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MCR 78-1323

10 MWe SOLAR THERMAL
CENTRAL RECEIVER PILOT PLANT

CONCEPTUAL DESIGN REVIEW PACKAGE

Dated October 16, 1978

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HELIOSTAT GENERAL REQUIREMENTS

HELIOSTAT CONFIGURATION

REFLECTIVE AREA	430 SQ. FT.
SIZE	22.6 x 22.6 FT.
FIELD CLEARANCE RADIUS	16 FT.
REFLECTING SURFACE	GLASS, SECOND SURFACE
STOWAGE	MIRROR FACE DOWN
ROTATIONAL REQUIREMENTS	AZ $\pm$ 270°, EL $^{+0}_{-195^\circ}$

HELIOSTAT OPERATIONAL REQUIREMENTS

SLEW	19.7°/MIN, MINIMUM
OPERATIONAL TEMPERATURE	+32°F TO +120°F
OPERATIONAL WINDS	20 MPH WITH GUSTS TO 27
INITIATE STOWAGE	36 MPH, INCLUDING GUSTS
DESIGN WIND RISE RATE	0.02 MPH/SEC^2
WIND SURVIVAL, ANY ATTITUDE	50 MPH, INCLUDING GUSTS
WIND SURVIVAL, STOWED	GUSTS TO 90 MPH @ $\pm$ 10° ANGLE OF ATTACK

HELIOSTAT WEIGHTS

PART DESCRIPTION	WEIGHT EACH	QUANTITY PER HELIOSTAT	TOTAL WEIGHT IN LBS.	
HELIOSTAT RACK ASSEMBLY				2742
MIRROR ASSEMBLY	115	12	1860	
BAR JOISTS -001	110	2	220	
BAR JOISTS -002	90	2	180	
TORQUE TUBE	412	1	412	
SUPPORT ARMS	25	2	50	
MOUNTING STUDS	½	36	18	
MOUNTING HARDWARE	-	1 LOT	2	
DRIVE UNIT ASSEMBLY				819
DRIVE MECHANISM	670	1	670	
SUPPORT BASE	90	1	90	
OIL	30	15 QUART	30	
MOTOR GEARHEADS	10	2	20	
ENCODER	3	2	6	
MOUNTING HARDWARE	-	1 LOT	3	
PEDESTAL ASSEMBLY				552
PEDESTAL	550	1	550	
COVER (ACCESS HOLE)	1	1	1	
MOUNTING HARDWARE	1	1 LOT	1	
CABLE AND ELECTRONICS				62
CABLE	40	1	40	
HELIOSTAT CONT. ELECTRONICS	20	1	20	
MOUNTING HARDWARE	-	1 LOT	2	

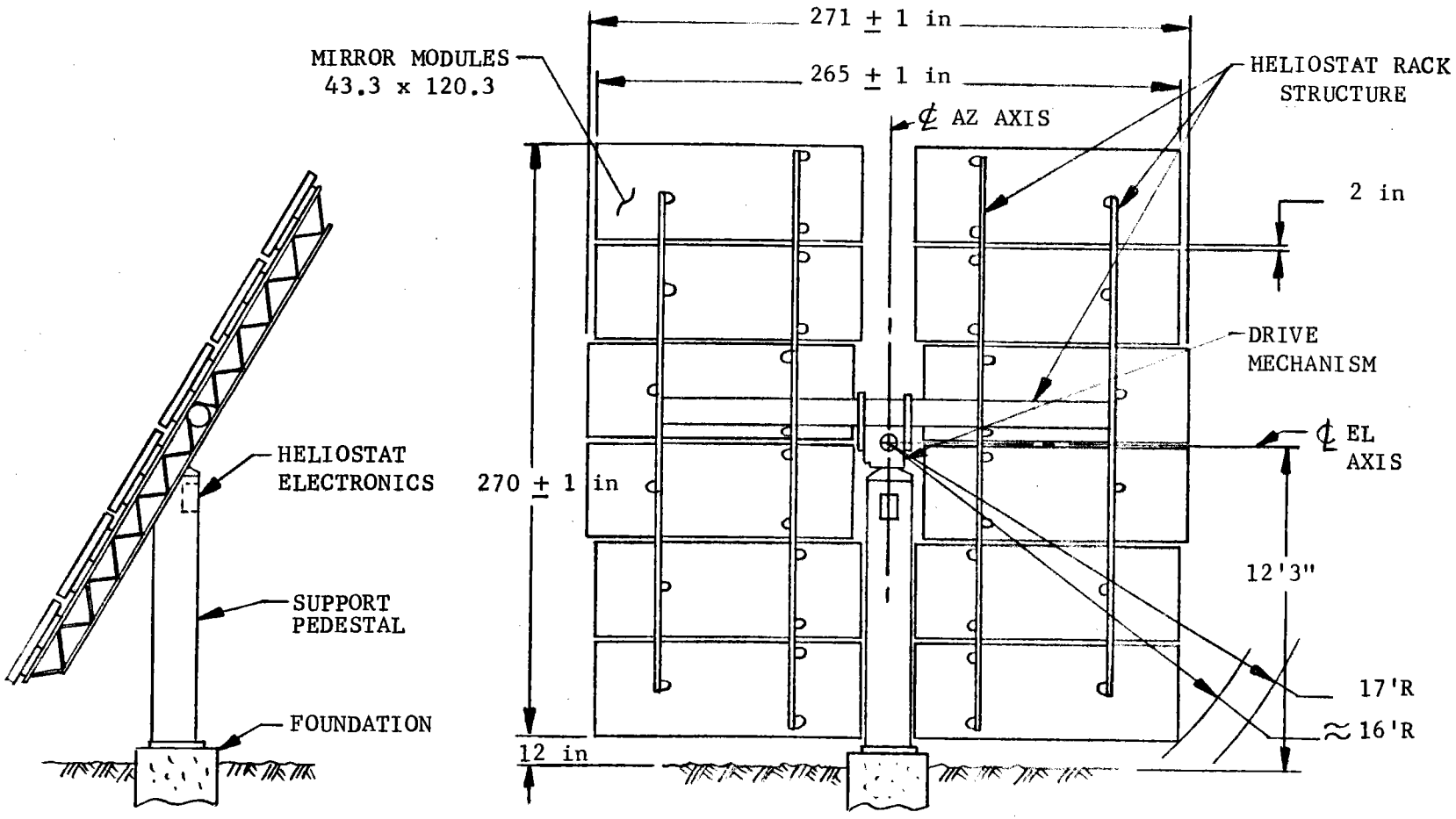
DIFFERENCES IN PHASE I AND PHASE II APPROACHES

PHASE I DESIGN DIFFERENCES	RATIONALE
1. HAC MINIMUM CONFIGURATION (NO REDUNDANCY AND NOT COMPLETE SOFTWARE)	COST SAVINGS
2. HC CONTAIN ERASABLE REPROGRAMMABLE MEMORIES	FLEXIBILITY IN HARDWARE AND SOFTWARE DESIGN AND DEBUGGING
3. ALIGNMENT WILL BE OPTICAL VIA A LASER BEAM	COST SAVINGS BY USE OF EXISTING EQUIPMENT FOR THESE SMALL QUANTITIES

HELIOSTAT STRUCTURES AND MECHANISMS

- 10 MWe COLLECTOR SYSTEM HELIOSTAT CONFIGURATION
  - VARIATION FROM BASELINE SUBMITTED IN PROPOSAL
- HELIOSTAT WINDLOADING ANALYSIS
  - HELIOSTAT COORDINATE SYSTEM
  - WINDLOADING COMPARISONS
  - HELIOSTAT WINDLOADS - MAXIMUM FROM ASCE APPROACH
- HELIOSTAT/FOUNDATION INTERFACE REQUIREMENTS
  - ACCEPTABLE ALTERNATIVES
- HELIOSTAT DRIVE MECHANISM
  - HELIOSTAT DRIVE MANUFACTURER
  - WORKING AGREEMENT
  - DRIVE MECHANISM DESIGN
- STTF DRIVE MECHANISM TESTS
- PROGRAM WORK PLAN

10 MW_e COLLECTOR SYSTEM HELIOSTAT



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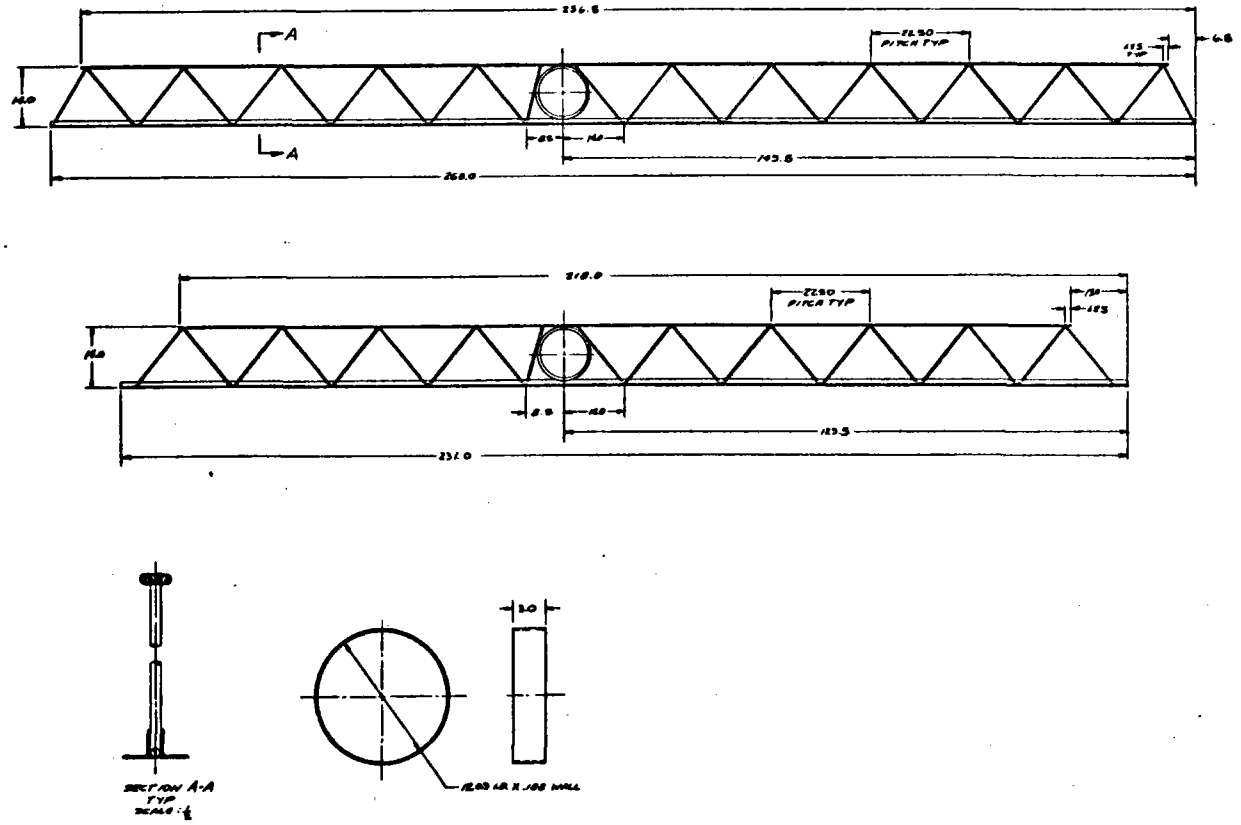
HELIOSTAT "EQUAL PITCH" BAR JOISTS



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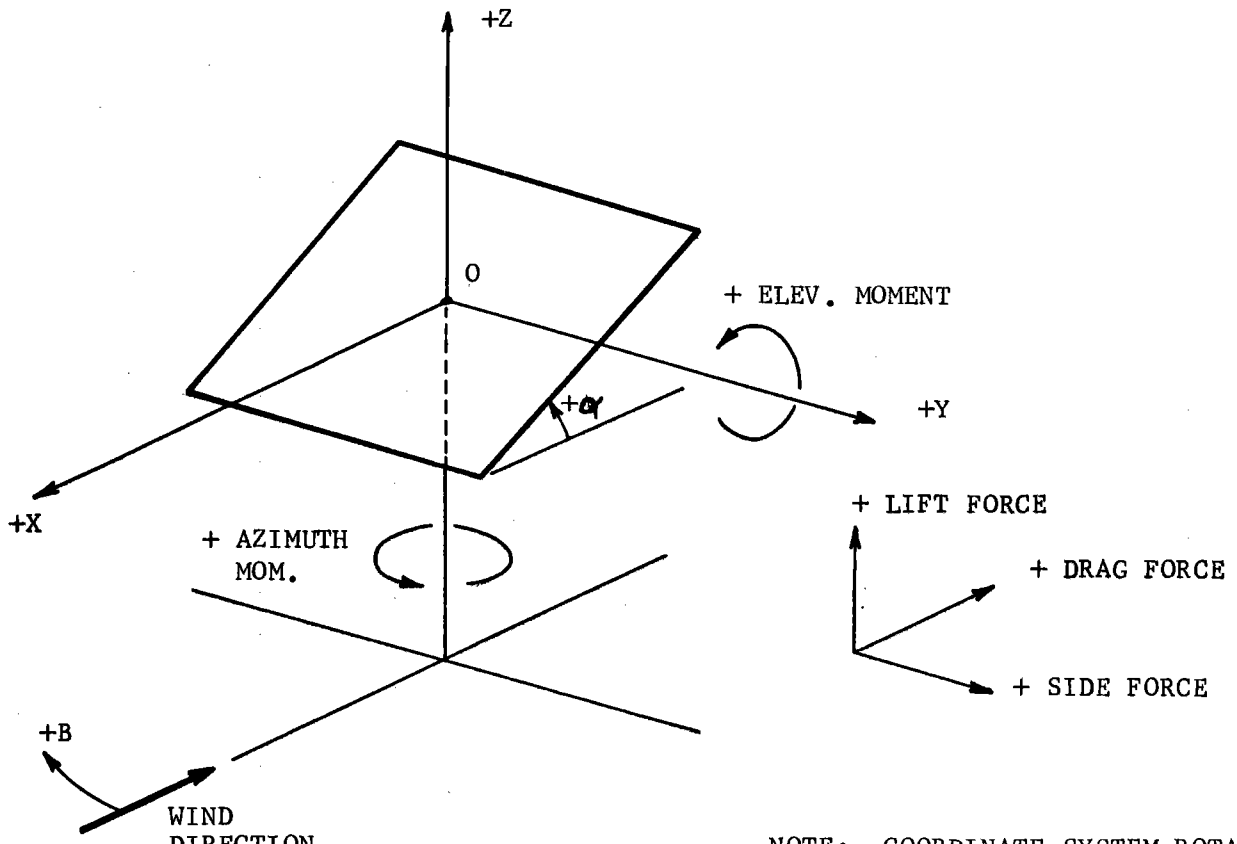
HELIOSTAT COORDINATE SYSTEM DEFINITION



NOTE: COORDINATE SYSTEM ROTATES ABOUT Z AXIS. LIFT, DRAG, AND SIDE FORCE DIRECTIONS ARE FIXED BY WIND DIRECTION.

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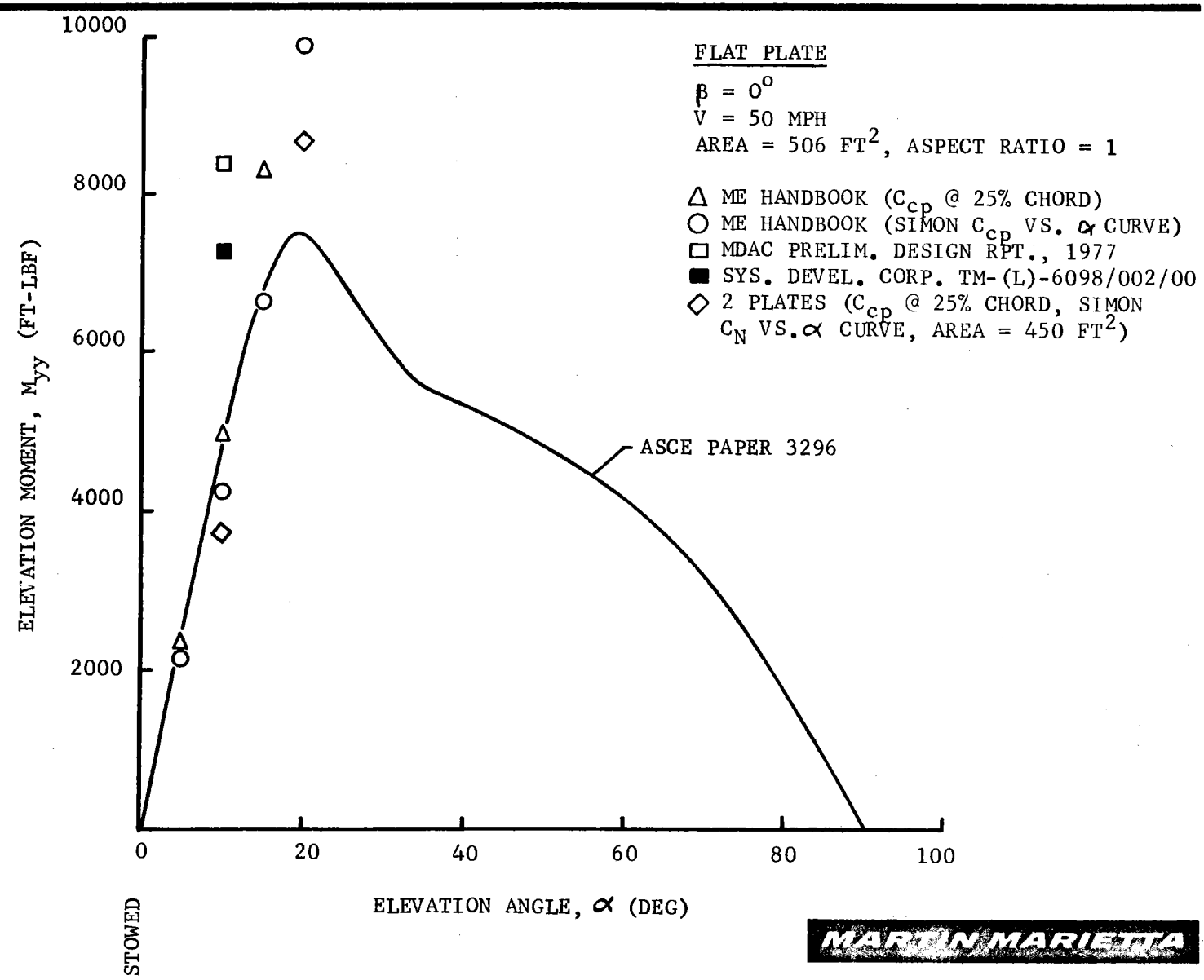
HELIOSTAT WIND LOADS - ASCE APPROACH

ELEV. ANGLE α (deg)	AZIMUTH ANGLE β (deg)	MOMENT M_{yy} (ft-lbf)	MOMENT M_{zz} (ft-lbf)	FORCES (lbf) DRAG	LIFT	SIDE
10	0	4930	0	272	878	0
20	0	7473	0	693	2029	0
90	0	0	0	2771	0	0
90	70	0	7473	693	0	2029

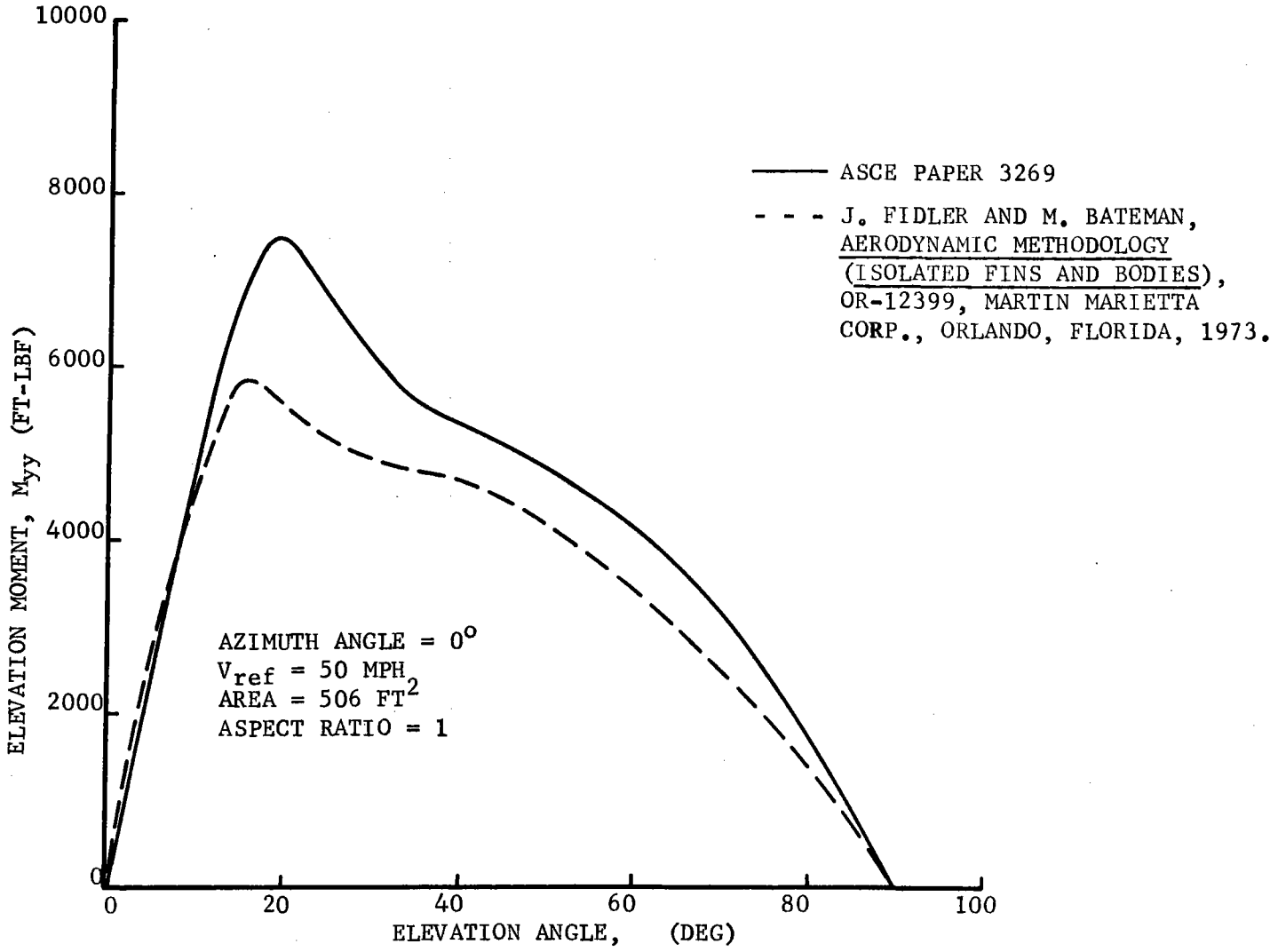
V_{ref} = 50 mph HORIZONTAL

THIN FLAT PLATE:
ASPECT RATIO = 1
AREA = 506 ft^2
SOLIDITY RATIO = 1

WINDLOADING COMPARISONS



HELIOSTAT ELEVATION MOMENT - COMPARISON OF METHODS



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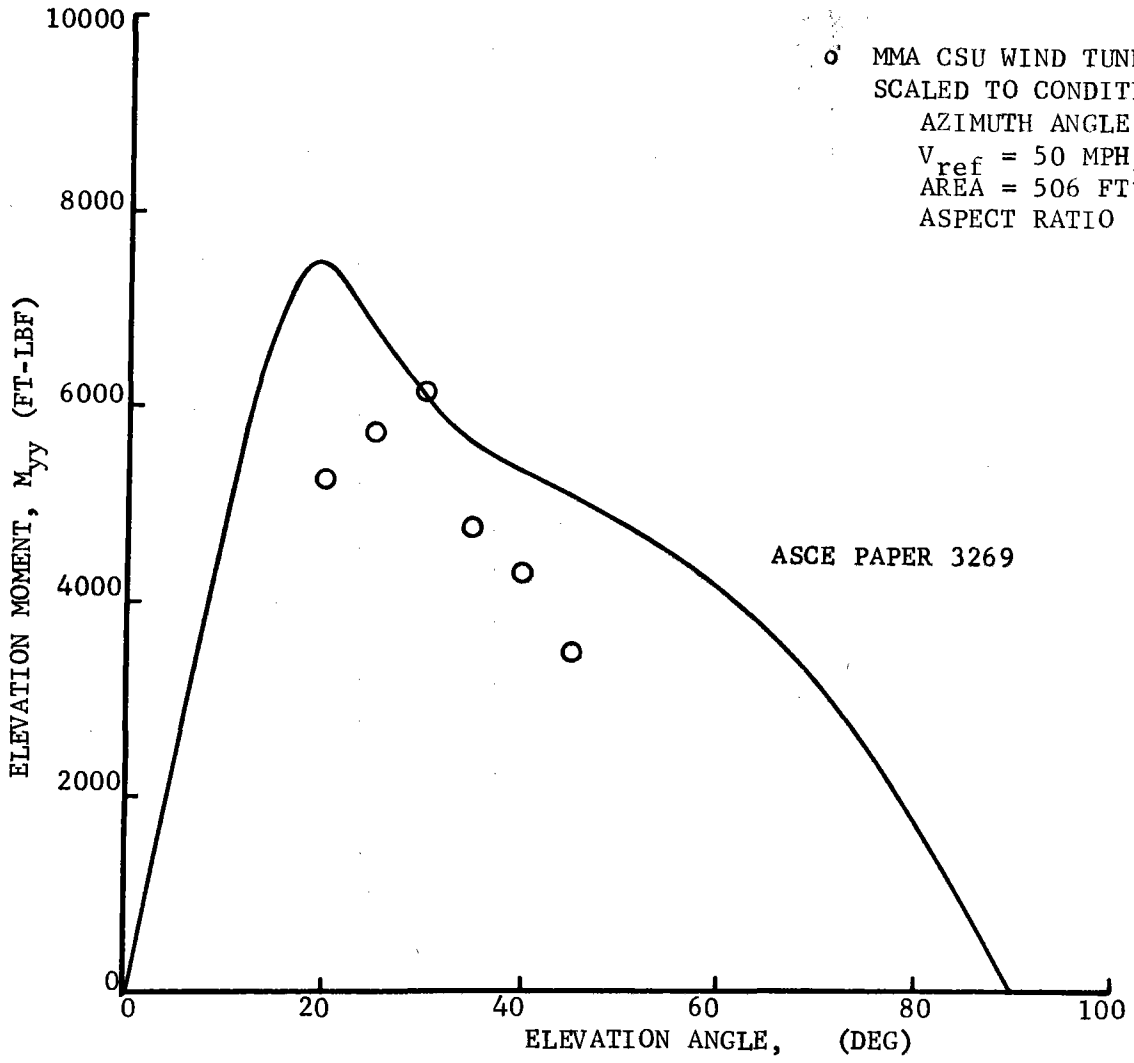
HELIOSTAT ELEVATION MOMENT - CSU WIND TUNNEL DATA



