



W. W. Hansen Experimental Physics Laboratory

STANFORD UNIVERSITY

STANFORD, CALIFORNIA 94305 - 4085

Gravity Probe B Relativity Mission

# VATTERFLY VALVE EMI TEST AND RESULTS

S0678 Rev. -

July 11, 2002

*Prepared by Barry Leathers  
Liberty Bel EMC/EMI Services  
for  
Pacific Design Technologies, Inc.  
1 June, 2002*

ITAR Control Req'd \_\_\_\_\_yes

~~X~~  
no  
RM for TC 7/11/02

---

Tom Langenstein

ITAR Assessment Performed

ITAR Control Required?

Yes/ No

Date



PACIFIC DESIGN TECHNOLOGIES, INC.

72 Santa Felicia Drive  
Goleta, CA 93117  
Ph: 805 961-9110  
Fax: 805 961-9120

FAX TRANSMITTAL SHEET

TO: Tom Langestein      DATE: 6/22/02  
COMPANY: Stanford University      FAX NO: 650-725-8312  
FROM: Kirt Dreher      NO. OF PAGES (including cover): 32  
SUBJECT: EMI Procedure for Vacuum Valves

Dear Tom,

Here is a copy of the procedure Barry Leathers prepared for testing the vacuum valves on the Gravity Probe B program.

Kirt Dreher  
Operations Manager

COPIES TO

R. Singley

B. Muhlfelder

R. Pressberg

File

FAX TO

> Jim Lockhart

@ 415-338-2178 (FAX)

415-338-2451 (TEL)

This facsimile may contain PRIVILEGED AND/OR BUSINESS SENSITIVE INFORMATION intended only for use of the addressee(s) named above. If you are not the intended recipient of this facsimile, or the employee or agent responsible for delivering it to the intended recipient, you are hereby notified that any dissemination or copying of this facsimile is strictly prohibited.

If you have received this facsimile in error, please immediately notify the above by telephone and return the original facsimile to us at the address above.

Form PD-G1046 1/23/01



PACIFIC DESIGN TECHNOLOGIES, INC.

72 Santa Felicia Drive  
Goleta, CA 93117  
Ph: 805 961-9110  
Fax: 805 961-9120

FAX TRANSMITTAL SHEET

TO: Tom Langestein      DATE: 6/22/02  
COMPANY: Stanford University      FAX NO: 650-725-8312  
FROM: Kirt Dreher      NO. OF PAGES (including cover): 32  
SUBJECT: EMI Procedure for Vacuum Valves

Dear Tom,

Here is a copy of the procedure Barry Leathers prepared for testing the vacuum valves on the Gravity Probe B program.

Kirt Dreher  
Operations Manager

Copies to

R. Singley

B. Muhlfelder

R. Pressberg

File

Fax to

> Jim Lockhart

@ 415-338-2178 (FAX)

415-338-2451 (TEL)

This facsimile may contain PRIVILEGED AND/OR BUSINESS SENSITIVE INFORMATION intended only for use of the addressee(s) named above. If you are not the intended recipient of this facsimile, or the employee or agent responsible for delivering it to the intended recipient, you are hereby notified that any dissemination or copying of this facsimile is strictly prohibited.

If you have received this facsimile in error, please immediately notify the above by telephone and return the original facsimile to us at the address above.

Form PD-G1046 1/23/01

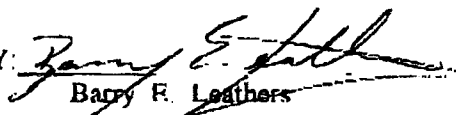
TP02-010

SHIELDING EFFECTIVENESS  
TEST PROCEDURE ON  
PACIFIC DESIGN TECHNOLOGIES  
2.5" AND 6" VACUUM VALVES  
PART NUMBERS 3179 AND 3223

PREPARE FOR:  
PACIFIC DESIGN TECHNOLOGIES  
P.O. 40468

PREPARED BY:  
LIBERTY BEL EMC/EMI SERVICES  
JUNE, 2002

APPROVED BY:

  
Barry E. Leathers

TP02-010

Page i

TABLE OF CONTENTSPARAGRAPHPAGE

|                                       |     |
|---------------------------------------|-----|
| TABLE OF CONTENTS                     | i   |
| LIST OF REVISIONS                     | ii  |
| TABLE OF FIGURES                      | iii |
| LIST OF TABLES                        | v   |
| 1.0 SCOPE                             | 1   |
| 2.0 APPLICABLE DOCUMENTS              | 2   |
| 3.0 INTERFERENCE CONTROL REQUIREMENTS | 3   |
| 4.0 TEST SAMPLE                       | 4   |
| 5.0 TEST SAMPLE CONFIGURATION         | 5   |
| 6.0 TEST SAMPLE OPERATION             | 6   |
| 7.0 TEST CONDITION                    | 7   |
| 8.0 INSTRUMENTATION                   | 8   |
| 9.0 TEST PROGRAM DEVIATION            | 10  |
| 10.0 TEST PROCEDURES                  | 11  |
| 11.0 TEST REPORT                      | 18  |

Rx Date/Time

JUN-22-2002(SAT) 10:32

310 537 4235

P.003

FROM : LIBERTY BEL EMC/EMI CONSULTING PHONE NO. : 310 537 4235

P03

TP02-010

Page ii

LIST OF REVISIONS

REVISION  
NUMBER  
AND DATE

PAGE  
CHANGED

PAGE  
SUBSTITUTED

PAGE  
ADDED

3

FROM : LIBERTY BEL EMC/EMI CONSULTING PHONE NO. : 310 537 4235

P04

TP02-010

Page iii

LIST OF FIGURES (TEST SETUPS)

| <u>FIGURE</u> |                                                                        | <u>PAGE</u> |
|---------------|------------------------------------------------------------------------|-------------|
| SE01-1        | Shielding Effectiveness ( 1MHz & 16MHz),<br>Front View (Cut-away)      | 14          |
| SE01-2        | Shielding Effectiveness ( 1MHz & 16MHz),<br>Side View (Cut-away)       | 15          |
| SE01-3        | Shielding Effectiveness ( 100MHz & 500MHz),<br>Side View (Cut-away)    | 16          |
| SE01-2        | Shielding Effectiveness ( 1GHz, 3GHz & 10GHz),<br>Side View (Cut-away) | 17          |

4

FROM : LIBERTY BEL EMC/EMI CONSULTING PHONE NO. : 310 537 4235

P05

TP02-010

Page iv

LIST OF FIGURES (APPENDIX A)

| <u>FIGURE NO.</u> |                                                | <u>PAGE</u> |
|-------------------|------------------------------------------------|-------------|
| A-1               | Engineering Test Data                          | 20          |
| A-2               | Drawing, 2.5" Vacuum Valve                     | 21          |
| A-3               | Drawing, 6" Vacuum Valve                       | 22          |
| A-4               | Dimensions, Shielded Enclosure Interface Plate | 23          |

FROM : LIBERTY BEL EMC/EMI CONSULTING PHONE NO. : 310 537 4235

P06

TP02-010  
Page v

LIST OF TABLES

TABLE NO.

