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Produced by the NASA Center for Aerospace Information (CASI)
IMS/Satellite Situation Center Report

Daily Summary for
IMS High-Altitude Satellites, Days 1-181 1977

REPORT NO. 7
OCTOBER 1976
IMS/Satellite Situation Center Report

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IMS High-Altitude Satellites, Days 1-181 1977

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October 1976

National Space Science Data Center/
World Data Center A for Rockets and Satellites
National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771
The Satellite Situation Center (SSC) and the Temporary IMS Central Information Exchange (TIMSCIE) Office support the activities of the IMS. In order that their services may be recognized by the agencies funding the IMS in the various countries and by the scientists participating in the IMS program, it would be appreciated if the data presented in this and other SSC publications were acknowledged in those papers where it has been used or proved useful in carrying out the IMS scientific programs.
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I. INTRODUCTION

The purpose of this report is to provide a concise and easily used description of the orbital positions of a number of high-altitude satellites capable of making magnetospheric measurements in the first half of 1977 as part of the International Magnetospheric Study (IMS). Six artificial satellites -- Vela 5B, IMP-H, IMP-J, Solrad 11A, Solrad 11B, and Hawkeye 1 -- have been chosen along with the Moon. Using this report, the principal investigators of the various operable experiments on these satellites and other IMS scientists hopefully can more easily define meaningful programs within the IMS framework to be performed. The Moon has been included because the Apollo lunar surface experiments package (ALSEP) suprathermal ion detector experiments (SIDES) are still operating and can determine plasma parameters as well as identify boundaries. Although present plans are to cease data acquisition of Hawkeye 1 at the end of 1976, it has been included to determine when such data could be extremely valuable. The data coverage for the Vela satellites is expected to be quite small in 1977; for that reason, we have included only Vela 5B in this report.

Only the first half of 1977 is presented here. There are two practical reasons why the whole year is not covered. Firstly, the Solrad satellites are to be maintained close to 180° apart by firing a thruster whenever their angular separation differs from 180° by more than approximately 3/4°. This implies that the orbit of one or both of these satellites will be changed slightly during 1976 and 1977. A 6-month prediction will be more accurate for this pair of satellites than will a 1-year prediction. This is also true for all the other artificial satellites although none of them have active thrusters. Secondly, to conform to the adopted IMS time standard of 1 cm/h, the satellite bar chart we have developed as the basic Satellite Situation Center (SSC) hardcopy product requires two pages to show the positions of the seven satellites for each day. To bind a document of over 400 pages into a single volume is difficult. Consequently, both accuracy of prediction and practicality of publication dictate a document which covers no more than 6 months.

Besides the daily position summary of the satellites, which will be described in detail in Section IV, tables which provide the crossing times of the bow shock and magnetopause, as well as the entry and exit times from the cusp, the high-latitude tail, the midlatitude tail, and the neutral sheet region, are given for each satellite. The supporting types of plots which are available on 35-mm film are also discussed. Based on the study of all available plots, the SSC has identified nine time periods which seem to present unusual opportunities to obtain good coverage of magnetospheric phenomena. However, the primary selection of Special Periods for 1977 will be accomplished by the scientists participating in the IMS, as described in Section II.
II. SELECTION OF SPECIAL OBSERVING PERIODS FOR 1977

The procedures for defining a program of magnetospheric observations in 1977 for the IMS will differ from that used in 1976. Last year, the IMS Steering Committee met at the SSC in early December and considered the predicted positions of six high-altitude satellites (Hawkeye 1, Vela 5B, 6A, and 6B, and IMP-H and -J along with information on synchronous and low-altitude spacecraft. This material, supplied by the SSC, was combined with listings of ground-based rocket and aircraft (GBR) programs as obtained from the IMS Directory No. 2, which were updated by personal knowledge of members of the Steering Committee. On the basis of these deliberations, 18 periods were chosen as Special IMS Periods for 1976. These were announced by the Steering Committee through a four-page letter in late December 1975, and the details were provided in IMS/Satellite Situation Center Report No. 6: Special IMS Periods for 1976.

For 1977, a more coordinated determination of important periods will be accomplished. Suggestions for Special Periods will be solicited by the IMS Steering Committee from the experimenters of satellites, particularly the high-altitude ones given here; and some important intervals based principally on GBR campaigns will also be identified. In addition, the nine periods identified by the SSC in this report will be considered. Two factors make this approach possible. Firstly, the Temporary IMS Central Information Exchange (TIMSCIE) Office located at World Data Center A for Solar Terrestrial Physics at Boulder, Colorado, has been producing a monthly IMS Newsletter throughout 1976 which gives detailed information available on GBR and satellite programs. This information has been gathered and verified by TIMSCIE personnel, using direct, telephone, and TELEX contact with the numerous IMS experimenters; and it represents the most up-to-date status of the various projects. Secondly, the SSC is now able to provide to the high-altitude experimenters predicted positions of such spacecraft in time for the various experimenters to reflect on the confluence of these satellites and to work up Special Periods based on scientific interests and previously approved data acquisition. Special coordination for such intervals can be achieved using the IMS Newsletter and other more rapid forms of communication between principals.

