Enardo DFA Series Detonation Flame Arrestor (USCG/ATEX Approved)

Table of Contents

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.

Fisher™ detonation 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 shall install or service the flame arrestor.

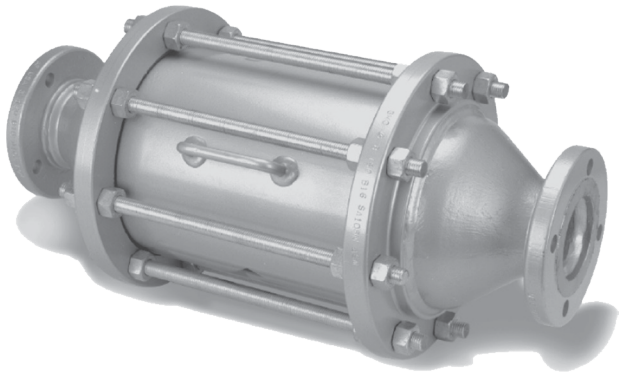

Figure 1. *Typical Enardo DFA Series Detonation Flame Arrestor*

Introduction

Scope of the Manual

This Instruction Manual provides instructions for installation, startup, maintenance and parts ordering information for the Enardo DFA Series detonation flame arrestor.

Product Description

The Enardo DFA Series detonation flame arrestor represents the best value in flame arrestor protection. The detonation flame arrestor provides protection against flame propagation in piping systems that are manifolded or have long run-up distances. These are typically used for extended pipe length or multiple pipe bend configurations to stop high pressures and flame velocities with detonations and overdriven detonations. It also stops confined and unconfined, low and high pressure deflagration. The design is unique in the ability to provide large flame channels which requires less frequent maintenance and greater ease in cleaning when service is required, translating to less down time. Enardo DFA Series detonation flame arrestors are bi-directional and proven to stop an ignited flammable vapor mixture approaching from either direction that can be travelling at subsonic or supersonic velocities. The

Specifications

The Specifications table lists the specifications for the detonation flame arrestors. Some, or all, of the following information is stamped on the nameplate attached to the arrestor: model number, flange size and rating, maximum initial operating pressure, EN number (European Standard), EU type examination certificate, notified body number, gas group, date of manufacture and serial number; other identification and customer tag number are optional.

Available Constructions

See Table 1 and Figure 3

Gas Group

D (IIA), C (IIB3) and B(IIC)

Flange Sizes and Rating

1 to 24 in. / 50 to 600 mm
CL150

Housing Size

4 to 48 in. / 100 to 1200 mm

Maximum Experimental Safe Gap (MESG)

See Table 2

Maximum Initial Operating Pressure(1)

See Table 3

Maximum Ambient Air Temperature

140°F / 60°C

Temperature Rating of Gasket(1)

Fiber Gaskets (standard): 450°F / 232°C
Graphite/Metal (optional): 1600°F / 870°C

Burning Rating

See Table 3

Housing Material

Carbon steel, 304 Stainless steel,
316 Stainless steel and Hastelloy®(2)

Element Material

304 Stainless steel, 316 Stainless steel
and Hastelloy®(2)

Certification(3)

EN 12874 ATEX Certified(4)(5)
U.S. Coast Guard (USCG) Approved(4)(5)

1. The pressure/temperature limits in this Instruction Manual and any applicable standard or code limitation should not be exceeded.
2. Hastelloy® housings and element material are not USCG approved.
3. Not all models are available with USCG and ATEX certifications. Contact your local Sales Office for more information.
4. USCG and ATEX approval report(s) are available upon request.
5. Flow test data available upon request.

