



VAREC SERIES 5000/5010 FLAME ARRESTERS

INSTRUCTION, OPERATION AND MAINTENANCE MANUAL

Before installation these instructions must be fully read and understood



SAFETY PRECAUTIONS

Read and understand this instruction manual before installing, operating or performing maintenance on varec 5000/5010 series flame arresters. Follow all precautions and warnings noted herein when installing, operating or performing maintenance on this equipment.

WARNING

Flame arresters should be installed upstream and not more than 15 feet from the ignition source for use in accordance with UL approval. Flame arresters must be isolated from the gas piping before performing maintenance. All gas must be blocked and pressure safely vented. Flame arresters are not capable of stopping a flame front in mixtures of air with hydrogen, acetylene, ethylene oxide, or carbon disulfide.

NOTE

Varec flame arresters bearing UL approval are tested for use on oil storage tanks, installed not more than 15 feet from the open end of the vent pipe (reference UL 525). These test conditions may not represent the actual service conditions or piping system design. API publication 2028 states that the arresters should be independently tested under actual service conditions before installation.

DISCLAIMER OF WARRANTIES

The contract between the seller and the buyer states the entire obligation of the seller. The contents of this instruction manual shall not become part of or modify any prior or existing agreement, commitment or relationship between the seller and buyer. There are no express or implied warranties set out in this instruction manual. The only warranties that apply are those in the existing contract between the seller and buyer.

The Varec 5000/5010 Series flame arresters have not been tested by Varec under all possible operational conditions and Varec does not have all the data relative to your application. The information in this instruction manual is not all inclusive and does not and cannot take into account all unique situations. Consequently, you should review this product literature in view of your application. If you have any further questions, please contact Varec for assistance.

LIMITATIONS OF SELLER'S LIABILITY

If it is determined that this instruction manual created some new warranties, Varec's liability shall be limited to repair or replacement under the standard warranty clause. In no case shall Varec's liability exceed that stated as Limitations of Remedy in the contract between Varec and our customer.

Safety precaution definitions:

CAUTION

Damage to equipment may result if this precaution is disregarded.

WARNING

Direct injury to personnel or damage to equipment which can cause injury to personnel may result if this precaution is not followed.

GENERAL

The Varec Model 5000/5010 Series flame arresters are designed to stop the propagation of flame from external sources. They are used on storage tank roofs, digester covers and in waste gas piping systems. These units are installed where fire protection is required in combination with pressure relief or shut-off valves in vapor balancing, recovery or open vent piping systems.

WARNING

Flame arresters are not capable of stopping a flame front in mixtures of air with hydrogen, acetylene, ethylene oxide, or carbon disulfide.

Flame arrester should be installed upstream of and not more than 15 feet from the ignition source for use in accordance with UL approval.

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CONSTRUCTION

The standard unit is constructed of a heavy cast housing containing a removable multiplate bank assembly with aluminum extensible frame. A fixed 316 S.S. frame is also available. Working pressure rating is 10 Psig (69.0 kPa). For material selection see Tables 4 and 6.

PRACTICAL LIMITATIONS

While flame arresters decrease the possibility of flame propagation in a system, certain variables must be evaluated to ensure safety. The relative fire hazard of flammable mixtures can be judged by the upper and lower explosive limits. These limits are expressed as percent by volume of the gas or vapor in air. The explosive range is that span of concentrations lying between the lower and upper limits. The upper limit is the point at which the mixture is too rich to burn, i.e., contains too little oxygen to support combustion. The broader the explosive range, the easier it is to create an air-gas explosive mixture. Conversely, when the explosive range is narrow, the chance of developing a hazardous air-gas mixture decreases.

Table 1 gives the approximate limits of flammability of some single gases, vapors and industrial mixtures in air at common temperatures and at atmospheric pressure.

WARNING

In all cases where the ratio of upper limit/lower limit exceeds 10, the use of flame arresters is not recommended. Also, the presence of any O₂ is dangerous because of the lack of homogeneity which is possible in gas mixtures. Any surplus of oxygen provides the potential for rapid explosion.

OPERATION

Flame arresters do not prevent ignition of flammable mixtures, but do prevent the propagation of a flame. The Varec 5000/5010 Series flame arresters stop flame propagation by absorbing and dissipating heat through the surface area of the bank sheets. Heat is absorbed as ignited gas attempts to pass through the small passages within the bank assembly. This action lowers the temperature of the gas below its ignition point and quenches the flame.

