OPERATION & MAINTENANCE MANUAL
Soil-Vapor Extraction/Air Sparge System

Dresses For Less Site
100 Commercial Street
Plainview, New York

Prepared for:

Laurel Environmental Associates., Ltd.
3 Lyn Court
Huntington, New York 11743-2999

November 1999

Prepared by:

EnviroTrac Ltd.
561 P Acorn Street
Deer Park, NY 11729

A Full Service Environmental Consulting and Contracting Firm

EnviroTrac

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PREFACE

The following manual contains information required to operate, maintain and troubleshoot the Soil-Vapor Extraction/Air Sparge (SVE/AS) System installed at 100 Commercial Street, Plainview, NY (site). Included are complete equipment specifications, detailed system layout drawings and Process and Instrumentation Diagrams. Also included are installation and maintenance documentation provided by manufacturers for specific system components.

For technical assistance and support services, EnviroTrac can be contacted at:

EnviroTrac Ltd.
561 P Acorn Street
Deer Park, NY 11729
(516) 586-1800 FAX: (516) 586-1879
24-hour Emergency Hotline: (516) 807-8976

CAUTION: This system includes equipment components that are potentially hazardous and must be operated and maintained in accordance with procedures outlined in this manual and its appendices. Failure to do so could lead to personal injury or equipment damage.

1.0 SYSTEM DESCRIPTION

1.1 Background

The site is located at 100 Commercial Street in Plainview, New York. Investigations have detected solvents in ground water. As a result, a soil vapor extraction/air sparge system to treat ground water contamination was selected as a remedial action.

1.2 Theory of Operation

Soil Vapor Extraction (SVE) technology consists of applying a vacuum to soils to induce vapor flow, thereby causing "stripping" (volatilization) of volatile organic compounds (VOCs). Stripped VOCs are carried within a vapor stream to a point above ground where they are treated or discharged directly into the atmosphere depending on regulatory emission limits.

An air sparge (AS) system consists of an air sparge blower or compressor which delivers (through piping) a clean source of air from above ground to particular "sparge points" in an aquifer. The compressed air then bubbles and diffuses with the formation water causing volatilization and enhancing biodegradation of VOCs. Air Sparging is typically used in conjunction with SVE.

1.3 System Layout

1.3.1 Soil-Vapor Extraction/Air Sparge Wells

EnviroTrac was not responsible in the construction of the SVE/AS wells. A total of nine (9) SVE wells and five (5) AS wells comprise the system.

1.3.2 Subsurface Piping Layout

The SVE/AS system includes a total of 9 soil vapor extraction points, 5 air sparge points,

and associated lines. Each wellhead is retrofitted with a bolt down observation well manhole and connected to individual 1½ inch or 2 inch diameter Schedule 80 PVC piping that was trenched and installed approximately 18-24 inches below grade. Trenches were backfilled and compacted using excavated materials and clean sand. A total of 14 lines were piped to the fenced remediation enclosure that houses the vacuum blower, air sparge blower, and associated equipment and controls. The trenching and piping layout is provided in Figure 1. Note that an additional SVE point was installed within the onsite soil stockpile and connected to the system via one of the SVE lines; therefore, not individually piped back to the equipment compound area.

1.3.3 System Manifolding and Controls

A. Soil Vapor Extraction (SVE)

A total of 9 SVE lines were manifolded within the system shed using 2" flexible hose and 2" Schedule 80 PVC. Each extraction line has a valve for the regulation of flow and a vacuum gauge. All of the system lines have been manifolded and connected to a vapor/water separator and particle filters before entering the extraction blower. An inlet air valve was added to the manifold to allow for vapor stream dilution. The system manifold allows for extraction from any combination of extraction points.

B. Air Sparge (AS)

After being compressed, warm air is cooled by an "air cooled aftercooler". From that point it will be delivered to the manifold. The manifold consists of 5 AS lines constructed of 1½" flexible tubing and 1½" Schedule 80 PVC. Each sparge line has a pressure gauge and a ball valve to control flow to each sparge point.

1.4 System Components

The SVE/AS system is designed for continuous operation. The system includes all the necessary instrumentation and controls for monitoring. A System Detail Plan is presented in Figure 1 and includes subsurface piping layout, equipment shed details, and Process &

Instrumentation Design diagrams.

1.4.1 SVE Blower and Associated Equipment

The SVE system design includes the use of a number of components. The main component is one (1) 5.5-hp regenerative blower. The extraction blower used is model R6P155Q-50, manufactured by GAST Manufacturing, Benton Harbor, MI. There is also a vapor/water separator equipped with a high water float that will shut down the system in the event of a full separator. The blower is fitted with a vacuum gauge and flowmeter as well as a vacuum relief valve and an in-line particle filter. The manufacturer specifications, including operation and maintenance manuals are provided in Appendix A.

1.4.2 Sparge Blower and Associated Equipment

The AS system includes the use of one (1) 6-hp regenerative sparge blower. The blower used is model R4H3060A, manufactured by GAST Manufacturing, Benton Harbor, MI. The air cooler used in conjunction with the sparge blower is manufactured by Thermal Transfer Products. A pressure gauge, in-line particle filter, flowmeters, and pressure relief valves have been provided for monitoring and safety reasons. Technical Information regarding this equipment can be found in Appendix B.

1.4.3 Gauges, Indicator Lights, and Switches

Each SVE line was provided with a 0 to 100 "H_2O vacuum gauge. To evaluate the blower performance a 0-100 "H_2O vacuum gauge was placed at the blower inlet.

The AS system has a system pressure gauge and individual sparge point pressure gauges. All pressures gauges have a minimum range of 0-30 psi.

The following is a brief description of the various indicator lights and switches:

The unit is equipped with a series of pilot lights and operational switches indicating the status of the system. All pilot lights and operational switches are clearly labeled on the

control panel. The sparge operational switch controls the sparge blower. The SVE operational switch controls the SVE blower. Both the sparge and SVE operational switches can override all alarms with the exception of the thermal. Turning these switches to the right will place the blowers in automatic mode. Turning these switches to the left will place the blowers in hand operated mode for testing purposes only. The blowers will be turned off when switches are in the center position. The central switch is used to test the lights (turn towards the left) and to reset the high knock-out drum condition (turn towards the right).

The following is a brief description of the various indicator lights:

SVE Not Ready, Yellow.	Illuminates when there is an SVE system start-up delay or a fault condition.
Sparge Not Ready, Yellow.	Illuminates when there is a sparge system start-up delay or a fault condition.
SVE Run, Green.	Illuminates when the SVE blower is running.
Sparge Run, Green.	Illuminates when the sparge blower is running.
SVE Thermal, Red.	Illuminates when there is an electrical overload in the SVE blower motor.
Sparge Thermal, Red.	Illuminates when there is an electrical overload in the sparge blower motor.
Sparge High Temp, Red.*	Illuminates when the air temperature from the AS system has exceeded the set limit. May indicate a possible air cooler failure. Sparge blower will shut down.

High SVE KO, Blue. Illuminates when a high water level is reached in the moisture separator drum. The SVE blower will shut down.

* - The air temperature switch is a dual set-point switch. This allows a high temperature shut-off point and a low temperature turn on point to be set for the AS blower. **PLEASE NOTE, IF THE SPARGE BLOWER SHUTS DOWN DUE TO A HIGH TEMPERATURE SITUATION, IT MAY AUTOMATICALLY RE-START WITHOUT NOTICE.**

1.4.4 Off-Gas Treatment

If necessary, air emission treatment consists of one air purification canister (activated carbon). The canister is supplied by Carbtrol Corporation, Westport, CT. Carbtrol Model G-2 consists of a 24-inch wide by 36-inch high steel drum with 170 pounds of vapor phase activated carbon (Appendix C). The maximum flow rate for the canisters is 300 cubic feet per minute (cfm).

2.0 SYSTEM MAINTENANCE

2.1 SVE Blower and Associated Equipment

SVE Blower: No maintenance required (refer to Appendix A).

Filter: In-line particle filters should be inspected monthly and if debris and particulates are observed the filters should be cleaned. **CAUTION:** system must be shutdown prior to filter inspection/cleaning.

Moisture Separator: Moisture separator requires no maintenance. Liquids that may accumulate within the separator should be monitored during monthly visits. If sufficient liquids do accumulate then the separator must be drained. This is performed by opening the drain valve located at the base of the separator. **CAUTION:** system must be shutdown

prior to draining the separator.

Vacuum Relief Valve: Valve should be checked regularly to ensure all internal mechanical components are moving freely.

2.2 Sparge Blower and Associated Equipment

Sparge Blower: Routine maintenance required (refer to Appendix B).

Filter: Particle filters should be inspected monthly and if debris and particulates are observed the filters should be cleaned. **CAUTION:** system must be shutdown prior to filter inspection/cleaning.

2.3 Off-Gas Treatment

Carbon units require no maintenance. Spent carbon canisters will be managed depending on waste classification. Spent canisters will be properly labeled and removed from the site following all applicable federal and state regulations. **CAUTION:** system must be shutdown prior to removing units.

3.0 SYSTEM TROUBLESHOOTING

3.1 SVE System and Components

Refer to Appendix A.

3.2 AS System and Components

Refer to Appendix B.

3.3 Off-Gas Treatment

Refer to Appendix C.

STANDARD EQUIPMENT LIMITED WARRANTY

All references to the Customer herein shall mean the Customer or the Lessee as applicable.

(a) EnviroTrac Ltd. warrants that any Equipment they provide will be free from substantial defects in material and workmanship under normal use for a period of one (1) year from the date such goods are delivered to the Customer.

(b) This warranty extends only to the original purchaser of the equipment and shall be void if the product is repaired, modified, or tampered with in any manner by any person other than EnviroTrac's authorized service personnel.

(c) If inspection does not disclose any defect covered by the warranty, the equipment will be returned to the Customer at its expense or, if the Customer elects, repaired or replaced at prevailing service rates.

(d) The operating efficiency of treatment, abatement and recovery equipment and systems is affected by factors extrinsic to their manufacture, including operating environment and such conditions of use as contaminant and related substance build-up, the frequency and type of operator maintenance and other external variables. For these reasons, specific levels of performance cannot be guaranteed for such equipment and systems.

(e) **THIS WARRANTY IS THE SOLE WARRANTY MADE BY ENVIROTRAC TO THE CUSTOMER AND IS IN LIEU OF ALL OTHER WARRANTIES OR OBLIGATIONS, EXPRESSED OR IMPLIED. ENVIROTRAC EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES OR MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE.**

(f) **THE CUSTOMER AGREES THAT IN NO EVENT SHALL ENVIROTRAC BE LIABLE FOR SPECIAL, INCIDENTAL, INDIRECT, EXEMPLARY OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF PROFITS OR LOSS OF USE OR ANY OTHER ECONOMIC LOSS, WHETHER BASED ON CONTRACT, TORT,OR ANY OTHER LEGAL THEORY.**

(g) **THE REMEDIES PROVIDED HEREIN ARE CUSTOMER'S SOLE AND EXCLUSIVE REMEDIES.**

Appendix A

Blowers and Associated Equipment

Gast Regenair® Blower Specifications

Practical Design

Gast Regenair® regenerative blowers are rugged industrial grade blowers, engineered for continuous long-life operation. Maintenance free, their only contacting moving parts are the shaft seal and motor ball bearings. Sealed air streams mean air and vapors passing through the blower do not become contaminated.

Rugged Construction

Blower impeller, housing and cover are made of cast aluminum which is inherently ductile and spark- and corrosion-resistant. Exterior castings are vacuum impregnated with a process conforming to Mil Spec. 17563B to eliminate porosity. The fluorocarbon blower shaft seal is lubricated with chemical resistant non-hydrocarbon grease for long life. The rotating mechanism of the blower and motor is dynamically balanced to prevent vibration. Every Gast Regenair® blower is performance tested as well as pressurized and leak-tested to less than 5 cc/minute.

Dependable Electric Motors

UL and CSA approved motors are multi voltage; most are dual frequency. Conforming to NEMA frame sizes, Gast motors are classified as EXPLOSION PROOF Division 1 and 2, Class 1, for Group D hazardous atmospheres. They are rated for continuous duty and carry full rated load at temperatures below class B motor insulation limits. Class F motor insulation is used in motors larger than 1 HP even though they operate at temperatures below class B insulation limits. All motors incorporate UL and CSA approved thermal protection.

Motor ball bearings are double sealed, with a B10 life exceeding 20,000 hours of continuous operation at the maximum rated continuous blower load. This extended bearing life is achieved by designing the blower and motor so bearings run cool, avoiding problems associated with high temperature bearing operation. Shell Dolium R, a long-life grease with a wide operating-temperature capacity and superior resistance to both contaminants and moisture, is the specified lubricant.

Pilot duty thermal overload protection is standard on all 1 HP and larger explosionproof motors. To conform to the National Electric Code, motor starters suitable for protecting motors with pilot duty thermal overloads must be used.

ISO 9001 GAST CERTIFIED

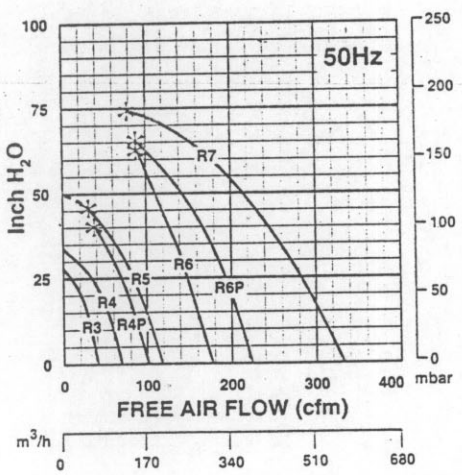
SOIL VAPOR EXTRACTION PUMPS – REGENERATIVE BLOWERS

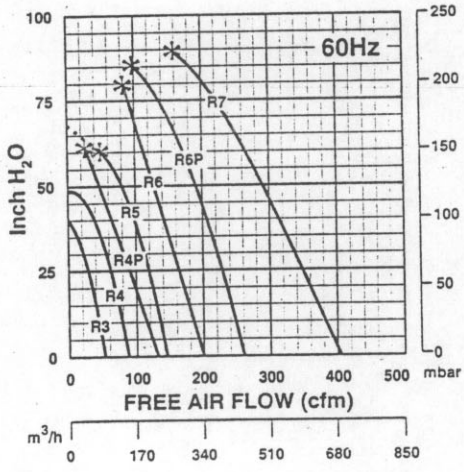
Product Specifications

Model Number	Phase	Hz	Motor Specifications Voltages	HP	Full Load Amps	Max Vac "H_2O	Max Vac mbar	Max Pressure "H_2O	Max Pressure mbar	Max Flow cfm	Max Flow m^3h	Net. Wt. lbs	Net. Wt. kg
R3105N-50	Single	50	110/220-240	.33	3-8/1.9-2.0	28	70	31	77	43	73	52	24
		60	115/208-230	0.5	5.2/2.9-2.6	40	100	43	107	53	90		
R4110N-50	Single	50	110/220-240	0.6	9.2/5.2-4.6	35	87	38	95	74	126	60	28
		60	115/208-230	1.0	11.4/6.2-5.6	48	120	51	127	92	156		
R4310P-50	Three	50	220/380	0.6	3.2/1.6	35	87	38	95	74	126	58	27
		60	208-230/460	1.0	3.4-3.3/1.65	48	120	51	127	92	156		
R4P115N-50	Single	50	110/220-240	1.0	15.2/7.6-8	40	100	45	112	112	190	79	36
		60	115/208-230	1.5	18.2/9.7-9.1	60	149	65	162	133	226		
R5125Q-50	Single	60	115/230	2.0	25/12.5	60	149	55	137	160	272	77	35
R5325R-50	Three	50	190-220/380-415	1.5	5.0-4.4/2.5-2.6	47	117	50	125	133	226	75	34
		60	208-230/460	2.0	6.0-5.6/2.8	60	149	65	162	160	272		
R6130Q-50	Single	50	220-240	2.5	14.7-13.5	65	162	75	187	182	309	129	59
		60	230	3.0	16.3	70	174	60	149	215	365		
R6340R-50	Three	50	190-220/380-415	3.0	14.4-13.4/7.2-6.8	65	162	75	187	180	306	112	51
		60	208-230/460	4.0	13-12/6	80	199	100	249	215	365		
→ R6P155Q-50	Single →	50	220-240	4.0	20.8-19.1	65	162	80	199	235	399	243	110
		60	230	5.5	29.9	85	212	95	237	280	476		
R6P355R-50	Three	50	190-220/380-415	4.5	14.9-11/7.45-5.8	65	162	80	199	232	394	233	105
		60	208-230/460	6.0	20-18/9	85	212	100	249	280	476		
R7100R-50	Three	50	190-220/380-415	8.0	20.8-18.9/10.4-9.5	72	179	80	199	350	595	297	134
		60	208-230/460	10.0	26.5-24/12	90	224	90	224	420	714		

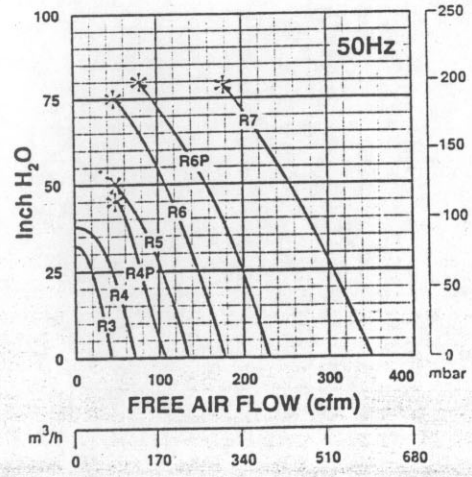
NOTICE: Performance specifications subject to change without notice.

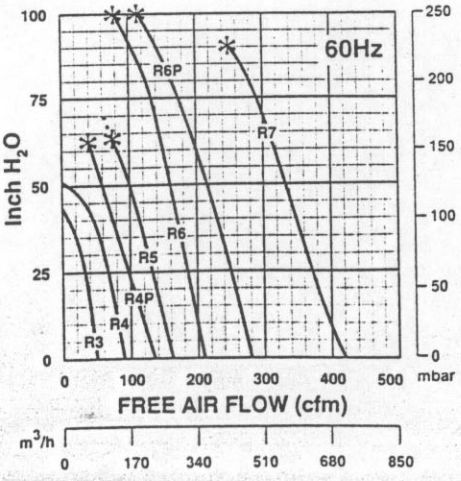
VACUUM





PRESSURE





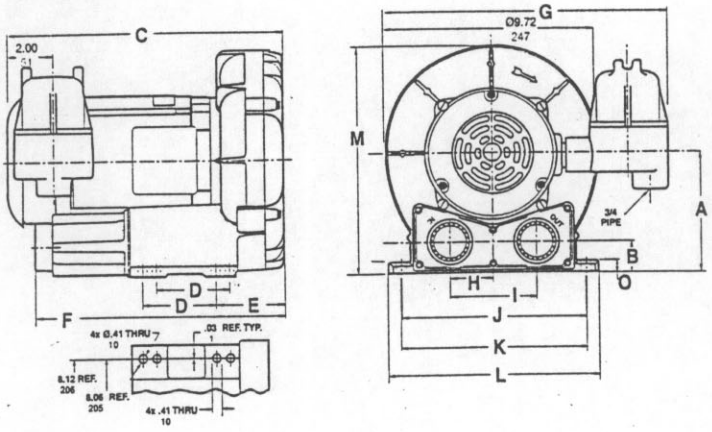
Free software identifies best Gast blowers for soil and groundwater remediation

Now you can size and select regenerative blowers and accessories for soil and groundwater remediation systems faster, easier and more accurately than ever before. Gast remediation system engineering software does the job and it is yours for the asking. The 3-½-inch IBM-compatible disk calculates performance when the blower is operating with both a vacuum and pressure load at the same time. The programs will also compensate for changes in performance from altitude and temperature, helping you identify the optimum Gast blowers for your application.

