

Draft

The recent inflight failure of the treadmill is likely to recur unless some ^{drastic} ~~unlikely~~ changes are made in ~~entire~~ current treadmill management. As a protection to the crew and a means of avoiding so the ensuing public flail a ^{proven} ready to go alternative ^{exercise} would seem desirable.

The following is such an alternative which has been ^{demonstrated} studied and tested inflight and which ^{can} meet any level of cardiorespiratory demand and which will meet most of the musculoskeletal requirements.

It ~~would also be a logical so~~ could also be used where a treadmill is not available alone, and as the safe haven exercise.

Background: ^{Early in the Shuttle program} At one time it was questionable when the treadmill would fly and an alternative was sought. I investigated proposed and investigated jogging in place as an alternative and it was successfully demonstrated.

Subsequently
on SL-2 (see photo). The pr / G prototype treadmill was
to flown on SL-3 and some 8 subsequent missions =
difficulty until replaced by the present unit.

Rationale: Locomotion in place i.e. walking, jogging
~~run~~ running = forward motion ^{generates} provides vertical
forces equivalent to normal ~~running~~ over ground locomotion. Since vertical
forces are the major forces in locomotion, the
required muscle activity ~~is~~ and ^{resulting} cardio-
vascular loads are closely approximate normal locomotor

It is activity, ^{Individual foot ground force} ~~Force~~ and cardiovascular load
are a function of mode (walk or run), step rate
and in jogging, ^{running,} maximum level of knee elevation
(as a simple measure). In weightlessness these loads
will ~~also~~ also depend directly upon equivalent
platform in the dynamics lab at JPL and
1. This ~~fact~~ is ~~not~~ accepted by anyone well versed in
exercise theory

body weight i.e. the force applied by a harness bungee arrangement.

Background Studies, ^{hardware} and demonstration:

It is a trivial matter to demonstrate that work loads of any level can be reached in this exercise by simply walking, jogging and running in place at increasing step rate and knee lifting of ~~the~~ ^{the} knees level while recording or counting pulse. Such an ^{experience} ~~exercise~~ will demonstrate this exercise's major disadvantage - boredom, however any motivated person can continue it for an hour or more.

The second question of how realistic closely the exercise simulates the forces of locomotion (as a single movement) was answered by setting up a vertical force platform in the dynamics lab at USC and making a series of ~~the~~ comparisons of

forces from normal locomotion and versus
jogging locomotion in place. Two ~~ex~~ typical
examples are shown ^{hardware} shown Figure 4-1.

~~During~~ The exercise was demonstrated in flight
by ~~STS-1~~ on STS-2. The treadmill harness
was loaded by
~~and~~ a set of 4 bungees attached to ^{middeck}
Brownline fittings ~~on~~ mounted on normal seat
studs. It worked as as planned, ^{experience} ~~as planned~~.

Proposed implementation: The simplest
case, as on the last flight, is to ~~simplify~~
attach the harness and walk/jog on the
³ belt movement.

treadmill. The treads, ~~unless on rollers~~ should
be capable of sustaining such usage for a
typical flight. In order to insure that
levels equivalent to one Earth can be reached, the

bungee forces must approximate body weight. The simplest
1. This is also true of the treadmill.

way to insure this is to fly a simple mechanical
for equivalent weight.
scales, which will

A preferred alternative is that shown in Fig. —
covering the range of
Four simple bungees, a Brown line stud attachments
would be flown to a T.M. harness. The forces/
length characteristics of the bungees would be known
and by stretching adjusting the T.M. harness strap
attachment & length and measuring the bungee length the forces can
be obtained from a look-up table.

Proper operation would consist of a warm
walk, jog, run at reduced BEW and then exercising
at Earth BEW. The actual work level could be
monitored by counting pulse rate or more
desirably by any of the combination available electronic
rate monitors.

1. I built such a scale which was also taken by the Life
Sciences and support contractor & has not been
subsequently heard from.

estimated
with table of step rates and knee lift heights
for equivalent weight.
could be available to provide rough guides to
exercise level.

alternative is, that shown in fig. 1
covering the range of
Such an arrangement could be made flown for a
weight of less than 10# and 1/2 locker. Such This

exercise has been extensively used on Earth, it is
including long use as a recommended exercise in
attachment of the Canadian Armed Forces, exercise programs
equivalent body weight

It is all physiologically & biomechanically sound.

Should there be any interest in this I will be
happy to provide additional details. When exercising
it is best 3:1 W. The actual work level could be

monitored by counting pulse rate or more
desirably by any of the combination available electronic
rate monitors.

successfully used on F13-35. It was
I built such a scale which was also taken by the Dept
Science and a support contractor & has not been
subsequently added to.