Human Mass Measurement under Weightlessness

When man entered space for extended periods
experienced mass
he not only ~~encountered the loss of weight~~
of mass
loss, but also left behind the only means
available ~~at the time~~ for studying this loss,
the gravimetric weighing machine or scales.
physical quantities
Most ~~measurements~~ can be measured by several
techniques but the very efficiency ~~of comp~~
gravimetric
of scales eliminated the need for
an alternative method, until man was
for prolonged periods
able to null gravity. ~~the effects~~ Indeed to
to fully appreciate the efficiency of such scales
one must try to design a non-gravimetric

mass measuring device that will exceed the performance of an Egyptian stone balance built 5500 years ago. Accuracy can be exceeded, just, but the balance is otherwise far ahead at this time.

~~The first finding to be noted in space~~ most & most striking, consistent most studied change in man produced by w is ~~wet~~ mass loss. Exact magnitude and time progression of this change can only be inferred from measurements made after the fact until some form of accurate on orbit mass measurement is available. The need

for such a device was ~~high on a list~~ very real. As a corollary of ~~the~~ body mass measurement, ~~the mass~~ measurement of intake & output is highly desireable.

~~Accuracy was the a major consideration~~ requisite

~~in~~ Among design considerations, accuracy was since there was little point in erroneous studies

was primary & since ~~as~~ difficulties increase exponentially ~ accuracy, the ~~least~~ ~~least possible~~ minimum consistient ~ studies was desirable. ~~Although no sense~~ human weight ~~can be a break point of~~ About 1/4# was considered sufficient for preliminary approximately studies. This is ~~about~~ the break point

in gravimetric scales. A good ~~pair~~ set of office scales will achieve this but ~~anything~~ appreciably higher ~~will~~ accuracy requires special order and increasing complexity.

Other design constraints were largely imposed by space flight requirements ~~and, user~~ ~~more significantly,~~

~~O R+A specs - the former~~ including:

Crew safety

Crew time

Simplicity

Reliability

Minimum mass + volume ~~&~~ + power requirements

Ability to withstand launch + operation

environments.

*

Design of a mass measuring device was first anticipated by the science fiction Heinlein writer, in, a centrifuge.

*(In the absence of significant gravitational attraction ~~some other aspect of mass must be~~ used for inertia is the only other practical property of mass to be used for its determination.)

A great many methods are possible and various schemes have been advocated at one time or another including, ~~the~~ conservation of momentum by projecting a known mass + velocity into a carriage a

the man and measuring resultant velocity,

Douglas A/C, ~~short~~ a two radius torsional pendulum SAM, accelerated beam balance Lockhead, ~~and~~

~~m~~ Methods tried include the short radius centrifuge Douglas A/C, results not available, a rolling trolley ~~not known~~ accelerated by known forces Lockheed, a spring mass oscillator using a wheeled cart results not available and a spring mass oscillators by Lockheed + NASA AMES. ~~Dnt~~ In addition to the device to be described here only

the latter two can be considered succesful.

The AMES device was designed for small masses including restrained animals ~~and had~~ long travel linear the Lockheed device used a roller ~~bearing~~ constrained seat accelerated supported by high forces. Its ~~accuracy~~ performance was good under one G but never approached operational hardware. ~~proceeded beyond laboratory hardware~~.

It is beyond the scope of this paper to describe the many theoretical and practical possibilities but rather a description of problems and results with of one practical system will be made. Apart from from some interesting anatomical and physiological aspects there a number of problems common to virtually

Tax, '71

Books

any system will be illustrated.

~~At the time of initial deeds~~ In 1965 it was first necessary to demonstrate that a linear spring/mass oscillator could achieve an accuracy of 1/4% even with rigid masses. This was achieved as follows and a small ~~spring/mass~~ unit for the mass range of 0-1 Kgm. built and demonstated.

Theoretically the spring mass oscillator consists of the following; a rigid mass constrained to move in a single axis coupled to an ideal linear spring which is in turn coupled to an infinite + rigid mass. If now the mass is displaced by a small amount and released, it will oscillate sinusoidally + ~~indefinitely~~ for at a frequency given by $F = \frac{1}{2\pi}\left(\frac{K}{M}\right)^{1/2}$.

Tax, '71

Books

Trips -
Auto Lic -
Orkin

Sheppard ENT Boner

Trauma - head and neck

Soft tissue

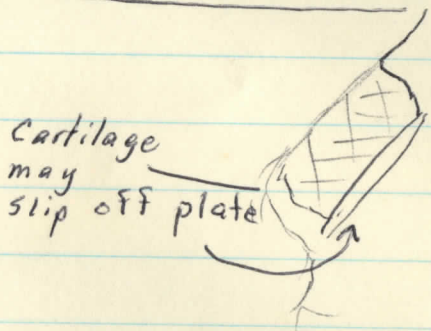
Vascular - air emboli from internal jugular

Facial nerve

4-0 nylon - 3-4mm. from wound edge - plain-xylo.

Bony tissue

Nasal fractures



Usually have black eye or blood in sclera ± bony fracture

Sinus - Frontal middle meatus

Ant. sinuses open under mid. turbinate

For ext. manipulation inj. inf. orbit

Int. nares - soak gauze ± xylo + pack nose

Use knife handle as aid

Facial Fractures

No functional effect ex. eye

Mandibular Fx. - leave

Dislocated -

Give IV demerol - 75 mgm. push down + back

Neck - Direct Trauma

Hyoid - Fx.

Larynx - Thyroid

Cricoid

Sheppard ENT Bomer

Fx- thyroid - hoarse, possible bloody cough - possible airway impairment -

Emergency Airway

Crico-thyrotomy

1" transverse skin incision

External Otitis

Fungus-

less painful

no onboard medication

cresatin