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LOOKING FOR ASBESTOS SUBSTITUTES

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PLAINTIFF'S EXHIBIT

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This paper is presented from the perspective of users in the Petroleum Industry. The use of data presented here for other industries may, therefore, have to be adjusted to reflect the unique requirements of those industries. It is felt, however, that the analyses process to find a substitute is valid in any industry.

In recent years some well known Manufacturers have removed asbestos products from their product lines. It is also no secret that governmental and environmental restrictions have placed a burden on manufacturers of asbestos products. Expectations are that asbestos products will become less available in the future. With this in mind the search for a substitute began a few years ago. This paper will review the following areas:

- ° What is considered a true asbestos substitute?
- ° Our findings on packing and gasket materials

Asbestos has served and is still serving industry well. It has been the "work-horse" packing and gasket material for refineries and chemical plants.

1. WHAT IS CONSIDERED A TRUE ASBESTOS SUBSTITUTE?

To answer this question, one should consider all the positive characteristics of asbestos packing and gaskets. A true substitute must be as good or better than asbestos in all of the following areas:

- ° Service reliability
 - Asbestos has served well in this area
 - There are PTFE, graphite, aramid based, ceramic based and mica based products available. All have varying process limitations. With this multitude of products, there are still too many manufacturers of substitute materials who are reluctant to divulge what their product is made of. One cannot buy "black boxes" when the safety of employees or the reliability of plants are involved. Also, many manufacturers have limited service data on their products. Some products were recently introduced and reliable long-term data is not available on them. All this makes it difficult to select suitable substitutes. One must be careful and not always take the manufacturer's claim at face value. If possible, test run a product before approving it.

° Maintain integrity in a fire

- It is not only economics that has made the use of asbestos gaskets so wide spread. A refinery cannot have leaking flanges during a fire. Asbestos has proven to maintain the integrity of the joint in a fire. Hence asbestos is found to be fire-safe. This is one area where research emphasis and available data is virtually non-existent for substitutes. Most research and data seen to-date concentrate only on the process compatibility of the substitute material.
- The characteristics of a packing or gasket in a fire should be a high consideration in all flammable or hazardous material services since no one wants a hydrocarbon sprinkler system in a fire.
- To date no manufacturer of asbestos substitutes has been able to present us with data of any firetest done on their products. We have firetested a mica based gasket and the result was such that this type of product is suspect. With the exception of pure (95%+) graphite, we consider all non-asbestos substitutes to be non-firesafe until we have completed some additional testing. Preliminary studies indicate that our decision is justified.

° Wide range of service applications

Asbestos gaskets are specified for 95% of our services. There is a safety and economic advantage to having a product that has a wide service application.

- The danger of misapplication is minimized. Our mechanics do not have to become application engineers.
- Standardizing is possible which minimizes requirements for storage, guidelines, etc.

° Economical

- The product must be economical, however, the other requirements must not be sacrificed. One can expect to initially pay more for the substitute materials. Graphite, however, is a good example of what happens when the use of a product becomes widespread. Just one year ago (depending on valve size) a valve with graphite packing cost 5%-25% more than an asbestos packed valve. Today most manufacturers quote the same price for both packings.

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Summarizing the discussion of asbestos substitutes:

To date, except for pure graphite materials, no substitute can indisputably claim to be fire-safe. Also, many have a limited range of applications. One questions then if they can truly claim to be an asbestos substitute. They are an available option in a limited service area but cannot and should not claim to be a substitute for asbestos. This implies equivalency with asbestos characteristics which is often an incorrect statement of facts. To date we have found that only pure flexible graphite equals or surpasses all the positive characteristics of asbestos.

2. OUR FINDINGS ON PACKING

For some time now, testing with various packing materials to identify suitable asbestos replacements has been in progress. The work of Curt Ball at the Baytown Refinery and the assistance of Exxon Research and Engineering Company in a two year test at the Baton Rouge Refinery are hereby acknowledged. It should be noted that asbestos packing is still acceptable. However, for reasons to be mentioned later, graphite is preferred when it is compatible with the service. Note that graphite does have service limitations. Most manufacturers can supply you with these limitations and this paper will not address this.

Early in our testing it became apparent that flexible graphite was the most suitable substitute since its characteristics equaled or surpassed the above-mentioned positive characteristics of asbestos. Enough firetests of valves packed with graphite have been witnessed to verify that pure graphite packing materials from reputable manufacturers can be considered fire-safe. We consider a product to be graphite (for refinery services) if it consists of more than 95% pure carbon, has no asbestos and the leachable chloride content does not exceed 50ppm. The next step was to determine the optimum configuration of the packing.

• Evolution of the packing configurations

- After some initial setbacks and incorrect configurations our experience and data from industry indicated that the "stacked" packing configuration showed very promising results. The stacked configuration consists of a graphite bull-ring on top and bottom and die-formed graphite rings in the middle. This is also called a "sandwich" configuration. The question was and still is "What is the optimum amount of packing rings?". The current configurations are shown on the following slides:
- Slide #1 - API-600 Valves
 - + The bull-rings (Type A) are made of interlaced braided carbon with a graphite coating. The dieformed rings (Type B) may contain no binders, lubricants or additives not approved by the Owner's Engineer.

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It is imperative that acceptable manufacturers and specific packing styles be selected for your plant since most manufacturers have a wide selection with varying quality to choose from. Do not be swayed by claims stating that a product is "X% cheaper". We have found that "30% more expensive" represented a small amount of total additional annual dollars. One failure can easily void the dollar savings. Check the actual dollars one would spend extra annually and then determine if the extra quality is worth it. When comparing costs also consider the costs of disposing of the asbestos product.

We have specified top quality materials only. Unfortunately, our accepted manufacturers and styles were removed from this slide since we refrain from publicly endorsing a manufacturer. Experience indicates that the first five rings (a "five-stack" packing) should hold 1200 psig. Data from industry indicates that this can be higher. We have no experience with these higher pressures, however. Most valves have stuffing boxes made per API-600 and require additional rings to fill the box. No more than nine rings are allowed. If the box requires more rings, then a spacer bushing should be used. Is this the optimum configuration? I do not think so. As we gain more confidence in the graphite packing, I suspect that less rings will be used.

- + Note #3 requires the packing to have an approved corrosion inhibitor. There are active and passive inhibitors and most manufacturers claim that their own type is the only one that will work. Which type to use is still an open question for us. Each have pros and cons. My recommendation is that the packing manufacturer be required to disclose which inhibitor is used and that lab and/or field data be required to substantiate any claims. It is too early to settle on a specific inhibitor. Only experience will tell which one lasts longer since most of those being proposed should work. What is recommended is that the need for a corrosion inhibitor be specified. The only two failures we have experienced are valves packed with graphite containing no corrosion inhibitors. The time between manufacturing and installation can be long. In our case the valves arrived too late for a unit turnaround and were stored for one year before being installed. They passed a hydrotest, but after the first stroking, hot oil was released through the packing. It was later determined that the year of storage had caused stem corrosion which destroyed the packing during stroking and a leak path was created. The valves were repacked and are still working fine. The additional cost of a corrosion inhibitor is minimal.

- Slide #2 - API-602 and Quarter Turn Valves

This reflects the requirements for these type of valves. Note the smaller quantity of packing rings. As more confidence is gained, we suspect that fewer rings will do an adequate job for most refinery services.

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• Densities Required

- This is an interesting topic. The definition needs to be standardized. When discussing densities, some use the density of the ribbon used to make the die-formed ring. Others use the density of the rings after they have been compressed in the stuffing box. This is confusing and has led to miscommunications. The densities quoted in this paper are the densities of the die-formed rings as purchased before placing in the stuffing box.

- What is the correct density to specify?

That depends on whom you are talking to. One manufacturer has valid arguments and examples to justify that his low density rings (70-75 lbs/cft) will work. Another is quoting equal success with high density rings (90 lbs/cft). Deciding who to believe is difficult for the engineer. Both densities have worked for us. The higher densities are easier to work with and are preferred by valve manufacturers.

However, once the density reaches 100 lbs/cft, field adjustment can become difficult. At 105 lbs/cft, adjustment is very difficult since the ring is extremely hard. Starting with a high density may benefit the valve manufacturers, but does not give the user the packing longevity lower densities allow.

Lower densities are especially needed when repacking valves. Many manufacturers do not adhere to the API-600 stuffing box dimensions. Four valves of different sizes from each of five manufacturers were checked in a recent survey. From the twenty valves, not one was in accordance with API-600 stuffing box dimensions for the stem diameters selected. With this kind of discrepancy higher density rings made to meet API-600 dimensions have less chance of working when repacking such a non-standard valve.

