DISTRIBUTION CODE H8

SPECIFICATION NO. EC 701A REV. 5

DATE: 4 Dec 1967

DOCUMENT CONTROL
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ENGINEERING CRITICAL COMPONENT SPECIFICATION

PERFORMANCE / DESIGN

AND

PRODUCT CONFIGURATION

REQUIREMENTS

FOR

IMAGE VELOCITY SENSOR

CDRL Sequence No. 56

CDRL Data Item No. C10

LAN: ~~3809-156-1~~
50286-46-2

CODE IDENTIFICATION NO. 23991

DEC 29 1967

GE MOL DEPARTMENT

INTERNAL SIGN-OFF SHEET

FOR

PART 1. PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS

IMAGE VELOCITY SENSOR

FOR

MANNED ORBITING LABORATORY SYSTEM

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ENGINEERING CRITICAL COMPONENT CONFIGURATION CHART

SPECIFICATION ISSUE & DATE	ECP'S	PRODUCTION EFFECTIVITY (SERIAL NUMBER)

SPECIFICATION CHANGE LOG

REVISIONS	SPECIFICATION TITLE	SPEC NO.	PAGE
	IMAGE VELOCITY SENSOR	EC701A, Rev. 5	

STATUS		REVISED BY							
REV	DATE	AN NO.	AN DATE	SCN NO.	SCN DATE	ECP NO.	PAGE AND/OR PARAGRAPH AFFECTED	ITEM AFFECTED	REMARKS

CEI NO.	CODE IDENT NO. 23991	GENERAL ELECTRIC	DISTRIBUTION CODES	DEPT MOL	LOCATION: RADNOR, PA.

PART I- PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS

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SPECIFICATION NO. EC 701A REV. 5

ENGINEERING CRITICAL COMPONENT SPECIFICATION

PART I. PERFORMANCE / DESIGN AND QUALIFICATION REQUIREMENTS

IMAGE VELOCITY SENSOR

4 December 1967
Date

1.0 SCOPE

THIS PART OF THIS SPECIFICATION ESTABLISHES THE REQUIREMENTS FOR PERFORMANCE, DESIGN, TEST AND QUALIFICATION OF ONE MISSION-DESIGN-SERIES OF EQUIPMENT IDENTIFIED AS THE IMAGE VELOCITY SENSOR -IVS-. THIS COMPONENT IS USED TO DETECT THE MOTION OF AN IMAGE IN AN IMAGE PLANE AND PROVIDE SIGNALS PROPORTIONAL TO THE MOTION. THIS COMPONENT IS ALSO REQUIRED TO PROVIDE SIGNALS WHICH INDICATE THE PRESENCE OF CLOUDS IN THE IMAGE, AND A CONDITION OF IMAGE BRIGHTNESS BELOW THE THRESHOLDS SPECIFIED. CLOUD DETECTION CAPABILITY SHALL NOT DEGRADE THE PRIMARY IVS TASK.

2.0 APPLICABLE DOCUMENTS

THE FOLLOWING DOCUMENTS, OF EXACT ISSUE SHOWN, FORM A PART OF THIS SPECIFICATION TO THE EXTENT SPECIFIED HEREIN. IN THE EVENT OF CONFLICT BETWEEN DOCUMENTS REFERENCED HERE AND THE DETAILED CONTENT OF SECTION 3, THE DETAILED REQUIREMENTS OF SECTION 3 SHALL BE CONSIDERED A SUPERSEDING REQUIREMENT. ANY CONFLICT BETWEEN A DOCUMENT LISTED IN THIS SECTION AND A LOWER TIER REFERENCED DOCUMENT SHALL BE RESOLVED IN FAVOR OF THE LISTED DOCUMENT.

SYSTEM PROGRAM DOCUMENTS

SAFSL 10003 1 SEPT 1966	ENVIRONMENTAL DESIGN AND TEST CRITERIA

SPECIFICATIONS

MILITARY

MIL-E-25366C 27 FEB. 1961	ELECTRICAL & ELECTRONIC EQUIP. & SYSTEMS, GUIDED MISSILES
MIL-E-5400H 1 JUNE 1965	ELECTRONIC EQUIPMENT, AIRCRAFT, GENERAL SPECIFICATION FOR

MIL-S-38130A 15 JULY 1966	SAFETY ENGINEERING OF SYSTEMS
MS 33586-A 16 DECEMBER 1958	METALS, DEFINITION OF DISSIMILAR

GENERAL ELECTRIC COMPANY

DR 1100A MARCH 1967 AN 1 THRU 5	ENVIRONMENTAL CRITERIA AND COMPONENT TEST REQUIREMENTS SPECIFICATION - MOL
DR 1110B 15 NOV. 1967	SELECTED AVE PARTS LIST
DR 1112 ADD 1 9 JAN. 1967	SELECTED PROCESSES FOR USE IN THE MOL MISSION MODULE, GENERAL SPEC FOR
DR 1113 18 APRIL 1966	SELECTED STRUCTURAL PARTS FOR USE IN THE MOL MISSION MODULE, GENERAL SPEC FOR
DR 1115 NOV. 1966	GENERAL SPECIFICATION FOR SELECTED MATERIALS FOR USE IN MOL LAB. MODULE
DP 1690 11 NOV 1966	ELECTROMAGNETIC COMPATIBILITY REQUIREMENTS FOR MOL PROGRAM
S-30000 18 SEPT 1964	DESIGN REQUIREMENTS FOR ELECTRONIC MODULES
S-30001 17 JUNE 1963	MODULE, ELECTRONIC, METAL FRAME-ASSEMBLY, INSTRUCTION FOR

S-30002 12 JUNE 1963	MODULES, ELECTRONIC, ENCAPSULATED -CORDWOOD- ASSEMBLY INSTRUCTION FOR
TR-951	IVS TESTER

STANDARDS

MIL-STD-130B CHANGE NO. 1 7 FEBRUARY 1964	IDENTIFICATION MARKING OF U.S. MILITARY PROPERTY
MIL-STD-143A CHANGE NO. 1 14 MAY 1963	SPECS AND STDS, ORDER OF PRECEDENCE
MIL-STD-454A 5 JAN 1965	GENERAL REQUIREMENTS FOR ELECTRONIC EQUIP
FED-STD-595 CHANGE NO. 2 19 FEBRUARY 1962	COLORS
MIL-STD-795 CHANGE NO. 1 26 AUG. 1964	COLORS

DRAWINGS
GENERAL ELECTRIC

GE-711-03013 REV 1	SPACE ENVELOPE AVAILABLE FOR IVS -M/A-
TBD	SPACE ENVELOPE AVAILABLE FOR IVS -A-

BULLETINS

ANA BULLETIN 400, REV. U 15 MAY 1964	ELECTRONIC EQUIPMENT, AIRCRAFT & GUIDED MISSILES, APPLICABLE DOCUMENTS

OTHER PUBLICATIONS
AIR FORCE EXHIBIT

MIL-HDBK-217A	RELIABILITY STRESS & FAILURE RATE DATA FOR ELECTRONIC EQUIPMENT
SP-63-470 VOL 1	FARADA
SSD 61-70A REVISION NO. 1 7 NOVEMBER 1962	COLOR & MARKING CRITERIA FOR LARGE SOLID MOTORS

3.0 REQUIREMENTS

3.1 PERFORMANCE

3.1.1 FUNCTIONAL CHARACTERISTICS

THE IVS SHALL SENSE IMAGE VELOCITY AT THE CENTER OF THE FORMAT OF THE IMAGE PROVIDED BY THE PAYLOAD PRIMARY OPTICS, DURING TARGET ACQUISITION AND TRACKING, AND RESOLVE IT INTO TWO VECTOR COMPONENTS ALONG PERPENDICULAR AXES -X, Y-. NOMINALLY, THE X COORDINATE IS DEFINED AS THE OBSERVED IN-TRACK COMPONENT OF VELOCITY FOR NADIR TARGETS AND THE Y COORDINATE IS DEFINED AS THE OBSERVED CROSS-TRACK COMPONENT OF VELOCITY FOR NADIR TARGETS. ALL REQUIREMENTS, UNLESS OTHERWISE NOTED, REFER TO THE RESULTANT VELOCITY AS RECONSTRUCTED FROM THESE COMPONENTS.

THE IVS SHALL PROVIDE THE FOLLOWING OUTPUT SIGNALS.

A. IMAGE VELOCITY
B. LOCK-ON SIGNAL
C. OPERATIONAL READINESS MONITORING
D. DIAGNOSTIC MONITORING
E. SIGNALS INDICATIVE OF CLOUDS WITHIN OPTICAL FOV
F. SUB THRESHOLD SCENE LUMINANCE INDICATION

3.1.1.1 PRIMARY PERFORMANCE CHARACTERISTICS

3.1.1.1.1 IMAGE VELOCITY OUTPUT SIGNALS

THE OUTPUT IMAGE VELOCITY SIGNALS FROM THE IVS SHALL BE PROVIDED IN RECTILINEAR COORDINATE FORM. EACH SHALL BE PROPORTIONED TO ITS RESPECTIVE COMPONENT OF THE IMAGE VELOCITY VECTOR RESOLVED ALONG THE IVS PERPENDICULAR AXES.

EACH COMPONENT OF IMAGE VELOCITY SHALL BE OUTPUTTED IN ANALOG FORM WITH A GAIN FACTOR OF 10 VOLTS PER IPS, A MAXIMUM -SATURATION- VALUE OF FIVE VOLTS AND AN IMPEDANCE OF LESS THAN 50 OHMS. A SEPARATE SENSE OR SIGN SIGNAL SHALL BE PROVIDED FOR EACH COMPONENT TO PROVIDE PLUS OR MINUS -POM- DIRECTION TO EACH COMPONENT AMPLITUDE SIGNAL. A SENSE SIGNAL BETWEEN ZERO AND 0.5 V SHALL DENOTE NEGATIVE POLARITY. A SENSE SIGNAL BETWEEN 2.4 AND 4.8 V SHALL DENOTE POSITIVE POLARITY. THE MAXIMUM VALUE REFERENCE VOLTAGE - NOMINALLY, FIVE VOLTS- SHALL SHALL ALSO BE OUTPUTTED FOR

REFERENCE PURPOSE FOR AN EXTERNAL A-D CONVERTER. THE OUTPUT IMPEDANCE OF THE SENSE AND REFERENCE LEVEL SHALL BE LESS THAN 20 K OHMS. ADDITIONAL CHARACTERISTICS OF THE IMAGE VELOCITY OUTPUT SIGNALS ARE

A. DYNAMIC RANGE

THE IVS SHALL PROVIDE SIGNALS REPRESENTATIVE OF TRUE IMAGE VELOCITIES FROM ZERO TO 0.3 IPS -600 MICRO RAD/SEC.- IN THE PRIMARY IMAGE PLANE. IMAGE SHEARING AND ROTATIONAL VELOCITY COMPONENTS IN THE IMAGE PLANE SHALL NOT BE SENSED.

B. LINEARITY

LINEARITY REQUIREMENTS ARE SPECIFIED SEPARATELY IN THE LARGE SIGNAL AND NULL REGIONS. THE LARGE SIGNAL REGION IS DEFINED OVER THE RANGE OF TRUE IMAGE VELOCITIES BETWEEN THE VALUES OF 0.0225 IPS AND 0.3 IPS.

THE NULL REGION IS DEFINED OVER THE RANGE OF TRUE IMAGE VELOCITIES BETWEEN THE VALUES OF ZERO AND 0.0225 IPS.

INDICATED IMAGE VELOCITY IS DEFINED AS THE RATIO OF SENSOR OUTPUT VOLTAGE TO THE SENSOR GAIN OF TEN VOLTS PER IPS.

1. LARGE SIGNAL REGION

THE CURVE RELATING THE TRUE AND INDICATED IMAGE VELOCITIES SHALL LIE WITHIN THE SHADED REGION IN FIGURE 1. IT NEED NOT BE REPEATED FOR DIFFERENT SCENES, BUT MUST FOR A GIVEN SCENE BE SINGLE-VALUED, I.E., THE SLOPE OF THE CURVE FOR ANY TRUE IMAGE VELOCITY SHALL ALWAYS BE OF POSITIVE POLARITY.

2. NULL REGION

THE CURVE RELATING THE TRUE AND INDICATED IMAGE VELOCITIES SHALL LIE WITHIN THE SHADED REGION IN FIGURE 2. THIS REQUIREMENT IS ON A PER AXIS BASIS. THE SLOPE OF THE CURVE AT ANY TRUE IMAGE VELOCITY FROM 0.001 IPS TO 0.0225 IPS SHALL BE FROM 0.9 TO 1.1. THE SLOPE IN THE THRESHOLD REGION DEFINED IN FIGURE 2 SHALL BE WITHIN THE RANGE 0 TO 1.1.

C. IVS NOISE AND BIAS

IVS NOISE AND BIAS REQUIREMENTS ARE SPECIFIED SEPARATELY IN THE LARGE SIGNAL AND NULL REGIONS. THESE REGIONS ARE DEFINED IN PARAGRAPH B.

1. NOISE DEFINITION

IVS OUTPUT NOISE FROM EACH AXIS WILL BE SEPARATED INTO ITS PERIODIC AND RANDOM COMPONENTS.

THE TOTAL NOISE WILL BE DEFINED BY THE EXPRESSION

$$N_T = \sqrt{N_X^2 + N_Y^2} \quad 2 \quad SIGMA$$

WHERE,

$N_X = N_{XR} + N_{XP}$ 2 SIGMA

$N_Y = N_{YR} + N_{YP}$ 2 SIGMA

N_T IS THE TOTAL NOISE IPS

N_{XR} IS THE RANDOM COMPONENT OF NOISE ABOUT THE X AXIS - IPS 2 SIGMA

N_{XP} IS THE TOTAL PERIODIC NOISE ABOUT THE X AXIS - IPS

N_{YR} IS THE RANDOM COMPONENT OF NOISE ABOUT THE Y AXIS - IPS 2 SIGMA

N_{YP} IS THE TOTAL PERIODIC NOISE ABOUT THE Y AXIS - IPS

2 SIGMA HEREIN DEFINED TO MEAN THAT MEASURED VALUES BE WITHIN THIS RANGE OF VALUES 95% OF THE TIME.

TOTAL PERIODIC NOISE -N_{XP} AND N_{YP}- ABOUT THE X-Y AXES SHALL BE OBTAINED AS FOLLOWS

NOTE ALL PERIODIC FREQUENCIES -AND AMPLITUDES- FOR EACH AXIS AND OBTAIN ALL POSITIVE COMPLEMENTARY FREQUENCIES FROM THE EXPRESSION,

COMPLEMENTARY FREQUENCIES = $(\pm f_{i_{x,y}} \pm \eta f_s)(f_{i_{cx}}, f_{i_{cy}})$

f_{i_x} ARE THE PRIMARY PERIODIC FREQUENCIES ABOUT

THE X AXIS - HZ
f_{iy} ARE THE PRIMARY PERIODIC FREQUENCIES ABOUT
THE Y AXIS - HZ
f_s IS THE SAMPLING FREQUENCY EQUALS 10 HZ
f_{icx} ARE THE COMPLEMENTARY PERIODIC FREQUENCIES ABOUT
THE X AXIS - HZ
f_{icy} ARE THE COMPLEMENTARY PERIODIC FREQUENCIES ABOUT
THE Y AXIS - HZ

ENTER EACH PRIMARY AND COMPLEMENTARY FREQUENCY ALONG THE ABCISSA IN FIGURE 3A OR FIGURE 3B -TBD- FOR FREQUENCIES ABOVE 15 HZ. OBTAIN THE CORRESPONDING $K_{ix,y}$ AND $K_{icx,cy}$ FOR EACH AXIS, OFF THE ORDINATE OF THE GRAPH. CALCULATE N_{xp} AND N_{yp} FROM THE SUMMATION,

$$N_{XP} = \sum^{i} K_{ix} A_{ix} + \sum^{i} K_{icx} A_{icx}$$

$$N_{YP} = \sum^{i} K_{iy} A_{iy} + \sum^{i} K_{icy} A_{icy}$$

A = HALF-AMPLITUDE OF EACH PERIODIC FREQUENCY - IPS

THE RANDOM COMPONENT (N_{XR}, N_{YR}) OF NOISE ABOUT X AND Y AXES WILL BE DETERMINED AS FOLLOWS:

THE POWER-SPECTRAL-DENSITY -PSD- OF THE RANDOM NOISE COMPONENT ABOUT EACH AXIS WILL BE COMPUTED BY A METHOD APPROVED BY THE GENERAL ELECTRIC COMPANY. A SUGGESTED TEXTBOOK APPROACH INVOLVES THE DETERMINATION OF PSD FROM THE EQUATION,

$$\text{PSD} = \Phi\left(\frac{IPS^2}{hz}\right) = \int_{-\infty}^{\infty} \phi(\tau) e^{-j\omega\tau} d\tau$$

WHERE,

$\phi(\tau)$ = AUTOCORRELATION FUNCTION

$$= \lim_{T \to \infty} \frac{1}{2T} \int_{-T}^{T} f(t) f(t+\tau) dt$$

THE DATA LENGTH, T, WILL BE 500 SECONDS. THE SAMPLING FREQUENCY WILL BE 10 HZ. PSD DATA VERSUS FREQUENCY WILL BE PLOTTED UP TO 30 HZ. THE SHAPE OF THE PSD WILL BE REPEATABLE AT 10 HZ INTERVALS AS ILLUSTRATED IN FIGURE 4. EACH CURVE Φ_X* AND Φ_Y* WILL BE MULTIPLIED BY THE APPROPRIATE ATTENUATION CHARACTERISTIC OF FIGURE 5A OR FIGURE 5B -TBD- AND THE RESULTANT AMPLITUDE OBTAINED AT CORRESPONDING FREQUENCIES. THE ATTENUATION CHARACTERISTIC OF FIGURE 5A IS ALSO SHOWN IN FIGURE 3A ON A DB SCALE.