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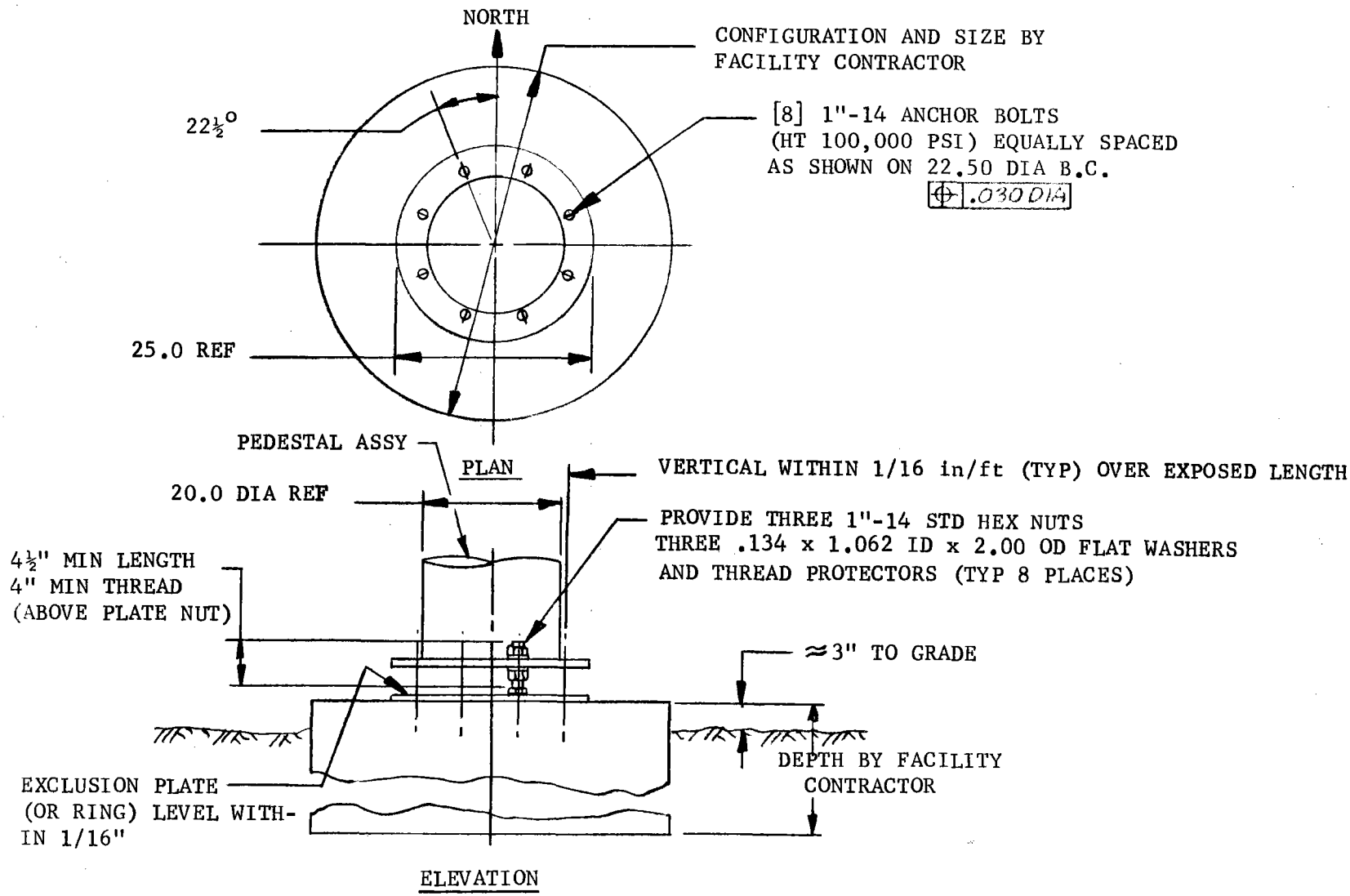
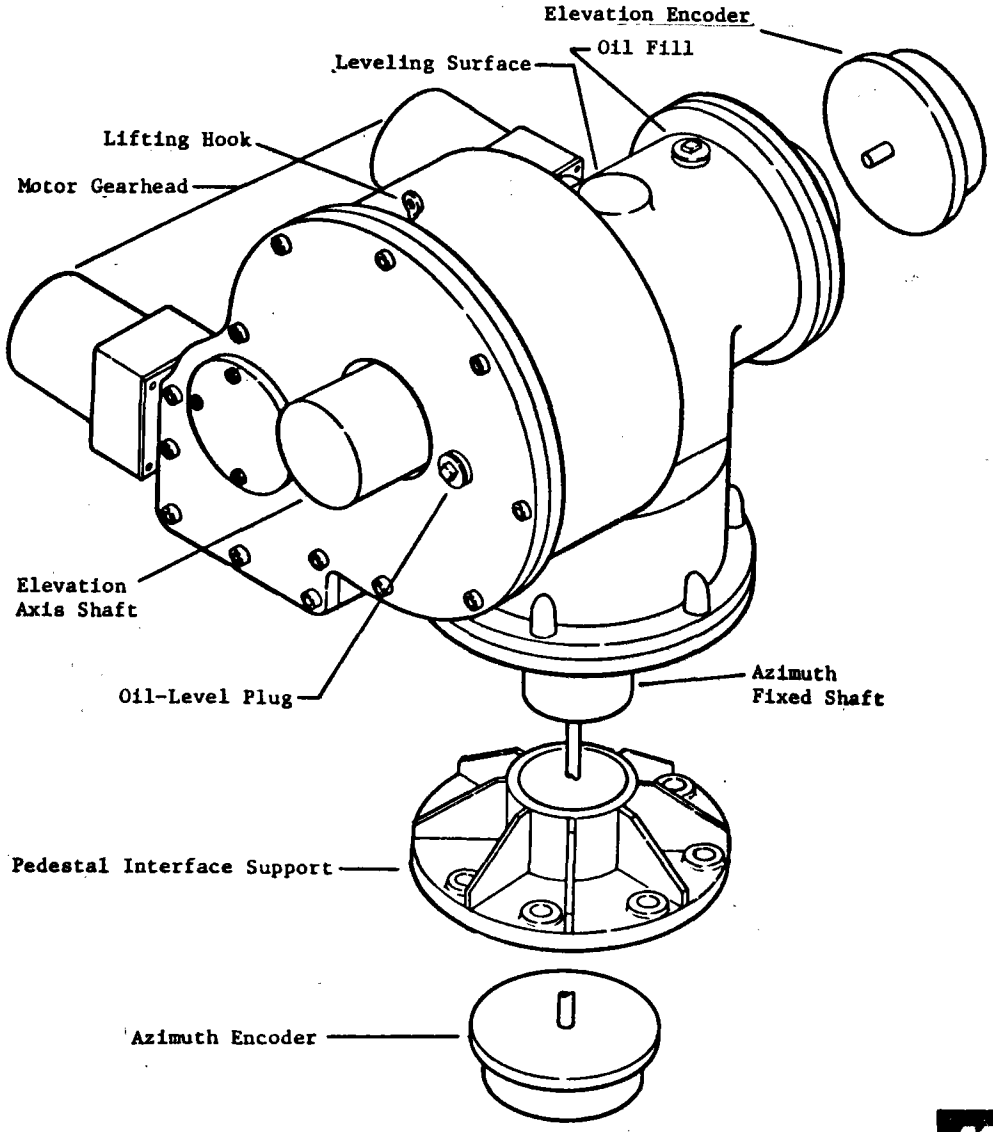
HELIOSTAT/FOUNDATION INTERFACE REQUIREMENTS



HELIOSTAT COMBINED AZIMUTH AND ELEVATION DRIVE



Drive Mechanism Assembly

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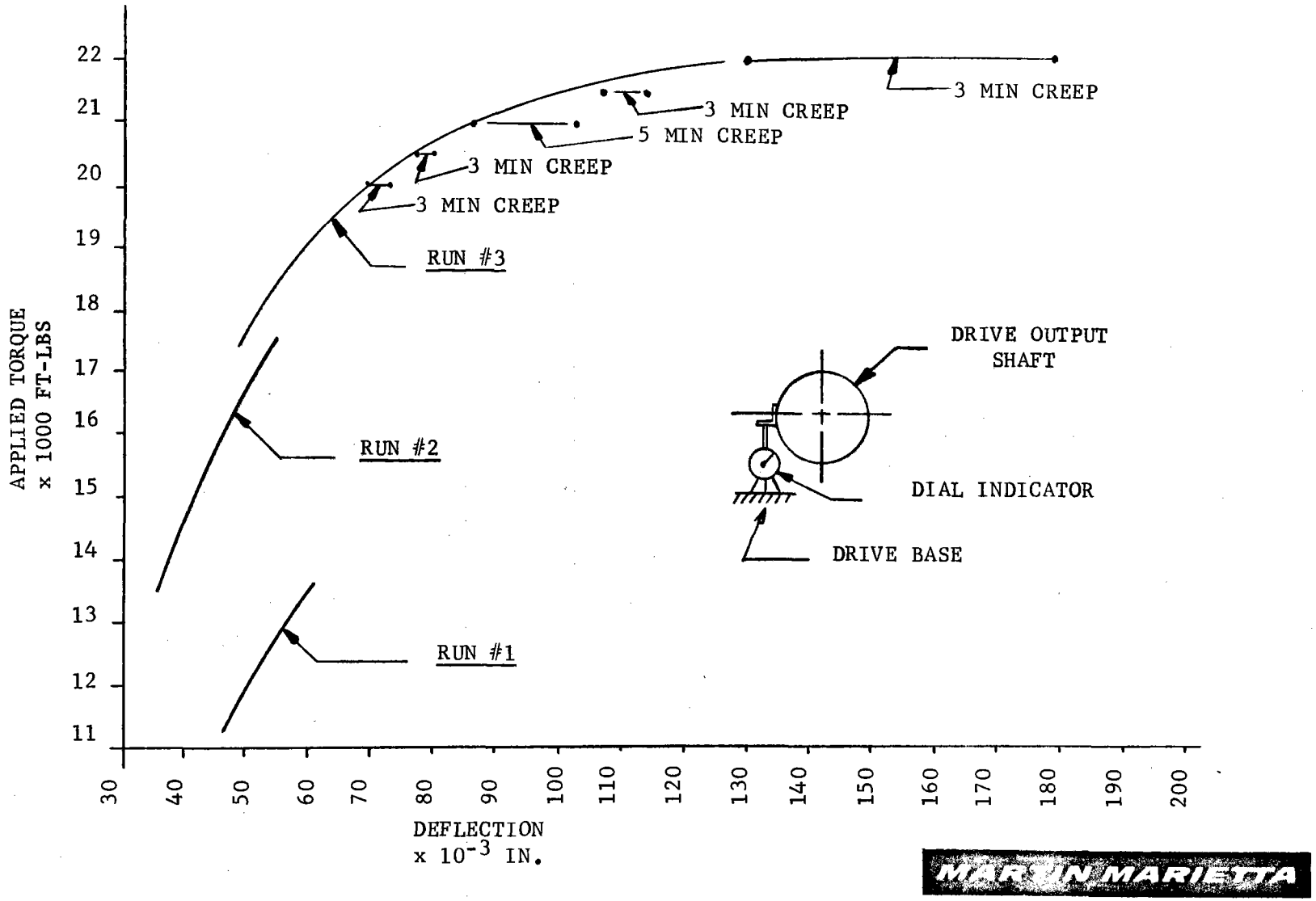
STTF DRIVE MECHANISM - TEST DATA



STRUCTURES AND MECHANISMS

WEEK OF	DRIVE MECHANISM	STRUCTURAL
10/2	DRIVE MANUFACTURER SELECTION	MIRROR MODULE DRAWINGS TO BALTIMORE
10/9	PRELIMINARY MEETING BETWEEN MMC/HUB CITY	TENTATIVE INTERFACE DRIVE MECHANISM, PEDESTAL, CONTROL ARMS
10/16	DRIVE MECHANISM PROGRAM PLAN	
10/23	ESTABLISH DRIVE MECHANISM INTERFACES	CONCEPTUAL DESIGN REVIEW
10/30		PEDESTAL I/F ADAPTER - PRELIMINARY ENCODER BRACKETS - PRELIMINARY
11/6	DRIVE MECHANISM FINAL DESIGN LAYOUT - PRELIMINARY DESIGN REVIEW	CONTROL ARMS - PRELIMINARY BAR JOISTS - PRELIMINARY
11/13	DRIVE MECHANISM DETAILING START	WINDLOADING ANALYSIS PRELIMINARY DESIGN REVIEW
11/20		PEDESTAL, ELEVATION BEAM DETAILS - PRELIMINARY
11/27		FOUNDATION REQUIREMENTS
12/4	RELEASE HOUSING DRAWINGS - ORDER PATTERNS, TOOLS, ETC.	
12/11		PEDESTAL ASSEMBLY - PRELIMINARY
12/18		

STRUCTURES AND MECHANISMS

WEEK OF	DRIVE MECHANISM	STRUCTURAL
12/25	DRIVE MECHANISMS DRAFTING COMPLETE	CHRISTMAS HOLIDAYS
1/1	DRIVE MECHANISM CRITICAL DESIGN REVIEW	
1/8		
1/15		PEDESTAL I/F ADAPTER (MOCKUP) TESTING
1/22		CONTROL ARM (MOCKUP) TESTING
1/29		
2/5		FACILITY CRITERIA CRITICAL DESIGN REVIEW
2/12		
2/19		
2/26	DRIVE MECHANISM 1ST ARTICLE AVAILABLE	
3/5		PREPRODUCTION AND PRODUCTION DESIGN DRAWINGS
3/12		

10 MW_e HELIOSTAT MIRROR ASSEMBLY

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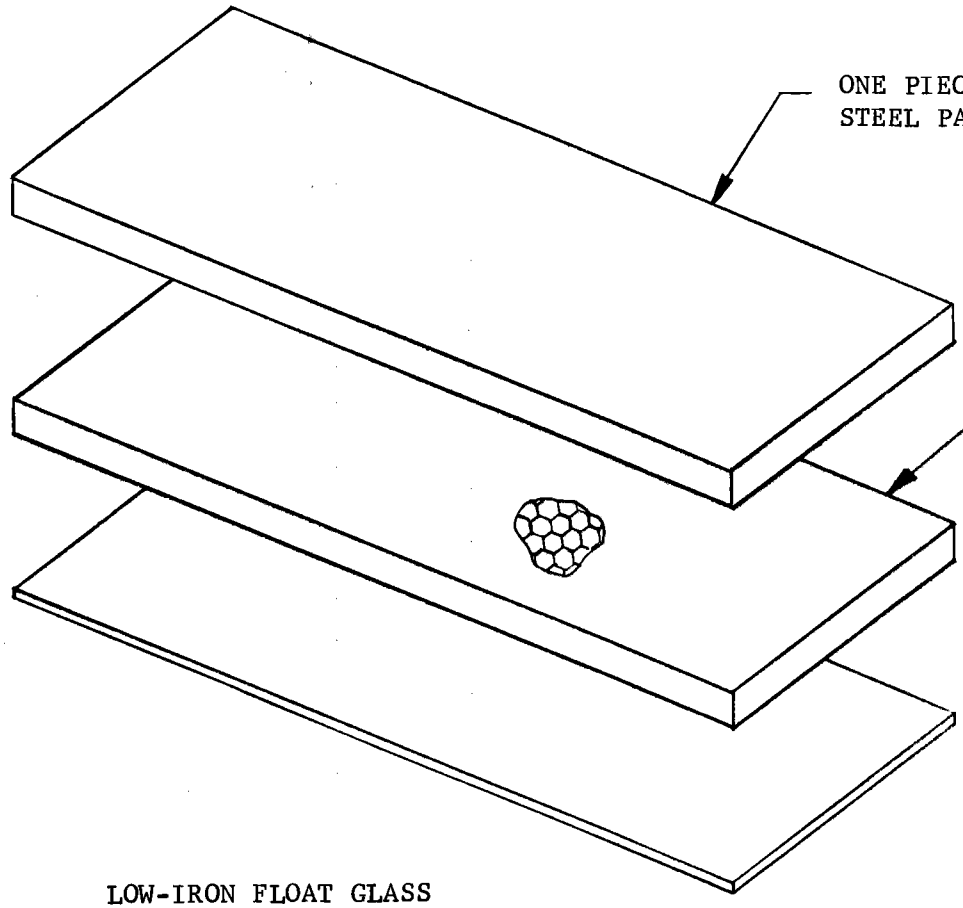
MIRROR ASSEMBLY STATUS

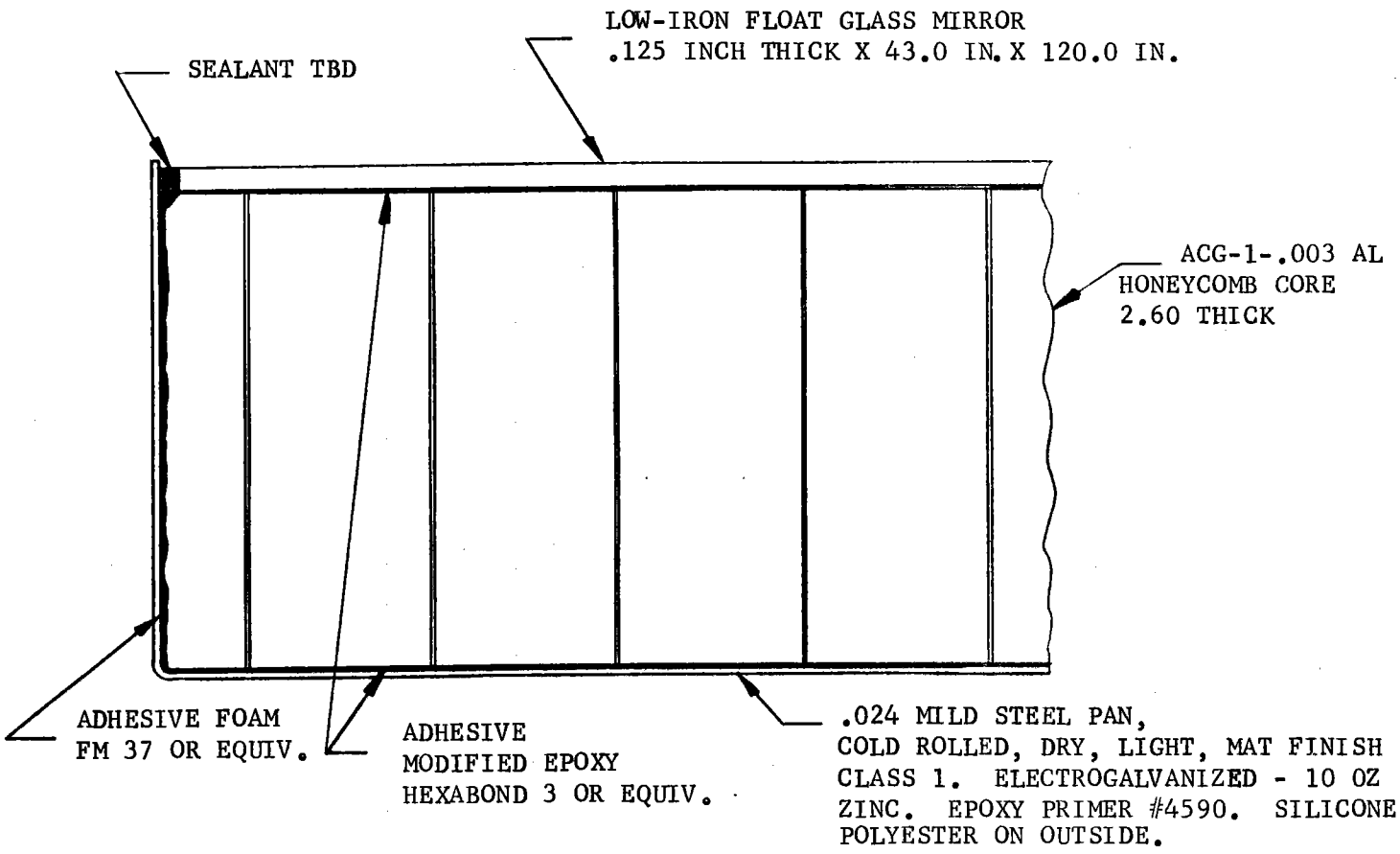
- DESIGN DRAWING RELEASED TO BALTIMORE DIVISION 10/9/78
- LONG-LEAD PROCUREMENT INITIATED: STEEL 10/5/78, H/C CORE 10/9/78
- SILVERING PROCUREMENT INITIATED 10/10/78, GARDNER MIRROR CORPORATION
- SEALANT EVALUATION TEST INITIATED 10/12/78
- NASTRAN MIRROR ASSEMBLY DETAIL DESIGN ANALYTICAL VERIFICATION IN PROCESS

EXPLOYED VIEW OF HONEYCOMB-CORE MIRROR ASSEMBLY



LOW-IRON FLOAT GLASS
MIRROR (SECOND SURFACE SILVERED)
.125 IN THICK X 43.0 IN. X 120.0 IN.

MIRROR ASSEMBLY CROSS SECTION



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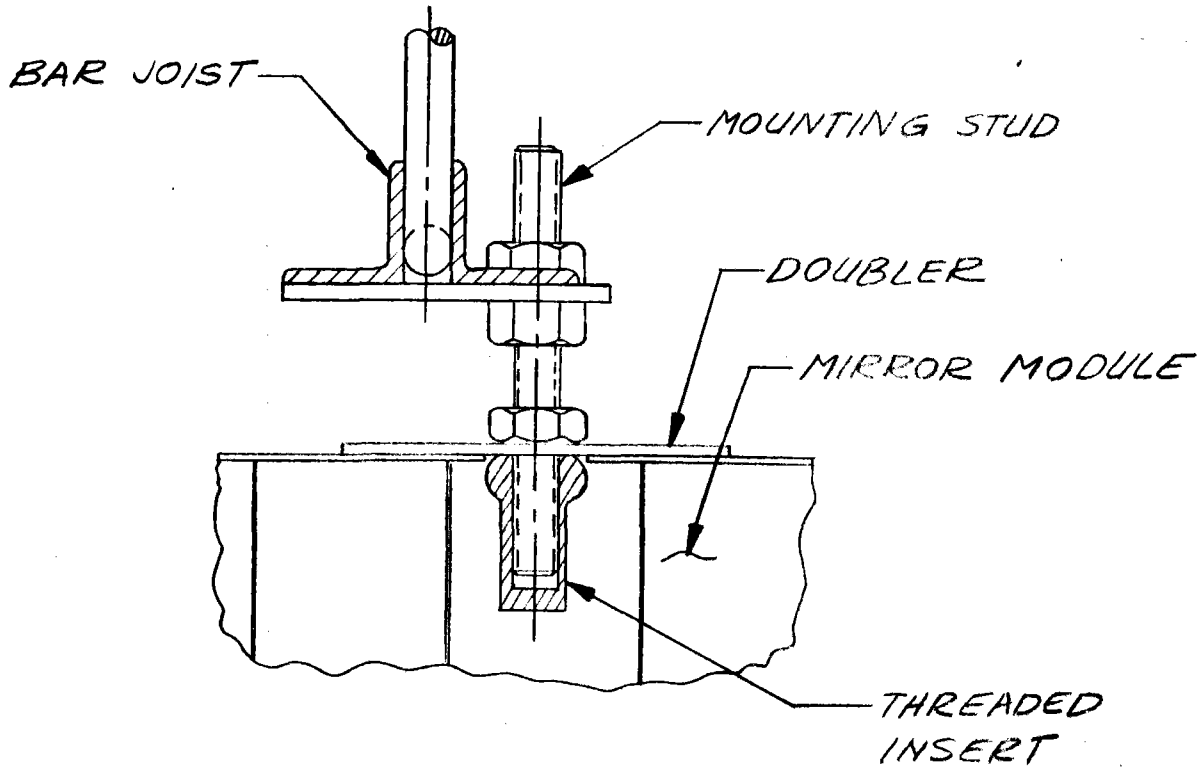
MIRROR MODULE MOUNTING CONCEPT



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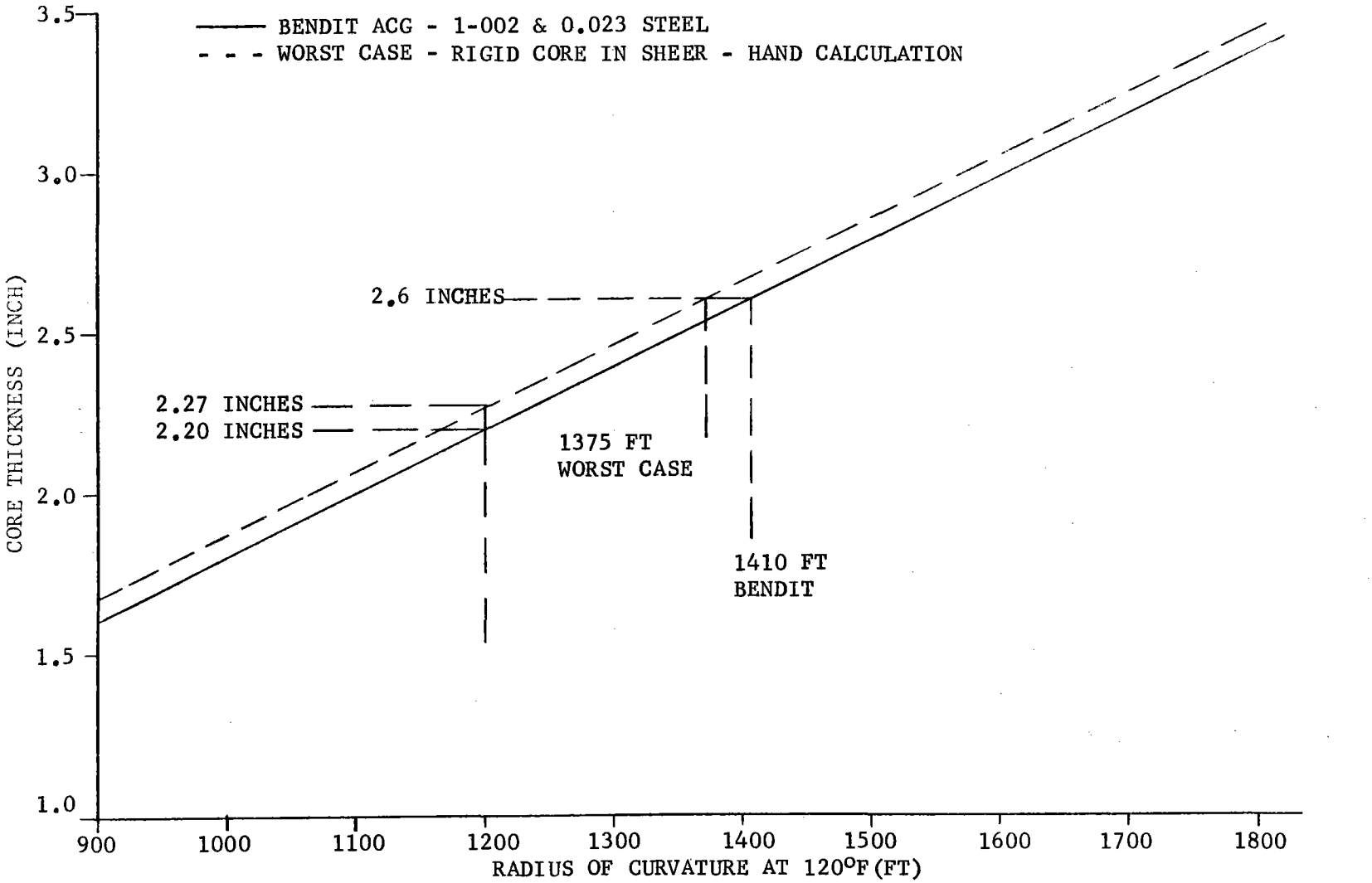
MIRROR ASSEMBLY - CHANGES FROM PROPOSAL DESIGN

ITEM	ORIGINAL PROPOSAL	NEW DESIGN	BASIS FOR CHANGE
HONEYCOMB CORE	ACG-3/4-003 3.2 IN. THICK	ACG-1-003 2.6 IN. THICK	MATERIAL AVAILABILITY COMMERCIALLY, COST REDUCTION 30% IN QUANTITY, ACCEPTABLE PERFORMANCE
ADHESIVE	MP 347, HIGH-TEMPERATURE-CURING EPOXY	HEXABOND 3 HIGH-TEMPERATURE-CURING EPOXY	EQUIVALENT ADHESIVE - LOWER COST - INCREASED PRODUCTION EFFICIENCY
SEALANT	PPC 2000 BUTYL CALKING COMPOUND	TBD - TEST IN PROGRESS	ORIGINAL SEALANT HAS UNACCEPTABLE CURING TIME FOR PRODUCTION RATES

MIRROR ASSEMBLY THERMAL BENDING VS CORE THICKNESS



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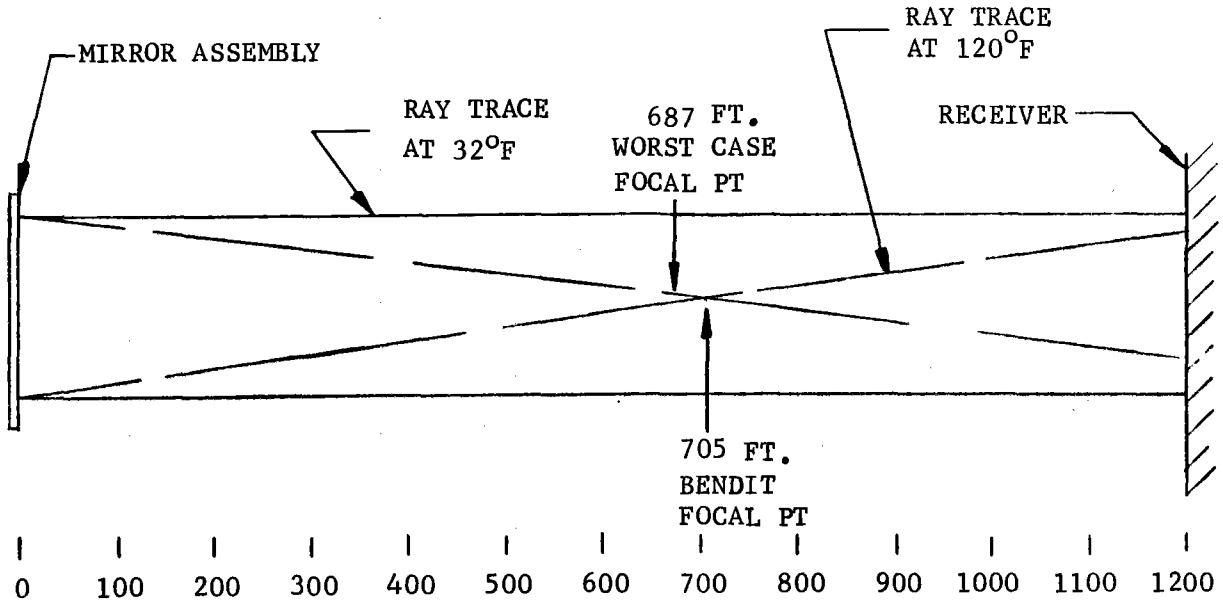
EFFECT OF THERMAL DISTORTION ON BEAM QUALITY FOR SINGLE MIRROR ASSEMBLY



AT 120°F IMAGE DIA.: 70% OF FLAT MIRROR (BENDIT)

AT 120°F IMAGE DIA.: 75% OF FLAT MIRROR (WORST CASE)

MIRROR ASSEMBLY LIFE

CRITICAL LIFE COMPONENTS:

STEEL: THREE LAYER LONG LIFE FINISH

- o ELECTROGALVANIZE: 0.10 OZ. ZINC CHEMICAL TREATMENT
- o EPOXY PRIMER
- o BAKED SILICONE POLYESTER PAINT

SEALANT: SELECTION TO BE BASED ON:

- o VENDOR LIFETIME PERFORMANCE DATA
- o MARTIN MARIETTA TEST PROGRAM

MIRROR ASSEMBLY SEALANT TEST PROGRAM

- PURPOSE - EVALUATE COMMERCIAL SEALANTS CAPABILITIES FOR SEALING GLASS MIRROR, EPOXY PRIMER AND STEEL EDGE INTERFACE.
- TEST CONDITIONS - 150°F, 95-100% RELATIVE HUMIDITY, TIME - TBD.
- CANDIDATE MATERIALS -

1)	PRODUCTS RESEARCH AND CHEMICAL	PR-365
2)	PRODUCTS RESEARCH AND CHEMICAL	PR-380M
3)	UNITED GILSONITE LABORATORIES	BUTYL CAULK
4)	UNITED GILSONITE LABORATORIES	ACRYLIC LATEX CAULK
5)	UNITED GILSONITE LABORATORIES	TUB AND TILE CAULK
6)	3M WEATHERBAN 101	
7)	SCOTCH - SEAL 1792	
8)	SCOTCH - SEAL 2084	
9)	ESSEX CHEMICAL PRO-SEAL 860	
10)	3M SCOTCH SEAL 1792	
11)	NATIONAL ADHESIVE'S DURIBBON 4050	
12)	GE SILPROOF WEATHERPROOFING SEALANT	
13)	SILICONE SEALANT RTV 108	

- SAMPLE SIZE 2" X 2" MIRROR ON 4" X 4" EPOXY PRIMED STEEL.