- Allowable densities for Exxon valves range from 75 to 85 lbs./cft. It was found that these ranges:
 - + Give the manufacturers the packing benefits of higher density while still allowing the users a reasonable adjustment capability required for a longer service life.
 - + Allows us the flexibility of repacking non-standard stuffing boxes without having to custom make each packing.
- Depending on whose product you use a compression of 3%-5% of each die-formed ring is needed to assure proper operation. The range of compression has a direct relationship with the original density of the die-formed packing ring.
- The search for the optimum density is not over and could be the topic of a separate paper. Time allotted, however, forces me to move on.

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- Environmental bonuses

Graphite packing is proving to reduce the hydrocarbon emission rates of the valves compared to asbestos. This is especially true in higher temperature services.

Summarizing our findings on packing:

While asbestos is still an approved packing material, graphite packing is proving to meet or surpass all the positive characteristics of asbestos. Increased usage is lowering the price to where graphite packing has become competitive with asbestos. Other non-asbestos substitutes to-date have not proven to be fire-safe which represents a major flaw to us.

3. OUR FINDINGS ON GASKETS

Currently, asbestos gaskets are still approved for the majority of our services. Only asbestos and graphite are approved in API-601 spiral wound gaskets. A major reason is the non-firesafe characteristics of other substitutes. The same deficiencies mentioned before for packing materials also apply to gaskets. With the amount of flange joints in a typical refinery, the requirement for a fire-safe gasket in a hydrocarbon or other flammable service is obvious. One cannot have leaking flanges in a fire. I have witnessed various firetests in which API-601 graphite spiral wound gaskets from known manufacturers were repeatedly re-used (up to six times in one case). These gaskets withstood the torture of an Exxon Company, USA firetest which can safely be considered a very severe firetest. Asbestos spiral wound gaskets could generally only be used once or twice. A mica-based spiral wound gasket, upon being subjected to a firetest, could not hold 10 psig after the fire was extinguished. Flange bolts were tightened until one broke without stopping the leak.

Studies made on some compressed non-asbestos gaskets showed that the tensile strength across the grain was less than 50% of the strength of asbestos gaskets specified for our refineries. This characteristic has also been observed in reports and studies made by others. In our experience a non-reinforced compressed graphite valve bonnet gasket blew out after 18 months in service. The low tensile strength is a concern and is one reason we have not approved the use of gaskets made of compressed non-asbestos materials. Graphite gaskets made with wire reinforcing have possibilities and are being reviewed.

Summarizing the discussion of gasket substitutes:

At this time compressed non-asbestos gaskets are considered experimental and not approved for general use. Spiral wound API-601 graphite gaskets from a reputable manufacturer are an acceptable substitute. Wire reinforced compressed graphite has promise and is being studied. I suspect that graphite will also be selected as the asbestos substitute once the deficiencies of compressed graphite gaskets are overcome.

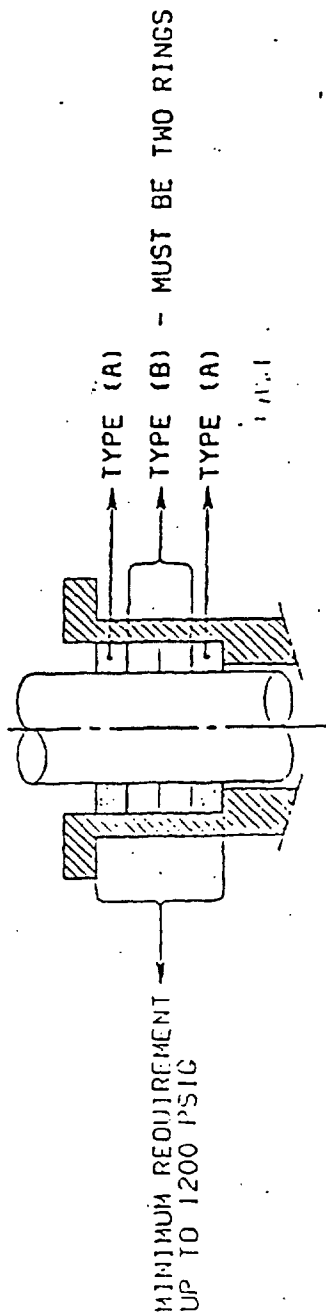
This concludes my talk and I will gladly answer any questions.

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BLOCK VALVE GRAPHITE PACKING GUIDE

TYPE	GENERIC DESCRIPTION
(A)	INTERLACED BRAIDED GRAPHITE FILAMENT WITH GRAPHITE COATING
(B)	FLEXIBLE GRAPHITE CONTAINING NO BINDERS, LUBRICANTS OR ADDITIVES. (DIE-FORMED. SEE NOTES 3 & 4 FOR EXCEPTIONS).



- NOTES:
1. OTHER MANUFACTURERS ARE BEING REVIEWED.
 2. OBSERVE TEMPERATURE, MANUFACTURER'S AND SERVICE LIMITATIONS.
 3. MUST HAVE APPROVED CORROSION INHIBITOR. MUST BE MORE THAN 95% PURE CARBON.
 4. AFTER DIE-FORMING, THE RING DENSITY TO BE:
 - MINIMUM 75 LBS./CU.FT.
 - HIGH 85 LBS./CU.FT.
 5. BELOW -100°F SERVICE, CONSULT
 6. SEE SHEET #1 FOR INSTALLATION INSTRUCTIONS.

DESIGNED BY	REV. 3	API 602 AND QUARTER TURN VALVES	SHEET OF	DWG. NO.
SCALE	DATE 5/86			

BLOCK VALVE GRAPHITE PACKING GUIDE (REV 3) ISSUED 5/86

INSTALLATION INSTRUCTIONS

GRAPHITE PACKING

1. CLEAN THE STUFFING BOX THOROUGHLY. MAKE SURE ALL PACKING IS REMOVED. IF PACKING A NEW VALVE, MAKE SURE ALL SURFACES ARE CLEAN.

2. RECOMMENDED FINISH ON STEM AND STUFFING BOX IS 32 RMS.

3. THE FOLLOWING DIAMETRICAL CLEARANCES SHALL BE ADHERED TO:

• STEM TO GLAND	.010" - .020"
• GLAND TO BONNET	.010" - .020"
• STEM TO BONNET	PER API-600, TABLE 2
• PACKING WIDTH	PER API-600, TABLE 2

	RECOMMENDED	MAX.
• PACKING TO STEM	.0001" - .0005"	.015"
• PACKING TO BONNET	.0005" - .0100"	.025"

4. CLEARANCE AT THE BOTTOM OF THE STUFFING BOX SHALL NOT EXCEED .020". ALWAYS INSTALL A BRAIDED GRAPHITE BULL RING AS SHOWN..

5. DIE-FORMED RINGS ARE FURNISHED ENDLESS AND PREFERRED INSTALLATION IS WITH AN ENDLESS RING. IF DUE TO CIRCUMSTANCES, ENDLESS RINGS CANNOT BE INSTALLED, THEY MAY BE ORDERED CUT AT A 45° ANGLE OR CUT ENDLESS RING BY USING A RAZOR BLADE. IF SPLIT RINGS ARE USED, MAKE SURE THAT THE SPLITS IN EACH SUCCEEDING RING ARE STAGGERED 90°.

6. INSTALL RINGS ONE AT A TIME TO MAKE SURE EACH RING IS SEATED PROPERLY. USING A SPLIT RING BUSHING HELPS PROPER INSTALLATION. COMPRESS EACH RING ABOUT 2% TO 3%. THIS MOLDS THE RINGS TO THE STEM AND THE BORE AND UNIFORMLY COMPACTS THE RING. EACH SUCCEEDING RING MUST BE INSTALLED IN THE SAME MANNER.

7. WHEN THE STUFFING BOX IS FILLED WITH THE CORRECT NUMBER OF RINGS, COMPRESS THE PACKING SO THAT THE FINAL HEIGHT OF THE PACKING IS APPROXIMATELY 75% OF ITS ORIGINAL UNCOMPRESSED HEIGHT. THIS MAY THEN REQUIRE ONE OR TWO ADDITIONAL RINGS TO MAKE SURE STUFFING BOX IS FILLED CORRECTLY. THE GLAND SHOULD HAVE FINAL CLEARANCE SUFFICIENT FOR FUTURE ADJUSTMENTS.

8. OPERATE THE VALVE ONCE OR TWICE TO HELP THE PACKING ADJUST. PRESSURIZE THE VALVE AND CHECK FOR LEAKAGE. IF REQUIRED, TIGHTEN EACH NUT APPROXIMATELY 1/4 TURN OR TWO FLATS AND RECHECK FOR LEAKAGE. REPEAT IF NECESSARY UNTIL LEAKAGE IS STOPPED.

9. FIELD ADJUSTMENTS

TIGHTEN EACH NUT APPROXIMATELY 1/4 TURN OR TWO FLATS AND RECHECK FOR LEAKAGE. REPEAT IF NECESSARY UNTIL LEAKAGE IS STOPPED.

