Model DFA 7236
Detonation Flame Arrestor

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⚠ 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 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 (Emerson) 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 detonation flame arrestor.

Introduction

Scope of the Manual

This Instruction Manual provides instructions for installation, startup and maintenance information for the Model DFA-7236 detonation flame arrestor.

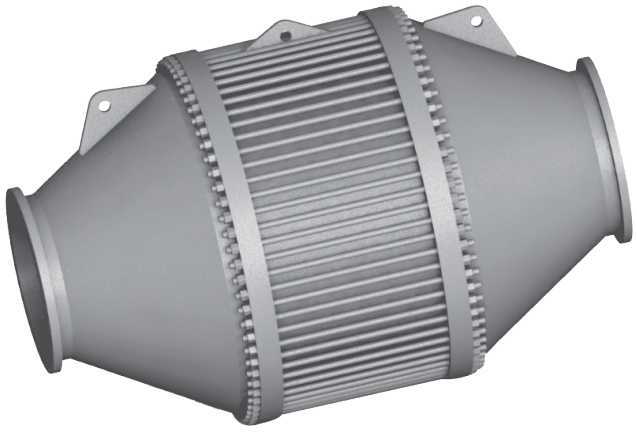

***Figure 1**. Typical Model DFA-7236 Detonation Flame Arrestor*

Product Description

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

The DFA Series is designed with flanged connections. The arrestor provides the option of the removal of the flame cell element assembly for cleaning and replacement with the arrestor removed from the ping.

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Specifications

The Specifications table lists the specifications for the detonation flame arrestor. The following information is stamped on the nameplate attached to the arrestor: model number, flange size and rating, maximum initial operating pressure, gas group, date of manufacture and serial number; other identification and customer tag number are optional.

Construction
Model DFA-7236

Gas Group
D (IIA)

Flange Sizes and Rating
36 in. CL150

Housing Size
72 in.

Maximum Experimental Safe Group (MESG)
0.035 in. / 0.90 mm for Group D Vapors

Maximum Initial Operating Pressure(1)
17.7 psia / 1.22 bar a

Temperature Rating of Fiber Gasket(1)
450°F / 232°C

Maximum Operating Temperature
140°F / 60°C

Burning Rating
5 minutes

Housing Material
Carbon steel

Element Material
304 Stainless steel, 316 Stainless steel

Certification
None

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

Principle of Operation

Detonation flame arrestors prevent 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.

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

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 Experimental 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.

Maximum Initial Operating Pressure, Detonation Rating and Burn Rating

CAUTION

Unlimited burning should not be allowed in any flame arrestor, regardless of its rating. If burning can occur for a period exceeding 5 minutes starting at ambient temperature,

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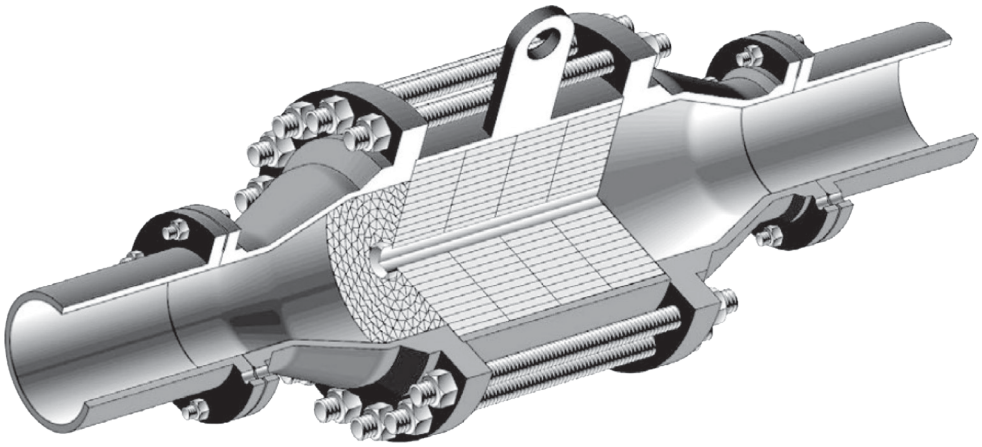

Figure 2. *Cut-away view of DFA Series Detonation Flame Arrestor*

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Detonation Flame Arrestor	**Housing Size**		**Connection Size**		**IEC Gas Group**	**Housing Material**	**Element Material**	**Connection Type**	**Options**					
DFA = Concentric	72 = 72 in.		36 = 36 in.		IIA (D)	C = Carbon steel 4 = 304 SST 6 = 316 SST	4 = 304 SST 6 = 316 SST	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 3. *DFA Series Detonation Flame Arrestor Available Constructions and Model Numbering System*

it is required that a temperature alarm and shutdown system must be installed.

