
APPENDIX J

Mechanical Equipment Technical Information

Sample Chlorinated Thermal/Catalytic Oxidizers

ANGUIL ENVIRONMENTAL SYSTEMS

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HCl Scrubber Module

Anguil's HCl Scrubber Module scrubs and neutralizes hydrochloric acid that is created during the oxidation of halogenated or mixed organic vapor contaminants.

How the HCl Scrubber Module Works

The outlet of a catalytic oxidizer, such as an Anguil Chlorinated Catalytic Oxidizer, is directed to the Anguil HCl Scrubber Module. A recirculation pump injects large volumes of water into a hastelloy quench section, inducing vapor flow through the scrubber. The water quenches the hot vapor and absorbs a portion of the HCl. The gases exit the eductor and enter a countercurrent absorption column. Recirculating solution is fed to the top of the absorption column through a nozzle. The remaining hydrochloric acid vapors are absorbed into the solution. The gases pass through a mist eliminator before exiting the column. Sodium hydroxide is added to control pH in the neutral range.

Anguil's Cost Effective Design

The HCl Scrubber Module is designed as part of Anguil's broad line of technologically advanced, yet user-friendly, air pollution control products. The Anguil product line includes over 1000 installations of Recuperative and Regenerative Catalytic and Thermal Oxidizers ranging in size from 100 to 100,000 SCFM (150 to 150,000 NM³/hr), Ceramic Filter Systems, Soil Remediation Equipment, Rotor Concentrators and Scrubbers. Each product line represents value-engineered systems with emphasis on cost minimization. All systems are designed for optimum performance and trouble-free operation.

Anguil strives to provide innovative pollution control technology including process analysis, engineering, equipment manufacturing, installation and post-sale 24-hour service.

System Components

Each Standard HCl Scrubber Module is fabricated from FRP and includes hastelloy quench, absorption column (consisting of a cylindrical tower filled with polypropylene spherical media), common liquid sump, recirculation pump, flanged inlet and outlet, hastelloy spray nozzle and liquid level indicator. The system components are assembled on an epoxy-painted steel base that is weather-resistant and corrosion-resistant.

HCl Scrubber Module Schematic

· [Learn More Case Study](#)

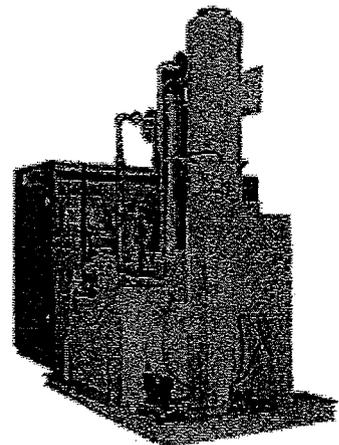
» [Integrated System for MDI Production](#)

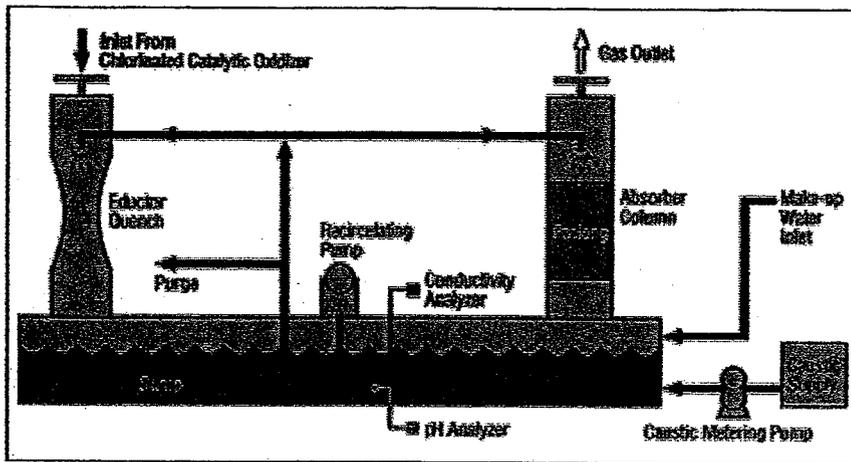
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FEATURES

pH control system automatically monitors the solution's acidity and adds sodium hydroxide.

Automatically adjusted blowdown valve purges solution from sump.

Inspection port.

Skid mounted.

Liquid level controls.

Safety shutdown if sump temperature exceeds 150° Fahrenheit.

First-out shutdown detector.

Automatic fresh water makeup.

Additional individual and common alarm contacts.

Conductivity controller.

BENEFITS

Maintains a nearly neutral solution to improve scrubbing efficiency.

No salt buildup.

Facilitates maintenance and troubleshooting.

Module can be quickly and efficiently transported and deployed.

Liquid levels in the scrubber recirculation tank are automatically monitored.

Safe operation.

Facilitates troubleshooting.

Prevents water depletion so operation is sustained.

Interface and expansion flexibility.

Regulates water discharge from scrubber.

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Chlorinated Catalytic Oxidizer

Anguil's Chlorinated Catalytic Oxidizer destroys halogenated or mixed organic vapor contaminants that are discharged from a variety of industrial process streams.

How the Chlorinated Catalytic Oxidizer Works

The Chlorinated model is selected based on volume of airflow, contaminant type and desired destruction efficiency. During operation, VOC-laden air is drawn into the Chlorinated Oxidizer's fan and is discharged into the system's heat exchanger. The air passes through the tube side of the heat exchanger and into the burner, where the contaminated air is raised to the catalyzing temperature. When the VOC-laden air passes through the specialty catalyst, an exothermic reaction takes place. The VOCs in the air stream are converted to carbon dioxide, water vapor and inorganic acids.

The hot, purified air then passes on the shell side of the heat exchanger where the energy released by the reaction is used to preheat the incoming air. This minimizes the system's fuel costs; in many cases the Chlorinated Oxidizer is self-sustaining. Finally, the air is exhausted into the atmosphere. In some cases, an Anguil scrubber module may be required to neutralize inorganic acids.

Anguil's Cost Effective Design

The Chlorinated Oxidizer is designed as part of Anguil's broad line of technologically advanced, yet user-friendly, air pollution control products. The Anguil product line includes over 1000 installations of Recuperative and Regenerative Catalytic and Thermal Oxidizers ranging in size from 100 to 100,000 SCFM (150-150,000 Nm³/hr), Ceramic Filter Systems, Soil Remediation Equipment, Rotor Concentrator Systems and Scrubbers. Each product line represents value-engineered systems with emphasis on cost minimization. All systems are designed for optimum performance and trouble-free operation.

Anguil strives to provide innovative pollution control technology including process analysis, engineering, equipment manufacturing, installation and post-sale 24-hour service.

System Components

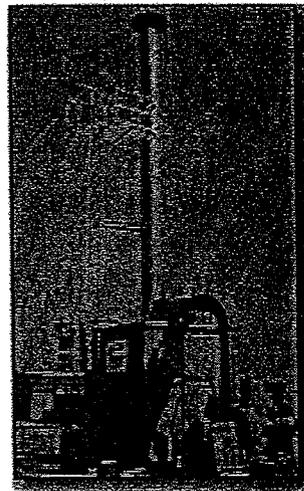
Standard Chlorinated Catalytic Oxidizer systems include a 316L stainless steel heat exchanger, modulating burner, fuel train, catalyst bed, motor, fresh air dilution valves, flanged inlet and outlet, system controls, temperature recorder, first-out shutdown detector and exhaust stack. All systems can be designed to meet exact customer specifications.

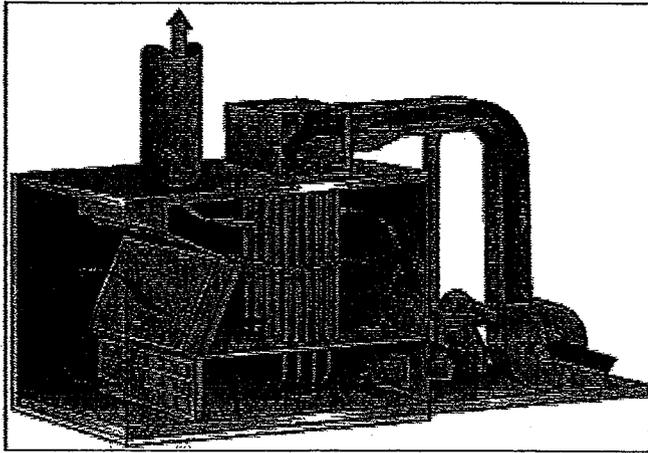
Chlorinated Catalytic Oxidizer System Schematic

Learn More Related Products
» [Catalytic Recuperative Oxidizer](#)
» [Regenerative Catalytic Oxidizer \(RCO\)](#)

Contact a sales engineer

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Options

- Collection plenum
- Variable frequency drive
- Acid gas scrubber
- Exhaust stack extensions
- U.L. labeled panel
- CE Certification
- NFPA Class 1 Division 2 explosion-proof design
- Flame arrestor
- Larger or custom systems available

Safety Shutdowns

The system will shut down safely and automatically if any of the following occur:

- Electrical power loss to the control panel
- Loss of proper air flow
- High/low temperature or gas pressure
- Flame-out of the burner

The first-out shutdown detector will indicate the cause of a shutdown.

FEATURES

BENEFITS

Reactor has fully welded, leak tested 316L stainless steel interior with high density insulation and polyurethane-coated exterior.

Assures safe, long-term operation.

Stainless steel shell and tube heat exchanger.

Provides economical operation without the high risk leak potential of plate-type exchangers.

Multiple FM/IRI approved burner options.

Offers fuel flexibility.

Thermocouple, digital controller and modulating burner maintain proper air temperature into the catalyst.

Reduces fuel usage.

Specialty halogenated destruction catalyst.

Provides high destruction efficiencies of up to 99+% for compliance with strict air regulations.

Control panel is composed of U.L. listed and internationally-approved components.

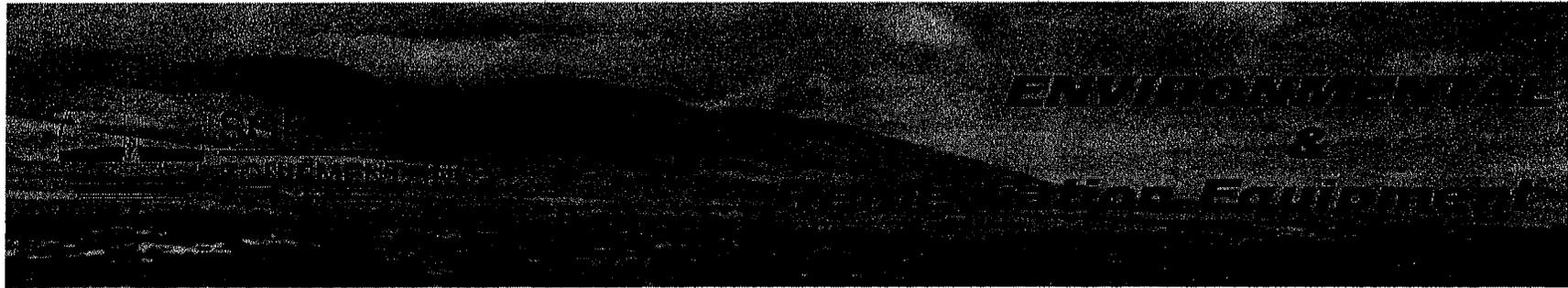
Reliably indicates the status of the burner, catalyst and safety circuits.

Tested and approved for safe operation by the American Gas Association Laboratories.

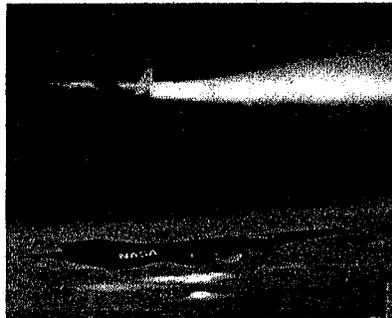
Ease of permitting.

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Since 1990



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Remediation Thermal Systems
(super small sizes)

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- [Compact-THERM](#)

Multi-Phase Remediation Systems

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- [Compact-THERM HI-Vac](#)

Chlorinated Oxidizers



Soil-Therm Equipment, Inc has an extensive amount of experience in the design and fabrication of Chlorinated Thermal Treatment Systems for all types of remediation applications. Ranging in sizes from 100 - 3000 scfm, SOIL-THERM has the experience to provide equipment that is right for your applications.

Typical System Components. A typical chlorinated system for remediation applications includes: SVE blower (p-d blower or liquid ring), water knockout, Nema 4 electrical controls and panel, Jet-THERM burner, heat exchanger, catalyst module, quench scrubber, packed tower scrubber, demister, FRP packed tower scrubber, caustic tank, caustic metering pump, PLC electrical controls, chart recorder, and more.

- Combination Systems

Custom & Integrated Systems

- Mobile-THERM
- Enclosed Systems
- Blower Systems
- Mobile Treatment Systems
- Chlorinated Systems
- Tank Degassing Oxidizers

Rental Systems

- Thermal System Rentals

Literature

Systems are complete - - skid or or trailer mounted. Give us a call with your requirements. Our Jet-THERM combustion process has proven destruction efficiencies of greater than 99.999%.

FORMER SOUTHLAND OIL FACILITY, CA For over 3-years, SOIL-THERM's customer has been operating a chlorinated SVE thermal oxidizer system with heat exchanger at the former Southland Oil facility. This site has extremely high concentrations of Benzene and Vinyl Chloride - - requiring the highest destruction efficiencies to meet the many regulatory agency requirements. The supplied Model 2003-CLR burner & oxidizer system has achieved continuous operation and complete compliance with the toughest air quality and DTSC requirements in the state. The data below proves our superior 'direct flame' combustion technology (without catalyst) that you're not gonna find with a Conventional Oxidizer system!

	Vinyl Chloride	Benzene	1,1 DCA
Influent	22,000 ppbv	714,000 ppbv	10,100 ppbv
Stack Exh	<0.1 ppbv	<0.1 ppbv	<0.1 ppbv
Destruction Efficiency	>99.9999%	>99.9995%	>99.999%

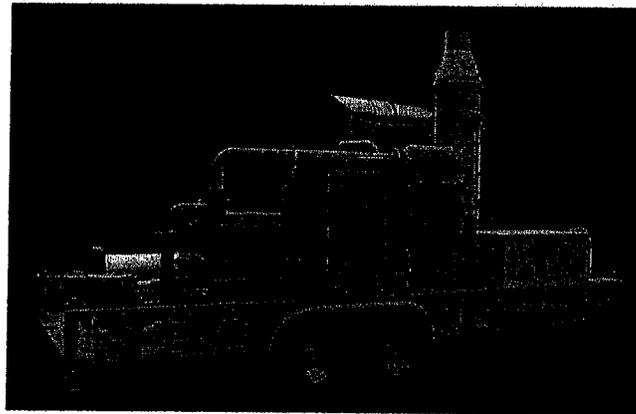
SOIL-THERM Destruction Efficiencies
(Model 2003-CLR Chlorinated Thermal Oxidizer)

"2004 TECHNOLOGY MERIT AWARD... for

implementing advances in its **Jet-THERM** combustion burner process to destroy methyl tert-butyl ether (MTBE) contaminants recovered in groundwater treated by soil-vapor extraction and multi-phase extraction."

