09:13:54 OCA PAD INITIATION - PROJECT HEADER INFORMATION 07/15/92

Active

Project #: E-25-X36 Cost share #: Rev #: 0
Center # : 10/24-6-R7548-0A0 Center shr #: OCA file #:
Work type : RES
Contract#: AGREEMENT DATED 6/23/92 Mod #: Document : AGR
Prime #: Contract entity: GTRC

Subprojects ? : N CFDA:
Main project #: PE #:

Project unit: MECH ENGR Unit code: 02.010.126
Project director(s):
BAIR S S III MECH ENGR (404)894-3273

Sponsor/division names: LUBRIZOL CORP / WICKCLIFFE, OH
Sponsor/division codes: 211 / 029

Award period: 920727 to 930126 (performance) 930126 (reports)

Sponsor amount	New this change	Total to date
Contract value	37,511.00	37,511.00
Funded	37,511.00	37,511.00
Cost sharing amount		0.00

Does subcontracting plan apply ?: N

Title: PIN-ON-DISC TESTER

PROJECT ADMINISTRATION DATA

OCA contact: Brian J. Lindberg 894-4820

Sponsor technical contact

DR. HYUN-SOO HONG
(216)943-4200

THE LUBRIZOL CORPORATION
29400 LAKELAND BLVD.
WICKLIFFE, OHIO 44092

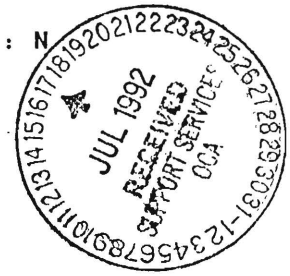
Sponsor issuing office

DR. STEPHEN A. DIBIASE
(216)943-4200

THE LUBRIZOL CORPORATION
29400 LAKELAND BLVD.
WICKLIFFE, OHIO 44092

Security class (U,C,S,TS) : U ONR resident rep. is ACO (Y/N): N
Defense priority rating : N/A N/A supplemental sheet
Equipment title vests with: Sponsor GIT X

Administrative comments -
INITIATION OF PROJECT E-25-X36 (FIXED PRICE).
AN ADVANCE PAYMENT OF $9,300 HAS BEEN REQUESTED FROM THE SPONSOR.



GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

NOTICE OF PROJECT CLOSEOUT

Closeout Notice Date 02/04/93

Project No. E-25-X36_____ Center No. 10/24-6-R7548-0A0_

Project Director BAIR S S III_____ School/Lab MECH ENGR_____

Sponsor LUBRIZOL CORP/WICKCLIFFE, OH_____

Contract/Grant No. AGREEMENT DATED 6/23/92_____ Contract Entity GTRC

Prime Contract No. _____

Title PIN-ON-DISC TESTER_____

Effective Completion Date 930126 (Performance) 930126 (Reports)

Closeout Actions Required:	Y/N	Date Submitted
Final Invoice or Copy of Final Invoice	Y	_____
Final Report of Inventions and/or Subcontracts	Y	_____
Government Property Inventory & Related Certificate	N	_____
Classified Material Certificate	N	_____
Release and Assignment	N	_____
Other _____	N	_____

CommentsEFFECTIVE DATE 7-27-92. CONTRACT VALUE $37,511_____

Subproject Under Main Project No. _____

Continues Project No. _____

Distribution Required:

Project Director	Y
Administrative Network Representative	Y
GTRI Accounting/Grants and Contracts	Y
Procurement/Supply Services	Y
Research Property Managment	Y
Research Security Services	N
Reports Coordinator (OCA)	Y
GTRC	Y
Project File	Y
Other HARRY VANN-FMD_____	Y
FRED CAIN-OOD_____	Y

NOTE: Final Patent Questionnaire sent to PDPI.

