Naval Facilities Engineering Systems Command
NAVY CRANE CENTER

# Submittal Guide

## October 2024

Navy Crane Center
Norfolk Naval Shipyard
Bldg 491
Portsmouth, VA 23709
(757) 967-3803

Change Record

| Date | Title or Brief Description | Entered By |
|---|---|---|
| May 2023 | Appendix K – Updated motor mounted disc brakes example.<br>Appendix P – Corrected calculations. | T. Woods |
| October 2023 | Removed captivation | T. Woods |

# Table of Contents

# I. Introduction

## A. Purpose

To provide guidance to contractors on the desired format and required content of submittals referenced in Navy Crane Center procurement contracts.

## B. Scope

This guide is applicable to all Navy Crane Center contracts, whether specifically invoked or not.

# II. Description of Submittals

This section lists and describes each of items required to be submitted by the crane contractor.
For submittals that reference a NAVCRANECEN form, all forms can be found on the NAVCRANECEN website at https://ncc.navfac.navy.mil/ under the “Downloads” page.

## A. Schedules, Status Reports, and RFIs

These documents are provided at various times during the contract period as the need arises. Schedules and Status Reports are typically required to be provided at the Post-Award meeting and monthly thereafter for the duration of the contract delivery order. Requests for Information (RFI) are required when needed. Specific requirements for the timing of submission will be provided in the delivery order documentation.

### i. Schedule with Milestones

The schedule with milestone submittal is the contractor's post-award schedule which captures the major events during design, fabrication, installation and testing of the crane. At a minimum, the schedule shall include:

1. Post Award Conference
2. First Design Package Submittal
3. Government Review of Design Package
4. Subsequent Design Package Submittal
5. Government Review of Design Package
6. Fabrication Initiation
7. Fabrication Completion
8. Pre-Installation Conference
9. Government-Witnessed Shop Test
10. Mobilization Start
11. Existing Crane Removal (if applicable)
12. New Crane Installation
13. Field Inspection & Acceptance Test
14. Crane Acceptance
15. Contract Completion Date
16. Receipt of Final Operation and Maintenance Manuals
17. Completion of Warranty

It is the contractor's responsibility to ensure that all required submittals are received in a timely fashion to support key milestone events. It is recommended that the contractor track the due dates of critical CDRLs (contracts data requirements list) on a submittal register that may be provided along with the project Milestone Schedule. Approval and/or acceptance of specific CDRLs are prerequisites to initiating key project milestones. Critical CDRL items that have caused project schedules to slip include, but are not limited to:

1. Final Stamped Drawings
2. Hook NDT Certification
3. Runway Rail Survey & Certification
4. Contractor Shop Test Procedure
5. Lift, Installation & Handling Plan
6. Accident Prevention Plan

Refer to Appendix A for a sample Schedule with Milestones.

ii. **Monthly status report**

The status report shall be in contractor's format. The first page of the report shall contain the following information:

1. Title/Project Description
2. Reporting Period
3. Contract Number
4. Name and Title of the Report Preparer
5. Security Classification (when required)
6. Distribution Statement

NCC recommends the report contain the following items, as applicable:

1. *Milestone/task status.* Include a brief statement of the overall project status, followed by the status of each milestone/task as defined by the contract. Address whether or not the project is on schedule; if not, describe the effort planned to meet the schedule. Provide explanation for schedule deviation(s) from previously submitted status report.

2. *Schedule.* Include updated schedule sheets or milestone charts identifying phase of task and percentage of completion of each task, technical instruction, or order. Identify key dates in any testing program and a description of tests performed and significant test results.

3. *Design & Review.* For designs in-process, provide estimated dates for design and drawing completion. For designs under review, indicate review level (100%, Final, Post-Final Back-check), and projected design approval date. List and briefly describe current Request(s) for Information (RFI).

4. *Problems & Deficiencies.* Describe outstanding problems existing as of

the previous status report, and their resolution status, indicating who has action to continue resolution. List new problem areas encountered or anticipated, their effect on the overall work effort/project, and steps being taken to remedy problem situations.

5. *Conference/Trip Outcomes.* Describe significant results of conferences, trips, or directives from the Contracting Officer's representatives. List all contract modifications issued.

6. *Other.* Provide any other information which may cause significant changes in the program schedule.

7. *Future plans.* Provide a summary of future progress, recommendations and proposals both for the next reporting period and for any long term plans.

8. *Appendices.* Attach appendices, where applicable, for tables, references, charts, or other descriptive material. Each appendix shall be identified and referenced in the appropriate area of the report.

The initial status report & schedule is due within 15 days of contract award. Submit subsequent monthly status report no later than the 1st of each month.

Refer to Appendix B for a sample Monthly Status Report.

iii. **RFI Form**

RFIs are used to document and respond to contractor inquires during the post award phase of an acquisition. An RFI form will be provided to the contractor to use as the official record in documenting contractor inquiries and NCC's responses for questions with an active procurement. Each RFI shall be a complete submittal that includes all information pertinent to the request or shall clearly reference the location of the information, if provided separately (e.g. in a recent/upcoming design submittal).
NCC's project manager is responsible for ensuring RFIs are processed in a timely manner.
NCC's lead engineer is responsible for evaluating any technical questions or recommendations from the contractor as compared to contractual requirements and the original scope of work.
NCC's contract specialist utilizes the completed RFI form to initiate a formal request for proposal when the RFI response requires a modification to the contract.

Refer to Appendix C for a sample of the NCC RFI Form.

B. **Drawings**

This section lists and describes drawings typically required to be submitted by the crane Contractor.

i. **General Drawing Border with Title Block**

All drawings must include a PE stamp as indicated in the example. Drawings submitted for review must follow the format described. Be sure to change drawing revision numbers to reflect the most current revision and to list a description of any changes in the revision blocks.

Refer to Appendix D for an example General Drawing Border with Title Block.

ii. **General Arrangement Drawings**

General arrangement drawings reflect the exact overall design and configuration of the crane and demonstrate proper interface with the facility/building and relation to other crane components, other cranes on the same rail system, and the lower rail system. These drawings show the layout of the crane, including all major components of the crane. These drawings show the plan view, front elevation view, side elevation view and trolley layout (if not included as product data) and typically include:

1. All dimensions specified in Appendix A of the specification, including:
   a. Span of girder from centerline to centerline of runway rails
   b. Hook height
   c. Distance from top of rail to lowest obstruction point on ceiling
   d. Distance from top of rail to floor
   e. Hook approach on both ends of the girder (centerline hook to runway rail)
   f. Runway hook approach (centerline hook to face of bumper).
   g. Distance between main and auxiliary hook (if applicable)
   h. Distance from top of pendant controller to floor.
   i. Distance from each end of girder to nearest obstruction on each wall
   j. Distance from top of trolley to lowest overhead obstruction
   k. Distance from centerline of rail to nearest obstruction on each wall.
   l. Rail size
   m. Mid-runway travel limits (if obstructions exist)
   n. Hook depth below floor level (if pits exist)
   o. Wheel spacing of bridge end trucks
   p. Runway power conductor location and dimensions (if new)

2. A list of crane system descriptions from section 1.3 of the specification, including:
   a. Total crane capacity
   b. Main hoist capacity
   c. Auxiliary hook capacity
   d. Rated speeds of bridge, trolley and hoists
   e. Minimum speeds of bridge, trolley and hoists
   f. Maximum wheel load without impact
   g. Voltage and full load amps

3. A list of weights of crane components, including:
   a. Total crane weight

b. Drive Girder
c. Idle Girder
d. Trolley/Hoist
e. End Trucks
f. Miscellaneous Equipment (e.g., Crosswalks and Girder Ties)

Refer to Appendix E for example General Arrangement Drawings.

iii. **Electrical Drawings**

Electrical drawings are the fundamental electrical submittal for cranes and reflect the exact design and configuration of the crane. These drawings show the layout of electrical equipment on the crane, including control panel enclosures, motors, brakes, limit switches, conduits, disconnects, and conductor systems. These drawings typically include:

1. A one line drawing showing wiring and connections between all electrical components and panels

2. Schematic representation of the control and power circuits of the crane. These schematics should show:
   a. Conductor sizes, type, and temperature, including notification of the use of finely stranded conductors.
   b. Type of overcurrent devices and the rating of the device. For adjustable circuit breakers, any adjustable settings for the breakers should be shown on the schematic. For fuses, the fuse type should be shown on the schematic.
   c. Motor nameplate data, as specified by NFPA 70
   d. A note or description for any special description of operation.
   e. Labels for all components that correspond to the nameplates that will be on the crane.
   f. Specific drive parameters which add clarity to the drawing and allows the schematic reader to verify functionality of the circuit.
   g. A systematic approach to naming components and for displaying relay and contactor contacts and coils, such that all drawings are easily referenced.
   h. Obvious connections between crane manufacturer's components and subcontractor component's (i.e. radio control systems, load monitoring systems, etc.), such that it is easy for the end user to navigate from the crane schematic to the component manufacturer's schematics
   i. All optional equipment removed from the schematics and not shown on the schematics as "optional".

3. Drawings showing component placement for all equipment located in a control panel.

4. Drawings showing the controller to be used and the layout of the controls and ancillary devices on the controller

5. Drawing to show festoon, cable, and festoon car layout

6. A complete material list of all electrical components on the crane

Refer to Appendix F for example Electrical Drawings.

iv. **Mechanical Drawings**

Mechanical drawings are typically limited to the drive arrangements. These drawings show the layout of the particular drive components with basic dimensions in plan view, front elevation view, side elevation view and trolley layout if not included as product data. Identify and label individual drive components with the appropriate part number, including:

1. Travel Wheels: Including dimensions and assembly including wheel material, tread hardness, wheel to axle fit and cross section.
2. Sheaves: Provide dimensional and assembly for top and equalizer sheaves, including sheave groove hardness and cross section.
3. Hook and Hook Block: Provide dimensional and assembly including the block cross section and hook. If the hook is not a commercial product, a separate drawing for the hook shall be provided.
4. Drawings for any non-commercial products
5. Reeving Diagram
6. Coupling and brake drum installation including: locations, applicable shaft engagement, and bore and key details.
7. Lubrication information showing the location of lubrication points, type of lubricant to be used, quantity required and the frequency of lubrication.

Refer to Appendix G for example Mechanical Drawings.

v. **Structural Drawings**

Structural drawings are the fundamental structural submittal for cranes and reflect the exact design and configuration of the crane. These drawings show the layout of the crane, including all major components of the crane and fabrication welding and bolted connection details. These drawings typically include:

1. Girder fabrication drawings. These drawings include:
   a. Dimensions of overall length of the girder
   b. Overall span length of the girder
   c. Location of full diaphragms
   d. Location of short diaphragms
   e. Location of stiffeners
   f. Material list including grade and size of components used

g. Connection details to the end trucks
h. Location and connection of trolley end stops
i. Installation requirements for structural bolted connections
j. Weld details for all components
k. Rail, rail clips, and rail splices
l. Lift points

m. Fall protection anchorages (if applicable)
n. Walkways, ladders and their connection to the girder

2. Bridge end truck fabrication drawings, if not included in product data. These drawings include:
   a. Dimensions of overall length of the end truck
   b. Wheel spacing
   c. Material list including grade and size of components used
   d. Location and connection of bridge bumpers
   e. Installation requirements for structural bolted connections
   f. Weld details for all components
   g. Rail sweeps
   h. Lift points
   i. Fall protection anchorages (if applicable)

3. Trolley end truck fabrication drawings, if not included in product data. These drawings include:
   a. Dimensions of overall length of the end truck
   b. Material list including grade and size of components used
   c. Location and connection of trolley bumpers
   d. Installation requirements for structural bolted connections
   e. Weld details for all components
   f. Rail sweeps
   g. Lift points (if applicable)
   h. Fall protection anchorages (if applicable)

4. Trolley fabrication drawings, if not included in product data. These drawings include:
   a. Dimensions of overall size of the trolley
   b. Material list including grade and size of components used
   c. Installation requirements for structural bolted connections
   d. Weld details for all components
   e. Lift points
   f. Fall protection anchorages (if applicable)

Refer to Appendix H for example Structural Drawings.

vi. **Control System and Network Drawings**

Control System and Network Drawings shall at a minimum include:

1. Network diagram must show interconnection cabling, equipment locations, names, models, and IP addresses on network communications schematic for all PLC, RTU, Supervisory Controller, and other Network-Capable Devices.

2. Software block, flow, and ladder diagrams.

Refer to Appendix I for example Control System and Network Drawings.

C. **Product Data**
Product Data is typically required for all major standard commercial components (as defined by section 2.4 of the solicitation). Submission is preferred to be provided prior to crane fabrication and must be approved prior to shop test. Specific requirements for the timing of submission will be provided in the delivery order documentation.

Submit product data in bookmarked .pdf format. Mark up catalog cuts to clearly identify which components are being used on the crane and to which items these components apply. On the submitted catalog data, clearly identify any options and features that are utilized or that are necessary to meet the crane specification. The catalog cuts should be complete, such that the reviewer can easily tell what equipment is being supplied, how it meets the specification and how it relates to the drawings.

i. **Electrical Product Data**
Electrical product data is the manufacturer's catalog data for specific electrical components used on the crane. Typically electrical catalog information is required for:

1. Variable Frequency Drives - Show drives used for each motion, show selections for reactors, show data logging equipment and dynamic braking resistors.

