D-ZERO PROJECT

ROTARY BAYONET ASSEMBLY TEST

D-ZERO ENGINEERING NOTE # 3740.510-EN-309
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ABSTRACT

This report documents the testing of a rotating bayonet assembly. It provides the details of how the test was carried out and the results of the testing. The testing was done on a mock up of an 1 1/2" x 3" gaseous argon bayonet assembly designed to allow a translational movement of 40". The test was necessary to provide a level of confidence in the design concept.

SUMMARY

The testing was a success. It provided confidence that the bayonet assembly design will work for the 1 1/2" x 3" pipe size. No leaks were detected during any of the testing. The o-ring seals did not leak when the bayonet assembly was misaligned. The force required to move the assembly was 15 to 60+ pounds force. This seems reasonable. No binding was observed with the misalignments. The misalignments were up to 2.7 degrees from true vertical. This misalignment is noticeable to the casual observer and should be greater than carefully installed field piping.

OBJECTIVE

The goal of the rotary bayonet assembly test was to:

1. Determine that the seals in the bayonet are sealing while it is being rotated.
2. Determine the effect misalignment of the bayonets from a true vertical has on the tightness of the o-rings.
3. Get an idea of the magnitude of the forces involved when exercising the assembly with misalignment.
4. Get an idea of how much misalignment can be tolerated.
5. Provide a level of confidence that the rotary bayonet concept will work as intended in the D-Zero cryogenic system.

PROCEDURE AND RESULTS

PART I - TEST OF SEALS WHILE ROTATING, 20 PSIG

1. Modify test set-up per B. Cyko sketch to allow pressurization of a rotary bayonet.
2. Level the floor mounted and track mounted bayonets.
3. Attach a regulated Helium gas bottle to the track mounted bayonet per attached schematic.
4. Pressurize the bayonet to 20 psig.
5. Sniff around the top of the bayonet joint and connections using hand held helium leak detector. If leaks are present, bleed down the pressure and repair the leaks. Record a presence of leaks.
6. Have track set up for maximum travel. Turn on driving motor.
7. Sniff top of bayonet during travel looking for a leak.
8. Watch for two full travel cycles. (Down and back equals one travel cycle.)
9. Record results of test.

Originally snoop was used to detect leaks. The pressure in the bayonet kept bleeding down and the snoop did not locate the leak. A Matheson Leak hunter[1] was then used which showed gas escaping through the Teflon taped fittings above the bayonet. The fittings were taken apart and then reassembled using Tite thread sealant. No leaks were detected after this action was taken. The inner o-rings used were from FNAL stock, Parker 2-334, 2 5/8" I.D. x 3" O.D. x 3/16" cross section. The ones called out on the bayonet assembly drawing (2 3/4" I.D. x .210" cross section) were not Fermi stock items. The original test set-up before modification to hold pressure is documented on drawing number 3740-MC-194348.

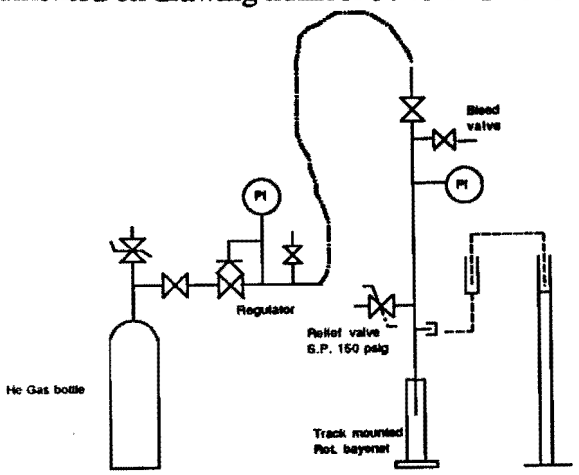


Figure 1. Piping schematic

PART II - TEST OF SEALS WHILE ROTATING, 90 PSIG

1. Increase the pressure to 90 psig.
2. Sniff around the top of the bayonet joint and connections. Record a presence of leaks.
3. Sniff top of bayonet during two travel cycles looking for a leak.
4. Turn-off driving motor.
5. Record results of test.
6. Valve out the helium gas bottle.
7. Verify that hand held helium leak detector senses helium by cracking a bleed valve at the helium gas bottle.