III. TABULAR INFORMATION FOR HIGH-ALTITUDE SATELLITES

The times at which the spacecraft cross magnetospheric boundaries or traverse certain regions provide a most concise description of orbital positions. Magnetopause crossing times are arranged chronologically in Table 1 and identified by satellite. From this display, it is easy to determine the near coincidence of multiple spacecraft crossing this boundary. For example, within the 5-hour period beginning at Day 3, Hour 13.70, Hawkeye 1, IMP-H, Vela 5B, and the Moon, all cross the magnetopause. Similar information for bow shock crossings is given in Table 2. The entry and exit times of satellites from the three regions of the magnetotail -- neutral sheet, midlatitude tail, and high-latitude tail -- are given in
Tables 3, 4, and 5, respectively. These are ordered by entry time into each region.

Hawkeye 1 is the only satellite considered which traverses the cusp or cleft region of the magnetosphere. The entry and exit times for all such cusp passes exceeding 0.3 hour in length are given in Table 6. Because of the nature of the orbit, all these passes traverse the Northern Hemisphere cusp.

The Special Periods recommended by the SSC are presented in Table 7. Although the approximate time corresponding to the region in which each satellite is marked is useful, a more detailed picture can be obtained by referring to the daily bar charts in the Appendix. Six hours should be subtracted from the first time shown, and 6 hours should be added to the last time shown for each period in Table 7 to allow for boundary movements and other factors during data acquisition.

The definition of the regions of space used by the SSC and the symbols denoting them are the same as used in IMS/SSC Report No. 6, but they are given again as Table 8 for completeness.

IV. STANDARD PLOTS FROM THE SSC

The types of plots which the SSC has found most useful have been evolving over the past few years. Since plots for all the high-altitude satellites presented in this report are available on 35-mm film in the SSC standard plots for the first half of 1977, it is useful to display an example of each plot. The Geocentric Solar Ecliptic (GSE) X-Y projection plot shown in Figure 1 has been used for some time by the SSC. However, the means of projection onto the X-Y plane has changed from previous reports, and the positional vector of the satellite is now rotated about the X-axis. This type of rotation is responsible for flattening the orbits of IMP-H and IMP-J in Figure 1. However, this rotation tends to show the position fairly accurately with respect to the bow shock or magnetopause.

However, to show the distance of the satellite from these boundaries, the boundary plot shown in Figure 2 was developed and first presented in IMS/SSC Report No. 6. The distance of the satellite from both the bow shock (marked with an S) and the magnetopause (marked with a P) can be determined for any time. Positive distances are on the concave side of the surfaces. The ecliptic longitude and latitude for these same satellites are given in Figure 3, which is referred to as the longitude/latitude plot. The neutral sheet plot given in Figure 4 shows the distance from the nominal neutral sheet as a function of time. Only the Northern Hemisphere midlatitude tail and high-latitude tail regions are labeled in this plot. The Geocentric Solar Magnetospheric (GSM) X-Y plots for these satellites shown in Figure 5 give the additional coordinates necessary for a three-dimensional picture.
In order to show the position of a high-inclination satellite such as Hawkeye 1, the SSC has employed the Solar Magnetic Coordinate System and produced plots in the magnetic latitude/magnetic local time plane. An example is shown in Figure 6 where time ticks are used to give specific positions.

It should be noted that the sample plots shown in Figures 1 through 6 depict the SSC Special Period No. 3 shown in Table 7. It should be remarked that in all the plots similar to Figures 1 and 6, the time labeling of the boundary crossings is not as accurate as in the tables of Section III where interpolated values are calculated.

The frequency of the above plots and the grouping of satellites on each type of plot for the first half of 1977 are presented in Table 9. These plots are available only on 35-mm film; and for the boundary, longitude/latitude, neutral sheet, and X-Y plots, the time axis on the film is .056 cm/h, which will yield the IMS standard of 1 cm/h when blown back with an 18.25 X magnification lens. The Nonsatellite Data File (NSDF) numbers shown in Table 9 should be quoted by those requesting the microfilm.

