OZONE INJECTION SYSTEMS

User Guide

1280 North Red Gum Street – Anaheim, CA 92806
(714) 632-1400 – fax (714) 632-1410
www.makoindustries.com

Safety Statements:

The Mako Industries Ozone Injection System produces ozone gas, which can cause danger to individuals if there is exposure. Typical side effects but not limited to, are irritations to eyes, nose, throat and respiratory system.

The Mako Industries Ozone Injection System is designed to be fully sealed, to prevent ozone leakage and it also includes an ambient ozone alarm, however should you experience the above symptoms consult the MSDS sheet for specific medical attention and shut down the system.

System Warnings

The Mako Industries Ozone Injection System utilizes high voltages. All personnel operating the Treatment System must be trained in the operation and maintenance of the system as well as the safety devices provided with the system.

1. Do not attempt to bypass any of the safety interlocks provided in an attempt to operate the unit. Unless authorized by Mako personnel for diagnostic purposes only. Bypassing safety switches will void the warranty and can cause major damage to equipment and personnel.
2. Do not modify or bypass the transformers, fuse blocks, or controllers in order to make the system operational unless authorized by Mako personnel.
3. Do not remove any equipment from the unit in order to make the unit operational.
4. Keep all body parts clear of the air intake valves and moving parts due to burns from high temperature conditions and severe bodily injury situations that can occur as a result of body contact with these parts.
5. Do not restrict, block or close the valve outlets during operation.
6. Disconnect incoming voltage to the unit control panel before attempting to work on the panel or other electrical components on the unit. Use a voltage meter to determine that the power is off. Have only qualified personnel work on the electrical components, preferably a qualified electrician.
7. Shutdown the system and contact Mako immediately if you are experiencing any unsafe conditions.

SYSTEM INSTALLATION AND START-UP

Follow each step listed here in exactly the order listed. For your safety, do not skip any steps or perform any steps out of order.

Installation:

1. Operate the unit on a level dry surface secure system to the ground so that it cannot move.
2. Connect the properly rated electrical supply with a ground to the control panel main disconnect using a qualified electrician.
3. Check voltage, wire size and amperage rating of electricity installed, making sure that it matches the manufacturers panel specifications and electrical drawings before proceeding.
4. Check 120-volt power circuit.
5. Check rotation of the compressors to be sure it is correct.
6. Check all ozone supply lines and make sure they are all connected to the compression fittings on the outlet of the valve manifold. Insure there is no leakage from the lines.

Start-up – Shutdown Procedures:

1. Verify that the **"Main Breaker"** in the control panel is in the **"Off"** position.
2. Open the system control panel door and have a qualified electrician verify that the voltage at top of the **"Main Disconnect"** is to 120 Volt / 1 phase / 40 Amp.
3. Turn the **"Main Breaker"** switch to the **"On"** position.
4. Turn the **"Control Power"** switch to the **"On"** position.
5. After setting time segments into the PLC interface for the station 1 – 20, push the **"Blower Start"** button on the PLC Interface, the breakthrough compressor should come on. The unit should begin cycling through injection stations for the time segment programmed into the PLC. See PLC section for programming instructions. After running 2 minutes to a well the **"Ozone On"** Light will appear if you have programmed Ozone Injection for that well.
6. To turn off Ozone to a well press **"Ozone De-Activation"** screen on the Interface for that well.
7. To shut the system down push the "**Blower Stop Button"** on the PLC Interface and turn the "**Main Breaker"** to the "**Off"** position.

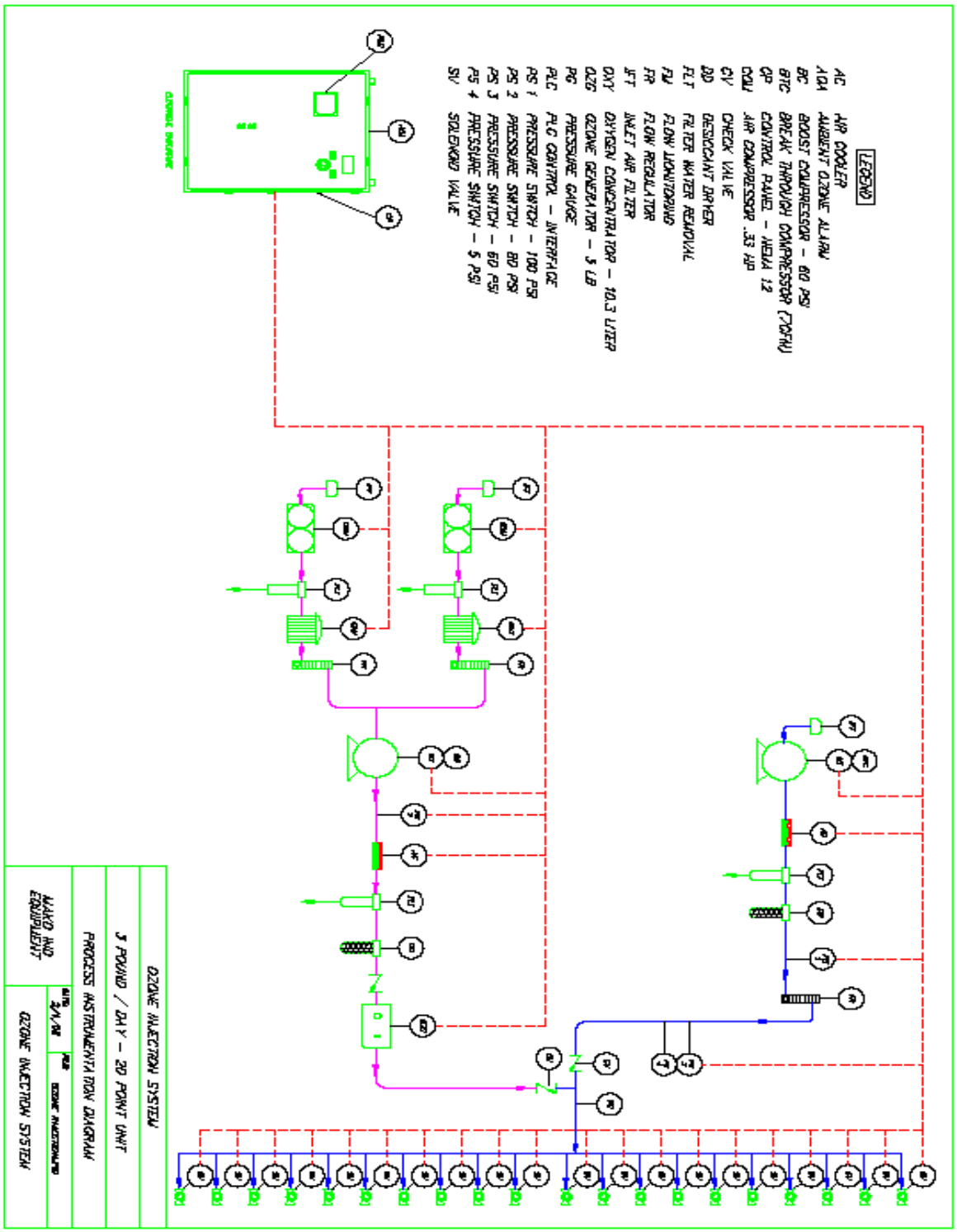
System Alarms

1. **Air Pressure Failure:** Air Pressure is above / below the maximum or minimum pressure settings for the system. The system will immediately go to the next well until it occurs for 3 straight wells. If that occurs unit will shut down.
   Ozone Line Pressure should not be less than 5 PSI or exceed 80 PSI after the boost compressor (See PID for location)
   Ambient Breakthrough Line Pressure should not be less than 5 PSI or exceed 100 PSI after the breakthrough compressor (See PID for location)
2. **Ambient Ozone Alarm:** Ozone is detected greater than 1 ppmv within the panel area. The system will immediately go to the next well until it occurs for 3 straight wells. If that occurs unit will shut down.

MAINTENANCE SHEDULE

Check Compressor Filters **(Clean or replace as needed)**	**Monthly**
Check Panel Intake Filters **(Clean or replace as needed)**	**Monthly**
Check Panel Ventilation Fans **(Insure Proper Ventilation at all times)**	**Monthly**
Check Panel Wire connections **(Tighten them if necessary)**	**Monthly**
Check Water Separator Filters **(Remove bowl cover, clean or replace as needed)**	**Monthly**
Replace Desiccant Dryer Media **(Change when Dryer Media turns Pink)**	**Monthly**
Check Process Air Tubing for Moisture **(Use air to blow out liquids)**	**Weekly**
Check Solenoid Valve Operation **(Insure proper operation, clean or replace as needed)**	**Monthly**
Check Flow Valve Operation **(Insure proper operation, clean as needed)**	**Monthly**
Check Compressor Operation **(Repair or replace diaphragms as needed)**	**Bi-Yearly**

Process Flow Diagram



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OIL-LESS PISTON VACUUM PUMPS & COMPRESSORS

OPERATION & MAINTENANCE MANUAL

Model 1HAB Shown

Model 3HBB Shown

Model 3HEB Shown

Model PCD Shown

Thank you for purchasing this Gast product. It is manufactured to the highest standards using quality materials. Please follow all recommended maintenance, operational and safety instructions and you will receive years of trouble free service.

IMPORTANT: PLEASE READ THIS MANUAL AND SAVE FOR FUTURE REFERENCE.

Product Use Criteria:

- Pump only clean, dry air.
- Operate at 32ºF - 104ºF (0ºC - 40ºC).
- Protect unit from dirt & moisture.
- Do not pump flammable or explosive gases or use in an atmosphere that contains such gases.
- Protect all surrounding items from exhaust air. This exhaust air can become very hot.
- Corrosive gases and particulate material will damage unit. Water vapor, oil-based contaminants or other liquids must be filtered out.
- Consult your Gast Distributor/Representative before using at high altitudes.
- These pumps are oil-less and require NO lubrication. The Teflon-filled rings are self-lubricating and require no oil.
- The motor bearings are grease-packed for the lifetime of the bearings.

GAST
A Unit of IDEX Corporation

ISO 9001 & 14001 CERTIFIED

www.gastmfg.com

Your safety and the safety of others is extremely important.

We have provided many important safety messages in this manual and on your product. Always read and obey all safety messages.

This is the safety alert symbol. This symbol alerts you to hazards that can kill or hurt you and others. The safety alert symbol and the words "DANGER" and "WARNING" will precede all safety messages. These words mean:

DANGER

You will be killed or seriously injured if you don't follow instructions.

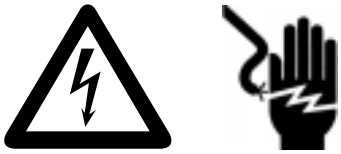
WARNING

You can be killed or seriously injured if you don't follow instructions.

All safety messages will identify the hazard, tell you how to reduce the chance of injury, and tell you what can happen if the safety instructions are not followed.

INSTALLATION

WARNING



Electrical Shock Hazard

Disconnect electrical power at the circuit breaker or fuse box before installing this product.

Install this product where it will not come into contact with water or other liquids.

Install this product where it will be weather protected.

Electrically ground this product.

Failure to follow these instructions can result in death, fire or electrical shock.

Correct installation is your responsibility. Make sure you have the proper installation conditions and that installation clearances do not block air flow.

Lift the unit by the motor shell, motor foot or flywheel (depending upon model design). Do Not lift unit by shroud, filters or mufflers. These parts are not designed to support the weight of the unit.

Blocking air flow over the product in any way can cause the product to overheat.

Install safety guards as required to prevent potential injury hazards or damage to surrounding objects.

Mounting
This product can be installed in any orientation. Mounting the product to a stable, rigid operation surface and using shock mounts will reduce noise and vibration.

Plumbing
Remove plugs from the IN and OUT ports. Connect with pipe and fittings that are the same size or larger than the product's threaded ports. Be sure to connect the intake and exhaust plumbing to the correct inlet and outlet ports. Ports will not support plumbing.

Accessories
If unit will be used in a system where it will be required to start against any system of back pressure, a positive sealing, one-way check valve should be installed in the air line between system and unit. This check valve is included with all tank mounted compressor units.

The product's intake and exhaust filters will provide adequate filtration in most applications. Check filters periodically and replace when necessary. Please consult your Gast Distributor/Representative for additional filter recommendations.

Install relief valves and gauges at inlet or outlet, or both, to monitor performance. Check valves may be required to prevent back streaming through the unit.

Motor Control
It is your responsibility to contact a qualified electrician and assure that the electrical installation is adequate and in conformance with all national and local codes and ordinances. Grounding is required.

Determine the correct overload setting required to protect the motor (see motor starter manufacturer's recommendations). Select fuses, motor protective switches or thermal protective switches to provide protection. Fuses act as short circuit protection for the motor, not as protection against overload. Incoming line fuses must be able to withstand the motor's starting current. Motor starters with thermal magnetic overload or circuit breakers protect motor from overload or reduced voltage conditions.

The wiring diagram supplied with the product provides required electrical information. Check that power source is correct to properly operate the dual-voltage motors.

Electrical Connection

WARNING

Electrical Shock Hazard

This product must be properly grounded.

Do not modify the plug provided. If it will not fit the outlet, have the proper outlet installed by a qualified electrician.

If repair or replacement of the cord or plug is necessary, do not connect the grounding wire to either flat blade terminal. The wire with insulation that is green or green with yellow stripes is the grounding wire.

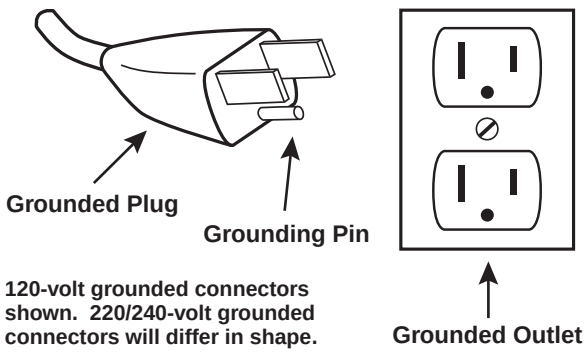
Check the condition of the power supply wiring. Do not permanently connect this product to wiring that is not in good condition or is inadequate for the requirements of this product.

Failure to follow these instructions can result in death, fire or electrical shock.

Model with a power supply cord:
This product must be grounded. For either 120-volt or 220/240-volt circuits connect power supply cord grounding plug to a matching grounded outlet. Do not use an adapter. (See diagram.)

In the event of an electrical short circuit, grounding reduces the risk of electric shock by providing an escape wire for the electric current. This product may be equipped with a power supply cord having a grounding wire with an appropriate grounding plug. The plug must be plugged into an outlet that is properly installed and grounded in accordance with all local codes and ordinances.

Check with a qualified electrician or serviceman if the grounding instructions are not completely understood, or if you are not sure whether the product is properly grounded. Do not modify the plug provided. If it will not fit the outlet, have the proper outlet installed by a qualified electrician.



120-volt grounded connectors shown. 220/240-volt grounded connectors will differ in shape.

Model that is permanently wired:
This product must be connected to a grounded, metallic, permanent wiring system, or an equipment grounding terminal or lead on the product.

Power supply wiring must conform to all required safety codes and be installed by a qualified person. Check that supply voltage agrees with that listed on product nameplate.

Extension cords:
Use only a 3-wire extension cord that has a 3-blade grounding plug. Connect extension cord plug to a matching 3-slot receptacle. Do not use an adapter. Make sure your extension cord is in good condition. Check that the gage wire of the extension cord is the correct size wire to carry the current this product will draw.