2. Motors - Show all information required by NFPA 430.7, motor type, and any options that are selected.

3. Electrical Enclosures - Show sizes and NEMA type of enclosures provided.

4. Runway Electrification and Collectors - Show all components for runway electrification system, ampacity of electrification system and collectors, collectors are of the tandem type, power feed componentry and connection, collector to crane componentry and connection, and any specialty options for outdoor or other special environments.

5. Limit Switches - Show both geared limit switches and weighted limit switches provided.

6. Bridge to Trolley Electrification - Show all equipment used for electrification including festoon cables, festoon cars, junction boxes, power feed componentry and connections, collector shoe componentry and connection, etc.

7. Operator Controls - Show controllers (pendant or radio) used on the crane, layout of controls, and options selected for controller. Show receiver information for radio controls systems.

8. Warning and Pilot Devices - Include all information for key switches, pilot lights, push buttons, and other devices.

9. Disconnect Switches - Provide current rating and fuses used for disconnect switches.

Refer to Appendix J for examples of electrical product data.

ii. **Mechanical Product Data**

Mechanical product data is the manufacturer's catalog data for specific components used on the crane. The majority of mechanical design is provided through catalog cuts. Typically catalog information is required for:

1. Hoists (if preassembled) - If the hoist is a preassembled unit, bought as a commercial component, the product data must be included. Clearly mark the options to show compliance with the specification. Note: typically one or more options are required from the basic equipment to meet the specification.

2. Speed Reducers - Indicate case material, size, reduction, efficiency rating, service factor, installation information and gear ratio.

3. Brakes - Indicate model and sizing. Show specific torque values and setting criteria; include electrical, installation and maintenance information.

4. Bearings - Show size, rating and housing information for bearings not internal to commercial components.

5. Couplings - Show size selection and installation criteria.

6. Load Block and Hooks - For commercial load blocks, show size selection.

7. Wheels and Sheaves

8. Wire Rope – Show size selection, class construction, lay, classification, and minimum breaking force.

9. Load Indication Device (LID)

Refer to Appendix K for examples of Mechanical Product Data.

iii. **Structural Product Data**
Structural product data is the manufacturer's catalog data for specific components used on the crane. Typically structural catalog information is required for:

1. Bridge End Trucks including drive units

2. Trolley End Trucks including drive units

3. Patented track used for bridge girders or for runways of underrunning cranes

4. Bumpers including bumper compression and the resulting force based on the total kinetic energy absorbed.

5. Swing gates

6. Painting system (including completed NCC Form "Coating System Summary Form")

Refer to Appendix L for examples of Structural Product Data.

iv. **Control System and Network Product Data**
Ensure the following is provided in the product data for PLC, RTU, Supervisory Controller, or other network-capable (whether networked or not upon delivery) control devices as applicable:

1. Hardware list (Hardware list must include the following for each device):
   a. Manufacturer
   b. Model
   c. Location
   d. Key technical ratings (e.g. memory)
   e. Serial number
   f. MAC addresses
   g. IP addresses

2. Software List (Software list must include the following for each device):
   a. Manufacturer
   b. Version/subversion
   c. Location/device
   d. Used network ports/protocols/services

3. List and discussion of all security features of Contractor hardware and software.

Refer to Appendix M for examples of Control System and Network Product Data.

D. **Design Data**

Design Data is typically required to be provided prior to crane fabrication and must be approved prior to shop test. Specific requirements for the timing of submission will be provided in the delivery order documentation.

These calculations shall be in compliance with the design requirements listed in the specification. Calculations should be complete such that the reviewer can easily tell values of input supplied, how it meets the specification, and how it relates to the calculations. Calculations should clearly state what the allowable design values are, what the calculated design values are and if the design meets the required design values. Submit calculations in bookmarked .pdf format.

i. **Electrical Calculations**

Electrical calculations are required to verify component section and for components which are not standard commercial products/assemblies. Electrical calculations are required for (as applicable):

1. Minimum required horsepower for each drive motor calculations shall be shown to use the following guidelines:
    a. Shall be based on the formulae given in CMAA 70
    b. Hoist motor sizing Kc factor shall not be less than 1.0.
    c. Bridge and trolley drive motor calculations should use the "E" factor that is the published gear reducer efficiency rating. If the published reducer efficiency is not available, then 0.9 should be used for "E".
    d. The bridge and trolley drive minimum acceleration time to rated speed shall be four and three seconds, respectively.
    e. No calculations shall be required to be submitted for packaged hoists, however, packaged hoists must still meet the acceleration and deceleration requirements.

2. Overcurrent protection calculations shall include:
    a. Citations for all applicable NEC articles, including, but not limited to 430.72, 450.3, and Section V of article 610
    b. Sized according to NEC guidelines, and with protective device coordination in mind when choosing proper sizes

3. Conduit Fill Calculations shall be shown to use the following guidelines:
    a. Data from each conduit run with wire type(s), size(s), and quantity of each, along with intended conduit size and type
    b. Calculations may refer to either Chapter 9 of NFPA 70 or the wire manufacturer's data sheets when calculating conduit fill
    c. NFPA 70 Chapter 9, Table 1 directs user of allowable cross sectional areas of conduit fill acceptable based on quantity of conductors in the respective conduit, such that 1 conductor may fill up to 53%, 2 conductors may fill up to 31%, and any application greater than 2 conductors is limited to 40% fill, all with respect to cross sectional area.

4. Protective device coordination study will include:
    a. Characteristic curves of each protective device, plotted together with other applicable protective devices with respect to current over time
    b. Devices are considered coordinated when no curves overlap. A specific example of an out-of-coordination design would be a hoist experiencing an overcurrent condition, but instead of its protective device opening, the upstream main breaker opens, effectively removing power from the entire crane before the hoist's breaker opens due to being out of coordination.

5. Lighting calculations (if required). These calculations shall include:
    a. Arrangement of lights required to meet the lighting requirements requested in the specifications. A typical specification, for example, may ask that lighting be provided such that 40 foot- candles at a distance of three feet from the floor be provided.
    b. An appropriate Light Loss Factor (LLF) shall be chosen to consider degradation of the light source over time to account for the accumulation of dust and dirt on the lamp, lenses, etc. through normal operation.
    c. Attention to type of lighting required per the specification must be given. Typical installations requiring metal halide lamps, for example, must either be a thick-glass parabolic reflector lamp (PAR) or use type O lamps with fixtures that provide a containment barrier and are physically constructed such that *only* type O lamps may be used, to be in accordance with NEC article 430.130 (F)(5).

Refer to Appendix N for examples of Electrical Calculations.

ii. **Mechanical Calculations**

Mechanical calculations are only required for non-commercial, custom designed and built components. They may be specifically requested. Generally, the calculations below are required, as applicable:

1. Drum Design calculations to include:
    a. Rope fleet angle for drum
    b. Calculations that show the drum can withstand all combined loads, including crushing or buckling, bending, torsion and shear, with consideration for stress reversal and fatigue
    c. Stress analysis for the drum shaft

2. Bearing Selection calculations applying to all bearings, hook thrust bearing and equalizer sheave bushing calculations shall include:
    a. Calculations for $L_{10}$ bearing life to show anti-friction bearings meet minimum life expectancy for the specified service class based on full rated speed as provided by CMAA 70, table 4.8.2-1
    b. Calculation to show that bearing spacing meets CMAA 70 requirements in section 4.11.2 for applicable shafting configuration
    c. Hook thrust bearing and equalizer sheave bushing require a simple

calculation to show the product ratings satisfy loading conditions

3. Shafting and Sheave Pin design calculations for normal operating condition. Impact shall not be included. Calculations shall include:
   a. Static and fatigue stresses calculations for applicable shaft configurations in CMAA 70 section 4.11.4
   b. Sheave pin design is considered shafting and requires stresses calculations

4. Load Bearing Support Member calculations shall show that the rated load stress does not exceed 20% of the average ultimate strength of the members' material.

5. Calculations verifying compliance with Section 4 of CMAA No.70 for any non-commercial items

6. Calculations verifying brake selections and settings

7. Calculations verifying coupling selections

Refer to Appendix O for examples of Mechanical Calculations.

iii. **Structural Calculations**

Structural calculations are required for components which are not standard commercial products/assemblies. Typically structural calculations are required for:

1. Verifying girder design. These calculations will follow CMAA 70 format and include:
   a. Calculations of load cases to ensure allowable stresses are not exceeded for the load cases requested in the specification
   b. Buckling analysis
   c. Location and size of diaphragms and stiffeners
   d. Required camber
   e. Verification that girder proportions are not exceeded
   f. Verification of weld sizes
   g. Verification of bolted connection design
   h. Calculations to ensure the maximum allowable wheel loading is not exceeded

2. Verifying bridge and trolley end truck and trolley design. These calculations will include:
   a. Load cases to ensure allowable stresses are not exceeded for the load cases requested in the specification
   b. Buckling analysis
   c. Verification of weld sizes
   d. Verification of bolted connection design

3. Verifying design of trolley and bridge bumpers and end stops in accordance with the specification.

4. Verifying shear and bending moment on the runway rail structure is not exceeded if wheel spacing is different than shown on crane information form.

Refer to Appendix P for examples of Structural Calculations.

E. **Test Reports**

NAVFAC P-307, Appendix E, paragraph 1.4 identifies the requirement for non-destructive testing of crane hooks in the Navy inventory. This submittal is required to support certification of Navy cranes. The details of submittal requirements are taken directly from NAVFAC P-307.

Test Reports are typically required to be provided prior and approved prior to shop test. Specific requirements for the timing of submission will be provided in the delivery order documentation.

i. **Hook Non-Destructive Test (NDT) Report**

Reports for hook NDT performed shall meet the requirements of the solicitation.

Refer to Appendix Q for an example of the Hook Non-Destructive Test (NDT) Report.

F. **Certificates**

Certificates are letters from the contractor or vendor stating compliance with specification. Include contract number, job location, crane serial number and CDRL number on all certificates. Certificates must be signed by a responsible person.

Certificates are typically required to be provided and approved prior to shop test. Specific requirements for the timing of submission will be provided in the delivery order documentation.

i. **Wire Rope Certificate**

The contractor shall provide the wire rope manufacturer's certification that the rope meets the published breaking force, or the actual breaking force of a sample taken from the reel and tested. Show the published breaking force on the wire rope certificate; the actual wire rope breaking force must meet or exceed the published value. Certification shall be traceable to the hoist, crane and reel.

Refer to Appendix R for an example of the Wire Rope Certificate.

ii. **Crane Runway Rail Certificate & Survey**

Navy Crane Center may provide a survey of the runway rail with the contract. The contractor shall provide a certificate stating that the existing runway is suitable for the new crane to operate without any restrictions. If the contractor does not find the existing runway rail to be suitable for the new crane, the contractor shall provide the Government with corrective actions necessary for the new crane to operate without restriction and provide a list of restriction for crane operation on the existing runway.

For new under-running runways, the contractor shall provide a runway survey showing that the new runway has been aligned to meet the specification requirements. The survey shall be performed by a professional surveyor and shall include adequate detail in order to verify each of the alignment tolerances provided in the documents referenced by the specification.

Refer to Appendix T for an example of the Crane Runway Rail Certificate and Survey.

iii. **Hazardous Material Certificate**
The contractor shall certify that the crane contains no hazardous materials. This letter should specifically reference the hazardous materials listed in the specification.

Refer to Appendix U for an example of the Hazardous Material Certificate.

iv. **Loss of Power Test Certificate**
As part of the test, power will be cut to the crane system. The loss of power test certificate is a letter stating that loss of power will not have detrimental effects to the product.

Refer to Appendix V for an example of the Loss of Power Certificate.

v. **Coupling Alignment Certificate**
The Contractor shall submit coupling alignment data records with certification that the alignment of all shafting connected by means of flexible couplings are within the manufacturer's installation tolerances. The shaft alignments shall be made using laser alignment equipment. Barrel couplings may be aligned using lasers or the OEM recommended method. The data records shall be taken after the coupling's final installation. Coupling alignments shall be verified by the Contractor and witnessed by the Government after crane installation. Barrel coupling alignment data record(s) shall be submitted on the official NAVCRANECEN form titled “Drum Barrel Alignment Data Sheet” located on the NAVCRANECEN website. All other coupling alignment data record(s) shall be submitted on the official NAVCRANECEN form titled “Shaft/Coupling Alignment Record Form” located on the NAVCRANECEN website.

Refer to Appendix W for an example of the Coupling Alignment Certificate.

vi. **Hook and Hook Nut Proof Test Certificate**
Only applies to custom designed and non-ferrous hooks.
The proof test shall be performed prior to the Hook NDT as required in Section E (i).

The Contractor shall submit certification that the hook and hook nut has been proof tested based on the rated capacity of the hoist it is installed on and satisfies the acceptance criteria of ASME B30.10.

