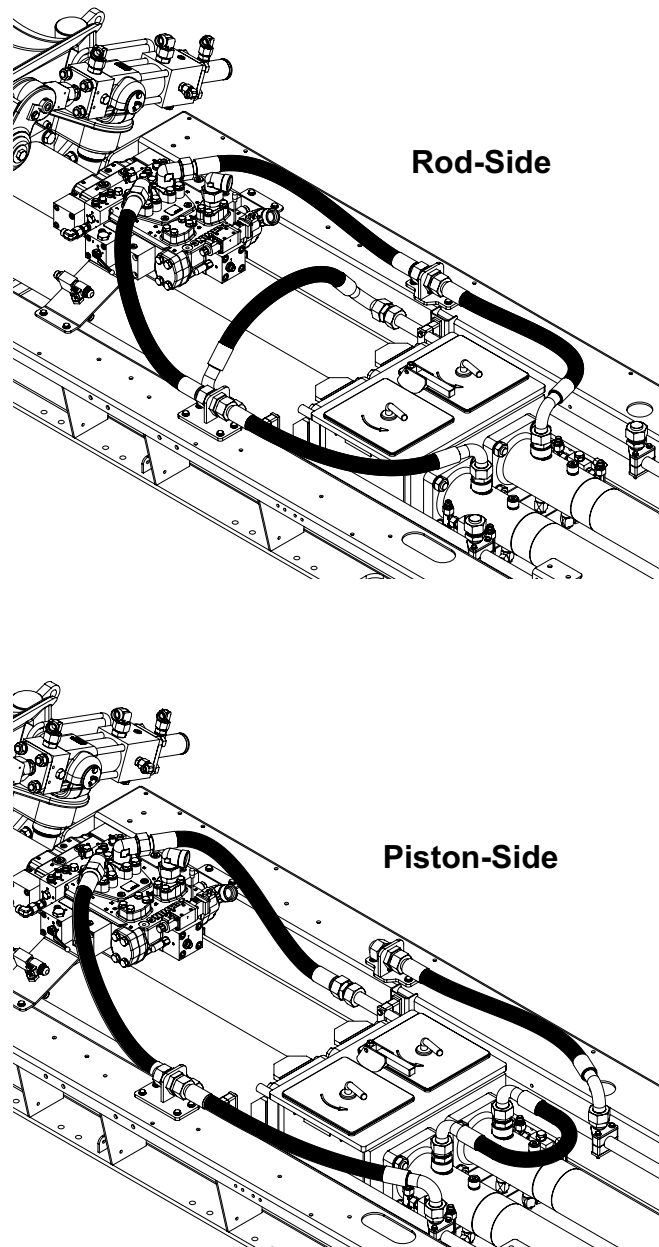
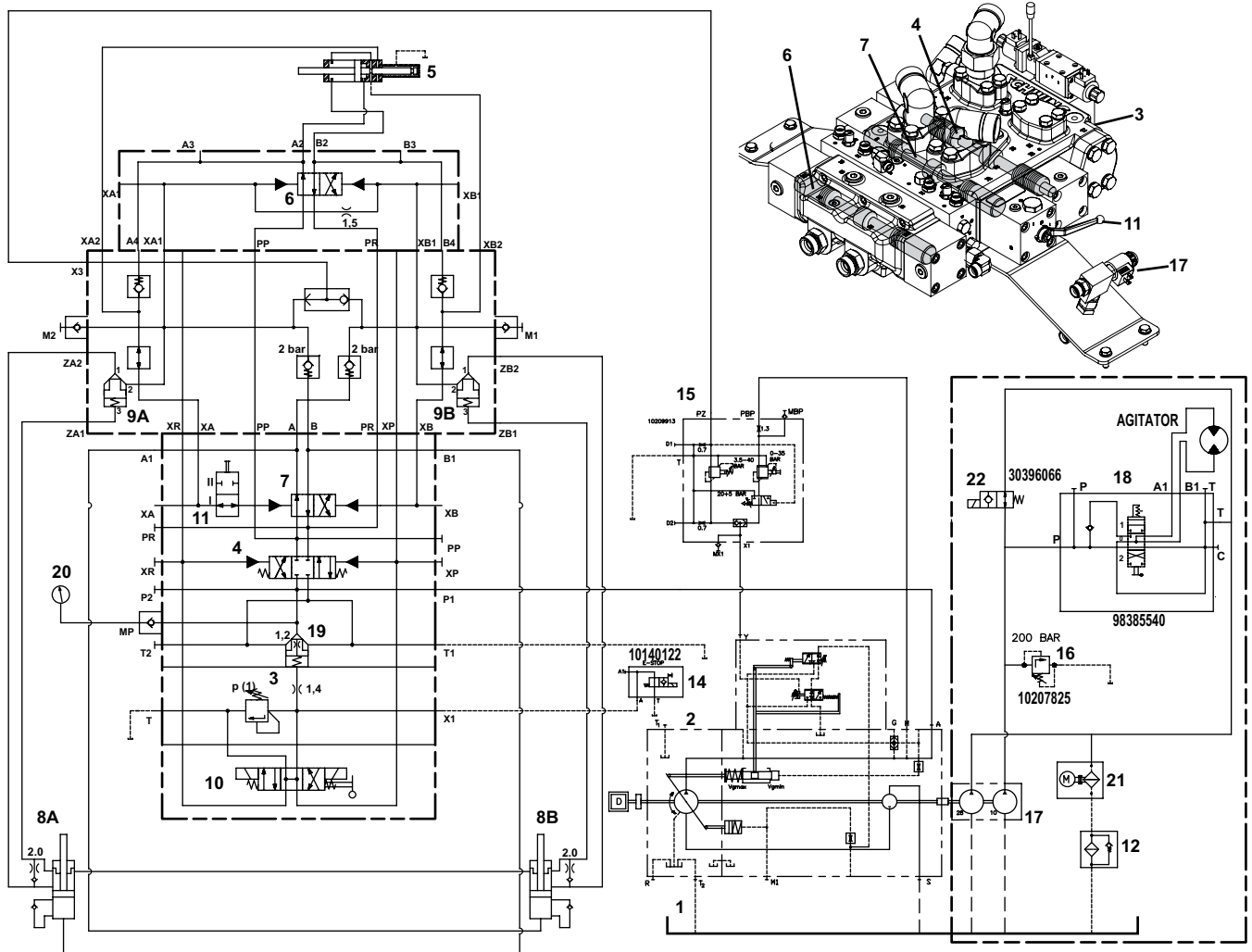


Figure 1
Rod-Side Versus Piston-Side Configuration



1	Hydraulic Oil Reservoir	14	Dump Valve (E-stop)
2	Main Hydraulic Pump	15	Stroke Limiter/Damper
3	Main Pressure Relief Valve	16	Agitator Relief Valve
4	Directional Control Valve (S1)	17	Agitator Hydraulic Pump
5	Rock Valve Slewing Cylinder	18	Agitator Circuit
6	Directional Control Valve (S3)	19	Main Relief Poppet Valve
7	Directional Control Valve (S2)	20	Concrete Pump Pressure Gauge
8A/8B	Differential Hydraulic Cylinder	21	Oil Cooler
9A/9B	Switching Valves	22	Agitator Dump Valve
10	Forward/Reverse Valve		
11	Quarter Turn Shut-Off Valve		
12	Hydraulic Oil Filter with Bypass Valve		

Safety Devices

The following paragraphs describe the safety devices found on the stationary pump. The devices listed here must be maintained in good working condition to avoid injury. Bypassing a safety device for servicing or emergency clean out should only be done by qualified personnel. All bypassed devices must be set back to their original state upon completion of the service or emergency procedure.

Emergency Stop Buttons (E-stop)

There are three emergency stop buttons (Figure 2) located on the concrete pump. Emergency stop buttons are found near the following:

- Hopper left side (curb side)
- Hopper right side (street side)
- Waterbox

An emergency stop button is also located on every remote.

Pushing an emergency stop (E-stop) button disables the hydraulic circuit.

To reset an E-stop on the concrete pump and enable the hydraulic circuit, pull the button back out and press the horn button on the active remote.

To reset an E-stop on a remote, turn the button clockwise and press the horn button.

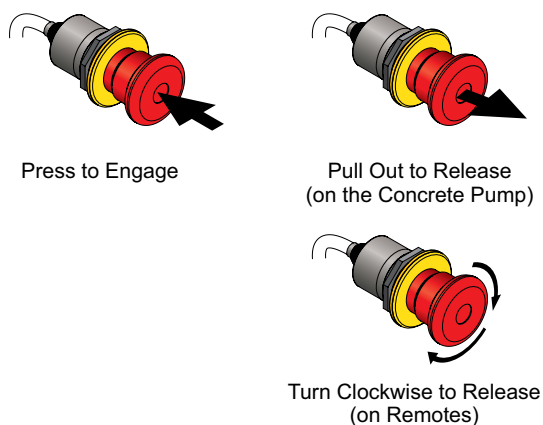


Figure 2
Emergency Stop (E-stop) Button

Dump Valve

The dump valve (Figure 3) is a safety device that consists of a 2-way solenoid valve with an override button.

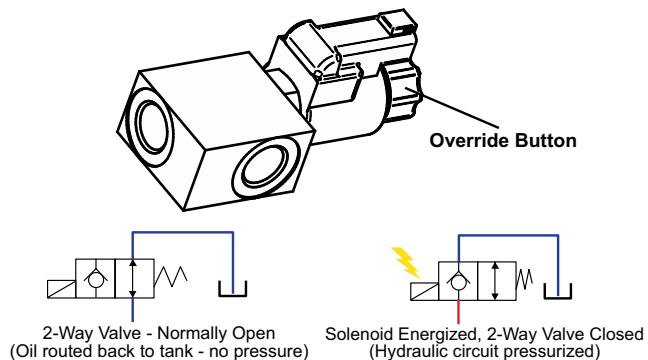


Figure 3
Dump Valve with Override Button

The 2-way solenoid valve is normally in the open position. When electrical current is applied to the dump valve solenoid, the 2-way valve will overtake the spring and place the valve in a the closed position. This will block the hydraulic oil from escaping to tank, allowing pressure to build in the circuit.

If an E-stop button is pressed, the electrical current to the solenoid is lost, the spring will return the 2-way valve to the normally open position. Hydraulic oil will be routed back to tank and pressure in that circuit will be lost.

To bypass the dump valve, press and hold the override button.

If power is lost to the dump valve, press and hold the override button (Figure 4) to restore hydraulic pressure. The concrete pump can now be placed into forward or reverse with handle located on the S1/S2 control block.

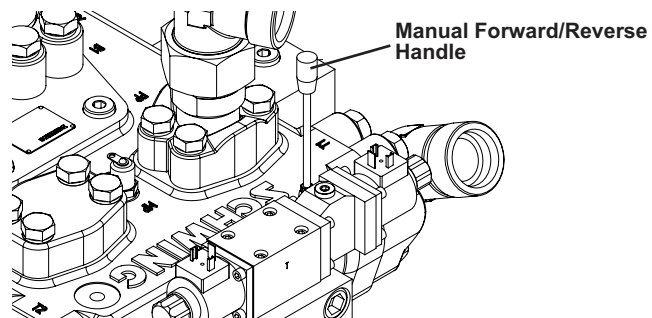


Figure 4
Concrete Pump Forward/Reverse Handle

Hopper Grate Sensor

The hopper grate sensor (Figure 5) consists of a switching cam and proximity sensor. The proximity sensor sends a signal to the PLC enabling the concrete pump, agitator, and accumulator dump valves. The switching cam is attached to the hopper grate. When the hopper grate is lifted, the edge of the switching cam will move towards the proximity sensor. The signal to the PLC will be lost, the concrete pump will go into the neutral position, and the agitator will stop moving.

Shutting the hopper grate will restore the signal to the PLC; the concrete pump and agitator will remain in neutral until you reactivate them.

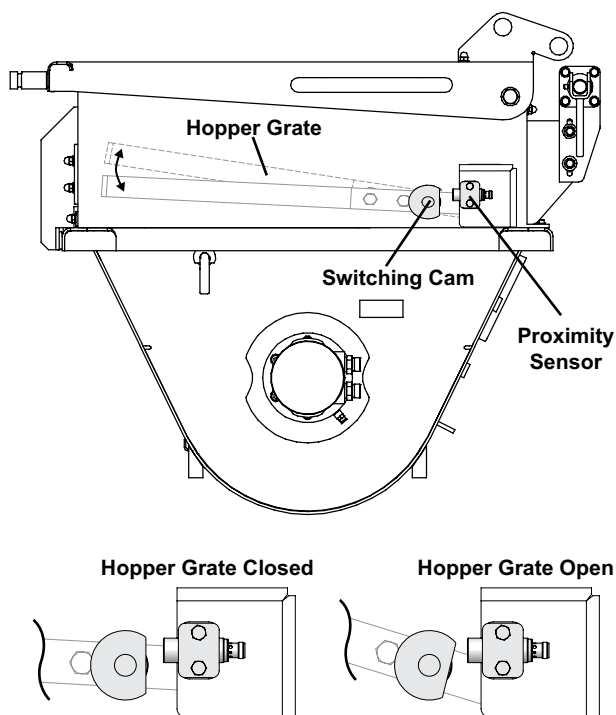


Figure 5
Hopper Grate Sensor

⚠ WARNING

Never put any part of your body in the hopper or in the concrete valve, either from above (through the hopper) or from below (through the outlet pipe or clean out door). Serious injury can result.

Pressure Relief Valves

Pressure relief valves limit the maximum pressure in a hydraulic circuit by diverting excess oil to the hydraulic tank when maximum pressures are exceeded. The relief pressures listed on the hydraulic schematics are not nominal figures; they are the hydraulic relief pressures that the concrete pump was designed to work with and that the components were designed to accommodate.

Under no circumstances should you raise hydraulic relief pressures. Conversely, lowering the hydraulic relief pressure settings may cause poor performance, heat, and related premature component failure. In some extreme cases, raising or lowering hydraulic relief pressures may cause dangerous operation. Check with the SCHWING Service Center before changing any hydraulic relief pressure settings.

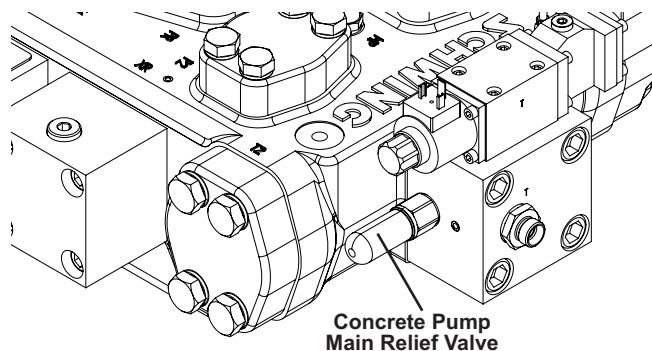


Figure 6
Pressure Relief Valve Example

Safety Guards

Safety guards (Figure 7) protect against personal injury. Do not operate the machine unless all the safety guards are in place. If they become damaged, lost, stolen, or inoperable for any reason, they must be replaced before operation continues.

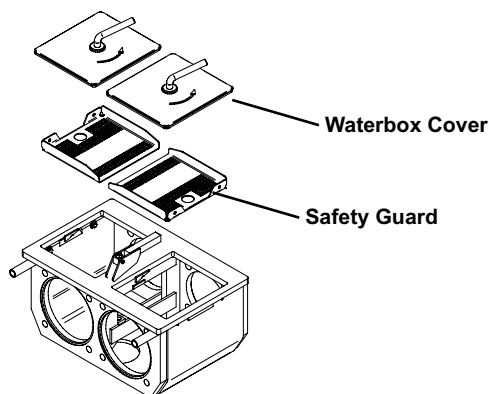


Figure 7
Safety Guard Example (Waterbox Safety Guard)

Fuses and Circuit Breakers

Fuses and circuit breakers protect against circuit overload. They do so by melting or opening when the current in an electrical circuit becomes higher than it was designed for. Here are some causes for circuit overload:

- Short circuits (positive goes to negative without resistance)
- Component malfunction (a coil that has to move a sticky valve)
- Mechanical interference (a shovel handle stuck through the oil cooler fan blade)

To maintain this safety device, simply replace a blown fuse with the correct size and type fuse, and never bypass a fuse. A very good rule of thumb for fuses is this: if it blows once, replace it, but if it blows again, something is wrong. Find the cause of the problem, and repair it before activating the circuit again.

Warning Horn

A warning horn (Figure 8) is mounted inside the pump below the the operator control station. It will activate automatically when a warning message, such as high oil temperature, is displayed, or it can be activated manually.

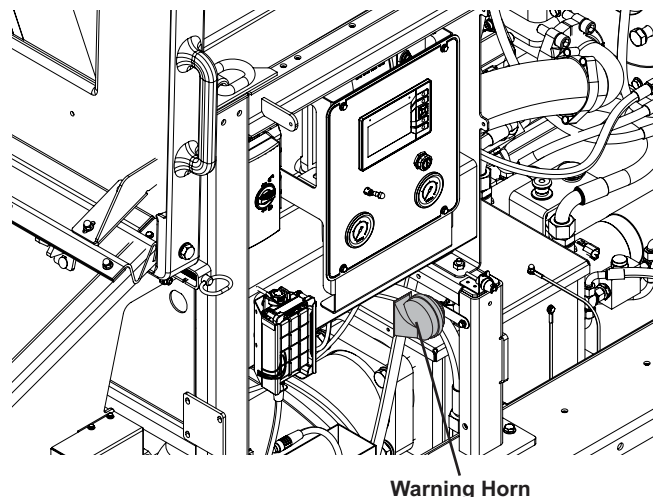


Figure 8
Warning Horn Mounted on Stroke Limiter Valve

Manual Activation



The horn can be manually sounded by pressing any horn button. A horn button is located on both the cable and radio remotes as well as on the passenger side of the hopper.

SCT II Warning Message



When a warning message is displayed, the horn will beep continuously, until the horn silence button is pressed on the HMI panel.

Reset Procedure

The horn must be sounded to reset the machine after an emergency stop button is reset.

Stroke Limiter

The stroke limiter valve controls the amount of oil put out by the concrete pump circuit hydraulic pumps, thereby controlling the strokes per minute of the concrete pump. It is a pressure reducing valve, receiving its pressure signal from the pumpkit and putting its reduced pressure signal output to the main hydraulic pumps at port X-1. This is the preferred method of speed control for the pump in many (but not all) cases. The damper valve and fast switch valve are part of the stroke limiter and help regulate the stroke limiter system.

Fast Switch Valve

The fast switch (reversing) valve interrupts the signal from the stroke limiter to the hydraulic pumps causing the rock valve to switch quickly. For example, if you have the stroke limiter adjusted so the unit is only making 4 strokes per minute, the rock valve cylinder would also operate very, very slowly. While there may be a very good reason for stroking slowly, there is no advantage to slow rock valve movement since it delays the start of the next stroke and allows time for concrete to slide out of the pipeline back into the hopper. The fast switch allows the rock valve to switch at a faster speed. The rock valve will switch at the speed determined by the damper valve. There is no adjustment necessary or possible with the fast switch valve.

Damper Valve

The damper valve is another pressure reducing valve. It also controls the oil output of the main hydraulic pumps, but it receive its main pressure signal from a different source and, therefore, controls the pumps at a different time. Basically, the stroke limiter controls how fast the differential cylinders move, and the damper controls how fast the rock valve cylinder moves.

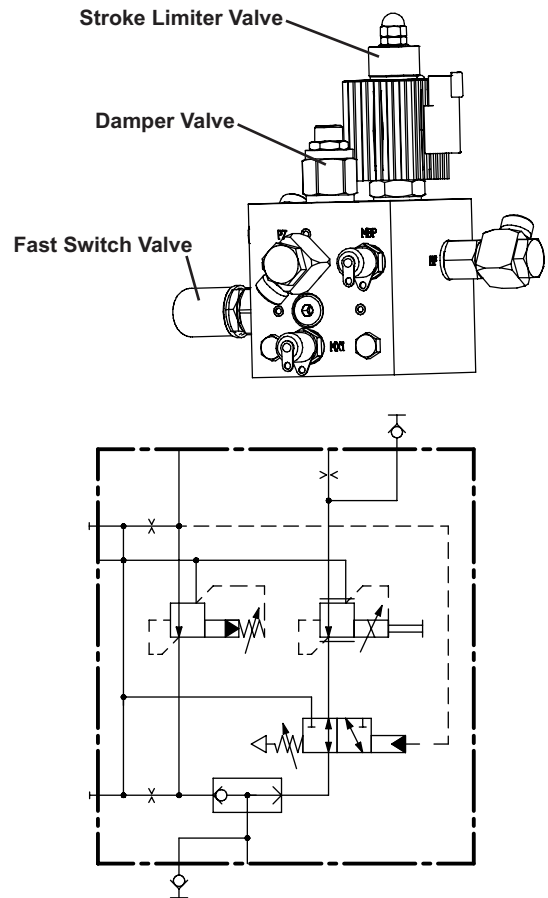
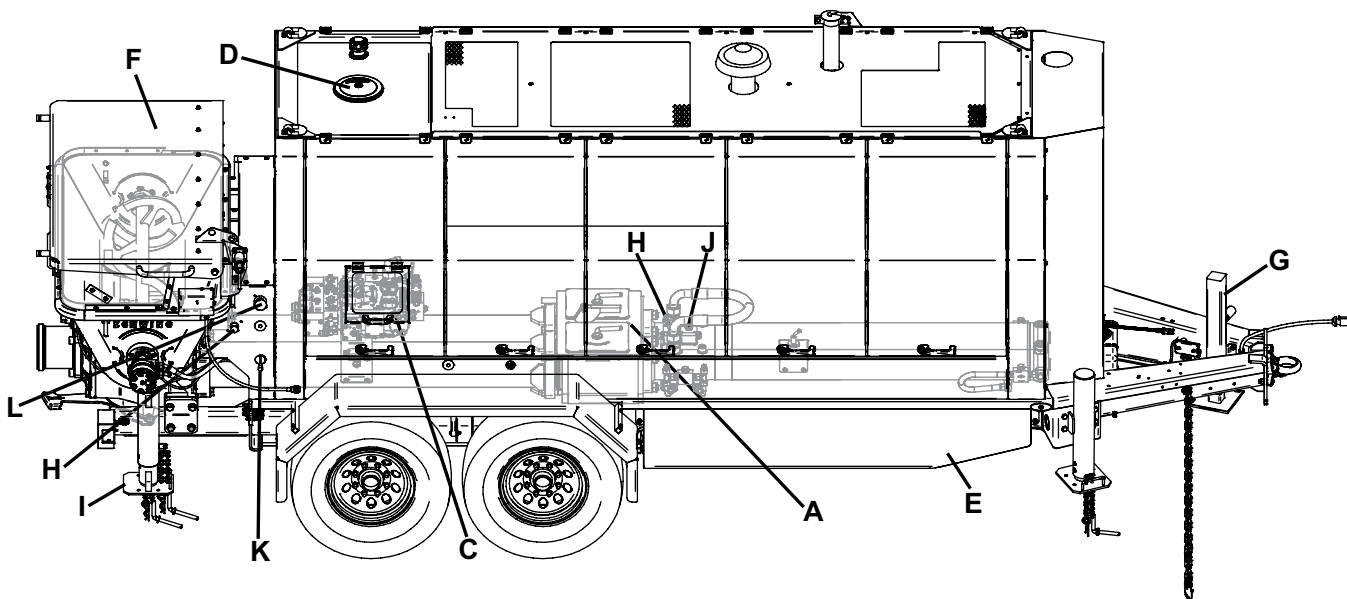
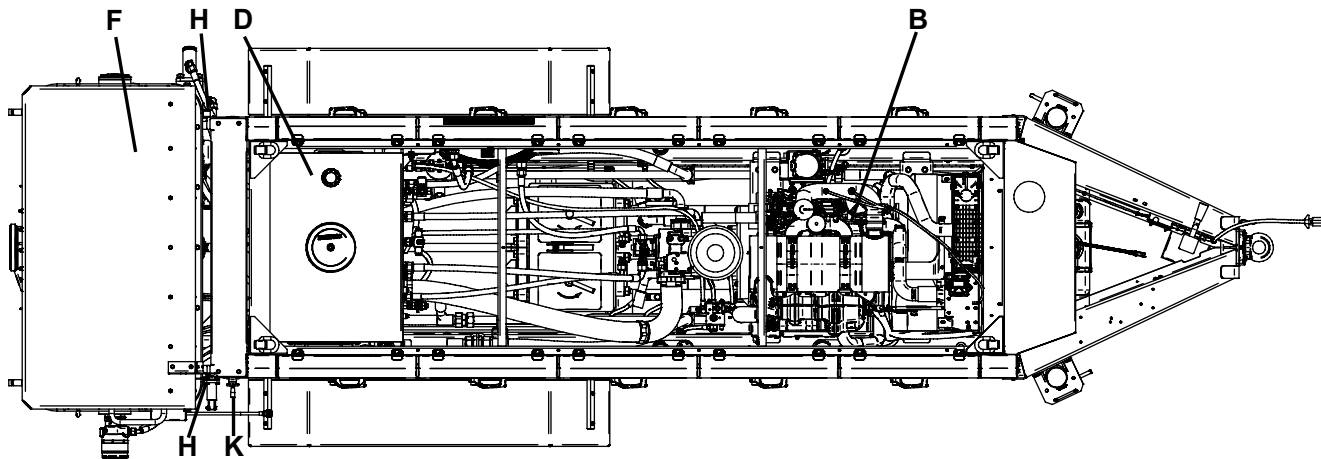


Figure 9
Stroke Limiter, Fast Switch, and Damper Valves

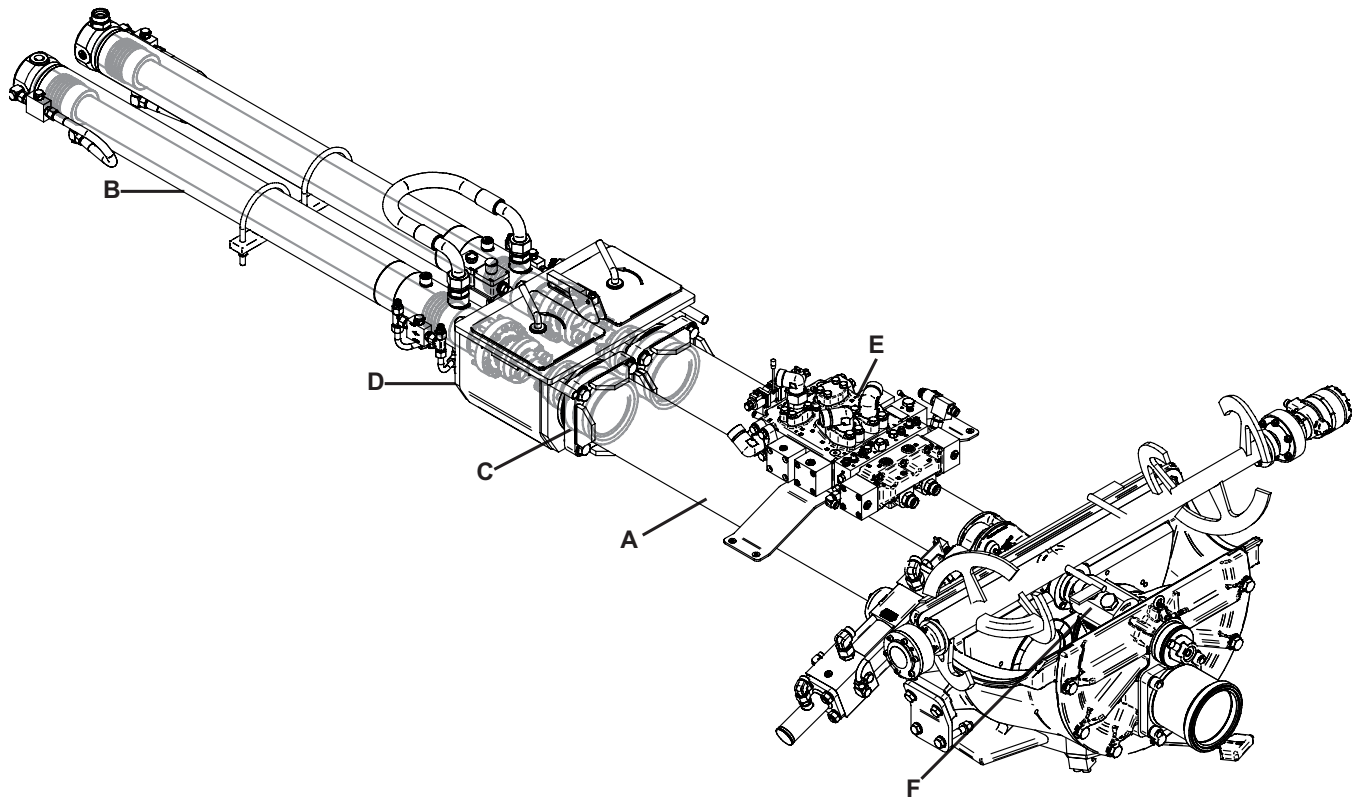
Machine Overview

- | | |
|-------------------------------|-----------------------|
| A. Pumpkit | G. Jack Stand |
| B. Power Pack | H. E-stop Stations |
| C. Rear Control Station (SCT) | I. Rear Outrigger |
| D. Hydraulic Tank | J. Ram Change Station |
| E. Fuel Tanks | K. Agitator Valve |
| F. Hopper | L. Horn Button |



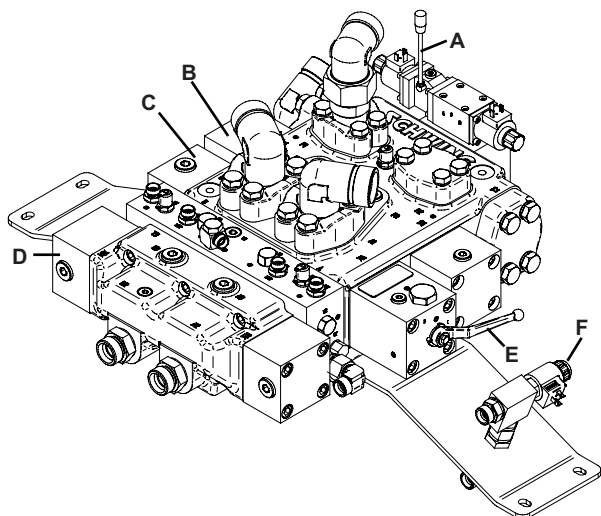
Pumpkit Overview

- A. Material Cylinders
- B. Differential Cylinders
- C. Rams
- D. Water Box
- E. Control Valves (S1/S2/S3)
- F. Rock Valve



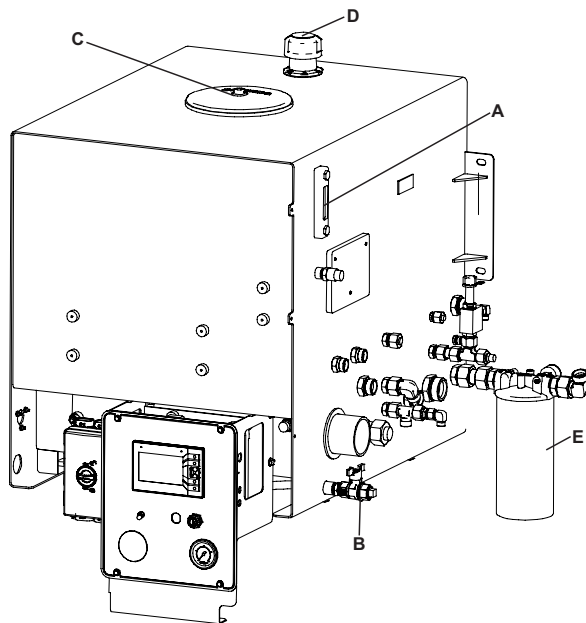
S1/S2/S3 Control Valve

- A. Concrete Pump Manual Forward/Reverse Handle
- B. S1 Spool (Internal)
- C. S2 Spool (Internal)
- D. S3 Spool (internal)
- E. Quarter Turn Valve (Shut-off Valve)
- F. Agitator Dump Valve



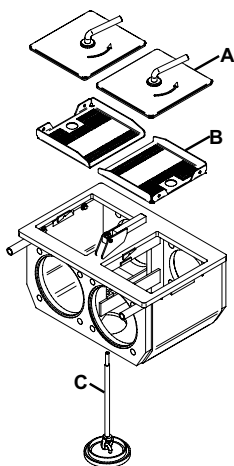
Hydraulic Tank

- A. Hydraulic Oil Level and Temperature Gauge
- B. Drain
- C. Clean Out Cover
- D. Breather
- E. Main System Filter



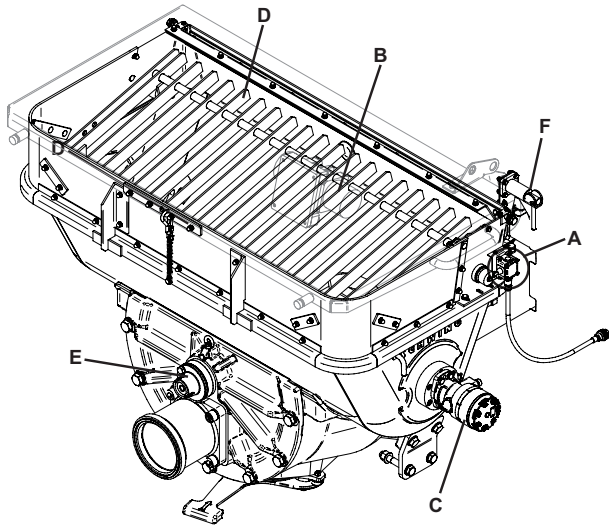
Waterbox

- A. Cover
- B. Safety Guard
- C. Drain



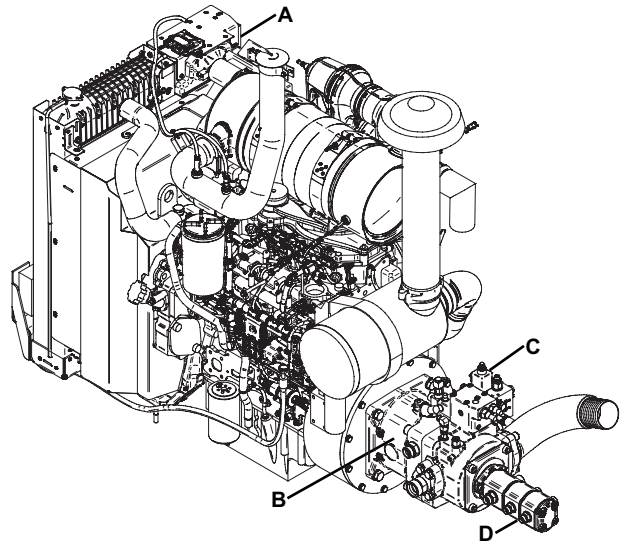
Hopper

- A. Hopper Grate Switch
- B. Vibrator (Optional)
- C. Agitator
- D. Hopper Grate
- E. Tension Nut
- F. Locking Pin



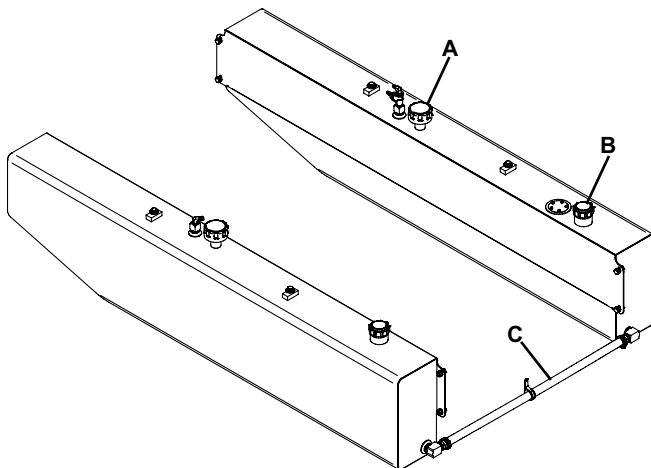
Power Pack

- A. Engine
- B. Main Hydraulic Pump
- C. Stroke Limiter
- D. Gear Pumps



Fuel Tanks

- A. Breather
- B. Fuel Cap/Gauge
- C. Cross Over Hose

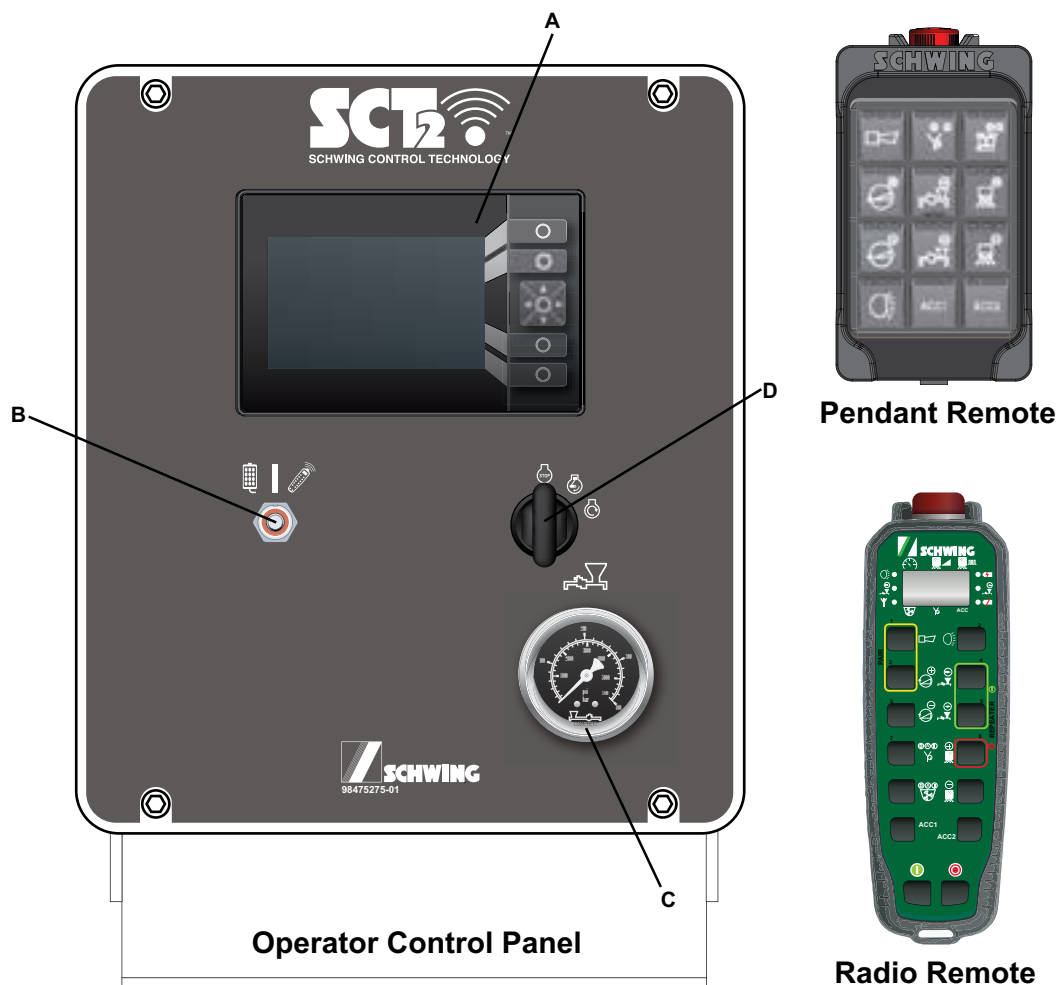


SCT II (SCHWING Control Technology)

The SCT II system allows the operator to electronically run all functions of the concrete pump. The system includes the operator control panel, pendant remote, and radio remote.

The operator control panel contains the following components:

- A. HMI (Human Machine Interface)
- B. Pendant/Radio Remote Selector Switch
- C. Concrete Pump Pressure Gauge
- D. Key Switch

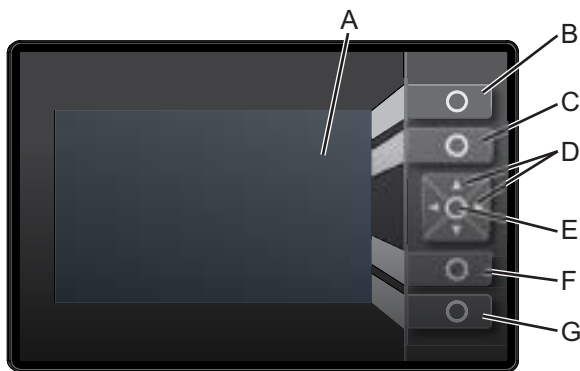


HMI (Human Machine Interface)

The HMI is the primary interface between the operator and the concrete pump. On the HMI operators can view and set machine parameters.

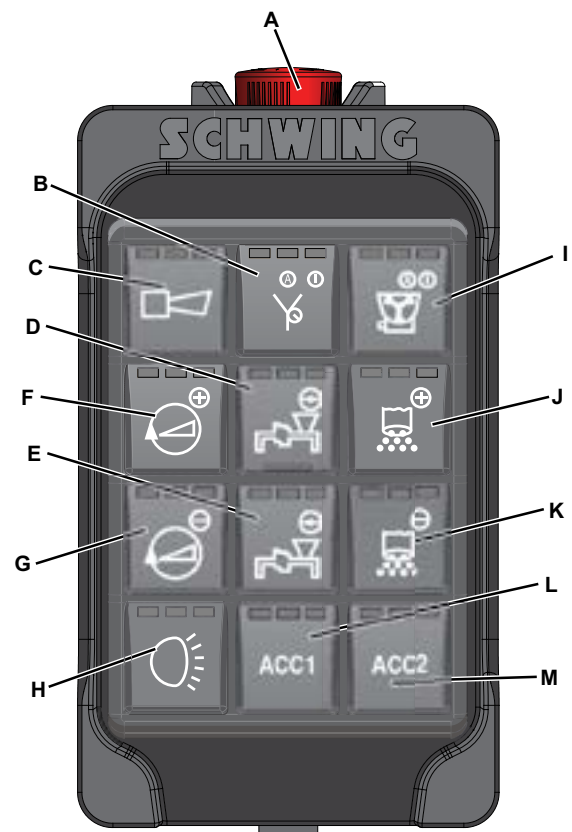
The HMI contains the following:

- A. LCD Touch Screen
- B. (F3) Function Button
- C. (F1) Function Button
- D. Navigation Arrows Button
- E. Enter Button
- F. (F2) Function Button
- G. (F4) Function Button



Pendant Remote

- A. E-stop Button
- B. Vibrator (On/Off) Button
- C. Horn/Reset Button
- D. Concrete Pump Forward Button
- E. Concrete Pump Reverse Button
- F. Throttle Increase Button
- G. Throttle Decrease Button
- H. Work Light Button
- I. Agitator (On/Off) Button
- J. Stroke Limiter Increase Button
- K. Stroke Limiter Decrease Button
- L. Accessory 1 Button
- M. Accessory 2 Button



Pendant Remote Buttons

E-stop Button

Pushing the emergency stop (E-stop) button disables the hydraulic circuit.

To reset the system and enable the hydraulic circuit, rotate the E-stop button clockwise, and press the horn button on the pendant remote.

Horn/Reset Button

Press once or press and hold to sound the horn. Press to reset E-stop requests.



= Horn / Off



= Horn / On (Push/Hold)



= E-stop Pressed



= E-stop Reset Request

Throttle Increase Button

Press once to increase engine throttle. Press and hold or press multiple times to ramp up engine throttle.



= Inactive



= Throttle (+) (Push/Hold)

Throttle Decrease Button

Press once to decrease engine throttle. Press and hold or press multiple times to ramp down engine throttle.



= Inactive



= Throttle (-) (Push/Hold)

Work Light Button

Press once to turn on the work lights, press again to turn work lights off.



= Work Light (Off)



= Work Light (On)

Vibrator (On/Off) Button

This button works in conjunction with the concrete pump forward button. When the vibrator button is pressed once (auto mode), the vibrator will turn on when the concrete pump is in the forward position and turn off when the concrete pump is off or in the reverse position. When the vibrator button is pressed twice (manual mode), the vibrator will run until the vibrator is shut off. Pressing the button a third time will turn the vibrator off.



= Vibrator OFF



= Vibrator Auto ON



= Vibrator Manual ON

Concrete Pump Forward Button

Moves the concrete pump into forward. This is called the pumping position. Press once to place the inactive concrete pump into forward. Press again to make the pump inactive.



= Inactive



= Pump/Forward

Concrete Pump Reverse Button

Moves the concrete pump into reverse. This is typically used for cleaning out or unclogging jams in the pipeline. Press once to place the inactive concrete pump into reverse. Press again to make the pump inactive.



= Inactive



= Pump/Reverse

Stroke Limiter Increase Button

Press once to increase strokes rate by one increment. The first LED on the stroke limiter (-) button will start blinking. Pressing four more times turns the LED solid; this indicates reaching five increments of thirty (15% output). Pressing the button again will increase one more increment; the second LED on the stroke limiter (-) button will start blinking. Pressing four more times turns the second LED solid; this indicates reaching ten increments of thirty (33% of output). Every five presses turns the next LED solid. Once all the LEDs on the stroke limiter (-) button are solid after fifteen presses, the first LED on the stroke limiter (+) button will start blinking. Repeat the process above to change the LEDs on the stroke limiter (+) button. When all of the LEDs on the stroke limiter (-) and stroke limiter (+) buttons are solid, thirty increments of thirty (100% output) has been reached .

Press and hold to ramp up strokes rate.



Stroke Limiter Decrease Button

Once all of the LEDs on the stroke limiter (-) and stroke limiter (+) buttons are solid (100% output) press once to decrease strokes rate by one increment. The third LED on the stroke limiter (+) button will start blinking. Pressing four more times turns the LED off; this indicates reaching twenty-five increments of thirty (83% output). Pressing the button again will decrease one more increment; the second LED on the stroke limiter (+) button will start blinking. Pressing four more times will turn the second LED off; this idndicates reaching twenty increments of thirty (66% of output). Every five presses turns the next LED off. Once all of the LEDs on the stroke limiter (+) button are off after fifteen presses, the third LED on the stroke limiter (-) button will start blinking. Repeat the process above to change the LEDs on the stroke limiter (-) button. When all of the LEDs on the stroke limiter (+) and stroke limiter (-) buttons are off, zero increments of thirty (0% output) has been reached.

Press and hold to ramp down strokes rate.



Agitator (On/Off) Button

This button works in conjunction with the concrete pump forward and concrete pump reverse buttons. When the agitator button is pressed once (auto mode), the agitator will turn forward when the concrete pump is in the forward position and will turn in the reverse direction when the concrete pump is in the reverse position. When the agitator button is pressed twice (forward mode), the agitator will run continuously. Pressing the button a third time turns the agitator off.



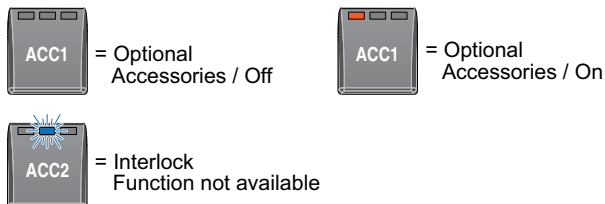
ACC1 and ACC2

This button can be used with optional accessories installed on the concrete pump. Press once to activate the installed function. The default for ACC1 is the water pump. Parameters for the ACC buttons can be changed using the Settings Screen.

If the optional high-pressure washer is installed, there is an interlock that will prevent you from running both accessories at the same time. If ACC1 is active, ACC2 will not work.

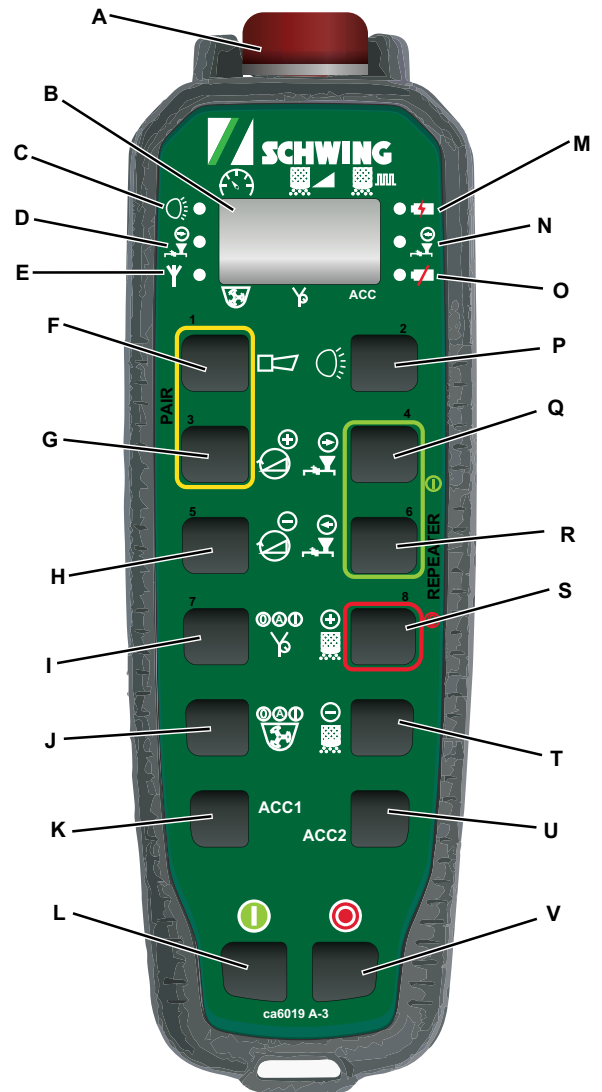
The high-pressure washer option has an interlock with the low water tank sensor. If the water tank is low, the center LED on the ACC button will flash blue. This indicates that the high-pressure washer cannot be activated.

If a compressor is installed and the compressor high-temperature alarm is activated, the center light on ACC button will flash blue and the compressor can't be activated.



Radio Remote

- A. E-stop Button
- B. LCD Screen
- C. Work Light Indicator Light
- D. Concrete Pump Forward Indicator Light
- E. Wireless Signal Indicator Light
- F. Horn/Reset Button
- G. Throttle Increase Button
- H. Throttle Decrease Button
- I. Vibrator (On/Off) Button
- J. Agitator (On/Off) Button
- K. Accessory 1 Button
- L. Power On Button
- M. Battery Charging Indicator Light
- N. Concrete Pump Reverse Indicator Light
- O. Battery Low Indicator Light
- P. Work Light Button
- Q. Concrete Pump Forward Button
- R. Concrete Pump Reverse Button
- S. Stroke Limiter Increase Button
- T. Stroke Limiter Decrease Button
- U. Accessory 2 Button
- V. Power Off Button



Radio Remote Buttons and Lights

E-stop Button

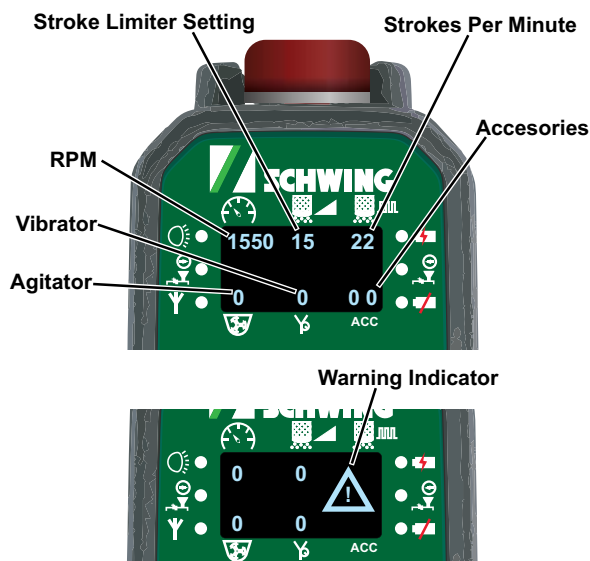
Pushing the emergency stop (E-stop) button disables the hydraulic circuit.

