

Memorandum

Department Personnel	DATE October 14, 1980
um	REFERENCE NO. ED80-793-ADW

f. L. Markham
E. E. Brown
L. A. Thiele
J. A. Smith
Ray Twist
R. P. Lowry

D. G. Pausky
R. S. O'Neal - Bay City
L. T. Johnston - Pampa
R. W. Schwausch - Clear Lake
E. V. Kunkel - CCCTC

SUBJECT: ENGINEERING SPECIFICATIONS, GASKETS AND PACKING

Attached is your copy of the section entitled "Gaskets and Packing for Piping and Related Equipment" for your "Engineering Specifications Book". Please replace the section, "Gasket Materials Specifications" of 2-25-69 with this section.

No radical changes have been made, but we have upgraded some materials for corrosive and toxic services, eliminated some obsolete services and materials, included packings, and provided some guidelines for possible new services.

A. D. Willbern
A. D. Willbern

ADW:ds
Attachment

002459



GASKETS AND PACKING FOR PIPING AND RELATED EQUIPMENT

, GASKETS

This section describes specific Chemcel gasket practices for flanges in piping and in associated equipment and to provide general design considerations for gasket usage.

Adhesives, sealant, and/or caulking compounds are not included in this category although they may sometimes be used advantageously to seal flanges with or without the use of a gasket.

II. CHEMCEL PRACTICES - GASKETS

A. Toxic and/or Highly Corrosive Services - Streams containing fluids such as formaldehyde, formic acid or sulfuric acid, and operating at temperature of 450° F or less to use Teflon Envelope Gaskets with Garlock 8748, or equal, insert.

(1) For higher temperatures (MO reactors) use 1/4" copper clad asbestos millboard.

(2) On MO reactor outlet piping, use 304 S/S spiral wound asbestos filled gasket as per API 601, Flexitallic GC.

B. Steam over 100 PSI & Other Fluids at 450° F to 800° F.

(1) Piping Flanges - Use 304 stainless steel spiral wound asbestos filled gaskets per API 601, with self centering external C/S compression ring, Flexitallic Style GC.

NOTE (a): This standard stock gasket is suitable for existing Chemcel services. A similar gasket is available in other materials for special situations, i. e., different metals for higher temperature, to avoid stress corrosion cracking, or severe corrosion.

Teflon, carbon or ceramic fill are available for services where asbestos is unsuitable.

(b): Similar first quality gaskets of other manufacturers may also be suitable, but should not be used without further testing. Relatively poor service has resulted from use of other similar gaskets.

(c): Gasket surfaces, including orifice plates, for spiral wound gaskets to have approximately 125 micro inch concentric or phonographic groove finish. Very smooth plates may permit creep of gasket.

(2) Process Equipment - Use metal jacketed asbestos gaskets with type of metal specified by design engineer or special spiral wound type gaskets.

C. Fluids Above 800° F

Use solid metal gaskets with kind of metal and design specified by design engineer.

D. General Service

Most process fluids including air, water, condensate, boiler feed water, and steam less than 100 PSIG, are to use Garlock #8748 gasket. This is a compressor asbestos material with Buna-N (nitrile) binder. It was formerly manufactured as "Belmont 585". Alternate materials are Crane 888, or Anchor 451.

NOTE (1): ASA Code for Pressure Piping B31.1 Par 617 prohibits use of this type of gasket on oil or other fluids above their spontaneous combustion temperature.

(2): The manufacturer states, confirmed by our experience, that this gasket will harden at about 250° F or higher temperatures. While this hardening is undesirable, the gasket remains serviceable and is the preferred material for hot boiler feed water and condensate.

(3): Generally, a 1/16" thickness is used. On larger flanges (18" and over) at moderate pressures and/or a poor gasket surface, a 1/8" thickness may be preferred.

E. Mild Services

For temperatures of 250° F or less and moderate pressures, vegetable fiber, rubber, or neoprene gaskets may be used with standard or light weight flanges. Use neoprene for oil and sunlight resistance. Rubber for water and dilute acids.