An undersized cord is a potential fire hazard, and will cause a drop in line voltage resulting in loss of power causing the product to overheat. The following table indicates the correct size cord for length required and the ampere rating listed on the product nameplate. **If in doubt, use the next heavier gage cord. The smaller the gage number, the heavier the wire gage.**

Minimum gage for extension cords

Amps	Volts	Length of cord in feet								
	120v	25	50	100	150	200	250	300	400	500
	240v	50	100	200	300	400	500	600	800	1000
0-2		18	18	18	16	16	14	14	12	12
2-3		18	18	16	14	14	12	12	10	10
3-4		18	18	16	14	12	12	10	10	8
4-5		18	18	14	12	12	10	10	8	8
5-6		18	16	14	12	10	10	8	8	8
6-8		18	16	12	10	10	8	6	6	6
8-10		18	14	12	10	8	8	6	6	4
10-12		16	14	10	8	8	6	6	4	4
12-14		16	12	10	8	6	6	6	4	2
14-16		16	12	10	8	6	6	4	4	2
16-18		14	12	8	8	6	4	4	2	2
18-20		14	12	8	6	6	4	4	2	2

OPERATION

WARNING

Injury Hazard

Install proper safety guards as needed.

Keep fingers and objects away from openings and rotating parts.

When provided, motor terminal covers must be in place for safe operation.

Product surfaces become very hot during operation, allow product surfaces to cool before handling.

Air stream from product may contain solid or liquid material that can result in eye or skin damage, wear proper eye protection.

Wear hearing protection. Sound level from motor may exceed 70 dBA.

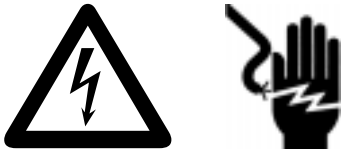
Failure to follow these instructions can result in burns, eye injury or other serious injury.

It is your responsibility to operate this product at recommended pressures or vacuum duties and room ambient temperatures. Do not start against a vacuum or pressure load. Do not remove relief valve head while unit is operating.

Start Up
If motor fail to start or slows down significantly under load, shut off and disconnect from power supply. Check that voltage is correct for motor and that motor is turning in the proper direction. If the motor is turning in the wrong direction, it will overheat.

MAINTENANCE

WARNING



Electrical Shock Hazard

Disconnect electrical power supply cord before performing maintenance on this product.

If product is hard wired into system, disconnect electrical power at the circuit breaker or fuse box before performing maintenance on this product.

Failure to follow these instructions can result in death, fire or electrical shock.

WARNING

Injury Hazard

Product surfaces become very hot during operation, allow product surfaces to cool before handling.

Air stream from product may contain solid or liquid material that can result in eye or skin damage, wear proper eye protection.

Failure to follow these instructions can result in burns, eye injury or other serious injury.

It is your responsibility to:
- **Regularly inspect and make necessary repairs to product in order to maintain proper operation.**
- **Make sure that pressure and vacuum is released from product before starting maintenance.**

If unit is operated at maximum duties in a fairly clean, 65ºF - 75ºF (18ºC - 24ºC) ambient environment with 35% relative humidity, complete first inspection and maintenance after 4000 hours of operation. Earlier maintenance may be required depending upon the environment.

Check intake and exhaust filters after first 500 hours of operation. Clean filters and determine how frequently filters should be checked during future operation. This one procedure will help assure the product's performance and service life.

Check the thickness of the rider ring. It should measure greater than .055". Change all rings if thickness measures .055" or less.

1. Disconnect electrical power supply to unit.
2. Vent all air lines.
3. Remove filter cover.
4. Check filter felt. Replace felt if it is covered with contamination or shows signs of increasing differential pressure.
5. Reinstall felt and filter cover.

Check that all external accessories such as relief valves and gauges are attached and are not damaged before re-operating product.

Pressure or Vacuum Tank Systems
Check the air filter cartridge. A dirty filter restricts air flow and causes unit to run hotter resulting in longer operating cycles.

Check the air receiver for moisture regularly. The humidity in the environment will determine how quickly moisture will accumulate and need to be drained.

Clean the pump and motor regularly. Dirt and film buildup on the outer shell affects the unit's ability to dissipate heat.

SHUTDOWN PROCEDURES

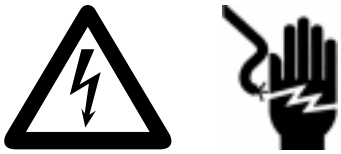
It is your responsibility to follow proper shutdown procedures to prevent product damage.
NEVER ADD OIL TO THIS OIL-LESS PUMP.

Proper shutdown procedures must be followed to prevent pump damage. Failure to do so may result in premature pump failure. Gast Manufacturing Oil-Less Piston Vacuum Pumps and Compressors are constructed of ferrous metals or aluminum which are subject to rust and corrosion when pumping condensable vapors such as water. Follow the steps below to assure correct storage and shutdown between operating periods.

1. Disconnect plumbing.
2. Operate product for at least 5 minutes without plumbing.
3. Run at maximum vacuum for 10 - 15 minutes.
4. Repeat step 2.
5. Disconnect power supply.
6. Plug open ports to prevent dirt or other contaminants from entering product.

SERVICE KIT INSTALLATION

WARNING



Electrical Shock Hazard

Disconnect electrical power supply cord before installing Service Kit.

If product is hard wired into system, disconnect electrical power at the circuit breaker or fuse box before installing Service Kit.

Vent all air lines to release pressure or vacuum.

Failure to follow these instructions can result in death, fire or electrical shock.

Gast will NOT guarantee field-rebuilt product performance. For performance guarantee, the product must be returned to a Gast Authorized Service Facility.

Service Kit contents vary. Most contain head and cylinder gaskets, valves, piston rings and seals, rider rings and felt filters.

1. Disconnect electrical power to pump.
2. Disconnect air supply and vent all air lines to release pressure or vacuum.
3. Remove shroud, cylinder head and valve components.
4. Remove cylinder and rings.
5. Clean all parts with water or non-petroleum based solvent such as Gast AH255B Solvent. Do Not use kerosene or ANY other combustible solvents.
6. Install piston seals, piston rings and rider rings on piston. Locate ring joints approximately opposite each other.
7. Use cylinder screws with washers to attach cylinder to bracket. Tighten screws only until they are finger tight.
8. Move pistons to top dead center position. Adjust each cylinder flush with top of piston.
9. Torque cylinder screws to 150-160 in. lbs.
10. Replace valve components in original order.
11. Install cylinder head and head screws. The exhaust ports have been marked on the cylinder heads by omitting the ends of two of the fins. Do not tighten screws at this time.
12 Install manifold nuts and seals on manifold. Insert into cylinder head and manifold.
13. Torque head screws to 150-160 in. lbs.
14. Turn fan by hand to check that rod assembly is not hitting head. If rod hits head, loosen cylinders and adjust.
15. Install manifold and tighten manifold nut one-quarter to one-half turn beyond finger tight.
16. Operate unit for 10 minutes. Tighten screws again.
17. Install fan shroud.

Check that all external accessories such as relief valves and gauges are attached to cover and are not damaged before re-operating product.

If pump still does not produce proper vacuum or pressure, send unit to a Gast Authorized Service Facility for repair.

SPECIFIC PROBLEMS AND REMEDIES

Unit stalls after vacuum or pressure starts building up in receiver:

1. Disconnect electrical power supply from unit.
2. Check that voltage from power source matches that listed on nameplate.
3. Check wiring connections against diagram on nameplate. Single voltage motors will operate only at designated voltage.

Motor will not start:

1. Disconnect electrical power supply from unit.
2. Check that voltage from power source matches that listed on nameplate.
3. Check wiring connections against diagram on nameplate. Single voltage motors will operate only at designated voltage.
4. Reconnect electrical supply to unit. Check that power is on. If extension cord is used, check that it is the correct size and length to adequately supply power to the unit.
5. If unit will still not operate, contact your Gast Distributor/Representative or a Gast Authorized Service Facility.

Motor starts at 0 PSI but will not start under pressure:

1. Replace the check valve.
2. Wait for the thermal overload switch to reset before attempting to operate.
3. If unit will not restart, the thermal overload switch may need to be replaced. If there isn't a thermal overload switch, the motor may be damaged and requires service.

Motor starts intermittently:

1. Disconnect electrical power supply from unit.
2. Check points in the pressure or vacuum switch for wear or dirt.
3. Check for dirt buildup or uneven wear.
4. Replace parts as required.

Unit cycles On-Off more often than when first installed:

1. Check air receiver and drain water that has accumulated.

Unit or motor is running more often than when first installed:

1. Check system for air leaks. If new or different pneumatic equipment has been added, the air requirements may have changed.
2. Check and clean filters.
3. Check for buildup of foreign material on head.
4. Check valves and rings for wear and damage.

Air receiver loses pressure:

1. Check for system leaks through pipes, fittings and seals.
2. Inspect the check valve to see if it is allowing air pressure to leak back into unit.
3. Pressure pumps will have bubbles around head assembly during operation. Stop operating the pump for a few minutes and check for air leaks at pump.
4. Vacuum systems should have the check valve removed and inspected for dirt buildup. It may be necessary to need an AV460 filter installed prior to tank to eliminate contaminants.

A leak is located at the unit:

1. Vent all pressure from inside the air receiver until gauge reads 0 PSI.
2. Inspect check valve for dirt buildup, wear and proper operation.
3. Replace check valve if necessary.

PARTS & ORDERING INFORMATION

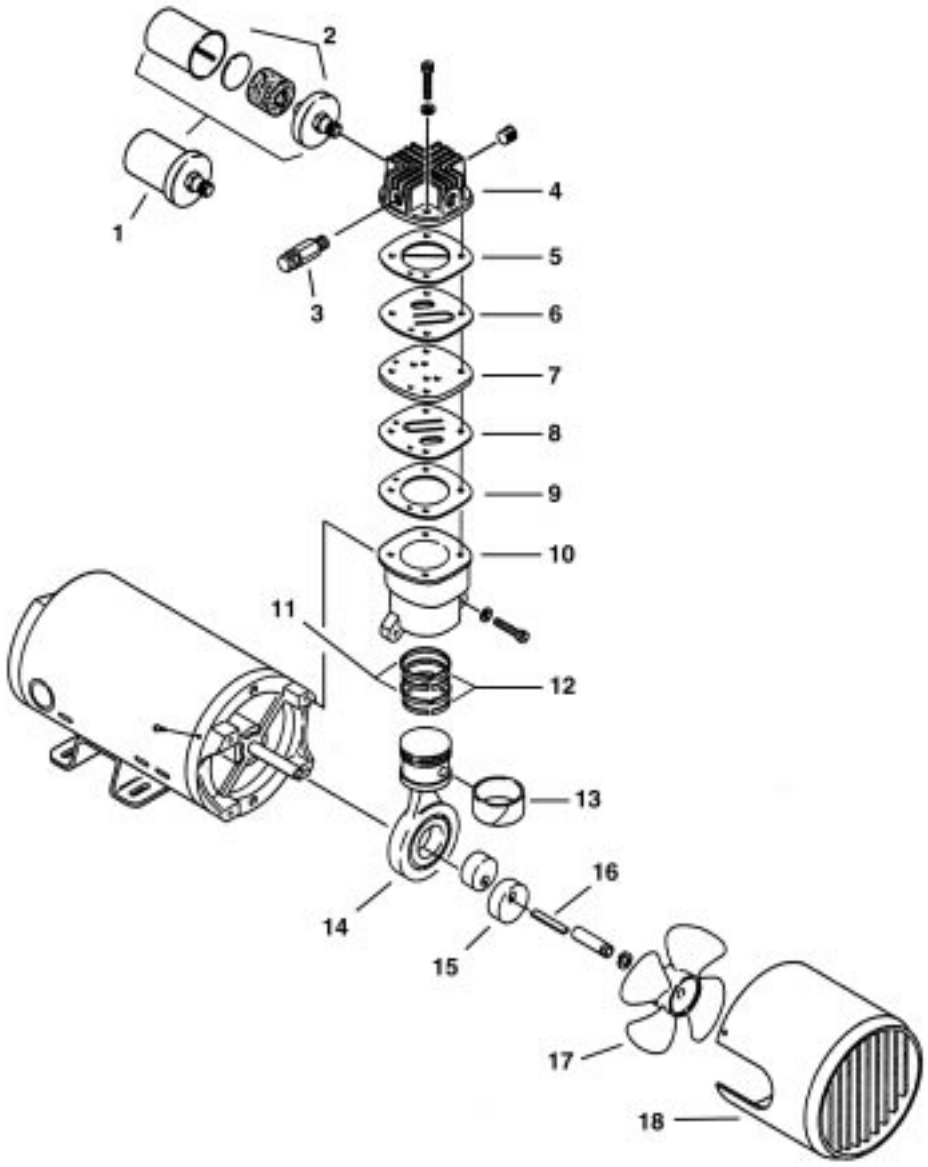
Please reference the exploded view on the opposite page for the following model and parts table.

1HAA / 1HAB SERIES

REF	DESCRIPTION	QTY	1HAA	1HAB	1HAE	1LAA	1VAF	2HAH	2LAF	3HEB	3HEE	3LEM
1	INLET FILTER ASSEMBLY	1	B300A	B300A	B300A	B300A	B300A	B300A	B300F	B300F	B300F	B300F
2 Δ	FELT	1	B344A	B344A	B344A	B344A	B344A	B344A	B344A	B344A	B344A	B344A
3	SAFETY VALVE	1	AT517F	AT517	AT517	AT517D	–	AT517	AT517D	AT517	AT517	AT517D
4	CYLINDER HEAD	1	AF508	AF508	AF508	AF508	AF508	AF508	AF508	AH691	AH691	AH691
5 Δ	HEAD GASKET	1	AF518	AF518	AF518	AF518	AF518	AF518	AF518	AF520A	AF520A	AF520A
6 Δ	OUTLET VALVE	1	AF531	AF531	AF531	AF531	AF531	AF531	AF531	AF545	AF545	AF545
7	PLATE VALVE	1	AF529	AF529	AF529	AF529	AF529	AF529	AF529	AK779	AK779	AK779
8 Δ	INLET VALVE	1	AF530	AF530	AF530	AF530	AF530	AF530	AF530	AF544	AF544	AF544
9 Δ	CYLINDER GASKET	1	AF519A	AF519A	AF519A	AF519A	AF519A	AF519A	AF519A	AF521	AF521	AF521
10	CYLINDER	1	AF510	AF510	AF510	AF510	AF510	AF510	AF510	AF509	AF509	AF509
11 Δ	PISTON RING	2	AF527	AF527	AF527	AF527	AF527	AF527	AF527	AF541	AF541	AF541
12 Δ	PISTON SEAL	2	AF526	AF526	AF526	AF526	AF526	AF526	AF526	AF540	AF540	AF540
13 Δ	RIDER RING	1	AF594	AF594	AF594	AF594	AF594	AF594	AF594	AF595	AF595	AF595
14	PISTON ROD ASSEMBLY	1	AF560A	AF560B	AF560E	AF560A	AF560F	AF560H	AF560F	AK893B	AK893E	AK893M
15	COUNTER WEIGHT	1	AF517A	AF517B	AF517E	AF517A	AF517D	AF517C	AF517D	AT780B	AK780E	AK780A
16	FLAT KEY	1	AF524	AF524	AF524	AF524	AF524	AF524	AF524	AB136	AB136	AB136
17	FAN	1	AF533	AF533	AF533	AF533	AF533	AF547	AF547	AF547	AF547	AF547
18	SHROUD	1	AF534	AF534	AF534	AF534	AF534	AF534	AF534	AT343	AT343	AT343
***	TANK ASSEMBLY	1	–	AF599-1	–	AK329-1	–	AF599-1	–	–	–	–
***	SERVICE KIT	1	K264	K264	K264	K264	K264	K264	K264	K514A	K514A	K514A

Model 1HAB shown.
*** Item not shown.
Δ Denotes parts included in the Service Kit.
Parts listed are for stock models. For specific OEM models, please consult the factory.
When corresponding or ordering parts, please give complete model and serial numbers.

EXPLODED PRODUCT VIEW – MODEL 1HAB



PARTS & ORDERING INFORMATION

Please reference the exploded view on the opposite page for the following model and parts tables.