THE RESULTANT CURVES Φ_{CCX} AND Φ_{CCY} SHALL THEN BE PROCESSED AS FOLLOWS TO YIELD THE DESIRED N_{XR} AND N_{YR}

$$N_{YR} = 2\sqrt{\frac{1}{\pi}\int_0^\infty \Phi_{ccy}\, d\omega} \quad (2\sigma)$$

$$N_{XR} = 2\sqrt{\frac{1}{\pi}\int_0^\infty \Phi_{ccx}\, d\omega} \quad (2\sigma)$$

2. LARGE SIGNAL REGION

THE SUM TOTAL CONTRIBUTION OF NOISE $-N_T-$ AND BIAS $-B_T-$ SHALL HAVE A MAGNITUDE WHICH DOES NOT LIE OUTSIDE THE SHADED REGION IN FIGURE 6 THE TOTAL BIAS $-B_T-$ SHALL BE DEFINED BY THE RSS OF B_X AND B_Y WHICH ARE, RESPECTIVELY, THE X AND Y COMPONENTS OF IVS BIAS.

$$B_T\,(2\sigma) = \sqrt{B_X(2\sigma)^2 + B_Y(2\sigma)^2}$$

3. NULL REGION

THE SUM TOTAL CONTRIBUTION OF NOISE $-N_T-$ AND BIAS $-B_T-$ SHALL NOT EXCEED 0.010IPS (2 SIGMA)

$$N_T + B_T \leq 0.010 \text{ IPS } (2\sigma)$$

D. SATURATION

THE IVS SHALL NOT SATURATE FOR INDICATED IMAGE VELOCITIES OF LESS THAN 0.3 IPS - 600 MICRO RAD/SEC. WHEN EITHER AXIS IS SATURATED THE IVS SHALL INDICATE THIS CONDITION FOR EACH

SATURATED AXIS. THE MINIMUM SIGNAL FOR THIS CONDITION SHALL BE A POLARITY SIGNAL CORRESPONDING TO THE VELOCITY POLARITY FOR COMPONENT VELOCITIES UP TO 0.5 IPS. AN EXTERNAL DISABLE SIGNAL CAN BE PROVIDED TO THE IVS DURING PERIODS OF KNOWN SATURATION. AFTER PERIODS OF SATURATION OF UP TO TWO SECONDS, THE IVS SHALL RECOVER FROM SATURATION WITHIN 0.1 SECOND AFTER THE IMAGE VELOCITY FALLS WITHIN ITS DYNAMIC RANGE. THE IVS SHALL RECOVER WITHIN 0.5 SECOND AFTER SATURATION PERIODS IN EXCESS OF TWO SECONDS. IN DEFINING THIS REQUIREMENT, THE IVS SHALL NOT BE CONSIDERED TO BE IN SATURATION WHEN AN EXTERNAL DISABLE SIGNAL IS SUPPLIED, REGARDLESS OF IMAGE VELOCITIES DURING THESE PERIODS. TIME OF RECOVERY FROM SATURATION IS DEFINED AS THE TIME AT WHICH THE IVS OUTPUT SIGNAL CHANGES FROM ITS SATURATED VALUE AND REGAINS A PROPORTIONAL RESPONSE STATE WITH SPECIFIED ACCURACY WITHIN THE DYNAMIC CONSTRAINTS AS DEFINED IN PARA. 3.1.1.1.1.E.

E. FREQUENCY RESPONSE

THE DYNAMIC RESPONSE OF THE IVS SHALL BE THAT OF A FIRST-ORDER LAG $1/(1 + S/2\pi f_o)$ OVER THE RANGE OF TRUE IMAGE VELOCITY FROM 0.0025 TO 0.25 IPS. AN ACCEPTABLE RANGE OF THE LAG FREQUENCY WILL BE

$$1\,hz < f_o < \infty$$

THE VENDOR SHALL SPECIFY THIS FREQUENCY SO THAT DEVIATIONS FROM FIRST-ORDER LAG PHASE AND AMPLITUDE CHARACTERISTICS CAN BE DETERMINED. DEVIATIONS FROM THE IDEAL AMPLITUDE AND PHASE CHARACTERISTICS OF THE FIRST-ORDER LAG DUE TO ALL SOURCES SUCH AS FILTERING, TIME DELAYS, ETC., WILL BE ALLOWED PROVIDED THEY DO NOT EXCEED THE MOST NEGATIVE PERMISSIBLE GAIN AND PHASE PLOTS SHOWN IN FIGURE 7. FOR FREQUENCIES LESS THAN 5 HZ. THE FOLLOWING TOLERANCES ARE PERMITTED

PHASE DEVIATION BETWEEN POM 5 DEGREES

AMPLITUDE DEVIATION BETWEEN POM 1.5 DB

3.1.1.1.2 LOCK-ON SIGNAL

THE IVS SHALL PROVIDE A SIGNAL FOR EACH AXIS INDICATING THE IMAGE LOCK-ON STATUS. THE OUTPUT SHALL BE BETWEEN 3.5 AND 5.0 VOLTS -LOGIC ONE- WHEN THE IMAGE IS IN THE LOCKED-ON CONDITION AND BETWEEN ZERO AND 0.5 VOLT -LOGIC ZERO- WHEN NOT LOCKED-ON OR IN A SATURATED CONDITION. LOCK-ON IS DEFINED AS SENSING THE IMAGE PROVIDED WITHIN THE REQUIREMENTS OF THIS SPECIFICATION.

3.1.1.1.3 OPERATIONAL READINESS SIGNAL

THE IVS SHALL PROVIDE AN OUTPUT SIGNAL TO DENOTE OPERATIONAL READINESS. A LOGIC ONE SHALL BE OUTPUTTED WHEN THE IVS IS OPERATIONALLY READY, AND A LOGIC ZERO SHALL BE OUTPUTTED WHEN THE IVS IS NOT OPERATIONALLY READY. THE OPERATIONAL READINESS IS DEFINED AS THE CAPABILITY TO SENSE AN IMAGE, WHEN PROVIDED.

3.1.1.1.4 DIAGNOSTIC MONITORING SIGNALS

A MAXIMUM SPACE ALLOCATION OF TWO EQUIVALENT FORMAT WORDS IS ASSIGNED TO THE IVS COMPONENT FOR DIAGNOSTIC MONITORING TO THE TELEMETRY. EVERY FOUR SECONDS AN EQUIVALENT FORMAT WORD PROVIDES FOR 256 EIGHT BIT SAMPLES -WORDS-. ALL IVS DIAGNOSTIC SIGNALS MUST BE NORMALIZED TO BE WITHIN THE RANGE OF ZERO TO FIVE VOLTS. THE IVS COMPONENT VELOCITY SIGNALS SHALL BE INCLUDED AMONG THE DIAGNOSTIC SIGNALS.

3.1.1.1.5 ALIGNMENT

THE IVS MOUNTING BASE SHALL BE INSCRIBED WITH ORTHOGONAL X AND Y INDEX MARKS. THE ELECTRICAL SIGNAL AXES OF THE COMPONENT SHALL BE RESPECTIVELY COINCIDENT WITH THESE INDICES WITHIN POM 0.5 DEGREE. THIS ALIGNMENT SHALL BE MAINTAINED THROUGHOUT THE SPECIFIED ENVIRONMENT AND OPERATING CONDITION RANGES.

3.1.1.2 SECONDARY PERFORMANCE CHARACTERISTICS

THE IVS SHALL BE OPERABLE, WITHIN THE REQUIREMENTS OF THIS SPECIFICATION, WITHIN THREE MINUTES AFTER INPUT VOLTAGE IS APPLIED AND WITHIN THE SPECIFIED ENVIRONMENT.

3.1.2 OPERABILITY

3.1.2.1 RELIABILITY

THE IVS SHALL HAVE A MTBF OF AT LEAST 10,000 HRS. WHERE FAILURE IS DEFINED AS THE INABILITY TO MEET THE FUNCTIONAL REQUIREMENTS OF THIS SPECIFICATION. DESIGN OF THE IVS SHALL BE SUCH THAT A FAILURE OF THIS COMPONENT SHALL NOT ADVERSELY AFFECT ANY OTHER EQUIPMENT WITH WHICH IT HAS AN INTERFACE.

3.1.2.2 MAINTAINABILITY

THE IVS SHALL BE DESIGNED. TO INCORPORATE EASE OF MAINTAINABILITY TO MINIMIZE EQUIPMENT DOWN TIME DURING TEST AND CHECKOUT.

3.1.2.2.1 MAINTENANCE AND REPAIR CYCLES

DESIGN OF THE IVS SHALL REQUIRE NO PERIODIC IN-FLIGHT MAINTENANCE. NO OTHER PERIODIC MAINTENANCE SHALL BE REQUIRED AT LESS THAN 45 DAY INTERVALS.

3.1.2.2.2 SERVICE AND ACCESS

PARTS REQUIRING PERIODIC MAINTENANCE OR ADJUSTMENT SHALL BE READILY ACCESSIBLE. THE DESIGN OF THE IVS SHALL PERMIT READY ACCESS TO PARTS TO SIMPLIFY INSPECTION, SERVICING AND REPLACEMENT. DESIGN SHALL PERMIT INTERCHANGING OF PARTS USED IN REDUNDANT CHANNELS.

3.1.2.3 USEFUL LIFE

THIS COMPONENT SHALL BE CAPABLE OF PERFORMING IN ACCORDANCE WITH THE REQUIREMENTS OF THIS SPECIFICATION THROUGHOUT A USEFUL OPERATIONAL LIFE OF 1112 HOURS, WHILE MEETING ALL COMBINATIONS OF THE FOLLOWING CONDITIONS

A. TRANSPORTATION- LIMITED TO 60 DAYS AS DEFINED IN DR 1100, PARAGRAPH 3.1.2.1.

B. STORAGE- PER PARAGRAPH 3.3.11 OF THIS SPECIFICATION.

C. HANDLING, ASSEMBLY AND CHECKOUT- 9 MONTHS MAXIMUM AS DEFINED IN DR 1100, PARAGRAPH 3.1.2.3.

D. PRE-LAUNCH PHASE- 13 MONTHS AS DEFINED IN DR 1100, PARAGRAPH 3.1.2.4.

E. LAUNCH AND ASCENT- 10 MINUTES AS DEFINED IN DR 1100, PARAGRAPH 3.1.2.5.

F. ORBITAL OPERATION- A MINIMUM TOTAL OF 2500 HRS. -556 HRS ON AND 1944 HRS. OFF- WITH A DUTY CYCLE OF 20 MINUTES ON AND 70 MINUTES OFF, EXCLUDING WARM-UP TIME.

3.1.2.4 ENVIRONMENTAL

THE COMPONENT SHALL BE DESIGNED TO WITHSTAND, AND SUFFER NO DEGRADATION OF PERFORMANCE AFTER EXPOSURE TO THE ENVIRONMENTAL CONDITIONS

SPECIFIED IN GE SPECIFICATION NO. DR 1100, TABLE 1 WITH THE FOLLOWING ADDITIONAL CONDITIONS. THE COMPONENT SHALL OPERATE DURING PORTIONS OF HANDLING, ASSEMBLY AND CHECKOUT AND PRE-LAUNCH AND DURING THE ON-ORBIT PHASE.

A. VIBRATION - THIS COMPONENT WILL BE SUBJECTED TO VIBRATIONS IMPOSED ON TRUSS MOUNTED COMPONENTS.

B. ACOUSTIC NOISE - THIS COMPONENT WILL BE SUBJECTED TO THE ACOUSTIC NOISE LEVELS IMPOSED ON INTERNAL COMPONENTS.

3.1.2.5 TRANSPORTABILITY

THE DESIGN OF THE COMPONENT AND ITS PACKAGING AND PACKING FOR SHIPMENT SHALL BE SUCH THAT THE COMPONENT SHALL MEET ALL PERFORMANCE REQUIREMENTS STATED IN SECTION 3.0 OF THIS SPECIFICATION AFTER THE PACKAGED COMPONENT IS SUBJECTED TO THE TRANSPORTATION ENVIRONMENTS DESCRIBED IN PARAGRAPH 3.1.2.4 OF THIS SPECIFICATION.

THE PACKAGING SHALL BE ADEQUATE TO MAINTAIN THE SPECIFIED CLEANLINESS CONDITIONS OF THE COMPONENT UNDER THE SPECIFIED SHIPPING ENVIRONMENTS. CONTAINERS SHALL BEAR PRECAUTIONARY LABELS OR MARKINGS THAT ARE COMPATIBLE WITH THE SPECIFIED CLEANLINESS REQUIREMENTS.

3.1.2.6 HUMAN PERFORMANCE

NOT APPLICABLE

3.1.2.7 SAFETY

THIS COMPONENT SHALL FULFILL THE SAFETY REQUIREMENTS AS DESCRIBED IN MIL-S-38130 AND GE SPECIFICATION NO. DR1100, PARAGRAPH 3.1.3.

3.1.2.7.1 FLIGHT SAFETY

ALL RECOGNIZED CLASS III AND IV HAZARDS AND POTENTIAL HAZARDS, AS IDENTIFIED IN MIL-S-38130, PARAGRAPH 3.2.3 SHALL BE REPORTED TO THE GENERAL ELECTRIC COMPANY BY MEANS OF THE PRESCRIBED HAZARD REPORT. PARTS WHICH MAY WORK LOOSE IN SERVICE SHALL BE SAFETY WIRED OR SHALL HAVE OTHER

APPROVED LOCKING MEANS APPLIED.

3.1.2.7.2 GROUND SAFETY

SAME AS PARAGRAPH 3.1.2.7.1 OF THIS SPECIFICATION.

3.1.2.7.3 NUCLEAR SAFETY

NOT APPLICABLE

3.1.2.7.4 PERSONNEL SAFETY

THE DESIGN OF THIS COMPONENT SHALL GIVE PRIME CONSIDERATION TO THE MINIMIZATION OF HAZARD TO PERSONNEL. SAFETY METHODS SHALL BE EMPLOYED TO SATISFY THE REQUIREMENTS OF MIL-S-38130. THE DESIGN SHALL PROVIDE FAILSAFE FEATURES FOR SAFETY OF PERSONNEL DURING THE INSTALLATION, OPERATION, MAINTENANCE, AND REPAIR OR INTERCHANGING OF A COMPLETE EQUIPMENT ASSEMBLY OR COMPONENT.

3.1.2.7.5 EXPLOSIVE AND/OR ORDNANCE SAFETY

NOT APPLICABLE

3.2 COMPONENT DEFINITION

3.2.1 INTERFACE REQUIREMENTS

THE IVS SHALL HAVE INTERFACES OF THE FOLLOWING NATURE WITH THE DESIGNATED SUBSYSTEMS-

A. ELECTRICAL
   POWER, INPUT SIGNALS, AND OUTPUT CONTROL AND MONITORING SIGNALS.

B. MECHANICAL
   CONSTRAINTS OF STRUCTURAL INTERFERENCE, VIBRATION GENERATION AND RESONANCE, STRUCTURAL MASS LOADINGS, ALIGNMENT.