Environmental Business Journal,
March, 2005

"I operate over 30 SVE thermal systems from all manufacturers. Based on my field experience, I have found that SOIL-THERM systems are much more energy efficient and outperform the others by far! They're also highly reliable and have excellent uptime". Darren



SOIL-THERM built a 500 scfm trailer mounted chlorinated catalytic oxidizer for an Air Force facility which included positive displacement SVE blower with noise enclosure, water knockout, quench scrubber, packed tower scrubber, caustic day tank, heat exchanger, all mounted on a dual-axle trailer.

SOIL-THERM designed and built this system for the former Aiea Laundry facility in Oahu, Hawaii. After 5 years



Azarian, Principal, Integral
Engineering Services, Inc.

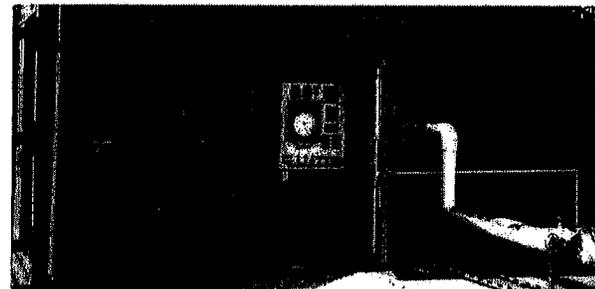
"It has been my field experience that SOIL-THERM oxidizer systems are as much as 50% more energy efficient than the other conventional oxidizers. Our SOIL-THERM mobile dual phase oxidizer system has been extremely reliable and versatile. Its custom design achieves excellent operation over a wide range of flows and concentrations". Dan Louks, Vice President, GSA Engineering

"We currently own three SOIL-THERM mobile dual phase thermal systems, custom built to our specs. These systems provide impressive processing rates, high destruction efficiencies, and are extremely reliable. We've used the others, SOIL-THERM is the best and uses at least 50% less fuel". Tom Waller, PE, Principal Engr, Holguin Fahan & Assoc.

"SOIL-THERM designed and built a Mobile-THERM system that was impressive to look at and operated using much less fuel than all others we've used. The finest equipment at a great price." Steve Diamond, EnviroTRAC

**"2003 TECHNOLOGY
MERIT AWARD... for
developing and deploying thermal**

operation, this 900 cfm enclosed chlorinated cat-ox system successfully cleaned the site of subsurface PCE contamination. System included heat exchanger, SVE blower, catalyst, quench scrubber, packed tower scrubber, and caustic tank - - all mounted inside the locking enclosure for continuous operation.



Due to the powerful SOIL-THERM Jet-Therm burner process, SOIL-THERM chlorinated thermal oxidizer systems are the top-performing systems on the market. With destruction capabilities of >99.99+ % for chlorinated compounds, the toughest air quality emissions requirements are met using a SOIL-THERM system.

Give us a call with your chlorinated thermal and catalytic oxidizer application needs. SOIL-THERM's experience will give you the edge in performance, reliability, and economical operation.

June, 2004. SOIL-THERM receives Emissions Source Test Data Report on 2002-CLR

In December, 2003 the CA State Air Resources Board in conjunction with the CA Department of Toxic Substances Control (DTSC) conducted a 3-day emissions monitoring test and sampling on the SOIL-THERM Model 2002-CLR located at the former Southland Oil facility in Commerce, CA. The sampling protocol was interested in emissions of Dioxins that result from the destruction of chlorinated compounds during normal operation at the facility. The final test result study, "*Source Test for Dioxins, Furans, and PCBs at the Former Southland Oil Facility, Commerce, California*" indicated that the SOIL-THERM system operated as follows:

- Average operating temperature: 1450 - 1480F
- NOx emissions: 9 ppmv (22.8 ppmv @ 3% O₂)
- CO emissions: 34 ppmv
- VOC emissions: < 0.2 ppmv (>99.97% destruction)
- Average Dioxins, Furans out Stack: 9.0 x 10⁻¹³ lbTEQ/hr
- Average PCB's out Stack: 1.3 x 10⁻¹³ lb TEQ/hr

developing and deploying thermal and catalytic systems with the new **Jet-THERM** combustion process technology... to achieve virtually 100% destruction of VOC's from soil-vapor-extractions, multi-phase-extraction, and chlorinate emissions control applications."

Environmental Business Journal,
January, 2004



SOIL-THERM
EQUIPMENT, INC.

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Hills, CA 91301 FAX: (818) 706-
2145

(818) 706-9875

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sales@soiltherm.com

Environmental Business Journal
"Industry's Best in 2003 & 2004"

These test results prove that the destruction efficiency of the SOIL-THERM chlorinated oxidizer is extremely high (>99.97%), the NOx emissions impressively low (22.8 ppmv @3% O₂), and PCB and Dioxin/Furan emissions were rated at <2 _____ . We would like to thank the CA Air Resources Board in selecting this SOIL-THERM oxidizer system for their testing program.

sales@soiltherm.com

ENERGY EFFICIENT Remediation Technologies

www.soiltherm.com

Sample Positive Displacement SVE Blower



Sutorbilt

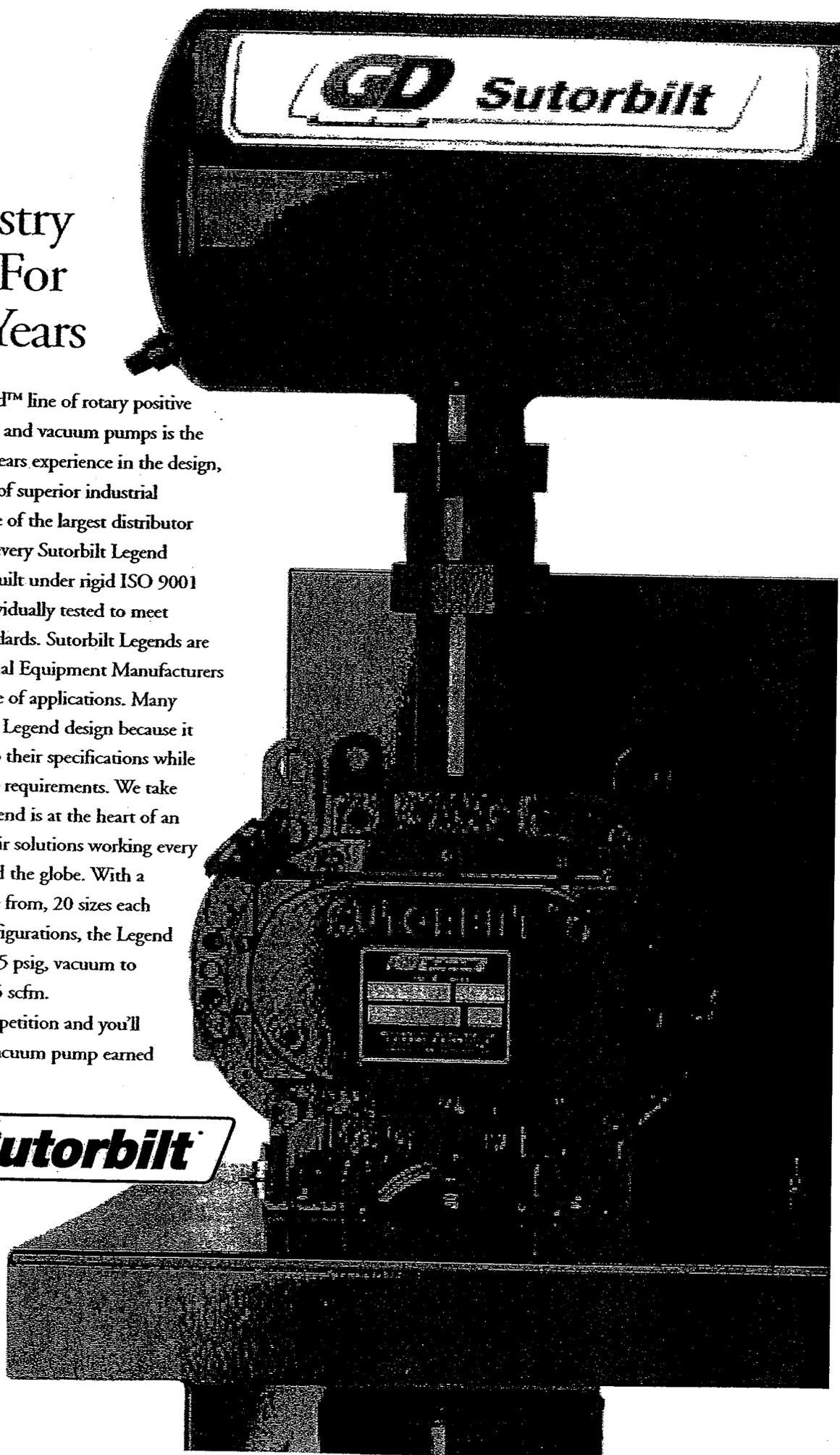
**Positive
Displacement
Lobe Blowers/
Vacuum Pumps**

LEGEND SERIES

Setting The Industry Standard For Over 60 Years

The Sutorbilt® Legend™ line of rotary positive displacement lobe blowers and vacuum pumps is the result of more than sixty years experience in the design, manufacture and support of superior industrial equipment. Backed by one of the largest distributor networks in the industry, every Sutorbilt Legend blower/vacuum pump is built under rigid ISO 9001 quality standards and individually tested to meet rigorous performance standards. Sutorbilt Legends are specified by leading Original Equipment Manufacturers worldwide for a wide range of applications. Many OEMs prefer the Sutorbilt Legend design because it can be easily customized to their specifications while meeting strict performance requirements. We take pride in the fact that a Legend is at the heart of an ever-expanding variety of air solutions working every minute of every day around the globe. With a variety of models to choose from, 20 sizes each available in 4 different configurations, the Legend Series delivers pressure to 15 psig, vacuum to 16 "Hg and flows to 3,015 scfm.

Compare us to the competition and you'll find out why this blower/vacuum pump earned the name "Legend".

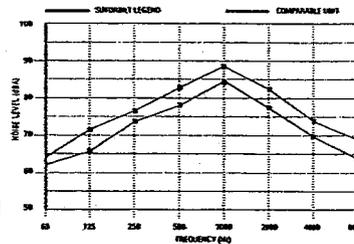


Proven Performance. Global Applications. Local Support.

Below are just a few examples of the industries that, over the decades, have depended upon the Sutorbilt® Legend™ to deliver clean, oil-free air to a wide range of global applications.

Industry	Application
Aquaculture	Aeration
Cement and Lime	Fluidization and Conveying
Chemical	Vacuum Processing and Conveying
Coal Bed/Landfill	Methane Gas Recovery
Dairy	Automated Milking
Dry Bulk Hauling	Trailer Unloading and Aeration
Environmental Services	Sewer Cleaning and Portable Restroom Services
Industrial	Material Vacuuming
Milling and Baking	Blending and Conveying
Oil and Gas	Gas Collection and Sparging
Power Generation	Fly Ash Conveying and Aeration
Process Gas	Gas Boosting
Pulp and Paper	Chip Conveying and Process Vacuum
Resin and Plastic	Processing and Conveying
Soil Remediation	Vacuum Extraction and Sparging
Vacuum Excavation	Potholing and Slurry Recovery
Wastewater	Aeration and Backwashing

50% Less Operating Noise



The sound data shown compares the Legend and a comparably sized blower operating at 3,275 rpm and 12 psig. An improved blower design significantly reduces the sound pressure output of the Legend blower. The typical reduction is 3 dBA which represents 50% less noise than the competition.



Superior Local Sales and Service

Our extensive network of authorized Sutorbilt distributors offers the most convenient local sales and service support of anyone in the industry today. These factory trained professionals are experts in blower/vacuum pump

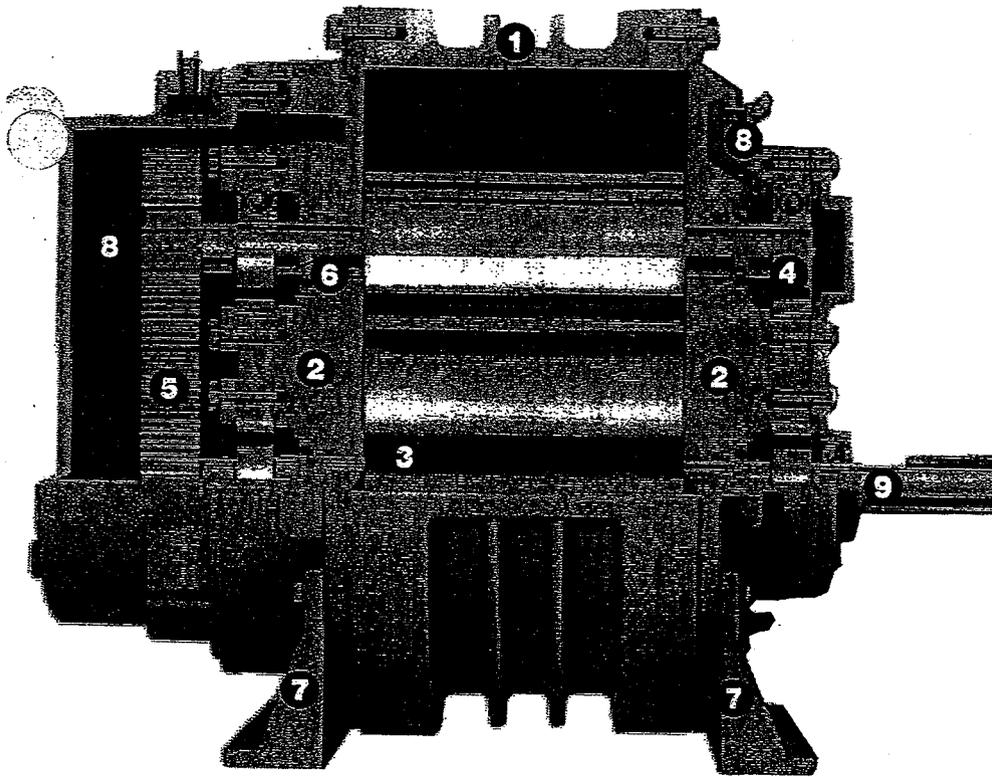
technology providing system installation guidance, troubleshooting and optimization recommendations of your new or existing applications.

Even a Legendary Warranty

Every Sutorbilt Legend Series blower/ vacuum pump is covered by an uncontested warranty for 24 months from the date of shipment or 18 months from the date of installation on all blower materials and workmanship. Replacement or repair costs will be at no charge including return freight. Contact your Local Sutorbilt Representative for written details.



Legendary Design Features



1 High-strength impeller case is heavily ribbed and machined from a single piece of cast iron and features oversized dowel pins for precise mounting and alignment of head plates.

These features result in reduced noise and more stable, vibration-free operation.

2 Head plates, machined from cast iron, are ground on the interior surface to precise operating tolerances. Bearing fits are machined into head plates to assure exact bearing positioning.

This ensures accurate, fixed-dimension clearances through all blower operating conditions and temperature ranges.

3 Impellers are machined from cast iron to an exact profile and are permanently fastened to steel shafts. They are dynamically balanced for smooth operation in any assembled position.

This provides extra strength and rigidity to handle continuous maximum loads without fatigue or deflection.

4 Anti-friction bearings are used exclusively. Smaller models are fitted with single-row ball bearings and cylindrical roller bearings; large models have double-row ball bearings and spherical roller bearings.

