

P. RYE

MIT/IL SOFTWARE ANOMALY REPORT

ASZ REFERENCE NO. J-113-03
PROGRAM LUMINARY 1B
PROGRAM REVISION Rev 116

1.1 ORIGINATOR: R. GOSS	1.2 ORGANIZATION: MIT/IL	1.3 DATE: 8/27/69	1.4 ORIGINATOR CONTROL NO.
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1.5 DESCRIPTION OF ANOMALY:

The quantity COEFFR, computed in the 1/ACCS Program, will be incorrectly determined to be an extremely small (essentially zero) value whenever the quantities 1JACCQ and 1JACCR are equal. In the present program (and previous programs), 1JACCQ and 1JACCR must differ by at least one bit and the anomaly is not observed. Modifications in future programs, however, might result in the occurrence of the anomaly. In particular, if values of LM descent mass...

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1.6 DESCRIPTION OF RUN:

The hybrid simulator was used with Luminary 116. The fixed constant HDESCNT was changed to allow higher values of LM descent mass to be used in the computations of 1JACCQ and 1JACCR. A mass was loaded in such that 1JACCQ and 1JACCR were computed to be exactly equal. Under these conditions the anomaly...

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- MIT ANALYSIS -

2.1 CAUSE:

In the "COMMEQS" section of 1/ACCS, the expression $(1JACCQ - 1JACCR) / 1JACCR$ is computed whenever 1JACCR is greater or equal to 1JACCQ.

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2.2 RECOGNITION:

The occurrence of the anomaly would result in a buildup of attitude errors and error rates about the Z-axis during each two-second interval in which the anomaly occurs.

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2.3 MISSION EFFECT:

The anomaly cannot occur for the present program. If it were to occur in a future program, control would be lost about the vehicle Z-axis for every two-second period in which the quantities 1JACCQ and...

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2.4 AVOIDANCE PROCEDURE:

For powered descent, the value of initial LM descent mass loaded into the computer should be selected to lie below the regions in which the anomaly can occur.

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2.5 RECOVERY PROCEDURE:

If anomaly were to occur in powered ascent, the DAP would automatically begin correcting errors at the end of the two-second interval. In powered...

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2.6 PROGRAM CORRECTION:

To correct anomaly, a ZL instruction should be added at "COMMEQS" in the 1/ACCS section.

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2.7 RECOMMENDED DISPOSITION (Fix, Work-around, etc):

For missions after Apollo 12, fix should be made.

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2.8 RECOMMENDED RE-TESTING:

When fix is made, above testing should be repeated.

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2.9 MIT/IL SIGNATURE: <i>P. Rye</i>	2.10 DATE: 8/27/69
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3.1 NASA DIRECTION:

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4.1 CLOSING ACTION TAKEN:

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3.2 NASA/ASZ SIGNATURE:	3.3 ORGANIZATION:	3.4 DATE:	4.2 SIGNATURE:	4.3 ORGANIZATION:	4.4 DATE:
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1.5 Description of Anomaly, cont'd.

∴ exceeding 16120 Kg were to be allowed in computing 1JACCQ and 1JACCR, then for various intervals of mass, 1JACCQ and 1JACCR could be equal. (The fixed constant IIDESCNT would have to be increased for this situation to occur.) Also, if the coefficients used to compute 1JACCQ and 1JACCR as a function of mass were to be modified, the anomaly might occur in either descent or ascent.

1.6 Description of Run, cont'd.

...was observed. Examination of individual computations provided an explanation for the anomaly.

2.1 Cause, cont'd.

The result of this computation should be either a negative number or zero. However, when $1JACCQ = 1JACCR$, a non-zero positive number may result from the division. This results from the fact that 1JACCQ and 1JACCR are single precision numbers, and the division computation uses both the upper and lower accumulators for the numerator. Since L was not zeroed before the computation, a positive number rather than zero can result from the division. This quotient is later subtracted from NEGMAX leading to an overflow and the subsequent incorrect value for COEFFR.

2.3 Mission Effect, cont'd.

...1JACCR were computed to be equal. If the anomaly were to occur during powered ascent, it would not be expected to exist in more than one two-second period. In descent, however, it could conceivably occur for several two-second periods. Appropriate action could prevent necessity for mission abort.

2.5 Recovery Procedure, cont'd.

...descent, it would be necessary for the astronaut to decrease the value of mass (through R03) to a value which lies below the regions in which the anomaly can occur.