Although the previous types of plots are useful in showing positions relative to magnetospheric regions, the limit is about three satellites per plot; and different plots are required in different regions. To present the crude three-dimensional position of all the high-altitude satellites in a single format regardless of the magnetospheric region, the bar charts which comprise the Appendix were developed by the SSC. This is the most concise presentation and allows for all satellites to appear on the same page. In this report each bar chart is 24 hours in length, and this time scale is the IMS standard, 24 cm in length. A three-letter mnemonic is used to represent the various regions of space:

- INP - Interplanetary Medium (I in Table 8)
- SHE - Magnetosheath (DS and NS in Table 8)
- SPH - Magnetosphere (DM and NM in Table 8)
- TAL - Magnetotail (HT, MT, and Sh in Table 8)

The subregions are given by providing the solar ecliptic local time on the bottom line of a satellite box while the second line gives the solar ecliptic latitude. There is one exception; for Hawkeye 1 the magnetic local time and geomagnetic latitude are employed. For both the interplanetary and magnetotail regions, the distance of the satellite from the bow shock and neutral sheet, respectively, is given in Earth radii; the notation \( r \) denotes a negative distance.

A vertical line is drawn in each satellite box when the satellite crosses from one region to the next. The boundary crossings S (bow shock) and P (magnetopause) appear at the crossing time above the satellite box. Thus, on Day 126, the P above the Vela SB box denotes the magnetopause crossing of 5.66 h as found in Table 1. The only other letters that appear
about the boxes are to denote entry \( \mathcal{C} \) to and exit \( \mathcal{C} \) from the cusp. An example of this can be seen in the plot for Day 5. If the interval within the cusp is less than 1 hour, only the letter C will appear above the box as shown on Day 3.
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Table 3. Neutral Sheet Passes, Days 1-181 1977
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Snlrad llB

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5olrad IlA

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5olrad 118

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5olrad 13A

106/6,61

lU6/10.77

5olrad 116

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5olrad 1IB

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116/16.37

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5olrad 118

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5olrad 11H

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Sol rad 11.1

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127/6.39

5olrad 110

21/7,92

22/14.30

Sol rad 11P

52/9,37

S«/ 22,03

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911/!3.75

90/17.09

Vuta SB

127/9.82

127/12.91

Yc la 5B

22/18.76

:2/22.16

5olrad 110

53/1.87

53/8.73

Sol raJ L A

90/16.93

90/17,G9

Snlrad 13A

127/11.48

6'8/11.53

IMP-J

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_'3/x_20

Solrnd 118

$3/15.90

53/16.03

Sol raJ lL1

9]/4.38

91/9,53

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128/]4.71

Ycla 50

23/3.81

23/14.55

INI'-Il

53/18.79

54/2.?6

5olrad IlA

91/14.75

92/8.06

1NI'-If

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Solrnd llA

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23/18,16

Sol: ad 61,1

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51/16.74

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INP-II

127/8.07

127/12.99

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93/2.02

93/7,12

5olrad IIB

129/18.66

55/15.40

5olrad IlB

93/8.97

9415.72

5olrad 118

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150/2.77

55/14.97

13n,/ .37

130/35.18

133118.36

131/7,14

INP-J

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5olrad IIA

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L'e Ia 5H

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27/14.07

Vcla 5H

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74/10.25

94/16.66

Solrnd IIA

132/1.91

27/13.79

27/18,05

Solrnd 118

57/9.79

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27/19.05

5olrad 118

58/14.217

58/17,90

Moon

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95/13.54

5olrad 118

134/17.95

135/4.36

1'e la SB

2"/21.58

ZA/1.79

5olrad ]lA

60/7.28

60/16 88

Sol rad 11A

96/5.66

96/10.21

Snlrad 118

135/9.70

135/16.82

5olrad IlA

28/15.?4

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96/16,68

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Yela SB

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Solrnd 11A

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Snlrad 11.1

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5olrad 118

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Table 3. High-Latitude Magnetotail Passes, Days 1-180, 1977

**ORIGINAL PAGE IS OF POOR QUALITY**
Table 6. Hawkeye 1 Northern Cusp Passes, Days 1-181 1977  
(Only those passes with durations in excess of 0.3 h are shown.)

