National Aeronautics and
Space Administration

**George C. Marshall Space Flight Center**
**Marshall Space Flight Center, Alabama 35812**

# OVERHEAD CRANE OPERATIONS

# SAFETY REQUIREMENTS DOCUMENT

## FOR CRANES
## CRN 0001 AND CRN 0002

**ENVIRONMENTAL TEST FACILITY BRANCH**
**STRUCTURAL AND ENVIRONMENTAL TEST DIVISION**
**TEST LABORATORY**
**ENGINEERING DIRECTORATE**

# This Procedure Describes Safety Critical Operations

**CHECK THE MASTER LIST—**
**VERIFY THAT THIS IS THE CORRECT VERSION BEFORE USE**

# OVERHEAD CRANE OPERATIONS
# SAFETY REQUIREMENTS DOCUMENT

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Overhead Crane/Hoist Operators: Signature by an operator indicates the operator has read the procedure, understands the operator responsibilities, and understands the hazards associated with operation of these cranes.

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**CHECK THE MASTER LIST—**
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## 1.0 GENERAL

This Standard Operating Procedure (SOP) describes crane/hoist operations, emergency steps, communication requirements, and inspection requirements for overhead cranes CRN 0001 and CRN 0002 in service at Building 4619, Marshall Space Flight Center (MSFC). This document describes safety requirements for critical and non-critical lift.

All lifts falling under the definition of "critical lift" shall be performed utilizing this procedure and specific critical lift operating procedure, written for each critical lift per the requirements of NASA-STD-8719.9 and MWI 6430.1. Critical lift procedures shall be approved by the Safety and Mission Assurance (S&MA) Office. MSFC Form 4339 shall be completed for each critical lift. Lifts of program critical hardware (PCH) shall be in accordance with MWI 6410.1. Additional requirements for critical lifts include special certifications for the equipment and personnel and operation checks before the lifts.

The overhead cranes CRN 0001 and CRN 0002 in building 4619 west high bay, are used by ETF personnel (both NASA and support contractor) as required to open or close chambers, to load hardware into the chambers, and for test facility repairs and modifications. The CRN 0001 Crane (the west-side crane) is a regular service lifting device. The CRN 0002 Crane (the east-side crane) is used as a standby service lifting device. The normal operation of ETF requires the frequent use of an overhead crane for non-critical lifts. All ETF personnel involved with a lift are required to have proper certification before operating the overhead crane per NASA Safety Standard For Lifting Devices And Equipment, NASA-STD-8719.9. The overhead cranes are not approved for performing load testing of any slings, cables, or other rigging devices and are not to be used for that type of activity. Also, this crane is not to be used for any type of side pull, as they are not designed for that purpose. Both cranes have two hoists, one 10 ton and one 3 ton, and any load to be lifted shall be within the rated capacity for the hoist being used. Any problems or discrepancies associated with the crane are to be reported to the ETF Branch Chief or the 4619 Building Manager Assistant immediately. The building manager assistant shall contact the facilities office to obtain maintenance on the crane. See Section 8 for phone numbers.

## 2.0 APPLICABLE DOCUMENTS

| | |
|---|---|
| NPR 8715.3 | NASA Safety Manual |
| NASA-STD-8719.9 | Standard For Lifting Devices And Equipment |
| MPR 8715.1 | Marshall Safety, Health, and Environmental (SHE) Program |
| MSOP-FA-ETF-413 | Control of Hazardous Energy (Lockout/Tagout) Procedure for the Environmental Test Facility (soon to be superseded by ET24-LOTO-SOP-001) |
| MWI 6410.1 | Packaging, Handling, and Moving Program Critical Hardware |
| MWI 6430.1 | Lifting Equipment and Operation |

| | |
|---|---|
| ET24-ETF-OWI-001 | Environmental Test Facility Test Operations |
| ED26 (02-01) | Memorandum for Record, Safety Assessment for the ETF (soon to be superseded by an ET24 memo, number unknown) |

## 3.0 RESPONSIBILITIES

Crane operation is the responsibility of ETF personnel who are authorized to operate the crane as documented in the MSFC Certification Tracking (CERTRAK) database. Other task assignments and responsibilities at the ETF shall be in accordance with the organizational work instruction (OWI) ET24-ETF-OWI-001.