DRN BY	TRD. BY	REV. 3	API-600 AND	SHEET 1 OF 3	DWG. NO.
SCALE	APPR	DATE 5/86	QUARTER TURN VALVES		

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GASKETS

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I. General

- A. A gasket specification should be included as part of each piping or equipment specification.
- B. Specifications
 - 1. Use approved piping specifications for gasket selection for established services.
 - 2. Plant experience with gaskets in a particular service can vary due to minor differences and should always be consulted.
 - 3. Gasket selection for new or unusual services should be made by a team of at least the manufacturing representative, project engineer and Mechanical R&D and specifications prepared accordingly.
 - 4. Whenever possible, the materials and styles specified should be those normally stocked.

II. Properties of a Gasket

A gasket is used to create a seal between two separable members of a mechanical assembly. The gasket selected must meet the needs of the materials contained and the faces to be sealed.

- A. The gasket must be impervious to the fluid handled in the system.
- B. The gasket must have sufficient chemical resistance at the service temperatures to be encountered, both at its outer and inner areas of contact with the fluid, to maintain its sealing ability.
- C. The gasket must not contaminate the system being sealed.
- D. The gasket must not promote corrosion of the flanges with which it comes in contact.
- E. The gasket must be capable of withstanding the required bolt loading without crushing or undergoing excessive plastic flow.

- F. The gasket must be sufficiently deformable to seal normal irregularities of the surfaces.
- G. The gasket must not cause excessive stresses in the flanges to be sealed at either the operating or gasket seating conditions.
- H. The gasket must be elastic enough to maintain a sealing load when the system is at its maximum pressure load and must be capable of withstanding pressure temperature cycling of the system.
- I. The gasket must develop adequate friction in contact with the flange face and have adequate strength to resist blow out under pressure.
- J. The gasket should be easy to install and to separate from the flange faces for ultimate removal.
- K. The gasket must resist damage in handling so it can perform its intended function.

III. Selecting the Right Gasket

- A. The right gasket to select will be influenced by:
 - 1. Design and materials of construction of the joint to be sealed and the bolting used.
 - 2. Nature of the fluid contained.
 - 3. Temperature of the system.
 - 4. Pressure to be sealed.
- B. Good practice in selection of a gasket is:
 - 1. Select a gasket with the thinnest thickness capable of performing the sealing requirement.
 - 2. Gasket sizes should always conform to ANSI standard sizes or be calculated by ASME or TEMA codes for the service conditions.
 - 3. Whenever possible a gasket should be selected from those listed in section IV. Other designs or materials will be necessary for certain jobs and these should be selected after being specifically engineered.

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C. Temperature limits of common gasket materials are:*

Compressed asbestos sheet	to 850°F
Teflon (TFE)	450°F
Viton rubber	400°F
Red rubber	200°F
Vegetable fiber	212°F
Grafoil	3,000°F
Spiral wound SS/asbestos	1,200°F

Maximum metal temperatures:

Copper	400°F
Lead	250°F
Aluminum	800°F
Carbon Steel	1,000°F
304, 316 SS	1,000°F
321, 347 SS	1,600°F

*at temperatures approaching the maximum temperature the allowable pressure is generally decreased below the maximum allowable pressure at lower temperature.

D. Ring-type gaskets for pipe flanges cut from flat sheet with the O.D. sized to center the gasket by the flange bolts are commonly available with two inside dimensions:

1. To fit the I.D. of schedule 40 pipe without leaving a crevice. To be used with weld neck or other flanges which come square to the pipe I.D.
2. To fit to the O.D. of standard pipe without having any gasket material project into the flow stream when slip on or screwed-type flanges are used.

E. Full-face gaskets extending to the O.D. of the flange with holes punched for the bolt holes are used with flat-faced flanges to limit bending of the flanges, particularly FRP plastic or cast iron flanges.

IV. Gasket materials and styles commonly used and available from stock.

A. Compressed asbestos sheet

1. JM-61 - white material for general service use.
Binder is SBR rubber. Cut gaskets 1/16" stocked. Sheets 1/32", 1/16", 1/8" thick stocked.
Maximum pressure x temperature (F) = 250,000. Maximum temperature = 850°F.

2. Garlock 7021 - Dark colored material for general service use. Binder is SBR rubber. Cut gaskets 1/8" thick stocked. Sheets 1/16", 1/8" thick stocked. Maximum pressure x temperature (F) = 300,000. Maximum temperature = 750°F.
3. Durabola - Dark colored sheet used for refrigeration and general service. Rolls 48" wide, 1/16" and 1/8" thick stocked. Binder is Buna S and crude rubber. Maximum temperature = 1100°F, pressure to 3,000 psi.
4. Garlock 900 - essentially the same as JM-61. Stocked 60"x63" sheets, 1/64" thick. Used for frangible safety assembly gaskets.

B. Felted asbestos sheet

1. J-M 83-B - Blue colored felted sheet (white chrysotile asbestos). Temperature to 400°F and pressures to 20 psi. Formerly was a Blue African Asbestos material 44"x51", 1/16" and 1/8" thick.

C. Rubber Sheet

1. Red Rubber - Goodrich SBR-75 or Boston Woven No. 50. 36" and 42" rolls 1/16" and 1/8" thick. Cut gaskets 1/8" thick stocked. General purpose rubber sheet.
2. HyCar, Goodrich, 36"x36" sheets 1/16", 1/8", 3/16", 1/4" thick stocked. For petroleum fuels and oils including Type A transmission fluids.
3. Silicone - Dow Corning Silastic #51, 24"x24", 1/16" and 1/8" thick. For high and low temperature - generally poor chemical resistance and mechanical strength.
4. Viton - Dow Bay City, 36"x36"x1/8" thick. High and low temperatures. Good resistance to chlorinated, aliphatic and aromatic hydrocarbons. Not for esters, ketones and amines.

D. Vegetable fiber sheet

1. Vellumoid - 36" wide rolls 1/32" and 1/16" thick stocked.

- E. Teflon sheet, TFE sheet, 24"x24"; 1/16", 1/8", 1/4" thick and 48"x48"; 1/8" thick stocked.

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F. Teflon Envelope gaskets

1. With three thicknesses of felted and compressed asbestos sheet round and oval shapes.
2. With two thicknesses of felted asbestos sheet and one thickness corrugated steel. Pfaudler CRT high pressure round and oval manhole gaskets.

G. Lead Envelope gaskets

1. Dow Boiler Shop - Chemical lead envelope with two thicknesses of JM-83B felted asbestos sheet.

H. Spiral wound SS/asbestos

1. 304 SS/asbestos with metal centering guide JM style 912. 150 psi ANSI flanges stocked. For high temperatures, steam Dowtherm A, etc. (Flexitallic SMG)
2. 304 SS/asbestos with compression limiting centering guide JM style 913. 300 psi ANSI flanges stocked. For high temperatures and pressures steam, Dowtherm A, etc. (Flexitallic CG)
3. 304 SS/asbestos with wire loop guide for centering around bolts. 400 psi ANSI flange stocked.

I. Metal Jacketed

1. JM 923 Aluminum jacketed asbestos, with flat face.
2. JM 926 Aluminum jacketed asbestos, corrugated face.

V. Good Installation Practices

- A. Use only one thickness of gasket between each pair of surfaces to be sealed.
- B. Obtain uniform gasket loading by properly staggering sequence of bolts tightened.
- C. Use a new gasket for each occasion a joint is to be resealed.
- D. Check bolting to assure agreement with specifications.



THE DOW CHEMICAL COMPANY
DOW ENGINEERING SPECIFICATION

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GASKETS AND LINED PIPE SPACERS

ITEM NO	DESCRIPTION
G-1	STD FLAT RING GASKET, 1/16 INCH THICK ASBESTOS, GOODYEARITE STYLE 104 OR NICOLET 295. (NOTE- MINUS 200 TO +750F.)
G-2	STD FLAT RING GASKET, 1/16 INCH THICK BLACK RUBBER, GARLOCK 353, JOHNS-MANVILLE JM-114C, STERLING 4010, OR HERCULES 504. (NOTE- MINUS 40 TO 300F.)
G-2A	STD FLAT RING GASKET, 1/8 INCH THICK BLACK RUBBER, GARLOCK 353, JOHNS-MANVILLE JM-114C, STERLING 4010, OR HERCULES 504. (NOTE- MINUS 40 TO 300F.)
G-2AF	FULL FACE GASKET, 1/8 INCH THICK BLACK RUBBER, GARLOCK 353, JOHNS-MANVILLE JM-114C, STERLING 4010, OR HERCULES 504. (NOTE- MINUS 40 TO 300F.)
G-3	STD FLAT RING GASKET, 1/16 INCH THICK CLOTH REINFORCED BLACK RUBBER, GOODRICH 60, STERLING 4200 OR HERCULES 509. (NOTE- MINUS 40 TO +350F.)
G-4	STD FLAT RING GASKET, 1/16 INCH THICK ASBESTOS, GARLOCK 900. (NOTE- MINUS 200 TO +700F.)
G-4A	STD FLAT RING GASKET, 1/8 INCH THICK ASBESTOS, GARLOCK 900. (NOTE- MINUS 200 TO +700F.)
G-4B	FULL FACE GASKET, 1/8 INCH THICK ASBESTOS, GARLOCK 900. (NOTE- MINUS 200 TO 700F.)
G-5	CORRUGATED GASKET, 1/32 INCH THICK MONEL, PARKER P-900 OR STERLING C. (NOTE- MINUS 325 TO +1500F.)
G-5A	CORRUGATED GASKET, 1/32 INCH THICK TYPE 347 STAINLESS STEEL, PARKER P-900 OR STERLING C. (NOTE- FOR HIGH TEMP SERVICE TO 1600F.)
G-6	CORRUGATED GASKET, 1/32 INCH THICK SOFT IRON, PARKER P-900 STERLING C. (NOTE- MINUS 50 TO +1000F.)
G-7	STD FLAT RING RED RUBBER GASKET, 1/16 INCH THICK, JOHNS-MANVILLE JM-107, GARLOCK 22, OR GOODRICH SBR-75. (NOTE- MINUS 40 TO +180F.)
G-7A	STD FLAT RING RED RUBBER GASKET, 1/8 INCH THICK, JOHNS-MANVILLE JM-107, GARLOCK 22, OR GOODRICH SBR-75. (NOTE- MINUS 40 TO +180F.)