HIGH-TEMPERATURE PIN-ON-DISC TESTER

Final Report to Lubrizol Corporation

Scott Bair
Principal Research Engineer

Farrukh Qureshi
Post Doctoral Research Assistant

George W. Woodruff School of Mechanical Engineering
Georgia Institute of Technology
Atlanta, GA 30332-0405

December, 1992

INTRODUCTION

A High-Temperature Pin-on-Disc Tester has been designed and constructed by the Georgia Tech Tribology & Rheology Laboratory for Lubrizol Corporation to meet specifications outlined in our letter of April 28, 1992 and modified during a telephone conversation on July 17, 1992. The tester provides the conventional stationary pin end sliding against a rotating disc face. A sliding velocity of 0.11 to 5.5 m/s is available. The temperature of the sealed disc enclosure with liquid bath can be regulated to 350°C. A load of up to 250 N is applied pneumatically. A bath thermocouple, friction force transducer and disc rpm sensor are provided.

DEVICE CONCEPT

The pin-on-disc machine is similar in concept to a machine which has been used extensively in the Georgia Tech Tribology & Rheology Laboratory with design improvements. Detail component drawings are included in the appendix. (Dimensions are in inches.) Load is applied by gas pressure acting on the differential area of the two journals (20.32 and 38.1 mm diameter) of the spindle shaft. The bearings and seals on these journals are sliding in rotation - thereby eliminating seal friction in the disc normal load direction. The lubricant is ATF. The spindle shaft is connected to the disc by a disc adapter which serves to thermally isolate the hot disc from the spindle assembly. Rotation of the spindle shaft is affected by a toothed belt pulley driven shaft acting through a ball spline. The disc is fastened to the adapter with a nut, draw bolt and washer. The locating surfaces of the disc adapter were ground while the spindle was rotating in its housing to assure true running.

The disc enclosure is sealed to retain a liquid lubricant bath and two fittings are provided for liquid circulation. Heat is provided with four 50W (at 120V) cartridge heaters. 350°C is

reached in about 1 hour of heating. One thermocouple resides in the liquid bath. Another thermocouple fitting has been provided so that the temperature of a drilled pin/pin block may be measured. The pin runs against the disc at a radius of about 21 mm. Rotation is clockwise as seen from the pin. Friction force is measured by a pair of elastic beams which connect the enclosure with the spindle housing. These beams are fitted with strain gauges (Micro Measurements Group CEA-06-125 UW-120) in a full bridge for temperature and normal force compensation. They are bonded by high-temperature epoxy. Excitation voltage is 12V and with a signal conditioner gain of 200 a sensitivity of 0.09 V/N (0.4 V/lbf) is obtained with a friction force/normal force cross talk of about 1%. The zero shift on heating to 350°C from ambient is about 0.4V (200 gain).

Rotational speed of the disc is measured by a magnetic pickup and toothed wheel (30 teeth). The normal force can be accurately determined from the pressure of regulated gas acting on a differential area of 815.4 mm^2 (1.264 in^2). A clean supply of gas at 60 to 200 psig (0.4 to 1.4 MPa) is required at the regulator supply port. A ½hp motor and speed control (120V) are provided. Two sets of motor pulleys and belts are used to provide the full rotating speed range of 0.11 to 5.5 m/s.

TESTER OPERATION

A detail drawing of the pin and disc is provided in the appendix. To install pin and disc specimen the disc is placed on the disc adapter within the enclosure. The ¼-28 nut is tightened to 7 Nm (60 in-lb) while holding the shaft by the ⅜-24 nut at the opposite end. The shaft is pushed toward the spindle housing as far as it will travel. The pin is placed in the pin holder and with a .25 to .5 mm shim (0.10 to 0.20 in) between the pin and disc the pin is pushed as far as

possible toward the spindle housing. The two large (8-32) pin holder screws are then tightened.

The friction force transducer is calibrated by applying a known horizontal force (with a mechanical force gauge or a pulley and weight) to the enclosure while noting the output from the signal conditioner. The normal force cross-talk can similarly be obtained for no rotation by applying a regulated gas pressure while noting the signal output. The friction signal should be zeroed at the temperature and load for the particular test.