1VBF – 3LBD SERIES

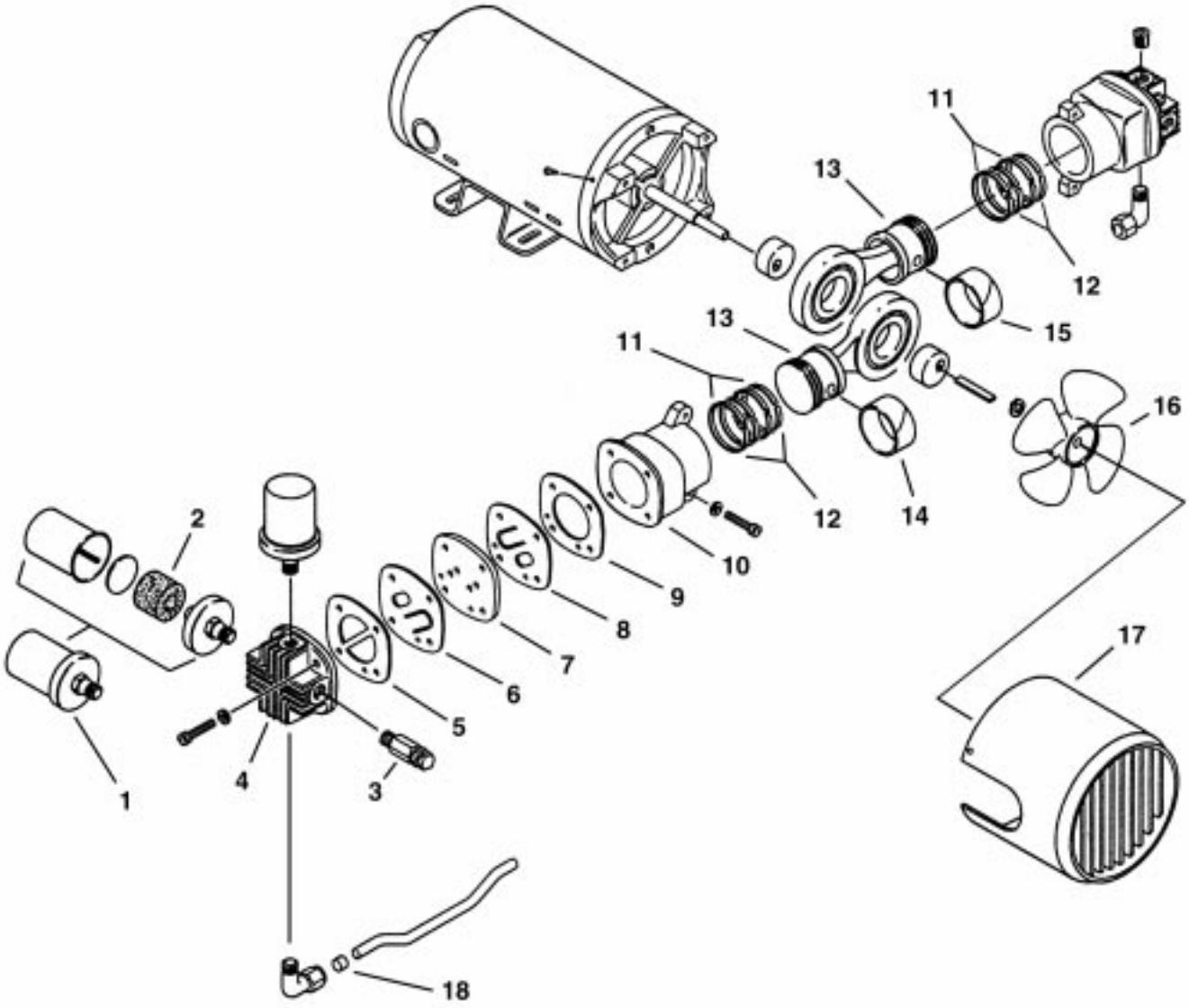
REF	DESCRIPTION	QTY	1VBF	1VSF	2LBB	2HBB	2HBC	3HBB	3HBE	3LBA	3LBD
1	INLET FILTER ASSEMBLY	1		B300A							
		2	B300A		B300A	B300A	B300A	B300A	B300A	B300A	B300A
2 Δ	FELT	2	B344A	B344A	B344A	B344A	B344A	B344A	B344A	B344A	B344A
3	SAFETY VALVE	1	–	–	AT517D	AT517	AT517	AT517	AT517	AT517D	AT517D
4	CYLINDER HEAD	2	AF508	AF508	AF508	AF508	AF508	AF508	AF508	AF508	AF508
5 Δ	HEAD GASKET	2	AF518	AF518	AF518	AF518	AF518	AF518	AF518	AF518	AF518
6 Δ	OUTLET VALVE	2	AF531	AF531	AF531	AF531	AF531	AF531	AF531	AF531	AF531
7	PLATE VALVE	2	AF529	AF529	AF529	AF529	AF529	AF529	AF529	AF529	AF529
8 Δ	INLET VALVE	2	AF530	AF530	AF530	AF530	AF530	AF530	AF530	AF530	AF530
9 Δ	CYLINDER GASKET	2	AF519A	AF519A	AF519A	AF519A	AF519A	AF519A	AF519A	AF519A	AF519A
10	CYLINDER	2	AF510	AF510	AF510	AF510	AF510	AF510	AF510	AF510	AF510
11 Δ	PISTON RING	4	AF527	AF527	AF527	AF527	AF527	AF527	AF527	AF527	AF527
12 Δ	PISTON SEAL	4	AF526	AF526	AF526	AF526	AF526	AF526	AF526	AF526	AF526
13	PISTON ROD ASSEMBLY	2	AF560F	AF560F	AF560B	AF560B	AF560C	AF560B	AF560E	AF560A	AF560D
14 Δ	RIDER RING	2	AF594	AF594	AF594	AF594	AF594	AF594	AF594	AF594	AF594
15	FLAT KEY	1	AF524	AF524	AF524	AF524	AF524	AF524	AH984	AF524	AH984
16	FAN/FAN ASSEMBLY	1	AF533	AF533	AF533	AF533	AF533	AF533	AF547	AF533	AF547
17	SHROUD	1	AF535	AF535	AF535	AF535	AF535	AF535	AF535	AF535	AF535
18 Δ	MANIFOLD SLEEVE	2	AF567A	AF567A	AF567A	AF567A	AF567A	AF567A	AF567A	AF567A	AF567A
***	SERVICE KIT	1	K260	K260	K260	K260	K260	K260	K260	K260	K260

4VCF – 6HCA SERIES

REF	DESCRIPTION	QTY	4VCF	4VSF	4HCJ	4LCB	4HCC	5LCA	5HCD	5HCE	6HCN	6HCA
1	INLET FILTER ASSEMBLY	1		B300F								
		2	B300F		B300A	B300A	B300A	B300F	B300A	B300A	B300F	B300F
2 Δ	FELT	2	B344A	B344A	B344A	B344A	B344A	B344A	B344A	B344A	B344A	B344A
3	SAFETY VALVE	1	–	–	AT517A	AT517E	AT517A	AT517F	AT517B	AT517B	AT517C	AT517C
4	CYLINDER HEAD	2	AF507	AF507	AF507	AF507	AF507	AF507	AF507	AF507	AF507	AF507
5 Δ	HEAD GASKET	2	AF520A	AF520A	AF520A	AF520A	AF520A	AF520A	AF520A	AF520A	AF520A	AF520A
6 Δ	OUTLET VALVE	2	AF545	AF545	AF545	AF545	AF545	AF545	AF545	AF545	AF545	AF545
7	PLATE VALVE	2	AF543	AF543	AF543	AF543	AF543	AF543	AF543	AF543	AF543	AF543
8 Δ	INLET VALVE	2	AF544	AF544	AF544	AF544	AF544	AF544	AF544	AF544	AF544	AF544
9 Δ	CYLINDER GASKET	2	AF521	AF521	AF521	AF521	AF521	AF521	AF521	AF521	AF521	AF521
10	CYLINDER	2	AF509	AF509	AF509	AF509	AF509	AF509	AF509	AF509	AF509	AF509
11 Δ	PISTON RING	4	AF541	AF541	AF541	AF541	AF541	AF541	AF541	AF541	AF541	AF541
12 Δ	PISTON SEAL	4	AF540	AF540	AF540	AF540	AF540	AF540	AF540	AF540	AF540	AF540
13	PISTON ROD ASSEMBLY	2	AF561F	AF561F	AF561J	AF561B	AF561C	AF561A	AF561D	AF561E	AF561N	AF561A
14 Δ	RIDER RING	2	AF595	AF595	AF595	AF595	AF595	AF595	AF595	AF595	AF595	AF595
15	KEY	1	AB136D	AB136D	AB136D	AB136D	AB136D	AB136D	AB136D	AB136D	AB136F	AB136F
16	FAN/FAN ASSEMBLY	1	AF547	AF547	AF547	AF547	AF547	AF547	AF547	AF547	AF747	AF747
17	SHROUD	1	AF549	AF549	AF549	AF549	AF549	AF549	AF549	AF549	AF656	AF656
18 Δ	MANIFOLD SLEEVE	2	AF567A	AF567A	AF567A	AF567A	AF567A	AF567A	AF567A	AF567A	AF567A	AF567A
***	SERVICE KIT	1	K263	K263	K263	K263	K263	K263	K263	K263	K263	K263

Model 1VBF shown.
*** Item not shown.
Δ Denotes parts included in the Service Kit.
Parts listed are for stock models. For specific OEM models, please consult the factory.
When corresponding or ordering parts, please give complete model and serial numbers.

EXPLODED PRODUCT VIEW – MODEL 1VBF



PARTS & ORDERING INFORMATION

Please reference the exploded views on the next page for the following model and parts tables.

PAB – VAB SERIES

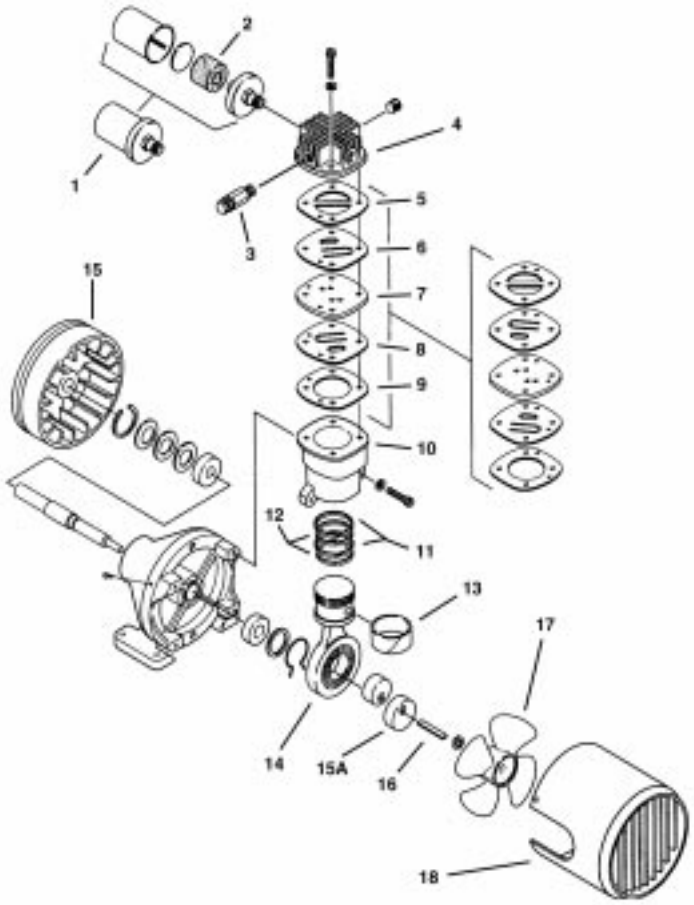
REF	DESCRIPTION	QTY	PAB	VAB
1	FILTER ASSEMBLY	1	B300A	B300A
2 Δ	FELT	1	B344A	B344A
3	SAFETY VALVE	1	AT517	–
4	CYLINDER HEAD	1	AF508	AF508
5 Δ	HEAD GASKET	1	AF518	AF518
6 Δ	OUTLET VALVE	1	AF531	AF531
7	PLATE VALVE	1	AF529	AF529
8 Δ	INLET VALVE	1	AF530	AF530
9 Δ	CYLINDER GASKET	1	AF519A	AF519A
10	CYLINDER	1	AF510	AF510
11 Δ	PISTON RING	2	AF527	AF527
12 Δ	PISTON SEAL	2	AF526	AF526
13 Δ	RIDER RING	1	AF594	AF594
14	PISTON ROD ASSEMBLY	1	AF560B	AF560B
15	PULLEY	1	AB140C	AB140C
15A	COUNTER WEIGHT	1	AF517B	AF517B
16	FLAT KEY	1	AF524	AF524
17	FAN	1	AF533	AF533
18	SHROUD	1	AF534	AF534
***	SERVICE KIT	1	K264	K264

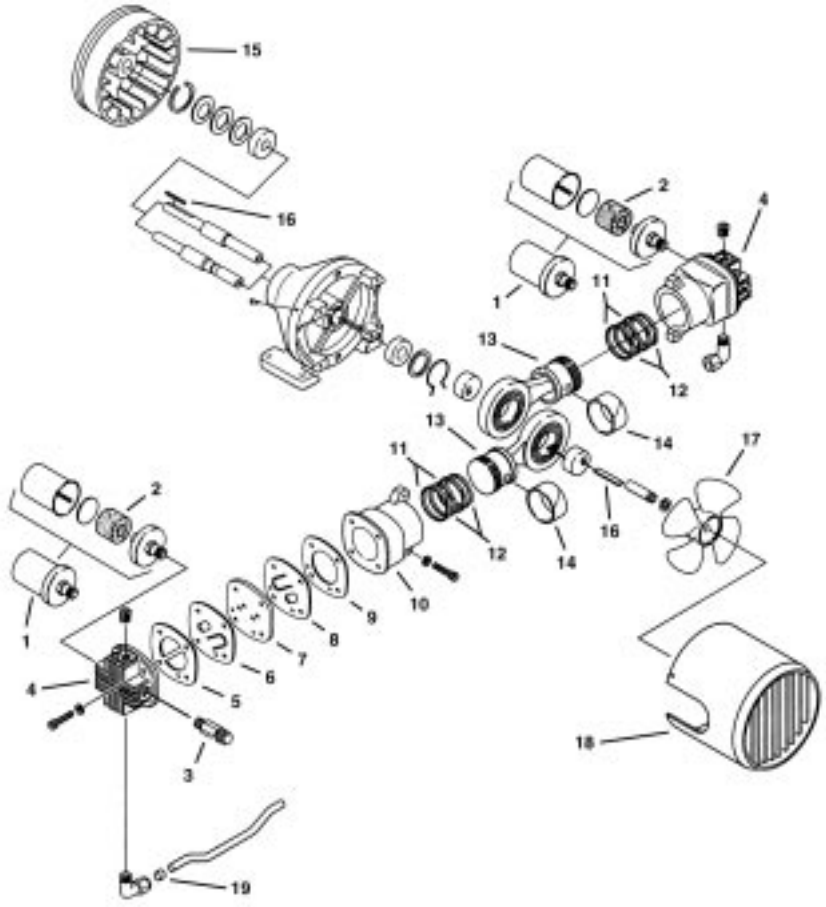
VBB – PCA-10 SERIES

REF	DESCRIPTION	QTY	VBB	VCD	PBB	PCA-10
1	FILTER ASSEMBLY	1	B300A	B300A	B300A	B300F
2 Δ	FELT	2	B344A	B344A	B344A	B344A
3	SAFETY VALVE	1	–	–	AT517	AT517C
4	CYLINDER HEAD	1	AF508	AF507	AF508	AF507
5 Δ	HEAD GASKET	1	AF518	AF520A	AF518	AF520A
6 Δ	OUTLET VALVE	1	AF531	AF545	AF531	AF545
7	PLATE VALVE	1	AF529	AF543	AF529	AF543
8 Δ	INLET VALVE	1	AF530	AF544	AF530	AF544
9 Δ	CYLINDER GASKET	1	AF519A	AF521	AF519A	AF521
10	CYLINDER	1	AF510	AF509	AF510	AF509
11 Δ	PISTON RING	2	AF527	AF541	AF527	AF541
12 Δ	PISTON SEAL	2	AF526	AF540	AF526	AF540
13	PISTON ROD ASSEMBLY	1	AF560B	AF561D	AF560B	AF561A
14 Δ	RIDER RING	1	AF594	AF595	AF594	AF595
15	PULLEY	1	AB140C	AK670	AB140C	AK670
16	FLAT KEY	1	AF524	AB136	AF524	AB136
17	FAN	1	AF533	AF547	AF533	AF661
18	SHROUD	1	AF535	AF549	AF535	AF656
19	MANIFOLD SLEEVE	2	AF567A	AF567A	AF567A	AF567A
***	SERVICE KIT	1	K260	K263	K260	K263

Models PAB and PBB shown.
** Item not shown.
Δ Denotes parts included in the Service Kit.
Parts listed are for stock models. For specific OEM models, please consult the factory.
When corresponding or ordering parts, please give complete model and serial numbers.