PAGE

1

Test Requirements

3

6

FROM : LIBERTY BEL EMC/EMI CONSULTING PHONE NO. : 310 537 4235

P07

TP02-010

Page 1

## 1.0 SCOPE

This test plan details the test procedures to be applied to the test sample, and the test limits necessary to verify compliance with the general EMI/EMC requirements of MIL-STD-285 and NSA65-6.

7

FROM : LIBERTY BEL EMC/EMI CONSULTING PHONE NO. : 310 537 4235

P08

TP02-010

Page 2

## 2.0 APPLICABLE DOCUMENTS

The following specifications and standards, of the issue in effect on the date of award of contract, shall form a part of this document to the extent specified herein. In the event of conflict between this document and the following specifications and standards, including the specifications and standards referenced herein, this document shall govern.

MIL-STD-285  
25 Jun 1957

Attenuation Measurements for Enclosures, Electromagnetic  
Shielding, For Electronic Test Purposes, Method of

NSA65-6  
20 Oct 1964

National Security Agency Specification for R.F. Shielded  
Enclosures for Communication Equipment: General Specification

MIL-STD-831  
28 Aug 1963

Test Report, Preparation of

MIL-STD-45662A  
15 Aug 1962

Calibration System Requirements

FROM : LIBERTY BEL EMC/EMI CONSULTING PHONE NO. : 310 537 4235

P09

TP02-010

Page 3

### 3.0 INTERFERENCE CONTROL REQUIREMENTS

The test sample shall be subjected to the electromagnetic interference requirements of MIL-STD-285 and NSA65-6.

The laboratory test results shall be compared with the specification limits for compliance therein. The applicable EMI test requirements are listed in Table 1.

| <u>FREQUENCY (Hz)</u> | <u>Table 1</u><br><u>SHIELDING EFFECTIVENESS (dB)</u> |
|-----------------------|-------------------------------------------------------|
| 1 MHz                 | 35                                                    |
| 16 MHz                | 35                                                    |
| 100 MHz               | 35                                                    |
| 500 MHz               | 35                                                    |
| 1 GHz                 | 35                                                    |
| 3 GHz                 | 35                                                    |
| 10 GHz                | 35                                                    |

9

FROM : LIBERTY BEL EMC/EMI CONSULTING PHONE NO. : 310 537 4235

P10

TP02-010

Page 4

#### 4.0 TEST SAMPLE

The test samples submitted for test shall be the Part Numbers 3179 and 3223, Vacuum Valves

#### 4.1 Connector Pin Functional Assignment

##### P1 (J1) Connector Pin (3179 & 3223)

##### Function

|   |                  |
|---|------------------|
| A | M1, PHA, +28 VDC |
| B | M1, PHA, -28 VDC |
| C | M1, PHB, +28 VDC |
| D | M1, PHB, -28 VDC |
| E | M2, PHA, +28 VDC |
| F | M2, PHA, -28 VDC |
| G | M2, PHB, +28 VDC |
| H | M2, PHB, -28 VDC |
| J | A - OPEN EXCITE  |
| K | A - OPEN SENSE   |
| L | A - CLOSE EXCITE |
| M | A - OPEN SENSE   |
| N | A - RETURN       |
| P | B - OPEN EXCITE  |
| R | B - OPEN SENSE   |
| S | B - CLOSE EXCITE |
| T | B - CLOSE SENSE  |
| U | B - RETURN       |

FROM : LIBERTY BEL EMC/EMI CONSULTING PHONE NO. : 310 537 4235

P11

TP02-010

Page 5

## 5.0 TEST SAMPLES CONFIGURATION

### 5.1 Primary Power

The primary power applied to the test samples is 28 VDC. The test samples shall not be supplied 28 VDC during the performance of the test required by this document.

### 5.2 Mounting and Bonding

The test samples shall be mounted and bonding to a shielded enclosure interface plate. The dimension a the interface plate are show in Figure A- 4. The plate shall mounted and bonded to the shielded enclosure at the point indicated as the room peneration panel

### 5.3 Support Equipment

Electronic support equipment will not be required during the performance of test required by this document.

FROM : LIBERTY BEL EMC/EMI CONSULTING PHONE NO. : 310 537 4235

P1

TP02-010  
Page 6

## 6.0 TEST SAMPLE OPERATION

### 6.1 Open Valve

There shall be one open valve mode of operation which is define as follows:

A. Manual open and secure the valve.

B. Make EMI measurements.

### 6.2 Close Valve

There shall be one close valve mode of operation which is define as follows:

A. Manual close and secure the valve.

B. Make EMI measurements.

**Note:** Personnel and equipment to monitor performance of the test sample will be provided by Pacific Design Technologies.

### 7.1 Primary Power

The primary power per paragraph 5.1 will not be needed during the performance of test required by this document.

All AC voltages are RMS unless otherwise noted.

### 7.2 Test Facility

One Shielded enclosure manufactured by Electronics Construction Company shall be used as the test facility for the conduction of the EMI test. The enclosure shall have a shielding effectiveness of at least 10 dB higher than the requirement listed in Table 1.

### 7.3 Inspection

All electromagnetic interference tests described herein may be witness by the authorized representatives of Pacific Design Technologies.

shall be calibrated under an approved program in accordance with MIL-STD-46002. In particular, measurement antennas, current probes, field sensors, and other devices used in the measurement loop shall be calibrated at least every two years.

13

TP02-010

Page 8

**8.0 INSTRUMENTATION****8.1 Radio Interference and Field Intensity Meter**

The following test instruments are available for performing tests covered in this document.

| <u>FREQUENCY RANGE</u> | <u>NOMENCLATURE</u>   | <u>SERIAL NO.</u> |
|------------------------|-----------------------|-------------------|
| 10KHz - 1.0GHz         | Hewlett Packard 8590A | 2839A03856        |
| 10KHz - 32MHz          | Ailtech NM 17/27      | 113 / 128         |
| 30MHz - 1GHz           | Ailtech NM 37/57      | 190 / 826         |
| 1GHz - 10GHz           | CarNel Labs NM 67     | 67-B              |
| 10KHz - 320GHz         | Tektronix 492P        | 1383              |

**ACCESSORIES**

|                            |       |         |
|----------------------------|-------|---------|
| Tektronix Digital Plotter  | 4662  | B057076 |
| Tektronix Display Terminal | 4107A | B023281 |
| Tektronix Controller       | 4041  | B020576 |

**8.2 Antennas**

The following antennas are available for performing tests covered in this document..

