FADU Flange Assembly
September 2016
Safer, Accurately, Quicker, and Over All Cost Saving
BOLTED FLANGE CONNECTIONS ARE ENGINEERED JOINTS

In all bolted flange connections... it’s all about applying AND maintaining the **Clamping Load**
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    - Understand Bolt Load and Bolt Relaxation
    - Understand Gasket Behavior using Different Gasket Designs

- **Load Indicating Technology**
  - Understanding Load Indicating and design (SPC4)
  - Benefits of SPC4 with actual examples
  - SPC4 Demonstration unit
Hooke’s Law

Extension is proportional to the applied load.

Target Load

Extension

Resulting Elastic Extension

Applied Bolt Load

Ultimate Strength

Failure

Yield Point

Resulting Elastic Extension

Extension
Bolt Marking Examples

- L1 B7: Material ASTM A193 B7
- L1 B16: Material ASTM A193 B16
- L1 B8: Material ASTM A193 B8 Class 1
- L1 B7M: Material ASTM A193 B7M 100% Conformance to spec
- 123: "Example" traceability code placed on opposite end of grade/MFG stamp
- L1 B8M: Material ASTM A193 BBM Class 1
- L1 B8MSH: Material ASTM A193 BBM Class 2
- L1 B8SH: Material ASTM A193 BB Class 2
- L1 L7: Material ASTM A320 L7
- L1 B7ZN: Material ASTM A193 B7 with zinc coating
Proper Gasket Installation
Gasket Installation Procedures

Assuring Joint Integrity and Maximum Safety
A Guide to Successful Gasket Installation

Successfully sealing a flanged connection is dependent upon all components of a well-designed flange system working well together. This document provides guidance to maintenance operators, engineers, and fitters to ensure successful gasket installation and assembly of bolted flange connections. It is intended to complement other plant-approved installation procedures.

Tools Required

Specific tools are required for cleaning and tensioning the fasteners. Additionally, always use standard safety equipment and follow good safety practices. Acquire the following equipment prior to installation:

- Calibrated torque wrench, hydraulic or other tensioners
- Wire brush (brass if possible)
- Helmet and safely goggles
- Lubricant
- Other plant-specified equipment
Remove all foreign material and debris from the seating surfaces, fasteners (bolts or studs), nuts, and washers. Use plant-specified dust control procedures.

Examine fasteners (bolts or studs), nuts, and washers for defects such as burrs or cracks.

Examine flange surfaces for warping, radial scores, heavy tool marks, or anything prohibiting proper gasket seating.

Replace components if found to be defective. If in doubt, seek advice.
2 Align Flanges

Align flange faces and bolt holes without using excessive force.

Report any misalignment.
Flange Alignment

Fig. E-3  Rotational-Two Hole

3 mm (1/8 in.) max.

Fig. E-4  Excessive Spacing or Gap
**Flange Parallelism**

**Fig. E-1** Centerline High/Low

1.5 mm (\(\frac{1}{32}\) in.) max.

**Fig. E-2** Parallelism

Maximum 0.8 mm (\(\frac{1}{32}\) in.)

difference between the widest and narrowest

**Fig. E-3** Rotational Two Hole
Assure gasket is the specified size and material.

Examine the gasket to ensure it is free of defects.

Carefully insert gasket between flanges.

Make sure the gasket is centered between the flanges.

Do not use joint compounds or release agents on the gasket or seating surfaces unless specified by the gasket manufacturer.

Bring flanges together, ensuring the gasket isn’t pinched or damaged.
Lubricate load-bearing surfaces

Use only specified or approved lubricants.

Liberally apply lubricant uniformly to all thread, nut, and washer load-bearing surfaces.

Ensure lubricant doesn’t contaminate either flange or gasket face.
Always use proper tools: calibrated torque wrench or other controlled tensioning device.

Install and tighten bolts

Consult your gasket manufacturer and/or engineering department for guidance on torque specifications.

Always torque nuts in a cross bolt tightening pattern.

