

Type Testing of Process Valve Packing for Fugitive Emissions

API STANDARD 622
FIRST EDITION, AUGUST 2006



Type Testing of Process Valve Packing for Fugitive Emissions

Downstream Segment

API STANDARD 622
FIRST EDITION, AUGUST 2006



SPECIAL NOTES

API publications necessarily address problems of a general nature. With respect to particular circumstances, local, state, and federal laws and regulations should be reviewed.

Neither API nor any of API's employees, subcontractors, consultants, committees, or other assignees make any warranty or representation, either express or implied, with respect to the accuracy, completeness, or usefulness of the information contained herein, or assume any liability or responsibility for any use, or the results of such use, of any information or process disclosed in this publication. Neither API nor any of API's employees, subcontractors, consultants, or other assignees represent that use of this publication would not infringe upon privately owned rights.

API publications may be used by anyone desiring to do so. Every effort has been made by the Institute to assure the accuracy and reliability of the data contained in them; however, the Institute makes no representation, warranty, or guarantee in connection with this publication and hereby expressly disclaims any liability or responsibility for loss or damage resulting from its use or for the violation of any authorities having jurisdiction with which this publication may conflict.

API publications are published to facilitate the broad availability of proven, sound engineering and operating practices. These publications are not intended to obviate the need for applying sound engineering judgment regarding when and where these publications should be utilized. The formulation and publication of API publications is not intended in any way to inhibit anyone from using any other practices.

Any manufacturer marking equipment or materials in conformance with the marking requirements of an API standard is solely responsible for complying with all the applicable requirements of that standard. API does not represent, warrant, or guarantee that such products do in fact conform to the applicable API standard.

All rights reserved. No part of this work may be reproduced, stored in a retrieval system, or transmitted by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher. Contact the Publisher, API Publishing Services, 1220 L Street, N.W., Washington, D.C. 20005.

Copyright © 2006 American Petroleum Institute

FOREWORD

This standard is under the jurisdiction of the API Subcommittee on Piping.

This standard shall become effective on the date printed on the cover but may be used voluntarily from the date of publication.

Nothing contained in any API publication is to be construed as granting any right, by implication or otherwise, for the manufacture, sale, or use of any method, apparatus, or product covered by letters patent. Neither should anything contained in the publication be construed as insuring anyone against liability for infringement of letters patent.

This document was produced under API standardization procedures that ensure appropriate notification and participation in the developmental process and is designated as an API standard. Questions concerning the interpretation of the content of this publication or comments and questions concerning the procedures under which this publication was developed should be directed in writing to the Director of Standards, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005. Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the director.

Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. A one-time extension of up to two years may be added to this review cycle. Status of the publication can be ascertained from the API Standards Department, telephone (202) 682-8000. A catalog of API publications and materials is published annually and updated quarterly by API, 1220 L Street, N.W., Washington, D.C. 20005.

Suggested revisions are invited and should be submitted to the Standards and Publications Department, API, 1220 L Street, NW, Washington, DC 20005, standards@api.org.

INTRODUCTION

The purpose of this API Standard is to establish a uniform procedure for evaluation of process valve stem packing. The testing approaches defined within this standard provide a method for evaluating packing systems independent of a particular manufacturer's valve(s). This testing program will provide a basis for the comparison of the emissions and life cycle performance of packing.

CONTENTS

	Page
1 SCOPE	1
2 REFERENCED PUBLICATIONS	1
3 TERMS AND DEFINITIONS	1
4 FUGITIVE EMISSIONS TEST	3
4.1 Test Fixture	3
4.2 Leak Test Equipment Selection and Calibration	4
4.3 Packing Selection and Installation	5
4.4 Test Procedure	5
5 CORROSION TEST	8
5.1 Corrosion Test Overview	8
5.2 Pre-Test Requirements	8
5.3 Ambient Corrosion Testing	9
5.4 High Temperature Corrosion Testing	10
5.5 Corrosion Test Reporting	11
6 PACKING MATERIALS TEST	11
6.1 Weight Loss	11
6.2 Density	11
6.3 Lubricant Content	11
6.4 Leachables	12
6.5 Packing Materials Test Reporting	12
APPENDIX A TEST DOCUMENTATION	13
ANNEX 1	21
ANNEX 2	23
 Figures	
1	3
2	6
3	7
4	7
5	8
6	9
7 High Temperature Corrosion Test System	10
A-1	21
A-2	23

Type Testing of Process Valve Packing for Fugitive Emissions

1 Scope

This API Standard specifies the requirements for comparative testing of block valve stem packing for process applications where fugitive emissions are a consideration. Packing(s) shall be suitable for use at -20°F to 1000°F (-29°C to 538°C). Factors affecting fugitive emissions performance that are considered by this Standard include temperature, pressure, thermal cycling, mechanical cycling and corrosion.

This standard does not provide acceptance criteria for valve packing, nor is it intended to replace proof testing of valve assemblies or valve production testing.

1.1 This standard establishes requirements and parameters for the following packing tests.

- a. Fugitive emissions
- b. Corrosion
- c. Packing material

1.2 Test methods apply to valve packing for use with the following stem motion(s):

- a. Rising stem (eg: gate valves)
- b. Rotating stem (eg: ball valves)

1.3 The test for fugitive emissions is based upon elements of EPA Method 21, providing comparative values of packing performance.

1.4 Suitability of packing tested to this standard for use in a manufacturer's valve may be confirmed by re-testing the packing in the actual valve in accordance with Section 4 of this Standard. Acceptance criteria shall be by mutual agreement between the valve manufacturer and purchaser.

2 Referenced Publications

The following standards contain provisions that, through reference in this text, constitute provisions of this API Standard. At the time of the publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

Applicable reference standards: API Standards 599, 600, 602, 603, 608, 609, ASME B16.34 and MSS SP-96, MSS SP-120 and EPA Method 21.

3 Terms and Definitions

For the purposes of this standard, the following definitions shall apply.

3.1 active inhibitor: A type of galvanic corrosion inhibitor typically applied as a surface coating to packing, providing a sacrificial anode material corroding in preference to the surrounding metal. See also "corrosion inhibitor, galvanic corrosion, passive inhibitor, pitting."

3.2 actuate: To cause movement of a valve stem either by raising, lowering, or turning it.

3.3 anti-extrusion ring: A ring of packing used at one or both ends of a packing set to prevent extrusion of packing material into clearances.

3.4 ambient temperature: $65 - 75^{\circ}\text{F} \pm 10^{\circ}\text{F}$ ($18 - 24^{\circ}\text{C} \pm 6^{\circ}\text{C}$)

3.5 axial: In the direction of a shaft or stem axis.

3.6 braided packing: Packing typically constructed of intertwining strands of synthetic or natural fibers. Strands may consist of yarn or filaments, and may also include metallic materials. Two primary braid configurations are square and interbraided or interlocking.

3.7 bolt torque: The amount of twisting or turning effort (expressed as ft-lb or Nm) required to turn the nuts on a gland flange, commonly used to describe the load that a gland flange exerts on a valve packing set.

- 3.8 bore diameter:** The inside diameter into which packing is inserted; also called the stuffing box bore.
- 3.9 bushing:** Cylindrical spacer used to take up excess space in a stuffing box.
- 3.10 corrosion inhibitor:** An ingredient added to packing, which decreases the potential for galvanic corrosion in the stuffing box. Corrosion inhibitors may be classified as either passive or active. See also, “active inhibitor, galvanic corrosion, passive inhibitor, pitting.”
- 3.11 die-formed packing:** A valve stem packing typically constructed from ribbons of graphite tape or braided packing that has been subjected to pre-compression with tooling of a specific geometry. This process changes the shape and density of the material from its original free shape and natural density to a defined shape and higher density.
- 3.12 EPA Method 21:** A leak check method established by the Federal Government Environmental Protection Agency (EPA) for performing emissions measurements on equipment such as valves, pumps, and flanges.
- 3.13 eccentricity:** The distance that the central axis of a valve stem is offset from the central axis of the stuffing box through which it passes.
- 3.14 emissions:** Gaseous or liquid leak given off by a piece of equipment. This is usually used in reference to volatile organic hydrocarbons (VOC’s) and typically expressed in parts per million volumetric (ppmv, or ppm).
- 3.15 galvanic corrosion:** An electro-chemical reaction that may occur between a metal and a material of a different chemical nobility, such as another metal, carbon, or graphite when both materials are exposed to an electrically conductive media. See also, “active inhibitor, corrosion inhibitor, passive inhibitor, pitting.”
- 3.16 gland flange:** A movable part which protrudes into a stuffing box to compress a packing set or packing ring.
- 3.17 gland load:** The amount of load applied to a packing set. This may be expressed in terms of force (lbf, N) or in terms of stress (psi, kPa) or torque (lbf-ft, Nm).
- 3.18 gland stud:** A threaded rod or eye-bolt, extending from a valve body against which the gland flange is tightened to compress a packing set.
- 3.19 leak:** Measurable amount of test fluid escaping from the test gland.
- 3.20 leak rate:** The quantity of test fluid passing through (or around) a seal in a given period of time.
- 3.21 mechanical cycle:** A motion of the stem simulating the movement of a valve obturator from the fully closed position to the fully open position, and returning to the fully closed position. See also, “stroke.”
- 3.22 obturator:** The valve closure element, such as a gate, disc, plug or other component, controlling the flow of fluid, as used in international standards, per MSS SP-96.
- 3.23 packing set:** A grouping of individual packing rings designed to fill the area of the valve packing gland or stuffing box.
- 3.24 passive inhibitor:** A type of galvanic corrosion inhibitor blended into the raw graphite used in packing, providing a protective coating to prevent a galvanic reaction from occurring. See also, “active inhibitor, corrosion inhibitor, passive inhibitor, pitting.”
- 3.25 pitting:** Surface cavities that occur on a metal as a result of galvanic corrosion or mechanical erosion. See also, “galvanic corrosion.”
- 3.26 quarter-turn valve:** A valve that will fully open or close with a $90 \pm 5^\circ$ rotation of the stem, through the packing gland.
- 3.27 rising stem valve:** A valve in which the movement of the stem is in an axial direction, with no rotation.
- 3.28 spacer bushing:** See “Bushing”
- 3.29 stem:** The metal rod that connects the internal closure element (obturator, such as a disc or ball) of a valve to a hand-wheel, handle, or actuator.
- 3.30 stroke:** One half of a mechanical cycle starting from either a fully open or fully closed position. See also, “mechanical cycle.”
- 3.31 stuffing box:** The space into which a compression packing is inserted. Also known as a packing chamber.

