CM#: FAST-PROC-115

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MAGNETIC TEST PROCEDURE FOR THE FAST SPACECRAFT

June 13, 1994

Goddard Space Flight Center
Greenbelt, Maryland

Attachment 14

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Table of Contents

1.0 PURPOSE

The purpose of this test is to characterize the magnetic field structure of the Fast Auroral SnapshoT (FAST) Spacecraft. Data collected will be used to determine spacecraft compliance with the SMEX-FAST " Magnetic Contamination and EMI/EMC Control and Implementation Plan" (FAST-SPEC-012).

2.0 APPLICABLE DOCUMENTS

The following documents form part of this procedure to the extent specified herein. In the case of conflict, the information presented in this procedure shall take precedence.

a. SPACECRAFT MAGNETIC TEST FACILITY(ATTITUDE CONTROL TEST FACILITY) SMTF (ACTF), NASA Document X-754-83-9

b. SPACECRAFT MAGNETIC TEST FACILITY OPERATING PROCEDURE, NSI Document 12-01-403

c. SMEX-FAST EMI/EMC AND MAGNETIC TEST PLAN

d. SMEX-FAST MAGNETIC CONTAMINATION AND EMI/EMC CONTROL AND IMPLEMENTATION PLAN, FAST-SPEC-012 Rev. A

3.0 TEST FACILITIES

The measurements will be conducted at the GSFC Spacecraft Magnetic Test Facility (SMTF), building 305. The SMTF contains a 13 meter coil system capable of nulling the ambient geomagnetic field to zero, with a uniformity of 0.001% within a spherical volume of two meters in diameter. The facility also contains the following additional equipment used for testing:

1- Helmholtz perm-deperm coil system, 2.9 meter diameter
1- Helmholtz perm-deperm coil system, 1.5 meter diameter
3- Fluxgate magnetometers
1- Dynamic Signal Analyzer, Hewlett Packard model HP 3562A
1- Proton magnetometer, Varian model 4931
1- Data Acquisition & Analysis System, Hewlett Packard 87 microcomputer
1- Ea. dolly, turntable, & S/C mounting fixtures
2- Power Supplies for perming & deperming (DC. & 60 Hz)

4.0 General Requirements

4.1 Contamination Control

Class 100,000 Clean Room conditions shall be maintained in the Spacecraft Magnetic Test Facility for the duration of the FAST Spacecraft magnetics test. The SMTF HEPA filter system fans shall be operated for a minimum of three days prior to the arrival of the FAST Spacecraft at the SMTF.

4.2 ESD Control

The FAST Spacecraft contains ESD sensitive components. ESD preventative measures will therefore be used before and during the magnetic test in order to prevent any damage to spacecraft systems.

4.3 Changes to Test Procedure

The Magnetic Test Procedure presented herein may be modified as necessary at the discretion of the cognizant test engineer. All changes to this procedure shall be annotated in the margins of the master copy. All changes shall be initialed and dated by the code 754 Test Engineer and an authorized Project Representative.

4.4 Responsibilities

4.4.1 Code 754.2/NSI Responsibility

Code 754.2/NSI shall provide the equipment and personnel needed to conduct the magnetic test of the FAST SPACECRAFT. Code 754.2/NSI shall be responsible for operating and monitoring all test equipment needed for this test. Code 754.2 shall provide documentation of the tests including photographs of the test setups and a test report. The test conductor shall be a designated representative of Code 754.2.

4.4.2 Code 740 Responsibilities

Code 740 is responsible for the handling and operation of the FAST Spacecraft during the Magnetics Test. Code 740 shall designate a Test Director who shall be the single point of contact with code 754.

5.0 TEST SEQUENCE

The FAST Spacecraft magnetic test sequence shall be performed as indicated in the table below.

Test	Spacecraft Operating Mode	Spacecraft Power Source
Initial perm	off	none
post deperm	off	none
post deperm	normal mode w/ instruments on	solar array connectors
post deperm	normal mode w/ instruments & transmitter on	solar array connectors
post deperm	normal mode w/ instruments on	battery
post deperm	normal mode w/ instruments on & battery charging	solar array connectors
post deperm	normal mode w/ instruments & ACS sensors off	battery
post deperm	normal mode w/ instruments & ACS sensors off	battery & solar array connectors

An array of 60 compact florescent lamps will be used for tests where spacecraft power will be supplied by the spacecraft solar arrays.

6.0 TEST PROCEDURE

6.1 TEST SETUP

6.1.1 Set up three triaxial magnetometers on a north horizontal line passing through the center of the facility coils. Position the three magnetometer probes 1.0 meters, 1.5 meters and 2.0 meters from the center of the facility coils respectively.

6.1.2 Energize all test instrumentation and adjust the coil currents until zero field (<1.0 nT) is established inside the facility coil system.

6.1.3 Align the magnetometer probes to the coil system axes.

6.1.4 Perform an end-to-end data system calibration.

6.1.5 Perform a dry run magnetic mapping of the facility test dolly to ensure that no magnetic materials are present on the facility test dolly.

6.2 PERMANENT MAGNETIZATION

6.2.1 Initial Perm

6.2.1.1 Position the spacecraft outside the coil system on the facility test dolly.

6.2.1.2 Perform the initial background measurements.

6.2.1.3 Roll the spacecraft into the center of the test facility coils and note spacecraft orientation with respect to facility axes.

6.2.1.4 Rotate the table 360 degrees in azimuth and acquire the triaxial magnetic field data at each 10 degree increment of rotation.

6.2.1.6 Roll the spacecraft to the outside of the test facility coil system.

6.2.1.7 Perform the final background measurement.

Note: At this time the data collection and analysis program will start reducing the data and calculating the three axial dipole moments.

6.2.2 5 Gauss Deperm

After completing the initial perm measurement sequence, the item is demagnetized by exposure to a 5 Gauss diminishing sinusoidal magnetic field. Once the deperm sequence is completed, post deperm measurements are performed in an identical manner to those of the initial perm measurements (steps 6.2.1.1 to 6.2.1.7).

7.0 TEST LIMITS

The magnetic test limits for the FAST Spacecraft are :

Initial Perm - 4 nT maximum field @ 1 meter

Post Deperm - 2 nT maximum field @ 1 meter

8.0 ADDITIONAL TESTING

Trimming and calibration of the ACS magnetometer and alignment of the science fluxgate magnetometer will also take place at the Spacecraft Magnetic Test Facility. A separate procedure will be developed by code 740 to cover these tests.

NSI Technology Services Corporation

A Subsidiary of
ManTech International Corporation

Memorandum

To: D. R. Mitchell/754.2

From: P. K. Harris

Subject: FAST Spacecraft Magnetic Measurements

Date: July 15, 1994

Copies: T. Cesko/NSI
C. A. Harris/NSI
D. H. Orbock/NSI

In reply refer to:

Introduction

Magnetic testing was performed on the Fast Auroral SnapshoT (FAST) Spacecraft from June 20 through July 1, 1994, in accordance with GSFC Document 7542-87-94, "Magnetic Test Procedure for the FAST Spacecraft."

Test Description

On June 22-25, magnetic field mappings were performed on the FAST Spacecraft in the Spacecraft Magnetic Test Facility (SMTF) at the Magnetic Test Site to characterize the magnetic field structure of the spacecraft. The initial perm, post 5 Gauss (5.0×10^5 nT) deperm, and DC stray magnetic field states of the spacecraft were measured at magnetometer distances of 1.0, 1.5, and 2.0 meters. Figure 1 shows the spacecraft on the spacecraft dolly in the center of the facility coils with the facility magnetometer probes visible. Figure 2 shows the spacecraft inside the facility deperming coils.

The SMTF was also utilized for trimming and calibration of the FAST ACS magnetometer and alignment of the FAST science fluxgate magnetometer. Figure 3 shows the FAST Spacecraft in the center of the coils with one of the magnetometer booms extended. In addition, calibrations were performed on the FAST Torque Coils.

Test Results

The resulting dipole moments measured in $mA\text{-}m^2$ ($Gauss\text{-}cm^3$) for the FAST Spacecraft are presented in Table 1. Table 2 gives a brief description of the conditions under which each test run was performed. Figure 4 shows the solar simulator setup for test run FSS/1.

Since calibration and alignment of the FAST magnetometers were performed by Code 740, the data from these tests are not provided in this report.

Table 3 shows the dipole moments measured in A-m^2 (10^3 Gauss-cm^3) for the calibration of the two FAST Torque Coils. Test runs F/C-2 through F/C-13 are from the first torque coil with F/C-2 through F/C-7 showing decreasing field strength and F/C-8 through F/C-13 showing decreasing field strength with the field in the reverse direction. Test runs F/C-14.1 through F/C-25 are from the second torque coil with F/C-14.1 through F/C-19 showing decreasing field strength and F/C-20 through F/C-25 showing decreasing field strength with the field in the reverse direction. The dipole moments measured were in agreement with the torque coil specifications provided by the FAST project personnel.

The complete test data (except for the torque coils calibration) are provided in the attached computer printouts (Attachments 1-13). Attachments 1 and 2 show that the FAST Spacecraft exceeds the magnetic test limits of 4 nT at 1 meter for the initial perm measurement and 2 nT at 1 meter for the post deperm measurement. These test limits are specified in GSFC 7542-87-94, which is included as Attachment 14.

