



## HELIUM EXPANSION ENGINE DYNAMIC O-RING TEST PROGRAM

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### INTRODUCTION

The Koch Wet and Dry Expansion Engines use Dynamic O-rings at the warm end (crosshead) of a plunger type piston to seal the low temperature gas to atmosphere.

Each piston uses two O-rings and two grease impregnated felts that supply lubrication during operation.

These engines each have two cylinders which run 180° out of phase. For more information about these expanders see "Fermilab's Satellite Refrigerator Expansion Engines" by Tom Peterson, in Advances in Cryogenic Engineering, Vol. 29, 1984.

### METHOD USED

An existing spare wet engine was used to test the crosshead O-rings. This engine was driven by a DC Drive controlling the speed at 250 RPMS.

With the four engine cylinder valves propped open and the inlet and outlet bayonet valves closed, a trapped volume of Helium gas was transferred back and forth within the two cylinders.

A high pressure Helium bottle supplied makeup gas the condition of the O-rings was determined by the loss of Helium gas. One thousand hours of continuous operation was selected as inspection time.

### CONCLUSIONS

TEST 4: With Houghton Cosmolube Grease: Cylinders O-rings, and felts looked very good. Had a sort of slippery feel and very little grease migrated down walls of the cylinders.

TEST 6: Which lost a remarkable only 100 psi proved planned or accidental mixing of greases have no effect on wear. One important area not measured after each test was finish of cylinder walls.

NOTE: This test program and all test data where a result of an interested engine technical group particularly Tom Peterson, Ernest Ramirez, Mark Gilmour and Jeff Spencer.

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## TEST RESULTS

TEST	<sup>1</sup> 'O' RING	<sup>2</sup> FELTS	'O' RING GREASE	CROSS HEAD GREASE	<sup>3</sup> CROSS HEADS	HOURS	<sup>4</sup> HELIUM LOSSES	INSPECTION	REMARKS
1	#7507	BOOTH	CITGO PREM EP2	EXXON LIDOK EP1	SLEEVED	946	2000 PSI	'O' RING WEAR, TOP SIDE FELTS LIMITED WEAR	
2	#7507	BOOTH	CITGO PREM EP2	EXXON LIDOK EP1	SLEEVED	1,079	5,545 PSI	'O' RINGS WEAR, TOP SIDE FELTS LIMITED WEAR	SMALL 'BACK UP' 'O' RINGS WERE USED ON #1 CYLINDER TO PREVENT STANDARD 'O' RING FROM MOVING
3	#7507	BOOTH	HONGHTON COSMOLUBE	HONGHTON COSMOLUBE	SLEEVED	69	1,200 PSI	CHIPPED 'O' RINGS #1 SIDE	#1 CYLINDER BACK-UP RINGS USED #2 CYLINDER STANDARD
4	#7507	BOOTH	HONGHTON COSMOLUBE	HONGHTON COSMOLUBE	SLEEVED	980	2,094 PSI	'O' RINGS AND FELTS NO APPRECIABLE WEAR	
5	#7507	3- BOOTHS SEE REMARKS	MIXED SEE REMARKS	MIXED SEE REMARKS	STANDARD CHROME PLATED	143	350 PSI	#2 CYLINDER FELTS SHOWED APPRECIABLE WEAR	#1 CYLINDER-CITGO PREM EP2 ON 'O' RINGS AND FELTS, EXXON LIDOK EP1 ON CROSS HEAD #2 CYLINDER-MIXED CITGO PREM EP2 AND EXXON LIDOK AND USED ON 'O' RINGS AND FELTS #1 CYLINDER-PLACED A THIRD FELT ABOVE 'O' RINGS AS A WIPER FELT
6	#7507	3- BOOTHS	MIXED	MIXED	STANDARD CHROME PLATED	1,001	100 PSI	#1 AND #2 'O' RINGS AND FELTS SHOWED NO APPRECIABLE WEAR	SAME AS TEST #5

- <sup>1</sup> 'O' RINGS- PRECISION RUBBER PRODUCTS, LEBANON TENN.,.210 DIA. NITRILE, 70 DUROMETER ,HAND BUFFED
- <sup>2</sup> FELTS-BOOTH FELT CO.,CHICAGO,ILL. TYPE BDF 1/4" SQUARE 30 DEGREE BEVEL
- <sup>3</sup> CROSS HEADS AND SLEEVES- CARBON STEEL .0002 CHROME PLATE 12 RMS FINISH.
- <sup>4</sup> HIGH PRESSURE BOTTLE 213 SCF AT 2200 PSI