Tighten the nuts in multiple steps:

1. Tighten all nuts initially by hand. (Larger bolts may require a small hand wrench.)
2. Torque each nut to approximately 30% of full torque.
3. Torque the nuts to approximately 60% of full torque.
4. Torque each nut to full torque, again using the cross bolt tightening pattern. (Large-diameter flanges may require additional tightening passes.)
5. Apply at least one final full torque to all nuts in a clock-wise direction until all torque is uniform. (Large-diameter flanges may require additional tightening passes.)
Fig. 3  Example Legacy Pattern 12-Bolt Tightening Sequence

Tightening sequence for 12 bolts (Round 1 through Round 3):

1-7-4-10 → 2-8-5-11 → 3-9-6-12
Caution: Consult your gasket manufacturer and/or engineering department for guidance and recommendations on retightening.

Do not retorque elastomer-based, asbestos-free gaskets after they have been exposed to elevated temperatures unless otherwise specified.

Retorque fasteners exposed to aggressive thermal cycling.

All retorquing should be performed at ambient temperature and atmospheric pressure.
SPIRALWOUND WR
(WITHOUT INNER RING)

0.125" THICKNESS OF GUIDE RING

0.175" THICKNESS OF WINDING

COMPRESSSION 0.175" - 0.125" = 0.05"
SPIRALWOUND WRI (WITH INNER RING)

0.125" THICKNESS OF GUIDE RING

0.175" THICKNESS OF WINDING

0.125" THICKNESS INNER RING

WRI

COMPRESSION 0.175" - 0.125" = 0.05"

IF COMPRESSION IS AROUND 0.043"
THIS MEANS WE HAVE NOT
COMPRESSED TO THE GUIDE RING YET
LP-3

1/16" THICKNESS GUIDE RING

0.02" THICKNESS FACING PER SIDE

0.125" THICKNESS SERRATED CORE

COMPRESSION \((0.125" + 2(0.02"))\) BOTH FACING) = 0.165"

IF COMPRESSION IS AROUND 0.02" THIS MEANS WE HAVE COMPRESSED EACH FACE OF GRAPHITE TO ABOUT 0.01" ABOUT 50%
SPC4 Bolts

Lamons SPC4™ Load Indicating Fasteners for Industrial Applications
WHY DO WE HAVE LEAKY HEAT EXCHANGERS AND CRITICAL FLANGES AND HOW DO WE SOLVE LEAKY HEAT EXCHANGERS AND CRITICAL FLANGES?

PROBLEMS & SOLUTIONS
In all bolted flange connections... it’s all about applying **AND** maintaining the **Clamping Load**
Heat Exchanger and Critical Flange LEAKS can be Eliminated! HOW?

1. Select a Gasket that will tolerate movement and Load
2. Eliminate Friction Factors
3. Set stud loads high to a targeted gasket stress
4. Set stud loads with reasonable level of accuracy
5. Field Success reported with re-tightening of the connection after start-up
Corrugated Metal Gaskets - CMG

Advantages:

- High sealing ability
- Maintains high bolt loads in HE when retightened
- Choice of metal and facing material
- Sizing to meet ASME B16.5 and special flanges
- Minimum Gasket Stress:
  - Lower M & Y factors
  - $M = 2.75$
  - $Y = 3,700$ PSI
• Heavy 22ga (0.031”) thick substrate that is corrugated to a height of approximately .055”

• .125” Pitch (corrugation frequency) is utilized for optimal performance

• Premium SGL Polycarbon flexible graphite laminate is utilized as a covering layer material
Primary Factors that Impact CMGC Gasket Performance

- Metal Substrate Thickness
- Corrugation Design and Pitch Frequency
- Graphite Quality
CMGC Crush Comparison

Lamons CMG
- 4” 150 loaded to 7000psi flange gasket stress for 5 min @ ambient temperature
- .031 (22ga) substrate with 1/8” pitch substrate geometry

Competitor CMGC
- 4” 150 loaded to 7000psi flange gasket stress for 5 min @ ambient temperature
- .024 (24ga) substrate with ¼” pitch substrate geometry
Kammpro Gasket Features

