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U. S. NAVAL ENGINEERING EXPERIMENT STATION
Annapolis, Maryland

NP/L5/J10(712B)
Test 010276C

31 MAY 1957

From: Director
To: Chief, Bureau of Ships

Subj: Investigation of packings and gaskets for use in hydraulic systems employing phosphate ester fluids; NS-066-001, Evaluation Report 010276C

Ref: (a) Military Specification MIL-P-5514A

Encl: (1) Table I
(2) Table II
(3) Table III

1. As requested by Bureau of Ships Code 532 of 22 May 1957, this is a progress report of the subject investigation covering various packings and gaskets which are being subjected to performance tests under simulated service conditions. The results obtained are given in Tables I and II. Also, measurements of torque to open and close a 6" valve in the normal manner under 1200 psi pressure of Cellulube 220 with installations of various valve stem packings are given in Table III.

2. With one exception as noted below, all flange gasket materials have performed satisfactorily as no leakage has occurred from the joints. However the tests are not considered conclusive as they have been underway only a short time and were conducted at room temperature. The results obtained of the metallic-encased gaskets are not in agreement with the report that the Bureau has received as to the performance of this gasket in actual service use. The variation in results may be due to the type of finish of the gasket faces of the flanges and to the method of installation of the gasket. Information as to the effect of the flange finish was obtained in the test. The joint was broken and the gasket and flanges were examined. The gasket was visibly marked and indented on its surfaces by the serrations of the faces of the steel flanges. Roughness measurements showed that the gasket finish changed from 6-12 RHR before the test to 90-275 RHR afterward. No apparent change occurred in the finish of the faces of the steel flanges. Apparently the embedding of the flange serrations into the gasket was sufficient to prevent leakage.

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3. Information as to the method of installation of the gasket was obtained in a second test of the metallic-encased gaskets. A new gasket was installed by the artisan assigned to the work who tightened the flange bolt nuts as much as possible with a 16 inch open-end wrench. Under these conditions leakage occurred from the joint at 500 psi pressure. The bolts were further tightened by driving the wrench with a 5 pound maul, as employed in the first test. No leakage has occurred from this joint under 1500 psi in 48 hours of test. The test of the gaskets is continuing under 1200 psi and 150°F conditions.

4. Because the Vyram O-ring was subjected to pressures higher than recommended by reference (a) without the use of a back-up ring, it was removed for examination. The O-ring was found to contain a very fine circumferential cut as described in Table I. To determine if this undesirable condition will occur at lower pressures as are now encountered in actual service the material will be tested further. The test set-up is being modified to permit circulation of the hydraulic fluid through the flange joints at 150°F and 1200 psi.

5. Of the valve-stem packings only the Garlock 5861 has given satisfactory service. The Crane C-12 packing requires too frequent gland adjustment to prevent leakage. The square-braided (Symbol 1103) and lattice-braided asbestos valve-stem packings were unsatisfactory due to extraction of their graphite and lubricating oil by the Cellulube 220. Also these packings require greater torque to open and close the valve than the other packings.

6. The results obtained from hydraulic ram packings designated A and F in Table II have been satisfactory and indicate that the packings will continue to perform satisfactorily for the prescribed test of 1000 hours. At no time has there been chattering of the rams due to gripping of the packings. During the progress of the test of Packing A a jelly-like substance exuded from the stuffing boxes of the ram but did not appear to affect the performance of the packing. The composition of this packing is such that the manufacturer does not recommend its use for temperatures above 150°F. The other ram packings gave unsatisfactory results in a short period of test as noted in Table III.

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7. It is recommended that Symbol 1103, Garlock 731 and Crane C-12 valve-stem packings and the combinations of Garlock hydraulic packings designated B, C, D and E in Table II be considered unsuitable for use in hydraulic systems employing phosphate ester fluids. Recommendations as to the suitability of the other materials will be made upon completion of the tests now in progress.

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TABLE I

Performance Test - Flange joints and hand operated valves

Material	Spec	Fitting	Conditions	Remarks
Metallic-encased gasket 4-5/8" I.D. x 6-3/16" O.D. x 3/32" thick	HH-G-101a, Type I	4" steel flanges 900 series ASA B16.5 Finish of faces - 550-800 RHR, 40 spiral serrations per inch	Hourly cycles from 0-1800 psi internal pressure of Cellulube 220 at room temp.	No leakage during 475 cycles of test. Gasket removed and found to be compressed to 1/16" thickness
O-ring AN-6227-58 Linear Vyram XYJ 72-L	None	4" steel flanges 900 series with O-ring groove per BUSHIPS Dwg CVA-60-S8301-1307761	Ditto	No leakage during 475 cycles of test. O-ring removed and found to be permanently compressed 4.1%. Also it contained a very fine crack or cut approx. 3/32" from the flashline extending around the outer periphery
Lock-o-seal 350-130-16 with Buna-N O-ring	None	AND10056 Tubing fitting end	Ditto	No leakage during 475 cycles of test. Buna-N O-ring removed to be replaced by synthetic rubber o-ring more suitable for Cellulube at manufacturer's request. Composition unknown and as yet not determined
Gask-o-seal 1470-130-1 Buna-N and steel	None	Flange joint: 1" valve to 1" pipe	Cellulube at room temp, pressure maintained at 1200 psi 5 days per week and reduced to 0 gage over weekend	No leakage during 1500 hrs. Test continuing
Duroid 5600 Teflon and silica-alumina fiber sheet	None	Ditto		Ditto

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TABLE I (Cont'd.)