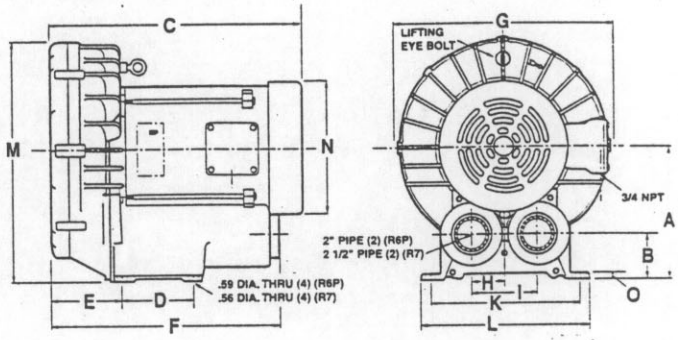
Call 1-800-952-4278 to receive your free remediation system engineering software.

SOIL VAPOR EXTRACTION PUMPS – REGENERATIVE BLOWERS

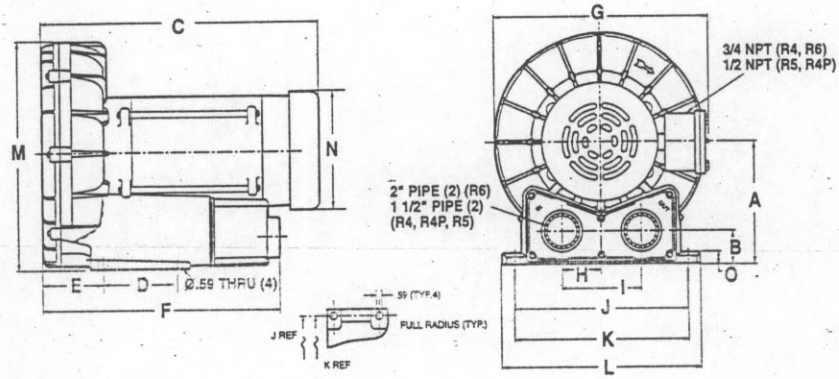
Model R3



Models R6P, R7



Models R4, R4P, R5, R6



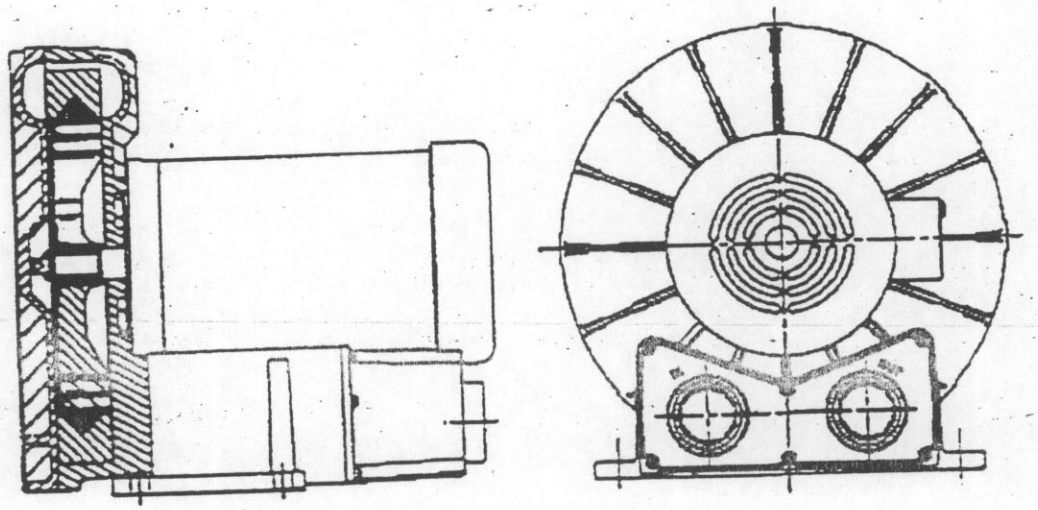
Product Dimensions Metric (mm) U.S. Imperial (inches)

Model	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
R3105N-50	131	35	310	83	80	281	324	49	99	205	206	238	258	-	13
	5.17	1.37	12.20	3.25	3.03	11.06	12.75	1.94	3.88	8.06	8.12	9.38	10.15	-	.53
R4110N-50	157	43	389	95	72	316	313	50	101	225	227	254	293	175	11
	6.18	1.68	15.30	3.75	2.85	12.44	12.31	1.98	3.96	8.86	8.93	10.00	11.73	6.88	.44
R4310P-50	157	43	356	95	72	316	313	50	101	225	227	254	293	175	11
	6.18	1.68	14.03	3.75	2.84	12.44	12.31	1.98	3.96	8.86	8.93	10.00	11.73	6.88	.44
R4P115N-50	177	47	442	114	83	354	338	60	121	260	262	298	346	175	15
	6.98	1.84	17.41	4.50	3.25	13.93	13.31	2.38	4.75	10.25	10.31	11.75	13.6	6.88	.60
R5125Q-50	178	46	445	114	91	361	344	60	121	260	262	298	350	173	15
	7.00	1.82	17.50	4.50	3.58	14.22	13.56	2.38	4.75	10.25	10.31	11.75	13.78	6.81	.59
R5325R-50	178	46	423	114	91	361	344	60	121	260	262	298	350	183	15
	7.00	1.82	16.66	4.50	3.58	14.22	13.56	2.38	4.75	10.25	10.31	11.75	13.78	7.19	.59
R6130Q-50	197	49	511	140	98	404	389	62	125	289	290	329	391	217	13
	7.75	1.94	20.13	5.50	3.85	15.89	15.30	2.46	4.92	11.38	11.42	12.96	15.38	8.56	.52
R6340R-50	197	49	478	140	98	404	385	62	125	289	290	329	390	217	13
	7.75	1.94	18.82	5.50	3.85	15.89	15.17	2.46	4.92	11.38	11.42	12.96	15.34	8.56	.52
R6P155Q-50	248	80	602	140	137	438	428	64	127	-	290	325	463	257	13
	9.77	3.15	23.7	5.51	5.39	17.25	16.87	2.50	5.00	-	11.42	12.80	18.21	10.12	.50
R6P355R-50	248	80	554	140	137	438	428	64	127	-	290	325	463	257	13
	9.77	3.15	21.80	5.51	5.39	17.25	16.87	2.50	5.00	-	11.42	12.80	18.21	10.12	.50
R7100R-50	274	92	577	216	212	545	457	100	200	-	375	410	509	257	14
	10.79	3.64	22.72	8.50	8.33	21.46	18.00	3.94	7.88	-	14.76	16.14	20.02	10.12	.56

Notice: Specifications subject to change without notice.

Post Office Box 97
Benton Harbor, Michigan 49023-0097
Ph: 616/926-6171
Fax: 616/925-8288

Maintenance Instructions for Gast Standard Regenerative Blowers



For original equipment manufacturers special models, consult your local distributor

Gast Rebuilding Centers

Gast Mfg. Corp.
2550 Meadowbrook Rd.
Benton Harbor MI. 49022
Ph: 616/926-6171
Fax: 616/925-8288

Gast Mfg Corp.
505 Washington Avenue
Carlstadt, N. J. 07072
Ph: 201/933-8484
Fax: 201/933-5545

Brenner Fiedler. & Assoc.
13824 Bentley Place
Cerritos, CA. 90701
Ph: 310/404-2721
Ph: 800/843-5558
Fax: 310/404-7975

Wainbee, Limited
121 City View Drive
Toronto, Ont. Canada M9W 5A9
Ph: 416/243-1900
Fax: 416/243-2336

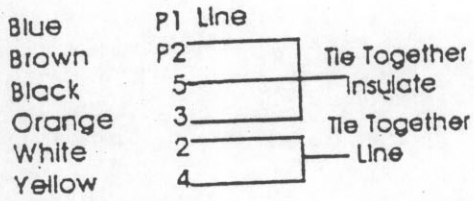
Wainbee, Limited
215 Brunswick Drive
Pointe Claire, P.Q. Canada H9R 4R7
Ph: 514/697-8810
Fax: 514/697-3070

Gast Mfg. Co. Limited.
Halifax Rd. Cressex Estate
High Wycombe, Bucks HP12 3SN
Ph. 44 494 523571
Fax: 44 494 436588

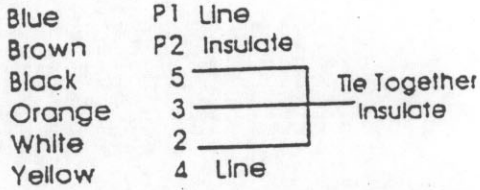
Japan Machinery Co. Ltd.
Central PO Box 1451
Tokyo 100-91 Japan
Ph: 813/3573-5421
Fax: 813/3571-7865

Wiring Diagrams for Regenerative Blowers
Models R1102, R2103, R3105-1, R4110-2, R5125-2, R6125-2

Low Voltage *Single Phase*

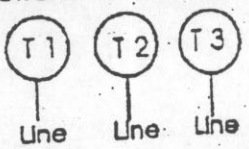


High Voltage *Single Phase*



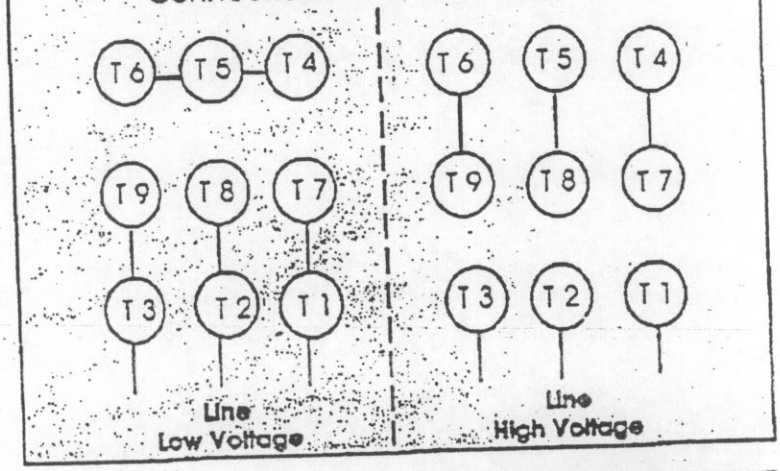
Model R2303F

Connections for 3 Phase, 3 Leads



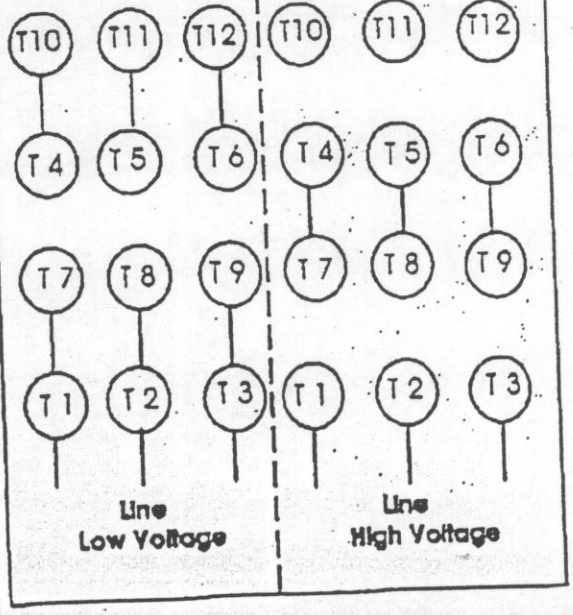
Model R2303A, R3305A-1, R4310A-2, R6350A-2 R6P350A, R6PP3110M, R6PS3110M,R7100A-2

Connections for 3 Phase, 9 Leads



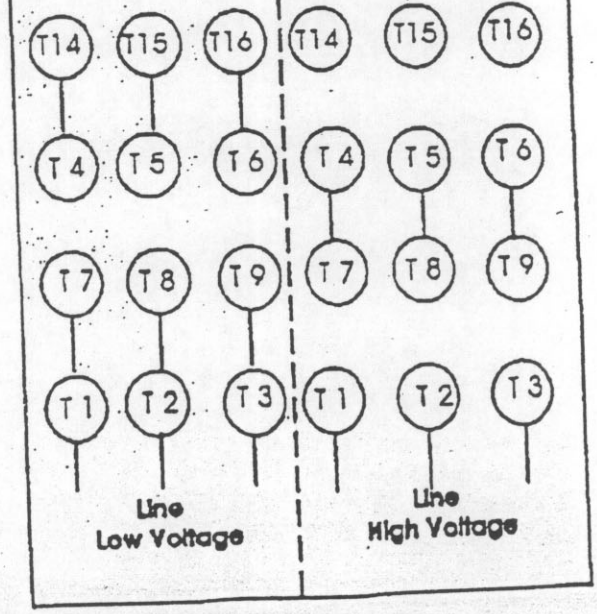
Models R6335A-2, R6P335A

Connections for 3 Phase, 12 Leads

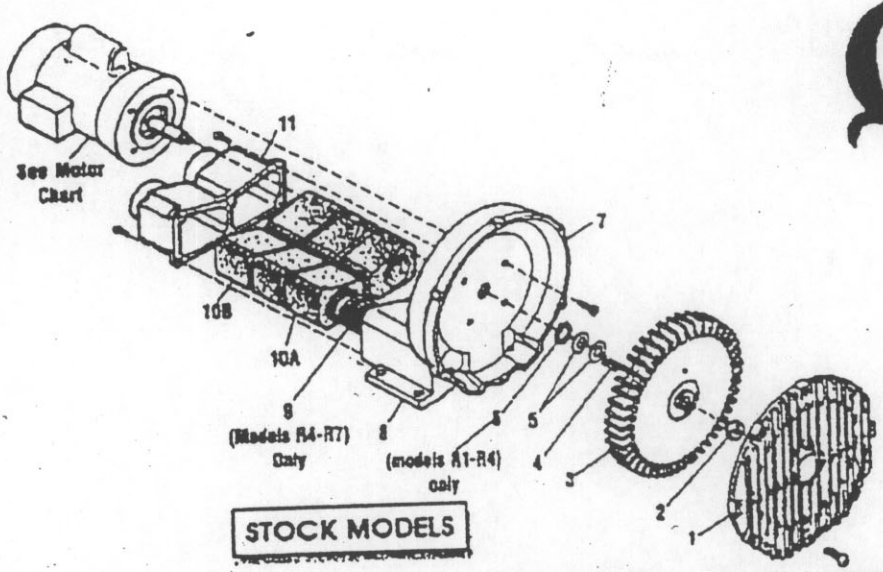


Models R5325A-2, R6325A-2

Connections for 3 Phase, 12 Leads



To reverse rotation on any three phase motor, interchange any two external motor line connections to any two line leads.



STOCK MODELS

Part Name	R1	R2	R3	R4	R5	R6	R6P	R6PP/R6PS	R7
Cover	AJ101A	AJ101B	AJ101C	AJ101D	AJ101EQ	AJ101F	AJ101K	(2)AJ101KA	AJ101G
Stopnut	BC187	BC187	BC181	BC181	BC181	BC181	BC181	(2)BC182	BC183
Impeller	AJ102A	AJ102BQ	AJ102C	AJ102D	AJ102E	AJ102FR	AJ102K	(2)AJ102KA	AJ102GA
Square Key	AH212C	AH212	AB136A	AB136D	AB136	AB136	AB136	(2)AB136	AC628
Shim Spacer (s)	AJ132	AE686-3	AJ109	AJ109	AJ109	A109	A109	A109	AJ110
Retaining Ring	AJ145	AJ145	AJ149	AJ149					
Housing	AJ103A	AJ103BQ	AJ103C	AJ103DR	AJ103E	AJ103F	AJ103K	AJ103KD	AJ103GA
Muffler Box					AJ104E	AJ104F			
Spring				AJ113DR	AJ113DQ	AJ113FQ	AJ113FQ		AJ113G
1A Foam	(4)AJ112A	(4)AJ112B	(4)AJ112C	(4)AJ112DS	(4)AJ112ER	(6)AJ112F	(8)AJ112K		(8)AJ112GA
1B Foam		(2)AJ112BQ	(2)AJ112CQ	(2)AJ112DR	(2)AJ112EQ				
1 Muffler Extension/ Adapter Plate	AJ106A	AJ106BQ	AJ106CQ	AJ106DQ	AJ106ER	AJ106FQ	AJ106K		AJ106GA

MOTOR CHART

REGENAIR MODEL NUMBER	MOTOR NUMBER	MOTOR SPECIFICATIONS 60 HZ VOLTS	50 HZ VOLTS	PHASE
R1102	J112X	115		1
R1102C	J112X	115		1
R2103	J411X	115/208-230	110/220	1
R2105	J411X	115/208-230	110/220	1
R2303A	J313	208-230	220	3
R2303F	J313	208-230	220	3
R3305-1/R3305-12	J410	208-230/460	220/380-415	3
R3305A-1/R3305A-13	J410	208-230/460	220/380-415	3
R4310-2	J610	208-230/460	220/380-415	3
R4310A-2	J610	208-230/460	220/380-415	3
R5125-2	J810X	208-230/460	220/380-415	3
R5325A-2	J810X	208-230/460	220/380-415	3
R6125-2	J810X	208-230/460	220/380-415	3
R6325A-2	J810X	208-230/460	220/380-415	3
R6350A-2	J1013	230		1
R6150J-2	J1013	230		1
R6350A-2	J910X	208-230/460	220/380-415	3
R6P335A	J910X	208-230/460	220/380-415	3
R6P350A	J1110A	208-230/460	220/380-415	3
R6P355A	J1110A	208-230/460	220/380-415	3
R7100A-2	J01100	208-230/460	220/380-415	3
R6PP/R6PS3110M	J01100	208-230/460	220/380-415	3
R7E3140M				

* No lubrication needed at start up. Bearings lubricated at factory.

* Motor is equipped with alemite fitting. Clean tip of fitting and apply grease gun. Use 1 to 2 strokes of high quality ball bearing grease.

Typical Grease
Shell Dolium R

Hours of service per year	*Suggested Relube Interval*
5,000	3 years
Continual NormalApplication	1 year
Seasonal service motor idle for 6 months or more	1 year beginning of season 6 months
Continuous-high ambients, dirty or moist applications.	

Safety

This is the safety alert symbol. When you see this symbol, personal injury is possible. The degree of injury is shown by the following signal words:
DANGER: Severe injury or death will occur if hazard is ignored.
WARNING: Severe injury or death can occur if hazard is ignored.
CAUTION: Minor injury or property damage can occur of hazard is ignored.
Review the following information carefully before operating.

General Information

DANGER: Do not pump flammable or explosive gases or operate in an atmosphere containing them. Ambient temperature for normal operation should not exceed 40 degrees C (105 degrees F). For higher ambient operation, consult the factory. Blower performance is reduced by the lower atmospheric pressure of high altitudes. If it applies to this unit, consult a Gast distributor or the factory for details.

Installation

WARNING: Electric Shock can result from bad wiring. Wiring must conform to all required safety codes and be installed by a qualified person. Grounding is required. All single impeller blowers can be mounted in any position. All dual impeller models must be mounted with shaft horizontal. The flow of cooling air over the blower and motor must not be blocked.
PLUMBING - The threaded pipe ports are designed as connection ports only and will not support the plumbing. Be sure to use the same or larger size pipe and fittings to prevent air flow restriction and over-heating of the blower. When installing plumbing, be sure to use a small amount of pipe thread lubricant. This protects the threads in the aluminum blower housing. Dirt and chips, often found in new plumbing, should not be allowed to enter the blower.
WARNING: Do no operate with inlet or exhaust plumbing removed as it protects against the high speed impeller.
NOISE - To reduce noise and vibration, the unit should be mounted on a solid surface that will not increase sound. The use of shock mounts or vibration isolation material is recommended. If needed, inlet or discharge noise can be reduced by attaching muffler assemblies (see accessories).
ROTATION - The Gast Regenair blower should only rotate clockwise as viewed from the electric motor side. This is marked with an arrow in the casting. Proper rotation can be confirmed by checking air flow at the IN and OUT ports. On blowers powered by a three phase motor, rotation is reversed by changing any two of the three power wires.

Operation

WARNING: Solid or liquid material exiting the blower or piping can cause injury.
CAUTION: Attach blower to solid surface before starting to prevent injury or damage from unit movement. Any foreign material passing through the blower can cause internal damage. The use of filters is strongly recommended.
CAUTION: Outlet piping can cause burns. Mark "Caution hot surface" and guard or limit access.
Air temperature increases when passing through the blower. When run at duties above 50 in. H_2O, metal pipe may be required for hot exhaust air.
The blower must not be operated above the limits for continuous duty. "Standard" R1, R2, R3 and R4 can operate continuously with no air flowing through the blower. Other units can only be run at the rating shown on the model number label. Do *not* close off inlet (for vacuum) or exhaust (for pressure) to reduce extra air flow. This will cause added heat and motor load.
ACCESSORIES - Gast pressure gauges AJ496 or AE133 and vacuum gauges AJ497 or AE134 show blower duty. The Gast pressure/vacuum relief valve, AG258, will limit the operating duty by admitting or relieving air. It also allows full flow through the blower when the relief valve closes.