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<td>177/23</td>
<td>S</td>
<td>P</td>
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*This type of notation indicates that the satellite passed from one to the other of two regions of interest (in this case, from the magnetopause P to the cusp C) at the approximate time shown in column 2.*

*See Table 8 for definitions of symbols.*
### Table 8. Definitions of Regions of Space for Special Periods

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<tr>
<th>Region</th>
<th>Symbol</th>
<th>Definition</th>
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<td>High-Latitude Magnetotail</td>
<td>HT</td>
<td>$X_{GSM} &lt; -10R_E$, $Z_{GSM} - Z_{sh} &gt; 6R_E$</td>
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<tr>
<td>Midlatitude Magnetotail</td>
<td>MT</td>
<td>$X_{GSM} &lt; -10R_E$, $6R_E \geq Z_{GSM} - Z_{sh} \geq 2R_E$</td>
</tr>
<tr>
<td>Neutral Sheet</td>
<td>Sh</td>
<td>$X_{GSM} &lt; -10R_E$, $2R_E &gt;</td>
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<tr>
<td>Dayside Magnetosphere</td>
<td>DM</td>
<td>Magnetosphere for $X_{GSE} &gt; 0R_E$</td>
</tr>
<tr>
<td>Nightside Magnetosphere</td>
<td>NM</td>
<td>Magnetosphere for $0R_E \geq X_{GSE} \geq -10R_E$</td>
</tr>
<tr>
<td>Dayside Magnetosheath</td>
<td>DS</td>
<td>Magnetosheath for $X_{GSE} &gt; 0R_E$</td>
</tr>
<tr>
<td>Nightside Magnetosheath</td>
<td>NS</td>
<td>Magnetosheath for $0R_E \geq X_{GSE}$</td>
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<tr>
<td>Interplanetary Medium</td>
<td>I</td>
<td></td>
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<tr>
<td>Dayside Access Region (cusp)</td>
<td>C</td>
<td>$80^\circ \geq$ Mag. Lat $\geq 75^\circ$, $16h \geq$ Mag. Local Time $\geq 8h^*$</td>
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<td>Bow Shock Wave</td>
<td>S</td>
<td>Corresponds to 420 km/sec Solar Wind Speed</td>
</tr>
<tr>
<td>Magnetopause</td>
<td>P</td>
<td>Corresponds to 420 km/sec Solar Wind Speed</td>
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GSM: Geocentric Solar Magnetospheric Coordinate System  
GSE: Geocentric Solar Ecliptic Coordinate System
Table 9. Satellite Plots for Days 1-181 1977 Available on Microfilm

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<th>Content</th>
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<td>181 pairs of boundary plots and long./lat plots, each showing 1 day for IMP-H, -J, and the Moon.</td>
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<td>181 pairs, as above, for Hawkeye 1.</td>
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<td>181 pairs, as above, for Solrad 11A, 11B, and Vela 5B.</td>
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<tr>
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<td>91 frames of GSE plots, each showing 2 days for Hawkeye 1.</td>
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<td>91 frames of GSE plots, each showing 2 days for Solrad 11A, 11B, and Vela 5B.</td>
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<tr>
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<td>91 frames of SI plots, each showing 2 days for Hawkeye 1.</td>
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Figure 1. Sample GSE Projection
BOUNDARY PLOT

SAT ID: SOLR-11A VELA-5B HAWKEYE1

Figure 2. Sample Boundary Plot
BOUNDARY PLOT
SAT ID: SOLR-11A VELA-5B HAWKEYE1
ECLIPTIC POLAR COORDINATES

Figure 3. Sample Longitude/Latitude Plot
Figure 4. Sample Neutral Sheet Plot
Figure 5. Sample X-Y Plot
MAGNETIC LATITUDE-MAGNETIC LOCAL TIME PROJECTION

Figure 6. Sample SM Projection
APPENDIX

DAILY BAR CHARTS FOR FIRST HALF OF 1977

The bar chart explained in Section IV is used to provide a daily summary for the high-altitude satellites of this report. Referring to Table 7, one sees that the first SSC-recommended Special Period covers the period Day 3, Hour 17 to Day 4, Hour 20. By comparing the bar charts of Day 3 and Day 4 with these table entries, it is easy to see how much additional information the bar chart provides.
DAY 3 1977

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TIME IN HOURS OF DAY
DAY 4 1977

MOON

TAL
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IMP-J

INP
19F 19F 19F 19F 18F 18F 29N 24N 24N 24N 24N 24N 24N 24N 24N
37N 35N 32N 29N 10H 10H 10H 10H 12H 12H 12H

IMP-H

SHE
3H 4H 5H 5H 5H 5H 5H 5H

VELA -5B

TAL
6r 4F 3F 2F 2F 1F 1F 0r 0r 1r 2r 2r 3r 5r 15 16N 16N 16N 16N 16N 16N 16N 16N
44S 32S 17S 17S 17S 17S 17S 17S 22H 23H 0H 0H 0H 0H 0H 0H
22H 23H 23H 23H 23H 23H 23H 23H