TABLE 1 - FLAMMABILITY LIMIT OF GASES AND VAPOR

Product	Limits in air pressure		Product	Limits in air pressure		Product	Limits in air percent	
	Lower	Higher		Lower	Higher		Lower	Higher
Acetaldehyde	4.1	55	Ethyl-Alcohol	4.3	19	Methyl-Alcohol	7.3	36
Acetone	3	11	Ethyl-Bromide	6.7	11.3	Methyl-Chloride	10.7	17.4
Acetylene	2.5	81	Ethyl-Chloride	3.8	15.4	Methyl-Ethyl-Ketone	1.8	10
Ammonia	15	28	Ethyl-Ether	1.9	48	Methyl-Formate	5.9	20
Benzene	1.4	7.1	Ethyl-Formate	2.7	13.5	Methyl-Propyl-Ketone	1.5	8
Benzine	1.1		Ethylene	3.1	32	Natural gas	3.8	17
Blast furnace gas	35	74	Furfural	2.1		Norane	0.8	
Butadiene	2	11.5	Gasoline	1.4	7.6	Octane	1	
Butane	1.9	8.5	Hexane	1.2	7.5	Pentane	1.5	7.8
Butylene	2	9.6	Heptane	1.2	6.7	Propane	2.1	9.5
Carbon Disulphide	1.25	44	Hydrocyanic acid	6	41	Propyl-Alcohol	2.1	13.5
Carbon Monoxide	12.5	74	Hydrogen	4	75	Propylene	2.4	10.3
Cyclohexane	1.3	8	Hydrogen-Sulhide	4.3	5	Pyridine	1.8	12.4
Cyclopropane	2.4	10.4	Isobutane	1.8	8.4	Styrene	1.1	6.1
Decane	0.8	5.4	Isopentane	1.4	7.6	Toluene	1.4	6.7
Ethane	3	12.5	Isopropyl-Alcohol	2	12	Water gas	7	72
Ethyl-Acentate	2.5	9	Methane	5.3	14	Xylene	1	6

Reference: Bureau of Mines bulletin 503, Limits of flammability of gases and vapors, 1952

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INSTALLATION

The 5000 Series flame arrester (ref. Figure 2) is designed for vertical application in pipe lines and on tank or digester roofs. The 5010 Series flame arrester (ref. Figure 3) is designed for horizontal positioning in pipelines, however, it may be in either direction.

The cover, roof or piping system must have the appropriate flange(s) installed for mating with the flame arrester. Flame arrester with aluminum housings should be mated with an ANSI Class 125 F.F. flange. The 316 stainless steel housing should be mated with an ANSI Class 150 R.F. flange. The arrester must be located with clearance allowed for removal of the bank assembly.

The flange of vertical mounting must be plumb and level to ensure proper operation of the pressure relief valve (when used in combination with the flame arrester).

The flange for horizontal mounting must be oriented to ensure that arrester drain hole will be at the extreme bottom (6 o'clock) position.

1. Remove the flame arrester from the shipping container or pallet.
2. Remove flange protectors. Inspect for and remove any packing or other loose material in the inlet/outlet chambers of the housing.
3. Remove cover and extract bank assembly. Inspect for shipping debris or damage and correct as required. Insert bank and replace cover. Tighten cap screws uniformly.

WARNING

The aluminum bank assembly weighs from 10 to 80 pounds and the 316 S.S. assembly is substantially heavier. Use the appropriate tools and equipment when handling these units to avoid injury.

4. Place the appropriate full face flange gasket (by others) on the flange.

CAUTION

If it is necessary to mate an ANSI Class 125 F.F. flange with an ANSI Class 150 R.F. flange, use the proper spacer to convert the raised face to a flat face.

5. Place the arrester on the flange, and position the unit so that the bank assembly can be readily extracted for inspection and maintenance.

NOTE

When installing the Model 5010 in a horizontal position, check the drain hole to see that it is functional. Install the appropriate drain piping along with a Varec Drip trap or an isolation valve.

6. Install mounting hardware and tighten uniformly.

The flame arrester is now installed and ready for use.

