STINGRAY Standard Turntable Power Washer
Installation, Operations, and Maintenance Manual

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StingRay has attempted to provide a Manual that is reliable and accurate. The information contained in this Manual is subject to change at any time without notification. The information contained in this version of the Manual supersedes all previous versions and some information may not be accurate due to changes in the product or operating system since this version of the Manual was completed. Please report any discrepancies or omissions to StingRay. No liability is assumed with respect to the information contained herein.

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Welcome and Introduction

This section describes this manual and other resources that will help you get the most out of your StingRay Parts Washer. Before you use the washer, read the entire manual to learn about installation, operations, maintenance, and troubleshooting.

Refer to chapter *"Options"* for descriptions of any options you have purchased.

Purpose of Manual

The *StingRay Standard Turntable Power Washer* manual is a comprehensive guide that contains information and operating instructions/procedures you need to operate the power washer as intended. *Operating instructions are also referred to as "procedures" in this manual.*

The next section, *Important Safety Instructions and Warnings,* contains general warnings and cautions that are meant to be observed at all times when you work with the washer. User Training is required to work with the power washer. *Be sure all operators and maintenance personnel read and UNDERSTAND the instructions in this section*. In addition, operating instructions/procedures are preceded as necessary by warnings and cautions that alert operators to reasonably foreseeable risks of injury to people or damage to property.

IMPORTANT! Keep this manual and all safety and operating instructions. Operators must refer to them to safely install, operate, maintain, repair, troubleshoot, or work with the washer in any way.

StingRay knows that its ***users don't want washing machines ... they want clean parts***. The manual has been written with this objective in mind and every chapter, from *"Installation"* to *"Troubleshooting"* and *"Options",* provides guidelines and suggestions for helping you achieve that goal ... *safely.*

Audience

This manual is intended for you, if you need to clean parts, whether you have already bought a StingRay Parts Washer system or are thinking about buying one. You will find StingRay Parts Washers in all types and sizes of shops and manufacturing facilities -- wherever there are tough industrial cleaning problems.

Those who will find this manual especially useful include the following:

- Maintenance supervisors
- Maintenance staff
- Manufacturing engineers
- Operators
- Shop supervisors
- Contractors

How the Manual Is Organized

Review the *Table of Contents* to get a feel for what is in the manual and where it is located. The *List of Figures* lists all graphics by figure number and title and refers you to the correct page.

Important Safety Instructions and Warnings contain general warnings and cautions that are meant to be observed at all times when you work with the washer. Be sure all operators read and heed the instructions in that section.

Chapter 1, "Overview", presents an overview of the StingRay Standard Turntable Power Washer, including a theory of operation.

Chapter 2, "Installation", explains how to install the StingRay Parts Washer. Pay special attention to the prerequisites, particularly placement planning, and to the safety/precaution information.

Chapter 3, "Basic Operations", provides step-by-step instructions on how to load and wash parts.

Chapter 4, "Advanced Operations: Process-Control", describes how to establish operating parameters to optimize the performance of your power washer.

Chapter 5, "Maintenance", discusses the maintenance of your power washer. Use the information in this chapter to establish and follow a service schedule.

Chapter 6, "Troubleshooting", contains problem symptoms/probable causes for key assemblies and components of your washer. Use this chapter to help diagnose and correct a problem.

Chapter 7, "Options", contains installation, operations, maintenance, and troubleshooting information on the Clean Machine and any other power washer options you may have purchased from StingRay.

At the end of the manual you will find an *Index*. Use it to find information quickly.

How to Use This Manual

Read the entire manual *before* you attempt to install, operate, or maintain the power washer. This will provide the foundation you need to understand how the washer works and how to use it to your best advantage.

Staff members who are responsible for specific features or functions will benefit from paying special attention to corresponding information in the manual.

After you have read the entire manual thoroughly, use the *Table of Contents*, *List of Figures*, and *Index* to refer to information, as you need it.

StingRay Technical Services

StingRay Technical Services department is available to provide you with the support you might need.

If you have a question about the washer or its operation, first look in this manual and in other printed product-support documentation. If you cannot find the answer, contact *StingRay Technical Services*. Our phone number is on the title page near the beginning of the manual and in the following section, *"Other Resources -- HELP".*

Before your power washer is delivered, you will receive a courtesy call from StingRay Technical Services. Our expert engineers and technicians will review your specifications and answer questions about placement planning, installation, utility and service requirements.

Other Resources

In addition to this manual and our technical service staff, StingRay offers the following product support:

- Vendor-supplied manuals
- Startup
- HELP
- On-line 24/7 User SUPPORT Website

Vendor-supplied Manuals

Your washer is delivered with vendor-supplied manuals and cutsheets for some assemblies and parts. Refer to these documents for additional details on installation, operations, and maintenance.

Startup

A StingRay factory-trained technician is optionally available to perform startup and customer training. Call StingRay Customer Care to request this service.

As part of this service, the StingRay technician will fill in the *Field Startup Procedure (FSP)* form to begin your one-year warranty coverage.

HELP

If you can't find the answer to your question in this manual, contact StingRay:

STINGRAY Manufacturing
2450 Adie Road
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***Phone*: (314) 447-9000**
***Missouri Direct*: (314) 447-9000**
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Website: www.stingraypartswasher.com

STINGRAY Customer Care
***Phone*: (314)-567-3708**
***Fax*: (314)-567-6318**
E-mail: service@stingwash.com
Website: www.stingrayservice.com

Other Product-Support Services

Contact StingRay to receive the following information:

Audio Cassettes:

"Shop Productivity and Profit"
"Bake Ovens, EPA, OSHA, and Hazardous Waste Disposal"
"How StingRay Parts Washers Work"

Printed Material:

- Hazardous waste lab reports
- Procedure for sludge disposal
- Message to financial management
- Ins & outs of leasing
- Performance specifications for the parts washer in which you are interested
- List of users
- Testimonials
- StingRay parts cleaning cost analysis

Videos:

- All About Parts Washing

StingRay Website: www.stingraypartswasher.com

Important Safety Instructions and Warnings

The following important safety instructions and warnings apply to installing, operating, maintaining, and troubleshooting the StingRay Parts Washer. They also apply to repairing the washer, or to working with it in any way.

Read all of the following safety instructions and warnings thoroughly *before* you install, operate, maintain, troubleshoot, repair the washer, or work with the washer in any way!

SAVE THE SAFETY INSTRUCTIONS AND WARNINGS IN THIS SECTION!

GENERAL SAFETY INSTRUCTIONS FOR OPERATING THIS PRODUCT:

1. ***Read all safety and operating instructions/procedures before installing, operating, maintaining, repairing, or troubleshooting the washer ... or working with it in any way.***

2. ***Know how to STOP the washer. Be familiar with all its controls.***

3. ***Stay alert at all times, and watch what you are doing.***

4. ***Do not operate the washer if you are tired, or if you have had anything alcoholic to drink, or if you have taken any drugs, including prescription medications.***

5. ***Keep the operating area clear of people.***

6. ***Do not overreach or stand on unstable support. Keep good footing and balance at all times.***

7. ***Follow the instructions given in this manual for installation, operations, maintenance, and troubleshooting.***

CAUTION! GROUNDING INSTRUCTIONS: The washer must be grounded! Grounding provides a path of least resistance for electric current, thus reducing the risk of electric shock during maintenance, troubleshooting, or repair.

CAUTION! GROUNDING INSTRUCTIONS: The washer must be connected to a grounded, metal, permanent wiring system; OR an equipment-grounding conductor must be run with the circuit conductors and connected to the equipment-grounding terminal or lead on the washer.

WARNING! IF YOUR POWER WASHER USES A GAS BURNER: If you do not follow installation and operating instructions exactly, a fire or explosion may result, causing loss of life, personal injury, or damage to property.

WARNING! VENTING OF EXHAUST GASES: Do NOT vent exhaust gases into a wall, a ceiling, or a concealed space of a building. Refer to the instructions in this manual for correct venting instructions.

WARNING! Do NOT overload the INTERNAL RESERVOIR COVER or other HORIZONTAL SURFACES. The covers are chemical-solution covers and are not designed for walking or standing. Other horizontal surfaces are not designed for walking or standing. Walking on the internal reservoir cover, tank cover, or other horizontal surfaces could result in serious injury or death.

CAUTION! All StingRay Parts Washer systems use a water-based alkaline cleaner. DO NOT attempt to use any type of organic solvent, emulsion cleaner, or acid! USE ONLY water-based alkaline cleaners! Use of chemicals not recommended by STINGRAY will void your warranty and can be dangerous resulting in possible personnel injury.

WARNING! NEVER attempt to disable the automatic pressure equalization (APE) timer or the wash-delay timer on the wash pumps and start-up system! Disabling the APE timer or the wash-delay timer can cause water hammer to occur, resulting in severe damage or injury.

WARNING! Be sure that people installing the power washer are qualified and trained for the task.

WARNING! Set up your power washer installation to conform to all local code requirements.

WARNING! The standard power washer is designed to be installed inside a building, not outside.

WARNING! DO NOT EVER get inside the washer cabinet when the main power supply is ON. This could result in severe injury or death.

CAUTION! WHEN LOADING AND UNLOADING PARTS! -- Always wear gauntlet-type thermally protected and water-repellent protective gloves, protective eyewear, a filter-type air mask, and a full body apron that is thermally protected and water-repellent.

WARNING! Be sure that people performing maintenance are qualified and trained for the task.

WARNING! Be sure that people performing repairs are qualified and trained for the task.

WARNING! Disconnect/turn OFF power before opening the control panel. NEVER leave the control panel open when the power is ON.

CAUTION! You must turn the main power supply OFF before performing many maintenance procedures. BE SURE to turn the main power supply back ON after you perform maintenance.

CAUTION! If the main power supply is OFF for a time period that exceeds the power-outage carry-over specified in the vendor-supplied 7-Day-Clock Manual, be sure to re-set the 7-Day Clock (located inside the electrical control panel).

SAVE THE SAFETY INSTRUCTIONS AND WARNINGS IN THIS SECTION!

1 Overview

Purpose

This chapter introduces you to the *StingRay Standard Turntable Power Washer*. Read it to gain a general understanding of your power washer *before* you attempt to install, operate, or maintain the washer.

Prerequisites

You will find it helpful to have read the introductory material, especially *"Welcome",* so that you understand how this manual is organized.

What You Will Learn In This Chapter

In this chapter you will learn about the following:

- Your new StingRay Parts Washer
- Materials and Components
- Theory of Operation
- Washer Inspection

1. Your New StingRay Parts Washer

Your new StingRay Parts Washer is an engineered state-of-the-art machine designed to exacting standards in order to give you the highest-quality cleaning. Your washer incorporates the many technological and engineering advances we have made at StingRay in our ongoing research-and-development program.

Read this section for a general understanding of the washer's purpose, usage, and manufacturing information. This section also shows you a diagram of the washer with principal parts labeled.

1.1. Getting Acquainted

StingRay Parts Washers are non-solvent-based cleaning systems. They are designed to clean parts in a wide range of industrial settings, for example, in the rebuilding of engines and brake systems, electric motors, and during manufacturing assembly.

All StingRay Parts Washers operate automatically. With reasonable care and maintenance, your washer will give you years of top-quality cleaning.

1.2. Major Components

The following figure shows the StingRay Standard Turntable Power Washer. The principal parts are labeled. Major features of the power washer are explained in the next several sections.

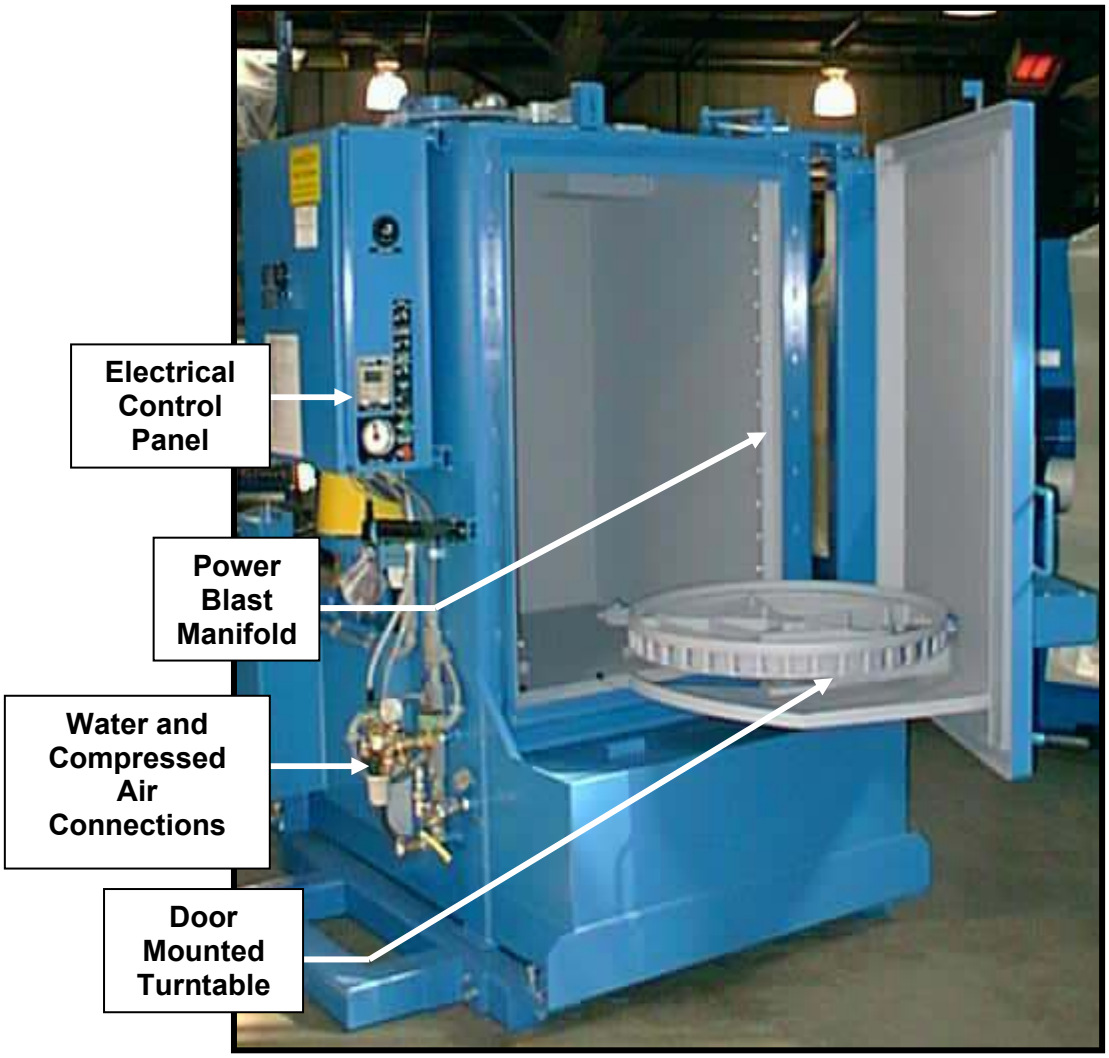


Fig. 1 - 1: Standard Turntable Power Washer, View 1

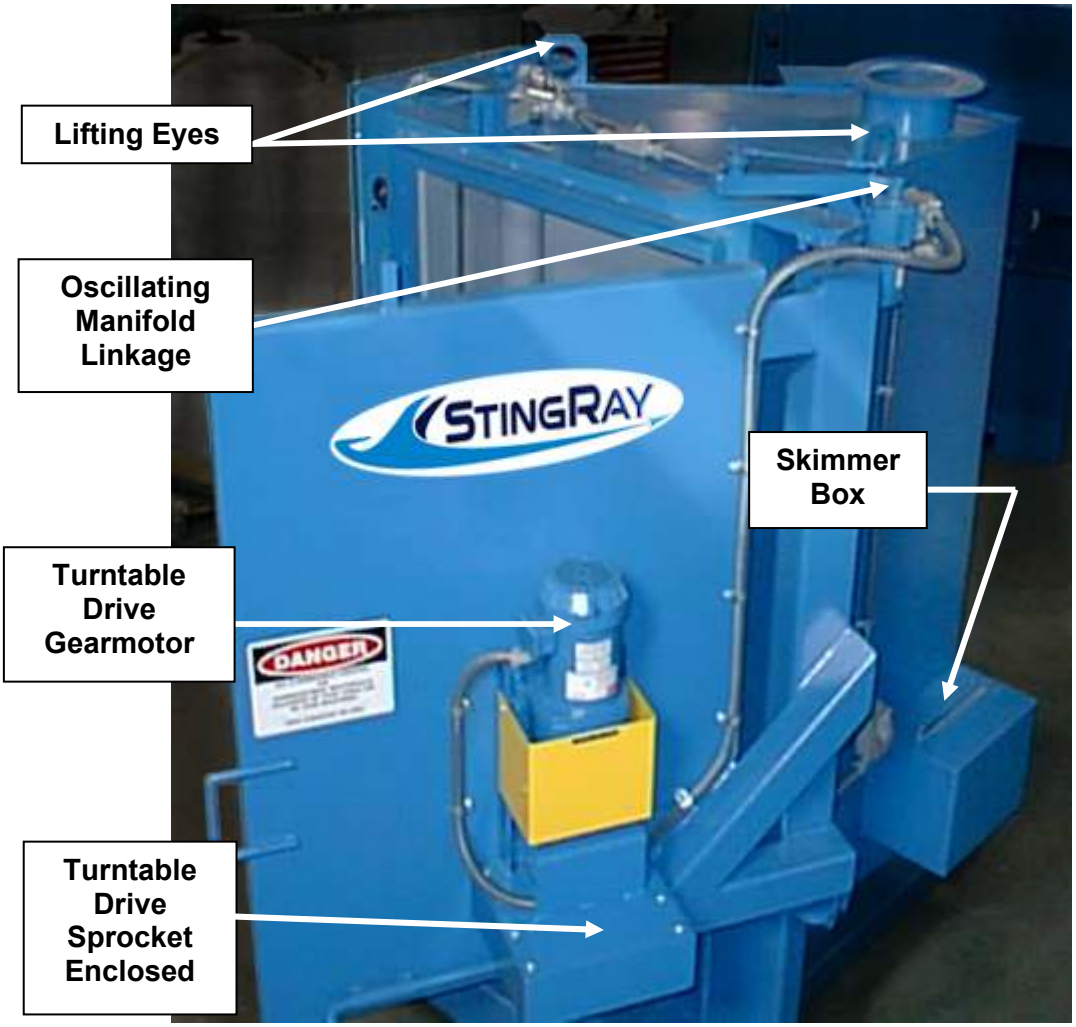


Fig. 1 - 2: Standard Turntable Power Washer, View 2

2. Materials, Components & Standards of Construction

All StingRay Parts Washers are American-made, using high quality, industrial-grade materials and components. The machine and control system is designed and built to meet the stringent standards of ANSI/NFPA-79 (American National Standards Institute/National Fire Protection Agency) electrical standards for industrial machinery.

2.1. Electrical Standards

All electrical components are UL approved.

Wiring is numbered and color-coded THHN 14-gauge minimum with thermoplastic insulation.

A power disconnect interlocked with the electrical-control-panel enclosure door is available on all StingRay power washers.

Nameplates identify each electrical device (*for example*, pump, turntable and skimmer motors; solenoid valves) outside the electrical control panel. All electrical devices (*for example*, timers, relays, motor starters) inside the electrical control panel are clearly labeled.

Separate temperature-compensated overloads are provided for each motor load. Each motor has a separate ground-wire pulled through a conduit and attached to the back panel of the electrical control panel to ensure a positive earth-ground without relying on the machine structure to supply the grounding path.

A transformer provides control power and allows for a single source of power to the machine.

All fusing is rated at 200,000 AMP interrupt capability.

All operator controls are oil-tight, providing reliable operation under the harshest environmental conditions.

2.2. Cabinet Construction

Cabinets are built of boilerplate sheet steel, with seams continuously MIG-welded for superior strength. Box tubing and angle have 1/4-inch-thick to 1-inch-thick (6mm - 25 mm) walls. All exterior surfaces are primed and coated with a two-part Polyamide-Epoxy.

3. Theory of Operation

StingRay defines the term *to clean* as *to overpower the soils*. The StingRay Parts Washer is a high-impact pressure, high-temperature, water-based cleaning system that uses a combination of the following factors to achieve cleaning results:

Power x Temperature x Chemical x Time = Clean

The relationship of these variables can be varied in an infinite number of ways to achieve the same level of cleanliness. Your own needs determine the relative value of each variable. Keep in mind that the StingRay Parts Washer provides one of the highest blasting powers in the cleaning industry, allowing you to reduce wash-cycle times to a minimum. Additionally, the high blasting power allows you to operate the washer at lower cleaning temperatures, thus saving energy and using less chemical than spray washers.

The *exact* combination of the factors must be determined for your application, based on the types of soils to be removed, the degree of cleanliness required, the cycle time required, the types of parts to be cleaned, and so on.

3.1. How the Power Washer Works

The power washer operates on a timed cycle. The operator places the parts to be cleaned in the washer on the turntable, closes and latches the door, and then starts the timed cleaning cycle.

During the cleaning cycle, a high-temperature, high-pressure, water-and-detergent cleaning solution blasts soils from the parts.

After the cycle has stopped and the steam has exhausted, the operator removes the cleaned parts.

The power washer utilizes closed loop, waste minimization technology, continuously reusing its cleaning solution and effectively reducing pollution potential. Because the washer is fully enclosed, it is safe for the operator, since the high-pressure, high-temperature spray is locked inside the cabinet.

In order to better understand how the four factors affect cleaning, let's look at each one more closely:

- ***Power***
- ***Temperature***
- ***Chemical***
- ***Time***

3.1.1. Power

The first key factor in the power washer's ability to clean is *power* -- the blasting power required to strip even the toughest soils from parts.

Pressure and Flow = Power

Power means the physical forces that remove the soils. The following formula expresses in horsepower (HP) the "cutting power" of the solution blasted from each nozzle tip:

HP = (GPM x PSI) / 1714

GPM (gallons per minute)	=	flow per nozzle
PSI (pounds per square inch)	=	pressure

In general, StingRay systems blast with four to 100 times more "cutting power", depending on pump size, than jet spray systems.

What really counts, however, is ***impact pressure*** -- the force of the spray at the target surface. It is impact pressure that most directly affects how quickly and effectively the soils are removed. The impact per square inch of a given nozzle depends on the following:

- **Flow and pressure produced by the pump**
- **Type of nozzle**
- **Spray pattern distribution**
- **Spray angle**

StingRay cleaning systems achieve an optimal balance of these factors to provide the highest impact pressure at the part surfaces.

Closed-Loop System and Grit-Blasting

The StingRay Parts Washer is a closed-loop system. This means that none of the washing or rinsing solution is discharged. Therefore, as soils are removed from parts, a patented feature reclaims the grit and blasts it back at the wash load to provide a vigorous scouring action, without any damage to parts. Thus, the grit becomes a valuable cleaning medium and actually acts to increase the impact pressure.

Note: **In applications where the wet grit blast is not desired, StingRay can provide fine filtration, including sub-micron filtration, to remove it.**

In terms of results, wet grit blasting means that the dirtier the power washer gets, the faster it cleans. This feature is desirable for most rebuilding applications and some manufacturing ones.

3.1.2. Temperature

As temperature increases, greases and oils become more fluid; in other words, their viscosity decreases. Since grease is the primary binder that holds and contains the soils on the parts, higher washing temperatures above 160° F (71° C) generally produce better cleaning results.

Secondly, chemical is more aggressive at higher temperatures. As a general rule, for every 10° F (-5.6° C) rise in temperature above 160° F, a chemical reaction doubles in speed.

3.1.3. Chemical

Chemical is the third key factor in overpowering soils and removing them from the surface of parts. While chemicals are necessary to enhance the cleaning process, your StingRay Parts Washer does not rely primarily on chemical concentration. This is because your StingRay sales technician worked with you to determine your cleaning needs, such as:

- Required degree of cleanliness
- Nature of the soils to be removed
- Pump size and performance requirements
- Size, shape, and surface of the parts to be cleaned
- Applications and usage of the power washer in your shop

Because your StingRay Parts Washer's configuration has been customized specifically to meet your requirements, the washer will successfully meet your cleaning standards when charged with a *light* chemical concentration, as compared to conventional washers. In general, this means that a 2-5% concentration by volume of a quality non-foaming chemical compound will give excellent cleaning results. However, like temperature and power, the exact type and amount of chemical are subjective and depend on your shop's needs.

Chemical cleaners fall into three general categories:

- **Organic solvents**
- **Emulsion cleaners**
- **Aqueous (water-based) alkaline cleaners**

StingRay systems use an aqueous (water-based) alkaline cleaner, not a solvent, so you don't have to deal with solvent vapors or hazardous-waste contaminants. Generally, the water-based alkaline cleaner is composed of water, an alkali source, a sequestrate, a surfactant package, and corrosion inhibitors.

A *sequestrate* is a binding agent that prevents undesirable chemical reactions, such as those that would form insoluble products like hard-water soap scum. The *surfactant* is a substance that lowers surface tension in order to penetrate and loosen soils. It coats oil droplets to prevent them from recombining. A *corrosion inhibitor* slows down the rate of chemical reaction that produces rust.

The water-based alkaline cleaner works by undercutting the soil, then "popping" it from the part surface. Light oils float to the solution surface, where they can be skimmed or filtered off. Heavier soils sink to the bottom and can be filtered or removed as sludge.

A key feature of this type of cleaner is that you only have to dispose of the *contaminants* as waste -- the washer can recycle the *liquid until the saturation point.* As the wash solution is used it will become increasingly more contaminated. At some point, the solution will become fully saturated and it will become necessary to change the wash solution and recharge the washer with new water and chemical.

Call StingRay Manufacturing for information on recycling technologies.

Removal of Soils

The water-based alkaline cleaner readily removes the following soils:

- Cutting oils
- Shop dirt
- Low-melt waxes
- Rust preventatives
- Finger prints
- Paint
- Cosmoline
- Varnish
- Grease
- Mill markings
- Diesel carbon
- Carbon dust
- Coolants
- Road soils
- Oil and chips

Applications

The water-based alkaline cleaner has many applications. It is successfully used, for example, in the following ways:

- Pre-clean
- Before teardown cleaning
- Before anodizing
- Before Re-assembly
- At the finishing process before packaging
- Before painting
- During in-process
- Before plating

Usage

When you work with a water-based alkaline cleaner, remember these points:

1. Most parts "flash"-dry within a minute or two after removal from the washing cabinet.

2. Parts that sit for some time before the next in-process operation are protected by a layer of corrosion inhibitor.

3. You can easily remove the layer of corrosion inhibitor by a water rinse. StingRay can provide an optional Auto Rinse Cycle (ARC) for your washer that will remove chemicals and oils with heated fresh water to "flash"-dry parts without rusting.

4. If you need to dry the parts quickly, StingRay can provide an air or heated drying phase.

5. All parts and materials washed in a StingRay Parts Washer are clean and generally paintable without further preparation.

6. In cleaning parts, you will have to periodically adjust the chemical concentration.

3.1.4. Time

Time lets power, temperature, and chemical do their work in overpowering soils and removing them from parts. If soils are heavy and built-up, for example, setting a longer wash-cycle time will clean the parts.

StingRay Parts Washer wash-cycle times are more efficient than those of conventional washers, due to the greater power of the system. This power comes from the following:

- StingRay pump technology, and

- StingRay oscillating Power Blast Manifold

3.1.5. General Information and Conclusion

This section, "*Theory of Operation*", has given you an overview of how the StingRay Parts Washer operates.

StingRay defines the term *to clean* as *to overpower the soils*. *Cleanliness* is proportional to the combination of the following factors:

- ***Power***
- ***Temperature***
- ***Chemical***
- ***Time***

The *exact* combination of these factors is variable and depends on your cleaning standards and operating requirements for the materials that you are cleaning. Since cleaning standards vary from shop to shop, through testing you can achieve an optimal balance of these four factors to meet your cleaning standards.

3.2. Operating Principles of Key Features

This section describes the key features of the standard turntable power washer and their operating principles. The features are presented in general functional order. As you read, you may wish to refer to Figs. 1-1 and 1-2.

3.2.1. Pumping System

The pumping system is the heart of the power washer. StingRay's inventive pump suction/discharge allows pumps to operate at blast pressures far higher than those of conventional power washers.

Pump Assembly: A flexible coupling joins the pump and electric-motor shafts. The pump is barrel-mounted and seal-less, without bearings or other metal-to-metal contact in the "wet end". The pump and the motor are mounted on a structural steel baseplate. Principal pump components are a casing, shaft, impeller, backhead or suction head, baseplate, discharge piping, bearing frame, and bearings.

Basic Pump Function: The pump draws solution through the 5/32-inch - diameter (4 mm) openings of the pump suction filter. The solution is drawn through the suction tube to the pump inlet. Finally, the solution leaves the pump under pressure and travels through piping to the Power Blast Manifold (PBM). The pump is capable of handling hot alkaline cleaners and can pass solids and grit up to 1/2-inch (13 mm) in diameter.

Pump Motor: Pump motors are industrial grade TEFC with a minimum 1.15 Service Factor, Class "F".

3.2.2. Power Blast Manifold (PBM)

After the cleaning solution leaves the pump, it travels through piping to the Power Blast Manifold (PBM), where it is distributed to the spray nozzles. U.S. Patent 4,741,351 protects the PBM's unique design.

PBM Assembly: The PBM is supported and rotates between the upper bearing at the cabinet roof and the (sealed) swivel joint near the cabinet floor. The *sealed swivel joint* affords the best connection between a *stationary* pipe and a *rotating* assembly because the joint allows high-pressure, high-temperature flow into the PBM assembly as it rotates on bearings. The swivel joint makes it possible to hard-connect steel pipe to steel pipe and still be able to rotate the assembly.

Nozzles: The opening diameter of the nozzles is larger than the 5/32-inch (4 mm) openings in the pump suction filter. Therefore, grit that will pass through the filter will also go through the manifold assembly and the nozzles. The result is that the entire system is virtually self-cleaning.

Basic PBM Function: The PBM pivots on its vertical axis, driven by a gear motor through a crank-and-arm linkage that produces a 46° angle of oscillation and return throughout the wash cycle. The sweep and speed of the PBM are not synchronized to the turntable, so the wash load is blasted from a different angle with each pass at the nozzles. The offset upper and lower PBM arms allow each nozzle to blast on its own plane without deflecting the blast from other nozzles in the manifold -- this ensures that virtually all the blasting force reaches the parts.

The rotating PBM offers several advantages over a fixed manifold. In terms of cleaning results, the most important advantage is that the non-synchronous rotation of the PBM relative to the turntable rotation blasts the wash loads from different angles with each turntable pass by the wash nozzles. The recesses and pockets that would be hidden to a fixed manifold are accessible to the oscillating PBM. This means cleaner parts.

Nozzles: Nozzle placement evenly distributes blasted solution throughout the wash cabinet: From the bottom up, across the cabinet, and from the top downward. This ensures that each portion of the wash load comes clean at about the same time in a single wash cycle.

3.2.3. Door-Mounted Turntable

The turntable is designed and engineered to the highest safety standards. It is capable of supporting loads from 1,700 lbs. (770 kg) to 40,000 lbs. (18140 kg), depending on power washer size.

Turntable Assembly: The turntable is mounted on the inside of the cabinet door on the turntable support arm. The turntable swings fully out of the cabinet when the operator opens the door. This allows easier loading, including the use of an overhead crane. The turntable uses the highest quality industrial bearings that, with scheduled greasing, should last the life of the power washer. During loading, the turntable may be rotated for easier placement of parts by pressing the "jog" button on the control panel.

Basic Turntable Function: During the wash cycle the turntable rotates at approximately 29 feet (8.9 m) per minute. The rotation is not synchronized to the sweep and speed of the PBM. The turntable is driven by the turntable drive system.

3.2.4. Turntable Drive System

This system rotates the turntable and controls its speed. It also serves as a clutch to allow table slippage, if a wash load shifts and jams the turntable.

Turntable Drive System Assembly: The drive motor assembly mounts onto a small box on the door of the cabinet. The assembly's key features are a gear motor, a slip-clutch shaft coupling, two flange mount bearings, the plastic drive sprocket, and a sprocket support plate. The slip clutch is located just below the drive motor and couples the motor shaft to the sprocket jackshaft. The sprocket is mounted on the end of the jackshaft.

Basic Turntable Drive System Function: The drive system uses a plastic drive sprocket to engage and drive the sprocket teeth on the turntable. If factory-preset torque is exceeded, the slip clutch functions as a torque limiter, and slips.

3.2.5. Automatic Steam Exhaust (ASE)

The automatic steam exhaust (ASE) system is designed to remove steam from the power washer cabinet *during* the wash cycle and the optional automatic rinse cycle (ARC); and for a timed period *after* the rinse cycle.

The ASE serves two purposes:

1. It reduces the amount of steam that leaks into the shop area during the wash cycle and when the door is opened.

2. It makes room for rinse water to be used as makeup water, when the ASE is used in conjunction with the optional ARC. (See "*Automatic Rinse System" (ARC)* section below).

Basic ASE Function: The ASE is a draft-induced system. A fan creates a nominal negative pressure inside the cabinet to pull steam out of the cabinet through the steam-exhaust piping. The nominal negative pressure ensures that minimum vapor and heat energy losses occur during power washer operation.

3.2.6. Automatic Rinse System (ARC)

The automatic rinse system (ARC) is a fresh-water rinsing system. It uses waterline pressure to rinse parts after the wash portion of a cleaning cycle. An optional chemical injector pump in the system provides for application of rust inhibitor during the rinse cycle. This chemical injector pump allows adjustment of the flow rate of chemical injected into the rinse water. The pressure regulator and gauge allows the operator to adjust the rinse spray characteristics of flow and pressure.

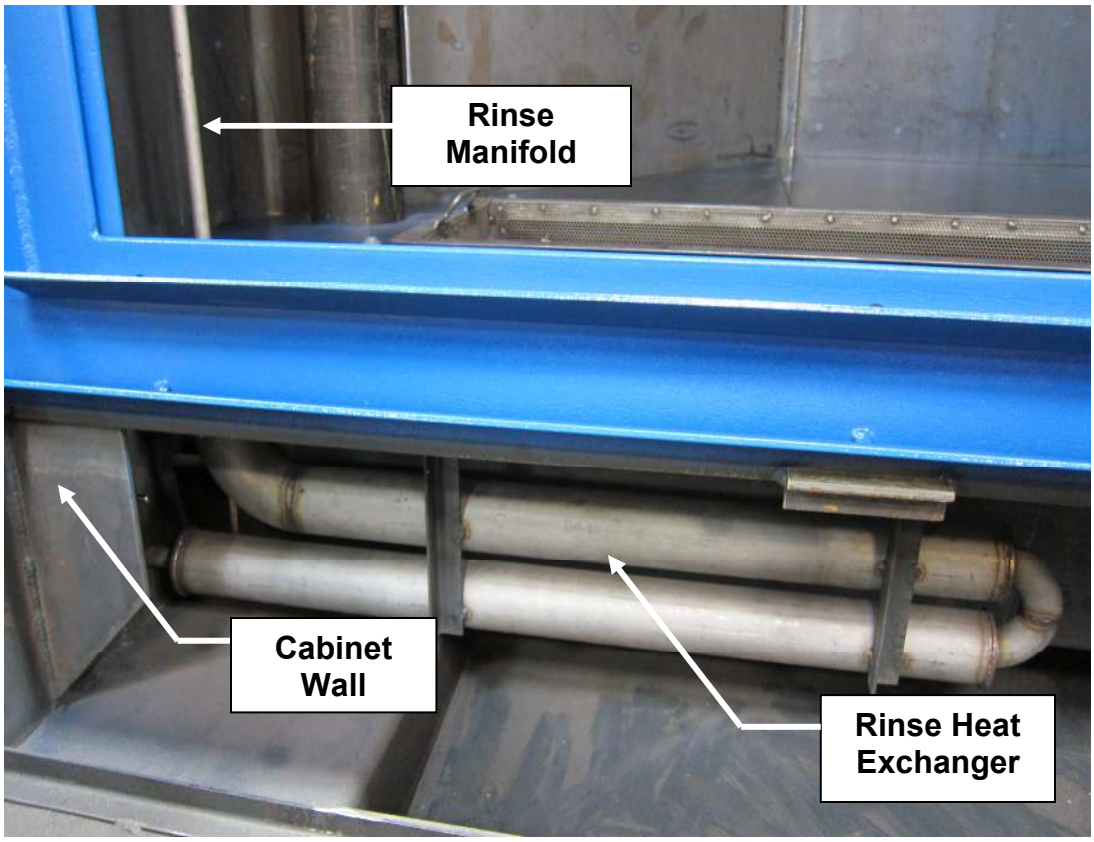


Fig. 1 - 3: Rinse System

All rinse-system components in the washer cabinet are made of stainless steel. External parts are made of corrosion-resistant materials.

Rinse time is controlled by two factors:

- The amount of water that can be made up, due to water loss through steam-exhaust evaporation or drag-out;

- or -

- The rinse timer inside the control panel.

In terms of rinse cycle time, water loss takes priority: The amount of required makeup water determines the maximum rinse time allowed.

Basic ARC Function: Rinse water is filtered and its pressure is regulated before it reaches the rinse solenoid valve. When a rinse cycle begins, the solenoid valve opens, allowing fresh water to enter the rinse system. As the water enters through the valve, the optional chemical injector pump pumps rust inhibitor into the rinse water. Next, the water is heated as it travels through a heat exchanger mounted in the wash-solution reservoir. From there the water flows into the fixed rinse manifold and sprays out through nozzles onto the parts.

Rinse water becomes makeup water, so no solution is discharged outside the cabinet. This also improves chemical management because all rinsed chemical remains in the reservoir.

3.2.7. Heating System

There are three types of heating systems available for the power washer:

- **Gas (natural gas or propane)**
- **Electric**
- **Steam**

First, let's look at general operating principles that apply to all the systems. Following that we'll take a closer look at principles specific to each system.

Note: **The discussions of heating-system operating principles assume that the 7-day clock is set to allow heating to occur.**

Basic Heating System Function: A thermocouple measures wash solution temperature. It is connected to the electronic temperature controller, which turns the heating device on or off, depending on the *set point*. (The temperature controller is located on the face of the control panel.)

Specific Systems

Gas Burner: The forced-air gas burner fires into an immersion-tube heat exchanger. Exhaust gases are removed through the flue pipe.

Electric: Immersion heating elements are threaded into couplings in the cabinet wall, suspending them in the solution. An electrical contactor in the control panel supplies power to the elements.

Steam: This type of system contains a control valve, a plate-coil heat exchanger, and a steam trap. When heat is required, the valve opens, and pressurized steam flows into the heat exchanger. Steam condensate is released from the heat exchanger through the steam trap.

3.2.8. Water-Level Control System

The float system supplies water-level information for the rinse, water-fill, and heating systems. The principal features of the system are:

- Additional available rinse water through the rinse bank.
- Low solution level detection that provides system protection for both the wash pumps and the heating system.
- High-level indication that can be used to initiate a maximum/overfill warning light or alarm.
- High-level shut-off of water fill.

Basic Solution-Level Control System Function: The float system is able to detect four water levels via two limit switches and a torpedo-shaped cam. A relay in the control panel is connected to each limit switch. With the various combinations of the ON and OFF positions of the two limit switches, the system is able to detect the following four water level conditions:

LOW-LOW: The wash pump and heating systems are disabled to prevent damage to these systems. When the water level is below LOW-LOW, neither the heating system nor the wash pumps will function. The water-fill valve will be open to provide water-fill.

LOW: This is the minimum safe operating condition. The heat exchanger should be fully submerged and the pump suction filter screen should be fully submerged. Once the water level reaches the LOW position, the heating system and the wash pumps will be enabled. The washer can operate at this condition. When the machine is not in a cleaning cycle (wash, rinse, hot-air blow-off, and ASE), the water-fill valve will open and fill the machine to the SET POINT.

SET POINT: This is the minimum water level when the machine is not in a cleaning cycle. The machine will automatically fill to this level. Reservoir volume between the SET POINT and HIGH is called the ***rinse-bank***.

HIGH: Whenever water level is above the HIGH level, the water-fill and rinse are disabled. This is the maximum water level possible for operation of the machine.

The following figure shows the four different levels detected by the float system and the positions of the two limit switches at each level. Below each diagram is a table that shows which systems are enabled or disabled at each level.

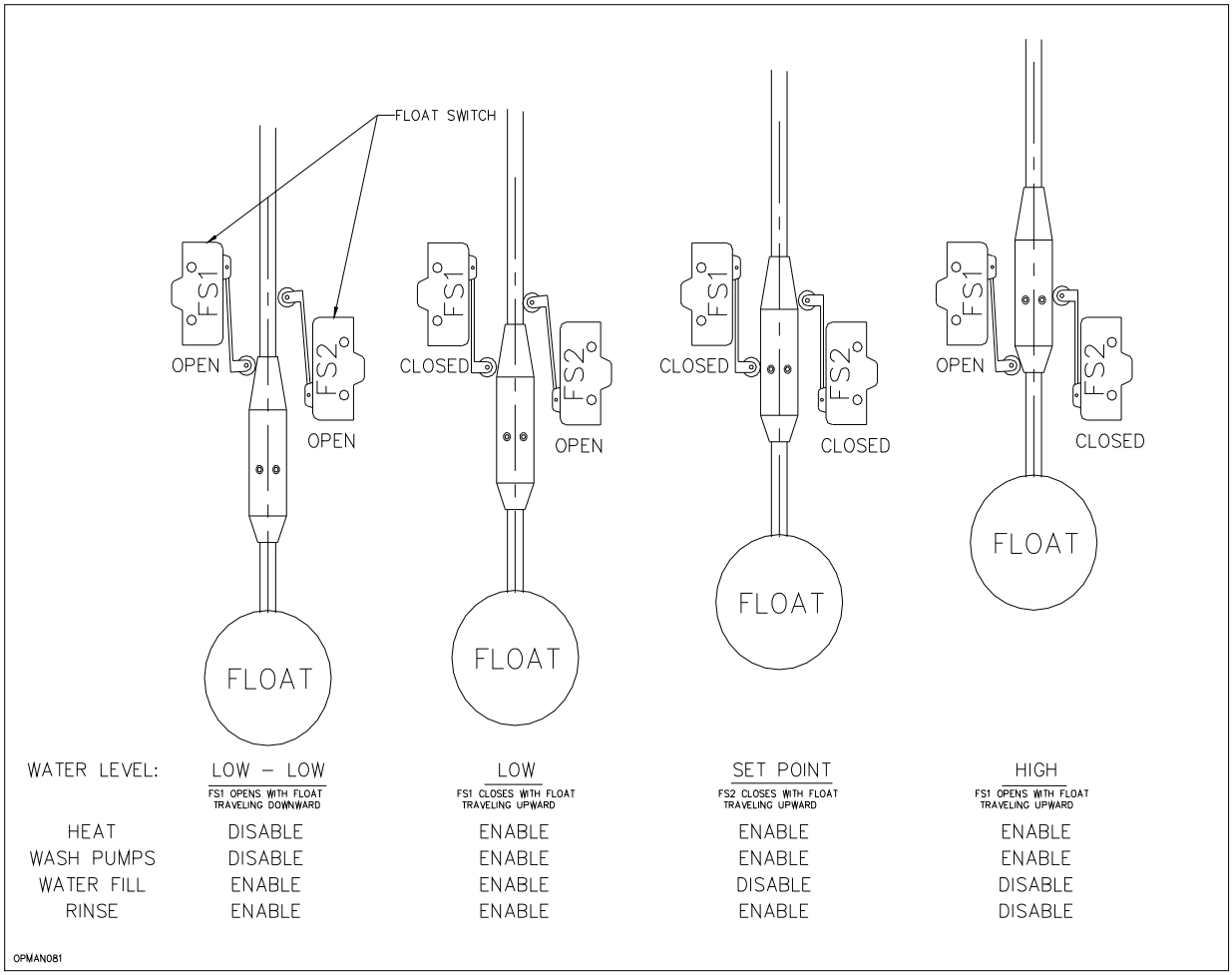


Fig. 1 - 4: Float-Level Mechanics

The ***rinse-bank*** is the amount of space available in the reservoir for additional rinse water. Since the water-fill system only fills to the SET POINT, the ***rinse-bank*** allows accumulation of available rinse volume during:

- Wash cycles
- *Between* wash cycles
- Parts loading *and* unloading
- Heat-up
- Overnight

This allows longer rinses than would be possible with a simple single set-point/water-fill and rinse system:

- With the single set-point system, only water evaporated or discharged from the machine cabinet during a cleaning cycle makes room for rinse water.

- With the rinse-bank system, by contrast, any time water is evaporated or removed (via drag-off) it increases the ***rinse-bank***. This water permits *longer* rinse cycles and is available for *added* rinse time.

The following figure shows the water level dimensional differences between each water-level position detected by the float system *(Low-Low*, *Low, Set-point, High)*.

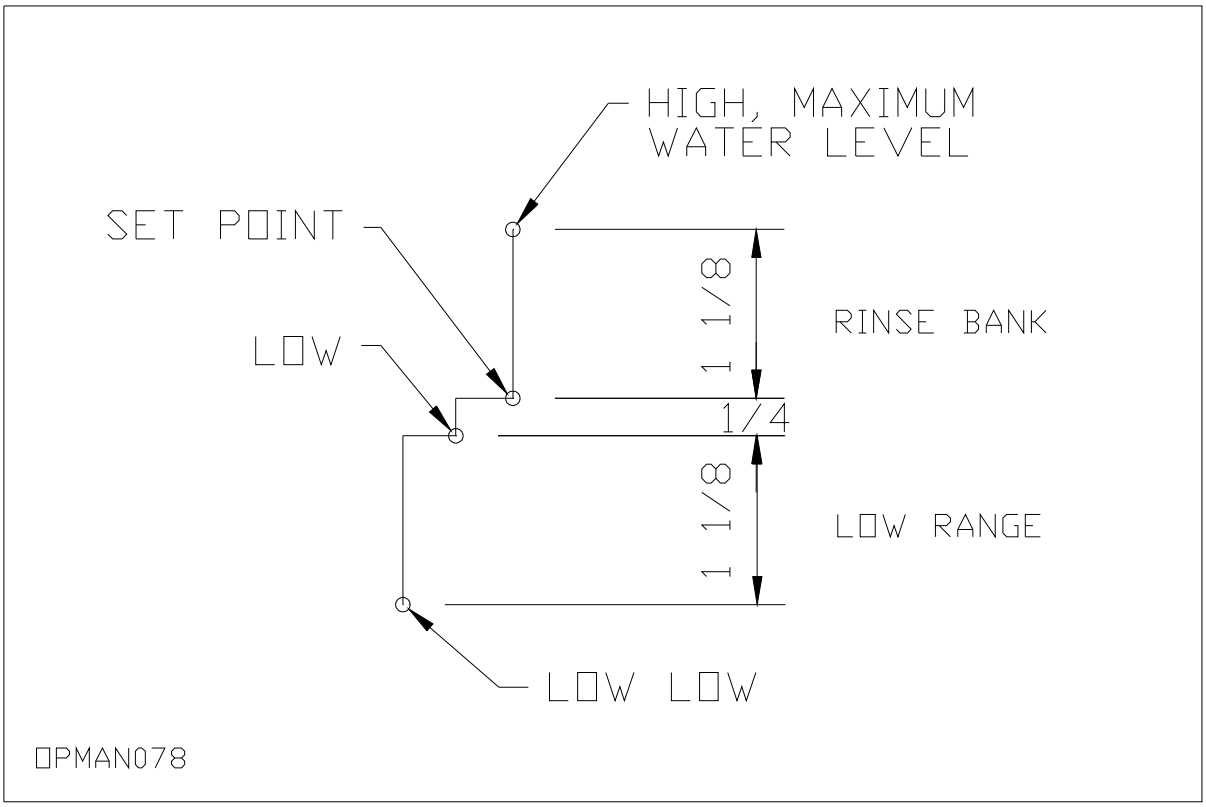


Fig. 1 - 5: Water Level Differences at Four Positions

3.2.9. Power Washer Control System

This section discusses the power-washer control system and sequence of operation when powered up for a wash cycle. Operator controls are located on

the outside of the (electrical) control panel to the left side of the door. Major system controls are housed inside the electrical panel. A number of system features are logically interdependent in order to help ensure safe operation of the washer.

This section is divided into the following parts:

- Operator controls
- Major components
- Sequence of washer operation
- Interdependent system features
- Electrical schematics

See chapters on "*Installation"* and *"Advanced Operations: Process-Control"* for more detailed information on using the control system.

Operator Controls

The operator uses these controls in day-to-day wash-cycle operations. They are located on the outside of the (electrical) control panel to the left side of the door, and include:

Hour Meter	Monitor the total number of hours of washer cycle time for scheduled maintenance procedures from *start* to the *end* of cycle.
Rinse off/auto	Set the rinse switch to *AUTO* to enable the rinse cycle; OFF bypasses the rinse cycle.
7-Day Dual-Circuit Clock	Program *circuit #1* to control heat-up days and start/stop times for heat and water-fill; program *circuit #2* to control the "auto" runtime for the optional Clean Machine or Oil Skimmer.
Wash Cycle Timer	Set 0-30 minute wash cycle, resets after each wash cycle
7 Day Clock	Select *BYPASS* to override the 7-day clock. Select *ON* to enable the 7-day clock control.
Turntable Jog	Press the *TURNTABLE JOG* button to rotate the turntable for easier loading/unloading.
Start (Run Light)	Press the *START* button to begin the wash cycle. The green run light illuminates indicating cycle running.

***Note**:* The start circuit is interlocked with the door closed limit switch. The opening and closing of the washer door resets the start circuit.

Stop/*Reset* Press the *STOP* button to stop washer operations (heat source and water-fill functions are not affected). The green “Run Light” extinguishes indicating cycle terminated.

> ***NOTE:*** If you have purchased any options, such as Oil Skimmer or Conductivity Controller, their operator controls will appear on the control panel, if applicable. Refer to chapter *"Options"* for more information.

> ***NOTE:*** If you specified any custom features, your control panel may differ slightly from the standard panel.

For more detailed information on operator controls and their usage, refer to chapter *"Basic Operations".* For more information on installing, operating, and maintaining options, refer to chapter *"Options".*

Major Components

The power washer is delivered with a factory pre-wired control transformer. It automatically reduces line voltage to single-phase 120 Volt AC control voltage.

Controls inside the electrical control panel are used to set up basic washer operating logic. These controls include:

- Timers and relays that control the cycle logic such as Rinse and ASE cycle time.
- 7-day clock
  A programmable device that allows the operator to preset the days of the week and time of day for the washer to heat up. The clock also allows the operator to set the days of the week and time of day when the washer is in normal "shut-down" mode. In conjunction with "shut-down" mode settings, the operator can, for example, set the controls to begin automatic operation of skimmers and the optional Clean Machine, based on clock "end-of-day."
- Motor starters with overloads
- Fusing

Sequence of Washer Operation

The operator initiates a cycle by closing and latching the door and depressing the start button. The wash cycle begins and the following sequence of operation occurs automatically. The Automatic Pressure Equalization (APE) process is the first step insuring washer start-up without water hammer. Water hammer results from the rapid expansion of the air inside the washer cabinet that is heated from ambient to wash temperature from the solution blasting from the wash manifold.

APE/Wash-Delay *Single Pump-* 20 HP, 30HP & 40HP pumps are started via a motor Softstarter. This AC electrical device reduces the electric current surge of the motor during power up ramping the motor speed from zero to full speed over a 10 second time period. The gradual speed increase prevents water hammer.

Or

Duplex Pumps only: The booster pump starts first and pre-heats the air in the cabinet for 10 seconds to 60 seconds, depending on the wash-delay timer setting. Then the timer activates the main wash-pump power-up circuit. Never set the timer to less than 10 seconds.

Wash Pump The main wash pump motor *starter* engages, activating the main wash pump motor. The power blast manifold (PBM), the turntable drive motor and the auto steam exhaust (ASE) blower motor also start. This begins the wash cycle. When the 0 to 30-minute wash cycle timer times out, the wash pump starter and power blast manifold (PBM) stop operating. This ends the wash cycle.

Rinse System *(optional)* The rinse solenoid opens, and the auto rinse cycle (ARC) begins. When the ARC timer times out, the rinse cycle has finished.

ASE Blower Motor After the rinse cycle finishes, the auto steam exhaust (ASE) blower motor continues, until the ASE timer times out, ending the ASE cycle. The turntable drive motor stops and the cycle is complete.

Interdependent System Features

Some washer system features are linked to others, in terms of control logic. Here is a list of principal interdependent features:

Door-Limit Safety Switch: The loading door must be shut before the wash cycle can begin.

Door-Limit Safety Switch verification: The door limit switch is interlocked with the start circuit, which verifies the proper operation of this switch. Opening and closing the wash door resets the start circuit allowing a wash cycle to begin.

Water and Heating System: The heating system functions *only* if there is sufficient water in the washer to activate the circuit. See *"Water-Level Control System"* section above.

Makeup Water and Rinse System: The rinse system functions *only* when there is a need for makeup water or when the ***rinse-bank*** is low. See sections *"Water-Level Control System"* and *"Automatic Rinse System (ARC)" above*.

7-Day Clock and Heating System: The 7-day clock controls daily heating periods, *unless* the operator uses the clock-override switch to bypass the 7-day clock.

Wash Pumps and Start-Up System (APE): Air in the cabinet is pre-heated in order to prevent rapid expansion (water hammer) when the wash pump starts. How this works depends on whether you have a single-pump or a duplex-pump system.

Single-Pump System: All 20-, 30-, and 40-horse power systems – use an AC electrical soft-starter. The soft-starter continuously controls the three-phase motor's voltage supply during the power-up phase to gradually accelerate the pump motor from zero RPM to full speed over 10 seconds to prevent water hammer.

Duplex-Pump System: The booster pump starts first and pre-heats the air for 10 seconds to 60 seconds, depending on your wash delay timer setting. Then the timer initiates the main wash-pump power-up.

WARNING! Do not disable the APE (automatic pressure equalization) wash-delay timer! -- Water hammer could occur, resulting in severe damage or injury! The wash-delay timer should never be set to less than 10 seconds.

Electrical Schematics

Provided Electrical Schematics show the ladder logic diagram of the washer operation, the wire numbers and color codes. The provided electrical layout diagram shows the location of all electrical components in the electrical enclosure. Please refer to the electrical schematics provided with your washer.

4. Washer Inspection

When you receive your new StingRay Parts Washer, inspect it for freight damage –

Do this before installation!

Here are some tips:

Inspect:		***For:***
Entire cabinet, including the top	➔	*dents or scrapes*
Electrical wire conduits	➔	*breakage*
Cabinet door	➔	*dents or scrapes; Misalignment*
Water hoses and pipes	➔	*breaks or cracks*
Solenoid valves	➔	*breakage*
Electrical control panel door	➔	*dents and scrapes*
Motors	➔	*damage*
Pump frame	➔	*cracked; loose bolts*
External gauges	➔	*damage*

Fig. 1 - 6: Washer Inspection before Installation

Record any damage
on the bill of lading.
Report any damage to StingRay.

2 Installation

Purpose

This chapter provides operating instructions/procedures for installation and startup of the *StingRay Parts Washer*. Correct installation of the washer is important for the following reasons:

- To ensure that the washer functions properly.
- To ensure that placement of the washer on your shop floor fits into the workflow pattern.
- To validate your warranty.

Prerequisites

Before you begin to install the parts washer, be sure you have followed the recommendations in this section.

- ❑ **Information**: Read the entire manual before installation.
- ❑ **Expert Help and Equipment**: For leveling, anchoring, installing, and startup have the following on hand:
  - Qualified, trained personnel
  - Proper lifting equipment
  - Anchoring materials
  - Steel shims
  - Flue pipe (for gas heated machines only)
  - Auto Steam Exhaust (ASE) pipe
  - Power supply wires, ground, conduit & fittings.
  - Water-tight hub for incoming power & conduit.
  - Rain cap(s)

- Hand-Tools, including masonry drill (Continued)
- Voltmeter and amp meter

❑ **Steam-Exhaust PVC Kit**: Order your kit through StingRay. Refer to section *"Steam Exhaust (Output)"* in this chapter.

❑ **1/2-inch NPT water regulator**, *if* your water pressure is greater than 125 PSI (862 kilopascals).

❑ **Compressed Air Filter and Regulator**: 1/2-inch NPT size. (You will need this only if compressed air is required for your washer.)

❑ **Placement Planning**: Refer to your *Services to be Provided by Others and Service Requirements (SBO)* letter from StingRay for specific utilities required for your parts washer, and its overall dimensions. Here is a checklist to use as you plan placement:

❍ *Route*: Plan the route you intend to use to move the washer from the loading dock to its installation location. Refer to the SBO for the washer's overall dimensions and weight. Be sure the washer will fit through all doorways.

❍ *Maintenance and Service Access*: Leave enough access space around the washer in the installation location to reach all system components for maintenance and service, especially the pump area (pump removal). StingRay recommends a minimum of 3 feet. Allow for cleanout with the door in full-open position (180° angle from the cabinet doorframe).

❍ *Operations Access*: Leave adequate space to work with the washer during normal operations. Allow sufficient room for loading and unloading the washer with the door in a half-open position (90° angle from the cabinet doorframe).

❍ *Overhead*: Allow for easy installation of flue pipes and steam-exhaust pipes. Be sure the area is clear of overhead shop equipment. Plan for the shortest and most direct run, to avoid needing a larger steam-exhaust motor or more complex piping.

❍ *Roof*: If you intend to run the steam-exhaust and gas flue pipes through the roof, be sure this is feasible. Plan for the shortest and most direct run, to avoid needing a larger steam-exhaust motor or more complex piping.

Ensure that flue-pipe clearances from combustible material are in accordance with NFPA, local, state, and national standards and/or the flue manufacturer's instructions.

- *Utilities*: Check how far utility sources are from the washer -- gas, water, compressed air, and electricity. Plan for the *exact* route you intend to use -- the shortest and most direct run -- to avoid complex wiring and piping.

  CAUTION! Do not run electrical or other utility conduits over the pumps as they may prevent removal of the motor or pump.

- *Combustion Air:* If you have a gas-type burner as a heat source, ensure there is an adequate supply of combustion air in the area in which the burner is located to assure complete combustion at all times.

  If the parts washer is installed in a room by itself, the room should have its own combustion air supply. This should take the form of louvers through an outside wall, or, if the room is in the center of a building, properly sized ductwork to a source of outside air.

  If the Parts Washer is located in a large open area of a plant, it will normally draw its combustion air from inside the plant. However, problems will arise if there is an imbalance between exhaust and makeup air in the plant such that there is a positive or negative pressure relative to outside.

  Refer to the latest issue of the *National Fuel Gas Code* (American National Standard ANSI Z223.1) for details. In general, it specifies that a permanent opening or openings have a total free area of not less than 1 square inch (2.5 sq. cm) per 4,000 BTU per hour total input rating of all appliances is required.

- *Floor*: Plan to set the washer flat on the floor, so that it can be anchored to the floor for safe door loading.

- *Options*: If you have ordered optional equipment, such as the sludge scraper, allow adequate space in the washer area form operation and mantenance.

- *Grounding -- Electrical:* Plan for a proper grounding system to reduce the risk of electric shock.

- *Earthground -- Corrosion*: Plan for an earthground to prevent corrosion.

Results of Correct Installation

If you plan the placement of your washer and follow other StingRay-recommended installation procedures, you should achieve the following results:

- A safe installation
- Proper accessibility to the washer for operations and maintenance
- Proper and efficient functioning of all utilities
- Proper functioning of all cycles, according to specifications
- Assurance that your warranty is valid and in effect

Safety/Precautions

Before you begin installation, read and follow these recommended safety/precaution instructions:

CAUTION! GROUNDING INSTRUCTIONS: The washer must be grounded! Grounding provides a path of least resistance for electric current, thus reducing the risk of electric shock during maintenance, troubleshooting, or repair.

CAUTION! GROUNDING INSTRUCTIONS: The washer must be connected to a grounded, metal, permanent wiring system. The equipment-grounding conductor must be run with the circuit conductors and connected to the equipment-grounding terminal on the washer.

WARNING! IF YOUR PARTS WASHER USES A GAS BURNER: If you do not follow installation and operating instructions exactly, a fire or explosion may result, causing loss of life, personal injury, or damage to property. Do not store or use gasoline or other flammable vapors and liquids in the vicinity of the Parts Washer.

WARNING! VENTING OF EXHAUST GASES: Do NOT vent exhaust gases into a wall, a ceiling, or a concealed space of a building. Refer to the instructions in this chapter for correct vent installation instructions.

WARNING! Be sure that the people installing the equipment and the Parts Washer are qualified and trained for the task. They should meet any licensing standards required in your area.

WARNING! Set up your Parts Washer installation to conform to all local, state and national code requirements.

WARNING! Do NOT add water, chemical, or turn on the power during installation! These steps are part of the startup procedure: Wait until "Startup Procedure," at the end of this chapter, to add water, chemical, or turn on the power!

WARNING! The parts washer is designed to be installed inside a building, not outside.

What You Will Learn In This Chapter

In this chapter you will learn the following about installing the washer:

- Lifting and moving
- Placement
- Unpacking
- Leveling and Anchoring
- Services and Connections
- Startup Procedure
    * Power-up
    * 7-Day clock initialization

1. Lifting and Moving

After you have planned the placement of the washer and selected a suitable site, use one of the following methods to lift and move the washer:

1. Use a **forklift** to lift and move the washer: lift only on the machine perimeter base frame. The forks must be long enough to reach to the opposite side of the base frame.

> ***WARNING! Be sure the forks extend far enough. DO NOT lift on the floor of the washer. Lifting the washer in such a way that the ends of the forks hit the floor of the washer will damage the floor.***

2. You may also use **machinery rollers**. Be sure to lift or support the washer on the perimeter of the base frame only.

3. Use a **crane** to raise the washer by the *lifting eyes*, located on the top left and top right sides of the cabinet, as shown in FIG. 2-1.

> ***WARNING! Use lifting equipment rated for the weight of your parts washer. To find out the weight, refer to the StingRay Parts Washer specification section in the* Services to be Provided by Others and Service Requirements (SBO) *letter that you received from StingRay.***

> ***WARNING! Lift the washer by the lifting eyes only. DO NOT attach chains or cables to a central point from the washer lifting eyes as the sidewalls and roof of the cabinet may collapse or you may bend the lifting eyes. Use a spreader beam to divide/spread the vertical load to each eye.***

> ***WARNING! Stand clear of the washer during lifting and moving.***

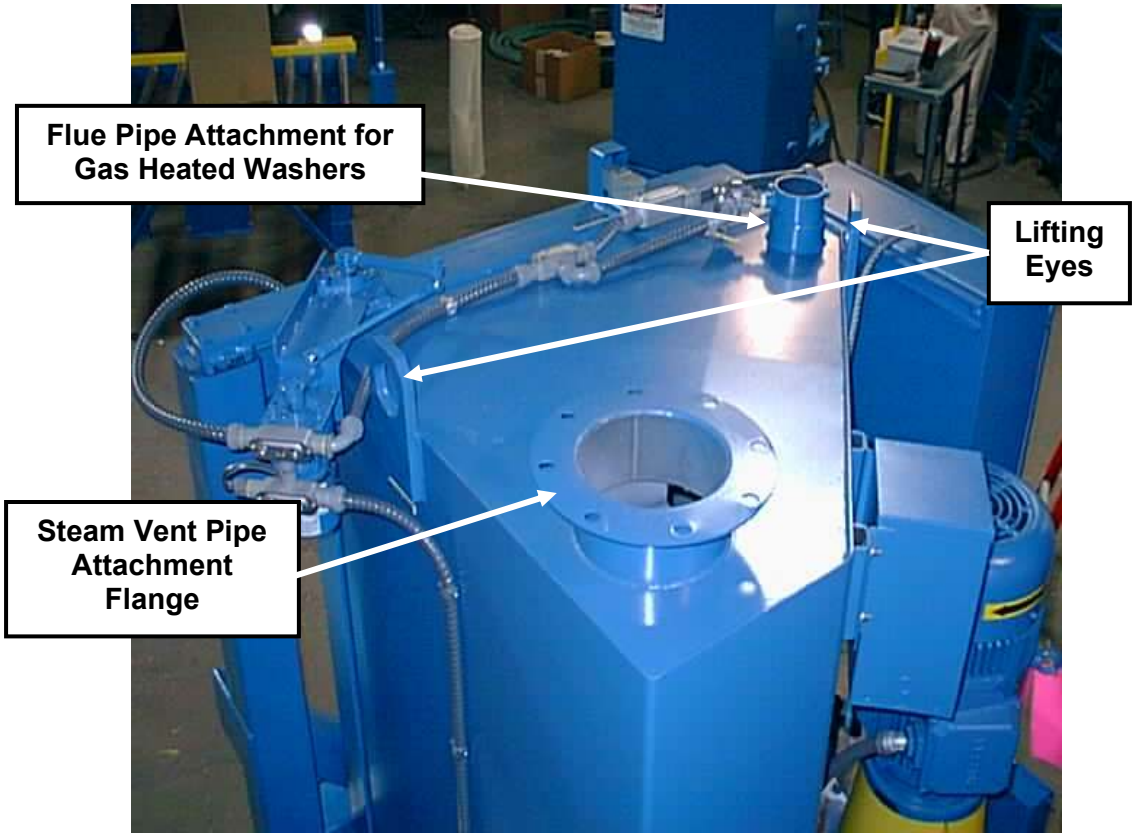


Fig. 2 - 1: Raising the Parts Washer by the Lifting Eyes

2. Placement

After you have moved the washer to the installation location, place it according to your plan. Watch the overhead and side areas around the washer as you place it. Walk around the washer and verify clearances.

Refer to section *"Prerequisites, Placement Planning"* at the beginning of this chapter for placement guidelines and recommendations.

You may want to jot down special placement notes here as you plan:

3. Unpacking

After you have placed the washer in the installation site, unpack it. Check the packing slip (attached to the washer) to see *what* to look for.

> ***Note:*** **Many items and accessories are shipped in the washer cabinet on the turntable.**

Follow this general procedure:

1. Remove the packing material from the outside of the washer cabinet.
2. Remove the tie wrap securing the door latch. Unlatch the cabinet door and open door slowly and carefully.

   NOTE: Some items secured to turntable may have shifted during shipment.
3. Remove the cartons strapped to the turntable.
4. Check all standard items, accessories, and documentation against the packing slip. Refer to Fig. 1-1 and Fig. 1-2 to identify major components.
5. Remove the rubber grommet and tie from the stainless steel rod coming out of the top of the Water Level Solution Control box. The grommet is used to protect the float ball during shipment and can be discarded.
6. Open the electrical control panel. Inside the enclosure you will find a manila pouch with the following:
   - Vendor Cut Sheets and Manuals
   - *Field Startup Procedure (FSP)* form
   - SBO (Service By Others)
   - Electrical Ladder Diagram and Panel Layout
   - Washer Manual
   - Replacement parts BOM (Bills Of Material)
   - Cover Letter
   - Service Schedule

After you have moved, placed, and unpacked the washer you are ready to perform the following parts of the installation process:

- Leveling and anchoring
- Connection procedures
- Services and connections verification
- Startup procedure

IMPORTANT! Before you go any further, get the *Field Startup Procedure (FSP*) form (it is in a pocket on the inside of the electrical control panel door). You will use the form as a checklist to ensure correct installation as you follow the steps in the next several sections.

***Use the* Field Startup Procedure (FSP) *form in this way*:**

1. As you install the washer, fill in the *Field Startup Procedure (FSP)* form.
2. After you have completed a successful installation, sign and date the form.
3. Make 1 copy and keep for your records. Mail/FAX to StingRay the other copies being sure it is properly signed and dated.
4. Keep your copy in your maintenance records. You will need it during maintenance procedures, and any time you call StingRay.

NOTE: Information gathered on the **Field Startup Procedure Form** (**FSP) is critical** in verifying initial performance and in providing a benchmark for future diagnostic and troubleshooting efforts! ***Be sure to fill in the FSP during installation!***

4. Leveling and Anchoring

The parts washer should be placed on a flat floor suitable for "anchoring" the washer. For example:

- Concrete floor
- Concrete pad
- Steel structure

4.1. Leveling

Follow this procedure:

1. Find the leveling and anchoring feet (at each corner of the washer at floor level).
2. Find the leveling bolt/nut and the anchor hole on each leveling and anchoring foot.

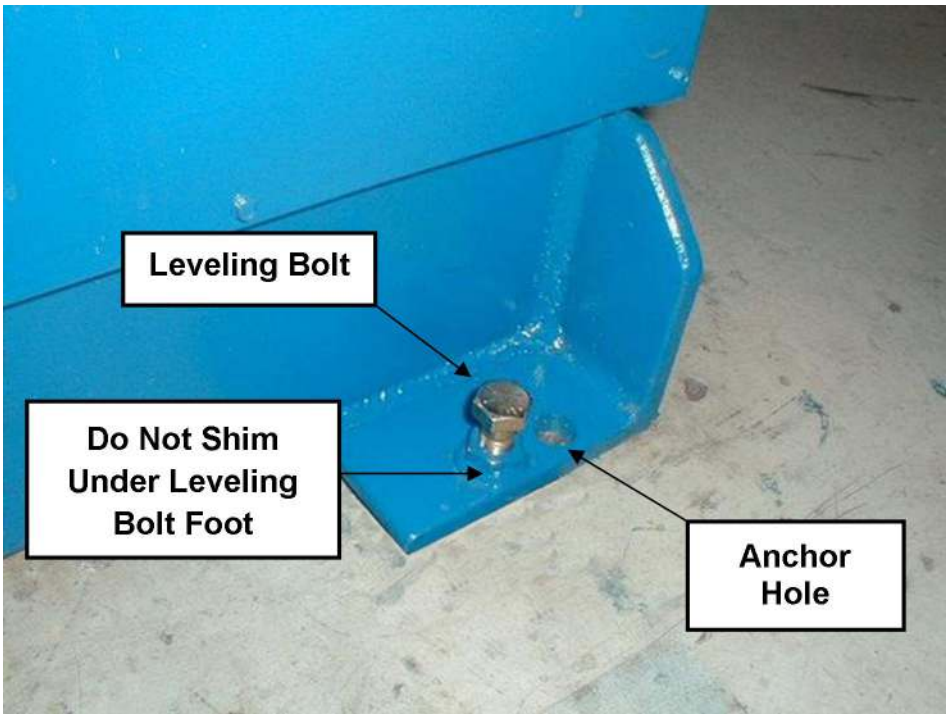


Fig. 2 - 2: Leveling and Anchoring Feet

3. Adjust the leveling bolts so the cabinet door will stop and remain in any open position with minimum "creeping" to a more open or closed position. Do **NOT**

level the machine using a bubble level on the reservoir or other part of the machine.

Turn the leveling bolt *clockwise* to *raise* the corner of the cabinet. Turn the leveling bolt *counterclockwise* to *lower* the corner of the cabinet.

4. Level the washer from front to back first, then side to side.

5. After leveling, shim under the frame of the washer, so that the washer frame is supported by the shims, NOT by the leveling bolts. Shim under the door post, door frame, and at each corner. Place additional shims under the entire frame, at least three feet apart (quantity required will depend on machine size (refer to Fig. 2-3). For clamshell-style washers, place shims under the vertical turntable support tube.

Follow this procedure:

A. Start with all leveling bolts adjusted so machine frame is sitting on the floor. While holding the door open slightly away from the door seal

Note: If the door swings closed, raise the rear leveling bolts. If the door swings open, raise the front leveling bolts. Continue to adjust the front or rear leveling bolts until the door stays in position.

B. Open the Door to a position that is 90° to the doorframe. Determine if the door swings to the left or right.

Note: If the door swings right, raise the right side leveling bolts, raising the leveling bolts together. If you add three turns to the front side bolt, add three turns to the level bolt in the rear on the same side. Continue raising the bolts until the door stays at the 90° open position.

C. Recheck the door swing with the door slightly open. Adjust the front or rear leveling bolts in tandem to keep the door motionless.

D. Position the door so it is open to a 45° angle from the doorframe. The door should remain motionless in this position. If it does, you have a perfectly level doorpost. If not, repeat the previous steps until the door remains motionless at any open position.

Note: This procedure positions the upper and lower doorpost shafts so they are in plane both front to rear, and left to right.

5. After leveling, ***shim under the frame*** of the washer, so that the washer frame is supported by the shims, *not* by the leveling bolts. Shim under the door post, door frame, and at each corner. Place additional shims under the entire

frame at least every three feet apart (quantity required will depend on machine size) (Refer to Fig. 2-3).

WARNING! Do not shim under the leveling/anchoring feet. This will interfere with the leveling bolts. Shim under the frame of the washer only.