P. K. Harris
Magnetics Engineer

PKH/pkh

Table 1. FAST S/C Magnetic Dipole Moments in mA-m^2

Run	Magnetization	M_X	M_Y	M_Z	M_T
F/1	Initial Perm	-139.6	82.3	-73.4	177.9
F/2	Post Deperm	-72.3	51.7	-27.9	93.1
F/3	Perm - Stray	-109.5	64.1	25.2	129.4
F#1	Perm + Stray	-135.1	109.2	70.2	187.4
F#2	Perm + Stray	-147.5	9.1	50.0	156.0
F#3	Perm + Stray	-147.4	121.9	23.4	192.7
F#4	Perm + Stray	-137.2	108.1	54.9	183.1
F#5	Perm + Stray	-115.3	102.1	65.3	167.3
F#6	Perm + Stray	-123.2	135.6	36.5	186.8
F#7	Perm + Stray	-157.9	131.1	59.1	213.5
F#8	Perm + Stray	-144.4	117.7	51.7	193.3
F#9	Perm + Stray	-143.3	118.5	44.2	191.1
FSS/1	Perm + Stray	-75.3	80.2	8.1	110.3

Table 2. FAST S/C Test Description

Run	Magnetization	Description
F/1	Initial Perm	Spacecraft power off.
F/2	Post Deperm	Spacecraft power off.
F/3	Perm - Stray	Spacecraft power off w/ GSE connected.
F#1	Perm + Stray	Spacecraft in normal mode w/ instruments on (1.4 A lower shunt current).
F#2	Perm + Stray	Spacecraft in normal mode w/ instruments & transmitter on (4.2 A umbilical current w/ same shunt current).
F#3	Perm + Stray	Spacecraft in normal mode w/ instruments & transmitter on (3.2 A umbilical current w/ drop in shunt current).
F#4	Perm + Stray	Spacecraft in normal mode w/ instruments on (side B upper shunt current).
F#5	Perm + Stray	Spacecraft in normal mode w/ instruments on (battery power -1.8 A).
F#6	Perm + Stray	Spacecraft in normal mode w/ instruments on (battery charging 1.4 A).
F#7	Perm + Stray	Post TQ spin coil on/off (battery charging).
F#8	Perm + Stray	Post TQ spin coil on/off (reverse direction & half field strength).
F#9	Perm + Stray	Post precession coil (vertical) on/off.
FSS/1	Perm + Stray	Spacecraft in normal mode w/ instruments & ACS sensors off (solar simulator illuminated).

Note: For stray field measurements, background taken with S/C in center of coils.

Table 3. FAST S/C Torque Coils Calibration Dipole Moments in A-m^2

Run	M_X	M_Y	M_Z	M_T
F/C-1	-8.4	10.6	3.2	13.9
F/C-2	-77.5	54.3	-3.5	94.7
F/C-3	-20.7	78.1	-3.0	80.8
F/C-4	-28.3	61.1	-2.5	67.4
F/C-5	-17.0	36.6	-1.5	40.4
F/C-6	-5.7	12.2	-0.5	13.5
F/C-7	-0.1	0.1	0.0	0.1
F/C-8	39.4	-85.7	3.6	94.4
F/C-9	33.7	-73.4	3.1	80.8
F/C-10	28.1	-61.1	2.5	67.3
F/C-11	16.8	-36.6	1.5	40.3
F/C-12	5.5	-12.1	0.5	13.3
F/C-13	-0.1	0.1	0.0	0.1
F/C-14.1	-0.2	0.4	85.1	85.1
F/C-15	-0.1	0.5	72.6	72.6
F/C-16	0.1	0.3	60.3	60.3
F/C-17	0.0	0.1	37.7	37.7
F/C-18	-0.1	0.1	12.3	12.4
F/C-19	0.0	0.2	-0.6	0.6
F/C-20	0.1	-0.1	-83.4	83.4
F/C-21	0.2	-0.2	-71.0	71.0
F/C-22	0.2	-0.2	-61.9	61.9
F/C-23	-0.1	-0.1	-36.2	36.2
F/C-24	0.1	0.2	-12.1	12.1
F/C-25	-0.3	0.2	-0.5	0.6

