



Updated Apollo 15 LRRR (300 Corner)
Pointing Analysis for Hadley Rille

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ATM-1021	
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This report summarizes the results of the Apollo 15 LRRR pointing analysis conducted for the final site coordinates specified for Hadley Rille and for the planned prime and possible contingency deployment times. The data presented supersedes that given for the Hadley Rille site in ATM-933.

Prepared by: K. Wainio JWB
K. Wainio

Approved by: J. Brueger
J. Brueger



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This report summarizes the results of the Apollo 15 LRRR pointing analyses conducted for the final site coordinates specified for Hadley Rille and for the planned prime and possible contingency deployment times. The analysis provides the parameter values for the array tilt angle and the shadow mark angle which are necessary to properly align the experiment on the lunar surface. These parameters are used to set the sun compass plate angle, the leveling leg stop and leg length and the sun compass shadow mark settings.

The site coordinates used are defined in reference A. Preliminary information provided in telecon discussions between BxA and NASA/MSC personnel was the basis for the analysis and the data was confirmed by reference A. The planned deployment times used in the analysis were provided in reference B and are generally compatible with EVA start times and deployment times given in references A and C, respectively.

1. ANALYSIS RESULTS

The pointing angles required to aim the LRRR array to the mean position of the earth from the Hadley Rille site are summarized in Table 1. The final coordinates defined for the site, which are the basis of the calculated data, are also given for reference purposes. Data are included for Apollo launch during each of the months of July through December, 1971. Emplacement would then occur during the last week of each month.

The position of the shadow mark line on the LRRR sun compass is dependent on the time at which the LRRR experiment is emplaced on the lunar surface. The shadow mark locations have been evaluated for emplacement at various times, as expressed in terms of sun angles. Table 1 provides data for sun angles of 15° and 25° . Sun angle, as used here, is defined as $90^{\circ} - (\text{Longitude of sun} - \text{Longitude of Site})$, where the longitude of the sun is related to the Greenwich Mean Time (GMT) and the date as given in Ephemeris data. The sun compass gnomon is assumed to be vertical, which is the case for the LRRR (300) design, since the sun compass assembly is required to be adjustable for all lunar sites. The design parameters given are defined in Figure 1.



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TABLE 1

Pointing Angle Requirements at Hadley Rille

Hadley Rille

Coordinates: $3^{\circ} 39' 14''$ E
 $26^{\circ} 4' 26''$ N

Array Tilt Angle: 26.426°

Orientation of Tilt Axis: 81.73° East of South

Shadow Mark Angles:

Emplacement at 15° Sun Angle

July 1971	181.77
August	181.04
September	180.46
October	180.17
November	180.28
December	180.91

Emplacement at 25° Sun Angle

July 1971	176.90
August	176.15
September	175.55
October	175.26
November	175.38
December	176.05