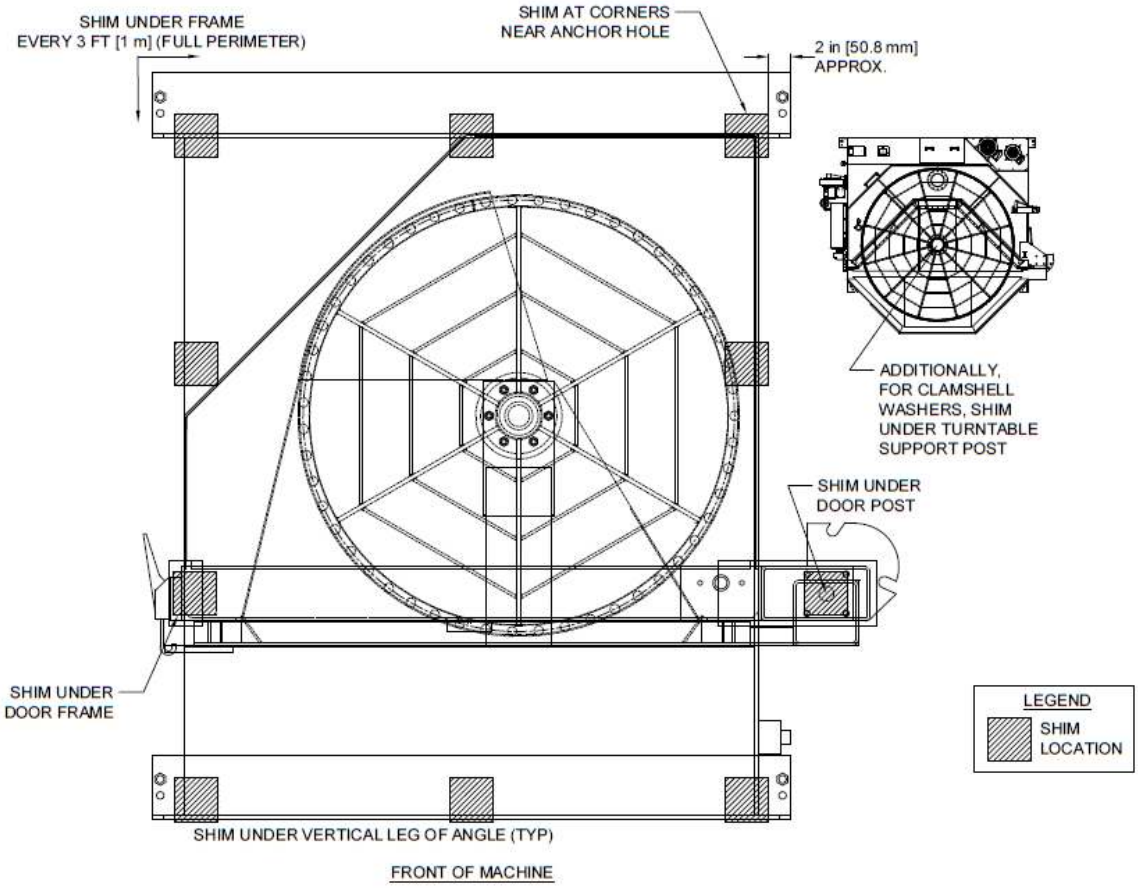


Fig. 2 - 3: General Shim Placement, Top View of Base Frame

6. When the washer is level and the shims are in place, back off the tension of the screws on the leveling bolts, so that the washer rests solidly on the shims.

7. Re-check the door to be sure it does not "creep." If it does, repeat the leveling and shimming procedure.

4.2. Anchoring

After you have properly placed, leveled, and shimmed the parts washer, anchor it to the floor.

Follow this procedure:

1. Use the anchor holes provided. Generally, there is an anchor bolt location on each leveling/anchoring foot. Depending on the washer size and configuration, there may be additional anchor bolt locations, i.e. SR72, SR84 & SR100 washers have additional anchor bolt holes on the rear base angle. Washers with the optional Jib Crane have anchor bolts at the base of the vertical I-beam.

2. Use anchor bolts whose diameter equals the diameter of the anchor holes. Consult your local distributor of anchoring products for an anchoring system that meets your requirements.

3. Install the anchor bolts solidly and completely into the floor, so that each bolt can carry its full tensile strength. (StingRay recommends an epoxy-injection bolt-anchoring system.)

4. You may wish to grout the washer's base angle, and on clamshell-style washers, the turntable vertical support tube, also. If so, keep the following in mind:

Grouting is designed to fill the area between the base angle and the concrete -- permanently and completely -- and securely bond the base angle to the concrete. However, grout is not "glue," nor does it do the work of the anchor bolts. It is meant to provide vertical support and absorb operating forces. Additionally, grout seals the base angle to the floor, so that water and moisture cannot get under the washer and cause corrosion.

When placing grout, follow the manufacturer's detailed instructions to the letter! This will help prevent voids and other grout-repair problems later.

In general, use only non-shrink grout. The distributor should be able to tell you whether the grout has been tested for shrinkage, before and after hardening. And remember that most epoxy grouts require bone-dry concrete.

For example, for concrete flooring, StingRay recommends an epoxy grout. To test for dryness of concrete, tape a rubber mat or plastic sheet to the concrete; check for condensation after 24 hours. Don't apply the epoxy if there is any moisture.

Your distributor should give you the manufacturer's detailed instructions for:

- Preparing the base angle

- Equipment needed
- Mixing the grout
- Application

5. Services and Connections

Begin services and connections *only after* you have leveled and anchored the washer.

5.1. Introduction

You are now ready to connect the utilities to the washer, and install options. To do this, use your utilities connection plan, devised during placement planning. (Refer to section *"Prerequisites, Placement Planning"* at the beginning of this chapter.)

Your plan and the SBO tell you which of the following utility connections and options' installations you must make. Use this manual to locate the connections on the parts washer.

> ***WARNING! Be sure that the people who install the parts washer and make connections are qualified and trained for the task. They should meet all licensing standards required in your area.***

Utility connection procedures are divided into two major parts:

- Inputs
- Outputs

These are discussed in the sections that follow.

After you have connected utilities, install any options you may have purchased from StingRay.

5.2. Connection Procedures - Inputs

This section describes *input* connection procedures. The next section describes *output* connection procedures.

Use your placement plan and the SBO form to determine which of the following utility connections you must make.

Input Utility Connections:

- Heat source
    - Gas (natural and propane)
    - Electric
    - Steam
- Water
- Compressed air
- Electricity

Depending on your parts washer configuration and optional equipment, refer to the applicable sections in this manual for information on making the necessary connections.

5.2.1. Heat Source

Depending on the washer's configuration and options, it will use one of the following heat sources:

- Gas (natural and propane)
- Electric
- Steam

A description of each type of heat source follows.

Gas & Oil Heat Source

For proper connection of the gas heat source, natural or propane, refer to the specifications in the SBO and to the vendor manual provided with the burner.

Burner Mounting

The parts washer is equipped with a burner, as shown in one of the following figures. Locate the figure that refers to your burner size. ***NOTE:*** After burner mounting is completed, check to be sure there is a close fit between the burner and the combustion chamber.

Fig. 2 - 4: Mounting the Combustion Burner (Up to 180,000 BTU)

For combustion burners up to 180,000 BTU

Follow this procedure

1. Bolt the heat exchanger adapter to the burner with the gasket and hardware provided.
2. Install the burner assembly into the heat exchanger with four bolts and washers. **CAUTION:** *Do NOT over-tighten the bolts to the point where the adapter distorts!*

Now go to the *"Burner Fuel and Electrical Connection"* section.

Fig. 2 - 5: Mounting the Combustion Burner (Up to 400,000 & 990,000 BTU)

For combustion burners up to 400,000 BTU and 990,000 BTU

Follow this procedure

Most Eclipse Combustion Burners come pre-mounted on the Parts Washer and do not require mounting.

Note: Now go to the *"Burner Fuel and Electrical Connection"* section (Page 2-19)

Burner Fuel and Electrical Connection

For all combustion burners, *follow this procedure*: *(Eclipse Burners are pre-wired to the Parts Washer and require no further wiring.)*

1. Locate the *unconnected 1/2-inch (13-mm) PVC conduit* containing:

    - *One orange wire*
    - *One white wire*
    - *One green wire*

    and install it in the *burner junction box conduit fitting*. (The conduit was secured for shipment on the right side of the washer.)

2. Terminate the orange, white, and green wires to the wires in the burner junction box as shown in the following figure. (Please note that for Riello Burners the orange wire lead connects to L, the white wire connects to N, and the green wire connects to the green ground screw in burner junction box).

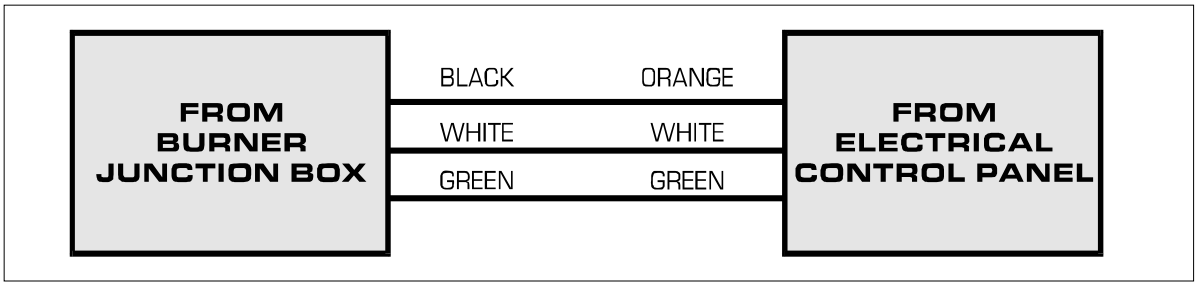


Fig. 2 - 6: Burner Junction Box -- Wiring

3. ***(Gas)*** Connect the gas supply pipe to the *combination gas valve inlet* for burners with 180,000 BTU/hr rating or *gas regulator* inlet for larger Eclipse burners (natural or propane gas).

Note: Be sure the gas supply line is of adequate size for the firing rate of your burner and for the length of the gas pipe supply run. Refer to the gas burner vendor manual for information on pipe capacities versus run lengths. Be sure to support the gas supply line with supports to avoid strain on the burner gas train

WARNING! NEVER apply gas pressure above 12 w.c.i. to the combination gas valve inlet, or damage may occur! If incoming gas pressure is above 12 w.c.i., a proper gas pressure regulator is required. A lock-up type regulator stops gas flow above set-point without venting gas to atmosphere. Do NOT use an internal relief-type regulator without running the vent to a safe discharge area.

4. Turn *ON* the *main gas supply*.
5. Perform leak tests at all fuel pipefittings and joints, including all connections on the burner, and all piping installed to the burner. To do this, spray a solution of soap and water around all fittings and look for bubbles. If you see bubbles, the fittings and joints are not tight, and are leaking.
6. Turn *OFF* the *main gas supply.*

Electric Heat Source

The electric heating elements have already been installed at the factory. No further connection procedures are required.

Steam Heat Source

For proper connection of the steam heat source, you need to know:

- Your plant steam pressure;
- The length of run from the steam source to the washer;
- The steam flow rate required.

Find the steam flow rate in your SBO specification. Longer runs from your steam source require larger pipes. Use the following table to size your supply piping:

SIZING STEAM PIPING

Pipe Size, Inches (Schedule 40)	Lb/hr steam for piping pressure drop of 1 psi/100ft Steam Pressure, psig					
	5	10	25	50	100	150
3/4	31	34	43	53	70	84
1	61	68	86	110	140	170
1-1/4	135	150	190	235	310	370
1-1/2	210	230	290	370	485	570
2	425	470	590	750	980	1,150
2-1/2	700	780	980	1,250	1,600	1,900
3	1,280	1,450	1,800	2,250	2,950	3,500
4	2,700	3,000	3,800	4,750	6,200	7,400
6	8,200	9,200	11,500	14,500	19,000	22,500
8	17,000	19,000	24,000	30,000	39,500	47,000

Fig. 2 – 7: Steam Heat Source: Piping Size

Follow this procedure:

1. Install the steam supply line to the *steam solenoid* on the side of the washer. Install an in-line strainer before the steam solenoid control valve to prevent dirt and debris from clogging the control valve. Install a shut-off valve in-line ahead of the strainer. Install a pressure gauge in the supply line.

2. Install the condensate line to the *steam trap* on the right side of the washer. The condensate is gravity feed from the heat exchanger. Be sure your condensate system is designed to handle the output from the heat exchanger and trap.

3. Make *connections* to your in-plant steam power system, according to your plant codes and other local codes.

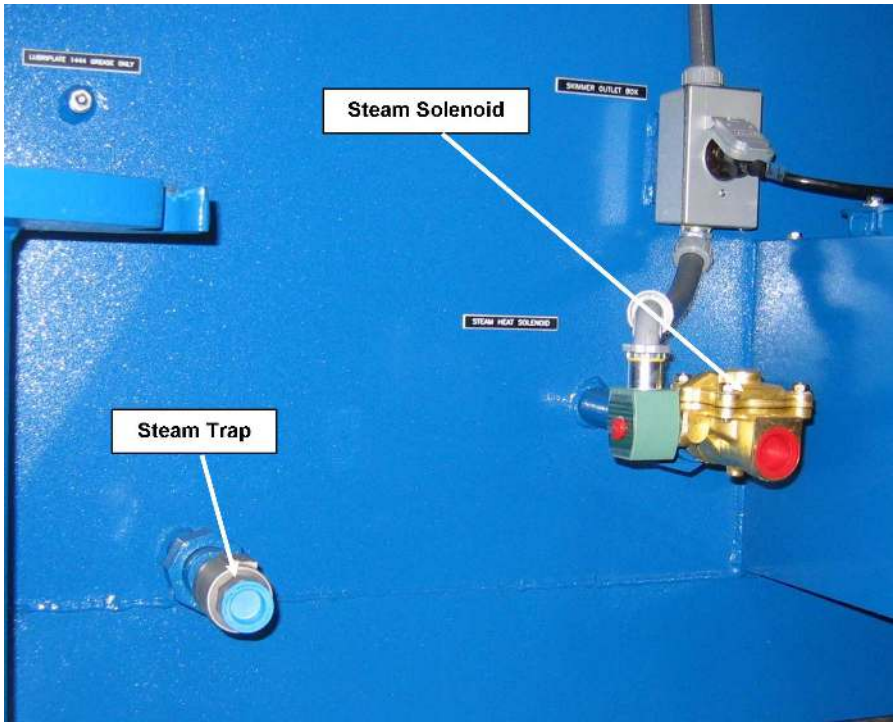


Fig. 2 - 8: Steam Solenoid and Steam Trap Installation

5.2.2. Water (Input)

Refer to the specifications in the SBO form for correct water-line sizes. A 1/2-inch-diameter NPT (13 mm) water line is required for automatic water-fill and the optional Auto Rinse Cycle (ARC).

Follow this procedure:

1. Install a *water regulator*, if incoming water pressure is greater than 125 PSI (862 kilopascals). The regulator should regulate water pressure to 100-125 PSI (690-862 kilopascals). (***NOTE**:* The water regulator is *not* provided by StingRay.) (Note: Minimum water pressure required is 25 PSI).

2. Connect a 1/2-inch-diameter (13 mm) water supply line to the washer inlet. (***NOTE:*** The washer water supply inlet is a ***BRASS*** fitting. Refer to the following figure for the connection location.)

3. If you have a rinse system, install the brass drain plug. The drain plug is shipped in the control panel. Do not overtighten.

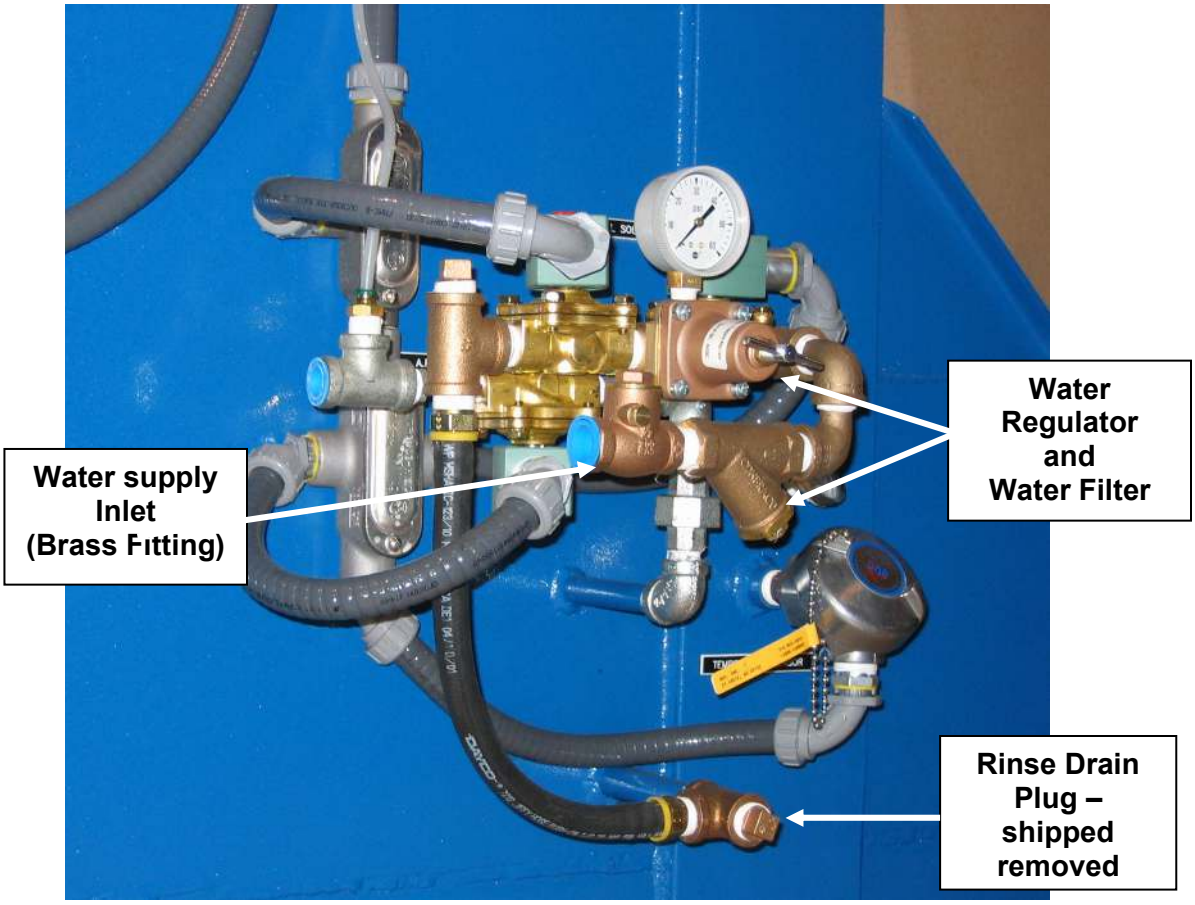


Fig. 2 - 9: Water Connection Location

5.2.3. Compressed Air (Input)

> ***NOTE! Do NOT connect a compressed air line to a BRASS fitting on the machine. The compressed air-line connection is a GALVANIZED fitting. If you do NOT have a galvanized fitting you will not need a compressed air line.***

If washer requires compressed air, follow this procedure:

1. Install a compressed-air line to the washer. The connection size is specified on your SBO document and is most often a 3/8 inch NPT fitting. (The incoming pressure range should be between 60-125 PSIG 414-860 kilopascals).

2. Connect an air filter and regulator in-line with the washer's compressed-air inlet. Refer to the following figure.

3. Connect the air-supply line to the filter.

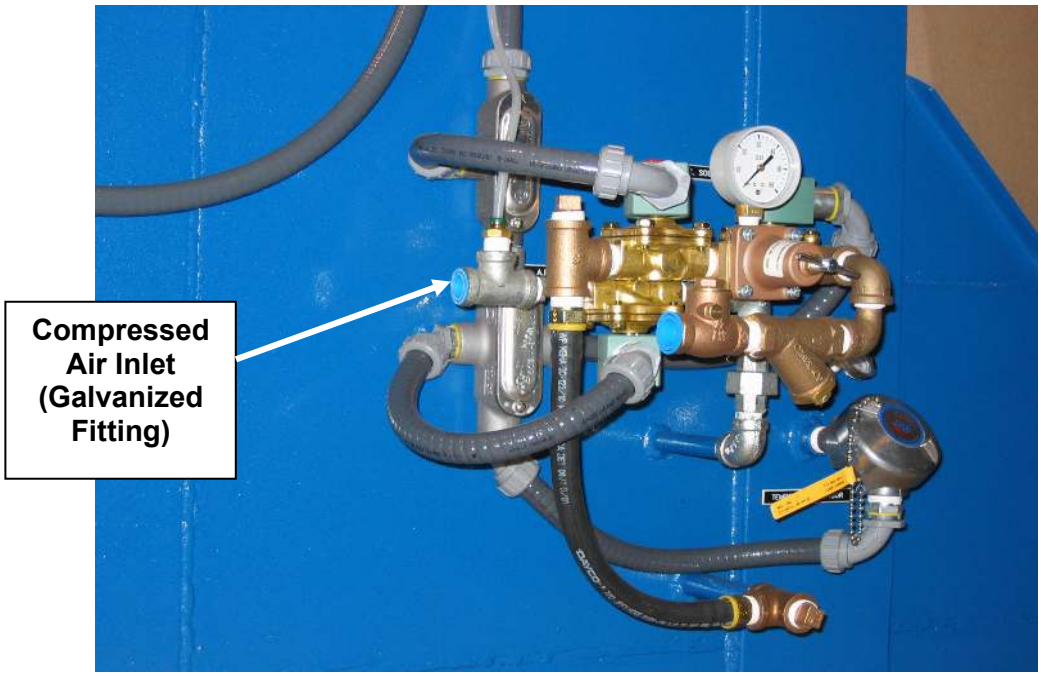


Fig. 2 - 10: Compressed-Air Connection

5.2.4. Electricity (Input)

NOTE: **<u>You are responsible</u> for meeting all local and national electrical codes that apply to the power source and to the wiring from the power source to the StingRay Parts Washer. *Be sure that* people who are qualified and trained for the task do all electrical installation and connections. *They should meet all local licensing requirements.***

NOTE: **If your washer is NOT equipped with an electrical disconnect, the NEC *(National Electrical Code)* requires a main disconnect.**

> ***CAUTION! GROUNDING WARNING: The washer must be grounded! Grounding provides a path of least resistance for electric current, thus reducing the risk of electric shock during maintenance, troubleshooting, or repair.***

> ***CAUTION! GROUNDING INSTRUCTIONS: The washer must be connected to a grounded, metal, permanent wiring system; the equipment-grounding conductor must be run with the circuit conductors and connected to the equipment-grounding terminal in the washer electrical control enclosure.***

Earthgrounding to Prevent Corrosion

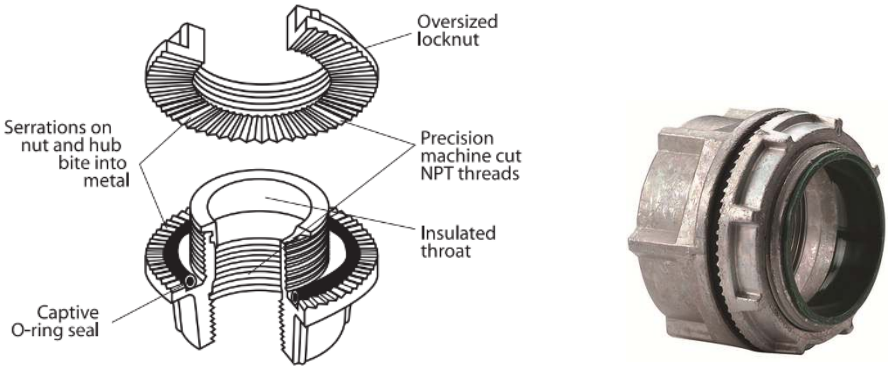
The washer must be securely grounded to prevent stray electrical fields from causing galvanic corrosion. Under some circumstances, such corrosion can very quickly cause serious structural damage to the washer (in only several months).

> ***WARNING! Use the proper equipment-grounding circuit per the National Electrical Code Article 250.***

The Parts Washer must be grounded using a copper conductor. Do ***NOT*** depend on raceways or a conduit as an equipment ground. Install an equipment-grounding conductor connected to the Parts Washer's ground lug in the Control Panel *and* connected to your electrical service system ground according to the National Electrical Code Article 250. Use a conductor ***EQUAL or GREATER*** in size to the equipment service conductor to reduce the resistance to ground. A low-resistance path-to-ground is required to minimize the potential for galvanic corrosion.

To connect power to the washer, *follow this procedure:*

1. Verify washer *voltage* and *amperage* requirements (in the SBO form).
2. Select a *feeder-wire size* that meets approved *national* and *local code* requirements.
3. Use a ground conductor of ***EQUAL*** *or* ***GREATER*** size (to the feeder wire).
4. Select a location on the electrical enclosure for the incoming power wires and ground conductors. If you have the optional NFPA 79 electrical system the best place is normally above the disconnect in your enclosure. **Install** a liquid tight conduit hub for your incoming conduit type and size. Conduit hubs provide a liquid, oil and dust tight



termination of electrical conduit through the walls of the sheet metal enclosure. Hubs provide oversized locknuts for a strong vibration-proof termination and a captive O-ring seal to keep moisture out of the enclosure. Serrations on the hub body and locknut provide an effective positive ground path. The insulated throat protects conductors from sharp edges.

5. Connect *power* from the *main power supply* to the *washer*, following NEC methods. Use proper size *wires* in the conduit, and make watertight connections to the *electrical control panel*.

6. Attach the *feeder wires* to the *power distribution block OR disconnect switch*, located in the *electrical control panel*. (Refer to the following figure for the location of the power distribution block.)

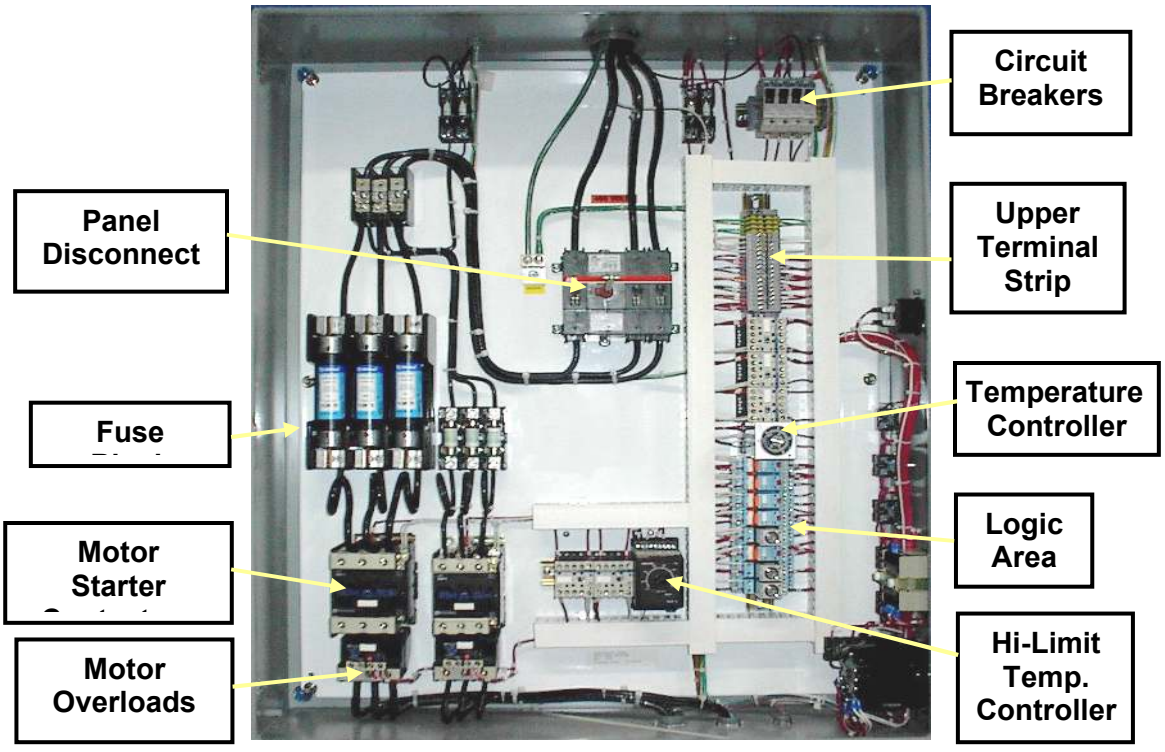


Fig. 2 - 11: General Layout of the Electrical Control Panel (Block Diagram)

WARNING! Do <u>NOT</u> turn the main power supply ON at this point!

5.3. Connection Procedures - Outputs

This section describes *output* connection procedures. The previous section describes *input* connection procedures.

Use the SBO form to determine which of the following utility connections you must make.

<u>Output Utility Connections:</u>

- Steam exhaust
  - Pipe
  - Fan
- Flue pipe
- Drain

Depending on your parts washer configuration and optional equipment, refer to the applicable sections in this manual for information on making the necessary connections.

5.3.1. Steam Exhaust (Output)

For the size of the steam exhaust, refer to the specifications in your SBO (Services by Others).

<u>The following materials can be used for steam pipe</u>:

- **Schedule 40 or 60 PVC pipe** (see *"Prerequisites, PVC Kit",* at the beginning of this chapter). StingRay washers are set up to use PVC pipe for the steam exhaust. Your washer and ASE (auto steam exhaust) blower unit arrive equipped for using PVC fittings. **StingRay highly recommends PVC**, because it is simpler to install, requires no welding, is lighter, and does not rust.
- Schedule 20 or 40 black iron pipe or stainless steel can be used instead of PVC. However, they lack PVC's advantages. If you opt to use metallic pipe, you will need special adapters to modify the flanges on the ASE blower unit. Any piping used must be water tight and leak-proof. <u>Do NOT use PVC duct or Stainless Steel duct</u>.

PVC thick wall pipe is a proven solution for discharging the hot steam vapors from the StingRay Washer. It is easy to cut and install. Unlike metal, PVC fittings never rust, scale, or pit, and provide many years of maintenance-free service. Substantially lower material costs versus steel alloys or lined steel, combined with lighter weight and ease of installation, PVC pipe and fittings reduce installation costs by as much as 60% over conventional metal systems. PVC is simple to bond together. StingRay recommends using silicone RTV silicone adhesive rather than tradition PVC cement. RTV provides much longer working times to properly align pipe and fittings. You can also add a fillet of RTV at each join to add extra assure of leak-free performance. PVC fittings and PVC pipe are in use in hundreds of installations demonstrating its appropriateness for the vapor service temperatures seen in the StingRay Parts Washers.
The following steam-exhaust ***installation instructions assume the use of PVC pipe***.
If you use metallic pipe instead, installation steps will be similar to those given here. However, you will have to adapt and modify flanges and fittings as necessary to complete the assembly.

NOTE: *If your washer is equipped with a hot-air blow-off (HABO) system, refer to that option in the "Options", Chapter 7, for special instructions for steam-exhaust installation.*

General installation consists of the following procedures:

1. Install piping.
2. Install the ASE blower unit in piping.
3. Provide rain cap.

> ***WARNING! The steam-exhaust pipe connection must be independent of any other pipe connection. It <u>cannot</u> share a steam vent pipe with any other equipment.***

Steam-Exhaust Pipe

Refer to the following figure for the location of the steam-exhaust vent pipe flange. The pipe flange is located on the roof of the washer cabinet for steam exhaust attachment.

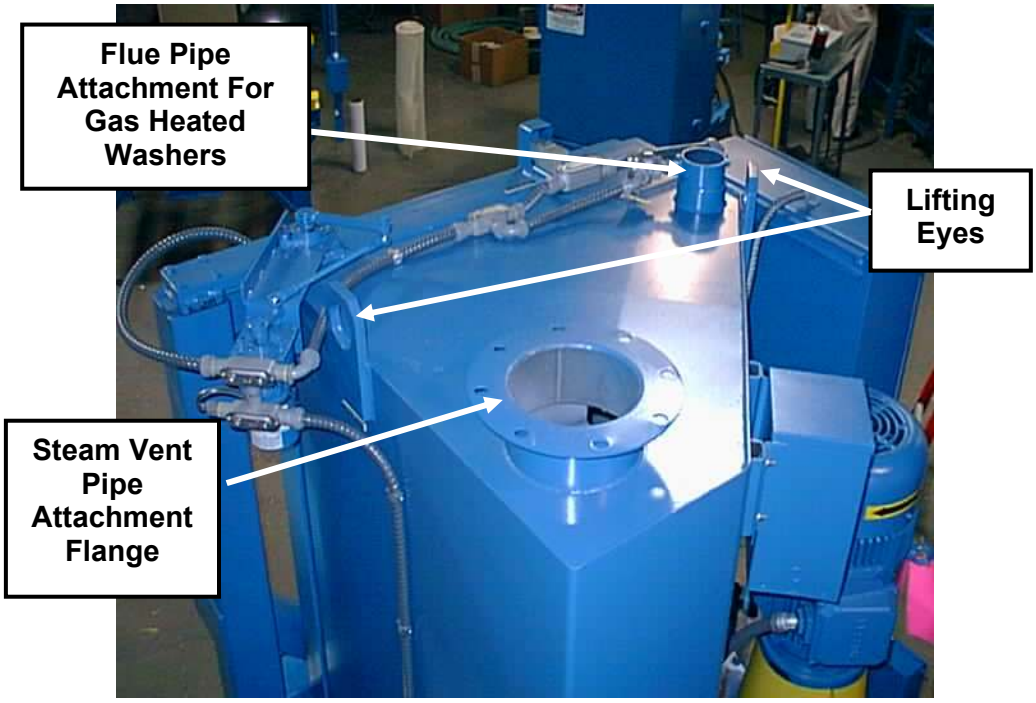


Fig. 2 - 12: Steam-Exhaust Vent Pipe and Flue Pipe Attachments

The steam-exhaust pipe may exit your building either vertically or horizontally, as shown in the following figure. This figure does not show you how to install the ASE blower unit in the piping (see ASE Assembly Figure 2-13); rather, it represents a general view of the two possible configurations (vertical or horizontal). You will select one of these configurations when you install the piping and blower. ***Note:*** Install venturi such that fan motor shaft is horizontal. Use a twist transition supplied from StingRay, if required.

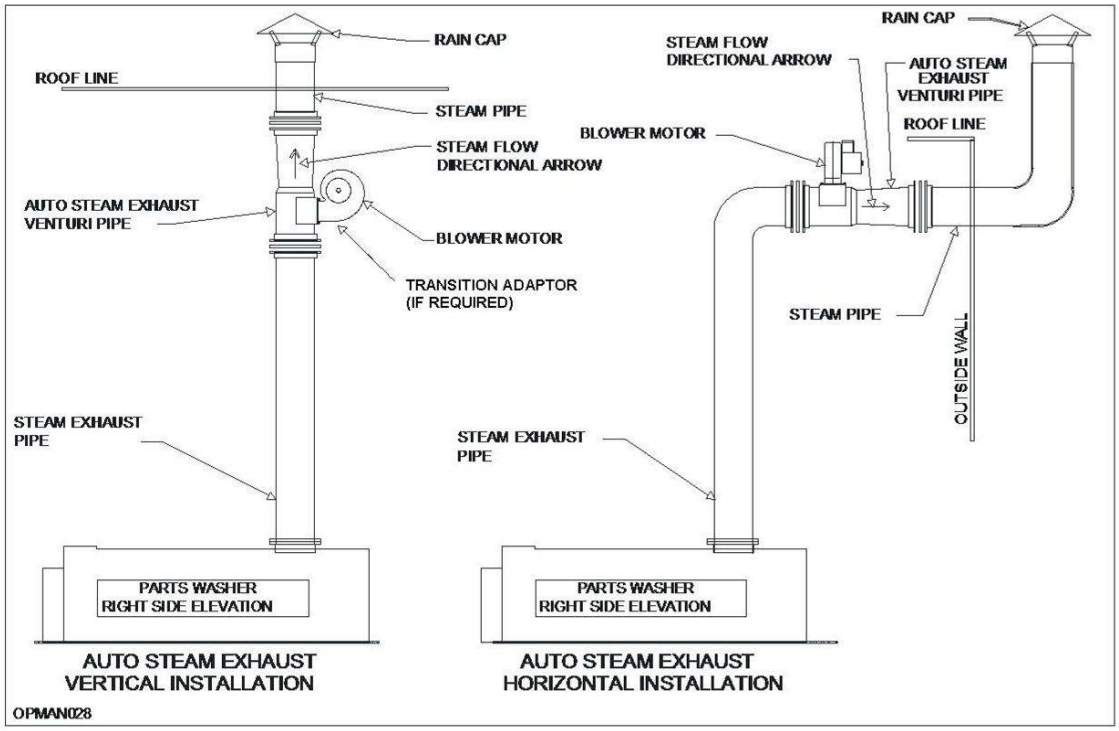


Fig. 2 - 13: Auto Steam Exhaust (ASE) Piping and Blower Installation Configurations

> **Note**: Any horizontal section of steam exhaust pipe must rise by 1/2-inch (13 mm) per foot (30.5 cm) of pipe. This is necessary for proper condensation drainage back to the washer.

Steam-Exhaust Fan

The auto steam exhaust (ASE) Venturi and blower assembly is provided by StingRay. It is provided separate with the washer and must be mounted in the steam-exhaust piping. Mount blower and fan to the venturi as shown in the diagrams using hardware provided. Use RTV silicone adhesive as a form-in-place gasket to seal all connection points. Do not mount fan housing such that it is below blower inlet, as condensation may collect in blower housing.

Note: The ASE blower assembly is provided with one of these motors:

- 1/10-HP motor for StingRay 30s and 40's;
- 1/4-HP motor for StingRay 52's to 8473's;
- 2-HP motor for StingRay 10073's and Clamshells.

If your steam exhaust vent pipe exceeds 30 feet (9 m), a 1/4-HP or larger motor is required and can be obtained from StingRay. If your vent pipe is extremely long, or if there is extreme negative pressure in your shop area, StingRay may need to assist you in determining the proper size venturi blower and motor assembly. (When calculating pipe length, each 90°-angle bend equals 10 feet [3 m] of straight pipe.)

CAUTION! You must mount the ASE assembly in line with the steam-exhaust pipe, and as far away from the washer as possible, at least 20 ft. if possible. – It's best to install where the steam-exhaust pipe leaves the building. ***DO NOT INSTALL ASE ASSEMBLY DIRECTLY ON TOP OF THE WASHER!*

CAUTION! If you are mounting the Venturi Tube in a horizontal position, mount it such that the fan is above the tube 45° from the vertical, as shown in Figures 2-13 through 2-15. This position allows condensation to drain back into the washer and not remain in the blower unit.

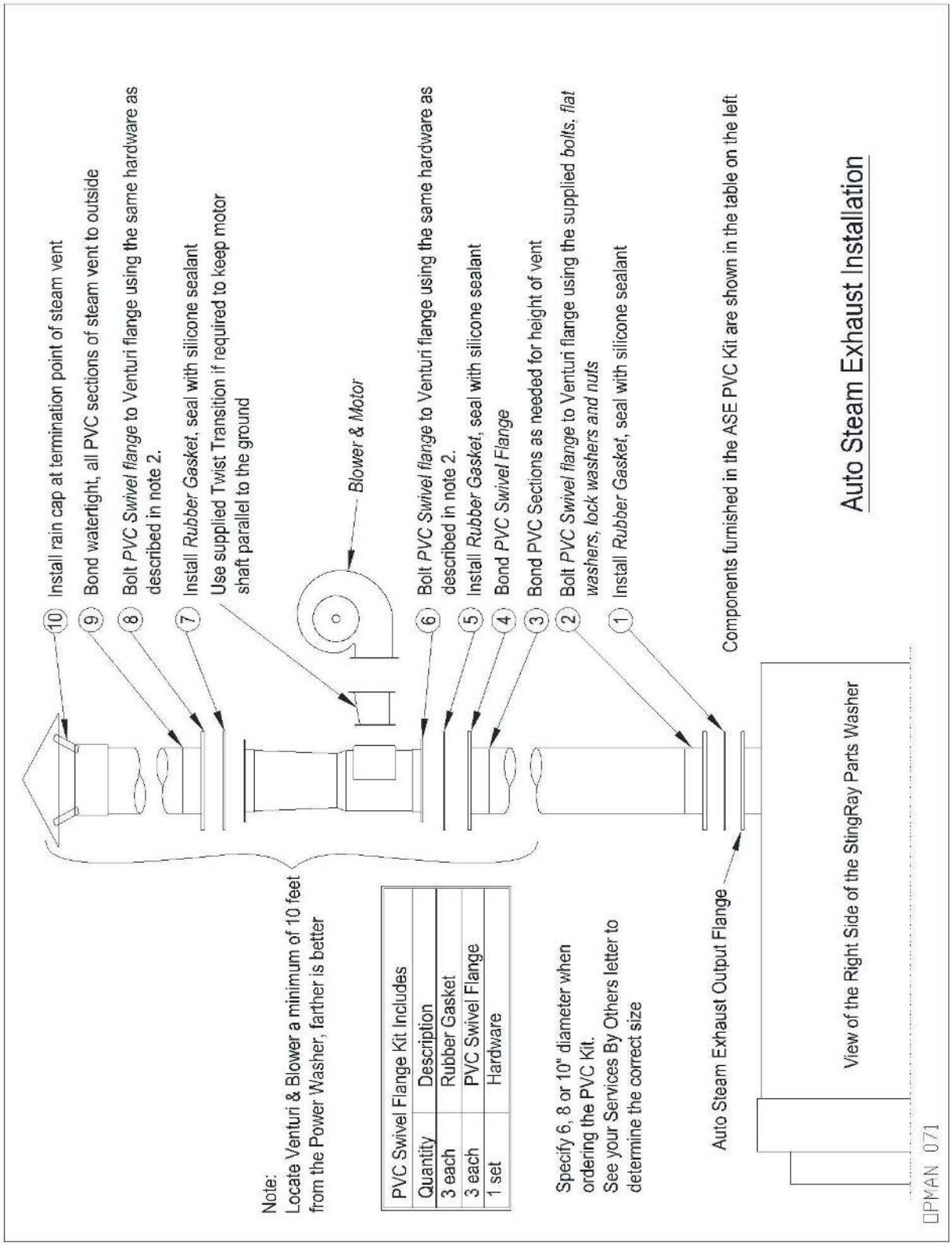


Fig. 2 - 14: Auto Steam Exhaust (ASE) Piping and Blower Assembly

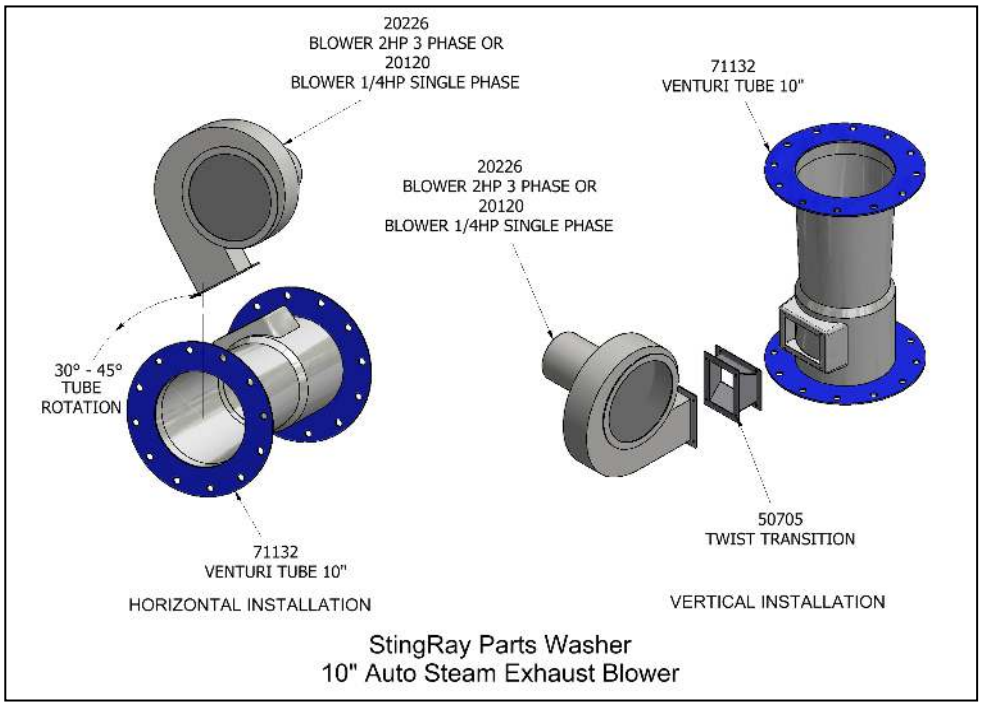


Fig. 2 – 15: Installation for 1/4-HP or 2-HP Transition

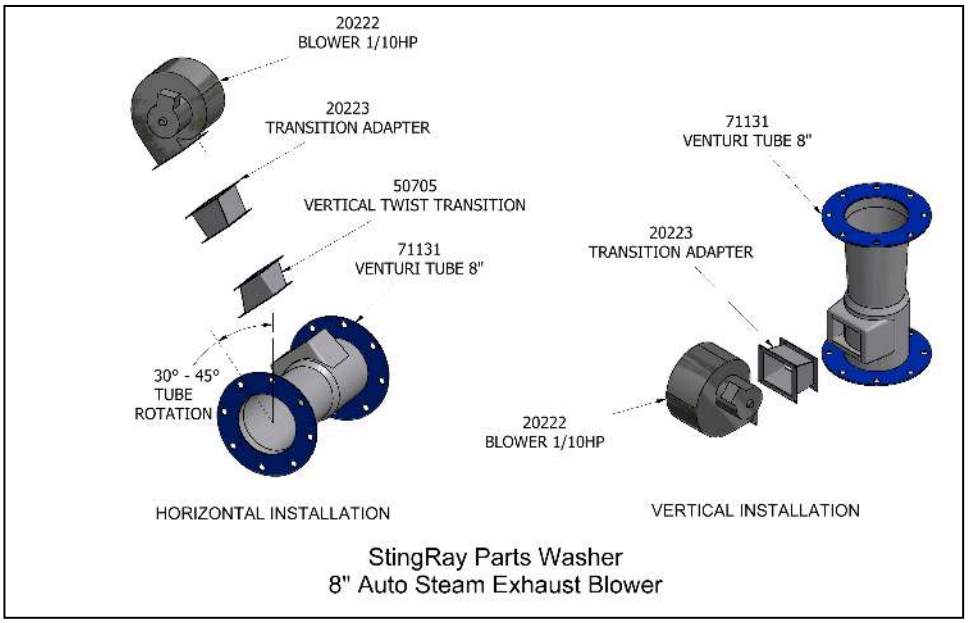


Fig. 2 – 16: Installation for 1/10-HP Transition

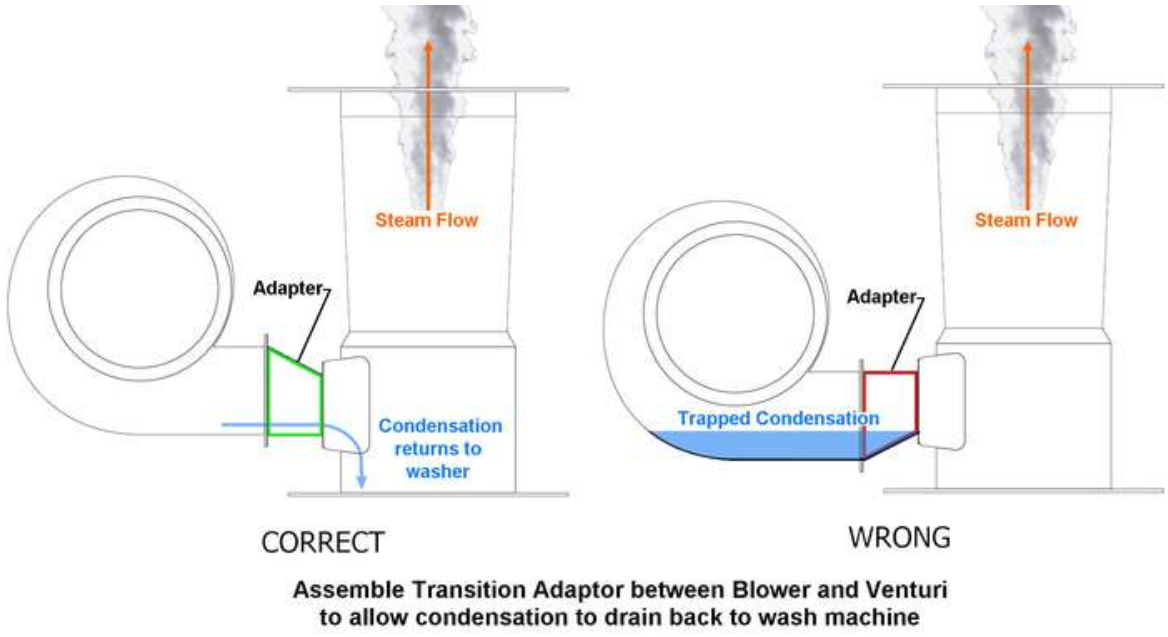


Fig. 2 – 17: Proper ASE Transition to Avoid Condensation

After you have installed the piping and the blower; *follow this procedure to complete the electrical connection of the blower to the washer*:

1. Install an approved liquid-tight *conduit* containing *three wires* (red - hot; white - neutral; green - ground; all wires #14-gauge stranded THHN copper, minimum) from the ASE *blower assembly* to the upper terminal block in the Control Panel. (Attach the *three wires* as indicated in the accompanying figure.)

2. Attach one end of the red wire (hot) to the ASE motor circuit overload device located at the top of the control panel next to the terminal blocks. Refer to your machine's panel layout drawing on the inside of the enclosure door for the exact location. Splice the other end of the red wire to one of the black wires on the ASE motor.

3. Attach one end of the white wire (neutral) to an N (Neutral) terminal. Splice the other end of the white wire to the second black wire on the ASE motor.

4. Attach one end of the green wire (ground) to a green ground terminal. Connect the other end of the green wire to a screw on the ASE motor.

***NOTE**:* You must supply the length of wire, fittings, and conduit required to extend from the ASE motor to the Control Panel.

Note: The wiring diagram as shown is for the standard 115 volt A. C. motor.

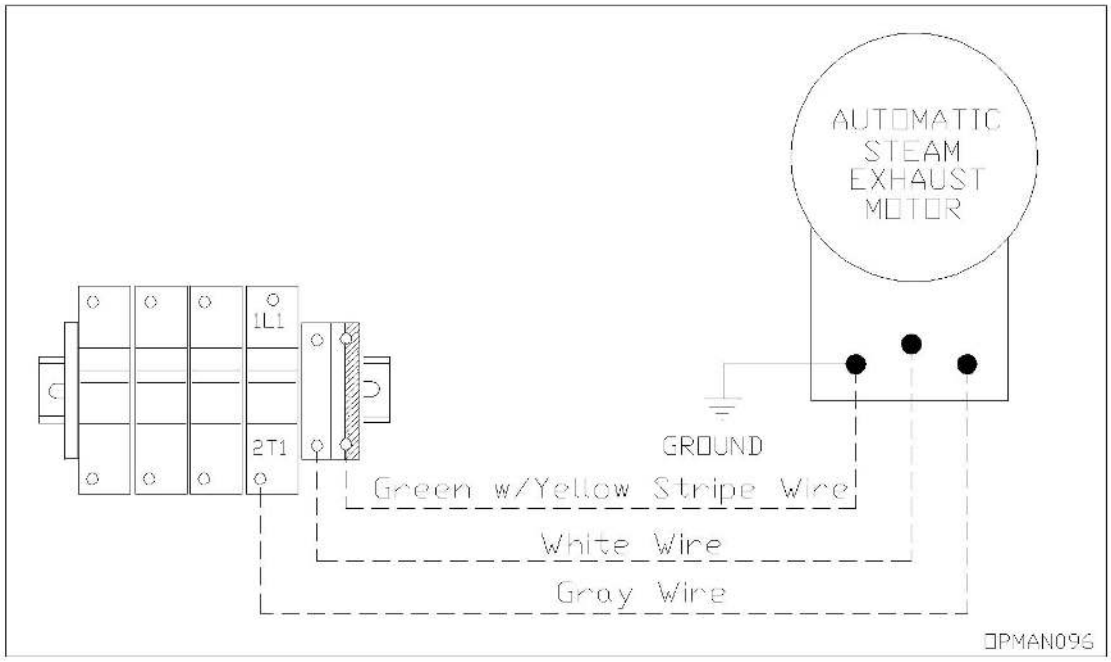


Fig. 2 - 18: Wiring the ASE Blower Assembly

5.3.2. Flue Pipe (Output)

***NOTE**:* A flue pipe is used ONLY for gas burner heated machines.

WARNING! The flue pipe connection must be independent of any other pipe connection. It cannot share a heating-system flue pipe with any other equipment.

WARNING! Be sure that people who install and adjust the burner are qualified and trained for the task. Be sure they use appropriate flue-gas monitoring instruments for measuring oxygen, carbon dioxide, AND CARBON MONOXIDE. The immersion tube firing gas burner is difficult to install and set properly. GET PROFESSESIONAL help. You MUST set the burner with a FLUE GAS Analyzer. You MUST use a slack tube WATER MANOMETER to measure pressure in water column inches (wci). Your Flue Gas Analyzer must read CO2, CO, O2, and efficiency to properly set the burner. The flue gas analyzer must be CALIBRATED and working properly. If you cannot read the proper amount of oxygen in atmospheric air then your analyzer is NOT working. If you do not have the proper equipment, then DON'T TRY to set the burner.

WARNING! VENTING OF EXHAUST GASES: Do NOT vent exhaust gases into a wall, a ceiling, or a concealed space of a building. Refer to the instructions in this chapter for correct vent installation instructions.

Flue Pipe installation

Standard StingRay Gas Burner installations must conform to specific requirements in order to avoid failures in the field and/or less than specified performance. StingRay will not warranty operation of the standard gas burner in any installation that does not strictly adhere to these requirements. If all of the requirements cannot be met, upgrading to the StingRay/Eclipse High Output burner system is required. See StingRay Engineering Standard Specification **ESS 058** for specific requirements. (ESS 058 is reproduced at the end of this chapter for your convenience.)

Your StingRay Parts Washer is capable of producing exhaust gas temperatures up to 1000 deg F.

The gas burner flue installation must comply with all applicable local, state and/or national gas codes for **materials, pipe size,** and **installation** procedures.

Note: StingRay recommends a minimum of 16-gauge double wall steel for the flue pipe.

IMPORTANT:

The flue pipe system installed on the StingRay Parts Washer must be sized to create the proper draft during burner firing. The draft required is ± .25 WCI pressure at the flue-pipe stub during burner firing.

Typical installations with an equivalent 10-50 foot flue exhaust run generally will function properly with a flue pipe size 2" larger than the exhaust stub to obtain the required draft pressures of ± .25 WCI at the flue pipe stub.

> ***NOTE: Do NOT install a flue pipe that is the same size as the washer flue stub pipe!***

StingRay Manufacturing does not recommend the use of draft inducers or barometric dampers in a properly designed exhaust system.

To install the flue, follow this procedure

1. Find the *flue pipe attachment* on top of the *washer* cabinet. (Refer to Fig. 2-10 for the location of the pipe stub. On some washers, the flue pipe attachment is by the steam-exhaust pipe attachment.)

2. Route the approved flue pipe from the Parts Washer to the outside of the building, taking care to maintain minimum clearances to combustible materials as specified by the National Fuel Gas Code (American National Standard ANSI Z223.1) and other applicable codes.

   Refer to *"Placement Planning/Roof"* at the front of this chapter.

   > ***Note**:* Horizontal flue runs are NOT recommended. If a horizontal flue-pipe section is required it must rise a minimum of 3 inches (75 mm) per pipe foot (per 30.5 cm of pipe).

3. Be sure the exhaust vent ends in a *vertical* position. The vent termination point must be a minimum of 3 feet (1 meter) above the roof peak or more as required by local and/or national codes.

4. Install a *rain cap* at the *end* of the pipe. (***NOTE**:* The rain cap is *not* supplied by StingRay.)

5.3.3. Drain (Output)

A capped drainpipe connection is located on the machine frame at the low point of the washer reservoir floor.

You may use the drain to hook up the washer to a water-treatment system, or to a pumping system.

However, your washer is easily serviced using a diaphragm pump equipped with a hose and an appropriate strainer. This configuration allows you to pump solution from the washer into approved containers for disposal according to local regulations. StingRay offers an air diaphragm pump used for this purpose.

For more information, refer to chapters *"Advanced Operations: Process Control,"* and *"Maintenance"* in this manual.

5.4. Installation of Options

If you purchased any options with your washer, such as an Oil Coalescer, Pure Rinse, Sludge Scraper, Jib Boom, etc., refer to Chapter 7, *"Options"* for information on installation.

5.4.1. Removable Door Position Lock Plate:

Fig. 2 – 19: Removable Door Position Lock Plate

Assembly Instructions:

The door position lock plate is removed from some StingRay Parts Washers to reduce the machine width for reduced shipping cost. The position lock plate must be re-installed on the machine to use the lock feature. Follow these instructions for installing the lock plate on your machine.

1. The position lock plate is packed with the other accessories of your new StingRay. Unpack the lock plate and the two (2) ½" diameter bolts, washers and lock washers.

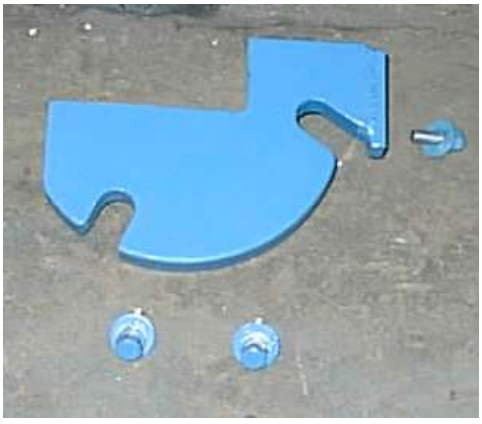


Fig. 2 – 20: Door Position Lock Plate and Attachment Hardware

2. The lock plate attaches to the machine door post support. The doorpost support is shown in the picture below on the left. Position the lock plate on the door post support. Line up the two holes with the mounting holes on the doorpost support as shown.

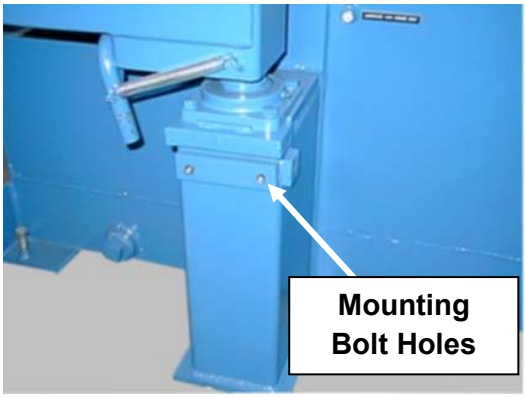


Fig. 2 - 21: Doorpost Support Without Lock Plate Attached

Fig. 2 - 22: Positioning the Door Lock Plate

3. Install the ½" diameter bolts into the mounting holes and tighten the bolts. The completed installation should appear as shown on the right.

Fig. 2 - 23: Tighten the Mounting Bolts

Fig. 2 - 24: Completed Lock Plate Installation

4. Open the door and check that the position lock holds the door in the load/unload and service positions.

5.5. Inspection and Verification

Now you have completed the services and connections required for your washer. Before performing the startup procedure, inspect all services and connections made on the washer during installation. Use the following information:

- *Services to be Provided by Others and Service Requirements (SBO)* letter from StingRay
- *Field Startup Procedure (FSP)* form

Fill in the *Physical Installation* section of the *Field Startup Procedure (FSP)* form as you inspect what you have done and ensure that all connections have been properly made. During this inspection you will inspect the following items and document your inspection results on the *FSP*:

- Visual inspection

  Leveling

  Anchoring

- Physical Inspection of Installation

  Water Supply

  Electrical Supply

  Gas Supply

  Gas Burner Flue

  Steam Exhaust

- Check placement and leveling. Fill out the FSP form (*Field Startup Procedure)*
- If a combustion burner is used complete “Gas Burner Test “ in the FSP form
- Inspect electrical connections. Fill out the FSP form
- Inspect the ASE assembly. Fill out the FSP form
- Verify your water connection. Fill out the FSP form
- Inspect the drain and pump systems. Fill out the FSP form

Fig. 2 - 25: Services and Connection Inspection

If you note any problems that cannot be solved by making minor adjustments, refer to chapter *"Troubleshooting,"* or call StingRay Tech Services.

6. Startup Procedure

A StingRay factory-trained technician is optionally available to perform startup and customer training. Call StingRay Technical Services to request this service. As part of this service, the StingRay technician will fill in the *Field Startup Procedure (FSP)* form to begin your warranty coverage.

If you perform the startup, training your staff to operate the parts washer is your responsibility.

The startup procedure consists of the following activities, in this order:

- Electrical Connections Inspection
- Lubrication Procedure
- Power-Up Procedure
    - Preliminary Checks
    - Supply Voltage
    - Water Fill
    - Water Level Control Validation
    - Control Voltage Measurement
    - Heat – Gas, Electric, Steam Test
    - Pump/s Rotation Direction
    - Temperature Control setting
    - Voltage Readings
    - Water Hammer Test
    - Amp Readings of all loads
    - Standard Operational Checks
        - Pump Low-Low Water Shutdown
        - Door Close Limit Switch Operation
        - Heater Low-Low Water Shutdown
- Chemical-Charging Procedure
- Test-Wash Procedure

NOTE: Fill in the ***Field Startup Procedure (FSP)*** **form** as you perform startup. Send it to StingRay Tech Services when complete. After verification and acceptance, your warranty period begins. ***This form must be received by StingRay within 60 days after receipt of your washer!***

WARNING! Be sure that people who perform the startup procedure are qualified and trained for the task. They must follow all procedures exactly as described.

6.1. Electrical Connections Inspection

WARNING! Be sure the electrical power to the washer is turned OFF.

Open the electrical control panel door.

Check ALL electrical connections and components for tightness. It is common for some to loosen during shipping as copper wires settle quite easily.

Inspect timers and relays in the electrical control panel to be sure they are "seated" in their sockets.

Close the electrical control panel door.

6.2. Lubrication Procedure

Your parts washer is pre-lubricated at the factory. If you install the washer within a six-month period after delivery, no lubrication is necessary before startup.

However**, *you must* establish a lubrication schedule**, based on hours of operation. Refer to chapters *"Advanced Operations: Process-Control"* and *"Maintenance".*

If the washer has been sitting for more than one year after delivery, see Chapter 5, *"Maintenance"* for information on the proper lubrication procedure before startup.

6.3. Power-up Procedure

> ***NOTE**:* If you need to stop the power-up procedure at any point, press the *stop button* on the washer's control panel or *turn off the main power supply*.

Follow this procedure:

Preliminary Checks:

1. Is the cabinet *door closed*?
2. Is the *clock-override switch set to Bypass*?
3. Is the *wash timer* set to *"0"?*
4. Verify that the rubber grommet used for protecting the float ball during your washer shipment is removed from the water level control float rod.

Supply Voltage:

> ***CAUTION**: This procedure exposes personnel to dangerous voltages and the risk of electrocution. Be sure the people performing this task are qualified and trained for the task.*

1. Verify that the electrical panel door is closed and latched.
2. Turn on the building main power supply to the Parts Washer.
3. Turn electrical disconnect located on the StingRay Washer Control Enclosure door to the “OFF” position.
4. Open electrical enclosure door.
5. Measure and record incoming voltage available to the washer. Perform this test at the *supply side* of the *main disconnect or at the distribution block.*

Water-Fill:

1. Set the *temperature controller adjustment to "32°F -or- 0°C."* This will prevent the burner or heating elements from activating when the washer is empty of water, should damage to the washer have occurred in shipping. Refer to chapter *"Advanced Operations: Process-Control"* for more information.

2. Close electrical panel door.

3. Turn the electrical disconnect located on the StingRay Washer Control Enclosure door to the “ON” position. If the pump/s come on, turn the disconnect “OFF” and **immediately** contact StingRay for additional instructions.

4. Turn the 7-day clock control switch to *Bypass*.

5. Verify by visual inspection or by sound that the washer reservoir begins to fill with water (the water-fill solenoid should open when you turn the main power supply and the clock-override switch ON). Refer to Fig. 2-7 for the water-supply connection location.

6. After about two hours, check the washer reservoir to verify or adjust the set-point water level. (While the reservoir fills, you can continue with the power-up procedure.)

Water-Level Control:

The water-level control system is fully installed in the parts washer and requires only verification that the set-point water level is correct for operation of the machine. Follow these steps to verify or adjust the set-point water level:

1. Remove the float control box cover by removing four (4) screws. Refer to the following figure:

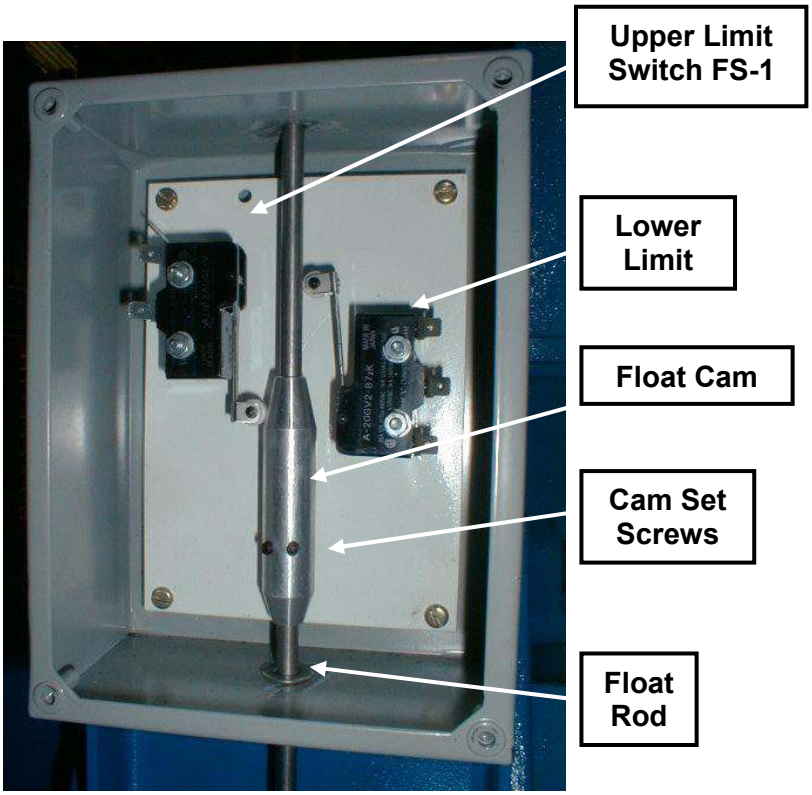


Fig. 2 - 26: Float Control Box

> ***NOTE**: Do NOT leave fresh water in the washer without chemical for more than a few hours.*

2. During the initial startup of your parts washer the washer will fill itself to the set-point water level. This water level is controlled by the position of the cam on the float rod.

Moving the cam **down** on the float rod **raises** the water level, while moving the cam **up** on the float rod **lowers** the water level.

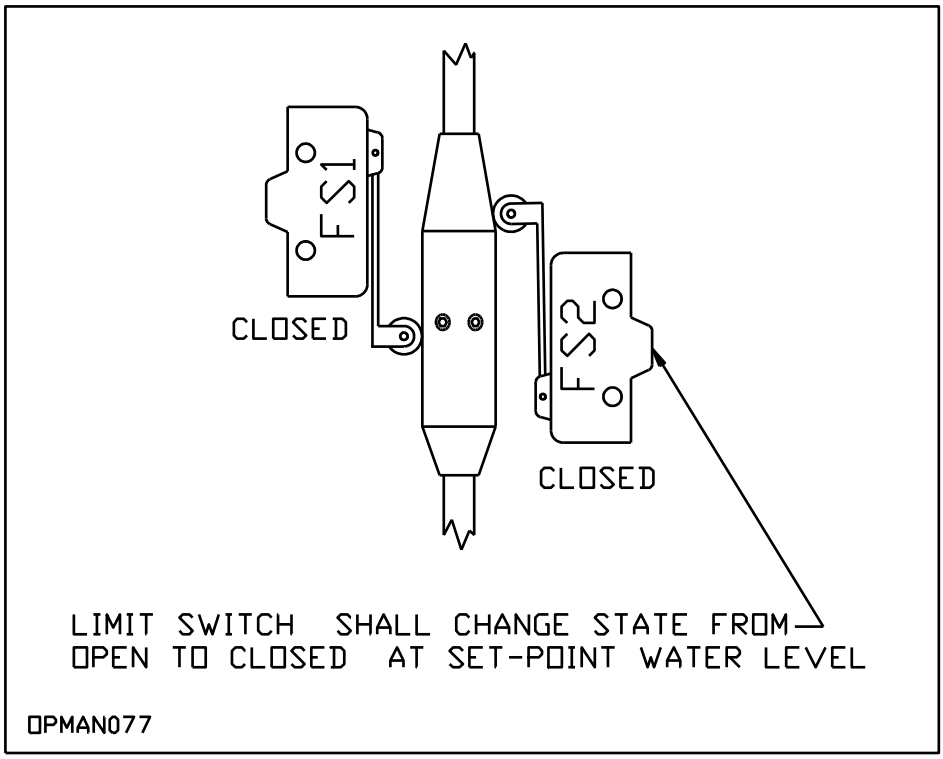


Fig. 2 - 27: Float Cam at Set-Point Water Level

When the washer completes filling to the set-point water level, the cam and float limit switches should appear as shown in figure 2-26.

Turn *OFF* power to the washer.

- Make sure the water is calm.
- Remove the front reservoir cover.
- Verify the water level in the machine when the cam is in relationship to the limit switches as shown in the figure above.
- Find the water-level indicator (a 3/8"-square rectangular bar) welded to the right wall at the front of the reservoir. Refer to the following figure.

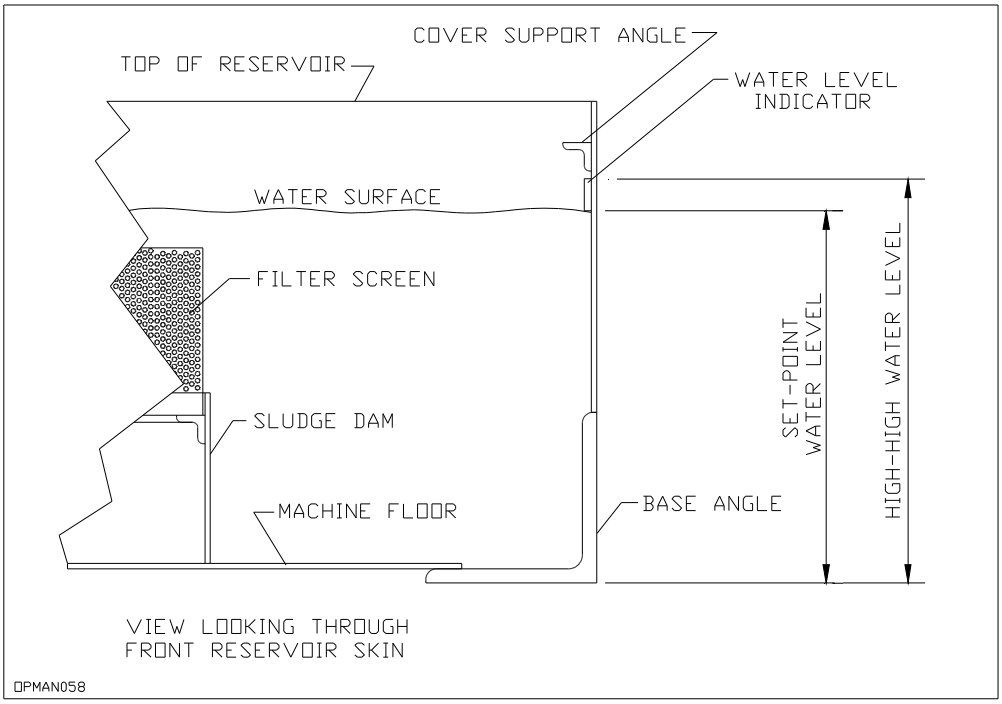


Fig. 2 - 28: Water-Level Set-Point Dimensions and Measurement Location

NOTE: **The top of the water-level indicator shows the HIGH HIGH water level. The bottom shows the SET POINT.**

3. *If the water level is more than 1/8" inch above or below the bottom of the water-level indicator,* you will need to adjust the cam on the float rod. Follow the steps below.

   -Or-

   If your water level is correct, skip to step 6.

4. Mark the current location of the cam on the float rod with a marker or a piece of tape before making any adjustments.

   If the water-level measurement you made is higher than the indicator, you will need to move the cam **up** the float rod by the difference between the indicator and the measured value.

   If the measurement is lower than the indicator, you will need to move the cam **down** the float rod by the difference between the indicator and the measured value.

   Measure the distance to the new position and mark it on the float rod.

Next, loosen the two set-screws on the cam with an Allen wrench.

Finally, slide the cam to the new location and re-tighten **both** set-screws.

5. Turn power on to the washer and test the new level by allowing the washer to fill to the new set point.

   NOTE: It will be necessary to remove water from the washer if the new level is lower than the old set point.

   Verify that the set-point level is correct. If necessary, repeat the above steps until the set-point level is at the indicator, plus or minus 1/8 inch.