Servicing

WARNING: Disconnect electric power before servicing. Be sure rotating parts have stopped. Electric shock or severe cuts can result. Inlet and exhaust filters need occasional cleaning or replacement of the elements. Failure to do so will result in more pressure drop, reduced air flow and hotter operation. The outside of the unit requires cleaning of dust and dirt. The inside of the blower also may need cleaning to remove material coating the impeller and housing. If not done, the buildup can cause vibration, hotter operation and reduced flow. Noise absorbing foam in the mufflers may need replacement.
KEEP THIS INFORMATION WITH THE BLOWER. REFER TO IT FOR SAFE INSTALLATION, OPERATION OR SERVICE.

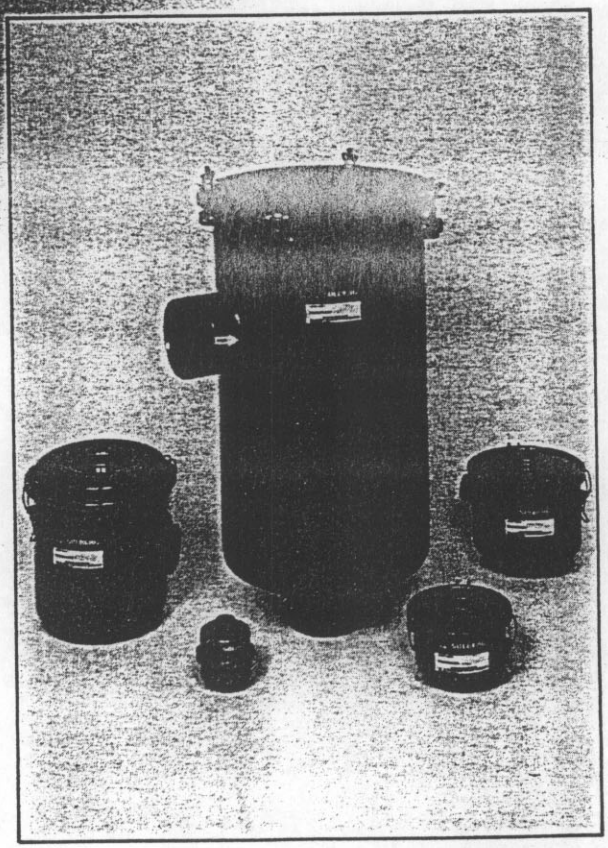
TROUBLESHOOTING

Symptom	*Possible Diagnosis*	*Possible Remedy*
Excess Vibration	Impeller damaged or contaminated by foreign material	Replace or Clean impeller. Install adequate filtration.
Abnormal sound	Motor bearing failed Impeller rubbing against cover or housing	Replace bearings Repair blower, check clearances
Increase in sound	Foreign material or heat can destroy muffler foam.	Replace foam muffler elements, filter foreign material.
Blown fuse	Electrical wiring problem	Have qualified person check that impeller turns, check fuse, wiring diagram or wiring capacity.
Unit very hot	Running at too high a pressure or vacuum	Install a relief valve and pressure or vacuum gauge

SOLBERG

INLET VACUUM AIR FILTERS

CSL-Series
(Closed System "L")
1/2" FPT to 12" Flange
Up to 4950 CFM



Bulletin CSL-60

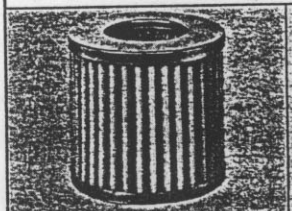
INLET VACUUM AIR FILTERS

CSL Series
(Closed System "L")
1/2" FPT to 12" Flange
Up to 495Q CFM

Since 1968 Solberg has been manufacturing quality OEM and industrial filters for air compressor, blower and vacuum applications. By pioneering many filter manufacturing techniques and building their own production machinery, Solberg is fulfilling their commitment of continual product improvement and prompt response to customer needs.

The Solberg line includes most all sizes of inlet, inline, and exhaust system filters and elements, filter silencers, oil mist filters, high temperature filters and more. There is a choice of media to suit specific duty requirements. As the filter specialist, Solberg can also provide reliable products for individual needs and unique filter applications. Ask for an engineering evaluation of your requirements.

SMI MODEL NUMBERS - CSL Series


W/Polyester Element


W/Paper Element

CSS-05-025	CSS-04-025
CSS-05-038	CSS-04-038
CSS-07-038	CSS-06-038
CSS-07-050/050HC	CSS-06-050/050HC
CSL-843-050HC	CSL-842-050HC
CSL-843-075HC	CSL-842-075HC
CSL-843-100HC	CSL-842-100HC
CSL-849-100HC	CSL-848-100HC
CSL-843-125HC	CSL-842-125HC
CSL-849-125HC	CSL-848-125HC
CSL-849-150HC	CSL-848-150HC
CSL-851-200HC	CSL-850-200HC
CSL-851-250HC	CSL-850-250HC
CSL-235P-300	CSL-234P-300
CSL-335P-300	CSL-334P-300
CSL-235P-400	CSL-234P-400
CSL-335P-400	CSL-334P-400
CSL-245P-500	CSL-244P-500
CSL-345P-500	CSL-344P-500
CSL-275P-600	CSL-274P-600
CSL-375P-600	CSL-374P-600
CSL-235P-400F	CSL-234P-400F
CSL-335P-400F	CSL-334P-400F
CSL-245P-500F	CSL-244P-500F
CSL-345P-500F	CSL-344P-500F
CSL-275P-600F	CSL-274P-600F
CSL-375P-600F	CSL-374P-60
CSL-377P-800F	CSL-376P-800F
CSL-685P-1000F	CSL-384P(2)-1000F
CSL-485P(2)-1200F	CSL-484P(2)-1200F

CSL-235P-400F

- Connection size; 400 = 4"; F at the end of model # denotes flange connection.
- Element part #; Odd #'s = Polyester, Even #'s = Paper, Even #'s + s = Wire Mesh. P = Polyurethane foam pre-filter included.
- CSL denotes Closed

APPLICATIONS

- Soil Venting
- Soil Remediation
- Vacuum Pumps & Systems
- Intake Suction Filters
- Blowers
- Pneumatic Conveying Systems
- Air Compressors
- Remote Installations

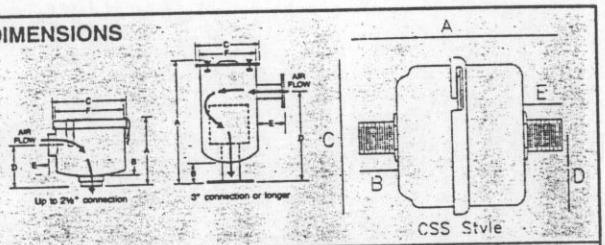
FEATURES

- Use as an elbow in a package without removing for service
- Rugged all steel construction
- Low pressure drop
- Positive sealing - Vacuum tested
- Large dirt holding capacity and easy field cleaning, especially when mounted horizontally or inverted
- 1/4" FPT tap holes on inlet & outlet for differential pressure gauge (3" & larger)

OPTIONS
(Inquiries Encouraged)

- Larger sizes available
- Support stands
- Stainless steel housings
- Epoxy coated housings
- Hot dipped galvanized housings
- Unique centrifugal 2-stage filtering system/baffle plates
- Special fittings available for volume orders
- Various elements available - see Element bulletin
- Activated carbon pad or prefilter to reduce odor

Inline filters with optional baffle plates provides centrifugal flow to knock down large particulates.

EFFECTIVE SURFACE AREA OF ELEMENT IN SQUARE FEET		CONNECTION		Flow SCFM	Approx. Shipping Wt. Lbs.	DIMENSIONS					
											
Polyester	Paper	Size	Type			A	B	C	D	E	F
THREADED CONNECTIONS											
.2	.2	1/4"	MPT	6	.5	3-5/8"	5/8"	2-1/2"	1-13/16"	5/8"	—
.2	.2	3/8"	MPT	6	.5	3-5/8"	5/8"	2-1/2"	1-13/16"	5/8"	—
.58	.58	3/8"	MPT	8	1	4-1/4"	5/8"	3-1/4"	2-1/8"	5/8"	—
.58	.58	1/2"	FPT	10	1	4"	1/2"	3-1/4"	2-1/8"	1/2"	—
.6	1.75	1/2"	FPT	10	3	4-3/8"	3/8"	5-7/8"	2-5/8"	9/16"	5"
.6	1.75	3/4"	FPT	20	3	4-3/8"	3/8"	5-7/8"	2-5/8"	9/16"	5"
.6	1.75	1"	FPT	25	3	4-3/8"	5/8"	5-7/8"	2-5/8"	3/4"	5"
2.0	4.5	1"	FPT	40	5	6-1/2"	3/4"	7-5/16"	4-1/2"	3/4"	6-13/16"
.6	1.75	1-1/4"	FPT	45	3	4-3/8"	5/8"	5-7/8"	2-5/8"	3/4"	5"
2.0	4.5	1-1/4"	FPT	60	5	6-1/2"	3/4"	7-5/16"	4-1/2"	3/4"	6-13/16"
2.0	4.5	1-1/2"	FPT	80	5	6-1/2"	3/4"	7-5/16"	4-1/2"	3/4"	6-13/16"
4.5	13.75	2"	FPT	150	15	10-1/4"	3/4"	8-3/4"	5"	3/4"	7-5/8"
4.5	13.75	2-1/2"	FPT	195	15	10-1/2"	1"	8-3/4"	5-1/2"	1-1/4"	7-5/8"
8.3	22.8	3"	MPT	300	47	27-1/8"	3"	14"	18-1/2"	3"	12"
12.0	34.0	3"	MPT	300	50	27-1/8"	3"	14"	18-1/2"	3"	12"
8.3	22.8	4"	MPT	520	52	27-1/8"	3"	14"	18-1/2"	3"	12"
12.0	34.0	4"	MPT	520	55	27-1/8"	3"	14"	18-1/2"	3"	12"
14.0	35.5	5"	MPT	800	82	28-1/8"	3"	18-1/2"	19-1/2"	3"	16"
22.1	57.0	5"	MPT	800	88	28-1/2"	3"	18-1/2"	19-1/2"	3"	16"
19.0	45.4	6"	MPT	1100	95	28-1/8"	4"	18-1/2"	20-1/2"	4"	16"
28.0	68.1	6"	MPT	1100	97	28-1/8"	4"	18-1/2"	20-1/2"	4"	16"
FLANGED CONNECTIONS											
8.3	22.8	4"	FLG	520	62	27-1/8"	3"	14"	18-1/2"	3"	12"
12.0	34.0	4"	FLG	520	64	27-1/8"	3"	14"	18-1/2"	3"	12"
14.0	35.5	5"	FLG	800	90	28-1/8"	3"	18-1/2"	19-1/2"	3"	16"
22.1	57.0	5"	FLG	800	88	28-1/2"	3"	18-1/2"	19-1/2"	3"	16"
19.0	45.4	6"	FLG	1100	110	28-1/8"	4"	18-1/2"	20-1/2"	4"	16"
28.0	68.1	6"	FLG	1100	113	28-1/8"	4"	18-1/2"	20-1/2"	4"	16"
50.0	125.0	8"	FLG	1800	185	38"	4"	22-1/2"	25-1/2"	4"	20"
100.0	280.0	10"	FLG	2900	380	57-1/2"	4"	26-13/32"	45"	4"	24"
150.0	400.0	12"	FLG	4950	465	70"	4"	26-13/32"	57"	4"	24"

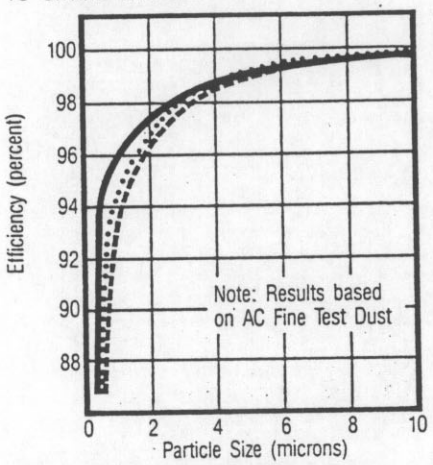
REPLACEMENT ELEMENTS

GSL Series
1/2" FPT to 12" Flange
Up to 4950 CFM

POLYESTER

Dust Removal efficiency of polyester media at face velocity of:

15 cfm/ft²-media ——————
30 cfm/ft²-media .....
45 cfm/ft²-media - - - - - - -



- Galvanized metal endcaps
- Reinforced with epoxy coated steel wire on both sides of cloth
- Nominally 99+% efficient at 10 microns
- Washable - lukewarm water and mild detergent
- Dust loading capacity 40-50% greater with polyurethane prefilter

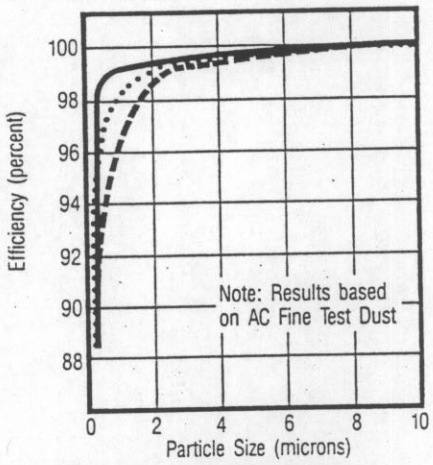
ADVANTAGES

- Less maintenance
- More durable
- Moisture resistant
- Handles hot air and oil mist from unload cycle of reciprocating compressor

PAPER

Dust Removal efficiency of paper media at face velocity of:

10 cfm/ft²-media ——————
15 cfm/ft²-media .....
20 cfm/ft²-media - - - - - - -

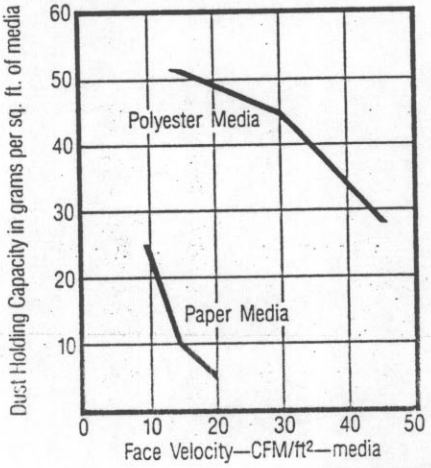


- Galvanized metal endcaps
- Heavy duty industrial strength paper
- Nominally 99+% efficient at 10 microns
- Reinforced with heavy gauge galvanized expanded metal
- Dust loading capacity 40-50% greater with polyurethane prefilter

ADVANTAGES

- Less expensive
- More surface area per given size
- Higher efficiency

Influence of Face Velocity on Dust Holding Capacity



NOTE

Additional interchangeable elements listed in Element Brochure EL-10

SMI ELEMENT NUMBERS			EFFECTIVE SURFACE AREA IN SQUARE FEET		DIMENSIONS		
Polyester	Paper	Flow CFM	Polyester	Paper	I.D.	O.D.	HT
05	04	6	.2	.2	—	2-1/4"	1"
07	06	10	.58	.58	—	3"	1-3/8"
843	842	40	.6	1.75	2-3/8"	3-7/8"	2-3/4"
849	848	80	2.0	4.5	2-9/16"	5"	4-3/4"
851	850	195	4.5	13.75	3-1/2"	5-7/8"	8-3/4"
235P	234P*	520	8.3	22.8	4-3/4"	7-7/8"	9-5/8"
335P	334P*	520	12.0	34.0	4-3/4"	7-7/8"	14-1/2"
245P	244P*	850	14.0	35.5	6"	9-3/4"	9-5/8"
345P	344P	850	22.1	57.0	6"	9-3/4"	14-1/2"
275P	274P	1100	19.0	45.4	8"	11-3/4"	9-5/8"
375P	374P	1500	28.0	68.1	8"	11-3/4"	14-1/2"
377P	376P	1800	50.0	125.0	9"	14-5/8"	14-1/2"
385P	384P	1800	50.0	140.0	14"	19-5/8"	14-1/2"
485P	484P	2880	75.0	200.0	14"	19-5/8"	21-1/2"
685P	—	3500	100.0	—	14"	19-5/8"	28-1/2"

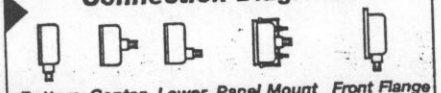
* Plastisol Encaps
P = Polyurethane Prefilter

SOLBERG Manufacturing, Inc.

Corrosive Service Compound Gauges

For information about pressure gauges, see page 384.

Connection Diagrams



Compound gauges measure both above and below atmospheric pressure.

Dry and Liquid-Filled 304 Stainless Steel Case Gauges

Dry

- Accuracy: 2½" dial size: Grade A
  4" dial size: Grade 1A
- Type 316 stainless steel bourdon tube
- Connections (Type 316 stainless steel):
  2½" dial size: ¼" NPT male
  4" dial size: ½" NPT male
- Lens material: 2½" dial size: plastic lens
  4" dial size: glass lens

To Order Please specify pressure range in psi listed at right except the vacuum only gauge indicated with a ■ (specify vacuum only gauge).

Pressure Ranges Available

Vacuum/Pressure Range, Hg/psi	Figure Intervals, Hg/psi	Graduation Marks, Hg/psi
0-30"/___■	5"/___	0.5"♦/___
0-30"/0- 15	10"/ 5	1"/0.5
0-30"/0- 30	10"/ 5	1"/0.5
0-30"/0- 60	10"/10	1"/1
0-30"/0-100	30"/10	2"/1
0-30"/0-160	30"/20	5"/2
0-30"/0-200	30"/20	5"/2
0-30"/0-300	30"/50	10"/5

■ Vacuum only gauge. ♦ 0.2" for 4" dial size.

Dial Size	DRY Bottom Connection Each	DRY Center Back Connection Each	DRY Lower Back Connection Each	LIQUID FILLED Bottom Connection Each	LIQUID FILLED Center Back Connection Each	LIQUID FILLED Lower Back Connection Each
2½"	38595K1 $46.82	38595K2 $53.55		38605K1 $62.44	38605K2 $72.89	
4"	38595K3 68.36		38595K4 $75.09	38605K3 98.56		38605K4 $108.00

Vacuum Gauges

For information about pressure gauges, see page 384.

Steel Case Gauges — Grade B

- Copper alloy bourdon tube
- ¼" NPT male brass connection
- Acrylic lens
- Dual-scale dial with Inches of Hg/bar readings

Dial Size	Vacuum Range, Hg	Figure Intervals, Hg	Graduation Marks, Hg	Vacuum Range, bar	Bottom Connection Each	Center Back Connection Each	Panel Mount Center Back Connection Each
1½"	0-30"	5"	0.5"		4002K15★ $10.72	4002K35★ $10.81	
2"	0-30"	5"	0.5"	0 to −1	4002K14 8.00	4002K34 8.14	4002K24 $12.07
2½"	0-30"	5"	0.5"	0 to −1	4002K11 13.16	4002K31 9.87	4002K21 13.40
4"	0-30"	5"	0.5"	0 to −1	4002K41 19.56	4002K42 19.56	

★ Single scale: 0-30" Hg; ⅛" NPT male connection; polycarbonate lens.

Liquid-Filled ABS Case Gauges — Grade A

- Copper alloy bourdon tube
- ¼" NPT male brass connnection
- Polycarbonate lens
- Dual scale with Inches of Hg/kPa readings

Dial Size	Vacuum Range, Hg	Figure Intervals, Hg	Graduation Marks, Hg	Vacuum Range, kPa	Bottom Connection Each	Center Back Connection Each
2½"	0-30"	5"	0.5"	0-100	38465K11 $17.70	38465K31 $17.70

Ultra-Low Vacuum Diaphragm Gauges

- Diaphragm element for extremely low vacuum readings in Inches of Water.
- Gauge is especially sensitive; maximum vacuum range in Inches of Water should not be exceeded
- Case material: 2½" dial size: steel
  4" dial size: stainless steel
- Accuracy: 2½" dial size: Grade A
  4" dial size: Grade 1A
- Copper alloy diaphragm
- ¼" NPT male brass connection
- Acrylic lens

To Order Please specify vacuum range in Inches of Water listed at right.