Great care is required to prevent damage to the strain gauges mounted on the beams. Tools should not be allowed to strike these gauges. (In the event that one gauge on either beam fails, the transducer can be converted to half-bridge operation.)

Oil level in the spindle housing should be checked about every ten hours of operation. Oil (automatic transmission fluid) should flow freely from the ⅛ NPT port in the side of the housing. Oil is added by removing the 5/16-24 set screw and 3/16 inch steel ball from the housing top.

REQUIRED INSTRUMENTATION

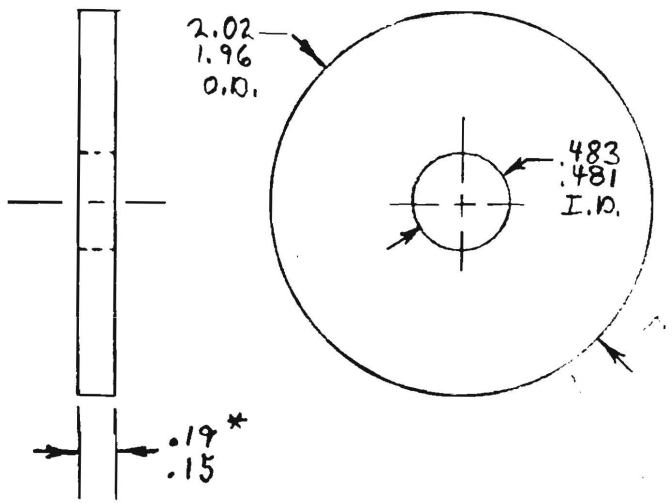
1) Thermocouple reading device - type K

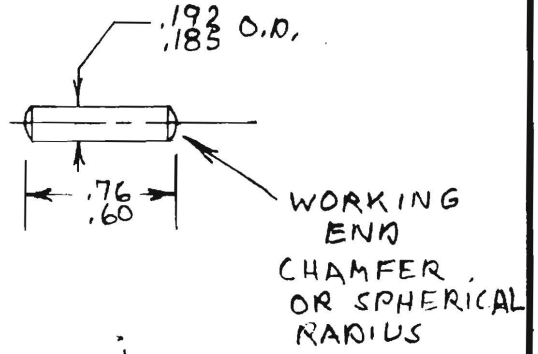
2) Temperature controller - 120V output

3) Strain gauge signal conditioner - 12V excitation, gain approximately 200, selectable low-pass filter