TIME IN HOURS OF DAY

0 2 4 6 8 10 12 14 16 18 20 22 24
DAY 5 1977

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DAY 6 1977

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**Time in Hours of Day**

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DAY 8 1977

MOON

S

IMP-J

INP

37S 38S 39S 40S 39S
2F 1F 2F 2F 39S
18H 19H 19H 20H 21H

IMP-H

20F 21F 21F 21F 21F
5S 8S 11S 14S 16S
12H 12H 12H 13H 13H

VELA -5B

51S 54S 53S 45S 27S
17H 19H 20H 22H 23H

TIME IN HOURS OF DAY
DAY 9 1977

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**TIME IN HOURS OF DAY**

**DAY 10 1977**
DAY 11 1977

MOON
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3S — 25 — 2S — 2S
4H — 5H — 5H

IMP-J
6F — 3F — 2F — 1F — 0F — 0F — 1F — 1F — 2F — 2F — 2F — 1F
12S — 8S — 4S — 4N
1H — 1H — 2H

IMP-H
13F — 11F — INP — 9F — 6F — 2F
25S — 24S — 24S — 23S — 21S
17H — 17H — 18H — 18H — 19H

VELA-5B
2F — 3F — 4F — INP — 4F — 4F
36N — 22N — 22N — 8S — 22S
11H — 11H — 12H — 13H — 14H

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DAY 12 1977

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TIME IN HOURS OF DAY

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### DAY 13 1977

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**TIME IN HOURS OF DAY**
DAY 14 1977

MOON

INP

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7H 7H 7H 8H 8H

IMP-J

INP

6r 8r 10r 12r 13r
32N 34N 36N 38N 39N
5H 5H 6H 6H 7H

IMP-H

TAL

9r 7r 5r 8r 10r
2S 0N 3N 6N 9N
22H 22H 23H 23H 24H

VELA -5B

TAL

2r 3r 8r 11r
5S 12N 36N 43N
0H 1H 2H 3H

SPH

52N 5H

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**TIME IN HOURS OF DAY**

**DAY 15 1977**
DAN 16 1977

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TIME IN HOURS OF DAY

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DAY 22 1977

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TIME IN HOURS OF DAY

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**Day 30 1977**

**Time in Hours of Day**
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**Time in Hours of Day**

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DAY 32 1977

MOON

5S  5S  5S  5S  5S
21H 22H 22H 22H 22H

IMP-J

12F  11F  9F  6F  4F
32S  35S  38S  40S  40S
15H  16H  17H  17H  18H

IMP-H

17F  18F  19F  19F
0N  3S  7S  10S  13S
9H  9H  10H  10H  11H

VELA-5B

41S  36S  1F  1F  1F  2F  2F  2F  1F  1F
21H 21H  1F  1F  1F  2F  2F  2F  1F  1F

SPH

1F  1F  1F  1F  2F  2F  2F  2F  1F  1F

TAL

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**TIME IN HOURS OF DAY**

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- 2
- 4
- 6
- 8
- 10
- 12
- 14
- 16
- 18
- 20
- 22
- 24

**DAY 33 1977**
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TIME IN HOURS OF DAY

DAY 35 1977
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DAY 37 1977

MOON

SHE

4S  3S  3S  3S  3S
2H  2H  2H  2H  2H

P

IMP-J

TAL

SHE

6r  13r  15r
15N  19N  21N
1H   1H   2H

IMP-H

INP

SHE

9F  7F  4F
16S  14S  12S
18H  18H  19H

VELA-5B

TAL

SHE

2r  3r  4r  6r  8r  10r
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22H  23H  0H  2H

TIME IN HOURS OF DAY
DAY 37 1977

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TIME IN HOURS OF DAY

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DAY 38 1977

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TIME IN HOURS OF DAY

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### DAY 39 1977

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**Day 40, 1977**

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RAD  
-11B

TAL
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5N 4N 3N 1N
2H 4H 5H 6H

SPH

SHE

0r 0N 7H

HAWK  
EYE-1

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11H
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SPH
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57N 24S

2N 8H

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DAYS 44 1977

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DAY 45 1977

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**TIME IN HOURS OF DAY**

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DAY 50 1977

MOON
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4N    3N    3N    3N    3N
13H   13H   13H   13H   13H

IMP-J
11^r  26N   29N   31N   33N   35N
1H    2H    2H    2H    3H

IMP-H
8^r   5^r   8^r   6^r   2^r   1^r   1^r   0^r
10S   8S    6S    4S    3S    0N
18H   18H   19H   19H

VELA -5B
6^r   5^r   53S   53S   45S   27S   19S
15H   17H   19H   20H   21H

SHE

INP

SHE

SPH

TAL

TIME IN HOURS OF DAY
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DAY 51 1977

