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PLATFORM HOISTS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

It is not the intent to specify herein all details of design and construction. It shall be the responsibility of the hoist manufacturer to ensure that the equipment has been designed and constructed in accordance with all engineering codes, standards, Government regulations.

These hoist systems will be used for lifting a platform with a limited number of personnel riding the platform. The safety requirements needed for personnel lifts are contained in NASA-STD-8719.9, Chapter 9. These safety requirements have been modified to meet this lifting application and are described in this specification section.

The contractor shall have full responsibility for compliance with the requirements of the specifications. Review of drawings, catalog, or specifications by Designated NASA Representative with regard to general design and controlling dimensions does not constitute acceptance of any design, material, or equipment that will not fulfill the function or performance requirements established herein.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B17.1	Keys and Keysets

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2010; Errata 2010) Structural Welding Code - Steel
AWS D14.1/D14.1M	(2005) Specification for Welding Industrial and Mill Cranes and Other Material Handling Equipment

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ASME INTERNATIONAL (ASME)

ASME B30.10	(2009) Hooks
ASME NOG-1	(2010) Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)

ASTM INTERNATIONAL (ASTM)

ASTM A1023/A1023M	(2009; E 2012) Standard Specification for Stranded Carbon Steel Wire Ropes for General Purposes
ASTM A240	(2012) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 519	(1992; R 1993; Errata 2004) Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA-STD-8719.9	(2002) Standard for Lifting Devices and Equipment

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 6	(1993; R 2011) Enclosures
NEMA MG 1	(2011; Errata 2012) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 508C	(2002; Reprint Nov 2010) Power Conversion Equipment

1.3 SYSTEM DESCRIPTION

1.3.1 General

This specification describes the performance requirements for the design, construction, installation and testing of four (4) new hoisting systems used for raising and lowering work platforms located in the Vehicle Assembly Building (VAB) High Bay 3. Each hoist within a single hoist system shall be capable of independent operation or in synchronized combination with other hoists in the same system.

Two hoist systems will be lifting main "extensible platforms". Each system will have four hoists rated for 50 tons each for a total of eight (8) 50 ton hoists.

Two hoist systems will be lifting "elevator access platforms". Each system will have four hoists rated for 7.5 tons each for a total of eight (8) 7.5 ton hoists. These are adjustable access platforms located at various

elevator landings.

The Hoist Systems are located on top of towers in the Vehicle Assembly Building (VAB), an existing 525' tall enclosed building, that processes aerospace vehicles in preparation for movement to a launch pad. The towers contain new platforms stacked at multiple levels within each of the two separate towers.

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This specification assumes the VAB High Bay 3 platforms will be installed by a separate contract, which may be initiated earlier or concurrent with the work described herein. Coordination of this work with the VAB High Bay 3 project by the hoist manufacturer is required. This shall allow for the interface and clearance within the platform structures including the hoist reeving, its lower block and slings. This work is shown on drawing 79K39267 and specification 79K39268.

The contractor shall make inspections and field measurements as required to assure compatible facility system interfaces. A full functional test of these interfaces, including full platform operational testing shall be demonstrated during acceptance testing (reference paragraph 3.4.4.2 of this section).

1.3.1.1 Hoist Enhanced Safety Requirements

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The extensible platform hoists and the elevator access platform hoists shall be provided with enhanced safety features that have been selected to accommodate NASA critical lift requirements. These requirements are related to special safety requirements needed to support platform hoisting operations and the need to have personnel on the platform during coordinated hoist movement. This safety rational provides requirements to accommodate platform safety assuming the failure of any one hoist of the four hoists during a coordinated hoist operation. Enhanced safety features must provide assurance that any single hoist failure cannot result in a load drop accident. The safety rational assumes the failed hoist must retain partial load of the platform by the proper operation of the emergency drum brake and the wire rope must remain intact. The other three hoists are assumed to remain intact, and the platform remains safe.

Based on worst case center-of-gravity location of the platform, platform safety is accommodated in several ways:

Any single failed hoist (of the four hoist systems) must support its load even during a mechanical failure of the hoist machinery (not including the emergency drum brake and the wire rope). Although some load drift may occur during hoist failure, total load motion must be small enough to assure the failed hoist retains the load. A separate emergency drum brake shall be provided to prevent excessive movement of any one corner of the platform.

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In the event of excessive platform movement the platform could tip (noting a worse case center-of-gravity location of the platform) resulting in excessive platform movement. It is for this reason the structural columns that support each corner of the platform is designed to safely wedge the platform into building columns, however, this will result in two hoists (instead of four hoists holding the weight of the platform, the remaining hoists may be overloaded). This cannot occur during excessive tipping of the platform that would result on failure of the emergency drum brake system except when multiple failures occur (such as a failure of a safety system like the emergency drum brake and the structural failure when the platform wedges itself into structure.

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Personnel on the platform will be tethered to the platform with safety harnesses.

Based on this enhanced safety design the platform hoists shall comply with the following:

- Each hoist shall be equipped with an emergency drum brake. This will eliminate load drop accident even during a mechanical failure of the hoist machinery. Any load motion that may occur shall be minimized and the failed hoist shall still support a portion of platform weight.

- Two hoist holding brakes shall be provided on the hoist high speed shaft. These brakes shall be designed to support 150 percent of the torque needed to lift the rated load (special testing for the hoist brakes is required to assure brake function).

- A special 10:1 wire rope design factor shall be provided based on the published wire rope breaking strength.

1.3.2 Extensible and Elevator Access Platform Operation

Platforms shall be normally fixed in place and pinned to structural columns of the building. The platforms serve to provide access to various work stations around the launch vehicle by personnel. During normal work activities, the platforms hoist slings are detached and withdrawn. Periodically it is necessary to raise or lower a platform to a different elevation within the stack.

Platforms within the stack can be repositioned within the elevation limits of the platform directly above or directly below. Repositioning of a platform within the stack shall be accomplished by attaching slings from the four overhead hoists to four corners of the platform to pick up the platform. After the slings are securely attached to the platform, the hoist control system energizes the four hoists to lift the platform and relieve the pin pressure at the platform connections to the columns. After the pins are removed from the column connections, the platform load is supported by the hoist slings. The platform is free to be repositioned by the hoisting system.

At the new location, the platform is reconnected (pinned) to the building structure and the hoisting slings disconnected and withdrawn from the platform. The hoist control system shall provide normal speed and inching speeds for the four hoists synchronized operation and individual hoist operation for final positioning and pin alignment or removal at individual platform corners. A no-load or empty hook speed is provided for rapid hook positioning. Each tower contains platforms installed at varying elevations in the tower and stacked on top of each other and attached to the same building columns. During platform hoisting and positioning operations, a limited number of personnel will be riding the platforms to disconnect, align and connect the platform to the building columns before removing the hoist slings.

1.3.3 Extensible Platforms

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There are two (2) extensible platform towers having a stack of ten (10) platforms in each tower one at a time. Each platform is approximately 38'-0" by 76'-0" wide with a total weight of 340,000 pounds.

The platforms have similar shapes and geometry but have differences in total weight and center of gravity.

The physical differences in weight and center of gravity will necessitate differences in hoist line pull during platform movements. Each independent control system shall synchronize speeds between each of the four hoists regardless of actual hoist line pull. In this manner the four hoists attached to the four corners of the platform will raise and lower the platform and maintain the platform in a level state.

1.3.4 Elevator Access Platforms

There are two (2) elevator access platform towers having a stack of ten (10) platforms in each. Each platform is approximately 19'-0" by 24'-0" wide with a total weight of 30,000 pounds.

The platforms have similar shapes and geometry but have differences in total weight and center of gravity. The physical differences in weight and center of gravity will necessitate differences in hoist line pull during platform movements. Each independent hoist control system shall synchronize speeds between each of the four hoists regardless of hoist line pull. In this manner the four hoists attached to the four corners of the platform will raise and lower the platform and maintain the platform in a level state.

1.4 SUBMITTALS

The submittal requirements for the 50 ton hoists and 7-1/2 ton hoists include engineering details needed for design and fabrication of a custom engineered and manufactured hoists. The submittals are specific to provide approval of structural and mechanical items for detailed components. The submittal requirements include standard manufacturers literature needed for selection and approval of commercial equipment for use on custom engineered and manufactured equipment.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings; G

General Arrangement Drawings shall show capacities, duty class, and details for all of the main components of the electric wire rope hoist including parts descriptions, manufacturer's model numbers, and shall include clearances and interfaces within the facility, lifts, speeds, and weight breakdown. Weights shall be shown for: hoist and load block; total net weight. The hoist shall be shown in plan, side and end elevation.

Submit shop drawings showing all principal mechanical components, principal dimensions, details of structural connections, and related component details. Include complete schematic wiring diagram with description of operation. Manufacturer's catalog data will suffice for items of standard manufacturer.

Electrical Schematics

The drawings shall integrate all control equipment to provide clear and continuous control logic between sheets. The compiling of individual manufacturers drawings as a substitute for integrated drawings will not be acceptable. All electrical schematics shall be provided such that a functional analysis can be performed.

Documentation for Microprocessor-Based Control Systems

Documentation for Microprocessor-Based Control Systems, if provided, shall include complete manufacturer's catalog data which shall include definitions of their functions and their relation to the integrated control system. Programmed parameters shall be provided, along with complete instruction on programming method.

As-Built Drawings

On or before completion date of the contract, the Contractor shall submit to the designated NASA representative a complete set of as-built drawings in accordance with the Contract which incorporates all comments, annotations, conditions of approval and corrections. The set shall include assembly drawings with part list, detail drawings on custom engineered components, and electrical drawings including electrical schematics and wiring diagrams.

SD-03 Product Data; G

Product data shall be provided for all assemblies and subassemblies including but not limited to the following:

Application software
Drive Controllers
Control Parameter Settings
Control Components
Hoist Electrification
Hoist Control Stations
Motors
Brakes
Drum Brake
Couplings
Uninterruptible Power Supply (UPS)
Capacity Overload Protective Device
Hoist Limit Switches
Master Switches and control console components
Wire Rope

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Batteries - The Contractor shall submit a list of devices that contain batteries. This list shall indicate the estimated life of each individual battery, location of each battery, and the procedure for replacement of each battery. This can be supplied by the devices cut sheets.

SD-05 Design Data; G

Hoist Structural Support Calculations

Submit floor loading structural design calculations verifying the size of structural members, structural supports and components for

the hoist drive assembly as imposed to the concrete floor slabs. Include stress and loading diagrams.

