

## Free Vent Flame Arrestor

### Table of Contents

- Introduction..... 1
- Specifications ..... 2
- Principle of Operation ..... 3
- Factors Affecting Flame Arrestor Performance..... 3
- Installation ..... 3
- Maintenance ..... 4
- Recommended Spare Parts ..... 6
- Parts Ordering ..... 6
- Parts List..... 7



Figure 1. Typical Free Vent Flame Arrestor

 **WARNING**

**Failure to follow these instructions or to properly install and maintain this equipment could result in an explosion, fire and/or chemical contamination causing property damage and personal injury or death.**

**Enardo flame arrestor must be installed, operated and maintained in accordance with federal, state and local codes, rules and regulations and Emerson Process Management Regulator Technologies Tulsa, LLC instructions.**

**Failure to correct trouble could result in a hazardous condition. Call a qualified service person to service the unit. Installation, operation and maintenance procedures performed by unqualified person may result in improper adjustment and unsafe operation. Either condition may result in equipment damage or personal injury. Only a qualified person must install or service the flame arrestor.**

### Introduction

#### Scope of the Manual

This Instruction Manual provides instructions for installation, startup, maintenance and parts ordering information for the free vent flame arrestor.

#### Product Description

Enardo free vent flame arrestor (FVFA) are designed to allow free venting in combination with flame protection for vertical vent applications. This product is installed at the top of an atmospheric vent line or storage tank.

Free vent flame arrestor are typically used for the end of line applications when the system operating pressure is near atmospheric levels and when there is minimal probability of a flame stabilizing on the flame arrestor element for an extended period.

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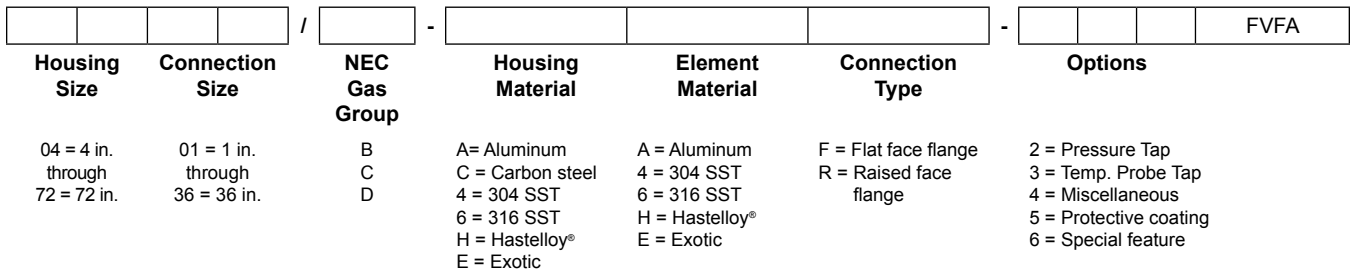
# Free Vent Flame Arrestor

## Specifications

The Specifications section lists the specifications for the free vent flame arrestor. The following information is stamped on the nameplate attached to the arrestor: housing size, connection size, NEC gas group, housing material, element material, connection type and other options; other identification and customer tag number are optional.

<p><b>Available Constructions</b> See Figure 2</p> <p><b>NEC Gas Group</b> B, C and D</p> <p><b>Connection Flange Size</b> 1 to 36 in. / 25 to 900 mm</p> <p><b>Flange Rating</b> ANSI Class 150 lb.</p> <p><b>Housing Size</b> 4 to 72 in. / 100 to 1800 mm</p>	<p><b>Operational Temperature (T<sub>o</sub>)<sup>(1)</sup></b> 450°F / 232°C</p> <p><b>Endurance Burn Time</b> See Table 2</p> <p><b>Housing Material</b> Aluminum, Carbon steel, 304 Stainless steel, 316 Stainless steel, Hastelloy® and Exotic</p> <p><b>Element Material</b> Aluminum, 304 Stainless steel, 316 Stainless steel, Hastelloy® and Exotic</p>
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1. The temperature limits in this Instruction Manual and any applicable standard or code limitation should not be exceeded.