3.32 surface finish: A measure of the roughness of a surface typically expressed in micro-inches or micro-meters.

4 Fugitive Emissions Test

4.1 TEST FIXTURE

4.1.1 The test stand packing gland is constructed as a fixture designed to simulate the actuation of a typical valve. A test gland arrangement with a combined leak detection/gland flange is shown in Figure 1. The test fixture shall orient the stem in a horizontal position and shall be constructed so as not to affect test results. The use of bushings is allowed as necessary. Test stands may be equipped with multiple test fixtures. See Annex 1 for construction details.

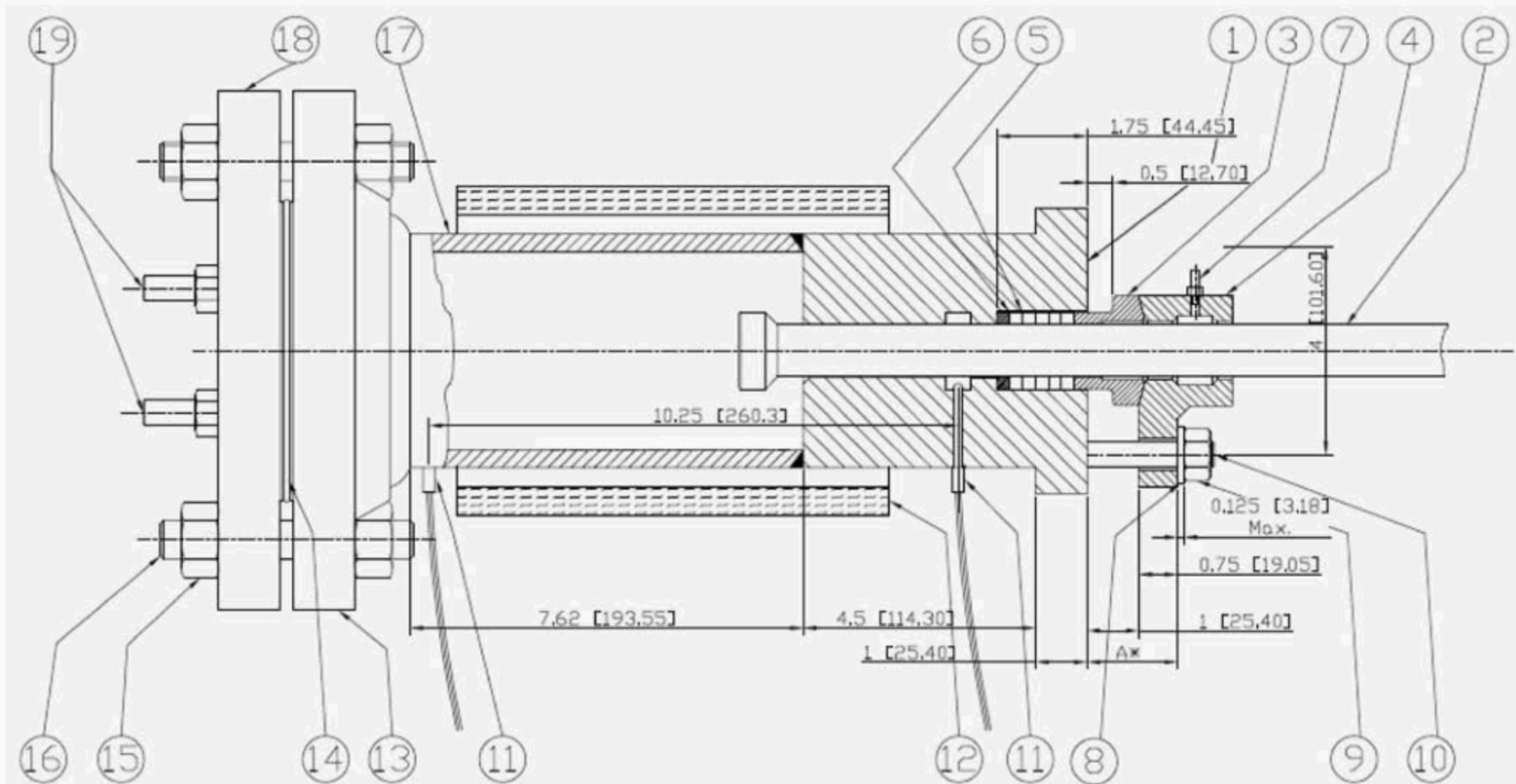


Figure 1

4.1.1.1 Test fixture components

1. Bonnet
2. Stem
3. Gland
4. Gland flange
5. Stem packing
6. Bushing
7. Leak detection fitting
8. Washer
9. Gland nut
10. Gland stud
11. Thermocouple
12. Heating element
13. Bonnet flange
14. Gasket
15. Flange stud nut
16. Bonnet studs
17. Housing

- 18. Blind flange
- 19. Gas inlet and outlet ports

4.1.1.2 Test fixture packing gland dimensions and tolerances shall be as follows:

- a. Stem diameter: 1.000 in. +0.0/-0.008 in. (25.4 mm +0.0/-0.2 mm)
- b. Stem straightness: Max. 0.0016 in. per 12 in. (0.04 mm per 305 mm)
- c. Stem cylindricality: 0.0016 in.: (0.04 mm) Max.
- d. Stem surface finish: 16-32 μ -in. Ra (0.40 – 0.80 μ m Ra)
- e. Stuffing box diameter: 1.5 in. +0.010/-0.0 in. (38.1 +0.25/-0.0 mm)
- f. Stuffing box depth: 1.75 in. \pm 0.062 in. (44.5 mm \pm 1.5748 mm)
- g. Stuffing box surface finish: 125 μ -in. Ra +50 /-25 μ -in. (3.20 μ m Ra +1.25/-0.625 μ m)
- h. Gland bottom machined flat parallel to gasket surface: Max. 0.006 in. (0.15 mm)
- i. Gland to stuffing box diametrical clearance: 0.005 – 0.015 in. (0.13 – 0.38 mm)
- j. Stem to gland (flange) diametrical clearance: 0.020 – 0.030 in. (0.5 – 0.8 mm)
- k. Gland stud diameter: $\frac{5}{8}$ in. -11UNC (2 pieces, length per Figure 1)

4.1.1.3 Test fixture components shall be constructed of carbon steel materials except for:

- a. Stem: ASTM A182 Grade F6a 200-275 HB (Rc15-28.8)
- b. Gland bolts/studs: ASTM A193 Grade B7
- c. Gland nuts: ASTM A194 Grade 2H
- d. Housing: 4 in. Schedule 80 Seamless Pipe or A-105
- e. Flanges: 4 in. Class 300 Per ASME 16.5 (material group ASME B 16.5 Table F2-1.1) or A-105

4.1.2 Mechanical Cycle:

The test fixture shall be equipped with an actuator capable of stroking the test stem to simulate the mechanical cycle of a valve as follows:

- a. Rising stem:
 - Rate: 0.12 in. to 0.20 in. (3 mm to 5 mm) per second
 - Stroke: 4 in. \pm 0.12 in (102 mm \pm 3 mm)
- b. Rotating stem:
 - Rate: 5° to 10° per second
 - Stroke: 90° \pm 5°

4.1.3 External Loads

The actuator(s) shall not apply any transverse forces, i.e. side load to the test stem.

4.1.4 Temperature Monitoring:

The test fixture(s) shall be equipped with thermocouples for continuously monitoring temperature during thermal cycling.

4.1.5 Temperature shall be monitored and recorded at two locations.

- a. At the flow line of the test chamber
- b. Adjacent to the stuffing box
- c. The flow line thermocouple shall control the test temperature between room temperature and 500°F \pm 5°F (260°C \pm 3°C)
- d. The temperature at the thermocouple adjacent to the stuffing box shall be a reference measurement.

4.1.6 The fixture shall be heated using an external heat source, blanket, heating coils or other suitable equipment.

4.2 LEAK TEST EQUIPMENT SELECTION AND CALIBRATION

4.2.1 Monitoring equipment shall be a flame ionization vapor analyzer capable of providing on-board data logging with digital readout. The equipment shall be certified as intrinsically safe for use with the test fluid.

