SECTION 14611 VERTICAL LIFT GATE OPERATING SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES:

A. Scope of Work: The WORK related to the rope drum hoist shall consist of the following tasks: submittal of drawings and data, fabrication, shop testing, delivery to the site, installation, field checkout, startup, testing and placement into operation, including electrical equipment. The finished WORK shall be complete, with all appurtenances, and all in accordance with these Specifications.

B. Electrical equipment shall include control equipment, electrical control cabinet, wiring and all the required accessories.

C. The hoist shall be capable of raising and lowering the roller gate under the design head condition.

1.02 REFERENCES:

A. Aluminum Association (AA)
   1. Standards and Data - Aluminum Standards and Data

B. American Gear Manufacturers Association (AGMA)
   1. 9 - Gear Handbook

C. American National Standard Institution (ANSI)
   1. B1.1 - Unified Inch Screw Threads (UN and UNR Thread Form)
   2. B20.7 - Base Mounted Drum Hoists

D. American Society for Testing and Materials (ASTM)
   1. A 27 – Steel Castings, Carbon, for General Application
   2. A36 - Carbon Structural Steel
   3. A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
   4. A227/A227M - Steel Wire, Cold-Drawn for Mechanical Springs
   5. A229/A229M - Steel Wire, Oil-Tempered for Mechanical Springs
   6. A512 - Cold-Drawn Butt Weld Carbon Steel Mechanical Tubing
   7. B209 - Aluminum and Aluminum-Alloy Sheet and Plate
   8. B211 - Aluminum and Aluminum-Alloy Bar, Rod, and Wire
   9. E114 – Ultrasonic Pulse-Echo Straight-Beam Examination by Contact Method
   10. E709 – Guide for Magnetic Particle Testing

E. American Welding Society (AWS)
   1. D1.1 - Structural Welding Code for Steel
   2. D1.2 - Structural Welding Code for Aluminum

F. Federal Specifications (FS)
   1. RR-C-271D - Chains and Attachments, Welded and Weldless
   2. RR-S-550D - Sockets, Wire Rope
   3. RR-W-410D - Wire Rope and Strand

G. Institute of Electrical and Electronics Engineers (IEEE)
   1. Std 112 - Polyphase Induction Motor and Generators

H. National Electrical Manufacturers Association (NEMA)
   1. MG 1 - Motors and Generators

2. MG 2 – Safety Standard and Guide for Selection, Installation, and Use of Electrical Motors and Generators

I. Society of Automotive Engineers (SAE)

1. SAE/AISI 1095 - Chemical Compositions of SAE Carbon Steels
2. SAE/AISI 8620 - Chemical Compositions of SAE Carbon Steels

1.03 SYSTEM DESCRIPTION:

A. General Requirements:

1. Hoist shall be complete with drums, drive shafts, couplings, worm gear reducers, sheaves, drive motor, brake, wire rope fittings, welded rigid steel base frame, anchor bolts, electrical equipment, hoist cover , position indicator, slack cable limit switches, and accessories.
2. Each hoist shall be furnished as a complete unit capable of being installed and removed without breakdown into individual components (i.e. skid-mounted with anchor bolts to connect to the operating platform).
3. Drum and cable hoists must be designed and detailed for each specific installation. Sizes of structural members and components must be sized appropriately for the conditions provided within the design criteria.
4. Operation of the gates will be subject to automatic control based on headwater elevations.
5. Each gate shall operate at a speed of 6 inches per minute plus or minus 10%.

B. Design Criteria:

1. Design Loading:
   a. General:
      i. Rated hoist capacity shall be calculated as specified under paragraph “Operating Loading Conditions” below.
      ii. Walkways and stairs shall be designed for a normal loading of 100 lb/ft2 on the projected area of the entire walkway or stair.
   b. Lifting Pins and Connections: Lifting pins and lifting lugs shall be designed for the rated hoist pull of the hoist.
   c. Loading on Dogging Devices:
      i. Loading on a dogging device shall be 150% of the load corresponding to the heaviest weight to be dogged. This load shall be considered evenly distributed between the dogging members.
2. Allowable Stresses:
   a. Stresses in Steel Structures:
      i. The design and allowable stresses for structural steel members shall be as per AISC publication - Manual of Steel Construction, Allowable Stress Design.
   b. Mechanical Components:
      i. General: Working stresses, bearing pressures, and other design criteria for mechanical components including shafts, pins and gears shall be based on consideration of functional requirements, dynamic loadings, impact, and stress concentration effects. Stresses computed for rated hoist capacity shall not exceed 20% of the ultimate strength of the materials involved. Working stresses for stalled conditions (or by motor pull-out torque) may be increased to 90% of the minimum yield strength or elastic limit of the materials used.
      ii. Wire Rope: For rated hoist capacity, tension in the wire ropes shall not exceed 20% of the breaking strength of the rope, and for stalled conditions it shall not exceed 70% of the breaking strength.

iii. Gears: Gears shall be designed to meet the requirements of applicable AGMA Standards. At rated loads and speeds, durability and strength rating of the gears shall be based on service factor of 2.0.

iv. Bearings and Bushings:

a) Average bearing pressures shall be calculated by dividing the bearing load by the effective projected area of the bearing.

b) For bronze bushings under normal loading condition, the average bearing pressure shall not exceed 10% of the yield point; the product of bearing pressure in lb/in 2 and circumferential velocity in ft/sec shall not exceed 1400.

c) For stalled conditions the limits may be multiplied by 2.25.

d) For Self-Lubricating Bushings on Corrosion-Resistant Steel Pins, average bearing pressure for "Lubrite" for normal loading condition shall not be higher than 90% of the recommended value by "Lubrite" manufacturer, but in no case higher than 4200 lb/in2.

e) The allowable average bearing pressure shall not exceed 7000 lb/in2 for loading caused by stalled conditions for self- lubricating bearing.

v. Anti-Friction Bearings: Anti-friction bearings shall be suitable for the respective application, shall have both inner and outer races, and shall conform to current standards of the Anti Friction Bearing Manufacturer's Association (AFBMA). Anti-friction bearings shall be selected to have an L-10 life of 50,000 hr under rated loaded conditions.

