

#298

AE-B

ION MASS SPECTROMETER DATA

66-044A-01A

1 tape

Table of Contents

1. Introduction
2. Errata/Change Log
3. LINKS TO RELEVANT INFORMATION IN THE ONLINE NSSDC INFORMATION SYSTEM
4. Catalog Materials
 - a. Associated Documents
 - b. Core Catalog Materials

1. INTRODUCTION:

The documentation for this data set was originally on paper, kept in NSSDC's Data Set Catalogs (DSCs). The paper documentation in the Data Set Catalogs have been made into digital images, and then collected into a single PDF file for each Data Set Catalog. The inventory information in these DSCs is current as of July 1, 2004. This inventory information is now no longer maintained in the DSCs, but is now managed in the inventory part of the NSSDC information system. The information existing in the DSCs is now not needed for locating the data files, but we did not remove that inventory information.

The offline tape datasets have now been migrated from the original magnetic tape to Archival Information Packages (AIP's).

A prior restoration may have been done on data sets, if a requestor of this data set has questions; they should send an inquiry to the request office to see if additional information exists.

2. ERRATA/CHANGE LOG:

NOTE: Changes are made in a text box, and will show up that way when displayed on screen with a PDF reader.

When printing, special settings may be required to make the text box appear on the printed output.

Version	Date	Person	Page	Description of Change
01				
02				

3 LINKS TO RELEVANT INFORMATION IN THE ONLINE NSSDC
INFORMATION SYSTEM:

<http://nssdc.gsfc.nasa.gov/nmc/>

[NOTE: This link will take you to the main page of the NSSDC Master Catalog. There you will be able to perform searches to find additional information]

4. CATALOG MATERIALS:

- a. Associated Documents To find associated documents you will need to know the document ID number and then click here.
<http://nssdcftp.gsfc.nasa.gov/miscellaneous/documents/>

- b. Core Catalog Materials

AE-B

Ion Mass Spectrum Data Tape

66-044A-01A SPIO-00065

This data set has been restored. There was originally 1 9-track, 800 BPI tape written in Binary. There is one restored tape. The DR tape is a 3480 cartridge and the DS tape is 9-track, 6250 BPI. The tape was created on a 360 computer. The DR and DS number along with the corresponding D number and the time span is as follows:

DR#	DS#	DD#	FILES	TIME SPAN
DR03619	DS03619	D17689	1	06/09/66 - 01/17/67

REQ. AGENT
CMT

RAND NO.
RC3208

ACQ. AGENT
RNH

AE-B

ION MASS SPECTROMETER DATA

66-044A-01A

This data set consists of 1 AE-B Ion Mass Spectrometer Data tape. The tape is 1600 BPI, 9 track, binary with 1 file. This tape was created on an IBM 360/75 computer. Listed below is the tape and its start and stop times.

<u>D#</u>	<u>C#</u>	<u>TIME SPAN</u>
D-17689	C-14538	June 9, 1966 - January 17, 1967

UNITED STATES GOVERNMENT

Memorandum

TO : FILES

DATE: November 12, 1974

FROM : Virginia B. Zanner
Data Analysis Branch

SUBJECT: AE/B Ion Mass Spectrometer Data Final Quality Control

BACKGROUND

In preparing the final synoptic file of the AE-B Ion Mass Spectrometer Data, it was deemed desirable, so as to increase the reliability of the validation process through the use of human judgment, to scan printouts from the computer analysis output file (BHT#2) and to compare them, turnon by turnon and peak by peak, with the corresponding COM volt-edit display (vs. time) of sweep data and raw volt data for the spectrometer ion current spectra.

A combination of several factors, inadequately programmed tests, bypassing of existent tests in an effort to "make things run", and insufficient documentation on the tape library contents and provenance, to say nothing of old-fashioned human error, caused the inclusion in the AE/B orbital aspect files of a certain percentage of nonsensical location data. The same factors enabled this bad O/A data to slip through the analysis programs. Therefore, the final synoptic file of AE-B Ion Mass Spectrometer data known as BHT#2A contained a certain percentage of this bad O/A data. In addition, about 2% of the peak values were for unwanted (12, 16) or non-existent (0,*) masses. A third class of "bad" mass values resulted from the failure of the decomp program to correctly detect the sweep flag changes, causing mass 4 to be labelled 25 and mass 1 to be labelled 6. All of these cases could be detected or corrected by simple programmed tests.

The most important deficiency in the BHT file, however, was the existence of missing or erroneous peak current values, resulting from the failure of the preliminary analysis program to correctly handle the data in the presence of disturbances such as noise, sun spikes, data dropouts and exaggerated oscillation. This, only the visual comparison of the analog display and printout could detect.