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FORM HDC-9011



THE DOW CHEMICAL COMPANY
DOW ENGINEERING SPECIFICATION

GASKETS AND LINED PIPE SPACERS

E48-850
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ITEM NO	DESCRIPTION
G-7AF	FULL FACE RED RUBBER GASKET, 1/16 INCH THICK, JOHNS-MANVILLE JM-107, GARLOCK 22, OR GOODRICH SBR-75. (NOTE- MINUS 40 TO +180F.)
G-7F	FULL FACE RED RUBBER GASKET, 1/8 INCH THICK, JOHNS-MANVILLE JM-107, GARLOCK 22, OR GOODRICH SBR-75. (NOTE- MINUS 40 TO +180F.)
G-7AR	FULL FACE 1/8 INCH THICK RED RUBBER GASKET, ID OF GASKET TO BE EQUAL TO ID OF RUBBER-LINED PIPE, JOHNS-MANVILLE JM-107, GARLOCK 22 OR GOODRICH SBR-75. (NOTE- MINUS 40 TO 180F.)
G-7AS	STD FLAT RING 1/8 INCH THK RED RUBBER GASKET, ID OF GASKET EQUAL TO ID OF PLASTIC-LINED PIPE, JOHNS-MANVILLE JM-107, GARLOCK 22 OR GOODRICH SBR-75. (NOTE- MINUS 40 TO 180F.)
G-8	CORRUGATED STEEL JACKETED ASBESTOS GASKET, PARKER P-926, STERLING DC. (NOTE- MINUS 50 TO +900F.)
G-9	STD FLAT RING GASKET, 1/16 INCH THICK ASBESTOS WITH SILICON RELEASING AGENT, JOHNS-MANVILLE JM-60, GARLOCK 7021 OR NICOL 225 OR 245. (NOTE- MINUS 200 TO +700F.)
G-9A	STD FLAT RING GASKET, 1/8 INCH THICK ASBESTOS WITH SILICON RELEASING AGENT, JOHNS-MANVILLE JM-60, GARLOCK 7021 OR NICOLET 225 OR 245. (NOTE- MINUS 200 TO +700F.)
G-9B	FULL FACE GASKET, 1/8 INCH THICK ASBESTOS WITH SILICON RELEASING AGENT, JOHNS-MANVILLE JM-60, GARLOCK 7021 OR NICOLET 225 OR 245. (NOTE- MINUS 200 TO +700F.)
G-10	SOLID SOFT IRON RING JOINT GASKET FOR 600-LB RTJ FLANGE, ANSI B16.5, BRINELL HARDNESS 80-90. (NOTE- MINUS 20 TO +750F.)
G-11	SOLID SOFT IRON RING JOINT GASKET FOR 900-LB RTJ FLANGE, ANSI B16.5, BRINELL HARDNESS 80-90. (NOTE- MINUS 20 TO +750F.)
G-12	SOLID SOFT IRON RING JOINT GASKET FOR 1500-LB RTJ FLANGE, ANSI B16.5, BRINELL HARDNESS 80-90. (NOTE- MINUS 20 TO +750F.)
G-13	SOLID SOFT IRON RING JOINT GASKET FOR 300-LB RTJ FLANGE, ANSI B16.5, BRINELL HARDNESS 80-90. (NOTE- MINUS 20 TO +750F.)
G-14	KERCSEAL, GOODRICH 116 OR STERLING 9900 SHEET GASKET, 1/8 INCH THICK. (NOTE- MINUS 20 TO +150F.)

ST0211076

FORM HDC-0011



THE DOW CHEMICAL COMPANY
DOW ENGINEERING SPECIFICATION

GASKETS AND LINED PIPE SPACERS

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4- 9-86
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ITEM NO	DESCRIPTION
G-15	SPIRAL-WOUND, NICKEL-ASBESTOS GASKET, PARKER P-912 OR STERLING WL. (NOTE- MINUS 325 TO +900F.)
G-15A	SPIRAL-WOUND, NICKEL-TEFLON GASKET, PARKER P-912 OR STERLING WL. (NOTE- MINUS 325 TO +450F.)
G-15B	SPIRAL-WOUND, NICKEL WITH TEFLON IMPREGNATED BLUE ASBESTOS FILLER, PARKER P-912 OR STERLING WL. (NOTE- MINUS 325 TO +500F.)
G-16	SPIRAL-WOUND, STAINLESS STEEL-ASBESTOS GASKET, PARKER P-912, STERLING WL. (NOTE- MINUS 425 TO +900F.)
G-16A	SPIRAL-WOUND, STAINLESS STEEL-TEFLON GASKET, PARKER P-912, STERLING WL. (NOTE- MINUS 425 TO +900F.)
G-17	4000-LB LENS RING IN ACCORD WITH TEXAS DIVISION STD 43-527. (NOTE- SIZES 1/2 THRU 4, MINUS 20 TO +900F.)
G-17A	4000-LB LENS RING IN ACCORD WITH DOW ENGINEERING STANDARD 43-527 (NOTE- SIZES 1/2 THRU 4, MINUS 20 TO +900F.)
G-17AB	5300-LB BLIND LENS RING IN ACCORD WITH DOW ENGINEERING SPECIFICATION 43-533. (NOTE- SIZES 1/2 THRU 6, MINUS 20 TO +900F.)
G-17B	5300-LB BLIND LENS RING IN ACCORD WITH TEXAS DIVISION STD 43-533. (NOTE- SIZES 1/2 THRU 6, MINUS 20 TO +900F.)
G-17C	5300-LB LENS RING IN ACCORD WITH TEXAS DIVISION STD 43-530. (NOTE- SIZES 1/2 THRU 6, MINUS 20 TO +900F.)
G-18	STD FLAT RING GASKET, 1/8 INCH THICK ETHYLENE PROPYLENE RUBBER, PLASTIC LINED PIPE DEPARTMENT, DOW CHEMICAL COMPANY, FOR USE WITH DOW PLASTIC LINED STEEL PIPE. (NOTE- MINUS 60 TO +250F.)
G-18A	STD FLAT RING GASKET, 1/8 INCH THICK VITON, PLASTIC LINED PIPE DEPARTMENT, DOW CHEMICAL COMPANY, FOR USE WITH DOW PLASTIC LINED STEEL PIPE. (NOTE- MINUS 50 TO + 250F.)
G-19	ETHYLENE PROPYLENE RUBBER HALF GASKET, PLASTIC LINED PIPE DEPARTMENT, DOW CHEMICAL COMPANY, FOR USE WITH DOW PLASTIC LINED STEEL PIPE. (NOTE- MINUS 60 TO +250F.)

