

Other: film, electrodes  
 flx. = flexible  
 \*Option

#### Protocol:

Two participants during recording. Subject will don harness, attach bungees and with the force plate and DVM adjust bungee loads to equivalent body weight. Required only in flight - Harness and bungees with negligible force will be used preflight with known body weight. EKG electrodes will be attached and all inputs to recorder made. Electrical (push button) calibration of system will be made.

A. Preflight: After an initial training session with preliminary data recording a minimum of 3 recording sessions with 3 minimum and 5 desired subjects will be made as follows:

- 1g. Standing quietly
- 3 minutes Walk in place (IP) at 80 steps minute
- 3 minutes Walk (IP) at 120 minutes
- 3 minutes Jog (IP) 130 steps/min. knees raised to  $H_1$
- 3 minutes Jog (IP) 130 steps/min. knees raised to  $H_2$
- 3 minutes Run (IP) 160 steps/min. knees raised to  $H_3$
- 1 minute Run (IP) maximum effort

$H_1, 2, 3$  will be individually determined knee heights during initial session and an on board scale used to adjust weight equivalent force. Rate will be adjusted to an optical pacer. Inflight it would be desirable to reduce the bungee forces to .8 to .5 body weight and repeat above protocol at same step rate without knee height control (if time allows). Sessions should be done 3 times during L-30 and 2 times (min.) inflight after L+3 and on R+1 and 2.

#### Data processing/analysis:

The rate, maximum force, initial force rate and duty cycle, will be determined from graphic records and treated statistically preflight. Displacement and major angles will also be obtained from photographic records and statistically treated as will heart rate obtained from graphic EKG

arrangement. Bungees will attach to the standard deck studs. Foot surface will be a strain gage force plate with frequent response of D.C. to 100Hz. and a simple battery operated amplifier will process its output for monitoring by an onboard digital volt meter (DVM) and recorded by an existing flight recorder. Single plane motion will be recorded by a previously calibrated on board camera. Heart rate will be obtained from EKG, recorded by existing amplifiers coupled to the recorder.

A. Development/qualification: Bungee to standard Browline stud fittings will be fabricated (unless units flown on STS-2 could be found). The force plate will be fabricated (two metal sheets and four metal supports with strain gages) as well as a single chip, totally enclosed battery operated amplifier. All other items are qualified. Camera and DVM are STS flight items.

B. Option: If time and mission allowed, EMG could be obtained from 3 major muscles with existing amplifiers and recorder. All of these items are qualified.

C. Size and Weight:

	Volume stowed on board	Weight	Qualified
1. Subject force harness -			X
2. Bungees and attachments -	8 x 8 x 8", flx.	3lbs.	
3. Force plate	14 x 14 x 1", rigid	8 lbs.	
4. Force plate amplifiers and cables	2 x 2 x 4"	1/4 lbs. rigid	X
5. Recorder _____ rigid _____			
6. Camera, lights, etc. on board			X
7. EKG amplifiers and cables on board			X
8. *EMG amplifiers and cables	4 x 4 x 4, rigid	1/4 lbs.	X
9. Min. LED pacer.	1 x 1 x 2",	1/8 lbs. rigid	

records. These values will be compared to in and post-flight values for significant differences.

Hypotheses-A. Bungee loaded locomotion in weightlessness produce forces and motion similar to 1g and adequate for locomotor exercise.

B. Reduction of bungee forces produce linearly related reduction in forces increases in axial amplitudes and decreased equivalent heart rate response.

C. An indication of heart rate response to known mechanical work loads in weightlessness will be derived and this will be closely related to equivalent 1.g. response.