

MEDB 5.1 Functional Fitness Assessments

3.2 Medical Requirements Overview

TABLE 3.2: MEDICAL REQUIREMENTS OVERVIEW

| | |
|--|--|
| MEDB# and Title: | MEDB 5.1 Functional Fitness Assessments |
| Sponsor: | Medical Operations |
| Discipline: | Bone, Muscle & Exercise |
| Category: | Medical Requirements (MR) |
| References: | SSP 50260 ISS Medical Operations Requirements Document (MORD) Medical Evaluation Documents (MED) Volume B Section 5.1 |
| Purpose/Objectives: | Physical fitness is assessed pre- and post-flight to guide individual physical training and to determine individual responses to training countermeasures. |
| Measurement Parameters: | Skeletal muscle strength, endurance, flexibility, agility, balance, and hand grip. |
| Deliverables: | Assessment of skeletal muscle strength, endurance, flexibility, agility, balance, and hand grip. |
| Flight Duration: | ≥30 days |
| Number of Flights: | Every Expedition |
| Number and Type of Crew Members Required: | All ISS crewmembers. |
| Other Flight Characteristics: | N/A |

MEDB 5.1 Functional Fitness Assessments

3.3 Preflight Training: NA

3.4 Preflight Activities

TABLE 3.4: PREFLIGHT ACTIVITIES

| | | | | | |
|--|--|---|---|-----------------------------------|---|
| Preflight Activity | Description: | Functional Fitness assessment is scheduled for 60 minutes twice during the preflight period and twice during the postflight period. Pre-flight activities will include: Sit & Reach Bench Cone Agility Test Push-ups Crunches Single Leg Stand Test Pull-ups Leg Press Hand Grip | | | |
| | Schedule: | Duration: 60 minutes | Schedule: L-9/6 m, L-90/30 d *AME results may be used if occurring in specified window. Otherwise these will be standalone sessions. | Flexibility: +/- 2 Days | Personnel Required: Astronaut Strength, Conditioning and Rehabilitation (ASCR)/Crewmember |
| Ground Support Requirements Hardware/Software | Preflight Hardware: | | Preflight Software: | Test Location: | |
| | Leg Press (Cybex) Sit & Reach Bench Hand Grip Dynamometer | Smith Bench Padded Exercise Mat 4 cones | NA | U.S. and Russia | |
| Testing Facilities | Minimum Room Dimensions: | Number of Electrical Outlets: | Temperature Requirements: | Special Lighting: | |
| | 35 ft x 35 ft Room | NA | 20-25°C | N/A | |
| | Hot or cold running water: | Privacy requirements: | Vibration/Acoustic Isolation: | Other: | |
| | N/A | Access to room must be controlled during testing | N/A | N/A | |
| Constraints/Special Requirements: | No maximal exercise 4 hours prior to testing. No food 90 minutes prior to testing. Test Termination Criteria: <ul style="list-style-type: none"> ▪ Volitional Fatigue ▪ Pain ▪ Orthostatic Hypotension | | | | |
| Launch Delay Requirements: | N/A | | | | |
| Notes: | Pre-flight activities will be scheduled outside normal exercise periods. | | | | |
| Data Delivery | Preliminary MAT reports for all sessions will be delivered to Crew Surgeon by the ASCR within 48 hours of test completion. A final report shall be delivered to the Crew surgeon via the Medical Mission Information System (MMIS) 14 days following the test session. | | | | |

MEDB 5.1 Functional Fitness Assessments

Exercise Definitions:

- **Flexibility:** The range of motion around the joint.

Sit and Reach

Measures lower back and hamstring flexibility. The test is more reliable if the astronaut has warmed up and has completed some static stretching prior to the test.

- The astronaut sits with their bare feet flat against the “sit-and-reach box”, legs extended. Knees should be straight as possible.
- One hand is placed on top of the other and arms extended forward.
- Reach forward (exhaling) slowly and as far as possible at the hip.
- The score is the best of three trials, is measured in inches using the D scale, and is the most distant point on the box contacted by the fingertips.

- **Muscle Strength:** The force that a muscle or muscle group can put forth against a prescribed load in one maximal effort; 1 repetition max (1RM).

Smith Bench Press

Measures upper body strength in a controlled environment. Proper warm up and static stretching is required prior to the test.

- The astronaut will complete 2-3 sets of warm up beginning with a subjective predicted maximum of 30% for 10 repetitions.
- The weight is increased conservatively, 10 to 20%, each trial. At the same time the number of repetitions is decreased until reaching 1 repetition.
- Repeat sets of 1RM until the astronaut fails to complete the lift.
- 3-5 minutes rest between each successful set is recommended.
- The astronaut should use that rest time to stretch.
- Record the 1RM value as the maximum weight lifted for the last successful trial.