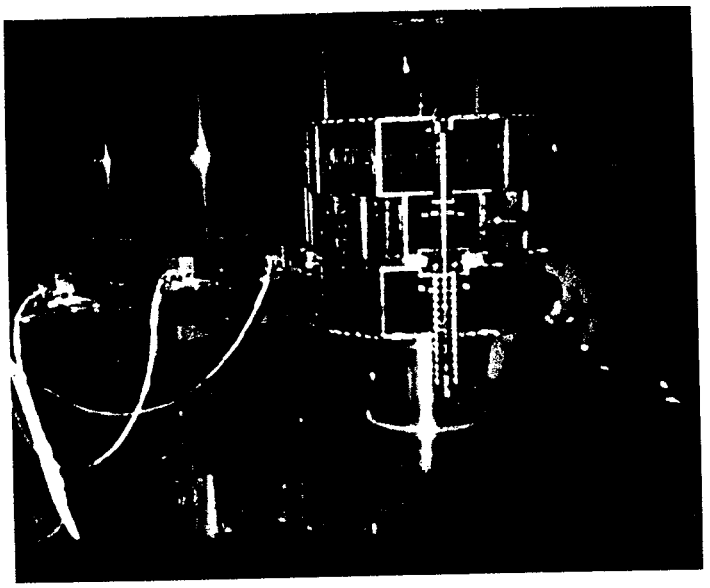

Figure 1
EAST S/C in Center of Coils with Magnetometers Visible

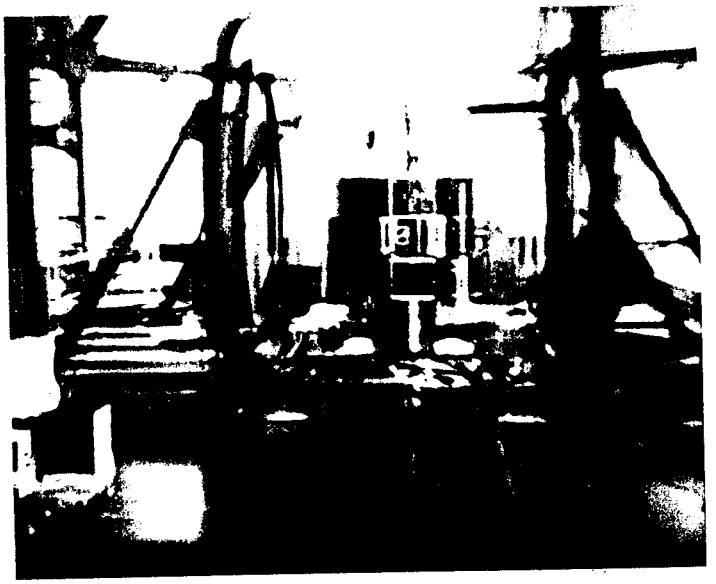

Figure 2
EAST S/C Inside Compensating Coils

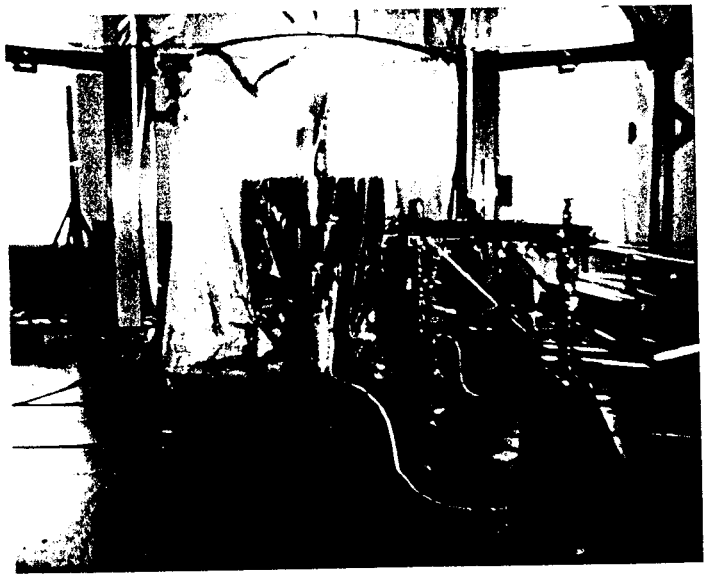

Figure 3
S/C with Magnetometer Boom Extended

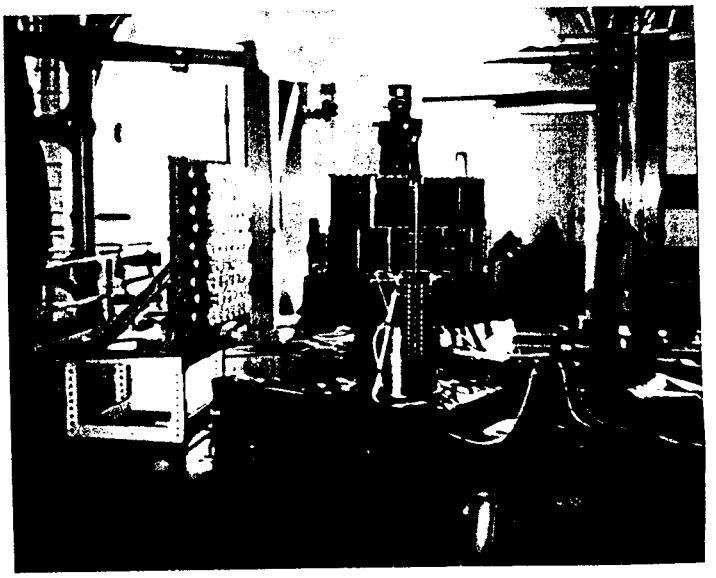

Figure 4
Solar Simulator Setup

FAST S/C F/1 DATE:06/22/94

MAGNETIZATION PROBE DISTANCE IN METERS

INIT. PERM PROBE 1= 1 : PROBE 2= 1.5 : PROBE 3= 2

MAGNETIC FIELD IN NANOTESLA

ANGLE	X1	Y1	Z1	X2	Y2	Z2	X3	Y3	Z3
DATA SCANS									
0	-8.5	-25.3	2.9	-5.3	-4.9	1.8	-2.8	-1.0	.8
10	-.3	-17.3	6.0	-3.3	-4.5	2.3	-2.6	-1.3	1.3
20	3.2	-11.4	7.5	-1.4	-3.9	2.7	-2.1	-1.3	1.3
30	4.7	-7.6	8.2	-.7	-3.0	2.8	-1.5	-1.1	1.1
40	5.8	-5.0	9.1	.6	-2.7	2.3	-1.0	-.9	.6
50	5.5	-3.3	9.2	.7	-2.2	2.7	-.7	-.7	.9
60	5.1	-2.4	9.9	1.7	-2.2	1.9	-.6	-.8	.9
70	3.6	-1.8	9.7	1.7	-1.8	2.8	-.3	-.8	.8
80	2.5	-2.4	9.0	1.8	-1.8	2.9	0.0	-.8	1.4
90	3.1	-4.4	9.9	2.0	-1.8	3.4	0.0	-.7	1.0
100	6.4	-6.2	11.2	2.4	-1.9	3.3	.4	-.9	1.3
110	9.8	-5.7	13.3	3.0	-1.7	3.5	.6	-.8	1.5
120	11.0	-4.5	16.6	3.8	-2.1	4.2	.9	-.8	1.3
130	12.3	-5.7	19.1	4.7	-2.1	4.5	1.1	-.7	1.3
140	15.5	-8.3	21.0	5.2	-2.3	4.0	1.4	-.9	.9
150	23.4	-11.5	23.2	6.1	-1.8	5.2	1.4	-.7	1.9
160	33.6	-10.5	26.1	7.0	-1.1	4.9	1.8	-.4	1.8
170	43.1	-3.9	29.8	8.3	-.5	5.2	1.8	-.3	1.5
18	42.3	10.0	30.2	8.0	1.2	4.3	1.7	.3	1.3
19	26.9	19.7	26.5	7.3	1.8	5.4	1.5	.3	2.3
200	12.5	16.5	19.9	5.6	2.3	3.8	1.2	.6	1.6
210	10.2	7.1	15.3	4.6	2.1	2.8	.6	.7	1.6
220	15.0	3.1	10.1	4.1	2.3	2.8	.2	1.2	1.2
230	16.3	6.1	3.6	2.7	2.0	1.5	-.3	1.1	1.1
240	13.6	10.8	-1.4	2.4	3.2	1.0	-.8	1.4	.6
250	7.0	13.8	-3.9	1.0	3.4	.9	-1.2	1.2	.9
260	.4	15.6	-2.5	-.6	3.8	.7	-1.8	1.1	.5
270	-6.3	17.8	-1.7	-2.1	4.2	.9	-1.3	1.2	.5
280	-13.2	21.8	-1.8	-2.2	4.8	.6	-1.2	1.4	.6
290	-27.4	28.2	-3.8	-4.7	4.7	.9	-2.1	1.0	.5
300	-49.8	30.7	-8.4	-7.7	3.7	.6	-2.8	.7	.3
310	-73.6	22.6	-14.0	-9.9	2.4	.3	-3.2	.5	.7
320	-83.3	1.8	-16.7	-11.8	.3	.1	-3.3	.1	.7
330	-70.9	-22.6	-14.5	-11.4	-2.7	.7	-3.1	-.9	.8
340	-46.5	-34.7	-8.4	-9.6	-4.6	1.4	-2.9	-1.6	.9
350	-22.8	-33.7	-2.1	-6.7	-5.5	1.7	-2.3	-1.7	.6

DIPOLE MOMENTS IN GAUSS-CM^3

X	Y	Z	T
-139.6	82.3	-73.4	177.9

FAST S/C F/2 DATE:06/22/94

MAGNETIZATION PROBE DISTANCE IN METERS

POST PERM PROBE 1= 1 : PROBE 2= 1.5 : PROBE 3= 2

MAGNETIC FIELD IN NANOTESLA

ANGLE	X1	Y1	Z1	X2	Y2	Z2	X3	Y3	Z3
DATA SCANS									
0	.7	-18.3	1.2	-2.4	-7.5	1.1	-.3	-1.8	.3
10	4.0	-13.6	4.0	-.7	-7.4	1.7	.2	-1.7	.6
20	4.9	-3.0	4.5	0.0	.6	1.7	.2	.6	.7
30	4.2	2.1	5.0	.7	4.1	1.8	.8	1.5	.8
40	4.8	1.5	6.1	1.5	2.8	1.4	1.2	1.0	.6
50	5.8	-7.4	5.1	.7	-5.1	1.5	1.0	-1.4	.5
60	7.0	-6.9	5.8	1.4	-5.0	1.6	1.5	-1.3	.6
70	8.7	-7.0	6.4	3.1	-4.7	1.9	1.8	-1.3	.8
80	10.7	-5.8	5.1	2.9	-4.6	.9	2.3	-1.3	.8
90	11.1	-4.5	5.8	2.8	-4.3	1.6	2.1	-1.3	.8
100	10.5	-2.8	6.5	2.8	-4.3	1.6	2.1	-1.3	.8
110	8.6	-2.1	8.1	2.5	-3.5	2.0	2.0	-1.2	.9
120	8.2	-1.9	9.7	3.4	-4.1	3.0	2.6	-1.2	1.0
130	6.4	-2.5	10.2	3.7	-4.0	2.3	2.5	-1.2	1.2
140	5.5	-4.0	12.5	2.8	-4.7	2.7	1.2	-1.3	.3
150	6.8	-5.8	12.6	3.0	-4.9	1.6	1.4	-1.4	.7
160	8.4	-3.2	12.7	2.3	-1.5	2.7	1.4	-.5	1.2
170	10.9	-2.2	13.2	3.0	-1.4	3.2	1.2	-.4	1.0
18	11.9	-2.0	14.2	3.7	-2.3	2.9	2.0	-.5	1.4
19	10.0	-2.2	13.1	2.4	-2.7	2.4	1.5	-.8	.7
200	11.5	-6.3	13.3	3.1	-4.9	2.3	1.6	-1.4	.7
210	15.1	-8.2	11.8	3.7	-4.3	1.6	1.8	-1.3	.1
220	20.8	-6.3	7.5	2.9	-4.0	1.2	1.6	-1.2	.5
230	22.2	-.2	.3	2.7	-3.2	.3	1.4	-1.2	-.4
240	18.4	6.2	-3.8	2.8	-2.3	.6	.9	-1.1	.2
250	10.0	8.9	-6.8	1.2	-1.7	.2	.7	-1.0	.5
260	3.1	9.7	-6.4	.7	-1.5	-.3	.1	-1.1	-.1
270	-5.8	18.7	-6.3	-2.4	6.1	-.4	-.5	1.3	.1
280	-13.0	20.3	-5.5	-2.5	6.9	0.0	-.8	1.3	-.3
290	-24.5	22.2	-6.8	-5.0	6.4	-.1	-1.8	1.3	-.1
300	-38.6	19.8	-9.4	-6.7	5.4	.4	-2.2	1.2	-.2
310	-50.2	11.4	-12.7	-7.3	4.2	-.7	-1.6	1.1	.2
320	-50.1	-3.2	-13.3	-6.3	2.5	.1	-1.4	1.0	-.1
330	-38.2	-15.8	-10.4	-5.7	1.2	.5	-1.2	.9	-.2
340	-21.0	-20.1	-6.0	-5.3	.1	.7	-.9	.8	.5
350	-7.5	-16.2	-2.1	-3.3	.5	.9	.1	.7	.3