3. Operating Loading Conditions:

a. Force Components:

i. For calculating the operating loading conditions, either the maximum or minimum value shall be applied to each one of the force components, so that the most conservative results will be obtained.

ii. Weight: The nominal gate weight component shall also include the weight of the ballast (if any) and of any other gate-mounted equipment. The maximum weight component shall be the nominal weight increased by the weight of the connecting components between gate and hoist, and trapped water, as applicable.

iii. Buoyancy: The nominal buoyancy shall be calculated using the volume of the gate including ballast and any other gate-mounted equipment.

iv. Hydrostatic Effects: Nominal magnitude of hydrostatic effects shall be calculated using the design geometry of the part or detail under such effect and the applicable hydrostatic pressures.

v. Friction Forces: Maximum friction forces shall be calculated using design forces and maximum friction coefficients. Minimum friction forces shall be calculated using design forces and minimum friction coefficients.

b. Seals:

i. Normal force shall be calculated by summing the hydrostatic water load acting on the seal and the seal pre-compression force. Hydrostatic water load shall be calculated by considering the thrusts acting behind the seal and in front of the seal up to the centerline of seal contact and calculating the normal force caused by these thrusts directly or by their moments.

ii. Pre-compression forces shall be used as given by the seal manufacturer or if such data is not available, pre-compression forces shall be determined by tests made by the manufacturer.

iii. Friction Coefficients for Seals

	Maximum	Minimum
Rubber on steel	1.0	0.3
Rubber on corrosion-resistant steel	0.8	0.2
Fluoro-carbon on corrosion-resistant steel	0.15	0.05
Bronze on corrosion-resistant steel	0.5	0.15

c. Roller Bearings: Friction coefficients of maximum 0.010 and minimum 0.00 shall be used. These friction coefficients shall be applied to the bearing bore.

d. Bottom Seal Compression Force shall be calculated by dividing the nominal weight of the gate minus nominal frictional forces and buoyancy, when the gate is nearly closed, by the length of the bottom seal. Bottom seal compression force shall not be less than 250 lb/ft.

4. Combination of Force Components: Force components shall be combined according to the table "Force Combination Cases" below to establish the required operating forces.

5. Safety of Closure:

a. Safety of closure by gravity shall be demonstrated for all operating conditions including under dewatered condition.

b. Force combination Case I shall be used with an additional allowance equal to 15% of all negative force components. The sum of all force components, including additional allowance, shall be positive to demonstrate safety of closure.

6. Required Operating Forces:

a. All required operating forces shall be applied to the hoist connection points.

b. Required operating forces for the gate shall be determined by operating the gate under unbalanced head conditions. The required operating force shall be noted on the Shop Drawings submitted for review. Minimum unbalanced head condition shall be 14 feet**.**

c. Required Pull Force: Force combination (See Table below) Case II shall be used to calculate required normal rated hoist pull, which shall be at least 120% of the sum of all force components.

d. Required Lowering Control Force: Force Combination Case III shall be used. Hoist rated lowering control capacity shall be at least 120% of the sum of all components.

	Force Combination Cases		
	I	**II***	**III**
Application Force Components	**Safety of Closure**	**Normal Pull**	**Lowering Control**
Weight	+0.95 Nom.	+1.05 Max.	+1.05 Max.
Buoyancy	-1.05 Max.	-0.95 Nom.	-0.95 Nom.
Hydrodynamic uplift	-1.1 Nom.		
Hydrodynamic downpull		+1.1 Nom.	+1.1 Nom.
Sliding friction	-1.3 Max.	+1.0 Max.	-0.8 Min.
Seal friction	-1.3 Max.	+1.0 Max.	-0.8 Min.
Guiding device friction	-1.5 Max.	+1.0 Max.	nil
Bottom seal compression	-1.0 Nom.	nil	nil
Additional allowances	-1.0 Nom.	+1.0 Nom.	nil

7. Hoist

a. General: Design criteria used for hoist design shall ensure that the hoist can perform all operations as specified and can be safely operated under any loading condition in the environment for which it is intended.

b. Rated Hoist Capacity: Rated hoist capacity shall be considered evenly distributed between both drums of a hoist and on each rope of each drum.

c. Hoist Stalled Condition: Overload due to stalled hoist shall correspond to the breakdown torque (maximum torque) of the hoist motor. Gate shall be considered blocked and the pull forces evenly divided between both sides of the hoist. Minimum friction coefficients and maximum efficiencies shall be assumed in the system.

d. Efficiency and Friction: Efficiency of the hoist and their parts shall be calculated with the following assumptions:

i. Efficiency of drum equal to or less than 0.95.

ii. Friction coefficient between shafts and bearings: self-lubricating bearings: 0.15, bronze: 0.30, roller bearings: 0.01.

iii. Meshing efficiency of straight gears (excluding bearing losses): 0.985 or less.

iv. Where friction acts to produce favorable calculation results, such as for stalled hoist loading, only 50% of friction coefficients and losses shall be considered.

8. Controls:

a. All equipment for local control of the hoist shall be supplied.

b. Local gate control cabinets shall provide an electrical interface for remote controls including remote position indication.

9. Life Expectancy: Mechanical computations based on life expectancy shall consider an equivalent service of 50,000 hours referred to nominal (rated or design) load; 10,000 starts shall be the basis of design for those parts whose design is governed by the number of starting and stopping operations.

