HIRES: How to Position and Focus a CCD

By Jack Osborne

February 12, 2002

This report contains a collection of photographs taken while the Keck 1 spectrograph we call HIRES was being designed and built. HIRES was constructed at UCSC during the period 1988 to 1993.

Steve Vogt invented the optical layout and the plan.

Next, using AutoCAD 2-D software for the first time (all previous work at Lick Observatory was done with pencil and paper) the spectrograph was designed.

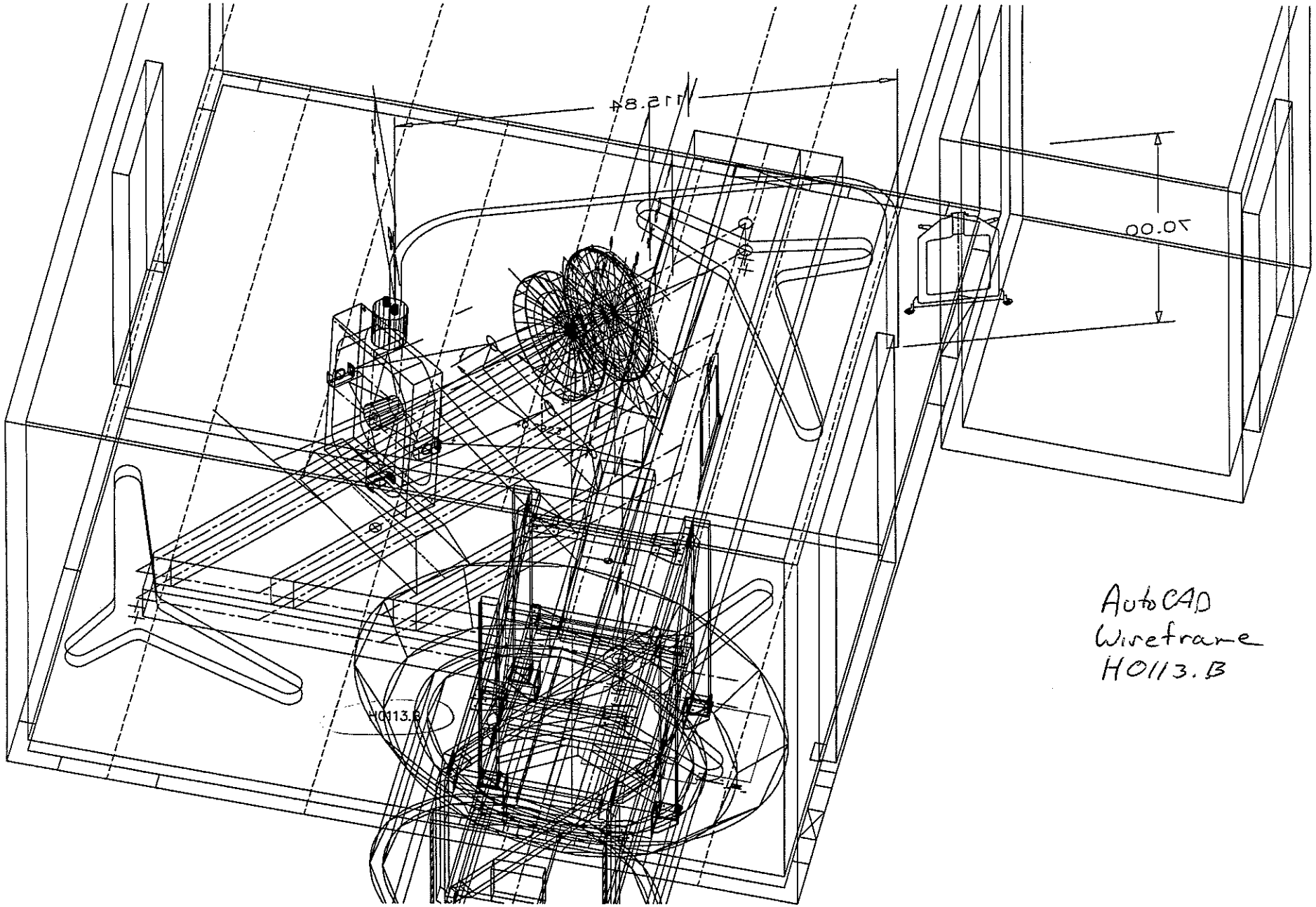
After commissioning, I described how we got the CCD where it goes a number of times, and after the last time, I put together this notebook. That's why there is very little description here: I used the pictures and drawings and talked about how and why things are like they are.

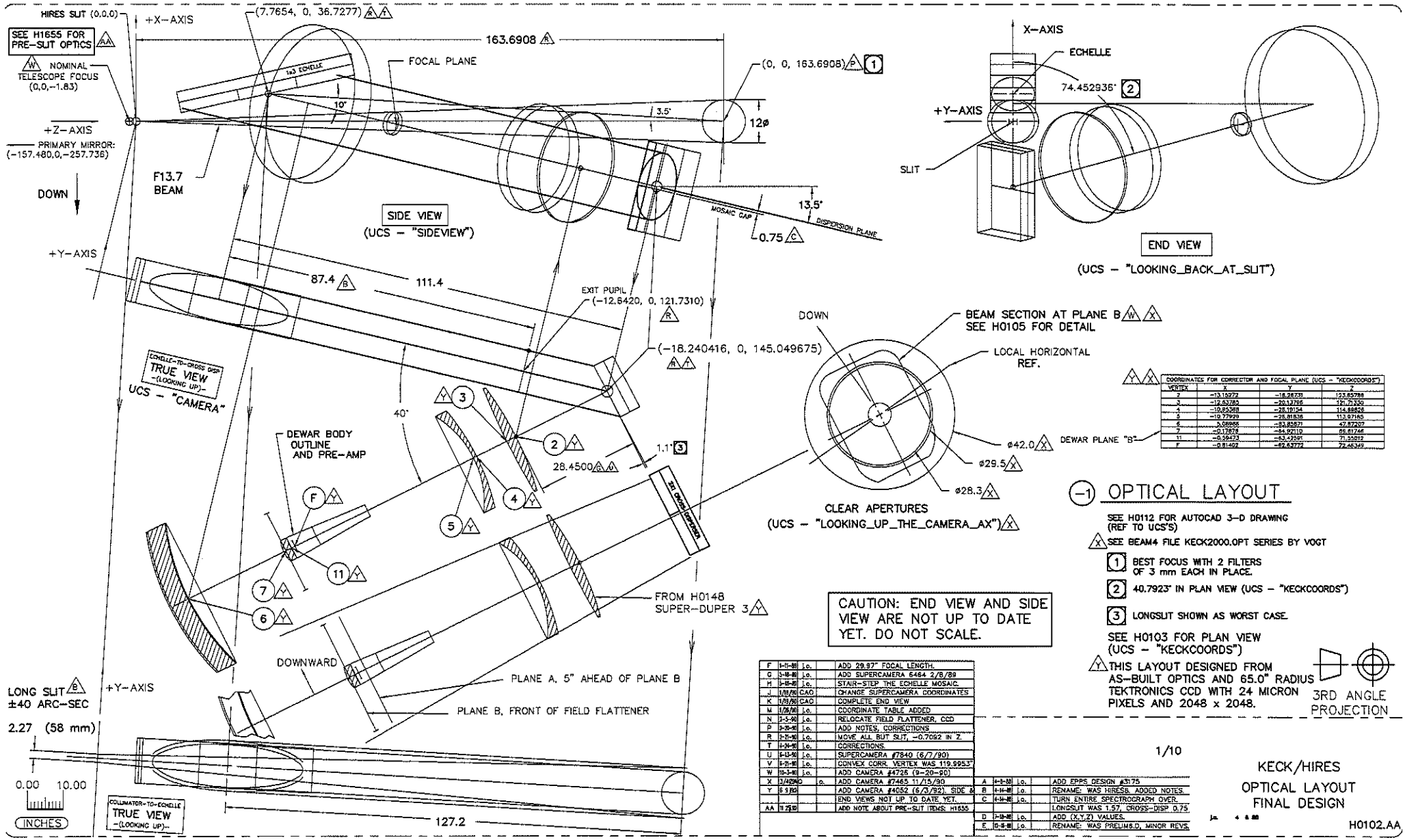
I am retiring now and so this present report is intended to tidy up this album. All of the photos have hand-written titles, like 42-30. The '42' corresponds to a sleeve of 35-mm negatives in a large box of nearly 4000 negatives now stored with Steve Vogt. The '30' is the number printed on the negative. In some cases there will be an 'A' next to this second number. The Appendix to this report lists the CCD photos in the larger set of HIRES photos. Also, in the Appendix, some of the photo captions are listed.

I hope this report helps future modifications to HIRES. There are many things that we would do differently now, but it would be impossible to list all of them here. Moving the CCD to focus the spectrograph was novel at the time and was quite a challenge. Cooling with liquid nitrogen will probably not be done in the future. Designing a space frame on day one would have killed us when we found we had to shift the dewar by 15 inches, so the optical bench was a good decision. We went to great lengths to leave hooks for a second side to HIRES. This will never be used. We also made the camera mirror easily changeable so that a second mirror (coated for blue) could be quickly installed. This never happened, but the 'kinematic' mounting is there.

This description is stored as a text file with the HIRES drawings, and is named: hires/misc/CCD.21202.HIRES.doc. The appendix is there too: hires/misc/HIRES.Photo.Inventory.5.doc.

Mechanical Drawings


AutoCAD
Wireframe
H0113.B



VERTEX	X	Y	Z
2	-13.15272	-16.56731	123.65788
3	-12.83265	-20.13796	121.71330
4	-10.85368	-25.19154	114.68826
5	-10.77929	-25.81838	113.97165
6	-5.08986	-83.85871	47.87207
7	-5.17878	-84.90719	66.61746
11	-6.58473	-83.42591	71.55012
F	-0.81402	-82.63772	72.46349

COORDINATES FOR CORRECTOR AND FOCAL PLANE (UCS - "KECKCOORDS")

-1 OPTICAL LAYOUT

SEE H0112 FOR AUTOCAD 3-D DRAWING (REF TO UCS'S)

X SEE BEAM4 FILE KECK2000.OPT SERIES BY VOGT

1 BEST FOCUS WITH 2 FILTERS OF 3 mm EACH IN PLACE.

2 40.7923" IN PLAN VIEW (UCS - "KECKCOORDS")

3 LONGSLIT SHOWN AS WORST CASE.

SEE H0103 FOR PLAN VIEW (UCS - "KECKCOORDS")

Y THIS LAYOUT DESIGNED FROM AS-BUILT OPTICS AND 65.0" RADIUS TEKTRONICS CCD WITH 24 MICRON PIXELS AND 2048 x 2048.

3RD ANGLE PROJECTION

CAUTION: END VIEW AND SIDE VIEW ARE NOT UP TO DATE YET. DO NOT SCALE.

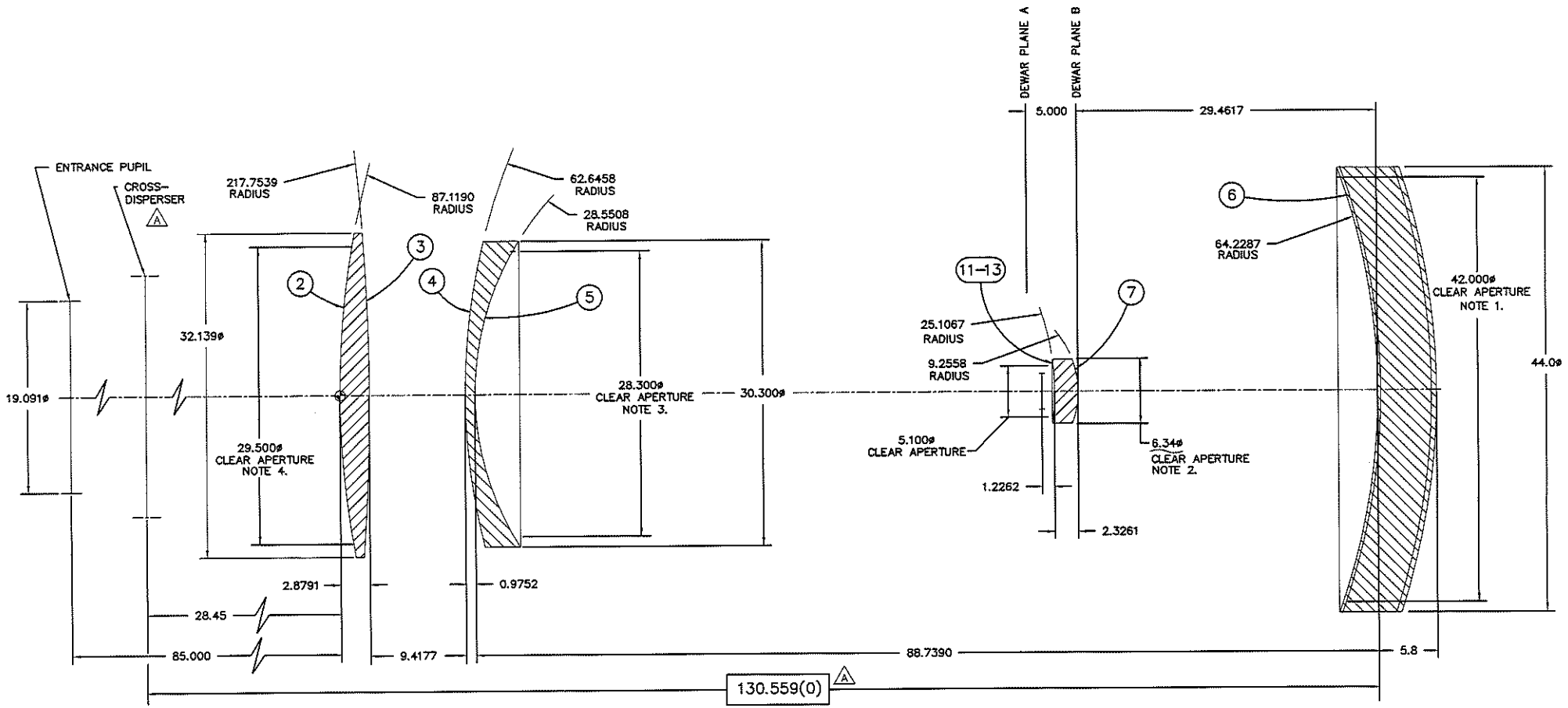
F	1-11-88	J.o.	ADD 29.97" FOCAL LENGTH.
G	5-18-88	J.o.	ADD SUPERCAMERA 5464 2/8/89
H	5-18-88	J.o.	STAIR-STEP THE ECHELLE MOSAIC.
J	1/19/90	CAO	CHANGE SUPERCAMERA COORDINATES
K	1/19/90	CAO	COMPLETE END VIEW
M	1/26/90	J.o.	COORDINATE TABLE ADDED
N	3-5-90	J.o.	RELOCATE FIELD FLATTENER, CCD
P	3-20-90	J.o.	ADD NOTES, CORRECTIONS
R	3-21-90	J.o.	MOVE ALL BUT SLIT, -0.7052 IN "Z
T	4-24-90	J.o.	CORRECTIONS.
U	5-13-90	J.o.	SUPERCAMERA #7840 (6/7/90)
V	8-21-90	J.o.	CONVEX CORR. VERTEX WAS 119.9953"
W	10-3-90	J.o.	ADD CAMERA #4726 (9-20-90)
X	1/4/91	o.	ADD CAMERA #7465 11/15/90
Y	6 3 92		ADD CAMERA #4052 (6/3/92), SIDE & END VIEWS NOT UP TO DATE, YET.
AA	11 2 93		ADD NOTE ABOUT PRE-SLIT ITEMS: H1655

A	4-1-88	J.o.	ADD EPPS DESIGN #3175
B	4-14-88	J.o.	RENAME: WAS HIRES8, ADDED NOTES.
C	4-14-88	J.o.	TURN ENTIRE SPECTROGRAPH OVER.
			LONGSLIT WAS 1.57, CROSS-DISP 0.75
D	7-19-88	J.o.	ADD (X,Y,Z) VALUES.
E	10-5-88	J.o.	RENAME: WAS PRELIM8.0, MINOR REVS.

1/10

KECK/HIRES
OPTICAL LAYOUT
FINAL DESIGN

H0102.AA



(-1) EPPS DESIGN #4052 (6/3/92)

FINAL "AS-BUILT" PRESCRIPTION
USE WITH R=65.0" CONVEX TEK CCD
T = 0°C
THIS DRAWING REPLACES H0135, SUPER-DUPER II
WHICH WAS EPPS DESIGN #7465 (11/15/90)
THE FLAT FIELD VERSION #4753 IS DRAWING H0149.

B 6.7° FOV (FIELD OF VIEW)

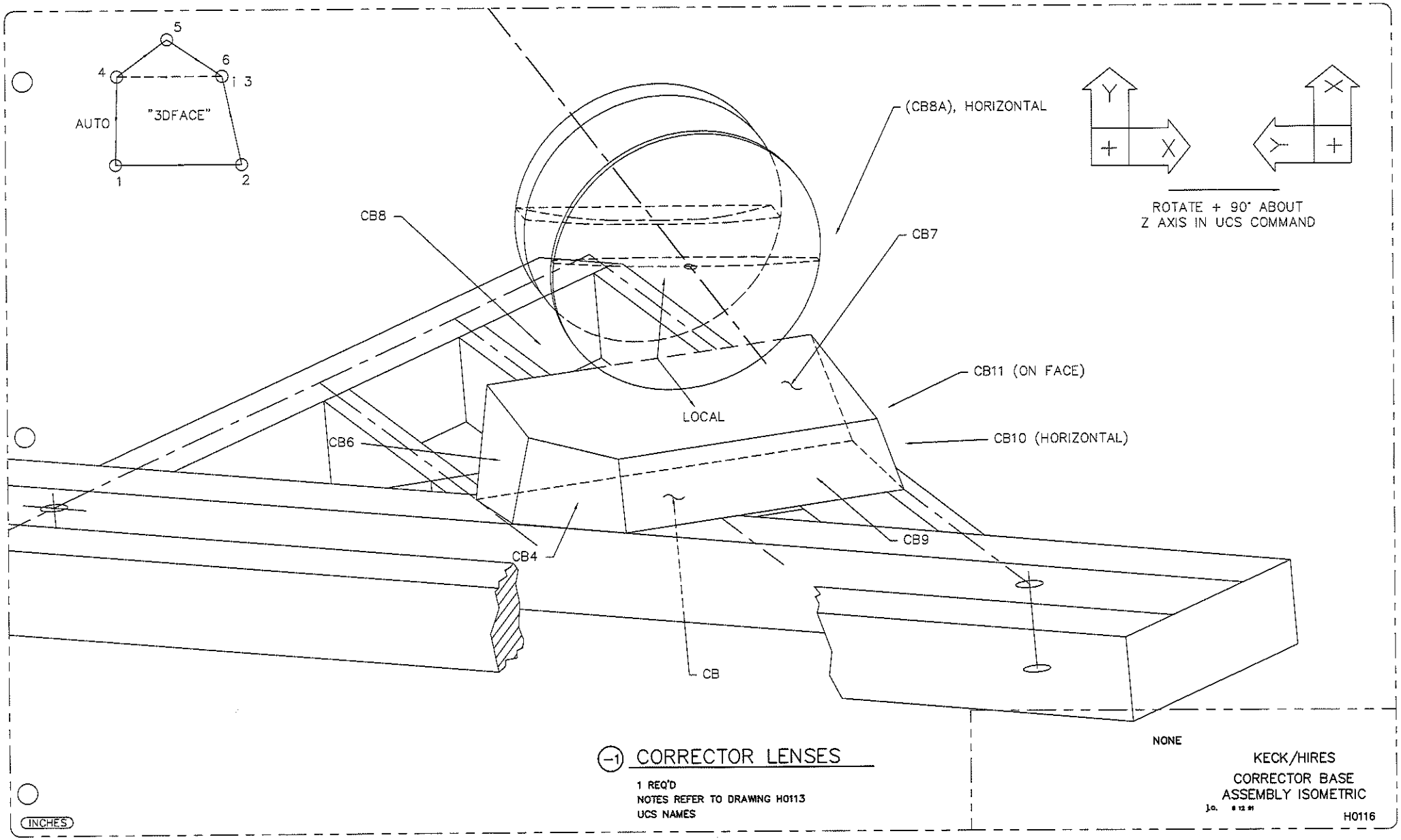
NOTES:
1. 37.603ø CLEAR APERTURE FOR THIS CCD.
SEE H5400-H5405, H5415, H0144 FOR DETAILS
2. 6.34ø C.A. FROM 6.44ø BLANK
SEE H7181 FOR LENS DETAIL
3. 25.90ø C.A.
SEE H0136, H0142, H0145, H0147
4. 27.13ø C.A.
SEE H0136, H0141, H0146

0.00 4.00
INCHES

1/4

A	8 11 92	j.o.	ADD DIMENSION TO CROSS-DISPERSER
B	5 13 93	j.o.	ADD FIELD OF VIEW NOTE

KECK/HIRES
SUPER-DUPER CAMERA III
AS-BUILT "CURVED FIELD"
H.EPPS ø 3 92
ja. 6 8 92
H0148.B



(-1) CORRECTOR LENSES

1 REQ'D
NOTES REFER TO DRAWING H0113
UCS NAMES

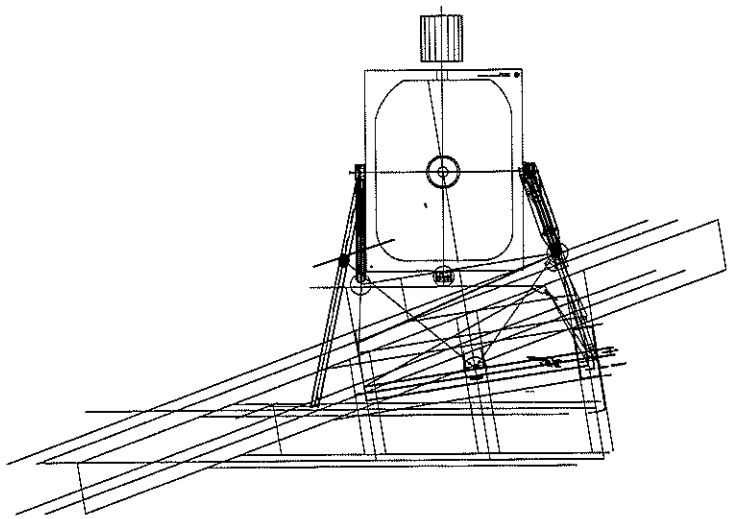
NONE

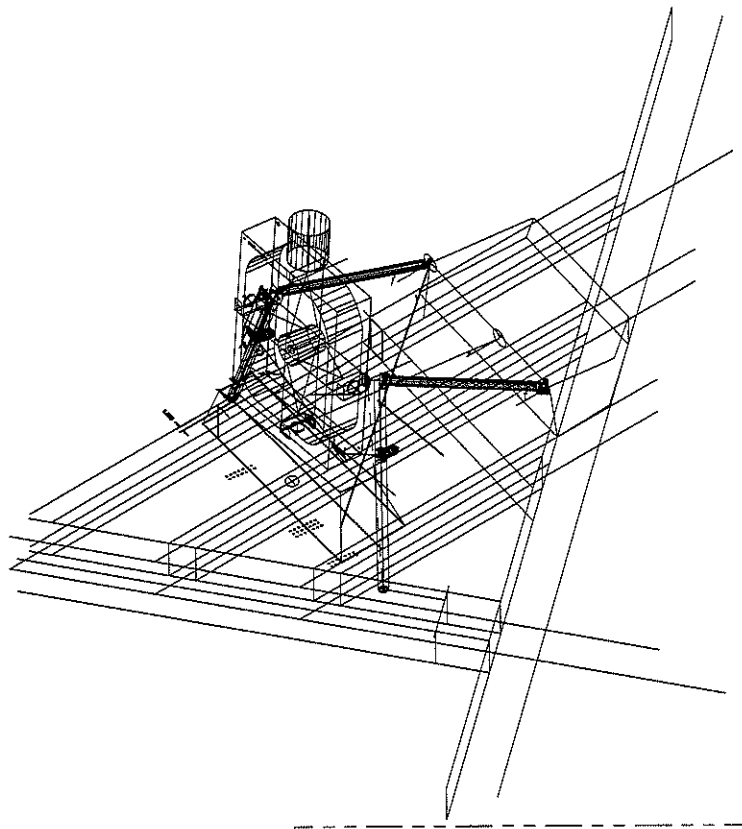
KECK/HIRES
CORRECTOR BASE
ASSEMBLY ISOMETRIC

J.o. 8 12 91

H0116

INCHES



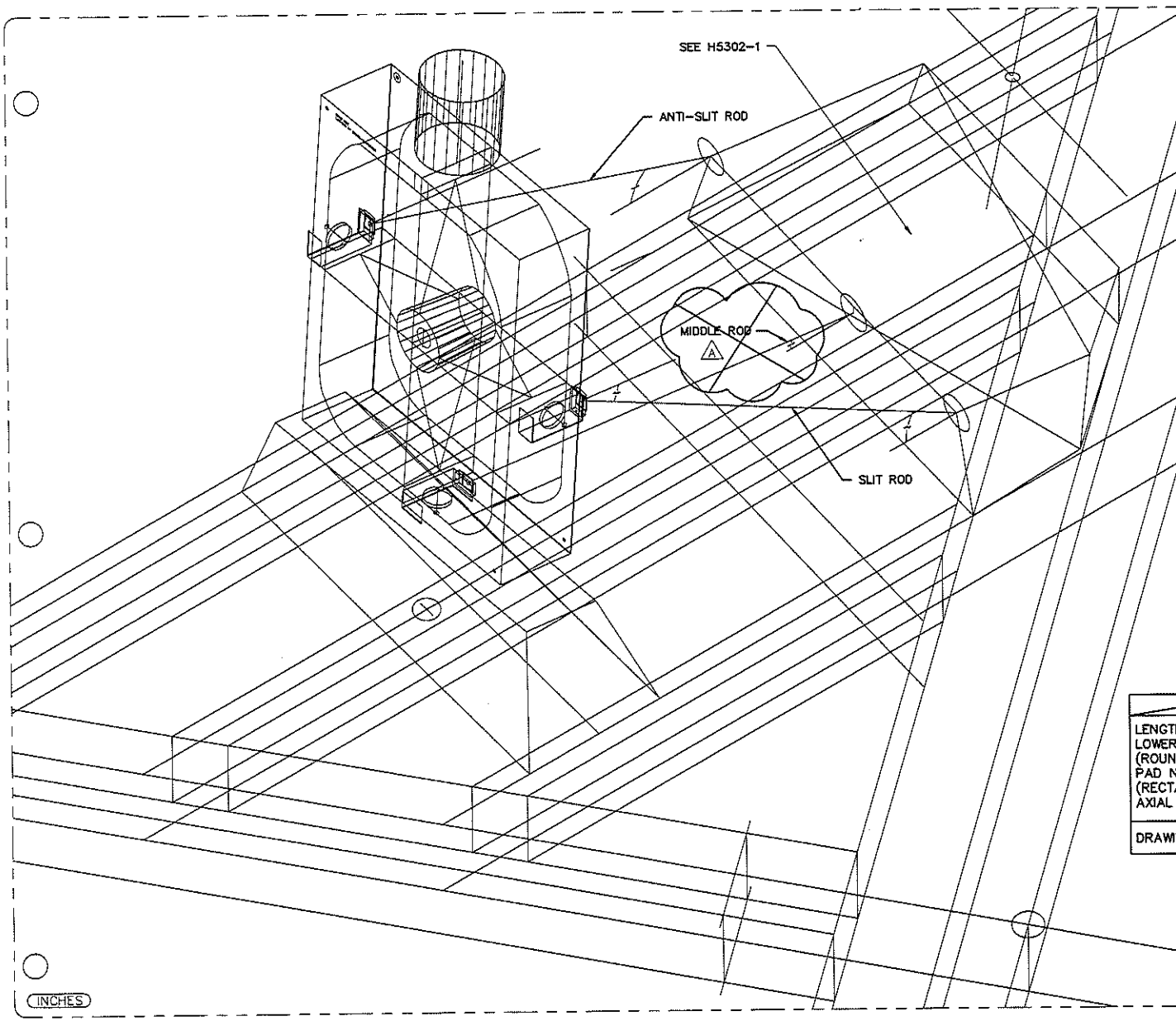


1/10 SCALE

C | 2 3 93 | Jo. | PRESENTATION PLOT.

KECK/HIRES
CCD FOCUS (3-D DRAWING)
DRIVE SUPPORT STRUCTURE
Jo. 95 01
H7340.C

INCHES



(-1) PUSHROD DRIVE LAYOUT

FROM H0113.A
GENERAL ARRANGEMENT

	PUSHRODS:		
	ANTI-SLIT	SLIT	MIDDLE
LENGTH OVERALL	48.23	50.064	45.27
LOWER NODE (ROUND FLANGE)	30.64"	35.96"	10.30"
PAD NODE (RECTANGLE)	20.45"	25.76"	0"
AXIAL TWIST	176.44"	168.8° B	NONE
DRAWING	H7304	H7305	H7306

1/4

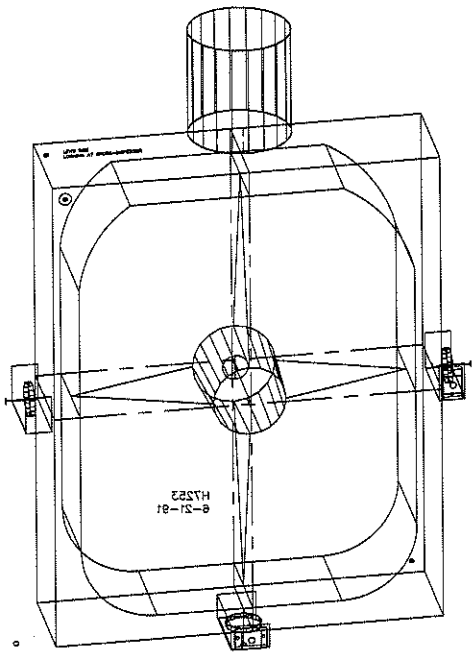
A	9 25 92	j.o.	FINISH MIDDLE DRIVE.
B	5 3 93	j.o.	168.8° WAS 177.25°.

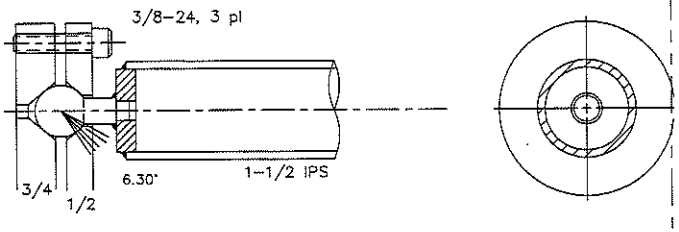
KECK/HIRES
CCD FOCUS PUSHRODS
ASSEMBLY

j.o. 7891

H7303.B

INCHES



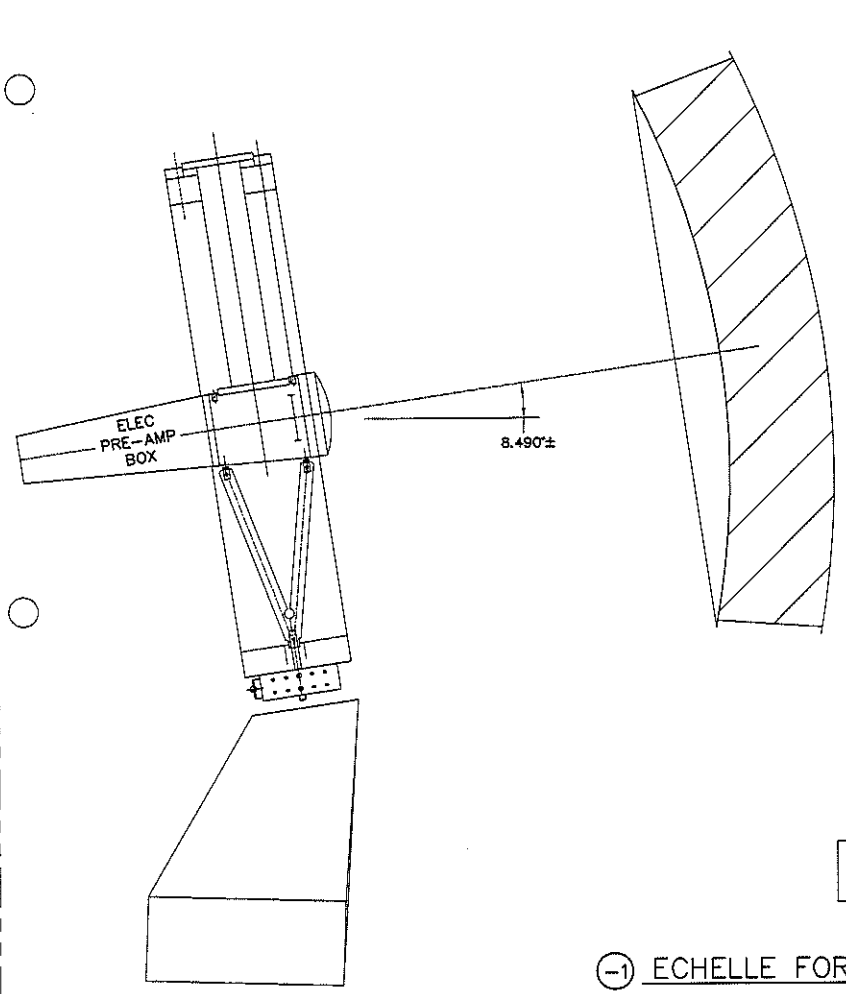


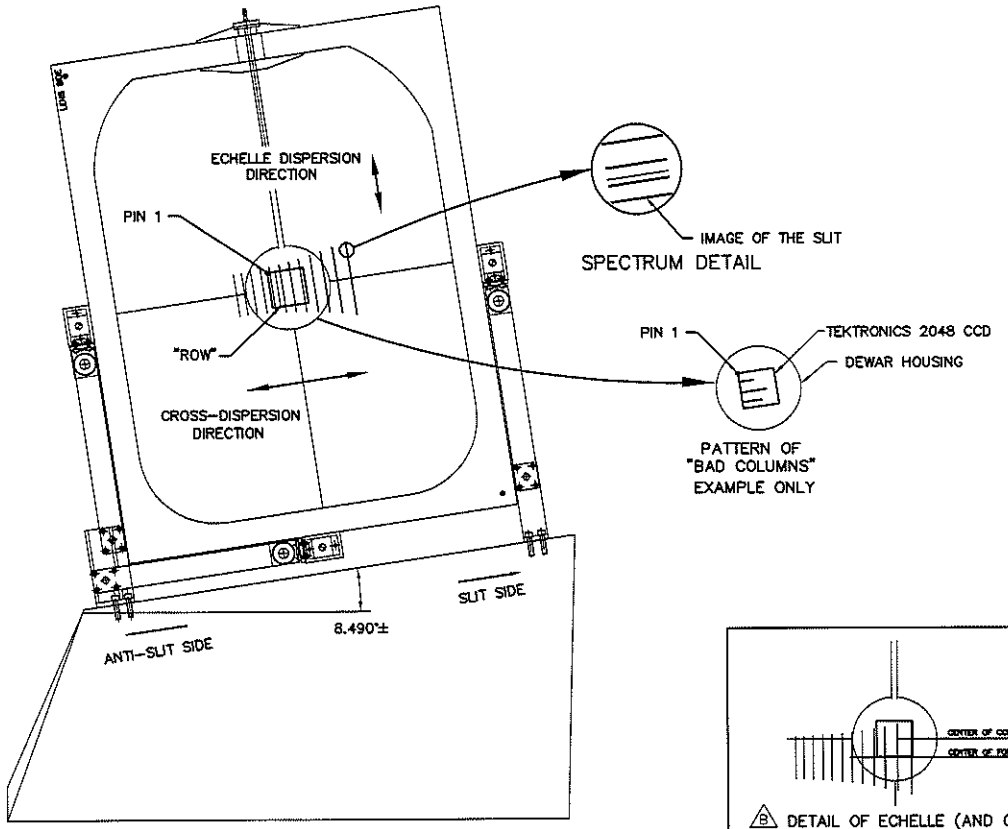
INCHES

FULL

KECK/HIRES
DEWAR BLOCK
3-D

H7253





VIEW LOOKING DOWNWARD ABOUT 8.5°
TOWARD THE CROSS-DISPERSER GRATING (1x2 MOSAIC)

(-1) ECHELLE FORMAT

NOTES:
1. CCD CAN BE ROTATED 180° WITHOUT ROTATING THE SOCKET. PIN 1 WOULD BE ON A DIAGONAL CORNER TO THAT SHOWN.
2. THE SOCKET MAY BE ROTATED 90° BUT NOT -90°.

(B) DETAIL OF ECHELLE (AND CROSS-DISPERSER) MOTIONS CAUSING FORMAT TO MOVE AROUND ON THE CCD (TEK).
TOTAL MOTION IS 2.28° (THETA = 3.86° TO THETA = 6.14°, WHERE THETA = 5° AT THE CENTER. SEE H3200 FOR ECHELLE DRIVE ASSEMBLY.
SEE H4026 FOR CROSS-DISPERSER OPTICAL DERIVATIONS. SEE H3XXX FOR ECHELLE DET.

0.00 4.00 (C)

INCHES

3RD ANGLE PROJECTION

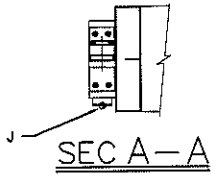
A	5 5 92	j.o.	RE-DRAW ECHELLE FORMAT.
B	10 21 92	j.o.	ADD ECHELLE TILT NOTES.
C	12 7 92	j.o.	RE-VISIT IN PREP. FOR DEWAR #2

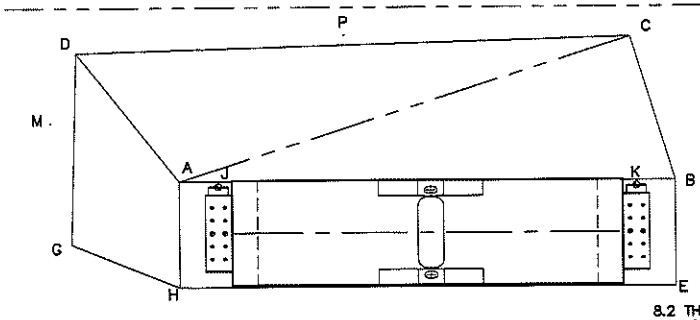
1/4

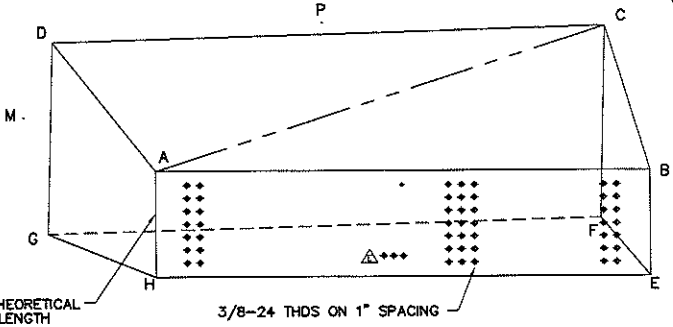
KECK/HIRES
DEWAR WITH CCD
ORIENTATION

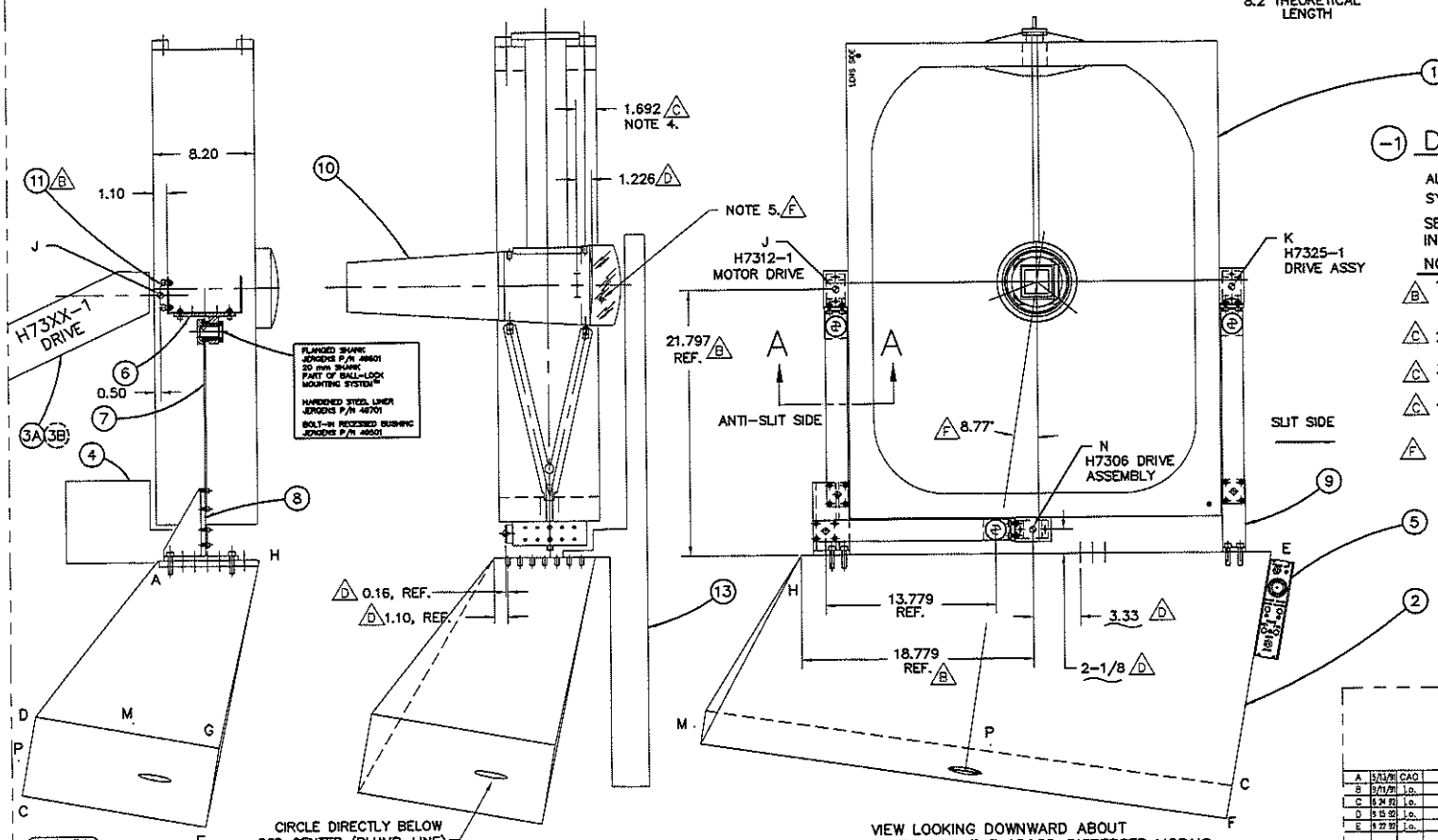
j.o. 5 4 92

H7260.C









(–1) DEWAR AND SUPPORT

ALL VIEWS IN THE COORDINATE SYSTEM OF THE DEWAR FRAME.

SEE H6500 FOR INITIAL ALIGNMENT INFORMATION.

NOTES:

B 1. JERGENS P/N 35902 PAD C1018 WITH CARBURIZED 75–77 R30H HEAT TREAT.

C 2. 4.2" WEDGE ADDED. H7252–4 FAR SIDE.

C 3. "M" AND "P" DEFINED ON H7225, NOT TO SCALE HERE.

C 4. 1.692 WAS 1.37 (DESIGN #4052 FROM 6/3/92, 65.0 RADIUS FOCAL PLANE)

F 5. SEE H7276 FOR LENS SUPPORT DETAILS.

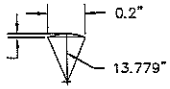


IMAGE MOTION DUE TO FOCUS CHANGE:

A	H7270–1	13	1	DARKSLIDE ASSEMBLY	
C	H7252–3	12	1	WEDGE	NOTE 2.
B	H7231–3	11	3	REST PAD	NOTE 1.
	H7500–1	10	1	PRE–AMP BOX	ASSY
	H7252–2	9	1	SLIT SIDE BASE	STEEL
	H7252–1	8	1	FIXED BASE BRACKET	STEEL
	H7251–2	7	3	FLEX ARM	ST.STL
	H7251–1	6	3	MOVING BRACKET	STEEL
	H7050–1	5	1	JUNCTION BOX	ASSY
A	H7305–1	4	1	DRIVE	ASSY
A	H7325–1	3B	1	DRIVE	ASSY
B	H7312–1	3A	1	DRIVE	ASSY
	H7215–1	2	1	SUPPORT BASE	STL
	H7209–1	1	1	DEWAR ASSEMBLY	

INCHES

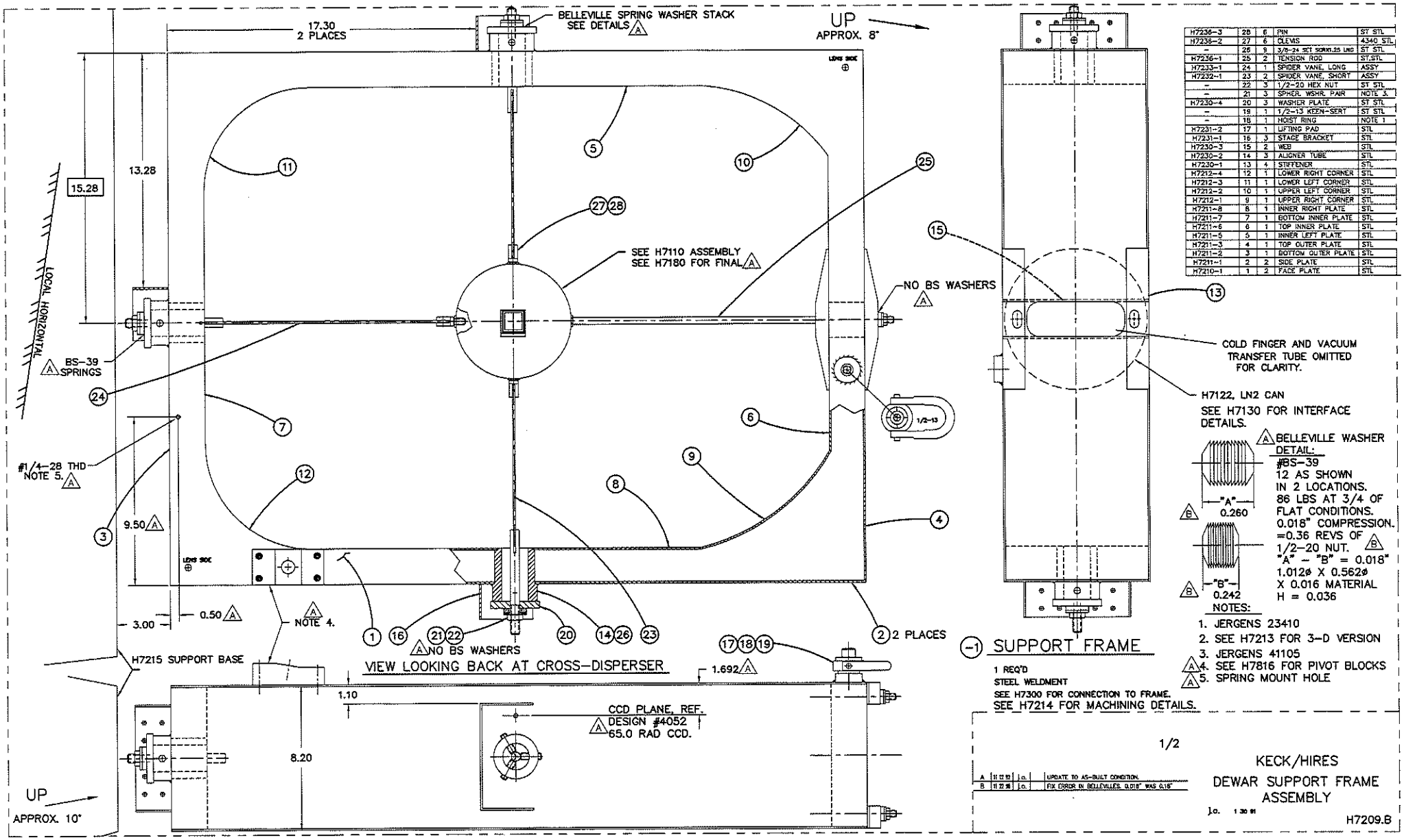
1/4

A	5/13/91	CAO	ADDED SEC A–A
B	9/11/91	J.o.	ADD PART 11, REST PAD.
C	6 24 92	J.o.	ADD NODES M AND P.
D	8 15 92	J.o.	REMOVE ENCODER.
E	8 27 92	J.o.	ADD DRIVE SUB–ASSY CALLOUTS, AND DARKSLIDE OUTLINE.
F	10 30 92	J.o.	ADD LENS HOLDER ASSEMBLY.