APPENDIX

COMPONENT DRAWINGS



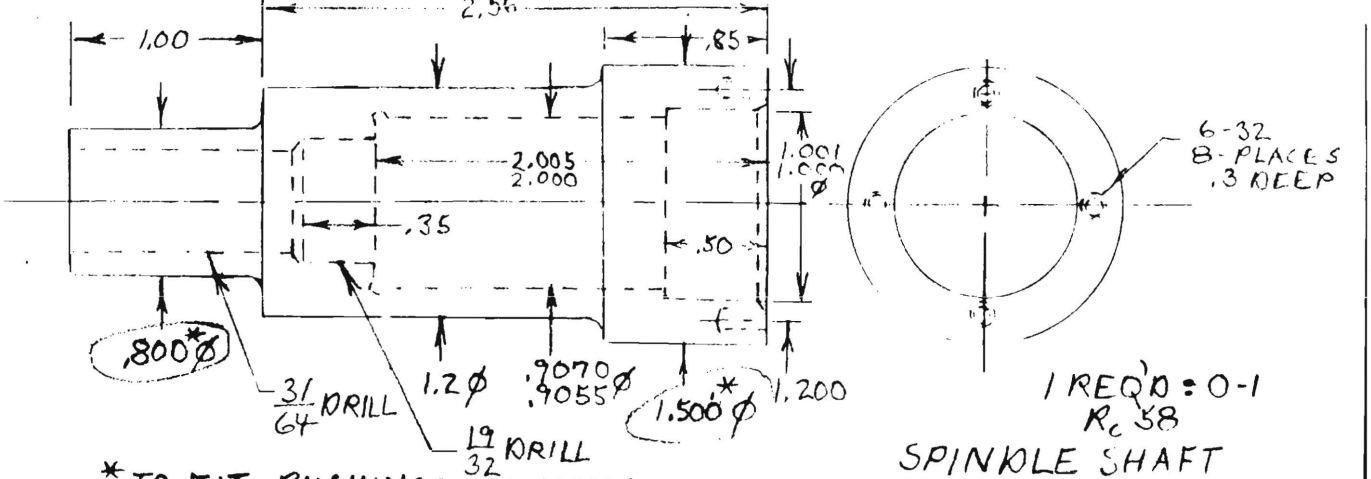


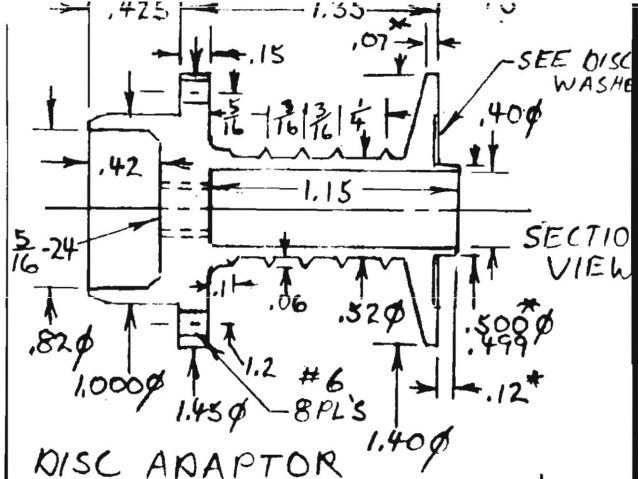
* THICKNESS UNIFORM TO 0.002 in.

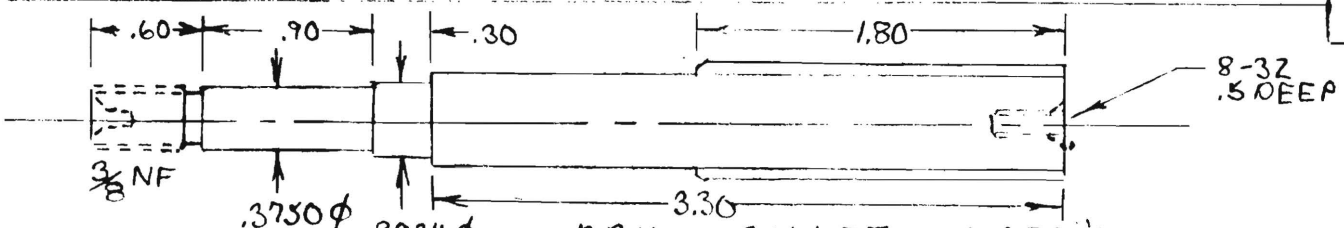
SPECIMENS; PIN-ON-DISC TESTER

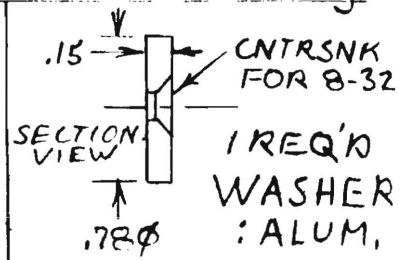
INITIALS	DATE

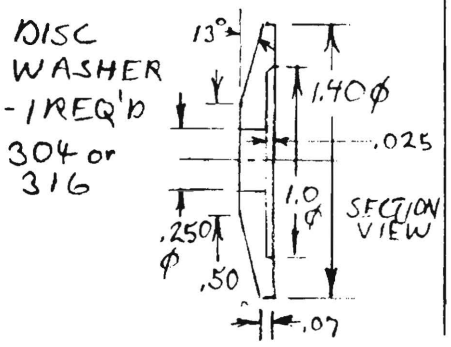
TRIBOLOGY & RHEOLOGY LABORATORY
SCHOOL OF MECHANICAL ENGINEERING
GEORGIA INSTITUTE OF TECHNOLOGY

