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*Document #40-01-648 *
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FAILURE MODES AND EFFECTS ANALYSIS AND OPERATING AND SUPPORT HAZARD ANALYSIS (O&SHA) OF THE ONE-HALF TON HAND CHAIN HOISTS LOCATED IN BUILDINGS M-16 AND M-20 WALLOPS FLIGHT FACILITY

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Attachment:

Memorandum from L. Bennett to J. Reddish/T. Wilson, Wallops Island, Subject: Wallops Island Facility Building 16 Review of Temporary Hoist Calculations, dated August 25, 1995

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LIST OF ABBREVIATIONS AND ACRONYMS

AGMA	American Gear Manufacturers Association
ANSI	American National Standards Institute
CAT	Category
CIL	Critical Items List
CMAA	Crane Manufacturers Association of America, Inc.
CSFP	Critical Single Failure Point
F/H	Flight Hardware
FMEA	Failure Modes and Effects Analysis
GSE	Ground Support Equipment
NASA	National Aeronautics and Space Administration
NFPA	No. 70, National Electric Code
NHB	NASA Handbook
NSTS	National Space Transportation System
OEM	Original Equipment Manufacturer
O&SHA	Operating and Support Hazard Analysis
REV.	Revision
SAA	System Assurance Analysis
SFP	Single Failure Point
SHA	System Hazard Analysis
WFF	Wallops Flight Facility

SECTION 1 - SUMMARY OF FINDINGS

1.1 System Criticality

The lifting systems installed in Buildings M-16 and M-20 at the Wallops Flight Facility each consists of a Coffing CA Aluminum one-half ton Hand Chain Hoist secured to connecting hardware and roof structure supporting members. The function of the chain hoist/supporting structure is to handle the shipping container cover for PEGASUS SAC-B/HETE flight hardware (F/H). A failure of the chain hoist could cause personnel injury, damage, or loss of the shipping container and/or F/H within. Therefore, these lifting systems are assessed as Critical.

1.2 Mechanical Critical Items

There were six Critical Items identified during this analysis. These items, defined as Single Failure Points (SFP) in accordance with NSTS 22206, Revision D, are listed below. Refer to Section 5.1, the Mechanical FMEA Worksheets, for further detail.

Part Name	Critical Failure Mode	Criticality Category
Disc Brake	Fails to engage, due to excessive wear/glazing of the brake disc	2
Pawl Assembly	Fails to engage due to structural failure caused by excessive wear, corrosion, spring failure	2
Ratchet Assembly	Fails to engage due to wear, bearing binding	2
Gear	Structural Failure due to overloading	2
Pinion Shaft	Structural Failure due to overloading	2
Load Flange	Slipping under load due to excessive wear, scoring	2

NOTE: The Criticality Category is defined in Paragraph 5.1.

The technical rationale for retaining the mechanical Critical Items is documented in Paragraph 5.7.1. In summary, the hoist is high quality, off-the-shelf, OEM type equipment which meets the requirements of NSS/GO-1740.9B. A periodic test, inspection, and maintenance program is in place to ensure safe operation with minimum risk to personnel and/or damage to flight hardware/facility. Risk acceptance performance

determined retention of the Critical Items to be an acceptable risk - uncertainties are controlled/managed.

Hazard Severity Level:

Catastrophic (could result in fatality or loss of flight hardware)

Likelihood of Occurrence:

Remote (not expected to happen)

1.3 Electrical Critical Items

There are no electrical items associated with the one-half ton hand chain hoist.

1.4 Critical Flex Hose

There are no flex hoses associated with this equipment.

1.5 Critical Orifices

There are no orifices associated with this equipment.

1.6 Critical Filters

There are no filters associated with this equipment.

1.7 Criticality Category 1R Items

There were no Criticality IR items identified in the critical output functions in Section 4.

1.8 Requirements of NSS/GO-1740.9B

Performance of the FMEA for the one-half ton hand chain hoist verified compliance to the requirements of NSS/GO-1740.9B, "NASA Safety Standard for Lifting Devices and Equipment."

1.9 Recommendations

The recommended hazard elimination and control provisions are summarized in Paragraph 5.8, Risk Assessment. Additional recommendations pertinent to the detection of failure causes are summarized in Paragraph 6.3.

Performance of the FMEA and O&SHA and resultant conclusions support the manufacturer's instructions pertinent to the significance of periodic test, inspection, maintenance and operator training. Implementation of the recommendations provides for corrective action, in addition to the available detection methods, to provide safe hoisting operations.

1.10 Critical Control/Monitor Functions

There are no control/monitor functions associated with this hand chain hoist.

1.11 Sneak Circuits Identified

There was no Sneak Circuit Analysis performed for this system.

SECTION 2 - SYSTEM SUMMARY

2.1 Documentation List

The following documents were used in completing this analysis:

Document	Rev.	Title
NSS/GO-1740.9	B	NASA Safety Standard for Lifting Devices and Equipment
NSTS 22206	D	Requirements for Preparation and Approval of Failure Modes and Effects Analysis (FMEA) and Critical Items List (CIL)
Publication Part No. CA-680-1		Duff-Norton Operating and Maintenance Instructions with Parts List - CA Series
NSI Report Number 44-06-401		Appendix I, Periodic Test and Inspection Report for Manually Operated Chain Hoist No. M-20-1, August 1995
T. Wilson to J. Reddish		FMEA Analysis of Existing Structure and Connections for PEGASUS Project Lifting Devices (M-16 and M-20), July 20, 1996
Attachments 1, 2, and 3		Supplement to Analysis of Existing Structure and Connections, July 27, 1995
ANSI B30.16		American National Standards Institute (ANSI)
NHB 1700.1(V1-B)		NASA Safety Policy and Requirements Document
RECERT-42-011		A Standard Operating Procedure for Preparation of a Request for a Waiver/Deviation to the Mandatory Requirements of NSS/GO-1740.9B, "NASA Safety

2.2 System Description

The lifting system installed in Buildings M-16 and M-20 consists of a Coffing CA Aluminum Hand Chain Hoist secured to connecting hardware and roof structure supporting members. The function of the chain hoist/supporting structure is to handle the shipping container cover for PEGASUS SAC-B/HETE flight hardware.

2.2.1 Hand Chain Hoist

The hand chain has an aluminum housing for portability. Gearing is made from alloy steel forgings. Hooks are steel forgings and the load chain is heat-treated alloy steel. The hand chain wheel is one piece construction of aluminum alloy. Hoist specifications follow.

Capacity	1000 Pounds
Weight With Standard Chain	22 Pounds
Standard Lift	8 Feet
Pull on Hand Chain To Raise Load (Approx.)	58 Pounds
Pull on Hand Chain To Lower Load (Approx.)	7 Pounds
Hand Chain Overhaul for One Foot Lift	18 Feet
Throat Opening of Standard Hook	1 Inch
Maximum Distance Between Hooks	110-5/8 Inches
Minimum Distance Between Hooks	13-1/4 Inches

SECTION 3 - DEFINITIONS AND GROUND RULES

3.1 Definitions

These definitions are necessary to an understanding of the ground rules contained in this document.

<u>Component</u> - A combination of parts, devices, and structures, usually self-contained, which perform a distinctive function in the operation of the overall equipment. A "black box" (e.g., transmitter, power supply, cryogenic pump, filter assembly).

<u>Correcting Action</u> - An identification of actions, automatic or manual, which could be taken to mitigate the effect of failure.

<u>Critical Item</u> - A critical item is defined as any one of the following:

1. A Criticality Category 1, 1S, or 2 Single Failure Point.
2. A redundant hardware item where the second failure results in loss of life or F/H and the item cannot be checked out during normal ground operations (i.e., a single fault tolerant item which fails Redundancy Screen A).

Critical Items List (CIL) - The CIL represents an analysis of the hardware design, highlighting those items which do not meet the requirements of the applicable codes and standards.

Critical System - A system is assessed as Critical if loss of overall system function or improper performance of a system function could result in loss of life, damage or loss of flight hardware or facilities.

Criticality - The relative measure of the consequences of a failure mode.

Criticality Categories

Criticality	Potential Effect or Failure
1	Single failure which could result in loss of life or flight hardware.
1R	Two redundant hardware items, which if both failed, could result in loss of life or flight hardware (or loss of a safety or hazard monitoring system).
1S	Single failure in a safety or hazard monitoring system that could cause the system to fail to detect, combat, or operate when needed during the existence of a hazardous condition and could result in loss of life or flight hardware.
2	Single failure which could result in loss (damage) of a flight hardware system or personnel injury.
3	All others.

Criticality Assessment - An analysis of each system function to determine if loss or improper performance of the function could result in loss of life/injury and/or damage to flight hardware or facilities.

Fail Safe - The ability to sustain a failure without causing loss of load or damage to the load. (Includes the capability to safe the lifting device and successfully terminate operations.)

Failure - The inability of a system, subsystem, component, or part to perform its required function within specified limits, under specified conditions for a specified duration.

Failure Effect - The effects documented address worst case.

Failure Mode - A description of the manner in which an item can fail.

Function - The activity or operation that a part, component, or system must perform to accomplish its intended purpose.

Hazard - Existing or potential condition that can result in or contribute to a mishap.

Hazard Report Status -

1. Closed - Corrective action/evaluation has been completed. Requirements have been identified and closed loop control is established. Governing procedural controls are in place. In case of hazards which document design deficiencies, the modification has been completed, the modified system configuration has been verified, and the certification has been documented.