**Figure 2. Free Vent Flame Arrestor Available Constructions and Model Numbering System**

**Table 1. Maximum Experimental Safe Gap (MESG)**

NEC Gas Group	MESG, mm	TEST GAS
B	0.28	Hydrogen
C	0.65	Ethylene
D	0.90	Propane
G.M.	1.12	Methane

**Table 2. Free Vent Flame Arrestors' Endurance Burn Time<sup>(1)</sup>**

NEC Gas Group	Maximum Initial Pressure, psia / kPa	Endurance Burn Time, minutes
D (Steel and Stainless steel models up to 12 in. and under)	15.4 / 106	30
D (all other Group-D)	15.4 / 106	5
C	15.4 / 106	4
B	15.4 / 106	2

1. Applicable to all sizes.

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# Free Vent Flame Arrestor

## Principle of Operation

The free vent flame arrestor prevent flame propagation by absorbing and dissipating heat using spiral wound crimped ribbon flame cells. These cells allow maximum flow with maximum protection. The free vent flame arrestor is used to stop the propagation of confined and unconfined low pressure deflagrations. It prevents an ignited atmospheric vapor cloud from propagating beyond the flame arrestor into the vent line or tank.

Free vent flame arrestor allow free venting and flame protection for vertical vent applications. Designed with flanged connections, this arrestor allows removal of the flame cell element without their removal of the venting assembly.

## Factors Affecting Flame Arrestor Performance

### Gas Group



**Methanol is classified by the National Electrical Code (NEC) as a Group D vapor. However, our lab tests indicate that methanol exhibits characteristics unlike other Group D vapors under certain conditions. We therefore recommend that an arrestor rated for Group C vapors be specified for methanol service.**

The type of gas in the system determines its gas grouping and therefore predetermines the type of arrestor element required. The element must be designed to accommodate the specific gas group that could possibly ignite and propagate in the system. The more explosive gases require the flame cell to absorb the heat more quickly and efficiently. The NEC groups gases into A, B, C, D and G.M. categories depending on the Maximum Experimental Safe Gap (MESG) of the gas.

### Maximum Experimental Safe Gap (MESG)



**Verify that the flame arrestor being installed has the appropriate gas group rating for your process. This information is shown on the nameplate attached to the element housing. Do not remove or alter this nameplate.**

The measurement of the maximum gap between two equatorial flanges on a metal sphere that will prevent a flame from being transmitted from the sphere to the surrounding flammable mixture. MESG is dependent on gas composition. The stoichiometric mixture (ideal air/fuel ratio for the most efficient combustion) is used to determine the minimum MESG for a given gas. See Table 1.

### Maximum Initial Operating Pressure

The free vent flame arrestor is intended to operate at atmospheric pressure when at or near static flow conditions.

### Endurance Burn Time



**Unlimited burning should not be allowed in any flame arrestor, regardless of its burn time rating. If burning can occur for a period exceeding two minutes starting at ambient temperature, it is recommended that a temperature alarm and shutdown system be installed.**

Endurance burn time is the time it takes for a stabilized flame, at greatest heat saturation conditions, to heat the arrestor element above the auto-ignition temperature of the process gas stream resulting in flame propagation through the arrestor.

### Installation



**Always make sure that the system is at atmospheric pressure and there is no ignitable gas that could flash when either installing or maintaining the unit.**

### Connection

Enardo flame arrestors are normally provided with CL150 raised or flat face flanges. Other flange patterns are available upon request. Make sure the companion flange installed in adjacent piping matches the flange on the flame arrestor.

Standard compressed fiber gaskets that will withstand temperatures of 450°F are standard. Graphite gaskets with higher temperature ratings are available as an option.

# Free Vent Flame Arrestor

## Positioning

### WARNING

**No instrument, tubing or other device whatsoever shall circumvent the flame arrestor in such a manner to allow a flame path to exist around the flame element of the arrestor. When instrumentation is installed in such a manner that it creates a path circumventing the flame element of an arrestor, measures must be taken to prevent passage of flame through the instrumentation device and/or system. Instrumentation must be capable of withstanding the maximum and minimum pressures and temperatures to which the device may be exposed.**

### CAUTION

**The flame arrestor is fitted with lugs for lifting the element assembly during servicing operations. These lugs are not intended for lifting the entire unit during installation. Damage to the flame arrestor may result from improper lifting. Use appropriately rated nylon straps rigged on the outside of the tension studs to lift heavy units.**

The free vent flame arrestor should be positioned in a vertical orientation. Models that have pressure taps allow the installation of a pressure gauge determine blockage. The pressure gauge are normally mounted vertically.