If the temperature sensor(s) indicate a temperature excursion beyond anticipated normal operating temperature, shutdown should be initiated and review of the process should be commenced, as necessary.

Maximum initial operating pressure is the pressure of the system at or near static flow conditions. High pressure deflagration and detonations 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.

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

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. Although the Enardo detonation flame arrestor is not limited by pipe length, using a minimum length is a preferred design and installation practice.

Bends and/or Flow Obstructions

CAUTION

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

Valves or other equipment that can obstruct the flow due to restricting the piping flow area (e.g. partially closed valves) shall be reviewed to ensure that they cannot be in a partially closed position during normal operation. Flame transmission can occur due to restrictions on the downstream side of the flame arrestor.

Bends in piping, pipe expansions and/or contractions, valves orifice plates or flow obstructing devices of any kind cause 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. Obstructions in protected side piping can cause pressure buildup that might inhibit the effective performance of the DFA Series under certain conditions.

Installation

WARNING

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

Lifting

DFA Series arrestors are not designed for single point lifting. An appropriately designed spreader bar must be used when lifting or moving the unit. The angle of the lift lines should be no more than 5° from the vertical (refer to Figure 4). Recommended shackles are Crosby 1-3/4" 25t-G-2130 (Stock No. 1019659) or equivalent.

Connection

DFA Series arrestors 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.

Positioning

CAUTION

The detonation flame arrestor element is fitted with lugs for lifting the element assembly during servicing operations. These lugs are not intended for lifting the entire unit. Damage to the detonation flame arrestor may result from improper lifting. The unit should be lifted using the lugs located on each end-section or with appropriately rated Nylon (PA) straps rigged on the outside of the tension studs. Detonation flame arrestors fitted with temperature sensors are directional dependent if the temperature sensor is only installed on one side of the arrestor. The sensor must be located on the unprotected side of the arrestor in that case.

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 vapor flow. Models that have drain plugs are designed for horizontal installation and should be installed with the drain ports 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 DFA Series is not bi-directional when temperature sensors are installed unless a sensor is installed on both sides of the arrestor element assembly. 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.

DFA Series detonation flame arrestors 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.