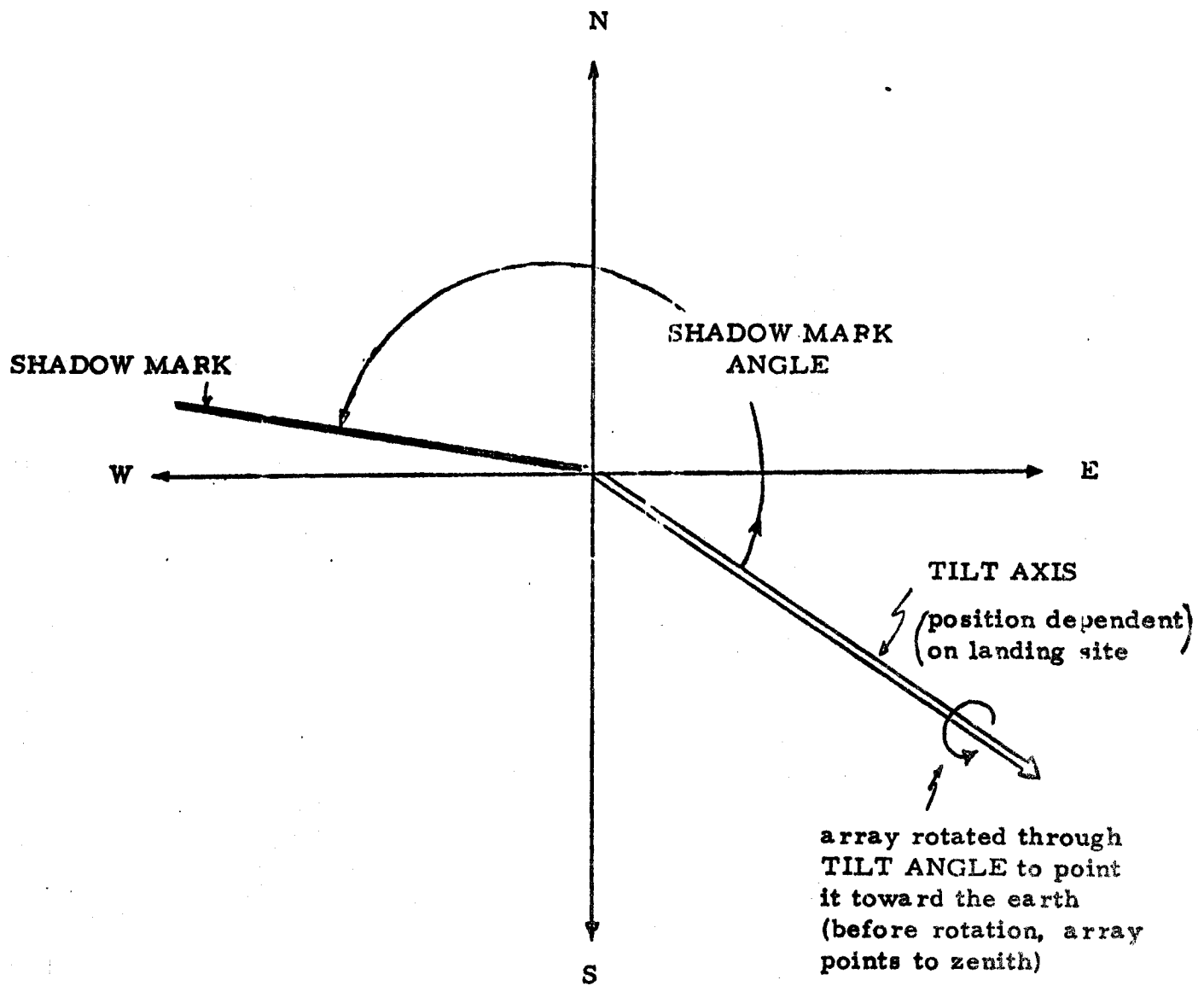


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Figure 1 Illustration of Pointing Parameters





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The array tilt angle is a function only of the lunar deployment site. To provide a more convenient presentation of the sun shadow mark setting data, this parameter has been plotted versus sun angle and deployment time (GMT and date) as shown in Figure 2.

2. RECOMMENDED SUN COMPASS SETTING

From information provided in reference B, the deployment time of the LRRR during EVA 1 is given as 1829 GMT, 31 July 1971. From Figure 2, the proper compass setting is seen to be 177.6° . This setting has been incorporated in the LRRR flight model by ECN 2347200-501 D (CRD 62134). It can be seen that the setting is not strongly sensitive to time (i. e. , only a 0.5 degree error results from a ± 2 hour change in deployment time).

3. CONTINGENCY ALIGNMENT

Information has also been provided in reference B to define the time for a possible contingency deployment of the LRRR during the second EVA. The compass setting required for the contingency deployment time, given in reference B as 1300 GMT on 1 August, is 172.6° . This represents a 5° clockwise change from the prime deployment setting.

In the event that deployment is required at the contingency time given, it is recommended that the LRRR be aligned such that the gnomon sun shadow line is set on the line marking identified with a + on the LRRR sun shadow plate, rather than on the center marking. This line, identified by a +, is designed to be at 5° clockwise from the center mark and will therefore compensate for the movement of the gnomon sun shadow line from the prime deployment time to the contingency time.



