

HI-Q

Environmental
Products Co.

7386 Trade Street
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Air Sampling & Radiation Monitoring Equipment, Systems & Accessories

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CF-900 Series



Portable Air Sampler

MANUAL FLOW CONTROL



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INTRODUCTION

GENERAL DESCRIPTION:

This Portable, High Volume Air Sampling System is ideal for continuous or intermittent sampling. The two stage brushed blower can be adjusted to any flow rate up to the capacity of the pump. The CF-900 series high volume air samplers are designed for sampling airborne particulate and/or radioiodine in the environment.

The CF-901, comes standard with a 1½" female straight pipe threaded (FSPT) intake which accepts all HI-Q CF-Series holders (excluding 8" x 10"). The models CF-902 and CF-903 have a 4" diameter threaded ring installed on the air intake to allow for 4" diameter paper only sampling. From the 4" diameter ring an operator has the option of either adapting up to an 8" X 10" paper only holder (CFPH-810), or adapting down to a 47mm or 2" diameter combination style or paper only filter holder (CFPH-XX). Upon ordering the CFPH-810 it is recommended that an additional CF-900 Series base extension stabilizer plate adapter (used to balance the unit P/N CFBOX-STABILIZER KIT) be purchased as well. Adapting down from a CFPH-810 to any of the CF-Series paper only or combination holders requires the use of an FHA-4CF, 4" diameter ring to 1½" FSPT Adapter.

Each unit has a label indicating the designed power requirements. Either 115VAC, 60Hz, or the 230VAC, 50/60Hz.

The main components of the CF-900 Series Air Sampling Systems are: A two stage brushed blower, an SCR motor speed controller, a 3 wire grounded power cord, motor fuse protection, an electronic elapsed, resettable timer (9 programmable time ranges) and a precision rotameter. All, of which are housed in a 2-component, polyurethane primed and painted aluminum cabinet housing.

NOTE: THIS UNIT IS NOT RATED EXPLOSION PROOF. IT SHOULD NOT BE USED IN ANY POTENTIALLY EXPLOSIVE ATMOSPHERES.

UNPACKING THE UNIT:

Each unit is cushion packed to reduce the possibility of damage in transit. If the carton or unit shows any damage, report it immediately to the shipping carrier and file a damage claim. Each unit is tested, calibrated, and fully operative when it leaves the factory. If there is a problem call the factory immediately.

SYSTEM DESCRIPTION

INPUT POWER:

The CF-900 series are available in two different voltage ranges: 115 VAC and 230 VAC.

The electrical disconnect for this unit is the power cord. Always unplug the power cord from the electrical outlet before performing any service to the unit.

For 115 VAC units, the power requirements are as follows:

Voltage:	115 V~, 50/60 Hz
Current:	11.7 A
Power:	400 W

For 230 VAC units, the power requirements are as follows:

Voltage:	230 V~, 50/60 Hz
Current:	3.3 A
Power:	220 W

Explanation of Electrical Symbols:

V~:	Volts Alternating Current (VAC)
Hz:	Hertz
A:	Amps
W:	Watts
Ⓢ:	Protective Earth Ground
⊕:	Shock Hazard

FUSE:

The CF-900 series are available in two different voltage ranges: 115 VAC and 230 VAC. Fuses used are as follows:

For 115 VAC operation: 15 A, T, 250V

For 230 VAC operation: 7 A, T, 250V

The fuse is located directly above the power cord in a bayonet style holder. To check the fuse or change it, unplug the external power cord from the unit. Then, push in and rotate the fuse holder cap in a counter-clockwise direction. The fuse will come out with the fuse holder cap.

If the fuse needs to be replaced, use a 15 Amp, Slo-Blo, fuse for a 115VAC model or a 7 Amp, Slo-Blo, fuse for a 230VAC model. Remove the old fuse from fuse holder cap and replace with the appropriately rated fuse. Insert the fuse holder cap with fuse into the socket, push in and rotate clockwise until closed and locked.

ENVIRONMENTAL CONDITIONS:

Operating Temperature Range: 0 to 50°C
Storage Temperature Range: -40 to 60°C
Operating and Storage Humidity: 0 to 85% maximum non-condensing

ELAPSED TIMER:

The electronic, re-settable timer indicates elapsed sampling time on an LCD display in 9 time ranges. The timer is wired in series with the blower and starts when the unit is turned on. The timer holds the total elapsed sample time. The timer is re-set to zero by pressing the re-set button on the timer. The timer operates from 3.6 Volts supplied by a non-replaceable internal 7-year lithium battery that makes it independent from the supply voltage and the cyclic rate. All running time readings are maintained even after the unit is turned off either deliberately, or due to loss of power. This feature eliminates the need to install an event meter or chart recorder. The total volume of air sampled may be verified (to the displayed value) by multiplying the flow rate setting by the minutes of running time. Battery life is dependent upon usage and operating/storage conditions. Signal and reset contacts that remain closed for long periods of time reduce battery life.

FLOW METER:

The flow is measured using a direct reading precision rotameter. It is made of shatter-proof polycarbonate plastic. The rotameter is calibrated at the factory and does not require any maintenance other than annual re-calibration as required. The flow meter is sensitive to changes in upstream pressure and should be calibrated with the same filter media that will be used in the field. Using a different size or type of filter media will change the upstream pressure drop that the flow meter was originally calibrated with and will affect the indicated flow in proportion to the change in pressure drop between the calibrated filter media and the new filter media.

SELECTION OF FILTER HEAD:

A wide variety of filter heads will fit the CF-900 series sampler units. The CF-901, comes standard with a 1½" female straight pipe threaded (FSPT) intake which accepts all HI-Q, CF-Series holders (excluding 8 x 10). Models CF-902 and CF-903 come standard with a 4" diameter threaded ring, which can be used immediately as a 4" diameter paper only holder, or adapted down with HI-Q's FHA-4CF to fit CF-Series type holders. From the standard 4" diameter ring an operator can also adapt up to an 8" x 10" paper only holder,

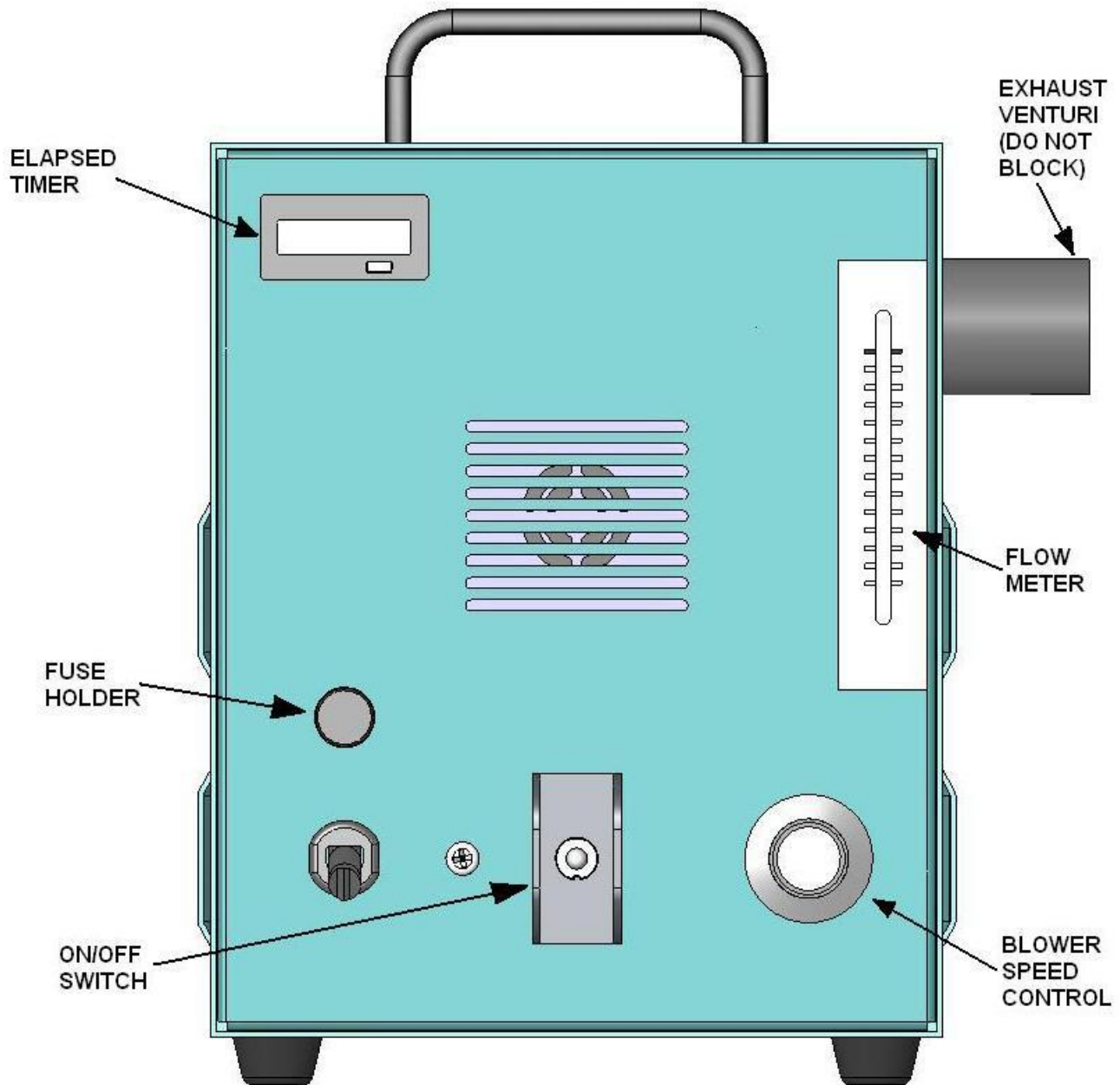
using HI-Q's CFPH-810. For operation of this unit with the 8" X 10" paper only holder, a base plate extender is recommended for added stability P/N: CFBOX-STABILIZER KIT (included w/ CF-903).