DIPOLE MOMENTS IN GAUSS-CM^3

X	Y	Z	T
-72.3	51.7	-27.9	93.1

FAST S/C F/3 DATE:06/22/94

MAGNETIZATION PROBE DISTANCE IN METERS

PE - STRAY PROBE 1= 1 : PROBE 2= 1.5 : PROBE 3= 2

MAGNETIC FIELD IN NANOTESLA

ANGLE	X1	Y1	Z1	X2	Y2	Z2	X3	Y3	Z3
DATA SCANS									
0	-4.7	-5.5	2.7	-.9	-.1	0.0	.1	-.1	-.3
10	4.4	7.5	-2.5	2.1	.7	.1	.9	0.0	.2
20	7.2	15.0	-2.0	3.5	1.3	-.4	1.6	.2	.3
30	8.3	18.5	-2.8	4.6	1.8	.2	1.8	.1	.7
40	9.1	19.5	-2.0	5.6	2.5	0.0	2.5	.3	-.2
50	10.4	19.7	-1.6	5.6	2.5	0.0	2.3	.5	.6
60	11.8	19.6	-1.8	6.6	2.8	.8	3.0	.5	.3
70	13.9	19.7	-2.1	7.0	3.1	.6	2.8	.6	.6
80	16.1	21.2	-1.5	7.6	3.4	.5	3.2	.6	.2
90	16.1	22.9	-1.9	7.5	3.6	1.1	2.7	.8	.4
100	15.9	24.4	-2.2	7.6	3.7	-.2	3.1	.8	.8
110	14.7	25.3	-1.3	7.8	4.1	.7	3.1	1.0	.5
120	12.3	25.5	.2	6.4	4.0	.6	1.8	.8	.5
130	11.0	25.7	.6	6.7	5.0	.7	1.7	1.2	.5
140	11.6	24.6	2.2	6.8	4.3	1.0	2.1	1.3	.1
150	12.2	23.6	2.1	6.5	4.4	.3	1.9	1.4	.6
160	15.5	23.0	3.8	7.9	4.2	1.6	3.1	1.3	.7
1	17.4	24.0	4.0	7.6	4.3	2.1	3.0	1.3	1.0
1	17.2	25.4	4.7	7.9	4.7	1.0	3.0	1.4	1.1
190	17.3	25.6	3.9	8.3	5.0	1.0	3.3	1.5	.3
200	17.4	23.9	4.1	8.1	4.6	1.7	3.1	1.6	.5
210	21.3	22.3	3.1	8.4	5.3	.1	3.1	1.8	.8
220	27.3	23.9	-.6	8.4	6.1	-.3	2.8	2.0	.2
230	27.7	29.2	-6.2	7.3	5.9	-.6	1.4	2.0	.5
240	23.7	35.9	-12.4	7.4	7.2	-.8	2.3	2.3	-.1
250	16.1	39.0	-15.2	6.7	7.5	-1.8	1.9	2.6	-.2
260	8.8	40.3	-14.2	5.0	8.0	-1.3	1.3	2.7	0.0
270	.7	41.7	-13.6	3.2	8.8	-1.6	.6	2.8	-.3
280	-8.2	43.4	-13.3	.9	8.8	-1.6	-.8	2.7	-.4
290	-19.4	46.6	-15.1	-.7	8.8	-1.9	-.6	2.8	-.1
300	-34.5	47.7	-17.3	-3.3	8.6	-1.9	-1.4	2.3	-.5
310	-49.0	43.4	-17.6	-5.1	6.7	-1.7	-1.8	2.1	.2
320	-59.6	35.9	-11.4	-6.9	6.1	-1.5	-2.2	1.6	-.3
330	-65.4	24.6	4.2	-7.8	4.1	-.7	-2.5	1.0	0.0
340	-56.8	3.9	21.9	-6.5	1.7	-.5	-1.6	.6	.3
350	-29.2	-13.2	19.2	-4.5	.8	-.5	-1.0	.2	-.3

DIPOLE MOMENTS IN GAUSS-CM^3

X	Y	Z	T
-109.5	64.1	25.2	129.4

FAST S/C F#1 DATE:06/22/94

AGNETIZATION PROBE DISTANCE IN METERS

ERN STRAY PROBE 1= 1 : PROBE 2= 1.5 : PROBE 3= 2

MAGNETIC FIELD IN NANOTESLA

NGLE	X1	Y1	Z1	X2	Y2	Z2	X3	Y3	Z3
ATA SCANS									
0	-6.0	6.3	-.1	-.8	6.4	-.9	.7	2.8	.2
10	1.2	17.9	-8.5	.9	6.8	-2.1	.5	2.0	-.1
20	4.6	22.5	-8.3	2.4	6.9	-1.5	.7	1.5	.3
30	8.9	18.1	-7.1	4.6	1.6	.4	1.6	.7	.2
40	14.1	16.4	-6.8	7.1	1.6	.7	3.3	.7	.5
50	21.8	15.8	-6.5	8.8	1.5	.7	4.1	1.0	-.4
60	28.8	16.7	-4.5	11.0	1.8	1.3	5.1	1.0	.4
70	35.0	18.9	-5.9	12.0	2.0	1.8	5.5	1.2	.3
80	37.6	23.5	-6.2	11.2	3.8	-.4	4.6	1.8	-.4
90	41.2	27.7	-4.7	13.4	4.2	.4	5.0	2.1	.5
100	38.8	31.1	-5.5	12.8	5.2	1.3	4.9	2.3	.9
110	36.2	34.1	-3.8	12.8	6.1	-.1	5.1	2.5	.3
120	33.9	35.3	-2.3	13.1	5.5	.1	5.0	2.3	1.1
130	30.9	35.8	-1.7	12.5	6.1	.8	5.3	2.4	.9
140	30.1	35.2	-1.7	11.8	6.5	-.7	5.0	2.7	.9
150	29.2	34.6	-.6	12.0	6.6	1.2	4.3	2.8	.4
160	29.6	34.5	-1.3	11.4	6.9	1.1	4.6	2.9	1.3
170	30.7	35.0	-1.7	11.7	6.8	.8	4.7	2.9	1.0
180	29.9	36.2	-2.9	10.9	6.8	1.1	4.0	3.0	.3
190	27.2	36.4	-5.2	10.2	7.1	-.1	3.8	3.0	1.3
200	27.1	34.9	-6.1	10.5	7.4	1.6	3.7	3.0	.8
210	28.9	33.6	-5.3	9.5	7.2	.2	3.9	3.2	-.1
220	28.8	35.3	-6.4	9.1	7.3	-.6	3.4	3.2	.6
230	26.6	38.7	-8.6	8.8	7.6	-.5	2.9	3.3	-.4
240	21.0	41.7	-11.5	8.1	8.1	-1.2	2.4	3.3	.6
250	15.7	43.0	-11.7	6.9	8.5	-1.2	2.1	3.6	-.1
260	11.1	44.1	-12.7	5.8	8.8	-.4	1.3	3.6	-.2
270	4.5	46.6	-12.6	3.9	9.1	-.7	1.5	3.5	-.2
280	-3.8	49.4	-15.6	3.4	9.4	-2.2	.2	3.4	-.6
290	-15.2	52.8	-18.7	-.1	9.4	-1.4	-.3	3.6	-.3
300	-29.9	54.1	-21.1	-1.7	8.9	-1.1	-1.1	3.3	-1.1
310	-46.5	56.2	-22.9	-4.4	7.3	-1.7	-1.7	3.3	-1.1
320	-57.3	48.5	-18.6	-6.0	7.0	-.9	-1.9	3.3	-1.0
330	-63.5	37.2	-2.0	-7.0	6.8	-.8	-2.1	3.4	-.6
340	-56.6	16.2	15.2	-6.4	6.6	-.7	-1.7	3.8	.4
350	-29.3	-2.6	14.7	-3.8	6.5	.7	-1.2	3.9	-.1

DIPOLE MOMENTS IN GAUSS-CM^3

X	Y	Z	T
-135.1	109.2	70.2	187.4

FAST S/C F#2 DATE:06/22/94

MAGNETIZATION PROBE DISTANCE IN METERS

PERM + STRAY PROBE 1= 1 : PROBE 2= 1.5 : PROBE 3= 2

MAGNETIC FIELD IN NANOTESLA

ANGLE	X1	Y1	Z1	X2	Y2	Z2	X3	Y3	Z3
DATA SCANS									
0	-3.0	-1.3	2.0	-1.7	.2	.4	-.2	-.7	.4
10	-2.8	-1.6	.5	0.0	.1	.3	.2	-.8	.3
20	-3.5	-1.4	1.4	-1.4	-.1	.3	-.4	-.7	.2
30	-1.9	-2.0	2.0	-.6	-.9	.8	.3	-.6	-.2
40	-1.6	-2.0	1.0	-.6	-.6	.9	.3	-.6	.3
50	-1.6	-1.6	2.3	-.3	-.5	.9	.5	-.4	.2
60	9.0	12.8	-5.6	3.2	-.2	.4	1.8	-1.2	.1
70	11.8	13.9	-6.0	4.4	.9	-.1	2.2	-1.1	.7
80	17.9	12.5	-4.4	7.5	.9	1.1	3.0	-1.1	1.1
90	25.4	10.0	-4.2	8.7	-.2	-.3	4.1	-1.0	.2
100	35.1	10.4	-2.7	11.3	-.2	1.3	4.7	-.7	.4
110	41.6	12.7	-2.6	12.6	.7	1.1	5.1	-.6	.1
120	46.4	16.6	-4.4	12.9	1.9	.1	5.7	-.6	.6
130	48.6	30.1	-4.3	14.6	11.7	1.1	5.5	8.8	-.1
140	48.6	26.1	-3.7	15.2	3.4	.4	6.0	0.0	.5
150	48.3	29.0	-2.9	16.1	3.4	1.1	6.2	2.2	.4
160	46.4	41.1	-1.5	16.6	14.0	.6	6.0	9.7	.1
170	43.6	41.5	.2	15.5	14.0	1.0	6.3	9.6	.3
180	42.4	33.3	1.3	15.9	5.6	2.2	6.4	1.2	.2
190	40.9	32.7	.8	14.9	6.1	1.6	5.9	1.3	.9
200	39.3	33.4	-.1	13.5	6.5	1.0	5.7	1.5	1.2
210	39.5	34.2	.3	14.2	6.0	1.7	4.8	1.7	.9
220	38.0	35.8	-.2	13.3	6.2	2.0	4.9	1.8	.6
230	35.1	35.6	-2.4	12.3	6.6	1.8	4.8	1.8	.7
240	32.9	34.0	-3.4	12.1	7.3	1.0	4.5	1.8	.3
250	32.8	33.2	-4.0	11.0	7.1	.2	4.4	1.8	0.0
260	33.8	33.7	-4.6	11.2	6.6	-.7	4.2	1.9	-.2
270	31.5	37.5	-6.4	8.8	7.6	-.5	3.9	1.9	-.1
280	27.3	39.7	-7.6	10.2	7.4	1.1	3.5	2.1	.8
290	21.7	40.6	-9.7	8.9	7.5	.3	2.9	2.1	-.2
300	16.4	41.7	-10.7	7.2	8.2	.3	2.6	2.3	.4
310	8.8	44.7	-12.0	5.5	8.8	-1.6	1.8	2.2	-.7
320	1.8	47.4	-12.5	4.5	8.8	-.6	1.0	2.5	-.2
330	-10.2	50.7	-15.3	2.8	8.8	-.5	0.0	2.3	-.1
340	-27.0	51.8	-18.9	-1.0	8.5	-2.3	.2	1.9	-.9
350	-41.2	48.2	-20.1	-2.4	7.8	-1.2	-.5	1.6	-.3