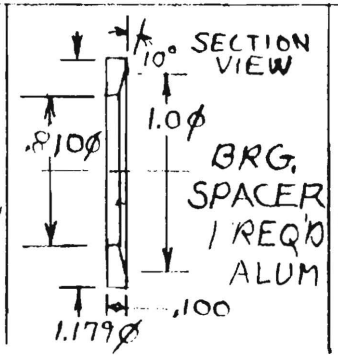

1.00
2.56
.85
2.005
2.000
.35
.50
1.001
1.000 ø
6-32
8-PLACES
.3 DEEP
.800*ø
31/64 DRILL
1.2ø
.9070
.9055ø
1.500*ø
1.200
19/32 DRILL
*TO FIT BUSHINGS IN HSNG
1 REQ'D : O-1
Rc 58
SPINDLE SHAFT

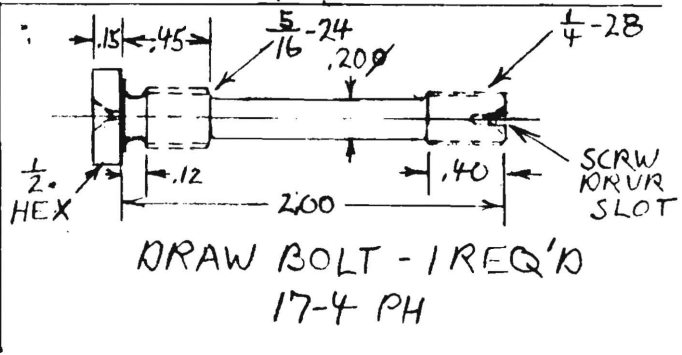

.425
1.35
.15
.07*
SEE DISC WASHER
5/16
3/16
3/16
1/4
.40ø
.42
1.15
5/16-24
SECTION VIEW
.1
.06
.52ø
.500*ø
.499
.82ø
1.000ø
1.45ø
1.2 #6
8 PL'S
.12*
1.40ø
DISC ADAPTOR
304 or 316
1 REQ'D
*Before Grinding


.60
.90
.30
1.80
8-32
.5 DEEP
3/8 NF
.3750ø
.3934ø
to fit brg.
3.30
DRIVE SHAFT - 1 REQ'D
MAKE FROM SPLINE SHAFT