Hoist mechanical and structural calculations for custom engineered equipment to component level

Emergency Brake Special Hoist Dynamic Analysis

SD-06 Test Reports; G

Shop Test Procedure
Post-Erection Inspection
No-Load Test
Operational Tests
Emergency Brake Testing
Emergency Brake Dynamic Testing
Hook NDE Report
Acceptance Test Procedure
NDE of Components Test Reports

SD-07 Certificates; G

Hazardous Material
Brake Settings
Loss of Power Tests (Ref. 3.4.4)
Hook Proof Load Test (Ref. 1.5.2.1)
Wire Rope Breaking Strength Test
Wire Rope End Fitting Proof Load Test (Ref. 2.4.1.f
NDE of Components Test Reports

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SD-10 Operation and Maintenance Data; G

Hoist systems, all mechanical and electrical components See paragraph 3.5.

Submit Data Package 5 as specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.5 QUALITY ASSURANCE

All structural, machine shop and assembly work shall be neat, accurate and equal in all respects to the best heavy machine tool practice and shall conform to the best practice of modern fabrication shops.

Where two or more units of the same class of equipment are required under this section and other sections of the specifications, these units shall be products of a single manufacturer.

Metal fits, tolerances, and finishes shall conform to those indicated on the approved drawings.

1.5.1 Contractor Qualifications

Custom manufactured hoists and its related systems shall be designed and manufactured by a company with a minimum of 10 years of specialized experience that is regularly engaged in the designing and manufacturing of hoists for material handling of high dollar items for aerospace, nuclear, chemical, steel mill industries or personnel rated hoisting equipment. Only companies experienced in this type of development and manufacturing

and their applications will be considered qualified to meet requirements of the Contract Documents.

All software developed specifically for this project shall be done by personnel with a minimum of three years experience in writing and interfacing software on the development platforms chosen.

The Contractor shall supply company credentials and experience levels of individual(s) performing design and software development for this project for approval by the Contracting Officer.

1.5.2 Inspections

All parts shall be inspected to ensure compliance with the finishes and tolerances established by the approved shop drawings. The material to be furnished shall be subject to inspection and tests in the mill, shop and field by Government Inspectors. When materials and workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship, or both, at any time before final acceptance of the hoists. Parts which fail to conform to the approved shop drawings shall be replaced with acceptable parts unless a specific method of repair is authorized in writing by the designated NASA representative.

Certification and inspection test reports shall be submitted to the designated NASA representative for approval on the following items described in paragraphs 1.5.2.1 through 1.5.2.5. Final approved certification and inspection test reports shall be submitted in the Acceptance Data Package.

1.5.2.1 Hooks, Proof Load and Throat Spread Measurement

Prior to acceptance testing, hooks shall be individually proof load tested in accordance with ASME B30.10.

A throat dimension base measurement shall be established by installing two tram points and measuring the distance between these tram points (+/- 1/32 inch). This base dimension shall be recorded. The distance between tram points shall be measured after load test. The hook shall be able to withstand the proof load test without permanent deformation.

As part of acceptance testing, the hoist shall be proof load tested to 125 percent. The hooks shall be measured for hook throat spread before and after testing. An increase in the hook throat opening from the base measurement is cause for rejection.

1.5.2.2 Non-Destructive Examination of Mechanical Components

For the extensible platform and elevator access platform hoists mechanical components (within the hoist load path) shall receive non-destructive examination. This includes, all hooks, hook nuts and sheave pins, hoist drum shafts. Non-destructive examination (NDE) shall be completed prior to assembly in accordance with ASME NOG-1 Section 7100 and Table 7210-1.

Acceptance criteria shall be in accordance with ASME NOG-1 Section 7100.

After acceptance testing all hooks shall be given an additional magnetic particle or liquid penetrant examination after 125% proof load test. Hook disassembly is not required.

1.5.2.3 Welders Certification and NDT of Welding

The extensible platform and elevator access platform hoists require welders certifications and NDT reports on welding. These shall be completed and available for inspection by Government Inspectors. All welder certification and NDT reports shall be submitted with the hoist data package, at the end of the contract.

Welders and welding operations must be qualified in accordance with AWS D1.1/D1.1M or AWS D14.1/D14.1M.

1.5.2.4 Certificates of Compliance

Certificates of Compliance shall be provided on the following items:

a. Electrical Components and Controls in compliance with contract requirements.

b. Motors - Hoist motors, wiring, contract drawings, over-current protection, and grounding shall conform to NFPA 70, and to UL standards; the label or listing with re-examination of the UL shall be accepted as evidence that the materials conform to this requirement and to NFPA 70.

c. Shop testing and acceptance testing in compliance with contract requirements.

1.5.2.5 Certificates

a. Certification of actual wire rope breaking strength test for each supplied wire rope, with traceable identification to the wire rope manufacturer.

b. Certification that the hoist systems contains no hazardous material, asbestos, cadmium, lead, elemental mercury, or PCBs.

c. Certification of brake settings, including the allowable range of and the initial setting of each.

d. Certification and acceptance of NDE of components test reports in accordance with requirements herein.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery and Storage

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Inspect materials delivered to site for damage; unload and store with minimum handling. Store materials on-site shall be protected from the weather, if stored outdoors, they shall be protected in weather-proof enclosures.

1.6.2 Handling

Handle materials in such a manner as to ensure delivery to final location in undamaged condition. Make repairs to damaged materials at no cost to Government.

PART 2 PRODUCTS

2.1 HOISTING SYSTEM COMPONENTS

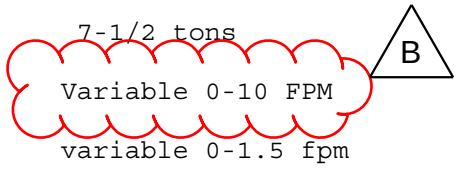
The 50-ton extensible platform and the 7-1/2 ton elevator access platform hoists shall be a built-up unit generally made from commercially available or made to order motors, brakes, couplings and gear reducers. These components shall be engineered together as an assembly mounted on a custom designed and built equipment frame with custom drums and shafts.

All equipment shall be built and equipped to accommodate the exceptions, features and capabilities specified herein and on the accompany contract drawings.

2.1.1 General

The hoisting systems shall be comprised of four (4) hoists operated by an electrical control system for raising and lowering a work platform while occupied by a limited number of personnel and equipment. The hoisting system shall incorporate the following features:

FEATURE	EXTENSIBLE PLATFORMS	ELEVATOR PLATFORMS
Hoist Load Rating	50 tons	7-1/2 tons
Normal Hook Speed	Variable 0-10 FPM	Variable 0-10 FPM
Inching Hook Speed	variable 0-1.5 fpm	variable 0-1.5 fpm
No-Load Hook Speed	2 ½ x Normal Speed	2 ½ x Normal Speed
Controls	AC flux vector drives	AC flux vector drives
Brakes	Two 150% Rated Torque Holding Brakes; One 150% Rated Torque Emergency Drum Brake	Two 150% Rated Torque Holding Brake; one 150% rated torque emergency drum brake
Safety Switches	Two Upper-limit switches Control & Final power sw. Gear-opr. Lower-limit sw.	Two Upper-limit switches Control & Final power sw. Gear-opr. Lower-limit sw.



2.2 COMMON REQUIREMENTS

2.2.1 Identification Plates and Signage

Provide manufacturer installed identification plates of non-corrosive metal showing, in clearly legible permanent lettering, the manufacturer's name, model number, capacity rating in pounds, and other essential information.

All electrical enclosures shall be labeled with PPE requirements per Section 26 05 71.00 40, LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES.

Hoist and corbel signs shall be provided to assist in platforms movement operation using each respective hoist. Each hoist including its respective extensible platforms corbels and elevator landing platforms corbels shall be provided with signage to include the following:

Hoist location signage shall be provided indicating its corresponding platform corner, i.e. NE, NW, SE, and SW. These shall correspond to the hoist control console labels. All hoist location signs shall be visible by the operator standing at the hoist operator's console.

Corbels at all platforms locations shall be labeled according to its location NE, NW, SE, and SW.

Signage shall meet requirements described in the contract drawings.

2.2.2 Miscellaneous Equipment Features

Hoist structural support calculations and imposed loads to the building. B

Drip pans shall be provided under components that contain oils or grease that has the capability to leak out. This may include oil containment pan or barrier so an oil leak will be contained in local area around the unit. The volume of drip pan oil shall accommodate all oil that could leak out.

All couplings with setscrews shall have loctite applied to them and marking putty applied to indicate any loosening.

All fasteners next to open edges shall be Ny-lock type or equal self locking.

All belts, chains, and rotating equipment shall have proper covers to prevent inadvertent contact from personnel.

All Zirk fittings shall be pressure relief fittings.

No plastic tie wraps are permissible on the hoist exterior.

NASA will define any passwords and receive four keys for every lock.

The conduits shall not exceed 90% of NFPA 70 required fill capacity allowing 10% left for additions. A non-conductive messenger cable shall be added to each conduit run to provide future wire pulling capability.

All crimped lugs shall be ring lugs; forked lugs will not be allowed. No wire splices shall be allowed. All termination shall be made at terminal blocks or on electrical devices.

2.2.3 Hoist Electrification

Provide enclosures for control panels, controls, and brakes in accordance with NEMA 250 and NEMA ICS 6, Classification Type 12.

All control enclosures and cabinets shall be provided with work lighting. Lighting shall be on interlock switches so that the light comes on when the door to the panel is opened and goes off when the door is shut. B

The interior of the enclosures shall be painted white.

All electronic components and wiring shall be properly labeled to match the drawing. All lights, switches, and components on the hoist control panel shall be properly labeled to designate its purpose. All control panels shall be properly labeled to indicate what components are inside.

The existing building ambient temperature at the location of where the

hoists will be located ranges from 40 degrees F to 100 degrees F with 10% to 95% relative humidity. All electronic equipment shall be rated for or above this temperature range for continuous duty. If the electronic equipped cannot meet this temperature requirement then the contractor shall provide environmental equipment on the enclosures to maintain the electronic equipment in proper operating ranges. Provide cooling unit on each control panel. Provide ductwork, etc. inside each enclosure for uniform airflow distribution. The cooling unit shall be designed not to require condensate drain and cool the panel interior to 80 degrees F with all equipment running at full load. Cooling units shall be accessible for regular service and maintenance.

2.3 HOIST SYSTEM

2.3.1 Design Requirements

Hoist system shall include the following design requirements:

a. Powered hoists shall include brakes, a controlled braking means, and an overload limiting device.

b. Design the mainline contactor, along with the power-off/power-on circuitry to remove power from the drive motors, brakes and control circuit. The control circuit shall not operate unless a power-on button is depressed.