DIPOLE MOMENTS IN GAUSS-CM^3

X	Y	Z	T
-147.5	9.1	50.0	156.0

FAST S/C F#3 DATE:06/22/94

MAGNETIZATION PROBE DISTANCE IN METERS

PER STRAY PROBE 1= 1 : PROBE 2= 1.5 : PROBE 3= 2

MAGNETIC FIELD IN NANOTESLA

ANGLE	X1	Y1	Z1	X2	Y2	Z2	X3	Y3	Z3
DATA SCANS									
0	-5.1	-4.4	2.1	-1.3	-.1	-.2	-.3	.2	.8
10	3.2	7.0	-3.0	1.1	-.2	-1.0	.5	-.2	0.0
20	6.8	11.6	-4.6	3.0	.3	-.7	.9	-.3	0.0
30	10.4	20.5	-2.7	4.6	8.9	-1.0	1.7	8.4	.6
40	16.2	18.6	-2.4	6.5	8.1	.5	2.7	7.7	-.2
50	24.0	8.9	-.7	8.1	.3	.4	3.0	-.3	.3
60	31.5	9.5	-1.8	9.6	.4	.6	3.7	-.2	.6
70	38.9	11.7	-1.4	11.7	.6	1.0	4.9	0.0	.7
80	44.6	15.4	-1.0	12.8	1.6	-.2	4.8	.3	.3
90	47.1	26.8	-2.0	13.6	7.0	.4	5.4	4.7	1.0
100	48.2	25.1	-1.0	14.4	3.7	1.4	5.7	1.5	.4
110	46.4	28.5	-.5	14.3	4.8	.5	5.8	1.8	.6
120	43.0	31.2	.7	14.9	5.3	1.0	5.5	1.6	1.0
130	40.9	31.5	1.7	14.0	5.3	1.2	5.4	1.9	.9
140	38.9	31.8	2.0	13.5	6.1	.6	5.6	2.0	-.3
150	36.9	31.8	2.4	12.8	6.4	1.0	4.9	2.2	.6
160	37.4	31.9	2.3	12.5	6.4	.8	4.8	2.5	-.2
170	36.4	32.9	3.1	13.3	6.6	.8	4.2	2.2	-.1
180	35.3	33.5	1.4	12.3	6.6	1.1	4.5	2.6	.2
190	32.9	34.2	-.2	11.7	7.1	-.5	3.9	2.4	.3
200	30.3	32.3	-1.1	10.5	6.8	-.2	3.9	2.6	0.0
210	31.6	31.2	-.4	10.7	7.0	-.2	3.3	3.0	-.2
220	31.4	32.0	-2.1	9.4	7.0	-.2	3.0	2.7	.2
230	29.9	35.2	-4.1	9.5	7.5	-.1	2.7	2.9	-.6
240	24.7	37.8	-6.3	8.6	7.7	-.8	2.6	2.9	-.3
250	18.9	39.2	-7.7	7.9	8.2	-1.6	2.0	3.2	-.4
260	12.6	40.7	-8.6	4.9	8.7	-.5	1.4	4.0	-.2
270	7.9	45.7	-8.7	4.8	12.0	-1.2	.8	6.2	-.3
280	-.9	48.4	-11.5	3.1	10.2	-.7	-.2	3.3	-.4
290	-14.4	49.1	-14.6	-1.0	9.5	-1.5	-.4	3.2	-.4
300	-28.1	50.2	-15.8	-1.5	8.5	-.8	-1.4	2.9	-1.1
310	-46.4	47.1	-19.0	-5.6	8.1	-2.2	-1.6	2.5	-.5
320	-55.6	39.3	-14.2	-6.0	6.7	-1.1	-2.6	2.0	-.7
330	-60.7	27.7	2.8	-6.1	4.3	-.5	-2.4	1.5	-.1
340	-53.9	7.0	20.9	-5.4	2.0	-.7	-2.1	.8	-.5
350	-29.2	-10.3	18.4	-5.6	.3	-.4	-1.6	.2	.3

DIPOLE MOMENTS IN GAUSS-CM^3

X	Y	Z	T
-147.4	121.9	23.4	192.7

FAST S/C F#4 DATE;06/22/94

MAGNETIZATION PROBE DISTANCE IN METERS

PERM + STRAY PROBE 1= 1 : PROBE 2= 1.5 : PROBE 3= 2

MAGNETIC FIELD IN NANOTESLA

ANGLE	X1	Y1	Z1	X2	Y2	Z2	X3	Y3	Z3
DATA SCANS									
0	-1.1	7.9	.5	-.3	1.4	-.7	.9	.6	-.6
10	7.2	19.1	-6.7	1.8	3.4	-1.2	1.6	1.3	-.7
20	10.8	24.0	-6.5	4.4	4.3	-.9	2.2	1.7	-.9
30	14.3	24.7	-6.5	6.0	4.4	-1.4	3.1	1.7	-1.2
40	19.8	20.7	-5.1	7.5	3.7	-1.5	3.7	1.5	-.8
50	26.7	13.7	-3.9	9.0	2.5	.1	4.4	1.0	-1.0
60	32.9	14.2	-3.4	10.0	2.6	-.6	4.4	1.0	-.3
70	39.1	16.7	-4.7	11.3	3.0	.4	5.3	1.2	-.5
80	43.9	20.2	-4.4	13.6	3.6	-.6	5.8	1.4	-.4
90	45.3	32.8	-3.8	13.9	5.9	.4	5.9	2.3	0.0
100	44.3	28.1	-4.0	14.0	5.1	.2	5.9	2.0	-.5
110	42.1	30.5	-1.9	14.1	5.5	-.6	6.0	2.1	0.0
120	39.3	32.3	-1.7	14.2	5.8	.6	5.9	2.3	.1
130	36.6	32.9	-2.1	13.5	5.9	-.5	5.7	2.3	.2
140	35.2	32.5	-.7	13.0	5.9	-.3	5.4	2.3	-.7
150	34.9	32.0	-.3	12.7	5.8	.6	5.1	2.2	-.8
16	35.1	40.7	-.3	12.3	7.3	.2	5.3	2.9	.5
17	35.8	41.2	-.8	12.1	7.4	-.5	5.4	2.9	-1.0
180	35.4	41.9	-2.0	12.0	7.5	.4	5.1	2.9	-.6
190	33.5	38.1	-3.3	10.9	6.9	-.1	4.9	2.7	-.3
200	33.5	32.0	-5.2	11.2	5.8	-1.0	3.9	2.2	-.6
210	35.5	30.9	-4.6	11.0	5.6	.5	4.4	2.2	-.2
220	36.1	32.6	-5.3	10.6	5.9	-1.2	3.5	2.3	-.7
230	33.6	43.8	-8.9	10.1	7.9	-.7	3.7	3.1	-.5
240	27.9	40.0	-11.2	9.3	7.2	-1.8	3.7	2.8	-.9
250	21.6	45.9	-11.9	8.3	8.3	-1.3	3.1	3.2	-.2
260	16.1	42.5	-12.2	6.4	7.7	-1.0	2.5	3.0	-.6
270	10.2	44.7	-12.4	5.2	8.0	-2.6	1.8	3.1	-.5
280	2.1	47.3	-13.6	3.3	8.5	-2.6	1.0	3.3	-.7
290	-9.3	50.9	-16.5	2.1	9.2	-2.0	-.1	3.6	-.4
300	-25.7	52.3	-19.9	-1.3	9.4	-2.0	-.1	3.7	-.4
310	-42.0	48.6	-21.6	-3.6	8.7	-1.0	-1.3	3.4	-.2
320	-52.0	40.7	-17.2	-4.5	7.3	-2.5	-.9	2.9	-.7
330	-58.0	29.9	-1.2	-5.7	5.4	-1.8	-1.3	2.1	-.2
340	-50.8	9.2	16.9	-4.9	1.7	-1.4	-1.2	.6	-1.0
350	-24.6	-8.1	15.5	-3.9	-1.5	-1.4	-.5	-.6	-.7