MAINTENANCE

Maintenance is the most important factor in the operation of the flame arrester. The bank sheets must be kept clean to prevent a decrease in gas flow through the system and loss of heat absorbing efficiency.

WARNING

Failure to properly maintain the unit could result in reduction of safety and impairment of system operation.

A regular inspection program is important. The frequency of inspection is determined by the application. Consideration should be given to the amount and nature of water or solids in the gas and the corrosivity of the process stream. Generally, the first inspection should be made 30 days after commissioning. Inspections should continue on a 30 day schedule unless excessive deposits or accumulation of foreign matter are found. If so, the frequency of inspections should be increased. Adjust inspection frequency to maintain free and unrestricted flow through the arrester.

WARNING

Flame arrester must be isolated from the gas piping before removing cover plate. All gas must be blocked and pressure safely vented. Ensure that arrester is cool after a fire, or wear appropriate protective clothing.

1. Remove cover cap screws and cover plate. Pull out bank assembly by pulling on bank handle. If desired, the bank assembly may be removed from the housing.

WARNING

The aluminum bank assembly weighs from 10 to 80 pounds and the 316 S.S. assembly is substantially heavier. Use the appropriate tools and equipment when handling these units to avoid injury.

- a. Extend the aluminum frame to its full open position. Both sides of each grid sheet may be inspected and cleaned without removal from the frame.
 - b. The 316 S.S. frame is non-extensible and must be disassembled to access the bank sheets.
2. Check for corrosion, bent, warped or otherwise damaged sheets that could cause an opening for a direct flame path. Replace with a new bank assembly if necessary.

3. Bank assembly cleaning procedure is based on the type of residue to be removed. Determine if residue type is Group I, II, or III. Follow the cleaning procedures for the selected group.

WARNING

Use all volatile and flammable solvents carefully to avoid ignition or prolonged breathing. Use protective clothing and gloves when using acid to avoid burns from contact with skin.

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Group I

Residue type: soil, sand, pollen, and metallic salts.

Cleaning procedure

- a. Wash bank sheets with a mild solvent such as petroleum naphtha or commercial petroleum derived cleaning fluids.
- b. Rinse sheets with a solvent that does not leave an oily film. This is necessary to avoid collecting foreign matter.
- c. Blow out dry particles with compressed air.
- d. Wash bank sheets with hot water.
- e. Steam bank assembly clean.

Group II

Residue type: metallic oxides and metallic carbonates.

Cleaning procedure

- a. Wash bank sheets as described in Group I, Step 1.
- b. Soak entire bank assembly in cold 35% nitric acid.

CAUTION

Use acid only on aluminum or stainless steel bank assemblies. Do not use on carbon steel or monel.

NOTE

If residue still remains, place bank assembly in boiling 35% nitric acid. Once all residue is removed, soak bank assembly in a solution of baking soda and water (8 ounce baking soda to 3 gallons water) to neutralize any remaining acid. Blow dry using compressed air.

Group III

Residue type: organic tars, organic gums and sulfur organic residues.

Cleaning procedure

- a. Wash bank sheets as described in Group I, Step 1.
- b. Blowout with compressed air.

- c. Wash bank sheets with a strong solvent such as benzol, xyol, carbon tetrachloride, acetone, carbon disulfide, paint thinner (not lacquer), or a mixture of 1/3 each of benzol, alcohol and acetone.

4. If residue cannot be removed by the above procedures, replace with a new bank assembly.

WARNING

Clogged bank assembly can restrict flow and reduce ability to stop flame propagation.

5. Place the bank assembly into the arrester housing. Install new gasket, cover plate, and cap screws.

- a. The aluminum extensible frame bank assembly may not go entirely back into place. The force needed to compress bank into place is supplied by tightening cover plate cap screws.
- b. The 316 S.S. fixed frame bank assembly should allow cover to close readily.

6. Install all cap screws hand tight. Cross tighten all cap screws evenly around cover (see Figure 1). Torque to 40-50 ft-lbs.

7. The flame arrester is ready to be placed back into service. Perform soap test. If any leakage is detected, further tighten cap screws (maximum torque not to exceed 60 ft-lbs).