FLOW RATE:

The flow rate is adjusted using the blower speed control knob. The maximum flow rate of the CF-900 Series air sampler is dependent on the pressure drop across the filter media and the size as shown below:

Model	Filter Paper	Filter Size	Max. Flow Rate *
CF-901	FP2063-20	2" diameter (51mm)	12 CFM
CF-901	FP5211-20	2" diameter (51 mm)	6.5 CFM
CF-902	FP2063-102	4" diameter (102 mm)	35 CFM
CF-902	FP5211-102	4" diameter (102 mm)	22 CFM
CF-903	FP2063-810	8" x 10" (203mm x 254mm)	60 CFM
CF-903	FP5211-810	8" x 10" (203mm x 254mm)	55 CFM

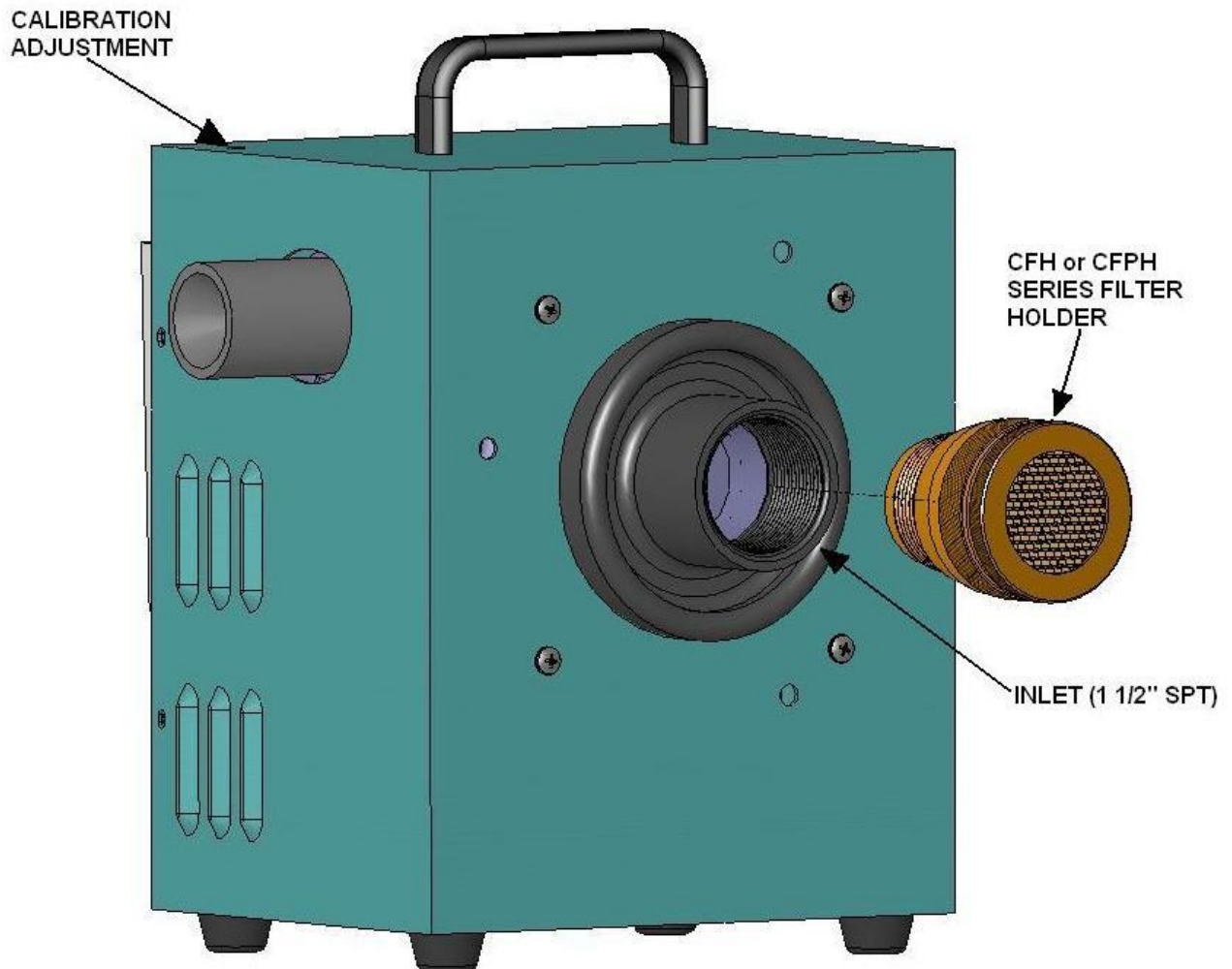
*Approximate Values



CF-100XBRL SERIES

FILTER HOLDERS

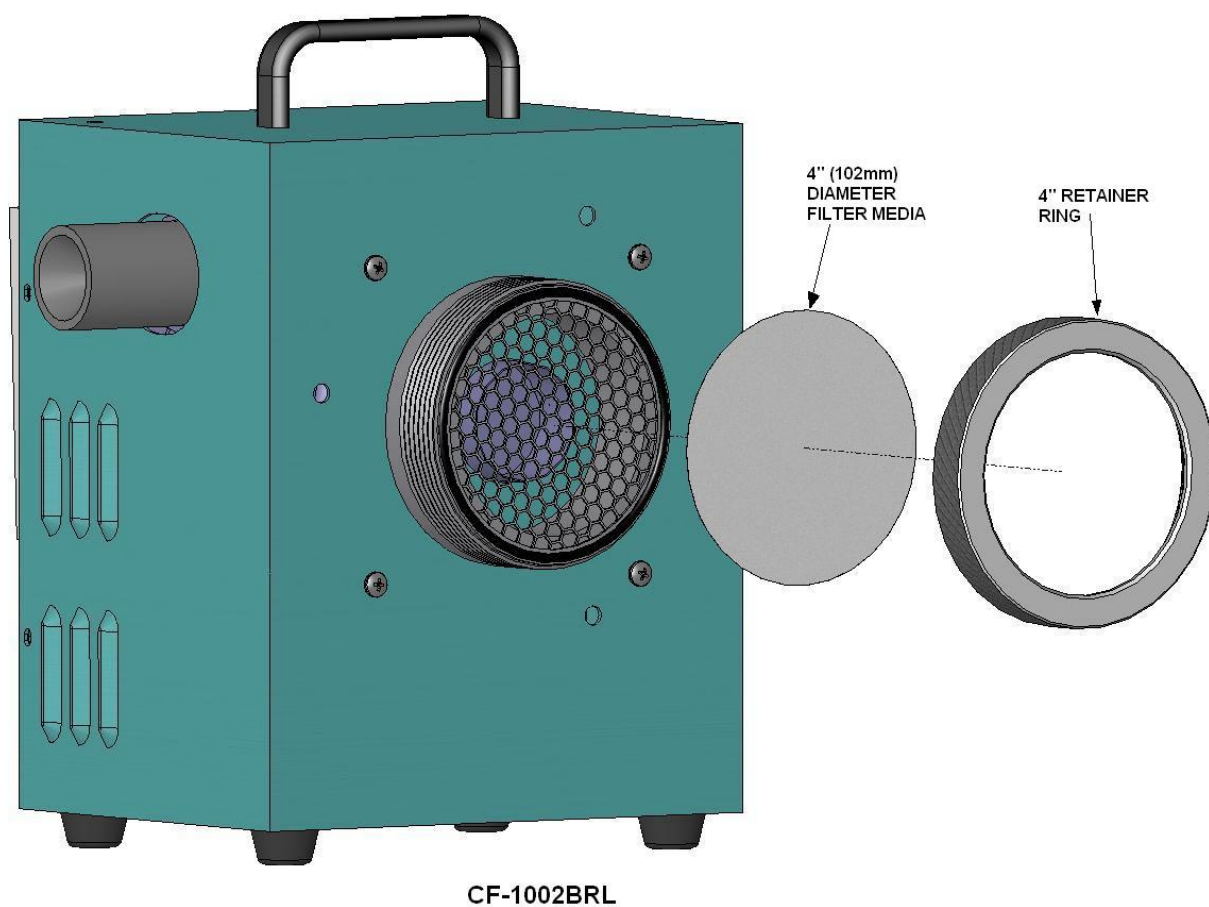
The CF-901 inlet has 1½" female straight pipe thread (FSPT) that accepts any of HI-Q's CFH or CFPH series holders as well as accepting any 1½" male straight pipe thread (MSPT).