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DOW ENGINEERING SPECIFICATION

GASKETS AND LINED PIPE SPACERS

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ITEM NO	DESCRIPTION
G-19A	VITON HALF GASKET, PLASTIC LINED PIPE DEPARTMENT, DOW CHEMICAL COMPANY, FOR USE WITH DOW PLASTIC LINED STEEL PIPE. (NOTE- MINUS 50 TO +250F.)
G-19B	HYPALON HALF GASKET, PLASTIC LINED PIPE DEPARTMENT, DOW CHEMICAL COMPANY, FOR USE WITH DOW PLASTIC LINED STEEL PIPE. (NOTE- MINUS 30 TO +250F.)
G-20	SOLID TYPE 304 STAINLESS STEEL RING JOINT GASKET FOR RTJ FLANGE, ANSI B16.5, BRINELL HARDNESS 160, 0.04 TO 0.08 PER CENT CARBON. (NOTE- MINUS 425 TO +1500F.)
G-21	SOLID TYPE 316 STAINLESS STEEL RING JOINT GASKET FOR RTJ FLANGE, ANSI B16.5, BRINELL HARDNESS 160, 0.04 TO 0.08 PER CENT CARBON. (NOTE- MINUS 325 TO +1500F.)
G-24	SPIRAL-WOUND, 316 STAINLESS STEEL-ASBESTOS GASKET, FLEXITALLIC CG, GARLOCK CR, LAMONS WR, PARKER P-913 OR STERLING GR. (NOTE- MINUS 325 TO +1100F.)
G-24A	SPIRAL-WOUND, 316 STAINLESS STEEL-TEFLON GASKET, FLEXITALLIC CG, GARLOCK CR, LAMONS WR, PARKER P-913 OR STERLING GR. (NOTE- MINUS 50 TO +450F.)
G-25	LEAD RING GASKET FOR ANSI B16.5, SMALL TONGUE AND GROOVE FLANGE, STERLING PM OR AMERAFLEX LEAD. (NOTE- MINUS 200 TO +200F.)
G-26	STD FLAT RING GASKET 1/16 INCH THICK NEOPRENE, GARLOCK 7986, STERLING 4050 OR HERCULES 517. (NOTE- MINUS 50 TO +250F.)
G-26A	STD FLAT RING GASKET 1/8 INCH THICK NEOPRENE, GARLOCK 7986, STERLING 4050 OR HERCULES 517. (NOTE- MINUS 50 TO +250F.)
G-26AF	FULL FACE GASKET, 1/8 INCH THICK NEOPRENE, GARLOCK 7986, STERLING 4050 OR HERCULES 517. (NOTE- MINUS 50 TO +250F.)
G-27	SOLID SOFT IRON RING JOINT GASKET FOR 2500-LB RTJ FLANGE, ANSI B16.5, BRINELL HARDNESS 80-90. (NOTE- MINUS 20 TO +750F.)
G-28	TEFLON ENVELOPE STYLE GASKET, 3/16 INCH THICK FILLER, JOHNS-MANVILLE JM-933-C-8360, GARLOCK 8764, OR STERLING 885-V. (NOTE- MINUS 325 TO +450F.)
G-28R	TEFLON ENVELOPE STYLE GASKET, 1/8 INCH NEOPRENE FILLED, PEABODY DCRE E-26 OR STERLING 885-V/4050. (NOTE- MINUS 50 TO +200F.)

FORM HDC-8011

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THE DOW CHEMICAL COMPANY
DOW ENGINEERING SPECIFICATION

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GASKETS AND LINED PIPE SPACERS

ITEM NO	DESCRIPTION
G-29	STD FLAT RING GASKET, 1/16 INCH THICK VITON RUBBER, GARLOCK 9663, STERLING 770 OR AMERAFLEX 1444. (NOTE- MINUS 50 TO +400F.)
G-29A	STD FLAT RING GASKET, 1/8 INCH THICK VITON RUBBER, GARLOCK 9663, STERLING 770 OR AMERAFLEX 1444. (NOTE- MINUS 50 TO +400F.)
G-30	TEFLON HALF GASKET, PLASTIC LINED PIPE DEPARTMENT, DOW CHEMICAL COMPANY, FOR USE WITH DOW PLASTIC LINED STEEL PIPE. (NOTE- MINUS 20 TO +250F.)
G-31	SOLID SOFT ANNEALED INCONEL RING JOINT GASKET FOR RTJ FLANGE, ANSI B16.5. (NOTE- MINUS 325 TO +1200F.)
G-33	SOLID SOFT ANNEALED NICKEL RING JOINT GASKET FOR RTJ FLANGE, ANSI B16.5. (NOTE- MINUS 325 TO +600F.)
G-33L	SOLID SOFT ANNEALED LOW CARBON NICKEL RING JOINT GASKET FOR RTJ FLANGE, ANSI B16.5. (NOTE- MINUS 325 TO +1200F.)
G-34	SPIRAL-WOUND, MONEL-ASBESTOS GASKET, FLEXITALLIC CG, GARLOCK CR, LAMONS WR, PARKER P-913 OR STERLING GP. (NOTE- MINUS 325 TO +800F.)
G-34A	SPIRAL-WOUND, MONEL-TEFLON GASKET, FLEXITALLIC CG, GARLOCK CR, LAMONS WR, PARKER P-913 OR STERLING GR. (NOTE- MINUS 325 TO +450F.)
G-35	SPIRAL-WOUND, NICKEL-ASBESTOS GASKET, FLEXITALLIC CG, GARLOCK CR, LAMONS WR, PARKER P-913 OR STERLING GR. (NOTE- MINUS 325 TO +900F.)
G-35A	SPIRAL-WOUND, NICKEL-TEFLON GASKET, FLEXITALLIC CG, GARLOCK CR, LAMONS WR, PARKER P-913 OR STERLING GR. (NOTE- MINUS 325 TO +450F.)
G-36	STD FLAT RING GASKET, 1/16 INCH THICK WHITE ASBESTOS, JOHNS-MANVILLE JM-61 OR NICOLET 226. (NOTE- MINUS 200 TO +700F.)
G-36A	STD FLAT RING GASKET, 1/8 INCH THICK WHITE ASBESTOS, JOHNS-MANVILLE JM-61 OR NICOLET 226. (NOTE- MINUS 200 TO +700F.)
G-37	SPIRAL-WOUND, INCONEL-CERAMIC (FIBERFRAX) GASKET, LAMONS WR. (NOTE- FOR HIGH TEMP SERVICE TO +2000F.)

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DOW ENGINEERING SPECIFICATION

GASKETS AND LINED PIPE SPACERS

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ITEM NO	DESCRIPTION
G-38	STANDARD FLAT RING GASKET, 0.015 INCH THICK GRAFOIL GTA, UNION CARBIDE CORP. (NOTE- MINUS 200 TO +700F.)
G-39	STD FLAT RING GASKET, 1/16 INCH THICK GYLON, GARLOCK 37719. (NOTE- MINUS 200 TO +500F, SIZES 3/4 THRU 16.)
G-39A	STD FLAT RING GASKET, 1/8 INCH THICK GYLON, GARLOCK 37719. (NOTE- MINUS 200 TO +500F, SIZES 3/4 THRU 16.)
G-40	SPIRAL-WOUND, 304 STAINLESS STEEL-ASBESTOS GASKET, FLEXITALLIC CG, GARLOCK CR, LAMONS WR, PARKER P-913 OR STERLING GR. (NOTE- MINUS 425 TO +1100F.)
G-40A	SPIRAL-WOUND, 304 STAINLESS STEEL TEFLON GASKET, FLEXITALLIC CG, GARLOCK CR, LAMONS WR, PARKER P-913 OR STERLING GR. (NOTE- MINUS 425 TO +450F.)
G-40AC	SPIRAL-WOUND, 304 STAINLESS STEEL TEFLON GASKET WITH STAINLESS STEEL GAGE RING, FLEXITALLIC CG, GARLOCK CR, LAMONS WR, PARKER P-913 OR STERLING GR. (NOTE- MINUS 425 TO +450F.)
G-40C	SPIRAL-WOUND, 304 STAINLESS STEEL-ASBESTOS GASKET WITH STAINLESS STEEL GAGE RING, FLEXITALLIC CG, GARLOCK CR, LAMONS WR, PARKER P-913 OR STERLING GR. (NOTE- MINUS 425 TO +1100F.)
G-41	STANDARD FLAT RING GASKET 1/16 INCH THICK NEOPRENE-ASBESTOS, GARLOCK 7228, JOHNS-MANVILLE JM-76 OR NICOLET 355. (NOTE- FOR FREON SERVICE, MINUS 150 TO +300F.)
G-41A	STANDARD FLAT RING GASKET 1/8 INCH THICK NEOPRENE-ASBESTOS, GARLOCK 7228, JOHNS-MANVILLE JM-76 OR NICOLET 355. (NOTE- FOR FREON SERVICE, MINUS 150 TO +300F.)
G-42	FULL FACE GASKET, 1/8 INCH THICK ETHYLENE PROPYLENE RUBBER. (NOTE- MINUS 60 TO +250F.)
G-43	FULL FACE GASKET, 1/8 INCH THICK VITON RUBBER, LITHARGIC CURED, 60 DUPOMETER OR LESS HARDNESS, MOSITES 1035 CURED.
G-44	SPIRAL-WOUND 304 STAINLESS STEEL-ASBESTOS GASKET WITH STAINLESS STEEL INNER AND OUTER COMPRESSION-GAUGE RINGS, ID SAME AS SCH 5S PIPE, FLEXITALLIC CGI, GARLOCK CRI, LAMONS WRI, PARKER P-913-IR OR STERLING GR-IR.