To reset the system and enable the hydraulic circuit, turn the E-stop button clockwise and press the horn button on the radio remote.

Indicator Lights

	Orange = On
	Orange = Pump Forward
	Green = Linked Green Flashing = Connecting
	Blue = Battery Charging
	Orange = Pump Reverse
	Flashing Red = Battery Low Red = Loss of Signal

LCD Screen



LCD Screen Indicator

	RPM Readout
	Stroke Limiter Setting (0 to 30)
	Current Strokes Per Minute
	0 = Off A = Auto Agitator 1 = Manual
	0 = Off A = Auto Vibrator 1 = Manual
ACC (Accessories)	0 0 = ACC1=Off ACC2=Off 1 0 = ACC1=On ACC2=Off 0 1 = ACC1=Off ACC2=On
	Warning message See SCT2 HMI LCD Display



Horn/Reset Button

Press once or press and hold to sound the horn. Press to reset E-stop requests.



Throttle Increase Button

Press once to increase engine throttle. Press and hold or press multiple times to ramp up engine throttle.



Throttle Decrease Button

Press once to decrease engine throttle. Press and hold or press multiple times to ramp down engine throttle.



Vibrator (On/Off) Button

This button works in conjunction with the concrete pump forward button. When the vibrator button is pressed once (auto mode), the vibrator will turn on when the concrete pump is in the forward position and turn off when the concrete pump is off or in the reverse position. When the vibrator button is pressed twice (manual mode), the vibrator will run until the vibrator is shut off. Pressing the button a third time will turn the vibrator off.



Agitator (On/Off) Button

This button works in conjunction with the concrete pump-forward and concrete pump-reverse buttons. When the agitator button is pressed once (auto mode), the agitator will turn forward when the concrete pump is in the forward position and will turn in the reverse direction when the concrete pump is in the reverse position. When the agitator button is pressed twice (forward mode), the agitator will run continuously. Pressing the button a third time turns the agitator off.



Work Light Button

Press once to turn on the work lights, press again to turn work lights off.



Concrete Pump Forward Button

Moves the concrete pump into forward. Press once to put the concrete pump into forward. Press again to make the pump inactive. When the concrete pump is in forward, the concrete pump forward indicator light will turn orange.



Concrete Pump Reverse Button

Moves the concrete pump into reverse. Press once to put the concrete pump in reverse. Press again to make the pump inactive.



Stroke Limiter Increase Button

The stroke limiter (+) button is used to increase the strokes rate with zero being minimal output and thirty being maximum output. Press once to increase strokes per minute by increments of one (3%). Hold down the stroke limiter (+) button to continually ramp up the strokes rate.



Stroke Limiter Decrease Button

The stroke limiter (-) button is used to decrease the strokes rate with thirty being maximum output and zero being minimal output. Press once to decrease strokes per minute by increments of one (3%). Hold down the stroke limiter (-) button to continually ramp down the strokes rate.



Accessory 1 and Accessory 2 Buttons

These buttons are used with optional accessories installed on the concrete pump. Press once to activate the installed function.



Power On Button

Turns the radio remote ON when pressed. Press and hold to refresh the LCD screen.

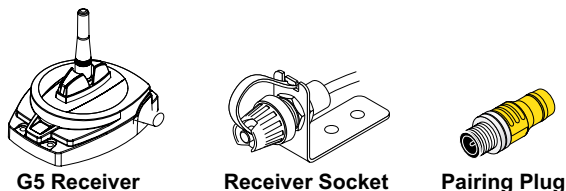


Power Off Button

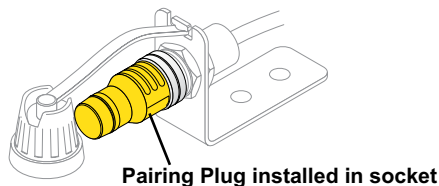
Turns the radio remote OFF when pressed.

Safe Pairing of Transmitter to Receiver

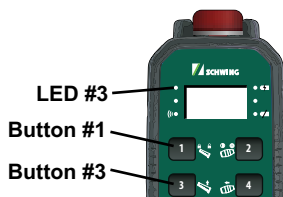
Safe pairing is used to get a unique assignment between a single transmitter and a single G5 receiver. To exchange the transmitter and receivers IDs when replacing either the receiver or transmitter in a system follow the safe pairing procedure below:



1. Power off the receiver by turning the ignition key switch to STOP.
2. Install the pairing plug into the receiver socket.



3. Simultaneously press button #1 and button #3 on the transmitter (radio remote). LED #3 will light up indicating the transmitter is ready for safe pairing.



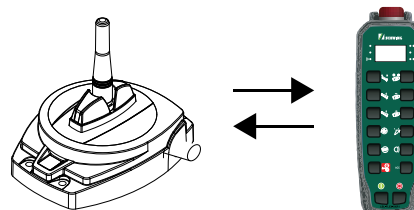
4. Within 10 seconds, reapply power to the receiver by putting the ignition key switch in the RUN position.
5. The transmitter will confirm the download is complete by flashing LED #3 eight times.



6. The receiver LCD screen will flash Po-Id.



7. Power off the receiver by turning the ignition key switch to STOP. Remove the pairing plug from the receiver socket. Reapply power to the receiver by putting the ignition key switch in the RUN position. The transmitter has now been paired to the receiver.



NOTE

If pairing is performed when the transmitter battery is low, it may look like the pairing works but it does not. This is a safety precaution. Recharge or replace the battery, and repeat the pairing procedure.

HMI LCD Screens

Start-Up Screen

When the ignition key switch is turned on, power will be supplied to the operator control panel. The Start-Up Screen will briefly appear on the HMI LCD screen.

Home Screen

The Home Screen appears after the Start-Up Screen and displays the following information:

- A. Engine Temperature
- B. Fuel Level
- C. DEF Level
- D. Shutdown Lamp
- E. Message Center
- F. Warning Lamp
- G. Engine Oil Pressure
- H. Stroke Counter 1
- I. Hydraulic Oil Temperature
- J. Symbols Display
- K. Engine RPM
- L. Battery Level
- M. Strokes per Minute
- N. Stroke Counter 2



- Press  to disable the horn (if active).
- Press  to go to the Event Log Screen.
- Press  and hold to reset stroke counter 1.
- Press  to go to the Menu Screen.
- Press  and hold to reset stroke counter 2.
- Press  to go to the Maintenance Screen.

Pump Status Symbols

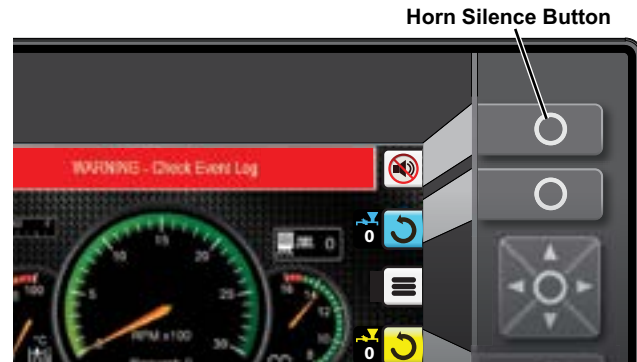
The Symbols Display on the Home Screen shows all relevant pump status symbols.

Symbol	Description
	Radio Remote Mode
	Pendant Remote Mode
	Oil Cooler Green = On Red Outline = Override Enabled
	Emission System Malfunction
	Regeneration of the DPF is Required
	DPF Regeneration is Active
	Wait-to-Start
	Engine Coolant Temperature High
	Engine Oil Pressure Low

Warning and Info Messages

The Message Center on the Home Screen will notify you to check the Event Log Screen when there is a warning message ("WARNING: Check Event Log"). The horn will beep until the horn silence button is pressed on the HMI, and pressing the horn also opens the Event Log Screen to view specific warning messages. Info messages flash through the Message Center and are also displayed on the Event Log Screen.

A Fault Isolation Manual is available with detailed troubleshooting steps. Contact the SCHWING Service Center for assistance addressing warning messages.



Warning Messages	
Vbb0-Voltage Low	Agitator Dump Valve-Short Circuit
Vbb1-Voltage Low	Agitator Dump Valve-Open Circuit
PLC Processor-High Temp	Comm Loss HMI<>PLC
HMI Processor-High Temp	Comm Loss SCT2<>SCC
Pump Forward Valve-Short Circuit	Comm Loss PLC<>Engine
Pump Forward Valve-Open Circuit	Comm Loss PLC<>Radio
Pump Reverse Valve-Short Circuit	Comm Loss PLC<>Keypad
Pump Reverse Valve-Open Circuit	E-Stop Button Error-Cycle Buttons
Stroke Limiter Valve-Error	Hopper Switch Error-Cycle Switch
Stroke Limiter Valve-Overload	Fuel Level Sensor Error
Agitator Forward Valve-Short Circuit	Potential Power Loss at F21/CB10
Agitator Forward Valve-Open Circuit	HMI Processor-High Temp
Agitator Reverse Valve-Short Circuit	Engine Oil Pressure - Low
Agitator Reverse Valve-Open Circuit	Engine Oil Pressure - High
Oil Temp Sensor Error	
Operate Oil Cooler Manually	Info Messages
Water Level Low	WARNING: Check Event Log
Hydraulic Oil Level Low	Reset E-Stop Request
Battery Level Low	E-Stop Left
Grease Level Low	E-Stop Right
Fuel Level Low	E-Stop Water Box
Hydraulic Oil Temp High	E-Stop Radio Remote
Compressor Temp High	E-Stop Pendant Remote
Engine Fault-DM1 Code	Hopper Grate Open
SCC Fault-Check Cab Display	Hopper Switch Bounce Detected
Pump Dump Valve-Short Circuit	Ram Change Mode
Pump Dump Valve-Open Circuit	Override is Active
Accumulator Dump Valve-Short Circuit	Set Date/Time
Accumulator Dump Valve-Open Circuit	DM1 Engine Code - SPN*** FMI***
	Unit Serial Number Changed from *** to ***

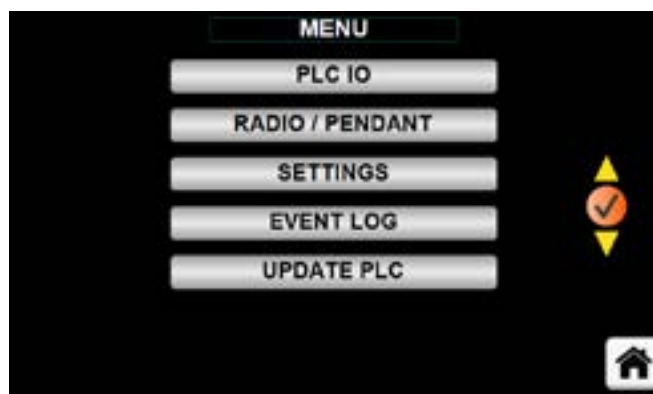
Menu Screen

The Menu Screen displays these additional status and parameter settings screens:

- PLC I/O
- Radio/Pendant
- Settings
- Event Log
- Update PLC

To access the additional screens, either press the button on the screen or use the  to scroll up and down the menu items. After the desired screen is highlighted, press .

- Press  to return to the Home Screen.



PLC IO Screen

Displays the electronic input and output signals. This screen can be used to assist in troubleshooting electrical issues.

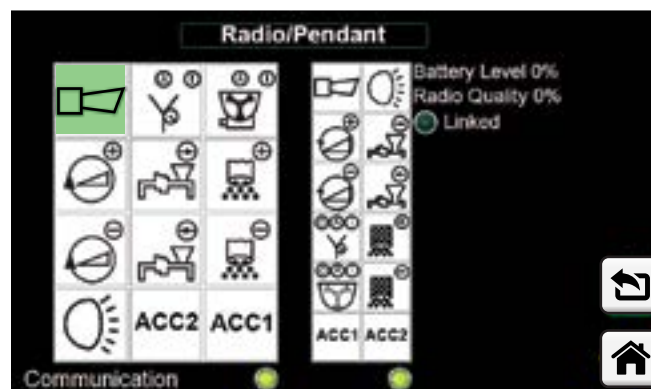
PLC		
Source	Value	Function
Vbb15	13.6 V	Vbb15 Supply Voltage
Vbb30	13.6 V	Vbb30 Supply Voltage
Vbb0<	13.6 V	Vbb0 Input Voltage
Vbb0>	13.6 V	Vbb0 Output Voltage
Vbb0-A	57 mA	Vbb0 Amps
Vbb1<	13.6 V	Vbb1 Input Voltage
Vbb1>	13.6 V	Vbb1 Output Voltage
Vbb1-A	43 mA	Vbb1 Amps
Temp.	37 °C	PLC Temperature
HMI		
IN0		
IN1		
OUT0		Oil Cooler/PTO
OUT1		Backup Throttle Control
Vbb15	13.6 V	Vbb15 Voltage
Vbb30	13.6 V	Vbb30 Voltage
Vbb0	13.6 V	Vbb0 Voltage
Temp.	41 °C	Temperature

- Press  to return to the Home Screen.
- Press  to return to the previous screen.
- Press  to scroll through the PLC IO Screen.

Radio/Pendant Screen

Displays active functions on the radio and pendant remotes. A green overlay will appear over the function that is being activated. Battery level and radio quality percentage are shown. When the radio remote is properly linked, the “Linked” field will be highlighted with a green dot.

When the radio and pendant remotes are properly connected a green dot will be displayed below the Radio or Pendant icons (Communication).



- Press  to return to the Home Screen.
- Press  to return to the Menu Screen.

Settings Screen

The Settings Screen allows operators to turn on or off installed functions or change parameters. To change settings, operators need to login. Pressing the button prompts operators to provide a password. The default password is "1" "2" "3" "4". Pressing the button will allow operators to change or reset the password.

Use the arrows to select the parameter to change. The selected parameter will have a green outline around it. If a password hasn't been provided, this outline will be grey. With a variable parameter selected, such as "Stroke Limit Min. Current," use the arrows to raise or lower the value. For on/off parameters such as Low Oil Sensor, press to turn on or off the function.

- Use the arrows to move through the list of settings. A green outline will mark which setting is selected.
- Use the arrows to raise or lower a setting.
- Press to turn a specific setting on or off.



- Press to login into the system.
- Press to logout of the system.
- Press to change or reset the password.
- Press to return to the Home Screen.
- Press to return to the Menu Screen.

Event Log Screen

Any time the SCT2 HMI displays a message, it is recorded as an event. Events can either be a warning message or contain important information. All events are recorded in the Event Log Screen. The Event Log Screen displays the time, message, and what type of event. If the event has a yellow triangle with an exclamation point, it's a warning and the issue must be addressed right away. If a circle with an "I" is displayed, the message contains information on machine status and no immediate action needs to be taken. Events can also be active or inactive. Active events are highlighted in red; inactive events are light grey.

- Use the arrows to move through the list of events. A green outline will mark which event is selected.
- Press to acknowledge a highlighted event.



All events are stored in the Event History Screen. The Event History Screen can be accessed by pressing .

- Press to go to the Event History Screen.
- Press to return to the Home Screen.
- Press to return to the Menu Screen.

Event History Screen

The Event History Screen stores all event messages. Events can be filtered by date.

- Use the  arrows to move through the list of events. A green outline will mark which event is selected.
- Press  to acknowledge a highlighted event.
- Press  to filter events by date range.



- Press  to return to the Home Screen.
- Press  to return to the previous screen.
- Press  to return to the Event Log Screen.

Event History Screen - Date Filter

- Press "Start Date," and a calendar will appear. Chose the start date.



- Once the start date has been selected, press "End Date," and choose the end date.



The events that fall into the date range selected will be displayed. When the machine is restarted, the filtered dates will be reset.



- Press  to return to the Home Screen.
- Press  to return to the previous screen.
- Press  to return to the Event Log Screen.

Maintenance Screen

The Maintenance Screen displays four parameters and four functions.

The four parameters are:

- Engine Hours
- Pumping Hours
- High Oil Temp Count
- Stroke Count Total

- Use the  arrows to move through the list of parameters. If a green outline is around the parameter and the  symbol appears, the green parameter number can be reset.
- Press and hold the enter button for three seconds to clear the green parameter field.



The four functions below can be turned on/off or changed on the Maintenance Screen:

- Oil Cooler Constant On (SCT2 Fan Constant On)
- Metric Conversion
- Override Enable
- Language

- Use the  arrows to move through the list of functions. A green outline will mark which function is selected.
- Press  to turn on or off a specific function
- Use the  arrows to change the language function.
- Press  to change the internal clock settings.

It's important to have the correct time set to validate the Event Log Screen.

Maintenance Screen - Clock Setting

It's important to have the correct time to validate the Event Log Screen.

To set the internal clock:

- Press  to change the internal clock and date settings.
- A date and time settings screen will appear. Select the parameter you would like to change.



- With the parameter selected, a number pad will appear. Use the keypad to change the selected parameter. Press OK.



- When all the parameters have been set, press OK.

Communication

If the PLC, pendant remote, radio remote, and engine are communicating with the HMI, a green outline will appear around those words. If communication is disrupted, the outline will be red.



Communication status can also be checked by looking at the ETH0 light on the PLC. If the ETH0 light isn't flashing green, communications between the PLC and HMI has been lost.



Manual Greaser Button

If Auto Grease Mode is enabled on the Settings Screen (factory set with auto-greaser option), the  button will appear on the Maintenance Screen. Pressing this button resets the auto-greaser timer. Example: if the Auto Grease Mode setting is 4 minutes ON and 240 minutes OFF, pressing the  button will immediately turn the auto-greaser ON for 4 minutes and then OFF for 240 minutes. The  button will change to  when the auto-greaser is running. This feature allows you to manually grease the machine before or after a job.



- Press  to activate the manual grease cycle.
- Press  to return to the Home Screen.
- Press  to return to the Menu Screen.

Software Version

The installed PLC software version is shown on the bottom of the Maintenance Screen. In the event of display failure, you can use your pendant remote to determine your software version.

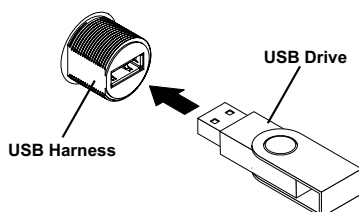
Flip the pendant/radio remote selection switch to radio mode. Press and hold the ACC2 button on the pendant remote, and after 2 seconds a series will be displayed on the pendant remote.

Example: PLC V02.01 will be shown as:



Updating HMI Software via USB

The SCT2 HMI can be updated via USB drive. A USB cable harness is located next to the operator control panel. Remove the cap on the USB cable harness and insert the USB drive.

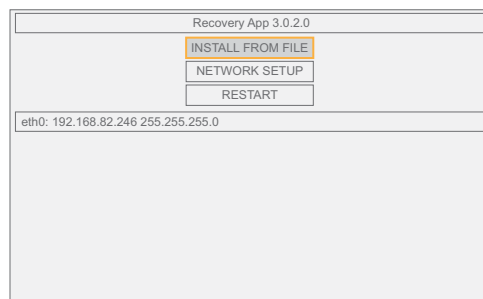


With the machine turned off. Hold down any three buttons on the HMI panel while turning the key switch to the ON position.

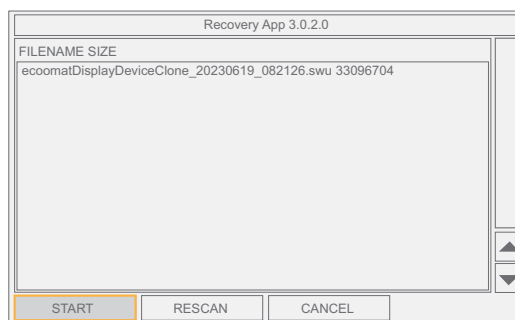


Press and hold three of these buttons simultaneously while starting the machine.

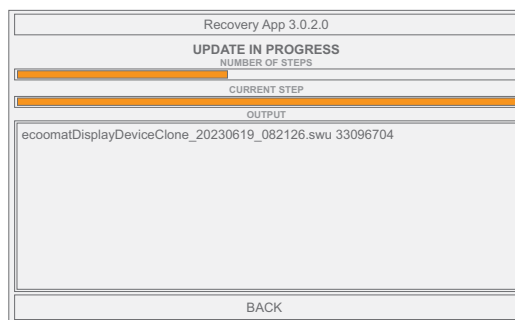
The download may begin automatically within a few seconds. If not, select **INSTALL FROM FILE**.



A file explorer screen will appear; select the file to install by pressing on the screen or using the navigation arrow buttons. With the file selected, press the “**START**” button.



A download status screen will appear. After the screen indicates the download is complete, restart the system by turning the key to the OFF position.



With the software updated on the HMI, we now have to update the PLC (see page 53).

Updating PLC Controller

From the Home Screen, press the  button. On the Menu Screen, press the UPDATE PLC button.



If the current version in PLC is equal to the install version, a pop-up window will appear; press Yes to continue with the installation or Cancel to quit.



Press  to log in to update the PLC. After a number pad appears, use the keypad to enter the access code and then press OK.



Once logged in, the "Download to Controller" button will appear; press this button to update the PLC.



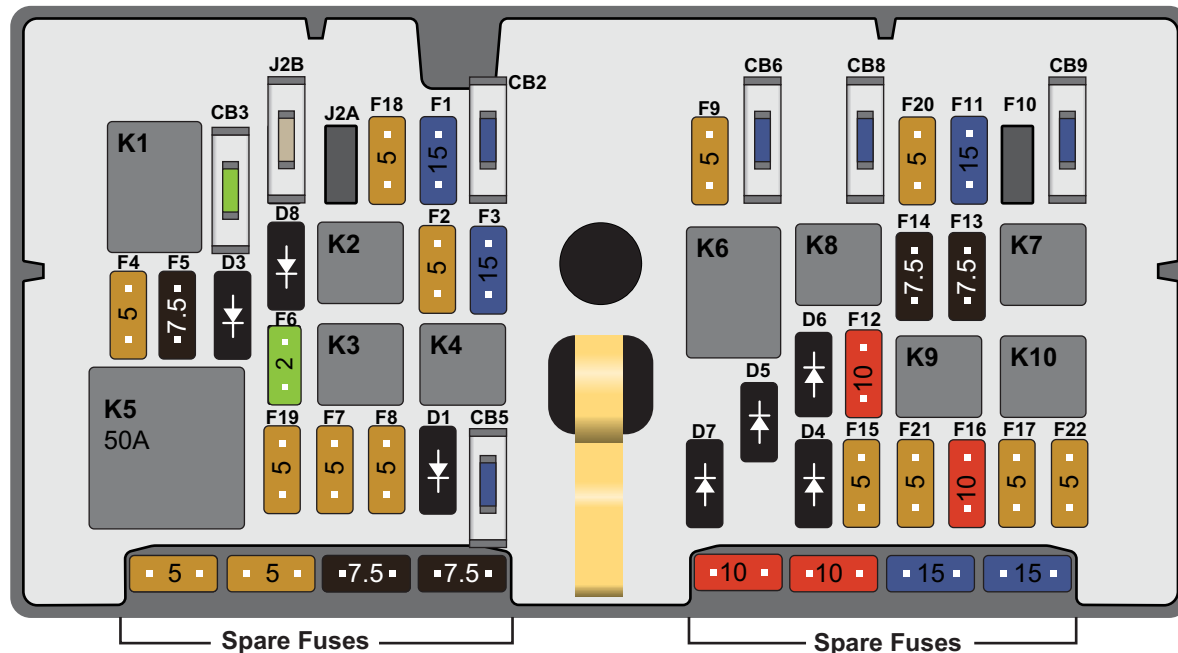
Fuses

F1	Pump Display Vbb30	15A
F2	Acc1 & Acc2 Power	5A
F3	Pump Display Vbb0	15A
F4	eVBBs	5A
F5	SCT2 Dump Valve Override	7.5A
F6	N/A	2A
F7	Telematics	5A
F8	D+ Alternator	5A
F9	Spare Ignition	5A
F10	Spare Relay Power (Max 10A)	10A
F11	Spare Battery	15A
F12	Spare Ignition	10A
F13	Horn	7.5A
F14	Grease Pot	7.5A
F15	Spare Ignition	5A
F16	Spare Ignition	10A
F17	Spare Ignition	5A
F18	PLC Vbb30	5A
F19	Pendant, PLC Vbb15, Display Vbb15	5A
F20	N/A	5A
F21	E-stop Circuits, Radio Power	5A
F22	SCT2 Sensors	5A

CB2	PLC Vbb0	15A
CB3	Oil Cooler	30A
CB5	PLC Vbb1	15A
CB6	Vibrator	15A
CB8	SCT2 Exp Module Vbb2	15A
CB9	Ignition Switch	15A
J2A	DO NOT USE	-
J2B	N/A	-

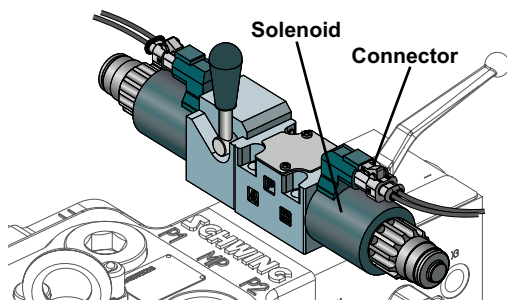
Relays

K1	Oil Cooler
K2	N/A
K3	ACC2
K4	ACC1
K5	SCT2/Pump
K6	Ignition
K7	Spare
K8	Vibrator
K9	Grease Pot
K10	Horn

Fuse/Relay Locations

Checking Solenoids

Check any wires, terminals, or other connections to the solenoid, as well as the mounting of the solenoid itself, to ensure that everything is connected solidly and that none of the terminals are corroded.



If all the connectors and wires are ok, disconnect the connector plug. Use a multimeter to test resistance (ohms) in the coil. Set the multimeter dial to resistance (Ω), and place probes on both power terminals (Figure 10). Compare resistance readings with the table below. If the resistance reading is higher for a specific function, the solenoid has degraded and is not conducting enough electricity to function properly. The solenoid should be replaced. If the ohms reading is too low, the solenoid is conducting too much current. The solenoid should be replaced.

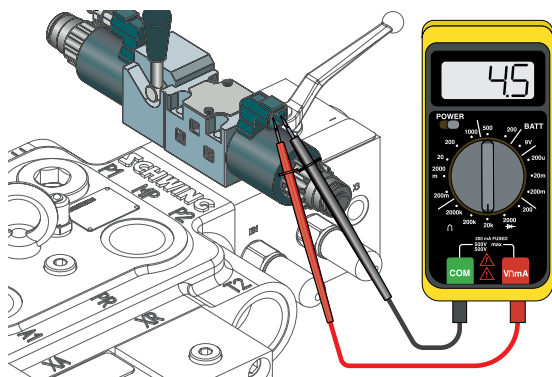


Figure 10
Testing the Resistance

Refer to the electrical schematic for the recommended resistance reading for each specific coil that is tested.

Troubleshooting Screens

PLC IO Screen

Displays the electronic input and output signals. This screen can be used to assist in troubleshooting electrical issues.

Output	Value	Function
000	0 mA	Oil Cooler Relay
001	9 mA	Concrete Pump Dump
002	1 mA	Vibrator Relay
003	13 mA	Accumulator Dump
004	3 mA	Grease Pump Relay
005	15 mA	Agitator Dump
006	5 mA	Concrete Pump Forward
007	0 mA	Concrete Pump Reverse
100	0 mA	Stroke Limiter
101	10 mA	Work Light
102	9 mA	
103	19 mA	Acc1 Relay
104	0 mA	Acc2 Relay
105	2 mA	Horn Relay
106	0 mA	Agitator Forward
107	10 mA	Agitator Reverse

- Press to return to the Home Screen.
- Press to return to the previous screen.

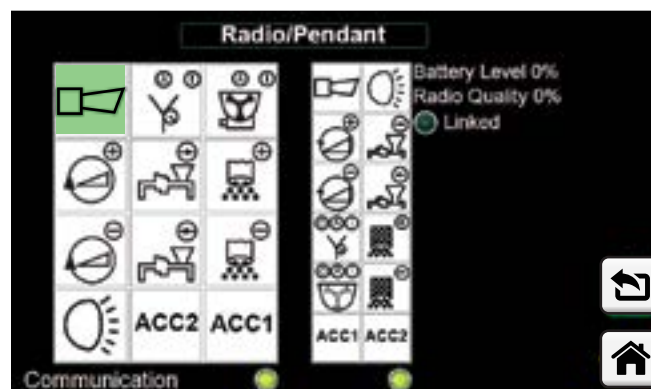
Example

To test the input or output of a particular function, navigate to the PLC IO Screen. Activate the stroke limiter function. A green indicator light will appear next to output 100. This indicates the stroke limiter function is outputting a signal from the PLC.

Radio/Pendant Screen

Displays active push buttons on the radio remote and pendant remote. When the radio and pendant remotes are properly connected a green dot will be displayed below the Radio or Pendant icons (Communication).

- Press to return to the Home Screen.
- Press to return to the previous screen.



CAT Engine Error Codes

CAT engine code faults are displayed on the Event Log Screen.



- Use the  arrows to move through the list of engine code faults.
- Press  to return to the Home Screen.

The codes are displayed in the form “SPN - FMI.”

- Suspect Parameter Numbers (SPN)
- Failure Mode Identifier (FMI)

The ECM/ECU also attaches a text description to the message that is transmitted over the J1939 data link.

The FMI is used along with the SPN to provide specific information that relates to a Diagnostic Trouble Code (DTC). The FMI may indicate that a problem with an electronic circuit or an electronic component has been detected. The FMI may also indicate that an abnormal operating condition has been detected.

The failure mode of the DTC is determined by evaluating the electronic signal from the suspect circuit.

Contact your local Caterpillar dealer for help troubleshooting fault codes.

Failure Mode Identifier (FMI) Codes

FMI	Description
0	Data Valid but Above Normal Range (Most Severe)
1	Data Valid but Below Normal Range (Most Severe)
2	Data is Erratic, Intermittent, or Incorrect
3	Voltage Above Normal
4	Voltage Below Normal
5	Current Below Normal or Open Circuit
6	Current Above Normal or Grounded Circuit
7	Mechanical System Not Responding Correctly
8	Abnormal Frequency, Pulse Width, or Period
9	Abnormal Update Rate
10	Abnormal Rate of Change
11	Other Failure Mode Not Identifiable
12	Bad Intelligent Device or Component
13	Out of Calibration
14	Special Instructions
15	Data Valid but Above Normal Range (Least Severe)
16	Data Valid but Above Normal Range (Moderately Severe)
17	Data Valid but Below Normal Range (Least Severe)
18	Data Valid but Below Normal Range (Moderately Severe)
19	Receive Network Data in Error (Multiplexed Data)
20	Data Drifted High
21	Data Drifted Low
22-30	Reserved for SAE Assignment
31	Condition Exists

Suspect Parameter Numbers (SPN)

SPN	Description
16	Engine Fuel Filter Differential Pressure
18	Engine Extended Range Fuel Pressure
19	Engine Extended Range Engine Oil Pressure
20	Engine Coolant Pressure
21	Engine ECU Temperature
22	Engine Extended Crankcase Blow-By Pressure
27	EGR #1 Valve Position
30	Engine Crankcase Blow-By Pressure
48	Extended Range Barometric Pressure
51	Engine Throttle Position
52	Engine Intercooler Temperature
81	DPF #1 Intake Pressure
94	Engine Fuel Delivery Pressure
95	Engine Fuel Filter Differential Pressure
96	Fuel Level
97	Water In Fuel Indicator
98	Engine Oil Level
99	Engine Oil Filter Differential Pressure
100	Engine Oil Pressure
101	Engine Crankcase Pressure
102	Engine Intake Manifold #1 Pressure
103	Engine Turbocharger #1 Speed
104	Engine Turbocharger Lube Oil Pressure #1
105	Engine Intake Manifold #1 Temperature
106	Engine Air Inlet Pressure
107	Engine Air Filter 1 Differential Pressure
108	Barometric Pressure
109	Engine Coolant Pressure
110	Engine Coolant Temperature
111	Engine Coolant Level
112	Engine Coolant Filter Differential Pressure
115	Alternator Current
130	Engine Power Specific Fuel Economy
131	Engine Exhaust Back Pressure
132	Engine Inlet Air Mass Flow Rate
133	Engine Average Fuel Rate
135	Engine Fuel Delivery Pressure
147	Engine Average Fuel Economy
148	Engine Instantaneous Fuel Economy

149	Engine Mass Flow Rate
152	Number Of ECU Resets
153	Engine High-Resolution Crankcase Pressure
156	Engine Injector Timing Rail #1 Pressure
157	Engine Injector Metering Rail #1 Pressure
166	Engine Rated Power
167	Charging System Potential
171	Ambient Air Temperature
172	Engine Air Inlet Temperature
173	Engine Exhaust Gas Temperature
174	Engine Fuel Temperature #1
175	Engine Oil Temperature #1
176	Engine Turbocharger Oil Temperature
189	Engine Rated Speed
190	Engine Speed
234	Software Identification
235	Engine Total Idle Hours
236	Engine Total Idle Fuel Used
247	Engine Total Hours of Operation
249	Engine Total Revolutions
250	Engine Total Fuel Used
251	Time
252	Date
257	Cold Restart of Specific Component
258	Warm Restart of Specific Component
259	Acknowledgement of Warm or Cold Restart
354	Relative Humidity
355	Engine Oil Life
411	EGR Differential Pressure
412	EGR Temperature
430	Engine Starter Solenoid Voltage
441	Auxiliary Temperature #1
442	Auxiliary Temperature #2
443	Auxiliary Gage Pressure Reading #2
590	Engine Idle Shutdown Timer State
591	Engine Idle Shutdown Timer Function
592	Engine Idle Shutdown Timer Override
593	Engine Idle Shutdown has Shutdown Engine
625	Proprietary Data Link
639	J1939 Network #1
640	Engine External Protection Input

641	Engine Turbocharger Variable Geometry Actuator #1
642	Engine Turbocharger Variable Geometry Actuator #2
643	Engine External Fuel Command Input
644	Engine External Speed Command Input
645	Engine Tachometer Signal Output
646	Engine Turbocharger #1 Wastegate Drive
648	Engine Exhaust Back Pressure Sensor
649	Engine Exhaust Back Pressure Regulator Control Command
650	Electronic Drive Unit Power Relay
651	Engine Injector Cylinder #1
652	Engine Injector Cylinder #2
653	Engine Injector Cylinder #3
654	Engine Injector Cylinder #4
655	Engine Injector Cylinder #5
656	Engine Injector Cylinder #6
675	Engine Glow Plug Lamp
676	Engine Glow Plug Relay
677	Engine Starter Motor Relay
678	ECU 8 Vdc Supply
679	Engine Injection Control Pressure Regulator
723	Engine Speed Sensor #2
724	Engine Oxygen Sensor Heated
728	Engine After Cooler-Oil Cooler Coolant Temperature
729	Engine Inlet Air Heater Driver #1
730	Engine Inlet Air Heater Driver #2
731	Engine Knock Sensor
835	Oil Level Indicator Output
854	Heater Circuit #1
898	Engine Requested Speed/Speed Limit
923	PWM Output
966	Engine Test Mode Switch
967	Engine Idle Decrement Switch
968	Engine Idle Increment Switch
971	Engine Derate Switch
1040	Total Fuel Used
1041	Start Signal Indicator
1075	Engine Electric Lift Pump for Engine Fuel Supply
1076	Engine Fuel Injection Pump Fuel Control Valve

1077	Engine Fuel Injection Pump Controller
1078	Engine Fuel Injection Pump Speed/Position Sensor
1081	Engine Wait to Start Lamp
1082	Engine Coolant Load Increase
1107	Engine Protection System Timer State
1108	Engine Protection System Timer Override
1109	Engine Protection System Approaching Shutdown
1110	Engine Protection System has Shutdown Engine
1111	Engine Protection System Configuration
1127	Engine Turbocharger #1 Boost Pressure
1128	Engine Turbocharger #2 Boost Pressure
1129	Engine Turbocharger #3 Boost Pressure
1130	Engine Turbocharger #4 Boost Pressure
1131	Engine Intake Manifold #2 Temperature
1132	Engine Intake Manifold #3 Temperature
1133	Engine Intake Manifold #4 Temperature
1134	Engine Intercooler Thermostat Opening
1135	Engine Oil Temperature #2
1136	Engine ECU Temperature
1192	Engine Turbocharger Wastegate Actuator Control Air Pressure
1207	Engine ECU Temperature
1208	Engine Pre-filter Oil Pressure
1209	Engine Exhaust Gas Pressure
1210	Engine Fuel Rack Position
1213	Malfunction Indicator Lamp (MIL)
1214	Suspect Parameter Number
1215	Failure Mode Identifier
1216	Occurrence Count
1217	Freeze Frame Length
1218	Active Trouble Codes
1219	Previously Active Trouble Codes
1230	Current Data Link
1237	Engine Shutdown Override Switch
1238	Traction Control Override Switch
1241	Engine Gas Mass Flow Rate #1
1242	Instantaneous Estimated Brake Power
1247	Engine Power
1248	Engine Peak Torque #1
1264	Engine Extended Crankcase Blow-By Pressure
1322	Engine Misfire for Multiple Cylinders

1323	Engine Misfire Cylinder #1
1324	Engine Misfire Cylinder #2
1325	Engine Misfire Cylinder #3
1326	Engine Misfire Cylinder #4
1327	Engine Misfire Cylinder #5
1328	Engine Misfire Cylinder #6
1350	Time Since Last Service
1351	Air Compressor Status
1352	Engine Cylinder #1 Knock Level
1353	Engine Cylinder #2 Knock Level
1354	Engine Cylinder #3 Knock Level
1355	Engine Cylinder #4 Knock Level
1356	Engine Cylinder #5 Knock Level
1357	Engine Cylinder #6 Knock Level
1378	Engine Oil Change Interval
1379	Service Component Identification
1380	Engine Oil Level Remote Reservoir
1381	Engine Fuel Supply Pump Inlet Pressure
1382	Engine Fuel Filter Differential Pressure
1383	Engine was Shut Down Hot
1384	Engine has Been Shut Down from Data Link Information
1385	Auxiliary Temperature #1
1386	Auxiliary Temperature #2
1387	Auxiliary Pressure #1
1388	Auxiliary Pressure #2
1389	Engine Fuel Specific Gravity
1390	Engine Fuel Valve #1 Inlet Absolute Pressure
1391	Engine Fuel Valve Differential Pressure
1392	Engine Air to Fuel Differential Pressure
1413	Engine Cylinder #1 Ignition Timing
1414	Engine Cylinder #2 Ignition Timing
1415	Engine Cylinder #3 Ignition Timing
1416	Engine Cylinder #4 Ignition Timing
1417	Engine Cylinder #5 Ignition Timing
1418	Engine Cylinder #6 Ignition Timing
1485	ECM Main Relay
1558	Programming Error, Device Refused to Enter Programming Mode
1559	Programming Error, Device Timed out While Entering the Programming Mode

1560	Programming Error, Device Timed out While Erasing
1561	Programming Error, Device Timed out While Programming
1562	Programming Error, Device did not Accept Program Line
1668	J1939 Network #4
1669	J1939 Network #5
1670	J1939 Network #6
1671	J1939 Network #7
1672	J1939 Network #8
1673	J1939 Network #9
1674	J1939 Network #10
1692	Engine Desired Absolute Intake Manifold Pressure
1693	Engine Turbocharger Wastegate Valve Position
1694	Engine Gas Mass Flow Sensor Fueling Correction
1706	SPN Conversion Method
1761	Aftertreatment #1 DEF Tank Volume #1
1762	Hydraulic Pressure
2773	Engine Fuel Supply Flow Rate
2774	Engine Fuel Return Flow Rate
2775	Engine Fuel Supply Temperature
2776	Engine Fuel Return Temperature
2791	EGR Valve Control
2901	ECU Part Number
2902	ECU Serial Number
2903	ECU Location
2904	ECU Type
3052	Engine Misfire Monitor
3056	Engine Oxygen Sensor #1 Monitor
3057	Engine Oxygen Sensor #2 Monitor
3058	EGR System Monitor
3059	Engine Positive Crankcase Ventilation System Monitor
3060	Engine Cooling System Monitor
3061	Engine Cold Start Emission Reduction Strategy System Monitor
3064	Aftertreatment DPF System Monitor
3065	Comprehensive Component Monitor
3216	Aftertreatment #1 Intake NO _x
3217	Aftertreatment #1 Intake O ₂
3218	Aftertreatment #1 Intake Gas Sensor Power in Range

3219	Aftertreatment #1 Intake Gas Sensor at Temperature
3220	Aftertreatment #1 Intake NO _x Reading Stable
3221	Aftertreatment #1 Intake Wide-Range O ₂ Reading Stable
3222	Aftertreatment #1 Intake Gas Sensor Heater Preliminary FMI
3223	Aftertreatment #1 Intake Gas Sensor Heater Control
3224	Aftertreatment #1 SCR Intake NO _x Sensor Preliminary FMI
3225	Aftertreatment #1 Intake O ₂ Sensor Preliminary FMI
3226	Aftertreatment #1 Outlet NO _x
3227	Aftertreatment #1 Outlet O ₂
3228	Aftertreatment #1 Outlet Gas Sensor Power In Range
3229	Aftertreatment #1 Outlet Gas Sensor at Temperature
3230	Aftertreatment #1 Outlet NO _x Reading Stable
3231	Aftertreatment #1 Outlet Wide-Range O ₂ Reading Stable
3232	Aftertreatment #1 Outlet Gas Sensor Heater Preliminary FMI
3233	Aftertreatment #1 Outlet Gas Sensor Heater Control
3234	Aftertreatment #1 Outlet NO _x Sensor Preliminary FMI
3235	Aftertreatment #1 Outlet O ₂ Sensor Preliminary FMI
3236	Exhaust Gas Mass
3237	Aftertreatment Intake Dew Point Message
3238	Aftertreatment Exhaust Dew Point Message
3239	Aftertreatment Intake Dew Point Message
3240	Aftertreatment Exhaust Dew Point Message
3241	Exhaust Gas Temperature #1
3242	Aftertreatment #1 DPF Intake Temperature
3245	Exhaust Gas Temperature #3
3246	Aftertreatment #1 DPF Outlet Gas Temperature
3249	Exhaust Gas Temperature #2
3250	Aftertreatment #1 DPF Intermediate Temperature
3251	Aftertreatment #1 DPF Differential Pressure
3255	Aftertreatment #2 Intake NO _x
3256	Aftertreatment #2 Intake %O ₂

3257	Aftertreatment #2 Intake Gas Sensor Power in Range
3258	Aftertreatment #2 Intake Gas Sensor at Temperature
3259	Aftertreatment #2 Intake NO _x Reading Stable
3260	Aftertreatment #2 Intake Wide-Range %O ₂ Reading Stable
3262	Aftertreatment #2 Intake Gas Sensor Heater Control
3265	Aftertreatment #2 Outlet NO _x
3266	Aftertreatment #2 Outlet %O ₂
3267	Aftertreatment #2 Outlet Gas Sensor Power in Range
3268	Aftertreatment #2 Outlet Gas Sensor at Temperature
3269	Aftertreatment #2 Outlet NO _x Reading Stable
3270	Aftertreatment #2 Outlet Wide-Range %O ₂ Reading Stable
3272	Aftertreatment #2 Outlet Gas Sensor Heater Control
3275	Aftertreatment #2 Exhaust Gas Temperature #1
3276	Aftertreatment #2 DPF Intake Temperature
3279	Exhaust Gas Temperature #3
3280	Aftertreatment #2 DPF Outlet Temperature
3283	Exhaust Gas Temperature #2
3284	Aftertreatment #2 DPF Intermediate Temperature
3285	Aftertreatment #2 DPF Differential Pressure
3289	Transmission Requested Gear Feedback
3290	Address Acknowledged
3291	Address Negative Acknowledgement
3292	Address Access Denied
3293	Address Busy
3294	Distance Since Diagnostic Trouble Codes Cleared
3295	Minutes Run by Engine While MIL Activated
3296	Time Since Diagnostic Trouble Codes Cleared
3306	Variable Valve Timing and/or Control
3344	Support Variable Rate TSC1 Message
3345	Support TSC1 Control Purpose Group 1 of 4
3346	Support TSC1 Control Purpose Group 2 of 4
3347	Support TSC1 Control Purpose Group 3 of 4
3348	Support TSC1 Control Purpose Group 4 of 4
3349	TSC1 Transmission Rate
3350	TSC1 Control Purpose

3358	EGR Inlet Pressure
3360	Aftertreatment #1 DEF Controller
3361	Aftertreatment #1 DEF Dosing Unit
3362	Aftertreatment #1 DEF Dosing Unit Input Lines
3363	Aftertreatment #1 DEF Tank Heater
3364	Aftertreatment #1 DEF Tank Quality
3471	Aftertreatment #1 Fuel Pressure Control Actuator
3472	Aftertreatment #1 Air Pressure Control Actuator
3473	Aftertreatment #1 Failed to Ignite
3474	Aftertreatment #1 Loss of Combustion
3475	Aftertreatment #2 Fuel Pressure Control Actuator
3476	Aftertreatment #2 Air Pressure Control Actuator
3477	Aftertreatment #2 Failed to Ignite
3478	Aftertreatment #2 Loss of Ignition
3479	Aftertreatment #1 Fuel Pressure Control
3480	Aftertreatment #1 Fuel Pressure #1
3481	Aftertreatment #1 Fuel Rate
3482	Aftertreatment #1 Fuel Enable Actuator
3483	Aftertreatment #1 Regeneration Status
3484	Aftertreatment #1 Ignition
3485	Aftertreatment #1 Supply Air Pressure
3486	Aftertreatment #1 Purge Air Pressure
3487	Aftertreatment #1 Air Pressure Control
3488	Aftertreatment #1 Air Pressure Actuator Position
3489	Aftertreatment #1 Air Enable Actuator
3490	Aftertreatment #1 Purge Air Actuator
3491	Aftertreatment #1 Atomization Air Actuator
3492	Aftertreatment #1 Air System Relay
3493	Aftertreatment #2 Fuel Pressure Control
3494	Aftertreatment #2 Fuel Pressure
3495	Aftertreatment #2 Fuel Rate
3496	Aftertreatment #2 Fuel Enable Actuator
3497	Aftertreatment #2 Regeneration Status
3498	Aftertreatment #2 Ignition
3499	Aftertreatment #2 Supply Air Pressure
3500	Aftertreatment #2 Purge Air Pressure
3501	Aftertreatment #2 Air Pressure Control
3502	Aftertreatment #2 Air Pressure Actuator Position
3503	Aftertreatment #2 Air Enable Actuator
3504	Aftertreatment #2 Purge Air Actuator
3505	Aftertreatment #2 Atomization Air Actuator

3506	Aftertreatment #2 Air System Relay
3509	Sensor Supply Voltage #1
3510	Sensor Supply Voltage #2
3511	Sensor Supply Voltage #3
3512	Sensor Supply Voltage #4
3513	Sensor Supply Voltage #5
3514	Sensor Supply Voltage #6
3515	Aftertreatment #1 DEF Temperature #2
3516	Aftertreatment #1 DEF Concentration
3517	Aftertreatment #1 DEF Tank Level
3518	Aftertreatment #1 DEF Conductivity
3519	Aftertreatment #1 DEF Temperature #2 Preliminary FMI
3520	Aftertreatment #1 DEF Properties Preliminary FMI
3521	Aftertreatment #1 DEF Property
3522	Aftertreatment #1 Total Fuel Used
3522	Aftertreatment #1 Total Fuel Used
3523	Aftertreatment #1 Total Regeneration Time
3524	Aftertreatment #1 Total Disabled Time
3525	Aftertreatment #1 Total Number of Active Regenerations
3526	Aftertreatment #2 Total Fuel Used
3527	Aftertreatment #2 Total Regeneration Time
3528	Aftertreatment #2 Total Disabled Time
3529	Aftertreatment #2 Total Number of Active Regenerations
3530	Aftertreatment #1 Regeneration Manually Disabled
3531	Aftertreatment #2 Regeneration Manually Disabled
3532	Aftertreatment #1 Diesel Exhaust Fluid Tank Level Preliminary FMI
3542	Requested Engine Control Mode
3543	Engine Operating State
3549	Engine Oil Filter Outlet Pressure
3550	Engine Oil Priming Pump Switch
3551	Engine Oil Priming State
3554	Engine Ventilation Status
3556	Aftertreatment Fuel Injector #1
3557	Engine Intake Manifold #2 Pressure
3562	Engine Intake Manifold #2 Pressure
3563	Engine Intake Manifold #1 Absolute Pressure
3609	DPF #1 Intake Pressure
3610	Aftertreatment #1 DEF Outlet Pressure

3611	Aftertreatment #2 DPF Intake Pressure
3644	Engine Derate Request
3659	Engine Injector Cylinder #1 Actuator #2
3660	Engine Injector Cylinder #2 Actuator #2
3661	Engine Injector Cylinder #3 Actuator #2
3662	Engine Injector Cylinder #4 Actuator #2
3663	Engine Injector Cylinder #5 Actuator #2
3664	Engine Injector Cylinder #6 Actuator #2
3665	Engine Injector Cylinder #7 Actuator #2
3666	Engine Injector Cylinder #8 Actuator #2
3670	Maximum Crank Attempts per Start Attempt
3671	Crank Attempt Count on Present Start Attempt
3695	DPF Regeneration Inhibit Switch Status
3696	DPF Regeneration Force Switch Status
3697	DPF Lamp Command
3698	Exhaust System High Temperature Lamp Command
3699	Aftertreatment DPF Passive Regeneration Status
3700	DPF Active Regeneration Status
3701	DPF Status
3702	DPF Active Regeneration Inhibited Status
3703	DPF Active Regeneration Inhibited due to Inhibit Switch
3707	DPF Active Regeneration Inhibited due to Accelerator Pedal Off Idle
3708	DPF Active Regeneration Inhibited due to out of Neutral
3710	DPF Active Regeneration Inhibited due to Parking Brake not Set
3711	DPF Active Regeneration Inhibited due to Low Exhaust Gas Temperature
3712	DPF Active Regeneration Inhibited due to System Fault Active
3713	DPF Active Regeneration Inhibited due to System Timeout
3714	DPF Active Regeneration Inhibited due to Temporary System Lockout
3715	DPF Active Regeneration Inhibited due to Permanent System Lockout
3716	DPF Active Regeneration Inhibited due to Engine not Warmed Up
3719	DPF #1 Soot Loading Percent
3720	DPF #1 Ash Load Percent
3721	DPF #1 Time Since Last Active Regeneration

3722	DPF #2 Soot Loading Percent
3723	DPF #2 Ash Load Percent
3750	DPF #1 Conditions not Met for Active Regeneration
3821	EGR Valve #2 Control
3822	EGR Valve #2 Position
3826	Aftertreatment #1 DEF Average Consumption
3828	Aftertreatment #1 Commanded DEF Consumption
3830	Aftertreatment #1 Secondary Air Differential Pressure
3831	Aftertreatment #1 Secondary Air Temperature
3832	Aftertreatment #1 Secondary Air Mass Flow
3833	Aftertreatment #2 Secondary Air Differential Pressure
3834	Aftertreatment #2 Secondary Air Temperature
3835	Aftertreatment #2 Secondary Air Mass Flow
3837	Aftertreatment #1 Secondary Air Pressure
3838	Aftertreatment #2 Secondary Air Pressure
3936	Aftertreatment DPF System
4076	Engine Coolant Temperature #2
4077	Aftertreatment #1 Fuel Pressure #2
4193	Engine Coolant Pump Outlet Temperature
4194	Engine Coolant Thermostat Opening
4195	Engine Coolant Thermostat Mode
4201	Engine Speed Sensor #1
4202	Engine Speed Sensor #3
4203	Engine Speed Sensor #1 Timing Pattern Status
4204	Engine Speed Sensor #2 Timing Pattern Status
4205	Engine Speed Sensor #3 Timing Pattern Status
4240	Engine Exhaust Gas Oxygen Sensor Closed Loop Operation, Bank #1
4241	Engine Exhaust Gas Oxygen Sensor Closed Loop Operation, Bank #2
4243	Engine Oil to Coolant Differential Temperature
4244	Engine Run Relay
4256	Cranking Voltage
4265	Aftertreatment #1 Transformer Secondary Output
4289	Aftertreatment #1 Three Way Catalytic Converter Intake Gas Temperature
4290	Aftertreatment #1 Three Way Catalytic Converter Outlet Gas Temperature
4291	Aftertreatment #1 Three Way Catalytic Converter Differential Pressure
4301	Aftertreatment #1 Fuel Injector #1 Heater Control