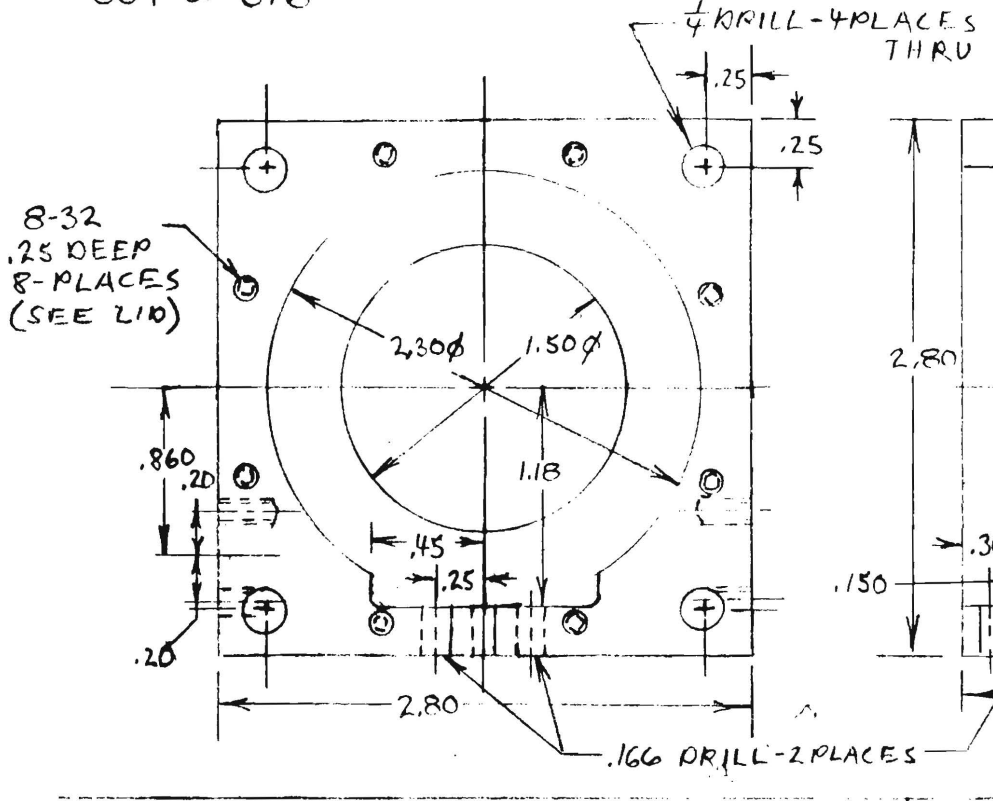

.15
CNTRSNK
FOR 8-32
SECTION VIEW
.78ø
1 REQ'D
WASHER
: ALUM.