No leaks were detected. Even while pulling on the vertical piping of the assembly to try to cause additional loading, no leaks were found. We verified that the hand held leak detector sensed the helium. The audible tone sounded and the LED display showed a 100 plus division indication.

[1] Model 8065, Catalog no. 96310, FNAL no. 65891, Serial no. 21116. Sensitivity as used was 10-4 std cc/sec helium. Calibrated by MJ 1/19/90 and due for recalibration 1/19/91.

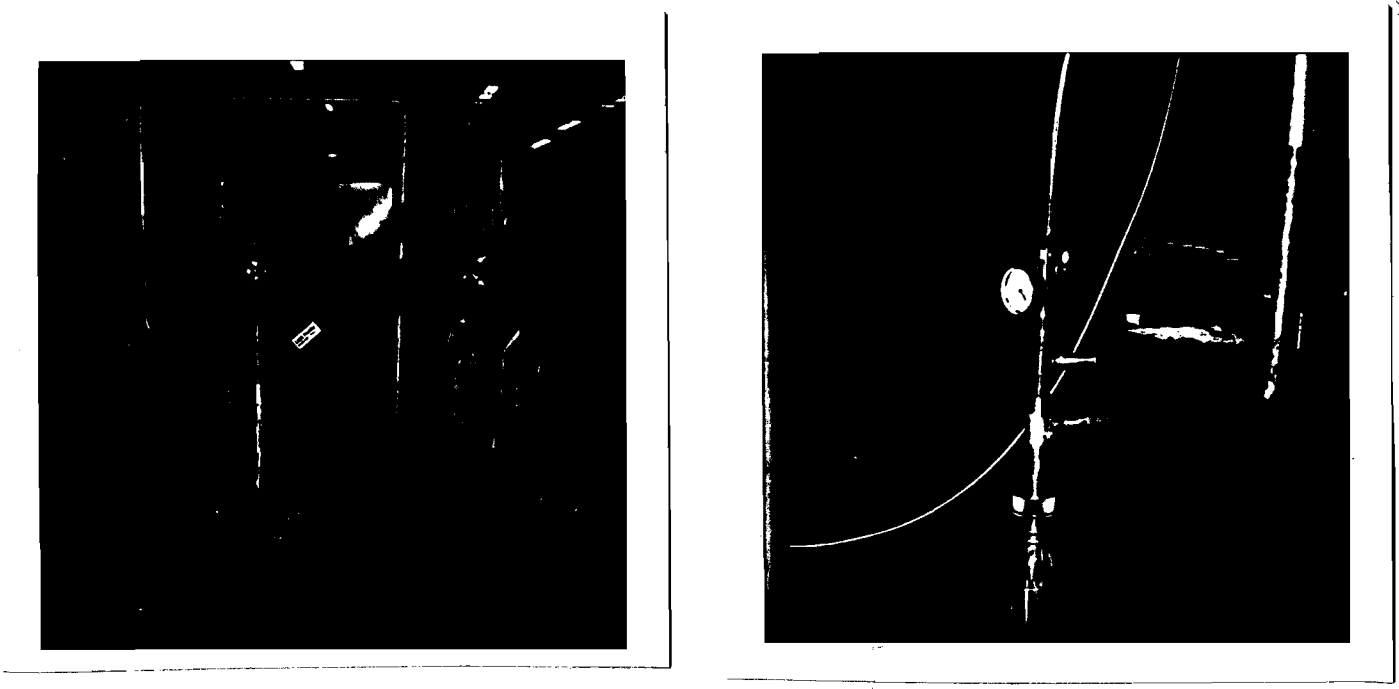


Figure 2. Polaroid pictures of Part II of the test

PART III - TEST OF SEALS WITH MISALIGNMENT

1. Make bayonet mounted on track unleveled by removing or adding shims under mounting plate. Should be unleveled from vertical by one to two degrees.
2. Make floor mounted bayonet unleveled by removing or adding shims under mounting plate. Should be unleveled from vertical by one to two degrees.
3. Record amount and direction of misalignment.
4. Bayonet should still be at 90 psig pressure.
5. Sniff around the top of the bayonet.
6. Sniff top of bayonet periodically during two travel cycles looking for a leak.
7. Record results of test.
8. Change misalignment and repeat 3 thru 7.
9. Record pressure shown on the gauge and go home for the evening.

The track mounted bayonet travels north and south direction. The table below describes the misalignments. No leaks were detected at any point for any of the misalignments. During misalignment #2 the track mounted bayonet was translated 1/2" to the west as well. The pressure was at 92 psig before leaving in the evening.

Misalignment #	Track mounted bayonet	Floor mounted bayonet