6. Replace the cover on the float box and tighten the four screws.

> ***NOTE: If your washer has a rinse system, once cleaning operations start, water levels in the washer can be higher than the set-point water level. This happens whenever the washer automatically uses the rinse-bank for longer rinses.***
>
> ***To verify the correct set-point water level after operations started, you must allow the washer to fill to the set point. You can check this by observing the position of the float cam relative to the limit switches in the float box. (Refer to Fig. 1-3: Float-Level Mechanics) If the cam is higher than the set point, you have to remove solution from the washer and allow the washer to fill to the set point to check set-point water level.***

Control Voltage:

> ***CAUTION****: This procedure exposes personnel to dangerous voltages and the risk of electrocution. Be sure the people performing this task are qualified and trained for the task.*

1. Measure and record the control voltage to establish a baseline reading by taking readings from *#10 wire on fuse #3* to any *neutral terminal* (on the terminal strip at the top of the electrical control panel). Refer to Fig. 2-9 for terminal-strip location.

2. Verify that voltage readings at each additional #10 terminal are between 110 to 130 volts.

6.3.1. Heat – Gas (180,000 BTU): (if applicable)

WARNING! IF YOUR PARTS WASHER USES A GAS BURNER: You must follow installation and operating instructions exactly to prevent a fire or explosion that may result, causing loss of life, personal injury, or damage to property.

WARNING! Proper setup and adjustment of gas-combustion equipment requires combustion-analysis tools (gas manometers and gas combustion analyzer) and knowledge of gas combustion.

If you do not have the proper expertise or equipment, seek professional help.

Improper adjustment of gas-combustion equipment can cause carbon monoxide discharge, fire, or explosion, resulting in loss of life, personal injury, or property damage.

1. Measure and record the incoming gas pressure to the burner. (***NOTE**: In the power-up procedure, the burner will not fire until correct water level is reached, and the clock-override switch is turned *ON*.)

2. Verify that the incoming pressure is within the range specified in the table below. Lower gas pressures can reduce the burner firing rate and increase the time it takes for the machine to heat. Gas differential pressures other than those in the table below will cause firing rates other than those obtained at the factory. Use the gas pressures in Fig. 2-18 as an initial starting point for burner adjustments.

3. If your washer has a burner with one of the firing rates listed in Fig-2-18, make initial flue damper and burner air-inlet shutter settings as shown.

   ***NOTE:** Gas pressures below are expressed in WCI.*

Firing Rate (K/BTU)	Burner Number	Maximum Incoming Gas Pressure Unfired	Minimum Incoming Gas Pressure Field	Manifold Gas Pressure Fired	Burner Air Shutter Opening	Burner Air Shutter Opening	Burner Head Setting	Machine Flue Damper Opening
180	40P200 PROPANE	14	12	3.5	3.75	B6	4	30°
180	40N200 NAT'L GAS	7	5	3.5	3.75	B6	4	30°

Fig. 2 - 29: Initial Burner Settings

NOTE: At this point, all manual gas valves should be closed.

4. Verify that the washer reservoir is filled to the factory pre-set level with water. The burner cannot fire until correct water level is reached.

5. Set the temperature controller according to the following table. After you set the controller, the burner will begin a purge trial for ignition and attempt to fire. ***NOTE:*** *The set-point on the controller can differ from the actual temperature.*

   At this point you should follow the startup procedure in the burner vendor's manual.

   NOTE: Due to various installation variables, it may be necessary to adjust operating parameters to obtain consistent burner performance.

Maximum Operating Temperature

Altitude in Feet		*Temperature* ° F
0 - 2000		190° F (88° C)
2000	- 4000	185° F (85° C)
4000	- 5000	180° F (82° C)
5000	and above	call StingRay

WARNING! Do NOT exceed recommended settings, or serious damage can occur to the wash pump (cavitation).

Fig. 2 - 30: Maximum Operating Temperature

6. Take a sample of flue gases where the flue pipe attaches to the roof of the washer cabinet. There is a port at the flue damper for this measurement. You need a flue gas analyzer to make this measurement. NOTE: If you are unsure about the proper operation of the flue gas analyzer, a simple test is to measure the oxygen percent of air outside of the plant. The percent oxygen in our atmosphere is relatively constant at 20.9% regardless of altitude. Even though at higher altitudes air is less dense the percentage of oxygen remains the same. If your flue gas analyzer doesn't measure the percentage of atmospheric air at 20.9% it is not working properly. Oxygen sensors in flue gas analyzers need regular replacement and are a common maintenance item.

WARNING! A certified burner technician, using flue-gas-analyzing equipment must make any adjustments to the burner.

7. Verify that the fuel/air mixture is correct, by comparing your readings with the following table. Refer also to your vendor-supplied burner manual.

> ***WARNING! Proper air/fuel mixture is imperative for efficient operation and safety.***

Correct Air/Fuel Mixture

Unburned combustibles	0%
Carbon dioxide (natural gas)	9% -10%
Carbon dioxide (propane gas)	10% -12%
Oxygen	3% to 5%
Combustion efficiency	70% *or more*
Stack temperature	350° F to 1000° F (177° C to 371° C)
Carbon monoxide	200 PPM *or less*

8. Record the water temperature by reading digital temperature read out on the control panel. ***NOTE****: Generally, it takes less than two hours for water to heat from 70*° F (21° C) *up to* 190° F (88° C)*. While the water is heating, you may continue with the power-up procedure.*

6.3.2. Heat – Gas (400,000 BTU to 990,000 BTU): (if applicable)

IJ3 & IJ4 Models Start-up Procedure (See Fig. 2-30)

Electrical Set-up – Verification:

1. Turn off the gas supply valve to your burner.
2. Verify main power is on at main disconnect.
3. Set reservoir water temperature controller in the main washer control panel to 150ºF (65ºC).
4. Verify the temperature controller is calling for heat. (this is verified by the illuminated red LED light on the temperature controller)
5. Verify the washer reservoir is filled to set-point water level.
6. Verify burner control disconnect is in the on position (IJ4 models only).
7. Verify the "power on" (IJ4 Models Only) light located on the burner control enclosure is illuminated.
8. Turn the Burner power selector to the off position on the burner control enclosure.

Supply Gas (Natural or Propane) Settings – Verification:

1. Verify the gas supply valve provided with your burner is turned off.
2. Open the gas pet cock valve and attach a manometer hose to the gas pet cock valve of the incoming side of the StingRay provided gas train.
3. Turn gas on (Slowly) at the gas supply valve.
4. Adjust factory in-coming gas pressure by reading the manometer. **Set in-coming gas pressure between 18 W.C.I. (46 mbar) and 50 W.C.I. (124 mbar)** using your factory regulator.
5. Turn gas off at the gas supply valve.
6. Remove manometer hose and close the gas pet cock valve.

Gas Pressure Limit Switches (Verify / Set):

1. Verify and adjust if required the low gas pressure limit switch to 14 W.C.I. (35 mbar).
2. Verify and adjust if required the high gas pressure limit switch to 22 W.C.I. (55 mbar) or 4 W.C.I. higher than incoming gas pressure (whichever is greater).

Air Damper Settings – Verification:

1. Remove the actuator (damper control) cover by removing the 4 screws on the outside of the cover.
2. Verify the ignition orange cam adjuster setting is at 30º. If the orange adjuster is not set to 30º, adjust the cam using a small flat head screw driver and turn the white plastic screw counterclockwise to decrease the angle or clockwise to increase the angle.
3. Verify the damper is physically at 30º degrees by viewing the slot on the damper shaft located on the opposite side of the air inlet. The slot should be 30º from horizontal with the lowest end of the slot pointing towards the burner head (pointing away from the washer cabinet).
4. Verify the high fire; red cam adjuster setting is at 90º. If the red adjuster is not set to 90º, adjust the cam using a small flat head screw driver and turn the white plastic screw counterclockwise to decrease the angle or clockwise to increase the angle. The pre-operational test setting should be 90º.

Spark Rod Verification – Setting:

1. With the spark rod cap removed, verify and adjust if required the distance from the end of the spark rod to the face of the brass reducer bushing screwed into the burner head.

    - IJ3 Models – 2.67 Inches (68 mm)
    - IJ4 Models – 3.42 Inches (87 mm)

Trial for Ignition:

1. Attach the 1st water manometer to read gas pressure differential across the orifice plate by using a small screw driver to unscrew the two pet cock valves on either side of the orifice plate at least one full turn counterclockwise and attaching the manometer hoses.
2. Attach the 2nd water manometer to read air pressure differential between the damper inlet and the combustion chamber by unscrewing the pet valve located below the damper shaft at the air inlet and the remaining pet cock valve on the face of the burner head at least one full turn counterclockwise and attaching the manometer hoses.
3. The ratio regulator located downstream from the main gas train is for setting ignition (low fire) only. The ratio regulator was set at the factory for optimum ignition (low fire).

4. Turn gas on at the StingRay provided gas supply valve.
5. Push the “Pilot Test Button” (latched) on the Vari-Flame controller located inside the Eclipse electrical enclosure to prevent the burner from going to high fire after ignition.

   Note: Several seconds following step 6 the burner will start its firing sequence. First the blower starts, then the trial for ignition. The burner will not go to high fire at this point.

6. Turn the “Burner Power” selector switch to the “ON” position.

   Note: If the burner ignites skip forward to step #15. If the burner fails to ignite, perform the following steps.

7. Bleed the gas line by disconnecting 1 manometer hose from either pet cock valve until you smell gas, and then reattach the manometer hose. (Turn the burner selector switch to On until trial for ignition occurs then back to Off)
8. Turn the “Burner Power” selector switch to the “OFF” position and back to the “ON” position. If the burner still does not ignite, repeat this step 2 more times.
9. If the burner still fails to ignite verify the damper is physically at 30º as described in air damper settings #3 above.
10. On the ratio regulator, turn the diaphragm adjusting screw counterclockwise until the screw is fully extended, then turn the screw clockwise 6 full (360º) revolutions.
11. Turn the “Burner Power” selector switch to the “OFF” position and back to the “ON” position.
12. If the burner still fails to ignite, turn the ratio regulator diaphragm screw clockwise ½ (180º) revolution.
13. Turn the “Burner Power” selector switch to the “OFF” position and back to the “ON” position.
14. If the burner still fails to ignite, repeat steps 12 and 13 until the burner ignites.
15. At successful ignition, repeat step 13 two additional times to ensure stable ignition.
16. Verify the LED lamps on the proving switch (if equipped) are visible through the switch cover.

High Fire:

1. Turn the “Burner Power” selector switch to the “OFF” position.

   Note: Steps 2, 3, 4 are for field start-up only

2. Using a 9/16” wrench remove the flue gas test port located on the top of the parts washer in the flue pipe stub.
3. Insert the flue gas analyzer adapter into the test port.
4. Insert a calibrate flue gas analyzer probe (set for the proper gas type application) into the adapter. NOTE: If you are unsure about the proper operation of the flue gas analyzer, a simple test is to measure the oxygen percent of air outside of the plant. The percent oxygen in our atmosphere is relatively constant at 20.9% regardless of altitude. Even though at higher altitudes air is less dense the percentage of oxygen remains the same. If your flue gas analyzer doesn’t measure the percentage of atmospheric air at 20.9% it is not working properly. Oxygen sensors in flue gas analyzers need regular replacement and are a common maintenance item.
5. Push the “Pilot Test Button” (unlatched) on the Vari-Flame controller to allow the burner to go to high fire from ignition (low fire).

   Note: Several seconds following step 6 the burner will start its firing sequence. First the blower starts, then the trial for ignition, and then ramps up to high fire.

6. Turn the “Burner Power” selector switch to the “ON” position.
7. Once burner has stabilized at high fire, compare the gas pressure differentials to that listed on the parts washer birth plate. Ideally the manometer pressure differential should closely match that of the listed pressure differential.
8. If the Gas Pressure differential differs from that listed on the birth plate continue with instruction #9, otherwise continue at instruction #10
9. Adjust the red (high fire) damper control cam using a small flat head screw driver and turn the white plastic screw clockwise to decrease the angle (reduces the gas pressure differential) or counterclockwise to increase the angle (if original setting is less than 90º), (raises the gas pressure differential) until the manometer differential matches that listed on the birth plate.
10. At successful high fire, verify air pressure differential matches that of the birth plate, allow the burner to operate for two minutes.
11. Turn the “Burner Power” selector switch to the “OFF” position and back to the “ON” position.
12. Repeat steps 10 and 11 two additional cycles to ensure stable ignition and high fire.

Field Start-up:

1. Use the Combustion flue gas analyzer to verify proper combustion:

    - Unburned combustibles 0%
    - Carbon dioxide (natural gas) 9% 10%
    - Carbon dioxide (propane gas) 10% - 12%
    - Oxygen 2% - 5% (Target 3%)
    - Combustion efficiency 78% or greater
    - Stack temperature 350ºF to 650ºF (180ºC to 350ºC)
    - Carbon monoxide 100PPM or less (0-10PPM is expected)

2. At successful flue gas analysis, document actual results on the StingRay provided “Field Start-up form”, retain for StingRay Customer Care and customer records.
3. Remove flue gas analyzer, and replace the test port plug.
4. Notify the responsible customer representative or the StingRay Service Technician for further requirements or powering down the StingRay Parts Washer.

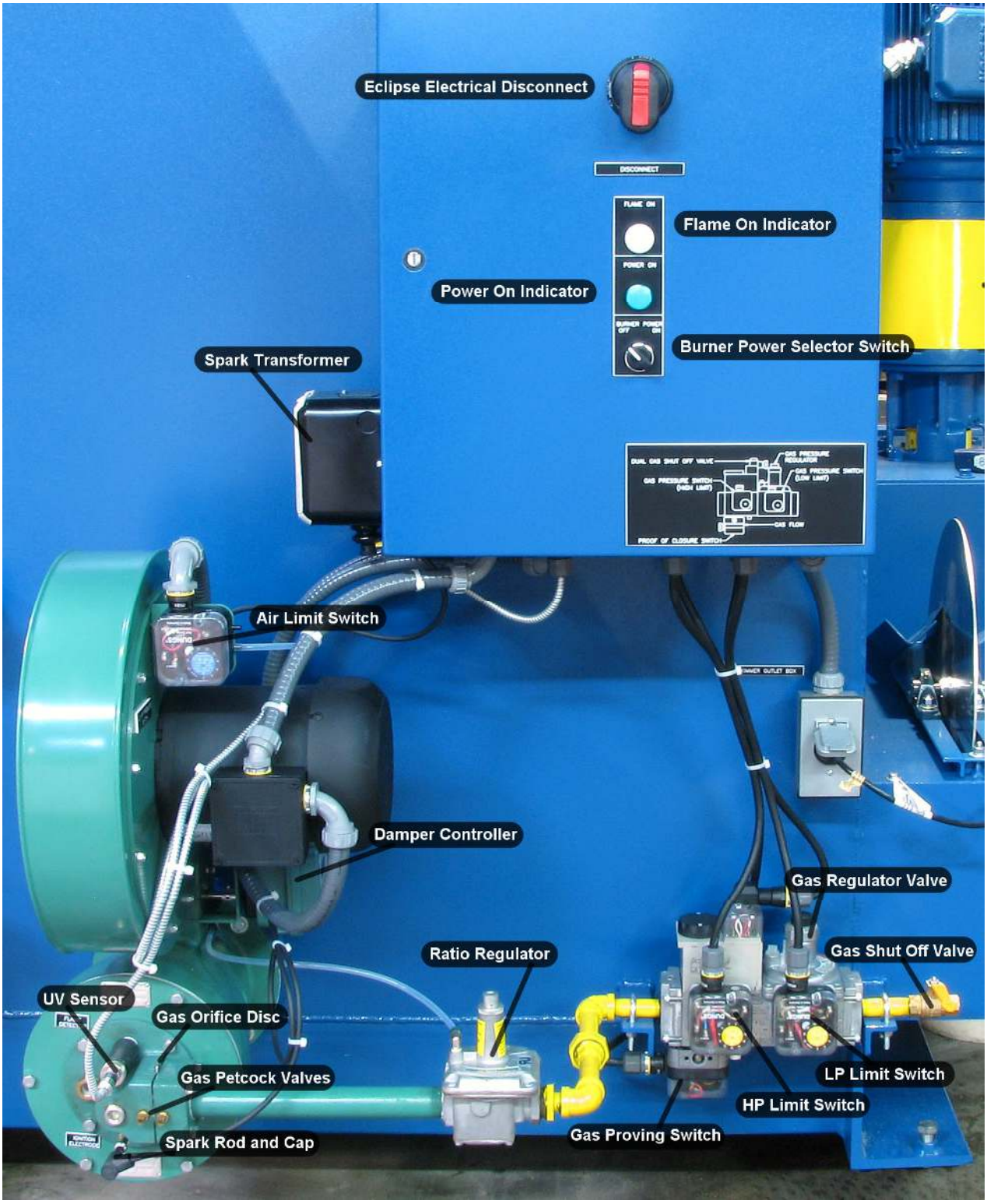


Fig. 2 - 31: 400,000 to 990,000 BTU Burner Diagram

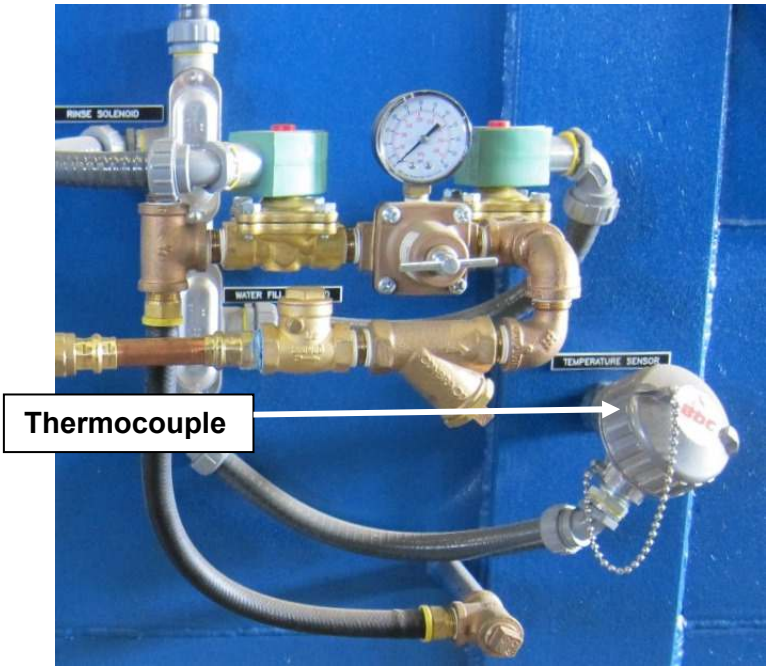


Fig. 2 - 32: Water Temperature Thermocouple Location

Hi-Limit Controller Adjustment:

StingRay Parts Washers are equipped with a safety control system to prevent over temperature of the gas heating system. A temperature sensor is located in the flue gas stack and connected to a hi-limit controller in the electrical control enclosure. If the flue temperature exceeds the set point on the hi-limit controller, the heating system will shut down.

NOTE: StingRay Parts Washers are shipped with the Hi-Limit Control set to a predetermined value for your machine size. YOU ARE RESPONSIBLE for accurate adjustment of the Hi-Limit Controller. All set-up adjustments are to be done only by people who are qualified and trained for the task.

***NOTE:* The Hi-Limit control adjustment should be performed as an integral part of the burner start-up procedure.**

To set-up the Hi-Limit controller, proceed as follows:

1. Adjust the temperature control unit to 220 degrees F.
2. Allow the burner to operate until the water temperature reaches 200 degrees F.
3. Measure and record the exhaust stack temperature.
4. Adjust the Hi-Limit controller 100 degrees F. over the measured exhaust temperature.
5. Reset the temperature control unit to the proper temperature (see Fig. 2–26).

The Hi-Limit control is now properly adjusted.

> ***NOTE: The set-up and proper adjustment of the HI-LIMIT controller is the responsibility of the end user. Failure to perform the proper set-up will render the HI-LIMIT control system inoperative and may violate local codes.***

Heat - Electric: (if applicable)

1. Set the temperature controller.
2. Check to be sure that the washer is heating.

Heat - Steam: (if applicable)

1. Set the temperature controller.
2. Check to be sure that the washer is heating.

Heat - Oil: (if applicable)

1. Set the temperature controller.
2. Follow the instructions in your vendor-supplied oil-burner manual.

Temperature:

1. Verify that the washer continues to heat up properly. ***NOTE****: Generally, it takes about two hours for water to heat from 70*° F (21° C) *up to* 190° F (88° C). *While the water is heating, you may continue with the power-up procedure.*

Pump Rotation Direction:

1. Close and latch the washer cabinet door. (Door to remain closed for balance of this test).

2. Verify proper rotation of the pumps by the following procedure:

   - Set a 15 minute wash time on the *0-30 minute timer*.
   - Press the s*tart* button.
   - Immediately press the s*top* button.
   - Observe rotation direction of the wash pump shafts. Verify the *clockwise rotation of the pumps when looking from the top down*. (***NOTE**:* If not correct, have an electrician reverse the direction of the pump by swapping any 2 of the 3 main power-supply wires at the disconnect or main distribution block. Swap the main power supply wires and not the wires at the pump motor contactors as this correctly "phases" the whole machine.)
   - Repeat test to verify correct rotation of pump/s.

3. If the pump direction is correct, set the *wash time* for *10 minutes*.

Water Hammer Cycle Test:

Perform the water hammer cycle test *after* the reservoir is completely filled *and after* the washer is fully heated. **During winter time**, "water hammer" may occur more frequently, or be more severe, due to lower ambient temperatures. Refer to steps below to eliminate water hammer.

Note: Water hammer is the result of cooler ambient air entering a hot washer cabinet. When the pump system comes on, this cool air is rapidly heated by the hot water solution, which results in a rapid expansion in excess of the normal exhaust system capacity. The excess air pressure generated may cause ejection of hot solution from the washer.

4. Open washer cabinet door wide open for a minimum of 30 seconds. Close and latch the door.
5. Stand to the side of the washer and press the start button.
6. If water is ejected from under the front reservoir cover:

   - Press the *stop* button.
   - For duplex pump systems: Add additional time to the wash delay timer. Simplex pump systems use a motor soft-starter to prevent water

hammer. The soft-starter is factory set to 10 seconds and not user changeable. Call StingRay Tech service if water hammer is an issue for simplex pump systems.

- Repeat steps #4 thru #6 until the water hammer stops.

Verify Power Utilities under full load:

> ***CAUTION****: This procedure exposes personnel to dangerous and hazardous voltages. Be sure the people performing this task are qualified and trained for the task.*

7. Turn the electrical disconnect on the control enclosure door OFF. Open electrical enclosure door.

8. With door open, turn the disconnect ON.

9. Press start. Measure and record the incoming voltage to the washer *with wash pump(s) running, and all equipment on the washer operating,* so you have the maximum amperage draw.

> ***NOTE:*** Take the measurements inside the electrical control panel, at the power distribution block. Refer to Fig. 2-9. If the voltage is more than 10% below the voltage stated on the nameplate of the washer, stop the startup procedure. You must correct the low voltage condition before proceeding with the start-up.

10. With pumps running, measure and record the amp draw from the wash pump motor(s), using a clamp-on amp meter.

> ***NOTE****:* Take the amperage measurement at the load side of the wash pump starter(s) on each power leg. If the washer is equipped with a duplex pump system or multiple pumps, take amp readings separately on each wash pump motor, with all pumps running.

Compare amperage readings with the maximum amp load, which is calculated as follows:

a) On each pump motor, find the manufacturer's specification tag. The tag indicates two things: **(1)** Full-load amperage draw at your specified voltage; and **(2)** The service factor, which is stamped on the motor nameplate.

b) Multiply the full-load draw (as indicated on the motor tag) by the service factor in order to calculate the maximum allowable amp load.

c) The actual amperage draw reading on each motor is to fall *below* the maximum calculated allowable amp load.

Verify the factory pre-set times for the optional Auto Rinse Cycle (ARC) and the Auto Steam Exhaust (ASE) timers per the following tables.

Timer for:	***Factory Setting:***
Auto Rinse Cycle (ARC)	1 minute
Auto Steam Exhaust (ASE)	1 minute

Additional Operational Checks:

1. With machine running a wash cycle, manually depress the float rod down. Verify wash cycle stops immediately. Wash cycle should not be able to be restarted until float rod is released and allowed to return to its normal position and the wash door is opened and re-closed.

WARNING! Stand to the side of machine for this test.

2. With machine running a wash cycle, CAREFULLY release the door latch handle only enough to allow the door to open slightly (1/4” / 6 mm). Wash cycle should stop immediately. Wash cycle cannot be restarted until door is properly closed and secured.

3. With machine not running a wash cycle, but with heating system on, manually depress the float rod down. The heating system should immediately shut off. When rod is allowed to return to its normal position, the heating system should again become functional.

If any of the proceeding operational checks steps do not function as described, correct the problem before proceeding.

6.4. Chemical-Charging Procedure

If you have successfully completed the startup procedure to this point, you are ready to charge the washer with cleaning chemical.

When you charge the washer with chemical, always follow the chemical manufacturer's recommendations.

In general, most manufacturers recommend 4-6 oz. (120ml - 180ml) of chemical per gallon of water.

> ***WARNING! When handling chemicals, always wear gauntlet-type thermally protected and water-repellent protective gloves, protective eyewear, a filter-type air mask, and a full body apron that is thermally protected and water-repellent. Use a long-handled shovel only when working with or dispensing granular chemical. (Some chemical is liquid.)***

*For **granular chemical,** follow this procedure*:

1. Open and secure Parts Washer door.
2. Using a Long-handled shovel and wearing protective gear and clothing, slowly pour or shove chemical onto the drip pan under the turntable of the StingRay Parts Washer. Do not dump chemical directly into washer reservoir. Violent exothermic (heat released) reactions, splashing of chemically and physically heated solutions, and the premature release of fumes may occur. Avoid contact with chemical and solution. Avoid inhaling dust and fumes. Note: For higher chemical concentrations or larger parts washers it is best to add powder chemical in batches. Do **not** add chemical past the bottom of the turntable spokes and do **not** add more than 100 pounds (45 kg) of chemical at a time.
3. Close the washer door and run a 15-minute wash cycle to dissolve the detergent. Operate the wash cycle @ 160 to 190 degrees F.
4. After wash cycle completes verify that the entire chemical on the drip pan is dissolved into the washer reservoir. If not it may be necessary to run additional wash cycles or stir the chemical with a steel rod to break-up any clumps.

*For **liquid chemical,** follow this procedure*:

1. Turn the ***main power supply OFF***.
2. Pump out a volume of water equal to the volume of liquid chemical planned for addition. If you fail to do this you may over fill the washer.

3. Pump the liquid chemical ***SLOWLY*** from drums over the washer doorframe onto the internal reservoir cover or through the internal reservoir cover screen. Close the washer door.

> ***CAUTION! Use extreme caution when pumping liquid chemical! The operator should stand back from the washer and wear gauntlet-type thermally protected and water-repellent protective gloves, protective eyewear, a filter-type air mask, and a full body apron that is thermally protected and water-repellent.***

> ***WARNING! Do NOT pour liquid chemical into the front reservoir.***

4. Turn the *main power supply ON*. Run a 10 minute wash cycle to mix the chemical.

6.5. 7-Day Dual-Circuit Clock Initialization

After you have completed the chemical-charging procedure, initialize the 7-day dual-circuit clock.

Follow these instructions:

1. Set the 7-day clock. Refer to the vendor-provided manual for details. Also refer to section *"Setting the 7-Day Dual-Circuit Clock"* in Chapter 4, *"Advanced Operations: Process-Control"* in this manual.

2. Re-set the clock-override switch, located on the control panel, from the *on* position to the *off* position: this allows the 7-day clock to automatically operate the heating circuit.

3. To perform a test wash of actual parts, see Chapter 3, *"Basic Operations".*

6.6. Rinse System Chemical Injector (Optional)

This option arrives factory-installed. All you have to do is open a rust inhibitor chemical bucket, place the strainer tube in the bottom of the bucket, and prime the injector pump.

To prime the injector pump, *follow these guidelines*:

1. Shut off the incoming water supply.
2. Turn off the main-power-supply disconnect switch, located on the outside of the door of the electrical control panel and open the door.
3. Set the rinse timer to the maximum rinse time. (The rinse timer is located inside the electrical control panel.)
4. Close the door of the electrical control panel.
5. Turn on the main-power-supply disconnect switch.
6. Put the washer in to the rinse cycle.

   To do this, press *start*, then turn the wash timer to *0*.
   (When the washer begins a rinse cycle, the injector pump turns on.)
7. Turn injector-pump speed to *10*, until solution enters injector discharge.

   CAUTION! Do not adjust injector-pump speed unless you have already put the washer in to the rinse cycle! Adjust injector-pump speed control ONLY while the injector pump is running.

   The injector pump is now primed. NOTE: if you experience trouble getting the pump to prime loosen the compression fitting on injector and temporarily remove the discharge hose. See figure below.
8. Press *stop*.
9. Turn off the main-power-supply disconnect switch, located on the outside of the door of the electrical control panel.
10. To set the rinse timer and injector-pump speed control, refer to Chapter *4, "Advanced Operations: Process-Control".*

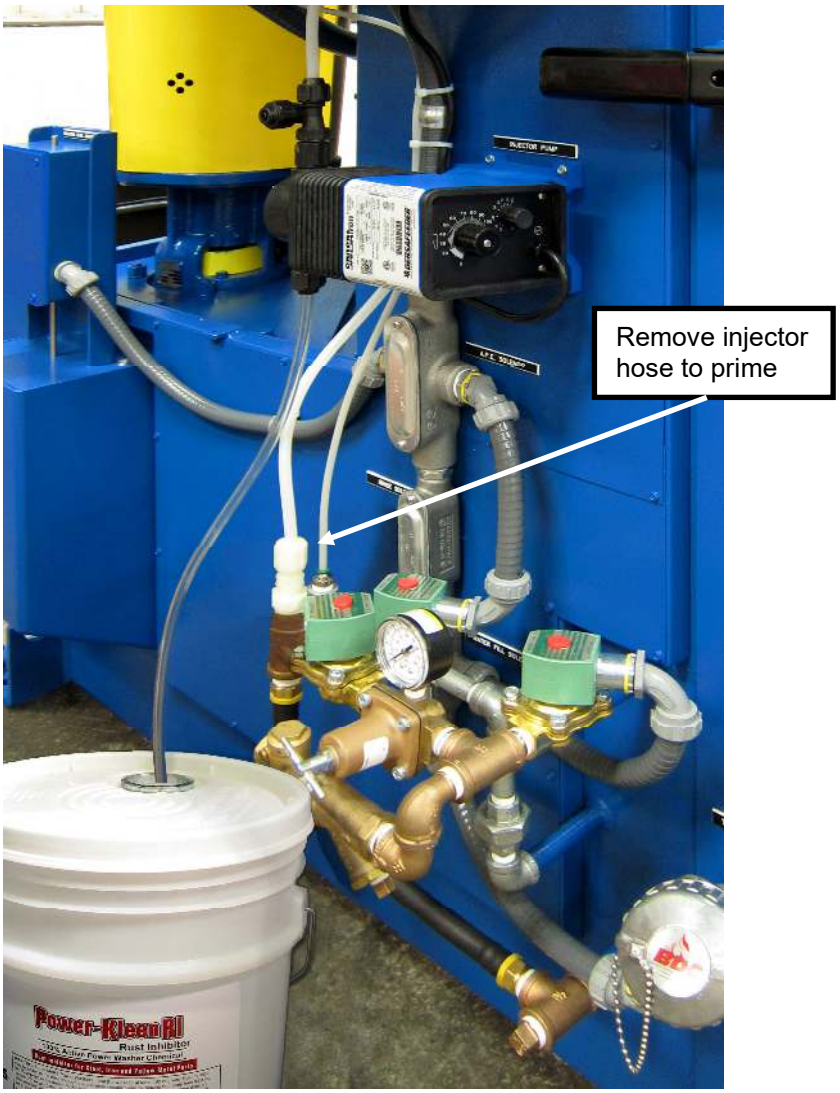


Fig. 2 – 33: Rinse Chemical Injector System

6.7. Startup Problems

If you have any problems during the startup procedure, do the following:

- Re-read this chapter *"Installation".*
- Refer to chapter *"Troubleshooting".*
- Call StingRay.

After you have completed startup with no problems, you are ready to run a wash cycle. Refer to chapter *“Basic Operations”.*

Reference: StingRay ENGINEERING STANDARD: ESS 058

Requirements for Gas Burner Flue & Venting Installation

Standard StingRay Parts Washer Flame Gas Burner installations must conform to each of the following requirements in order to avoid failures in the field and/or less than specified performance. StingRay will not warranty operation of the standard gas burner in any installation that does not strictly adhere to these requirements.

WARNING: IMPORTANT: CRITICAL

The immersion tube firing gas burner is difficult to install and set properly. GET PROFESSESIONAL help. You MUST set the burner with a FLUE GAS Analyzer. You MUST use a slack tube WATER MANOMETER to measure pressure in water column inches (wci). Your Flue Gas Analyzer must read CO_2, CO, O_2, and efficiency to properly set the burner. The flue gas analyzer must be CALIBRATED and working properly. If you cannot read the proper amount of oxygen in atmospheric air then your analyzer is NOT working. If you do not have the proper equipment then DON’T TRY to set the burner.

YOUR INSTALLATION **MUST** COMPLY WITH THE FOLLOWING GUIDELINES:

DO:

DO ensure that no part of the flue is installed at an angle more than 45º from the vertical.

DO ensure that the flue diameter is not less than 2” larger than the diameter of the washer outlet.

DO ensure that the effective height of the flue stack with bends (vertical distance between washer and terminal) is at least twice the horizontal distance between the washer and terminal.

DO try to position the flue exhaust pipe inside the building to avoid excessive cooling.

DO ensure that the flue pipe connection from the washer rises vertically for at least (36”) before any change of direction is contemplated. The reason for this is that the initial draft is crucial nearer the washer because of the higher flue gas temperature. Any horizontal or angled runs at the bottom of the flue will create severe restriction to gas movement and affect the washer gas burner operation.

DO ensure that the end of the exhaust pipe is vertical and is at least 15 feet above the outlet of the washer.

DO ensure that the end of the exhaust pipe is above the roof peak a minimum of 3 feet or installed in accordance with the National Gas Code.

DO ensure that the end of the exhaust pipe has an AGA approved rain cap.

DO ensure that the gas supply pipe is at least the following minimum diameters for a run 40 feet or less. If the run is longer than 40 feet call StingRay Tech Services to discuss the proper size.

Burner Output (BTU/hour)	Supply Pipe Diameter (inches)
180,000	1.00”
380,000	1.25”
750,000	2.00”

Use the minimum number of elbows in the gas supply pipe possible. In no case shall more than 4 elbows be used unless the supply pipe is the next size larger than the above minimums.

DO ensure that all joints are properly, securely, and efficiently made.

DO ensure the EXACT gas pressure required is available at the burner regulator. If your pressure drops more than 0.30 wci between the conditions of firing the burner and shut-off then your supply pipe is too small.

DON’T:

DON’T run horizontal flue from the washer.

DON’T run horizontal flue anywhere in the system.

DON’T use bends if they can be avoided.

DON’T position the flue exhaust pipe run externally of the building if it can be avoided.

DON’T connect the gas to the washer until the installation has been checked and approved by a gas engineer registered with the local gas company.

DON’T end the flue exhaust duct less than 3 feet above the roof peak or in accordance with the national gas code.

DON'T use single wall galvanized ducting as a flue system.

DON'T use un-insulated flue systems externally (outside the building).

DON'T allow any combustible materials to come into contact with any flue pipe.

DON'T install the burner system at an elevation more than 1000 feet above sea level; contact StingRay.

DON'T install the system in a location with changing air pressure caused by exhaust fans, ventilation equipment or exhaust blowers. Anything that causes positive or negative pressure in the building will affect the performance of the burner.

Additional considerations regarding DRAFT:

Natural Draft is Never a Constant

Temperature, the flue exhaust pipe height, and the total length of run including all elbows have the greatest impact on natural draft in flue, vents, and stacks. The draft will constantly change as the burners modulate, start up or shut down. The draft is also affected by outdoor temperature, barometric pressure and wind, so a flue exhaust pipe is not a very good draft controller. Draft variations due to fluctuations in outdoor air temperature alone can be substantial. During the operation, the flue exhaust pipe will be "oversized" most of the time, which can lead to inefficient and erratic operation. Changes in weather, barometric shifts or draft conditions caused by building heating/ventilating/air conditioning may necessitate readjustment of the burner air/fuel settings. This condition is virtually eliminated with the StingRay Eclipse Burner system because the burner has an extremely powerful fan and fires at above atmospheric pressure to overcome draft changes. The StingRay Eclipse firing pressure is 3 to 4 times higher than the StingRay standard burner.

Efficiency and Emissions

For a gas burner heating a washer to be efficient and produce the lowest possible emission level, it must maintain a perfect flame and maximize heat transfer. A perfect flame can only be obtained by maintaining a precise fuel-to-air ratio. The correct air-to-fuel ratio can only be achieved with a proper air supply and proper draft. It is not uncommon to see high-efficiency burners operate at efficiency levels of low-efficiency burners. This is purely a result of lack of draft control making the additional investment in high-efficiency wasted. The StingRay Eclipse Burner system utilizes a ratio regulator that varies the air-to-fuel ratio under varying atmospheric anomalies and firing conditions to maintain an optimum ratio for maximum efficiency.

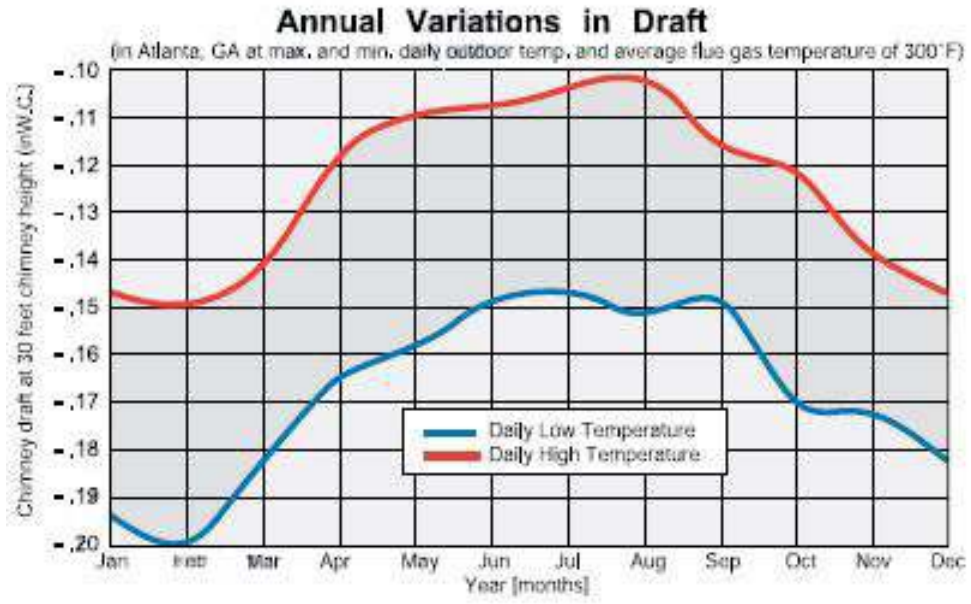


Fig. 2 - 34: Annual Variations in Draft

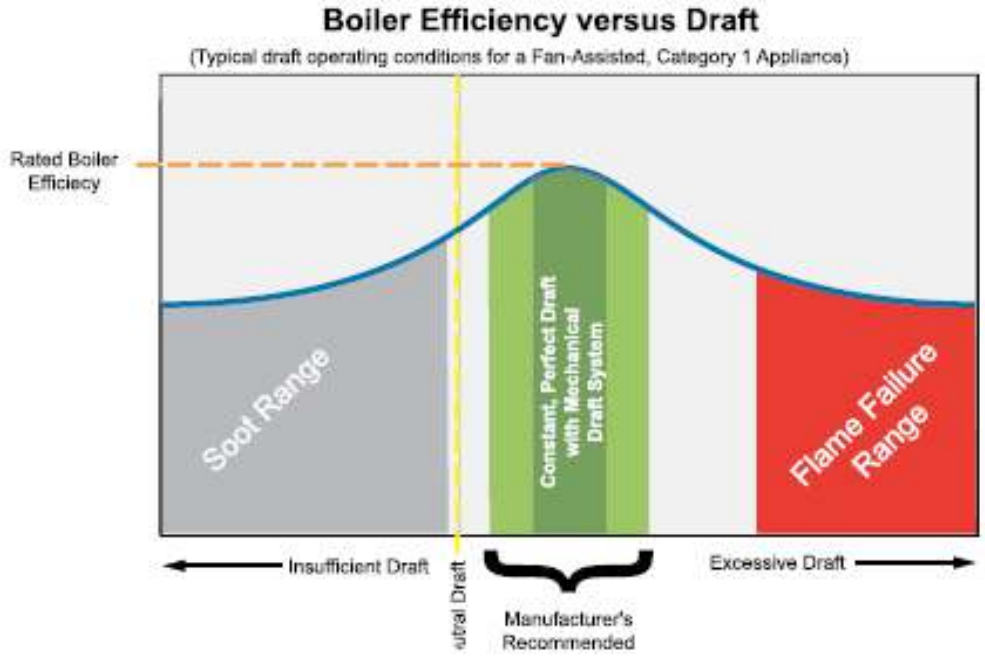


Fig. 2 - 35: Boiler Efficiency vs. Draft

3 Basic Operations

Purpose

This chapter provides step-by-step instructions on how to load and wash parts. Read it before you operate the washer for the first time.

Prerequisites

Before you read this chapter or operate the washer for the first time, we recommend that you read the following thoroughly:

- *"Important Safety Instructions and Warnings"* (in the front material)
- Chapter 1, *"Overview"*

> This chapter, *"Basic Operations",* assumes that appropriate operating parameters have been established for your washer. Refer to Chapter 4, *"Advanced Operations: Process-Control"* for information on establishing process-control parameters.

Safety/Precautions

Before you operate the washer, read and follow these recommended safety/precaution instructions:

> ***WARNING! NEVER get inside the washer cabinet when the main power supply is ON. This could result in severe injury or death.***

> ***CAUTION! WHEN LOADING AND UNLOADING PARTS! -- Always wear gauntlet-type thermally protected and water-repellent protective gloves, protective eyewear, a filter-type air mask, and a full body apron that is thermally protected and water-repellent.***

CAUTION! <u>WHEN LOADING AND UNLOADING PARTS</u>! -- After a cleaning cycle, parts are very hot. Trace amounts of chemical residue remain on part surfaces and in recesses. <u>Before</u> you remove a part from the washer cabinet, be sure to <u>drain back into the washer</u> any solution that remains on a part surface or in recesses.

What You Will Learn In This Chapter

In this chapter you will learn the following about operating the washer:

- Control Panel
- Standard Cleaning Cycle
    - Checking water temperature
    - Using the clock-override switch
    - Opening the Door
    - Loading and Securing Parts
    - Closing and locking the Door
    - Verifying Wash Temperature
    - Setting the Timer
    - Setting the Rinse Cycle (optional)
    - Starting the Washer
    - Verifying Proper Function
    - Opening the Door after a Cycle
    - Unloading Parts
- Continuous Operation

1. Control Panel

The following figure shows the standard control panel, located on the outside of the washer cabinet to the left of the door. The operator uses these controls in day-to-day cleaning-cycle operations:

Hour Meter	Monitor the total number of hours of washer cycle time for scheduled maintenance procedures, from *start* to the *end* of cycle.
Rinse off/auto	Set the rinse switch to *AUTO* to enable the rinse cycle; OFF bypasses the rinse cycle.
7-Day Dual-Circuit Clock	Program heat-up days and start/stop times for heat and water-fill; program circuit #2 to control the "auto" runtime for the optional Clean Machine or Oil Skimmer.
Wash Cycle Timer	Set 0-30 minute wash cycle
7 Day Clock	Select *BYPASS* to override the 7-day clock. Select *ON* to enable the 7-day clock control.
Turntable Jog	Press the *TURNTABLE JOG* button to rotate the turntable for easier loading/unloading.
Start (Run Light)	Press the *START* button all the way to begin the wash cycle. The green run light illuminates indicating cycle running. **Note**: The start circuit is interlocked with the door closed limit switch. The opening and closing of the washer door resets the start circuit.
Stop/*Reset*	Press the *STOP* button to stop washer operations (heat source and water-fill functions are not affected). The green “Run Light” extinguishes indicating cycle terminated.
Temperature Controller	Set and monitor the wash solution temperature

> ***NOTE:*** If you have purchased any options, such as the Clean Machine, Oil Skimmer, or Conductivity Controller, their operator controls will appear on the control panel, if applicable. Refer to Chapter 7, *"Options"* for more information.

> ***NOTE:*** If you specified any custom features, your control panel may differ slightly from the standard panel. For example, your wash timer may be located inside the electrical control panel. If you requested a *water fault indicator*, it illuminates only if the water level falls below operational requirements.

For more information on installing, operating, and maintaining options, refer to Chapter 7, *"Options".*

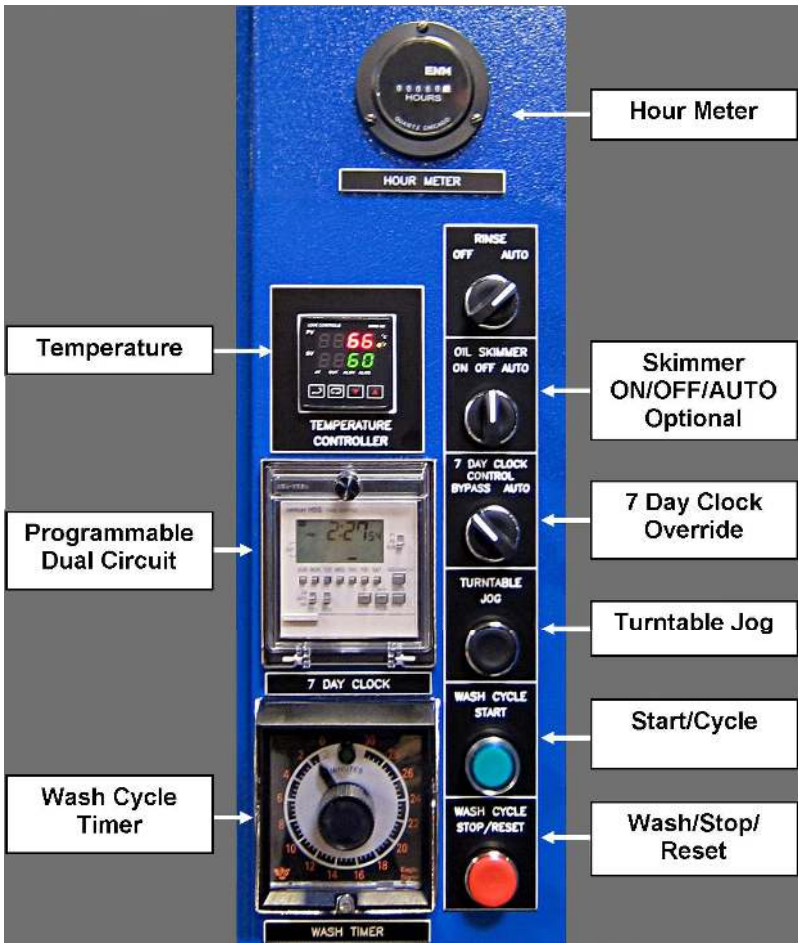


Fig. 3 - 1: Standard Turntable Power Washer Control Panel

2. Standard Cleaning Cycle

This section explains how to operate the washer. Read it before you run a cleaning cycle for the first time.

2.1. Checking Water Temperature

Check the water temperature to verify that the washer has reached the *minimum operating temperature* specified by your process-control instructions. Refer to the following figure for the gauge's location.

> ***WARNING! Do NOT operate the washer unless it has reached minimum operating temperature.***

Scheduled Shift: During a scheduled shift, check the temperature about every 15 minutes until it reaches the specified operating temperature. If the gauge shows no change after 30 minutes or so ***and*** the washer has not reached the specified operating temperature, refer to chapter *"Troubleshooting."*

Non-scheduled Shift: To run a wash cycle during a non-scheduled shift, use the *clock-override switch* to bypass the 7-day clock. Refer to the next section.

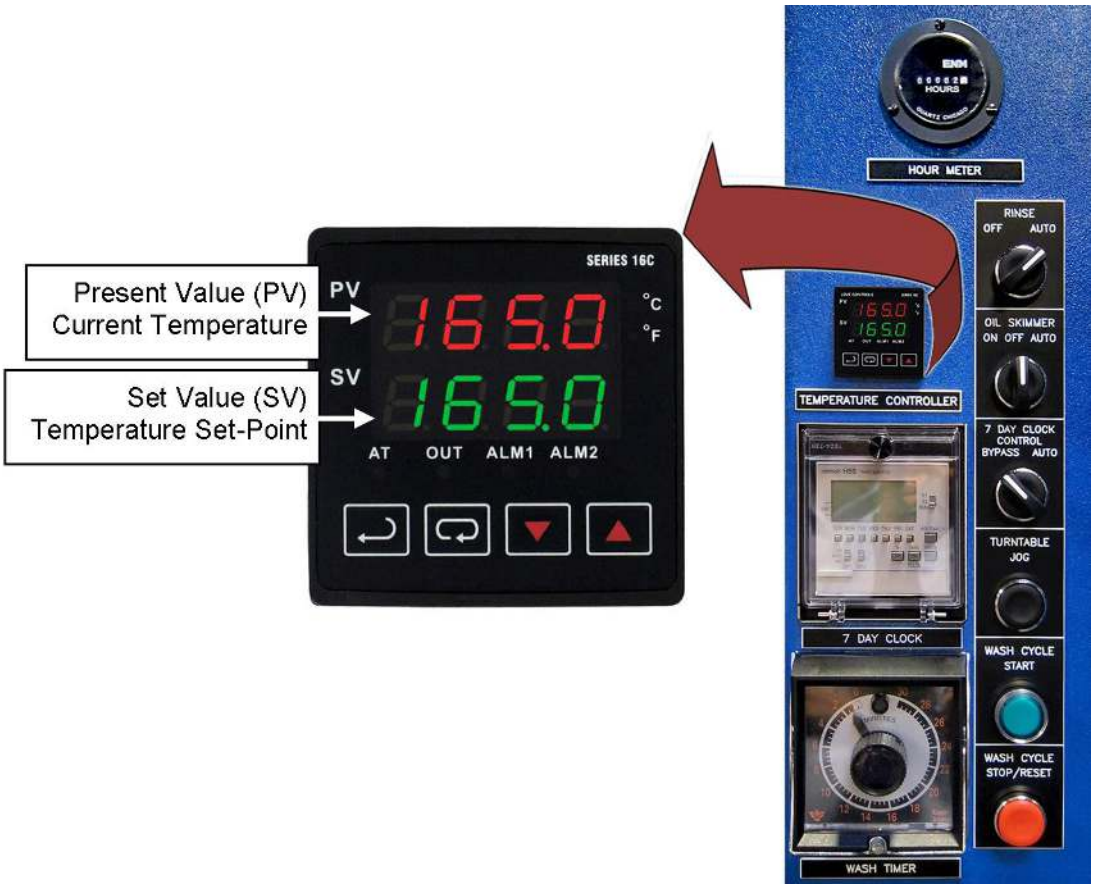


Fig. 3 - 2: Water Temperature Controller & Read Out

NOTE:

The water temperature controller monitors and displays the wash solution temperature in the wash tank. During the start of a cleaning cycle, wash solution temperature will decrease for the following reasons:

- A cold washer cabinet (first wash of the day or extended idle time between washes).
- Cold air in washer cabinet (door left open for extended time).
- Washing action on cold parts (cooling of returning water).
- Stratification of hot and cold water during extended idle times.
- Excess steam extraction (ASE system extracting excessive steam and heat).

This fluctuation from temperature setpoint (highest desired solution temperature as set on the internal temperature control unit) is to be considered normal operation of the system.

To increase the “average” wash temperature, increase the set point temperature on the control unit. This will increase the “starting” wash solution temperature.

See the Digital Temperature Controller operating guide at the back of this manual for instructions on changing the set-point temperature.

2.2. Using the Clock-Override Switch

Use the clock-override switch to bypass the 7-day clock and heat the washer. Refer to Fig. 3-1. Generally, you would use this switch under the following conditions:

- You are *not* on a scheduled production shift
- *And* you need to run a wash cycle
- *And* the temperature read-out shows the washer is not at operating temperature

Check the temperature read-out about every 15 minutes until it reaches the specified operating temperature. If the read-out shows no change after 30 minutes or so *and* has not reached the specified operating temperature, refer to Chapter 6, *"Troubleshooting."*

Allow approximately 1-2 hours for the washer to reach operating temperature from an “ambient” condition.

2.3. Opening the Door

Door Latch

Pull the latch *handle* away from the washer cabinet to release the latch. Refer to the following figure.

Swing the latch *hook* away from the door handle.

Pull the door open *slowly*.

Fig. 3 - 3: Cabinet Door Latch

Position Lock

Pull the door open *slowly*, until it locks in the *first* position.

> ***WARNING! Do NOT let the door swing open and slam into the lock position. This could break the door position lock. It is designed to break under overload conditions to prevent damage to the door bearings and support structure.***

To lock the door in the *second* position:

1. *Rotate the position-lock handle upward to release the* lock from the first position.
2. Move the *door* back *slowly*.
3. Release the *position lock*.
4. Continue pushing the *door* until it locks in place.

The position-lock handle is located at the bottom of the door. The two position locks hold the door open at approximately 60° angle and 90° angle, respectively, from the front of the cabinet. Refer to the following figure.

Securing the Door Always be sure that the open door is locked in position:

- Visually check the position lock, *or*
- Try to pull or push the door

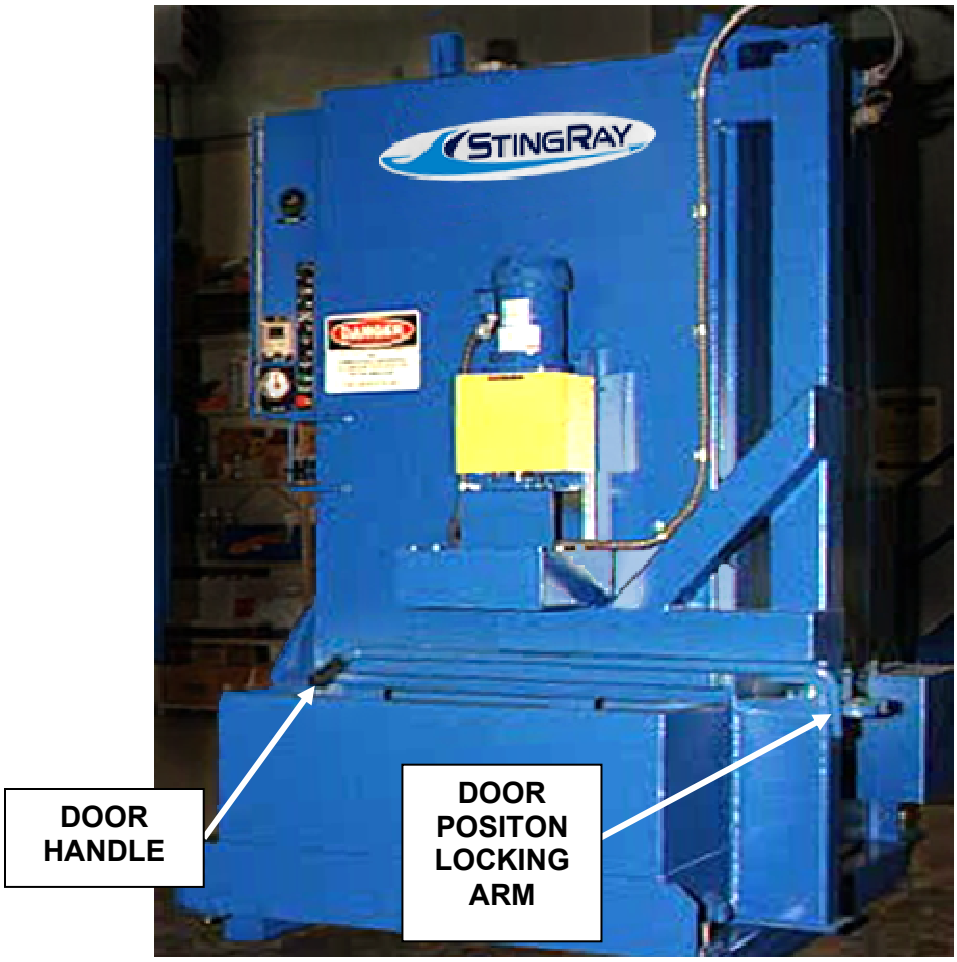


Fig. 3 - 4: Cabinet Door Position Lock

2.4. Loading and Securing Parts

Place all parts as near to the center of the turntable as possible. Position parts vertically whenever possible in order to take greatest advantage of the PBM's blasting system.

WARNING! All parts must fit within the diameter of the turntable. The load should be centered on the turntable and must not extend beyond the edge of the turntable.

Securing Devices All parts, small or large must be loaded at the center of the turntable and secured to the turntable. The type, size, and weight of the part determine whether you would use, for example, chains or nylon tie-downs. Remember that the washer blasts parts with a lot of power, especially models with larger pumping systems.

NOTE! **Turntable load ratings are for parts loaded *exactly* at the *center* of the turntable.**

Guideline: Assume that every nozzle hits every part with 15 lbs. (6.8 kg) of force.

Recommendations:

- Wrap securing devices *tightly* around all fixtures and parts.
- Loop securing devices through eyelets, stems, hooks, and handles on fixtures.
- Wrap securing devices around the outer perimeter of the part load at least once, and through any part openings, ports, etc., if possible.
- Wrap the ends of each securing device into appropriate slots, handles, etc., on fixtures, or attach to hooks on the turntable, so they don't catch on the turntable sprocket drive.

- Be sure that all securing devices clear the lower manifold nozzles and the turntable support arms, if the devices extend below the bottom of the turntable.

Fixtures

Smaller parts can be placed into *baskets*. Fasten larger parts to the turntable using *fixtures.*

The turntable contains *adapter holes* for securing fixtures.

If you have purchased optional "quick change" fixtures from STINGRAY, refer to chapter *"Options"* for more information on using them.

2.5. Closing and Locking the Door

CAUTION! Close the door slowly! Be especially careful if the floor is wet or slippery!

Position Lock

To close the door, rotate the *position-lock handle upward* to release the lock from the first or second position. Then, hold the handle up and push the door *slowly* toward the cabinet, until it shuts.

The position-lock handle is located at the bottom of the door. Refer to Fig. 3-4.

Door Latch

Swing the latch *hook* toward the door handle.

Push the latch *handle* toward the washer cabinet to close and lock the latch. Refer to Fig. 3-3.

2.6. Verifying Wash Temperature

Check the water temperature read-out again to verify that the washer has reached the *minimum operating temperature* specified by your process-control instructions *before* setting the timer. Refer to Fig. 3-2 for the gauge's location.

If the gauge still has not reached the specified operating temperature, refer to Chapter 6, *"Troubleshooting".*

WARNING! Do NOT operate the washer unless it has reached minimum operating temperature. Excessive foaming and additional water loss may occur.

2.7. Setting the Wash-Cycle Timer

Rotate the 0-30 minute wash-cycle timer knob *counterclockwise* to desired time to set wash-cycle time. Refer to Fig. 3-1. During a wash cycle, the black pointer on the timer will remain at set point. The red cycle-progress pointer will move to indicate time remaining. At the end of a wash cycle, the red pointer will reset to the time indicated by the black pointer. This feature allows you to repeat the same cycle time by just pressing *start*.

NOTE! **The red pilot light on the timer is *on* during the wash portion of a cleaning cycle.**

Actual Wash Time Set the timer to your shop's normal operating standards. If none exist, you will have to develop them. Only experimentation will give you optimal wash time.

NOTE*:* In general, most cleaning cycles can be completed in less than 15 minutes.

2.8. Setting the Rinse Cycle (Optional)

If you have the optional Automatic Rinse Cycle (ARC), setting the *rinse off/auto switch* to the *auto* position will *enable* the rinse cycle. Setting the switch to *off* will *bypass* the cycle; no rinse will occur. Refer to Fig. 3-1.

2.9. Starting the Washer

Press the *start* button to begin the wash cycle (Refer to Fig. 3-1). The button will remain illuminated during the cycle.

Shifting Load: If the load on the turntable is not centered on the turntable and secured to the turntable, it will shift (noisily) as soon as the main wash

pump starts. The turntable-drive-motor jackshaft may also stop rotating. If this occurs:

1. Press the *STOP* button. Wait at least 10 seconds for the pumps to stop running. (Refer to Fig. 3-1.)
2. Verify that the *start* button light is off.
3. Open the door *slowly* (parts could fall out on you).

CAUTION! Open the door slowly! Stand back to avoid any traces of steam! Stand back to avoid falling parts!

4. Center the parts on the turntable.
5. Secure the parts.
6. Close and lock the door.
7. Press the *START* button again.

***NOTE:* To stop the cleaning cycle at any time, press the *STOP* button. To restart the washer, the start circuit must be reset by opening and reclosing the washer door.**

2.10. Verifying Proper Function

Normal Cycle During the cleaning cycle, verify proper function in the following ways:

- Listen to the pump -- does it sound normal?
- Is the turntable drive-motor jackshaft rotating?

Cycle Completion At the end of the cleaning cycle, the following things should happen:

- *START* button light turns off.
- Turntable drive-motor and ASE blower turns off.
- Wash timer red pointer resets to set point wash time.

2.11. Opening the Door after a Cycle

Wait for the lighted *start* button to turn off before you open the door after a cleaning cycle.

> ***CAUTION! Open the door slowly! Stand back to avoid any traces of steam! Stand back to avoid falling parts!***

Door Latch Pull the latch *handle* away from the washer cabinet to release the latch (Refer to Fig. 3-3).

Swing the latch *hook* away from the door handle.

Pull the door open ***slowly*.**

Position Lock Pull the door open *slowly*, until it locks in the *first* position. Do *not* open the door past the first position lock: this allows remaining solution to drip into the reservoir, not onto the floor.

The position-lock handle is located at the bottom of the door. Refer to Fig. 3-4.

Securing the Door Always be sure that the open door is locked in position:

- Visually check the position lock

- Or-

- Try to pull or push the door

2.12. Unloading Parts

Press the *TURNTABLE JOG* button to rotate and position the table for easier unloading (Refer to Fig. 3-1).

Remove the cleaned parts.

3. Continuous Operation

To operate the washer continuously, repeat *"2.4. Loading and Securing Parts"* through *"2.12. Unloading Parts".*

You may need to add chemical or perform maintenance. Refer to Chapter 4, *"Advanced Operations: Process-Control"* and Chapter 5, *"Maintenance"* in this manual.

4 Advanced Operations: Process-Control

Purpose

This chapter explains how to establish operating parameters to optimize the performance of your StingRay Parts Washer. Use information about the following to help get the best cleaning results and optimize energy usage, while minimizing chemical usage and problems:

- Managing chemical concentration
- Setting rinse cycle time (optional ARC)
- Setting the 7-day dual-circuit clock
- Monitoring assemblies and parts

Prerequisites

Before you read this chapter, we recommend that you read the following thoroughly:

- *"Important Safety Instructions and Warnings"* (in the front material)
- Chapter 1, *"Overview"*
- Chapter 3, *"Basic Operations"*

Safety/Precautions

Before you operate the washer, read and follow these recommended safety/precaution instructions:

WARNING! <u>Never</u> get inside the washer cabinet when the main power supply is ON. This could result in severe injury or death.

What You Will Learn In This Chapter

In this chapter you will learn the following about establishing operating parameters:

- Chemical-Concentration Management
- Temperature Adjustment
- Rinse-System Control (optional ARC)
- Setting the 7-day Clock
- Steam-Exhaust Timer
- Monitoring

1. Chemical-Concentration Management

This section discusses the following topics:

- Chemical: General
- Selecting the right chemical
- Selecting the right concentration
- Maintaining the proper chemical charge
- Problems
    - Foaming related to chemical concentration
    - Supersaturation of solution
- Charging the power washer with chemical

1.1. Chemical: General

Your StingRay Parts Washer uses an aqueous (water-based) alkaline cleaner, not a solvent. When charged with a *light* concentration of cleaner, the washer will give you excellent cleaning results. Generally, *light* means a 2-6% concentration by volume of a high quality non-foaming chemical compound.

Good chemical management should be done on a daily basis. Check the concentration of the cleaning solution and adjust it as necessary -- this is important not only for cleaning results, but it will also reduce cleaning time and other chemical-related problems such as foaming.

You must also use some chemical during the cleaning cycle in order to prevent corrosion (rusting) damage to the washer itself.

Most chemicals provide adequate corrosion prevention at low concentrations, but some do not. Generally, to prevent corrosion the pH of the solution must be above 10.5. Your StingRay Service Tech. can discuss with you in more detail the pH requirements and which chemicals may cause corrosion. If you do not know what your solution pH is, you must monitor it to verify that it is kept above 10.5. All StingRay Power-Kleen Chemicals provide the necessary corrosion inhibitors to prevent damaging corrosion.

StingRay Parts Washers are aqueous based cleaning systems. They are designed and manufactured to work with wash solutions that are of the same specific gravity and viscosity as water. Chemicals or additives, which alter the specific gravity or viscosity of the wash solution, will change the overall performance of the system. Use only chemicals that are designed for use in aqueous systems.

1.2. Selecting the Right Chemical

When you select a chemical, *first* determine the compound best suited for the type of metal or part. *Second*, take into account the type of soils to be removed.

Use the following guidelines in selecting the right chemical:

Type of Metal

For **ferrous metals**, such as cast iron or steel, select a caustic compound containing sodium hydroxide or potassium hydroxide.

For **non-ferrous metals**, such as aluminum, select compounds specifically designed to wash parts without destroying them. Such compounds contain, for example, sodium metasilicate, trisodium phosphate, and sodium bicarbonate. The compound may also contain a small percentage of inhibited caustic to make it more aggressive, without damaging the metals.

WARNING! Exposing aluminum to a high concentration of caustic chemical, such as sodium hydroxide or potassium hydroxide, will blacken the surface of the parts being cleaned, and, if exposed for five minutes or more, can etch the surface.

Type of Soils

A wide range of compounds is available to remove soils. Each compound reacts differently with the soils -- some are more aggressive than others at "popping" certain soils from part surfaces. However, no compound removes all types of soils equally well.

To select a chemical, decide which soils you most want removed.

For further details on various chemical compounds and their suitability for your application, call your StingRay Service Tech to discuss your requirements.

WARNING! The selected chemical must be <u>non-foaming</u>.

WARNING! The selected chemical must prevent corrosion to the steel parts in your washer. Generally, a solution pH above 10.5 is required. Do not use chemicals that cause corrosion or that cause a solution pH below 10.5. All StingRay Power-Kleen Chemicals provide the necessary corrosion inhibitors to prevent damaging corrosion.

1.3. Selecting the Right Concentration

The StingRay Parts Washer is a high-pressure, high-temperature cleaning system that uses a balance of the following factors to achieve cleaning results:

Power x Temperature x Chemical x Time =
Clean

Because the *exact* combination of these factors depends on your shop's cleaning standards and operating requirements, specific chemical concentration recommendations are not possible. Below are formulas for calculating the amount of chemical needed to charge a reservoir of water for cleaning. To use these you will need to know the volume of your washer's reservoir and the recommended initial chemical concentration. Select the formula to use based on whether your chemical is powder or liquid.

For Powder:

Reservoir Size (gal) x Recommended Concentration (oz/gal) = Lbs. of Chemical to add.
Divided by 16 oz. / lb.

For Liquid:

Reservoir Size (gal) x Recommended Concentration (oz/gal) = Gals. of Chemical to add.
Divided by 128 fluid ozs. / Gal

You must test and adjust the variables in your application to determine an effective chemical type and concentration.

Chemical concentration depends on:

- Your cleaning standards
- Type of metal or material being cleaned
- Shape of parts
- Type of soils to be removed
- Rate of speed required in cleaning
- Operating temperature of the washer
- Water hardness

Every chemical compound has an optimal operating temperature range. Generally, chemical is more aggressive at higher temperatures. As a general rule, for every 10° F (6° C) rise in temperature, a chemical reaction doubles in speed.

The StingRay Chemcial Group offers a complete range of chemcials for use in StingRay Parts Washers. They can help you select the proper chemical from our Power Kleen line and recommend an appropriate initial chemcial concentration.

If you are using you own chemcials, contact your chemical supplier for details -- and adjust your StingRay Parts Washer's chemical concentration accordingly.

1.4. Maintaining the Proper Chemical Charge

After you have developed an effective chemical concentration, as described in the previous section, you must monitor and maintain it for optimal cleaning results and washer performance.

Initially, you could start by monitoring chemical concentration weekly (or every 40 hours of washer operation). However, you should develop a monitoring schedule based on the frequency of washer operation, degree of cleanliness required, the types of soils to be removed from parts, and so on. Your monitoring schedule should account for all the variables in your application in order to give you the best cleaning results, while using the least amount of chemical possible.

For help in developing a chemical-concentration-monitoring schedule, call your StingRay representative to discuss your application(s) and requirements or contact your chemical supplier.

There are two fast and accurate monitoring methods:

1. **Titration Test**

   Perform this test to determine the concentration of chemical by titrating the alkalinity of the solution with an indicator and a drop count.

   The results determine the number of ounces of chemical to add per gallon of water-capacity.

   Refer to chapter *"Maintenance"* for procedural information.

2. **Conductivity Test**

   Conductivity testing equipment is optionally available from StingRay. Refer to chapter *"Options"* if you have purchased a conductivity controller and probe equipment for your washer.

1.5. Problems

There are two principal problems related to managing chemical concentration:

- Foaming
- Supersaturation of solution

For related information, refer to Chapter 5, *"Maintenance"* and Chapter 6, *"Troubleshooting".*

1.5.1. Foaming Related to Chemical Concentration

Foaming can occur for these reasons:

- Chemical compound
- Type of soils being removed
- Improper solution temperature

Chemical **T**he de-foaming component in a chemical compound represents only a small percentage of the total compound. And, de-foaming component percentages vary from compound to compound. Since the washer requires only a

light chemical charge, you may need to add a *"booster charge" of de-foamer*, if foaming is a problem.

Consider adding a defoaming agent rather than more chemical, given the following conditions:

- Your cleaning needs are being met.
- You have determined that the type and amount of chemical are appropriate for the soils being removed.
- You have determined that the washer's operating temperature is appropriate for the type of soils and the type and amount of chemical.

Soils

The type(s) of soils can react adversely with the chemical during cleaning to cause a foaming problem. Select a chemical that is appropriate for the soils to be removed. It is also a good idea to check with your StingRay representative or your chemical supplier to be sure that the type and amount of chemical are appropriate for the following:

- Type of metal
- Makeup of part(s)
- Operating temperature of the washer

Temperature

Test and adjust the washer's operating temperature to determine what is optimal for your chemical. Remember that altitude, water hardness, and types of soils can also affect the temperature-and-chemical reaction. Refer to section *"Temperature Adjustment"* in this chapter.

If you need to discuss your application(s) and requirements, call your StingRay representative or contact your chemical supplier.

1.5.2. Supersaturation of Solution

The StingRay Parts Washer is a closed-loop cleaning system. It re-uses the cleaning solution without discharging it for treatment or disposal.

When the cleaning solution is fully saturated with greases and oils, merely adding more chemical will not improve cleaning results -- the volume of emulsified greases and oils is greater than the grease to be removed and has no where to go. This condition is called *supersaturation of solution*.

To correct this problem, you must remove *greases and oils* from the solution. Allow solution to cool and oils to rise to surface, then:

- Manually skim greases and oils from the front reservoir; change the solution.

- Or -

- Run the optional **Oil Skimmer** device. If you have purchased one from StingRay, refer to chapter *"Options"* in this manual.

As part of the sludge clean-out procedure, you will clean out/re-charge the power washer with chemical. Refer to Chapter 5, *"Maintenance"* for the sludge clean-out procedure.

1.6. Charging the Power Washer with Chemical

Refer to Chapter 2, *"Installation",* section *"Startup Procedure, Chemical-Charging"* for instructions.

1.7. Corrosion Protection

Since alkaline cleaners are non-corrosive to ferrous metals the cost to manufacture cleaning equipment can be reduced. Stainless steel is not required for construction and protection of the reservoirs, pumps, tanks, cabinets, and turntables. In fact carbon steel can be used for the reservoirs and cabinets with no detrimental effects as long as the concentration of alkalinity is maintained. With proper maintenance of your chemical concentration the carbon steel components are well protected and will provide years of service. Carbon steel StingRay Parts Washers are still in service that are 20+ years old.

Many chemicals provide adequate corrosion prevention at low concentrations, but some do not. Generally, to prevent corrosion in carbon steel the pH of the solution must be above 10.5.

StingRay Parts Washers are aqueous based cleaning systems. They are designed and manufactured to work with wash solutions that have the same specific gravity and viscosity as water. Chemicals or additives, which alter the specific gravity or viscosity of the wash solution will change the overall performance of the system. Use only STINGRAY Power Kleen chemicals or other chemicals that are designed for use in aqueous systems.