Optimum bearing selection provides longer blower life and added overhung shaft load capacity.

5 Timing gears, precision machined from alloy steel forgings, are permanently pinned to the shafts.

This assures non-slip timing even under the most strenuous loading conditions.

6 High temperature Viton® oil seals.

These maximize the seal life in continuous, severe-duty applications to provide leak-free operation.

7 Flex-Mount™ design is adaptable to either vertical or horizontal installation.

The feet are precisely machined and match the footprints of many competitive units.

8 Timing gears and gear end bearings are splash lubricated utilizing an abundant oil reservoir. A graphite gasketed, oil-tight housing encloses the timing gears. Drive end bearings are grease lubricated through fittings. Lip-type seals prevent oil and grease from entering the impeller chamber.

Superior gear and bearing lubrication is assured at all operating conditions with minimal maintenance.

9 High strength steel drive shaft is extended for V-belt drive or direct connection.

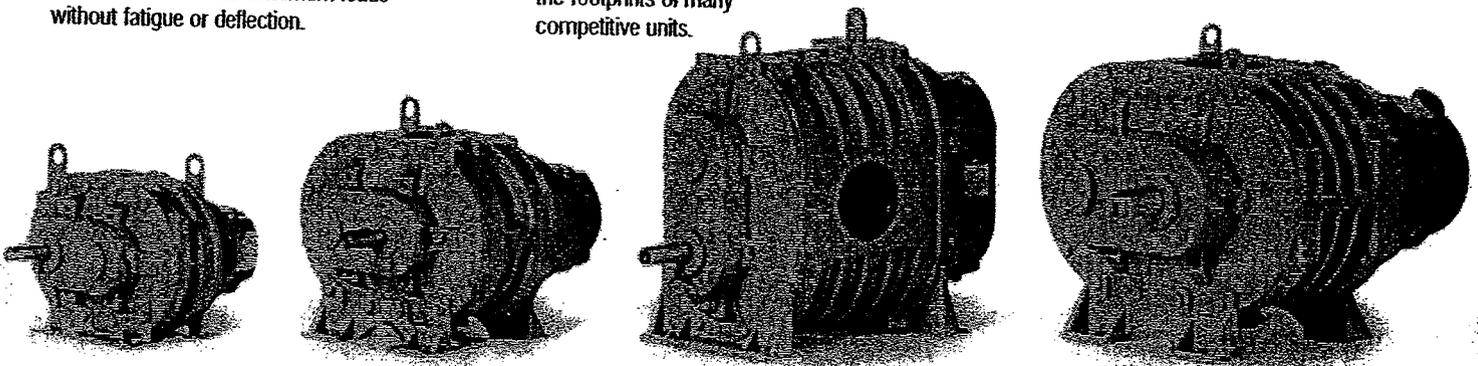
This feature provides greater blower durability and installation flexibility.



Available With Mechanical Gas Seals

The Legend design accommodates mechanical gas seals for critical gas applications with proven results based on a large installed base.

This field proven seal design allows trouble-free operation in critical gas applications.



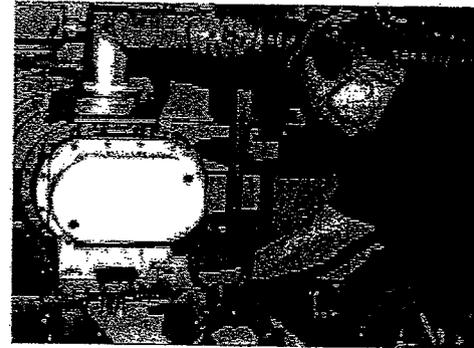
State-Of-The-Art Quality

Sutorbilt Legend blowers and vacuum pumps are engineered and produced in Gardner Denver's state-of-the-art manufacturing facility in Sedalia, Missouri. This 330,000 sq. ft. plant is ISO 9001 certified and produces hundreds of different blower and compressor models.

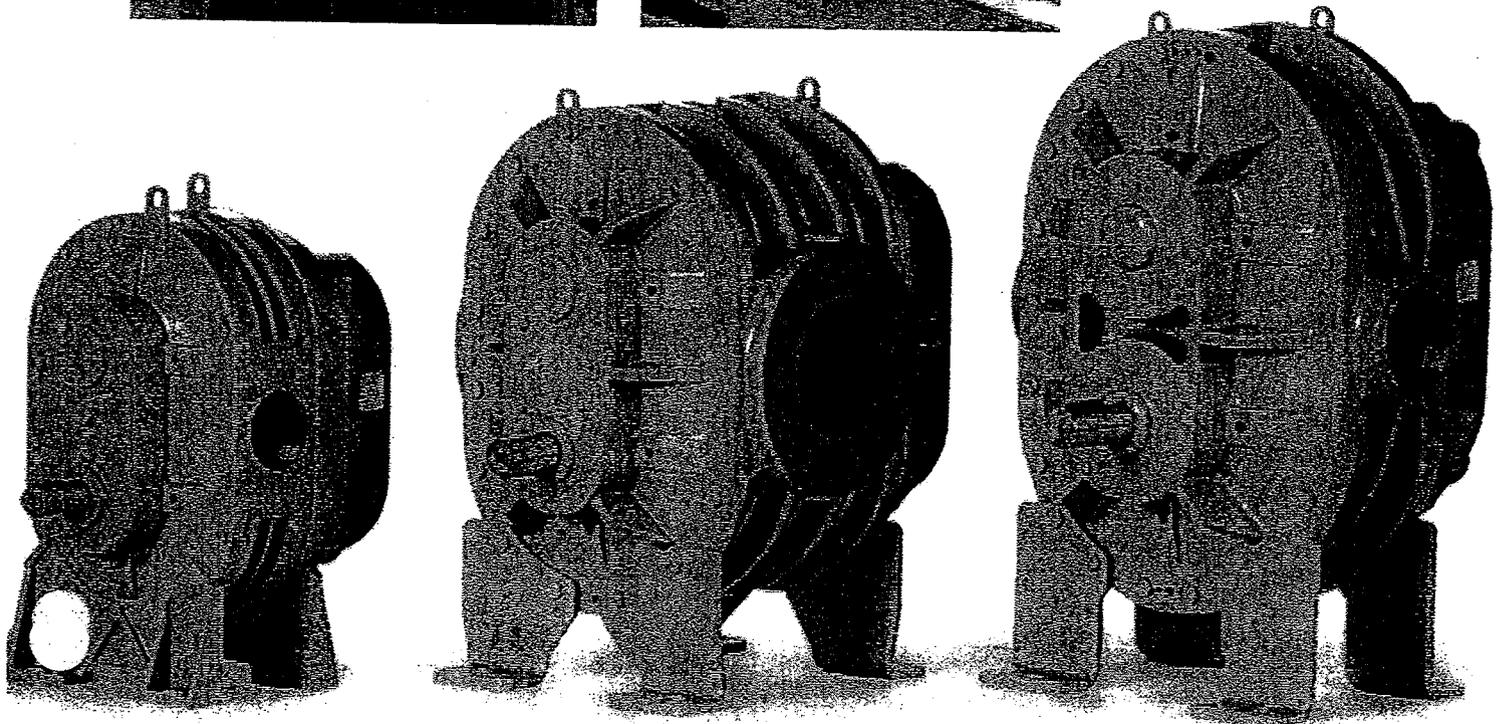
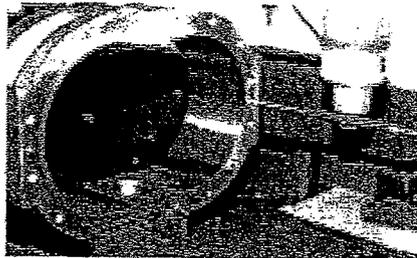


Over the years Gardner Denver has made significant investments in people and modern precision machinery. Gardner Denver's Flexible Machining System (FMS) assures consistent production of the highest quality Legend components.

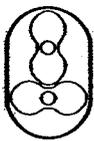
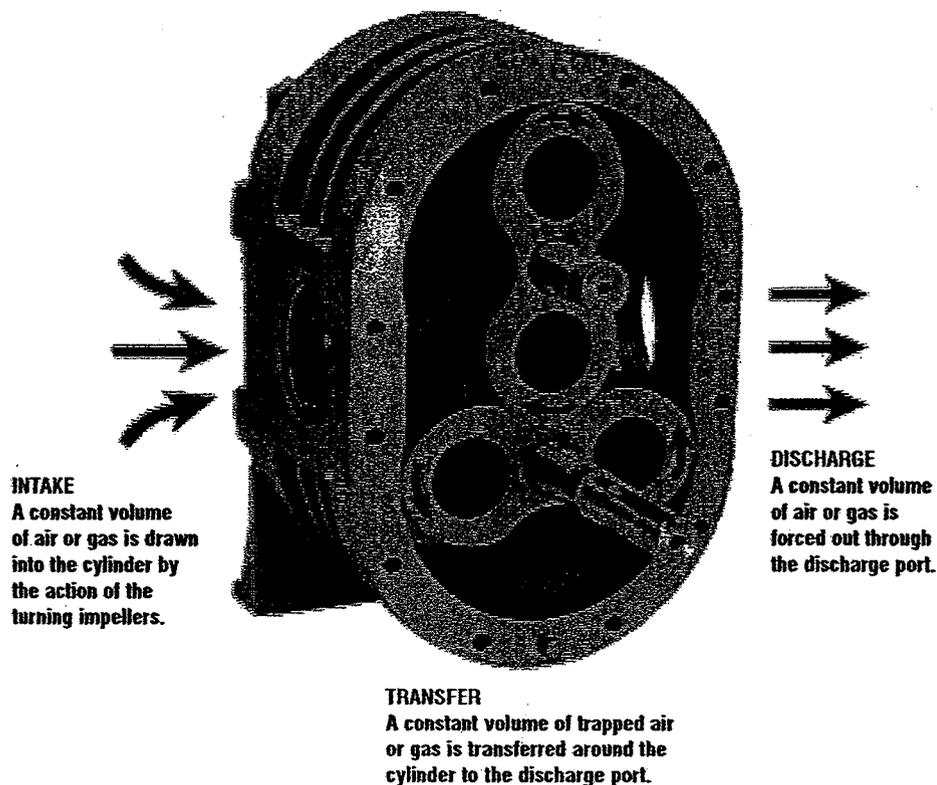
Extra attention to detail is found throughout the manufacturing process like the use of advanced coordinate measuring equipment. Legend components are subjected to numerous quality inspections before they are assembled.



Prior to leaving the factory, every Legend is run tested against rigid standards using our advanced computer automated testing equipment.



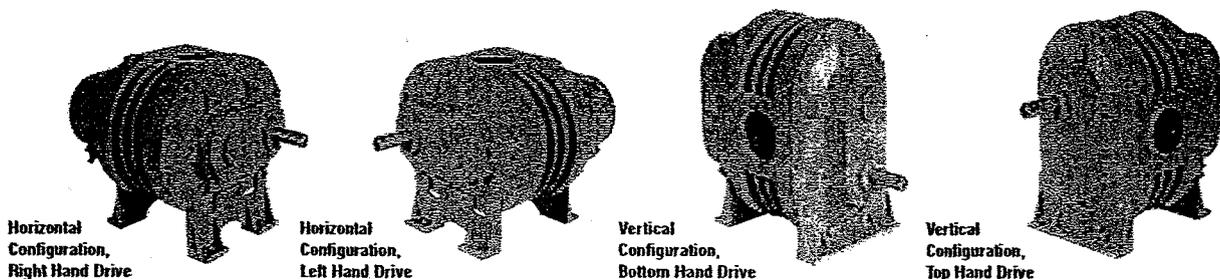
The Sutorbilt® Positive Displacement Cycle



Two specially designed figure-eight impellers turn in opposite directions within a machined housing, transferring a constant volume of air or gas from the inlet to the discharge with every rotation of the blower drive shaft. No lubrication within the cylinder is required as the rotating components are held in close tolerance to each other and do not make contact. The impeller positioning is maintained by precision timing gears affixed to each impeller shaft. All essential gear and bearing lubrication occurs externally to the cylinder assuring clean, oil-free gas delivery under all operating conditions. Compression occurs after the gas leaves the blower and encounters system resistance in performing its intended work.

Flex-Mount™ Design Provides Maximum Installation Versatility

Flex-Mount™ design gives the Legend positive displacement blower and vacuum pump total application flexibility. It also assures complete interchangeability on existing and new applications and compatibility as replacements for most competitive installations.



Sutorbilt® Legend™ Pressure Performance Data

SIZE	DIA. INLET & OUTLET	DISPL. CU. FT./REV.	RPM	2 PSIG		3 PSIG		4 PSIG		5 PSIG		6 PSIG		7 PSIG	
				CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP
				2LP 2LVP	2"-S	0.035	2,800	76	1.1	71	1.6	67	2.1	63	2.5
3,250	91	1.3	86				1.8	82	2.4	79	2.9	75	3.4	72	4.0
3,560	102	1.4	97				2.0	93	2.6	78	3.2	86	3.7	83	4.3
5,275	162	2.0	157				2.8	153	3.7	149	4.6	146	5.3	143	6.1
3LP 3LVP	2½"-S	0.104	1,760	149	1.9	142	2.8	135	3.7	130	4.5	124	5.2	120	6.1
			2,265	202	2.4	194	3.5	188	4.7	182	5.6	177	6.7	172	7.8
			2,770	254	2.9	247	4.3	240	5.5	235	6.8	230	8.2	225	9.6
			3,600	341	3.7	333	5.3	327	7.1	321	8.9	316	10.6	311	12.4
4LP 4LVP	3"-S	0.170	1,760	253	3.0	243	4.5	234	5.7	227	7.1	220	8.5	213	9.9
			2,190	326	3.7	316	5.3	307	7.1	300	8.8	293	10.6	286	12.4
			2,620	400	4.4	389	6.3	381	8.4	373	10.6	366	12.7	360	14.8
			3,600	566	5.8	556	8.7	547	11.6	539	14.5	533	17.4	526	20.3
5LP 5LVP	4"-S	0.350	1,500	483	5.2	449	7.5	438	10.0	427	12.4	418	14.9	409	17.4
			1,760	554	5.8	540	8.8	529	11.7	518	14.6	509	17.5	500	20.4
			2,100	673	7.0	659	10.5	648	13.9	637	17.4	628	20.9	619	24.4
			2,850	936	9.5	922	14.2	910	18.9	900	23.6	890	28.4	882	33.1
6LP 6LVP	6"-F	0.718	1,170	739	8.0	716	11.9	697	15.9	680	19.9	664	23.9	650	27.9
			1,760	1,162	12.0	1,139	18.0	1,120	24.0	1,103	29.9	1,088	35.9	1,074	41.9
			1,930	1,284	13.1	1,261	19.7	1,242	26.3	1,225	32.8	1,210	39.4	1,196	46.0
			2,350	1,586	16.0	1,563	24.0	1,544	32.0	1,527	40.0	1,512	48.0	1,497	56.0
7LP 7LVP	8"-F	1.200	1,170	1,277	13.3	1,248	20.0	1,224	16.6	1,203	33.3	1,184	39.9		
			1,465	1,631	16.7	1,602	25.0	1,578	33.3	1,557	41.7	1,538	50.0		
			1,760	1,985	20.0	1,956	30.0	1,932	40.0	1,911	50.1	1,892	60.1		
			2,050	2,333	23.3	2,304	35.0	2,280	46.6	2,259	58.3	2,240	70.0		
8LP 8LVP	10"-F	1.740	880	1,366	14.5	1,329	21.8	1,298	29.0	1,271	36.3	1,246	43.5		
			1,170	1,871	19.3	1,834	28.9	1,803	38.6	1,775	48.2	1,750	57.9		
			1,375	2,228	22.7	2,191	34.0	2,159	45.4	2,132	56.7	2,107	68.0		
			1,800	2,967	29.7	2,930	44.5	2,899	59.4	2,871	74.2	2,847	89.1		