Table 1. *Enardo DFA Series Detonation Flame Arrestor Available Construction (USCG/ATEX Approved)(1)*

MODEL(2)	FLANGE SIZE		HOUSING SIZE		USCG			ATEX	
	In.	mm	In.	mm	D	C	B	IIA	IIB3
Enardo DFA-0401	1	25	4	100					
Enardo DFA-0602(3)	2	50	6	150		✓			✓
Enardo DFA-0802	2	50	8	200	✓	✓			
Enardo DFA-0803	3	75	8	200	✓	✓		✓	✓
Enardo DFA-1004	4	100	10	250	✓	✓		✓	✓
Enardo DFA-1206	6	150	12	300	✓	✓		✓	✓
Enardo DFA-1608	8	200	16	400	✓	✓		✓	✓
Enardo DFA-2010	10	250	20	500	✓	✓		✓	✓
Enardo DFA-2412	12	300	24	600	✓	✓		✓	✓
Enardo DFA-2814	14	350	28	700	✓	✓		✓	✓
Enardo DFA-3016	16	400	30	750	✓	✓		✓	✓
Enardo DFA-3418	18	450	34	850	✓	✓		✓	✓
Enardo DFA-3620	20	500	36	900	✓	✓		✓	✓
Enardo DFA-4824(3)	24	600	48	1200	✓				

1. Not all models are available with USCG and ATEX certifications. Contact your local Sales Office for more information.
2. Includes eccentric construction.
3. Eccentric construction not USCG or ATEX certified.

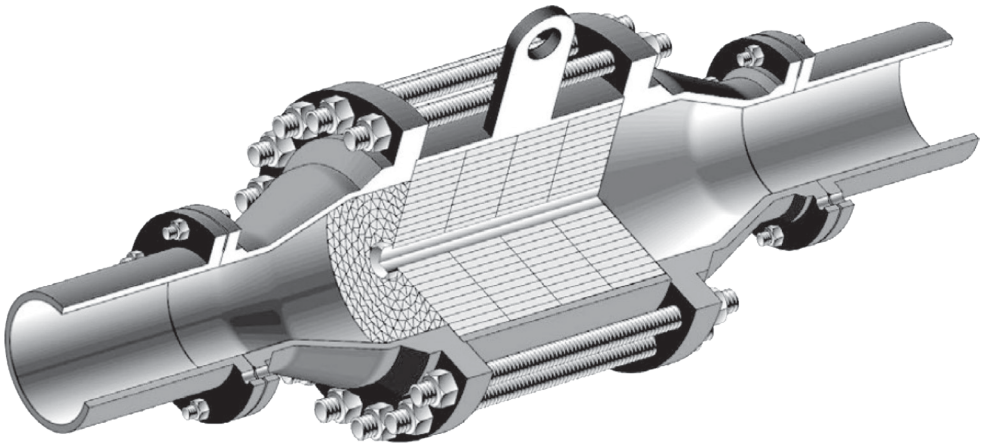

Figure 2. *Cut-away view of Enardo DFA Series Detonation Flame Arrestor*

					/		-				-			
Detonation Flame Arrestor	**Housing Size**		**Connection Size**		**NEC Gas Group**	**Housing Material**		**Element Material**	**Connection Type**		**Options**			
Enardo DFA = Concentric Enardo DFAE = Eccentric	04 = 4 in. through 48 = 48 in.		01 = 1 in. through 24 = 24 in.		D (IIA) C (IIB3) B (IIC)	C = Carbon steel 4 = 304 SST 6 = 316 SST H = Hastelloy®(1)		4 = 304 SST 6 = 316 SST H = Hastelloy®(2)	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			

Note: Not all models are available with USCG and ATEX certifications. Contact your local Sales Office for more information.

Figure 3. *Enardo DFA Series Detonation Flame Arrestor Available Constructions and Model Numbering System*

patented element offers maximum flow to pressure drop characteristics enhancing the value of the flame arrestor in any system.

The Enardo DFA Series is designed with flanged connections, the arrestor provides the option of the removal of the flame cell element for easy cleaning and replacement without disconnecting the pipe connection.

Figure 4. *Product Identification and Marking for ATEX Units*

Markings

Nameplate Information

A nameplate will be attached to the arrestor and will contain the following information:

- **Model Number:** Ex. DFA 1206/D (see model information above)
- **Flange Size and Rating:** Ex. 6 in. CL150
- **Maximum Initial Operating Pressure, P_o**
- **EN Number:** Ex. ISO EN 16852 (if applicable) or EN 12874
- **EU Type Examination Certificate (if applicable)**
- **Notified Body Number (if applicable):** Ex. 0518
- **Gas Group:** Ex. IIA or IIB3, D, C
- **Date of Manufacture**
- **Serial Number**
- **Other Identification (Optional)**
- **Customer Tag Number (Optional)**

Hastelloy® is a mark owned by Haynes International, Inc.
1. Hastelloy® housings are not USCG approved.
2. Hastelloy® element material is not USCG approved.

