



UNION CARBIDE CORPORATION
CHEMICALS AND PLASTICS

P.O. BOX 8004, SOUTH CHARLESTON, W. VA. 25303

SOUTH CHARLESTON PLANT

January 7, 1977

RECEIVED

JAN 11 1977

J.F.E.

Ms. Susan Wyatt
Emission Standards and Engineering
Office of Air Quality Planning and Standards
United States Environmental Protection Agency
Research Triangle Park
North Carolina 27711

Subject: Additional Data Union Carbide Corporation's Request for Approval
of Equivalency §61.65 (b) (4) Leakage from Relief Valves

Dear Ms. Wyatt:

In answer to your telephone inquiry regarding Union Carbide Corporation's request for approval of equivalency §61.65 (b) (4) Leakage from Relief Valves dated November 19, 1976 we offer the following additional information:

Union Carbide Corporation's proposal to use "O" ring seat pressure seal safety relief valves in vinyl chloride service is based upon the use of "O" ring gaskets in vinyl chloride service since 1952 and the use of the "O" ring seat pressure seal safety relief valve since 1969. The only innovation involved is the use of the "O" ring seat pressure seal safety relief valve in vinyl chloride service. (See Attachments I and II for data on conventional relief valves and the "O" ring seat pressure seal relief valves). Union Carbide Corporation has been engaged in the manufacture of organic chemicals and resins since before 1930. During this period it has established a base of safety technology and engineering standards which is widely recognized throughout the industry. We would not propose a safety relief valve system which did not meet our own and governmental agency standards for performance, longevity and safety. Union Carbide Corporation's relief valve comments on the EPA National Emission Standard for Vinyl Chloride dealt with its concern for process safety.

You wished to know what documentation we had that "O" rings can be made of materials which are essentially impervious to chemical attack by vinyl chloride monomer. You wanted published information as opposed to a statement by Union Carbide Corporation.

UCC
052382

Letter to Ms. Susan Wyatt
January 7, 1977
Page Two

Union Carbide Corporation has been unable to obtain any published data on vinyl chloride resistance by synthetic elastomers used for the manufacture of "O" ring gaskets. Experience has shown that vendor's information and published reports, if available, are not satisfactory material selection criteria unless they encompass laboratory testing, trial installations, followup and actual operating experience for the specific application. To meet its needs Union Carbide Corporation has a materials selection group as an integral part of its Engineering Division whose sole function is to study materials resistance to chemical and corrosion attack and to recommend specific materials for various applications. This group screens materials by laboratory testing and then tests promising ones under plant conditions. This program gives good reliability in selection of materials for process equipment.

Attached is a tabulation of Union Carbide Corporation's laboratory test data on gasket materials (Attachment III) exposed to liquid vinyl chloride for 111 days at 33°F. Tests show effect on hardness, volume and weight change as well as visual inspection. These items are summarized in a resistance rating. "R" means good resistance for any application. "F" means fair resistance, use depends on the specific service. "X" means unsuitable. For "O" ring gaskets the material must be resilient, not cold flow and resist solvation; thus, the potential "O" ring gaskets are Viton, Neoprene, Buna N, Hypalon and EPR. Plant tests and experience with Buna N, Viton and EPR have shown that "O" ring gaskets made from these materials perform well for long periods. The tabulation of test results shown is the accumulation of years of testing. As new materials are marketed they are tested in the laboratory and plant tests scheduled if they show merit. One such material is Dupont's Kalrez, a per-fluoroelastomer (See Attachment IV). Kalrez is currently under laboratory test in vinyl chloride with completion scheduled March 1, 1977. This could conceivably be superior to the presently used Buna N, Viton and EPR in which case it would be used in vinyl chloride service. (The resistance to ethylene dichloride and vinyl acetate by Kalrez is excellent.)

The ultimate test for any "O" ring material is its performance in plant manufacturing equipment in vinyl chloride service. "O" ring gaskets in vinyl chloride service at Union Carbide Corporation plants are as follows:

1. Eighteen dispersion resin polymerizers at South Charleston, West Virginia equipped with double mechanical seals on the agitators using Buna N "O" rings for shaft packing have been in service since 1952 without any seal failures due to "O" ring problems. New "O" ring gaskets are installed each time the seals are overhauled which occurs between six months and a year. (Most mechanical seals contain one or more "O" rings for shaft packing. See Attachment V.)

Letter to Ms. Susan Wyatt
January 7, 1977
Page Three

2. Twenty-six suspension resin polymerizers at Texas City, Texas equipped with double mechanical seals on the agitators using Buna N "O" rings for shaft packing have been in service since 1960 without any seal failures due to "O" ring problems. New "O" ring gaskets are installed during overhauls at one-to two-year intervals.

3. Forty-five double mechanical seals have been installed since 1974 on solvent resin polymerizers at South Charleston, West Virginia and Texas City, Texas using EPR "O" rings for shaft packing rings. No failures due to "O" ring problems have been experienced. This installation is too new to have data on seal overhaul schedules.

4. Fifteen pumps in vinyl chloride service at the Texas City, Texas plant have double mechanical seals with EPR "O" ring for shaft packing. These were installed in 1975; thus, no statement of "O" ring life can be made except that the rings are over one year old in liquid VCM service. Liquid vinyl chloride service is much more demanding than gaseous vinyl chloride service.

5. Forty-four quick opening Lenape manways equipped with EPR "O" ring gaskets are in service on suspension and dispersion resin reactors at South Charleston, West Virginia and Texas City, Texas since 1965. These gaskets are replaced after one-to two-weeks due to mechanical damage to the gasket from opening and closing the manway. There have been no gasket failures, however.

6. Union Carbide Corporation uses a fleet of eighty tank cars for vinyl chloride transport. Each car is equipped with "O" ring seat relief valves such as Midland Manufacturing Corporation type A-1150 equipped with Viton "O" rings on the seat and the stem. These valves are approved by the Association of American Railroads for tank cars in vinyl chloride service. The safety valves are overhauled every five years and new "O" rings installed. Detectable leakage through these valves is unusual. In the year 1976 only one or two of these safety valves leaked and had to be replaced. These safety valves have only a single resilient gasket seat while the proposed safety valves have a lapped metal-to-metal seat and a resilient "O" ring gasket seat; thus, resistance to leakage is much greater in the proposed safety valves. (See Attached Midland Manufacturing, Inc. tank car safety valve drawing. Attachment VI)

Union Carbide Corporation is using "O" ring gaskets in many other vinyl chloride process equipment items including ball and plug valve stem packing. It is felt, however, that the preceding examples show that "O" ring gaskets are reliable in vinyl chloride service particularly with our program of annual overhaul of relief valves.

UCC
052384

Letter to Ms. Susan Wyatt
January 7, 1977
Page Four

The second question you asked was what failure frequency rate would be expected for the "O" rings in the proposed safety valves.

The preceding examples of "O" rings installed in vinyl chloride service indicate long life. Based on the performance of "O" rings in the tank car relief valves and the fact that all plant relief valves are overhauled annually and new gaskets installed, the failure frequency rate for "O" rings in the proposed safety valves would be nil.

The third question you asked was do we know of other companies who have used "O" ring seat pressure seal safety relief valves in VCM service.

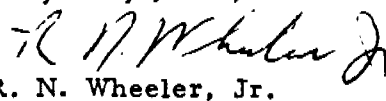
The safety valve vendor, Farris Teledyne, states that a major producer of vinyl chloride/polyvinyl chloride is purchasing the valves for vinyl chloride service. Despite telephone inquiries to many companies, we have not been able to confirm this statement by the vendor.

In our request for equivalency we pointed out that the Chlorine Institute, Inc. accepted "O" ring seat pressure seal safety valves equipped with Viton "O" rings as equivalent to a rupture disc in series with a conventional safety valve. In terms of resistance to corrosion and to chemical attack as well as freedom from leakage and good valve reliability, this application is much more demanding than the proposed use of the "O" ring seat pressure sealed safety valves in vinyl chloride service.