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TIME IN HOURS OF DAY

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DAN 51 1977

SOL
RAD
-11A

S

INP
SPH

SOL
RAD
-11B

INP
SPH

HAWK
EYE-1

SHE

TIME IN HOURS OF DAY
DAY 53 1977

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**TIME IN HOURS OF DAY**

**DAY 54 1977**
DAY 54 1977

SOL RAD -11A

SHE

0N
18H

SPH

2N
19H

TAL

3N
20H

4N
21H

5N
22H

SOL RAD -11B

SHE

0r
1F
2r
3r
4r
5r

INP

1S
3S
4S
5S

7H
8H
9H
10H

HAWK EYE-1

SHE

64N
68N
8H

SPH

75N
14H

20H
8H

29N
7H

SHE

28N
8H

30N
8H

P

TIME IN HOURS OF DAY
DAY 55 1977

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TIME IN HOURS OF DAY
DAY 55 1977

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5N  6N  6N  1H  5N  4N
22H  24H  1H  2H

SOL RAD -11B
5^R  5^R  5^R  4^R  3^R
5S  6S  6S  5S  4S
10H  11H  12H  13H  15H

HAWK EYE-1
30N  46N  70N  65N  59N
8H  9H  8H  7H  8H

TIME IN HOURS OF DAY
DAY 56 1977

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TIME IN HOURS OF DAY

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- **20H**

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#### IMP-H
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- **22S**
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- **14H**

#### VELA-5B
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#### SHE
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DAY 61 1977

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TIME IN HOURS OF DAY

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DAY 62 1977

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DAY 64 1977

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SHE

S

P

SPH

TAL

9r

11r

0r

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P

INP

3r

4s

S

T

H

EYE-1

HAWK

SHE

SPH

0

2N

4N

7H

58N

9H

8N

5H

79N

8H

TIME IN HOURS OF DAY

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**Time in Hours of Day**

**DAY 67 1977**

**SHE**

**INP**

**VELA-5B**
### Day 67 1977

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**TIME IN HOURS OF DAY**

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## DAY 68 1977

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DAY 69 1977

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4H 4H 4H 5H 5H

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33S 37S 39S 39S 38S
13H 14H 15H 16H 17H

IMP-H
18F 19F 20F 21F 22F
13S 15S 17S 19S 21S
8H 9H 9H 9H 10H

VELA-5B
49S 39S 25S 6S
17H 18H 19H 5S

SHE SPH TAL

TIME IN HOURS OF DAY
0 2 4 6 8 10 12 14 16 18 20 22 24
DAY 69 1977

SOL RAD -11A

INP
2 1 0
2 1 15 16

SHE
1 17
18

SPH
3 19
20

SOL RAD -11B

TAL
6 5
3 2
3 4

SPH
1 4
1 5
2 6
3 7
4 8

SHE

INP
0 1 2
0 1 4

SPH
55 36 10 26 29
55 36 10 26 29

SHE
29 31
29 31

HAWK EYE-1

SHE
64 67 74
64 67 74

SPH
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SHE
29 31
29 31

TIME IN HOURS OF DAY

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D IP 70 1977

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DAY 72 1977

SOL RAD -11A

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## DAY 76 1977

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**DAY 80 1977**

**TIME IN HOURS OF DAY**

- SOL RAD -11A
- SOL RAD -11B
- HAWK EYE-1

- SHE
- SPH
- TAL
- INP
- C
- P
DAYS 81 1977

TAL
4F 3F 2F 2F 1F 0F 0F 1F 2F 3F 7F 9F
6N 5N 3N 2N 0N
23H OH 2H 3H 4H

INP
5F 5F 4F 3F 2F 1F
6S 5S 4S 3S 1S 15H
11H 12H 13H 14H

SHE
41N 59N 77N 69N 68N 71N
7H 8H 6H 5H 6H 7H

TIME IN HOURS OF DAY
DAY 82 1977

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**DAY 84 1977**

TIME IN HOURS OF DAY
DAY 84 1977

SOL RAD -11A

INP
5T 4T 2T 1T 0T
4S 2S 1S
13H 14H 15H

SHE
1N 16H 18H

SOL RAD -11B

TAL
0T 0T 0T 0T 0T 0T 1T 1T 1T 2T 3T
4N 3N 1N
1H 2H 3H

SPH
8T 0T
1N 4H

SHE
1S 2S
4H 5H

HAWK EYE-1

SHE
65N 69N 74N 55N 53N 11N 26N 29N 29N
7H 8H 13H 17H 18H 6H 6H 6H 6H 6H

SPH
11N 26N 29N 32N

SHE
29N 29N 6H

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DAYS 86 1977

SOL RAD -11A

TAL
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6N 5N 4N 3N 1N
22H 24H 1H 2H 3H