KECK/HIRES
DEWAR AND SUPPORT ASSEMBLY

J.o. 2 20 91

H7250.F



H7236-3	28	6	PIN	ST STL
H7236-2	27	6	CLEVIS	4340 STL
–	26	9	3/8-24 SCI SCRW1.25 LNG	ST STL
H7236-1	25	2	TENSION ROD	ST.STL
H7233-1	24	1	SPIDER VANE, LONG	ASSY
H7232-1	23	2	SPIDER VANE, SHORT	ASSY
–	22	3	1/2-20 HEX NUT	ST STL
–	21	3	SPHER. WSHR. PAIR	NOTE 3.
H7230-4	20	3	WASHER PLATE	ST STL
–	19	1	1/2-13 KEEN-SERT	ST STL
–	18	1	HOIST RING	NOTE 1
H7231-2	17	1	LIFTING PAD	STL
H7231-1	16	3	STAGE BRACKET	STL
H7230-3	15	2	WEB	STL
H7230-2	14	3	ALIGNER TUBE	STL
H7230-1	13	4	STIFFENER	STL
H7212-4	12	1	LOWER RIGHT CORNER	STL
H7212-3	11	1	LOWER LEFT CORNER	STL
H7212-2	10	1	UPPER LEFT CORNER	STL
H7212-1	9	1	UPPER RIGHT CORNER	STL
H7211-8	8	1	INNER RIGHT PLATE	STL
H7211-7	7	1	BOTTOM INNER PLATE	STL
H7211-6	6	1	TOP INNER PLATE	STL
H7211-5	5	1	INNER LEFT PLATE	STL
H7211-3	4	1	TOP OUTER PLATE	STL
H7211-2	3	1	BOTTOM OUTER PLATE	STL
H7211-1	2	2	SIDE PLATE	STL
H7210-1	1	2	FACE PLATE	STL

A BELLEVILLE WASHER DETAIL:
#BS-39
12 AS SHOWN
IN 2 LOCATIONS.
86 LBS AT 3/4 OF
FLAT CONDITIONS.
0.018" COMPRESSION.
=0.36 REVS OF B
1/2-20 NUT.
"A" – "B" = 0.018"
1.012ø X 0.562ø
X 0.016 MATERIAL
H = 0.036

"A" 0.260
"B" 0.242

NOTES:
1. JERGENS 23410
2. SEE H7213 FOR 3-D VERSION
3. JERGENS 41105
A 4. SEE H7816 FOR PIVOT BLOCKS
A 5. SPRING MOUNT HOLE

-1 SUPPORT FRAME
1 REQ'D
STEEL WELDMENT
SEE H7300 FOR CONNECTION TO FRAME.
SEE H7214 FOR MACHINING DETAILS.

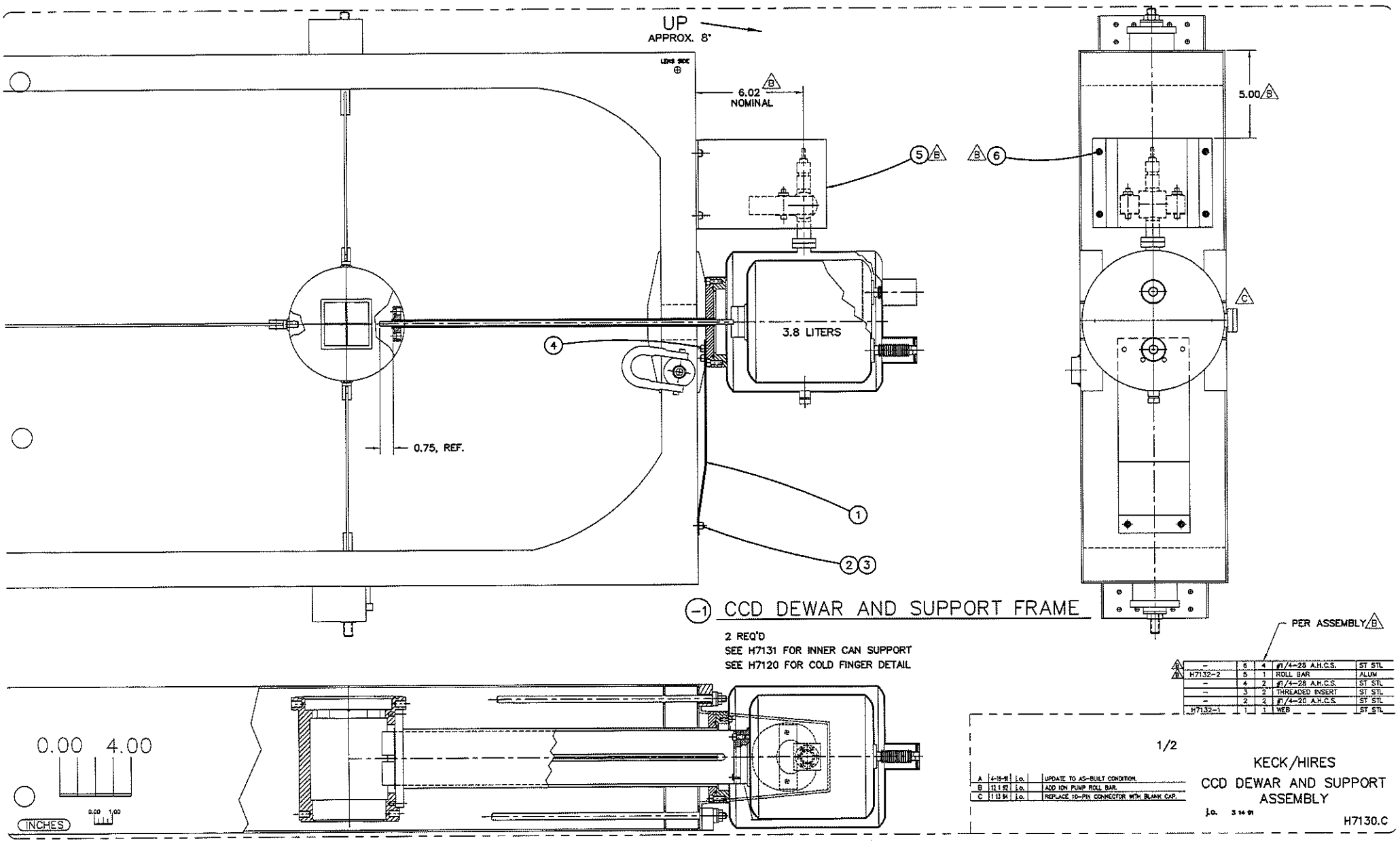
A	11 12 93	j.c.	UPDATE TO AS-BUILT CONDITION.
B	11 22 96	j.c.	FIX ERROR IN BELLEVILLES. 0.018" WAS 0.15"

1/2

KECK/HIRES
DEWAR SUPPORT FRAME
ASSEMBLY

j.c. 1 30 91

H7209.B



-1 CCD DEWAR AND SUPPORT FRAME

2 REQ'D
SEE H7131 FOR INNER CAN SUPPORT
SEE H7120 FOR COLD FINGER DETAIL

PER ASSEMBLY B

A	–	6	4	#1/4-28 A.H.C.S.	ST STL
A	H7132-2	5	1	ROLL BAR	ALUM
	–	4	2	#1/4-28 A.H.C.S.	ST STL
	–	3	2	THREADED INSERT	ST STL
	–	2	2	#1/4-20 A.H.C.S.	ST STL
	H7132-1	1	1	WEB	ST STL

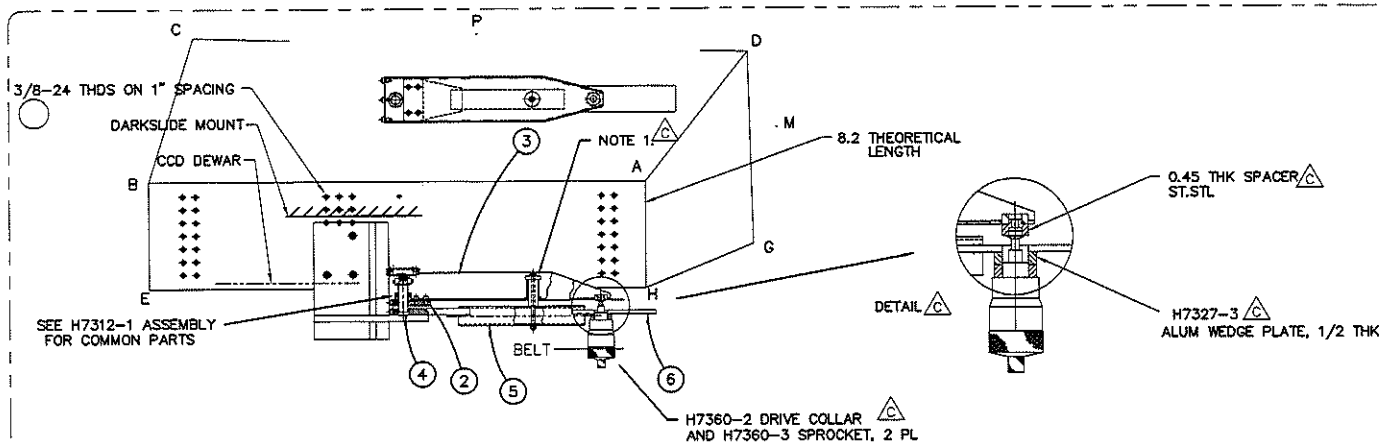
1/2

A	4-15-91	j.o.	UPDATE TO AS-BUILT CONDITION.
B	12 1 92	j.o.	ADD ION PUMP ROLL BAR.
C	1 13 94	j.o.	REPLACE 10-PIN CONNECTOR WITH BLANK CAP.

KECK/HIRES
CCD DEWAR AND SUPPORT ASSEMBLY

j.o. 3 14 91

H7130.C

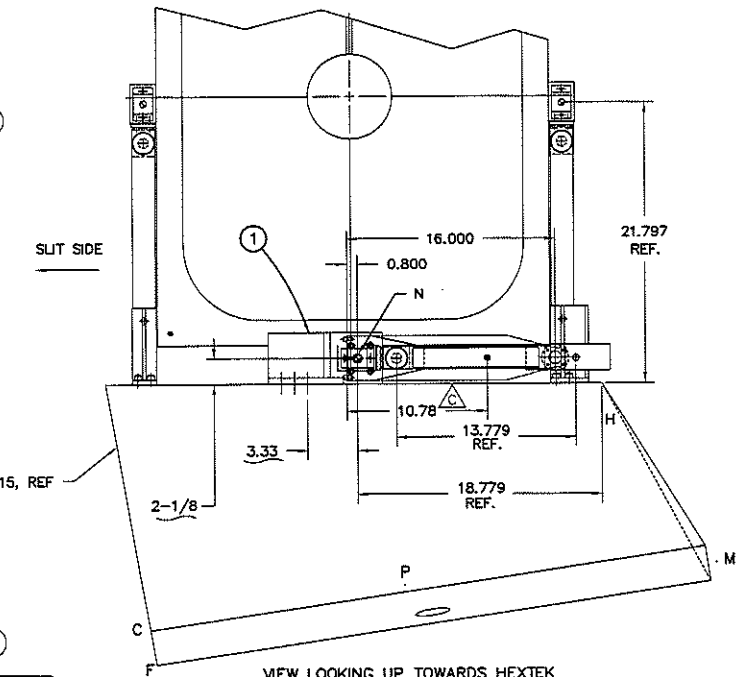


(-1) LOWER DRIVE ASSEMBLY

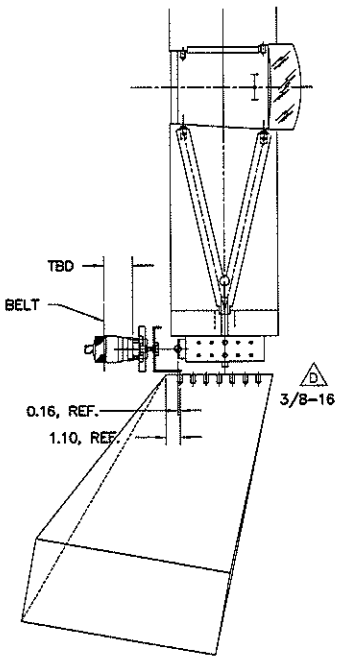
LAYOUT DRAWING

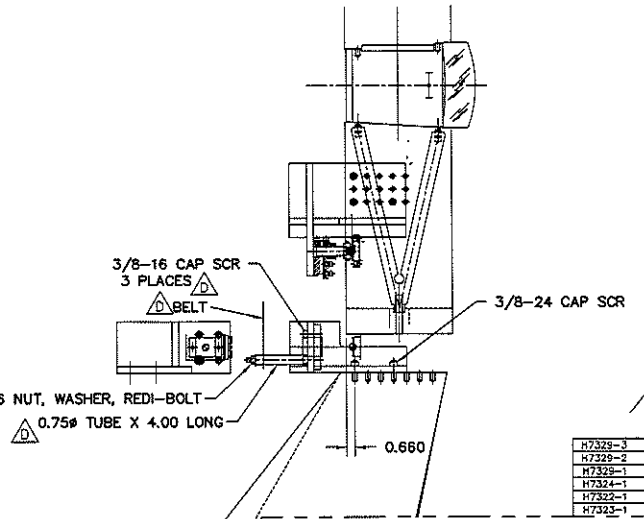
NOTES:

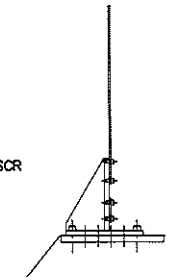
C 1. SEE H7325 FOR SIMILAR SPRING DETAIL.



VIEW LOOKING UP TOWARDS HEXTEK







H7329-3	6	1	JOINT PLATE	STEEL
H7329-2	5	1	TUBE	STEEL
H7329-1	4	1	FULCRUM PLATE	STEEL
H7324-1	3	1	LEVER ARM	ASSY.
H7322-1	2	1	NUT PLATE	ST.STL
H7323-1	1	1	ANCHOR BRACKET	STEEL

A	3 20 93	j.o.	UPDATE TO AS-BUILT CONDITION.
C	3 29 93	j.o.	ADD DRIVE SPRING, NOTES.
D	10 1 93	j.o.	ADD BELT GUIDE.

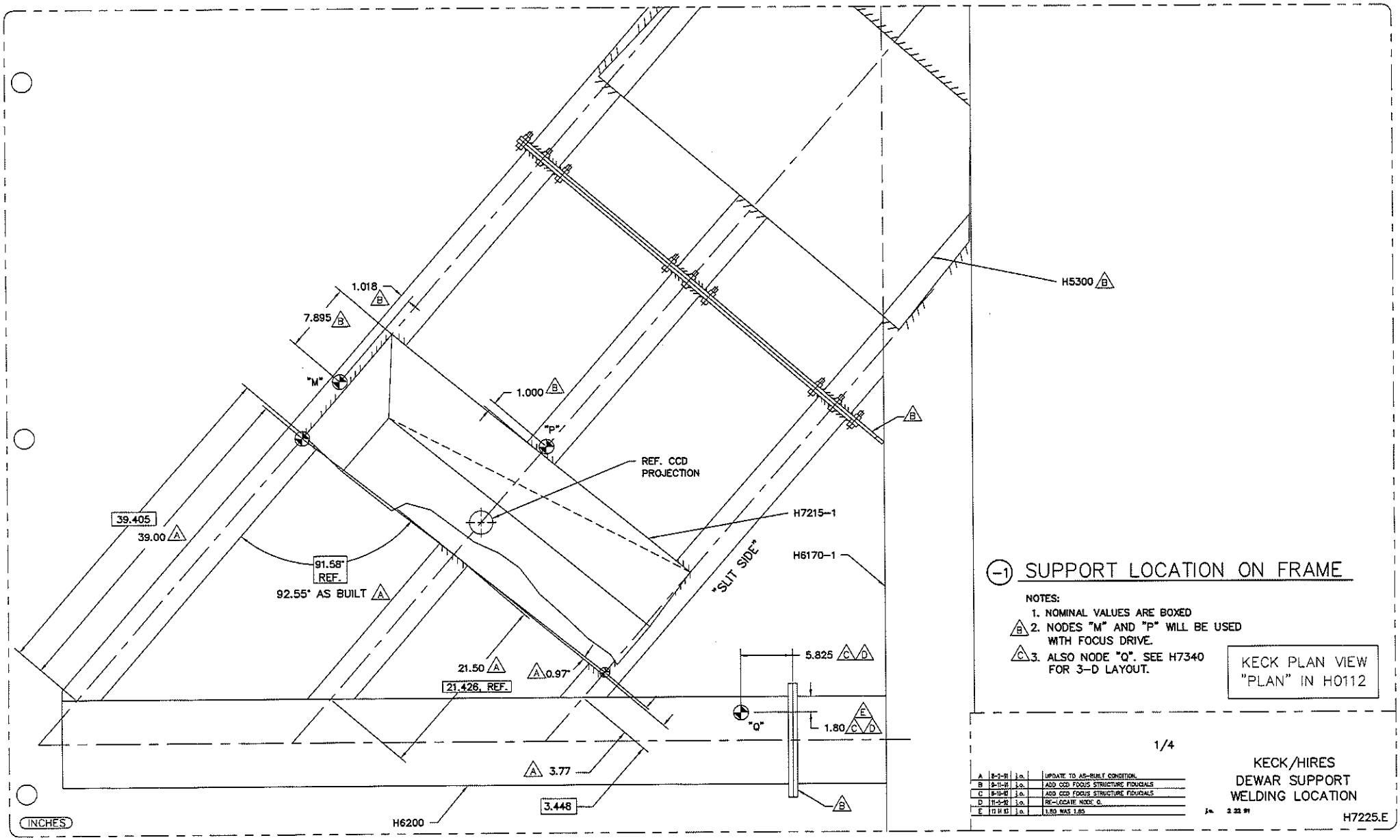
1/4

KECK/HIRES
CCD FOCUS
LOWER DRIVE ASSEMBLY

j.o. 9 16 92

H7306.D

INCHES



-1 SUPPORT LOCATION ON FRAME

NOTES:

1. NOMINAL VALUES ARE BOXED
2. B NODES "M" AND "P" WILL BE USED WITH FOCUS DRIVE.
3. C ALSO NODE "Q". SEE H7340 FOR 3-D LAYOUT.

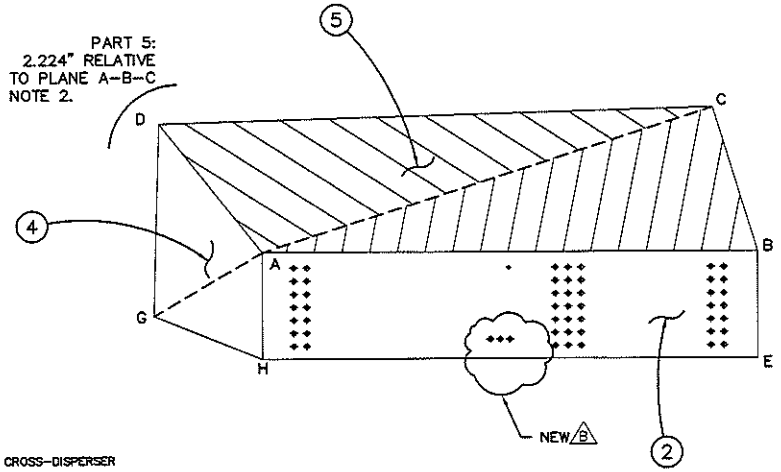
KECK PLAN VIEW "PLAN" IN H0112

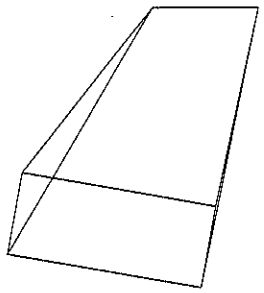
1/4

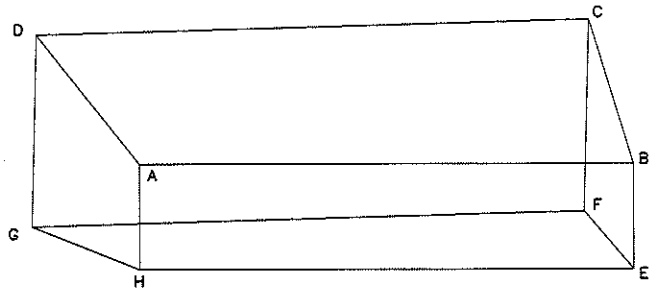
A	8-2-91	j.o.	UPDATE TO AS-BUILT CONDITION.
B	9-11-91	j.o.	ADD CCD FOCUS STRUCTURE FIDUCIALS
C	8-19-92	j.o.	ADD CCD FOCUS STRUCTURE FIDUCIALS
D	11-5-92	j.o.	RE-LOCATE NODE Q.
E	11 H 93	j.o.	1.80 WAS 1.85

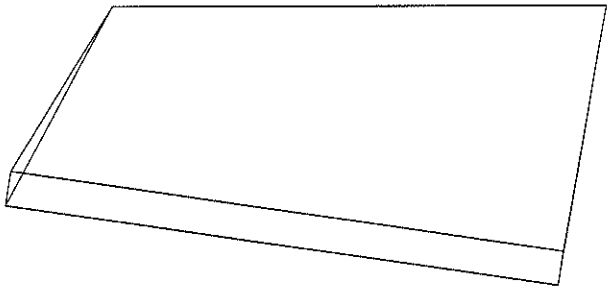
KECK/HIRES
DEWAR SUPPORT
WELDING LOCATION

H7225.E

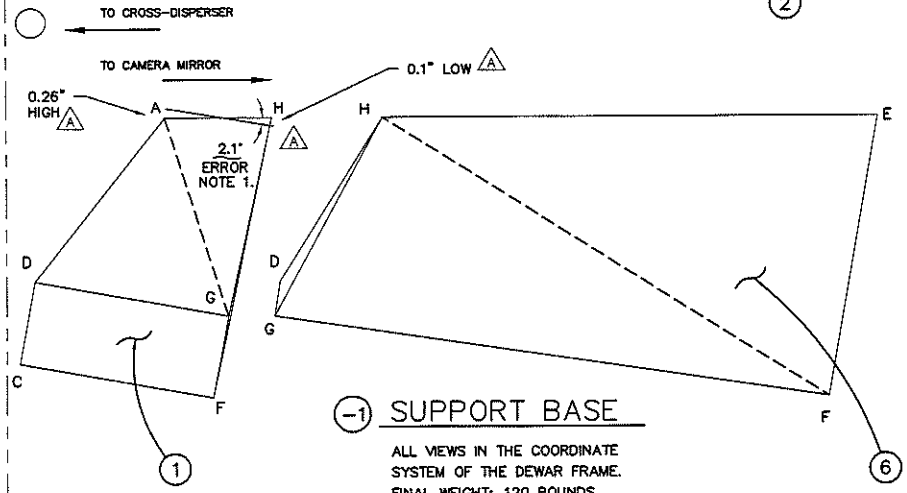








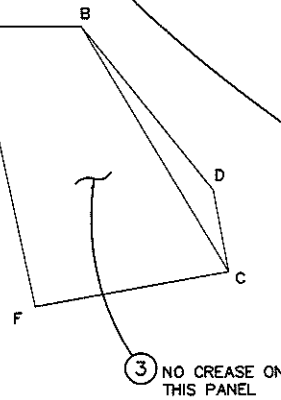
-0 WIREFRAME DRAWING



-1 SUPPORT BASE

ALL VIEWS IN THE COORDINATE SYSTEM OF THE DEWAR FRAME.
FINAL WEIGHT: 120 POUNDS

NOTES:
A 1. 10.3° DESIGN – 8.4° ACTUAL
A 2. AUTOCAD ALLOWS 3–D FACE TO BE NON–PLANAR ENTITY.



NO CREASE ON THIS PANEL

LOOKING AT THE CAMERA MIRROR

H7221–1	6	1	FARSIDE PLATE	STL
H7219–1	5	1	NEARSIDE PLATE	STL
H7220–1	4	1	OUTSIDE PLATE	STL
H7218–1	3	1	INSIDE PLATE	STL
H7217–1	2	1	TOP PLATE	STL
H7216–1	1	1	BOTTOM PLATE	STL

A	7 30 92	j.o.	SURVEYED AFTER WELDING (9-12-91)
B	9/11/92	CAO	ADDED 3 3/8 HOLES

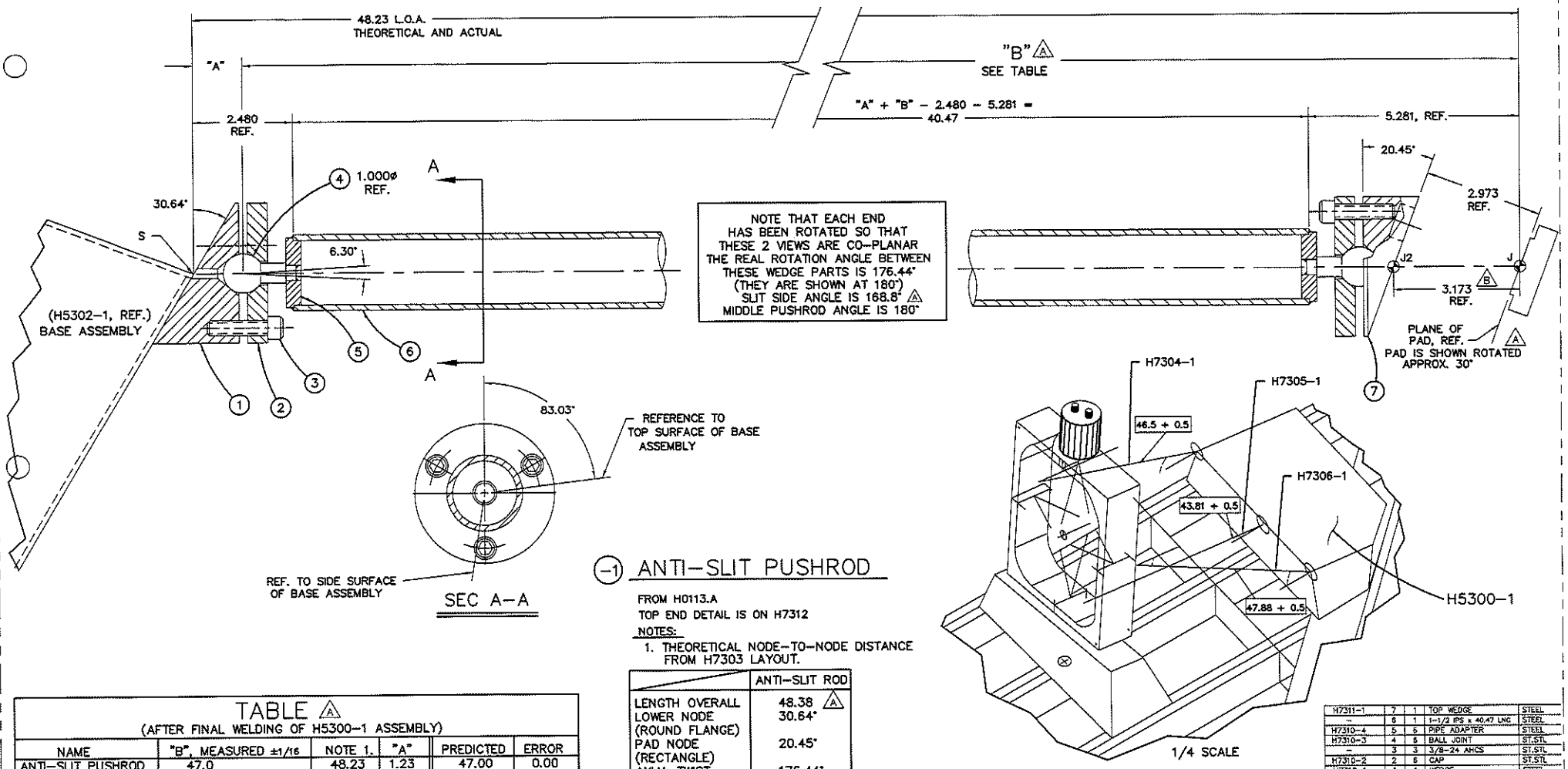
1/4

KECK/HIRES
DEWAR SUPPORT BASE
WELDMENT

j.o. 2 20 81

H7215.B

INCHES



(−1) ANTI−SLIT PUSHROD

FROM H0113.A

TOP END DETAIL IS ON H7312

NOTES:

1. THEORETICAL NODE−TO−NODE DISTANCE FROM H7303 LAYOUT.

	ANTI−SLIT ROD
LENGTH OVERALL	48.38 △A
LOWER NODE (ROUND FLANGE)	30.64°
PAD NODE (RECTANGLE)	20.45°
AXIAL TWIST	176.44°

TABLE △A

(AFTER FINAL WELDING OF H5300−1 ASSEMBLY)

NAME	"B", MEASURED ±1/16	NOTE 1.	"A"	PREDICTED	ERROR
ANTI−SLIT PUSHROD	47.0	48.23	1.23	47.00	0.00
SLIT SIDE PUSHROD	48.38	50.064	1.463	48.60	0.22
MIDDLE PUSHROD	44.31	45.27	1.033	44.237	0.07

H7311−1	7	1	TOP WEDGE	STEEL
−−	6	1	1−1/2 IPS x 40.47 LNG	STEEL
H7310−4	5	6	PIPE ADAPTER	STEEL
H7310−3	4	6	BALL JOINT	ST.STL
−−	3	3	3/8−24 AHCS	ST.STL
H7310−2	2	6	CAP	ST.STL
H7310−1	1	1	WEDGE	STEEL

△A AFTER OPTICAL DESIGN WAS FROZEN: #4052 (6/3/92) 65" RADIUS CONVEX TEKTRONICS CCD. SEE ALSO H6500.E OR LATER REV.

A	5 15 92	j.o.	ADD NOTES AFTER MEASURING SPACINGS
B	8 3 92	j.o.	ADD NODE NAMES.

FULL

KECK/HIRES

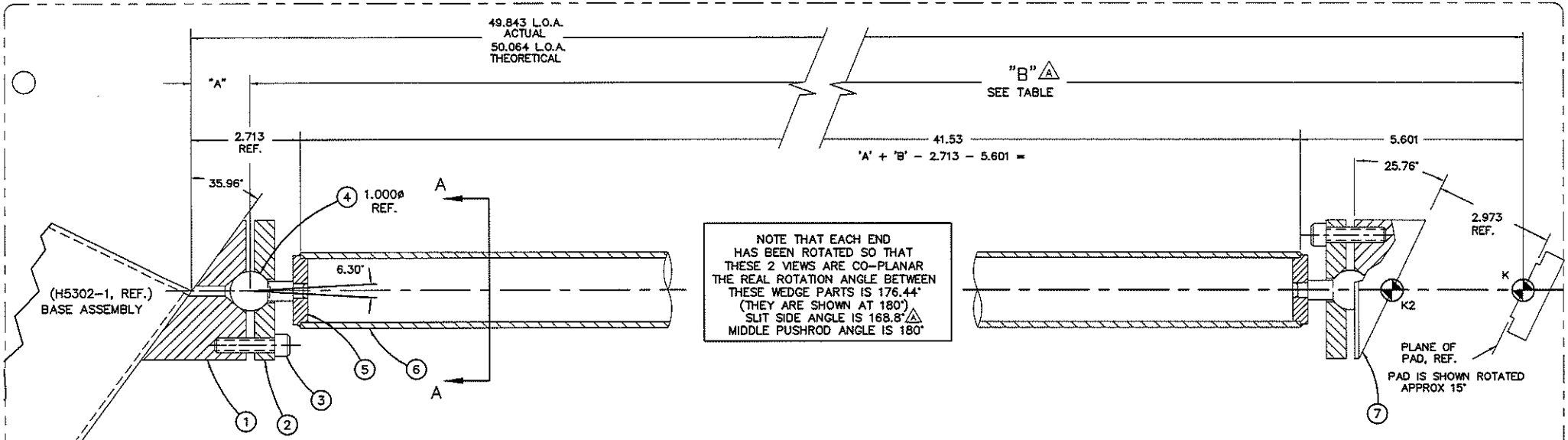
CCD PUSHROD (3−D)

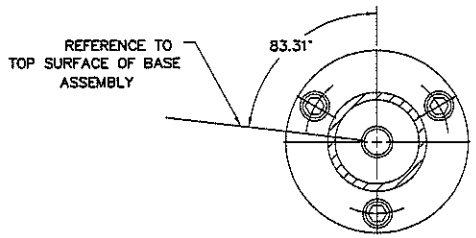
ANTI−SLIT ROD

j.o. 7 8 91

H7304.B

INCHES





SEC A–A

(-1) SLIT SIDE PUSHROD

FROM H0113.A

TOP END DETAIL IS ON H7325

NOTES:

1. THEORETICAL NODE-TO-NODE DISTANCE FROM H7303 LAYOUT.

	SLIT SIDE ROD
LENGTH OVERALL	50.064 A
LOWER NODE (ROUND FLANGE)	35.96"
PAD NODE (RECTANGLE)	25.76"
AXIAL TWIST	168.8° A

PARTS 2, 3, 4, 5 ARE ITEMIZED ON H7304.

H7326-1	7	1	TOP WEDGE	STEEL
-	6	1	1-1/2 IPS x 41.53 LNG	STEEL
H7307-1	1	1	WEDGE	STEEL

TABLE A

(AFTER FINAL WELDING OF H5302-1 ASSEMBLY)

NAME	"B", MEASURED ±1/16	NOTE 1.	"A"	PREDICTED	ERROR
ANTI-SLIT PUSHROD	47.0	48.23	1.23	47.00	0.00
SLIT SIDE PUSHROD	48.38	50.064	1.463	48.60	0.22
MIDDLE PUSHROD	44.31	45.27	1.033	44.237	0.07

A AFTER OPTICAL DESIGN WAS FROZEN: #4052 (6/3/92) 65" RADIUS CONVEX TEKTRONICS CCD. SEE ALSO H6500.E OR LATER REV.

FULL

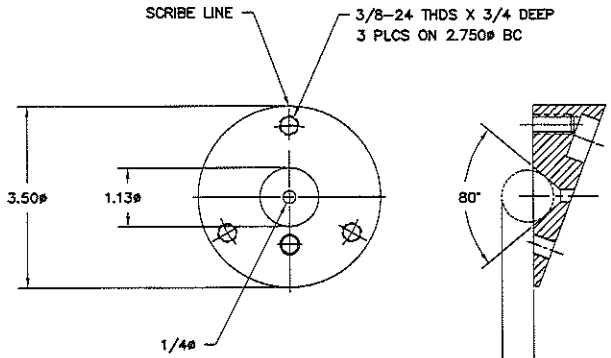
A	8.5.92	j.o.	FINISH DESIGN WORK.

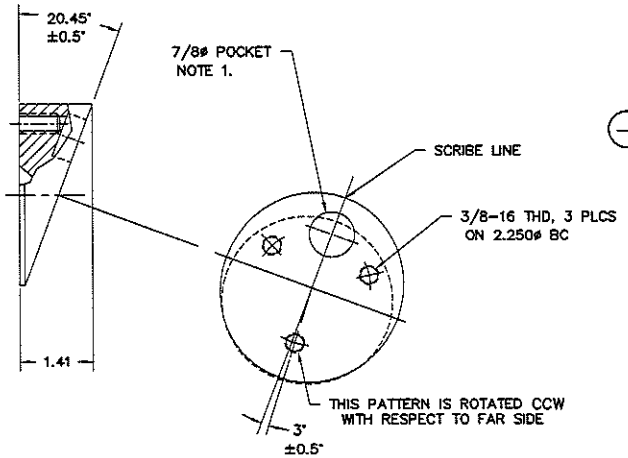
KECK/HIRES
CCD PUSHROD
SLIT SIDE ROD

j.o. ##.91

H7305.A

INCHES

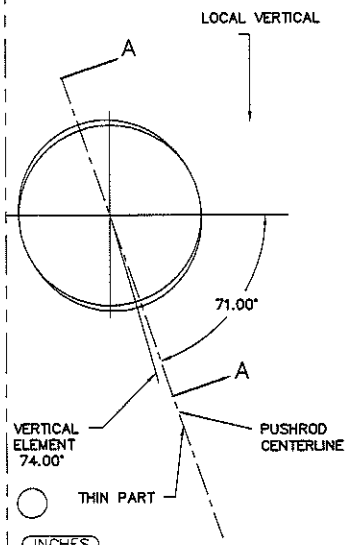


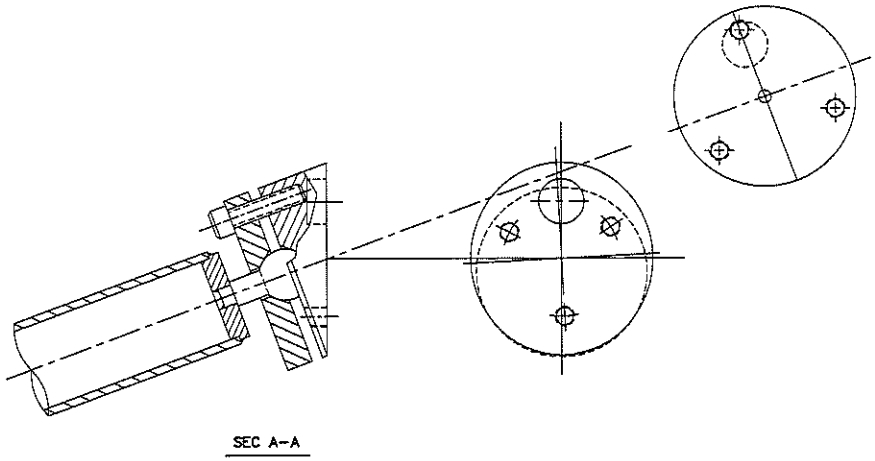


(-1) TOP WEDGE, ANTI-SLIT SIDE

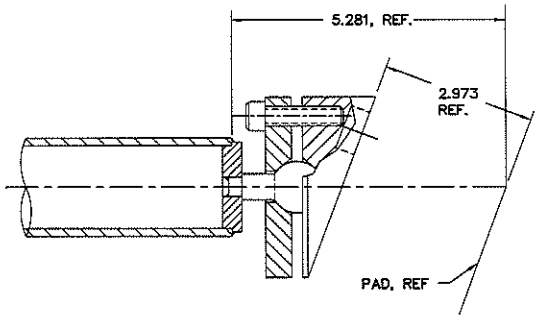
1 REQ'D
STEEL
NOTES:

1. CLEARANCE FOR 3/4X32 SCREW. LOCATE AFTER ASSEMBLY. DEPTH = 5/16





SEC A-A



- REFERENCE LAYOUTS -

INCHES

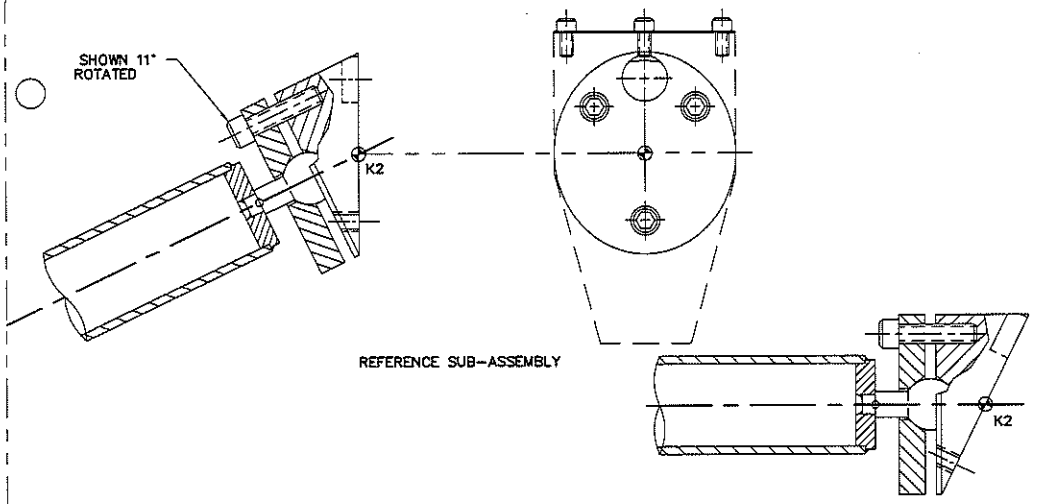
FULL

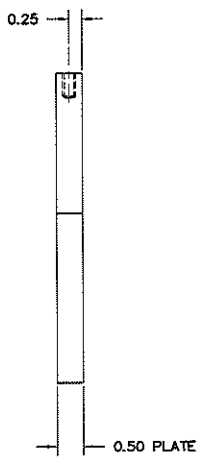
A | 8 8 92 | J. O. | GENERAL REVISIONS.

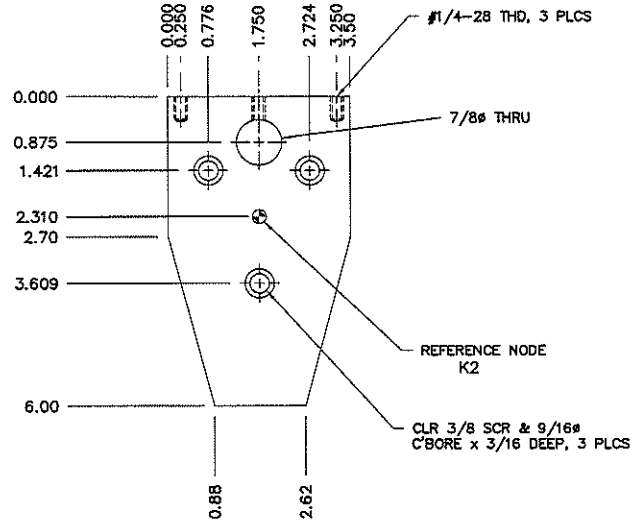
KECK/HIRES
CCD PUSHROD DETAIL
ANTI-SLIT SIDE

J.O. 7 10 01

H7311.A

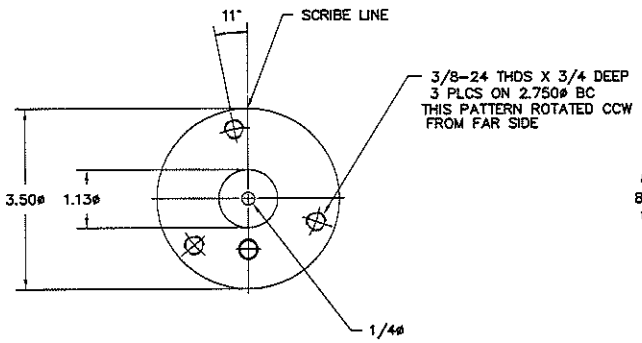


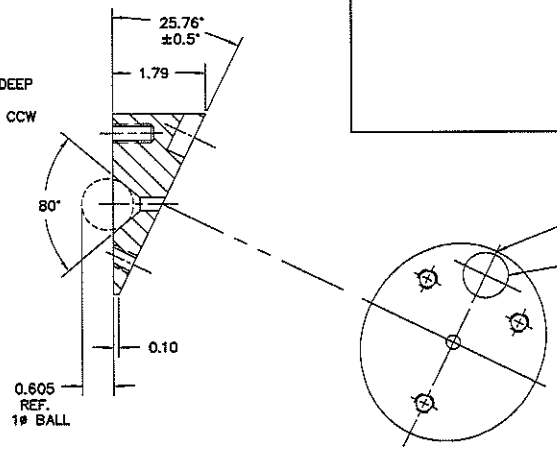


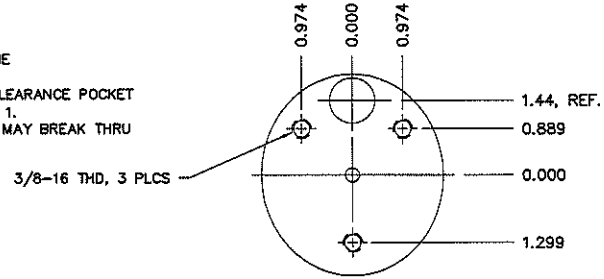


(-2) WEDGE HOLDER

1 REQ'D
ST.STEEL
NOTES:
1. SLIT SIDE.







(-1) TOP WEDGE, SLIT SIDE

1 REQ'D
STEEL
NOTES:
1. CLEARANCE FOR 3/4-32 SCREW. LOCATE AFTER ASSEMBLY
2. NOTE THAT 3/8-24 THREADS ON ONE SIDE AND 3/8-16 THREADS ON OPPOSITE SIDE.

INCHES

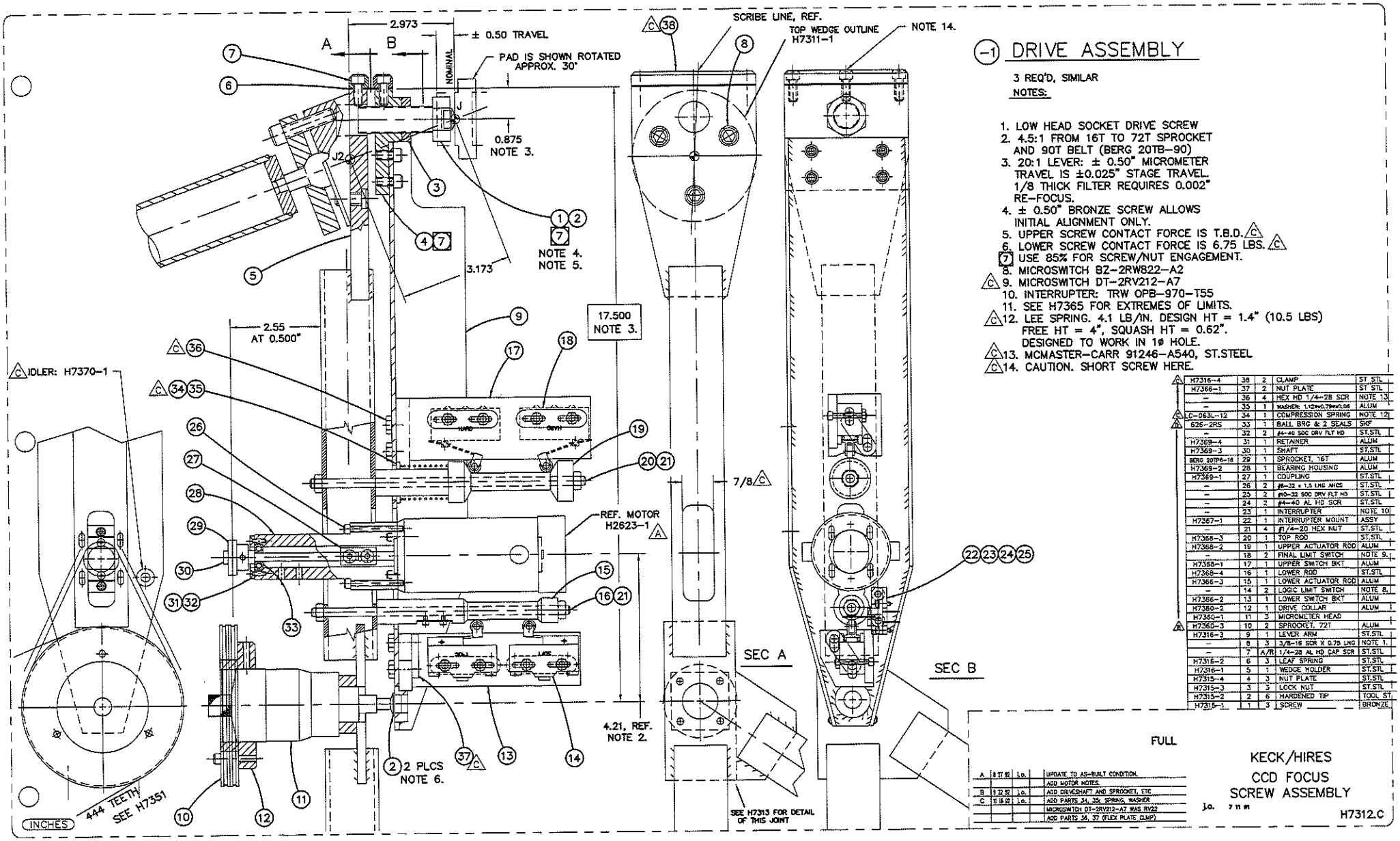
FULL

A | 8 27 92 | j.o. | ADD NODE NAMES

KECK/HIRES
CCD FOCUS DETAIL
SLIT SIDE JOINT

j.o. 8 5 92

H7326.A



(-1) DRIVE ASSEMBLY

3 REQ'D, SIMILAR

NOTES:

1. LOW HEAD SOCKET DRIVE SCREW
2. 4.5:1 FROM 16T TO 72T SPROCKET AND 90T BELT (BERG 20TB-90)
3. 20:1 LEVER: ± 0.50" MICROMETER TRAVEL IS ±0.025" STAGE TRAVEL. 1/8 THICK FILTER REQUIRES 0.002" RE-FOCUS.
4. ± 0.50" BRONZE SCREW ALLOWS INITIAL ALIGNMENT ONLY.
5. UPPER SCREW CONTACT FORCE IS T.B.D. △C
6. LOWER SCREW CONTACT FORCE IS 6.75 LBS. △C
7. USE 85% FOR SCREW/NUT ENGAGEMENT.
8. MICROSWITCH BZ-2RW822-A2
9. △C MICROSWITCH DT-2RV212-A7
10. INTERRUPTER: TRW OPB-970-T55
11. SEE H7365 FOR EXTREMES OF LIMITS.
12. △C LEE SPRING. 4.1 LB/IN. DESIGN HT = 1.4" (10.5 LBS) FREE HT = 4", SQUASH HT = 0.62". DESIGNED TO WORK IN 1ø HOLE.
13. △C MCMASTER-CARR 91246-A540, ST.STEEL
14. △C CAUTION. SHORT SCREW HERE.