## Piping Expansions and Reductions Adjacent to Flame Arrestors

Enardo free vent flame arrestor may be installed in any vapor control line that is smaller than or equal to the nominal pipe diameter of the arrestor's connection flanges.

## Maintenance

1. Keep the element openings clean to prevent loss of efficiency in absorbing heat. Remove the element assembly and clean the elements to prevent the openings from becoming clogged with particulate matter.
2. Clean the element with a suitable cleaning media (solvent, soap, water or steam) then blow dry using compressed air. Be careful not to damage

or dent the cell openings as this would hamper the effectiveness of the unit.

3. Do not clean arrestor elements by rodding to remove blockages. Cleaning the elements by rodding could damage the elements and seriously impair the arrestor's performance. If the arrestor element cannot be cleaned satisfactorily, replace it.
4. For best cleaning results, clean the entire element surface using a high pressure sprayer with spray wand (1500 to 3000 psig / 103 to 207 bar). Hold the spray nozzle perpendicular to the surface being cleaned to maximize spray media penetration into the element. Alternately spray each side of the element surface until clean.
5. The cleaning interval should be governed by the amount and type of particulate in the system to which it is installed and must be determined by the user. To determine the maintenance interval, check the element in the first few months of operation to find how quickly particulate accumulates in the cells.

### Note

**Under no circumstance should the element bank be disassembled from its shell for cleaning or replacement.**

6. After cleaning, thoroughly inspect the element for damage. If damaged, replace the element. Replace the element section as a complete assembly.

## Element Disassembly

### WARNING

**Isolate gas supply and bring system to atmospheric pressure to prevent ignitable gas from flashing while performing maintenance.**

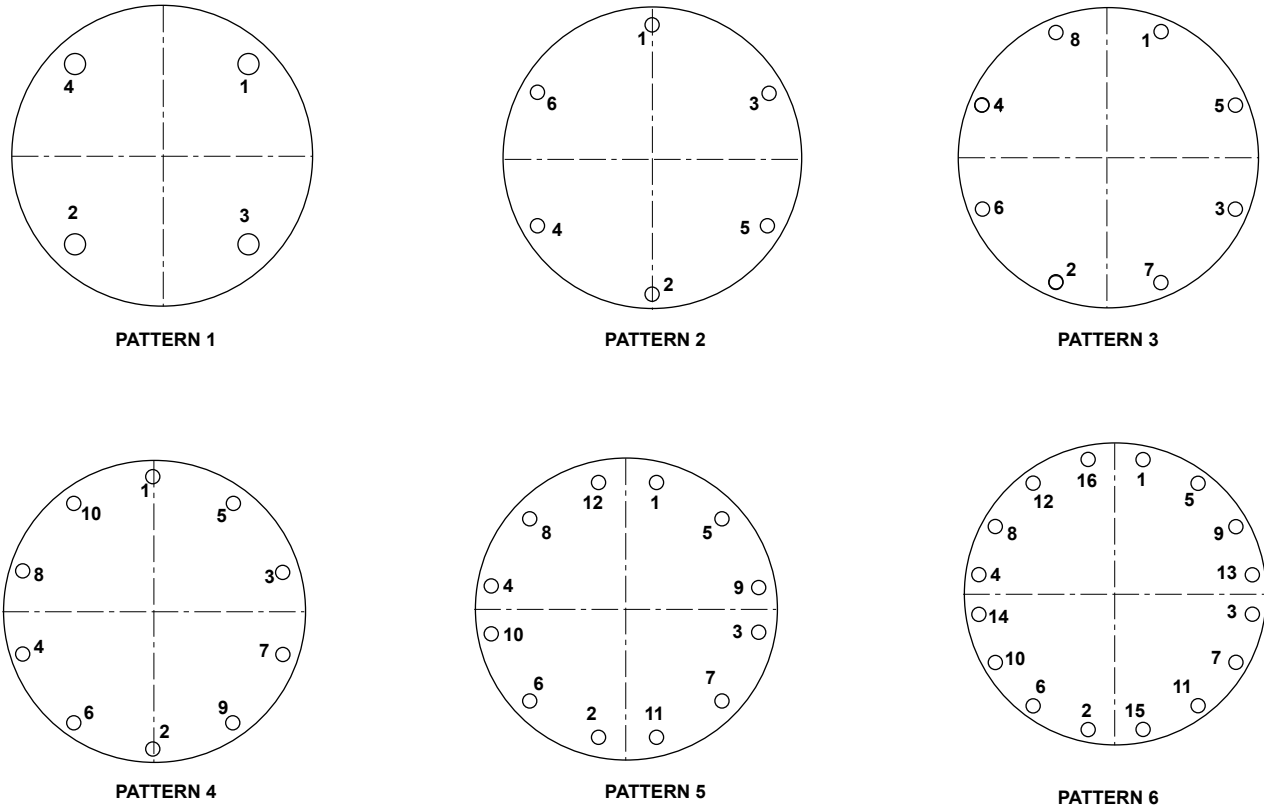
1. Remove the top wing nuts.
2. Remove the hood and screen. It is not necessary to remove the hex nuts located directly under the hood. These nuts are used for positioning the hood.