SOL RAD -11B

INP
5F 5F 5F 4F 4F
6S 6S 5S 3S 2S
10H 11H 12H 13H 14H

HAWK EYE-1

SHE
60N 69N 76N 75N 42N 35N 10N 18N 21N 27N
69N 76N 75N 42N 35N 10N 18N 21N 27N
7H 12H 15H 18H 6H 6H
9H 12H 15H 18H 6H 6H

SPH

TIME IN HOURS OF DAY
0 2 4 6 8 10 12 14 16 18 20 22 24
DAY 87 1977

MOON

25^R  23^F  21^F  19^F  18^F
5S   5S   5S   5S   5S
18H  18H  18H  19H  19H

IMP-J

33N  35N  36N  37N  38N
24H  0H   1H   1H   1H

IMP-H

11^F  9^F  6^F  3^F  1^F 0^r
0N   3N   6N   9N   12N
17H  17H  18H  18H  19H

VELA -5B

3^F  2^F  1^F 0^r
47S  53S  52S  44S
11H  13H  15H  16H

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**TIME IN HOURS OF DAY**

DAY 87 1977
DAY 88 1977

MOON
17F — 15F — 12F — 10F — 8F
5S — 5S — 5S — 5S — 5S
19H — 19H — 19H — 19H — 20H

IMP-J
38N — 39N — 39N — 39N — 38N
2H — 2H — 2H — 3H — 3H

IMP-H
12N — 15N — 18N — 20N — 22N
19H — 19H — 20H — 20H — 21H

VELA-58
32S — 17S — 9S — 16N — 11r — 13r
18H — 18H — 19H — 20H — 24N — 32N

TIME IN HOURS OF DAY

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### DAY 89 1977

#### MOON

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- SOL RAD -11B
- HAWK EYE-1

**DAY 97, 1977**
DAY 99 1977

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**TAL**

**SPH**

**SHE**

**TIME IN HOURS OF DAY**
DAY 100 1977

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DAYS 101 1977

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TIME IN HOURS OF DAY
DAY 102  1977

MOON

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**TIME IN HOURS OF DAY**
DAY 105 1977

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TIME IN HOURS OF DAY

0  2  4  6  8  10  12  14  16  18  20  22  24
DAY 106 1977

MOON

- 47F - 47F - 48F - 48F - 48F
- 2N - 2N - 2N - 1N
- 10H - 11H - 11H

IMP-J

- 13F - 12F - 12F - 11F - 10F
- 37S - 35S - 32S - 28S - 24S
- 14H - 15H - 16H - 16H - 17H

IMP-H

- 11F - 13F - 15F - 17F - 18F
- 15S - 17S - 19S - 21S - 22S
- 6H - 6H - 7H - 7H - 8H

VELA -5B

- 2F - 1F - 1F - 0F - 0F
- 53S - 45S - 38S - 24S - 24S
- 13H - 15H - 16H - 17H - 18H

S

INP

TIME IN HOURS OF DAY

0 2 4 6 8 10 12 14 16 18 20 22 24
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**TIME IN HOURS OF DAY**

0  2  4  6  8  10 12 14 16 18 20 22 24

*DAY 107 1977*
DAY 108 1977

SOL RAD
-11A

S

INP
0r 1r
5S 5r
6S 6r
7H 9H

P

SHE
3S 5S
6H 6H

INP
1r 0r
3N 4N
5N 6N
6H 21H

P

SHE
4N 5N
6N 21H

SPH
5N 6N
6H 21H

TAL

HAWK EYE-1

33S 7N 25N 37N 46N 52N 53N 49N 44N 43N 46N

0 2 4 6 8 10 12 14 16 18 20 22 24
TIME IN HOURS OF DAY

TIME IN HOURS OF DAY

0 2 4 6 8 10 12 14 16 18 20 22 24

TIME IN HOURS OF DAY

0 2 4 6 8 10 12 14 16 18 20 22 24

TIME IN HOURS OF DAY

0 2 4 6 8 10 12 14 16 18 20 22 24
**DAY 109  1977**

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DAY 110 1977

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TIME IN HOURS OF DAY

DAY 110 1977
DAY 111  1977

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### Day 111 1977

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DAY 112 1977

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DAYS 117 1977

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DAYS 119 1977
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DAYS 123 1977

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- **SOL RAD -11B**

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DAY 132  1977

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7H ——— 8H ——— 8H ——— 8H ——— 8H

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16H ——— 16H ——— 17H ——— 17H ——— 17H