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

NATIONAL ELECTRIC CODE (NEC)	INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC) GROUP	MESG		TEST GAS LIST
		In.	mm	
Group D	Group IIA	0.035	>0.90	Propane
Group C	Group IIB3	0.026	≥0.65	Ethylene
Group B	Group IIC	0.020	<0.50	Hydrogen

Table 3. *Detonation Arrestor Size Ranges and Rating, Maximum Initial Pressure and Burn Rating*

DETONATION FLAME ARRESTOR MODEL	DETONATION FLAME ARRESTOR SIZE RANGE		GAS GROUP	MAXIMUM INITIAL PRESSURE		DETONATION RATING	BURN RATING	
	In.	mm		psia	bar a		ATEX (EN 12874)	USCG
Enardo DFA***/D	2 to 12	50 to 300	D (IIA)	22.7	1.56	Unstable	Stabilized	Type 1 (2 hours)
Enardo DFA***/D	14 to 20	350 to 500	D (IIA)	20.7	1.43	Unstable	Stabilized	Type 1 (2 hours)
Enardo DFA***/D	24	600	D (IIA)	16.0	1.1	Unstable	N/A	Type 2 (15 minutes)
Enardo DFAE***/D	2 to 20	50 to 500	D (IIA)	20.7	1.43	Unstable	1 minute	Type 2 (15 minutes)
Enardo DFA***/C	2 to 20	50 to 500	C (IIB3)	20.7	1.43	Unstable	1 minute	Type 2 (15 minutes)
Enardo DFAE***/C	2 to 20	50 to 500	C (IIB3)	20.7	1.43	Unstable	1 minute	Type 2 (15 minutes)

Principle of Operation

Detonation flame arrestor prevents flame propagation as it enters the exposed side of the unit to the protected side by absorbing and dissipating heat using spiral wound crimped ribbon flame cells. This detonation flame arrestor utilizes an element assembly that dampens the high velocities and pressures associated with deflagration and detonations while quenching the flame front. These cells allow maximum flow with maximum protection.

Detonation flame arrestor has the heat capacity and structural design to withstand all dynamic conditions of flame propagation and still stop the flame. Detonation flame arrestor is used when the flame can be in any of the detonation states.

Limits of Use for Detonation/Deflagration Flame Arrestors:

- The following vapors are not within the scope of the products covered by this IOM:
  - Explosive mixtures of vapors and gases, which tend to self-decompose (e.g. Acetylene) or which are chemically unstable
  - Carbon Disulphide, due to its special properties;
  - Mixtures other than gas-air or vapor-air mixtures (e.g. higher oxygen-nitrogen ratio, chlorine as oxidant, etc.)
- Minimum distance between flame arrestor connection and a restriction on the protected side is 10 L/D, but not less than 3 m.
- Arrestors shall only be installed into piping with a nominal size that is smaller than or equal to the nominal size of the flame arrestor connection.

Factors Affecting Flame Arrestor Performance

Gas Group

⚠ WARNING

Methanol is classified as a Group-D (IIA) vapor. However, our lab tests indicate that methanol exhibits characteristics unlike other Group-D (IIA) vapors under certain conditions. We therefore recommend that an arrestor rated for Group-C (IIB3) 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 International Electrotechnical Commission (IEC) groups gases and vapors into Groups IIA through IIC categories depending on a number of factors including the Maximum Experimental Safe Gap (MESG) of the gas. The National Electrical Code (NEC) groups gases into A, B, C, D and G.M. categories.

Maximum Experimental Safe Gap (MESG)

WARNING

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

The Maximum Experimetal Safe Gap (MESG) is the measurement of the maximum gap between two equatorial flanges on a metal sphere that prevents a flame from being transmitted from the sphere to the surrounding flammable mixture. MESG is dependent on gas composition. The stoichiometric 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 MESG information.

Turbulence in Piping System

Elbows, tees, pipe expansions and/or contractions, spiral wound vapor hoses, valves, orifice plates and similar devices will 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. The likelihood for developing detonations via Deflagration to Detonation Transition (DDT) is enhanced by turbulent flow conditions.