Advantages:

- Soft sealing faces
- Flexible graphite facing material
- Serrated metal core
- Wide range of metal cores
- Sizing to accommodate application

- Minimum Gasket Stress:
  - Lower M & Y factors
  - $M = 2.75$
  - $Y = 3,700$ PSI
Lamons Kammpro ® Styles

Styles

<table>
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<th>Typical Applications</th>
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<tr>
<td>LP1</td>
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<td>LP2</td>
<td>Class 150-2500 lbs. Standard Pipework</td>
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<tr>
<td>LP3</td>
<td>Class 150-2500 lbs. Standard Pipework</td>
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Cutting Tool is specifically designed to accurately achieve desired geometry.

All serrations are cut simultaneously and on the same fixed plane.

The height of the core and cutting tool is constant during the cutting phase.

The height of the table is the only adjustment required for operator, which minimizes potential for error.
Lamons Kammprofile Milling Technology

- Consistent pitch, depth and geometry
- High quality finish
- Repeatable
LAMONS ACHE LP1 INTEGRAL PLUG & GASKET

Built-in Kammprofile ACHE Plug
Lamons Kammpro RTJ/RF Adapter
Lamons Premium Gasket - CorruKamm™
Lamons CorruKamm™

- M-2.75 PSI
- Y-3700 PSI
Correcting Geometry

- Machined profile, not formed.
- Strategically indexed and aligned so that deflection **CAN** occur.

*Maximum stability and resiliency.*
*Maximum deflection and conformance.*
Thermal Cycle Test

![Thermal Cycle Test Graph]

**Thermal Cycle Test - 608°F (320°C)**

- **Pressure (psi)**
  - 490
  - 485
  - 480
  - 475
  - 470
  - 465
  - 460
  - 455
  - 450
  - 440

- **Number of Temperature Cycles**
  - 1
  - 2
  - 3
  - 4
  - 5
  - 6
  - 7
  - 8
  - 9
  - 10
  - 11
  - 12
  - 13
  - 14
  - 15
  - 16
  - 17
  - 18
  - 19
  - 20
  - 21
  - 22
  - 23
  - 24

- **Lines and Legends**
  - Corruckamm
  - CMG
  - Kammprofile
  - SWG
  - Failed
Gasket Stress chart

Loss Of Gasket Stress
ASME B16.5

Temperature

elapsed time [hrs]

internal pressure [psi]

elapsed time [hrs]

25000
20000
15000
10000
5000

0
5
10
15
20
25
30

Corr GR
Kamm LP2 GR
CMG GR
SWG WR GR
Temperature
Stress vs. Deflection for All Test 1

- **Corrukamm**
- **Spiral**
- **Wound**
- **CMG**

Graph showing the relationship between gasket stress and deflection for different types of gaskets.
In all bolted flange connections... it’s all about applying **AND** maintaining the **Clamping Load**
Heat Exchanger and Critical Flange LEAKS can be Eliminated!

1. Select a Gasket that will tolerate movement
2. Eliminate Friction Factors
3. Set stud loads high to a targeted gasket stress
4. Set stud loads with reasonable level of accuracy
5. Field Success reported with re-tightening of the connection after start-up
- **Nickel 328**
  - Up to 2000F
  - Nut factor = 0.14

- **Moly-B**
  - Up to 1500F
  - Nut factor = 0.13

- **Arctic Grade**
  - -30F to 450F
  - Nut factor = 0.15

- **GP-450**
  - Up to 450F
  - Nut factor = 0.17
  - Economical
What makes Premium lubricants work?

Nickel 328:

77% solids for smoother application, coverage and oxidation inhibition.

One quart can weighs 5lbs.

Nickel melts at 2495F and that is generally considered its upper temperature rating.

A closer look shows that Nickel also oxidizes at around 800F; forming nickel oxide which rivals a 2H nut in hardness.