△A	H7316-4	38	2	CLAMP	ST.STL
	H7366-1	37	2	NUT PLATE	ST.STL
	–	36	4	HEX HD 1/4-28 SCR	NOTE 13
	–	35	1	WASHER: 1.125x0.734x0.06	ALUM
△C	LC-063L-12	34	1	COMPRESSION SPRING	NOTE 12
△A	626-2RS	33	1	BALL BRG ø 2 SEALS	SHF
	–	32	2	#4-40 SOC DRV FLT HD	ST.STL
	H7369-4	31	1	RETAINER	ALUM
	H7369-3	30	1	SHAFT	ST.STL
	BERG 20TP6-16	29	1	SPROCKET, 16T	ALUM
	H7369-2	28	1	BEARING HOUSING	ALUM
	H7369-1	27	1	COUPLING	ST.STL
	–	26	2	#8-32 x 1.5 LNG AHCS	ST.STL
	–	25	2	#10-32 SOC DRV FLT HD	ST.STL
	–	24	2	#4-40 AL HD SCR	ST.STL
	–	23	1	INTERRUPTER	NOTE 10
	H7367-1	22	1	INTERRUPTER MOUNT	ASSY
	–	21	4	ø1/4-20 HEX NUT	ST.STL
	H7368-3	20	1	TOP ROD	ST.STL
	H7368-2	19	1	UPPER ACTUATOR ROD	ALUM
	–	18	2	FINAL LIMIT SWITCH	NOTE 9
	H7368-1	17	1	UPPER SWITCH BKT	ALUM
	H7368-4	16	1	LOWER ROD	ST.STL
	H7366-3	15	1	LOWER ACTUATOR ROD	ALUM
	–	14	2	LOGIC LIMIT SWITCH	NOTE 8
	H7366-2	13	1	LOWER SWITCH BKT	ALUM
	H7360-2	12	1	DRIVE COLLAR	ALUM
	H7360-1	11	3	MICROMETER HEAD	
△A	H7360-3	10	2	SPROCKET, 72T	ALUM
	H7316-3	9	1	LEVER ARM	ST.STL
	–	8	3	3/8-16 SCR X 0.75 LNG	NOTE 1
	–	7	A/R	1/4-28 AL HD CAP SCR	ST.STL
	H7316-2	6	3	LEAF SPRING	ST.STL
	H7316-1	5	1	WEDGE HOLDER	ST.STL
	H7315-4	4	3	NUT PLATE	ST.STL
	H7315-3	3	3	LOCK NUT	ST.STL
	H7315-2	2	6	HARDENED TIP	TOOL ST
	H7315-1	1	3	SCREW	BRONZE

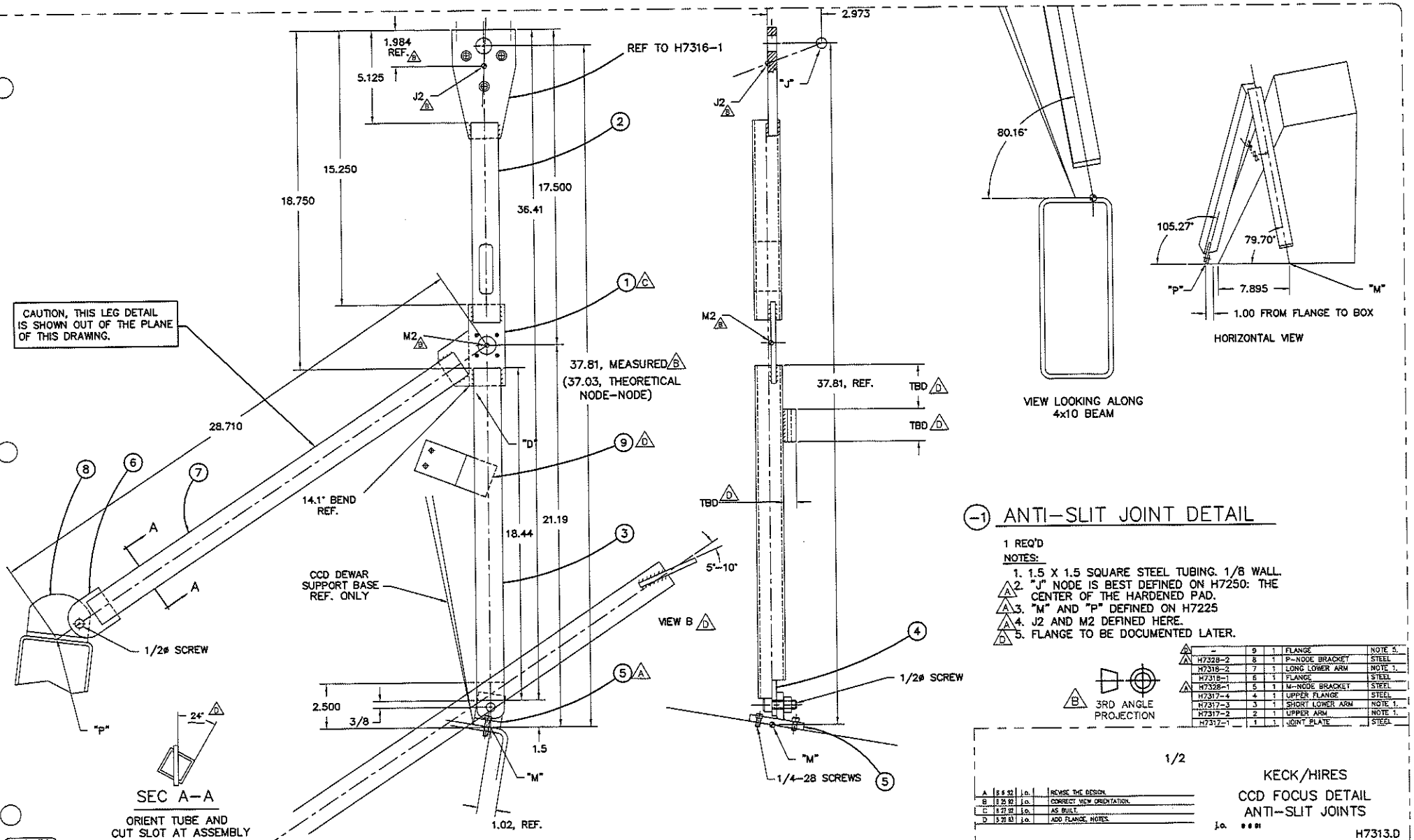
FULL

A	8 27 92	j.o.	UPDATE TO AS-BUILT CONDITION.
			ADD MOTOR NOTES.
B	8 22 92	j.o.	ADD DRIVESHAFT AND SPROCKET, ETC
C	11 16 92	j.o.	ADD PARTS 34, 35: SPRING, WASHER
			MICROSWITCH DT-2RV212-A7 WAS RV22
			ADD PARTS 36, 37 (FLEX PLATE CLMP)

KECK/HIRES
CCD FOCUS
SCREW ASSEMBLY

j.o. 7 11 91

H7312.C



-1 ANTI-SLIT JOINT DETAIL

1 REQ'D

NOTES:

1. 1.5 X 1.5 SQUARE STEEL TUBING. 1/8 WALL.
2. A "J" NODE IS BEST DEFINED ON H7250: THE CENTER OF THE HARDENED PAD.
3. A "M" AND "P" DEFINED ON H7225
4. A J2 AND M2 DEFINED HERE.
5. D FLANGE TO BE DOCUMENTED LATER.

B 3RD ANGLE PROJECTION

A	–	9	1	FLANGE	NOTE 5.
A	H7328-2	8	1	P-NODE BRACKET	STEEL
	H7318-2	7	1	LONG LOWER ARM	NOTE 1.
	H7318-1	6	1	FLANGE	STEEL
A	H7328-1	5	1	M-NODE BRACKET	STEEL
	H7317-4	4	1	UPPER FLANGE	STEEL
	H7317-3	3	1	SHORT LOWER ARM	NOTE 1.
	H7317-2	2	1	UPPER ARM	NOTE 1.
	H7317-1	1	1	JOINT PLATE	STEEL

A	5 6 92	j.o.	REVISE THE DESIGN.
B	8 25 92	j.o.	CORRECT VIEW ORIENTATION.
C	8 27 92	j.o.	AS BUILT.
D	5 20 93	j.o.	ADD FLANGE, NOTES.

1/2

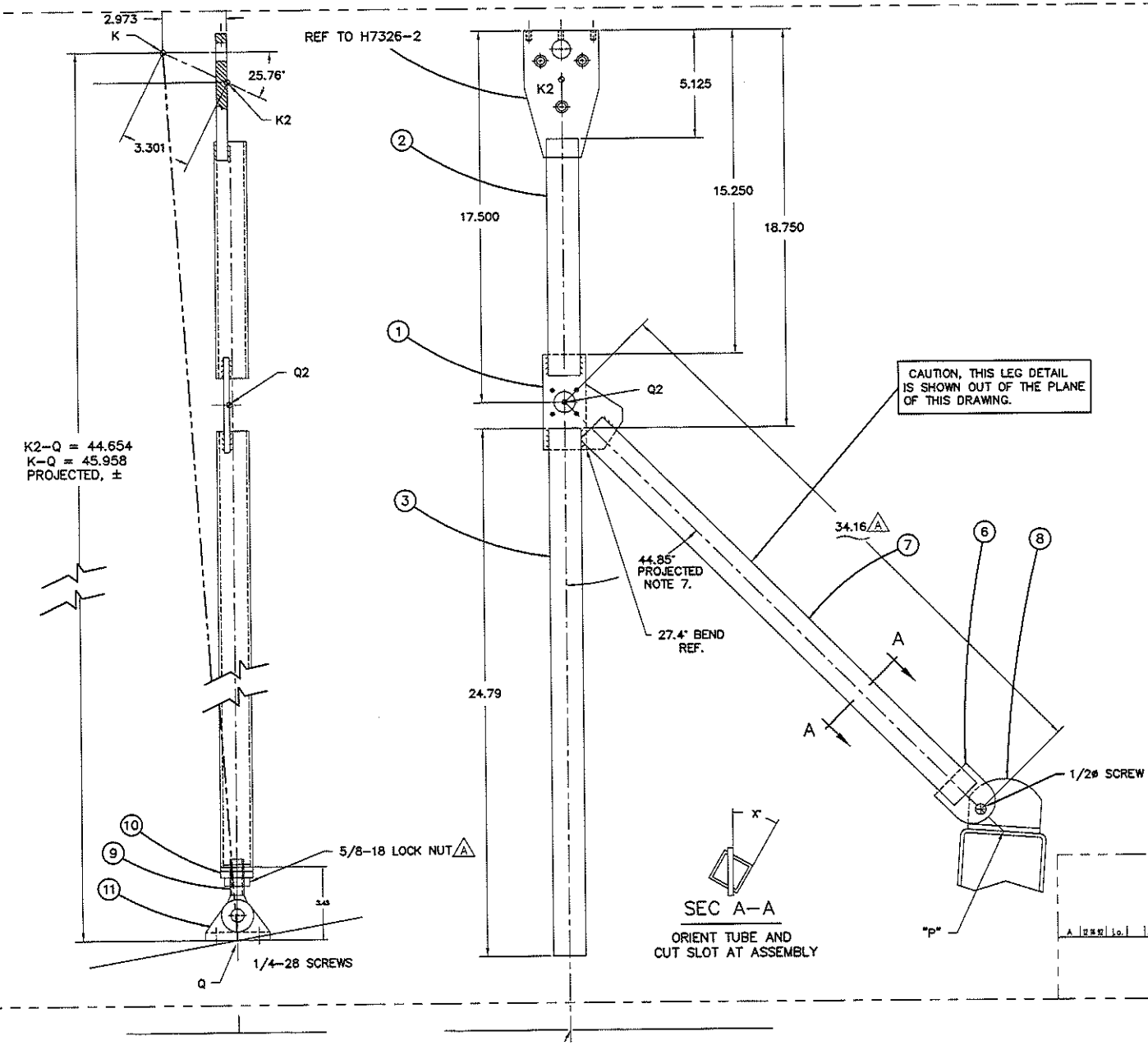
KECK/HIRES

CCD FOCUS DETAIL
ANTI-SLIT JOINTS

j.o. ●●●

H7313.D

INCHES



(-1) SLIT-SIDE JOINT DETAIL

1 REQ'D

NOTES:

1. 1.5 X 1.5 SQUARE STEEL TUBING. 1/8 WALL.
2. "K" NODE IS BEST DEFINED ON H7250: THE CENTER OF THE HARDENED PAD.
3. "P" AND "Q" DEFINED ON H7225.
4. K2 AND Q2 DEFINED HERE.
5. SEE H7305 FOR PUSHROD ASSEMBLY.
6. H7340 HAS 3-D DERIVATIONS.
7. 62.43" IN REALITY BETWEEN AXES. 24.72" UP FROM PLANE OF Q2 JOINT PLATE.

H7321-5	11	1	CLEVIS	STEEL
H7321-4	10	1	EYE MOUNT	STEEL
H7321-3	9	1	THREADED EYE	STEEL
H7326-2	8	REF.	P-NODE BRACKET	STEEL
H7320-1	7	1	LONG LOWER ARM	NOTE 1.
H7318-1	6	1	FLANGE	STEEL
--	5			
--	4			
H7321-1	3	1	SHORT LOWER ARM	NOTE 1.
H7320-2	2	1	UPPER ARM	NOTE 1.
H7319-1	1	1	JOINT PLATE	STEEL

A	12 18 92	J.o.	ADD LOCK NUT, DIMENSION.

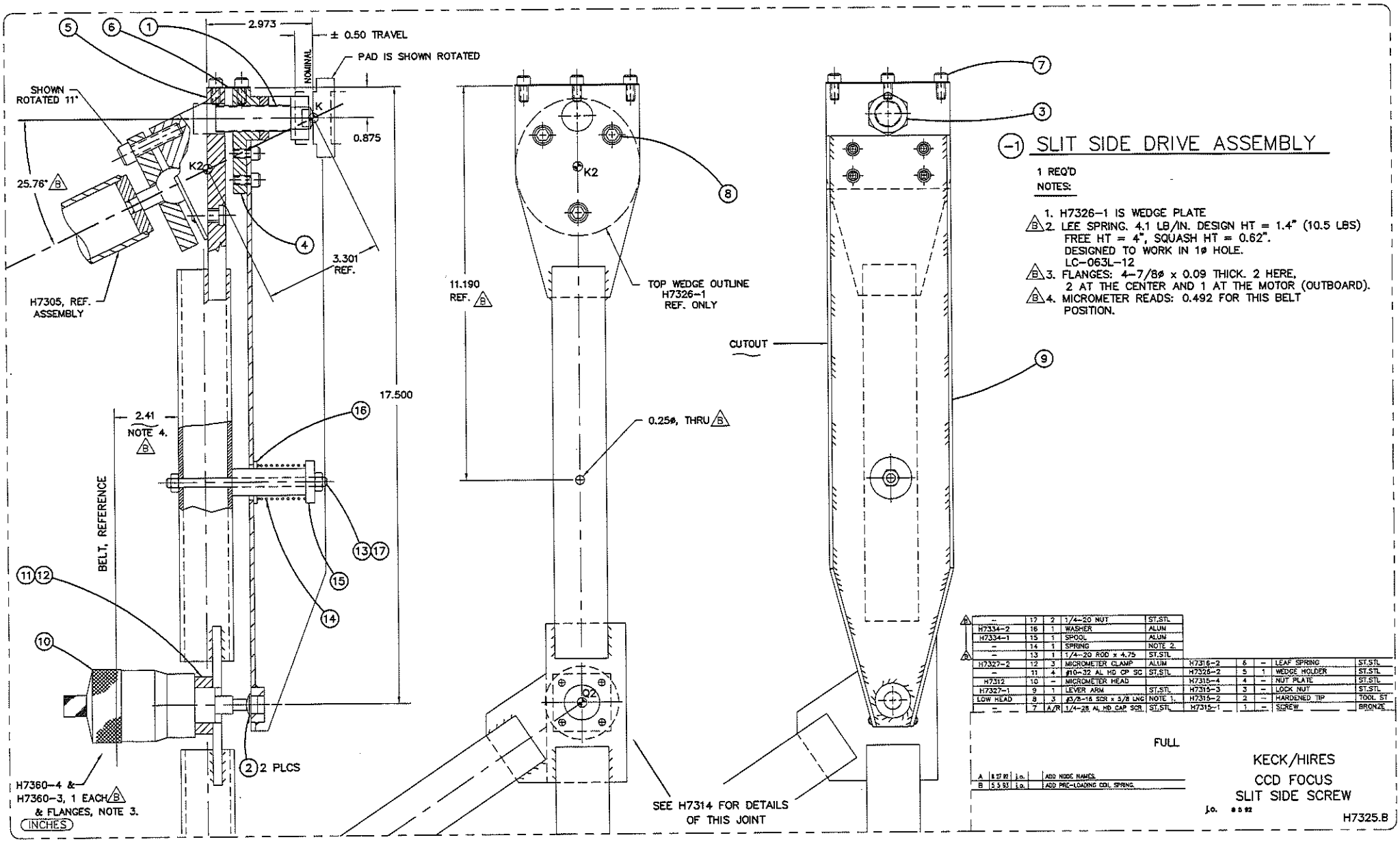
1/2

KECK/HIRES

CCD FOCUS DETAIL
SLIT-SIDE JOINTS

J.o. 6 26 91

H7314.A



(-1) SLIT SIDE DRIVE ASSEMBLY

1 REQ'D

NOTES:

1. H7326-1 IS WEDGE PLATE
2. B LEE SPRING. 4.1 LB/IN. DESIGN HT = 1.4" (10.5 LBS) FREE HT = 4", SQUASH HT = 0.62". DESIGNED TO WORK IN 1ø HOLE. LC-063L-12
3. B FLANGES: 4-7/8ø x 0.09 THICK. 2 HERE, 2 AT THE CENTER AND 1 AT THE MOTOR (OUTBOARD).
4. B MICROMETER READS: 0.492 FOR THIS BELT POSITION.

--	17	2	1/4-20 NUT	ST.STL					
H7334-2	16	1	WASHER	ALUM					
H7334-1	15	1	SPOOL	ALUM					
--	14	1	SPRING	NOTE 2.					
--	13	1	1/4-20 ROD x 4.75	ST.STL					
H7327-2	12	3	MICROMETER CLAMP	ALUM	H7316-2	6	--	LEAF SPRING	ST.STL
--	11	4	#10-32 AL HD CP SC	ST.STL	H7326-2	5	1	WEDGE HOLDER	ST.STL
H7312	10	--	MICROMETER HEAD		H7315-4	4	--	NUT PLATE	ST.STL
H7327-1	9	1	LEVER ARM	ST.STL	H7315-3	3	--	LOCK NUT	ST.STL
LOW HEAD	8	3	ø3/8-16 SCR x 5/8 LNG	NOTE 1.	H7315-2	2	--	HARDENED TIP	TOOL ST
--	7	A/R	1/4-28 AL HD CAP SCR	ST.STL	H7315-1	1	--	SCREW	BRONZE

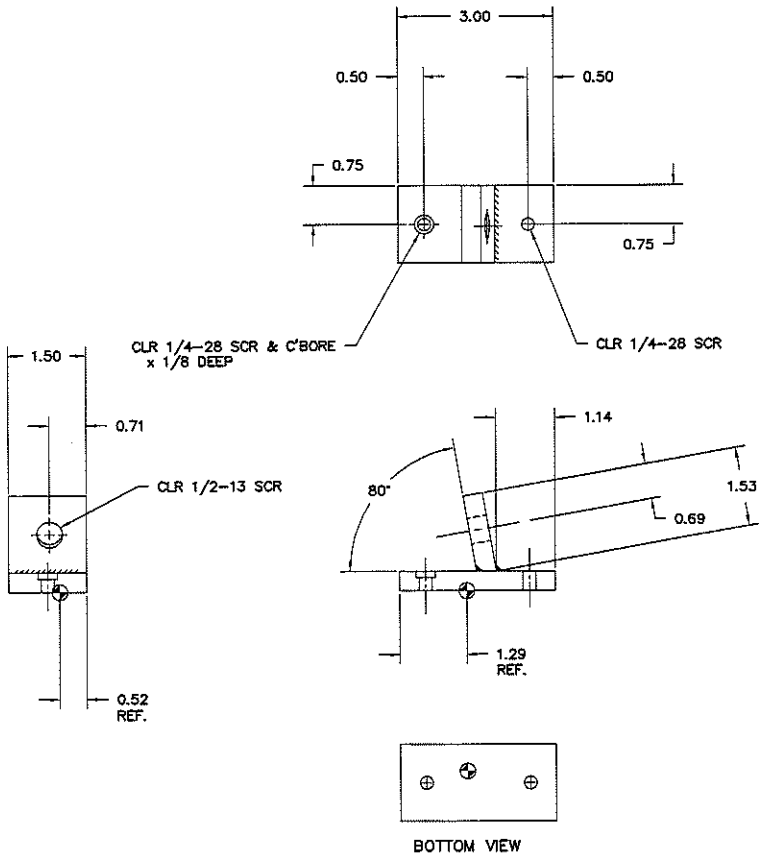
A	8 17 92	j.o.	ADD NODE NAMES.
B	5 5 93	j.o.	ADD PRE-LOADING COIL SPRING.

FULL

KECK/HIRES
CCD FOCUS
SLIT SIDE SCREW

j.o. 8 5 92

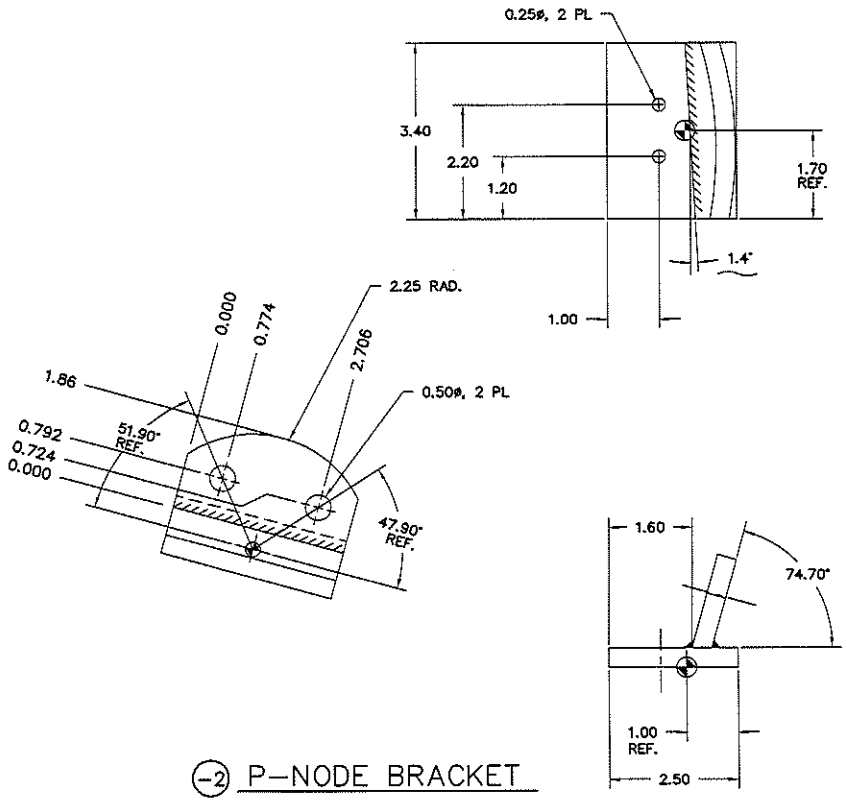
H7325.B



(-1) M-NODE BRACKET

1 REQ'D
STEEL WELDMENT
NOTES:

1. SEE H7225 FOR LOCATION ON OPTICAL BENCH.
2. USE 3/8 THK STEEL PLATE



(-2) P-NODE BRACKET

1 REQ'D
STEEL WELDMENT
NOTES:

1. SEE H7225 FOR LOCATION ON OPTICAL BENCH.
2. USE 3/8 THK STEEL PLATE.
3. SEE H7340; UCS = PLANOFFPADATP, ET AL

(A)

INCHES

FULL

A | 5 26 92 | j.o. | FINISH PART -2.

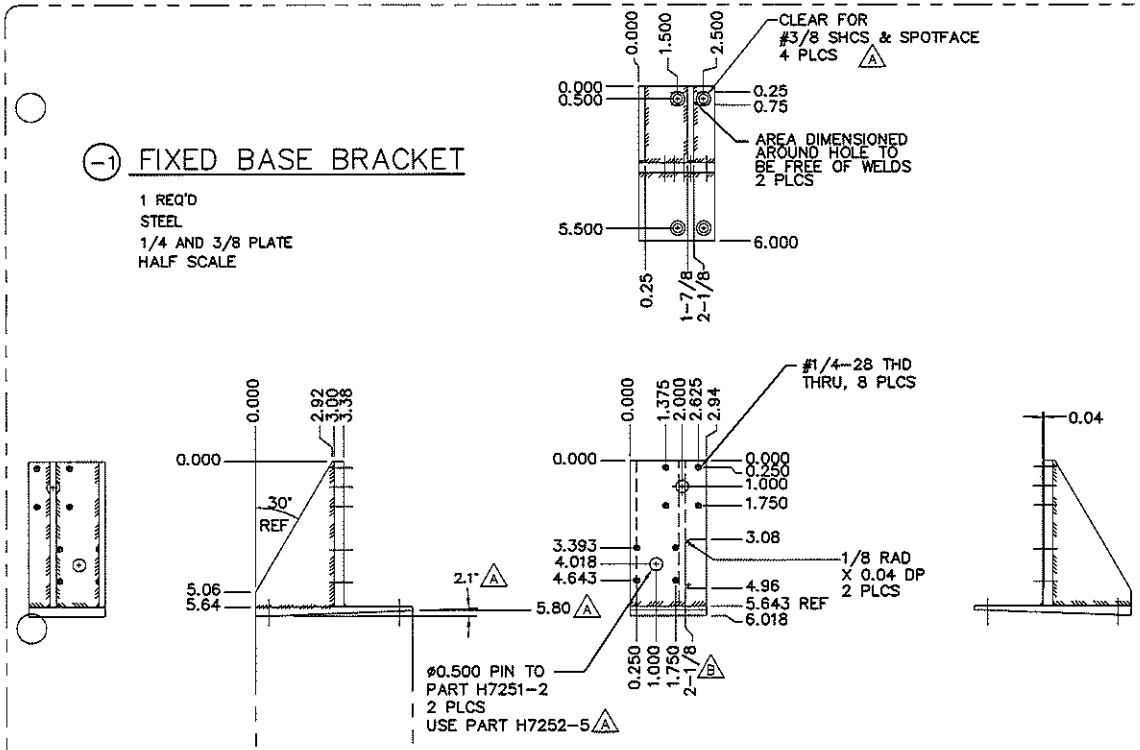
KECK/HIRES
CCD FOCUS DETAIL
ANTI-SLIT JOINTS

j.o. 8 10 92

H7328.A

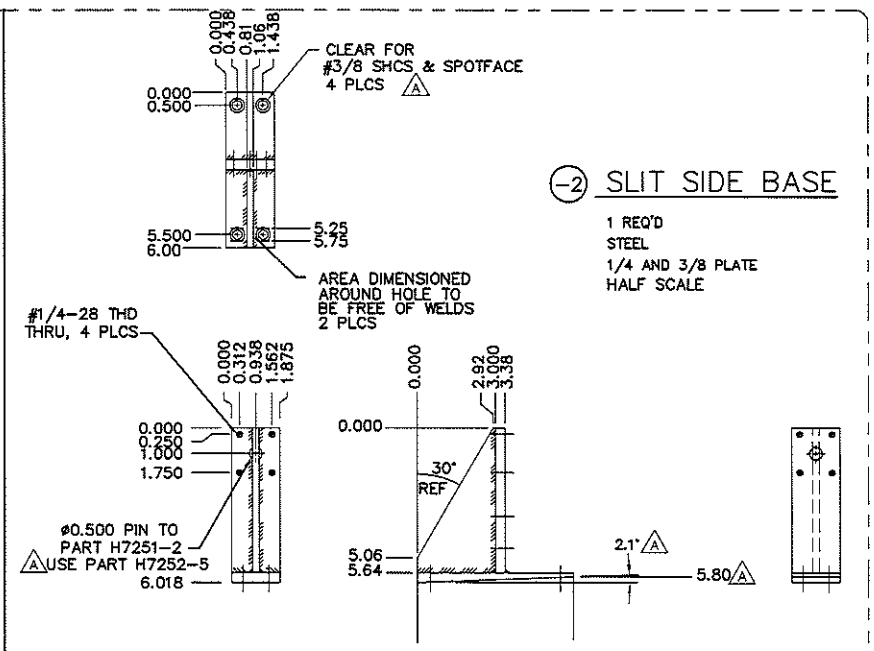
(-1) FIXED BASE BRACKET

1 REQ'D
STEEL
1/4 AND 3/8 PLATE
HALF SCALE



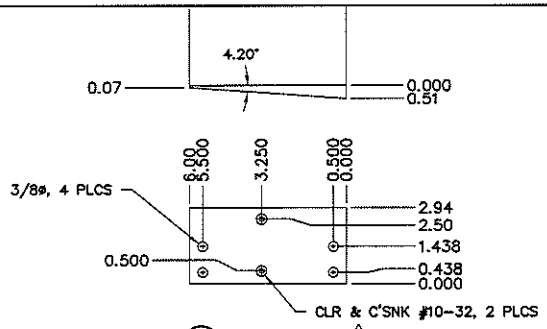
(-2) SLIT SIDE BASE

1 REQ'D
STEEL
1/4 AND 3/8 PLATE
HALF SCALE



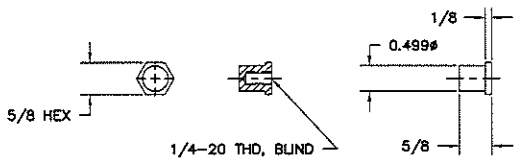
(-3) WEDGE A

1 REQ'D
ALUM
ATTACH TO BASE OF PART H7252-1
HALF SCALE



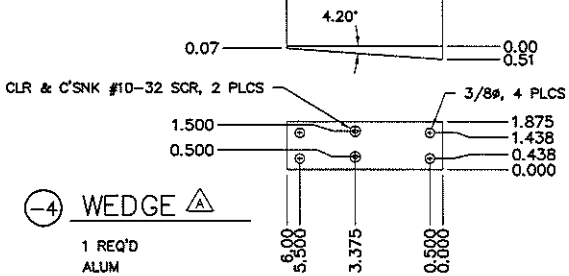
(-5) LOCATING PIN A

3 REQ'D
ST. STEEL
FULL SCALE



(-4) WEDGE A

1 REQ'D
ALUM
ATTACH TO BASE OF PART H7252-2
HALF SCALE



NOTED

A	9-12-11	J.o.	ADD 2.1° WEDGE TO PARTS -1, -2
			AFTER SURVEYING BASE, H7215-1
			CUT OFF 0.22" ON ONE END.
B	5/20/13	CAO	UPDATE TO AS-BUILT CONDITION.

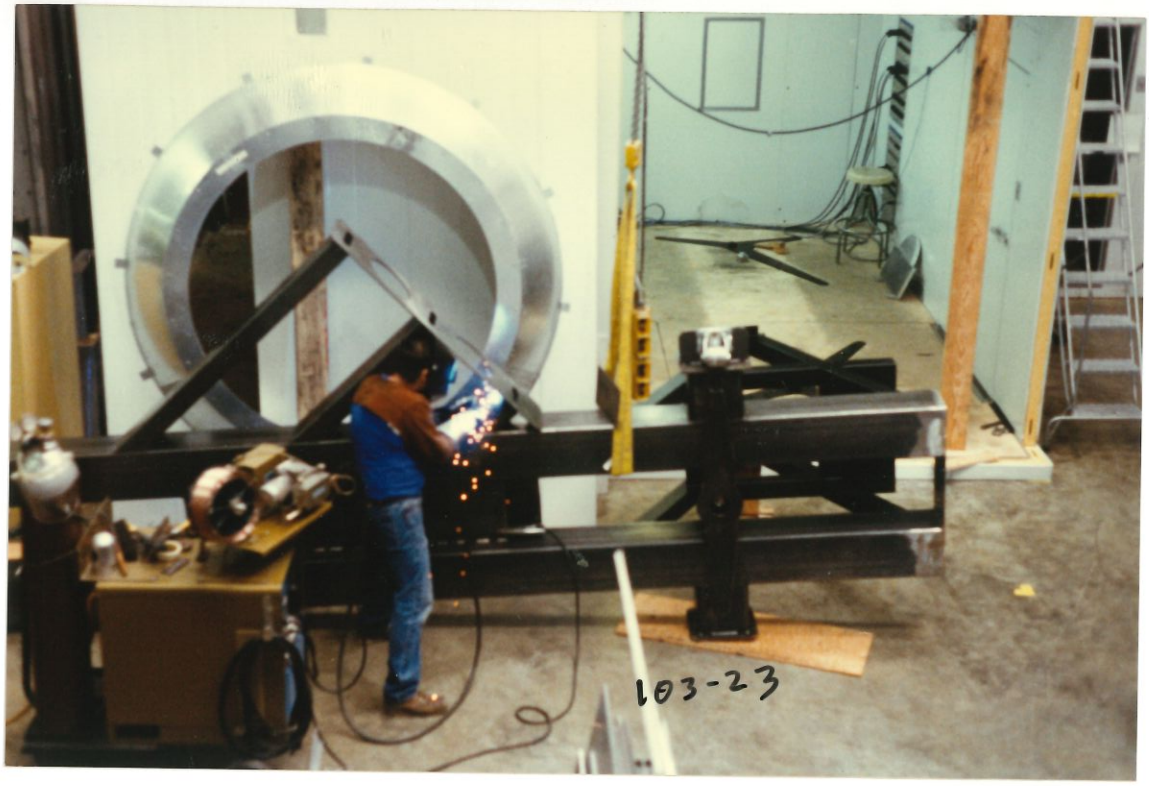
KECK/HIRES
DEWAR AND SUPPORT
DETAILS

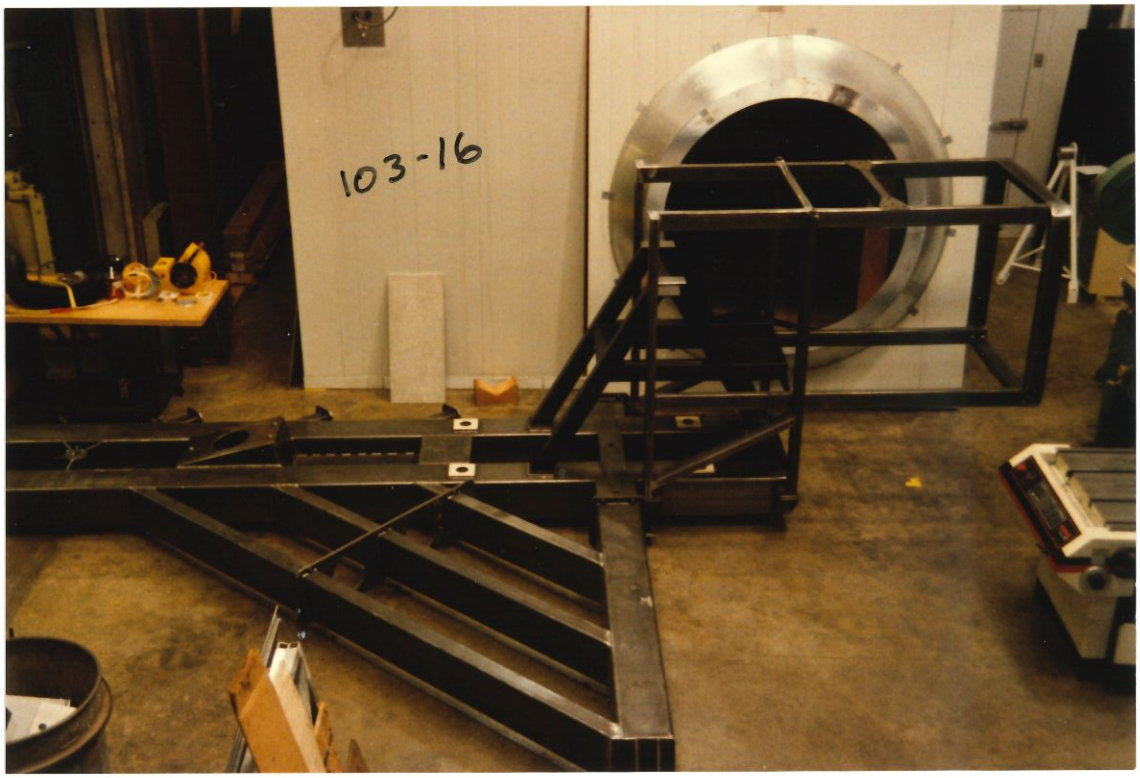
J.o. [illegible]
CAO [illegible]

H7252.B

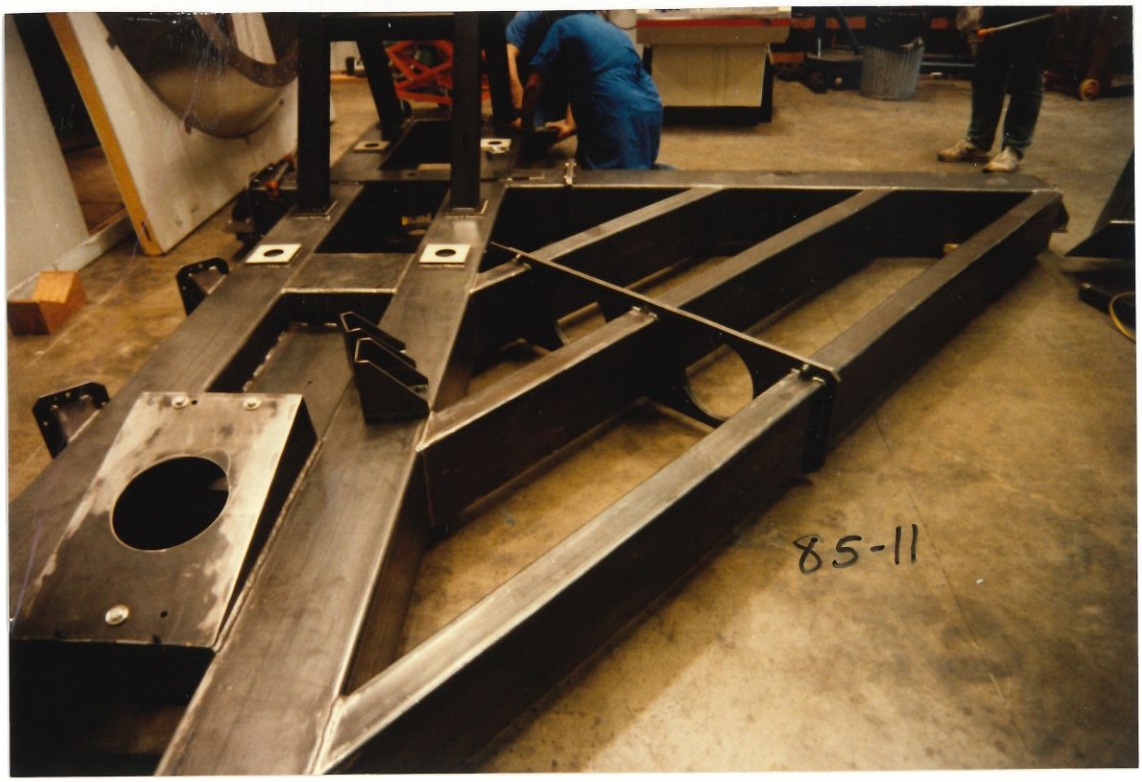
INCHES

Optical Bench

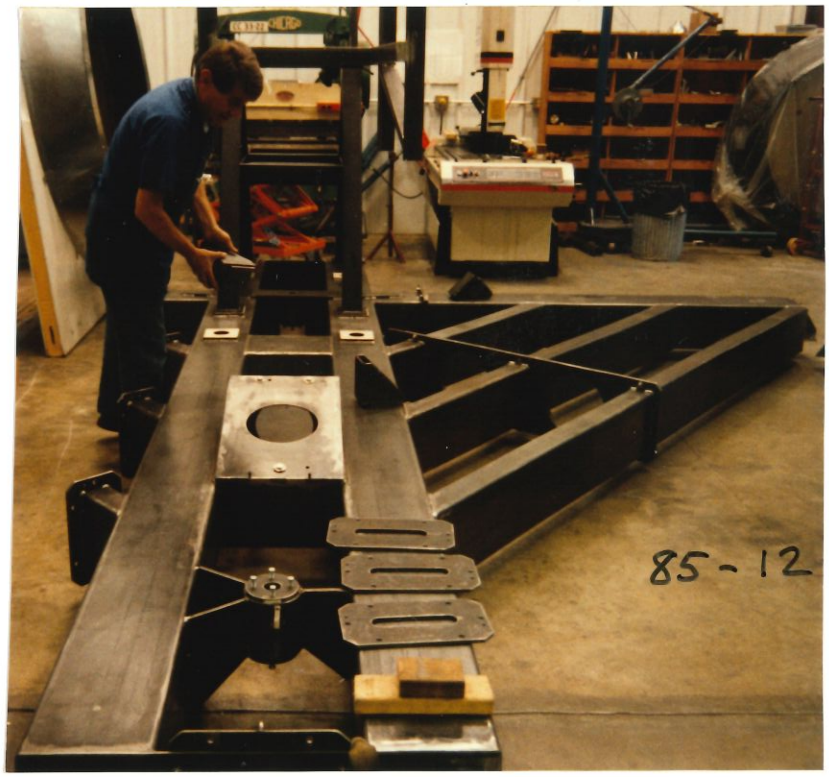




HIRES' main frame. The frame sits on three points on the Nasmyth Platform. Insulated housing is in the background. (103-16)


85-11

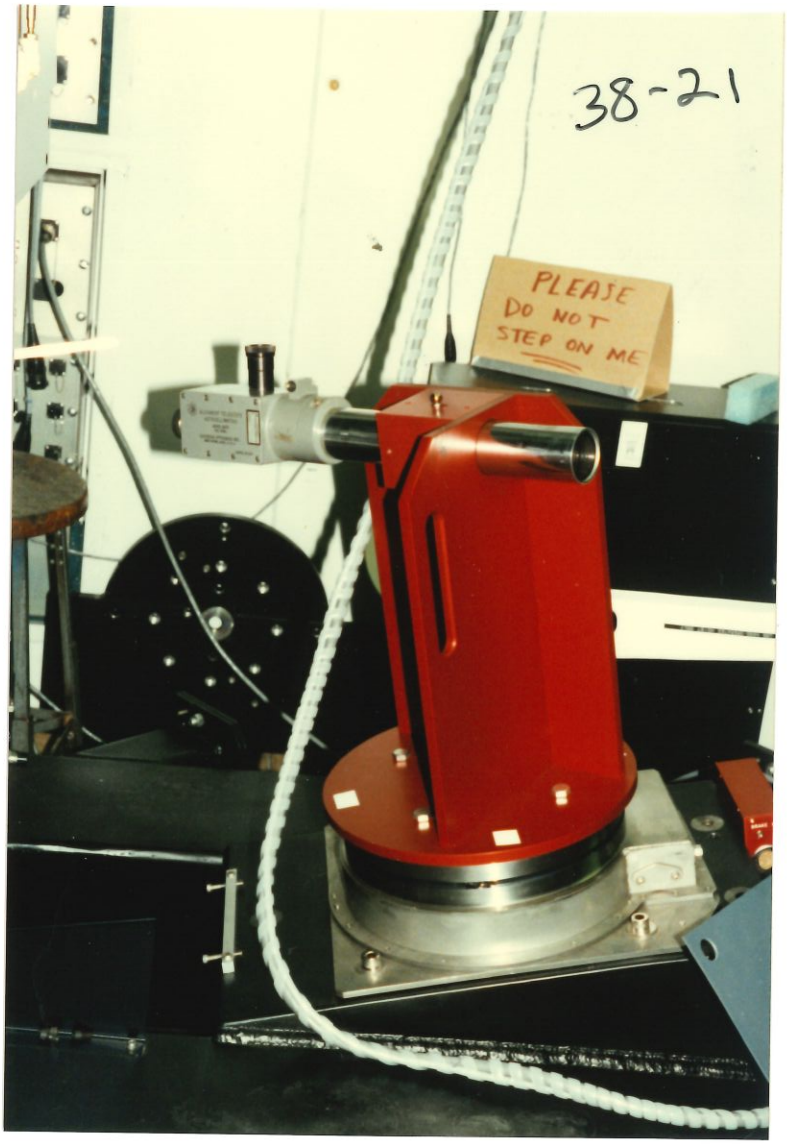

103-22


85-12

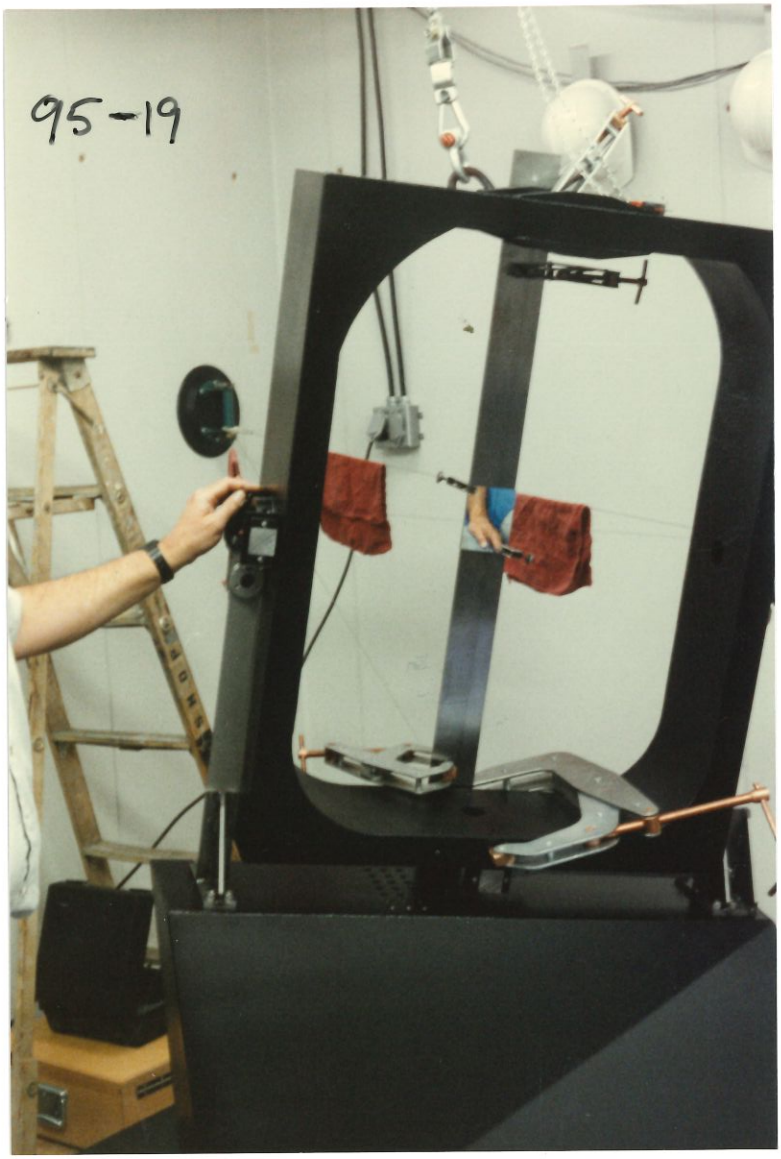
Strings and Levels

1. Davidson Auto-Collimator mounted in the Cross-Disperser Turntable Fixture. Half-inch Tooling Ball above is on the Turntable axis. The Turntable is first aligned on the slit and then rotated exactly 40 degrees (to 3 arc-sec precision, which is over-kill), and this is defined as the Camera Axis.