F. Conveyors, Elevators and Similar Enclosures

For very light flanges and to seal rough surfaces at very low (<6 inches of water) pressure, use closed cell neoprene sponge.

III. BASIC FLANGE AND GASKET DESIGN

Criteria for gasketed flange design is established in Section VIII of the ASME Boiler and Pressure Code. Mandatory Appendix II of the Code requires that complete calculations shall be made to insure that the joint satisfies two separate and independent conditions.

These are:

- (1). Operating Condition Minimum bolt loading shall be determined in accordance with the following equation:

$$(1) \quad W_m = \frac{3.14 G^2 P}{4} + 2 b \ 3.14 G_m P$$

002462

This equation states that the minimum required bolt loading for operating condition is the sum of the hydrostatic end force plus a residual gasket load on the contact area of the gasket times a gasket factor, 'm'.

The gasket factor 'm' is suggested in Table UA 49.1 (see Attachment I) for various general gasket materials, but it is not mandatory.

- (2). Gasket Seating - 'Minimum bolt loading required to seal the gasket regardless of internal pressure is determined by the equation:

$$(2) \quad Wm_2 = 3.14 \, b \, G \, y$$

This equation states that the minimum required bolt loading for gasket seating equals the gasket effective seating area times the gasket minimum seating stress 'y'. Suggested values of 'y' are also given in Table UA 49.1 while 'Effective Gasket Width' and effective dimensions are given in Table UA 49.2 (see Attachment II).

Wm_1 = bolt loading condition 1 (operating)

Wm_2 = bolt loading condition 2 (gasket seating)

3.14 = π

G = gasket effective diameter

P = operating or design pressure

b = effective gasket width

m = gasket factor

y = gasket seating factor

002463

Issued: 10-15-80

The joint must compress the gasket to fill all voids in the flange surface and stress the gasket so that fluid will not enter it. Adequate stress must be retained in the gasket when there is maximum internal fluid pressure which tends to open the flange and relieve gasket compression. A soft gasket fills the voids readily, but may be squeezed out of the joint or crushed by bolting, or be blown out by high pressure. A hard thin gasket requires very smooth sealing surfaces, and heavy flanges and bolting to provide the very high seating force to seal the joint. An efficient joint is usually a compromise between these extremes.

It may be noted that when using a relatively soft gasket at high pressure the gasket resilience will add to the bolt loading when pressure testing so that bolt overload could occur during test while the joint is satisfactory for gasket seating and normal service. A harder gasket would contribute less load during the test and may be replaced later with the preferred gasket to avoid otherwise redesigning the joint for the test condition. Flange dimensions for most situations are well covered in ASA Standards. Gasket diameters are covered in ANSI Standard B16.21 for the various standard flanges. The standard is not very helpful with material or thickness selection, however, since Section 4.2 states, "Selection of the proper material for a given service is the responsibility of the user... and any applicable code or governmental regulation. The material selected shall be suitable for the fluid and temperature condition

Issued: 10-15-80

of service". Section 5.1 states "Selection of gasket thickness is the responsibility of the user, considering properties of gasket material as well as the intended service application...."

IV. CHEMCEL PRACTICE, PACKING

A. General

Soft packings are used in glands or stuffing boxes of pumps and other equipment, control valves, and regular valves. While all use packing to seal by squeezing it between the box ID and a shaft O. D., the packing needs of the three categories are somewhat different. Pumps require sealing against relatively fast rotary motion, the control valve stem has generally slow or infrequent reciprocating motion, while most other valves have an infrequent combined or hilical motion. Packing friction is very important in the pump since it robs horsepower and creates heat. Friction is less important for valves, but must not be high enough to overload operators or cause valve stem wear. In all cases the packing must provide effective sealing over an extended period of time with minimal adjustment. It must resist corrosive and solvent action of the fluids involved at the service temperature. While there are many manufacturers of packings, most with similar types of materials, the following usage has evolved over the years at Chemcel. Please advise the Engineering Department and Purchasing when additional field testing proves that alternate and/or better materials should be used.