Below is a short introduction to the complete chemical line offered by StingRay Parts Washers.

1.8. StingRay Chemicals

StingRay Power Kleen detergents and additives are specially formulated for use in all StingRay Parts Washers. Power Kleen products cover a wide range of applications and most likely there is a Power Kleen product specifically designed for your particular cleaning applications. In all cases Power Kleen products provide the highest degree of efficient, effective cleaning while maintaining the integrity of your machine.

Power Kleen products are highly effective at controlling foaming and are labeled "Controlled Foam" products. Additional defoamer products are available to help in difficult foaming situations.

Power Kleen products remain effective longer than many other detergents used in cabinet washer applications and, in many instances, less Power Kleen detergent is required for a given application. Power Kleen chemicals have 100% concentrated active ingredients. The reason StingRay compounds remain active longer is that they contain NO fillers. Other chemical suppliers may "fill" or bulk up their chemistries with non-active ingredients that do nothing except fill up the chemical drum. These fillers end up as sludge in the bottom of the Power Washer and must be disposed of, thus adding to the disposal costs. Since StingRay Power Kleen is fully active chemistry, 100% of the chemical goes to work cleaning your parts. As a result, your cleaning dollar goes further and your disposal costs are less.

1.9. Recommended Chemicals

Power Kleen I – Iron and Steel (Powder)
Fast acting, long lasting Power Washer detergent for removing heavy oils and grease, many types of carbon, and other deposits from all ferrous metals. This is StingRay's most aggressive chemical. Also used in paint stripping applications.

Power Kleen IL – Liquid
Removes mill oils, heavy greases, lubricants, carbonaceous soils and other soils commonly encountered in maintenance and production for Aqueous Parts Washer cleaning applications.

Power Kleen II – Aluminum Safe
Multi-Metal, biodegradable Power Washer detergent for removing oil, grease, and dirt from both ferrous and non-ferrous materials.

Power Kleen IIIL – Electric High-rinse
Liquid Power Washer detergent for removing oil, grease, and dirt from electric motors, generators, etc. Highest rinsability factor with no conductive residue.

Power Kleen V –
Lower pH, Good Rinsing, Low Foaming Detergent Safe for Aluminum, Steel, Iron, Rubber, and Plastic in Aqueous Parts Washers

Power Kleen RI – Rust Inhibitor
Applied during the Aqueous Parts Washer rinse cycle by being injected to the fresh incoming water. Provides rust protection for short-term storage of parts after cleaning.

Power Kleen CR --Carbon Removal Additive
We offer additive for all of our Power Kleen Detergents to boost the carbon removal during the cleaning in an Aqueous Parts Washer.

Power Kleen Rust Buster
Strips rust from inside of Aqueous Parts Washer cabinet to revive rusted and corroded surfaces.

Power Kleen Defoamer A
Non-Silicone formula reduces foam in Aqueous Parts Washer that produce excessive foam.

Power Kleen Defoamer S
Silicone based superior antifoam formula for Aqueous Parts Washer that produce excessive foam.

The StingRay Manufacturing web site www.stingraypartswasher.com contains a vast information base for cleaning chemistry and has complete information for the entire Power Kleen line of chemicals. At the site you may download MSDS sheets for each product and find more in-depth application data for each product. Optionally, you may call StingRay Tech Services staff who are trained to help washer users select the most appropriate product for their specific cleaning applications and answer questions regarding chemical use and application.

2. Temperature Adjustment

The recommended maximum temperature operating points are shown in the following figure. ***NOTE:*** *The set point on the controller can differ from the actual temperature.*

Maximum Actual Operating Temperature

Altitude in Feet	*Temperature* ° F
0 - 2000	190° F ((88° C)
2000-4000	185° F (85° C)
4000-5000	180° F (82° C)
5000 and above	call StingRay

WARNING! Do NOT exceed recommended settings, or serious damage can occur to the wash pump (cavitation).

Fig. 4 - 1: Maximum Actual Operating Temperature

The temperature controller is located on the face of the operator control panel. To change the temperature set-point, refer to the Digital Temperature Controller adjustment instructions at the back of this operating manual.

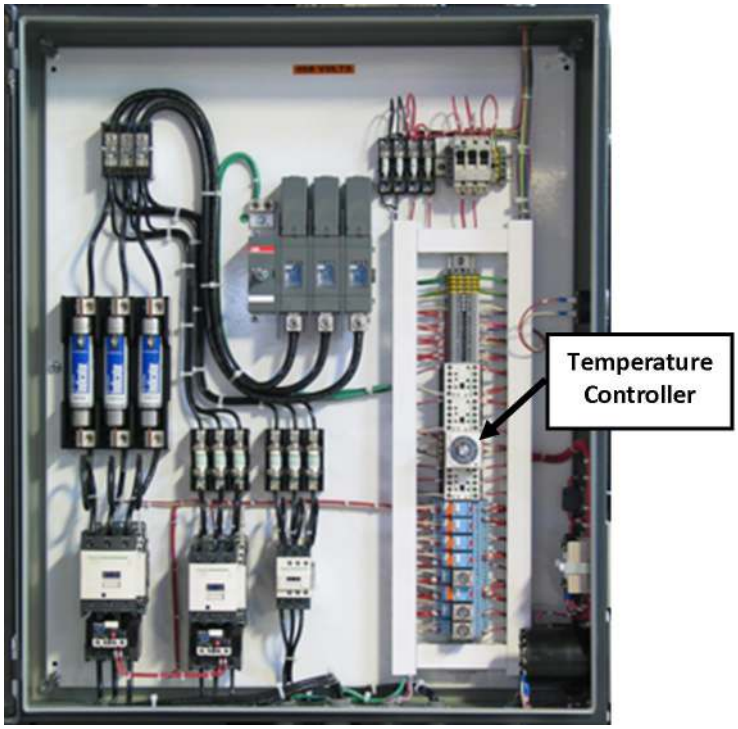


Fig. 4 - 2: General Layout of the Electrical Control Panel (Block Diagram)

Since temperature is only one of the variables that affect cleaning results, no general rule can be given for the temperature setting. You must test and adjust temperature, as well as other variables, to determine the optimum. Start with the recommendation of your StingRay Service Tech or your chemical supplier.

Guidelines:

As temperature increases, greases and oil become more fluid. Since grease is the primary binder that holds and contains the soils on the parts, heat melts the binder generally producing better cleaning results. *Do not exceed recommended temperatures shown in Fig. 4-1, however, or the main wash pump may sustain severe damage due to cavitation.*

Use the following table as a guide in testing and adjusting temperature:

Temperature	***Type of Soil***
140-160°F (60-71° C)	Light Oils
160-175°F (71-79° C)	Greases
175°F + (+79° C)	Carbon, Paint

NOTE:

- Higher temperatures use more energy.
- Higher temperatures will allow a longer rinse cycle, due to greater evaporation.

3. Rinse-System Control (optional ARC)

The Automatic Rinse System (ARC) is a fresh-water rinsing system. It is powered by waterline pressure. It allows the operator to control rinse characteristics and the application of a rust inhibitor by means of the chemical injector pump.

The following controls rinse time:

- Amount of makeup water needed, due to water loss through evaporation or drag-out.
- Automatic rinse system (ARC) timer.

In controlling rinse cycle time, water loss takes priority. The amount of makeup water required determines the maximum rinse time allowed, if any.
Set rinse cycle duration by adjusting the automatic rinse cycle (ARC) timer located in the electrical control panel. Refer to Fig. 4-2.

WARNING! Disconnect power before opening the control panel to make adjustments.

3.1. Setting the Rinse Timer

The rinse timer is an adjustable timer with a range of 0-10 minutes.

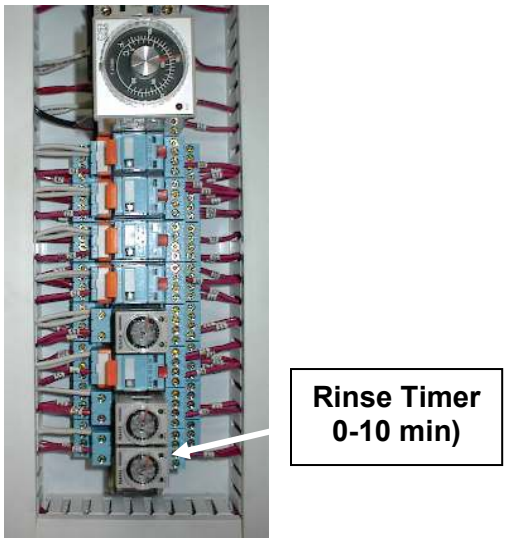


Fig. 4 - 3: Automatic Rinse Cycle (ARC) Timer Increments

If you find that your rinse is not long enough, consider operating at a higher temperature in order to evaporate more water during the wash cycle. Also, be sure that the Auto Steam Exhaust (ASE) is removing steam -- moving up to the next ASE motor size may be an answer.

3.2. Rinse Injector Pump

The chemical injector pump allows adjustment of the flow rate of chemical injected into the rinse water. It delivers liquid additive at very precise dosage rates (per minute). Generally the rinse injector system is used to deliver a rust inhibitor to provide short term corrosion prevent for freshly cleaned iron and steel parts. The regulator and gauge allow the operator to adjust the rinse spray characteristics of flow and pressure.

Rinse Chemical Injector System

You may use StingRay RI rust inhibitor or you may contact your chemical supplier for an appropriate inhibitor chemical, and for instructions on using it.

> ***NOTE**:* Monitor inhibitor-chemical usage visually. Replace buckets as needed to ensure that inhibitor chemical is applied with each rinse.

Before you operate the rinse system with injector pump, you need to make the following two adjustments.

To adjust the chemical concentration in the rinse water (chemical injector pump), *follow this procedure*:

1. Determine the number of nozzles your washer has for its rinse system Your washer will have 3, 4, or 5 rinse nozzles.

2. Determine the rinse-regulator pressure your washer currently uses in the rinse cycle.

> ***NOTE:*** StingRay sets the washer's rinse-regulator pressure to 30 PSI (206 kilopascals) at the factory. However, your washer's pressure may differ, depending on the incoming water-supply pressure.

3. Change the pressure, if you wish.

4. Determine the flow rate of the rinse system with the Rinse Flow Rate Chart (Refer to Fig. 4-4).

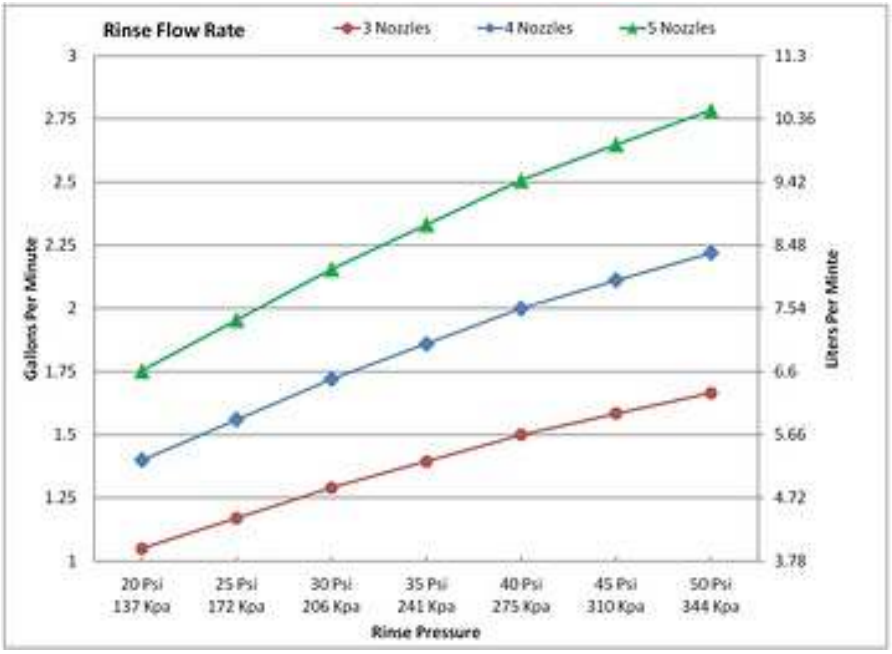


Fig. 4 – 4: Rinse Flow Rate Chart

5. Determine the chemical mix ratio, *in ounces per gallon (oz./gal.) or in milliliter per liter (ml/l)*, that you require for the rinse solution concentration.

6. The injector pump maximum flow rate is 3oz/minute (88 milliliter/minute) @ 60Hz or 2.5 oz/minute (74 milliliter/minute) @ 50Hz.

7. Calculate injector pump setting by multiplying the Rinse Flow Rate by the mix ratio, then divide by the pump's maximum flow rate.

   Example #1: Three (3) Nozzle, 60Hz washer with a rinse pressure of 40 psi needs a 1 oz/gal concentration. Chart shows a 3-nozzle washer @ 40 psi has a flow rate of 1.5 gal/min. The calculation is:

   (1.5 gal/min X 1oz/gal) / 3oz/min = .5 or 50%.

   Example #2: Four (4) Nozzle, 50Hz washer with a rinse pressure of 241 Kpa needs an 8 milliliter/liter concentration. Chart shows a 4-nozzle washer @ 241 Kpa has a flow rate of 7 liters/min. The calculation is:

   (7 liters/min X 8 Milliliter/liter) / 74 milliliter/minute = .76 or 76%

Fig. 4 – 5: Rinse Injector Pump Controls

3.3. Rinse Water-Flow Adjustment

To operate the water regulator, *follow these guidelines*:

> ***NOTE****:* The regulator is factory pre-set. Adjust it to achieve rinse characteristics that meet your requirements.

To Get This:		**Adjust the Regulator for**:
Smaller drops, more volume	➔	Higher gauge reading
Larger drops, less volume	➔	Lower gauge reading

Generally, medium settings (30-35 PSI [208 - 242 kilopascals) give the best results.

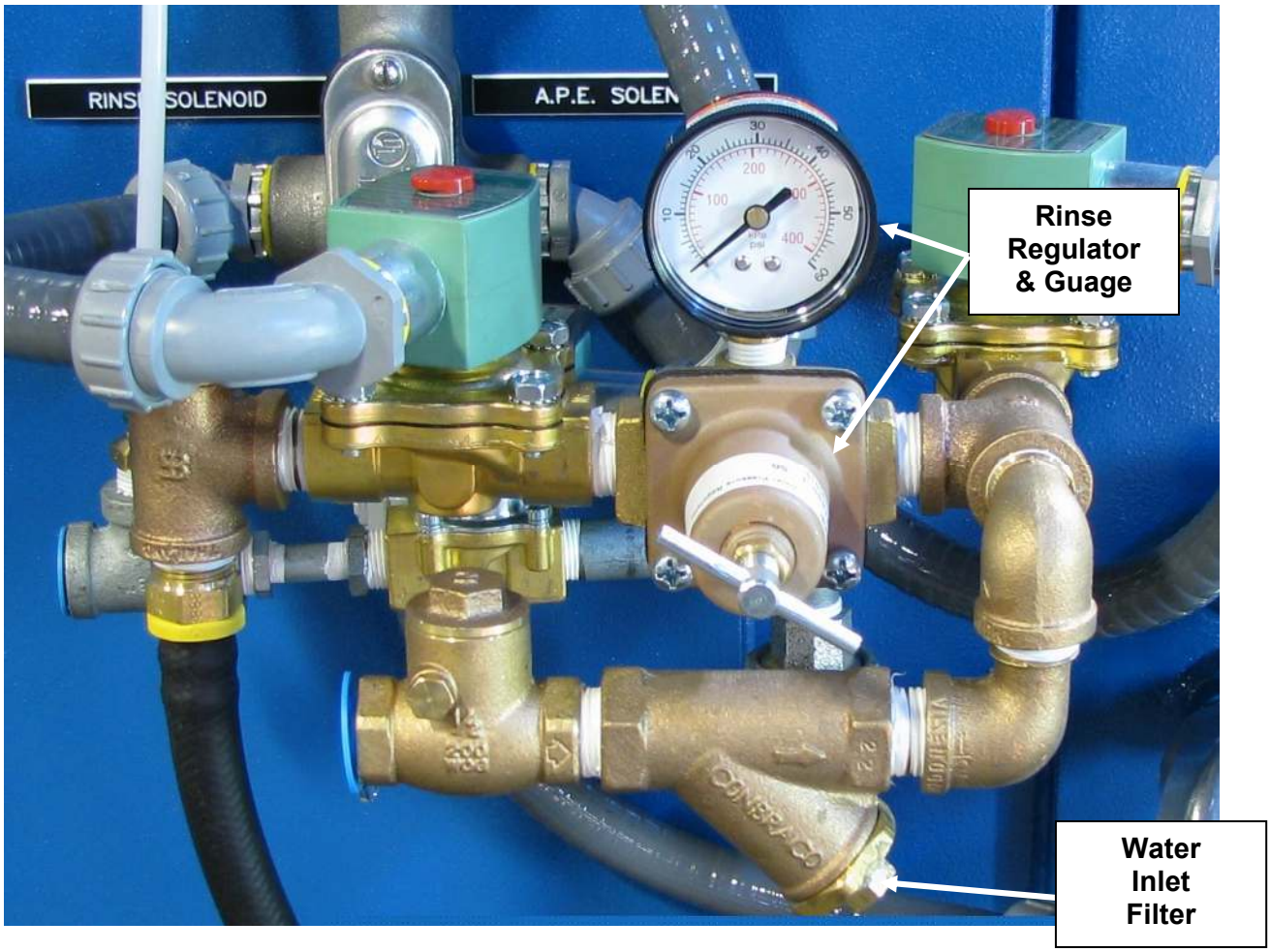


Fig. 4 - 6: Rinse Water Flow Adjustment

4. Setting the 7-Day Dual-Circuit Clock

The 7-day clock is a programmable digital dual-circuit clock that allows you to pre-set the days of the week and the time of day for the washer to:

- Heat up/water-fill
- Remain in "shut-down" (*off*) mode
- Program "run" times for optional devices

The clock is located on the face of the electrical control panel, as shown in the following figure. **Circuit #1** controls the heating and water-fill times. **Circuit #2** controls the "auto" runtime for optional devices such as the Clean Machine and the Oil Skimmer.

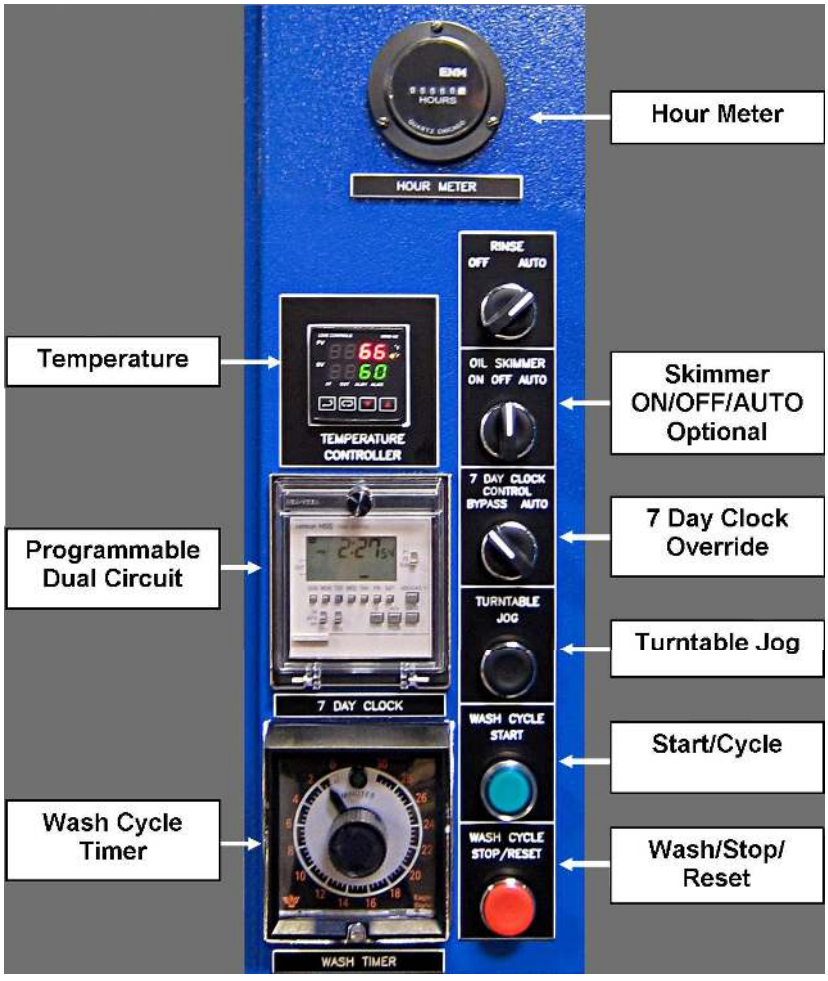


Fig. 4 - 7: Standard Turntable Power Washer Control Panel

Refer to your vendor-provided manual bound into the back of this manual for instructions on setting the clock.

CAUTION! If the main power supply is OFF for a time period that exceeds the power-outage carry-over specified in the vendor-supplied 7-day dual-circuit clock manual, be sure to reset the 7-day dual-circuit clock.

4.1. 7-Day Dual-Circuit Clock and Optional Devices

A separate manual/off/auto switch controls some optional devices, such as the Clean Machine and the Oil Skimmer and circuit #2 of the 7-day dual-circuit clock, located on the face of the electrical control panel.

In order for these devices to work in "automatic mode", *follow this procedure*:

1. Program the 7-day clock's circuit #2 for the operating runtime (day of week, start time, and stop time).

2. Set the device's *manual/off/auto* switch to *auto*.

***NOTE**: **If you omit step #1,** devices that are controlled by a *manual/off/auto* switch will *not* work when you set the switch to *auto.* (You can, however, run such devices manually by setting the switch to *manual*.)*

For more information on operating options that you have purchased from StingRay, refer to Chapter 7, *"Options".*

5. Steam-Exhaust Timer

The steam-exhaust timer controls the length of time that the automatic steam exhaust (ASE) operates after the end of the wash or rinse cycle. The timer is located inside the electrical control panel. Refer to Fig. 4-2.

How the ASE cycle actually works depends on your washer's configuration:

ARC (optional) If your washer is equipped with the optional automatic rinse cycle (ARC) the automatic steam exhaust (ASE) cycle removes steam from the washer cabinet:

- During the wash cycle
- During the optional automatic rinse cycle (ARC)
- For the ASE timer-set period of time *after* the automatic rinse cycle (ARC) cycle has completed

No ARC If your washer is *not* equipped with the optional automatic rinse cycle (ARC), the automatic steam exhaust (ASE) cycle removes steam from the washer cabinet:

- For the ASE timer-set period of time *after* the wash cycle has complete

5.1. Setting the ASE Timer

The steam exhaust timer is an adjustable 0-10 minute timer.

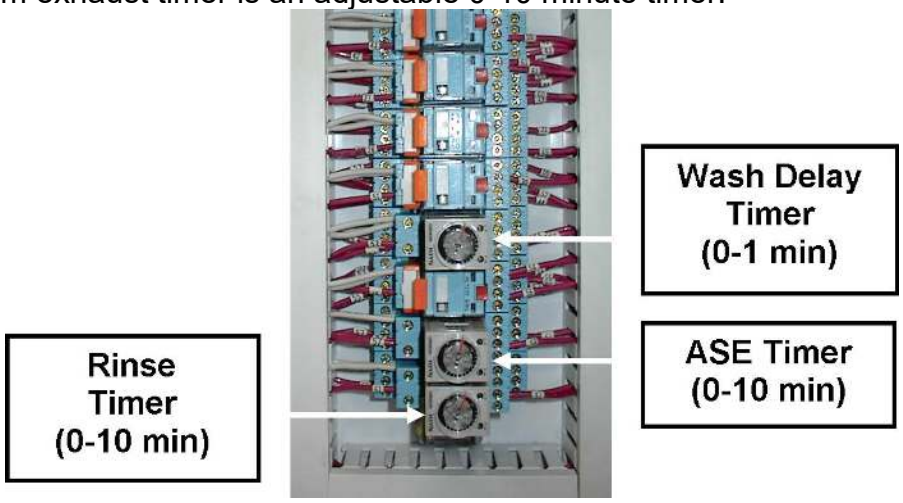


Fig. 4 - 8: Automatic Steam Exhaust (ASE) Cycle Timer Increments

Many factors affect optimal run-time for the ASE cycle. For example:

- Operating temperature of the power washer
- Atmospheric pressure
- Feet above sea level at the installation site

To test for the most effective ASE cycle, *follow this procedure*:

1. Start by setting the ASE timer to 5 minutes.
2. Run the ASE cycle.
3. Check to see if any steam remains in the cabinet after the ASE cycle has completed.
4. Increase or decrease the ASE timer by one-minute increments. (Generally, if steam remains in the cabinet, increase the timer by one minute.)
5. Repeat steps #2 - #4 until the cabinet is purged of steam.

WARNING! When you run this test, do not open the washer cabinet door until the automatic steam exhaust (ASE) cycle has completed. Steam can contain chemical used in the wash cycle. Refer to your chemical supplier's warnings about the chemical you use.

***NOTE**:* When the *start* button light goes out, the ASE cycle has finished.

6. Monitoring

You must set up a monitoring schedule for washer assemblies and parts. Start with the following:

- Lubrication
- Sludge build-up
- Intake filter
- Amp draw & nozzle wear

Use the *Service Schedule* on the front of the control-panel door as a guide in establishing a monitoring schedule.

> ***NOTE**:* It is important to keep a monitoring record -- post it on the side of the washer or on the door. Have operators initial the record each day after monitoring and indicate if any maintenance procedures need to be performed.

Refer to chapter *"Maintenance"* for maintenance procedures.

6.1. Monitoring Lubrication

Monitoring lubrication of the following *on a daily basis* is extremely important for reliable washer performance:

- Turntable bearings
- Power blast manifold (PBM) swivel (*joint and upper bearing*)
- General lubrication (bearings, motors, and pumps)

Assemblies and parts need to be greased or oiled based on the hours of operation. Refer to the *Service Schedule* on the front of the control-panel door.

> ***NOTE**:* It is important to keep a lubrication record -- post it on the side of the washer or on the door. Have operators initial the record each day after completing lubrication procedures.

6.2. Other Monitoring

In addition to monitoring lubrication, include the following on your initial monitoring schedule:

- Sludge build-up (daily)
- Pump intake filter (daily)
- Amp draw & nozzle wear (monthly)

General Guidelines:

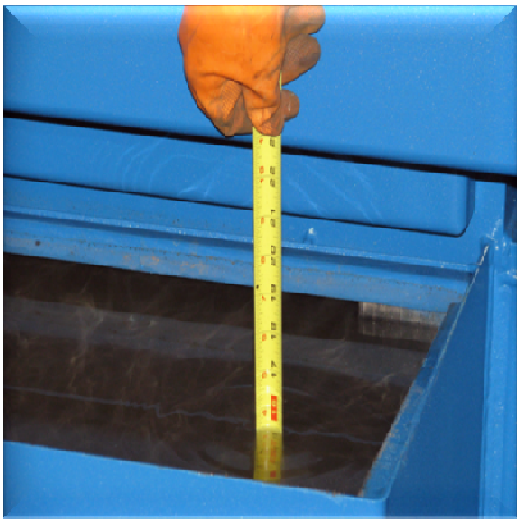
Sludge Monitor daily. Clean out *sludge* when there is about 4 inches (10.16 cm) of it on the bottom of the front reservoir.

Pump Intake Filter Monitor daily. Clean the *pump intake filter* every 8 hours of operation to remove sludge and other material plugging it.

Amp Draw/Nozzles Monitor the *amp draw at the wash pump* on a *monthly* basis to detect nozzle wear. (Nozzle wear is not always visible.)

Perform maintenance procedures based on the hours of operation. Refer to the *Service Schedule* on the front of the control-panel door.

Refer to Chapter 5, *"Maintenance"* and Chapter 6, *"Troubleshooting"* for more information.



5 Maintenance

Purpose

This chapter discusses the maintenance of your StingRay Parts Washer. In general, the washer is *not* maintenance-intensive. A few key items, however, need regular, scheduled care: Use the information in this chapter to establish and follow a service schedule.

Good maintenance is essential for cleaning results, and long economical life of the washer.

Prerequisites

Before you read this chapter, we recommend that you read the following thoroughly:

- *"Important Safety Instructions and Warnings"* (in the front material)
- Chapter 1, *"Overview"*
- Chapter 4, *"Advanced Operations: Process-Control"*

Safety/Precautions

Before you perform maintenance on the washer, read and follow these recommended safety/precaution instructions:

> ***WARNING! NEVER get inside the washer cabinet when the main power supply is ON. This could result in severe injury or death.***

> ***WARNING! Turn the main power supply OFF before opening the electrical control panel!***

WARNING! Be sure that people performing maintenance are qualified and trained for the task.

CAUTION! You must turn the main power supply OFF before performing many maintenance procedures. BE SURE to turn the main power supply back ON after you perform maintenance.

CAUTION! If the main power supply is OFF for a time period that exceeds the power-outage carry-over specified in the vendor-supplied 7-day clock manual, be sure to re-set the 7-day clock (located inside the electrical control panel).

WARNING! DO NOT OVERLOAD the internal reservoir cover (IRC) or other horizontal surfaces. The IRC is intended as a chemical-solution cover ONLY! Horizontal surfaces are NOT designed for walking or standing! Walking on the IRC, tank cover, or other horizontal surfaces could result in serious injury or death.

What You Will Learn In This Chapter

In this chapter you will learn the following about maintenance:

- Service schedule, based on hours of washer operation
- Performing Maintenance and common washer adjustments
- Sludge Monitoring and Clean-Out
    - Heat-exchanger and suction tube (cleaning)
    - Heating elements (cleaning)
- Maintenance of Options

1. Service Schedule

Your washer comes with a maintenance *Service Schedule* along with the StingRay Parts Washer Manual located in a white pouch inside of the main electrical-control-panel. The following figure shows part of the schedule, organized by hours of washer operation or length of time. Maintenance procedures for items in the schedule follow and are grouped by washer systems and assemblies. *Use the **Hour Meter** on the washer's control panel to schedule maintenance by hours of operation or length of time.*

Service Schedule

Frequency	Date	Technician
8 Hours (At the end of every shift)		
Wash Pump Intake Filter (inspect/clean	_____	_____
Turntable Bearings (grease: Lubriplate 1444) **(All machines except SR30's & SR40's with Turntable Hubs)**	_____	_____
PBM Swivel Joint (grease: Lubriplate 1444)	_____	_____
Sludge Level (monitor)	_____	_____
SHIM Fold Down Arm Swivel Joint – ***Option*** (grease: Lubriplate 1444)	_____	_____
SHIM Manifold Selector Valves & Handle – ***Option*** (operate between Short & Full positions)	_____	_____
40 Hours (Weekly)		
Chemical Concentration (test / record)	_____	_____
Auto-Lubrication – ***Option*** (inspect / refill)	_____	_____
Filtration – ***Option*** (inspect / replace)	_____	_____
Oil Skimmer Wheel & Frame – ***Option*** (inspect / clean)	_____	_____
Pure Rinse RO System – ***Option*** (inspect / flush)	_____	_____
160 Hours (Monthly)		
PBM & Rinse Nozzles (inspect / monitor)	_____	_____
Air Intake – Burner Blower Motor (clean)	_____	_____
Sludge Scraper Chain Tension – ***Option*** (inspect / tighten)	_____	_____
Sludge Scraper Wiper Blade – ***Option*** (inspect / adjust)	_____	_____
Oil Coalescer Pack, Chamber & Float Ball – ***Option*** (inspect / clean)	_____	_____

1100 Hours (6 Months)

(SR30's & SR40's) Turntable Hub Assembly (grease: Lubriplate 1444)	_____	_____
Slip Clutch / Torque Limiter (inspect)	_____	_____
PBM Swivel 2-1/2" Jam Nut (inspect / adjust)	_____	_____
PBM Manifold & Nozzles (flush)	_____	_____
Voltage at Power Distribution Block (measure)	_____	_____
Amperage Draw at Wash Pump(s) (measure)	_____	_____
Turntable Drive Bearings (grease: XHP222)	_____	_____
Upper Manifold Bearing (grease: XHP222)	_____	_____
Door Bearings (grease: XHP222)	_____	_____
Wash Pump & Pump Motor (grease: XHP222)	_____	_____
Wash Pump Couplings (inspect)	_____	_____
Oil Skimmer Wheel Bearings (grease: XHP222)	_____	_____
Solution Control – Float Ball & Rod (inspect / clean)	_____	_____
Water Solenoid Valves (inspect / clean)	_____	_____
Incoming Fresh Water Y Strainer (inspect / clean)	_____	_____
Air Intake – Steam Exhaust Blower Motor (clean)	_____	_____
Sludge Scraper Take-up Bearing – ***Option*** (grease: XHP222)	_____	_____
VFD Heat Sink – ***Option*** (inspect / clean)	_____	_____
HABO Heating Element & Air Discharge Nozzles – **Option** (inspect / clean)	_____	_____
Center Probe Teflon Bearing Plate – ***Option*** (inspect)	_____	_____
Center Probe Chain & Lift Pin – ***Option*** (oil / inspect)	_____	_____
Jib Crane Bronze Washer – ***Option*** (inspect)	_____	_____

Solution Clean-out

(1-month, 3-months or 6-months: Will vary depending on your cleaning process, type of parts, amount of soils being removed and reservoir sludge depth.)

Heating System (Electric elements, gas or steam heat exchanger) (inspect / clean)	_____	_____
Wash Pump Intake Filter (inspect / clean)	_____	_____
Sludge Dam Filter (inspect / clean)	_____	_____
Thermocouple (inspect / clean)	_____	_____
Rinse Heat Exchanger & Manifold (inspect / clean)	_____	_____
Solution Control Reservoir (inspect / clean)	_____	_____
Oil Skimmer / Surface Scraper Reservoir – ***Option*** (inspect / clean)	_____	_____
Oil Coalescer Reservoir & Float Ball – ***Option*** (inspect / clean)	_____	_____
Oil Coalescer Pump Suction Filter – ***Option*** (inspect / clean)	_____	_____

Fig. 5 - 1: Service Schedule

For more details about any of the maintenance tasks above please review this chapter (all standard features) or Chapter 7 Options (labeled with ***Option*** above) which has subsections for each individual option to help you with operation, maintenance and troubleshooting.

2. Performing Maintenance and Common Washer Adjustments

This section gives maintenance instructions and common washer adjustments for items listed in Fig. 5-1, except sludge monitoring and clean-out, which is in section 3. Items are grouped by washer systems and assemblies.

2.1. Pumps and Power Blast Manifold (PBM) Assembly

This section describes maintenance procedures for the following:

- Wash pump intake filter (inspect/clean)

- PBM swivel joint (grease; Lubriplate 1444)
- PBM nozzles (inspect/monitor)
- PBM swivel jam nut (inspect/adjust)
- Amperage draw at wash pump (measure)
- Upper manifold bearing (grease; Mobilith XHP222)
- Wash pump and pump motor (grease; Mobilith XHP222)
- Wash pump couplings (inspect)

2.1.1. Wash Pump Intake Filter (Inspect/Clean)

Follow this procedure (refer to fig. 5-2)

> ***CAUTION! Do not remove the pump intake filter box from the reservoir.***

1. Remove the front reservoir cover.

2. Clean the pump intake filter box with a stiff-bristle wire brush. (The filter box is located at the bottom-front-left corner of the reservoir.)

3. Run the brush across the top, back, and right hand-side of the filter box to remove sludge and gasket material.

4. Replace the reservoir cover.

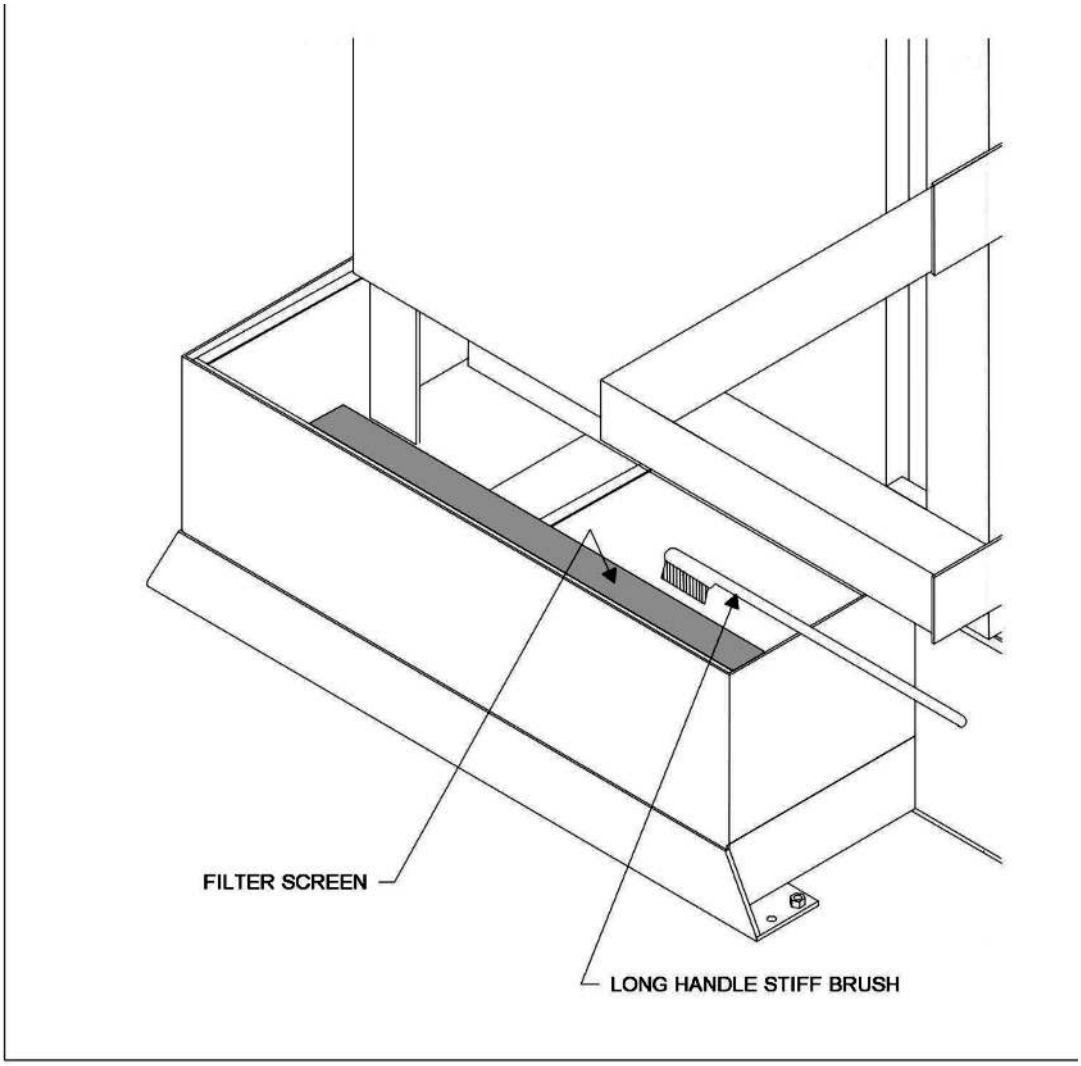


Fig. 5 - 2: Cleaning the Pump Intake Filter Box

2.1.2. PBM Swivel Joint (Grease)

Grease the PBM Swivel Joint with Lubriplate 1444. Refer to the following figure.

> ***NOTE**:* It is ***imperative*** that the PBM swivel be greased every 8 hours of operation!

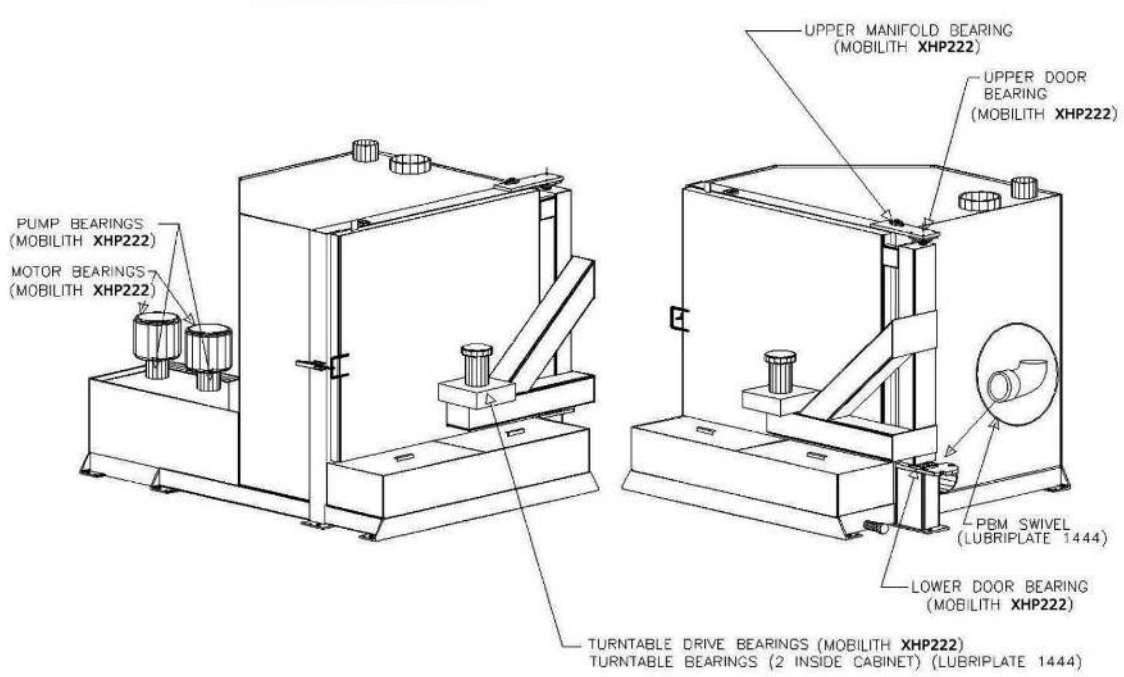


Fig. 5 - 3: Lubrication Chart (Note: Mobilith AW-2 has been replaced by XHP222)

2.1.3. PBM Nozzles (Inspect/Monitor)

Inspect the PBM wash-and-rinse nozzles for clogging and alignment. The flat-spray nozzles are aligned with "punch" marks on the manifold to ensure an overall uniform coverage which gives you the best cleaning results. When you check for clogging, be sure to check that all nozzles are correctly aligned, as indicated in the following figure.

Monitor the amperage draw at the main wash pump(s) to check for worn nozzles: A higher amperage draw than normal (check your baseline readings) indicates that nozzles may need to be replaced. Remember that a worn nozzle is not always visually apparent -- nozzle tips can look fine, but actually be quite worn. Since a worn tip can spray at up to 30% over capacity, amperage draw will be higher.

If nozzles need to be cleaned or replaced, *follow this procedure*:

> ***WARNING! Do not stand or walk on the floor inside the cabinet or on the reservoir cover.***

1. Turn the *main power supply OFF*.

2. Remove the nozzle with a 9/16-inch (14 mm) wrench.

3. Remove any debris.

4. Apply 6 –7 turns of Teflon tape to the threads.

5. Re-install the old nozzle, or install a new one. Thread nozzle finger tight and snug up with wrench 1 to 1-1/2 turns. Observe alignment "punch" marks on the PBM and align the "V" slot in the nozzle with the marks. Do not over tighten. Refer to the following figure.

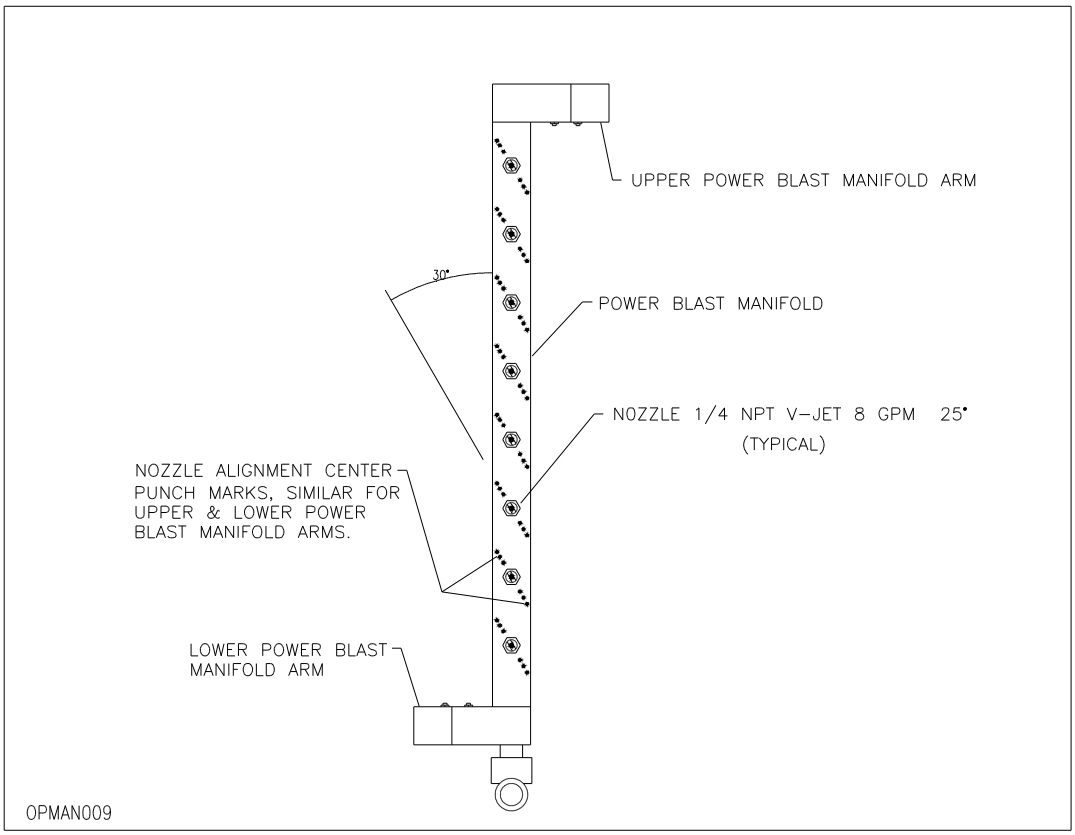


Fig. 5 - 4: Cleaning and Replacing the PBM Nozzles

2.1.4. PBM Swivel (Inspect/Adjust)

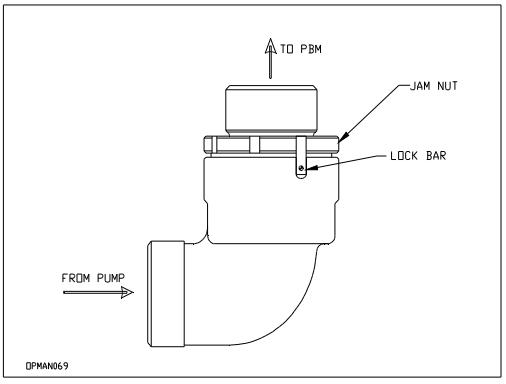
Inspect the PBM swivel to be sure it is rotating freely.

Follow this procedure:

1. Turn the *main power supply OFF*.
2. Disconnect the *PBM linkage* from the *PBM upper bearing/shaft*.
3. Open the washer cabinet *door.*
4. Push the *manifold* back and forth. *If* it does not move freely *and if* you have been greasing the manifold regularly, you need to adjust the jam nut. The jam nut is located on the swivel at the bottom of the PBM manifold. The swivel assembly allows for take-up of the packing after it wears.
5. Swivels with *Jam Nuts* only: Adjust the *PBM swivel jam nut* so that it swings freely, but is as tight as possible in order to prevent leaking around the joint.

   Follow this procedure:

   - Remove the lock bar.
   - Screw the nut clockwise to the next locking slot (until compression on the packing causes the nipple to rotate with a mild amount of torque).
   - Re-install the lock bar.
   - You may repeat this process until the packing has worn too badly to keep a tight seal.



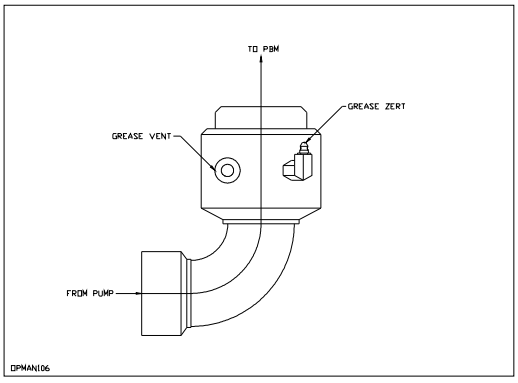


Fig. 5 - 5: Swivel Jam Nut **Non-adjustable swivel**

2.1.5. Amperage Draw at Wash Pump(s) (Measure)

Measure and record the amp draw from the wash pump motor(s) using a clamp-on amp meter.

> ***CAUTION! Be sure that ONLY a qualified electrician performs this maintenance task!***

> ***NOTE**:* Take the amperage measurement at the load side of the wash pump starter(s) on each power leg. If the washer is equipped with a duplex pump system, take amp readings separately on each wash pump motor with both pumps running.

Compare amperage readings with the maximum amp load, which is calculated as follows:

On each pump motor, find the manufacturer's specification tag. The tag indicates two things: **(1)** Full-load amperage draw at your specified voltage; *and* **(2)** The service factor, which is either 1.15 or 1.25 times the full-load amperage, depending on motor size and incoming voltage.

Multiply the full-load draw (as indicated on the motor tag) by the service factor in order to calculate the maximum allowable amp load.

The actual amperage draw reading on each motor is to fall below the maximum calculated allowable amp load.

If the actual amperage draw reading exceeds the maximum calculated allowable amp load, this could indicate that nozzles are worn and need to be replaced or that there are some other leaks in the system. Refer to section *"PBM Nozzles"* above and to chapter *"Troubleshooting/Wash Pump System".*

2.1.6. Upper Manifold Bearing (Grease)

Grease the PBM upper manifold bearing with Mobilith XHP222.
Refer to Fig. 5-3.

2.1.7. Wash Pump and Pump Motor (Grease)

***NOTE**:* 10 HP wash pumps and motors are a one-piece unit with only two bearings requiring lubrication at each end of the motor.

***NOTE**:* Use Mobilith XHP222 to grease the pump and the pump motor.

CAUTION! Over-greasing creates heat. Do NOT over-grease the pump or pump motor.

CAUTION! Too much lubricant is a major cause of premature motor failure. If you apply too much grease, it is eventually forced out of the bearing housing and begins dripping on the motor windings. The grease then attacks and destroys the insulation, resulting in early motor failure.

CAUTION! Use ONLY a manually operated grease gun. Do NOT use a power grease gun.

To grease the pump, *follow this procedure*: (refer to the following figure)

1. Turn the *main power supply OFF*.
2. Remove the *plugs* opposite the *grease fittings* on both ends of the bearing frame.
3. Clean the *grease fittings*.
4. Use a *manually operated grease gun* on the fittings.
5. Add approximately *1 ounce (2.9 ml) of fresh grease* for each *bearing* (which is about *2-3 hand-pumps of grease* for each *bearing until fresh grease comes out of plug.*).
6. Replace the *fittings* and *plugs*.

7. Turn the *main power supply ON*.

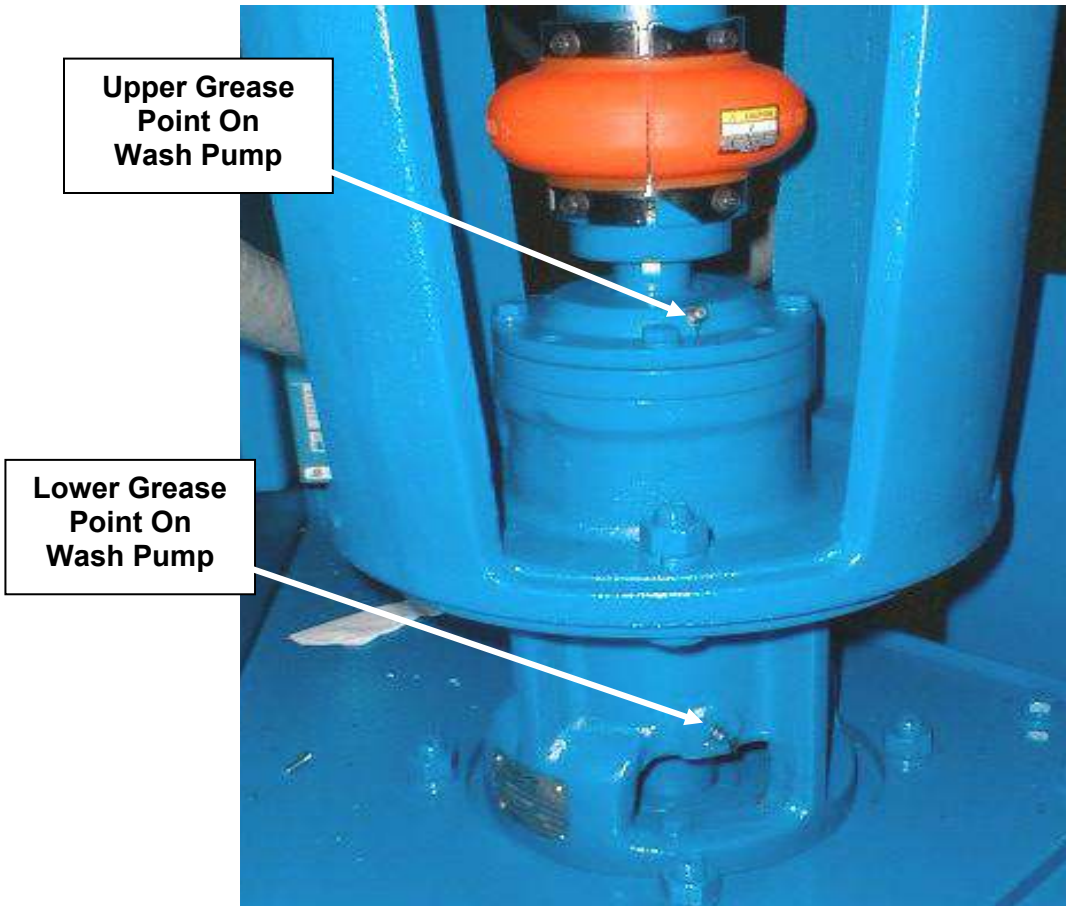


Fig. 5 - 6: Wash Pump and Pump Motor(s)

To grease the pump motor(s), *follow this procedure*: (refer to the previous figure)

1. Turn the *main power supply OFF*.
2. Clean the *grease fittings.*
3. Grease the wash pump motor point.
4. Use a *manually operated grease gun*.
5. Add approximately *1 ounce (2.9 ml) of fresh grease* (which is about *8-10 hand-pumps of grease*).
6. Turn the *main power supply ON*.

2.1.8. Wash Pump Couplings (Inspect)

Inspect the wash pump(s) couplings for the following:

- Wear
- Separation
- Misalignment

Refer to Fig. 5-6 as you inspect couplings for the following:

Wear If couplings are worn, replace them.

Separation If couplings are separated, loosen them and re-adjust their position.

Misalignment If couplings are misaligned, they are also probably worn or separated. Loosen the couplings and re-adjust their position. Also, check the bolts for tightness.

2.2. Heating System

This section describes maintenance procedures for the following:

- Air intake - burner blower motor (clean)
- Burner blower motor (oil)

2.2.1. Air Intake - Burner Blower Motor (Clean)

Clean the air intake on the burner blower motor (natural gas, L.P. gas, or fuel-oil fired burners only) with a compressed-air blower or a soft brush, in order to remove dust and dirt. Refer to the following figure.

2.2.2. Burner Blower Motor (Oil)

Oil the burner blower motor with a standard electric-motor oil, suitable for small electric motors. For example, 10W-50 SAE oil. Refer to the following figure.

Fig. 5 - 7: Burner Blower Motor (180,000 BTU Burner Shown)

2.3. Water-Level Control System

This section describes maintenance procedures for the following:

- Float assembly (inspect/clean)
- Water solenoid valves (clean or replace)

2.3.1. Float Assembly (Inspect/Clean)

Inspect/Clean

Inspect the float assembly periodically. The single-ball float system normally requires little or no cleaning -- however, under some operating conditions, you may have to clean the operating rod and float ball.

Refer to the following figure to locate these parts:

- Check the *cam set screws* for tightness.
- Check the *float ball to rod connection* for tightness.
- Clean the *float ball*, if necessary.

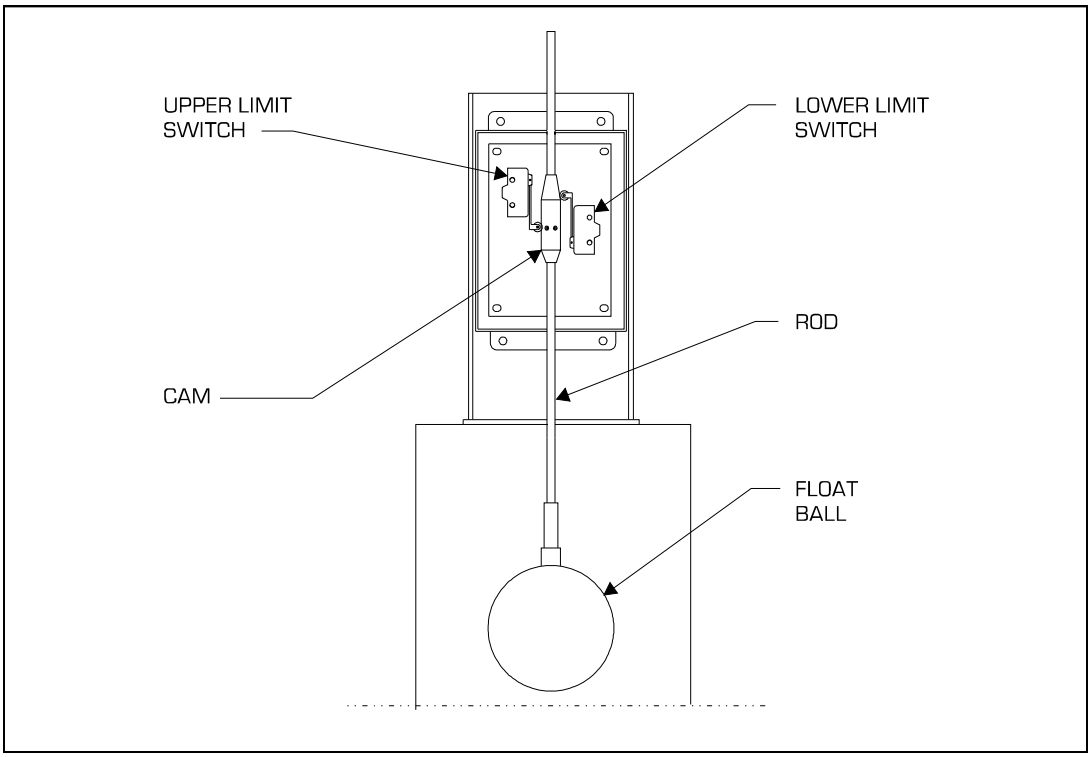


Fig. 5 - 8: Float Assembly

<u>Making Adjustments</u> (see chapter "Installation/Power-Up Procedure/Water-Level Control" for more information)

If the water level is more than 1/8" above or below the water-level indicator, *<u>follow this procedure</u>*:

1. Remove solution until the solution level is below the set-point.

2. Let the washer fill automatically and shut off.

3. *If the water level is more than 1/8" inch above or below the water-level indicator,* you will need to adjust the cam on the float rod. Follow the steps below.
   - Turn the power *OFF.*
   - Remove the float-control box cover.

4. Mark the current location of the cam on the float rod with a marker or a piece of tape before making any adjustments.

   If the water-level measurement you made is higher than the indicator, you will need to move the cam **up** the float rod by the difference between the indicator and the measured value

If the measurement is lower than the indicator, you will need to move the cam **down** the float rod by the difference between the indicator and the measured value.

Measure the distance to the new position and mark it on the float rod.

Next, loosen the two set-screws on the cam with an Allen wrench.

Finally, slide the cam to the new location and re-tighten **both** set-screws.

5. Turn power on to the washer and test the new level by allowing the washer to fill to the old set-point.

   NOTE: It will be necessary to remove water from the washer if the new level is lower than the new set-point.

   Verify that the set-point level is correct. If necessary, repeat the above steps until the set-point level is at the indicator, plus or minus 1/8" inch.

6. Replace the cover on the float box and tighten the four screws.

NOTE: If your washer has a rinse system, once operations have started water levels in the washer can be higher than the set-point water level. This happens whenever the washer automatically uses the rinse-bank for longer rinses.

To verify the correct set-point water level after operations have started, you must allow the washer to fill to the set-point. You can check this by observing the position of the float cam relative to the limit switches in the float box. (Refer to Fig. 1-3: Float-Level Mechanics) If the cam is higher than the set-point, you will have to remove solution from the washer and allow the washer to fill to the set-point to check set-point water level.

REMEMBER!! ***NEVER CHANGE*** **THE POSITION OF THE LIMIT SWITCHES** -- they are pre-set. For more information on the limit switches, refer to chapter *"Overview."*

2.3.2. Water Solenoid Valves (Clean or Replace)

Disassemble the water solenoid valves and clean or replace the diaphragms with re-build kits.

Refer to your vendor-supplied cut sheet for instructions.

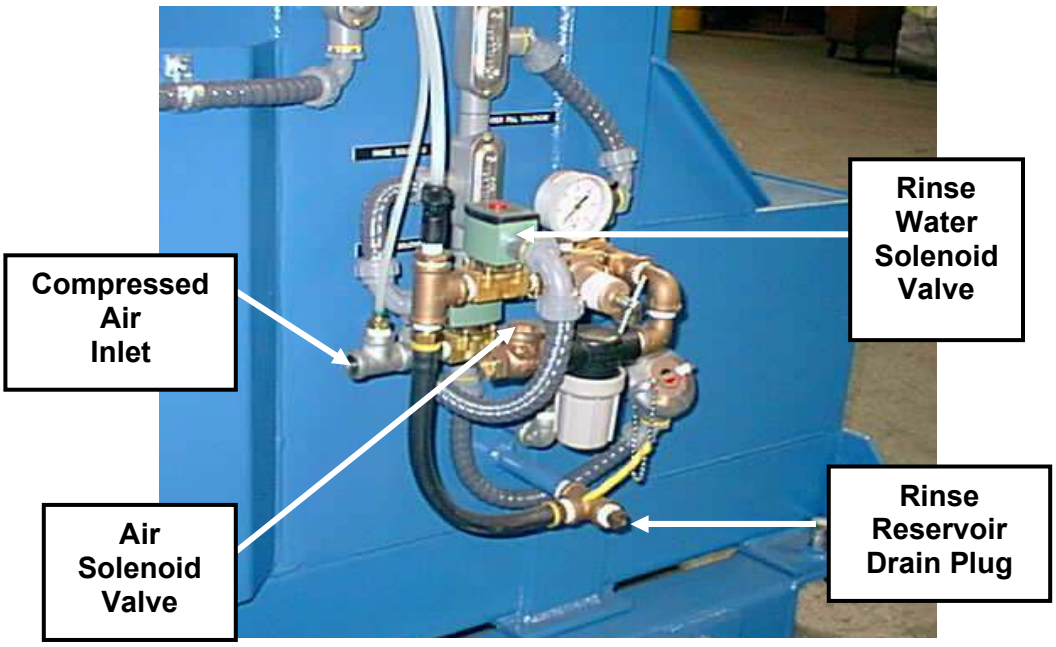


Fig. 5 - 9: Solenoid Valves

2.4. Turntable and Drive Assembly

This section describes maintenance procedures for the following:

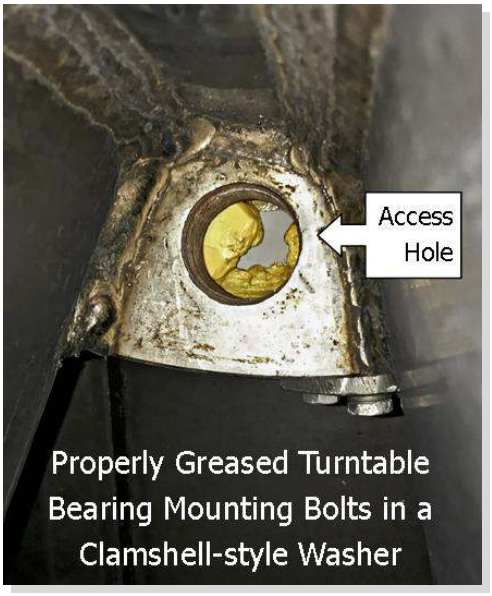
- Turntable bearings (grease; Lubriplate 1444)
- Turntable drive bearings (grease; Mobilith XHP222)
- Slip clutch/torque limiter (inspect)
- Door bearings (grease; Mobilith XHP222)

2.4.1. Turntable Bearings (Grease)

Grease the upper and lower turntable bearings with Lubriplate 1444. Refer to Fig. 5-3.

> ***NOTE:*** It is ***imperative*** that the turntable bearings be greased every 8 hours of operation! (except for StingRay washers with 30” and 40” diameter turntables)

Pump in enough grease at each lubrication interval to completely fill the bearing. The quantity required will depend on the bearing size and other wash parameters which you set. As a rule of thumb when using a hand grease gun, pump until the grease gun feels "stiff" and then add an additional 2 or 3 pumps/squirts or until grease is visible at the seals.



Properly Greased Turntable Bearing Mounting Bolts in a Clamshell-style Washer

StingRay Washers with 30" and 40" diameter Turntables: Turntable roller bearings only.

StingRay's 30" and 40" diameter turntables have extended life bearings that require lubrication every 1100 hours of operation.
To lubricate the turntable roller bearings proceed as follows:

1. Remove the turntable.
2. Remove the rubber seal from the top of the turntable spindle head.
3. Locate zerk fitting and re-lubricate bearing with Lubriplate 1444 until grease is visible around upper bearing nut.
4. Replace seal and re-install turntable.

2.4.2. Turntable Drive Bearings (Grease)

Grease the turntable drive bearings with Mobilith XHP222. Refer to Fig. 5-3.

2.4.3. Slip Clutch/Torque Limiter (Inspect)

The slip clutch is factory pre-set to 45 foot-pounds (6.2 kg-m), which is 5 foot-pounds (.7 kg-m) below the allowable motor torque. Slight slippage during washing is common and normal.

Inspect the slip clutch/torque limiter during operation of the washer. Under normal operation you may see some slippage -- the sprocket jack shaft starts and stops while the motor shaft turns constantly. However, if the clutch slips constantly and nothing is jamming the turntable, you need to adjust the clutch.

You will need to remove the motor-drive assembly to adjust the clutch. Clamp the assembly on its side in a vise or clamp it to a secure work surface so that the sprocket can be rotated.

Follow this procedure: (refer to the following figure)

1. Devise a means of restraining the sprocket. (*For example:* Weld a nut to the bottom sprocket support plate. Use a nut that is appropriate for your torque wrench.)
2. Use a torque wrench with 80 foot-pound (10.9 kg-m) capability.
3. Loosen the set screws on the large hexagon torque-adjusting nut.
4. Restrain the torque-limiter threaded shaft at the motor. Use the torque wrench to turn the sprocket until the clutch slips.
5. Tighten or loosen the large hexagon torque-adjusting nut to adjust the clutch setting.
6. Set the max torque to 75 foot-pounds (10.2 kg-m) to slip the clutch.
7. Tighten the set screws on the large hexagon torque-adjusting nut.

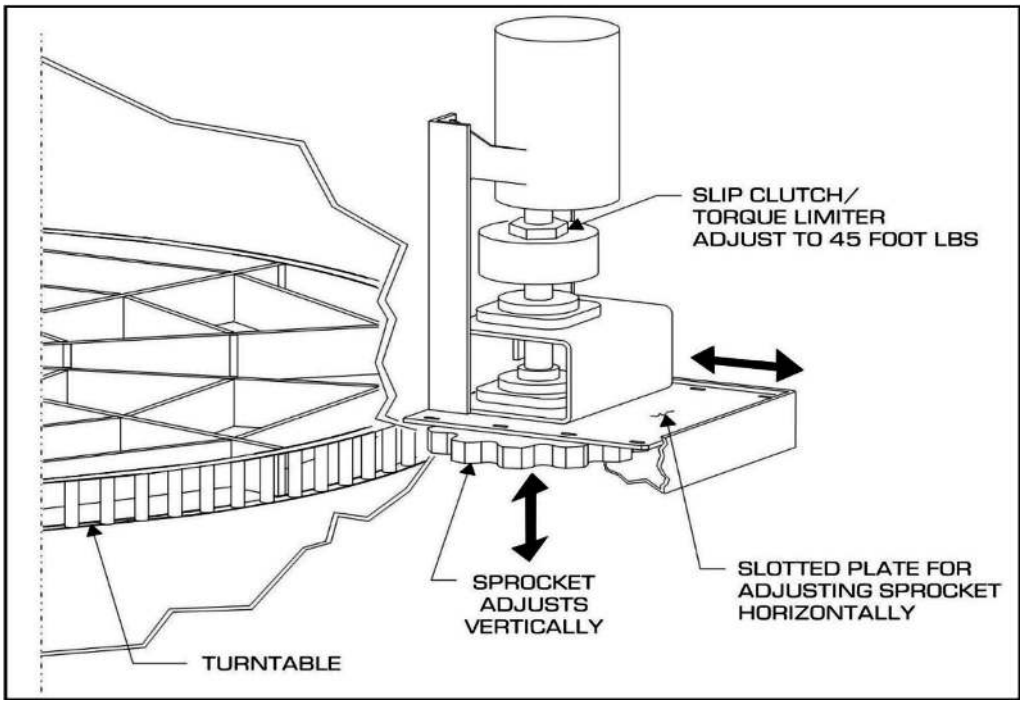


Fig. 5 - 10: Turntable Drive and Turntable: Slip Clutch/Torque Limiter

2.4.4. Door Bearings (Grease)

Grease the upper and lower door hinge bearings with Mobilith XHP222. Refer to Fig. 5-3.

2.5. Auto Steam Exhaust (ASE) Assembly

ASE Blower Motors are lubricated for life. No additional lubrication is required.

2.6. Chemical Concentration

There are two methods to test chemical concentration and maintain the proper chemical charge:

- Titration Test
- Conductivity Test

1. Titration Test

Titration is the estimation of the strength of a compound by measuring the amount of another compound of known strength that is required to produce an observable reaction.

Almost all titration kits supplied with cleaning compounds use phenolphthalein (indicator P) as a reactant and an acid (hydrochloric or phosphoric) as a neutralizer. The indicator P turns red or pink or blue when added to a sample of the solution. By counting the drops of acid it takes to turn the solution back to its original color, you can arrive at a good *estimate* of the chemical concentration.

Titration Testing Guidelines:

- Perform a titration test weekly.
- Contact your chemical supplier for test kits.
- Use a kit designed specifically for your chemical.
- Follow test kit instructions.
- Add chemical based on the results of the test.

Visit www.marttechservices/chemical for additional titration instructions.

When you perform a titration test, do the following:

1. Allow the sample solution to cool to room temperature.
2. Filter the cooled solution to remove impurities.

3. Hold the titration reagents vertical when you add drops to the sample. This ensures "size accuracy" of the drops coming out of the reagent bottles.
4. Use clean libratory flasks, vials, and bottles for all titrations. Dirty tools can produce invalid test results.
5. After testing the sample, pour it back into the washer.

For improved testing accuracy:

1. Prepare a "control" sample using fresh city water and chemical to the desired concentration.
2. Titrate this "control" sample.
3. Compare titrations of the wash solution to the results of the "control" in order to determine if you need to add chemical.

2. Conductivity Test (optional)

If your washer is equipped with optional conductivity-test instruments, refer to chapter *"Options",* section *"Chemical Concentration Controller",* for information on performing a conductivity test.

2.7. Voltage

This section describes maintenance procedures for the following:

- Voltage at power distribution block (measure)

2.7.1. Voltage at Power Distribution Block (Measure)

Measure and record the incoming voltage to the washer *with wash pump(s) running.*

CAUTION! Be sure that ONLY a qualified electrician performs this maintenance task!

NOTE: Take the measurements inside the electrical control panel, at the power distribution block. If the voltage drop is more than 10% below the voltage required for operation of the washer, call StingRay.

3. Sludge Monitoring and Clean-Out

This section describes maintenance procedures for the following:

- Sludge (monitor and clean out)
- Heat exchanger and suction tube (clean)
- Heating element(s) (clean - electric only)

Generally, when you clean out sludge, clean the heat exchanger and suction tube as well as the heating elements (if you have electric heat), since all require that the washer be emptied.

> ***NOTE**:* Maintenance of heating elements may need to be done more often than sludge clean-out or cleaning of the heat exchanger and suction tube.

> ***WARNING! Do <u>not</u> stand or walk on the floor inside the cabinet, or on the reservoir cover.***

3.1. Sludge Monitoring

To monitor and measure sludge accumulation on the bottom of the reservoir, *follow this procedure*:

1. Remove the front-reservoir cover.
2. In the front-right corner of the reservoir, push a long stick vertically down to the reservoir floor.
3. Remove the stick.
4. Observe the sludge mark on the stick.
5. If 4 inches (10 cm) of sludge is indicated, clean out the washer.