SIZE	DIA. INLET & OUTLET	DISPL. CU. FT./REV.	RPM	7 PSIG		9 PSIG		10 PSIG		12 PSIG		13 PSIG		14 PSIG	
				CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP
				2MP 2MVP	1"-S	0.017	2,800	25	1.7	22	2.1				
3,250	33	1.9	30				2.5	28	2.7						
3,560	38	2.1	35				2.7	34	3.0						
5,275	67	3.1	64				3.9	63	4.4	60	5.1				
3MP 3MVP	2"-S	0.060	1,760	64	3.6	59	4.6								
			2,265	95	4.6	89	5.8	87	6.4						
			2,770	125	5.5	119	7.1	117	7.9	112	9.5				
			3,600	175	7.2	169	9.2	167	10.2	162	12.3				
4MP 4MVP	2½"-S	0.117	1,760	144	6.8	136	8.8	132	9.8						
			2,190	194	8.5	186	10.9	182	12.1						
			2,620	245	10.2	236	13.1	233	14.5						
			3,600	359	14.0	351	18.0	347	20.0						
5MP 5MVP	4"-S	0.210	1,500	237	10.5	227	13.4	222	14.9	213	17.9	209	19.4		
			1,760	292	12.3	281	15.8	277	17.5	268	21.0	263	22.8		
			2,100	363	14.6	353	18.8	348	20.9	339	25.1	335	27.2		
			2,850	521	19.9	510	25.5	506	28.4	497	34.0	493	36.9		
6MP 6MVP	5"-S	0.383	1,170	332	14.9	316	19.1	309	21.2	296	25.5	289	27.6	283	29.7
			1,760	558	22.4	542	28.8	535	32.0	522	38.3	515	41.5	509	44.7
			1,930	622	24.5	607	31.5	600	35.0	587	42.0	580	45.5	574	49.1
			2,350	784	29.9	768	38.4	761	42.7	748	51.2	741	55.5	735	59.7
7MP 7MVP	6"-F	0.733	1,170	693	28.5	671	36.6	661	40.7						
			1,465	909	35.6	887	45.8	877	50.9						
			1,760	1,125	42.8	1,103	55.0	1,093	61.1						
			2,050	1,338	49.9	1,316	64.1	1,306	71.2						
8MP 8MVP	8"-F	1.040	880	709	30.4	681	39.0	669	43.4						
			1,170	1,011	40.4	983	51.9	970	57.7						
			1,375	1,224	47.4	1,196	61.0	1,183	67.8						
			1,800	1,666	62.1	1,638	79.9	1,625	88.7						

SIZE	DIA. INLET & OUTLET	DISPL. CU. FT./REV.	RPM	7 PSIG		8 PSIG		9 PSIG		11 PSIG		13 PSIG		15 PSIG	
				CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP
				3HP 3HVP	1½"-S	0.045	1,760	46	2.6	44	3.0	41	3.4		
2,265	69	3.4	66				3.9	64	4.3	60	5.3				
2,770	91	4.1	89				4.7	87	5.3	83	6.5				
3,600	129	5.4	126				6.1	124	6.9	120	8.4	117	10.0	113	11.5
4HP 4HVP	1½"-S	0.069	1,760	80	4.0	77	4.6	74	5.2						
			2,190	110	5.0	107	5.7	104	6.4	99	7.9				
			2,620	139	6.0	137	6.9	134	7.7	129	9.4	124	11.1		
			3,600	207	8.2	204	9.4	201	10.6	196	13.0	192	15.3	188	17.7
5HP 5HVP	2½"-S	0.140	1,500	154	7.0	151	8.0	147	9.0	140	10.9				
			1,760	191	8.2	187	9.3	183	10.5	177	12.8	171	15.2	165	17.5
			2,100	238	9.8	235	11.1	231	12.5	224	15.3	218	18.1	213	20.9
			2,850	343	13.2	340	15.1	336	17.0	329	20.8	323	24.6	318	28.4
6HP 6HVP	3"-S	0.227	1,170	188	8.8	182	10.1	177	11.3	168	13.8	159	16.4		
			1,760	321	13.3	316	15.1	311	17.0	302	20.8	293	24.6	285	28.4
			1,930	360	14.5	355	16.6	350	18.7	340	22.8	332	27.0	324	31.1
			2,350	455	17.7	450	20.2	445	22.8	436	27.8	427	32.9	419	37.9
7HP 7HVP	4"-S	0.367	1,170	332	14.2	326	16.3	319	18.3	308	22.4	297	26.5	287	30.5
			1,465	441	17.8	434	20.4	428	22.9	416	28.0	405	33.1	396	38.2
			1,760	549	21.4	542	24.5	536	27.6	524	33.7	514	39.8	504	45.9
			2,050	655	25.0	649	28.5	642	32.1	631	39.2	620	46.4	610	53.5
8HP 8HVP	4"-S	0.566	880	363	16.5	354	18.9	345	21.2	329	26.0	315	30.7	301	35.4
			1,170	528	22.0	518	25.1	509	28.3	493	34.5	479	40.8	465	47.1
			1,375	644	25.8	634	29.5	626	33.2	609	40.6	595	48.0	581	55.3
			1,800	884	33.8	875	38.6	866	43.5	850	53.1	835	62.8	822	72.4

Sutorbilt® Legend™ Vacuum Performance Data

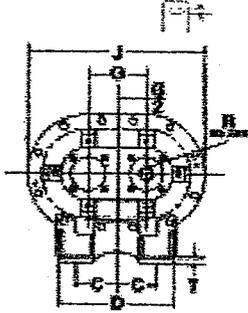
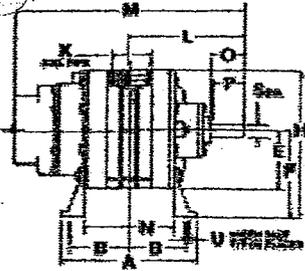
SIZE	DIA. INLET & OUTLET	DISPL. CU. FT./REV.	RPM	2" Hg		4" Hg		8" Hg		10" Hg		12" Hg		14" Hg	
				CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP
				LOW VACUUM UNITS											
2LP 2LVP	2"-S	0.035	2,800	82	0.7	74	1.1	61	2.0	55	2.5				
			3,250	98	0.7	90	1.3	77	2.3	71	2.8	64	3.4		
			3,560	108	0.8	101	1.4	88	2.5	82	3.1	75	3.7		
			4,165	130	0.9	122	1.6	109	2.9	103	3.6	96	4.3		
			5,275	168	1.1	161	1.9	148	3.6	142	4.5	135	5.2	128	6.0
3LP 3LVP	2½"-S	0.104	1,760	158	1.1	147	1.9	128	3.6	118	4.5	108	5.1		
			2,265	211	1.3	200	2.4	180	4.6	171	5.5	160	6.6		
			2,770	264	1.5	252	2.9	233	5.4	223	6.7	213	8.1		
			3,600	350	1.9	338	3.7	319	7.0	309	8.7	299	10.5	288	12.2
4LP 4LVP	3"-S	0.170	1,760	266	1.6	250	3.0	224	5.6	211	7.0	197	8.4		
			2,190	339	1.9	323	3.7	297	6.9	284	8.7	270	10.4		
			2,620	412	2.3	396	4.3	370	8.3	357	10.4	343	12.4	329	14.5
			3,600	579	3.1	563	5.7	537	11.4	524	14.3	510	17.1	495	20.0
5LP 5LVP	4"-S	0.350	1,500	480	2.6	459	5.1	424	9.8	406	12.2	388	14.7		
			1,760	571	3.1	550	5.7	515	11.5	497	14.3	479	17.2	459	20.1
			2,100	690	3.6	669	6.8	634	13.7	616	17.1	598	20.5	578	24.0
6LP 6LVP	6"-F	0.718	1,170	766	4.1	732	7.8	674	15.7	645	19.6	615	23.5		
			1,760	1,190	5.9	1,115	11.8	1,097	23.5	1,068	29.4	1,038	35.3	1,005	41.2
			1,930	1,312	6.5	1,278	12.9	1,219	25.8	1,191	32.3	1,160	38.7	1,127	45.2
			2,350	1,614	7.9	1,579	15.7	1,521	31.4	1,492	39.3	1,462	47.2	1,429	55.0
7LP 7LVP	8"-F	1.200	1,170	1,312	6.5	1,268	13.1	1,195	26.2	1,159	32.7	1,121	39.2		
			1,465	1,666	8.2	1,622	16.4	1,549	32.8	1,513	40.9	1,475	49.1		
			1,760	2,020	9.8	1,976	19.7	1,903	39.3	1,867	49.2	1,829	59.0		
8LP 8LVP	10"-F	1.740	880	1,411	7.1	1,355	14.3	1,261	28.5	1,214	35.7	1,165	42.8		
			1,170	1,916	9.5	1,860	19.0	1,766	37.9	1,719	47.4	1,670	56.9		
			1,375	2,273	11.1	2,217	22.3	2,122	44.6	2,076	55.7	2,026	66.9		
			1,800	3,012	14.6	2,953	29.2	2,862	58.4	2,815	72.9	2,765	87.6		

SIZE	DIA. INLET & OUTLET	DISPL. CU. FT./REV.	RPM	6" Hg		10" Hg		12" Hg		14" Hg		15" Hg		16" Hg	
				CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP
				MEDIUM VACUUM UNITS											
2MP 2MVP	1"-S	0.017	2,800	31	0.8	24	1.2								
			3,250	39	0.9	32	1.4								
			3,560	44	0.9	37	1.5	34	1.8						
			4,165	54	1.1	48	1.7	44	2.1	40	2.4				
			5,275	73	1.4	67	2.2	63	2.6	59	3.0	57	3.2		
3MP 3MVP	2"-S	0.060	1,760	76	1.6	63	2.6	57	3.1						
			2,265	106	2.0	93	3.3	87	3.9						
			2,770	136	2.4	124	4.0	117	4.7	110	5.4				
			3,600	186	3.1	174	5.0	167	6.0	160	7.0	156	7.5		
4MP 4MVP	2½"-S	0.117	1,760	161	3.0	142	4.9	132	5.8						
			2,190	211	3.7	193	6.0	183	7.2						
			2,620	262	4.4	243	7.1	233	8.6	222	10.0				
			3,600	376	5.9	358	9.8	348	11.8	337	13.7	331	14.7	325	15.7
5MP 5MVP	4"-S	0.210	1,500	258	4.5	235	7.3	223	8.8	209	10.3				
			1,760	313	5.2	290	8.6	277	10.3	264	12.1				
			2,100	384	6.2	361	10.3	349	12.3	335	14.4	328	15.4		
6MP 6MVP	5"-S	0.383	2,850	542	8.4	519	13.9	506	16.7	493	19.5	485	20.9	477	22.3
			1,170	363	6.3	328	10.4	310	12.5	290	14.6	279	15.7	267	16.7
			1,760	589	9.4	554	15.7	536	18.8	516	22.0	505	23.5	493	25.1
			1,930	655	10.3	619	17.2	601	20.7	581	24.1	570	25.8	558	27.5
7MP 7MVP	6"-F	0.733	2,350	815	12.6	780	21.0	762	25.2	741	29.3	731	31.4	719	33.5
			1,170	738	12.0	688	20.0	662	24.0	633	28.0	618	30.0	601	32.0
			1,465	954	15.0	904	25.0	878	30.0	850	35.0	834	37.5	817	40.0
			1,760	1,170	18.0	1,121	30.0	1,094	36.1	1,065	42.1	1,050	45.1	1,034	48.1
8MP 8MVP	8"-F	1.040	2,050	1,383	21.0	1,333	35.0	1,307	42.0	1,278	49.0	1,263	52.5	1,246	56.0
			880	765	12.8	703	21.3	670	25.6	634	29.8	615	32.0	594	34.1
			1,170	1,067	17.0	1,005	28.3	972	34.0	936	39.7	917	42.5	896	45.3
			1,375	1,280	20.0	1,218	33.3	1,185	40.0	1,149	46.6	1,130	50.0	1,109	53.3
1,800	1,722	26.2	1,660	43.6	1,627	52.3	1,591	61.0	1,572	65.4	1,551	69.7			

SIZE	DIA. INLET & OUTLET	DISPL. CU. FT./REV.	RPM	6" Hg		8" Hg		12" Hg		14" Hg		15" Hg		16" Hg	
				CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP
				HIGH VACUUM UNITS											
3HP 3HVP	1½"-S	0.045	1,760	55	1.1	50	1.5	40	2.2						
			2,265	78	1.4	73	1.9	62	2.8						
			2,770	100	1.7	95	2.3	85	3.5	79	4.1	76	4.4		
			3,600	138	2.3	133	3.0	122	4.5	117	5.3	113	5.7	110	6.0
4HP 4HVP	1½"-S	0.069	1,760	91	1.7	85	2.3	72	3.4						
			2,190	121	2.1	115	2.8	102	4.2	95	4.9	91	5.3		
			2,620	151	2.5	144	3.4	132	5.1	124	5.9	120	6.3		
			3,600	218	3.5	212	4.6	199	6.9	192	8.1	188	8.7	184	9.3
5HP 5HVP	2½"-S	0.140	1,500	170	2.9	161	3.9	144	5.9	134	6.8				
			1,760	206	3.4	198	4.6	180	6.9	171	8.0	165	8.6		
			2,100	254	4.1	245	5.5	228	8.2	218	9.6	213	10.3		
			2,850	359	5.6	350	7.4	333	11.2	323	13.0	318	14.0	312	14.9
6HP 6HVP	3"-S	0.227	1,170	209	3.7	197	4.8	173	7.4	159	8.7	152	9.3		
			1,760	343	5.6	331	7.4	307	11.2	293	13.0	286	14.0	278	14.9
			1,930	381	6.1	370	8.2	345	12.2	332	14.3	325	15.3	317	16.3
			2,350	477	7.5	465	9.9	441	14.9	427	17.4	420	18.6	412	19.9
7HP 7HVP	4"-S	0.367	1,170	359	6.0	344	8.0	314	12.0	297	14.0	288	15.0	278	16.0
			1,465	467	7.5	453	10.0	422	15.0	406	17.5	396	18.8	387	20.0
			1,760	575	9.0	561	12.0	531	18.1	514	21.1	505	22.6	495	24.1
			2,050	682	10.5	667	14.0	637	21.0	620	24.5	611	26.3	601	28.0
8HP 8HVP	4"-S	0.566	880	400	7.0	380	9.3	338	13.9	315	16.2	302	17.4		
			1,170	564	9.3	544	12.3	502	18.5	479	21.6	466	23.1	453	24.7
			1,375	680	10.9	660	14.5	618	21.7	595	25.4	582	27.2	569	29.0
			1,800	921	14.2	901	19.0	859	28.5	835	33.2	823	35.6	809	38.0