2.3.2 Material Requirements

Cast Iron with less than 15% elongation shall not be used for components within the load path of the lifted load, with the exception of electric motors, hydraulic related components, and brake wheels.

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2.3.3 Safety

The Contractor is responsible for checking the proper operation and condition of safety devices, electrical components, mechanical equipment, and structural assemblies prior to installation. Immediately report any observed defective components and replace.

2.4 ELECTRIC WIRE ROPE HOIST

2.4.1 Hoisting Ropes

Provide the following:

a. Rope lengths shall be sufficient to provide required lift of 85 feet per contract drawings and to maintain a minimum of three full wraps of rope at the dead end(s) of the drum, with the block in the geared lower limit position.

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b. The hoist manufacturer shall select the wire rope type for both hoist systems. The wire rope shall be selected with due consideration given to rope lay and compacted strand wire rope suitable for multiple wrapped wire rope drum and suitable number of parts of reeving as applicable. Hoisting ropes shall conform to ASTM A1023/A1023M, improved or extra improved plow steel, uncoated, 6 by 37 class construction, with an independent wire rope core. End fittings shall develop 100 percent of the wire rope strength.

c. Wire rope design factors for the 50-Ton Extensible Platform and 7-1/2 Ton Elevator Access Platform Hoists shall be 10:1 based on the manufacturer's published breaking strength. The hoist line pull shall be determined by rated load of the hoist, plus the weight of the load block, divided by the total number of parts of rope in the reeving system.

d. All wire rope shall be inspected prior to installation. The inspection shall be performed per the wire rope users manual. After installation all wire rope shall be properly lubricated.

e. Methods and recommendations from the Wire Rope Users Manual shall be used for all aspects of end fitting attachments, seizing of ends, and wire rope handling.

f. Wire rope end fittings shall be galvanized open spelter sockets. Provide wire rope end fitting proof load test assembly to 200% rated load.

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2.4.2 Load Block and Sheaves

The load block shall be an enclosed steel safety type which will shroud the sheave and protect the operator. The sheave assembly shall be mounted on a steel axle and carried on sealed, antifriction bearings. The hook for the 50 ton hoist shall be mounted on a lower block trunnion.

Sheave pitch diameters shall be 22 times wire rope diameter. Sheave grooves shall properly support the wire rope circumference.

2.4.3 Hook Assembly

Hooks and hook swivels shall be heat-treated alloy steel forgings marked in accordance with ASME B30.10. Hook assembly shall be carried on antifriction bearings to permit free swivel under rated-capacity load without twisting wire rope.

Hook assembly shall include a machined and threaded shaft and swivel lock-nut with a suitable easily removal locking device to prevent nut from backing off.

Hook shall have a spring-loaded, heavy duty, swinger type safety latch such as Bullard Swinger type gate "Rollox" or "Tip-lok" safety latch as applicable, or equal.

Each load block shall be labeled with its rated capacity.

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2.4.4 Wire Rope Drum

Provide steel or ductile cast iron wire rope drum. Drum shall be flanged at each end to preclude the wire rope moving off the end of the drum. Drum pitch diameter shall be no less than ten times the diameter of the wire rope.

The wire rope groove radius, depth of and spacing shall be as recommended by LeBus International. In order to accommodate lifting the four corners of the platform in a level manner the tolerance of the drum pitch diameter of each of the four hoists in the four hoist system shall accommodate equal lift speeds by the synchronized hoist motors. The rope length shall be accurately controlled to assure each hoist transition to successive wire

rope layers together so the drum pitch diameter and line speed remains constant between the four hoists.

The wire rope fleet angle shall not be greater than 2 degrees.

Wire rope dead end to the drum shall be by means of a rope clamp or a swaged terminal in a keyhole slot. The drum and other parts shall be designed and fabricated to allow convenient inspection of hoist rope termination. Fastener holes shall be located between the clamp grooves. A minimum of two fasteners shall be provided for each rope clamp. When wire rope sockets are used, end grooves of the drum barrel shall be turned into the anchor point with a radius of not less than six rope diameters. The rope socket shall be anchored inside the drum against a rigid surface which is welded in place. The holes in the drum barrel for insertion and removal of the socket and rope shall be closed with pipe plugs or a bolted keeper plate to prevent the rope from coming out should the drum be overdriven in the down direction.

In the event of failure of a drum shaft, coupling or bearing, the drum must be retained on the hoist frame in a manner that precludes disengagement of any gearing or brake acting on the drum and precludes disablement of the load-retaining function of these components.

The hoist drum shall be proportioned to store all wire rope needed to provide full travel of the hook with not less than three full turns remaining on the drum at its lowest elevation, as defined by the setting of the lower limit switch.

The following is required when the drum provides multiple layers of spooling of the wire rope. Drum shall have flanges at each end of the wire rope spool to a height of not less than two rope diameters above the final layer. Drum grooves shall be LeBus International, Inc., Longview, Texas or equal. Drum grooves must provide correct and repetitive action of layer of wire rope spooling throughout the hoisting range. This wire rope grooving, when combined with proper fleet angle control, shall force the cable to conform to the proper spool pattern, and control the position of each succeeding layer to prevent abnormal wire rope spooling such as "cutting in" or skip wrapping.

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2.4.5 Bearings

Bearing shall be precision, antifriction type. They shall be installed in accordance with the manufacturers recommendations. Bearings shall be fitted with pressure lubrication fitting conforming to industry standard practice or permanently lubricated. Pressure fittings where provided shall be easily accessible from a safe location. Bearings shall be lubricated for their application and shall be shielded or sealed to prevent leakage.

Exposed bearings and load block bearings shall be pre-lubricated and factory sealed.

2.4.6 Keys and Keyways

Custom design keyways for the extensible platform hoists shall be the parallel type and machined /fitted to ANSI B17.1, Class 2, fit requirements for the respective shaft diameter. Keys and keyways shall be dimensioned, with tolerances on the drawings. The manner of key installation shall preclude a key shifting out of its intended position.

2.4.7 Couplings

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Coupling rating shall be determined by the coupling manufacture's published selection methods based on operating speed, design horsepower, dynamic effects and brake torque. Couplings shall be located immediately next to bearings. Couplings shall be suitable for its location within the hoist machinery. All machinery alignment shall be within the coupling manufacturer's tolerance for parallel offset and angular alignment (and their combination) and shall accommodate all loading conditions of the hoist. If external gearing is provided, alignment of gearing to achieve full face width contact at rated load shall be provided. Machinery arrangements such as three bearings on the same drive shaft are not permitted, they must be separated by an appropriate coupling of a full flexible type or half flexible as needed. Couplings shall be lubricated as recommended by the manufacturer. All couplings shall be press fitted and keyed.

2.5 MOTORS

Motors shall conform to NEMA MG 1. All motors shall be minimum 60 minute duty rating. Motor insulation shall be Class H with a Class B temperature rise. All motors shall be equipped with thermal trip type over-temperature protection and shall provide warning and over-temperature indications to the operator.

2.5.1 Hoist Motors

Provide AC inverter duty, totally enclosed non-ventilated (TENV), squirrel cage induction type hoist motors.

2.5.1.1 Control Devices

All control devices including motor starters, contactors, circuit breakers and the like shall be per Section 26 05 71.00 40 LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES.

2.5.2 Adjustable Frequency Drive Controls

2.5.2.1 Hoist Electric Drive Controllers

The hoist controller must enable the drive motor to develop full torque zero speed to accommodate brake torque testing prior to brake release. The motor drives shall be Magnetek Electromotive flux vector Impulse VG+ series 4 motor drives or approved equal. The drive shall be listed to UL 508C.

The drive unit shall have the following control components, application software features:

1. Reverse Plug Simulation function that allows the operator to smoothly and quickly stop and change directions without setting the brake.
2. Encoder loss detection.

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3. Phase loss detection.
4. Shapped Shaft Detection.
5. Provide a redundant hardware safety circuit that guarantees motor and brake power are removed when an E-STOP switch or safety controller opens that drive.
6. Ground Fault protection.

7. Key pad display including diagnostics.
8. Stall Prevention.
9. Static Auto Tune.
10. Load checking that prevents lifting an overload (thermal overload protective device).
11. Output accuracy 0.01% or greater.
12. Braking torque 150%.
13. Thermal Overload UL recognized.
14. Drives shall conform to CENELEC EN 61800-3.
15. Fault reporting capability

2.5.2.2 Hoist Control Stations

The Hoist Control Station shall be provided for each 4 hoist system. Each control station shall consist of a Central Control Station located adjacent to the hoists.

The Central Control Station shall have a selector switch to switch between inching speed, normal speed and empty hook speed. Each Central Control Station shall also have an emergency stop button.

The Central Control Station shall be provided with a control parameter settings to synchronize hoist movement where all four hoists are operating together. The drive shall synchronize hook speed of all four hoists. Speeds shall be regulated regardless of the load on any platform corner to provide level movement of the platform.

The Central Control Station shall be provided with an independent control of each hoist so that any one hoist can be selected and operated. In addition, the control station shall provide for all four hoists to be operated together. Also, for special control of the extensible platform hoists only the hoist control station shall provide for two east hoists or two west hoists operated together with synchronized hook speeds regardless of load on the hooks.

The hoist central operator's control console shall be built with superior workmanship and attention to detail. This includes proper layout of controls and uniform console appearance.

Considerations pertaining to correct human factors practices shall be provided. Legibility of all displays and access to components shall be provided. The hoist central operator's control console shall be designed with consideration to a preliminary control console arrangement provided on the contract drawings. The final design shall include consideration to access of controls on the operator's station, visibility of controls allowing for proper operator reach of control items.

The control console interior parts shall be arranged to provide good visibility for operation and maintenance access.

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Console shall include ferrous metal construction, white painted control console with hinged and locking access doors that house interior control components, wiring and terminal strips.

Console interior shall be painted white.

The hoist central operators control console shall be provided with a dust cover to protect the console components when not in use.