3.2. Sludge Clean-Out and Heat Exchanger/ Suction Tube (Clean)

Clean the heat exchanger and suction tube when you clean out sludge, since both maintenance procedures require that the washer be emptied. If your washer uses electric heat, clean the heating elements as well (see the following section for instructions).

Follow this procedure:

1. Turn the *main power supply OFF*.
2. Allow the *solution to cool* to room temperature.
3. Remove the front *reservoir cover*.
4. Use oil-absorbent pads or newspaper to *soak up floating oil and scum*.
5. Discard the pads by an *approved waste-disposal method*.
6. Pump the ***solution*** *into holding barrels*.

CAUTION! Do NOT pump out the SLUDGE!

7. Move the door position lock to allow the washer cabinet *door* to open to a 180° angle from the cabinet frame.

8. Remove the internal reservoir cover.

9. Remove *sludge* from the bottom of the reservoir.

10. Dispose of the *sludge* by an approved waste-disposal method.

11. Clean under the *heat exchanger* with a stiff brush.

12. Flush out the *suction tube*.

13. Replace the *internal reservoir cover.*

14. Position the door at a 90° angle from the cabinet frame.

15. Pump *solution* from the *holding barrels* back into the *reservoir*.

16. Replace the *front reservoir cover*.

17. Turn the *main power supply ON*.

> ***NOTE****:* The power washer controls will automatically fill the reservoir with the correct amount of water.

18. Perform a *chemical-titration test*, and add chemical as indicated by the test results.

19. Allow solution to heat up to operating temperature before running a wash cycle.

3.3. Heating Elements (Clean - Electric Only)

This procedure applies to electrically heated power washers *only*.

> ***NOTE****:* Maintenance of heating elements may need to be done more often than sludge clean-out or cleaning of the heat exchanger and suction tube.

Follow this procedure:

> ***WARNING! Turn the main power supply OFF and allow solution to cool to room temperature before cleaning heating elements.***

1. Remove the front *reservoir cover*.
2. Pump the ***solution*** *into holding barrels*.

> ***NOTE****:* Empty solution to a level just below the heating elements.

3. Position the door at a 180° angle from the cabinet frame.
4. Remove the *internal reservoir cover.*
5. Wire-brush or pressure wash the *heating element(s)*. Refer to the following figure.
6. After cleaning the heating element(s), pump solution back into the reservoir.
7. Re-install the reservoir cover.
8. Turn the *main power supply ON*.
9. Allow solution to heat up to operating temperature before running a wash cycle.

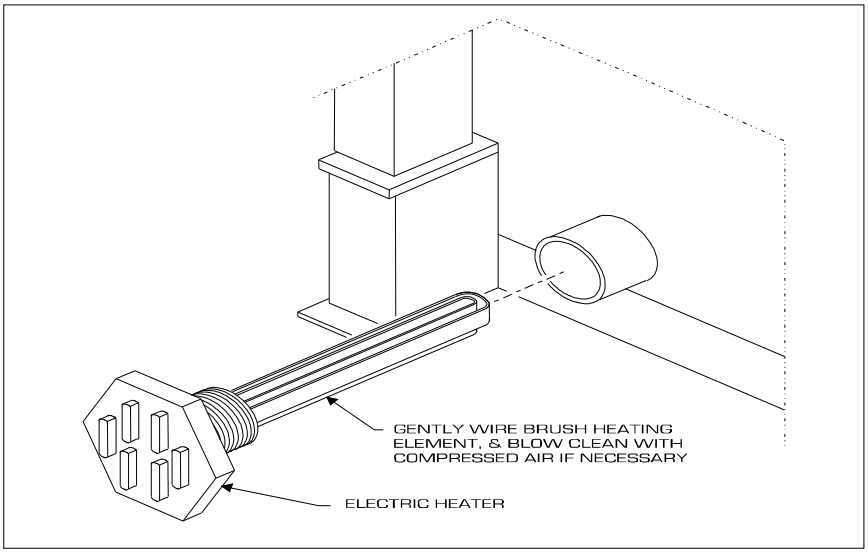
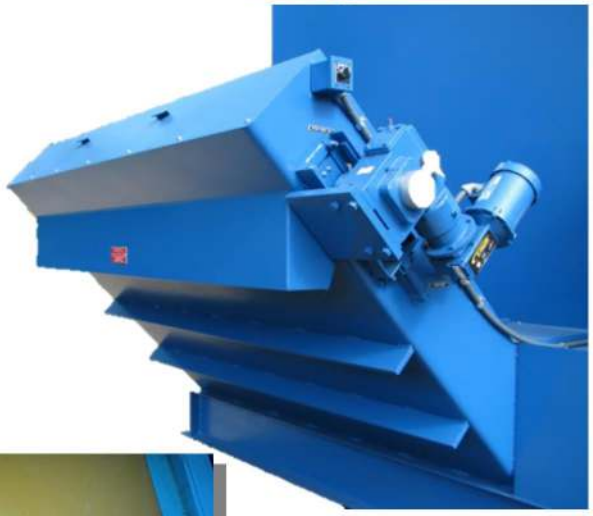
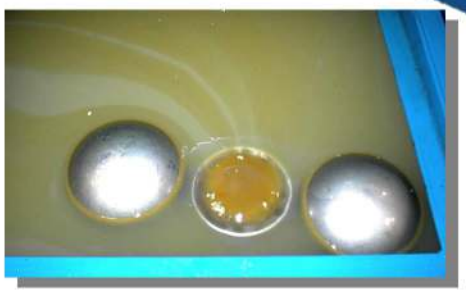


Fig. 5 - 11: Cleaning the Heating Elements

4. Maintenance of Options

For instructions on performing maintenance of options you have purchased from StingRay, refer to chapter *"Options".*





6 Troubleshooting

Purpose

This chapter contains information about troubleshooting the power washer. Key components are listed, along with symptoms of problems and their causes. In the unlikely event that your washer malfunctions, use this chapter to help diagnose and correct the problem.

In many cases, you can use procedures in Chapter 2, *"Installation",* Chapter 4, *"Advanced Operations: Process-Control" ,*or Chapter 5, *"Maintenance"* to correct a problem after you have diagnosed it.

In other instances, refer to your vendor-supplied manuals or cut sheets for instructions on correcting problems.

Prerequisites

Before you read this chapter, we recommend that you read the following thoroughly:

- *"Important Safety Instructions and Warnings"* in the front of this manual
- Chapter 1, *"Overview"*
- Chapter 4, *"Advanced Operations: Process-Control"*
- Chapter 5, *"Maintenance"*

Safety/Precautions

Before you take any corrective action or attempt to repair the power washer, read and follow these recommended safety/precaution instructions:

WARNING! <u>NEVER</u> get inside the washer cabinet when the main power supply is ON. This could result in severe injury or death.

WARNING! Be sure that people who perform repairs are qualified and trained for the task.

What You Will Learn In This Chapter

In this chapter you will learn about troubleshooting the following:

- Startup
- Ineffective Cleaning
- Wash Pump System
- Heating System
- Turntable Drive
- Nozzles
- Foaming
- Power Blast Manifold (PBM)
- Solution-Level Control System
- Door Limit Switch
- Rinse System
- Automatic Steam Exhaust (ASE)
- Electrical Control System

1. Startup

Use procedures in chapters *"Installation", "Advanced Operations: Process-Control",* or *"Maintenance"* to correct a problem after you have diagnosed it.

Or, refer to your vendor-supplied manuals or cut sheets for instructions on correcting problems.

Problem:	***Washer will not start***
Check This:	**Probable Cause(s)**
APE pressure switch (obsolete as of Sept, 2016)	Misadjusted/Failed Insufficient compressed-air supply Air Pressure too low
Clock override	Set to *OFF* (must be *ON or set to By-Pass*)
7-day clock	Not programmed; program 1 must be *ON*
Compressed-air supply	Shut-off Disconnected Air Pressure too low Quick disconnect air fittings restricting flow
Door	Not closed Door limit switch is interlocked with start circuit. To reset start circuit, washer door must be opened and closed so start circuit detects door limit switch contacts transfer indicating proper operation.
Door limit switch	Trip-tab is not closing the switch (adjust)
Power	No power to machine, disconnect off, main fuses or circuit breaker tripped.
Water Level	Water is shut off, water level too low

Fig. 6 - 1: Troubleshooting: Startup

2. Ineffective Cleaning

Use procedures in chapters *"Installation", "Advanced Operations: Process-Control",* or *"Maintenance"* to correct a problem after you have diagnosed it.

Or, refer to your vendor-supplied manuals or cut sheets for instructions on correcting problems. Use procedures in chapters *"Installation", "Advanced Operations: Process-Control",* or *"Maintenance"* to correct a problem after you have diagnosed it.

Or, refer to your vendor-supplied manuals or cut sheets for instructions on correcting problems.

Problem:	***Ineffective cleaning of parts***
Check This:	**Probable Cause(s)**
PBM	Linkage not connected or broken Not rotating, swivel locked-up, motor burned-out Manifold crank arm slipping on Shaft (Tighten) (Note: for older washers an updated crank arm is available to prevent slippage
Turntable sprocket drive	Turntable not rotating Shafts not spinning (watch during wash cycle, or "jog")
Nozzles	Clogged or worn, not aligned properly
Pumps	Not operating (see *"Wash Pump System"* below) Unusual sounds (cavitation, see Fig. 6-8 Low amperage
Temperature	Incorrect for chemical being used – too low (raise)
Chemical concentration	Incorrect (run a titration test) Too low (increase concentration)
Parts Position	Poor positioning of parts (re-position – align dirtiest parts toward vertical manifold blast)
Time	Wash cycle too short (increase)

Fig. 6 - 2: Troubleshooting: Ineffective Cleaning of Parts

3. Wash Pump System

Use procedures in chapters *"Installation", "Advanced Operations: Process-Control",* or *"Maintenance"* to correct a problem after you have diagnosed it.

Or, refer to your vendor-supplied manuals or cut sheets for instructions on correcting problems.

This section contains tables on the following problems:

- Wash pump motor won't start
- Wash pump surges
- Wash pump fails to deliver solution
- Wash pump motor trips overload -- high amperage reading
- Seal leakage at wash pump mounting plate
- Wash pump or motor vibrates or is noisy

Problem:	***Wash pump motor won't start***
Check This:	**Probable Cause(s)**
Power	Not *ON*
Motor Starter	Overload tripped (reset it)
Voltage	Too low
Fuses	Blown (remove and measure continuity)
Wires	Not tight enough
Wash timer	Not set to a value above “0”
Door limit switch	Not activating (door not closed)

Fig. 6 - 3: Troubleshooting: Wash Pump Motor Won't Start

Problem:	***Wash pump surges***
Check This:	**Probable Cause(s)**
Reservoir	Low solution level (check float assembly & solenoid)
Filter	Screen clogged

Fig. 6 - 4: Troubleshooting: Wash Pump Surges

Problem:	***Wash pump fails to deliver solution***
Check This:	**Probable Cause(s)**
Pump impeller	Partially clogged or loose
Pump suction	Partially clogged (clean suction filter)
Motor	Incorrect [counterclockwise] rotation
Motor Coupling	Broken coupling or spider damaged (replace)
Reservoir	Low solution level (check float assembly & solenoid)
Nozzles	Clogged
Manifold	Piping Disconnected or broken

Fig. 6 - 5: Troubleshooting: Wash Pump Fails to Deliver Solution

Problem:	***Wash pump motor trips overload -- high amperage reading***
Check This:	**Probable Cause(s)**
Pump or motor	Mechanical defects (rotate pump shaft by hand to verify if one of the following is causing the problem): Bent shaft Loose impeller Pump casing unbolted Throttle bushing failure
Solution	Too viscous (drain and replace) Chemical concentration too high Chemical has a high specific gravity Chemical reaction with contaminates (jelling)
Nozzles	Missing or excessively worn (replace) Incorrect number of nozzles.
Manifold Piping	Leaking (clean-out plugs are missing or loose) Leaking high-pressure piping passing excess water. Loose pipefittings Union not tight Swivel leaking at packing gland. (tighten)
Voltage	Low Voltage or service capacity (amp capacity)

Fig. 6 - 6: Troubleshooting: Wash Pump Motor Trips Overload -- High Amperage Reading

Problem:	***Seal leakage at wash pump mounting plate***
Check This:	**Probable Cause(s)**
Pump	Mechanical defects: Throttle bushing failure Seal failed
Shaft	Shaft-slinger failure

Fig. 6 - 7: Troubleshooting: Seal Leakage at Wash Pump Mounting Plate

Problem:	***Wash pump or motor vibrates or is noisy***
Check This:	**Probable Cause(s)**
Pump or motor	Bearings: Need lubrication Need to be replaced Damaged
Pump	Throttle bushing failure, impeller failure Impeller unbalanced due to foreign object –bolt or rock or other object jammed in impeller
Pump Shaft	Shaft bent or broken
Pump & motor	Coupling: Loose/dropped Wearing out Spider damaged – worn out
Pump	Impeller: Loose Damaged Bearings –failed Pump is running backwards- verify CW looking down
Pump	Clogged -- restricts impeller
Pipes	Pipe strains - discharge piping, improperly connected
Thrust bearing	Snap ring has worn a groove in the bearing frame & is spinning
Temperature too high	Pump cavitation

Fig. 6 - 8: Troubleshooting: Wash Pump or Motor Vibrates or Is Noisy

4. Heating System

Use procedures in chapters *"Installation", "Advanced Operations: Process-Control",* or *"Maintenance"* to correct a problem after you have diagnosed it.

Or, refer to your vendor-supplied manuals or cut sheets for instructions on correcting problems.

This section contains tables on the following problems:

- Water does not heat (gas/oil burner does not ignite)
- Water does not heat (steam)
- Water does not heat (electric)

StingRay Electric Heating System

Problem:	***Water does not heat (gas/oil burner does not ignite)***
Check This:	**Probable Cause(s)**
Gas burner	Check for 120 volts at burner Not burning enough fuel - Check for gas at specified pressures
Blower motor not running	Check for fan obstruction (blower motor must be running)
No ignition	Flameproving rods Corroded (replace) Igniter rods Corroded (replace) Burner controller defective (replace)
Poor combustion	Fuel/gas mixture Incorrect Main gas valve Defective Check for proper gas pressures Obstruction in flue. (clean out) Burner unit dirty. Clean Flue Damper Misadjusted
Hi-Limit	Hi-Limit tripped. Check for overtemp condition. Reset Hi-Limit controller. If problem continues contact StingRay Immediately.
Temperature controller	Not set high enough to call for heat. (Increase temp) Loose wires. (tighten). Thermocouple (sensor) not functioning. (Replace) Thermocouple wires backwards, incorrect wire type Controller failed
Reservoir	Low solution level (check float assembly and solenoid)
Float assembly	Not working (clean assembly) Cam slipped, limit switch failed (verify relays trip)
7-day clock	Incorrect setting

Fig. 6 - 9: Troubleshooting: Water Does Not Heat (Gas/Oil Burner Does Not Ignite)

Problem:	***Water does not heat (steam)***
Check This:	**Probable Cause(s)**
Steam System	Steam solenoid not activated Steam source: Steam not available from in-plant source Steam trap not operating -- may be clogged Steam-heat exchanger, hole in exchanger -- steam escaping
Temperature controller	Not set high enough to call for heat. (Increase temp) Loose wires, (tighten). Thermocouple (sensor) not functioning. (Replace)
Reservoir	Low solution level (check float assembly & solenoid)
Float assembly	Not working (clean assembly)
7-day clock	Incorrect setting

Fig. 6 - 10: Troubleshooting: Water Does Not Heat (Steam)

Problem:	***Water does not heat (electric)***
Check This:	**Probable Cause(s)**
Electric heaters	Defective element. (Replace) Defective wires, (loose, burned) Check for voltage Check for proper amperage Blown fuse. (Replace)
Temperature controller	Not set high enough to call for heat. (Increase temp) Loose wires, Tighten Thermocouple (sensor) not functioning. (Replace)
Reservoir	Low solution level (check float assembly & solenoid)
Float assembly	Not working (clean assembly)
7-day clock	Incorrect setting

Fig. 6 - 11: Troubleshooting: Water Does Not Heat (Electric)

Rapid ON/OFF Cycling of heat system: This condition is caused by the temperature sensor probe being too close to the heat source. Position sensor probe tip to maintain a minimum of 4-6” from heat source. If probe is positioned properly, refer to temperature controller instructions for increasing the hysteresis.

5. Turntable Drive

Use procedures in chapters *"Installation", "Advanced Operations: Process-Control",* or *"Maintenance"* to correct a problem after you have diagnosed it.

Or, refer to your vendor-supplied manuals or cut sheets for instructions on correcting problems.

This section contains tables on the following problems:

- Turntable does not rotate

Problem:	***Turntable does not rotate***
Check This:	**Probable Cause(s)**
Drive-gear motor	Not operating
Fuse/ overload	Blown/tripped
Slip clutch	Not operating – slipping- clutch plate worn or loose Turntable bearing jammed or failed Turntable bearings tight (grease)
Jack shaft	Not turning (not driven)
Sprocket	Not engaging table teeth (check with door open and "jog") Not lined up
Turntable	Not rotating freely: Defective bearings Loose bearings
Load on table	Shifted, and is causing imbalance or jam
Securing devices	Caught on washer structure below table

Fig. 6 - 12: Troubleshooting: Turntable Does Not Rotate

6. Nozzles

Use procedures in chapters *"Installation", "Advanced Operations: Process-Control",* or *"Maintenance"* to correct a problem after you have diagnosed it.

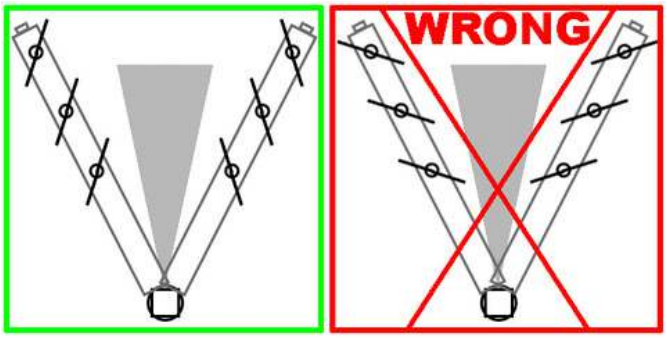
Or, refer to your vendor-supplied manuals or cut sheets for instructions on correcting problems.

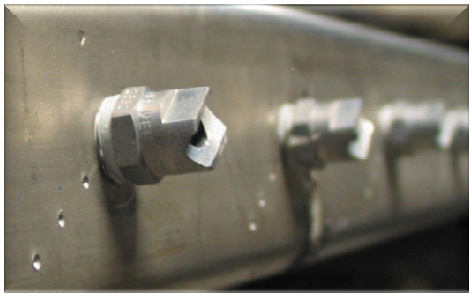
This section contains tables on the following problems:

- Nozzles: ineffective cleaning

Problem:	***Nozzles -- Ineffective cleaning***
Check This:	**Probable Cause(s)**
Nozzles	Missing Nozzles plugged—inspect and clean Worn out (check amperage draw) Not aligned with marks on PBM
Pump amperage	Nozzles worn out (amperage too high)
Manifold	Swivel is leaking Clean-out plugs are missing

Fig. 6 - 13: Troubleshooting: Nozzles -- Ineffective Cleaning





7. Foaming

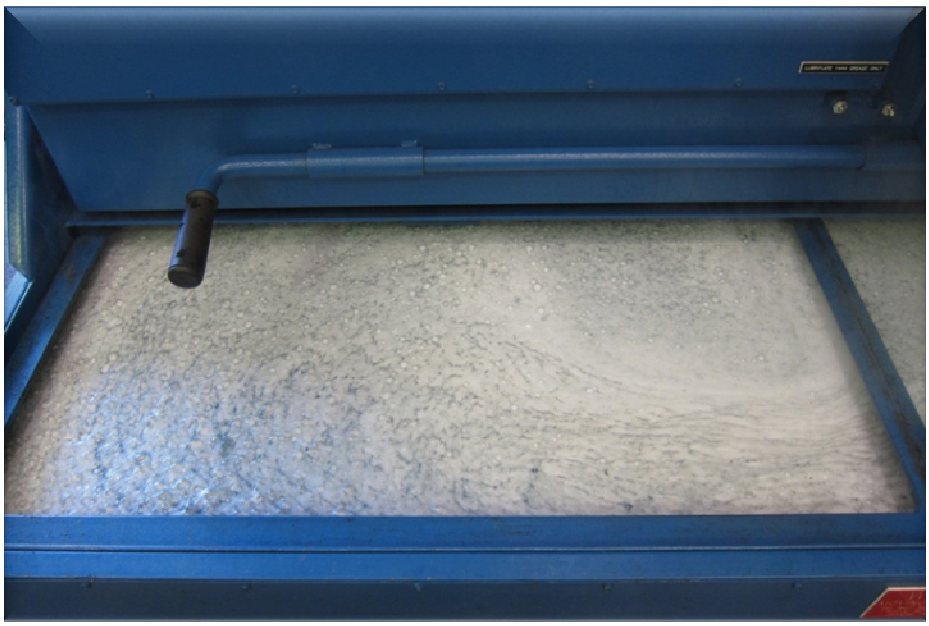
Use procedures in chapters *"Installation", "Advanced Operations: Process-Control",* or *"Maintenance"* to correct a problem after you have diagnosed it.

Or, refer to your vendor-supplied manuals or cut sheets for instructions on correcting problems.

NOTE: Visit support website for foaming trouble-shooter

Problem:	***Foaming***
Check This:	**Probable Cause(s)**
Operating temperature	Too low (raise temperature)
Chemical	Concentration: Wrong type of chemical Concentration too low Visit www.StingRayService.com for additional information
Defoamant	Not enough (add some defoamer to solution)
Oil skimmer	Removing defoamant (adjust skimmer timer to skim when solution is cooler)

Fig. 6 - 14: Troubleshooting: Foaming



8. Power Blast Manifold (PBM)

Use procedures in chapters *"Installation", "Advanced Operations: Process-Control",* or *"Maintenance"* to correct a problem after you have diagnosed it.

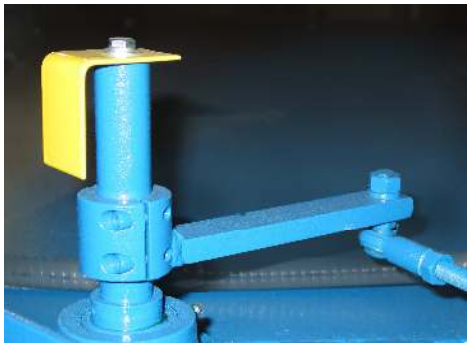
Or, refer to your vendor-supplied manuals or cut sheets for instructions on correcting problems.

This section contains tables on the following problems:

- PBM not oscillating

Problem:	***PBM not oscillating***
Check This:	**Probable Cause(s)**
Linkage	Not connected
	Out of adjustment
	Loose – slipping on shaft
	Not connected to shaft
	Broken (replace)
Bearings	Failed
Swivel	Not properly adjusted
	Not lubricated
	Not moving freely
	Wore out (replace)
PBM gear motor	Not rotating (check wires/fuses/overload tripped)
	Motor failed (replace)
PBM mounting plate	Motor not securely attached to it
PBM Arms	Not adjusted properly- hitting wall (adjust)
	Parts jamming under turntable (remove parts)

Fig. 6 - 15: Troubleshooting: PBM Not Oscillating



9. Solution-Level Control System

Use procedures in chapters *"Installation", "Advanced Operations: Process-Control",* or *"Maintenance"* to correct a problem after you have diagnosed it.

Or, refer to your vendor-supplied manuals or cut sheets for instructions on correcting problems.

This section contains tables on the following problems:

- Water not filling reservoir
- Water overflowing reservoir
- System not heating

Problem:	***Water not filling reservoir Water overflowing reservoir System not heating***
Check This:	**Probable Cause(s)**
Float rod	Binding
Limit switches	Not connected
	Dislocated
	Failed (replace)
Torpedo cam	Slipped
Float	Dirty or jammed (clean)
	Missing ball
7-day clock	Incorrect setting
Clock override	Not set to *ON or By-Pass*
Solenoid valves	Clogged
	Failed (replace)
Water Strainer	Clogged
Water Supply	Off (turn on water)

Fig. 6 - 16: Troubleshooting: Water Not Filling Reservoir, or Water Overflowing Reservoir, or System Not Heating

10. Door Limit Switch

Use procedures in chapters *"Installation", "Advanced Operations: Process-Control",* or *"Maintenance"* to correct a problem after you have diagnosed it.

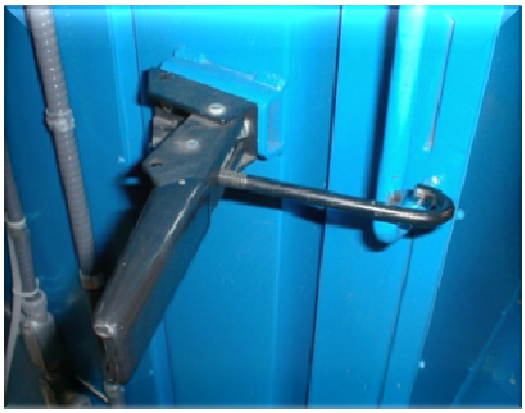
Or, refer to your vendor-supplied manuals or cut sheets for instructions on correcting problems.

This section contains tables on the following problems:

- Washer will not start

Problem:	***Washer will not start***
Check This:	**Probable Cause(s)**
Door limit switch (does not activate)	Door not closed Loose bolts (switch has slipped from mounting) Door tab not closing against switch (bend tab toward switch to make contact) Door limit switch is interlocked with start circuit. To reset start circuit, washer door must be opened and closed so start circuit detects door limit switch contacts transfer indicating proper operation. Switch failed (replace) Activation tab broken or jammed

Fig. 6 - 17: Troubleshooting: Washer Will Not Start



11. Rinse System

Use procedures in chapters *"Installation", "Advanced Operations: Process-Control",* or *"Maintenance"* to correct a problem after you have diagnosed it.

Or, refer to your vendor-supplied manuals or cut sheets for instructions on correcting problems.

This section contains tables on the following problems:

- No rinse cycle

Problem:	***No rinse cycle***
Check This:	**Probable Cause(s)**
Rinse timer	Not set above "0"
Steam-exhaust fan	Not operating
Rinse solenoid	Not energizing
	Failed (replace)
	Clogged
Power	Not *ON*
Float assembly	(see section *"Solution-Level Control System"*)
Wash-cycle timer	Cycle times too short to allow evaporation – no makeup water needed (so no rinse cycle is possible)
Supply/Discharge hoses	Deteriorated
	Leaking
Nozzles	Clogged
Gauge reading	Water turned *OFF*
Regulator	Adjusted too low (adjust to higher pressure)

Fig. 6 - 18: Troubleshooting: No Rinse Cycle

12. Automatic Steam Exhaust (ASE)

Use procedures in chapters *"Installation", "Advanced Operations: Process-Control",* or *"Maintenance"* to correct a problem after you have diagnosed it.

Or, refer to your vendor-supplied manuals or cut sheets for instructions on correcting problems.

This section contains tables on the following problems:

- ASE will not operate
- ASE leaks liquid

Problem:	***ASE will not operate***
Check This:	**Probable Cause(s)**
Wires	Not tight enough
Fuses	Blown
Blower fan	Wheel off shaft
	Corroded
ASE motor	Not operating - overload tripped
Piping	Clogged
	Collapsed
ASE timer	Not set above "0"

Fig. 6 - 19: Troubleshooting: ASE Will Not Operate

Problem:	***ASE leaks liquid***
Check This:	**Probable Cause(s)**
Piping	Clogged
Installation	Not done properly (re-read chapter *"Installation"*)
Motor	Too small for work environment/conditions
	Not positioned properly (see *"Installation")*
Rain cap	Missing (and required for your configuration)

Fig. 6 - 20: Troubleshooting: ASE Leaks Liquid

13. Electrical Control System

Use procedures in chapters *"Installation", "Advanced Operations: Process-Control",* or *"Maintenance"* to correct a problem after you have diagnosed it.

Or, refer to your vendor-supplied manuals or cut sheets for instructions on correcting problems.

This section contains tables on the following problems:

- Electrical control system failure

> ***CAUTION! Always turn the main power supply OFF before working on the electrical control system.***

> ***NOTE**:* Use your electrical schematics to work on the electrical control system.

> ***NOTE**:* If a part or assembly on the power washer will not work, check the "probable cause" electrical components given below.

Problem:	***Electrical control system failure***
Check This:	**Probable Cause(s)**
Overload(s)	Need to be reset
Relay(s)	Need to be tightened or replaced
Fuse(s)	Need to be replaced
Timer(s)	Need to be tightened
	Need to be reset

Fig. 6 - 21: Troubleshooting: Electrical Control System Failure

Also be sure to check:

- **Facility fuses** - If defective, replace
- **Source voltage** - If *OFF*, turn *ON*

7 Options

Purpose

This chapter contains information on any options you have that purchased from StingRay. The material in this chapter is meant to be used with material in other chapters -- for example, Chapter 2, *"Installation", Chapter 3, "Basic Operations",* and Chapter 5, *"Maintenance."*

Prerequisites

Before you read this chapter, we recommend that you read the following thoroughly.

- *"Important Safety Instructions and Warnings"* (in the front material)
- Chapter 1, *"Overview"*

Safety/Precautions

Before you install, operate, or maintain any option, read and follow these recommended safety/precaution instructions:

WARNING! <u>NEVER</u> get inside the washer cabinet when the main power supply is ON. This could result in severe injury or death.

WARNING! Be sure that people who install and maintain the washer and options are qualified and trained for the task.

What You Will Learn In This Chapter

In this chapter you will learn the following about each option:

- Theory of Operation
- Installation
- Operations
- Maintenance
- Troubleshooting

1. Automatic Turntable/Swivel Bearings Lubrication

The automatic turntable and swivel bearings lubrication system helps ensure that the critical bearings inside the wash chamber are lubricated as required.

1.1. Theory of Operation

The automatic lubrication system consists of the following:

- Grease reservoir.
- Electric Grease Piston Pump: 0.171 cubic inches/min, 5000 psi max, 4 or 8 liter capacity for 30-day capacity, NLGI #2 grease at ambient temperature with low-level sensor. Pump reservoir cover is transparent for visual confirmation of fill level. Standard grease fitting for filling. Pressure Relief valve on discharge port.
- Quick fill ALS manual filler pump available as an **option**. With the pump, a whole tube of grease is easy to put into reservoir in a few seconds. StingRay Parts # 85239
- Dividing valve meters grease to each bearing. An electronic sensor embedded in the dividing valve provides feedback to the controller to verify the system is distributing grease.
- Grease lines to bearings inside of the wash cabinet. Lines & fittings inside cabinet are Stainless Steel. External lines are flexible Nylon.
- System Controller.
- Yellow solid on Warning Light on main control panel indicates empty reservoir, power outage, failure to deliver grease.
- Green Lube Light indicator on main control panel turns on when grease pump runs.

NOTE: Use Lubriplate 1444 grease ONLY.

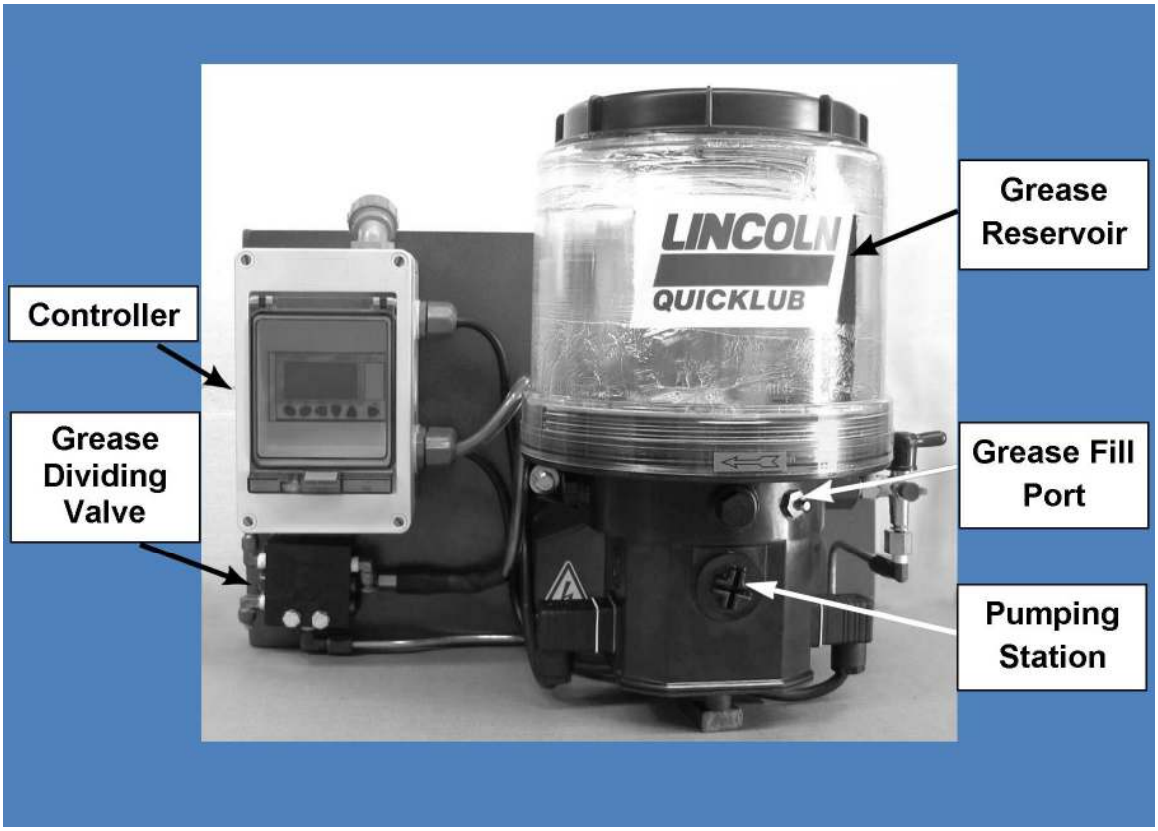
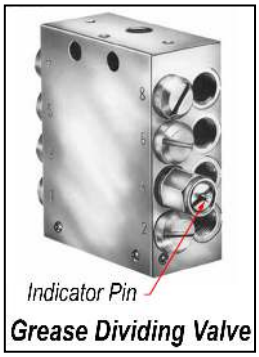


Fig. 7 - 1: Automatic Lubrication System

The fully automatic lubrication system is designed to provide a simple and inexpensive method of automating the lubrication of critical machine bearings inside of the wash cabinet. The Grease System Controller continuously monitors the total wash time of the machine. At the end of a wash cycle the controller operates the grease pump, delivering a specific amount of grease based on total wash time. The amount delivered is programmed by StingRay and may be adjusted by the user. The pumping station delivers grease to the dividing valve through a supply line.



The dividing valve proportions the proper amount of grease to each bearing. The dividing valve is more than a drilled manifold block and incorporates a series of metering pistons that accurately dispense grease from each outlet. The grease-dividing valve is the heart of the lubrication system with a capability of overcoming 1000 psi of backpressure to assure that each bearing receives the proper amount of grease. An indicator pin confirms the valve has completed a full cycle. An electrical sensor connected to the controller verifies completion of grease piston strokes. Grease lines carry the grease from the dividing valve to each of the lubrication points.

The lubrication points on the standard power washer are:

- Upper Turntable Bearing
- Lower Turntable Bearing (except 30's and 40's)
- PBM Swivel Bearings

1.2. Installation

The automatic lubrication system arrives factory-installed.

1.3. Operations

The lubrication system is always operating in an automatic mode, monitoring the total wash time and automatically delievering grease to the bearings inside the wash chamber. There is no on/off switch. The only operator required function is to monitor the grease reservoir and maintain an adequate supply of grease.

The lubrication sequence is performed automatically or may be performed manually. The lubrication sequence consists of a factory programmed number of divider valve strokes to deliever a specific amount of grease. You may adjust the percentage of the programmed amount of grease.

A grease cycle is one divider valve stroke.

To run a manual cycle, press button "A" on the controller for 5 seconds.

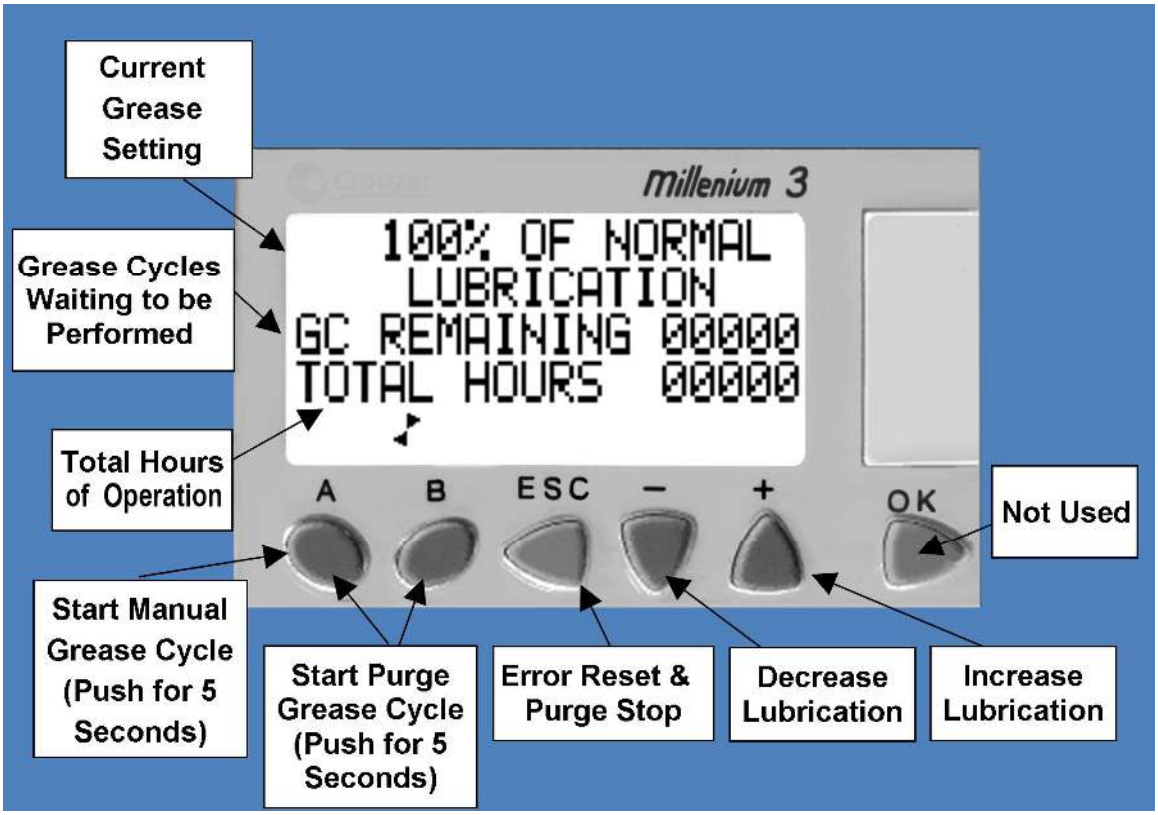


Fig. 7 - 2: Automatic Lubrication System Controller Interface

SET-UP:
Verify Lubrication:

Monitor the system carefully after initial installation. The proper amount of lubrication varies for different operating conditions. The Grease System requires adjustment to your particular operating conditions.

After start-up of your washer watch for the green indicator light on the main control panel at the end of wash cycles. For the first several days of washer operation check the amount of grease delivered to the turntable bearings and the PBM swivel each time you see the green pump light operate. The proper amount of lubrication purges all water from the bearings and pumps out a small bead of grease around the perimeter of the bearing seal and a small amount from the swivel overflow port.

Reduce the amount of lubrication if you see excess grease dripping at the swivel overflow port or a pile of grease on the internal reservoir cover below the turntable bearing. Increase the amount of grease if you see no grease around the perimeter of the lower turntable bearing seal or the swivel overflow port.

How to change the amount of lubrication:

Press the + and – keys to increase or decrease the percentage of factory programmed lubrication. The +/- keys change the programmed grease amount in 10% increments. The percentage may be adjusted between 30% to 300% of the factory program.

Total Hours of Operation: A maintenance reading indicating the total run time of the grease pump since installation

1.4. Maintenance

Monitor the grease level in the reservoir on a weekly basis. Refill the reservoir when the level is ¼ full to maintain an adequate supply of grease.

Filling the Reservoir with Grease:

> ***CAUTION:*** *Do not over-fill the grease reservoir. Grease will escape from the weep hole.*

> ***CAUTION:*** *Refill with* ***Lubriplate 1444*** *grease ONLY. Do not mix grease types as many are incompatible with each other.*

> ***WARNING:*** *Take great care to prevent dirt, metal chips or other debris from entering the lubrication system. Debris can jam the divider valve pistons and stall the pump.*

Follow these steps to refill the grease reservoir:

1. Wipe the reservoir grease **Fill Port** with a clean cloth. (see Figure 7-1)
2. Attach a grease gun or pump to the grease fitting.
3. Fill the reservoir until the follower plate assembly reaches the maximum level mark.
4. Push "ESC" on control panel if error light is on.

Purge Mode for Maintenance:

The system includes a special purge mode used to repair a broken line, test the system, empty the grease lines of one type of grease and replace it with another or for other maintenance operations.

To run the system in Purge Mode, press the “A” and “B” buttons simultaneously for 5 seconds. In purge mode the pump does not stop until you press “ESC”. Press “ESC” to STOP the pump.

If the purge is left ON, the system will shut-off when the low grease level switch is triggered.

NOTE: Use Lubriplate 1444 grease ONLY.

1.4. Troubleshooting

This section contains tables on the following problems:

- Automatic lubrication system pump does not run.
- Automatic lubrication system pump does not deliver the lubricant.

Problem:	***Automatic lubrication system pump does not run***
Check This:	**Probable Cause(s)**
Power Supply interrupted	Check the power supply and circuit breaker Check the line leading from the fuses to the pump plug
Electric Motor Defective	Check the power supply to the motor. If necessary, replace the motor

Fig. 7 - 3: Troubleshooting: Automatic Lubrication System Pump Does Not Run

NOTE: If a lubriant low-level is available, the low level is indicated by the flashing light of the signal lamp in the case of pumps without printed circuit board. The flashing frequency depends on the speed of the motor.

NOTE: Depending on the ambient temperature it may take 10 minutes of operation before the pump elements reach their full lubricant output.

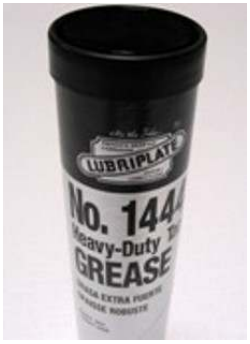
NOTE: When push-in type fittings are used, the high-pressure plastic hose which is under pressure cannot be easily disconnected from the safety valve. For this purpose, loosen the pressure relief valve or filling nipple on the pressure relief valve in order to relieve the high-pressure hose.

NOTE: **Use Lubriplate 1444 grease ONLY.**

Problem:	***Automatic lubrication system pump does not deliver the lubricant***
Check This:	**Probable Cause(s)**
Reservoir Empty	Fill up the reservoir with clean grease or oil. push "ESC" on controller. Allow pump to run until the lubricant issues from all the lubrication points.
Air Bubbles in the Lubricant	Trigger an additional lubrication cycle. Loosen outlet fitting or the main line at the pressure relief valve. The lubricant must issue without airl bubbles.
Suction hole of the Pump element clogged	Remove the pump element. Check the suction hole for foreign particles. If there are any, remove them.
Pump piston worn	Replace the pump element.
Check valve in the Pump element defective or clogged	Replace the pump element.

Fig. 7 - 4: Troubleshooting: Automatic Lubrication System Pump Does Not Deliver the Lubricant

NOTE: **Use Lubriplate 1444 grease ONLY.**



Long Term Answer to Lubricating

2. Center Manifold

The optional center manifold is used to clean very narrow-diameter, hollow, long parts whose interior is inaccessible to the washing solution. Examples of such parts include gun barrels, long pipes, and turbine pumps.

The center manifold oscillates vertically inside the part as the part rotates in the center of the turntable. The center manifold cleans the interior as the power blast manifold (PBM) cleans the exterior.

2.1. Theory of Operation

A *superstructure* on the reinforced roof of the washer cabinet houses the *center manifold*, as shown in the following figure. The center manifold consists of a vertical manifold tube the length of the work height of the washer with 2 wash nozzles located horizontally and connected to the lower end. The tube is guided through a pair of bushings in the cabinet roof. The tube is raised and lowered by a roller chain and carriage, which are driven by a gear motor.

Wash solution is piped to the vertical manifold tube through a hose attached to the back of the cabinet roof. Optionally, an extra tube may be attached to the vertical manifold tube for carrying rinse water to a pair of rinse nozzles on the lower end of the manifold. Flexible tubing is connected to the hose to carry rinse water. The fluid flow for the center manifold is provided from a tap off the flow to the power blast manifold (PBM).

Door Lock. The center manifold system incorporates an additional feature on the standard washer to help prevent accidental damage to the vertical manifold tube or parts on the turntable. An electrically actuated solenoid locks the washer cabinet door closed during operating cycles to prevent accidental opening with the center manifold in the down position. The door remains locked until the manifold returns to the *home* position. The lock functions automatically whenever the center manifold system is used (in manual *and* automatic modes).

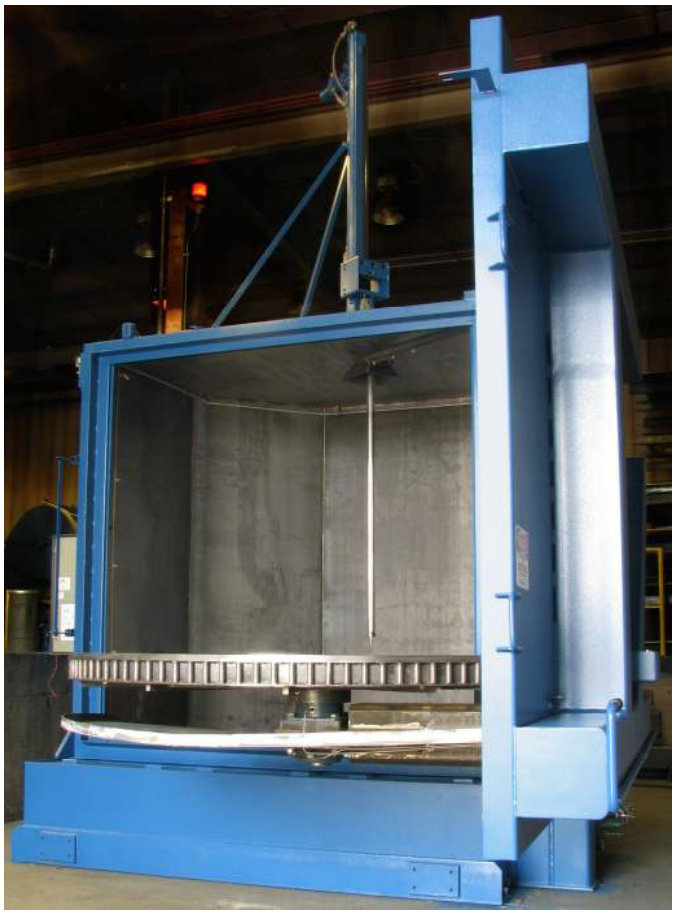
Power is required to unlock the door. In the event of a power failure or if power is turned off to the machine, the door-lock solenoid will de-energize and lock the door. The lock can be manually by-passed by pushing up the small pin that protrudes below the solenoid lock box and opening the door. This will probably require the assistance of another person. Be sure the manifold is in the *home* position before performing this procedure.

2.2. Installation

This option arrives with the vertical manifold and superstructure disconnected.

To install the center manifold, *follow this procedure*: (refer to the following figure)

1. Place beads of sealant around the roof opening.
2. Place the superstructure (frame and mechanism) on the pad support on the roof.
3. Connect the superstructure plate to the pad on the roof.
4. Connect the wash and rinse lines to the connections on the roof.
5. Connect bracing, if supplied.
6. Connect wires to the gear motor and to the brake assembly to the limit switch.



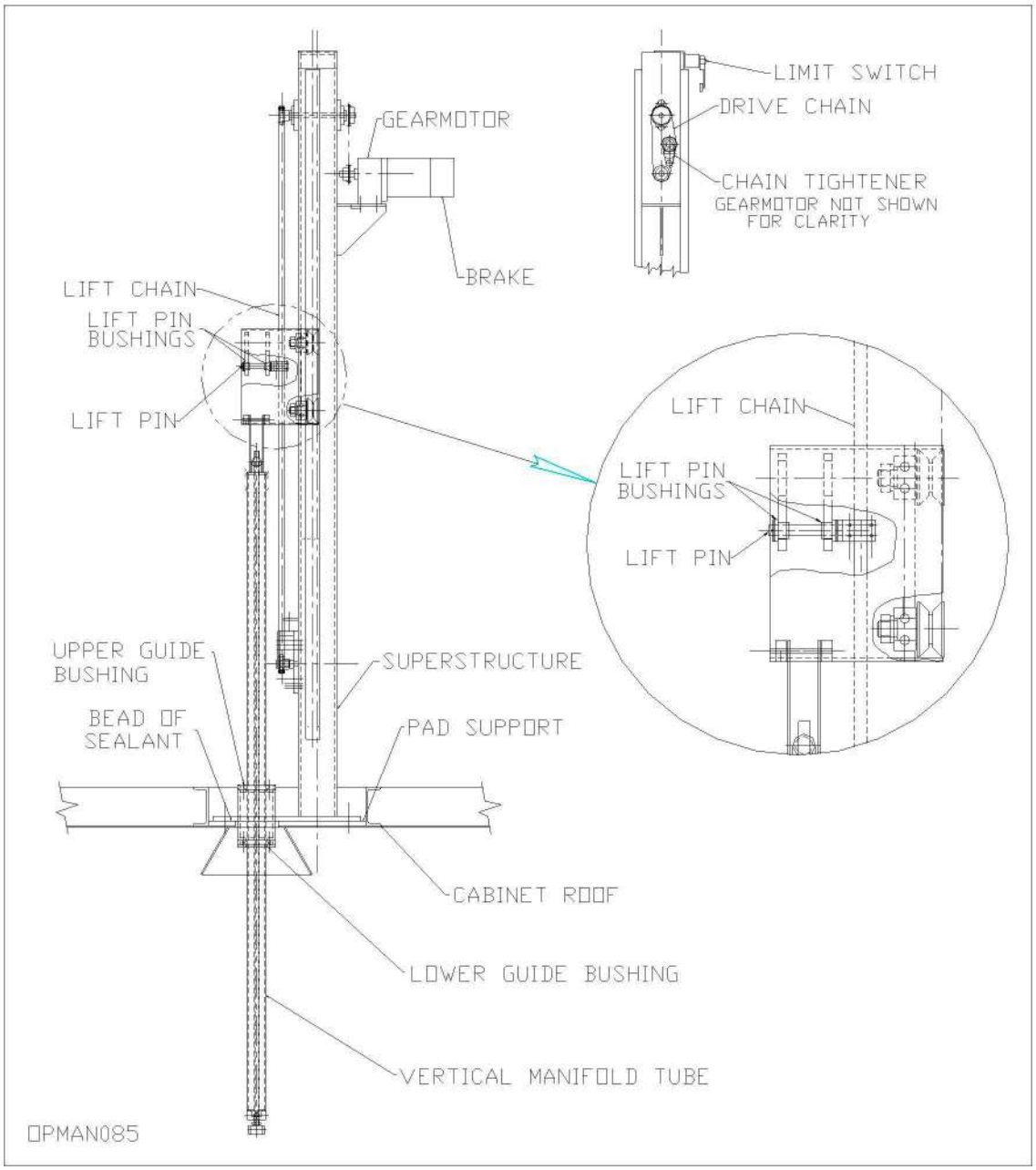


Fig. 7 - 5: Center Manifold Mechanism and Superstructure

2.3. Operations

> ***WARNING! The minimum inside diameter of a part that can be cleaned by the center manifold is 5 inches.***

To operate the center manifold, *follow this procedure*:

1. Verify that the manifold is *up* near the roof of the cabinet.

> ***NOTE:*** The center manifold has an automatic *Home* (or *up*) position controlled by a limit switch at the top of the superstructure.

2. Place the part to be washed in the center of the turntable. (A special fixture may be needed to keep the part centered on the turntable and properly aligned with the center manifold.)

> ***WARNING! Be sure the part is centered properly, so that the center manifold does not hit the part!***

3. Set the ***center manifold mode*** *selector switch*, located on the washer's control panel, to one of the following:

    - *Man:* Turns *auto* mode *OFF*. Activates the ***manifold jog*** *push button,* which lets you manually control the down/up position of the center manifold.

    - *Auto:* Returns the manifold to the *home* position and sets *automatic cycle* as part of the wash/rinse cycle. A light on the control panel illuminates each time the center manifold strokes during operation. The center manifold works with the power blast manifold (PBM).

    - *OFF:* Returns the manifold to the *home* position and disables *auto* cycle.

Refer to chapter *"Basic Operations"* for more information on loading and unloading parts.

2.4. Maintenance

Refer to the previous figure to help locate parts during maintenance procedures.

Every 40 Hours of Operation

Oil the chains and lift-pin bushings in the carriage.

Follow this procedure:

1. Turn the *main power supply OFF*.
2. Verify that the manifold is up near the top of the cabinet roof, in the *Home* position.
3. Inspect the lift chain; lift pin, and bushings for wear and looseness.
4. *If loose,* tighten the lift chain by using the adjuster located near the bottom of the superstructure.
5. Check the adjustment of the drive chain at the gear motor. Remove any excess play with the chain tightener.

Every 250 Hours of Operation

Teflon Bearing Plates

Inspect the Teflon bearing plates in the double-bearing housing. Look for excessive sideways movement of the center manifold or for bearing wear (hole is oblong): Replace the plates.

2.5. Troubleshooting

This section contains tables on the following problems:

- Water leaks onto cabinet roof
- Center manifold assembly does not work
- Center manifold light does not illuminate

Problem:	***Water leaks onto cabinet roof***
Check This:	**Probable Cause(s)**
M**anifold hose**	Cracked (replace)
	Loose (tighten)
Rinse pipefittings	Broken tubing (replace)
	Loose fittings (tighten)

Fig. 7 - 6: Troubleshooting: Water Leaks Onto Cabinet Roof

Problem:	***Center manifold assembly does not work***
Check This:	**Probable Cause(s)**
Superstructure	Damaged (replace)
Limit switch	Damaged (replace)
Electric solenoid	Burned out (replace)
Fuses	Blown (turn power *OFF* and pull <u>out</u> of electrical panel to check)
Relay(s)	Need to be tightened or replaced
Overload	Tripped (reset)
	Chain jammed
	Brake not releasing

Fig. 7 - 7: Troubleshooting: Center Manifold Assembly Does Not Work

Problem:	***Center manifold light does not illuminate***
Check This:	**Probable Cause(s)**
Selector switch	Not set to *auto* or *manual* (manifold at *home* position)
Switch light bulb	Burned out (replace)

Fig. 7 - 8: Troubleshooting: Center Manifold Light Does Not Illuminate

3. Chemical Conductivity Controller

After you have determined an effective chemical concentration, as described in chapters *"Overview"* and *"Advanced Operations: Process-Control,"* you must monitor and maintain that concentration to provide consistent cleaning performance.

The optional Chemical Conductivity Controller automatically monitors and maintains chemical concentration by electronically measuring the (electrolytic) conductivity of the cleaning solution. This is a useful technique for figuring out when to add more detergent to a high-ionic strength cleaning solution such as those based on salts. (Potassium hydroxide, sodium hydroxide, or sodium metasilicate) This is **not** a useful technique for monitoring high emulsifying cleaners that rely on surfactants for a significant part of the cleaning mechanism.

Electrolytes are ionic compounds such as salts, acids, or bases. Added to water, or a water-based (aqueous) solution, they increase its conductivity.

Conductivity is defined as the ability of a substance to conduct electric current. All aqueous solutions conduct electricity to some degree. The addition of electrolytes increases conductivity. Since conductive liquids consist of ionic compounds (electrolytes) dissolved in water, more ions in the solution indicate higher conductivity. In applications using very pure to very concentrated chemical solutions, a rising conductivity reading indicates a generally increasing chemical concentration.

Thus, a simple electronic conductivity test can measure the makeup of a ionic solution and indicate its approximate chemical concentration. Unfortunately, compounds other than cleaning chemicals affect the conductivity of the solution. (These compounds include iron oxide (rust) and carbon, both commonly found in most washing applications.) And some cleaning compounds are not conductive. Conductivity measuring systems provide an *estimate* of the strength of the chemical in the solution by measuring the *relative* conductivity of the solution.

Conductivity is expressed in millionths of a Siemen:
microSiemens/cm, or μS/cm. One mS/cm equals 1000 μS/cm.

Contact your chemical supplier for a chart of conductivity vs. concentration for your chemical and to determine if conductivity measurement is an appropriate technique for controlling the concentration of your solution.

3.1. Theory of Operation

The Chemical Conductivity Controller system consists of the following:

- Conductivity controller
- Electrode-probe
- Peristaltic pump
- Tubing

For the system to function properly, the concentration of your chemical must be proportional to its conductivity.

The system measures conductivity with electronics connected to a *probe* immersed in the washer's cleaning solution. A concentrated chemical is added by a pump to maintain the conductivity of the solution at the selected set point.

The *conductivity controller* uses a set point for the minimum allowable conductivity. When the *electrode probe* senses that **conductivity has fallen below the set point** you have selected, it closes a relay. If the relay closes while the wash pump is operating, the *peristaltic pump* activates and pumps concentrated chemical solution into the washer's reservoir. Concentrate is only added during the wash cycle, so that mixing occurs. When the probe senses that **conductivity has risen above the set point**, the controller relay opens. This prevents the peristaltic pump from adding concentrate.

The *peristaltic pump* turns rollers, which squeeze concentrate through the precision-bore, *high-tolerance tubing* in a wave-like motion, acting like a positive-displacement pump. The concentrate comes in contact *only* with the tubing, *not* the pump. The pump is self-priming and non-siphoning.

The probe is mounted to the end of a tube. This tube is used to insert the probe into the pump suction tube. The probe can be removed without draining the washer.

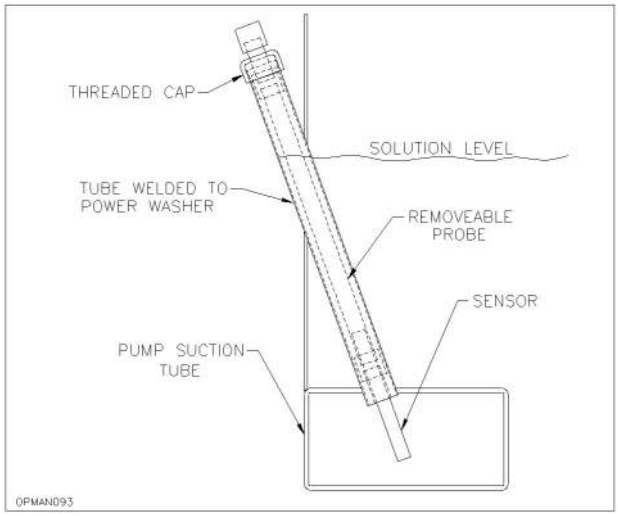


Fig. 7 - 9: Chemical Conductivity Probe

Chemical Management

When a washer is first put into service, it is easy to compute the concentration of the cleaning compound because you started with a fixed volume of water and added a known quantity of chemical. After you begin using the washer, however, you can only *estimate* the chemical concentration -- until you drain the washer, clean it out, and recharge it with fresh water and chemical.

There are two commonly used estimating tools:

- Conductivity measuring systems
- Titration kits

Conductivity Measurement

A conductivity measuring system measures the strength of a fixed electrical current flowing between two or more electrodes that are held at a fixed distance. Since the addition of cleaning compounds (chemical) to water changes the capacity of water to conduct electricity, conductivity measuring systems can provide an *estimate* of the strength of the chemical in the solution by measuring the *relative* conductivity of the solution.

Unfortunately, compounds other than cleaning chemicals also affect the conductivity of the solution in the washer. These compounds include iron oxide (rust) and carbon, both commonly found in most washing applications.

This means that while conductivity measuring systems can be used as a control point, this is done with the understanding that the oils, greases, metal particles, and other contaminants that are byproducts of the cleaning process affect conductivity.

Thus, the only true measure of chemical concentration is to use titration tests in conjunction with conductivity measurements to determine a correlation. Once you know the correlation, you can get a fairly accurate estimate of chemical concentration in the solution by using a conductivity measuring system.

Titration

Titration is the estimation of the strength of a compound by measuring the amount of another compound of known strength that is required to produce an observable reaction.

Almost all titration kits supplied with cleaning compounds use phenolphthalein (indicator P) as a reactant, and an acid (hydrochloric or phosphoric) as a neutralizer. The indicator P turns red or pink or blue when added to a sample of the solution. By counting the drops of acid it takes to turn the solution back to its original color, you can arrive at a good *estimate* of the chemical concentration.

Correlating Titration Results and Conductivity Measurements

To measure the chemical concentration in your washer's cleaning solution, titrate the solution once a week and perform a conductivity test at the same time. Your objective is to learn how chemical concentration and conductivity vary from wash to wash. Set up a graph that shows the correct concentration and then graph the actual variance in concentration and conductivity.

After several weeks of testing and graphing, you should see a pattern -- this is the correlation between chemical concentration and conductivity. Given any conductivity reading on your graph, you will most likely see a difference between the ideal and the actual chemical concentration of the solution. Use this "compensation factor" to know how to adjust chemical concentration based on conductivity readings.

Conclusion

After you have developed a correlation between chemical concentration (the results of titration) and conductivity measurement testing, you can use a conductivity measuring system to provide a *close estimate* of the strength of the chemical in the solution.

At this point, conductivity measurement can be used for one of two purposes:

- As an indicator of the need to titrate.
- As an indicator of the need to add chemicals.

If the correlation between conductivity and titrated concentration is close enough for the purposes of the operator, then titration should only be used as a periodic check on the conductivity measuring system.

3.2. Installation

The Chemical Conductivity Controller system is factory-installed and shipped ready for use.

The electrode-probe arrives installed in the washer, based on your specifications.

3.3. Operations

Follow this procedure:

1. Check the *conductivity reading* on the *controller panel* at the chemical concentration recommended by your chemical supplier or developed through process-control testing (refer to chapter *"Advanced Operations: Process-Control."*)

2. Adjust the *LO set point* to this reading.

> ***NOTE**:* Refer to the controller-vendor-supplied manual for instructions on changing ranges and setting set points.

3. Insert the *peristaltic pump suction tube* into a *barrel* of 50%-diluted chemical concentrate.

> ***NOTE:*** The peristaltic pump only pumps during wash cycles when chemical is needed.

3.4. Maintenance

Every 160 hours of operation:

- *Monitor* chemical usage by the peristaltic pump. Replace the empty barrel after the concentrate has been completely used.

- *Test* peristaltic pump operation:
    1. Set the controller *LO set point* 10% below the actual solution conductivity.
    2. Run a wash cycle.
    3. Verify that the pump is pumping chemical into the reservoir.
    4. Re-set the LO set point to your *control set point*.

Peristaltic Pump and Tubing

The pump has few moving parts and no seals or valves to clog, clean, or replace. As tubing fatigues (and eventually cracks), move it to a section that has not been under the pump rollers. Then, continue pumping.

When you run low on tubing, order a new spool.

Sludge Clean-Out

During sludge clean out, clean the probe thoroughly. Follow the vendor-supplied instructions.

3.5. Troubleshooting

This section contains tables on the following problems:

- Peristaltic pump does not pump
- Concentration cannot be maintained

Problem:	***Peristaltic pump does not pump***
Check This:	**Probable Cause(s)**
Pump tubing	Cracked (move or replace)
Barrel	Empty of concentrate (replace)
Power	Not *ON*
Fuses	Not intact (remove and measure continuity)
Overloads	Not all of them are re-set
Probe	Dirty (clean)
Set point	Too high (set below readout level)
Pump motor	Defective (replace)

Fig. 7 - 10: Troubleshooting: Peristaltic Pump Does Not Pump

Problem:	***Conductivity cannot be maintained***
Check This:	**Probable Cause(s)**
Peristaltic pump tubing	Cracked (move or replace)
Barrel	Empty of concentrate (replace)
Conductivity controller	Set point incorrectly set Defective (replace)
Chemical	Concentration: Wrong type of chemical Wrong concentration recommended or developed Concentration not proportional to conductivity

Fig. 7 - 11: Troubleshooting: Conductivity Cannot Be Maintained

4. Internal Reservoir Cover

The internal reservoir cover provides the following benefits:

- Safety: Provides a barrier covering the wash solution reservoir. This isolates the operator from accidental contact with the hot wash solution as might occur if someone was to slip and fall.

- Catch: Catches small parts that may loosen during the cleaning cycle and fall from the turntable. The floor prevents the parts from falling into the solution and being lost in the reservoir.

- Insulation: Provides a thermal insulation cover over the reservoir tank. This slows down the heat loss from the reservoir (saves energy) especially when the cabinet door is open.

4.1. Theory of Operation

The internal reservoir cover is steel-sheet-supported by angles welded to the cabinet walls above the wash solution reservoir and below the turntable. It funnels all liquid back through an expanded-metal screen area to the reservoir.

The internal reservoir cover is removable for sludge clean out and other maintenance procedures. It is held in place by thumbscrews, which are easily removed and replaced.

4.2. Installation

If you purchase the optional internal reservoir cover, your power washer is delivered with the internal reservoir cover factory-installed and ready to use.

4.3. Operations

There are no operational procedures for the internal reservoir cover.

WARNING! Do NOT OVERLOAD the internal reservoir cover or other horizontal surfaces. The internal reservoir cover is intended as a chemical-solution cover ONLY! Horizontal surfaces are NOT designed for walking or standing! Walking on the internal reservoir cover, tank cover, or other horizontal surfaces could result in serious injury or death.

4.4. Maintenance

Clean the internal reservoir cover as required. Pay particular attention to the expanded-metal screen area: be sure that no bolts or other parts, gasket material, or debris clog the screen. **NOTE: If your internal reservoir cover has the optional chip baskets, do not stand on or in the baskets**.

If the expanded-metal screen or the optional chip baskets becomes clogged, the pump(s) may flood the IRC, resulting in cleaning solution or rinse water pouring over the doorframe into the front reservoir. Refer to section *"Troubleshooting."*

4.5. Troubleshooting

This section contains tables on the following problems:

- Water leaks over doorframe

Problem:	***Water leaks over doorframe***
Check This:	**Probable Cause(s)**
Internal Reservoir Cover	Expanded-metal screen area clogged with bolts or other parts, gasket material, debris (clean screen)

Fig. 7 - 12: Troubleshooting: Internal Reservoir Cover: Water Leaks Over Door Frame

5. 50 Hertz Electrical Power

This option is intended for installation sites that use 50 Hz electrical power instead of 60 Hz. The pump system has been reconfigured using V-belts to drive the pump, enabling a washer powered by 50 Hz to deliver the same performance as one powered by 60 Hz. This results in the same efficiency, pressures, and flows.

All other systems and components are the same. For 50 Hertz with the Variable Frequency Drive (VFD), please see Section 8, Variable Frequency Drive.

5.1. Theory of Operation

The pump motor is no longer directly coupled to the pump. This option uses a V-belt drive to recover the loss in rpm and turn the pump at the same rpm it would turn at 60 Hz. The bigger sheave (pulley) is on the pump motor; the smaller, on the pump.

The pump motor is mounted on an adjustable base at the side of the reservoir. This allows for aligning the belt drive as well as tensioning the belt(s). Depending on the horsepower of the pump, the V-belt drive uses 1 to 3 belts.

5.2. Installation

This option arrives factory-installed.

5.3. Operations

Operations are the same as those for a standard washer.

5.4. Maintenance

After the first 8 hours of operation, check belt tension and sheave alignment.

To adjust belt tension, *follow this procedure:*

1. Remove the *belt guard*.

2. Turn the upper and lower adjusting bolts on the motor's adjustable base to tighten or loosen belts. Turn each of the bolts *exactly* the same number of turns to maintain belt alignment.

3. Use a *belt tension checker* to verify proper tension. **NOTE:** Follow belt-tensioner directions for proper tension adjustment.

> ***NOTE:*** When a properly tensioned belt is running, the tight side of the belt forms a straight line from sheave to sheave. The slack side slightly bows.

To verify sheave alignment*,* *follow this procedure*:

1. Remove the *belt guard*.

2. Adjust belt tension.

3. Use a *level* to verify that the motor shaft and the pump shaft are parallel. (This prevents excessive wear of the sheaves and belts.)

4. Be sure that the sheaves are at the same height in the same plane, so that the belts run true.

Every 250 hours of operation:

- Visually inspect belt(s) for wear, and adjust tension as needed.

General Maintenance

- Keep belts clean. *Never* use belt dressing! This will damage belts and cause early failure. See www.marttechservices.com for more information

- Be sure that air can circulate freely around the V-belt drive, and that temperatures are moderate. This will extend belt life.

- *Never* cover the expanded metal guards (vents) that protect the V-belt drive.

- Replace belts with original manufacturer's equipment or equivalent.

- Keep extra belts stored in a cool, dark, dry place.

5.5. Troubleshooting

This section contains tables on the following problems:

- Squealing sounds from pump area
- No wash cycle (no water pumped): simplex pump system
- Poor cleaning results *or* abnormal pump noise: duplex pump system

Problem:	***50 Hz electrical power -- Squealing sounds from pump area***
Check This:	**Probable Cause(s)**
Belt(s)	Slippage (tighten) Worn and frayed (replace)
Sheaves	Walls worn, with resulting belt slippage (replace)

Fig. 7 - 13: Troubleshooting: 50 Hz Electrical Power -- Squealing Sounds from Pump Area

Problem:	***50 Hz electrical power -- No wash cycle (no water pumped): simplex pump system***
Check This:	**Probable Cause(s)**
Belt(s)	Broken (replace)

Fig. 7 - 14: Troubleshooting: 50 Hz Electrical Power -- No Wash Cycle (No Water Pumped): Simplex Pump System

Problem:	***50 Hz electrical power -- Poor cleaning results or abnormal pump noise: duplex pump system***
Check This:	**Probable Cause(s)**
Main pump belt(s)	Broken (replace)
Booster pump belt(s)	Broken (replace) If squeaks, align adjust with belt tensioner to proper setting See www.marttechservices.com for belt adjustment

Fig. 7 - 15: Troubleshooting: 50 Hz Electrical Power -- Poor Cleaning Results *or* Abnormal Pump Noise: Duplex Pump System

6. Filters

The optional *Filters* remove particles as small as 1 micron from the wash solution. If you have purchased this option, your StingRay representative will have worked with you to select a micron rating that best suits your washer's configuration and your applications.

When you purchase replacement filters, be sure the micron-rating is appropriate for your washer's configuration: A filter with extremely fine pores could significantly increase the pressure-differential and overload the capacity of the filter housing, affecting pump pressure and flow rate.

6.1. Theory of Operation

The two filter types are:

- Bag
- Cartridge

Filter Types

Bag filters are generally recommended for 50-100 microns, although they can filter down to 1 micron at lower flow rates. Bag filters are less expensive than cartridge filters, easier to change, and re-usable. One filter at a time is inserted into the housing. Bags are constructed of polypropylene, especially selected for reliable performance in a hot, caustic environment.

Cartridge filters are rated for 1-50 microns. Multiple filters may be inserted into the housing.

Filter housings have a swing-away lid. Filter elements are inserted into the housing from the top. The housing lid is tightened with swing-bolts.

The following table shows micron comparisons to guide you in selecting filters.

Micron Comparisons

Substance	***Microns***
Table salt	100
Human hair (avg. dia.)	50-70
White blood cell	25
Talcum powder	10
Cocoa ...	8-10
Red blood cell	8
Bacteria (cocci)	2

Fig. 7 - 16: Micron Comparisons

***NOTE**:* The lower limit of visibility to the naked human eye is 40 microns.

Filtering System Configurations

There are two filtering system configurations. The following diagram shows solution flow:

Wash pump	➔	Filter	➔	Manifold (PBM)
Or				
Filter pump	➔	Filter	➔	Eductor nozzles (in reservoir)

The filter-pump-driven system allows for continuous filtering operation.

6.2. Installation

The filters are delivered installed, according to the configuration you specified.

6.3. Operations

The *wash-pump-driven configuration* is fully automatic and runs during the wash cycle.

To operate the filter-pump-driven configuration, *follow this procedure*:

1. Set the *filter-pump timer*, located in the washer's electrical control panel. The standard 5-hour timer is numbered 1-10 (each number represents a 1/2-hour increment). The timer controls the length of time the filter pump operates in *auto* mode, *if* you set the selector switch to *auto* (in the following step).

2. Set the filter pump's *selector switch*, located on the washer's control panel, to one of the following:

    - *Manual:* Activates the filter pump. It will run continuously.

    - *Off:* Turns the filter pump off.

    - *Auto:* Automatically activates the filter pump at the beginning of a wash cycle and runs the filter pump for the time indicated on the *filter-pump timer.*

6.4. Maintenance

Every 40 hours of operation:

- Check the filter elements. Replace dirty elements.