CF1001BRL

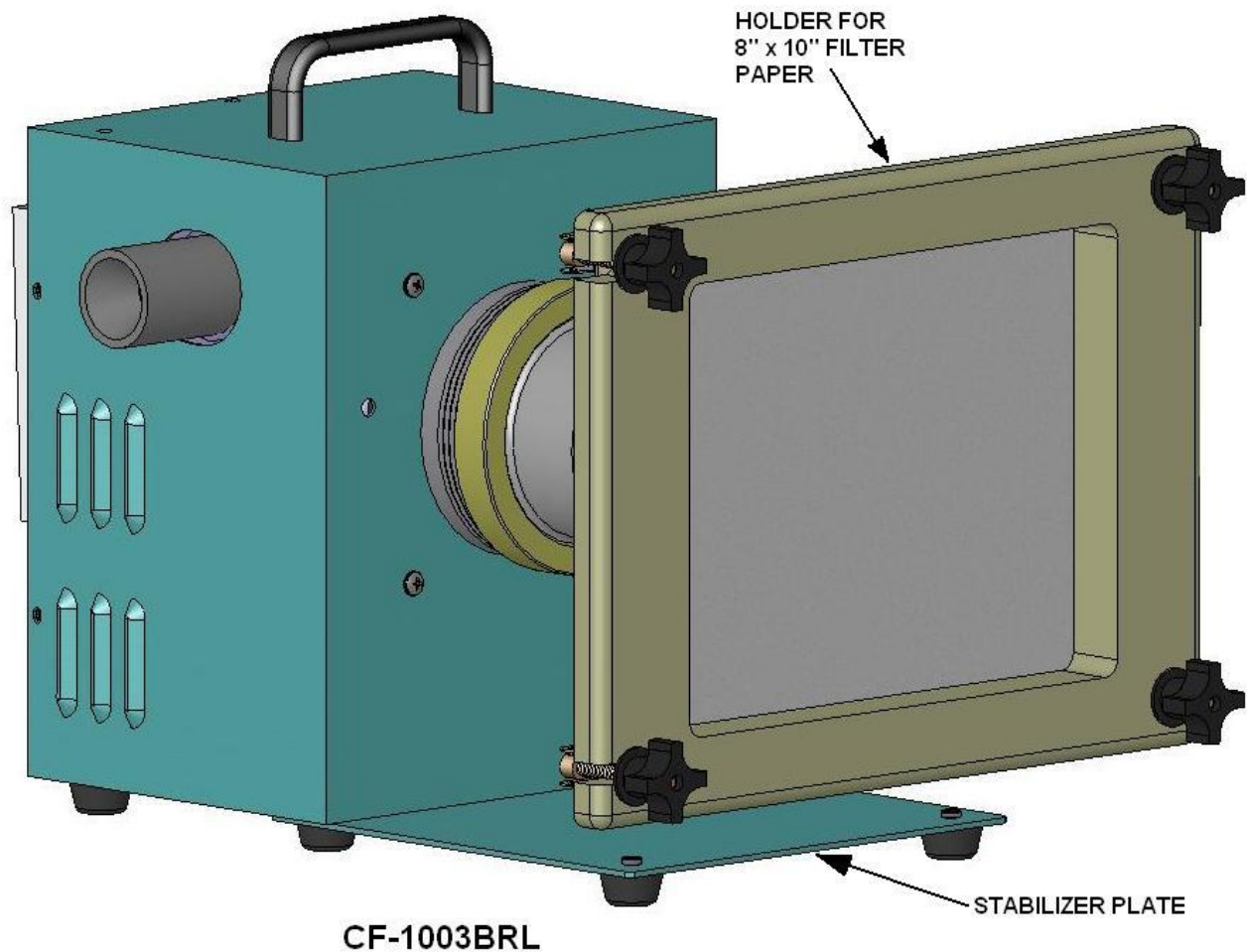
****CF-1001BRL shown in figure, filter application identical for CF-901.****

The CF-902 comes with a 4" diameter (paper only) holder.



CF-1002BRL shown in figure, filter application identical for CF-902.

The CF-903 is calibrated for use with the CFPH-810 8"x10" paper only holder which attaches to the 4" filter paper holder.



****CF-1003BRL shown in figure, filter application identical for CF-903.****

The CF-902 and CF-903 may also use any of HI-Q's CFPH or CFH series filter holders by incorporating HI-Q's FHA-4CF 4" diameter paper ring to a 1½" female straight pipe thread adapter. Note that changing to a different size filter media will affect the flow calibration of the sampler.

OPERATION

After affixing the appropriate filter head, plug unit into a 3 wire grounded outlet. Note the timers starting number, or reset the timer to zero by pushing the timer's reset button. Start the unit and adjust the rotameter reading with the motor speed control pot to the desired flow rate. This high volume pump is intended for use as an intermittent grab sampling pump. The motor manufacturer states that the original motor brush life is between 900-1200 hours. Replacement brushes, after being seated, generally last between 600-800 hours. HI-Q has found that operating at less than maximum flow extends the brush life.

NOTE: Like all devices designed to move a high volume of air, the CF-900 series is rather loud. Operators should use hearing protection when using the CF-900 series air samplers.

OPERATING THE CF-900:

1. Install filter holder on CF-900 Series Sampler. Use an adapter if needed.
2. Install desired filter media in filter holder.
3. Plug unit into standard wall receptacle.
4. Turn power switch on.
5. Adjust flow rate control knob to desired sample rate.
6. Reset sample timer to begin sample.
7. When sample time is complete, turn unit off and remove sample media.
8. The filter media can now be scanned with a detector or removed and placed into a polybag for transport to the lab/testing facility.

CALIBRATION:

Before being shipped out, each CF-900 series Air Sampler is individually calibrated against a NIST traceable standard at sea level and ambient temperature. It is good practice however, to occasionally check the rotameter calibration against a secondary source such as a calibrated HFC-SIDE-XX series air flow calibrator. Upon ordering choose the correct HFC-SIDE-XX unit for your flow range and flow measurement units. The correct inline adapter must also be selected to connect to the inlet of the sampling filter holder. For the most accurate calibration results, calibration must be performed with the intended filter media in the holder.

With a small flat head screwdriver and the correct flow range HFC-SIDE-XX unit, fine adjustments to incorrect flow rate readings can be made in the field by tightening or loosening the brass needle valve in the back of the rotameter. For "quick-fix" changes stick a piece of masking tape over the rotameter scale and mark according to in-line Air Flow Calibrator unit.

The following procedure is for verifying the flow rate or re-calibration.

EQUIPMENT REQUIRED:

1. Air Flow Calibrator:

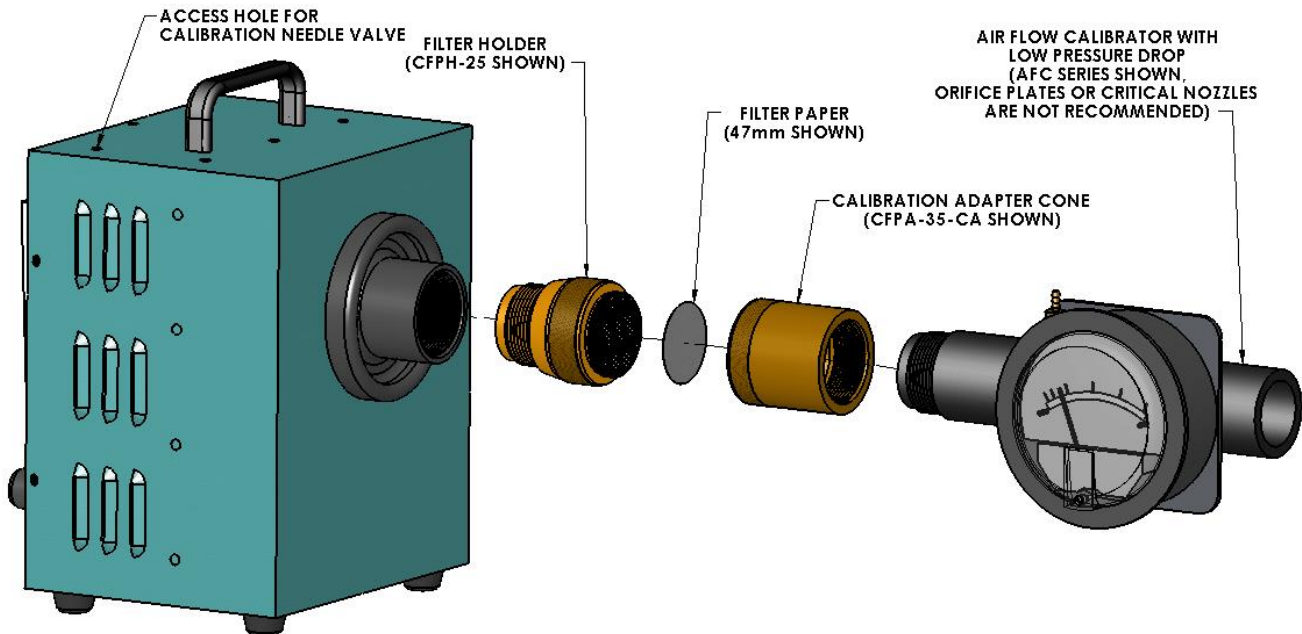
- HFC-SIDE-8 for a CF-901
- HFC-SIDE-35 for a CF-902
- HFC-SIDE-50 for a CF-903

A laminar flow element/water manometer type calibrator may also be used.

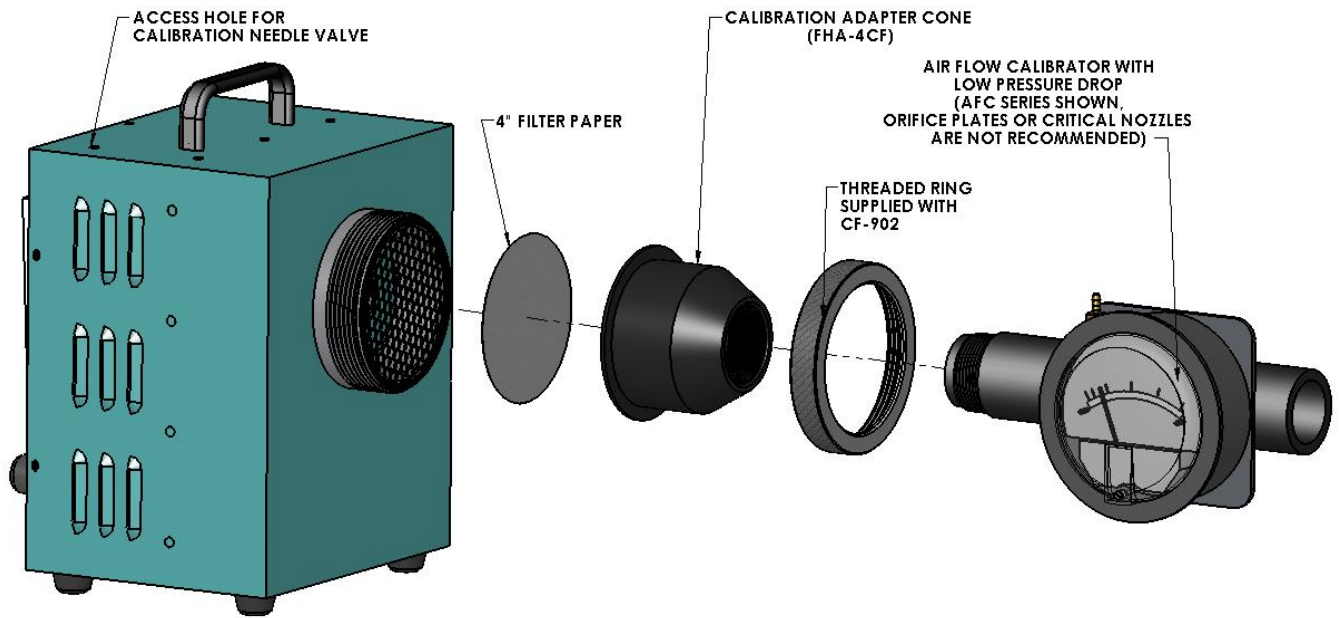
Note: Orifice plates or other calibrators that generate a high pressure drop will cause the calibration conditions to differ too much compared to operational conditions and should not be used.