| <u>FREQUENCY RANGE</u> | <u>NOMENCLATURE</u>           | <u>SERIAL NO.</u> |
|------------------------|-------------------------------|-------------------|
| 10kHz - 32MHz          | 41" Rod Ant, Ailtech 945942-1 | TBD               |
| 20MHz - 200MHz         | Biconical, Ailtech 94455-1    | TBD               |
| 370MHz - 1 GHz         | Dipole, Stoddart 91598-2      | TBD               |
| 1GHz - 18 Ghz          | Double Ridge Guide, EMCO 3115 | TBD               |

**8.3 Signal Generator**

The following laboratory type signal generators are available for performing the tests covered by this test plan.

| <u>FREQUENCY RANGE</u> | <u>MANUFACTURER</u> | <u>MODEL NO.</u> | <u>SERIAL NO.</u> |
|------------------------|---------------------|------------------|-------------------|
| Signal Generator       | Ailtech             | 460              | 515               |
| Signal Generator       | Alfred              | 650              | Main Frame        |
| 1 - 2GHz Plug-in       | Alfred              | 650              | 1854-7            |
| 2 - 4GHz Plug-in       | Alfred              | 650              | 1880              |
| 8 - 12.4GHz Plug-in    | Alfred              | 650              | 1625              |

14

FROM : LIBERTY BEL EMC/EMI CONSULTING PHONE NO. : 310 537 4235

P15

TP02-010

Page 9

**8.4 Auxiliary Instrumentation**

The following items of test equipment are available for interference and/or susceptibility testing.

| <u>NOMENCLATURE</u> | <u>MANUFACTURER</u> | <u>MODEL NO</u> | <u>SERIAL NO</u> |
|---------------------|---------------------|-----------------|------------------|
| RF Amplifier        | IFI                 | 5520            | 011171LB01       |
| RF Amplifier        | Eaton               | 3552A           | 2189-90310       |
| RF Amplifier        | ENI                 | 350L            | 26192            |
| RF Amplifier        | ENI                 | 240L            | 525              |
| TWTA                | Hughes              | 1177H01F000     | 152              |
| TWTA                | Hughes              | 8020H03F00      | 271              |

**8.5 Accessory Equipment**

Accessory equipment used in conjunction with measurement receiver shall not degrade measurement integrity.

**8.6 Equipment Substitution**

If necessary, the test engineer may substitute similar instruments for those listed above, with equivalent tolerance, performance characteristics, and or sensitivity

**8.7 Excess Personnel and Equipment**

The area shall be kept free of unnecessary personnel, equipment, cable racks, and desks. Only the equipment essential to the test being performed shall be in the test area or enclosure. Only personnel actively involved in the test shall be permitted in the enclosure.

**8.8 Calibration Requirements**

Test equipment and accessories required for measurement in accordance with this document shall be calibrated under an approved program in accordance with MIL-STD-45662. In particular, measurement antennas, current probes, field sensors, and other devices used in the measurement loop shall be calibrated at least every two years.

15

TP02-010

Page 10

### 8.8.1 Measurement System Test

At the start of each emission test, the complete system (including measurement receivers, cables, attenuators, couplers, and so forth) shall be verified by injecting a known signal, as stated in the individual test method, while monitoring system output for the proper indication. The RMI test engineer shall verify that all instruments are in calibration during their use. The date of last calibration for each instruments used shall be recorded at the time of use and reported in the EMI test report.

### 8.8.2 Antenna Factors

Factors for electric field test antennas shall be determined in accordance with SAE ARP-958.

### 8.9 Instrument Operation

Interference measuring instrument operation and calibration shall be in accordance with the test specification and the manufacturers recommendations. In the event of conflict, the test procedure shall take precedence except as otherwise noted. Meters shall be operated in the peak mode of operation for all measurements. The instruments are direct meter reading

### 8.10 Measurement Instrument Grounding

The interference measuring instruments shall be physically grounded with only one connection at all times and the antenna shall be remote from the meter if possible.

### 8.11 Accuracy of Measurement

The expected accuracy of measurement shall be:

Frequency Accuracy:  $\pm 2\%$

Amplitude Accuracy:  $\pm 2$  dB.

Distance:  $\pm 5\%$

Time (waveforms):  $\pm 5\%$

Amplitude, measurement system (includes measurement receivers, transducers, cables and so forth):  $\pm 3$ dB

FROM : LIBERTY BEL EMC/EMI CONSULTING PHONE NO. : 310 537 4235

P16

TP02-010

Page 11

## 9.0 TEST PROGRAM DEVIATION

Unless otherwise directed by the responsible engineer, electromagnetic interference test described herein may be performed in any sequence indicated in Table 1 of this document.

In the event that the test plan deviations are required during the normal qualification test program, they shall be made only upon approval of the cognizant representative and his approval shall be noted in the test log with complete description and justification for such deviations.

17

FROM : LIBERTY BEL EMC/EMI CONSULTING PHONE NO. : 310 537 4235

P17

TP02-010

Page 12

## 10.0 TEST PROCEDURE

### 10.1 Prequalification Acceptance Tests

Prior to the start of EMI testing, a functional test of the test sample shall be performed to insure proper operation of the test system.

### 10.2 Ambient Tests

Ambient condition measurements shall be made across the frequency range for all frequency domain emissions testing. Ambient measurements shall be made with all equipment on except for the system under test.

TP02-010

Page 12

### 10.3 Shielding Effectiveness

#### 10.3.1 Shielding Effectiveness, SE01, 1MHz - 10GHz

In the performance of this test, the Dynamic Range (dB) which is the difference between the receiver noise floor and the amplitude of the received signal, and the enclosure's Shielding Effectiveness (dB) without the test samples installed must first be determined to insure that test conditions are adequate before evaluating the test samples. Refer to Figure A-1 for test data sheet.

#### 10.3.2 The following procedures shall be followed.

- A. Setup the test equipment and shielded enclosure as shown in Figures SE01-1 and SE01-2, the electric field measurement. Note: At the room penetration panel, the solid blank interface plate is installed. Open the door which signal isolates the two antennas.
- B. With the transmitter's signal turned off, tune the EMI meter for a 1 MHz signal. Measure and record this level as the Receiver Noise (RN) at the frequency of 1MHz.
- C. Repeat Step B for the frequency of 16 MHz.
- D. Turn the transmitter on and allow sufficient time to stabilize.
- E. Tune the transmitter for a 1 MHz signal to be received and monitored by the EMI meter.
- F. Re-tune the EMI meter so as to receive the 1MHz transmitted signal. Measure the received signal amplitude, increase the amplitude at the signal generator, if the difference between received signal amplitude and the receiver noise floor RN is not greater than or equal to the required shielding effectiveness level (dB) plus 10. Once the signal amplitude above receiver noise floor requirement is met record as the Open Door (OD) Reading at the frequency of 1 MHz. Record generator (Gs) setting. Compute and record the Dynamic Range (DR), where  $DR (dB) = OD - RN$ .
- G. Repeat Steps E and F for the frequency of 16 MHz.
- H. Turn transmitter off. With the solid blank plate in place at the penetration panel, move both the transmit and receive antennas so that they are separated by the common wall; the distance separating the antennas shall be maintained. The antennas shall be laterally centered on the blank plate. Close and secure the door.