C. OPTICAL
   INPUT SIGNAL CONDITIONS.

D. THERMAL

3.2.1.1 SCHEMATIC ARRANGEMENT
SEE FIGURE 8.

3.2.1.2 DETAILED INTERFACE DEFINITION

3.2.1.2.1 NORMAL INPUT POWER CONDITIONS

THIS COMPONENT SHALL BE CAPABLE OF FUNCTIONING WITHIN THE PERFORMANCE REQUIREMENTS OF THIS SPECIFICATION WHILE OPERATED WITH INPUT POWER HAVING THE FOLLOWING CHARACTERISTICS

A. OPERATING VOLTAGE RANGE- BETWEEN PLUS 22.0 AND 31.0 VDC.

B. VOLTAGE RIPPLE- 3.0 V RMS -DP1690, PARA. 4.2.4.2.2.1, 30 HZ TO 150 KHZ APPLIES EXCEPT FOR RIPPLE LEVEL WHICH SHALL BE 3.0 V RMS INSTEAD OF 10% OF SUPPLY VOLTAGE-.

C. OPERATING POWER- THE MAXIMUM POWER CONSUMED SHALL BE LESS THAN 50 WATTS PEAK EXCEPT FOR TRANSIENT AS DEFINED IN PARAGRAPH 3.2.1.2.1.D WITH 24 VOLTS INPUT DURING OPERATION INCLUDING WARM UP.
THE MAXIMUM AVERAGE POWER CONSUMED SHALL BE LESS THAN 25 WATTS WITH 24 VOLTS INPUT AND AVERAGED OVER A 20 MIN. OPERATING PERIOD PLUS A 3 MIN. WARM UP TIME. RELATIVELY CONSTANT POWER INPUT TO THE IVS IS PREFERRED OVER THE INPUT SUPPLY VOLTAGE PROFILE. WITH INPUT VOLTAGES HIGHER THAN 24 VOLTS, HIGHER POWER CONSUMPTION, PROPORTIONAL TO THE SQUARE OF THE RATIO OF ACTUAL TO NOMINAL INPUT VOLTAGE, CAN BE TOLERATED.

D. TURN-ON POWER- THE MAXIMUM POWER SURGE DURING POWER TURN-ON SHALL BE LESS THAN 100 WATTS AND SHALL NOT EXCEED A 10 MILLISECOND DURATION.

E. TRANSIENT LEVEL- POM 100 VOLTS -SEE DP 1690, PARAGRAPH 4.2.4.2.3, CONDUCTED TRANSIENT, FOR DETAILED DEFINITION-.

F. TRANSIENT DURATION- SEE DP 1690, PARAGRAPH 4.2.5.4.4, CONDUCTED TRANSIENT SUSCEPTIBILITY, FOR DETAILED DEFINITION.

3.2.1.2.2 ABNORMAL CONDITIONS

THIS COMPONENT SHALL SURVIVE THE FOLLOWING CONDITIONS WITHOUT DAMAGE.

A. UNDER AND OVER VOLTAGE - THIS COMPONENT SHALL WITHSTAND CONTINUOUS VOLTAGE FROM PLUS 20 TO 22 VDC AND FROM PLUS 31 TO 33 VDC, AND SHALL GIVE SPECIFIED PERFORMANCE IMMEDIATELY UPON RETURN TO COMPONENT OPERATING VOLTAGE PER PARAGRAPH 3.2.1.2.1.A

B. POWER INTERRUPT - THIS COMPONENT SHALL WITHSTAND A VOLTAGE RANGE FROM ZERO TO 20 VOLTS WHICH CAN LAST UP TO ONE SECOND AND SHALL GIVE SPECIFIED PERFORMANCE WITHIN FIVE SECONDS AFTER RETURN OF NORMAL OPERATING VOLTAGE.

C. THE IVS SHALL NOT OUTPUT ANY SIGNAL WHICH WILL DAMAGE ANY OTHER EQUIPMENT OF THE ORBITING VEHICLE AS A RESULT OF CONDITIONS IN A AND B OF THIS PARAGRAPH.

3.2.1.2.3 SENSOR OUTPUT CHANNELS

THE INTERFACING LOAD IMPEDANCE TO THE IVS WILL BE 100K OHMS OR GREATER FOR EACH CHANNEL. A SCHEMATIC REPRESENTATION OF THE IVS INTERFACE IS SHOWN IN FIGURE 8.

A. IMAGE VELOCITY SIGNAL OUTPUTS

THE SENSOR SOURCE IMPEDANCES FOR THE X AND Y AMPLITUDE SIGNAL OUTPUT CHANNELS SHALL BE LESS THAN 50 OHMS. THE OUTPUT SIGNALS SHALL BE FROM ZERO TO 5 VOLTS AND SHALL BE LINEARLY PROPORTIONED TO IMAGE VELOCITIES OF ZERO TO POM 0.5 IPS FOR EACH VELOCITY COMPONENT CHANNEL. SEE SECTION 3.1.1.1.1 FOR COMPLETE DESCRIPTION.

B. LOCK-ON SIGNAL

OUTPUT IMPEDANCE SHALL BE LESS THAN 2 K OHMS, WITH AN OUTPUT AS DESCRIBED IN PARA. 3.1.1.1.2 WHEN THE IVS HAS ESTABLISHED AN IMAGE VELOCITY SIGNAL OUTPUT WITHIN THE REQUIREMENTS

OF SECTION 3.1.1.1.1.

C. READY SIGNAL

OUTPUT IMPEDANCE SHALL BE LESS THAN 2 K OHMS, WITH AN OUTPUT AS DEFINED IN PARA. 3.1.1.1.3.

D. DIAGNOSTIC SIGNALS

OUTPUT IMPEDANCE FOR EACH DIAGNOSTIC SIGNAL SHALL BE LESS THAN 2K OHMS.

E. CLOUD DETECTION SIGNAL

CLOUD DETECTION SIGNAL SHALL BE LOGIC ONE IN THE PRESENCE OF CLOUDS, A LOGIC ZERO IN THE ABSENSE OF CLOUDS, AND THE OUTPUT IMPEDANCE SHALL BE LESS THAN 2K OHMS.

F. SUB THRESHOLD SCENE LUMINANCE INDICATION

SUB THRESHOLD SCENE LUMINANCE INDICATION SHALL BE LOGIC ONE WITH ACCEPTABLE SIGNAL LEVEL, A LOGIC ZERO FOR SUB THRESHOLD SIGNAL LEVEL, AND THE OUTPUT IMPEDANCE SHALL BE LESS THAN 2K OHMS.

3.2.1.2.4 MOUNTING PROVISIONS

THE IVS SENSOR HEAD SHALL BE MOUNTED AS SHOWN ON GE DRAWING 711-03013. ALTERNATE MOUNTINGS WILL BE CONSIDERED TO RESULT IN AN OPTIMAL MECHANICAL INTERFACE FOR A PARTICULAR SENSOR HEAD PACKAGE.

A MAXIMUM WEIGHT AS DEFINED IN PARA. 3.3.1.2 SHALL BE SUPPORTED FROM THIS MOUNT AND SHALL BE HARD MOUNTED.

3.2.1.2.5 OPTICAL INTERFACE

GE WILL PROVIDE STANDARD SCENES WHICH REPRESENT THE TARGETS TO BE VIEWED AND WHICH HAVE THE FOLLOWING CHARACTERISTICS. THE IVS SHALL OPERATE WITHIN SPECIFICATIONS FOR THESE CHARACTERISTICS.

A. IMAGE FORMAT- THE IVS WILL RECEIVE AN AERIAL IMAGE OF A RANDOM PATTERNED GROUND SCENE AS OBSERVED ABOVE THE ATMOSPHERE AND PROJECTED THROUGH AN OPTICAL SYSTEM AT AN IMAGE PLANE HAVING A CIRCULAR FORMAT WITH 2.8 INCH DIAMETER.

B. RESIDUAL MOTIONS

THE IVS SHALL PERFORM WITHIN SPECIFICATIONS IN THE PRESENCE OF OFFCENTER IMAGE RESIDUAL MOTIONS -IMAGE ROTATION, EXPLOSION AND/ORSHEARING-THAT RESULT FROM TRACKING GROUND SCENES FROM PLUS 30 DEGREES TO MINUS 40 DEGREES IN STEREO, AT ALL OBLIQUITY ANGLES BETWEEN POM 40 DEGREES. OBLIQUITY ANGLES ARE MEASURED FROM THE LOCAL VERTICAL. THE STEREO ANGLE IS MEASURED IN THE PLANE CONTAINING THE LOS TO THE TARGET AND THE OBLIQUITY LOS, AND IS MEASURED WITH RESPECT TO THE OBLIQUITY LOS.

THE OPTICAL AXIS OF THE PAYLOAD PRIMARY OPTICAL SYSTEM IS ALIGNED TO THE LOCAL HORIZONTAL AND THE RELATIVE VELOCITY VECTOR -SUM OF ORBIT VELOCITY AND LOCAL SURFACE VELOCITY- WITHIN POM 5 DEGREES.

C. FORMAT ILLUMINATION GRADIENT

THE ILLUMINATION ACROSS THE IMAGE FORMAT WILL BE NEARLY UNIFORM. ILLUMINATION AT THE MAXIMUM RADIUS OF THE FORMAT WILL BE WITHIN 5% OF THE ILLUMINATION AT THE OPTICAL AXIS.

D. SCENE LUMINANCE AND RADIANCE

THE IVS SHALL FUNCTION WITHIN SPECIFICATIONS AS AN IMAGE VELOCITY SENSOR FOR GROUND SCENE APPARENT AVERAGE LUMINANCE AS SHOWN IN FIG 9. PERFORMANCE TO SPECIFICATION WITHIN THE LIMITS OF CURVES 2 AND 3 FROM 5 DEGREES TO 90 DEGREES SUN ANGLE IS A REQUIREMENT- PERFORMANCE WITHIN THE LIMITS OF CURVES 1 AND 3 IS A DESIGN GOAL.

SINCE TYPICAL SENSORS HAVE SPECTRAL RESPONSES UNLIKE THAT OF THE HUMAN EYE, PHOTOMETRIC UNITS HAVE LIMITED VALUE IN DETERMINING THE IMAGE PLANE IRRADIANCE LEVELS. THE RANGE OF SCENE LUMINANCE AS GIVEN IN FIGURE 9 MAY BE CONVERTED TO RADIOMETRIC UNITS BY ASSUMMING A SPECTRAL DISTRIBUTION APPROXIMATING THAT OF SUNLIGHT -5800 DEGREES K. BLACK BODY-. IN THIS CASE, THE VALUES OF SCENE LUMINANCE -FT. LAMBERTS- CAN BE CONVERTED TO SCENE RADIANCE, N -WATTS/M^2-SR. - BY USING THE LUMINOUS EFFICENCY OF SUNLIGHT, 98.7 LUMENS PER TOTAL RADIANT WATT AND THE APPROPRIATE AREA

FACTOR. SINCE THE OPTICAL ASSEMBLY TRANSMITTANCE -FIGURE 10- IS SPECIFIED ONLY FOR WAVE LENGTHS IN OR NEAR THE VISIBLE, A MORE USEFUL CONVERSION IS SCENE RADIANCE IN -EFFECTIVE- WATTS/M^2-SR. IN A SPECIFIC WAVELENGTH INTERVAL LIKE 0.4 TO 0.75 MICRONS. THE MINIMUM OF 150 FT LAMBERTS OF FIGURE 9 AT 5 DEGREES SUN ANGLE IS EQUIVALENT TO 515 LUMENS/ M^2-SR. SINCE ABOUT 44% OF SUNLIGHT LIES IN THE 0.4 TO 0.75 MICRON BAND, THERE ARE 98.7/0.44 OR 224 LUMENS PER VISIBLE OR EFFECTIVE WATT. THEREFORE 5.5 LUMENS/M^2-SR. IS EQUIVALENT TO 2.3 -EFFECTIVE- WATT/M^2-SR. TO OBTAIN USEFUL VALUES OF IMAGE PLANE IRRADIANCE, H -WATTS/CM^2 - SPECTRAL TRANSMITTANCE T_λ -INCLUDING VIGNETTING AND BLOCKAGE FACTORS- AND OPTICAL SPEED, F MUST BE APPLIED TO THE SCENE RADIANCE

$$H = \frac{\pi \int N_\lambda T_\lambda \, d\lambda}{4F^2}$$

THE MINIMUM IRRADIANCE LEVEL AT THE IVS SENSOR IMAGE PLANE, CORRESPONDING TO THE MINIMUM SCENE LUMINANCE OF 150 FT. LAMBERTS, IS

$$3.54(10^{-6}) \int_{.4\mu}^{.75\mu} T_\lambda \, d\lambda \quad \text{WATTS/CM}^2$$

AS DISCUSSED IN SUBPARAGRAPH E, THE VALUE OF THIS INTEGRAL IS FOUND BY COMBINING THE TRANSMITTANCE VALUES OF FIGURE 10 WITH STEREO VIGNETTING FACTORS WHICH ARE AS LOW AS 0.326.

THE SENSOR OUTPUT WILL DEPEND ON THE INTEGRATED EFFECT OF ITS PARTICULAR SPECTRAL RESPONSE AND THIS SPECTRAL TRANSMITTANCE FACTOR IN THE EXPRESSION FOR IMAGE PLANE IRRADIANCE ABOVE

$$S = \int R_\lambda H_\lambda \, d\lambda$$

WHERE R_λ IS RESPONSIVITY OF SENSOR - VOLTS/WATT/CM^2 -

THEREFORE NO MEANINGFUL MINIMUM IVS IMAGE PLANE IRRADIANCE LEVEL CAN BE GIVEN BY A SINGLE VALUE.

FOR PURPOSES OF COMPARISON WITH THE RESPONSE OF THE EYE, THE MINIMUM VALUE OF IVS IMAGE PLANE ILLUMINANCE FOR A STEREO ANGLE OF PLUS 30 DEGREES -WORST CASE- IS APPROXIMATELY 0.0062 FT. CANDLES

E. TRANSMITTANCE

THE TRANSMITTANCE TO THE IMAGE PLANE WILL BE AS SHOWN IN FIGURE 10, CURVE 1.

THE TRANSMITTANCE IS REDUCED BY THE EFFECTS OF TRACKING MIRROR APERTURE VARIATION WITH STEREO -PITCH- ANGLE. THE REDUCED TRANSMITTANCE RANGE IS 32.6% TO 72.9% OF THE ABOVE VALUES FOR STEREO RANGE FROM PLUS 30 DEGREES TO MINUS 40 DEGREES. THE TRANSMITTANCE IN FIGURE 10 INCLUDES EFFECTS OF THE FOLLOWING FACTORS--

1-GLASS TRANSMITTANCE
2-GLASS SURFACE REFLECTANCE
3-MIRROR REFLECTANCE
4-MAIN PELLICLE REFLECTANCE
5-SECONDARY PELLICLE REFLECTANCE

THE IVS SHALL PERFORM IN ACCORDANCE WITH THE REQUIREMENTS OF THIS SPECIFICATION FOR THE TRANSMITTANCE VALUES SHOWN IN FIGURE 10, CURVE I. WITH CHANGES IN THE PRESENT DESIGN BASELINE, THE TRANSMITTANCE MAY BE INCREASED TO THE VALUES SHOWN IN FIGURE 10, CURVE 2 AS A MAXIMUM. HOWEVER, CHANGES IN THE BASELINE COULD RESULT IN SIGNIFICANT PENALTIES TO THE MISSION. IT WILL BE CONSIDERED A DEVIATION FROM THIS SPECIFICATION IF THE IVS REQUIRES TRANSMITTANCE VALUES HIGHER THAN CURVE 1, THE HIGHER THE REQUIRED TRANSMITTANCE, THE GREATER THE DEVIATION.

F. PRIMARY OPTICAL SYSTEM CHARACTERISTICS

THE OPTICAL SYSTEM WILL HAVE A FOCAL LENGTH OF [redacted] AND A FOCAL RATIO -RELATIVE APERTURE- OF [redacted] OBSCURATION WILL BE 12.7% -AREA-, FOR AN APPROXIMATELY CIRCULAR CENTRAL OBSTRUCTION.