2. Open - Corrective measurement/procedural hazard controls are not in place, or evaluation is pending.

Interface - The point or area where a relationship exists between two or more parts, systems, programs, persons, or procedures wherein physical and/or functional compatibility is required.

Loss of Lifting Device - Loss of the capability to provide the level of device performance required for normal or emergency operations.

Passive Component - A component that may be necessary to the performance or structural integrity of the system but has no active function.

Redundancy - Multiple ways of performing a function.

1. Operational Redundancy - Redundant elements, all of which are fully energized during the subsystem operating cycle. Operational redundancy includes load sharing redundancy wherein redundant elements are connected in such a manner that, upon failure of one unit, the remaining redundant elements will continue to perform the subsystem function. Switching out the failed element is not required.

2. Standby Redundancy - Redundant hardware items that are nonoperative until they are switched into the subsystem upon failure of the primary items. Switching can be accomplished by either automatic or manual means.

3. Like Redundancy - Identical hardware items performing the same function.

4. Unlike Redundancy - Nonidentical hardware items performing the same function. Safety features which provide protection for specific failure modes are considered as unlike redundancy for that failure mode; i.e., relief valves which provide protection against overpressurization after failure of a regulator.

Safety or Hazard Monitoring System - A system whose function is to detect or combat a hazardous situation which has occurred because of prior failures or events during hazardous operations.

Single Failure Point (SFP) - A single item of hardware, the failure of which could result in loss of life or damage to a flight hardware system.

Variance - Documented and approved permission to perform some act contrary to established requirements.

Waiver - A variance that authorizes departure from a particular safety requirement, where an increased level of risk has been accepted.

3.2 Ground Rules

The analysis shall assess all active components between the load hook and the nearest brake since failure of these components could result in dropping the load. The following ground rules shall be used:

3.2.1 The brake shall be identified as a Single Failure Point, in the event the hoist has only one brake and the criticality shall be assigned based on the worst-case effect of its failure. An eddy current brake shall not be considered capable of holding the load. See Paragraph 5.6.1 reference: manually operated (nonpowered), off-the-shelf, OEM type hoists.

3.2.2 For shafts located between the drum and brake, the method of shaft attachment shall be analyzed. The shaft attach points shall be considered passive, in the event that the shaft is welded or physically attached to the drum by a method approved by hoisting standards.

3.2.3 Bearings on drums and shafts shall be analyzed only to determine if the bearings can fail and drop the load.

3.2.4 Gear boxes, speed reducers, and couplings shall be considered Single Failure Points in the event that they are located between the drum and nearest brake.

3.2.5 Redundant items with control circuitry must be analyzed to determine whether or not a single credible failure can affect the controls for both redundant components.

3.2.6 A single limit switch on the trolley or bridge drive shall not be identified as a SFP in the event that there is also an acceptable mechanical stop.

3.2.7 Non-compliance to the requirements of NSS/GO-1740.9, "NASA Safety Standard for Lifting Devices and Equipment," shall be identified in the FMEA.

3.2.8 Passive components will not be analyzed in the FMEA. The current list of passive components includes the hook, load block, wire rope, sheaves, and rope drum. However, the drum shafts shall be analyzed as to the attachment method.

3.2.9 Manually operated (nonpowered) hoists that are off-the-shelf, OEM type are acceptable for Critical and non-Critical lift applications. They shall comply with applicable ANSI requirements. These hoists need only be equipped with at least one brake as described in industry standards and no limit switches, if proper over-travel restraint is provided.

3.3 Document worst case failure effects for every identified failure mode.

SECTION 4 - CRITICALITY ASSESSMENT

4.1 Purpose

The purpose of a lifting system criticality assessment is to assess each subsystem function to determine if loss or improper performance of the function could result in loss of life and/or load or damage to the lifting system. The assessment is performed without regard to redundancy. System functions are identified as either Critical or non-Critical.

4.2 Criticality Assessment Worksheet

The one-half-ton Hand Chain Hoist subsystems are assessed on the following Criticality Assessment Summary Sheet.

SYSTEM CRITICALITY ASSESSMENT SUMMARY WORKSHEET

LIFT SYSTEM: ONE-HALF-TON HAND CHAIN WINCH

LOCATION: BUILDINGS M-16 AND M-20

PREPARED BY: M. CROMPTON

DATE: DECEMBER 1995

SUBSYSTEM	FUNCTION	TIME PERIOD	EFFECT OF LOSS/FAILURE	CRITICALITY CATEGORY	NOTE
HAND CHAIN HOIST MOTION - UP/DOWN	RAISE/LOWER LOAD	PRE/POST TEST LIFTING OPERATIONS	A CATASTROPHIC FAILURE OF THE HOIST SYSTEM - CAUSE DAMAGE TO FLIGHT HARDWARE	C	
STRUCTURAL SUPPORT	SECURES CHAIN HOIST TO ROOF STRUCTURE SUPPORTING MEMBERS	PRE/POST TEST LIFTING OPERATIONS	A CATASTROPHIC FAILURE OF THE STRUCTURAL SUPPORT COULD CAUSE DAMAGE TO FLIGHT HARDWARE	C	ASSESSMENT INCLUDED AS PART OF THE OPERATING AND SUPPORT HAZARD ANALYSIS

C = Critical
NC = Not Critical

SECTION 5 - FAILURE MODES AND EFFECTS ANALYSIS AND CIL

5.1 Mechanical FMEA Worksheets and Block Diagrams

The mechanical components of the chain hoist documented in Section 4 were identified from the documents and diagrams referenced in the Documentation List. An analysis of these components was performed and documented on the following FMEA worksheets. A current list of passive components follows:

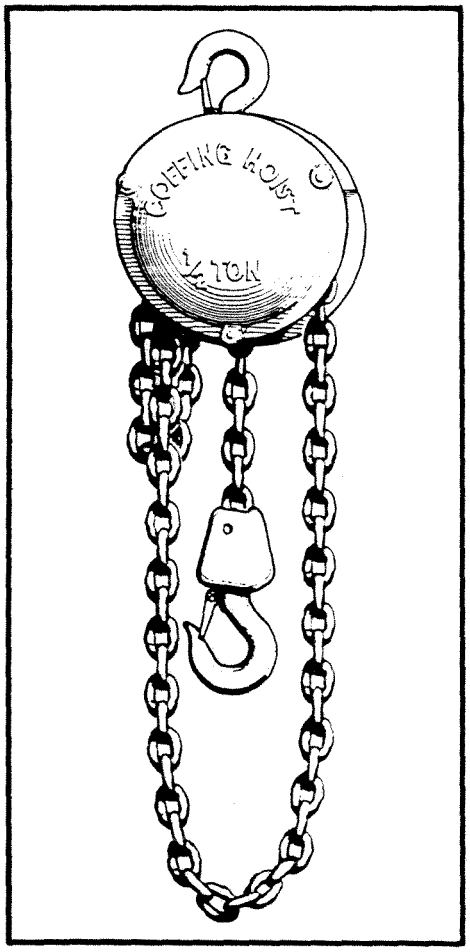
Passive Components

- Hook
- Load Block
- Hand Chain
- Sheaves
- Drum
- Structural components are not analyzed as part of this analysis. Such items that constitute a safety concern shall be considered in the Operating and Support Hazard Analysis which is included herein.

The following Figures illustrate the 1/2-ton Coffing hand chain hoist, connecting hardware, and roof structure supporting members.

Figure 1: CA Aluminum Hand Chain Hoist
Figure 2: Exploded Illustration of Model CA Hoist
Figure 3: Beam Clamp
Figure 4: Building M-16 Roof Framing
Figure 5: Building M-20 Roof Framing
Figure 6: Truss Diagram

Additional details are provided in the referenced analysis of existing structure and connections.