DIPOLE MOMENTS IN GAUSS-CM^3

X	Y	Z	T
-137.2	108.1	54.9	183.1

FAST S/C F#5 DATE:06/22/94

MAG .IZATION PROBE DISTANCE IN METERS

PERM + STRAY PROBE 1= 1 : PROBE 2= 1.5 : PROBE 3= 2

MAGNETIC FIELD IN NANOTESLA

ANGLE	X1	Y1	Z1	X2	Y2	Z2	X3	Y3	Z3
DATA SCANS									
0	3.1	4.9	-.6	1.0	.9	-.1	.5	.3	.2
10	10.1	14.5	-7.5	3.6	2.6	-.6	1.3	1.0	-.4
20	12.4	18.2	-8.2	5.2	3.3	-.1	1.8	1.3	.6
30	15.2	18.8	-8.0	6.8	3.4	.5	2.4	1.3	.5
40	20.1	16.9	-6.8	7.9	3.0	1.2	3.0	1.2	.2
50	26.3	15.6	-5.8	9.3	2.8	.3	3.6	1.1	.5
60	33.1	16.5	-5.5	10.4	3.0	-.1	4.0	1.2	.4
70	39.4	18.6	-5.3	11.3	3.3	.4	4.3	1.3	.2
80	42.5	22.1	-5.3	12.1	4.0	.5	5.1	1.5	.1
90	45.3	26.5	-6.0	14.1	4.8	-.1	5.3	1.9	.8
100	44.3	30.0	-4.6	14.5	5.4	.8	5.5	2.1	.2
110	42.0	42.4	-3.3	13.9	7.6	.7	5.3	3.0	.2
120	38.7	43.7	-2.6	14.4	7.9	-.4	5.2	3.1	.1
130	36.5	44.4	-1.9	13.7	8.0	1.7	5.1	3.1	1.3
140	34.4	44.6	-.3	13.2	8.0	1.5	5.0	3.1	.3
15	34.6	43.9	-.7	12.9	7.9	.6	4.7	3.1	.3
160	34.6	44.0	-.8	12.5	7.9	2.6	4.6	3.1	1.3
170	34.8	44.3	-1.2	11.9	8.0	1.0	4.4	3.1	.8
180	33.5	45.1	-2.0	11.5	8.1	-.1	4.1	3.2	.7
190	30.9	49.4	-3.9	11.4	8.9	1.2	4.5	3.5	.6
200	29.9	43.7	-4.8	10.5	7.9	.1	4.3	3.1	.4
210	31.1	36.5	-6.1	10.8	6.6	-.1	4.4	2.6	.7
220	32.0	33.6	-5.7	10.2	6.0	-.5	3.9	2.4	.4
230	30.2	42.7	-7.3	9.6	7.7	.5	3.6	3.0	-.4
240	25.1	46.1	-10.2	8.7	8.3	-.5	3.1	3.2	.7
250	20.3	40.5	-12.5	8.0	7.3	-.9	2.8	2.8	-1.1
260	15.5	41.1	-11.8	6.8	7.4	-1.2	2.6	2.9	.3
270	10.5	46.0	-12.9	5.7	8.3	-1.5	2.3	3.2	-.1
280	3.8	48.3	-14.3	4.6	8.7	-.8	1.7	3.4	-.4
290	-5.6	47.3	-17.2	2.4	8.5	-2.7	.6	3.3	-.6
300	-17.8	53.7	-20.7	.8	9.7	-1.7	.7	3.8	-.8
310	-30.1	49.5	-22.3	-1.0	8.9	-1.8	0.0	3.5	-1.1
320	-39.2	44.5	-17.8	-2.6	8.0	-.5	-.1	3.1	-.3
330	-46.1	36.2	-1.8	-3.2	6.5	-.4	-.2	2.5	.1
340	-41.8	17.1	16.1	-2.6	3.1	-1.2	0.0	1.2	-.3
350	-17.2	.4	15.3	-.8	.1	-.2	.6	.0	-.6

DIPOLE MOMENTS IN GAUSS-CM^3

X	Y	Z	T
-115.3	102.1	65.3	167.3

FAST S/C F#6 DATE:06/22/94

MAGNETIZATION PROBE DISTANCE IN METERS

PER STRAY PROBE 1= 1 : PROBE 2= 1.5 : PROBE 3= 2

MAGNETIC FIELD IN NANOTESLA

ANGLE	X1	Y1	Z1	X2	Y2	Z2	X3	Y3	Z3
DATA SCANS									
0	3.5	6.5	-4.6	1.5	.3	.4	.7	.0	1.1
10	7.7	11.6	-6.7	3.8	.7	.7	1.3	-.0	.8
20	11.7	12.3	-4.9	5.5	.8	.4	1.9	.1	.5
30	17.0	11.7	-4.5	7.0	1.0	1.7	2.6	.1	1.0
40	23.7	11.2	-3.2	8.1	1.3	-.1	3.1	.1	.9
50	31.3	11.6	-2.7	10.4	1.4	.9	3.7	.2	1.3
60	37.4	14.5	-2.1	11.2	2.1	.6	4.4	.2	.8
70	41.0	18.4	-3.1	12.1	2.7	1.1	4.7	.3	1.2
80	43.0	22.6	-1.7	13.5	3.8	.4	4.7	.4	1.4
90	41.9	26.1	-2.7	13.6	4.5	1.9	5.0	.4	1.5
100	40.0	29.7	.2	13.6	5.0	.9	5.1	.5	1.1
110	37.5	31.0	.7	14.0	6.0	.7	5.1	.6	1.3
120	34.6	31.6	1.7	13.4	5.9	2.1	5.0	.6	1.2
130	32.7	31.0	1.9	12.9	6.3	.7	4.6	.6	1.0
140	32.5	30.1	1.4	12.3	6.2	.8	4.7	.8	1.3
150	34.1	29.9	1.6	12.6	7.0	1.5	4.8	.7	1.6
160	34.5	31.0	1.5	12.1	6.7	1.1	4.5	.8	.8
170	32.8	32.5	.3	11.6	7.2	1.3	4.1	.9	1.3
18	31.2	32.4	-1.5	11.2	6.9	1.3	4.2	.8	.8
19	30.7	34.2	-1.8	11.1	10.5	1.5	4.0	1.9	.7
200	31.5	33.3	-1.8	10.7	10.5	1.2	3.7	1.9	1.0
210	33.1	35.4	-1.5	10.5	11.1	1.3	3.7	2.0	.2
220	31.4	39.3	-4.1	9.7	12.1	.7	3.3	2.3	1.2
230	26.1	42.4	-7.1	9.3	12.7	.2	3.3	2.3	1.0
240	20.5	36.5	-8.7	8.1	5.2	.1	2.6	-.0	.8
250	15.6	46.1	-9.9	6.8	13.9	-.3	2.0	2.5	.7
260	9.0	47.8	-9.6	4.8	13.6	-.3	1.3	2.2	.5
270	.6	49.2	-12.4	3.1	11.7	-.6	.7	1.6	.4
280	-12.7	47.5	-14.0	.8	6.3	0.0	-.2	-.1	.2
290	-30.6	49.6	-17.2	-1.5	6.0	-1.7	-.8	-.2	.1
300	-48.3	45.1	-19.1	-4.3	4.7	-1.2	-1.8	-.3	.2
310	-60.3	36.1	-14.1	-5.9	3.1	-1.7	-2.0	-.4	.2
320	-65.1	24.0	1.4	-6.4	1.1	.3	-2.0	-.6	.8
330	-57.8	2.5	18.7	-6.3	-1.3	-.2	-1.6	-.8	.7
340	-29.9	-15.1	17.0	-3.9	-2.8	.2	-1.1	-1.0	1.0
350	-6.4	-9.4	2.8	-1.5	-3.4	.6	-.8	-1.0	.9

DIPOLE MOMENTS IN GAUSS-CM^3

X	Y	Z	T
-123.2	135.6	36.5	186.8

FAST S/C F#7 DATE:06/22/94

AGNETIZATION

PROBE DISTANCE IN METERS

ERM STRAY

PROBE 1= 1 : PROBE 2= 1.5 : PROBE 3= 2

MAGNETIC FIELD IN NANOTESLA

NGLE	X1	Y1	Z1	X2	Y2	Z2	X3	Y3	Z3
ATA SCANS									
0	-1.4	1.9	-.2	-.3	2.8	.3	-.5	2.9	.1
10	8.2	11.6	-7.5	2.9	.1	0.0	.3	-.1	.5
20	12.7	17.4	-7.5	5.0	.5	-.1	1.2	0.0	.4
30	16.0	18.6	-7.2	6.8	.6	-.2	2.0	0.0	.5
40	21.1	17.7	-6.6	8.2	1.2	-.2	2.7	-.2	.3
50	28.5	16.6	-5.0	10.1	.6	.3	3.3	-.1	.3
60	37.0	16.6	-4.2	12.7	.9	.7	4.4	.3	1.5
70	44.7	19.2	-3.7	14.7	1.7	1.1	4.6	.9	.4
80	50.3	23.3	-4.1	16.2	2.6	1.2	5.3	.8	.6
90	52.3	28.5	-4.1	16.8	3.5	.6	5.5	1.1	.5
100	53.4	32.4	-3.2	17.7	4.3	1.5	5.9	1.3	.5
110	50.8	36.2	-1.5	18.1	4.9	1.4	6.3	1.4	.8
120	47.8	38.9	-1.6	17.1	6.0	1.3	6.2	1.7	.8
130	45.1	39.0	-.4	16.8	6.4	1.2	6.3	2.0	.7
140	43.3	39.5	.8	16.8	6.6	.7	6.1	2.2	.4
150	42.2	39.4	1.0	16.3	7.1	.7	5.7	2.4	.8
160	41.2	38.9	.1	15.6	7.4	1.4	5.7	2.6	.9
170	41.3	39.5	-.5	15.4	7.8	1.5	5.7	2.5	.9
180	39.2	41.0	-1.6	14.0	7.4	.8	4.9	3.1	1.1
190	36.6	40.7	-2.8	14.2	7.0	1.1	4.7	3.0	.6
200	35.3	39.8	-3.9	13.5	8.2	.5	4.5	3.0	.5
210	35.7	38.3	-5.0	12.3	8.2	0.0	4.2	3.0	.7
220	37.2	39.6	-4.7	12.3	7.8	-.2	4.1	2.9	0.0
230	36.2	42.6	-5.5	12.5	8.3	.2	3.9	3.0	-.3
240	29.9	46.7	-9.5	10.4	9.0	.1	3.5	3.5	-.4
250	24.6	47.4	-11.0	9.1	9.5	-.9	2.9	3.4	0.0
260	20.0	49.1	-10.8	8.6	9.9	.5	2.2	3.5	.5
270	11.9	52.7	-12.6	6.6	10.6	-.6	1.5	3.8	.7
280	3.9	56.8	-14.4	5.0	10.8	-1.1	.9	3.7	-.3
290	-11.5	61.9	-16.7	2.5	10.7	-1.0	0.0	3.7	-.1
300	-32.1	62.9	-20.7	-1.2	10.5	-1.6	-1.3	3.3	-.2
310	-52.4	57.8	-23.5	-4.5	9.4	-2.1	-1.6	2.8	-.3
320	-63.6	46.0	-19.0	-5.0	7.3	-1.6	-2.2	2.8	-.5
330	-66.9	33.1	-3.0	-6.1	5.0	-.4	-2.2	2.0	-.2
340	-56.7	9.7	15.8	-5.8	2.6	-.2	-1.6	1.8	-.1
350	-26.2	-8.0	15.3	-3.2	.5	-.3	-.9	.4	.3