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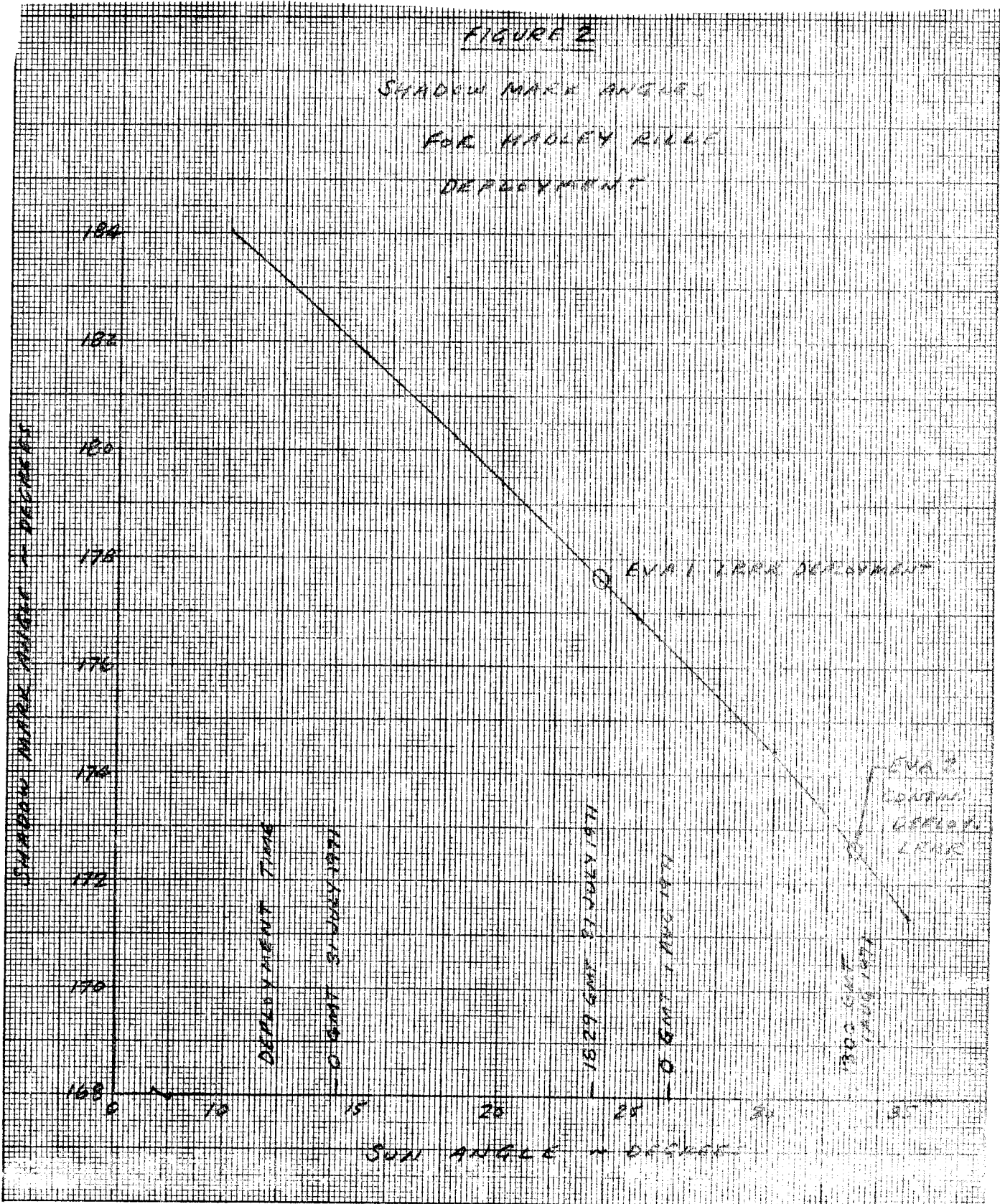
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Subject: Apollo 15 and 15 Landing Coordinates and Sun Angle
Data.
- B. Bendix Contact Report 978-951-120 dated 6 May 1971,
Subject: Apollo 15 Landing Site Coordinates and Sun Elevation
Angle and Shadow Line Azimuth.
- C. NASA Document, Apollo 15 Preliminary Lunar Surface
Procedures, MSC, April 30, 1971.