CA SERIES

FIGURE 1
CA ALUMINUM HAND CHAIN HOIST

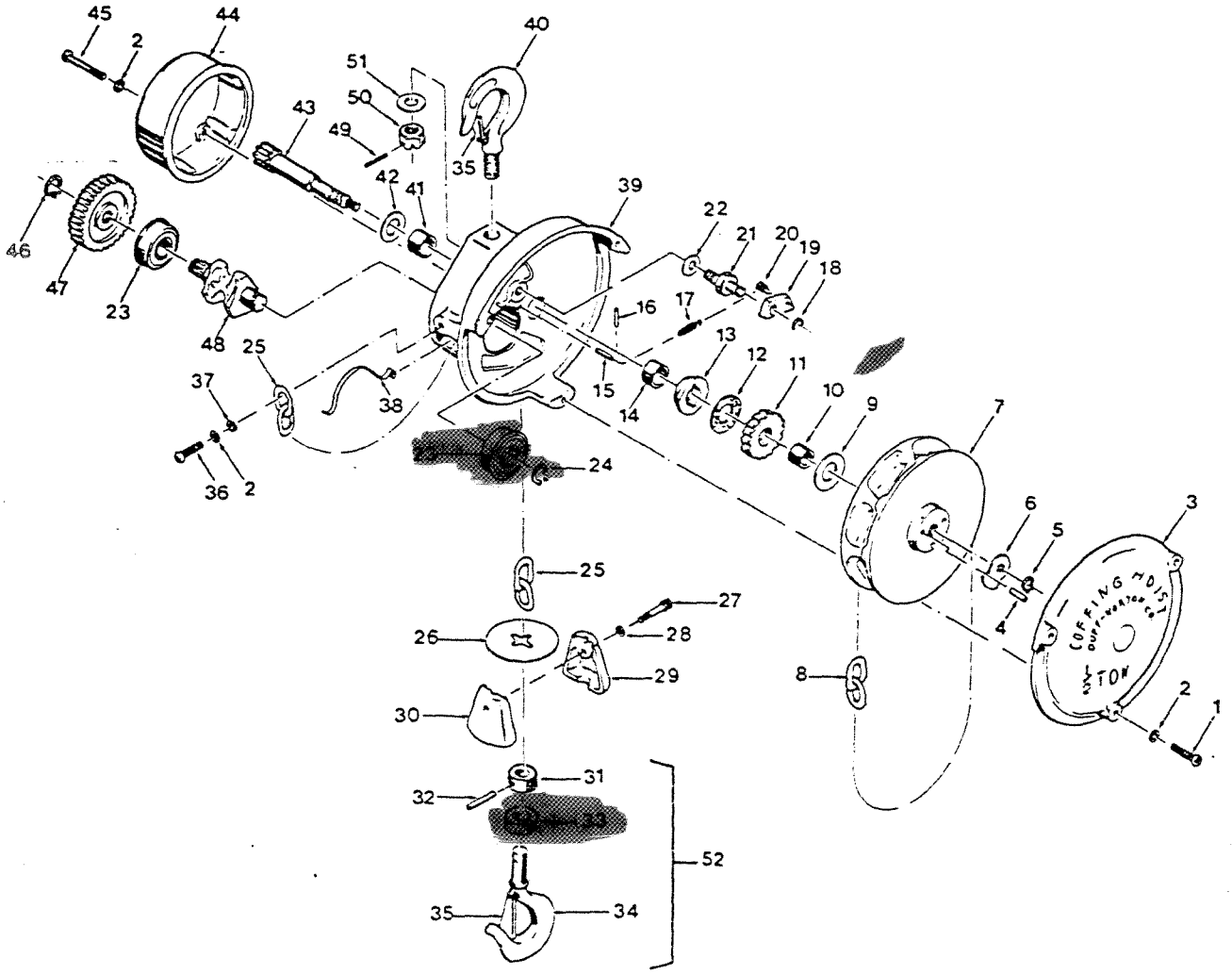


FIGURE 2
EXPLODED ILLUSTRATION OF MODEL CA HOIST

[redacted] = CRIT 3

= CRIT 2

FORM 447

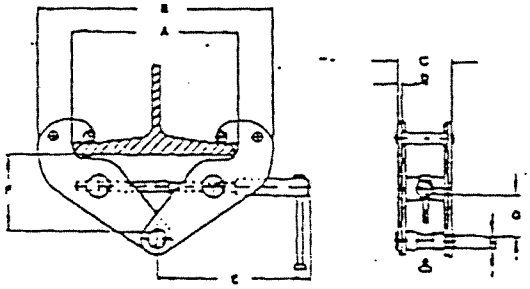
19/25

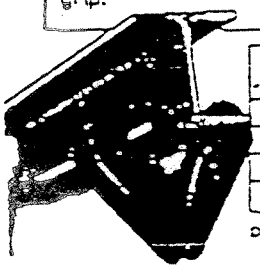
New! FROM WALLACE PRODUCTS BEAM CLAMPS

The Wallace Beam Clamp is designed for a wide variety of uses whenever you need a hoisting or rigging point fast!

The threaded adjustment mechanism easily attaches to a wide range of flange widths to provide a safe and secure grip.

The suspension bar is built-in for convenience and to keep headroom requirements to a minimum. All wearing parts are quickly and easily replaced. Each and every unit is tested and certified before we ship it so you can use it with confidence.





Capacity Tons	MODEL NUMBER	Flange Width Min.	Flange Width Max.	Net Wt. (lbs.)	Price	A Max.	B Min.	B Max.	C	D	E	F Min.	F Max.	G	H
1	WBC-1R	3.0	9.0	8.8	$50.00	10.6	6.9	14.4	2.9	0.2	8.4	2.9	5.4	1.2	0.80
2	WBC-2R	3.0	9.0	13.2	57.00	10.6	7.3	15.0	2.9	0.2	8.4	2.9	5.4	1.2	0.80
3	WBC-3R	3.9	9.0	17.6	93.00	11.6	8.7	16.7	4.0	0.3	10.0	4.1	6.3	2.4	0.87
5	WBC-5R	3.9	10.2	22.0	105.00	12.6	9.8	18.7	4.0	.03	10.0	3.5	6.3	1.8	1.10

DIMENSIONS ARE IN INCHES.

B. E. WALLACE PRODUCTS CORP. • 71 BACTON HILL ROAD, FRAZER, PA 19355-1005
1-800-553-LIFT (OUTSIDE PA) • (610) 647-1400 (IN PA) • FAX (610) 644-8043 FOR YOUR CONVENIENCE 24 HOURS A DAY