HEXABOND ADHESIVE TESTS

- HEXCEL CORPORATION: MATERIAL COMPATIBILITY TESTS OF HONEYCOMB-ADHESIVE-MIRROR BACK INTERFACE.

- MARTIN MARIETTA CORPORATION - BALTIMORE:

  SAMPLE NUMBER: 55 - 2" X 2"

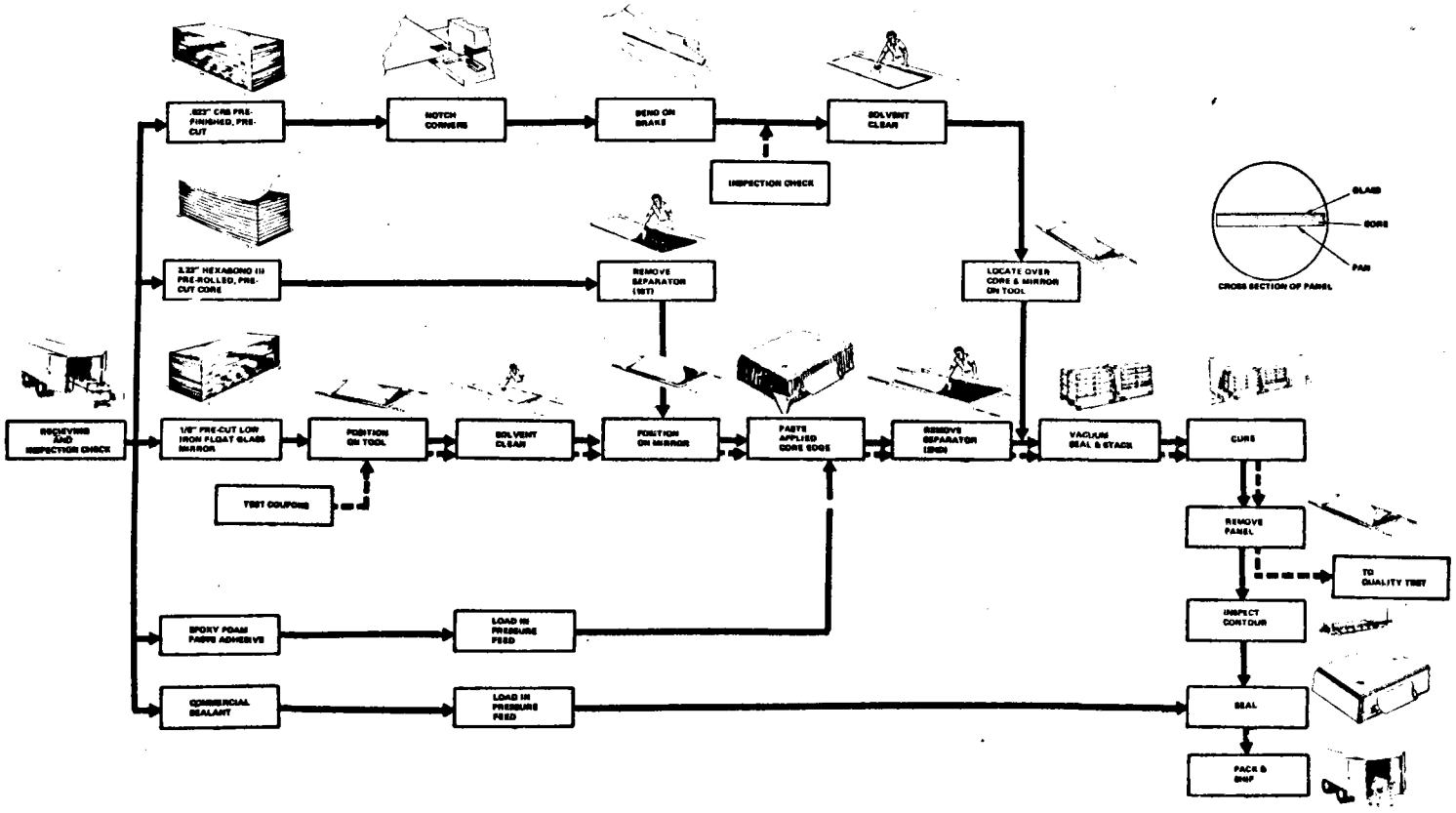
  SAMPLE STRUCTURE: 0.125" FLOAT GLASS - 3.23" ACG-3/4-.003 HEXABOND COATED ALUMINUM HONEYCOMB CORE - 0.017" PREFINISHED STEEL.

  TEST: A. FLATWISE TENSION PULL TESTS

  B. FLATWISE TENSION LOAD TEST

  C. ENVIRONMENTAL SOAK (150°F, 100% RH) THEN FLATWISE TENSION PULL TESTS.

MIRROR ASSEMBLY - PRODUCTION FLOW DIAGRAM



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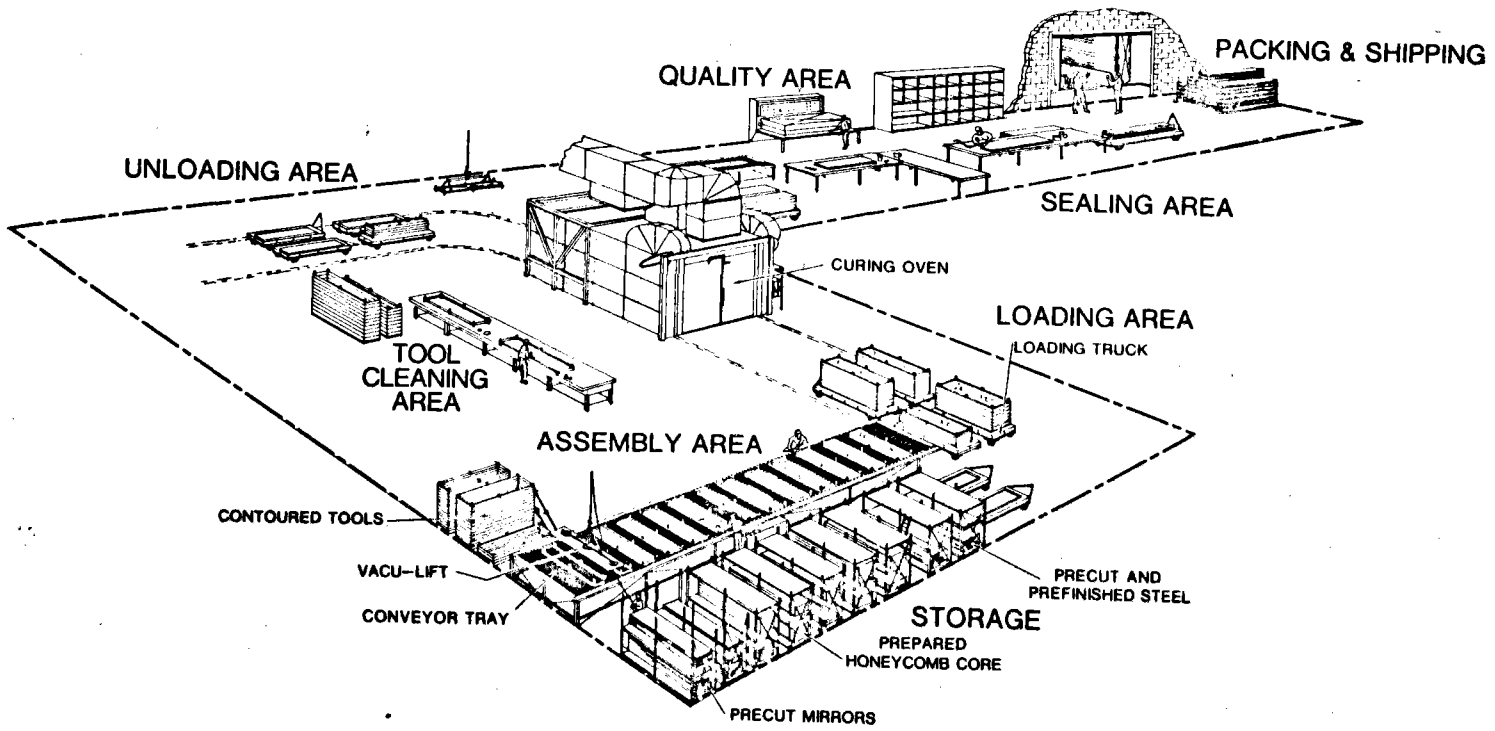
MIRROR ASSEMBLY - PRODUCTION AREA PLAN



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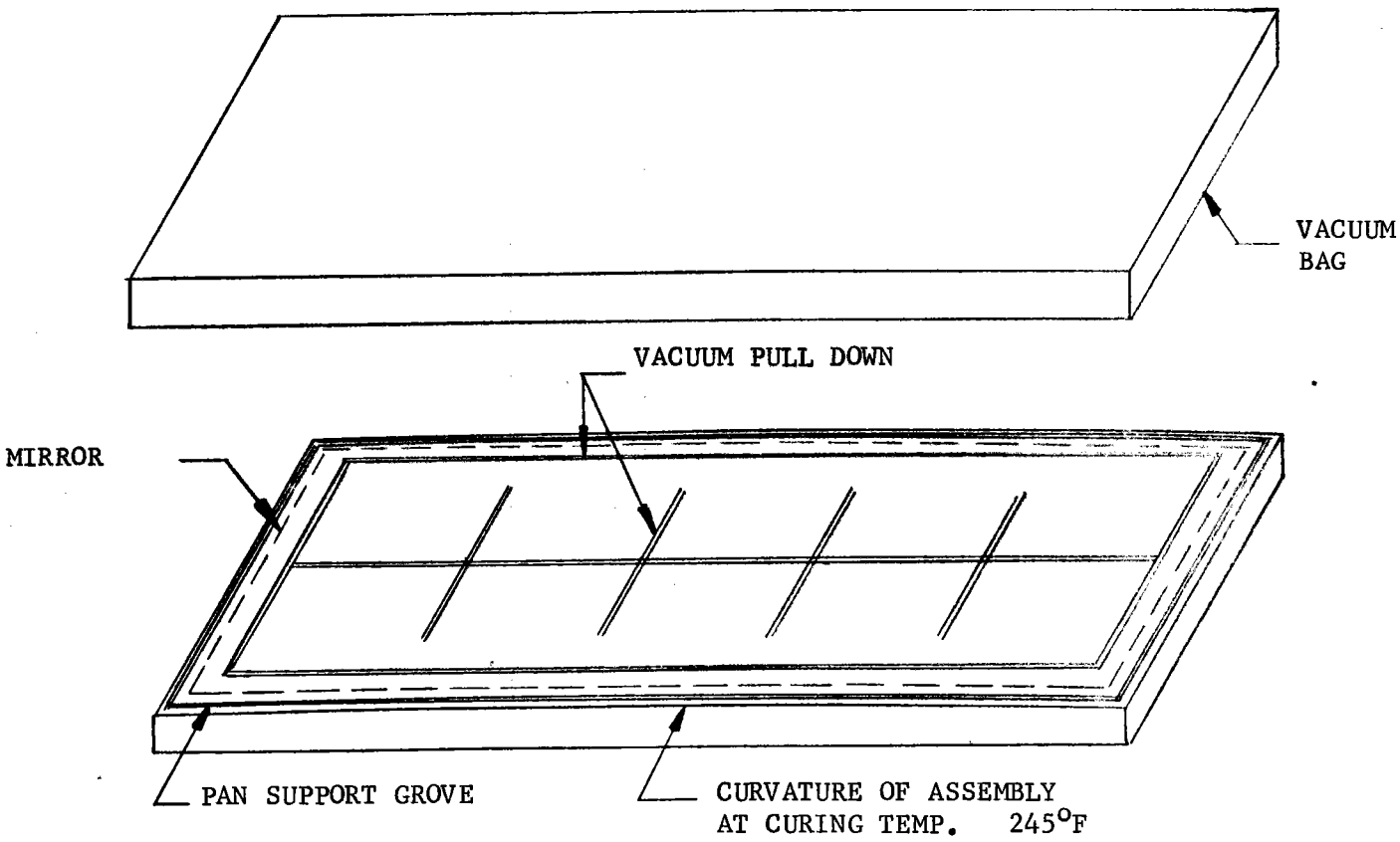
MIRROR ASSEMBLY PRODUCTION TOOL

- HOT BOND TOOL - STABILIZED FOR HOT BOND PROCESS
- TOOL CURVED TO SHAPE FOR CORRECT MIRROR CURVE AT BOND TEMPERATURE ($\sim 245^{\circ}F$)
  FOR FLAT MIRROR SHAPE AT $32^{\circ}F$
- VACUUM HOLD DOWN FOR MIRROR
- FAST ACTING VACUUM BAG FOR UNIFORM PRESSURE DURING BONDING
- TOOL FLATNESS TOLERANCE GOAL $\pm$ 0.2 MRAD MAX SLOPE ERROR

MIRROR ASSEMBLY PRODUCTION TOOL (CONCEPTUAL)



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MIRROR ASSEMBLY DESIGN VERIFICATION ANALYSIS

NASTRAN COMPUTER ANALYSES

- THERMAL DEFLECTION ANALYSIS
  - MIRROR DEFLECTION
  - GLASS STRESS
- STRUCTURAL LOADS ANALYSIS
  - MIRROR DEFLECTION
  - SUPPORT LOCATION AND SIZE
  - GLASS STRESS
  - STRUCTURAL STIFFNESS
- WIND LOADS ANALYSIS
  - MIRROR DEFLECTION
  - GLASS STRESS
  - SUPPORT LOCATION AND SIZE
  - STRUCTURAL STIFFNESS

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NASTRAN MODEL - MIRROR MODULE

PROGRAM: NASTRAN

* NASA STRUCTURAL ANALYSIS PROGRAM
* FINITE ELEMENT ANALYSIS
* ACCEPTED INDUSTRYWIDE
* DEVELOPED BY NASA IN THE 1960's
* MACNEAL-SCHWENDLER CORP. VERSION LOCATED AT MARTIN MARIETTA/ORLANDO
* STATE OF THE ART

SIZE:
- 80 NODES
- 60 PLATES
- 23 BARS
- 2 STRUCTURAL SUPPORTS
- 16 PLANE OF SYMMETRY CONSTRAINTS

RELATIONSHIP BETWEEN PLATE ELEMENT FORCES AND STRAINS:

$$\begin{Bmatrix} f \\ m \\ q \end{Bmatrix} = \begin{bmatrix} TG_1 & T^2G_4 & 0 \\ T^2G_4 & IG_2 & 0 \\ 0 & 0 & T_sG_3 \end{bmatrix} \begin{Bmatrix} \Delta\epsilon \\ \Delta\chi \\ \gamma \end{Bmatrix}$$

ELEMENT FORCES — STRAINS

$$\begin{bmatrix} TG_1 & T^2G_4 & 0 \\ T^2G_4 & IG_2 & 0 \\ 0 & 0 & T_sG_3 \end{bmatrix}$$

WHERE:

T = TOTAL THICKNESS OF PLATE

I = UNIT BENDING INERTIA OF PLATE

T_s = CORE THICKNESS

$$\begin{bmatrix} \frac{E}{1-\nu^2} & \frac{\nu E}{1-\nu^2} & 0 \\ \frac{\nu E}{1-\nu^2} & \frac{E}{1-\nu^2} & 0 \\ 0 & 0 & \frac{E}{2(1+\nu)} \end{bmatrix} = \left[G_e\right]_i$$

FOR ISOTROPIC FACE SHEETS

E = YOUNG'S MODULUS

ν = POISSON'S RATIO

$$G_1 = \frac{1}{T}\int_{-\frac{T}{2}}^{\frac{T}{2}} \left[G_e\right] \, dZ$$

$$G_2 = \frac{1}{I}\int_{-\frac{T}{2}}^{\frac{T}{2}} Z^2 \left[G_e\right] \, dZ$$

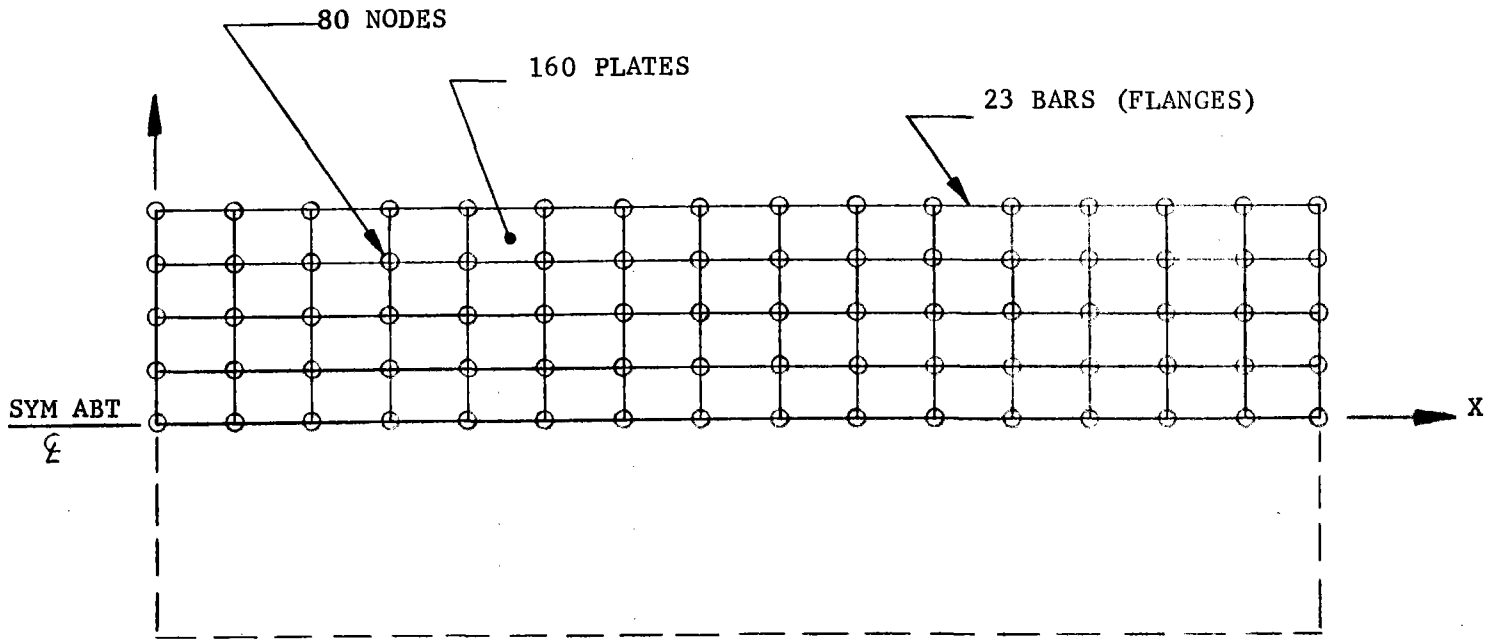
$$G_3 = \begin{bmatrix} G_L & 0 \\ 0 & G_W \end{bmatrix}$$

$$G_4 = \frac{1}{T^2}\int_{-\frac{T}{2}}^{\frac{T}{2}} (-Z) \left[G_e\right] \, dZ$$

G_L = CORE SHEAR MODULUS IN L DIRECTION

G_W = SAME, FOR W DIRECTION

NASTRAN MIRROR MODULE MODEL

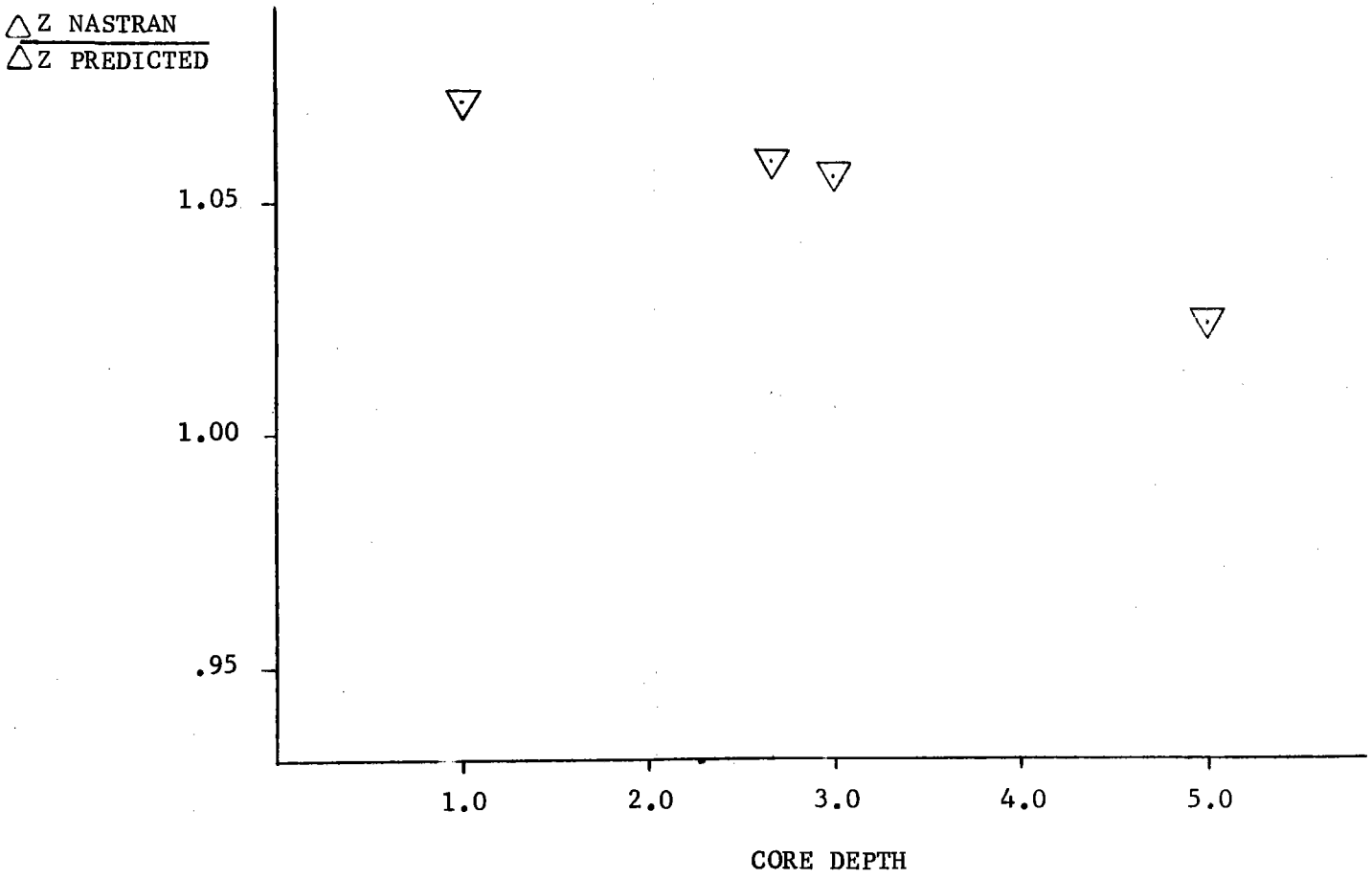


SUPPORT CONSTRAINTS:

A) NODES IN THE PLANE OF SYMMETRY ARE CONSTRAINED AGAINST ROTATION ALONG THE X AXIS AND AGAINST TRANSLATION IN THE Y DIRECTION.

B) THE STRUCTURAL SUPPORTS ARE MODELED BY CONSTRAINING THE APPROPRIATE NODES AGAINST TRANSLATION IN THE Z DIRECTION. ONE OF THE SUPPORTS IS ALSO CONSTRAINED AGAINST TRANSLATION IN THE X DIRECTION.

UNIFORM NORMAL WIND LOAD VERIFICATION



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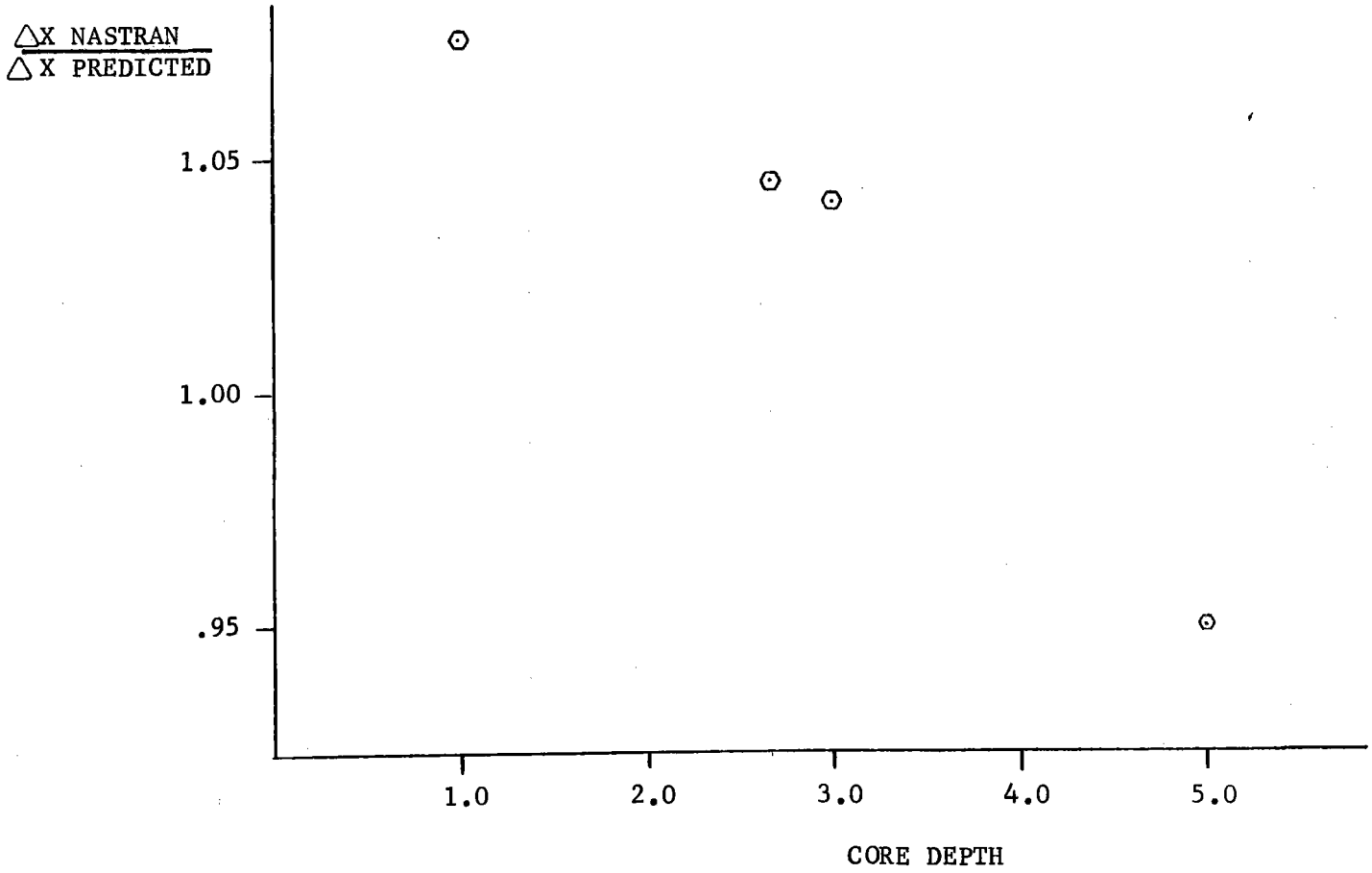
LINEAR THERMAL EXPANSION VERIFICATION



