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8 Series High Pressure Deflagration Flame Arrestor

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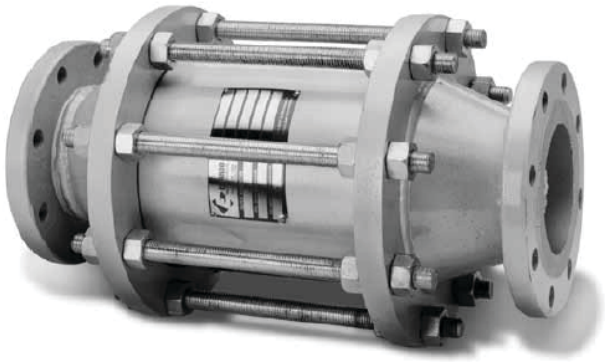

Figure 1. *8 Series High Pressure Deflagration Flame Arrestor*

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 high pressure deflagration flame arrestors 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 (Emerson™) instructions.

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 shall install or service the 8 Series high pressure deflagration flame arrestor.

Introduction

Scope of the Manual

This manual provides specifications, installation and maintenance instructions and parts ordering information for the 8 Series high pressure deflagration flame arrestor.

Product Description

8 Series high pressure deflagration flame arrestors is designed to protect equipment against high velocity and pressure flame fronts inherent in applications beyond the performance range of a standard flame arrestor but not yet to the detonation phase of flame development and provide an economical alternative to a detonation arrestor. The 8 Series high pressure deflagration flame arrestor is designed to surpass standard flame arrestors for applications that include extended lengths of pipe with one bend, elevated operating pressures and extended flame stabilization on the flame cell element. The arrestors are bi-directional and can stop low, medium and high

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Specifications

The Specifications table lists the specifications for the 8 Series high pressure deflagration flame arrestors. Specification is stamped on the nameplate attached to the flame arrestor.

Available Construction
See Table 1 and Figure 2

Gas Group
B, C and D

Flange Size and Rating
2 to 24 in. / 50 to 600 mm
CL150 FF and RF

Housing Size
8 to 48 in. / 200 to 1200 mm

Temperature Rating of Gaskets(1)
Fiber Gaskets **(standard)**: 450°F / 232°C or higher

Pipe Length
See Table 4

Housing Material
Carbon steel, 304 Stainless steel, 316 Stainless steel, Hastelloy® and Exotic

Cell Material
304 Stainless steel, 316 Stainless steel and Hastelloy®

1. The pressure/temperature limits in this Instruction Manual and any applicable standard or code limitation should not be exceeded.

8					/		-				-			
Deflagration Flame Arrestor	**Housing Size**		**Connection Size**		**NEC**		**Housing Material**	**Element Material**	**Connection Type**		**Options**			
E8 if eccentric configuration	08 = 8 in. through 48 = 48 in.		02 = 2 in. through 24 = 24 in.		Gas Group B C D		C = Carbon Steel 4 = 304 SST 6 = 316 SST H = Hastelloy® E = Exotic	4 = 304 SST 6 = 316 SST H = Hastelloy® E = Exotic	F = Flat face flange R = Raised face flange		1 = Drain Plug 2 = Pressure Tap 3 = Temperature Probe Tap 4 = Miscellaneous 5 = Protective coating 6 = Special feature			

Figure 2. *8 Series High Pressure Deflagration Flame Arrestor Available Constructions and Model Numbering System*