19

TP02-010

Page 13

- I. Repeat Steps D through G using the predetermined generator (Gs) settings of Stop F. Record as the Blank Plate Reading (BP) for the appropriate frequency.
- J. Compute the Shielding Effectiveness (S.E. of BP) of the blank plate as:  

$$\text{S.E. of BP(dB)} = \text{OD} - \text{BP}$$
 for the appropriate frequency. Note: S.E. of BP(dB) must be greater than or equal to the requirements of Table 1 before continuing.
- K. Turn transmitter off. Replace the blank plate with an interface plate having any one of the two test samples mounted on it. The test sample shall be centered both vertically and laterally on the plate. The antennas shall be laterally centered on the plate; the distance separating the antennas shall be maintained. Close and secure the door.
- L. With the valve in the open position per paragraph 6.1, repeat Step I through J. Record as the Open Valve Reading (OV) for the appropriate frequency. Compute S.E. of OV(dB) = OD - OV, for the appropriate frequency.
- M. With the valve in the close position the paragraph 6.2, repeat Step I through J. Record as the Close Valve Reading (CV) for the appropriate frequency. Compute S.E. of CV(dB) = OD - CV, for the appropriate frequency.
- N. Repeat Steps A through M for the setup shown in Figure SE01-3, the plane wave measurements of 100MHz and 500MHz.
- O. Repeat Steps A through M for the setup shown in Figure SF01-4, the plane wave measurements of 1GHz, 3GHz and 10GHz.
- P. Repeat Steps A through O for the second test sample.

### 10.3.3 Data Presentation

Data presentation shall be as follows:

- A. Provide indications of compliance with this document requirements.

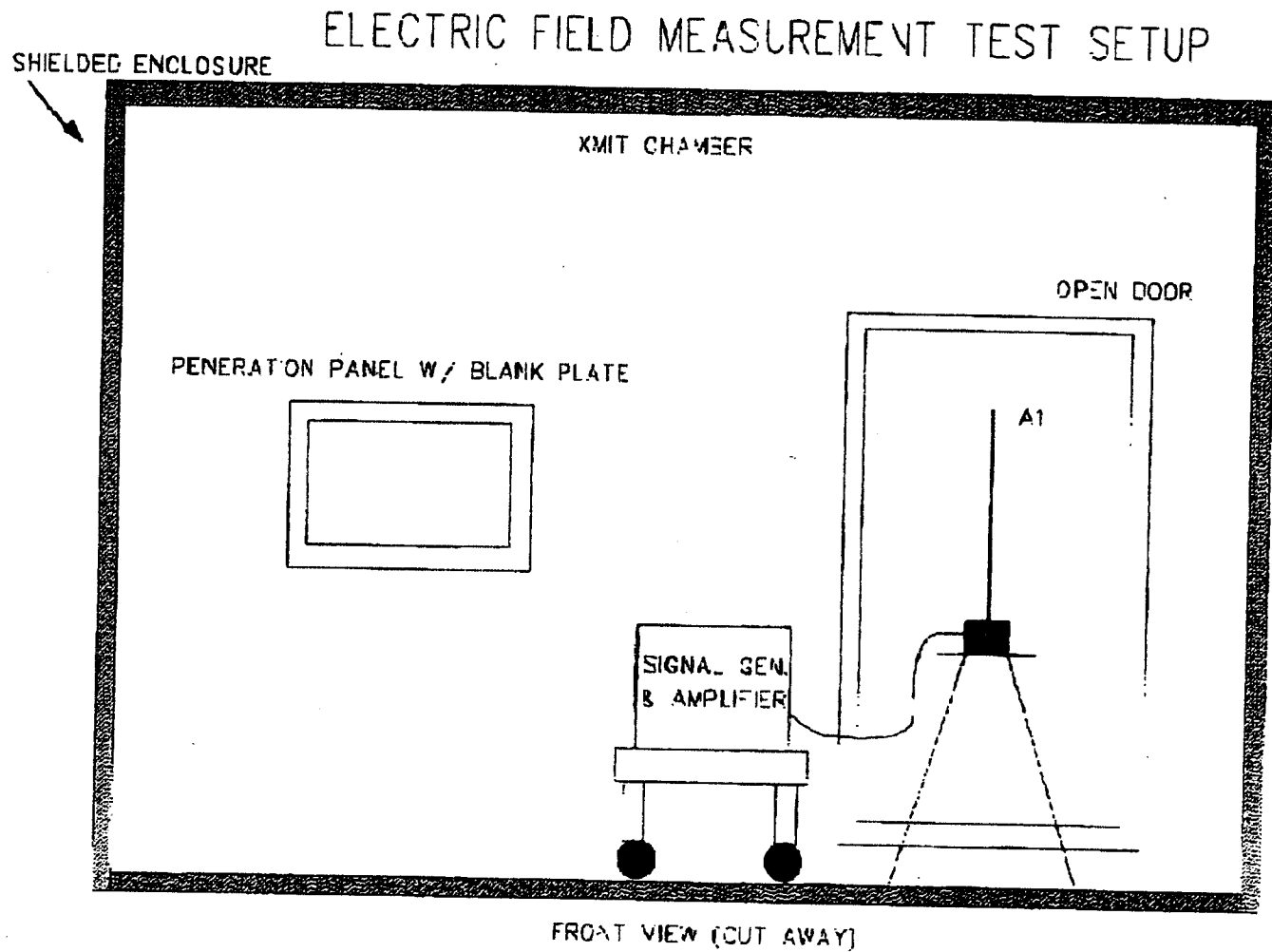


FIGURE SEC-1 SHIELDING EFFECTIVENESS (1MHz & 16MHz)