-THIS OBSCURATION IS FACTORED INTO THE REDUCED TRANSMITTANCE OF SECTION E-

G. IMAGE CONTRAST THE INPUT IMAGE-PLANE SCENE WILL HAVE AN AVERAGE ILLUMINATION AND A RANGE OF MODULATIONS OVER A RANGE OF TWO DIMENSIONAL SPATIAL FREQUENCIES. THESE ARE

DESCRIBED BY A TWO DIMENSIONAL WIENER SPECTRUM OF THE FORM

$W = \frac{K}{\gamma^{M+2}}$ WHERE $\gamma = (\gamma_x^2 + \gamma_y^2)^{1/2}$

W = (FOOT LAMBERT)^2/(CYCLE PER FOOT)^2

K = WIENER SPECTRUM LEVEL - FOOT LAMBERTS^2/(CYCLE PER FOOT)^2

γ = SPATIAL FREQUENCY - CYCLES PER FOOT

γ_x, γ_y = ORTHOGONAL COMPONENTS OF γ

THE RANGE OF VALUES FOR THESE PARAMETERS ARE DEFINED TO BE THE FOLLOWING

K - FUNCTION OF SUN ANGLE PER FIGURE 11

$4 \times 10^{-3} < \gamma <$ 0.19 CYCLE PER FOOT

$0.1 < M < 0.7$

IN ALL CASES THERE MAY BE LOCAL AREAS OF HIGH ILLUMINATION DUE TO SPECULAR REFLECTIONS. THE IVS SHALL NOT BE DAMAGED BY INTERVALS OF HIGH ILLUMINATION UP TO 30,000 FOOT LAMBERTS APPARENT SCENE LUMINANCE.

H. IMAGE VELOCITY FREQUENCY CONTENT

THE INPUT IMAGE MAY INCLUDE VIBRATION WITH VARIOUS RANDOM FREQUENCIES TO 200 RAD/SEC.

I. IMAGE PLANE

THE IMAGE PLANE FOR THE IVS WILL VARY WITH THE SLANT RANGE TO TARGET. THE NOMINAL IMAGE PLANE LOCATION WILL BE 4.9 INCHES FOR THE REFERENCE AS SHOWN ON DRAWING 711-03013 THE IMAGE PLANE WILL SHIFT A TOTAL OF APPROXIMATELY 0.041 INCHES, FOR AN ALTITUDE RANGE OF 70 TO 230 N MILES, WITH LINE-OF-SIGHT STEREO ANGLE RANGE OF PLUS 30 DEGREES TO MINUS 40 DEGREES AND OBLIQUITY ANGLE RANGE OF PLUS 40 DEGREES TO MINUS 40 DEGREES.

J. MODULATION

RELATIVE MODULATION FOR DEFOCUSED CONDITIONS WILL BE AS DEFINED IN FIGURES 12 AND 13.

3.2.1.2.6 THERMAL INTERFACE

IT SHALL BE A DESIGN GOAL THAT A MINIMUM OF 90% OF THE TOTAL STEADY-STATE ELECTRONICS BOX HEAT DISSIPATION BE TRANSMITTED INTO A COLD PLATE IN THE CONSOLE ENVELOPE REF. DWG. 711-03013. THE HEAT WILL BE REMOVED FROM THE COLD PLATE BY FLUID TRANSFER. POWER DISSIPATION AT THE SENSOR HEAD SHALL BE HELD TO AN ABSOLUTE MINIMUM WITH A DESIGN GOAL OF 3 WATTS MAX. REFERENCE DR1100 FOR THERMAL ENVIRONMENT THAT THE COMPONENT MUST ACCEPT.

3.2.2 COMPONENT IDENTIFICATION

NOT APPLICABLE.

3.3 DESIGN AND CONSTRUCTION

3.3.1 GENERAL DESIGN FEATURES

THIS COMPONENT IS SHOWN ON GE DRAWING 711-03013 AND IN FIGURE 14 OF THIS SPEC. THE GENERAL DESIGN FEATURES ARE AS SPECIFIED IN THE SUB-PARAGRAPHS LISTED BELOW.

3.3.1.1 OVERALL DIMENSIONS

THE MAXIMUM DIMENSIONS FOR PACKAGING AND MOUNTING THE IVS HEAD SHALL BE CONSISTENT WITH THE SPACE ENVELOPE DEFINED BY SECTION 3.2.1.2.4

THE COMBINED PACKAGING OF THE SENSOR HEAD TOGETHER WITH ALL OTHER IVS ELEMENTS WHICH ARE SUPPORTED AT THE IMAGE INTERFACE AND MOUNTED WITHIN THE ENVELOPE DEFINED BY DRAWING 711-03013 HAS NOMINAL DIMENSION OF 10 INCHES X 10 INCHES X 8 INCHES. IVS ELEMENTS WHICH ARE MOUNTED IN THE CONSOLE TRAY SHALL HAVE MAXIMUM DIMENSIONS OF 6 INCHES X 6 INCHES X 6 INCHES. REFER TO FIGURE 14 FOR ELECTRONICS PACKAGE DEFINITION.

3.3.1.2 WEIGHT

THE MAXIMUM WEIGHT FOR THE IVS SHALL BE 22 POUNDS TOTAL, EXCLUSIVE OF INTERCONNECTING CABLING.

3.3.1.3 PACKAGING ENVELOPES

THE IVS HEAD SHALL BE PACKAGED FOR INSTALLATION IN THE LAB. MODULE WITHIN THE MOUNTING ENVELOPE DEFINED BY DWG. 711-03013.

REMAINING ELEMENTS SHALL BE LOCATED IN A CONSOLE ENVELOPE WHICH IS ALSO LOCATED IN THE LABORATORY MODULE. THE IVS HEAD SHALL BE CONNECTED TO THE IVS ELECTRONICS BOX BY A SINGLE MULTI-CONDUCTOR CABLE. FOR THE MISSION EQUIPMENT, THIS CABLE WILL BE SUPPLIED BY THE GENERAL ELECTRICAL COMPANY. THE VENDOR SHALL SUPPLY A TEN FOOT LONG INTERCONNECTING CABLE WITH THE IVS FOR TEST AND CHECKOUT PURPOSES, AND SHALL SUPPLY ELECTRICAL SPECIFICATIONS AND OTHER SPECIAL PROVISIONS THAT WILL BE NEEDED TO FABRICATE THE ACTUAL MISSION CABLING.

ALL CONNECTORS SHALL BE IN ACCORDANCE WITH DR 1110A WITH BENDIX TYPE JT CONNECTORS THE PREFERRED TYPE.

THREE SEPARATE CONNECTORS SHALL BE USED ON THE ELECTRONICS BOX FOR POWER INPUT, SIGNAL INPUTS/OUTPUTS, AND INTERCONNECTING TO THE IVS HEAD. THE LOCATION OF ELEMENTS OF THE IVS SHALL BE IN ACCORDANCE WITH THERMAL, MECHANICAL AND FUNCTIONAL REQUIREMENTS AS DEFINED BY THIS SPECIFICATION.

3.3.1.4 COMPONENT SEAL

THE INTERFACE BETWEEN THE SENSOR HEAD ASSEMBLY AND THE MOUNTING SURFACE SHALL CONTAIN A SEAL TO PREVENT TRANSMISSION OF STRAY LIGHT AND PARTICLES OF 55 MICRON SIZE OR LARGER.

THE SENSOR HEAD ASSEMBLY AND ELECTRONICS ASSEMBLY SHALL HAVE SEALING AS REQUIRED FOR OPERATION WITHIN THE HELIUM ENVIRONMENT SPECIFIED IN DR1100 AND TO PREVENT CORONA FORMATION WHEN POWER IS APPLIED IMMEDIATELY FOLLOWING EXPOSURE TO VACUUM.

3.3.2 SELECTION OF SPECIFICATIONS AND STANDARDS.

THE ORDER OF PRECEDENCE FOR THE SELECTION OF SPECIFICATIONS AND STANDARDS SHALL BE IN ACCORDANCE WITH MIL-STD-143. ONLY THOSE MILITARY DOCUMENTS LISTED IN ANA BULLETIN 400 AND/OR DOD INDEX OF SPECIFICATIONS AND STANDARDS SHALL BE INTERPRETED AS BEING GROUP 1 DOCUMENTS AS DEFINED IN MIL-STD-143. THE USE OF STANDARDS AND SPECIFICATIONS OTHER THAN THOSE LISTED OR REFERRED TO BY THOSE LISTED IN SECTION 2 HEREIN, SHALL REQUIRE PRIOR APPROVAL OF THE GENERAL ELECTRIC COMPANY. ANY MIL-STD-143 GROUP II THROUGH V DOCUMENTS SELECTED FOR USE SHALL AUTOMATICALLY NECESSITATE THE PREPARATION OF A SPECIFICATION CONTROL DRAWING WHICH SHALL BE SO DRAFTED AS TO ESTABLISH THE SPECIFIC DOCUMENT BEING REFERENCED, ITS DATE OF ISSUE AND CONTROL RESPONSIBILITY FOR ITS USE.

3.3.3 MATERIALS, PARTS AND PROCESSES

MICROELECTRONIC ELEMENTS SHALL BE USED IN ELECTRONICS CIRCUITRY WHEREVER THEIR USAGE IS REASONABLE FOR THE PARTICULAR APPLICATION. IN THOSE INSTANCES WHERE IT CAN BE SHOWN TO THE SATISFACTION OF THE GENERAL ELECTRIC COMPANY THAT THE USE OF MICRO-ELECTRONIC CIRCUITRY IS NOT

FEASIBLE, THEN DISCRETE PARTS MAY BE USED. THESE ELEMENTS AND/OR PARTS SHALL BE IN ACCORDANCE WITH GE SPECIFICATION NO. DR 1110 -SELECTED AVE PARTS LIST-. IN THE EVENT THEY DO NOT APPEAR IN DR1110 DATA SHALL BE FURNISHED IN ACCORDANCE WITH REQUIREMENTS OF DR1110 FOR THEIR SUBSEQUENT INCLUSION.

WHERE DISCRETE PARTS ARE USED, MODULAR PACKAGING OF THESE PARTS SHALL BE USED WHEREVER PRACTICABLE. THE MODULAR PACKAGING TECHNIQUES TO BE EMPLOYED SHALL BE SIMILAR TO THOSE DESCRIBED IN GE SPECIFICATION S-30000, S-30001 AND S-30002 -EXCLUDING LOWER TIER REFERENCES- OR THEY SHALL BE IN ACCORDANCE WITH TECHNIQUES EMPLOYED BY THE VENDOR - ALL SUBJECT TO GE APPROVAL.

OTHER MATERIALS, PARTS AND PROCESSES SHALL BE IN ACCORDANCE WITH GE SPECIFICATIONS NO. DR 1100, DR 1112, DR 1113, DR 1115 AND NON-CONFLICTING PORTIONS OF MIL-E-25366 AND MIL-E-5400.

IN THE CASE OF THE USE OF EQUIPMENT BUILT TO A DESIGN PREVIOUSLY ACCEPTED BY THE GOVERNMENT, IT WILL NOT BE NECESSARY TO CHANGE THE DESIGN TO USE ONLY PARTS THAT ARE ON THE MOL SELECTED PARTS LISTS PROVIDED THAT

A. EVIDENCE OF PRIOR ACCEPTANCE OF THE EQUIPMENT IS SUBMITTED.

B. PRIOR APPLICATION-S- INCLUDED DEMONSTRATED CAPABILITY IN EQUIVALENT OR MORE SEVERE ENVIRONMENTS THAN SPECIFIED IN PARAGRAPH 3.1.2.4 HEREIN.

3.3.4 STANDARD AND COMMERCIAL PARTS

FOR OTHER THAN ELECTRONIC OR ELECTRICAL PARTS MAXIMUM USE SHALL BE MADE OF COMMERCIALLY AVAILABLE STANDARD MIL, AN AND MS PARTS.

IF IT BECOMES NECESSARY TO USE COMMERCIAL PARTS OTHER THAN THOSE LISTED AS STANDARD, A LIST SHALL BE SUBMITTED TO THE GENERAL ELECTRIC COMPANY IDENTIFYING EACH PART BY NAME, CATALOG NUMBER, NUMBER OF PARTS REQUIRED, MANUFACTURER/S NAME AND EQUIVALENT APPROVED GOVERNMENT SPEC-IFICATION -IF AVAILABLE- WHICH CAN BE SUBSTITUTED FOR THE COMMERCIAL PART. THE REASON AND SUBSTANTIATION FOR THE USE OF THE COMMERCIAL OR NONSTANDARD ITEM SHALL ALSO BE SUBMITTED.

3.3.5 MOISTURE AND FUNGUS RESISTANCE

THIS COMPONENT SHALL CONFORM TO THE REQUIREMENTS OF MIL-STD-454, REQUIREMENT 4. WHENEVER PRACTICABLE, MATERIALS AND PROCEDURES WHICH HAVE DEMONSTRATED THE CAPABILITY OF BEING IMPERVIOUS TO MOISTURE AND FUNGUS SHALL BE SELECTED. PROTECTIVE COATINGS WILL NOT BE ACCEPTABLE AS MOISTURE AND FUNGUS PREVENTATIVES ON PARTS WHICH WILL LOSE THE COATINGS DURING THE NORMAL COURSE OF MANUFACTURE, ASSEMBLY, AND TEST.

3.3.6 CORROSION OF METAL PARTS

3.3.6.1 ELECTROLYTIC CORROSION

USE OF DISSIMILAR METALS IN DIRECT CONTACT WITH EACH OTHER SHALL BE AVOIDED AS PER THE REQUIREMENTS OF MIL-E-5400, PARAGRAPH 3.1.8.1, AND MS 33586 UNLESS SUITABLY PROTECTED BY PLATING, PAINTING OR OTHER SURFACE TREATMENT. METAL SPRAYING OR PLATING OF DISSIMILAR METALS TO PROVIDE SUITABLE MATING SURFACES OR SEPARATION BY SUITABLE INSULATING MATERIAL IS PERMISSABLE.

3.3.6.2 STRESS CORROSION

METALS, TECHNIQUES, AND PROCESSES SHALL BE SELECTED AND EMPLOYED WITH REGARD TO HEAT TREATMENT PROCEDURES, CORROSION PROTECTION, FINISH, ASSEMBLY AND INSTALLATION, SO THE SUSTAINED OR RESIDUAL SURFACE TENSILE STRESSES, STRESS CONCENTRATIONS AND THE HAZARDS OF STRESS CORROSION, CRACKING AND HYDROGEN EMBRITTLEMENT ARE MINIMIZED.

3.3.6.3 PROTECTIVE METHODS

METHODS AND MATERIALS FOR CLEANING, SURFACE TREATMENT, AND APPLICATION OF FINISHES AND PROTECTIVE COATINGS SHALL BE IN ACCORDANCE WITH DR 1100, PARAGRAPH 3.2.6.3, PROTECTIVE TREATMENT.

3.3.7 INTERCHANGEABILITY AND REPLACEABILITY

EACH PART, SUBASSEMBLY, OR ASSEMBLY BEARING A PARTICULAR SUPPLIER S PART NUMBER SHALL BE COMPLETELY INTERCHANGEABLE WITH ALL OTHER PARTS, SUB-ASSEMBLIES, OR ASSEMBLIES BEARING THE SAME NUMBER. THE REQUIREMENT OF MIL-

STD-454, REQUIREMENT 7, SHALL APPLY.

3.3.8 WORKMANSHIP

THIS COMPONENT, INCLUDING ALL PARTS AND ASSEMBLIES, SHALL BE CONSTRUCTED AND FINISHED IN ACCORDANCE WITH MIL-STD-454, REQUIREMENT 9.

3.3.9 ELECTROMAGNETIC INTERFERENCE

THIS COMPONENT SHALL CONFORM TO THE REQUIREMENTS OF GE SPECIFICATION NO. DP 1690.

3.3.10 IDENTIFICATION AND MARKING

IDENTIFICATION AND MARKING SHALL BE IN ACCORDANCE WITH MIL-E-5400, PARAGRAPH 3.1.19, MIL-STD-130, AND SSD 61-70. SELECTED COLORS SHALL BE IN ACCORDANCE WITH FED-STD-595 AND MIL-STD-795.

3.3.11 STORAGE

THIS COMPONENT SHALL BE CAPABLE OF PERFORMANCE PER PARAGRAPH 3.1 AFTER THREE -3- YEARS STORAGE, IN AN ENVIRONMENT AS DEFINED IN PARAGRAPH 3.1.2.4 OF THIS SPECIFICATION.

3.3.12 CLEANLINESS

THIS COMPONENT SHALL BE ASSEMBLED IN A CLEAN AREA WHICH MEETS THE REQUIREMENTS OF FED STD 209, CLASS 10,000, OR IT SHALL BE CAPABLE OF BEING CLEANED AFTER ASSEMBLY FOR USE IN SUCH AN AREA.

THERE SHALL BE NO EVIDENCE -OR FLUORESCENCE- OF OILS OR VOLATILE CONTAMINATION WHEN SURFACES ARE EXAMINED EITHER VISUALLY OR BY ULTRA VIOLET LIGHT.