B. Pumps

While most of our process pumps use mechanical seals (see Pumps, in Rotating Equipment Section), packing is preferred for water,

and similar streams where moderate leakage is acceptable. Packing is also used for high concentration (> 51%) formaldehyde where solification is a severe problem for seals, and where D. I. water may be provided to flush through lantern rings and avoid any loss of formaldehyde to the atmosphere.

- (1) Boiler feed pumps use formed rings of John Crane Superseal #1.
- (2) Other water and effluent services use John Crane #810.
This is a square braided lubricated asbestos material.
- (3) Corrosive services at moderate temperature use John Crane C-1050 which is a braided Teflon yarn with TFE dispersion.
- (4) High concentration formaldehyde and other corrosive or high temperature packed pumps use John Crane #1625 GF. This is a braided graphite filament yarn which is very corrosive and heat resistant, self lubricating, and a good conductor to dissipate frictional heat.

NOTE: Provide lantern rings and demineralized water flush to stuffing box to prevent escape of any toxic material.

C. Control Valves

Control valves are usually supplied with die pressed or formed packing rings made into sets for the valves.

- (1) General Service
The preferred packing is die formed John Crane Superseal #5D.
- (2) Corrosive Services
 - (a) John Crane Style C-60, Teflon impregnated,
 - (b) John Crane Style C-1050, a braided Teflon yarn with TFE dispersion, and
 - (c) solid Teflon rings.

002466

NOTE: Rings of pressed graphite foil are frequently furnished for corrosive and general high temperature service by control valve manufacturers. While highly regarded in literature, our experience with graphite foil has been relatively poor and other materials, particularly Superseal #5D, are preferred, where applicable. Replacement graphite foil rings could be made by winding on and field forming Garlock Ribbon Grafoil in the box. A ring of braided graphite filament packing (John Crane 1625 GF) on each side of the graphite foil should provide improved service.

D. Valve Packing

(1) General Service

John Crane 1871, a wire inserted asbestos packing lubricated with graphite is to be used for water, air, and steam at temperatures up to 1200° F.

(2) Corrosive Service

Use John Crane Style C-60, a Teflon coated braided asbestos or Style C-1050, a braided Teflon yarn with TFE dispersion for temperatures up to 450° F.

002467

TABLE UA-49.1
GASKET MATERIALS AND CONTACT FACINGS¹
 Gasket Factors (*m*) for Operating Conditions and Minimum Design Seating Stress (*y*)