As noted earlier, Union Carbide Corporation would not propose a device which we were not confident would perform as expected. Union Carbide Corporation has fifty "O" ring seat pressure sealed safety valves equipped with low temperature Buna N "O" rings in ethylene service at its plants in Texas City, Texas; Victoria, Texas; Taft, Louisiana and Ponce, Puerto Rico. These have been performing as expected since 1969. More of this type of safety valve are being installed in our plants where freedom from leakage and positive reseating after relieving are critical.

I hope this letter answers your specific questions on "O" ring gaskets and shows the sound technical base for Union Carbide Corporation's request that "O" ring seat pressure seal safety relief valves be approved as equivalent to §61.65 (b) (4) Leakage from Relief Valves.

Very truly yours,



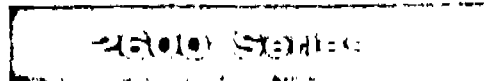
R. N. Wheeler, Jr.

RNWJr. /pm
Attachments

UCC
052385

Farris Safety-Relief Valves

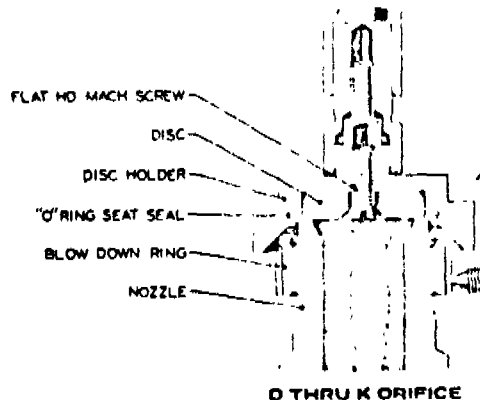
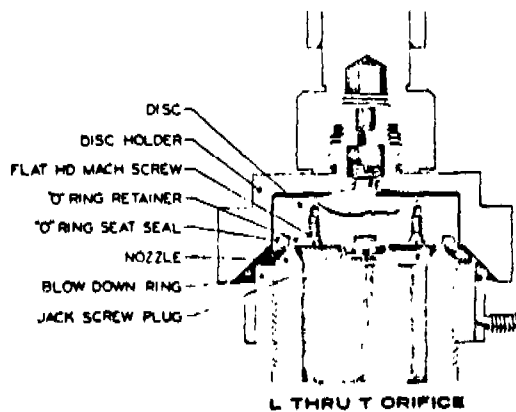
ATTACHMENT 1



Farris "O" Ring Seat Pressure Seal for Conventional or BalanSeal

Eliminates leakage and costly product loss as well as costly down time and maintenance on troublesome applications such as:

- Operation too close to set pressure.
- Light, hard to hold fluids.
- Minute foreign particles.
- Discharge piping strains
- Vibratory applications.
- Corrosive fluids.
- Nozzle icing conditions.



Recognizing the need for a resilient seat in a safety-relief valve for extreme tightness, Farris Engineering Corporation first made available an "O" Ring seat seal in early 1950. Although limited in pressure, the "O" Ring design received phenomenal acceptance since it made possible complete tightness at pressures much closer to the valve set pressure than was ever possible with the standard metal to metal seats.

The present "O" Ring Seat Pressure Seal design is an improvement which allows the use of the "O" Ring Seat Seal to higher pressures and, equally important, the spring load is solely carried by the metal to metal portion of the seat with the "O" Ring becoming a pressure seal within its recessed chamber and the outer edge of the nozzle, assuring the ultimate in tightness.

The "O" Ring Seat Pressure Seal is available in our 2600 Series line of flanged safety-relief valves — conventional or BalanSeal construction — for pressures

up to a maximum of 1500 PSIG

Referring to the selection tables on pages 22 thru 49, substitute a "C" for the fourth digit "A" in the type number for the conventional valve and a "D" for the fourth digit "B" in the type number for the BalanSeal construction when an "O" Ring Seat Seal is required:

26FA10 becomes 26FC10 (Conventional)

26FB10 becomes 26FD10 (BalanSeal)

The pressure limit of the Conventional or BalanSeal valves covered in the selection tables is the same for the O Ring design in all type numbers and orifices with the 150 lb., 300 lb. and 600 lb. inlet flanges. On the "O" Ring design in all type numbers and orifices 1500 lbs. is the limit for the "O" Ring design, not the conventional valve limit shown in the selection tables & charts. Refer to "O" Ring Material Selection Chart on page 21 for Temperature and Pressure ratings of the various "O" Ring materials available.

UCC
052386

Why an "O" Ring Seal Pressure Seal?

In the normal operation of a safety-relief valve the disc must lift off the nozzle very slightly to "simmer," allowing pressure build up within the secondary orifice (huddling chamber), causing the valve to "pop" fully open. Simmering occurs many times in the process industries where, as a result of process changes, minor upsets, etc., operating pressure fluctuates higher than normal, causing safety-relief valves to "simmer," but not fully open. This will cause serious misalignment in the valve and after the pressure drops the valve will very often continue to leak below the normal operating pressure.

While this can be overcome by actually popping the valve, this is not always possible. The use of the Farris "O" Ring Seat Pressure Seal will always overcome this difficulty.

As occurs very frequently operating pressures are too close to valve set pressures. As the operating pressure approaches the set pressure, seat loading is diminished reducing the force which affects tightness. With the use of the Farris "O" Ring Seat Pressure Seal, tightness can be obtained at relatively higher operating pressures than with metal to metal or other soft seat safety-relief valves.

On light, hard to hold fluids such as hydrogen, helium, light hydrocarbon, anhydrous ammonia, etc., metal to metal seats are often penetrated, causing leakage problems. The Farris "O" Ring Seat Pressure Seal will overcome leakage on these hard to hold fluids.

On applications where heavy vibrations occur — i.e. barges, tankers, pumps, compressors, etc., leakage of metal to metal seats develop as a result for as the set pressure is approached the spring force is minimized and the vibration tends to reduce the effect of spring loading, causing leakage. The Farris "O" Ring Seat Pressure Seal will maintain tightness as the spring force is not a factor in the tightness of the "O" Ring design.

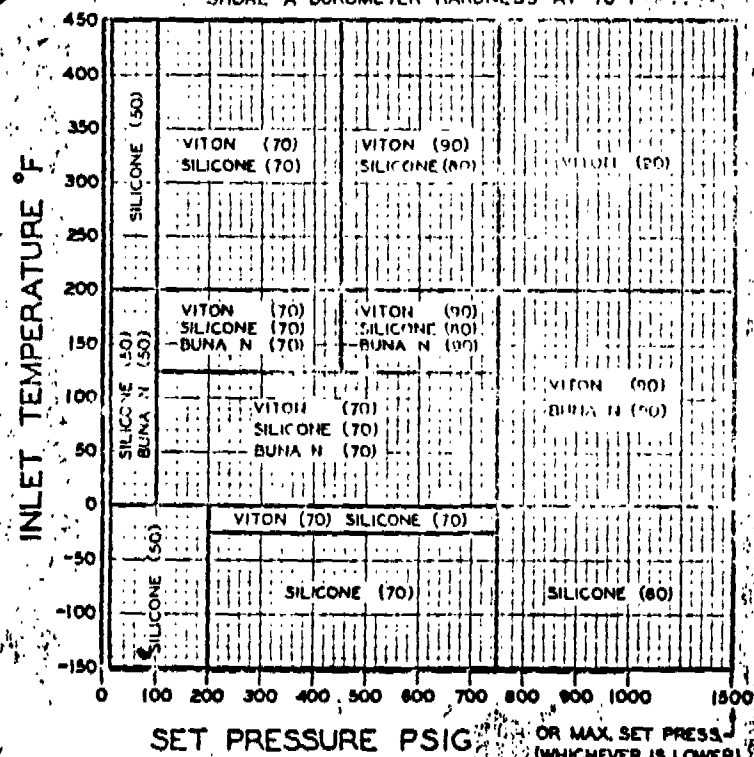
Where occasional minute foreign particles are carried in the flowing medium, metal to metal seats are usually marred or scratched when the valve is blowing. This creates troublesome leakage problems after the valve closes. The Farris "O" ring seat pressure seal will absorb without damage the impact of these particles and will eliminate particle deformation of the mating metal seating surface on the nozzle as the valve closes, thus reducing the incidence of leakage in valves on most process units. When necessary, simply replace the "O" ring to maintain tightness.