3.1 **Lift Supervisor:** Ensures only certified crane/hoist operators operate cranes/hoists; riggers are certified to perform load line configurations; and designates the lift spotter/flagman. The lift supervisor also ensures that all safety requirements for performing a safe lift are followed.

3.2 **Spotter/Flagman:** Coordinates lift movement and gives directions to the crane operator and tag line operators.

3.3 **Crane/ Hoist Operator:** Responsible for the safe movement of the load. The crane/hoist operator stops a lift when they believe the lift is unsafe, and may refuse to continue the lift until their concerns are reported to the responsible supervisor and addressed.

3.4 **Riggers**: Ensure the load has a proper center of gravity and that certified rigging hardware (slings, shackles, etc.) is properly attached.

3.5 **Tagline Operators:** Responsible for keeping the load stabilized whenever load swinging is anticipated to be a hazard.

3.6 **Move Manager:** A move of program critical hardware (PCH) requires a move manager (MM) in accordance with MWI 6410.1. The MM assures the safe handling/moving of PCH by the ETF personnel. The ETF MM shall monitor movements of PCH while it is at the ETF.

## 4.0 PRE-OPERATIONS

4.1 The designated spotter/flagman reviews the lift path for any hazards pertaining to the equipment, facility, load, and interfaces as a whole and ensures personnel egress paths and the path to the crane/hoist power panel box are free of obstructions.

4.2 The crane/hoist operator reviews previously noted problems/discrepancies to determine possible impact on the planned activity.

4.3 The operator/spotter establishes safety zones with barriers (rope, cones, etc.).

4.4 The operator performs an inspection and pre-operational check to demonstrate operational readiness. (See Attachment 1 - Daily Overhead Crane Checklist)

4.5 The crane/hoist operator ensures the load to be lifted is not beyond the rated load capacity of the crane/ hoist. If the load to be lifted approaches (≥50%) the rated capacity of the crane/ hoist, the operator tests the holding brakes by raising the load minimally (e.g., 1 inch) above the surface and holding it 5 minutes to allow any dynamics to dampen out.

4.6 When radio communications are used, the crane/hoist operator and the lift supervisor shall test the communication system. If communication is lost during the lift, the lift is halted until communication has been restored. For critical lifts, additional communication shall be maintained between a person posted at the crane power disconnect and the lift supervisor.

4.7 Only standard hand signals are used. (See Attachment 2).

4.8 Hands are to be free from encumbrances while personnel are using crane cab access ladders. Articles that are too large to be carried in pockets or belts are lifted and lowered by hand-line.

## 5.0 OPERATIONS

5.1 Lifts are performed under the direction of only one person, the lift supervisor or the designated lift spotter/flagman. The lift supervisor shall follow special instructions given by the MM when PCH is being lifted. The MM shall provide any special instructions to the lift supervisor prior to the lift.

5.2 Before starting a lift, the hook is centered over the load to prevent swinging or side pulls.

5.3 These cranes/hoists are not used for side pulls.

5.4 If there is a slack condition, determine if the rope is properly seated on the drum and in the sheaves before starting the crane/ hoist.

5.5 Loads are secured, balanced, and controlled with proper slings. Use tag lines to keep the load stabilized whenever load swing is anticipated.

5.6 During lifting, take care to prevent sudden movements and avoid obstructions.

**Personnel are not to be located under suspended or moving loads.**
EXCEPTION: NASA Alternate Standard for Suspended Load Operations (NASA-STD-8719.9 Appendix A).
NOTE: Suspended load operations are "Critical Lifts," and subject to "Critical Lift" requirements.