—•••••

4.2.2 The equipment shall meet the following performance requirements in the flame ionization mode using methane as the test fluid.

- a. Variation: less than $\pm 2\%$ at 100 ppm.
- b. Dynamic range: 1.0 – 50,000 ppm.
- c. Linear range: 1.0 – 10,000 ppm.
- d. Minimum detectable level (defined as 2 x the peak noise): 300 ppb hexane
- e. Maximum response time to reach final value: 3 seconds.
- f. Maximum recovery time to return to 10% of initial value: 5 seconds
- g. Sample flow rate at probe inlet: 0.30 – 0.40 gal/min (1.14 – 1.51 l/min)

4.2.3 The testing equipment shall be calibrated according to the manufacturer's directions. A current record of test equipment calibration shall be maintained by the test facility.

4.2.4 The test equipment shall be inspected prior to each use to insure against fouling of the detector probe. This shall be done to EPA Method 21, using an external calibration gas, with a known methane concentration.

4.3 PACKING SELECTION AND INSTALLATION

4.3.1 Pre-qualification

Packing submitted for type testing shall be pre-qualified for use in temperatures -20°F to 1000°F (-29°C to 538°C). Any pre-qualification testing to confirm acceptability shall be documented and included with the final test report.

4.3.2 Packing Selection

4.3.2.1 Test packing shall be selected at random from either:

- a. A standard production lot as supplied by the manufacturer, or
- b. Distributor stock.

4.3.2.2 Test packing shall be $1/4$ in. (6.3 mm) cross-section.

4.3.2.3 Validation of a random selection process shall be provided to the testing facility.

4.3.3 Packing Installation

A qualified laboratory representative or technician shall install the packing according to the manufacturer's standard installation instructions except that the maximum packing bolt stress shall not exceed 25,000 psi. (172,369 kPa). However, the packing stress (load) during the testing shall not exceed the packing manufacturer's recommended maximum value.

4.3.3.1 For all packing installations:

- a. All test fixture components shall be thoroughly cleaned with acetone or equivalent solvent prior to testing.
- b. Any reconditioned parts shall be inspected and shall comply with the requirements of 4.1.2.
- c. Components shall be inspected for damage prior to assembly.
- d. Caution shall be taken to avoid contact between the stem and gland.
- e. Fasteners shall be lubricated.
- f. Gland (flange) height measured from a specific datum shall be recorded.
- g. Special preparation of the packing or assembly components is prohibited.

4.4 TEST PROCEDURE

4.4.1 Test Fluid

The test fluid used shall be dry methane gas, 97% minimum purity, subjected to a temperature range from ambient to 500°F (260°C) and pressures from 0 to 600 psig (0 to 4,237 kPa).

4.4.2 Mechanical and Thermal Cycling

4.4.2.1 Packing shall be subject to a total of 1500 mechanical cycles and 3 thermal cycles per Figure 2. Mechanical and thermal cycling shall begin with the test fixture at ambient temperature.

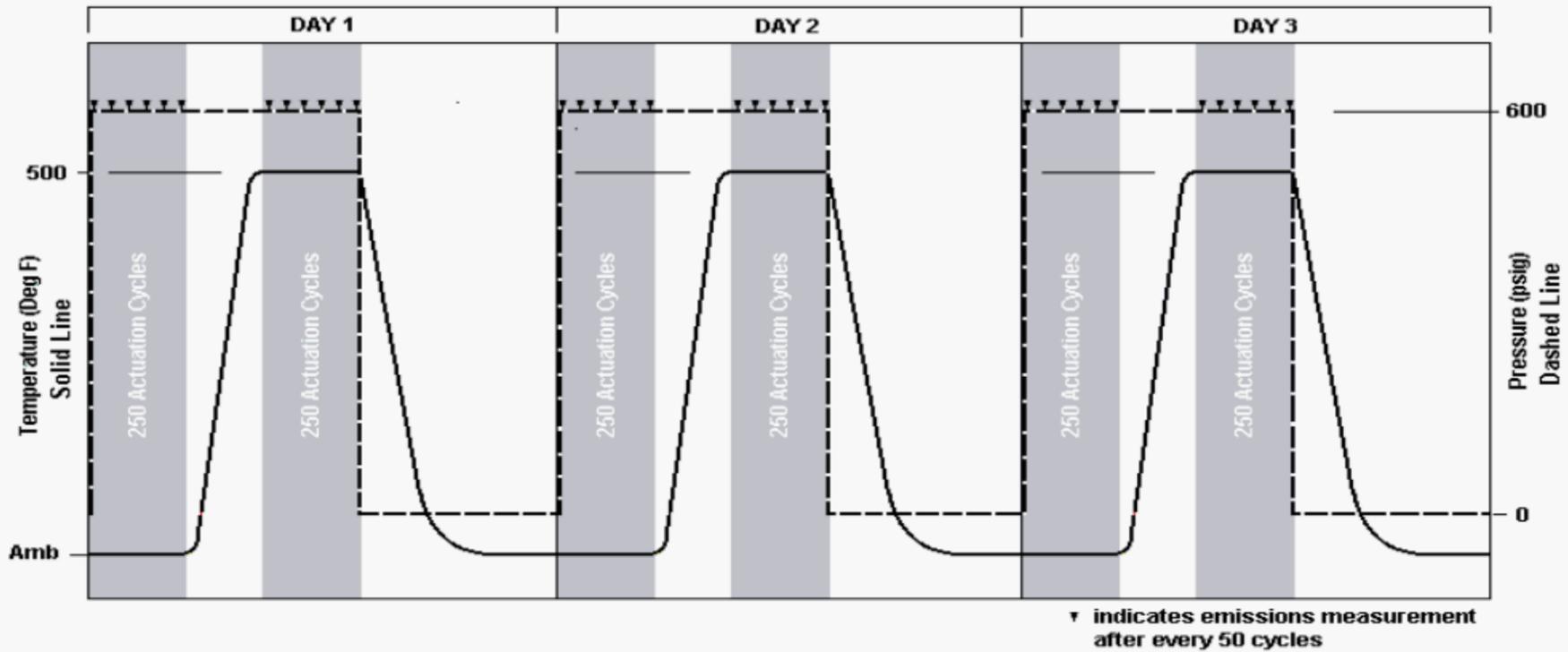


Figure 2

4.4.2.2 Test Profile Explanation:

- Test duration of 3 days.
- 500 mechanical cycles per day.
- 1 temperature cycle per day.
- Pressure stays at 600 psig ± 10 psig (4,137 kPa ± 69 kPa) for:
 - 250 cycles at ambient, and
 - 250 cycles at 500°F ± 5 °F. (260°C ± 3 °C)
- Reduce the pressure to zero at the end of each day (thermal cycle).
- Daily cycling is to be divided up as follows:
 - Up to 6 hours for ambient cycling at pressure (250 cycles).
 - Max. 2 hours to bring up to temperature (no cycling during this time).
 - Up to 6 hours for at high temperature cycling (250 cycles).
 - Overnight 10 hour cool down with no cycling during this period

4.4.3 Leak Measurement

4.4.3.1 Leak measurements shall be conducted initially at the start of each day and at the completion of every 50 cycles.

Note: This test procedure requires 14 hours of monitoring per day.

4.4.3.2 Leak measurement shall be conducted using a fixed detection probe located at the 12 o'clock position directly above the potential leak point as per Figure 3.

4.4.3.3 Leak measurements shall be taken while the stem is in the static condition.

4.4.3.4 The connection to the fixture and methane leak detector shall be made using tubing having the same inside diameter as the standard leak probe and connected as shown in Figures 3 and 4.

4.4.3.5 The emissions leak test system shall conform to all local and governmental safety standards and shall be equipped with pressure relief valve(s) / rupture disc and vents.