Sutorbilt® Legend™ Dimensional Data

Horizontal Configurations



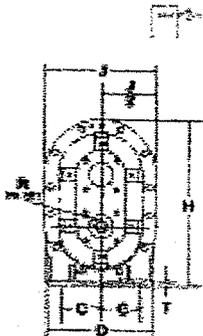
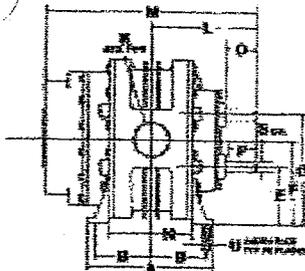
TOP HEAD CENTRAL
W/ TYPICAL CONNECTION



TOP HEAD CENTRAL
W/ TYPICAL CONNECTION
FLANGE CONNECTION

SIZE	WT.	CONN.	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	R	S	T	U
2M	36	S	5	2	2	6	3	3	2	7	9	1	5	10	2	1	1	3/8	.625	1/2	1/2
2L	39	S	7	3	2	6	3	3	2	7	9	2	6	12	4	1	1	3/8	.625	1/2	1/2
3H	71	S	6	2	2	7	3	5	3	8	11	1	5	11	3	2	1	3/8	.750	1/2	1/2 x 1/2
3M	79	S	7	3	2	7	3	5	3	8	11	2	6	12	4	2	1	3/8	.750	1/2	1/2 x 1/2
3L	95	S	10	4	2	7	3	5	3	8	11	2	7	15	7	2	1	3/8	.750	1/2	1/2 x 1/2
4H	106	S	7	3	3	8	4	6	4	10	12	1	6	13	4	2	2	3/8	.875	1/2	1/2 x 1/2
4M	125	S	9	4	3	8	4	6	4	10	12	2	8	16	6	2	2	3/8	.875	1/2	1/2 x 1/2
4L	150	S	12	5	3	8	4	6	4	10	12	3	9	18	8	2	2	3/8	.875	1/2	1/2 x 1/2
5H	205	S	8	3	3	9	5	7	5	12	15	2	8	17	4	2	2	1/2	1.125	1/2	1/2 x 1/2
5M	237	S	10	4	3	9	5	7	5	12	15	4	9	19	6	2	2	1/2	1.125	1/2	1/2 x 1/2
5L	270	S	14	6	3	9	5	7	5	12	15	4	11	23	10	2	2	1/2	1.125	1/2	1/2 x 1/2
6H	389	S	9	3	4	11	6	8	6	14	18	3	9	19	5	2	2	1/2	1.375	1/2	1/2 x 1
6M	426	S	13	5	4	11	6	8	6	15	18	5	10	22	9	2	2	1/2	1.375	1/2	1/2 x 1
6L	565	F	20	9	4	11	7	8	6	16	18	6	14	29	16	2	2	1/2	1.375	1/2	1/2 x 1
7H	523	S	12	4	5	15	9	11	7	20	22	4	10	21	5	3	2	1/2	1.562	1/2	1/2 x 1
7M	671	F	17	7	5	15	8	11	7	19	22	6	12	26	11	3	2	1/2	1.562	1/2	1/2 x 1
7L	804	F	24	10	5	15	8	11	7	19	22	8	16	33	18	3	2	1/2	1.562	1/2	1/2 x 1
8H	820	S	13	5	6	16	10	12	8	22	25	4	11	24	7	3	3	1/2	1.750	1/2	1/2 x 1
8M	996	F	19	8	6	16	10	12	8	22	25	8	14	29	13	3	3	1/2	1.750	1/2	1/2 x 1
8L	1,260	F	27	12	6	16	10	12	8	22	25	10	18	37	21	3	3	1/2	1.750	1/2	1/2 x 1

Vertical Configurations



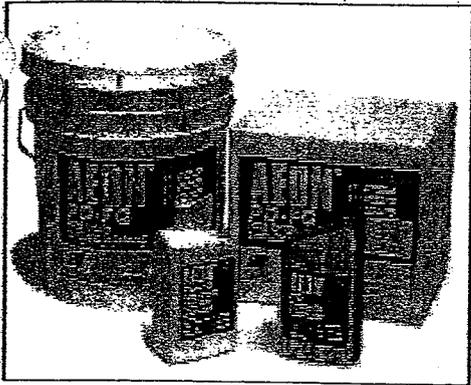
TOP HEAD CENTRAL
W/ TYPICAL CONNECTION



TOP HEAD CENTRAL
W/ TYPICAL CONNECTION
FLANGE CONNECTION

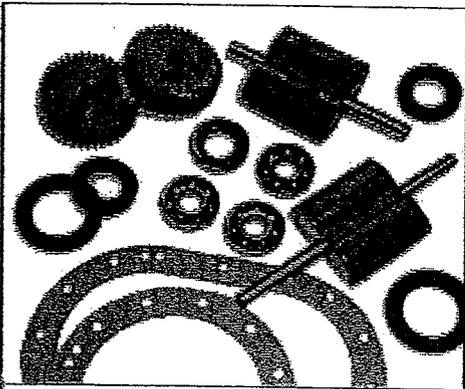
SIZE	WT.	CONN.	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	R	S	T	U
2MV	36	S	5	2	1	5	3	4	6	9	6	1	5	10	2	1	1	3/8	.625	1/2	1/2
2LV	39	S	7	3	1	5	3	4	6	9	6	2	6	12	4	1	1	3/8	.625	1/2	1/2
3HV	71	S	6	2	2	6	4	6	8	11	7	1	5	11	3	2	1	3/8	.750	1/2	1/2 x 1/2
3MV	79	S	7	3	2	6	4	6	8	11	7	2	6	12	4	2	1	3/8	.750	1/2	1/2 x 1/2
3LV	95	S	10	4	2	6	4	6	8	11	7	2	7	15	7	2	1	3/8	.750	1/2	1/2 x 1/2
4HV	106	S	7	3	3	8	4	6	8	12	8	1	6	13	4	2	2	3/8	.875	1/2	1/2 x 1/2
4MV	125	S	9	4	3	8	4	6	8	12	8	2	8	16	6	2	2	3/8	.875	1/2	1/2 x 1/2
4LV	150	S	12	5	3	8	4	6	8	12	8	3	9	18	8	2	2	3/8	.875	1/2	1/2 x 1/2
5HV	205	S	8	3	3	9	5	8	10	15	10	2	8	17	4	2	2	1/2	1.125	1/2	1/2 x 1/2
5MV	237	S	10	4	3	9	5	8	10	15	10	4	9	19	6	2	2	1/2	1.125	1/2	1/2 x 1/2
5LV	270	S	14	6	3	9	5	8	10	15	10	4	11	23	10	2	2	1/2	1.125	1/2	1/2 x 1/2
6HV	389	S	9	3	4	11	8	11	14	20	12	3	9	19	5	2	2	1/2	1.375	1/2	1/2 x 1
6MV	426	S	13	5	4	11	8	11	14	20	12	5	10	22	9	2	2	1/2	1.375	1/2	1/2 x 1
6LV	565	F	20	9	4	11	8	11	14	20	12	6	14	29	16	2	2	1/2	1.375	1/2	1/2 x 1
7HV	523	S	12	4	5	14	11	14	18	25	19	4	10	21	5	3	2	1/2	1.562	1/2	1/2 x 1
7MV	671	F	17	7	5	14	11	14	18	25	17	6	12	26	11	3	2	1/2	1.562	1/2	1/2 x 1
7LV	804	F	24	10	5	14	11	14	18	25	17	8	16	33	18	3	2	1/2	1.562	1/2	1/2 x 1
8HV	820	S	13	5	6	16	12	16	20	29	20	4	11	24	7	3	3	1/2	1.750	1/2	1/2 x 1
8MV	996	F	19	8	6	16	12	16	20	29	20	8	14	29	13	3	3	1/2	1.750	1/2	1/2 x 1
8LV	1,260	F	27	12	6	16	12	16	20	29	20	10	18	37	21	3	3	1/2	1.750	1/2	1/2 x 1

S= Threaded connections std. NPT. F= flange connections. Intake and outlet connections are same type and size. Dimensions in inches, weight in pounds. Dimensions for installation purposes will be furnished upon request.



Protect your Sutorbilt investment with AEON™ PD, the only lubricant specially formulated for all blowers in any environment.

- 100% synthetic for matchless service life.
- Retains its superior lubricating properties a minimum of four times longer than a premium grade mineral oil at most operating conditions.
- Eliminates seasonal oil viscosity grade changes.
- Superior lubrication in severe, high temperature applications.
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Retain your Sutorbilt advantage with Genuine Gardner Denver Replacement Parts.

- Gardner Denver guarantees to supply the proper parts for your specific blower every time. Replacement parts incorporate the most recent design upgrades.
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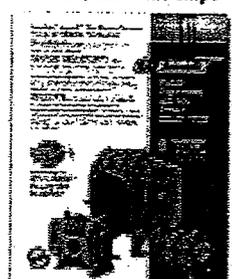
**CycloBlower XP Series
Blowers/Vacuum Pumps**



**DuroFlow Industrial Series
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**Sutorbilt Methane Gas
Blowers/Vacuum Pumps**



For additional information, contact your local representative or

Gardner Denver Blower Division

100 Gardner Park, Peachtree City, GA 30269

Toll Free 800-543-7736 ext. 486

Phone 770-632-5000 • Fax 770-486-5629

E-mail: blowersmktg@gardnerdenver.com

Visit our web site: www.gardnerdenver.com

For Parts Information, Contact:

Gardner Denver Blower Division Customer Service

Phone 770-632-5000 • Fax 770-486-5629

Gardner Denver

Sample Submersible Groundwater Pump

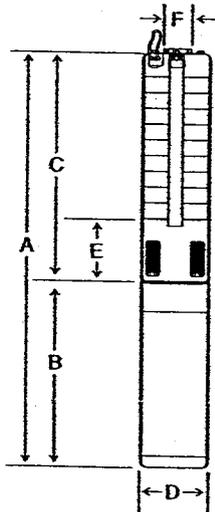
Submittal Data



JOB or CUSTOMER:	
ENGINEER:	
CONTRACTOR:	
SUBMITTED BY:	DATE:
APPROVED BY:	DATE:
ORDER NO:	DATE:
SPECIFICATION REF:	

QUANTITY	TAG NO.	MODEL NO.	GPM	FEET	VOLT	PHASE	COMMENTS
					230	3	
					230	3	
					230	3	
					230	3	

Dimensions



Technical Data

FLOW RANGE:
 5E8: 0 - 10 U.S. GPM
 10E5: 0 - 15 U.S. GPM
 16E4: 0 - 35 U.S. GPM
 25E3: 0 - 50 U.S. GPM

MOTORS: Grundfos MS402E Environmental Submersible Motor
 2.0 HP/ 230V/ 3PH
 Maximum Operating Motor Temperature: 104°F (40°C)
 Maximum Operating Pressure: 220 PSI
 Maximum Number of Starts Per Hour: 100
 Motor Fluid: Deionized water with 30% propylene glycol

DISCHARGE SIZE:
 5E8: 1" NPT
 10E5: 1 1/4" NPT
 16E4: 1 1/4" NPT
 25E3: 1 1/2" NPT

MATERIALS OF CONSTRUCTION: See reverse side.
INSTALLATION: Unit to be installed vertically for submerged operation.
MAXIMUM SETTING DEPTH: Not to exceed 600 ft.
MAXIMUM SUBMERSION: 500 ft.

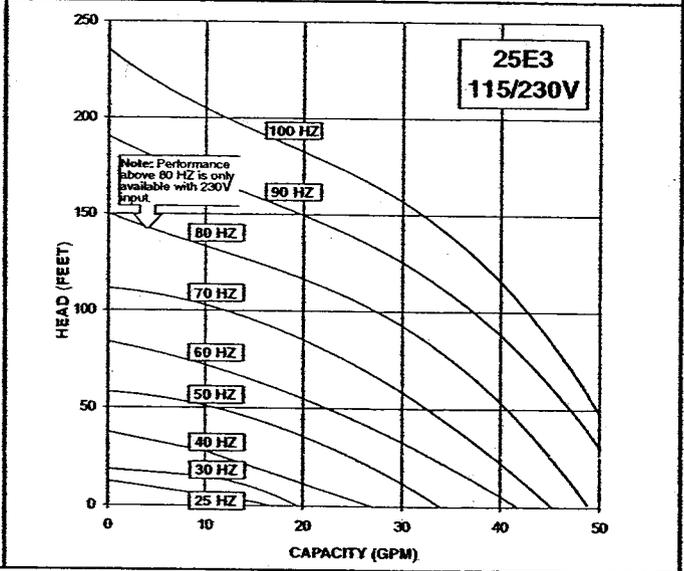
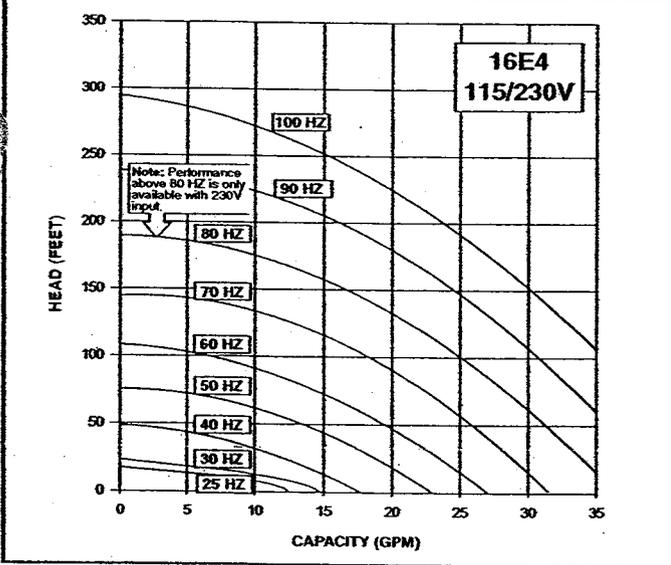
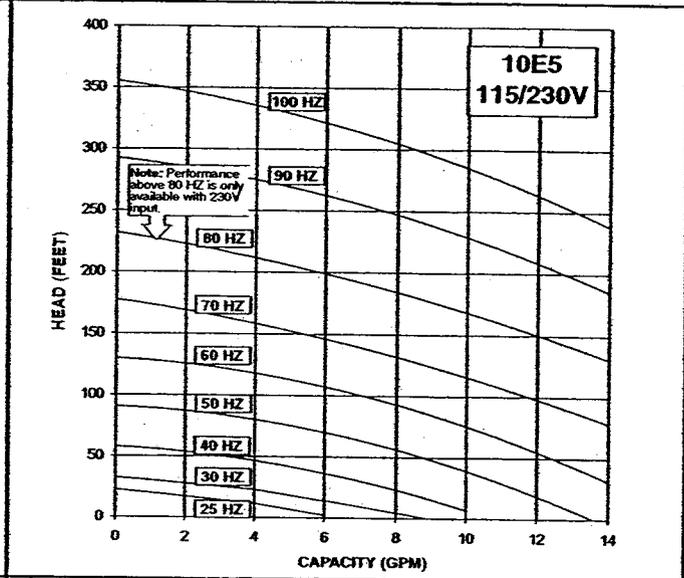
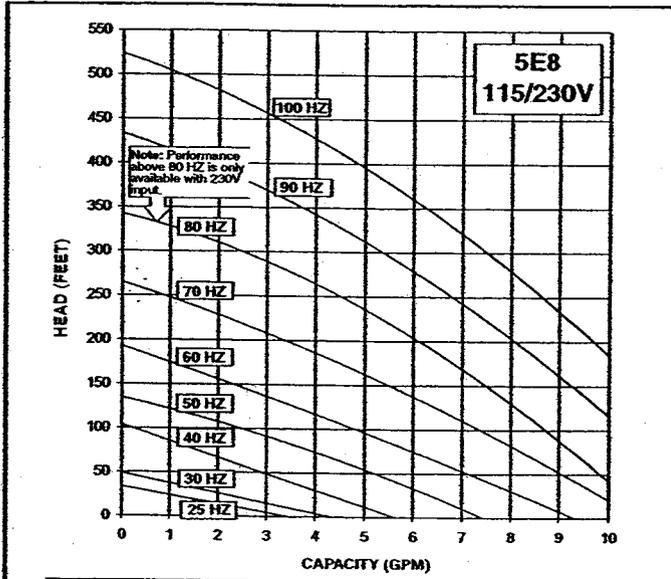
Electrical Data, Dimensions, and Weights

Model	Motors				DIMENSIONS IN INCHES						Net Weight (Lbs.)*	Ship. Weight (Lbs.)*
	HP	SF	PH	Volts	Overall Length A	Motor Length B	Pump End Length C	Max. Dia. D	Inlet E	Disch. Pipe Size (NPT) F		
5E8	2	1.25	3	230	26 7/16	13 7/16	12 7/8	3 7/16	3 1/4	1	37	39
10E5	2	1.25	3	230	23 3/8	13 7/16	10 5/16	3 7/16	3 1/4	1 1/4	35	37
16E4	2	1.25	3	230	22 7/8	13 7/16	9 7/16	3 7/16	3 1/4	1 1/4	34	36
25E3	2	1.25	3	230	22	13 7/16	8 7/16	3 7/16	3 1/4	1 1/2	34	36

* Does not include motor leads.