1.	Top tilted South 0.95 degrees	Top tilted North-East 0.5 degrees
2.	Top tilted West 1.1 degrees	Top tilted East 0.6 degrees
3.	Top tilted East 2.2 degrees	Top tilted East 0.6 degrees

PART IV - MEASUREMENT OF FORCES AND SEAL TEST

1. Record pressure shown on the gauge in the morning. The bayonet should be at 90 psig.
2. Unplug power cord going to motor control box.
3. Remove the worm screw that automates the track mounted bayonet.
4. Measure the force required to pull the track mounted bayonet. Record the value.

5. Use the hand held helium leak detector and sniff around the top of the bayonet while causing the track mounted bayonet to rotate. Also sniff when track mounted bayonet is at different track positions. Record any indication of a leak.
6. Increase the misalignment a degree or so. Record the amount and direction of misalignment.
7. Repeat steps 4 thru 6 until comfortable amount of data is taken.
8. Loosen nut on track mounted bayonet and sniff for leaks. (Simulates a nut loosening up)
9. Bleed down the pressure.
10. Pull the bayonet assembly apart and inspect the bearing surfaces and o-ring. Record any observations.
11. Measure the force to pull the track mounted female bayonet without the assembly inserted.
12. End of test.

The bayonet was isolated and the flexible tube supplying helium was disconnected during this test. The forces were measured using two Chatillon spring scales with ranges 0-15 and 0-60 pounds respectively. No leaks were detected at any time during the test. The misalignments were noticeable without the use of a level. Misalignments are given by direction the top of the bayonet was tilted toward and the angle from a vertical level.