**WARNING**

**Person(s) do not ride the hook or load at anytime.**
EXCEPTION: Ref.: NASA-STD-8719.9 Appendix C Lifting Person with a Crane.
NOTE: Personnel Lifts with a Crane/ hoist are "Critical Lifts," and subject to "Critical Lift" requirements.

5.7 An operator shall be at the crane controls at all times while a load is suspended (OSHA Requirement Ref: NASA STD-8719.9 Section 4.7x.). If the length of the operation requires an operator change, the change shall be performed by:

5.7.1 Communicating with the lift supervisor the need to change operators and wait until the lift supervisor agreement to proceed.
5.7.2 Verifying the load has stopped moving.
5.7.3 Switching **OFF** the controls and hand over to the incoming operator.
5.7.4 The incoming operator shall reestablish communication with the lift supervisor.
5.7.5 Switching **ON** the controls.
5.7.6 Proceeding with the lift as directed by the lift supervisor.

5.8 Loads are suspended and transported minimally (1 - 2 inches) above the surface level or at a level where the operator has a clear view of the load. The crane operator lifts the load high enough to clear obstacles.

5.9 Crane crew discipline is maintained at all times during the lift operation.

5.10 Outdoor operations are not to be performed if winds are above 20 knots (23 mph, 37 km/hr) steady state or if gusts exceed 35 knots (40 mph, 65 km/hr). Weather information may be obtained from the Internet. One uniform resource locator (URL) that may be used for local weather information is http://www.weather.com/weather/local/USAL0287.

5.11 The load shall not be lowered beyond where there are less than two full wraps of rope remaining on the drum.

## 6.0 SPECIFIC SAFETY REQUIREMENTS FOR CRANES CRN 0001 and CRN 0002

6.1 Verify that the crane electrical power disconnect is accessible. The crane shall not be operated if its power disconnect switch is unreachable by ETF personnel. The crane power disconnect switch is located overhead in Building 4619 West High Bay, just left of column 17 between Rooms 158 and 160, in the hallway that starts at the south east corner of room 155 (south of the Flat Floor area). The disconnect switch has a yellow label marked "CRANE DISCONNNECT" and a yellow rope attached. When PCH is being lifted, one person shall stay at the disconnect with a means of communication with the lift supervisor. This disconnect switch interrupts power to both cranes.

6.2 Before the first lift of the day is initiated, the operator shall complete the Daily Inspection Checklist (see Attachment 1) to verify proper operation of the crane(s). Any discrepancies are to be reported to the Building 4619 Building Manager Assistant or the ETF Branch Chief to obtain maintenance as required. The crane shall not be used until repairs are made. Lockout/tagout the crane in accordance with MSOP-FA-ETF-413 (soon to be superseded by ET24-LOTO-SOP-001) until the repair crew arrives.

6.3 Before lifting loads that weigh ½ or more of the cranes rated load, a break check shall be performed. Lift the load a few inches and verify the brakes hold the load for 5 minutes. This brake test shall be performed on all lifts of PCH.

6.4 All lift personnel shall wear approved hard hats and safety shoes.

6.5 Do not perform side pulls. The CRN 00001 and CRN 00002 cranes are designed for vertical lifts only.

6.6 During hoisting, care shall be taken to ensure that there is no sudden acceleration or deceleration of the moving load, and that the load does not contact any obstructions.

6.7 Loads shall be secured, balanced, and controlled with proper associated lifting equipment per Section 7. Tag lines shall be used to keep the load stabilized whenever load swinging is anticipated to be a hazard or when the load is lifted above head level. Personnel controlling a tag line shall take care not to impart undesirable motion to the load.

6.8 Lift shall be performed with the three large bay doors closed. Lifts performed while one or more bay doors are opened, shall be performed only during calm-wind conditions as delineated in Paragraph 5.10.