Due to corrosion, metal to metal seats may eventually leak. With the proper selection of the Farris "O" Ring Seat Pressure Seal tightness can more satisfactorily be maintained.

Nozzle icing conditions result from the refrigerant effect of the flowing media when a valve relieves. Ice actually forms on the seat, thus causing leakage. The Farris "O" Ring Seat Pressure Seal again overcomes this troublesome type of leakage.

"O" Ring Material Selection Chart

FIGURES IN PARENTHESES INDICATE
SHORE A DUROMETER HARDNESS AT 70°F



Standard tightness of "O" ring valves: No bubbles at 95% of set pressure. Applies to both conventional and bellows valves. At set pressures 60 PSIG and below, leakage test shall be made at 3 PSIG below set pressure.

Service recommendations for "O" Ring materials

BUNA N

Air
Anhydrous Ammonia
Butane
Butene
Butylene
Carbon Dioxide
Diesel Oil
Ethyl Ether
Ethylene Glycol
Freons #11 & 12
Fuel Oil
Gasoline
Helium
Hydrogen
Hydrogen Sulphide
Kerosene
Lube Oil
Natural Gas
Nitrogen
Oxygen
Propane
Standard Solvent

VITON

Acetylene Tetrabromide
Air
Amyl Alcohol
Aroclor #1248
Benzene
Butadiene
Butane
Butene
Butylene
Carbon Disulphide
Carbon Tetrachloride
Chlorine (Dry Gas)
Cyclohexane
Dowtherm "A"

VITON (con't.)

Ethyl Chloride
Ethylene
Ethylene Glycol
Ethyl Alcohol
Gasoline
Hexane
Hydrochloric Acid
Hydrogen Sulphide
Isobutyl Alcohol
JP 4 Fuel
JP 5 Fuel
Kerosene
Lube Oils
Methanol
Methylene Dichloride
Natural Gas
Naphtha
Nitric Acid
Nitrogen
Oronite #200 & #515
Propane
Propylene
Propyl Alcohol
Standard Solvent
Sulphur Dioxide
Sulphuric Acid
Toluene
Trichloroethylene
Turpentine
Vinegar
Water
Xylene

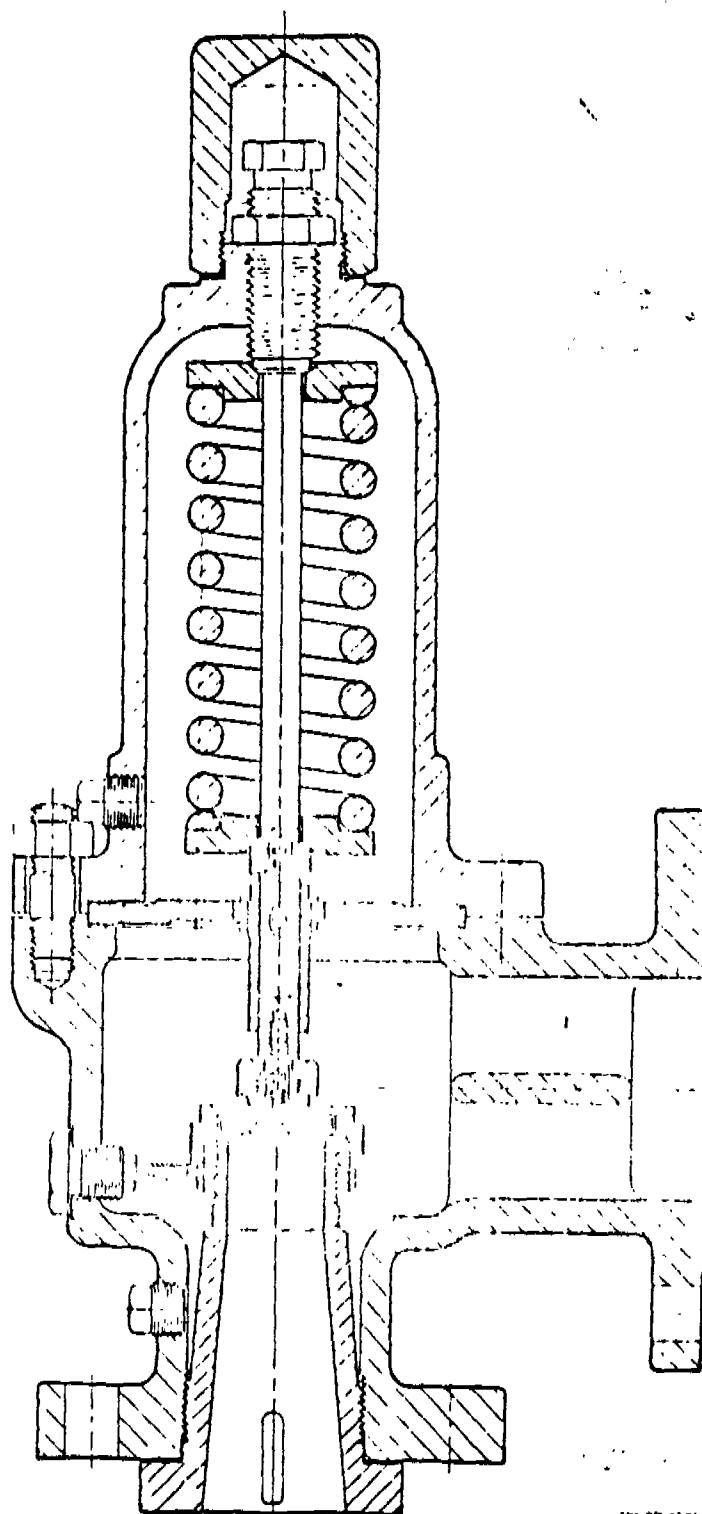
SILICONE

Air
Helium
Nitrogen
Oxygen

These recommendations are a guide only and service life of the "O" Ring is, of course, dependent on temperature, concentrations, catalysts that may be added and other conditions which are beyond our control.

表 1 (续)				
年份	地区	人口(万人)	人口密度(人/平方公里)	人口增长率(%)
1980	全国	9.87	122	1.32
1985	全国	10.59	135	1.32
1990	全国	11.33	148	1.32
1995	全国	12.11	161	1.32
2000	全国	12.95	174	1.32
2005	全国	13.84	187	1.32
2010	全国	14.79	200	1.32
2015	全国	15.84	213	1.32
2020	全国	16.99	226	1.32
2025	全国	18.24	239	1.32
2030	全国	19.59	252	1.32
2035	全国	21.04	265	1.32
2040	全国	22.59	278	1.32
2045	全国	24.24	291	1.32
2050	全国	25.99	304	1.32
2055	全国	27.84	317	1.32
2060	全国	29.79	330	1.32
2065	全国	31.84	343	1.32
2070	全国	33.99	356	1.32
2075	全国	36.24	369	1.32
2080	全国	38.59	382	1.32
2085	全国	41.04	395	1.32
2090	全国	43.59	408	1.32
2095	全国	46.24	421	1.32
2100	全国	48.99	434	1.32

ATTACHMENT II
 Farris Conventional Safety
 Relief Valve



6285

UCC
052388

FEB 18 1964

FARRIS & COMPETITIVE VALVE ASSEMBLY

(FARRIS) AFFILIATED COMPANIES

INCORPORATED UNDER THE LAWS OF CALIFORNIA

OFFICE - 1000 S. G STREET - LOS ANGELES, CALIFORNIA 90015
TELEPHONE - (213) 687-1111

ATTACHMENT III

MATERIALS ENGINEERING

UNION
CARBIDE

CHEMICALS/PLASTICS ENGINEERING

ELASTOMER AND GASKET MATERIALS FOR CHEMICAL SERVICE

The data in this section were obtained to provide personnel with useable information for the rapid selection of a gasket material for a proposed service. Selection of the test chemicals used was based on representative homologs from all types of organic chemicals. By analogy, the data should be applicable for the proper selection of a gasket material for nearly any chemical mixture, it is important to understand that the presence of a very small quantity of an aggressive chemical may be sufficient to attack the elastomer through selective absorption of that chemical from the solution. Consequently, the testing of mixtures is always advisable unless the entire composition is stable and innocuous.