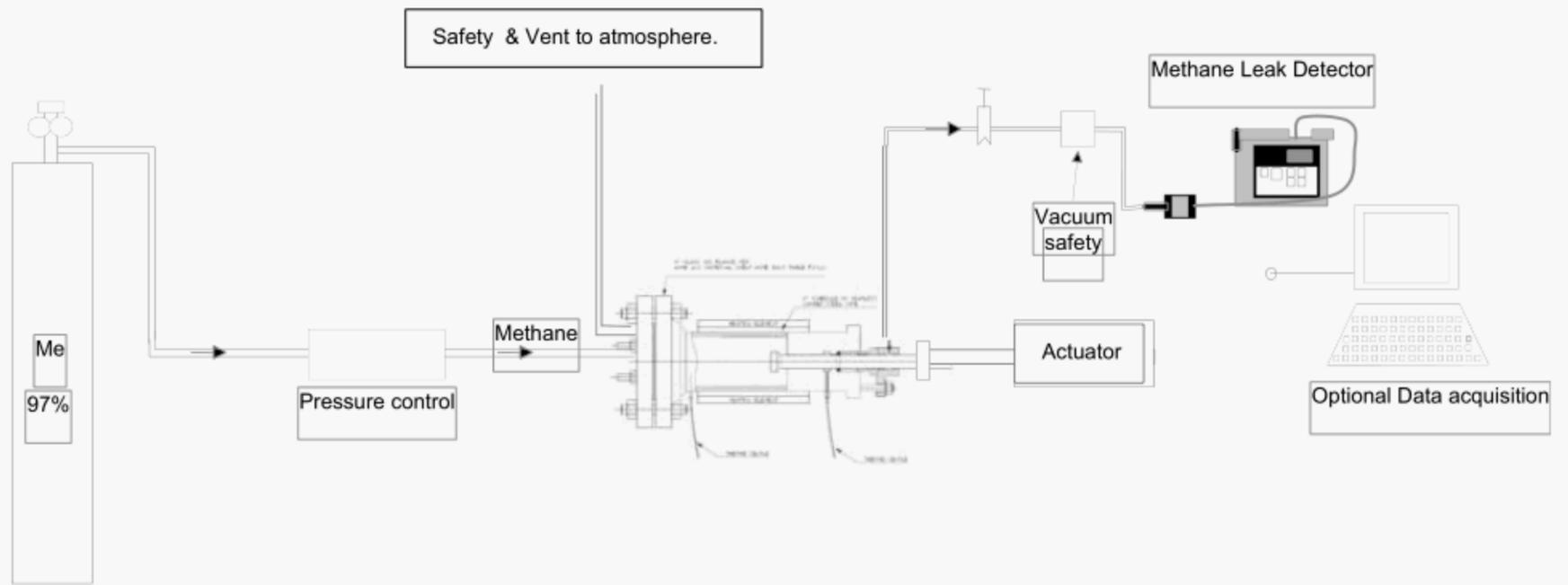


Figure 3

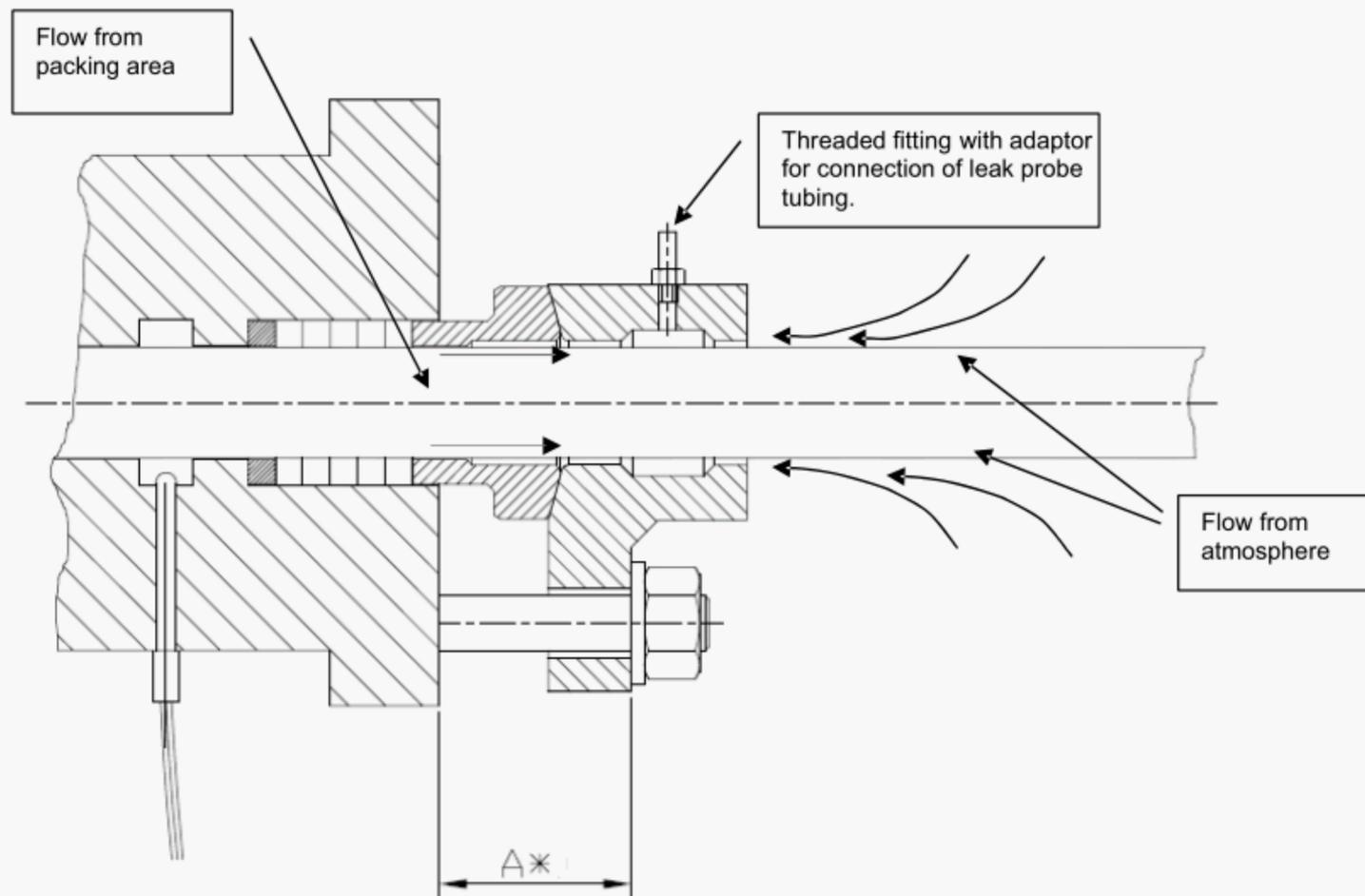


Figure 4

4.4.4 Packing Adjustment

4.4.4.1 The packing assembly shall be re-adjusted to the original manufacturers suggested gland load if the leak rate exceeds 500 PPMV.

- a. Mechanical cycling shall be discontinued during any necessary adjustments.
- b. The gland flange height shall be measured and recorded.
- c. Continue test.

4.4.4.2 Adjustments shall be reported as packing gland bolt torque values and as measured by recording the change in clearance between the gland flange and the top of the bonnet (reference dimension A* per Figures 1 and 4) or by a fixed height gauge. The gauge shall provide readout in 0.001 in. (0.025 mm) increments.

4.4.4.3 Flats of adjustment shall be indicated by use of a line marked on the gland flange and gland nuts at the start of the test.

4.4.5 Recording and Documentation

4.4.5.1 Fugitive emissions test results shall be provided on the Fugitive Emissions Test Report Summary provided in Appendix A.

- a. Leak measurements shall be recorded at the beginning of the test and at established intervals throughout the test, as required per Figure 2.
- b. The number of adjustments shall be recorded and the cycle number noted.

5 Corrosion Test

5.1 CORROSION TEST OVERVIEW

The corrosion test provides methods for evaluation of "cold" and "hot" corrosion caused by moisture in the packing. It also provides a means for evaluating the effect of inhibitor systems / valve stem metallurgy combinations with respect to corrosion rate and weight loss.

5.2 PRE-TEST REQUIREMENTS

Packing sets submitted for corrosion testing shall have an accompanying materials analysis providing details for each style of packing contained in the set. Details shall include:

- a. Primary material used in manufacture
- b. Type of corrosion inhibitor(s)
- c. Inhibitor content by weight
- d. Method of application/distribution of inhibitors in/on the packing (i.e. active or passive)
- e. Packing test specimen size shall be identical to that required for leak testing.

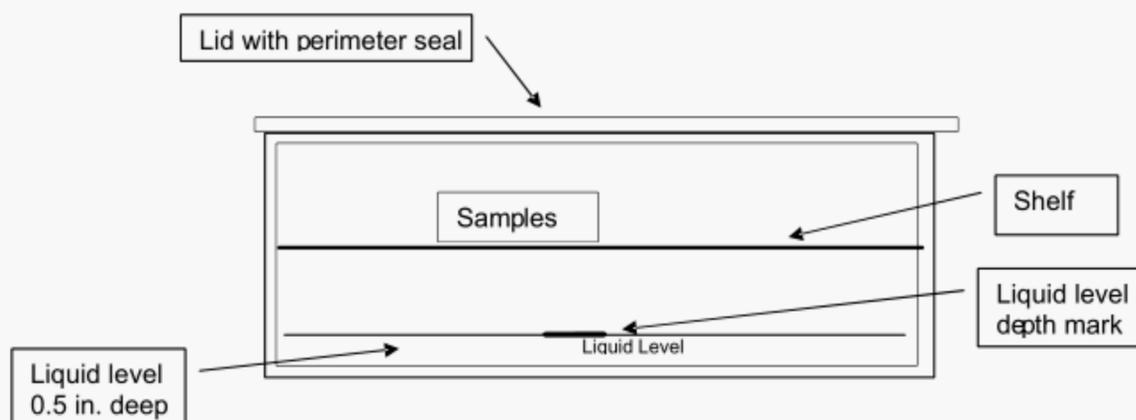


Figure 5

5.3 AMBIENT CORROSION TESTING

5.3.1 The ambient corrosion testing vessel shall consist of an enclosure large enough for containment of several sample fixtures. The enclosure shall be equipped with a shelf or rack suspended above a liquid bath as shown in Figure 5.