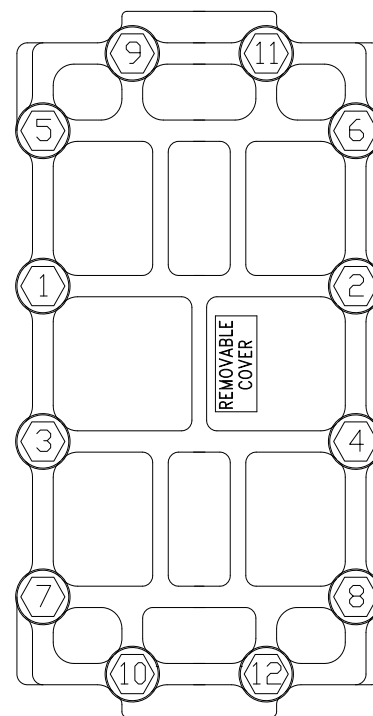


FIGURE 1

REPLACEMENT PARTS

When ordering replacement parts specify flame arresters by model number, series number and pipe size. Identify replacement parts by item number, description and material as shown on reference drawings. Include part number where possible.

TABLE 2 - REPLACEMENT PARTS

Size	2	3	4	6	8	0	1
Nominal	2 in.	3 in.	4 in.	6 in.	8 in.	10 in.	12 in.
Pipe size	50 mm	75 mm	100 mm	150 mm	200 mm	250 mm	300 mm
Bank assembly alum. ext. frame w/alum sheets	BM 6027	BM6055	BM6090	BM6126	BM6245	BM6269	BM6716
Bank assembly alum. ext. frame w/316 S.S. sheets	BM18996-000	BM18998-000	BM19000-000	BM18956-000	BM18958-000	BM19002-000	BM19004-000
Bank assembly 316 S.S. fixed frame w/316 S.S. sheets	BM19882-600	BM19883-600	BM19884-600	BM19885-600	BM19886-600	BM19887-600	BM19888-600
Gasket kit compressed non-asbestos	13-09101-02	13-09101-03	13-09101-04	13-09101-06	13-09101-08	13-09101-10	13-09101-12

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FIGURE 2
5000 Series flame arrester