FIGURE 3
BEAM CLAMP

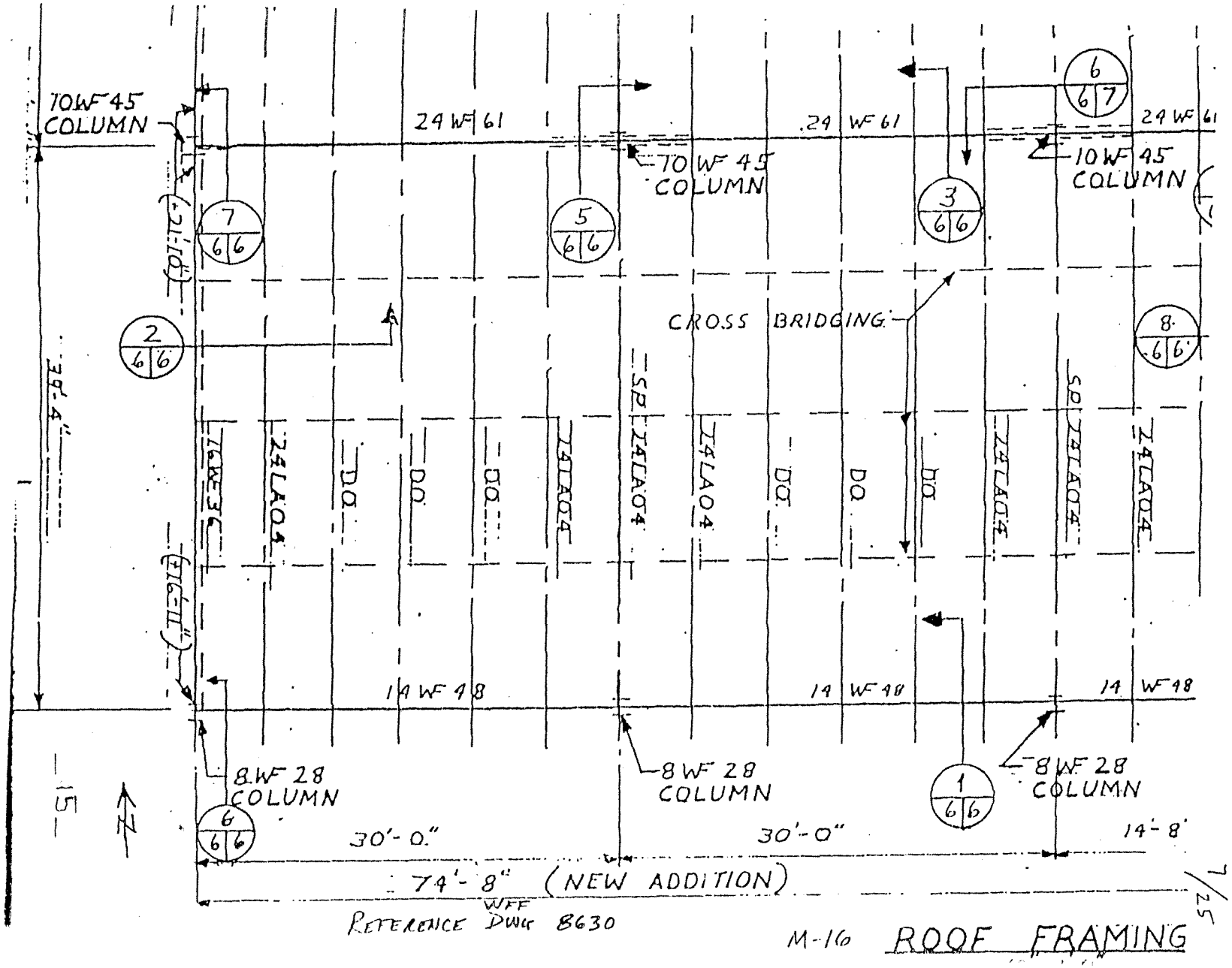


FIGURE 4
BUILDING M-16 ROOF FRAMING

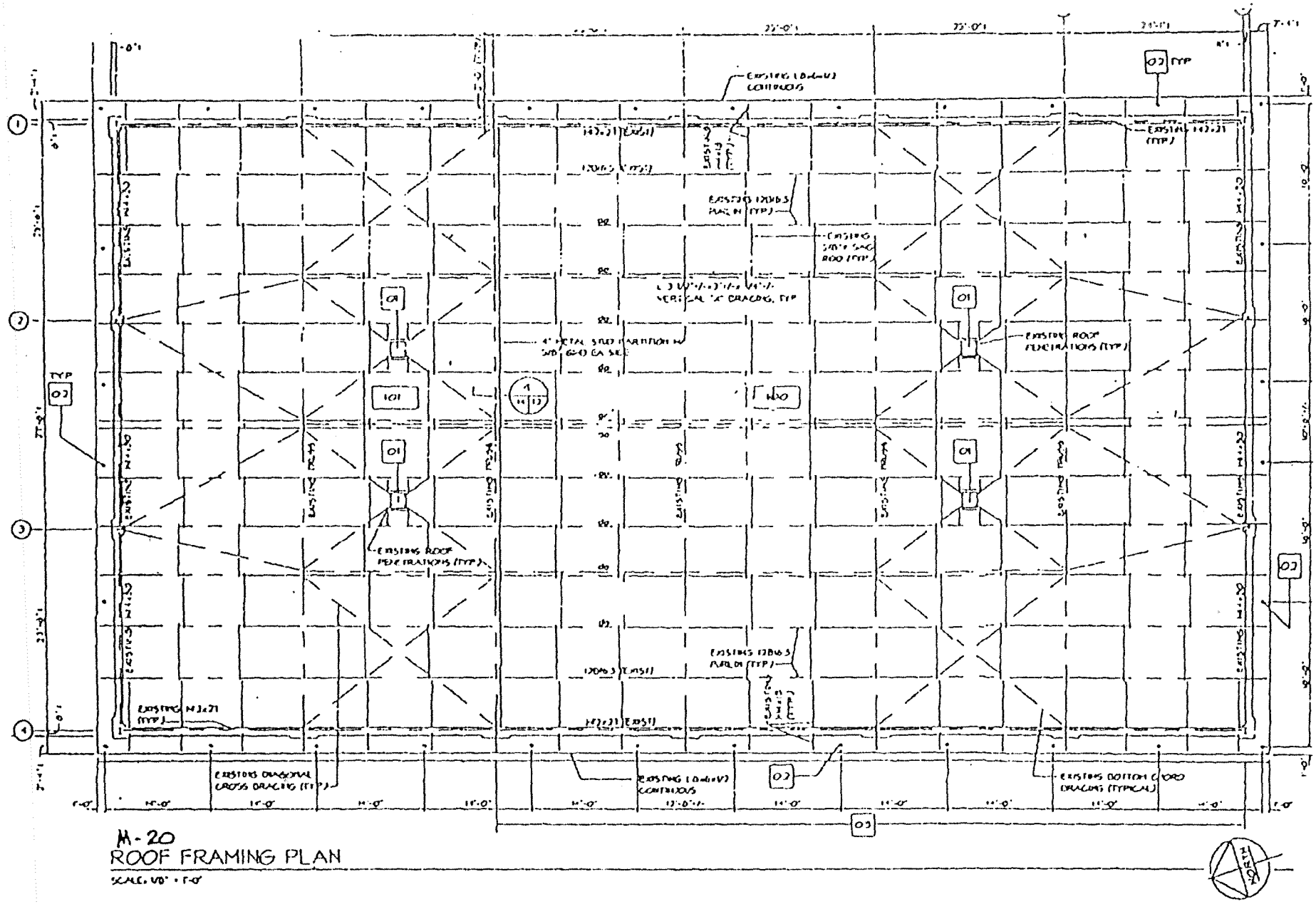
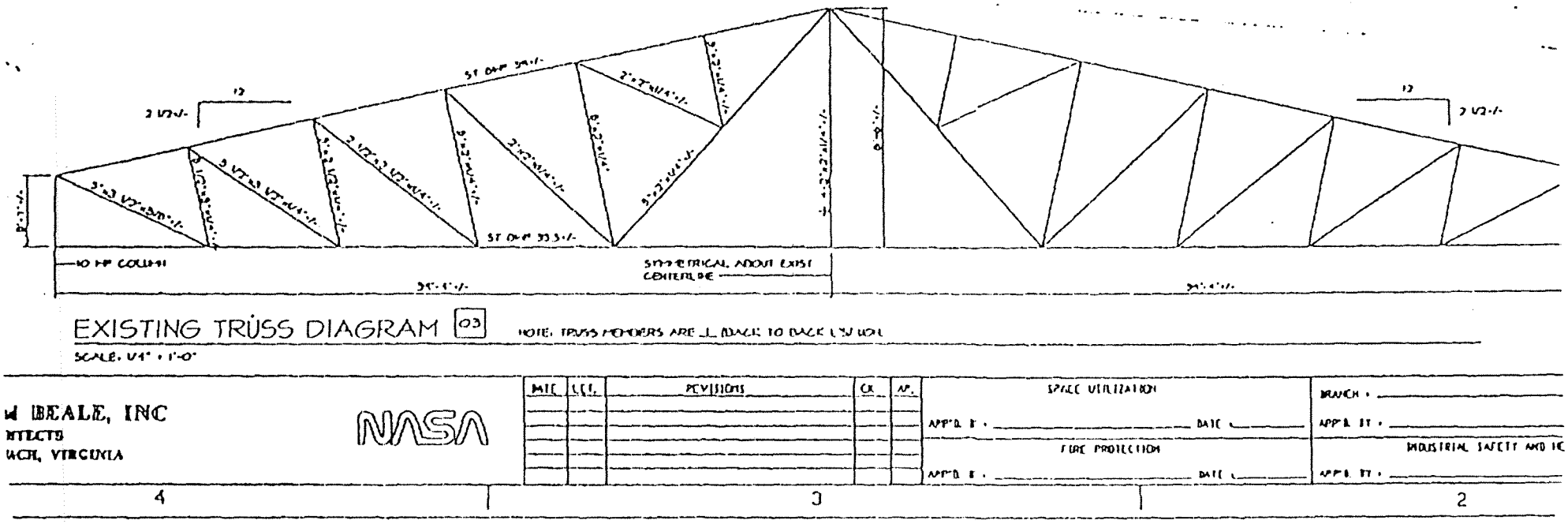


FIGURE 5
BUILDING M-20 ROOF FRAMING



REFERENCE WFF DWG. 2868

FIGURE 6
TRUSS DIAGRAM

FAILURE MODE AND EFFECTS ANALYSIS (FMEA) WORKSHEET

SYSTEM: BUILDINGS M-16 AND M-20
SUBSYSTEM: 1/2-TON HAND CHAIN HOISTS

DATE: MARCH 1996
PREPARED BY: M. CROMPTON

INDEX NO.	PART NAME	PART FUNCTION	A. FAILURE MODE B. CAUSE C. DETECTION METHOD D. CORRECTING ACTION E. TIME TO EFFECT	FAILURE EFFECT ON SYSTEM PERFORMANCE	FAILURE EFFECT ON CRITICAL HARDWARE AND/OR PERSONNEL SAFETY	CRIT CAT
9 & 12	DISC BRAKE	PROVIDES BRAKING ABILITY TO THE HOIST SYSTEM	A. FAILS TO ENGAGE B. EXCESSIVE WEAR, GLAZING OIL CONTAMINATION C. LOAD CREEPS DOWN, DAILY AND PERIODIC SAFETY INSPECTIONS D. REPLACE DISCS E. FUNCTION OF SERVICE CONDITIONS	CATASTROPHIC FAILURE OF THE BRAKE WILL ALLOW THE LOAD TO DROP	LOAD WILL DROP, COULD CAUSE DAMAGE TO FLIGHT HARDWARE	2
19 & 20 17 21	PAWL ASSEMBLY INCLUDING REVERSE PAWL SPRING AND STUD	FUNCTIONS TO ENGAGE RATCHET TO PREVENT REVERSE MOTION	A. FAILS TO ENGAGE, STRUCTURAL FAILURE B. EXCESS WEAR, CORROSION, STRETCHED SPRING, BINDING C. HOOK DRIFT	FAILURE OF THE PAWL ASSEMBLY WILL ALLOW THE LOAD TO DROP	LOAD WILL DROP, COULD CAUSE DAMAGE TO FLIGHT HARDWARE	2
11 & 10	RATCHET ASSEMBLY	ENGAGES PAWL ASSEMBLY TO PREVENT REVERSE MOTION	A. FAILS TO ENGAGE B. WEAR, BINDING WORN BEARING C. HOOK DRIFT	FAILURE OF THE RATCHET ASSEMBLY WILL ALLOW THE LOAD TO DROP	LOAD WILL DROP, COULD CAUSE DAMAGE TO FLIGHT HARDWARE	2