4331	Aftertreatment #1 DEF Actual Dosing Quantity
4332	Aftertreatment #1 SCR System #1 State
4333	Aftertreatment #1 DEF Actual Quantity of Integrator
4334	Aftertreatment #1 DEF #1 Pressure (Absolute)
4335	Aftertreatment #1 SCR Dosing Air Assist Absolute Pressure
4336	Aftertreatment #1 SCR Dosing Air Assist Valve
4337	Aftertreatment #1 DEF Doser #1 Temperature
4338	Aftertreatment #1 SCR Dosing Valve Exhaust Temperature Reduction Request
4340	Aftertreatment #1 DEF Line Heater #1 State
4341	Aftertreatment #1 Diesel Exhaust Fluid Line Heater #1 Preliminary FMI
4342	Aftertreatment #1 DEF Line Heater #2 State
4343	Aftertreatment #1 Diesel Exhaust Fluid Line Heater #2 Preliminary FMI
4344	Aftertreatment #1 DEF Line Heater #3 State
4345	Aftertreatment #1 Diesel Exhaust Fluid Line Heater #3 Preliminary FMI
4346	Aftertreatment #1 DEF Line Heater #4 State
4347	Aftertreatment #1 Diesel Exhaust Fluid Line Heater #4 Preliminary FMI
4348	Aftertreatment #1 DEF Dosing Requested Quantity
4350	Aftertreatment #1 DEF Requested Quantity of Integrator
4352	Aftertreatment 1 Diesel Exhaust Fluid Doser Fault Suppression Request
4353	Aftertreatment #1 DEF Doser Heating Mode Request
4354	Aftertreatment #1 DEF Line Heater #1
4355	Aftertreatment #1 DEF Line Heater #2
4356	Aftertreatment #1 DEF Line Heater #3
4357	Aftertreatment #1 DEF Line Heater #4
4365	Aftertreatment #1 Diesel Exhaust Fluid Tank #1 Temperature Preliminary FMI
4366	Aftertreatment #1 Diesel Exhaust Fluid Tank #1 Heater Preliminary FMI
4367	Aftertreatment #1 DEF Quick Thaw Tank Volume
4368	Aftertreatment #1 DEF Quick Thaw Temperature
4369	Aftertreatment #1 Diesel Exhaust Fluid Tank #2 Level 2
4370	Aftertreatment #1 Diesel Exhaust Fluid Tank #2 Level Preliminary FMI
4371	Aftertreatment #1 Diesel Exhaust Fluid Tank #2 Temperature Preliminary FMI

4372	Aftertreatment #1 DEF Quick Thaw Heater
4373	Aftertreatment #1 Diesel Exhaust Fluid Tank #2 Heater Preliminary FMI
4358	Aftertreatment #1 SCR Catalyst Exhaust Gas Differential Pressure
4360	Aftertreatment #1 SCR Catalyst Intake Gas Temperature
4363	Aftertreatment #1 SCR Catalyst Outlet Gas Temperature
4364	Aftertreatment #1 SCR Catalyst Conversion Efficiency
4374	Aftertreatment #1 DEF Pump #1 Motor Speed
4375	Aftertreatment #1 DEF Pump Drive Command
4376	Aftertreatment #1 DEF Return Valve
4377	Aftertreatment #1 Outlet NH3
4383	Aftertreatment #1 Outlet NH3 Gas sensor heater control
4384	Aftertreatment #2 DEF Actual Dosing Quantity
4385	Aftertreatment #2 SCR System #1 State
4386	Aftertreatment #2 Diesel Exhaust Fluid Actual Quantity of Integrator
4387	Aftertreatment #2 DEF #1 Pressure (Absolute)
4390	Aftertreatment #2 DEF Doser #1 Temperature
4393	Aftertreatment #2 DEF Line Heater #1 State
4394	Aftertreatment #2 Diesel Exhaust Fluid Line Heater #1 Preliminary FMI
4395	Aftertreatment #2 DEF Line Heater #2 State
4396	Aftertreatment #2 Diesel Exhaust Fluid Line Heater #2 Preliminary FMI
4397	Aftertreatment #2 DEF Line Heater #3 State
4398	Aftertreatment #2 Diesel Exhaust Fluid Line Heater #3 Preliminary FMI
4399	Aftertreatment #2 DEF Line Heater #4 State
4400	Aftertreatment #2 Diesel Exhaust Fluid Line Heater #4 Preliminary FMI
4401	Aftertreatment #2 Diesel Exhaust Fluid Dosing Requested Quantity
4403	Aftertreatment #2 Diesel Exhaust Fluid Requested Quantity of Integrator
4405	Aftertreatment #2 Diesel Exhaust Fluid Doser Fault Suppression Request
4406	Aftertreatment #2 Diesel Exhaust Fluid Doser Heating Mode Request
4407	Aftertreatment #2 DEF Line Heater #1
4408	Aftertreatment #2 DEF Line Heater #2

4409	Aftertreatment #2 DEF Line Heater #3
4410	Aftertreatment #2 DEF Line Heater #4
4413	Aftertreatment #2 SCR Catalyst Intake Gas Temperature
4417	Aftertreatment #2 Diesel Exhaust Fluid Average Consumption
4418	Aftertreatment #2 SCR Commanded Diesel Exhaust Fluid Consumption
4419	Aftertreatment #2 SCR Conversion Efficiency
4420	Aftertreatment #2 Diesel Exhaust Fluid Temperature #2
4421	Aftertreatment #2 Diesel Exhaust Fluid Concentration
4422	Aftertreatment #2 Diesel Exhaust Fluid Conductivity
4423	Aftertreatment #2 Diesel Exhaust Fluid Temperature #2 Preliminary FMI
4424	Aftertreatment #2 Diesel Exhaust Fluid Properties Preliminary FMI
4425	Aftertreatment #2 Diesel Exhaust Fluid Type
4426	Aftertreatment #2 DEF Tank Volume #1
4427	Aftertreatment #2 DEF Tank Temperature
4428	Aftertreatment #2 Diesel Exhaust Fluid Tank Level 2
4429	Aftertreatment #2 Diesel Exhaust Fluid Tank Level Preliminary FMI
4430	Aftertreatment #2 Diesel Exhaust Fluid Tank #1 Temperature Preliminary FMI
4431	Aftertreatment #2 DEF Tank Heater
4432	Aftertreatment #2 Diesel Exhaust Fluid Tank #1 Heater Preliminary FMI
4433	Aftertreatment #2 DEF Tank #2 Level
4434	Aftertreatment #2 Diesel Exhaust Fluid Tank #2 Temperature
4435	Aftertreatment 2 Diesel Exhaust Fluid Tank 2 Level 2
4436	Aftertreatment 2 Diesel Exhaust Fluid Tank 2 Level Preliminary FMI
4437	Aftertreatment 2 Diesel Exhaust Fluid Tank 2 Temperature Preliminary FMI
4438	Aftertreatment 2 Diesel Exhaust Fluid Tank 2 Heater
4439	Aftertreatment 2 Diesel Exhaust Fluid Tank 2 Heater Preliminary FMI
4440	Aftertreatment #2 DEF Pump Motor Speed
4441	Aftertreatment #2 DEF Pump Drive Percentage

4442	Aftertreatment #2 DEF Dosing Unit #1 Diverter Valve
4450	Aftertreatment #2 DEF Controller
4451	Aftertreatment #2 DEF Dosing Unit
4452	Aftertreatment #2 DEF Dosing Unit #1 Input Lines
4453	Aftertreatment 2 Diesel Exhaust Fluid Tank Quality
4750	EGR Cooler Inlet Temperature
4765	Aftertreatment #1 Diesel Oxidation Catalyst Intake Gas Temperature
4766	Aftertreatment #1 Diesel Oxidation Catalyst Outlet Gas Temperature
4767	Aftertreatment #1 Diesel Oxidation Catalyst Differential Pressure
4771	Aftertreatment #2 Diesel Oxidation Catalyst Intake Temperature
4772	Aftertreatment #2 Diesel Oxidation Catalyst Outlet Temperature
4773	Aftertreatment #2 Diesel Oxidation Catalyst Differential Pressure
4779	Aftertreatment #1 Three Way Catalyst Differential Gas Temperature
4781	DPF #1 Soot Mass
4783	DPF #1 Mean Soot Signal
4785	DPF #1 Soot Sensor
4792	Aftertreatment #1 SCR System
4797	Engine Injector Cylinder #9 Actuator #2
4798	Engine Injector Cylinder #10 Actuator #2
4799	Engine Injector Cylinder #11 Actuator #2
4800	Engine Injector Cylinder #12 Actuator #2
4801	Engine Injector Cylinder #13 Actuator #2
4802	Engine Injector Cylinder #14 Actuator #2
4803	Engine Injector Cylinder #15 Actuator #2
4804	Engine Injector Cylinder #16 Actuator #2
4805	Engine Injector Cylinder #17 Actuator #2
4806	Engine Injector Cylinder #18 Actuator #2
4807	Engine Injector Cylinder #19 Actuator #2
4808	Engine Injector Cylinder #20 Actuator #2
4817	Engine Intake Manifold #1 Absolute Pressure
5018	Aftertreatment #1 Diesel Oxidation Catalyst System
5019	EGR Outlet Pressure
5024	Aftertreatment #1 Intake NOx Sensor Heater Ratio
5025	Aftertreatment #1 Intake NOx Sensor New Part Deviation NOx Gain

5026	Aftertreatment #1 Intake NOx Sensor New Part Deviation NOx Offset
5027	Aftertreatment #1 Intake NOx Sensor O2 Pressure Correction
5028	Aftertreatment #1 Intake NOx Sensor NOx Pressure Correction
5029	Aftertreatment #1 Intake NOx Sensor NO2 Correction
5030	Aftertreatment #1 Intake NOx Sensor NH3 Correction
5031	Aftertreatment #1 Outlet NOx Sensor Heater Ratio
5032	Aftertreatment #1 Outlet NOx Sensor New Part Deviation NOx Gain
5033	Aftertreatment #1 Outlet NOx Sensor New Part Deviation NOx Offset
5034	Aftertreatment #1 Outlet NOx Sensor O2 Pressure Correction
5035	Aftertreatment #1 Outlet NOx Sensor NOx Pressure Correction
5036	Aftertreatment #1 Outlet NOx Sensor NO2 Correction
5037	Aftertreatment #1 Outlet NOx Sensor NH3 Correction
5077	Engine Protect Lamp Command
5082	Engine Oil Pressure Low Lamp Command
5083	Engine Coolant Temperature High Lamp Command
5099	Engine Oil Pressure Low Lamp Data
5137	Aftertreatment #1 DEF Tank Heater Command
5138	Aftertreatment 2 Diesel Exhaust Fluid Tank Heater Command
5245	Aftertreatment Selective Catalytic Reduction Operator Inducement Active
5246	Aftertreatment SCR Operator Inducement Severity
5252	EGR #2 Differential Pressure
5255	EGR #2 Temperature
5257	EGR #2 Mass Flow Rate
5264	EGR #2 Valve Control
5272	Unexpected Engine Shutdown
5273	Crank Terminate Relay
5276	Engine Exhaust Manifold Bank #1 Flow Balance Valve Actuator Control
5302	Aftertreatment #1 Post SCR NH3 Conversion Efficiency
5304	Aftertreatment #1 NOx Adsorbing Catalyst Conversion Efficiency

5323	Engine Fuel Control Mode
5324	Engine Glow Plug #1
5325	Engine Glow Plug #2
5326	Engine Glow Plug #3
5327	Engine Glow Plug #4
5370	Engine Desired Turbocharger Wastegate Actuator #1 Position
5374	Engine Desired Throttle Valve #1 Position
5376	Engine Throttle Valve #1 Temperature Status
5381	Engine Fuel Valve #1 Temperature Status
5386	Engine Turbocharger Wastegate Actuator #1 Command
5392	Aftertreatment #1 DEF Dosing Unit #1 Loss of Prime
5394	Aftertreatment DEF Dosing Valve
5401	Engine Turbocharger Turbine Bypass Actuator
5414	Aftertreatment 1 Diesel Exhaust Fluid Tank 2 Heater Command
5415	Aftertreatment 2 Diesel Exhaust Fluid Tank 2 Heater Command
5417	Fuel Filter (Suction Side) Intake Pressure
5418	Engine Fuel Actuator #1
5419	Engine Throttle Actuator #1
5420	Engine Turbocharger Compressor Bypass Actuator #1
5421	Engine Turbocharger Wastegate Actuator #1
5422	Engine Intake Manifold #2 Absolute Pressure
5423	Aftertreatment #1 Fuel Pump Relay Control
5424	Aftertreatment #1 Fuel Flow Diverter Valve Control
5425	Aftertreatment #1 Fuel Pressure #2 Actuator Control
5429	EGR #2 Intake Absolute Pressure
5430	EGR #1 Intake Pressure (absolute)
5434	Aftertreatment 1 Diesel Exhaust Fluid Tank Fill Valve Command
5435	Aftertreatment #1 DEF Pump State
5436	Aftertreatment #2 DEF Pump State
5437	Aftertreatment 2 Diesel Exhaust Fluid Tank Fill Valve Command
5438	Aftertreatment 2 Diesel Exhaust Fluid Pump State
5439	Aftertreatment 2 Diesel Exhaust Fluid Tank Drain Valve Command
5441	Engine Fuel Injection Timing Error for Multiple Cylinders

5443	Aftertreatment #1 Hydrocarbon Dosing System
5447	Engine Fuel Valve #1 Operation Status
5468	Engine Oil Relative Dielectricity
5478	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Loss of Prime (obsolete)
5480	Aftertreatment #1 DEF Controller Temperature
5485	Aftertreatment #1 DEF Pump Orifice Flow
5486	Exhaust Emission Controller ECU Temperature
5487	Aftertreatment #1 Burner Unit Combustion Chamber Temperature
5488	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 5 State
5489	Aftertreatment 2 Diesel Exhaust Fluid Line Heater 5 Preliminary FMI
5490	Aftertreatment 2 Diesel Exhaust Fluid Line Heater 5
5491	Aftertreatment #1 DEF Line Heater Relay
5495	Aftertreatment #1 DPF Soot Mean Calibration Offset
5499	Intake Valve Actuation System Oil Pressure Solenoid Status
5506	Hydrocarbon (HC) Doser Status
5569	DPF #1 Soot Sensor ECU Internal Temperature
5571	High-Pressure Common Rail Fuel Pressure Relief Valve
5578	Engine Fuel Delivery Absolute Pressure
5579	Engine Filtered Fuel Delivery Pressure
5580	Engine Filtered Fuel Delivery Absolute Pressure
5589	Aftertreatment #1 Secondary Air Absolute Pressure
5591	Aftertreatment #1 DPF Air Control Module
5629	DPF Active Regeneration Inhibited due to Low Exhaust Gas Pressure
5631	Engine Throttle Valve Differential Pressure
5706	Aftertreatment #1 DEF Pump Heater
5707	Aftertreatment #1 DEF Pump Heater Command
5721	Aftertreatment #1 Outlet NO _x Sensor Operation Hours
5722	Aftertreatment #1 Intake NO _x Sensor Operation Hours
5826	Emission Control System Operator Inducement Severity
5837	Fuel Type
5745	Aftertreatment #1 Diesel Exhaust Fluid Dosing Unit Heater

5746	Aftertreatment #1 Diesel Exhaust Fluid Dosing Unit Heater Relay
5748	Aftertreatment #2 DEF Dosing Unit #1 Loss of Prime
5758	Aftertreatment #1 Intake Gas Sensor Power Supply
5759	Aftertreatment #1 Outlet Gas Sensor Power Supply
5760	Aftertreatment #2 Intake Gas Sensor Power Supply
5761	Aftertreatment #2 Outlet Gas Sensor Power Supply
5798	Aftertreatment #1 DEF Dosing Unit Heater Temperature
5799	Aftertreatment #1 SCR Dosing Air Assist Pump Relay
5833	Engine Fuel Mass Flow Rate
5838	EGR Valve Malfunction
5839	Diesel Exhaust Fluid Consumption Malfunction
5840	Diesel Exhaust Fluid Dosing Malfunction
5841	DEF Quality Malfunction
5963	Aftertreatment #1 Total DEF Used
5964	Aftertreatment #2 Total Diesel Exhaust Fluid Used
5965	Aftertreatment #1 DEF Control Module Relay Control
5966	Aftertreatment #1 DEF Control Module Power Supply
5967	Aftertreatment #2 Diesel Exhaust Fluid Control Module Relay Control
5968	Aftertreatment #2 DEF Control Module Power Supply
5969	Engine Exhaust Manifold Bank #2 Temperature #2
5970	Engine Exhaust Manifold Bank #1 Temperature #2
5971	Aftertreatment #2 Diesel Exhaust Fluid Dosing Unit Heater
5972	Aftertreatment #2 DEF Doser Absolute Pressure
5973	Aftertreatment #2 DEF Line Heater Relay #1
5974	Aftertreatment #2 DEF Dosing Valve #1
5978	Aftertreatment #1 DPF Time to Next Active Regeneration
5980	Engine Turbocharger Differential Speed
6476	Aftertreatment DEF Doser Cooldown Interrupted Count
6477	Aftertreatment DEF Doser Purge Interrupted Count

6478	Aftertreatment Diesel Exhaust Fluid Doser Cooldown Complete This Cycle
6479	Aftertreatment Diesel Exhaust Fluid Doser Cooldown Complete Last Cycle
6480	Aftertreatment Diesel Exhaust Fluid Doser Purge Complete This Cycle
6481	Aftertreatment Diesel Exhaust Fluid Doser Purge Complete Last Cycle
6482	After-Run Completion this Cycle
6571	Engine Main Chamber Fuel Absolute Pressure
6572	Engine Main Chamber Fuel Desired Absolute Pressure
6573	Engine Pre-Chamber Fuel Absolute Pressure
6574	Engine Pre-Chamber Fuel Desired Absolute Pressure
6575	Engine Main Chamber Air Fuel Ratio
6576	Engine Main Chamber Desired Air Fuel Ratio
6577	Engine Pre-Chamber Air Fuel Ratio
6578	Engine Pre-Chamber Desired Air Fuel Ratio
6579	Engine Exhaust NO _x
6580	Engine Exhaust Desired NO _x
6581	Aftertreatment #1 Hydrocarbon Doser #2
6586	Aftertreatment #1 SCR Intake Pressure
6587	Aftertreatment #2 SCR Intake Pressure
6588	Operator Shutdown with High Exhaust Temperature
6797	Aftertreatment #1 SCR Intake Absolute Pressure
6798	Aftertreatment #2 SCR Intake Absolute Pressure
6806	ECU Interface Mismatch
6875	Aftertreatment #1 DEF Dosing Pressure
6877	SCR Operator Inducement Override Enable
6880	Total Number of SCR Operator Inducement Override Events
6935	Aftertreatment #1 SCR System Total Cleaning Time
7105	Aftertreatment #1 Inconsistent Configuration Detected
7107	Aftertreatment #1 DEF Pump
7320	Engine Multiple Cylinder Knock Level
7416	Aftertreatment #1 DEF Pump Power Relay
7417	Aftertreatment #1 DEF Control Module Circuit Breaker
7421	Engine Charge Air Cooler Bypass Valve #1 Command

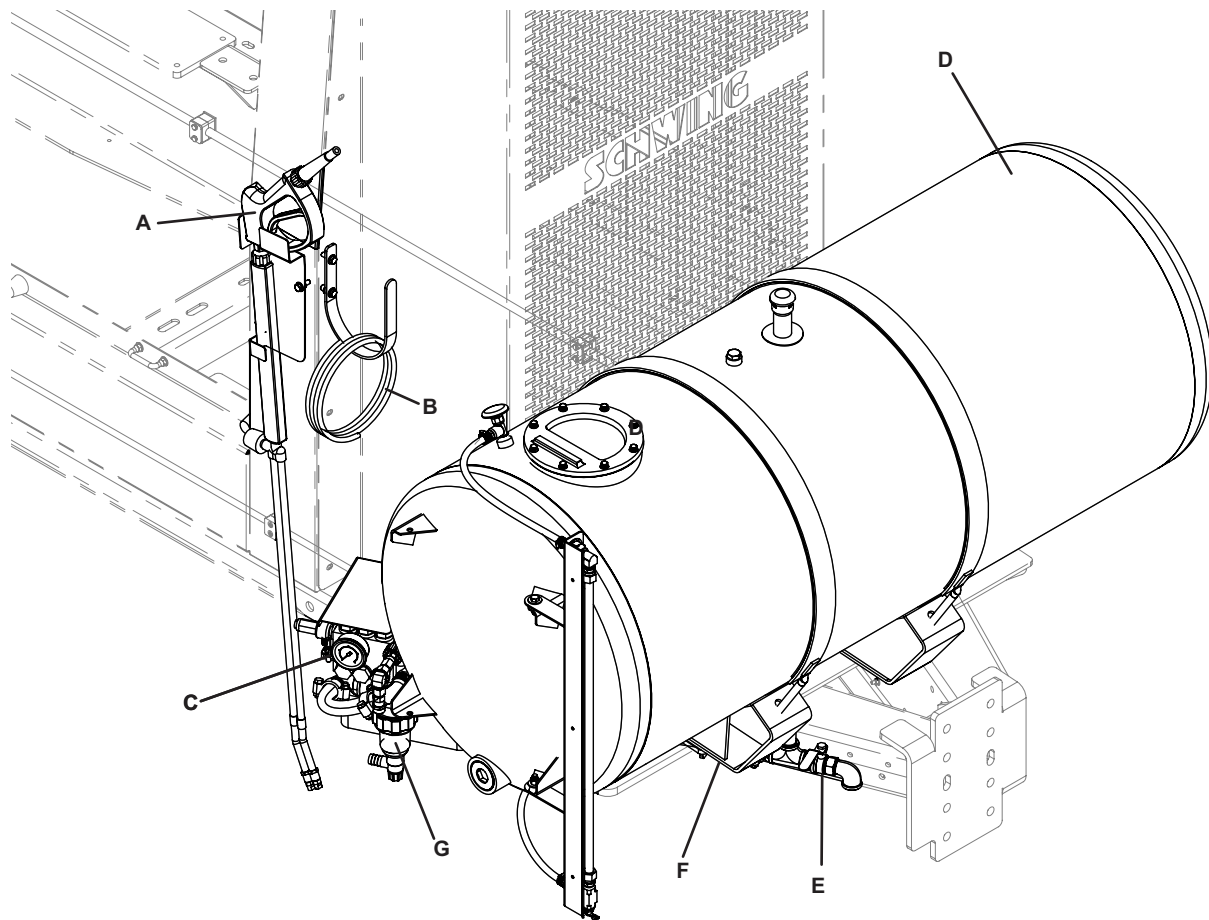
7422	Engine Charge Air Cooler Bypass Valve #2 Command
7441	Aftertreatment Ambient Air Temperature
7457	Aftertreatment #1 DEF Dosing Unit #2
7458	Aftertreatment #1 DEF Dosing Unit #2 Input Lines
7459	Aftertreatment #1 DEF Doser #2 Absolute Pressure
7460	Aftertreatment #1 DEF Doser #2 Temperature
7462	Aftertreatment #2 DEF Dosing Unit #2
7463	Aftertreatment #2 DEF Dosing Unit #2 Input Lines
7464	Aftertreatment #2 DEF Doser #2 Pressure (Absolute)
7465	Aftertreatment #2 DEF Dosing #2 Temperature
7488	Aftertreatment #1 DEF Dosing Valve #3
7489	Aftertreatment #2 DEF Dosing Unit #3
7501	Engine Charge Air Cooler #2 Bypass
7504	Aftertreatment #1 SCR System Sulfation Level
7522	Aftertreatment #1 DEF Control Module #2 Power Supply #1
7523	Aftertreatment #1 DEF Control Module #2 Power Supply #2
7524	Aftertreatment #1 SCR System #2 State
7525	Aftertreatment #2 SCR System #2 State
7526	Aftertreatment #2 DEF Line Heater Relay #2
7528	Aftertreatment #1 DEF Controller #2 Temperature
7529	Aftertreatment #2 DEF Controller Temperature
7530	Aftertreatment #1 DEF Tank Volume #2
7531	Aftertreatment #2 DEF Tank Volume #2
7533	Aftertreatment #2 DEF Control Module #2 Power Supply #1
7534	Aftertreatment #2 DEF Control Module #2 Power Supply #2
7535	Aftertreatment #2 DEF Controller #2 Temperature
7536	Aftertreatment #1 DEF Dosing Unit #2 Diverter Valve
7537	Aftertreatment #2 DEF Dosing Unit #2 Diverter Valve
7538	Aftertreatment #1 DEF Controller #2
7539	Aftertreatment #2 DEF Controller #2
7540	Aftertreatment #1 DEF Line Heater Relay #3
7541	Aftertreatment #1 DEF Dosing Unit #2 Loss of Prime
7542	Aftertreatment #2 DEF Dosing Unit #2 Loss of Prime

7543	Aftertreatment #1 DEF Dosing Unit #2 Heater Temperature
7544	Aftertreatment #2 DEF Dosing Unit #1 Heater Temperature
7545	Aftertreatment #2 DEF Dosing Unit #2 Heater Temperature
7546	Aftertreatment #1 DEF Dosing Valve #4
7547	Aftertreatment #2 DEF Dosing Valve #4
7561	Aftertreatment #1 DEF Line Heater #5
7562	Aftertreatment #1 DEF Line Heater #6
7563	Aftertreatment #1 DEF Line Heater #7
7564	Aftertreatment #1 DEF Line Heater #8
7565	Aftertreatment #1 DEF Line Heater #9
7567	Aftertreatment #2 DEF Line Heater #6
7568	Aftertreatment #2 DEF Line Heater #7
7569	Aftertreatment #2 DEF Line Heater #8
7570	Aftertreatment #2 DEF Line Heater #9
7572	Aftertreatment #1 DEF Tank Temperature #2
7573	Aftertreatment #1 DEF Tank Heater #2
7574	Aftertreatment #2 DEF Tank Temperature #2
7575	Aftertreatment #2 DEF Tank Heater #2
7585	Tire Location (PGN 0x7F00) <DNT>
7586	Tire Sensor Identification Number
7587	Tire Sensor Enable Setting
7588	Aftertreatment DEF Heater Circuit Breaker
7598	Aftertreatment #1 DEF Backflow Valve #1
7599	Aftertreatment #1 DEF Backflow Valve #2
7600	Aftertreatment #2 DEF Backflow Valve #1
7601	Aftertreatment #2 DEF Backflow Valve #2
7602	Aftertreatment #1 DEF Controller #1 Identification
7603	Aftertreatment #1 DEF Controller #2 Identification
7604	Aftertreatment #2 DEF Controller #1 Identification
7605	Aftertreatment #2 DEF Controller #2 Identification
7606	Aftertreatment DEF Tank Volume
7607	Aftertreatment DEF Tank Temperature
7720	Engine Common Rail Oil Pressure
7721	Engine Common Rail Oil Absolute Pressure
7782	Engine Protection due to Turbocharger Overspeed
7840	Engine Speed Governor Mode
523527	ECU CPU
523535	Engine Injector Charge Voltage
523536	EGR Response

523537	EGR Motor Temperature Sensor
523547	CAN Data Link
523548	CAN Data Link
523572	EGR Position Sensor
523574	EGR Actuator Coil Low Side Driver
523575	EGR Actuator
523576	EGR Actuator Temperature
523577	EGR Actuator Temperature Sensor
523578	EGR Actuator Data Link
523589	Engine Coolant Temperature During Stationary Regeneration
523590	Stationary Regeneration Duration
523601	Exhaust Gas Temperature
523602	Aftertreatment Regeneration Frequency
523603	Engine Coolant Temperature
523604	CAN Data Link
523700	EEPROM Checksum

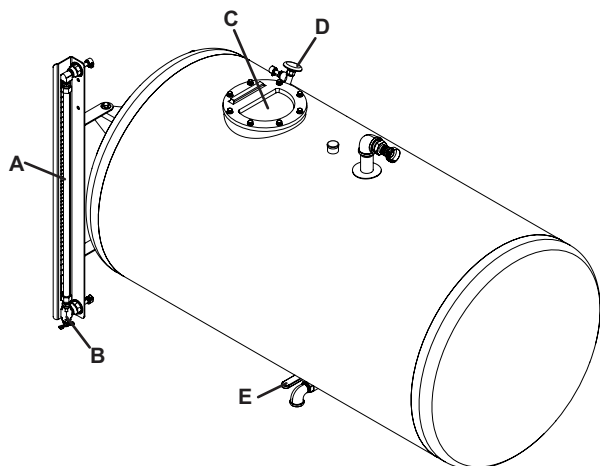
HP Water System

- A. HP Spray Wand
- B. Water Hose
- C. HP Water Pump Assembly
- D. Water Tank Assembly
- E. Water Tank Drain Valve
- F. Water Pump Fill Valve (under tank)
- G. Filter



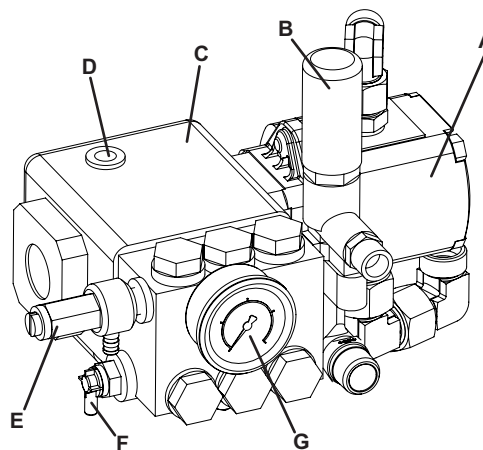
Water Tank Assembly

- A. Water Level Gauge
- B. Water Level Gauge Drain
- C. Flapper Valve
- D. Water Level Gauge - Shut-Off Valve
- E. Water Tank Drain Valve



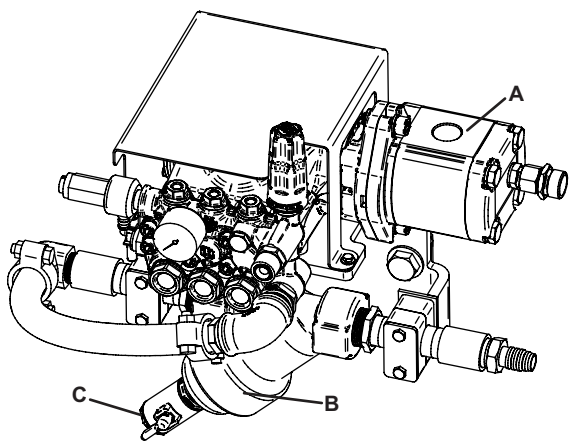
HP Water Pump Assembly

- A. Gear Pump
- B. Pressure Relief Valve
- C. Pump
- D. Gear Oil Plug
- E. Safety Valve
- F. Thermal Safety Valve
- G. Pressure Gauge



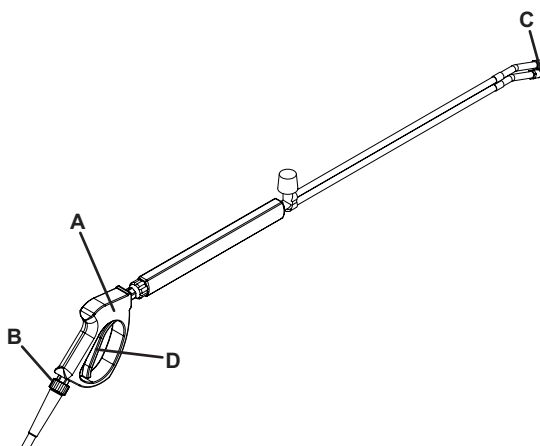
HP Water Pump / Filter

- A. Gear Pump
- B. Filter
- C. Filter Drain



HP Spray Wand

- A. Spray Wand Handle
- B. Hose Connection
- C. HP Nozzle
- D. Trigger



High-Pressure Cleaning System (HPCS)

Operational Warnings

In the event of a malfunction:

- Release the spray wand trigger immediately.
- Press the ACC1 button on the radio or pendant remote to stop the high-pressure pump.
- Release remaining pressure in the spray wand by squeezing the trigger.

Severe injury may be caused by systems under pressure

WARNING

If a malfunction occurs, high-pressure hydraulic oil and steam can escape from the overpressure pump valves, resulting in severe injuries.

Clear the area of personnel before operating the high-pressure washer.

In case of emergency, press the E-stop button on the machine.

All protective covers must be attached and in good working condition.

Risk of severe injury due to high-pressure water jet

WARNING

The high-pressure water jet can cause severe injuries.

Never leave the spray gun of the HPCS unattended while under operating pressure.

Never work with the high-pressure cleaning system from a ladder. Always provide sufficient stability.

- Always hold the spray wand with both hands and consider the recoil of the HPCS.
- Never work in the danger zones of vehicles, machines, job sites, etc.
- Never direct the spray wand at people, animals, or fragile/loose material.
- Stop operation if people or animals are approaching the area.

- The water jet of the HPCS can damage hydraulic hoses, lubrication points, and other machine components.
- Only use the HPCS to clean machine components that are exposed to concrete.
- Prevent the system from being switched on unintentionally or without proper authorization by closing and locking the covers over the control devices on the machine.
- Do not twist, tear or bend high-pressure hoses; the smallest damage to the hose can result in serious accidents.

Repairs may only be carried out by authorized personnel. Unauthorized opening of the pump voids the warranty. Only use original spare parts.

Altering the factory-set pressure relief limit is strictly prohibited.

Danger to life due to voltage transfer

DANGER

Electrical components may not come into contact with water. This may result in danger to life due to voltage transfer.

Do not point the high-pressure washer directly at electronics or electrical components.

Danger to life from inhalation or ingestion of dangerous substances

DANGER

Do not clean any material containing dangerous substances (abestos, lead, etc.).

Do not use chemicals, detergents, or hot water as spraying agent.

May be fatal if swallowed or inhaled.

Overview

The hydraulically powered high-pressure pump (HP pump) is installed on the front of the machine, next to the water tank.

Opening the water pump supply valve (Figure 11) provides water to the high-pressure pump from the water tank. **Water MUST be supplied to the high-pressure pump BEFORE starting.**

Pressing the ACC1 button on the radio or pendant remote (Figure 11) switches a directional valve, sending oil to the hydraulic motor of the high-pressure pump. The high pressure pump will start immediately.

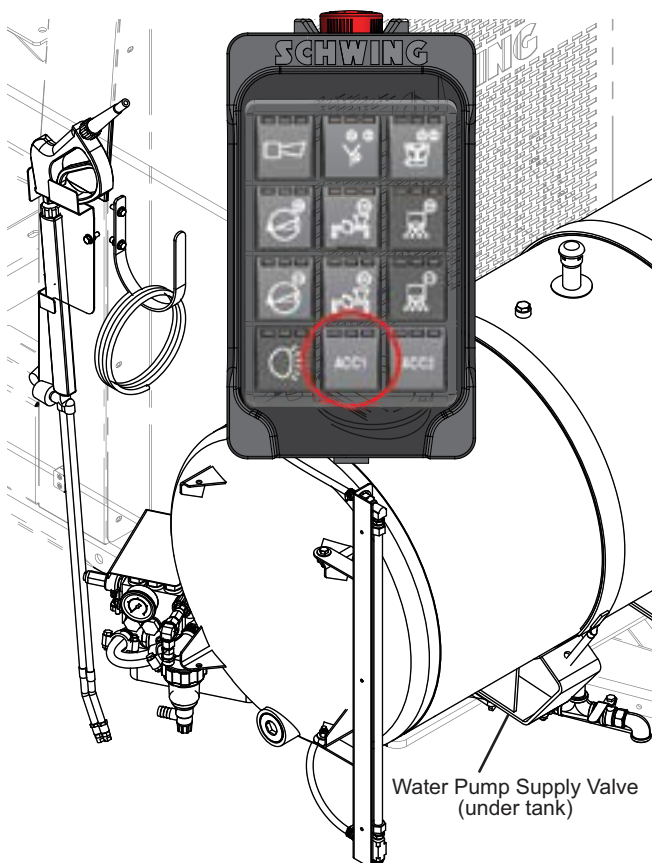


Figure 11
ACC1 Button and Water Pump Supply Valve

NOTE

Any damages caused by incorrect operation, maintenance or repair will void your warranty.

This also applies to using non-SCHWING replacement parts, as well as other changes to the machine that were not approved by SCHWING.

Water Supply

The high-pressure pump draws in water from the water tank. Only use clean water to fill the water tank. Dirty water quickly wears down the water pump and clogs the water filter, causing damage to the HP pump.

Operation (Start-Up)

- Check the water level in the water tank; the HP pump will not start if there is not enough water in the tank.

Note: *There is a water level sensor installed in the water tank. The HP pump will not start if the sensor reads low water levels.*

- Clean the water filter insert.
- Check the suction line of the water tank to the HP pump for leaks. Air leaks can cause damage to the high-pressure pump.
- Always vent the system before the device is started (See "Venting" on page 73).

Material damage caused by air in the system

NOTE

Vent the system on the water side before start-up. Otherwise damage to the high-pressure pump can occur, which is not covered by the manufacturer warranty.

- Open the suction line of the high-pressure pump to the water tank by opening the water pump supply valve, located under the water tank (Figure 11).

Rolling/Unrolling the HP Hose

Personal injury due to defective high-pressure hoses

WARNING Pulling on the spray gun detaches it from the high-pressure hose. Pressure may cause the spray gun to detach from the hose like a projectile and cause injuries.

Do not pull on the spray gun when unrolling or rolling up, but only the high-pressure hose.

- Switch off the HPCS, by pressing the ACC1 button.
- Use caution when unrolling the hose from the holder. Do not pull on the spray wand until the hose is out of the holder.
- Clean the high-pressure hose from the outside before rolling it up.
- Guide the hose by hand while it's being rolled onto the hose holder.
- Ensure that the high-pressure hose is rolled up evenly.

Venting

- Reduce engine speed to idle.
- Hold the spray wand tightly and direct the spraying nozzle so the water can flow out freely.
- Actuate the trigger of the gun until water no longer escapes from the spraying nozzle.
- Switch on the HP pump using the ACC1 button on the radio or pendant remote (Figure 12). The pump starts to work by drawing in water from the water tank and pumping it to the spray gun. If the trigger is not actuated, the HP pump cannot pump water to the spray wand.
- Switch off the HPCS in the event of malfunctions.
- If necessary, reference "HP Pump Troubleshooting Table" on page 89. Only start cleaning if the HPCS is functioning properly.

Cleaning

- Begin the cleaning work by pressing the spray wand trigger.
- Always pay attention for leaks on your machine.
- Stop work immediately if leaks occur and carry out troubleshooting according to the "High-Pressure Pump Troubleshooting" on page 77.

The speed of the machine's engine affects the water pressure.

- Increase the drive speed of the engine only so far that an increase in the water pressure is still detectable.
- If an increase in the water pressure is detected, slightly reduce the speed of your engine.
- Ensure that the automatic operation is working properly by squeezing and releasing the spray wand trigger several times (Figure 12).

If the trigger is not actuated, the HP pump may not pump water to the spray wand.

Shut-Down

- Release the spray wand trigger.
- Turn off the HP pump by pressing the ACC1 button on the radio or pendant remote (Figure 12).
- Actuate spray wand trigger again until water stops flowing.



Figure 12
Spray Wand Trigger and ACC1 Button

Operating Faults

WARNING If a malfunction occurs, high-pressure hydraulic oil and steam can escape from the overpressure pump valves, resulting in severe injuries.

Clear the area of personnel before operating the high-pressure washer.

In case of emergency, press the E-stop button on the machine.

The diffuser in the thermal safety valve on the “water side” (Figure 13) can be rotated.

- Ensure that the opening is aligned so that any vented steam cannot injure persons or damage the machine

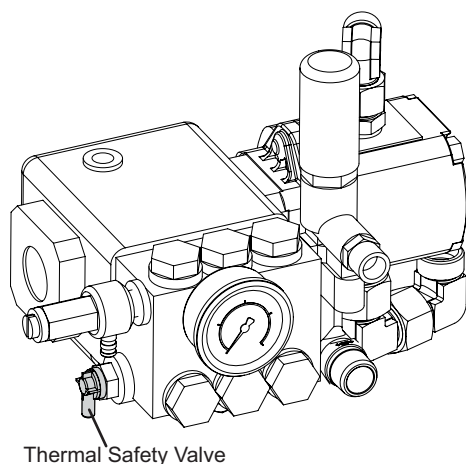


Figure 13
Thermal Safety Valve

Winter Operation (Below 5°C)

Only switch on a system that is free of ice

This can be achieved by carefully draining the system after the last use (see “Draining the System” procedure in the next column).

- Run the HP system without pressure for approximately one minute before starting cleaning work.
- Set a low drive speed.

Material damage due to frost

NOTE Switching on a frozen HPCS system can result in severe material damage. Never operate the HP pump in high-pressure mode if the oil is cold.

Never begin operating the high-pressure pump if parts of the pump are still frozen.

Do not attempt to thaw the high-pressure pump in a different manner (e.g. with a blowtorch).

Allow the pump to warm up by letting it idle for approximately 1 minute.

Draining the System

In order to avoid freezing, the system must be carefully drained after every operation.

- Close the water pump supply valve (Figure 1) and open the filter drain (Figure 14).
- Disconnect the spray wand hose from the pump and manually drain.
- Open water tank drain.

Material damage due to “running dry”

NOTE The high-pressure pump will be destroyed if it is switched on while the suction pipe is closed!

Do not under any circumstances operate the pump without water!

- Before restarting the HPCS, fill water tank, close the filter drain, and open the water pump supply valve (Figure 11).

Maintenance and Inspections

Cleaning the Suction Filter

Check the suction filter before starting, and clean it, if necessary. Set cleaning intervals according to the operating conditions.

Clean the filter as follows:

- Close the water pump supply valve (Figure 11).
- Loosen the filter bowl (Figure 14) by hand.
- Remove the screen from the housing of the suction filter.
- Rinse the screen and housing of the suction filter under running water. Do not use any cleaning agents or objects.
- Replace heavily soiled or damaged screens.
- Do not operate the HP pump without a sieve element.
- Check and replace the O-rings, if necessary.

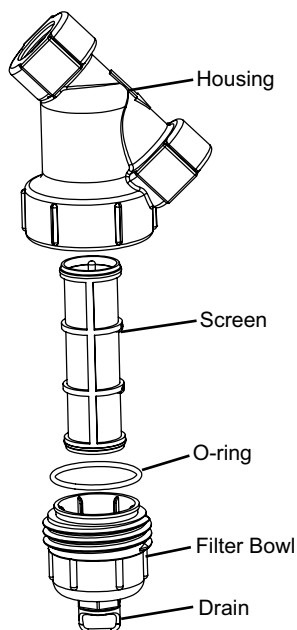


Figure 14
HP Filter Assembly

Functional Testing

Under normal operating conditions, the water pressure is at approximately 170 bar (2500 psi). The highest value is thereby reached when the spray wand is closed.

When the spray wand trigger is squeezed, water is again pumped and the pressure decreases. Regularly check that the pump switches off when the trigger is closed.

Changing the Oil in the Pump

Before changing the oil, read and follow the instructions of the manufacturer (Interpump Group S.p.A.).

In particular, the required torque for the oil drain screw.

The oil must be at operating temperature for the oil change.

- Place a reservoir under the oil drain screw that can hold all of the old oil.
- Remove the dipstick from the lock (Figure 15).
- Remove the oil drain screw (Figure 15).
- Let all of the old oil drain out.
- Screw on the oil drain screw with a torque of 15 ft-lbs once all of the old oil has drained out.
- Pour in the fresh oil through the lock (Figure 15).
- Fill the fresh oil up to the middle line of the oil level indicator (Figure 15).
- Reinsert the dipstick into the lock once you have finished topping off the oil.

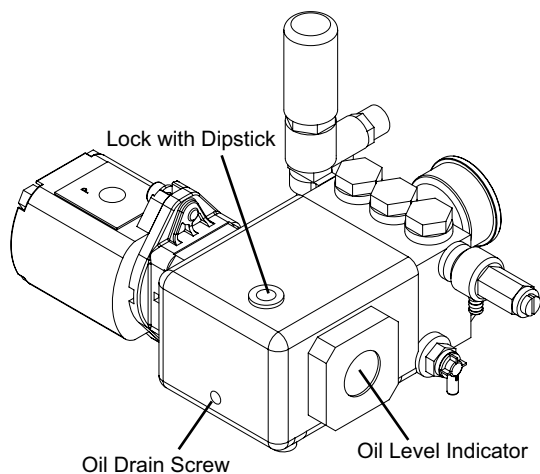


Figure 15
HP Water Pump

Recommended Oil Type for the Pump

The manufacturer recommends the following oil for a temperature range between 15°F and 105°F:

SAE 15 W-40 Mineral — ISO VG100DIN 51524 – Interpump X 9.9

The manufacturer recommends the following oil for a temperature range between 32°F and 122°F:

SAE 80 W-910 - ISO VG220 DIN 51524

Environmental damage

NOTE

Old oil must be collected in containers and disposed of according to the local regulations.

Under no circumstances may it be disposed of in a way that is harmful to the environment.

Maintenance Intervals for the Pump

When:	What:
After the first 50 hours	Oil change
Every 500 hours	Oil change
Every 100 hours	Inspection/replacement: valve set, pump seals

Prolonged Downtime

For prolonged periods of inactivity, SCHWING recommends filling the high-pressure pump with antifreeze (glycol) or a pump preservation oil on the water side.

Repair

In the event of a fault, try to find the error with the aid of the “HP Pump Troubleshooting Table” on page 92.

Do not dismantle the high-pressure pump

WARNING

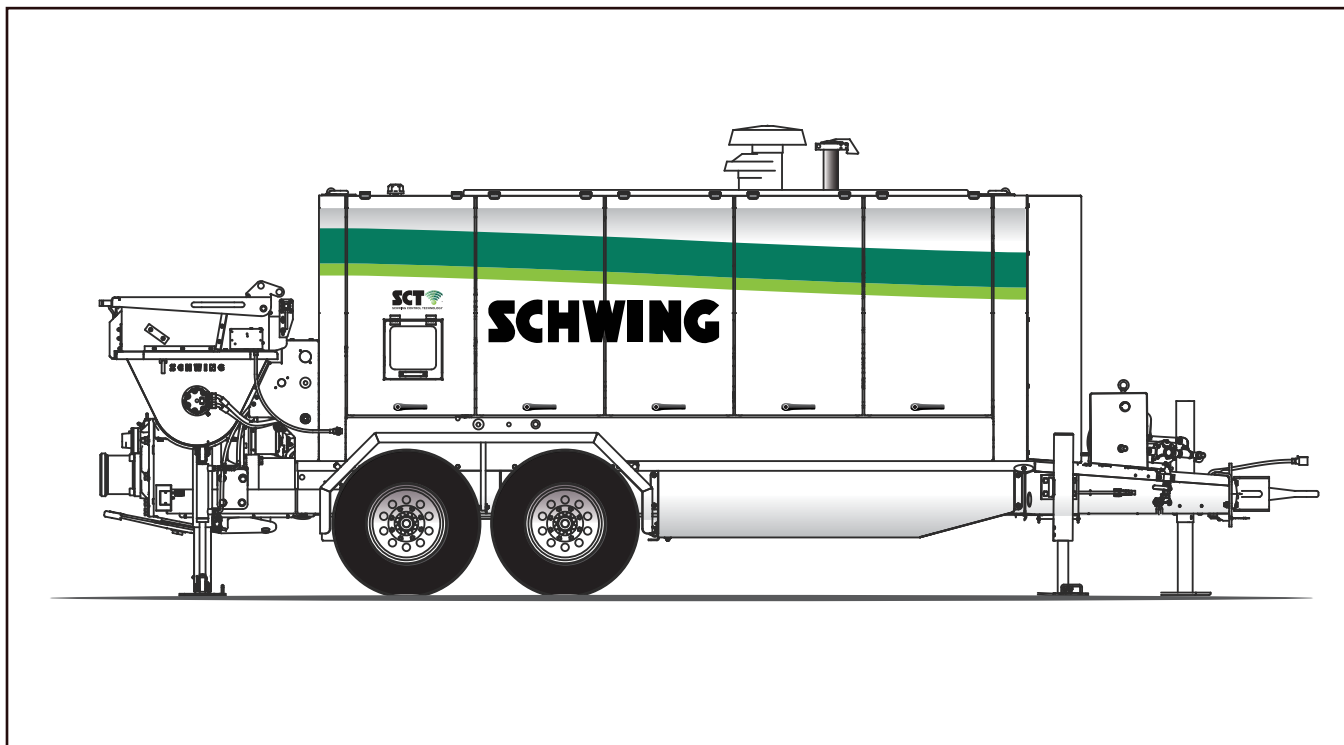
Improperly assembled high-pressure pumps can cause severe injuries on failure.

If you cannot remedy a fault, please contact the SCHWING Service Center or send the high-pressure pump to the manufacturer for repairs.

High-Pressure Pump Troubleshooting

High-Pressure Pump Does Not Run:	
Water tank empty	Fill water tank
Switching error	Switch hydraulic directional valve Acknowledge electrical control
Spray Pressure Fluctuates:	
Insufficient water supply	Ball valve in the water suction line not switched properly Clean suction filter Relay the suction line without kinks
Air is sucked in	Check the hydraulic system for leaks
Spraying nozzle blocked	Clean
High-Pressure Pump Shuts Down During Spraying Operations:	
Spraying nozzle blocked or too small	Clean nozzle or use proper nozzle
High-Pressure Pump Does Not Shut Down When The Gun Is Closed Or Switches On By Itself:	
Water leak in the high-pressure line	Check O-rings, couplings, and connections
High-Pressure Pump Or Hydraulic System Becomes Too Hot:	
Cross-sectional narrowing in the hydraulic system	Check pipe work

High-Pressure Pump Runs, But Does Not Build Up Any Pressure:	
Pump sucks in air	Switch ball valve in the water suction line
Oil flow insufficient	Increase the drive speed
Drive hydraulics defective	Switch ball valve and check other functions (water pump)
Pump Makes Noises	
Pump sucks in air	Check water suction line
Cavitation	Suction line interior destroyed Suction filter dirty
Water Leaking Between Pump Head And Piston Housing	
O-ring defective	Repair (contact SHWING Service Center)
Oil Sprays From The Safety Valve	
Dynamic pressure too high in the return pipe	Check hydraulic system



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Preparing for the Job

Personal Protective Equipment (PPE)

Waterproof gloves and steel-toed work boots will help prevent burn and damage to the skin caused by the lime in the concrete. There are boots made specifically for concrete work that protect your feet from lime and accidental impact.

Hard hats protect from falling objects on the job site.

Safety goggles prevent splashed concrete from getting in the eyes. Whenever there is danger of ricocheted rocks or sand (when shotcreting, for example), wear a full face shield.

Safety vests make make more visible to others while on the jobsite preventing possible accidents.

Snug-fitting work clothes help prevent accidents involving moving parts.

Hearing protection is recommended when on or near an operating concrete pump. Concrete pumps may generate higher sound pressure levels than O.S.H.A. allows for constant exposure.

Breathing protection will prevent inhalation of dangerous contaminants when mixing grout or any time there is airborne cement or other fine powder nearby.