EXPLODED PRODUCT VIEWS – MODEL PAB (TOP) & MODEL PBB (BOTTOM)





PARTS & ORDERING INFORMATION

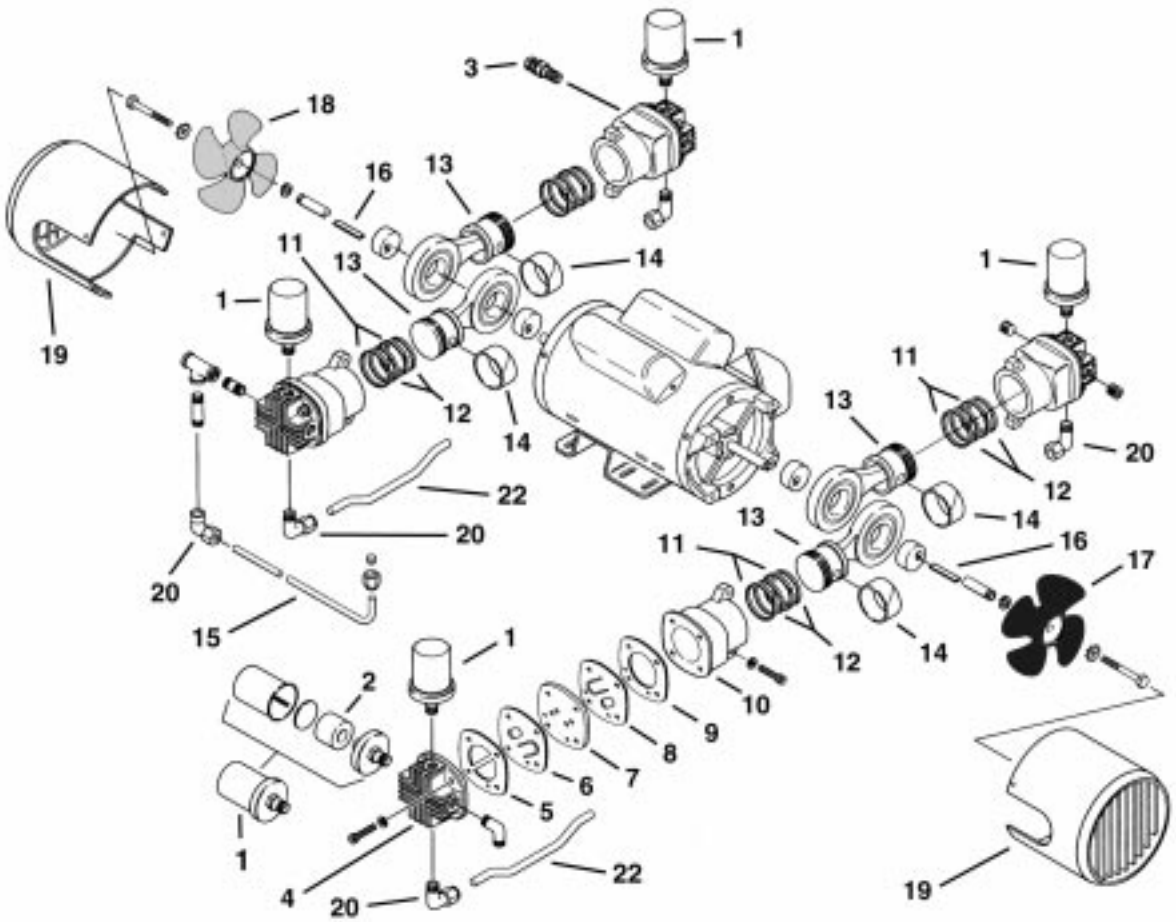
Please reference the exploded view on the next page for the following model and parts table.

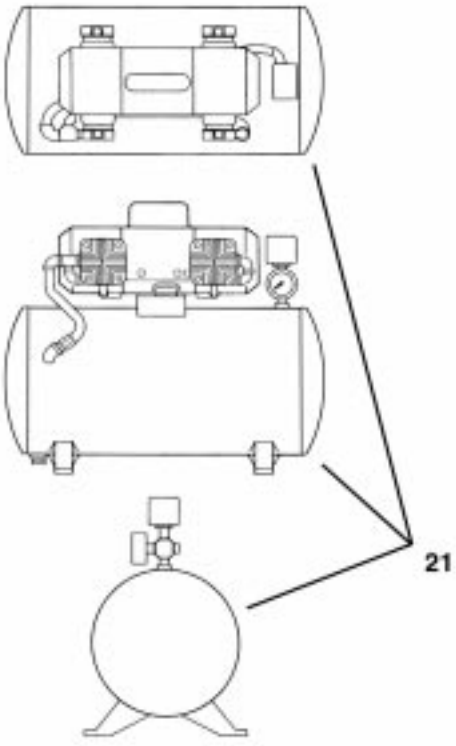
5VDF – 8LDF SERIES

REF	DESCRIPTION	QTY	5VDF	5VSF	6LCF **	6HDK	7LDE	7HDD	7HDE	8HDM	8HDN	8LDF
1	INLET FILTER ASSEMBLY	2		B300F	B300F							
		4	B300F			B300A	B300F	B300A	B300A	B300F	B300F	B300F
2 Δ	FELT	2		B344A	B344A							
		4	B344A			B344A	B344A	B344A	B344A	B344A	B344A	B344A
3	SAFETY VALVE	1	–	–	AF720	AF720A	AF720	AF720A	AF720A	AF720A	AF720A	AF720
4	CYLINDER HEAD	4/2 **	AF507	AF507	AF507	AF507	AF507	AF507	AF507	AF507	AF507	AF507
5 Δ	HEAD GASKET	4/2 **	AF520A	AF520A	AF520A	AF520A	AF520A	AF520A	AF520A	AF520A	AF520A	AF520A
6 Δ	OUTLET VALVE	4/2 **	AF545	AF545	AF545	AF545	AF545	AF545	AF545	AF545	AF545	AF545
7	PLATE VALVE	4/2 **	AF543	AF543	AF543	AF543	AF543	AF543	AF543	AF543	AF543	AF543
8 Δ	INLET VALVE	4/2 **	AF544	AF544	AF544	AF544	AF544	AF544	AF544	AF544	AF544	AF544
9 Δ	CYLINDER GASKET	4/2 **	AF521	AF521	AF521	AF521	AF521	AF521	AF521	AF521	AF521	AF521
10	CYLINDER	4/2 **	AF509	AF509	AF509	AF509	AF509	AF509	AF509	AF509	AF509	AF509
11 Δ	PISTON RING	8/4 **	AF541	AF541	AF541	AF541	AF541	AF541	AF541	AF541	AF541	AF541
12 Δ	PISTON SEAL	8/4 **	AF540	AF540	AF540	AF540	AF540	AF540	AF540	AF540	AF540	AF540
13	PISTON ROD ASSEMBLY	4/2 **	AF561F	AF561F	AF561F	AF561K	AF561E	AF561D	AF561E	AF561M	AF561N	AF561F
14 Δ	RIDER RING	4/2 **	AF595	AF595	AF595	AF595	AF595	AF595	AF595	AF595	AF595	AF595
15	MANIFOLD	1	AF659	AF659	–	AF659	AF659	AF659	AF659	AF659	AF659	AF659
16	SQUARE KEY	2/1 **	AB136F	AB136F	AB136F	AB136F	AB136F	AB136F	AB136F	AB136F	AB136F	AB136F
17	FAN/FAN ASSEMBLY-CCW	1	AF748	AF748	AF748	AF748	AF748	AF748	AF748	AF748	AF748	AF748
18	FAN ASSEMBLY-CW	1	AF747	AF747	AF747	AF747	AF747	AF747	AF747	AF747	AF747	AF747
19	SHROUD	2/1 **	AF656	AF656	AF656	AF656	AF656	AF656	AF656	AF656	AF656	AF656
20	MANIFOLD SLEEVE	2	–	–	AF567A	–	–	–	–	–	–	–
20	MANIFOLD SLEEVE	5	AF567A	AF567A	–	AF567A	AF567A	AF567A	AF567A	AF567A	AF567A	AF567A
21	TANK ASSEMBLY	1	–	–	AF606-1	AF606-1	AF606-1	AF606-1	–	AF606-1	AF606-1	–
22	MANIFOLD	2/1 **	AF550E	AF550E	AF550E	AF550C	AF550D	AF550B	AF550D	AF550A	AF550A	AF550E
***	SERVICE KIT	1	K303	K303	K263	K303	K303	K303	K303	K303	K303	K303

Model 5VDF shown.
** 6LCF is a two-cylinder unit. Other models are four-cylinder units.
*** Item not shown.
Δ Denotes parts included in the Service Kit.
Parts listed are for stock models. For specific OEM models, please consult the factory.
When corresponding or ordering parts, please give complete model and serial numbers.

EXPLODED PRODUCT VIEW – MODEL 5VDF





WARRANTY

Gast finished products, when properly installed and operated under normal conditions of use, are warranted by Gast to be free from defects in material and workmanship for a period of twelve (12) months from the date of purchase from Gast or an authorized Gast Representative or Distributor. In order to obtain performance under this warranty, the buyer must promptly (in no event later than thirty (30) days after discovery of the defect) give written notice of the defect to Gast Manufacturing Incorporated, PO Box 97, Benton Harbor Michigan USA 49023-0097 or an authorized Service Center (unless specifically agreed upon in writing signed by both parties or specified in writing as part of a Gast OEM Quotation). Buyer is responsible for freight charges both to and from Gast in all cases.

This warranty does not apply to electric motors, electrical controls, and gasoline engines not supplied by Gast. Gast's warranties also do not extend to any goods or parts which have been subjected to misuse, lack of maintenance, neglect, damage by accident or transit damage.

THIS EXPRESS WARRANTY EXCLUDES ALL OTHER WARRANTIES OR REPRESENTATIONS EXPRESSED OR IMPLIED BY ANY LITERATURE, DATA, OR PERSON. GAST'S MAXIMUM LIABILITY UNDER THIS EXCLUSIVE REMEDY SHALL NEVER EXCEED THE COST OF THE SUBJECT PRODUCT AND GAST RESERVES THE RIGHT, AT ITS SOLE DISCRETION, TO REFUND THE PURCHASE PRICE IN LIEU OF REPAIR OR REPLACEMENT.

GAST WILL NOT BE RESPONSIBLE OR LIABLE FOR INDIRECT OR CONSEQUENTIAL DAMAGES OF ANY KIND, however arising, including but not limited to those for use of any products, loss of time, inconvenience, lost profit, labor charges, or other incidental or consequential damages with respect to persons, business, or property, whether as a result of breach of warranty, negligence or otherwise. Notwithstanding any other provision of this warranty, BUYER'S REMEDY AGAINST GAST FOR GOODS SUPPLIED OR FOR NON-DELIVERED GOODS OR FAILURE TO FURNISH GOODS, WHETHER OR NOT BASED ON NEGLIGENCE, STRICT LIABILITY OR BREACH OF EXPRESS OR IMPLIED WARRANTY IS LIMITED SOLELY, AT GAST'S OPTION, TO REPLACEMENT OF OR CURE OF SUCH NONCONFORMING OR NON-DELIVERED GOODS OR RETURN OF THE PURCHASE PRICE FOR SUCH GOODS AND IN NO EVENT SHALL EXCEED THE PRICE OR CHARGE FOR SUCH GOODS. GAST EXPRESSLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE OR PURPOSE WITH RESPECT TO THE GOODS SOLD. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTIONS SET FORTH IN THIS WARRANTY, notwithstanding any knowledge of Gast regarding the use or uses intended to be made of goods, proposed changes or additions to goods, or any assistance or suggestions that may have been made by Gast personnel.

Unauthorized extensions of warranties by the customer shall remain the customer's responsibility.

CUSTOMER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF GAST PRODUCTS FOR CUSTOMER'S USE OR RESALE, OR FOR INCORPORATING THEM INTO OBJECTS OR APPLICATIONS WHICH CUSTOMER DESIGNS, ASSEMBLES, CONSTRUCTS OR MANUFACTURES.

This warranty can be modified only by authorized Gast personnel by signing a specific, written description of any modifications.

MAINTENANCE RECORD

DATE	PROCEDURE PERFORMED

MAINTENANCE RECORD

DATE	PROCEDURE PERFORMED

TROUBLESHOOTING CHART

Low		High		Pump	Motor	Excess	Reason and remedy
Vacuum	Pressure	Vacuum	Pressure	Overheat	Overload	Noise	for problem.
	•			•	•	•	Filter dirty. Clean or replace.
•			At pump	•	•	•	Muffler dirty. Clean or replace.
•	•					•	Valves dirty or valves bent. Clean or replace.
•	•					•	Damaged or worn piston rings. Repair or replace.
	•			•	•		Leaky relief valve. Inspect and adjust.
•	•					•	Damaged valves. Replace.
•		At pump	•	•	•	•	Plugged vacuum/pressure line. Inspect and repair.
•	•			•	•		Low voltage, won't start. Check power source.
•	•					•	Worn rings/piston hitting cylinder. Replace.
	•			•	•	•	Cylinder misadjustment. Realign.
•	•					•	Leaky hose or check valve. Replace.
•	•			•	•	•	Dirt or liquid on top of piston. Inspect and clean.
•	•					•	Blown head gasket. Replace.

AUTHORIZED SERVICE FACILITIES

Gast Manufacturing Inc.
2550 Meadowbrook Road
Benton Harbor, MI 49022
TEL: 269-926-6171
FAX: 269-925-8288
www.gastmfg.com

Gast Manufacturing Inc.
505 Washington Avenue
Carlstadt, NJ 07072
TEL: 201-933-8484
FAX: 201-933-5545
www.gastmfg.com

Air-Oil Products Corp.
301 30th Street NE 31,#112
Auburn, WA 98002
TEL: 800-282-2672
FAX: 877-808-4601
www.air-oil.com

Brenner Fiedler & Assoc
13824 Bentley Place
Cerritos, CA 90701
TEL: 800-843-5558
TEL: 310-404-2721
FAX: 310-404-7975
www.brenner-fiedler.com

D & F Distributors
1144 Indy Court
Evansville, IN 47725
TEL: 812/867-2441
FAX: 812/867-6822
www.dfdistrib.com

John Henry Foster Co.
4700 Lebourget Drive
St. Louis, MO 63134-0820
TEL: 314-427-0600
TEL: 1-800-444-0522
FAX: 314-427-3502
www.jhf.com

Hydraulic & Pneumatic Sales
11100 Park Charlotte Blvd.
Charlotte, NC 28273
TEL: 704-588-3234
FAX: 704-588-1569
www.hpsalesinc.com

Kinequip, Incorporated
365 Old Niagara Falls Blvd.
Buffalo, NY 14228-1636
TEL: 716-694-5000
TEL:1-800-982-8894
www.kinequip.com

James E. Watson & Co.
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Bucks, England HP10 9SD
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FAX: 011-44 1628 532470
http://www.gastltd.com

Japan Machinery Co., Ltd
Central PO Box 1451
Tokyo, 100-91 Japan
TEL: 81-3-3573-5421
FAX: 81-3-3571-7865
or: 81-3-3571-7896
www.japanmachinery.com

74R & 75R SERIES
ROCKING PISTON OIL-LESS PUMPS

OPERATION & MAINTENANCE MANUAL

Model 74R Shown

Model 75R6 Shown

Thank you for purchasing this Gast product. It is manufactured to the highest standards using quality materials. Please follow all recommended maintenance, operational and safety instructions and you will receive years of trouble free service.