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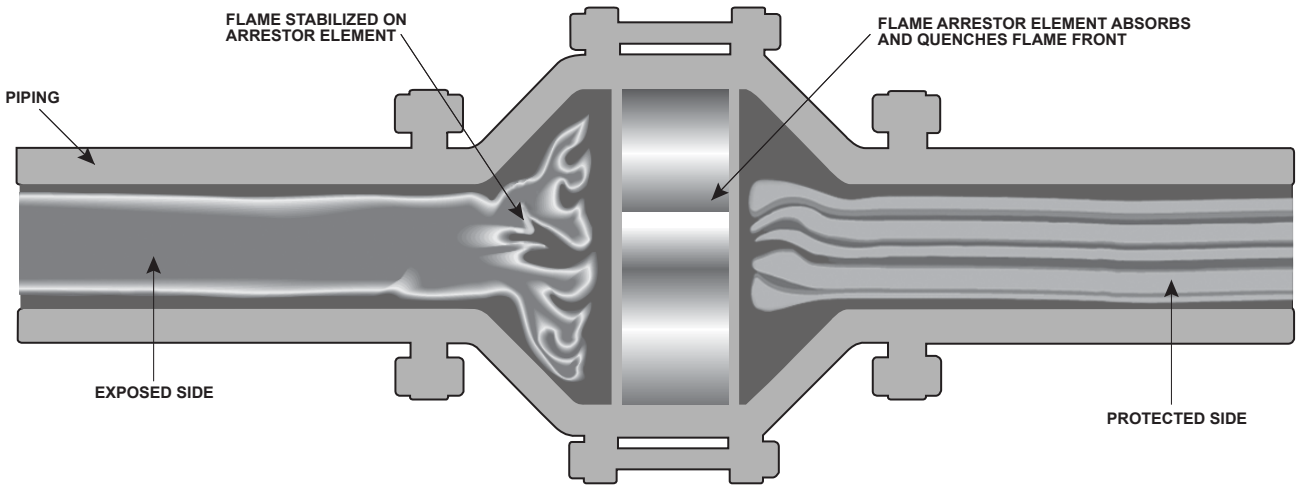

Figure 3. *Flame Arrestor Operation*

Table 1. *8 Series High Pressure Deflagration Flame Arrestor Available Construction*

MODEL	FLANGE SIZE		HOUSING SIZE	
	In.	mm	In.	mm
80802	2	50	8	200
80803	3	75	8	200
80804	4	100	8	200
81206	6	150	12	300
81608	8	200	16	400
82010	10	250	20	500
82412	12	300	24	600
82814	14	350	28	700
83016	16	400	30	750
83018	18	450	34	850
83620	20	500	36	900
84824	24	600	48	1200

pressure deflagrations. Enardo utilizes a patented (US Patent No. 5415233) element assembly that dampens the high velocities and pressures associated with deflagration and detonations while quenching the flame front.

Designed with flanged connections, this arrestor allows removal of the flame cell element for easy cleaning and replacement without removing the arrestor body from the pipe connection. Standard housing construction is carbon steel or stainless steel. The element is available in Stainless steel. Special material and protective coating are available on request.

Principle of Operation

The high-pressure deflagration flame arrestor is an enhanced version of the standard deflagration flame arrestor, designed to stop flames in the low, medium, and high pressure deflagration states. Flame arrestor allows gas to pass though it but stops flame in order to prevent a larger fire of explosion. Arrestor prevents flame by absorbing and dissipating the heat from flame as it attempts to travel through the spiral wound crimped ribbon flame cells. These cells allow maximum flow with maximum protection. See Figure 3.

Table 2. *Maximum Experimental Safe Gap (MESG)*

NATIONAL ELECTRIC CODE (NEC)	MESG		TEST GAS LIST
	In.	mm	
Group B	0.011	0.28	Hydrogen
Group C	0.026	0.65	Ethylene
Group D	0.035	0.90	Propane
G.M.	0.044	1.12	Methane

Table 3. *8 Series High Pressure Deflagration Flame Arrestor Endurance Burn Time*

HIGH PRESSURE DEFLAGRATION FLAME ARRESTORS - ALL SIZES			
Gas Group	Maximum Initial Pressure		Endurance Burn Time
	psia	kPa	
D	19.7	136	15 Minutes
C	16.7	115	15 Minutes
B	16.7	115	5 Minutes

Factors Affecting Flame Arrestor Performance

Gas Group

WARNING

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 National Electrical Code (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)

WARNING

Verify that the high pressure deflagration 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 stochiometric mixture (the ideal air/fuel ratio for the most efficient combustion) is used to determine the minimum MESG for a given gas. See Table 2 for the MESG per gas group.

Table 4. *8 Series High Pressure Deflagration Flame Arrestor, For All Sizes Pipe Length Rules*

	GAS GROUP "B"	GAS GROUP "C"	GAS GROUP "D"
Maximum length of pipe between the flame arrestor and the ignition source with a maximum of one 90° bend. Multiple bends or any additional obstructions are not recommended.	15 ft. / 4.5 m.	35 ft. / 10.6 m.	60 ft. / 18 m.

Maximum Initial Operating Pressure

This is the pressure of the system at or near static flow conditions. High pressure deflagration can occur more easily at higher system operating pressures than at pressures near atmospheric. Elevated pressures condense the ignitable gas giving the flame more matter and energy to release thereby boosting the flame heat intensity.