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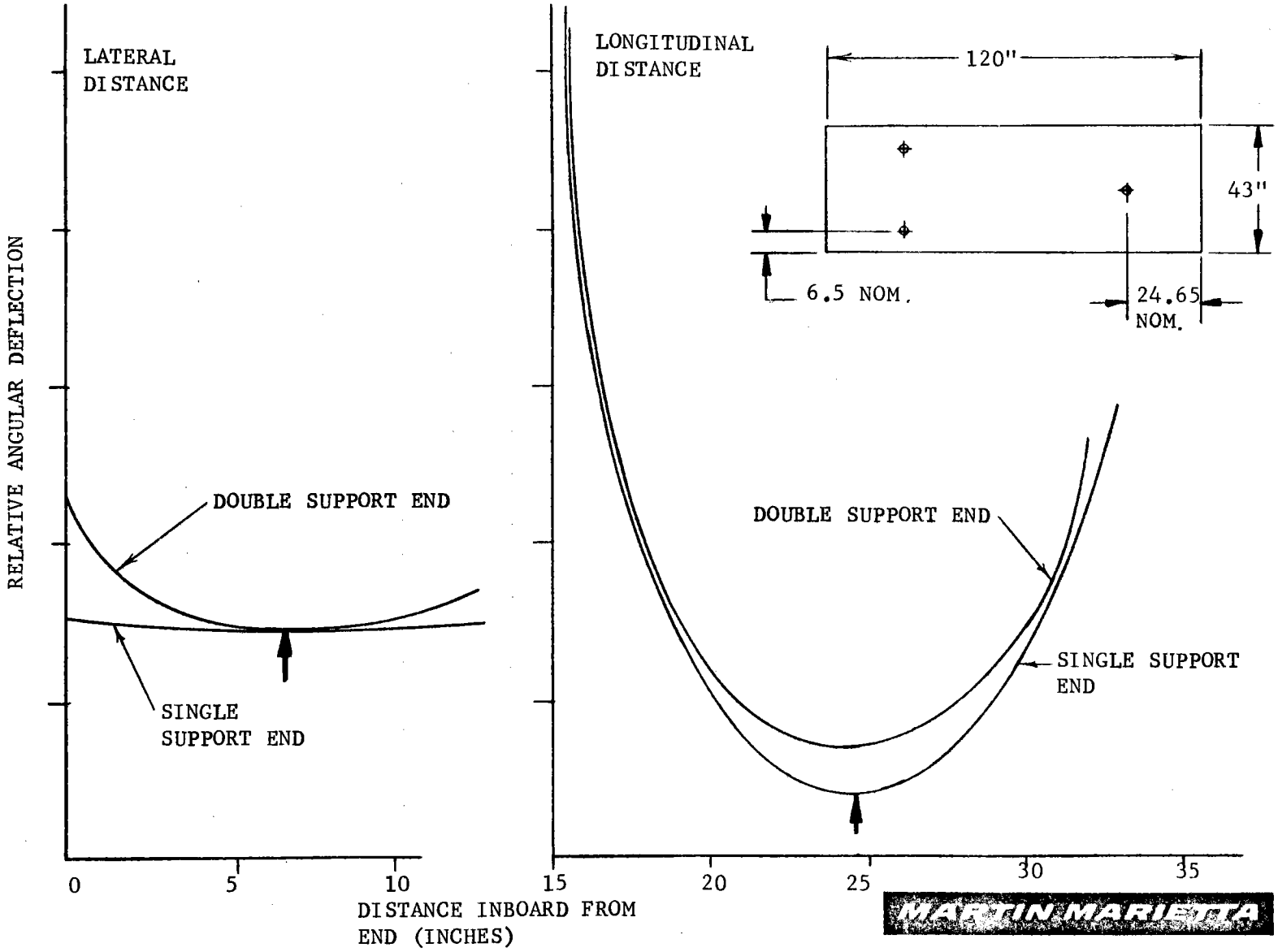
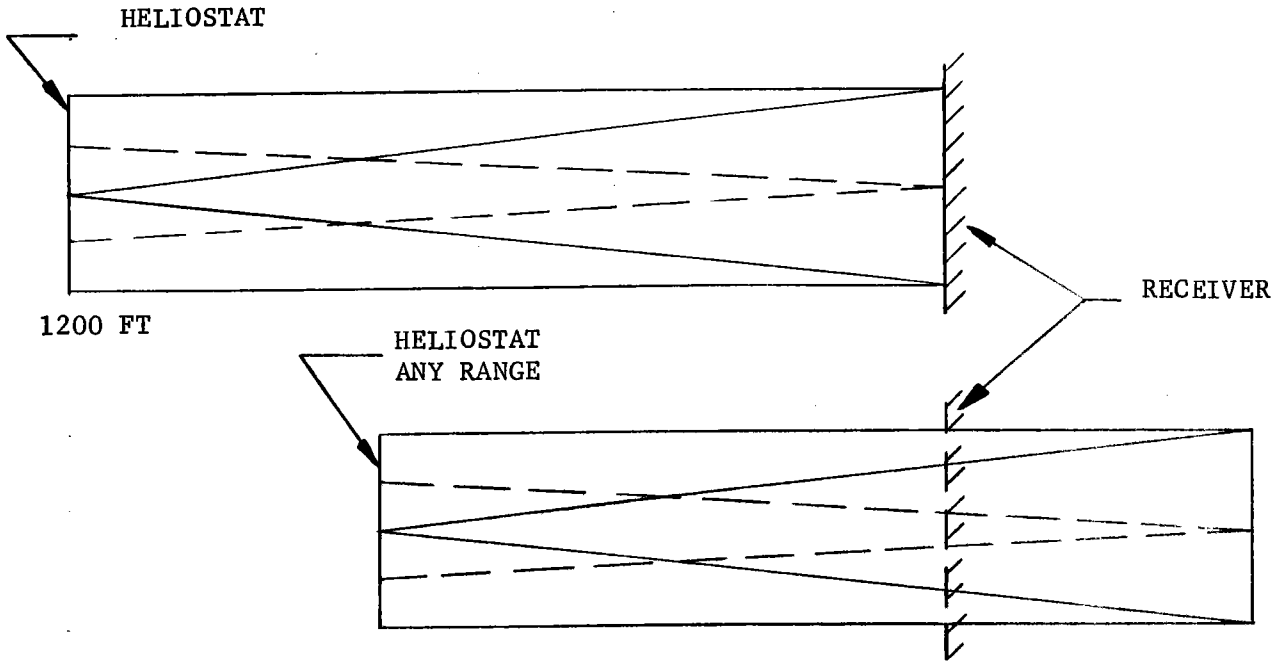
ANALYSIS APPROACH TO MIRROR ASSEMBLY SUPPORT LOCATIONS



HELIOSTAT ALIGNMENT, POINTING AND REALIGNMENT

MIRROR ASSEMBLY ALIGNMENT CONCEPT - SIMPLIFIED VIEW

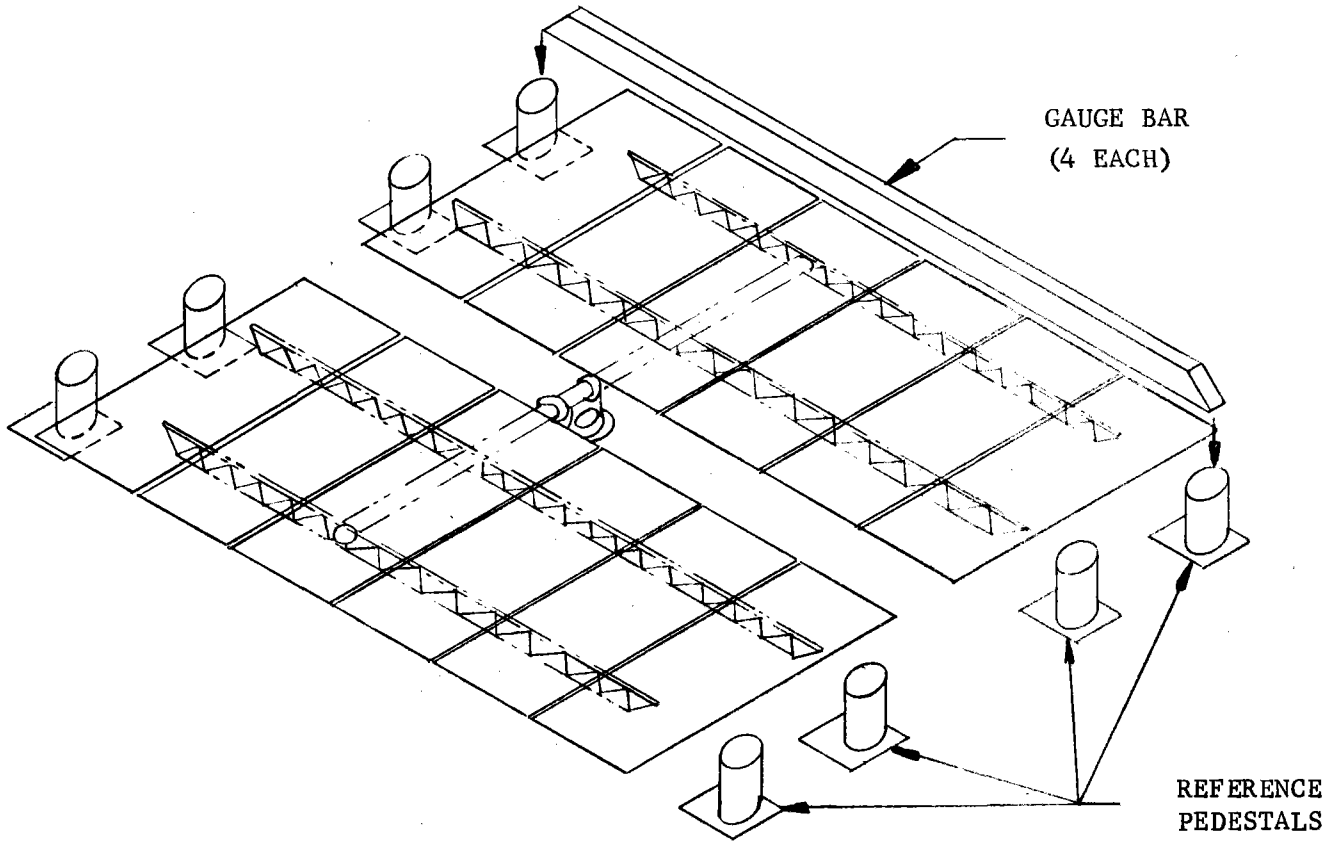


- o IMAGE SIZE FOR ALIGNED HELIOSTAT (FLAT MIRROR ASSYS.) AT 1200 FT ≈ SIZE OF HELIOSTAT.
- o IMAGE SIZE FOR ANY HELIOSTAT ALIGNED FOR 1200 FT ≈ SIZE OF HELIOSTAT.
- o ALL HELIOSTAT IMAGES ARE UNIFORMLY SPREAD OVER RECEIVER.
- o GIVES DESIRABLE IMAGE SIZE AND UNIFORMITY (NO HOT SPOTS).

MIRROR ASSEMBLY ALIGNMENT - PHASE II

- ALIGNMENT IS LAST STEP ON ASSEMBLY LINE.
- OPTIMIZED FOR PRODUCTION LINE EFFICIENCY.
- MIRROR SURFACE DIRECT READOUT - MAXIMUM ACCURACY.
- DIGITAL READOUT TO MINIMIZE READING ERROR.
- STANDARD SIMPLE CALIBRATION - SURFACE PLATE REFERENCE.
- ALLOWS ALIGNMENT VARIATION WITH NO HARDWARE CHANGE.
- LOW-COST ALIGNMENT FIXTURE.

REFLECTIVE ASSEMBLY ALIGNMENT FIXTURE



HELIOSTAT POINTING - ENCODER BIAS DETERMINATION

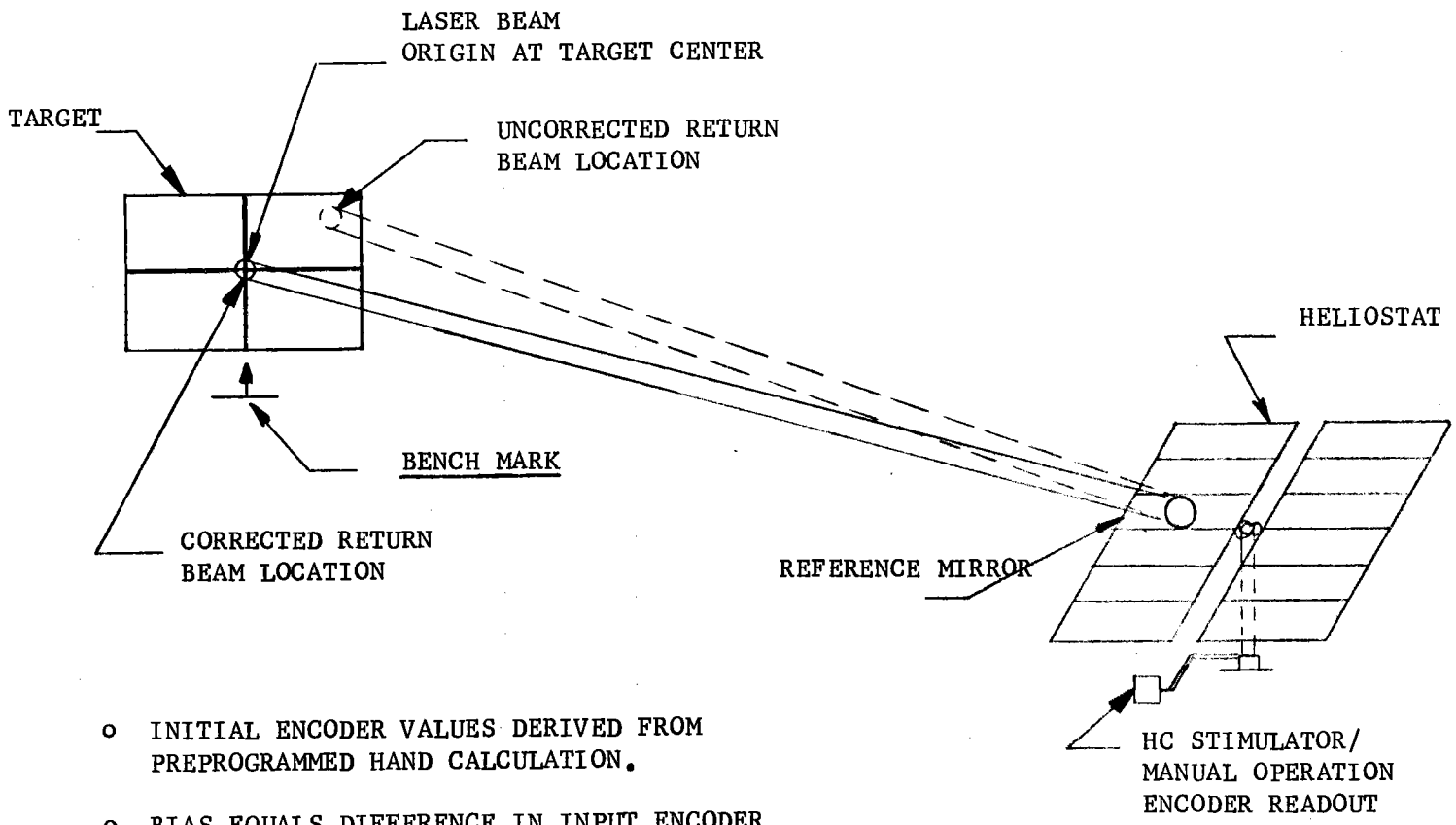
CONSTRAINTS

- MUST BE PERFORMED AFTER FIELD INSTALLATION.

APPROACH

- LASER ORIGINAL/REFLECTED BEAM AUTOCOLLIMATION.
- HELIOSTAT OPERATION BY HC STIMULATOR.
- MANUAL LASER OPERATION AND POINTING.
- ENCODER INPUT BY PREPROGRAMED HAND-HELD CALCULATOR OR STIMULATOR.
- MANUAL REFLECTED BEAM POINTING CORRECTION.
- REQUIRES KNOWLEDGE OF HELIOSTAT AND TARGET CENTER LOCATION COORDINATES.
- FIELD TIME - 10 MINUTES PER HELIOSTAT PLUS SET UP.
- NO CONTROL COMPUTER INTERFACE.

HELIOSTAT POINTING - ENCODER BIAS DETERMINATION



- o INITIAL ENCODER VALUES DERIVED FROM PREPROGRAMMED HAND CALCULATION.
- o BIAS EQUALS DIFFERENCE IN INPUT ENCODER VALUE AND CORRECTED RETURN BEAM ENCODER VALUES.
- o REQUIRES LOCATION KNOWLEDGE OF TARGET AND HELIOSTAT.

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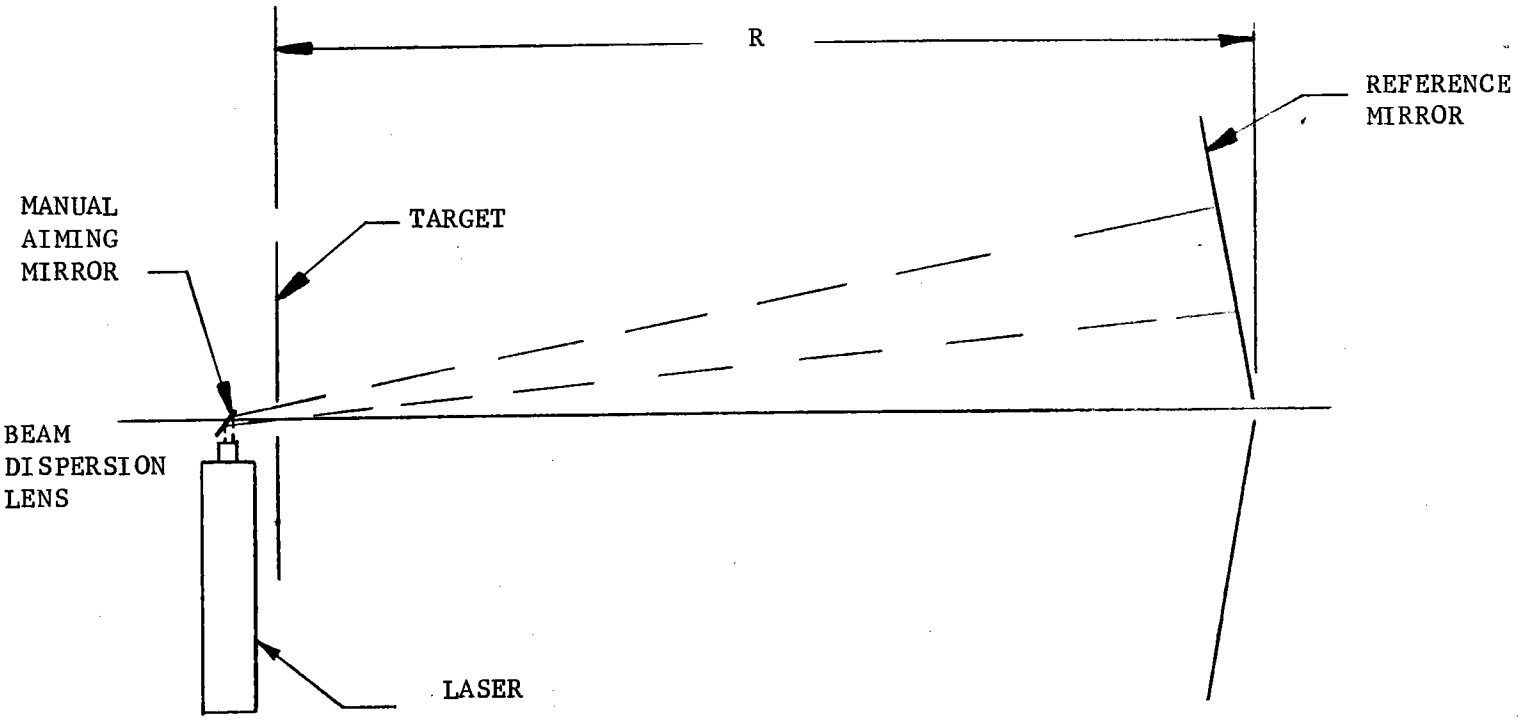
HELIOSTAT POINTING - OPTICAL DIAGRAM

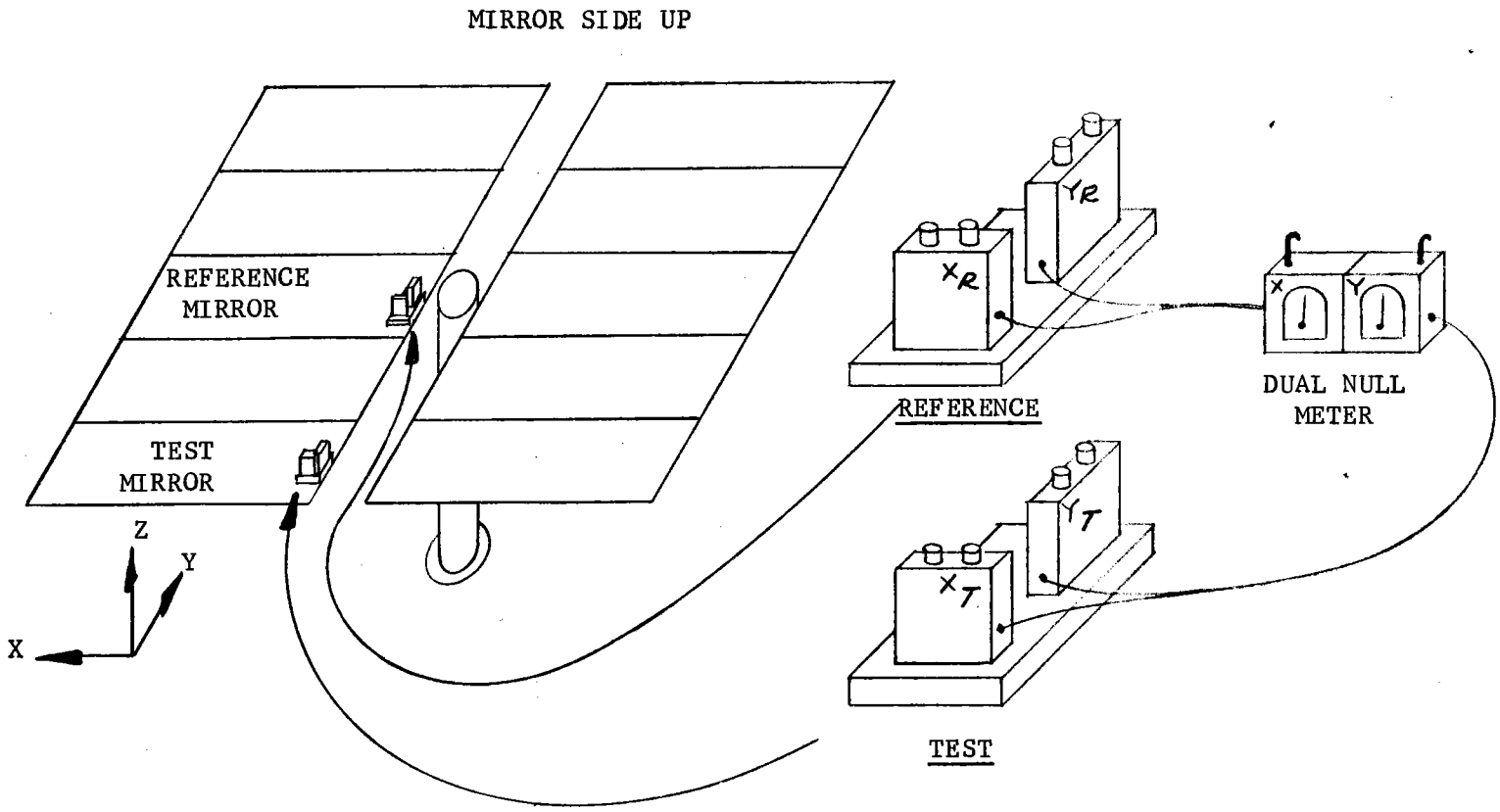


MARTIN MARIETTA

HELIOSTAT REALIGNMENT

- PRE-COMPUTE TWO AXIS SLOPE DIFFERENCE BETWEEN THE REFERENCE MIRROR ASSEMBLY AND OTHER MIRROR ASSEMBLIES.
- MANUALLY POSITION THE HELIOSTAT TO PRODUCE DESIRED SLOPE RANGE OF REFERENCE MIRROR AS MEASURED WITH A 2 AXIS INCLINOMETER.
- MEASURE 2 AXIS SLOPE DIFFERENCE BETWEEN REFERENCE MIRROR AND MIRROR BEING ALIGNED WITH DIFFERENTIAL INCLINOMETER SYSTEM.
- ADJUST MIRROR BEING ALIGNED TO CORRECT SLOPE RELATIVE TO REFERENCE MIRROR.

DIFFERENTIAL INCLINOMETER SYSTEM FOR HELIOSTAT REALIGNMENT



MARTIN MARIETTA

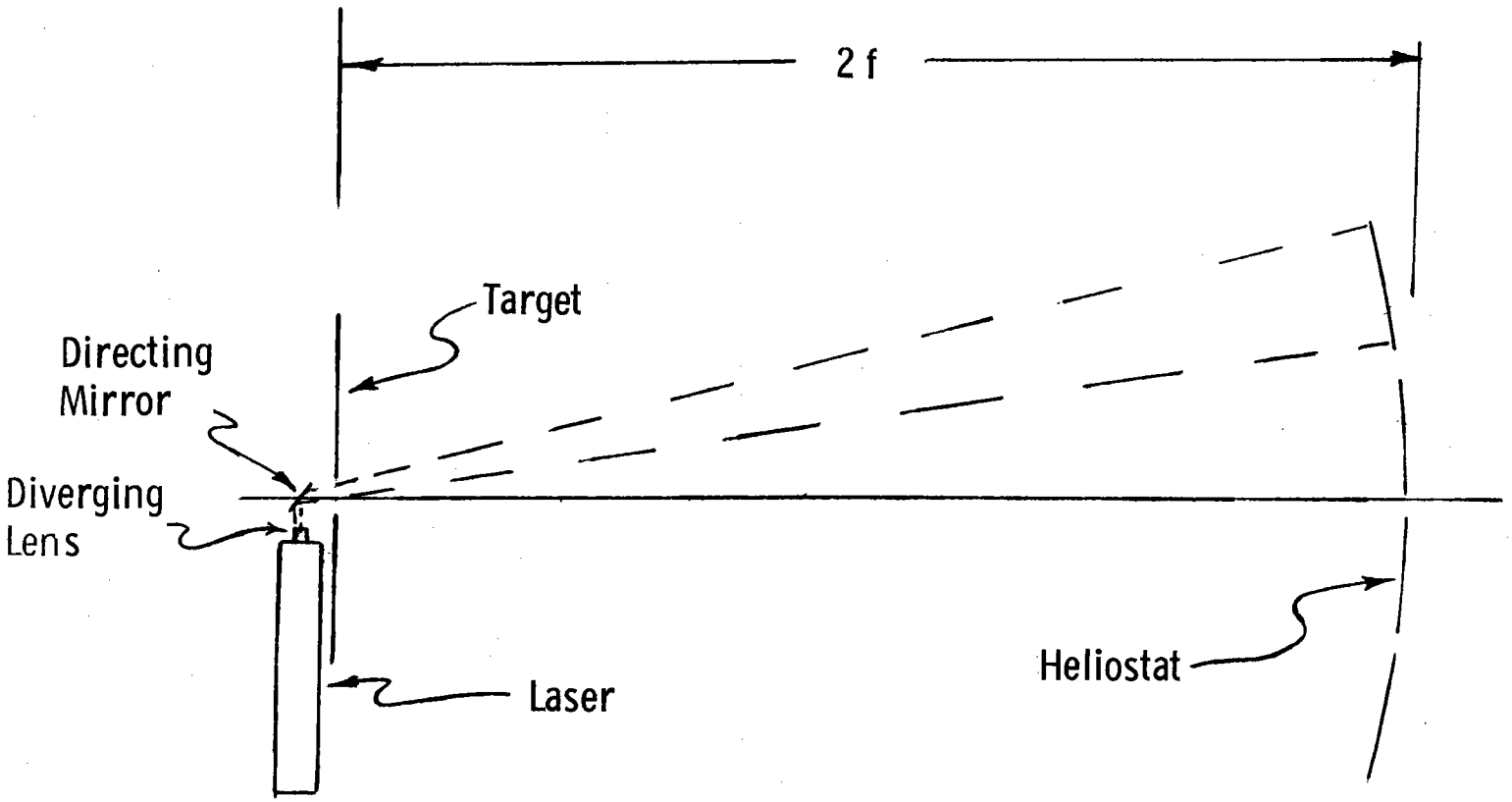
PREPRODUCTION HELIOSTAT ALIGNMENT - PHASE I (OPTION A)

- ALIGNMENT WILL BE DONE USING STTF LASER/COLLIMATOR (L/C) AND TARGET.
- ALIGNMENT WILL USE STTF ALIGNMENT COMPUTER PROGRAM MODIFIED FOR 10 MWe HELIOSTAT.
- COMPUTER PROGRAM RUN ON DENVER DDC TO MINIMIZE STTF COMPUTER REQUIREMENTS.
- ALIGNMENT WILL HAVE BETTER THAN 13-BIT ACCURACY.
- HELIOSTAT POSITIONING DURING ALIGNMENT BY HFC STIMULATOR.
- ALIGNMENT WILL BE VERIFIED USING THE SUN.
- REQUIRES EXACT LOCATION COORDINATES OF THE HELIOSTATS, L/C AND TARGET CENTER.

PREPRODUCTION HELIOSTAT ALIGNMENT - PHASE I - (OPTION B)

- SPHERICAL ALIGNMENT
- 50 MW HeNe LASER - (STTF SPARE)
- LOCATE LASER AT TARGET CENTER 2f (2400 FT.) FROM HELIOSTAT
- STATIC MANUAL ALIGNMENT NOT DEPENDENT ON ENCODER ACCURACY
- VERIFY ALIGNMENT WITH THE SUN

HELIOSTAT ALIGNMENT AT THE CENTER OF CURVATURE



INTERPRETATION OF PERFORMANCE SPECIFICATION

BEAM POINTING ERRORS - $\leq$1.5 MRAD STANDARD DEVIATION (REFLECTED BEAM) WITH SUN ELEV. $\geq 15^{\circ}$.

- o DOES NOT INCLUDE STRUCTURAL DEFLECTIONS DUE TO WIND OR GRAVITY.

BEAM QUALITY - $\geq$90% OF REFLECTED ENERGY WITHIN AREA 1.4 MRAD LARGER THAN THEORETICAL BEAM SHAPE.

- o INCLUDES SPECULAR DISPERSION, MIRROR IRREGULARITIES, MIRROR THERMAL DISTORTIONS, AND MISALIGNMENT BETWEEN FACETS.
- o DOES NOT INCLUDE STRUCTURAL DEFLECTIONS OF THE MIRROR MODULE OR SUPPORT STRUCTURE.

REFLECTIVE SURFACE STATIC AND DYNAMIC DEFLECTIONS - $\leq$1.7 MRAD STANDARD DEVIATION (MIRROR NORMAL DEFLECTION)

- o INCLUDES ALL WIND-INDUCED STRUCTURAL DEFLECTIONS (ON DRIVE MECHANISM, STRUCTURE, AND MIRROR MODULE).
- o WIND VELOCITY: 9.23 M/S STEADY/12 M/S STEADY WITH GUSTS.
- o STANDARD DEVIATIONS DETERMINED FROM DISTRIBUTIONS OF WIND DIRECTION, HELIOSTAT GIMBAL ANGLES, AND DEFLECTIONS OVER THE HELIOSTAT SURFACE.