The control console will include the following items:

Console Functional Requirements
Power on button
Stop button
Emergency stop button
3 position hoist speed selector switch with the following chooses:
Inching speed
Normal speed
No load speed
4 position selector switch with the following choices:
- Four hoists tandem lift
- Two east hoists tandem lift
- Two west hoists
- Independent hoist operation
4 position selector switch with the following choices:
- Hoist 1 NE
- Hoist 2 SE
- Hoist 3 NW
- Hoist 4 SW
Master switch control
Bypass key for final upper limit
Indicator lights as follows:
A run light for each hoist (green)
Power on light (white)
Hoist over temp warning (amber) for each hoist
Hoist over temp cutout light (red) for each hoist
Emergency Brake set (red)

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2.5.2.3 Dynamic Braking, Controlled Braking Means

Provide dynamic braking for hoist electric drives. The hoist brakes shall set after the associated controller decelerates motor to a controlled stop. Size the hoist controllers to provide sufficient starting torque to initiate motion of that drive mechanism from standstill with 0 to 125 percent of rated load on the hook. The hoist controller shall enable the drive motor to develop full torque continuously at zero speed. Drive motors shall run smoothly, without torque pulsations at the lowest speed and be energized at a frequency not exceeding 60 HZ for normal speed for the hoist drive.

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2.6 HOIST LIMIT SWITCHES

Each hoist shall be furnished with upper and lower control limit switches to prevent hook over travel in either vertical direction. These switches electrical contacts shall be normally closed contacts. These limit switches shall allow the motor to come to a normal stop and allowing the brakes to set, and shall be set to attain maximum vertical hook height at any speed and to provide safe margins for drift.

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The lower limit switches shall be a geared type control circuit lower limit switch. The upper control limit switch shall be paddle or weighted type control circuit upper limit switch. The control circuitry design shall ensure these limit switches stop motion in the protected direction and permit normal operation in the opposite back-out direction. These switches shall be located in accessible areas and shall reset automatically.

Each hoist shall be furnished with a second, higher power type, weight-operated upper limit switch. This switch's electrical contacts shall

be a set of normally closed electrical contacts wired into the mainline circuit, hoist power contactor control circuit such that all hoist motion shall be precluded after the limit switch is encountered. This normally closed contact may be located in the low voltage circuit.

After the second upper limit switch has been activated, normal movement of the load will require action (resetting) at the upper limit switch. A upper limit switch bypass key shall be provided on the hoist control console that will allow the operator to bypass the second upper limit switch and travel only in the downward direction to back out of power limit switch.

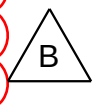
The weighted power upper limit shall be adjusted sufficiently low to ensure that the hoist will not two-block (or otherwise damage wire rope) if the hoist actuates the weighted upper limit at full speed with no load. Both limits shall be tested from slow speed to full speed to verify correct operation and clearance.

The control upper limit switch shall be positioned low enough to prevent initiation of the weighted upper limit switch when traveling into the control limit switch at no load speed. This limit switch shall be tested for correct operation and clearance.

2.7 BRAKES

2.7.1 Hoist Electric Holding Brakes

Each hoist shall be equipped with two electric holding brakes on the hoist high speed shaft. The shall be electrically released, spring applied. One of the holding brakes acts as a primary brake; the other holding brake acts as a backup with a time delay setting (set after the primary brake sets). The time delay shall be provided to accommodate normal control stop, loss of power or emergency stop as necessary,



Each holding brake capacity shall be sized to produce 150 percent of the rated load hoist torque.

All brakes shall be adjustable from 50-100 percent of their rated capacity. Brakes shall have thermal capacity for frequency of operation required by service.

Each brake shall be provided with a manual release mechanism, hand lever or other easily actuated release method. This feature shall not self-lock in the open position.

The brake system shall be able to accommodate manual lowering operation under full load. The contractor shall verify the brake can be manually released to allow the lowering of the load at a slow controlled manner to allow operators to safe the load upon a control system failure.

The Contractor shall provide a hoist holding brake release indication for control verification. This may include adding proximity switches or other device to the brake shoe linkage. This must indicate a physical movement of the brake linkage, not energizing the brake coil. This brake release information shall be provided to the control system to assure brake release occurs correctly, to enable hoist run commands.

All brake shoe friction material shall be non-asbestos type.

2.7.1.1 Hoist Holding Brake Testing

The Contractor shall provide a method to statically test the holding torque of each hoist holding brake (independent of each other). The test will demonstrate each brake is producing its design torque (i.e. the design holding torque produced by the brake). The brakes shall be statically tested by the Contractor at 100% of its design torque for no movement at the brake wheel and at 110% for slip.

This testing method may require the Contractor to provide a shaft extension with a lug on the back of the new motor or lug on the brake wheel. Torque is applied by using a torque multiplier (if required) and a calibrated torque wrench to manually apply a known torque to the motor shaft extension to measure the capacity to each brake.

The Contractor shall provide the torque multiplier and all fittings necessary to perform these tests with an appropriate testing procedure. The torque multiplier and fittings shall be provided to the government after testing. The calibrated torque wench will be provided by others.

It must be possible to perform this test without major disassembly of components for attachment of torque measurement devices. Other approved methods for brake testing can be provided with approval.

2.7.1.2 Brake Safety Guards

The Contractor shall provide an enclosed hoist brake or provided with metal safety guards. These guards shall be shaped to provide close fitting protection so moving parts are guarded from contact with personnel and shall protect against debris from falling onto the brake wheel. These covers shall be easily removable to accommodate inspection and maintenance.

2.7.2 Emergency Brake

In addition to the two electric holding brakes the hoist will be equipped with an emergency drum brake. The emergency brake is located on the drum. The emergency brake is intended to operate in an emergency in case of a component malfunction or failure in the hoist load path (between the hoist motor and the drum). This machinery arrangement provides two electric holding brakes and an emergency brake to prevent load drop or excessive load travel during a hoist emergency.

The emergency brake shall consist of a caliper type disc brake mounted on a drum flange. The wire rope drum shall be equipped with an integral steel flange, machined for and equipped with the caliper brake. The drum flange shall be corrosion resistant steel such as ASTM A240 Type 316, or 2101 duplex stainless steel suitable for service with emergency brake friction material and in service in a marine environment. B

The caliper brake applies a normal force on the drum flange through the brake friction material. This force is applied on equal and opposite sides of the drum flange with the brake shoes self-aligning.

The brake shall be spring set and released by hydraulic, pneumatic pressure or by thruster motor. The hydraulic or pneumatic source shall be an electric hydraulic pump and reservoir or an electric air compressor with air receiver and manual water drain valve. The pressure source shall be equipped with a pressure switch that will start and stop the unit and thereby keep a predetermined pressure applied to the brake springs. The

system shall be equipped with a pressure regulator and pressure gauge. All such components shall be integral to the hoist frame.

The response time for the emergency brake actuation system shall be provided so as to stop a full rated load in 6 inches or less of hook travel as measured from hook location when overspeed is sensed. B

The emergency brake torque capacity shall be not less than 150%. All brake friction material shall be non-asbestos type.

2.7.2.1 Emergency Brake Control

The emergency brake shall not be applied during normal operation. The brake shall be released by actuation of the power-on switch. The brake shall be set by actuation of the power-off switch, the overspeed switch, detection of hoist drive machinery discontinuity, other motor drive fault detection and the emergency stop switch.

The activation of the emergency brake shall be provided by an independent system to detect drum overspeed directly at the drum shaft. A second activation system shall detect drive machinery discontinuity between the motor and drum shafts, such as Electromotive Snap Shaft Delta Speed, or equal. Drive system discontinuity is determined by comparing motor speed to drum speed (they should differ by a fixed ratio). The overspeed shall be adjustable to trip between 105 percent and 135 percent of the maximum rated drum speed. Other emergency brake control and actuation shall be provided as recommended by the drive manufacturer.

The Contractor shall provide an emergency brake release indication for the operator control console and control system verification. This may include adding a proximity switch or other device to the mechanical brake linkage. This must indicate a physical movement of the brake linkage to indicate the brake is set or partially set. This brake release information shall be provided to the control system to assure brake release occurs correctly, to assure brake calipers do not drag and to enable hoist run commands. A red emergency brake set lamp shall be provided on the Hoist Control Station to indicate emergency brake is set to the operator.

If any emergency brake of the four hoist system is set all four hoists shall be shut down. Activation of the brake by either the emergency stop switch or overspeed switch will require manual resetting of the main circuit breaker before normal hoist operation is restored.

The drum overspeed actuation shall be set at 120 percent of maximum rated drum speed for dynamic emergency brake testing.

2.7.2.2 Emergency Brake; Special Dynamic Analysis

The contractor shall provide a special engineering analysis on the emergency brake system to demonstrate the emergency brake will decelerate and stop 100% load during a drum overspeed of 120% rated speed. The analysis shall model dynamic effects of the hoist drive machinery inertia and response time of the overspeed system to detect overspeed, actuate and set the emergency brake. The analysis shall demonstrate the emergency brake system and its actuation system will respond and provide energy absorbing needed to decelerate and hold the load with load movement that is no greater than 6 inches. B

The analysis shall be submitted in report form and shall be signed by a

registered professional engineer. The report shall be reviewed and approved by the contracting officer prior to hoist fabrication.

2.7.2.3 Emergency Brake Testing

The Contractor shall provide a method to statically test the holding torque of the emergency brake (independent of the other brakes). The test will demonstrate the emergency brake is producing its design torque (i.e. the design holding torque). The brakes shall be statically tested by the contractor at 100% of its design torque for no movement at the brake wheel and at 110% for slip.

This testing method may be done similar to holding brake testing, using the same tools and methods where torque is manually applied to the high speed shaft through the gear reducer to the emergency brake.

The Contractor shall provide any special tools and fittings necessary to perform these tests with an appropriate testing procedure. The calibrated torque wench will be provided by others.

It must be possible to perform this test without major disassembly of components for attachment of torque measurement devices. Other approved methods for brake testing can be provided with approval.

2.7.2.4 Emergency Brake Dynamic Testing

The Contractor shall complete a dynamic test of emergency brake during final hoist acceptance testing. The test shall demonstrate the brake functions as intended to safely decelerate a load after the overspeed system detects a 120% overspeed of the hoist drum.

The test will include lifting a load a safe distance above the floor. The two hoist holding brakes will be electrically released to purposely allow the load to start accelerating to the floor. During this time the drum, gear reducer, motor and brakes will be back driven as the load accelerates. Once the drum reached 120% rated speed the overspeed system will detect the drum overspeed and the emergency brake will automatically set. The emergency brake must decelerate and stop the moving load and absorb the inertia of the moving hoist machinery and motor.

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This test will be completed at 50% and 100% rated load on one 50-ton and one 7-1/2 ton hoist only. The acceptance criteria for this test load movement (after hoist overspeed is detected) must be no greater than 6 inches with 100% rated load on the hook.