Endurance Burn Time

WARNING

Unlimited burning should not be allowed in any flame arrestor, regardless of its burn time rating. If burning can occur for a period exceeding 2 minutes starting at ambient temperature, it is recommended that a temperature alarm and shutdown system be installed. All Enardo High Pressure Deflagration Flame Arrestors are provided with temperature probe taps for this purpose.

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. See Table 3 for the endurance burn time of each gas group.

Pipe Lengths

Extended lengths of pipe allow the flame to advance into more severe states of flame propagation such as high pressure deflagration or detonations. High pressure deflagration flame arrestors should be installed in accordance with Table 4.

Bends and/or Flow Obstructions

CAUTION

For maximum safety, avoid bends and flow obstructions within 10 pipe diameters on the protected side of the flame arrestor.

Bends in piping, pipe expansions and/or contractions, valves, orifice plates or flow obstructing devices of any kind contribute to turbulent flow. Turbulent flow enhances mixing of the combustible gases, greatly increasing the combustion intensity. This can result in increased flame speeds, higher flame temperatures and higher flame front pressures than would occur in normal flow conditions.

Installation

WARNING

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 high pressure deflagration flame arrestors are normally provided with CL150 raised or flat face flanges. Other flange such as CL300 are available upon request. Make sure the companion flanges installed in adjacent piping match the flanges on the high pressure deflagration flame arrestors.

Standard compressed fiber gaskets that will withstand temperatures of 450°F / 232°C or higher are normally used, but other materials of equal or higher temperature capability may be used at the customer's discretion.

Positioning

CAUTION

The high pressure deflagration 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 high pressure deflagration flame arrestor may result from improper lifting. The units should be lifted using appropriately rated Nylon (PA) straps rigged on the outside of the tension studs.

The arrestor should be positioned such that the element is accessible for removal. The tension studs are supplied with jacking nuts on one half of the bolting circumference. Install the unit so that the jacking nuts (on the inside of the studs) are positioned on the opposite side from the direction that the element assembly will be removed.

Models that have drain plugs are designed for horizontal installation and should be installed with the drain plugs aligned at the bottom of the unit. Models that have pressure taps are designed to allow pressure gauges to be installed on both sides of the flame cell assembly to determine blockage. The pressure taps should be aligned at the top to allow easy viewing of the gauges. Units that are equipped with optional internal cleaning systems should be connected to a source of cleaning media such as water, steam or other suitable solvent.

Flow Direction

The Enardo high pressure deflagration flame arrestor is bi-directional and can be installed either vertically or horizontally. Consideration should be given to non-symmetrical assemblies that include features such as clean-out ports, temperature monitoring device or other options that might have a preferred installation direction to suit the needs of the customer.

Piping Expansions and Reductions Adjacent to High Pressure Deflagration Flame Arrestors

WARNING

No instrument, tubing or other device whatsoever shall circumvent the high pressure deflagration 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 and at a minimum be capable of withstanding a hydrostatic pressure test of 350 psig / 24 bar.

An Enardo high pressure deflagration 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.

When it is necessary to increase the diameter of the piping on the downstream side of the high pressure deflagration flame arrestor, a length of pipe at least 120 pipe diameters must be installed between the high pressure deflagration flame arrestor and the expansion. A pipe diameter is considered as the inside diameter of pipe having a nominal size equal to the high pressure deflagration flame arrestor's connecting flanges.

Maintenance

WARNING

Flame cells must be inspected for damage immediately following a deflagration and/or stabilized burn.

1. Carefully remove the element assembly from the arrestor and place it on a soft surface such as plywood.
2. Inspect the flame cell visually for any signs of corrosion or other damage.
3. Inspect the flame cell with a calibrated pin gauge to ensure maximum crimp size openings do not exceed the following values for their respective gas group:
   - Explosion Group D – 0.062 in. / 1.57 mm
   - Explosion Group C – 0.038 in. / 0.965 mm
   - Explosion Group B – 0.017 in. / 0.432 mm
4. If any damage is noted, or crimp openings exceed maximum size allowable, replace the element assembly.
5. 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. 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. Do not clean the arrestor elements by rodding to remove blockages, as this practice will damage the elements and seriously impair the arrestor's performance. If the arrestor element cannot be cleaned satisfactorily, replace it.
6. For best cleaning results, use a high pressure sprayer with spray wand (1500 to 3000 psig / 103 to 207 bar) to clean the entire element surface. 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.
7. 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 the user should check the element in the first few months of operation to find how quickly particulate accumulates in the cells.
8. After cleaning, thoroughly inspect the element for damage. If damaged, replace it.