Performance Curves

Redi-Flo4™ Variable Performance Pumps



Materials of Construction

REDI-FLO4 PUMP END

Description	Material
Check Valve Housing, Check Valve, Diffuser Chamber, Impeller, Suction Interconnector, Inlet Screen, Pump Shaft, Straps, Cable Guard, Priming Inducer	304 SS
Check Valve Seat	304 SS & Teflon®
Impeller Seal Ring	Teflon®
Coupling	329/420/431 SS
Intermediate Bearings	Teflon®

GRUNDFOS ENVIRONMENTAL MOTOR

Description	Material
NEMA Flange, Studs & Fasteners, Stator Housing, Fill Plug Screw	304 SS
Nuts	316 SS
Sand Slinger	FPM
Motor Shaft	431 SS
Diaphragm	FPM
Fill Plug Washer	Teflon®

GRUNDFOS ENVIRONMENTAL MOTOR LEADS

Description	Material
Connector Sleeve	304 SS
Connector Potting	Scotch Cast #4® Epoxy w/FPM Cap
Connector Plug	FPM
Lead Insulation	Tefzel (Teflon® Blend)

NOTES: Specifications are subject to change without notice.
Teflon® is a registered trademark of DuPont.
Scotch Cast #4® is a registered trademark of 3M company.

L-SI-TL-104 09/02
PRINTED IN U.S.A.

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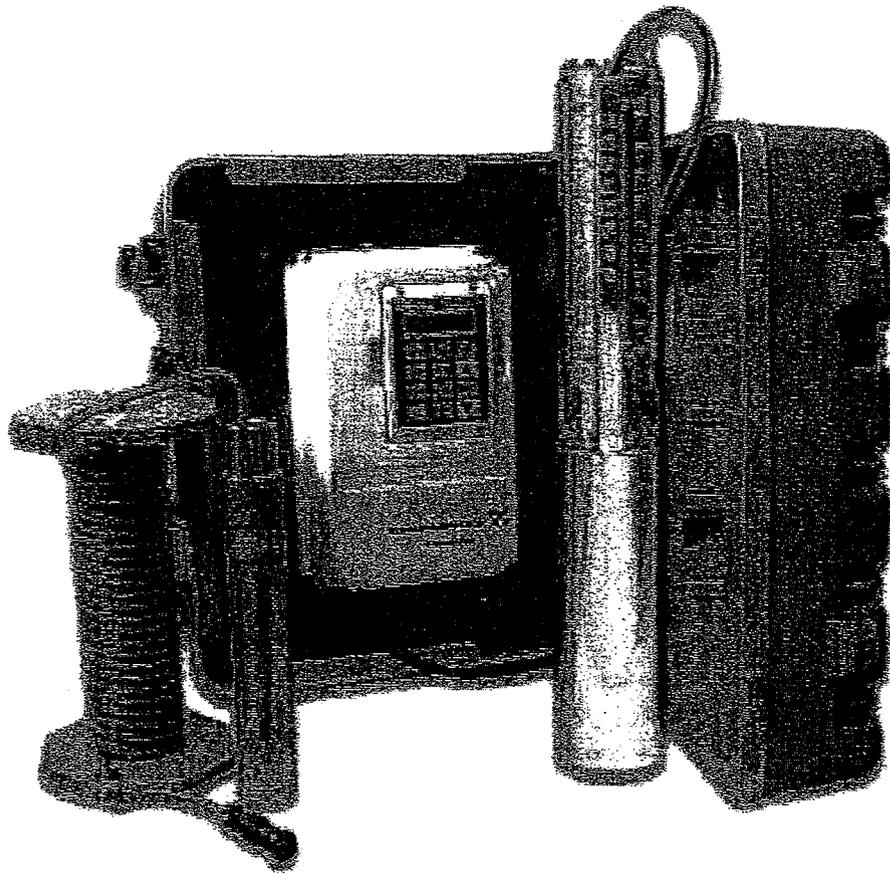
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Telephone: 011-52-81-8144-4000
Fax: 011-52-81-8144-4010

GRUNDFOS

Redi-Flo Variable Frequency Drive

(USA) Installation and operating instructions



SAFETY NOTICE

This equipment contains voltages that may be as great as 1000 volts! Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.

PRECAUTIONS:

-  **WARNING:** Do not touch any circuit board, power device or electrical connection before you first ensure that power has been disconnected and there is no high voltage present from this equipment or other equipment to which it is connected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.

-  **WARNING:** Be sure the system is properly grounded before applying power. Do not apply AC power before you ensure that grounds are connected. Electrical shock can cause serious or fatal injury.

-  **WARNING:** Do not remove cover for at least five (5) minutes after AC power is disconnected to allow capacitors to discharge. Electrical shock can cause serious or fatal injury.

-  **CAUTION:** Disconnect motor leads (T1, T2 and T3) from control before you perform a "Megger" test on the motor. Failure to disconnect motor from the control will result in extensive damage to the control. The control is tested at the factory for high voltage / leakage resistance as part of Underwriter Laboratory requirements.

-  **CAUTION:** Do not connect AC power to the Motor terminals T1, T2 and T3. Connecting AC power to these terminals may result in damage to the control.

QUICK START GUIDE

To operate the Redi-Flo VFD system, simply:

1. Submerge the RF2 or RF4 pump in the water to be pumped.
2. Connect the motor lead to the Redi-Flo VFD. (Note: With RF4 Variable Performance Pumps you must have an adapter cord to connect to Redi-Flo VFD.

#3 and #4 for operation with generator only.

WARNING: Do not let the generator run out of gas while powering the VFD. If it surges and creates excessive voltage, internal VFD damage could result.

3. If using a generator, start the generator and allow it to warm up.
4. If the generator has a circuit breaker, close the breaker and check the output voltage from the generator. The output voltage must be within the specified ranges (refer to Technical Specifications, at the end of this manual) to ensure proper operation and prevent damage to the system. If the voltage is too high or too low, adjustments to the generator must be performed to allow the system to run.
5. Plug the Redi-Flo VFD into a generator or connect to utility power supply. The unit accepts 115V or 230V sources. Refer to the Input Power Terminals section for wiring instructions.

WARNING: Incorrect wiring on the 115V or 230V terminals will damage the drive.

6. The VFD will initialize and be ready to drive the motor. After the initialization screen appears, the following will be displayed:

STP	0V	REDIFL2
LOC	0.0A	0.00HZ

- STP means the drive is stopped
- V indicates motor volts
- REDIFL2 indicates Redi-Flo2 pump mode
- LOC means the drive is in Local Keypad Mode
- A indicates motor amps
- HZ indicates motor frequency

The VFD defaults to Redi-Flo2 operation. To change to Redi-Flo4 press the sequence SHIFT-▼-SHIFT keys. Use sequence SHIFT-▲-SHIFT to return to Redi-Flo2.

7. Press the FWD key to start the motor and use the ▲ and ▼ arrow keys to increase or decrease speed. Continuous holding of the arrow key will increase the rate of speed change. The STOP key is used to stop the motor.
8. Pressing the ENTER key allows the user to quickly set the speed to any given value by using the ▲ and ▼ arrows to change speed and the SHIFT key to cursor between digits.
9. When powering down, unplug the Redi-Flo VFD from the generator BEFORE removing the motor lead from the Redi-Flo VFD or turning off the generator.

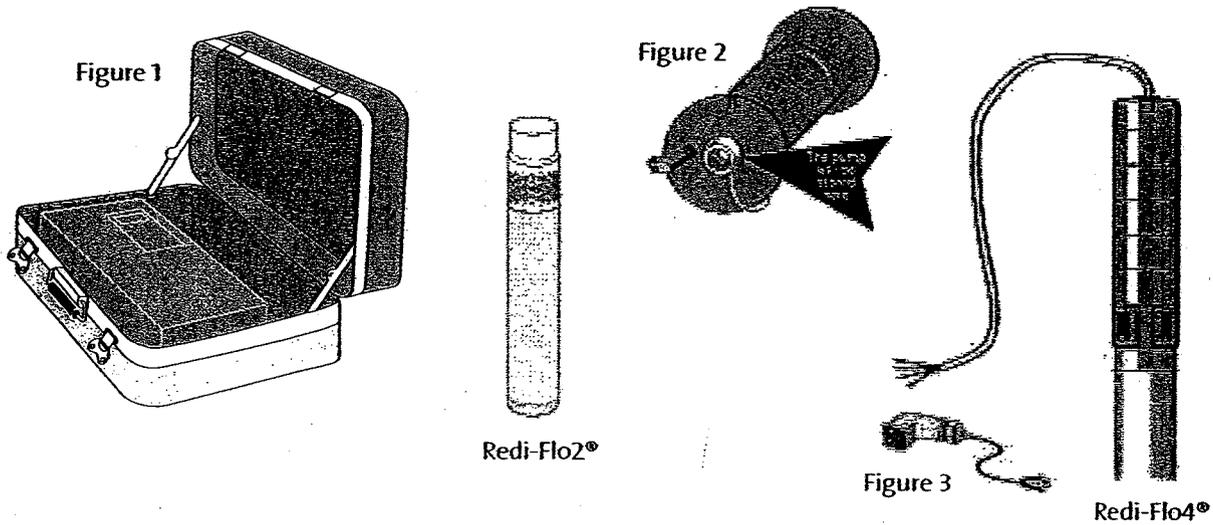
Note: To prevent tripping power source circuit breakers please observe the following: When using the Redi-Flo4 pump and a VFD power source of 115VAC, motor speeds of greater than 70Hz may draw over 15 amps. For 230VAC power source motor speeds greater than 90 Hz may draw over 15 amps. In RediFlo4 mode, 100 Hz cannot be exceeded without changing parameters.

PRE-INSTALLATION CHECKLIST

Components of Your Redi-Flo VFD System

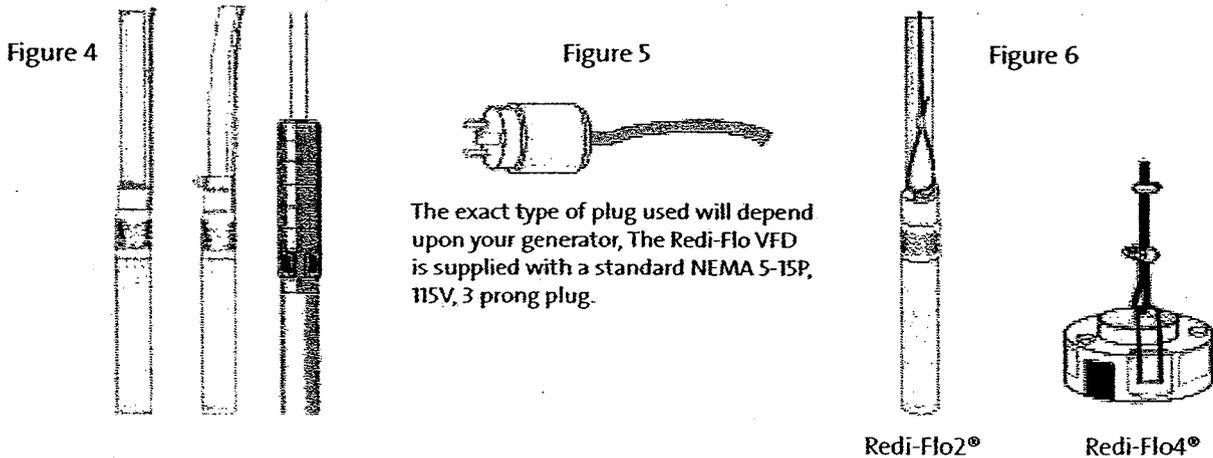
Your Redi-Flo Variable Performance Pump system should contain the following components:

1. Redi-Flo Variable Frequency Drive, (See Figure 1)
2. Either a Redi-Flo2® pump and motor with lead (Figure 2) or a Redi-Flo4™ Variable Performance pump, motor, lead, lead/plug and RF4 x VFD adapter cord (Figure 3).



To operate the system you will also need:

1. A discharge hose or pipe to connect to the pump (See Figure 4).
2. An electrical plug to connect the Redi-Flo VFD power cord to your portable generator may be needed if the supplied plug is not compatible with your generator (See Figure 5).
3. Safety cable and hardware for lowering and lifting the pump (See Figure 6).

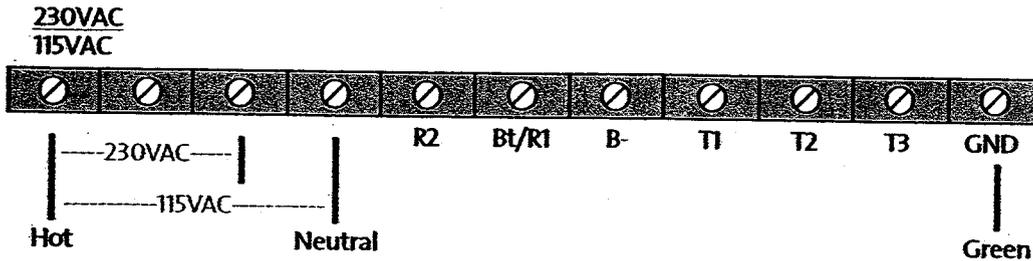


ASSEMBLING THE REDI-FLO VFD SYSTEM

INPUT POWER TERMINALS

The input voltage can be changed between 115V and 230V by changing the line input connections as shown below:

Warning - If the Redi-Flo VFD is miswired for the incoming voltage, internal damage may occur to the drive.