Figure 1
Personal Protective Equipment

Pipeline and Clamps

Determine what kind of concrete you will be pumping. Use a pipe and/or hose system that is three to four times larger than the biggest rock in the mix. Use the chart below to select the correct pipe diameter for the job.

Largest Stone Size	Minimum Pipe/Hose Diameter
3/8 inch (peagravel)	1 1/2 inches
1/2 inch	2 inches
3/4 inch	3 inches
1 inch	4 inches
1 1/4 inch	5 inches
1 1/2 inch	5 inches

Are extra pipe sections needed to make the pour?

Use the following checklist for pipeline needs:

- Pipe sections
- Adapter pipes
- End hoses
- Reducers
- Clamps for all pipe end styles and sizes
- Clamp pins

Have all pipe and pipe accessories inspected for condition, loaded, and secured for travel before moving the unit. Keep in mind the pressure rating of the unit when inspecting the condition of pipe accessories; refer to the chart regarding pipe-wall thickness versus pressure provided in the Appendix.

Tools and Accessories

These are common tools and accessories used for concrete pumping:

- Shovel
- Bucket/barrel for mixing slurry
- Pipeline lubrication mixes
- Grease gun and grease tubes
- Spray can filled with form oil
- Clean out balls
- Water hose and nozzle
- Clean out rake
- Working lamps for night work
- Approved air blow-out cap
- Hand tools
- Hammer

Tow Vehicle

It is recommended to carry the following items in the vehicle towing the stationary pump:

- Valid driver's license
- Fuel permit
- Vehicle registration information
- Insurance card
- First aid kit
- Flares
- Reflector signs
- Fire extinguisher
- Maps
- Job ticket
- Job site contact information

Check with your local Department of Transportation for any other requirements.

Tow Vehicle Pre-check

- Check truck engine oil level and condition.
- Check antifreeze/coolant level in the radiator.
- Check battery fluid level and condition.
- Check tire condition and air pressure.
- Check brake system air pressure.
- Clean the windows/mirrors of ice, frost, mud, etc.
- Remove any debris from the cab, especially the floor. Accidents can happen when foreign objects are stuck between the clutch or brake pedal and the fire wall.

Stationary Pump Pre-check

- Check diesel fuel level. (Fill with ultra-low sulfur diesel only.)
- Check DEF tank fluid level (if applicable).
- Verify diesel engine oil level.
- Radiator coolant level should be full.
- Check battery and battery cable connections.
- Check condition of belts and hoses.
- Verify all safety guards are in place.
- Grease agitator bearings and rock shaft.
- Clean any dirt or debris from engine air intake.
- Check tire condition and air pressure.

DEF Tank

A small DEF tank, mounted on the front subframe, must be refilled regularly, typically at every diesel fuel refill interval. You can use any brand DEF fluid that meets ISO 22241-1. DEF cleanliness is extremely important as contaminants can degrade the life of DEF and SCR system components. Clean the fill area prior to refilling, and use a clean filling spout.

Structural Integrity of the Stationary Pump

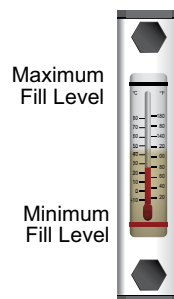
Give the unit a visual inspection. Look for cracks, chipped paint, rust (especially rust under the paint), and missing parts. Clean and repaint areas that have chipped paint to avoid damage to structural steel. Replace missing parts before using the unit. Report any structural abnormalities to the SCHWING Service Center before using the unit. If SCHWING determines that repair is necessary for safe operation, **do not operate the unit until repairs are complete.**

Hydraulic Oil Level and Condition

The oil should be clear and clean looking. "Milky" looking oil, or oil with a lot of air bubbles, should be changed right away.

NOTE

Oil that holds air bubbles overnight should be replaced. Air bubbles in the oil during operation do not indicate an oil issue but instead indicate a problem with the integrity of the hydraulic seals somewhere in the system.



Top off oil levels ONLY with the same type of oil that is in the reservoir. Do not mix name brands, even if they have the same viscosity. Each oil manufacturer uses different additive packages to accomplish anti-foaming, silt settling, anti-wear, etc. The mixing of these different chemical additive packages may render them useless.

Drain water from the hydraulic reservoir each morning. Open the drain valve at the bottom of the reservoir (Figure 2), and when the liquid changes from water to clean oil close the valve. Always use a drain pan or bucket to capture the drained liquid. Because of condensation, which increases with drastic heating-cooling cycles, there may be a small amount of water in the tank every day. However, it should settle to the bottom of the tank overnight. The water that is drained should be clean and so should the oil that follows it.

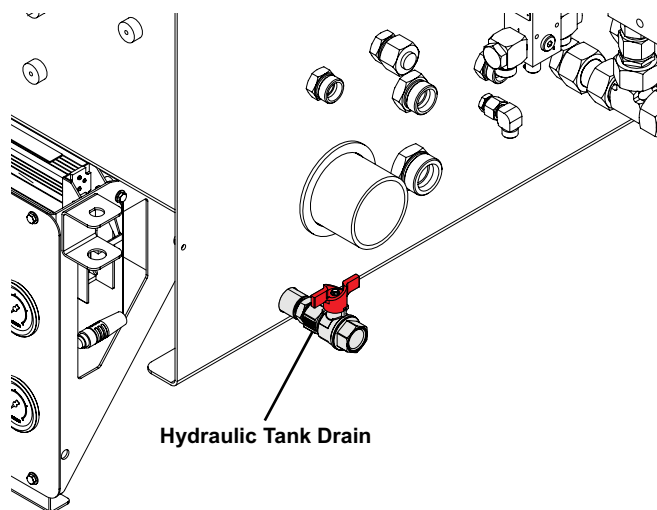


Figure 2
Hydraulic Tank Drain

Visually check the unit for hydraulic leaks. Repair any leaks, and replace the lost oil before operating the machine. Lost hydraulic oil harms the environment and is also expensive to clean up.

Ensure that everything on the unit is ready for road travel. This includes securing all accessories and miscellaneous equipment.

WARNING Don't overload the stationary pump by using it as a cargo trailer. The chassis was designed to carry only the weight of the trailer. Never travel with concrete in the hopper.

Attaching the Tow Hitch

Use the following steps to hook the stationary pump to the towing vehicle:

1. With the attached jack, raise your stationary pump pintle hitch high enough to clear the receiver mount on the tow vehicle.
2. Open the receiver mount latch by removing the safety pin and lifting lock (Figure 3).

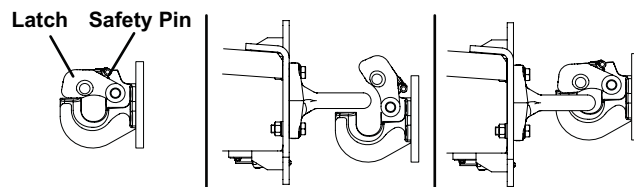


Figure 3
Receiver Mount

3. Line up the center of your vehicle with the center of your stationary pump. Stop the vehicle once the pintle hitch is over the receiver mount.
4. Lower the pintle hitch onto the receiver mount until the full weight of the stationary pump is on the mount. The stationary pump must be level with the tow vehicle (Figure 4).

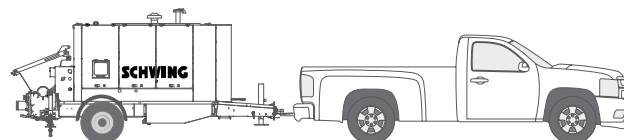


Figure 4
Stationary Pump Level with Tow Vehicle

NOTE Under normal use, wear may occur on the bottom of the pintle eye. To keep this wear to a minimum, periodically apply a little grease under the eye.

5. Close latch and re-insert safety pin.
6. Raise the front jack all the way up.
7. Run the safety chains under the tongue so they cross one another. This keeps the trailer tongue from hitting the ground if it accidentally comes loose from the hitch while moving.

8. Plug in the electrical connections for the trailer brake lights, and hook up the breakaway switch cable (Figure 5).

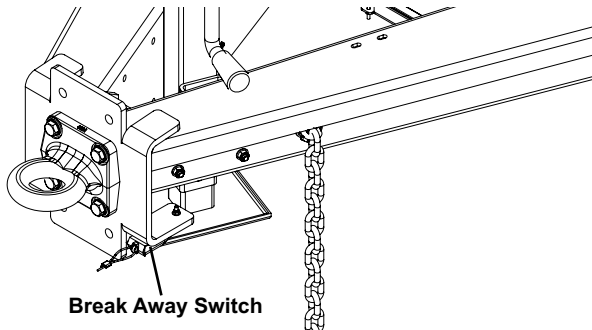


Figure 5
Break Away Switch

9. Check to make sure the pintle hitch and receiver mount are firmly attached.
10. Pull the tow vehicle forward a few feet.
11. Stop the vehicle, place it in park, set the emergency brake, and turn on the vehicle lights.
12. Check and make sure the lights and the stoplights are working on the stationary pump and nothing has worked loose at the hitch.

Towing the Stationary Pump

Before towing the stationary pump, become familiar with driving the vehicle-stationary pump combination. A good way to get used to maneuvering, including some practice backups, is to drive in an open parking lot or at least a familiar area. Backing up can be especially difficult. While backing up, try turning in the opposite direction; if the stationary pump needs to go right, turn the wheel left.

The most difficult part of driving with a stationary pump is making turns. While it does not seem like there might be a need for it, drivers pulling stationary pumps must overshoot their turns, taking them wide enough so that the stationary pump's path does not put it off the road or in contact with telephone poles or other street-side obstacles (Figure 6). Cutting a corner with a stationary pump will put the stationary pump, as well as pedestrians, other drivers, and yourself in danger of a collision.

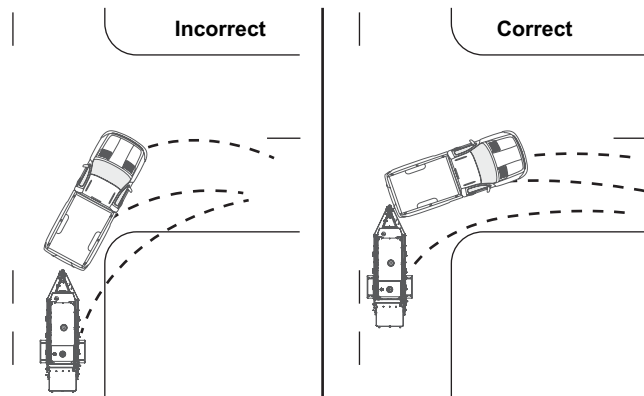


Figure 6
Use Caution While Making Turns

If you start a corner too tight and get into trouble, stay calm and stop. Make sure the roadway behind you is clear, back up a little bit, and take the turn again wider.

Remember that the larger the load, the longer it will take you to stop. Keep an extra safe distance behind cars in front of you, and test the stopping power of your vehicle and stationary pump before you have to stop suddenly.

Another important thing to avoid when pulling a stationary pump is "jackknifing." Named for the position of the vehicle and stationary pump, this is most common when backing up with a stationary pump. It is basically a situation where the angle between the vehicle and the stationary pump it is pulling is less than 90 degrees, or beyond an L shape to a V shape.

Avoid this by never letting the stationary pump position get beyond the L shape. When reversing with a stationary pump, just take it slow and get a feel for the stationary pump. Keep your movement of the steering wheel to a minimum, and remember, you can pull forward to straighten out. Jackknifing will damage the hitch and stationary pump.

Make sure you are within your vehicle's towing capacity. SCHWING stationary pumps have a braking mechanism that helps slow the stationary pump along with the vehicle.

Machine Loading/Unloading

Lifting with a Crane

When lifting the stationary pump with a crane, use suitable slings and only attach them to the machines lifting eyes.

⚠ DANGER Do NOT exceed load capacity of lifting eyes due to additional weight of accessories and left over pumping material. Determine weight of loads before lifting.

When lifting, determine the center of gravity of the stationary pump by lifting carefully. All cables or chains on the lifting gear must be tensioned evenly, and the stationary pump must be raised evenly at all support points.

Chain lengths that are too short lead to serious strain on the subframe; the individual chain lengths must be a minimum of 8 feet.

Reference ASME B30 for more information on safe lifting practices.

Lifting with a Forklift

Skid-mounted stationary pumps can be lifted with a forklift using the installed lifting channels.

Reference ASME B56 for more information on safety standards for rough terrain forklift trucks.

Loading on a Flatbed Trailer

To safely load a trailer, consider overall load weight, load weight distribution, and how to secure the load properly.

The gross machine weight is shown on the Main ID tag (Figure 1, page 12). The weight does not include added accessories or left over pumping material.

Load the cargo onto the trailer with approximately 60% of the cargo in the front half of the trailer. Secure the stationary pump to the trailer using appropriate straps, chains and tensioning devices. The stationary pump has brackets on all four corners to attach tie down straps.

⚠ WARNING Shifting cargo can result in loss of control of the trailer, and can lead to death or serious injury.

Unit Setup

Selecting the Setup Location

When arriving on the job, check with the job supervisor to determine where to set up. If possible, choose a flat, firm, and dry location that allows hopper access for two ready-mix trucks. Safe setup areas will have the following features:

- Free of building materials or scrap that would prevent the machine's outriggers from contacting the ground directly.
- Any hidden voids and excavations (septic tanks, backfilled areas, sprinkler installations, etc.) are clearly marked so the operator can place the outriggers on solid ground.
- Far enough from excavations and other holes that the outrigger legs can maintain a one-to-one ratio back from the base edge (Figure 7) or as recommended by the machine manufacturer.
- Proper distance from any area that may contain falling debris.
- Adequate lighting.
- Adequate access in and out of the setup area.

One-to-One Rule

For every 1 foot of vertical drop, stay back from the base edge 1 foot. (Distance "B" must be equal to or greater than distance "A.")

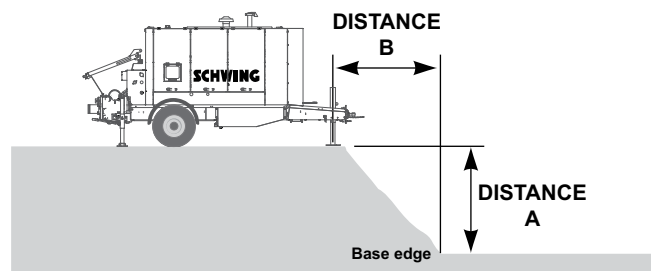


Figure 7
One-to-One Rule

Calculating the Outrigger Load

After an appropriate set up location is identified, provide a stable base for the outriggers. If the chosen site does not have stable soil conditions, select a different site. Under no circumstances should the stability of the unit be compromised by placing it on unstable soil.

The following chart can be used as a guideline to help determine the load-bearing capacity of various soil types. If the type of soil on the job site is unknown, ask the site manager.

Soil Type	PSI
Virgin ground	22
Asphalt	29
Compressed, crushed stone	36
Clay/silt soil, firm	43
Mixed granular soil	51
Firm, compacted gravel	58
Firm, compacted gravel (more compacted)	72
Firm, compacted gravel (class V)	109
Brittle, weathered rock	145

To determine the load the outriggers will impose on the soil, divide the total force of the outrigger (located on a decal on the outrigger leg) by the number of square inches of soil contact:

Soil pressure (psi) = total outrigger force (lb) ÷ area of soil contact (sq in)

$$\frac{\text{total outrigger force (lb)}}{\text{area of soil contact (sq in)}} = \text{Soil pressure (psi)}$$



Figure 8
Outrigger Load Decal

Extending the Outriggers

Use the following steps to enable the hydraulic outriggers:

1. Select a proper setup area (see “Unit Setup” on page 85).
2. Start the machine (see “Starting the Machine” on page 89).
3. Place proper cribbing below the outrigger feet.
4. Push the agitator button: once on, this will enable the hydraulic outrigger circuit.
5. Open the needle valve.
6. Move the outrigger hand valve towards the hopper (rear of machine) to lower the outrigger cylinder.
7. Move the outrigger valve handle towards the front of machine to raise the outrigger cylinder.
8. Close the needle valve to prevent outrigger drift.

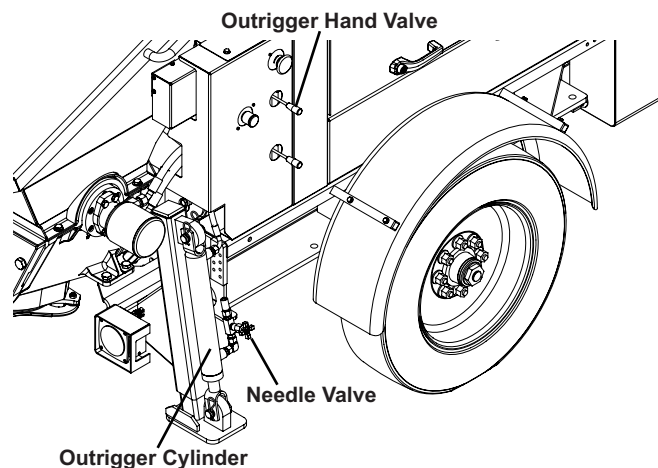


Figure 9
Hydraulic Outrigger Components

NOTE

Manual outriggers are a optional feature. If your unit is equipped with manual outriggers, refer to the “Manual Outriggers” instructions on page 108.

Laying Out the Pipeline

Begin at the point of discharge, and work back towards the pump. In most cases a rubber hose is needed at the point of discharge.

Placing crews always prefer 3-inch or 4-inch rubber hose over 5-inch hose. Use a reducer at the discharge end.

Reduce to a smaller diameter as close as possible to the point of discharge, keeping the long part of the run a larger diameter.

Use the fewest hoses possible; hose has greater resistance to flow than pipe does, so more pressure is needed to push through hose than through pipe.

Use the largest-diameter hose allowable. The diameter of the hose determines the largest-size stone the machine can pump. If pumping stone larger than 1 inch in diameter, do not use hose that is 3 inches or smaller; this would result in a blockage.

Do not use hose to change pipeline direction. Pipe elbows are available with many degrees of bend, and pipes require less pumping pressure than hose.

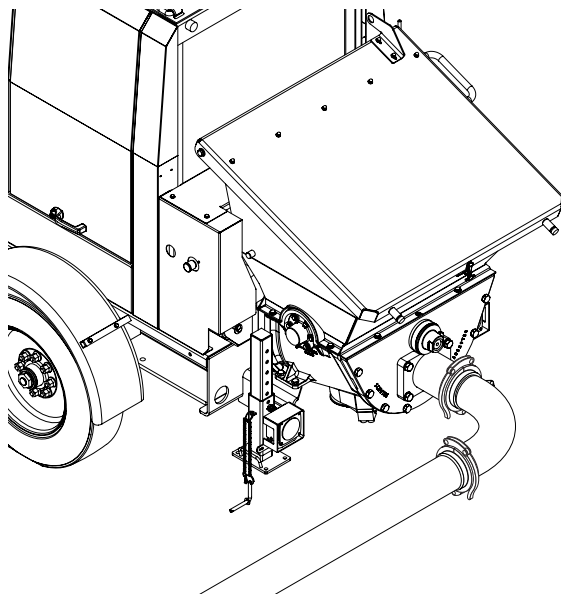


Figure 10
Laying Pipeline

Pumping Preparation

If setup is complete before the first ready-mix truck arrives on the job, use this time to get some things ready for the day.

- Find out who will be giving you signals throughout the day. To avoid confusion, only one person should give you signals. Make sure both of you understand what signals should be used. The American Concrete Pumping Association (ACPA) has standardized hand signals for concrete pumping.

INSTRUCCIONES DE SEGURIDAD				SAFETY INSTRUCTIONS			
 Recommended hand signals Señales de mano recomendadas				 (2 golpes) (2 taps)			
1. START PUMP SPEED UP	2. SLOW PUMP DOWN	3. STOP PUMP	4. LITTLE BIT	5. RELIEVE PRESSURE	6. ADD WATER 4-GALLONS	7. ALL DONE CLEAN UP	
1. PRENDER LA BOMBA ACELERAR	2. BAJAR VELOCIDAD A LA BOMBA	3. PARAR LA BOMBA	4. UN POCO	5. ALIVIA LA PRESIÓN	6. AÑADIR AGUA 4-GALONES	7. TERMINADO LIMPIAR	
8. BOOM UP	9. BOOM DOWN	10. BOOM LEFT	11. BOOM RIGHT	12. OPEN OR EXTEND BOOM	13. CLOSE OR RETRACT BOOM	14. STOP BOOM	
8. PLUMA HACIA ARRIBA	9. PLUMA HACIA ABAJO	10. PLUMA A LA IZQUIERDA	11. PLUMA A LA DERECHA	12. ABRIR O EXTENDER LA PLUMA	13. CERRAR O RETRAER LA PLUMA	14. PARAR LA PLUMA	

- Talk to the placing crew foreman to make sure the placing crew is aware of the safety rules described in the Safety Manual and especially understand the importance of not kinking the tip hose.
- Review the safety rules with any laborers who have been assigned to work at the pump. Show them the concrete pump stop switch and E-stop buttons.
- If a laborer will be backing ready-mix trucks up to your hopper, emphasize the danger they are in when they place themselves between the pump and the ready-mix truck.
- Place your water hose where it will be out of the way but still handy for washing pipes and clamps and spraying down the hopper.
- When using the pendant remote, position the remote box and cable where they will be out of the way.

Filling the Waterbox

Remove the waterbox cover and fill the waterbox with water (Figure 11). **Do not remove the waterbox grate for this procedure. Place the water hose or nozzle in the access hole provided.**

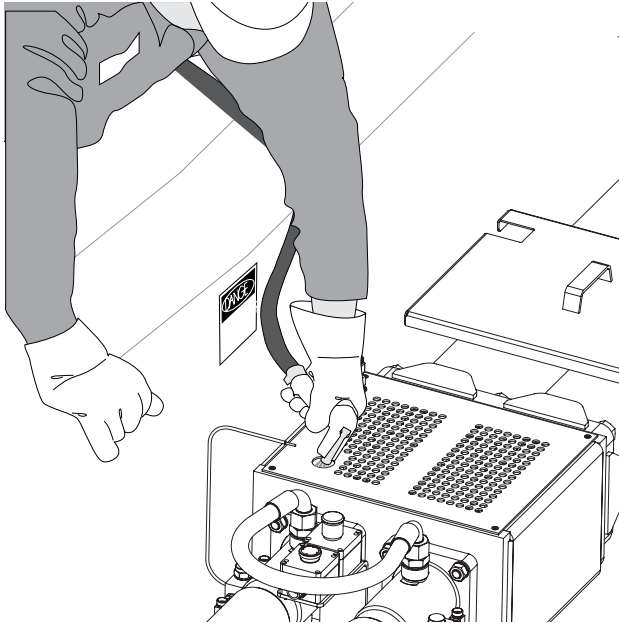


Figure 11
Filling the Waterbox

Greasing the Bearings and Rock Valve

Grease the agitator bearings. The grease zerks for the agitator are located on the manual greasing station (Figure 12). Do not pump in grease until it is visible around the agitator shaft. When greasing the agitator bearings, watch the rubber grease cones located inside the hopper; the cones should bulge slightly when they are full of grease. The grease shouldn't come out around the shaft because wherever grease comes out then concrete will be able to go in.

Once concrete gets inside the grease cone, the bearings will wear out quickly. When re-greasing after the hopper is full of concrete and the cones are no longer visible, give the zerks a couple of squirts. This is one of the few times when it is better to under-grease than to over-grease. Re-grease agitator bearings every 2 or 3 hours, as the pour allows.

1 ○	5 ○	1 Right Hand Inside Shift Cylinder
2 ○	6 ○	2 Left Hand Shift Cylinder
3 ○	7 ○	3 Right Hand Shift Cylinder
4 ○	8 ○	4 Right Hand Agitator
		5 Left Hand Inside Shift Cylinder
		6 Left Hand Side Agitator
		7 Front Rock Pivot
		8

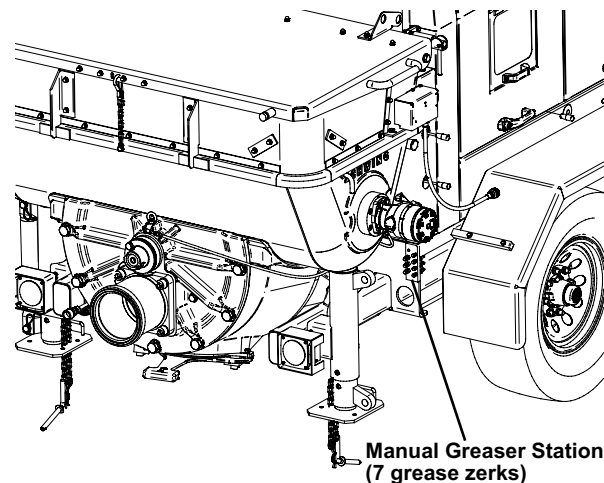


Figure 12
Manual Greaser Station

Grease the rock valve lubrication points before the pour begins. Once started, grease them every couple of hours. The rock valve has seven grease zerks, located on a central greasing block (Figure 12).

Starting the Machine

- Ensure all safety guards are in place.
- From the operator control panel, turn the ignition key switch to the RUN position. The SCT2 controller will initialize, and the SCHWING logo will appear on the screen. When the system has finished initializing, the Engine Status Screen will be displayed (Figure 13). Turn and hold the key switch in the START  position; when the engine starts, release. You can't start the engine until the SCT2 controller has initialized.

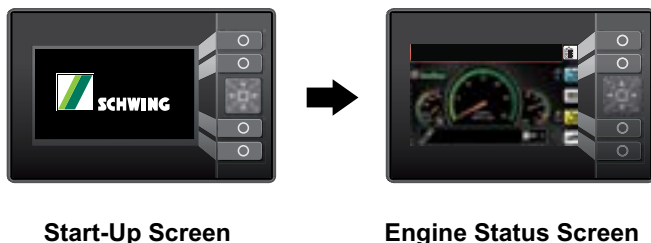


Figure 13
Start-Up and Engine Status Screens

- After starting, the engine may stay at a low speed for 1 to 25 seconds to allow engine systems to stabilize. The duration will depend on the ambient temperature, time since last run, and other factors.

NOTE

In ambient temperatures from 32°F to 104°F (0°C to 60°C) the warm-up time is approximately 3 minutes. In temperatures below 32°F (0°C) additional warm-up time may be required.

SCHWING does not recommend operating the machine in ambient temperatures above 104°F.

- With the engine properly warmed-up, press the horn button to clear all E-stop requests.
- Use the throttle up button to increase engine RPM. Press and hold this button until the engine is at maximum RPM.

Checking the Machine

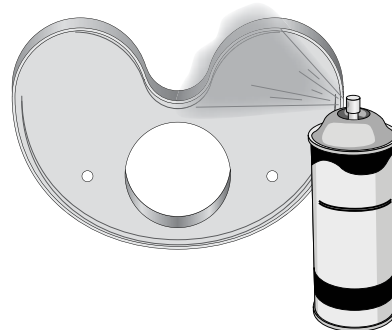
- Raise the hopper cover and secure with a locking pin.

WARNING Crushing hazard! Always secure the hopper cover with the locking pin.

- Clear E-stop requests by pressing the horn button on the remote. Press the agitator enable button. Place the agitator handvalve in either the forward or reverse position. Carefully lift the hopper grate cover. Ensure the agitator stops when lifted. If the agitator continues to move, shut down the machine and check the hopper grate switch.

WARNING Do not operator the machine if the hopper grate switch is malfunctioning.

- Check your hydraulic pressures. See "Check Hydraulic Pressure" procedure on page 137.
- Lubricate the outlet wear plate with water or WD40. Spray inside the outlet pipe and in front of the rock valve. DO NOT put your hand inside the outlet pipe; spray from the outside only. Never operate the rock valve without first lubricating the outlet wear plate. Moving the kidney seal against a dry plate will cause excessive wear and premature failure.



- Ensure proper airflow to the pump by keeping the area around the pump clear and by making sure any enclosures provide proper ventilation.
- Fill the waterbox if this hasn't been done already.
- With the outlet wear plate lubricated and the waterbox filled, stroke the machine a couple of times by placing the concrete pump in the forward position.
- If the machine is stroking properly, either shut down the machine (page 90) or begin pumping the job (page 97).

Shutting the Machine Down

NOTE

Stopping the engine immediately after the engine has been working under load can result in overheating and accelerated wear of engine components.

Avoid accelerating the engine prior to shutting down the engine.

Avoiding hot engine shutdowns will maximize turbocharger shaft bearing life.

To shut the machine down, place all functions in the neutral or OFF position. Reduce engine RPM to a low idle, and allow the engine to idle for 5 minutes in order to cool.

When the engine has cooled, turn the ignition keyswitch to the OFF position.

If your machine is equipped with DEF, after key-off the DEF pump will circulate the DEF fluid for a given time in order to cool the DEF injector. The DEF pump will also purge the DEF system of fluid to protect the lines from freezing in cold conditions. Disconnecting the battery power too soon may prevent purging of the DEF fluid lines; do not disconnect the battery until the indicator light has shut off (Figure 14).

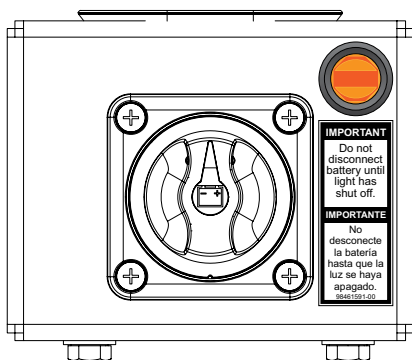


Figure 14
Battery Switch with Indicator Light

Lubricating Slurry

Shovel a couple loads of sand or dirt into the bottom of the rock valve housing, above the clean out door. This will prevent concrete from filling the door area and setting during the course of the day (Figure 15).

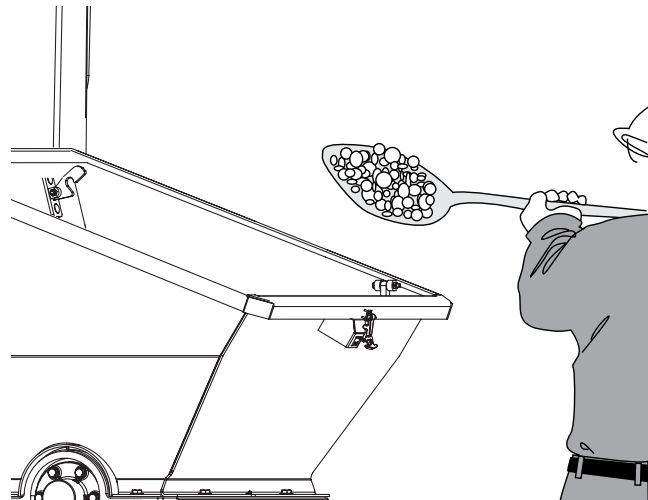


Figure 15
Sand to Cover Hopper Clean Out Door

Lubricating the Pipeline

When the ready-mix trucks arrive on the job, the pipeline can be lubricated. SCHWING strongly recommends lubricating the pipeline before pumping into dry pipe. In some parts of the United States and Canada the concrete is so rich with cement fines that operators do not lubricate before beginning pumping operations. This practice is not recommended. The time saved by not lubricating is far less than the time spent removing pipe sections to remove a rock jam caused by dry pipe. Most importantly, the blockages caused by failure to lubricate can be dangerous (see the information on blockages in the Safety Manual).

There are commercially available products that will lubricate a pipeline with much less volume (therefore much less weight) than portland cement and water. These products usually come in sandwich-sized plastic bags and lubricate about 100 feet of 5-inch pipe per bag. Instructions for mixing vary by manufacturer. These products are less expensive than portland cement and do not set like cement. If you use these products, pay close attention to the instructions and warnings on the package.

If only Portland cement is available for lubricating the weight requires extra consideration. Before mixing the slurry, put on all necessary personal protective equipment. Choose one of the methods shown below based on the job situation.

Barrel Method

If a helper is assigned to work at the pump, the slurry can be mixed in a barrel (Figure 16). The barrel method provides a good consistency and breaks up clumps of cement in the slurry. However, the barrel, which weighs 200 to 300 pounds, will need to be lifted to pour the slurry into the hopper. Do not attempt to lift the barrel alone.

To use this method, lay a sack of portland cement on top of a barrel that has been filled with approximately 25 gallons of water. Use a shovel blade to break open the sack, allowing the cement to fall into the barrel. When the bag is empty, set it off to the side and mix the cement and water with the shovel blade. Break up any cement clumps and continue mixing until the mixture is smooth and creamy. A helper is needed to lift the barrel and pour the mixture into the hopper (Figure 17). The mixture may not cover the openings to the material cylinders, but that is not important at the moment.



Figure 16
Mixing Slurry in Barrel

Make one barrel of slurry for each 100 feet of laid pipeline that the concrete will flow through. If the concrete will be going through more than 200 feet of pipe, arrange to have a grout mixture supplied by the ready-mix plant. Unless at least .5 yard of grout mixture is delivered to the pump, do not try to pump this mix yet. Using the barrel method, sand can be added to the slurry if needed. This is helpful if pumping through over 300 feet of line, but if only two sacks of portland cement are available.

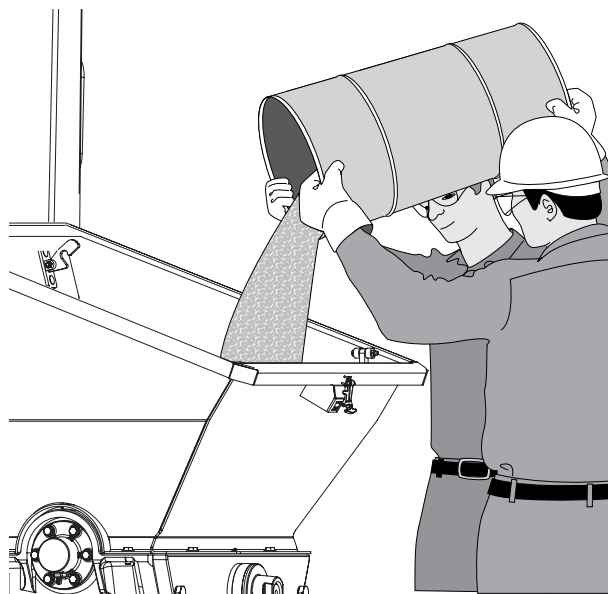


Figure 17
Pouring Slurry into Hopper

Hopper Method

If no helper is available to help lift the barrel, lay the sack of cement on the hopper grate and break it open.

WARNING Amputation/crushing hazard! Never stand on hopper grate.

Get a water hose and direct the spray into the hopper, aiming at the edge of the pile of cement. This will wash the cement into the bottom of the valve housing and will mix the cement as well. Try to break up clumps of cement with the spray, but do not put your hands or any other body part into the hopper. Mix more slurry as needed for the length of the pipeline, as described above.

Locate the operator control panel on the rear of the machine. The pump can be controlled with either the pendant or radio remote.

To use the pendant remote, place the Pendant/Radio switch to the Pendant position (Figure 18). Connect the pendant to the remote cable located just behind the operator control panel. Press the horn button to clear all E-stop requests. The machine can now be operated from the pendant remote.

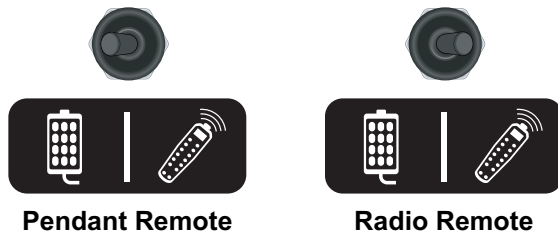


Figure 18
Pendant/Radio Remote Switch

To use the radio remote, place the Pendant/Radio switch to the Radio position. Press the power (green) button on the radio remote to turn it on. Press the horn button to clear all E-stop requests. The machine can now be operated from the radio remote.

To agitate the slurry mix:

- With the cement washed to the bottom of the hopper, press the concrete pump forward and then reverse buttons (Figure 19) to cycle the rock valve back and forth a few times. This will agitate the mix. Do not try to pump this mix until you can add concrete.
- Use the throttle up button (Figure 19) to increase the engine RPM to the specified maximum engine speed. Note: The ECU will not allow you to go above this limit.

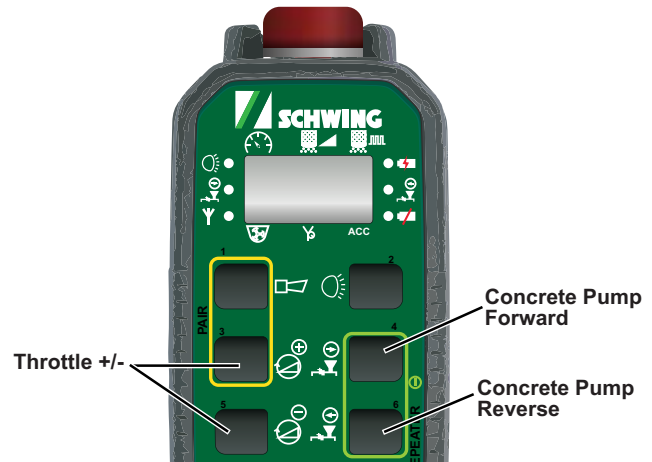
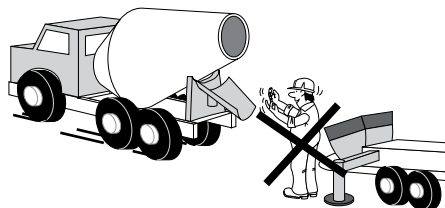


Figure 19
Concrete Pump Forward/Reverse and Throttle Buttons

- After the correct amount of slurry has been placed in the hopper, open the hopper lid and direct the first ready-mix truck to backup to the hopper. Do not stand between the ready mix truck and the concrete pump; you could be crushed between the machines.

WARNING Crushing hazard! Never allow anyone to stand between the concrete mixer truck and the pump.



- Look at the concrete before putting it into your hopper. If the mixing fins of the truck are badly worn, the rock, sand, cement, and water will not be properly mixed. Do not allow a chute full of gray rocks to be put into the hopper; this will plug the line before concrete can come out of the pipe. If the first chute full is all rock, have the driver dump it off to the side and show you the next chute full. The second chute full will almost always look much better than the first. If it does not, dump it to the side too. You will learn by experience what mixes can and cannot be pumped. When the mix looks good, place the pump in forward using the concrete pump forward button. Allow a couple of strokes to get some of the slurry into the pipeline ahead of the concrete. Position the rock valve so the open cylinder is on the opposite side of the hopper from the ready-mix chute, and shut off the pump. This allows the concrete to push the remaining slurry, below the rock valve, into the open cylinder. It also helps to place the agitator in reverse to pull the rocky part of the first chute full of concrete toward the end of the hopper, and direct the creamy concrete below the rock valve. Have the driver fill the hopper, and as the slurry is pushed into the open cylinder, you can put the pump in forward and begin pumping.

- Pump slowly and watch the concrete pump circuit pressure gauge until the slurry starts to escape from the pipe or hose. If the line plugs, immediately switch the pump to reverse mode, and notify the ready-mix driver to stop dumping. When pumping in reverse, always close the hopper lid to prevent debris from escaping. To remove the plug, rock the concrete by alternately pumping a few strokes in forward and a few in reverse, or remove the plug manually. Rocking the concrete in forward and reverse usually only works well when pumping vertically so gravity can help to create a vacuum in the line.

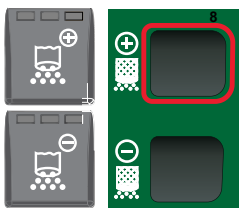
WARNING Expulsion hazard! Never remove a clamp from, or open, a pressurized pipeline.

Do not open a blocked pipeline without first sucking the concrete back into the hopper. Operating the pump into reverse for several strokes will release the pressure on the blockage. Understand the safety rules for opening a blocked pipe explained in the Safety Manual.

Once concrete has emerged from the point of discharge, stop pumping. Wait for the start signal from your spotter before you start pumping.

Controlling the Concrete Pump

Stroke Limiter



The stroke limiter is a hydraulic device that can be electrically adjusted with the stroke limiter (+) and (-) buttons located on either the radio or pendant remote. Its function is to raise and lower the output of the hydraulic pumps that operate the concrete pumpkit.

This has the advantage of allowing the engine to remain at higher RPM where horsepower is at the maximum.

The stroke limiter has an adjustment range of 95 percent. That means it can go from as low as 4 strokes per minute to maximum strokes per minute. The stroke limiter only adjusts the output of the hydraulic pumps while the differential cylinders are moving. That means that when the differential cylinders are stopped at the end of the stroke and the rock valve is moving, the pumps don't return to maximum output until the rock valve cylinder has completed its travel.

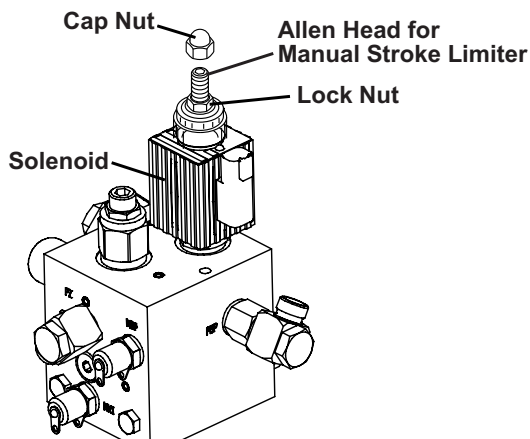


Figure 20
Stroke Limiter Control Block

If electrical control of the stroke limiter is lost, it can be adjusted manually by removing the cap nut located on the top of the solenoid assembly and loosening the lock nut with a 1/2 inch wrench. The adjustment is then accomplished with a 5/32 inch allen wrench by turning the screw in (clockwise) to decrease strokes or out (counter clockwise) to increase strokes. Always return the manual stroke limiter to maximum strokes (full counter clockwise out position) when electrical power is restored.

Pendant Remote

To use the pendant remote, place the pendant/radio switch to the pendant position (Figure 21). Connect the pendant to the remote cable located just behind the operator control panel. Press the horn button to clear all E-stop requests. The machine can now be operated from the pendant remote.



Figure 21
Selecting the Pendant Remote

Radio Remote

To use the radio remote, place the pendant/radio switch to the radio position (Figure 22). Press the power (green) button on the radio remote to turn it on. Press the horn button to clear all E-stop requests. The machine can now be operated from the radio remote.

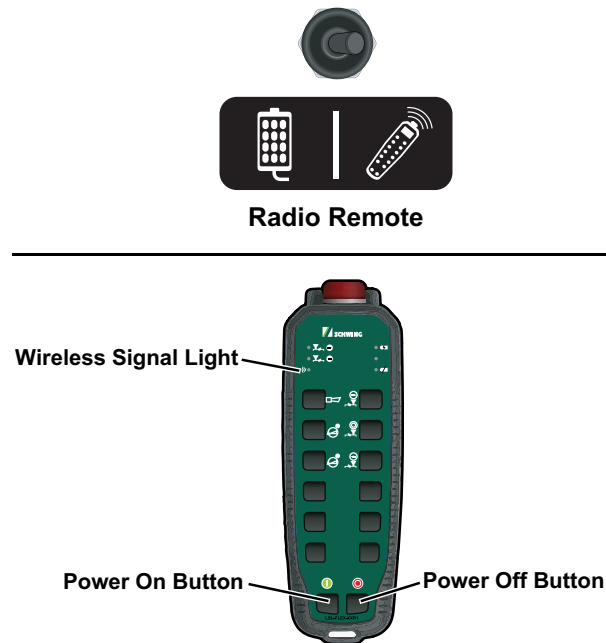
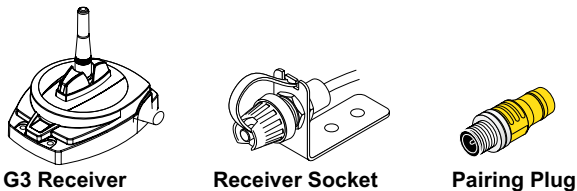


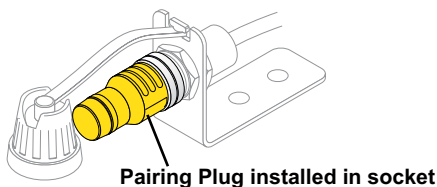
Figure 22
Selecting the Radio Remote

Safe Pairing of Transmitter to Receiver

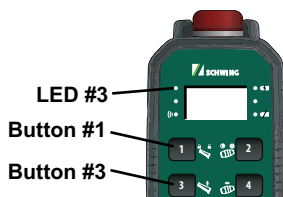
Safe pairing is used to get a unique assignment between a single Transmitter and a single G3 Receiver. To exchange the Transmitter and Receivers ID's when replacing either the Receiver or Transmitter in a system follow the Safe Paring procedure below:



1. Remove power to the Receiver by turning the engine off.
2. Install the pairing plug into the receiver socket.



3. Simultaneously press button #1 and button #3 on the Transmitter. LED#3 will light indicating the Transmitter is ready for Safe Pairing.



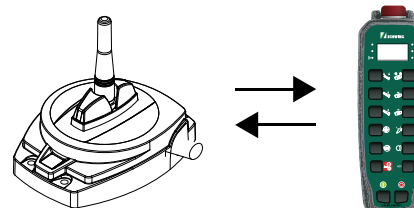
4. Re-apply power to the Receiver by putting the ignition switch in the RUN position. (Step 4 must be done within 10 seconds of step 3).
5. The Transmitter will confirm the download is complete by flashing LED#3 eight times.



6. The Receiver LED Display will flash Po-Id.



7. Turn off the power to the Receiver by shutting off the engine. Remove the pairing plug from the receiver socket. Restart the truck engine to power up the Receiver. The Transmitter has now been paired to the Receiver.



NOTE

If pairing is performed during low battery on the Transmitter it may look like the pairing works but it does not. This is related to a safety precaution. Replace battery and repeat the pairing procedure.

Pumping the Job

Operate this machine from the ground to avoid falling and other possible hazards.

If you cannot see the point of discharge from where you are operating the unit, make sure your spotter is in position before you start the pump.

As soon as the spotter gives you the start signal, move the pump into forward, and alert the ready-mix driver to start dumping.

⚠ WARNING Do not completely empty the hopper because air will be drawn into the concrete cylinders. This air will compress during the pushing stroke and explode into the hopper or hose tip when the transfer tube switches.

Concrete must always cover the openings of the material cylinders so air will not be sucked into the material cylinders. If that occurred, concrete would be rapidly expelled as compressed air escaped on the next stroke. This can be extremely dangerous, so be sure the ready-mix driver understands the situation. If air has entered the material cylinders, cushion the expulsion by stopping the concrete pump and filling the hopper with concrete before the next stroke. When the hopper is full, it is still not safe to resume pumping. Even with the hopper full of concrete, some compressed air will be introduced into the delivery pipeline. When it reaches the discharge point, the air will cause the concrete to be expelled forcefully (Figure 23). If the hose handler is walking on a wall or column, or is in another precarious position when this occurs, an accident could easily occur.

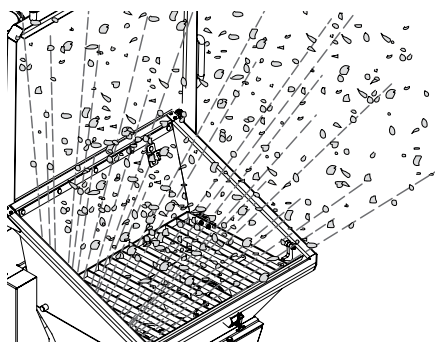


Figure 23
Concrete Exploding from Hopper

It is best to avoid ever sucking air into the material cylinders. **If you do accidentally suck air into the material cylinders, warn the hose handler and clear the immediate area around the hose until the air is released and concrete is flowing steadily.** Point out the E-stop buttons to the driver if you will be standing somewhere other than at the operator control panel. The driver can warn you or stop the machine if a dangerous situation develops.

Always keep an eye on the point of discharge or on your spotter. On a typical job site it is difficult to hear the spotter yelling, so it is important to rely on hand signals.

As the day progresses and the crew removes pipe sections from the end of the slickline, wash the pipes, clamps, and gaskets with water as soon as possible. If you do not wash them until the pour is finished, you will not be able to get the hardened concrete out of them. This job can be done between loads of concrete or by a laborer at almost any time.



Figure 24
Washing the Pipe System

Time Constraints

If anything goes wrong on the unit while it is pumping, you only have 15 to 30 minutes to solve the problem before the concrete sets. (Less time with old concrete on a hot day, and more time with fresh concrete on a cool day.) If it will take longer than 30 minutes to fix the problem, clean out before you begin repairs. If concrete is beginning to set, you will have to clean out in a very quick and efficient manner. There are additional "Clean Out" instructions on page 100. If you don't panic and keep moving, you can usually avoid cleaning or replacing the pipes.

Old concrete on a hot day is the worst case scenario; the concrete may go from being pumpable to setting very, very quickly. This is called 'flashing', and if it happens, you may lose some pipe. See additional "Quick Clean Out" instructions on page 106.

Cold Conditions

Always keep the hopper at least half full. If any problem arises with the unit while it is pumping, you have just 15 to 30 minutes to solve it before the concrete begins to set, and possibly less time if the temperature is extremely cold. If you know you will need more time, clean out before you begin repairs. If the concrete is beginning to set or freeze, you will have to clean out quickly and efficiently.

Delays

Expect delays on the job. Waiting for concrete, workers needing to finish the next form to be pumped, and form failures are all common delays. Make good use of this idle time by washing pipe, clamps, and gaskets that have been removed from the delivery system, washing splashed concrete from the hopper area, eating lunch, or taking care of miscellaneous tasks. Concrete begins to set as soon as it becomes motionless, so approximately every 5 minutes give the pump a stroke. This will make the concrete in the elbows and reducers change its shape, thus breaking the set. Concrete setting in the pipeline acts like a blockage. Blockages can be dangerous because the pump will create maximum pressure on the concrete. Always keep the hopper at least half full. If the concrete is getting stiff, add water to the hopper while you are waiting. A word of warning regarding this procedure: the concrete will eventually set up anyway. If you wait so long that the concrete is setting, it is a good idea to clean out and then start over when the fresh concrete has arrived.

- If you are waiting for a form to be finished or repaired, or anytime that the delay has nothing to do with waiting for concrete, you can give the pump one or two strokes in 5-minute intervals for a longer time because the ready-mix truck will be able to refill your hopper. Be careful about where the concrete is pouring when you are giving the machine these one or two-stroke cycles. If the form is broken, you will complicate matters by putting more concrete into it.
- Eventually, you will have to make a call; once concrete begins to set while it is being pumped, you have only minutes to get the machine cleaned out. See "Clean Out" on page 100 for this procedure.
- Also consider the condition of the concrete in the ready-mix trucks. If three or four trucks have been waiting on the site for a period of time, the concrete may be setting up. If it is a hot day and the concrete is setting up, you are risking a pipe cleaning party by pumping this concrete. The concrete pump operator must make the decision to use or not to use this concrete.

Keep the Waterbox Full

Remember to check the water in the waterbox regularly (stopping the pump before opening the waterbox covers). Water is very important for cooling the differential cylinders and for lubricating the rubber rams.

Under no circumstances should you remove the hopper grate while the machine is operating, nor should the machine be operated when the grate is not in place. If the grate is in place, it will catch all types of foreign objects: mixer fins, clumps of unmixed cement, cats, dogs, rebar, golf clubs, tools of all sorts, etc. If any of these items made it into your hopper, they would probably cause a blockage, which is always dangerous.

⚠ WARNING Amputation/crushing hazard! Keep hopper grate in place during operation and cleaning.

Blockages

If there is a blockage in the pipeline that you cannot remove by the backward/forward rocking motion (two strokes in reverse, then two strokes forward), you will have to disassemble the pipeline to find it. Before you disassemble the pipeline, you must relieve the pressure by pumping in reverse for several strokes.