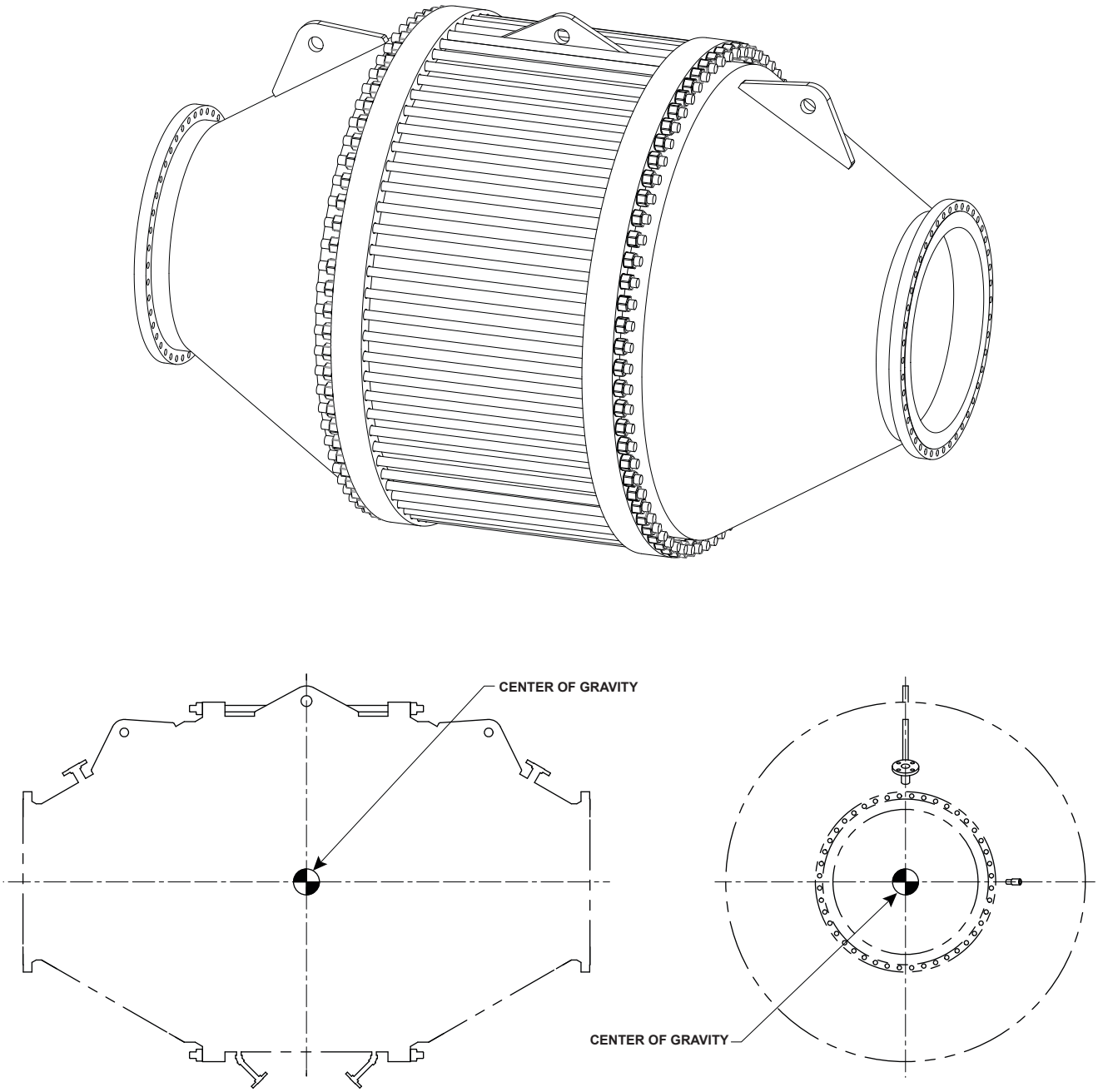

Figure 4. *Lifting Diagram*

Maintenance

Detonation Flame Arrestor Element Assembly Cleaning

1. Keep the element openings clean to prevent loss of efficiency in absorbing heat. Remove the entire unit 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.

Inspecting Model 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 with the entire flame arrestor out of the line.
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 DFA-7326/D Explosion Group D (IIA) – 0.063 in. / 1.6 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 (internally between the flame cells) 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

Removal and installation of the detonation arrestor and associated piping require the use of adequate equipment and manpower to prevent injury. The Model DFA-7236 detonation flame arrestor should be entirely removed from the system for servicing.

To remove the element assembly:

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.

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

MODEL	BOLT SIZE	TIGHTENING STEPS AND TORQUE (FT-LBS / N•m)					
		1	2	3	4	5	6
DFA-7236	1.50 in.	Snug	80 / 110	250 / 340	450 / 610	700 / 950	1000 / 1360
1. Using machine oil as lubricant. See Bolt Lubrication section on page 7 and torque correction factors for other lubricants in Table 2.							

Table 2. *Torque Correction Factors for Common Lubricant*

DESCRIPTION	COEFFICIENT OF FRICTION	MULTIPLY TORQUE VALUE IN TABLE 1 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

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. Heavy-Duty Lubricating Paste.
- 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 1 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 1 assumes that only machine oil is used as a lubricant. Table 2 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.

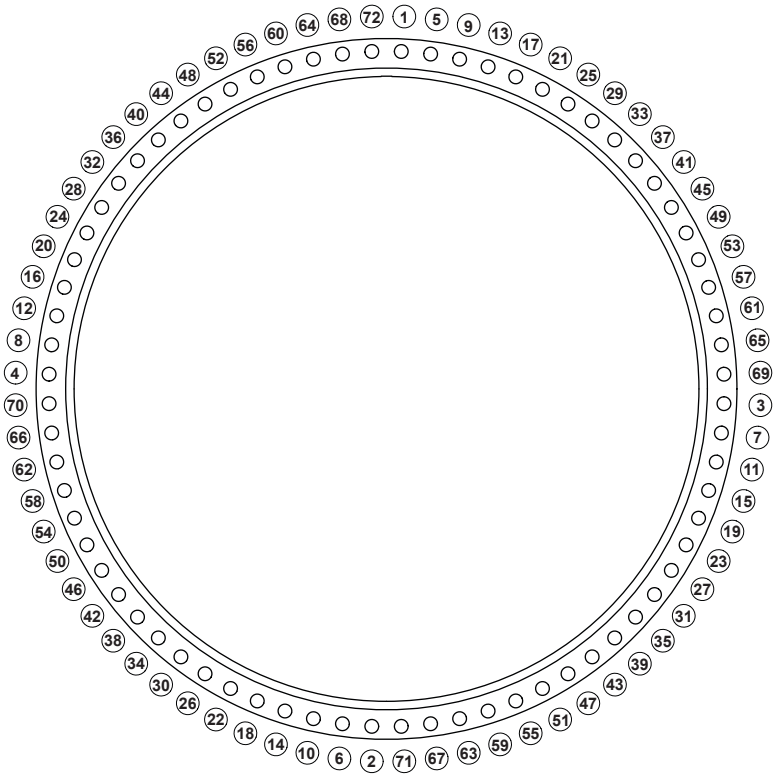

Figure 5. *Flange Pattern Tightening Sequence*

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