

### Program Status - M074 and M172

1. There has been a considerable degree of inefficiency in the development of mass measurement hardware in support of experiments M074 and M172. This has resulted from the advanced state of the development of the instruments, and USAF efforts to press on with the flight qualification and production of flight units. It appears in retrospect that this has been premature. Changes in plans for the SIVB workshop configuration and in environmental loading specifications have occurred repeatedly. So have the NASA scientific and technical requirements changed frequently. These changes have caused several major redesign efforts, and forced us to abandon a nearly completed flight qualification program including documentation.

At the present time we are holding a contract procurement pending the receipt of information from the NASA concerning 1) revised environmental specifications and possible changes in the configuration, stowage and use of the equipment resulting from the decision to launch the workshop dry, and 2) plans to fly the SMMD on an Apollo lunar flight.

2. The original SMMD experiment protocol submitted by USAF in November 1966 required an engineering flight prior to a mission wherein the instrument would be used to obtain data for other experiments. The objectives of such a flight experiment are:

a. To confirm theoretical and ground laboratory predictions of instrument performance in space in regard to dynamic interrelations with the spacecraft, (factors such as mass, orientation, relative centers of mass, vibration, acceleration, air currents, temperature, etc.), measuring standard fixed and liquid masses.

b. To obtain operational experience and an evaluation of crew procedures and time lines.

c. The foregoing would enable further optimization of instrument design prior to use in the AAP workshop.

There is a flight design of the SMMD using battery power now available that is completely suitable for an Apollo flight. Two instruments have been built and could be used in such a program, either as training and flight qualification units, or with some component replacement as flight units. The previously accomplished R&QAdocumentation with appropriate changes and additions can be used.

3. For the Apollo Applications Program we believe there are two categories of effort that will be required in the hardware acquisition program. The first category includes design changes imposed by newly established scientific requirements or by the need to utilize new state-of-the-art components. These efforts will be required irrespective of the flight vehicle used. The second category includes design changes required in relation to the specific flight vehicle and spacecraft configuration.

It is apparent that an array of mass measuring instruments will be needed in all space station missions beginning with AAP and continuing into subsequent larger systems. It would seem most economical and efficient to perfect the instruments, and minimize changes in them as defined in category two above, by the provision of shock and vibration isolation and appropriate interface subsystems as required in the new vehicle, without changing the basic instrument.

4. Together with representatives of NASA/MSC (See Atch 1) we have identified the following as possibly required for AAP (dry launch). Some of them necessitate decisions by NASA concerning scientific or technical requirements.

#### Category 1

1) Conversion of visual display on the instrument from Pin lites to light emitting diodes. (SMMD and BMMD)

2) Study and appropriately reduce the number of digits in the visual display. (SMMD and BMMD)

3) Convert the visual display information from time to actual mass. (SMMD and BMMD).

4) Study and document the accuracy of liquid mass measurement, and redesign the weighing pan and sample restraints to optimize that accuracy. (SMMD)

5) Increase the capacity of the SMMD from 1 to 2 Kgm.

6) Provide a data output (oscillation period, not converted to mass) to the space craft data system. (SMMD and BMMD)

7) Study and provide means to automate acquisition of data necessary to the use of the instruments including mass data (period of oscillation), instrument temperature, time, crewman, sample identification. (SMMD and BMMD)

Items 3), 5), 6), and 7) necessitate decisions from NASA concerning their requirements. The investigators feel that they all would improve the effectiveness of the mass measurement program.

#### Category 2

1) Provision of vibration and shock isolation (mounting plate or box). (SMMD and BMMD)

2) Provision of thermal isolation (from spacecraft structure, not atmosphere). (SMMD and BMMD)

These items require the establishment of environmental specifications and determination of AAP configuration by NASA prior to further MMD development.

5. All of the foregoing was discussed at a coordination meeting 31 July 1969 (See Atch 1). NASA has not been able to resolve the action items resulting from the meeting (recapitulated above) as of this date.

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Memo For the Record,  
31 July 1969