Attaching the Pump to the pipe

When connecting the discharge pipe or tubing to the pump, a back-up wrench should be used. It is recommended that a safety cable be attached to the pump (using special brackets and cables, sold separately) anytime plastic pipe or flexible tubing is used (as shown in figure 6). A check valve may also be added to Redi-Flo2® pumps to prevent fluid from flowing back into the pump after it is turned off (backflow prevention). A check valve is standard on Redi-Flo4™ pumps. Always check to ensure joints are fastened securely. The use of a torque arrestor is not required when using the Redi-Flo VFD.

Lowering the Pump Into the Well

Make sure the electrical motor leads are not cut or damaged in any way when the pump is being lowered into the well. Do not use the motor leads to support the weight of the pump. To protect against surface water entering the well and contaminating the well, the well should be finished off utilizing a locally approved well seal.

The motor lead should be secured to the discharge pipe or tubing at frequent intervals to prevent sagging, looping and possible motor lead damage. Teflon® wire ties are recommended for environmental applications.

IMPORTANT

Plastic pipe and tubing tend to stretch under load. This stretching must be taken into account when securing the motor lead to the riser pipe or tubing. Leave three to four inches of slack between clipped points. This tendency to stretch will also affect the calculation of the pump setting depth. When plastic pipe or tubing is used, it is recommended that a safety cable be attached to the pump to raise and lower it. Redi-Flo4™ pumps are designed to accommodate this cable and Redi-Flo2® pumps can be fitted with a safety cable bracket (part number 1A0019).

ASSEMBLING THE REDI-FLO VFD SYSTEM

OPERATING CONDITIONS

To ensure the Redi-Flo Variable Performance Pumping system operates properly, follow these guidelines:

- The Redi-Flo2® or Redi-Flo4™ pump must be installed vertically with the discharge end pointed upwards.
- The electrical voltage supply to the Redi-Flo VFD must always be within + or - 10% of the specified power supply (103.5 - 126.5 VAC at 115V connection or 207 - 253 VAC at 230V).
- For best performance when operating on a generator, 115V generators should be set at 120V without load and 230V generators should be set at 240V without load. Use a separate meter to set voltage; do not rely on built-in meters found on generators. Verify generator voltage stays within tolerance at full load.
- The pump and motor must always be completely submerged in fluid to ensure lubrication and cooling of the motor.
- The temperature of the fluid being pumped should be according to the technical specifications shown in the motor specifications.
- The installation depth of the pump should always be at least three feet below the maximum drawdown level of the well.
- Redi-Flo pumps are not recommended for well development or pumping fluid containing abrasives.
- Redi-Flo2® pumps are not recommended for continuous operation applications.
- The warranty of the Redi-Flo pumps will be void if other than the Redi-Flo VFD is used or if corrosive fluids are pumped.
- The service life of dedicated Redi-Flo pumps may be compromised if the ambient water quality exceeds one or more of the following values:

pH<5 DO>2 ppm H2S>1 ppm CL->500 ppm TDS>1000 ppm

Adherence To Environmental Regulations

When handling and operating the Redi-Flo Variable Performance Pump system, all environmental regulations concerning the handling of hazardous materials must be observed. When the pump is taken out of operation, great care should be taken to ensure that the pump contains no hazardous materials that might cause injury to human health or to the environment.

Purging A Well

If the pump is used to purge a well, start the pump at minimum speed and gradually increase to desired speed. Redi-Flo products are not recommended for well development.

Generator Usage

Minimum generator size

For generators with voltage regulation
For generators without voltage regulation
Recommended for optimal performance

(Redi-Flo2/Redi-Flo4)

2500/3400 watts at 115/230VAC, single phase
5000/6700 watts at 115/230VAC, single phase
4000/5400 watts at 115/230 VAC, single phase
with voltage regulation

Dual Input Capability

Redi-Flo VFD can accept 115V or 230V single phase input voltage. Refer to the input power terminal section on page 4 for connection instructions.

Enclosure

The Redi-Flo VFD NEMA 4 enclosure is designed for outdoor duty and is resistant to damage as a result of incidental exposure to rain.

UL Approvals

The Redi-Flo VFD is UL Listed to U.S. and Canadian electrical safety standards.

Dual Functionality

The Redi-Flo VFD can change from operating Redi-Flo2® (MP1) to Redi-Flo4™ Variable Performance pumps with a few keystrokes.

Optimized Volts/Frequency (V/Hz) Pattern

The Redi-Flo VFD V/Hz pattern is specially optimized to allow the most efficient operation of Redi-Flo2® and Redi-Flo4™ variable performance pumps.

REDI-FLO VFD KEYPAD OVERVIEW

Overview

The keypad is used to program the control parameters, to operate the motor and to monitor the status and outputs of the control by accessing the display options, diagnostic menus and the fault log.



Indicator Lights

- JOG - (Green) lights when Jog is active.
- FWD - (Green) lights when FWD direction is commanded.
- REV - (Green) lights when REV direction is commanded.
- STOP - (Red) lights when motor STOP is commanded.

Motor Selection - The VFD defaults to Redi-Flo2 operation, to change to Redi-Flo 4, press the key sequence "Shift - ▼ - Shift." Use the sequence "Shift - ▲ - Shift" to return to Redi-Flo2.

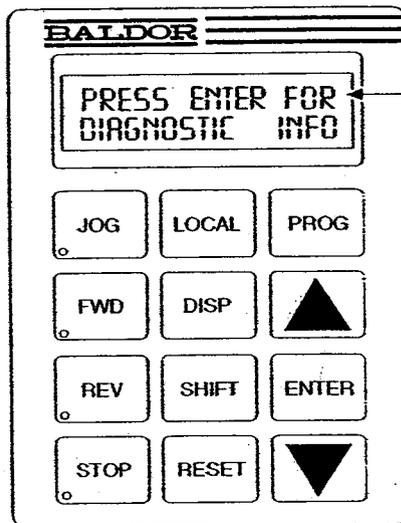
JOG - Press JOG to select the preprogrammed jog speed. After the jog key has been pressed, use the FWD or REV keys to run the motor in the direction that is needed. The JOG key is only active in the local mode.

FWD - Press FWD to initiate forward rotation of the motor. (Active in Local and Jog modes).

REV - Press REV to initiate reverse rotation of the motor. (Active in Local and Jog modes).

STOP - Press STOP to initiate a stop sequence. Depending on the setup of the control, the motor will either regen or coast to a stop. This key is operational in all modes of operation unless it has been disabled by the Keypad Stop parameter in the Keypad (programming) Setup Block.

LOCAL - Press LOCAL to change between the local (keypad) and remote operation.



DISP - Press DISP to return to display mode from programming mode. Provides operational status and advances to the next display menu item.

SHIFT - Press SHIFT in the program mode to control cursor movement. Pressing the SHIFT key once moves the blinking cursor one character position to the right. While in program mode, a parameter value may be reset to the factory preset value by pressing the SHIFT key until the arrow symbols at the far left of the keypad display are flashing, then press an arrow key. In the display mode the SHIFT key is used to adjust the keypad contrast.

RESET - Press RESET to clear all fault messages (in local mode). Can also be used to return to the top of the block programming menu without saving any parameter value changes.

Keypad Display - Displays status information during Local or Remote operation. It also displays information during parameter setup and fault or Diagnostic Information.

PROG - Press PROG to enter the program mode. While in the program mode the PROG key is used to edit a parameter setting.

▲ (UP Arrow)

Press ▲ to change the value of the parameter being displayed. Pressing ▲ increments the value to the next greater value. Also, when the fault log or parameter list is displayed, the ▲ key will scroll upward through the list. In the local mode pressing the ▲ key will increase motor speed to the next greater value.

ENTER - Press ENTER to save parameter value changes and move back to the previous level in the programming menu. In the display mode the ENTER key is used to directly set the local speed reference. It is also used to select other operations when prompted by the keypad display.

▼ (Down Arrow)

Press ▼ to change the value of the parameter being displayed. Pressing ▼ decrements the value to the next lesser value. Also, when the fault log or parameter list is displayed, the ▼ key will scroll downward through the list. In the local mode pressing the ▼ key will decrease motor speed to the next lesser value.

MOTOR CONTROL VIA KEYPAD

The Redi-Flo VFD can operate the motor in three (3) different ways from the keypad.

1. Speed adjustment using the Keypad arrow keys
2. Speed adjustment with Keypad entered values
3. JOG Command

1) Keypad arrow speed control

Press FWD or REV to select desired direction of motor rotation, then press or hold the up arrow key ▲ to increase speed or use the down arrow key ▼ to reduce motor speed. Continuously holding the arrow key will cause the speed to change in larger increments. The minimum speed increment produced by the arrow keys is defined in PROG/Keypad Setup/Keypad Speed INC. Default value of 0.10 Hz can be changed by the user.

2) Keypad speed entered value

Press the ENTER key and use the ▲ and ▼ arrow keys to adjust digits and the SHIFT key to cursor to the desired digit. Press ENTER when finished selecting desired motor speed to return to the display mode. Press the FWD or REV key to run the motor in the desired direction at the programmed speed.

3) JOG Command

The JOG key can be used to ramp the pump up to a predetermined speed in the forward or reverse direction. Press the JOG key then hold the FWD or REV key, and the pump will ramp to the speed set in PROG/Jog Settings/Jog Speed. Acceleration and deceleration times for Jog can also be set in this programming menu.

DISP Key

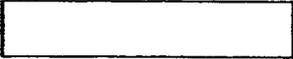
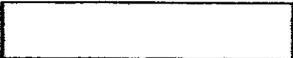
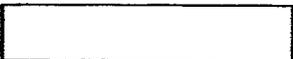
The DISP key can be used for accessing diagnostic and troubleshooting screens as shown below:

Action	Description	Display	Comments
Apply Power	Display mode showing mode, voltage, current & frequency status.	<pre> STP 0V REQ#FLZ LOC 0.0 A 0.0 HZ </pre>	No faults present. Local keypad mode. If in remote mode, press local for this display.
Press DISP key	Scroll to fault log block.	<pre> PRESS ENTER FOR FAULT LOG </pre>	Press ENTER to view the fault log if desired.
Press DISP key	Scroll to diagnostic info block.	<pre> PRESS ENTER FOR DIAGNOSTIC INFO </pre>	Press ENTER to view diagnostic information if desired.
Press DISP key	Scroll to local speed ref. block.	<pre> PRESS ENTER FOR LOCAL SPEED REF </pre>	Press ENTER to change motor speed.
Press DISP key	Display mode showing output frequency.	<pre> STOP FREQUENCY LOCAL 0.00 HZ </pre>	
Press DISP key	Display mode showing motor speed (based on output frequency).	<pre> STOP MOTOR SPEED LOCAL 0 RPM </pre>	
Press DISP key	Display mode showing output current.	<pre> STOP CURRENT OUT LOCAL 0.00 A </pre>	
Press DISP key	Display mode showing output voltage.	<pre> STOP VOLTAGE OUT LOCAL 0 V </pre>	

MOTOR CONTROL VIA KEYPAD

Adjusting Display Contrast

When AC power is applied to the VFD, the keypad should display the status of the unit. If there is no display visible, or if it is difficult to read, use the following procedure to adjust the display. Contrast may be adjusted in the display mode when motor is stopped or running.

Action	Description	Display	Comments
Apply Power	No visible display		
Press DISP Key	Places control in display mode		Display mode.
Press SHIFT key 2 times	Allows display contrast adjustment		
Press ▲ or ▼ Key	Adjusts display intensity	ADJUST CONTRAST ⏏ (ENTER) TO SAVE	
Press ENTER	Saves level of contrast and exits to display mode	STP 0V 0 RPM LOC 0.0 R 0.0 HZ	

Advanced Programming

A password is required for advanced programming features. **Altering some default settings for Redi-Flo2 or Redi-Flo4 could possibly damage the motor or VFD.** For additional programming instructions, please refer to the full programming guide found at the Baldor website: www.Baldor.com The manual can be found under Support — installation and operation manuals. It is Baldor manual number MN715, Series 15H Inverter.

LEVEL 1 BLOCKS		LEVEL 2 BLOCKS	
Preset Speeds	Input	Output Limits	Brake Adjust
Preset Speed #1	Operating Mode	Operating Zone	Resistor Ohms
Preset Speed #2	Command Select	Min Output Frequency	Resistor Watts
Preset Speed #3	ANA CMD Inverse	Max Output Frequency	DC Brake Voltage
Preset Speed #4	ANA CMD Offset	PK Current Limit	DC Brake Frequency
Preset Speed #5	ANA CMD Gain	REGEN Limit	Brake on Stop
Preset Speed #6	CMD SEL Filter	REGEN Limit ADJ	Brake on Reverse
Preset Speed #7	Power Up Mode	PWM Frequency	Stop Brake Time
Preset Speed #8			Brake on Start
Preset Speed #9	Output	Custom Units	Start Brake Time
Preset Speed #10	Digital Out #1	MAX Decimal Places	
Preset Speed #11	Digital Out #2	Value at Speed	Process Control
Preset Speed #12	Digital Out #3	Value DEC Places	Process Feedback
Preset Speed #13	Digital Out #4	Value Speed REF	Process Inverse
Preset Speed #14	Zero SPD Set PT	Units of Measure	Setpoint Source
Preset Speed #15	At Speed Band	Units of MEAS 2	Setpoint Command
	Set Speed Point		Set PT ADJ Limit
Accel / Decel Rate	Analog Out #1	Protection	At Setpoint Band
Accel Time #1	Analog Out #2	External Trip	Process PROP Gain
Decel Time #1	Analog Scale #1	Local Enable INP	Process INT Gain
S-Curve #1	Analog Scale #2		Process DIFF Gain
Accel Time #2	Underload Set Point		Follow I:O Ratio
Decel Time #2		Miscellaneous	Follow I:O Out
S-Curve #2		Restart Auto/Man	Encoder Lines
	V/Hz and Boost	Restart Fault/Hr	Integrator Clamp
	Ctrl Base Frequency	Restart Delay	Minimum Speed
	Torque Boost	Factory Settings	
Jog Settings	Dynamic Boost	Language Select	Skip Frequency
Jog Speed	Slip Comp Adj	STABIL ADJ Limit	Skip Frequency #1
Jog Accel Time	V/Hz Profile	Stability Gain	Skip Band #1
Jog Decel Time	V/Hz 3-PT Volts		Skip Frequency #2
Jog S-Curve	V/Hz 3-PT Frequency	Security Control	Skip Band #2
	Max Output Volts	Security State	Skip Frequency #3
Keypad Setup		Access Timeout	Skip Band #3
Keypad Stop Key		Access Code	
Keypad Stop Mode			Motor Data
Keypad Run Fwd		Motor Voltage	Synchro Starts
Keypad Run Rev		Motor Rated Amps	Synchro Starts
Keypad Jog Fwd		Motor Rated Speed	Sync Start Frequency
Keypad Jog Rev		Motor Rated Frequency	Sync Scan V/F
3 Speed Ramp		Motor Mag Amps	Sync Setup Time
Switch on Fly			Sync Scan Time
LOC. Hot Start			Sync V/F Recover
			Sync Direction
			Communications
			Protocol
			Baud Rate
			Drive Address

TROUBLESHOOTING GUIDE TO ERROR MESSAGES

INDICATION	POSSIBLE CAUSE	CORRECTIVE ACTION
Command Select	Incorrect operating mode programmed.	Change Operating Mode in the Level 1 Input block to one that does not require the expansion board.
	Need expansion board.	Install the correct expansion board for selected operating mode.
Bus Overvoltage Trip or HW Overvoltage	DECEL Rate set too low a value	Lengthen DECEL time. Add external dynamic braking resistors or module.
	Input voltage too high.	Verify proper AC line voltage. Use step down transformer if needed. Use line reactor to minimize spikes.
Bus Undervoltage	Input voltage too low.	Verify proper AC line voltage. Use step up transformer if needed. Check power line disturbances (sags caused by start up of other equipment). Monitor power line fluctuations with date and time imprint to isolate power problem.
External Trip	Motor draws excessive current.	Check motor for overloading. Verify proper sizing of control and motor.
	External trip parameter incorrect.	Verify connection of external trip circuit at J4-16. Set external trip parameter to "OFF" if no connection made at J4-16.
Hardware Protect	Fault duration too short to be identified.	Reset control. Check for proper grounding of power wiring and shielding of signal wiring. Replace control board.
Heatsink Temp	Motor Overloaded.	Correct motor loading. Verify proper sizing of control and motor.
	Ambient temperature too high.	Relocate control to cooler operating area. Add cooling fans or air conditioner to control cabinet.
	Built-in fans are ineffective or inoperative.	Verify fan operation. Remove debris from fan and heatsink surfaces. Replace fan or check fan wiring.