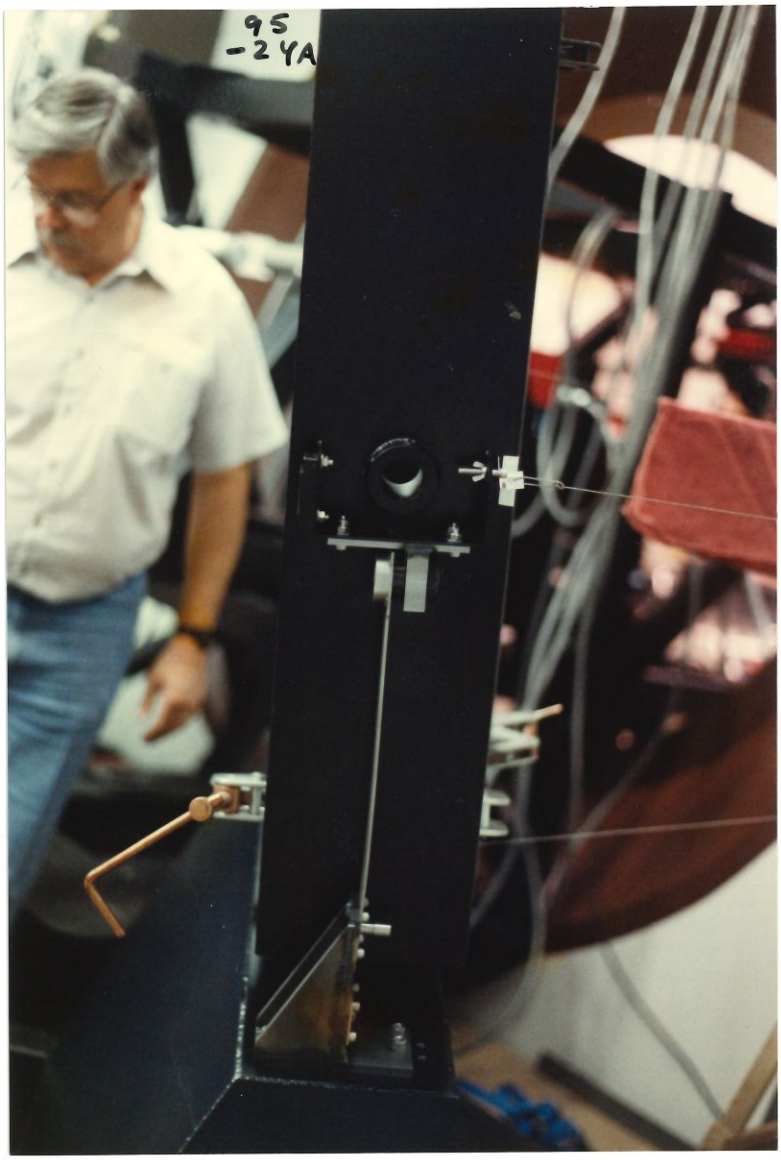

15-29

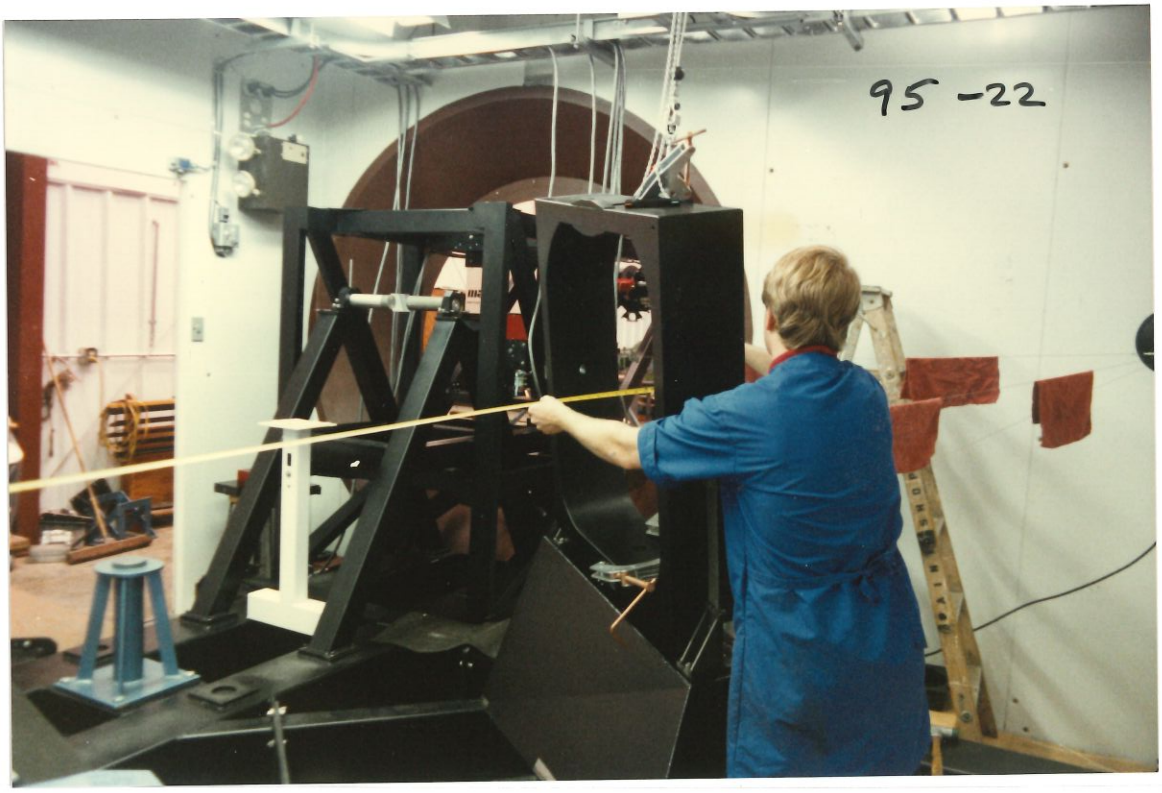


Another view of the Cross-Disperser turntable and alignment fixture. This time, with the second Davidson Alignment Telescope. (38-21)

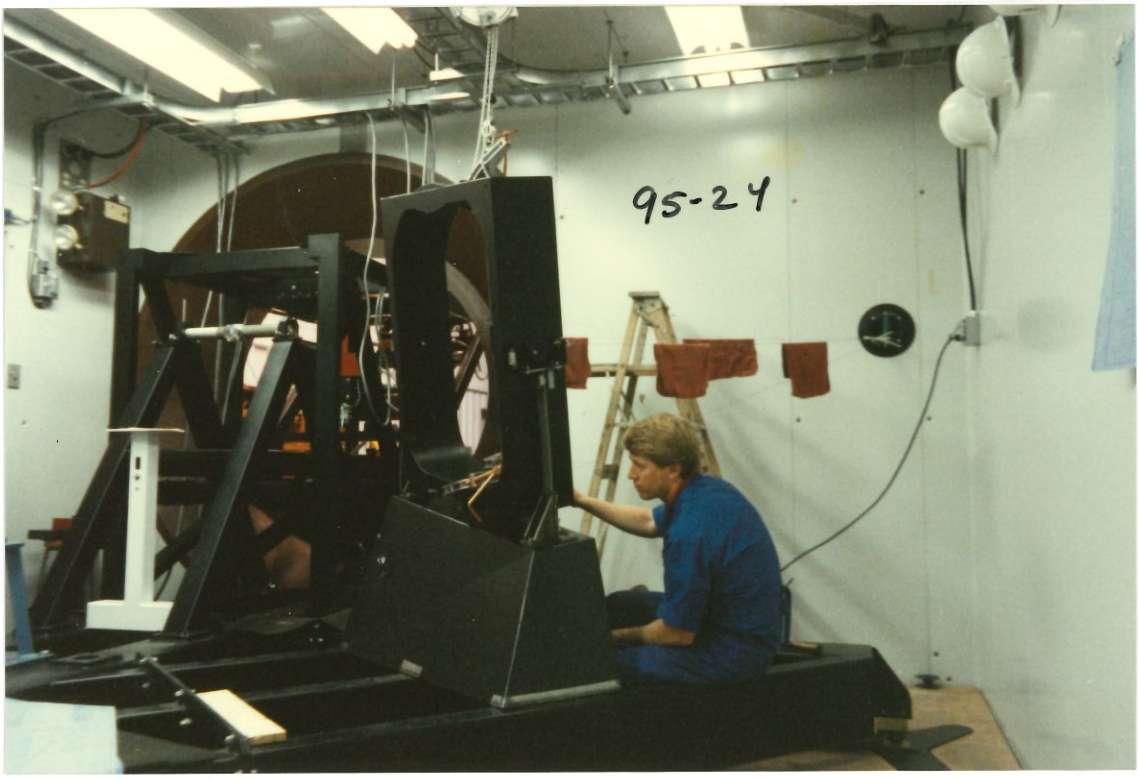


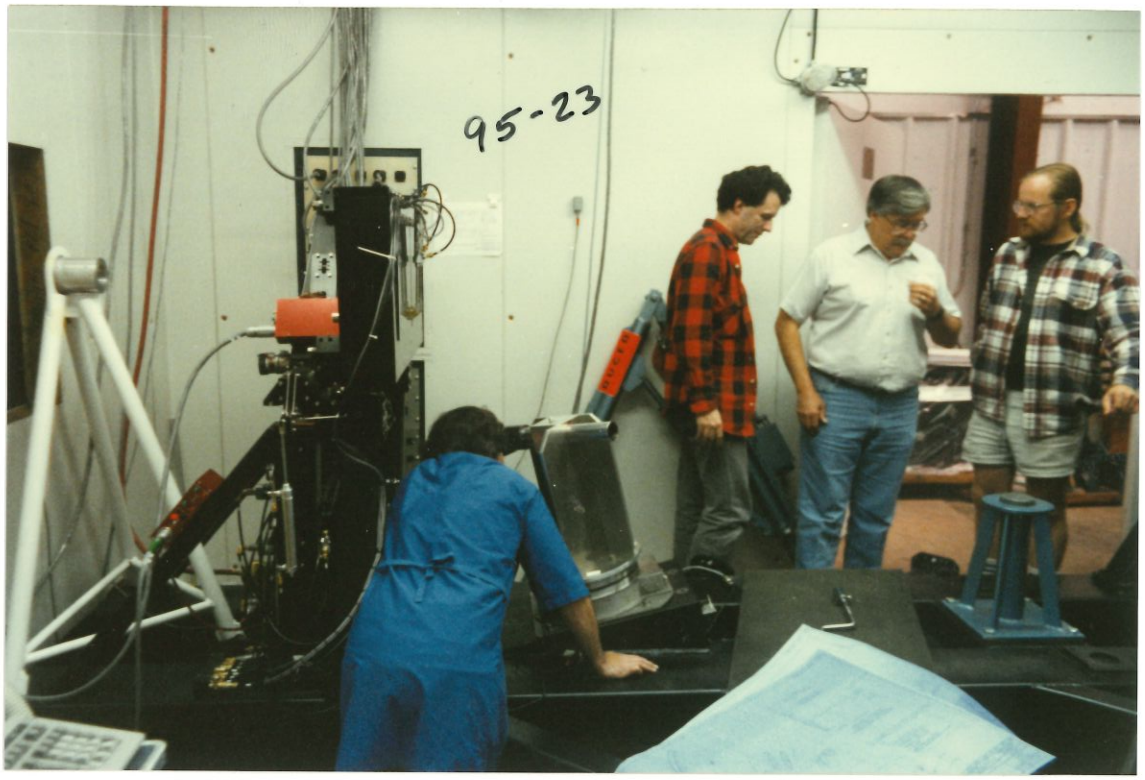
2. Mirror and Cross Wires to put the Frame onto the Camera Axis. The three flexible elements hold the Frame during measuring. Once the Frame is determined to be correct, the elements are pinned to their three mounting points.


95
-24A

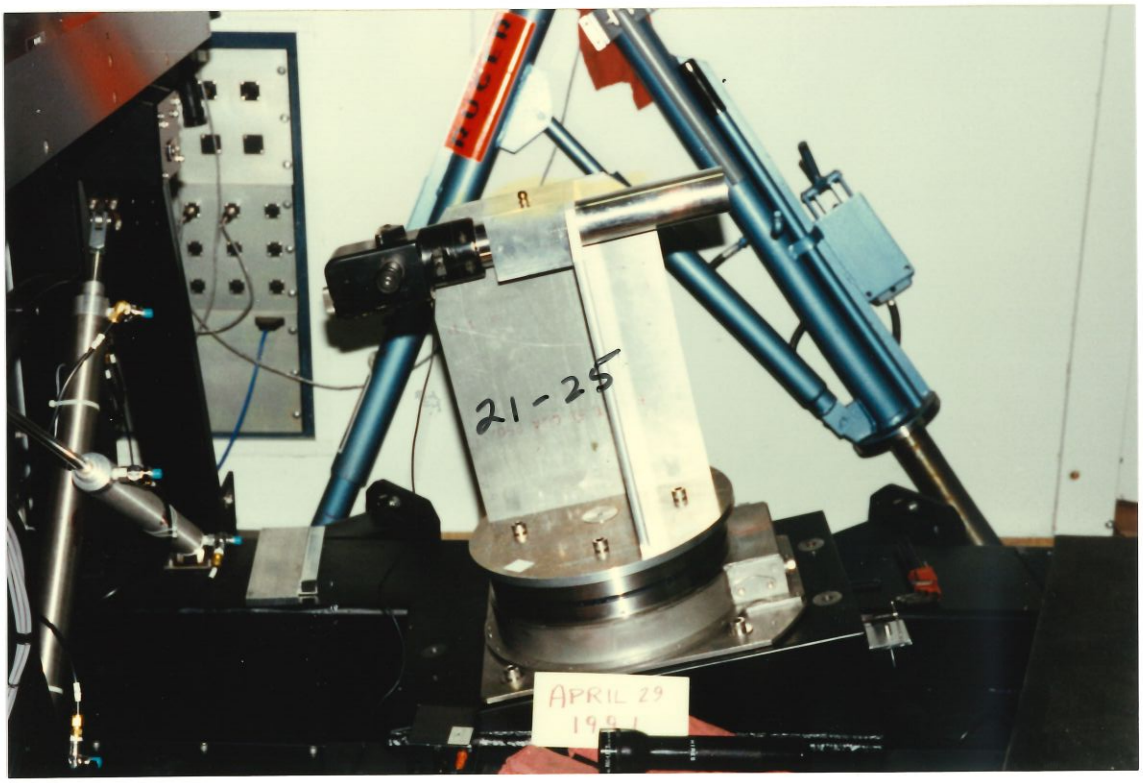


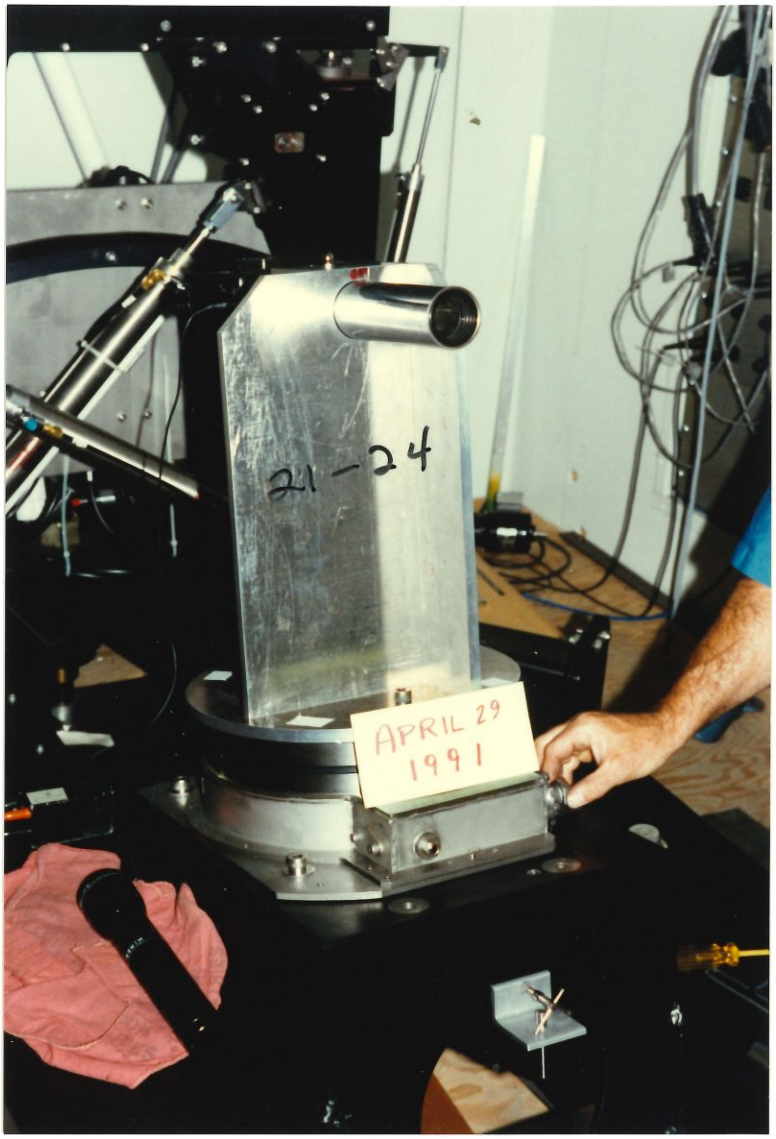
Measuring from the turntable tooling ball to the dewar frame (95-22)

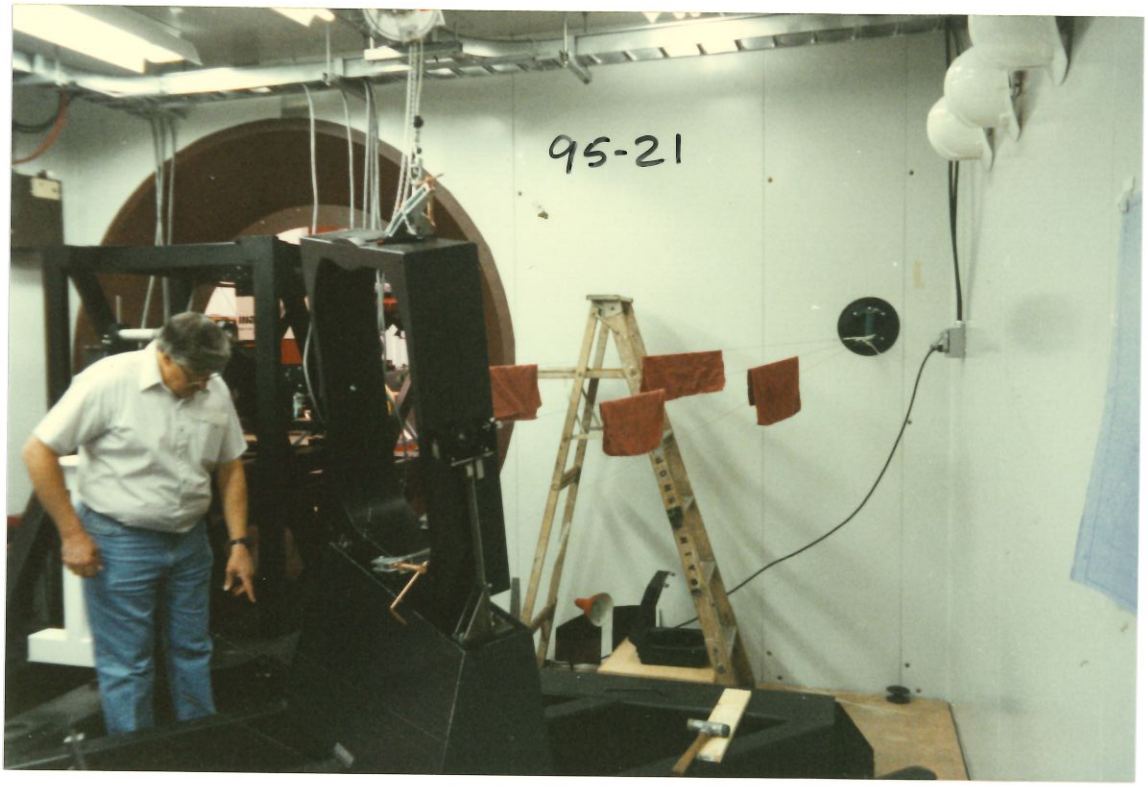




The main Auto-Collimator tripod is in the white structure in the left of this view. It has been welded to the black main frame. The welds are painted grey. (95-23)



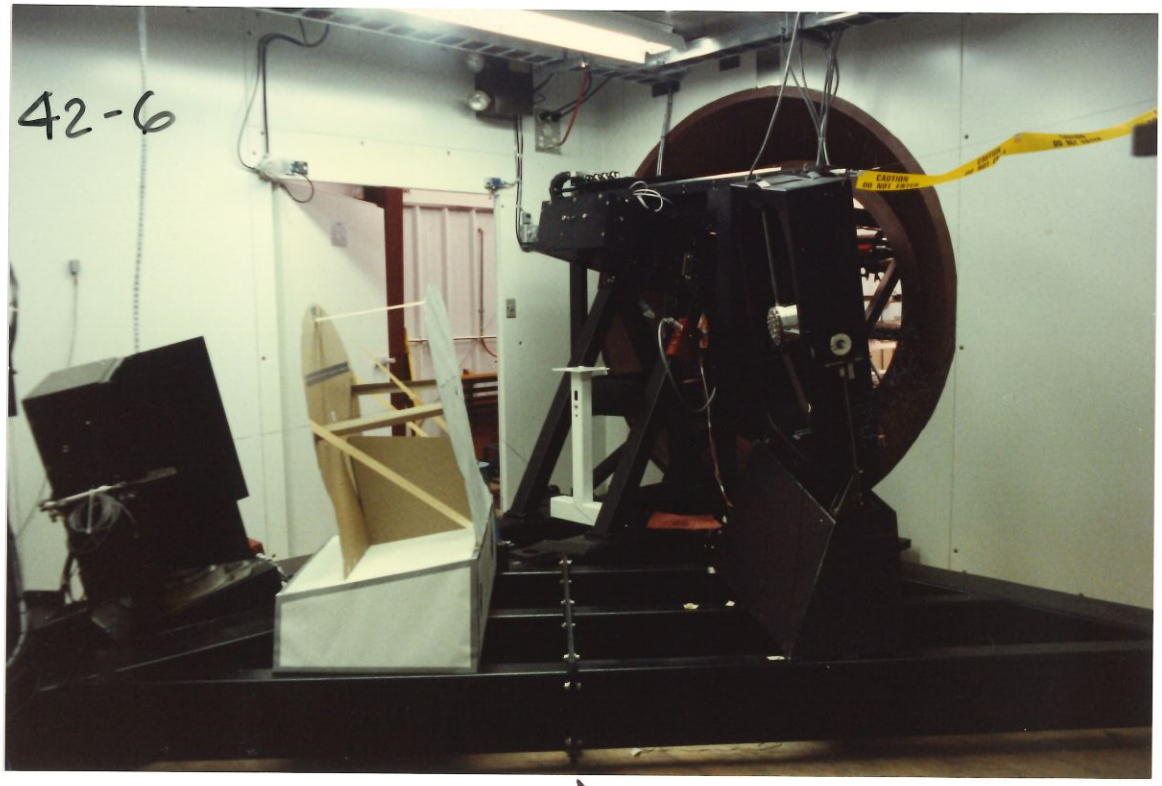

21-24
APRIL 29
1991



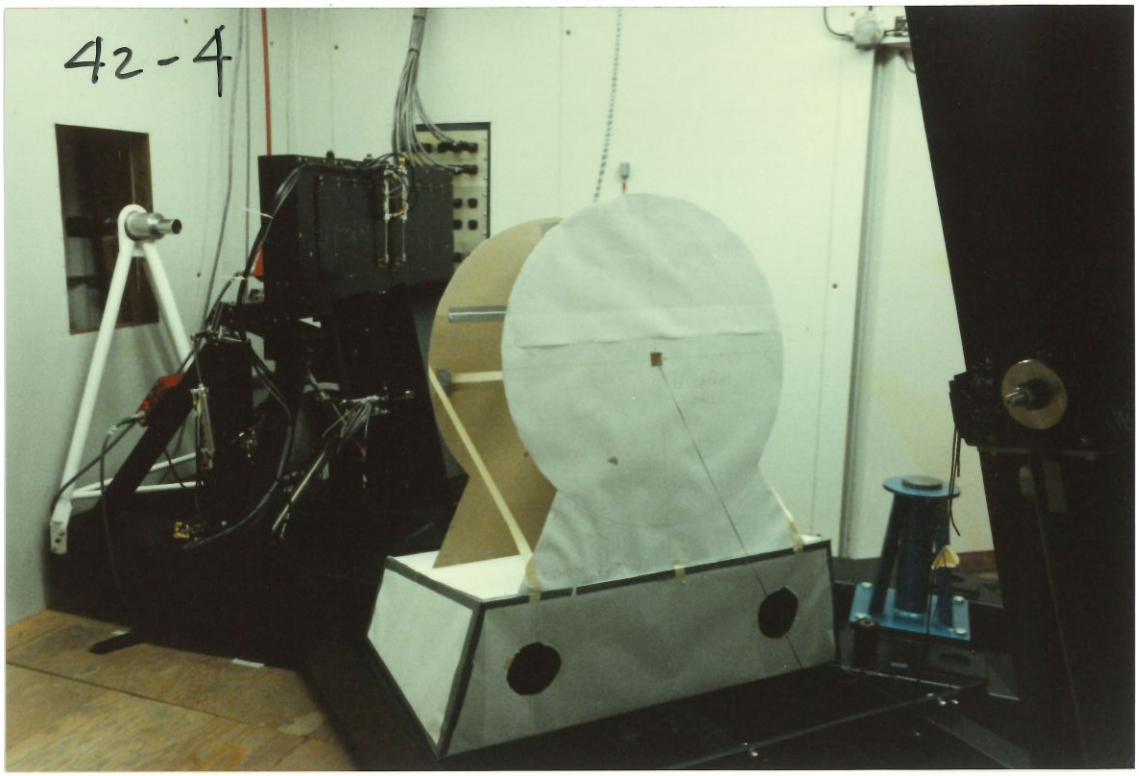
3. The Dewar Frame is heavy and so is positioned with a hoist from the ceiling and wires with turnbuckles attached to a large vacuum clamp on an interior wall. The red shop cloths on the temporary support wires are for safety. Adjustment is now to +/- 0.1 inch.

4. Neal Jern is inspector here.

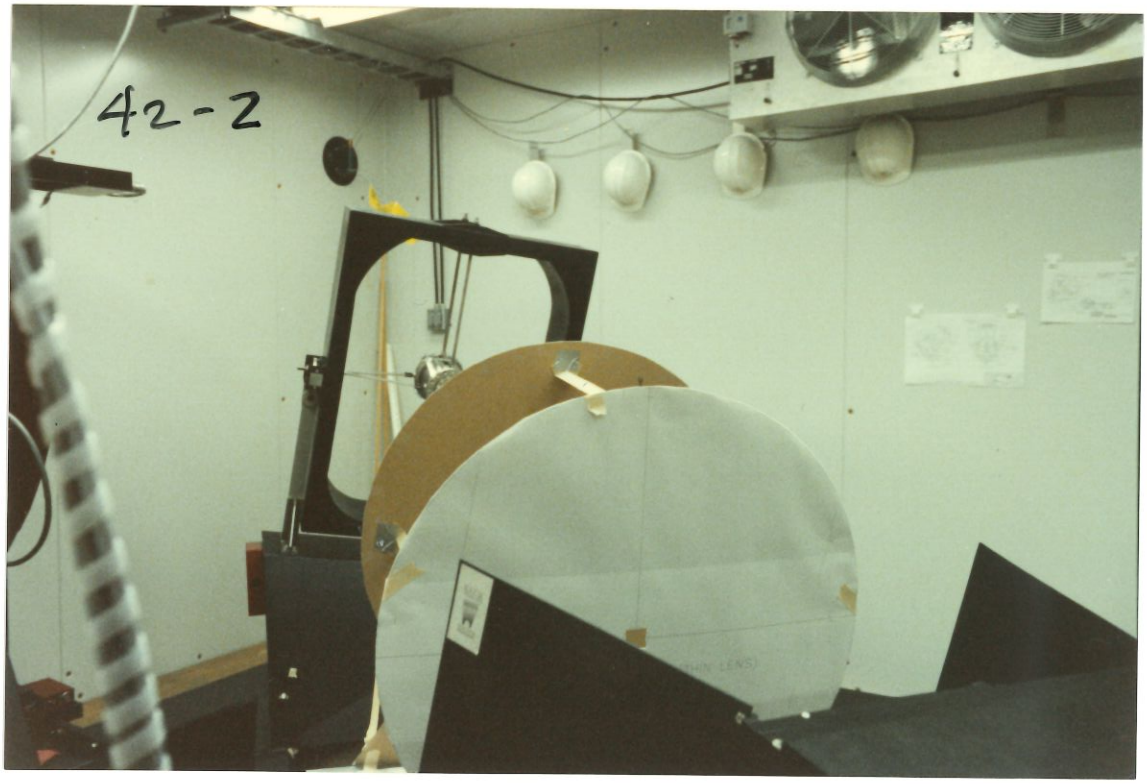
Cardboard Models

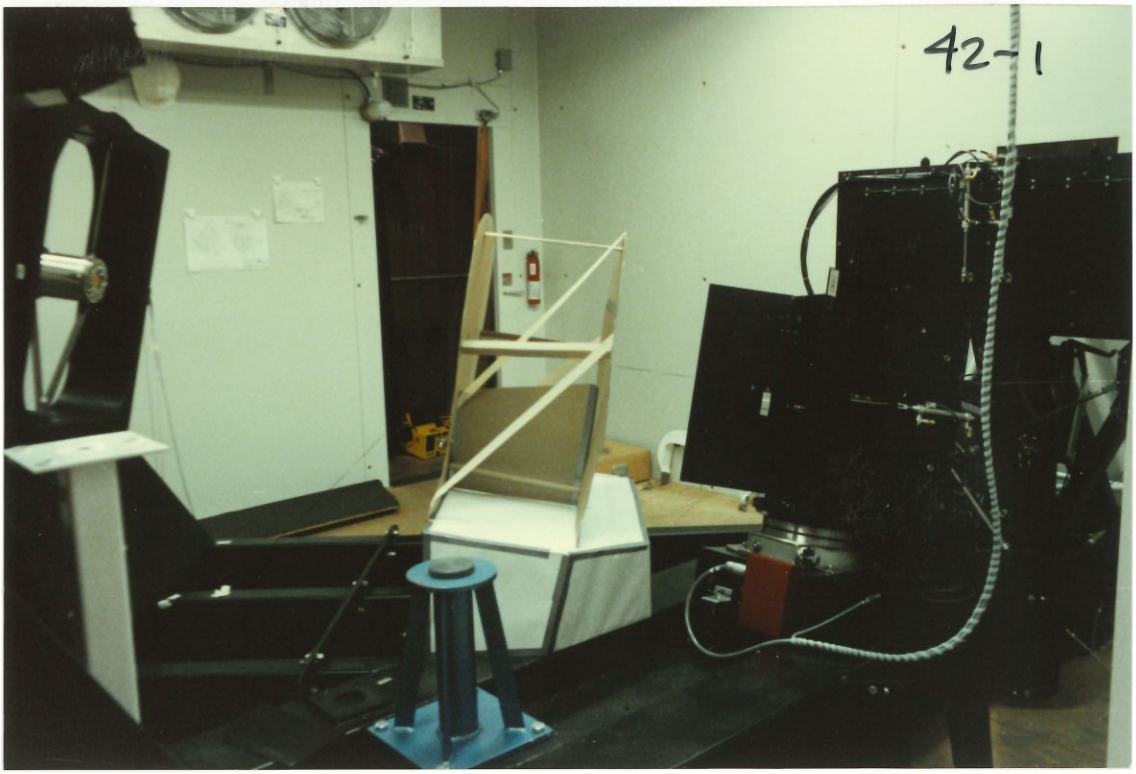


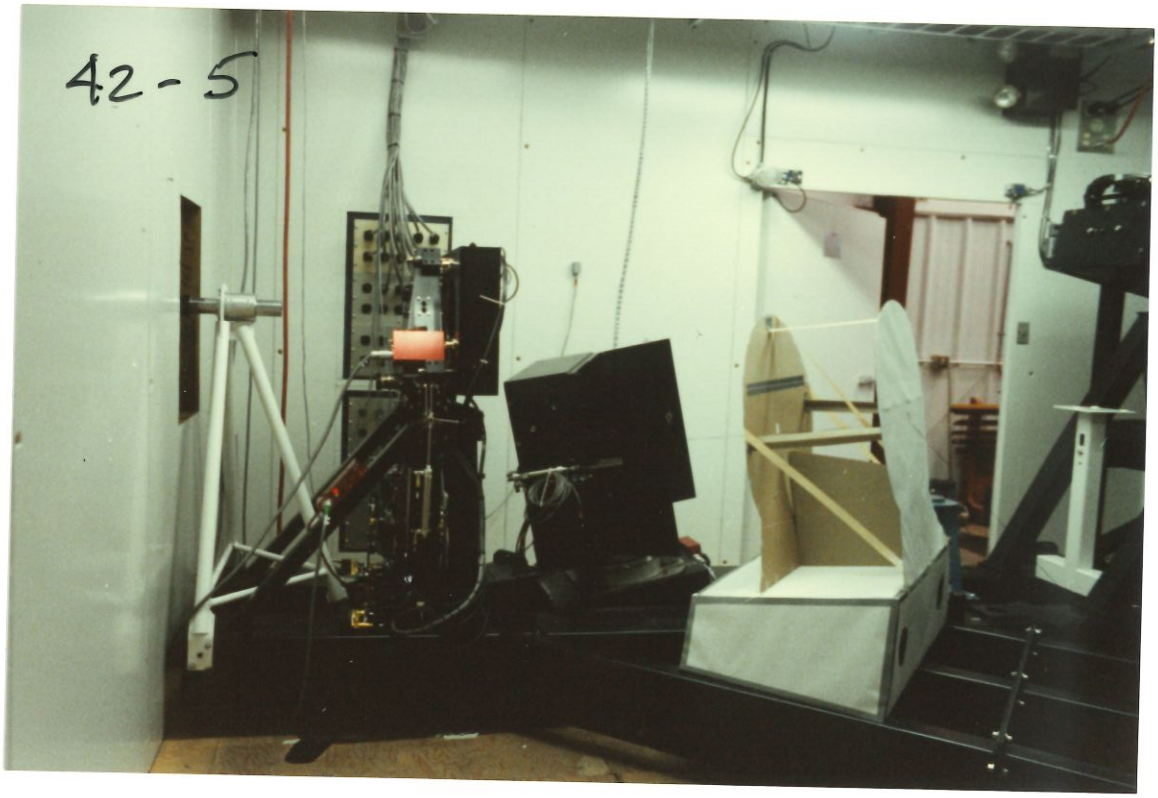
5. After the 3-D layout in AutoCAD, a cardboard full-size model is cut and taped together for a trial fit. This view also shows the take-apart joint for shipping, which is why the supporting elements must also be removable.

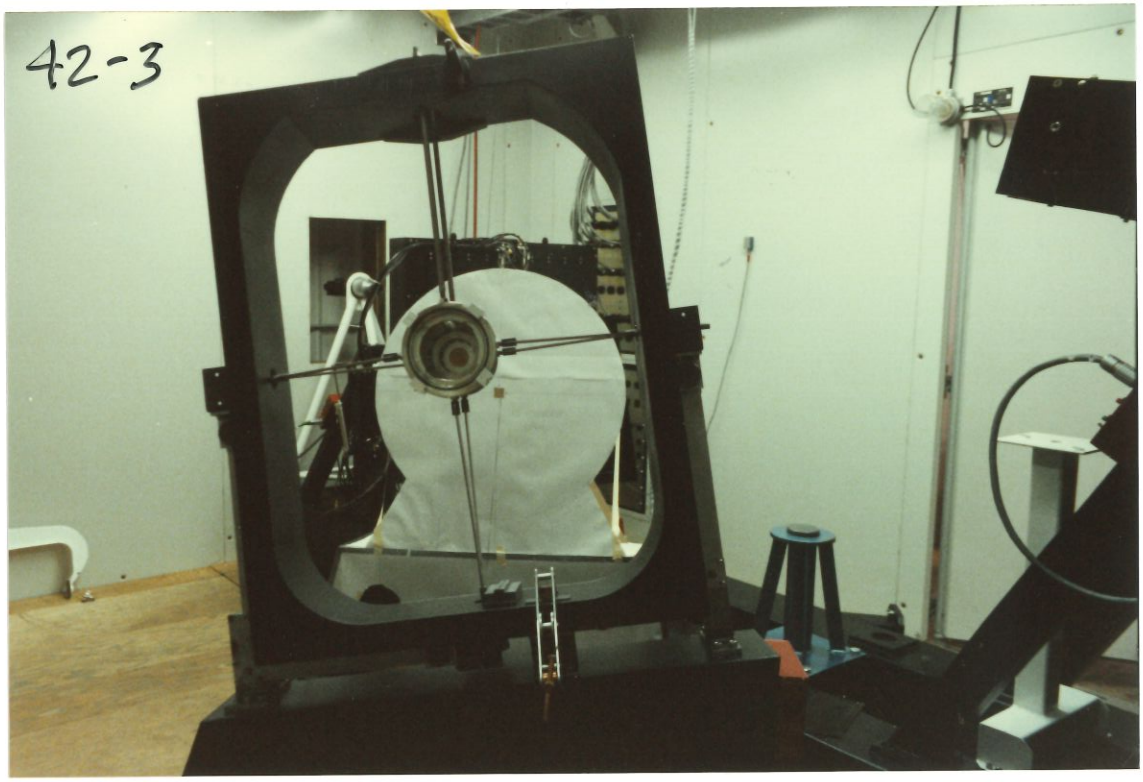


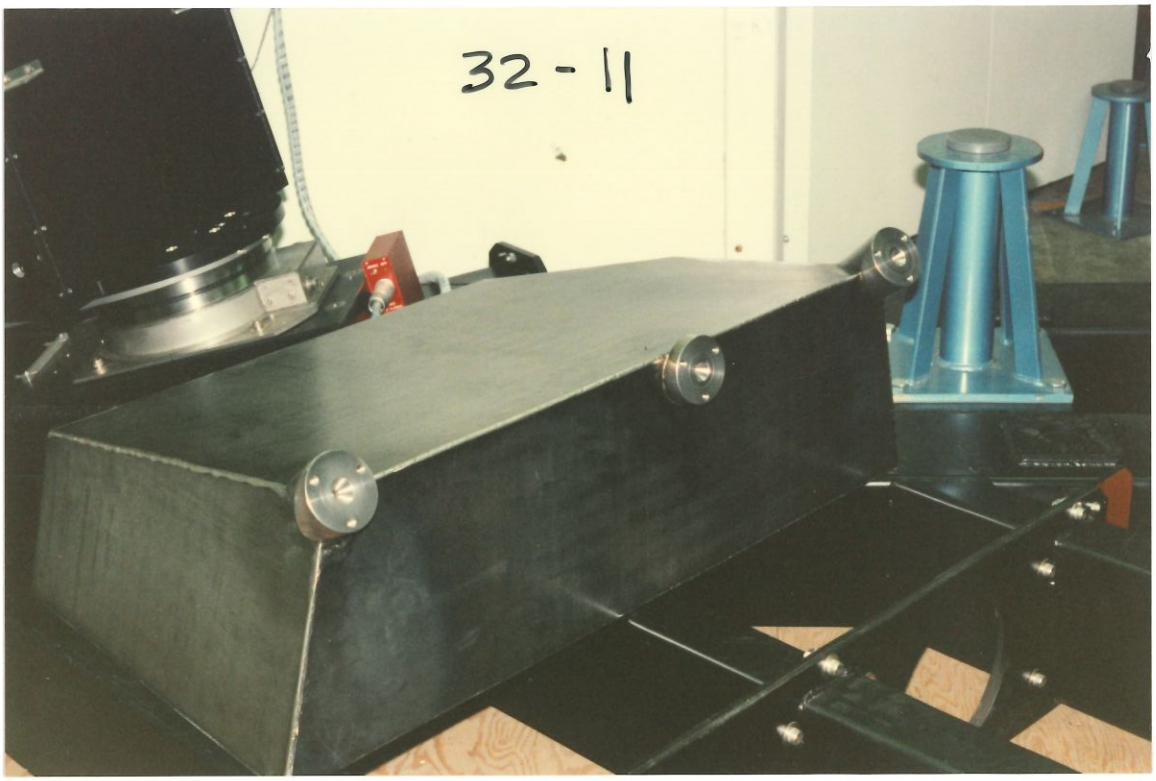
Cardboard lens mount and cardboard support box to check rough alignment. (42-1 thru –5)




42-1

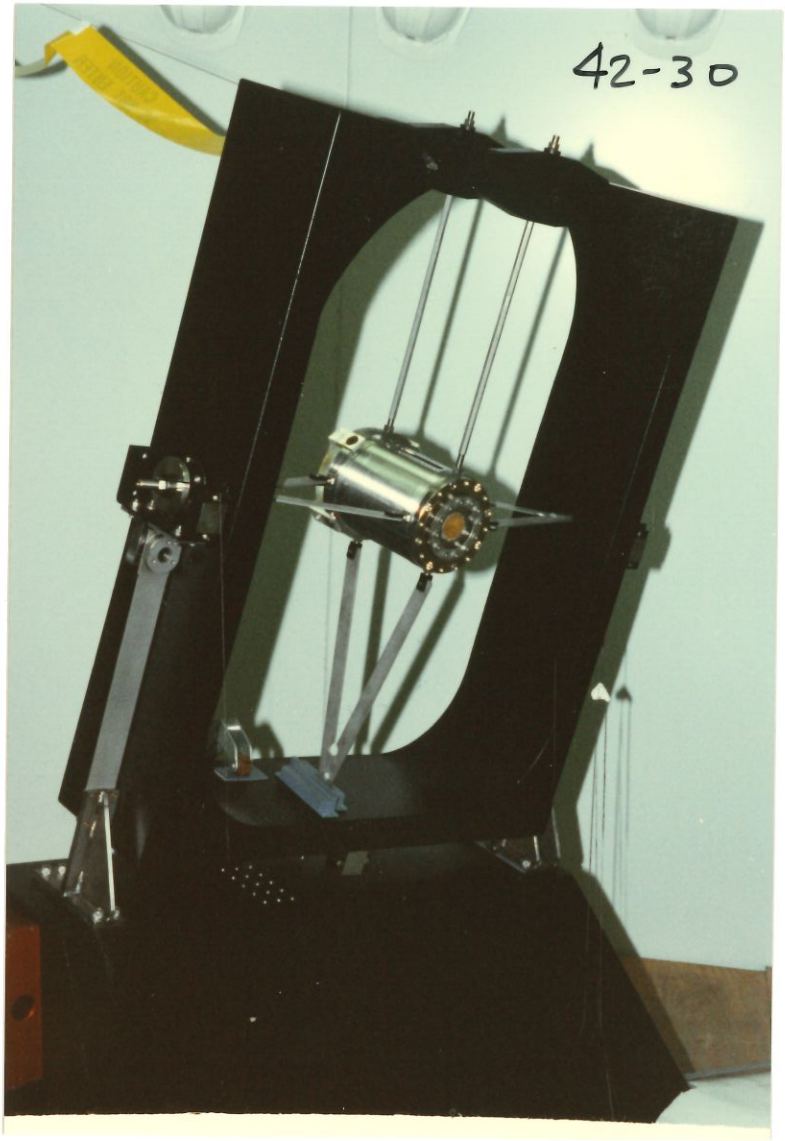

42-5


42-3

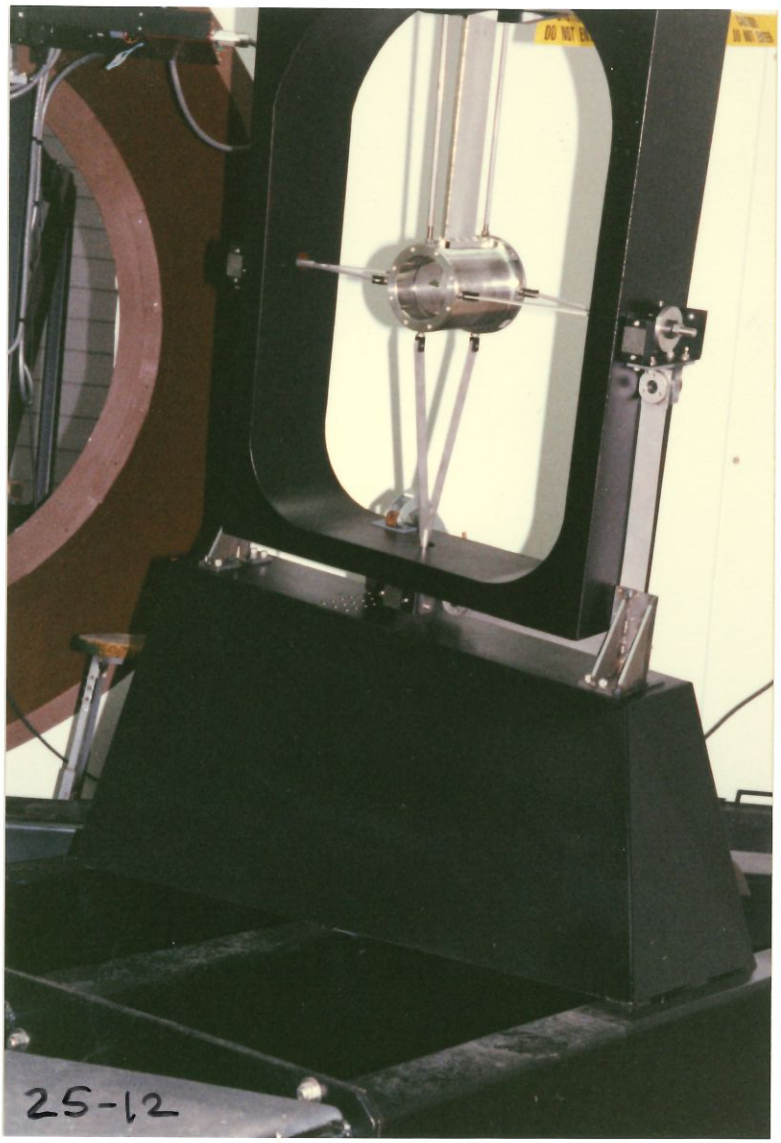


6. The final box in position. Panels are 1/8" thick mild steel plates (easy to shear). The three socket halves are cut to approximately the right angle and welded in place. The plan is for the ball joint to make up the position errors in location.

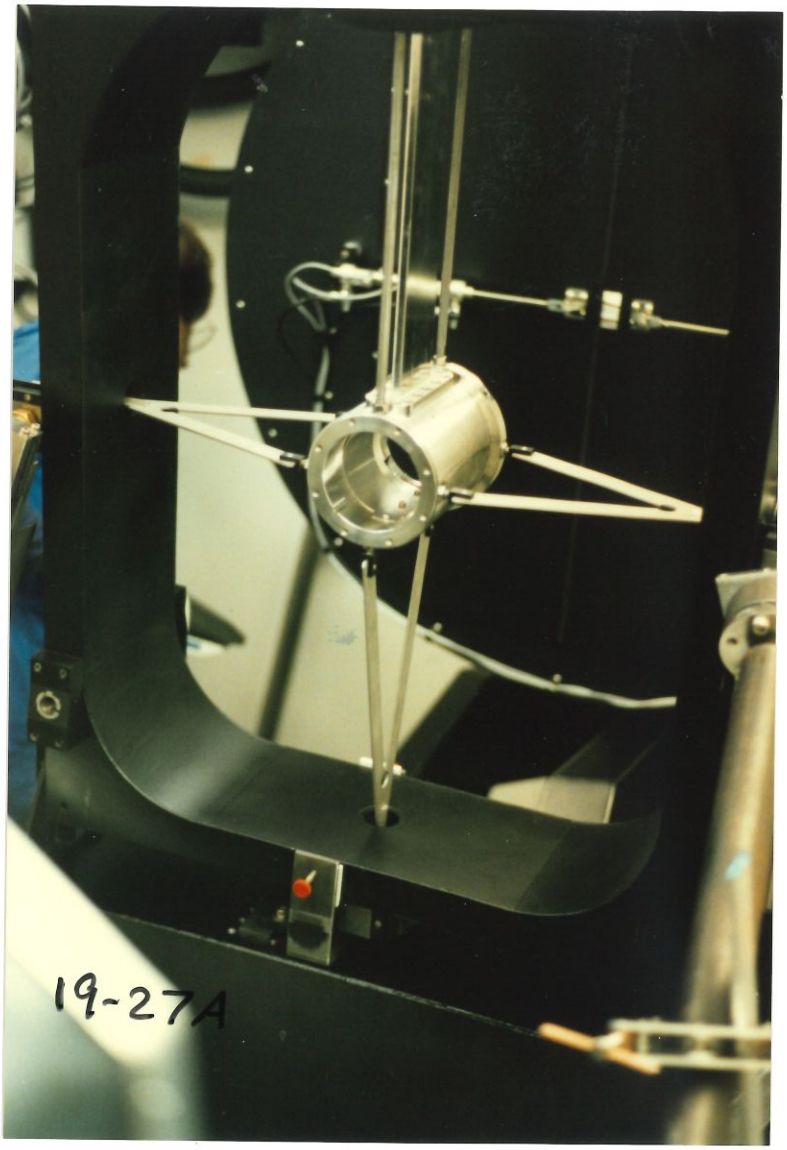
Struts and Flex Links

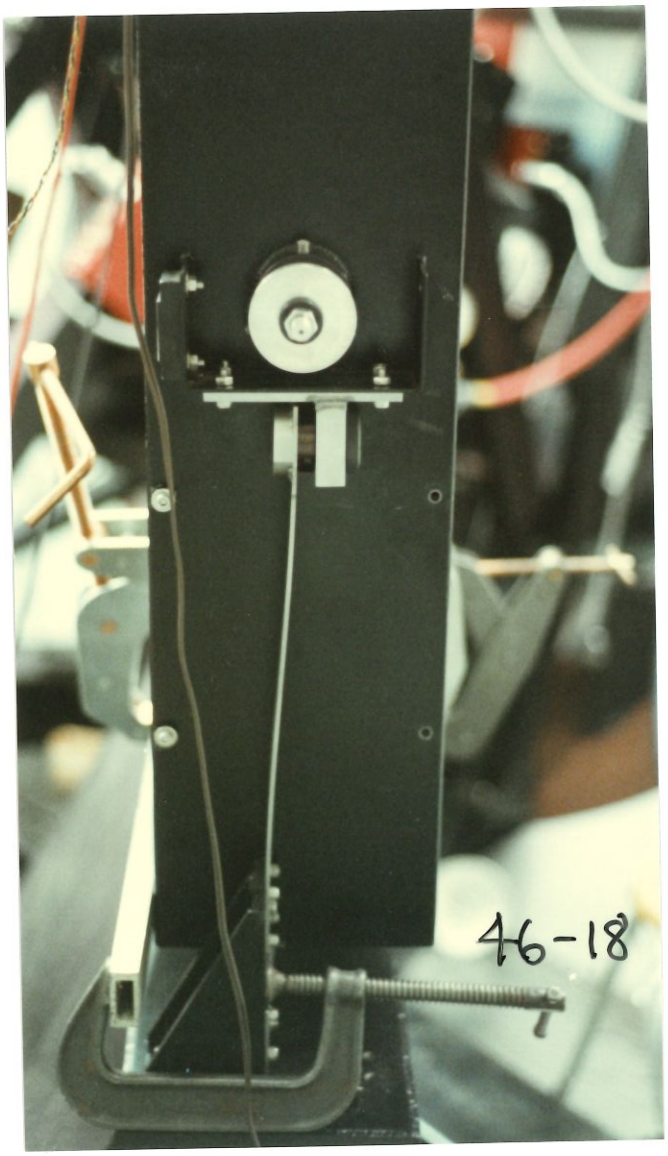


Slit side flex plate (42-30).