Dial Size	Bottom Connection Each
2½"	4106K1 $31.26
4"	4106K2 73.71

Vacuum Ranges Available

Vacuum Range, Inches of Water	Figure Intervals, Inches of Water	Graduation Marks, Inches of Water
0- 15	1	0.1
0- 30	5	0.2
0- 60	5	0.5
0-100	10	1

Cast-Aluminum Case Gauges — Grade 3A

- Copper alloy bourdon tube
- ¼" NPT male brass connection
- Glass lens
- Dual-scale dial with Inches of Hg/kPa readings

Dial Size	Vacuum Range, Hg	Figure Intervals, Hg	Graduation Marks, Hg	Vacuum Range, kPa	Front Flange Bottom Connection Each
4½"	0-30"	2"	0.10"	0 to −100	4105K1 $187.45
6"	0-30"	2"	0.10"	0 to −100	4105K2 226.60

Full View Brass Vacuum Gauge — ±5% Accuracy (Not Graded)

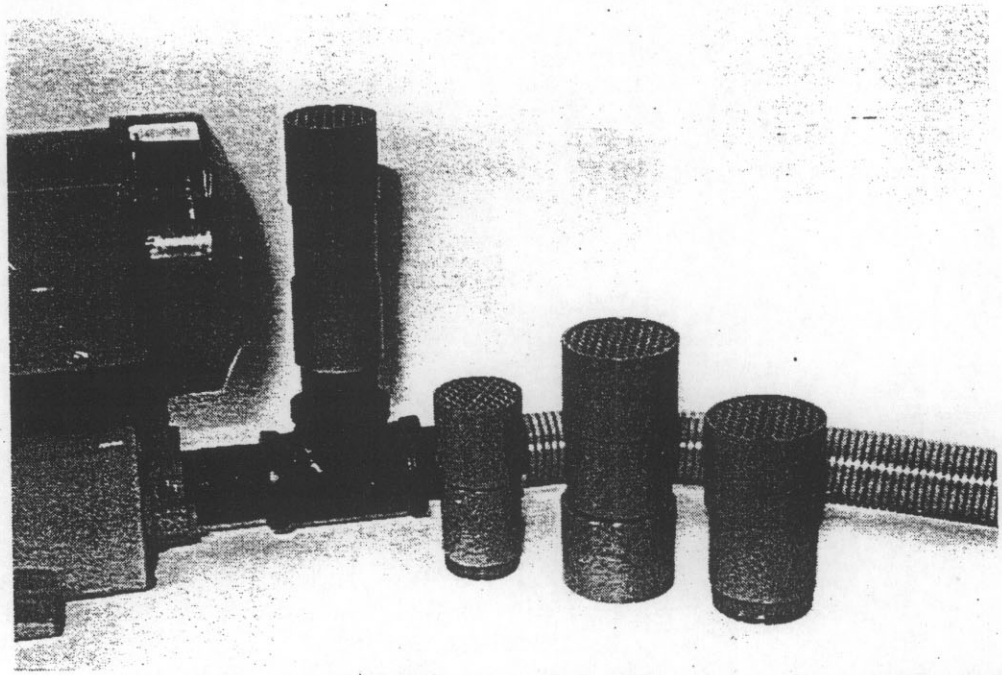
- Readings are visible 360° around
- Vacuum range is 3"-30" Hg; graduated in inches and mm
- Rubber diaphragm helps eliminate leaks
- ¼" NPT male brass connection
- Brass fitting with Lexan lens and cover

Overall Size, Dia. × Ht.	Bottom Connection Each
1" × 5"	40355K48 $83.93

FUJI ELECTRIC

Park 80 West Plaza II
Saddlebrook, NJ 07663
Phone: (201)712-0555
Fax: (201)368-8258

VACUUM AND PRESSURE RELIEF VALVES

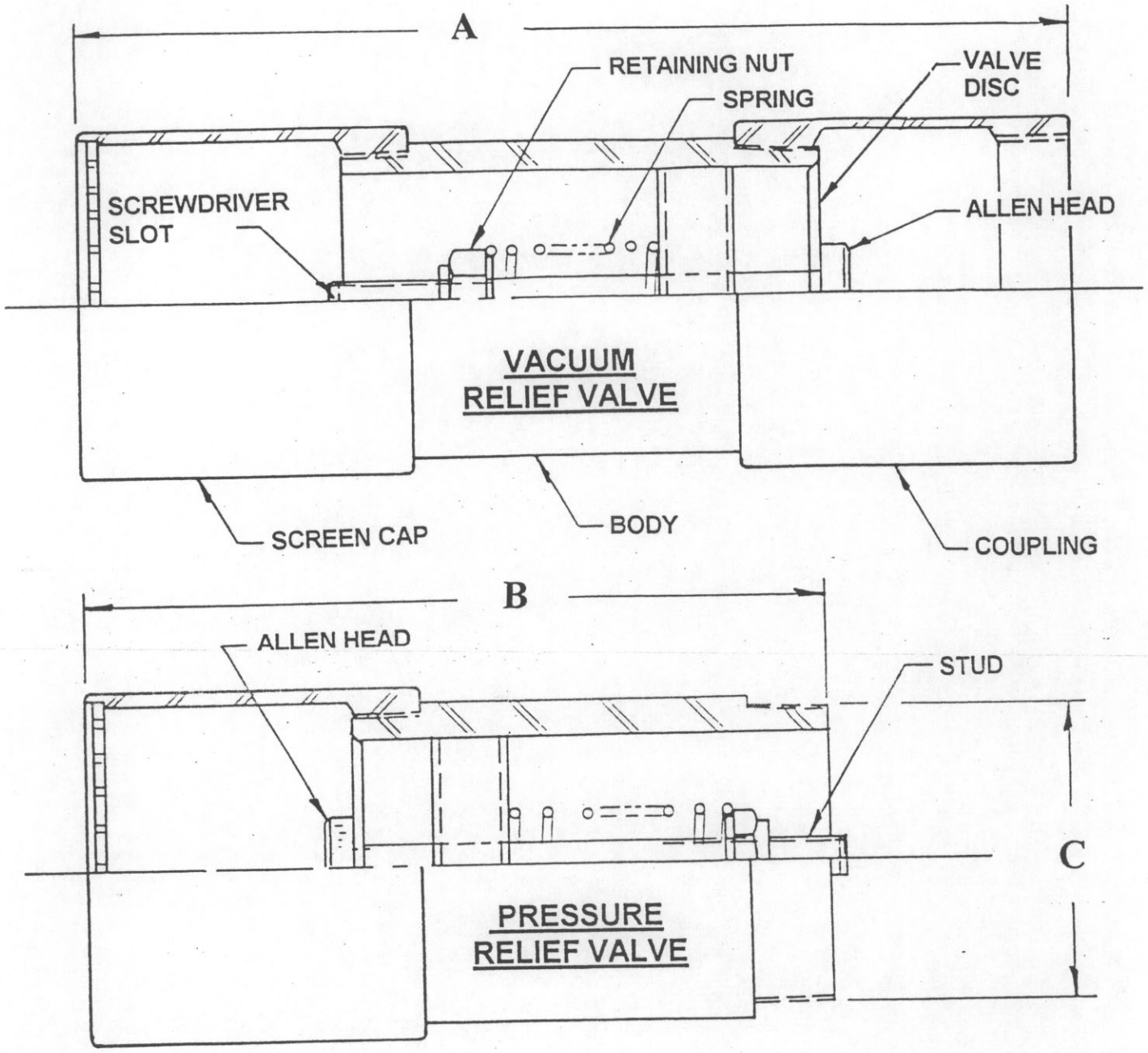


The Fuji Vacuum and Pressure Relief Valves are designed to protect Ring Compressors from overheating either in a vacuum or pressure ("dead-head") condition. Valves are preset to provide protection for each Ring Compressor. Or, Valves are adjustable to provide down to approximately 65% "dead-head" vacuum or pressure. Valves for Fuji Models VFC 309A, VFC409A, VFC504A are 1-1/2" NPT size. Valves for Models VFC604A, VFC704A, and VFC804A are 2" NPT. Model VFC904A Valves are 2-1/2" NPT. Valves should be checked periodically to assure proper setting.

Vacuum and Pressure Relief Valve Settings

	Model	Ring Compressor	Factory Set H_2O	Adjustment Range
VACUUM	VV3	309	39"	39" to 25"
	VV4	409	42"	42" to 27"
	VV5	504	60"	60" to 39"
	VV6	604	86"	86" to 55"
→	VV7	704	85"	85" to 56"
	VV8	804	100"	100" to 65"
	VV9	904	97"	97" to 75"
PRESSURE	PV3	309	42"	42" to 27"
	PV4	409	46"	46" to 29"
	PV5	504	68"	68" to 44"
	PV6	604	100"	100" to 65"
	PV7	704	98"	98" to 64"
	PV8	804	127"	127" to 82"
	PV9	904	120"	120" to 82"

Factory Settings within the Adjustment Range may be made if specified on order.



To adjust Vacuum or Pressure Relief Valve, remove Screen Cap, hold Retaining Nut or Allen Head with 1/2" Wrench and turn stud with Screwdriver. It is suggested that a Vacuum or Pressure Gauge be used to make accurate adjustments.

Ring Compressor	A	B	C
309, 409, 504	6-1/4	4-11/16	1-1/2 NPT
604, 704, 804	6-1/4	4-11/16	2 NPT
904	9-3/8	6-3/4	2-1/2 NPT

Measurement Accessories

Blower Connection Key
NPT – American National Standard Taper Pipe Thread (Male)
NPSC – American National Standard Straight Pipe Thread for Coupling (Female)
SO – Slip On (Smooth – No Threads)

Air Flow Meter

FEATURES

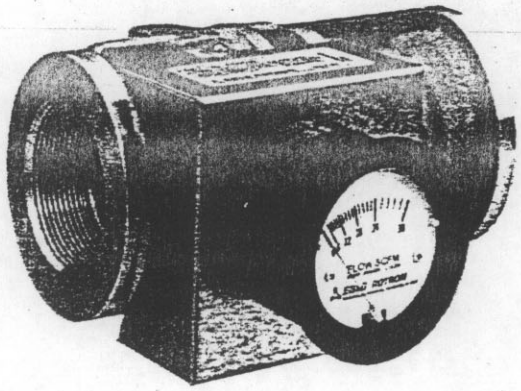
- Direct reading in SCFM
- Low pressure drop (2-4" typical) across the flow meter
- Non-clogging, low impedance air stream
- Light weight aluminum
- No moving parts
- Large easy-to-read dial
- Accurate within 2% at standard conditions
- Good repeatability
- Available in 2", 3" and 4" sizes
- Factory configured for quick installation
- .048" Allen key supplied for gauge adjustment

OPTIONS

- For 4-20 mA outputs and digital readouts see page G-9
- High temperature version (above 140°F)
- Corrosion-resistant version with Chem-Tough™ or in stainless steel
- FDA-approved Food Tough™ surface conversion
- High pressure version (100 PSI)

BENEFITS

- OPTIMIZE SYSTEM EFFICIENCY
  Measuring the correct air flow can assist you in fine-tuning to your system's optimal efficiency.
- BALANCE MULTI-PIPING SYSTEMS
  When evacuating CFM from more than one pipe, different run lengths or end system impedance can cause one pipe to handle more CFM than the other. With an accurate CFM reading, piping can be balanced by bleeding air in/out or by creating an extra impedance.
- DETECT CHANNELING OR PLUGGING
  For systems in which channeling or plugging can occur, a change in the CFM measured can help indicate the unseen changes in your system.

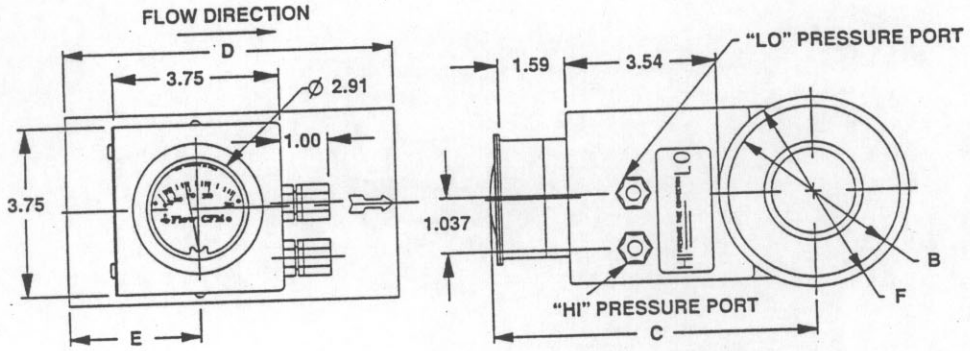


Current Models		Flow Range	B	C	D	E	F	Replaces	
Model	Part #	(SCFM)	Threads	Length	Width			Model	Part #
FM20C030Q	550599	6-30	2" - 11.5 NPSC	7.18"	7.0"	2.0"	3.75"	FM20A030Q	550312
FM20C045Q	550600	9-45						FM20A045Q	550313
FM20C065Q	550601	13-65						FM20A065Q	550314
FM20C125Q	550602	25-125			5.6"			FM20A125Q	550256
FM20C175Q	550603	35-175						FM20A175Q	550255
FM20C225Q	550604	45-225						FM20A225Q	550254
FM30C250Q	550605	50-250	3" - 8 NPSC	7.52"	7.4"	2.5"	4.43"	FM30A250Q	550259
FM30C350Q	550606	70-350						FM30A350Q	550258
FM30C475Q	550607	95-475						FM30A475Q	550257
FM40C450Q	550608	90-450	4" - 8 NPSC	8.00"	7.7"	2.7"	5.43"	FM40A450Q	550262
FM40C600Q	550609	120-600						FM40A600Q	550261
FM40C850Q	550610	170-850						FM40A850Q	550260

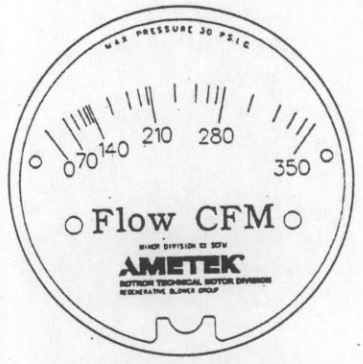
Blower Model Reference Key	
A = SPIRAL	E = DR/EN/CP 606, S543, 6, 623, S7, S75
B = DR/EN/CP 068, 083, 101, 202	F = DR/EN/CP 707, 808, S85, 858, S9, P9 (Inlet Only)
C = DR/EN/CP 303, 312, 313, 353	G = DR/EN/CP 823, S13, P13 (Inlet Only)
D = DR/EN/CP 404, 454, 513, 505, 555, 523	H = DR/EN/CP 909, 1223, 14, S15, P15 (Inlet Only)

Measurement Accessories

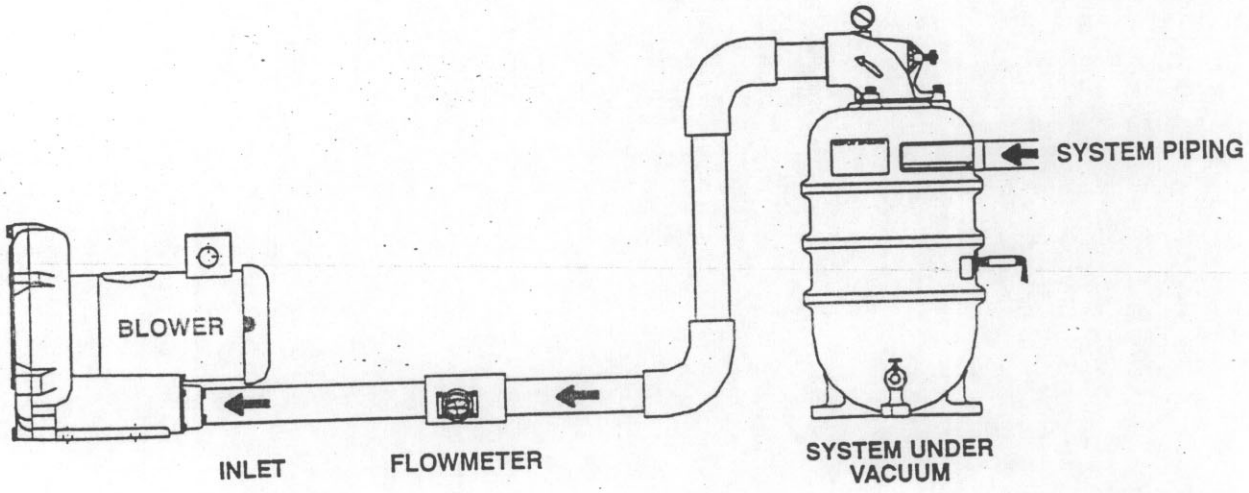
TYPICAL FLOW METER ARRANGEMENT



ANALOG FLOW METER



TYPICAL GAUGE FACE



HIGH TEMPERATURE/PRESSURE CORRECTION

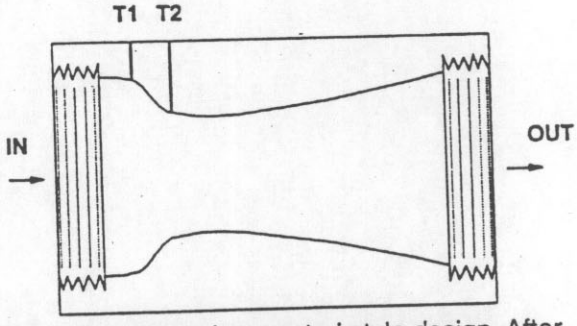
$$SCFM_2 = \frac{SCFM_1}{\sqrt{\left(\frac{14.7}{Pf_2}\right) \times \left(\frac{530}{Tf_2 + 460}\right)}}$$

Pf_2 = Absolute Pressure in PSIA

Tf_2 = Temperature in °F

- Use on inlet to limit need to correct for high pressure or elevated outlet temperature
- Standard model limits = 140°F and 30 PSIG

HOW IT WORKS



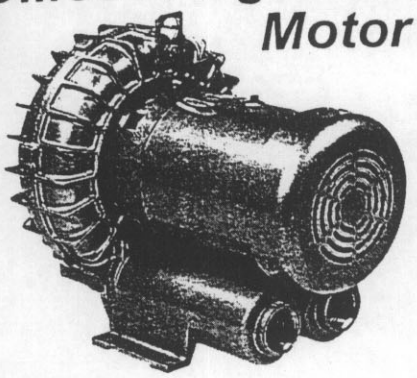
Rotron's flow meter is a venturi style design. After air enters the inlet, the pressure is measured in the T1 tap. The second tap, T2, measures the pressure at the throat. The differential between T1 and T2 registers across a special calibrated CFM gauge to provide accurate readings. The throat is then expanded back to the original size to keep pressure loss to under 2-4 IWG.