The materials chosen for testing represent typical commercial products available in that category of material (e.g. butyl). In no manner is it implied that the material listed for that category is either the best or the poorest of materials available in that group.

Initial data were obtained by exposure of the gasket materials for 105 days at 78°F in the chemical. Those materials showing good resistance to a chemical in the initial exposure at 78°F were evaluated in the same environment at a higher temperature. The criteria used for the recommendation were as follows:

X	Unsuitable	Volume change of 30 percent or more Hardness change (Duro. A) of 15 points or more Weight change of 50 Mg/Cm ² or more
F	Fair	Volume changes of 10 to 30 per cent Hardness changes (Duro. A) of 5 to 15 points Weight changes of 10 to 50 Mg/Cm ²
R	Recommended	Essentially no changes in the physical properties

The rating of "F" (fair resistance) in the Table indicates that a significant amount of attack occurred on the elastomer during the test. These data should be interpreted to indicate the elastomer would probably provide satisfactory service when compressed between two flange faces in a piping system, but could not be used as an exposed diaphragm in a valve. The "R" rating would indicate that the elastomer could be used in any service while "X" shows inadequate resistance of the elastomer under any circumstances.

Note: Teflon gaskets are resistant to all chemicals currently processed in the Division. Temperatures up to 320°C are allowable with the possible exception of amine exposures above 175°C.

When using Teflon gaskets, do not use solid sheet material. The following are suitable gaskets where Teflon is required.

Johns-Manville 91 or 92
Garlock 8406
R/M Fluorobestos
Flexon 500
Taskline (Duriron Co.)
Teflon sponge
Teflon felt
Teflon envelopes

UCC
052389

CHEMICAL RESISTANCE OF GASKET MATERIALS

Test Chemical: Vinyl chloride
Exposure: 111 days at 33°F

Gasket Material	Hardness (c)			Volume Change, %		Wt. Change, % (b)	Color Solution (d)	Comments on Specimen	Rating
	Start	End (a)	48 hrs. (b)	End (a)	48 hrs. (b)				
Viton A	86	75	83	+18.8	+ 0.6	- 3.7	Yellow	Slightly swollen	F
Neoprene 7797	82	57	-	+39.5	-	+5.0	-	Slightly Swollen	F
Butyl K-53	66	49	63	+35.7	nil	- 0.8	Yellow	Swollen	X
Thiokol 3060	71	58	75	+29.3	- 0.3	- 1.6	Yellow	Swollen & tacky	X
Black rubber 3773	68	55	72	+40.3	- 1.0	- 6.4	Yellow	Swollen	X
Hycar, D-24	63	47	78	+37.5	-17.6	- 0.8	Yellow	Swollen	X
Buna N (OR-25)	83	71	87	+25.5	- 9.9	- 9.1	Yellow	Slightly swollen	F
Hypalon	72	58	-	+55.9	-	+4.0	-	Slightly Swollen	F
Silicon No. 65	53	46	51	+39.6	- 3.8	- 4.2	Yellow	Swollen	X
Buna S	46	40	56	+33.2	-26.5	-23.3	Yellow	Swollen	X
EPR	53	48	-	+2.2	-	+6.0	-	Slightly Swollen	F
Natural rubber, gum	47	35	46	+56.4	-10.8	-12.1	Yellow	Swollen	X
Red rubber No. 107	81	63	89	+35.9	- 8.2	- 4.9	Yellow	Swollen	X
Adiprene L-100	45*	37*	43*	+30.0	+ 0.3	- 0.1	Yellow	Swollen	X
Saraloy 300	65								
Garlock asbestos 7735	65*	68*	68*	+ 1.0	+ 0.3	- 1.3	Yellow	No visible change	R
U. S. asbestos No. 899	71*	67*	68*	+ 1.2	+ 0.3	- 1.9	Yellow	No visible change	R

- (a) Information obtained on the specimens immediately after removal from the solution.
(b) Information obtained on the specimens after drying 48 hours at 78°F.
(c) Hardness expressed as Durometer "A" except where * appears. Asterisk indicates Durometer "D" hardness.
(d) Color of solution at start of test was 5 Pt-Co.

Resistance Rating: R - Resistance good; recommended material.
F - Resistance fair; use of the material depends on specific service.
X - Unsuitable.

This is true laboratory test data by Union Carbide Corporation - 1-4-77

Given under my hand this 4th day of January 1977. My commission expires July 7, 1979.

J. C. Canterbury

Charles H. Carter
NOTARY PUBLIC



INTERNAL CORRESPONDENCE

ATTACHMENT IV

CHEMICALS AND PLASTICS

P. O. BOX 8361, SOUTH CHARLESTON, WEST VIRGINIA 25303

To (Name) Mr. J. C. Canterbury

Date May 25, 1973

Division

Location Bldg. 770-346

Originating Dept. Engineering *K2/REZ*

Copy to MECCO

Subject Chemical Resistance of
DuPont's ECD-006- *KALREZ*
Perfluoroelastomer -
Black Vulcanizate

In a continuing program to evaluate new elastomeric materials for possible use in chemical service, ECD-006 perfluoroelastomer, a synthetic rubber manufactured by E. I. DuPont de Nemours and Company has been tested. The material has far greater resistance to organic chemicals than any other fluoroelastomer evaluated.

The ECD-006 is produced in both gum and black vulcanizates, the primary difference being the addition of carbon black to the black vulcanizate to increase the mechanical strength. Only the black vulcanizate was evaluated in these tests.

Results of the laboratory tests (Table I) indicate an exceptionally broad range of chemical resistance for ECD-006, although failure occurred in organic acid, aldehyde, latex and certain amine test media. Compared with "Viton A", another widely used fluoroelastomer, ECD-006 offers a much greater potential for use in organic chemical process streams.

In addition to the superiority of ECD-006 over "Viton A" in chemical resistance, DuPont reports greatly improved continuous heat resistance for ECD-006. The ECD-006 remains usefully elastic after 200 days at 260°C (500°F) compared to +40 days at 260°C for "Viton A" according to their data. The physical properties of the two elastomers are reported by DuPont to be similar.

The recommendation of ECD-006 over "Viton A" and possibly other elastomers would be obvious except that the price of ECD-006 is approximately 20 times that of "Viton A" at the present time. Hopefully, the price of the new ECD-006 will be reduced with time. There may be special situations however, where the high cost of ECD-006 can be justified at the present time.

*FRANKIS J. Asti, Market Development**Area code 202 772-3434**H. T. Pritt*
H. T. Pritt

HTP/ds

UCC
052391Attachment: 1 Table
Not book Refer nc : 29JCC-6212043 Index: G, 23, 50, 119, 155, 157,
162, 166, 168, 181, 184,
187, 190, 194, 195, 197,
199, 207, 208, 218, 221,
229, 223, 239, 242, 245, 267

TABLE I

CHEMICAL RESISTANCE OF ECD-006 PERFLUOROELASTOMER

Test Conditions: Specimens (3.0" x 0.5") of the elastomer were immersed in the following chemicals for 100 days at 45°C.