5.3.2 The compression fixture shall be as shown in Figure 6.

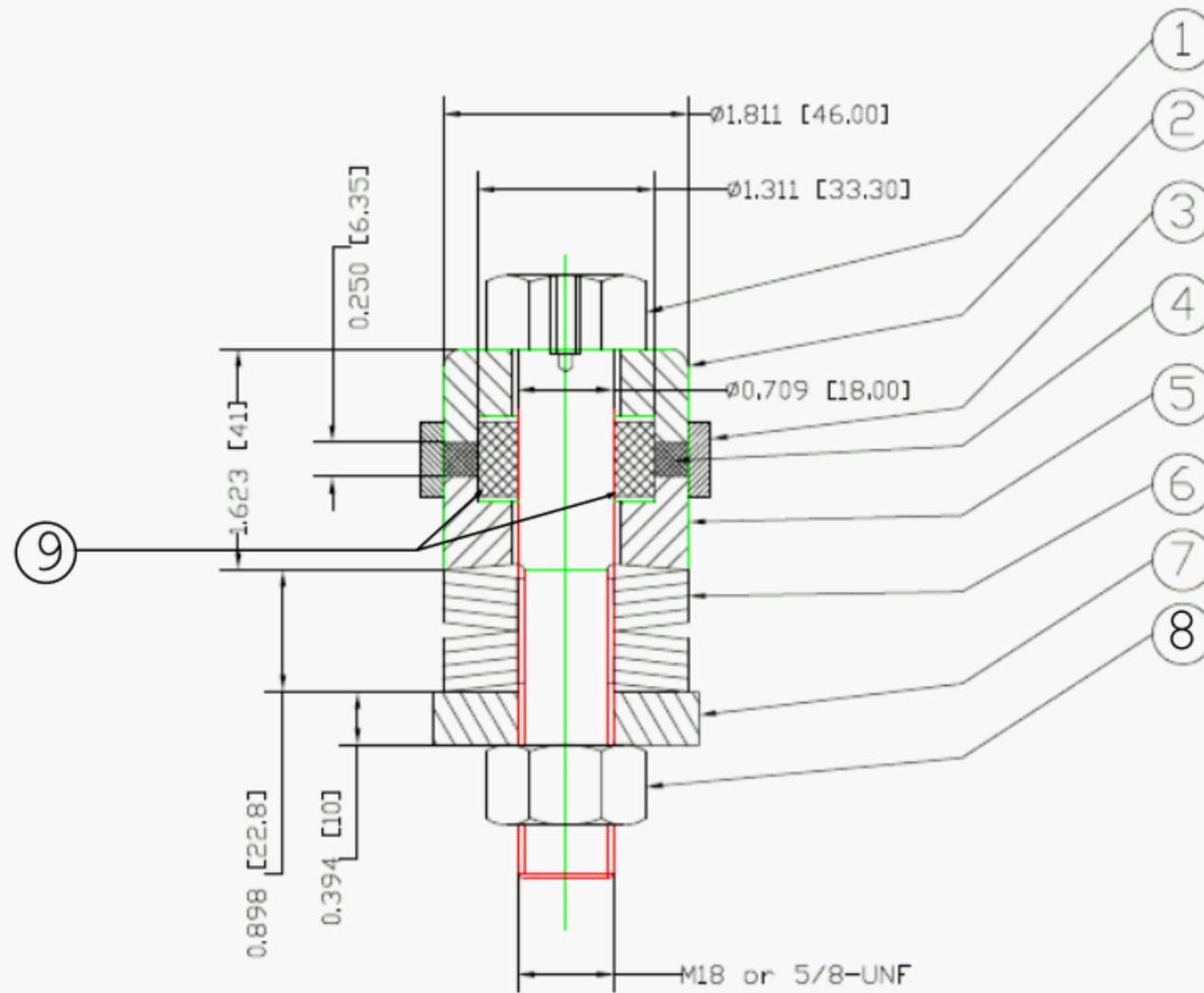


Figure 6

5.3.2.1 Compression test fixture components

1. Bolt
2. Top housing
3. Packing retainer
4. Packing
5. Lower housing
6. Disc springs
7. Washer
8. Nut
9. Metal test specimen

5.3.3 Prior to the start of corrosion testing, the compression fixture shall be:

- a. Cleaned in an ultrasonic acetone bath
- b. Adjusted so as to provide a 4350 psi (30 Mpa) \pm 100 psi (0.69 Mpa) compressive stress on the test packing.

5.3.4 Prior to assembly of test set, packing samples shall be wetted by soaking in de-mineralized water for 24 hours, creating a damp environment at ambient temperature, 72°F \pm 20°F (22°C \pm 11°C).

5.3.5 The test vessel shall be filled to a level of 0.5 in. (1.27 cm).

5.3.6 Test samples shall be assembled on the compression fixtures and placed into the ambient corrosion test vessel.

5.3.7 The test packing shall be installed around a test specimen (metal ring), representing the valve stem material being evaluated.

- a. Sample steel rings shall be machined from metal rods having the same properties as the finished valve stem.
- b. Nominal dimensions of the machined sample shall be according to MSS SP-120.
- c. Nominal finish shall be 16 – 32 (μ -in. R_a (0.4 – 0.8 μ m R_a)

5.3.8 The duration of the test shall be 28 days.

5.4 HIGH TEMPERATURE CORROSION TESTING

5.4.1 The high temperature corrosion test rig shall provide a heated chamber for multiple individual test fixtures containing samples of metal and packing. See Annex 2.

5.4.2 The housing shall be equipped with electric heating elements or a heater blanket that surrounds the outer periphery of the device, and allows for insertion of multiple test fixtures. See Figure 7 and Annex 2.

5.4.3 Each test fixture shall be equipped with a vapor feed line, providing constant replenishment of fluid to the test samples.

5.4.4 Prior to the start of corrosion testing, the compression fixture shall be adjusted so as to provide a 4350 psi (30 Mpa) compressive stress on the test packing.

5.4.5 Packing samples shall be subjected to de-mineralized water at a test temperature of 300°F, $\pm 30^\circ\text{F}$ (149°C $\pm 17^\circ\text{C}$). The water pressure shall be maintained at 650 psig, ± 32.5 psig (45 bar ± 2.25 bar).

5.4.6 The duration of the test shall be 35 days.

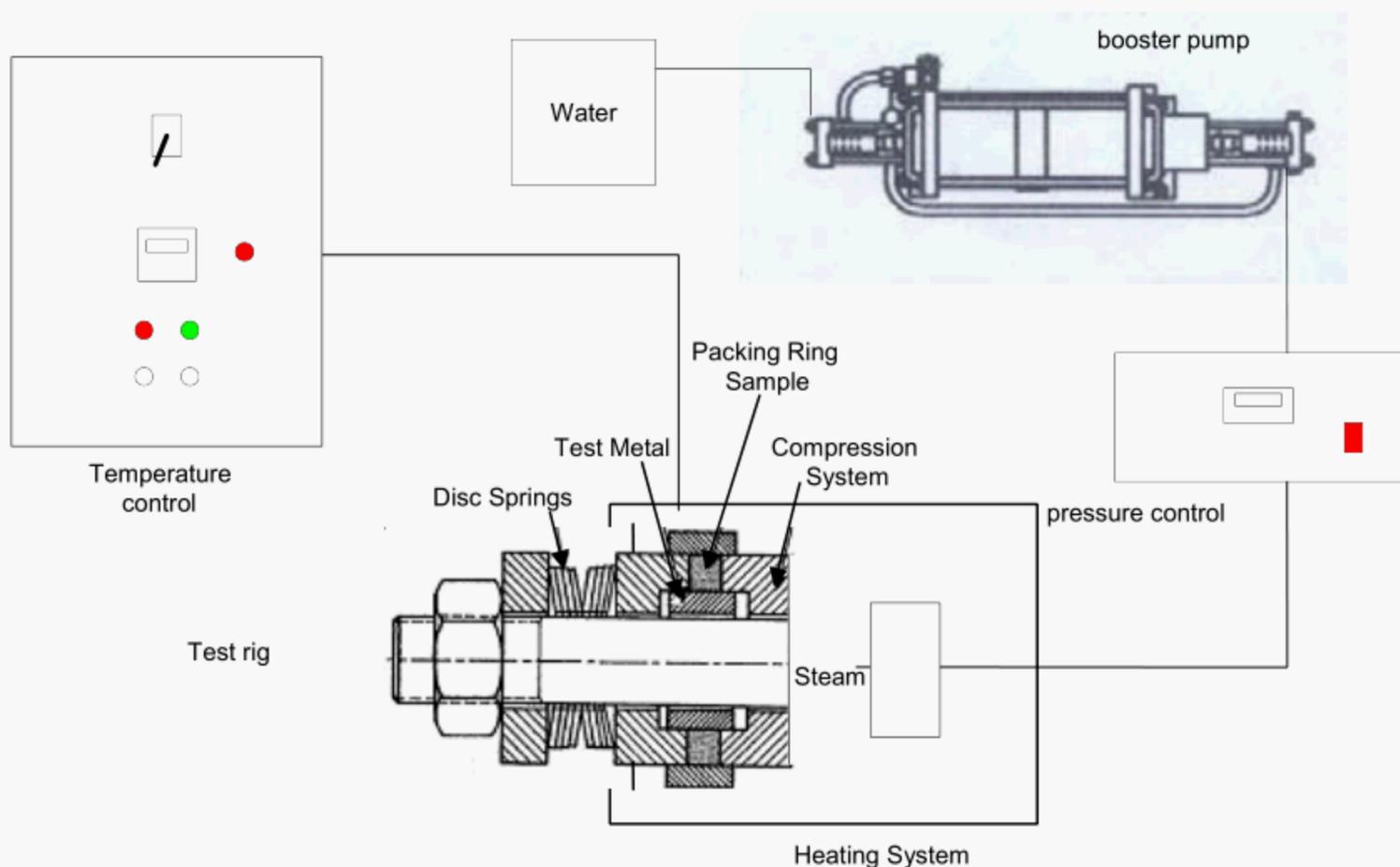


Figure 7—High Temperature Corrosion Test System

5.5 CORROSION TEST REPORTING

Corrosion test data shall be reported on the Corrosion Test Data Sheet provided in Appendix A. The report shall include the following information:

- a. Photographic record of each sample at 100X and 600X magnification.
- b. X-ray corrosion analysis shall be provided in graphic form.
- c. Descriptive report on the degree of stem/shaft pitting that occurred, which shall include the percent of surface area that is corroded, the mean pit depth and the maximum pit depth.