Appendix B

Sparge Blower and Associated Equipment

GAST

Oilless Regenerative Blowers, Motor Mounted



REGENAIR® R4H Series

MODELS R4H3060A, R4H3060B

10.25 PSI MAX. PRESSURE, 128 cfm OPEN FLOW (60 HZ)
13.5" HG MAX. VACUUM, 121 cfm OPEN FLOW (60 HZ)

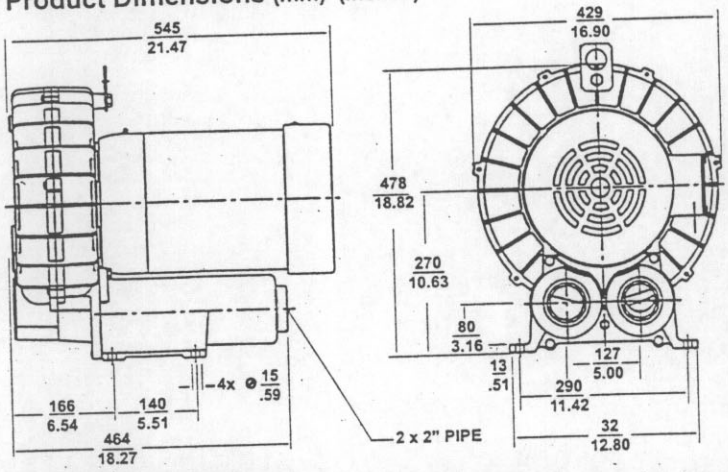
PRODUCT FEATURES

- Made in the U.S.A.
- Oilless operation
- UL and CSA approved TEFC motor with permanently sealed ball bearings. Class F insulation, IP54 rated enclosure
- Cast aluminum blower housing. Dual impeller and cover are cast aluminu
- Can be mounted in any plane
- CE compliant - Declaration of Conformity on file
- Inlet and outlet have internal muffling

RECOMMENDED ACCESSORIES

- Pressure gauge AE133F
- Inlet filter (pressure) AJ126D
- Pressure relief valve PV102 (60 Hz), PV098 (50 Hz)
- Vacuum gauge AE134F
- Vacuum gauge for monitoring inlet filter restriction AJ497
- Vacuum relief valve AG258
- Silencer for vacuum relief valve AJ121D
- In line filter (vacuum) AJ151E
- External muffler for additional silencing AJ121F

Product Dimensions (mm) (Inches)



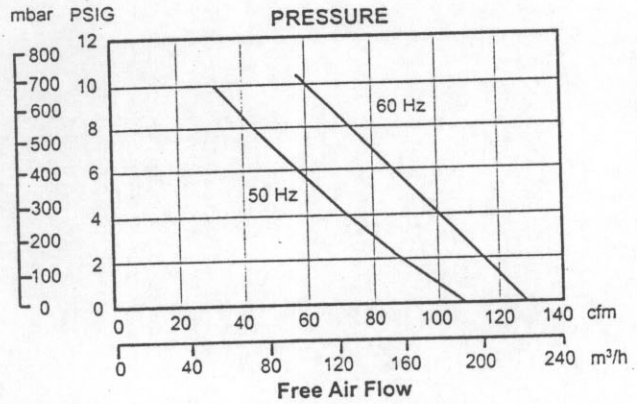
Product Specifications

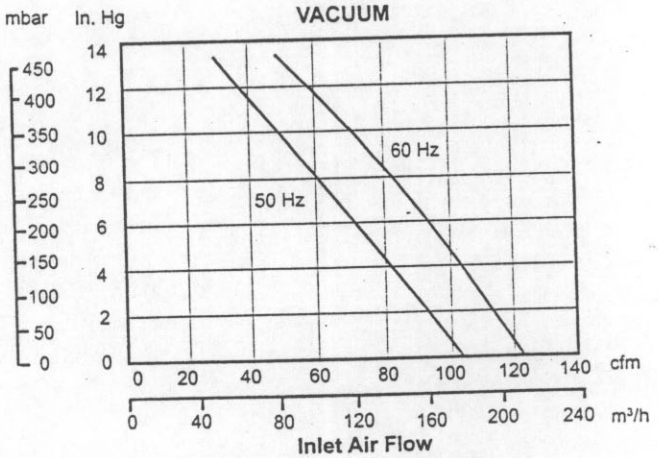
Recommended NEMA starter size for motor - 2/1

Specifications subject to change without notice

Model Number	Motor Specs	Full Load Amps	Locked Rotor Amps	HP	KW	RPM	Max Vac In. Hg	Max Vac mbar	Max Pressure PSIG	Max Pressure mbar	Max Flow cfm	Max Flow m³h	Net Wt. lbs.	Net Wt. kg
R4H3060A →	208-230/460-60-3	19.5-18.2/9.1	83 @ 460V	6	4.50	3500	13.5	457	10.25	706.7	128	217	200	91
→	190-220/380-440-50-3	16.8-16.0/8.4-8.0		5	3.75	2850	13.5	457	10	690	107	182		
R4H3060B	575-60-3	7.3	67 @ 575V	6	4.50	3500	13.5	457	10.25	706,7	128	217	200	91

Product Performance (Metric, U.S. Imperial)





Pressure vs. Air Temp Rise Over Ambient (°F)

PSIG	60 Hz	50 Hz
0	25	10
2	49	42
4	78	72
6	117	118
8	161	171
10	210	230
10.25	220	–

Pressure vs. K Watts Input

PSIG	60 Hz	50 Hz
0	1.88	1.12
2	2.71	1.87
4	3.58	2.58
6	4.51	3.36
8	5.42	4.14
10	6.43	5.08
10.25	6.55	–

Vacuum vs. Air Temperature Rise (°F)

In. Hg	60 Hz	50 Hz
0	24	16
2	36	29
4	51	44
6	69	65
8	90	91
10	129	127
12	168	174
13	195	202
13.5	207	212

Vacuum vs. K Watts Input

In. Hg	60 Hz	50 Hz
0	1.9	1.17
2	2.24	1.44
4	2.58	1.73
6	2.92	2.07
8	3.30	2.39
10	3.67	2.75
12	4.08	3.11
13	4.31	3.30
13.5	4.40	3.42

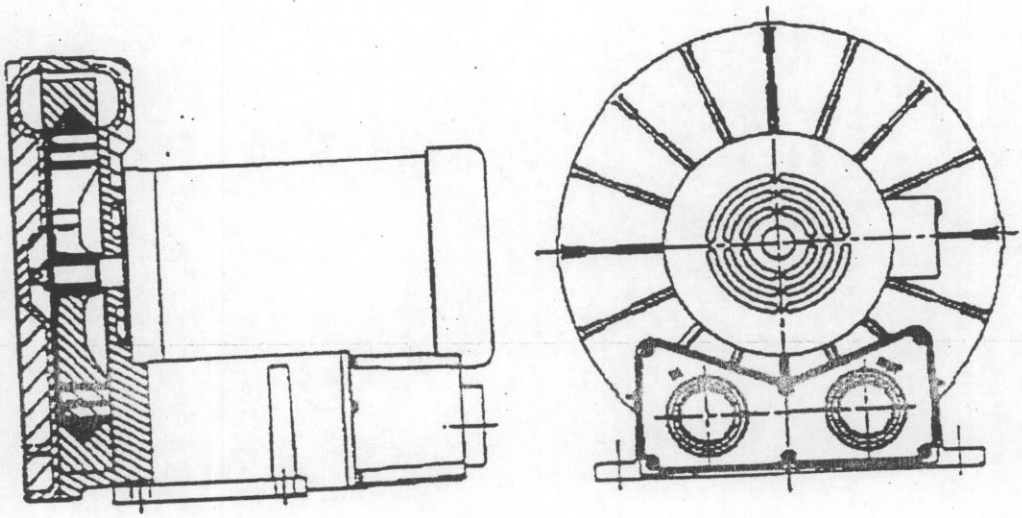
GAST MANUFACTURING, INC.
A Unit of IDEX Corporation
PO Box 97, Benton Harbor, Michigan 49023-0097
Phone: 616-926-6171 • Fax: 616-925-8288

IDEX CORPORATION

GAST

Post Office Box 97
Benton Harbor, Michigan 49023-0097
Ph: 616/926-6171
Fax: 616/925-8288

Maintenance Instructions for Gast Standard Regenerative Blowers



For original equipment manufacturers special models, consult your local distributor

Gast Rebuilding Centers

Gast Mfg. Corp.
2550 Meadowbrook Rd.
Benton Harbor MI. 49022
Ph: 616/926-6171
Fax: 616/925-8288

Gast Mfg Corp.
505 Washington Avenue
Carlstadt, N. J. 07072
Ph: 201/933-8484
Fax: 201/933-5545

Brenner Fiedler. & Assoc.
13824 Bentley Place
Cerritos, CA. 90701
Ph: 310/404-2721
Ph: 800/843-5558
Fax: 310/404-7975

Wainbee, Limited
121 City View Drive
Toronto, Ont. Canada M9W 5A9
Ph: 416/243-1900
Fax: 416/243-2336

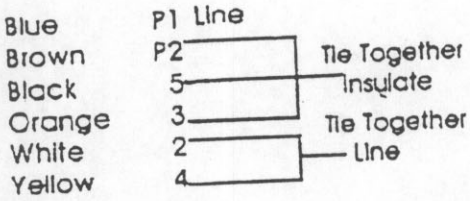
Wainbee, Limited
215 Brunswick Drive
Pointe Claire, P.Q. Canada H9R 4R7
Ph: 514/697-8810
Fax: 514/697-3070

Gast Mfg. Co. Limited.
Halifax Rd. Cressex Estate
High Wycombe, Bucks HP12 3SN
Ph. 44 494 523571
Fax: 44 494 436588

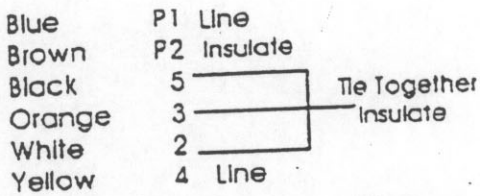
Japan Machinery Co. Ltd.
Central PO Box 1451
Tokyo 100-91 Japan
Ph: 813/3573-5421
Fax: 813/3671-7865

Wiring Diagrams for Regenerative Blowers
Models R1102, R2103, R3105-1, R4110-2, R5125-2, R6125-2

Low Voltage *Single Phase*

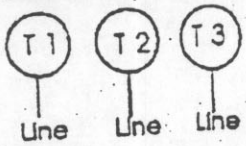


High Voltage *Single Phase*



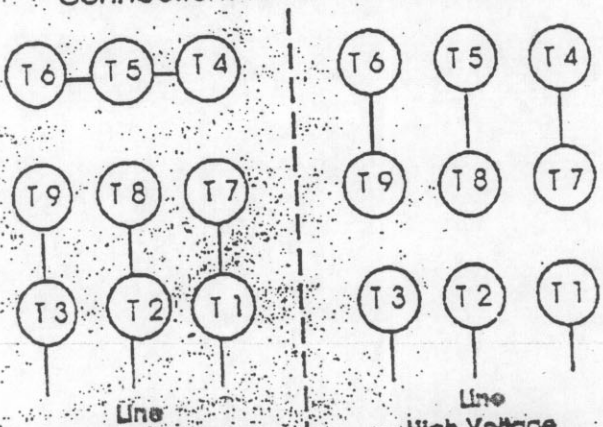
Model R2303F

Connections for 3 Phase, 3 Leads



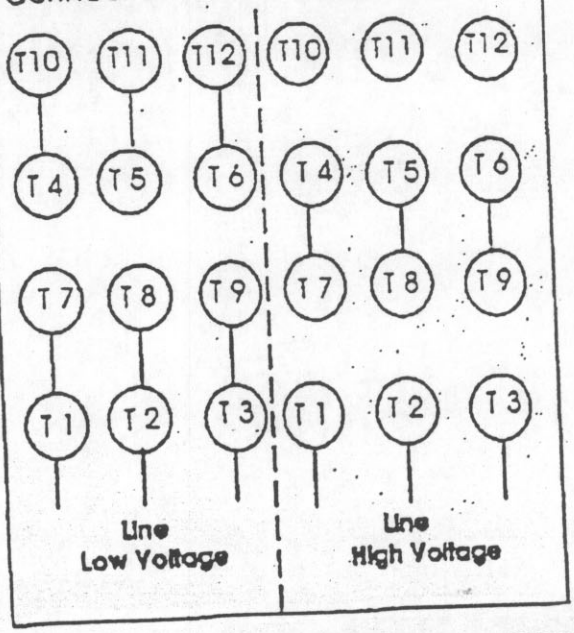
Model R2303A, R3305A-1, R4310A-2, R6350A-2 R6P350A, R6PP3110M, R6PS3110M, R7100A-2

Connections for 3 Phase, 9 Leads



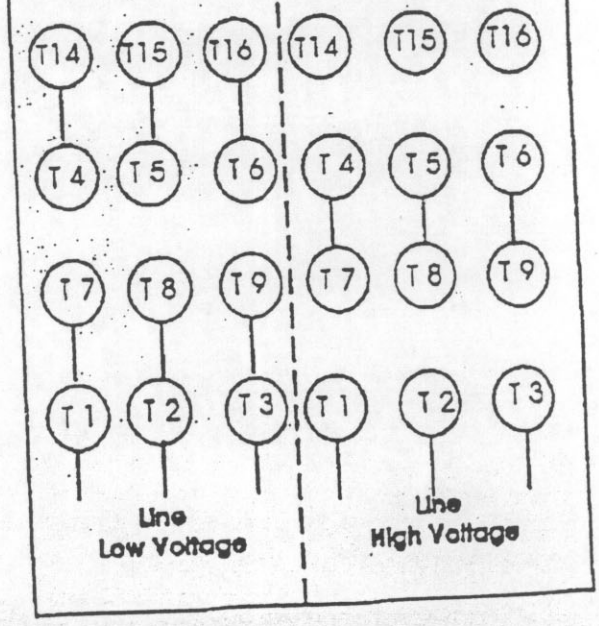
Models R6335A-2, R6P335A

Connections for 3 Phase, 12 Leads

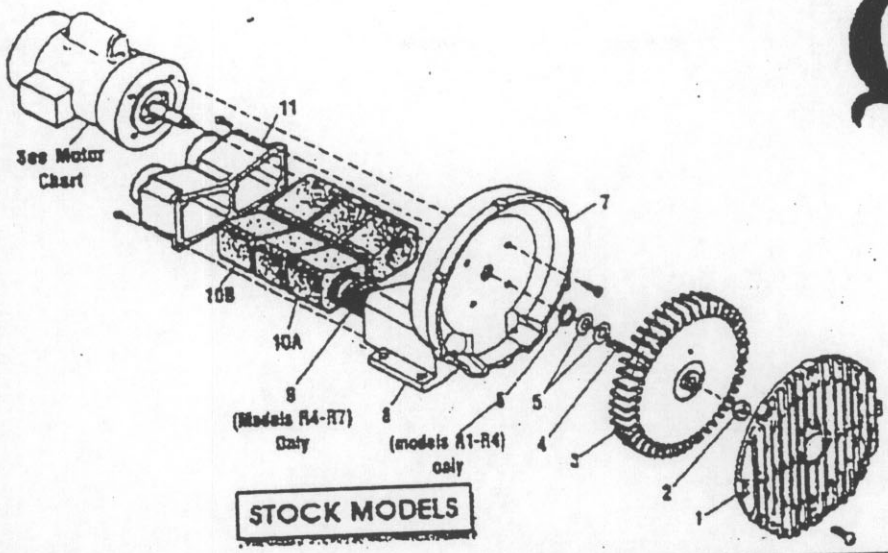


Models R5325A-2, R6325A-2

Connections for 3 Phase, 12 Leads



To reverse rotation on any three phase motor, interchange any two external motor line connections to any two line leads.



STOCK MODELS

Part Name	R1	R2	R3	R4	R5	R6	R6P	R6PP/R6PS	R7
Cover	AJ101A	AJ101B	AJ101C	AJ101D	AJ101EQ	AJ101F	AJ101K	(2)AJ101KA	AJ101G
Stopnut	BC187	BC187	BC181	BC181	BC181	BC181	BC181	(2)BC182	BC183
Impeller	AJ102A	AJ102BQ	AJ102C	AJ102D	AJ102E	AJ102FR	AJ102K	(2)AJ102KA	AJ102GA
Square Key	AH212C	AH212	AB136A	AB136D	AB136	AB136	AB136	(2)AB136	AC628
Shim Spacer (s)	AJ132	AE686-3	AJ109	AJ109	AJ109	A109	A109	A109	AJ110
Retaining Ring	AJ145	AJ145	AJ149	AJ149					
Housing	AJ103A	AJ103BQ	AJ103C	AJ103DR	AJ103E	AJ103F	AJ103K	AJ103KD	AJ103GA
Muffler Box					AJ104E	AJ104F			
Spring				AJ113DR	AJ113DQ	AJ113FQ	AJ113FQ		AJ113G
1A Foam	(4)AJ112A	(4)AJ112B	(4)AJ112C	(4)AJ112DS	(4)AJ112ER	(6)AJ112F	(8)AJ112K		(8)AJ112GA
1B Foam		(2)AJ112BQ	(2)AJ112CQ	(2)AJ112DR	(2)AJ112EQ				
1 Muffler Extension/ Adapter Plate	AJ106A	AJ104BQ	AJ106CQ	AJ106DQ	AJ104ER	AJ106FQ	AJ104K		AJ104GA

MOTOR CHART

REGENAIR MODEL NUMBER	MOTOR NUMBER	MOTOR SPECIFICATIONS 60 HZ VOLTS	50 HZ VOLTS	PHASE
R1102	J112X	115		1
R1102C	J112X			
R2103	J411X	115/208-230	110/220	1
R2105	J411X			
R2303A	J313	208-230	220	3
R2303F	J313			
R3305-1/R3305-13	J410	208-230/460	220/380-415	3
R3305A-1/R3305A-13	J410			
R4310-2	J610	208-230/460	220/380-415	3
R4310A-2	J610			
R5325-2	J810X	208-230/460	220/380-415	3
R5325A-2	J810X			
R6325-2	J810X	208-230/460	220/380-415	3
R6325A-2	J810X			
R6150J-2	J1013	230		1
R6350A-2	J910X	208-230/460	220/380-415	3
R6P335A	J910X			
R6P350A	J1110A	208-230/460	220/380-415	3
R6P355A	J1110A			
R7100A-2	J1100	208-230/460	220/380-415	3
R6PP/R6PS3110M	J01100			
R7R3140M				

* No lubrication needed at start up. Bearings lubricated at factory.

* Motor is equipped with alemite fitting. Clean tip of fitting and apply grease gun. Use 1 to 2 strokes of high quality ball bearing grease.

Typical Grease
Shell Dolium R

Hours of service per year	*Suggested Relube Interval*
5,000	3 years
Continual NormalApplication	1 year
Seasonal service motor idle for 6 months or more	1 year beginning of season 6 months
Continuous-high ambients, dirty or moist applications.	

Safety

This is the safety alert symbol. When you see this symbol, personal injury is possible. The degree of injury is shown by the following signal words:

DANGER: Severe injury or death will occur if hazard is ignored.
WARNING: Severe injury or death can occur if hazard is ignored.
CAUTION: Minor injury or property damage can occur of hazard is ignored.
Review the following information carefully before operating.

General Information

DANGER: Do not pump flammable or explosive gases or operate in an atmosphere containing them. Ambient temperature for normal operation should not exceed 40 degrees C (105 degrees F). For higher ambient operation, consult the factory. Blower performance is reduced by the lower atmospheric pressure of high altitudes. If it applies to this unit, consult a Gast distributor or the factory for details.

Installation

WARNING: Electric Shock can result from bad wiring. Wiring must conform to all required safety codes and be installed by a qualified person. Grounding is required. All single impeller blowers can be mounted in any position. All dual impeller models must be mounted with shaft horizontal. The flow of cooling air over the blower and motor must not be blocked.
PLUMBING - The threaded pipe ports are designed as connection ports only and will not support the plumbing. Be sure to use the same or larger size pipe and fittings to prevent air flow restriction and over-heating of the blower. When installing plumbing, be sure to use a small amount of pipe thread lubricant. This protects the threads in the aluminum blower housing. Dirt and chips, often found in new plumbing, should not be allowed to enter the blower.
WARNING: Do no operate with inlet or exhaust plumbing removed as it protects against the high speed impeller.
NOISE - To reduce noise and vibration, the unit should be mounted on a solid surface that will not increase sound. The use of shock mounts or vibration isolation material is recommended. If needed, inlet or discharge noise can be reduced by attaching muffler assemblies (see accessories).
ROTATION - The Gast Regenair blower should only rotate clockwise as viewed from the electric motor side. This is marked with an arrow in the casting. Proper rotation can be confirmed by checking air flow at the IN and OUT ports. On blowers powered by a three phase motor, rotation is reversed by changing any two of the three power wires.

Operation

WARNING: Solid or liquid material exiting the blower or piping can cause injury.
CAUTION: Attach blower to solid surface before starting to prevent injury or damage from unit movement. Any foreign material passing through the blower can cause internal damage. The use of filters is strongly recommended.
CAUTION: Outlet piping can cause burns. Mark "Caution hot surface" and guard or limit access.
Air temperature increases when passing through the blower. When run at duties above 50 in. H_2O, metal pipe may be required for hot exhaust air.
The blower must not be operated above the limits for continuous duty. "Standard" R1, R2, R3 and R4 can operate continuously with no air flowing through the blower. Other units can only be run at the rating shown on the model number label. Do *not* close off inlet (for vacuum) or exhaust (for pressure) to reduce extra air flow. This will cause added heat and motor load.
ACCESSORIES - Gast pressure gauges AJ496 or AE133 and vacuum gauges AJ497 or AE134 show blower duty. The Gast pressure/vacuum relief valve, AG258, will limit the operating duty by admitting or relieving air. It also allows full flow through the blower when the relief valve closes.