<u>Chemical</u>	<u>Hardness</u> (1)	<u>Mgs./CM²</u> <u>Change</u>	<u>Gross Thick.</u> <u>Change, Inches</u>	<u>Comments</u>
Acetic Acid, Glacial	75	+40.95	+0.012	*Moderately swollen; no wrinkles
Acetic Acid, 10%	63	+56.74	+0.016	*Badly swollen; blistered; wrinkled
Acetic Anhydride	79	+ 4.45	+0.002	Very slightly swollen; no other visible change.
Acetone	75	+ 3.01	+0.003	Very slightly swollen; no other visible change.
Acetonitrile	75	+ 1.42	None	No visible change.
Ammonium Hydroxide	75	+ 6.06	+0.003	Very slightly swollen and bleached; no other visible change.
Aviation Gas	73	+ 3.63	+0.001	Very slightly swollen; no other visible change.
Benzene	75	+ 3.88	None	Very slightly swollen; no other visible change.
Butanol	74	- 0.73	None	No visible change.
Butyl Acetate	75	+ 5.05	+0.003	Very slightly swollen; no other visible change.
Butyl Carbitol	75	+ 0.81	+0.001	No visible change.
Butyl Cellosolve	75	+ 1.56	+0.001	No visible change.
Butyraldehyde	71	+39.1	+0.019	*Moderately swollen; blistered
Carbon Tetrachloride	69	+11.2	+0.003	Slightly swollen; no other visible change.
Ethanol, SD-2B	72	+ 1.6	None	No visible change.
Ethyl Acetoacetate	73	+ 2.6	None	No visible change.
Ethylene Chlorohydrin	66	+ 9.0	+0.005	Slightly swollen and softened.
Ethylenediamine	64	+20.4	+0.009	*Swollen and blistered.
Ethylene Dichloride	72	+ 4.1	+0.001	No visible change.
Ethylene Glycol	73	+ 0.16	None	No visible change.
2-Ethyl Hexanoic Acid	74	+ 0.9	None	No visible change.
FLEXOL Plasticizer DOP	75	+ 0.2	None	No visible change.
Formaldehyde	64	+28.0	+0.007	*Moderately swollen and softened.

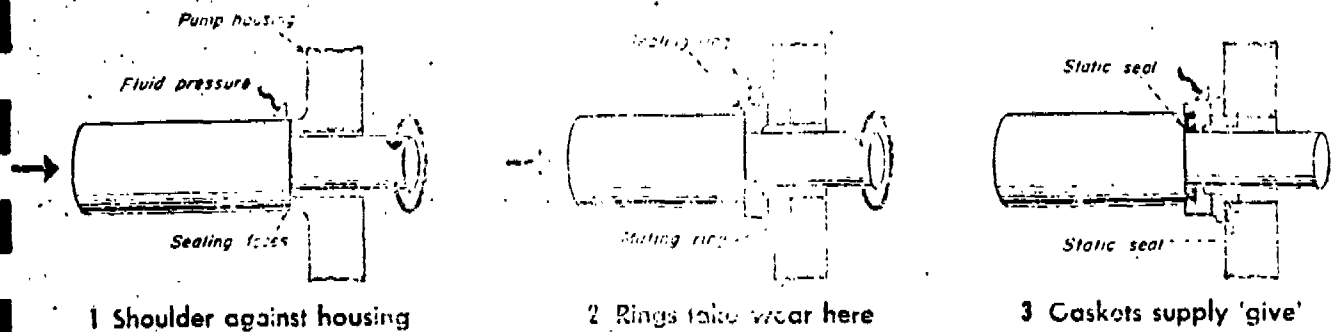
TABLE I (continued)

Chemical	Hardness (1)	Mgs./CM ² Change	Gross Thick. Change, Inches	Comments
Formic Acid, 90%	42	+131.9	+0.033	*Badly swollen and softened.
Glyoxal, 40%	75	+ 2.9	-0.010	No visible change.
Hexanol	75	+ 1.5	None	No visible change.
Hydrochloric Acid, 10%	73	+ 7.3	+0.002	Very slightly swollen; no other visible change.
Isophorone	74	+ 1.8	None	No visible change.
Kerosene	73	+ 1.4	None	No visible change.
Methanol	74	+ 1.6	None	No visible change.
Methyl Ethyl Ketone	71	+ 3.1	+0.001	No visible change.
Monoethanolamine	71	+ 2.2	+0.001	No visible change.
Nitric Acid, 10%	69	+ 12.0	+0.003	Slightly swollen and softened.
Phenol	76	+ 1.8	None	No visible change.
Sodium Hydroxide, 10%	77	+ 3.7	None	No visible change.
Sulfuric Acid, 98%	75	+ 5.6	None	Very slightly swollen; some absorption.
UCAR Latex WC-130	59	+ 28.4	+0.010	*Moderately swollen; softened.
Vinyl Acetate	74	+ 3.0	+0.001	No visible change.
Water at 90°C	73	+ 11.7	+0.004	Very slightly swollen; no other visible change.

(1) Original hardness - 75 Durometer (Shore) A

* No good. Based on previous standards of admissible changes in the properties of an elastomer when tested in this manner, the material should not be used in the chemical exposure listed.

UCC
052393



Starting from scratch, let's design a typical

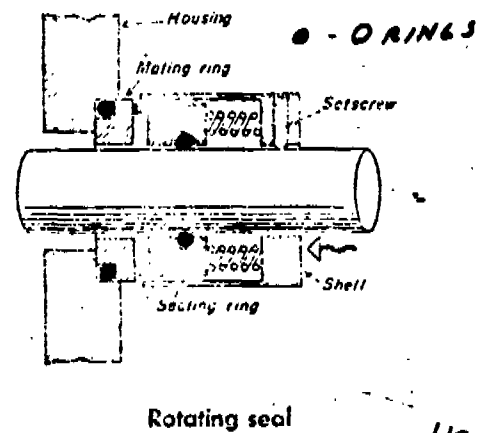
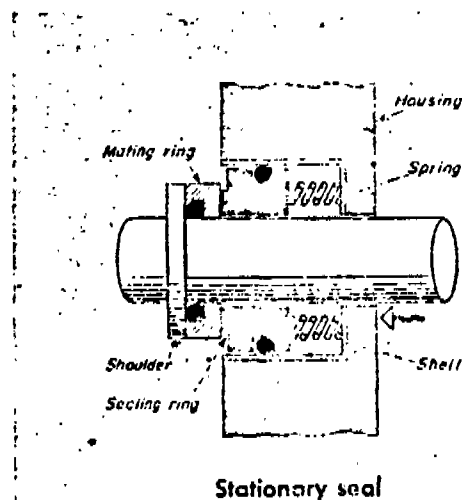
► SIMPLEST FORM of mechanical seal has a shoulder on shaft pressing against machine housing, Fig. 1. This will work if housing and shoulder are both finished properly and shaft is loaded against housing at all times so fluid inside casing won't leak through. But this isn't practical on most machines. For one thing, there is always some shaft end-play and run-out (gyration). There are other reasons, also.

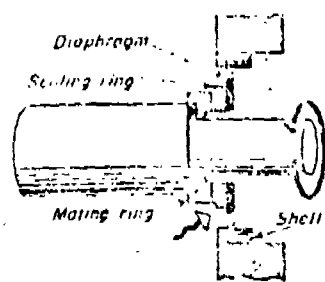
Next step is to press a sealing ring into the housing and press another ring on the shaft, Fig. 2. Now sealing surfaces of rings are easier to machine and lap. Also, rings can be renewed when they wear without machining sealing area of shaft or housing. But keeping shaft against the sealing area is a problem. So is shaft run-out or gyration because rings are rigid and run-out would cause leakage.