1.04 GENERAL REQUIREMENTS:

A. Standard Products:

1. All equipment, materials, and accessories to be furnished under this Section shall be the standard products of a manufacturer regularly engaged in the production of such items.

2. All equipment shall be suitable for long term exterior use in the hot, humid South Florida environment.

3. Design of equipment and materials shall be based on manufacturer's design calculations and experience, but shall not be less than the values specified. Further, the selection, arrangement, and assembly of all circuitry and components thereof shall be accomplished by or under the direct supervision of a firm thoroughly experienced in providing such services.

4. All components of gate operating machinery shall be the products of reputable manufacturers with a reliable service network to promptly furnish any and all necessary spare, replacement, and worn-out parts upon request of the DISTRICT.

5. Manufacturer's standard unit sizes are acceptable.

1.05 SUBMITTALS:

A. General arrangement drawings showing the gate outline, hoist, support frames, and auxiliary equipment, indicating overall dimensions, tolerances and clearances with respect to the civil structures. These drawings shall include the list of various hoist components and the required operating capacity of the hoist.

B. Detailed shop drawings of hoist and hoist support structure, showing the details of rope drums, gearings, shafts, sheaves, brakes, base frame, including base plates & anchoring, position indicator, welding details including type of nondestructive tests proposed.

C. Design Calculations: Design calculations including structural analysis of hoist frame, dogging devices, anchors, bearing plates, walkway and other major items such as drum, sheaves, brakes, rope, gear reduction, considering normal as well as stalled conditions; required hoisting force calculations; motor horsepower calculations.

D. Catalog information on all electrical and mechanical standard purchased items, with selected model clearly marked and referenced to the relevant drawing number. Additionally, following information will also be submitted.

1. Hoist Motor: Motor characteristics, curves or tabulated data (tested or calculated), indicating the speed, power factor, efficiency, current and kilowatt input, all plotted or tabulated against torque or percent of rated motor load.
2. Brake: Detailed descriptive data covering the brake, with necessary catalogue cuts, photographs, and drawings to indicate clearly brake construction and materials used. Releasing device specifications and characteristics, including input current and minimum voltage required for brake release.
3. Rotary Limit Switch: Detailed descriptive data covering its construction, range, rating, accuracy, and calibration for gate travel.
4. Slack cable limit switch.

E. Test Reports: The CONTRACTOR shall provide test reports for the gate operator, motor, and brake.

1. Gate operator shall be tested through the full range of gate travel and make adjustments as required. Testing shall be accomplished in both a dewatered and flooded condition.
2. Motor tests shall be performed in accordance with the requirements of IEEE STD. 112. Routine Tests shall include the following:
    a. Impedance
    b. Performance and general operation
    c. Insulation resistance (one point)
    d. Motor winding heater test:
        i. Successful operations
        ii. Dielectric
3. Brake tests shall include the following:
    a. Check operation of brake release at the specified rated brake torque for rated and 85% terminal voltage
    b. Insulation resistance of release magnet including leads and terminal block
    c. Resistance measurement of release
    d. Brake space heater test
        i. Successful operation
        ii. Dielectric

F. Operation and Maintenance Manual:

1. Detailed operating and maintenance instructions, which shall include reduced-size copies of applicable drawings, applicable parts list, spare parts list. Submittal shall also include catalogs covering all equipment furnished and which may be needed or useful in operation, maintenance, repairs, dismantling or assembling, and for repair and identification of parts for ordering replacements.
2. Operating and maintenance manual shall outline step-by-step procedures required for system startup, operation, and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features.
3. Maintenance manual shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed.

G. Arrangement of the local control cabinet (LCC) including control panel layout and nameplate schedules, and point to point interconnections of control equipment.

H. Full line electrical diagram showing the power connection, control transformers, and other instruments.

I. Description of electrical controls.

J. As built drawings included all field modifications.

K. Shop and Field Test Procedures

L. Shop and Field Test Results

M. Storage and Handling Instructions: Detailed instructions shall be submitted for storage and handling of the equipment at the site prior to installation. The instructions shall include identification of parts requiring special outdoor, indoor, or temperature or humidity controlled storage for both long and short term storage; space requirement; procedure for unloading, placing, stacking, and blocking of equipment; and maintenance procedures for both long and short term storage. "Short" and "Long" terms shall be defined in calendar months.

N. Installation Instructions: Detailed step by step instructions for the installation of the equipment together with reduced size copies of applicable drawings shall be submitted for review before proceeding with the installation of the equipment. The instructions shall include information on slinging and handling major pieces of equipment, erection tolerances, alignment of embedded parts, and any special precautions to be taken during installation.

O. Design and location of anchor bolts, bolt size, load on each bolt

1.06 SHIPMENT:

A. Shipment Preparation: Prepare equipment and materials for shipment in a manner to facilitate unloading and handling, and to protect against damage or unnecessary exposure in transit and storage. Include:

1. Crates or other suitable packaging materials.
2. Covers and other means to prevent corrosion, moisture damage, mechanical injury and accumulation of dirt in motors, electrical equipment and machinery.
3. Suitable rust-preventive compound on exposed machined surfaces and unpainted iron and steel.
4. Grease packing or oil lubrication in all bearings and similar items.

B. Marking: Tag or mark each item of equipment or material as identified in the delivery schedule or on Submittals and include complete packing lists and bills of material with each shipment. Each piece of every item need not be marked separately provided that all pieces of each item are packed or bundled together and the packages or bundles are properly tagged and marked. Mark partial deliveries of component parts of equipment to identify the equipment, to permit easy accumulation of parts, and to facilitate assembly.