6.9 Personnel shall not be located under a suspended or moving load at anytime. This includes personnel located in enclosed rooms such as the V-7/Sunspot Clean Room. In lifting operations involving the Sunspot Chamber, a tool shall be utilized to gather thermocouples and connections out from under the suspended

dome to make connections and disconnections. Personnel shall not reach their hands under a suspended load.

6.10 The crane operator shall remain at the control until the lift is completed. If the lift is not completed on one shift, the operator shall remain at the controls until the next shift operator takes the controls. The controls shall remain in the operator's hand or hands at all times during the lift.

## 7.0 ASSOCIATED LIFTING EQUIPMENT

### 7.1 **Slings**

7.1.1 Tagging

Slings and lift beams shall be permanently tagged or marked by MSFC. The information on the tag or mark shall include a serial number, the load test expiration date, and a safe load rating. The material of nonmetallic ropes and slings shall be identified on the tag.

7.1.2 Inspection

Each day prior to first use, slings, fasteners, lift beams and all attachments shall be inspected for damage or defects by an MSFC-certified crane operator.

7.1.3 Removal from Service; Wire Rope Slings

Wire rope slings shall be removed from service if any of the following conditions are present.

1. Five or more broken wires.
2. One broken wire within one lay distance from an end attachment.
3. Wear or scraping that extends around 1/3 or more of the rope circumference.
4. Kinking, crushing, bird caging, or any other distortion of the wire rope structure.
5. Evidence of heat damage.
6. End attachments that are cracked, deformed, or worn.
7. Hooks that are permanently deformed or bent.
8. Corrosion of the rope or end attachments.
9. Expired load test.

7.1.4 Removal From Service; Synthetic Web Slings

Synthetic web slings shall be removed from service if any of the following conditions are present.

1. Acid or caustic burns.
2. Melting or charring of the web material.
3. Snags, punctures, tears, or cuts.

4. Broken or torn stitches.
5. Hooks that are permanently deformed or bent.
6. End attachments that are cracked, deformed, or worn.
7. Expired load test.

7.1.5 Removal from Service; Lift Beams

Lift beams and fixtures shall be removed from service if any of the following conditions are present.

1. If any of the wire rope or webbing attached to the fixture is removed from service per Paragraphs 7.1.3 or 7.1.4 above.
2. Deformation or bending in the beam.
3. Evidence of heat damage.
4. End attachments that are cracked, deformed, or worn.
5. Corrosion of the beam or attachments.
6. Expired load test.

7.1.6 Load Test

Slings and lift beams shall be load tested and inspected prior to use and annually in accordance with NASA-STD-8719.9. Slings shall be tested with shackles and other attaching fixtures that are used with that sling.

7.1.7 Operations; Slings

1. Slings shall be loaded no more than ½ their rated safe load. An exception is allowed if the load configuration of the sling(s) is in accordance with 29 CFR 1910.184, documented and approved by an ETF mechanical engineer.
2. Slings shall be sufficiently long so that they are no more than $45^{o}$ from vertical when loaded (i.e. the vertical distance between the ends of the sling shall be equal to or exceed the horizontal distance between the ends of the sling). An exception is allowed if the angle-to-load configuration of the slings is in accordance with 29 CFR 1910.184, documented and approved by an ETF mechanical engineer.
3. A sling used in a critical lift shall be loaded no more than ½ its rated safe load and no more than $45^{o}$ from vertical when loaded without exception.
4. Only slings of equal length shall be used in a multi-sling lift.
5. Select slings of suitable rated capacity, use proper hitch, and attach the sling securely to the load.
6. Verify all slings are tight and carrying the load when the load is first lifted.
7. The sling shall not have kinks, knots, or twists.
8. Lift the load slowly. Avoid shock loading.
9. Do not pull a sling from under a load that is resting on the sling. Block the load up to remove the sling.