Servicing

WARNING: Disconnect electric power before servicing. Be sure rotating parts have stopped. Electric shock or severe cuts can result. Inlet and exhaust filters need occasional cleaning or replacement of the elements. Failure to do so will result in more pressure drop, reduced air flow and hotter operation. The outside of the unit requires cleaning of dust and dirt. The inside of the blower also may need cleaning to remove material coating the impeller and housing. If not done, the buildup can cause vibration, hotter operation and reduced flow. Noise absorbing foam in the mufflers may need replacement.
KEEP THIS INFORMATION WITH THE BLOWER. REFER TO IT FOR SAFE INSTALLATION, OPERATION OR SERVICE.

TROUBLESHOOTING

Symptom	*Possible Diagnosis*	*Possible Remedy*
Excess Vibration	Impeller damaged or contaminated by foreign material	Replace or Clean impeller. Install adequate filtration.
Abnormal sound	Motor bearing failed Impeller rubbing against cover or housing	Replace bearings Repair Blower, check clearances.
Increase in sound	Foreign material or heat can destroy muffler foam.	Replace foam muffler elements, filter foreign material.
Blown fuse	Electrical wiring problem	Have qualified person check that impeller turns, check fuse, wiring diagram or wiring capacity.
Unit very hot	Running at too high a pressure or vacuum	Install a relief valve and pressure or vacuum gauge

Measurement Accessories

Blower Connection Key
NPT – American National Standard Taper Pipe Thread (Male)
NPSC – American National Standard Straight Pipe Thread for Coupling (Female)
SO – Slip On (Smooth – No Threads)

Air Flow Meter

FEATURES

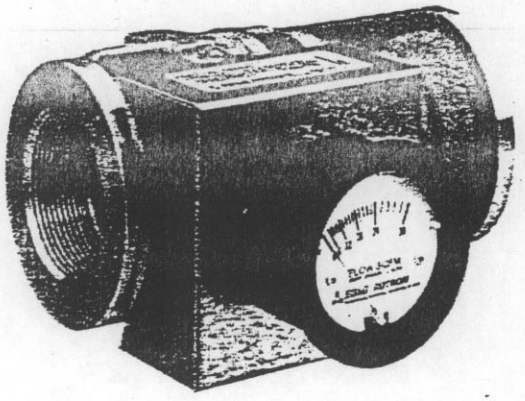
- Direct reading in SCFM
- Low pressure drop (2-4" typical) across the flow meter
- Non-clogging, low impedance air stream
- Light weight aluminum
- No moving parts
- Large easy-to-read dial
- Accurate within 2% at standard conditions
- Good repeatability
- Available in 2", 3" and 4" sizes
- Factory configured for quick installation
- .048" Allen key supplied for gauge adjustment

OPTIONS

- For 4-20 mA outputs and digital readouts see page G-9
- High temperature version (above 140°F)
- Corrosion-resistant version with Chem-Tough™ or in stainless steel
- FDA-approved Food Tough™ surface conversion
- High pressure version (100 PSI)

BENEFITS

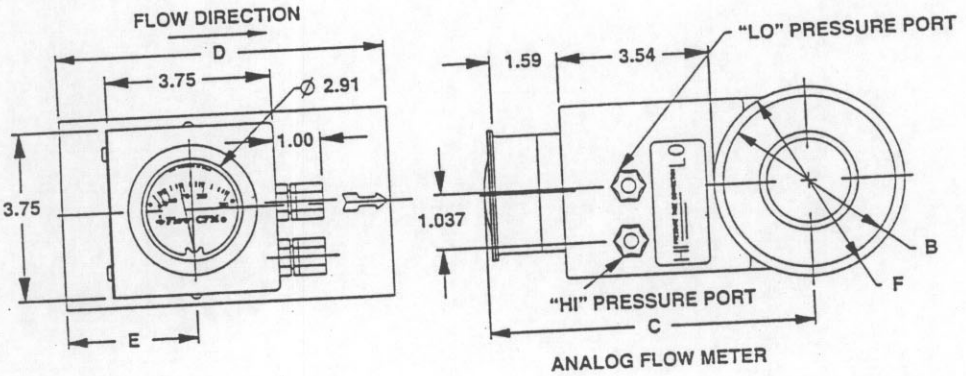
- OPTIMIZE SYSTEM EFFICIENCY
  Measuring the correct air flow can assist you in fine-tuning to your system's optimal efficiency.
- BALANCE MULTI-PIPING SYSTEMS
  When evacuating CFM from more than one pipe, different run lengths or end system impedance can cause one pipe to handle more CFM than the other. With an accurate CFM reading, piping can be balanced by bleeding air in/out or by creating an extra impedance.
- DETECT CHANNELING OR PLUGGING
  For systems in which channeling or plugging can occur, a change in the CFM measured can help indicate the unseen changes in your system.



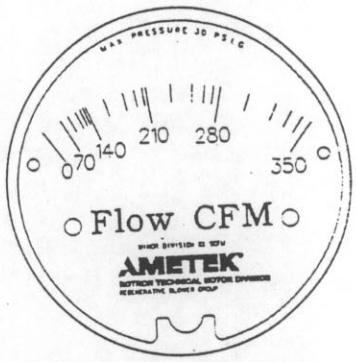
Current Models		Flow Range	B	C	D	E	F	Replaces	
Model	Part #	(SCFM)	Threads	Length	Width			Model	Part #
FM20C030Q	550599	6-30	2" - 11.5 NPSC	7.18"	7.0"	2.0"	3.75"	FM20A030Q	550312
FM20C045Q	550600	9-45						FM20A045Q	550313
FM20C065Q	550601	13-65						FM20A065Q	550314
FM20C125Q	550602	25-125			5.6"			FM20A125Q	550256
FM20C175Q	550603	35-175						FM20A175Q	550255
FM20C225Q	550604	45-225						FM20A225Q	550254
FM30C250Q	550605	50-250	3" - 8 NPSC	7.52"	7.4"	2.5"	4.43"	FM30A250Q	550259
FM30C350Q	550606	70-350						FM30A350Q	550258
FM30C475Q	550607	95-475						FM30A475Q	550257
FM40C450Q	550608	90-450	4" - 8 NPSC	8.00"	7.7"	2.7"	5.43"	FM40A450Q	550262
FM40C600Q	550609	120-600						FM40A600Q	550261
FM40C850Q	550610	170-850						FM40A850Q	550260

Blower Model Reference Key	
A = SPIRAL	E = DR/EN/CP 606, S543, 6, 623, S7, S75
B = DR/EN/CP 068, 083, 101, 202	F = DR/EN/CP 707, 808, S85, 858, S9, P9 (Inlet Only)
C = DR/EN/CP 303, 312, 313, 353	G = DR/EN/CP 823, S13, P13 (Inlet Only)
D = DR/EN/CP 404, 454, 513, 505, 555, 523	H = DR/EN/CP 909, 1223, 14, S15, P15 (Inlet Only)

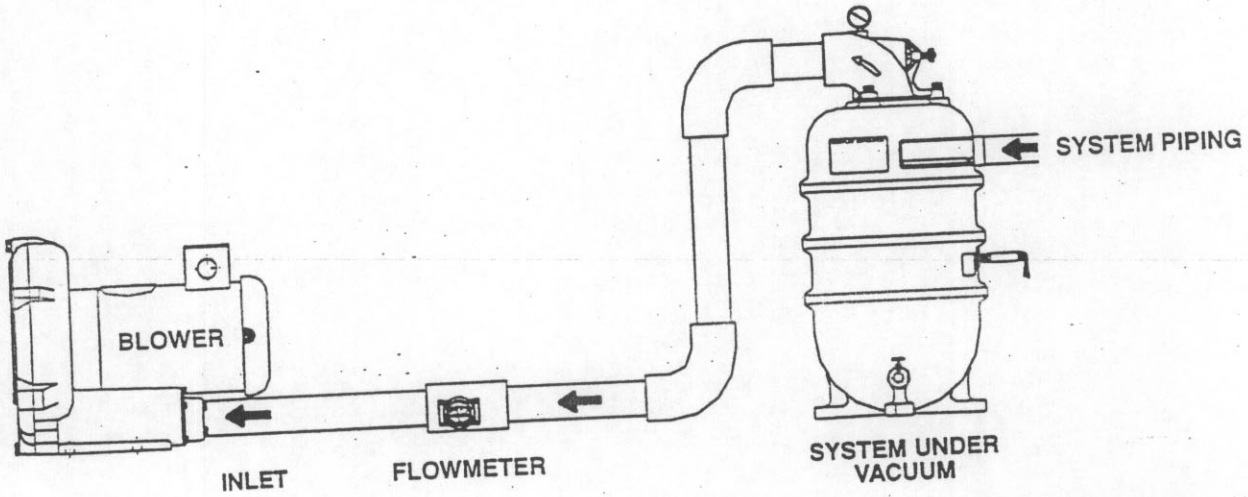
TYPICAL FLOW METER ARRANGEMENT



ANALOG FLOW METER



TYPICAL GAUGE FACE



HIGH TEMPERATURE/PRESSURE CORRECTION

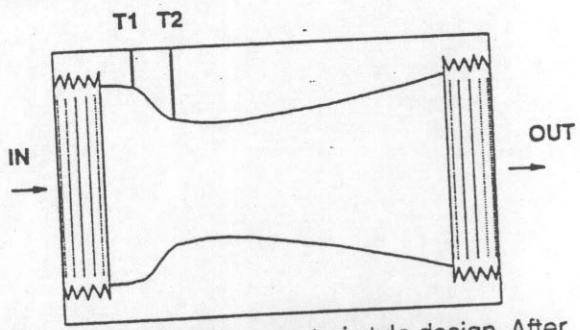
$$SCFM_2 = \frac{SCFM_1}{\sqrt{\left(\frac{14.7}{Pf_2}\right) \times \left(\frac{530}{Tf_2 + 460}\right)}}$$

Pf_2 = Absolute Pressure in PSIA

Tf_2 = Temperature in °F

- Use on inlet to limit need to correct for high pressure or elevated outlet temperature
- Standard model limits = 140°F and 30 PSIG

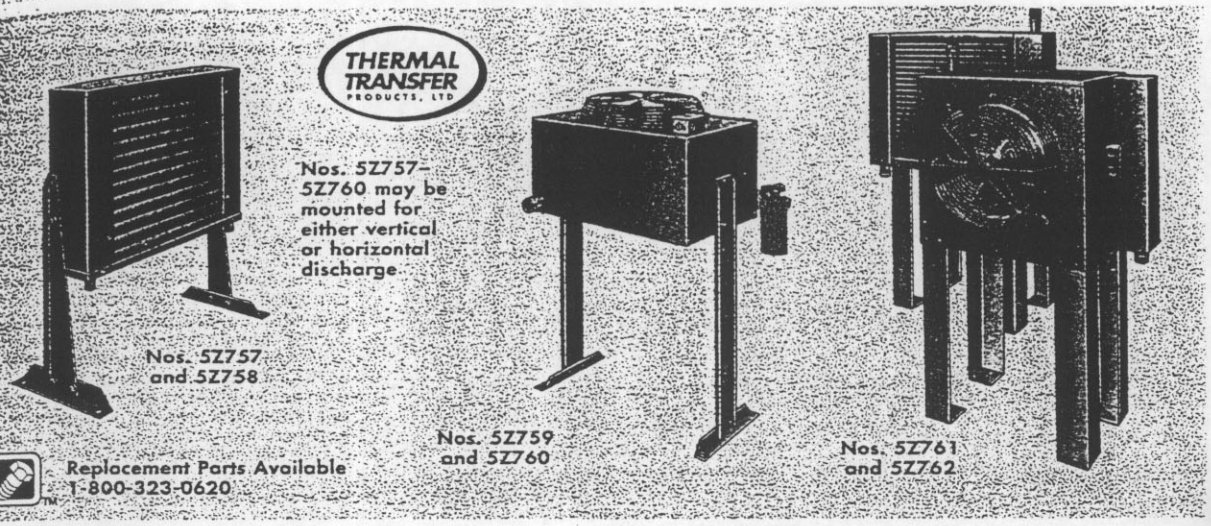
HOW IT WORKS



Rotron's flow meter is a venturi style design. After air enters the inlet, the pressure is measured in the T1 tap. The second tap, T2, measures the pressure at the throat. The differential between T1 and T2 registers across a special calibrated CFM gauge to provide accurate readings. The throat is then expanded back to the original size to keep pressure loss to under 2-4 IWG.

AIR-COOLED AND WATER-COOLED AFTERCOOLERS

AIR-COOLED AFTERCOOLERS



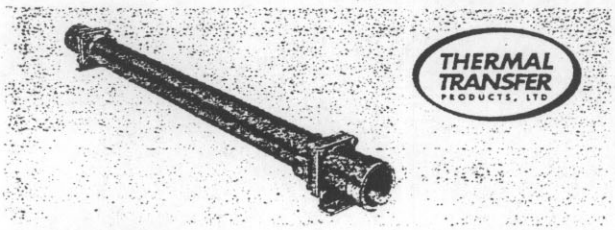
- Remove harmful water, oil, and contaminants from compressed air systems
- Precool hot air from compressor to temperatures required for use with compressed air dryers
- High efficiency copper tube/aluminum fin heat exchangers provide close approach temperatures with minimal power consumption
- Heavy-duty construction for long, trouble-free life
- Single point electrical junction box for ease of installation
- Includes legs
- Nos. 5Z759-5Z762 include ambient air filter to protect core from airborne contaminants
- Guards conform to OSHA requirements
- Fan motors are UL Recognized, CSA Certified
- Min. 80 PSI, max. 250 PSI, 350°F max.

NOTE: Use of flexible metal hose between air compressor and aftercooler is recommended to prolong equipment life. Separator and drain required to remove condensed water and oil. See Index for hose, separators, and drains.

Maximum Comp. HP	Max. CFM @ 100 PSI*	Fan HP	Volts, 60 Hz	Max. Amp/Draw	Inlet / Outlet (M)NPT (In.)	Dimensions (In.) H	W	D	Stock No.	List	Each	Shpg. Wt.
5	20	1/12	115/230	2.4/1.2	1/2	21 7/8	20 3/8	9 5/8	5Z757	$386.83	$299.25	24.0
10	35	1/12	115/230	2.4/1.2	1/2	21 7/8	20 3/8	9 5/8	5Z758	430.14	335.25	30.0
15	50	1/12	115/230	2.4/1.2	1	42 1/4	26 1/8	15 1/2	5Z759	564.31	437.00	65.0
25	100	1/12	115/230	2.4/1.2	1 1/2	42 1/4	26 1/8	15 1/2	5Z760	752.13	582.50	68.0
35	150	1/4	115	7.2	1 1/2	46 1/2	43 1/2	17 3/4	5Z761	993.86	767.50	150.0
→ 50	240	1/4(2)	115	7.2†	2	49 1/2	47 5/8	17 3/4	5Z762	1304.03	1011.00	164.0

(*) Ratings based on 15°F approach with 250°F inlet temperature. (†) Two motors, 7.2 each.

WATER-COOLED AFTERCOOLERS



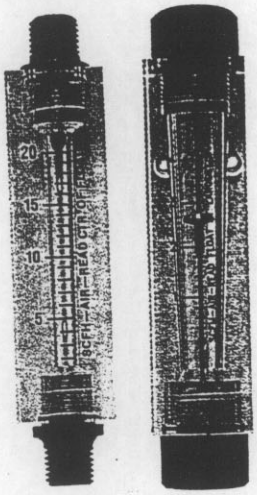
- Remove damaging water, oil, and contaminants from compressed air systems
- Highly efficient cooler is built with corrosion resistant copper tubes, brass shell, and internal baffles
- 3 GPM of cooling water needed per 100 CFM of air
- Cast-iron end bonnets are removable for servicing

For best performance, install aftercoolers so water flows in opposite direction to compressed air. 250 PSI maximum air pressure, 250 PSI maximum water pressure. 350°F maximum operating temperature. Mounting feet at both ends.

Maximum Comp. HP	Max. CFM @ 100 PSI*	Cooling Area Surface (Sq. Ft.)	NPT Inlet & Outlet (In.) Water	Air	Dimensions (In.) Length	Width	Height	Stock No.	List	Each	Shpg. Wt.
10	40	3.5	1/2	1	23 1/4	3 1/8	3 1/2	5Z625	$254.65	$202.50	10.0
25	110	4.7	1/2	1 1/2	36 5/8	3 1/8	3 1/2	5Z626	285.76	227.75	15.0
60	300	18.0	1	2 1/2	50 5/16	5 1/4	6 1/4	5Z627	555.87	441.75	44.0

(*) Cooling compressed air to 15°F above inlet water temperature. Note: 3 GPM water flow required for each 100 SCFM.

Cole-Parmer® Economical Direct-Reading Flowmeters

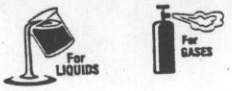


50-mm flowmeter 03279-06 *50-mm flowmeter 03279-50*

- *Easy to install and operate*
- *Made of sturdy acrylic*

These flowmeters are easy to operate and install—mount vertically in your in-line system. Use these direct-reading flowmeters for your general-purpose applications. Precision bored to close tolerances for high resolution. Flowmeters for air are factory-calibrated at standard temperature and pressure (70°F and 14.7 psi); flowmeters for liquids are factory calibrated for liquids with 1.0 specific gravity.

Flowmeters are constructed of a solid block of clear acrylic and a 316 stainless steel float. Other wetted materials include acrylic metering tube, 316 stainless steel guide rod, polysulfone float stops, EPR O-rings, and PVC end fittings (except 127-mm round flowmeters for air applications, which have aluminum end fittings).



Specifications

Accuracy
50-mm flowmeters: ±6% full-scale
127-mm flowmeters: ±2.5% full-scale

Repeatability
50-mm flowmeters: ±2% full-scale
127-mm flowmeters: ±0.5% full-scale

Maximum operating temperature:
130°F (54°C)

Maximum pressure
Liquid models: 150 psi
Air models: 100 psi

Flowmeter type	Dimensions		Connections	Shpg wt
	Height	Diameter		
50 mm	4¾"	1⅜"	¼" NPT(M)	1 lb (0.5 kg)
127 mm	9¼"	1⅜"	½" NPT(F)	1 lb (0.5 kg)
03248-64 thru -70	10¼"	2"	1" NPT(F)	2 lb (1.0 kg)
03248-72 and -73	12⅛"	2"	1½" NPT(M)	4 lb (1.9 kg)
03248-74 thru -83	13¼"	3"	2" NPT(F)	4 lb (1.9 kg)
03248-96 and -97	10¼"	2"	1" NPT(F)	2 lb (1.0 kg)
03248-98 and -99	13¼"	3"	2" NPT(F)	4 lb (1.9 kg)

For liquid applications			For air applications		
Cat. no.	Flow rate	Price	Cat. no.	Flow rate	Price
50-mm flowmeters (square)					
P-03247-32	7 GPH	$ 37.00	P-03279-00	2 scfh	$ 37.00
P-03247-34	12 GPH	37.00	P-03279-02	5 scfh	37.00
P-03247-36	22 GPH	37.00	P-03279-04	10 scfh	37.00
P-03247-38	40 GPH	37.00	P-03279-06	20 scfh	37.00
P-03248-40	60 GPH	37.00	P-03279-08	30 scfh	37.00
P-03248-41	75 GPH	37.00	P-03279-10	60 scfh	37.00
P-03248-46	1.0 GPM	48.00	P-03279-50	4 scfm	43.00
P-03248-48	2.0 GPM	48.00	P-03279-52	8 scfm	43.00
P-03248-49	3.5 GPM	48.00	P-03279-54	14 scfm	43.00
P-03248-50	5.0 GPM	48.00	P-03279-56	20 scfm	43.00
127-mm flowmeters (square)					
P-03248-56	1.0 GPM	64.00	P-03248-92	4 scfm	64.00
P-03248-58	5.0 GPM	64.00	P-03248-93	8.2 scfm	64.00
—	—	—	P-03248-94	14 scfm	64.00
—	—	—	P-03248-95	20 scfm	64.00
127-mm flowmeters (round)					
P-03248-64	10.0 GPM	160.00	P-03248-96	40 scfm	190.00
P-03248-66	15.0 GPM	160.00	P-03248-97	62 scfm	190.00
P-03248-68	21.0 GPM	160.00	P-03248-98	165 scfm	545.00
P-03248-70	30.5 GPM	168.00	P-03248-99	245 scfm	545.00
P-03248-72	40.0 GPM	200.00	—	—	—
P-03248-73	50.0 GPM	200.00	—	—	—
P-03248-74	60.0 GPM	480.00	—	—	—
P-03248-77	100 GPM	480.00	—	—	—
P-03248-83	200 GPM	480.00	—	—	—

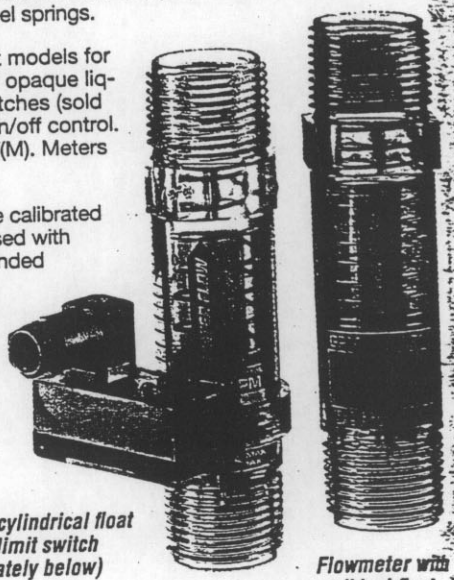
Direct Reading In-Line Flowmeters

- *Mount in any position and still get accurate readings*
- *Order a limit switch for on/off control of pumps and valves*

These low-cost flowmeters are built with a spring-retained piston for direct, accurate readings regardless of the position you mount them. Use them in hydraulic systems, for chemical processing, or for determining pump performance. Meters are built with polysulfone bodies and stainless steel springs.