1.07 WARRANTY:

A. The MANUFACTURER shall warrant the EQUIPMENT, MATERIALS and PRODUCTS specified in this section against defective materials and workmanship with the MANUFACTURER'S standard warranty, but for no less than two years from the date of Substantial Completion, and as described in Article 13 of SECTION 00700 - General Terms and Conditions. If the MANUFACTURER'S standard warranty is less than the stipulated period, the MANUFACTURER shall provide a special MANUFACTURER'S extended warranty for the stipulated period, or a Maintenance Bond in the form attached herein, to extend the MANUFACTURER'S warranty period for the stipulated period.

B. The CONTRACTOR shall warranty the WORK against defects for one year from the date of Substantial Completion and as described in Article 13 of SECTION 00700 - General Terms and Conditions.

PART 2 - PRODUCTS

2.01 GENERAL:

A. General layout of an electric motor operated wire rope hoist shall be as shown on the Bid Drawings.

B. Each hoist shall be designed to perform its intended function in accordance with the requirements of the Contract Documents.

2.02 HOIST MOTOR:

A. Motor Type: The hoist motor shall conform to the latest applicable standards of the ANSI, IEEE, and NEMA MG 1. Motor shall be designed for full voltage starting, reversing, and continuous full-load operation, single phase, 120 V, 60 Hz. Motor shall be NEMA Design B squirrel-cage induction type with a nominal speed of 1750 RPM, rated with a service factor of 1.15. The motor shall have Class F or better insulation with temperature rise in accordance with NEMA standards at 40°C ambient. Motor housing shall be totally enclosed fan cooled (TEFC) type. Motor terminal box shall be sized to accommodate the splicing of the motor conductors. Lifting eyes (eye-bolts) shall be furnished for handling the motor.

B. Winding Heaters: Motor shall be equipped with winding heaters connected such that they are de-energized when the motor is energized. Winding heaters shall be 120 volt, with leads terminated in two-piece watertight motor terminal compartment secured to the motor frame. The terminal compartment shall have threaded conduit entrance. Motor shall be equipped with motor winding thermostats connected to the motor controls to de-energize the motor when overheated

2.03 BRAKE:

A. Brake Rating: Hoist shall be provided with spring set, 120 V ac electrical release shoe type brakes with a rated capacity of not less than 150% of the rated full load torque of the hoist motor. The torque rating shall be based on open construction, 1-hour duty. Brakes shall be arranged to set when the motor power supply is cut off or fails to release when the hoist motor is operated. The releasing magnets shall be thrust or torque motor operated of the ac shunt type and of standard stock design, suitable for operation on 120/140-V, 60-hz power at 85% of rated voltage. Manual release shall be provided to permit handcranking or portable power-drive operation. Brake enclosure shall be of weatherproof construction, with the upper half of the case removable for convenient access to the enclosed mechanism. Enclosure shall be equipped with a 115-V ac electric heater, controlled by the same contactor as specified for the motor heater. Means shall be provided for varying the holding torque and adjusting the position of the shoes to compensate for wear. Brake drum wearing surfaces, linkage bearings, and other miscellaneous small metal parts shall be corrosion-resistant. Insulation of electrical coils shall be moisture proof. Except for brake wheels, shoes, and electrical parts, no cast iron shall be used in brake construction.

B. Brake Enclosing Case: The outdoor NEMA Type 4-watertight enclosing case shall be in accordance with the manufacturer's standard practice for the conditions indicated.

C. An AC Disc Brake shall be provided to hold the gate in the stationary open position when the motor is not in operation and in the case of power failure.

2.04 SPEED REDUCERS:

A. Type: Speed reducers shall be designed, rated, and manufactured in accordance with AGMA standards. Speed reducers shall be of the double input/double output worm gear type with worm under arrangement for output shaft. Speed reducer unit shall be self-locking so as to prevent the over-speeding of load in lowering direction. Housing shall be rigid close-grained high tensile (minimum class 30) gray iron type (ASTM A319), to provide corrosion resistance and sound dampening characteristics. The motor shall be mounted on the speed reducer in such a manner as to permit easy removal.

B. Design Parameters: Motor horsepower and RPM shall be such that motor and gear reducer combination supplies adequate torque for gate raising, and resulting gate operating speed is approximately 6 inch per minute.

C. Gearing: Worm gear shall be made from a centrifugally cast bronze alloy material meeting requirement of AGMA 9 or better. The running efficiency for a double reduction worm gear is assumed to be 35%. For the loaded start condition, 7% efficiency should be assumed. The worm gear reducer shall drive the two-transmission shafts which, in turn, are coupled to the cable drums. The gearboxes and associated power transmission components shall be designed, rated and manufactured in accordance to AGMA Standards.

D. Bearings: Bearings shall be antifriction, tapered roller type on all shafts and equipped with grease retaining rings and seals to allow bearings to be permanently lubricated. The overhung member on the input shaft and the output shaft shall be designed for 5,000 hours L-10 minimum bearing life (25,000 average hours).

E. Seals: Provide spring loaded lip oil seals on the input and output shaft.

F. Shafts: Speed reducer shall have double extended input and output shafts. Worm shaft shall be heat treated alloy SAE/AISI 8620 steel. All shafts shall be 'stress proof' steel.

G. Keyway: Keyway shall be a standard keyway in accordance with the manufacturer's recommendations and designed to develop the full strength of the shaft. The minimum keyway size shall be 5/8 inches wide by 5/8 inches high, by 3 inches long. Key material shall have minimum compressive yield strength of 53,000 pounds per square inch.

2.05 DRIVE AND DRUM SHAFTS:

A. Each shaft shall be solid and drilled and tapped on each end with a 1/2 inch diameter by 1 inch deep right hand thread, for rotary limit switches. The minimum specified shaft diameter shall be 2-1/2 inches based on SAE/AISI 1095 hot-rolled steel. A solid steel alloy drum shaft shall be provided and supported by rigid pillow blocks mounted on structural members of the hoist frame.