7.1.8 Operations; Lift Beams

1. Lift beams shall be loaded no more than ½ their rated safe load for critical lifts. If the lift is a non-critical lift, then the lift beam shall be loaded no more than the rated safe load.
2. Lower slings that attach the load to the beam shall be vertical when loaded.
3. Select a lift beam of suitable rated capacity and a proper width for the load. Attach the beam securely to the load.
4. Lift the load slowly. Avoid shock loading.

7.1.9 Slings, lift beams, and lifting fixtures shall be stored in a location to mitigate potential damage from corrosion, moisture, heat, sunlight, or chemicals.

### 7.2 Hydra-sets

The customer supplies hydra-sets used at the ETF. The customer's hydra-set shall be used in accordance with NASA-STD-8719.9.

7.2.1 Tagging

Hydra-sets shall be permanently tagged or marked by a NASA facility. The information on the tag or mark shall include a safe load rating.

7.2.2 Periodic Load Testing

Hydra-sets shall have a current load test. Periodic load testing shall be current if performed within one year for critical lift or four years for non-critical lifts. The periodic load testing shall be indicated either by tagging, marking, or documentation.

7.2.3 Inspection

Each day, prior to first use, the customer's hydra-set shall be inspected for damage or defects by a person authorized by NASA to operate hydra-sets.

## 8.0 EMERGENCY OPERATIONS

### 8.1 Personnel Injury

8.1.1 Secure operations and safe the load.
8.1.2 Immediately secure the area.
8.1.3 Move injured personnel only if necessary to prevent further injury.
8.1.4 Notify: Ambulance 911
8.1.5 MSFC Safety 4-8628 (alternate 4-0046) to report the mishap after securing the scene.

### 8.2 Damage to Equipment/Hardware

8.2.1 Secure operations and safe the load.
8.2.2 Immediately secure the area.

8.2.3 Notify:

| | |
|---|---|
| Facilities | 4-3919 |
| MSFC Safety | 4-8628 (alternate 4-0046) to report the mishap after securing the scene |

## 8.3 Loss of Crane/Hoist Control

8.3.1 Operator presses the Emergency Stop.

8.3.2 If emergency stop has no effect, turn off power at the crane/hoist breaker panel and lockout/tagout the panel. The crane disconnect is located overhead, just left of column 17, near the south east corner of Building 4619 west highbay east of room 155. The disconnect panel is marked with yellow label "CRANE DISCONNECT." Another yellow label is located on the wall at eye level marked "OVERHEAD CRANE DISCONNECT." The overhead disconnect panel is operated by a yellow rope.

8.3.3 Secure operations and safe the load. Where possible, provide load support to prevent a suspended load situation.

8.3.4 Notify:

| | |
|---|---|
| Facilities | 4-3919 |
| MSFC Safety | 4-0046 (alternate 4-8628) to report the mishap after securing the scene. |

## 8.4 Crane/Hoist Brake Failure

8.4.1 Operator immediately controls the drop by use of the UP control. When possible, provide load support to prevent a suspended load situation.

8.4.2 Notify:

| | |
|---|---|
| Facilities | 4-3919 |
| MSFC Safety | 4-0046 after securing the scene (alternate 4-8628) |

## 8.5 Power Loss

8.5.1 Place barricades around the area under the suspended load.

8.5.2 Assign one person on the lift Branch to stand watch at the load to prevent others from entering the area under the load.

8.5.3 If the load is small and near enough to ground level, the operator may transfer the load to a fork truck. Otherwise, maintain a watch at the load until power returns.

# Attachment 1

# Daily Overhead Crane/ Hoist Checklist

This checklist shall be completed every day the crane is operated. Once completed, it shall be placed in the crane checklist folder (located in the control room) for at least 90 days. Regularly discard any checklist more that 90 days old.