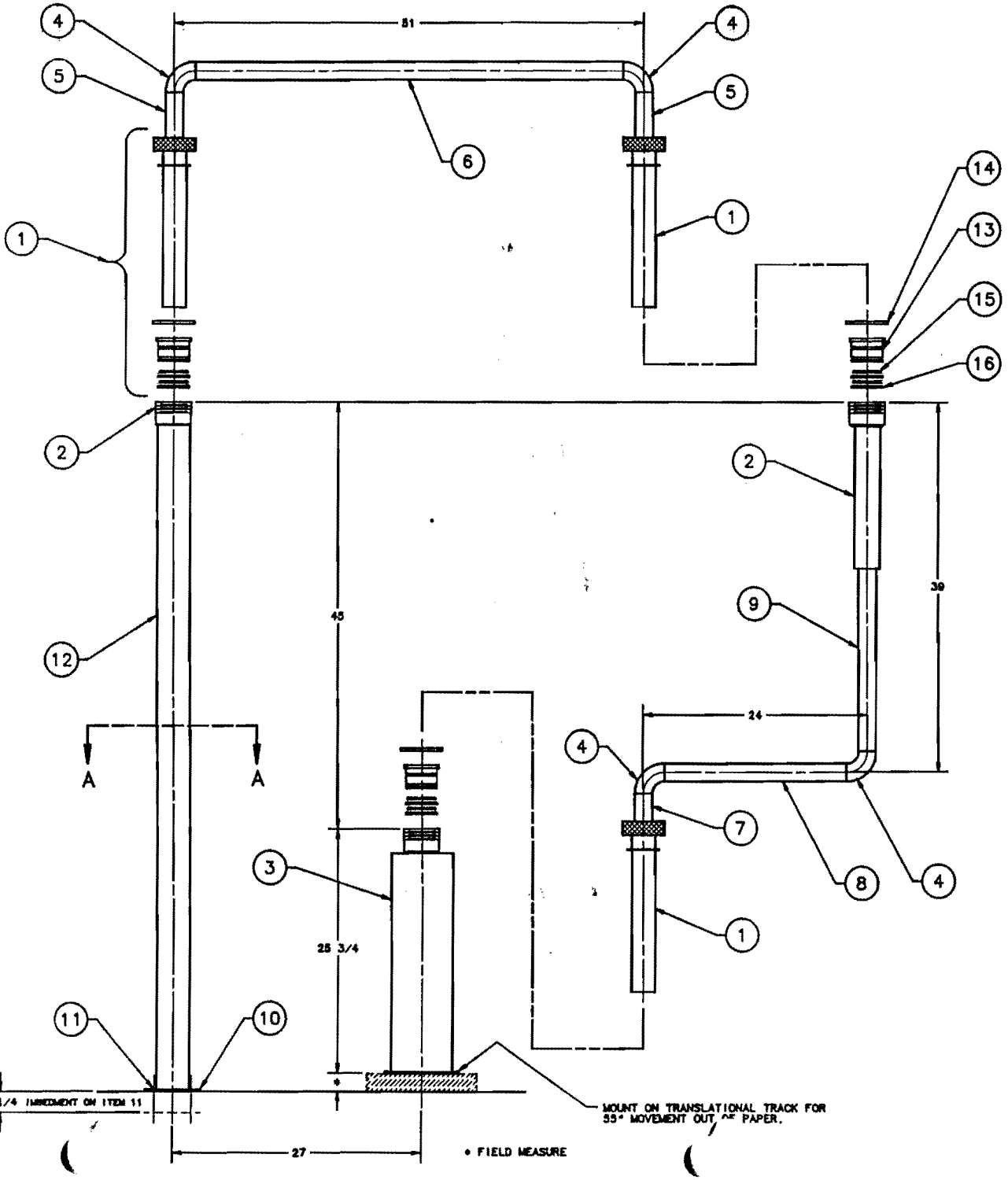
Trial	Track mnted bayonet	Floor mnted bayonet	Force (lbf)
1.	East 2.2 degrees	East 0.6 degrees	9 to 10 to go south and north
2.	North 2.7 degrees	West 1.2 degrees	20 to go south, 35-48 to go north 20 to go south, 35 to go north 20 to go south, 20 to go north
3.	North 2.7 degrees	South-SW 1.6 degrees	12-15 to go south, up to 18 to go north
4.	NW 2.2 deg.	Not tilted, straight	45 and up, > 60 at times
5.	West 0.6 degrees	Not tilted, straight	13-18 to go south, 12 to go north

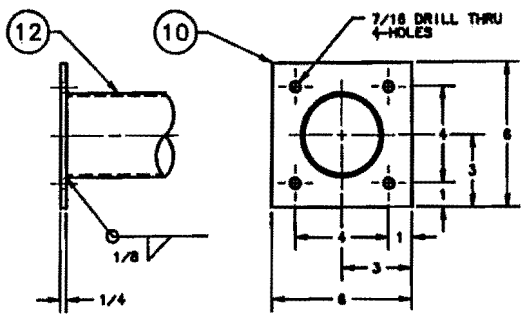
The bayonet assembly was taken apart and every o-ring was inspected and looked good. No scuffs or other marks were found. The Teflon bearing on the bottom of the male stingers were fine. No scratches were found on any of the Teflon pieces. The track mounted female piece took 9 to 15 lbf to move on the track without the rest of the piping attached.