2.06 LIMIT SWITCH:

A. Normal Operation: Limit switches shall contain all the contacts required for making and breaking control and interlocking circuits necessary for the proper control and operation in the manner specified or required.

B. Construction: The limit switches shall be of compact and rugged construction, totally enclosed in outdoor NEMA Type 4 watertight case, and include stainless steel mounting hardware. The cover shall be provided with cap screws or other approved means for readily breaking the cover free for removal unless the gasket is so designed that it will not stick. All parts shall be of corrosion-resisting metal or treated in an approved manner to render it resistant to corrosion. The switch shall permit final adjustment in the field. Tapped bosses shall be provided for making all conduit connections to the switch.

C. Switches: The CONTRACTOR shall provide snap acting contacts rated 10 amperes at 115 volts, minimum. The CONTRACTOR shall also provide suitable terminals for connecting external conductors. The tripping mechanism shall be designed for fail-safe operation and shall reset the contacts when moving in the reverse direction.

D. Rotary Limit Switch: Provide worm and gear reduction rotary limit switch as described on the Standard Mechanical Detail Reference Drawings M1 and the following specifications:

1. Provide a rotary limit switch to signal full open and full close gate positions

2. One normally open and one normally closed limit switch shall operate when the unit reaches full open and full close set points

3. The rotary limit switch enclosure shall be weather proof and rated NEMA 4

4. Mount enclosure on drum support member

5. Mount switch (GE CR115E421112) or approved equal at the end of the unit's cable drum shaft

6. Provide a ½ inch diameter stainless steel shaft extension threaded into the end of the drum shaft and a rubber jawed flexible coupling to the switch

7. Set points shall be field adjustable

8. The switch adjustments shall be at near mid travel when the rotary limit switch is properly calibrated

E. Slack Cable Limit Switch: Provide rotary lever type position switch as described on the Standard Mechanical Detail Reference Drawings M1 and the following specifications:

1. The switch shall be heavy duty, industrial grade, rotary lever type position switch with adjustable cast zinc lever arm, and length as required

2. Mount the switch on the support member of the hoist frame for activation by the release of the spring/cylinder under slack cable conditions

3. The tripping mechanism shall be designed for fail-safe operation and shall reset the contacts when moving in the reverse direction

4. Snap acting contacts shall be rated 10 amperes at 115 volts, minimum

5. All parts shall be corrosion-resistant

6. Enclosure shall be NEMA type 4 watertight case with stainless steel mounting hardware and tapped bosses for conduit connection

7. Spring shall be manufactured from oil-tempered ASTM A229/A229M hard-drawn ASTM A227/A227M/rid steel wire with closed and ground ends

8. The spring shall be determined by the manufacturer based on the loading conditions

2.07 DRUM:

Hoist drums shall be made of cast steel (ASTM A27 Grade 70-40) or welded steel (ASTM A36) of sufficient strength to sustain the combined crushing and bending loads of the rope pull. The cable drum shall be sized in accordance with industry standards to reduce stresses on the wire rope for a longer service life. Drum and cable hoists shall be used to lift vertical lift roller gates of width greater than ten (10) feet. The cable drum shall be cast iron, cast steel, or a fabricated steel construction, and grooved to ensure the proper lay of the cable. Grooves shall have a minimum depth of 0.375 times the rope diameter. The minimum groove pitch shall be the rope diameter plus 1/8 in. The drums shall be designed so that not less than 3wraps of each part of hoisting rope will remain in the grooves when the hook is at the lowest position for the lift specified and so that at least 3/4 reserve turn is available, without overlapping of the rope, when the block is in the uppermost position corresponding to tripping of the block operated limit switch. The pitch diameter of the drums shall be not less than 24 times the rope diameter when 6 x 37 rope is furnished. Drum flange height shall be not less than 2.5 times the rope diameter. The drums shall be arranged in such a way that rope fleet angle does not exceed 3 degrees on either side for entire travel of gate.

2.08 TACKLE BLOCKS AND SHEAVES:

A. The tackle blocks shall be all-steel, bolted construction, consisting of sheaves with bronze bushings, side plates and end fittings. Each hoist unit shall have an upper and lower tackle block of the size arrangement shown in the drawings. Tackle blocks shall be designed and rated for the working load limits and shall accommodate the required rope diameter (bronze bushed sleeves). The pitch diameter for running sheaves shall be not less than 24 times the outside rope diameter. The pitch diameter of equalizer sheaves shall not be less than one half of the diameter of running sheaves. The sheave pins shall be corrosion resistant. All sheaves shall be equipped with standard replaceable roller bearings with dust and water resistant seals. Each sheave shall be lubricated by an individual grease fitting.

2.09 WIRE ROPE AND FITTINGS:

A. The hoisting rope shall be a standard product of the wire rope manufacturer and conforming to FS RR-W-410D Type 304 stainless. The rope shall be 6 x 37 class construction with independent wire rope core (IWRC), preformed, regular lay construction, and of stainless steel Type 302 or 304 having a nominal analysis of 18% chromium and 8% nickel.

B. At installation, the rope for each hoist shall be cut to proper length. The block end of the rope shall terminate in an open spelter socket which shall be bolted to the shackle at the bottom of the upper block.

C. Furnish two 3/4-inch wire rope dogging slings for each gate, complete with end fittings and pins. End termination for the dogging slings shall consist of forged steel grooved spelter sockets and pins rated for

use with IWRC wire rope conforming to FS RR-S-550D, B. Rope shall conform to FS RR-W-410D Type 304 stainless, Class 3.

D. Provide forged bolt-type anchor shackles to attach the upper block to the eye-bolt and the lower block to the gate. The shackles shall conform to FS RR-C-271D.

E. All fittings shall be proof tested and rated to develop the full strength of the wire rope conforming to FS RR-C-271D and shall be made up in accordance with the Fitting Manufacturers recommendations.