2.8 LOAD BLOCK AND SHEAVES

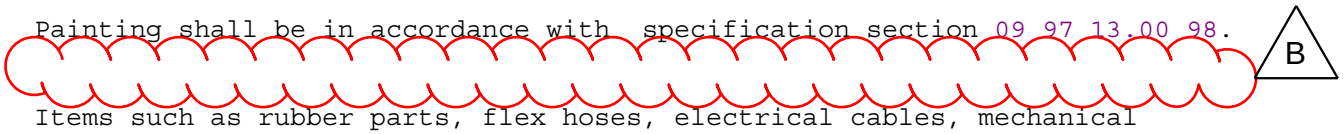
2.8.1 Gear Assembly

The hoist shall have an enclosed gear reducer selected by the hoist manufacturer. AGMA rated certified helical, herringbone spiral bevel type or their combinations may be used for hoist. Worm drive reducers are not acceptable. The reducers shall be base mounted and shall be standard products of manufacturers regularly engaged in production of this type of equipment for commercial applications. Housings shall be ridged and properly shaped to maintain precise alignment of gears and support of bearings under varying loads. Gear orientation and bearing location within the enclosures shall provide a means for oil lubrication of the mating surfaces of the gears and bearings. The housing shall include inspection

covers for inspection of gears at meshing points, a breather, a cover or closed filler opening, a pipe plug closed drain opening that is accessible and capable of draining the contents down into a pan or bucket.

2.9 PAINTING SYSTEM

Painting shall be in accordance with specification section 09 97 13.00 98.



Items such as rubber parts, flex hoses, electrical cables, mechanical linkages such as shoe brake adjustment linkage (paint brake body), chain and sprocket assembles, timing wheels and the like shall be left uncoated.

Items such as carbon steel motor shafts, emergency brake drum flange, flex couplings, and the like shall be protected from corrosion during shipment with a suitable corrosion protection coating such as Cosmoline, (or approved equal). This shall be applied to these areas before shipment. Cosmoline shall be reapplied at the end of acceptance testing for lasting corrosion protection in the hoist environment. The emergency brake drum flange shall be cleaned after installation (and before testing) and left un-coated for brake service.

Items such as threaded fasteners and threaded studs shall be left unpainted. These items shall be coated with a long term corrosion protection film barrier such as Zep Linebacker (or approved equal). This film shall protect against corrosion on outdoor surfaces that resists rain, salt water and many corrosive industrial environments. This can be easily removed with a solvent or degreaser when desired.

2.10 SOFTWARE AND HARDWARE

This Section is required only if the contractor chooses to use a control PLC in the design of the hoist controls. At that time all parts of this section will become applicable.

All communication between microprocessor, electronic systems and application software shall be of the speed and data quality such that operations between units appear seamless. Random communication faults will not be acceptable. All software systems shall be tied together with a common clock such that when comparing reported data events within or between systems it shall be discernable to the relative timing sequence of when these events occurred relative to each other.

All hoist communication and software related wiring shall be protected against outside interference and static noise. Any loss of communication between software systems, on either primary or redundant channels, shall be detectable and reported as a system fault. It shall be determined whether this loss of communication is sufficient reason to automatically shut down hoist operations or whether the hoist can continue operations. These determinations shall be approved by the Contracting Officer.

Two new laptop computers with individual protective carrying cases shall be provided with this contract. Both laptops shall be loaded with identical software containing all the software development platforms used to develop custom software for these hoist systems as well as any software written specifically for these hoist systems. Two back-up copies shall also be provided on non-volatile memory such as a memory stick or card. All software licenses and software code custom written for these hoists or hoist systems shall become the property of the Government. Any passwords,

keys, locks, etc shall be given to and become property of the Government. There shall be a procedure available to allow for password changes. All interface cables needed for communications between the laptop and hoist devices shall be provided for each laptop. The laptop shall be able to connect to the PLC directly or through Ethernet.

Laptops shall be able to communicate with data systems on the hoists when directly connected to hoist interface components. When the laptop(s) is connected to devices on the hoist through direct connection, there shall be no restrictions except for password protection.

The laptop(s) shall be able to view operating software and operating logic "real-time" to the greatest extent possible. Where individual devices are monitored, such as relays, encoders, brakes, master switches, potentiometers, switches, etc the laptop displays shall show the changes of states of these devices as they occur as well as the internal ladder logic (or equal) state changes within the PES or other software devices.

The control PLC shall monitor communication health.

2.11 HOIST, ELECTRICAL AND CONTROL REQUIREMENTS

The operator input has direct control of the speed. Provisions shall be provided so that the hoist control system can tolerate both actuation of an emergency stop and loss of power or the interruption of over-current protection devices without damage to components under normal loading conditions. In order to mitigate software corruption due to power transients, provisions shall be made to insure that line power supplied to microprocessor based devices is conditioned to remain within the input specifications of the devices and is monitored by the control system which shall initiate a shutdown upon detection of the out-of-tolerance condition. Provide uninterruptible power supply (UPS) for these functions with 10% spare capacity and full load run of 30 minutes.

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Performance response to controls shall be instantaneous, except where time delay devices and relays are provided. Operation shall be smooth and quiet. Heat rise in motors, brakes, and transistors during maximum capacity operation shall not exceed the design limitation.

The control system shall include over-current protection, under and over-voltage protection, phase loss protection and line transient protection. The system shall be capable of detecting these conditions before they adversely affect the control system and perform a safe and normal shut-down. All control system shall conform to NFPA 70.

Protective devices shall include a fused circuit disconnect switch for each motor controller.

Provide enclosed type circuit breaker readily accessible to the hoist operator for hoists disconnect (ability to open and close the breaker without opening the enclosure). Provide for lockout/tagout of all hazardous energy sources.

Each hoist system shall be equipped with an emergency stop function that will remove power to the entire four hoist system. This can be accomplished using a shunt trip on the main isolation breaker or a main contactor just downstream of the main isolation breaker.

On AC motors, overload relays shall be provided for each phase of the motor

windings. Operation of any protective device (overload, under voltage, undercurrent, control-circuits fuses, or stopping device) shall safely stop hoist motion, without any adverse affects on the control circuit.

Safety devices and brakes shall be positive in action without slipping, chattering, or jamming and shall have a fail-safe design.

The hoist control system shall not permit a failure causing the hoist to fail to a higher speed range then commanded. Failure to a lower speed range or stop is permitted.

All hoists shall be capable of simultaneous and independent operation without degradation of control function.

The hoist controls shall not allow inadvertent initiation of a run command. All master switches or motion control devices out of center or neutral position upon power up shall prevent any hoist movement.

The hoist master switch will be used for normal operation in inching, normal and empty hook speed ranges. Pulling the master switches toward the operator will raise the load and pushing the master switch away from the operator will lower the load. Neutral position will bring the load to a controlled stop and set the brakes.

All speeds shall be maintained to within plus or minus 2 percent of commanded speed.

A standard closed-loop system consisting of an AC induction motor controlled by a flux vector drive shall be used for the hoist motors. Each motion shall have an independent drive for each motor. Selected speeds shall be constant, without any fluctuation within a (+/-) 2 percent error tolerance loaded or unloaded. On a closed loop system the control system shall provide programmable acceleration and deceleration functions. All acceleration shall be continuous with no stepping, and shall follow a near linear slope. Controls shall be able to maintain (+/-) 0.005 inches load position without drift of the load upon brake release and brake engagement. Power system harmonic performance shall be per IEEE 519.

Provide static reversing, adjustable frequency flux vector controllers for hoists electric drives. Provide dynamic braking for all electric drives. All electric drives should be sized with dynamic braking resistors capable of bringing the rated load to stop without overheating the drive.

The hoist brakes must set only after the associated controller decelerates the motor to a controlled stop.

2.12 SAFETY AND RELIABILITY

2.12.1 Reliability Engineering Analysis

A hoists control system reliability analysis will be completed by an independent third party under NASA contract. This reliability analysis will begin upon first receipt of the mechanical and electrical control system drawings, control schematics and block diagrams. This will continue throughout the submittal process to final acceptance testing of the hoist control system.

In order to assure accuracy of this analysis, the Contractor will provide the services of the hoists electrical control engineer(s) to assist with

the reliability analysis. The Contractor shall provide those services and at the completion of the final acceptance testing submit a certification that the reliability engineering analysis is correct and accurate and reflects proper control system design and safety function of the hoists.

The reliability engineering analysis will involve a step-by-step component failure analysis of the hoists electrical control system. This is a formal engineering analysis to determine if a failure of any individual component causes the hoist to react in an unsafe manner. This is a comprehensive system and component analysis on the hoist electrical control system that assumes failure of any individual component and determines if the hoist fail into a safe mode.

This will include failure modes and effects analysis (FMEA) and a software analysis. This will determine failure states of the components and the effect of each failure state on the rest of the hoist system (and ultimately the safety of the load).

The Contractor electrical control design engineer(s) will be responsible for providing detail information to the reliability engineer to assure a full understanding of the control, safety systems and software. As the reliability analysis is completed the contractor will review and comment on the adequacy and correctness of the analysis until the reliability analysis is completed and agreed upon.

2.12.2 Automatic Functional Safety Requirements

The control system shall be designed fail safe to ensure that a failure of any mechanical or electrical component will not cause the hoists to operate in an unsafe manor as defined below.

Failure modes that cause a slowdown of load motion or results in load motion coming to a safe stop are acceptable.

Failure modes that cause an increase in speed, an un-commanded direction shift, or loss of load control are unacceptable.

Failure modes that actuate an emergency stop, or a stop made by an emergency shutdown system is acceptable.

Should the reliability analysis reveal any single item failure given the stated criteria, the Contractor will be responsible for correcting this problem at no additional cost to the contract.

2.12.3 Fail Safe Protection Through Manual or Automatic Means

Fail safe protection can be accomplished through manual or automatic means. Because of the slow speed operation of this hoist system operator intervention can be used to provide fail safe protection. For this to be acceptable, the operator, while operating the hoists, must first perceive the incorrect load motion and react to it by releasing the control button, master switch, or depress the emergency stop switch on the control station. Operator intervention must occur before unacceptable load travel occurs.

Safing the load is accomplished by removing power from the hoists either manually through the emergency stop switch or automatically through the automatic control systems of the hoists control system e-stop or shutdown system. Removing power on the hoists using circuitry that is independent of the hoist control system is the fundamental electrical fail-safe feature

provided to protect the load.

PART 3 EXECUTION

3.1 GENERAL

The hoist manufacturer shall provide a qualified erection superintendent to supervise the delivery, unloading, assembly, and erection of the hoist systems to inspect and approve the installation; and to place each system into operation.