Fig. 3 shows next step: mounting of resilient gaskets in

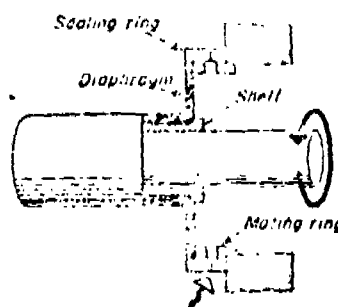
back of rings to give some movement to rings. This also seals fluid leakage around back of rings. But trouble is this simple design is very seldom practical because of the very limited shaft end-motion these static seals (gaskets) can absorb. Besides, you won't be able to obtain and maintain the correct contact force to keep sealing faces together.

Solution is to give either one of the sealing faces axial motion to absorb end-play and shaft run-out, thus holding the rings together at all times. Fig. 4 shows one way to do this. Here we place a diaphragm in the housing. This flexible member gives the sealing ring more axial movement than the gasket we used in Fig. 3. Diaphragm should keep a steady pressure against the two rings so there's no leakage, even if shaft gyrates a little and it has some end-play. So the diaphragm serves three purposes: (1) acts as inner

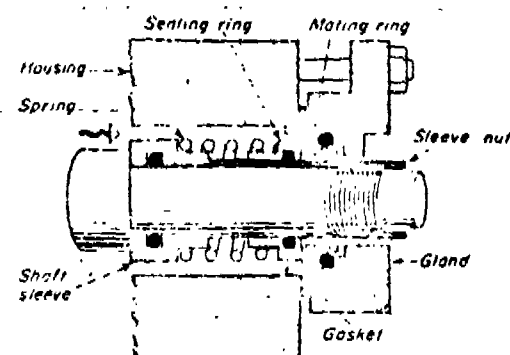




4 Stationary seal



5 Rotating seal



6 Here is complete seal

O-RINGS

modern mechanical seal for our plant

seal between seal ring and housing (2) serves as spring member to create contact force, and (3) prevents rotation between seal ring and housing.

Types of seals. There are two basic types of mechanical seals—stationary and rotating. In a stationary seal the sealing ring is in the machine housing and does not move. In a rotating seal, the sealing ring turns with the shaft.

Seal shell. On a rotating seal, Fig. 5, the seal shell is press fitted onto the shaft. On a stationary seal, the shell is press fitted into the housing. The seal shell is a member to which the diaphragm is fastened and which was not used in the previous four diagrams.

Fig. 6 shows all the functional elements of a mechanical seal. Here the mating ring is wedged into the gland, with the O-ring preventing leakage around it, and giving it some

resilience. Shaft sleeve is held against a shoulder on shaft by a nut. Sleeve also acts as backing ring. If shaft is not threaded as this one, then a setscrew through sleeve is used to hold sleeve on the shaft. Sealing ring is held against mating ring with coil-type spring. Flat gasket between housing and gland prevents leakage. O-rings seal casing fluid along shaft, past sealing ring and in back of mating ring.

For best results, fluid being sealed should be on the outside of mechanical seal so it must travel inward to seep between seal faces. This is important—particles in fluid tend to travel towards a region of higher velocity. This effect is distinct from centrifugal force, which also exists. The effect is most pronounced with viscous liquids; it is less with gases. Solids have less tendency to work between seal faces with fluid on the outside of revolving ring.

Stationary vs rotating mechanical seals

Now you might ask why we have two types of seals. Here are some answers to help you decide on how best to apply each type.

Advantages. Most machines have a rotating shaft with stationary seals, sketch, left. Main advantage of this seal is centrifugal forces don't work on the flexible seal ring because it's stationary. Mating ring is the only rotating member, but it's comparatively small and is usually rigidly attached to shaft. This is done by either a clamping action or over-balanced hydraulic forces which hold it firmly in place. These seals are used on shafts that often travel at 15,000 feet per minute (not rpm) or higher. Shaft diameter may be more than 3 in. This means that the centrifugal forces developed can be extremely high.

On other hand, rotating mechanical seal is subject to centrifugal forces, sketch left. This keeps flexible seal-ring from working freely against mating ring. So this design is

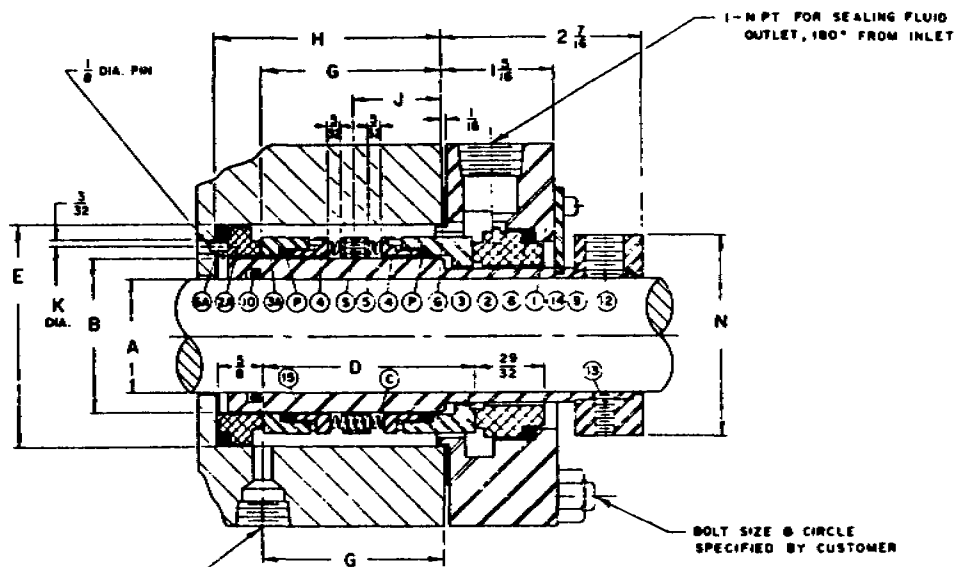
seldom used for high speeds. Main advantage is easy installation on straight shafts found in most machines.

Stationary seal needs a back-up shoulder for positioning the mating ring. Shoulder's relative trueness to shaft will directly effect the face run-out of mating ring.

In rotating seal, mating ring is retained in housing. This housing is usually more easy to machine, therefore it holds the locating shoulder in a true plane. Since rotating seal ring is the flexible member, it's positioned by the mating ring faces. The seal itself can easily be locked by a set-screw, friction fit or similar means on any smooth shaft.

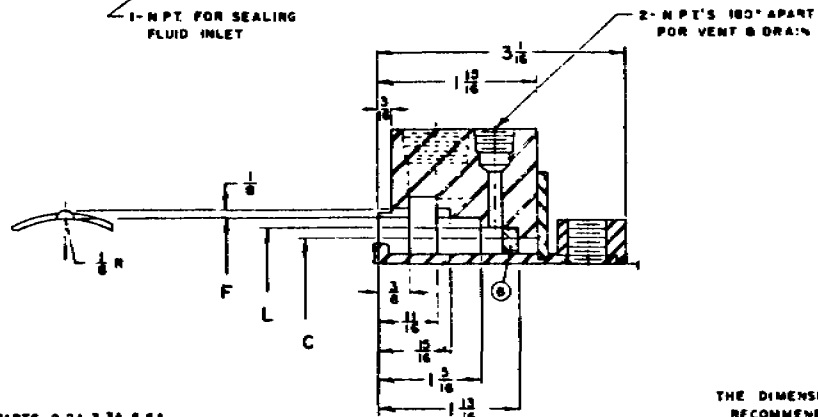
Another advantage for rotating seal is its use in chemical solutions where solids may precipitate and tend to foul the sliding-seal components. Because of centrifugal force, the rotating seal has a greater tendency to free itself from sludges and sediment. But stationary seals may have other design details that often better overcome this advantage.