Gasket Material		Gasket Factor <i>m</i>	Min. Design Seating Stress <i>y</i>	Sketches and Notes	Use Facing Sketch	Use Column
					Refer to Table UA-49.2	
Self-Energizing Types O Rings, Metallic, Elastomer other gasket types considered as self-sealing		0	0	...	...	...
Elastomers without fabric or a high percentage of asbestos fiber: Below 75A Shore Durometer 75A or higher Shore Durometer		0.50 1.00	0 200		(1a),(1b), (1c),(1d), (4),(5)	II
Asbestos with a suitable binder for the operating conditions	1/8 thick	2.00	1600			
	1/16 thick	2.75	3700			
	1/32 thick	3.50	6500			
Elastomers with cotton fabric insertion		1.25	400			
Elastomers with asbestos fabric insertion, with or without wire reinforcement	3-ply	2.25	2200			
	2-ply	2.50	2900			
	1-ply	2.75	3700			
Vegetable fiber		1.75	1100			
Spiral-wound metal, asbestos filled	Carbon	2.50	10,000		(1a),(1b)	
	Stainless or Monel	3.00	10,000			
Corrugated metal, asbestos inserted or Corrugated metal, jacketed asbestos filled	Soft aluminum	2.50	2900		(1a),(1b), (1c),(1d)	
	Soft copper or brass	2.75	3700			
	Iron or soft steel	3.00	4500			
	Monel or 4-6% chrome	3.25	5500			
	Stainless steels	3.50	6500			
Corrugated metal	Soft aluminum	2.75	3700		(1a),(1b), (1c),(1d)	
	Soft copper or brass	3.00	4500			
	Iron or soft steel	3.25	5500			
	Monel or 4-6% chrome	3.50	6500			
	Stainless steels	3.75	7600			
Flat metal jacketed asbestos filled	Soft aluminum	3.25	5500		(1a),(1b), (1c),(1d), ¹ (2) ²	
	Soft copper or brass	3.50	6500			
	Iron or soft steel	3.75	7600			
	Monel	3.50	8000			
	4-6% chrome Stainless steels	3.75 3.75	9000 9000			
Grooved metal	Soft aluminum	3.25	5500		(1a),(1b), (1c),(1d), (2),(3)	
	Soft copper or brass	3.50	6500			
	Iron or soft steel	3.75	7600			
	Monel or 4-6% chrome	3.75	9000			
	Stainless steels	4.25	10100			
Solid flat metal	Soft aluminum	4.00	8800		(1a),(1b), (1c),(1d), (2),(3), (4),(5)	
	Soft copper or brass	4.75	13000			
	Iron or soft steel	5.50	18000			
	Monel or 4-6% chrome	6.00	21800			
	Stainless steels	6.50	26000			
Ring joint	Iron or soft steel	5.50	18000		(6)	
	Monel or 4-6% chrome	6.00	21800			
	Stainless steels	6.50	26000			

NOTES:

- (1) This table gives a list of many commonly used gasket materials and contact facings with suggested design values of *m* and *y* that have generally proved satisfactory in actual service when using effective gasket seating width *b* given in Table UA-49.2. The design values and other details given in this table are suggested only and are not mandatory.
- (2) The surface of a gasket having a lap should not be against the nubbin.

002468

Table UA-49.2

SECTION VIII — DIVISION 1

TABLE UA-49.2
EFFECTIVE GASKET WIDTH

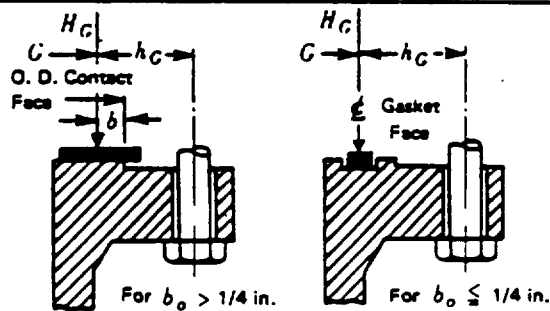
Facing Sketch (Exaggerated)	Basic Gasket Seating Width, b_o	
	Column I	Column II
(1a)	$\frac{N}{2}$	$\frac{N}{2}$
(1b) ¹		
(1c)	$\frac{u' + T}{2} : \left(\frac{u' + N}{1} \max \right)$	$\frac{u' + T}{2} : \left(\frac{u' + N}{4} \max \right)$
(1d) ¹		
(2)	$\frac{u' + N}{4}$	$\frac{u' + 3N}{8}$
(3)	$\frac{N}{4}$	$\frac{3N}{8}$
(4) ¹	$\frac{3N}{8}$	$\frac{7N}{16}$
(5) ¹	$\frac{N}{4}$	$\frac{3N}{8}$
(6)	$\frac{w}{8}$	

Effective Gasket Seating Width, "b"

$$b = b_o, \text{ when } b_o \leq \frac{1}{4} \text{ in.}$$

$$b = \frac{\sqrt{b_o}}{2}, \text{ when } b_o > \frac{1}{4} \text{ in.}$$

Location of Gasket Load Reaction



NOTE: The gasket factors listed only apply to flanged joints in which the gasket is contained entirely within the inner edges of the bolt holes

NOTE:

(1) Where serrations do not exceed 1/64 in. depth and 1/32 in. width spacing, sketches (1b) and (1d) shall be used.

002469