Each hoist shall be assembled at the factory, properly wired, tested without load, and disassembled only as required for shipment. Each disassembled part shall be match marked or otherwise controlled for final field assembly.

The sequence of acceptance testing for all hoist systems shall be completed in order to assure individual hoists, two hoist and four hoists systems function properly. This is to assure safe platform handling and (assuming the hoists are used to initially install the platforms) assure safe platform installation onto T-rails.

Testing is also completed to assure proper function of the hoist systems, and platforms systems. This including alignment and interface with platform T-rail system with all platforms and platform corbels.

Hoist system performance will be demonstrated to assure proper hoist performance is provided to move any platform (with and without dead load on the platform) to a new elevation. This includes raising the platform to unload its support pins on the corbels, retracting corbel pins and then raising or lowering the platform to a new elevation where corbel pins are aligned and re-inserted into the t-rails.

Prior to installation of a platform the each hoist system will be tested for proper system function in accordance with unloaded and loaded testing requirements using test weights. This includes single hoist, two hoist and four hoist tandem operational tests. Also hoist proof-load, hook measurement and NDE shall be completed.

After functional acceptance testing the hoists maybe used for initial platform installation. Platform installation will also be used to assure proper performance of the platforms, its T-rails and corbels.

Once the platforms are installed functional testing of the hoist systems shall be completed to demonstrate proper hoist platform interface and platform movement to new elevations.

Post acceptance testing inspection shall be completed after all its respective platform installation and functional testing.

3.2 ERECTION SERVICES

The hoist systems shall be erected in accordance with the manufacturer's printed and approved instructions and as directed by the manufacturer's erection superintendent and in his presence. Adequate and safe erection equipment and rigging shall be provided by the Contractor as required to install and test the hoists.

3.3 FIELD QUALITY CONTROL

3.3.1 Post-Erection Inspection

After erection, the Contractor, the Contracting Officer, and a hoisting system manufacturer's representative, shall jointly inspect the hoist systems and components to determine compliance with specifications and approved submittals. Notify the Contracting Officer 10 days before the inspection.

3.4 TESTING

3.4.1 General

The hoist shall be tested in the shop prior to shipment and after installation. All testing shall be witnessed by a designated NASA Representative. The manufacturer shall prepare detailed, step by step, test procedures, with blank space for date, Contractor/Designated NASA Representative acceptance, description of item to be tested, how it will be tested, and acceptance limits. Submit test procedures to the Designated NASA Representative for approval at least 30 days prior to testing and make additions and deletions as noted. The Designated NASA Representative shall be given a minimum of two weeks notice before the start of testing. The Contractor shall not start any Government required testing until he is prepared to conduct all such tests. The Contractor shall repeat any test, or portion of a test at the direction of the Designated NASA Representative where the Designated NASA Representative determines that a subsequent adjustment has affected a previously demonstrated capability. The Government reserves the right to require additional testing on any component or system that shows signs of deficiencies, potential failure or other anomalous performance, until determined acceptable by the Designated NASA Representative. The Contractor shall take immediate action to correct any deficiencies disclosed by test and shall rerun the test as directed by the Designated NASA Representative. The Designated NASA Representative shall be given a reasonable period of time to evaluate results before notification of acceptance. The Contractor shall be the test conductor and record time and conditions for each test. A reproducible copy of the completed test, with data, shall be provided in accordance with submittal requirements.

3.4.2 Certification and Inspection Test Reports

Certification and inspection test reports for shop testing and acceptance testing shall be provided as required in paragraph of this section entitled "Certificates of Compliance".

3.4.3 Shop Assembly and Testing

Shop testing will be completed on one four hoist set of 50-ton hoists and its associated control console and one four hoist set of the 7-1/2 ton hoists and its associated control console. Shop testing of the other two four hoist sets and their control consoles will not be witnessed by the government. Testing of these hoist systems is the responsibility of the Contractor. Full acceptance testing of all units shall be completed during a acceptance testing on site. The Contractor shall be responsible for full compliance with all contract requirements for all equipment.

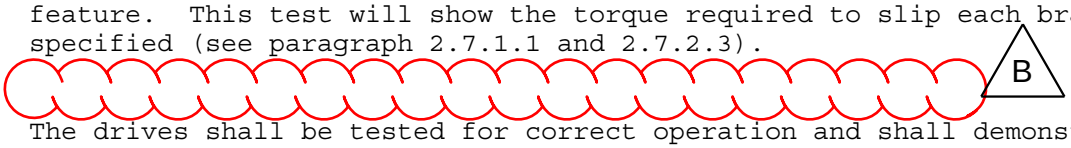
The hoist and hoist control system shall be fully assembled for shop testing purposes. Assembled panels and hoist control console and four

hoists shall be temporarily wired and powered with the motor drive programmed and tuned to the appropriate configuration at the Contractor's plant. Equipment shall be wired and examined visually and dimensionally for fit, quality of material, adjustment, workmanship, finish, etc.

For the purposes of the shop testing "fully assembled" shall mean that all hoist control elements shall be assembled in the shop to permit the demonstration of the full function of the control system performance requirements specified. This will include all control panels (fully assembled) and hoist operator's console (fully assembled) with all systems temporarily wired for full functional testing. Hoist shall be tested for proper operation and clearances. Each hoist shall be assembled for testing on its equipment base, without reeving.

Safety covers and guards, etc. that will be removed for shipment need not be in place. All safety covers shall be present and fit checked prior to shipment. Electrical pull box and junction box covers need not be installed when electrical connections wire numbers, etc. are exposed for inspection, troubleshooting.

The shop test shall demonstrate all operational control functions the hoist controls are designed to perform. Hoist speeds in both directions shall be checked and recorded. All brakes shall be checked for proper operation and clearance. Each hoist brake and emergency brake torque shall be static tested by using a torque wrench and by using the motor drive brake testing feature. This test will show the torque required to slip each brake, as specified (see paragraph 2.7.1.1 and 2.7.2.3).



The drives shall be tested for correct operation and shall demonstrate the coordinated movement, and system communication in a tandem operation of the four hoists, two individual hoists (east and west groups for 50-ton hoist only) and as individual hoists. For all operating speeds and operational scenarios an accurate drum speed and hook positioning shall be measured for the simulated full range of motion. Verify motor drive encoder feed-back-speed is the same on each hoist within the published tolerance of the motor drive. Verify loss of encoder feedback is recognized by the motor drive.

Motor voltage and amperage shall be checked and recorded.

All limit switches shall be tested individually to assure correct operation including all limit switch by-pass functions.

Any deficiencies noted shall be corrected and re-tested prior to shipment.

3.4.4 Acceptance Test

3.4.4.1 General

During installation of the each platform level, the corbel clearance shall be verified to assure smooth vertical clearance of each platform along the length of the T-Rails (clearance will be verified from the bottom of the T-Rail up to its operational elevation).

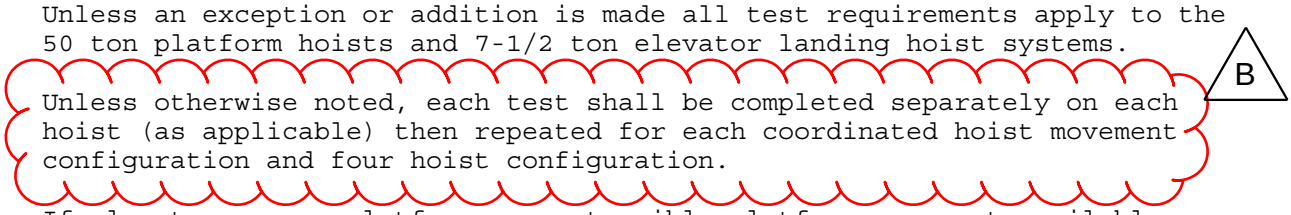
Acceptance testing shall be completed on all four (4) hoist systems (a total of 16 hoists) with their control consoles completely installed and finished.

Acceptance testing shall be per the requirements of the Approved Test Procedure. The Contractors shall provide a competent on site engineer/technician to oversee and assist in the installation and acceptance testing of the hoist systems and their related control systems.

The Government will provide test weights and power for these tests. These tests shall be performed after final installation. Prior to testing, the hoist systems shall be inspected for damage during shipment and installation. The hoist systems shall be tested to prove that it meets all operating requirements for which it was designed.

3.4.4.2 Acceptance Test Hoist Platform Systems

Unless an exception or addition is made all test requirements apply to the 50 ton platform hoists and 7-1/2 ton elevator landing hoist systems.



Unless otherwise noted, each test shall be completed separately on each hoist (as applicable) then repeated for each coordinated hoist movement configuration and four hoist configuration.

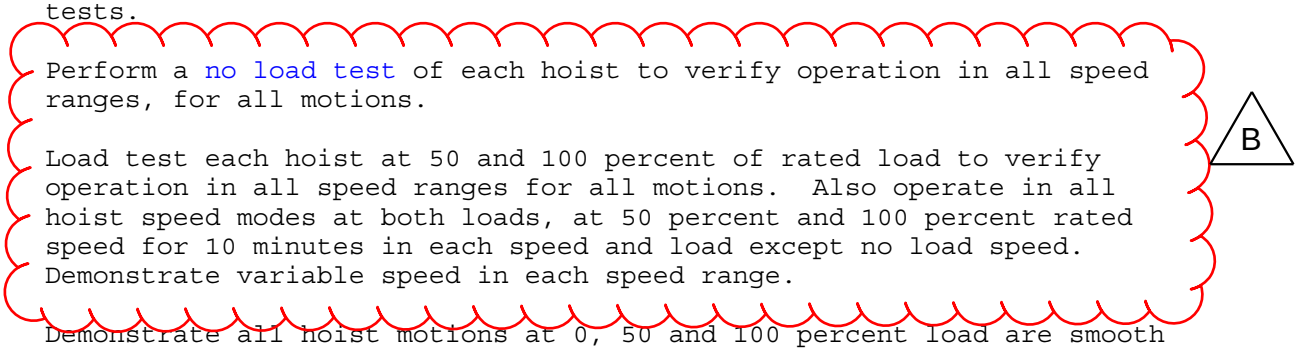
If elevator access platforms or extensible platforms are not available these tests shall be done using test weights.

Acceptance test shall include, but not be limited to the following:

Test all limiting controls and safety devices such as limits switches, and reset features etc. Demonstrate the design lift of each hoist.

Verify each hoists lower block, its reeving and slings have adequate clearance through full hoist travel.