### CAUTION

**The screen might have sharp edges. Use care when handling.**

3. Remove the upper nuts from the tensioning studs.
4. Remove the upper flange.
5. Remove the element assembly.

# Free Vent Flame Arrestor



**Figure 3. Flange Pattern Tightening Sequence**

**Table 3. Tightening Steps and Torque Values for Free Vent Flame Arrestors with Aluminum End Sections Only**

FREE VENT FLAME ARRESTORS WITH ALUMINUM END SECTIONS ONLY		TIGHTENING STEPS AND TORQUE, ft-lb	
Model	Pattern	Step 1	Step 2
802-A, 803-A and 804-A	1	Snug	25
1006-A, 1206-A and 1408-A	2	Snug	25
1608-A	3	Snug	25
2010-A	3	Snug	50

**Table 4. Tightening Steps and Torque Values for Free Vent Flame Arrestors with Steel or Stainless Steel End Sections Only**

FREE VENT FLAME ARRESTORS WITH STEEL OR STAINLESS STEEL END SECTIONS ONLY		TIGHTENING STEPS AND TORQUE, FT-LB				
Model	Pattern	Step 1	Step 2	Step 3	Step 4	Step 5
401 and 401.5	1	Snug	30			
602, 603 and 604	1	Snug	20	40		
802, 803 and 804	1	Snug	20	50		
1006 and 1206	2	Snug	20	50		
1408	2	Snug	25	60		
1608	3	Snug	25	50	80	
1810	3	Snug	25	50	90	
2008 and 2010	3	Snug	25	50	75	100
2412	4	Snug	35	70	100	130
2614 and 2616	4	Snug	35	70	100	140
2814	5	Snug	35	70	100	125
3016	5	Snug	35	70	100	130
3620	6	Snug	35	70	100	120

# Free Vent Flame Arrestor

**Table 5. Torque Correction Factors for Common Lubricants**

DESCRIPTION	COEFFICIENT OF FRICTION	MULTIPLY TORQUE VALUE IN TABLES 3 AND 4 BY
Machine Oil	f = 0.15	1.00
API SA2 Grease	f = 0.12	0.80
Never-Seez® (Ni base)	f = 0.11	0.73
Never-Seez® (Cu base)	f = 0.10	0.67
Molykote® G-n Paste	f = 0.06	0.40

## CAUTION

**Some element assemblies are heavy and will require the use of adequate equipment and manpower to prevent injury.**

### Element Re-assembly

1. Thoroughly clean the gasket sealing faces being careful not to damage the sealing surface. Lightly grease one side of a new gasket and place it in the machined recess of the interior flange on the conical sections and in the upper flange.
2. Replace the flame element assembly with a new assembly or properly cleaned and inspected existing unit.
3. Re-assemble in the reverse order of disassembly.
4. Tighten the tensioning studs as detailed on the Procedure section.