FAILURE MODE AND EFFECTS ANALYSIS (FMEA) WORKSHEET

SYSTEM: BUILDINGS M-16 AND M-20
SUBSYSTEM: 1/2-TON HAND CHAIN HOISTS

DATE: MARCH 1996
PREPARED BY: M. CROMPTON

INDEX NO.	PART NAME	PART FUNCTION	A. FAILURE MODE B. CAUSE C. DETECTION METHOD D. CORRECTING ACTION E. TIME TO EFFECT	FAILURE EFFECT ON SYSTEM PERFORMANCE	FAILURE EFFECT ON CRITICAL HARDWARE AND/OR PERSONNEL SAFETY	CRIT CAT
47	GEAR	PROVIDES MECHANICAL COUPLING BETWEEN THE PINION SHAFT AND THE LOAD LINE	A.1 FAILS STRUCTURALLY B.1 OVERLOAD C.2 NOISY OPERATION D.1 N/A E.1 IMMEDIATELY	FAILURE OF THE GEAR WILL ALLOW THE LOAD TO DROP	LOAD WILL DROP, COULD CAUSE DAMAGE TO FLIGHT HARDWARE	2
43	PINION SHAFT	PROVIDES COUPLING BETWEEN THE HOIST INPUT AND OUTPUT FUNCTIONS	A.2 FAILS STRUCTURALLY B.2 OVERLOAD C.2 NOISY OPERATION D.2 N/A E.2 IMMEDIATELY	FAILURE OF THE PINION SHAFT WILL ALLOW THE LOAD TO DROP	LOAD WILL DROP, COULD CAUSE DAMAGE TO FLIGHT HARDWARE	2
23, 10, & 33	BEARINGS	REDUCES SHAFT TO LOAD HANDLING PART FRICTION AND MAINTAINS PART ALIGNMENT	A. COMPRESSION FAILURE B. OVERLOADING	HOIST SYSTEM INOPERATIVE	DELAY FOR REPAIRS	3
13	LOAD FLANGE	FUNCTIONS AS A PRESSURE PLATE TO PERMIT THE BRAKING MECHANISM TO AUTOMATICALLY STOP AND HOLD THE LOAD	A. SLIPPAGE UNDER LOAD B. EXCESSIVE WEAR, SCORING C. LOAD CREEPS DOWN D. REPLACEMENT E. FUNCTION OF SERVICE CONDITIONS	CATASTROPHIC FAILURE OF THE LOAD FLANGE WILL ALLOW THE LOAD TO DROP	LOAD WILL DROP, COULD CAUSE DAMAGE TO FLIGHT HARDWARE	2

5.2 Electrical FMEA Worksheets and Block Diagrams

There are no electrical functions associated with this equipment.

5.3 Flex Hose FMEA Worksheets

There are no flex hoses associated with this equipment.

5.4 Orifice FMEA Worksheets

There are no orifices associated with this equipment

5.5 Filter FMEA Worksheets

There are no filters associated with this equipment.

5.6 Requirements of NSS/GO-1740.9B

The design of the 1/2-ton hand chain hoist is compliant with the requirements of NSS/GO-1740.9B, "NASA Safety Standard for Lifting Devices and Equipment."

5.7 Critical Items List

Six Critical Items were identified during this analysis. These items are summarized on the following Critical Items List. The Critical Items are defined as Single Failure Points (SFP) in accordance with NSTS 22206, Revision D.

ITEM	QUANTITY	CRITICALITY
a. Disc Brake	1	2
b. Pawl Assembly	1	2
c. Ratchet Assembly	1	2
d. Gear	1	2
e. Pinion Shaft	1	2
f. Load Flange	1	2

5.7.1 Critical Item Acceptance Rationale Sheets

The technical rationale for accepting the risk of retaining the Critical Items are documented on the following Critical Item Sheets.

Critical Item: Disc Brake
Criticality Category: 2

System/Area: 1/2 Ton Coffing Hand Chain Hoist/Buildings M-16 and M-20

Item No.: 9 and 12, see Figure 2

Function: Provides braking ability to the hoist

Critical Failure Mode: Fails to engage

Failure Cause: Excessive disc wear, glazing and/or oil contamination

Failure Effect: Load will drop, could cause damage to flight hardware

ACCEPTANCE RATIONALE

Design:

The use of high quality, off-the-shelf, OEM type equipment is acceptable for Critical and non-Critical lift applications. The 1/2-ton hand chain hoist meets all user requirements, the requirements of NSS/GO-1740.9B, and complies with applicable ANSI standards.

Test:

- Periodic testing is performed in accordance with "Appendix I, Periodic Test and Inspection Report for Manually Operated Chain Hoist No. M-20-1, August 1995."
- Hoist is operated through its entire length of travel prior to each Critical lift or once a day if multiple lifts are to be performed. Log books are completed noting any possible problems.
- Hoist has been proof load tested to 125% rated load after installation and prior to first use.
- Hoist system is load tested at 100% rated load annually.

Inspection:

- Periodic Inspection is performed in accordance with "Periodic Test and Inspection Report for Manually Operated Chain Hoist, Hoist No. M-20-1." This procedure provides specific instructions pertinent to the Critical Items identified in this analysis.
- Daily inspection is performed prior to first use each day the hoist is used, in accordance with the requirements of NSS/GO-1740.9B, "NASA Standard for Lifting Devices and Equipment."

Failure History:

There is no history of load brake failures or unexplained anomalies experienced during hand chain hoist operation.

Operational Use:

- Provisions for corrective actions, e.g., redundancy, are not required to circumvent the specified failure once it has occurred.

- In accordance with Paragraph 406.b.(16) of NSS/GO-1740.9B:

  > When raising loads that approach the rated capacity of the hoist, the operator shall know the weight of the working load. The operator shall test the holding brakes each time a load approaching the rated load is handled. The brakes shall be tested by raising the load minimally above the surface and holding the load with the brake. The load should be held long enough to allow any dynamics to dampen out.

- The most probable failure mode would result in the load creeping down. A certified operator is trained in the special hazards and special procedures associated with the lift and to mitigate the effects of this deficiency, once it has occurred.

Critical Item: Pawl Assembly
Criticality Category: 2

System/Area: 1/2 Ton Coffing Hand Chain Hoist/Buildings M-16 and M-20

Item No.: 19, Pawl Assembly, includes Item No. 17 - Reverse Pawl Spring and Item No. 20 - Spring Anchor Pin.

Function: To engage ratchet to prevent reverse motion.

Critical Failure Mode: Fails to engage/structural failure

Failure Cause: Excess wear, corrosion, stretched spring, binding

Failure Effect: Failure of the pawl assembly will allow the load to drop

ACCEPTANCE RATIONALE

Design:

The use of high quality, off-the-shelf, OEM type equipment is acceptable for Critical and non-Critical lift applications. The 1/2-ton hand chain hoist meets all user requirements, the requirements of NSS/GO-1740.9B, and complies with applicable ANSI standards.

Test:

- Periodic testing is performed in accordance with "Appendix I, Periodic Test and Inspection Report for Manually Operated Chain Hoist No. M-20-1, August 1995."
- Hoist is operated through its entire length of travel prior to each Critical lift or once a day if multiple lifts are to be performed. Log books are completed noting any possible problems.
- Hoist has been proof load tested to 125% rated load after installation and prior to first use.
- Hoist system is load tested at 100% rated load annually.

Inspection:

- Periodic Inspection is performed in accordance with "Periodic Test and Inspection Report for Manually Operated Chain Hoist, Hoist No. M-20-1." This procedure provides specific instructions pertinent to the Critical Items identified in this analysis.
- Daily inspection is performed prior to first use each day the hoist is used, in accordance with the requirements of NSS/GO-1740.9B, "NASA Standard for Lifting Devices and Equipment."

Failure History:

There is no history of pawl assembly failures or unexplained anomalies experienced during hand chain hoist.

Operational Use:

Provisions for corrective actions, e.g., redundancy, are not required to circumvent the specified failure once it has occurred.

- In accordance with Paragraph 406.b.(16) of NSS/GO-1740.9B:

  > When raising loads that approach the rated capacity of the hoist, the operator shall know the weight of the working load. The operator shall test the holding brakes each time a load approaching the rated load is handled. The brakes shall be tested by raising the load minimally above the surface and holding the load with the brake. The load should be held long enough to allow any dynamics to dampen out.

- An operator shall be at the hoist controls at all times while a load is suspended, in accordance with Paragraph 406.b.(7) of NSS/GO-1740.9B. This provision must be included in the Critical lift procedure.

- The most probable failure mode would result in the load creeping down. A certified operator is trained in the special hazards and special procedures associated with the lift and to mitigate the effects of this deficiency, once it has occurred.

Critical Item: Ratchet Assembly
Criticality Category: 2

System/Area: 1/2-Ton Coffing Hand Chain Hoist/Buildings M-16 nd M-20

Item No.: 10 and 11, see Figure 2

Function: Engages pawl assembly to prevent reverse motion

Critical-Failure Mode: Fails to engage

Failure Cause: Wear, binding, worn bearing

Failure Effect: Failure of the ratchet assembly will allow the load to drop

ACCEPTANCE RATIONALE

Design:

The use of high quality, off-the-shelf, OEM type equipment is acceptable for Critical and non-Critical lift applications. The 1/2-ton hand chain hoist meets all user requirements, the requirements of NSS/GO-1740.9B, and complies with applicable ANSI standards.

Test:

- Periodic testing is performed in accordance with "Appendix I, Periodic Test and Inspection Report for Manually Operated Chain Hoist No. M-20-1, August 1995."
- Hoist is operated through its entire length of travel prior to each Critical lift or once a day if multiple lifts are to be performed. Log books are completed noting any possible problems.
- Hoist has been proof load tested to 125% rated load after installation and prior to first use.
- Hoist system is load tested at 100% rated load annually.

Inspection:

- Periodic Inspection is performed in accordance with "Periodic Test and Inspection Report for Manually Operated Chain Hoist, Hoist No. M-20-1." This procedure provides specific instructions pertinent to the Critical Items identified in this analysis.
- Daily inspection is performed prior to first use each day the hoist is used, in accordance with the requirements of NSS/GO-1740.9B, "NASA Standard for Lifting Devices and Equipment."

Failure History:

There is no history of ratchet assembly failures or unexplained anomalies experienced during hand chain hoist operation.