Choose cylindrical float models for maximum visibility with opaque liquids. Use with limit switches (sold separately below) for on/off control. Connectors are 1" NPT(M). Meters measure 5¼"H.

Ribbed float models are calibrated for water and can be used with liquids that have suspended solids up to 400-µm in diameter. Meters with 1" NPT(M) plastic connectors measure 5¼"H; meters with ¾" NPT(M) brass connections measure 8¼"H.



Flowmeter with cylindrical float shown with limit switch (sold separately below)

Flowmeter with ribbed float

Specifications

Accuracy: ±7% of full-scale
Repeatability: ±1.0%
Maximum pressure: 250 psi

Maximum fluid temperature:
180°F (82°C)
Shpg wt: 1 lb (0.5 kg)

Flowmeters with Cylindrical Floats (1" NPT(M) end fittings)

Range (GPM)	Water flowmeters*		Oil flowmeters*	
	Cat. no.	Price	Cat. no.	Price
0.5 to 4	P-03231-00	$55.00	P-03231-20	$55.00
1 to 7	P-03231-05	55.00	P-03231-25	55.00
1 to 10	P-03231-10	55.00	P-03231-30	55.00
1 to 16	P-03231-15	55.00	P-03231-35	55.00

Flowmeters with Ribbed Floats (calibrated for water*)

Range (GPM)	1" NPT(M)		¾" NPT(M)	
	Cat. no.	Price	Cat. no.	Price
1.5 to 7	P-03231-40	$40.00	P-03231-50	$68.00
3 to 10	P-03231-42	40.00	P-03231-52	68.00
3 to 17	P-03231-44	40.00	P-03231-54	68.00
4 to 24	P-03231-46	40.00	P-03231-56	68.00

*Water flowmeters are calibrated for specific gravity = 1.00; oil flowmeters are calibrated for specific gravity = 0.876.

Limit switches for use with flowmeters that have cylindrical floats (models 03231-00 through -35). Use for on/off control of pumps, valves, alarms, or other equipment associated with flow devices.

P-03231-70 Limit switch; 100 to 200 VAC, 0.02 to 1.0 amp $88.00
P-03231-75 Limit switch; 7 to 24 VDC, 0.5 amp $88.00

C-P Facts-on-Demand™
1-800-410-6090
International
1-847-247-2932

For pressure drop information regarding flowmeters on this page, call and enter document no. 24510. Pressure drops will be faxed to you instantly.

About Pressure Gauges

General service gauges work with noncorrosive gases and liquids such as air, water, and steam. The wetted parts (bourdon tube or diaphragm, and connection socket) are typically made of a copper alloy such as brass or bronze.

Corrosive service gauges measure the pressure of mild acids and bases. The wetted parts are usually Type 316 stainless steel. If you're dealing with highly corrosive media, we recommend using a diaphragm seal between the medium and your gauge (see page 395).

ASME (ANSI) Accuracy—Gauge accuracy is categorized by ASME (ANSI) standard B40.1. We offer gauges in the following ASME (ANSI) grades:

Grade B—Calibrated to an accuracy of ±2% of span over the middle half of scale and ±3% of span over the first and last quarters of the scale. Though often used in industry, they're commonly referred to as commercial and utility gauges.

Grade A—Calibrated to an accuracy of ±1% of span over the middle half of the scale and ±2% over the first and last quarters of the scale. These industrial gauges are more accurate than Grade B but less accurate than Grade 1A.

Grade 1A—Calibrated to an accuracy of ±1% of span over the entire range of the gauge, making them a good choice for many demanding industrial applications.

Grade 2A—Calibrated to an accuracy of ±.5% of span over the entire range of the gauge. Commonly called process gauges, they're used for measuring process pressure.

Grade 3A—Calibrated to an accuracy of ±.25% of span over the entire range of the gauge. Use these as test gauges.

Grade 4A—Calibrated to an accuracy of ±.1% of span over the entire range of the gauge. These gauges are generally used in laboratories as precision test instruments.

Environment and Case Selection—In a clean, dry, noncorrosive environment, a painted-steel-case gauge will be adequate. Brass is an economical way to go in damp areas, and stainless steel cases are better in corrosive environments. In situations that allow use of plastic, the ABS-case gauges can save you money and will perform excellently in dry as well as damp and corrosive environments.

Dry or Liquid-Filled—Most of the gauges we offer are "dry," containing only the gauge mechanism inside the case. These work well for most applications. In some environments, however, vibration and pressure fluctuations can cause the gauge needle to jump, making the gauge more difficult to read. Liquid-filled gauges contain glycerin, reducing this "pointer flutter." An air bubble inside allows for expansion due to temperature changes.

Dial Face—The term ***"Dial Size"*** refers to the diameter of the dial face, not the overall gauge diameter. ***"Figure Intervals"*** refers to the distance (in psi) between figures on the dial face. ***"Graduation Marks"*** refers to the hash marks between the figure intervals. For example, this gauge illustrated above has figure intervals of 10 psi and graduation marks of 2 psi means you'll find a numeral every 10 psi and hash marks at every 2 psi on the dial face.

Range Selection—Choose a gauge with a full-scale pressure range that is approximately twice the required normal operating pressure. The maximum operating pressure should not exceed 75% of the full scale range. Failure to select a range within these criteria may result in fatigue failure of the bourdon tube or diaphragm.

Connection Diagrams
Gauges are available in one or more of the connection styles pictured here. Each gauge listing contains its available connection styles.

General Service Pressure Gauges

Painted-Steel Case Gauges — Grade B


Single Scale

- Copper-alloy bourdon tube
- ¼" NPT male copper-alloy connection (1½" is ⅛" NPT)
- Polycarbonate lens (4½" is glass)
- Available with psi/kPa dual scale
  psi single scale
  kPa single scale

Dual scale models display both psi and kPa pressure ranges. **To Order** Please specify the pressure range in psi using the psi table.

Single scale models display psi or kPa pressure ranges. **To Order** Please specify the pressure range (in psi or kPa) from the appropriate table.

psi Pressure Ranges Available

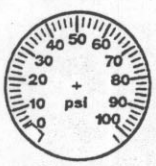
Pressure Range, psi	Figure Intervals, psi	Graduation Marks, psi
0- 15	1	0.5
0- 30	5	0.5
0- 60	5	1
0- 100	10	2
0- 160	20	5
0- 200	20	5
0- 300■	50	5
0- 400	50	10
0- 600▲	100	20
0-1,000	200	20
0-2,000	400	50
0-3,000	500	100
0-5,000	1,000	100

kPa Pressure Ranges Available

Pressure Range, kPa	Figure Intervals, kPa	Graduation Marks, kPa
0- 100	10	2
0- 200	20	5
0- 400	50	10
0- 700	100	20
0- 1,100	200	20
0- 1,400	200	20
0- 2,000	200	50
0- 2,800	400	50
0- 4,200	1000	100
0- 7,000	1000	200
0-14,000	2000	200
0-20,000	5000	1000
0-35,000	5000	1000

■ Single scale has figure intervals at 30 psi.
▲ Single scale has figure intervals at 50 psi; graduation marks at 10 psi.


Dual Scale


Single Scale

Dial Size	Bottom Connection	Each	Center Back Connection	Each	Panel Mount Center Back Connection	Each
psi/kPa Dual Scale						
1½"	4000K507★	$11.49	4000K508★	$11.89	4000K509★	$14.79
2"	4000K511	10.95	4000K515	11.90	4000K518	16.40
2½"	4000K512	11.94	4000K516	13.94	4000K519	17.54
3½"	4000K513	15.99	4000K517	16.95	4000K521	26.49
4½"	4000K514♦	21.12	—	—	—	—
psi Single Scale						
1½"	3846K3★	11.49	3846K5★	11.89	3846K7★	14.79
2"	3846K13	10.95	3846K15	11.90	3846K17	16.40
2½"	3846K23	11.94	3846K25	13.94	3846K27	17.54
3½"	3846K71	15.99	3846K75	16.95	3846K77	26.49
4½"	3846K81♦	21.12	—	—	—	—
kPa Single Scale						
1½"	3803K11★	10.82	3803K12★	10.60	3803K13★	14.79
2"	3803K14	10.03	3803K15	10.57	3803K16	14.95
2½"	3803K17	11.64	3803K18	13.82	3803K19	17.54
3½"	3803K21	15.48	3803K22	16.75	3803K23	26.32
4½"	3803K24♦	21.13	—	—	—	—

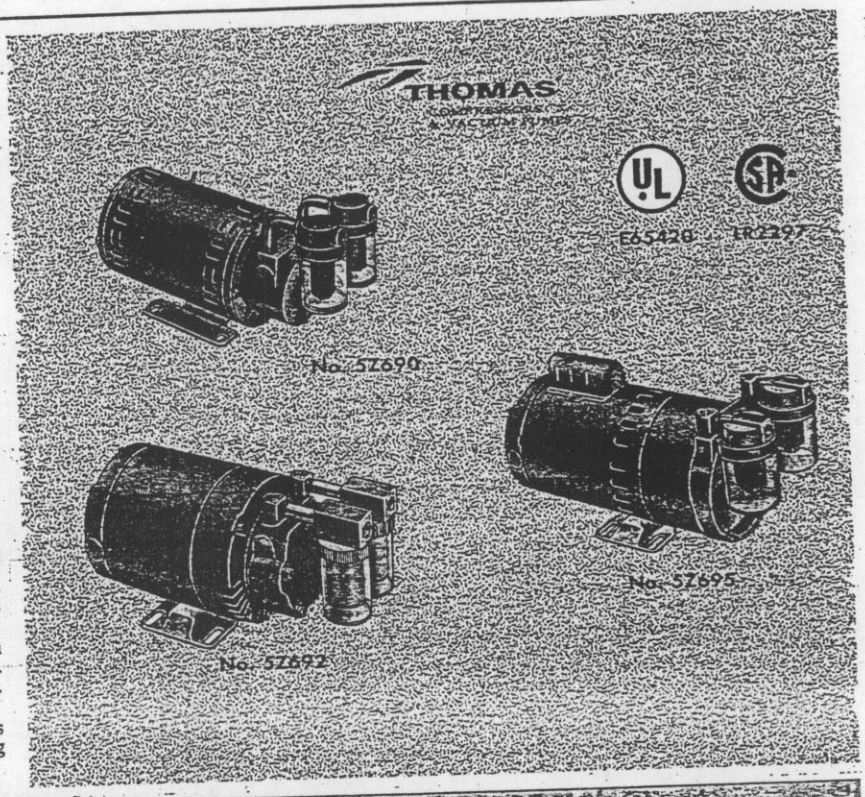
★ 1½" dial size: pressure ranges up to 300 psi/2,000 kPa. ♦ 4½" dial size: pressure ranges up to 600 psi/4,200 kPa.

ROTARY VANE VACUUM PUMPS AND VACUUM/PRESSURE RELIEF VALVES

- Oil-less design prevents downstream oil contamination problems, allows mounting in non-regular maintenance areas, and provides long life
- Self-adjusting, self-lubricating vanes for maximum efficiency and sustained pump capacity throughout service life
- Cast iron pump housing provides strength and durability as well as an optimum running surface for vanes
- Permanently lubricated and sealed bearings provide long, service-free life
- All models include intake and exhaust filters. For use as a compressor; units are easily converted by removing discharge filter

Rotary vane compressors and vacuum pumps for continuous duty in general vacuum and low pressure applications such as aeration, vacuum frames, packaging equipment, printing presses, air sampling, and graphic arts. Time proven rotary pump design with integral motor combine to provide a high efficiency pneumatic or vacuum supply in a compact unit. Precision machined surfaces provide close tolerance alignment of moving parts for high quality products with maximum performance and long life. Open dripproof, ball bearing motors with automatic reset thermal protection. Ambient temperature range: 35° to 95°F. Gray enamel finish.

NOTE: Units may not fit your applications as is. Additional plumbing or mounting alterations may be required.



PERFORMANCE DATA

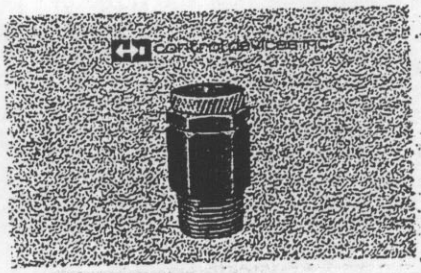
HP	Stock No.	Free Air CFM @ Vacuum (Hg") 0	5	10	15	20	25	Max. Vac.	Free Air CFM @ Pressure (PSI) 0	5	10	Max. PSI Cont. / Int.†	Port Size (F)NPT Inlet	Outlet
1/10	5Z690*	1.50	1.10	0.80	0.50	0.20	—	24"	1.50	1.20	0.95	10/10	1/8"	1/8"
1/8	5Z691*	1.85	1.45	1.05	0.65	0.24	—	23	1.85	1.60	1.15	15/15	1/4	1/4
1/6	5Z692*	3.00	2.35	1.75	1.10	0.50	—	24	3.00	2.40	1.80	10/10	1/4	1/4
1/4	5Z693*	4.00	3.25	2.46	1.75	0.92	0.25	26	4.00	3.60	3.20	10/10	1/4	1/4
1/2	5Z694	7.20	5.90	4.43	3.10	1.66	0.30	26	7.20	6.70	6.20	10/15	3/8	3/8
3/4	5Z695	10.00	8.10	6.15	4.30	2.31	0.40	26	10.00	9.50	9.00	10/10	3/8	3/8

(*) Perfomance rated with motor run at 60 Hz. If 50 Hz is used, deduct 17% from ratings.
(†) Intermittent duty not to exceed 15 minute operating intervals.

ORDERING DATA

HP	Volts	Full Load Amps @ 115V, 60 Hz	Hz	RPM	Dimensions (In.) L	W	H	Thomas Model	Stock No.	List	Each	Shpg. Wt.
1/10	115	1.3	50/60	1725	8 1/2	4	5	SR-0015-VP	5Z690	$255.63	$242.00	8.5
1/8	115	2.9	50/60	1725	12	5 3/4	6	TA-0015-V	5Z691	318.81	306.25	17.0
1/6	115	3.4	50/60	1725	14	6 3/8	7 1/4	TA-0030-V	5Z692	343.70	330.00	32.0
1/4	115	4.6	50/60	1725	14 3/8	6 3/8	7 1/4	TA-0040-V	5Z693	349.74	336.75	24.0
1/2	115/230	8.4	60	1725	16 3/4	6 1/2	7 3/4	TA-0075-V	5Z694	522.06	503.50	42.0
3/4	115/230	9.4	60	1725	17	6 1/2	7 3/4	TA-0100-V	5Z695	577.26	556.50	44.0

VACUUM/PRESSURE RELIEF VALVES



- Relieve vacuum from 0-30" Hg., pressure to 20 PSI
- Easily convert from vacuum to pressure relief by reversing poppet and spring

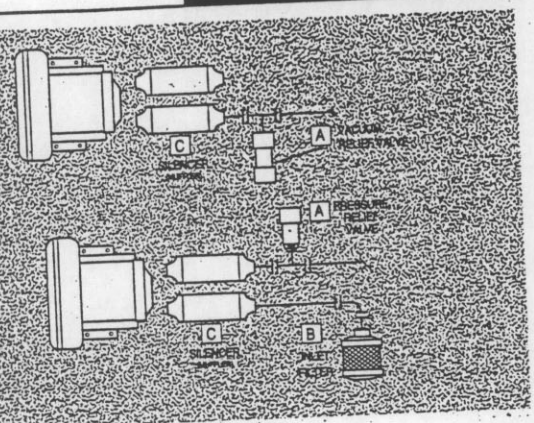
Compatible with rotary vane, diaphragm, and piston pumps to 3 HP. To size, match maximum air flow of vacuum pump/compressor to maximum flow capacity of relief valve. Brass body with zinc plated wire spring. Poppet on Stock No. 5Z763 is chrome steel ball; Nos. 5Z764 and 5Z765 have nylon poppet with nitrile seal.

Flow Cap. CFM	(M)NPT Inlet (In.)	Length (In.)	Hex (In.)	Mfr's. Model	Stock No.	List	Each	Shpg. Wt.
0-2	1/4	1 3/4	9/16	VR-25	5Z763	$8.10	$7.88	0.2
0-15	3/8	2	11/16	VR-33	5Z764	14.15	12.75	0.3
0-54	3/4	2 3/4	1 1/16	VR-75	5Z765	34.90	28.80	0.4

REGENERATIVE BLOWER ACCESSORIES

REGENERATIVE BLOWER APPLICATION CHART

Application	Example	Pressure	Vacuum
Aeration	Fish Hatcheries–Sewage	•	
Agitation	Spas–Chemical Baths	•	
By-Product Recovery	Debris–Dental	•	•
Cushioning	Printing–Paper	•	•
Drying/Cooling	Film–Paint–Dry Cleaners–Printing	•	•
Exhausting	Clean Rooms–Nonaggressive Fumes	•	•
Material Transport	Small Pellets–Powders	•	
Misting	Lubricants–Paint–Printing	•	•
Oxygenation	Furnaces–Chemical Baths		•
Packaging	Blister–Shrink Wrap		•
Pneumatic Conveying	Bank & Mail Systems–Plastics	•	•
Separation	Printing–Paper		•
Degasing	Dairy–Plastic Molding		•



FUJI

[A] VACUUM AND PRESSURE RELIEF VALVES

- Protect regenerative blowers (ring compressors) from overheating
- Relief valves for either vacuum or pressure (deadhead) conditions
- Field adjustable for use with other manufacturer's regenerative blowers (ring compressors)

Vacuum and pressure relief valves are preset at minimum air flow or maximum pressure/vacuum level for Fuji regenerative blowers. Field adjustable for Gast, Rotron, Siemens, and Spencer regenerative blowers (see Fuji Regenerative Blower Cross-Reference listed on facing page).