Performance Test - Flange joints and hand operated valves

Material	Spec	Fitting	Conditions	Remarks
Garlock 731, lattice-braided asbestos valve-stem packing	None	1", 1500 psi gate valve, 5/8" stem, 1/4" packing	Cellulube at room temp., valve opened & closed hourly, pressure held at 1200 psi 5 days per week & reduced to 0 gage over weekend	At 1200 psi, leakage occurred after 100 hours which could not be stopped
Garlock 5861 Teflon-suspensoid lattice-braided-asbestos valve-stem packing	None	Ditto	Ditto	No leakage during 150 Hours of test
Crane C-12, square-braided asbestos valve-stem packing lubricated on the outer surface with Teflon	None	Ditto	Ditto	Frequent gland adjustment is required to prevent leakage. Daily adjustment made during 500 hours of test
Symbol 1103 square-braided asbestos valve stem packing immersed in 158°F cellulube for 3 weeks prior to test	MIL-P-17577 (Navy) Type I	6", 600 psi globe valve, 2" stem 1/2" packing	Pressure-1200 psi, temperature-115°F (max. obtainable with present test set-up)	At 1200 psi, leakage could not be stopped

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TABLE I (Cont'd.)

Performance Test - Flange joints and hand operated valves

Material	Spec	Fitting	Condition	Remarks
Garlock 5861	None	6", 600 psi globe valve, 2" stem 1/2" packing	Pressure - 1200 psi, temperature 115°F (max. obtainable with present test set-up)	No leakage during 200 hours of test
Colt Mfg. Co. 1701B Symbol 2150 gasket	MIL-A-17472	6", 600 psi globe valve, gasket in seat and bonnet joints	Ditto	No leakage during 6 weeks of test
Flexitallic Co. Spiral-wound metallic-asbestos gasket, Symbol 2410	MIL-G-16265	6", 600 psi globe valve, gasket in blank flange-joint on outlet	Ditto	No leakage during 6 weeks of test

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TABLE II

Performance Test - Hydraulic ram and valve stem

Material	Service	Remarks
A - E.F. Houghton & Co Vim Lea packing, thiokol impregnated leather	Hydraulic ram-test of MIL-P-2911 para. F-3a with Cellulube 220 at 150°F and 1500 psi	Satisfactory during 700 hours except that a substance of greaselike consistency exuded from the stuffing boxes after 150 hours of test. Nature of substance not yet determined
B- Garlock Packing Co #8220V type with butyl binder, 9283 D fillers & 7857 adapters	Ditto	Unsatisfactory-caused chattering of the rams due to gripping of the packing. Test stopped after a few hours operation
C- Same as B but coated with molybdenum disulfide	Ditto	Ditto
D- Same as B - graphite coated	Ditto	Ditto
E- Similar to B but apex cut off bottom ring	Ditto	Ditto
F- Garlock 8220 with 9283 D fillers & butyl & cotton adapters	Ditto	Satisfactory during 675 hours - Test continuing
Garlock 5861 1/4" size	Slide valve of hydraulic ram, 5/8" dia. stem, conditions as above	Satisfactory during 800 hours of test. Leakage from gland 0.21 pints/day
Crane Packing Co C-12, 1/4" size	Ditto	Unsatisfactory-requires frequent gland adjustment to control leakage at same low rate as Garlock 5861. Gland almost home after 700 hours of test

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TABLE II (Cont'd.)

Performance Test - Hydraulic ram and valve stem

Material	Service	Remarks
Garlock Packing Co. Style 731	Slide valve of hydraulic ram, 5/8" dia. stem, conditions as above	Unsatisfactory - created excessive friction and leakage could not be controlled

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TABLE III

Torque Requirements - Valve Stem Packings

Packing	To open valve, lb-ft	To close valve, lb-ft
Symbol 1103 (1)	55.0	92.5
Garlock 731 lattice braided asbestos	75.0	100.0
Garlock 5861(2) teflon-filled, lattice braided asbestos	40.0	90.0
Crane C-12(3) teflon-filled, square braided asbestos	40.0	90.0

(1) Leakage could not be stopped at 1200 psi pressure.
(2) Under condition of initial tightness, packing compressed 20%.
(3) Under condition of initial tightness, packing compressed 52%.

ENCLOSURE (3)

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