Operational Use:

Provisions for corrective actions, e.g., redundancy, are not required to circumvent the specified failure once it has occurred.

- In accordance with Paragraph 406.b.(16) of NSS/GO-1740.9B:

  > When raising loads that approach the rated capacity of the hoist, the operator shall know the weight of the working load. The operator shall test the holding brakes each time a load approaching the rated load is handled. The brakes shall be tested by raising the load minimally above the surface and holding the load with the brake. The load should be held long enough to allow any dynamics to dampen out.

- An operator shall be at the hoist controls at all times while a load is suspended, in accordance with Paragraph 406.b.(7) of NSS/GO-1740.9B.

- The most probable failure mode would result in the load creeping down. A certified operator is trained in the special hazards and special procedures associated with the lift and to mitigate the effects of this deficiency, once it has occurred.

Critical Item: Gear
Criticality Category: 2

System/Area: 1/2-Ton Coffing Hand Chain Hoist/Buildings M-16 and M-20

Item No.: 47, see Figure 2

Function: Provides mechanical coupling between the pinion shaft and the load line

Critical Failure Mode: Fails structurally

Failure Cause: Overload

Failure Effect: Failure of the gear will allow the load to drop

NSTS 22206 requires that gear boxes, speed reducers, and couplings shall be considered Single Failure Points if they are located between the drum and the nearest brake.

ACCEPTANCE RATIONALE

Design:

The use of high quality, off-the-shelf, OEM type equipment is acceptable for Critical and non-Critical lift applications. The 1/2-ton hand chain hoist meets all user requirements, the requirements of NSS/GO-1740.9B, and complies with applicable ANSI standards.

Test:

- Periodic testing is performed in accordance with "Appendix I, Periodic Test and Inspection Report for Manually Operated Chain Hoist No. M-20-1, August 1995."
- Hoist is operated through its entire length of travel prior to each Critical lift or once a day if multiple lifts are to be performed. Log books are completed noting any possible problems.
- Hoist has been proof load tested to 125% rated load after installation and prior to first use.
- Hoist system is load tested at 100% rated load annually.

Inspection:

- Periodic Inspection is performed in accordance with "Periodic Test and Inspection Report for Manually Operated Chain Hoist, Hoist No. M-20-1." This procedure provides specific instructions pertinent to the Critical Items identified in this analysis.

- Daily inspection is performed prior to first use each day the hoist is used, in accordance with the requirements of NSS/GO-1740.9B, "NASA Standard for Lifting Devices and Equipment."

Failure History:

There is no history of gear failures or unexplained anomalies experienced during hand chain hoist operation.

Operational Use:

Provisions for corrective actions, e.g., redundancy, are not required to circumvent the specified failure once it has occurred.

- In accordance with Paragraph 406.b.(16) of NSS/GO-1740.9B:

  > When raising loads that approach the rated capacity of the hoist, the operator shall know the weight of the working load. The operator shall test the holding brakes each time a load approaching the rated load is handled. The brakes shall be tested by raising the load minimally above the surface and holding the load with the brake. The load should be held long enough to allow any dynamics to dampen out.

- An operator shall be at the hoist controls at all times while a load is suspended, in accordance with Paragraph 406.b.(7) of NSS/GO-1740.9B.

- The most probable failure mode would result in unusual gear noise during operations. A certified operator is trained in the special hazards and special procedures associated with the lift and to mitigate the effects of this deficiency, once it has occurred.

Critical Item: Pinion Shaft
Criticality Category: 2

System/Area: 1/2-Ton Coffing Hand Chain Hoist/Buildings M-16 and M-20

Item No.: 43, see Figure 2

Function: Provides coupling between the hoist input and output functions.

Critical Failure Mode: Fails structurally

Failure Cause: Overload

Failure Effect: Failure of the pinion shaft will allow the load to drop

ACCEPTANCE RATIONALE

Design:

The use of high quality, off-the-shelf, OEM type equipment is acceptable for Critical and non-Critical lift applications. The 1/2-ton hand chain hoist meets all user requirements, the requirements of NSS/GO-1740.9B, and complies with applicable ANSI standards.

Test:

- Periodic testing is performed in accordance with "Appendix I, Periodic Test and Inspection Report for Manually Operated Chain Hoist No. M-20-1, August 1995."
- Hoist is operated through its entire length of travel prior to each Critical lift or once a day if multiple lifts are to be performed. Log books are completed noting any possible problems.
- Hoist has been proof load tested to 125% rated load after installation and prior to first use.
- Hoist system is load tested at 100% rated load annually.

Inspection:

- Periodic Inspection is performed in accordance with "Periodic Test and Inspection Report for Manually Operated Chain Hoist, Hoist No. M-20-1." This procedure provides specific instructions pertinent to the Critical Items identified in this analysis.
- Daily inspection is performed prior to first use each day the hoist is used, in accordance with the requirements of NSS/GO-1740.9B, "NASA Standard for Lifting Devices and Equipment."

Failure History:

There is no history of pinion shaft failures or unexplained anomalies experienced during hand chain hoist operation.

Operational Use:

Provisions for corrective actions, e.g., redundancy, are not required to circumvent the specified failure once it has occurred.

- In accordance with Paragraph 406.b.(16) of NSS/GO-1740.9B:

  > When raising loads that approach the rated capacity of the hoist, the operator shall know the weight of the working load. The operator shall test the holding brakes each time a load approaching the rated load is handled. The brakes shall be tested by raising the load minimally above the surface and holding the load with the brake. The load should be held long enough to allow any dynamics to dampen out.

- An operator shall be at the hoist controls at all times while a load is suspended, in accordance with Paragraph 406.b.(7) of NSS/GO-1740.9B.

- The most probable failure mode would result in jerky, rough, and noisy operations due to gear misalignment resulted from shaft bending. A certified operator is trained in the special hazards and special procedures associated with the lift and to mitigate the effects of this deficiency, once it has occurred.

Critical Item: Load Flange
Criticality Category: 2

System/Area: 1/2-Ton Coffing Hand Chain Hoist/Buildings M-16 and M-20

Item No.: 13, see Figure 2

Function: Functions as a pressure plate to permit the braking mechanism to automatically stop and hold the load

Critical Failure Mode: Slippage under load

Failure Effect: Catastrophic failure of the load flange will allow the load to drop.

ACCEPTANCE RATIONALE

Design:

The use of high quality, off-the-shelf, OEM type equipment is acceptable for Critical and non-Critical lift applications. The 1/2-ton hand chain hoist meets all user requirements, the requirements of NSS/GO-1740.9B, and complies with applicable ANSI standards.

Test:

- Periodic testing is performed in accordance with "Appendix I, Periodic Test and Inspection Report for Manually Operated Chain Hoist No. M-20-1, August 1995."
- Hoist is operated through its entire length of travel prior to each Critical lift or once a day if multiple lifts are to be performed. Log books are completed noting any possible problems.
- Hoist has been proof load tested to 125% rated load after installation and prior to first use.
- Hoist system is load tested at 100% rated load annually.

Inspection:

- Periodic Inspection is performed in accordance with "Periodic Test and Inspection Report for Manually Operated Chain Hoist, Hoist No. M-20-1." This procedure provides specific instructions pertinent to the Critical Items identified in this analysis.
- Daily inspection is performed prior to first use each day the hoist is used, in accordance with the requirements of NSS/GO-1740.9B, "NASA Standard for Lifting Devices and Equipment."

Failure History:

There is no history of load flange failures or unexplained anomalies experienced during hand chain hoist operation.

Operational Use:

Provisions for corrective actions, e.g., redundancy, are not required to circumvent the specified failure once it has occurred.

- Manually operated hoists are acceptable for Critical lift operations, in accordance with NSS/GO-1740.9B. The hoists shall comply with applicable ANSI requirements and have at least one brake as described by industry standards.

- An operator shall be at the hoist controls at all times while a load is suspended, in accordance with Paragraph 406.b.(7) of NSS/GO-1740.9B.

- The most probable failure mode would result in the load creeping down. A certified operator is trained in the special hazards and special procedures associated with the lift and to mitigate the effects of this deficiency, once it has occurred.

5.8 Risk Assessment

The following evaluation of risk acceptance was performed in accordance with the criteria of NHB 1700.1(V1-B) and RECERT-42-011. A Risk Assessment Matrix is included. See Figure 7. The Severity and suggested Likelihood of Occurrence for each of the Critical Items is documented. The Controls are considered to be in place for accepting residual risk. Definitions for Risk Severity Level, Likelihood of Risk Occurrence and Risk follow.

Risk Severity Level

Marginal - a hazard that could result in a mishap or minor mishap inflicting first-aid injury to personnel, and/or damage to flight hardware or ground equipment which can be tolerated or repaired without significant program delay.

Critical - a hazard that could result in serious injury to personnel and/or damage to flight hardware or ground equipment which could cause a significant program delay.

Catastrophic - a hazard that could result in a mishap causing fatal injury to personnel and/or loss of one or more major elements of the flight hardware or ground facility.

Likelihood of Risk Occurrence

Probable - expected to happen
Occasional - could happen
Remote - not expected to happen

Risk

Unacceptable Risk - Uncertainties Exist. Further action will be required to reduce the risk to an acceptable level.

Acceptable Risk - Minor Uncertainties Exist. The level of risk from the activity is assessed to be sufficiently low to approve the activity.