Refer to Appendix X for an example of the Hook and Hook Nut Proof Test.

vii. **Welding Certifications**

The contractor shall provide a certificate stating that all welders, welding operators, weld inspector(s) and welding procedure (qualification) meet the requirements of AWS D 14.1 for all work performed in manufacturing the crane.

The contractor shall provide a separate certificate stating that all welders, welding operators, weld inspector(s), and welding procedure (qualification) meet the requirements of AWS D 1.1 for all work performed in installing/welding parts supporting the crane at/to building interfaces.

Note: More prescriptive welding certifications will be required for Special Purpose Service and ordnance handling cranes.

Refer to Appendix Y for an example of the Welding Certifications.

viii. **Public Domain Software**

The Contractor shall provide a declaration that public domain software (e.g., freeware, shareware) is not used in the system.

Refer to Appendix Z for an example of the Public Domain Software Certificate.

ix. **Software and Services Certificate**

The Contractor shall provide a certificate stating that all software and services not required for operation and/or maintenance of the product has been removed. If removal is not technically feasible, then disable software not required for the operation and/or maintenance of the product. Configure the product to allow the ability to re-enable ports and/or services if they are disabled by software. The removal of software or services shall not impede the primary function of the product. If software that is not required cannot be removed or disabled, document a specific explanation and provide risk mitigating recommendations and/or specific technical justification. The software/service to be removed and/or disabled shall include, but not be limited to:

1. Cameras
2. Games
3. Device drivers for product components not procured/delivered
4. Messaging services (e.g., email, instant messenger, peer-to-peer file sharing)
5. Source code
6. Software compilers in user workstations and servers
7. Software compilers for programming languages that are not used in the control system
8. Unused networking and communications protocols
9. Unused administrative utilities, diagnostics, network management, and system management functions
10. Backups of files, databases, and programs used only during system development
11. All unused data and configuration files
12. Remove and/or disable, through software, physical disconnection, or engineered barriers, all services and/or ports in the procured product not required for normal operation, emergency operations, or troubleshooting. This shall include communication ports and physical input/output ports (e.g., USB docking ports, video ports, and serial ports).

Refer to Appendix AA for an example of the Software and Services Certificate.

x. **Hazardous Environment Certificates**

As applicable for the environment, the following certificates may be required:

1. Contractor Hazardous Environment Certificate
   The Contractor shall provide a certificate stating the new crane and all associated components excluding the hoist are designed for operation in the hazardous environment specified.

2. Hoist Manufacturer Hazardous Environment Certificate
   The Contractor shall provide a certificate from the hoist manufacturer stating that the hoist is designed for operation in the hazardous environment specified.

G. **Manufacturer's Instructions**

Manufacturer's Instructions are submittals typically provided in the lead-up to shop test and/or mobilization and provide instructions regarding the sequencing and method of quality control testing and performance of work onsite. Specific requirements for the timing of submission will be provided in the delivery order documentation.

i. **Shop Test Procedure**

The Contractor is required to develop and submit a shop test procedure that will demonstrate operation, performance, and safety of the crane. Appendix B of the solicitation typically provides the minimum requirements that the test procedure shall conform to.

ii. **Crane Installation Plan**

The crane installation plan should address all steps required for the removal of existing components and installation of the new crane. An installation plan shall include the following:

1. A drawing containing:
   a. Weight of each component to be lifted
   b. Location of the center of gravity of each component to be lifted
   c. Location of laydown area
   d. Shipping route to laydown area
   e. Location of each component prior to being lifted
   f. Location of each component in the installed position.
   g. Method of attachment for rigging gear to component to be lifted
   h. Required torques, if necessary
   i. Location of interferences
   j. Calculated tension force in lifting gear
   k. Overhead clearances between structure and rail (runway and bridge)
   l. Overhead clearances between point sheave and overhead structure

2. A narrative of the lifting plan containing:
   a. Safety precautions
   b. Sequence of events
   c. Down rated capacity of forklift due to shifting of load center if applicable

3. Data Sheet of Lifting Equipment Used:
   a. Load charts for forklifts, tri-lifters, mobile cranes etc.
   b. Swivel Hoist Rings
   c. Hook Information
   d. Ground loading requirements

Refer to Appendix BB for an example of the Crane Installation Plan.

iii. **Accident Prevention Plan (APP)**

The Accident Prevention Plan should include descriptive information for each of the categories in the delivery order. Accident Prevention Plans and

Safety plans shall be site specific and, as a minimum, meet the requirements of Appendix E of the solicitation. The plans shall be prepared, signed, approved, and concurred on by applicable contractor personnel. Please attach documentation and certification for applicable categories.

Safety Plans shall describe specific requirements and/or procedures for the equipment being installed, inspected and/or maintained.

Procedures or requirements in a Corporate or Company Safety Program may be referenced in a Safety plan. If referenced, the procedures or requirements must be provided with the APP. Referencing a Corporate Safety Program or Manual as a Safety Plan is not site specific and is unacceptable.

Based on a risk assessment of contracted activities and on mandatory OSHA compliance programs, the Contractor shall address all applicable occupational risks and compliance plans.

Using the EM 385-1-1 as a guide, plans may include but are not limited to:

1. Overview - Background information, including:
    a. Contractor Name
    b. Contract Number
    c. Project Name
    d. Project #
    e. Project Description
    f. Brief Description of Work to be Performed
    g. Project Location
    h. Project Contacts, including the name, title, phone number and signature of the following:
        i. The Plan Preparer (Qualified Person or Competent Person, such as the corporate safety staff person or QC)
        ii. Plan Approval (Company/Corporate Officers authorized to obligate the company)
        iii. Plan Concurrence (e.g., Chief of Operations, Corporate Chief of Safety, project manager or superintendent, project safety professional, project QC)
    i. Responsibilities & Authorities
        i. Statement of the employer's ultimate responsibility for the implementation of the SOH program
        ii. Identification and accountability of personnel responsible for safety at both corporate and project level
        iii. The names of Competent and/or Qualified Person(s) and proof of competency/qualification
        iv. Requirements that no work shall be performed unless a designated competent person is present on the job site
        v. Line of authority
        vi. Policies and procedures regarding non-compliance with safety requirements (including disciplinary actions)
        vii. Provide written company procedures for holding managers and

supervisors accountable for safety

2. Description of Plan Implementation
3. Subcontractors & Suppliers shall provide procedures for coordinating SOH activities with other employers on the job site and contain the following:
   a. Identification of subcontractors and suppliers
   b. Safety responsibilities of subcontractors and suppliers
4. Description of Medical Support
   a. On-site medical support
   b. Off-site medical arrangements describing rescue and medical duties for those employees who are to perform them and the name(s) of on-site Contractor personnel trained in first aid and CPR
      *Note: A minimum of two employees shall be certified in CPR and first-aid per shift/site.*
5. Personal Protective Equipment
6. Safety and Health Policy
   a. Provide a copy of the current corporate/company Safety and Health Policy statement, detailing the commitment to providing a safe and healthful workplace for all employees.
   b. The Contractor's written safety program goals, objectives, and accident experience goals for this contract should be provided.
7. Safety & Health Inspections
   a. Specific assignment of responsibilities for a minimum daily job site safety and health inspection including:
      i. Who will conduct the inspections
      ii. Proof of inspector's training/qualifications (e.g., copy of license, state license/inspector number, documentation of training completion)
      iii. Procedures for documentation, deficiency tracking system
      iv. Follow-up procedures
   b. Any external inspections/certifications that may be required (e.g., USCG, State/Local)
8. Procedure for Accident Reporting
   a. The Contractor shall identify person(s) responsible for Accident Reporting, including Investigations, Reports, Logs, and Exposure data.
   b. The requirements for accident reporting and notification shall be listed in this section.
9. Training
   a. Requirements for new-employee Safety and Occupational Health orientation training
   b. Requirements for mandatory training and certifications applicable to the project (e.g., explosive actuated tools, confined space entry, crane operator, driver, vehicle operator, hazmat training, and PPE) and any requirements for periodic retraining/recertification
10. Equipment Inspection Records
11. Emergency Response Plans, including:
    a. Emergency escape procedure and emergency escape route

assignments including a predetermined assembly meeting area after an evacuation

b. Emergency rescue procedures (e.g., for employees working at heights or in confined spaces)
c. Rescue and medical duties for those employees who are to perform them
d. The preferred means of reporting fires and other emergencies (e.g. location of phones at the job site, and the posting of emergency telephone numbers and reporting instructions for ambulance, physician, hospital, fire, and police).
e. Sketch or map that will be posted at the job-site highlighting the route to the nearest medical facility and hospital
f. Names and job titles of persons who can be contacted for further information of duties under the accident prevention plan
g. Spill containment plant to contain and isolate the entire volume of a spilled hazardous substance
h. Person-overboard plan for work over or immediately adjacent to water, including the wearing of U.S. Coast guard approved life jackets and the immediate availability of a skiff, and a person trained in operating it

12. Activity Hazard Analysis
    a. Project-specific hazards and controls shall be identified by an Activity Hazard Analysis (AHA) for each phase/activity of work that:
        i. Identifies the work activity steps
        ii. Identifies the potential hazards of each step
        iii. Lists the measures for elimination or control of the hazards
13. Critical Lift Plan
    a. Installations utilizing critical lifts require a critical lift plan to ensure the safety of equipment and personnel. Critical lift plans shall be developed, reviewed and signed by all personnel involved in the lift and shall:
        i. Specify the exact size and weight of the load to be lifted and all crane and rigging components which add to the weight
        ii. Specify the manufacturer's maximum load limits for the entire range of the lift as listed in the load charts
        iii. Specify the lift geometry and procedures, including:
            1. Crane position
            2. Center of gravity of the load
            3. Lift height
            4. Load radius
            5. Boom length and angle, for the entire range of the lift
        iv. Designate the operator, lift supervisor and rigger and state their qualifications.
        v. Include a rigging plan, which:
            1. Shows the lift points
            2. Describes rigging procedures and gear requirements
        vi. Describe the ground condition and outrigger or crawler track

requirements (and, if necessary, the design of mats) needed to achieve a level, stable foundation of sufficient bearing capacity for the lift.

vii. Describe the operating base condition and any potential list (for floating cranes).

viii. List of environmental conditions under which lift operations are to be stopped.

ix. Specify the coordination and communication requirements for the lift operation.

x. For tandem or tailing crane lifts, specify the make and model of the cranes, the line, boom, and swing speeds, and the requirements for an equalizer beam.

xi. For lifts of personnel, demonstrate compliance with the requirements of 29 CFR 1926.550 (g).

14. Hazard Communication Plan

a. A written plan for protecting personnel and property during the transport, storage and use of hazardous materials which addresses:

i. Items required by 29 CFR 1926.59 (e)

ii. Emergency procedures for spill response and disposal of hazardous materials

iii. Hazardous Material Exclusions - aside from those used in the contract, the materials listed in Appendix E of the solicitation are prohibited from the Government job-site or activity

iv. Yellow Plastic Exclusion - Yellow packaging materials are used by activities to contain and/or identify material, and therefore are not permitted for use by contractors on the naval activity, to prevent potential incident.

v. Spills - Construction equipment shall have adequate oil absorbent material staged at the crane to contain a hydraulic component/system failure/leak. Contractors are responsible to clean up non-emergency oil and hazardous substance spills from their equipment.

vi. Labeling system to identify contents on all containers on-site

vii. Current inventory of hazardous chemical on site.

viii. Location and use of Safety Data Sheets (SDSs):

1. SDS for each hazardous substance at the Government job site will be maintained in an inventory, provided to the Contracting Officer, and made available to all potentially exposed employees.
2. For emergency response purposes, each entry in the inventory shall include the approximate quantities that will be on site at any given time.
3. A site map will be attached to the inventory showing where inventoried hazardous substances are stored.
4. The inventory and the site map shall be updated as frequently as necessary to ensure accuracy.

ix. Training (to include potential safety and health effects from exposure to hazardous substances)

        x. Notification process when hazardous substances are brought onto the Government job site and that all employees potentially exposed to the substance will be advised of information in the SDS for the substance.