2. Filter holder adapter for connecting calibrator to filter media holder. Contact HI-Q Environmental Products to select the correct in-line adaptor fittings.

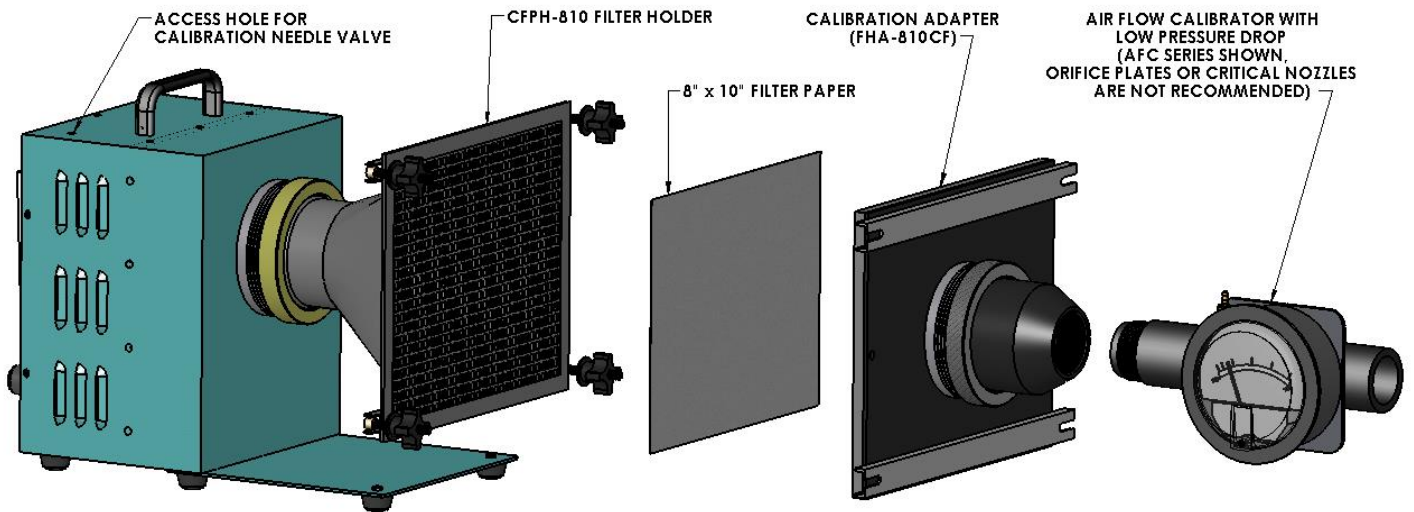
Note that all flow connections must be leak tight. Since the flow connections must be leak tight, HI-Q recommends against the use of the Munro filter holders.



CF-901 CALIBRATION CONFIGURATION



CF-902 CALIBRATION CONFIGURATION



CF-903 CALIBRATION CONFIGURATION

RE-CALIBRATION PROCEDURE:

1. Install filter media holder, new collection filter media, and filter holder adapter into the pump intake. It is essential that one recalibrates the CF-900 Series with the same collection filter media as that which will be used for sampling in the field. Varying the maximum pressure drop (caused by the collection filter media) at calibration will affect the overall accuracy of the calibration during use.
2. Connect air flow calibrator to the inlet of the in-line filter holder adapter.
3. Unplug power cord from outlet.
4. Remove the front panel screws and separate the front panel from the housing to expose the rotameter needle valve which has a red dust cover over it. Remove the dust cover.
5. Support face panel securely in a vertical position for proper operation of the rotameter.
6. Plug in power cord and turn on power.
7. Adjust flow rate for a calibrator flow rate near the normal operating rate.
8. Read the flow rate on the rotameter. It should be the same as the calibrator flow rate within +/- 5% full scale. If not, proceed to step #9.
9. Re-calibrate flow meter by adjusting the small, brass needle valve located near the top of the rotameter. Adjust until rotameter indicates the same flow rate as the calibrator. If matching the flow rate is not possible it may be necessary to re-mark the existing scale or purchase a blank scale and re-mark it.

MAINTENANCE:

The Timer and Flow Meter are maintenance free and must be replaced if defective

The motor in the CF-900 is a 2 stage, non-lubricated motor-blower which has ball bearings. All of the components, besides the motor brushes, should be maintenance free.

It is recommended that the motor brushes be changed every 900-1200 hours depending on use. It may be necessary to replace the entire blower/motor assembly after 4,000 to 5,000 hours of combined or continuous use.

CHANGING THE MOTOR BRUSHES:

1. **Unplug the unit from the power supply.**
2. Remove screws from the blower cover.
3. Remove the two spring clip motor cover holders.
4. Remove the cover.
5. Remove the two brush screws, freeing the brush (both sides).
6. Slip the wire out of the old brush assembly and

- into the new, CAT# CF-900-003 brushes.
7. Re-assemble in reverse order.

REPLACING THE MOTOR:

1. **Unplug the unit from the power supply.**
2. Remove the screws from front cover.
3. Disconnect rotameter tubing, wire connectors and ground lead.
4. Remove internal screws from pressure chamber plate.
5. Remove motor and pressure chamber plate (leaving motor mount screws in place).
6. Remove the four motor mount screws.
7. Replace the motor and re-assemble in reverse order.

SCR CONTROLLER:

On rare occasions, the SCR controller can malfunction. The symptoms are a fluctuating or stuttering speed. If this happens, the controller must be replaced with #SCR-15 (115V) or #SCR-23 (230V).

TIMER:

The timer is maintenance free. The 115 VAC & 230 VAC CF-900 Series Air samplers all use the same programmable minute or hour timers. Timers will actuate with a constant voltage between 10 v and 300 v (AC 50/60 Hz or DC). Input current 0.5 mA max. The timer operates from 3.6 Volts supplied by a non-replaceable lithium battery. Nominal battery life is 7 years. Battery life is dependent upon usage. Signal and reset contacts that remain closed for long periods of time reduce battery life.

CLEANING:

If the CF-900 series high volume air sampler requires cleaning, clean only with a clean, damp cloth. Do not spray with cleaners or water as this may create a shock hazard.

NOTE: If the CF-900 series high volume air sampler is used in a manner inconsistent with this manual, the protection features provided with this equipment may be impaired.

SPARE/REPLACEMENT PARTS LIST FOR CF-900 SERIES AIR SAMPLERS

Part #	Description
CF901-000	115 VAC REPLACEMENT BLOWER FOR THE CF-901 SERIES AIR SAMPLER. INCLUDES HARD MOUNTED 1½" FEMALE STRAIGHT PIPE THREADS.
CF901-000/230	230 VAC REPLACEMENT BLOWER FOR THE CF-901 SERIES AIR SAMPLER. INCLUDES HARD MOUNTED 1½" FEMALE STRAIGHT PIPE THREADS.
CF900-001	BLOWER/MOTOR, 115VAC 50/60
CF900-002	BLOWER/MOTOR, 230 VAC 50/60
CF900-003B	REPLACEMENT MOTOR BRUSHES (2/SET)
CF900-004	4" THREADED RING
CF900-005	4" PAPER RETAINER RING
CF901-006	O-RING TO SUPPORT 1 ½" FEMALE SPT (CF-901 ONLY)
CF900-006	"O" RING FOR 4" THREAD RING
CF900-007	SUPPORT SCREEN FOR 4" PAPER
CF900-009F	FRONT (INLET SIDE) MOTOR MOUNT GASKET
CF900-009B	BACK (DOWNSTREAM SIDE) MOTOR MOUNT GASKET
CF900-010	MOTOR SPEED CONTROL ASSEMBLY 115VAC
CF900-011	MOTOR SPEED CONTROL ASSEMBLY 230VAC
CF900-012	KNOB NUT FOR SPEED CONTROL
CF900-013	FUSE HOLDER
CF900-014	SLO-BLO FUSE 115 VAC Units
CF900-015	TOGGLE SWITCH W/ON/OFF PLATE
CF900-016	SWITCH GUARD
CF900-017	ELECTRONIC TIMER IN MINUTES & TENTHS
CF900-018	RESET PUSH BUTTON ASSEMBLY FOR TIMER (6/1998 & UP)
CF900-019	POWER CORD, 16/3, 8 FEET
CF900-020	IN-LINE AIR FILTER
CF900-021	UN-CALIBRATED ROTAMETER
CF900-022	BLANK SCALE FOR ROTAMETER
CF900-022A	NEEDLE VALVE ASSEMBLY FOR THE ROTAMETER.
CF900-023	RUBBER FOOT (4 NEEDED)
CF900-024	HANDLE
CF900-025	SLO-BLO FUSE 230 VAC UNITS
CF900-026-UL	UL ELECTRONIC TIMER IN HOURS & TENTHS (FOR UL LISTED UNIT)
CF900-026	ELECTRONIC TIMER IN HOURS & TENTHS
CF900-027	"O" RING FOR SUPPORT 1 ½" FEMALE STRAIGHT PIPE THREAD
CF900-028	REPLACEMENT CABINET MOUNTED 1 ½" FEMALE STRAIGHT PIPE THREAD KIT FOR THE CF-901 SERIES AIR SAMPLER TO CONVERT OLD STYLE CF-901 WITH MOTOR MOUNTED 1 ½" FEMALE STRAIGHT PIPE THREAD. INCLUDES SHEET METAL MOUNTING RING, GASKETS AND SCREWS.

