

Lyndon B. Johnson Space Center
Houston, Texas
77058

NOV 02 1989

Reply to Attn of:

SD-89-121

TO: Distribution
FROM: SD/Dr. William E. Thornton
SUBJECT: Exercise Hardware Development

Hardware status: Isometric force measuring unit, see attached memo SD-89-120. Other units are scheduled as below:

<u>Item</u>	<u>Delivery Date</u>
Treadmill #1	November 15th
Subject weight load unit #1	December 15th
Rowing machine	February 15th
Isotonic exerciser	February 15th
Treadmill #2	May 15th
Subject weight load unit #2	June 15th
Prototype Ergometer	June 15th

As noted in a previous memo, work is proceeding rapidly on the contract. We should be able to do a significant amount of testing of the treadmill prior to end of the year and a meeting for planning of this with MACDAC or other support personnel is in order. My chief concerns are belt wear and noise with increased wear and addition of optional motor drive to the treadmill.

As verbally presented to you, it would expedite development if we could purchase an existing test article treadmill, equipped with cycle counters that would allow extensive belt life and other component testing for the treadmill itself will be needed for a variety of other tests. This item if procured by a contractor can be delivered in 2 weeks.

We should also purchase a motor drive for the treadmill for while I have worked with all varieties of treadmill, there is no experience available on low friction, motor driven units for none have been previously built.

We need to start DTO's on flight items now.

If advantage is to be taken of the second contract phase, we should fund it now and begin processing for we had 180 days to exercise this option, i.e., have the second phase contract let and there is hardly time now. We know enough to specify and build a flight treadmill for EDO and if this is started now it can be flight tested and ready.

We also should extend the contract to build a recording isometric force measuring unit which would have been part of the original contract had funds been available.

We should also test a shock/vibration isolation unit ASAP and might possibly have a test unit for EDO but the development of this is going at an incredibly slow pace.

I am hurting for time to try to implement the above and badly need useful support.



William E. Thornton, M.D.

Enclosure

SD:WEThornton:nlf:11/1/89:32785

Distribution:

SD/S. Pool

SD/T. Brown

SD5/B. Harris

VP/C. McCullough

Lyndon B. Johnson Space Center
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OCT 31 1989

Reply to Attn of

SD-89-120

TO: BG41/Contracting Officer, Warren Sylvester
FROM: SD/Technical Monitor
SUBJECT: Contract NAS 9-18230

Item 3, isometric force measuring system delivery has been delayed through unavailability to the contractor of a Shuttle seat for fit testing through no fault of the contractor. He now has the seat, design has been confirmed and can be delivered as specified in 45 days.

He has informally made an Engineering Change Proposal (ECP) which without additional cost would produce a much more usable and efficient design. We would like to formally present this ECP and if accepted use it in lieu of the original design. It is estimated that this process will require 4 weeks or less.

We would like to delay the delivery date of this item 10 weeks to accommodate the above delays, neither of which were caused by the contractor.

Other items on the contract are proceeding normally and delivery is expected to meet or precede the established dates.

W. E. Thornton

W. E. Thornton, M.D.

cc:
SD/T. Brown
SD5/B. Harris

SD:WThornton:nlf:10/31/89:32785

Memo

14 Nov. '89

To/ Travis Brown

Subj./ Equipment Interfaces

All of the exercise equipment now in work is designed to interface ^{with existing} ~~to~~ Orbiter ^{+ locations} Brownline line fittings, e.g. - treadmill, isotonic exerciser (this item may also use a permanent ~~the~~ crew handrail), a universal space gym and rowing machine. The isometric strength ^{attaches to standard} ~~mer instrument mounting~~ ^{on} the portable oxygen supply mount on the mid-deck seats.

We have discussed tentative ^{mounting} changes desired by the project office for the EDO flight treadmill & Mr. O'Bryant and apparently can ~~be~~ ^{then} accommodate, but these changes are in his hands.

I will provide you with a sketch of the proposed flight arrangements ~~to be made~~ in the next day or two -

W.T.

Still get a typed version to you when possible -

W.T.

Memo

14 Nov. 89

Sam Pool, T. Brown, B. Harris, H. Crawford
(Exercise equipment status)

The prototype treadmill is ready for
delivery tomorrow acceptance at the
contractor's tomorrow^{Nov 15} however unavoidable
official travel prevents me from going to the
contractor. I shall return Nov. 21 and
immediately go to SAT and test, verify &
accept the unit.