6 Packing Materials Test

The packing materials test considers weight loss, density, lubricant content, and leachables as per the procedures outlined below. For new configurations, test packing shall be selected at random from a minimum production lot as supplied by the manufacturer. For existing configurations, test packing shall be provided by a blind selection of production product from the manufacturer's normal distribution network. Validation of the random or the blind selection of process shall be provided to the testing lab.

6.1 WEIGHT LOSS

- a. Conducted in an oven with full exposure to air. (Oxygen-rich environment.)
- b. Select a test ring of a sample packing set. If the packing set is comprised of more than one type of packing ring, each type shall be tested.
- c. Record weight.
- d. Preheat oven to 300°F (150°C).
- e. Place sample in oven for one hour.
- f. Remove samples, cool to room temperature, and record weight.
- g. Increase oven temperature to 500°F (260°C) and repeat steps e and f.
- h. Increase temperature to 1000°F in 100°F (538°C/6°C) increments, repeating steps e and f after each increase.
- i. Discontinue test if weight loss exceeds 50%.

6.2 DENSITY

Packing Density shall be determined by dividing the sample weight by the sample volume, with the sample volume determined as follows:

- a. Braided packing volume shall be determined by measuring the sample length, width and thickness.

$$\text{Volume} = \text{Length} \times \text{Width} \times \text{Thickness}$$

- b. Die-formed packing (ring form) volume shall be determined by the following equation:

$$\text{Volume} = [(\text{OD}^2 - \text{ID}^2) \times \text{Thickness} \times \pi] / 4$$

6.3 LUBRICANT CONTENT

6.3.1 PTFE Content:

PTFE content shall be established by determining the % total fluorine in the packing, and comparing with a base fluorine percentage of 76, as follows:

- a. Determine total percent of fluorine content using ASTM D129 and D1179.
- b. Divide total percent of fluorine as obtained in (a) above by 0.76 to obtain the approximate percent of PTFE content.

6.3.2 Wet Lubricant:

Wet lubricant percentage shall be determined by dividing the "weight of the lubricant extract" by the "original sample weight" and multiplying by 100. The procedure shall be as follows:

- a. Cut samples into short lengths, and record the total sample weight. (Approx. 15 grams is required)
- b. Place cut samples into an extraction thimble and insert thimble into Soxhlet extraction unit that is nearly filled with a solvent such as methylene chloride.

- c. Turn on water flow through the condenser and bring the methylene chloride to a moderate boil through the use of the “low” setting on a hot plate. Extract for approximately 16 hours.
- d. Record the weight of a dry evaporation dish.
- e. Pour the Methylene Chloride extract solution into the dry evaporating dish and evaporate over a steam bath. Continue to pour the extract solution from the flasks into the dish until all the methylene chloride has been evaporated.
- f. Place the evaporation dish in a hot-air oven set between 212°F – 250°F for 30 minutes. Cool the evaporation dish to room temperature in a desiccator.
- g. Record the weight of the evaporation dish and lubricant extract.
- h. Calculate the lubricant weight by subtracting the weight of the dry evaporation dish per (step d) from the combined weight in step (g).

6.4 LEACHABLES

Leachables testing shall be per the following:

- a. Packing submitted for testing shall contain a corrosion inhibitor.
- b. Chloride Testing shall be per ASTM D512
- c. Leachable Fluoride Testing shall be per ASTM D1179
- d. Proof of testing and analysis shall be maintained and provided with the final test report.

6.5 PACKING MATERIALS TEST REPORTING

Packing Materials Test data shall be reported on the Material Test Data Sheet per Appendix A.

APPENDIX A—TEST DOCUMENTATION

- A.1 FUGITIVE EMISSIONS TEST REPORT SUMMARY**
- A.2 AMBIENT TEMPERATURE CORROSION TEST DATA SHEET**
- A.3 HIGH TEMPERATURE CORROSION TEST DATA SHEET**
- A.4 MATERIALS TEST REPORT**

A.1—Fugitive Emissions Test Report Summary

API Std 622						
Fugitive Emissions Testing Report Number: _____						
Application Profile: Check One <input type="checkbox"/> Rotating <input type="checkbox"/> Rising				Manufacturer:		
Testing Facility: Technician: Witness: Start Date: Completion:				Description:		Date:
Gland Load Information psi.		Gland Nut Torque: ft-lbs		Source: <input type="checkbox"/> Manufacturer <input type="checkbox"/> Distributor Packaged: Indicate New or <input type="checkbox"/> New Current Product <input type="checkbox"/> Current		
Notes concerning installation instructions						
Testing Profile Details						
Test Segment	Leak Measurement	Temperature	Reference Temperature at Packing Gland	Flats Adjusted—Gland Nut Torque ft-lbs & Reference A Height		
Day 1 Start, Ambient 0 – 250 cycles P = _____	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
High Temperature 250 – 500 cycles P = _____	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
Day 2 Start, Ambient 500 – 750 cycles P = _____	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
High Temperature 750 – 1000 cycles P = _____	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
Day 3 Start, Ambient 1000 – 1,250 cycles P = _____	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
High Temperature 1250 – 1,500 cycles P = _____	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
A graph depicting the test profile with associated leak checks and readjustments shall be provided by the testing authority.						

API Std 622	
Emissions Testing Report Summary	
Test Number:	Test Date:
Packing Material:	Style Number:
Packing Manufacturer:	Source of Sample:
Test Packing Cross-section:	Laboratory Name:
	Location of Test:
Packing Gland OD and ID (at the packing): OD = ID =	Packing Gland Bolt Diameter =
Number of Mechanical Cycles:	Packing Compression % of Free Height =
	Torque on Gland Nuts (each side) = _____ / _____ as installed
Number of Thermal Cycles:	Mechanical Cycles Prior to Readjustment:
Maximum Test Pressure:	Number of Readjustments:
Packing Configuration: Number of rings tested: Circle the following Ring shape (square, circular, vee) Solid or split Braided Die formed Spool stock Wire or other reinforcement Corrosion inhibitor & type Other	Show Sketch of Packing Installation-define each ring:

A.2—Ambient Temperature Corrosion Test Data Sheet

API Std 622		
Ambient Corrosion Testing: Materials Qualification and Functional Testing Report		
Product Manufacturer:	Materials Analysis: Laboratory: Test Number:	Date:
Pre-Qualification Analysis Information		
Primary Material of Manufacture:	Corrosion Inhibitor(s)	Inhibitor Volume by Weight
Corrosion Testing Facility	Test Technician	Date Start/Complete
Ambient Corrosion Testing	Load Stress:	S____ C____
Metal Sample Description	Observations	
1.		S____ C____
2.		S____ C____
3.		S____ C____
4.		S____ C____
5.		S____ C____
6.		S____ C____
7.		S____ C____
8.		S____ C____
<p>All reports shall include the following:</p> <ol style="list-style-type: none"> 1. Microscopic view photographic record of results. Magnification levels of 100X and 600X. 2. X-ray corrosion analysis (in graphic form.) 3. Descriptive report on the degree of stem/shaft pitting that occurred <ol style="list-style-type: none"> a. Percent of surface area that is corroded b. The mean and maximum pit depth 		
<p>A schematic of the actual test vessel shall be provided. For tests having greater numbers of samples than provided for on this form, the testing lab will fill in a separate form for each sample tested.</p>		

A.3—High Temperature Corrosion Test Data Sheet

API Std 622		
High Temperature Corrosion Testing: Materials Qualification and Functioning Testing Report		
Product Manufacturer:	Materials Analysis: Laboratory: Test Number:	Date:
Pre-Qualification Analysis Information		
Primary Material of Manufacture:	Corrosion Inhibitor(s)	Inhibitor Volume by Weight
Corrosion Testing Facility	Test Technician	Date Start/Complete
	Load Stress:	S____ C____
Metal Sample Description	Observations	
1.		S____ C____
2.		S____ C____
3.		S____ C____
4.		S____ C____
5.		S____ C____
6.		S____ C____
7.		S____ C____
8.		S____ C____
<p>All reports shall include the following:</p> <ol style="list-style-type: none"> 1. Microscopic view photographic record of results. Magnification levels of 100X and 600X. 2. X-ray corrosion analysis (in graphic form.) 3. Descriptive report on the degree of stem/shaft pitting that occurred <ol style="list-style-type: none"> a. Percent of surface area that is corroded b. The mean and maximum pit depth 		
<p>A schematic of the actual test vessel shall be provided. For tests having greater numbers of samples than provided for on this form, the testing lab will fill in a separate form for each sample tested.</p>		