### Torquing Instruction

## CAUTION

**Excessive or uneven torquing can cause permanent damage to gaskets and housing.**

#### Tools/Supplies Required:

- Torque wrench appropriate for the specified torque.
- Socket wrenches of the proper size to fit the hex nuts being tightened.
- Molydisulfide based lubricating paste. Molykote® G-n or equivalent.
- Brush suitable for applying lubricant to the studs.
- Wiping rags necessary for the clean-up of excessive lubricant.

#### Procedure:

1. Use studs and nuts that are free of visible contamination and corrosion.

2. Apply lubricant to the threads of the stud protruding outboard of the interior flanges and to the face of the hex nuts which will contact the flange.
3. Assemble the nuts to the studs such that the amount of thread extending outboard beyond the nut is approximately equal on both ends.
4. Tighten the nuts to the values shown in Tables 3 and 4 following the designated sequence, repeating the sequence as shown. Flange pattern tightening sequences are shown in Figure 3.

#### Bolt Lubrication

Lubrication will affect required torque of clean fasteners in good condition more than any other factor. In fact, 90% of applied torque goes to overcome friction while only 10% actually stretches the bolt. Tables 3 and 4 assumes that only machine oil is used as a lubricant. Table 5 lists several common lubricants and their effect on torque required to stretch bolts to 50% of their yield strength. Most are available from local bearing distributors.

### Recommended Spare Parts

For installations that require frequent maintenance and minimum downtime it is recommended that the user purchase a spare element assembly and several spare element gaskets. The spare element assembly can be installed immediately and the dirty assembly can then be cleaned and be stored as a spare for the next maintenance interval.

#### Note

**Element gaskets should be replaced each time the cell assembly is loosened and removed to insure a gas tight seal.**

### Parts Ordering

When corresponding with your local Sales Office about this equipment, always reference the equipment serial number stamped on the nameplate.

When ordering replacement parts, specify the complete 7-character part number of each required part as found in the following parts list.

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# Free Vent Flame Arrestor

## Parts List

**Table 6. Group B Gas Replacement Element Assembly Part Numbers**

HOUSING	PART NUMBER						
	Aluminum	Aluminum	Carbon Steel	Carbon Steel	304 Stainless Steel	Carbon Steel	316 Stainless Steel
FLAME CELL	Aluminum	304 Stainless Steel	Aluminum	304 Stainless Steel	304 Stainless Steel	316 Stainless Steel	316 Stainless Steel
Models 401 and 401.5	7011773	7011774	7048598	7048513	7002212	7048512	7002210
Models 602, 603 and 604	7011775	7011776	7048599	7056501	7056502	7056503	7056504
Models 802, 803 and 804	7011725	7011777	7056505	7002216	7002286	7048511	7002215
Model 1004	7011778	7011779	7056506	7002205	7056507	7002290	7056509
Model 1206	7011780	7011781	7056510	7002257	7002282	7056511	7002298
Model 1408	7011782	7011783	7056512	7048508	7056513	7056514	7056515
Model 1608	7011784	7011785	7056508	7056516	7056517	7056518	7056519
Model 1810	7011786	7011787	7056520	7056521	7056522	7056523	7056524
Model 2010	7011727	7011788	7056525	7056526	7056527	7056528	7056529
Model 2210	7011789	7011790	7056530	7056531	7056532	7056533	7056534
Model 2412	7011791	7011792	7056535	7056536	7056537	7056538	7056539