- When you go to the pipeline to find the blockage, take your hammer with you. Wear all of your personal protective devices for this procedure. Most of the time, you will find the blockage in a reducer, hose, or elbow. Relieving pressure by reversing the pump will make the pipeline sound different when tapped with a hammer than if it were pressurized. "Tapped" is a key word here; the pipe can be damaged by striking it hard. You should be able to hear the difference. An empty pipe has a definite reverberating "tong" sound, a full pipe without pressure will have a meaty "thak" sound, and a pressurized pipe full of concrete will have a thin "tik" sound because the forces on the steel will not allow it to vibrate. **Once you have located the blockage, carefully remove the clamps from the blocked pieces. While wearing a full face shield, turn away from the clamp as you pull the handle. The pressure should be relieved by stroking in reverse, but sometimes a blockage will store pressure because there is another blockage upstream or downstream. It is better to be safe than sorry. Once the clamps are removed, the danger is past.** Displace the blocked piece enough that you can push a piece of rebar or another long poking device into it. If the blockage is in a hose, it will help to hit the outside of the hose with the hammer. Again, do not damage the hose by hitting it so hard that the steel braids inside get permanently disfigured. When the blockage is loosened, elevate one end of the pipe or hose and dump out all remaining concrete.
- Once the blockage is removed, clean up the clamp, gasket, and pipe end with a rag, or, in a pinch, wipe the concrete off with your hands. (Always wear rubber gloves when working with concrete.) Reassemble the pieces, and pin the clamps. Return to the pump and start pumping in forward again, slowly at first, until you are sure that there are no more blockages. If there is another blockage, relieve the pressure again by pumping in reverse for several strokes before finding the remaining blockages.

- Do not use compressed air to remove a blockage. The concrete pump has at least six times more pressure available than an air compressor. If the pump won't push the plug, compressed air certainly won't. In addition, air that is compressed builds a reservoir of pressure that will continue to be dangerous even when the compressor is shut off.

Clearing Agitator Jams

If the agitator is jammed with large aggregate, a direction-change push button at the rear of the unit can be used to clear the aggregate. Pressing and holding the button will momentarily switch the agitator direction, and releasing the button will return the agitator to its normal direction. A backward/forward motion should loosen the aggregate. This button is only effective if the agitator is activated in auto or continuous run mode.

Clean Out

You will often have to wait for the “balance load” of concrete to arrive. This is usually 1 or 2 yards that the contractor ordered at the last minute. This often happens late in the day, so typically four of the five ready-mix drivers have gone home. The same person who brought the next-to-last load will have to get the balance load. This gives you time to get ready for clean out and to stow pipeline, clamps, and accessories. If the concrete in the machine will be old by the time the ready-mix driver returns (the most dangerous time for concrete setting in the machine), be aware of it and take any steps necessary to keep the concrete alive. Clean out, if necessary, but if the balance load is very small, refilling the hopper, material cylinders and pipeline may use up the entire balance load without ever delivering concrete to the form. In that case, another balance load would need to be ordered, and no one is going to be happy about that.

The balance load is usually fresh concrete. If at least 0.5 yards is pumped, the machine will be filled with fresh concrete for clean out, which is to your advantage. The worst thing that can happen is that, on a hot day, the balance load is only one wheelbarrow full. Fresh concrete will not flow through the pipe when the balance load is pumped, so the concrete that is in the end of the pipe for cleaning is as old as the next-to-last load. Be careful! With old concrete, it is imperative that the pipe be cleaned immediately upon finishing the pour.

- Check your water supply! You will need water for clean out.
- If cleaning the pipeline by forcing a sponge ball through the line with air or water, wet the ball first. You can start soaking your sponge ball in your 5-gallon bucket when half an hour of pumping remains, or you can start soaking the ball in the morning; if you let the ball soak all day, it will not last as long.

⚠ WARNING

Hose whip hazard! Never use compressed air to clean out rubber hose. The result could be a violent whip of the hose as the air is released. If water must be conserved, dump the hoses manually and rinse them with the water nozzle.

Cleaning the Hopper

Do not do the following procedure while the pump is engaged in either Forward or Reverse. The pump must be in OFF or Neutral position.

WARNING Amputation hazard. Stop the pump before cleaning the rock valve and hopper.

Remove the hairpin from the wedge (Figure 25). Remove the clamp from between the tapered bend and the first elbow or the clamp between the elbow and reducer (your preference). Knock the wedge from the holding bolt on the tapered bend, and store it in the wedge holder, which is welded to the hopper as shown in (Figure 25).

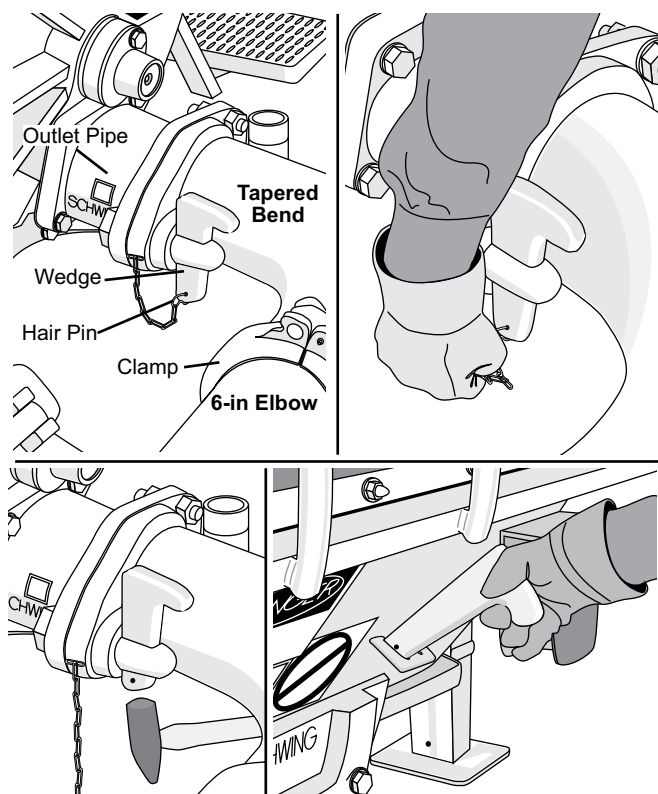


Figure 25
Hopper Outlet Pipe and Wedge Pin

Swing the tapered bend open. Do not put your hands into the outlet pipe under any circumstances. If your cleanout ball is inside of the outlet pipe, it will get pumped out in the following procedure. Clear the area around the outlet pipe, and put the pump in "forward" mode. Once the tapered bend is opened, the risk of compressed air is eliminated, so you can let the machine cycle until the concrete stops flowing from the outlet pipe. Then place the pump switch in the "off" position. Don't let the machine cycle dry for an extended period of time, because without concrete for lubrication, the rubber rams and kidney seal will get hot and eventually be damaged.

If your cleanout ball did not get pumped out in the previous step, it should be found in the tapered bend or in the 6-in elbow. Remove the ball, spray it off with water, and store it off to the side, so it doesn't get buried in the cleanout debris.

Using your hammer, tap on the T-handle that opens the cleanout door on the bottom of the hopper (Figure 26). When the door opens, the concrete at the bottom of the hopper should fall out.

If the concrete does not fall out, aim your hammer upward and pound any material that is lodged in the cleanout door. A couple of taps will probably free the material, but if you need to, keep tapping until it all material is free. **You can minimize or eliminate this procedure by putting sand or dirt in the bottom of the rock valve housing before you begin pumping.**

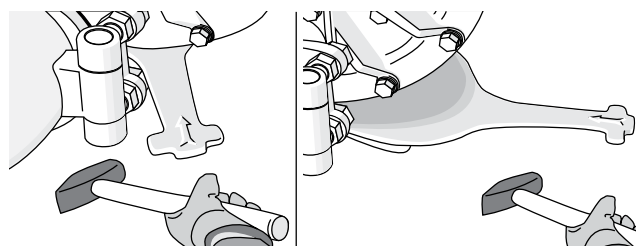


Figure 26
Opening the Hopper Cleanout Door

For the following procedure, be sure of your footing and keep the hopper grate in place. Spray water into the hopper from above (Figure 27).



Figure 27
Clean Agitator and Hopper

- Keep the agitator turning until you have sprayed the blades clean (Figure 27). Wash the material from the hopper out of the cleanout door on the bottom.
- Stop the agitator from turning with the agitator switch on the control panel. Do not proceed to the next step until this is done. Visually confirm that the agitator has stopped by looking into the hopper.
- Poke any material that has set in the corners of your hopper with a piece of rebar or another stiff, long bar (Figure 28). Do not remove the hopper grate for this cleanout procedure. This procedure must be done with the hopper grate in place. **Do not spend too much time on this procedure**, or the concrete will have time to set up in the rock valve and material cylinders.



Figure 28
Remove Hardened Concrete From Hopper

If concrete in the hopper has completely set, you will need to use a chipping hammer or another power tool to clean it. The grate is removable for this purpose.

⚠ WARNING Amputation/crushing hazard. Never work inside the hopper without disabling the hydraulic system.

For safety reasons, return to your shop before you remove any concrete that has completely set. Once the concrete has set, there is no advantage to chipping it away at the job site.

Cleaning the Rock Valve

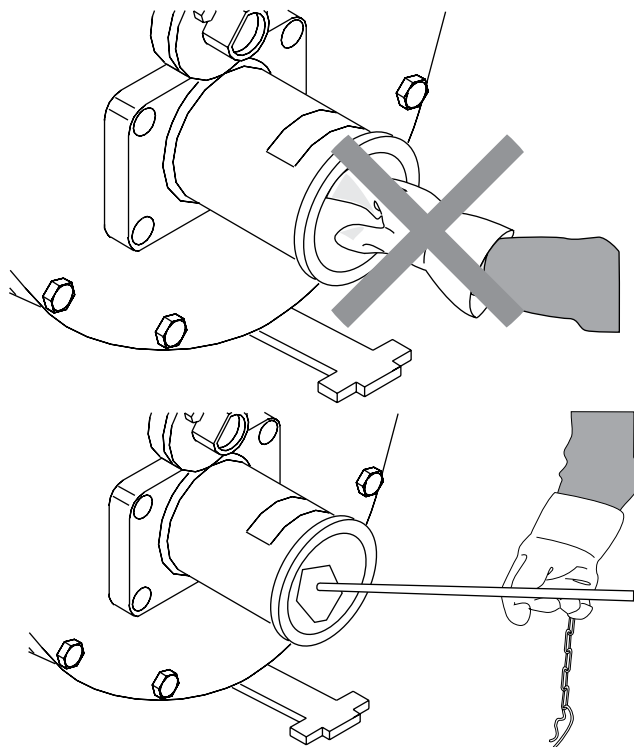


Figure 29
Rock Valve and Material Cylinder Cleanout

Once the hopper is clean, you should clean out the rock valve and material cylinders. Before you begin this step, bring the engine speed to an idle. Stroke the concrete pump one complete stroke in reverse, until the rock valve shifts across, then stop the pump. This step ensures that the exposed material cylinder will have the rubber ram extended to the end, thereby eliminating the need to pull material from deep inside the cylinder.

⚠ WARNING Amputation hazard! Stop pump before cleaning the rock valve and hopper.

Be sure that the concrete pump is turned to the OFF position before proceeding. Using your cleanout rake, pull any material from the exposed material cylinder, the rock valve, and the outlet pipe (Figure 29).

- Spray water into the opening, washing the end of the rubber ram, the material cylinder, the rock valve, and the outlet pipe (Figure 30). Continue washing until the water that leaves the valve is clear and clean. Visually inspect that no rocks, sand, or clumps of concrete remain. If there is still material, continue spraying water.

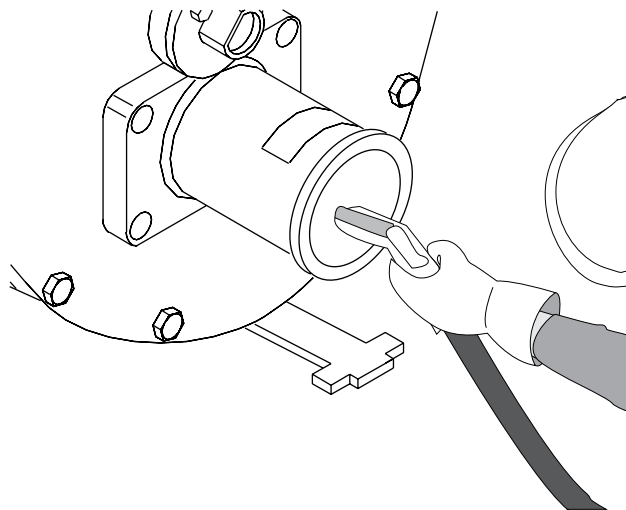


Figure 30
Spraying Out the Rock Valve

- Be sure that your rake and other tools are out of the rock valve area, then cycle the machine in reverse for one more stroke. This will expose the opposite material cylinder, and completely extend its rubber ram. Remove any loose material with the clean out rake, then spray out the material cylinder as in the previous step.
- By putting the pump into reverse mode, you are sucking from the direction of the pipeline (which is not connected during the cleanout procedure) and pumping into the hopper. Because of this, you may find that you now have some material in the bottom of the hopper again. You need to wash this material out.
- Spray off the clamps, gaskets, and wedges.
- Close the hopper cleanout door, and reattach the bungee cord, if used.

Cleaning the Waterbox

To clean the waterbox, (Figure 31) start by lowering the engine RPM to an idle. Leave the waterbox cover in place for now. Open the drain and allow the existing water to flow out the bottom. When water stops flowing, give the unit a stroke or two in either forward or reverse. This will force the water in the extended cylinder back into the waterbox and out the drain. The waterbox is empty when no more water flows out the drain, even after the unit is cycled.

WARNING Crushing/amputation hazard! Disable the hydraulic system before removing waterbox guards.

Stop the pump and secure it against unintentional starting by pushing the emergency stop button.

Remove the waterbox covers and spray the waterbox and cylinders through the safety grate, until all cement fines and grout are flushed.



Figure 31
Spraying Out the Waterbox

If you will not be filling the waterbox again until just before the next pour, follow this procedure:

- Replace the waterbox cover.
- Put the pump into forward or reverse for one or two strokes to force the clean water out the drain.
- Close the drain.

If you will be refilling the waterbox immediately, simply close the drain and finish filling the waterbox. Remember to replace the waterbox cover before restarting the unit.

If the concrete pump will be transported or stored in below freezing temperatures, drain all the water from the waterbox.

Preparing for Travel

Securely store your clean out rake, sponge ball, grease gun, hammer, shovel, and accessories for travel.

- Hand any concrete delivery tickets to the concrete supervisor when turning in your job ticket for signing.
- Before you leave, walk around the tow vehicle and stationary pump. Look for any loose items and look under the unit for personnel and obstructions. Check tires for pressure and wear. Many driving accidents happen on the way back to the shop after a job, or on the way to a second job. The walk around check before going on the road may prevent these accidents. Think about the route, bearing in mind the time of day, road construction, and other conditions.

External Cleaning

We recommend washing the exterior of the stationary pump during breaks to prevent concrete from setting. We also recommend spraying the outside of the hopper with form oil. Form oil is designed to inhibit the bond between the stationary pump and the concrete. Use only environmentally friendly oils and make sure no oil gets inside the hopper.

High-Pressure Washer

Observe the operating instructions of the high-pressure washer and wear the appropriate personal protective equipment.

⚠ WARNING Never point or aim the gun/wand at yourself or anyone else. Never put your hand, fingers or body directly in front of the spray nozzle.

📖 NOTE Do not spray directly at electronics or electrical components.

Newly painted surfaces may only be cleaned with a garden hose and cold water during the first 3 months of operation. New paint needs 3 months to properly cure. This also applies to repainted areas. Use a soft brush if necessary.

High-pressure shouldn't be used in areas with mechanical paint damage because this can cause painted areas to separate even more. Damaged painted surfaces should be repaired as soon as possible and in a professional manner.

Use the following guidelines for high-pressure washing:

- Maximum water temperature: 140°F.
- Maximum water pressure: 100 bar (1450 psi).
- Minimum spraying distance: 12 inches.
- Do not use additives.

If the high-pressure washer used generates a higher water pressure, the spraying distance must be increased accordingly.

Use of Cleaning Agents

Do not use aggressive cleaning agents. They can affect different materials (e.g. rubber) and painted surfaces.

Commercially available paint cleaning and care products can be used as long as they do not exceed a pH value of 9 or fall below a pH value of 4.

Always rinse off cleaning agent with clean water. Do not leave puddles.

Protecting New Paint

First 30 to 45 days

- Park stationary pump in the shade. Avoid extreme hot and cold conditions when possible.
- Paint can easily chip from gravel road debris during the first 30 to 45 days. Avoid towing on gravel when possible.
- Tree sap or factory emissions can spot or mar a freshly painted surface. Be mindful of where you park.
- Clean bird droppings as soon as possible. Droppings have high acid content and will damage freshly painted surfaces.
- Solvents such as gas, oil, antifreeze, transmission fluids or windshield cleaners can damage a new finish. If contact occurs, immediately rinse with water and do not wipe.
- Ice and snow should not be scraped from newly painted surfaces. Remove loose material with a soft brush.

Special Pumping Situations

The following paragraphs describe operations that may be required due to timing or weather conditions.

Quick Clean Out

Setting concrete must be cleaned out in a hurry. Accidents happen when you panic; stay calm and work as fast as you can without skipping any safety rules.

Prioritize the order of clean out by calculating the amount of time and money involved to replace any components that are ruined by failure to clean before the concrete completely sets. To help make these calculations, use the following list which is arranged in order from the most expensive and difficult to replace to the easiest and least expensive to replace.

- Rock valve cast housing
- Rock valve
- Material cylinders
- Hopper
- Pipeline

An experienced operator will dump the hopper and material cylinders and then rake out the bulk of the material from the valve in just a couple of minutes, moving immediately to the pipeline. The rest of the material in the hopper and valve can be chipped out if it will not wash clean. Be sure to disable the hydraulic system on the unit by stopping the engine, placing the key in your pocket, and putting a "Do Not Operate" tag on the ignition switch before entering the valve or hopper area for chipping.

When cleaning a machine with setting concrete, do not worry about getting each part perfectly clean before moving on to the next part. Once the bulk of the concrete from a component is removed with water, it will be thinned enough to not completely set. It can be cleaned out more thoroughly later.

Cold-Weather Pumping

It is possible (and routine in some parts of the world) to pump concrete with outside temperatures as low as -10°F, and even colder under certain circumstances. This can present a variety of problems compared with pumping in moderate temperatures, such as:

- Water in the waterbox freezes while you are driving to the job.
- The hydraulic components are slow in responding to your commands.
- Slurry freezes in the pipeline when you are starting the pour.
- Concrete freezes in the line or the hopper while you are pumping.
- The concrete is loaded with calcium chloride or an equivalent to allow the concrete to set before it freezes; this additive accelerates setting time in much the same way that hot weather accelerates setting time.
- Washing components with water causes them to become coated with ice, which will not melt until the temperature rises above freezing.
- Machine parts that you sometimes stand on or grasp become very slippery when they become coated with ice.

Some of these potential problems can be solved or tolerated, but others cannot. Here are some tips for cold-weather pumping:

- In locations that have cold winters, store the machine indoors. If you do not have a heated shop, consider renting one.
- Do not put water in the waterbox before driving to the job. If possible, contact the ready-mix company and arrange for the first truck to be loaded with hot water to fill the waterbox and to mix your slurry. Arrange for the last truck to be filled with hot water and clean out using this water.
- If you are expecting cold weather for extended period, change the oil to a thinner viscosity type, such as an ISO VG 32. Be aware, however, that this oil cannot protect the components to as high of a temperature as the standard oil that shipped with your unit (ISO VG 46).

Pours that require a separate pipeline are usually canceled when the weather is very cold. If the pour is not canceled, be sure that any pipeline laid outside is covered with insulated blankets and has a hot air supply flowing through it from a torpedo heater or a similar heat source. If the pipeline is not heated, the concrete will probably not be able to get through the line because the slurry will freeze against the walls of the pipe resulting in a blockage. This can result in a blockage. To clear the line, take all normal steps to clear the block, and work fast enough that the concrete will not freeze again as soon as it starts moving.

If the concrete freezes in the pipeline, pumping is finished until the line has warmed up. The good news is that the concrete will not set when it is frozen. Once the pipeline is brought into a warm place, it can be cleaned out.

If the concrete freezes in the hopper, pumping is finished. Find a warm place to bring the machine and clean it as it warms.

If the concrete contains calcium chloride, keep the concrete alive using the same techniques used for pumping on hot days. The calcium chloride accelerates setting, but if it does freeze, the setting stops. As the machine begins to warm up, the concrete will begin to set, even more quickly than on the job, because it is now in a warm area. Do not waste time when cleaning a machine in these conditions.

Be very careful of ice when pumping in cold conditions. Never stand on ice-coated pipes or other round objects

Emergency Procedures

Emergency Override Buttons



DANGER If the hydraulic dump valves are electrically overridden, the E-stop buttons will no longer be operable. This removes all E-stop buttons and the hopper grate sensors as machine safeguards. This procedure should only be performed by a certified operator.

If there is an electrical malfunction, the dump valve will open, disabling the hydraulic circuit. If you cannot correct the electrical power loss problem, try activating the dump valve by pushing the override buttons while another person activates the concrete pump forward/reverse handle, on the S1/S2 Control Block.

Override Button



Forward/Reverse Override Handle

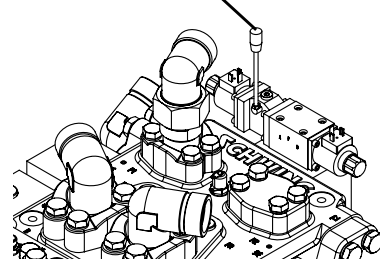


Figure 32

E-stop Override Buttons and Concrete Pump Forward/Reverse Override Handle

For information on where to look and what to do if you lose electricity on the unit, contact the SCHWING Service Center at 1-888-292-0262.

Loss of Radio Remote

If your radio remote stops functioning and the battery LED is off, the battery is probably dead. Remove the battery from the radio remote, and replace it with a fully charged battery. The dead battery should then be placed in the charger.

Optional Equipment

Auto-Greaser

For information on setting or adjusting the auto-greaser reference the “Manual Greaser Button” instructions in the Overview section.

CAUTION

Do not run auto-greaser on empty.

Hopper Mounted Vibrator

This device is an electric motor that has eccentric weights attached to a shaft at each end. When the motor spins, the weights shake the unit, and whatever is attached to it (the hopper grate or hopper, in our case). The purpose of this device is to assist low slump concrete in falling through the grate, and into the concrete cylinders. If your use of this machine includes pumping of low slump concrete, you will find this option invaluable.

Hydraulic Oil Level Sensor (Electronic)

The hydraulic oil level sensor monitors the machine hydraulic oil level. If the hydraulic oil level is low, a pump fault will display on the operator panel HMI LCD screen.

Manual Outriggers

SP 2000 pumps are equipped with hydraulic outriggers. Manual outriggers are an optional feature.

To extend the manual outriggers:

1. Remove safety chains from the tow vehicle. Open the receiver latch by removing the safety pin and lifting the lock on the receiver mount.
2. Place suitable cribbing below the foot of the front jack.
3. Use the front jack to raise the pintle hitch off the receiver mount.
4. Drive the tow vehicle away from the set up area.
5. Lower the front jack to level the stationary pump.
6. Place suitable cribbing below the outrigger feet. Remove pins from the rear outriggers, and gently lower each outrigger to the ground using the outrigger handles.
7. Place the pins in the next available holes on the outriggers, and secure with a safety clip.

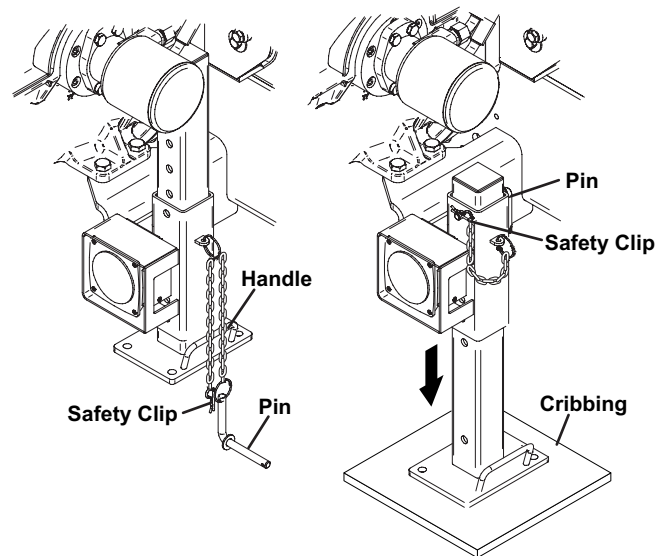
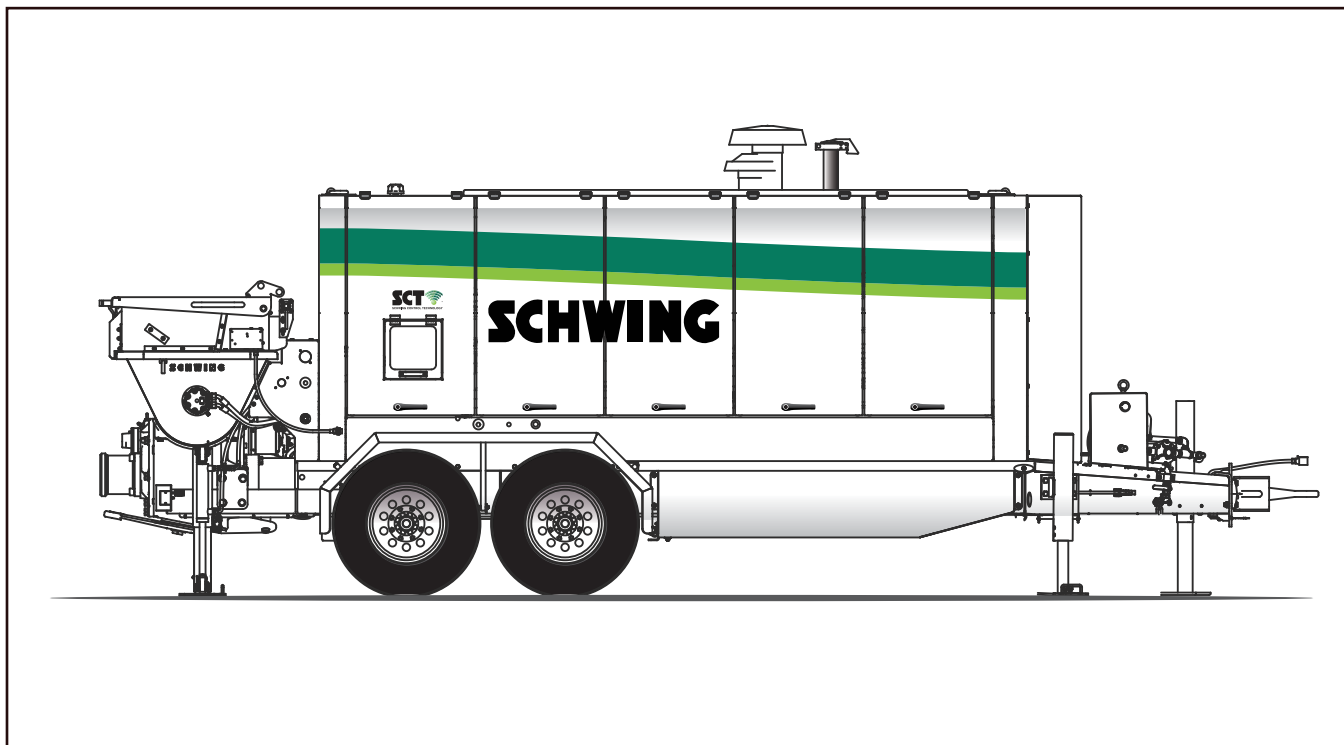


Figure 33
Setting Manual Outriggers



Maintenance

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Regular maintenance is required to keep the machine in good working condition. There are two kinds of maintenance: preventive and scheduled.

Preventive maintenance will help you avoid unnecessary repairs, but eventually even well-maintained machine parts wear out and require repair or replacement.

Scheduled maintenance needs to be done on a timely basis. That may be daily, weekly, monthly, quarterly, semi-annually, or annually. It is a good idea to create and keep a checklist to track what maintenance is due and when. Keep accurate records of maintenance performed and when the work was completed.

Hoses and Fittings

SCHWING uses metric fittings and hoses with metric threads on the couplings. There are six sizes of tubes and fittings and six sizes of hoses, all measured by diameter.

All block threads are metric or BSPP.

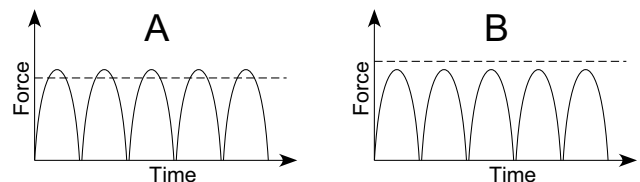
Hose Size	Hose ID (mm)	Connects with Fitting and Tube Size
8	8	12
13	13	16
16	16	20
20	20	25
25	25	30
32	32	38

Tube and Fitting Size	Tube and Fitting OD (mm)	Connects with Hose Size	Tube and Fitting ID (mm)
12	12	8	8
16	16	13	13
20	20	16	16
25	25	20	20
30	30	25	25
38	38	32	32

Torque Specifications

When performing maintenance that requires removing and replacing bolts, you must adhere to the torque specifications for those bolts.

The graph below demonstrates what happens to a bolt if it is not properly torqued. The dashed line represents the pre-stress or tightness of the bolt. As the device that uses the bolt goes through its normal functions, the bolt in Example A below (which is not tight enough) gets stretched and relaxed with every duty cycle because the bolt is pre-stressed under the maximum force of the cycle. In Example B below, the torque on the bolt has been raised to the proper level (which is more than the maximum force of the duty cycle), so the bolt doesn't ever feel the cycle. In the examples below, bolt B would last much longer than bolt A. The torque specifications for bolts used on this concrete pump are found in the Appendix section of this manual.



Welding Precautions

To avoid possible electronic component damage, check the owners manual of the truck to see if anything other than the battery must be disconnected prior to welding anywhere on the unit.

Adjusting Relief Valves

Take care when raising relief valve pressure settings. In extreme cases, this can cause hoses or fittings to burst or other components to fail. To be safe, you should begin the adjustment procedure by turning the adjustment device to the lowest possible setting, and then bringing the device back up to the proper setting.

Removing Safety Devices

Sometimes you will have to remove a safety guard (Figure 1) or another safety device to perform maintenance. For these situations, you must take extra care to ensure your own safety and that of your co-workers. If you have to put your hands, feet, or any other body part into a part of the machine that would normally be guarded, be sure to follow the approved "Lockout/Tagout Procedure."

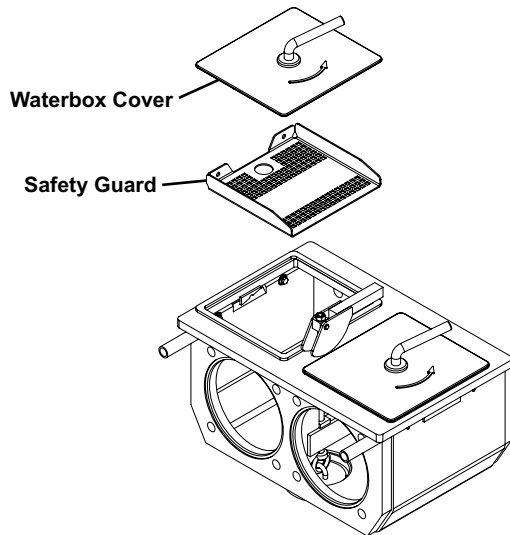
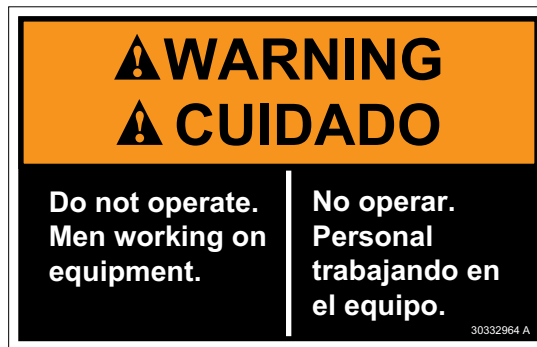


Figure 1
Safety Guard Example (Waterbox Safety Guard)

Lockout/Tagout Procedure

SCHWING includes approved warning devices with all new concrete pumps and recommends the following procedure prior to performing any maintenance in an area of the unit that would normally be guarded:

- Stop the diesel engine.
- Remove the key from the operator control panel, and place it in your pocket.
- Put the static cling "DO NOT OPERATE" label next to the operator control panel.
- Perform the needed service on the unit.
- Remove the labels and reinstall the key.
- Store the label in the document holder for future use.



Before restarting the machine after performing maintenance, be sure to put away all tools, parts, and supplies, and clear the area of personnel.

Before starting the unit at any time, yell "Clear!" and allow enough time for response before proceeding.

Replacing the Hydraulic Pump

It is highly recommended that prior to the installation of any hydraulic pump that the drive spline is lubricated with a special pre-assembly grease (Figure 2). SCHWING recommends the Texaco-Chevron coupling grease to add extended life to the spline and related parts. SCHWING also recommends removing and re-greasing all hydraulic pump splines every year. See the "Maintenance Chart" on page 117.

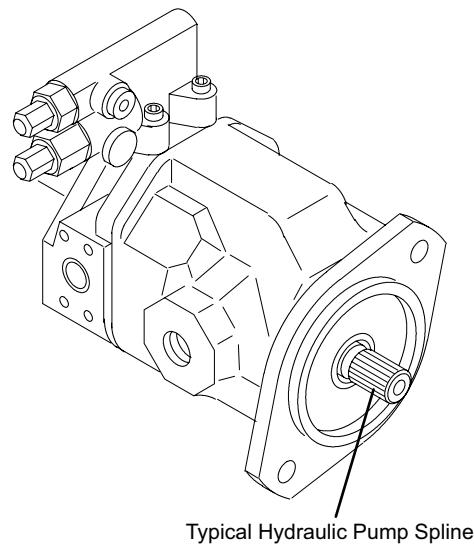


Figure 2
Hydraulic Pump Spline

Hydraulic Oils

General Information

Hydraulic oils are rated for viscosity, heat dissipation, foaming characteristics, pour point, anti-wear additives, anti-corrosive additives, lubricating qualities, compressibility, temperature range, temperature stability, and other functions. Although many different brands of oil meet these specifications, they may use different chemical additive packages to achieve the end result. For this reason, do not mix two different brands of oil. The additive package from one brand may be incompatible with the additive package from the other, rendering both packages useless.

Recently a few manufacturers have introduced biodegradable hydraulic oils onto the market. These oils are based on vegetable extracts instead of mineral extracts. They are considered safer for the environment in the event of a spill, although the additive packages are not inert. These oils must not be mixed with mineral-based hydraulic oils, even in very small amounts. When wanting to use this type of hydraulic oil when pumping a job in an environmentally sensitive location, contact the SCHWING Service Center at 1-888-292-0262 for instructions on making the change from mineral oil. Reference ISO 15380 for more information.

Viscosity of hydraulic oil is similar in concept to the different weights of motor oil. For example, in the winter you may run 5W-30 in your car, while in the summer you run 10W-40. The same is true for hydraulic systems. In climates where the weather changes from extremely hot to extremely cold conditions, consider changing the weight of the hydraulic oil used each season. The International Standards Organization (ISO) has developed a method of grading hydraulic oils for viscosity. For summer in northern North America, SCHWING recommends ISO VG 46 weight oil, while in the winter we recommend ISO VG 32 or even VG 22, depending on how cold it gets in your area. For southern North America and Central America, we recommend ISO VG 46 for the winter and ISO VG 68 or VG 100 for the summer, depending on how hot it gets. The lower the ISO VG number the thinner the oil and the lower the pour point of the oil. On the other hand, the thinner the oil, the lower the temperature will have to be before it breaks down the lubricating film that protects your components.

The quality of the oil needed for use in a SCHWING concrete pump is in the DIN system. The ratings have to do with the chemical additive package that is introduced into the oil. Both the DIN rating HLP and HV qualities are approved for use in our concrete pumps.

Specific Information

New SCHWING factory equipment is filled with Texaco Rando HD 46 hydraulic oil, which has an ISO viscosity rating of VG 46. If you want your new concrete pump filled with a different brand or different viscosity oil, you should specify it when ordering.

Many other brands of oil have been approved for use in SCHWING equipment, including:

- Mobil Univis
- Shell Tellus oil
- BP Energol
- Aral Vitam
- Esso Nuto
- Esso Univis
- Total Azolla
- Wintershall Wiolan

The order of the brands listed is not significant. Any oil that meets the quality and viscosity standards described above can be used.

Filter all new oil to meet ISO 4406 18/16/13.

“Industrial” Gear Lubricant Codes

CLP - An “industrial” gear lubricant oil with additives to improve corrosion protection, aging stability, and protection against wear in areas with many types of friction, and to increase gear stability under load. Meets DIN 51517.

Vehicle Gear Box Oil Codes

GO 90 - BI standard lubricant, a gear box oil that meets API-GL 5.

Hydraulic Oil Recommendations

Viscosity (ISO):	VG32		VG 46		VG68	
Quality (DIN):	HLP	HVLP	HLP	HVLP	HLP	HVLP
ARAL-Vitam	GF 32	HF 32	GF 46	HF 46	GF 68	/
BP-Energol HLP BP-Bartran	HM 32	HV 32	HM 46	HV 46	HM 68	HV 68
KLÜBER-Lamora	HLP 32	/	HLP 46	/	HLP 68	/
MOBIL DTE MOBIL Nuto MOBIL DTE 10 MOBIL Unavis	24 H 32	Excel 32 N 32	25 H 46	Excel 46 N 46	26 H 68	Excel 68 N 68
SHELL-Tellus	32	T 32	Multi Grade Hydraulic Oil Tellus T 46*			
TEXACO-Rando	HD 32	HDZ-32	HD 46	HDZ 46	HD 68	HDZ 68
WINTERSHALL- Wiolan	HS 32	HV 32	HS 46	HV 46	HS 68	HV 68

Biodegradable Hydraulic Oils

Type of fluid	Synthetic hydraulic fluids based on Polyglycol, HEPG			Synthetic hydraulic fluids based on esters, HEES			
ISO- viscosity class	VG 22	VG 32	VG 46	VG 22	VG 32	VG 46	VG 68
Manufacturer ↓							
ESSO		Univis WEPG 32	Univis WEPG 46			Univis HEES 46	
MOBIL/USA					Envirosyn 32 H	Envirosyn 46 H	Envirosyn 68 H
PETRO-Canada					Premium ECO HT-E 32	Premium ECO HT-E 46	
SHELL					Naturelle HF-X 32 ¹⁾	Naturelle HF-E 46 Naturelle HF-X 46 ¹⁾	Naturelle HF-E 68
VALVOLINE			Ultrasyn PG 46		Unisyn HLP 22/46	Unisyn HLP 32/68	

Filtration

General Information

Filtration is the single most important method of keeping your unit's hydraulic system operational. Particles that could damage the components are introduced into the oil by the differential cylinders and the valves, through the reservoir breather, and by internal wear in the components. Additionally, when you change hydraulic oil, the new oil is not clean enough to be used in a concrete pump without being pre-filtered. In fact, new hydraulic oil is only filtered at the refinery to 40 μm . The oil in your unit needs to be filtered to a MINIMUM of 25 μm , and preferably finer than that. Filters are rated by:

- the size of particles they trap, and whether that size is nominal or absolute
- the dirt holding capacity, in grams
- the clean element pressure drop for a given flow rate (in psi and gpm or bar and L/min), and
- the ratio of particles of a given size encountered versus particles passed (referred to as the beta ratio). An example of a beta ratio would be $\beta_{25} = 200$ (pronounced beta twenty five equals two hundred). This means that for every 200 particles of 25 microns or larger that hit the filter media, one makes it through. A finer filter would be, for example, $\beta_{12} = 200$. A coarser filter example would be $\beta_{25} = 75$. For concrete pumps, medium to fine filtration is required.

Specific Information

Here are some facts regarding filtration as they relate to your pump:

- Your unit has a separate oil conditioning circuit, which includes an oil cooler and a filter. The oil is pumped from the reservoir, through the cooler and filter, back to the reservoir.
- As delivered from the factory, your concrete pump is equipped with a filter that is rated at 10 μm absolute.
- The beta ratio is $\beta_{10} = 200$. In this case, the beta ratio means that for every 200 particles of dirt that hit the filter media that are 10 μm or larger in size, 1 will make it through. Although we are not happy about the one particle that is allowed through, we do not use finer filtration because the

components don't require it. Additionally, a finer filter would plug up with dirt too often, resulting in high maintenance costs to you. We have settled on a compromise that should afford long service life and minimum maintenance costs. Don't be fooled by the one particle that gets through, this is a high quality element with very good trapping characteristics.

- The clean element pressure drop is about 3 psi at 22 gpm (element only) +7 psi for the housing, making a total of 10 psi DP (drop in pressure) when the element is clean. The pressure drop varies with the viscosity of the oil, which means pressure in the filter will be high until the oil is heated to normal operating temperatures. The filter will hold 55 grams of dirt, when operating at a flow rate of 27 gpm. The flow rate is important, because the filter would hold more if you operated at a lower flow rate. Good filtration is not cheap, but it will save you thousands of dollars by preventing component failure.
- Your concrete pump is equipped with a recirculation type of filtration system, meaning that there is a pump that sucks oil from the reservoir, pumps it through the filter and cooler, and back to the tank. Whenever the engine is running, oil is being filtered. The filtration is done with a spin-on filter assembly (Figure 3). It is equipped with an integral bypass check valve set at 50 psi. The bypass valve protects the filter element from damage, as explained below. The assembly is equipped with an anti-back-flow check valve, which prevents oil from draining out of the tank while you are changing the spin-on element. There is a dirty filter indicator to tell you when the element is dirty. You should replace the element whenever the indicator enters the yellow area and the oil is heated above 20°C. Under normal circumstances, the element will need replacement about every 6 months. The element has been designed to remove all particles large enough to cause undue wear and jobsite breakdowns ($\beta_{10} = 200$). You can keep the hydraulic system running year after year by replacing the element when replacement is due. Do not substitute "will fit" elements in this housing.

Bypass Check Valve

The filter is equipped with an integral bypass check valve with a 50 psi pressure-to-open rating.

When the filter is clogged with dirt, oil is having a hard time making it through, the pressure difference between the filter inlet and the outlet rises. This pressure difference (commonly referred to as a pressure differential) is called delta P and is shown on the schematic as DP. When the DP reaches 50 psi, the check valve opens and the oil returns to the tank unfiltered. If the filter did not have the bypass check valve, it would simply break apart when it was clogged.

All of the dirt ever trapped by the filter, plus the filter itself, could go directly into the system.

The filter could also split open and leak to the ground, draining the reservoir, and contaminating the environment.

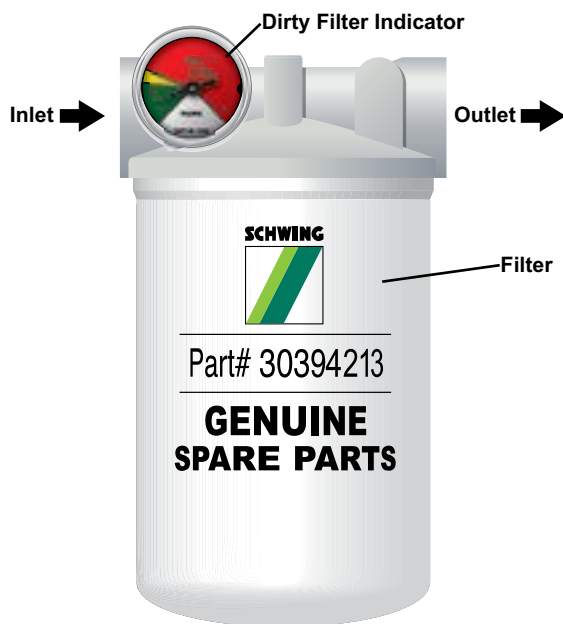


Figure 3
Hydraulic Oil Filter

Scheduled Maintenance Maintenance Chart

Component	Daily	Weekly	Monthly	Semi-Annually	Annually	Page
Check Engine Fluid Levels	√					118
Check/Fill DEF Tank Fluid Levels	√					118
Check Tires	√					118
Check Hydraulic Oil	√					118
Bleed Moisture From Hydraulic Tank	√					118
Check the Differential Cylinder Rods	√					118
Clean Debris from Engine Compartment	√					118
Inspect Bolts on Rams	√					119
Grease Rock Valve and Agitator Bearings	√					119
Inspect For Damage and Leaks	√					119
Check If Maintenance Is Due	√					119
Check Hydraulic Pressures	√					119
Adjust the Rock Valve Tension Nut		√				121
Inspect and Rotate the Cutting Ring		√				121
Lubricate Mechanical Moving Parts		√				122
Check the Unit Mounting Hardware			√			123
Clean Hydraulic Oil Cooler Fins			√			123
Change Hydraulic Oil (Seasonal Reasons)				√		123
Change Hydraulic Oil Return Filter				√*		123
Change Fuel Tank Breather Filter				√		123
Change Hydraulic Oil (Age Reasons)					√	124
Safety Inspection					√	124
Lifting Frame Rings Inspection					√	124
Re-Grease Hydraulic Pump Splines					√	124
Inspect Axle Bearings and Trailer Brakes					√	124
Inspect Shroud Door Gas Springs					√	124

* or as needed

Daily Maintenance

Check Engine Fluid Levels

Check the levels and condition of the lubricants and coolant in the engine. Follow the manufacturer's recommendations for quantity and type.

Check/Fill DEF Tank Fluid Levels

Refill DEF tank fluids if necessary. Typically DEF fluid is added when you refill the diesel fuel. You can use any brand DEF fluid that meets ISO 22241-1.

A remote fill spout is located on the on the front of the stationary pump (Figure 4). DEF cleanliness is extremely important as contaminants can degrade the life of DEF and system components. Filtering is recommended when filling the DEF tank. Prior to filling the DEF tank, clean the blue colored DEF tank filler cap and surrounding areas. Avoid filling the DEF tank from a contaminated container or funnel and overfilling of the tank.

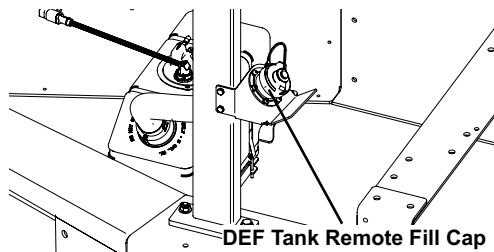
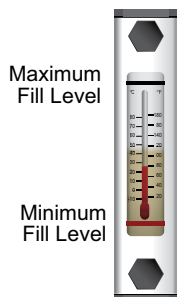


Figure 4
DEF Tank Remote Fill Spout

Check Tires

Check the condition of the tires on the stationary pump. Do not tow the unit with bald, cracked, or damaged tires.

Check Hydraulic Oil



Check the level and condition of the hydraulic oil. If necessary, fill the hydraulic tank with the same brand and type of oil. Add only filtered oil. Use a filter cart to pump oil into the tank. New oil contains more contaminants than SCHWING approves for their machines. Replace "milky" looking oil, which is a sign of water contamination. Try to determine the source of the water. If the oil has turned milky quickly, such as from one day to the next, then simply replacing the oil will not solve your problem.

Bleed Moisture from Hydraulic Tank

Bleed the water out of the bottom of the hydraulic oil tank by opening the drain valve at the bottom of the reservoir (Figure 5). Place a drain pan under the drain valve, open the valve, and watch the liquid as it leaves the valve. When the liquid changes from water to clean oil, close the valve. Due to condensation, which increases with dramatic heating-cooling cycles, there may be a small amount of water in the tank every day. However, it should settle to the bottom of the tank overnight. The water that is drained should be clean and so should the oil that follows it.

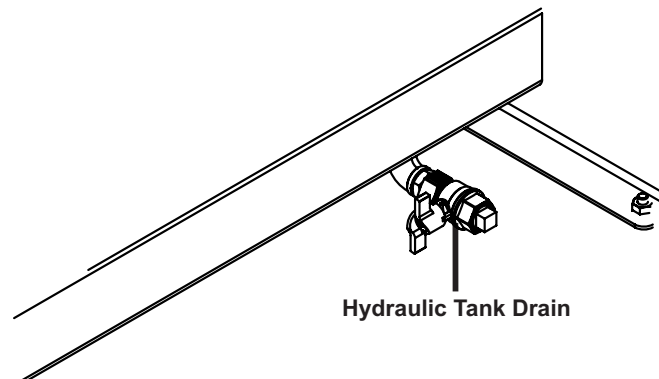


Figure 5
Hydraulic Tank Drain

Check the Differential Cylinder Rods

With the engine turned off, remove the waterbox cover. Remove the waterbox safety guard, or use a flashlight and look through the waterbox safety guard holes. Check for excessive hydraulic oil around or below the differential cylinder rod. Excessive oil in the waterbox is an indication that the rod packings are worn out. Failure to replace worn rod packings will result in water and debris from the waterbox entering the differential cylinder, damaging the cylinder components and contaminating the hydraulic oil. You should replace your differential cylinder rod packings every year.

Clean Debris from Engine Compartment

Inspect the engine compartment, and remove all debris. Environmental debris can build up on engine components causing overheating or possible fire risks. Debris acts to insulate components limiting airflow. Worst case scenario, debris could reach temperatures high enough to cause combustion.

Inspect Bolts on Rams

Visually inspect the bolts on the rubber rams each day. If you see something unusual, shut off the engine, place the key in your pocket, remove the waterbox cover and safety guard, and inspect the bolts with a wrench. If the bolts are loose, tighten them with a torque wrench to the "Torque Specifications for Metric Bolts" listed in the Appendix. Remember to replace the waterbox safety guard and cover before using the machine.

Grease Rock Valve and Agitator Bearings

Grease the rock valve and agitator bearings using the manual greasing station located on the rear, passenger side of the stationary pump (Figure 6). If the unit was equipped with the optional automatic greasing system, check the grease levels each day and check for any damage or leaks in the system.

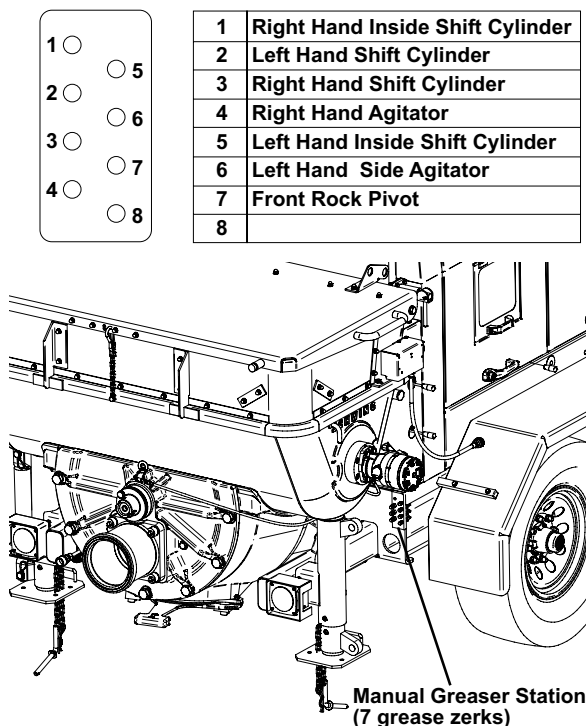


Figure 6
Agitator Grease Points

Inspect for Damage or Leaks

Visually inspect the unit for damage or leaks each day. Repairs should be made before the machine is operated.

Check if Maintenance is Due

Check your "Scheduled Maintenance Checklist" to see if any weekly, monthly, semi-annual, or annual maintenance is due.