We have done two things to reduce the oxidation process; 50% nickel which forms its own barrier when oxidizing and added a rare earth fluoride which also reduces oxidation and has excellent lubricating properties.
Engineers and contractors know the benefits of using a quality thread lubricant, and the Lamons Moly-B and Nickel 328 certainly fall into that category. To that end, Lamons wanted to share some case history information with the industry, along with some recent support regarding the effectiveness of Nickel 328.

In the very late 90's Superior Plant Services used two of Lamons Approved Product sites for case studies. One being Murphy Oil in Meraux (now Valero) and the other being ExxonMobil Chalmette (now being PBF Energy). Both studies were conducted on the reactor nozzles of the sites Hydrocrackers. Refineries know that these are very hot connections using typically large fasteners in excess of 2 inches, and usually have to be split or torched off after the normal 3 to 5 year run between turnarounds. Both site locations agreed to use the Nickel 328 product on their connections in hopes of achieving a manual break out of these connections during their next outage. ExxonMobil had expressed that if they achieved greater than a 50% manual break out the experiment would be deemed a success. During the 2004 turnaround the manual break out was 93%! Needless to say they were thrilled and have since used this product in all of their high temperature connections where disassembly had been an issue in the past.

ExxonMobil shut that Hydrocracker down in 2009 and it has been idle since.
PBF Energy acquired the site last October and has decided to re-start the Hydrocracker. The reactor has 5 nozzles on it, each with 30 studs tapped into the reactor side and nutted to the nozzle flanges. The studs range from 2-1/4" to 2-1/2" in diameter. In 2004 the studs were not removed, but the nutted connections had the Nickel 328 applied. As of this morning the last nozzle elbow has been removed with 100% manual disassembly! In conclusion, the connections were made up in 2004, ran for 5 years, sat dormant for 7 years and 150 large nuts were disassembled without the aid of nut splitters or having to be cut off. That's what I call performance!

**Installation Tip:** It's suggested not to use a typical brush application method and adopt using a butter knife or something similar that will allow them to evenly spread and drive the product completely and consistently into the threads of the studs and the nuts for best results. Proper and complete inclusion of the lubricant into the threads helps to mitigate possible galvanic action that could occur where air gaps exist. The brush works well for the load bearing surface of the nuts but not on the threads. This is the method that has been practiced since 2004 with excellent results.

**Pictured Below** – 30" Nozzle that 328 was used in conjunction LP1 technology

**Nickel 328**
Unequaled in its ability to reduce seizing and galling in high temperature applications, Nickel 328 has very predictable and consistent friction factors. The upper temperature limit is 2500°F long term, intermittent or sustained. The K-Factor through 13000 lbs. load is .172, from 13,001 through 93,000 lbs. is .144 and above 93,001 lbs. through 650,000 lbs is .120. The highest solids content available is 77%.

**Kammpro Style LP1**
Is manufactured without a guide ring for tongue and groove, or recessed flange applications such as Male and Female. It is typically used in heat exchanger applications and applied as an upgrade to double jacketed gaskets especially when lower load is needed. It is highly suggested to have the nubbin (if present) machined out when applying Kammpro LP1 in heat exchanger applications.
What makes Premium lubricants work?

What makes our lubricants work?

Moly-B:

74% solids for smoother application and coverage.

One quart can weighs 4.5lbs.

Molybdenum Disulfide is the primary ingredient and has a natural ability to cling to metal.

Because Molybdenum Disulfide breaks down at 750F, that is generally considered its upper temperature limit.

A closer look however shows that about 75% of the Moly becomes Molybdenum Oxide which has strong lubricating properties up to 1200F.