IMPORTANT: PLEASE READ THIS MANUAL AND SAVE FOR FUTURE REFERENCE.

Product Use Criteria:

- Pump only clean, dry air.
- Operate at 32ºF - 104ºF (0ºC - 40ºC).
- Protect unit from dirt & moisture.
- Do not pump flammable or explosive gases or use in an atmosphere that contains such gases.
- Protect all surrounding items from exhaust air. This exhaust air can become very hot.
- Corrosive gases and particulate material will damage unit. Water vapor, oil-based contaminants or other liquids must be filtered out.
- Consult your Gast Distributor/Representative before using at high altitudes.
- This pump is oil-less and requires NO lubrication.

GAST
A Unit of IDEX Corporation

ISO 9001 & 14001 CERTIFIED

www.gastmfg.com

Your safety and the safety of others is extremely important.

We have provided many important safety messages in this manual and on your product. Always read and obey all safety messages.

This is the safety alert symbol. This symbol alerts you to hazards that can kill or hurt you and others. The safety alert symbol and the words "DANGER" and "WARNING" will precede all safety messages. These words mean:

DANGER

You will be killed or seriously injured if you don't follow instructions.

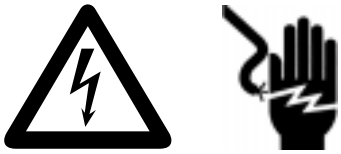
WARNING

You can be killed or seriously injured if you don't follow instructions.

All safety messages will identify the hazard, tell you how to reduce the chance of injury, and tell you what can happen if the safety instructions are not followed.

INSTALLATION

WARNING



Electrical Shock Hazard

Disconnect electrical power at the circuit breaker or fuse box before installing this product.

Install this product where it will not come into contact with water or other liquids.

Install this product where it will be weather protected.

Electrically ground this product.

Failure to follow these instructions can result in death, fire or electrical shock.

Correct installation is your responsibility. Make sure you have the proper installation conditions and that installation clearances do not block air flow.

Blocking air flow over the product in any way can cause the product to overheat.

Mounting
This product can be installed in any orientation. Mounting the product to a stable, rigid operating surface and using shock mounts will reduce noise and vibration.

Plumbing
Remove plugs from the IN and OUT ports. Connect with pipe and fittings that are the same size or larger than the product's threaded ports. Be sure to connect the intake and exhaust plumbing to the correct inlet and outlet ports. Ports will not support plumbing.

Accessories
The product's external intake and exhaust muffler will provide adequate filtration in most applications. Check filters periodically and replace when necessary. Consult your Gast Distributor/Representative for additional filter recommendations.

Install relief valves and gauges at inlet or outlet or both, to monitor performance. Check valves may be required to prevent back streaming through the pump.

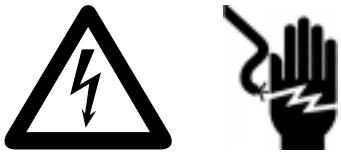
Motor Control
It is your responsibility to contact a qualified electrician and assure that the electrical installation is adequate and in conformance with all national and local codes and ordinances. The metal capacitor must be grounded.

Determine the correct overload setting required to protect the motor (see motor starter manufacturer's recommendations). Select fuses, motor protective switches or thermal protective switches to provide protection. Fuses act as short circuit protection for the motor, not as protection against overload. Incoming line fuses must be able to withstand the motor's starting current. Motor starters with thermal magnetic overload or circuit breakers protect motor from overload or reduced voltage conditions.

The wiring diagram supplied with the product provides required electrical information. Check that power source is correct to properly operate the dual-voltage motors.

Electrical Connection

WARNING



Electrical Shock Hazard

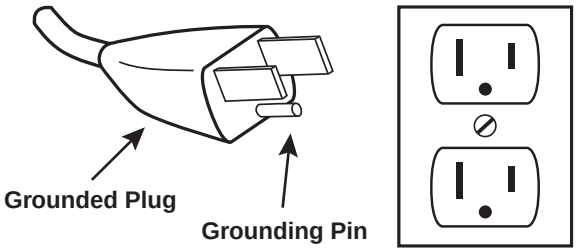
This product must be properly grounded.

Do not modify the plug provided. If it will not fit the outlet, have the proper outlet installed by a qualified electrician.

If repair or replacement of the cord or plug is necessary, do not connect the grounding wire to either flat blade terminal. The wire with insulation that is green or green with yellow stripes is the grounding wire.

Check the condition of the power supply wiring. Do not permanently connect this product to wiring that is not in good condition or is inadequate for the requirements of this product.

Failure to follow these instructions can result in death, fire or electrical shock.



120-volt grounded connectors shown. 220/240-volt grounded connectors will differ in shape.

Model with a power supply cord:
This product must be grounded. For either 120-volt or 220/240-volt circuits connect power supply cord grounding plug to a matching grounded outlet. Do not use an adapter. (See above diagram.)

In the event of an electrical short circuit, grounding reduces the risk of electric shock by providing an escape wire for the electric current. This product may be equipped with a power supply cord having a grounding wire with an appropriate grounding plug. The plug must be plugged into an outlet that is properly installed and grounded in accordance with all local codes and ordinances.

Check with a qualified electrician or serviceman if the grounding instructions are not completely understood, or if you are not sure whether the product is properly grounded. Do not modify the plug provided. If it will not fit the outlet, have the proper outlet installed by a qualified electrician.

Model that is permanently wired:
This product must be connected to a grounded, metallic, permanent wiring system, or an equipment grounding terminal or lead on the product.

Power supply wiring must conform to all required safety codes and be installed by a qualified person. Check that supply voltage agrees with that listed on product nameplate.

Extension cords:
Use only a 3-wire extension cord that has a 3-blade grounding plug. Connect extension cord plug to a matching 3-slot receptacle. Do not use an adapter. Make sure your extension cord is in good condition. Check that the gage wire of the extension cord is the correct size wire to carry the current this product will draw.

An undersized cord is a potential fire hazard, and will cause a drop in line voltage resulting in loss of power causing the product to overheat. The following table indicates the correct size cord for length required and the ampere rating listed on the product nameplate. **If in doubt, use the next heavier gage cord. The smaller the gage number, the heavier the wire gage.**

Minimum gage for extension cords

Amps	Volts	Length of cord in feet								
	120v	**25**	**50**	**100**	**150**	**200**	**250**	**300**	**400**	**500**
	240v	**50**	**100**	**200**	**300**	**400**	**500**	**600**	**800**	**1000**
0-2		18	18	18	16	16	14	14	12	12
2-3		18	18	16	14	14	12	12	10	10
3-4		18	18	16	14	12	12	10	10	8
4-5		18	18	14	12	12	10	10	8	8
5-6		18	16	14	12	10	10	8	8	8
6-8		18	16	12	10	10	8	6	6	6
8-10		18	14	12	10	8	8	6	6	4
10-12		16	14	10	8	8	6	6	4	4
12-14		16	12	10	8	6	6	6	4	2
14-16		16	12	10	8	6	6	4	4	2
16-18		14	12	8	8	6	4	4	2	2
18-20		14	12	8	6	6	4	4	2	2

OPERATION

WARNING

Injury Hazard

Install proper safety guards as needed.

Keep fingers and objects away from openings and rotating parts.

When provided, motor terminal covers must be in place for safe operation.

Product surfaces become very hot during operation, allow product surfaces to cool before handling.

Air stream from product may contain solid or liquid material that can result in eye or skin damage, wear proper eye protection.

Wear hearing protection. Sound level from motor may exceed 70 dBA.

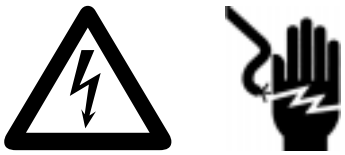
Failure to follow these instructions can result in burns, eye injury or other serious injury.

It is your responsibility to operate this product at recommended pressures or vacuum duties and room ambient temperatures. Do not start against a vacuum or pressure load.

Start Up
If motor fails to start or slows down significantly under load, shut off and disconnect from power supply. Check that the voltage is correct for motor and that motor is turning in the proper direction. Check the plug, cord and switch for damage. If so equipped, the thermal protection switch has tripped, the motor can restart after cooling.

MAINTENANCE

WARNING



Electrical Shock Hazard

Disconnect electrical power supply cord before performing maintenance on this product.

If product is hard wired into system, disconnect electrical power at the circuit breaker or fuse box before performing maintenance on this product.

Failure to follow these instructions can result in death, fire or electrical shock.

WARNING

Injury Hazard

Product surfaces become very hot during operation, allow product surfaces to cool before handling.

Air stream from product may contain solid or liquid material that can result in eye or skin damage, wear proper eye protection.

Clean this product in a well ventilated area.

Failure to follow these instructions can result in burns, eye injury or other serious injury.

It is your responsibility to:

- **Regularly inspect and make necessary repairs to product in order to maintain proper operation.**
- **Make sure that pressure is released from product before starting maintenance.**

Check intake and exhaust filters after first 500 hours of operation. Clean filters and determine how frequently filters should be checked during future operation. This one procedure will help to assure the product's performance and service life.

1. Disconnect electrical power supply to unit.
2. Vent all air lines.
3. Remove filter cover.
4. Check filter felt. Replace felt if it is covered with contamination or shows signs of increasing differential pressure.
5. Reinstall felt and filter cover.

Check that all external accessories such as relief valves and gauges are attached to cover and are not damaged before re-operating product.

SHUTDOWN PROCEDURES

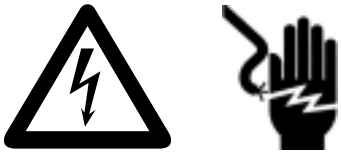
It is your responsibility to follow proper shutdown procedures to prevent product damage.
NEVER ADD OIL TO THIS OIL-LESS PUMP.

Proper shutdown procedures must be followed to prevent pump damage. Failure to do so may result in premature pump failure. Gast Manufacturing Rocking Piston Oil-Less Pumps are constructed of ferrous metals or aluminum which are subject to rust and corrosion when pumping condensable vapors such as water. Follow the steps below to assure correct storage and shutdown between operating periods.

1. Disconnect plumbing.
2. Operate product for at least 5 minutes without plumbing.
3. Run at maximum vacuum for 10 to 15 minutes.
4. Repeat step 2.
5. Disconnect power supply.
6. Plug open ports to prevent dirt or other contaminants from entering product.

SERVICE KIT INSTALLATION

WARNING



Electrical Shock Hazard

Disconnect electrical power supply cord before installing Service Kit.

If product is hard wired into system, disconnect electrical power at the circuit breaker or fuse box before installing Service Kit.

Vent all air lines to release pressure or vacuum.

Failure to follow these instructions can result in death, fire or electrical shock.

Gast will NOT guarantee field-rebuilt product performance. For performance guarantee, the product must be returned to a Gast Authorized Service Facility.

Service Kit contents vary. Most contain gasket and filter parts.

1. Disconnect electrical power to pump.
2. Disconnect air supply and vent all air lines to release pressure or vacuum.
3. Mark the orientation of the ports so cover will be reinstalled correctly.
4. Remove screws from the head of the pump. Remove the head of the pump.
5. Mark orientation of valve plate(s). Remove valve plate(s).
6. Remove and discard old cups(s), retainer screws, cylinder O-ring(s), head O-ring(s), valves and valve retainers.
7. Install new cup(s) on rod(s) facing up.
8. Reinstall retainer plates.
9. Apply a thread locking compound (Loctite 222) to retainer screws. Torque screws to 34-38 in. lbs.
10. Carefully install cylinder(s) over cup(s) at an angle to avoid damaging cup(s).
11. Clean valve plates with water based solvent. Take care to not scratch valve seats.
12. Install valves and valve retainers. Check that the orientation with the ports is correct.
13. Apply a thread locking compound (Loctite 222) to retainer screws. Torque screws to 10-13 in. lbs.
14. Install cylinder O-ring(s) in the bottom of valve plate(s).
15. Check that the orientation of valve plate(s) with the ports is correct.
16. Install head O-rings in the O-ring grooves on top of valve plate.
17. Reinstall head over valve plate(s) checking that orientation with ports is correct.
18. Torque screws to 50 in. lbs.

Check that all external accessories such as relief valves and gauges are not damaged before re-operating product.

If pump still does not produce proper vacuum or pressure, send unit to a Gast Authorized Service Facility for repair.

WARRANTY

Gast finished products, when properly installed and operated under normal conditions of use, are warranted by Gast to be free from defects in material and workmanship for a period of twelve (12) months from the date of purchase from Gast or an authorized Gast Representative or Distributor. In order to obtain performance under this warranty, the buyer must promptly (in no event later than thirty (30) days after discovery of the defect) give written notice of the defect to Gast Manufacturing Incorporated, PO Box 97, Benton Harbor Michigan USA 49023-0097 or an authorized Service Center (unless specifically agreed upon in writing signed by both parties or specified in writing as part of a Gast OEM Quotation). Buyer is responsible for freight charges both to and from Gast in all cases.

This warranty does not apply to electric motors, electrical controls, and gasoline engines not supplied by Gast. Gast's warranties also do not extend to any goods or parts which have been subjected to misuse, lack of maintenance, neglect, damage by accident or transit damage.

THIS EXPRESS WARRANTY EXCLUDES ALL OTHER WARRANTIES OR REPRESENTATIONS EXPRESSED OR IMPLIED BY ANY LITERATURE, DATA, OR PERSON. GAST'S MAXIMUM LIABILITY UNDER THIS EXCLUSIVE REMEDY SHALL NEVER EXCEED THE COST OF THE SUBJECT PRODUCT AND GAST RESERVES THE RIGHT, AT ITS SOLE DISCRETION, TO REFUND THE PURCHASE PRICE IN LIEU OF REPAIR OR REPLACEMENT.

GAST WILL NOT BE RESPONSIBLE OR LIABLE FOR INDIRECT OR CONSEQUENTIAL DAMAGES OF ANY KIND, however arising, including but not limited to those for use of any products, loss of time, inconvenience, lost profit, labor charges, or other incidental or consequential damages with respect to persons, business, or property, whether as a result of breach of warranty, negligence or otherwise. Notwithstanding any other provision of this warranty, BUYER'S REMEDY AGAINST GAST FOR GOODS SUPPLIED OR FOR NON-DELIVERED GOODS OR FAILURE TO FURNISH GOODS, WHETHER OR NOT BASED ON NEGLIGENCE, STRICT LIABILITY OR BREACH OF EXPRESS OR IMPLIED WARRANTY IS LIMITED SOLELY, AT GAST'S OPTION, TO REPLACEMENT OF OR CURE OF SUCH NONCONFORMING OR NON-DELIVERED GOODS OR RETURN OF THE PURCHASE PRICE FOR SUCH GOODS AND IN NO EVENT SHALL EXCEED THE PRICE OR CHARGE FOR SUCH GOODS. GAST EXPRESSLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE OR PURPOSE WITH RESPECT TO THE GOODS SOLD. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTIONS SET FORTH IN THIS WARRANTY, notwithstanding any knowledge of Gast regarding the use or uses intended to be made of goods, proposed changes or additions to goods, or any assistance or suggestions that may have been made by Gast personnel.

