

Draft

The recent inflight failure of the treadmill is likely to recur unless some ^{drastic} ~~unlike~~ changes are made in ~~entire current~~ the 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} will 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

Draft

body weight is. Subsequently on SL-2 (see photo). The pr 1/6 prototype treadmill was to flown on SL-3 and some 8 subsequent missions $\approx$ difficulty until replaced by the present unit.

Rationale: Locomotion in place i.e. walking, jogging, ~~run~~ running $\approx$ 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 $\approx$ closely approximate normal locomotion.

It is activity, ^{Individual foot ground force} $\frac{Force}{A}$ 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

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 & this exercise by simply walking, jogging and running in place at increasing step rate and knee lifting of ~~between~~ ^{between} 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 measure). This was answered by setting up a vertical force platform in the dynamics lab at USC and making a series of ~~star~~ comparisons of

forces from normal locomotion and versus
jogging locomotion in place. Two ex typical
examples are shown shown Fig 1 & 2.

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

Proposed implementation: the simplest
case, as on the last flight, is to simply
attach the harness and walk/jog on the
treadmill ^{3 belt movement}. 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 scale, ^{for equivalent weight.} which will ^{in place of} ^{roughly typical}

A preferred alternative is that shown in Fig. —
 Four simple bungees ^{covering the range of} Brown line study attachments would be flown to a T.M. harness. The force/length characteristics of the bungees would be known and by stretching adjusting the T.M. harness strap attachment ^{equivalent body weight BEW} & 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 ^{belt movement} 0.8th BEW. The actual work level could be ~~monitored~~ 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 a support contractor, & has not been subsequently heard from.

estimated
was a table of step rates and knee lift heights
for equivalent weight.
could be available to provide rough guides to
exercise levels. alternative is that shown in Fig. 1.
Such an arrangement could be made for a
weight of less than 10⁴ and 1/2 lockers. Such This
exercise has been extensively used on Earth, it is
including long rise as a recommended exercise in
attachment 11. It is also recommended by the
Canadian Armed Forces exercise programmes.
It is all physiologically & biomechanically sound.
Should there be any interest in this I will be
happy to provide additional details. When exercising
at 1/2 lock B.E.W. the actual work load could be
monitored by counting pulse rate or more
desirably by any of the combination portable electronic
rate monitors.

successfully used on STB-35. It was
I built such a scale which was also taken by B. Rife
Science and a support contractor & has not been
subsequently heard from.