Per our previous agreements we will
leave this treadmill at the contractor's for ^{~ 2 weeks}
fitting and installation of subject weight
load units which will be delivered Dec. 15.

~~The con the~~

W.T.,

H. Thornton

~~Will~~ still get a typed version
to you when possible -
W.T.

[Nov, 1989]

36422

To - S.P.

Procedures & Calibration

Subj. - ~~Review~~ of Instrumented Treadmill

It was agreed ~~the~~ that ~~a~~ calibration, establishment of operating procedures, a review of data to date and a demonstration and reference publication ^{be done} for the treadmill I designed and had built for SSC in 1987. This is a unique device which can provide invaluable information for both EDO & space station exercise efforts but to date has been so misused as to render the data worse than misleading. I was willing to put aside all prior ^{concerns & agreements} ~~agreements~~ as to ~~the~~ professional & intellectual property ~~considerations~~ in an effort to insure the proper use ^{for SSC} implement the proper utilization of this device.

Per our agreement I have repeatedly

tried to implement ~~the~~ ^{this} agreement ^{to} Dr. Greenisen but have been repeatedly delayed for weeks by ^{their} leave, travel, [&] other priorities. He agreed to recent meetings which were finally consummated for the first time yesterday morning in which a simple series of calibrations were agreed to ^{which were} to begin yesterday afternoon. This was cancelled and rescheduled for 1400 today and then cancelled just prior for other priorities, leave, etc. to some unknown future.

It ~~is~~ would be impossible ^{to} ignore the hostility and readiness to take offence at this initial ^{meeting} ~~was~~ and the continued nature of the delays. ^{It is} ~~is~~ neither ~~this is~~ ~~not~~ the nature nor intent, nor advisable, to ~~pro~~ provoke ~~nor~~ participate in such a situation hence

I suggest we implement an alternative which
can achieve the ^{original} goal of and insofar
as possible avoid repetition of ~~this~~
this experience -

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas
77058



Reply to Attn of: SP34-89-238

DEC 11 1989

TO: SD5/William Thornton, M.D.
FROM: SP34/Manager, Anthropometry and Biomechanics Laboratory (ABL)
SUBJECT: Load Cell Instrumented Treadmill


Thank you for your analysis of the frequency response and load cell calibration of the treadmill. This analysis was timely and an important data set for the ABL. While you and I have thoroughly discussed the use and misuse of the load cell instrumented treadmill, it seems relevant that I reply to your six recommendations. In particular, since the treadmill is about to be returned from the Del Mar Corporation, our communication is essential to returning the treadmill to "active duty".

The following is in response to your six recommendations contained in the "Instrumented Treadmill Performance" memorandum:

- a. Calibration curves have been run on the treadmill and a loss of linearity was determined. As discussed with you, the treadmill was returned to the Del Mar Corporation for analysis and repair. Subsequently, the Corporation informed us that the load cells and the load cell mounting brackets were damaged. Repairs are now being finalized.
- b. Pre and post test calibration will now be included in all future test protocols. The ABL has calibrated weights that are certified by the NASA/JSC Calibration and Standards Lab that will be used for pre and post test verification of treadmill calibration.
- c. A copy of specifications and documentation will be provided by the Del Mar Corporation when the treadmill is returned. The treadmill should not be accepted until such documentation is provided. Included in this documentation will be the load limits established by the manufacturer and a certificate of calibration. If the treadmill is only to be used in the zero elevation configuration the manufacturer will so state. For transportation, the ABL will design and fabricate a tie down system that will not load the cell or the load cell mounting fixtures.
- d. An operating checklist based on manufacturers specifications will be established and included in all test protocols. Limitations of the treadmill will also be incorporated in the checklist.

e. The treadmill has been utilized to examine the physical mechanics of locomotion via video motion tracking. EMG data from the soleus and vastus lateralis muscles have also been taken. Fz was only one aspect of data collected in past studies. When the treadmill is returned, the ABL will use one of the same subjects in the same experimental procedure from one of the previous studies. Comparisons can then be made as to the degree of error in Fz during these previous studies. If the Fz data is hopelessly flawed it will, of course, be eliminated from the total data set. It should also be noted that no Fz data has been included in the data sets from the partial-g locomotion studies.

f. The treadmill will only be operated by either you or a qualified member of the ABL staff.



Michael Greenisen, Ph.D.

cc:

SD/S. Pool, M.D.

SD5/M. Bungo, M.D.

SD5/B. Harris, M.D.

SP/C. Perner

SP3/W. Langdoc

SP34/T. Bagian

SP34/MGreenisen:lg:11/27/89:33874