Leg Press

Measures lower body strength by performing the leg press.

- The subject begins with a 50 percent of a subjective predictive maximum, for about 10 repetitions.
- The weight is increased conservatively about 15 to 20 percent each trial at the same time the number of repetitions is decreased.
- If the lift is successful, the subject should rest 3 to 5 minutes before attempting the next weight increment. During the rest the subject should stretch the muscle group.
- Follow this procedure until the subject fails to complete the lift. The 1 RM is typically achieved within 3 to 5 trials. Record the 1-RM value as the maximum weight lifted for the last successful trial.

- **Muscle Endurance:** the ability to do a continuous physical activity without advantageous rest stops or nonessential body movements.

Pull ups/Assisted

Measures local muscle endurance of the latissimus dorsi, elbow flexors & pectoral muscles.

- Use an overhand or underhand grip. Must use same grip for all sessions.
- Pull up is completed when chin reaches above the bar.
- Movement is through a full range of motion.
- Number completed is score.

MEDB 5.1 Functional Fitness Assessments

Push ups/Modified

Measures local muscle endurance of the pectoral and shoulder muscles.

- Begin movement in an “up” position, back straight, head up, hands shoulder-width apart.
- Modified position is with back straight, head up; hands shoulder width apart and knee bent at 90-degree angle with ankles crossed.
- Each repetition should be completed with the same range of motion, back straight and pushing up to a straight arm position.
- Maximum completed in 2 minutes will be the score recorded.

Sliding Crunches

Measure local abdominal endurance.

- Begin exercise by lying on back, legs flexed to 90 degrees, chin at chest and arms at the side of the body.
- Pressing back into floor and contracting abdominal muscles, slide hands to the heel of the foot. Keep arms and forearms on the floor, chin on the chest. If necessary head can be supported with one arm.
- Maximum completed in 2 minutes will be the score recorded.

Agility

Measures the ability to move and change directions quickly

- Cones should be placed at corners of 15ft x 15ft square
- Movement pattern diagram. Note shuffle
- The score is the best of 3 time trials
- See Appendix A

Stand Test

Measures the ability to balance.

- Begin by standing on one leg for 15 seconds.
- At the end of 15 seconds, switch to opposite leg for 15 seconds.
- Each trial is performed 3 times.

Hand Grip Test

Measures local strength of the hands.

- Begin by measuring the device to proper fit of the hands.
- Squeeze the dynamometer with one hand. At the completion of the trial, switch hands.
- Repeat each hand 3 times.
- Score is the total force of both hands

3.5 In-Flight Activities: No In-Flight Activities

MEDB 5.1 Functional Fitness Assessments

3.6 Postflight Activities

TABLE 3.6: POSTFLIGHT ACTIVITIES

| | | | | | |
|--|---|--|-----------------------------|----------------------------------|----------------------------|
| Postflight Activity | Description: | Functional Fitness assessment is scheduled for 60 minutes twice during the preflight period and twice during the postflight period. Post-flight activities will include: | | | |
| | Schedule: | Sit & Reach | Bench | Cone Agility Test | |
| | | Push-ups | Crunches | Single Leg Stand Test | |
| | | Pull-ups | Leg Press | Hand Grip | |
| | | Duration: | Schedule: | Flexibility: | Personnel Required: |
| | | 60 Minutes | R+5/7 | None | ASCR/ |
| | | 60 Minutes | R+30 | +/- 2 Days | Crewmember |
| Ground Support Requirements Hardware/Software | Postflight Hardware: | | Postflight Software: | Test Location: | |
| | Leg Press (Cybex) | Smith Bench | N/A | U.S. and Russia | |
| Sit & Reach Bench | Padded Exercise Mat | | | | |
| Hand Grip Dynamometer | 4 cones | | | | |
| Testing Facilities | Minimum room dimensions: | Number of electrical outlets: | | Temperature requirements: | Special lighting: |
| | 35ft x 35ft Room | NA | | 20-25°C | N/A |
| | Hot or cold running water: | Privacy requirements: | | Other: | |
| | NA | Access to room must be controlled during testing | | N/A | |
| Constraints/Special Requirements: | No maximal exercise 4 hours prior to testing. No food 90 minutes prior to testing. Test Termination Criteria: <ul style="list-style-type: none"> ▪ Volitional Fatigue ▪ Pain ▪ Orthostatic Hypotension | | | | |
| Notes: | Post flight Activities are scheduled during rehab period. | | | | |
| Data Delivery | Preliminary MAT reports for all sessions will be delivered to Crew Surgeon by the ASCR within 48 hours of test completion. A final report shall be delivered to the Crew surgeon via MMIS within 14 days following the test session. | | | | |