In addition, Bismuth Aluminates were added which has excellent lubricating properties up to 1500F.
Moly B Lubrication

- Unsurpassed anti-seizing and anti-galling performance
- Excellent rust and corrosion inhibitors content
- Upper temperature limit is 750°F, but contains solid additives that remain intact up to 1500°F

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## TORQUE VALUE USING NO LUBRICATION

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TORQUE VALUE USING **GP-450** LUBRICATION

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# Lamons Loading Recommendation

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<td>Effective Gasket Sealing Width (in)</td>
<td>D</td>
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<td>Gasket Load Reaction Diameter (in)</td>
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<td>Hydrostatic End Force (lbs)</td>
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<td>Bolt Root Area (in²)</td>
<td>A₉</td>
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<td>Operating Bolt Load (lbs)</td>
<td>Wₘ₁</td>
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<td>Gasket Sealing Bolt Load (lbs)</td>
<td>Wₘ₂</td>
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<td>bolt stress (psi)</td>
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<td>bolt torque (ft-lbs)</td>
<td>67</td>
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<tr>
<td>minimum required gasket stress (psi)</td>
<td>5,000</td>
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<tr>
<td>actual gasket stress (psi)</td>
<td>13,410</td>
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</table>
Importance of Lubrication

2" - B7 Studs
Torqued to 50% Yield

- No Lubricant
- Moly Lube on Threads Only
- Moly Lube on Face Only
- Moly Lube on Thread and Face

Torque (ft./lbs.)
Despite many factors that comprise the complexity of bolted joints, performance can be simplified by concentrating on the **Clamp Load**.

All these factors impact on **Clamp Load**.

The most effective means to ensure bolted joint performance is to target and maintain, accurate and uniform **Clamp Load**.
Does using NEW bolts actually make a difference?

Absolutely!
E-1586B Floating Head Final Torque
New Coarse Thread Bolts
E-1585A Floating Head Final Torque, Clad Gasket
Used Fine Thread Studs
Galled Bolts Cost

Time and Money!

The interrupted job time for one galled bolt is often more than the total job time.

Additional manpower and specialized equipment are likely to be needed.

Often multiple galled studs will alter the path forward and jeopardize the critical path.

Even a single galled bolt equals wasted time and money poorly spent.
Measuring Bolt Elongation

Strain Gauges
- Incorporates a bonded device that is wired to a digital readout
- Reports tension in the fastener through electrical resistance
- Requires a high degree of operator expertise
- Not well suited for a field environment
- Must be reassembled to monitor load once placed in service

Ultrasonic
- Incorporates an acoustic coupling device that uses a pulse-echo technique
- Measures time of flight of the loaded fastener and compares it to that of the unloaded condition to give elongation
- Coupled to an electronic device capable of converting the pulse echo time of flights to load
- Requires a high degree of operator expertise
- Must be reassembled to monitor load once placed in service
SPC4™ Load Indicating Bolts
Methods For Targeting Clamp Load

Operator Feel with Hand Wrenches

- Wide range of accuracy dependent upon operator experience
- Very dependent upon friction
- Size of connection and number of bolts will increase variance exponentially
Impact Wrenches

- Dependent upon many variables such as incoming air pressure, volume of air line, and condition of tool
- Offers no feedback to operator that the proper torque has been applied
- Very dependent upon friction
- Promotes a level of inaccuracy and offers very random control
Torque Test Setup

Test Setup

Torque Test Setup

www.VFBOLTS.com

www.SHELL.com
Accuracy of Clamping Method

- SPC4
- Hydraulic Tensioners
- Torque Wrench
- Operator ‘Feel’

Target Clamp Load

-40%  -30%  -20%  -10%  +10%  +20%  +30%  +40%
SPC4 manufacturing & function

- A small hole is drilled into the end of a B7 or B16 stud bolt
- Gage pin consisting of the same metallurgy as stud bolt is press fit into the drilled hole and secured at the bottom with a gnurled tip and small amount of epoxy
- Datum disc is fitted at the top of the bolt head and forms a flat surface with the gage pin when the bolt is unloaded
- When load is applied to the bolt the datum head stretches along with bolt as the gage pin is anchored at the original position
- A mechanical or electronic load reader measures the amount of displacement from the datum head and gage pin
- All sizes and diameters of SPC4’s are calibrated where 100% equals .005” displacement so the same load reader can be used for all SPC4 lengths and diameters
- Mechanical load data readings are translated to bolt load in lbs that is then correlated to joint clamp load
SPC4™ Load Indicating Bolts