A1 & A2: Rod Antenna w/ Counterpoise  
D: 26 INCHES

21

21

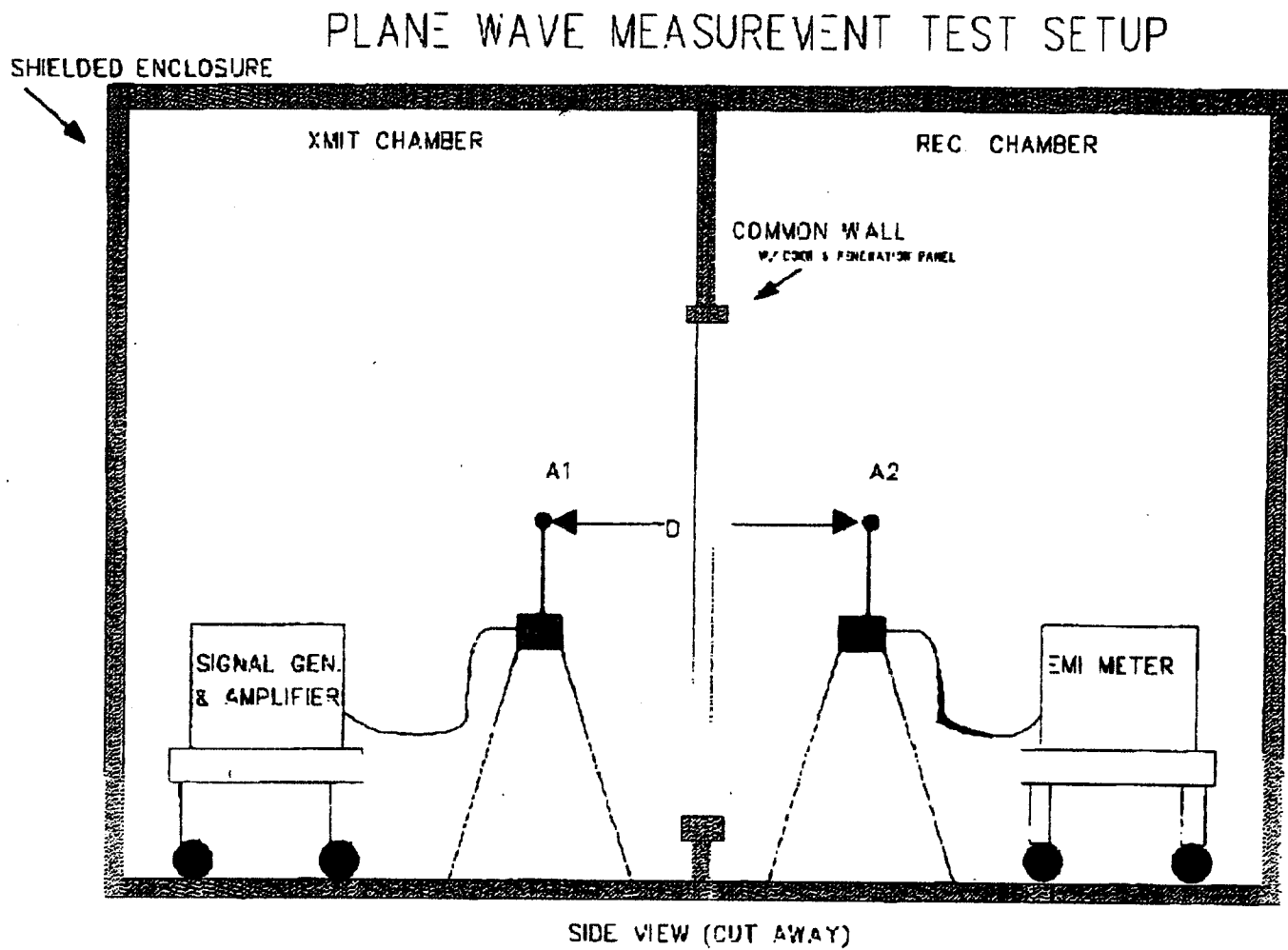


FIGURE SEQ-3 SHIELDING EFFECTIVENESS (100MHz & 500MHz)

A1 & A2: Dipole Antennas

D:  $\lambda/2$  where  $\lambda = 300/\text{frequency (MHz)}$

TP02-010  
Page 16

22

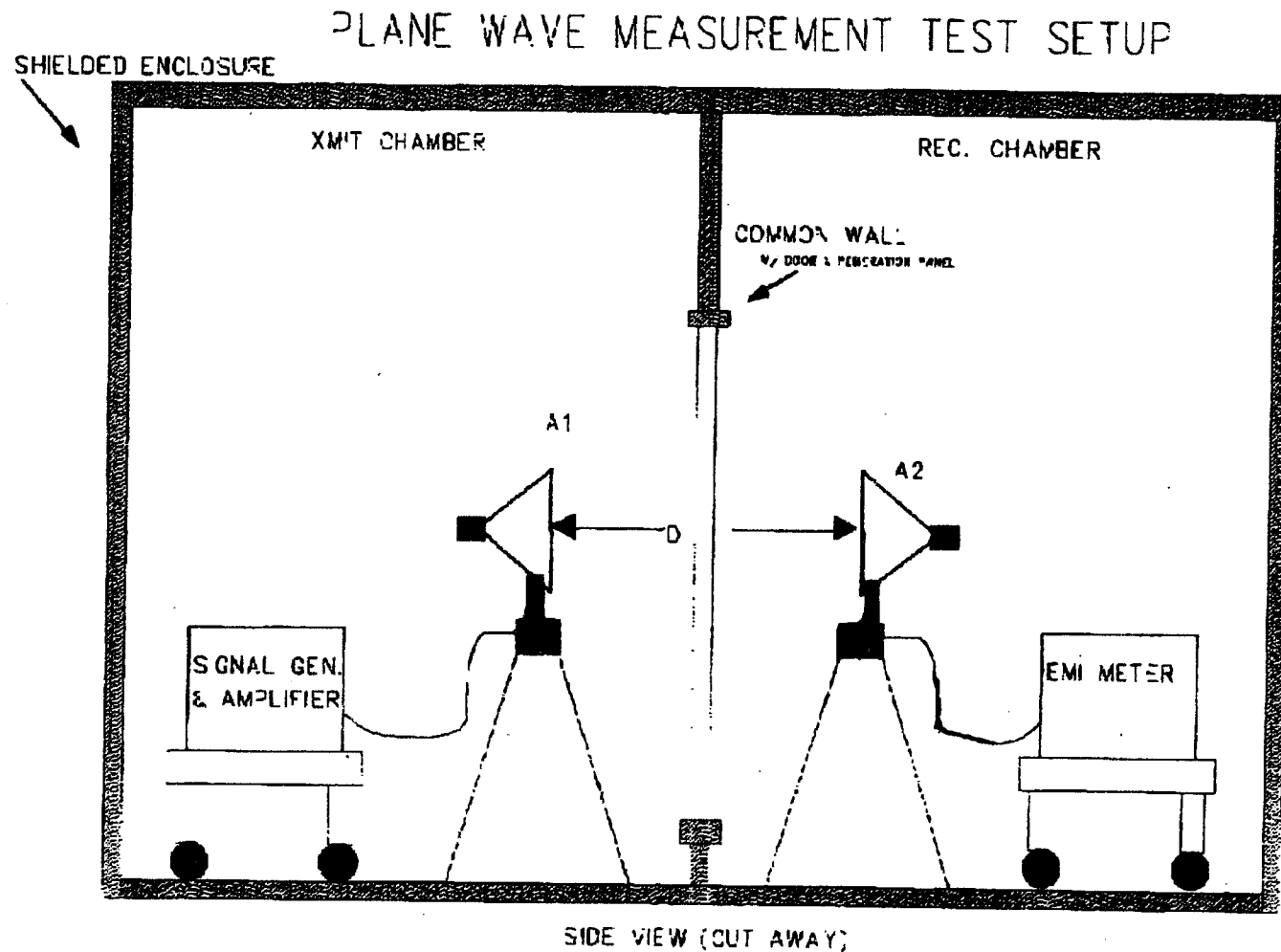


FIGURE SE0'-4 SHIELDING EFFECTIVENESS (1GHz, 3GHz  
 & 10GHz)