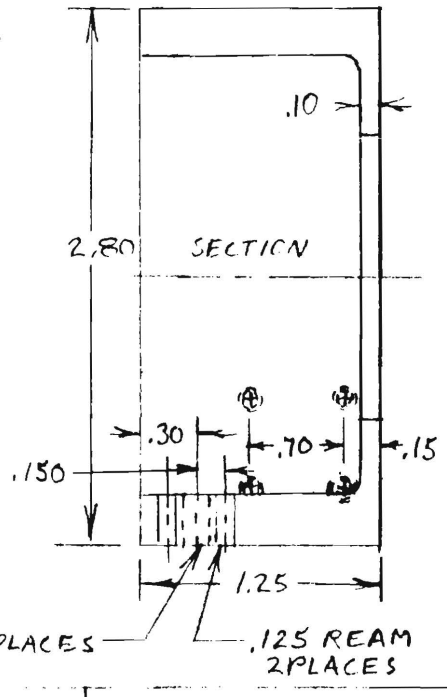

DISC
WASHER
- 1 REQ'D
304 or
316
13°
1.40ø
.025
1.0ø
SECTION VIEW
.250ø
.50
.07


10° SECTION VIEW
1.0ø
.810ø
BRG. SPACER
1 REQ'D
ALUM
.100
1.179ø

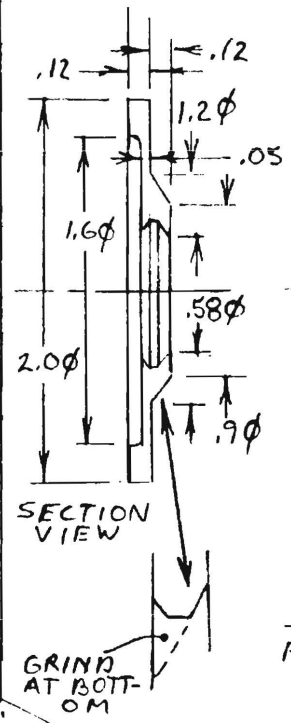

.15
.45
5/16-24
.20ø
1/4-28
1/2" HEX
.12
.40
2.00
SCRW DRVR SLOT
DRAW BOLT - 1 REQ'D
17-4 PH

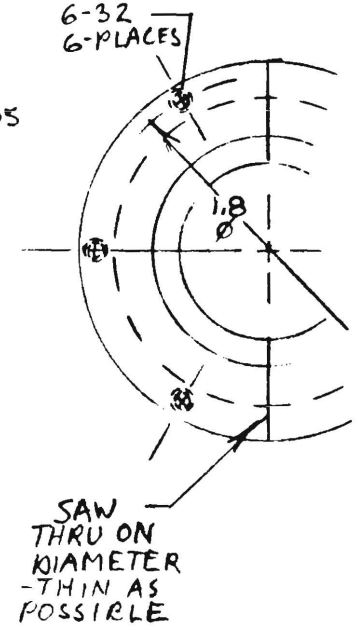
304 or 316

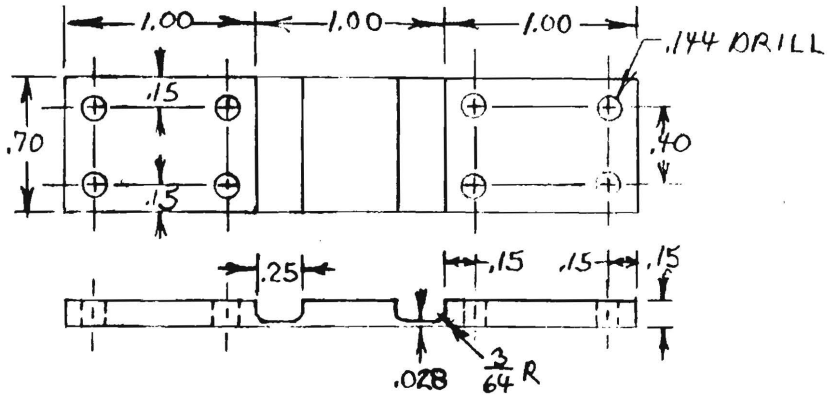




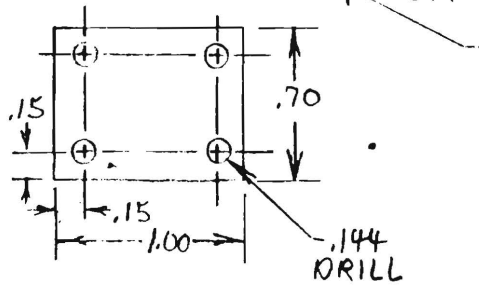