If you notice that cleaning results are not as good as usual or that more time is necessary, check the filter elements. If they are dirty, replace them.

If your washer is equipped with the optional pressure-differential gauge, replace the filter when the pressure-differential has increased by 10 PSI (142 kg/cm^2) or more.

6.5. Troubleshooting

This section contains tables on the following problems:

- Wash load not clean
- Solution leaks from filter cover

Problem:	***Wash load not clean***
Check This:	**Probable Cause(s)**
Filter	Dirty (change filter)

Fig. 7 - 17: Troubleshooting: Wash Load Not Clean

Problem:	***Solution leaks from filter cover***
Check This:	**Probable Cause(s)**
Cover gasket	Dirty (clean)
Cover clamps	Loose (tighten)

Fig. 7 - 18: Troubleshooting: Solution Leaks from Filter Cover

7. Variable Frequency Drive (VFD)

The optional *Variable Frequency Drive* is an electronic device that controls pump motor speed. The result is control of pressure and flow output.

7.1. Theory of Operation

The StingRay AC variable speed drive provides control of motor speed and torque for energy efficient wash pressure and flow control. The Variable Frequency Drive (VFD) controls the speed of the pump motor thereby adjusting the pressure and flow discharge.

7.2. Installation

If you specify that your *Variable Frequency Drive* be mounted on the washer cabinet, no further installation is required.

7.3. Operations

The VFD is mounted externally of the main control panel. To make pressure adjustments change the pump motor speed using the digital control panel on the VFD. The VFD allows for fully variable pump pressures using a simple set-point adjustment on the digital readout. Safe guards pre-programmed at the factory limit the adjustments within the normal operating range of the pump.

In addition to providing the pressure adjustment the VFD functions as the pump motor starter with overload protection, provides a soft-start function for reduced amp draw on start-up and provides the automatic pressure equalization on simplex pumps systems to prevent water hammer. The VFD is factory pre-set to 10 seconds to ramp the pump motor from zero to full speed. The overload set-point, APE setting and maximum amp draw are factory preset and not user adjustable.

To change the Pressure output of the Pump:

1. Reference the Pressure/Speed graph provided with the documents in your washer to determine the motor speed required for the desired pressure. A sample is shown above.
2. Using the digital control panel on the VFD press the SCREEN TOGGLE BUTTON until Motor Speed (rpm) is shown in the center of the screen (see Fig 7-20)
3. The pump speed may be adjusted at any time whether the pump is operating or not. When the pump is operating, the speed is adjusted with the UP & DOWN BUTTONS. When the pump is “off”; Press the STOP BUTTON and then use the UP & DOWN BUTTONS to adjust the pump to the desired speed.
4. The pump speed is adjustable from 1000 rpm to 3600 rpm
5. The pump operates at the new speed setting until manually changed.

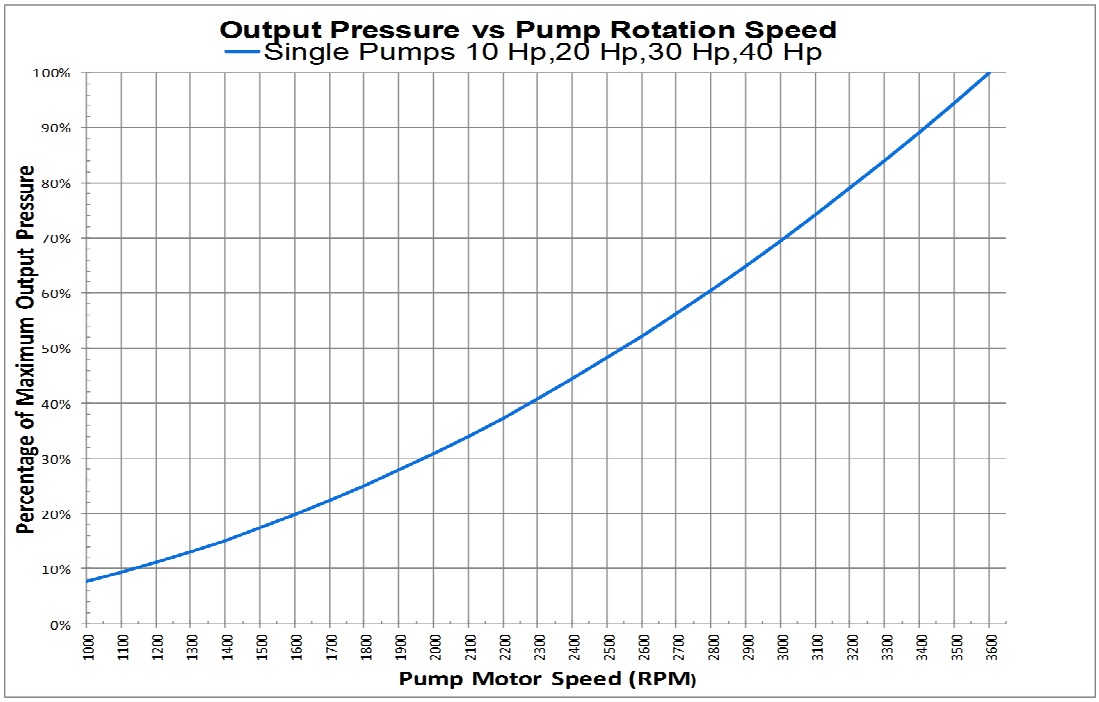


Fig. 7 - 19: Setting Pump Pressure – Simplex Pump

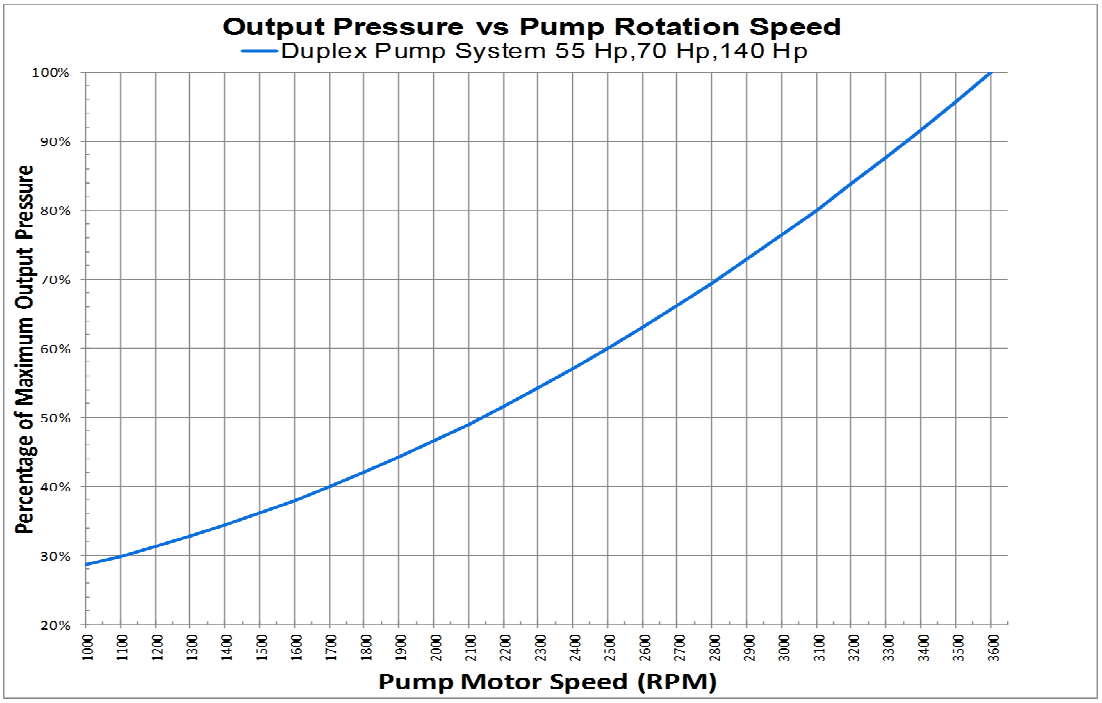


Fig. 7 - 20: Setting Pump Pressure – Duplex Pump

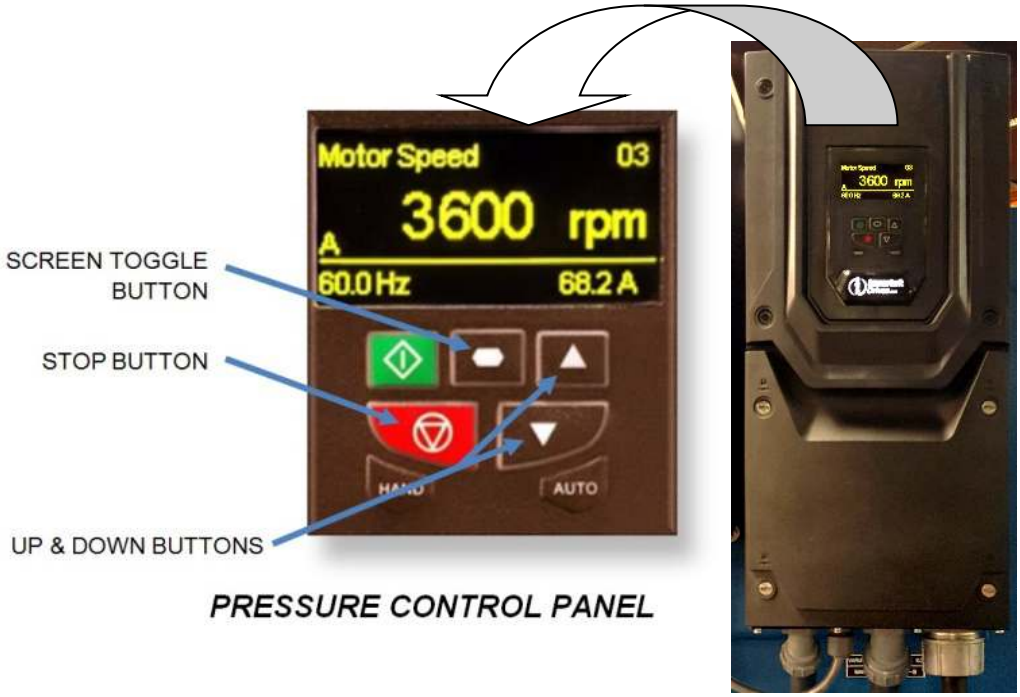


Fig. 7 - 21: Pressure Control Panel

7.4. Maintenance

Every 6 months:

Clean Heat Sink.

7.5. Troubleshooting

This section contains tables on the following problems:

- Pressure Control Panel displays errors.

Problem:	***Pressure Control Panel dispays errors***
Check This:	**Probable Cause(s)**
Fault Displays:	
O-I (Over Current)	Check the motor and motor connection cable for phase-phase and phase-earth short circuits. Check the pump mechanically for a jam, blockage or stalled condition.
It.trp (Overload Trip)	See *Chapter 6, Fig 6-6.*
O-t (Over Temperature Trip)	Ensure the drive internal cooling fan is operating. Ensure the cooling airflow path to-and-from the drive is not restricted.
P-loss (Input phase loss)	Drive requires a 3-phase supply; one input phase has been disconnected or fuse blown.
Fan-F (Cooling fan fault)	Ensure the drive internal cooling fan is operating.
O-Torq (Exceed max torque)	Ensure pump is rotating freely.
Out-F (Output phase loss)	One of the motor output phases is not connectd to the drive.

Fig. 7 - 22: Troubleshooting: Pump Motor Does Not Run

8. Hot-Air Blow-Off (HABO)

The optional Hot-Air Blow-Off (HABO) system "flash"-dries parts by high-velocity, direct blasts of air that blow most of the water off parts. Heat evaporates any remaining water.

All HABO systems are delivered with the following features:

- Heater contactor wired in-line with blower
- Over-temperature protection
- Duct-heater
- TEFC fan motor
- Direct-coupled aluminum, balanced fan blade
- High-velocity conversion nozzles 3 inches (7.6 cm) from the edge of the turntable

8.1. Theory of Operation

The HABO system activates after wash and rinse cycles have completed: The fan turns on while the turntable continues to rotate. Air is inducted from outside the washer cabinet by the fan and blown through the electric heating coils. The air picks up heat as it passes around the heating coils. Finally, the heated air is accelerated to high velocity as it travels through the plenum and out the nozzles to blow water off parts on the turntable.

The heating units are sized to provide a minimum of 110° F (43° C) rise above ambient to operating air temperature.

Steam-Exhaust Fan

NOTE*:* The HABO system removes steam using a variable-speed AC-drive centrifugal steam-exhaust fan, which replaces the standard ASE unit. The centrifugal fan differs from the standard unit in two keyways:

- The inlet is at a 90° angle from the outlet.
- The outlet ducting is *square* and connects to a *round* pipe.

Therefore, you must modify the standard installation procedures given in chapter *"Installation"* in this manual to account for these two differences. Refer to the following section, *Installation,* for more information.

The centrifugal fan runs at two speeds:

- *Low speed* provides normal steam exhaust. (It works similar to the auto steam exhaust [ASE] feature).
- *High speed* minimizes steam leakage from the cabinet during HABO.

Refer to the vendor-supplied cutsheet for instructions on setting fan speed.

Controlling HABO Heat

Thermocouples in the outside plenum on top of the washer cabinet and a temperature controller inside the electrical control panel control HABO heat.

NOTE: The *outside plenum* contains the blower unit, the thermocouples, and the heating element.

A redundant (back-up) heat-source measuring system works in conjunction with a high-level shutdown system to de-activate the HABO system if the heating element should overheat. Refer to section *"Troubleshooting."*

8.2. Installation

If you have a HABO system, you must modify standard ASE installation procedures. Refer to the following figures.

StingRay has available as an option flanged transition pieces to adapt the ASE fan to round ducting.

To install the HABO, *follow these guidelines*:

1. There are two couplings welded into the ASE fan blade housing. Use one of these couplings to connect a drain. This will allow condensed water vapor to drain back to the washer's drain coupling in the machine pump frame.
2. The output of the ASE fan can be rotated to any direction. Select a direction for the output that puts one of the two drain couplings on the fan in the DOWN position.

3. Remove the fan housing and rotate it to the selected direction.

4. During reassembly, thoroughly caulk all joints of the fan with a good-quality silicone caulk.

   Tip: Seal all joints with a 100% pure silicone caulking compound to prevent dripping and leaking from the steam in the exhaust.

   Tip: If at all possible, install the ASE fan **outside** to eliminate many of the nuisance dripping problems associated with steam condensing in the fan.

Tip: If your planned piping route contains any 90° elbows, install the fan at the elbow.

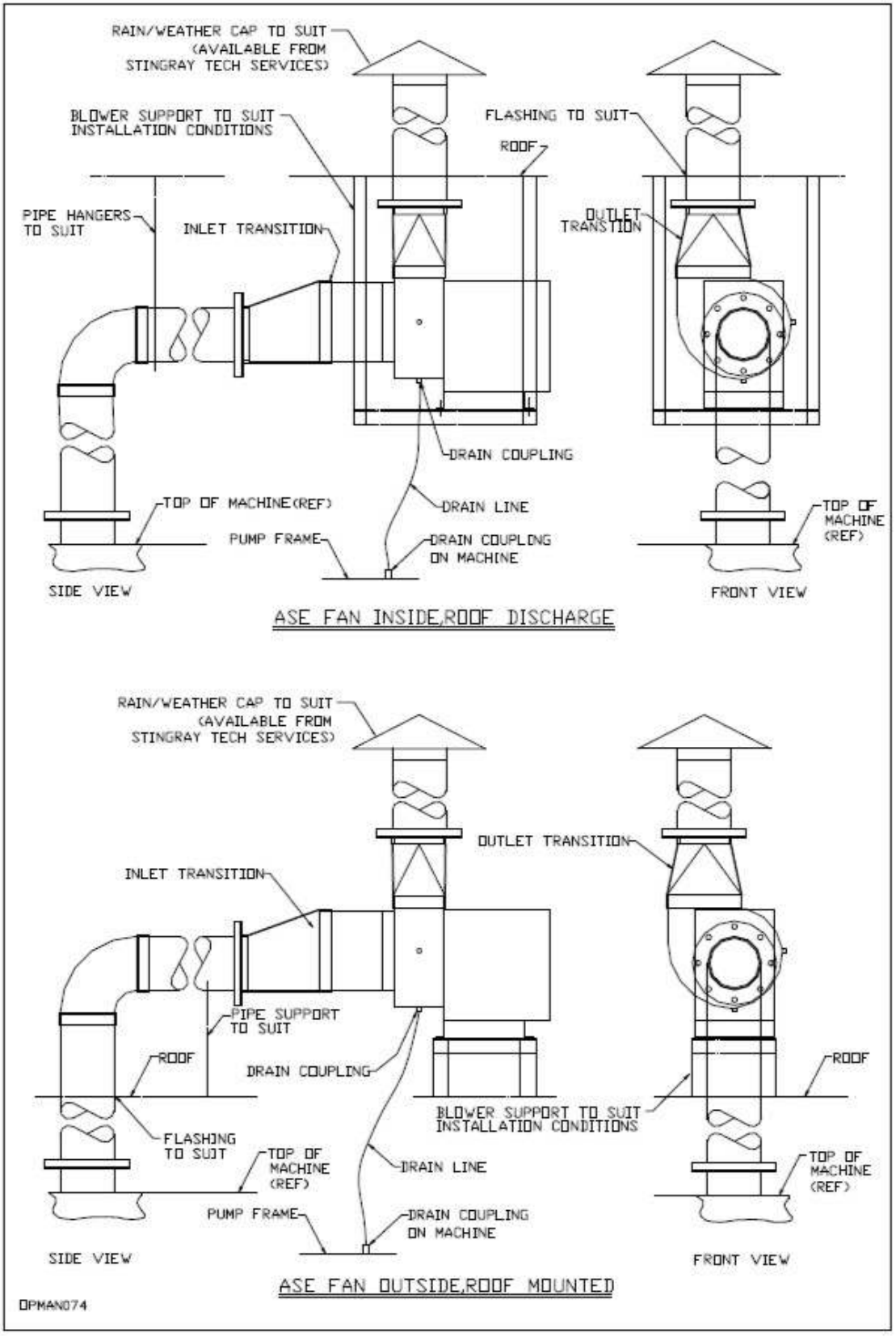


Fig. 7 - 23: HABO -- ASE Fan Installation

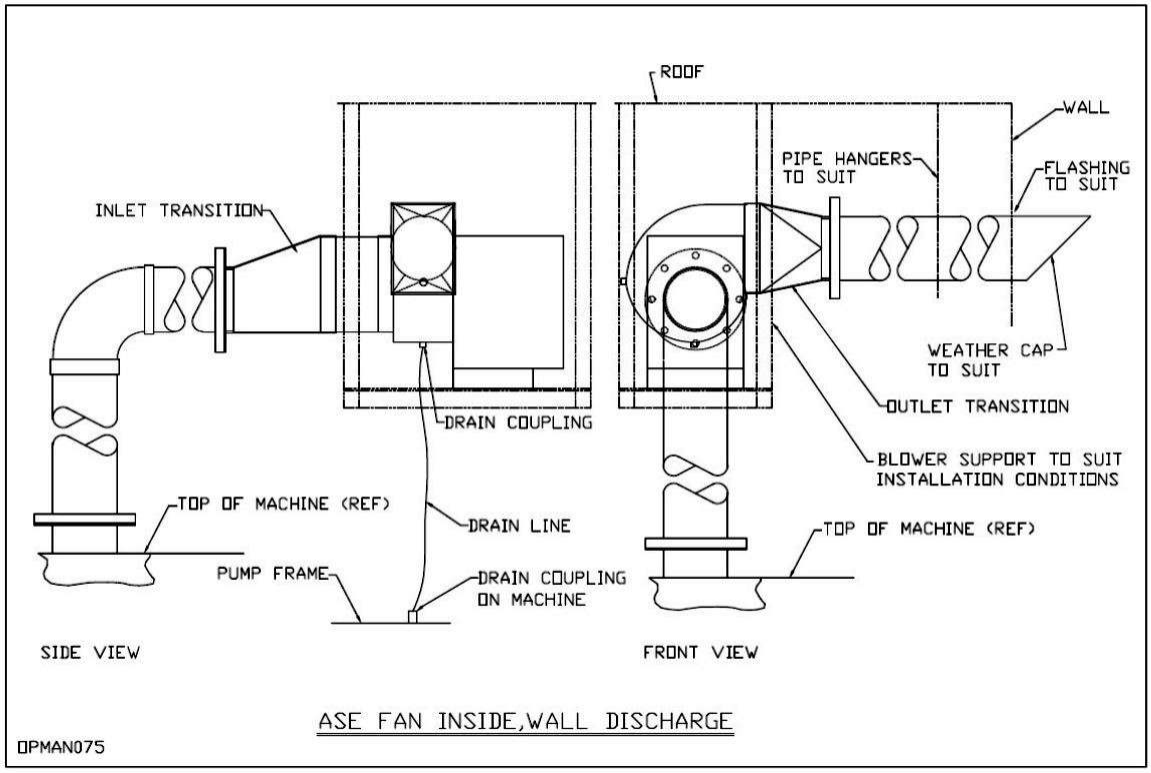


Fig. 7 - 24: HABO -- ASE Fan Installation

The HABO *inside plenum*, located in the washer cabinet and shown in the following figure, is always shipped installed.

The *outside plenum*, which contains the blower unit, the thermocouples, and the heating element, is shipped installed on smaller washers. You must install the outside plenum on larger washers.

To install the outside plenum on larger washers, *follow this procedure*:

1. Turn the *main power supply OFF*.
2. Place a bead of sealant on the flange on the machine.
3. Mount the *outside plenum* on the washer *cabinet*.
4. Bolt the *plenum* to *connection points* on the *cabinet*.
5. Connect *heating-element wires* and *blower-motor wires* to the *conduit* on the washer match corresponding wire *labels*.
6. Turn the *main power supply ON*.

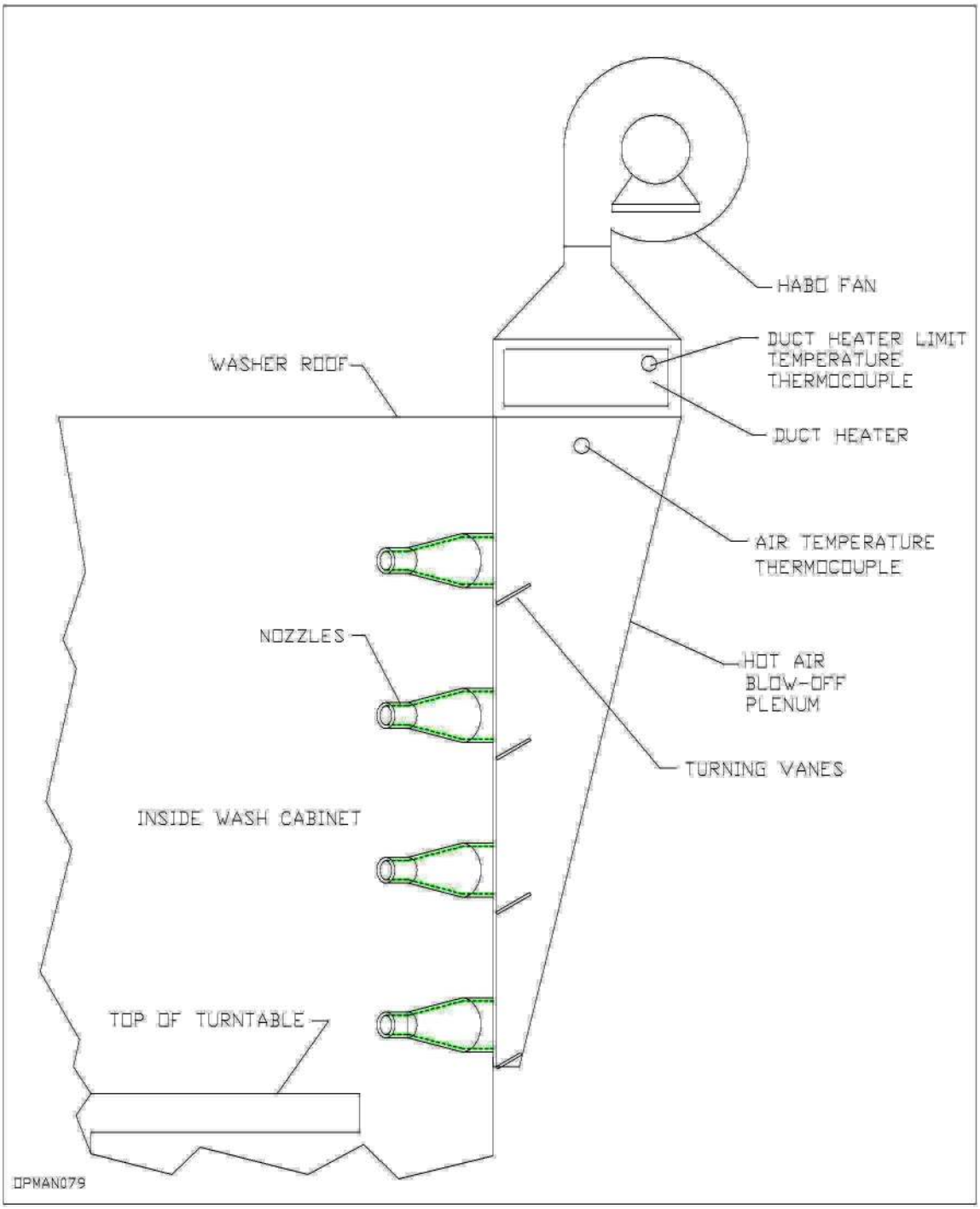


Fig. 7 - 25: Hot-Air Blow-Off (HABO) Inside Plenum

8.3. Operations

Refer to chapter *"Basic Operations"* for general washer operating procedures.

> ***WARNING! Turn the washer's main power supply OFF before opening the electrical control panel.***

Follow this procedure:

1. Position *parts on the turntable* so they will drain as best as possible. (Deep pockets or hidden areas will retain water.)

2. Place *parts as close to the nozzles as possible*. (Air velocity is highest near the outer edge of the turntable.)

3. Set the *HABO temperature controller* to the desired temperature. (The controller is located inside the electrical control panel.)

> ***WARNING! Do NOT set the HABO temperature controller above a maximum set point of 250°F (121°C)! Exceeding 250°F (121°C) may burn out the electric element or trip the over-temp sensor system.***

4. Set the *HABO timer*, located inside the electrical control panel. Each numbered increment on the timer increases HABO duration by 1 minute. The maximum run-time is 10 minutes

5. Set the *HABO auto/off switch*, located on the control panel, to *auto*. This will activate the HABO system after the wash cycle, unless your washer is equipped with the optional auto rinse cycle (ARC). If your washer is so equipped, then the HABO system activates *after* the *rinse cycle*.

6. Refer to the vendor-supplied cutsheet for instructions on setting fan speed.

   If your washer is equipped with HABO, it is also equipped with auto steam exhaust (ASE). An added benefit of HABO is that you can also use the HABO steam-exhaust fan-speed control to adjust the amount of steam exhaust during ASE cycles.

NOTE: If you set the ASE higher than the absolute minimum required for the desired rinse cycle, the steam exhaust wastes energy and raises operating costs. Initially, set the ASE speed control to the lowest setting that will satisfactorily keep steam in the washer during operation. If this setting does not provide an adequate rinse, adjust it higher for longer rinse cycles.

8.4. Maintenance

Every 1100 hours of operation:

- **Oil** the HABO blower motor with a standard electric-motor oil, suitable for small electric motors. For example, 10W-50 SAE oil.

  Refer to the vendor-supplied cutsheet for grease/oil points.

- **Inspect and clean** the electric heating coils:
  - Turn the *main power supply OFF*.
  - Remove the *coils* from the *upper plenum*.
  - Carefully clean any debris from the coils.
  - Insert the coils back in the upper plenum.
  - Turn the *main power supply ON*.

\

8.5. Troubleshooting

This section contains tables on the following problems:

- HABO heating element begins to overheat

Problem:	***HABO heating element begins to overheat***
Check This:	**Probable Cause(s)**
Fan	Not activating (check HABO selector switch, fuses)
Fan motor	Burned out Blown fuse
Fuses	Blown (pull out of electrical control panel to check) *Be sure to shut off power **before** checking!*
Temperature controller	Heat set-point set too high (do not exceed 250°F/ 121° C)
Over-temp	Tripped (reset the over-temp device)

Fig. 7 - 26: Troubleshooting: HABO Heating Element Begins to Overheat

9. Jib Crane – Rear Mount

The optional Rear Mounted Jib Crane is designed to pick up parts in front of the reservoir and place them on the turntable. The crane is rear washer-mounted, with a hoist. The crane is sized by washer, with a load capacity compatible with that of the washer turntable. The maximum load capacity is stenciled on the crane.

NOTE: The jib-crane kit with trolley is supplied by StingRay. The hoist is provided by others, not by StingRay.

9.1. Theory of Operation

The operator pivots the horizontal lifting jib crane about a column located in the rear-center of the washer. A roller on the jib crane rides on a support over the top of the doorframe. Stops at each end of the support limit the arc-travel of the crane.

9.2. Installation

WARNING! Never cut or weld or add anything to the column or jib-crane structure!

WARNING! Use only the bolts provided.

Follow this procedure: (refer to the following two figures)

1. Mount the *column* on the studs welded to the machine cabinet. The studs are located at the rear-center of the washer. There are 2 studs at the top of the washer cabinet and 2 studs at the bottom.

2. Using the hardware provided, install a flat washer, then a lock washer, then a nut on each stud.

3. Tighten the nuts to 200 ft-lbs.

4. Install the boom track on the mounting pads located on top of the door frame.

5. Using the hardware provided, install 8 bolts and lock washers.

6. Make sure the *wheel stops* are located toward the *back of the washer* (not the front).

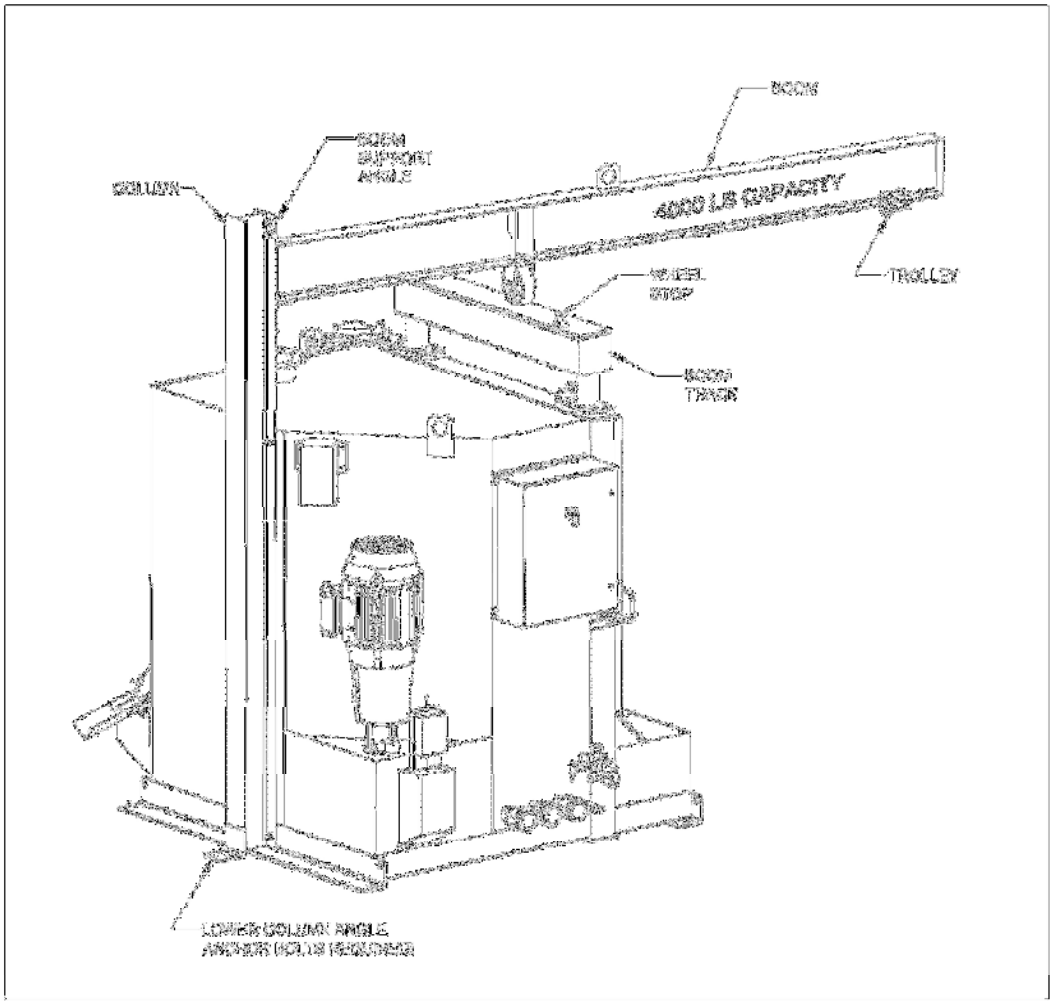


Fig. 7 - 27: Jib Crane, Rear-Mounted

7. Follow these instructions to install the boom:

   - Use a lifting method that maintains a level condition for the boom at all times.
   - Lift the boom in the orientation it is used with the wheel on the lower flange, using the lifting lug or a forklift.
   - Raise the boom until the lower boom sharft is slightly above the column divot point.
   - Position the boom shaft over the hole in the bronze bushing.
   - Lower the boom shaft into the bronze bushing on the column while at all times keeping the boom level.

8. Fit **BOTH** *bronze washers* onto the ***TOP*** portion of the boom shaft. It is important that NO washers go on the bottom shaft. (See Fig 7-29)

9. Fit the *Boom Support Angle* onto the *shaft over the TWO washers*. (Verify that there is a bronze bushing in the angle.)

10. Bolt the *Angle* to the *Column* with the hardware provided. Use a flat washer, then lock washer, then a nut on each connection. Tighten to 200 ft-lbs.

11. Follow the trolley installation instructions to install the trolley on the lower flange of the beam.

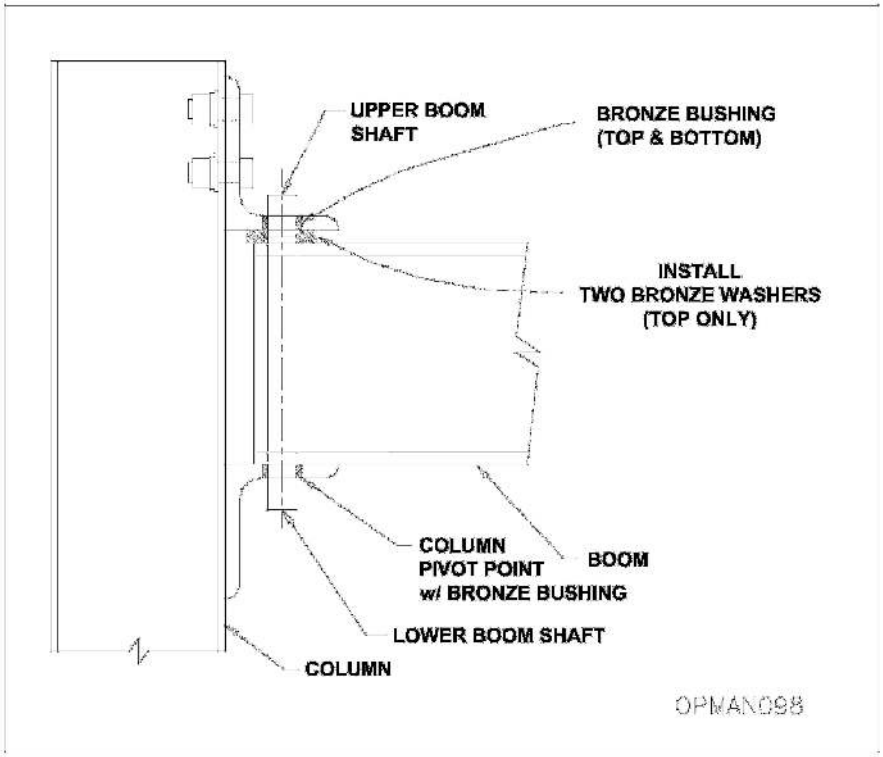


Fig. 7 - 28: Rear Mounted Jib Crane: Bronze Bushing and Washer Locations

Since the crane is a lifting device, be sure to check the installation work:

1. Swing the *crane* manually -- and *carefully* -- to be sure it moves freely.

2. Check all *bolts* for tightness.

3. Check the *jib-crane wheel* located at the top-front of the cabinet above the door to be sure that the *shaft pin* is actually all the way through the wheel and held in place by the cotter pin.

9.3. Operations

WARNING! Be sure you have anchored the washer to the floor BEFORE using the Jib Crane! DO NOT OPERATE the Jib Crane if you have not anchored the washer to the floor -- the washer could tip over and severely injure or kill the operator!

WARNING! Be sure the washer reservoir is filled to capacity with solution BEFORE using the Jib Crane! DO NOT OPERATE the Jib Crane if you have not filled the reservoir to capacity with solution -- the washer could tip over and severely injure or kill the operator!

To **load a part using the Rear Mounted Jib Crane**, *follow this procedure*:

1. Hold the *door position-lock handle up* and push the door *slowly* away from the cabinet *past the first position lock* (wider than a 90° angle from the washer frame).

2. Move *parts* up to the front reservoir.

3. Attach the *hoist* to a part.

4. Lift the part.

5. Rotate and hold the *door position-lock handle up* and push the door *slowly* toward the cabinet, until it locks in the first (90° angle) position.

6. Move the part over the *center* of the *turntable*.

7. Lower the part to the turntable.

8. Remove the hoist from the part.

To **unload a part from the washer using the Rear Mounted Jib Crane**, *follow this procedure*:

1. Pull the door open *slowly*, until it locks in the *first* position (90° angle from cabinet frame).

2. Use the *"jog" button*, located on the control panel, to *rotate the turntable* for easy access to the *part* you wish to unload.

3. Attach the *hoist* to a *part*.

4. Lift the part.

5. Rotate and hold the *door position-lock handle up* and push the door *slowly* away from the cabinet *past the first position lock* (wider than a 90° angle from the washer frame).

6. Lower the part to the *transporter*.

7. Remove the hoist from the part.

9.4. Maintenance

Inspect the jib crane according to OSHA 29CFR Section 1910.179.

Every 160 hours of operation:

- Inspect the bronze washer on the crane shaft to be sure it is in good condition. Replace the washer if it is worn.

Every year inspect the jib crane for the following:

- Swing the crane manually -- and carefully -- to be sure it moves freely.
- Check all bolts and parts for tightness.
- Check the jib-crane wheel located at the top-front of the cabinet above the door to be sure that the shaft pin is actually all the way through the wheel and held in place by the cotter pin.
- Verify that there are no permanent distortions; or cracked or corroded members.

Repair or replace parts as needed.

9.5. Troubleshooting

This section contains tables on the following problems:

- Crane does not swing freely

Problem:	***Crane does not swing freely***
Check This:	**Probable Cause(s)**
Bronze washer	Bronze washer on crane shaft has worn (replace)
Jib-crane wheel track	Dirty (clean)

Fig. 7 - 29: Troubleshooting: Crane Does Not Swing Freely

10. Jib Crane – Door Frame Mount

The StingRay Door Frame Mounted Jib Crane provides a convenient loading means anchored to the parts washer. The load capacity of this style crane is generally lower than the turntable capacity. The maximum load capacity is indicated on the crane.

The engineered crane, with supplied trolley, provides simple installation of overhead lifting equipment. No foundation or other structural enhancements are needed to the building. Simple bolt-on installation to the parts washer. Small, nimble cranes are faster than motorized bridge cranes.

For lighter loads the highly maneuverable door frame jib crane provides a wide range of picking locations. The lower mass crane and optimum door jamb location reduces operator fatigue and yet still reaches the full turntable as well as the side of the washer. The 180 degree swing range allows storing the jib crane out of the shop isle way and clear of the loading area in front of the washer. This clears the loading area and allows use of a forklift or overhead crane in tandem with the StingRay Jib Crane.

NOTE: The jib crane kit with trolley is supplied by StingRay. The hoist is provided by others.

10.1. Theory of Operation

The operator pivots the horizontal lifting jib crane about a column located on top of the door frame structure. Stops at each end of the column limit the arc-travel of the crane. Using the jib crane, the operator loads and unloads parts from anywhere on the washer turntable to areas in front of the washer and to the parts washer side.

10.2. Installation

WARNING! Never cut or weld or add anything to the column or jib crane structure!

WARNING! Use only the bolts provided.

WARNING! Be sure you have anchored the washer to the floor BEFORE using the Jib Crane! DO NOT OPERATE the Jib Crane if you have not anchored the washer to the floor -- the washer could tip over and severely injure or kill the operator!

Follow this procedure: (refer to the following two figures)

Fig. 7 - 30: Jib Crane Component Parts

1. Mount the *column* on the anchoring pad located over the pillar on the top of the door frame header using the *bolts* provided. There are 4 bolts going through the column flange into the pad on the top of the washer cabinet. Locate the post such that the lower pivot faces forward.

2. Place *lock washers* on the bolts, insert then tighten the *bolts.*

3. Mount the *right hand brace on the pad located on the door frame header and to the vertical column using lock washers and bolts provided.*

4. Mount the rear turnbuckle from the back of the washer cabinet to the vertical column using lock washers and bolts provided.

5. Verify the column is plumb with a bubble level. Adjust turnbuckle as required.

6. Lift the horizontal crane using an overhead crane or a forklift such that crane is lifted horizontally.

7. Install the two bronze thrust washers on the LOWER crane shaft and lower the crane so the shaft enters into the lower pivot point on the column. Make sure the crane remains level at all times and does not torque the lower pivot bushing.

8. Position the upper pivot plate on top of the column and over the upper crane shaft. NOTE: There are no bronze washers on the upper shaft.

9. Install the 2 anchoring bolts to hold the pivot plate in place. Torque all bolts to specified torque (See Fig. 7-32).

10. Release crane lifting equipment and test crane swing.

11. Install Trolley per instructions included from the manufacturer.

12. Attach your hoist to the trolley. Follow the hoist and trolley manufacturer's instructions.

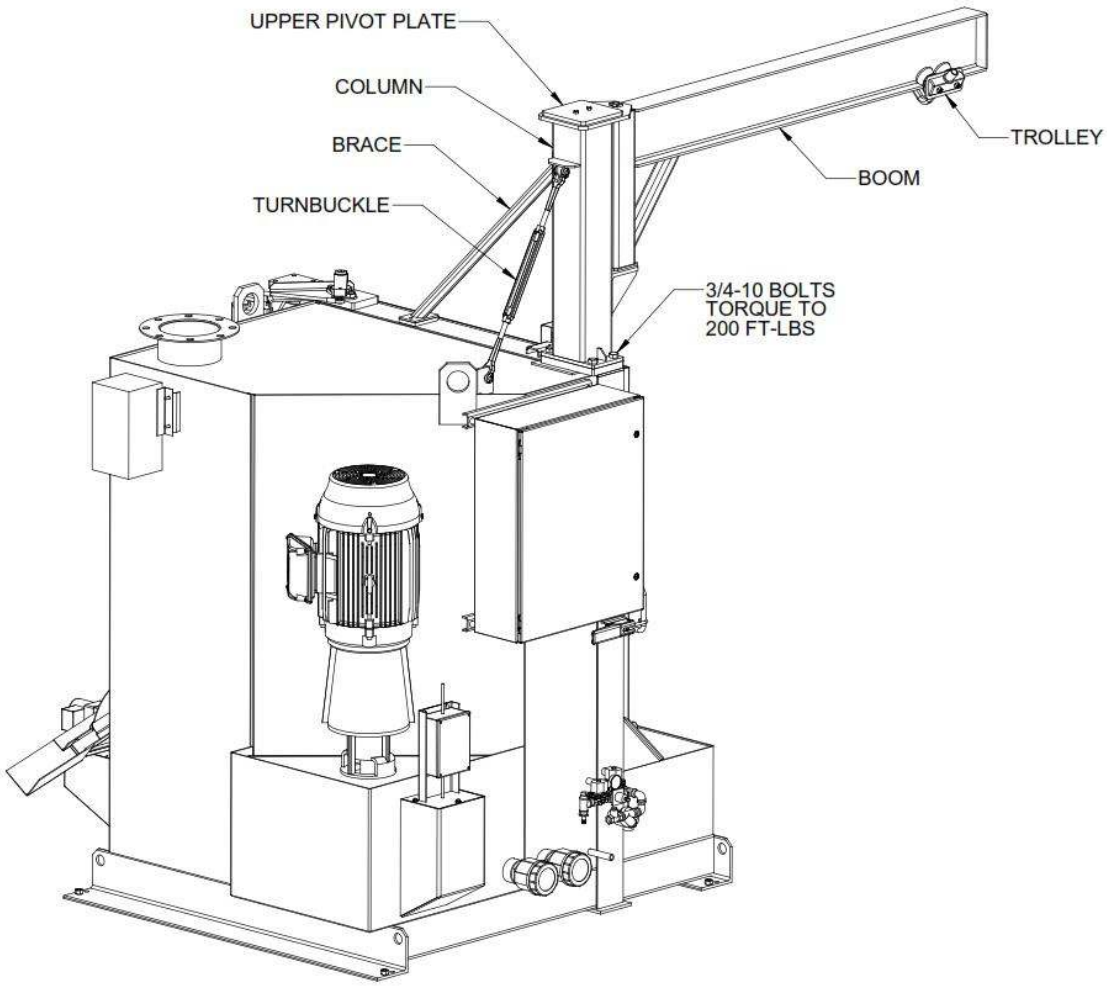


Fig. 7 - 31: Washer Jib Crane, Door Frame Mount

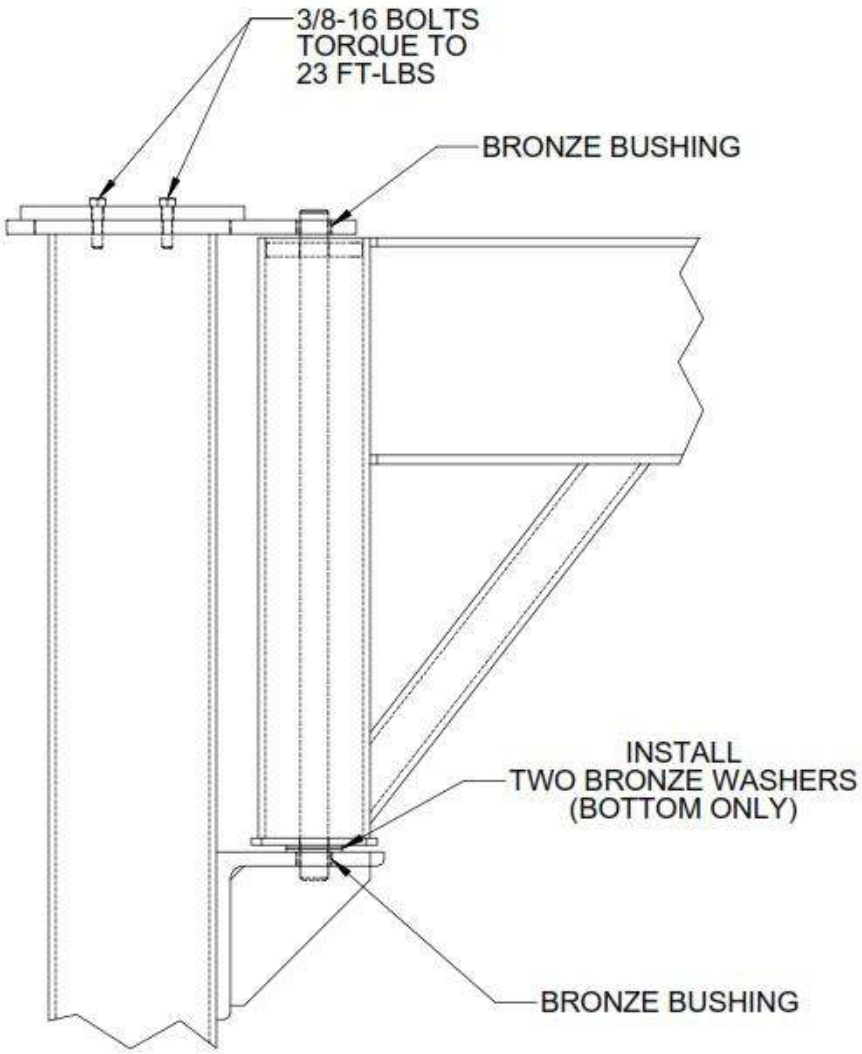


Fig. 7 - 32: Jib Crane: Thrust Washers Location

The Jib Crane is a lifting device, be sure to check the installation work:

1. Swing the *crane* manually -- and *carefully* --verifing it moves freely. It should stay in the position when released.
2. Check all *bolts* for tightness with torque wrench.
3. Check the *jib crane pivot points for proper installation of thrust washers* located at the top-front of the cabinet above the door. Verify that the bushing is in place on both pivot points.

10.3. Operations

WARNING! Be sure the washer reservoir is filled to the solution set point BEFORE using the Jib Crane! DO NOT OPERATE the Jib Crane if you have not filled the reservoir to capacity with solution -- the washer could tip over and severely injure or kill the operator!

To **load a part using the Jib Crane**, *follow this procedure*:

1. Hold the *door position-lock handle up* and push the door *slowly* away from the cabinet *to the first position lock*.
2. Move *parts* up to the front reservoir.
3. Attach the *hoist* to a part.
4. Lift the part.
5. Move the part over the *center* of the *turntable*.
6. Lower the part to the turntable.
7. Remove the hoist from the part.

To **unload a part from the washer using the Jib Crane, Follow instructions in reverse for loading.**

10.4. Maintenance

Inspect the jib crane according to OSHA 29CFR Section 1910.179.
Every 160 hours of operation:

- Inspect the bronze washers on the lower crane shaft to be sure they are in good condition. Replace washers if worn.
- Lubricate the bronze washers on the crane shaft and the shaft bushings with a good quality lubricating oil.

Every year inspect the jib crane for the following:

- Swing the crane manually -- and carefully -- to be sure it moves freely.
- Check all bolts and parts for tightness.
- Verify that there are no permanent distortions; or cracked or corroded members.

Repair or replace parts as needed.

10.5. Troubleshooting

This section contains tables on the following problems:

- Crane does not swing freely

Problem:	***Crane does not swing freely***
Check This:	**Probable Cause(s)**
Bronze washers **Levelness**	Bronze washers on crane shaft are worn (replace) Verify and adjust by shimming or turnbuckle adjustment that the unloaded crane is completely horizontal in a position facing forward and with the crane positioned at 90 degrees to the washer cabinet.

Fig. 7 - 33: Troubleshooting: Crane Does Not Swing Freely

11. Oil Skimmer

The optional Oil Skimmer removes from the surface of the power washer's sump floating oils, greases, sludge, fatty acids, and other contaminants that cling to the wheel. These contaminants cling to the rotating skimmer wheel and are then scraped off into a container by spring-loaded wiper blades. Water is not removed.

The skimmer provides these benefits:

- Extension of cleaning-solution life
- Better cleaning results
- Reclamation of oil in many cases

11.1. Theory of Operation

The Oil Skimmer is mounted in a small box on the side of the power washer cabinet. Refer to the following figure.

Skimmer Assembly: The skimmer is electrically connected to the washer by a standard 120V 3-prong grounded plug. It is operated by a single-phase, 60-cycle gear motor. The skimmer is lightweight and has only one moving part.

The skimmer's *manual/off/auto* switch is located on the washer's control panel.

Skimmer Function: The lower part of the skimmer wheel is submerged in the solution. As the wheel rotates, it picks up oil and other clinging contaminants from the surface of the solution. The contaminants are collected in the run-off trough and directed to a suitable disposal container. The skimmer will remove up to 30 gallons (114 liters) of contaminants each hour.

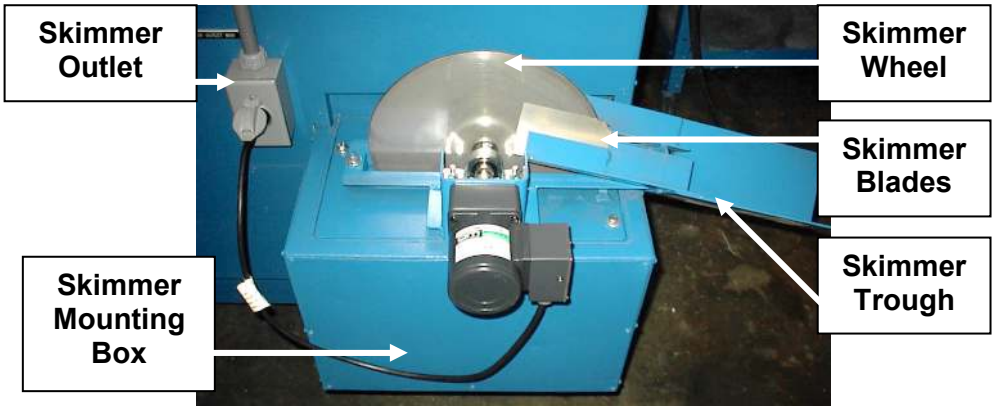


Fig. 7 - 34: Oil Skimmer Assembly

11.2. Installation

Follow this procedure:

1. Unpack the *skimmer assembly* from the turntable inside the washer cabinet.

2. Set the *assembly* into the *skimmer box*.

3. Tighten the *wing nut*.

4. Attach the *grounded plug to the outlet* on the *washer*.

11.3. Operations

The Oil Skimmer is designed to operate when the washer is in use, *or* after hours, when the washer is in "shut-down" (*off*) mode.

To operate the Oil Skimmer, *follow this procedure*:

1. Set the skimmer's *selector switch*, located on the washer's control panel, to one of the following:

    - *Manual:* Activates the skimmer. It will run continuously.

    - *Off:* Turns the skimmer off.

- *Auto:* Automatically activates and runs the skimmer according to the program set for circuit #2 of the 7-day clock.

> ***NOTE**:* You *must* program the 7-day clock's circuit #2 for *ON/OFF* times and set the skimmer's selector switch to *auto.*

NOTE: Oil skimming works best when the emulsified oils are allowed time to float and collect on the surface of the solution. Program your 7-day clock circuit #2 to run the Oil Skimmer several hours after washer shutdown in order to achieve the best oil-skimming results. Also, some defoamers float on the surface at higher temperatures. By skimming when the solution is cooler, less defoamer will be skimmed off with the oils.

11.4. Maintenance

Every 40 hours of operation:

- **Clean** the wheel and frame. If necessary, remove the skimmer assembly and box cover to clean out any sludge in the box.

During sludge clean out:

- **Clean** the wheel and frame. If necessary, remove the skimmer assembly and box cover to clean sludge out of the box.

Refer to chapter *"Maintenance"* for more information on sludge clean out.

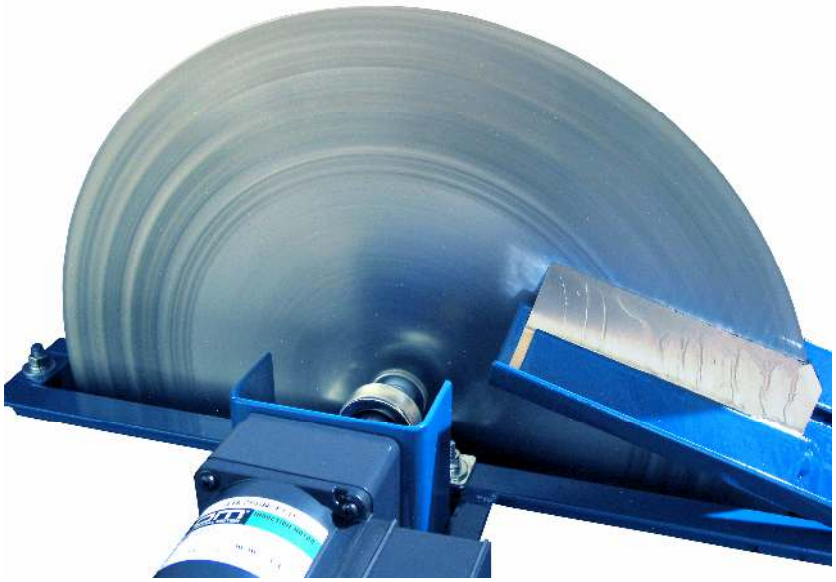
11.5. Troubleshooting

This section contains tables on the following problems:

- Skimmer-wheel does not skim

Problem:	***Skimmer-wheel does not skim***
Check This:	**Probable Cause(s)**
Drain trough	Clogged
Blades	Not contacting wheel: Bend to adjust Replace if worn
Wheel	Not turning (check/tighten shaft nuts)
Motor	Motor not turning (115 V): Fuse needs to be replaced Overload tripped Wires need to be tightened Motor needs to be replaced

Fig. 7 - 35: Troubleshooting: Skimmer-Wheel Does Not Skim



12. Oil Coalescer

The *Oil Coalescer* is an oil/water separator that uses gravity separation techniques to separate waste oil from aqueous parts washer cleaning solution. The system removes oil to a lower concentration than a disc oil skimmer.

12.1. Theory of Operation

The *Oil Coalescer* is a continuous process device. It can run during washing as well as during idle periods. The system has a floating suction head located in the washer reservoir and a processing chamber mounted to the outside of the washer. Inside the processing chamber is a separation reservoir, an overflow reservoir, and a coalescer media pack.

The floating suction head removes free-floating oils from the parts washer surface with a diaphragm pump. The pump discharges the oil concentrated solution into the coalescing chamber top. The solution travels down the chamber through the coalescer media to the overflow chamber.

In the chamber, the coalescing media attracts and agglomerates small oil droplets until they are large globules and buoyant enough to float to the surface. The adjustable weir removes accumulated oil from the surface that drains to a container next to the washer for disposal.

Cleaned solution is returned to the aqueous parts washer reservoir. Bottom drain allows removal of any accumulated solids that sink. Coalescing efficiency is improved during periods when washer solutions are cooler such as non-production hours. Non-emulsifying parts washing cleaners take maximum advantage of coalescer technology.

12.2. Installation

The Oil Coalescer is factory-installed. A compressed air supply is required for operation.

1. Provide and install a 1/2-inch-diameter (13 mm) compressed-air line to the washer air –inlet. **Note:** If your washer uses compressed air for other functions there is one common connection and you may have already installed the required compressed air-line. An additional air-line is NOT required. (The incoming pressure range should be between 60-125 PSIG 414-860 kilopascals).

2. Connect an air filter in-line with the washer's compressed air inlet. **Note:** The compressed air inlet is a 1/2 inch NPT fitting. The in-line filter is suppled by others.

12.3. Operations

***Follow this procedure*:**

1. Close the pump speed control valve attached to the pump.
2. Set the coalescer regulator pressure to 60 psi.
3. Open the pump speed control valve two full turns, stopping at 0.
4. Place the oil discharge hose into a 5 gallon collection bucket or other suitable container (customer supplied).
5. Ensure the top of the floating suction head pipe is approximately 1/8" below the surface of the reservoir water. (Adjustments should be made when reservoir water is calm at the surface).
    a. Adjusting heights are accomplished by raising the suction head float balls to lower the suction head or by lowering the suction head float balls to raise the suction head.
    b. Loosen the nuts of the suction head float balls, adjust both float balls to be of equal height, retighten the nuts, re-install the float ball assembly, and check for proper height (approximately 1/8" below reservoir water surface).
6. Set Coalescer panel switch to "Manual" to start diaphragm pump. Allow pump to fill the oil coalescer collection chamber. (Pump is self-priming.)
7. Adjust the water level to the top of the water level plate by screwing the water weir up or down (see Fig. 7-36). (**Note:** It is important to not allow the water to flow across the top of the water level plate).
8. Adjust the oil weir to a height of 1/8" to 1/4" above the water level. (This will allow the oil to collect on top of the water and flow to the collection bucket.)

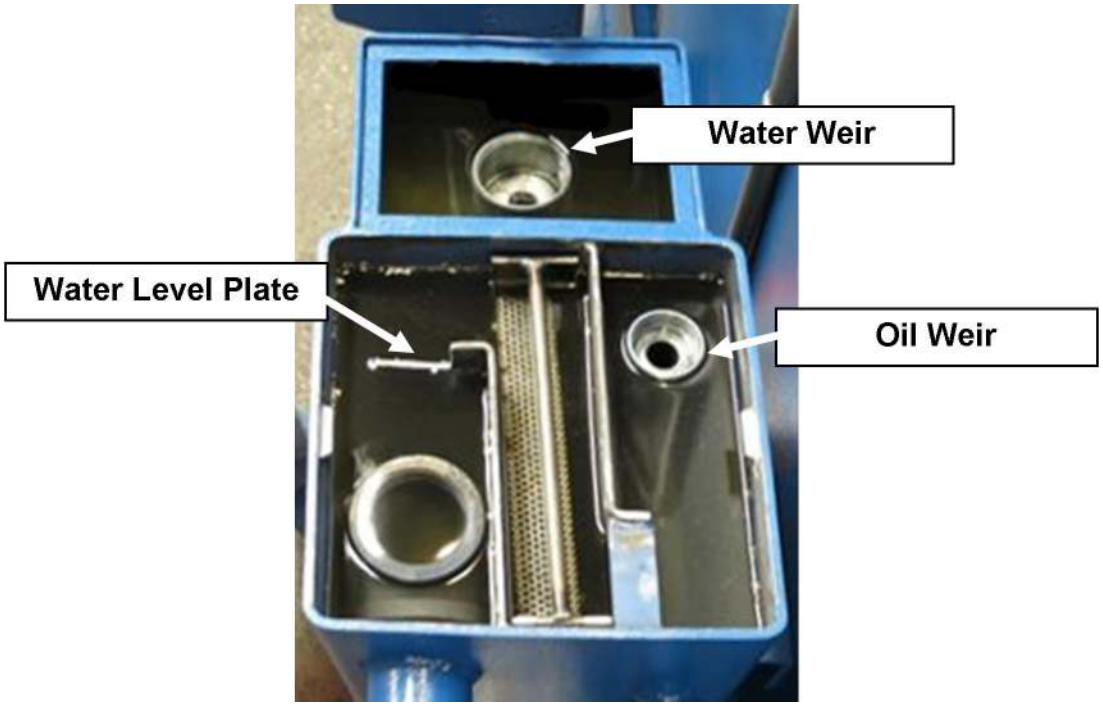


Fig. 7 - 36: Oil Coalescer Collection Chamber

12.4. Maintenance

Oil Coalescer Pack: Clean the oil coalescer pack weekly to remove sludge, sediment, and debris. Depending on the type of cleaning and the number of cleaning cycles, the coalescer pack may require more frequent inspection and cleaning.

1. Weekly (minimum) the coalescer pack should be visually inspected for sludge, sediment, and debris.
2. Clean visible sludge, sediment, and debris that cover more than 50% of the coalescer pack. Follow these steps:
    a. Turn off the oil coalescer.
    b. Remove the coalescer pack by sliding up and out.
    c. Place coalescer pack in the parts washer for one wash cycle.
    d. Re-install the coalescer pack.
    e. Turn on the oil coalescer.
    f. Adjust water and oil flow in accordance with the operating instructions.

Oil Coalescer Collection Chamber: Clean the coalescer collection chamber during the same intervals as the machine wash reservoir. Follow these steps:

1. Remove the oil coalescer pack.
    a. Deactivate the oil coalescer.
    b. Remove the coalescer pack by sliding up and out.
    c. Place in the parts washer for one wash cycle.
2. Follow customer washer lockout tag-out procedures.
3. Remove the drain plug.
4. Drain oil coalescer. (Approximately 15 gallons).
5. Rinse/clean the interior of the coalescer collection chamber. Ensure that all sludge, sediment, and debris are removed.
6. Install the drain plug.
7. Install the oil coalescer pack.
8. Fill chamber and adjust water and oil weirs in accordance with the operating instructions.

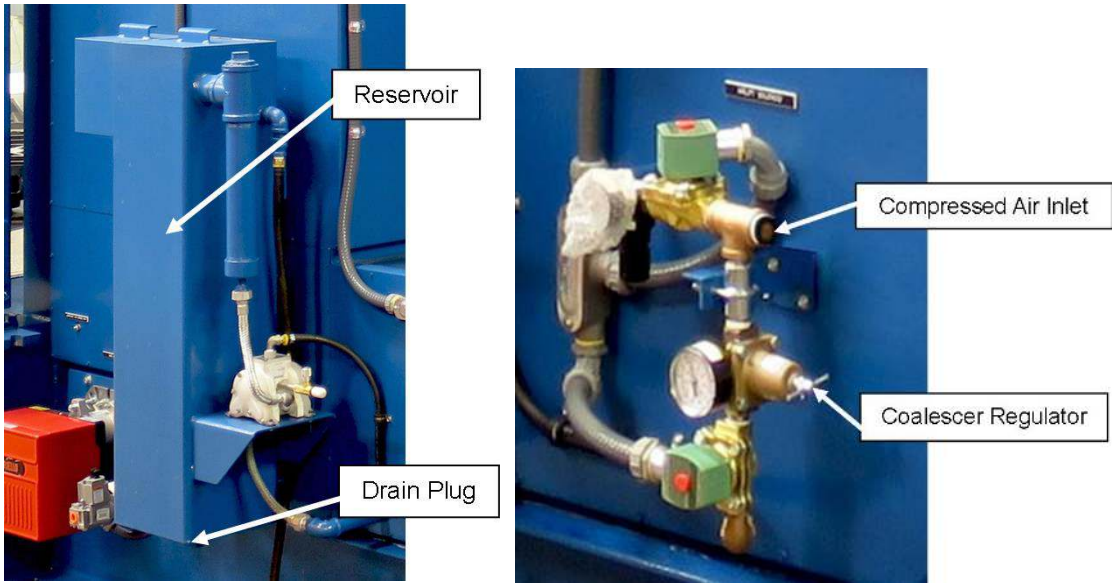


Fig. 7 - 37: Oil Coalescer Reservoir and Regulator

Pump Suction Filter and Y-strainer: Clean the pump suction filter during the same intervals as the machine wash reservoir. Follow these steps:

1. Remove screen from Y-strainer by unscrewing the outer screen plug.
2. Clean screen and inside of Y-strainer.
3. Apply new PTFE tape to plug.
4. Install screen and tighten plug.

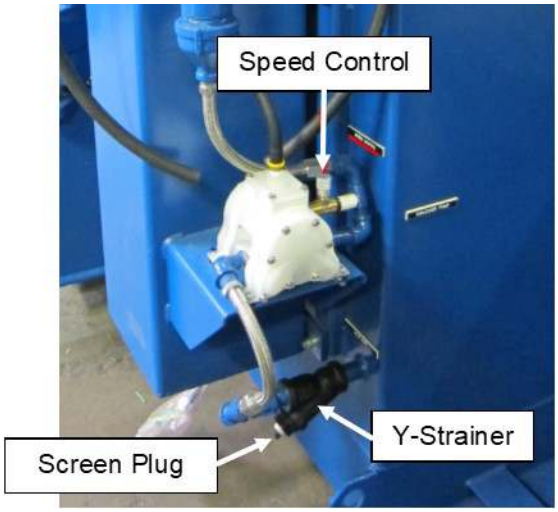


Fig. 7 - 38: Oil Coalescer Pump Suction Filter

Floating Suction Head (Float Balls): Inspect and clean the suction head float balls weekly (minimum).

1. Visually inspect the float balls for sludge and debris accumulation.
2. Slide suction head float assembly up and off the suction tube.
3. Secure the suction head float assembly in the parts washer and wash for one cycle.
4. Re-install suction head float assembly and ensure the suction head slides freely along the suction tube.

.

12.5. Troubleshooting

Your Oil Coalescer is designed and tested to provide many years of trouble free performance. Should you encounter operational trouble, the following provides technical reference for troubleshooting.

Problem:	***Pump not pumping***
Check This:	**Probable Cause(s)**
Air Supply	Check air supply
Floating Suction Head	Adjusted too high (readjust)
Air Discharge Muffler	Plugged (clear)
Air-pressure	Too Low (check air-supply system)
Pump Speed Control	Not opened properly (open)
Diaphragm Pump	Plugged with debris (clear)
Floating Suction Head	Clogged with debris or sludge (clear)

Fig. 7 - 39: Troubleshooting: Oil Coalescer Pump Not Pumping

Problem:	***Excessive water removed with oil***
Check This:	**Probable Cause(s)**
Oil Weir	Too close to or below water level (readjust)
Pump Speed Control	Adjusted too high (readjust)

Fig. 7 - 40: Troubleshooting: Excessive Water Removed with Oil

Problem:	***Excessive air being pumped into oil***
Check This:	**Probable Cause(s)**
Pump Speed Control	Adjusted too high (readjust)
Floating Suction Head	Adjusted too high (readjust)

Fig. 7 - 41: Troubleshooting: Excessive Air Pumped into Oil Coalescer Chamber

Problem:	***Cleaned Solution not draining back into washer reservoir***
Check This:	**Probable Cause(s)**
Water Weir	Adjusted too high (readjust)
Drain Tube to Washer Reservoir	Clogged (unclog)

Fig. 7 - 42: Troubleshooting: Cleaned Solution Not Draining Back into Washer Reservoir

13. Power-Assisted Door

The optional *Power-Assisted Door* supplies power to the door of the washer cabinet, which makes heavier-weight loads easier to handle: the operator can easily open and close the door weighted with up to 20,000 pounds (9070 kg) of load.

> ***NOTE:*** **The door can be operated manually, without power-assist.**

13.1. Theory of Operation

The *Power-Assisted Door* is pneumatically powered. A tandem air/hydraulic cylinder dampens and smoothes door operation. Speed-control valves on top of the cabinet can be adjusted to regulate the general range of opening and closing speed.

You can fine-tune your control of the speed at which the door opens and closes by raising and lowering the position-lock handle, which is located at the bottom of the door. The handle works like a throttle to increase and decrease speed.

13.2. Installation

The *Power-Assisted Door* is shipped installed on the cabinet. The speed-control valves are factory pre-set for a moderate opening and closing speed range.

13.3. Operations

> ***WARNING! NEVER put hands, legs, or head inside the door! This could result in severe injury or death!***

> ***WARNING! Before you attempt to open or close the power-assisted door, be sure you have enough clearance for the full arc-travel of the door as it swings!***

WARNING! NEVER swing the power-assisted door open to a position lock at an accelerated speed! Control the speed of the door by the position-lock handle, located at the bottom of the door. Use the handle like a throttle to adjust speed.

To operate the door, *follow this procedure*:

1. Select *open* or *close* on the *power-assist selector switch*, located on the front of the door.

2. Unlatch the door, if it is latched.

3. Lift and hold the *position-lock handle up* to keep the power-assist activated.

4. Release the handle to stop the power-assist.

The position-lock handle is located at the bottom of the door. The two position lock slots hold the door open at approximately a 60° angle and a 90° angle, respectively, from the front of the cabinet.

Securing the Door

Always be sure that the open door is locked in position:

- Visually check the position lock slot, *or*
- Try to pull or push the door

Refer to chapter *"Basic Operations"* for more general information on opening and closing the door.

13.4. Maintenance

Every 160 hours of operation:

- Check the filter/regulator/lubricator unit. The lubricator has an oil reservoir, and is located on the right side of the washer. Add oil, if required, to the fill-level.

Refer to your vendor-supplied cutsheet for instructions.

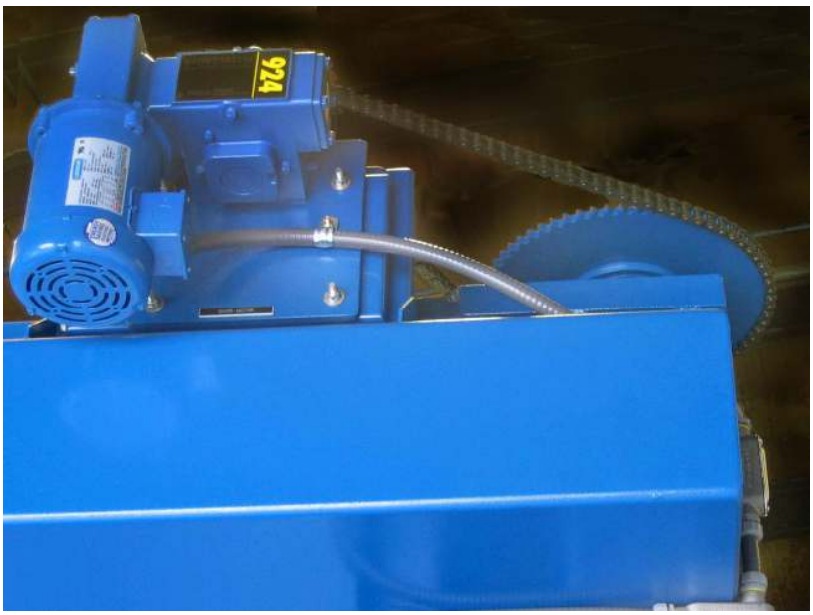
13.5. Troubleshooting

This section contains tables on the following problems:

- Power-assist does not activate

Problem:	***Power assist does not activate***
Check This:	**Probable Cause(s)**
Control valve	Stuck (replace)
Position-lock handle	Defective limit switch (replace)
Selector switch	Defective (replace)
Air-pressure	Not in the 75-100 PSI [1000-1400 kg/sq cm] range (check air-supply system)
Electric solenoid	Burned out (replace)

Fig. 7 - 43: Troubleshooting: Power-Assist Does Not Activate



14. Pump Pressure Gauge

The optional pressure gauge indicates the amount of pressure in the piping from the wash pump to the power blast manifold (PBM).