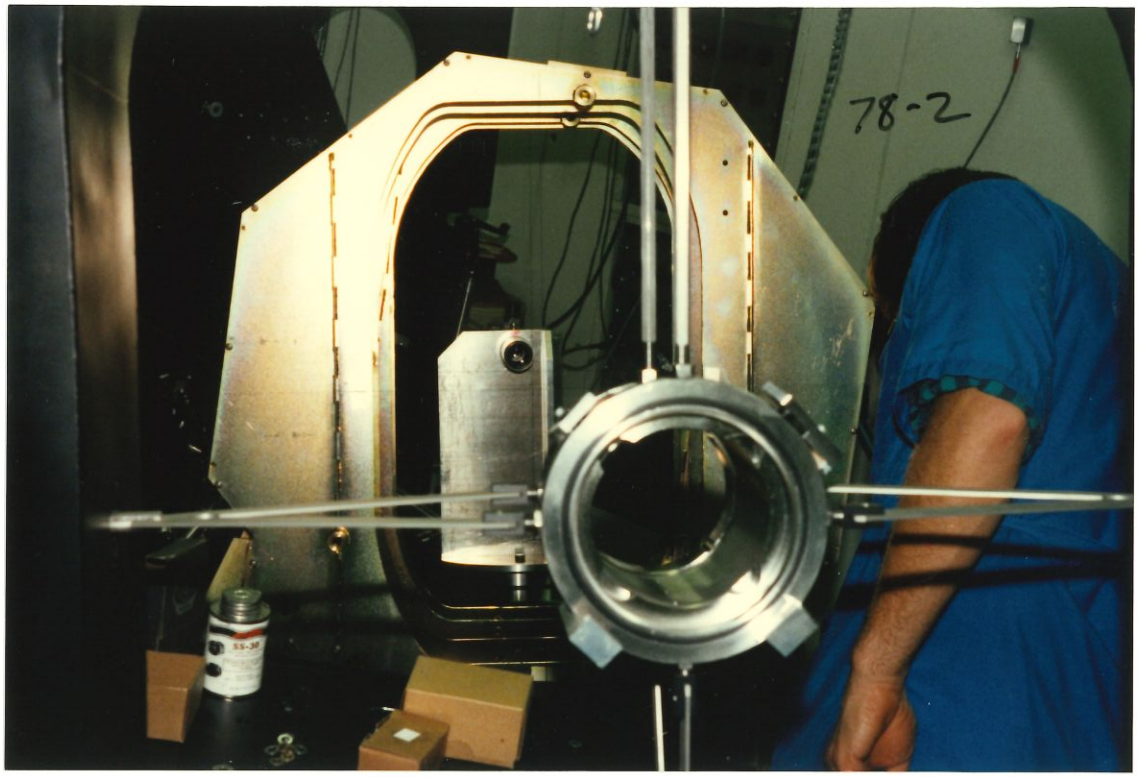


Anti-slit side flex plate (25-12).

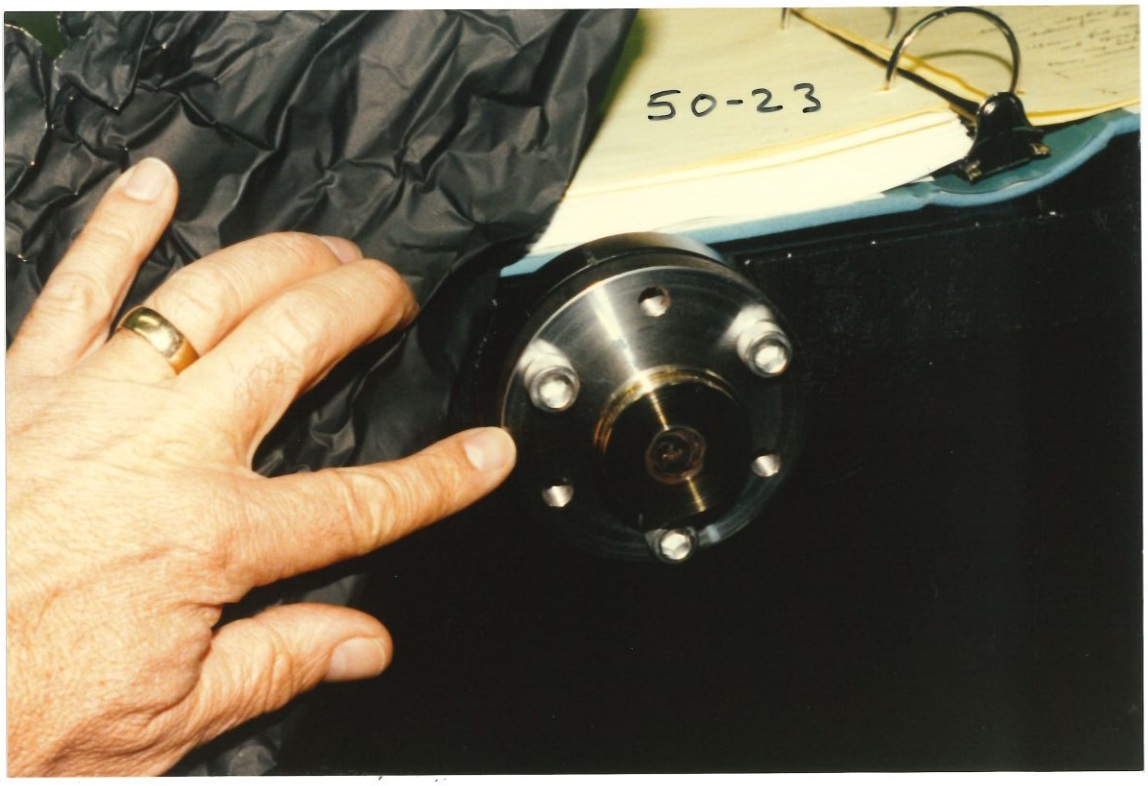

19-27A



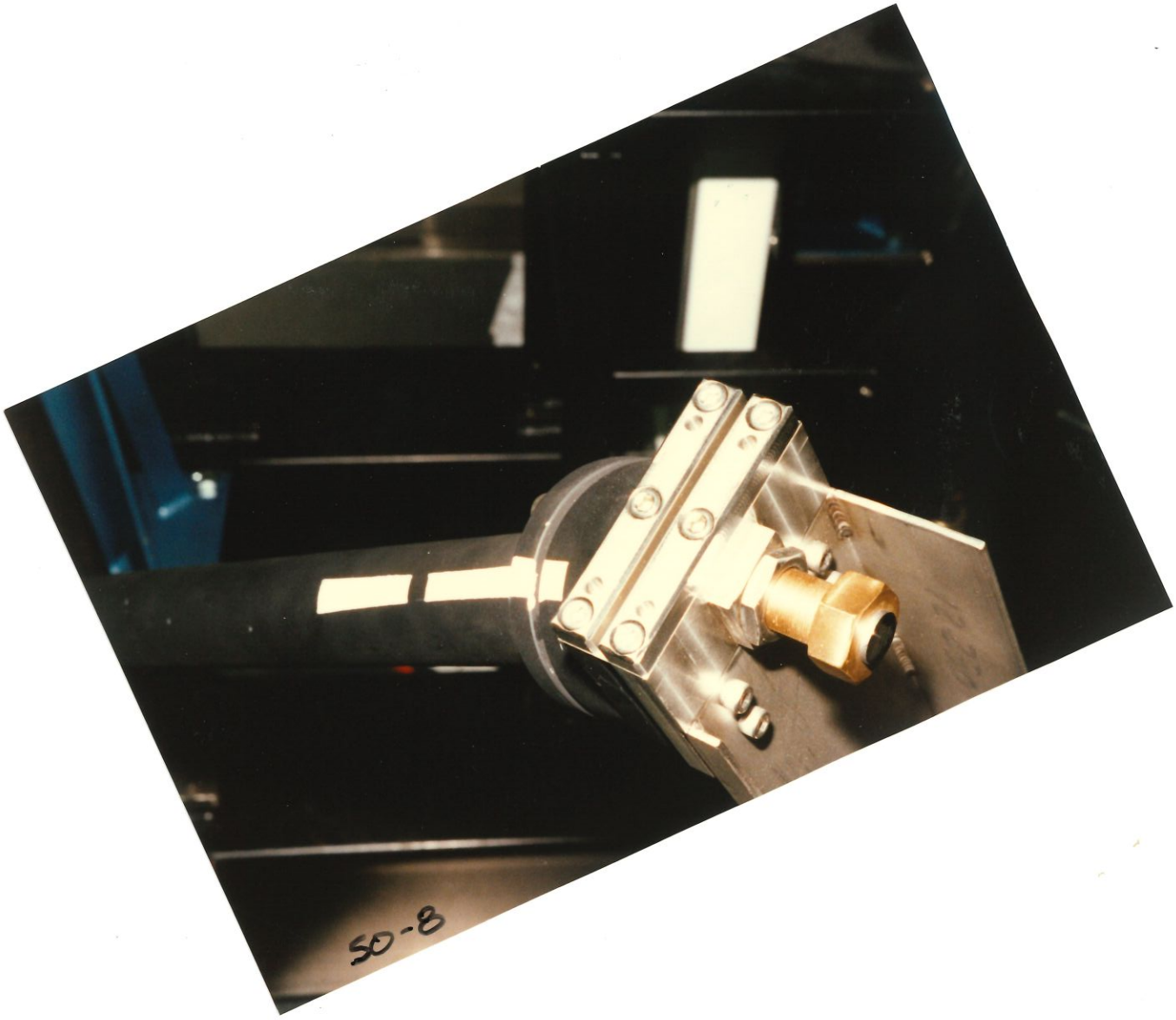
One of three flex plates that support the dewar. Steel, 1/8" x 2". (46-18)


78-2

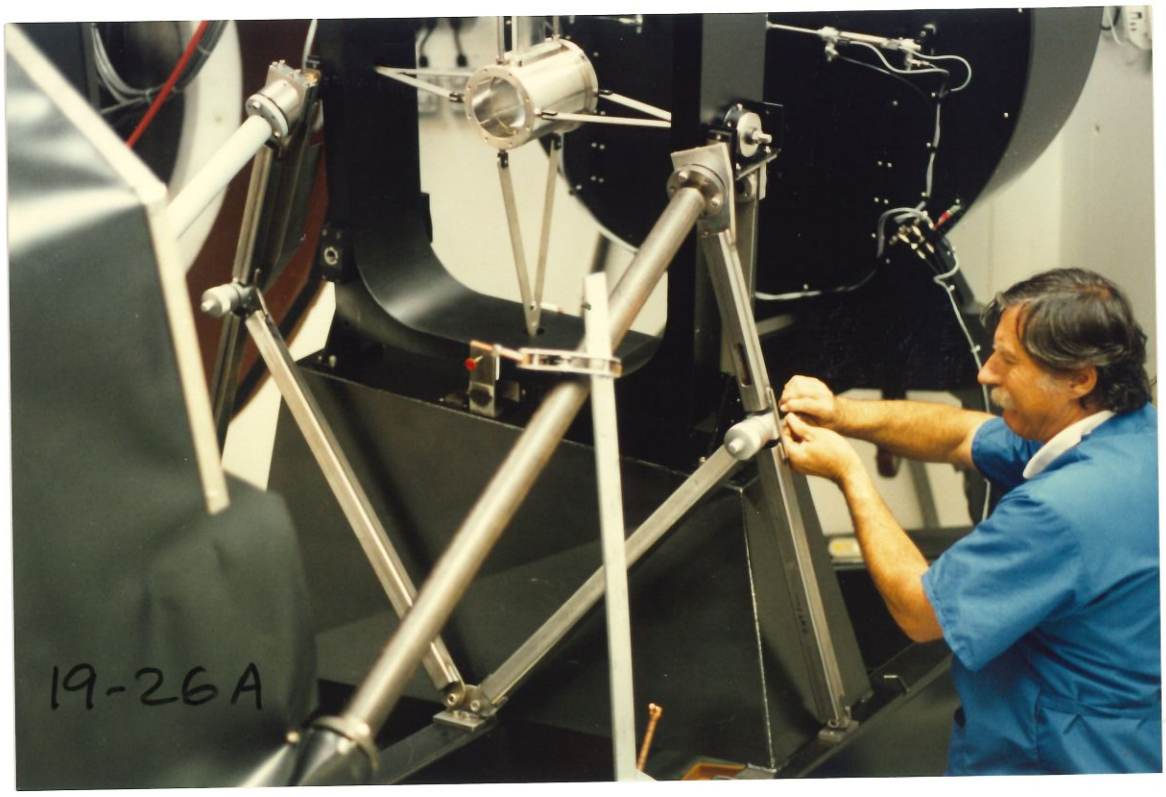
Alignment check with the empty lens cells. Jim Ward is adjusting (78-1, -3)



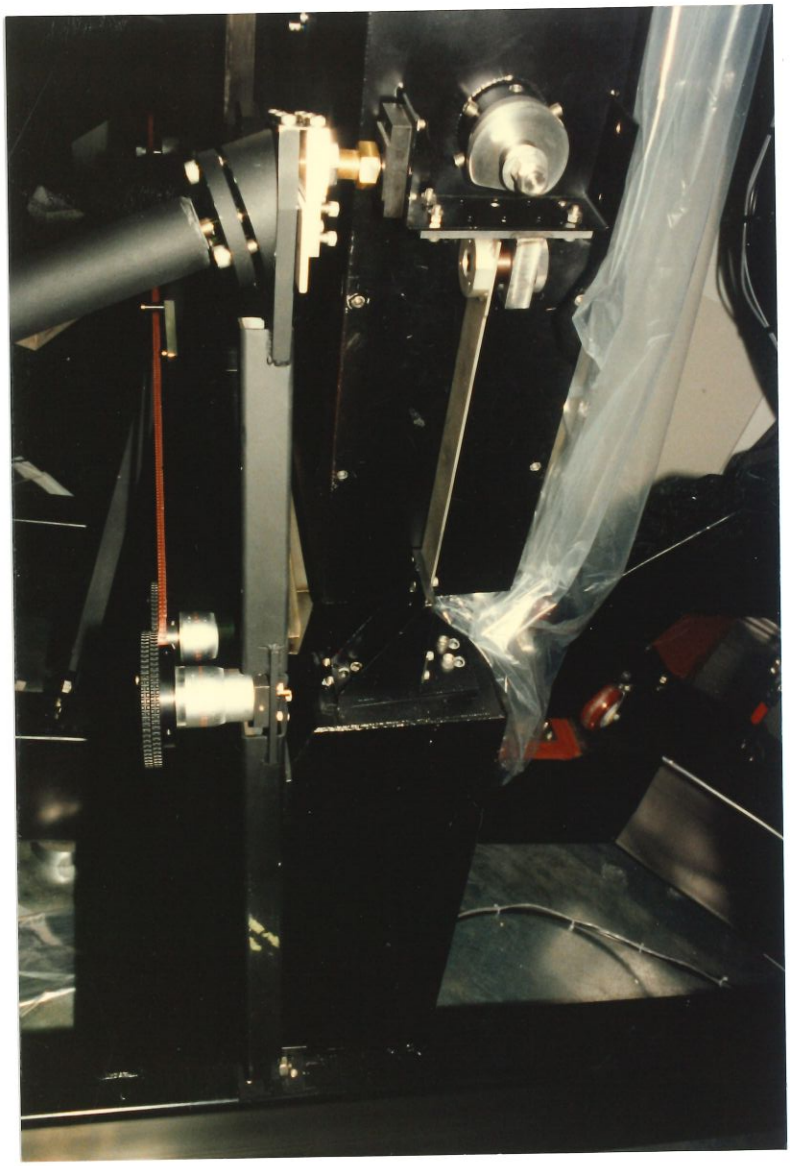
7. Detail of the central ball joint before the tube is cut to the measured length and welded to the ball.



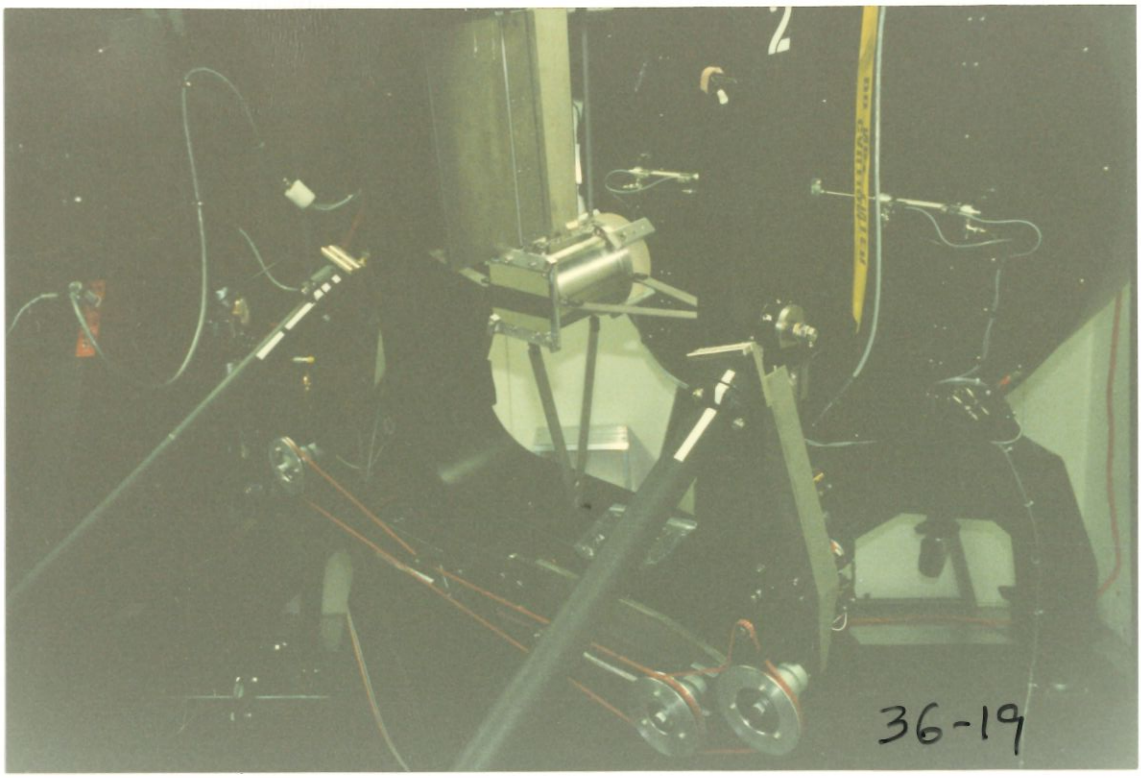
8. Upper joint detail shows the clamping flange and upper ball, angled socket, flex plate mounting to the scissors bracket, and bronze adjusting screw with hardened steel pad. This bronze screw can make up +/-0.5 inch of miss-location. This view also shows the large white index marks to make sure the right round tube goes back into the right position with the top up and rotated at the right angle in case the ball is not round.



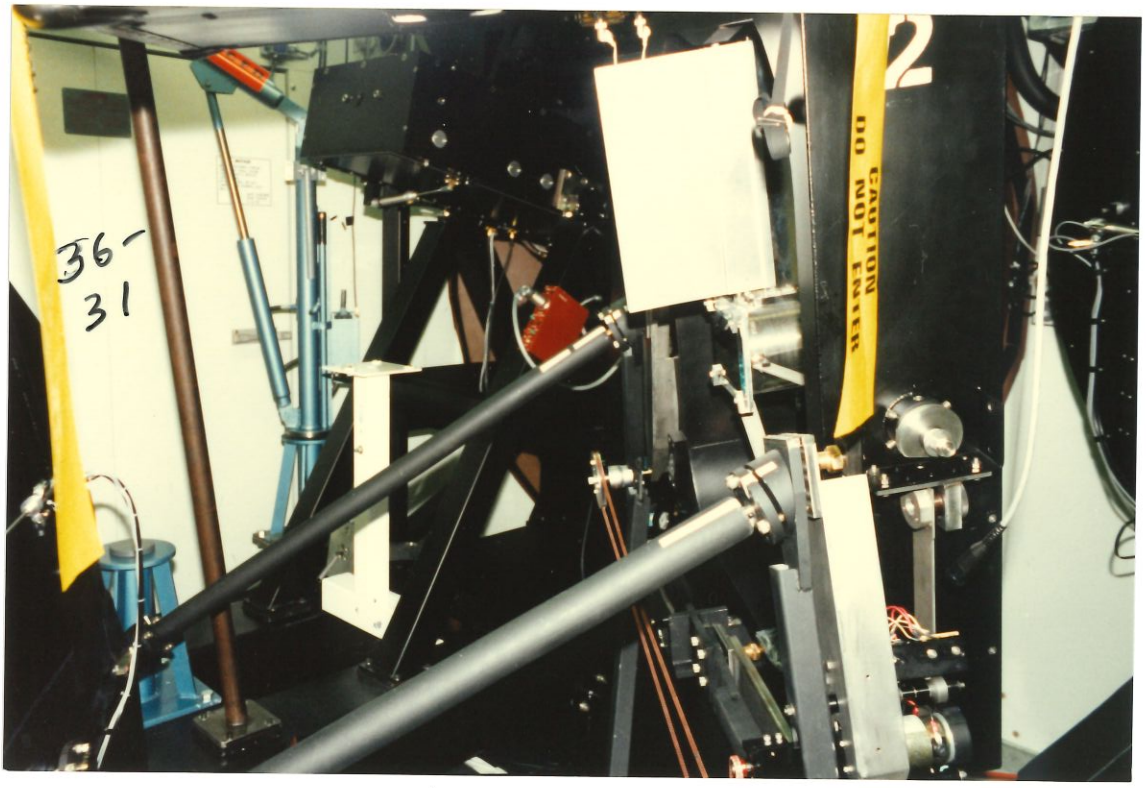
9. This photo shows Dick Kanto assembling one of the three micrometer drive screws in the square tube space-frame structure. This is the right side, or also called "anti-slit side". Note the temporary clamp holding the right round rod in position.



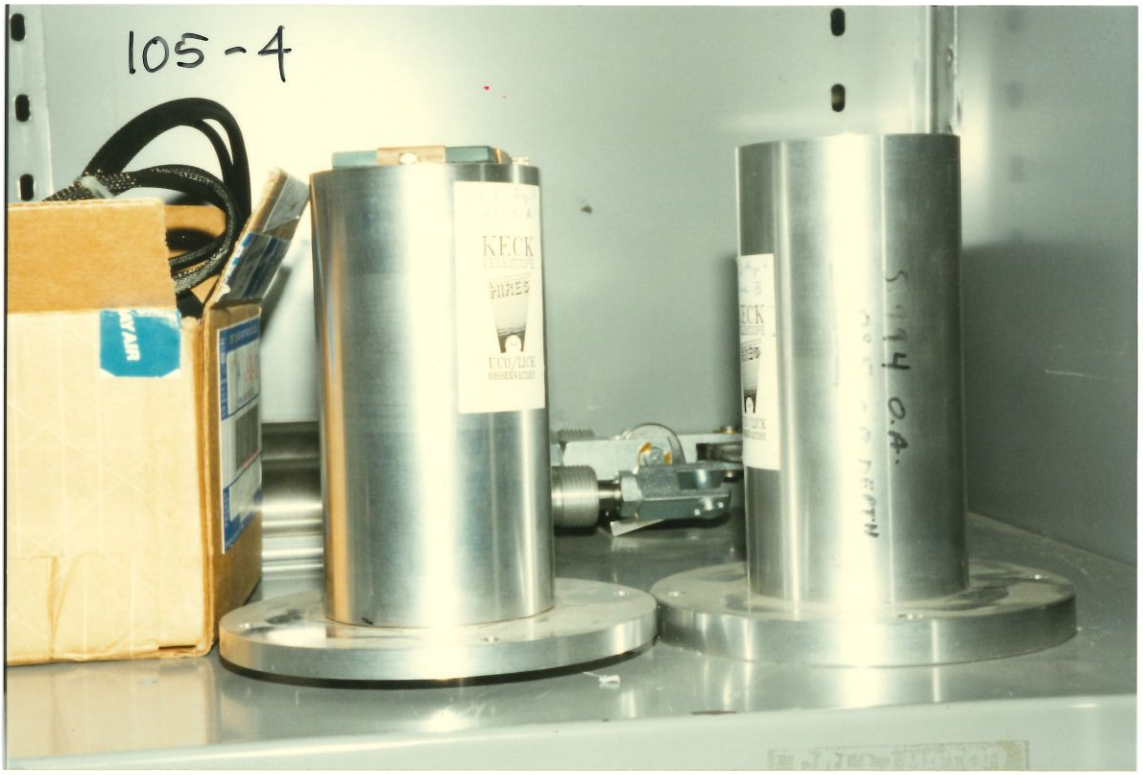
10. A good view of the right side support, flex link, bronze screw and Dewar Frame push pad, micrometer screw, but no scissors drive bracket.

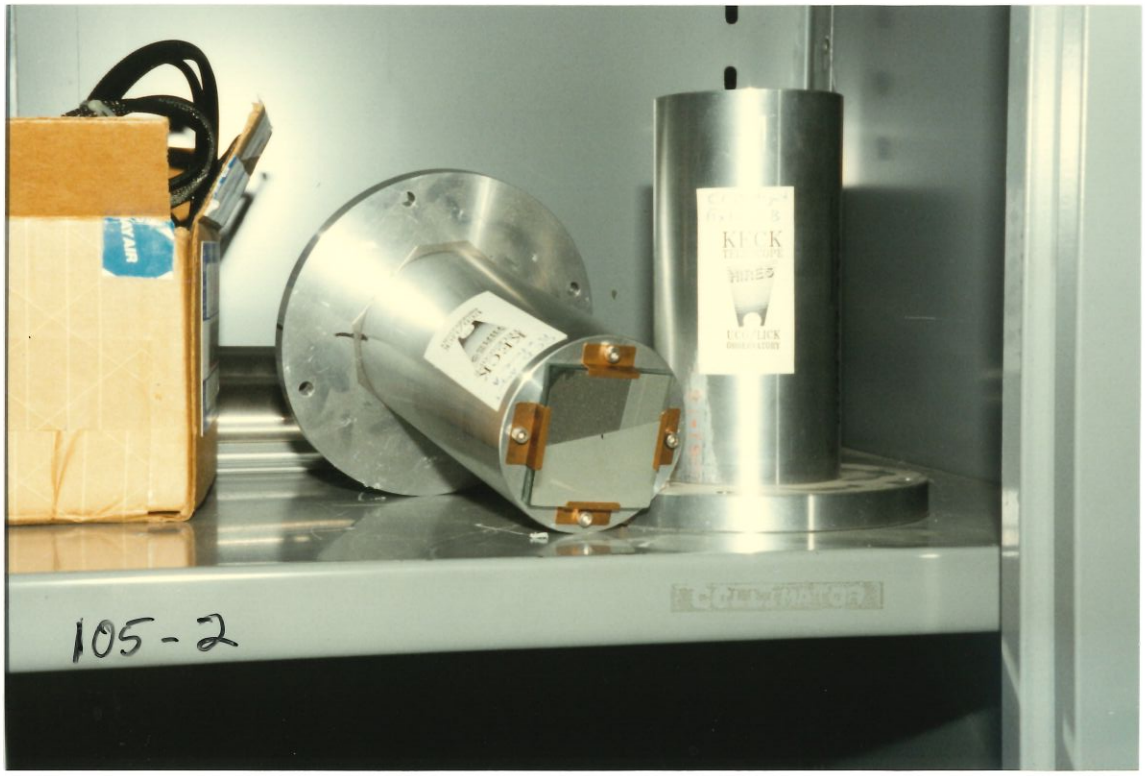


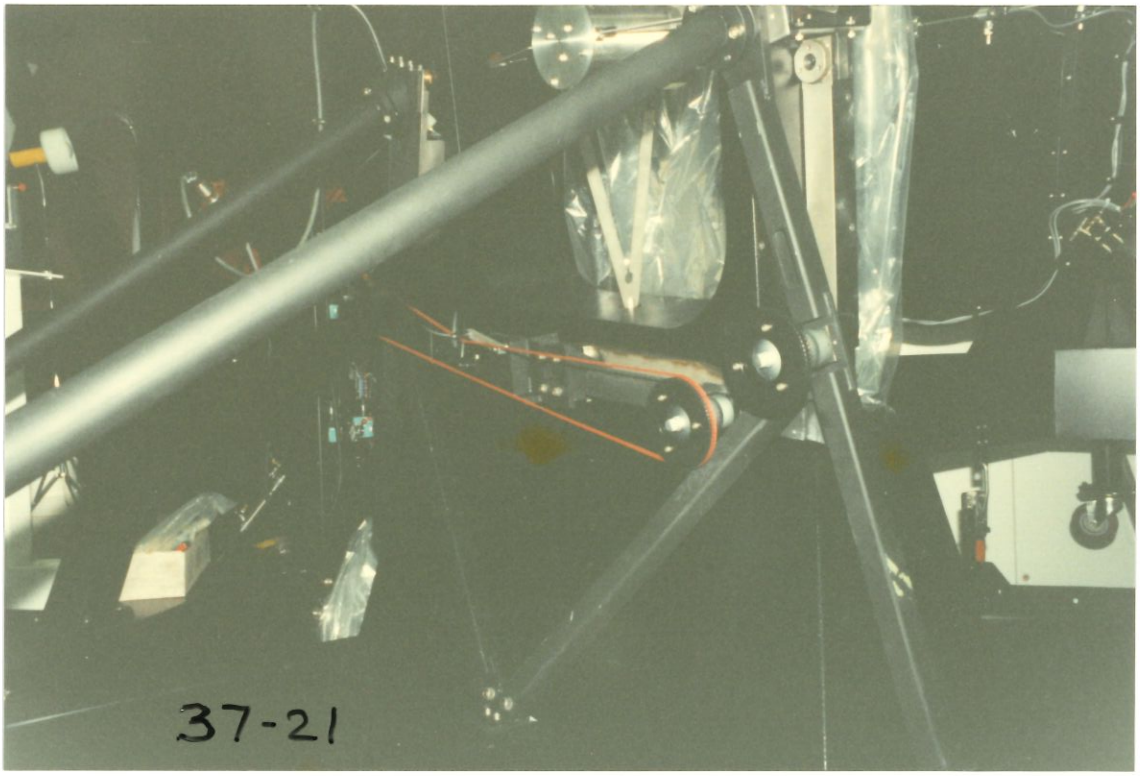
Note the flat alignment mirror mounted on the rear of the dewar body (36-19)

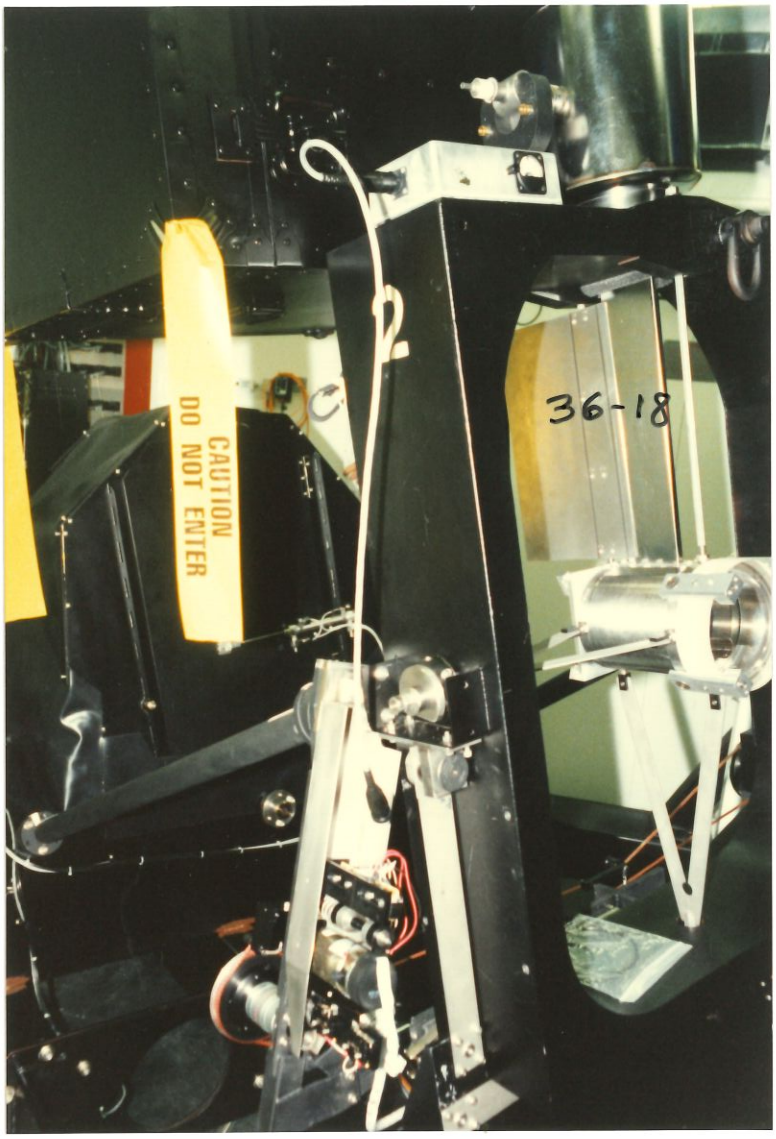


Alignment tooling to present mirrors at either end of the dewar. Also, to locate the CCD height. (105-2, -4)



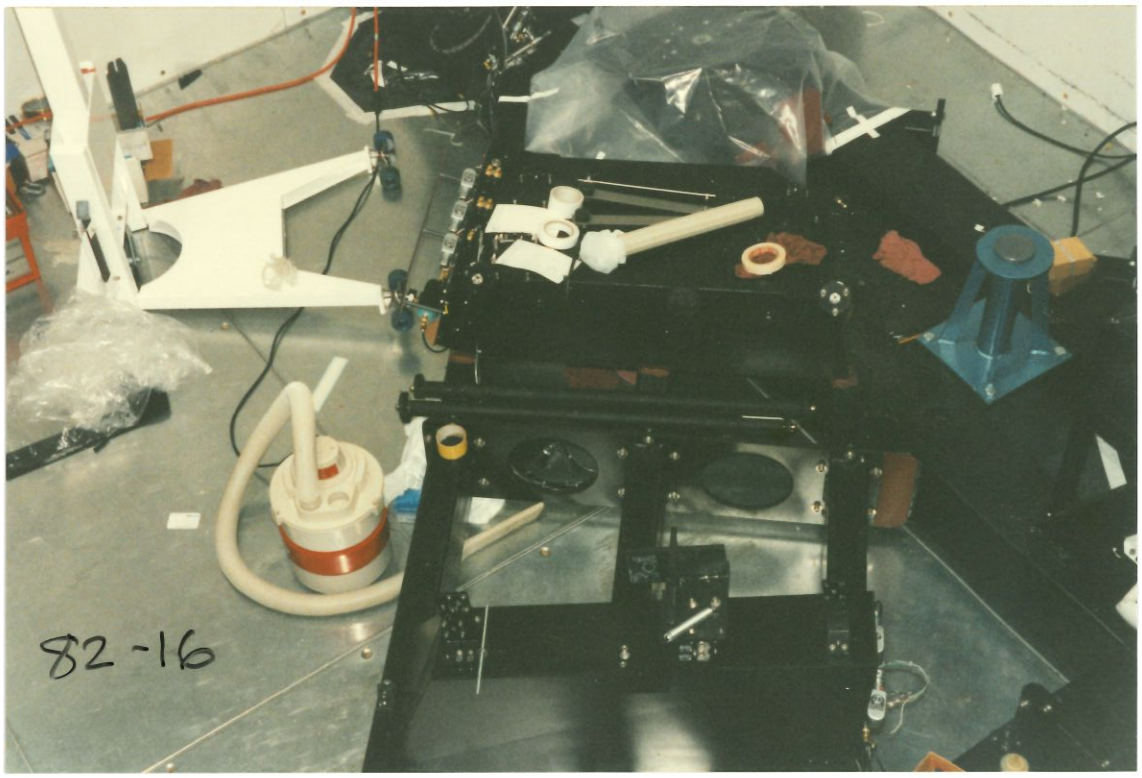



37-21

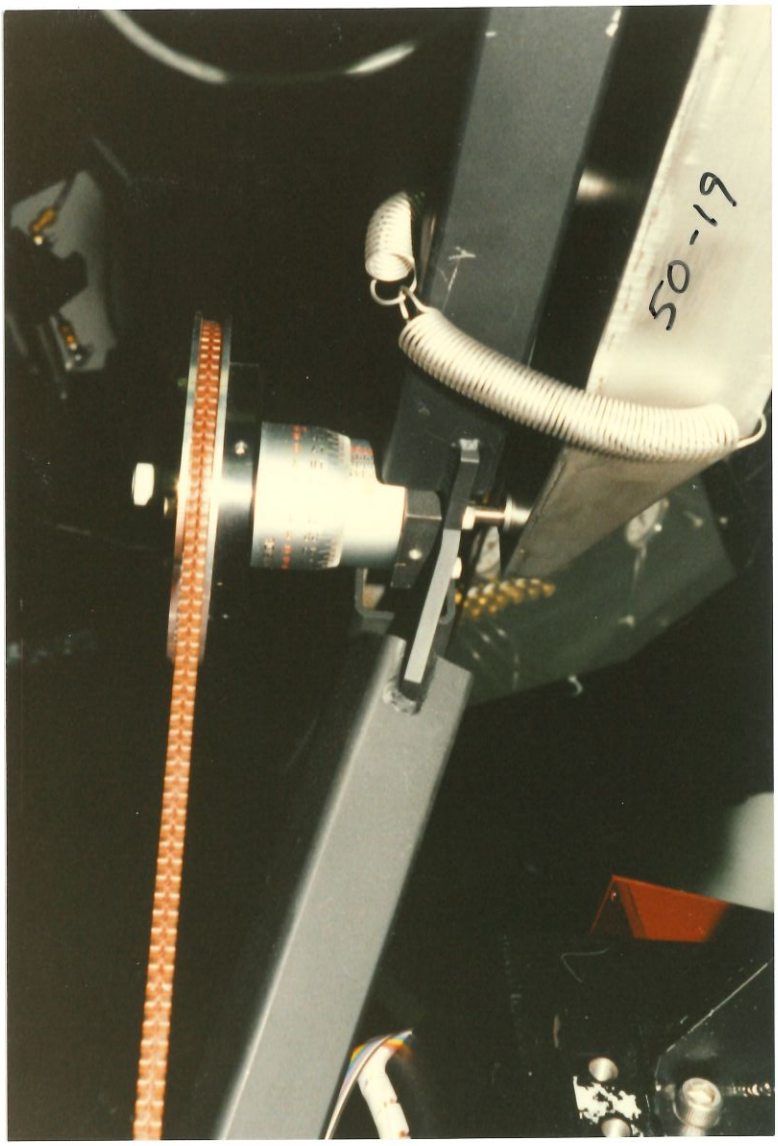

CAUTION
DO NOT ENTER
36-18

Dis-Assembly and Pin

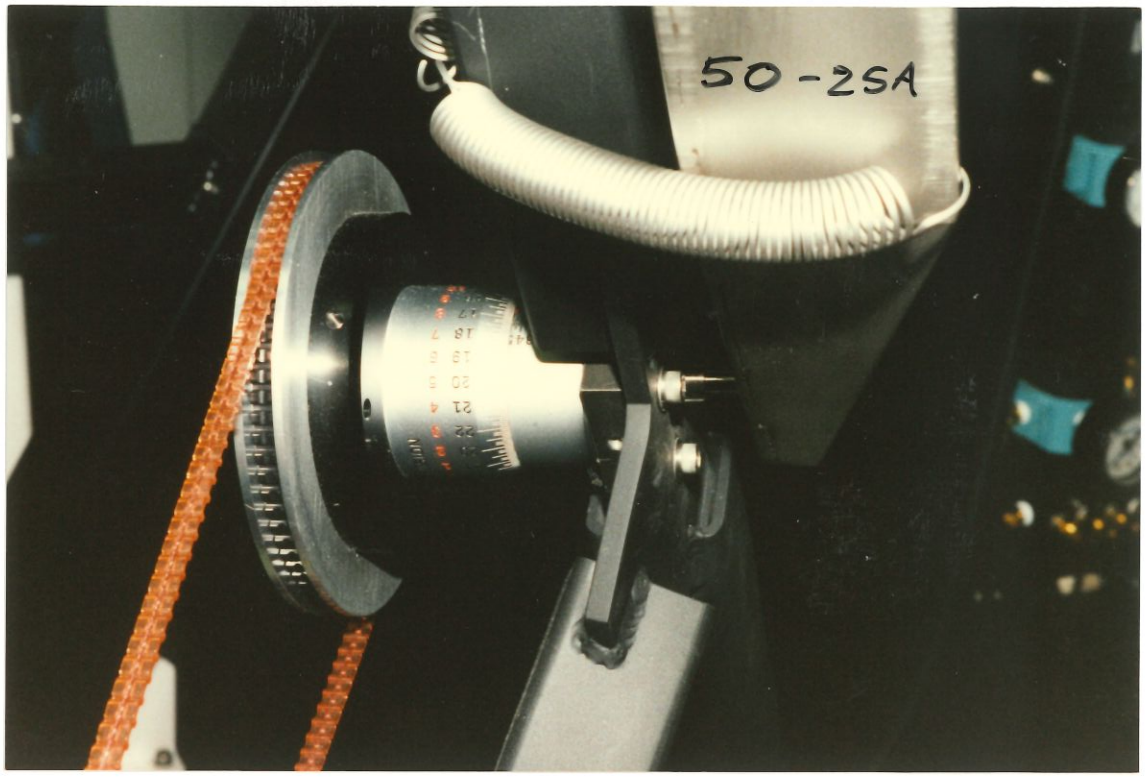
11. Aerial view during dis-assembly for pack and ship to Hawaii. (April of 1993)



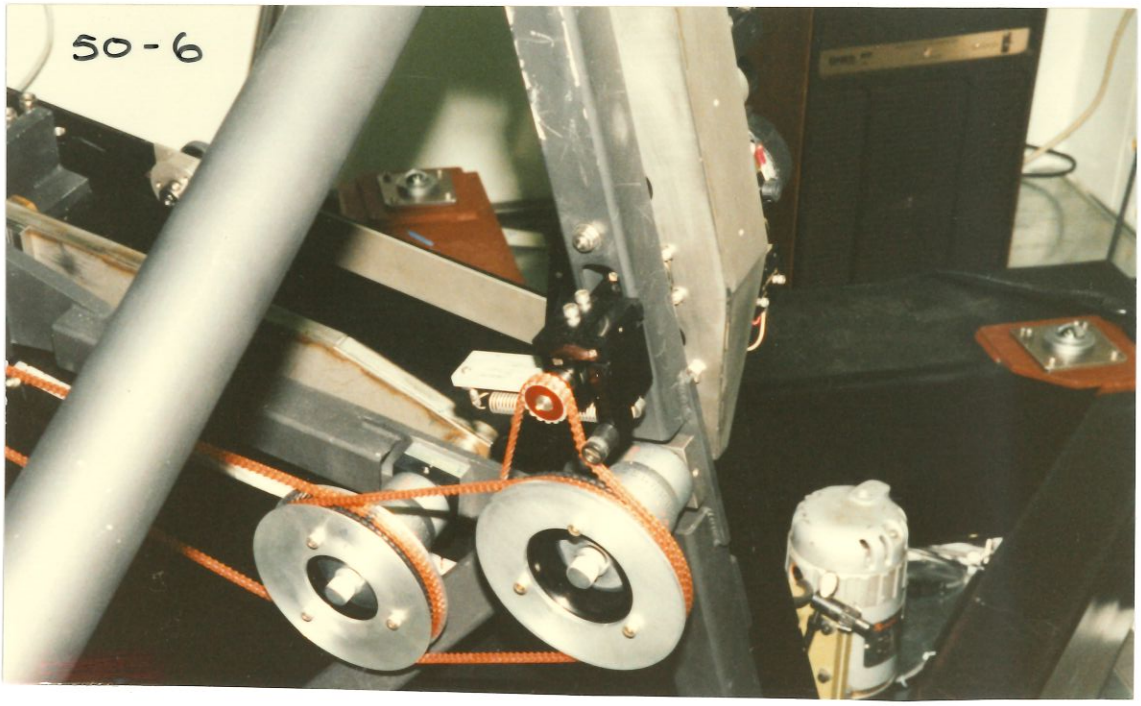
The special dewar lifter is in the upper left. It is white with skateboard wheels to fit under the main frame. It uses a manual hoist with web belt. (82-16)



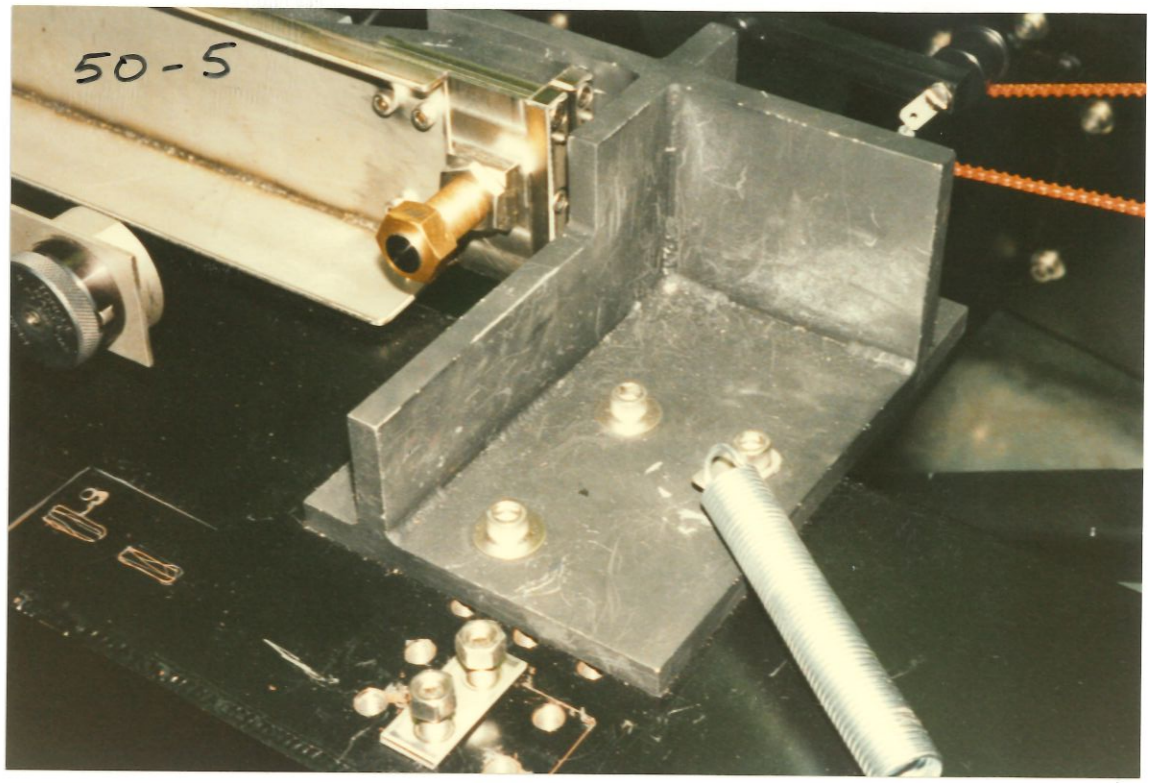
12. This photo shows the left micrometer drive screw and the red timing belt. The coil spring serves to keep the scissors drive plate in contact with the drive screw face.