APPROACH

In cleaning up the BHT file, so as to present for archiving only verified data points, several steps were necessary:

1. Creation of BLKDBH

The original 7-track unblocked 7094 tape was filtered by a program BHLOC which eliminated those records containing impossible location data,



converted longitudes to the 0° - 360° range and created a 9-track blocked tape BLKDBH on reel 11-686. This tape was then used for all further studies.

2. Program IPRINT, with several alternative outputs, was used to study the data file and accumulate statistics on various "error" conditions. The most useful of these outputs were:

a. A printout of errors only, i.e. records with unwanted masses, bad satellite velocity, negative density, and number of peaks per pass other than 6. (See Figure 1)

b. Average time relative to first mass 14 peak time for each mass peak, computed from those turn-ons with exactly 6 masses.

c. A listing in 6 peak per turn-on format with extra peaks to one side. (See Figure 2)

3. The listing from 2-c above was used to make a preliminary comparison of each printed peak value with the volt-edit plot microfilm display. Types of discrepancies were noted and correction cards were made up for any necessary changes.

4. In studying the data in this manner two programmable editing features were developed which made it possible to preserve as much original data as possible and minimize the change card entries. These included:

a. Time criteria for the selection of "correct" peak values.

b. Erroneous mass numbers resulting from failure to detect sweep flag changes proved unique and therefore translatable to proper values. In addition, it was discovered that a filter on VMAG (satellite velocity) was needed to complete the elimination of bad orbital data.

5. Special programming was needed to eliminate certain turn-ons or peak samples which caused the general program to blow in a unique fashion. A list was developed of turn-ons having only the second mass 14 and/or 16 peaks, in order to place the values in the correct slot in the fixed format output. This list is not necessarily comprehensive but contains those turn-ons which were noticed at time of checkout of the original 64 reels. During checkout of M1 reels (additional) it had been decided to eliminate those turn-ons with less than three data points since it is impossible to extrapolate the O/A data necessary to compute number density for added points, and therefore no such turn-ons were checked even though volt-edit film may exist.

6. Comparison of Volt-Edit Plots and Current Printout

Each plot was scanned for general agreement with the corresponding current values on the printout. For a complete set of 6 and only 6 peak values with a fairly clean plot, no reference to the conversion tables was necessary, this decision being based on a careful reading and conversion of half a dozen such cases. (See Figure 3)

For those passes with data dropouts, noise, sunpeaks, or exaggerated signal oscillation, a more careful scrutiny was called for, since such phenomena could have either obscured a peak to the analysis program which was readable by eye, have been interpreted as an erroneous or non-existent peak by the program, or obscured the baseline interpretation causing a more generalized effect on peak values in the area. (See Figure 4). In addition some data were completely off scale (Channel 9 saturated). All these obscuring conditions were noted in the form of flags.

7. The other type of corrections needed was the clean-up of apparent errors or malfunctions in previously entered corrections.

There were enough of the latter to suggest a most careful scrutiny of the present correction procedures at every step:

- a. Proofreading of the cards punched from correction forms.
- b. Scanning for sense which raised several questions resolved by the rereading of the film.
- c. Scanning of the sorted cards for "duplicate" turn-ons, some of which turned out to be keypunch errors. Where true duplicates occurred, it was encouraging that the readings rarely varied.
- d. Programmed check of data values against valid windows in conversion.

PROGRAM DESCRIPTION (See Appendix A for flow chart)

The N4DENS program developed reads the BLKDBH data, rejects turn-ons with unbelievable satellite velocity values (an indication of non-valid O/A), corrects mass values, rejects unwanted masses, chooses one value per mass occurrence basing the selection on relative time, interpolates missing O/A data where possible, inserts new values from correction cards, deletes bad values as flagged on correction cards, computes location codes and sets various quality indicators.

For those ion current values for which a satellite velocity has been validated, the program then computes number density, according to the following equations:

AE-B Current to Concentration Equations

Units: I_c (amperes) V (V_m /sec)
 n (ions/cm³)

Mass 1

$$n = \frac{0.61 I_c}{1.46 \times 10^{-16} V + 6.16 \times 10^{-19} V^3}$$

Mass 4

$$n = \frac{0.61 \quad I_c}{4.38 \times 10^{-16} V + 7.40 \times 10^{-18} V^3}$$

Mass 14

$$n = \frac{2.2 \quad I_c}{-2.19 \times 10^{-16} V + 2.44 \times 10^{-17} V^3}$$

Mass 16

$$n = \frac{2.2 \quad I_c}{-2.19 \times 10^{-16} V + 2.78 \times 10^{-17} V^3}$$

Various combinations of output may be selected by means of selection flags read in from the DATA5 file. They are:

IFL6 = 1 data base current and number density are printed out
(See Figure 5)

2 both data base and error messages are printed

3 error messages only are printed (See Figure 6)

IFL8 = 1 data base, with location codes and quality indicators added, is written on FTO8 on tape

3 no tape output

INPUTS

1. BLKDBH tape 11-686

```
//FT09F001 DD DSN=BLKDBH,UNIT=2400-3,DISP=(OLD,KEEP),LABEL=(,SL,,IN),
              DCB=(RECFM=VBS,LRECL=92,BLKSIZE=27604,DEN=3)
```

Logical record (1 per peak reading) All words are REAL*4.