Acceptable Risk - Uncertainties Controlled/Managed. The in-place controls have significantly reduced the risk level such that hazard occurrence is not expected to happen.

The recommended Controls are summarized below.

- Test and inspection procedures are performed by qualified personnel according to written (specific and general) technical operating practices approved in accordance with NSS/GO-1740.9B, Paragraphs 402 and 403.

- Only certified and trained operators shall be authorized to use/operate lifting devices, including hoist operations, in accordance with the practices defined in NSS/GO-1740.9B, Paragraph 406.

- Critical lift operators must be trained in the specific hazards and special procedures associated with the lift in accordance with NSS/GO-1740.9B, Paragraph 405.b.(c)(2).

- Verification of the aforementioned Hazard Elimination and Control Provisions shall be audited to establish that the procedures/training conform to the specified requirements. Closure concurrence shall be by the Deputy RECERT Manager or his authorized representative.

- Risk assessment was performed in accordance with RECERT-42-011. The overall risk assessment is arrived as follows:

  Hazard Severity Level: Catastrophic
  Likelihood: Remote
  Risk: Acceptable (Uncertainties Controlled/Managed)

  See Figure 7.

GSFC RECERTIFICATION
HAZARD SEVERITY LEVELS VERSUS LIKELIHOOD OF OCCURRENCE FOR RISK ASSESSMENT*

		HAZARD* SEVERITY LEVELS		
		MARGINAL (COULD RESULT IN MINOR INJURY OR MINOR FLIGHT HARDWARE DAMAGE)	CRITICAL (COULD RESULT IN SERIOUS INJURY OR SIGNIFICANT FLIGHT HARDWARE DAMAGE)	CATASTROPHIC (COULD RESULT IN FATALITY OR LOSS OF FLIGHT HARDWARE)
LIKELIHOOD	*PROBABLE (EXPECTED TO HAPPEN)*	UNACCEPTABLE RISK (UNCERTAINTIES EXIST)	UNACCEPTABLE RISK (UNCERTAINTIES EXIST)	UNACCEPTABLE RISK (UNCERTAINTIES EXIST)
	OCCASIONAL (COULD HAPPEN)	ACCEPTABLE RISK (MINOR UNCERTAINTIES EXIST)	UNACCEPTABLE RISK (MINOR UNCERTAINTIES EXIST)	UNACCEPTABLE RISK (MINOR UNCERTAINTIES EXIST)
	REMOTE (NOT EXPECTED TO HAPPEN)	ACCEPTABLE RISK (UNCERTAINTIES CONTROLLED/ MANAGED)	ACCEPTABLE RISK (UNCERTAINTIES CONTROLLED/ MANAGED)	ACCEPTABLE RISK (UNCERTAINTIES CONTROLLED/ MANAGED)

* THIS GSFC RECERT RISK ASSESSMENT MATRIX IS A MODIFIED VERSION OF FIGURE G-1, APPENDIX G, IN NHB 1700.1(V1-B), "NASA SAFETY POLICY AND REQUIREMENTS DOCUMENT," JUNE 1993.

Figure 7

SECTION 6 - OPERATING AND SUPPORT HAZARD ANALYSIS (O&SHA)

6.1 Objectives

This Operating and Support Hazard Analysis for the 1/2-Ton hand chain hoist located in Buildings M-16 and M-20 identifies potential hazards, evaluates their risk level, and provides the mechanism for their elimination and control. Failure of passive components and generic hazards are evaluated. Areas reviewed in this analysis are as follows:

a. Concerns that could cause death/injury to personnel or loss/damage to flight hardware.

b. Design issues that effect normal operation of the lifting system.

This Analysis includes an engineering stress analysis, "FMEA Analysis of Existing Structure and Connections for Pegasus Project Lifting Devices (M-16 and M-20); T. Wilson to J. Reddish, dated July 20, 1995.

Those conditions found in the Buildings M-16 and M-20 environment - human relationship that could cause potential sources of danger are not part of this analysis. The latter analyses shall be combined, by others, with the analysis herein to develop the Systems Hazard Analysis (SHA).

6.2 O&SHA Worksheets

An analysis of the aforementioned concerns was performed and documented on the following O&SHA worksheets.

OPERATING AND SUPPORT HAZARD ANALYSIS (O&SHA) WORKSHEET

SYSTEM: BUILDINGS M-16 AND M-20 CATEGORY: CRITICAL APPLICATION PHASE: LIFTING OPERATION DATE: FEBRUARY 1996
SUBSYSTEM: 1/2-TON HAND CHAIN HOIST PREPARED BY: M. CROMPTON
CLOSURE CONCURRENCE: _____ PROJECT MANAGER _____ DEPUTY RECERT MANAGER

HAZARDOUS CONDITION	HAZARD CAUSE	HAZARD EFFECT	SEVERITY	SAFETY REQUIREMENTS	HAZARD ELIMINATION/ CONTROL PROVISIONS	LIKELIHOOD OF OCCURRENCE	STATUS	VERIFICATION METHOD
H1-HOIST CAPACITY EXCEEDED	OPERATOR UNFAMILIAR WITH HOIST OPERATION	LOAD WILL DROP. COULD CAUSE DAMAGE TO FLIGHT HARDWARE	CATASTROPHIC	NSS/GO-1740.9B: • PARA. 406.b.(4) REQUIRES THAT HOISTS SHALL NOT BE LOADED BEYOND RATED LOAD EXCEPT DURING AUTHORIZED TESTS. • PARA. 405.b.(2) REQUIRES CRITICAL LIFT OPERATORS TO BE TRAINED IN THE SPECIFIC HAZARDS AND SPECIAL PROCEDURES ASSOCIATED WITH THE LIFT.	GSFC REQUIRES APPROVED TECHNICAL INSPECTION PROCEDURES FOR LIFTING DEVICES AND EQUIPMENT (LDE). AN LDE OPERATOR TRAINING, EXAMINATION AND LICENSING PROGRAM IS IN PLACE, IN ACCORDANCE WITH NSS/GO-1740.9B, PARA. 405.a.	REMOTE	OPEN	• FMEA: NSI DOCUMENT NO. 40-01-648 • REVIEW PROCEDURES • INSPECTION
H2-CRANE UNSATISFACTORY FOR USE	NONCOMPLIANT WITH INSPECTION AND MAINTENANCE REQUIREMENTS	LOSS OF PERSONNEL, FLIGHT HARDWARE OR EQUIPMENT	CATASTROPHIC	GMI 1710.6B ESTABLISHES THE POLICY AND REQUIREMENTS OF THE RECERT PROGRAM TO MEET THOSE OF NSS/GO-1740.9B.	THE RECERT GROUP PERFORMS TESTS AND INSPECTIONS TO MAINTAIN LDE CERTIFICATION STATUS CURRENT. GSFC REQUIRES APPROVED TECHNICAL INSPECTION PROCEDURES FOR LIFTING DEVICES AND EQUIPMENT (LDE).	REMOTE	CLOSED	• REVIEW TEST AND INSPECTION REPORTS
				PARA. 401.f.(1) OF NSS/GO-1740.9B REQUIRES THAT HOIST COMPONENTS MEET ALL APPLICABLE REQUIREMENTS OF OSHA, ANSI, AND CMAA.	GMI 1710.6 REQUIRES THAT LIFTING DEVICES SHALL BE DESIGNED, FABRICATED, AND CERTIFIED IN ACCORDANCE WITH APPLICABLE CODES, STANDARDS, AND RECERT PROCEDURES. VERIFY FACTOR OF SAFETY EQUAL TO 3 TIMES YIELD AND 5 TIMES ULTIMATE.	EXISTING	OPEN	• FMEA/O&SHA: NSI DOCUMENT NO. 40-01-648 • VERIFY LDE CERTIFICATION DOCUMENTATION
H3-INADEQUATE SUPPORT STRUCTURE	SUPPORT STRUCTURE LOAD RATING DEFICIENT	LOSS OF PERSONNEL, FLIGHT HARDWARE, OR EQUIPMENT	CATASTROPHIC	BUILDING DESIGN CONSIDERATIONS SHALL BE IN ACCORDANCE WITH ANSI B30.16 REQUIREMENTS	PERFORM DESIGN AND ANALYSIS TO QUALIFY ROOF STRUCTURE IN EXISTING BUILDINGS.	REMOTE	OPEN	VERIFY USE OF ANALYZED COMPONENTS
					VERIFY THAT STRUCTURE IS NOT WEAKENED DUE TO REPEATED STRESSES.	REMOTE	OPEN	VERIFY CONTINUED ABILITY TO SUPPORT LOAD

OPERATING AND SUPPORT HAZARD ANALYSIS (O&SHA) WORKSHEET

SYSTEM: BUILDINGS M-16 AND M-20 CATEGORY: CRITICAL APPLICATION PHASE: LIFTING OPERATION DATE: FEBRUARY 1996
SUBSYSTEM: 1/2-TON HAND CHAIN HOIST PREPARED BY: M. CROMPTON
CLOSURE CONCURRENCE: _____ PROJECT MANAGER _____ DEPUTY RECERT MANAGER