FORM HDC-9011

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ITEM NO	DESCRIPTION
G-44A	SPIRAL-WOUND 304 STAINLESS STEEL-TEFLON GASKET WITH STAINLESS STEEL INNER AND OUTER COMPRESSION-GAUGE RINGS, ID SAME AS SCH 8S PIPE, FLEXITALLIC CGI, GARLOCK CRI, LAMONS WRI, PARKER P-913-IR OR STERLING GR-IR.
G-45	STD FLAT RING GASKET, 1/16 INCH THICK TEFLON (TFE), GARLOCK OR RESISTOFLEX. (NOTE- MINUS 50 TO +500F.)
G-45A	STD FLAT RING GASKET, 1/8 INCH THICK TEFLON (TFE), GARLOCK OR RESISTOFLEX. (NOTE- MINUS 50 TO +500F.)
G-46	SPIRAL-WOUND, INCONEL-GRAFOIL GASKET, FLEXITALLIC CG, OR LAMONS WR. (NOTE- FOR HIGH TEMP SERVICE TO +2000F.)
G-47	NEOPRENE GASKET AS FURNISHED BY VENDOR FOR CONCRETE CYLINDER PIPE.
G-48	STD FLAT RING GASKET, 1/16 INCH THICK BLUE-GARD COMPRESSED NCN-ASBESTOS, GARLOCK STYLE 3000. (NOTE - MINUS 20 TO 600 F SIZES 3/4 THRU 54.)
G-49	STD. FLAT RING GASKET, 1/8 INCH THICK BLUE-GARD COMPRESSED NCN-ASBESTOS, GARLOCK STYLE 3000. (NOTE - MINUS 20 TO 600F. SIZES 3/4 THRU 54.)
G-SPACERS	FOLLOWING ARE SPACERS TO BE UTILIZED WITH DOW PLASTIC-LINED PIPING SYSTEMS. USE N-223 FOR SARAN* RESIN SPACERS.
G-151	1/2" THK RING SPACER, SARAN* RESIN, DOW FIG. 230.
G-152	1/2" THK POLYPROPYLENE RING SPACER, DOW FIG. 230
G-153	1/2" THK KYNAR RING SPACER, DOW FIG. 230
G-154	1/2" THK TEFLON RING SPACER, DOW FIG. 230
G-155	1 1/2" THK BEVELLED RING SPACER, SARAN* RESIN, DOW FIG. 230
G-156	1 1/2" THK POLYPROPYLENE BEVELLED RING SPACER, DOW FIG. 230
G-157	1 1/2" THK KYNAR BEVELLED RING SPACER, DOW FIG. 230
G-158	1 1/2" THK TEFLON BEVELLED RING SPACER, DOW FIG. 230
G-159	1/2" THK BLIND SPACER, SARAN* RESIN, DOW FIG. 232
G-160	1/2" THK POLYPROPYLENE BLIND SPACER, DOW FIG. 232

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THE DOW CHEMICAL COMPANY
DOW ENGINEERING SPECIFICATION

GASKETS AND LINED PIPE SPACERS

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ITEM NO	DESCRIPTION
G-161	1/2" THK KYNAR BLIND SPACER, DOW FIG. 232
G-162	1/2" THK TEFLON BLIND SPACER, DOW FIG. 232

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FORM HDC-8011

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PIPING CATALOG DESCRIPTIONS
DOW CHEMICAL U. S. A.
MICHIGAN DIVISION

DATE: 9-4-86
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ITEM	DESCRIPTION
	PLATE 6061-T6, WITH ANSI B16.5 150 LB DRILLING. MINIMUM THICKNESS OF FLANGES: 2 TO 8" 3/4" THICK 10 TO 12" 1" THICK
G-100*M	GASKET MATERIAL TO BE CHOSEN TO BE SUITABLE FOR PROCESS CONDITIONS
G-101*M	SPIRAL-WOUND SPIROFALIC STEEL-ASBESTOS, 1/8 INCH THICK GASKET, PARKER P-911.
G-102*M	GASKETS ARE NOT REQUIRED WITH RADIAL LOCK SYSTEM, EXCEPT WHERE CONNECTION TO EQUIPMENT OR PIPING OTHER THAN RADIAL LOCK.
G-103*M	WHERE GASKETS ARE REQUIRED IN A RADIAL LOCK SYSTEM, USE A FLAT GASKET MADE OF A GASKET MATERIAL SUITABLE FOR THE PROCESS FLUID IN THE SYSTEM.
G-104*M	GASKETS NOT REQUIRED WITH MORAF <R> SYSTEM EXCEPT WHEN CONNECTING TO EQUIPMENT OR PIPING OTHER THAN MORAF.
G-105*M	GASKET MATERIAL TO BE CHOSEN TO BE SUITABLE FOR PROCESS CONDITIONS. GASKET SHALL BE FULL FACE TYPE.
G-106*M	GASKETS FOR THIS SPECIFICATION SHALL BE FULL FACE ELASTOMER GASKETS HAVING A SHORE "A" HARDNESS OF 50 TO 60. GASKET MATERIAL TO BE CHOSEN TO BE SUITABLE FOR PROCESS CONDITIONS.
G-107*M	WHERE GASKETS ARE REQUIRED IN CONJUNCTION WITH A MORAF<R> SYSTEM, USE A TEFLON ENVELOPE GASKET OR A FLAT GASKET MADE OF A MATERIAL SUITABLE FOR THE PROCESS FLUID IN THE SYSTEM.
G-108*M	FULL FACE GASKET, 3/16 OR 1/4 INCH THICK BUTYL SHEET RUBBER HAVING A SHORE "A" HARDNESS BETWEEN 50 AND 60. (NOTE- USE WITH FRP FLANGES.)
G-109*M	WHERE GASKETS ARE REQUIRED IN CONJUNCTION WITH A MORAF<R> SYSTEM, USE THE FOLLOWING GASKET OR GASKETS. (NOTE- SELECT PROPER

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PIPING CATALOG DESCRIPTIONS
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MICHIGAN DIVISION

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ITEM -----	DESCRIPTION -----
	GASKETS AND INSERT AFTER THIS NOTE.)
G-110*M	STD. FLAT RING GASKET - 1/16 INCH THICK UNILION JOINTING NO. 433 (GREEN FINISH) FROM THE JAMES WALKER PACKING CO., INC.
G-26A*M	STD FLAT RING GASKET 1/8 INCH THICK WHITE NEOPRENE.
G-26AW*M	STD. FLAT RING GASKET, 1/8 INCH THICK WHITE NEOPRENE (FOOD GRADE MATERIAL - FDA APPROVED)
G-28CLT*M	TEFLON ENVELOPE GASKETS- TYPE CLT WITH COMP. ASBESTOS CORE AND FELTED ASBESTOS EACH SIDE. GARLOCK STYLE 9026-CLT.
G-28CRT*M	TEFLON ENVELOPE GASKET- TYPE CRT WITH CORRUG- ATED STEEL CORE AND FELTED ASBESTOS EACH SIDE PFAUDLER CRT OR GARLOCK STYLE 8571-CRT. (NOTE- USE WITH GLASS LINED EQUIP. NOZZLES, GLASS LINED PIPE, FITTINGS AND VALVES.)
G-35C*M	SPIRAL-WOUND, ALLOY 20/ ASBESTOS GASKET, FLEXITALLIC CG, PARKER P-913.
G-36*M	STD FLAT RING GASKET 1/16 INCH THICK WHITE ASBESTOS, DURABULA-WHITE
G-36A*M	STD FLAT RING GASKET 1/8 INCH THICK WHITE ASBESTOS, DURABULA-WHITE
G-36AJ*M	STD FLAT RING GASKET, 1/8 INCH THICK WHITE ASBESTO JOHNS-MANVILLE JM-61.
G-36F*M	FULL FACE FLAT GASKET 1/8 INCH THICK, WHITE ASBESTOS, JM 61.
G-36J*M	STD FLAT RING GASKET, 1/16 INCH THICK WHITE ASBESTOS, JM 61.
G-42*M	STD. FLAT RING GASKET, 1/8 INCH THICK ETHYLENE PROPYLENE RUBBER. (NOTE- MINUS 60 TO +250F.)
G-44A*M	SPIRAL-WOUND 304 STAINLESS STEEL-TEFLON GASKET WITH STAINLESS STEEL INNER AND OUTER COMPRESSION RINGS, ID TO MATCH PIPE ID.