Note

Under no circumstance should the element bank be disassembled from its shell for cleaning or replacement. The element section must be replaced as a complete assembly.

Cleaning of units equipped with this system may be accomplished in several ways including periodic cleaning using manually operated valves, by use of an automated cycle timing method, or by having the cleaning operation initiated whenever the pressure loss across the arrestor element exceeds a predetermined value.

Element Assembly, Disassembly and Reassembly Instructions

WARNING

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

1. Loosen all jacking (inside) nuts on tension studs between conical sections of the flame arrestor.
2. Tighten the inside jacking nuts on the tension studs forcing the two conical sections apart. When the two flange faces have separated, remove the tension studs that do not have inside jacking nuts, so that the element assembly can be removed. The inside jacking nuts are installed on all tension studs that facilitate jacking the unit apart. The inside jacking nuts are not installed on tension studs that are taken out, for ease of removal.

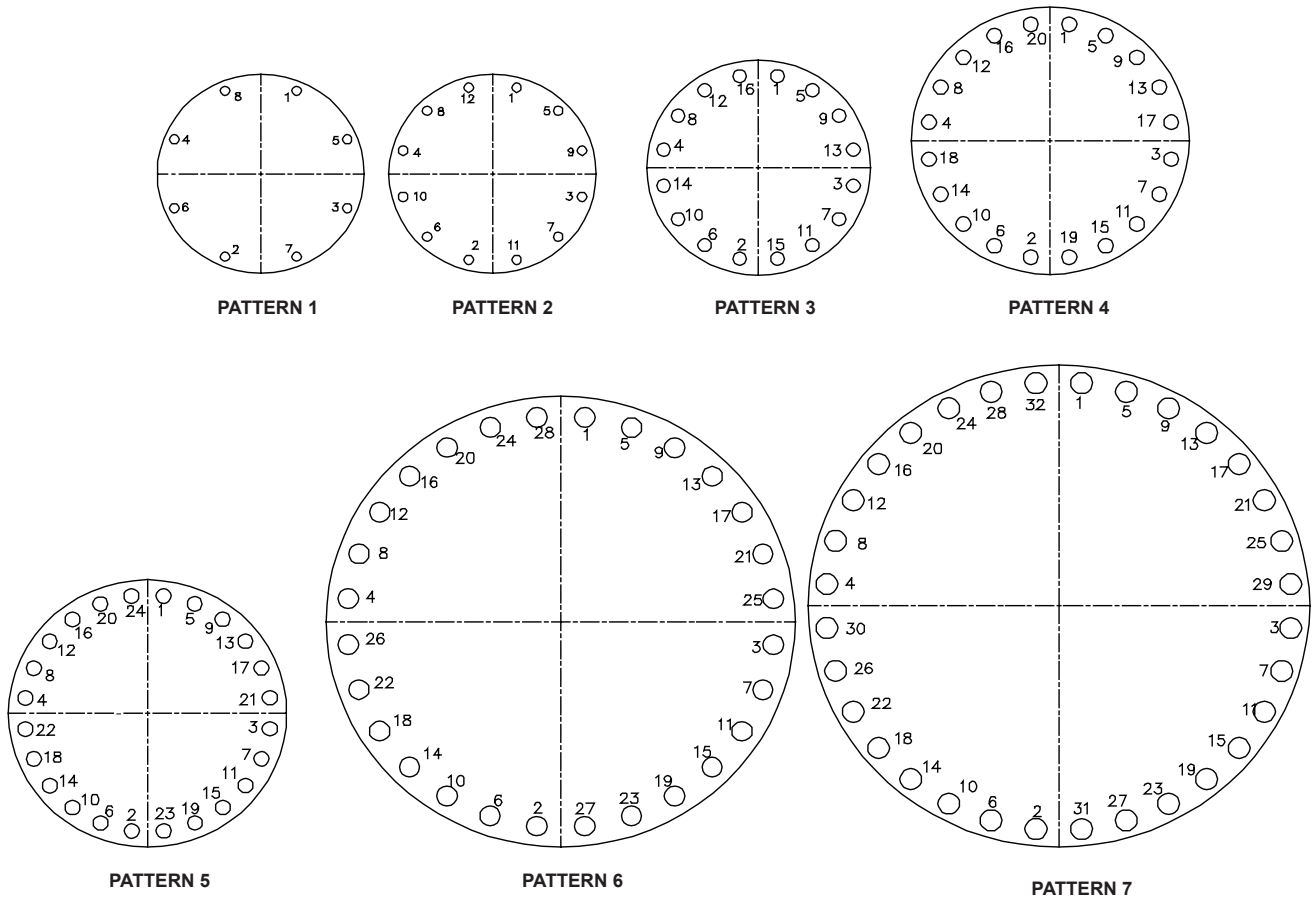

Figure 4. *Flange Pattern Tightening Sequence*

Table 5. *Tightening Steps and Torque Values*[1][2]

			TIGHTENING STEPS AND TORQUE (lbf-ft / N•m)			
Model	**Pattern**[2]	**Bolt size, In.**	**Step 1**	**Step 2**	**Step 3**	**Step 4**
80802, 80803, 80804	1	3/4-10	Snug	20 / 27	45 / 61	
81206	2	7/8-9	Snug	25 / 34	50 / 68	
81608	2	1-8	Snug	25 / 34	50 / 68	75 / 102
82010	3	1-1/4-8	Snug	35 / 47	70 / 95	120 / 163
82412	4	1-1/4-8	Snug	35 / 47	70 / 95	120 / 163
82814	5	1-1/4-8	Snug	35 / 47	70 / 95	120 / 163
83016	6	1-1/4-8	Snug	35 / 47	70 / 95	120 / 163
83620	7	1-1/2-8	Snug	50 / 68	120 / 163	170 / 230

1. Using machine oil as lubricant. See Bolt Lubrication section on page 9 and torque correction factors for other lubricants in Table 6.
2. See Figure 4.

Table 6. *Torque Correction Factors for Common Lubricants*

DESCRIPTION	COEFFICIENT OF FRICTION	MULTIPLY TORQUE VALUE IN TABLE 5 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

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