Pipe Length

Extended lengths of pipe allow the flame to advance into more severe states of flame propagation such as high pressure deflagration and detonations.

Enardo Detonation Flame Arrestors are not limited by pipe length.

Flow Restrictions at Protected Side of the Arrestor; Pressure Piling

When flame propagation occurs, unburned and pressurized flammable vapors are forced through the detonation flame arrestor into the protected (cold) side piping. Restrictions close to the protected (cold) side of the arrestor will restrict the passage of the unburned flammable vapors causing pressurization to occur inside the crimped passages of the detonation flame arrestor element assembly. This pressurization can result in flame passage through the arrestor to the protected side during a flame propagation event.

WARNING

For maximum safety, avoid bends and flow obstructions within 10 pipe diameters but not less than 3 meters on the protected (cold) side of the detonation flame arrestor.

Maximum Initial Operating Pressure and Fundamental Burning Velocity

The Maximum Initial Operating Pressure of the detonation arrestor is indicated on the product nameplate in absolute pressure units. This is the maximum allowable pressure that is allowed at the instant the flowing velocity of the process vapors drops to a value to or less than the fundamental burning velocity of that particular flammable vapor stream. When the flowing velocity drops to this level, any flame in the system can propagate back toward the fuel source. High pressure deflagrations and detonations can occur more easily at higher system operating pressures than at pressures near atmospheric. Elevated pressures compress the system vapors and can cause the flame propagation to become more intense.

WARNING

If flame propagation occurs when the system pressure is higher than the Maximum Initial Operating Pressure, the flame arrestor could be ineffective in stopping the flame propagation.

Detonation State

Unstable (overdriven) detonations exist during a deflagration to detonation transition (DDT) before a stable detonation is reached. An unstable detonation is the most severe condition where pressure and velocity are at maximum values. Detonation arrestors rated for unstable detonations may be placed in any location in a piping system, provided installation is in accordance with all sections of this manual.

Stabilized Burning

Refer to Table 3 and 6 for stabilized burning limitations for the Detonation Flame Arrestors covered within the scope of this document.

⚠ WARNING

Unlimited burning should not be allowed in any flame arrestor, regardless of its rating. In installations where there is a potential for stabilized burning, it is recommended that a temperature sensor, alarm and shutdown system be installed. Stabilized burning after ignition creates additional hazards in applications where there could be a continuous flow of the flammable mixture towards the unprotected side of the flame arrestor. An overheated Detonation Flame Arrestor will fail and allow flame propagation to move into the protected side of the process.

⚠ WARNING

Scorched, discolored paint or discolored metal on unprotected (hot) side end section and/or adjacent piping is possible indication of a stabilized flame inside the Detonation Flame Arrestor. This is an abnormal condition that must be corrected. Do not operate any system where indications of stabilized burning are observed. Effective corrective measures must be taken to correct this condition. Any Detonation Flame Arrestor with indications of stabilized burning must be removed from service and thoroughly inspected by personnel with appropriate training and qualifications.

⚠ WARNING

Temperature sensors must be used with flame arrestors having 1 minute ATEX burn ratings. Never disconnect or remove these devices.

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 DFA Series are normally provided with CL150 raised or flat faced flanges. Other flanges such as CL300 are sometimes provided on special request. Make sure the companion flanges installed in adjacent piping match the flanges on the detonation flame arrestor.

Standard compressed fiber gaskets that withstands 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.

For proper torquing of the detonation arrestor to the process piping, please refer to Tables 6, 7 and 8.

Positioning

⚠ CAUTION

The detonation 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 detonation flame arrestor may result from improper lifting. The unit should be lifted using appropriately rated Nylon (PA) straps rigged on the outside of the tension studs. Detonation flame arrestors fitted with temperature sensors are directional dependant. The sensor must be located on the unprotected side of the arrestor.

The arrestor should be positioned such that the entire arrestor is accessible for removal. Install the unit such that the flow arrow located on the unit points in the direction travelling with the product flow. 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. Observe recommended installation practice as detailed bends and/or flow obstruction section.