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PIPING CATALOG DESCRIPTIONS
DOW CHEMICAL U. S. A.
MICHIGAN DIVISION

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ITEM -----	DESCRIPTION -----
	PARKER SPIROTALLIC P-913I.R. OR FLEXI-TALLIC CGI.
G-44B*M	SPIRAL-WOUND GASKET WITH CARBON STEEL OUTER COMPRESSION GAGE RING, 304 S.S. & ASBESTOS WINDINGS AND 304 S.S. INNER RING. FLEXITALLIC CGI, PARKER P-913-IR OR LAMONS WRI.
G-44C*M	SPIRAL-WOUND 304 STAINLESS STEEL-ASBESTOS GASKET WITH STAINLESS STEEL INNER AND OUTER COMPRESSION-GAUGE RINGS, ID TO MATCH PIPE ID, FLEXITALLIC CGI, GARLOCK CRI, LAMONS WRI, PARKER P-913-IR OR STERLING GR-IR.
G-45*M	FULL FACE GASKET, 1/16 INCH THICK TEFLON (TFE), GARLOCK OR RESISTOFLEX. (NOTE- MINUS 50 TO +500F.)
G-45A*M	FULL FACE GASKET, 1/8 INCH THICK TEFLON (TFE), GARLOCK OR RESISTOFLEX. (NOTE- MINUS 50 TO +500F.)
G-48B*M	SPIRAL-WOUND GASKET WITH CARBON STEEL OUTER COMPRESSION GAGE RING, 316 S.S. & ASBESTOS WINDINGS AND 316 S.S. INNER RING. FLEXITALLIC CGI, PARKER P-913-IR OR LAMONS WRI.
G-48C*M	SPIRAL-WOUND 316 STAINLESS STEEL- ASBESTOS GASKET WITH STAINLESS STEEL INNER AND OUTER COMPRESSION-GAUGE RINGS, ID TO MATCH PIPE ID, FLEXITALLIC CGI, GARLOCK CRI, LAMONS WRI, PARKER P-913-IR OR STERLING GR-IR.

JC-1*M	PERMATEX NO. 2
JC-100*M	PERMATEX NO. 2, FEL PRO C-100 OR MOLY-LIT. DO NOT USE TEFLON TAPE.
JC-101*M	TFE THREAD PASTE "LA-CO SLIC-TITE" MFG BY LAKE CHEMICAL CO./MARKAL CO. CHICAGO, IL. (NOTE- MINUS 50 TO +500F.)
JC-102*M	KEY ABSOLUTE OR RECTOR SEAL NO. 15. DO NOT USE HYDROCARBON BASED PIPE COMPOUNDS.
JC-103*M	JOINT COMPOUND TO BE CHOSEN TO BE SUITABLE FOR PROCESS CONDITIONS

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ST0211085

ESSEX CHEMICAL CORP.
Piping & Valves for Hillsdale 4/8/74

I. SCOPE

The intent and purpose of this specification is to provide for a complete piping system. The contractor shall provide sufficient labor, materials except as noted, tools, scaffolding, etc. to furnish and install all items indicated on the plans and/or in the specifications relating to the contract. The contractor shall also provide certificates of insurance as required by the owner.

Any question regarding either the plans or specifications shall be brought up by the contractor before bids are submitted.

All work shall be carried out in conformity with the best practices in the field in a workmanlike manner and to the satisfaction of the owner's representative.

Work shall comply with all local, state and national codes and agencies having jurisdiction.

Contractors shall make the necessary applications, pay the required fees, secure the proper permits and furnish the owner with certificates of approval of their work with application for final payment.

All alterations, repairs due to modification, debris removal in connection with this contract shall be the responsibility of this contractor.

II. WORK INCLUDED

1. Compressed air piping, fittings and valves
2. Gas piping, fittings and valves
3. Hot oil piping, fittings and valves
4. Nitrogen piping, fittings and valves
5. Process piping, fittings and valves
6. Steam piping, fittings and valves
7. Vacuum piping, fittings and valves
8. Water piping, fittings and valves
9. Hangers, sleeves
10. Tests
11. Small in-line equipment and instrument installation
12. Guarantee

III. This contractor shall read the specifications and examine the drawings of all other trades with which his work has or may have contact.

Bill Jackson
Comments?
John Smith

S10211094

IV. COMPRESSED AIR

A. Pipe

All compressed air pipe to be furnace butt welded, ASTM-A120 galvanized, OH or EF process, Sch. 40, threaded ends, size range 1/4 inch to 2 inches.

B. Fitting

1. All compressed air unions to be galvanized, ground joint, iron to brass seats equal to ASTM-A197, threaded, size range 1/4 inch to 2 inch for 150 psi service.

2. All other fittings to be galvanized equal to ASTM-A197, threaded, size range 1/4 inch to 2 inch for 150 psi service.

C. Valves

1. All compressed air ball valves to be bronze body equal to ASTM-B62, threaded, bronze trim, Buna N seats and seals, wrench operated, Worcester Econ-O-Miser or equal, size range 1/4 inch to 2 inch for 150 psi service.

2. All compressed air globe valves to be bronze body equal to ASTM-B62, threaded, bronze trim, renewable composition disc for air service, internal screw, rising stem, union bonnet, integral seats, size range 1/4 inch to 2 inch for 150 psi service.

3. All compressed air check valves to be bronze body equal to ASTM-B62, lift check, bronze trim, renewable composition disc for air service, threaded, union cap, size range 1/4 inch to 2 inch for 150 psi service.

D. Joints

In all threaded joints, the threads to be wrapped with Teflon tape to withstand 150 psi when made up, minimum 2 turns.

E. Gaskets

All compressed air gaskets to be 1/16 inch thick asbestos, JM-60 or equivalent.

ST0211095

V. GAS PIPING (Natural Gas)

A. Pipe

All gas pipe to be seamless carbon steel equal to ASTM-A53, Grade B, OM or EF, Schedule 40, size range 3/4 inch to 2 inch for 150 psi service, threaded ends.

B. Fittings

All gas fittings to be malleable iron equal to ASTM-A197 for 150 psi in size range 3/4 inch to 2 inch. Unions to be the same except ground joint brass to iron seat.

C. Valves

All gas valves to be bronze or malleable iron, plug cocks or globe valves as required by local regulations.

ST0211096

VI. HOT OIL

A. Piping

All hot oil piping to be seamless carbon pipe equal to ASTM-A53, Grade B, OH or EF, Schedule 40, size 1/2 inch to 3 inch.

B. Valves

1. All hot oil gate valves to be drop forged steel ASTM A-182, Grade F2 or equivalent, socket weld ends, outside screw and yoke, rising stem, bolted bonnet and gland gasket joint with stainless steel ASTM A-182, Grade F6 trim and stem for 800 psi service at 850°F, Henry Vogt Machine Co. SW-12112 to SW-12113, size range 3/4" to 2", or equivalent.

2. All hot oil globe valves to be drop forged carbon steel ASTM A-105, Grade 2, socket weld ends screw bonnet, gasket joint, inside stem screw, integral seat with stainless stem ASTM A-182, Grade F6, for 5000 psi service at 450°F, Henry Vogt Machine Co. 9874 to 9878 series size range 1" to 2", or equivalent.

3. All hot oil valves to be installed with stems at an angle of 15° below horizontal where possible. Valves in vertical lines to have stems horizontal.

4. All hot oil strainers to be cast carbon steel equal to ASTM-A216-58T, Grade WCB with weld ends "Y" construction with Monel 1/16" perforate basket.

C. Fittings

1. All hot oil fittings to be forged carbon steel equal to ASTM-A181, Grade 1, 300 psi welded ends.

2. All hot oil gaskets to be Flexitallic 316 stainless steel with blue African asbestos, type GG.

3. All hot oil joints shall be 300 psi ASA drilling forged steel flanges equal to ASTM-A181, Grade 1. These joints shall be kept to a minimum. Where special fittings such as screwed thermowells or screwed rotary joints, etc. are supplied, these screwed joints are to be backwelded.

D. Welding

All hot oil pipe welding shall conform to ASA-B31.3 1959, Chapter V, heading 327 Welding.

ST0211097

VII. NITROGEN

A. Piping

All nitrogen piping shall be ASTM-B88, Type L, copper tubing, size 1/2 inch to 2 inch.

B. Valves

All nitrogen valves shall be non-metallic disc, globe, bronze 150 psi solder ends internal screw, rising stem, 1/2 inch to 2 inch. Discs for gas service, Fairbanks Figure 0582 or equivalent.

C. Fittings

All nitrogen fittings to be copper solder type 1/2 inch to 2 inch.

D. Solder

All nitrogen piping joints shall be soldered with 95/5* lead tin solder.

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VIII. PROCESS PIPING

1. Prepolymer Piping

A. Pipe

All rigid prepolymer pipe to be seamless steel equal to ASTM-A53, Grade B, OH or EF process, Schedule 40, weld ends, size range 3 inch to 6 inch except where piping makes up to existing screwed connections when threaded ends will be used.

All prepolymer flexible metal hose to be supplied by Essex Chemical with suitable ends and of suitable size to be installed into system.

B. Fittings

All prepolymer fittings to be steel butt welding equal to ASTM-A234, Grade WPB, size range 3 inch to 6 inch for 150 psi service.

All prepolymer flanges to be steel weld neck equal to ASTM-A181, Grade 1, size range 3 inch to 6 inch for 150 psi service.

C. Valves

All prepolymer butterfly valves to be ductile iron body equal to ASTM-A339, ductile iron disc, viton seat size range 3 inch to 6 inch for 150 psi service (Demco, NE series, lug type or equivalent). Worcester Economizer for 2 inch or smaller, Teflon fitted.