15. Hazardous Energy Control Plan
    a. An OSHA compliant Energy Control Program provides the procedures and methods for the control of hazardous energy during the installation, maintenance, and inspection of all equipment where the unexpected energization or movement of this machinery could result in a release of energy which might cause injury to personnel and/or property damage.
    b. A hazardous energy control plan should describe:
        i. Specific energy control requirements
        ii. Lock-out/tag-out procedures
    c. The contractor should comply with 29 CFR 1910.147 and 29 CFR 1910.333 when on activity property. The contractor may use OSHA standard STD 1-7.3 as a guide to follow in the control of hazardous energy when on the job-site.
    d. The contractor should use the colors designated by the activity for the "locks" used in lock-out/tag-out for the respective energy sources when on activity property.
    e. Lock-out/tag-out tags are "danger tags" and should comply with the colors required by 29 CRF 1926.200(b)
16. Fall Protection and Prevention Plan
    a. Description of the fall hazards at the job site
    b. Type of fall protection/prevention methods or systems to be used
    c. Training requirements for employees exposed to fall hazards
    d. Type of fall protection equipment and systems provided to the employees that might be exposed to fall hazards
    e. Identify the tie-off points (anchorages) to be used for attachment of personal fall arrest equipment that are capable of supporting at least 5,000 pounds per employee attached, or have been designed, installed, and used as follows:
        i. As part of a complete personal fall arrest system which maintains a safety factor of at least two
        ii. Under the supervision of a Qualified Person (as defined in Appendix E of the solicitation)
    f. If there is a need to devise an anchor point from existing structures such as beams, or eye-bolt, a qualified person should be used to evaluate the anchorages.
17. Fire Protection & Prevention Plan
    a. Must cover items described in NFPA 241, including fire prevention during hot work
    b. Should state that welding, burning, and open flame work will only be performed on the Government job-site when:
        i. The methods have been approved by the activity (cognizant Safety Office) where the job-site is located
        ii. The activity where the job-site is located has been notified that

hot work is going to be performed, when it is going to be performed, and the number of days needed

iii. A fire watch is provided by the contractor
iv. An adequate fire extinguishing equipment is available
v. Fuel bottles are placed by the contractor at ground level and outside of the hot work area

c. Severe Weather Plan
d. Lists procedures to follow during severe weather; must state:
    i. Cranes shall not be operated when wind speeds at the top of the crane approach maximum wind velocity recommendations of the manufacturer
    ii. Operations undertaken during weather conditions that produce icing of the crane structure or reduced visibility shall be performed at reduced functional speeds and with signaling means appropriate to the situation
    iii. When conditions are such that lightning could occur, all crane operations shall cease

18. Emergency Lighting Plan
    a. Emergency lighting facilities for means of egress are described in NFPA 101-2000 Life Safety Code
    b. Emergency illumination is typically required for not less than 1-1/2 hours in the event of failure of normal lighting
    c. Emergency lighting facilities must provide initial illumination that is not less than an average of 1 ft.-candle (10 lux) and, at any point, not less than 0.1 ft.-candle (1 lux), measured along the path of egress at floor level.
    d. If the on-site work is being performed in a building that has emergency lighting facilities that provides adequate illumination of the egress routes from the contractor work areas during a power failure, then the building's emergency lighting plan may be used for this submission.
19. Work Site Lighting Plan
    a. Absolute minimum illuminances at any time and location where safety is related to visibility are described in IESNA Lighting RR- 96
    b. Plan should assure that adequate illumination is provided in work areas within a crane, within a building, and during nighttime operations
20. Drug & Alcohol Prevention Plan
    a. A drug and alcohol prevention plan shall prohibit, for employees on the job-site:
        i. Illegal drug use
        ii. Consumption of alcohol
        iii. Use of prescription drugs that have adverse side effects that may affect workplace safety
21. Site Sanitation Plan
    a. Plan shall describe the provisions for:
        i. Supplying adequate drinking water
        ii. Supplying toilet facilities
        iii. Supplying washing facilities and waste disposal

- iv. Steps taken to ensure all debris is kept clear from work areas, passageways and stairs, in and around work structures

22. Mobile Cranes & Articulating Boom Cranes (if this equipment is being used)
    - a. Plan must comply with ASME B30.5 for mobile cranes; ASME B30.22 for articulating boom cranes, ASME B30.3 for construction tower cranes, or ASME B30.8 for floating cranes
    - b. For mobile cranes with original equipment manufacturer's (OEM) rated capacities of 50,000 pounds or greater, the crane operator needs to be designated as qualified by a source that qualifies crane operators. The contractor shall provide to the Contracting Officer proof of current qualifications as per contract data requirements list (CDRL) "Crane Operator's Qualification" contained in the contract.
    - c. In addition to meeting the requirements of 29 CFR 1926, the plan shall indicate that mobile cranes be equipped with:
        - i. An anti-two-block device or a two-block damage prevention feature for all points of two-blocking
        - ii. A boom angle indicator or radius indicator readable from the operator's station
        - iii. A boom hoist disconnect, shutoff, or hydraulic relief to automatically stop the boom hoist when the boom reaches a predetermined high angle
        - iv. For telescoping booms:
            1. Boom length indicator readable from the operator's station
            2. Integrally mounted holding device provided with the telescopic hydraulic cylinder(s) to prevent uncontrolled retraction of the boom during a hydraulic system failure
            3. An integrally mounted holding device provided with boom support hydraulic cylinder(s) to prevent lowering of the boom in the event of a hydraulic system failure
        - v. For night operations, lighting shall be adequate to illuminate the working areas while not interfering with the operator's vision.
        - vi. Each load shall be rigged/attached independently to the hook/master-link in such a fashion that the load cannot slide or otherwise become detached. The practice of "Christmas tree lifting" steel is prohibited. Long slender objects shall be rigged to be lifted horizontally using two independent choker or eyebolt type pick-up points in such a fashion that the load cannot slide or otherwise become detached, taking into account the sling angle to the load in determining sling loadings.
        - vii. Piers and waterfront areas such as along dry docks and quay walls may have load restrictions
            1. Notify the Contracting Officer prior to moving a crane onto a pier, dry dock, or other waterfront area. Provide the Contracting Officer with the crane make, model, and configuration in which it is to be used.
            2. The contractor shall comply with cribbing requirements issued with the contract.

3. Fueling and equipment maintenance is prohibited on piers and other over water sites.

23. Jacking Operations Plan (if applicable)
    a. Jacking operations shall be designed and planned by a registered professional engineer who has experience in jacking systems.
    b. Plan shall include detailed instructions and sketches indicating the prescribed method of erection or disassembly.
    c. Plan shall include provisions for ensuring lateral stability of the ground or pier area during the lifting of the crane onto the crane rails.
    d. A jacking operations plan should discuss the following:
        i. Jacks/lifting units shall be marked to indicate their rated capacity as established by the manufacturer. The rated load shall be legibly and permanently marked in a prominent location on the jack by casting, stamping, or other suitable means.
        ii. Jacks/lifting units shall not be loaded beyond their rated capacity as established by the manufacturer.
        iii. The operator shall make sure that the jack used has a rating sufficient to lift and sustain the load. Jacking equipment shall be capable of supporting at least two and one-half times the load being lifted during jacking operations and the equipment shall not be overloaded. For the purpose of this provision, jacking equipment includes any load bearing component, which is used to carry out the lifting operation(s).
        iv. Equipment shall be designed and installed so that the lifting rods cannot slip out of position or the contractor shall institute other measures, such as the use of locking or blocking devices, which will provide positive connection between the lifting rods and attachments and will prevent components from disengaging during lifting operations. In the absence of a firm foundation, the base of the jack shall be blocked. If there is a possibility of slippage of the cap, a block shall be placed in between the cap and the load.
        v. Jacks/lifting units shall have a safety device installed which will cause the jacks/lifting units to support the load in any position in the event any jack lifting unit malfunctions or loses its lifting ability.
        vi. Jacking operations shall be synchronized in such a manner to ensure even and uniform lifting of the load. During lifting, all points at which the load is supported shall be kept within tolerance of that needed to maintain the load in a level position. The operator shall watch the stop indicator, which shall be kept clean, in order to determine the limit of travel. The indicated limit shall not be overrun.
        vii. If a leveling is automatically controlled, a device shall be installed that will stop the operation when the specified tolerance set forth in paragraph (vi.) above is exceeded or where there is a malfunction in the jacking (lifting) system.
        viii. If leveling is maintained by manual controls, such controls shall

be located in a central location and attended by a competent person while lifting is in progress. The competent person must be experienced in the lifting operation and with the lifting equipment being used. A "competent person" is defined as one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

ix. After the load has been raised, it shall be cribbed, blocked, or otherwise secured at once.
x. The maximum number of annually controlled jacks/lifting units on the load shall be limited to a number that will permit the operator to maintain the load level within specified tolerances of paragraph (vi.) above, but in no case shall that number exceed fourteen.
xi. Under no circumstances, shall any employee who is not essential to the jacking operation be permitted immediately beneath the load while it is being lifted.
xii. Jacks/lifting units shall be positively secured so that they do not become dislodged or dislocated.
xiii. Each jack shall be thoroughly inspected at times which depend upon the service conditions. Inspections shall be not less frequent than the following:
    1. For constant intermittent use: once every 6 months
    2. For jacks sent out of shop for special work: when sent out and returned
    3. For a jack subjected to abnormal load or shock: immediately before and immediately thereafter
xiv. Repair or replacement parts shall be examined for possible defects.
xv. Jacks, which are out-of-order, shall be tagged accordingly, and shall not be used until repairs are made.
xvi. All jacks shall be properly lubricated at regular intervals.
xvii. Hydraulic jacks exposed to freezing temperatures shall be supplied with adequate antifreeze liquid.

24. Asbestos Hazard Abatement Procedure (if applicable)
    a. Plan must be in accordance with 29 CFR 1926.1101
    b. Plan shall include, but is not limited to:
        i. Safety precautions
        ii. Confined space entry procedures
        iii. Encapsulation and removal procedures
        iv. The precise personal protective equipment to be used
        v. Location of the asbestos control areas
        vi. Sequencing of asbestos related work
        vii. Disposal plan
        viii. Type of wetting agent and asbestos sealer to be used
        ix. Locations of local exhaust equipment

x. Planned air monitoring strategies
xi. Detailed description of environmental pollution control method
xii. Special safety precautions that must be taken if any part of the building is occupied (if applicable)
xiii. Signed certificates that employees performing removal:
    1. Have received training in the proper handling of asbestos-containing materials and wastes
    2. Understand the health implications and risks involved
    3. Understand the use and limits of respiratory equipment to be used
xiv. Information on each testing laboratory selected for sampling, analysis, and reporting of airborne concentrations of asbestos fibers, including:
    1. Name, address, telephone number
    2. Certification of American Industrial Hygiene Association (AIHA) accreditation
    3. Certification that persons counting the samples have been judged proficient by current inclusion on the AIHA Asbestos Analysis Registry
    4. Certification that the laboratory successfully participates in the Proficiency Analytical Testing Program
xv. Written evidence that the landfill for disposal is approved for asbestos disposal by EPA State and local regulations
xvi. Statement that the contractor will comply with all applicable laws, ordinances, criteria, rules, and regulations of Federal, State, regional, and local authorities regarding handling, storing, transporting, and disposing or asbestos waste materials

25. Material Containing Lead Removal Plan (if applicable)
    a. Plan should show that disposal of material containing lead is in accordance with Federal and local hazardous waste management regulations; plan shall include (but is not limited to):
        i. Sketch showing the location, size, and details of lead control areas, critical barriers, physical boundaries, location and details of decontamination facilities, viewing ports, and mechanical ventilation system
        ii. Description of equipment and materials, the appropriate engineering controls implemented, and job responsibilities for each activity such as cutting, sawing, sanding, scraping, abrasive blasting, and/or high temperature cutting of materials containing lead paint from which lead is emitted
        iii. Eating, drinking, smoking and sanitary procedures, interface of trades, sequencing of lead related work, collected waste water and dust containing lead and debris, air sampling, respirators, personal protective equipment, and a detailed description of the method of containment of the operation to ensure that airborne lead concentrations of 30 micrograms per cubic meter of air are not reached or exceeded outside of the lead control area
        iv. Operational and environmental sampling, training and strategy,

sampling and analysis strategy and methodology, frequency of sampling, duration of sampling, and qualifications of sampling personnel in the air sampling portion of the plan

v. Certificate for each employee, signed and dated by the accredited training provider, stating that each employee has received the required training in accordance with 40 CFR 745

vi. The name, address, and telephone number of the testing laboratory selected to perform the air and wipe sampling, testing, and reporting of airborne concentrations of lead (use a laboratory participating in the EPA National Lead Laboratory Accreditation Program)

vii. Description of the disposal of all material, whether hazardous or non-hazardous in accordance with all laws and provisions and all Federal, State or local regulations

Additional plans that may be contained in the APP include:

1. Layout Plans
2. Access and Haul Road Plan
3. Respiratory Protection Plan
4. Health Hazard Control Program
5. Process Safety Management Plan
6. Radiation Safety Program
7. Abrasive Blasting
8. Night Operations Lighting Plan
9. Wild Land Fire Management Plan
10. Float Plan
11. Demolition Plan
12. Excavation/Trenching Plan
13. Emergency Rescue (tunneling)
14. Underground Construction Fire Prevention and Protection Plan
15. Compressed Air Plan
16. Formwork and Shoring Erection and Removal Plans
17. Pre-Cast Concrete Plan
18. Lift Slab Plans
19. Steel Erection Plan
20. Site Safety and Health Plan for HTRW work
21. Blasting Safety Plan
22. Diving plan
23. Confined Space Program.

Please refer to Appendix E of the solicitation for clarification of any requirements or definitions.

Refer to Appendix CC for examples of certain items required to be in the Accident Prevention Plan.

iv. **Training Course Outline**

The contractor shall prepare a training course outline. The outline shall contain enough detail for the Government to determine that all topics are adequately covered as prescribed in the specification.

Refer to Appendix DD for an example of the Training Course Outline.