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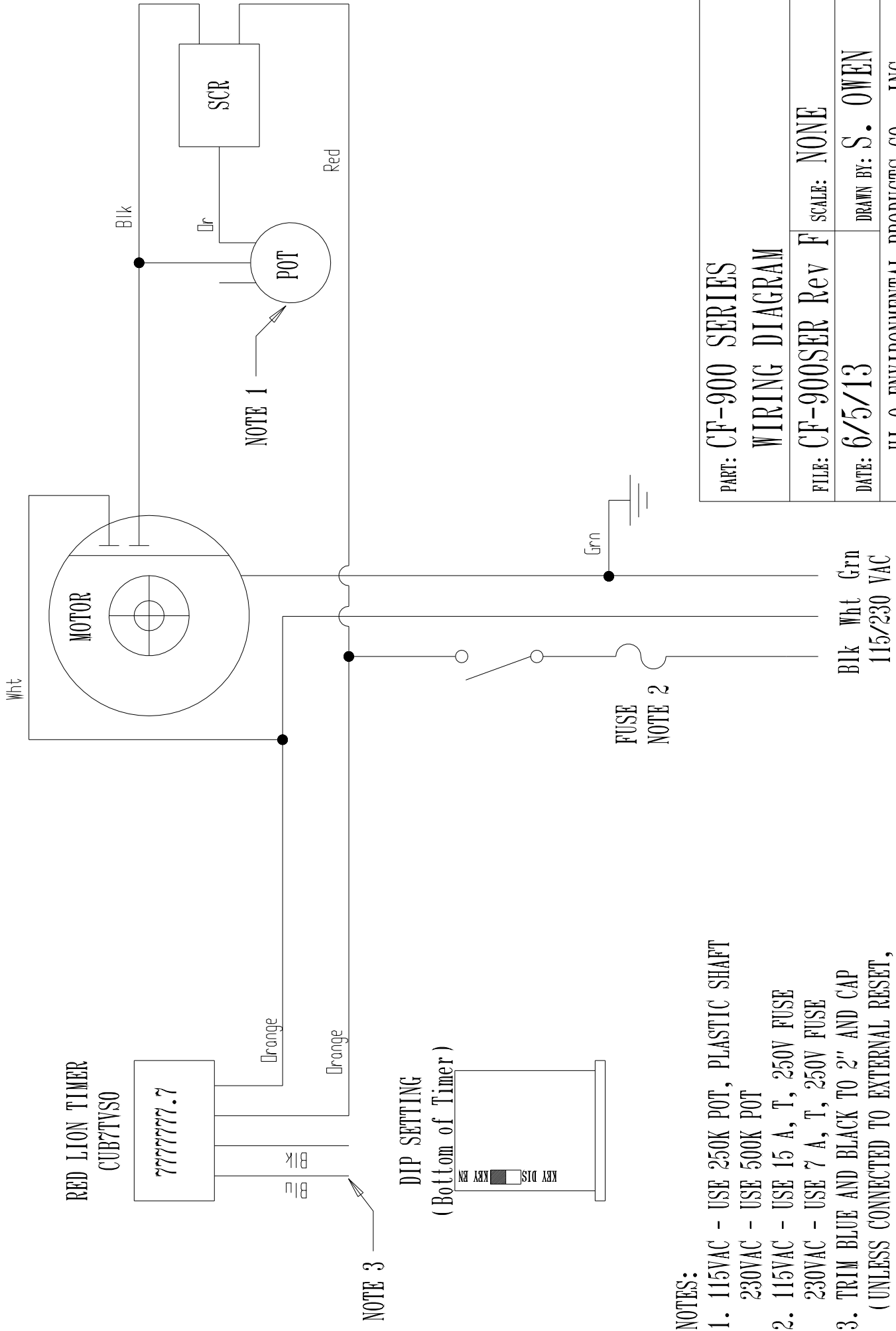
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Appendix A

Wiring Diagram



PART: CF-900 SERIES	
WIRING DIAGRAM	
FILE: CF-900SER Rev F	SCALE: NONE
DATE: 6/5/13	DRAWN BY: S. OWEN
HI-Q ENVIRONMENTAL PRODUCTS CO., INC. 7386 TRADE STREET, SAN DIEGO, CA 92121 PHN: 858-549-2820 FAX: 858-549-9657	

- NOTES:**
- 115VAC - USE 250K POT, PLASTIC SHAFT
230VAC - USE 500K POT
 - 115VAC - USE 15 A, T, 250V FUSE
230VAC - USE 7 A, T, 250V FUSE
 - TRIM BLUE AND BLACK TO 2" AND CAP
(UNLESS CONNECTED TO EXTERNAL RESET,
THEN SET DIP TO "KEY DIS")

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF HI-Q ENVIRONMENTAL PRODUCTS COMPANY. ANY REPRODUCTION IN PART OR WHOLE WITHOUT THE WRITTEN PERMISSION OF HI-Q ENVIRONMENTAL PRODUCTS COMPANY IS PROHIBITED.

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Appendix B

Vacuum Pump Specifications



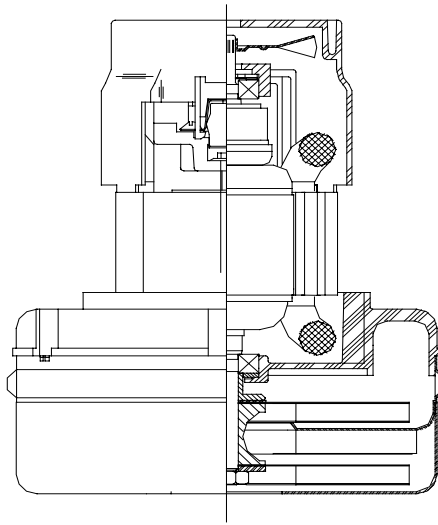
Model: 116471-00
116471-13*

DESCRIPTION

- Two stage
- 120 volts
- 5.7"/145 mm diameter
- Double ball bearings
- Single speed
- Peripheral bypass discharge
- Thermoset fan end bracket
- Aluminum commutator bracket

DESIGN APPLICATION

- Equipment operating in environments requiring separation of working air from motor ventilating air
- Designed to handle clean, dry, filtered air only



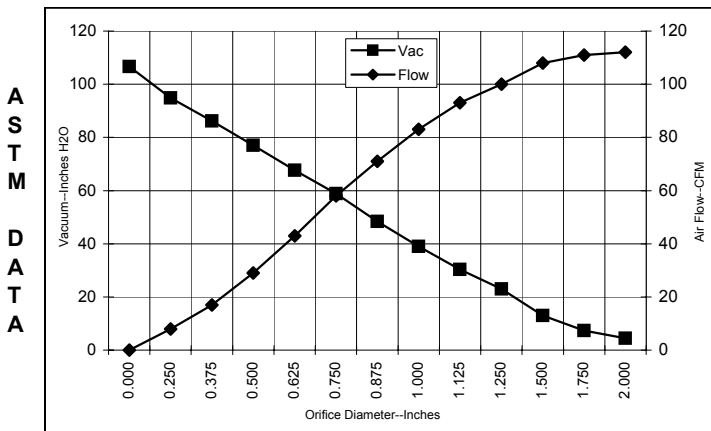
SPECIAL FEATURES

- Suitable for 120 volt AC operation, 50/60 Hz
- UL recognized, category PRGY2 (E47185)
- CSA certified, class 1611 01 (LR31393)
- Provision for grounding
- Skeleton-frame design
- The Lamb Electric vacuum motor line offers a wide range of performance levels to meet design needs.

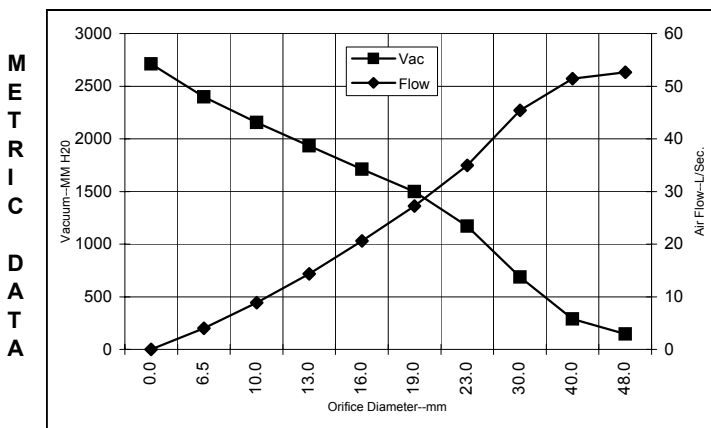
***Model 116471-13 features patented air seal bearing construction. U.S. Patent #4,088,424 and epoxy painted fan case**

TYPICAL MOTOR PERFORMANCE.*

(At 120 volts, 60Hz, test data is corrected to standard conditions of 29.92 Hg, 68° F.)



Orifice (Inches)	Amps	Watts (In)	RPM	Vac (In.H2O)	Flow (CFM)	Air Watts
2.000	11.4	1323	19700	4.4	112.0	58
1.750	11.5	1335	19600	7.4	111.0	97
1.500	11.6	1349	19450	13.0	108.0	165
1.250	11.7	1363	19350	23.0	100.0	269
1.125	11.7	1365	19350	30.3	93.0	330
1.000	11.6	1345	19550	39.0	83.0	382
0.875	11.3	1308	19825	48.4	71.0	404
0.750	10.7	1253	20350	58.8	58.0	397
0.625	10.0	1173	21000	67.7	43.0	341
0.500	9.2	1079	21925	77.0	29.0	265
0.375	8.3	981	22975	86.2	17.0	176
0.250	7.6	903	24100	94.9	8.0	91
0.000	6.9	828	25400	106.7	0.0	0



Orifice (mm)	Amps	Watts (In)	RPM	Vac (mm H2O)	Flow (L/Sec)	Air Watts
48.0	11.4	1328	19656	145	52.7	75
40.0	11.6	1345	19495	288	51.4	145
30.0	11.7	1364	19350	686	45.4	303
23.0	11.4	1317	19756	1170	34.9	399
19.0	10.7	1251	20363	1498	27.2	396
16.0	10.0	1176	20974	1711	20.6	343
13.0	9.3	1088	21833	1932	14.3	273
10.0	8.4	996	22818	2154	8.9	189
6.5	7.6	907	24044	2399	4.0	95
0.0	6.9	828	25400	2710	0.0	0

Note: Metric performance data is calculated from the ASTM data above.