F. All rope fittings not otherwise specified shall be of stainless steel.

2.10 FLEXIBLE COUPLINGS:

A. Flexible couplings shall have a minimum 2-1/2-inch bore to match shaft diameters. Couplings shall be provided with means for field adjustment and with suitable means for permanent attachment to torque shafts after field adjustment.

2.11 GATE POSITION SWITCH AND INDICATOR ASSEMBLIES:

A. General: The Gate hoist shall be provided with a potentiometer based gate position indicator arrangement as shown on the specification drawings. The LCC (local control cabinet) shall be equipped with a display unit to receive signals from the position transmitter and indicate the gate position. Position indication function shall be accurate within plus or minus 10 mm of gate travel.

2.12 PILLOW BLOCKS:

A. Pillow blocks shall be split housing type, for easy removal of bearing from the shaft. All bearings shall be placed as closely as possible to the shaft loading points. Pillow blocks shall include accessible grease fittings. Bearing housing shall be held securely and accurately to alignment by means of fitted bolts, dowels, or shear lugs, which shall also resist all lateral forces, without considering any lateral resistance due to fasteners or friction. Bearings shall have oil-tight enclosures which will preclude the entrance of foreign matter. Special covers or other devices shall be furnished to protect the bearings against entry of dust and rain

2.13 HOIST FRAME:

A. All equipment shall be mounted on a structural steel frame to form a single self contained unit as indicated in the contract drawings in accordance to ASTM A36 Steel.

B. The frame shall be a rigid design to limit deflection that could damage or disturb the alignment of the supported mechanical components. Mounting shall be common type readily available from stock.

C. Provide aluminum diamond plate over the areas of the frame which are above the galvanized steel fasteners.

D. Provide lifting hooks for handling the hoist, if required.

E. Components:

1. Steel: unless otherwise indicated or specified, W shapes to conform to A992, channels to conform to ASTM A572 GR/ 50, angles and plates to conform to ASTM A36, and steel pipe to conform to ASTM A501
2. Stainless Steel: conform to ASTM A240, type 316
3. Connection bolts, nuts and washers:
    a. Conform to ASTM A325, unless otherwise indicated or specified
    b. Galvanized when connecting to galvanized steel.
    c. Welding: All welding shall be shielded metal arc, submerged arc or flux cored arc. Other welding processes may be used if qualified by applicable tests as prescribed in the AWS D1.1 code. Use E70 electrodes for shielded metal arc welding, F7 series electrodes for submerged arc, and E70T series electrodes for flux cored arc welding.

d. Galvanizing: Galvanize steel after fabrication to conform to ASTM A123 and ASTM A153, where indicated or specified. Nuts, bolts, and washers may be hot-dip galvanized to conform to ASTM A153.

F. Steel frame fabrication:

1. Fabricate all steel to conform to AISC specifications, codes, and standards

2. Permissible variations for sweep, camber, length and cross-section of all steel members shall conform to ASTM A6, AISC "Manual of Steel Construction, Part 1" and AISC "Quality Criteria and Inspection Standards", unless indicated otherwise

G. CONTRACTOR shall coordinate final dimensions with specific equipment provided.

2.14 COVERS:

A. Hinged, flip-up housings shall be provided for the wire rope drums and the gears. Housings and enclosures shall be dust-resistant and weatherproof constructed of aluminum not less than 10 gage thick for permanent outdoor installation. Housings shall provide easy and convenient access to lubricating points. All lubricating points shall be provided with drip trays. Design shall provide for easy cleaning and emptying of trays. Exposed portions of shafts shall be treated with manufacturer's standard primer and two coats of moisture proof varnish.

2.15 NAMEPLATES:

A. Nameplates shall be provided and attached to the motor frame and a part of the brake which ordinarily will not be renewed during its life service.

1. Nameplates attached to a part of the brake shall clearly indicate the manufacturer's name, identification symbols, serial number and salient design features such as type, frame, torque, rating, voltage, phase and frequency.

2. Nameplates attached to the motor frame shall indicate clearly motor characteristics per NEMA MG-2 and show a lead connection diagram. Identification or serial numbers shall be die stamped on the frame.

B. Nameplates shall conform to standard practice using permanently embossed or engraved lettering.

C. If adjustment to the nameplate is required, pertinent information for making adjustments shall be provided.

2.16 ALUMINUM CHECKERED PLATE:

2.17 Fabricate from Alloy 6061-T6, pattern tolerances in accordance with AA Standards and Data; 3/8 inch thick unless indicated otherwise on Drawings. The CONTRACTOR shall provide stiffener angles at checkered plate joints welded to one plate and fastened to other plate. The CONTRACTOR shall also provide stiffener angles, bars or other supports to limit deflection to 1/300 of span.

2.18 WELDING:

A. Welding shall be performed in accordance with AWS D 1.1 and AWS D 1.2.

2.19 GREASE:

A. The grease shall be nontoxic of the type used in the food industry, shall be water resistant, shall have rust and corrosion inhibitors and a NLGI 1 grade. The grease shall be 4024 Quinplex Food Industry Lubricant as manufactured by Lubrication Engineers, Inc., Fort Worth, Texas 76111, or approved equivalent.

2.20 QUALITY CONTROL REQUIREMENTS:

A. Tests of Materials:

1. General: All materials or parts used in the equipment shall be tested, in conformity with applicable methods prescribed by the ASTM, or such other organization as may be specifically required, and in general accordance with the best commercial methods.
2. Nondestructive Tests: All hoist drums and drum shafts shall be ultrasonically tested in accordance with the ASTM E114.