Test all operating controls which the hoist is required to perform and other control features which are not otherwise called out in these tests.



Perform a no load test of each hoist to verify operation in all speed ranges, for all motions.

Load test each hoist at 50 and 100 percent of rated load to verify operation in all speed ranges for all motions. Also operate in all hoist speed modes at both loads, at 50 percent and 100 percent rated speed for 10 minutes in each speed and load except no load speed. Demonstrate variable speed in each speed range.

Demonstrate all hoist motions at 0, 50 and 100 percent load are smooth in all speed ranges including loss of power tests.

Test each hoist holding brake and emergency brake then demonstrate the holding capability with the torque wrench and using the motor drive feature as completed during shop testing.

Emergency brake dynamic testing shall be completed as specified in paragraph 2.7.2.4.

Demonstrate manual load lowering at 50 percent and 100 percent rated capacity of each hoist type (reference paragraph 2.7.1). Using one elevator platform hoist demonstrate by safely lowering one corner of the elevator access platform one foot, or until the platform wedges itself into the T-rail. Using one extensible platform hoist

demonstrate lowering one corner of the extensible platform one foot or until the platform wedges into the T-rail.

Proof load test each 7-1/2 ton hoist at 125 percent rated load. Lift and lower the load in normal and inching speeds approximately 6 inches and stop and hold the load for three minutes. Confirm the holding brake does not slip. Raise this load 6 ft. stop hold the load for 3 minutes lower to the floor.

The 50-ton hoists shall be proof load tested at 125% rated load using separate test weights with a tandem lift of the two north hoist pairs and south hoist pairs. Each hoist pair will lift 125% rated load simultaneously to provide proof load of hoist and common upper block support structures. Test will include tandem lifting of the two test loads in normal and inching speeds approximately 6 inches. Stop the hoists and hold the load for three minutes. Confirm the holding brake on each hoist does not slip. Raise the load 6 ft. stop and hold the load for three minutes, lower the load to the floor.

Measure hook for hook throat spread before and after hook proof load test in accordance with paragraph 1.5.2 of this section. Measure the distance between tram points before and after load test. Hook NDE report shall follow in accordance with paragraph 1.5.2.2 of this section.

Check for motor overheating during each test. Each load test, at each speed range, shall be run consecutively without a break. If any adjustments are required during performance of the tests, test shall be voided and rerun.

Demonstrate accessibility and maintainability features of the Hoist System for lubrication, brake adjustment, and general maintenance by actual field evaluation.

Test to demonstrate hoist speeds while simultaneously operating the four hoist system at no-load. Accurately measure actual hook speeds of all four units. Verify motor drive encoder feedback speed is the same to each hoist within the published tolerance of the motor drive.

Repeat the hoist speed test when one hoist is loaded to 50 percent rated capacity, one hoist is loaded at 100% rated capacity and the other two hoists are unloaded. Simultaneously operate the four hoists system for one minute. Accurately measure actual hook speeds and encoder feedback speed of all four hoists. This will demonstrate hoist speed regulation when the four hoists operate at significantly different loads. Finally, repeat the test by moving the two test weights to the unloaded hoist pair, measure and record hoist speeds and motor frequencies (it is not necessary to rotate both test weights among the four hoists). After one minute of operation (at full hoist speed) the total travel distance of each hoist shall be within six inches of each other.

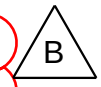
Full functional testing of the four hoist systems, all mechanical and electrical components, shall be demonstrated for both Extensible Platforms and Elevator Access Platforms. Testing shall include the following on all 20 platforms:

Platform unpinning platform movement to a new locations and platform pinning shall be demonstrated. This test will be completed on each

platform. Platform will be moved 5 feet (or similar distance as determined by contracting officer representative) and moved back to its final operational elevation. If at the time of full functional testing the extensible platforms or elevator access platforms are not installed or available for performing this test, this test will not be required.

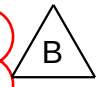
Demonstrate operation of the elevator landing hoists emergency stop control and reset features on each hoist control console and each remote emergency stop control location.

Demonstrate operation of the extensible platform hoists emergency stop control and reset features on each hoist control console. This test will be completed under full load, full speed.



The test procedure shall list all recorded data and acceptance ranges. Three copies of the completed test log shall be delivered to the Designated NASA Representative not later than 48 hours after the completion of each test.

At the conclusion of acceptance testing, the Contractor shall complete a detailed wire rope inspection on each hoist in the presence of a government inspector. Inspection and acceptance criteria shall be per wire rope users manual. All lifting slings to be turned over to the Government shall be inspected. Damaged slings shall be replaced at no additional cost to the Government.



3.5 OPERATOR TRAINING

3.5.1 General

The Contractor shall provide a person(s) knowledgeable in the mechanical and electrical features, control characteristics, design function, and limitations of the hoist and various hoist control systems. This person(s) shall be knowledgeable at the engineering level of the hoist mechanical and electrical control systems.

3.5.2 Personnel Training

The Contractor shall be required to conduct both classroom discussion and hands-on-operation of the hoists for approximately 20 people. These people will be the engineering, operators and maintenance personnel for the hoist system once it is turned over to the Government. Also included shall be discussion covering items in the Contractor furnished operation, service, maintenance and spare parts (O&M) manuals. This classroom activity shall be conducted at the job site after acceptance tests are complete. Class shall provide 1/2 day training to engineering personnel and 1/2 day training to operation and maintenance personnel.

3.5.3 O&M Manuals

The Contractor shall submit 6 copies of the project Operation and Maintenance (O&M) Data Manuals specifically applicable to the contract and a complete and concise depiction of the provided equipment, product and systems stressing and enhancing the importance of the system operation, interactions and preventative maintenance.

O&M Manuals shall include the following information as a minimum (See Section 01 78 23, Data Package 5:

a. Safety precautions
b. Operator prestart
c. Startup, shutdown, and post-shutdown procedures
d. Normal operations
e. Emergency operations
f. Operator service requirements
g. Environmental conditions
h. Lubrication data
i. Preventive maintenance plan and schedule
j. Cleaning recommendations
k. Troubleshooting guides and diagnostic techniques
l. Wiring diagram, control diagrams and electrical schematics
m. Maintenance and repair procedures
n. Removal and replacement instructions
o. Spare parts and supply list
p. Product submittal data
q. O&M as-built drawings
r. Parts identification
s. Warranty information
t. Personnel training requirements
u. Testing equipment and special tool information
v. Testing and performance data
w. Contractor information

-- End of Section --

SECTION TABLE OF CONTENTS

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UTILITY HOISTS

SECTION 41 22 23.20

UTILITY HOISTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASME INTERNATIONAL (ASME)

ASME B30.11	(2010) Monorails and Underhung Cranes - Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings
ASME B30.16	(2012) Overhead Hoists (Underhung)
ASME HST-4	(1999; R 2010) Performance Standard for Overhead Electric Wire Rope Hoists

B

ASTM INTERNATIONAL (ASTM)

ASTM A1023/A1023M	(2009; E 2012) Standard Specification for Stranded Carbon Steel Wire Ropes for General Purposes
ASTM A275	(2008; R 2013) Standard Test Method for Magnetic Particle Examination of Steel Forgings
ASTM E543	(2013) Standard Practice for Agencies Performing Non-Destructive Testing

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2011; Errata 2012) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.179	Overhead and Gantry Cranes

1.2 SYSTEM DESCRIPTION

Provide commercially designed and manufactured hoist systems having electric powered and controlled hoists complete, tested and ready for operation. Hoist equipment, materials, installation, examination, inspection, and workmanship shall conform to the applicable requirements of NFPA 70, ASME B30.11, ASME B30.16, ASME HST-4, as modified and supplemented

by this specification. Reference in these publications to the "authority having jurisdiction" means the "Contracting Officer."

1.2.1 Design Requirements

Submit shop drawings showing hoist capacity, principal dimensions, details of structural connections, and all component details. Include complete schematic wiring diagram with description of operation. Manufacturer's catalog data will suffice for items of standard manufacturer.

1.2.1.1 Trade Coordination

The Contractor is responsible for the coordination of his work with the work of all trades involved and as it relates to the building structure and hoist assemblies.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

B

SD-02 Shop Drawings

Hoists and portable cart assemblies; G;
Complete schematic wiring diagram with description of operation; G

SD-03 Product Data

Electric Wire Rope Hoist; G
Pendant Pushbutton Station; G
Schackles, hoist rings and support hardware building electrical power interface equipment.

Manufacturer's descriptive data and technical literature, performance charts and curves, catalog cuts, and installation instructions, and parts list. G

SD-06 Test Reports; G

Acceptance Test Reports
125 percent Rated Load test
No-Load Test
Post-Erection Inspection
Operational Tests
Wire Rope Breaking Strength
Hook NDT Report
Hook Tram Measurement
Spelter Socket, Wire Rope, and Eye Hook Assembly Proof-Load Test

SD-07 Certificates; G

Compliance with all listed Standards
Overload/Safe for Testing
Hazardous Material
Brake Settings
Loss of Power Test

B

SD-10 Operation and Maintenance Data

Hoist system, all components, Data Package 3; G

Submit Data Package 3 as specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 QUALITY ASSURANCE

1.4.1 Certificates:

a. Certification of minimum wire rope breaking strength for each hoist, with traceable identification for each hoist installed. Where applicable, submit factory certification of the wire rope rated capacity.

b. Certification that the hoist system contains no hazardous material, asbestos, cadmium, lead, elemental mercury, or PCBs.

c. Overload/Safe for Testing certification that the hoist system is safe to test on a semi-annual overload basis with a test load of 125 percent of rated capacity with no detrimental effects.

d. Certification that testing may be performed in which hoist system is subjected to a Loss of Power Test during operation with no detrimental effects.

e. Certification that the hoist system design and fabrication is in compliance with all listed standards.

f. Certification of brake settings, including the allowable range of adjustment for hoist brakes and the initial setting of each.

1.4.2 Pre-Erection Inspection

Before erection, the Contractor shall inspect the hoist systems and components at the job site to determine compliance with specifications and manufacturer's data and shop drawings as approved. Notify the Contracting Officer 10 days before the inspection.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

Inspect materials delivered to site for damage; unload and store with minimum handling. Store materials on-site in enclosures. Protect materials not suitable for outdoor storage to prevent damage or corrosion during periods of inclement weather, including subfreezing temperatures, precipitation, and high winds. Store materials susceptible to deterioration by direct sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on ground. When special precautions are required, prominently and legibly stencil instructions for such precautions on outside of equipment or its crating.