DIPOLE MOMENTS IN GAUSS-CM^3

X	Y	Z	T
-157.9	131.1	59.1	213.5

FAST S/C F#8 DATE:06/22/94

MAGNETIZATION

PERM + STRAY

PROBE DISTANCE IN METERS

PROBE 1= 1 : PROBE 2= 1.5 : PROBE 3= 2

MAGNETIC FIELD IN NANOTESLA

ANGLE	X1	Y1	Z1	X2	Y2	Z2	X3	Y3	Z3
DATA SCANS									
0	-1.0	-.8	-.7	-.3	1.9	-.3	-.1	1.6	-.7
10	8.8	11.5	-5.7	2.8	.2	-.4	.8	-.3	-.2
20	12.4	16.6	-6.7	4.9	.3	-.5	1.4	-.4	.1
30	16.6	17.6	-6.2	6.7	.6	.8	2.2	-.1	.5
40	21.6	16.7	-4.9	8.2	.8	.5	2.8	-.3	.2
50	28.0	16.2	-4.4	9.7	.9	.1	3.6	-.2	.5
60	35.3	17.3	-3.7	11.3	1.5	.4	4.0	.2	.1
70	41.7	19.8	-3.5	12.7	2.0	1.5	4.6	.5	.6
80	45.7	23.6	-3.4	13.9	2.6	.7	4.7	.6	.4
90	47.1	27.7	-4.0	14.5	3.4	-.1	5.3	.8	.3
100	45.9	42.1	-3.7	14.9	14.8	.1	5.8	8.1	.3
110	43.7	34.4	-1.8	15.0	5.0	1.1	5.6	1.3	.5
120	40.8	39.0	-.5	15.1	8.5	.8	5.4	4.9	.2
130	38.8	39.7	-.1	15.1	8.7	1.4	5.2	4.8	.6
140	37.2	38.9	.8	14.4	9.0	.5	5.3	3.0	.8
150	37.2	35.2	1.3	14.5	6.5	.9	5.8	2.4	.5
1	37.5	34.9	1.0	14.0	6.7	1.2	5.6	3.7	.8
1..	38.2	36.1	.5	13.5	6.5	.7	5.3	2.3	.3
180	37.7	37.2	-1.0	13.6	6.8	1.4	5.1	2.7	.5
190	35.3	37.9	-2.6	12.9	6.9	.7	5.0	2.8	-.2
200	33.9	37.5	-3.7	11.9	7.1	.1	4.0	2.8	-.1
210	35.1	35.1	-3.4	11.5	7.2	.3	3.6	2.7	.3
220	36.5	36.2	-4.1	11.2	6.9	1.0	3.6	2.6	.5
230	33.6	39.8	-5.8	10.5	7.3	-.1	3.4	2.7	.2
240	29.0	42.8	-8.8	9.4	8.0	0.0	2.7	2.8	-.2
250	23.5	44.8	-9.7	9.0	8.4	-.2	2.4	3.1	.4
260	17.8	46.1	-10.7	7.2	8.8	-1.0	2.0	3.2	-.8
270	11.4	49.0	-11.8	6.1	9.4	-.8	1.2	3.2	-.3
280	2.0	52.9	-14.5	3.7	9.8	-1.2	.2	3.3	-.2
290	-11.0	57.0	-16.3	1.7	10.0	-.9	0.0	3.2	.3
300	-29.3	58.7	-20.1	-.8	9.5	-1.5	-.9	2.9	-.5
310	-48.0	53.6	-21.8	-3.7	8.3	-1.2	-1.6	2.6	-.2
320	-59.2	43.6	-17.3	-5.9	6.6	-.8	-2.3	1.8	.1
330	-63.4	30.5	-2.0	-6.8	4.4	-.1	-2.3	1.3	-.1
340	-53.8	9.1	17.3	-5.4	2.1	0.0	-1.8	.7	-.1
350	-25.5	-7.9	16.4	-3.4	.6	.4	-1.1	.3	-.1

DIPOLE MOMENTS IN GAUSS-CM^3

X	Y	Z	T
-144.4	117.7	51.7	193.3

FAST S/C F#9 DATE:06/22/94

AGNETIZATION PROBE DISTANCE IN METERS

ERM STRAY PROBE 1= 1 : PROBE 2= 1.5 : PROBE 3= 2

MAGNETIC FIELD IN NANOTESLA

NGLE	X1	Y1	Z1	X2	Y2	Z2	X3	Y3	Z3
ATA SCANS									
0	-1.4	-1.7	1.8	-1.0	-.2	-.8	-.9	0.0	-.2
10	7.8	10.4	-5.3	2.5	.2	.6	.5	-.2	.4
20	11.2	16.0	-5.9	4.8	.9	.4	1.0	0.0	0.0
30	14.8	17.0	-5.5	6.1	.9	.3	1.7	0.0	.3
40	20.0	16.0	-3.9	8.1	1.0	.9	2.6	-.2	.4
50	26.6	15.8	-3.3	9.3	1.2	.4	2.9	0.0	0.0
60	34.1	16.6	-2.9	10.6	1.5	1.2	3.8	0.0	.3
70	40.7	19.1	-2.5	12.5	1.9	.9	4.7	.3	.1
80	44.4	23.0	-3.2	13.8	2.7	.9	5.0	.5	.3
90	46.2	27.3	-2.6	14.4	3.7	1.1	5.1	.9	.2
100	45.7	31.1	-1.8	14.9	4.2	1.1	5.1	1.2	.1
110	43.1	34.1	-1.2	14.8	5.0	1.4	5.2	1.3	.5
120	39.9	35.4	-.3	14.8	5.5	1.4	5.5	1.7	.5
130	37.4	35.7	.8	14.3	5.8	1.2	5.0	3.0	.8
140	35.7	36.3	1.3	13.9	6.2	.9	4.9	1.9	.3
150	35.5	34.8	1.5	13.6	6.5	1.9	4.8	2.2	.5
160	35.8	34.9	1.3	13.1	6.8	1.6	4.6	2.3	.5
170	35.9	35.7	.8	12.7	7.3	.9	4.4	2.3	.4
180	35.4	36.9	-.6	12.4	7.0	1.1	4.2	2.3	.6
190	33.2	37.5	-1.6	11.9	7.0	.8	4.1	2.4	.1
200	32.5	35.7	-3.2	11.8	7.1	1.5	3.9	2.8	.6
210	33.7	34.1	-3.2	11.1	7.3	1.6	3.7	2.9	.4
220	34.7	35.8	-3.1	11.0	7.4	-.2	3.4	2.6	0.0
230	32.2	39.3	-5.7	10.3	7.8	.1	3.1	2.8	-.1
240	27.6	42.3	-7.7	9.8	8.8	-.1	2.8	3.0	.2
250	21.9	43.9	-9.7	8.6	8.8	-.7	2.4	3.0	-.3
260	16.5	45.3	-10.2	7.2	9.3	-.9	2.0	3.1	-.7
270	10.2	49.0	-10.9	5.7	10.0	-.9	1.3	3.3	-.6
280	.6	52.6	-13.2	3.9	10.1	.5	.5	3.3	.2
290	-13.0	56.5	-16.4	1.2	10.2	-.9	-.4	3.2	-.2
300	-30.8	58.1	-19.2	-1.4	9.8	-1.3	-1.3	3.0	-.6
310	-49.1	53.3	-21.2	-4.0	8.8	-1.5	-1.8	2.5	.2
320	-60.4	43.0	-16.8	-6.0	8.8	-1.0	-2.3	4.7	.4
330	-64.1	29.7	-1.5	-6.3	4.4	-.7	-1.9	1.4	-.1
340	-55.0	8.2	17.8	-5.8	2.1	-.3	-1.7	1.1	-.2
350	-26.1	-9.0	16.2	-3.1	.6	.4	-.8	.3	-.3

