

[June, 1990]

W/SA

Lyndon B. Johnson Space Center  
Houston, Texas  
77058

Reply to Attn of

SD/90-138

TO: Distribution

FROM: SD/William E. Thornton, M.D.

SUBJECT: Status of Treadmills in the Current STS Program

Development of treadmills (TM) for U.S. space flight began with Skylab IV, and as resources and conditions allowed, has progressed through five ground prototypes and a flight model. The second ground prototype (1974) also became the first true TM to fly (approximately 10 flights) and somewhat degraded copies of that unit are now the standard STS TM, a 16-year old design that was always recognized as having many limitations. A design for an adequate unit is now complete and could be built and be flown in 9 months, but it will almost certainly be more than 1 year before a replacement is at hand.

In the meantime, the originally inadequate TM has been further compromised while at the same time it is the only flight exercise device available<sup>1</sup> and is being pushed far beyond its intended limits. It should not be surprising that there is increasing criticism of this unit including a recent Detailed Supplementary Objectives whose hypothesis was that the TM in space was an inadequate (leg) exercise. Much of the current and future DSO research program is in large part built around this device.

Some of the problems and their causes include: There are no valid maintenance, inspection and test procedures. The contractor was never tasked or even contacted to provide inspection, maintenance, or other procedures. Instead the support contractors (SC) have evolved (documented ?) tear down, inspection, and wipe down procedures which at one time included removal of surface lubricant. Both the fabrication contractor and I have made repeated verbal pleas that we be allowed to develop such procedures in cooperation with the SC. At one time I ran on every TM at every grade and speed and measured their 1-g performance prior to flight with the support of the S.C. but this procedure appears to have been dropped. I have offered repeatedly to establish objective 1-g standards and performance limits that would allow the S.C. to perform such testing and ensure reliable, repeatable performance.

Additional harnesses have been fabricated, and the shoulder straps are too short.

1. A flight rowing machine has been delivered and is in the certificate process.

Some results possibly related to the above include: There was excess wear of bogies and associated links on some TM's. They ran in the surface lubricated tracks which had been wiped dry.

There is large performance variation from TM to TM; and so far as can be determined, no such information is provided the user/investigator. There are reported to have been complaints of excess shoulder load and pain which would be consistent with short shoulder harness.

Of more concern is the current investigative use of a device that was never tested and is not adequately instrumented. While there are many inherent limitations in this TM, knowledge of its performance and limitations and utilization of it accordingly would reduce many current problems. For this reason, a flight Detailed Test Objective proposal is being made which will do simple static force load measurements, tread speeds, and estimates of equivalent elevation angles. This would be followed, if appropriate, by biomechanical and kinematic studies. Criticisms would be documented and corrected as possible. This could be done in parallel with or prior to any further DSO testing. The data and other information obtained would be analyzed and used to prepare an operating manual.

The suggested procedures would allow standard procedures for maintenance, standards for performance and operating procedures and limitations for the TMs. This should aid both operations and investigations.



William E. Thornton, M.D.

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