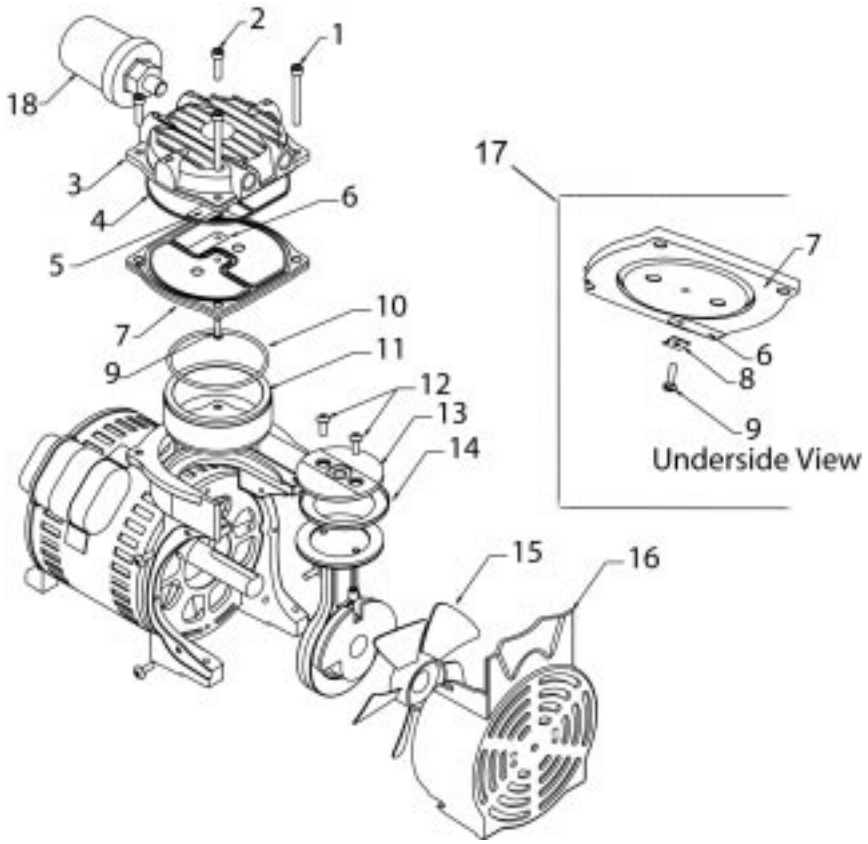
Unauthorized extensions of warranties by the customer shall remain the customer's responsibility.

CUSTOMER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF GAST PRODUCTS FOR CUSTOMER'S USE OR RESALE, OR FOR INCORPORATING THEM INTO OBJECTS OR APPLICATIONS WHICH CUSTOMER DESIGNS, ASSEMBLES, CONSTRUCTS OR MANUFACTURES.

This warranty can be modified only by authorized Gast personnel by signing a specific, written description of any modifications.

EXPLODED PRODUCT VIEW, PARTS & ORDERING INFORMATION

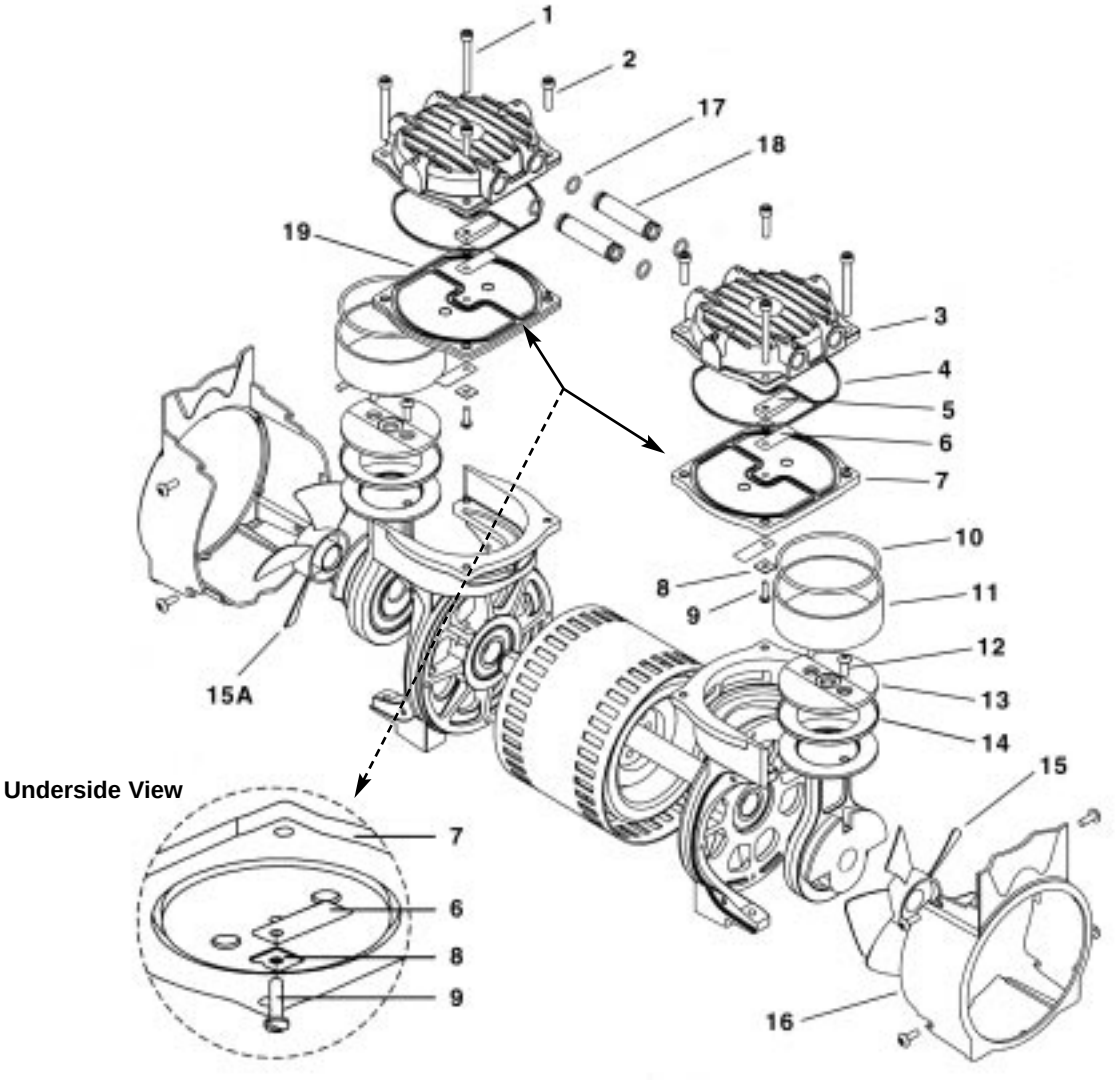
REF	DESCRIPTION	QTY	74R1	75R1
1	CAP SCREWS	2	BB570	BB570
2	CAP SCREWS	2	BB516C	BB516C
3	HEAD	1	AP200E	AP200E
4 Δ	HEAD O-RING	1	AP109	AP109
5	VALVE LIMITER	1	AP110	AP110
6 Δ	LEAF VALVES	2	AF817	AF817
7	VALVE PLATE	1	AP101A	AP101A
8	VALVE RETAINER	1	AF819A	AF819A
9	VALVE SCREW	1	BB330A	BB330A
10 Δ	CYLINDER O-RING	1	AT276	AT276
11	CYLINDER	1	AP119	AT275
12 Δ	RETAINER SCREWS	2	AT283	AT283
13	RETAINER PLATE	1	AT715	AT566A
14 Δ	PISTON CUP	1	AT329	AT280
15	FAN	1	AP108A	AP108A
16	GRILLE SHROUD	1	AP107A	AP107A
17	VALVE PLATE ASSEMBLY	1	AP102A	AP102A
18	FILTER	1	B300A	B300A
***	SERVICE KIT	1	K806	K806



* 74R shown.
*** Item not shown.
Δ Denotes parts included in the Service Kit.
Parts listed are for stock models. For specific OEM models, please consult the factory.
When corresponding or ordering parts, please give complete model and serial numbers.

EXPLODED PRODUCT VIEW, PARTS & ORDERING INFORMATION

REF	DESCRIPTION	QTY	75R6
1	CAP SCREW	4	BB750
2	CAP SCREW	4	BB516C
3	HEAD	1 1	AP200A AP201A
4 Δ	HEAD O-RING	2	AP109
5	VALVE LIMITER	2	AP110
6 Δ	LEAF VALVE	4	AF817
7	VALVE PLATE	2	AP101A
8	VALVE RETAINER	2	AF819A
9	VALVE SCREW	2	BB330A
10 Δ	CYLINDER O-RING	2	AT276
11	CYLINDER	2	AT275
12 Δ	RETAINER SCREW	4	AT283
13	RETAINER PLATE	2	AT566A
14 Δ	PISTON CUP	2	AT280
15	FAN	1	AP108A
15A	FAN - LEAD END	1	AP108
16	GRILLE SHROUD	1	AP107
17 Δ	O-RING	4	AK846
18	TUBE	2	AP125A
19	VALVE PLATE ASSEMBLY	2	AP102A
***	SERVICE KIT	1	K797



* 75R shown.
*** Item not shown.
Δ Denotes parts included in the Service Kit.
Parts listed are for stock models. For specific OEM models, please consult the factory.
When corresponding or ordering parts, please give complete model and serial numbers.

PART NO. 70 - 6850 G496PL (REV-D)

TROUBLESHOOTING CHART

Low		High		Pump	Won't	Excess	Reason and remedy
Vacuum	Pressure	Vacuum	Pressure	Overheat	Start	Noise	for problem.
•	•	•		•	•		Filter dirty. Clean or replace.
•	•		•	•	•		Muffler dirty. Clean or replace.
•	•						Valves dirty or valves bent. Clean or replace.
•	•						Worn cup. Repair or replace.
			•	•	•		Relief valve set too high. Inspect and adjust.
•	•						Relief valve set too low. Inspect and adjust.
•	•	•	•	•	•		Plugged vacuum/pressure line. Inspect and repair.
•		•					Collapsed vacuum line. Inspect and repair.
				•	•		Low voltage, won't start. Check power source.
				•	•	•	Voltage wrong. Check power source.
•	•					•	Worn cup/piston hitting cylinder. Replace.
				•		•	Cylinder misadjustment. Realign.
•	•				•		Leaky hose or check valve. Replace.
•	•			•	•	•	Dirt or liquid on top of piston. Inspect and clean.
•	•			•	•	•	Motor not wired correctly. Check wiring diagram/line voltage.
•	•					•	Blown head gasket. Replace.

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Fax: (852) 2690 1012
www.gasthk.com

ATF

Features:
Reliable Oxygen Production

Rugged, Environmentally Tolerant Design

Compact & Lightweight for Maximum Design Flexibility

Constant Pneumatic Impedance

Constant Delivery Pressure

Benefits:
No Maintenance Required

Low Capital and Operating Costs

Maximum Design Flexibility

Quiet Operation For Use In Any Location

Extended Compressor Life

The ATF Family

Oxygen Concentrator Modules

Patented Simplicity for Reliable Long Life

The unique design of the Advanced Technology Fractionator® (ATF) oxygen module eliminates dozens of components and interconnections found in conventional PSA systems. A patented single rotary distribution valve built into the ATF® module is continuously rotated at low speed by a small motor. The valve is maintenance free, self-cleaning, insensitive to contamination, and invulnerable to wear. It sequentially directs the flow of compressed air to a group of four sieve beds (adsorption), while at the same time another four beds are purged into the atmosphere though the valve (desorption). The remaining four of the twelve beds are interconnected through the valve to equalize pressure as the sieve beds sequentially transition between adsorption and desorption. In contrast to a conventional PSA system, the small amplitude pressure swings generated by the ATF's twelve sieve beds eliminate loud noise pulses, eliminate the need for a pressure regulator, and reduce compressor wear.

SeQual

The ATF Advantage

ATF® oxygen modules incorporate proven pressure swing adsorption (PSA) principles into a unique patented design which is far more compact, efficient, rugged and lower in cost than conventional PSA systems. The ATF® module offers unparalleled design flexibility and enables applications where on-site/on-board oxygen generation was previously impractical.

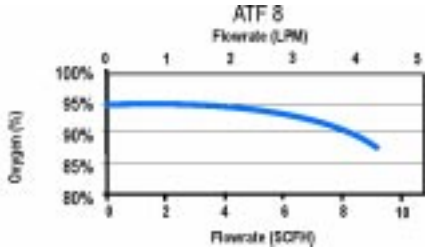
ATF® vs. Conventional PSA Systems

	Conventional	ATF
Pneumatic Connections	40-60	10
Electrical Connections	20-30	5
Solenoid Valves	2-8	0
Control Electronics	Required	None
Inlet Air Pressure (PSIG)	90	35
Pressure Reducing Regulator	Required	None
Maintenance	Required	None
Product Tank	Required	None

The ATF Family

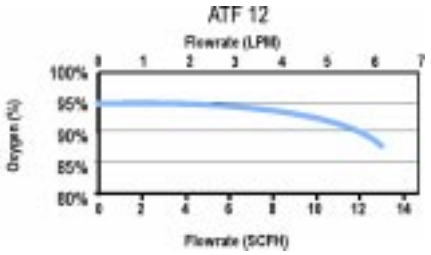
ATF-8 Series

The ATF-8 provides oxygen from 0-8 standard cubic feet per hour (SCFH)/ 0-3.8 liters per minute (LPM) at 90-95% purity.



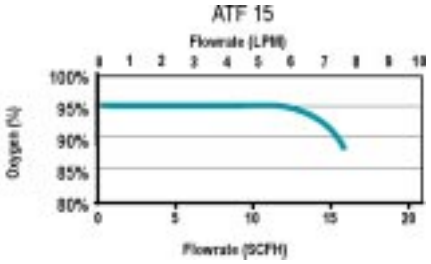
ATF-12 Series

The ATF-12 provides oxygen from 0-12 standard cubic feet per hour (SCFH)/ 0-5.5 liters per minute (LPM) at 90-95% purity.



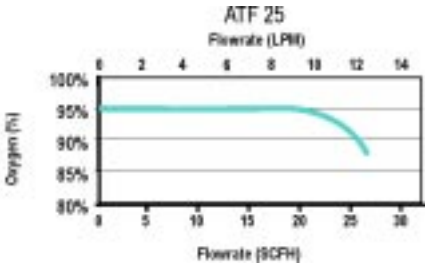
ATF-15 Series

The ATF-15 provides oxygen from 0-15 standard cubic feet per hour (SCFH)/ 0-7 liters per minute (LPM) at 90-95% purity.



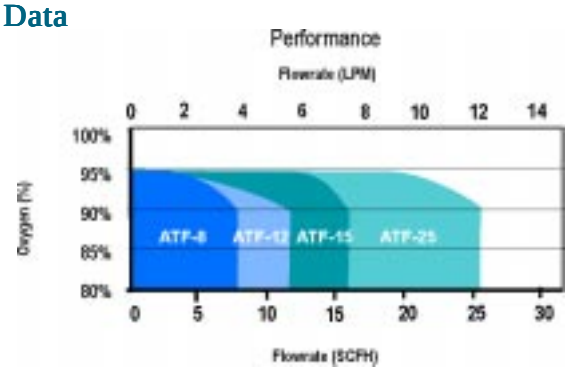
ATF-25 Series

The ATF-25 provides oxygen from 0-25 standard cubic feet per hour (SCFH)/ 0-11.8 liters per minute (LPM) at 90-95% purity.



Advanced Technology Fractionators Performance Data

This technical data is presented as a basis for ATF and compressor selection only. Performance is based upon nominal units tested under lab conditions. Please call for additional information.