14.1. Theory of Operation

A coupling welded into piping between the pump and the PBM is used as a pressure tap point for a glycerin-filled pressure gauge. The pressure tap piping is a large diameter for easy clean out.

The pressure gauge assembly includes a diaphragm seal that prevents solution from entering the gauge. Pressure on the diaphragm is transmitted through the glycerin inside the gauge to the reading dial.

14.2. Installation

This option arrives factory-installed.

14.3. Operations

There are no operator instructions. The pump pressure gauge will indicate the pressure in the piping from the wash pump to the power blast manifold (PBM).

14.4. Maintenance

WARNING! NEVER disconnect the pressure gauge from the diaphragm seal! Glycerin will leak out and damage the gauge assembly!

If the gauge does not read pressure, *follow this procedure*:

1. Unscrew the diaphragm seal and gauge *together*.

2. Clean the gauge pipe out.

3. If the problem persists, replace the gauge and diaphragm-seal assembly.

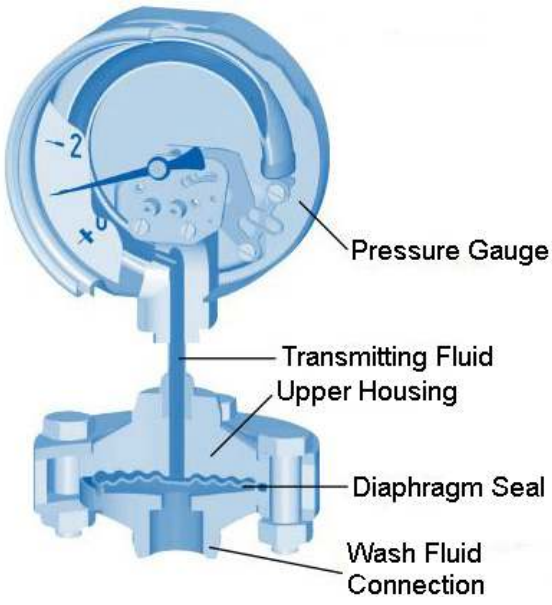
14.5. Troubleshooting

This section contains tables on the following problems:

- Pump pressure gauge does not work

Problem:	***Pump pressure gauge does not work***
Check This:	**Probable Cause(s)**
Gauge pipe	Clogged (clean out)
Gauge	Damaged (replace) Glycerin leakage (replace)
Diaphragm seal	Damaged (replace)

Fig. 7 - 44: Troubleshooting: Pump Pressure Gauge Does Not Work



15. Rack and Fixture Set, or Small-Parts Basket

All parts must be secured to the turntable during the cleaning cycle. To do this, use the following:

- Rack and fixture set
- Small-parts basket

Refer to chapter *"Basic Operations - Loading and Securing Parts"* for information on using securing devices.

15.1. Theory of Operation

The rack and fixture set and small-parts basket are optionally available from StingRay. Refer to the following two figures.

You may want to discuss your requirements with your StingRay representative, especially before you alter or add to the basic configuration to customize it for an application.

15.2. Installation

There is no installation required. The rack and fixture set and small-parts basket arrive ready to use.

NOTE: Large racks or fixtures may need to be assembled.

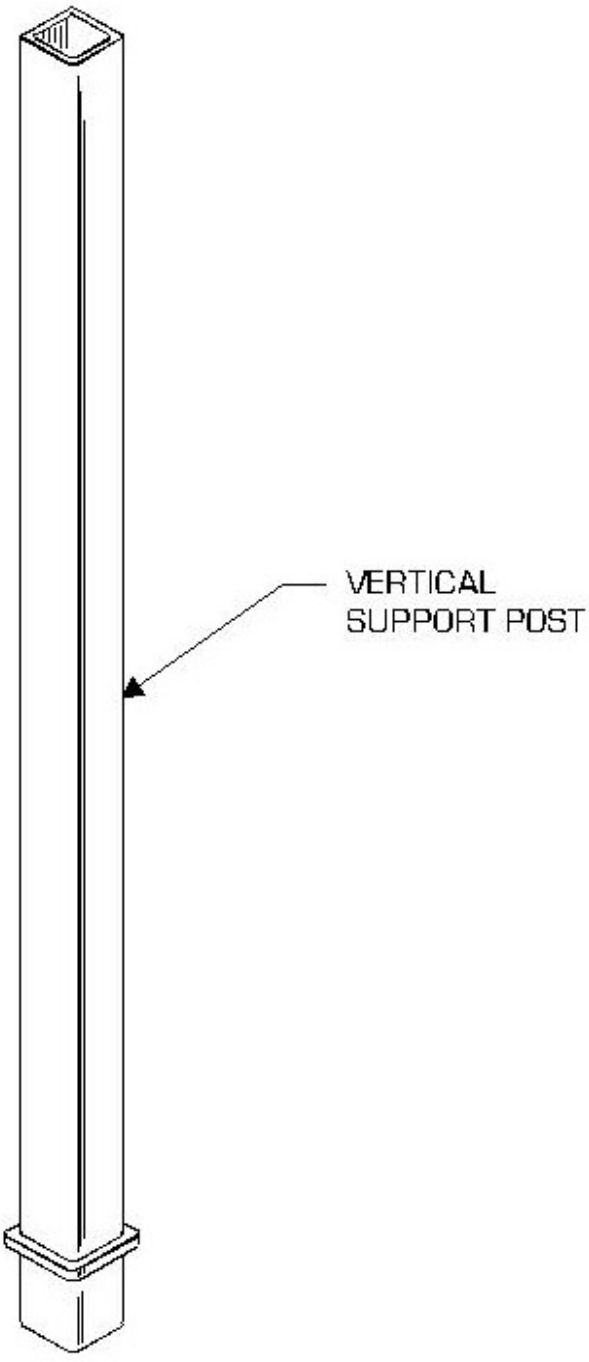


Fig. 7 - 45: Rack and Fixture Set

15.3. Operations

Refer to chapter *"Basic Operations - Loading and Securing Parts"* for information on using securing devices with the rack and fixture set.

To use the rack and fixture set, *follow this procedure*:

1. Select the appropriate 16-inch (40.6 cm) or 32-inch (81.3 cm) vertical post.

2. Insert it into a *turntable socket* that will position the *load nearest the center* of the turntable and ensure that no part of the load will hang outside the turntable.

3. Attach a *head rack* or other *fixture* to the *top* of the *centering vertical post,* facing the center of the turntable.

4. Load the *part* vertically inside the head rack or fixture.

5. Attach *securing devices*, as described in chapter *"Basic Operations - Loading and Securing Parts."*

To use the small-parts basket, *follow this procedure*: (refer to the following figure)

1. Load *small parts* into the *basket*.

2. Secure the *lid*.

3. Place the basket on the *center* of the *turntable*.

4. Attach *one end of the chain* to a *hook* located on the inner surface of the *turntable*'s outer rim.

5. Run the chain through both *basket handles*.

6. Attach the *end of the chain* or a *link* to a *hook,* located on one end of the load binder.

7. Attach the *hook* on the *other end* of the load binder to a *chain eyelet* directly across (180° angle) from the first hook.

8. Tighten the chain with the provided *load binder*.

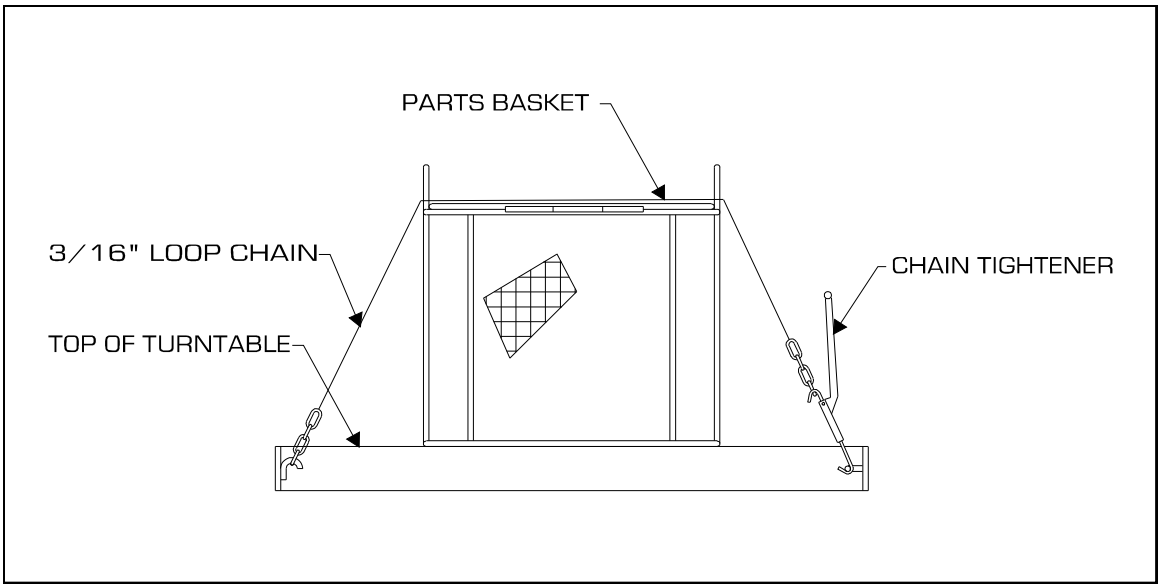


Fig. 7 - 46: Small-Parts Basket

15.4. Maintenance

Clean racks, fixtures, and baskets as required.

15.5. Troubleshooting

If you properly secure all parts, using racks, fixtures, small-parts baskets, and appropriate securing devices, no problems should arise from these options.

16. Remote Grease Fittings

The optional *Remote Grease Fittings* allow you to grease the turntable or the Power Blast Manifold (PBM) swivel bearings from the outside of the washer cabinet.

16.1. Theory of Operation

This option eliminates the need to disassemble any part of the washer or to get inside the cabinet in order to grease the turntable or the Power Blast Manifold (PBM) swivel bearings. It improves accessibility, reducing maintenance time.

This option is available for any bearing in the washer.

16.2. Installation

The optional *Remote Grease Fittings* are delivered installed, according to your specifications.

16.3. Operations

The *Remote Grease Fittings* are located on the nearest outside surface of the washer to the bearing. They are placed at a convenient height for the operator.

The remote turntable grease point is on the cabinet door. The remote swivel grease point is on the wash manifold side of the washer near the door.

16.4. Maintenance

None.

16.5. Troubleshooting

None.

17. Rinse Wand

The Rinse Wand is an optional addition to the standard rinse system. Its purpose is to manually rinse spot areas after a wash cycle.

The Rinse Wand consists of a gun-shaped handle with an extended tube that has a spray nozzle at its apex. The spray wand is hand-operated. Whenever the operator depresses the trigger, water from the supply line is released through the nozzle at line pressure.

NOTE: The water from the wand is not heated and contains no chemicals.

17.1. Theory of Operation

Supply-line water pressure powers the spray. The wand uses a two-gallon-a-minute fan-shaped nozzle. Since water from spray is normally returned to the water reservoir, a solenoid valve connected to the solution-level control system disallows spray-wand use whenever the solution level is at the HIGH-HIGH (maximum) mark. A light on the control panel indicates this condition.

17.2. Installation

This option is factory-installed.

17.3. Operations

After a cleaning cycle has completed, open the washer door to the first door-position lock stop. Use the *jog button* to rotate the turntable as you inspect the wash load for any area that may need additional rinsing. If you find such an area, release the *jog button* to stop the turntable.

> ***WARNING! Be sure to wear protective gear (face shield, gauntlet gloves, rubber apron)! Spray could be deflected back at you and could contain chemical residue that could cause serious chemical and scald-type burns to eyes and skin!***

Follow these operating guidelines:

1. Stand back several feet from the washer.
2. Aim the wand at the part.
3. Pull the trigger and direct the spray to the area that needs to be rinsed.

Remember the following:

- Wand water is not heated. It will not flash-dry as quickly as rinse water in the washer.
- Wand water returns to the reservoir and uses part of the rinse-bank (*rinse-bank* is the available volume for rinse water). Therefore, use of the wand could result in shortened rinses or no rinse at all. Keep rinse-wand use to a minimum to avoid this problem.
- Rinse-wand water contains no chemical additives such as rust inhibitor. Therefore, excessive use of the wand could cause rusting of parts.

17.4. Maintenance

Lubricate the gun trigger periodically.

17.5. Troubleshooting

This section contains tables on the following problems:

- No hand rinse

Problem:	***No hand rinse***
Check This:	**Probable Cause(s)**
Light on control panel	Solution level at HIGH-HIGH (maximum) mark Solenoid failed (replace)
Nozzle	Clogged (remove and clean)

Fig. 7 - 47: Troubleshooting: Rinse Wand: No Hand Rinse

18. Sludge Scraper

The Sludge Scraper removes sludge from the power washer's reservoir to a bin or barrel. The materials to be removed by the sludge scraper can be any solid material or any material that is of a consistency that will not run off of the scraper bars.

The sludge scraper provides these benefits.

- Extension of cleaning-solution life
- Better cleaning results

18.1. Theory of Operation

The washer is mounted on the sludge-scraper assembly, which replaces the original floor of the washer's reservoir. Part of the assembly extends as a chute behind the washer at a 45-degree angle.

When the Sludge Scraper is operating, scraper bars move across the bottom of the reservoir, collecting sludge and carrying it up the chute. At the end of the chute, the sludge drops into a bin or barrel. The scrapers then move back down the chute into the washer reservoir and begin to scrape the bottom of the reservoir.

The scrapers are attached to a sprocket-mounted drag chain that continuously rotates. The drag chain is direct drive with a head shaft-mounted gear motor and internal torque-limiter factory set at 33 ft-lbs.

The gear motor is a reversable AC-drive motor.

The Scraper is operated with a Mode Selector Swich on the main control panel with three selections: Auto, Manual and Off. In Manual Mode, there is a remote forward/reverse jog switch on the scraper chute.

An external view of the sludge scraper is shown in the following figure.

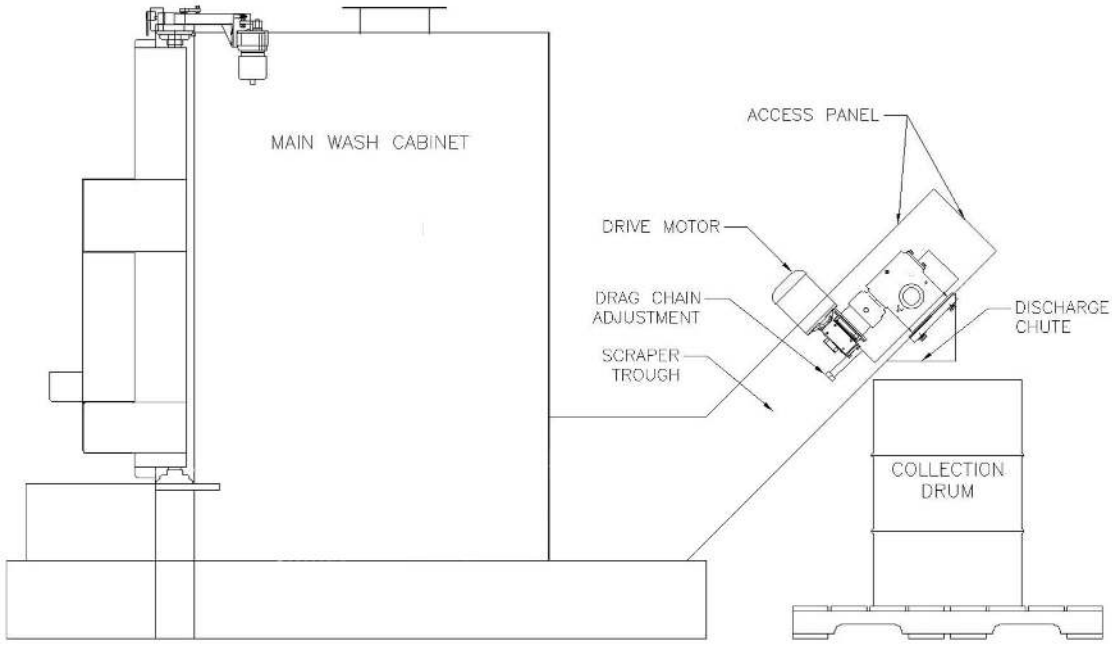


Fig. 7 - 48: Sludge Scraper -- External View

18.2. Installation

The Sludge Scraper is factory-installed.

18.3. Operations

The Sludge Scraper is designed to operate when the washer is in use, or after hours, when the washer is in "shut-down" (off) mode. A forward and reverse jog feature is provided to help free any scraper jams.

> ***WARNING! NEVER put your hands into the scraper chute! This could result in severe injury.***

To operate the Sludge Scraper, follow this procedure:

WARNING! Disconnect power before opening the control panel.

1. Set the Sludge Scraper timer, located in the washer's electrical control panel. The 1-hour timer is numbered 1-10 (each number represents a 6-minute increment). The timer controls the length of time the scraper operates in AUTO mode.

2. Set the scraper's mode selector switch, located on the washer's control panel, to one of the following:

    - MAN (MANUAL): Allows manual operation of the sludge scraper using the chute mounted FWD/REV switch.

    - OFF: Turns the scraper off.

    - AUTO: Automatically activates and runs the scraper at the end of a wash cycle for the time indicated on the scraper timer, 0 to 1 hour. The scraper will not operate during a wash cycle.

To operate the jog function, follow this procedure:

1. Set the selector switch on the control panel to MAN.

2. Go to the sludge scraper's discharge area and rotate the forward or reverse lever switch located in the small sludge scraper control panel.

18.4. Maintenance

Every 40 hours of operation:

Check chain tension.

If you need to adjust the tension of the drag chain, adjust the large bolts on the take-up frames. Adjust both sides equally.

The slip clutch is factory pre-set to 33 ft-lbs (4.5 kg-m), which is 5 ft-lbs. (.7 kg-m) below the allowable motor torque. Slight slippage during washing is common and normal.

Lubricate the take-up bearings with Lubriplate 1444 grease. The grease fittings are located at the chute end of the sludge scraper.

Check the blade wiper's initial contact when the wiper blade is at the top of the scraper bar.. To adjust the location of the initial contact, use the wiper adjustment bolts (See Fig. 7-48).

A diagram of the scraper is shown in the following figure.

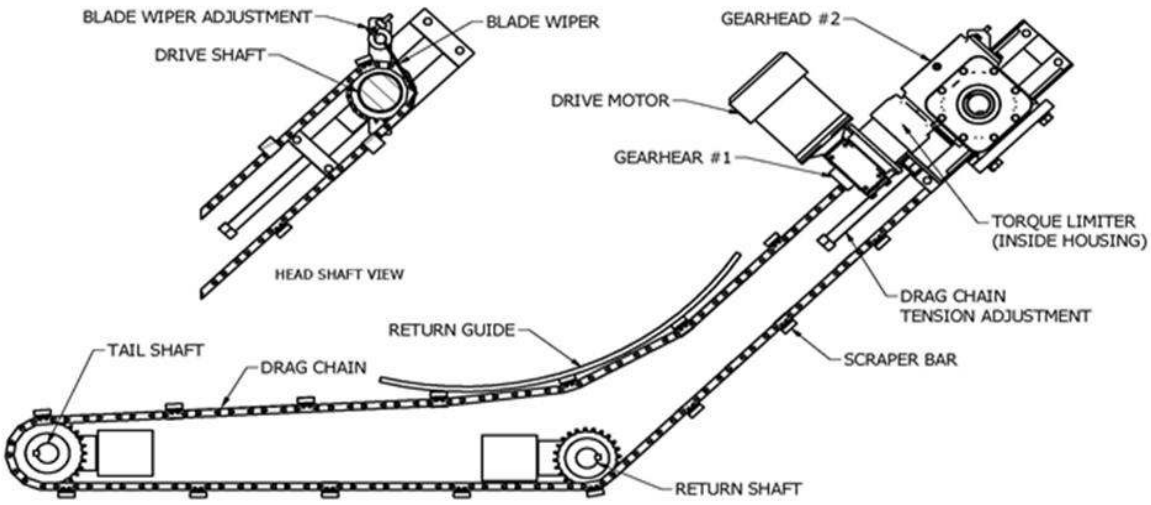


Fig. 7 - 49: Sludge Scraper -- Diagram of Parts

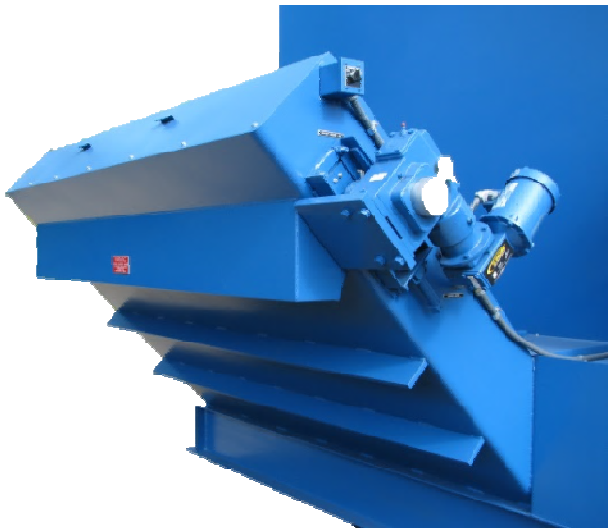
18.5. Troubleshooting

This section contains tables on the following problems:

- Sludge scraper drag chain does not move

Problem:	***Sludge scraper drag chain does not move***
Check This:	**Probable Cause(s)**
Chain	Caught on something (Use reverse jog) Broken Drive sprocket too loose (adjust tension -- tighten)
Sprockets	Chain is not on sprockets
Torque-limiter	Not adjusted correctly
Motor	Motor not turning: Selector switch OFF 7-day clock not set properly Fuse needs to be replaced Wires need to be tightened Motor needs to be replaced

Fig. 7 - 50: Troubleshooting: Sludge Scraper Drag Chain Does Not Move



19. Airlift System

The optional Airlift System adds the additional function of grease and floating contaminant removal to the parts washer sludge scraper. The Airlift System is the least expensive way of automatically removing floating grease. If your unit is equipped with the Mini Surface Drag-off Conveyor, the Airlift System is included.

The Airlift System provides these benefits:

- Removal of grease and other contaminants that float
- Increases the length of the cleaning solution life
- Reduces clean out costs
- Improves quality of cleaning

19.1. Theory of Operation

Grease and other floating contaminants are removed by compressed air-powered circulation system in conjunction with the sludge scraper. The airlift forces floating waste in front of the scraper bars for removal. Circulation of wash solution improves washer heat-up and recovery times by reducing thermal stratification.

Compressed air released through eductors creates fluid circulation in the reservoir. Solution is “lifted” from the bottom and moved across the solution surface toward the sludge scraper blades. Floating waste is forced in front of the blades, lifted out of the solution, dragged up the scraper chute and deposited in drums along with the waste hauled off the bottom of the reservoir.

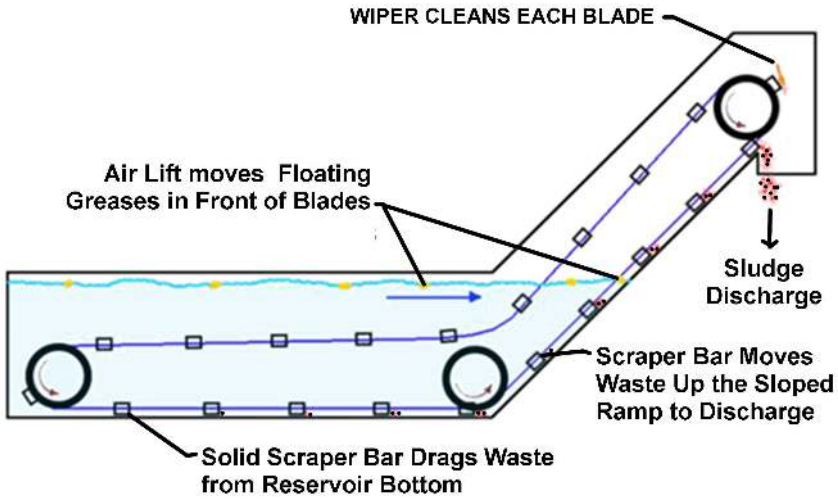


Fig. 7 - 51: Airlift System in Sludge Scraper

19.2. Installation

If you purchase the optional airlift system, your power washer is delivered with the airlift system factory-installed and ready to use. If your unit is equipped with the Mini Surface Drag-off Conveyor, the Airlift System is included.

1 Provide and install a 1/2-inch-diameter (13 mm) compressed-air line to the washer air –inlet. **Note:** If your washer uses compressed air for other functions there is one common connection and you may have already installed the required compressed air-line. An additional air-line is NOT required. (The incoming pressure range should be between 20-125 PSIG 138-860 kilopascals).

2 Connect an air filter in-line with the washer's compressed-air inlet. **Note:** The compressed air inlet is a 1/2 inch NPT fitting.

3. Airlift Regulator: Set the pressure regulator to the lowest setting that moves the solution at a steady rate. This pressure is generally within the 5 to 10 psi range, but can be more or less depending on your particular machine configuration and incoming compressed air configuration. Excessive air pressure will not yield more flow and tends to cool the wash solution instead of circulating it.

9.3. Operations

The airlift system is automatically controlled during scraper operating times and during washer heat-up periods. This system connects to factory compressed air.

19.4. Maintenance

During clean-out, inspect system and clean out any debris or soil build-up.

19.5. Troubleshooting

Problem:	***Airlift System is not functioning***
Check This:	**Probable Cause(s)**
Eductors	Clogged (Clean out)
Air Valve	Clogged (Clean out)
	Not opening (Replace)
Regulator	Clogged (Clean out)
	Set too low (Set to proper pressure)
Compressed Air	Blocked (Clean out)

Fig. 7 - 52: Troubleshooting: Airlift System is Not Functioning

20. Short High Impact Manifold (SHIM) System

The Short High Impact Manifold (SHIM) is designed to give you the advantage of two machines in one. A standard work height machine and a shorter work height, ultra high impact machine. When retracted you have the benefit of the entire cabinet height to wash tall parts and, when deployed, all the blasting energy is concentrated into a smaller work area for shorter loads and baskets of parts.

20.1. Theory of Operation

Two Power Blast Manifolds are coupled together and a set of valves directs the flow to one of the Manifolds. The Standard PBM is full height and SHIM, when deployed, reduces the work height by approximately one-half. The SHIM Manifold has a fold down horizontal upper arm. The vertical sections of the standard and SHIM manifold have the same number of nozzles so that the nozzles in the SHIM are packed more tightly together. The nozzles in the standard Manifold have a 25 degree blast pattern while the SHIM has narrower 15 degree pattern nozzles, thus more than doubling the impact pressure for shorter wash loads. A SHIM manifold is shown in the following figure.

20.2. Operations

Choose the proper manifold with the selector valve. Refer to the selector valve schematic diagram below and on the front of the Power Washer door for manifold selection.

To deploy the SHIM, reposition the PBM selector valve handle, remove the locking pin in the fold down arm section, pivot the arm to its horizontal position, and replace the locking pin to hold the horizontal SHIM arm in place.

> Be sure the fold down arm is locked in the proper position for the height of the wash load. A tall wash load may hit the fold down arm and damage the PBM drive

Do not walk on the internal reservoir cover to raise or lower the fold down arm or to switch the selector valve. Stand on the outside reservoir lid and reach into cabinet to make adjustments.

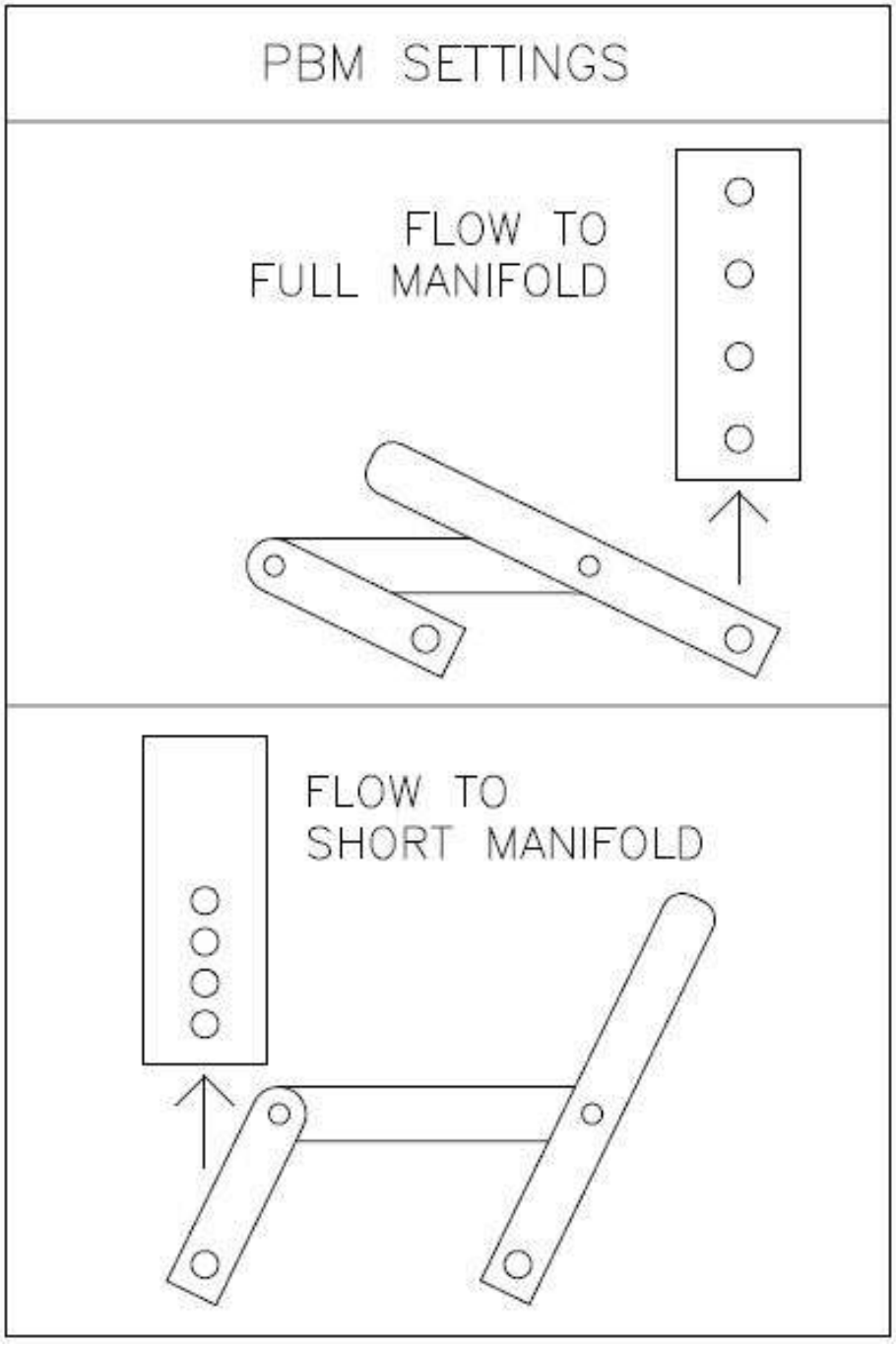


Fig. 7 - 53: SHIM Manifold Selector Valve Schematic (See Door of Washer)

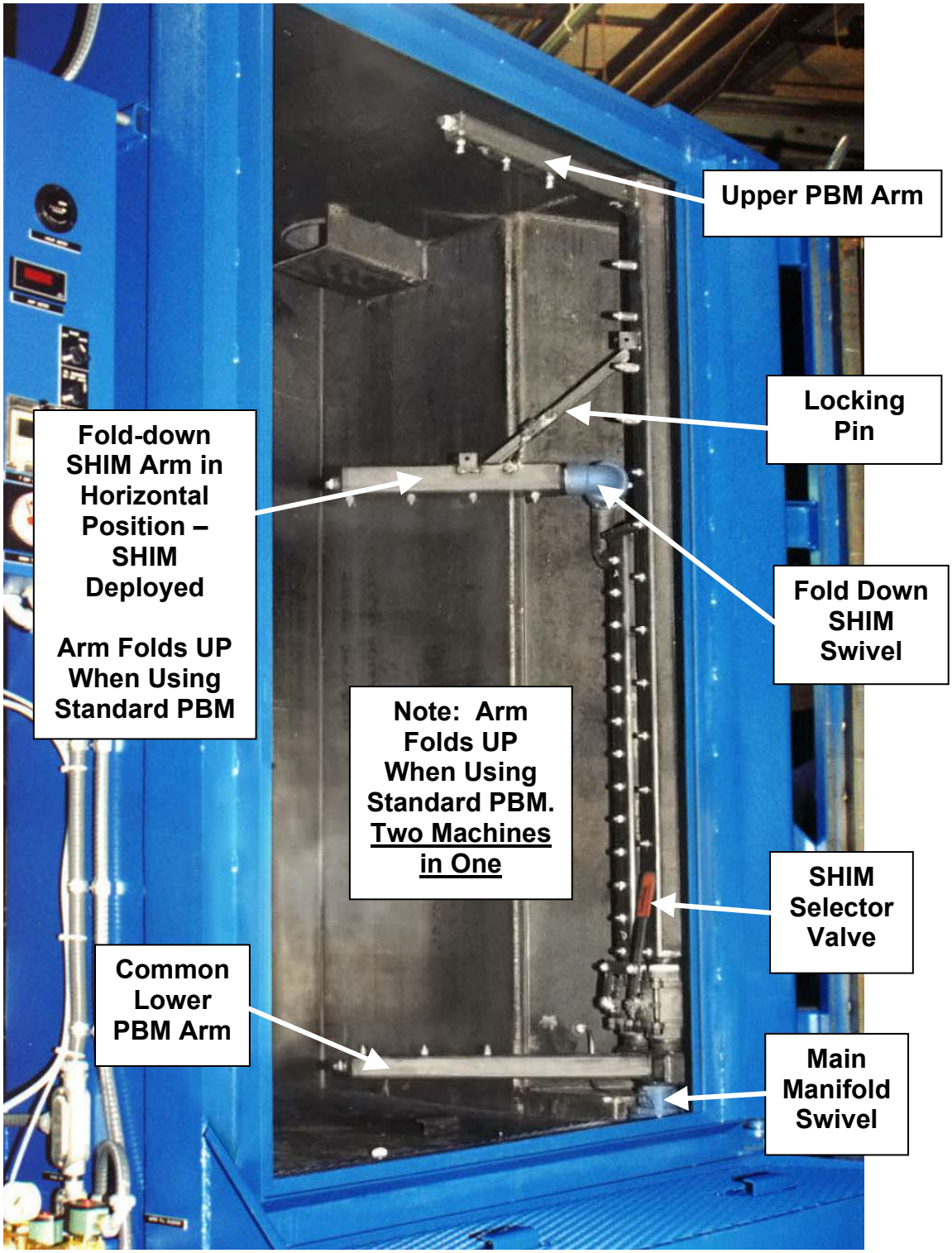


Fig. 7 - 54: SHIM Manifold System SR4063

20.3. Maintenance

Lubricate Fold down Arm Swivel every 8 hours of operation or as required with Lubriplate 144 grease.

Replace worn nozzles in both manifolds as required to prevent overloading of pumping system

20.4. Troubleshooting

Use procedures in chapters *"Installation", "Advanced Operations: Process-Control",* or *"Maintenance"* to correct a problem after you have diagnosed it.

Or, refer to your vendor-supplied manuals or cut sheets for instructions on correcting problems.

This section contains tables on the following problems:

- PBM not oscillating

Problem:	***PBM not oscillating***
Check This:	**Probable Cause(s)**
Linkage	Not connected
	Out of adjustment
	Loose
	Not connected to shaft
Bearings	Failed
Swivel	Not properly adjusted
	Not lubricated
	Not moving freely
PBM gear motor	Not rotating (check wires/fuses/overload tripped)
PBM mounting plate	Motor not securely attached to it

Fig. 7 - 55: Troubleshooting: PBM Not Oscillating

21. Pure Water/Pure Rinse: Integrated RO Water Fill & Rinse System

The StingRay Pure Water option is an integrated Reverse Osmosis filtration system that removes hard water minerals and other contaminates from the incoming water supply and stores the purified water in a machine mounted tank. The transfer pump runs on-demand when the solution level control system calls for make-up water or to provide water for the optional Auto Heated Rinse Cycle.

21.1. Theory of Operation

The Pure Water system is a machine specific engineered option that is sized and configured to produce and store purified water based on the consumption demand of the Parts Washer. The incoming water supplied to the system first travels through a 5 micron sediment filter to remove any solids and protect the pump. Additionally, the sediment filter is an activated charcoal block that removes chlorine to prevent damage to the membranes. The membranes provide the means of filtration for the system. Reverse Osmosis is a filtration method that uses a pump to force the incoming water through a thin film membrane. The pure water flow, exiting through the membrane, is called Permeate. This water is stored in the holding tank mounted on the machine. Water that does not pass through the membrane contains a higher concentration of deposits and undesirable hard water minerals, is called Concentrate. The Concentrate water is sent to the drain. To reduce overall water consumption, some of the Concentrate is sent through the recycle valve back to the inlet of the pump so it takes another trip through the system and turns more of the Concentrate into Permeate. The hydraulic flow schematic shown in Fig. 7-55 illustrates this functionality.

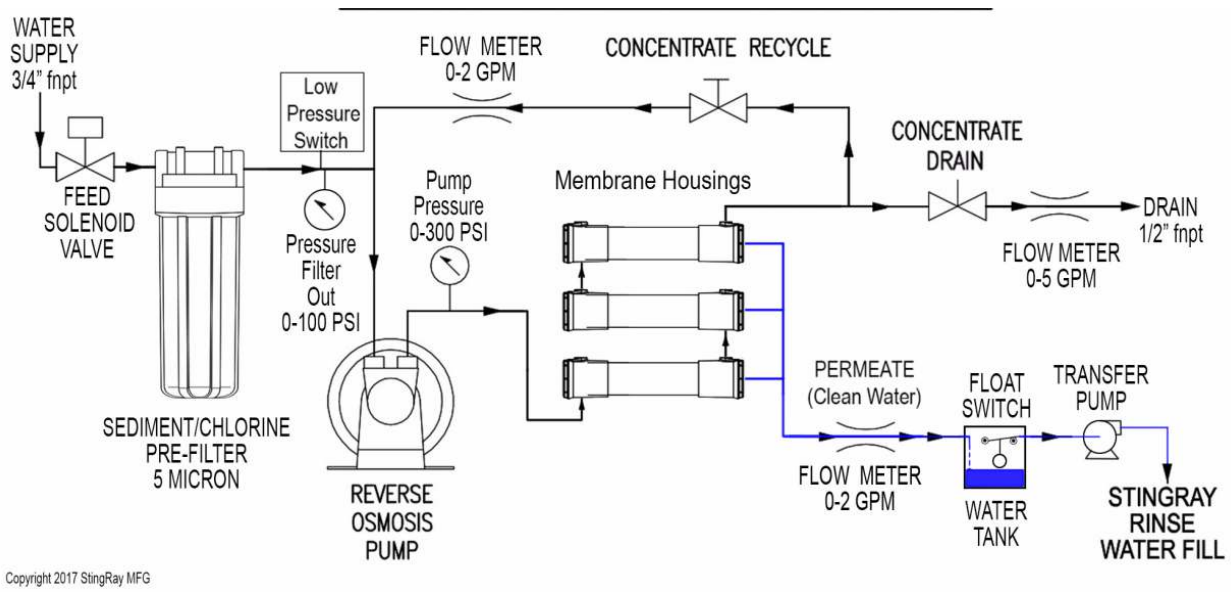


Fig. 7-56: General Schematic StingRay Pure Water Option

The incoming water conditions limit how much Concentrate can be recycled. To properly configure the Pure Water system, a detailed analysis of the incoming water supply is required. An incoming water analysis is available from your munincipal water supplier. In general, the Pure Water system operates effectively with a Total Dissolved Solids (TDS) value less than 2000 ppm and a preferred Total Hardness value of 0 ppm to 250 ppm. Values of hardness above zero shorten the life of the membranes. When the quality of the incoming water has values exceeding the Preferred Range, additional conditioning equipment such as an antiscalant injector or a water softener system can be utilized to prolong the life of the membranes.

The individual components of the Pure Water system are identified in Fig. 7-56:

1. Solenoid Valve – Turns On/Off Feed Water
2. Activated Carbon Block Pre-filter - removes chlorine and sediment to 5 micron
3. Pressure Switch – Low pressure shut down
4. RO Pump – Pressurizes RO System
5. Concentrate Valve – Controls flow of waste (concentrated) water to the drain
6. Recycle Valve – Controls flow of Concentrate Water back to the feed.
7. Recycle Flow Meter
8. Concentrate Flow Meter
9. Permeate Flow Water
10. Filter Out Pressure Gauge
11. Pump Pressure Gauge
12. Membrane Housings
13. Control Switch, Turns System On/Off

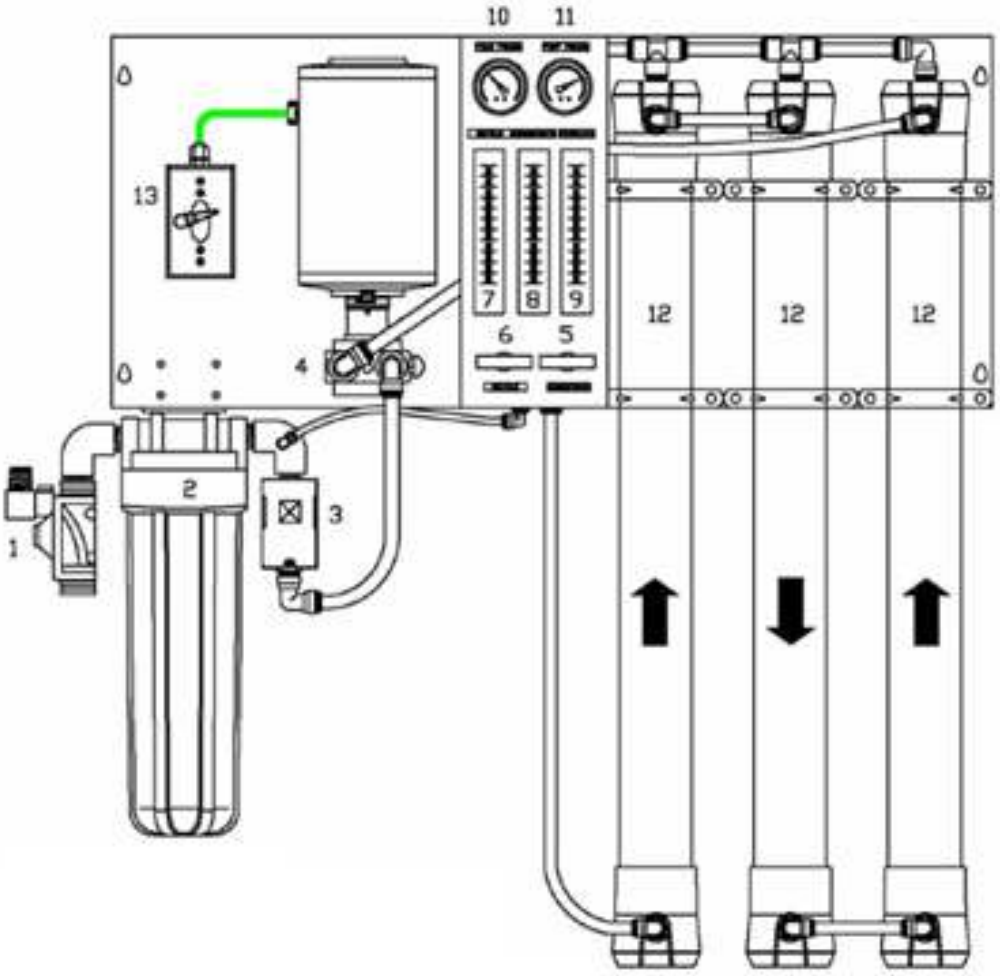


Fig. 7-57: Pure Water System Components

21.2. Installation

The Pure Water System is fully installed, wired, plumbed, and tested at the factory. Only the inlet water supply and concentrate (waste) discharge need connection.The incoming water supply requires connection to the ¾" NPT bulkhead fitting on top of the Pure Water System enclosure. Incoming water pressure must be regulated to between 45 – 85 psi (310-590 kPa) and at a temperature between 40 – 85 °F (5 - 30°C). Then, the waste line is connected to the ½" NPT drain connection located under the Pure Water tank frame. Once these connections are made, the system is ready for purging and the start-up procedure. Please refer to the spec sheet attached to the Pure Water system enclosure for your machine specific spec sheet. You will use these settings in the Start-Up Procedure.

INSTALLATION

1. Check all plumbing and electrical connections for tightness and verfity they did not loosen during shipment.
2. Connect water supply to ¾" NPT fitting located on top of system housing.
3. Connect drain line to ½" NPT fitting located under the water tank mounting frame.

PURGING & START-UP PROCEDURE

1. System Purge.
    a. Fully open concentrate valve.
    b. Fully close recycle valve.
    c. Engage bypass lever (red) on the feed solenoid (Fig. 7-57).
    d. Turn on the water supply and let the system purge until no visible bubbles appear in the concentrate flow meter.
    e. Disengage the bypass lever.
2. Apply electrical power to the machine, which provides power for the Pure Water system.
3. Regulate incoming water supply between 45 – 85 psi (310-590 kPa) then read Filter Out pressure gauge and record in Table 1 on the system spec sheet.
4. Adjust pump bypass screw (Fig. 7-58), concentrate valve, and recycle valve to the system settings indicated on the machine specific spec sheet.
5. Subtract 10 psi (70 kPa) from the initial Filter Out reading and record on the spec sheet. This value indicates when it is time to change the filter cartridge..
6. Allow system to fill the machine reservoir and actuate float level switch, ensure system shuts off when machine reservoir and holding tank is full.

Fig. 7 – 58: Feed Solenoid Bypass Lever

Fig. 7 – 59: Pump Bypass Screw

21.3. Operations

The functions of the Pure Water system are integrated with the standard automatic features of the Parts Washer. When the machine is empty such as when it is first installed or after draining and cleaning, the Pure Water system fills the entire reservoir to set point automatically, however this process takes several hours so it is suggested to allow the machine to fresh fill overnight. Keep in mind that pure water is an aggressive form of water and can cause corrosion quickly on bare steel surfaces. Means to protect the cabinet with rust preventative is important.

During normal cleaning operation, the Pure Water system runs and produces permeate automatically when the Water Tank is below the fill point. During a Rinse Cycle, the transfer pump runs automatically to provide the rinse system with water. When the machine is not running a wash cycle and the water level is below set point, the transfer pump runs automatically to fill the machine with make-up water as described in Chapter 3.2.8.

21.4. Maintenance

Refer to Fig. 7-52 to help locate the individual components described in the maintenance procedures.

Every 40 Hours of Operation

System Flushing removes hard water particles and other solids from the surface of the membranes increasing efficiency and prolonging membrane life.

Follow this procedure:

1. Perform flushing procedure with RO system running while tank is filling.
2. Fully open the Concentrate (waste) Valve and fully close the Recycle Valve.
3. Allow the system to run for 10 to 20 minutes. If necessary, the system can be “forced” on by pressing the float rod on the machine down for about 30 sec which causes the pump to fill the machine with water from the tank.
4. After 10 to 20 minutes, adjust the Concentrate Valve and Recycle Valve to the previous settings.

Every 200 Hours of Operation

Replace the pre-filter cartridge (p/n 54502) to prevent the membranes from fouling by chlorine and to prevent damage to the pump from sediment. The pre-filter cartridge may need replacement more often depending on operating conditions, if the pressure on the Filter Out gauge drops by 10 psi (70kPa) from when it was first installed, it is time to change the cartridge.
Replacement filter cartridges (p/n 54502) are available from StingRay Tech Services.

Follow this procedure:

1. Have the new cartridge ready along with a 5 gallon bucket.
2. Turn off the Control Switch on the RO System Panel. This closes (deenergizes) the Solenoid Valve.
3. Using the black filter housing wrench, loosen the filter housing. When looking down at the wrench, turn handle clockwise.
4. Remove wrench from housing and continue turning until the housing can be pulled down off the mount.
5. Dump the old cartridge and water into the bucket.
6. Place the new, unwrapped cartridge centered into the housing and install onto the base. Snug by hand, then tighten with wrench ¼ turn.
7. Perform the System Purge procedure as described in Section 20.2.
8. Check for leaks and tighten the housing if necessary.

Every 1000 Hours of Operation

Replace the membranes. Observe the Permeate flow meter and compare to the Permeate Flow value found on the system performance specifications table located on the RO enclosure door. The membranes may need to be replaced sooner if Permeate water production drops by 20% or if the system is operating at a higher pressure. Do not operate above 150 psi (1034kPa). If the system is supplied with hard water containing calcium and magnesium particles, the membranes can foul with scale at a faster rate and will require replacement more often to maintain the desired level of Permeate water production.

Replacement Membranes (p/n 54500) are available from StingRay Tech Services. Detailed membrane installation instructions are included.

21.5. Troubleshooting

Problem:	*Low Filter Pressure*
Check This:	**Probable Cause(s)**
Low Supply Pressure	Increase inlet pressure
Cartridge Filter Plugged	Change Filter
Solenoid Valve Malfunction	Replace coil and/or solenoid valve
Pump Motor Failure	Check motor amp draw and winding continuity
Pump Damage	Install pump repair kit
Damaged Concentrate Valve	Check/Clean/Replace needle valve
Leaks	Ensure proper hose insertion/replace fitting

Fig. 7 - 60: Troubleshooting: Low Filter Pressure

Problem:	*Low Permeate Flow*
Check This:	**Probable Cause(s)**
Low Inlet Flow	Adjust concentrate valve
Cold Feed Water	Permeate production decreases proportionately with temperature
Low Operating Pressure	See Low Filter Pressure
Defective Membrane	
Brine Seal	Inspect and/or replace o-rings
Fouled or Scaled Membrane	Clean membranes and/or replace

Fig. 7 - 61: Troubleshooting: Low Permeate Flow

Problem:	*High Permeate Flow*
Check This:	**Probable Cause(s)**
Damaged Product Tube	
O-Rings	Inspect and/or replace o-rings
Damaged or Oxidized	
Membrane	Replace membrane
High Feed Water Temperature	Do not exceed 85°F (29°C) feed water temperature

Fig. 7 - 62: Troubleshooting: High Permeate Flow

Problem:	***Poor Permeate Quality***
Check This:	**Probable Cause(s)**
Low Operating Pressure	See 'Low Filter Pressure'
Damaged Product Tube O-Rings	Inspect and/or replace o-rings
Damaged or Oxidized Membrane	Replace membrane

Fig. 7 - 63: Troubleshooting: Poor Permeate Quality

Problem:	***No Water Fill in Washer***
Check This:	**Probable Cause(s)**
Float switch failed or stuck	Replace switch
Transfer Pump Not Running	Check pump overload/Service pump
No Permeate in Water Tank	Check RO System overload/Check Settings
Water Supply Shut Off	Open water supply
Pre-filter Clogged	Replace filter
Membranes Clogged/Fouled	Service/replace membranes

Fig. 7 - 64: Troubleshooting: No Water Fill in Washer

Problem:	***Transfer Pump Runs Constantly***
Check This:	**Probable Cause(s)**
Delay Timers Set Incorrectly	Set timers as shown on electrical schematic

Fig. 7 – 65: Troubleshooting: Transfer Pump Runs Constantly

Problem:	***Washer Fills Slowly***
Check This:	**Probable Cause(s)**
RO System Operating Below Spec	Service RO System
Reduced RO System output	Incoming water quality limits permeate flow
Limited RO System Capacity	By design, machine takes several hours to fill

Fig. 7 – 66: Troubleshooting: Washer Fills Slowly

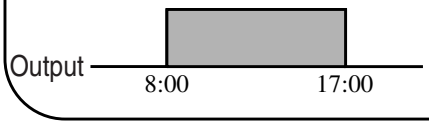
★How would you like to use the Time Switch?

The H5S Time Switch offers **simple operation** to set various time controls.

You want the Time Switch to turn an output ON/OFF at a scheduled time.

<Cases> • You want to put a machine into operation between certain times.
• You want to turn on a light between certain times.

Timer operation is recommended.

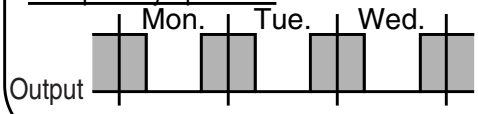


☞ 4-1

You want the Time Switch to turn outputs ON/OFF over several days.

<Cases> • You want to put a machine into operation from 22:00 to 8:00 in the next morning.
• You want to turn ON an output at 10:00 on Monday and turn it OFF at 17:00 on Friday.

Multiple-day operation is recommended.

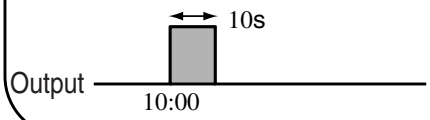


☞ 4-2

You need a pulse-output for a short time.

<Cases> • You need an ON pulse-output to activate a device for preheating.
• You want to ring a chime or time signal.

Pulse-output operation is recommended.

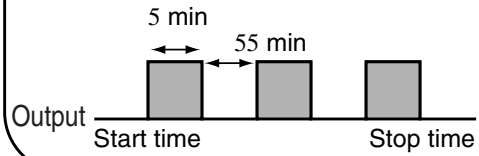


☞ 4-3

You want the Time Switch to turn outputs ON/OFF at the same intervals.

<Case> • You want to water plants for five minutes every hour from 9:00 to 17:00.

Cyclic operation is recommended.



☞ 4-4

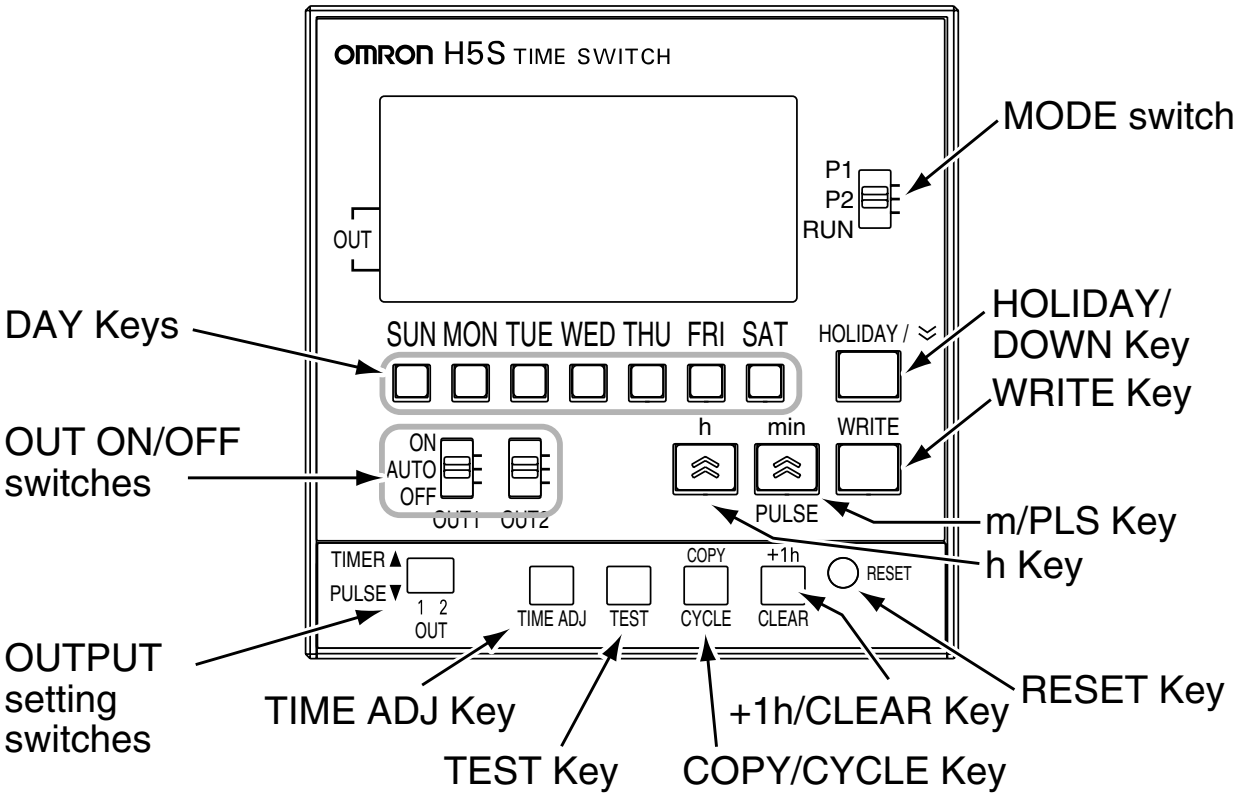
※ Refer to the main part to know the other functions or those details.

2. Nomenclature

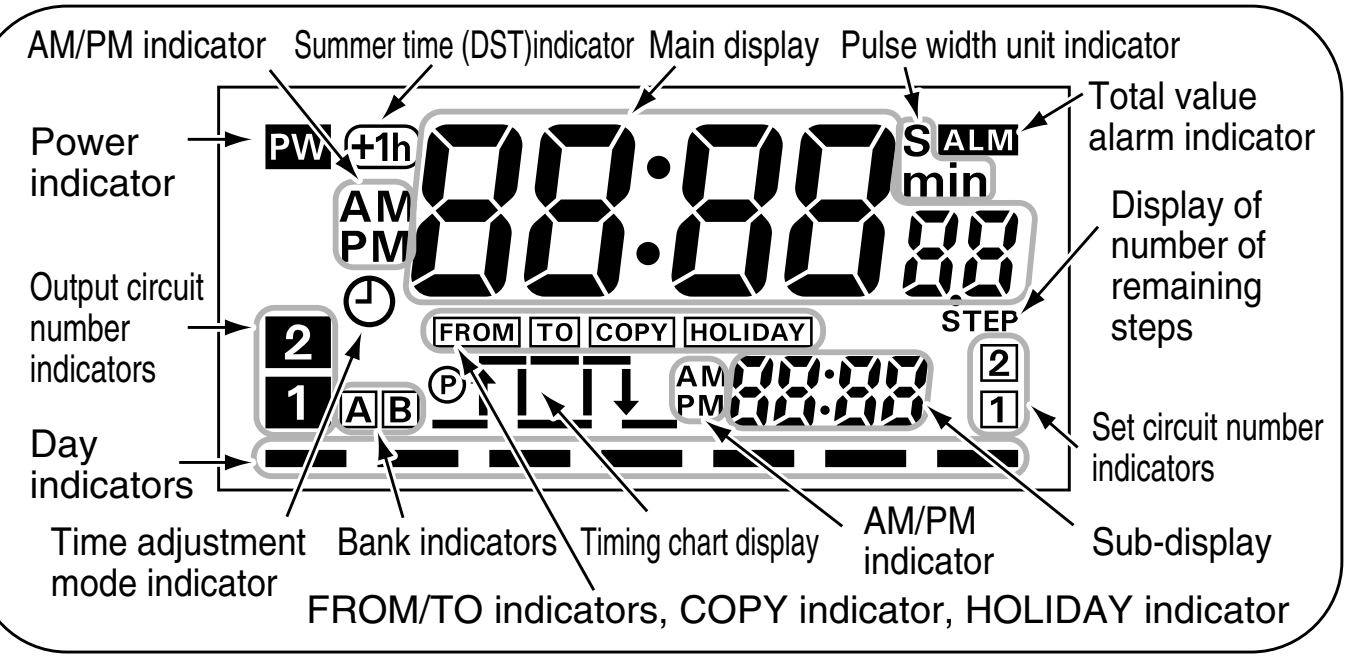
Weekly
2 chnls

<Front panel>

<Weekly 2 chnls>



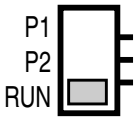
<Display>



3. Time Adjustment Weekly 2 chnls

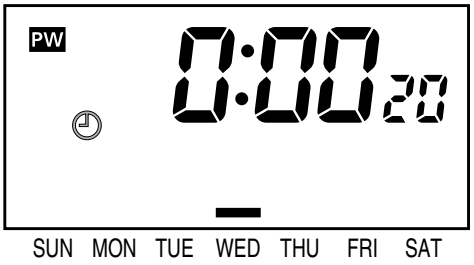
【Example】The current time (day/hour/minute) is set to Saturday 17:28.

① Set the Mode Switch to RUN.

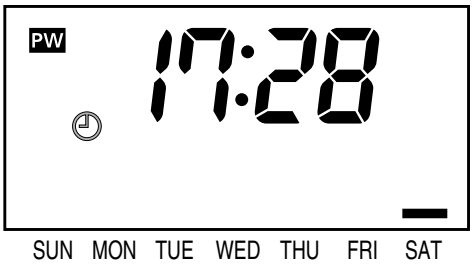


The ▭ color indicates flashing.

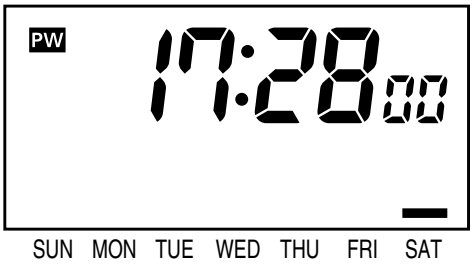
② Press [TIME ADJ] for 2 s or more.
The ◴ symbol flashes.



③ Press [SAT].
(The bar (▬) mark at the Saturday position will turn ON.)
Set the time with [h] and [m]. ※1



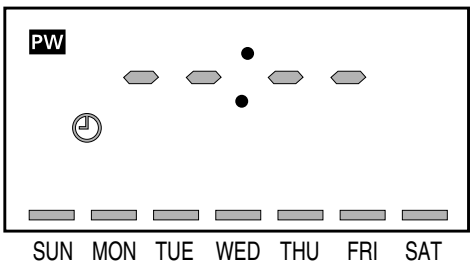
④ Press [WRITE] to confirm the setting, and the Time Switch will start timing from 0 second.



※1 Holding down these Keys rapidly advances the value.
Pressing [≪] decrements the value of the Key that was last pressed.

≪Note≫

- On first power-up or after a reset (☞ Section 8), the time adjustment display appears on the screen. Adjust the time by following the steps ③ and ④.
- If [TIME ADJ] is pressed again before confirming the time adjustment setting, the setting is cancelled.

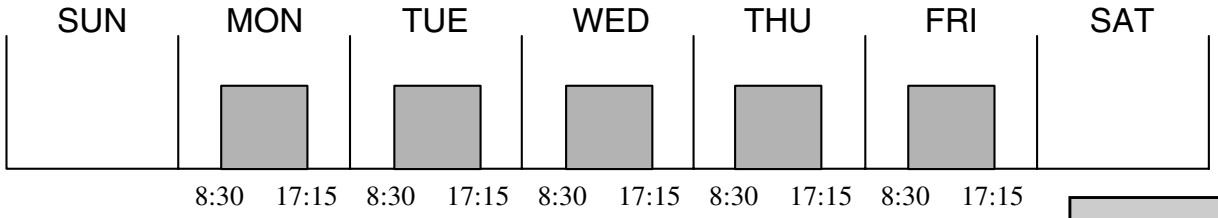


4. Basic Operations

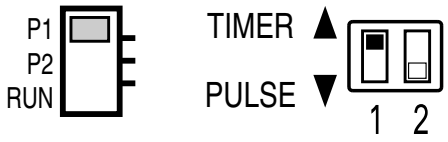
4-1. Ordinary Timer Operation

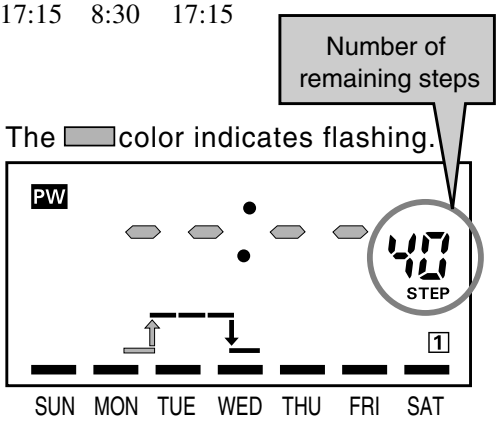
Weekly 2 chnls | Yearly 2 chnls | Yearly 4 chnls

【Example】The Time Switch turns ON circuit 1 or circuit 2 at 8:30 and turns it OFF at 17:15 from Monday through Friday.

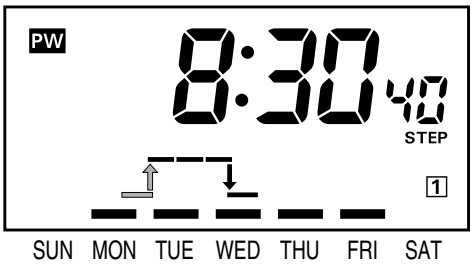


① Set the Mode Switch to P1 or P2. ※1
→See Section 4-5 for 4 channel type.



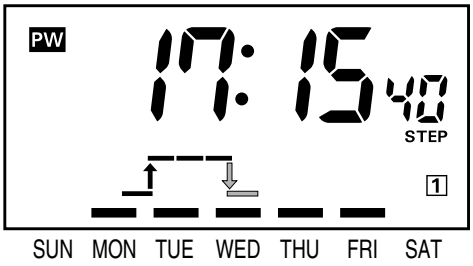


② Press the DAY Keys to turn on the bars (—) at the positions of Monday through Friday. Set the ON time with [h] and [m]. ※2



③ Press [WRITE].
Set the OFF time with [h] and [m]. ※2

④ Press [WRITE] to confirm the settings.



※1 If one or more programs have already been set, the display starts showing the set programs. To add another program, press [WRITE] repeatedly until "--:--" is displayed.

※2 Holding down these Keys rapidly advances the value. Pressing [≫] decrements the value of the Key that was last pressed.

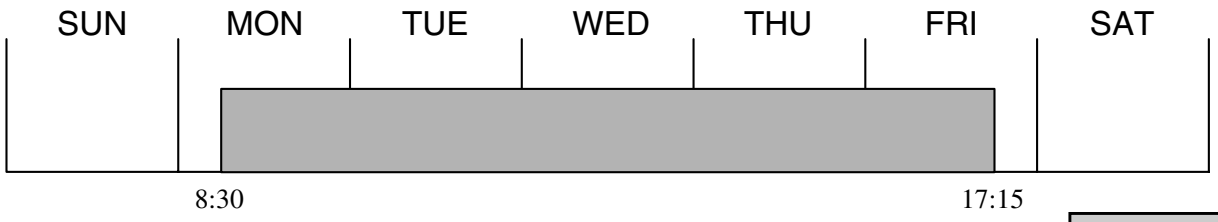
≪Note≫

- If multiple settings are required, repeat the steps ② through ④.
- Both the ON and OFF times must be set.
- All the set weekly programs can be checked by pressing WRITE in program setting mode.
- When the Mode Switch is set to P1 or P2 (to PRGM for 4 channel type), the Time Switch stop automatic operation. To forcibly turn ON or OFF the output, use the OUT ON/OFF switches.
- The set data will be cleared if the OUTPUT setting switch is moved between the TIMER and PULSE positions after the data has been set.

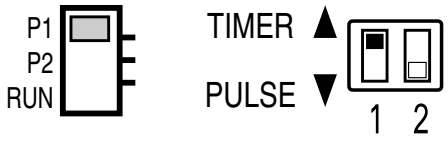
4-2. Multiple-day operation

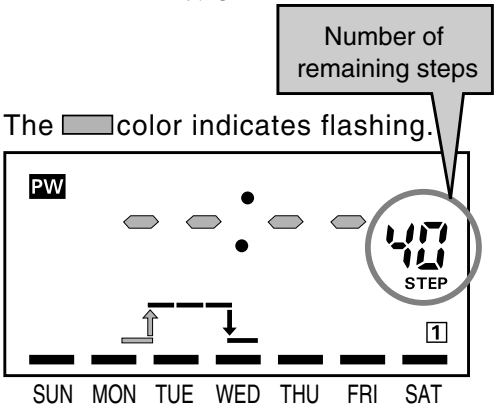
Weekly 2 chnls | Yearly 2 chnls | Yearly 4 chnls

【Example1】The Time Switch turns circuit 1 or circuit 2 ON continuously between 8:30 on Monday and 17:15 on Friday.

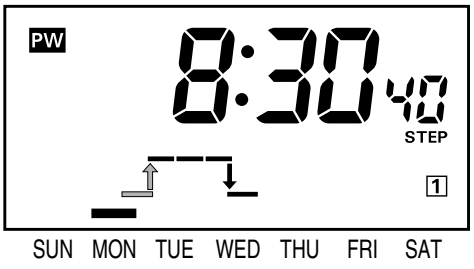


① Set the Mode Switch to P1 or P2. ※1
→See Section 4-5 for 4 channel type.

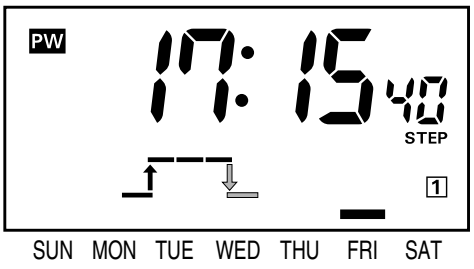




② Press [MON] to turn on the bar (▬) at the Monday position.
Set the ON time with [h] and [m] .※2



③ Press [WRITE] .
Press [MON] to turn off the bar (▬) at the Monday position and press [FRI] to turn on the bar (▬) at the Friday position.
Set the OFF time with [h] and [m] . ※2

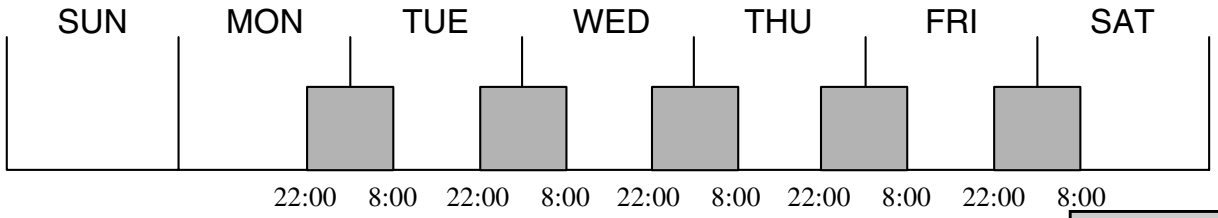


④ Press [WRITE] to confirm the settings.

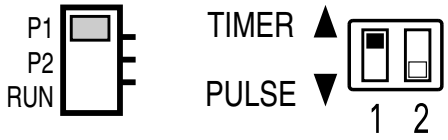
※1 If one or more programs have already been set, the display starts showing the set programs. To add another program, press [WRITE] repeatedy until "- - : - -" is displayed.

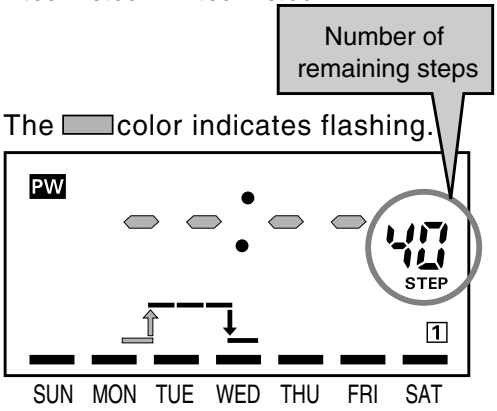
※2 Holding down these Keys rapidly advances the value.
Pressing [≫] decrements the value of the Key that was last pressed.

【Example 2】The Time Switch turns ON circuit 1 or circuit 2 at 22:00 from Monday through Friday and turns it OFF at 8:00 each following morning.

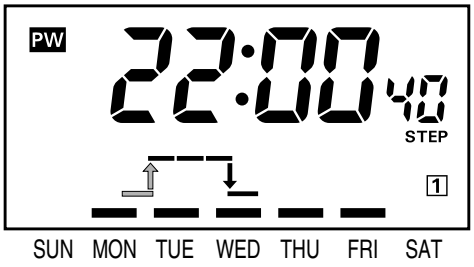


① Set the Mode Switch to P1 or P2. ※1
→See Section 4-5 for 4 channel type.

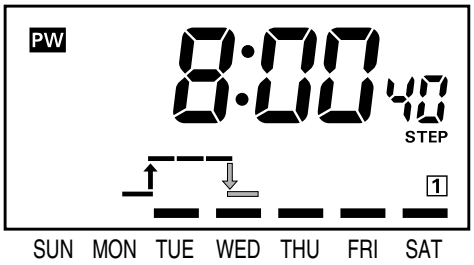




② Press the DAY Keys to turn on the bars (▬) at the positions of Monday through Friday.
Set the ON time with [h] and [m]. ※2



③ Press [WRITE].
Press [MON] to turn off the bar (▬) at the Monday position and press [SAT] to turn on the bar (▬) at the Saturday position.
Set the OFF time with [h] and [m]. ※2



④ Press [WRITE] to confirm the settings.