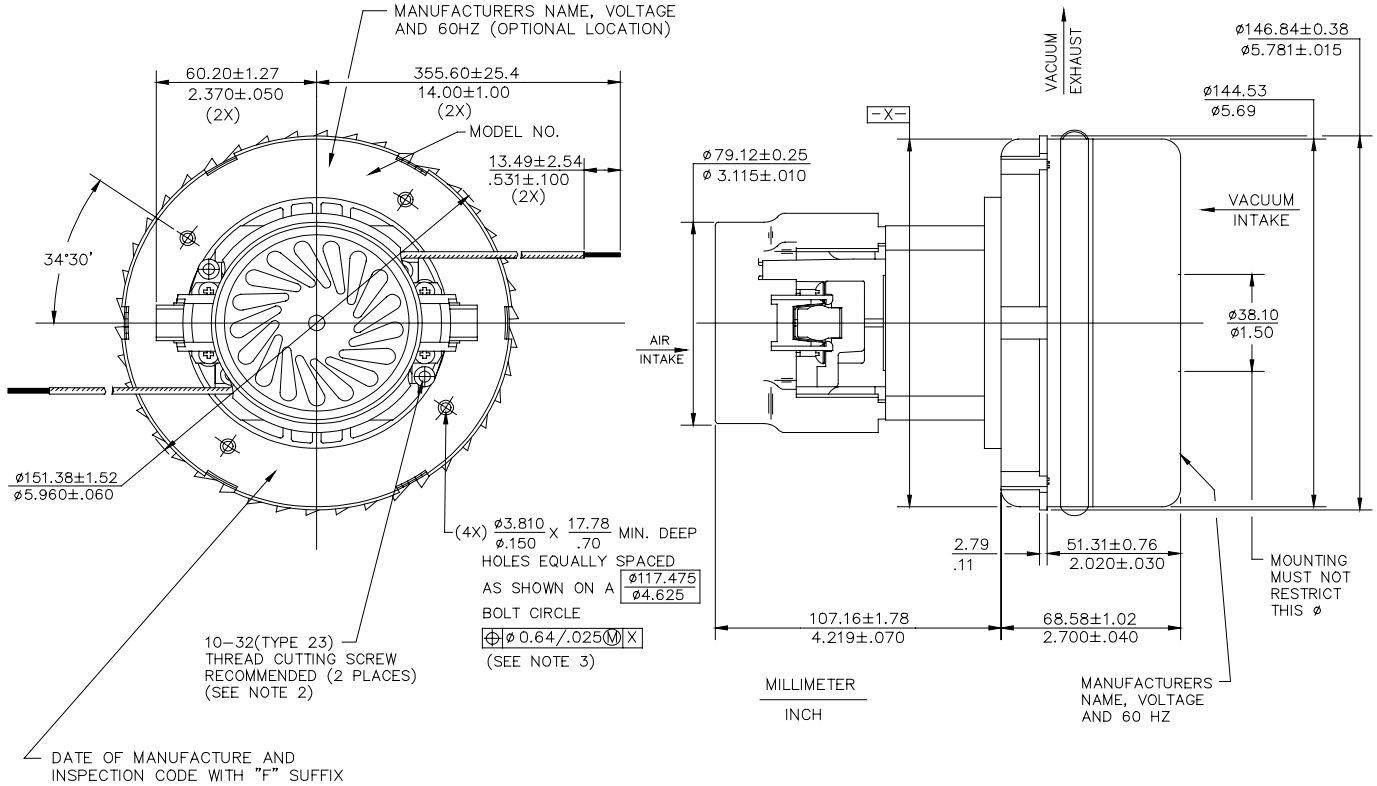
* Data represents performance of a typical motor sampled from a large production quantity. Individual motor data may vary due to normal manufacturing variations.

Test Specs:	120 volts	Minimum Sealed Vacuum:	99.0"	ORIFICE:	7/8 "	Minimum Vacuum:	42.0"	Maximum Watts:	1550
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DIMENSIONS

NOTES:

1. LEADS: 18GA STRANDED, LEADS CAN BE ANY COLOR EXCEPT GREEN OR GREEN WITH YELLOW STRIPE.
2. GROUNDING OR EARTHING PROVISIONS: USE HOLES AS INDICATED FOR GROUNDING OR EARTHING. REFER TO APPROPRIATE LISTING OR REGULATORY AGENCY FOR PROPER METHOD OF GROUNDING OR EARTHING.
3. RECOMMENDED SCREW SIZE 10-16 TYPE BT OR TYPE 25 THREAD CUTTING SCREW. MAXIMUM PENETRATION 17.40/.685.



IMPORTANT NOTE: Pictorial and dimensional data are subject to change without notice. Contact factory for current revision levels.

WARNING - When using AMETEK Lamb Electric bypass motors in machines that come in contact with foam, liquid (including water), or other foreign substances, the machine must be designed and constructed to prevent those substances from reaching the fan system, motor housing, and electrical components. Lamb Electric vacuum motors other than hazardous duty models should not be applied in machines that come in contact with dry chemicals or other volatile materials. Failure to observe these precautions could cause flashing (depending on volatility) or electrical shock which could result in property damage and severe bodily injury, including death in extreme cases. All applications incorporating Lamb Electric motors should be submitted to appropriate organizations or agencies for testing specifically related to the safety of your equipment.



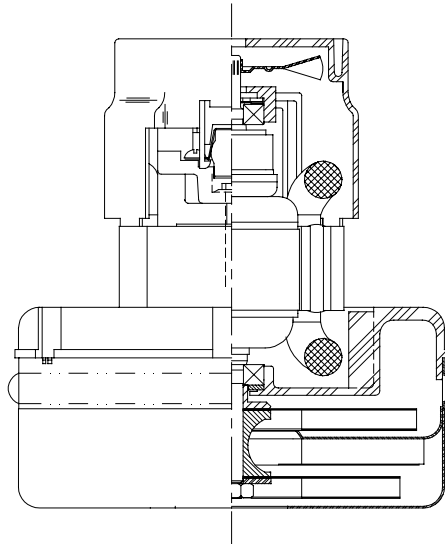


DESCRIPTION

- Two stage
- 240 volts
- 5.7"/145 mm diameter
- Double ball bearings
- Single speed
- Peripheral bypass discharge
- Thermoset plastic fan end bracket
- Aluminum commutator bracket

DESIGN APPLICATION

- Equipment operating in environments requiring separation of working air from motor ventilating air
- Designed to handle clean, dry, filtered air only



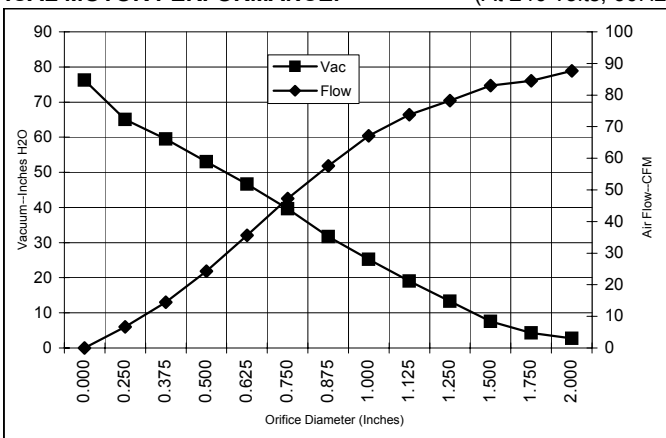
SPECIAL FEATURES

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- CSA certified, class 1611 01 (LR31393)
- Provision for grinding
- Open frame design
- The Lamb Electric vacuum motor line offers a wide range of performance levels to meet design needs

TYPICAL MOTOR PERFORMANCE.*

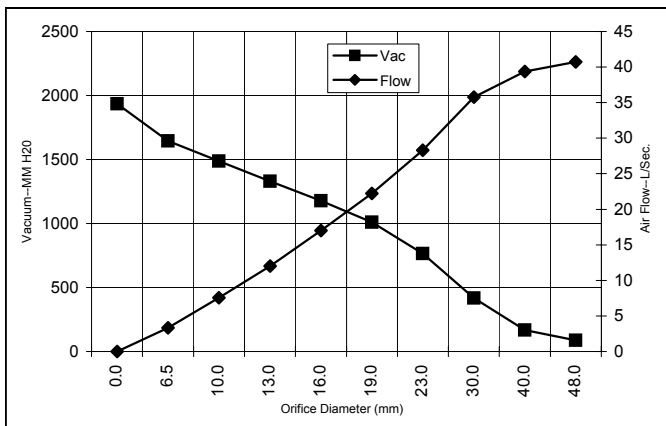
(At 240 volts, 60Hz, test data is corrected to standard conditions of 29.92 Hg, 68° F.)

ASTM DATA



Orifice (Inches)	Amps	Watts (In)	RPM	Vac (In.H ₂ O)	Flow (CFM)	Air Watts
2.000	3.5	766	18333	2.7	87.7	28
1.750	3.5	766	18280	4.3	84.5	42
1.500	3.6	776	18227	7.6	83.0	74
1.250	3.6	781	18068	13.3	78.2	120
1.125	3.6	781	18015	19.0	73.8	165
1.000	3.6	778	17273	25.2	67.1	199
0.875	3.5	757	17273	31.7	57.6	215
0.750	3.4	735	18280	39.6	47.3	220
0.625	3.3	706	18788	46.6	35.6	195
0.500	3.1	671	19477	53.0	24.3	151
0.375	2.8	633	20346	59.5	14.5	101
0.250	2.7	584	21194	65.0	6.7	51
0.000	2.4	540	22550	76.2	0.0	0

METRIC DATA



Orifice (mm)	Amps	Watts (In)	RPM	Vac (mm H ₂ O)	Flow (L/Sec)	Air Watts
48.0	3.5	766	18310	86	40.7	34
40.0	3.6	773	18243	168	39.4	64
30.0	3.6	781	18039	417	35.8	145
23.0	3.5	762	17273	764	28.3	211
19.0	3.4	734	18290	1009	22.2	220
16.0	3.3	707	18768	1177	17.0	196
13.0	3.1	675	19408	1330	12.0	155
10.0	2.9	639	20216	1487	7.5	109
6.5	2.7	586	21152	1644	3.3	54
0.0	2.4	540	22550	1935	0.0	0

Note: Metric performance data is calculated from the ASTM data above.