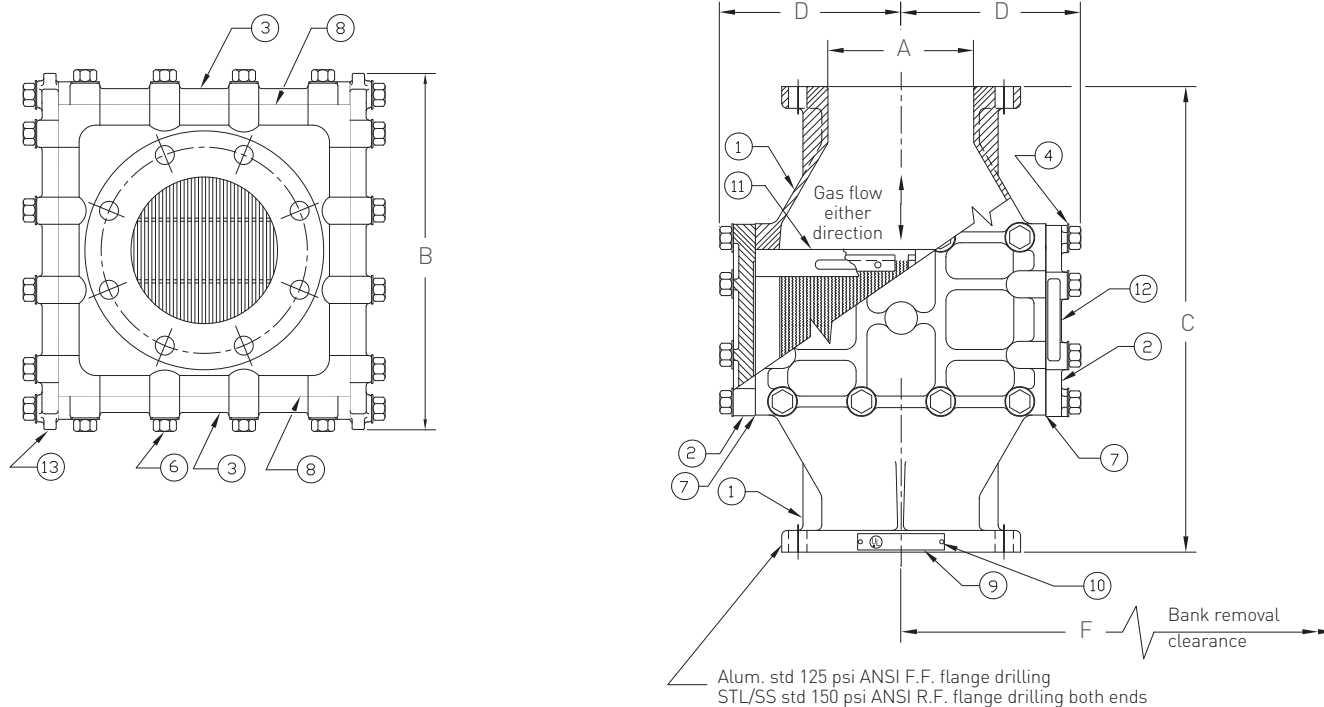


TABLE 3 - DIMENSIONS 5000 SERIES

Size	A (Alum.) in. (mm)	A (CS/SS) in. (mm)	B in. (mm)	C in. (mm)	D in. (mm)	F in. (mm)
2"	2.19 [56]	2.00 [51]	9.00 [229]	12.56 [319]	4.31 [109]	19.00 [483]
3"	3.38 [86]	3.03 [77]	11.50 [292]	13.81 [351]	5.75 [146]	23.25 [591]
4"	4.62 [117]	4.69 [119]	14.50 [368]	16.56 [421]	7.12 [181]	28.12 [714]
6"	6.75 [171]	6.75 [171]	16.50 [419]	21.44 [545]	8.38 [213]	31.12 [790]
8"	9.00 [229]	9.00 [229]	21.62 [549]	27.25 [692]	10.88 [276]	38.62 [981]
10"	11.12 [282]	11.12 [282]	24.00 [610]	28.38 [721]	12.00 [305]	41.62 [1057]
12"	12.50 [318]	12.50 [318]	31.00 [787]	34.25 [870]	14.75 [375]	50.00 [1270]

TABLE 4 - MATERIALS OF CONSTRUCTION 5000 SERIES

Item	Description	Material			
		Model 5000X1	Model 5000X2	Model 5000X3	Model 5000X6
1	End housing	Aluminum	Aluminum	Steel	316 S.S.
2	Cover plate	Aluminum	Aluminum	Steel	316 S.S.
3	Side plate	Aluminum	Aluminum	Steel	316 S.S.
4	Washer	Zn Pl Stl	Zn Pl Stl	Zn Pl Stl	304 S.S.
6	Cap screw	Zn Pl Stl	Zn Pl Stl	Zn Pl Stl	304 S.S.
7	Gasket, cover plate	Compressed non-asbestos	Compressed non-asbestos	Compressed non-asbestos	Compressed non-asbestos
8	Gasket, side plate	Compressed non-asbestos	Compressed non-asbestos	Compressed non-asbestos	Compressed non-asbestos
9	U.L. listing tag	Aluminum	-	-	-
10	Drive screw	18-8 SST	18-8 SST	18-8 SST	18-8 SST
11	Bank assembly	Alum. ext. frame/alum. sheets	Alum. ext. frame/316 S.S. sheets	Fixed 316 S.S. frame/316 S.S. sheets	Fixed 316 S.S. frame/316 S.S. sheets
12	Cover tag	Aluminum	Aluminum	Aluminum	Aluminum
13	Rear plate	Aluminum	Aluminum	Steel	316 SST

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FIGURE 3
5010 Series flame arrester