3.3.13 VIBRATION

3.3.13.1 SENSOR GENERATED VIBRATION

THE MAXIMUM EXCITATION DURING FRAME EXPOSURE TIMES WHICH THE IVS SHALL GENERATE IS 3.0 INCH- OZ. ABOUT ANY AXIS AND 0.01 POUNDS AXIAL FORCE ALONG ANY AXIS MEASURED AT THE IVS MOUNT. DURING SLEW TIMES, TWICE THE

FOREGOING VALUES WILL BE PERMITTED.

3.3.13.2 RESONANCE

THE IVS SHALL BE DESIGNED TO HAVE STRUCTURAL ELEMENTS WITH NATURAL FREQUENCIES IN EXCESS OF 50 CPS. EFFECTS OF INTERNAL RESONANCES ON IVS OUTPUT SHALL BE INCLUDED IN THE PRIMARY PERFORMANCE REQUIREMENTS DESCRIBED IN PARAGRAPH 3.1.1.1.

3.3.14 SENSOR GENERATED NOISE -ACOUSTIC-

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4.0 QUALITY ASSURANCE PROVISIONS

4.1 CATEGORY I TEST

4.1.1 ENGINEERING TEST AND EVALUATION

THIS COMPONENT SHALL BE SUBJECTED TO SUCH TESTS AS ARE NECESSARY TO PROVIDE DATA, NOT OBTAINABLE BY OTHER TESTING SPECIFIED HEREIN, TO VERIFY CONFORMANCE WITH THE REQUIREMENTS OF SECTION 3.

4.1.2 PRELIMINARY QUALIFICATION TESTS

NOT APPLICABLE

4.1.3 FORMAL QUALIFICATION TESTS

TWO COMPONENTS OF A NEW DESIGN SHALL BE SUBJECTED TO THE TESTS DEFINED HEREIN.

4.1.3.1 INSPECTION

THE FOLLOWING REQUIREMENTS OF SECTION 3 SHALL BE VERIFIED BY INSPECTION OF THIS COMPONENT AT TIME AND PLACE OF TESTING PRIOR TO THE START OF QUALIFICATION TESTING.

3.1.1.1.5	ALIGNMENT
3.3.1	GENERAL DESIGN FEATURES
3.3.3	MATERIALS, PARTS AND PROCESSES
3.3.4	STANDARD AND COMMERCIAL PARTS
3.3.7	INTERCHANGEABILITY & REPLACEABILITY
3.3.8	WORKMANSHIP
3.3.10	IDENTIFICATION AND MARKING
3.3.12	CLEANLINESS

4.1.3.2 ANALYSES

THE FOLLOWING REQUIREMENTS OF SECTION 3 SHALL BE VERIFIED BY REVIEW OF ANALYTICAL DATA AT THE CONCLUSION OF ENVIRONMENTAL TESTING.

3.1.2.1	RELIABILITY
3.1.2.2	MAINTAINABILITY
3.1.2.3	USEFUL LIFE

3.1.2.7	SAFETY
3.2.1	INTERFACE REQUIREMENTS
3.3.2	SELECTION OF SPECIFICATION & STANDARDS
3.3.5	MOISTURE AND FUNGUS RESISTANCE
3.3.6	CORROSION OF METAL PARTS
3.3.11	STORAGE

4.1.3.3 DEMONSTRATIONS

NOT APPLICABLE.

4.1.3.4 TEST

4.1.3.4.1 TEST CONDITIONS AND PROCEDURES

THE TEST CONDITIONS AND PROCEDURES FOR THIS COMPONENT SHALL CONFORM TO THE REQUIREMENTS OF GE SPECIFICATION NO. DR 1100 PARAGRAPHS 3.3 -TESTS- AND 4.2 -TEST CONDITIONS- FOR COMPONENTS INTERNALLY TRUSS MOUNTED IN ZONE 2.

4.1.3.4.2 DESIGN/PERFORMANCE VERIFICATION TESTS

THE FOLLOWING REQUIREMENTS OF SECTION 3 SHALL BE VERIFIED DURING THE FORMAL QUALIFICATION TEST PROGRAM AS SPECIFIED IN SUBSEQUENT PARAGRAPHS HEREIN

3.1.1.1	PRIMARY PERFORMANCE CHARACTERISTICS
3.1.1.2	SECONDARY PERFORMANCE CHARACTERISTICS
3.1.2.3	USEFUL LIFE
3.1.2.4	ENVIRONMENTAL
3.1.2.5	TRANSPORTABILITY
3.2.1.2.2	ABNORMAL CONDITIONS
3.3.9	ELECTROMAGNETIC INTERFERENCE
3.3.13	VIBRATION
3.3.14	SENSOR GENERATED NOISE

4.1.3.4.3 PRELIMINARY PERFORMANCE TESTS

4.1.3.4.3.1 DIELECTRIC STRENGTH AND INSULATION RESISTANCE

THE COMPONENT SHALL BE TESTED FOR DIELECTRIC STRENGTH AND INSULATION RESISTANCE PER PARAGRAPH 4.3.1.2 OF GE SPECIFICATION NO DR. 1100

4.1.3.4.3.2 CONTINUITY TEST

PRIOR TO THE APPLICATION OF POWER, A CONTINUITY TEST SHALL BE PERFORMED ON THIS COMPONENT TO PRECLUDE THE POSSIBILITY OF EQUIPMENT MALFUNCTION OCCURING AS A RESULT OF MANUFACTURING DEFECTS. CARE SHALL BE EXERCISED IN THE SELECTION OF TEST EQUIPMENT USED FOR THIS TEST SO THAT THERE IS NO POSSIBILITY OF DAMAGING INTERNAL CIRCUITS OF THE IVS.

4.1.3.4.3.3 PERFORMANCE TEST

SUITABLE TESTS WILL BE DESIGNED AND PERFORMED ON A GE IVS TESTER DELINEATED BY SPECIFICATION TR951 TO VERIFY PERFORMANCE COMPLIANCE WITH THE REQUIREMENTS SPECIFIED IN PARAGRAPHS 3.1.1.1 AND 3.1.1.2 OF THIS SPECIFICATION. THE FOLLOWING TESTS SHALL BE INCLUDED AS A PART OF THE PERFORMANCE TEST.

A. STATIC RANGE

THE IVS SHALL BE SUBJECTED TO IMAGE PLANE VELOCITIES FROM ZERO TO BEYOND 0.3 INCH PER SECOND IN A NUMBER OF ARBITRARY DIRECTIONS TO DETERMINE THE SATURATED RESPONSE THRESHOLD PROFILE AS A DEMONSTRATION OF ITS RANGE OF PROPORTIONAL RESPONSE.

B. LINEARITY - KNOWN IMAGE VELOCITIES SHALL BE IMPUTTED TO THE IVS TO DETERMINE LINEARITY OF RESPONSE. THE RANGE OF VALUES SHALL BE FROM ZERO IPS THROUGH 0.3 IPS IN SUFFICIENTLY SMALL INCREMENTS TO VERIFY THAT THE IVS PERFORMANCE IS WITHIN TOLERANCE AS SPECIFIED BY FIGURE 1A. THE OUTPUT SIGNAL SHALL BE PERMITTED TO STABILIZE AFTER THE INSERTION OF EACH TEST VELOCITY POINT BEFORE IT IS READ AND RECORDED. THE OUTPUT SHALL, IN EACH CASE, BE RECORDED WITH AND WITHOUT THE INCLUSION OF A 0.01 CPS

FILTER. THE DIRECTION OF THE IMAGE VELOCITY SHALL BE REVERSED FOR ONE TEST CASE, AND THIS VELOCITY SHALL NOT BE ALIGNED WITH EITHER AXIS OF THE SENSOR.

A CURVE RELATING THE TRUE VELOCITY TO THE INDICATED VELOCITY SHALL BE CONSTRUCTED AND COMPARED TO THAT SPECIFIED IN FIGURE 1.

C. SATURATION CHARACTERISTICS

SATURATING IMAGE VELOCITIES OF VARIOUS DURATIONS SHALL BE PROVIDED TO THE IVS AND THE OUTPUT MONITORED TO DEMONSTRATE COMPLIANCE WITH THIS SPECIFICATION.

D. FREQUENCY RESPONSE

A FREQUENCY RESPONSE TEST SHALL BE CONDUCTED ON THE IVS WITH THE GAIN AND PHASE RELATIONSHIPS BETWEEN THE INPUT IMAGE VELOCITY AND THE INDICATED VELOCITY PLOTTED VERSUS FREQUENCY. THE INPUT VELOCITIES SHALL COVER THE RANGE 0.0125 IPS -25 MICRO RAD/SEC.- TO .25 IPS -500 MICRO RAD/SEC.- FOR THE FREQUENCY RANGE INDICATED IN FIG 7.

E. NULL ACCURACY

THE IVS SHALL BE PROVIDED WITH INPUT IMAGE VELOCITIES FROM ZERO TO 0.02 IPS -40 MICRO RAD/SEC.- FROM VARIOUS DIRECTIONS. THE OUTPUT RECORD SHALL BE ANALYZED TO DETERMINE THE ERROR BIAS AND THE NOISE POWER SPECTRAL DENSITY.

F. POWER INTERRUPT

THE IVS SHALL BE REQUIRED TO DEMONSTRATE THE ABILITY TO RETURN TO SPECIFIED PERFORMANCE AFTER THE EXPOSURE TO ABNORMAL VOLTAGE CONDITIONS DESCRIBED IN PARA 3.2.1.2.2-A. THE DEMONSTRATION OF POWER INTERRUPT DOES NOT REQUIRE THE SUPERPOSITION OF EMI -RIPPLE AND TRANSIENT- REQUIREMENTS BUT DOES REQUIRE THE DEMONSTRATION OF SPECIFIED PERFORMANCE AT A LOW LINE VOLTAGE OF 22 VOLTS AND THE SUPERPOSITION OF THE EMI REQUIREMENTS PER DP 1690, DURING EMI TESTING WITHOUT INDICATING A POWER INTERRUPT

CONDITION.

4.1.3.4.4 OPERABILITY ASSURANCE TESTS

THE COMPONENT SHALL BE TESTED TO THE REQUIREMENTS SPECIFIED IN PARAGRAPH 4.3.2 OF DR 1100. THE PERFORMANCE TEST SHALL CONSIST OF PARAGRAPH 4.1.3.4.3.3 OF THIS SPECIFICATION.

4.1.3.4.5 QUALIFICATION ENVIRONMENTAL TESTS

THESE TESTS SHALL BE PERFORMED IN ACCORDANCE WITH PARAGRAPH 4.4 OF DR 1100. THE PERFORMANCE TEST SHALL CONSIST OF PARAGRAPH 4.1.3.4.3.3 OF THIS SPECIFICATION.

A. ACCELERATION PARAGRAPH 4.4.3.4 OF DR 1100 APPLIES EXCEPT THAT REFERENCE TO PHASE C COMPONENTS DOES NOT APPLY. THE COMPONENT SHALL NOT BE REQUIRED TO OPERATE DURING THIS TEST, HOWEVER, POWER VOLTAGES SHALL BE APPLIED AND MONITORED.

B. VIBRATION PARAGRAPH 4.4.3.5 OF DR 1100 APPLIES.

C. SHOCK TESTS PARAGRAPHS 4.4.3.6, 4.4.3.6.1, 4.4.3.6.2, AND 4.4.3.6.3 APPLY.

D. ACOUSTIC NOISE PARAGRAPH 4.4.3.7 AND 4.4.3.7.1 APPLY.

E. TEMPERATURE CYCLING PARAGRAPH 4.4.3.1 APPLIES.

F. THERMAL ALTITUDE PARAGRAPH 4.4.3.2 APPLIES.

G. OXYGEN COMPATIBILITY PARAGRAPH 4.4.3.15 APPLIES.

H. HELIUM COMPATIBILITY PARAGRAPH 4.4.3.15 APPLIES.

I. HUMIDITY PARAGRAPH 4.4.3.8 APPLIES.

J. ELECTROMAGNETIC COMPATIBILITY PARAGRAPH 4.4.3.12 APPLIES.

K. FUNGUS PARAGRAPH 4.4.3.9 APPLIES.

L. SALT FOG PARAGRAPH 4.4.3.10 APPLIES.

M. LEAKAGE PARAGRAPH 4.4.3.11 APPLIES.

N. ENDURANCE PARAGRAPH 4.4.3.19 APPLIES.

THE COMPONENT SHALL BE OPERATED FOR A TOTAL OF 1200 HOURS ON TIME, INCLUDING THE TIME ACCUMULATED DURING PREVIOUS CHECKOUT AND QUALIFICATION TESTS. THE DUTY CYCLE FOR THIS TEST IS 20 MINUTES ON AND 70 MINUTES OFF, UNLESS TEMPERATURE STABILIZATION ON THE OFF CYCLE IS LESS

THAN 70 MINUTES, THEN THE DUTY CYCLE SHALL BE 20 MINUTES ON AND TIME TO STABILIZE OFF. THE COMPONENT SHALL BE GIVEN PERFORMANCE TESTS, PARAGRAPH 4.1.3.4.3.3, AFTER EVERY 100 HOURS OF OPERATION.

4.1.4 RELIABILITY TEST AND ANALYSIS

A RELIABILITY MATHEMATICAL MODEL OF THE IVS SHALL BE CONSTRUCTED SHOWING THE FUNCTIONAL RELATIONSHIP OF ALL PARTS AND ASSEMBLIES. A LISTING OF ALL FUNCTIONAL PARTS SHALL BE SUPPLIED WITH A STATEMENT OF APPLIED OPERATIONAL STRESS LEVEL FOR EACH PART -VOLTAGE, CURRENT, MECHANICAL LOADS, VIBRATION, TEMPERATURE, ETC.-. FOR EACH PART APPLICATION, A FAILURE RATE SHALL BE STATED. MILITARY HANDBOOK MIL-HDBK-217 -FOR ELECTRICAL AND ELECTRONIC PARTS- AND SP 63-470, VOL. 1 -FARADA- -FOR ALL OTHER PARTS- SHALL BE USED AS THE CONTROLLING SOURCES OF FAILURE RATE DATA -WITH THE USE OF APPROPRIATE APPLICATION FACTORS- UNLESS USE OF OTHER RATES IS JUSTIFIED BY DATA DERIVED FROM TESTS OR PRIOR PROVEN EXPERIENCE IN EQUIVALENT APPLICATIONS.

USING THE PROCEDURE ABOVE, THE RELIABILITY AND/OR THE MTBF FOR THE EQUIPMENT SHALL BE COMPUTED AND SUBMITTED. THIS ANALYSIS WILL CONSTITUTE ADEQUATE DEMONSTRATION OF THE DESIGN RELIABILITY, PROVIDED THAT THE COMPUTED RELIABILITY AND/OR THE MTBF MEETS OR EXCEEDS THE DESIGN REQUIREMENT STATED IN PARAGRAPH 3.1.2.1, AND PROVIDED THAT THE RELIABILITY MODEL AND ASSOCIATED RELIABILITY COMPUTATION ARE UPDATED FOR EVERY SUBSEQUENT CHANGE IN CONFIGURATION OR APPLICATION.