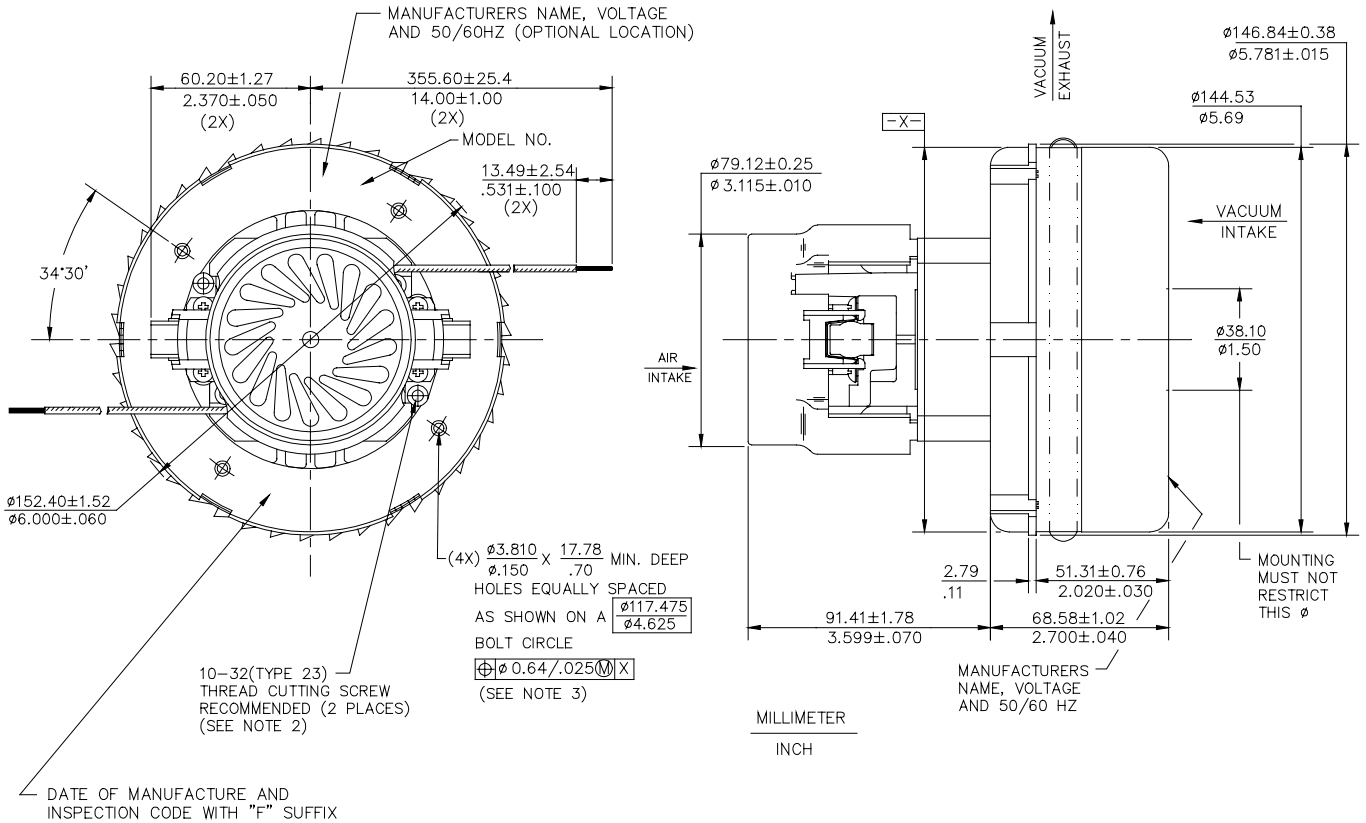
* Data represents performance of a typical motor sampled from a large production quantity. Individual motor data may vary due to normal manufacturing variations.

Test Specs:	240 volts	Minimum Sealed Vacuum:	70.0"	ORIFICE:	7/8 "	Minimum Vacuum:	30.0"	Maximum Watts:	870
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DIMENSIONS

NOTES:

1. LEADS: 18GA STRANDED, LEADS CAN BE ANY COLOR EXCEPT GREEN OR GREEN WITH YELLOW STRIPE.
2. GROUNDING OR EARTHING PROVISIONS: USE HOLES AS INDICATED FOR GROUNDING OR EARTHING. REFER TO APPROPRIATE LISTING OR REGULATORY AGENCY FOR PROPER METHOD OF GROUNDING OR EARTHING.
3. RECOMMENDED SCREW SIZE 10-16 TYPE BT OR TYPE 25 THREAD CUTTING SCREW. MAXIMUM PENETRATION 17.40/.685.



IMPORTANT NOTE: Pictorial and dimensional data are subject to change without notice. Contact factory for current revision levels.

WARNING - When using AMETEK Lamb Electric bypass motors in machines that come in contact with foam, liquid (including water), or other foreign substances, the machine must be designed and constructed to prevent those substances from reaching the fan system, motor housing, and electrical components. Lamb Electric vacuum motors other than hazardous duty models should not be applied in machines that come in contact with dry chemicals or other volatile materials. Failure to observe these precautions could cause flashing (depending on volatility) or electrical shock which could result in property damage and severe bodily injury, including death in extreme cases. All applications incorporating Lamb Electric motors should be submitted to appropriate organizations or agencies for testing specifically related to the safety of your equipment.



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Appendix C

Flow Meter Specifications



Series RM Rate-Master® Flowmeters

Specifications - Installation and Operating Instructions



Fig. 1

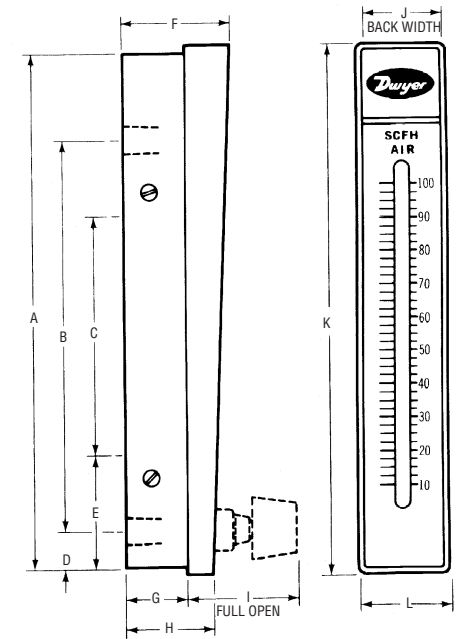


Fig. 2

Dimensions in Inches (Centimeters)			
	Model RMA	Model RMB	Model RMC
A	4 -9/16 (11.59)	8-1/2 (21.59)	15 -1/8 (38.42)
B	3 (7.62) 1/8 NPT CONN.	6-7/16 (16.35) 1/4 NPT CONN.	12 -1/4 (31.12) 1/2 NPT CONN.
C	1-5/8 (4.13) 10 - 32 Thds.	3-15/16 (10.00) 1/4 - 20 Thds.	8-3/4 (22.23) 3/8 - 24 Thds.
D	3/8 (.95)	5/8 (1.59)	1 (2.54)
E	1-1/16 (2.70)	1-7/8 (4.76)	2-3/4 (6.99)
F	1-3/16 (3.02)	1-3/4 (4.45)	2-1/2 (6.35)
G	11/16 (1.75)	1 (2.54)	1-7/16 (3.65)
H	61/64 (2.42)	1-7/16 (3.65)	1-31/32 (5.00)
I	1-3/8 (3.49)	1-13/16 (4.60)	2-1/2 (6.35)
(OPEN)			
J	3/4 (1.91)	1-1/4 (3.18)	2 (5.08)
K	4-13/16 (12.22)	8-3/4 (22.23)	15-3/8 (39.05)
L	1 (2.54)	1-1/2 (3.81)	2-1/4 (5.72)

Panel Cutout For Flush Mounting			
High	4-5/8 (11.75)	8-9/16 (21.75)	15 -3/16 (38.58)
Wide	7/8 (2.22)	1-5/16 (3.33)	2-1/16 (5.24)
Panel Hole Sizes for Surface Mounting			
Pipe	7/16 (1.11)	5/8 (1.59)	15/16 (2.38)
Bolt	1/4 (0.64)	9/32 (0.71)	13/32 (1.03)

The Series RM Rate-Master® Flowmeters are furnished in three models (see Fig. 2), each available in a broad array of flow ranges with direct reading scales for air, gas or water. Installation, operation and maintenance are very simple. Only a few common-sense precautions must be observed to assure long, trouble-free service.

CAUTION: Rate-Master® Flowmeters are designed to provide satisfactory long-term service when used with air, water or other compatible media. Refer to factory for information on questionable gases or liquids. Avoid solutions of acids, bases or salts having a pH below 5.0 or above 8.5. Caustic solutions, antifreeze (ethylene glycol) and aromatic solvents should definitely not be used.

Calibration

Each Rate-Master® Flowmeter is calibrated at the factory. If at any time during the meter's life, you wish to re-check its calibration, do so only with devices of certified accuracy. DO NOT attempt to check a Rate-Master® Flowmeter with a similar flowmeter, as seemingly unimportant variations in piping and back pressure may cause noticeable differences in the indicated reading. If in doubt, return your Rate-Master® Flowmeter to the factory. Before proceeding with installation, check to be sure you have the Rate-Master® flowmeter model and flow range you require.