DIPOLE MOMENTS IN GAUSS-CM^3

X	Y	Z	T
-143.3	118.5	44.2	191.1

FAST S/C FSS/1 DATE:06/24/94

MAGNETIZATION PROBE DISTANCE IN METERS

PEP STRAY PROBE 1= 1 : PROBE 2= 1.5 : PROBE 3= 2

MAGNETIC FIELD IN NANOTESLA

ANGLE	X1	Y1	Z1	X2	Y2	Z2	X3	Y3	Z3
DATA SCANS									
0	4.4	8.7	-2.5	1.6	1.6	-.2	.5	.1	.8
10	6.4	15.9	-2.5	2.7	2.9	.1	1.1	.2	.5
20	6.5	21.5	-.2	3.9	3.9	.3	1.1	.3	.7
30	6.6	26.5	-.8	4.2	4.8	-.3	1.3	.3	.8
40	7.4	19.3	.2	4.8	3.5	1.0	1.7	.2	.9
50	9.2	19.4	.4	4.9	3.5	.7	1.8	.2	.8
60	11.0	28.7	-.1	5.3	5.2	.6	1.9	.4	.7
70	12.5	20.9	-.8	5.7	3.8	1.5	2.2	.3	.9
80	13.1	32.2	-.7	5.9	5.8	-.5	2.1	.4	.6
90	13.4	23.9	-.2	6.5	4.3	1.2	2.3	.3	.8
100	11.7	25.3	1.2	5.8	4.5	1.1	2.2	.3	.4
110	9.7	31.1	2.8	5.7	5.6	.4	2.2	.4	.4
120	8.2	31.6	2.8	5.5	5.7	.6	2.1	.4	1.2
130	7.7	27.3	4.3	5.4	4.9	1.3	2.0	.3	1.1
140	9.5	23.7	3.5	5.8	4.3	1.5	2.0	.3	1.0
150	11.3	23.3	4.2	5.4	4.2	1.2	1.9	.3	.9
160	13.2	24.3	3.8	5.5	4.4	.5	2.0	.3	.8
170	12.8	25.8	2.2	5.4	4.6	.7	1.7	.3	1.1
18	11.8	26.3	1.4	4.8	4.7	.8	1.6	.3	.7
19	12.3	24.0	-.4	5.1	4.3	.8	2.0	.3	.9
200	14.2	34.7	-1.5	5.0	6.2	.1	2.0	.4	.6
210	16.5	25.8	-1.3	5.0	4.6	.5	1.8	.3	.4
220	15.4	32.5	-2.6	5.0	5.8	.2	1.8	.4	.4
230	11.8	31.6	-4.8	4.9	5.7	.5	1.7	.4	.5
240	6.7	33.0	-6.3	4.1	5.9	.3	1.4	.4	.8
250	3.0	34.1	-6.6	2.9	6.1	-.4	.9	.4	.2
260	-1.8	36.1	-6.5	2.4	6.5	-.5	.5	.5	.4
270	-8.1	38.8	-7.3	1.3	7.0	-.4	.3	.5	.7
280	-17.6	41.7	-10.0	-.8	7.5	-.3	.3	.5	.4
290	-31.9	43.6	-12.9	-3.2	7.8	-.6	-1.1	.5	.2
300	-46.7	41.6	-14.1	-4.7	7.5	-.6	-1.5	.5	.4
310	-57.3	48.7	-9.7	-6.5	8.8	-.6	-1.6	.6	0.0
320	-61.8	31.3	4.8	-6.9	5.6	-.5	-1.6	.4	.5
330	-52.9	1.1	20.8	-6.1	.2	-.3	-1.2	.0	.2
340	-23.6	-14.8	16.8	-3.9	-2.7	.3	-.5	-.2	-.4
350	-2.5	-4.8	2.2	-.4	-.9	-.4	.1	-.1	.4

DIPOLE MOMENTS IN GAUSS-CM^3

X	Y	Z	T
-75.3	80.2	8.1	110.3

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MAGNETIC TEST PROCEDURE FOR THE FAST SPACECRAFT

June 13, 1994

Goddard Space Flight Center
Greenbelt, Maryland

Attachment 14

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Table of Contents

1.0 PURPOSE

The purpose of this test is to characterize the magnetic field structure of the Fast Auroral SnapshoT (FAST) Spacecraft. Data collected will be used to determine spacecraft compliance with the SMEX-FAST " Magnetic Contamination and EMI/EMC Control and Implementation Plan" (FAST-SPEC-012).

2.0 APPLICABLE DOCUMENTS

The following documents form part of this procedure to the extent specified herein. In the case of conflict, the information presented in this procedure shall take precedence.

a. SPACECRAFT MAGNETIC TEST FACILITY(ATTITUDE CONTROL TEST FACILITY) SMTF (ACTF), NASA Document X-754-83-9

b. SPACECRAFT MAGNETIC TEST FACILITY OPERATING PROCEDURE, NSI Document 12-01-403

c. SMEX-FAST EMI/EMC AND MAGNETIC TEST PLAN

d. SMEX-FAST MAGNETIC CONTAMINATION AND EMI/EMC CONTROL AND IMPLEMENTATION PLAN, FAST-SPEC-012 Rev. A

3.0 TEST FACILITIES

The measurements will be conducted at the GSFC Spacecraft Magnetic Test Facility (SMTF), building 305. The SMTF contains a 13 meter coil system capable of nulling the ambient geomagnetic field to zero, with a uniformity of 0.001% within a spherical volume of two meters in diameter. The facility also contains the following additional equipment used for testing:

1- Helmholtz perm-deperm coil system, 2.9 meter diameter
1- Helmholtz perm-deperm coil system, 1.5 meter diameter
3- Fluxgate magnetometers
1- Dynamic Signal Analyzer, Hewlett Packard model HP 3562A
1- Proton magnetometer, Varian model 4931
1- Data Acquisition & Analysis System, Hewlett Packard 87 microcomputer
1- Ea. dolly, turntable, & S/C mounting fixtures
2- Power Supplies for perming & deperming (DC. & 60 Hz)

4.0 General Requirements

4.1 Contamination Control

Class 100,000 Clean Room conditions shall be maintained in the Spacecraft Magnetic Test Facility for the duration of the FAST Spacecraft magnetics test. The SMTF HEPA filter system fans shall be operated for a minimum of three days prior to the arrival of the FAST Spacecraft at the SMTF.

4.2 ESD Control

The FAST Spacecraft contains ESD sensitive components. ESD preventative measures will therefore be used before and during the magnetic test in order to prevent any damage to spacecraft systems.

4.3 Changes to Test Procedure

The Magnetic Test Procedure presented herein may be modified as necessary at the discretion of the cognizant test engineer. All changes to this procedure shall be annotated in the margins of the master copy. All changes shall be initialed and dated by the code 754 Test Engineer and an authorized Project Representative.

4.4 Responsibilities

4.4.1 Code 754.2/NSI Responsibility

Code 754.2/NSI shall provide the equipment and personnel needed to conduct the magnetic test of the FAST SPACECRAFT. Code 754.2/NSI shall be responsible for operating and monitoring all test equipment needed for this test. Code 754.2 shall provide documentation of the tests including photographs of the test setups and a test report. The test conductor shall be a designated representative of Code 754.2.

4.4.2 Code 740 Responsibilities

Code 740 is responsible for the handling and operation of the FAST Spacecraft during the Magnetics Test. Code 740 shall designate a Test Director who shall be the single point of contact with code 754.

5.0 TEST SEQUENCE

The FAST Spacecraft magnetic test sequence shall be performed as indicated in the table below.

Test	Spacecraft Operating Mode	Spacecraft Power Source
Initial perm	off	none
post deperm	off	none
post deperm	normal mode w/ instruments on	solar array connectors
post deperm	normal mode w/ instruments & transmitter on	solar array connectors
post deperm	normal mode w/ instruments on	battery
post deperm	normal mode w/ instruments on & battery charging	solar array connectors
post deperm	normal mode w/ instruments & ACS sensors off	battery
post deperm	normal mode w/ instruments & ACS sensors off	battery & solar array connectors

An array of 60 compact florescent lamps will be used for tests where spacecraft power will be supplied by the spacecraft solar arrays.

6.0 TEST PROCEDURE

6.1 TEST SETUP

6.1.1 Set up three triaxial magnetometers on a north horizontal line passing through the center of the facility coils. Position the three magnetometer probes 1.0 meters, 1.5 meters and 2.0 meters from the center of the facility coils respectively.

6.1.2 Energize all test instrumentation and adjust the coil currents until zero field (<1.0 nT) is established inside the facility coil system.

6.1.3 Align the magnetometer probes to the coil system axes.

6.1.4 Perform an end-to-end data system calibration.

6.1.5 Perform a dry run magnetic mapping of the facility test dolly to ensure that no magnetic materials are present on the facility test dolly.

6.2 PERMANENT MAGNETIZATION

6.2.1 Initial Perm

6.2.1.1 Position the spacecraft outside the coil system on the facility test dolly.

6.2.1.2 Perform the initial background measurements.

6.2.1.3 Roll the spacecraft into the center of the test facility coils and note spacecraft orientation with respect to facility axes.

6.2.1.4 Rotate the table 360 degrees in azimuth and acquire the triaxial magnetic field data at each 10 degree increment of rotation.

6.2.1.6 Roll the spacecraft to the outside of the test facility coil system.

6.2.1.7 Perform the final background measurement.

Note: At this time the data collection and analysis program will start reducing the data and calculating the three axial dipole moments.

6.2.2 5 Gauss Deperm

After completing the initial perm measurement sequence, the item is demagnetized by exposure to a 5 Gauss diminishing sinusoidal magnetic field. Once the deperm sequence is completed, post deperm measurements are performed in an identical manner to those of the initial perm measurements (steps 6.2.1.1 to 6.2.1.7).

7.0 TEST LIMITS

The magnetic test limits for the FAST Spacecraft are :

Initial Perm - 4 nT maximum field @ 1 meter

Post Deperm - 2 nT maximum field @ 1 meter

8.0 ADDITIONAL TESTING

Trimming and calibration of the ACS magnetometer and alignment of the science fluxgate magnetometer will also take place at the Spacecraft Magnetic Test Facility. A separate procedure will be developed by code 740 to cover these tests.