Valve Type	Preset Limit In. / Water (In.)	For Regen. Blower Stock No.	Connection (In.)	Fuji Model	Stock No.	List	Each	Shpg. Wt.
Vacuum	39	5Z187, 5Z649	1½ (F)NPT	VV3	5Z573	$128.07	$117.95	1.8
	42	4Z751, 4Z752	1½ (F)NPT	VV4	5Z574	128.07	117.95	2.0
	60	4Z753, 5Z650	1½ (F)NPT	VV5	5Z575	128.07	117.95	1.8
	86	5Z188	2 (F)NPT	VV6	5Z576	147.95	136.70	2.7
	85	5Z651	2 (F)NPT	VV7	5Z652	147.95	136.70	2.3
	100	5Z189, 5F243*	2 (F)NPT	VV8	5Z653	147.95	136.70	2.3
Pressure	42	5Z187, 5Z649	1½ (M)NPT	PV3	5Z577	103.21	97.10	1.3
	46	4Z751, 4Z752	1½ (M)NPT	PV4	5Z578	103.21	97.10	1.5
	68	4Z753, 5Z650	1½ (M)NPT	PV5	5Z579	103.21	97.10	1.8
	100	5Z188	1½ (M)NPT	PV6	5Z580	128.07	117.95	1.8
	98	5Z651	1½ (M)NPT	PV7	5Z654	128.07	117.95	2.1
	127	5Z189, 5F243*	1½ (M)NPT	PV8	5Z655	128.07	117.95	1.8

(*) 2 required for 5F243.

[B] INLET FILTERS WITH REPLACEABLE COVERS

- Filter particles from inlet air to protect regenerative blowers
- Can be used with other manufacturer's regenerative blowers

Inlet filters are specifically designed to protect regenerative blowers (ring compressors) by filtering damaging particles from inlet air. Filters have perforated outer cylinders. Inner cylinder is wrapped with fine (0.009") mesh screen.

Replaceable filter covers are made of 7/8" thick, 100% polyester filter media. Provide 80% efficiency to 5 microns. Can also be used with Gast, Rotron, Siemens, and Spencer regenerative blowers (see Fuji Regenerative Blower Cross-Reference listed on facing page).

INLET FILTERS WITH COVERS

Ht. (In.)	Dia. (In.)	Inlet (M)NPT (In.)	For Regen. Blower Stock Nos.	Fuji Model	Stock No.	List	Each	Shpg. Wt.
7³/₈	3⅞	1¼	5F241, 4Z749, 5F242 4Z750, 5Z187, 5Z649	F-123	5Z581	$95.69	$87.50	1.5
8	5⅛	1½	4Z751, 4Z752 4Z753, 5Z650	F-45	5Z582	106.45	97.25	2.8
14	5⅛	2	5Z188, 5Z651	F-67	5Z583	128.07	116.90	3.1
23½	8¼	3	5Z189, 5F243	F-89	5F244	338.20	311.75	8.5

REPLACEMENT FILTER COVERS

For Use With Filter No.	Fuji Model	Stock No.	List	Each	Shpg. Wt.
5Z581	C-123	5Z584	$10.05	$9.56	0.2
5Z582	C-45	5Z585	12.25	11.52	0.1
5Z583	C-67	5Z586	14.22	13.48	0.5
5F244	C-89	5F245	21.76	20.62	0.3

[C] MUFFLERS

- Specifically designed for quieting regenerative blowers operating for pressure or vacuum
- One muffler will lower sound level (at 1 meter) by 5 dBa

Mufflers for use in environments where noise level reduction is desired or required to comply with specified or regulated noise levels. Mufflers will reduce noise levels by 5 dBa; a 3 dBa reduction lowers noise levels by 50%. Can be used on inlet and/or outlet side and/or in the pressure relief valve circuit.

Inlet (F)NPT (In.)	For Fuji Regenerative Blower Stock Nos.	Dimensions (In.) L	Dia.	Fuji Model	Stock No.	List	Each	Shpg. Wt.
1	5F241, 4Z749, 5F242, 4Z750 5Z187, 5Z649	12	2½	VFY-021A	5F246	$54.01	$49.45	3.0
1¼		12	2½	VFY-023A	5F247	59.96	55.15	2.5
1½	4Z751, 4Z752, 5Z650, 4Z753	12	3	VFY-024A	5F248	92.86	85.50	3.6
2	5Z188, 5Z651	15¾	3½	VFY-026A	5F249	124.71	114.60	5.3
2½	5Z189	21	4½	VFY-028A	5F250	201.35	191.25	9.8
3	5F243	26	5	VFY-029A	5F251	275.02	253.75	13.0

Appendix C

Off-Gas Treatment

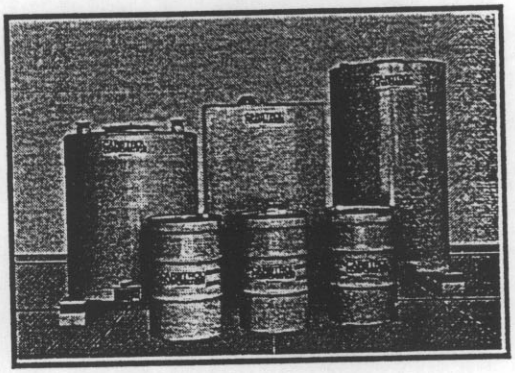
CARBTROL®

ACTIVATED CARBON PRODUCTS

CARBTROL supplies only the highest capacity activated carbons produced to exacting specification. Our carbons typically have a 10 to 40 percent greater adsorption capacity than most industrial grade products. See page two of this brochure for a discussion of activated carbon quality.

BULK ACTIVATED CARBONS

	Mesh Size	Activity/ Capacity	Apparent Density	Total Surface Area
VAPOR:				
CSV (Virgin)	4 x 8	60-65 CCl_4	30-32 lbs./cf	1400-1600 m^2/g
CSVR (Reactivated)	4 x 10	60 CCl_4	30-32 lbs./cf	1200-1400 m^2/g
LIQUID:				
CSL (Virgin)	8 x 20	1100 I_2	30-32 lbs./cf	1200-1400 m^2/g
CSLR (Reactivated)	8 x 30	1000 I_2	30-32 lbs./cf	1000-1200 m^2/g



STANDARD ADSORPTION VESSELS

	Model	Maximum Flow	Amount of Carbon	Design Pressure	Dimensions	Weight
LIQUID:						
Canisters	L-1	10 gpm	200 lbs.	10 psi	24"Ø x 34" H	250 lbs.
	HP-90	10 gpm	90 lbs.	75 psi	12"Ø x 53" H	125 lbs.
	HP-200	10 gpm	200 lbs.	75 psi	22"Ø x 48" H	250 lbs.
Adsorbers	L-4	50 gpm	1000 lbs.	11 psi	4'Ø x 62" H	1500 lbs.
	L-5	50 gpm	1800 lbs.	11 psi	4'Ø x 75" H	2400 lbs.
	L-6	100 gpm	2600 lbs.	11 psi	5'Ø x 87" H	4000 lbs.
	HP-1000	50 gpm	1000 lbs.	75 psi	36"Ø x 90" H	1500 lbs.
	HP-1700	100 gpm	1700 lbs.	75 psi	48"Ø x 101" H	2300 lbs.
VAPOR:						
Canisters	G-1	100 CFM	200 lbs.	10" w.c.	24"Ø x 36" H	240 lbs.
	G-2	300 CFM	170 lbs.	10" w.c.	24"Ø x 36" H	210 lbs.
	G-3	500 CFM	140 lbs.	10" w.c.	24"Ø x 36" H	180 lbs.
Adsorbers	G-4	600 CFM	1000 lbs.	11 psi	4'Ø x 62" H	1500 lbs.
	G-5	1000 CFM	2000 lbs.	2 psi	4'Ø x 75" H	2650 lbs.
	G-6	600 CFM	1800 lbs.	11 psi	4'Ø x 86" H	2500 lbs.
	G-7	4000 CFM	1600 lbs.	3 psi	4'Ø x 86" H	2200 lbs.
	G-8	5000 CFM	2600 lbs.	3 psi	5'Ø x 88" H	3300 lbs.
	G-9	2000 CFM	2600 lbs.	3 psi	5'Ø x 88" H	3300 lbs.

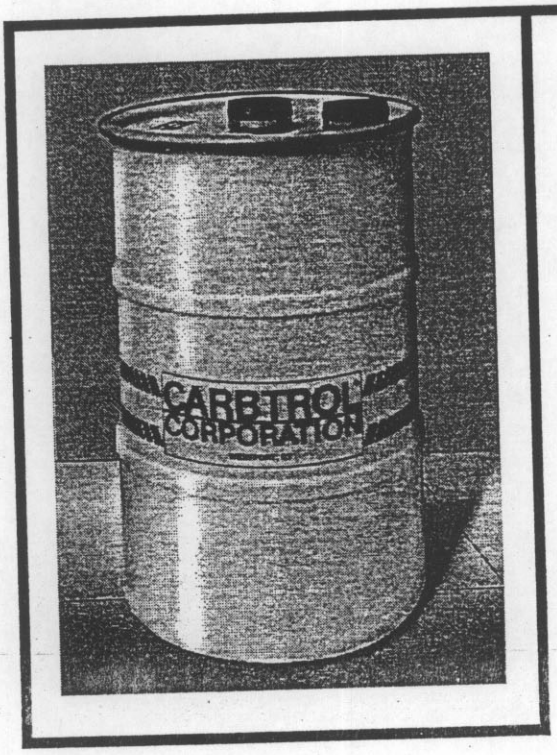
CARBTROL® CORPORATION

51 Riverside Avenue, Westport, CT 06880 • 1-800-242-1150 • (203) 226-5642

CARBTROL®

AIR PURIFICATION CANISTERS 140-200 LB. ACTIVATED CARBON

G-1
G-2
G-3



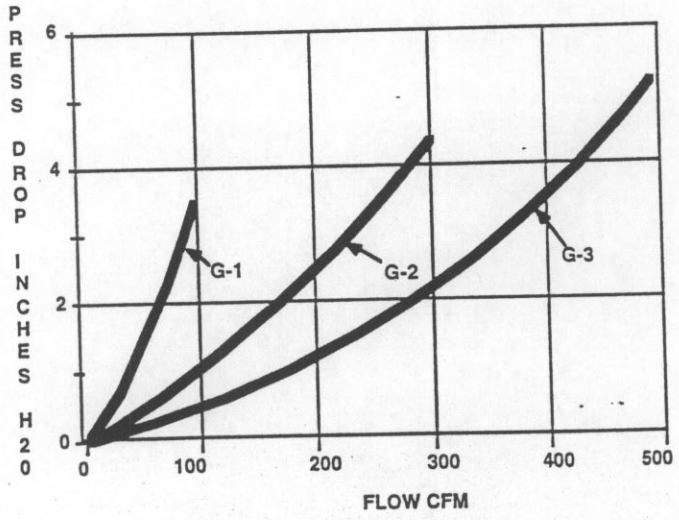
The CARBTROL "G" Canisters handles flows up to 500 CFM.

FEATURES

- High activity carbon.
- Epoxy lined steel or polyethylene construction.
- Acceptable for transport of hazardous spent carbon.
- Side drain for removal of accumulated condensate.
- Low pressure drop.
- PVC internal piping.
- High temperature (180°F) steel units available.

APPLICATIONS

- Soil vapor remediation
- Air stripper exhausts
- Tank vents
- Exhaust hoods
- Work area purification
- Sewage plant odor control



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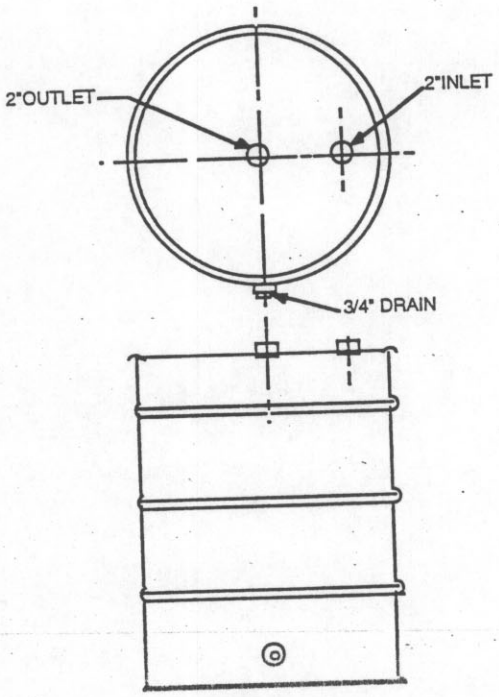
51 Riverside Avenue, Westport, CT 06880 • 1-800-242-1150 • (203) 226-5642

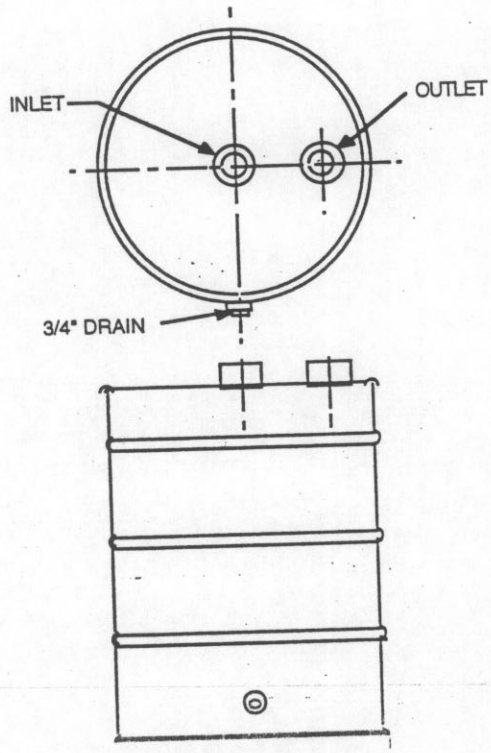
CARBTROL®

AIR PURIFICATION CANISTERS
140-200 LB. ACTIVATED CARBON

G-1
G-2
G-3



MODEL G-1



MODEL G-2,G-3

SPECIFICATIONS

MODEL	DIAMETER/HEIGHT	CARBON WEIGHT	INLET/OUTLET	MAX. RATED FLOW	APPROX. SHIP WT.
G-1*	24"/36"	200 lbs.	2"/2"	100 CFM	240 lbs.
G-2*	24"/36"	170 lbs.	4"/4"	300 CFM	210 lbs.
G-3P	24"/36"	140 lbs.	6"/6"	500 CFM	180 lbs.
G-3S	24"/34"	140 lbs.	4"/4"	500 CFM	180 lbs.

* Specify: Polyethylene (P) or Epoxy Lined Steel (S)

CARBTROL®
CORPORATION

GRANULAR ACTIVATED CARBON FOR TREATMENT OF VOC EMISSIONS

CARBTROL® Corporation
February 1992
Rev. 10/92

INTRODUCTION

The emission of VOC compounds to the atmosphere has been of increasing concern as their impact on air quality becomes more evident. Recent changes in air discharge standards have placed additional regulatory emphasis on the control of volatile compounds.

Of the various technologies available, activated carbon adsorption has proven effective and economical for many VOC treatment applications. Activated carbon technology has gained widespread acceptance for control of hydrocarbons, organic solvents, acid gases and general odor causing compounds among others. Common uses include: tank vents, reactor vents, paint spraying and solvent cleaning operations.

CARBTROL® Corporation has played a key roll in the development of modular activated carbon treatment systems for a variety of air pollution control applications. The following information summarizes the key process and technical issues which we feel are important in this area.

ADSORPTION

Adsorption is a process where by an organic contaminant is separated from an air stream and accumulated on the surface of an adsorbent such as granular activated carbon. The process can be characterized as a condensation reaction which is driven by molecular attraction between the contaminant and the activated carbon surface.

While most compounds adsorb to some degree, the process is most effective on higher molecular weight and high boiling materials. Compounds having molecular weights over 50 and boiling points above 50ºC are generally good candidates for vapor phase adsorption.

Granular activated carbon is a particularly good adsorbent medium due to its high surface area to volume ratio. This high surface area permits the accumulation of a large number of contaminant molecules resulting in a high carbon capacity.

ADSORPTION CAPACITY

The specific capacity of a granular activated carbon to adsorb volatile organic compounds is related to: molecular surface attraction, the total surface area available per unit weight of carbon, and the concentration of volatile compounds in the gas stream.

The basic instrument for evaluating activated carbon use is the adsorption isotherm. The isotherm represents an empirical relationship between the amount of contaminant adsorbed per unit weight of carbon and the equilibrium gas concentration.

This relationship can be expressed in the form:

$$X/M = KC^{1/n}$$

where:

X/M	=	Amount of contaminant adsorbed per unit weight of carbon
C	=	Concentration of contaminant in the gas stream
K,n	-	Empirical constants particular to the contaminant

The constants K and n are determined by plotting experimental results on log-log paper with the concentration of contaminant on the X axis and the amount of contaminant adsorbed on the y axis. The slope of the line developed is equal to 1/n and the intercept equal to K. These dimensionless, empirical constants are useful for comparing the adsorption capacities for different compounds or for assessing the adsorption capacities of various activated carbons.

Vapor phase adsorption isotherms have been developed for most commercial activated carbons for a variety of specific compounds. Figure 1 presents a typical adsorption isotherm used to predict activated carbon adsorption capacity. An isotherm is specific to a particular contaminant and the type of activated carbon used.

ADSORPTION INFLUENCES

In addition to the activated carbon product and the vapor concentration, both system temperature and humidity influence adsorption capacity.

Temperature

Vapor phase adsorption capacity is know to vary inversely with the temperature of the contaminated gas stream. The influence of temperature is established for a specific activated carbon by comparison of a series of adsorption isotherms developed over the proposed operating temperature range. The attached Figure 2 presents Trichloroethylene adsorption isotherms developed over the temperature range of 40 to 140°F. At the 100 ppmv gas concentration level, the adsorption capacity of Trichloroethylene is reduced by about 1/3 when moving from 40°F to 80°F. Of note is the fact that adsorption temperature effects are more significant at lower contaminant concentrations.

In vapor phase adsorption applications, temperature effects must be considered where gas temperatures would present undue influence on the adsorption process. In such a case, use of an air to air heat exchanger may be necessary for controlling the gas temperature.

Humidity

System humidity has been shown to have a negative effect upon adsorption at relative humidity levels above 40%. This is particularly true for low concentration gas streams and relative humidity levels approaching 100%. As the relative humidity of a gas stream approaches 100%, the activated carbon pores become saturated with water. Adsorption that occurs under saturated conditions is consistent with carbon capacities indicative of aqueous phase adsorption. Figure 3 presents the effect of relative humidity on Trichloroethylene adsorption at three gas concentration levels. At the 100 ppmv level, the adsorption capacity for Trichloroethylene is reduced approximately 80% as the system humidity increases from 40 to 90%.

In many VOC control applications, the discharge gas contains high levels of humidity resulting from the process in which it is generated. Under these conditions, the relative humidity must be reduced to below 40% to obtain optimum adsorption capacity. This can often be accomplished by increasing the temperature of the gas stream by 20°F.

In practice, the temperature adjustment can be made by use of the heat of compression of the motive fan or by use of a heat exchanger, prior to the adsorption process.

DESIGN CONSIDERATIONS

As a contaminated gas stream passes through a confined bed of activated carbon, a dynamic condition develops which establishes a mass transfer zone. This "mass transfer zone" is defined as the carbon bed depth required to reduce the contaminant concentration from the initial to the final level, at a given gas flow rate.

As the mass transfer zone moves through a carbon bed and reaches its exit boundary, contamination begins to show in the effluent. This condition is classified as "breakthrough" and the amount of material adsorbed is considered the breakthrough capacity. If the bed continues to be exposed to the gas stream, the mass transfer zone will pass completely through the bed and the effluent contaminant level will equal the influent. At that point, saturation capacity is reached. The saturated capacity is that which is represented by the adsorption isotherm.

Fortunately, the depth of the mass transfer zone in most vapor phase adsorption applications is only several inches. The difference in breakthrough and saturation capacity for deep carbon beds is usually not significant. In engineering practice, the depth of the mass transfer zone is controlled by limiting the linear gas velocity through the carbon bed to approximately 60 FPM.

An additional design issue involves the selection and balancing of the system operating temperature and relative humidity. Since both of these parameters exert a negative effect on adsorption, the relative effect of both must be considered. CARBTROL has found that for most low concentration vapor applications the negative effect of relative humidity controls the design. Thus, the increase in adsorption capacity achieved by reducing relative humidity will normally significantly offset the capacity loss related to a 20°F gas temperature increase.

CHOICE OF TECHNOLOGIES

Carbon adsorption is an extremely versatile technology. For many VOC applications it has proved to be the least expensive gas treatment option. Adsorption is particularly effective in treating low concentration vapor streams and in meeting stringent emission levels.

Some high concentration applications, however, may require a combined technology approach to vapor treatment. This might include the use of a refrigerated condensation system to reduce VOC concentrations prior to final treatment on activated carbon.

Austin R. Shepherd
Vice President - Technical Director

FIGURE #3