A.4—Materials Test Report

API Std 622 Packing Materials Test Report (seperate test report required for different packing ring requirements)			
Testing Laboratory		Technician	Date
Product Name/Model	Base Composition of Material	Source: <input type="checkbox"/> Manufacturer <input type="checkbox"/> Distributor Packaged:	Date:
Indicate New or Current Product	<input type="checkbox"/> New <input type="checkbox"/> Current	Description of Product: <input type="checkbox"/> Die-formed <input type="checkbox"/> Braided <input type="checkbox"/> Other	
Weight Loss (Oven) Testing			
Measurement Equipment Name and Manufacturer(s)			
Calibration Dates on Oven Recorders:			
Calibration Dates on Weighing Equipment:			
Start Sample Weight:			
Weight after one hour at 300°F.		Variation, weight _____%_____	
Weight after one hour at 500°F.		Variation, weight _____%_____	
Weight after one hour at 600°F.		Variation, weight _____%_____	
Weight after one hour at 700°F.		Variation, weight _____%_____	
Weight after one hour at 800°F.		Variation, weight _____%_____	
Weight after one hour at 900°F.		Variation, weight _____%_____	
Weight after one hour at 1000°F.		Variation, weight _____%_____	

API Std 622			
Packing Density			
Calibration Date:		Braided Construction Volume $V_{bc} = L \times W \times T$	
Sample Weight:		Die Formed Packing Ring Volume: $V_{df} = [(OD^2 - ID^2) \times Thickness \times \pi] / 4$	
Density = Sample Weight / Sample Volume =			
Lubricant Content			
Packing Lubricant Content		Volume %	
Leachables			
ASTM D 512 Chlorides	Value:	Lab Name:	Date:
ASTM D 1179 Fluorides	Value:	Lab Name:	Date:
Corrosion Inhibitor		Type(s):	
Certification of Selected Process:			
New Configurations:		Existing Configurations:	
Validation of Random Selection: Y_____ N_____		Validation of Random Selection	
Lot Size:		Distributor:	
Signature:		Signature:	

ANNEX 1

1.0 EMISSIONS TEST FIXTURE CONSTRUCTION

- 1.1 The test fixture shall be constructed to simulate a Class 300 NPS4 block valve.
- 1.2 Flanges shall be carbon steel, Class 300 NPS4 per ASME B16.5 Table F2-1.1 minimum.
- 1.3 Gaskets shall be spiral wound type, 4 in. Class 300 per ASME B16.20 with flexible graphite.
- 1.4 The body of the test fixture shall be made from NPS4 carbon steel seamless pipe having schedule 80 minimum pipe schedule or from A-105 or other suitable carbon steel materials.
- 1.5 The body of the assembly shall provide sufficient clearance to enable movement of the shaft, of 7.62 in. (0.19 m), minimum.
- 1.6 The packing gland shall be ASTM A216 Grade WCB or from A-105 or other suitable carbon steel materials.
- 1.7 Stem shall be ASTM A182 Grade F6a 200-275 HB (Rc15-28.8).
- 1.8 Gland bolts/studs: ASTM A193 Grade B7.
- 1.9 Gland nuts: ASTM A194 Grade 2H.
- 1.10 Heating shall be provided by external heating blankets or coils.
- 1.11 Insulation may be applied to the body, flanges and gland areas.
- 1.12 A primary measurement thermocouple shall be positioned to monitor temperature of the fixture body.
- 1.13 A reference measurement thermocouple shall be positioned as dimensioned in Figure A-1.
- 1.14 The emissions measuring equipment shall be coupled to the modified gland (flange) using flexible tubing with an identical inside diameter as that of the detection probe tubing supplied with the detector.

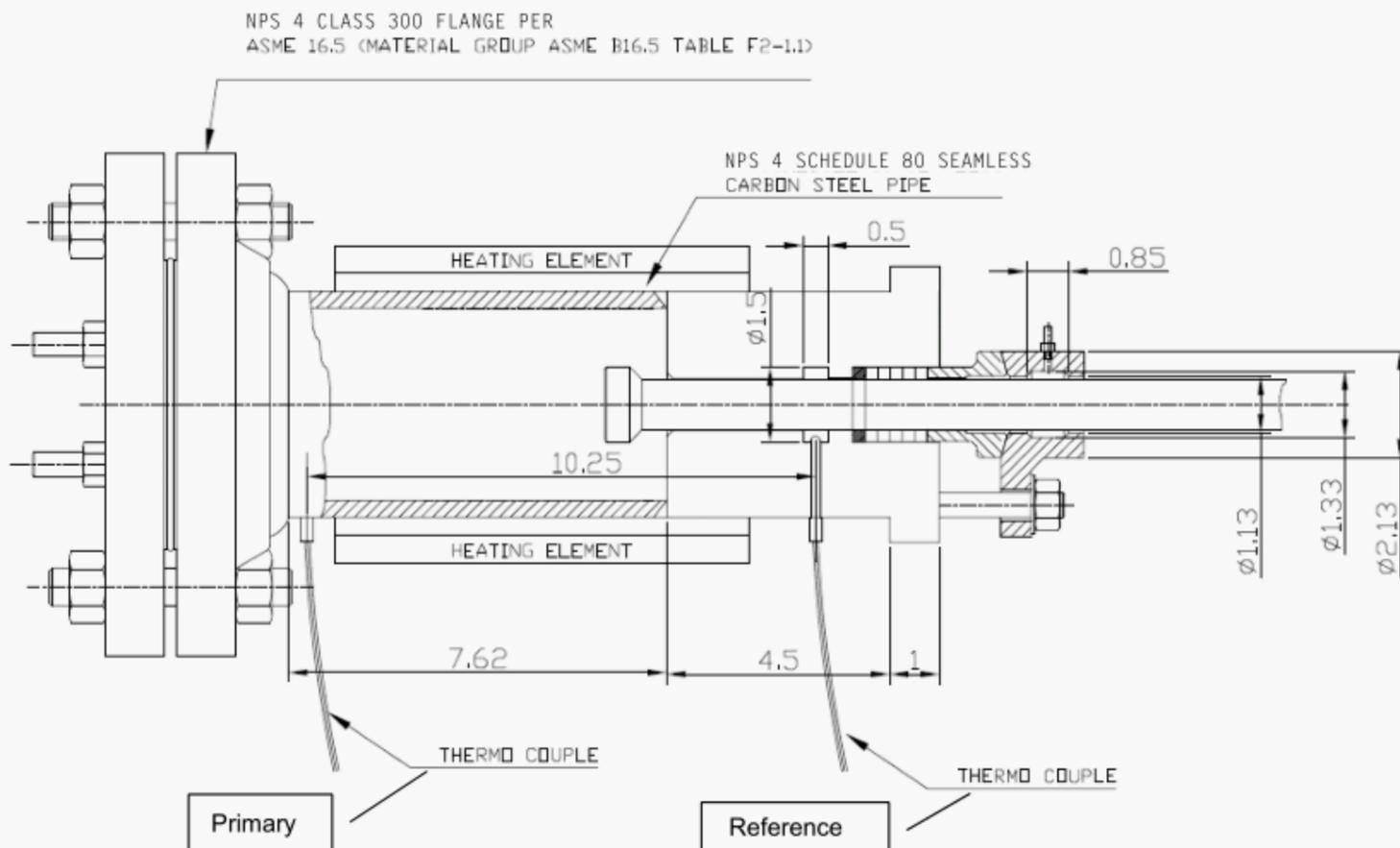


Figure A-1

ANNEX 2

2.0 High Temperature Corrosion Test Fixture Construction

- 2.1 The fixture may be constructed to allow for multiple test assemblies.
- 2.2 The fixture design shall be designed to accommodate a single ring of packing having a 0.250 in. (6.35 mm) square cross-section.
- 2.3 The fixture housing shall be fabricated from ASTM A216 Grade WCB.
- 2.4 The fixture bolt(s) shall be ASTM A182 Grade F6a 200-275 HB (Rc15-28.8).
- 2.5 Fixture nut(s) shall be ASTM A194 Grade 2H.
- 2.6 Compression gland load nut shall be ASTM A216 Grade WCB.
- 2.7 Compression gland top piece shall be ASTM A216 Grade WCB.
- 2.8 A buffer seal washer shall be located between the housing and pressurization housing.
- 2.9 The fixture shall be equipped with a fluid flow transition fitting which shall be fabricated from ASTM A216 Grade WCB.
- 2.10 Belleville washers shall be used to maintain a compressive load of 4350 psi (30 Mpa).