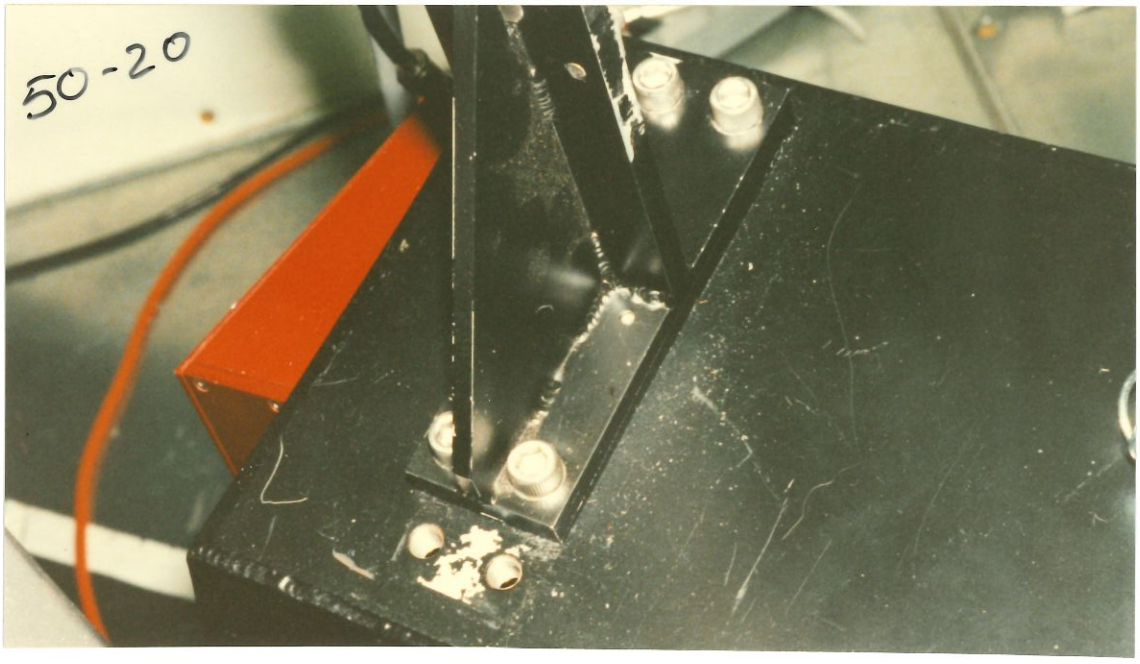
13. A view of the left drive screw. This screw moves +/-0.3 inches. By a 20:1 reduction in the scissors linkage, the detector moves +/-.015 inches.



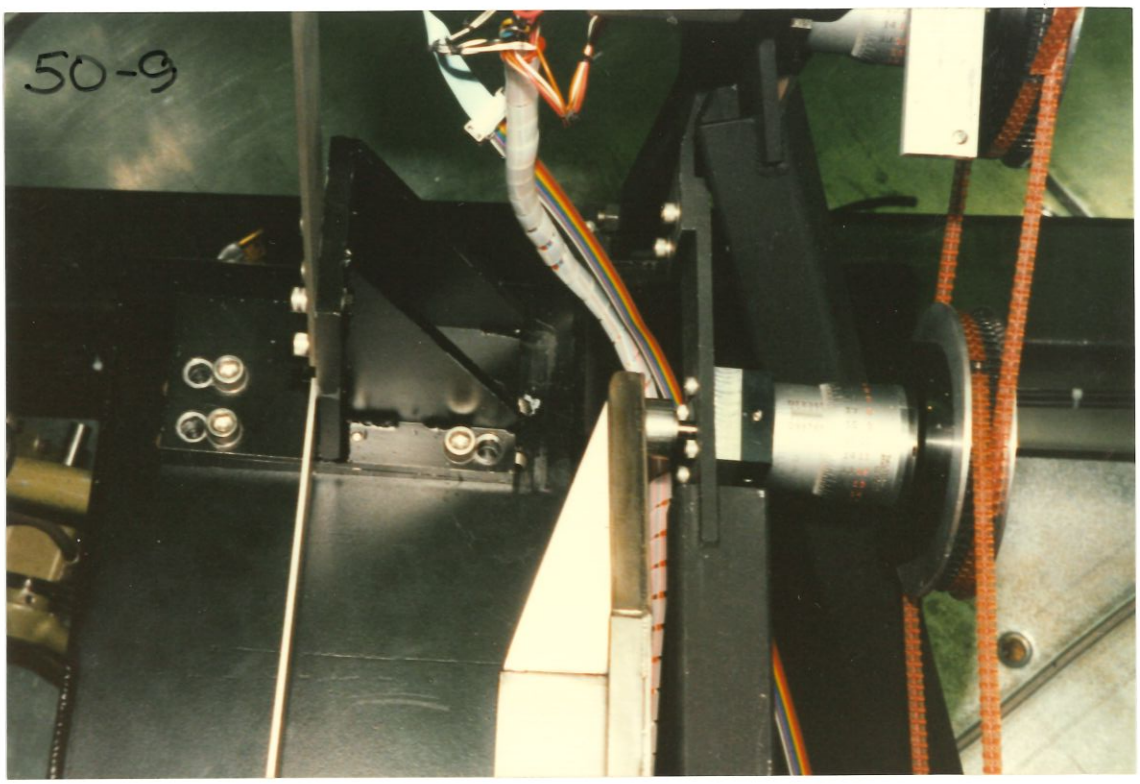
14. Right drive micrometer screw and center screw. Both end up on the right side. The motor pulley can be seen extending through the framework.



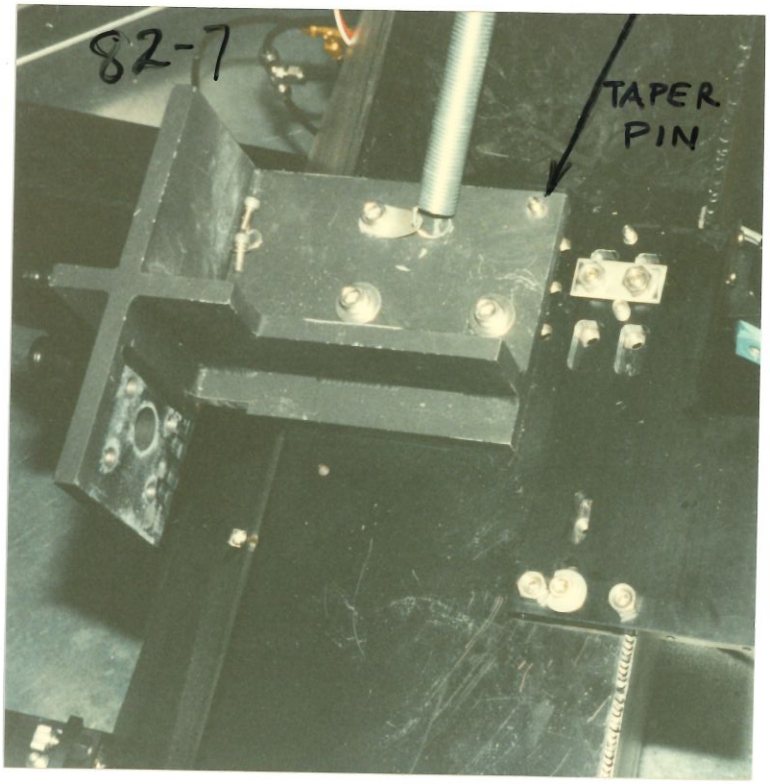
15. Middle support bracket. This view is looking back at the Corrector Lens Cells (not visible).

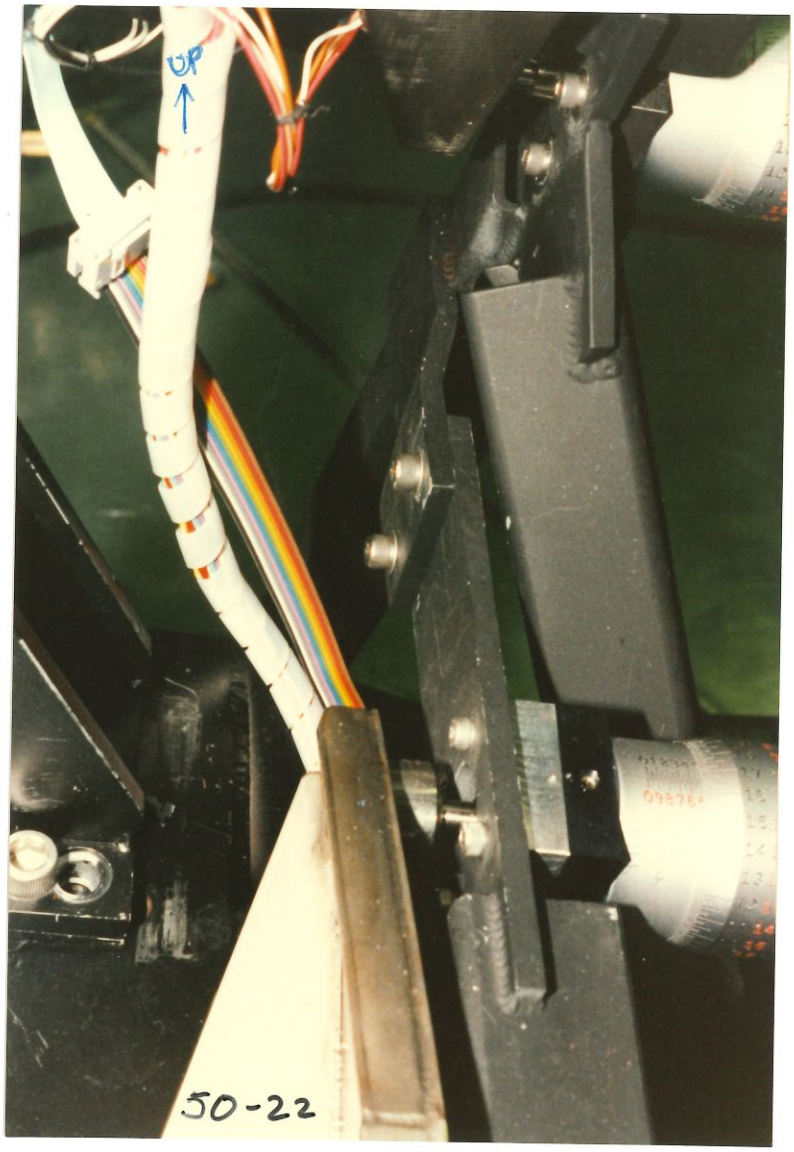


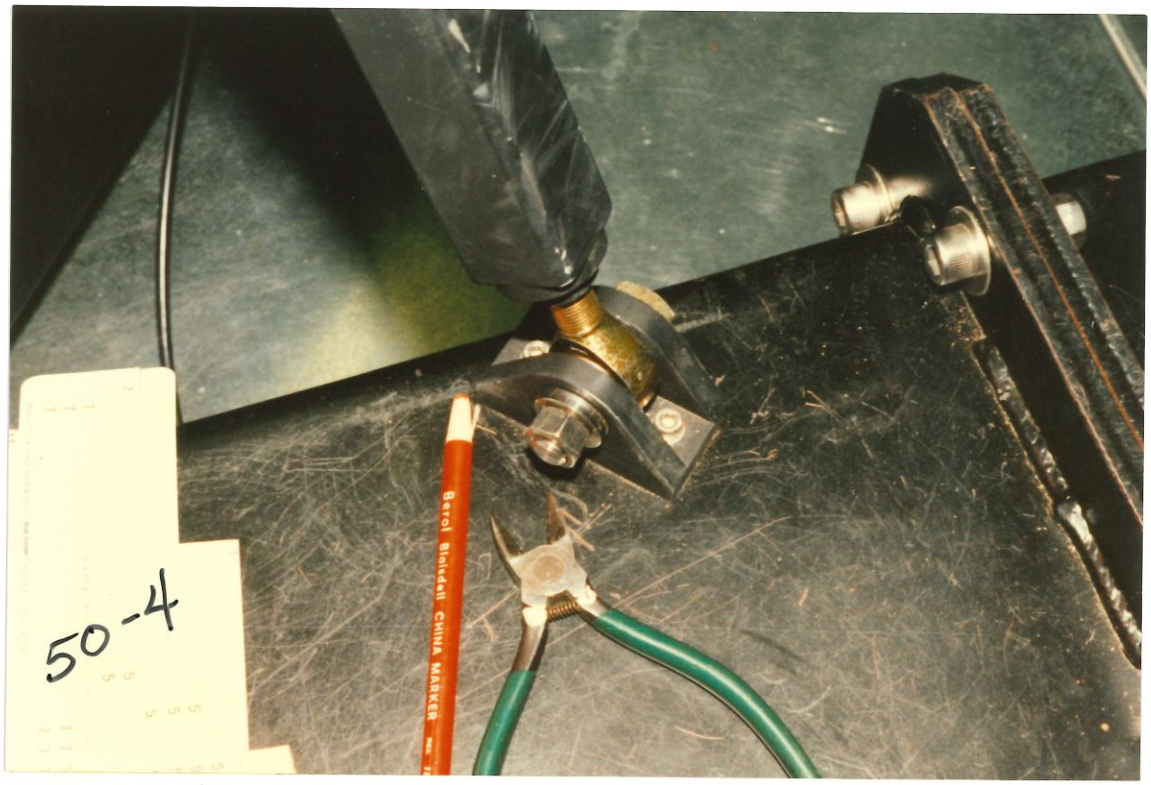
16. Left Bracket: Wedge plate is visible under bracket. Box weldment is 1/8" steel plate on 5 sides with 1/2" top surface that has tapped 3/8-24 holes in it.



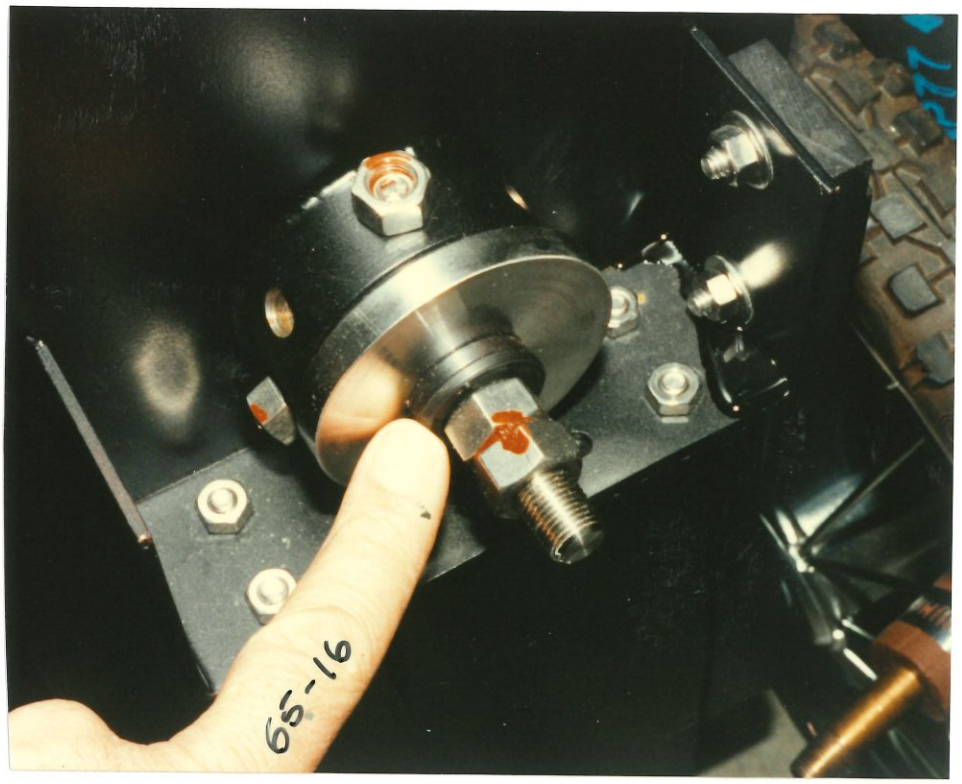
17. Right Bracket final location. Wedge plate here also. Compare this photo with "First Cut" photo under the "Strings and Levels" section.

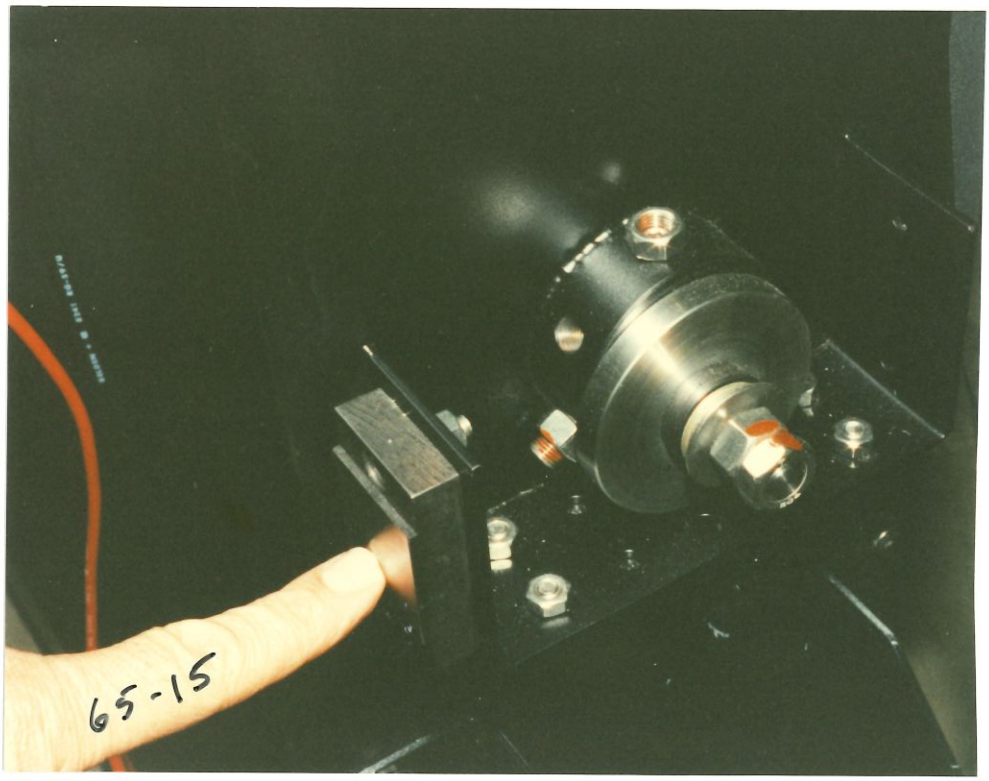

82-7
TAPER
PIN


UP
50-22

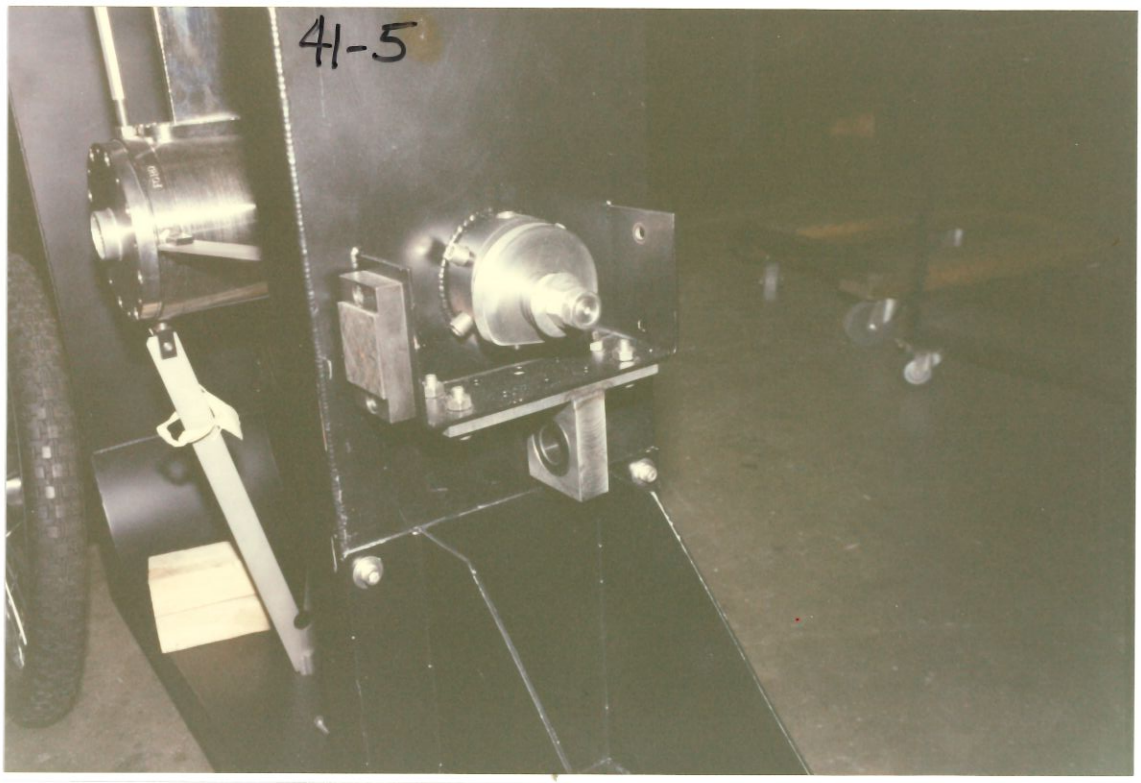


18. Left side lower brace mount. Rod end provides adjustment in half turn increments (0.025").



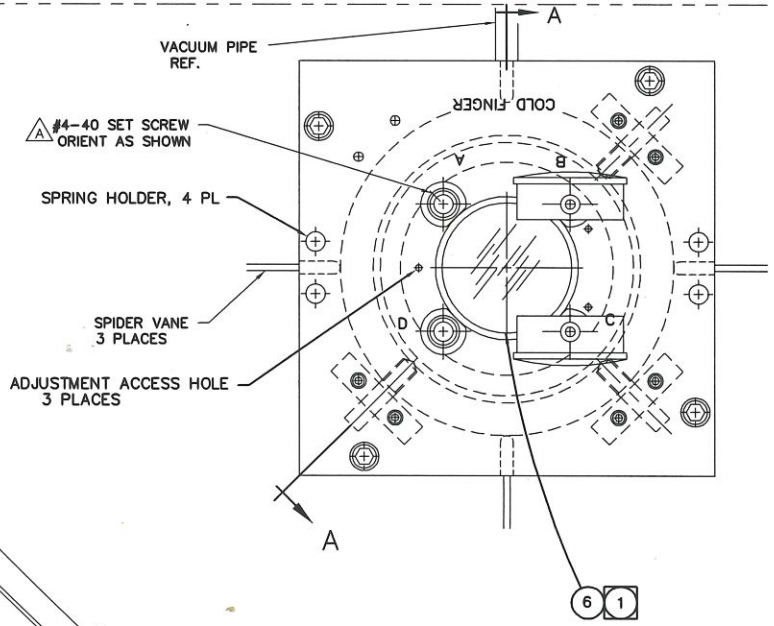


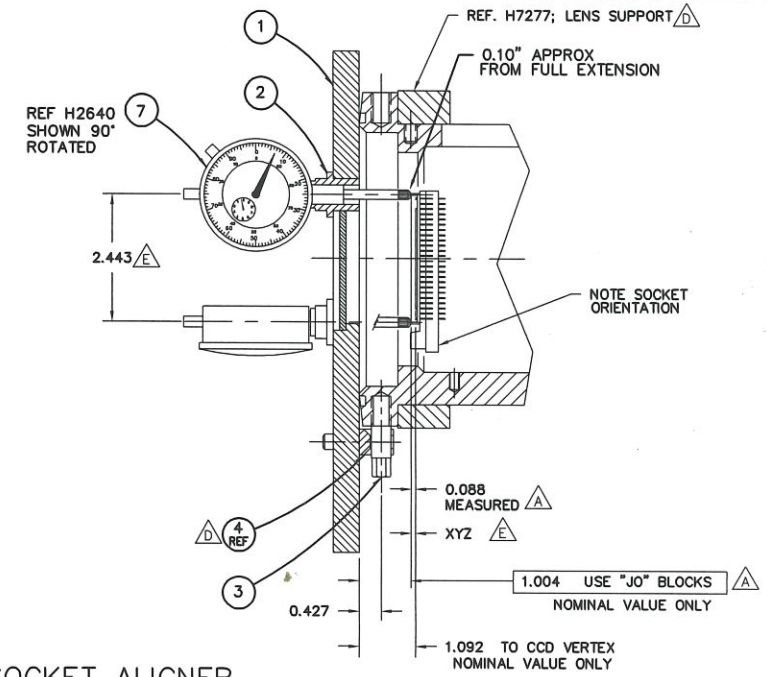
Alignment adjustments are preserved with red paint.



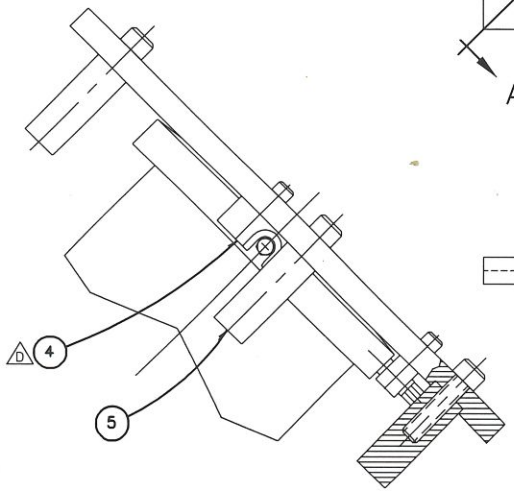
Hardened bushing detail. This is the Ford dewar. It is the second dewar intended for the mosaic of four (4) Ford CCD's, in case the Tektronix CCD was not available in time. It has been collimated and can be exchanged in Hawaii.

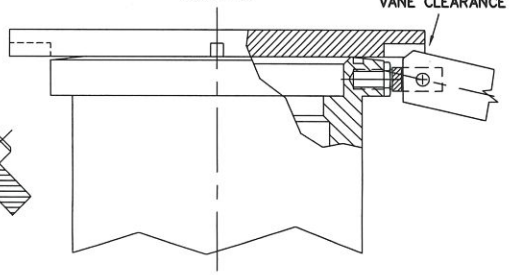
Move the CCD





SEC A-A





ONLY 2 DIAL INDICATORS SHOWN

0.00 1.00

(-1) SOCKET ALIGNER

1 REQ'D
ASSEMBLY

NOTES:

1. RTV WINDOW IN PLACE.
2. STORE IN SCHRY-WAY WOODEN CASE MD10 12X12X6
3. ENGINEERING GRADE DEVICE INSTALLED 12-2-92
   TEKTRONICS TK2048EB3-E
   806-7424-83
   SERIAL NO. 1428BR09-01
4. LRIS ENGINEERING GRADE DEVICE:

#2416	7	4	DIAL INDICATOR	MITUTOYO
–	6	1	WINDOW, 2.74# x 1/8 THK	
H7188-5	5	4	FOOT	ALUM
H7188-4	4	3	GUIDE BLOCK	ALUM
H7188-3	3	3	ALIGNMENT PIN	SST
H7188-2	2	4	BUSHING	BRASS
H7188-1	1	1	ALIGNMENT PLATE	ALUM

F	3 12 93	j.o.	CLOSE TO FINAL ADJUSTMENT OF CCD.
A	7 30 92	j.o.	UPDATE TO AS-BUILT CONDITION.
B	12 1 92	j.o.	ADD CASE INFORMATION.
C	12 2 92	j.o.	ALIGN NEW CHIP.
D	1 22 93	j.o.	CUT OFF GUIDE BLOCKS TO CLEAR LENS SUPPORT HARDWARE.
E	3 3 93	j.o.	DOC'T 3RD MOVE. PREP FOR NEXT CCD

FULL

KECK/HIRES
CCD ROUGH ALIGNER ASSEMBLY

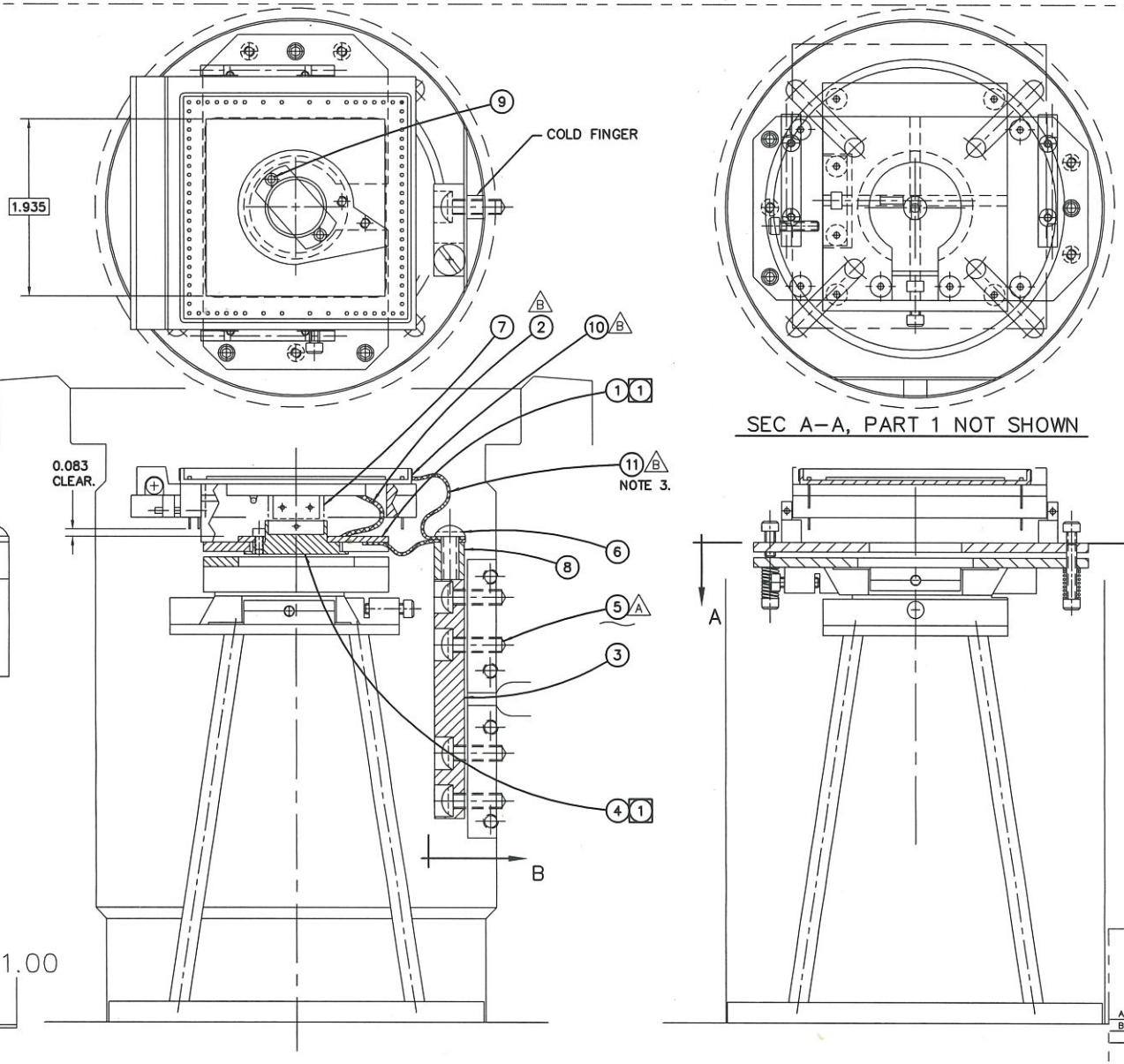
j.o. 7 1 92
CAD. 7/7/92
j.o. 7 8 92

H7187.F

CORNER READINGS

	FIRST IMAGING CHIP		SECOND IMAGING CHIP		
CORNER	12-2-92	1-12-93 (D)	2-10-93 (E)	3-11-93 (F)	
"A"	1.0158 (C)	0.9788	1.0000 − 0.0169 = 0.9831	1.0000 − 0.0137 = 0.9863	
"B"	1.017 (C)	0.9800	1.0000 − 0.016 = 0.9840	1.0000 − 0.0137 = 0.9863	
"C"	1.0165 (C)	0.9795	1.0000 − 0.025 = 0.9750	1.0000 − 0.0440 = 0.9560	
"D"	1.0160 (C)	0.9790	1.0000 − 0.044 = 0.9560	1.0000 − 0.0830 = 0.9170	

INCHES



SEC A–A, PART 1 NOT SHOWN

VIEW B

0.00 1.00

INCHES

(-1) COOLING CONNECTIONS

NOTES:

1. ASSEMBLY SHOULD HAVE 0.02" VERTICAL CLNCE.
2. THIS CONFIGURATION IS FOR A TEKTRONICS CCD
3. SEE H7162 FOR COLD STRAP DETAIL.

B	H7164-1	10	1	TOP COOLING CLAMP	ASSY
	–	9	2	#2-56 AL HD SCR	ST.STL
	H7162-3	8	1	SPOOL	OFHC
	H7160-6	7	1	COIL SPRING	LEE
	x 1.00 LNG	6	1	VENTED SCREW, 10-32	BRASS
A	x 0.62 LNG	5	4	VENTED SCREW, 8-32	BRASS
	H7163-1	4	1	FLANGED AXLE	ALUM
	H7162-2	3	1	COLD FINGER ADAPTER	OFHC
	H7160-4	2	1	PAD ASSEMBLY	ASSY
B	H7162-1	1	1	COOLING PLATE	OFHC

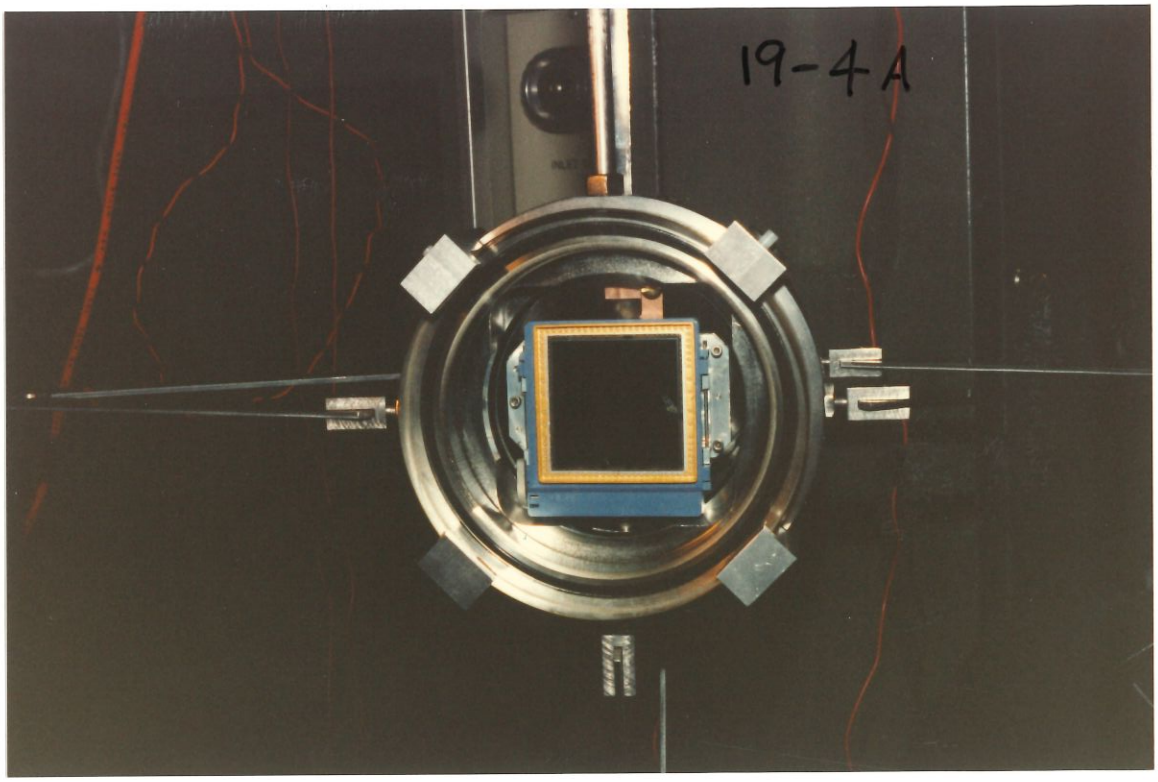
2:1

A	10 28 92	j.o.	PART -5: #8-32 WAS #10-32.
B	4 9 93	j.o.	MODIFY PART 1; ADD PART 10, NOTE 3
			NO 90° ALTERNATE POSITION.

KECK/HIRES
CCD COOLING
DETAIL

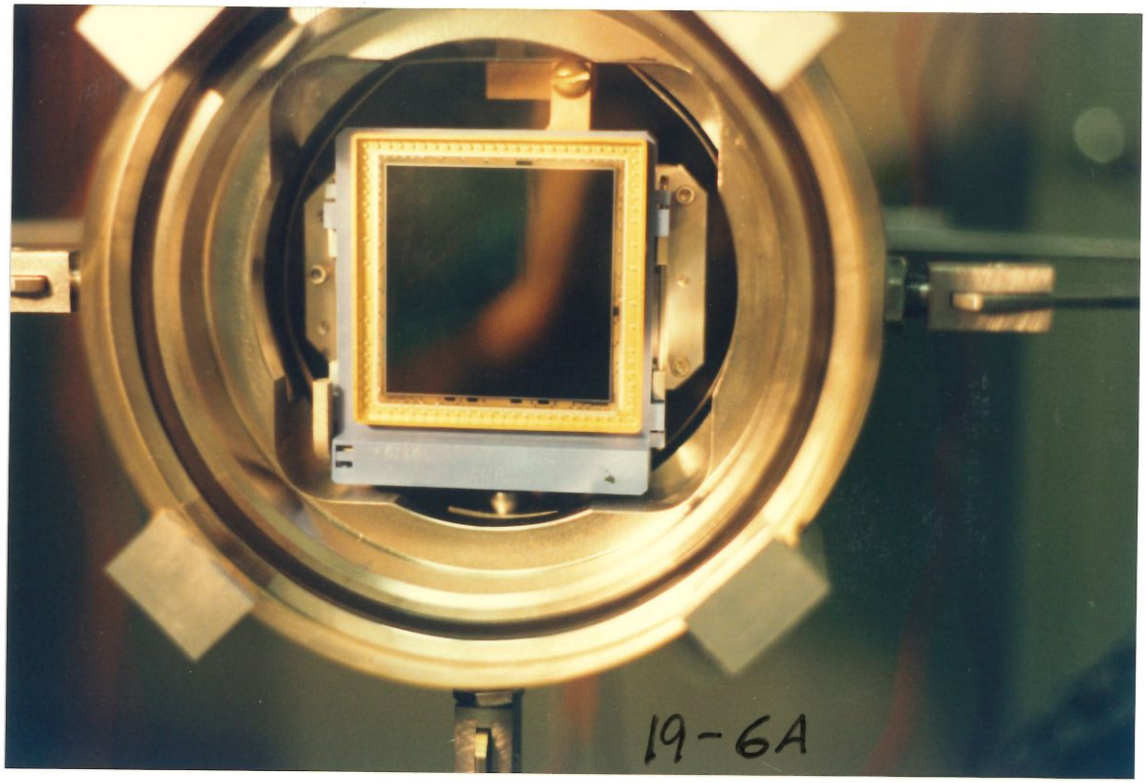
j.o. 7 27 92

H7161.B

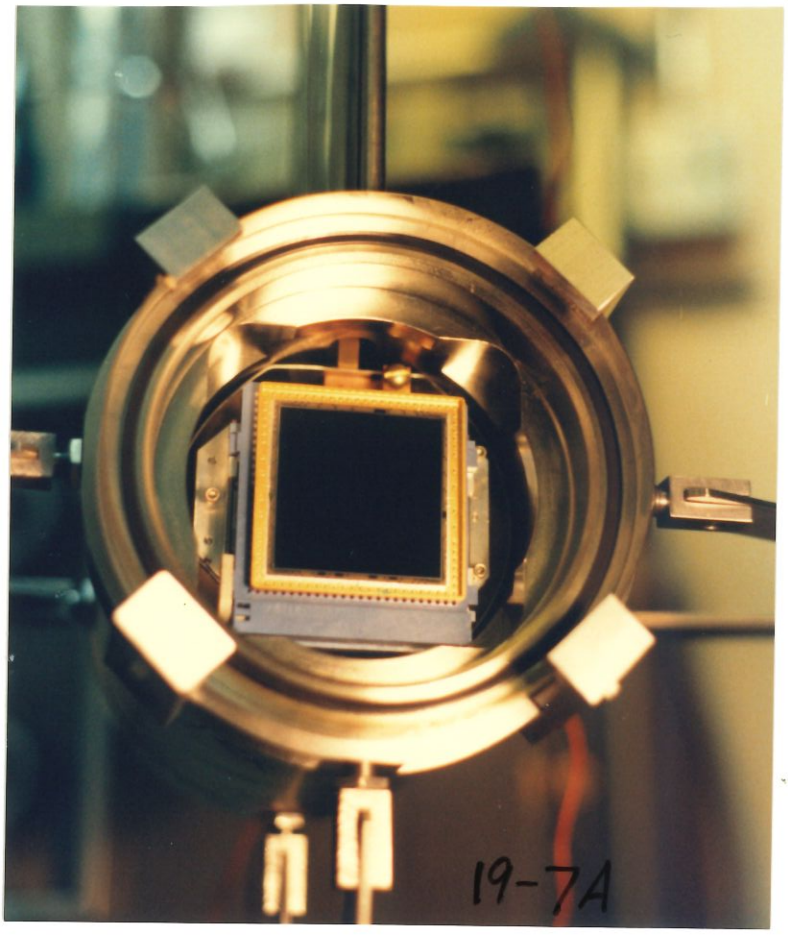


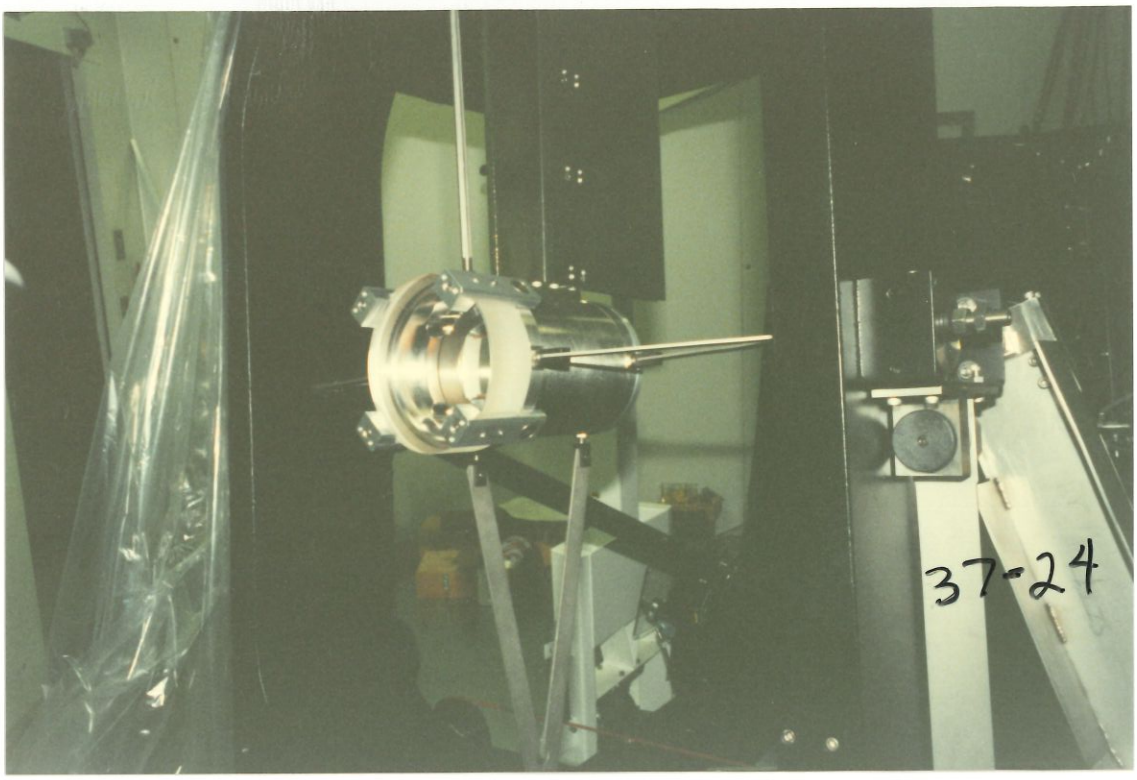
19. The three adjusting screws can be seen: #4-40 Allen head cap screws. These provide piston adjustment, relative to the field flattener dewar window and also two angular adjustments (tip and tilt). The cap screw can move 0.0005" for a tip or tilt of 42 arc-sec, which is 7 degrees of rotation with an allen wrench. The lateral adjustments were built but never used. The third angle is adjusted by rotating the spider assembly at its base. (Not visible in this photo) There is an eccentric mounted in a slot in the lower spider flange. +/-0.4 degrees.

20. Not photographed is the alignment tool. It has 4 dial indicators for making relative adjustments to the CCD while attached to the ZIF socket. These are warm adjustments with a naked detector and so very hazardous. Hence, no photos were allowed.