3. Thoroughly clean the gasket sealing faces being careful not to damage the sealing surface. For reassembly, lightly grease one side of a new gasket and place it in the machined recess of each interior flange on the two conical sections.
4. Replace the flame element assembly with a new assembly or properly cleaned and inspected existing unit.
5. Loosen the jacking nuts on the tension rods until the flame cell assembly seats onto the gaskets.
6. Replace all tensioning studs and hand tighten the outer nuts. Check to be sure that all the jacking nuts are completely loose and not making contact with the flange face.
7. Torque the bolts in sequence as shown in Torquing Instruction.

Torquing Instruction

CAUTION

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

Tools/Supplies Required

- Hand operated conventional torque wrench or power assisted 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 torque values shown in Table 5 following the designated sequence, repeating the sequence as shown. Flange pattern tightening sequences are shown in Figure 4.

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. Table 5 assumes that only machine oil is used as a lubricant. Table 6 shows a list of 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.

Molykote® G-n is a mark owned by Dow Corning Corporation.
Never-Seez® is a mark owned by Bostik, Inc.

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.

Parts List

Table 7. *Part Numbers for Replacement Element Assembly Gaskets*[1]

MODEL	PART NUMBER	
	Standard Gasket (Compressed Fiber)	High Temperature Gasket (Graphite Base)
80802, 80803, 80804	7008125	7049223
81206	7008136	7049236
81608	7008107	7049207
82010	7008109	7049209
82412	7008111	7049211
82814	7008113	7049213
83016	7008114	7049214
83620	7008117	7049217

1. Two (2) required per assembly.

Table 8. *Replacement Element Assemblies Part Numbers (Group D Gas)*

HOUSING MATERIAL	CARBON STEEL	304 STAINLESS STEEL	CARBON STEEL
Flame Cell Material	**304 Stainless Steel**	**304 Stainless Steel**	**316 Stainless Steel**
Model	**Part Number**		
80802, 80803, 80804	8000903	8000922	8000901
81206	8000904	8000923	8000905
81608	8000906	8000924	8000907
82010	8000908	8000925	8000909
82412	8000910	8000926	8000911
82814	8000912	8000927	8000913
83016	8000914	8000928	8000915
83620	8000918	8000930	8000919

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