- A gauge pin is inserted into one end of the bolt and a datum disc is installed to allow attachment of load reader.
- Certified to ASTM F2482
SPC4 Calibration & Retro-fit

- SPC4 order is placed
- Fasteners provided with Certs & MTR’s to VF Bolt
- Valley Forge engineering creates a simplified drawing, load calculations & process routing
- Automated load calibration verification test – 91% of min. yield strength
- QC verifies MTR’s to order
- CNC machines datum disc
- Engineering finalizes and issues load calibration test report (graph)
- Automated multi-station indexing drilling machine
- Install gage pin – B7 is press fit & B16 is threaded in place
- Machine datum disc flat to establish zero in unloaded state
- Serial number engraving
- QC assembles cert package
- Packaged and shipped
SPC4 Pricing Estimation

Standard fastener & nut cost

+ 

Retro-fit adder cost $60 (includes metal protective cap)
**Principles of Operation**

- Calibrated for all sizes that 0.005” equal 100% Yield Strength of de-rated SPC4
- Displacement is a direct measure of applied load
- Linear scale (within yield point)
- Calibration is +/-6%
Easily snaps on/off fastener and eliminates need for electrical reading device

Gauge fits in pocket

Allows accurate reading of **bolt load** – even after a period of time following start-up of equipment

**Tested in unloaded condition to 538°C** – works with B16 material.
SPC4™ Load Indicating Fastener Calibration Certificate

Valley Forge & Bolt Manufacturing Company • 4410 W. Jefferson St • Phoenix, AZ 85043 • 602-269-5748 • www.vfbolts.com

Calibration Date: 21 Jan 2014
Customer: Lamons
Customer P.O.: SAMPLES - PETE
Customer P/N: N/A

Fastener S/N: A140100614-A140100617
Fastener P/N: N/A
Fastener Size: 0.625"-11 X 3.50"
Fastener Type: Hex Bolt

Ref. No.: 1401117
Reference Gage Length [in]: 1.8500
Extension [in]: 0.0050
Jack Area [sq. in]: 4.627

100% on Dial/Reader: 100% of Yield Stress Load
Design Load [lb]: 14,600 lb
Proof Load: 10,220 lb (70.0% of Design Load)

NOTE: Curves are extrapolated from 70.0% (Proof Load) to 100%. 100% represents the 0.2% yield stress load of the bolt (14,600 lb).

The 4 fastener(s), with serial number(s) indicated above, are calibrated to 70.0% of the yield load (Nominal 10,220 lb) and are certified to fall within the indicated design limits.
FIBERGLASS FLANGE LOW MAX FT-LBS ALLOWED

- Flange manufacturer for 5/8” bolt – 30 ft/lbs Max
- 30 ft/lbs will equal 23% yield
- 30 ft/lbs will equal 3360 lbf (clamp load)
<table>
<thead>
<tr>
<th></th>
<th>Applied Torque (ft-lbs)</th>
<th>Indicated Load (% of Yield)</th>
<th>Clamp Load (lbf)</th>
<th>Flange Gap (Inches)</th>
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*Table 1*
CASE HISTORY

FIVE 30” FLANGES WITH 20 EACH 5/8” 316SS BOLTS

ALWAYS LEAKED

INSTALLED SPC4 BOLTS ON AUGUST 15, 2014

NO LEAKS FROM AUG 15, 2014 TO CURRENT
FLINT Hills Chemical Titanium Exchanger 11% Max Bolt Stress Always Has Been a Leaker. 2011-2015 No Leaks
Accuracy of Clamping Method

- Target Clamp Load
- Operator ‘Feel’
- Torque Wrench
- Turn of Nut
- Load Indicating Washers
- Bolt Elongation
- Load Indicating Fasteners
CITGO Lemont Alky E-503
Tube side - 600# superheated steam (650 deg F)
Shell side – Isobutane (390 deg F)
## SPC4 Load data on 120E-503

### 120E-503 Regeneration Heater - Channel Cover SPC4 Data

<table>
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</table>

- After 2 cycles
- After 6 cycles
- After 17 cycles

- Cool/offline
**NOTES:**

> Load indicator reading of 100% equates to 209,500 lbf (approximate de-rated yield load of the stud)