TROUBLE SHOOTING GUIDE (CONT.)

INDICATION	POSSIBLE CAUSE	CORRECTIVE ACTION
HW Desaturation	Accel/Decel rate set too short. Torque Boost set too high. Electrical noise in logic circuits. Motor overloaded.	Lengthen Accel/Decel rate. Reduce torque boost value. Check for proper grounding of power wiring and shielding of signal wiring. Verify proper sizing of control and motor or reduce motor load.
HW Power Supply	Power supply malfunctioned.	Check internal connections. Replace logic power board.
HW Ground Fault	Output current (motor current) leakage to ground.	Disconnect wiring between control and motor. Retry test. If GND FLT is cleared, reconnect motor leads and retry the test. Repair motor if internally shorted. Replace motor lead wire with low capacitance cable. If GND FLT remains, contact your dealer.
Motor Will Not Start	Motor overloaded.	Check for proper motor loading. Check couplings for binding. Verify proper sizing of control and motor.
	Motor may be commanded to run below minimum frequency setting.	Increase speed command or lower minimum frequency setting.
	Incorrect Command Select parameter.	Change Command Select parameter to match wiring at J4.
	Incorrect frequency command.	Verify control is receiving proper command signal at J4.
Motor Will Not Reach Maximum Speed	Max Frequency Limit set too low.	Adjust Max Frequency Limit parameter value.
	Motor overloaded.	Check for mechanical overload. If unloaded motor shaft does not rotate freely, check motor bearings.
	Improper speed command.	Verify control is receiving proper command signal at input terminals. Verify control is set to proper operating mode to receive your speed command.
Motor Will Not Stop Rotation	MIN Output Speed parameter set too high.	Adjust MIN Output Speed parameter value.
	Improper speed command.	Verify control is receiving proper command signal at input terminals. Verify control is set to receive your speed command.
Motor runs rough at low speed	Torque boost set too high.	Adjust torque boost parameter value.
	Misalignment of coupling.	Check motor/load coupling alignment.
	Faulty motor.	Replace with a new motor.

TROUBLE SHOOTING GUIDE (CONT.)

INDICATION	POSSIBLE CAUSE	CORRECTIVE ACTION
New Base ID	Replaced Control or circuit board.	Restore parameters to factory settings. Reset control.
No Display	Lack of input voltage.	Check input power for proper voltage.
	Loose connections.	Check input power termination. Verify connection of operator keypad.
	Adjust display contrast.	See Adjust Display Contrast.
NV Memory Fail	Memory fault occurred.	Press "RESET" key on keypad. Restore parameter values to factory settings. If fault remains, call dealer.
3 Sec Overload	Peak output current exceeded 3 sec rating.	Check PK Current Limit parameter in the Level 2 Output Limits block. Check motor for overloading. Increase ACCEL time. Reduce motor load. Verify proper sizing of control and motor.
1 Min Overload	Peak output current exceeded 1 minute rating.	Check PK Current Limit parameter in the Level 2 Output Limits block. Check motor for overloading. Increase ACCEL/DECCEL times. Reduce motor load. Verify proper sizing of control and motor.
Over Speed	Motor exceeded 110% of MAX Output Freq parameter value.	Check Max Output Freq in the Level 2 Output Limits block.
Param Checksum	Memory fault occurred.	Press "RESET" key on keypad. Restore parameter values to factory settings. If fault remains, call dealer.
Unknown Fault Code	Microprocessor detected a fault that is not defined in the fault code table.	Press "RESET" key on keypad. Restore parameter values to factory settings. If fault remains, call dealer.
Unstable Speed	Oscillating load. Unstable input power. Slip compensation too high.	Correct motor load. Correct input power. Adjust slip compensation.
uP Reset	A software watchdog timer has reset the processor because a process has timed out.	Press "RESET" key on keypad. If fault remains, call dealer.
FLT Log MEM Fail	Corrupt data in fault log (may occur on older systems only).	Press "RESET" key on keypad. If fault remains, call dealer.
Current SENS FLT	Failure to sense phase current.	Press "RESET" key on keypad. If fault remains, call dealer.
Bus Current SENS	Failure to sense bus current.	Press "RESET" key on keypad. If fault remains, call dealer.

HOW TO ACCESS DIAGNOSTIC INFORMATION

Action	Description	Display	Comments
Apply Power			
	Display mode showing Local mode voltage, current & frequency status.	<pre> STP 0V RED:FL2 LOC 0.0 A 0.0 HZ </pre>	No faults present. Local keypad mode. If in remote/serial mode, press local for this display.
Press DISP key	Scroll to fault log block.	<pre> PRESS ENTER FOR FAULT LOG </pre>	Press ENTER to view the fault log if desired.
Press DISP key	Scroll to diagnostic info block.	<pre> PRESS ENTER FOR DIAGNOSTIC INFO </pre>	Press ENTER to view diagnostic information if desired.
Press ENTER key	Access diagnostic information.	<pre> STOP FREQ REF LOCAL 2.00 HZ </pre>	
Press DISP key	Display mode showing control temperature.	<pre> STOP CONTROL TEMP LOCAL 25.0° C </pre>	Displays operating temperature in degrees C.
Press DISP key	Display mode showing bus voltage.	<pre> STOP BUS VOLTAGE LOCAL 321V </pre>	
Press DISP key	Display mode showing bus Current.	<pre> STOP BUS CURRENT LOCAL 0.00A </pre>	
Press DISP key	Display mode showing PWM Frequency.	<pre> STOP PWM FREQ LOCAL 2497 HZ </pre>	
Press DISP key	Display mode showing % overload current remaining.	<pre> STOP OVRLO LEFT LOCAL 100.00% </pre>	
Press DISP key	Display mode showing real time opto inputs & outputs states. (0=Open, 1=Closed)	<pre> DIGITAL I/O 00000000 1110 </pre>	Opto Inputs states (Left); Opto Outputs states (Right).
Press DISP key	Display mode showing actual drive running time since the Fault log was cleared.	<pre> TIME FROM PUR UP 000000.01.43 </pre>	HR.MIN.SEC format.
Press DISP key	Display operating zone with rated hp and input voltage (for the operating zone) and control type.	<pre> 1 HP STD CT 230V INVERTER </pre>	
Press DISP key	Display mode showing continuous amps; PK amps rating; amps/volt scale of feedback, power base ID.	<pre> XXA XXAPK XXA/V ID:XXX </pre>	
Press DISP key	Display mode showing which Group1 or 2 expansion boards are installed.	<pre> I NOT INSTALLED II NOT INSTALLED </pre>	
Press DISP key	Display mode showing software version and revision installed in the control.	<pre> SOFTWARE VERSION XXX-X.XX </pre>	
Press DISP key	Displays exit choice. Press ENTER to exit.	<pre> PRESS ENTER FOR DIAGNOSTIC EXIT </pre>	Press ENTER to exit diagnostic information.

HOW TO ACCESS THE FAULT LOG

When a fault condition occurs, motor operation stops and a fault code is displayed on the Keypad display. The control keeps a log of the last 31 faults. If more than 31 faults have occurred, the oldest fault will be deleted from the fault log. To access the fault log, perform the following procedure:

Action	Description	Display	Comments
Apply Power	Display mode showing Local mode voltage, current & frequency status.	<pre>STP 0V RE:FL2 LOC 0.0 A 0.0 HZ</pre>	No faults present. Local keypad mode. If in remote/serial mode, press local for this display.
Press DISP key	Press DISP to scroll to the Fault Log entry point.	<pre>PRESS ENTER FOR FAULT LOG</pre>	
Press ENTER key	Display first fault type and time fault occurred.	<pre>EXTERNAL TRIP T: 0:00:30</pre>	Typical display.
Press ▲ key	Scroll through fault messages.	<pre>PRESS ENTER FOR FAULT LOG EXIT</pre>	If no messages, the fault log exit choice is displayed.
Press RESET key	Return to display mode.	<pre>STOP FREQUENCY LOCAL 0.00 HZ</pre>	Display mode stop key LED is on.

How to Clear the Fault Log Use the following procedure to clear the fault log.

Action	Description	Display	Comments
Apply Power	Display mode showing Local mode voltage, current & frequency status.	<pre>STP 0V RE:FL2 LOC 0.0 A 0.0 HZ</pre>	Display mode.
Press DISP key	Press DISP to scroll to the Fault Log entry point.	<pre>PRESS ENTER FOR FAULT LOG</pre>	
Press ENTER key	Displays most recent message.	<pre>EXTERNAL TRIP T: 00000:00:30</pre>	
Press SHIFT key		<pre>EXTERNAL TRIP T: 00000:00:30</pre>	
Press RESET key		<pre>EXTERNAL TRIP T: 00000:00:30</pre>	
Press SHIFT key		<pre>EXTERNAL TRIP T: 00000:00:30</pre>	
Press ENTER key	Fault log is cleared.	<pre>FAULT LOG NO FAULTS</pre>	No faults in fault log.
Press ▲ or ▼ key	Scroll Fault Log Exit.	<pre>PRESS ENTER FOR FAULT LOG EXIT</pre>	
Press ENTER key	Return to display mode.	<pre>PRESS ENTER FOR DIAGNOSTIC INFO</pre>	

FAULT MESSAGES

FAULT MESSAGE	DESCRIPTION
Invalid Base ID	Failure to determine control horsepower and input voltage configuration from the Power Base ID value in software.
NV Memory Fail	Failure to read or write to non-volatile memory.
Param Checksum	Parameter Checksum error detected.
Low INIT Bus V	Low bus voltage detected on startup.
HW Desaturation	High output current condition detected (greater than 400% of rated output current). On B2 size controls, a desat error can indicate any of the following: low line impedance, brake transistor failure or internal output transistor overtemperature.
HW Surge Current	High output current condition detected (greater than 250% of rated output current).
HW Ground Fault	Ground Fault detected (output current leakage to ground).
HW Power Supply	Control Board power supply failure detected.
Hardware Protect	A general hardware fault was detected but cannot be isolated.
1 MIN Overload	Peak output current exceeded the 1 minute rating value.
3 SEC Overload	Peak output current exceeded the 3 second rating value.
Overcurrent	Continuous current limit exceeded.
BUS Overvoltage	High DC Bus voltage.
Bus Undervoltage	Low DC Bus voltage condition detected.
Heat Sink Temp	Control heatsink exceeded upper temperature limit. For size B2 controls, this fault may indicate the main heatsink or the gate drive circuit board is too hot.
External Trip	Connection between J4-16 and J4-17 is open.
New Base ID	Control board detected a change in the Power Base ID value in software.
REGEN RES Power	Excessive power dissipation required by Dynamic Brake Hardware.
Line REGEN	Fault in Line REGEN converter unit - Series 21H Line REGEN Inverter control.
EXB Selection	Expansion board not installed to support the selected Level 1 Input Block, Command Select parameter.
Torque Proving	Unbalanced current in the three phase motor leads.
Unknown FLT Code	Microprocessor detected a fault that is not identified in the fault code table.
µP RESET	A software watchdog timer has reset the processor because a process has timed out.
FLT Log MEM Fail	Corrupt data in fault log (may occur on older systems only).
Current SENS FLT	Failure to sense phase current.
Bus Current SENS	Failure to sense bus current.

TECHNICAL SPECIFICATIONS

DESCRIPTION	RF2	RF4
Part I	Rated Power & Markings	
Input Voltage	1 X 115V +/- 10% or 1 X 230V +/- 10%	
	Single Phase Input	
Output Voltage	3 X 220V	3 X 230V
Continuous Output Current (230V input)	6.05A	8.25A
Continuous Output Current (115V input)	6.05A	6.50A
Part II	Fundamental Parameters	
Control System	PWM	
Output Voltage	Clamp @ 220V	Clamp @ 230V
Carrier Freq.	Selectable: 1-5 KHz	
Freq. Resolution	0.1Hz*	
Input Freq. Range	48 – 62 Hz	
Maximum Output Frequency(230V input)	400 Hz	100 Hz
Maximum Output Frequency(115V input)	400 Hz	80 Hz
Base Frequency	400 Hz	100 Hz
Torque Boost	0 – 15% Nominal Voltage	
V/F Pattern	Selectable Linear/Square Law	
Accel Time	0.5 – 3600 Seconds	
Decel Time	0.5 – 3600 seconds	
Accel/Decel Pattern	Linear	
Part III	Protective Functions	
Ground Fault	Ground Fault detection for Equipment Protection	
Overcurrent	Output Short Circuit Locked Rotor	
Over Voltage	400VDC	
Under Voltage	200VDC	
Motor Overload	I ² x T Characteristic	
Line Start Lock Out	VFD will not start upon input power application	
Line Transient Rating	860 VAV, 810J MOV Between any power input terminal & Ground 360 VAC, 380 J MOV Between any two power input terminals	
Part IV	Ambient Operating Conditions	
Operating Temp.	-10 to 40 degree C	
Storage Temp.	-30 to 65 degree C	
Vibration	0.5G, Max / 57-150 Hz	
Elevation	3300 ft. without derating	
Max source fault current	5 Kamps	
Enclosure rating	UL Type 4, No Direct Sunlight	

WARRANTY SERVICE

The Redi-Flo VFD is covered by the original equipment manufacturers warranty for a period of 24 months. To obtain warranty services, contact the distributor or dealer from which it was purchased to obtain instructions. Under no circumstances should defective product be returned to the distributor, dealer, or GRUNDFOS without a return materials authorization (RMA).

SERVICE PARTS

Only four repair parts are available, the carrying case, the keypad, power cord and Harting motor connection. Contact the dealer from which the unit was purchased for these parts.

BE > THINK > INNOVATE >

Being responsible is our foundation
Thinking ahead makes it possible
Innovation is the essence

L-RF-IO-009 Rev. 06/02

Printed in the U.S.A.

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