Check Hydraulic Pressures

Check your main pressure cut-off pressure cut-off setting. Pressure relief settings are shown below and on the hydraulic schematic that shipped with this unit. Changes in pressures may indicate trouble in one or more hydraulic components.

Component	Pressure
Pressure Cut-Off	300 bar
Main Relief	310 bar
Agitator Relief	200 bar
Auxiliary Relief	200 bar

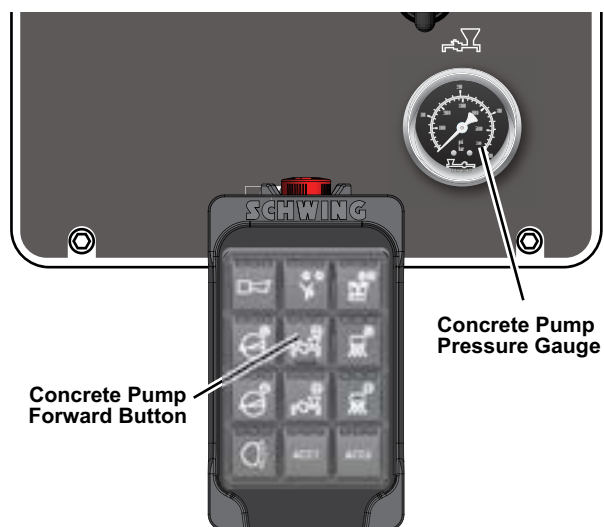


Figure 7
Operator Control Panel and Pressure Gauges

Checking Main Pressure Cut-Off

With the engine running and E-stops cleared, increase the throttle to maximum RPM. Close the quarter turn valve (Figure 8). Put the concrete pump into forward using the Concrete Pump Forward button. With the quarter turn valve closed, the concrete pump will not be able to shift. The reading on the concrete pressure gauge will show pressure cut-off (Figure 7). If the reading is different from your schematic, refer to "Setting Main Relief Pressure" on page 130.

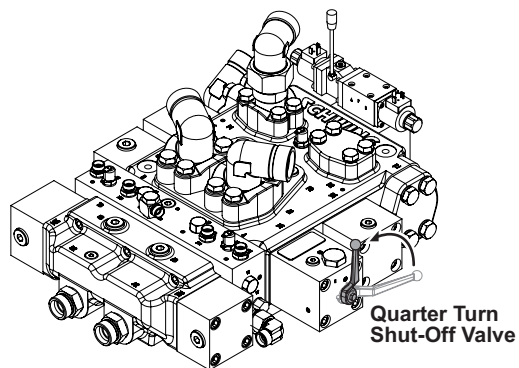


Figure 8
Closing the Quarter Turn Valve

Weekly Maintenance

Adjust the Rock Valve Tension Nut

Remove the 16-mm keeper bolt, grasp the tension nut by hand, and turn it clockwise (Figure 9). There are holes for the keeper bolt on the spacer behind the tension nut. The object is to place the keeper bolt in the furthest hole that you can reach when you turn the tension nut by hand. If the tension nut will turn enough to get all the way to the next hole, then turn it back to the previous hole. Do not put a wrench on the tension nut to get it to go to the next hole. Replace and tighten the keeper bolt. Over-tightening the tension nut will cause premature wear on the kidney seal.

The tension nut adjusts the spacing of the rock valve on the kidney seal end. Spacing between the spectacle plate and cutting ring is compensated for by the pressure spring as the spectacle plate wears.

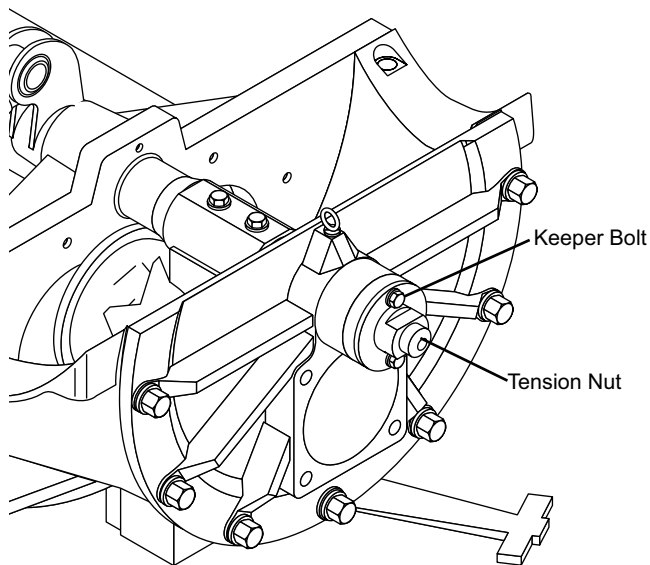


Figure 9
Adjusting the Rock Valve Tension Nut

Inspect and Rotate the Cutting Ring

Needing to rotate the cutting ring depends more on the type of concrete and the number of cubic yards pumped than on a time schedule, but it should be checked for wear at least once per week and rotated as needed.

To rotate the cutting ring:

1. Turn off the engine and put the key in your pocket.
2. Loosen the tension nut as explained in the “Adjust the Rock Valve Tension Nut” procedure.
3. Loosen the eight cover bolts a couple of threads, but do not remove the bolts (Figure 10).
4. Loosen the 12 x 35 bolt on the end of the rock shaft by the slewing lever.
5. The rock valve will slide far enough out for you to loosen the cutting ring.

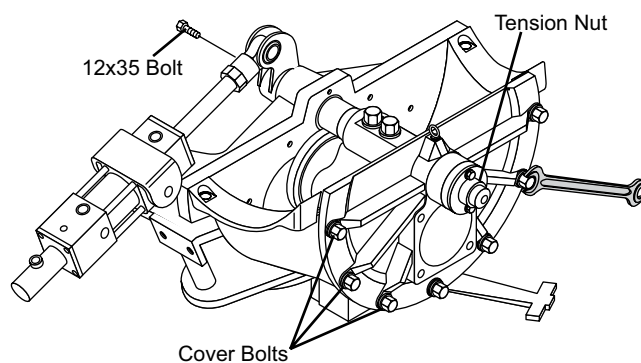


Figure 10
Loosening Bolts on Rock Valve Cover and Shaft

6. Lift the hopper grate and secure with locking pin.
7. From inside the hopper, tap the cutting ring forward, towards the spectacle plate. The ring should come loose. (If it does not, loosen the cover bolts a little more, then gently pry the rock valve rearwards a little more). Rotate the ring 90 degrees clockwise (Figure 11). It does not matter which way you rotate, but to keep from forgetting which way you went last time, we recommend going clockwise each time.

Rotate the Cutting Ring 90 Degrees Clockwise

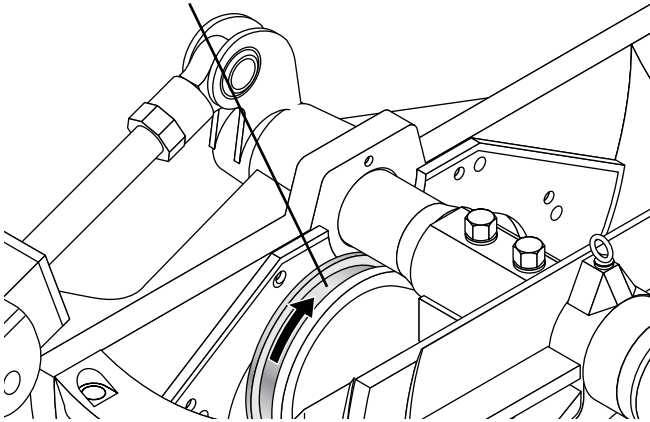
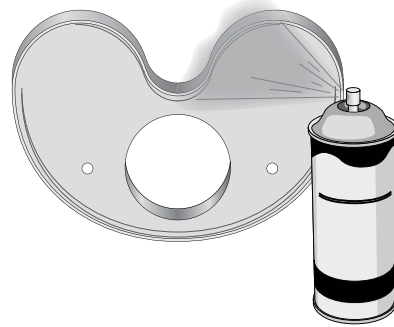


Figure 11
Rotating the Cutting Ring

8. Center the cutting ring in the rock valve. Tighten the cover bolts slightly, if needed, to be sure that the ring is not crooked.
9. Tighten the cover bolts just enough to bring the back plate up against the rock housing. Then tighten each bolt equally, using a torque wrench. Alternate which bolts you tighten, as you would when tightening a wheel on a car. The torque specs for these bolts (M20 x 65, 8.8 hardness) is 300 ft-lbs.
10. Tighten the tension nut according to the instructions in the "Adjust the Rock Valve Tension Nut" procedure. Tighten the keeper bolt.

Lubricate Mechanical Moving Parts

Lubricate mechanical moving parts with oil or a lubricant such as WD-40. This applies to pins, hinges, valve handles, and other components.



Monthly Maintenance

Check the Unit Mounting Hardware

Check for bolt tightness, cracks, and other abnormalities on the subframe, hydraulic tank, pumpkit, differential cylinders, and material cylinders.

Clean the Hydraulic Oil Cooler Fins

Spray out the coils of the oil cooler with a high-velocity water nozzle or pressure washer (Figure 12). If you use a pressure washer, be careful not to get so close that you damage the electric motor or bend the cooler fins.

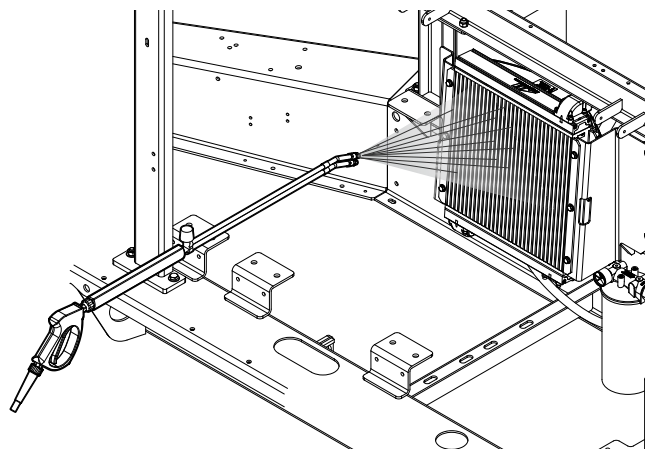


Figure 12
Pressure Washing Oil Cooler

Never point or aim the gun/wand at yourself or anyone else. Never put your hand, fingers or body directly in front of the spray nozzle.

Do not spray directly at electronics or electrical components.

Semi-Annual Maintenance

Change Hydraulic Oil (Seasonal Change)

If the machine will be used in a location where seasonal temperature changes are extreme, replace the machine's hydraulic oil every 6 months. Use an oil of the correct viscosity for the temperature in which the machine will be operated. If the used oil is saved in clean barrels that are then properly stored, the same oil can be reinstalled in the machine when another seasonal temperature change occurs. Hydraulic oil can be used for a maximum of two 6-month seasons. Contact your hydraulic oil dealer to obtain clean barrels and for proper storage procedures. Use a filter cart for transferring hydraulic oil. If you do not own one, consider buying or renting one. When changing the hydraulic oil for temperature reasons, use the "Change Hydraulic Oil (Age Reasons)" procedure on page 124.

Change Hydraulic Oil Return Filter

1. Make sure the engine is shut off. Place the key in your pocket.
2. Position a pan or bucket under the filter housing to catch drips. The check valve built into the filter, which prevents back flow, should not allow much leakage oil, but there will be some. Oil spills contaminate the environment.
3. Unscrew the filter element. Use an oil filter wrench, if needed.
4. Remove the spin-on element, and pour the oil out into the catch pan. Do not reuse this oil.
5. Remove the old element and replace with a new element.
6. Apply light grease around the gasket of the new filter, such as Lubriplate 105.
7. Tighten by hand, with the oil filter wrench, tighten another half turn.
8. Start the engine, and check for leaks.

Change Fuel Tank Breather Filter

Change the fuel tank breather filter every 6 months. The fuel tank breather filter protects the fuel in the tank from airborne moisture and particle contamination. Over time this filter can become clogged, leading to contamination in the fuel tank.

Annual Maintenance

Change Hydraulic Oil (Age Reasons)

Change the hydraulic oil annually. If you have recently changed the hydraulic oil because of changing weather conditions, you can ignore this procedure. The same filling rules that apply to adding hydraulic oil apply to filling the tank after draining and cleaning. Use the following procedure to change the hydraulic oil:

1. The engine must be shut off. Place the key in your pocket.
2. The oil should be cool. This is for safety reasons. Do not change oil that is above 120°F (50°C).
3. Drain the old oil into barrels or another waste oil receptacle. The oil can be pumped out of the inspection cover on the top of the tank or drained out of the bottom of the tank.
4. Once the oil is drained, clean the tank through the inspection cover using cleaning solvent and lint-free rags. Do not use gasoline! Remove all silt from the bottom of the tank.
5. Close the drain, if open. Refill by pumping new hydraulic oil out of the barrels with a filter cart. If you do not own one, consider buying or renting one.

 NOTE

Unfiltered new hydraulic oil is not clean enough to use in the machine. Filter oil to meet ISO 4406 code 18/16/13.

6. If this step is ignored, trouble with pumps and valves may occur immediately or within the first few days. See the information at the beginning of this section for specific information about hydraulic oils that are approved for use in SCHWING machines.
7. Change the main return filter before restarting the machine using the "Change Hydraulic Oil Return Filter" procedure on this page.

Safety Inspection

Some countries require annual safety inspections to be carried out by qualified personnel. Check your local regulations for requirements or reference the Safety Manual that shipped with your machine.

Inspect Lifting Frame Rings

The lifting frame rings must be inspected once a year or more frequently if the rings are subjected to heavy use.

Condition of the lifting rings and all repairs should be documented.

Immediately stop using lifting rings that show the following defects:

- Deformation
- Cuts, notches, cracks, incipient cracks
- Rings cannot freely rotate or turn
- Severe corrosion
- Wear exceeding 10% in the ring diameter area
- Unreadable identification marks

Re-Grease Hydraulic Pump Splines

SCHWING recommends removing and re-greasing all hydraulic pump splines with Texaco-Chevron coupling grease once a year.

Inspect Axle Bearings and Trailer Brakes

The axle bearings and trailer brakes must be inspected at least once a year.

Inspect the axle bearings and the brake magnets, shoes, and hubs for signs of wear, corrosion, and breakage. Document all repairs and replacements.

As the brake magnets and shoes become worn, they need to be changed to maintain maximum braking capability.

Clean brakes as needed. Clean the backing plate, magnet arm, magnet, and shoes, and make sure that any and all parts removed for cleaning are placed back into the same brake drum assembly.

Inspect Shroud Door Gas Springs

Open each shroud door. Ensure that the gas springs finish raising each door completely after the door has been opened approximately three-quarters of the way.

Unscheduled Maintenance

The following components will have to be maintained on the machine. The time of service varies dramatically from unit to unit because of the wide range of applications to which these machines are subjected. Differences in concrete and pressure play a major role in the wear of these components.

Changing Rams

When small bits of sand or pebbles are visible in the waterbox at the end of the day, it is time to change the rams.

To assist in ram replacement, SCHWING offers a ram change mode feature. This feature drops engine RPM and stroke limiter outputs to minimal levels. The differential cylinders will now move as slow as possible allowing the operator to easily position the rams inside the waterbox for replacement.

When changing rams, you will have to put your hands in the waterbox on several occasions. **You must stop the engine each and every time before putting your hands into the waterbox.**

Ram Change Mode

To activate ram change mode, press the ram change button located next to the waterbox (Figure 13). When pressed, engine RPM and stroke limiter outputs will be reduced to minimal levels. You must use the pendant remote to control the concrete pump forward and reverse. All other functions on the pendant remote will be disabled. Once enabled, you can only deactivate ram change mode by shutting off the engine and restarting the machine.

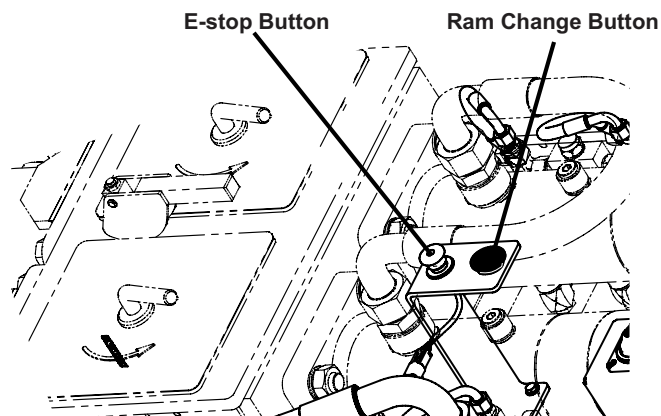


Figure 13
Ram Change Mode Button

Remove the Old Ram

1. Close the concrete pump quarter turn shut-off valve located on the concrete pump control block (Figure 14).

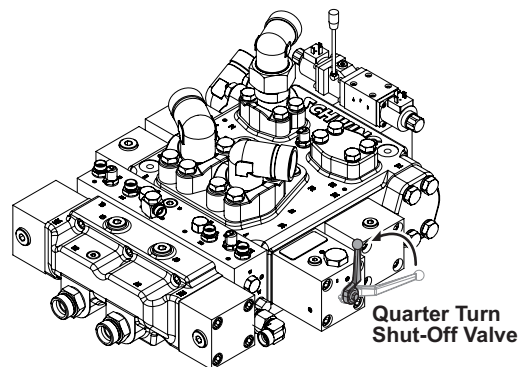


Figure 14
Closing the Quarter Turn Valve

2. Drain the waterbox. Remove the waterbox cover, and the bolt-down grate.
3. Press and hold either the concrete pump forward or reverse button on the pendant remote while simultaneously pressing the ram change button next to the waterbox; both buttons must be pressed within a half second of each other in order to move the differential cylinders (Figure 15). To stop the differential cylinders, release either the concrete pump forward or reverse button or ram change button. To activate the differential cylinder again, release any pressed button then simultaneously press the concrete pump forward or reverse button and ram change button again.

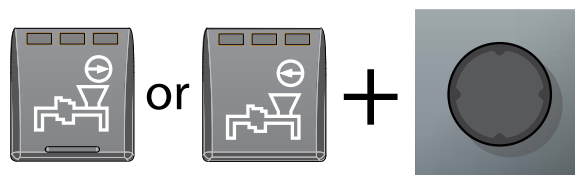


Figure 15
Press Concrete Pump Forward or Reverse Button with Ram Change Button to Move Differential Cylinders

4. Retract the left-hand side differential rod almost all the way into the waterbox (Figure 16). Leave about 1.5 inches of travel, which will allow you to remove the spacer coupling (dogbone). When in position, shut off the engine.

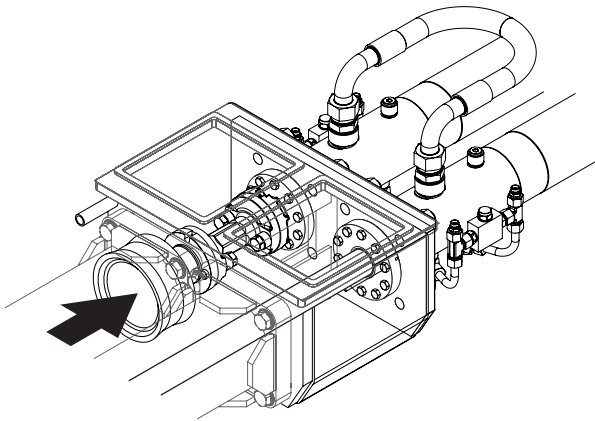


Figure 16
Retracting Spacer Coupling into the Waterbox

5. Using the 50mm open-end wrench and the 24mm X 30 mm box-end wrench provided, place the 50mm wrench on the spacer coupling to hold the assembly from turning. Use the 24mm x 30mm wrench to unscrew the four M20 bolts that hold the assembly together (Figure 17).

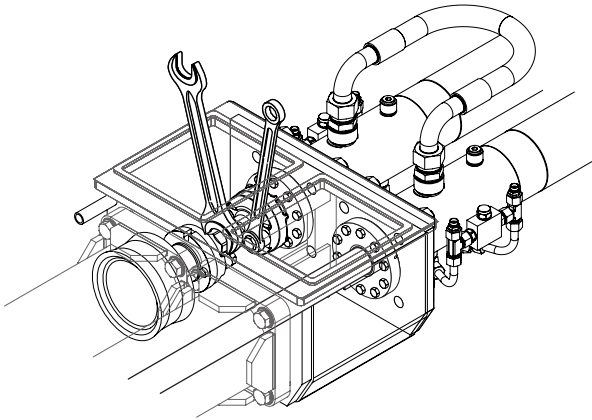


Figure 17
Loosening the Spacing Coupler Bolts

6. Restart the engine and clear all E-stop requests. With the concrete pump forward or reverse button and ram change button pressed, finish retracting the left-hand side rod into the waterbox. The spacer coupling will fall out. Release the concrete pump forward or reverse button or ram change button to stop the differential cylinders. Shut off the engine.

7. Remove the spacer coupling from the waterbox (Figure 18).

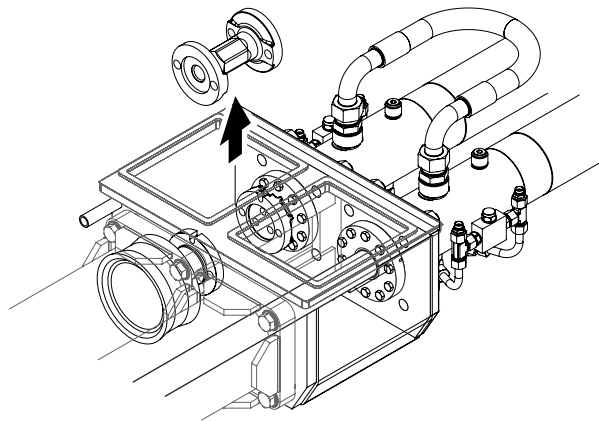


Figure 18
Removing spacer coupling

8. Restart the engine and clear all the E-stop requests. Press the concrete pump forward or reverse button and ram change button simultaneously to slowly extend the cylinder rod until it barely contacts the rubber ram flange (Figure 19). Release the concrete pump forward or reverse button or ram change button to stop the differential cylinders. Shut off the engine.

Be careful not to drive the rubber ram into the material cylinder. If you accidentally knock the ram into the material cylinder so far that you can't reach it, you will have to remove it by knocking it out from the rock valve end of the unit. Call the SCHWING Service Center at 1-888-292-0262.

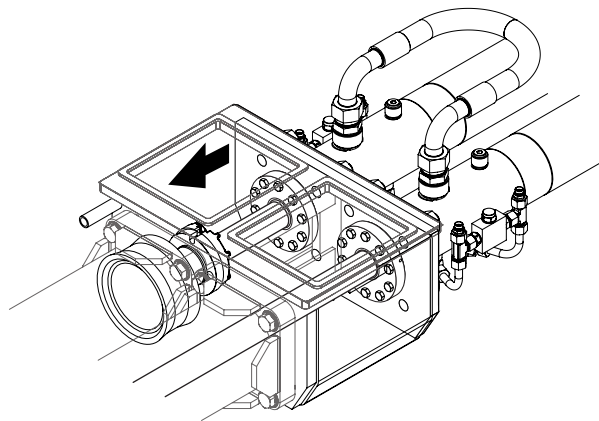


Figure 19
Extending Cylinder to Ram

9. There is a groove in the ram flange that will line up with a groove in the cylinder flange. The M12 x 45 bolt with nut will drop into this groove and allow you to pull the ram out. The fit should be snug, but there is no need to tighten the nut with tools (Figure 20). The ram flange and cylinder flange are shown outside of the waterbox for clarity of the illustration.

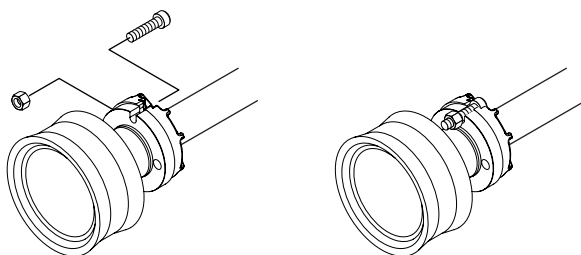


Figure 20
Bolting Ram to Differential Cylinder Rod

10. Restart the engine, and clear all E-stop requests. Press the concrete pump forward or reverse button and the ram change button simultaneously to slowly retract the cylinder rod until the ram is clear of the material cylinder (Figure 21). Release the concrete pump forward or reverse button or ram change button to stop the differential cylinders. Shut off the engine.

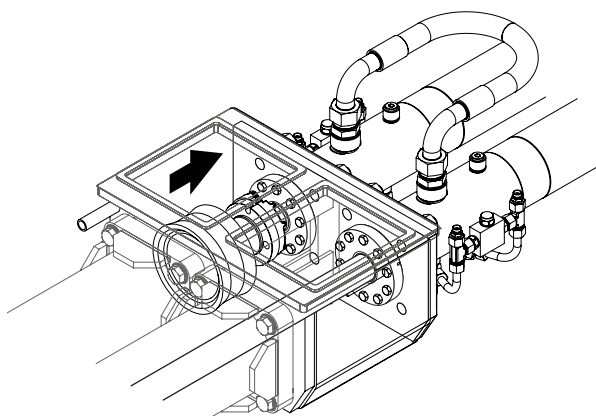


Figure 21
Retracting Ram into Waterbox

11. Remove the nut and bolt, and the ram will be free to come out of the waterbox (Figure 22).

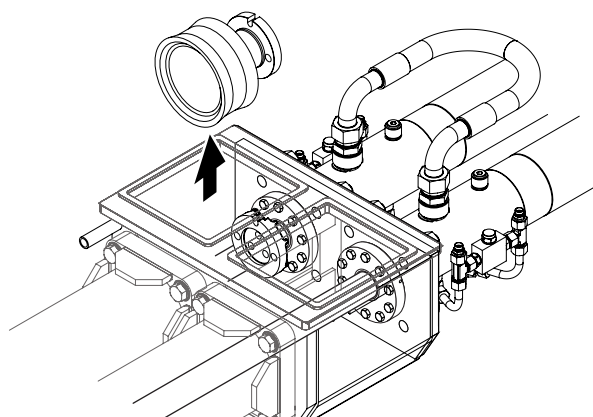


Figure 22
Removing Ram from Waterbox

Inspect Ram and Replace Piston Sealing

1. Disassemble the ram (Figure 23).
2. Replace the piston sealing. Piston sealing should fit snugly in guide ring.
3. Inspect all other components and replace if needed.

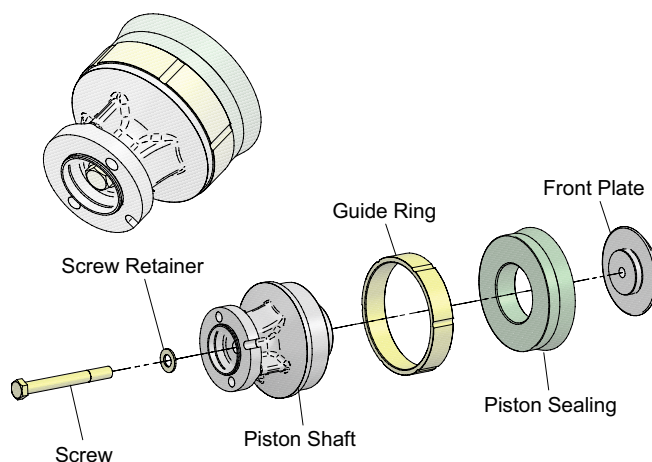


Figure 23
Ram and Components

Install the New Ram

1. Apply Loctite primer (or equivalent) to the M20 bolts. Allow the primer to dry.
2. While the primer is drying, apply a liberal coat of clean grease to the new rams. It is impossible to use too much grease during this procedure because the excess will be wiped off by the material cylinders during installation.
3. Hold the new ram up to the cylinder flange. Line up the grooves, and drop your nut and bolt into place to hold the assembly together (Figure 24). Tighten the nut only finger-tight.

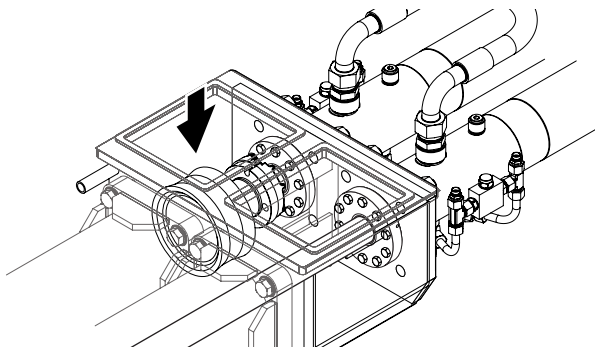


Figure 24
Installing New Ram

4. Restart the engine, and clear all E-stop requests. Press the concrete pump forward or reverse button and ram change mode button simultaneously. Slowly extend the cylinder until the ram is installed in the material cylinder but the mounting flange is still exposed enough to remove the nut and bolt (Figure 25). When in position, release the concrete pump forward or reverse button or ram change button to stop the differential cylinders. Shut off the engine. Remove the nut and bolt.

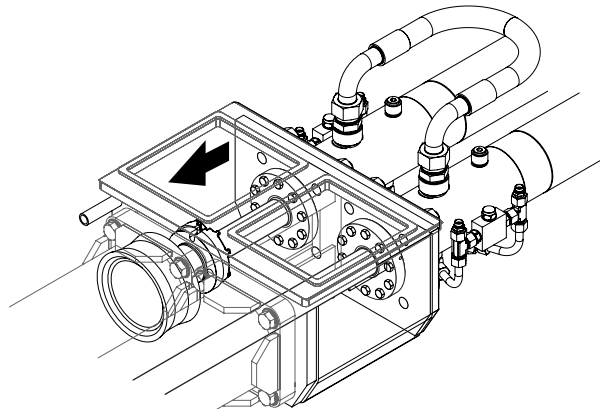


Figure 25
Pushing Ram into Material Cylinder

5. Restart the engine and clear all E-stop requests. Press the concrete pump forward or reverse button and ram change mode button simultaneously. Slowly retract the rod again (Figure 26), until there is room to install the spacer coupling.

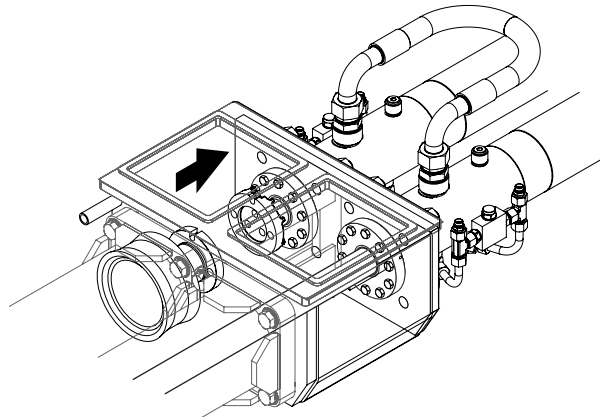


Figure 26
Retracting Cylinder Away from Ram

6. Release the concrete pump forward or reverse button or ram change button to stop the differential cylinders. Shut off the engine. Apply Loctite 242 or equivalent to two of the M20 bolts. Place the spacer coupling up against the flange of the new ram. Install two of the M20 bolts (with Loctite) and bushing; finger-tighten only.

It is important to install the spacer flange against the new ram first, not the cylinder flange. This gives you an extra 6 in to 8 in of safety margin when you extend the cylinder to meet the spacer flange. If you attach to the cylinder flange first, chances are good that you will accidentally knock the new ram into the material cylinder so far that you won't be able to reach it.

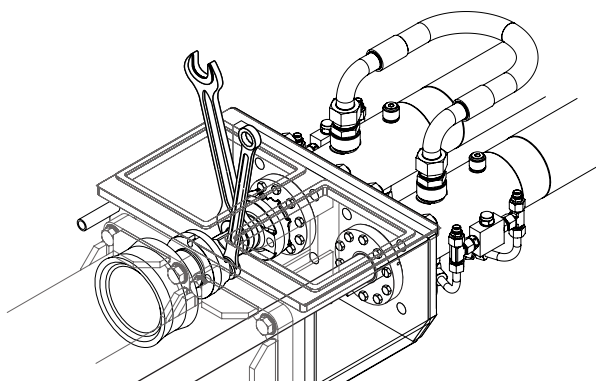


Figure 27
Attaching Spacer Coupling to Ram

7. Restart the engine, and clear all E-stop requests. Press the concrete pump forward or reverse button and ram change button simultaneously. Slowly move the cylinder down to where its flange butts up to the spacer coupling; be careful not to go too far (Figure 28).

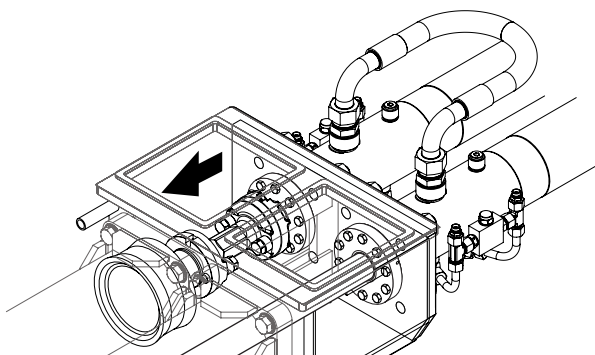


Figure 28
Moving Cylinder to Spacer Coupling

8. Release the concrete pump forward/reverse or ram change button to stop the differential cylinders. Shut off the engine. You may have to slightly rotate the spacer coupling to align the bolt holes with the cylinder flange. When aligned, coat the remaining two M20 bolts with Loctite and install, including the bushings. Once all four bolts are started, you may tighten the bolts to the torque spec for M20 10.9 bolts (420 ft-lbs).
9. Repeat all steps in the "Remove the Old Rams" procedure and "Install the New Rams" procedure for the righthand side ram.
10. Open the shut-off valve (Figure 29). The unit will not stroke with this valve closed.

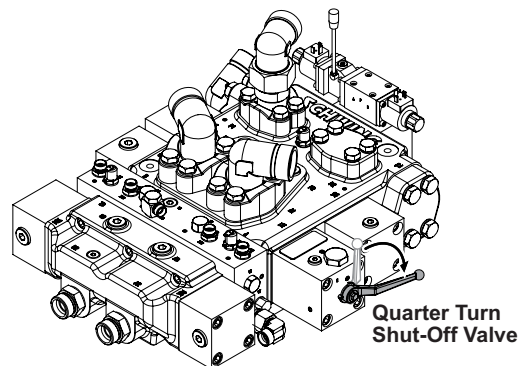


Figure 29
Opening the Quarter Turn Shut-Off Valve

Changing the Material Cylinders

The material cylinders eventually wear out. They are considered worn out when the chrome starts to wear off of the barrel. Normally the end attached to the rock valve wears out first because it sees the most concrete. The waterbox end may be in like-new condition because that end never experiences concrete. The material cylinders were designed to be able to flip end-for-end to move the worn part to the waterbox and the like-new part to the concrete valve for double the life. If you are going to do this, it is important to catch the wear on the material cylinders before they get too thin or break through in one or more spots. Once that happens, you cannot flip them because they will be structurally too weak to hold the pressure forces at the waterbox end.

The procedure for changing and aligning the material cylinders is the subject of Service Bulletin G-102/88. For additional assistance, contact the SCHWING Service Center at 1-888-292-0262.

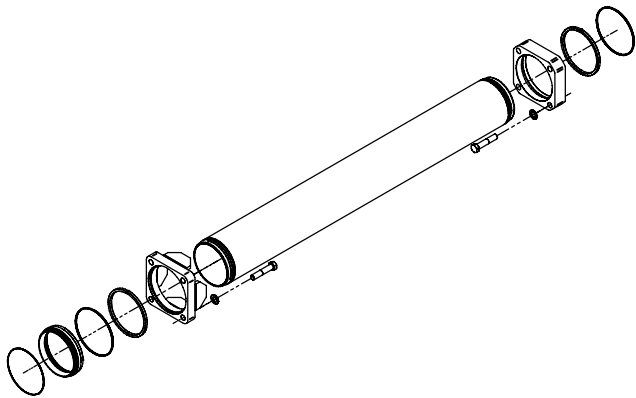


Figure 30
Material Cylinder Assembly

Setting Main Relief Pressure

Pressure settings must be made with the oil at normal operating temperatures (40°– 60°C).

Main system adjustments are preset at the factory. The following procedure begins with adjustment of the main relief cartridge and pressure cutoff. If proper pressures can not be obtained through these steps, contact the SCHWING Service Center.

It is vital that each adjustment screw be properly identified prior to making any adjustment. All screw adjustments for the system relief must be made with the pumpkit in the neutral position, and adjustments for pressure cutoff must be made with the engine shut off.

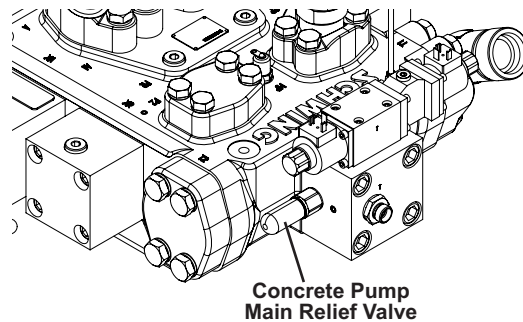
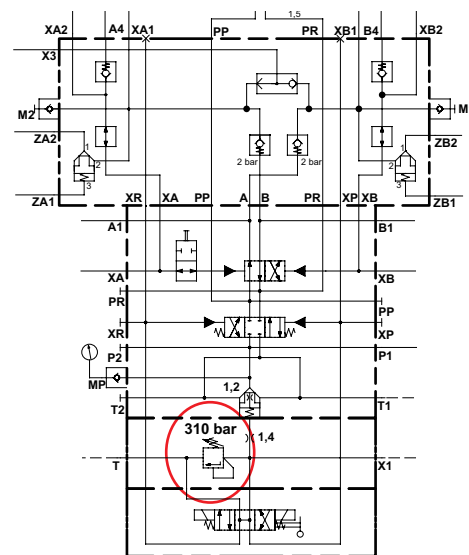


Figure 31
Relief Cartridges and Pressure Cut-Off Screw

1. With the engine running and E-stops cleared, increase the throttle to maximum RPM. Close the quarter turn valve (Figure 32).

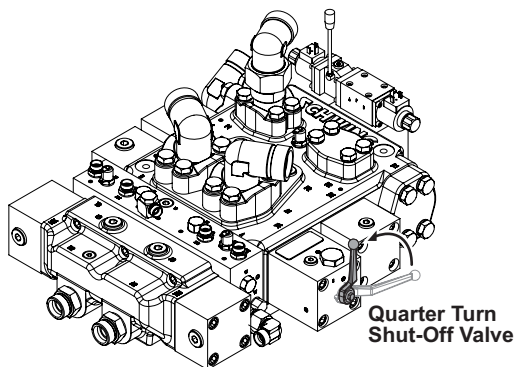


Figure 32
Closing the Quarter Turn Valve

2. At the operator control panel, select pendant control with the pendant/radio remote switch. Press and hold the stroke limiter (+) button on the pendant remote until the stroke limiter is at maximum output (Figure 33).

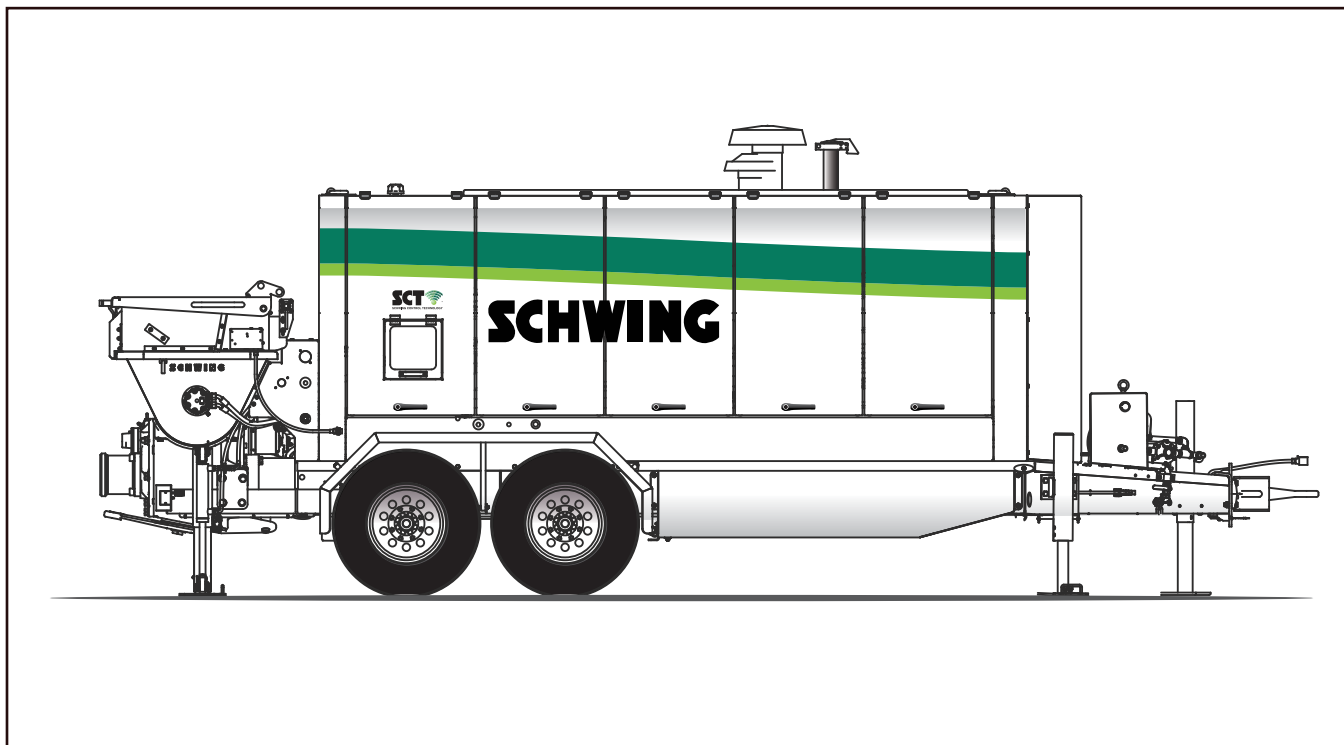


Figure 33
Pendant/Radio Remote Switch and Stroke Limiter Button

3. The main system control block pressure must be set first to properly set the pressure cutoff on the pump.

4. Go to the pressure cutoff screw on the hydraulic pump, and back off the jam nut with a 13mm wrench. Turn the adjustment screw *in* (clockwise) one quarter turn with a 4mm allen wrench then tighten the jam nut. This should raise pressure cut-off above the main relief valve pressure setting. Restart the engine and place the concrete pump into forward using the Concrete Pump Forward button. The system will pressure out, with the oil going over the main relief valve. The pressure showing on the Concrete Pump Pressure gauge will be the main relief valve setting.
5. To increase the main relief valve setting, stop the concrete pump with the Concrete Pump Stop button. On the main relief valve cartridge use a 9/16-in wrench to loosen the jam nut and a 5/32-in allen wrench to turn the adjustment screw *in* (clockwise). When increasing the pressure, the adjustments should be made in quarter turn increments. Your target pressure will be found on the hydraulic schematic.
6. When the proper main relief pressure is achieved, pressure cut-off can be set. Stop the engine and follow "Lockout/Tagout Procedure" on page 112.
7. Return the pressure cut-off screw to its original position by turning the pressure cut-off screw *out* (counterclockwise) one quarter turn and locking the jam nut.
8. Start the engine, clear the E-stops and increase the throttle to maximum RPM. Place the concrete pump into forward using the Concrete Pump Forward button. The pressure showing on the Concrete Pump Pressure gauge will show the pressure cut-off setting.
9. Go to the pressure cutoff screw on the hydraulic pump and back off the jam nut with a 13mm wrench. With a 4mm allen wrench turn the pressure cutoff screw *in* (clockwise) or *out* (counterclockwise) to achieve the target pressure shown on the hydraulic schematic.

After pressure cutoff is set, return the pump to neutral, bring engine RPM to idle, open the quarter turn valve, and either proceed to other pressure settings or shut off the engine.



Appendix

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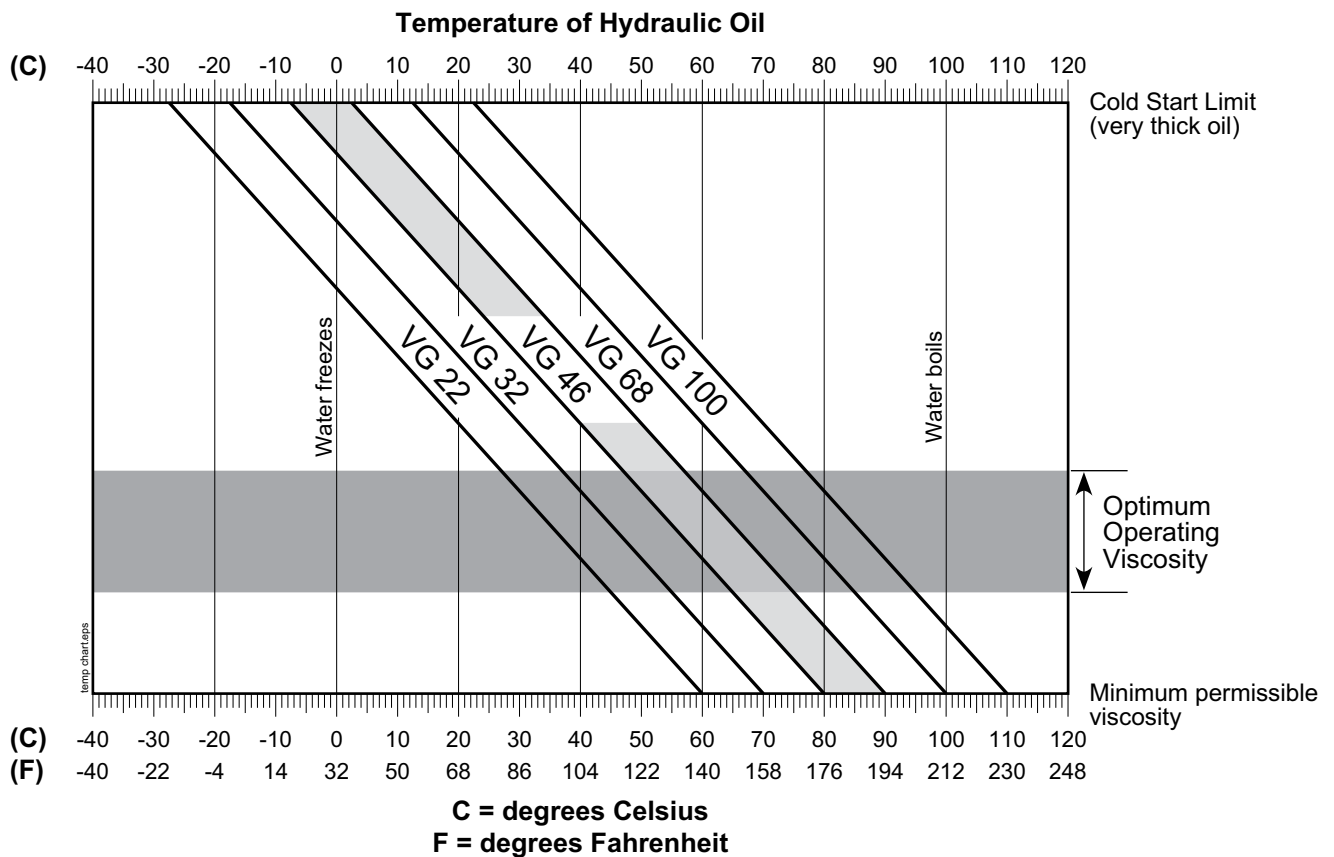
Hydraulic Oil Viscosity Chart

The illustration below shows the relationship between the oil temperature and its viscosity. As you can see, the oil gets thicker when the temperature is low and thinner as the temperature rises.

Your SCHWING concrete pump was delivered with Mobil Univis N46 hydraulic oil. This multi viscosity works for any temperature between -20°F and 100°F. If you have chosen to change to a regular viscosity oil, pay close attention to the following:

- The cold start limit represents the coldest temperature at which the oil is thin enough to flow into the hydraulic pumps. If it were any colder, the pumps would not be able to suck in the oil (cavitation).

- The minimum permissible viscosity represents the warmest temperature at which the oil will still be thick enough to provide lubrication and sealing. If it were warmer, the components would have metal-to-metal contact (thermal breakdown).
- The optimum operating viscosity is the range of oil thickness at which the oil works best (thin enough to flow easily, yet thick enough to protect the system components).
- An example of how to read a chart for VG 46 oil is given in the chart below. The chart shows the cold start limit as -8°C (18°F) and the minimum permissible viscosity as 90°C (194°F). The optimum range is 50°C to 76°C.



Torque Specifications for Metric Bolts

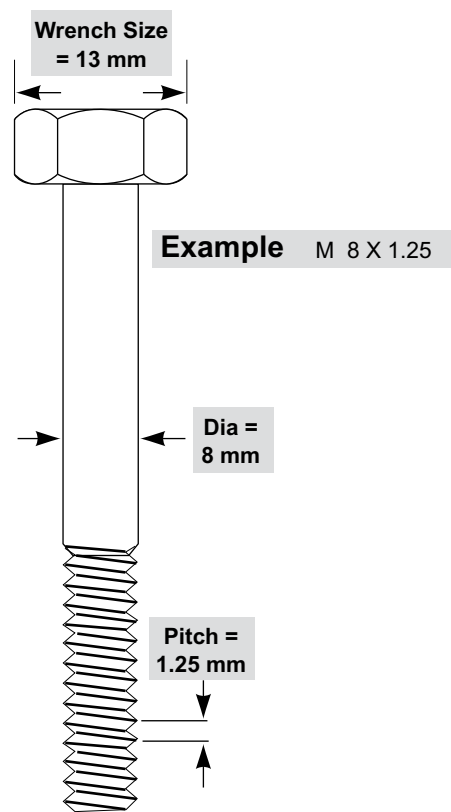
The following charts show the tightening torques specified for the bolts used on SCHWING equipment.

A torque wrench must be calibrated to within 1% of its indicated value throughout its range. Bolts must be torqued to within 4% of the requirement if the wrench has a dial scale. If no dial scale is present, the bolts must be torqued to within 6% of the requirement.

For example, a bolt to be torqued to a 200 ft-lbs requirement must be within 208 to 192 ft-lbs for a dial scale torque wrench.

SCHWING equipment uses two different types of bolts; one has a black or silver finish, and the other has a Dacromet/Geomet finish.

Torque specifications are very important for proper machine function. For more information on this subject, refer to the section on bolt tightening in the Maintenance section of this manual.



The torque specifications on the following pages refer to wrench size, bolt size and thread pitch. Above is an example showing what those numbers refer to.

Torque Chart

ZFSHL/Geomet 500 Coated

Electro-Galvanized

1. Setscrews and nuts

VALID for:	1.	ZFSHL (zinc flake coating) , GEOMET500 (GT500)
	2.	Black (PHO), electro-galvanized, galvanized screws and nuts mounted with assembly paste, such as Cu or MOS2, or with a screw lock (adhesive bond) Loxeal or Loctite.

In this case, a friction value of $\mu = 0.09$ is assumed!