DOUBLE MECHANICAL SEAL ASSEMBLY



- DURA SEAL PARTS**
- 1 GLAND RING
 - 2 INSERT
 - 2A THROAT BUSHING
 - 3 SEAL RING
 - 3A SEAL RING
 - 4 COMP RING
 - 5 COLLAR
 - 6 "O" RING
 - 6A "O" RING
 - 9 SLEEVE COLLAR
 - 10 "O" RING
 - 12 SET SCREW
 - 13 SET SCREW
 - 14 ECCENTRIC WASHER
 - 15 SLEEVE
 - C SPRINGS
 - G GASKET
 - P SHAFT PKG.
 - S SET SCREW
 - B THROTTLE BUSHING

NOTE, WE SUGGEST PARTS 2,2A,3,3A,6,6A
C,P,S & G BE KEPT IN STOCK AS SPARES



ALTERNATE GLAND ARRANGEMENT FOR VENT & DRAIN WITH THROTTLE BUSHING

TOLERANCE NOT SHOWN $\pm .015$

+001		+004		+005		+001		+005		+001		+005	
A	B	C	D	E	F	G	H	J	K	L	N		
750	1250	3 5	2 3/4	2 25	2 00	2 3/8	3	1 5/12	1 547	1 640	2		
812	1312	4 37		2 97	12 25				1 809	1 703	5		
875	1375	5 00		2 250	12 25				1 672	1 765	5		
937	1437	1 562		2 312	2 97				1 734	1 828	5		
1000	1500	1 625		2 375	2 250				1 797	1 890	5		
1062	1562	68		2 437	2 312				1 859	1 953	5		
1125	1625	1 750	3	2 500	2 375	2 3/8	3 1/4	1 5/12	1 922	2 015	5		
1187	1687	1 812		2 562	2 437				1 984	2 078	5		
1250	1750	1 875		2 625	2 500				2 047	2 140	5		
1312	1812	1 937		2 687	2 562				2 109	2 203	5		
1375	1875	2 000		2 750	2 625				2 172	2 266	5		
1437	1937	2 062		2 812	2 687				2 234	2 328	5		
1500	2000	2 125		2 875	2 750				2 297	2 390	5		
1562	2062	2 187		2 937	2 812				2 359	2 453	5		
1625	2125	2 250		3 000	2 875				2 422	2 515	5		
1687	2187	2 312		3 062	2 937				2 484	2 578	5		
1750	2250	2 375		3 125	3 000				2 547	2 640	5		
1812	2312	2 437		3 187	3 062				2 609	2 703	5		
1875	2375	2 500		3 250	3 125				2 672	2 765	5		
1937	2437	2 562		3 312	3 187				2 734	2 828	5		
2000	2500	2 625		3 375	3 250				2 797	2 890	5		
2062	2562	2 687		3 437	3 312				2 859	2 953	5		
2125	2625	2 750		3 500	3 375				2 922	3 015	5		
2187	2687	2 812		3 562	3 437				2 984	3 078	5		
2250	2750	2 875		3 625	3 500				3 047	3 140	5		
2312	2812	2 937		3 687	3 562				3 109	3 203	5		
2375	2875	3 000		3 750	3 625				3 172	3 266	5		
2437	2937	3 062		3 812	3 687				3 234	3 328	5		
2500	3000	3 125		3 875	3 750				3 297	3 390	5		
2562	3062	3 187		3 937	3 812				3 359	3 453	5		
2625	3125	3 250		4 000	3 875				3 422	3 515	5		
2687	3187	3 312		4 062	3 937				3 484	3 578	5		
2750	3250	3 375		4 125	4 000				3 547	3 640	5		
2812	3312	3 437		4 187	4 062				3 609	3 703	5		
2875	3375	3 500		4 250	4 125				3 672	3 765	5		
2937	3437	3 562		4 312	4 187				3 734	3 828	5		
3000	3500	3 625		4 375	4 250				3 797	3 890	5		
3062	3562	3 687		4 437	4 312				3 859	3 953	5		
3125	3625	3 750		4 500	4 375				3 922	4 015	5		
3187	3687	3 812		4 562	4 437				4 000	4 093	5		
3250	3750	3 875	3 1/8	4 625	4 500	2 1/8	3 1/4	1 5/12	4 062	4 155	5		
3312	3812	3 937		4 687	4 562				4 125	4 218	5		
3375	3875	4 000		4 750	4 625				4 187	4 280	5		
3437	3937	4 062		4 812	4 687				4 250	4 343	5		
3500	4000	4 125		4 875	4 750				4 312	4 405	5		
3562	4062	4 187		4 937	4 812				4 375	4 468	5		
3625	4125	4 250		5 000	4 875				4 437	4 530	5		
3687	4187	4 312		5 062	4 937				4 499	4 593	5		
3750	4250	4 375		5 125	5 000				4 561	4 654	5		
3812	4312	4 437		5 187	5 062				4 623	4 716	5		
3875	4375	4 500		5 250	5 125				4 685	4 778	5		
3937	4437	4 562		5 312	5 187				4 747	4 840	5		
4000	4500	4 625		5 375	5 250				4 809	4 902	5		

DURAMETALLIC CORPORATION
KALAMAZOO, MICH

DATE 1-18-64
DRAWN W M
TRACED
CHECKED

SCALE 40X
GRAPHIC 80
30-51,32

DOUBLE INSIDE NO. PTO
CARTRIDGE

THE DIMENSIONS SHOWN ARE THE
RECOMMENDED MINIMUM

DOUBLE INSIDE NO, PTO
CARTRIDGE

DURAMETALLIC CORPORATION

KALAMAZOO, MICH.

DATE	1-14-64	SCALE	50%
------	---------	-------	-----

DATE	7-12-54	BY	W. M.
DRAWN BY	W. M.	CHECKED BY	W. M.

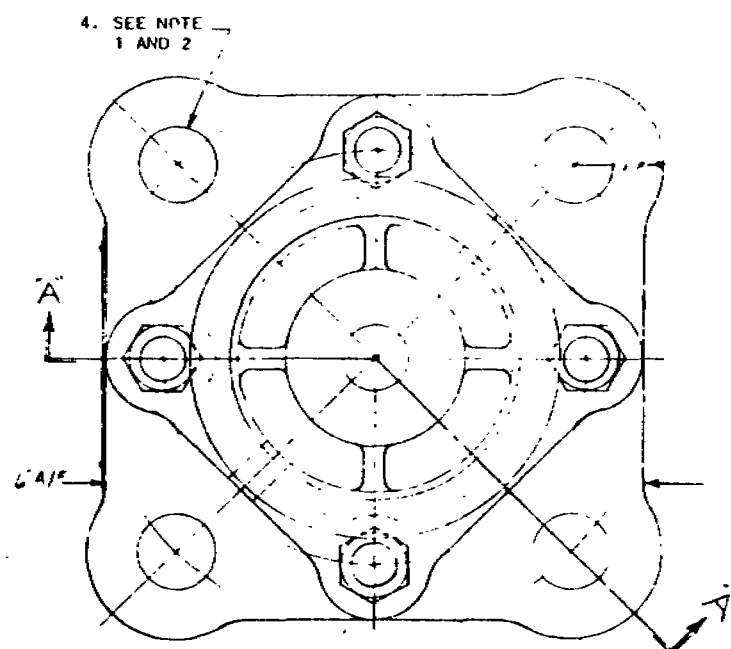
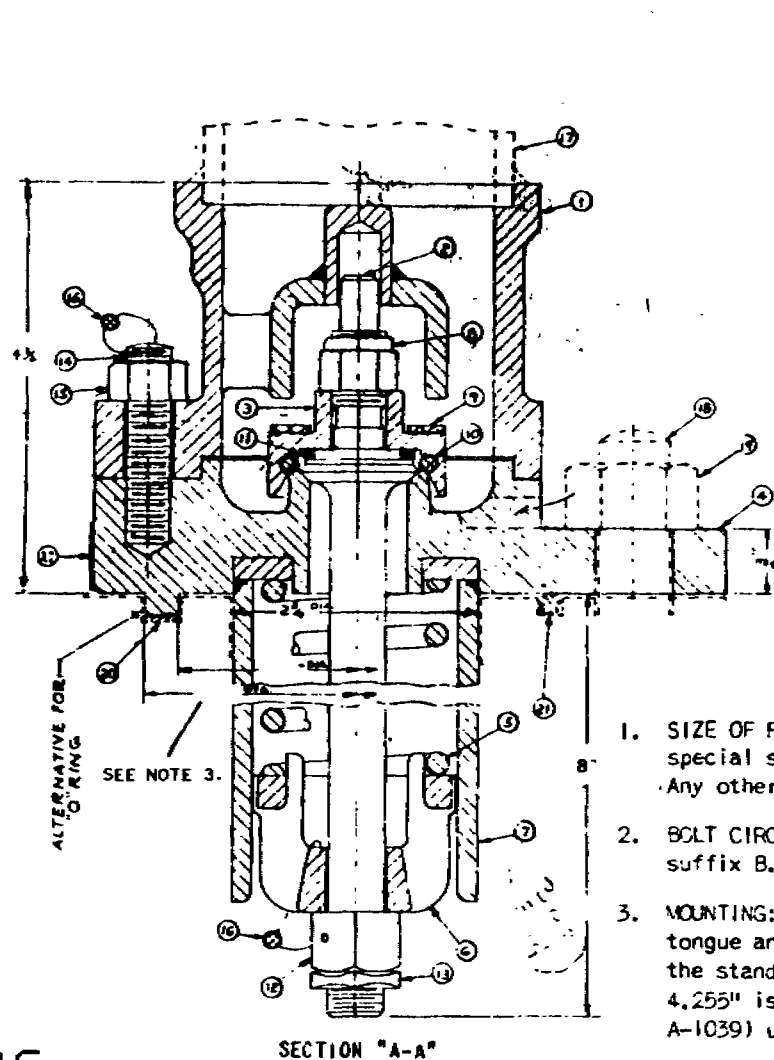
TRACED 30-51327