SPLIT SEAL - 1 REQ'D
304 or 316



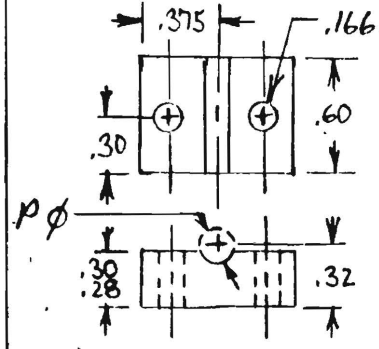




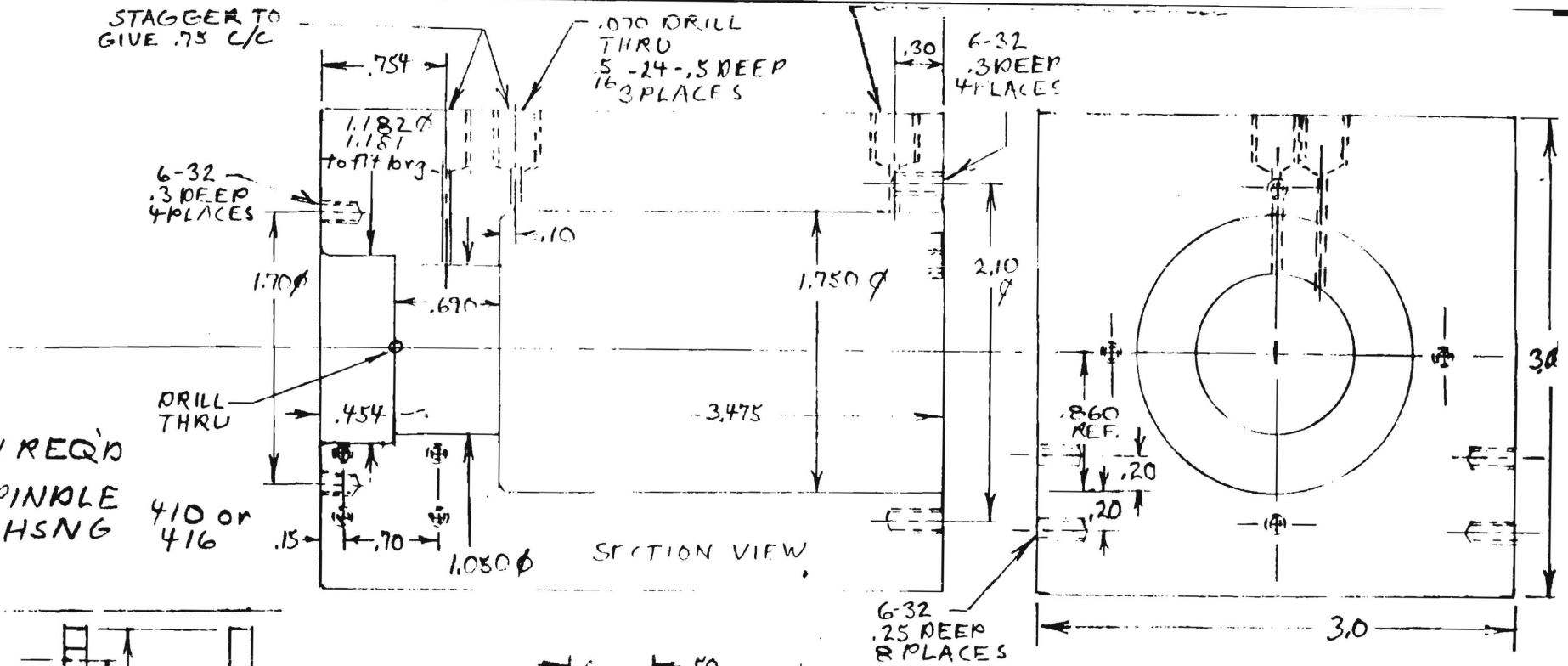
BEAM - 2 REQ'D - 17-4 PH

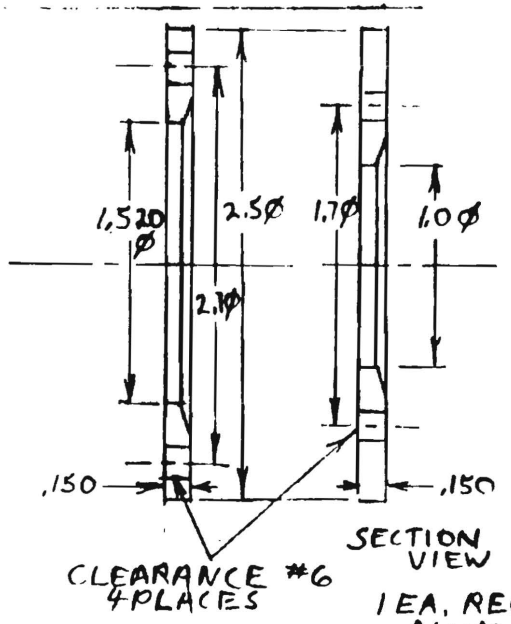


INSULATOR - 2 REQ'D
MACOR 0.10 THICK



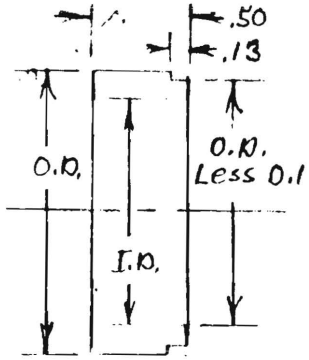
PIN BLOCKS - 2 - REQ'D
304 or 316
P = 3/16





1 EA. REQ'D ALUM.

RETAINERS



	O.D.	I.D.
1 EA.:	1.751	1.500
1 EA.:	1.051	.800

BUSHINGS
660 BRONZE
SECTION VIEW

LID - 1 REQ'D
304 or 316