H. **Manufacturer's Field Reports**
Manufacturer's Field Reports are typically required to be provided and accepted prior to crane installation. Specific requirements for the timing of submission will be provided in the delivery order documentation.

i. **Brake Adjustment Record**
The Contractor shall provide a brake adjustment record and installation/maintenance manuals for each brake on the crane. The brake adjustment record shall be submitted on the applicable brake record form located on the NAVCRANECEN website. Each brake measurement shall have a tolerance traceable to the associated brake manual or documentation provided by the brake manufacturer, location of measurements, and the actual brake setting.

Refer to Appendix EE for an example of the Brake Adjustment Report.

ii. **Shop Test Deficient Items List**
Upon completion of the Government witnessed shop test and inspection of the crane, a list of deficient items will be compiled. The Contractor is typically required to complete the Type of Rework and Resolution blocks as shown in the Updated Deficient Items List in Appendix FF.

Refer to Appendix FF for an example of the Shop Test Deficient Items List and an Updated Deficient Items List.

iii. **Field Test Record**
The Contractor shall follow the test procedure found in Appendix C of the solicitation that will demonstrate operation, capacity, and safety of the cranes. Any deviations to the field test required by the Contractor must be approved by the Contracting Officer. Upon successful completion of all testing, the Contractor shall submit records of all test data for each crane.

iv. **Operation and Maintenance Data**
The operation and maintenance manuals shall include a table of contents for operation instruction, preventive maintenance, parts information, drawing list, supply list, catalog cuts, photographs, and calculations. The body of the technical manuals shall include the following: contractor's detailed written procedures, operation instructions, preventive maintenance information, drawings, parts information, supplies needed, catalog cuts, photographs, and calculations. Maintenance information shall include recommended maintenance procedures and manufacturer's installation and maintenance manuals (for purchased components) and lubrication instructions. Operation information shall include detailed crane operating and safety instructions.

Parts information shall include all information on all contractor-designed parts, all purchased sub-assemblies and components including the manufacturer's part number. The information shall be broken-out to the smallest replacement part. Within these sections the following information shall also be included:

1. Maintenance and programming instructions for the drives

2. Maintenance instructions including maintenance, alignment, adjustment, and calibration instructions for commercial components and parts lists

3. Operating instructions and special precautions for starting/stopping, operation, and safety

4. Preventive maintenance instructions including location of lubrication points, type of lubricant to be used, and the frequency of lubrication, which shall agree with the lubrication drawing provided

5. Recommended spare parts list

6. A complete listing of all control system parameters with an explanation of their functions

7. Control system and network drawings and product data shall be included in the operation and maintenance manual

Refer to Appendix GG for an example of Operation and Maintenance Data.

I. **Closeout Submittals**

Closeout submittals are requested following crane acceptance, generally as part of the final technical manuals. They are typically required to be provided and accepted prior to final payment. Specific requirements for the timing of submission will be provided in the delivery order documentation.

i. **Control System Parameter Record**

After the crane has passed the final field test, the contractor shall complete a control system parameter record for the crane and provide the crane parameter file downloaded from the crane at time of acceptance, if applicable. The record shall include the contract number, contractor's name and address, date, and all control system parameters and their final settings. The contractor shall designate each control system parameter as either used or unused.

Refer to Appendix HH for an example of the Control System Parameter Record.

ii. **List of Parameters and Crane OEM's Approved Crane Range**

After the crane has passed the final field test, the contractor shall submit a parameter list for each electronic drive to document the crane designed parameter ranges in which each parameter can be safely tuned by the end user for each parameter specified in the parameter list used on the crane. The crane contractor-determined design range shall be the applicable portion of the drive's default range for each parameter. The crane contractor must provide justification for each range of each parameter on the list. When necessary, the justification shall include appropriate calculations.

Refer to Appendix II for an example of the List of Parameters and Crane OEM's Approved Crane Range.

iii. **Frequency Allocation Application**
The technical section of the frequency allocation application (DD Form 1494), addressing the Contractor's equipment, shall be completed by the manufacturer of the radio control equipment being furnished. DD Form 1494, the "Application for Equipment Frequency Allocation", is located on the NAVCRANECEN website.

Refer to Appendix JJ for an example of the Frequency Allocation Application.

iv. **Disabled Ports, Connectors, and Interfaces**
Provide disclosure of any known methods for bypassing computer authentication in the product, often referred to as backdoors, and provide written documentation that all such backdoors created have been permanently deleted from the system.
Provide summary documentation of the procured product's security features and security-focused instructions on product maintenance, support, and reconfiguration of default settings.

Provide documentation showing all disabled ports, connectors, and interfaces for all network-capable devices.

Refer to Appendix KK for an example of the Disabled Ports, Connectors, and Interfaces.

v. **Network-Capable Devices**
For every PLC, RTU, Supervisory Controller, or other network-capable (whether networked or not upon delivery) control device, deliver the following on CD/DVD:

1. Original firmware
2. Original firmware hash
3. SOP for application of firmware updates/patches
4. POC or website for firmware updates/patches
5. Count of interfaces and types
6. Protocols in use, per interface
7. Configuration file
8. SOP for configuration after the crane has passed the final field test, the contractor shall submit a parameter list for each electronic drive to document the crane designed parameter ranges in which each parameter can be safely tuned by the end user for each parameter specified in the parameter list used on the crane. The crane contractor-determined design range shall be the applicable portion of the drive's default range for each parameter. The crane contractor must provide justification for each range of each parameter on the list. When necessary, the justification shall include appropriate calculations.

Refer to Appendix KK for an example of the Network Capable Devices.

vi. **Engineering Workstation**
Deliver on CD/DVD the following:
1. SOP for application of software updates/patches
2. POC or website for software updates/patches including vendor provided software
3. Protocols in use, per interface
4. SOP for configuration
5. PLC programming interface software and licensing
6. Any other compatible software and licenses to allow crane software/firmware to be troubleshot, checked and upgraded, and for the data recorder to be accessed and information retrieved

Refer to Appendix KK for an example of the Engineering Workstation.

vii. **Control System Access and Control**
The Contractor shall document options for defining access and security permissions, user accounts, and applications with associated roles.

Refer to Appendix KK for an example of the Control System Access and Control.

viii. **Control System Account Management**
The Contractor shall document all accounts (including, but not limited to, generic and/or default) that need to be active for proper operation of the procured product.

Refer to Appendix KK for an example of the Control System Account Management.

ix. **Patch Management and Updates**
The Contractor shall provide documentation of its patch management program and update process (including third-party hardware, software, and firmware). This documentation shall include resources and technical capabilities to sustain this program and process.
This includes the Contractor's method or recommendation for how the integrity of the patch is validated by the Acquirer. This documentation shall also include the Supplier's approach and capability to remediate newly reported zero-day vulnerabilities.

Refer to Appendix KK for an example of the Patch Management and Updates.

x. **Malware Detection and Protection**
The Contractor shall provide, or specify how to implement, the capability to automatically scan any removable media that is introduced to the product being acquired.

Refer to Appendix KK for an example of Malware Detection and Protection.

xi. **Wireless Technology Provisions**
The Contractor shall document:

1. Specific protocols and other detailed information required for wireless devices to communicate with the control network, including other wireless equipment that can communicate with the Contractor-supplied devices
2. Use, capabilities, and limits for the wireless devices
3. Power and frequency requirements of the wireless devices (e.g., microwave devices meet the frequency requirements of Generic Requirements [GR]-63 Network Equipment Building System [NEBS] and GR-1089)
4. Range of the wireless devices and verify that the range of communications is minimized to both meet the needs of the Acquirer's proposed deployment and reduce the possibility of signal interception from outside the designated security perimeter
5. Wireless technology and associated devices compliance with standard operational and security requirements specified in applicable wireless standard(s) or specification(s) (e.g., applicable IEEE standards, such as 802.11)
6. Configuration control options that enable varying of the security level of the devices. The technical section of the frequency allocation application attached as Appendix JJ, addressing their equipment, shall be completed by the manufacturer of the radio control equipment being furnished under this contract.

Refer to Appendix KK for an example of Wireless Technology Provisions.

xii. **Control System Inventory**
The Contractor shall provide an inventory of all network-capable and microprocessor control devices in accordance with Appendix LL.

Refer to Appendix LL for an example of the Control System Inventory.

xiii. **Evaluation Status of Hardware and Software**
The Contractor shall provide information on Common Criteria or National Information Assurance Partnership (NIAP) or Federal Information Processing Standards (FIPS) evaluation status of hardware and software.

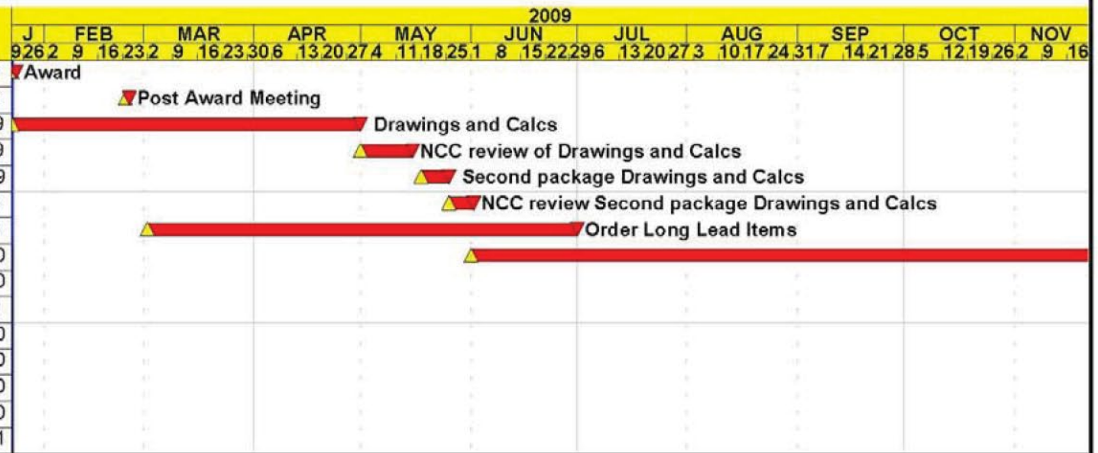
Refer to Appendix MM for an example of Evaluation Status of Hardware and Software.

# III. Appendix – Examples

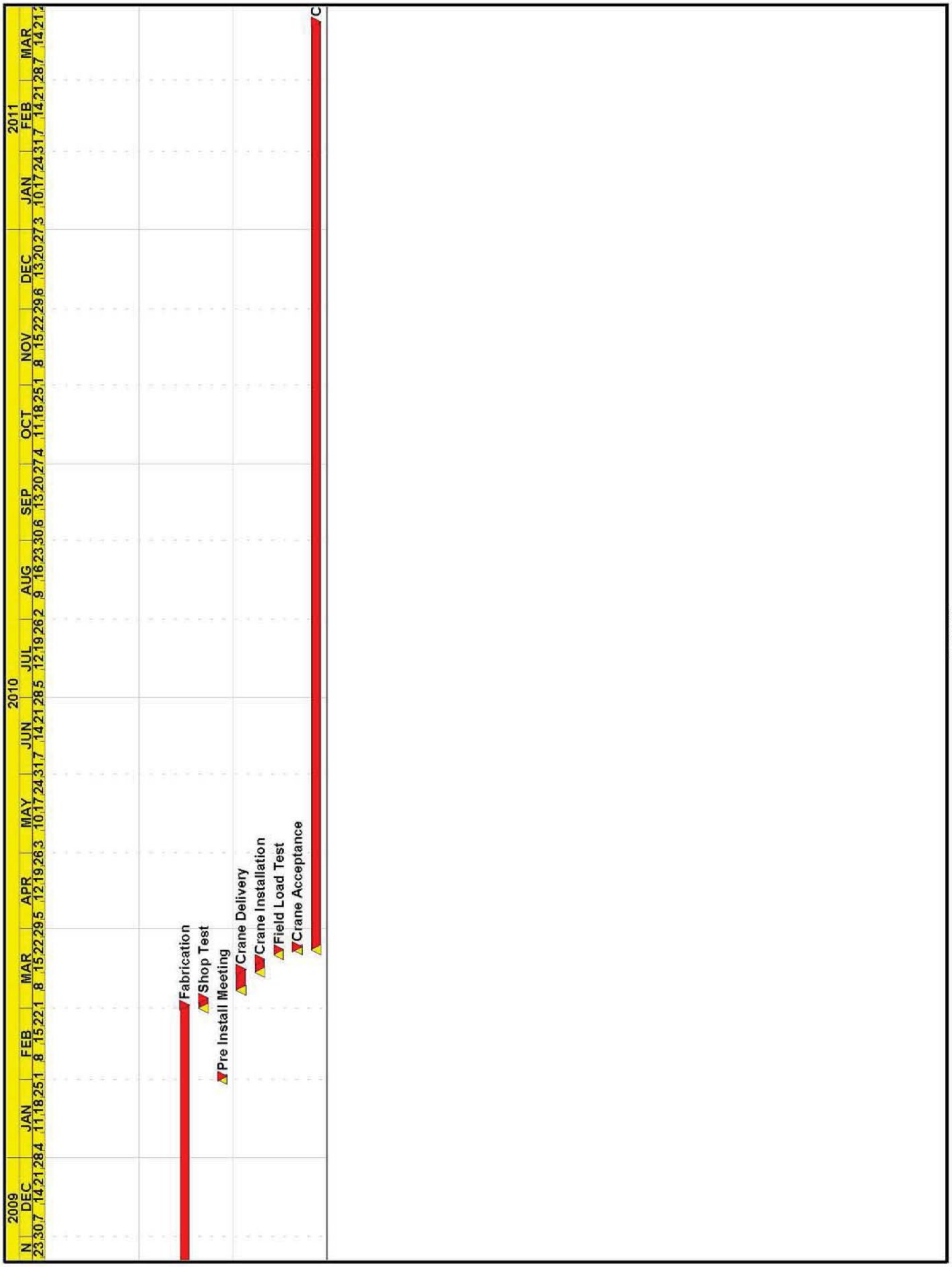
## A. Appendix A – Schedule with Milestones