RECOMMENDATIONS

Additional testing should be done on the actual bayonet assembly that will be used in the D-Zero cryo-system. This testing should have the vacuum jacket installed and use liquid nitrogen to test the cold sealing. Earlier testing of a rotary bayonet (See EN 171) has shown that one bayonet does work at liquid nitrogen temperatures. The other size assemblies need to be tested especially the 4" x 6" vent piping bayonet assembly. This assembly will be much stiffer than the 1 1/2" x 3" assembly that was just tack welded together.

REV.	DESCRIPTION	DRAWN / APPROVED	DATE





SECTION A-A

SCALE: 1"=4"

ITEM NO.	PART NO.	DESCRIPTION OR SIZE	QTY. REQ.
16	1045-6478	O-RING, PARKER #2-337	6
15	1045-6474	O-RING, PARKER #2-334	6
14	MB-273691	LOCKING NUT FOR 1 1/2" x 3" ROTARY BAYONET	3
13	MC-273692	O-RING CARRIER FOR 1 1/2" x 3" ROTARY BAYONET	3
12	———	PIPE, 3" SCH. 10S, APPROX. 70" LG. FIELD FIT LENGTH	1
11	1204-1104	HILTI KWIK BOLT, 3/8" x 3 1/2" LG.	4
10	———	PLATE, 8" x 8" x 1/4" THK.	1
9	———	PIPE, 1 1/2" SCH. 10S, x 19 3/8 LG.	1
8	———	PIPE, 1 1/2" SCH. 10S, x 19 1/2 LG.	1
7	———	PIPE, 1 1/2" SCH. 10S, x 20 13/16 LG.	1
6	———	PIPE, 1 1/2" SCH. 10S, x 48 1/2 LG.	1
5	———	PIPE, 1 1/2" SCH. 10S, x 22 5/8 LG.	2
4	1077-0162	ELBOW, 90°, L.R., 1 1/2" SCH. 10S	4
3	ME-273685	FEMALE BAYONET, 1 1/2" x 3" IN EXISTING STAND	1
2	ME-273685	FEMALE BAYONET, 1 1/2" x 3"	2
1	ME-273685	MALE BAYONET, 1 1/2" x 3"	3

PARTS LIST

UNLESS OTHERWISE SPECIFIED		ORIGINATOR	R. RUCINSKI 4-91
FRACTIONS ±1/64	DECIMALS ± ——	ANGLES ± ——	DRAWN B. CYKO 4-91
			CHECKED
			APPROVED
1. BREAK ALL SHARP EDGES 1/64 MAX. 2. DO NOT SCALE DRWG. 3. DIMENSIONING IN ACCORD WITH ANSI Y14.5 STD'S.			USED ON
√ MAX. ALL MACHINED SURFACES			MATERIAL SEE BILL OF MATERIAL C