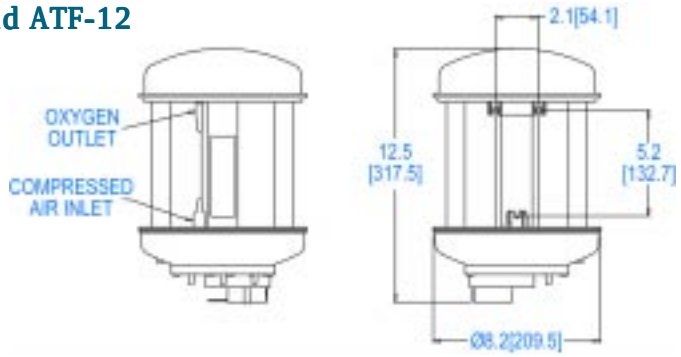
ATF Specifications and Performance

ATF Name	ATF Model #	Power Supply	Input Air Requirements		Performance Data		Weight
			Flow	Pressure	Flow 90% (+3%/-5%) O_2 at:	Oxygen Delivery Pressure	
ATF-8	1272	115 VAC (+/-10%) 60 Hz., 25 mA.	2.3 SCFM 65 LPM	25 PSIG 1.7 bar	8 SCFH 3.8 LPM 0.23 m^3/hr 1 GPM	9 PSIG 0.6 Bar	9.6 lbs 4.4 kg
	1265	110 VAC/220 VAC (+/-10%) 50 or 60 Hz., 25 mA.					
ATF-12	1255	110 VAC/220 VAC (+/-10%) 50 or 60 Hz., 25 mA.	3.0 SCFM 85 LPM	25 PSIG 1.7 bar	12 SCFH 5.7 LPM 0.34 m^3/hr 1.5 GPM	9 PSIG 0.6 Bar	9.8 lbs 4.5 kg
ATF-15	1245	115 VAC (+/-10%) 60 Hz., 25 mA.	3.2 SCFM 91 LPM	18 PSIG 1.2 bar	15 SCFH 7.1 LPM 0.42 m^3/hr 1.87GPM	7 PSIG 0.5 bar	14.7 lbs 6.7 kg
	1242	110 VAC/220 VAC (+/-10%) 50 or 60 Hz., 25 mA.					
ATF-25	1280	110 VAC/220 VAC (+/-10%) 50 or 60 Hz., 25 mA.	5.5 SCFM 156 LPM	35 PSIG 2.4 bar	25 SCFH 11.8 LPM 0.71 m^3/hr 3.12 GPM	14 PSIG 1 Bar	15 lbs 6.8 kg

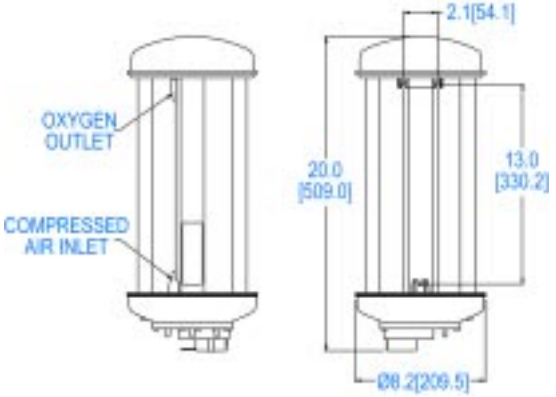
Envelope Dimensions

inches (mm)

ATF-8 and ATF-12



ATF-15 and ATF-25



Additional ATF Specifications

Compressed Air Input Requirements
Clean Air (oil-less)
Maximum temperature of 170°F (77°C)
(Performance rated at 120°F (49°C)

Ambient Temperature Parameters
40°F - 130°F (4°C - 54°C) inside operating enclosure
0°F - 140°F (-18°C - 60°C) storage

Oxygen Delivery Dewpoint: -100°F (-73°C)

Mounting
Two integral mounting pads provided
Optional toe clamps available
Vertical mounting preferred
Must be isolated from compressor vibration

Physical
Air inlet: Barb for 1/2" (12.7mm) ID tubing
O_2 outlet: Barb for 1/4" (6.4mm) ID tubing

Compressor Selection

Match the chosen ATF model and part number with the appropriate oil-less compressor part number.

ATF/Compressor Matching Table

ATF Name	ATF Model #	Recommended Compressor Part Number	Voltage (Volts)	Frequency (Hz)
ATF-8	1272	1201	115	60
	1265	1202	220	50
ATF-12	1255	1313	115	60
		1314	230	50
ATF-15	1245	1313	115	60
	1242	1314	230	50
ATF-25	1280	1318	115	60
		1354	220/230	60/50

Additional Compressor Specifications

This technical data is presented as a basis for ATF and compressor selection only. Compressor performance is based upon nominal units tested with ATFs under lab conditions. Please call for additional information.

Compressor Part #	Maximum Pressure (psi)	Motor	RPM	HP	Power Consumption kW	Net Weight lbs (kg)
1201	30	115V, 60Hz, 1∅	1660	1/3	0.4	13 (5.9)
1202	30	220V, 50Hz, 1∅	1430	1/3	0.4	17 (7.7)
1313	30	115V, 60Hz, 1∅	1650	1/3	0.5	16 (7.1)
1314	30	220V, 50Hz, 1∅	1425	1/3	0.5	14 (6.4)
1318	45	115V/230V, 60Hz, 1∅	1725	1	1	60 (27)
1354	45	220V/230V, 60Hz/50Hz, 1∅	1725/1425	1	1	60 (27)

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Email: industrialsales@sequal.com

ATF Family Accessories

Part No.	Description	ATF-8	ATF-12	ATF-15	ATF-25
9009	Economy Heat Exchanger	✔	✔	✔	✔
9110	Flowmeter 1-10 LPM	✔	✔	✔	
9116	Flow Meter 2-25 LPM				✔
9120	Flow Meter 1-10 SCFH	✔			
9122	Flow Meter 2-20 SCFH		✔	✔	
9124	Flow Meter 5-50 SCFH				✔
9125	Pressure Switch	✔	✔	✔	✔
9135	Continuous Oxygen Monitor	✔	✔	✔	✔
9150	Toe Clamps	✔	✔	✔	✔
9155	Compressed Air Hose ½" ID	✔	✔	✔	✔
9160	Oxygen Product Hose ¼" ID	✔	✔	✔	✔

9/99 1,500

789 7th St NW Sioux Center, IA 51250 Ph: (712) 722-0337 Fax: (712) 722-1787

TG-40

High Output Ozone Generator

Installation and Operation Manual

Table of Contents

Cautions, Warnings and Hazards:

Ozone is a powerful oxidizing agent. Observe strict operating procedures when using ozone equipment. ***It is imperative that only ozone compatible materials be used in conjunction with the ozone system.***

Ensure that the Ozone Generator is in a well-ventilated area. Do not allow rain or condensation to contact the Ozone Generator. The Ozone Generator is not weather proof. The unit must be operated indoors or in an enclosure in a non-condensing environment.

Note: If the operator has asthma, he/she must not enter an ozonated airspace. Ozone can induce and an asthma attack.

Carefully review and familiarize yourself with the following important safety information statements concerning the Ozone Generator.

WARNING Ozone is an extremely aggressive and powerful oxidizer. The Occupational Safety and Health Administration (OSHA) 8-hour exposure limit is 0.10-PPM. The OSHA 15-minute exposure limit for ozone is 0.3 PPM. Above 0.3 PPM, there is the risk of damage to respiratory tissues.

WARNING People who have no sense of smell should not operate this equipment.

WARNING **Never** attempt to verify ozone production by directly breathing or smelling the ozone outlet or the ozone-tubing outlet.

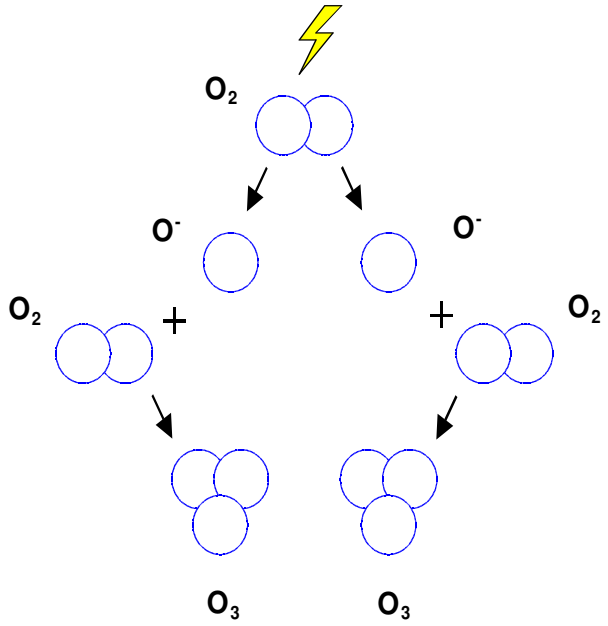
WARNING The ozone generator contains high voltages. Unauthorized entry can result in serious injury or death. For service instructions, contact Ozone Solutions.

WARNING Make sure all tubing connections between the ozone generator and the injection point are secure, and in good working condition. Failure to do so could result in the discharge of ozone into an undesired space.

Introduction

The TG-40 Ozone Generator produces ozone from oxygen via corona discharge. The Ozone Generator is capable of generating 40-gm/hr of ozone with a feed gas of 90% oxygen at 10-LPM, and 60 g/hr of ozone with a feed gas of 90% oxygen at 20-LPM. Ozone is used, among many other uses, for pathogen inactivation and destruction of odorous gases.

Ozone Generation from Corona Discharge



The TG-40 Ozone Generator generates ozone via corona discharge. In this process an electrical spark is used to split the molecular bond of oxygen, found in nature in the form of O2, into the atomic O- form of oxygen. These O- atoms attach themselves to other O2 molecules to form O3 (Ozone).

Theory of Operation

The spark inside the TG-40 is a controlled corona. This is produced by forcing a high voltage source through a dialectic and a small air gap. This occurs in call the corona cell. This spark occurs at a higher than line voltage and much higher than line frequencies. These changes in voltage and frequencies are accomplished with the circuit board and transformer inside the TG-40. The oxygen feed gas source is forced through the small air gap along the dialectic and intense corona (spark). This splits the O2 molecule and generates Ozone!

The basic fundamentals of flow and velocity of gas through the corona cell allow for more ozone production (g/hr) as oxygen flow increases. As the flow increases the concentration of ozone (% by weight) decreases, conversely as the flow decreases the concentration of ozone increases. At

very low oxygen flow rates the oxygen remains in the corona cell for a longer period of time. This contact time allows for a higher percentage of oxygen to be converted into ozone. The proper ozone production and concentration for the necessary application can be determined and achieved by using the TG-40 performance charts included with this manual.

While flow and pressure of the oxygen feed gas affect the ozone output the most the pressure of the feed gas in the corona cell also has an affect on the production of ozone. With higher pressures of oxygen there is more oxygen in a given space. This allows for more molecular O2 to be present in the corona cell, and be converted into O3. This also increases the contact time given the gas flow remains constant. The effect on the ozone generation process allows for the production of ozone to increase with higher pressures. Also, with higher pressures the TG-40 will consume more electrical power as it takes more energy to create a spark in an environment where more oxygen is present in the same space. The TG-40 automatically compensates for varying pressures and will maximize the ozone output for every pressure level. There is a point where pressures will begin to have a negative effect on ozone production. Higher pressures will increase the reaction rate of ozone, this will decompose the ozone back into O2 in less time than at ambient pressures.

The TG-40 is an air cooled ozone generator. The corona cell does create a substantial amount of heat that must be removed. This heat is created by high voltage and frequency corona that is contained inside the TG-40. The heat is removed by two 100 CFM fans on the front of the ozone generator.

Specifications

Ozone Output
20 g/hr Ozone - 4 LPM Oxygen
30 g/hr Ozone - 6 LPM Oxygen
40 g/hr Ozone - 10 LPM Oxygen
50 g/hr Ozone - 15 LPM Oxygen
60 g/hr Ozone - 20 LPM Oxygen
- these are estimates, see your specific performance chart for specific information

Feed Gas Requirements:
oxygen dried to a minimum of minus 70-deg F dewpoint. No minimum airflow required. Maximum airflow of 30 l/min (60 SCFH). Pressure on the corona cells must not exceed 100 PSI.

Maximum Cell Pressure
100 PSI

Electrical Input
120 VAC, single phase, 60 Hz, 5.0 Amps, 500 Watts
220 VAC, single phase, 50 Hz, 2.5 Amps, 500 Watts (optional)

Circuit Overload Protection
The TG-40 circuitry will protect from severe damage by shutting down the circuit board in the event there any of the following conditions occur:

- Water in the corona cell
- Temperatures above 105-deg F
- Negative pressures in the corona cell
- Contamination or debris in the corona cell

Installation:

Choose a location for the Ozone Generator that does not allow rain or condensation to contact the unit. The Ozone Generator is not weather proof. It must be operated indoors or in an enclosure in a non-condensing environment.

Be certain there is sufficient access space around the TG-40 to perform normal maintenance and service. Also ensure there will be a free flow of cooling air around the unit. Connect the unit to a grounded power source rated for the voltage and current requirements.

An RS-2 rack is required if wall mounting is needed. Install the mounting bracket (optional) on a secure wall. Attach the brackets with the screws provided 17-inches apart. (It may be advisable to secure a large piece of plywood to the wall for extra support.) Slide the ozone generator into the bracket and secure with 10-32 bolts and nuts, or equivalent.

IMPORTANT: *The location of the Ozone Generator must be well ventilated. Approximately 6 air changes per hour are recommended. Contact Ozone Solutions if further assistance is needed.*

Ozone/Oxygen Hookup:
Connect to the oxygen inlet and ozone outlet fittings on the rear of the TG-40. The ozone and oxygen connections are 3/8-inch stainless steel compression connections. (see image below). Ensure that stainless steel, Teflon, or another high quality ozone resistant tubing is used. Hand-tighten with the proper open ended wrench the compression fitting nuts that hold the tubing in place and seal the tubing to the TG-40. Remember the ferrule in this compression fitting is not reusable and will be secured to the tubing you have tightened into this fitting. Spray the fitting with soapy water when oxygen is flowing through the unit to ensure no leakage.

TG-40 Connections

Do not lay items on the ozone generator as the top is not designed to support any weight. This could potentially cause internal damage in the event the top is pushed against delicate internal parts in the TG-40 ozone generator.

If installing more than one generator, set all ozone generator flowrates to an identical setting so each generator has the same flowrate going through the unit.

IMPORTANT: Ensure that the oxygen flow is measured and controlled to rates that do not exceed rated capacity of the ozone generator.

Remote operation or control:
The TG-40 can be turned ON or OFF remotely, also the output of the unit can be adjusted from 0-100% via a 0-10 volt input. Please contact Ozone Solutions for more information on either of these options, as the use and type of control MUST be qualified prior to implementation.

Start-Up

1. Before initial startup of the ozone generator begin oxygen flow through the unit. Set the flow and pressure to the flow and pressure the unit will be operated at for your application.

2. Ensure there are no leaks at the rear input and output connections. This can be done by spraying a light mist of soapy water on the fittings and checking for air bubbles. Ensure no soapy water enters the ozone generator.

3. Ensure the downstream systems where ozone is to be used have no leaks or other open lines that may cause excess ozone to escape into the ambient atmosphere. It is important that the ozone will not escape in any areas where personnel is located.

4. To start the ozone generator, connect the unit to a grounded power source rated for the voltage and current requirements. Push the toggle switch on the front panel to the up position. The "ON" light will illuminate indicating ozone production.

5. The TG-40 is now producing ozone.

Operation

While the ozone generator is operating there is a light on the front of the unit to indicate ozone production. If this light is lit ozone should be present. The fans will also be turning to cool the unit at all times while the unit is ON. These fans are only used to cool the corona cell, they do not move air through the unit for ozone production.

Adjust the oxygen feed gas flow and pressure to the necessary values for the ozone production and concentrations necessary for your application. Use the attached ozone generator performance charts to evaluate the oxygen flow necessary.

Maximum ozone production is realized at 10-20 PSI of pressure. Pressures up to 100 PSI are acceptable but will not produce the maximum ozone production. If pressures higher than 30 PSI are to be used please contact Ozone Solutions for tuning information to maximize the efficiency of the ozone generator.

The ozone generator will not operate under a vacuum and must have at least 1 PSI of pressure for ozone production. Below 1 PSI the cell will shut down and produce no ozone.