B. Workmanship:

1. General:
   a. All work shall be performed and completed in a thorough workmanlike manner and shall follow the best modern practices in the design and manufacture of hoist. All work shall be done by personnel skilled in the related professions. All parts shall be made accurately to standard gages so as to facilitate replacement and repairs. All bolts, nuts, screws, rivets, threads, pipe, gages, gears, and measurements or dimensions shown on the Drawings shall conform to US standards. All special gages and templates necessary for field erection shall become the property of the DISTRICT.
   b. Like parts shall be interchangeable wherever possible. Machining of fits on renewable parts shall be accurate and to specific dimensions so that replacements made to the size shown on the Shop Drawings may be readily installed.
2. Welding:
   a. General: All welds shall be continuous and watertight. All welding shall be performed by the electric-arc method, by a process that excludes the atmosphere from the molten metal, and where practicable, by automatic machines. Machined surfaces of parts affected by welding shall be machined to final dimensions after welding. Machined surfaces of parts requiring stress relief shall be machined to final dimensions after the parts have been stress relieved. Localized stress relieving shall not be performed on shop welded parts.
   b. Minimum Weld Requirements: The minimum size of fillet welds shall be in. measured on the leg except if otherwise specified. Welds larger than 3/8 in. shall be made in not less than 2 passes. All groove welds including butt welds shall be full penetration, welded from both sides.
   c. Preparation of Base Material: Members to be joined by welding shall be cut to shape and size by mechanical means such as shearing, machining, grinding, or by gas or arc cutting, to suit the conditions. The design of welded joints and the selection of weld filler metal shall allow thorough penetration and good fusion of the weld with the base metal. The edges of surfaces (up to the thickness of the metal) to be welded shall be sound metal free of visible defects, such as laminations or defects caused by cutting operations, and free from rust, oil, grease, and other foreign matter.
   d. Technique of Welding: The technique of welding, the appearance and quality of the welds, and the methods used in correcting defective work on structural steel shall conform to the AWS D1.1. Special care shall be taken to avoid undercuts along the seams or warping of the structure. If undercuts appear along the welds, they shall be filled using a small diameter electrode of the same composition as the original electrode after slag, if any, is removed. Continuous and uniform maintenance of preheat and inter-pass temperatures will be required for all welds. Local preheating shall be used only for repairs on welds. Preheat and inter-pass temperatures shall also be as outlined in the welding procedure according to the applicable sections of AWS D1.1.
   e. Welding Qualifications: The qualification of welding procedures, welders, welding operators, and tackers shall conform to standards at least equal to Section 4, “Qualification” of AWS D1.1 (for structural steel welding). The CONTRACTOR shall furnish all facilities and all equipment, materials, and other articles required to conduct qualification tests of his welders and welding operators. Certificates of welders' qualifications shall be submitted when requested.
   f. Weld Finish: Welds shall in general be treated so that they will display good appearance and a surface suitable for painting. Structural welds shall be ground and blended to avoid

stress raisers. All welds that require nondestructive examinations shall be dressed by chipping and grinding as required for good interpretation by the selected weld examination methods.

3. Castings:

   a. General: Castings shall be free from injurious defects and shall be satisfactorily cleaned for their intended use. All bronze castings for bushings and bearings shall be centrifugally cast. Surfaces of castings which are not machined shall be dressed for good appearance and for painting. The location of existing defects shall be determined, and all defects which impair the strength or utility of the casting shall be removed to sound metal before repair. The structure of the castings shall be homogeneous and free from excessive nonmetallic inclusions. An excessive concentration of impurities or separation of alloying elements at critical points in a casting will be cause for its rejection.

   b. Repair Welding: Minor defects that will not impair the strength or serviceability of the castings may be repaired by welding in accordance with accepted foundry practice. Defects shall be considered minor when the depth of cavity properly prepared for welding is not greater than 25% of the actual wall thickness but in no case greater than 3/4" in. and when the area to be welded is smaller than 8 in2. However, an accumulation of minor defects which casts doubt as to the general quality of the casting shall be considered as a major defect. If removal of defects reduces the stress-resisting cross-section of the casting by more than 30%, the casting may be rejected. All castings repaired by welding of major defects after heat treatment shall be heat treated again.

C. Shop Assembly and Tests:

1. The hoist shall be completely assembled and tested in the shop to verify that all parts properly fit and operate as specified. The field connections between the various components shall be fitted and checked in the shop to assure proper fit during field erection. The hoist shall be operated and checked for proper controls. Reeving of drums and sheaves will not be required. The hoist shall be carefully match marked before dismantling for shipment.

2. All control elements, including brakes and limit switches, shall be connected and operated for the shop test. The control shall be tested and all relay operations checked.

D. Nondestructive Testing.

1. General: Unless otherwise indicated, all nondestructive tests shall be in accordance with the applicable sections of ASTM Volume 03.03. The Shop Drawings submitted for review shall define the areas, extent, and type of nondestructive examination to be employed.

2. Examination of Welds: All butt welds shall be given complete nondestructive examination by magnetic particle testing, supplemented on a spot check level by ultrasonic testing. All other welds shall be examined by dye penetrant method throughout their entire length. The DISTRICT shall have the right to request random spot-check examination of welds, as part of the equipment inspection. Examination of welds shall be in accordance with the technique and acceptance standards of AWS 1.1.

3. Examination of Castings: All castings shall be given a magnetic particle testing, both, before and after the final heat treatment in accordance with ASTM E709 or equivalent.

4. Examination of Forgings: Major forgings shall be given ultrasonic examination and other applicable nondestructive tests, to determine that they are sound. Nondestructive examination of minor forgings shall be in accordance with accepted good practice to assure their soundness, and the type of examination shall be indicated on the Shop Drawings. The structure of forgings shall be homogeneous and free from excessive nonmetallic inclusions. An excessive concentration of impurities or separation of alloying elements at critical points in a forging will be cause for its rejection.