Flow Direction

The Enardo DFA Series is not bi-directional when temperature sensors are required unless a sensor is installed on both sides of the arrestor element assembly. However, detonation arrestors are rated for stabilized burning and bi-directional. All arrestors covered in this manual 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 Detonation Flame Arrestor

⚠ WARNING

No instrument, tubing or other device whatsoever shall circumvent the detonation 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.

The Enardo DFA Series detonation 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 (unprotected) of the detonation flame arrestor, a length of pipe at least 120 pipe diameters must be installed between the detonation flame arrestor and the expansion. A pipe diameter is considered as the inside diameter of pipe having a nominal size equal to the detonation flame arrestor's connecting flanges.

Maintenance

Detonation Flame Arrestor Element Assembly Cleaning

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 clogging of particulates and other contaminants on the openings. 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 with wire or other hard objects to remove blockages. Cleaning the elements with wire or other hard objects could damage the elements and seriously impair the arrestor's performance. If the arrestor element cannot be cleaned satisfactorily, replace it.
2. For best cleaning results, use a high pressure sprayer with spray wand (1500 psig 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.
3. 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.
4. Thoroughly clean the gasket sealing faces being careful not to damage the sealing surface. For reassembly, use new gaskets and place them in the machined recess of each interior flange on the two conical sections.

5. Replace the flame element assembly with a new assembly or properly cleaned and inspected existing unit.
6. Locate the flame cell assembly such that it seats onto the gaskets.
7. Replace all tensioning studs and tighten the outer nuts hand tight only.
8. Torque the bolts in sequence as shown in the Torquing Instruction section. Refer to Figure 5 and Tables 4 and 5.

Note

Cleaning of units equipped with a cleaning 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.

Inspecting Enardo DFA Element Assembly Following Flame Propagation Event

1. Inspect the outboard flame cells for damage immediately following a deflagration, detonation and/or stabilized burn.
2. Carefully remove the element assembly from the arrestor.
3. Inspect the flame cells and the screens visually for any signs of corrosion or other damage and inspect the flame cells with a calibrated pin gauge to ensure maximum crimp size openings do not exceed the following values for their respective gas group. Use the following pin gauges as no-go gauges:
   - Model Enardo DFA(E)***/D Explosion Group D (IIA) – 0.063 in. / 1.6 mm
   - Model Enardo DFA(E)***/C Explosion Group C (IIB3) – 0.039 in. / 1 mm
4. If any damage is noted or crimp openings exceed maximum size allowable as indicated by the entry of the no-go gauge, replace the element assembly.

Note

Under no circumstance shall any element assembly not provided by Emerson be used in this assembly. Failure to use the correct screens may lead to arrestor failure.

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.

CAUTION

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

Note

Element assemblies are provided with hinges and jacking nuts to facilitate in-site cleaning of the flame cells or removal of the element assembly without the need for removal of the end sections from the piping system. This method is intended for use with detonation arrestors installed in horizontal piping configurations where adjacent piping is fully supported such that no loads are applied to the detonation arrestor.

CAUTION

Removal and installation of the detonation arrestor and associated piping require the use of adequate equipment and manpower to prevent injury. Detonation arrestors installed in inclined or vertical orientations should be entirely removed from the system for servicing.