4.2 CATEGORY II TEST PROGRAM

NOT APPLICABLE

6.0 NOTES

10.0 APPENDIX

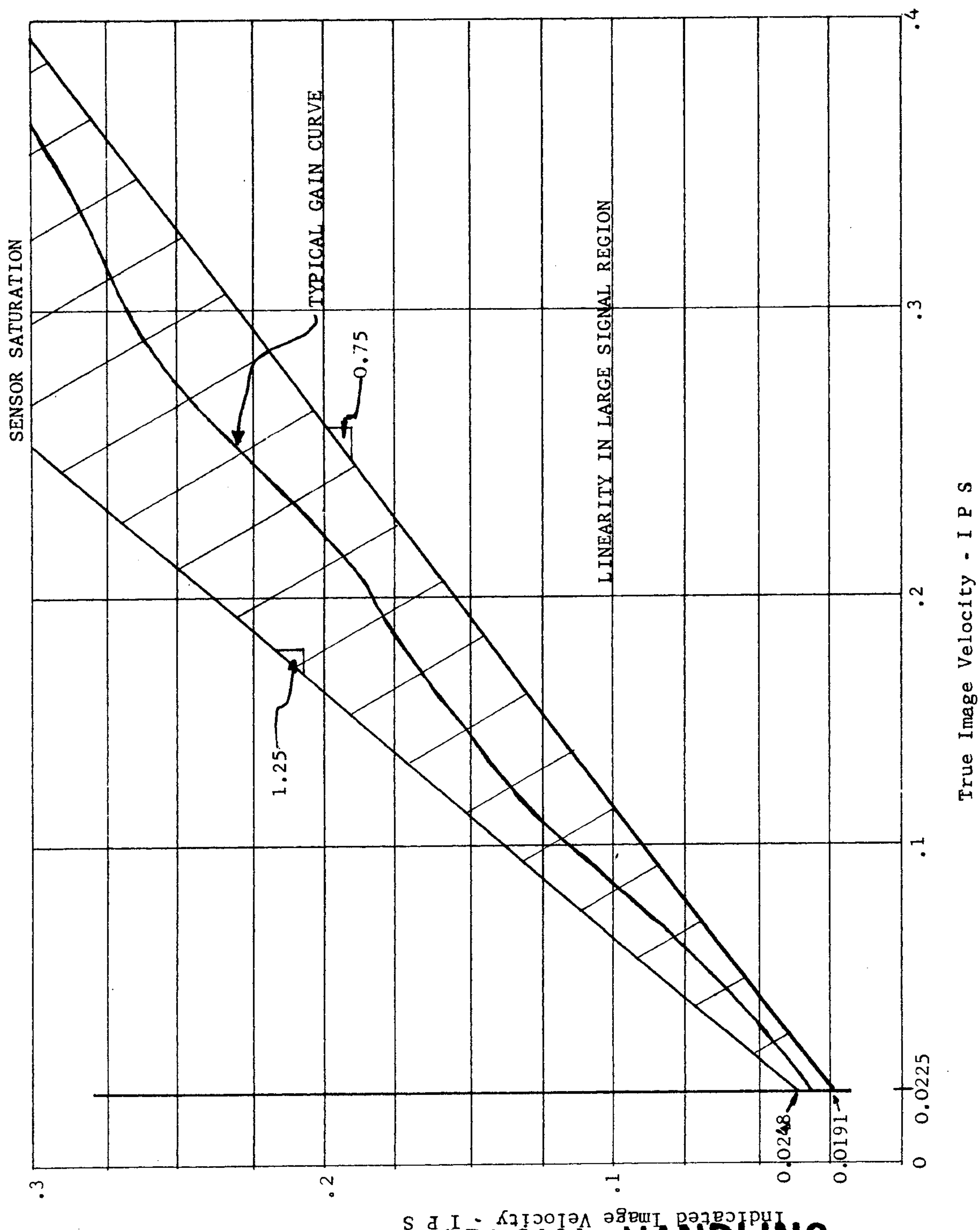

SENSOR SATURATION
TYPICAL GAIN CURVE
LINEARITY IN LARGE SIGNAL REGION
0.75
1.25
0.0248
0.0191
0.0225
0
.1
.2
.3
.4
True Image Velocity - I P S
Indicated Image Velocity - I P S

Figure - 1

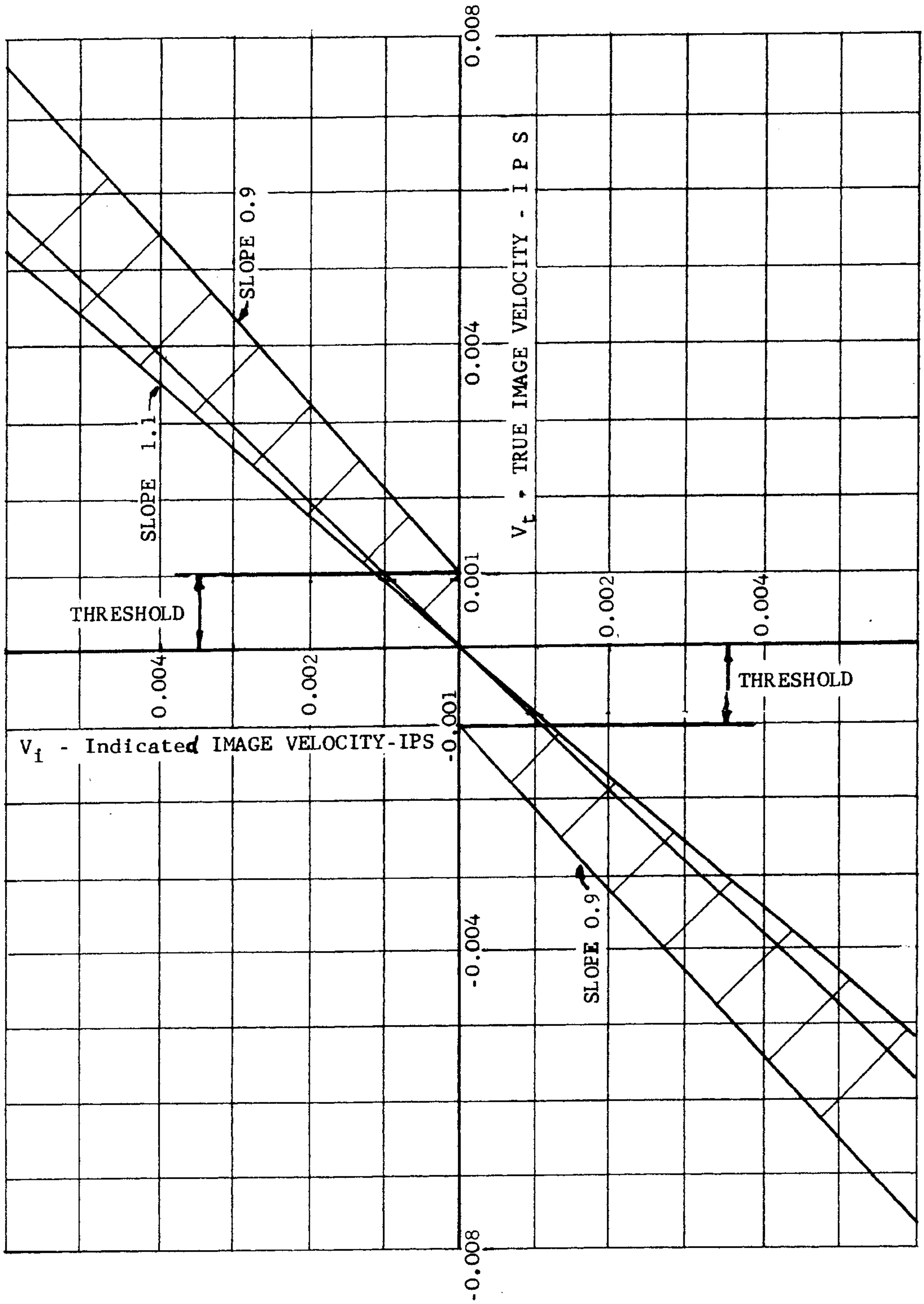


Figure 2 ALLOWABLE REGION OF INDICATED VELOCITY VS. TRUE VELOCITY EXCLUSIVE OF NOISE AND BIAS ERRORS.

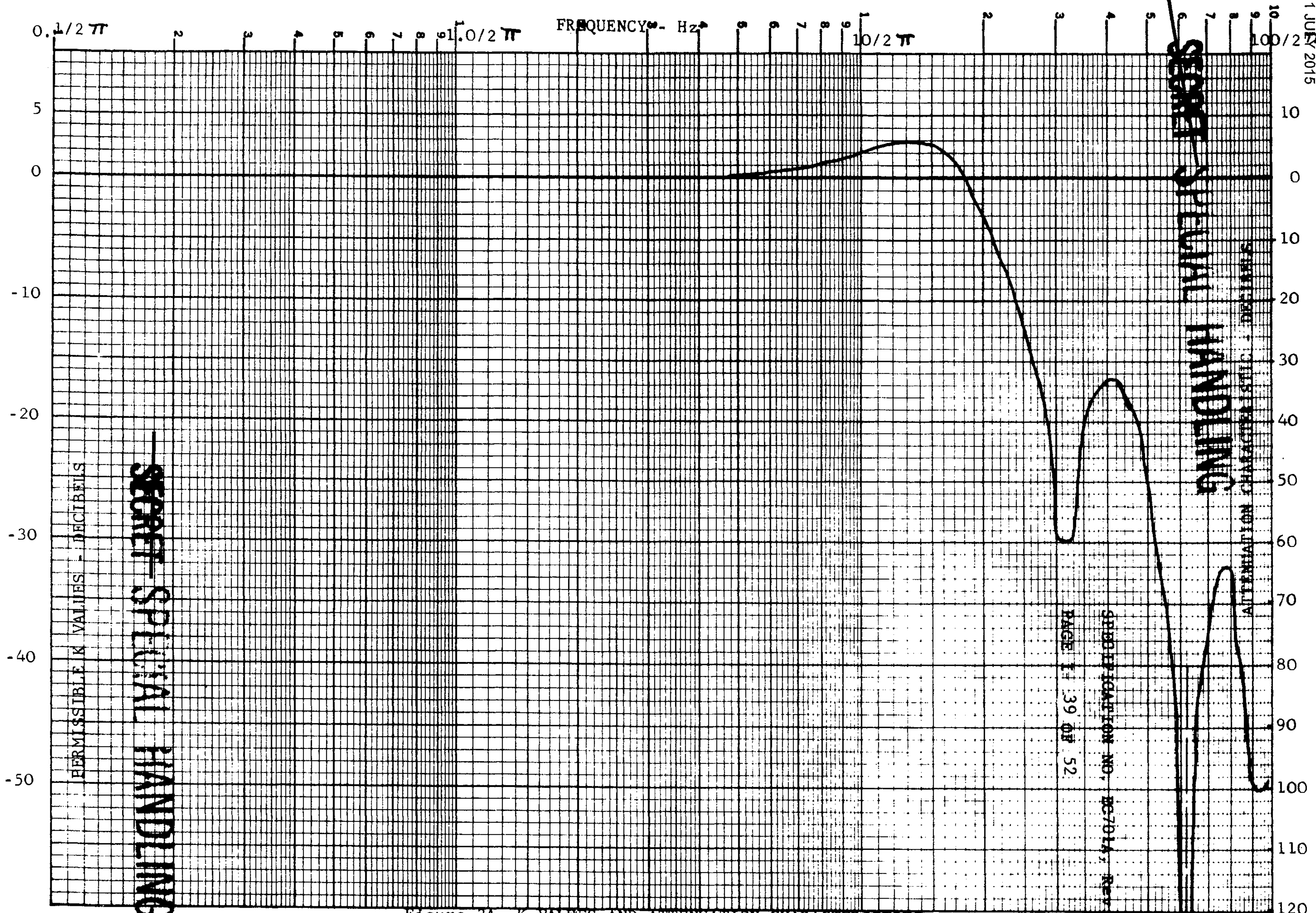
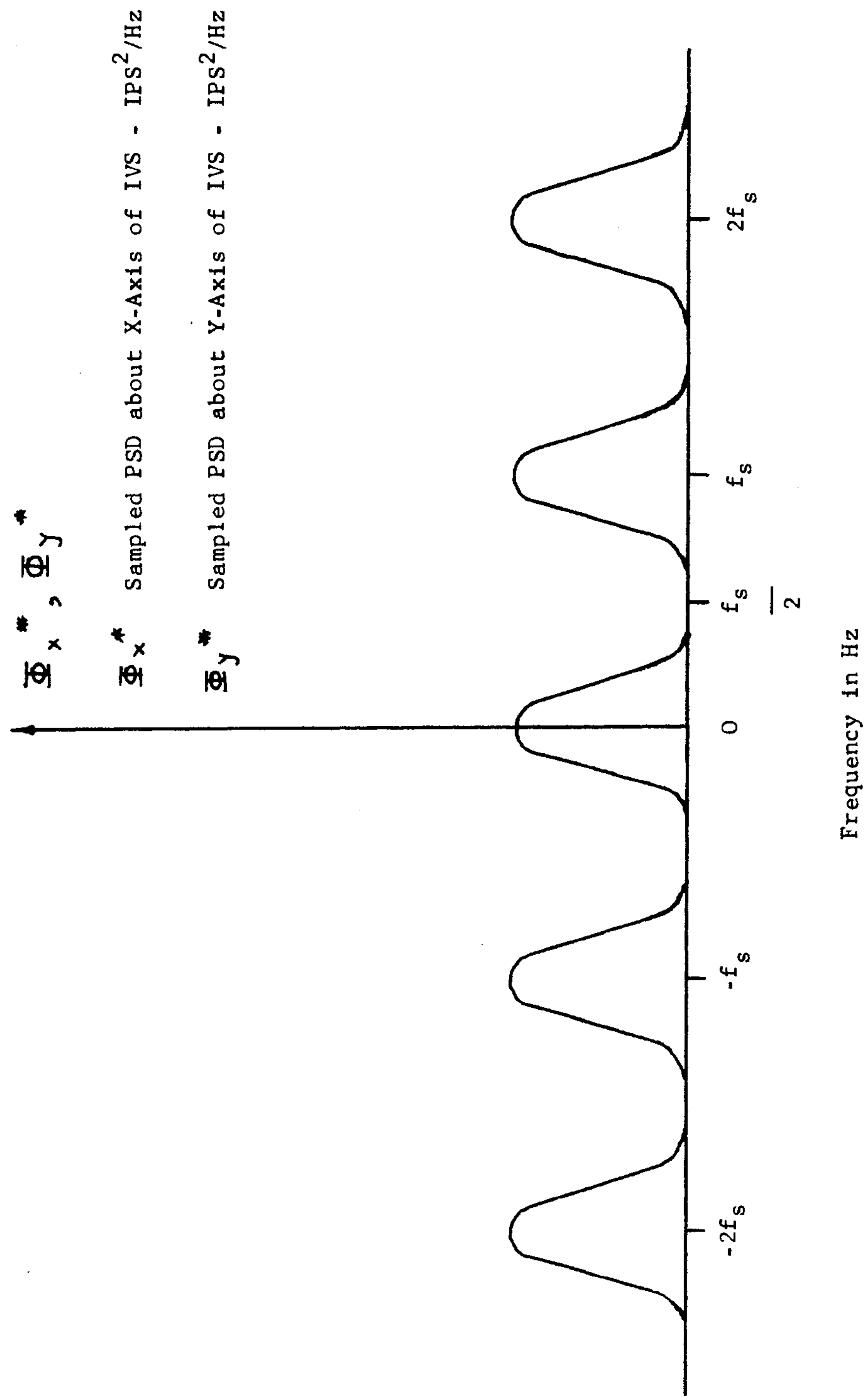


Figure 3A K VALUES AND ATTENUATION CHARACTERISTIES

LATER

Figure 3B.