A1 & A2: Horn Antennas

D:  $\geq \lambda \text{m} \times 2$  where  $\lambda \text{m} = 300 / \text{frequency (MHz)}$

1P02-010  
 Page 17

FROM : LIBERTY BEL EMC/EMI CONSULTING PHONE NO. : 310 537 4235

P2

TP02-010

Page 18

## 11.0 TEST REPORT

Upon completion of this program a separate report, conforming to MIL-STD-883C, shall be issued. The approved test plan shall be included as an Appendix to the report. The report shall include a description of any EMI fixes or modifications determined necessary to enable test sample compliance with EMI requirements

APPENDIX A

FROM : LIBERTY BEL EMC/EMI CONSULTING    PHONE NO. : 310 537 4235

P25



**Liberty BEL**

**ENIC/ENI**

## Services

TP02-010  
FIGURE A-1  
Page 20

## ENGINEERING TEST DATA

### TYPE TEST SHIELDING EFFECTIVENESS

PAGE \_\_\_\_\_

Project VACUUM VALVE

**Cust. and No.**      **PACIFIC DESIGN TECH.**

Part No.

Specification LBEL TP02-010

Serial No.

### Test Order

Conducted by

Approved/Witnessed by \_\_\_\_\_

Date \_\_\_\_\_

Date \_\_\_\_\_

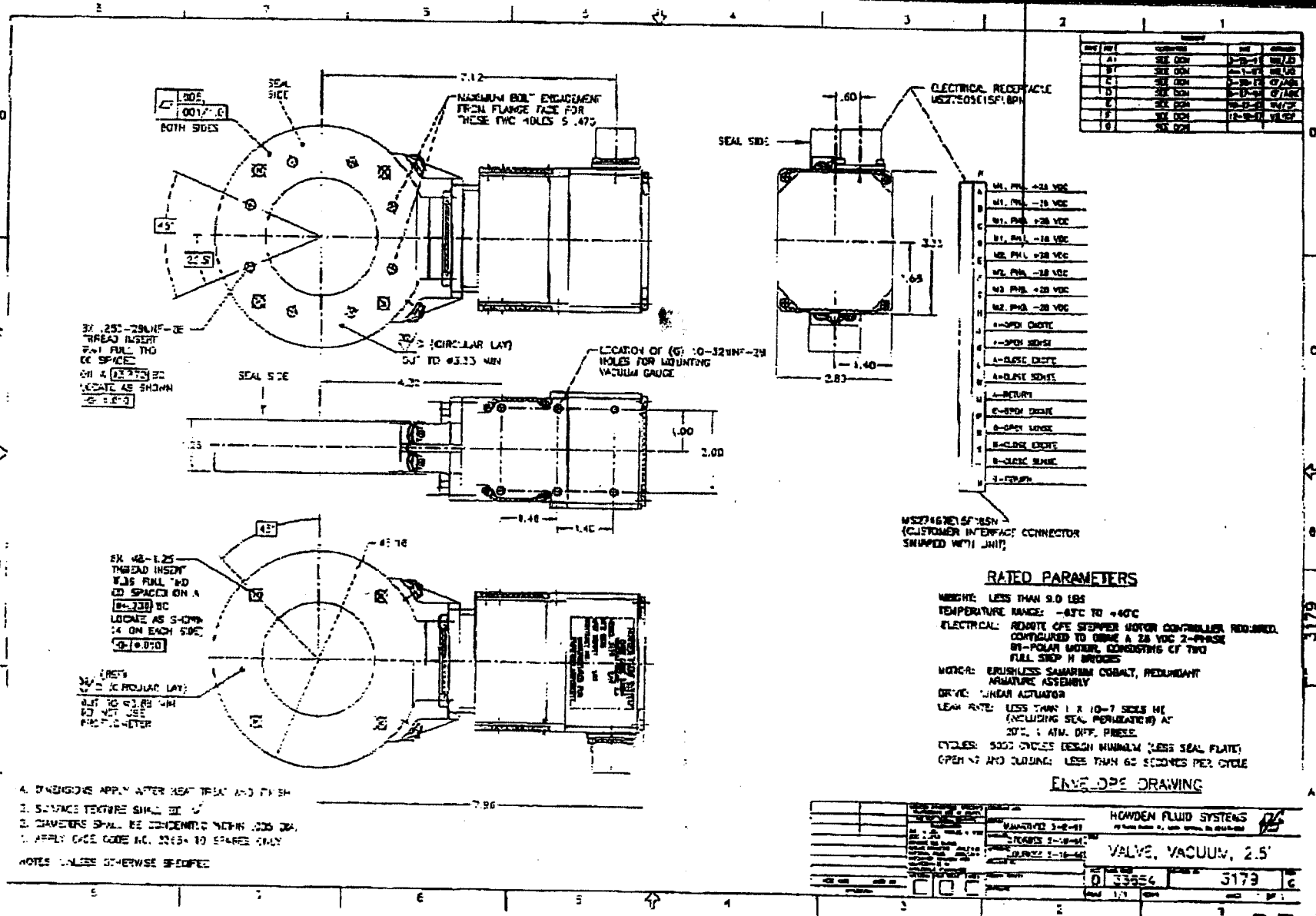
### Miscellaneous

[illegible]

• **U.S. DEPARTMENT OF COMMERCE**

26

| REV | NO | DATE  | BY    | CHK   |
|-----|----|-------|-------|-------|
| 1   | 1  | 10/02 | 10/02 | 10/02 |
| 2   | 2  | 10/02 | 10/02 | 10/02 |
| 3   | 3  | 10/02 | 10/02 | 10/02 |
| 4   | 4  | 10/02 | 10/02 | 10/02 |
| 5   | 5  | 10/02 | 10/02 | 10/02 |
| 6   | 6  | 10/02 | 10/02 | 10/02 |



TP02-010  
FIGURE A-2  
Page 21

27

Kx Date/Time

JUN-22-2002(SAT) 10:32

310 537 4235

P.027

FROM : LIBERTY BEL EMC/EMI CONSULTING PHONE NO. : 310 537 4235

P27

|   |   |   |   |   |   |   |   |   |    |    |    |
|---|---|---|---|---|---|---|---|---|----|----|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |