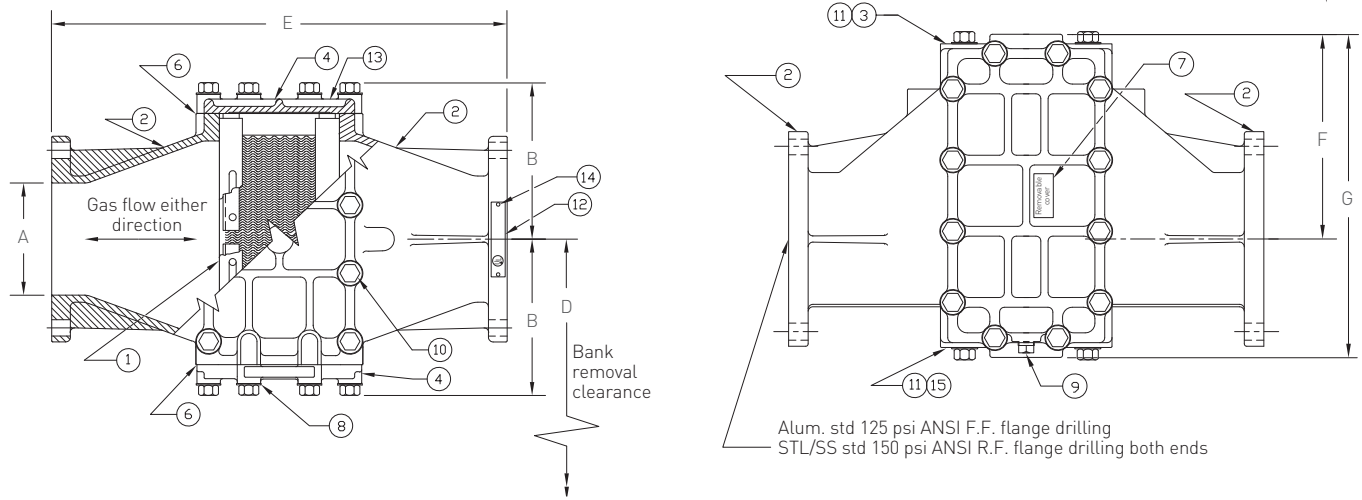


TABLE 5 - DIMENSIONS 5010 SERIES

Size	A	B	D	E (Alum.)	E (CS/SS)	F	G
	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)
2"	2.00 (51)	4.31 (109)	19.00 (483)	14.25 (362)	14.25 (362)	5.50 (140)	9.00 (229)
3"	3.00 (76)	5.75 (146)	23.25 (591)	16.00 (406)	16.00 (406)	7.19 (183)	11.50 (292)
4"	4.00 (102)	7.12 (181)	28.12 (714)	20.00 (508)	20.00 (508)	9.50 (241)	14.50 (368)
6"	6.00 (152)	8.38 (213)	31.12 (790)	24.38 (619)	24.38 (619)	10.50 (267)	16.50 (419)
8"	8.00 (203)	10.88 (276)	38.62 (981)	32.12 (816)	32.12 (816)	14.31 (363)	21.62 (549)
10"	10.00 (254)	12.00 (305)	41.62 (1057)	36.00 (914)	35.25 (895)	16.00 (406)	24.00 (610)
12"	12.00 (305)	14.75 (375)	50.00 (1270)	34.62 (879)	34.25 (870)	20.00 (508)	31.00 (787)