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

DØ DETECTOR
ROTATING BAYONET TEST SETUP ASSY. EC CRYOGENIC PIPING

SCALE	DRAWING NUMBER	SHEET NO.	REV.
1/8"=1"	3740-MC-19434	1	

FERMILAB

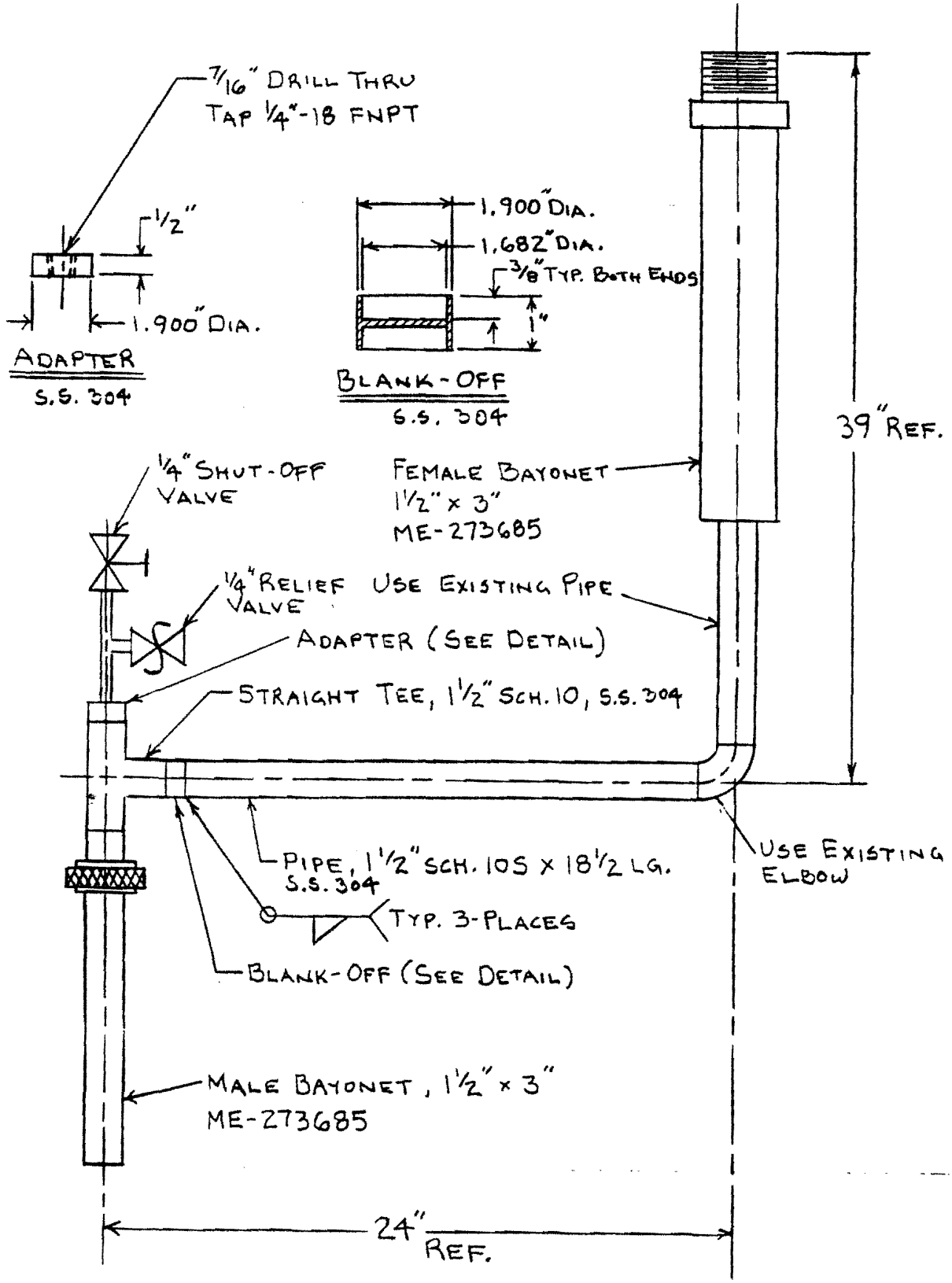
ENGINEERING NOTE

SECTION	PROJECT	SERIAL-CATEGORY	PAGE
RD/CRYO	DØ		1 OF 1

SUBJECT: ROTATING BAYONET TEST SETUP
"MODIFICATION FOR PRESSURE TESTING SEALS"

NAME: CYKO

DATE: 4-11-91 | REVISION DATE:



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