There is a potentiometer installed on the unit that can adjust the ozone output. This dial will adjust the ozone output from 0-100%. This is not perfectly linear and the actual output should be measured with an ozone analyzer. This dial adjusts the voltage to the cell from 0-100%.

Ensure that the Oxygen Generator is in a well-ventilated area. If the space is occupied, sufficient ventilation must be provided to prevent the accumulation of low oxygen concentration waste gas in the space. Approximately 3 air changes per hour are necessary.

Image of Pressure Gauge & Flowmeter (Optional)

Ensure the pressure gauge does not exceed 50% more than its listed maximum value. Doing so will permanently flex the pressure diaphragm causing damage.

The 0-10 LPM flowmeter permits visual observation of the oxygen flow. It is not ozone compatible so the user must ensure that ozone does not flow backwards through the unit. (In some cases the float may become stuck on the bottom of the flowmeter. Lightly tap the flowmeter to dislodge the float if this occurs.)

IMPORTANT: *When setting the flow and pressure of the ozone generator it is important to know that pressure will have a factor on the flow displayed on most flow meters. If the actual discharge pressure is substantially above atmospheric pressure, the reading can be adjusted to determine the precise flow rate, according to the following formula (using psig):*

$$(adjustedflow) = (measuredflow)x\sqrt{\frac{oxygenpressure + 14.7}{14.7}}\ .$$

Please contact Ozone Solutions if additional assistance is required.
Do not allow the oxygen or ozone to vent freely.

If the TG-40 ozone generator has a flow meter or pressure gauge installed these may be used to evaluate the flow and pressure on the corona cell. The pressure gauge on the unit can be used to calculate actual adjusted flow of the TG-40. The Pressure gauge and flow meter are installed before the corona cell and may not be 100% ozone resistant. It is important not to allow ozone to flow in the reverse direction when the oxygen flow is turned off. A check valve or water trap after the ozone generator is strongly recommended to prevent back flow.

Environment

The Ozone Generator is not weather proof; it must be operated indoors or in an enclosure in a non-condensing, dust free environment. Sufficient ventilation must be provided to prevent the accumulation of ozone in the event of a leak. Approximately 3 air changes per hour are recommended.

Temperature (Operating): 40°F to 95°F
Temperature (Storage): -20°F to 170°F

No dust or debris may be in the area, must be clean dry environment.

Maintenance

As long as the feed gas is kept dry, dust free, and pure, the ozone generator will not need maintenance. Ensure strict maintenance procedures of the oxygen generator as specified in the oxygen generator manual.

Service Parts

There are no serviceable parts inside the TG-40. If any part fails to operate or other problems arise call Ozone Solutions for service and repair.

Mechanical Specifications

Dimensions: 7-in H x 17-in W x 17-in D (2.7-cm H x 43-cm W x 43-cm D)
Weight: 35-lbs (15.8 kg)

Warranty

This piece of equipment is warranted against defects in workmanship and labor for period of one (1) year on all parts that are not outlined in the maintenance schedule. The liability is limited to the value of the equipment; Ozone Solutions shall not be liable for incidental or consequential damages. This warranty will be void if any piece of the equipment is used in any other manner than is explicitly outlined in the manual.

In lieu of all other warranties, express or implied, we warrant the equipment covered by this warranty, to be free from defects in material and workmanship under normal use and service. Our obligation under this warranty is limited to repairing or replacing any part or correcting any workmanship defective at time of installation and with respect to which a claim specifying the particular defect shall be delivered to us within 1 year from the acceptance of the equipment by you. Defective, repair, or replacement parts shall be returned to us F.O.B. factory. The removal by you of parts returned to us for repair or replacement and the installation by you of replacement or repaired parts shall be at your expense.

We do not warrant equipment manufactured by others, but will submit to you upon request the manufacturer's warranty. We do not assume any other liability in connection with the equipment covered by this proposal or its installation or erection, for loss of production, product, equipment, profits and liability for consequential damage to persons or property. We will make no allowances for repairs, alterations or other work done unless specifically agreed to in writing. It is the customers responsibility to ensure this system is operated in accordance to the specific O&M procedures provided.

How to Contact Ozone Solutions

By mail:

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Sioux Center, IA 51250 USA

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By fax: (712) 722-1787
By mobile phone: (712) 441-0210
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Environmental Remediation Systems

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Well Point Controller

20-Output Timer

Operation Manual

1280 N Red Gum St
Anaheim, CA 92806

www.makoindustries.com

Table of Contents

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Introduction

This manual describes how to utilize the Touch-panel HMI/PLC operated Well Point Controller for simple, easy setup of well point timing. Included in the controller are capabilities for datalogging, and optionally, retrieval of information via an Ethernet connection.

Theory of Operation

The controller is designed to cycle through 20 different outputs consecutively, each according to it's predetermined setpoint configured by the operator. The controller accepts 3 controlling inputs in order to control the wells in harmony with an associated ozone system. As the controller is operating, the accumulated “open” time (time that the output is ON) for each output is recorded and displayed on the Main Screen of the HMI panel. The data is logged in the form of a captured *.jpg image of the Main Screen being written to a user-installed USB memory device, which is updated every 15 minutes.

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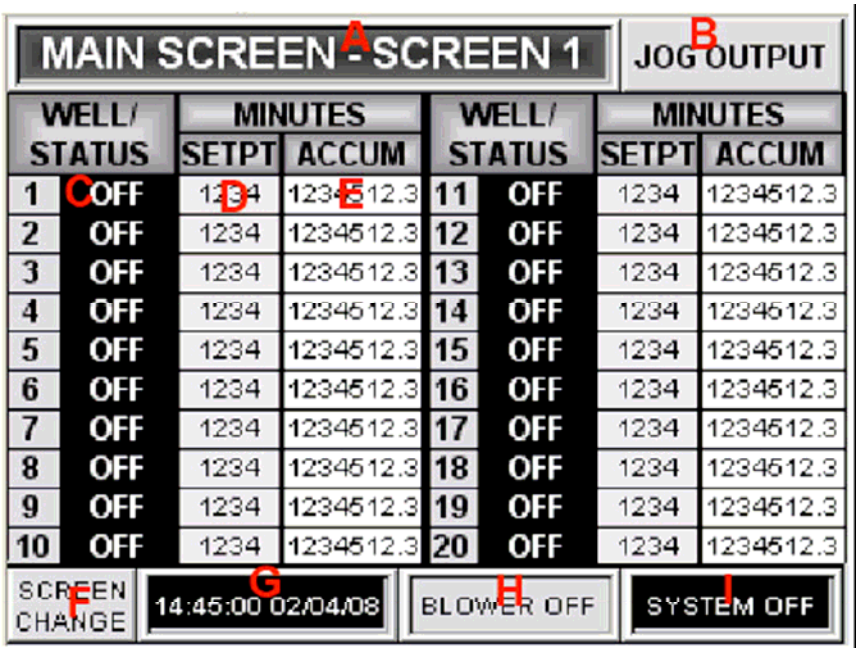
HMI Operation – Screen by Screen

Screen 1 – Main Screen



A. Screen Title

B. Jog Output Button – Touch to skip to the next well output in the cycle. A confirmation window will pop up, follow on-screen instructions.

C. Well Output Status Indicator – Displays "ON" or "OFF" according to well output status.

D. Setpoint Column – Displays setpoint for each well output in minutes.

E. Accumulated Time Column – Displays the accumulated minutes of "open time" (amount of time the output was "ON") for each well output.

F. Screen Change Button – Touch to open a scrolling menu which allows screen selection by number.

G. Time/Date Indicator – Displays current time and date.

H. Blower Status Indicator – Displays input status of the Blower Switch input.

- **"BLOWER OFF" -** Blower input is OFF, allowing the controller to cycle normally.
- **"BLOWER ON" -** Blower input is ON, signaling the controller to stop cycling and turn off the well outputs.

I. System Status Indicator – Displays input status of the System Start input.

- **"SYSTEM OFF" -** System Start input is OFF, signaling the controller to stop cycling and turn off the well outputs.
- **"SYSTEM ON" -** System Start input is ON, allowing the controller to cycle normally.

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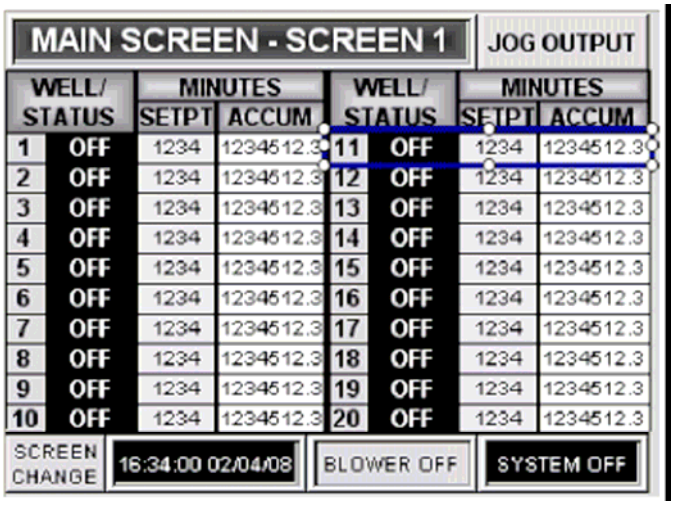
Main Screen – Other Functions

- **“INSERT NEW DEVICE” Indicator** – This pop-up message appears in the screen title area to indicate that the USB memory device has been removed.
-

  - When this message is present, data-logging cannot occur.
  - The message disappears shortly after a new USB memory device is inserted & recognized.

- **“SPEED x60” Indicator** – This pop-up message appears in the Date/Time area to indicate that the “Speed x 60 Input” has been activated. (the “Speed x60” Input will not affect accumulated times, they will remain accurate according to actual time).

- **Output Screen Shortcut Invisible Button** – See highlighted area in the figure below. For each well output, the area which pertains to it has an invisible button which links to the corresponding Output Screen for that well output. Touch this area to be taken directly to the screen for that particular output.



- **Reset & Upload Screen Invisible Button** – Touch the date/time indicator area & find a shortcut to the Reset & Upload Screen (Screen #23).

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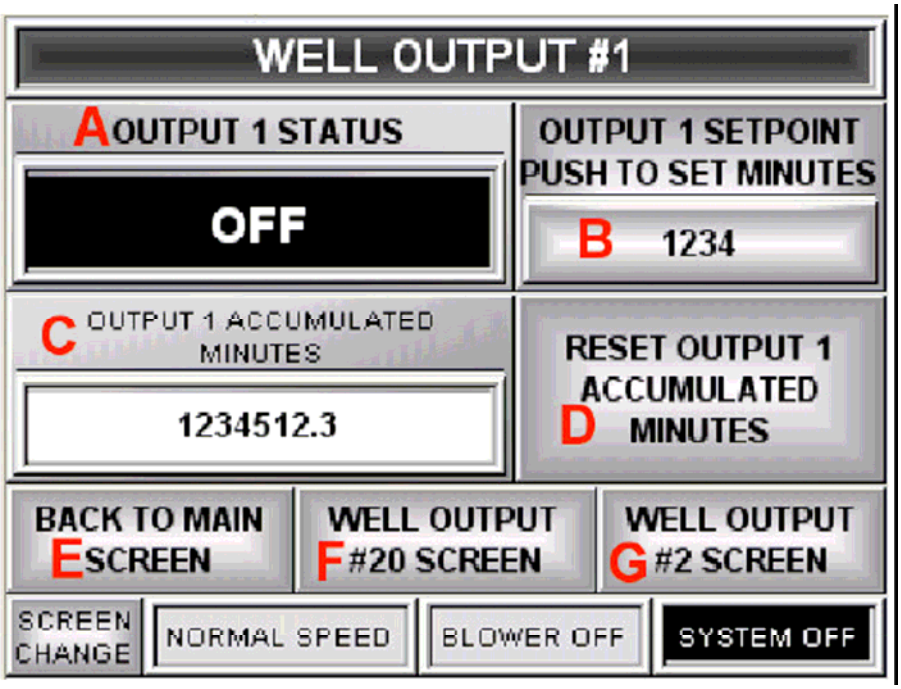
Screen #2 through Screen #21 – Well Output Configuration Screens



A. Well Output Status Indicator – Displays "ON" or "OFF" according to well output status.

B. Well Output Setpoint Selector – Opens a pop-up window which contains a numerical keypad, whereby a new setpoint can be entered. All numerical values are displayed in minutes.

C. Well Output Accumulated Minutes Indicator - Displays the accumulated minutes of "open time" (amount of time the output was "ON") for the well output.

D. Reset Accumulated Minutes Button – Touch here to open a confirmation window, which allows the user to reset the accumulated minutes for the output. Follow on-screen pop-up instructions. (Upon confirmation - resets accumulated minutes to "0", only for the well indicated on the current screen, not all wells).

E. "BACK TO MAIN SCREEN" Button – Touch here for a shortcut back to the Main Screen.

F & G. "WELL OUTPUT #__ SCREEN" Button – Touch here for a shortcut to the adjacent Well Output Screen.

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Screen #22 – Setup Screen 1

This screen allows adjustment of some of the HMI Panel local parameters.

- ALARMS – Touch to display alarm screen.
- ADJUST CLOCK – Touch arrows to adjust displayed time in 1-hour increments.
- ADJUST DISPLAY – Touch arrows to adjust panel brightness.
- ADJUST VOLUME – Touch to adjust speaker sound volume (not used).

Screen #23 – Reset & Upload Screen

This screen is the portal for switching USB memory devices safely, and for resetting all Well Output's Accumulated Minutes.

- “RESET ALL OUTPUTS ACCUMULATED MINUTES” - Touch here to open a confirmation window, which allows the user to reset the accumulated minutes for ALL Well Outputs. Follow on-screen pop-up instructions. (Upon confirmation - resets ALL 20 Well Output accumulated minutes to “0”).
- USB Device Status Indicator – This window indicates when the USB Memory device can be safely removed, and when a new USB Memory device needs to be inserted.
- “SAFELY REMOVE USB MEMORY DEVICE” Button – Touch here to instruct the HMI Panel to temporarily discontinue writing data to the USB memory device, so that the current device can be removed without interruption or loss of data. The change in color & the text followed by a “...” prompts the user to remove the device. The Device Status Indicator will then instruct the user to insert a new memory device so that data-logging can continue without interruption.

  NOTE: The HMI Panel has no user-accessible internal memory. It automatically delivers logged data to the USB Memory Device (assuming one is
  installed), every 15 minutes. If no memory device is installed, data will not be recorded.

Screen #24 – Information Screen

The Information Screen contains text of any instructions and other information which pertains to operation of the HMI Panel. Touch the buttons on the left side of the screen to toggle information pages ON/OFF as desired. (Information pages 2-4 are intentionally left blank.)

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Screen #25 through Screen #28 – Parameter Screens

The parameter screens are password protected, and are not user-accessible. They exist for setup & configuration purposes, access by installers or users is not necessary.

Power Loss – Memory Retention

If the PLC portion of the controller is without power for an extended period, loss of memory will occur. Generally, all data will be retained for 4 to 7 days, but one should not rely on this retention for any longer than necessary (power loss for even a few hours, if the controller is few years old, may risk data loss).

Data written to a USB memory storage device would not be immediately lost from the memory device – but if PLC memory loss does occur, then upon power-up, the new values of "zero" would appear on the "Main Screen" of the HMI Panel. Upon power-up, a new screen capture would over-write the previous data on the memory device, resulting in a loss of previous records.

Data loss would not affect the operation of the controller (except for loss of user-configured settings), any data loss would include only the following values:

Well Output Set-point values
Well Output Ozone Active/Inactive settings
Accumulated "Open Time" values, and
Accumulated "Open Time w/o3" values

Optionally, a replaceable battery can be obtained and installed which would extend the memory retention time considerably. The battery could be replaced periodically to ensure optimal memory retention conditions, and data would then be retained for at least 7 days – quite possibly longer. Contact Mako Industries for additional information if necessary.

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