TESTING IMPLICATIONS OF PERFORMANCE SPEC INTERPRETATION

BEAM POINTING

TEST UNDER (APPROXIMATELY) NO-WIND CONDITIONS.

USE A PRECISION REFERENCE MIRROR MOUNTED NEAR THE CENTER OF THE HELIOSTAT.

BEAM QUALITY

TEST UNDER (APPROXIMATELY) NO WIND CONDITIONS.

TEST AT (APPROXIMATELY) THE ELEVATION GIMBAL ANGLE USED FOR ALIGNMENT TO EXCLUDE STRUCTURAL DEFLECTION EFFECTS.

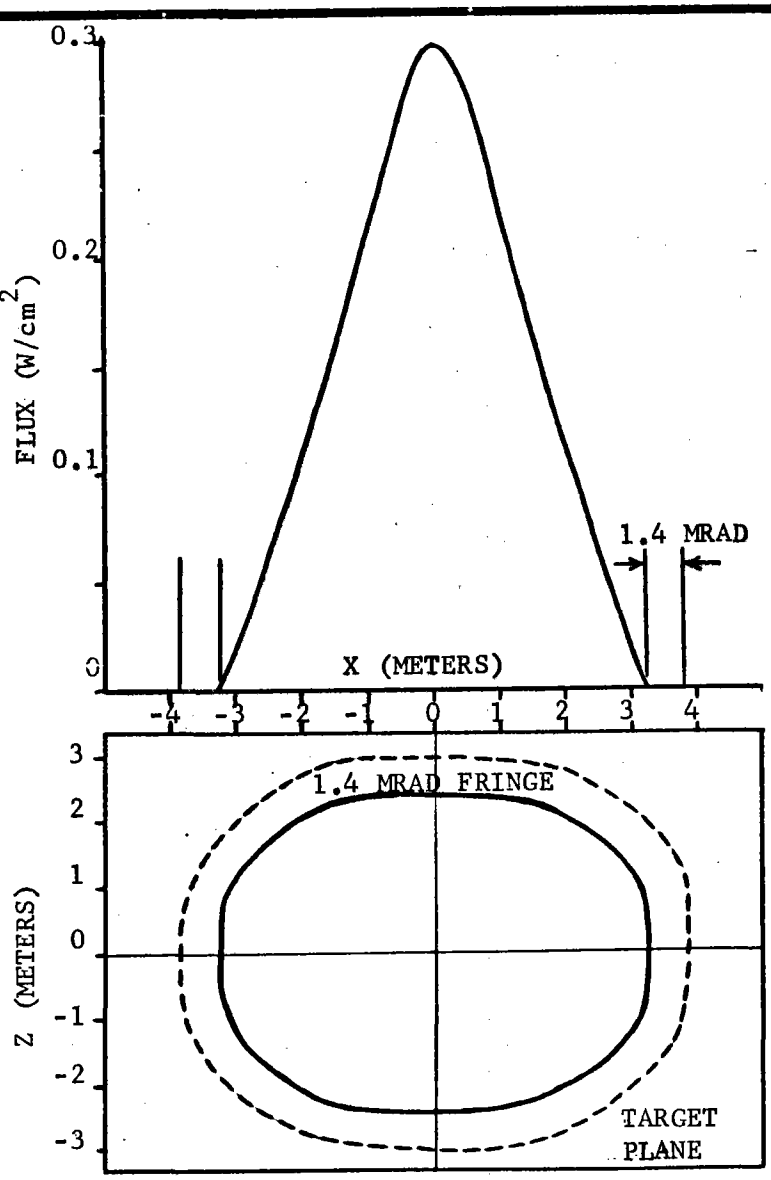
BEAM POINTING ERROR ALLOCATIONS

ERROR SOURCE	RESOLUTION	REFLECTED BEAM ERROR (1 σ) AZI	ELEV
ENCODER RESOLUTION	13 BIT WORDS	0.44	0.44
SUN POSITION PREDICTION	SEE NEXT TABLE	0.08	0.08
LIGHT PATH REFRACTION	22 ARC SEC	0.11	0.25
HELIOSTAT GEOMETRY ERRORS			
PAD LOCATION	$\pm$ 0.50 INCH	0.13	0.10
REF. FACET CENTER LOCATION	$\pm$ 0.25 INCH	0.06	0.06
PEDESTAL TILT	1.5 MRAD (3 σ)	0.71	0.50
DRIVE UNIT AZI. AXIS TILT	0.5 MRAD (3 σ)	0	0.24
DRIVE UNIT ELEV. AXIS TILT	0.5 MRAD (3 σ)	0.24	0.02
MIRROR SUPPORT MISALIGNMENT	1.2 MRAD (3 σ)	0.56	0.02
ALIGNMENT ERRORS			
ENCODER ERROR	$\pm$ 0.2 BIT	0.18	0.18
REFLECTED BEAM CENTROID	$\pm$ 2 INCHES	0.50	0.32
NORTH/SOUTH REF. DETERMINATION	0.01 DEGREE	0.17	0
RSS TOTALS		1.19	0.85
RSS BEAM POINTING TOTAL	$\sqrt{(EL)^2 + (AZ \cos 13.8^\circ)^2} =$		1.45

BEAM POINTING ERROR CALCULATION ASSUMPTIONS

ERROR SOURCE	ASSUMPTIONS
ENCODER RESOLUTION	EQUAL PROBABILITY WITHIN $\pm$ ½ BIT
SUN POSITION PREDICTION	CODED EPHEMERIS ALGORITHM (9 ARC SEC ACCURACY) CUBIC FIT ET TO UTC CONV. (0.3 SEC ACCURACY) LATITUDE/LONGITUDE UNCERTAINTIES (0.06 MRAD) 16-BIT SUN VECTOR WORDS SENT EVERY SECOND.
LIGHT PATH REFRACTION	SUN TO HELIOSTAT AND HELIOSTAT TO TARGET ALGORITHM CORRECTION ERRORS TO 22 ARC SEC.
HELIOSTAT GEOMETRY ERRORS	PAD AND REF. FACET LOCATIONS ON CLOSEST HELIOSTAT TILTS AND MISALIGNMENTS OF PEDESTAL AND AXES BASED ON MAXIMUM 3σ VALUE FOR 2000 HELIOSTATS. VALUES CONVERTED FROM MIRROR NORMAL TO REFLECTED BEAM.
ALIGNMENT ERRORS	ENCODER CAN BE CONTROLLED DURING ALIGNMENT TO $\pm$ 0.2 BIT. REFLECTED BEAM CENTROID FOR CLOSEST HELIOSTAT.

THEORETICAL BEAM SHAPE



HELIOS PROGRAM

KUIPER DISTRIBUTION SUNSHAPE
EXPONENTIAL DECAY FOR SUN EDGE
NO MIRROR ERROR DISTRIBUTION
RECTANGULAR FLAT FACETS
FACET REFLECTIVITY = 88%
HELIOSTAT LOCATION = (0, 357m,0)
HELIOSTAT SLANT RANGE = 366m
CALCULATED FOR SUMMER SOLSTICE NOON
CALIBRATED FOR VERNAL EQUINOX NOON
BARSTOW LATITUDE

1.4 MRAD FRINGE

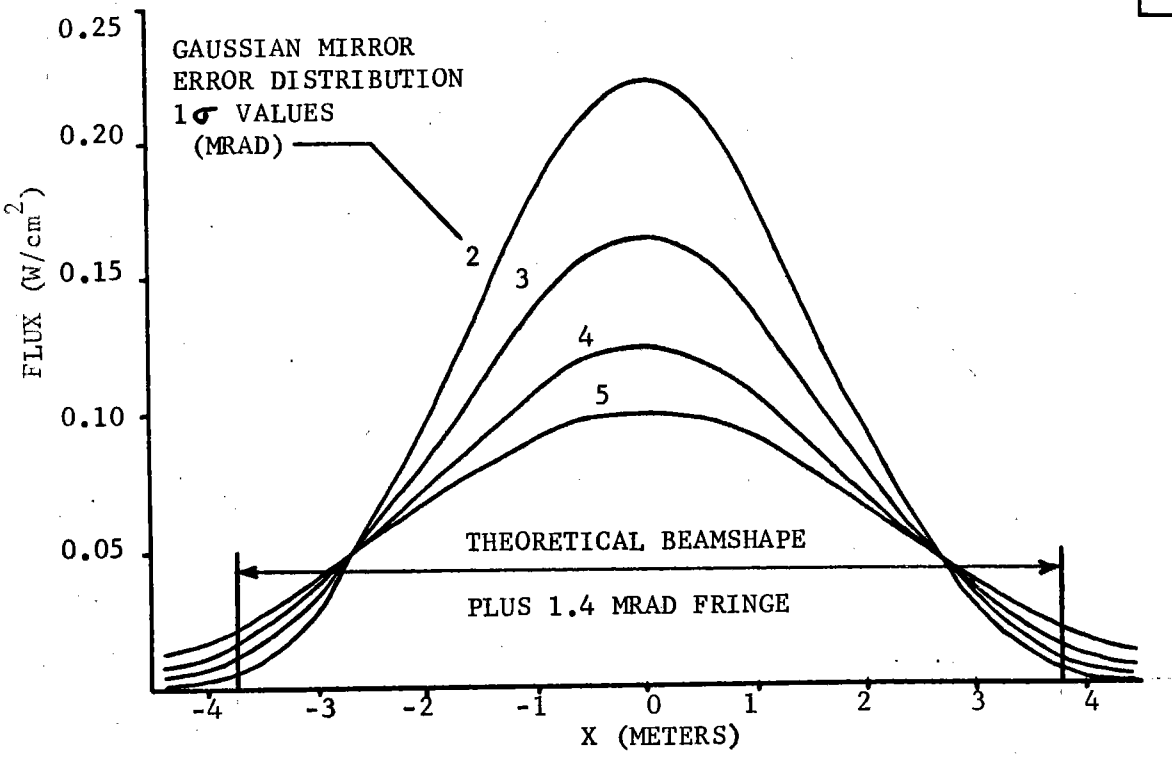
$-3.75 \leq X \leq 3.75$ METERS
$-3.00 \leq Z \leq 3.00$ METERS

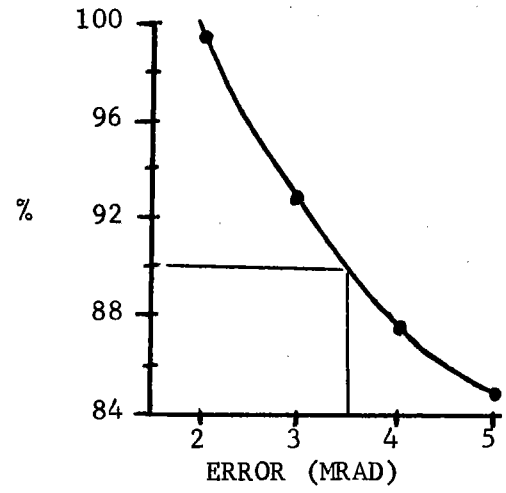
MARTIN MARIETTA

CONVOLUTED
DISTRIBUTIONS

(EFFECTIVE SUNSHAPES)

ERRORS (MRAD)	% WITHIN FRINGE O.D.
2	99.7
3	93.0
4	87.6
5	85.0





MARTIN MARIETTA

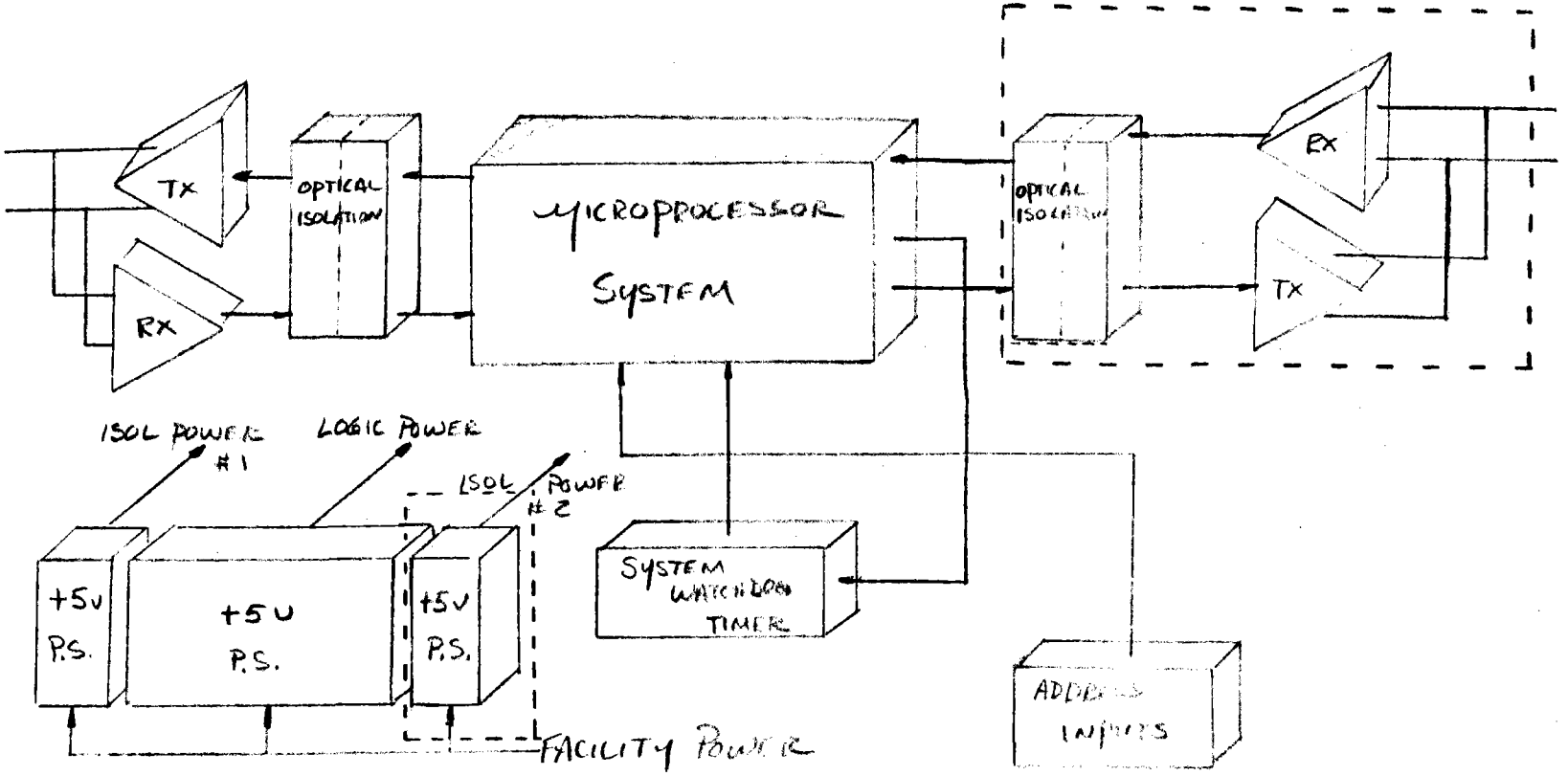
BEAM QUALITY ERROR ALLOCATIONS

ERROR SOURCE	REFLECTED BEAM ERROR (1σ) AZI	ELEV
SPECULAR DISPERSION	0.8†	0.8†
MIRROR IRREGULARITIES	1.4	1.4
MIRROR THERMAL DISTORTION	0*	0*
RELATIVE FACET MISALIGNMENT	1.4	1.4
RSS TOTALS	2.2	2.2
RSS BEAM POINTING TOTAL	3.1	

† DEPENDENT UPON QUALITY OF GFP GLASS.

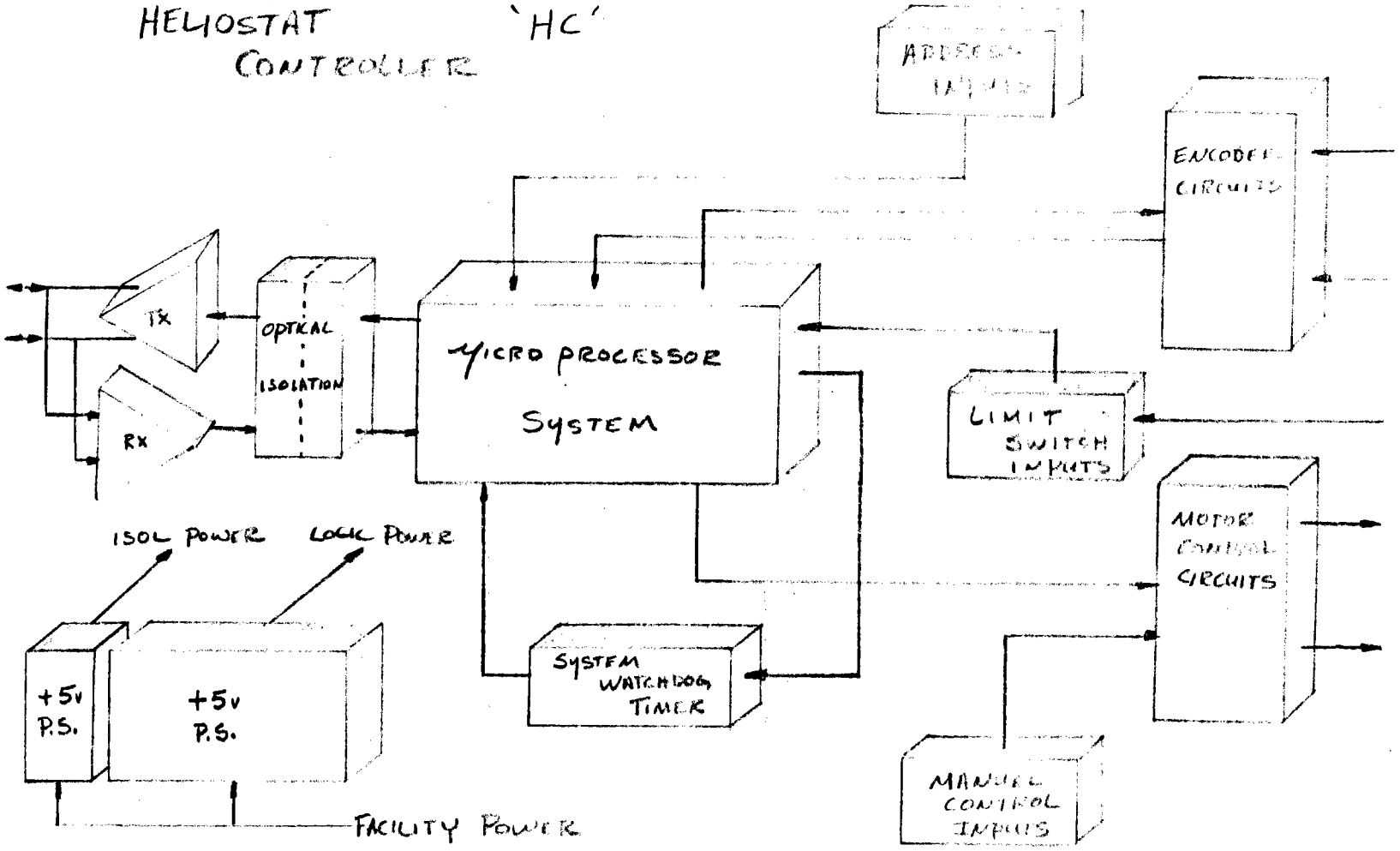
* THERMAL DISTORTION NEGLIGIBLE BECAUSE FACETS ARE DESIGNED TO BE FLAT AT 0°C (32°F) AND THERMAL EFFECTS UP TO 50°C (122°F) WILL RESULT IN A DECREASE IN BEAM SIZE.

HELIOSTAT FIELD CONTROLLER 'HFC'



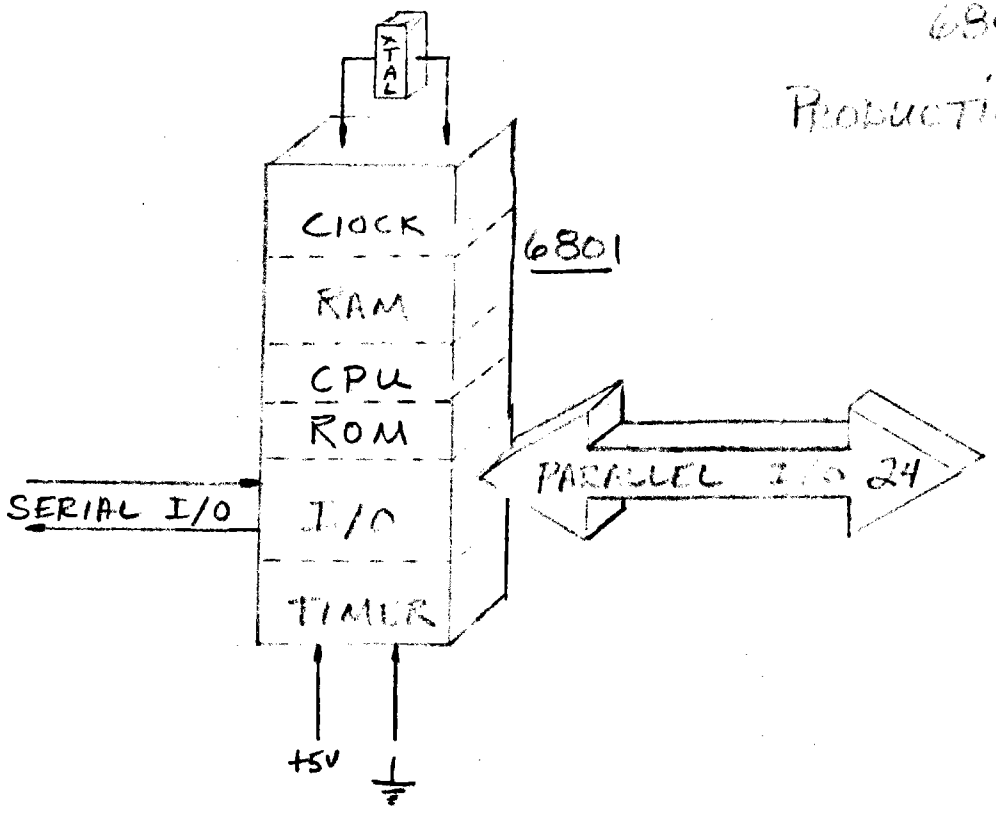
MARTIN MARIETTA

HELIOSTAT CONTROLLER 'HC'