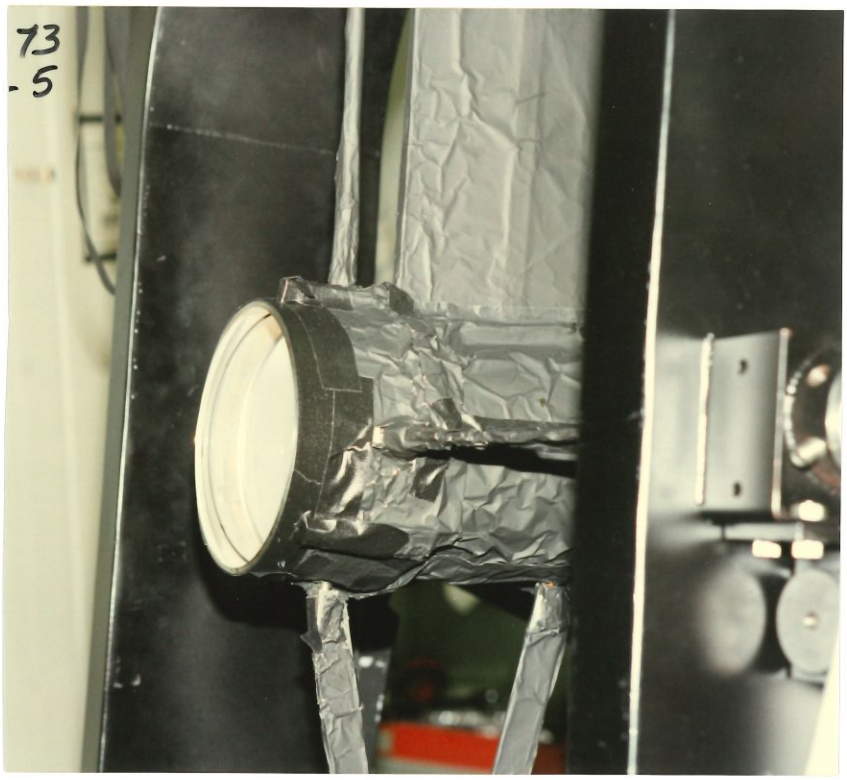


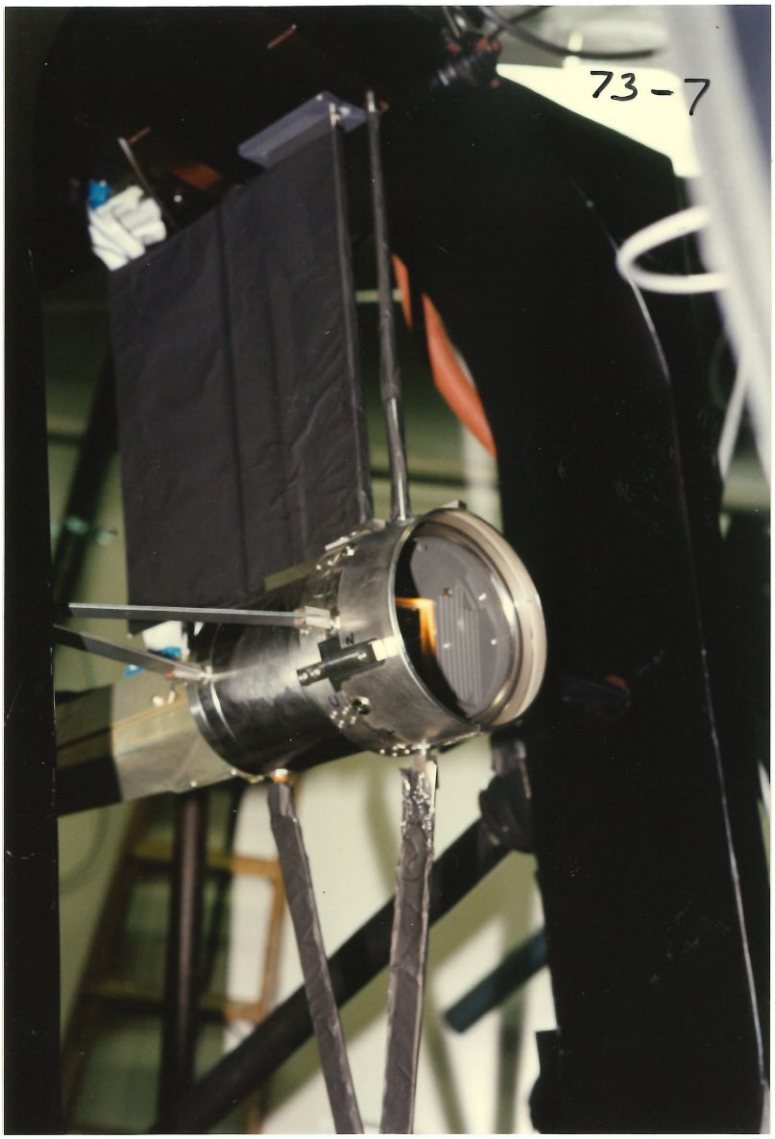
Tektronix 2048 x 2048 CCD with 24 micron pixels in a ZIF socket

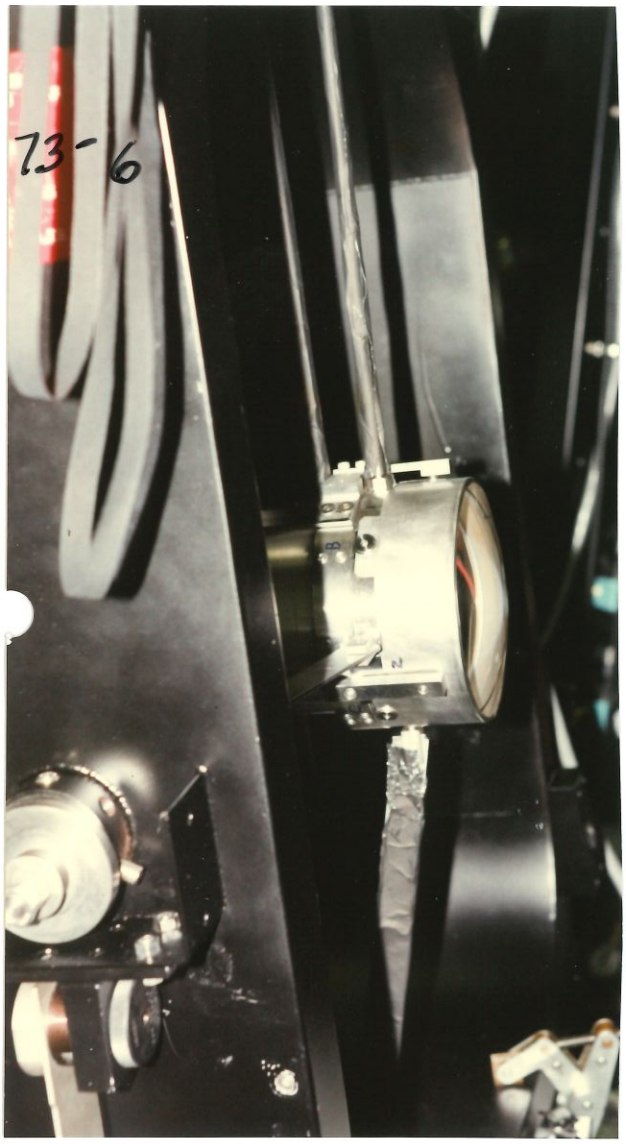


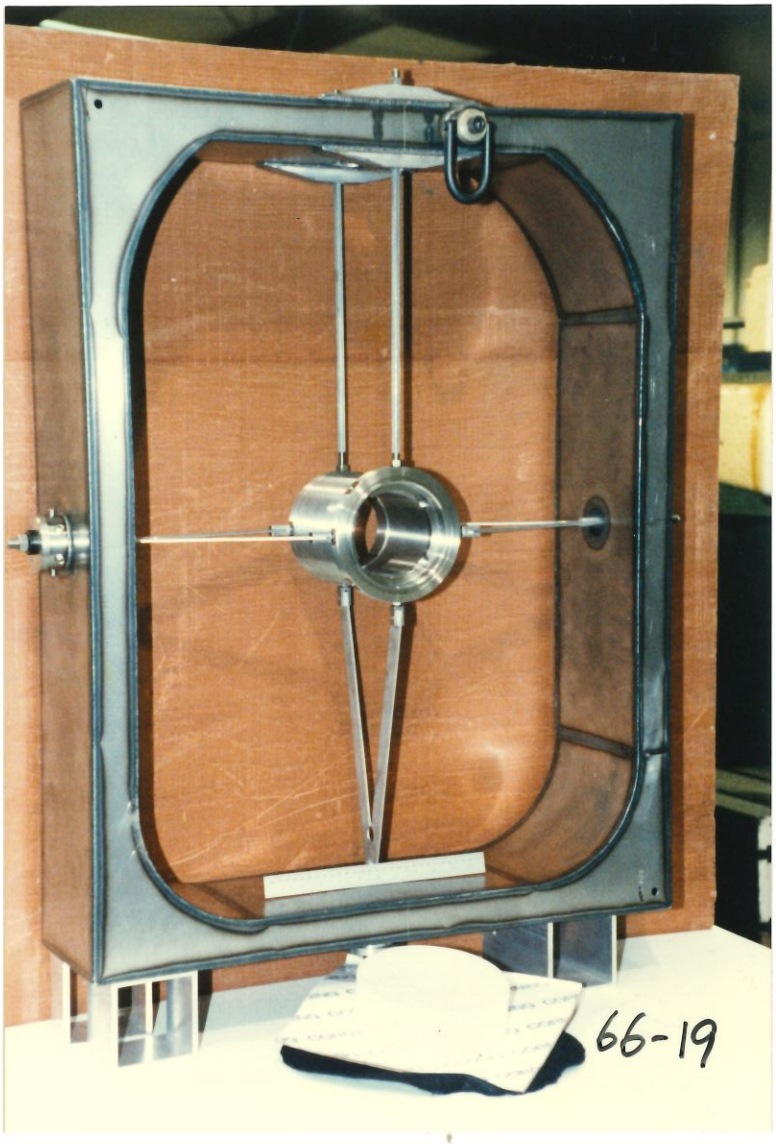


The dewar field flattener has four temporary holders/movers. These are removed after alignment and the vacuum holds the lens positioned. Then, small profile clamps are fitted to hold the lens in case the vacuum is gone. The assembly is blackened with black foil and black felt. (37-24) (73-6, -7) (73-5)

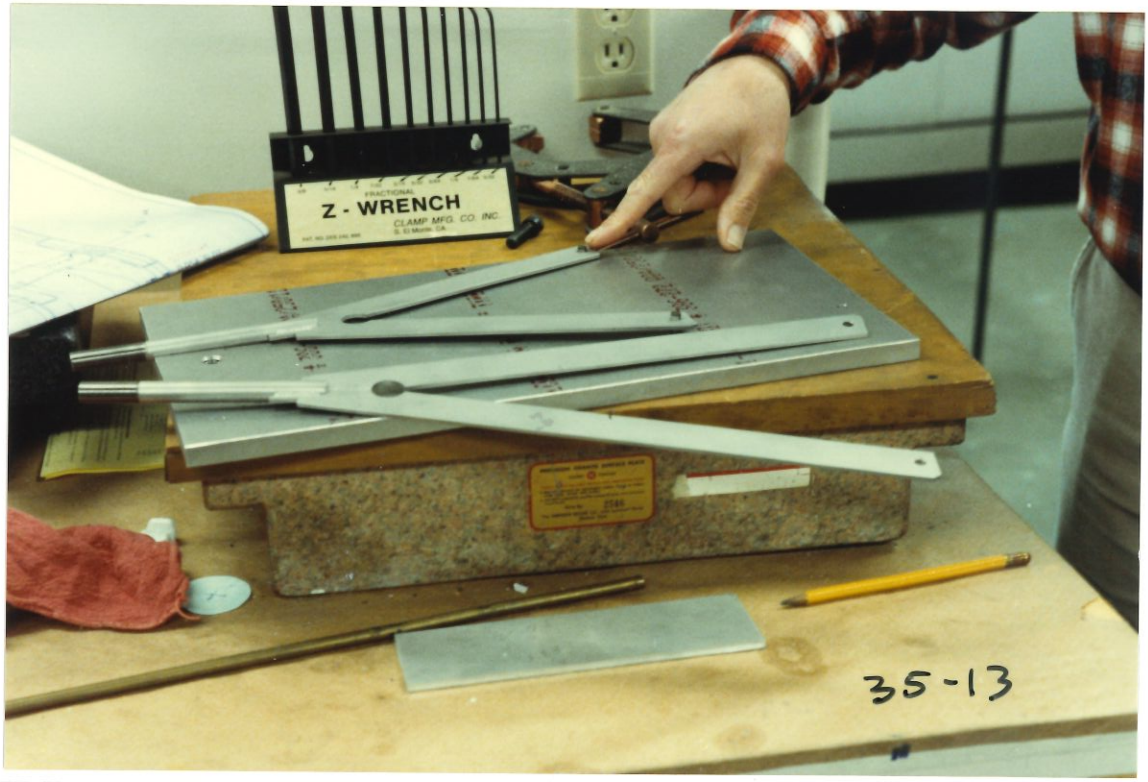



73-7

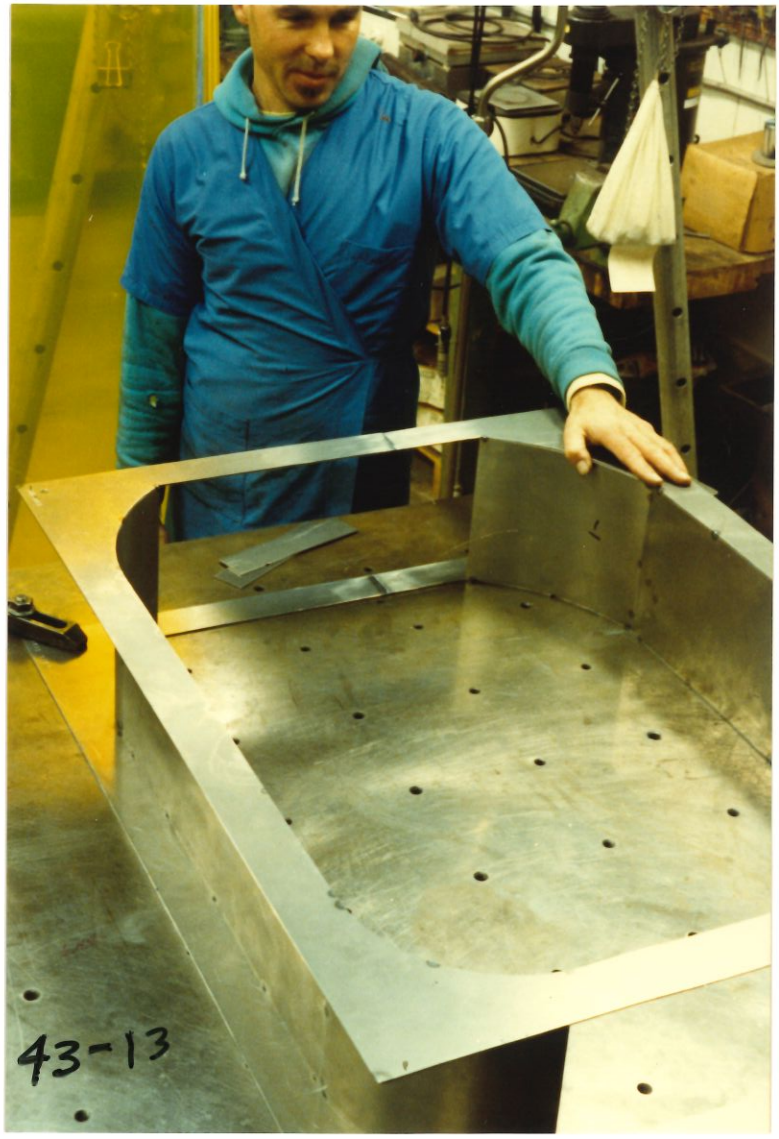

73-6


66-19

Spiders at initial installation and centering. (35-14)



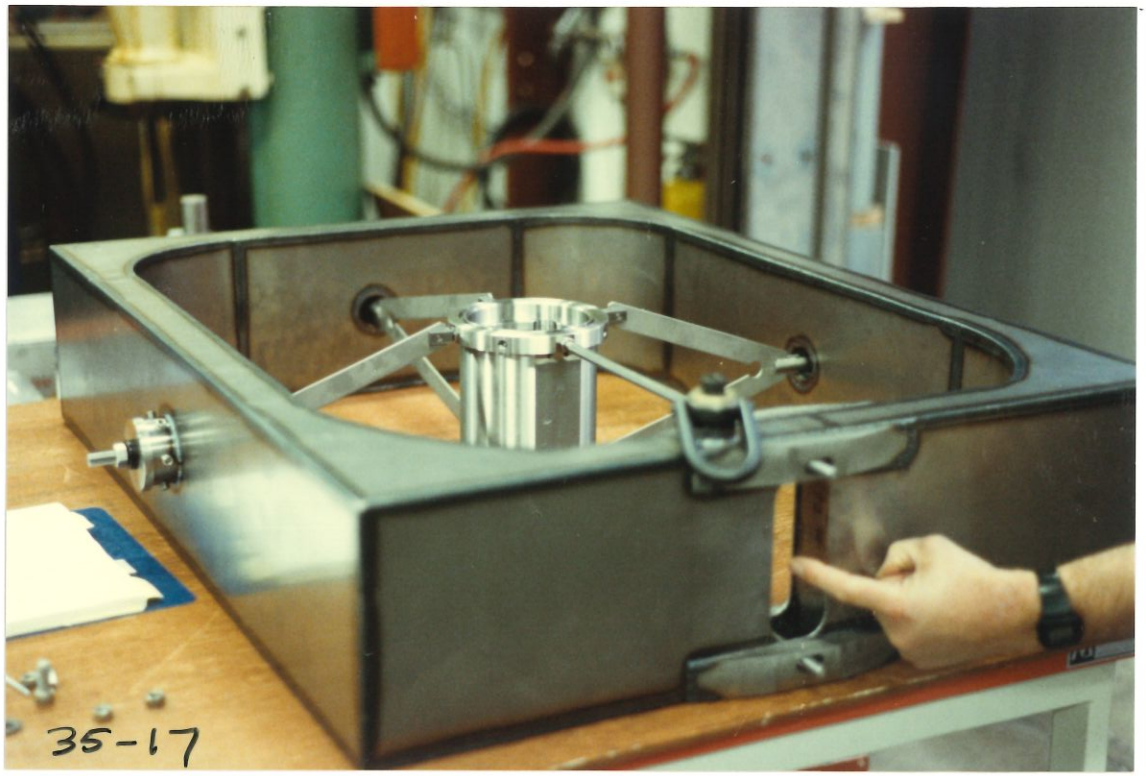
Spider welding fixture – 2 different lengths are used. (35-13)



Terry Pfister shown during tack-welding of the dewar frame (43-13).

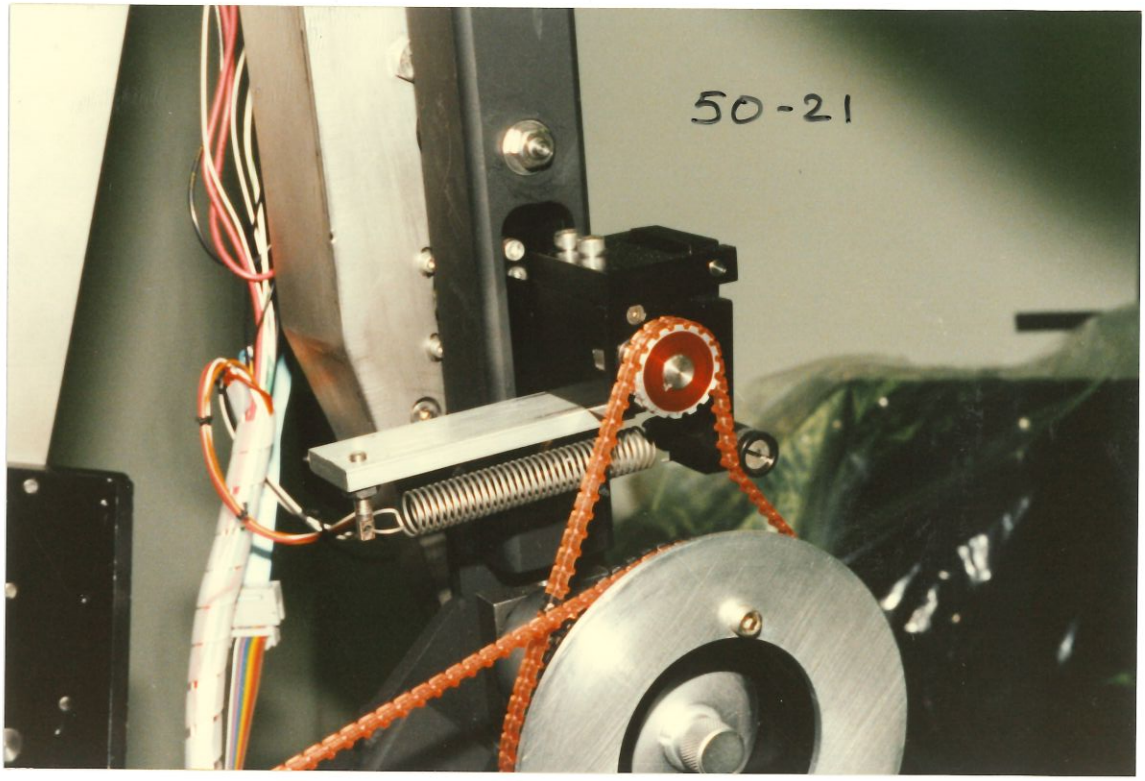
Welding

Dewar is intended to hang roughly at the installation angle. (35-18)

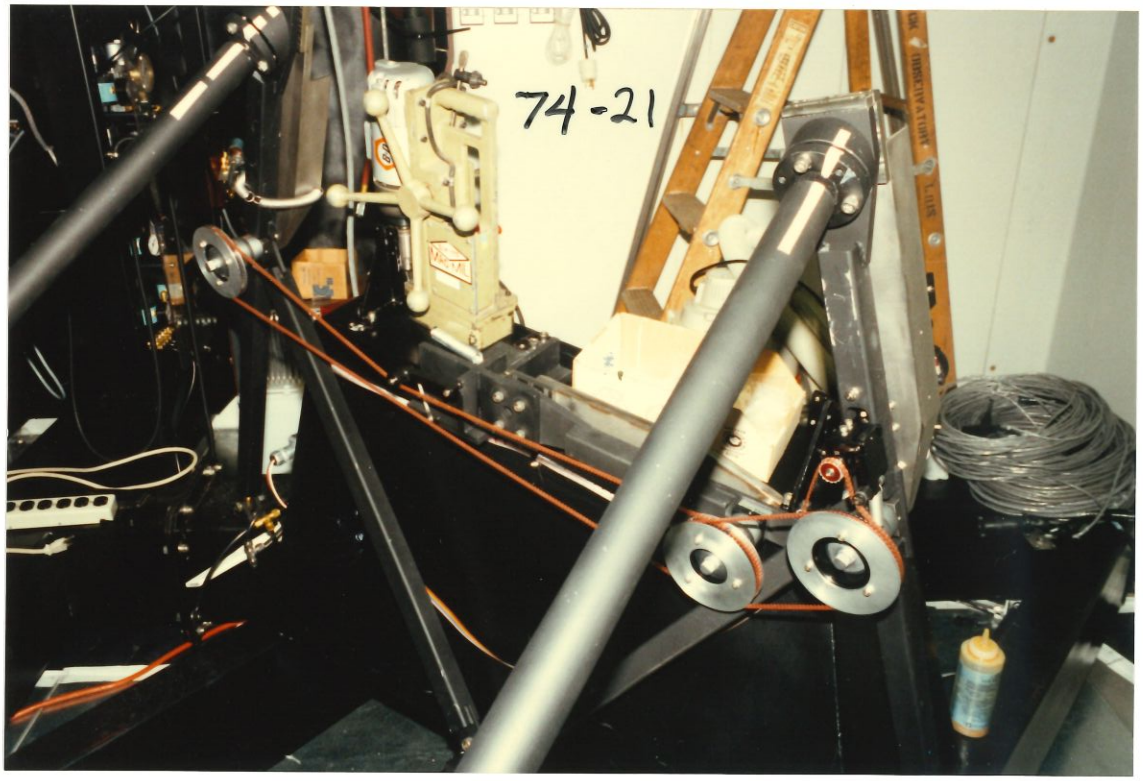


Liquid Nitrogen pipe goes thru this big slot. (35-17)

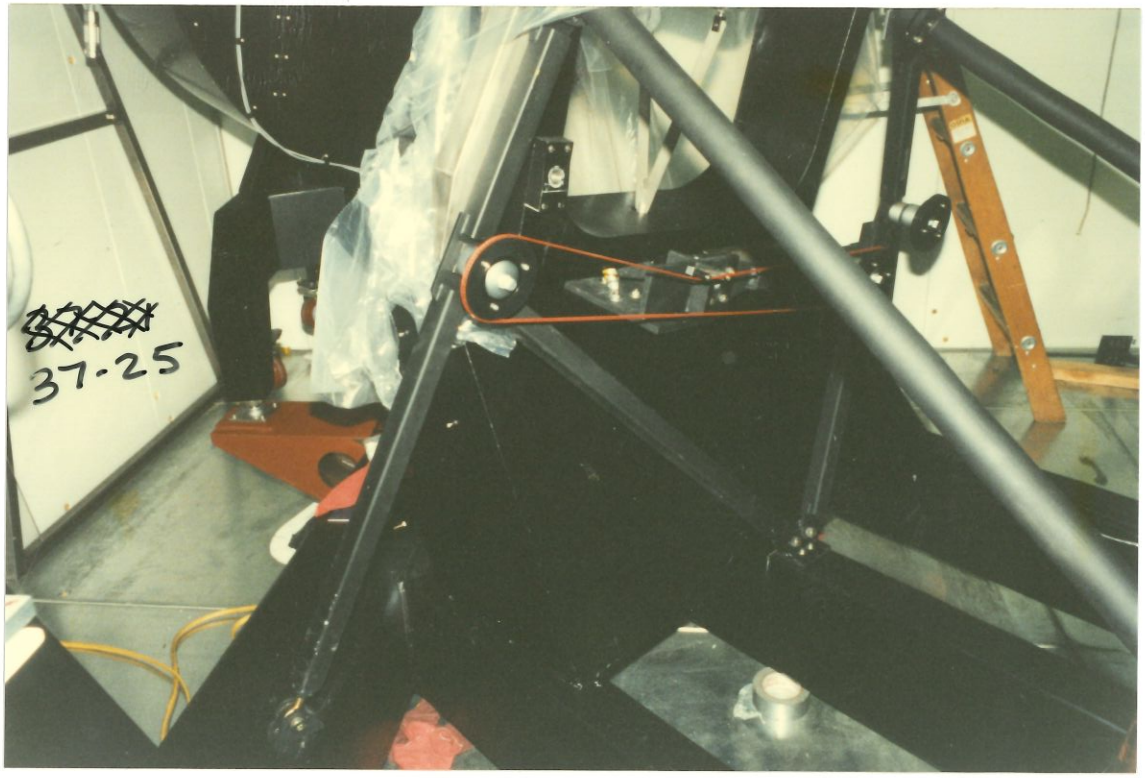
Focus Drive

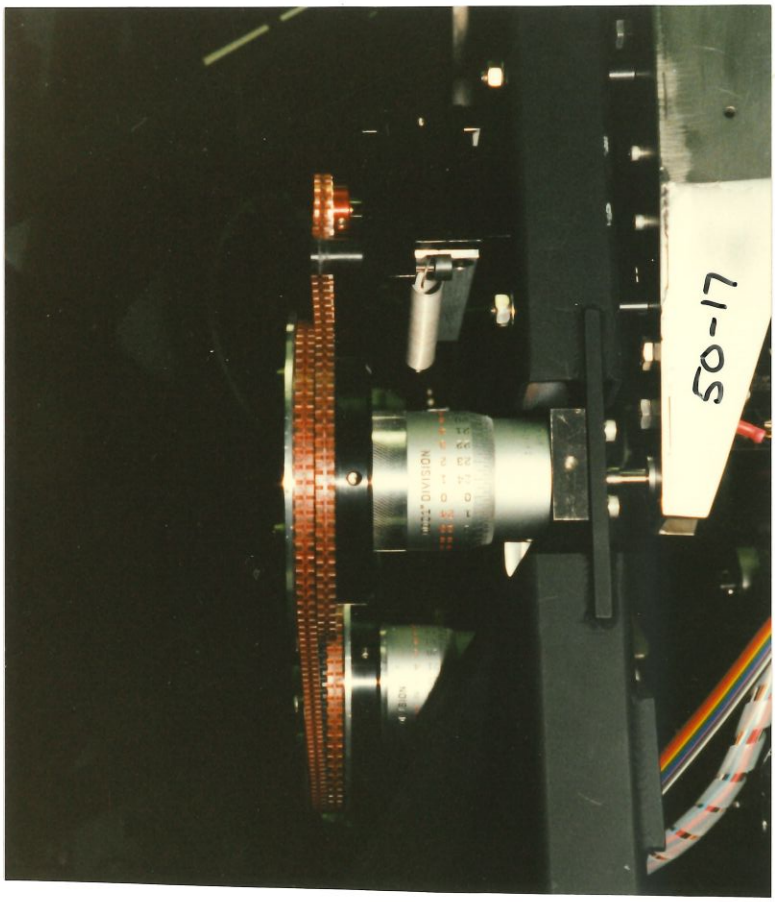


21. The right side drive pinion and belt tensioner.

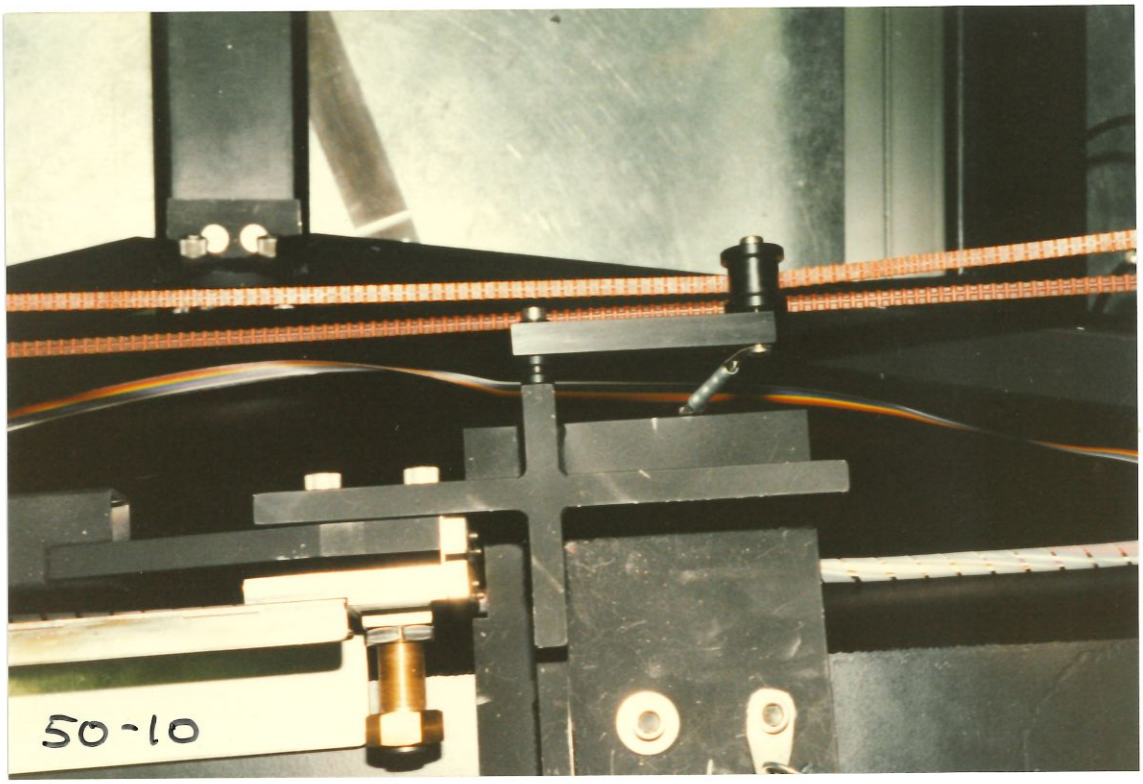


Mag-Mill used for pinning. (74-21)

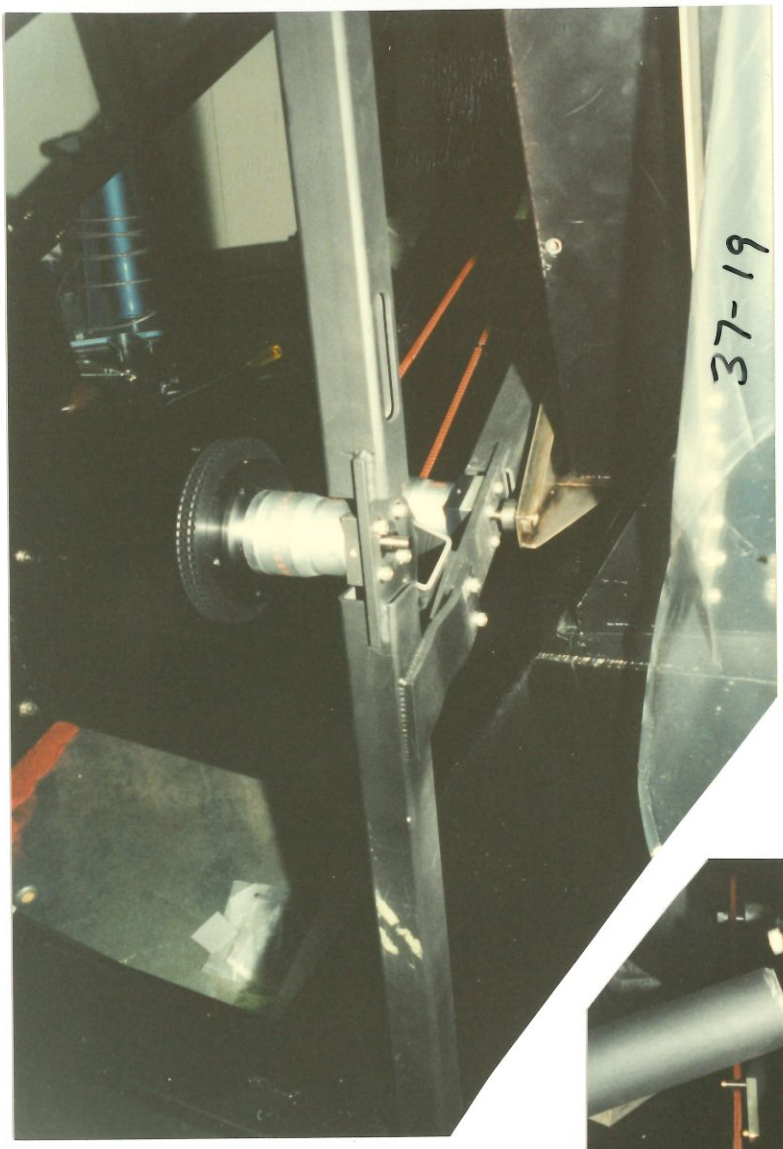


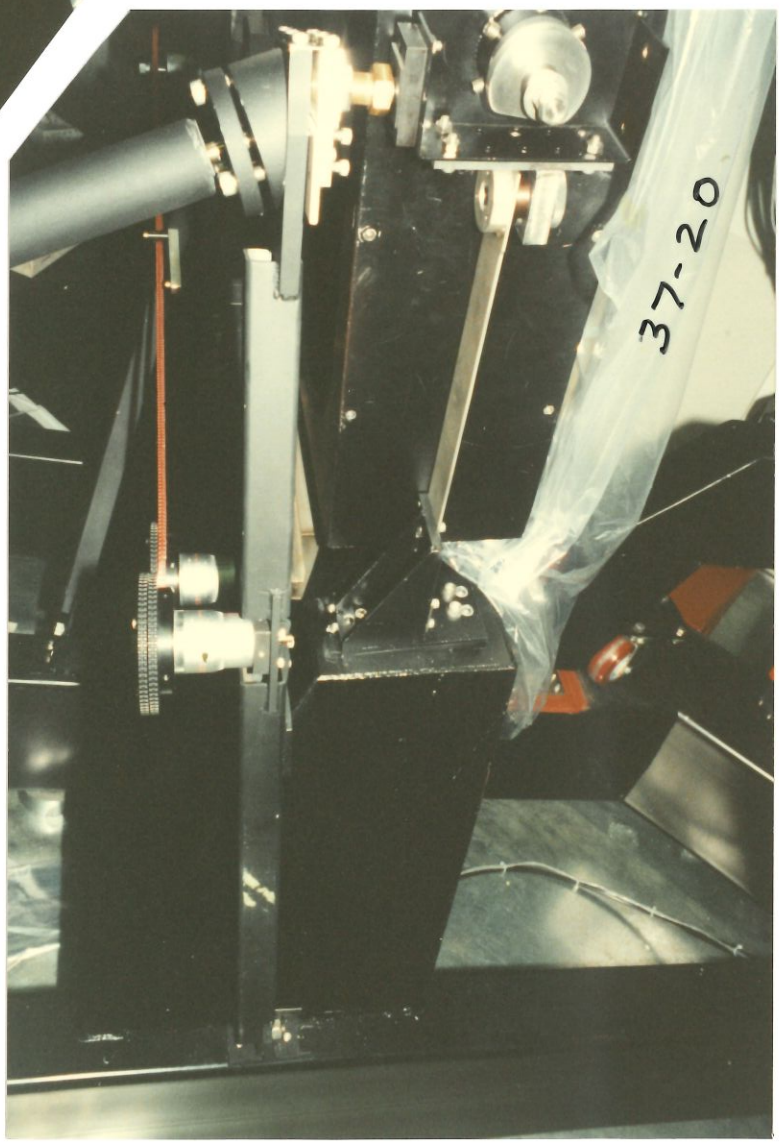


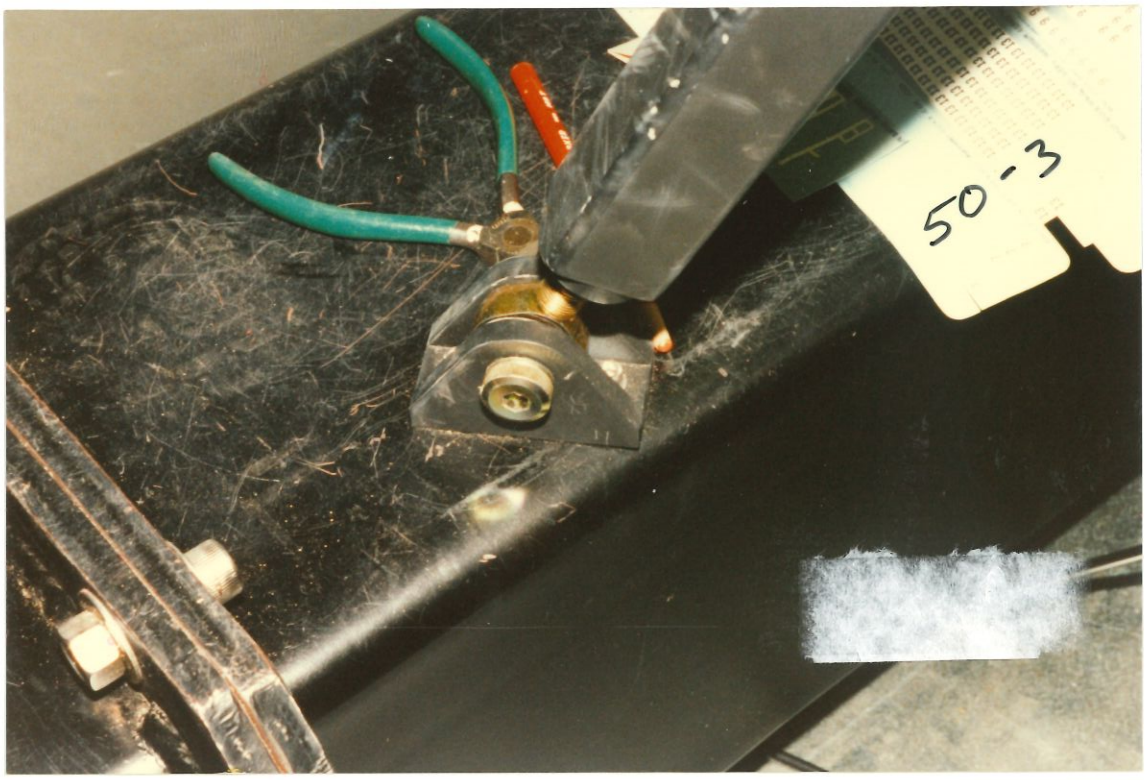
22. Right side view of the right side drive screw and dual belt system.



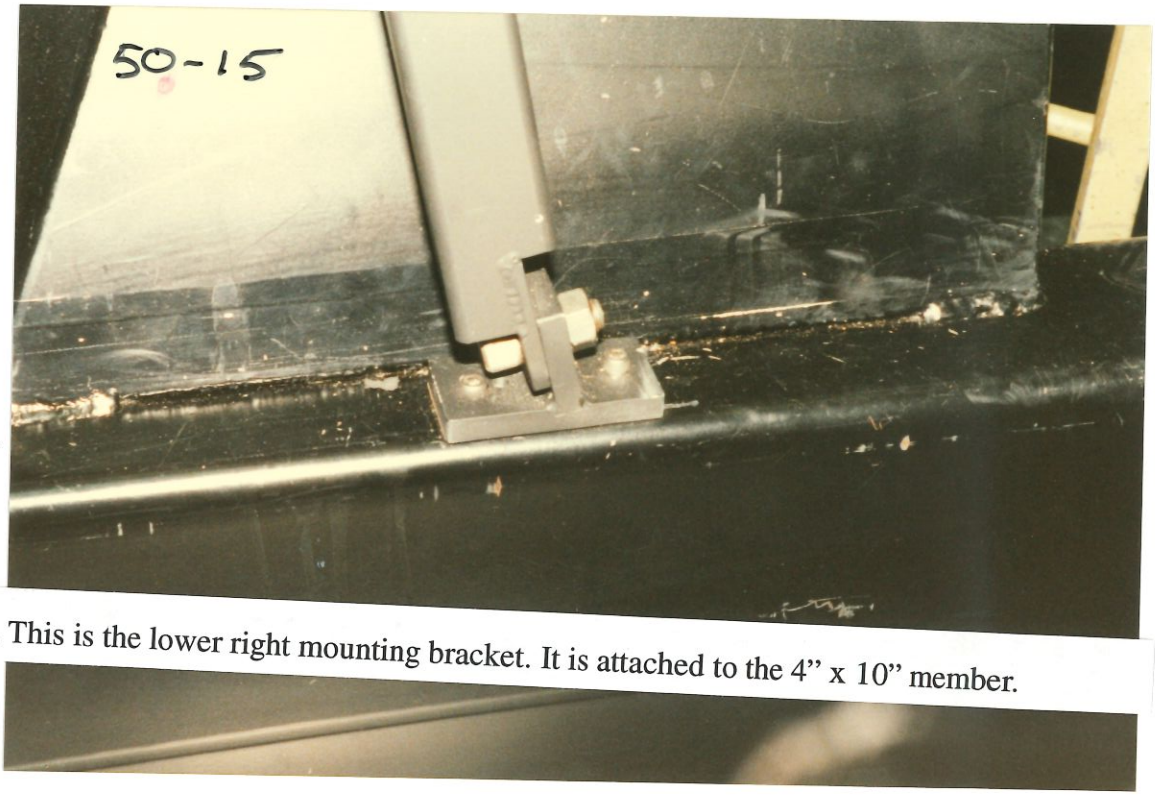
23. Looking down on the middle bracket. The bronze adjusting screw is visible as well as the idler and belt tensioner.


37-19

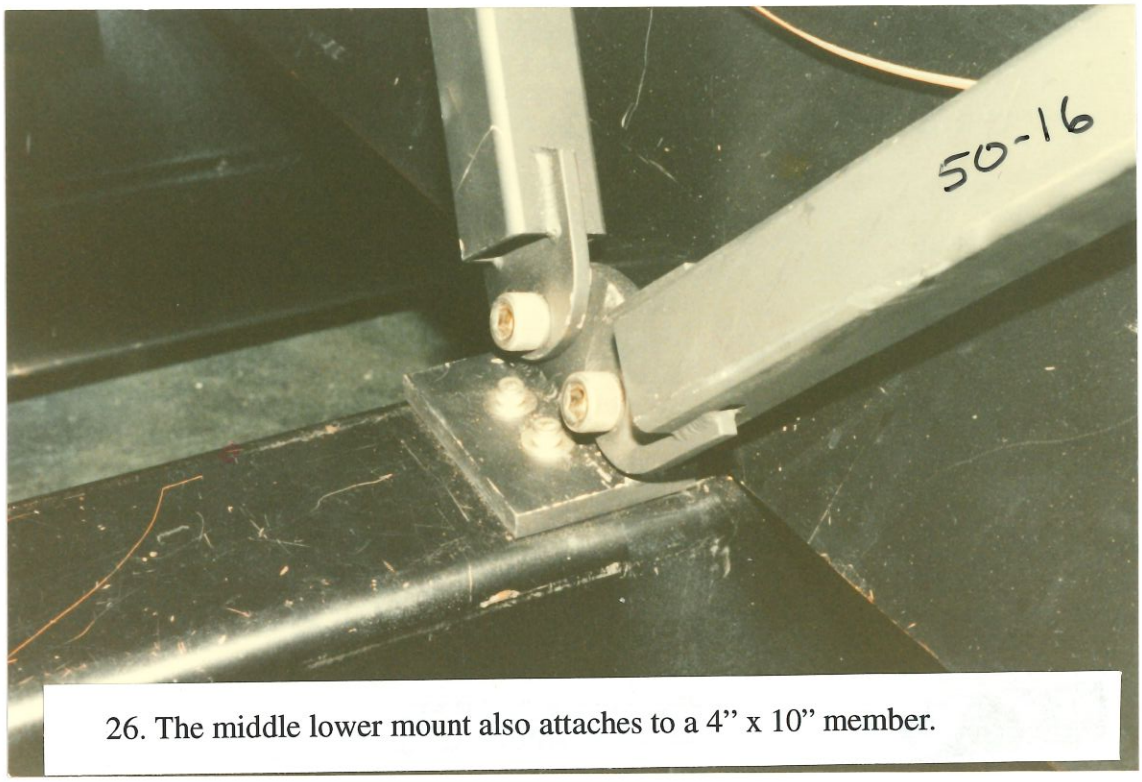

37-20



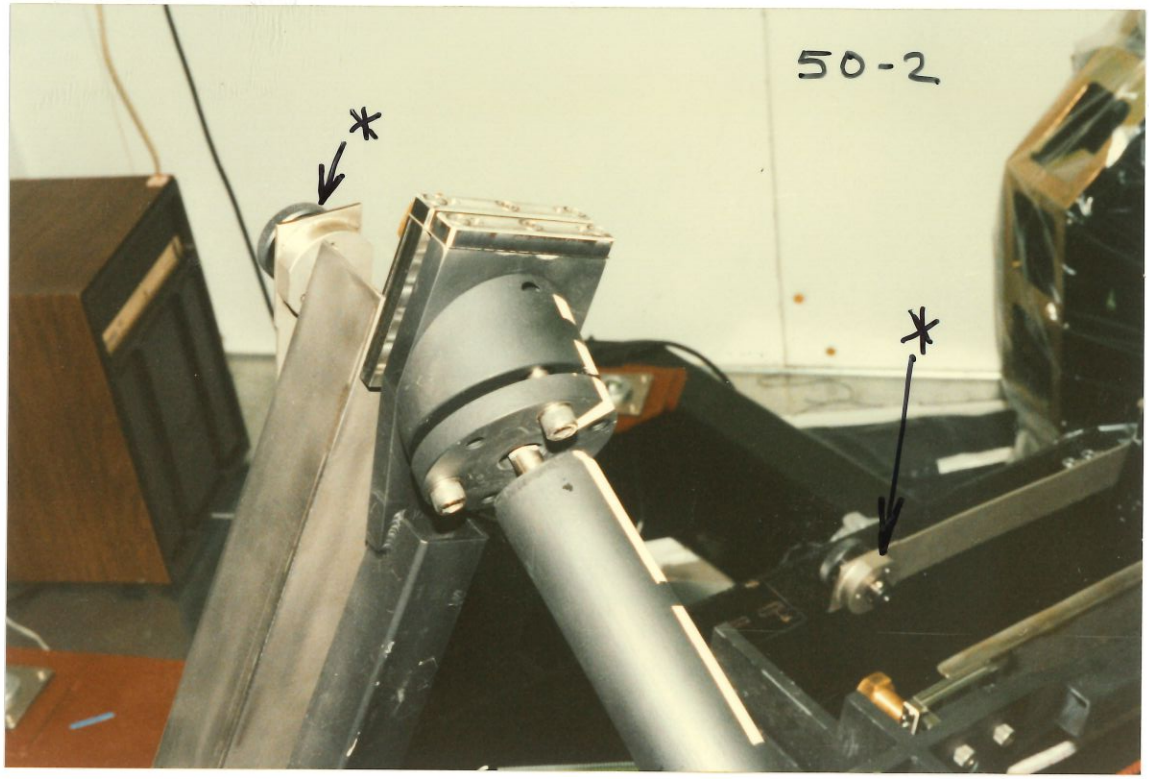
24. Square tube truss work: this is the lower left clevis attached to the 10" square mainframe of HIRES.



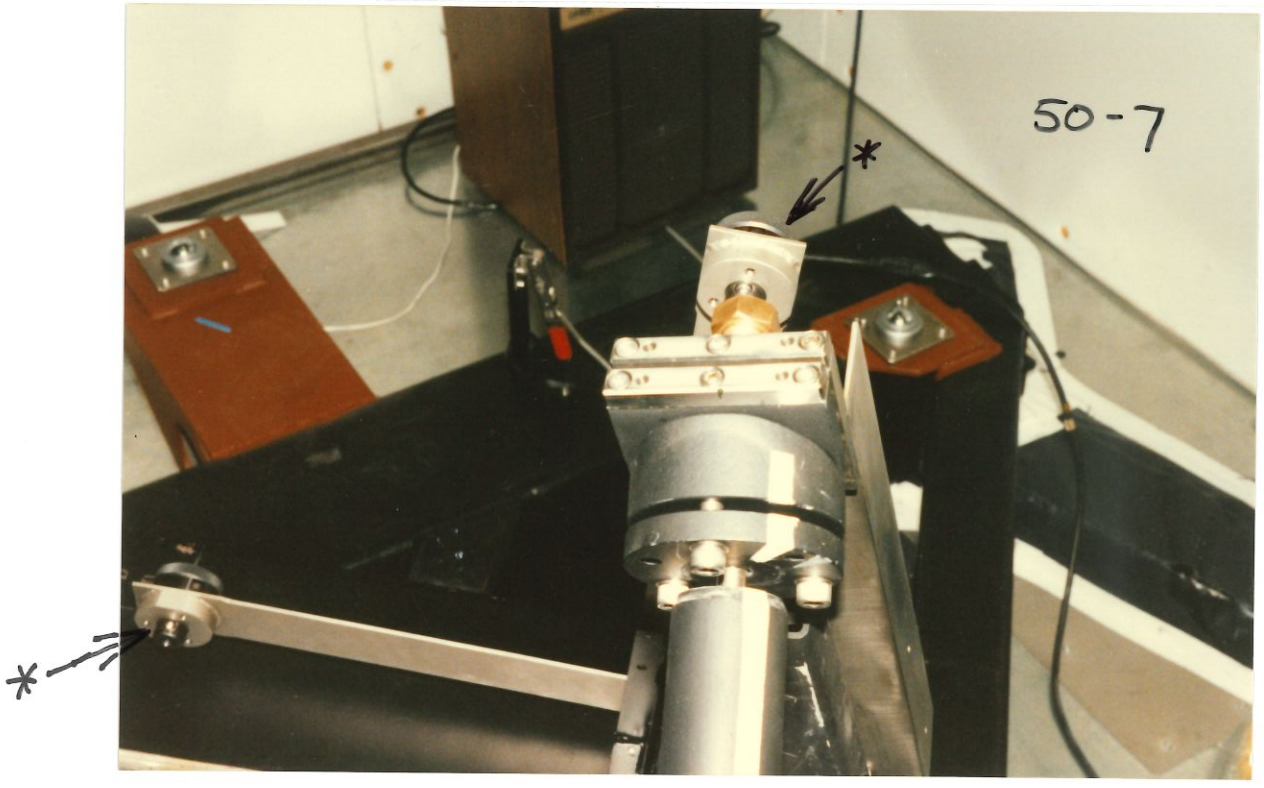
25. This is the lower right mounting bracket. It is attached to the 4" x 10" member.