PSD DISTRIBUTION

Figure 4

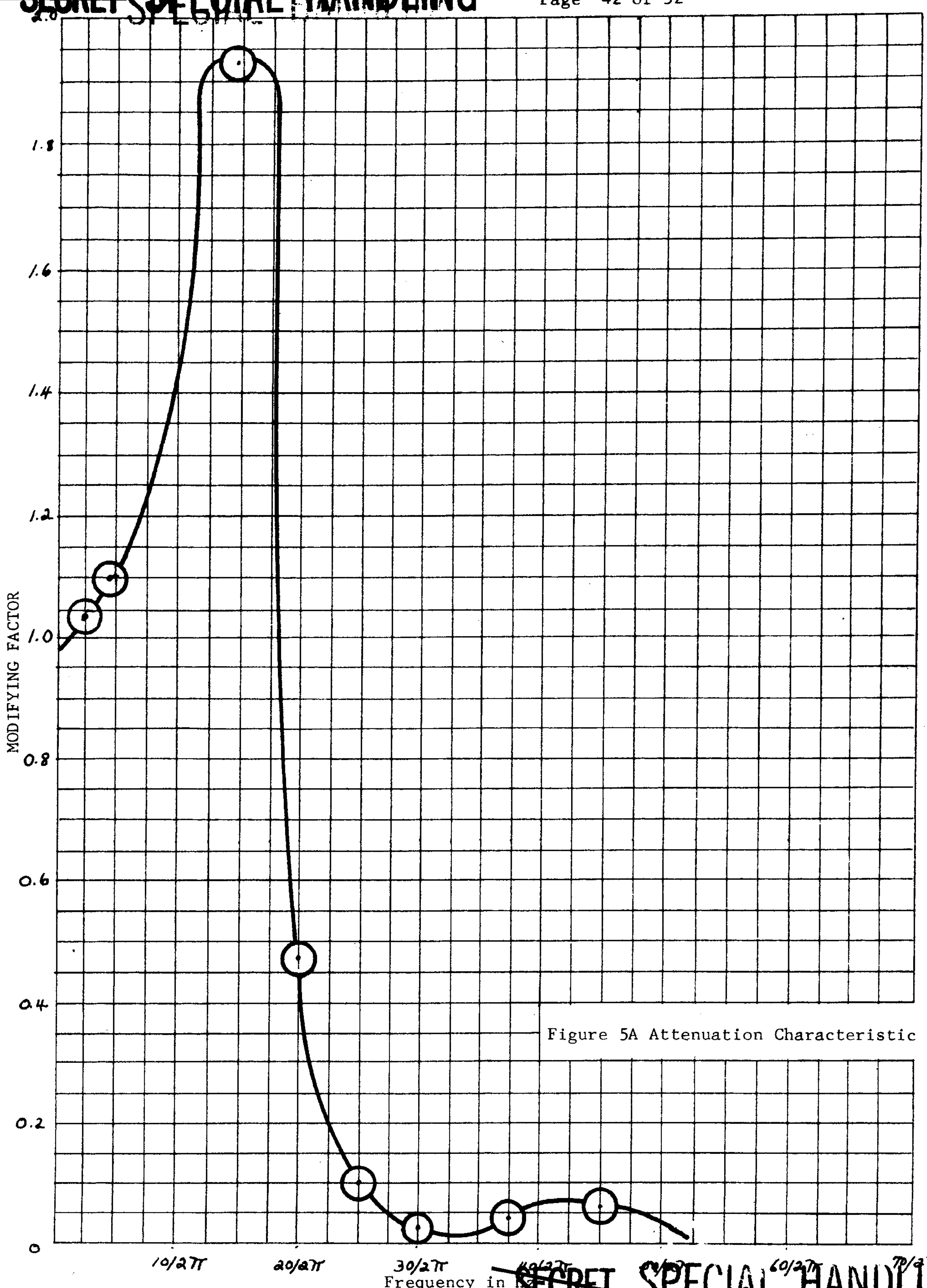


Figure 5A Attenuation Characteristic

LATER

Figure 5B

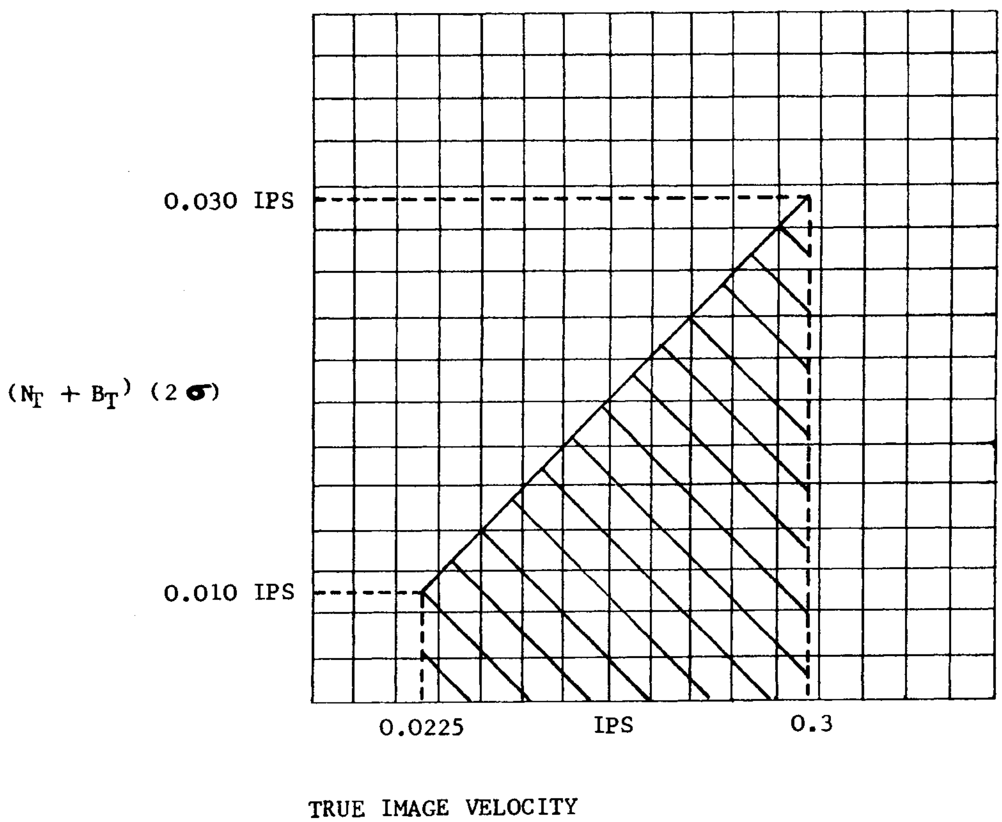


Figure 6 ALLOWABLE NOISE AND BIAS IN LARGE SIGNAL REGION

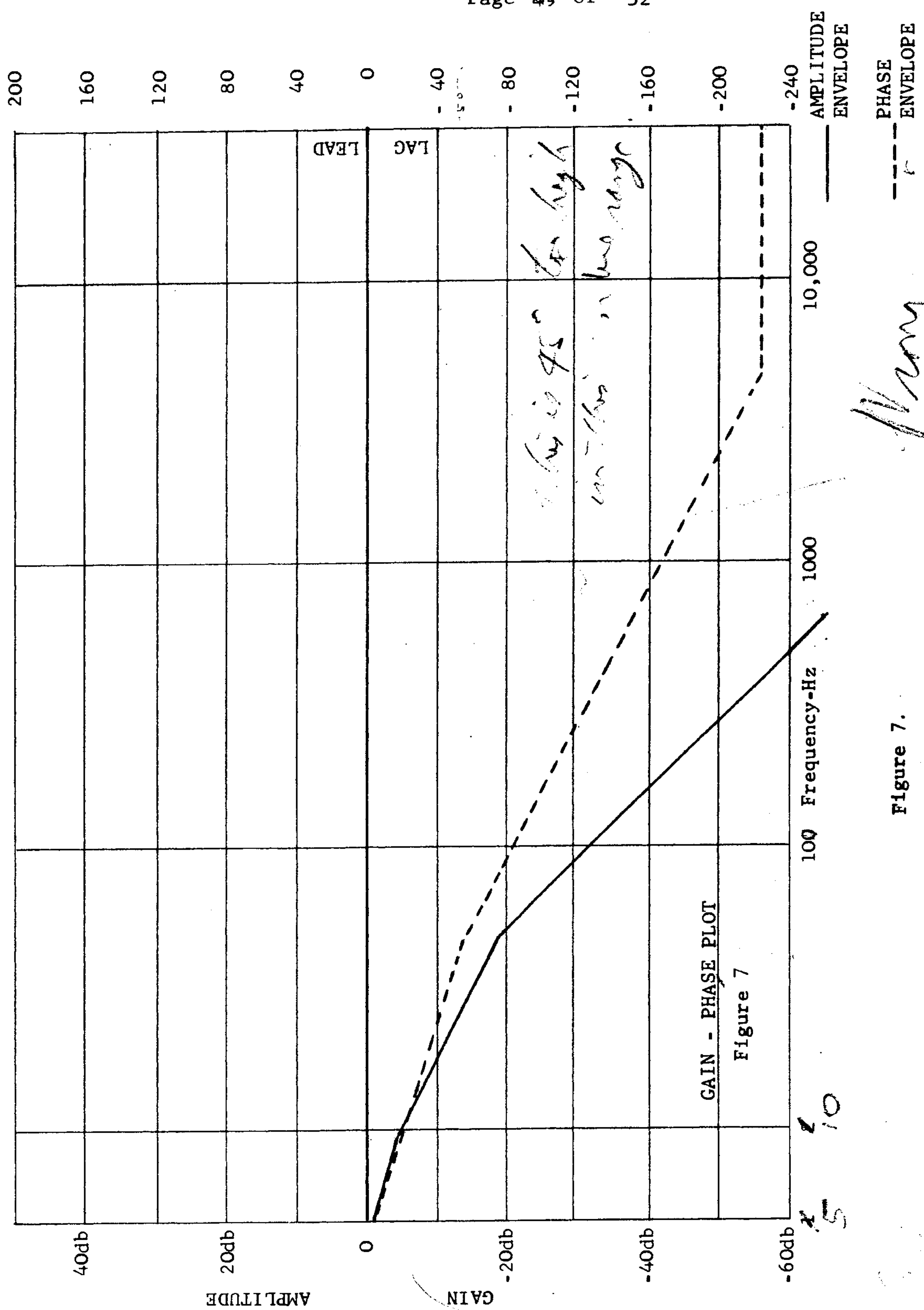
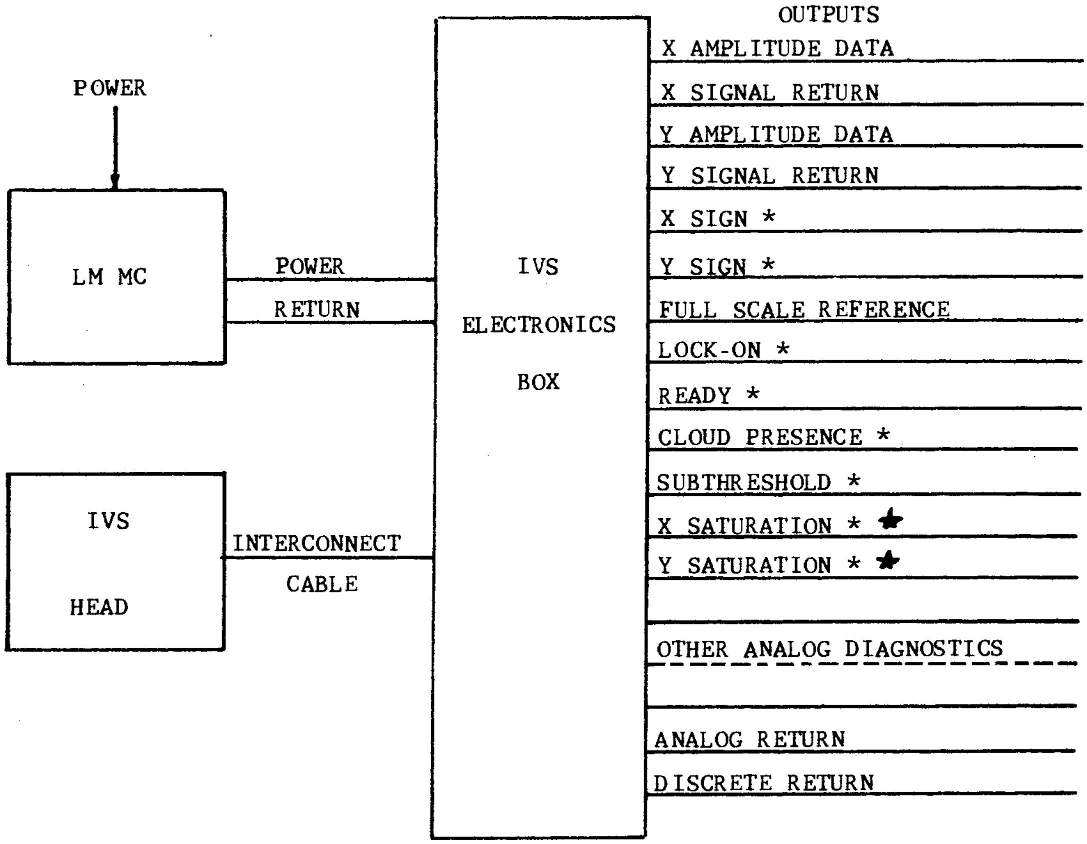

200
160
120
80
40
0
-40
-80
-120
-160
-200
-240
AMPLITUDE ENVELOPE
PHASE ENVELOPE
LEAD
LAG
10,000
1000
100 Frequency-Hz
10
5
GAIN - PHASE PLOT
Figure 7
40db
20db
0
-20db
-40db
-60db
AMPLITUDE
GAIN

Figure 7.



* Indicates Discrete Signal

★ It may be possible to meet saturation signal requirement on the x, y amplitude data lines.