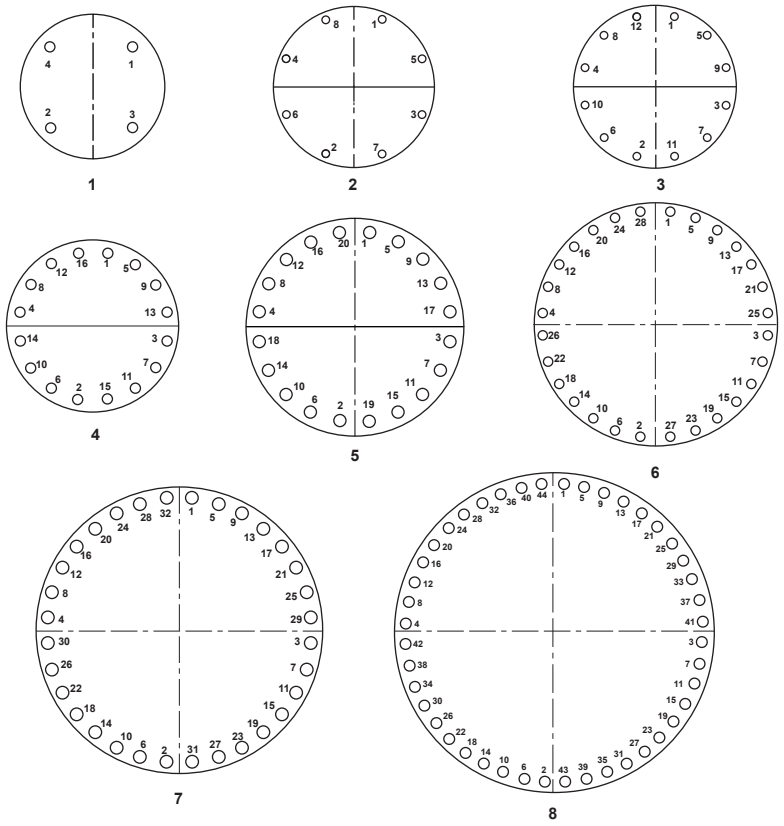

Figure 5. *Flange Pattern Tightening Sequence*

Table 4. *Tightening Steps and Torque Values for Internal Flanges*[1]

MODEL	PATTERN[2]	BOLT SIZE	TIGHTENING STEPS AND TORQUE (FT-LBS / N•m)					
			1	2	3	4	5	6
Enardo DFA-300.5	1	5/8-11	Snug	20 / 27	40 / 54	60 / 81		
Enardo DFA-0401	2	5/8-11	Snug	25 / 34	50 / 68	80 / 108		
Enardo DFA-0602	2	3/4-10	Snug	40 / 54	85 / 115	125 / 169		
Enardo DFA-0803	2	3/4-10	Snug	50 / 68	100 / 136	160 / 217		
Enardo DFA-1004	3	7/8-9	Snug	50 / 68	90 / 122	145 / 197		
Enardo DFA-1206	3	1-1/8-8	Snug	50 / 68	100 / 136	165 / 224		
Enardo DFA-1608	4	1-1/4-8	Snug	50 / 68	120 / 163	190 / 258		
Enardo DFA-2010	5	1-1/4-8	Snug	50 / 68	100 / 136	180 / 244	260 / 353	
Enardo DFA-2412	5	1-1/2-8	Snug	75 / 102	150 / 203	280 / 380	400 / 542	500 / 678
Enardo DFA-2814	6	1-5/8-8	Snug	75 / 102	150 / 203	320 / 434	450 / 610	550 / 746
Enardo DFA-3016	6	1-3/4-8	Snug	80 / 108	200 / 271	350 / 475	500 / 678	700 / 949
Enardo DFA-3418	6	1-7/8-8	Snug	80 / 108	250 / 339	400 / 542	750 / 1017	1200 / 1627
Enardo DFA-3620	7	2-8	Snug	80 / 108	250 / 339	450 / 610	800 / 1085	1100 / 1491
Enardo DFA-4824	8	1-1/2-8	Snug	100 / 136	200 / 270	380 / 515	540 / 732	680 / 922

1. Using machine oil as lubricant. See Bolt Lubrication section on page 11 and torque correction factors for other lubricants in Table 5.
2. See Figure 5.

Table 5. *Torque Correction Factors for Common Lubricant*

DESCRIPTION	COEFFICIENT OF FRICTION	MULTIPLY TORQUE VALUE IN TABLE 4 BY
Machine Oil	f = 0.15	1.00
API SA2 Grease	f = 0.12	0.80
Nickel-based Lubricant	f = 0.11	0.73
Copper-based Lubricant	f = 0.10	0.67
Heavy-Duty Lubricating Paste	f = 0.06	0.40