**NUT MUST NOT EXCEED MAX NUT POSITION DURING AND AFTER THE APPLICATION OF ANY LOAD**

---

**VALLEY FORGE & BOLT MANUFACTURING CO.**

4410 W. Jefferson St. Phoenix, AZ 85043

Phone 602-269-5748 Fax 602-269-7351

---

**USE ONLY FOR CUSTOMER APPROVAL -- APPROVED BY:**

**DATE:**

<table>
<thead>
<tr>
<th>VF PART#</th>
<th>S05F-14-7-APP</th>
<th>JOB #</th>
<th>DUE</th>
<th>CUSTOMER:</th>
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<td>QTY</td>
<td>FORGE DIA</td>
<td>FORGE LENGTH</td>
<td>FINAL DIA</td>
<td>TYP.</td>
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<td>N/A</td>
<td>N/A</td>
<td>1.750&quot;</td>
<td>8</td>
<td>ASTM A193 B16</td>
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**ITEM # | HEAT # | BLANK LENGTH | CUT COMPLETED DATE | FORGE COMPLETED DATE | MANUFACTURING LEVEL |

---

**Approved Source: Valley Forge & Bolt Mfg.**

4410 W. Jefferson Ave
Phoenix, AZ 85043
Vfbolts.com

---

**REVISION**

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**VALLEY FORGE & BOLT MANUFACTURING CO.**

4410 W. JEFFERSON ST. PHOENIX, AZ 85043

PHONE 602-269-5748 FAX 602-269-7351

---

**TITLE:** 1.25"-8 X 1 B16 SPECIAL ALL THREAD STUD W/ HEX

**DATE:** 123JUL15 **CHECK BY:** R. FLOCKEN DATE: 16JUN15

**VF PART NUMBER:** S05F-14-7-APP SHEET: 1 OF 1 **APPROVAL**
In Summary – CorruKamm & SPC4

In all bolted flange connections... it’s all about applying AND maintaining the Clamping Load.

FLANGE ASSEMBLY IS:
SAFER & QUICKER ASSEMBLY
GASKET THAT WILL RECOVER BOLT LOADS YOU CAN CHECK LESS DOWNTIME
OVER ALL COST SAVINGS & UNIT EFFICIENCY
SPC4 End-users
The three balls mounted in the washer are thicker than it, & protrude slightly on each of its sides.

The washer is placed between the nut and the flange or between the nut and a through-hardened steel washer (THSW).

During tightening, the nut and Ball Lock Washer are forced against the flange.

**Ball Lock Washers**
Ball Lock Washers

- Apply Moly B here ONLY!
- DO NOT APPLY TO WASHERS OR NUT!
- MOLY B ON ALL SURFACES, THIS SIDE ONLY

*Diagram illustration of flange and washers with labels.*
<table>
<thead>
<tr>
<th>Calculation Type</th>
<th>Loading Recommendation</th>
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<tbody>
<tr>
<td>Gasket Type</td>
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<tr>
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<tr>
<td>Gasket Sealing Surface OD (in)</td>
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<tr>
<td>Actual Gasket Stress (ps)</td>
<td>30,104</td>
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</table>

**Recommended Torque Stages**

1. First Stage: 452 ft-lbs
2. Second Stage: 944 ft-lbs
3. Third Stage: 1297 ft-lbs
4. Fourth Stage: 1441 ft-lbs

**Summary:**

- Gasket Area including ribs
- Factors that stress the gasket in different ways
- Utilizing M and Y factors of Gaskets
- Providing fiction factors
- Providing torque values and gasket stress
Questions & Comments?

Presenters:

**Pete Moser**
Lamons | Western Region Business Development Manager | Ferndale
2470 Salashan Loop | Ferndale, WA. 98248
Sealing Global - Servicing Local
Direct: 360-733-3831 | Mobile: 360-410-7819 | Office: 360-527-4366
Email: pete.moser@lamons.com | Web: www.lamons.com

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