Refer to the following pages for a sample Schedule with Milestones.

| Activity ID | Activity Description | Orig Dur | Rem Dur | % | Early Start | Early Finish |
|---|---|---|---|---|---|---|
| 001 | Award | 1 | 1 | 0 | 23JAN09 | 23JAN09 |
| 002 | Post Award Meeting | 1 | 1 | 0 | 24FEB09 | 24FEB09 |
| 003 | 100 % Drawings and Calc | 70 | 70 | 0 | 23JAN09 | 30APR09 |
| 004 | NCC review of Drawings | 11 | 11 | 0 | 01MAY09 | 15MAY09 |
| 005 | Final Design | 6 | 6 | 0 | 18MAY09 | 25MAY09 |
| 006 | NCC review | 5 | 5 | 0 | 26MAY09 | 01JUN09 |
| 007 | Order Long Lead Items | 87 | 87 | 0 | 02MAR09 | 30JUN09 |
| 008 | Fabrication | 196 | 196 | 0 | 01JUN09 | 01MAR10 |
| 009 | Shop Test | 4 | 4 | 0 | 01MAR10 | 04MAR10 |
| 010 | Pre Install Meeting | 1 | 1 | 0 | 01FEB10 | 01FEB10 |
| 011 | Crane Delivery | 6 | 6 | 0 | 08MAR10 | 15MAR10 |
| 012 | Crane Installation | 5 | 5 | 0 | 15MAR10 | 19MAR10 |
| 013 | Field Load Test | 2 | 2 | 0 | 22MAR10 | 23MAR10 |
| 014 | Crane Acceptance | 1 | 1 | 0 | 24MAR10 | 24MAR10 |
| 015 | Completion of Warranty | 261 | 261 | 0 | 24MAR10 | 23MAR11 |
| CDRLs | Critical Submittals | | | | | |
| A002 | Final Stamped Dwgs | 5 | 5 | 0 | 15FEB10 | 21FEB10 |
| A011 | Hook & Nut NDT Cert | 10 | 10 | 0 | 01FEB10 | 14FEB10 |
| A014 | Runway Cert. | 10 | 10 | 0 | 15FEB10 | 01MAR10 |
| A015 | Shop Test Procedure | 10 | 10 | 0 | 01FEB10 | 14FEB10 |
| A016 | Lift, Install & Handling Plan | 30 | 30 | 0 | 15JAN10 | 01MAR10 |
| A017 | Accident Prevention Plan | 10 | 10 | 0 | 15FEB10 | 01MAR10 |




| | | | |
|---|---|---|---|
| Project Start | 23JAN09 | Early Bar | D00 |
| Project Finish | | Float Bar | Crane Contractor |
| Data Date | 23JAN09 | Progress Bar | Crane Project Title, Project location |
| Plot Date | 17FEB09 | Critical Activity | Sheet 1A of 1B |


2009
N
DEC
JAN
FEB
MAR
APR
MAY
JUN
2010
JUL
AUG
SEP
OCT
NOV
DEC
JAN
2011
FEB
MAR
Fabrication
Shop Test
Pre Install Meeting
Crane Delivery
Crane Installation
Field Load Test
Crane Acceptance

B. **Appendix B – Monthly Status Report**

Refer to the following pages for a sample of Monthly Status Report.

July 2, 2010

From: John Smith, President
Crane Parts Manufacturers (CPM)

| | |
|---|---|
| Project: | 25/5 Ton OET Crane @ Anywheresville Shipyard, Bldg 1232 |
| Title: | July 2010 Monthly Project Status (CDRL-A001) |
| Contract Number: | N62470-104-D-XXXX Delivery Order XXXX |
| Security Level: | Unclassified |

To: ***NCC Contract Administrator*** Mr. Norm Yeatts
***NCC Project Manager*** Mr. Thomas Lund
***DCMA*** Mr. Jones

Project / Milestone Status:
Project is currently one week behind original baseline schedule. In the past month, 100% submittal review comments were received and crane design was revised accordingly. Final design has been submitted, reviewed by NCC and approved. Fabrication and procurement of vendor items has begun. Approval of RFI #2 for alternate motor has shortened lead time by 3 weeks, which shortens the project critical path by 2 weeks, this will bring the project back on schedule.

Schedule:
Gantt chart for project milestones and CDRLs is attached to this report.

Design & Review:
Final design has been submitted and approved on 19 June 2010. Four open back-check comments will be corrected on PE stamped drawings which will be submitted next month. RFI #2 for alternate motor was approved on 10 June 2010.

Problems / Deficiencies:
Removal of existing crane may require a roof penetration. CPM engineer to conduct site visit during week of 20 July 2010, and discuss w/ NCC and NNSY. Roof penetration may prolong site work by one week.

Conference / Trip Outcome:
Teleconference to discuss final design review comments was held 14 June 2010, brake issue was resolved and crane design was approved. Contract Mod # 003 was issued which incorporated RFI #2.

Other:
We have requested information on the facility max. ground loading pressure to aid in preparation of the crane removal & installation plans. Information needed by 15 October 2017.

Future Plans:
Fabrication and component procurement will continue. Work on APP and removal/install plan to begin following site visit in July. Pre-installation meeting tentatively scheduled for week of 9 September 2010. Shop test in late September / early October.

Appendices:
None.

John Smith

John Smith, President
Crane Parts
Manufacturers

C. **Appendix C – NCC RFI Form**

Please see the following page for a sample RFI.

| REQUEST FOR INFORMATION (RFI) | | 1. RFI Number RFI- |
|---|---|---|
| 2. CONTRACT NUMBER: | | |
| 3. CONTRACT TITLE: | | |
| 4. PRIME CONTRACTOR | 5. SUBCONTRACTOR / SUPPLIER | |
| | | |

| 6. SUBJECT OF RFI: | | | |
|---|---|---|---|
| a. DRAWINGS: | b. DETAILS: | c. SPECIFICATION | d. CPM ACTIVITY #: |
| | | | |
| 7. INFORMATION REQUESTED: | | | |

| a. Date Response Required By: | b. Date RFI Submitted: | c. Signature: |
|---|---|---|

8. CONTRACTOR RECOMMENDATION:

a. COST EFFECT: Increase: ☐ Decrease: ☐ None: ☐ Estimated Amount:

b. TIME IMPACT: Increase: ☐ Decrease: ☐ None: ☐ Estimated Calendar Days:

| 9. From: | 11. Reply Date: | 12. Signature: |
|---|---|---|
| 10. To: | | |

13. REPLY:

a. ☐ This response is for clarification only and results in no cost or time change to the contract.

b. ☐ This response requires a modification to the contract. A formal request for proposal will follow under separate correspondence. No work is authorized until the modification is signed by the Contracting Officer. The assigned Proposed Change (PC) is .

**The RFI process is intended to provide an efficient mechanism for responding to contractor's requests for information ONLY. This system DOES NOT authorize the contractor to proceed with work. To do so, the contractor proceeds at his own risk. If the contractor considers the RFI response a change, written notice to the Contracting Officer is required within 20 calendar days of the reply date.**

DISTRIBUTION: original file via FEAD ☐ PL ☐ ET ☐ A/E ☐ PC# via the Contracting Officer

Page 1 of 2

Request For Information Form – January 2022

## INSTRUCTIONS FOR COMPLETING REQUEST FOR INFORMATION FORM

### FOR THE CONTRACTOR

**Item 1.** Enter three-digit RFI number.
**Item 2.** Self-explanatory.
**Item 3.** Self-explanatory.
**Item 4.** Self-explanatory.
**Item 5.** Self-explanatory.
**Item 6.** Self-explanatory.

a. Specify any drawing numbers related to the RFI (if applicable)
b. Specify any detail numbers related to the RFI (if a applicable)
c. Specify the specification number related to the RFI (if applicable)
d. Specify Critical Path Method (CPM)/Schedule Activity # (if applicable).

**Item 7.** Provide a narrative detailing the requested information or requested design change.

a. Specify date response is requested.
b. Enter date RFI submitted.
c. Signature of preparer of RFI.

**Item 8.** If possible, provide a recommended solution to the problem and state if the proposed solution may be considered a change to the contract.

a. Indicate in the check box the cost effect. If applicable, provide estimated amount.
b. Indicate in the check box the time impact. If applicable, provide estimated calendar days.

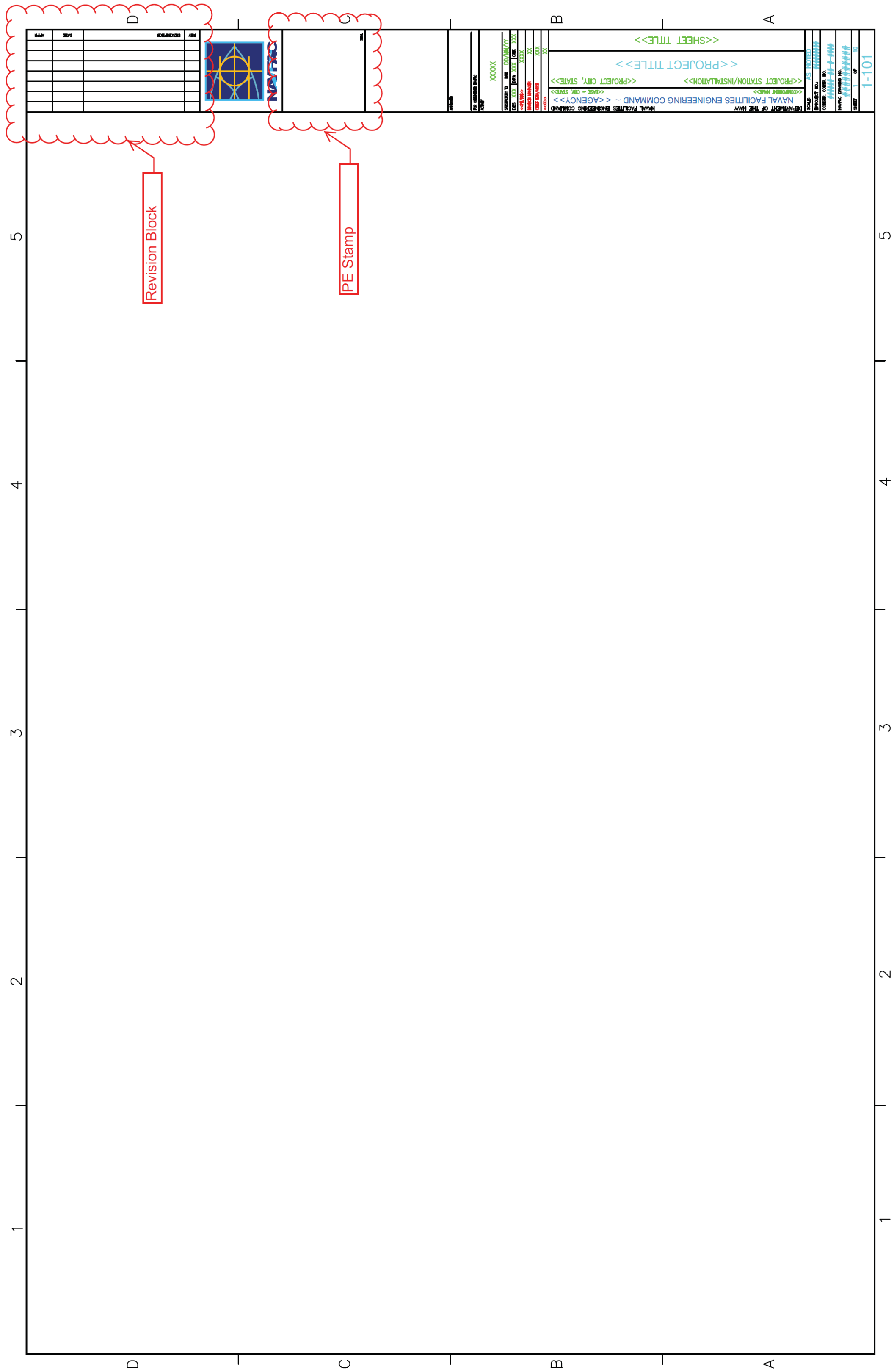
### FOR GOVERNMENT PERSONNEL

**Item 9.** Name of government official responding to RFI.
**Item 10.** Name of contractor point of contact.
**Item 11.** Enter date of RFI response.
**Item 12.** Signature of official responding to RFI.
**Item 13.** Provide a reply considering cost, schedule, safety, quality, client request, other risks, etc. At no time will the RFI response authorize the contractor to start work. Only the Contracting Officer may authorize additional or changed work.

a. Indicate in the check box if the response is for clarification only.
b. Indicate in the check box if the response requires a modification to be issued to the contract. If applicable, include the assigned Proposed Change (PC) number.