MEDB 5.1 Functional Fitness Assessments

3.7 Summary Schedule

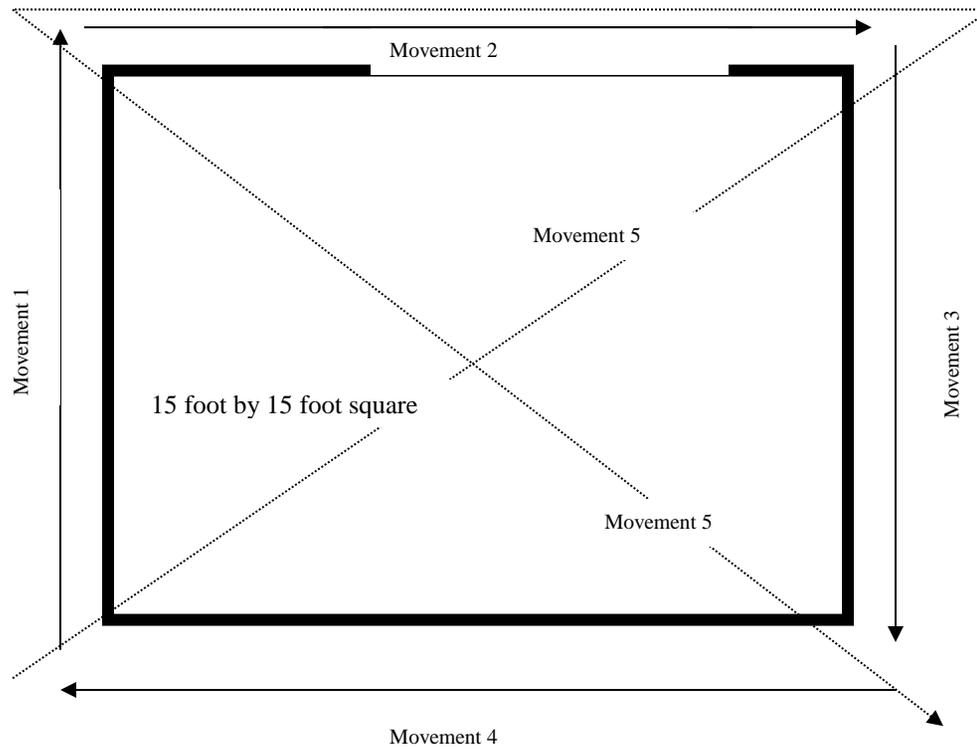
TABLE 3.7: SUMMARY SCHEDULE

| ACTIVITY | DURATION | SCHEDULE | FLEXIBILITY | BLOOD VOLUME | PERSONNEL REQUIRED | CONSTRAINTS |
|---|--------------------------|---------------------------|-------------------|--------------|---------------------|--|
| Preflight | | | | | | |
| <ul style="list-style-type: none"> ▪ Sit and reach ▪ Smith Bench ▪ Push-ups ▪ Sliding Crunches (sit-ups) ▪ Pull-ups ▪ Leg Press ▪ Cone Agility Test ▪ Stand Test ▪ Hand Grip | 60 minutes | AME L-9/6 m, L-90/30 d | +/- 2 Days | N/A | ASCR/ Crewmember | No maximal exercise 4 hours prior to testing. No food 90 minutes prior to testing. |
| Postflight | | | | | | |
| <ul style="list-style-type: none"> ▪ Smith bench ▪ Push-ups ▪ Pull-ups ▪ Sliding crunches ▪ Sit and reach ▪ Leg Press ▪ Cone Agility Test ▪ Stand Test ▪ Hand Grip | 60 minutes 60 minutes | R+5/7 R+30 (Leg Press) | N/A +/- 2 Days | N/A | ASCR/ Crewmember | No maximal exercise 4 hours prior to testing. No food 90 minutes prior to testing. |

MEDB 5.1 Functional Fitness Assessments

Appendix: A

Agility – Cone Test



- Movement 1 - Crewmember is to move forward
- Movement 2 - Crewmember is to shuffle to the right
- Movement 3 - Crewmember is to move backwards
- Movement 4 - Crewmember is to shuffle to the left
- Movement 5 – Crewmembers is to complete half a figure 8 moving forward only