LOCATION: Temperature, Pressure, Atmosphere and Vibration: Rate-Master® Flowmeters are exceptionally tough and strong. They are designed for use at pressures up to 100 psi (6.89 bar) and temperatures up to 130°F (54°C).

DO NOT EXCEED THESE LIMITS! The installation should not be exposed to strong chlorine atmospheres or solvents such as benzene, acetone, carbon tetrachloride, etc. The mounting panel should be free of excessive vibration, as it may prevent the unit from operating properly.

Inlet Piping Run: It is good practice to approach the flowmeter inlet with as few elbows and restrictions as possible. In every case, the inlet piping should be at least as large as the connection to the flowmeter; i.e., 1/8" Iron Pipe Size for RMA models 1/4" IPS for RMB models, 1/2" IPS for RMC models. Length of inlet piping makes little difference for normal pressure-fed flowmeters.

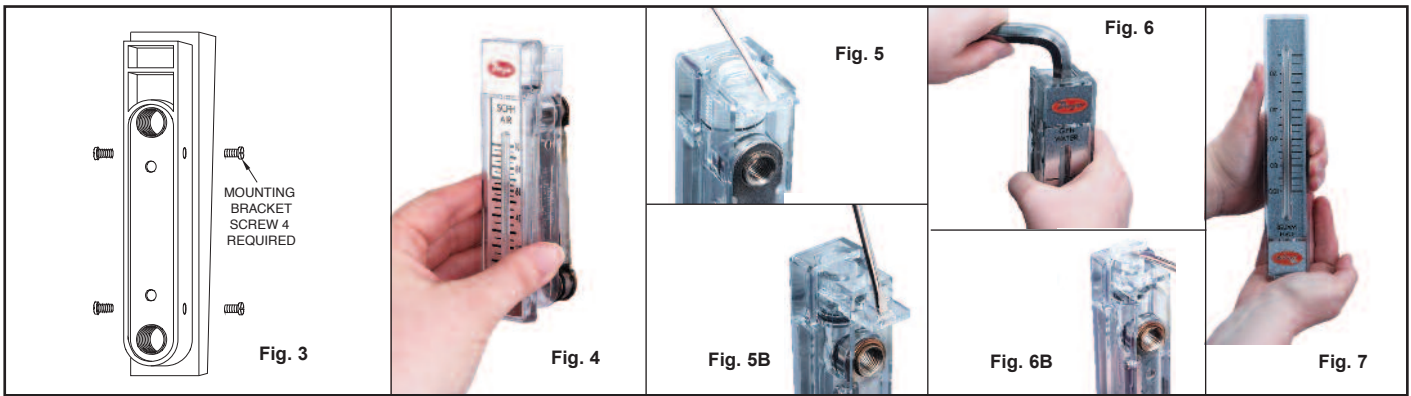
For flowmeters on vacuum air service, the inlet piping should be as short and open as possible. This will allow operation near atmospheric pressure and thereby insure the accuracy of the device. (**Note:** for vacuum air service, the flow control valve, if any, should be on the discharge side of the flowmeter. Either the TMV unit or a separate in-line valve may be applied.)

Discharge Piping: As on the inlet, discharge piping should be at least as large as the flowmeter connection. Also, for pressure-fed flowmeters on air or gas service, the discharge piping should be as short and open as possible. This will allow operation of the flow tube at near atmospheric pressure and insure the accuracy of the device. This is of less importance on water or liquid flowmeters, as the flowing medium is generally incompressible and moderate back pressure will not affect the accuracy of the instrument as calibrated.

POSITIONING AND MOUNTING

All Rate-Master® Flowmeters must be mounted in a vertical position with inlet connection at the bottom rear and outlet at the top rear.

Bezel or Through-Panel Mounting: Make panel cutout using appropriate dimensions from Fig. 2. Flowmeter must fit into panel freely without forcing or squeezing. Insert the flowmeter from the front of the panel and install the mounting clamps from the rear. Insert and tighten the clamp bolts in the locations shown in Fig. 3. Do not exceed 5 in./lbs. Make connections to inlet and outlet ports using pipe thread sealant tape to avoid leakage. Avoid excess torque, which may damage the flowmeter body.



Surface Mounting: Drill appropriate holes in panel, using the dimensions shown in Fig. 2. Hold the flowmeter in position in front of the panel and install the clamp bolts from the rear. (The mounting clamps may be used as washers, if desired, by installing them backwards or straightening them out.) Pipe up inlet and discharge following the directions in the previous sections.

Surface Mounting on Piping Only: An alternate method of surface mounting, omitting the clamp bolts and supporting the flowmeter solely on the connecting piping, is possible. For this method, extra-long or straight pipe threads should be used so that nuts may be run onto the pipe and later tightened against the back of the panel to retain the unit in proper position. Use appropriate hole layout in formation from Fig. 2, but omit the small holes.

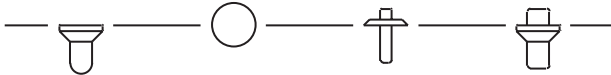
Surface Mounting on Piping Only Without Panel: For a temporary or laboratory type installation, the panel may be omitted altogether and the flowmeter installed directly in rigid piping. Its light weight permits this without difficulty.

OPERATION

To start system, open valve slowly to avoid possible damage. Control valves on BV and SSV models are turned clockwise to reduce flow, counter-clockwise to increase flow (valve is designed for flow adjustment only, not intended to be used as an open/shut-off valve). A nylon insert is provided in the threaded section of the valve stem to give a firm touch to valve and to prevent change of setting due to vibration.

The performance of low range units used in air or gas applications may be affected by static electricity. Excessive static charge may cause the ball float to behave erratically or provide a false reading. To ensure the proper function of the unit, the application should be designed to minimize or dispel static electricity.

The standard technique for reading a Variable Area Flowmeter is to locate the highest point of greatest diameter on the float, and then align that with the theoretical center of the scale graduation. In the event that the float is not aligned with a grad, an extrapolation of the float location must be made by the operator as to its location between the two closest grads. The following are some sample floats shown with reference to the proper location to read the float.



Variable Area Flowmeters used for gases are typically labeled with the prefix "S" or "N", which represents "Standard" for English units or "Normal" for metric units. Use of this prefix designates that the flowmeter is calibrated to operate at a specific set of conditions, and deviation from those standard conditions will require correction for the calibration to be valid. In practice, the reading taken from the flowmeter scale must be corrected back to standard conditions to be used with the scale units. The correct location to measure the actual pressure and temperature is at the exit of the flowmeter, except when using the Top Mounted Valve under vacuum applications, where they should be measured at the flowmeter inlet. The equation to correct for nonstandard operating conditions is as follows:

$$Q_2 = Q_1 \times \sqrt{\frac{P_1 \times T_2}{P_2 \times T_1}}$$

Where: Q_1 = Actual or Observed Flowmeter Reading
 Q_2 = Standard Flow Corrected for Pressure and Temperature

P_1 = Actual Pressure (14.7 psia + Gage Pressure)
 P_2 = Standard Pressure (14.7 psia, which is 0 psig)
 T_1 = Actual Temperature (460 R + Temp °F)
 T_2 = Standard Temperature (530 R, which is 70°F)

Example: A flowmeter with a scale of 10-100 SCFH Air. The float is sitting at the 60 grad on the flowmeter scale. Actual Pressure is measured at the exit of the meter as 5 psig. Actual Temperature is measured at the exit of the meter as 85°F.

$$Q_2 = 60.0 \times \sqrt{\frac{(14.7 + 5) \times 530}{14.7 \times (460 + 85)}}$$

$Q_2 = 68.5$ SCFH Air

CAUTION: Do not completely unscrew valve stem unless the flowmeter is unpressurized and drained of any liquid. Removal while in service will allow gas or liquid to flow out the front of the valve body and could result in serious personal injury. For applications involving high pressure and/or toxic gases or fluids, please contact factory for details.

MAINTENANCE

The only maintenance normally required is occasional cleaning to assure reliable operation and good float visibility.

Disassembly: The flowmeter can be disassembled for cleaning simply as follows:

1. Remove valve knob from RMB or RMC -BV or -SSV units by pulling the knob forward. It is retained by spring pressure on the stem half-shaft so that a gentle pull will remove it. On RMA-BV or -SSV models, turn the valve knob counter-clockwise until the threads are disengaged. Then withdraw the stem from the valve by gently pulling on the knob.
2. Remove the four mounting bracket screws located in the sides of the flowmeter. See Fig. 3. Pull the flowmeter body gently forward away from the back plate to avoid undue strain on the body. Leave the piping connections intact. There is no need to disturb them. See Fig. 4.
3. Threaded body style flowmeters - Remove the slip cap with a push on a screwdriver as shown in Fig. 5. Remove the plug ball stop as shown in Fig. 6 using allen wrench sizes as follows: Model RMA - 1/4", Model RMB - 1/2" and Model RMC - 3/4" Threadless body style flowmeters - Release the plastic retaining clip with a screw driver (Figure 5B), it will unclip from the valve body (TMV Option) or the plug ball stop, slide the clip back until the valve body or ball stop can be removed. The clip will remain in the body for convenience. Using a screwdriver gently lift up on the plug in the groove as shown in Figure 6B until the o-ring seal is released and remove the plug. For the TMV option gently pull up on the valve knob to release the valve body seals and remove the valve.
4. Take out the ball or float by inverting the body and allowing the float to fall into your hand, as shown in Fig. 7. (Note: It is best to cover the discharge port to avoid losing the float through that opening.)

Cleaning: The flow tube and flowmeter body can best be cleaned with a little pure soap and water. Use of a bottle brush or other soft brush will aid the cleaning. Avoid benzene, acetone, carbon tetrachloride, alkaline detergents, caustic soda, liquid soaps (which may contain chlorinated solvents), etc. Also, avoid prolonged immersion, which may harm or loosen the scale.

Reassembly: Simply reverse steps 1 through 4 and place the flowmeter back in service. A little stopcock grease or petroleum jelly on the "O" rings will help maintain a good seal as well as facilitate assembly. No other special care is required.

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Appendix D

Elapsed Timer Specifications

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Appendix E

Calibration Documentation