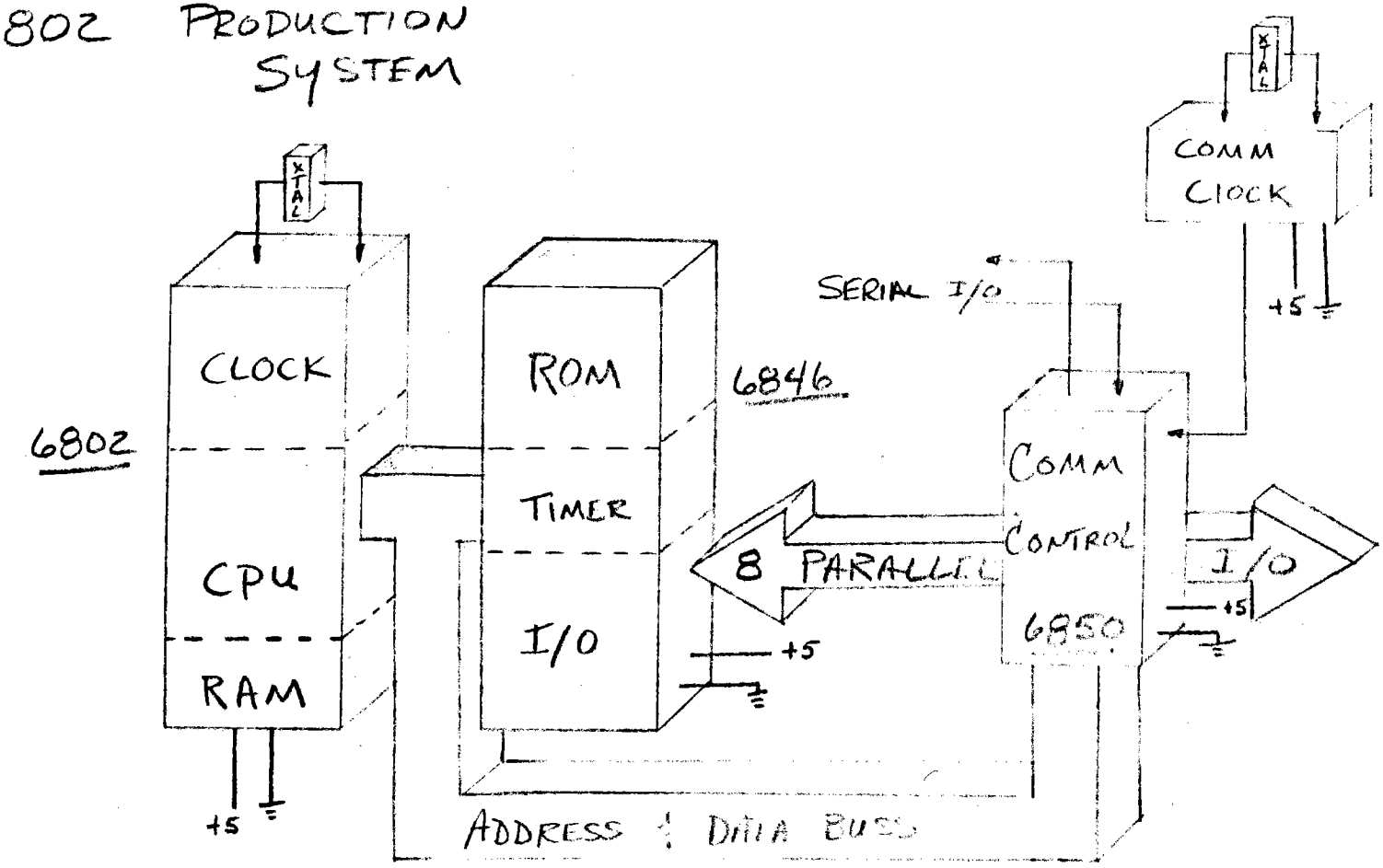
MARTIN MARIETTA

MOTOROLA
6801
PRODUCTION SYSTEM

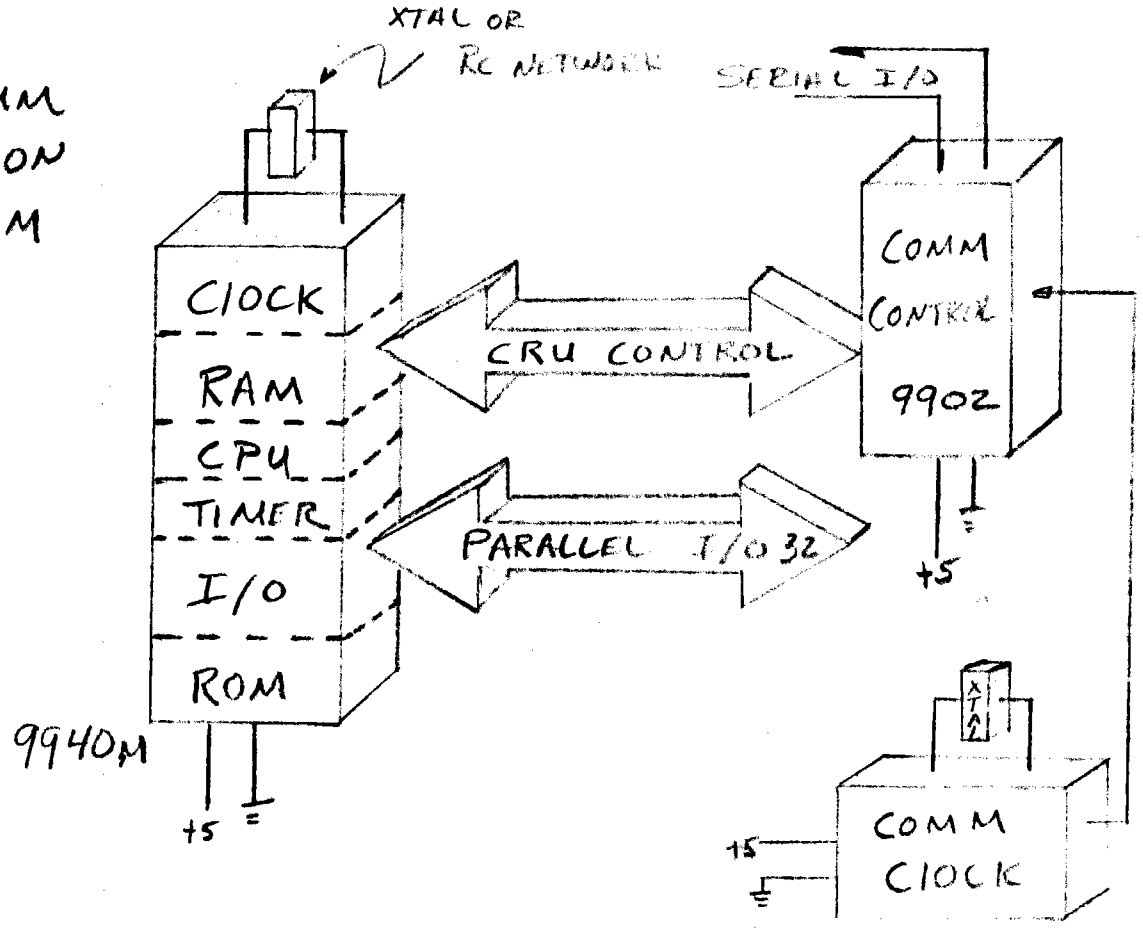


MARTIN MARIETTA

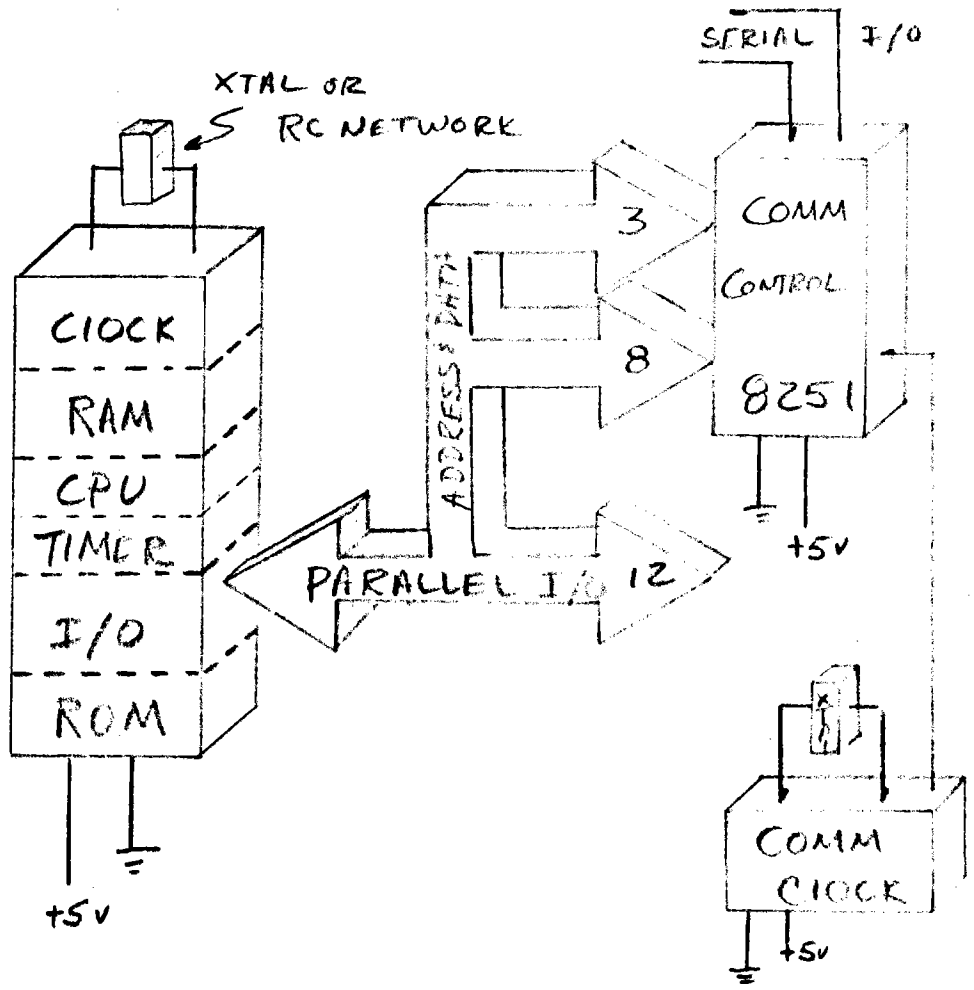
6802 PRODUCTION SYSTEM



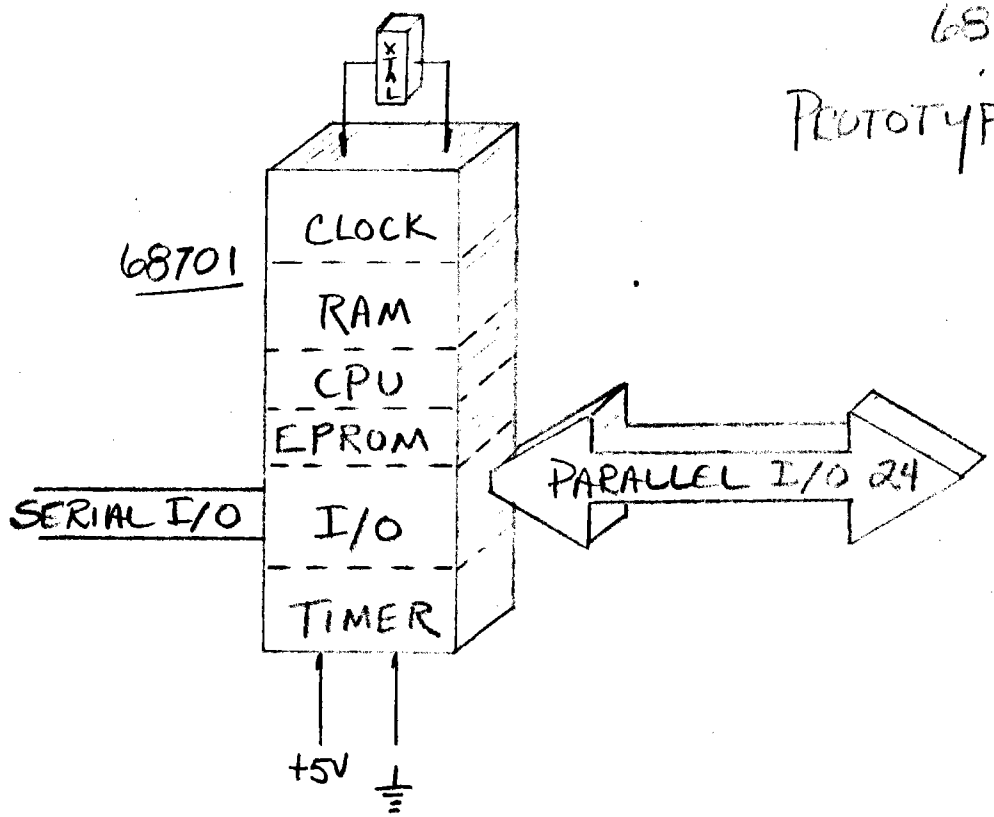
9940 Minimum Production System



8048 MINIMUM PRODUCTION SYSTEM



MOTOROLA
68701
PROTOTYPE SYSTEM



MINIMUM

SYSTEM CHARACTERISTICS

	6801	6802/6846	8048	9940
PROGRAM ROM (BYTES)	2K	2K	1K	2K
USER RAM (BYTES)	128	128	64	128
USEABLE I/O (PARALLEL)	24	8	24	32
ON CHIP UART	YES	NO	NO	NO
I/O W/MEMORY EXPANSION	8	8	12	32
TIMER	16 BIT	16 BIT	8 BIT	14 BIT
EXTERNAL PROGRAM ADDR. CAPABILITY	*65K	*65K	2K	NONE
EXTERNAL RAM ADDR. CAPABILITY	*65K	*65K	256	256 BIT
EPROM VERSION AVAILABILITY	4 QTR. '78	-	NOW	4 QTR '78

*ANY COMBINATION OF I/O , ROM & RAM

MINIMUM SYSTEM

COST COMPARISON

MAJOR SYSTEM PACKAGES	2000 QUANTITY	TOTAL
6801 Microcomputer	$16.50	$16.50
6802 Microprocessor, RAM, CLOCK	$ 8.55	$29.85
6846 ROM, I10, TIMER	$13.00	
6850 Asynchronous I/O	$ 3.30	
Communications Clock	$ 5.00	
8048 Microcomputer	$14.00	$24.44
8251 Asynchronous I/O	$ 5.44	
Communications Clock	$ 5.00	
9940 Microcomputer	$ 7.00	$16.10
9902 Asynchronous I/O	$ 4.10	
Communications Clock	$ 5.00	

* Low Cost

* Lowest Number of Chips

* Ram and Rom Easily expanded

* Will be used for both HFC and HC

DRIVE MOTOR TRADEOFF STUDY

OBJECTIVES

MEET PERFORMANCE REQUIREMENTS AT MINIMUM COST.

USE ONE MOTOR PER AXIS.

OBTAIN REDUCED-SPEED OPERATION ($\sim$ 1200 RPM OR LESS) USING SLEW MOTOR.

CANDIDATES

THREE PHASE A-C, SINGLE PHASE A-C, D-C.

RESULTS TO DATE

THREE-PHASE AND SINGLE-PHASE A-C MOTORS

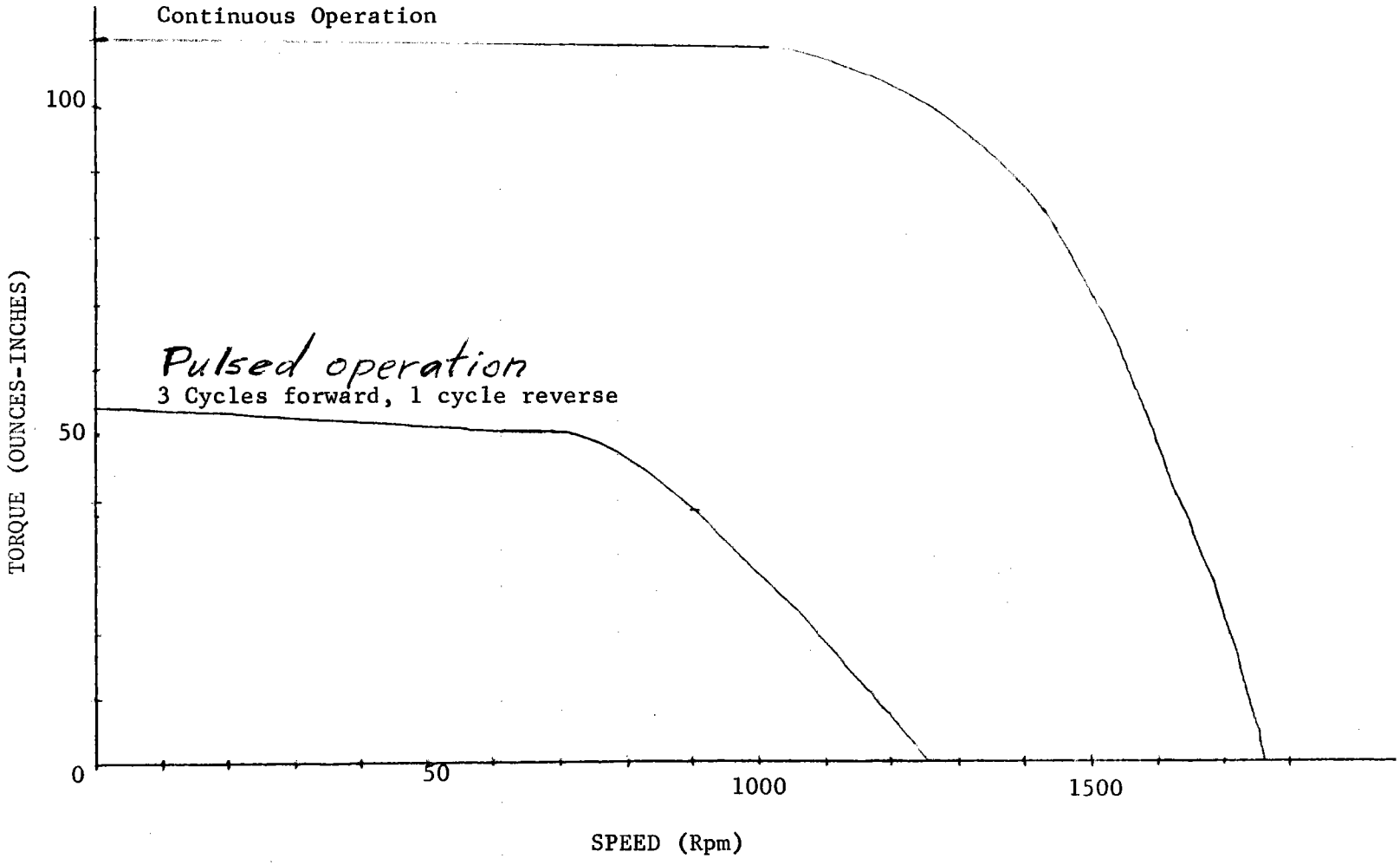
- CONTROLLER DESIGN
- BREADBOARD TEST
- SPEED-TORQUE CURVES

CONTINUING EFFORT

D-C MOTOR CONTROLLER DESIGN AND BREADBOARD TEST

D-C MOTOR BRUSH LIFE TEST

SPEED-TORQUE CURVES FOR SINGLE-PHASE MOTOR



MARTIN MARIETTA

MOTOR TRADE OFF RESULTS

TYPE OF MOTOR	D.C. MOTOR	SINGLE PHASE	THREE PHASE
NUMBER OF PARTS REQUIRED	TO BE DETERMINED	8	22
NUMBER OF EXTERNAL CONNECTIONS	10	12	18
NUMBER OF MICROPROCESSOR INTERFACE LINES	5	5	9
APPROXIMATE PARTS COST	TO BE DETERMINED	$31.00	$64.00
APPROXIMATE MOTOR COST	$100.00	$87.00	$92.00

MARTIN MARIETTA

ENCODER

* Incremental - 2048 Counts/Turn

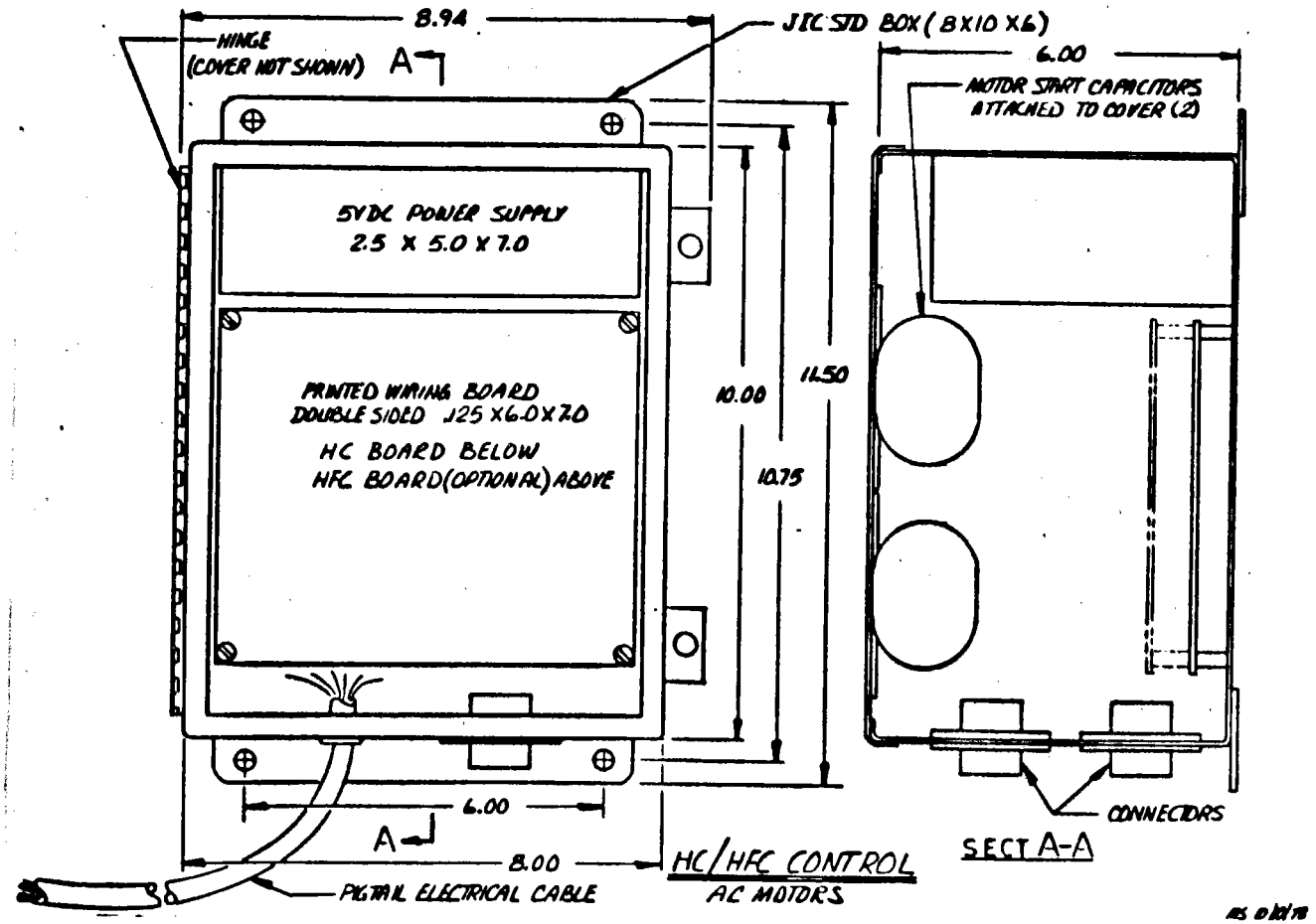
* Interface Electronics will have X4 Multiplier

* Development will include extensive EMI and Thermal Testing

MARTIN MARIETTA

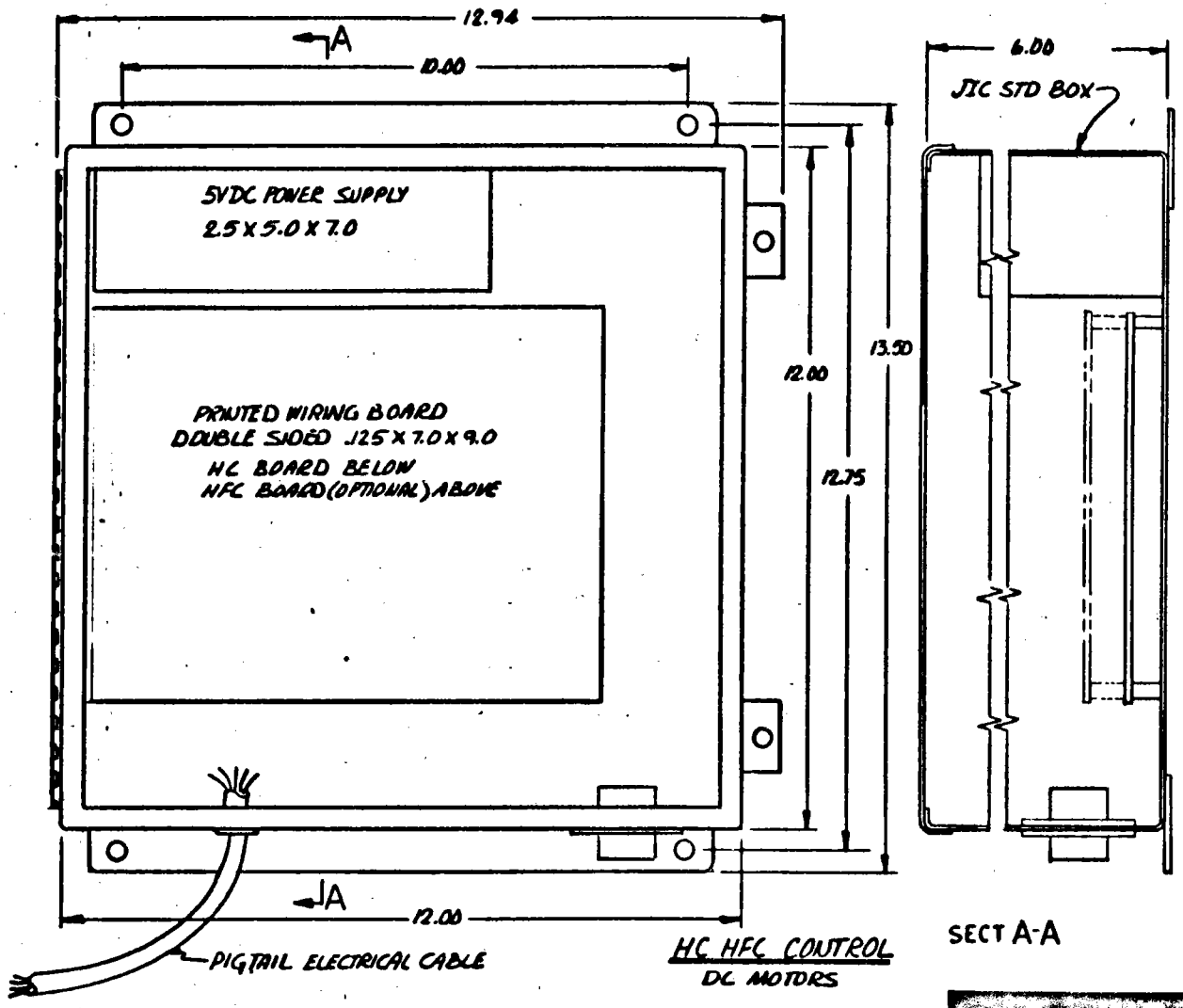
P/W BOARD DESIGN

- PW BOARDS WILL BE DOUBLE SIDED WITH PLATED-THRU HOLES, .062 THICK MATERIAL.
- LAYOUT AND DESIGN PER IPC-CM-770A
- FABRICATION PER IPC-A-600A
- INCORPORATE SOCKETS FOR PARTS SUCH AS OPTO-COUPLERS AND LINE DRIVERS THAT MAY REQUIRE REPLACEMENT.
- PROVIDE INTERFACE CONNECTIONS THAT UTILIZE SOLDERLESS TERMINALS.
- DESIGNED FOR FLOW SOLDERING
- BOARD SIZE APPROXIMATELY 6.0 X 7.0 INCHES
- SEPARATE BOARD DESIGNS FOR HC AND HFC


8.94
HINGE
(COVER NOT SHOWN)
A
JIC STD BOX (8X10X6)
6.00
MOTOR START CAPACITORS
ATTACHED TO COVER (2)
5VDC POWER SUPPLY
2.5 X 5.0 X 7.0
PRINTED WIRING BOARD
DOUBLE SIDED 12.5 X 6.0 X 2.0
HC BOARD BELOW
HFC BOARD (OPTIONAL) ABOVE
10.00
11.50
10.75
6.00
A
8.00
PIGTAIL ELECTRICAL CABLE
CONNECTORS
SECT A-A
HC/HFC CONTROL
AC MOTORS

HC/HFC CONCEPTUAL PACKAGING DESIGN - AC MOTORS

- STD COMMERCIAL STEEL BOX - 8 X 10 X 6 W/HINGED COVER
- OPEN FRAME 5V POWER SUPPLY, QUICK DISCONNECT TERMINATIONS
- DOUBLE SIDED, FLOW SOLDERED, PRINTED WIRING BOARD
- SOLID STATE RELAYS SOLDERED ON BOARD, QUICK DISCONNECT OUTPUT TERMINATIONS
- ADDRESSING WILL UTILIZE A PREWIRED DIP PLUG-IN, ON PW BOARD
- CONNECTORS - CRIMP TYPE PLUG IN CONTACTS
- TWO + 5V ISOLATED SUPPLIES TO BE INTEGRATED INTO BASIC 5V POWER SUPPLY ALLOWING A COMMON DESIGN FOR HC AND HFC



HC HFC CONTROL
DC MOTORS

MARTIN MARIETTA

HC/HFC CONCEPTUAL PACKAGING DESIGN - DC MOTORS

- STANDARD COMMERCIAL STEEL BOX - 12.0 X 12.0 x 6, W/HINGED COVER
- OPEN FRAME 5V POWER SUPPLY, QUICK DISCONNECT TERMINALS
- DOUBLE SIDED, FLOW SOLDERED PRINTED WIRING BOARD
- ADDRESSING WILL UTILIZE A PREWIRED DIP PLUG-IN ON PW BOARD.
- CONNECTORS - CRIMP TYPE PLUG IN CONTACTS
- HC PW BOARD WOULD HAVE SOLID STATE RELAYS (AC MOTORS) REPLACED BY APPROX. 16 SCRS, 8-PULSE TRANSFORMERS, 4-DIPS, 16 RESISTORS. ALL PARTS WILL BE MOUNTED ON PW BOARD.
- NO CHANGE TO HFC PW BOARD.
- TWO + 5V ISOLATED SUPPLIES TO BE INTEGRATED INTO BASIC 5V POWER SUPPLY ALLOWING A COMMON DESIGN FOR HC AND HFC CONTROLLERS.

ALTERNATE PACKAGING APPROACHES

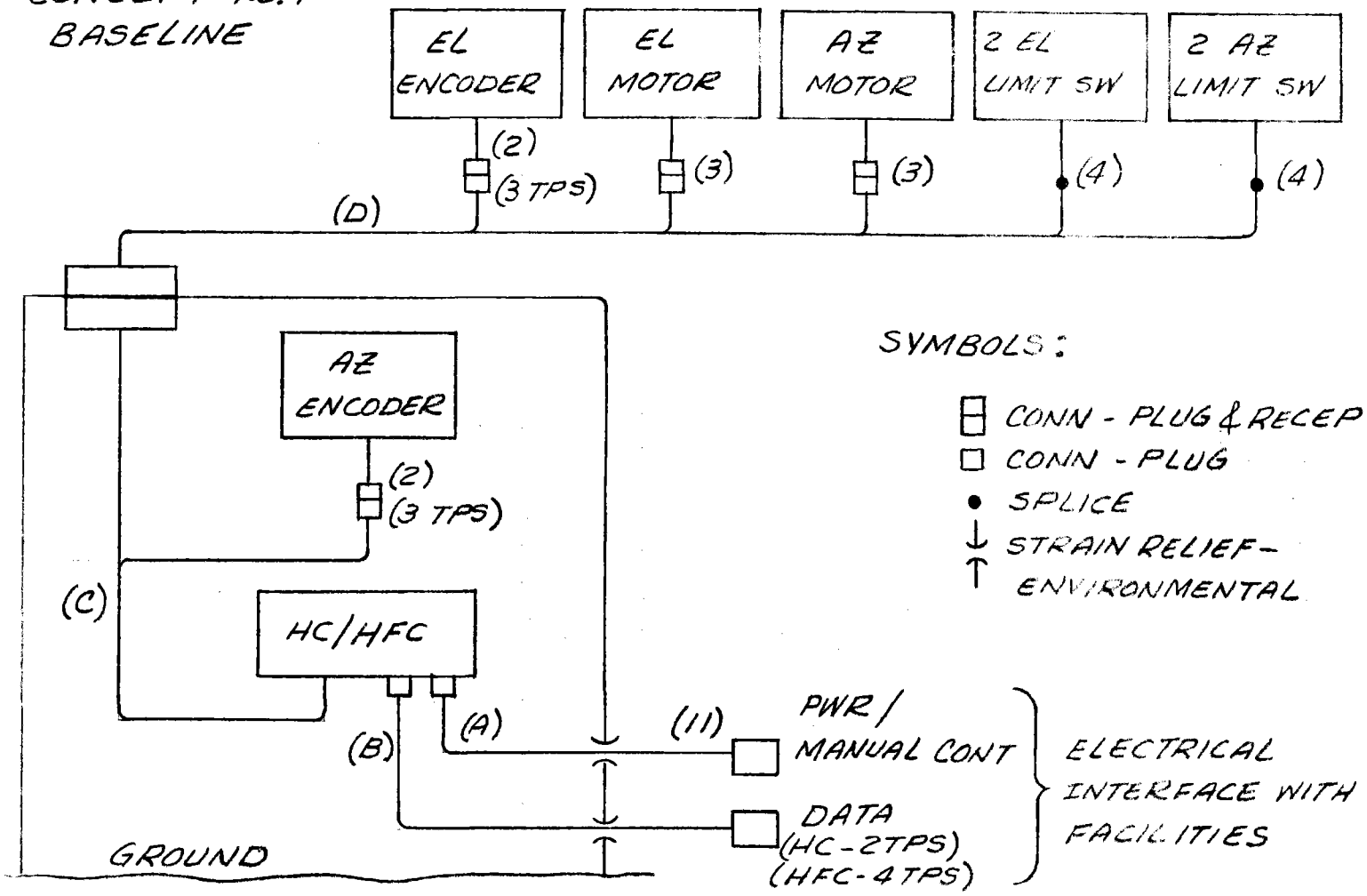
- SEPARATE PACKAGING DESIGNS FOR HC AND HFC CONTROLLERS
- SOLID STATE RELAYS MOUNTED DIRECTLY TO HC ENCLOSURE
- SEPARATE PW BOARD FOR SOLID STATE RELAYS AND/OR MOUNT SOLID STATE RELAYS ON SOCKETS
- PACKAGING CONCEPT BASED ON REPLACING PIG-TAIL CABLE WITH CONNECTORS

ELECTRICAL POWER AND DISTRIBUTION SYSTEM

- ELECTRICAL INTERFACE
  - HELIOSTAT TO FIELD
  - COMPUTER TO FIELD
  - FOCUS AND ALIGNMENT TO SITE
- LIGHTNING PROTECTION
  - GROUNDING COUNTER POISE
  - POWER CIRCUIT PROTECTION
  - DATA CIRCUIT PROTECTION
- ELECTRICAL POWER QUALITY AND QUANTITY
- TEST REQUIREMENTS
- EMI PROTECTION
- WIRE ROUTING

HELIOSTAT - CONCEPTUAL CABLE DESIGN

CONCEPT No. 1
BASELINE



SYMBOLS:

- CONN - PLUG & RECEP
- CONN - PLUG
- SPLICE
- STRAIN RELIEF - ENVIRONMENTAL

HARDWARE - CONCEPT #1

- SWITCHES (ENVIRONMENTAL) - 4 EACH - MICROSWITCH P/N 1SE1
  - SWITCH ROLLER - 4 EACH - MICROSWITCH P/N JE5
- STRAIN RELIEF - ENVIRONMENTAL - 2 EACH
- CABLES
  - CABLE A
    - CONNECTOR, 2 PLUGS - 11 CONTACTS
    - CABLE - 11 #20 PVC INSULATION WITH TPR JACKET
      - 13 FEET
  - CABLE B (HC)
    - CONNECTOR, 2 PLUGS - 6 CONTACTS
    - CABLE - 2TPS #20, PVC INSULATION WITH TPR JACKET
      - 13 FEET
  - CABLE B (HFC)
    - CONNECTOR, 2 PLUGS - 12 CONTACTS

HARDWARE - CONCEPT #1 (CONT)

- o CABLE - 4 TPS #20, PVC INSULATION WITH TPR JACKET
  - o 13 FEET
- o CABLE C
  - o CONNECTOR - 1 PLUG - 11 CONTACTS
    1 RECEPT - 25 CONTACTS
  - o CABLE - 27 #20, 6 TPS #20, PVC INSULATION, TPR JACKET
    - o 15 FEET
- o CABLE D
  - o CONNECTOR - 2 PLUGS - 3 CONTACTS
    1 PLUG - 11 CONTACTS
    1 PLUG - 25 CONTACTS
  - o CABLE - 16 #20, 3 TPS #20, PVC INSULATION, TPR JACKET
    - o 15 FEET