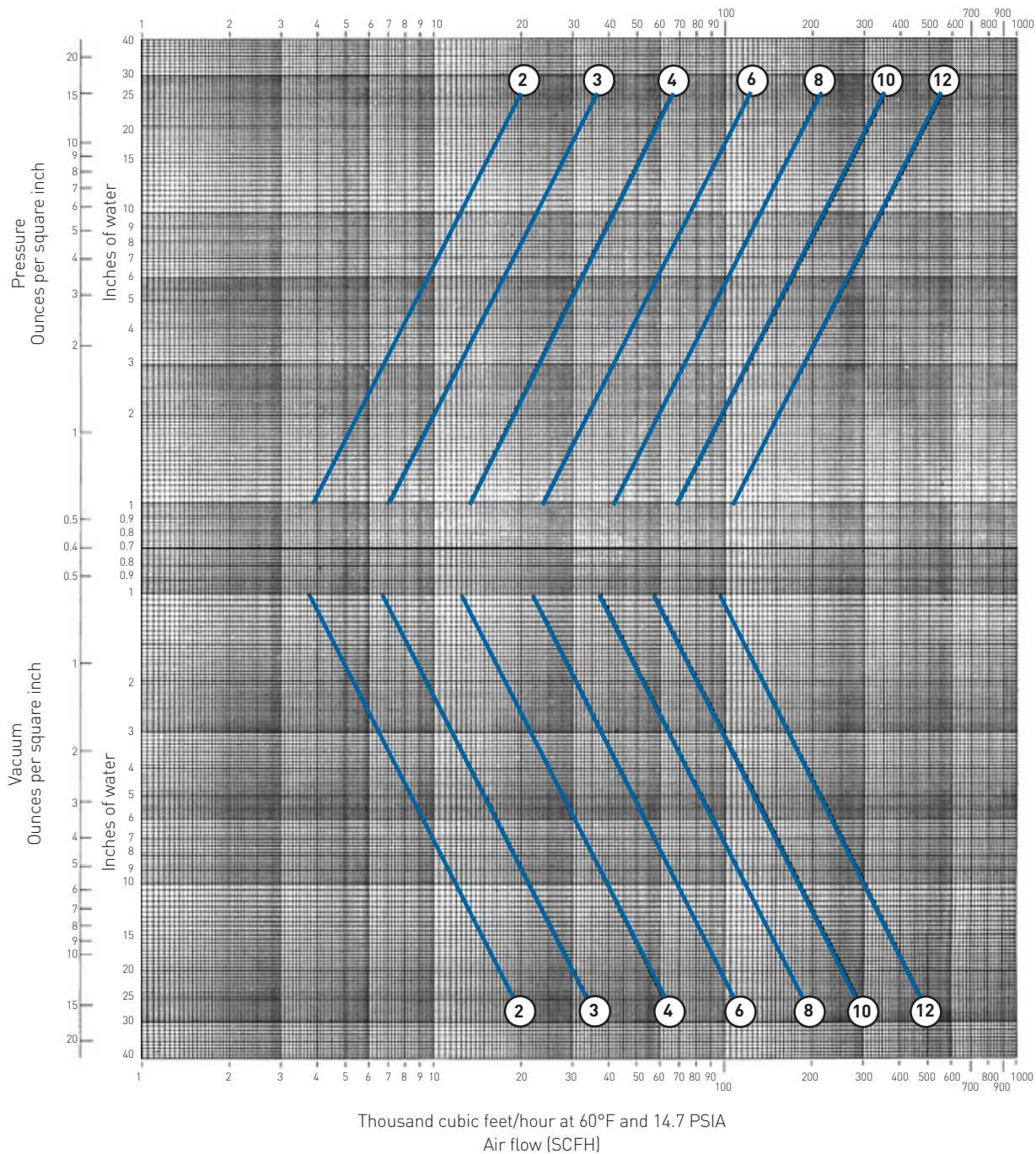
TABLE 6 - MATERIALS OF CONSTRUCTION 5010 SERIES

Item	Description	Material			
		Model 5010X1	Model 5010X2	Model 5010X3	Model 5010X6
1	Bank assembly	Alum. ext. frame/alum. sheets	316 S.S. fixed frame/316 S.S. sheets	316 S.S. fixed frame/316 S.S. sheets	316 S.S. fixed frame/316 S.S. sheets
2	End housing	Aluminum	Aluminum	Steel	316 S.S.
3/15	Side plate	Aluminum	Aluminum	Steel	316 S.S.
4	Cover plate	Aluminum	Aluminum	Steel	316 S.S.
6	Gasket, cover plate	Compressed non-asbestos	Compressed non-asbestos	Compressed non-asbestos	Compressed non-asbestos
7	Cover tag	Aluminum	Aluminum	Aluminum	Aluminum
8	Washer	Zn Pl Stl	Zn Pl Stl	Zn Pl Stl	304 S.S.
9	1/2" NPT plug	Zn Pl Stl	Zn Pl Stl	Zn Pl Stl	316 S.S.
10	Cap screw	Zn Pl Stl	Zn Pl Stl	Zn Pl Stl	304 S.S.
11	Gasket, side plate	Alum. ext. frame/alum. sheets	Compressed non-asbestos	Compressed non-asbestos	Compressed non-asbestos
12	U.L. listing tag	Aluminum	-	-	-
13	Rear plate	Aluminum	Aluminum	Steel	316 SST
14	Drive screw	18-8 SST	18-8 SST	18-8 SST	18-8 SST

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FIGURE 4
5000 And 5010 Series flame arresters



Air flow (CFH) at 22°C and 14.7 PSIA may be determined as follows:
multiply air flow from chart (SCFH) times the factor 1.0223

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