ELECTRICAL RECEPTACLE  
MS27505C13F18PN

|   |                  |
|---|------------------|
| A | U1, PWR, +28 VDC |
| B | U1, PWR, +28 VDC |
| C | U1, PWR, +28 VDC |
| D | U1, PWR, +28 VDC |
| E | U1, PWR, +28 VDC |
| F | U1, PWR, +28 VDC |
| G | U1, PWR, +28 VDC |
| H | U1, PWR, +28 VDC |
| I | A-CLOSE COIL     |
| J | A-OPEN COIL      |
| K | A-CLOSE COIL     |
| L | A-OPEN COIL      |
| M | A-RETURN         |
| N | B-OPEN COIL      |
| O | B-CLOSE COIL     |
| P | B-OPEN COIL      |
| Q | B-CLOSE COIL     |
| R | B-RETURN         |

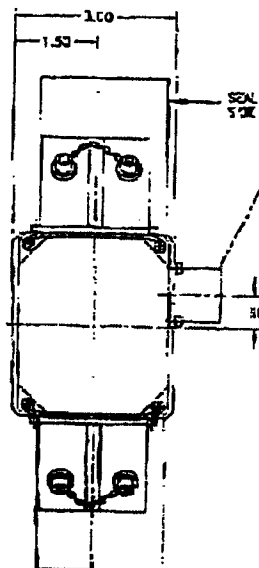
MS27462E15F1E5H  
(SHIPPED W/3 UNITS)

## ENVELOPE DRAWING

HOWDEN FLUID SYSTEMS

VALVE, VACUUM, 6"

D 33534 3225

TP02-010  
FIGURE A-3  
Page 22

## RATED PARAMETERS

WEIGHT: LIST MAX 16.0 LBS  
 TEMPERATURE RANGE: -80°C TO +40°C  
 ELECTRICAL: REMOTE ONE STOPPER MOTOR CONTROLLER REQUIRED.  
 DESIGNED TO DRIVE A 28 VDC 3-F-SEC  
 B-PHASE MOTOR, CONSUMING AT TWO  
 FULL STEP - 600000  
 MOTOR: BRUSHLESS SERVOMOTOR (C003), ADDITIONAL  
 WINDING ASSEMBLY  
 DRIVE: LINEAR ACTUATOR  
 LEAK RATE: LESS THAN 1 X 10<sup>-7</sup> SOCS HC  
 (MEASURING SEAL PERMEATION) AT  
 30°C AND 80% REL. HUM. PRESS  
 CYCLES: 5000 CYCLES DESIGN MINIMUM (LESS SEAL PLATE)  
 OPENING AND CLOSING: LESS THAN 60 SECONDS PER CYCLE

BY 7.265 THRU  
 1.500 T. 36  
 EQ SPACED ON A  
 37.275 EQ  
 LOCATE AS SHOWN  
 @ 1.012

0.085  
 0.017/1.0  
 BOTH SIDES

BY 1.012-1.50 THRU INSERT  
 7.265 THRU  
 LOCATE AS SHOWN  
 37.275 EQ  
 @ 1.012

1. DIMENSIONS APPLY AFTER POST TREAT AND FINISH
  2. SURFACE TEXTURE SHALL BE 1/4"
  3. DIMENSIONS SHALL BE CONCENTRIC WITH A DMS OR
  4. APPLY DMS DMS NO. 3345 TO SPARES ONLY
- NOTES: UNLESS OTHERWISE SPECIFIED

28

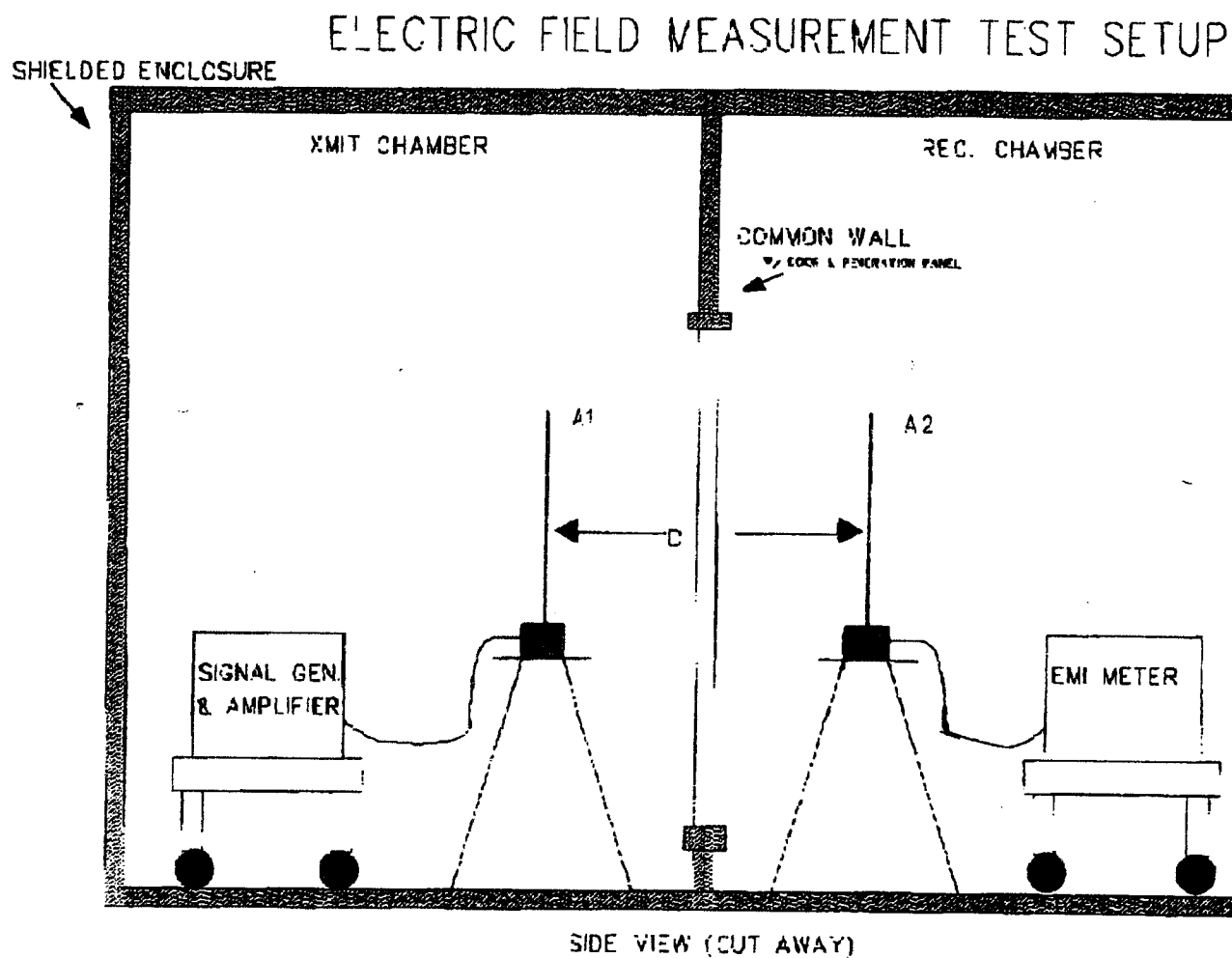


FIGURE SEQ1-2 SHIELDING EFFECTIVENESS (1MHz & 16MHz)