**CRANE DAILY INSPECTION CHECKLIST**

| DAILY INSPECTIONS<br>NASA-STD 87 19.9, 203, 206<br>NASA-STD | PASS | FAIL |
|---|---|---|
| **CHECK:**<br>- Annual inspection and load test tags within required intervals. | | |
| - Noted problems/discrepancies have been corrected. | | |
| - Hoist operations and brakes (up, down). | | |
| - Operation of upper limit switch with no load. | | |
| - Trolley for dual directional movement and brakes. | | |
| - Bridge for dual directional movement and brakes. | | |
| - Fluid systems for deterioration and leaks. | | |
| - Control mechanisms for wear and contamination. | | |
| - Hooks for cracks, deformities, and latch damage. | | |
| - Wire rope for revving, damage, kinks, and wire clips. | | |
| - Hoist chains for excessive wear or distortion. | | |
| **OPERATOR INITIALS:** | | |

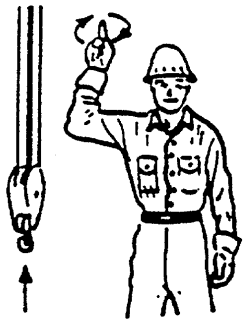
Failure items are to be reported to the Lead Supervisor and corrected prior to use. (Facilities Office work order desk 4-3919)

MSFC Form 4332 (January 1998) PDF

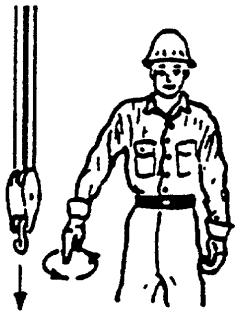
# Attachment 2

# Standard Hand Signals

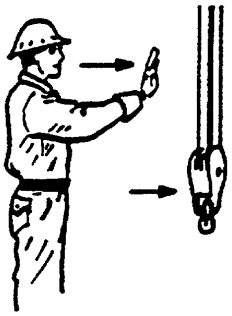
# HAND SIGNALS
# Overhead Cranes



HOIST - With forearm vertical, forefinger pointing up, move hand in small horizontal circle.

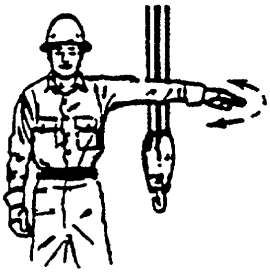


LOWER - With arm extended downward, forefinger pointing down, move hand in small horizontal circles.

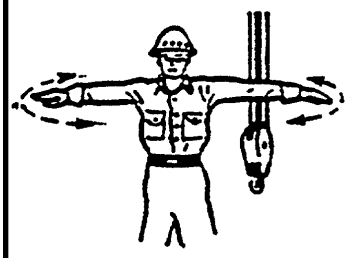


BRIDGE TRAVEL - Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.

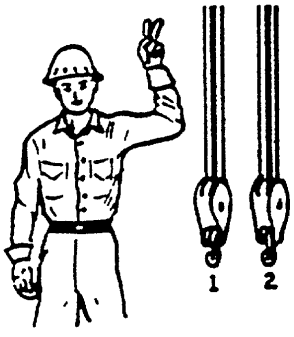
TROLLEY TRAVEL - Palm up, fingers closed, thumb pointing in direction of motion, jerk hand horizontally.



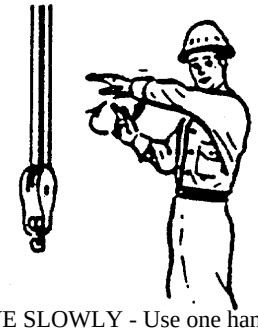
STOP - Arm extended, palm down, move arm back and forth.



EMERGENCY STOP - Both arms extended, palms down, move arms back and forth.




MULTIPLE TROLLEYS - Hold up one finger for block marked ”1” and two fingers for block marked “2”. Regular signals follow.



MOVE SLOWLY - Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal. (Hoist slowly shown as example.)