MARTIN MARIETTA CORPORATION HARDWARE MATING TO CABLES

- o CONNECTORS - 2 RECEP - 3 CONTACTS (MOTORS)

HARDWARE - CONCEPT #1 (CONT)

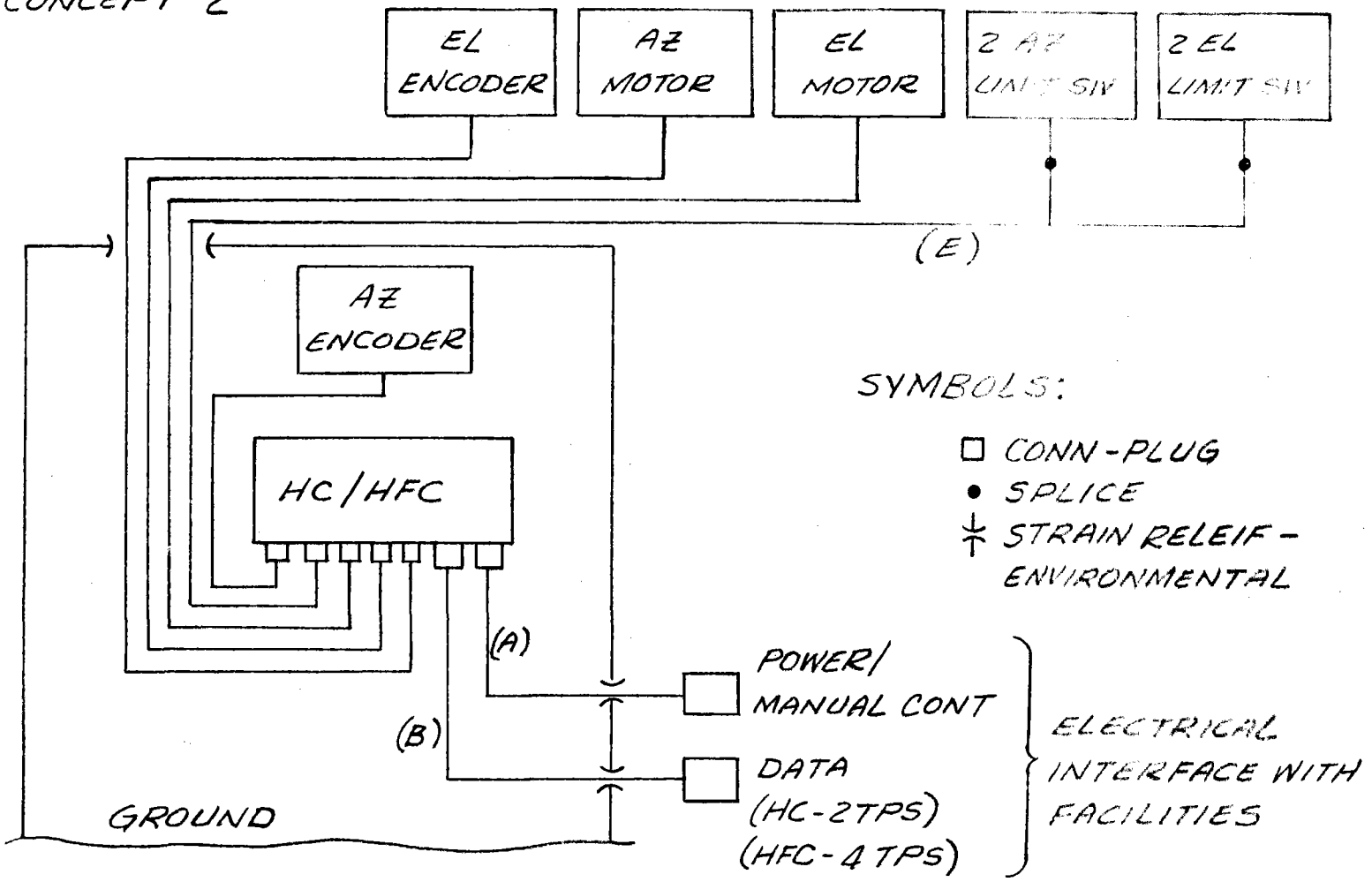
3 RECEP - 11 CONTACTS (ENCODERS/PWR TO HC)

1 RECEP - 6 CONTACTS (HC DATA)/(12 CONTACTS (HFC)

MISCELLANEOUS HARDWARE - TAPE, CLAMPS, STRING TIE, BOLTS, NUTS, WASHERS, STUDS (POWER DRIVEN), SPLICES, TOOLING, BONDING STRAPS, TERMINALS, FERRULES, ETC.

HELIOSTAT - CONCEPTUAL CABLE DESIGN

CONCEPT 2



HARDWARE - CONCEPT #2

- SWITCHES - SAME AS CONCEPT #1
- STRAIN RELIEF - ENVIRONMENTAL - 3 TO 6 EA
- CABLES
  - CABLE A - SAME AS CONCEPT #1
  - CABLE B (HC) - SAME AS CONCEPT #1
  - CABLE B (HFC) - SAME AS CONCEPT #1
  - CABLE E
    - CONNECTOR - 1 PLUG - 8 CONTACTS
    - CABLE - 8 #20, PVC INSULATION, TPR JACKET
      - 30 FEET

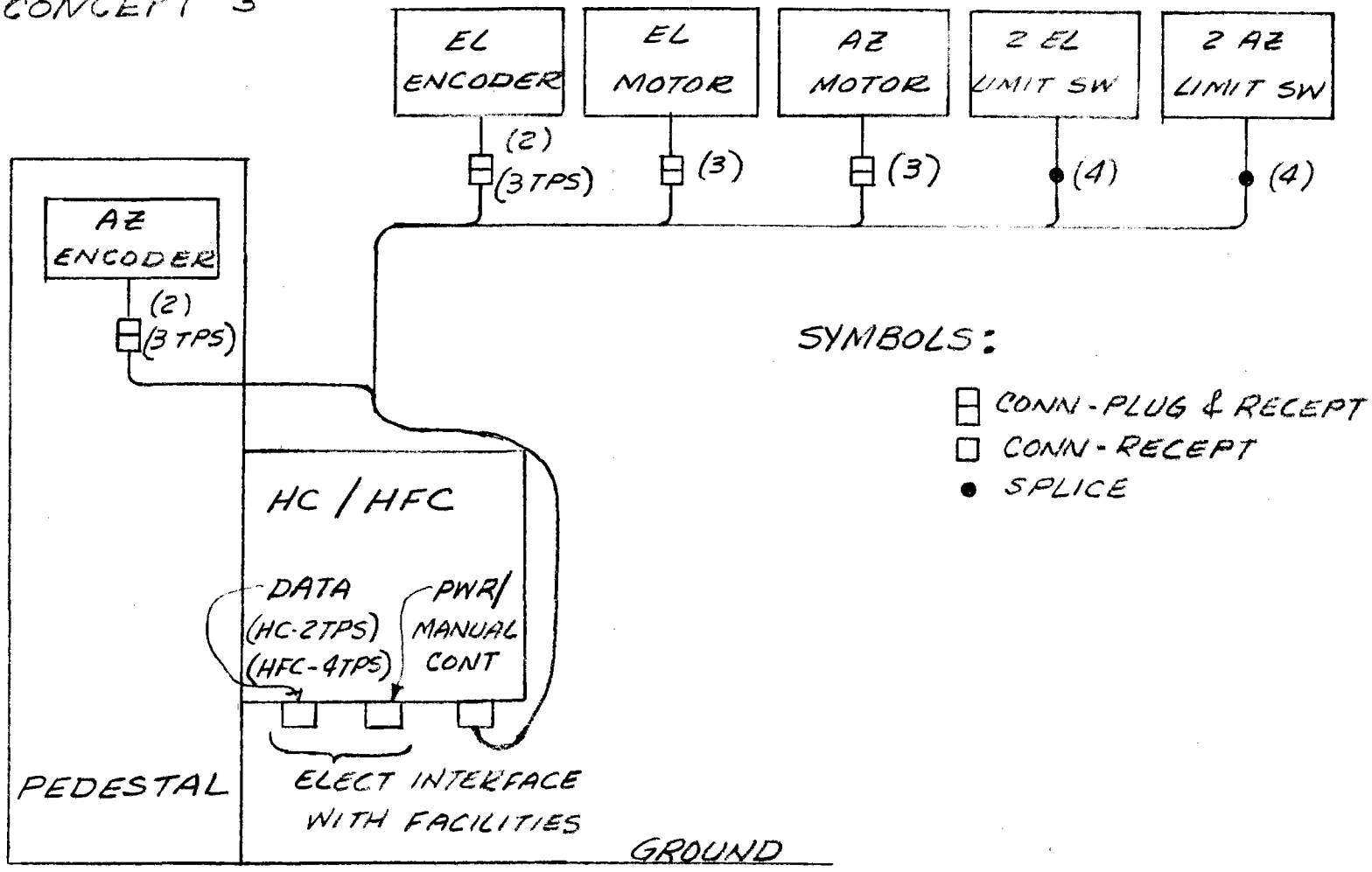
MARTIN MARIETTA HARDWARE MATING TO CABLES

- CONNECTORS - PAIRS - HC/HFC TO MOTORS/ENCODERS
  - 2 PAIR - 11 CONTACTS - ENCODERS
  - 2 PAIR - 3 CONTACTS - MOTORS

MISCELLANEOUS HARDWARE - BASICALLY THE SAME AS CONCEPT #1

HELIOSTAT - CONCEPTUAL CABLE DESIGN

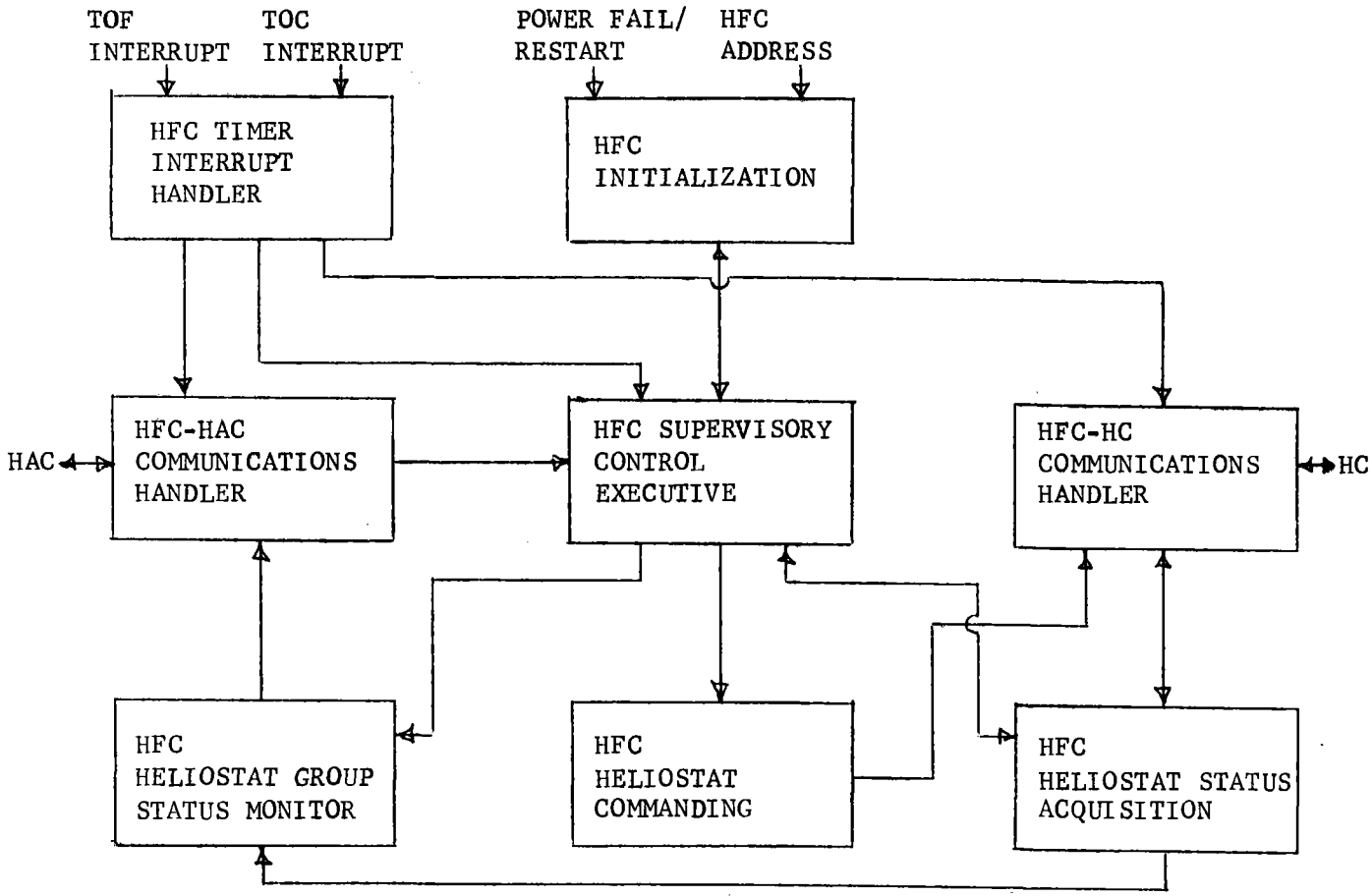
CONCEPT 3



SYMBOLS:

- CONN - PLUG & RECEPT
- CONN - RECEPT
- SPLICE

HFC SOFTWARE FUNCTIONAL FLOW DIAGRAM



HFC SUPERVISORY CONTROL EXECUTIVE

INPUTS

- COMMANDS FROM THE HAC VIA THE HFC-HAC COMMUNICATIONS HANDLER COMPONENT.
- TIMER INTERRUPT.

OUTPUTS

- ACTIVATION CONTROL OF OTHER HFC COMPONENTS.

PROCESSING

- RECEIVE AND INTERPRET COMMANDS FROM THE HAC.
- CONTROL ACTIVATION SEQUENCE AND OPERATIONS OF THE HFC HELIOSTAT COMMANDING, HFC HELIOSTAT STATUS ACQUISITION, HFC HELIOSTAT GROUP STATUS MONITOR, AND HFC INITIALIZATION COMPONENTS.
- MAINTAIN THE HFC SUN VECTOR WATCH-DOG TIMER.
- COMMAND HELIOSTAT STOWAGE UPON HAC COMMUNICATIONS LOSS OR SUN VECTOR TIMEOUT.

HFC-HAC COMMUNICATIONS HANDLER

INPUTS

- DATA BYTES RECEIVED FROM HAC.
- DATA MESSAGES TO BE OUTPUT TO HAC.
- RECEIVER BUFFER FULL AND TRANMITTER BUFFER EMPTY INTERRUPTS.

OUTPUTS

- DATA BYTES TRANSMITTED TO HAC.
- DATA MESSAGES RECEIVED FROM HAC.
- ACTIVATION OF THE HFC SUPERVISORY CONTROL EXECUTIVE COMPONENT.

PROCESSING

- RECEIVE INPUT BYTES AND STORE THEM INTO MESSAGE BUFFER.
- ACTIVATE THE HFC SUPERVISORY CONTROL EXECUTIVE COMPONENT WHEN INPUT BYTE COUNT EXHAUSTED.
- ACCUMULATE INPUT CHECKSUM AND VERIFY.
- TRANSMIT OUTPUT BYTES FROM MESSAGE OUTPUT BUFFER WHEN ACTIVATED BY THE HFC HELIOSTAT GROUP STATUS MONITOR COMPONENT.
- ACCUMULATE AND OUTPUT CHECKSUM AS LAST MESSAGE BYTE.
- MAINTAIN MESSAGE SYNC BY UTILIZING A WATCHDOG TIMER ON EACH INPUT BYTE.

INPUTS

- ACTIVATION BY THE HFC SUPERVISORY CONTROL EXECUTIVE COMPONENT.
- COMMANDS FROM THE HAC.
- HC STATUS FROM THE DATA-BASE.
- POINTING PARAMETERS (SUCH AS CLLP) FROM THE HFC DATA-BASE.

OUTPUTS

- REFORMATTED COMMANDS TO THE HC'S.

PROCESSING

- OUTPUT THE SUN VECTOR/SYNC MESSAGE TO THE HC'S UPON RECEIPT OF THE SUN VECTOR FROM THE HAC. REFORMATTED MODE COMMANDS FROM THE PREVIOUS SECOND ARE OUTPUT AT THIS TIME.
- REFORMAT HAC MODE COMMANDS INTO ACCEPTABLE HC FORMAT AND APPLY DATA-BASE PARAMETERS (SUCH AS CORRIDOR LIMIT POINTS) TO THE COMMAND WHERE APPLICABLE.
- PERFORM CORRIDOR WALK CONTROL BY APPLYING ΔZ TO CURRENT CORRIDOR WALK TARGET.
- UPON RECEIPT OF "GO-UP" OR "GO-DOWN" COMMAND, ENABLE CORRECT HELIOSTATS INTO CORRIDOR WALK MODE.

HFC HELIOSTAT STATUS ACQUISITION

INPUTS

- ACTIVATION BY THE HFC SUPERVISORY CONTROL EXECUTIVE COMPONENT.
- STATUS MESSAGES FROM THE HC'S VIA THE HFC-HC COMMUNICATIONS HANDLER COMPONENT.

OUTPUTS

- STATUS POLL COMMANDS TO THE HC'S VIA THE HFC-HC COMMUNICATIONS HANDLER COMPONENT.
- STATUS DATA TO THE HFC DATA-BASE.

PROCESSING

- POLL AND ACQUIRE HC STATUS AND STORE INTO THE HFC DATA-BASE.
- APPLY A WATCHDOG TIMER TO STATUS RESPONSES TO DETECT NON-RESPONDING HC'S.

HFC HELIOSTAT GROUP STATUS MONITOR

INPUTS

- ACTIVATION BY THE HFC SUPERVISORY CONTROL EXECUTIVE COMPONENT IN RESPONSE TO A HAC POLL OF THE HFC.
- STATUS DATA FROM THE HFC DATA-BASE.

OUTPUTS

- STATUS RESPONSE MESSAGES FOR THE HAC.

PROCESSING

- REFORMAT DATA FROM THE HC STATUS IN THE HFC DATA-BASE INTO THE HAC FORMAT.
- OUTPUT HELIOSTAT GROUP STATUS DATA (WITH HFC OPERATIONAL STATUS) TO THE HAC VIA THE HFC-HAC COMMUNICATIONS HANDLER COMPONENT.

HFC-HC COMMUNICATIONS HANDLER

INPUTS

- DATA BYTES RECEIVED FROM HC.
- DATA MESSAGES TO BE OUTPUT TO HC.
- RECEIVER BUFFER FULL AND TRANSMITTER BUFFER EMPTY INTERRUPTS.

OUTPUTS

- DATA BYTES TRANSMITTED TO HC.
- DATA MESSAGES FROM HC.
- REACTIVATION OF THE HFC HELIOSTAT STATUS ACQUISITION AND HFC HELIOSTAT COMMANDING COMPONENTS.

PROCESSING

- OUTPUT COMMAND BYTES FROM COMMAND MESSAGE BUFFER.
- ACCUMULATE AND OUTPUT MESSAGE CHECKSUM AS FINAL BYTE.
- RECEIVE INPUT BYTES AND STORE THEM INTO MESSAGE BUFFER.
- ACCUMULATE INPUT CHECKSUM AND VERIFY.
- REACTIVATE REQUESTING COMPONENT WHEN I/O BYTE COUNT IS EXHAUSTED OR IF BYTE TIMEOUT ON INPUT.
- MAINTAIN MESSAGE SYNC BY UTILIZING THE MC6801 μP'S "WAKE-UP" FEATURE AND A WATCHDOG TIMER ON EACH INPUT BYTE.

HFC TIMER INTERRUPT HANDLER

INPUTS

- TOF & TOC INTERRUPTS

OUTPUTS

- HAC I/O WATCHDOG TIMER TIMEOUT.
- HC I/O WATCHDOG TIMER TIMEOUT.
- SUN VECTOR WATCHDOG TIMER TIMEOUT.
- SYSTEM CLOCK.

PROCESSING

- MAINTAIN WATCHDOG TIMERS OF 833 μs GRANULARITY FOR THE HFC-HAC COMMUNICATIONS HANDLER AND HFC-HC COMMUNICATIONS HANDLER COMPONENTS. DRIVEN FROM THE TOC (TIMER OUTPUT CAPTURE) INTERRUPT OF THE MC6801 μP.
- MAINTAIN A SYSTEM CLOCK AND A SUN VECTOR WATCHDOG TIMER, BOTH DRIVEN FROM THE TOF (TIMER OVERFLOW) INTERRUPT OF THE MC6801μP. 50 ms GRANULARITY.

HFC INITIALIZATION

INPUTS

- POWER-ON INTERRUPT.
- INITIALIZATION COMMAND FROM THE HFC SUPERVISORY CONTROL EXECUTIVE COMPONENT.
- HFC ADDRESS.

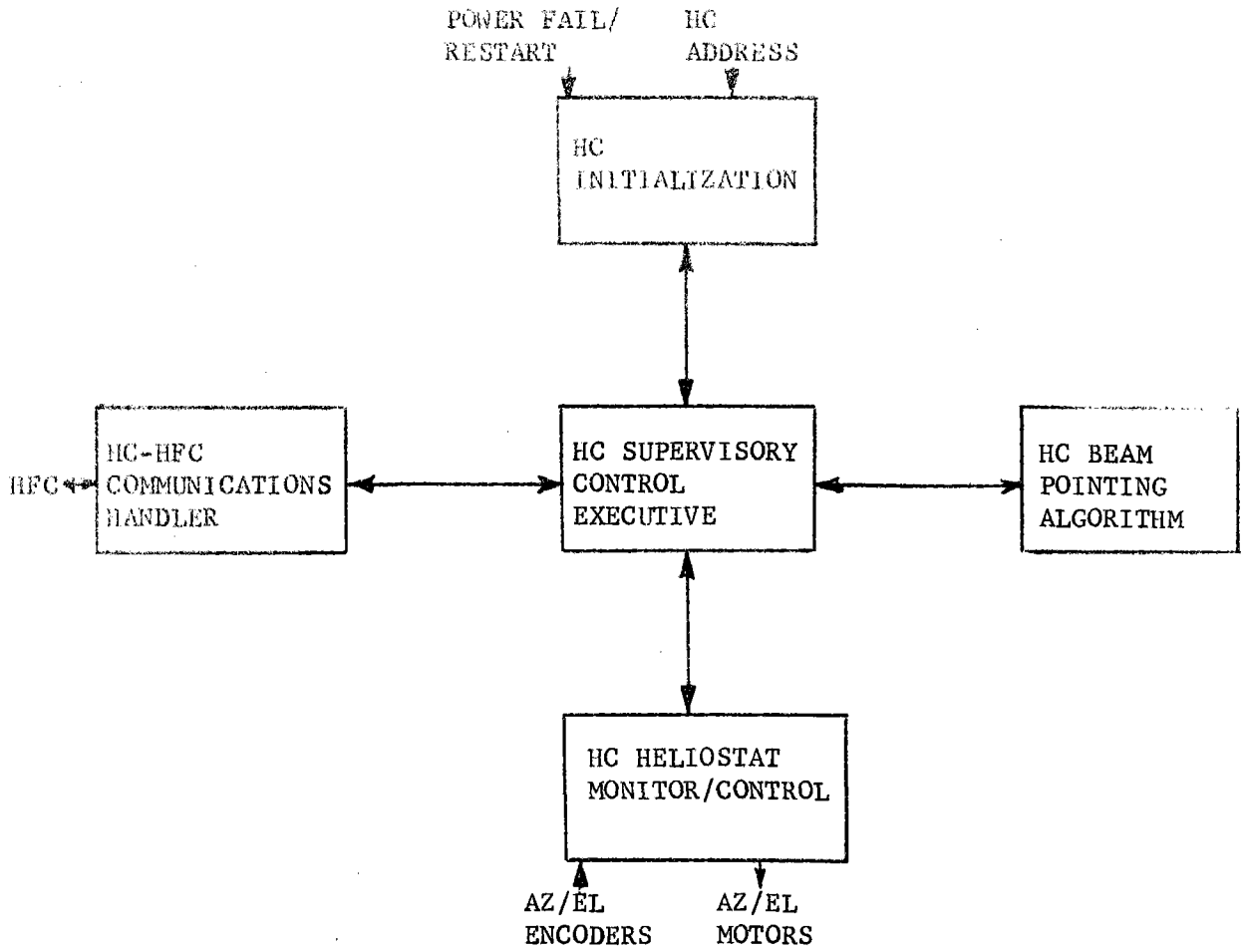
OUTPUTS

- DATA-BASE INITIAL VALUES.
- STOW COMMANDS.

PROCESSING

- PERFORM POWER-UP INITIALIZATION INCLUDING SENSING THE HFC'S ADDRESS.
- PERFORM COMMANDED INITIALIZATION WITH NEW DATA-BASE.
- COMMAND ALL HC'S ATTACHED TO THIS HFC TO ELEVATION STOW FIRST, THEN AZIMUTH STOW.
- DETERMINE ENCODER ZERO POINT REFERENCES TO INITIALIZE THE AZIMUTH AND ELEVATION POSITIONS.
- SUPPRESS 3 ABOVE IF HAC COMMUNICATIONS (SUN VECTOR) IS RESUMED IN A SPECIFIED AMOUNT OF TIME.

HC SOFTWARE FUNCTIONAL FLOW DIAGRAM



MARTIN MARIETTA

HC SUPERVISORY CONTROL EXECUTIVE

INPUTS

- o COMMANDS FROM THE HFC VIA THE HC-HFC COMMUNICATIONS HANDLER COMPONENT.
- o SUN VECTOR WATCH DOG TIMER.
- o STATUS DATA FROM THE HC DATA BASE.

OUTPUTS

- o STATUS DATA TO THE HC-HFC COMMUNICATIONS HANDLER COMPONENT.
- o ACTIVATION OF THE HC BEAM POINTING ALGORITHM AND HC INITIALIZATION COMPONENTS.
- o COMMAND AZIMUTH AND ELEVATION TO THE HC HELIOSTAT MONITOR CONTROL COMPONENT.

PROCESSING

- o INTERPRET AND PERFORM INPUT HFC COMMANDS.
- o ACTIVATE THE HC BEAM POINTING ALGORITHM COMPONENT WHEN NECESSARY TO CALCULATE AZIMUTH AND ELEVATION.
- o PREPARE THE STATUS RESPONSE TO THE HFC.
- o MONITOR THE SUN VECTOR WATCHDOG TIMER.
- o ACTIVATE THE HC INITIALIZATION COMPONENT WHEN COMMANDED OR WHEN THE SUN VECTOR WATCHDOG TIMES OUT.

INPUTS

- o DATA BYTES FROM THE SERIAL I/O INTERFACE .
- o RECEIVER BUFFER FULL INTERRUPT.
- o INPUT WATCHDOG TIMER INTERRUPT.
- o TRANSMITTER BUFFER EMPTY INTERRUPT.
- o STATUS DATA FROM THE HC SUPERVISORY CONTROL EXECUTIVE COMPONENT.

OUTPUTS

- o INPUT MESSAGES TO THE HC SUPERVISORY CONTROL EXECUTIVE COMPONENT.
- o DATA BYTES TO THE SERIAL OUTPUT INTERFACE.
- o ACTIVATION OF THE HC SUPERVISORY CONTROL EXECUTIVE COMPONENT.

PROCESSING

- o RECEIVE AND STORE INPUT BYTES FROM THE SERIAL I/O INTERFACE HARDWARE.
- o ACCUMULATE THE MESSAGE CHECKSUM AND VERIFY.
- o ACTIVATE THE HC SUPERVISORY CONTROL EXECUTIVE COMPONENT WHEN THE REQUESTED BYTE COUNT IS EXHAUSTED.
- o OUTPUT THE CURRENT STATUS WHEN POLLED BY THE HFC.
- o DETECT AN EARLY END OF MESSAGE BY A WATCHDOG TIMER TIMEOUT TO MAINTAIN MESSAGE SYNC.
- o SET THE SERIAL I/O WAKE-UP FUNCTION WHEN THE REQUESTED BYTE COUNT IS EXHAUSTED TO DETECT THE START OF THE NEXT MESSAGE.
- o OUTPUT ANY DATA REQUESTED BY THE HC SUPERVISORY CONTROL EXECUTIVE COMPONENT.

HC BEAM POINTING ALGORITHM

INPUTS

- $\bar{H}$, THE HELIOSTAT COORDINATES IN SCALED 16 BIT INTEGER.
- $\bar{T}$, THE DESIRED TARGET COORDINATES IN SCALED 16 BIT INTEGER.
- $\hat{S}$, THE SUN UNIT VECTOR IN SCALED 16 BIT INTEGER.
- RAZ, REL - REQUESTED AZIMUTH AND ELEVATION TO WHICH BIASES ARE TO BE ADDED.

OUTPUTS

- CAZ, CEL - CALCULATED AZIMUTH AND ELEVATION ACCORDING TO THE FOLLOWING FORMULAS:

$$\hat{B} = (\bar{T} - \bar{H}) / |\bar{T} - \bar{H}| \quad [\text{REFLECTED BEAM VECTOR}]$$

$$\hat{V} = (\hat{B} + \hat{S}) / |\hat{B} + \hat{S}| \quad [\text{HELIOSTAT NORMAL VECTOR}]$$

$$CAZ = TAN^{-1} (V_x / V_y)$$

$$CEL = TAN^{-1} (V_z / (V_x^2 + V_y^2)^{1/2})$$

- CMDAZ, CMDEL - COMMANDED AZIMUTH AND ELEVATION RESULTING FROM ADDING THE ENCODER BIASES TO THE CALCULATED AZIMUTH AND ELEVATION, CAZ/CEL OR TO AN ABSOLUTE AZ/EL REQUESTED BY THE HFC. THE HC SUPERVISORY CONTROL EXECUTIVE COMPONENT DETERMINES WHICH AZIMUTH AND ELEVATION PAIR.