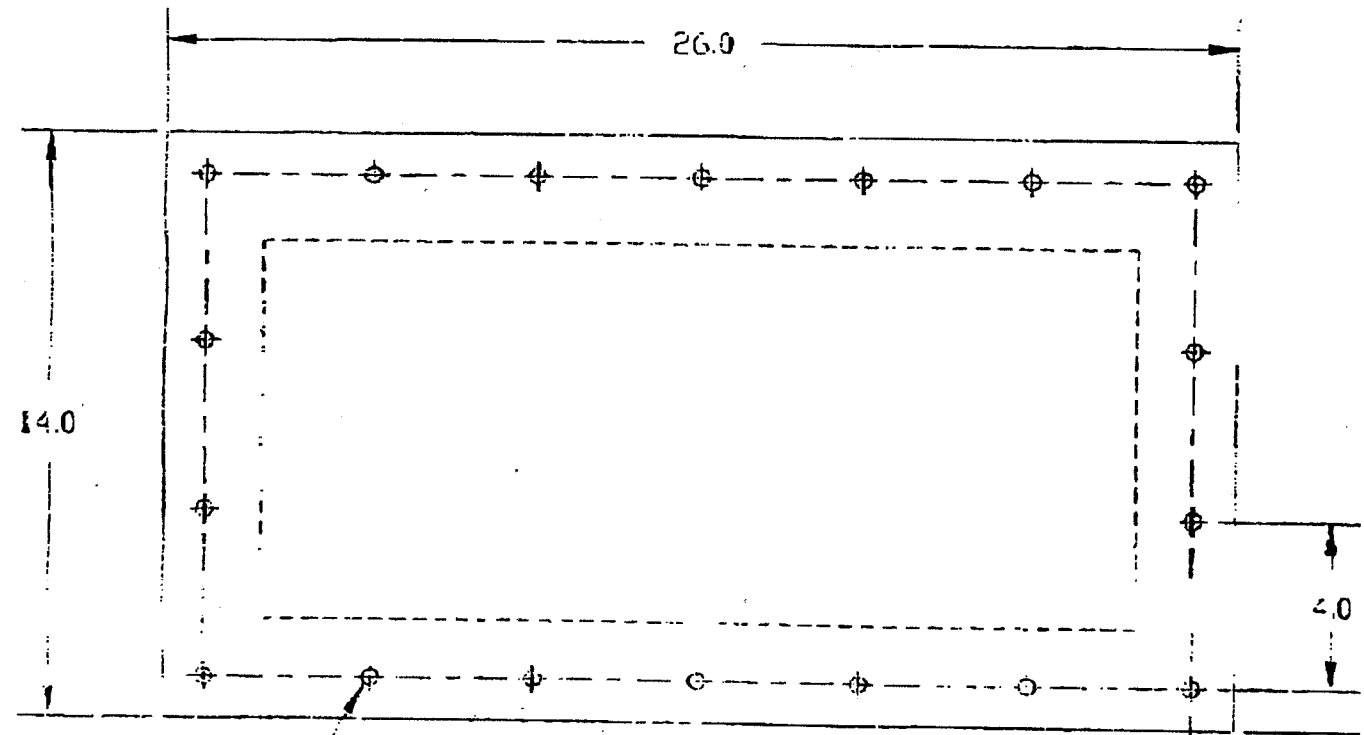
A1 & A2: Rod Antenna w/ Counterpoise  
 D: 26 INCHES

29

TP02-010  
 Page 15

**NOTES:**

1. DWG NOT TO SCALE.
2. ALL DIMENSIONS IN INCHES.
3. MAT'L: 3/8" THK. ALUMINUM
4. QTY: 1 EA.



**INTERFACE PLATE**

DRILL AND TAP FOUR  
1/4-20, X 18

**TP02-010**  
**FIGURE A-4**  
Page 23

|           |                 |
|-----------|-----------------|
| CUSTOMER  |                 |
| JOB NO.   |                 |
| DATE/REV. | 12-3-95, REV. A |
| PAGE      | 1 OF 1          |
| DRAWING   | FTP-1A.DWG, 126 |

30



**Liberty BEL EMC/EMI Services**  
**12811 S. Frailey Ave.**  
**E. Rancho Dominguez, CA 90221**  
**Phone: 310 537-4235**  
**Fax: 310 537-4235 (\*)**

**To: Kirt Dreher**

**From: Barry Leathers**

**Date: <sup>7</sup>8 July 02**

**Number of Pages: 1**

**Phone: (805) 961-9110**

**Fax: (805) 961-9120**

# FAX

**Remarks:**

*The following table lists the Shielding Effectiveness (SE) test results, you may need should Barry Mulfolder require preliminary information. I will begin work on the EMI test report and will be in contact with you on Monday, 8 July 02.*

| FREQ         | DYNAMIC RANGE | S.E.<br>BLANK<br>PLATE | 6" VALVE             |                       | 2.5" VALVE           |                       |
|--------------|---------------|------------------------|----------------------|-----------------------|----------------------|-----------------------|
|              |               |                        | S.E.<br>OPEN<br>FLAP | S.E.<br>CLOSE<br>FLAP | S.E.<br>OPEN<br>FLAP | S.E.<br>CLOSE<br>FLAP |
| (Hz)         | (dB)          | (dB)                   | (dB)                 | (dB)                  | (dB)                 | (dB)                  |
| 1 M (Vert)   | 89.2          | 88.4                   | 87.2                 | 87.9                  | 88.2                 | 87.6                  |
| 16 M (Vert)  | 91.6          | 89.6                   | 85.6                 | 85.8                  | 89.5                 | 90.2                  |
| 100 M (Vert) | 100           | 97                     | 78.7                 | 78.6                  | 82.5                 | 85.1                  |
| 100 M (Horl) | 100           | 97.8                   | 71.5                 | 74.5                  | 76.2                 | 79.2                  |
| 500 M (Vert) | 74            | 69.7                   | 42                   | 47                    | 62.6                 | 63.9                  |
| 1 G (Vert)   | 71.7          | 74.4                   | 12.8                 | 35.5                  | 58.5                 | 62.0                  |
| 3 G (Vert)   | 77.4          | 83.1                   | 7.4                  | 20.1                  | 12.3                 | 45.7                  |
| 3 G (Horl)   | 77.5          | 83.1                   | 0.7                  | 20.7                  | 11.8                 | 35.7                  |
| 10 G (Vert)  | 76.9          | 84.5                   | 7.8                  | 23.5                  | 13.2                 | 29.4                  |
| 10 G (Horl)  | 77.2          | 81.1                   | 0.5                  | 22.5                  | 5.5                  | 25.7                  |

31 of 31