Figure 8. IVS ELECTRICAL INTERFACE

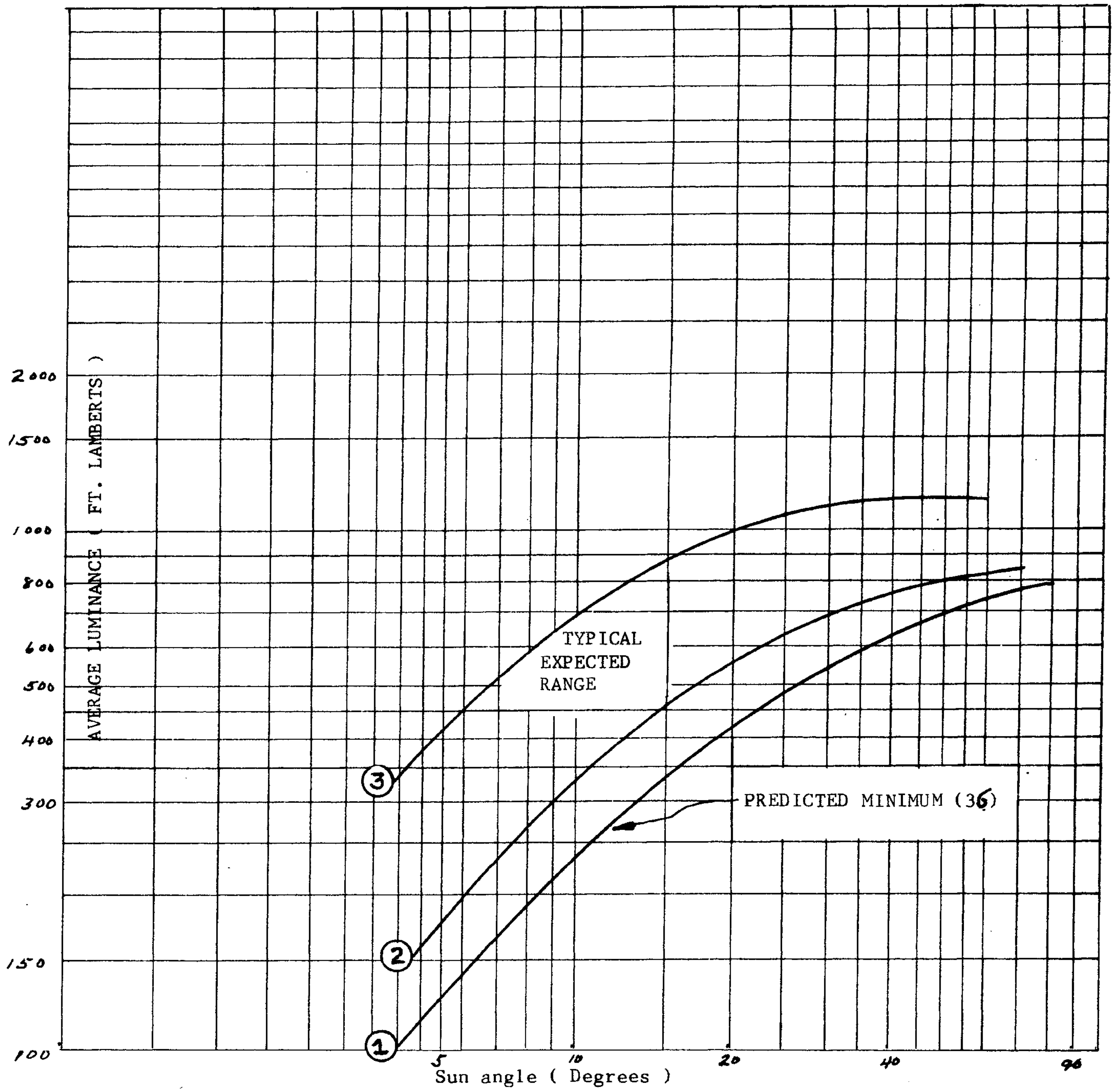
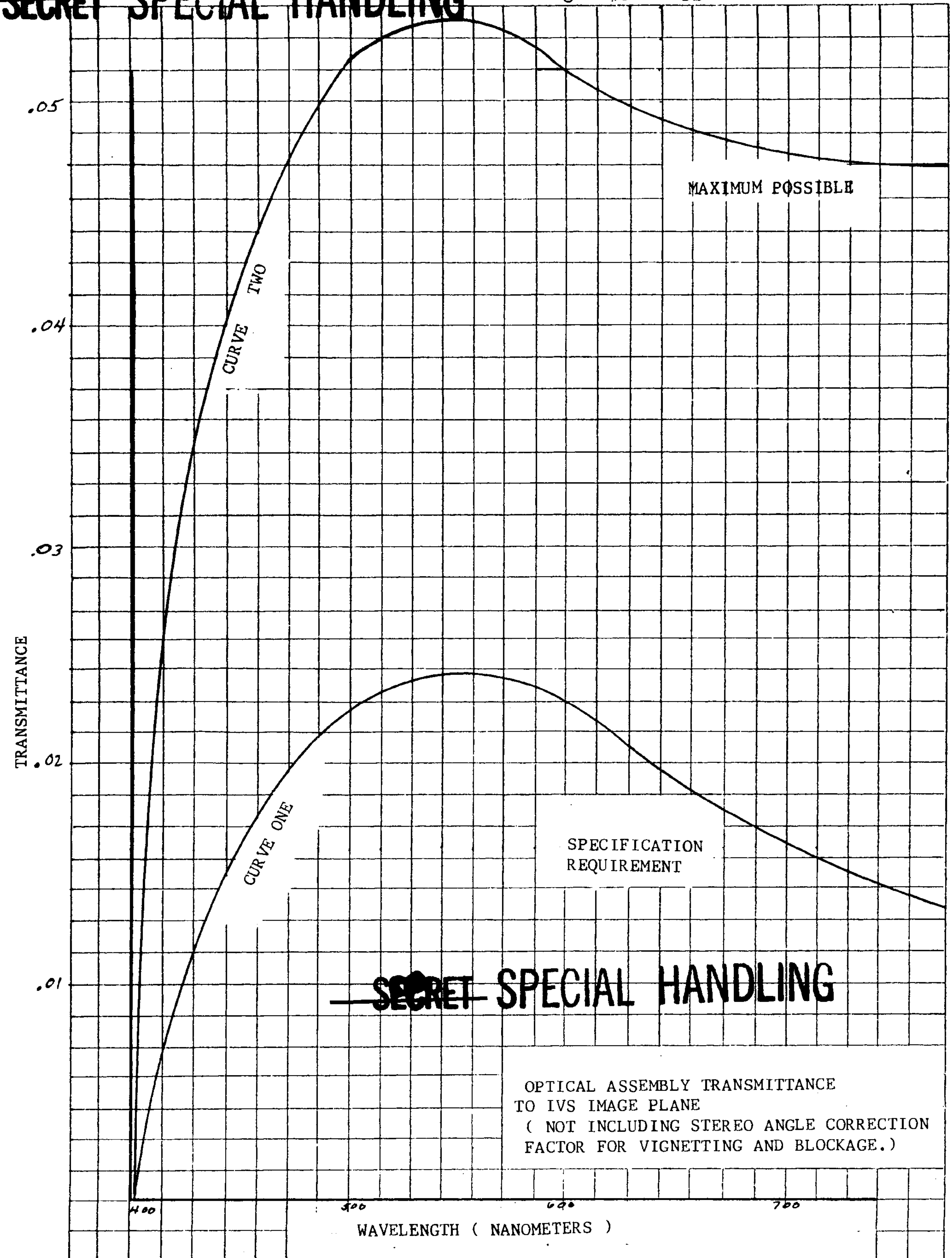
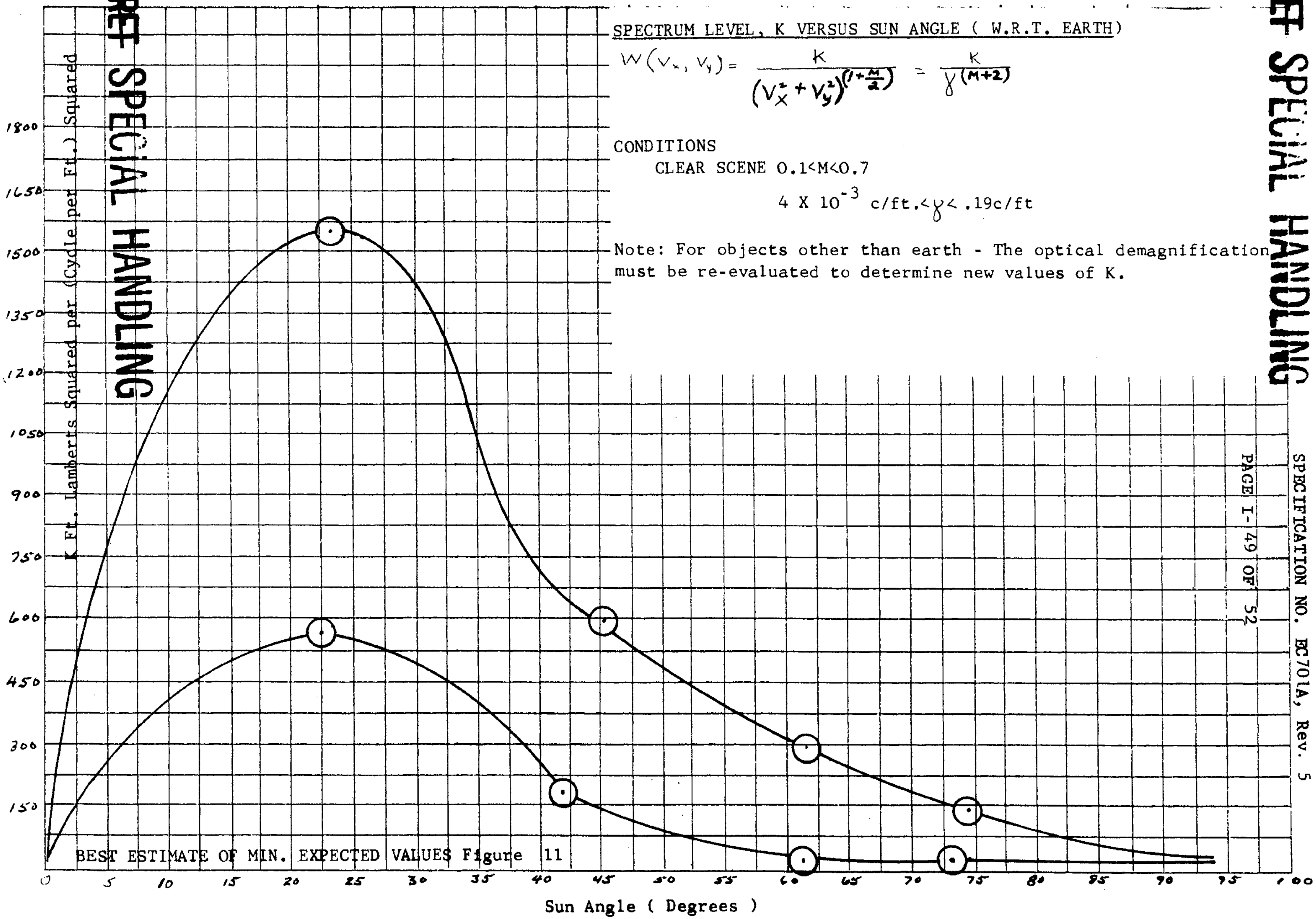


Figure 9 AVERAGE LUMINANCE VERSUS SUN ANGLE



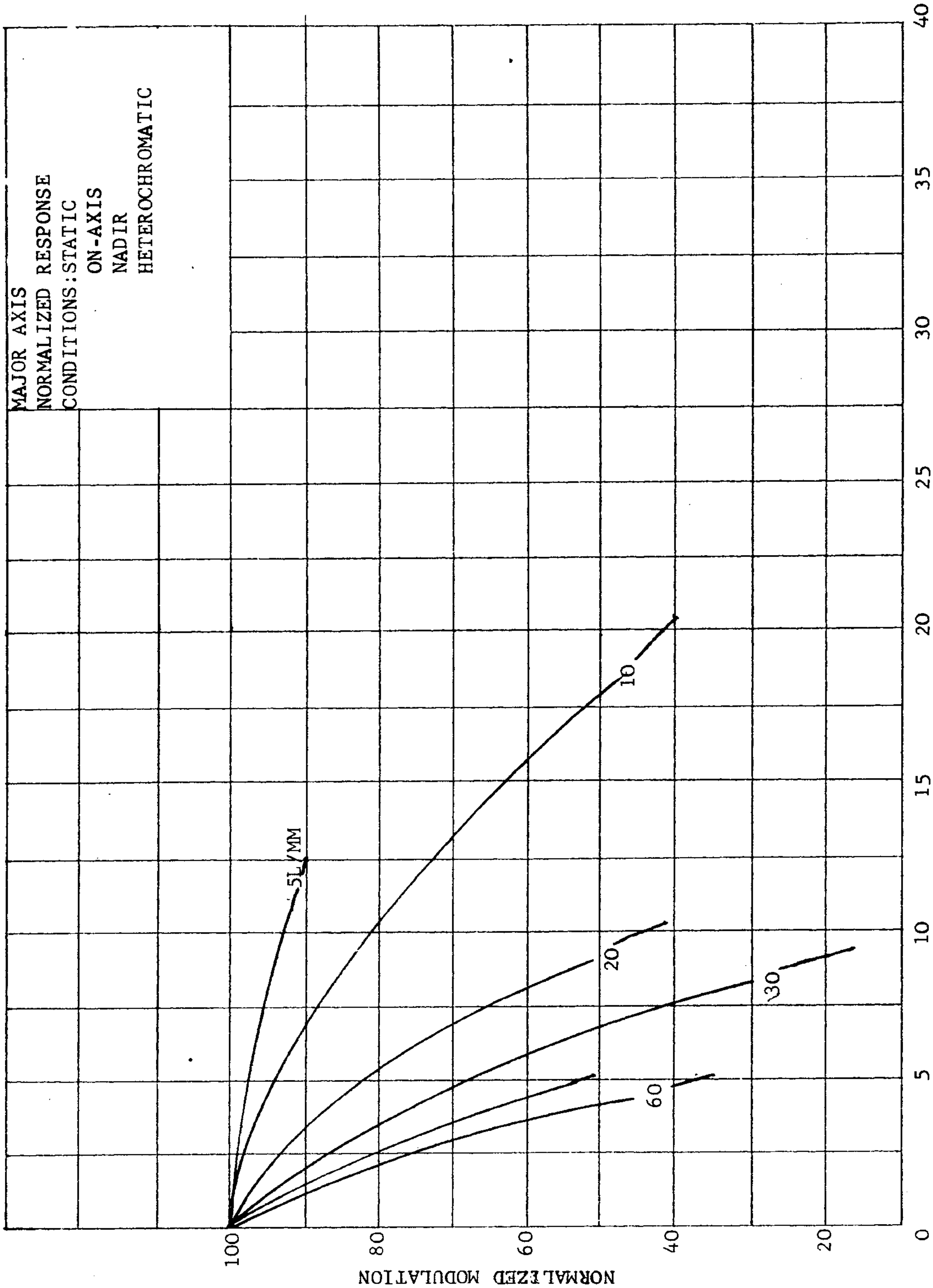
~~SECRET~~ SPECIAL HANDLING

Figure 10 OPTICS TRANSMITTANCE VERSUS WAVELENGTH



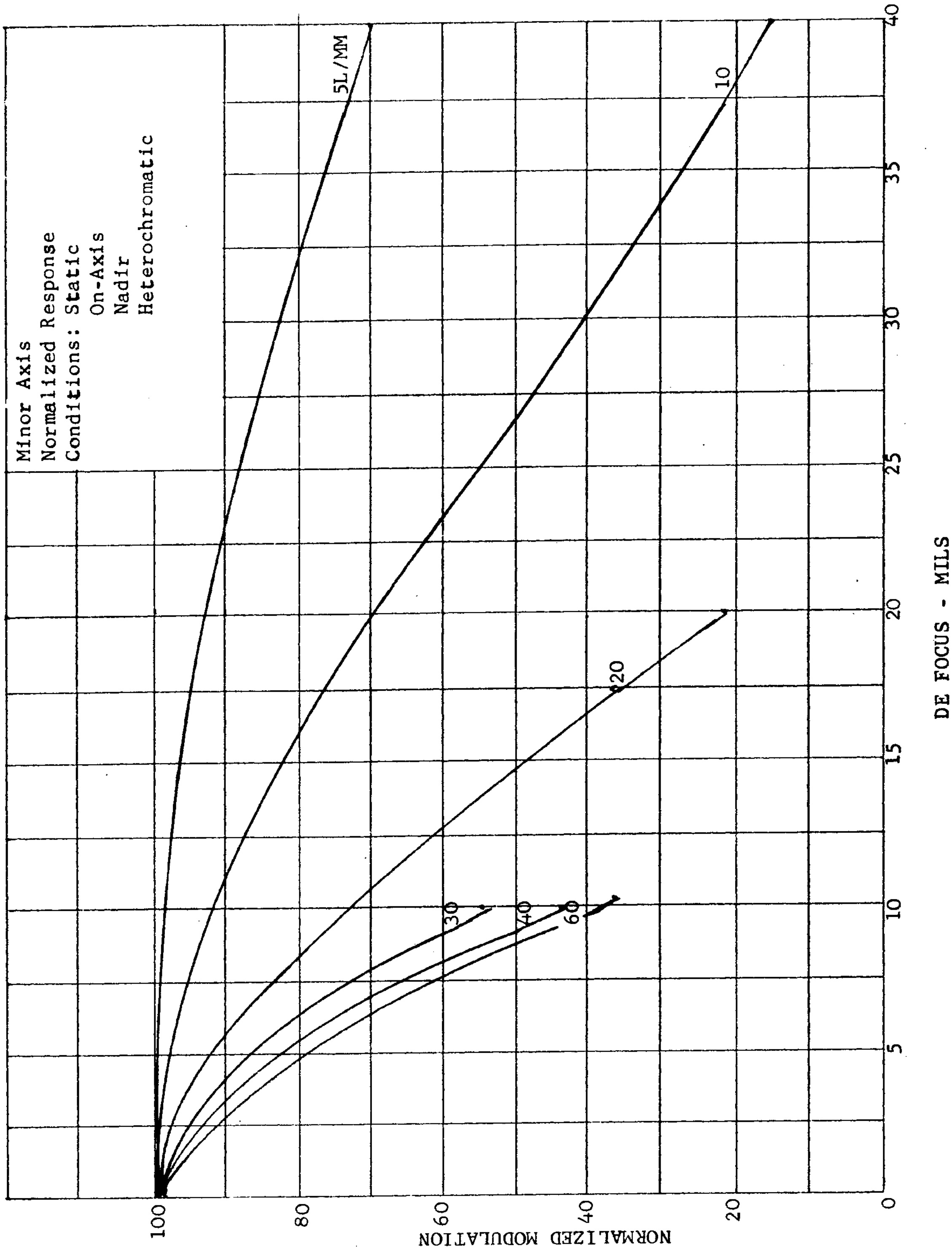
BEST ESTIMATE OF MIN. EXPECTED VALUES Figure 11

~~SECRET~~ SPECIAL HANDLING



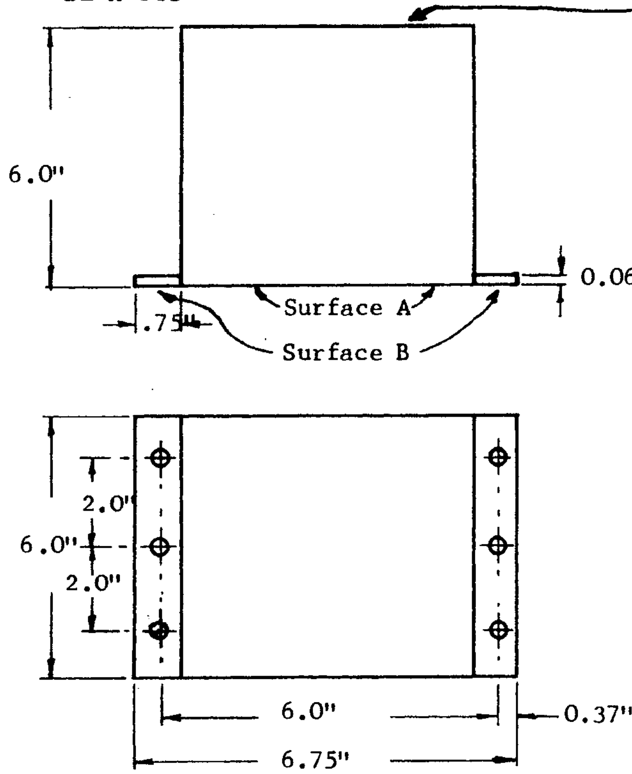
NORMALIZED RESPONSE

Figure 12



NORMALIZED RESPONSE
Figure 13

BETA SYSTEM ELECTONICS PACKAGE DEFINITION



All holes are clearance holes for 10-32 screws.

Hole placement within POM .005" of designated positions.

Dwg. Tolerances: 2 place digits POM .010"
3 place digits POM .005"

Dwg. Scale: None

DRAWING NOTES

1. Component to be mounted to Cold Plate heat exchange using 10-32 stainless screws 3/4" long. Screws to be furnished by sub-contractor.

2. Surface finish on surfaces A and B 32 microinches.

3. Screws torqued to 800 lb tensile force.

4. Surface flatness. Surface "A" 10 mils. Surface "B" 5 mils.

5. Surface finish to have Hemispherical Thermal Emissivity, E_H of $E_H \leq 0.15$

6. Component to be installed to Cold Plate using DC34 conductive grease.

Figure 14. ELECTRONICS BOX DEFINITION