D. Gaskets

All prepolymer gaskets to be 1/16 inch thick asbestos, JM-60 or equivalent.

E. Joints

In all threaded joints, the threads to be wrapped with Teflon tape to withstand 150 psi when made up, minimum 2 turns of tape

2. Sealant Piping

A. Pipe

All sealant rigid pipe to be seamless steel equal to ASTM-A53, Grade B, OH or EF process, Schedule 40, weld ends size range 4 to 8 inch.

All prepolymer flexible metal hose to be supplied by Essex Chemical with flanged ends for installation into the system.

B. Fittings

All sealant fittings to be steel butt welding equal to ASTM-A234, Grade WPB, size range 4 inch to 8 inches for 150 psi service.

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VIII. Process Piping Cont'd

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All sealant flanges to be steel weld neck equal to ASTM-A181, Grade 1, size range 4 inches to 8 inches for 150 psi service.

C. Gaskets

All sealant gaskets to be 1/16" thick asbestos, JM-60 or equivalent.

3. Isocyanate Piping

A. Pipe

All rigid pipe to be 304 stainless steel equal to ASTM-A312 commercial grade, schedule 10 lap joint ends or butt welded, size 1 inch to 2 inch. No straight run of pipe to exceed 40 foot without flanged union.

B. Fittings

All fittings to be 304 stainless steel equal to A.S.A. B36.19, schedule 10, butt welded, size range 1 inch to 2 inch. All connections to be lap joint flanged with 304 stainless steel stub ends and 150 pound A.S.A. steel lap joint flanges.

C. Valves

All valves to be 304 or 316 stainless steel ball type with teflon seats and seals, gate or globe with stainless steel seats and discs and braided teflon packing, flanged ends 150 psi A.S.A. drillings, size range 1 inch to 2 inch.

D. Joints

All joints to be flanged laps with teflon envelop over hard asbestos ring gaskets.

4. Piping other than Prepolymer, Sealant and Isocyanate

A. Pipe

All rigid pipe to be seamless steel equal to ASTM-A53, Grade B, OH or EF process, Schedule 40, threaded ends, size range 1/2 inch to 2 inch.

B. Fittings

All fittings to be malleable iron equal to ASTM-A197, threaded, size range 1/2 inch to 2 inch for 150 psi service. Unions to be the same except ground joint, brass to iron seat.

C. Valves

All valves to be ball type of bronze body equal to ASTM-B62 threaded, bronze trim, teflon seats and body seals, wrench operated, Worcester Econ-o-Miser or equal, size range 1/2 inch to 2

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VIII. Process Piping Cont'd

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for 150 psi service.

D. Joints

On all threaded joints, the threads to be wrapped with teflon tape and to withstand 150 psi when made up, minimum 2 turns of tape.

E. Gaskets

All gaskets for diol, triol, plasticizer, and toluene service to be 1/16" thick asbestos, JM-60 or equivalent.

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IX. STEAM

A. Piping

All steam piping shall be seamless carbon steel equal to ASTM-A53, Grade B, CH or EF, Schedule 40, threaded and sizes 1/2 inch to 3 inch for 15 psi.

B. Valves

All steam valves to be bronze body equal to ASTM-B61, with bronze trim equal to ASTM-B62, threaded, for 200 psi.

1. Gate valves to be internal screw, rising stem, size range 1/2 inch to 3 inch with union bonnet.

2. Globe valves to be internal screw, rising stem, renewable disc, integral seat, size range 1/2 inch to 3 inch with union bonnet.

3. Check valves to be swing check with renewable disc and integral seat, size range 1/2 inch to 3 inch with hex head cap.

C. Fittings

All steam fittings to be malleable iron equal to ASTM-A197, threaded, size range 1/2 inch to 3 inch for 150 psi service. Unions to be the same except ground joint, brass to iron seat.

D. Traps

All steam traps to be Armstrong disc type CD-33 or equal, threaded.

E. Strainers

All steam traps to be Sarco, semi-steel type AT, threaded or equal with 1/32" perforated brass screen and 1/4" NPT threaded blow down connection.

F. Joints

In all threaded joints, the threads to be wrapped with Teflon tape to be pressure tight when made up, minimum 2 turns of tape.

G. Gaskets

All steam gaskets to be 1/16" thick asbestos JM-60 or equivalent.

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X. VACUUM

A. Piping

All vacuum piping to be seamless steel pipe equal to ASTM-A53, Grade B, OH or EF, Schedule 40, size range 3/4 inch to 3 inch.

B. Valves

1. All vacuum ball valves to be bronze body equal to ASTM-B62, threaded, bronze trim, Teflon seats and body seals, wrench operated, Worcester Econ-O-Miser or equal, size range 3/4 inch to 3 inch for 150 psi service.

2. All vacuum check valves to be bronze body equal to ASTM-B62, swing check with renewable disc and integral seat, size range 3/4 inch to 3 inch for 150 psi service.

C. Fittings

All vacuum fittings to be malleable iron equal to ASTM-A197, threaded, size range 3/4 inch to 3 inch for 150 psi service. Unions to be the same except ground joint, brass to iron seat.

D. Joints

In all threaded joints the threads to be wrapped with Teflon tape and to be pressure tight when made up, minimum 2 turns of tape.

E. Gaskets

All vacuum gaskets to be 1/16 inch thick asbestos, JM-60 or equivalent.

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XI. WATER (Cooling)

A. Piping

All cooling water piping to be seamless steel pipe equal to ASTM-A53, Grade B, OH or EF, Schedule 40, threaded ends, size range 1/2 inch to 2 inches.

B. Valves

1. All cooling water gate valves to be bronze body and bronze trim equal to ASTM-B62, threaded, solid wedge, internal screw, rising stem, integral seats, threaded bonnet, size range 1/2 inch to 2 inches for 125 psi service.

2. All cooling water globe valves to be bronze body and bronze trim equal to ASTM-B62, threaded, renewable bronze disc, internal screw, rising stem, threaded bonnet, size range 1/2 inch to 2 inches for 125 psi service.

3. All cooling water check valves to be bronze body and bronze trim equal to ASTM-B62, threaded, swing check, renewable bronze disc, threaded cap, size range 1/2 inch to 2 inches for 125 psi service.

C. Fittings

All cooling water fittings to be malleable iron equal to ASTM-A197 threaded, size range 1/2 inch to 2 inches for 150 psi service. Unions to be the same except ground joint, iron to brass seats.

D. Joints

In all threaded joints, the threads to be wrapped with Teflon tape and to be pressure tight when made up, minimum 2 turns of tape.

E. Gaskets

All water gaskets to be 1/16 inch thick asbestos, JM-60 or equivalent.

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XII. HANGERS AND SLEEVES

A. All piping shall be properly supported, anchored or guided to prevent undue line deflection, excessive vibration and to protect piping and connected equipment from excessive loadings and expansion loadings. Do not support piping from any other piping.

B. Use adjustable hangers for overhead piping in groups. For individual hangers, provide hangers having adjustable swivel pipe rings. Support piping near floor from sidewalls or floor by approved wrought iron brackets and stanchions in such manner as to maintain its alignment while making suitable provision for necessary expansion.

C. Where piping passes through masonry or stud walls protect the pipe with wrought iron pipe sleeves equal to the width of the wall and of suitable diameter to accommodate bare pipe or insulated pipe as the case may be.

D. Where sleeves are to be installed in existing walls, cut hole, set sleeve and caulk around sleeve after installation.

E. Where pipe passes through existing roofs, proper flashing, rain protection, heat protection, etc. shall be used.

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XIII. TESTS

All welded pipe shall be pressure tested after installation. The test shall consist of injecting fluorinated refrigerant into the system and pressurizing to 40 psig with nitrogen or air. A halide tester will then be used at each joint and weld to determine leakage. The test will be approved by Essex Chemical representative before acceptance.

XIII. SMALL IN-LINE EQUIPMENT & INSTRUMENT INSTALLATION

The piping contractor shall be responsible for the installation and support of certain in line equipment such as air reducing sets, line filters, etc. In addition the contractor shall be responsible for installation and mounting of non-electrical instruments such as bulb type temperature recorders, pressure gages, thermometers, etc. All of these items shall be supplied by Essex Chemical.

XIV. Guarantee

On completion of the work and before applying for final acceptance the piping contractor shall furnish a written guarantee stating that all work complies with all local, state and national codes and local agencies having jurisdiction; and that it will be free from defects of materials and workmanship for one year from the date of issuance of owners final payment. The guarantee shall further state the contractor will at his own expense, repair and replace mechanical work which may become defective during the time of the guarantee, together with other work damaged as a consequence of such defect. Defect shall be when an item ceases to conform to the contract documents.

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ADDENDUM
TO
PIPING SPECIFICATION
DATED
FEB. 28, 1974

VALVES:

Substitution of iron body bronze trim globe and gate valves may be made in lieu of bronze body valves under the applicable original Specification.

R. W. Davis
May 10, 1974

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