Coarse-pitch thread						
Thread specification	* Mounting tightening torque (Nm, ft lb)					
	Strength class					
	8.8		10.9		12.9	
	Nm	ft lb	Nm	ft lb	Nm	ft lb
M 4 X 0.7	2.4	1.8	3.5	2.6	4	3.0
M 5 X 0.8	4.7	3.5	7	5.2	8	6.0
M 6 X 1	8.3	6.1	12	8.9	14	10
M 8 X 1.25	20	15	29	21	34	25
M 10 X 1.5	39	29	58	43	67	49
M 12 X 1.75	68	50	100	74	117	86
M 14 X 2	108	80	158	117	185	136
M 16 X 2	165	122	243	179	285	210
M 18 X 2.5	240	177	340	251	400	295
M 20 X 2.5	335	247	475	350	560	413
M 22 X 2.5	455	336	650	479	760	561
M 24 X 3	575	424	820	605	960	708
M 27 X 3	845	623	1200	885	1400	1033
M 30 X 3.5	1150	848	1640	1210	1920	1416
M 36 X 4	2000	1475	2850	2102	3330	2456
M 36 X 4**			2000**	1475**		

Fine-pitch thread						
Thread specification	* Mounting tightening torque (Nm, ft lb)					
	Strength class					
	8.8		10.9		12.9	
	Nm	ft lb	Nm	ft lb	Nm	ft lb
M 8 X 1	21	15	31	23	36	27
M 10 X 1	42	31	62	46	73	56
M 10 X 1.25	41	30	60	44	70	52
M 12 X 1.25	72	53	106	78	124	91
M 12 X 1.5	70	52	103	76	120	89
M 14 X 1.5	114	84	167	123	196	145
M 16 X 1.5	175	129	255	188	300	221
M 18 X 1.5	260	192	370	273	430	317
M 20 X 1.5	360	266	510	376	600	443
M 20 X 2	350	258	495	365	580	428
M 22 X 1.5	485	358	690	509	810	597
M 24 X 2	610	450	870	642	1020	752
M 27 X 2	890	656	1265	933	1480	1092
M 30 X 2	1230	907	1755	1294	2055	1516

* The mounting tightening torque corresponds to the axial force in the screw, whose yield point is used at 90% by traction and torsion.

** For octagonal tube boom column

Torque Chart

Black and Yellow Chromated

2. Setscrews and nuts

VALID for:	1.	Black (PHO), yellow chromated (A2C, A3C), electro-galvanized and galvanized (galv.) screws and nuts. Self-locking nuts.
-------------------	-----------	--

In this case, a friction value $\mu = 0.14$ is assumed!

Coarse-pitch thread						
Thread specification	* Mounting tightening torque (Nm, ft lb)					
	Strength class					
	8.8		10.9		12.9	
	Nm	ft lb	Nm	ft lb	Nm	ft lb
M 4 X 0.7	3.2	2.4	4.8	3.5	5.6	4.1
M 5 X 0.8	6.4	4.7	9.4	6.9	11	8.1
M 6 X 1	11	8	16	12	19	14
M 8 X 1.25	27	20	40	30	46	34
M 10 X 1.5	53	39	79	58	92	68
M 12 X 1.75	93	69	136	100	160	118
M 14 X 2	147	108	217	160	253	187
M 16 X 2	228	168	335	247	393	290
M 18 X 2.5	328	242	465	343	545	402
M 20 X 2.5	460	339	660	487	770	568
M 22 X 2.5	630	465	900	664	1055	778
M 24 X 3	795	586	1130	833	1325	997
M 27 X 3	1180	870	1675	1235	1960	1446
M 30 X 3.5	1600	1180	2275	1678	2660	1962
M 36 X 4	2780	2050	3960	2921	4630	3415

Fine-pitch thread						
Thread specification	* Mounting tightening torque (Nm, ft lb)					
	Strength class					
	8.8		10.9		12.9	
	Nm	ft lb	Nm	ft lb	Nm	ft lb
M 8 X 1	29	21	42	31	50	37
M 10 X 1	59	44	87	64	102	75
M 10 X 1.25	56	41	83	61	97	72
M 12 X 1.25	101	74	148	109	173	128
M 12 X 1.5	97	72	142	105	166	122
M 14 X 1.5	160	118	235	173	275	203
M 16 X 1.5	245	181	360	266	420	310
M 18 X 1.5	365	269	521	384	610	450
M 20 X 1.5	510	376	725	535	848	625
M 20 X 2	485	358	690	509	809	597
M 22 X 1.5	690	509	985	726	1150	848
M 24 X 2	865	638	1230	907	1440	1062
M 27 X 2	1265	933	1780	1313	2105	1553
M 30 X 2	1760	1298	2500	1844	2930	2161

* The mounting tightening torque corresponds to the axial force in the screw, whose yield point is used at 90% by traction and torsion.

Torque Chart VZD

3. Setscrews and nuts

VALID for:	1.	VZD screws and nuts
------------	----	---------------------

In this case, a friction value of $\mu = 0.12$ is assumed!

Coarse-pitch thread						
Thread specification	* Mounting tightening torque (Nm, ft lb)					
	Strength class					
	8.8		10.9		12.9	
	Nm	ft lb	Nm	ft lb	Nm	ft lb
M 4 X 0.7	2.9	2.1	4.3	3.2	5.0	3.7
M 5 X 0.8	5.8	4.3	8.5	6.3	10	7.4
M 6 X 1	10	7.4	14	10	17	13
M 8 X 1.25	24	18	36	27	42	31
M 10 X 1.5	48	35	71	52	83	61
M 12 X 1.75	83	61	122	90	143	105
M 14 X 2	132	97	195	144	228	168
M 16 X 2	205	151	300	221	352	260
M 18 X 2.5	295	218	420	310	490	361
M 20 X 2.5	415	306	590	435	690	509
M 22 X 2.5	565	417	805	394	940	693
M 24 X 3	710	524	1015	749	1190	878
M 27 X 3	1050	774	1500	1106	1750	1291
M 30 X 3.5	1430	1055	2035	1501	2380	1755
M 36 X 4	2485	1833	3540	2611	4140	3053

Fine-pitch thread						
Thread specification	* Mounting tightening torque (Nm, ft lb)					
	Strength class					
	8.8		10.9		12.9	
	Nm	ft lb	Nm	ft lb	Nm	ft lb
M 8 X 1	26	19	38	28	44	32
M 10 X 1	53	39	78	58	91	67
M 10 X 1.25	50	37	74	55	87	64
M 12 X 1.25	90	66	132	97	155	114
M 12 X 1.5	86	63	127	94	149	110
M 14 X 1.5	140	103	210	155	245	181
M 16 X 1.5	220	162	320	236	370	273
M 18 X 1.5	325	240	465	343	540	398
M 20 X 1.5	450	332	645	476	755	557
M 20 X 2	435	321	620	457	720	531
M 22 X 1.5	610	450	870	642	1020	752
M 24 X 2	770	568	1090	804	1280	944
M 27 X 2	1120	826	1600	1180	1870	1379
M 30 X 2	1560	1151	2220	1637	2600	1918

* The mounting tightening torque corresponds to the axial force in the screw, whose yield point is used at 90% by traction and torsion.

Recommended Emergency Hose Kit

SCHWING recommends that you carry one of each of the following hoses on the unit in case a hose is blown on the job. Each size listed represents the longest hose of each diameter that is installed on the unit at the factory. Keep the insides of the hoses clean until they are needed by capping the ends and using tape to hold the cap in place. Dirt introduced into your hydraulic system through the installation of a hose that was not kept clean will cause a variety of operational problems.

Diameter	Length	Part Number
8	6400 mm	30314105
13	6400 mm	30314106
16	1350 mm	10049948
20	1000 mm	10049959
25	2100 mm	30347677
32	1100 mm	10000230

A complete hose kit can be ordered through the SCHWING Service Center using the appropriate part number: 98487696.

Fitting Wrench Sizes

This chart is provided as an aid to selecting the proper wrench to hold or tighten the hydraulic fittings on SCHWING equipment. Sizes may change, so use this chart only as a guide.

Straight Fittings

Fitting or Tube Size (mm)	Metric Wrench Sizes		Nearest American Wrench Sizes	
	Cap Nut (mm)	Coupling Body (mm)	Cap Nut (in)	Coupling Body (in)
8	17	17	11/16	11/16
12	22	19	7/8	3/4
16	30	27	1 3/16	1 1/16
20	36	32	1 7/16	1 1/4
25	46	41	1 13/16	1 5/8
30	50	46	2	1 13/16
38	60	55	2 3/8	2 3/16

Banjo Fittings

End Cap Separate from Stem

Fitting or Tube Size	Metric Wrench Sizes			Nearest American Wrench Sizes		
	Cap Nut (mm)	Coupling Body (mm)	End Cap (mm)	Cap Nut (mm)	Coupling Body (in)	End Cap (in)
8 mm	17	22	19	11/16	7/8	3/4
12 / R 1/4 in	22	22	19	7/8	7/8	3/4
12 / R 3/8 in	22	27	22	7/8	1 1/16	7/8
12 / R 1/2 in	22	30	24	7/8	1 3/16	15/16
16 mm	30	32	27	1 3/16	1 1/4	1 1/16
20 mm	36	41	32	1 7/16	1 5/8	1 1/4
25 mm	46	50	41	1 13/16	2	1 5/8
30 mm	50	60	50	2	2 3/8	2
38 mm	60	70	55	2 3/8	2 13/16	2 3/16

End Cap Part of Stem

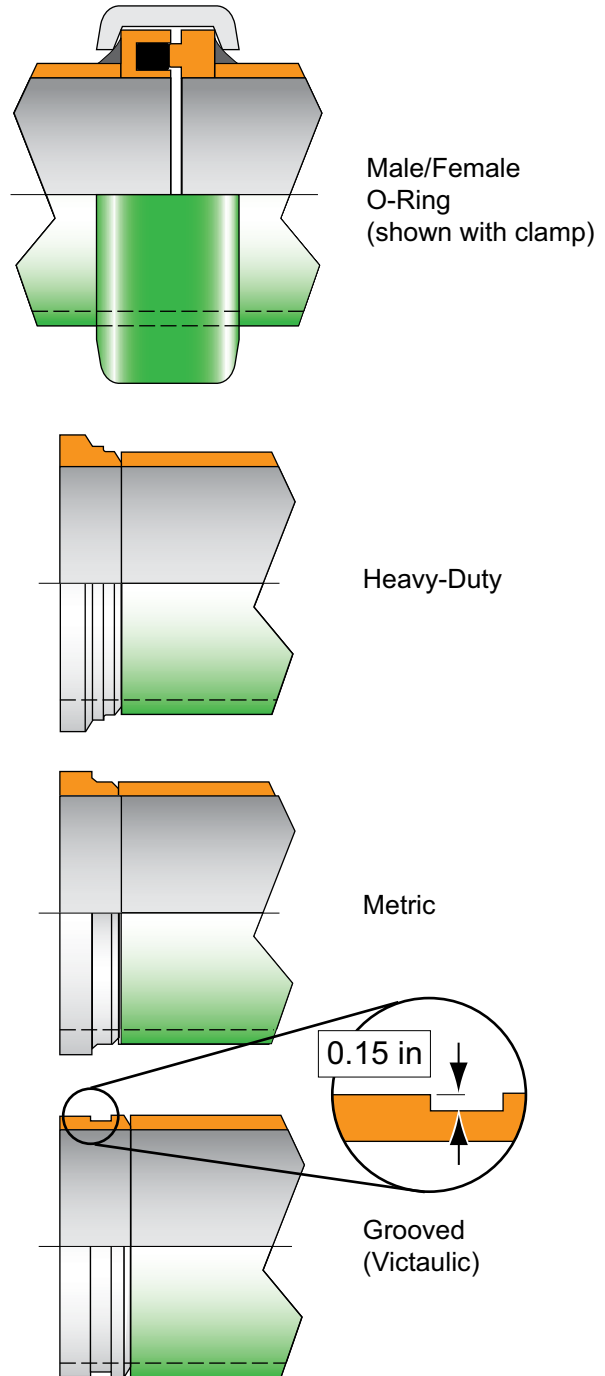
12 / R 3/8 in	22	24	22	7/8	15/16	7/8
16 mm	30	30	27	1 3/16	1 3/16	1 1/16
25 mm	46	46	41	1 13/16	1 13/16	1 5/8
38 mm	60	65	55	2 3/8	2 9/16	2 3/16

Weld-On Ends/Couplings Comparison

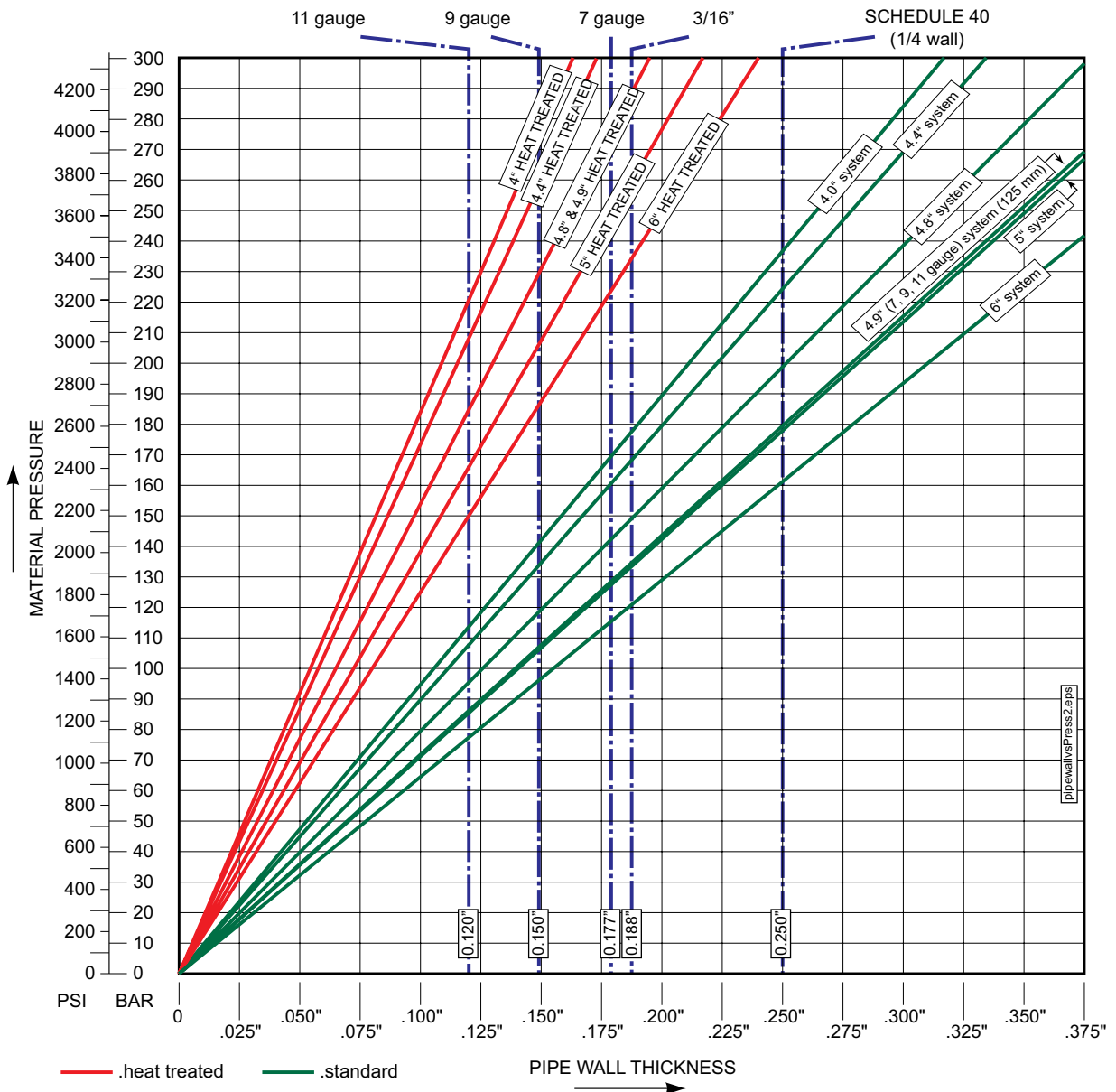
Shown is a comparison among commonly used ends/couplings. No two ends shown can be joined without the use of an adapter pipe or a special adapter clamp. Clamps and pipe strength must also be considered when determining proper system requirements. The ratios shown in the text below represent the safety factor from burst:working pressures.

1. Male/female O-ring style couplings have the highest pressure rating of the ends commonly used for concrete pumping. They can withstand 4350 psi at a 2:1 safety factor. They are self aligning and waterproof when used with O-rings in good condition. They are typically not used on booms because of their weight. Pipes equipped with this style coupling cannot be swapped end-for-end.
2. Heavy-Duty couplings are designed for pressures up to 2250 psi at a 2:1 safety factor. They have 20% more contact area than metric couplings and a tapered face that draws the pipe sections together during assembly. Both the ends and clamps weigh more than metric style and, therefore, should not be used on booms without consulting the manufacturer.
3. Metric couplings are designed for pressures up to 1400 psi at a 2:1 safety factor. They have 85% more contact area than grooved couplings. The face is flat and will not draw pipe together. Although they have a raised edge, they are not compatible with Heavy Duty couplings unless a special clamp or an adapter pipe is used to change from one style to the other. Metric connections are standard equipment on booms because of the weight savings compared with other styles.
4. Grooved couplings (lip height of 0.15 in or less) are designed for pressures only up to 750 psi at a 2:1 safety factor. The recessed groove is hard to clean when changing pipe on a job. The weld-on end fails before the pipe because the groove is cut into the pipe thickness, making it the weakest spot. Grooved couplings are not recommended for concrete pumping applications.

All pressure ratings listed refer to 5 inch (125 mm) diameters in like-new condition. Other pressures would apply to other sizes.



Minimum Pipe Wall Thickness Single Wall



1. This chart assumes a safety factor of 2:1. Higher safety factors may be required in some circumstances.
2. Wear reduces wall thickness. Thickness must be checked on a regular basis.
3. Pressures may be limited even more by clamp style or pipe end used.
4. The chart is based on 62,000 psi tensile strength. Heat-treated calculations are based on 120,000 psi tensile strength.
5. The chart is for pressure calculations ONLY. There is no allowance for mechanical forces other than pressure, and thicker walls may be needed for mechanical strength because of support or restraint considerations.
6. The chart does not take into account metal fatigue caused by pressure cycles.
7. The chart does not apply to the system at the back end of the pump. The outlet pipe, tapered bend, 6-inch elbow, and 6-inch to 5-inch reducer have a minimum wall thickness of 2 mm or .079 inches, and must be able to handle the maximum material pressure of the pumpkit.

Note! This chart is intended as a guide for concrete pumping applications and is subject to the notes, assumptions, and conditions listed above. Any other use of this chart is not recommended.

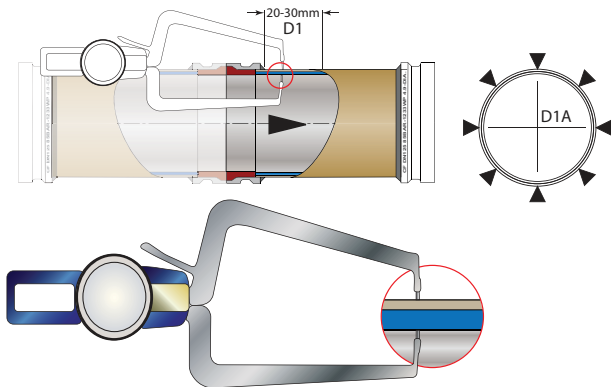
This chart does not apply to double-wall pipe. Double wall pipe can be checked by inspecting the inside of the pipe. If the insert is intact, the pipe is okay. If the insert is worn through, the pipe must be replaced. Contact your pipe supplier for the pressure capacity of your double-wall pipe.

Minimum Pipe Wall Thickness

Twin Wall

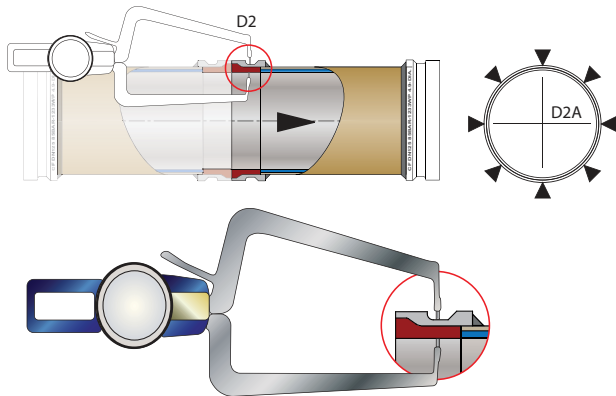
Measuring Points on Pipe Wall:

Measure multiple points circumferential, approximately 20 to 30 mm behind the weld zone (as illustrated in D1 and D1A). Measurements should be done on both ends of the pipe.



Measuring Points on Weld End:

Measure multiple points circumferential in the weld end groove as illustrated in (D2) and (D2A). Measurements should be done on both ends of the pipe.



S2000

Size	Overall Wall Thickness (New)	D1 in/mm	D2 in/mm
DN125/4.8	.180 / 4.572	.110 / 2.794	.230 / 5.842

S3000

Size	Overall Wall Thickness (New)	D1 in/mm	D2 in/mm
DN125/4.8	.188 / 4.775	.090 / 2.286	.230 / 5.842

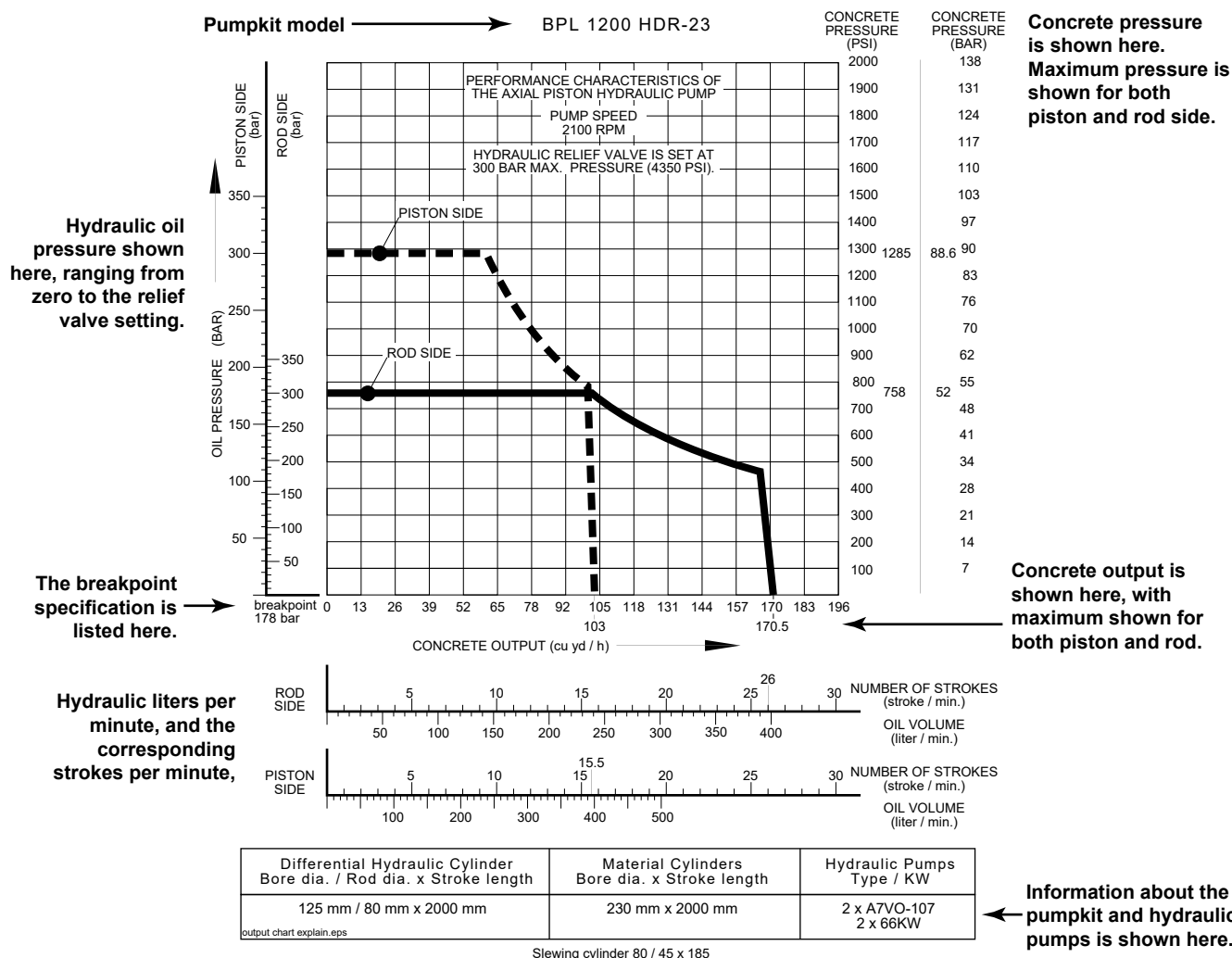
Output Charts

The hydraulic pumps that drive your concrete pump are horsepower controlled. When pressure rises past a certain point (known as the breakpoint), the pumps change their displacement per revolution, resulting in less flow and fewer strokes per minute. The reason for this is so the pumps will not stall your engine by drawing too much horsepower. Output charts show the horsepower curve (in kilowatts, or kW) of the concrete pump hydraulic circuit. From them, you can determine the:

- Maximum concrete pressure of the pumpkit.
- Maximum output (in cubic yards per hour) of the pumpkit.

- Maximum strokes per minute of your pumpkit.
- Maximum output (in L/min) of your hydraulic pumps,
- Output at various pumping pressures.
- Condition of your hydraulic pumps when used in conjunction with a flowmeter.
- Breakpoint of your hydraulic system.

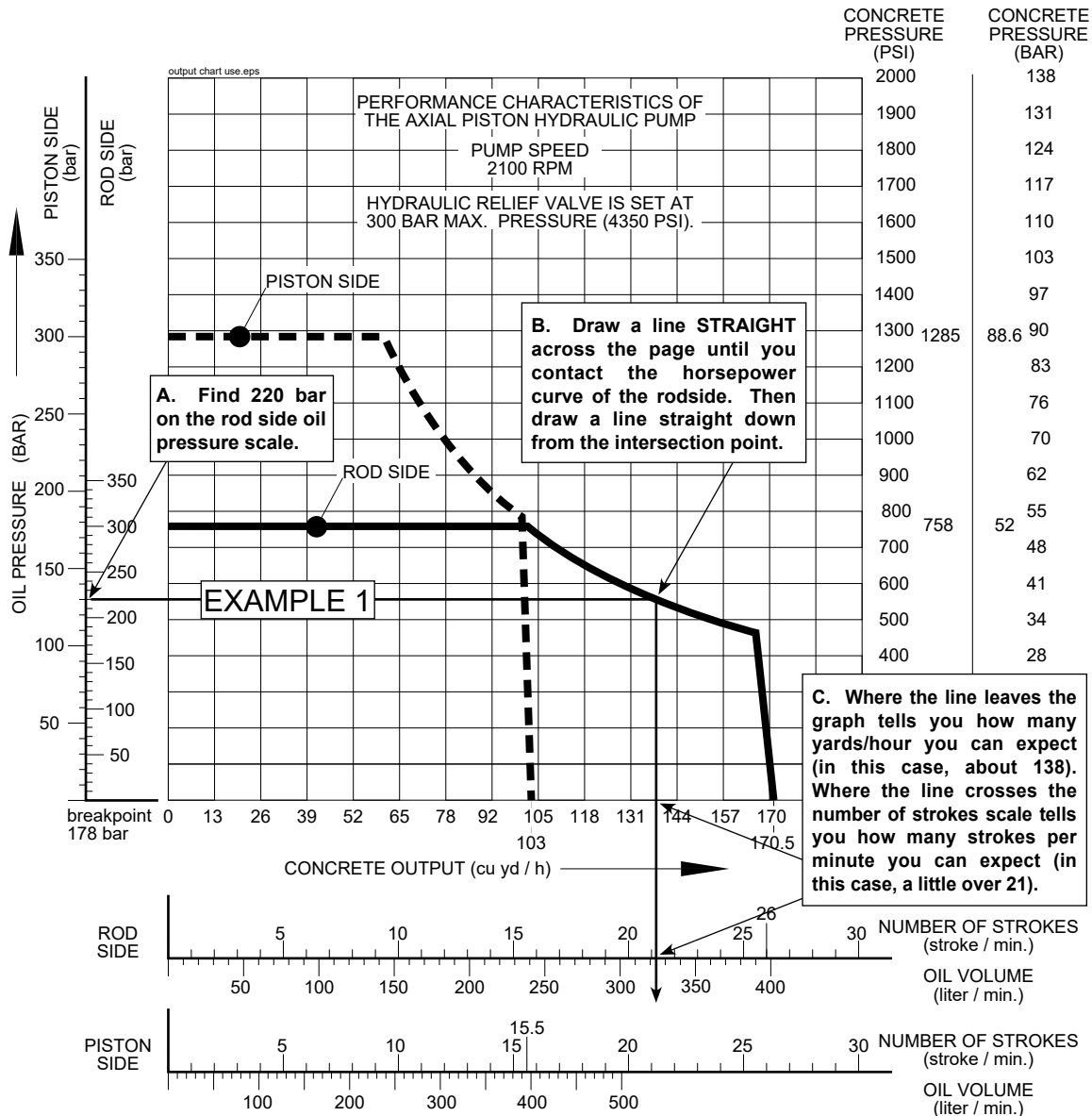
An explanation of an output chart is shown on the following pages, followed by some examples of chart usage. The output chart of the pumpkit shipped with this manual is shown later.



Example 1—Checking Flow at a Given Pressure

The machine is configured on the rod side (standard from the factory). It appears that the machine is not getting as many strokes per minute as usual. You count the strokes and see that you are getting about 21.5 strokes per minute. You check your pressure gauge and see that the hydraulic oil pressure is at 220 bar. To determine whether your unit is acting normally: locate the 220 bar oil pressure marking on the

rod side scale (Item A in the example below); draw a line straight across the page until you intersect with the horsepower curve (Item B); next, draw a straight line down from the intersection point until you pass through the rod side number of strokes scale, and read the strokes per minute. At 220 bar you should be getting a little more than 21 strokes per minute. Your unit is fine.



Example 2—Checking the Hydraulic Pumps

To determine whether your pumps are still in good working condition, use the output chart and a flow meter. Test one pump at a time, multiply the readings by two, and chart the result. You must multiply the readings because the chart is based on the output of two pumps, but we are only testing one at a time.

Breakpoint specification	1st Pump		2nd Pump	
	Liters/min (read on meter)	Total (for plotting)	Liters/min (read on meter)	Total (for plotting)
☐ 0 bar	_____	x 2 _____	_____	x 2 _____
100 bar	_____	x 2 _____	_____	x 2 _____
_____ breakpoint	_____	x 2 _____	_____ breakpoint	x 2 _____
☐ 150 or ☐ 200 bar	_____	x 2 _____	_____	x 2 _____
250 bar	_____	x 2 _____	_____	x 2 _____
300 bar	_____	x 2 _____	_____	x 2 _____

To test your pumps:

- Be sure you are using the chart that applies to your unit.
- Select the proper gear for pumping (found on the information plate mounted in the cab).
- Set the pump speed (input drive shaft) RPM. Pump speed information is found on line 16 of the Delivery Inspection Report, which arrived with your unit when it was new. A difference of even a few RPM will give you a bad reading. Check the RPM of the drive shaft with a digital tachometer if one is available.
- Know how to use your flowmeter. Read the instructions that came with it, and remember that a flowmeter must be calibrated periodically.
- Make two copies of the output chart so you don't ruin your original. You need one chart for each pump tested.

Read the flow at 0 bar, 100 bar, 150 or 200 bar, 250 bar, and 300 bar. Also, document the breakpoint. The breakpoint is where the flow drops off rapidly. You will be able to notice it on the flowmeter. If you think it would be helpful, copy the chart below. Check which reading you used (150 or 200 bar). The breakpoint will be very close to either 150 or 200 bar, so it is not necessary to take both readings. The breakpoint specification is shown on each output chart.

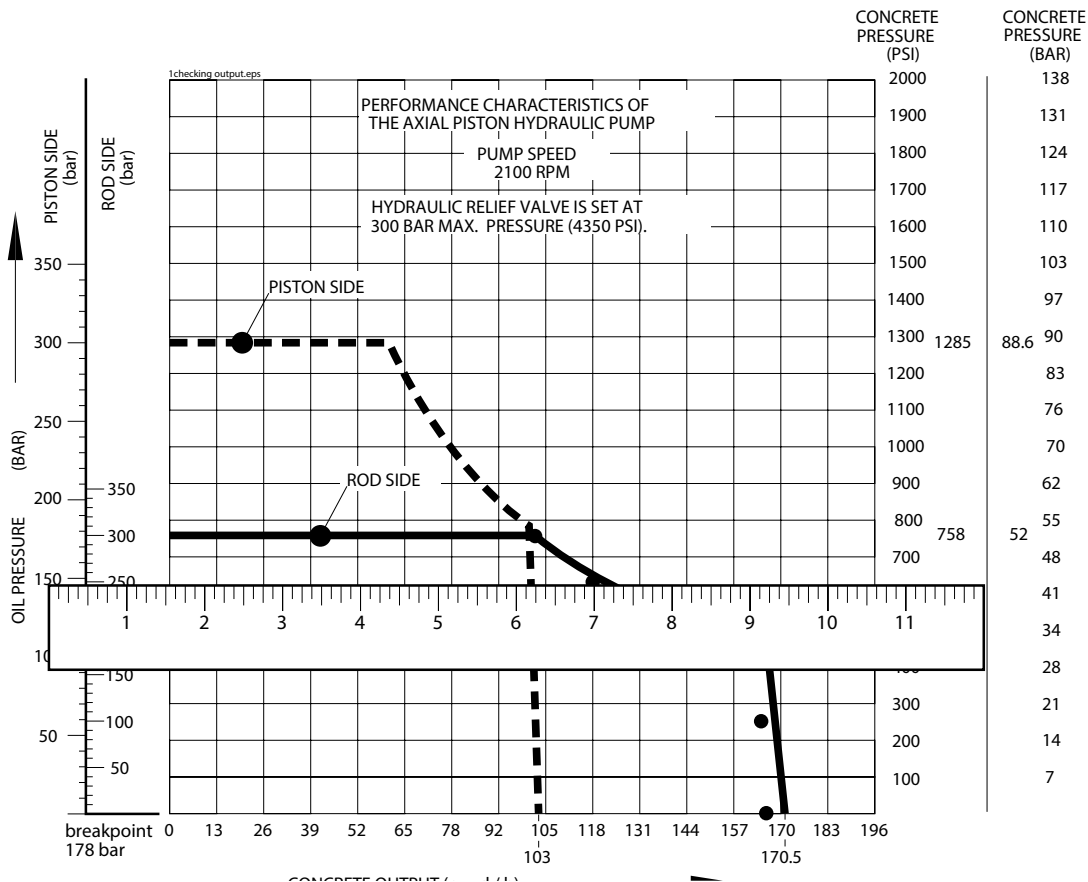
As an example, assume that these are the collected readings:

Breakpoint specification	1st Pump		2nd Pump	
	Liters/min (read on meter)	Total (for plotting)	Liters/min (read on meter)	Total (for plotting)
178	0 bar 199	x 2 398	_____	x 2 _____
	100 bar 196	x 2 392	_____	x 2 _____
178 breakpoint	194	x 2 388	_____ breakpoint	x 2 _____
☐ 150 or ☒ 200 bar	169	x 2 338	_____	x 2 _____
	250 bar 138	x 2 276	_____	x 2 _____
	300 bar 117	x 2 234	_____	x 2 _____

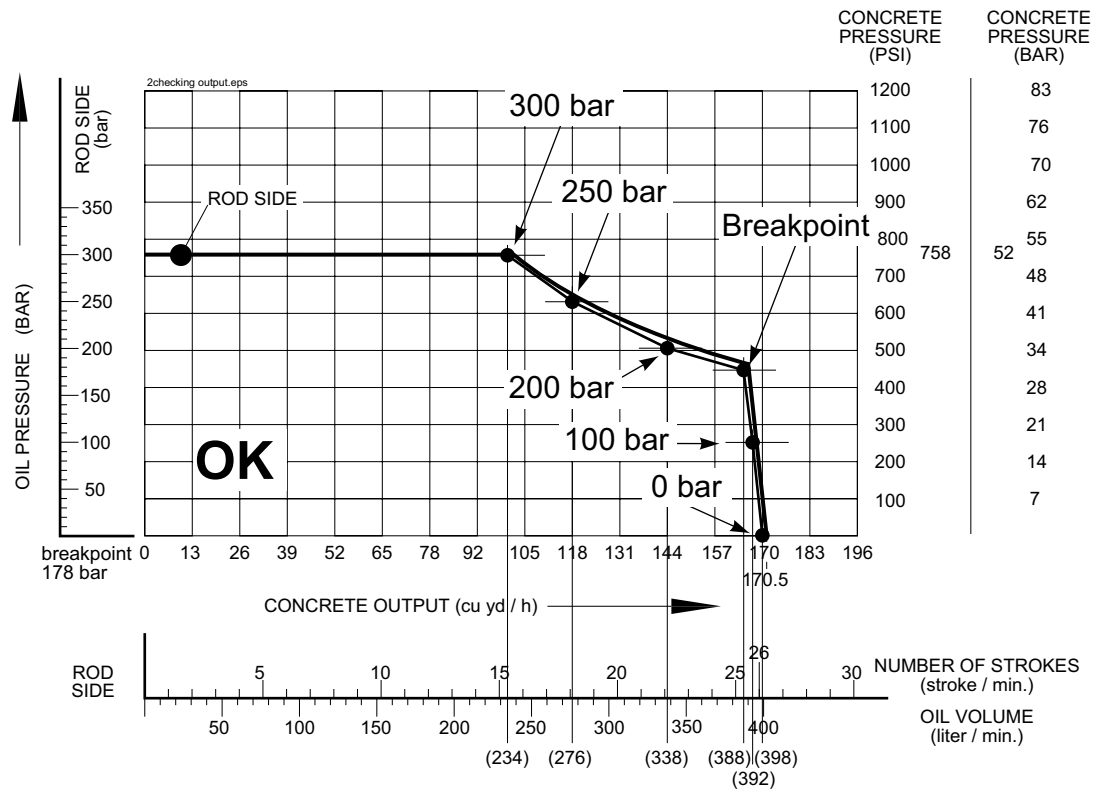
- Lay a straight edge horizontally across the page at the pressure point you are plotting. Draw a light line across the chart. The example below uses the rod side scales and curve (you could use the piston side scale and curve instead if you were configured on the piston side). The ruler is shown ready to draw a line at 250 bar hydraulic pressure.

- Turn the ruler sideways, and draw a light line up the page from the liters/minute reading you took at that pressure (remember to multiply the reading by two). In the example, 276 liters was measured at 250 bar.
- Put a dot at the point where the two lines intersect.

Do the same thing with each pressure reading. You should end up with six dots.



- Connect the dots. If the plotted line reasonably matches the specification plot on the chart, the pump is fine. If your line is to the lower left of the specification plot, the pump is getting weak. If your line is to the upper right, you have done the test incorrectly, or you are using the wrong chart. In our example, the pump is okay.

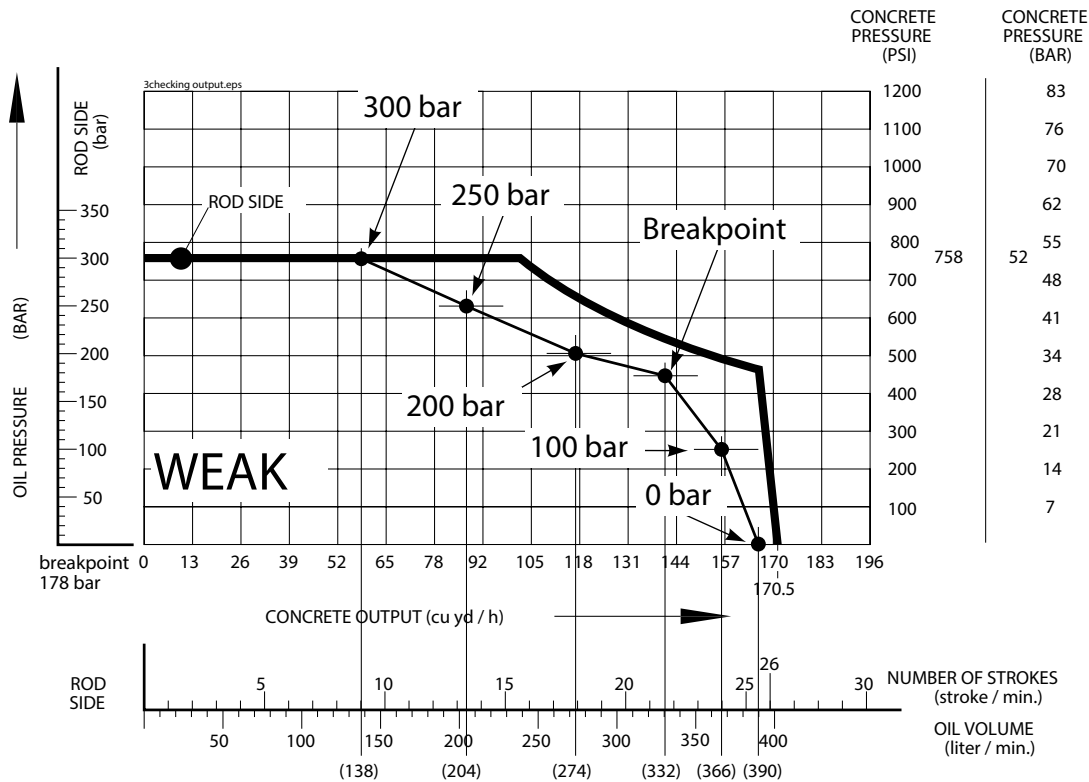


(Piston side scales have been removed for clarity.)

Check the second pump. Hook up the flowmeter just as when you checked the first pump. Again, ensure that you have the correct speed, gear, chart, and so on. This time the example will have worse results.

1st Pump				2nd Pump			
Breakpoint specification	Liters/min (read on meter)	Total (for plotting)		Liters/min (read on meter)	Total (for plotting)		
178	0 bar	199 x 2	398	195	x 2	390	
	100 bar	196 x 2	392	183	x 2	366	
178 breakpoint		194 x 2	388	178 breakpoint	166 x 2	332	
☐ 150 or ☒ 200 bar		169 x 2	338		137 x 2	274	
	250 bar	138 x 2	276		102 x 2	204	
	300 bar	117 x 2	234		69 x 2	138	

Again, plot the results on a clean copy of the flowchart. As this pump is plotted, it shows that the dots are moving quite a bit to the inside of the flow specification (see below).



Note: Piston side scales have been removed for clarity.

When you connect the dots, the line is completely below the specifications. This pump is very weak and will completely stop pumping oil soon. You may notice high heat with this unit if you are pumping at high oil pressures.

Never try to make up for a weak pump by increasing the speed of the engine. If the pump turns faster than specification, it will not be able to draw oil as fast as it is turning ("cavitation"), and immediate failure could result.

If the plotted curve matches the specification plot for a while but the breakpoint is too high or too low, it is possible to make an adjustment. Contact the SCHWING Service Center for the procedure.

There are many different possible pump kits and power settings for this unit. If you accidentally destroy your original output chart, please have your serial number handy when you call to get a replacement. Also, please advise us if you have changed differential cylinders, material cylinders, or hydraulic pumps, because you may need a different output chart than the one that was originally shipped with the unit.

Using a Nomograph

Concrete pumps are limited in what jobs they can do by three factors:

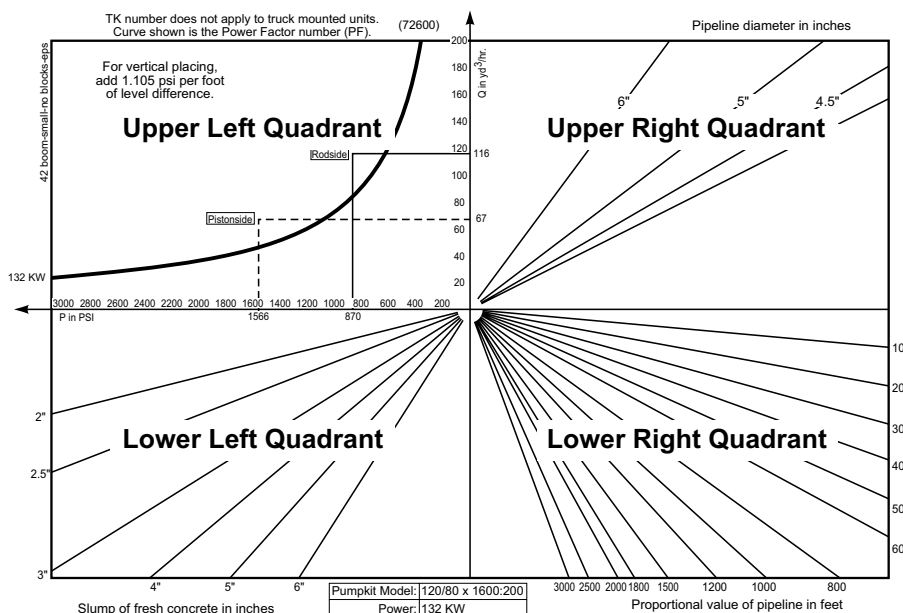
- the amount of power available,
- the maximum concrete output available, and
- the maximum concrete pressure available.

To estimate the power a pump requires to complete a particular job and to determine which pump is appropriate, a nomograph is used.

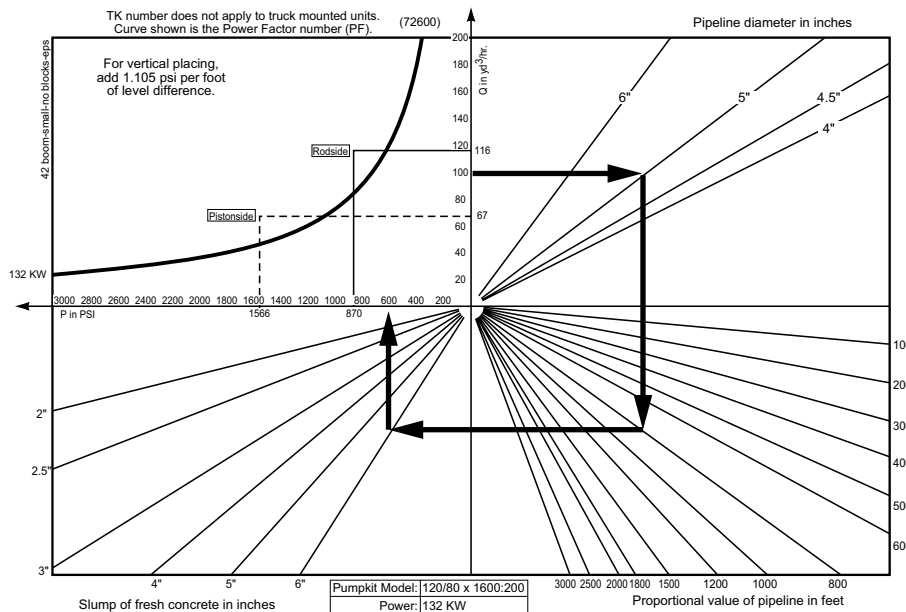
With a concrete pump that is driven by its own prime mover, such as a trailer-mounted concrete pump or a truck-mounted pump with a separate drive engine, the power rating (in kW) is shown for the engine or electric motor. With a truck-mounted pump that uses a PTO from the truck engine, the power rating reflects the power output of the hydraulic pumps only. (All the power from the truck engine is normally not available to the concrete pump and should not be used for power calculations.) If you know the required output for the job, the nomograph will help you calculate the required pressure. If you know the output and pressure, you can calculate the power requirement.

The nomograph was developed by extensive trial-and-error testing and has proven to be accurate to $\pm 10\%$ in nearly all pumping applications. The original nomographs used "spread measure" of fresh concrete instead of slump, and the two are not directly interchangeable. Some approximations are used in translating the charts from spread measure to slump, but the $\pm 10\%$ accuracy still applies. In all cases, it is assumed that you will receive fresh, high-quality concrete on your job and that the concrete will be plastic enough to flow into the material cylinders. If you know that the concrete will be hard to feed into the cylinders, you should adjust the output requirement to compensate for incomplete filling. For example, if you will need 50 cubic yards per hour into the form but the concrete is so stiff that it will fill the cylinders only 80%, you should multiply the required output by 1.25 ($1 \div 80\%$).

The nomograph is divided into four quadrants. The upper left quadrant is the beginning and end point of the graph, and it shows maximum output, pressure, and power for a specific machine. The upper right quadrant accounts for the relationship between concrete output and pipeline diameters. The lower right quadrant accounts for the resistance to flow of the entire pipeline system. The lower left quadrant accounts for the pumpability of the concrete.



To use the nomograph, begin at output required and move clockwise until you encounter the lines that represent your job situation. Each time you meet the line that applies, make a 90 degree turn until you come to a point on the bottom of the upper left quadrant that shows pressure required.



To illustrate the use of a nomograph, we will use a hypothetical job situation with the following specifications:

1. We will need an average output of 75 cubic yards per hour, but we will be pumping only 75% of the time. The rest of the time will be spent moving hose, removing pipe lengths, waiting for concrete trucks, and taking care of miscellaneous jobs. This means that when we are actually pumping, we will need an output rate of $75 \div 75 = 100 \text{ yd}^3/\text{hr}$.
2. We will use 5-inch diameter pipeline.
3. We will need the following pipeline lengths:

Separately laid pipeline:

- 40 ft of 5-inch rubber hose
- 150 ft of 5-inch horizontal steel pipe

Boom pipe, elbows, and deck system:

- 13 ft of 5-inch rubber hose
- 144 ft of 5-inch steel pipe (on the boom and pump deck)
- 5.25 ft of 6-inch x 5-inch reducer (on the pump)
- four 5-inch 45-degree elbows, radius 250 mm
- eleven 5-inch 90-degree elbows, radius 250 mm
- two 6-inch 90-degree elbows, radius 250 mm

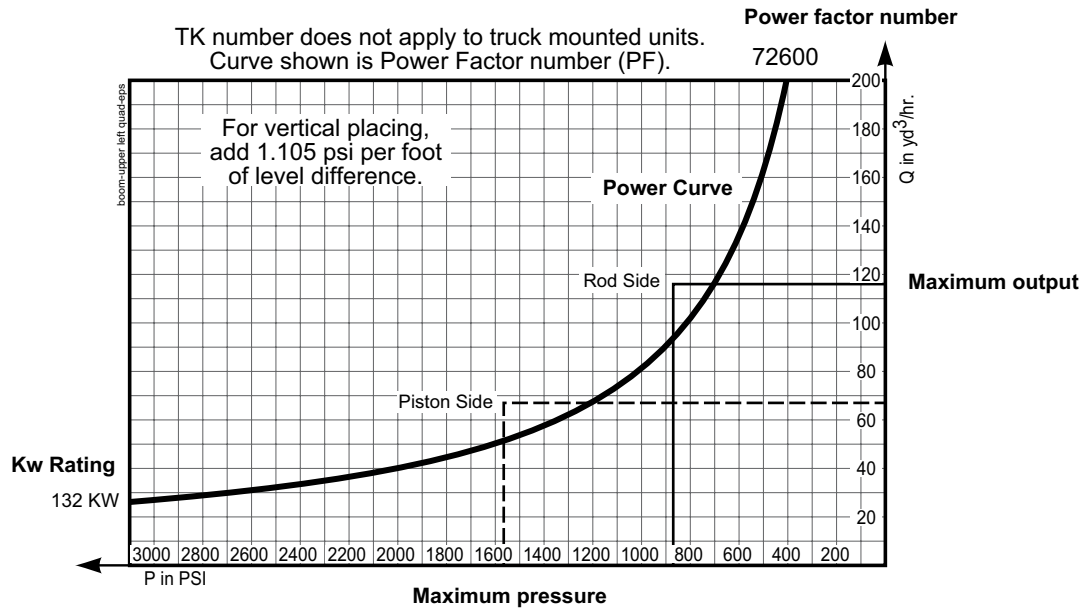
4. We will specify a slump of 5 inches x 6 inches and use the 5-inch line on the chart.

5. In addition, when we add the pressure for the vertical run, we will have to add 1.1 times 70 ft = 77 psi.

All of these criteria will be explained in detail as we go through the individual quadrants.