<u>WORD NO.</u>	<u>CONTENTS</u>	<u>UNITS</u>
1	Turn-on#	
2	Experiment number	
3	Mass	AMU
4	G1 - guard ring voltage	Volts
5	Vs - stopping voltage	Volts
6	Current	Amperes
7	Satellite velocity	Kilometers/second
8	Altitude	Kilometers
9*	B x Spin Axis	Degrees
10	Universal time	Seconds
11	Local time	Seconds
12*	Velocity Vector x Spin Axis	Degrees
13	Geographic Latitude	Degrees 1/
14	Geographic longitude	Degrees 2/
15	Magnetic latitude	Degrees 1/
16	Magnetic longitude	Degrees 2/
17*	Spin Axis x Sun	Degrees
18*	Theta	Degrees
19	McIlwain's parameter (L)	Earth Radii
20	Day of year	
21	Solar Zenith angle	Degrees
22	Dip Latitude	Degrees

1/ + = North, - = South

2/ + = East

* Questionable accuracy; Do not use

2. EBCDIC input (See Figure 7)

//DATA5 DO *

<u>RECORD</u>	<u>CONTENTS</u>
1	Header (72 alpha characters)
2	'IFL6--8' (skipped)
3	IFL6 in character 5: IFL8 in character 8
	1 Density p.o. 1 data base out
	2 Density p.o. + errors 2 no FT08 output
	3 Error messages only
4-23	Volt/Current conversion tables
24-28	List of turnons lacking microfilm
29-last	Correction cards (last card turn-on = 9999)

CHARS.

1-4	Turn-on	
6	Sun spike	
7	Sat ₁	
8	Sat ₂	
9	Noise	Indicators 1 = present
10	Other	
16-18	Volts	
19-20	Channel	Mass 14 ₁
21-23	Volts	
24-25	Channel	Mass 16 ₁
26-28	Volts	
29-30	Channel	Mass 4
31-33	Volts	
34-35	Channel	Mass 1
36-38	Volts	
39-40	Channel	Mass 14 ₂
41-43	Volts	
44-45	Channel	Mass 16 ₂

OUTPUTS

1. BHDENS Tape 11-337

```
//FT08F001 DD DSN=BHDENS,UNIT=2400-3,
DISP=(NEW,KEEP,LABEL=(,SL,,OUT),
DCB=(RECFM=VBS,LRECL=692,BLKSIZE=27684,DEN=3),
VOL=SER=11337
```

Logical record (1 per turnon) contains:

BASOUT(23,6),KFLAGS(15),OUTPUT(10),MSS(9)

BASOUT (REAL*4) contains for each of the six possible peaks the 22 words of the BLKDBH input record plus number density. Missing fields are filled with 99999.

#_BASOUT	(1, (J)	Turn-on #	
2		Exp number	
3		Mass	AMU
4		G-1	V
5		VS	V
6		Current	amp
*	7	VMag	km/sec
*	8	Alt	km
	9	BxSA	.
*	10	Univ time	sec
*	11	Local time	(recomputed from UT + GLong)
	12	VVxSA	.
*	13	Glat	.
*	14	Glong	.
*	15	Mlat	.
*	16	Mlong	.
	17	SAXS	.
	18	Theta	.
*	19	McIlwain's parameter(L)	Earth radii
	(20)	Day	.
*	21	Solar zenith angle	.
	22	Dip Lat	.
	23	Density	ions/cc

	J:	1	2	3	4	5	6
MASS:	14	16	4	1	14	16	
TREL:	0 sec	14 sec	76 sec	151 sec	205 sec	219 sec	

#1-22 same as BHT#2

* Interpolated if possible

KFLAGS [ALL "INTEGER *4] are as follows

(1) = KWAL	1 = verified	2 = not checked	3 = no film
(2) = NOA	number of original O/A values		
(3) = NOB	number of O/A values including interpolated		

OA Flags:

(4) = 14 ₁	0 = no value
(5) = 16 ₁	1 = original values from BH tape
(6) = 4 ₁	2 = interpolated from accepted points
(7) = 1	
(8) = 14 ₂	3 = interpolated from input points
(9) = 16 ₂	

Value Flags:

(10) = 14 ₁	0 = no value
(11) = 16 ₁	1 = original value
(12) = 4 ₁	2 = value from CORR card
(13) = 1	3 = not present on film
(14) = 14 ₂	4 = saturated (channel 9) - no value
(15) = 16 ₂	5 = new current value only (no OA to compute density)

OUTPUT [INTEGER *4] contains

WORD

(1)	turn-on	
(2)	month	
(3)	local hour	(time/3600 +1)
(4)	altitude code	(alt/10)
(5)	Glat code	((Glat + 90)/10)
(6)	Glong code	(Glong/10 + 1)
(7)	Mlat code	((Mlat + 90)/10)
(8)	Mlong code	(Mlong / 10 + 1)
-(9)	Day of year	
-(10)	Local time * 1000 in hours	

MSS[INTEGER *4] contains the mass index numbers of the input records for the turn-on, in order as read with remaining positions filled with zeros.

2. Density printout lists

(See Figure 5 for sample printout)

3. Error messages (See Figure 6) are:

MERROR: unacceptable mass (input record skipped)

VELER: impossible satellite velocity (input record skipped)

NOERR: number density ≤ 0 (current and number density set to 0 before processing)

BAD CARD INPUT from CORR, i.e. outside the conversion table lists
(value is not used)

COOKBOOK

DATA5 input to the program was prepared as follows:

- | | |
|------------------------|-----------------------------------|
| 1: 72-character header | |
| 2: (skipped) | |
| 3: col 5 IFL6 | 1: data base printout (Figure 5) |
| | 2: data base + error messages |
| | 3: error messages only (Figure 6) |
| col 8 IFL8 | 1: write revised data base |
| | 2: alternate tape output on FT08 |
| | 3: no FT08 output |

Records 4 to 23: Conversion tables for Volts to Current by channel.
(Deck CONTAB) . Last 2 items for each channel are minimum and maximum volts contained in the conversion table for that channel. Implicit volt values are steps of .05 v from .20 v to 1.00 v, steps of .1 v from 1.1 to 5.5 v and steps of 1.0 v from 6.0 v to 12.0 v. Table entries are corresponding current values with an implied exponent of -ch.

Records 24 to 28: List of turn-ons lacking microfilm. Last turn-on entered
(Deck NOMICR) should be 9999.

Records 29 up: Correction cards (See Figure 8). Last turn-on # should be 9999.

PROGRAM MODIFICATIONS

If an alternate FT08 output is desired, the WRITE statement and FORMAT should be inserted at statement 999 and the end signal WRITE if desired at statement 888.

JCL MODIFICATIONS

If no FT08 is desired, replace data set name BHDENS with DUMMY. If alternate FT08 is requested replace with appropriate statement.

TIME ESTIMATE

H02H02 for Data base printout with or without FT08. H01H02 for error printout and no FT08.

Recommendations for Future Data Reduction Procedures Suggested by this Experience:

1. Programmed checks of numbers against valid "real world" limits wherever possible.
2. Refusal to by-pass the above validity checks for the expedient of "getting the data through" -- what gets through is too frequently garbage.
3. Limiting so-called manual reduction to reasonable expectations of the physical capacity of the human instrument. Tired eyes and stupefied brains tend to bypass validity checks also.
4. Where possible two heads are better than one -- both for data reading and proofreading.
5. Plan man-machine interaction into the system from the start. It will happen anyway at some stage so try to design procedures to make it as easy as possible. Utilize the talents of both in the optimum way. Program the computer to do the straightforward menial tasks of checking and conversion, but rather than expending a lot of effort to take care of every conceivable case, simply detect the non-nominal state and refer it back to the human computer for handling. This AE-B IMS analysis program with its "inverse" program capability was a good first step in this direction, but too few built-in checks were employed. The bad orbital data which rendered so many turn-ons unusable was produced from a combination of program and human deficiencies which made it standard procedure in generating the O/A tape to:
 - (1) Ignore on-line messages
 - (2) Use the "bypass" switch setting to continue processing, and
 - (3) Only change to a new minute vector tape when the program demanded it rather than for the correct turn-on number.

Item three would have been bad enough for early turn-ons where the end of a min vector tape was overlapped by refined data on the next tape but was rendered worse by the fact that the program checked for data only and extrapolated, sometimes hours from the last records read in. A simple limit check on location and velocity at some stage should have prevented such data from being introduced into the BHT file, and, noticed and complained about early enough by the "customers", might have induced the operating group to correct the O/A files.

The object of computer applications should be the production of valid results, not the use of computer time.

V. B. Zanner,
Data Analysis Branch

cc: P. H. Smith Code 626
H. Brinton, Code 621
R. Horowitz, Code 601

[illegible]

[illegible]

451869F0
00000000
00000005
00003FB0

1 OF TAPE

• 22.10 =
• 00,01 HR =