IMP-H
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VELA-5B
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DAYS 136 1977

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### DAY 137 1977

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TIME IN HOURS OF DAY

DAY 137 1977
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**Day 138, 1977**

**Time in Hours of Day**
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**TIME IN HOURS OF DAY**

**DAY 152 1977**
DAY 154 1977

MOON

TAL

SHE

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IMP-J

INP

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34S 36S 38S 37S
8H 8H 9H 10H

IMP-H

TAL

SHE

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4S 8S 11S 15S
1H 1H 2H 2H

VELA-

SHE

SPH

TAL

5B

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0  2  4  6  8  10  12  14  16  18  20  22  24

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**TIME IN HOURS OF DAY**

0  2  4  6  8  10  12  14  16  18  20  22  24
### Day 160, 1977

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**Time in Hours of Day**

0  2  4  6  8  10 12 14 16 18 20 22 24
DAY 161  1977

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TIME IN HOURS OF DAY

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|------|------| |------| |------| |------| |
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| 8H   | 8H   | | 8H   | | 8H   | | 9H   | |
| SHE  | TAL  | |      | |      | |      | |
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| 23H  | 23H  | | 24H  | | 24H  | | 0H   | |
| INP  |      | |      | |      | |      | |
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| 15H  | 15N  | | 22N  | | 23N  | | 24N  | |
|      |      | | 16N  | | 16N  | | 17N  | |
|      |      | |      | |      | |      | |
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| 51S  | 42S  | | 29S  | | 14S  | | 3N   | |
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**TIME IN HOURS OF DAY**
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**DAYS 163 1977**

**TIME IN HOURS OF DAY**

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DAY 163 1977

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**Time in Hours of Day**

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**TIME IN HOURS OF DAY**

0 2 4 6 8 10 12 14 16 18 20 22 24
### DAY 165 1977

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**TIME IN HOURS OF DAY**

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DAY 167 1977

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INP

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49F

45
4S

12H
12H
12H
12H

IMP-J

INP

12F
13F
14F
15F

13S
37S
35S
32S

10H
10H
11H
12H

IMP-H

TAL

21S
21S
21S

17F
17S
17S
17F

2H
2H
2H
2H

VELA-5B

INP

2F 1F 1F 1F 1F

3F
3F
3F
3F

8S
8S
8S
8S

13H
13H
13H
13H

SHE

18N
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26N
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TIME IN HOURS OF DAY
DAY 167 1977

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TIME IN HOURS OF DAY

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DAY 169  1977

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**DAY 169 1977**

**TIME IN HOURS OF DAY**
DAY 170 1977

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|              | 16H      |         |         |         |

| HAWK EYE-1   | SPH 3N 44N 41N 38N 55N | SHE 0H 0H 0H 2H |
|              | 1H       |          |         |         |

**TIME IN HOURS OF DAY**

**DAY 170 1977**
DAY 172 1977

| SOL RAD -11A |  | SHE |  |
|--------------|  |     |  |
| 4F           |  | 1F  |  |
| 5N           |  | 6N  |  |
| 14H          |  | 16H |  |

| SOL RAD -11B |  | SPH |  |
|--------------|  |     |  |
| 6F           |  | 6S  |  |
| 4S           |  | 4H  |  |
| 1H           |  | 3H  |  |

| HAWK EYE-1   |  | SPH |  |
|--------------|  |     |  |
| 50N -24S -21N -34N -38N -38N -36N -34N -34N |  | 37N -43N -52N |
| 11H -0H -0H |  | 23H |  |
| 0H -0H -0H  |  | 0H  |  |

TIME IN HOURS OF DAY

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DAY 175 1977

SOL RAD -11A

SOL RAD -11B

HAWK EYE-1

TIME IN HOURS OF DAY
### Day 176 1977

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DAY 177  1977

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DAY 178  1977
DAY 179 1977

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21H 21H 22H 22H

IMP-J
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39S 38S 36S 33S 29S
8H 9H 10H 10H 11H

IMP-H
15F 12F 12F 22S 23S
17S 19S 20S 3H 3H
1H 2H 2H

VELA-5B
2F 2F 2F 3F 8F 16F
7N 8S 21S 32S 45S
1H 2H 2H 3H 4H

TIME IN HOURS OF DAY
DAY 179  1977

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DAY 180 1977

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|   | 19H| 19H| 19H| 19H|

| HAWK EYE-1 | SHE | SPH |
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|            | 2H  | 3H  |
|            | 3H  | 4H  |
|            | 3H  | 3H  |
|            | 85N | 89N |

TIME IN HOURS OF DAY
DAY 181 1977

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