The Quadrants

1. The upper left quadrant describes the power curve of a given hydraulic pump Kw rating and the maximum output and maximum pressure of a particular model of concrete pump.



Any concrete pump selected for a job must meet three technical parameters:

- the power factor number of the pump must be equal to or greater than the power factor number of the job,
- the maximum output required by the job must be available from the pump, and
- the maximum pressure required by the job must be available from the pump.

It is important to notice the pump maximum pressure and maximum output, even if the power factor number of the pump is larger than the job requires. These parameters are decided during the design stage of the unit and cannot be adjusted on the job. If the unit is able to go from rod side to piston side, maximum pressure and output can be exchanged—that is, you can decrease one while increasing the other the same amount.

The power factor number (PF) replaces the TK number on a truck-mounted unit. It is the Kw multiplied by a

constant (550) that has several efficiency factors figured in. When using an Americanized nomograph (pressure in psi and flow in cubic yards per hour), the pressure multiplied by the output must always be less than or equal to the PF. For example, if you needed 50 cubic yards per hour and determined that this will require 750 psi, you can multiply 50 by 750, which equals 37,500. Any pump you select must have a PF of 37,500 or greater. If you are using a nomograph that has been converted to metric units of measure (pressure in bar and output in cubic meters per hour), you can still multiply the pressure by the output, but you must multiply the answer by the conversion factor between metric and English units of measure to get the PF. The conversion factor for cubic yards to cubic meters and for bar to psi is 18.966. For all practical purposes, you can use 19. For example, if you need 50 cubic meters per hour and determine that your job setup will require 65 bar, you can multiply 50 by 65, which equals 3250. Multiply this by 19, and you find that your PF requirement is 61,750. Again, any pump you select for the job in this example should have a PF of 61,750 or greater.

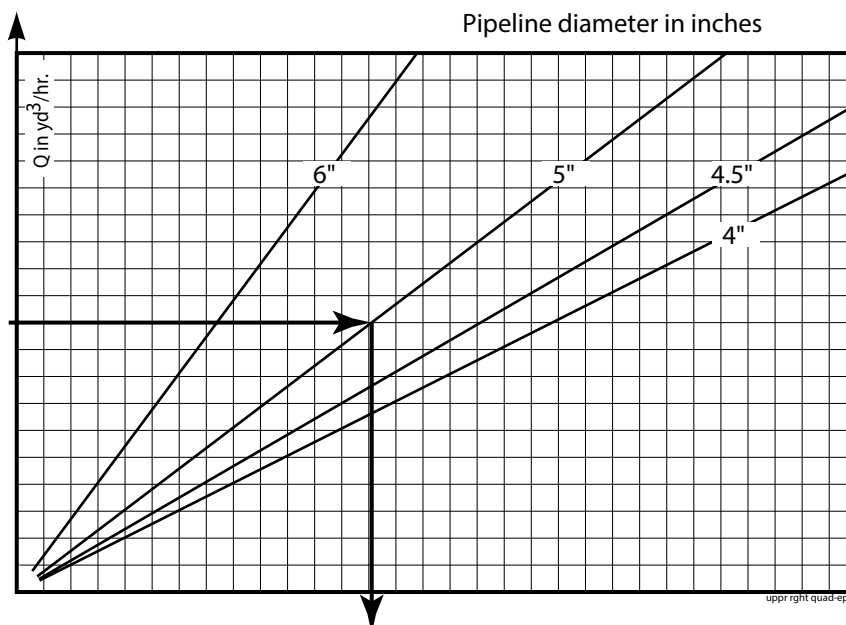
The **maximum output** (abbreviated as max Q) is determined by the size of the hydraulic pumps, the number of strokes per minute, and the size of the differential and material cylinders. The unit is usually designed so maximum output can be achieved only at less than maximum pressure.

Maximum pressure (abbreviated as max P) is determined by the size of the differential and material cylinders and the setting of the main relief valve. To be sure that the unit will handle the job, be careful to notice max P and max Q.

An example of why that is important: you contract to pump a job that requires only 20 yards per hour, and you calculate that you will need 2100 psi pressure; the PF of this job is 42,000 (20 x 2100), and the pump shown in the illustration has a TK of 72,600, so there is enough power available; however, the maximum pressure available from the pump is only 1570 psi, so this pump would not do the job.

2. Follow the chart in a straight line from required output into the upper right quadrant until you come to the size of the pipeline that you will use. A good rule of thumb for sizing pipeline is to use the largest diameter pipeline that you can. It takes less force to move concrete through a 6-inch pipeline than, for example, a 4-inch pipeline. When pressure is exerted on concrete in a pipeline, a paste of water and cement fines coats the inside of the pipeline

and forms a slippery layer on which the bulk of the concrete slides. While it is true that a 6-inch pipeline has 49 percent more surface area to coat than a 4-inch pipeline, the volume of concrete that can move on the layer is increased by 125%, which results in lower velocity of the concrete (in feet per second), lower friction, and, therefore, lower pressure. A pump that may not be capable of completing a difficult job through 4-inch or 5-inch pipe may be able to do it easily through 6-inch pipe. Experience has taught us that 5 inches is the optimum pipeline size for lengthy vertical runs, such as those found on high-rise buildings. It is large enough for most aggregate but small enough that you minimize the amount of concrete that slides back into the hopper when the concrete valve cycles, which we call backwash. You must also consider the people at the point of placement. Very few hose handlers, if any, can move 6-inch hose on a slab all day. There is no provision in the nomograph for mixing pipeline sizes. For example, if you will be reducing from 5-inch to 4-inch pipe, you should calculate the chart as if you were using 4-inch pipe for the entire distance. This will not be completely accurate, but you will be safe in your pressure calculation. In our example, we use 5-inch pipeline.



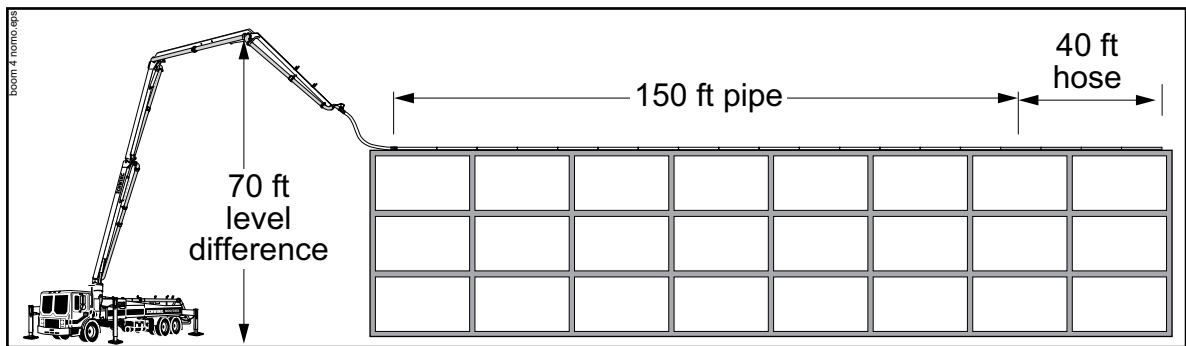
When the output line intersects the pipeline diameter that corresponds to your job, draw a line straight down into the lower right quadrant (see illustration).

3. The lower right quadrant refers to the proportional value of your pipeline. It is a way of taking into account not only the length of the pipeline, but also the number of bends, the increased resistance of flow in rubber hose, and other factors. It is more a measure of the resistance to flow than a measure of length. In calculating the proportional value of your pipeline, always apply the following criteria:

- each 90 degree bend with a radius of 250 mm (boom elbow) = 3.5 ft

- each 90 degree bend with a radius of 1 meter (long sweep) = 10 ft
- each 30 degree or 45 degree bend with a radius of 1 meter or 250 mm = 3 ft
- each section of rubber hose causes three times as much resistance as the same length of steel pipe (e.g., 12 ft of rubber hose has the same resistance as 36 ft of pipeline)

Figure all horizontal and vertical distances equally. The increased pressure required to push concrete vertically is accounted for by adding pressure, not distance. An example pipeline is shown below.



- elbow - 90 degrees, $r = 250 \text{ mm} \dots 3.5 \text{ ft}$
- elbow - 90 degrees, $r = 1 \text{ m} \dots 10 \text{ ft}$
- elbow - 30 degrees or 45 degrees, $r = 250 \text{ mm or } 1 \text{ m} \dots 3 \text{ ft}$

Example: You must go 150 feet out through the deck and boom pipe, including the tip hose, then through 40 feet of rubber hose. Calculate the proportional value as follows:

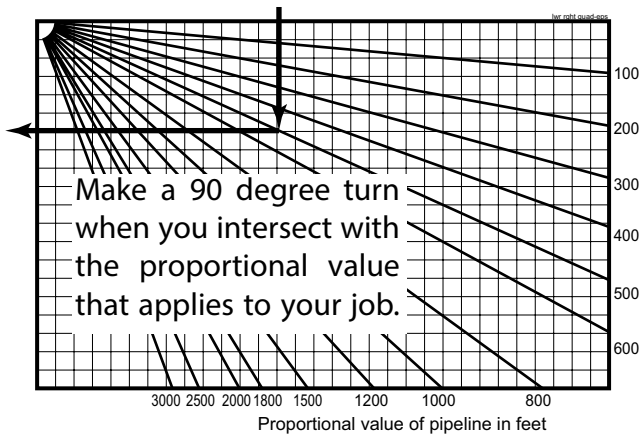
$$\begin{aligned}
 &\text{all boom system} = 260.0 \text{ ft (includes a 12-ft long, 5-inch tip hose)} \\
 &15 \text{ 10-foot pipe sections} = 150.0 \text{ ft} \\
 &40 \times 3 = 120.0 \text{ ft (for the rubber hose)} \\
 &\hline
 &\text{Total} = 530.0 \text{ ft}
 \end{aligned}$$

Round down to 500 ft to make it easy to use the chart.

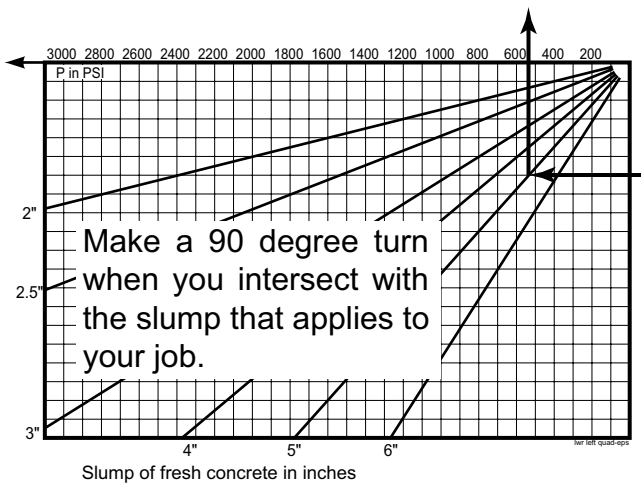
NOTE:

Proportional value of the 41-meter boom and deck pipe system is 260 ft. This value includes elbows, reducer, and tip hose.

Once you have calculated the proportional value of your pipeline, extend your line down from the upper right quadrant until it intersects with the line that represents your pipeline. When you reach the intersection, make a 90 degree turn clockwise into the lower left quadrant. As noted previously, 500 feet is the proportional value for this example.



4. The lower left quadrant refers to the pumpability of the concrete. If the concrete specifications allow a range in slump (for example 5 to 6 inches), always use the lower end to be safe. In this example, it is 5 inches. Extend the line from the lower right quadrant until it intersects with the 5-inch slump line, and then make a 90 degree turn clockwise. This will lead you back into the upper left quadrant through the pressure scale.



The line is re-entering the upper left quadrant through the pressure scale at about 550 psi. Remember, you now have to add the head pressure for the vertical rise. At 1.1 psi per foot of level difference and the 70-foot vertical run, you must now add $1.1 \times 70 = 77$ psi to the 550 psi from the chart.

$$550 \text{ psi} + 77 \text{ psi} = 627 \text{ psi}$$

When calculating the head pressure from vertical runs, it doesn't matter if the pipeline runs straight up and down or if it runs uphill at an angle. Only the level difference (in feet) is needed for the pressure calculation. If the pipeline is running downhill, the operator will need special knowledge, but you don't need to add any head pressure to the nomograph.

The nomograph is now complete. The PF of our job can be calculated like this:

$$PF = \text{psi} \times \text{yd}^3/\text{hr}$$

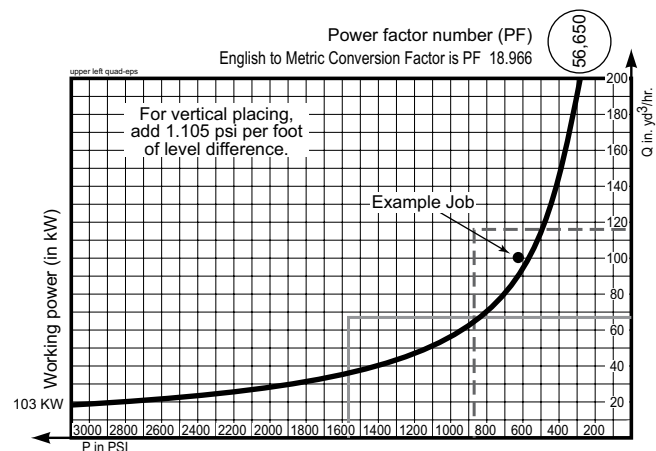
The unit needs to be capable of 627 psi and 100 yd^3/hr . The PF of this job is:

$$PF = (627 \times 100)$$

$$PF = 62,700$$

The unit must have a PF over 62,700, and it must be able to pump 100 yd^3/hr and 627 psi simultaneously. Look at the pump shown in the sample nomograph.

- Can the unit pump at 627 psi? **Yes**
 - Can the unit pump 100 yd^3/hr ? **Yes**
 - Can the unit pump both simultaneously? **No!**
- This unit will not do the job.**



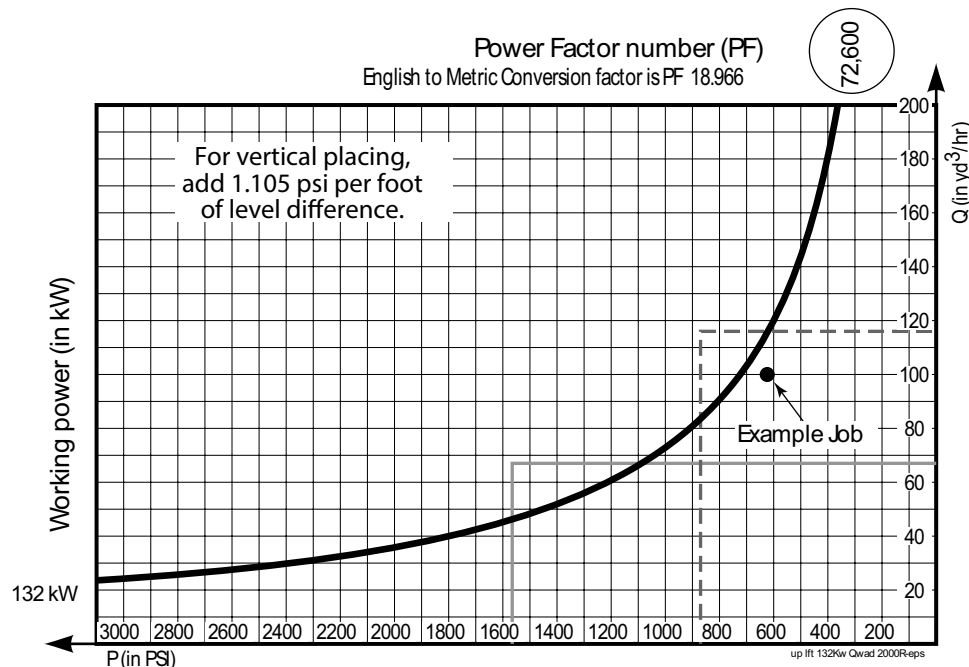
The engine is a little too small. The intersection of 100 yards³/hr and 627 psi has been plotted for visual representation, but you can see immediately that the PF of the job (62,700) is bigger than the PF of the unit (56,650). The curved black line represents the PF of the unit. If the unit is going to be able to handle the job, the intersection of pressure and yd³/hr will be to the right and down from the curved line. Anything to the left or above the line is beyond the power of the hydraulic pumps. If we could order this same unit with the pumps set to a higher kW, the PF of the higher kW unit would be 72,600, which would be sufficient.

Plotting the intersection of our hypothetical job again, you can see that it falls within the power zone of the hydraulic pumps of the higher kW unit.

Bearing in mind that the nomograph should only be considered accurate to within ± 10 percent, you should always calculate conservatively, and allow for the graph tolerance. In the case of our example, we should still be safe even if the pressure required were 10% greater

(690 psi). What if you already own the pump shown in our example? Is there anything that can be done to the job specifications to make the unit with the less powerful pumps work? You could use the smaller PF unit if you can get permission to do any of the following things:

- Pump the top of the building at 85 yd³/hr instead of 100 yd³/hr.
- Pump the top of the building at a 6-inch slump instead of 5 inches. (This would still be within specifications.)
- Remove some of the rubber hose at the end of the horizontal run. Normally, with job circumstances that did not require a substantial vertical run, you could also use 6-inch instead of 5-inch diameter pipeline. But in this example, the entire vertical run was made with the boom. The boom can never support a 6-inch pipeline.



Glossary of Terms

Accumulator

A hydraulic device that stores fluid power energy in much the same way that a capacitor stores electrical energy. Because an accumulator stores energy, it must be drained and depressurized before work begins on an actuator or hydraulic system equipped with an accumulator.

Agitator

A device set in the concrete hopper to keep concrete moving, which prevents it from setting. It is typically a rotating shaft to which several paddles have been mounted.

AWS D1.1

The code for structural welding with steel as defined by the American Welding Society. Sections 3, 5, and paragraph 9.25 of Section 9 apply.

Blanking Plate

Also referred to as a blanking plug or an end cap. It prevents material from falling out of the delivery system (typically the end hose) when moving a full boom over personnel or property.

Blockage

If the pump is pushing and concrete fails to come out at the point of discharge, a blockage is the cause. Blockages can create dangerous situations by causing high concrete pressure combined with the sometimes uncoordinated efforts of untrained workers to remedy the problem.

Bulk Density

The mass of a substance per volume. For example: 1 cubic foot of air weighs much less than 1 cubic foot of water; and one cubic foot of lightweight concrete weighs less than 1 cubic foot of steel-entrained concrete. Water has a higher bulk density than air, and steel-entrained concrete has a higher bulk density than lightweight concrete. All calculations for the operation manuals and specifications of concrete pumps are based upon 150 pounds per cubic foot, which is the approximate mass of hard rock (normal) concrete.

Certified Operator

An operator who has been issued a certification card by the American Concrete Pumping Association. There are several classes of certification, each relating to a different category of pump. For an operator to become certified, he or she must pass tests regarding

operation, setup, and clean out for each category of pump. They must also pass the safety rules test common to all certification categories, meet the experience requirements set forth for each category, and maintain a safe and clean driving record. Certified operators are considered qualified operators in their categories.

Certified Welder

As it relates to concrete pumping and this safety manual, a Certified Welder is a person who has applied for, taken, and passed the American Welding Society (AWS) or the European Normal (EN) test for structural steel welding. Anyone welding on a concrete pump placing boom, outrigger, tower, or other device must be certified to AWS D1.1 or EN287-1/PREN288-3.

Concrete Pressure

The force per square area that is exerted on the concrete. The concrete pressure is always a ratio in direct proportion to the hydraulic oil pressure on the concrete pump circuit.

Conductors

Materials that conduct electricity. Copper, silver, aluminum, gold, steel, and water are considered good conductors of electricity. Air, fiberglass, rubber, ceramics, and glass are considered poor conductors. All conductors have a resistance to the flow of electricity, which is measured in terms of ohms per linear foot. As voltage increases, more current flows through the same resistance. With high-voltage electric wires—8000 volts, for example—even poor conductors carry enough current through your body to ground to kill you. (As little as 35 milliamps can cause cardiac arrest.) Some conductors, such as air, resist electricity verywell, but if the voltage gets high enough, current will flow. (Lightning is a good example of this.)

Decibels

A measurement of volume equal to one tenth of a bel, abbreviated dB. As it applies to concrete pumps, it is a measurement of the sound pressure level one meter away from a noise source. Because constant exposure to loud sound can cause permanent hearing loss, OSHA has developed guidelines for time limits on exposure to sound at different volumes. The chart is in Section 6.9 of the Safety Manual.

Drive Engine

The primary source of power for a hydraulic system. Typically, the word engine denotes an internal combustion device, whereas the word motor denotes an electrical device.

Electrocution

Made by combining the words “electric” + “execution.” It means “death by electricity.”

EN 287-1 / PREN 288-3

The code for structural welding with steel as defined by the European Norm.

Expert

As used in this manual, an expert is defined as a person who, on the basis of specialized training and experience, has developed a high degree of knowledge and skill in the areas of concrete pumps, concrete pumping, clean out procedures, generally accepted engineering norms, and safety regulations to the extent of being able to evaluate equipment and processes as they relate to job safety. Experts demonstrate their knowledge and abilities by passing the certification testing and experience requirements of the American Concrete Pumping Association. Other experts may include master mechanics and after-sales service technicians of the manufacturer.

Fast Switch

A secondary hydraulic circuit added to single- circuit machines to disable the stroke limiter during the switch of the rock valve cylinder, thereby making the rock valve switch quickly. This circuit is not needed or available on twin- circuit machines.

Foreign Material

Material that was never intended to be pumped but ends up in the concrete hopper. Examples of foreign material include small animals, hammers, ready-mix truck fins, unmixed clumps of cement, hardened concrete that breaks away from ready- mix truck fins, and soft drink cans. Many of these items can create a blockage if they are pumped through the system.

Go Devil

A plug made from a rubber composite, usually with several fins that expand to seal when pressure is applied. Go devils are intended to be inserted in a steel delivery pipeline and pushed with water or compressed air for the purpose of cleaning the pipe. Not to be used with rubber hose or short sections of pipe.

Guide

An assistant brought in to help with backing up a truck or trailer or with other circumstances in which the driver cannot see enough to ensure safety.

High Voltage

For the purposes of this manual, any current over 120 Vac is considered high voltage. In the United States, electrically driven concrete pumps normally operate the motors at 480 Vac (high voltage) and the controls at 24 Vdc (low voltage). With electric wires in residential or industrial areas, the voltage is approximately 8000 volts to ground or 13,800 volts from phase to phase (distribution voltage). When dealing with electric wires that are mounted high above the ground on steel towers, the voltage ranges from 100,000 V to 1,000,000 V (transmission voltage).

Hopper Grate

A meshwork typically made from steel bars and placed over the concrete hopper. It serves to keep human body parts away from the agitator (when left in its proper position) and to keep large foreign objects from falling into the hopper, which could cause blockages if they were pumped. The hopper grate must be secured in position in order to be effective.

Jacking the Outriggers

Adjustment of the outriggers in the vertical direction. With boom-mounted concrete pumps, you should strive to make the adjustments so that the unit sits within 3 degrees of level.

Licensed Electrician

A qualified electrician licensed by the state, county, or municipality where the connections are to be made. In some locations, electricians are not required to be licensed, but the work should still be completed by a competent professional. Under no circumstances should high-voltage connections be made by a concrete pump operator or related personnel.

Maintenance

All procedures for servicing, inspection, and repair of concrete pumps and related equipment and devices. Maintenance and inspection are methods of maintaining the desired state of the equipment. Repair is the method of restoring the desired state of the equipment.

Maximum Pressure

When talking about a hydraulic system, maximum pressure refers to the highest pressure that can be achieved with the settings of the circuit relief valves. When discussing concrete output, maximum pressure refers to the pressure that will be developed if the hydraulic system pressure reaches the relief valve setting. Concrete pressure is always the force at which the differential cylinders are moving, divided by the cross-sectional area of the concrete cylinder. Maximum concrete pressure, then, is developed when the differential cylinders are moving with maximum force, which is determined by the hydraulic system relief valve setting. During normal pumping, the resistance of moving the concrete through the pipe or boom creates the pressure needed by the pump and is well under the maximum pressure.

Minimum Safety Distance

In this manual, the term “minimum safety distance” refers to the closest distance that you are allowed to approach an object or electrical wires while leaving room for errors in human judgment or machine malfunction. The distance from electrical wires in the United States is 20 feet, as recommended by the American Concrete Pumping Association. This distance may have other values in different countries.

Murphy’s Law

An old adage that says: “Anything that can go wrong, will go wrong, and at the worst possible time.”

Operational Area

The area around a working piece of equipment or point of discharge where dangers can be encountered because of the nature of the machinery or process in use. For safety reasons, do not allow unauthorized presence in the operational area.

OSHA

Occupational Safety and Health Administration. A branch of the US federal government that deals with job safety. One of the areas over which it has authority is construction job sites and workshops.

Personal Protective Equipment

Things worn to protect yourself from potential dangers in a concrete placing environment. Examples are: snug-fitting work clothes, steel-toed work boots, lime-resistant glove, safety glasses, ear muffs or ear plugs, rubber boots, and hard hats.

Point of Discharge

The location on the machine from which concrete is expelled from a delivery system. This can be the point of placement (the actual form that is being filled with concrete) or the clean out area after completion of a job.

Pour

Used by the concrete pumping industry and in this manual as a noun. It is the specific job for the pump during any given time period, e.g. “We’ll grab lunch right after the pour.”

Prime Mover

The primary power source for a hydraulic system. The term “prime mover” denotes neither an internal combustion engine nor an electric motor.

PTO (Power Take Off)

A switchable output from the transmission or an intermediate gearcase. On a concrete pump, the PTO is used to divert the power from the engine and drive train to turn the hydraulic pumps.

Qualified Operator

An individual who meets all the following qualifications:

- has reached the age of 18
- is physically and mentally capable
- has been trained in the proper operation and maintenance of the pump and placing boom, if applicable
- has demonstrated his or her capabilities to the hiring company with respect to the operation and maintenance of the pump and placing boom
- can be expected to perform assigned duties in a reliable manner

Qualified Personnel

A generic term used to describe people who are qualified to do work in their area of application. For example, having your boom repairs inspected by “qualified personnel” before use refers to inspection by a certified welder or certified welding inspector. Having repairs to your hydraulic system done by “qualified personnel” would refer to repairs made by qualified workshop personnel.

Qualified Workshop Personnel

An individual who meets all of the following qualifications:

- has reached the age of 18 years
- is physically and mentally capable
- has been trained in proper repair, maintenance, and inspection procedures plus the pertinent safety rules for concrete pumps and related equipment
- has demonstrated their capabilities to their company with regard to the procedures and rules discussed above
- can be expected to perform assigned duties in a reliable manner

Rock Jam

A specific type of blockage caused when the cement and fines of the concrete are not present in sufficient quantity to fully coat the larger aggregates and the walls of the delivery system. The rock (larger aggregates of the mix) forms a wedge inside the pipe. Resistance to movement then becomes overpowering, and the concrete stops. Increasing pressure to try to remove the wedge only results in forcing more of the finest particles past the rocks, compounding the problem. In some cases, the wedge can be broken up by alternately pumping in forward and then reverse.

Separate Pipeline

A pipeline, other than the placing boom pipeline, that is laid between the concrete pump and the point of discharge.

Shut-Off Valve

In hydraulics: a valve with the ability to stop the flow or pressure of hydraulic oil. Must be able to withstand the maximum pressure of the hydraulic circuit that it controls. In concrete: A manually or hydraulically operated valve that prevents the flow of concrete in either direction. Some concrete shut-off valves also have the ability to divert the flow of concrete to a different pipeline (for example, to a discharge point for clean out). The shut-off valve must be able to withstand the maximum pressure on the concrete of which the pump is capable.

Soil Pressure

The force per square area that is exerted on the ground by the outrigger legs. The amount of pressure that the soil will support varies with the composition and compaction of the soil. To determine the stability of the soil, see the chart in Section 5.16 of this manual.

Sponge Ball

A medium to hard, spherical sponge used to clean the inside of delivery pipelines.

Spotter

A spotter is a person who stands at a vantage point where he or she can see both the point of discharge and the pump operator. The spotter uses two-way radios or hand signals to direct the operator to operate the unit as required by the job circumstances. A spotter can be anyone who is familiar with the safety rules for the pump and workers and is equipped with a radio or knows the appropriate hand signals. A spotter is needed whenever the operator cannot safely see the point of placement or the distance between the unit and an unsafe area.

Sucking Back

The act of moving the concrete pump into the reverse mode for any of several reasons. Some examples of reasons to suck back:

- to relieve pressure in the delivery system before opening when a blockage has occurred
- to clean the boom with a sponge ball upon completion of the pour
- to remove concrete from the boom for the purpose of folding the boom for moving

Thrust Block

Also known as a "dead man." This is a large block of poured concrete, usually with one or more sweep elbows cast inside, placed at the bottom of a vertical run for the purpose of supporting the weight of the vertical run and for lateral stabilization of the pipeline. It stabilizes and supports the vertical run by virtue of its enormous mass (normally one cubic yard or larger).

Transport Position

Transport position refers to the position of the boom during transport. For transport, the boom is completely folded and lowered into the rests, and the boom straps are secured. When stowing in the traveling position because of a thunderstorm, however, the boom straps need not be secured if no travel is imminent.

Twin Circuit

The plumbing method used for the pumpkit in which the differential cylinders are moved by the main hydraulic pumps but the rock valve is moved by the oil stored in an accumulator.

Unauthorized

Without having authority or permission. Examples: Unauthorized operation of the boom could be operation by a passing teenager. Unauthorized repairs to the boom could be repairs made without the manufacturer's permission.

Unintentional Movement

Movement of the pump, boom, or related equipment without a specific, intentional command by the operator. An example of an unintentional movement is if an operator fell while walking with the remote control box and accidentally hit a joystick, which caused a boom movement. Unintentional movement can be avoided by disabling the hydraulic system with the emergency stop devices when the unit is not in immediate use.

Vertical Run

Sections of concrete delivery pipeline that run in an up and down direction. Vertical runs have very specific procedures and rules for installation, support, cleaning, and inspection. Concrete pumping personnel should, therefore, have specific training in these procedures and rules before attempting to use them in a job setting.

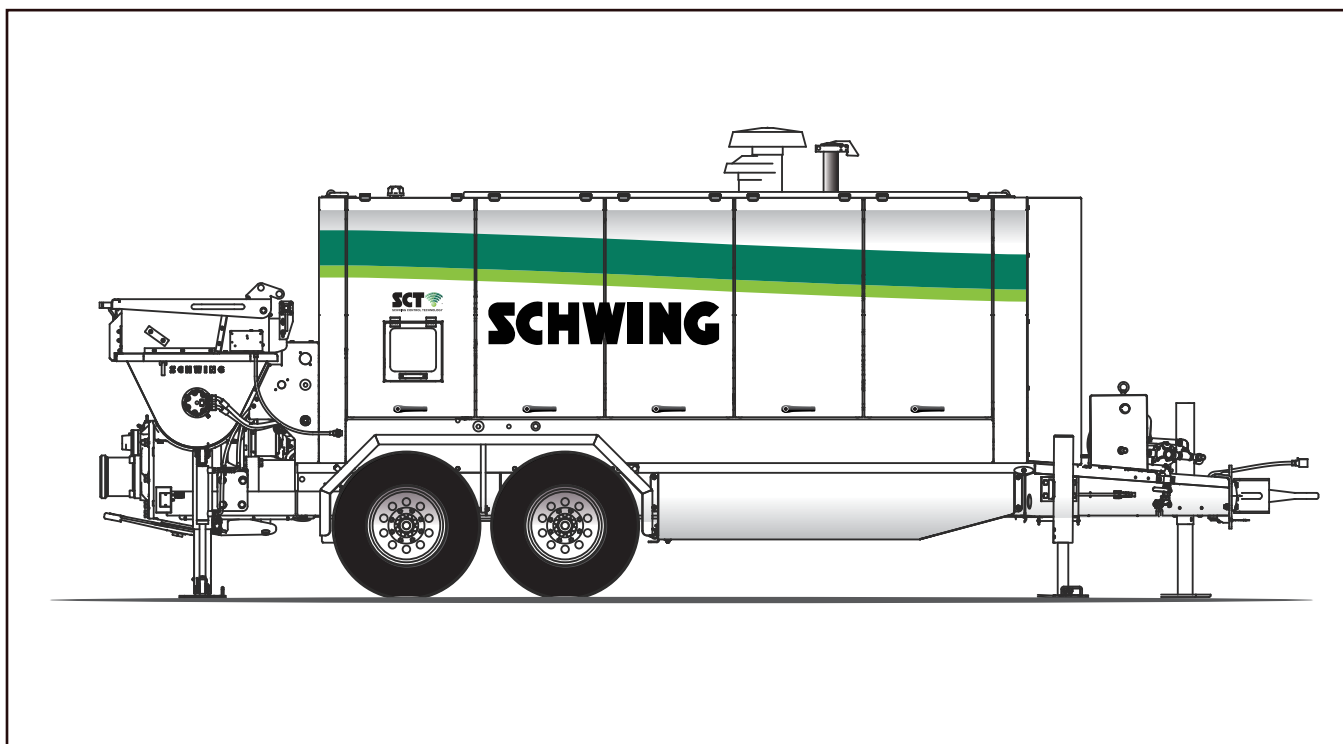
Water Jet

The stream of water that comes out the end of a water hose or pressure washer. The water jet is the only part of the water system that needs to go into the hopper, concrete valve, or waterbox for cleaning.

Additional Reading Material

This is a partial list of the books that have been written on the subject of concrete pumping. Omission of any relevant books was done so unintentionally.

- Pumping Concrete and Concrete Pumps. Karl Ernst v. Eckardstein. F. W. Schwing GmbH, 1983.
- Pumping Concrete—Techniques and Applications. Robert Allen Crepas. Aberdeen Group, 1991.



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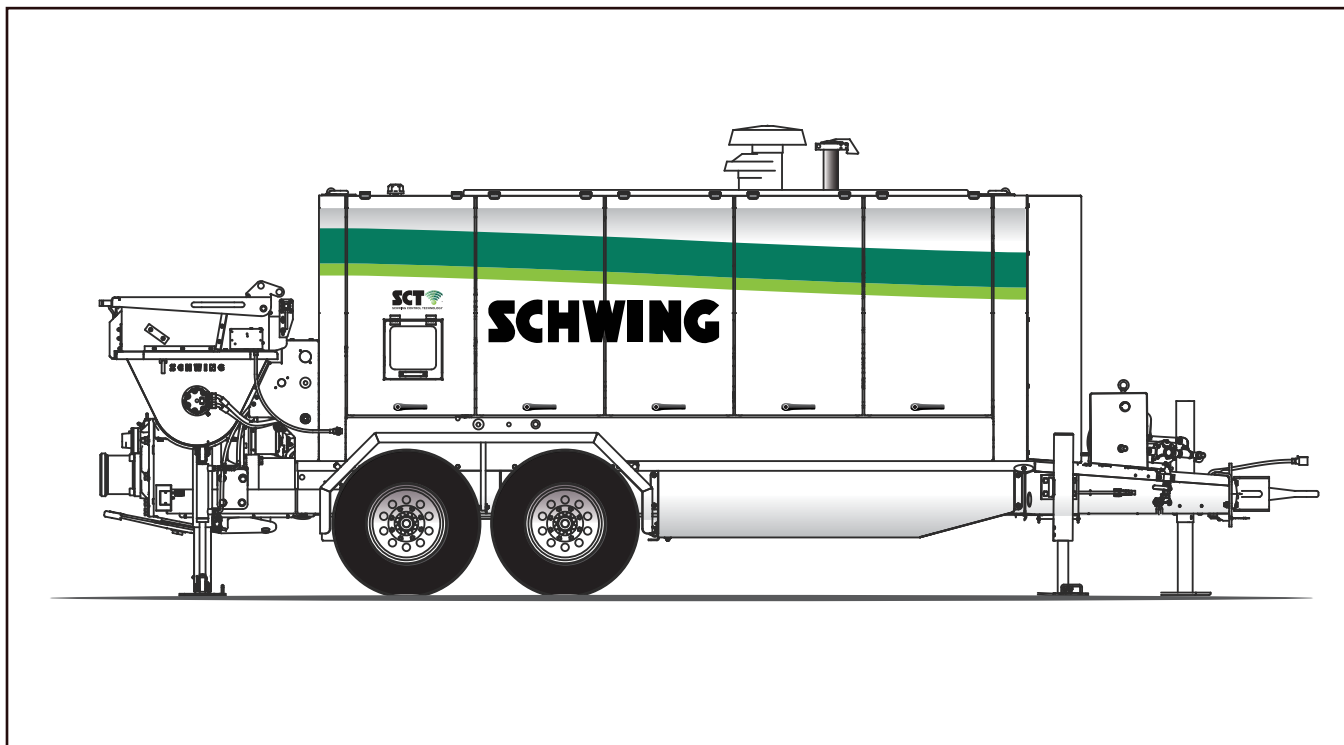
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Preparation

The Short Instruction section of this manual is for quick reference only. Operators need to read through and understand the entire manual.

Before using the stationary pump, please review the following topics:

- Safety (page 19)
- Safety Devices (page 28)
- Machine Overview (page 32)
- Personal Protective Equipment (page 81)
- Unit Setup (page 85)
- Pumping Preparation (page 87)



Figure 1
Personal Protective Equipment

Starting the Machine

- Ensure all safety guards are in place.
- From the operator control panel, turn the ignition key switch to the RUN position. The SCT2 controller will initialize, and the SCHWING logo will appear on the screen. When the system has finished initializing, the Engine Status Screen will be displayed (Figure 2). Turn and hold the key switch in the START  position; when the engine starts, release. You can't start the engine until the SCT2 controller has initialized.

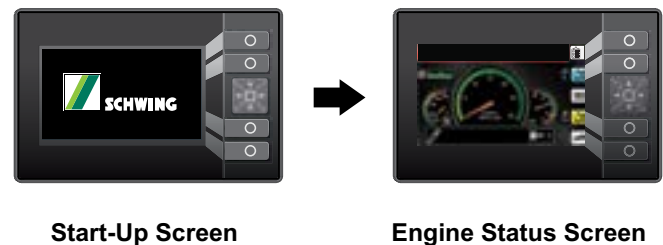


Figure 2
Start-Up and Engine Status Screens

- After starting, the engine may stay at a low speed for 1 to 25 seconds to allow engine systems to stabilize. The duration will depend on the ambient temperature, time since last run, and other factors.

NOTE In ambient temperatures from 32°F to 104°F (0°C to 60°C) the warm-up time is approximately 3 minutes. In temperatures below 32°F (0°C) additional warm-up time may be required.

SCHWING does not recommend operating the machine in ambient temperatures above 104°F.

- With the engine properly warmed-up, press the horn button to clear all E-stop requests.
- Use the throttle up button to increase engine RPM. Press and hold this button until the engine is at maximum RPM.

Checking the Machine

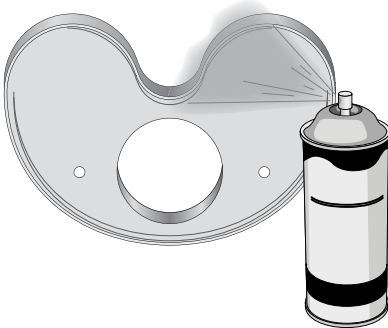
- Raise the hopper cover and secure with a locking pin.

WARNING Crushing hazard! Always secure the hopper cover with the locking pin.

- Clear E-stop requests by pressing the horn button on the remote. Press the agitator enable button. Place the agitator handvalve in either the forward or reverse position. Carefully lift the hopper grate cover. Ensure the agitator stops when lifted. If the agitator continues to move, shut down the machine and check the hopper grate switch.

WARNING Do not operator the machine if the hopper grate switch is malfunctioning.

- Check your hydraulic pressures. See "Check Hydraulic Pressures" procedure on page 119.
- Lubricate the outlet wear plate with water or WD40. Spray inside the outlet pipe and in front of the rock valve. DO NOT put your hand inside the outlet pipe; spray from the outside only. Never operate the rock valve without first lubricating the outlet wear plate. Moving the kidney seal against a dry plate will cause excessive wear and premature failure.



- Ensure proper airflow to the pump by keeping the area around the pump clear and by making sure any enclosures provide proper ventilation.
- Fill the waterbox if this hasn't been done already.
- With the outlet wear plate lubricated and the waterbox filled, stroke the machine a couple of times by placing the concrete pump in the forward position.
- If the machine is stroking properly, either shut down the machine (page 90) or begin pumping the job (page 97).

Shutting the Machine Down

NOTE

Stopping the engine immediately after the engine has been working under load can result in overheating and accelerated wear of engine components.

Avoid accelerating the engine prior to shutting down the engine.

Avoiding hot engine shutdowns will maximize turbocharger shaft bearing life.

To shut the machine down, place all functions in the neutral or OFF position. Reduce engine RPM to a low idle, and allow the engine to idle for 5 minutes in order to cool.

When the engine has cooled, turn the ignition keyswitch to the OFF position.

If your machine is equipped with DEF, after key-off the DEF pump will circulate the DEF fluid for a given time in order to cool the DEF injector. The DEF pump will also purge the DEF system of fluid to protect the lines from freezing in cold conditions. Disconnecting the battery power too soon may prevent purging of the DEF fluid lines; do not disconnect the battery until the indicator light has shut off (Figure 3).

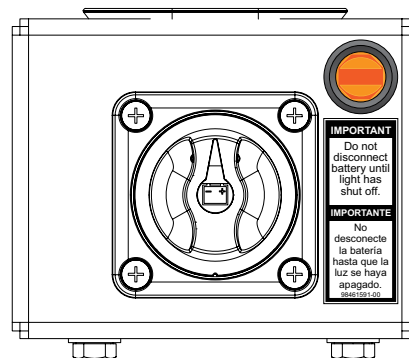
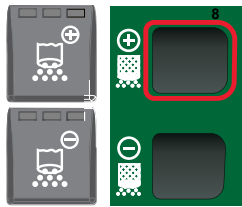


Figure 3
Battery Switch with Indicator Light

Controlling the Concrete Pump

Stroke Limiter



The stroke limiter is a hydraulic device that can be electrically adjusted with the stroke limiter (+) and (-) buttons located on either the radio or pendant remote. Its function is to raise and lower the output of the hydraulic pumps that operate the concrete pumpkit.

This has the advantage of allowing the engine to remain at higher RPM where horsepower is at the maximum.

The stroke limiter has an adjustment range of 95 percent. That means it can go from as low as 4 strokes per minute to maximum strokes per minute. The stroke limiter only adjusts the output of the hydraulic pumps while the differential cylinders are moving. That means that when the differential cylinders are stopped at the end of the stroke and the rock valve is moving, the pumps don't return to maximum output until the rock valve cylinder has completed its travel.

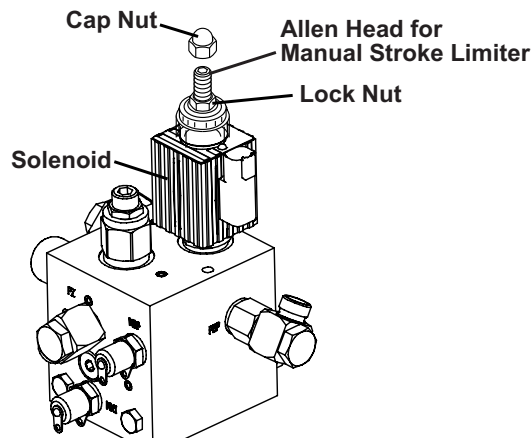


Figure 4
Stroke Limiter Control Block

If electrical control of the stroke limiter is lost, it can be adjusted manually by removing the cap nut located on the top of the solenoid assembly and loosening the lock nut with a 1/2 inch wrench. The adjustment is then accomplished with a 5/32 inch allen wrench by turning the screw in (clockwise) to decrease strokes or out (counter clockwise) to increase strokes. Always return the manual stroke limiter to maximum strokes (full counter clockwise out position) when electrical power is restored.

Pendant Remote

To use the pendant remote, place the pendant/radio switch to the pendant position (Figure 5). Connect the pendant to the remote cable located just behind the operator control panel. Press the horn button to clear all E-stop requests. The machine can now be operated from the pendant remote.



E-stop Button

Horn Button

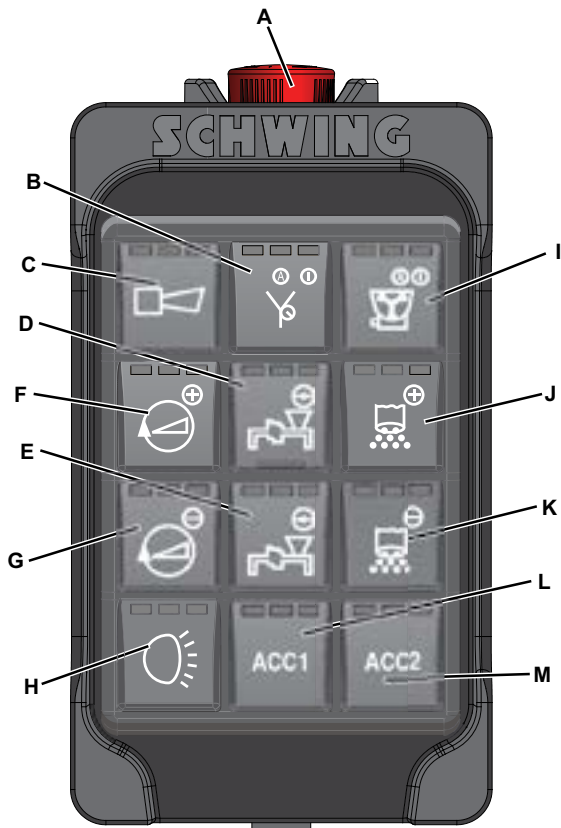


Figure 5
Selecting the Pendant Remote

Pendant Remote Functions

The pendant remote includes the following buttons:

- A. E-stop Button
- B. Vibrator (On/Off) Button
- C. Horn/Reset Button
- D. Concrete Pump Forward Button
- E. Concrete Pump Reverse Button
- F. Throttle Increase Button
- G. Throttle Decrease Button
- H. Work Light Button
- I. Agitator (On/Off) Button
- J. Stroke Limiter Increase Button
- K. Stroke Limiter Decrease Button
- L. Accessory 1 Button
- M. Accessory 2 Button



Radio Remote

To use the radio remote, place the pendant/radio switch to the radio position (Figure 6). Press the power (green) button on the radio remote to turn it on. Press the horn button to clear all E-stop requests. The machine can now be operated from the radio remote.



Radio Remote

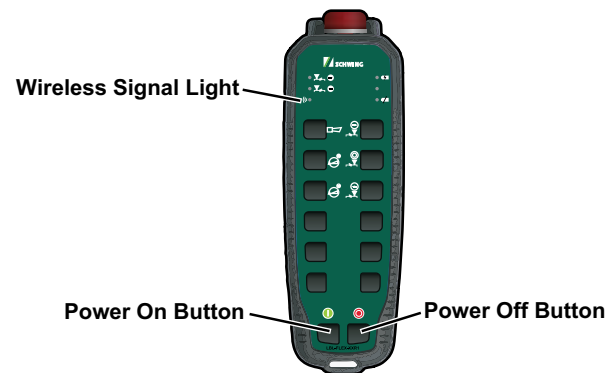
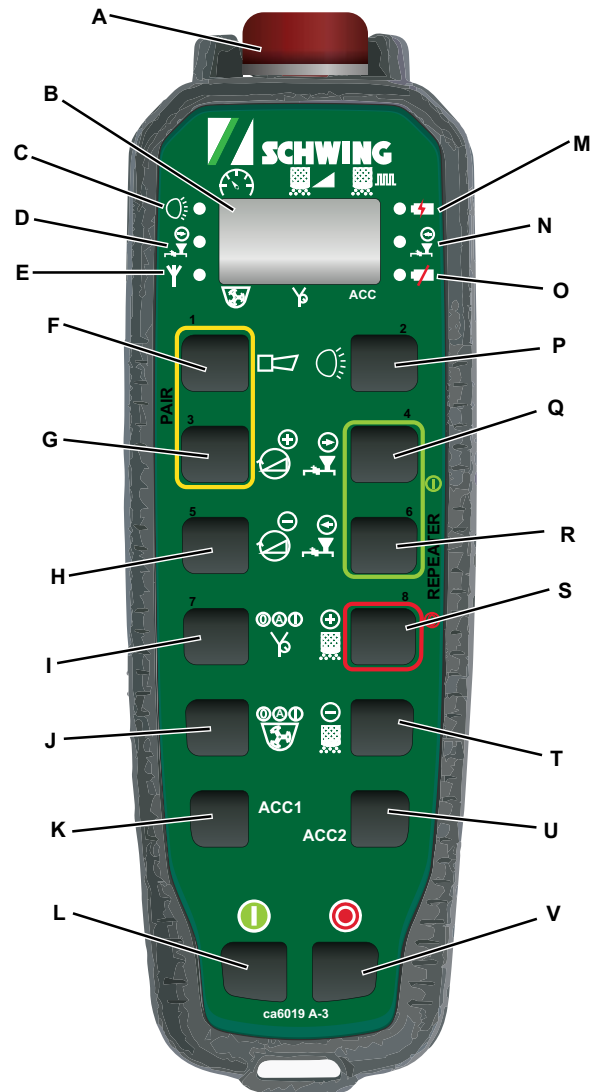


Figure 6
Selecting the Radio Remote

Radio Remote Functions

The radio remote includes the following lights and buttons:

- A. E-stop Button
- B. LCD Screen
- C. Work Light Indicator Light
- D. Concrete Pump Forward Indicator Light
- E. Wireless Signal Indicator Light
- F. Horn/Reset Button
- G. Throttle Increase Button
- H. Throttle Decrease Button
- I. Vibrator (On/Off) Button
- J. Agitator (On/Off) Button
- K. Accessory 1 Button
- L. Power On Button
- M. Battery Charging Indicator Light
- N. Concrete Pump Reverse Indicator Light
- O. Battery Low Indicator Light
- P. Work Light Button
- Q. Concrete Pump Forward Button
- R. Concrete Pump Reverse Button
- S. Stroke Limiter Increase Button
- T. Stroke Limiter Decrease Button
- U. Accessory 2 Button
- V. Power Off Button



Emergency Procedures

Emergency Override Buttons

⚠ DANGER If the hydraulic dump valves are electrically overridden, the E-stop buttons will no longer be operable. This removes all E-stop buttons and the hopper grate sensors as machine safeguards. This procedure should only be performed by a certified operator.

If there is an electrical malfunction, the dump valve will open, disabling the hydraulic circuit. If you cannot correct the electrical power loss problem, try activating the dump valve by pushing the override buttons while another person activates the concrete pump forward/reverse handle, on the S1/S2 Control Block.

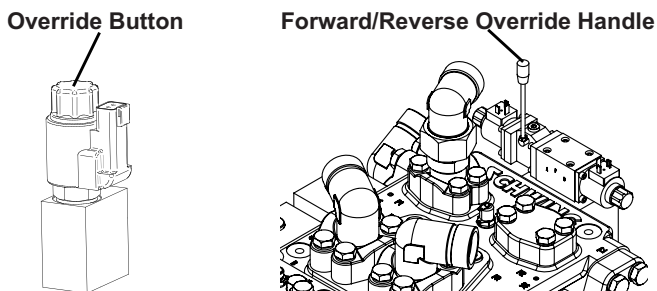


Figure 7
E-stop Override Buttons and Concrete Pump Forward/Reverse Override Handle

For information on where to look and what to do if you lose electricity on the unit, contact the SCHWING Service Center at 1-888-292-0262.

Loss of Radio Remote

If your radio remote stops functioning and the battery LED is off, the battery is probably dead. Remove the battery from the radio remote, and replace it with a fully charged battery. The dead battery should then be placed in the charger.