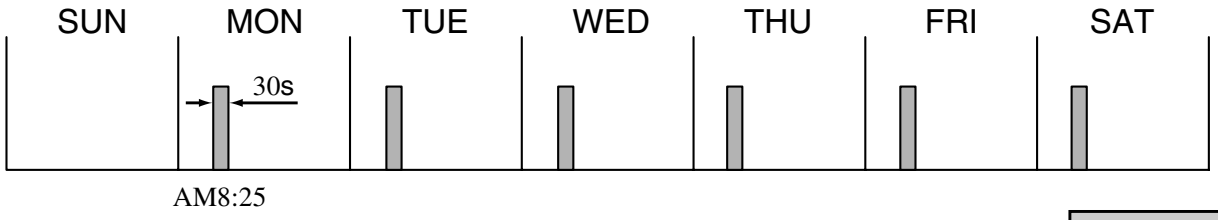
※1 If one or more programs have already been set, the display starts showing the set programs. To add another program, press [WRITE] repeatedly until "--:--" is displayed.

※2 Holding down these Keys rapidly advances the value.
Pressing [≫] decrements the value of the Key that was last pressed.

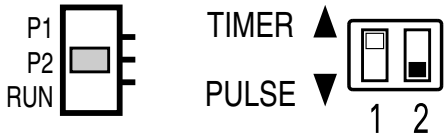
4-3. Pulse-output Operation

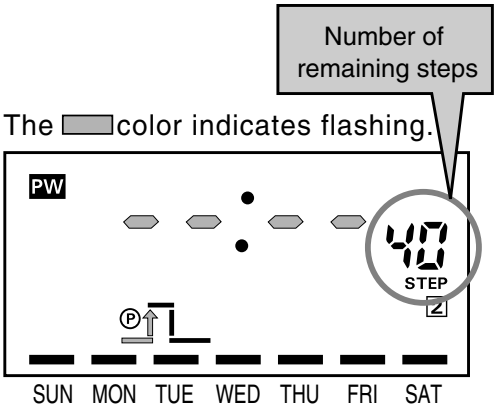
Weekly 2 chnls | Yearly 2 chnls | Yearly 4 chnls

【Example】The Time Switch turns ON circuit 1 or circuit 2 for 30 seconds at 8:25 am from Monday through Saturday.

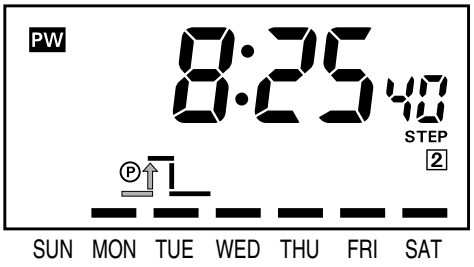


① Set the Mode Switch to P1 or P2. ※1
→See Section 4-5 for 4 channel type.

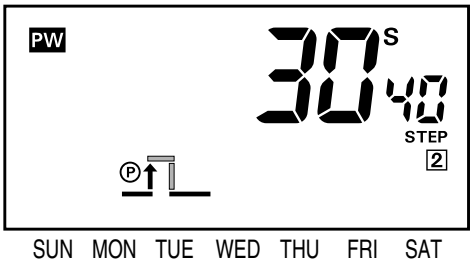




② Press the DAY Keys to turn on the bars (▬) at the positions of Monday through Saturday.
Set the ON time with [h] and [m] . ※2



③ Press [WRITE].
Set the pulse width with [PLS] .※2
The displayed pulse width changes by pressing this Key in the following order.
1s→2s→…→59s→1m→…59m→60m→1s



④ Press [WRITE] to confirm the settings.

※1 If one or more programs have already been set, the display starts showing the set programs. To add another program, press [WRITE] repeatedly until "--:--" is displayed.

※2 Holding down these Keys rapidly advances the value.
Pressing [≪] decrements the value of the Key that was last pressed.

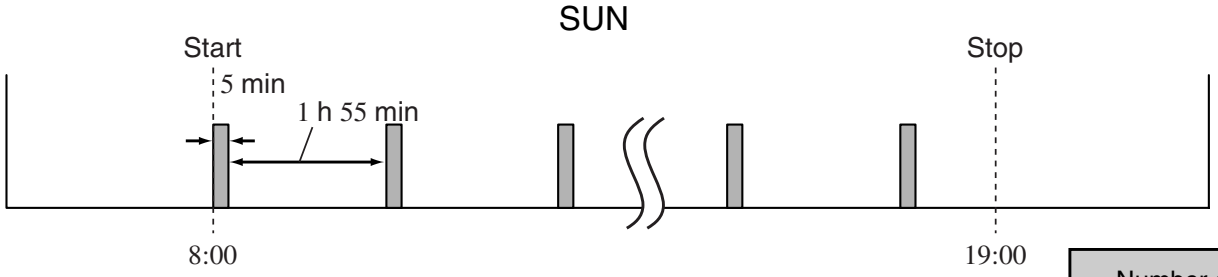
≪Note≫

- If multiple settings are required, repeat the steps ② through ④.
- Both the ON time and pulse width must be set.
- All the set weekly programs can be checked by pressing WRITE in program setting mode.
- When the Mode Switch is set to P1 or P2 (to PRGM for 4 channel type), the Time Switch stops automatic operation. To forcibly turn ON or OFF the output, use the OUT ON/OFF switches.
- The set data will be cleared if the OUTPUT setting switch is moved between the TIMER and PULSE positions after the data has been set.

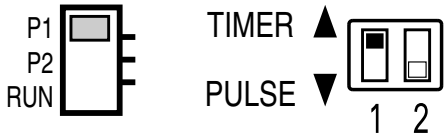
4-4. Cyclic Operation

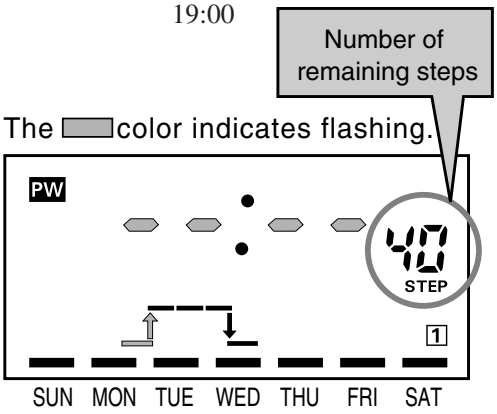
Weekly 2 chnls | Yearly 2 chnls | Yearly 4 chnls

【Example】The Time Switch turns circuit 1 or circuit 2 ON for 5 minutes and OFF for 1 hour 55 minutes repeatedly from 8:00 to 19:00 on Sunday.

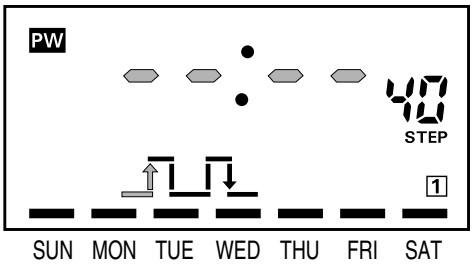


① Set the Mode Switch to P1 or P2. ※1
→See Section 4-5 for 4 channel type.

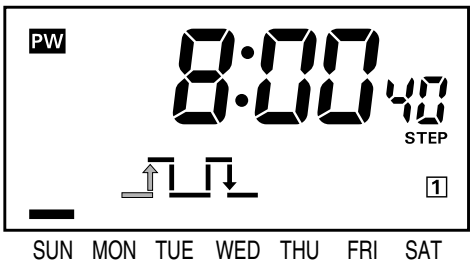




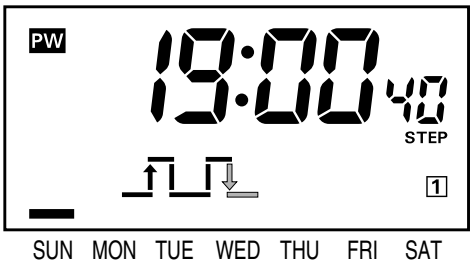
② Press CYCLE .
(The display moves to cyclic program setting mode.)



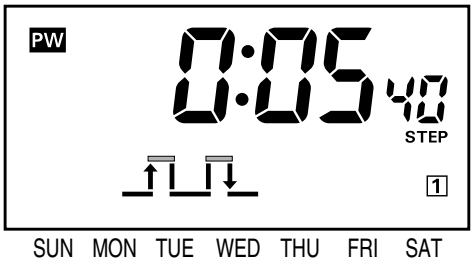
③ Press SUN to turn on the bar (—) at the Sunday position.
Set the start time to 8:00 with h and m .※2



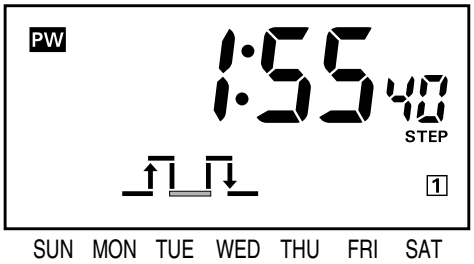
④ Press WRITE .
Set the stop time to 19:00 with h and m . ※2



⑤ Press WRITE.
Set the ON time period with h and m. ※2



⑥ Press WRITE.
Set the OFF time period with h and m. ※2



⑦ Press WRITE to confirm the settings.

※1 If one or more programs have already been set, the display starts showing the set programs. To add another program, press WRITE repeatedly until "--:--" is displayed.

※2 Holding down these Keys rapidly advances the value.
Pressing ≫ decrements the value of the Key that was last pressed.

≪Note≫

- If multiple settings are required, repeat the steps ② through ⑦.
- All the start/stop times, ON/OFF time periods must be set.
- All the set weekly programs can be checked by pressing WRITE in program setting mode.
- When the Mode Switch is set to P1 or P2 (to PRGM for 4 channel type), the Time Switch stops automatic operation. To forcibly turn ON or OFF the output, use the OUT ON/OFF switches.
- Set Cyclic operation so as not to overlap other operations in individual circuits.
- The set data will be cleared if the OUTPUT setting switch is moved between the TIMER and PULSE positions after the data has been set.

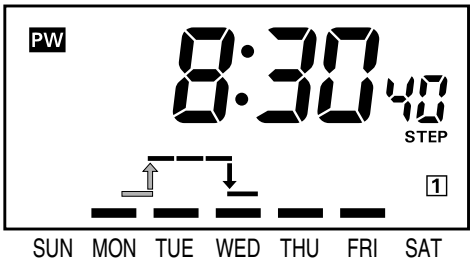
4-9. Clearing the Settings

Weekly 2 chnls | Yearly 2 chnls | Yearly 4 chnls

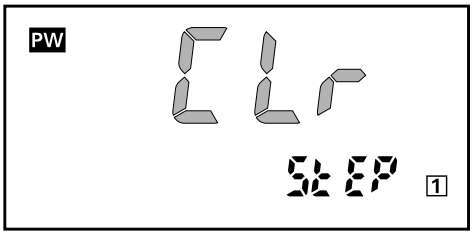
【Example 1】Clearing **a part of** the settings.

The ▭ color indicates flashing.

① Set the Mode Switch to P1 or P2 and select a setting to be cleared.
See Section 4-5 for 4 channel type.



② Give a short press on CLEAR .
("CLr" appears on the main display and "StEP" on the sub-display.)
※If CLEAR is held down for 3 s or more, the display moves to the mode for clearing all the settings of the circuit.



③ Press WRITE to clear the setting.

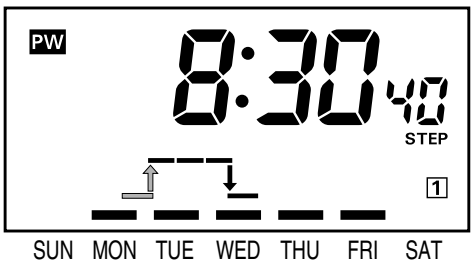
≪Note≫
- If CLEAR is pressed while "CLr" is flashing, clearing operation is cancelled.
- Each operation clears the following combination of settings.

Timer operation (weekly)	Both the ON/OFF times
Pulse-output operation (weekly)	Both the ON time and pulse width
Cyclic operation (weekly)	Both the start/stop times and ON/OFF time periods
Timer operation (yearly)	Both the start/end dates and ON/OFF times
Pulse-output operation (yearly)	Both the start/end dates, ON time and pulse width
Holiday operation (weekly)	All the holiday settings
Holiday operation (yearly)	Both the start/end dates
Day override operation (weekly)	All the day override operation settings

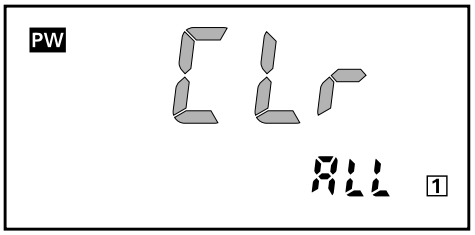
【Example 2】 Clearing **all the settings** of each circuit.

① Set the Mode Switch to the position of the circuit whose settings are to be cleared. See Section 4-5 for 4 channel type.

The ▭ color indicates flashing.



② Hold down [CLEAR] for 3 s or more. ("CLr" appears on the main display and "ALL" on the sub-display.)



③ Press [WRITE] to clear all the settings of the circuit.

≪Note≫
- If [CLEAR] is pressed while "CLr" is flashing, clearing operation is cancelled.
- The current time, set data of initial setting mode, holiday settings, or day override settings cannot be cleared in the same manner.
- Yearly programs are also cleared with the yearly types.

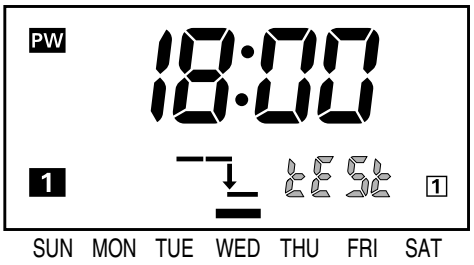
5-2. Program Check Function

Weekly 2 chnls | Yearly 2 chnls | Yearly 4 chnls

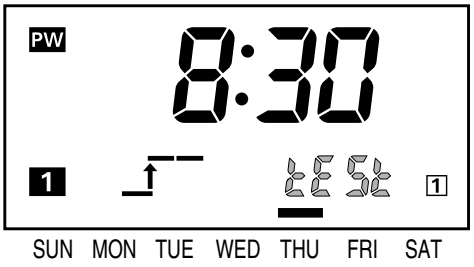
The set days and times when output turns ON and OFF over the course of one week can be displayed in the sequence the Time Switch is to operate.

The ▭ color indicates flashing.

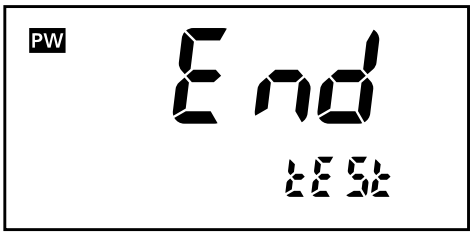
① Press TEST for 2 s or more in run mode.
("tESt" flashes and the day and time of the next change in output state is displayed.)



② Press WRITE.
The display shows the time of the next change in output state.
Each time WRITE is pressed, the display shows the days and times for one week.



③ If WRITE is pressed while displaying the last setting for the week, "End" is displayed for 2 s and the Time Switch automatically returns to run mode.



≪Note≫

- Output is not turned ON or OFF according to displays in program check mode but according to settings and the current time.
- Program check mode can be entered from run mode only.
- Holiday settings (☞ Section 5-1), day override operation settings (☞ Section 5-4: weekly type only), and yearly settings (☞ Section 4-6: yearly types only) are also displayed.
- Settings for one week from the current day on can be checked with this function.
- After one-week schedule set for the circuit 1 is displayed, the display starts to show one-week schedule set for the circuit 2.
- If no Key input is entered within 30 s or if TEST is pressed again for 2 s or more, the display automatically returns to run mode.

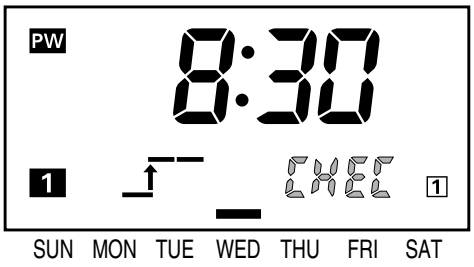
5-3. Checking the Settings

Weekly 2 chnls | Yearly 2 chnls | Yearly 4 chnls

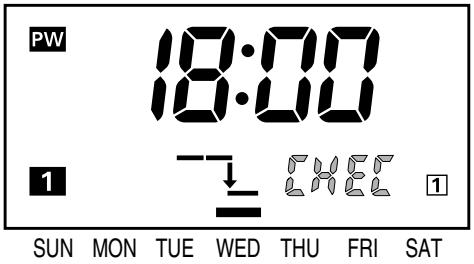
The set times for one day can be checked.

① Press one of the DAY keys for 2 s or more in run mode to check settings for the day. ("CHEC" flashes and the time of the next On time is displayed.)

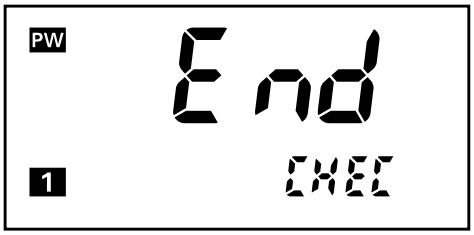
The ▭ color indicates flashing.



② Press WRITE .
The display shows the time of the next change in output state.



③ If WRITE is pressed with the last setting of the day displayed, "End" is displayed for 2 s before the Time Switch automatically returns to run mode.

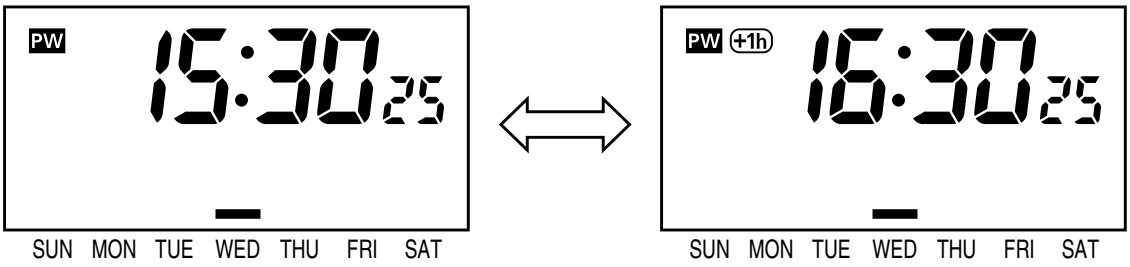


≪Note≫
- This mode can be entered from run mode only.
- Output is not turned ON or OFF according to displays but according to settings and the current time.
- Holiday settings (☞ Section 5-1), day override operation settings (☞ Section 5-4: weekly type only), and yearly settings (☞ Section 4-6: yearly types only) are also displayed.
- If no Key input is entered within 30 s or if one of the DAY keys is pressed again for 2 s or more, the display automatically returns to run mode.

5-5. Summer Time (DST) Adjustment (Manual)

Weekly 2 chnls | Yearly 2 chnls | Yearly 4 chnls

Each time [+1h] is pressed for 2 s or more, the current time switches between the current time and the current time+1 hour.

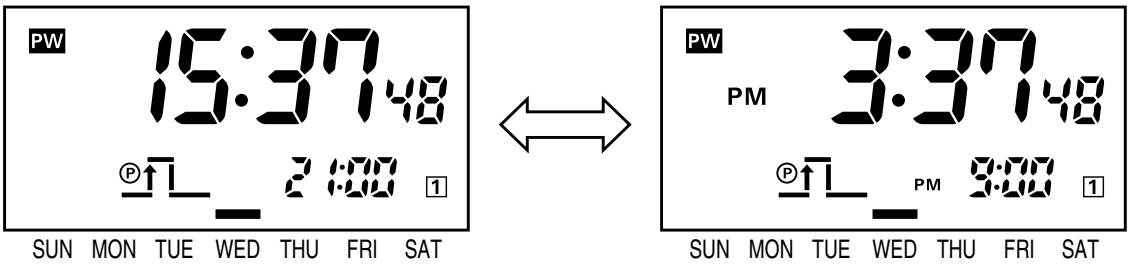


≪Note≫
- The +1h indicator is turned on during summer time.
- Manual summer time adjustment is possible in run mode only.
- If summer time adjustment (☞ Section 6-6-6) is set to automatic for the yearly types, manual adjustment is disabled.
- The settings are not changed by summer time adjustment.

5-6. Switching between 12-hour and 24-hour display

Weekly 2 chnls | Yearly 2 chnls | Yearly 4 chnls

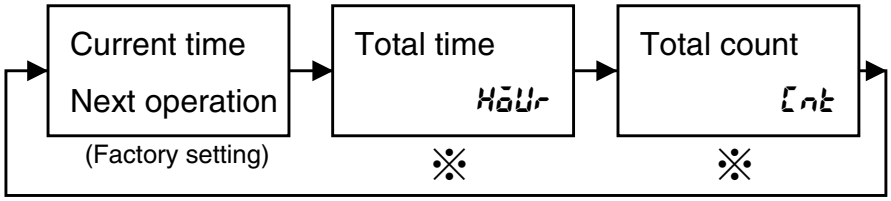
Each time [h] is pressed for 2 s or more, the current time switches between 12-hour (am/pm) and 24-hour display.



≪Note≫
- Switching is possible only in run mode.
- The factory setting is 24-hour display.

5-7. Display Switching **Weekly 2 chnls**

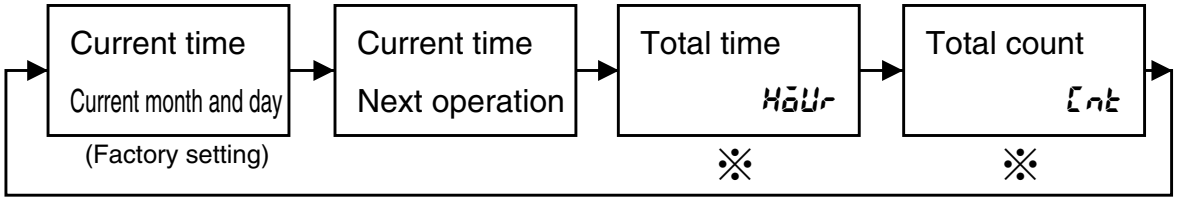
Each time [m] is pressed for 2 s or more, the displayed content switches as shown below.



※Displays only when the input selection is set to "tōtL". (☞Section 6-6-2)

5-7. Display Switching **Yearly 2 chnls**

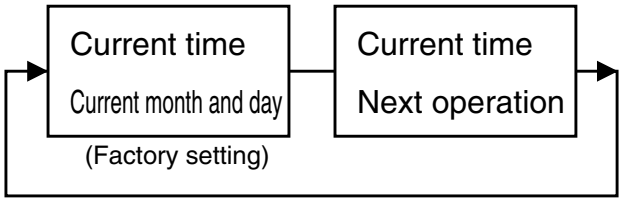
Each time [m] is pressed for 2 s or more, the displayed content switches as shown below.



※Displays only when the input selection is set to "tōtL". (☞Section 6-6-2)

5-7. Display Switching **Yearly 4 chnls**

Each time [m] is pressed for 2 s or more, the displayed content switches as shown below.

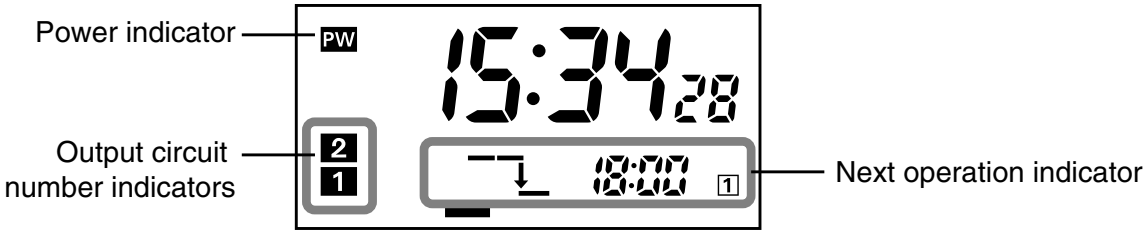


7. Operation while the Power Supply is OFF

Weekly 2 chnls | Yearly 2 chnls | Yearly 4 chnls

The display can be activated even when the power is OFF.
The current time can be displayed and settings can be made.

- While power is OFF, output as well as the output indicator and the power indicator are turned OFF.
- If no key input is entered within 2 min or more, the display is automatically turned off. To activate the display, press any Key for 1 s or more.
  ※Except for slide switches and DIP switches.
- A next operation is not displayed during the power off.
- Override and automatic return operation is not available.

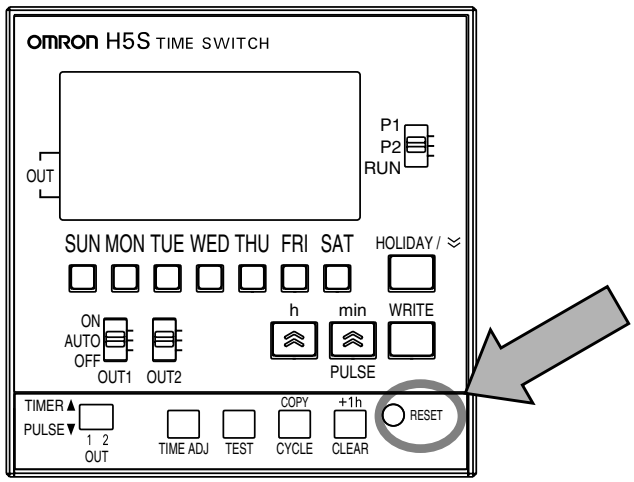


8. Resetting

Weekly 2 chnls | Yearly 2 chnls | Yearly 4 chnls

All the set data including the current time can be reset (initialized).

- Resetting is possible in any mode from run mode to setting mode.



<Diagram with the front cover open>

11. Troubleshooting

Weekly 2 chnls | Yearly 2 chnls | Yearly 4 chnls

◆Self-check function

When an error occurs, the following error codes are displayed.

Error code	Meaning	Output	Countermeasures
E1	CPU error	OFF	Press RESET.
E2	Memory error	OFF	Press RESET.

◆Troubleshooting

If there is a problem with the Time Switch, check the following items.

Problems	Check items	Section
The Time Switch does not operate when the power is turned ON.	Is the power actually ON? Check that the PW indicator is turned on.	<Operation>2
The Time Switch does not operate according to the settings.	Is the Time Switch wired correctly? Check the wiring.	<Installation>2,3
	Is the OUT ON/OFF switch set to AUTO?	<Operation>2
	Is the Time Switch set correctly?	<Operation>4
	Isn't the Time Switch set for holiday operation?	<Operation>5-1
	Isn't the Time Switch set for override and automatic return operation?	<Operation>5-8
	Isn't the Time Switch set for day override operation? (Weekly type only)	<Operation>5-4
	Isn't the Time Switch set for yearly operation? (Yearly types only)	<Operation>4-6
	Are banks (weekly type only) or seasons (yearly types only) set correctly?	<Operation>6-4 <Operation>6-5
Output does not turned ON when the OUT ON/OFF switch is set to ON.	Is the power actually ON? Check that the PW indicator is turned on.	<Operation>2
The time is fast or slow.	The time accuracy is influenced by the ambient temperature. Correct the present time in time adjustment mode.	<Operation>9 <Operation>3
	Is theTime Switch installed in a location subject to excessive noise? Timing performance may be adverserly affected if the Time Switch is installed in a location subject to excessive noise. Separate the Time Switch from any sources of noise.	–
The display does not appear.	If no Key input is entered within 2 minutes with the power OFF, the display is turned off.	<Operation>7
The display is incorrect.	The Time Switch may be affected by noise or surge. Separate the Time Switch from any sources of noise.	–
There is a black spot on the LCD display's surface.	Black spot may appear due to static electricity. The spot disappears after a while.	–

VERTICAL PUMP MANUAL

for

STINGRAY

PARTS WASHER

Carver
Creating Value.

TABLE OF CONTENTS

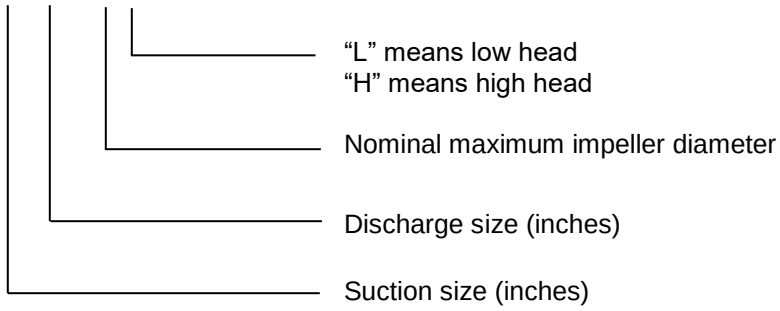
I. GENERAL DESCRIPTION AND SAFETY PRECAUTIONS.

A. GENERAL DESCRIPTION. The Vertical Pump is designed for the industrial washer application.

The pump is flexible coupled to a constant speed motor. The pump and motor are mounted on a structural steel baseplate. The pump end consists of a casing, shaft, impeller, backhead, suction head, column, baseplate, discharge piping, bearing frame, and bearings. The bearing frame supports the bearings above the solution tank, thereby preventing contamination of the bearings. Bearings are also protected from fluid and vapors by bearing cap and lip seals.

B. PUMP IDENTIFICATION. Use the following example for identifying information about your pump model number.

3 X 2 X 10H



C. NAMEPLATE. A nameplate is attached to each pump. The data on the nameplate should be recorded and filed for easy reference. Nameplate data should be furnished when ordering replacement parts or requesting information. Record pump serial number and model number on the lines below.

Pump Serial Number _____

Model Number _____

D. SAFETY PRECAUTIONS. This manual contains descriptions and instructions, which are the results of carefully conducted engineering and research efforts. The manual is designed to provide adequate instructions for the safe and efficient installation, operation, or maintenance of the pump. Failure or neglect to properly install, operate, or maintain the pump may result in personal injury, property damage, or unnecessary damage to the pump.

Observe all caution or danger tags attached to the equipment or included in this manual.

CAUTION

IMPORTANT SAFETY NOTICE

Various federal, state, and local laws and the regulations concerning OSHA affect installation, use, and operation of pumping equipment. Compliance with such laws relating to the proper installation and safe operation of pumping equipment is the responsibility of the equipment owner. All necessary steps should be taken by the owner to assure compliance with such laws before operating the equipment.

II. INSPECTION AND STORAGE.

A. INSPECTION. Upon receipt of the shipment, unpack and inspect the pump, motor assemblies, and individual parts to insure none are missing or damaged. Carefully inspect all boxes and packing material for loose parts before discarding them. Immediately report to the factory and to the transportation company if there are any missing or damaged parts incurred during shipment and file a "damage and/or lost in shipment" claim with the carrier.

B. STORAGE OF PUMP. If the pumping unit and/or parts are not immediately installed and operated, store the equipment in a clean, dry, well-ventilated place, free from vibrations, moisture, and rapid or wide variations in temperature.

Grease Lubricated Pump. Rotate the shaft for several revolutions at least once per month to coat the bearings with lubricant, retard oxidation and corrosion, and prevent possible false brinelling.

Consider a unit to be in storage when:

1. The pump has been delivered to the job site and is waiting to be installed.
2. The pump has been installed but operation is delayed pending completion of construction.
3. There are long (30 days or more) periods between operating cycles.
4. The plant (or department) is shut down for periods of longer than 30 days.

NOTE

Storage requirements vary depending on climatic environment, length of storage, and equipment. For storage periods of three months or longer, contact a representative from Carver Pump Company for specific instructions. Improper storage will damage equipment and will require non-warranty restoration and/or non-warranty product failures.

III. INSTALLATION.

Personnel who possess general training in the operation and maintenance of centrifugal pumps should install the pump. The pumps should be installed in accordance with good safety and machinery practices. Faulty installation will result in operating troubles and premature wear of parts.

After ascertaining the unit has suffered no damage in transit, the pumping unit can be installed. Proceed as follows:

CAUTION

To lift pumping unit, use a hoist or device with suitable lifting capacity. Do not pick up the complete unit by the motor or pump shaft. The motor alone may be lifted using the motor lifting eyes.

1. Make sure the mounting frame is level and clean and free of debris. Install pump into reservoir and bolt to mounting frame. Rotate the shaft by hand to verify that the pump rotates freely.
2. Connect piping. Extreme care should be taken when connecting new piping to ensure that no foreign matter such as dirt, chips, tools, etc., is in the piping, tank, or return piping as this will cause debris to draw into the pump and cause excessive damage. Any debris caught in the pump passageways will throw the pumping unit out of balance.

CAUTION

Ensure piping does not strain pump. Strain may cause misalignment. To ensure proper alignment, check pump shaft for freedom of rotation after installing and tightening piping.

3. Connect any necessary auxiliary piping and gauge lines.
4. Since the pumping unit is shipped with bearings greased, initial greasing is not necessary unless pumping unit has been in storage for an extended period of time.
5. Install motor on pump intermediate and install shaft coupling to connect pump shaft and motor shaft. Turn pump and motor shafts by hand to ensure free rotation. Attach coupling guard. Do NOT operate pump without guard in place.
6. Connect wiring to motor. Due to high voltage required to operate the pumping unit, personnel working with the equipment should be familiar with electrical safety practices and modern methods of resuscitation. Methods of modern resuscitation may be obtained from the Bureau of Medicine and Surgery.
7. Connect electrical power supply to motor.
8. Open system valves, if supplied.

IV. ALIGNMENT.

A flexible coupling connects the pump and motor. The pump intermediate (#61) motor bracket aligns the pump shaft and motor shaft.

V. OPERATION.

A. PRE-START CAUTIONS.

1. Before starting or operating the pump, read this entire manual, especially the following instructions.
2. Before starting the pump, rotate shaft by hand to assure all moving parts are free.
3. Before starting the pump, install closed guards around all exposed rotating parts.
4. Observe all caution or danger tags attached to the equipment.
5. Never run pump dry because the close running fits within the pump are liquid lubricated. Dry running may result in pump seizure.

B. STARTING THE PUMP. Once system valves have been adjusted to the specified pumping conditions, the pumping unit will operate without operator intervention. If problems occur while starting the pump, refer to Table 1, Troubleshooting.

1. Make sure no one is working on the pumping unit.
2. If the pumping unit has been idle for a period of time, make sure the unit is firmly attached to its mounting frame.

CAUTION

Check level of liquid in reservoir to ensure pump casing is under liquid level.

4. Jog starter switch on motor to check that direction of rotation is clockwise when viewed from the top looking downward. Direction of rotation must agree with the arrow stamped on the pump frame or base.
5. Start the pumping unit in accordance with the machine operating directions.
6. If excessive vibration or noise occurs during operation, shut the pump down and consult a representative from STINGRAY Parts Washers or MART Tech Services.
6. Pumping unit is now in full operation.
7. Check amperage draw of motor and compare to the motor nameplate in order to verify proper operation.

C. STOPPING THE PUMP.

1. Stop the pumping unit in accordance with the machine operating directions.
2. The pumping unit is now in the “off” position.

VI. MAINTENANCE.

A. BACKHEAD. The backhead is equipped with a throttle bushing. The inside diameter of the throttle bushing will increase with wear. If the pump is not equipped with a shaft sleeve, the throttle bushing requires replacement if the inside diameter is 1.644 inches (4.176 cm) or greater. If the pump is equipped with a shaft sleeve, the throttle bushing requires replacement if the inside diameter is 1.905 inches (4.839 cm) or greater.

B. BEARING TEMPERATURE. Bearing temperature should be monitored periodically. Normal operating temperatures are 120°F (49°C) to 160°F (71°C), depending on the ambient temperature. Bearings may appear to run hot when pump is first started. The lip seal, not the bearing, causes this to happen. When the seal is seated, temperature should drop to normal.

Check bearing temperature by placing a pyrometer against the bearing frame while pump is running. A temperature above 180°F (82°C) indicates possible damage or wear. The most common cause of high bearing temperature is over greased bearings.

C. BEARING LUBRICATION. Lubrication frequency depends on operating conditions. Normal duty calls for relubrication every 1000 hours of operation or every 6 months. Bearings are lubricated at Carver Pump Company with Mobilith Grease XHP222, which is a lithium complex soap type grease. Only Mobilith Grease XHP222 should be used. On the pump bearing frame, both bearings require grease.

To relubricate bearings, use the following procedure:

CAUTION

Over greasing creates heat and can damage the bearings. Do NOT over grease.

1. Never relubricate pump bearings while unit is running. If necessary, shut down pump in accordance with section V, Operation.

CAUTION

Care must be taken to avoid excess pressure which may damage the lip seal.

2. Remove bearing frame and cap plugs opposite of the fittings prior to lubricating.
3. Using a hand-operated grease gun on grease fittings, add approximately one ounce of fresh grease for each bearing until grease exits plug hole on opposite side of fitting. Reinstall For new bearings see Paragraph VIII.C.2 on page 9.
4. Reinstall plugs and fitting caps after lubrication is completed.

Bearing temperature may rise above normal immediately after lubrication, but should stabilize within 4 to 8 hours of operation.

VII. TROUBLESHOOTING.

If you have followed the installation and starting procedures outlined in this manual, the pump should provide reliable service and long life. However, if operating problems occur, significant time and expense will be saved if Table 1, Troubleshooting, is used to eliminate the most common causes of those problems.

Symptom	Probable Cause	Remedy
Failure to deliver liquid.	1. Discharge valve closed. 2. Discharge head above shutoff. 3. Impeller or suction partially clogged. 4. No power. 5. Liquid level in tank too low.	1. Check discharge valve. 2. Call StingRay Customer Care at 888-720-7222 3. Inspect impeller and suction pipe and clean. 4. Check power connection to motor. Check overloads 5. Add liquid to system.
Reduced capacity and/or pressure.	1. Discharge valve closed. 2. Damaged impeller. 3. Impeller or suction pipe partially clogged. 4. Liquid level in tank too low. 5. Total head too high. 6. Wrong rotation. 7. Speed too low. 8. Discharge piping loose. 9. Worn throttle bushing. 10. Worn swivel joint.	1. Check discharge valve. 2. Replace impeller. 3. Inspect impeller and suction pipe and clean. 4. Add liquid to system. 5. Call StingRay Customer Care at 888-720-7222. 6. Switch power connections to motor. 7. Wrong RPM Motor. 8. Check, inspect, tighten. 9. Check, inspect, replace 10. Check, inspect, replace.
Pump surges.	1. Liquid level in tank too low. 2. Solution is too hot. 3. Solution is too viscous.	1. Add liquid to system. 2. Lower solution temperature. 3. Drain and clean machine.
Pump loses prime after starting.	1. Liquid level in tank too low. 2. Solution is too hot.	1. Add liquid to system 2. Lower solution temperature.
Overload on motor.	1. Head lower than that for which pump is designed. 2. Mechanical defects of pump or motor such as bent shaft, binding or rubbing rotating element. 3. Liquid handled of higher specific gravity or lower viscosity than intended application. 4. Excess liquid being pumped. 5. Worn nozzles. 6. Worn throttle bushing. 7. Worn swivel joint.	1. Call StingRay Customer Care at 888-720-7222. 2. Replace defective parts or replace pump or motor. 3. Clean out and Change solution. 4. Call StingRay Customer Care at 888-720-7222. 5. Check, inspect, replace. 6. Check, inspect, replace. 7. Check, inspect, replace.
Insulation failure.	1. Oil or water soaked windings. 2. Excessive vibration.	1. Disassemble motor, clean and dry windings. 2. Refer to “vibrates or is noisy.”

Table 1: Troubleshooting

Symptom	Probable Cause	Remedy
Insulation failure. (cont.)	3. Wrong voltage.	3. Check voltage at motor terminals.
Vibrates or is noisy.	1. Insufficient or insecure pump mounting. 2. Mechanical defects of pump or motor such as bent shaft, binding rotating element, or warped impeller. 3. Foreign matter in pump impeller. 4. Strain due to piping or improper piping supports. 5. Misalignment. 6. Damaged bearings. 7. Throttle bushing is worn. 8. Impeller loose. 9. Cavitation.	1. Check reservoir pump mounting frame and bolt tightness. 2. Replace defective parts or replace pump or motor. 3. Disassemble pump. Clean and replace damaged parts. 4. Check piping alignment and remove piping weight from pump with proper supports. 5. Align pump and motor as outlined in section IV of this manual. 6. Replace bearings. 7. Replace throttle bushing. 8. Disassemble pump in accordance with section VIII. Inspect parts and replace damaged parts. 9. Clean suction screen or reduce operating temperature, if problem persists disassemble pump and inspect.
Rapid wear of coupling spider.	1. Misalignment. 2. Bent shaft.	1. Align pump and motor as outlined in section IV, Alignment. 2. Replace shaft.

Table 1: Troubleshooting (cont.)

VIII. DISASSEMBLY AND REASSEMBLY.

After extended operation, it may be difficult to separate some components. Rust solvent may be used and suitable extricating tools where possible. Use hammers with plastic or rubber heads; hammers with metal heads can damage the pump. Hoisting equipment should be used for lifting heavy parts. It is recommended that safety shoes and safety glasses be worn while working on this equipment.

A. DISASSEMBLY. During disassembly, match mark parts so they can be replaced in their original position and orientation.

1. Disconnect, lock out, and tag electrical power supply to motor. Disconnect motor wiring at motor.
2. Drain reservoir. As necessary, flush pump to remove corrosive or toxic liquids.
3. Disconnect discharge piping.
4. Remove hex bolts, nuts, and washers securing guard plates to intermediate (61). Remove guard plates.
5. Disconnect shaft coupling (70).
6. Remove bolts (65) attaching motor. Remove motor.

CAUTION

Use a hoist or suitable lifting device with adequate lifting capacity to lift motor. Do not pick up the complete pump and motor unit by the motor or pump shaft. The motor alone may be lifted using the motor lifting eyes.

7. Remove nuts, washer, and mounting bolts from the pump mounting plate. Lift the pump and mounting plate out of the tank and place in a suitable work area.

CAUTION

To lift pumping unit, use a hoist or device with suitable lifting capacity. Do not pick up the complete pump by the pump shaft.

8. Remove nuts (64) and capscrews (63) securing intermediate (61) to bearing frame (30). Remove intermediate (61).
9. Remove capscrews (10) and washers (38) securing suction head (3) to casing (2). Remove suction head (3). Remove suction head gasket (5).
10. Remove impeller capscrew (A4) and impeller washer (A1).
11. Remove impeller (1) from end of shaft (33) by hand. If impeller does not come off easily try using two pry bars and **gently** prying on inside of suction eye. Warning: If you pry too hard you can break the impeller. If the impeller does not come off easily then remove capscrews (35) and washers (37) from backhead (6) and tap backhead (6) gently to drive impeller (1) off shaft (33). Remove impeller key (A2). DO NOT HIT IMPELLER WITH A HAMMER - IT WILL BREAK.
12. Remove capscrews (10) and washers (38) securing backhead (6) to casing (2). Remove casing (2) from pumping unit.
13. Remove capscrews (35) and washers (37) securing column (31) to backhead (6). Remove backhead (6). Remove backhead o-ring (G16).
14. Remove shaft sleeve (34), if equipped.

NOTE

If throttle bushing (B3) is METAL, locking ring (B1) and capscrews (B4) are required. Setscrews (B5) are not required. (Note: Drawing shows (B5) pointing to cap screws – Drawing needs updating)

15. If METAL throttle bushing (B3) needs to be replaced, remove capscrews (B4) securing locking ring (B1) to backhead (6). If equipped with NON-METAL remove capscrews (B4) securing locking ring (B1) to backhead (6) remove locking ring (B1) remove setscrews (B5) and separate throttle bushing (B3) from locking ring (B1).
16. Loosen, but do not remove, setscrews (B6) in slinger (B2). Remove slinger (B2).
17. Remove capscrews (G9) securing bearing cap (G1) to bearing frame (30).
18. Pull shaft (33) and bearings from inboard side (motor coupling side/top side) of pumping unit.
19. Loosen set screws in coupling hub (70) and using a puller, remove hub from shaft (33). Remove coupling key (G11).
20. Remove bearing cap (G1) from shaft (33).
21. Un-crimp bearing lockwasher (G13). Un-screw bearing locknut (G4) and remove bearing lockwasher (G13).
22. Using a bearing press or bearing puller, remove radial bearing (G3) and thrust bearing (G2) from shaft (33).
23. Remove lip seals (G5) from ring (71) and bearing frame (30). Remove lip seal (G6) from bearing cap (G1).

B. PARTS INSPECTION.

1. After disassembly, all parts should be thoroughly cleaned and inspected. Damaged or worn parts should be replaced with new ones. All sealing faces should be perfectly clean. It is

recommended that lip seals, bearings, gaskets, and o-rings be replaced with new components.

2. Inspect inside diameter of the throttle bushing (B3). The inside diameter of the throttle bushing (B3) will increase with wear. If the pump is not equipped with a shaft sleeve, the throttle bushing requires replacement if the inside diameter is 1.644 inches (4.176 cm) or greater. If the pump is equipped with a shaft sleeve, the throttle bushing requires replacement if the inside diameter is 1.905 inches (4.839 cm) or greater.
3. If pump is not equipped with shaft sleeve, inspect the shaft diameter in the throttle bushing area. If the shaft diameter is 1.605 inches (4.077 cm) or less, replace the shaft. If the pump is equipped with shaft sleeve, inspect outside diameter of sleeve. If shaft sleeve outside diameter is 1.855 inches (4.712 cm) or less, replace shaft sleeve. On new components both the shaft sleeve and the shaft have a constant diameter everywhere in the throttle bushing area.
4. On the impeller, check the clearance as follows:
    a. Measure outside diameter of impeller (1) eye wear surface in three locations 120 degrees apart. The impeller eye is the ring on the suction end of the impeller opposite of the shaft hub. It is sometimes referred to as the “nose".
    b. Measure inside diameter of suction head (3) wear surface in three locations 120 degree apart.
    c. If difference between high reading of inside diameter of the suction head (3) and low reading of outside diameter of impeller (1) wear surface exceeds double the maximum clearances given in Table 2, replace suction head (3) and impeller (1).
    5. On bearing column (30) measure the inside diameter at the lower bearing (G3) location. Replace column if diameter exceeds .003” greater than outside diameter of new bearing
    6. Measure inside diameter of upper bearing G12 cartridge replace if greater than 3.5438 inches (9.001 cm). (This may differ for our HD pump--please call for specs)
    7. Measure inside diameter of bearing frame at upper bearing cartridge – replace if frame diameter exceeds 4.312 inches (10.952 cm). (This may differ for our HD pump--please call for specs)
    8. Inspect shaft at bearing locations. Replace shaft if inner race of bearings have “spun” on shaft. New bearings will not have sufficient press fit if bearings have spun on shaft.

Model(Suction x Discharge x Maximum Impeller Diameter)	FACTORY STANDARD DIAMETRIC CLEARANCE BETWEEN IMPELLER SUCTION CONE OD VS SUCTION HEAD ID	
	Minimum (inches)	Maximum (inches)
3 x 2 x 10H	0.012	0.017
5 x 4 x 11	0.016	0.021

Table 2: Enclosed Impeller Clearance

C. REASSEMBLY OF PUMP. During reassembly, return parts to their original position. Tighten nuts and bolts to the values listed in Table 5, Recommended Torque Values.

1. Install new lip seals (G5) in column (31) and bearing frame (30). Install new lip seals (G6) in bearing cap (G1).
2. Pack new bearings half full with Mobilith Grease XHP222. Press new radial bearing (G3) on shaft (33). Press thrust bearing (G2) in bearing cartridge (G12). Note: the amount of lubricant required is about 3 ounces for the upper bearing and 1-1/2 ounces for the lower bearing by weight.
3. Install bearing lockwasher (G13). Install and tighten bearing locknut (G4). Re-crimp bearing lockwasher (G13).
4. Install bearing cap (G1) and secure with capscrews (G9).
5. Install coupling key (G11). Install coupling hub.
6. Install shaft (33) through bearing frame (30).

CAUTION

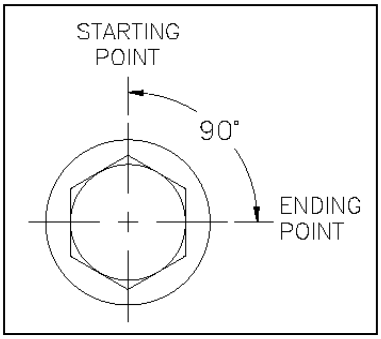
Take special care to avoid damaging seals. Lubricate seal lips and shaft before sliding shaft through seals. If seals are damaged, replace with new seals.

7. Install slinger (B2) on shaft (33) and secure with setscrews (B6).

8. If throttle bushing (B3) was removed, press new throttle bushing (B3) into backhead with a hydraulic press until the throttle bushing (B3) is flush with backhead (6).
9. Install locking ring (B1). If equipped with non-metal throttle bushing, use a ¼-20 NC-2 tap to tap drill through setscrew (B5) holes and tap throttle bushing (B3).
10. If equipped with non-metal bushing, insert setscrews (B5) through locking ring (B1) into throttle bushing (B3).
11. Install shaft sleeve (34), if equipped.
12. Install new backhead o-ring (G16) on backhead (6). Install backhead (6) on column (31) and secure with capscrews (35) and washers (37).
13. Lubricate the edge of the casing and Install casing (2) past o-ring and secure to backhead (6) with washers (38) and capscrews (10).
14. Install impeller key (A2). Install impeller (1) and secure with impeller washer (A1) and impeller capscrew (A4). Tighten capscrew to torque value shown in Figure 1. Proper torque is critical – if the capscrew is not properly torqued, the impeller may come loose and do severe damage to the pump. Use a strap wrench or a crescent wrench over the keyway to hold the shaft while tightening. Do not use a pipe wrench or try to jam the impeller with a screw driver while tightening. Holding the impeller by the vanes may break it.

Torque the impeller cap-screw as shown below.

Impeller Cap Screw & Washer



Torque Capscrew – ¼ turn

Fig 1: Impeller Cap Screw Torque Method

Follow these instructions for installation of the impeller cap-screw

1. Install the flange head capscrew with washer into the shaft with Loctite 262. Hand-tighten the screw until it is snug in the shaft and clamps the impeller washer tightly. Then, tighten the capscrew ¼ turn (90°), approximately 80-90 ft-lbs.
2. To ensure proper seating, loosen the capscrew, re-snug and retighten the capscrew ¼ turn (90°).

Use Loctite 262 Red when installing capscrew

NOTE

Use Loctite 262 Red when installing capscrew.

15. Install new suction head gasket (5) on suction head (3). Install suction head (3) and secure to casing (2) with lock washers (38) and capscrews (10).
16. Remove lifting eyes from casing (2). Install pipe plugs (11).

CAUTION

Use a hoist or suitable lifting device with adequate lifting capacity to lift motor and intermediate.

17. Install pumping unit into reservoir. Secure base to reservoir frame with lockwashers, nuts and capscrews.
18. Install intermediate (61) and motor on pumping unit. Secure intermediate (61) to bearing frame (30) with nuts (64) on capscrews (63).
19. Reconnect coupling.
20. Install guard plates and secure to intermediate (61) with capscrews and washers.

CAUTION

To lift pumping unit, use a hoist or device with suitable lifting capacity. Do not pick up the complete unit by the motor or pump shaft. The motor alone may be lifted using the motor lifting eyes.

21. Reconnect discharge piping.

CAUTION

Ensure discharge piping does not put strain on pump. Strain may cause misalignment. To ensure proper alignment, check pump shaft for freedom of rotation after installation of discharge piping.

23. Reconnect wiring to motor. Reconnect electrical power supply to motor. Fill machine with water and pump start pump.
24. Check for proper rotation direction of pump.
25. Rotate pump and motor by hand to ensure there is no binding or rubbing.

IX. STINGRAY PUMP 20-70HP PARTS LIST.

A. PARTS ORDERING. When ordering parts, please provide the following information:

1. Serial number of pump (located on nameplate).
2. Size of pump (2 X 3 X 10 or 4 x 5 x 11)
3. Part description (located on parts list on the following pages).
4. Part number (located on parts list).
5. Quantity of parts needed.

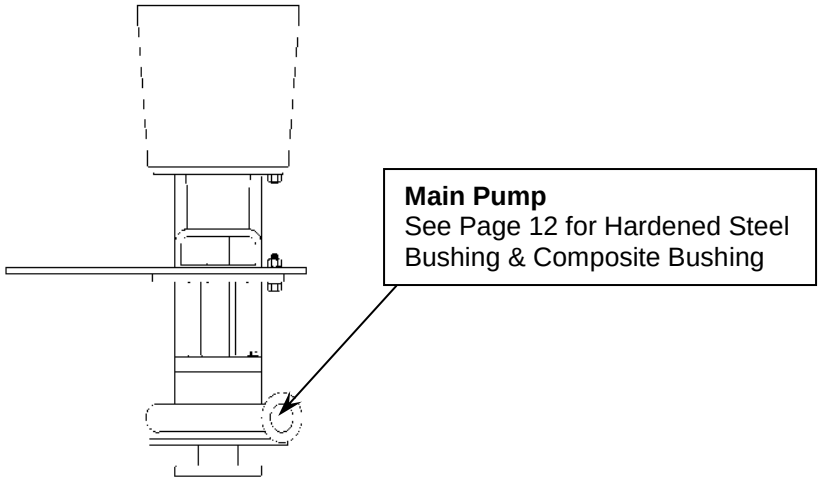
For replacement parts contact:

StingRay Customer Care
2450 Adie Road
Maryland Heights, MO, 63043
www.marttechservices.com

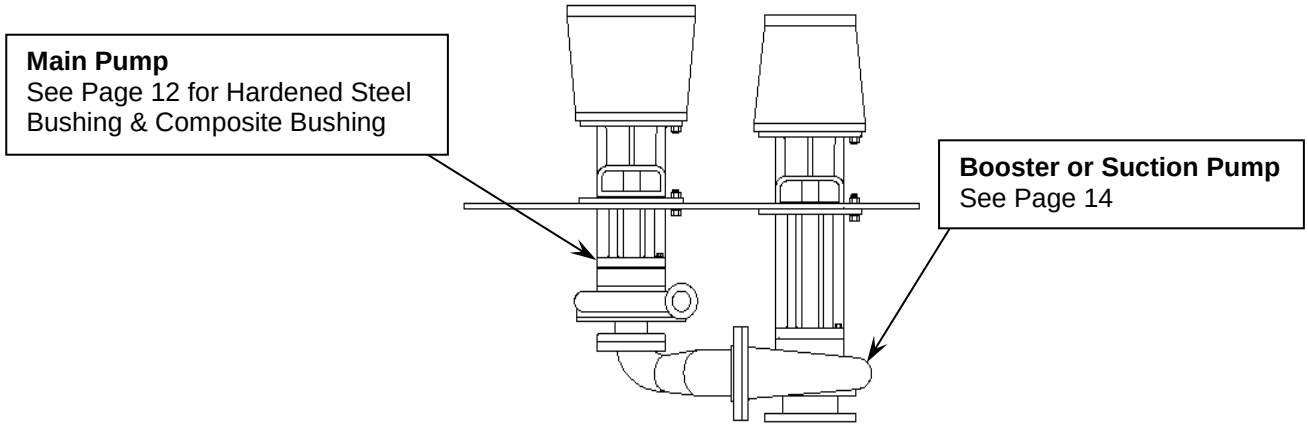
Toll-free: 888-720-7222
Switchboard: 314-567-3705
Fax: 314-567-6318
Email: patrickl@marttechservicers.com

If motor or motor parts are required, please specify name of manufacturer, horsepower, and frame size from motor nameplate.

B. PARTS DESCRIPTIONS & DRAWINGS. To determine the proper drawing to reference, determine if you have a simplex pump (single wash pump) or a duplex pump (suction pump feeding main wash pump). Refer to the following figures:



Simplex (Single) Pump System



Duplex (Dual) Pump System

In some applications, the pump may have been upgraded to fit your cleaning needs. These options may include:

- 1531 Frame Heavy-duty Main Pump
- 1530 Frame Chemical Pump w/ SS Shafts and Viton seals for corrosive chemical applications such as CEEBEE 300LF

Please use the following drawings to identify the parts except for the bearing frame, cartridges, caps, shafts, seals, and bearings. Please call StingRay Customer Care at 888-720-7222 for information on these parts.

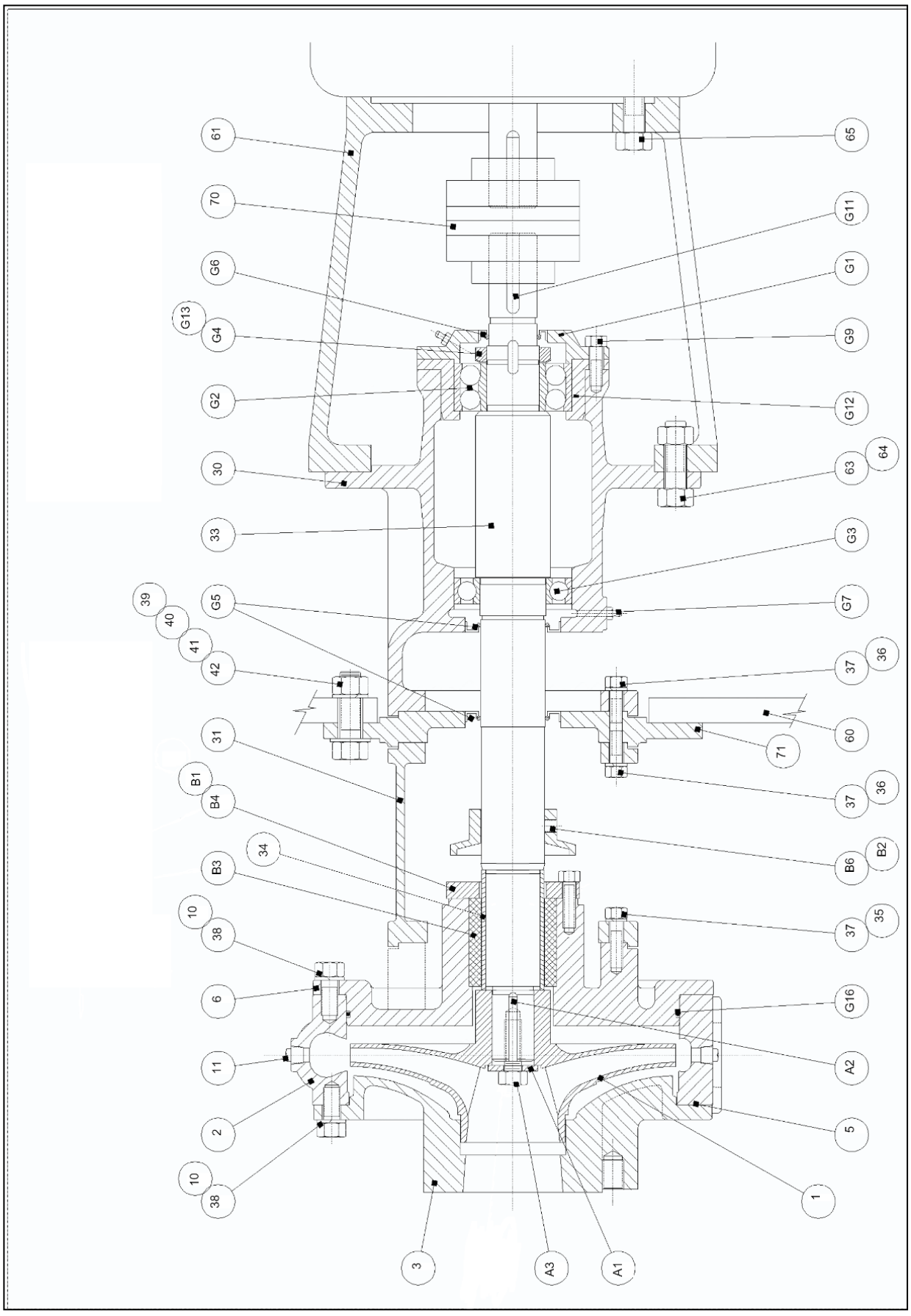


Fig. 2 3x2x10 Main Pump Cut Away 1530 Frame Hardened Steel Throttle Bushing

3x2x10 Main Pump 1530 Frame Hardened Steel/Composite Throttle Bushing w/Sleeve		
Sym	**Part #**	**PART DESCRIPTION**
1	“A” Kit	Impeller
2		Volute
3	“A” Kit	Suction head
4	“A” Kit	Gasket (suction head)
6	53037	Backhead
10		½”-13 Capscrew (suction head and backhead-Volute)
11		Plug (casing)
30	30300	Bearing frame 1530 (Call for 1531 HD Pump)
31	52306	Column
33	53203	Shaft (Call for 1531 HD & SS Pump)
34	“B” Kit	Shaft sleeve
35		3/8”-16 Capscrew (column-backhead)
36		3/8”-16 Capscrew (frame-column)
37		3/8” Lockwasher (column-backhead, column-base)
38		½” Lockwasher (suction head and backhead-Volute)
39		¾”-10Capscrew (column-base)
40		¾” Hex nut (column-base)
41		¾” Washer (column-base)
42		¾” Lockwasher (column-base)
60		Baseplate
61	52395	Intermediate 15HP-20HP
	52390	Intermediate 30HP
	52392	Intermediate 40HP-50HP
63		¾”-10 Hex head bolt (frame-intermediate)
64		¾”-10 Hex nut (frame-intermediate)
65		¾”-10 Hex head bolt (motor-intermediate)
70	71919	Coupling 30HP
70	72556	Coupling 40-50HP
71		Ring
A1	“A” Kit	Impeller washer
A2	“A” Kit	Impeller key
A5	“A” Kit	5/8”-11Impeller Bolt
B1	“B” Kit	Locking ring
B2	“B” Kit	Slinger
B3	“B” Kit	Throttle bushing
B4	“B” Kit	3/8”-16 Capscrew (locking ring-backhead)
B6	“B” Kit	Setscrew (slinger)
G1	53044	Bearing cap (Call for 1531 HD Pump)
G2	"C" Kit	Thrust bearing (Call for 1531 HD Pump)
G3	"C" Kit	Radial bearing (Call for 1531 HD Pump)
G4	“C” Kit	Bearing locknut (Call for 1531 HD Pump)
G5	“C” Kit	Lip seal (frame) (Call for 1531 HD & SS Pump)
G6	"C" Kit	Lip seal (bearing cap) (Call for 1531 HD Pump)
G7		Grease zerk
G9		3/8”-16 Hex head bolt (bearing cap-frame)
G10		Plug
G11		Coupling key
G12	53045	Bearing cartridge (Call for 1531 HD Pump)
G13		Bearing lockwasher
G16	46790	O-ring

Part #	Kit
30220	“A” Kit
30281	“B” Kit STL
85170	“B” Kit COM
51173	“C” Kit

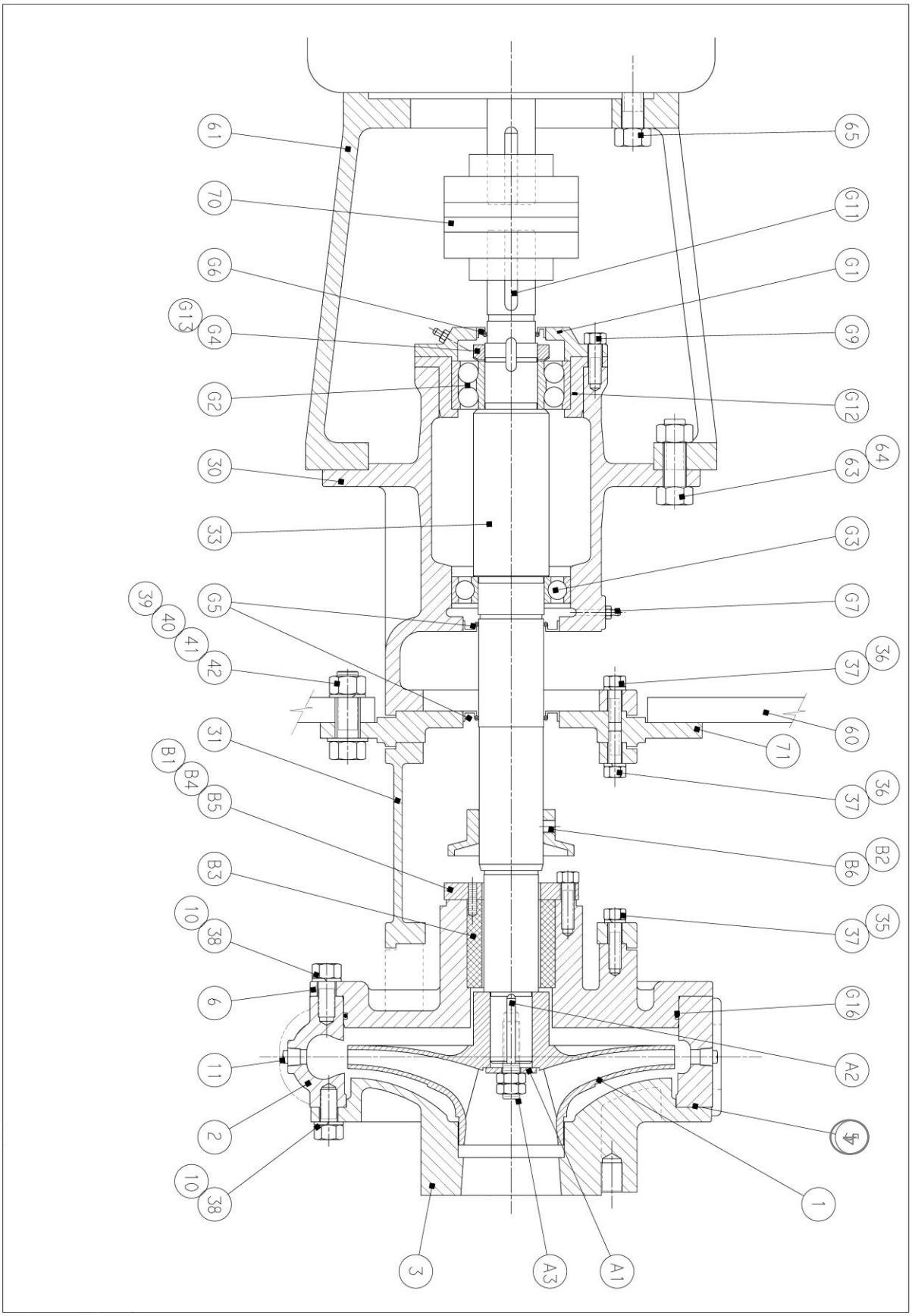


Fig. 3: 4x5x11 Booster Pump Cut Away 1530 Frame Composite Throttle Bushing

4x5x11Booster Pump 1530 Frame Composite Throttle Bushing w/o Sleeve		
Sym	**Part #**	**PART DESCRIPTION**
1	“A” Kit	Impeller
2		Volute/ Backhead
3	“A” Kit	Suction head
4	“A” Kit	Gasket (suction head)
10		½”-13 Capscrew (suction head--volute/backhead)
11		Plug (casing)
30	30300	Bearing frame
31	52306	Column
33	51174	Shaft
35		3/8”-16 Capscrew (column-backhead)
36		3/8”-16 Capscrew (frame-column)
37		3/8” Lockwasher (column-backhead, column-base)
38		½” Lockwasher (suction head -Volute)
39		¾”-10Capscrew (column-base)
40		¾” Hex nut (column-base)
41		¾” Washer (column-base)
42		¾” Lockwasher (column-base)
60		Baseplate
61	52395	Intermediate 15HP-20HP
	52390	Intermediate 30HP
	52392	Intermediate 40HP-50HP
63		¾”-10 Hex head bolt (frame-intermediate)
64		¾”-10 Hex nut (frame-intermediate)
65		¾”-10 Hex head bolt (motor-intermediate)
70	72555	Coupling
71		Ring
A1	“A” Kit	Impeller washer
A2	“A” Kit	Impeller key
A5	“A” Kit	5/8”-11Impeller Bolt
B1	“B” Kit	Locking ring
B2	“B” Kit	Slinger
B3	“B” Kit	Throttle bushing
B4	“B” Kit	3/8”-16 Capscrew (locking ring-backhead)
B5	“B” Kit	Setscrew (locking ring-bushing,)
B6	“B” Kit	Setscrew (slinger)
G1	53044	Bearing cap
G2	"C" Kit	Thrust bearing
G3	"C" Kit	Radial bearing
G4	“C” Kit	Bearing locknut
G5	“C” Kit	Lip seal (bearing frame, column)
G6	"C" Kit	Lip seal (bearing cap)
G7		Grease zerk
G9		3/8”-16 Hex head bolt (bearing cap-frame)
G10		Plug
G11		Coupling key
G12	53045	Bearing cartridge
G13		3/8” Bearing lockwasher

Part #	**Kit**
30230	“A” Kit
30280	“B” Kit
51173	“C” Kit
52238	Gasket Kit

Optional Upgrade:	
Harden Steel Bushing	
30281	“B” Kit
51804	Shaft

Bolt Size	Material Torque Value ft-lbs	
	Steel (or otherwise noted)	*316 Stainless Steel*
¼”-20	5	7
5/16”-18	11	12
3/8”-16	18	21
½”-13	39	45
5/8”-11	83	97
¾”-10	105	132
7/8”-9	160	203
1”-8	236	300

Table 3: Recommended Torque Values (except for impeller capscrew)

STINGRAY Pump Repair Kits & Application Upgrades

Please reference the appropriate exploded view drawing to verify the correct part number for your application.

A Kit Main Pump 20-50 hp
Impeller (1) trimmed to size
Suction Head (1)
Volute Gasket (1)
Bolts (8)
Impeller Bolt (1)
Impeller Washer (1)
Impeller Key (1)
O-Ring (1)

1530-30220

B Kit Main Pump 15-50 hp
Composite Throttle Bushing (1)
Shaft Sleeve SS (1)
Step Key SS (1)
Locking Ring (1)
Slinger (1)
Hex Bolts (2)
Set Screws (2)

1530-85170

B Kit Main Pump 15-50 hp
Throttle Bushing Hardened Steel (1)
Shaft Sleeve SS (1)
Step Key SS (1)
Locking Ring (1)
Slinger (1)
Hex Bolts (2)
Set Screws (2)

1530-30281

C Kit Main Pump 15-50 hp
Oil Seal (1)
Viton Seal (2)
Radial Bearing (1)
Thrust Bearing (1)
Bearing Locking Nut (1)

1530-51173
1531 HD-85240

Main Pump 20-50 hp Shaft s are available in several different options of material and use. W/ indicates the use of a shaft sleeve in the application.

1530 w/ -53203
1530 w/o-50489
1530 SS w/-30334
1531 HD w/-85241

A Kit Booster Pump 15-20 hp
Impeller (1) trimmed to size
Suction Head (1)
Volute Gasket (1)
Bolts (12)
Impeller Bolt (1)
Impeller Washer (1)
Impeller Key (1)
O-Ring (1)

1530-30230

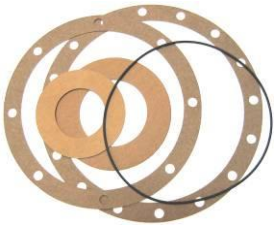
B Kit Booster Pump 15-50 hp
Composite Throttle Bushing (1)
Step Key (1)
Locking Ring (1)
Slinger (1)
Locking Ring Set Screw (2)
Hex Bolts (2)
Set Screws (2)

1530-30280

1530-51174

Booster Pump 15-20 hp Shaft

1530-30335



Duplex Gasket Kit

1530-52238

Viton Lip Seals
Stainless Steel Housing

1530 SS-30425

STINGRAY Pump Motor Couplings

Assy,Pump Coupling,15&20hp
1 Coupling 1-3/8
1 Coupling 1-5/8
1 Insert

72555

Assy,Pump Coupling,30hp,Simplex
1 Coupling 1-3/8
1 Coupling 1-5/8
1 Insert
1 Collar

71919

Assy,Pump Coupling,40&50hp
1 Coupling,1-3/8
1 Coupling,1-7/8
1 Coupling,Body

72556

Assy,Pump Coupling,40&50hp HD
1 Coupling,1-7/16
1 Coupling,1-7/8
1 Coupling,Body

72551

1-7/16 Pump Side Coupling for Heavy-Duty Pump System.

1531 HD-54706

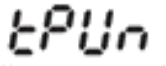
2450 Adie Road
Maryland Heights, MO 63043
Tele: 888-720-7222 Fax: 314-567-6318
Website: www.marttechservices.com

How to Change the Temperature Set Point on a StingRay Parts Washer with Digital Controller

1. Locate the Temperature Controller on the front of the Control Panel (See Fig. 1)
2. Adjust the SV Number (Green) to the desired Setting, using the  keys.
3. Then Press the  key to set the new Temperature Setting.

Temperature Controller, Fig. 1

How to Change Temperature Units to C or F

1. Press and hold the  key for 3 seconds to access the INITIAL SETTINGS Menu.
2. Press the  key twice to display: 
3. Press the  keys until the desired value is displayed on the lower green screen.
4. Press  .

How to Change the Low Limit Temperature Setting (Optional)

1. Go to the Low Limit Adjustment Screen by pressing the  Twice.
   (The PV red line will show )
2. Adjust the SV Number (Green) to the desired Setting, using the  keys.
3. Then Press the  key to set the new Low Limit Temperature Setting.
4. Press  once to return the Temperature Set Point Screen.

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