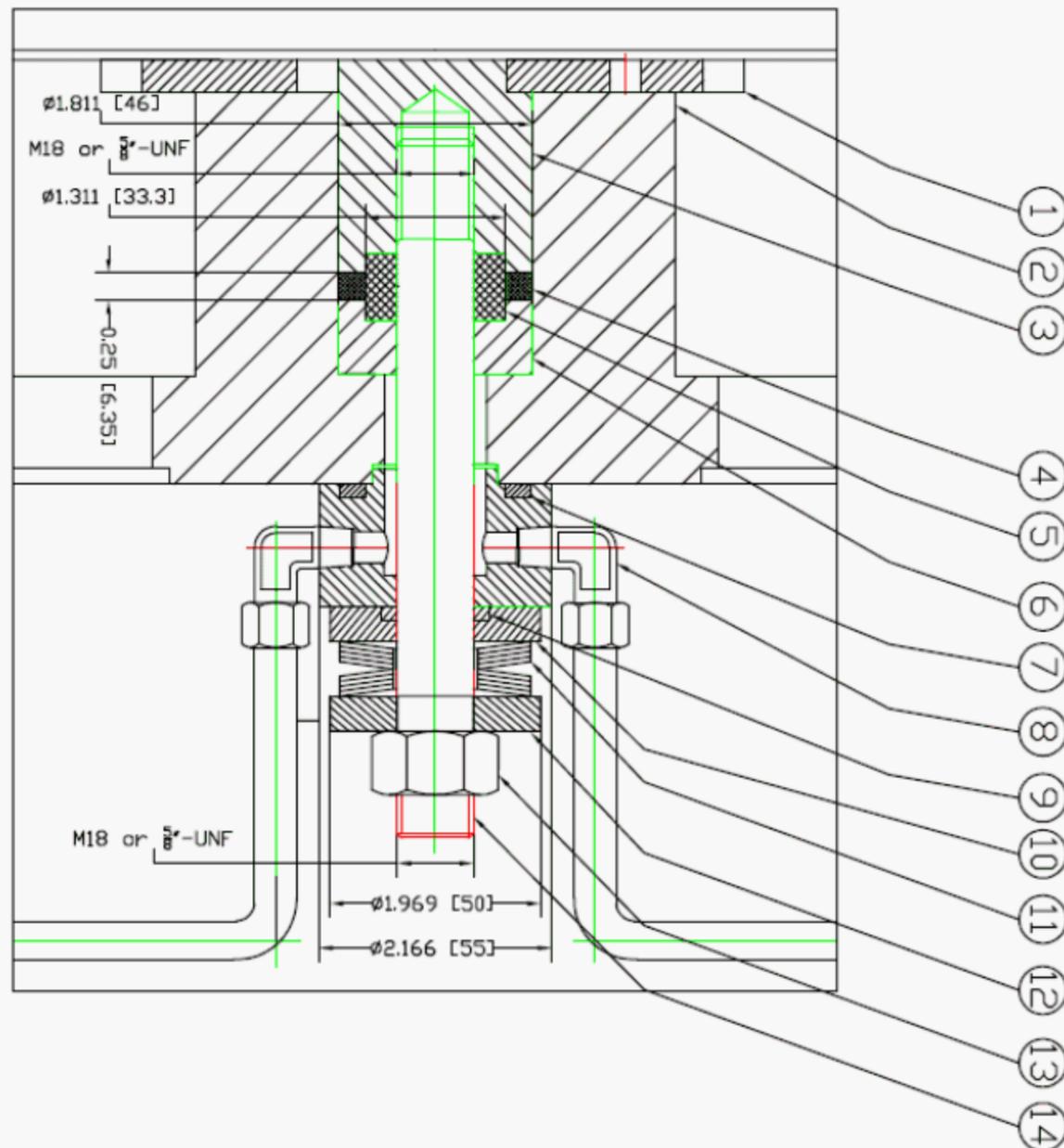


Figure A-2

2.11 Components (see Figure A-2)

1. Housing retainer
2. Fixture housing
3. Compression gland bottom piece
4. Packing sample
5. Metal test sample
6. Compression gland top piece
7. Seal
8. Tubing and fittings
9. Seal
10. Washer
11. Disc springs
12. Washer
13. Nut
14. Bolt / shaft



American Petroleum Institute

2006 Publications Order Form

Effective January 1, 2006.

API Members receive a 30% discount where applicable.

The member discount does not apply to purchases made for the purpose of resale or for incorporation into commercial products, training courses, workshops, or other commercial enterprises.

Available through Global Engineering Documents:

Phone Orders: 1-800-854-7179 (Toll-free in the U.S. and Canada)
303-397-7956 (Local and International)

Fax Orders: 303-397-2740

Online Orders: www.global.ihs.com

Date: _____

API Member (Check if Yes)

Invoice To (Check here if same as "Ship To")

Name: _____

Title: _____

Company: _____

Department: _____

Address: _____

City: _____ State/Province: _____

Zip/Postal Code: _____ Country: _____

Telephone: _____

Fax: _____

E-Mail: _____

Ship To (UPS will not deliver to a P.O. Box)

Name: _____

Title: _____

Company: _____

Department: _____

Address: _____

City: _____ State/Province: _____

Zip/Postal Code: _____ Country: _____

Telephone: _____

Fax: _____

E-Mail: _____

Quantity	Product Number	Title	SO★	Unit Price	Total
	C59406	Std 594, Check Valves: Flanged, Lug, Wafer and Butt-welding		\$74.00	
	C59905	Std 599, Metal Plug Valves--Flanged, Threaded and Welding End		\$58.00	
	CX60011	API 600, Bolted Bonnet Steel Gate Valves for Petroleum and Natural Gas Industries--Modified National Adoption		\$84.00	
	CX60206	Std 602, Steel Gate, Globe and Check Valves for Sizes DN 100 and Smaller for the Petroleum and Natural Gas Industries		\$80.00	
	C60306	Std 603, Corrosion-Resistant, Bolted Bonnet Gate Valves--Flanges and Butt-Welding Ends		\$49.00	
	CX60705	Std 607, Fire Test for Soft-Seated Quarter-Turn Valves		\$61.00	
	C60906	Std 609, Butterfly Valves: Double Flanged, Lug-and Water-Type		\$63.00	

Payment Enclosed P.O. No. (Enclose Copy) _____

Charge My Global Account No. _____

VISA MasterCard American Express Diners Club Discover

Credit Card No.: _____

Print Name (As It Appears on Card): _____

Expiration Date: _____

Signature: _____

Subtotal

Applicable Sales Tax (see below)

Rush Shipping Fee (see below)

Shipping and Handling (see below)

Total (in U.S. Dollars)

★ To be placed on Standing Order for future editions of this publication, place a check mark in the SO column and sign here:

Pricing and availability subject to change without notice.

Mail Orders – Payment by check or money order in U.S. dollars is required except for established accounts. State and local taxes, \$10 processing fee*, and 5% shipping must be added. Send mail orders to: **API Publications, Global Engineering Documents, 15 Inverness Way East, M/S C303B, Englewood, CO 80112-5776, USA.**

Purchase Orders – Purchase orders are accepted from established accounts. Invoice will include actual freight cost, a \$10 processing fee*, plus state and local taxes.

Telephone Orders – If ordering by telephone, a \$10 processing fee* and actual freight costs will be added to the order.

Sales Tax – All U.S. purchases must include applicable state and local sales tax. Customers claiming tax-exempt status must provide Global with a copy of their exemption certificate.

Shipping (U.S. Orders) – Orders shipped within the U.S. are sent via traceable means. Most orders are shipped the same day. Subscription updates are sent by First-Class Mail. Other options, including next-day service, air service, and fax transmission are available at additional cost. Call 1-800-854-7179 for more information.

Shipping (International Orders) – Standard international shipping is by air express courier service. Subscription updates are sent by World Mail. Normal delivery is 3-4 days from shipping date.

Rush Shipping Fee – Next Day Delivery orders charge is \$20 in addition to the carrier charges. Next Day Delivery orders must be placed by 2:00 p.m. MST to ensure overnight delivery.

Returns – All returns must be pre-approved by calling Global's Customer Service Department at 1-800-624-3974 for information and assistance. There may be a 15% restocking fee. Special order items, electronic documents, and age-dated materials are non-returnable.

***Minimum Order** – There is a \$50 minimum for all orders containing hardcopy documents. The \$50 minimum applies to the order subtotal including the \$10 processing fee, excluding any applicable taxes and freight charges. If the total cost of the documents on the order plus the \$10 processing fee is less than \$50, the processing fee will be increased to bring the order amount up to the \$50 minimum. This processing fee will be applied before any applicable deposit account, quantity or member discounts have been applied. There is no minimum for orders containing only electronically delivered documents.

There's more where this came from.

The American Petroleum Institute provides additional resources and programs to the oil and natural gas industry which are based on API® Standards. For more information, contact:

- API Monogram® Licensing Program Phone: 202-962-4791
Fax: 202-682-8070
- American Petroleum Institute Quality Registrar (APIQR®) Phone: 202-962-4791
Fax: 202-682-8070
- API Spec Q1® Registration Phone: 202-962-4791
Fax: 202-682-8070
- API Perforator Design Registration Phone: 202-962-4791
Fax: 202-682-8070
- API ISO/TS 29001 Registration Phone: 202-962-4791
Fax: 202-682-8070
- API Training Provider Certification Program Phone: 202-682-8490
Fax: 202-682-8070
- Individual Certification Programs Phone: 202-682-8064
Fax: 202-682-8348
- Engine Oil Licensing and Certification System (EOLCS) Phone: 202-682-8516
Fax: 202-962-4739
- API PetroTEAM™ (Training, Education and Meetings) Phone: 202-682-8195
Fax: 202-682-8222

Check out the API Publications, Programs, and Services Catalog online at www.api.org.

API
American Petroleum Institute

Helping You Get
The Job Done Right.®

Additional copies are available through IHS

Phone Orders: 1-800-854-7179 (Toll-free in the U.S. and Canada)
303-397-7956 (Local and International)
Fax Orders: 303-397-2740
Online Orders: global.ihs.com

Information about API Publications, Programs and Services
is available on the web at www.api.org



1220 L Street, NW
Washington, DC 20005-4070
USA

202.682.8000

Product No. C62201