Table 6. *Torque Values for Raised Face Connection Flange (Steel Only)*

NOMINAL PIPE DIAMETER	NUMBER OF BOLTS	BOLT DIAMETER		TORQUE	
		In.	mm	Ft-lbs	N•m
1	4	0.50	12.70	9	12.20
1-1/4	4	0.50	12.70	13	17.63
1-1/2	4	0.50	12.70	18	24.40
2	4	0.63	16.00	35	47.45
2-1/2	4	0.63	16.00	41	55.59
3	4	0.63	16.00	60	81.35
3-1/2	8	0.63	16.00	34	46.10
4	8	0.63	16.00	43	58.30
6	8	0.75	19.05	80	108.5
8	8	0.75	19.05	109	147.8
10	12	0.88	22.4	101	136.9
12	12	0.88	22.4	135	183.0
14	12	1.00	25.0	168	227.8
16	16	1.00	25.0	159	215.6
18	16	1.13	28.7	244	330.8
20	20	1.13	28.7	214	290.2
24	24	1.25	31.8	253	343.0

Assumptions: Use of SAE grade 5 bolts or studs or stronger.
No lubricant.
Compressed mineral fiber material or similar.
Notes: If lubricant is used on bolts, apply torque reduction factor listed in Lubricant Table.
For best results hardened steel washers should be used on all cast flange bolted connections.

Table 7. *Torque Values for Flat Face Connection Flange (Steel or Aluminum)*

NOMINAL PIPE DIAMETER	NUMBER OF BOLTS	BOLT DIAMETER		TORQUE	
		In.	mm	Ft-lbs	N•m
1	4	0.50	12.70	14	18.98
1-1/4	4	0.50	12.70	16	21.69
1-1/2	4	0.50	12.70	18	24.41
2	4	0.63	16.00	32	43.39
2-1/2	4	0.63	16.00	43	58.30
3	4	0.63	16.00	47	63.72
3-1/2	8	0.63	16.00	26	35.25
4	8	0.63	16.00	32	43.39
6	8	0.75	19.05	49	66.44
8	8	0.75	19.05	68	92.20
10	12	0.88	22.4	69	93.55
12	12	0.88	22.4	98	132.9
14	12	1.00	25.0	138	187.1
16	16	1.00	25.0	125	169.5
18	16	1.13	28.7	142	192.5
20	20	1.13	28.7	135	183.0
24	24	1.25	31.8	156	211.5
8 API	16	0.50	12.70	20	27.12
20 API	16	0.63	16.00	75	101.7
24 API	20	0.63	16.00	75	101.7

Assumptions: Use of SAE grade 5 bolts or studs or stronger.
No lubricant.
Elastomer <70 Durometer Shore A.
Notes: Flat faced flanges should never be mated to a raised face flange for installation.
If lubricant is used on bolts, apply torque reduction factor listed in Lubricant Table.
For best results hardened steel washers should be used on all cast flange bolted connections.

Table 8. *Torque Correction Factors for Common Lubricants Applied on Flanges*

DESCRIPTION	COEFFICIENT OF FRICTION	MULTIPLY TORQUE VALUE IN TABLE 6 BY
Machine Oil	f = 0.15	0.75
API SA2 Grease	f = 0.12	0.60
Nickel-based Lubricant	f = 0.11	0.55
Copper-based Lubricant	f = 0.10	0.50
Heavy-Duty Lubricating Paste	f = 0.06	0.30

1. Loosen all outermost nuts on tension studs.
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.
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 tighten the outer nuts hand tight only. 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 the Torquing Instruction section.

Torquing Instructions

CAUTION

Excessive or uneven torque 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 4 following the designated sequence, repeating the sequence as shown. Flange pattern tightening sequences are shown in Figure 5.

Bolt Lubrication

Lubrication affects 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 4 assumes that only machine oil is used as a lubricant. Table 5 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.

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 stored as a spare for the next maintenance interval.

Note

Element gaskets must be replaced each time the cell assembly is loosened and removed to ensure 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.

Molykote® G-n is a mark owned by Dow Corning Corporation.

Outside North America Only

Webadmin.Regulators@emerson.com
Enardo.com
Facebook.com/EmersonAutomationSolutions
LinkedIn.com/company/emerson-automation-solutions
Twitter.com/emr_automation

Emerson Automation Solutions

Americas
McKinney, Texas 75070 USA
T +1 800 558 5853
+1 972 548 3574
Tulsa, OK 74146 USA
T +1 918 662 6161

Europe
Bologna 40013, Italy
T +39 051 419 0611

Asia Pacific
Singapore 128461, Singapore
T +65 6777 8211

Middle East and Africa
Dubai, United Arab Emirates
T +971 4 811 8100

EMERSON™