**Table 7. Group C Gas Replacement Element Assembly Part Numbers**

HOUSING	PART NUMBER						
	Aluminum	Aluminum	Carbon Steel	Carbon Steel	304 Stainless Steel	Carbon Steel	316 Stainless Steel
FLAME CELL	Aluminum	304 Stainless Steel	Aluminum	304 Stainless Steel	304 Stainless Steel	316 Stainless Steel	316 Stainless Steel
Models 401 and 401.5	7011753	7011754	7048556	7048557	7048502	7048558	7048559
Models 602, 603 and 604	7011755	7011756	7048560	7048561	7048562	7048563	7002231
Models 802, 803 and 804	7011729	7011731	7048507	7002255	7002295	7002206	7048564
Model 1004	7011757	7011758	7048506	7002259	7048501	7048565	7048566
Model 1206	7011759	7011760	7048567	7002260	7048569	7048570	7048571
Model 1408	7011761	7011762	7048572	7048573	7048574	7048575	7002245
Model 1608	7011763	7011764	7048576	7048577	7048578	7048504	7048579
Model 1810	7011765	7011766	7048580	7048581	7048582	7048583	7048584
Model 2010	7011767	7011768	7048585	7002299	7048586	7048587	7048588
Model 2210	7011769	7011770	7048589	7048590	7048591	7048592	7048593
Model 2412	7011771	7011772	7048594	7048595	7048596	7048597	7002244

**Table 8. Group D Gas Replacement Element Assembly Part Numbers**

HOUSING	PART NUMBER						
	Aluminum	Aluminum	Carbon Steel	Carbon Steel	304 Stainless Steel	Carbon Steel	316 Stainless Steel
FLAME CELL	Aluminum	304 Stainless Steel	Aluminum	304 Stainless Steel	304 Stainless Steel	316 Stainless Steel	316 Stainless Steel
Models 401 and 401.5	7011741	7011742	7002246	7002261	7002275	7048509	7002201
Models 602, 603 and 604	7011734	7011735	7048514	7048515	7002279	7048516	7002266
Models 802, 803 and 804	7011704	7011712	7002253	7002203	7002217	7002211	7002202
Model 1004	7011705	7011713	7002254	7002204	7002291	7002214	7002292
Model 1206	7011706	7011702	7002256	7002239	7002233	7002283	7002293
Model 1408	7011707	7011714	7002263	7002228	7002223	7002262	7002268
Model 1608	7011708	7011715	7002248	7002247	7002234	7002280	7002297
Model 1810	7011736	7011737	7002252	7002251	7002289	7002250	7048518
Model 2010	7011709	7011716	7002213	7002249	7048519	7002218	7002296
Model 2210	7011710	7011717	7002240	7002207	7048520	7048510	7048521
Model 2412	7011711	7011718	7002258	7002265	7002232	7002264	7002276
Model 2612	7011703	7011738	7048522	7048523	7048524	7048525	7048526
Model 2814	7011726	7011739	7048505	7048527	7048528	7002281	7048529
Model 3016	7011721	7011740	7002243	7002270	7048530	7048531	7048532
Model 3200	7011732	7011733	7002230	7048533	7048534	7048535	7048536
Model 3400	7011743	7011744	7048537	7002226	7048538	7048539	7048540
Model 3600	7011745	7011746	7048541	7002241	7048542	7048543	7002274

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# Free Vent Flame Arrestor

**Table 9. Replacement Element Assembly Gasket for Cast Aluminum End Sections<sup>(1)</sup>**

MODEL	PART NUMBER	
	Standard Gasket (Compressed Fiber)	High Temperature Gasket (Graphite Base)
802-A, 803-A and 804-A	7008102	7049202
1004-A	7008135	7049235
1206-A	7008136	7049236
1408-A	7008124	7049224
1608-A	7008107	7049207
2000-A	7008109	7049209

1. Two required per assembly

**Table 10. Replacement Element Assembly Gasket for All Fabricated End Sections<sup>(1)</sup>**

MODEL	PART NUMBER	
	Standard Gasket (Compressed Fiber)	High Temperature Gasket (Graphite Base)
401 and 401.5	7008153	7049253
602, 603 and 604	7008134	7049234
802, 803 and 804	7008123	7049223
1004	7008135	7049235
1206	7008136	7049236
1408	7008124	7049224
1608	7008107	7049207
2008 and 2010	7008109	7049209
2412	7008111	7049211
2814	7008113	7049213
3016	7008114	7049214
3600	7008117	7049217

1. Two required per assembly

North America Only

**Emerson Process Management  
Regulator Technologies Tulsa, LLC**

9932 East 58th Street  
Tulsa, OK 74146-6411

Tel: +1 918 662 6161  
Fax: +1 918 662 0004

For further information visit [www.enardo.com](http://www.enardo.com)

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