E. Machine Work:

1. General: Sufficient machining stock shall be allowed on all parts to be machined to ensure true finished surfaces of solid material. Finished contact or bearing surfaces shall be true and exact to secure full contact. Journal and sliding surfaces shall be polished, and all surfaces shall be finished with sufficient smoothness and accuracy to insure proper operation when assembled. No machining shall be done on working surfaces of self-lubricating bushings or washers.
2. Finished Surfaces: All surfaces that require machining for their intended function and those surfaces that are normally machined in good shop practice shall be machined.
3. Pins and Pin Holes: Pin holes shall be drilled smooth and straight and at right angles to the axis of the member. The drilling shall be done after the member is securely fastened in position, and shall be line bored in one set-up where practicable.
4. Unfinished Surfaces: All work shall be laid out to secure proper matching of adjoining unfinished surfaces. Where there is a large discrepancy between adjoining unfinished surfaces, they shall be chipped and ground smooth, or machined, to secure proper alignment. Unfinished surfaces shall be true to the lines and dimensions shown on the Drawings and shall be chipped or ground free of all projections and rough spots. Depressions or holes not affecting the strength or usefulness of the parts may be filled in an approved manner.
5. Assembly: Before assembly, all bearing surfaces, journals, and grease and oil grooves shall be carefully cleaned and lubricated with an approved oil or grease. Solvents shall not be used on self-lubricating bearings. After assembly, each lubricating system shall be filled with an approved lubricant. Self-lubricating bearings shall not be greased and shall be assembled dry according to the manufacturer's instructions.
6. Surface Finish: The qualities of all surface finishes shall be selected with due regard for the nature and function of the surface and in accordance with conservative design practice.
7. Tolerances: Tolerances shall be selected by the CONTRACTOR to correspond to the accuracy required for the proper operation of the equipment, considering the nature and function of the part.

2.21 PAINTING:

Shop finishing (for all components not Stainless Steel or Galvanized):

A. Protective Coatings:

1. Coating systems include surface preparation, prime coat, finish coats, inspection, cleaning, and touch-up of surfaces and equipment
2. Concealed surfaces are not required to have finish coats, but prime coat should be applied and touched up prior to concealment
3. All structural steel and the mechanical assembly shall be painted gray

B. Coating Systems: (SECTION 09900 Protective Coatings)

1. Structural steel frames and support steel: System S-2
2. Reduction gear housing, couplings, pillow blocks, motor and brake: System S-2

PART 3 - EXECUTION

3.01 INSTALLATION:

A. All items of equipment furnished under this Section shall be installed at the locations indicated on the Drawings according to manufacturer's recommendations and to the American Standards and Recommendations. Each hoist unit shall be properly aligned and secured on the concrete operating platform as indicated on the Drawings. All anchor bolts shall be accurately set with the use of a template and firmly held in position at the time of placing the concrete. Where it is impracticable to place anchor bolts for installation of comparatively light metal accessories before the concrete is placed, holes shall be drilled in the concrete and concrete anchors installed as directed. The wire rope hoisting cables shall be properly revved through the hoist mechanisms, attached to the gate connections and adjusted for

uniform loading. All work of installation shall be done by personnel skilled in the particular trade. Competent supervisors shall direct the installation of all equipment. All moving parts of mechanical equipment and machinery shall be carefully and accurately installed, tested for proper operation and adjusted so that all parts move freely and function properly.

B. Erection Supplies: All labor, tools, supplies, bracing, spiders, shims (including special shim to suit a particular item of equipment), temporary fixtures, alignment tools, clamps, and all other items or materials necessary to assemble, erect, and install the hoist in a thorough workmanlike manner shall be provided. The proper grades and centerline to which hoist is to be set shall be established. Items to be grouted shall be checked for alignment, clearances, and fit before grouting.

C. Field Welding: All field welding required on the parts to be modified at the project site and any welding required for proper erection and installation of the equipment shall be performed. The welding procedures and welder's qualification shall be per AWS D1.1. The equipment, materials, consumables, facilities, and labor for non-destructive testing of welds shall be furnished by the CONTRACTOR.

D. Preliminary Checks: Before field assembly and erection, the hoist equipment shall be examined for damage during shipment. In particular, it shall be checked for rain or moisture damage to motors and panels, inadequate painting, accumulations of dirt and rubbish, and oil leaks.

3.02 FIELD SERVICING:

A. After final installation has been completed, all hoist unit subassemblies, including sheaves, shall be greased. The wire ropes shall be wiped with wire rope lubricant. After all servicing has been completed; the gate operating machinery shall be tested, regulated, and adjusted for satisfactory operation. The CONTRACTOR shall perform all servicing, testing, and adjusting in the presence of one or more representatives of the hoist unit manufacturer who shall advise and assist in these operations. Any changes or adjustments required to secure completely satisfactory operation shall be made by and at the expense of the CONTRACTOR.

3.03 FIELD TESTING:

A. Field testing shall include a load test on each hoist unit while the gate is in the dry, using a dial type strain gage interposed between one gate hoist base connection and its respective hoist rope socket and a length-equalizing link between the other base connection and its hoist rope socket. The strain gage, equalizer link and all necessary pins, shackles and accessories will be furnished by the DISTRICT. The gate will then be raised and lowered by the hoist through three complete cycles (or as near complete travel as is possible with the strain gage in position) and simultaneous readings taken on the rope load, motor current and line voltage for each 6 inches of gate travel, except that motor readings will not be taken while lowering the gate. The above-described tests will be conducted by the CONTRACTOR in the presence of the Contracting Officer. Above test shall be repeated to verify hoist rated capacity, under wet condition with gate under full design head, unless such test is waived by the DISTRICT. The CONTRACTOR shall furnish a written record of the tests to the Contracting Officer.

END OF SECTION