D. **Appendix D – General Drawing Border with Title Block**

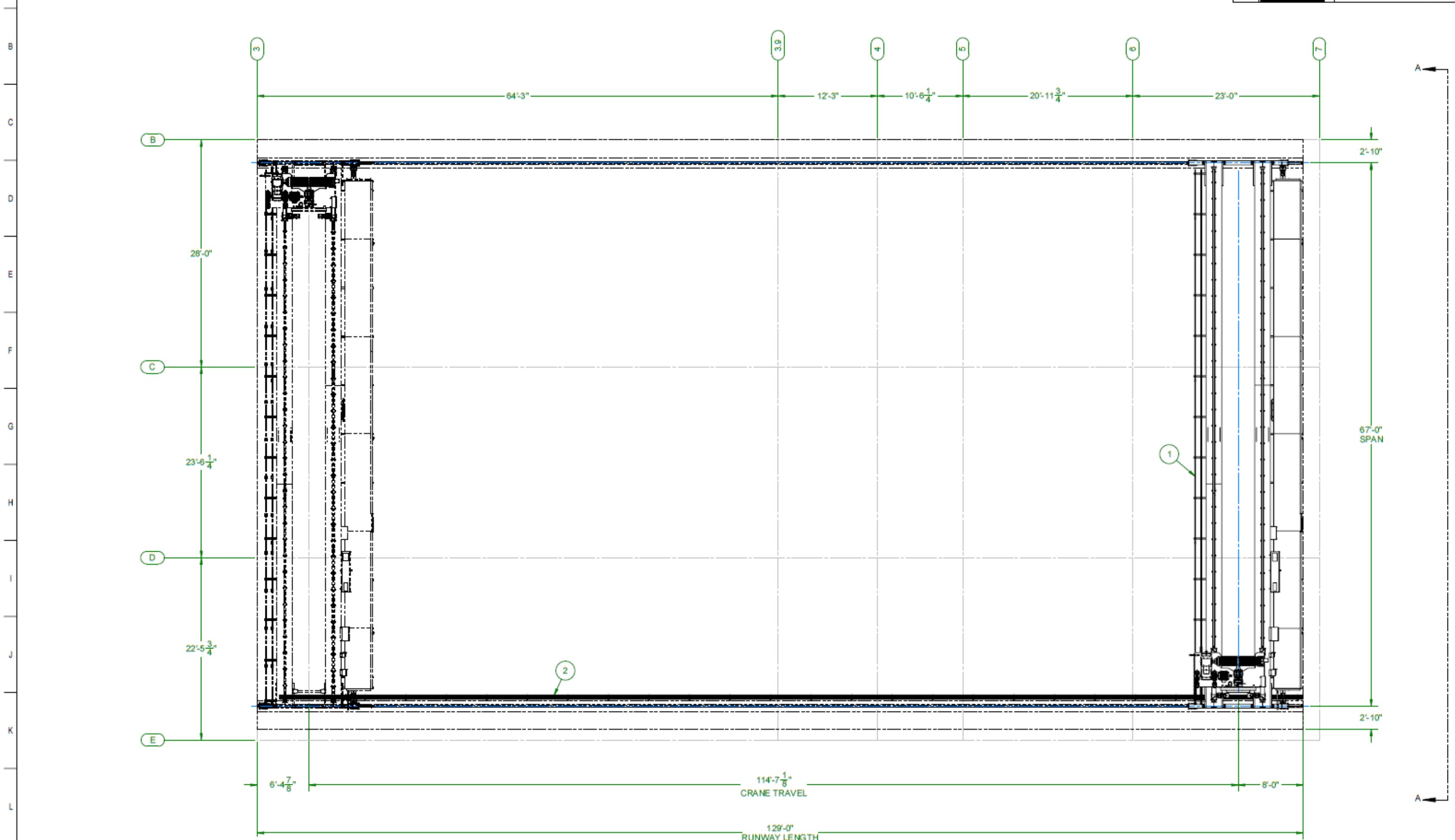
Please see the following page for an example of this item.


Revision Block
PE Stamp

E. **Appendix E – General Arrangement Drawings**

Please see the following pages for examples of general arrangement drawings.

i. General Arrangement




**BILL OF MATERIALS**

| ITEM NO. | PART NUMBER | DESCRIPTION | WEIGHT (LBS) | QTY. |
|---|---|---|---|---|
| 1 | [redacted] | CRANE ASSEMBLY ENV-002 | 40500.99 | 1 |
| 2 | | RUNWAY ELECTRIFICATION | 313.34 | 1 |

**Typical Parameters**

| MOTION | MANUFACTURER | MODEL NUMBER | CAPACITY (TONS) | SPEED (FPM) | SPEED REDUCER | MOTOR FRAME | H.P. | AVAILABLE LIFT | ROPE DIA. | REEVING |
|---|---|---|---|---|---|---|---|---|---|---|
| MAIN HOIST | PHC | 22059-300 | 20 | 15 | PHD9060P4 | 256T | 20 | 27'-0" | 1/2" | 4PD |
| AUX HOIST | - | - | - | - | - | - | - | - | - | - |
| MAIN TROLLEY | PHC | 22059-200 | 20 | 60 | SK2282 | 80S/4 | 2x 0.75 | SERVICE CLASS: CMAA D | | |
| AUX TROLLEY | - | - | - | - | - | - | - | POWER: 460V / 3PH / 60HZ | | |
| BRIDGE | PHC | 22059-100 | 20 | 75 | SK3282 | 90L/4 | 2x 2.0 | MAX WHL LOAD: 31,000 LBS | | |

REVISION TABLE

| REV. | DATE | BRIEF DESCRIPTION |
|---|---|---|
| 0 | 1/23/2023 | INITIAL ISSUE |

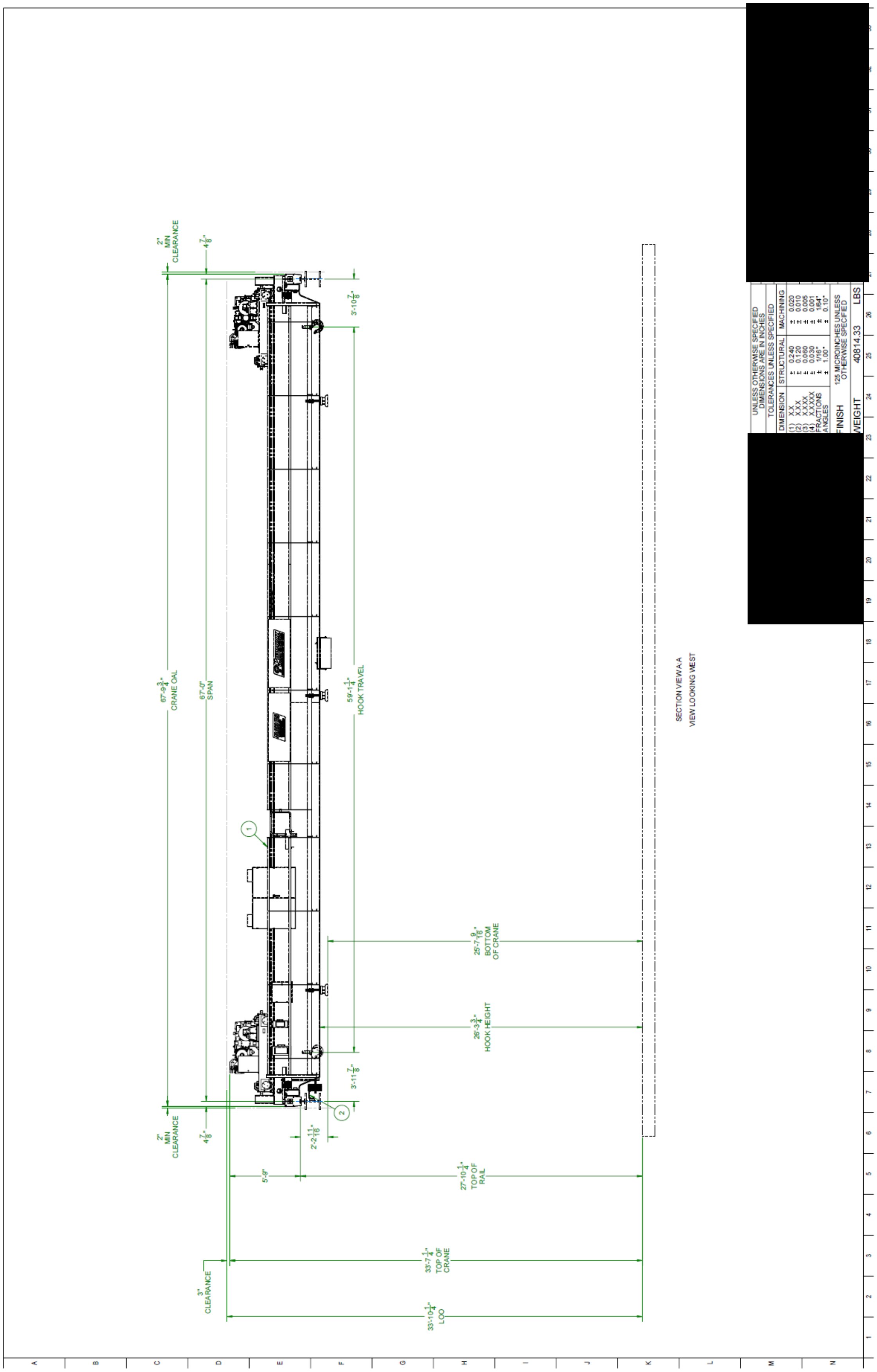
[redacted]

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES UNLESS SPECIFIED

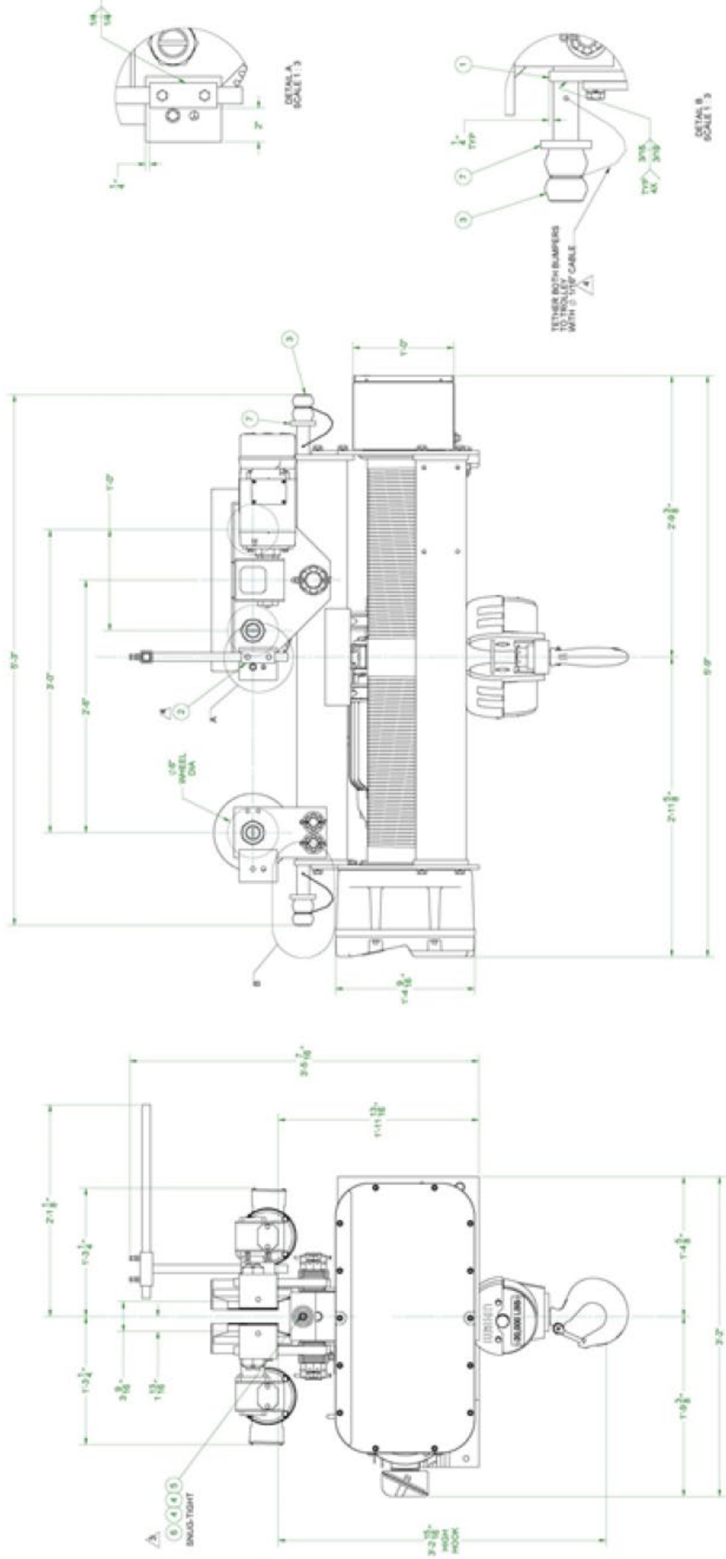
| DIMENSION | STRUCTURAL | MACHINING |
|---|---|---|
| (1) X.X | ± 0.240 | ± 0.020 |
| (2) X.XX | ± 0.120 | ± 0.010 |
| (3) X.XXX | ± 0.060 | ± 0.005 |
| (4) X.XXXX | ± 0.030 | ± 0.001 |
| FRACTIONS | ± 1/16" | ± 1/64" |
| ANGLES | ± 1.00° | ± 0.10° |