26. The middle lower mount also attaches to a 4" x 10" member.

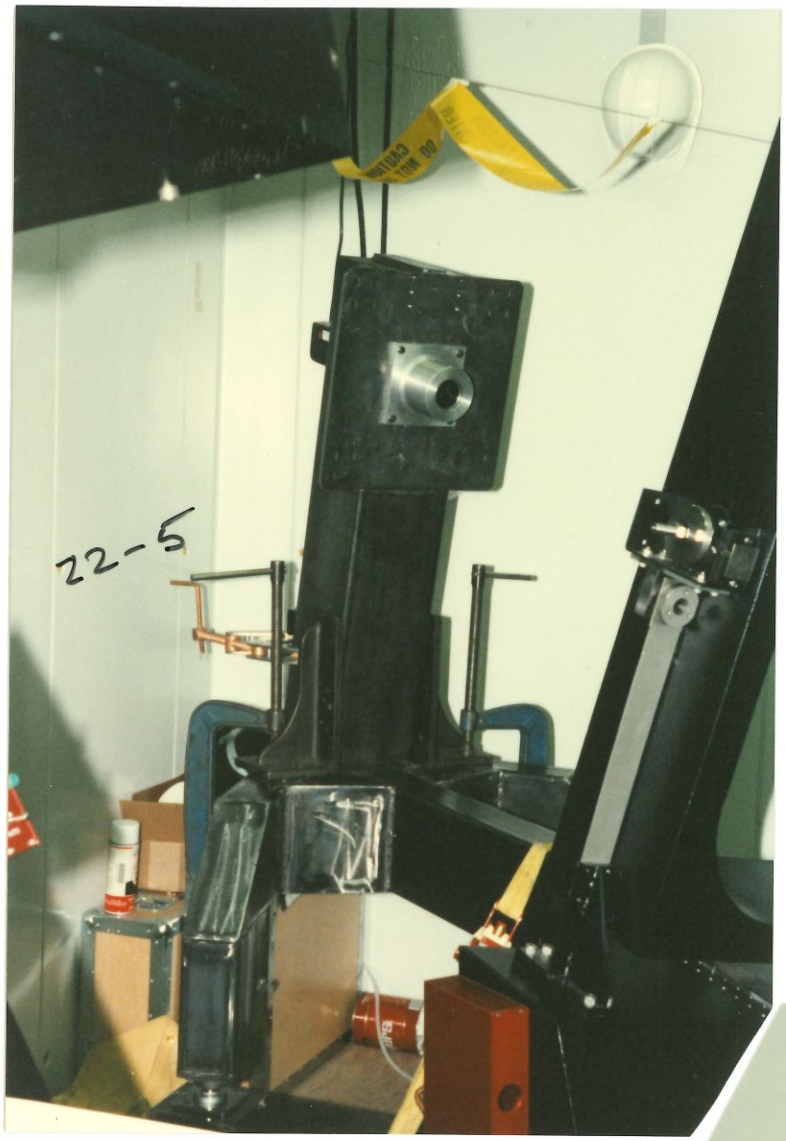


27. This view shows the left top ball and socket joint. Note by the differential clearance where the ball shank passes through the hole in the clamp ring that we missed the angle cut on the socket pad. The tolerance is tolerable, though. The index lines are visible here. Also, two of the three quick-connect locating pin assemblies can be seen. These are commercially available devices. They are very cumbersome to align in practice and an alternative coupler would be desirable.

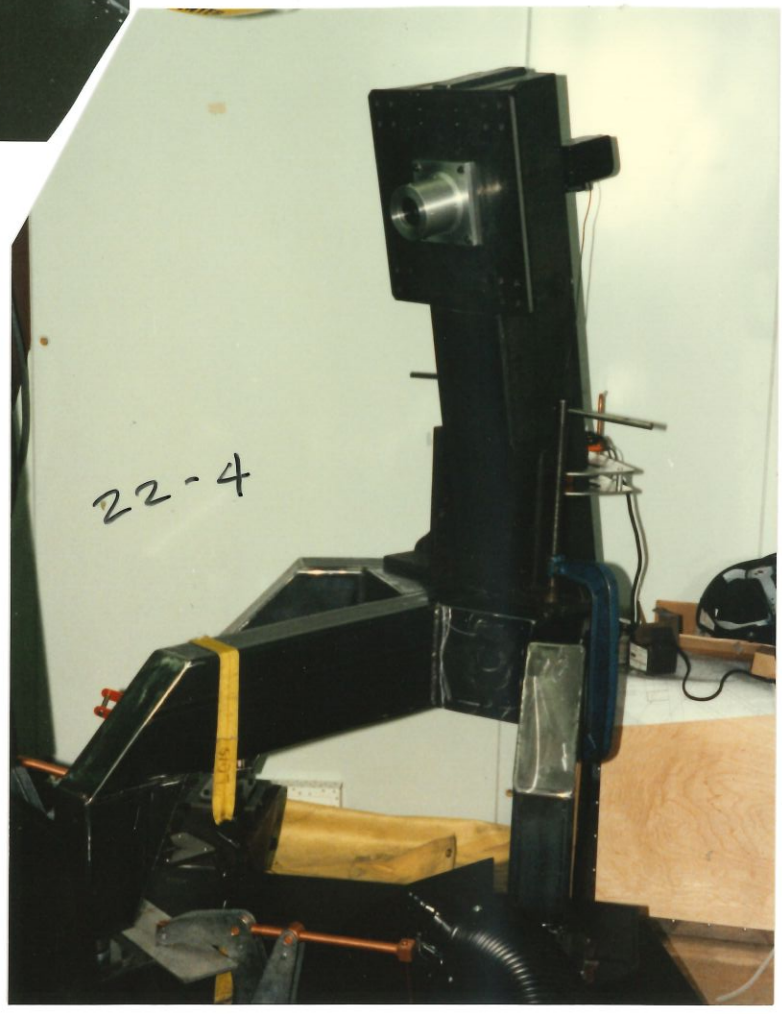


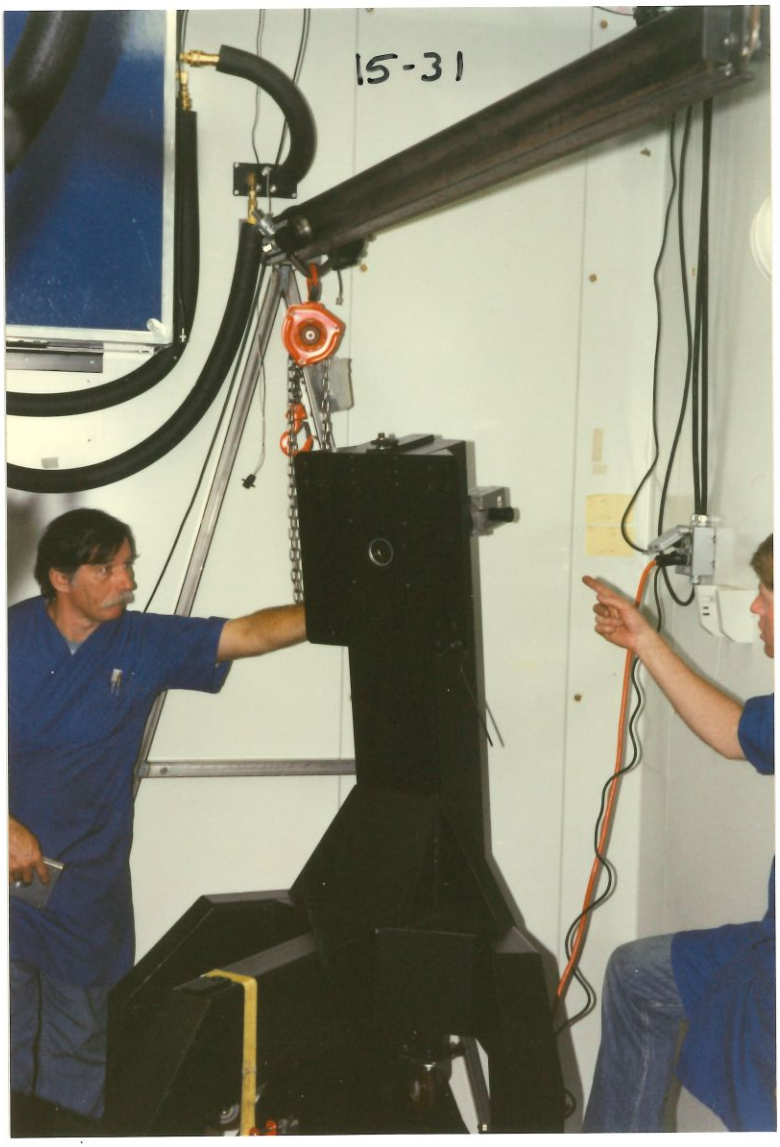
28. The right top ball and socket joint. The socket pad angle was much better at this joint. Two quick-connect locating pin assemblies can be seen.

Camera Mirror Mount



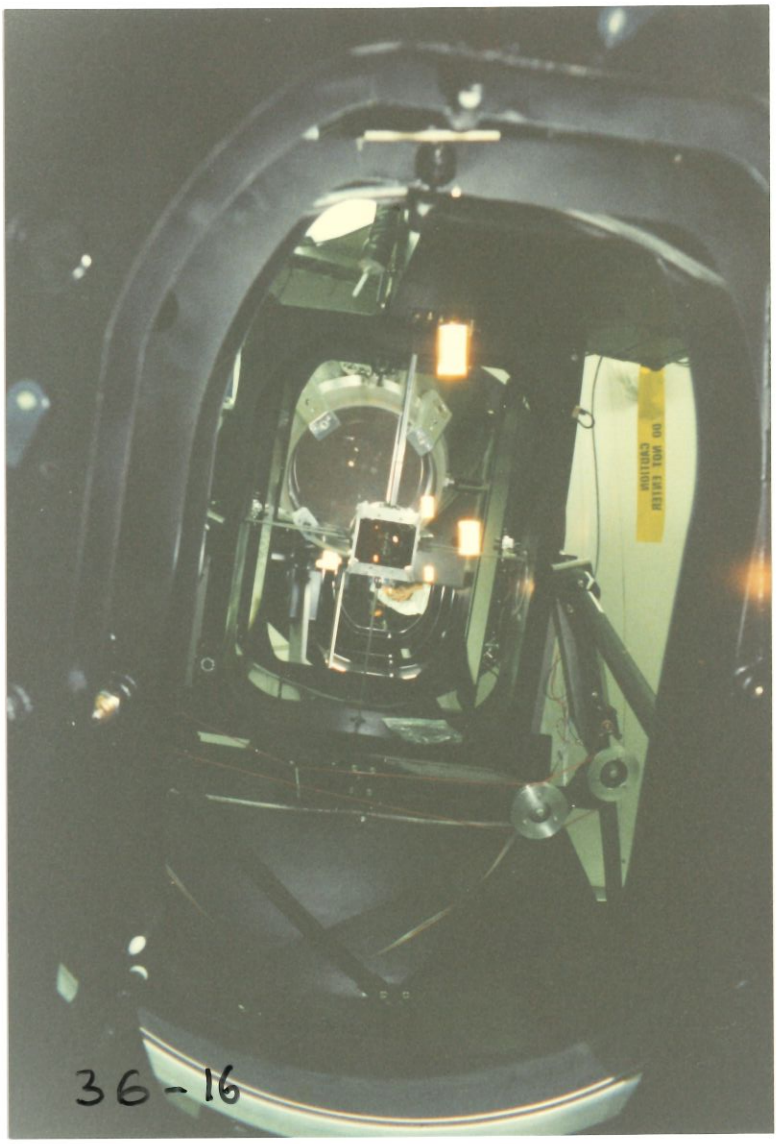
1. Locate kinematic base.
2. Clamp autocollimator mount.
3. Align everything
4. Weld together, dis-assemble, paint
5. Re-install and check alignment



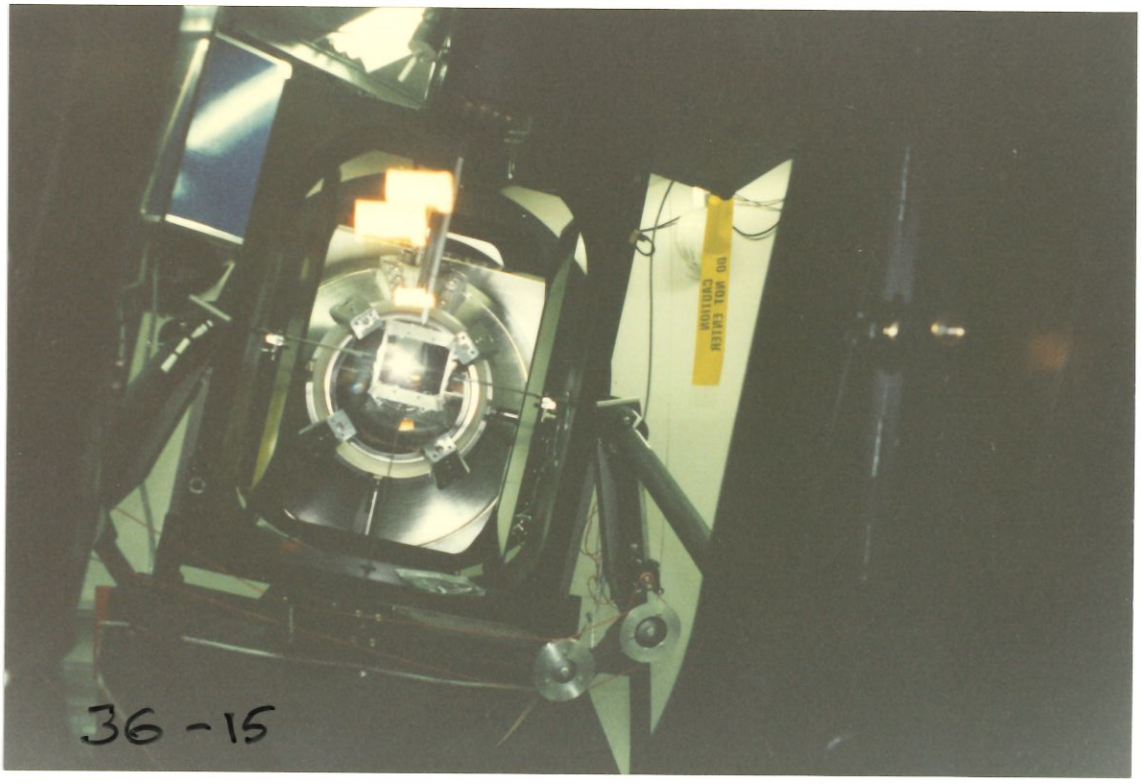


Hextek mirror mount and Dick Kanto and Jeff Lewis

Hextek mirror and Bruce Bigelow

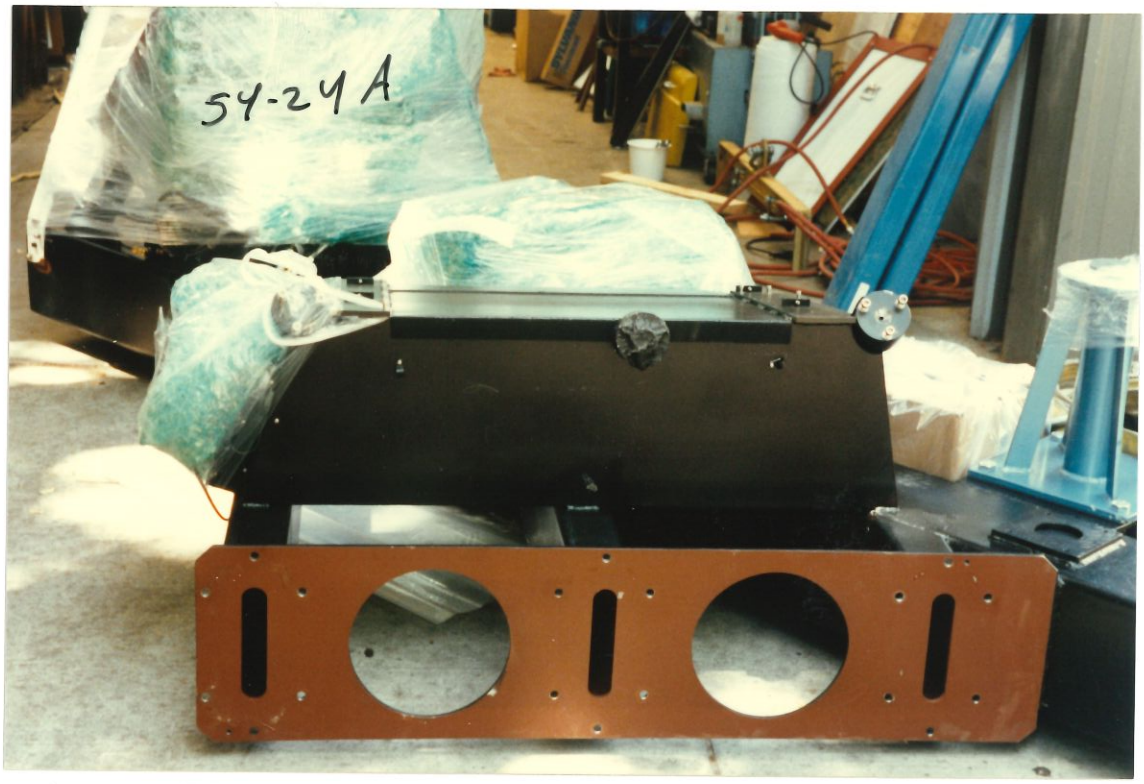


View from the Cross Disperser looking up through the Corrector Lenses. You can see the dewar Field Flattener imaged in the Camera Mirror.



View from the Cross Disperser looking up through the Corrector Lenses. You can see the dewar Field Flattener imaged in the Camera Mirror.

Shipping

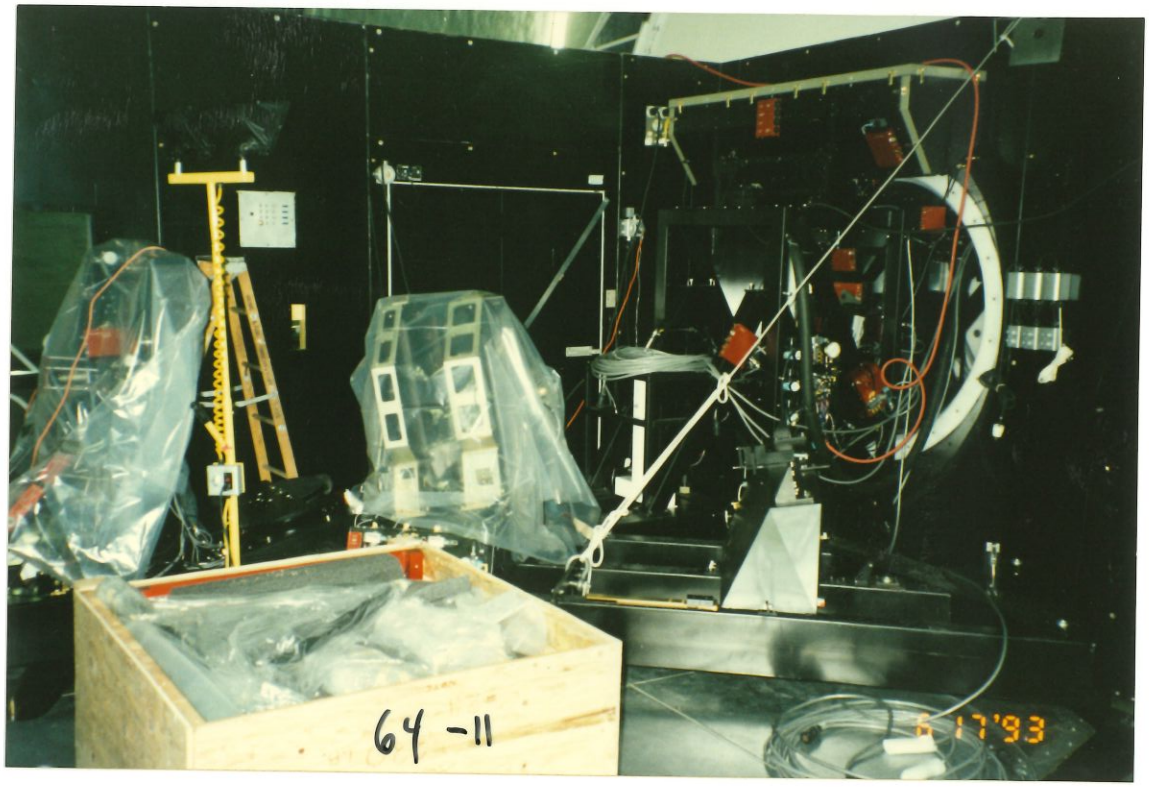


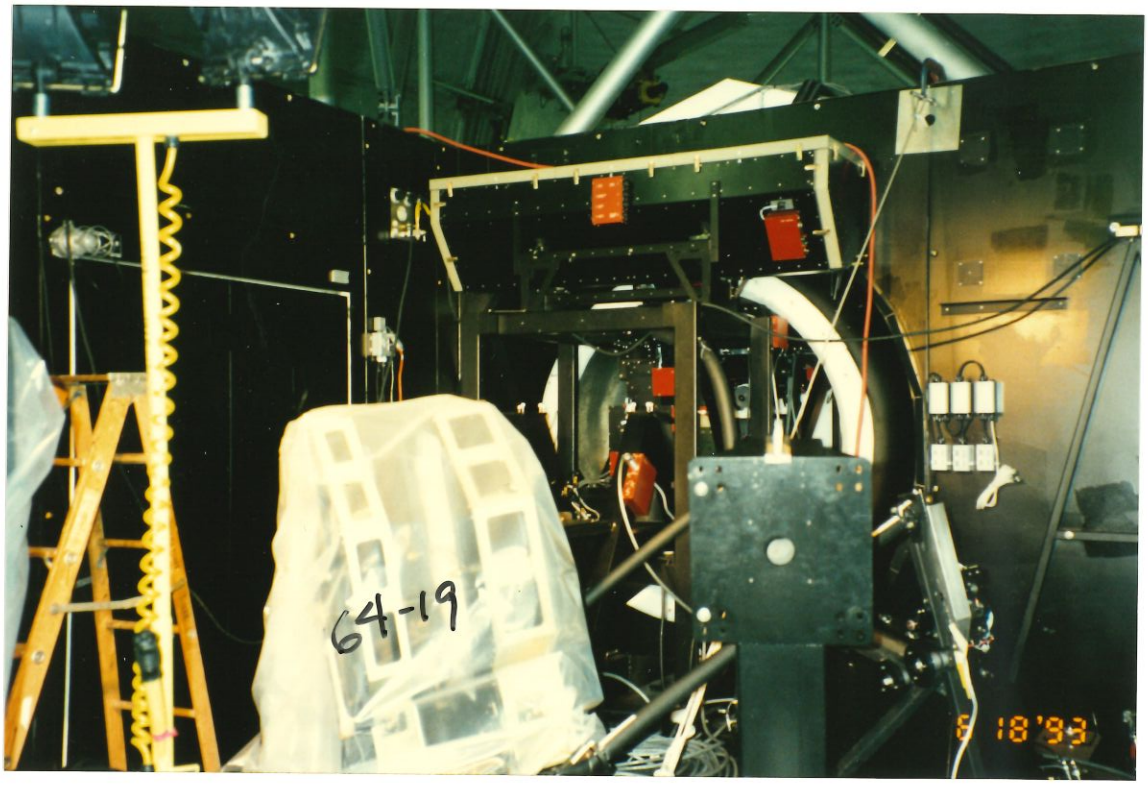
Leaving UCSC

Unloading at the Summit. Maurice Noé and Bob Moskitis

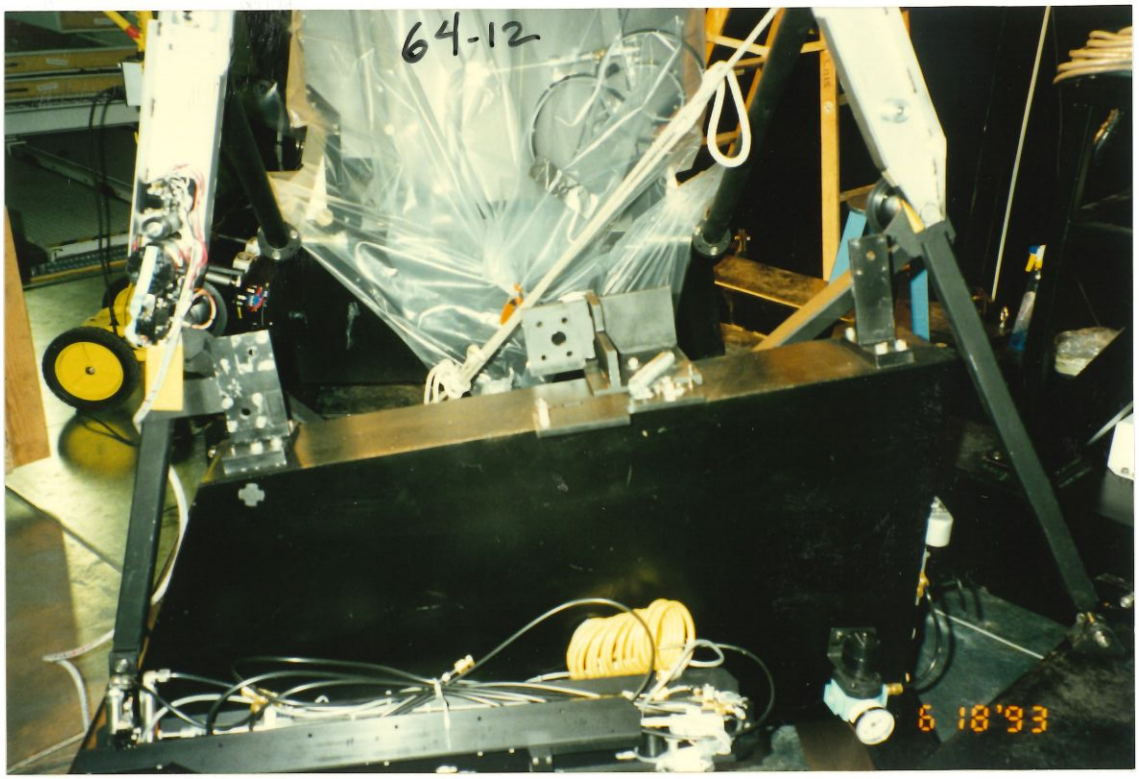
Keck I

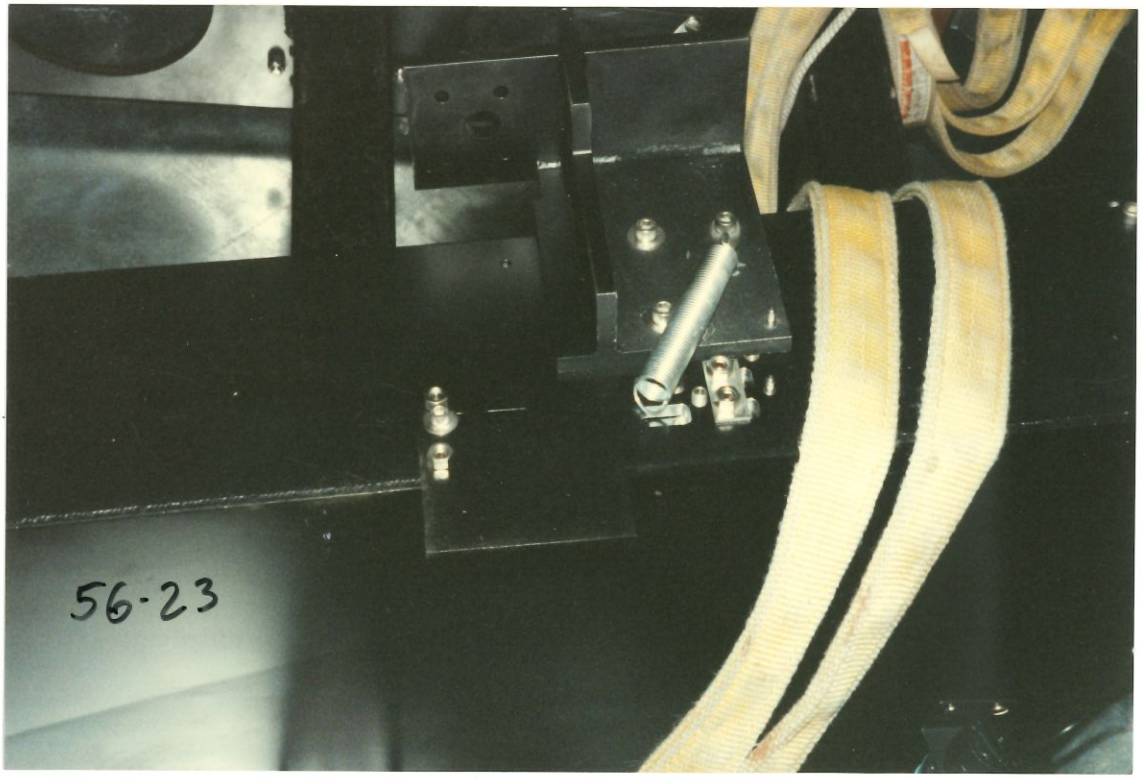

61-28

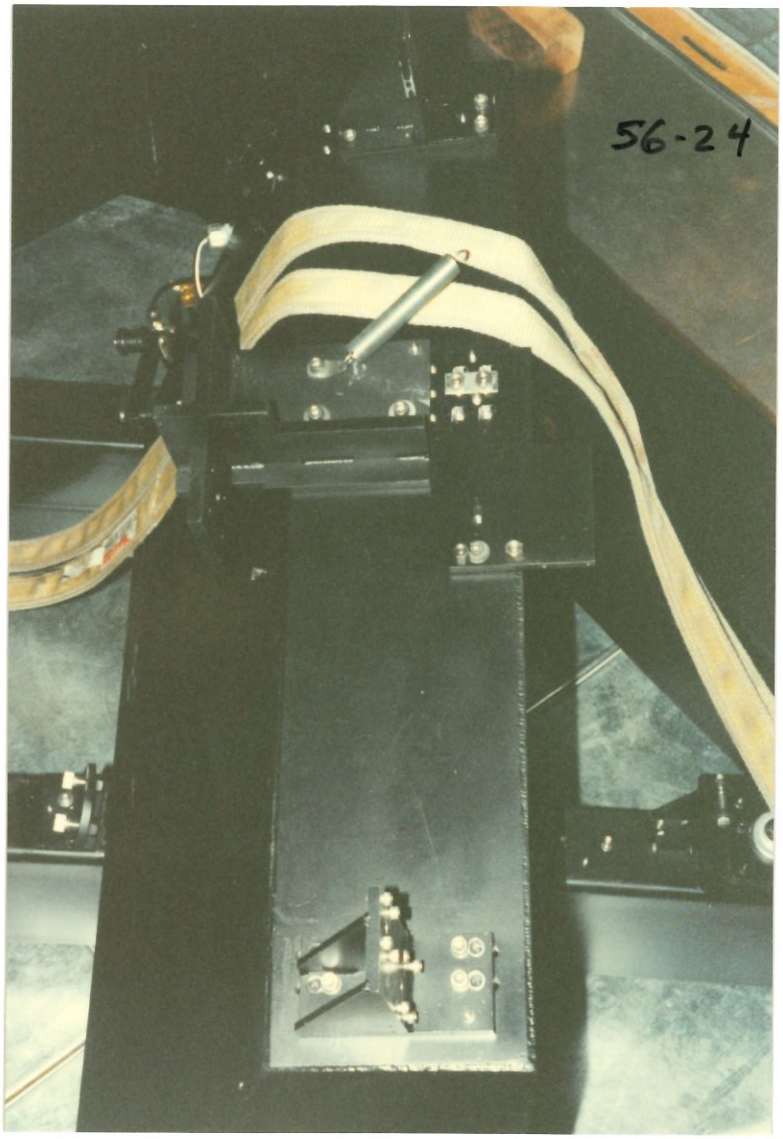


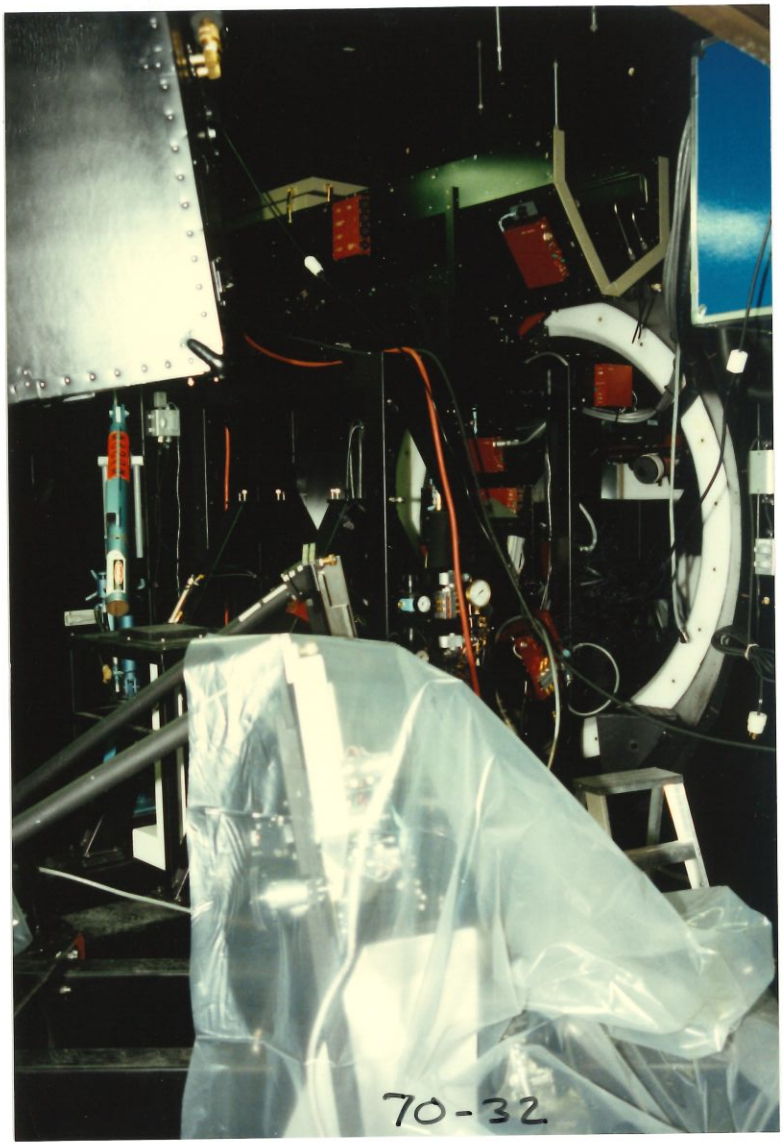


Re-assembly in Hawaii, June 18, 1993
(Note the walls are now painted black)


64-12
6 18'93

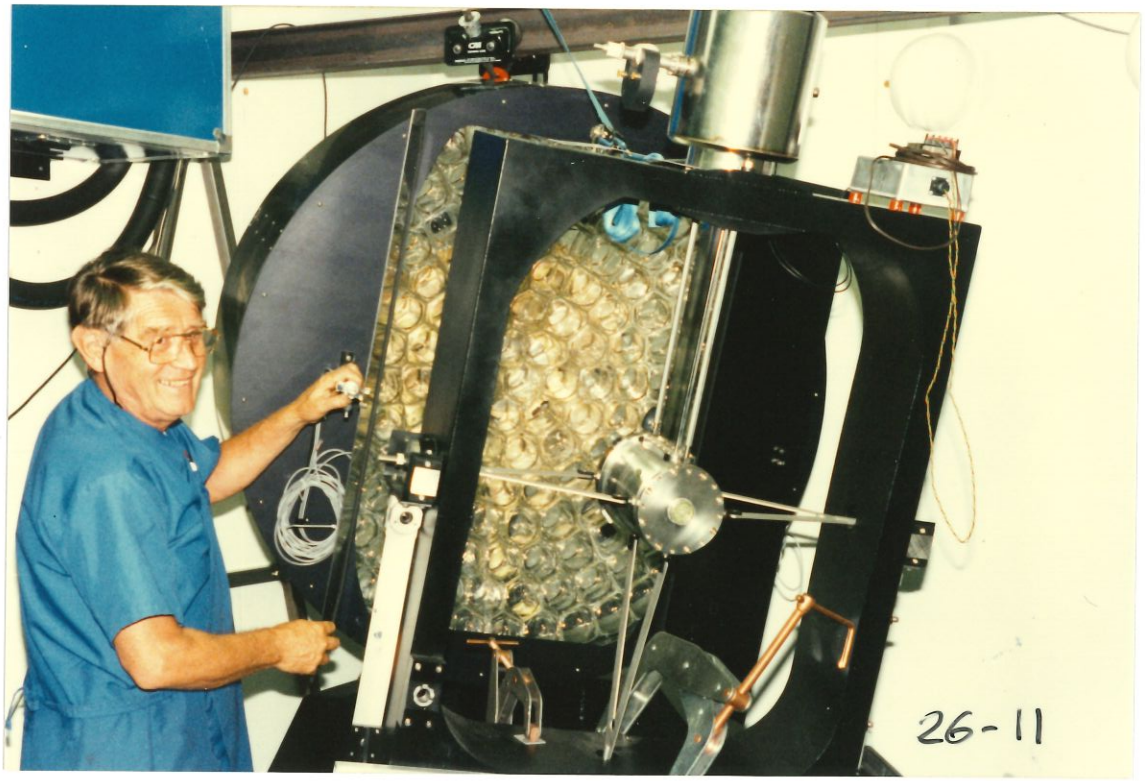

56-23


56-24


70-32

The Author

Neal Jern and Ron Laub, during commissioning



Erich Horn, at UCSC

Commissioning People: Neal Jern, Erich Horn, Bob Kibrick, Jack Osborne, Jeff Lewis, Jim Ward, Lance Bresee, and kneeling, Dick Kanto. Steve Vogt took the picture. Not present: Terry Ricketts, Dave Hilyard, Terry Pfister and Dean Tucker

Appendix

Filename: HIRES.Photo.Inventory.5.doc
How to Position and Focus a CCD
Selected Photos from the Construction of HIRES That Illustrate How to Build a Space-Frame/Monocoque Hybrid Structure to Position and Focus a CCD:
Jack Osborne 2/19/98

1. Davidson Auto-Collimator mounted in the Cross-Disperser Turntable Fixture. Half-inch Tooling Ball above is on the Turntable axis. The Turntable is first aligned on the slit and then rotated exactly 40 degrees (to 3 arc-sec precision, which is over-kill), and this is defined as the Camera Axis (15-35).

2. Mirror and Cross Wires to put the Frame onto the Camera Axis. The three flexible elements hold the Frame during measuring. Once the Frame is determined to be correct, the elements are pinned to their three mounting points (95-19).

3. The Dewar Frame is heavy and so is positioned with a hoist from the ceiling and wires with turnbuckles attached to a large vacuum clamp on an interior wall. The red shop cloths on the temporary support wires are for safety. Adjustment is now to +/- 0.1 inch (95-21).

4. Neal Jern is inspector here.

5. After the 3-D layout in AutoCAD, a cardboard full-size model is cut and taped together for a trial fit. This view also shows the take-apart joint for shipping, which is why the supporting elements must also be removable (42-6).

6. The final box in position. Panels are 1/8" thick mild steel plates (easy to shear). The three socket halves are cut to approximately the right angle and welded in place. The plan is for the ball joint to make up the position errors in location (32-11).

7. Detail of the central ball joint before the tube is cut to the measured length and welded to the ball (50-23).

8. Upper joint detail shows the clamping flange and upper ball, angled socket, flex plate mounting to the scissors bracket, and bronze adjusting screw with hardened steel pad. This bronze screw can make up +/-0.5 inch of miss-location. This view also shows the large white index marks to make sure the right round tube goes back into the right position with the top up and rotated at the right angle in case the ball is not round (50-8).

9. This photo shows Dick Kanto assembling one of the three micrometer drive screws in the square tube space-frame structure. This is the right side, or also called "anti-slit side". Note the temporary clamp holding the right round rod in position (19-26A).

10. A good view of the right side support, flex link, bronze screw and Dewar Frame push pad, micrometer screw, but no scissors drive bracket (No I.D.).

11. Aerial view during dis-assembly for pack and ship to Hawaii. (April of 1993) (82-21)

12. This photo shows the left micrometer drive screw and the red timing belt. The coil spring serves to keep the scissors drive plate in contact with the drive screw face (50-19).

13. A view of the left drive screw. This screw moves +/-0.3 inches. By a 20:1 reduction in the scissors linkage, the detector moves +/-.015 inches (50-25A).

14. Right drive micrometer screw and center screw. Both end up on the right side. The motor pulley can be seen extending through the framework (50-6).

15. Middle support bracket. This view is looking back at the Corrector Lens Cells (not visible) (50-5).

16. Left Bracket: Wedge plate is visible under bracket. Box weldment is 1/8" steel plate on 5 sides with 1/2" top surface that has tapped 3/8-24 holes in it (50-20).

17. Right Bracket final location. Wedge plate here also. Compare this photo with "First Cut" photo under the "Strings and Levels" section (50-9).

18. Left side lower brace mount. Rod end provides adjustment in half turn increments (0.025") (50-4).

19. The three adjusting screws can be seen: #4-40 Allen head cap screws. These provide piston adjustment, relative to the field flattener dewar window and also two angular adjustments (tip and tilt). The cap screw can move 0.0005" for a tip or tilt of 42 arc-sec, which is 7 degrees of rotation with an allen wrench. The lateral adjustments were built but never used. The third angle is adjusted by rotating the spider assembly at its base. (Not visible in this photo) There is an eccentric mounted in a slot in the lower spider flange. +/-0.4 degrees (19-4A).

20. Not photographed is the alignment tool. It has 4 dial indicators for making relative adjustments to the CCD while attached to the ZIF socket. These are warm adjustments with a naked detector and so very hazardous. Hence, no photos were allowed.

21. The right side drive pinion and belt tensioner (50-21).

22. Right side view of the right side drive screw and dual belt system (50-17).

23. Looking down on the middle bracket. The bronze adjusting screw is visible as well as the idler and belt tensioner (50-10).

24. Square tube truss work: this is the lower left clevis attached to the 10" square mainframe of HIRES (50-3).

25. This is the lower right mounting bracket. It is attached to the 4" x 10" member (50-15).

26. The middle lower mount also attaches to a 4" x 10" member (50-16).

27. This view shows the left top ball and socket joint. Note by the differential clearance where the ball shank passes through the hole in the clamp ring that we missed the angle cut on the socket pad. The tolerance is tolerable, though. The index lines are visible here. Also, two of the three quick-connect locating pin assemblies can be seen. These are commercially available devices. They are very cumbersome to align in practice and an alternative coupler would be desirable (50-2).

28. The right top ball and socket joint. The socket pad angle was much better at this joint. Two quick-connect locating pin assemblies can be seen (50-7).

Film Strip Number and Description:
Note that each strip has been tagged with a black label for future reference.

1.0 #22
· 5-92

· Kodak Gold 400-3
· 2 3 4 5 4x6 2 each

2.0 #42
· 7-10-91
· Kodak Gold 400-2
· 1 2 3 4 5 6 7 30 4x6 2 each

3.0 #25
· 6-91
· Kodak CC 400 5097
· 12 15 4x6 2 each

4.0 #32
· 9-91
· Kodak Gold 400-3
· 1 2 5 11 4x6 2 each

5.0 #15
· 8-10-92
· Fuji
· 29 31 35 4x6 2 each

6.0 #37
· 11-92
· Kodak Gold 400-3
· 1 thru 37 except 14 & 15 4x6 2 each

7.0 #66
· 2-91
· Kodak Gold 400-2
· 18 & 19 4x6 2 each

8.0 #21
· 12-90
· Kodak 5097 Gold 400-2
· 23 24 25 4x6 2 each

9.0 #19
· 9-92
· Kodak 400-3
· 2 thru 12 & 26A 27A 4x6 2 each

10.0 #65
· 5-93
· Kodak 400-3
· 15 & 16 4x6 2 each

11.0 #36
· 11-92
· Kodak Gold 400-3
· 15 thru 19 30 31 32 4x6 2 each

12.0 #26
· 8-10-92
· Kodak Gold 400-3
· 5 6 11 12 4x6 2 each

13.0 #35
· 3-91
· Kodak Gold 400-3
· 7 8 9 12 13 14 17 18 36 4x6 2 each

14.0 #43
· 3-91
· Kodak Gold 400-2
· 13 4x6 2 each

15.0 #41
· 12-92

· Fuji
· 3A & 9A 4x6 2 each
16.0 #95
· 5-91
· Kodak CC 400 5097
· 19 20 21 22 23 24 24A 4x6 2 each
17.0 #68
· 3-93
· Fuji
· 14 15 18 4x6 2 each
18.0 #38
·
· Kodak Gold 400-3
· 21 4x6 2 each
19.0 #46
· 7-92
· Kodak CC 400 5097
· 3 4 18 4x6 2 each
20.0 #50
· 4-20-93
· Kodak Gold 400-3
· 2 thru 10 15 16 17 19 20 21 22 23 26 4x6 2 each
21.0 #54
·
· Kodak Gold 400-3
· 24A 4x6 2 each
22.0 #56
· 7-93
· Kodak Gold 400-3
· 23 & 24 4x6 2 each
23.0 #61
· 6-93
· Kodak Gold 400-3
· 28 29 30 4x6 2 each
24.0 #64
· 6-93
· Kodak Gold 200-3
· 11 12 19 4x6 2 each
25.0 #70
· 7-93
· Kodak Gold 400-3
· 32 4x6 2 each
26.0 #72
· 7-93
· Kodak Gold 400-3
· 5A 6A 7A 12 12A 13A 4x6 2 each
27.0 #73
· 4-93
· Fuji
· 5 6 7 4x6 2 each
28.0 #74
· 4-28-93
· Kodak Gold 400-3
· 21 4x6 2 each
29.0 #78
· 1992

· Kodak Gold 400-3
· 1 2 3 4x6 2 each

30.0 #82
· 5-93
· Kodak Gold 400-3
· 7 14 16 20 21 4x6 2 each

31.0 #85
· 7-90
· Kodak Gold 400-2
· 11 12 13 14 4x6 2 each

32.0 #103
· 7-90
· Kodak Gold 400-2
· 15 16 22 23 4x6 2 each

33.0 (Formula for Photo I.D. is Strip Number Dash Negative Number, Like 103-4A)

Filename: morecaptions.doc
How to Position and Focus a CCD

Commissioning People: Neal Jern, Erich Horn, Bob Kibrick, Jack Osborne, Jeff Lewis, Jim Ward, Lance Bresee, and kneeling, Dick Kanto. Steve Vogt took the picture. Not present: Terry Ricketts, Dave Hilyard, Terry Pfister and Dean Tucker

The Author

Neal Jern and Ron Laub, during commissioning

Erich Horn, at UCSC

Leaving UCSC

Unloading at the Summit. Maurice Noe and Bob Moskitis

Hextek mirror and Bruce Bigelow

Hextek mirror mount and Dick Kanto and Jeff Lewis

Re-assembly in Hawaii, June 18, 1993
(Note the walls are now painted black)

1. Locate kinematic base.
2. Clamp autocollimator mount.
3. Align everything
4. Weld together, dis-assemble, paint
5. Re-install and check alignment

View from the Cross Disperser looking up through the Corrector Lenses. You can see the dewar Field Flattener imaged in the Camera Mirror.

View from the Cross Disperser looking up through the Corrector Lenses. You can see the dewar Field Flattener imaged in the Camera Mirror.

Hardened bushing detail. This is the Ford dewar. It is the second dewar intended for the mosaic of four (4) Ford CCD's, in case the Tektronix CCD was not available in time. It has been collimated and can be exchanged in Hawaii.

Alignment adjustments are preserved with red paint.

Tektronix 2048 x 2048 CCD with 24 micron pixels in a ZIF socket

Note the flat alignment mirror mounted on the rear of the dewar body (36-19)

Another view of the Cross-Disperser turntable and alignment fixture. This time, with the second Davidson Alignment Telescope. (38-21)

Measuring from the turntable tooling ball to the dewar frame (95-22)

Alignment tooling to present mirrors at either end of the dewar. Also, to locate the CCD height. (105-2, -4)

HIRES' main frame. The frame sits on three points on the Nasmyth Platform. Insulated housing is in the background. (103-16)

The main Auto-Collimator tripod is in the white structure in the left of this view. It has been welded to the black main frame. The welds are painted grey. (95-23)

Cardboard lens mount and cardboard support box to check rough alignment. (42-1 thru –5)

One of three flex plates that support the dewar. Steel, 1/8" x 2". (46-18)

Alignment check with the empty lens cells. Jim Ward is adjusting (78-1, -3)

The special dewar lifter is in the upper left. It is white with skateboard wheels to fit under the main frame. It uses a manual hoist with web belt. (82-16)

The dewar field flattener has four temporary holders/movers. These are removed after alignment and the vacuum holds the lens positioned. Then, small profile clamps are fitted to hold the lens in case the vacuum is gone. The assembly is blackened with black foil and black felt. (37-24) (73-6, -7) (73-5)

Dewar is intended to hang roughly at the installation angle. (35-18)

Spider welding fixture – 2 different lengths are used. (35-13)

Spiders at initial installation and centering. (35-14)

Liquid Nitrogen pipe goes thru this big slot. (35-17)

Mag-Mill used for pinning. (74-21)

Terry Pfister shown during tack-welding of the dewar frame (43-13).

Slit side flex plate (42-30).

Anti-slit side flex plate (25-12).