MIDLAND VALVES AND GAGES

FITTINGS - MOUNTINGS - ACCESSORIES

MIDLAND MANUFACTURING CORPORATION
7733 GROSS POINT ROAD - SKOKIE, ILLINOIS 60076
PHONE NUMBER: (312) 677-0333

UCC
052397



1. SIZE OF FLANGE HOLES: 7/8" is standard on all valves, except 3/4" on A-1035 and A-1039. If a special size of hole; i.e., 7/8" on A-1039 or 3/4" on A-1075 through A-1379 is desired, use suffix J. Any other Flange Hole, use suffix J.
2. BOLT CIRCLE: 6 1/2" is standard on all valves. If a special Bolt Circle of 6 1/2" is desired, use suffix B. Any other Bolt Circle use suffix C.
3. MOUNTING: The standard mounting on all valves, except A-1035 and A-1039, is the AAR Standard tongue and groove with an OD of 4.745" $\pm$.003 and an ID of 4.005" $\pm$.003. Or the A-1035 and A-1039 the standard mounting is a flat flange (no tongue and groove). If a special mounting 4.995" x 4.255" is desired, use suffix M. If a flat flange is desired for any valve (other than A-1035 and A-1039) use suffix F. For any other mounting use suffix P.

EXAMPLE OF ORDERING FOR SPECIAL REQUIREMENTS: A-1150-HPM is A-1150 valve with 4-3/4" with Holes on a 6 1/2" Bolt Circle, with a 4.995" x 4.255" tongue and groove mounting.

APPROXIMATE WEIGHT OF VALVE - 25#.

ITEM NO.	NO. REQ'D.	DESCRIPTION	MATERIAL FOR SS TRIM VALVES	PART NUMBERS FOR A-1035 Thru A-1375	MATERIAL FOR STAINLESS VALVES	PART NUMBERS FOR A-1039 Thru A-1379
1	1	TOP GUIDE	STL W/SS INSERT	10-1.XS	STAINLESS	10-1-SS
2	1	STEM	STAINLESS	10-2-SS	STAINLESS	10-2-SS
3	1	RETAINER	STEEL, CAD. PLT.	10-3-CS	STAINLESS	10-3-SS
4	1	BODY	STEEL, CAD. PLT.	10-4-CS	STAINLESS	10-4-SS
5	1	SPRING	STEEL, CAD. PLT.	SEE TABLE BELOW	STAINLESS	SEE TABLE BELOW
6	1	FOLLOWER	MALL. IRON, CAD. PLT.	10-6-MI	STAINLESS	10-6-SS
7	1	SPRING GUIDE	STEEL, CAD. PLT.	10-7-CS	STAINLESS	10-7-SS
8	1	TOP LOCK NUT	STEEL, CAD. PLT.	10-8-CS	STAINLESS	10-8-SS
9	1	WASHER	LAMIN. NEOPRENE*	10-9-LN	LAMIN. NEOPRENE*	10-9-LN
10	1	SEAT "O" RING	BUNA N-70D*	10-10-BN	BUNA N-70D*	10-10-BN
11	1	STEM "O" RING	BUNA N-70D*	10-11-BN	BUNA N-70D*	10-11-BN
12	1	BOTT. ADJ. NUT	STEEL, CAD. PLT.	10-12-CS	STAINLESS	10-12-SS
13	1	BOTT. LOCK NUT	STEEL, CAD. PLT.	10-13-CS	STAINLESS	10-13-SS
14	4	STUD	ALLOY, CAD. PLT.	10-14-AS	STAINLESS	10-14-SS
15	4	STUD NUT	STEEL, CAD. PLT.	10-15-CS	STAINLESS	10-15-SS
16	2	SEAL	LEAD W/SS WIRE	10-16-PB	LEAD W/SS WIRE	10-16-PB
17	1**	3" STD. PIPE	STEEL	10-17-CS	STAINLESS	10-17-SS
18	4**	3/4" STUD	ALLOY STEEL	10-18-AS	STAINLESS	10-18-SS
19	4**	3/4" NUT	STEEL	10-19-CS	STAINLESS	10-19-SS
20	1**	GASKET	LEAD	10-20-PB	LEAD	10-20-PB
21	1**	MOUNTING O RING	BUNA N-70D*	10-21-BN	BUNA N-70D*	10-21-BN
22	1	NAMEPLATE	STAINLESS	SEE TABLE BELOW	STAINLESS	SEE TABLE BELOW

* Alternate material available.

** Not furnished unless requested.

PLEASE NOTE: PLATING ON PARTS CAN BE CHANGED OR ELIMINATED ON WHICHEVER PARTS CUSTOMER SPECIFIES. THE PLATING ON THE ABOVE PARTS IS TYPE RECOMMENDED FOR GENERAL SERVICE.

STAINLESS TRIM VALVES				
VALVE NO.	PRESSURE SETTING	CFM (Air)	SPRING NO.	NAMEPLATE NO.
A-1035	35	661	10-35-AS	12-35-SS
A-1075	75	1109	10-75-AS	12-75-SS
A-1150	150	2004	10-150-AS	12-150-SS
A-1225	225	2884	10-225-AS	12-225-SS
A-1247	247	3070	10-225-AS	12-247-SS
A-1300	300	3516	10-300-AS	12-300-SS
A-1375	375	4220	10-375-AS	12-375-SS
A-1450	450	4705	10-450-AS	12-450-SS

STAINLESS VALVES				
VALVE NO.	PRESSURE SETTING	CFM (Air)	SPRING NO.	NAMEPLATE NO.
A-1039	35	661	10-39-SS	12-39-SS
A-1079	75	1113	10-79-SS	12-79-SS
A-1154	150	1940	10-154-SS	12-154-SS
A-1229	225	2670	10-229-SS	12-229-SS
A-1304	300	3695	10-304-SS	12-304-SS
A-1379	375	4615	10-379-SS	12-379-SS

- Ethylene Oxide

REVISED 1-4-67

UCC
052399