1.5.2 Handling

Handle materials in such a manner as to ensure delivery to final location in undamaged condition. Make repairs to damaged materials at no cost to Government.

1.6 MAINTENANCE

Submit Hoist system, all components, Data Package 3 for the entire system in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

PART 2 PRODUCTS

2.1 IDENTIFICATION PLATES

Provide manufacturer installed identification plates of non-corrosive metal showing, in clearly legible permanent lettering, the manufacturer's name, model number, capacity rating in pounds, and other essential information.

2.2 UTILITY HOIST SYSTEMS

Provide commercial hoists for special application described herein using electrical power and pushbutton control-type operations. The hoist shall meet the design requirements specified in ASME HST-4, Duty Class H3.

2.2.1 Descriptin of Hoists

2.2.1.1 Sling Hoist Cart (Drawing 79K39667, Sheet M-817)

Type Hoist (1 Req'd)	Modified Worm Gear Reducer
Capacity	2100 lb line pull
Hook Speed	24 to 40 FPM
Brake Motor	3 HP 460/3/60
Reduction Ratio	114.25 to 1
Frame	Heavy duty w/modified bolt holes per drawing
Modified Assembly	Gearbox rotated so the motor is up
Finish	Primed red enamel
Controls	Single speed electric motor control rated up to 7.5 HP at 460/3/60; magnetic reversing starter, thermal overload relay and fused control in NEMA 4 enclosure
Pendent Control	50 ft. long w/2 momentary contact push buttons in NEMA 4X enclosure
Wire Rope	450 ft. 3/8" dia IWRC extra improved plow steel
End Fittings	One end galvanized open spelter socket w/eye hook and safety latch and one end plain
Limit Switches	Geared upper and lower limits and secondary upper power limit switch.
Design Parameters	Therm Model No. 41WSM12-S

2.2.2 Safety

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Comply with the mandatory and advisory safety requirements of ASME B30.11, ASME B30.16, and 29 CFR 1910.179. The Contractor is responsible for checking the proper operation and condition of safety devices, electrical components, mechanical equipment, and structural assemblies prior to installation.

2.3 ELECTRIC WIRE ROPE HOIST

2.3.1 Hoisting Ropes

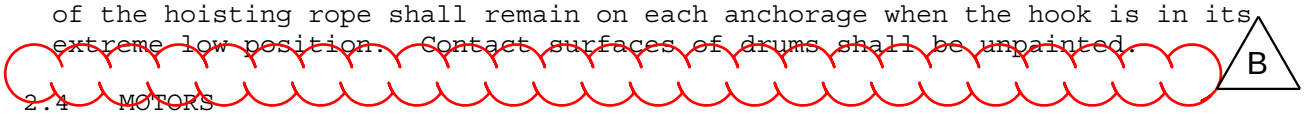
Hoisting ropes shall conform to ASTM A1023/A1023M, improved or extra improved plow steel, regular lay, galvanized, 6 by 37 class construction, with an independent wire rope core unless otherwise specified. Provide proof of wire rope breaking strength test report.

2.3.2 Sheaves

Pitch diameter of sheaves shall not be less than 12 times the rope diameter. Contact surfaces of sheaves shall be unpainted.

2.3.3 Drum

Provide steel or ductile cast iron drum. Pitch diameter of the drum shall not be less than 18 times the rope diameter. A minimum of two dead wraps of the hoisting rope shall remain on each anchorage when the hook is in its extreme low position. Contact surfaces of drums shall be unpainted.



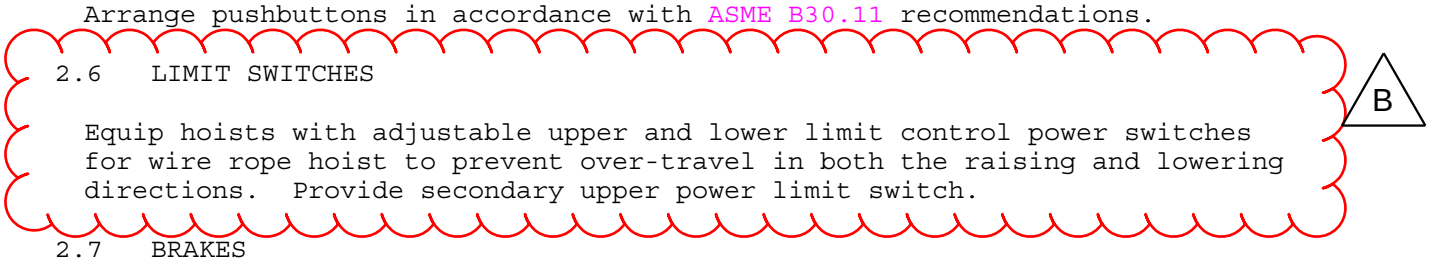
2.4 MOTORS

Motors shall conform to NEMA MG 1. All motors shall be minimum 60 minute duty rating. Motor insulation shall be Class H with a Class B temperature rise. Equip all motors with thermal trip type over-temperature protection.

2.5 CONTROLS

Provide control of electric hoist from a pendant pushbutton station. Arrange pushbuttons in accordance with ASME B30.11 recommendations.

2.6 LIMIT SWITCHES



Equip hoists with adjustable upper and lower limit control power switches for wire rope hoist to prevent over-travel in both the raising and lowering directions. Provide secondary upper power limit switch.

2.7 BRAKES

2.7.1 Hoist Brake

Provide hoist brake that is capable of stopping and holding a 125 percent rated load minimum.

2.8 LOAD BLOCK AND HOOK

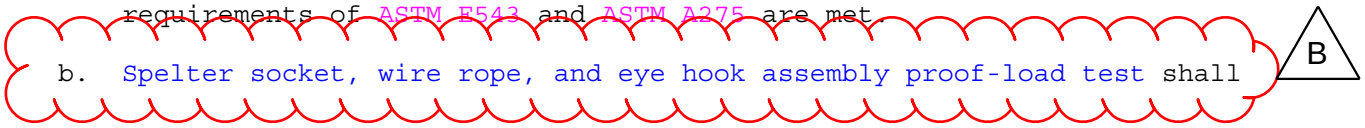
Provide safety hook fitted with self-closing, spring loaded steel safety latch. Provide unpainted hook and hook nut, permanently marked with an identification number.

2.8.1 Non-Destructive Testing

The following requirements apply:

a. The Hook NDT Report supplier shall provide a letter certifying that the requirements of ASTM E543 and ASTM A275 are met.

b. Spelter socket, wire rope, and eye hook assembly proof-load test shall



be tested to 200% rated load. B

2.9 BEARINGS

All bearings except those subject to a small rocker motion shall be anti-friction type. Provide a means for lubrication for bearings not considered to be lifetime lubricated by the manufacturer.

2.10 PAINTING SYSTEM B

Provide manufacturer's standard painting or shop painting of the commercial hoist components. The hoist cart shall be painted in accordance with Section 09 97 13.00 98 and Section 41 22 23.19, paragraph 2.9

PART 3 EXECUTION

3.1 SITE TESTING

3.1.1 Test Procedures

The Contractor shall prepare and submit for approval, the test procedures for individual hoist systems described herein.

3.1.1.1 Individual Hoist Testing

Upon receipt of individual hoist on site, a load test shall be performed to test 125% of the hoist rated load. Testing shall be performed using a dynameter in the presence of the Contracting Officer's representative.

3.1.1.2 Hoist System Testing

Procedures shall be developed to verify the safety and operational performance of each hoist after complete installation and assembly of the permanent structural, mechanical and electrical HB-3 stations. Tests shall demonstrate the safe performance of each hoist system after installation in designated locations on the drawings.

The systems test shall be performed to test 125% of the hoist rated line pull from the drum. Testing shall be performed using a dynameter in the presence of the Contracting Officer's representative.

a. Sling Cart Hoist - The sling hoist needs to be tested to 125% of its rated capacity after installation. The test will include lifting the load 6 inches, hold for three minutes lower to the load. A 100% load test will follow where the hoist is operated through its full travel to demonstrate full operation of the hoist. The 100% load test will be completed two times.

3.2 FIELD QUALITY CONTROL

3.2.1 Post-Erection Inspection

After erection, the Contractor and the Contracting Officer, shall jointly inspect the hoist systems and components to determine compliance with specifications and approved submittals. Notify the Contracting Officer 10 days before the inspection. A list of deficient items, if required, including a determination of criticality will be provided to the Contractor for corrective action. Outstanding items shall be noted for correction during the inspection. Items considered critical (load bearing, load

controlling, or operational safety devices) shall be corrected prior to further testing.

3.2.2 Operational Tests

a. After erection and inspection, test the hoist as specified. Test the systems in service to determine that each component of the system operates as specified, is properly installed and adjusted, and is free from defects in material, manufacturing, installation, and workmanship.

b. Furnish operating personnel, instruments, and all other necessary apparatus. The Contracting Officer will furnish to the Contractor test weights for testing. Receive and transport the loads from a location not more than 10 miles from the job site and return them to that location after the tests have been completed.

3.2.3 Test Data

Record test data and provide acceptance test reports on appropriate test record forms suitable for retention for the life of the hoist systems. Record operating and startup current measurements for electrical equipment (motors and coils) using appropriate instrumentation (i.e., clamp-on ammeters). Compare recorded values with design specifications or manufacturer's recommended values. Abnormal differences (i.e., greater than 10 percent from manufacturer's or design values) shall be justified or appropriate adjustments performed. In addition, note any high temperatures or abnormal operation of any equipment or machinery , investigate and correct. Record hoist speeds during each test cycle.

B

3.2.4 Hook Tram Measurement

Measure hook for hook throat spread before and after load test. Establish a throat dimension base measurement by installing two tram points and measuring the distance between these tram points (plus or minus 1/64 inch). Record this base dimension. Measure the distance between tram points before and after load test. An increase in the throat opening from the base measurement is cause for rejection.

3.2.5 No-Load Test

a. Hoist: Raise the load hook the full operating lift distance and verify satisfactory operation of hoist, upper limit switches, lower limit switch, and the hoisting and lowering speeds.

3.2.6 125 percent Rated Load Test

125 Percent of rated capacity

B

a. Hoist Static Test: Raise test load approximately one foot above the floor and hold for 10 minutes. Observe load lowering that may occur which indicates malfunction of hoisting component or brake. Lower the test load to the floor until the hoist line is slack.

b. Loss of Power Test: Raise the test load approximately 3 feet and while lowering test load at low speed, cut main power to hoist. The load must stop.

-- End of Section --