  CMDAZ = RAZ + AZBIAS
  CMDEL = REL + ELBIAS

PROCESSING

- CALCULATE CAZ AND CEL (CALCULATED AZIMUTH AND ELEVATION) FROM THE HELIOSTAT'S POSITION COORDINATES ($\bar{H}$), THE CURRENT TARGET COORDINATES ($\bar{T}$), AND THE SUN VECTOR ($\hat{S}$).
- PRODUCE THE CMDAZ AND CMDEL (COMMAND AZIMUTH AND ELEVATION) FROM THE REQUESTED AZ/EL (OUTPUT OF BEAM POINTING CALCULATION OR ABSOLUTE AZ/EL COMMAND FROM HFC) BY ADDING THE AZIMUTH AND ELEVATION ENCODER BIASES.

HC HELIOSTAT MONITOR/CONTROL

INPUTS

- AC WAVEFORM ZERO CROSSING DETECTOR INTERRUPT - $120H_z$.
- AZIMUTH AND ELEVATION ZERO POINT ENCODER MARKS.
- COMMAND AZIMUTH AND ELEVATION.
- AZIMUTH AND ELEVATION ENCODES DELTAS - 4-BITS EACH.

OUTPUTS

- MOTOR COMMANDS - $15H_z$.
- AZIMUTH, ELEVATION, AND GIMBAL STATUS.
- SOFTWARE WATCHDOG TIMER.

PROCESSING

- DRIVE AZIMUTH AND ELEVATION MOTORS TO ZERO THE DIFFERENCE BETWEEN THE COMMANDED AND CURRENT GIMBAL POSITIONS.
- DETERMINE MOTOR RATE (SLEW/SLOW) TO USE TO ACCOMPLISH THE ABOVE.
- CHANGE MOTOR COMMANDS ONLY AT THE ZERO CROSSINGS OF THE AC WAVEFORM.
- PERIODICALLY ($\sim 15H_z$) UPDATE THE AZIMUTH AND ELEVATION POSITIONS BY THE DELTAS OF THE ENCODERS. HANDLE $> \pm 270^{\circ}$ FOR AZIMUTH.
- ZERO OUT THE AZIMUTH AND ELEVATION POSITIONS WHEN THEIR RESPECTIVE ZERO MARKS ARE ENCOUNTERED ON THE ENCODER.
- CALCULATE THE DIRECTION AND MAGNITUDE OF THE AZIMUTH AND ELEVATION DELTAS IN SUPPORT OF 1 AND 2 ABOVE. HANDLE $> \pm 270^{\circ}$ FOR AZIMUTH.
- STORE AZIMUTH, ELEVATION, AND GIMBAL STATUS FOR OUTPUT TO THE HFC.
- UPDATE A SOFTWARE WATCHDOG TIMER FROM THE $120H_z$ ZERO CROSSING DETECTOR INPUT.
- MONITOR MOVEMENT RATES FOR ERRORS AND DETERMINE HELIOSTAT FAULTS.

HC INITIALIZATION

INPUTS

- POWER-ON INTERRUPT.
- HC ADDRESS.
- INITIALIZATION DATA FROM HAC VIA HFC.

OUTPUTS

- PROGRAM INITIALIZATION AND START UP.
- HARDWARE (μP) INITIALIZATION.
- STOW COMMANDS TO MOTOR CONTROLLER.

PROCESSING

- PERFORM POWER-UP INITIALIZATION INCLUDING SENSING THE HELIOSTAT'S ADDRESS.
- PERFORM COMMANDED INITIALIZATION WITH NEW DATA-BASE.
- COMMAND THE HELIOSTAT TO ELEVATION STOW FIRST AND THEN AZIMUTH STOW.
- FIND ENCODER ZERO POINT REFERENCES TO INITIALIZE THE AZIMUTH AND ELEVATION POSITIONS.
- SUPPRESS 3 ABOVE IF HFC COMMUNICATIONS (SUN VECTOR) IS RESUMED IN A SPECIFIED AMOUNT OF TIME.

Department of Energy
San Francisco Operations Office
1333 Broadway
Oakland, California 94612

Reply to:

DOE Site Office
P.O. Box 366
Daggett, CA 92327

ATTN: S. D. Elliott, Jr.

JUN 2 5 1983

Melvin W. Frohardt
Martin Marietta Aerospace
P.O. Box 179
Denver, CO 80201

Subj.: Request for patent clearance and TIC Distribution of Documents from DOE Contracts ET21007 and SF10539 (Solar One Heliostats, Phases I & II)

Dear Mel:

We are about to come out, with the help of EPRI, with a bibliography of key Project documents. To cope with anticipated requests for copies, I would like to arrange for properly cleared documents to be filed with and distributed through the DOE Technical Information Center at Oak Ridge. A check with TIC shows that only MCR-80-1377 has been cleared by them to date. Can you provide me with signed-off Patent Clearance Requests for:

- o The five indicated documents from the Phase I study (ET21007);
- o The twelve indicated documents from Phase II (SF10539);
- o The as-built drawing set provided via Sandia at the end of Phase II;
- o Any other Project documents generated by MMC you think the utility/industry community should have ?

I'd also appreciate a check on the Phase I CDR handout; was it MCR-78-1325?

Your help is greatly appreciated; it will save me (and you) a lot of running about once the bibliography comes out. I will insure that you get a copy; it lists about 500 documents, not including drawings (these we will provide to TIC in aperture card form at a later date, with a full index). Please call me ((619) 254-2672/-2142) if you have any questions or concerns.

Sincerely yours,

S. D. Elliott, Jr.
DOE Project Director

Department of Energy
San Francisco Operations Office
1333 Broadway
Oakland, California 94612

Reply to:

DOE Site Office
Post Office Box 366
Daggett, CA 92327

Mr. Melvin T. Frohardt
Martin Marietta Aerospace
Post Office Box 179
Denver, CO 80201

DEC 0 6 1983

Subj.: Closeout Actions on Martin Marietta Contracts with DOE San Francisco Operations Office

Dear Mel:

Nearly six months ago, I requested your assistance in finalizing patent clearance on a number of the documents from the Collector Phase I and Phase II contracts which we wish to enter into the DOE Technical Information Center system. Thus far, I have not had any response to this request. We are about to issue the bibliography developed by Burns & McDonnell under the EPRI-funded "Lessons Learned and Project Documentation" study (I assume you have received a copy of Vol. 1, "Lessons Learned" - if not, let me know and I will send you one), and we and TIC anticipate a substantial number of requests for key documents, including yours.

In addition, SAN Contracts Closeout (Sonia Jackson) advises me that several of the final documents needed to complete closeout (and release final payment of withheld funds), are as yet lacking, not only on the above two contracts, but also on the old Preliminary Design contract. I would greatly appreciate your assistance (or your guidance as to who can assist us) in getting this wrapped up and off both of our desks. To recapitulate (adding the items needed by SAN) for the three contracts:

DE-AC03-76ET20422 (Old Contract -1110), Central Receiver System Prel. Design:

- o A "Final Invoice", to be submitted to Sonia Jackson, with copy to me;
- o "Contractors Assignment of Refunds and Rebates", to Sonia;
- o "Contractors Release", to Sonia;
- o "Contractor Request for Patent Clearance" (send to me, only), for:
  - MCR-77-161, "System Safety Design Criteria for Central Receiver...System",
  - MCR-77-162, "System Safety Program Requirements for Solar Thermal Systems".

  (These were done under an extension to the Preliminary Design contract, and are valuable background documents.)

DE-AC03-78ET21007 Collector System, Phase I:

- o "Final Invoice", to Sonia, copy to me;
- o "Assignment of Funds and Rebates", to Sonia;

- o "Contractors Release", to Sonia;
- o "Contractor Request for Patent Clearance", to me, for:
  - MCR-78-1323, "10-MWe Solar Thermal Pilot Plant Conceptual Design Review";
  - MTR-78-1330, "10-MWe Solar Thermal Pilot Plant Preliminary Design Review";
  - MCR-79-1302, "10-MWe Solar Thermal Pilot Plant Final Design Review (2 Vols.)";
  - 40-0-500-4P, "10-MWe Solar Thermal Pilot Plant Phase II O&M Equipment";
  - 40-0-500-6P, "10-MWe Solar Thermal Pilot Plant Phase II Planning."

DE-AC03-80SF10539, Collector System Phase II

- o "Final Invoice", to Sonia, copy to me;
- o "Assignment of Funds and Rebates", to Sonia;
- o "Contractors Release", to Sonia;
- o "Contractor Request for Patent Clearance", to me, for:
  - MCR-79-1352B*; "Quality Assurance Plan for 10-MWe Phase II Collector..";
  - MCR-80-1304, "10-MWe Solar Pilot Plant Collector Subsystem Safety Plan";
  - MCR-81-1331B, "Hazard Analysis for 10-MWe ...Pilot Plant";
  - 40-0-500-2P, "10-MWe ...Pilot Plant Phase II Mfg. Plan, Rev. 2";
  - MCR-80-1341A, "10-MWe Collector Sybsystem Software/Firmware Functional Req'ts.";
  - MCR-80-1362, "System Description Document, Collector Subsystem...";
  - MCR-80-1376*; "Heliostat Stimulator Operators' Manual";
  - MCR-81-1708, "Operation Instructions, Heliostat Field Subsystem...";
  - MCR-81-1709A, "Maintenance Instructions, Heliostat Field Subsystem...";
  - MTR-81-1769, "...Collector Subsystem Functional Test Report";
  - MCR-81-1770, "Supplemental Spares Plan, Heliostat Field...";
  - MCR-80-1377A, "Software/Firmware Design Specifications...";
  - MCR-82-1701, "Control System Theory of Operation";
  - Drawing Set, as Identified in "Drawing Tree 400500 5132701";
  - Source Listing of Code for Heliostat Controller ROM or EPROM*
  - Source Listing of Code for Heliostat Field Controller ROM/EPROM*

Our files do not have current copies of the following other items identified in the Drawing Tree (400500 5132701):

Documents: 40M500-2S, "Foundation Req'ts.", 40M500-1T, "Installation Instructions", 40M500-2M, "Canting Procedures", 40M500-5P, "Acceptance Plan", MCR-80-1361, "Collector System Functional Test Plan", and MCR-81-1715, "Collector System Integrated Acceptance Test Plan."

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* Current copies of these four items are lacking from the Project files; your assistance in obtaining at least one copy of each will be most appreciated.

Drawings: 40M500 5132788, "Adapter Plate/Control Arm Heat Tool", 40M500 5132771, "Field Canting Tool", and 40E500 5132776, "Drive Unit Checkout Console".

While these items are not carried in the current version of the Bibliography (none of the Plant as-built drawings have been entered as yet), many, if not all, of them may be expected to be of interest to the solar community. I would appreciate at least one copy of each, again with your release. To save you considerable effort in preparing the Patent Clearance Request forms (I am enclosing several copies of the form), you may combine many of the above by simply clearing the "Drawing Tree", with its contents.

If you need the other closeout forms cited above (your Contract Administration staff should have them in stock), please call Sonia Jackson at FTS 536-4179, or write her at:

Ms. Sonia Jackson (CM)
Department of Energy
1333 Broadway
Oakland, CA 94612

Finally, since we are required to forward two clean, reproducible copies of each document to DOE/TIC, as well as needing one clean copy for our on-site archives, any "extras" you can turn up around your offices would be greatly appreciated; certainly, rather than throw anything of possible interest out, send it to me.

Mel, I know (believe me!) that this is all a significant amount of work, and I wish I didn't have to ask you (or your staff) to go through it, but it will be to our mutual benefit in the end to get these three contracts all cleaned up, and a comprehensive package of Project documentation (currently, over 550 documents, plus drawings) into the archives. If there is anything further I can do to assist you in this effort, please call on me.

Encl.: DOE Proj. Ofc. ltr. 6/25/83
Patent Clearance Req. Forms

Sincerely yours,

S. D. Elliott, Jr., Director,
DOE Project Office, Barstow

cc: H. C. Wroton, MMC
Sonia Jackson, DOE/SAN (CM)

PS: I keep running across references to a document I can't identify: MCR-78-1325; what was it?

MARTIN MARIETTA AEROSPACE

DENVER DIVISION
POST OFFICE BOX 179
DENVER, COLORADO 80201
TELEPHONE (303) 977-3000

January 30, 1984

Mr. Doug Elliott
DOE Site Office
Post Office Box 366
Daggett, CA 92327

Subject: Closeout Actions on Martin Marietta Contracts with DOE San Francisco Operations Office

Reference: Letter of December 06, 1983, S.D. Elliott, Jr. to M. Frohardt, Closeout of Contracts

In regard to the referenced letter, following is the status and actions in process to close out these items:

1. Contract Closeout Status

In regard to the closeout of cost type contracts DE-AC03-76ET20422, Central Receiver Test Facility, and DE-AC03-78ET21007, Collector System Phase I, we include the "Contractors Assignment of Refunds and Rebates" and "Contractors Release" with our final invoice package. The final invoices for these two contracts will be submitted upon completion of final settlement negotiations for our 1979 overhead and G&A rates which is currently in progress. In reference to the closeout of contract DE-AC03-80SF10539, Collector System Phase II, please see Attachment 1, the letter to Ms. Joann Littlehales dated January 23, 1984, for the current status.

2. Patent Clearance

The following documents are in the process of being cleared by our Patent office. When this transmittal is available, I will send a copy to you.

MCR-78-1323, "10-MWe Solar Thermal Pilot Plant Conceptual Design Review"
MCR-78-1330, "10-MWe Solar Thermal Pilot Plant Preliminary Design Review"
MCR-79-1302, "10-MWe Solar Thermal Pilot Plant Final Design Review (2 Vols)"
40-0-500-4P, "10-MWe Solar Thermal Pilot Plant Phase II O&M Equipment"
40-0-500-6P, "10-MWe Solar Thermal Pilot Plant Phase II Planning"

The remainder of the documents have been previously cleared by the following letters, copies of which are included in Attachment 2.

Letters from Phillip DeArment to Roger Gaither:

DAC-83-417, dated May 24, 1983
80-Y-15555, dated July 28, 1980
DAC-82-389, dated May 3, 1982
Letter dated March 11, 1982
Letter dated November 10, 1982

3. Documents

You requested copies of some documents and drawings in the referenced letter. Copies of the following drawings and documents are being submitted under Attachment 3.

MCR-78-1330, "Preliminary Design Review Package"
MCR-79-1352B, "Quality Assurance Plan for 10-MWe Phase II Collector"
MCR-80-1376, "Heliostat Stimulator Operators' Manual"
40M500-2S, "Foundation Requirements"
40M500-2M, "Canting Procedures"
40M500-1T, "Installation Instructions"
40M500-5P, "Acceptance Plan"
MCR-81-1715, "Collector System Integrated Acceptance Test Plan"
MCR-80-1361, "Collector System Functional Test Plan"
40M500 5132788, "Adapter Plate/Control Arm Heat Tool"
40M500 5132771, "Field Canting Tool"
Source Listing of Code for Heliostat Controller ROM or EPROM*
Source Listing of Code for Heliostat Field Controller ROM/EPROM

No drawing exists for 40E500 5132776, "Drive Unit Checkout Console" as this checkout console consisted of a stimulator to operate a production Drive Mechanism Assembly. Also MCR-78-1330 is the correct document number for the Preliminary Design Review Package rather than MCR-78-1325. MCR-78-1325 is the document number assigned to all the Monthly Progress Reports written during the Phase I contract.

Doug, I hope this will help in getting the documentation finalized. I will follow-up with the additional information identified. If you have any questions please call on me.

Sincerely yours,

MARTIN MARIETTA CORPORATION

Melvin W. Frohardt
Solar Programs

Enclosures

cc: H. Wroton
Sonia Jackson

MARTIN MARIETTA AEROSPACE

DENVER DIVISION
POST OFFICE BOX 179
DENVER, COLORADO 80201
TELEPHONE (303) 977-3000

March 13, 1984

Mr. Doug Elliott
DOE Site Office
Post Office Box 366
Daggett, CA 92327

ET21007

Subject: Closeout Actions on Martin Marietta Contracts with DOE San Francisco Operations Office

Reference: Letter of January 30, 1984, M. W. Frohardt to S. D. Elliott, Jr., Closeout of Contracts

As per Item 2 of the referenced letter, attached is a copy of a letter from our Patent Counsel, Phillip L. DeArment, to the Department of Energy Patent Counsel. This letter includes the Patent Certification for the documents in question.

It is my belief that this completes the information you have requested from us except for the final closeout of the contracts which is being handled by our Contracts department.

Please contact me if you need more information.

Sincerely yours,

MARTIN MARIETTA DENVER AEROSPACE

M. W. Frohardt
M. W. Frohardt
Solar Systems

cc: H. Wroton
C. Bolton

MARTIN MARIETTA AEROSPACE

DENVER AEROSPACE
POST OFFICE BOX 179
DENVER, COLORADO 80201
TELEPHONE (303) 977-6008

OFFICE OF CHIEF COUNSEL

8 March 1984

Refer to: DAC-84-0211

To: United States Department of Energy
P. O. Box 808
Livermore, California 94550

Attn: Assistant Chief for Prosecution
Office of Patent Counsel, L-376

Subj: Contract DE-AC03-79ET21007
Revised Final Patent Certification

1. Attached is a revised Patent Certification on the subject contract.

2. If you have any questions, please contact Mr. Melvin W. Frohardt at (303) 977-0123.

Very truly yours,

MARTIN MARIETTA CORPORATION

Phillip L. DeArment

Phillip L. DeArment
Associate Patent Counsel

PLD:jes

PATENT CERTIFICATION

DOE CONTRACT NO. DE-AC03-79ET21007

1. The following is a complete list of technical reports prepared during the course of the work under this contract and the DOE office to which the reports were sent:

SEE ATTACHED SHEET

2. Technical data of this contract other than reports (i.e., notebooks, drawings, etc.) are completely listed, as follows:

NONE

3. Each of the above-listed documents under paragraphs 1 and 2 has been examined for invention subject matter by me and/or technical personnel under my direction; to the best of my knowledge and belief, no inventions or discoveries were made or conceived in the course of or under this contract other than the following:

CONTRACTOR NO.	TITLE	DATE REPORTED	DOE NO.
NONE			

4. There were no subcontracts or purchase orders involving research and development, except as follows:

NONE

5. The completion date of this contract is as follows: 12/13/79

6. The following period is covered by this certification: 9/5/78 - 12/31/79

September 5, 1978 (Month Day Year) to December 31, 1979 (Month Day Year)

Martin Marietta Corporation
Contractor Denver Aerospace
P. O. Box 179
Denver, CO 80201
Address

Phillip L. DeArmont
Signature

Associate Patent Counsel
Title

Submit in duplicate to:

Roger S. Gaither
Assistant Chief for Prosecution
California Patent Group, L-376
U. S. Department of Energy
P. O. Box 808
Livermore, California 94550

Date of Certification

ATTACHMENT

1. MCR-79-1310-10 MWe Software/Firmware Functioning Segments Spec.

   MCR-79-1311-10 MWe Overall Plant Design

   MCR-79-1352-10 MWe Quality Assurance Plan for Phase II

   SENT TO: United States Department of Energy
   San Francisco Operations Office
   Solar Ten Megawatt Project Office
   9550 Flair Drive, Suite 210
   El Monte, California 91731

2. MCR-78-1323, "10-MWe Solar Thermal Pilot Plant Conceptual Design Review";

   MTR-78-1330, "10-MWe Solar Thermal Pilot Plant Preliminary Design Review";

   MCR-79-1302, "10-MWe Solar Thermal Pilot Plant Final Design Review (2 Vols.)";

   40-0-500-4P, "10 MWe Solar Thermal Pilot Plant Phase II O&M Equipment";

   40-0-500-6P, "10-MWe Solar Thermal Pilot Plant Phase II Planning"; and

   MCR-78-1325 "10-MWe Solar Thermal Pilot Plant Phase I Monthly Progress Reports."

DOE F 1325.8
(7-79)

U.S. DEPARTMENT OF ENERGY

memorandum

DATE MAY 0 8 1984

REPLY TO ATTN OF S. D. Elliott, Jr., Director, DOE Solar One Project Office

SUBJECT Submission of Five Reports under Contract DE-AC03-78ET21007 with Martin Marietta Aerospace Corporation

TO Roger S. Gaither, DOE/SAN Office of Patent Counsel
William D. Matheny, DOE/TIC Document Control

Enclosed are five documents prepared by the Martin Marietta Corporation, Denver Aerospace Division, for the Solar Ten-Megawatt Project Office, under Contract DE-AC03-78ET21007:

Primary Document No.	Secondary No.	Brief Title
DOE/ET/21007-1	(STMPO-283)	10 MWe...Conceptual Design Review
DOE/ET/21007-2	(STMPO-284)	10 MWe...Preliminary Design Review
DOE/ET/21007-3	(STMPO-285)	10 MWe...Final Design Review
DOE/ET/21007-4	(STMPO-286)	10 MWe...Phase II Operating & Maintenance Equipment
DOE/ET/21007-5	(STMPO-287)	10 MWe...Phase II Planning

One copy of each document, accompanied by a completed SAN Form 70, is provided to SAN/OPC for patent review and clearance; the Form 70's have been prepared by this office based upon the Patent Certification provided by the attached letter of March 13, 1984 from Martin Marietta. Please return the feedback copies of the Form 70's to this office; the documents may be returned to Mr. Mike Lopez at SAN/FGS.

Two copies of each document, accompanied by a completed DOE Form RA-426, are provided for archiving and announcement by the DOE Technical Information Center, and forwarding to the National Technical Information Service.

This action completes all documentation requirements under Contract DE-AC03-78 ET21007.

Doug Elliott

S. D. Elliott, Jr., Director,
DOE Solar One Project Office

Attch.: Martin Marietta ltr. 3/13/84

Encls.: 5 Documents, w/transmittal forms

cc: Mike Lopez, DOE/SAN (FGS)
Don Holz, DOE/SAN (ISEA)
Sonia Jackson, DOE-SAN (CM)
Mary Soderstrum, Burns & McDonnell

DEPARTMENT OF ENERGY
SAN FRANCISCO OPERATIONS OFFICE

CONTRACTOR REQUEST FOR PATENT CLEARANCE
FOR RELEASE OF UNCLASSIFIED DOCUMENT

Prime Contract No.	DE-AC03-78ET21007
Subcontract No.	(N/A)
Report No.	DOE/ET/21007-1 (STMPO-283)
Date of Report	October, 1978
Name & Phone No. of DOE Technical Representative	S. D. Elliott, Jr. (619) 254-2672

TO: Roger S. Gaither, Asst. Chief for Prosecution
Office of Patent Counsel/Livermore Office
P.O. Box 808, L-376
Livermore, California 94550

FROM: DOE Solar One Project Office
Post Office Box 366
Daggett, CA 92327

1. Document Title:
"10-MWe Solar Thermal Central Receiver Pilot Plant: Conceptual Design Review"

2. Type of Document: ☒ Technical Report, ☐ Conference Paper, ☐ Journal Article, ☐ Abstract or Summary, ☐ Copy of Oral Presentation, ☐ Other (please specify): _____

3. In order to meet a publication schedule or submission deadline, patent clearance by (routine) would be desired.

SENDER IS TO CHECK BOX #4 OR #5 BELOW.

☒ 4. I have reviewed (or have had reviewed by technically knowledgeable personnel) this document for possible inventive subject matter (Subject Inventions) and that no inventions or discoveries (Subject Inventions) are deemed to be disclosed in this document except as stated below:

a. Attention should be directed to pages _____ of this document.

b. This document describes matter relating to an invention:

i. Contractor Invention Docket No. _____.
ii. A disclosure of the invention was submitted to DOE on _____ (date)
iii. A disclosure of the invention will be submitted shortly _____ (approximate date)
iv. A waiver of DOE's patent rights to the contractor:
☐ has been granted, ☐ has been applied for; or ☐ will be applied for _____ (date)

☐ 5. This document is being submitted, but no review has been made of this document for possible inventive subject matter.

6. Remarks: See Martin Marietta ltr. 3/13/84 for Patent Certification

Reviewing/Submitting Official: Name (Print/Type) S. D. Elliott, Jr., Director
Title DOE Solar One Project Office
Signature S. D. Elliott, Jr. Date 8 May, 1984

TO: INITIATOR OF REQUEST

FROM: ASSISTANT CHIEF FOR PROSECUTION
Office of Patent Counsel/Livermore Office

☐ No patent objection to above-identified release.

☐ Please defer release until advised by this office.

Signed _____ Date Mailed _____

DOE Form RA-426
(10/80)

U.S. DEPARTMENT OF ENERGY

OMB NO. 038-R0190

DOE AND MAJOR CONTRACTOR RECOMMENDATIONS FOR ANNOUNCEMENT AND DISTRIBUTION OF DOCUMENTS

See Instructions on Reverse Side

1. DOE Report No.	2. Contract No.	3. Subject Category No.
DOE/ET/21007-1 (STMPO-283)	DE-AC03-78ET21007	UC-62

4. Title
"10 MWe SOLAR THERMAL CENTRAL RECEIVER PILOT PLANT: CONCEPTUAL DESIGN REVIEW 10/16/78"

5. Type of Document ("x" one)
- [X] a. Scientific and technical report
- [ ] b. Conference paper: Title of conference _____
  _____ Date of conference _____
  Exact location of conference _____ Sponsoring organization _____
- [ ] c. Other (specify planning, educational, impact, market, social, economic, thesis, translations, journal article manuscript, etc.)

6. Copies Transmitted ("x" one or more)
- [ ] a. Copies being transmitted for standard distribution by DOE–TIC.
- [ ] b. Copies being transmitted for special distribution per attached complete address list.
- [X] c. Two completely legible, reproducible copies being transmitted to DOE–TIC. (Classified documents, see instructions)
- [ ] d. Twenty-seven copies being transmitted to DOE–TIC for TIC processing and NTIS sales.

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- [ ] a. Normal handling (after patent clearance): no restraints on distribution except as may be required by the security classification.

Make available only [ ] b. To U.S. Government agencies and their contractors. [ ] c. within DOE and to DOE contractors. [ ] d. within DOE. [ ] e. to those listed in item 13 below.

- [X] f. Other (Specify) Archive/issue on request

8. Recommended Announcement ("x" one)
- [X] a. Normal procedure may be followed. [ ] b. Recommend the following announcement limitations:

9. Reason for Restrictions Recommended in 7 or 8 above.
- [ ] a. Preliminary information. [ ] b. Prepared primarily for internal use. [ ] c. Other (Explain)

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Does this information product disclose any new equipment, process or material? [X] No [ ] Yes If so, identify page nos. _____

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If so, identify the DOE (or other) disclosure number and to whom the disclosure was submitted.

Are there any patent-related objections to the release of this information product? [X] No [ ] Yes If so, state these objections.

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("x" one [ ] a. DOE patent clearance has been granted by responsible DOE patent group.
[X] b. Document has been sent to responsible DOE patent group for clearance.

11. National Security Information (For classified document only; "x" one)

Document [ ] a. does [ ] b. does not contain national security information

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13. Additional Information or Remarks (Continue on separate sheet, if necessary)

14. Submitted by (Name and Position) (Please print or type)
S. D. Elliott, Jr., Director, DOE Solar One Project Office

Organization
Post Office Box 366, Daggett, CA 92327 (619) 254-2672

Signature S D Elliott Jr

Date MAY 0 8 1984

DEPARTMENT OF ENERGY
SAN FRANCISCO OPERATIONS OFFICE

CONTRACTOR REQUEST FOR PATENT CLEARANCE
FOR RELEASE OF UNCLASSIFIED DOCUMENT

Prime Contract No.	DE-AC03-78ET21007
Subcontract No.	(N/A)
Report No.	DOE/ET/21007-1 (STNPO-203)
Date of Report	October, 1978
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TO: Roger S. Gaither, Asst. Chief for Prosecution
Office of Patent Counsel/Livermore Office
P.O. Box 808, L-376
Livermore, California 94550
Attn: D. Elliott

FROM: DOE Solar One Project Office
Post Office Box 366
Daggett, CA 92327

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2. Type of Document: ☒ Technical Report, ☐ Conference Paper, ☐ Journal Article, ☐ Abstract or Summary, ☐ Copy of Oral Presentation, ☐ Other (please specify): _____

3. In order to meet a publication schedule or submission deadline, patent clearance by (routine) would be desired.

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☒ 4. I have reviewed (or have had reviewed by technically knowledgeable personnel) this document for possible inventive subject matter (Subject Inventions) and that no inventions or discoveries (Subject Inventions) are deemed to be disclosed in this document except as stated below:

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iv. A waiver of DOE's patent rights to the contractor:
☐ has been granted, ☐ has been applied for; or ☐ will be applied for _____ (date)

☐ 5. This document is being submitted, but no review has been made of this document for possible inventive subject matter.

6. Remarks: See Martin Marietta ltr. 3/13/84 for Patent Certification

Reviewing/Submitting Official: Name (Print/Type) S. D. Elliott, Jr., Director
Title DOE Solar One Project Office
Signature _____ Date 8 May, 1984

TO: INITIATOR OF REQUEST

FROM: ASSISTANT CHIEF FOR PROSECUTION
Office of Patent Counsel/Livermore Office ~~Office~~

M. Lopez, SAN

☒ No patent objection to above-identified release.

☐ Please defer release until advised by this office.

LEC
5/14/84

Signed L. E. Cannahan Date Mailed 5/15/84

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COPY FOR CONTRACTOR'S (SENDER'S) FILES AFTER OPC RELEASE