HAZARDOUS CONDITION	HAZARD CAUSE	HAZARD EFFECT	SEVERITY	SAFETY REQUIREMENTS	HAZARD ELIMINATION/ CONTROL PROVISIONS	LIKELIHOOD OF OCCURRENCE	STATUS	VERIFICATION METHOD
H4-INADEQUATE WORKING SPACE	INADEQUATE SPACE TO PERMIT OPERATOR TO STAND CLEAR OF LOAD AND ADJACENT STRUCTURES	LOSS OF PERSONNEL, FLIGHT HARDWARE, OR EQUIPMENT	CATASTROPHIC	OPERATIONS SHALL BE IN ACCORDANCE WITH PARA. 406 OF NSS/GO-1740.9B.	CRITICAL LIFT OPERATORS MUST BE TRAINED IN THE SPECIFIC HAZARDS AND SPECIAL PROCEDURES ASSOCIATED WITH THE LIFT.	REMOTE	OPEN	REVIEW SPECIFIC WRITTEN CRITICAL LIFT PROCEDURE.
H5-IMPROPERLY SEATED LOAD	LOAD UNSECURED IN HOOK OR HAND CHAIN IS IMPROPERLY SEATED IN THE HAND CHAIN WHEEL	LOSS OF PERSONNEL, FLIGHT HARDWARE, OR EQUIPMENT	CATASTROPHIC	PARA. 101.C.(1)(c) OF NSS/GO-1740.9B REQUIRES THAT SPECIFIC WRITTEN PROCEDURES BE PREPARED AND FOLLOWED FOR ALL CRITICAL LIFTS.	CRITICAL LIFT OPERATORS MUST BE TRAINED IN THE SPECIFIC HAZARDS AND SPECIAL PROCEDURES ASSOCIATED WITH THE LIFT.	REMOTE	OPEN	REVIEW SPECIFIC WRITTEN CRITICAL LIFT PROCEDURE
H6-OPERATION WITH AN UNSAFE CONDITION	DEFICIENT HOOK, BRAKE, LOAD CHAIN, ETC.	LOSS OF PERSONNEL, FLIGHT HARDWARE, OR EQUIPMENT	CATASTROPHIC	PARA. 406.b.(3) OF NSS/GO-1740.9B REQUIRES THAT THE OPERATOR TEST ALL CONTROLS PRIOR TO OPERATION.	PARA. 403.f. OF NSS/GO-1740.9B REQUIRES THAT ALL INADEQUACIES BE CORRECTED PRIOR TO FURTHER USE.	REMOTE	OPEN	AUDIT MAINTENANCE DOCUMENTATION TO VERIFY CORRECTION OF INSPECTION DISCREPANCIES
H7-IMPROPER OPERATION	SIDE LOADING	LOSS OF PERSONNEL, FLIGHT HARDWARE, OR EQUIPMENT (FRACTURED HOIST HOUSING)	CATASTROPHIC	PARA 406.b.(13) OF NSS/GO-1740.9B REQUIRES THAT HOISTS NOT BE USED FOR SIDE PULLS.	PARA. 101.c.(1)(c) OF NSS/GO-1740.9B REQUIRES THAT SPECIFIC WRITTEN PROCEDURES BE PREPARED AND FOLLOWED FOR ALL CRITICAL LIFTS.	REMOTE	OPEN	REVIEW SPECIFIC WRITTEN, CRITICAL LIFT PROCEDURES
				PARA. 406 REQUIRES THAT OPERATORS BE CERTIFIED TO PERFORM CRITICAL LIFTS AND BE TRAINED IN THE SPECIFIC HAZARDS AND SPECIAL PROCEDURES ASSOCIATED WITH THE LIFT.	AN LDE OPERATOR TRAINING, EXAMINATION, AND LICENSING PROGRAM IS IN PLACE, IN ACCORDANCE WITH NSS/GO-1740.9B, PARA. 405.a.		CLOSED	VERIFY LDE CRITICAL LIFT OPERATOR CERTIFICATION
H7-IMPROPER OPERATION	SUSPENDED LOAD UNATTENDED	LOSS OF PERSONNEL, FLIGHT HARDWARE, OR EQUIPMENT	CATASTROPHIC	PARA. 406.b.(6) OF NSS/GO-1740.9B REQUIRES THAT PERSONNEL SHALL NOT BE LOCATED UNDER SUSPENDED LOADS.	PARA. 101.c.(1)(c) OF NSS/GO-1740.9B REQUIRES THAT SPECIFIC WRITTEN PROCEDURES BE PREPARED AND FOLLOWED FOR ALL CRITICAL LIFTS.	REMOTE	OPEN	REVIEW SPECIFIC WRITTEN, CRITICAL LIFT PROCEDURES

OPERATING AND SUPPORT HAZARD ANALYSIS (O&SHA) WORKSHEET

SYSTEM: BUILDINGS M-16 AND M-20 CATEGORY: CRITICAL APPLICATION PHASE: LIFTING OPERATION DATE: FEBRUARY 1996
SUBSYSTEM: 1/2-TON HAND CHAIN HOIST PREPARED BY: M. CROMPTON
CLOSURE CONCURRENCE: _____ PROJECT MANAGER _____ DEPUTY RECERT MANAGER

HAZARDOUS CONDITION	HAZARD CAUSE	HAZARD EFFECT	SEVERITY	SAFETY REQUIREMENTS	HAZARD ELIMINATION/ CONTROL PROVISIONS	LIKELIHOOD OF OCCURRENCE	STATUS	VERIFICATION METHOD
					AN LDE OPERATOR TRAINING, EXAMINATION, AND LICENSING PROGRAM IS IN PLACE, IN ACCORDANCE WITH NSS/GO-1740.9B, PARA. 405.a.	REMOTE	OPEN	VERIFY LDE CRITICAL LIFT OPERATOR CERTIFICATION

6.3 Recommendations

6.3.1 Implement the hazard elimination/control procedures described on the O&SHA Worksheets.

6.3.2 Update the technician test and inspection procedures to include specific details to detect the failure mode and causes identified in the FMEA and O&SHA. Include the pertinent Document No. in the "Verification Method" column for the Hazardous Condition addressed.

6.3.3 Update the critical lift operator training to include the specific hazards and special procedures identified in the FMEA and O&SHA Worksheets. Identify the corrective actions required to mitigate the effects of failure once it has occurred.

6.3.4 Periodic test, inspection, and maintenance of the hoist is a mandatory requirement of NSS/GO-1740.9B. This practice is recommended by the manufacturer of the hoist to ensure safe operation with minimum danger to personnel and/or damage to flight hardware/facility. Verify that the hoist certification, test, inspection, maintenance, and other operational checks have been performed and are current.

6.3.5 An analysis has been completed to qualify the roof structure in Buildings M-16 and M-20. Verify the use of the analyzed components and perform periodic inspection of the roof structure to detect damage or wear which would restrict the ability to support the imposed load.

- Track corrective actions.
- Maintain deficiency status current herein and document closure date. Document corrective action(s) and provide as an attachment to maintain this analysis current.
- Similarly, update this analysis to include pertinent facility improvements.
- Perform an analysis of the facility environment-human relationship that could cause potential sources of danger. Combine this analysis with the O&SHA, herein, to develop the Systems Hazard Analysis (SHA).

SECTION 7 - CONTROL LOGIC ANALYSIS

There are no control/monitor functions associated with this lifting system. No control logic analysis was, therefore, performed.

SYSTEM 8 - EMERGENCY SAFING ANALYSIS

This system is not controlled by a computer control system. No emergency safing analysis is, therefore, required.

SECTION 9 - SNEAK CIRCUIT ANALYSIS

The methodology for the control of sneak circuits is not implemented in the design of this lifting system. No sneak circuit analysis is, therefore, performed.

MANAGEMENT TECHNOLOGIES

MEMORANDUM

TO: J. Reddish/T. Wilson, Wallops Island

FROM: L. H. Bennett

SUBJECT: Wallops Island Facility Building 16
Review of Temporary Hoist Calculations

DATE: August 25, 1995

COPIES: M. Crompton/NSI GSFC
A. Zorn/NSI GSFC
E. Hemminger/NSI GSFC
S. Chan/NASA GSFC
W. Hargrove/NSI Wallops

In reply refer to:
LHB 082595

REFERENCES:

(1) NASA Wallops Island Document, M16/M20 Critical Lift Hoist Analysis, T. Wilson to J. Reddish, 7/20/95.

(1) NASA Wallops Island Document, Outstanding Items on Analysis of M16 and M2 T. Wilson to J. Reddish, 7/28/95.

NSI/GSFC Structural Analysis and Design section has recently reviewed you structural calculations on the subject hoist per References (1) and (2). We ar in agreement with the methods used for analysis and concur that the buildir structure will still meet building standard codes for the intended lift. We di note, however, that the load used for the calculations was the weight of th shipping container cover, 220 lbs, times a factor of safety on load of 2, or a overall load of 440 lbs. The calculations showed that, for 440 lbs concentrate load, that plenty of margin existed in the building roof and ceiling sectior so as not to violate the building code allowables.

Since the Project intends to install a temporary hoist rated at 1/2 ton, c 1000 lbs, and subsequently proof-tested to 125%, or 1250 lbs, we feel that from a safety standpoint, the calculations should be revised and documented fc a concentrated load of 1250 lbs. Preliminary calculations using your method ar 1250 lbs load indicate that the positive margin would still exist. This way the documentation would match the hardware used, and the proof load applied resulting in a low-risk evaluation in the Failure Modes and Effects Analysi (FMEA), currently being prepared by NSI/GSFC Recertification. This furthe covers the event that someone would lift a 1000 lb load, noting the rating c the hoist.

Lawrence H. Bennett

L. H. Bennett
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LHB/