FINISH: 125 MICROINCHES UNLESS OTHERWISE SPECIFIED
WEIGHT: 40814.33 LBS

[redacted]

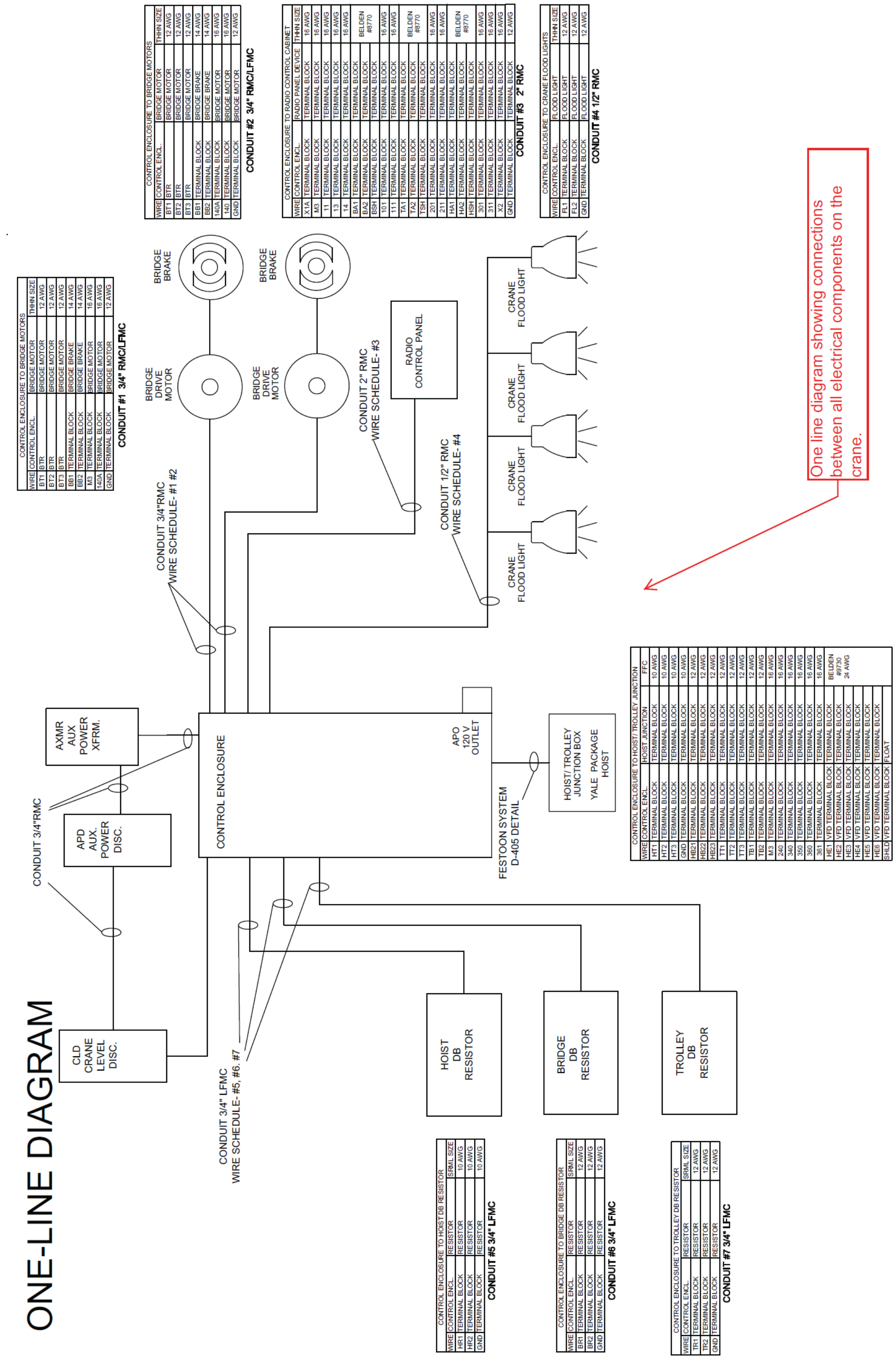

SECTION VIEW A-A
VIEW LOOKING WEST
CRANE OAL
SPAN
HOOK TRAVEL
MIN CLEARANCE
BOTTOM OF CRANE
HOOK HEIGHT
TOP OF RAIL
TOP OF CRANE
CLEARANCE
LOO
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES UNLESS SPECIFIED
DIMENSION
STRUCTURAL
MACHINING
FINISH
WEIGHT
40814.33
LBS

ii. Trolley Arrangement

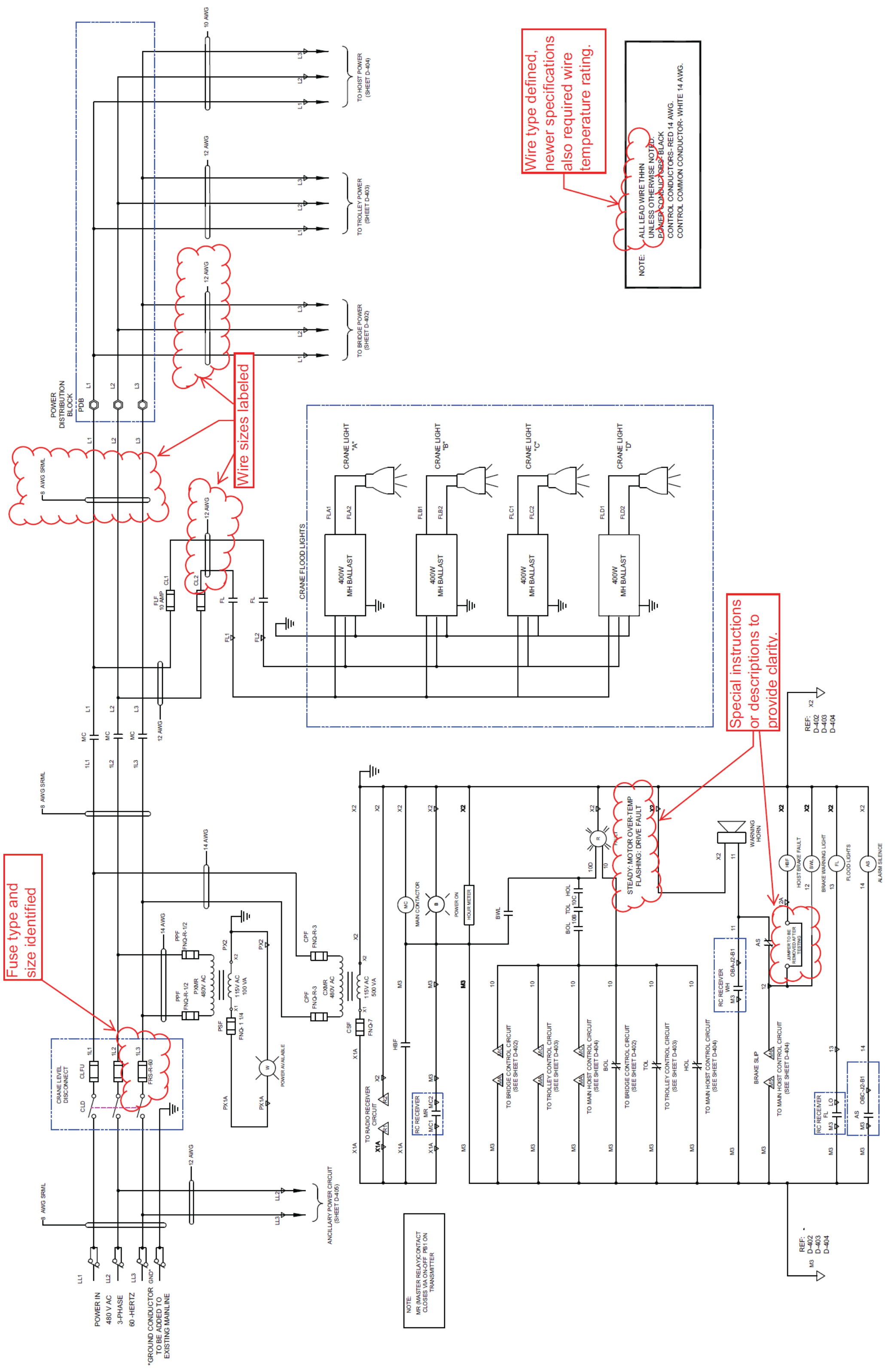


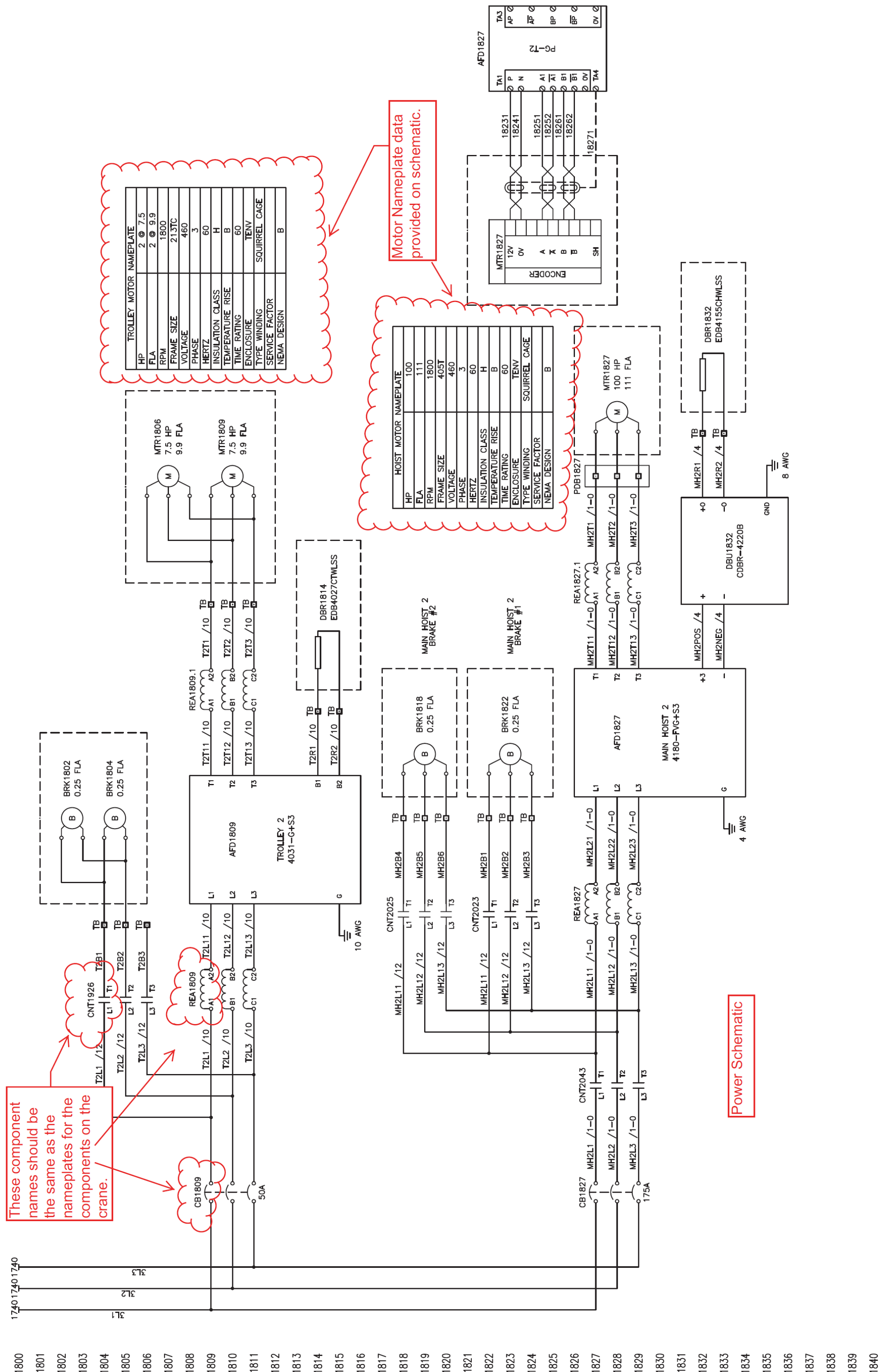
F. **Appendix F – Electrical Drawings**

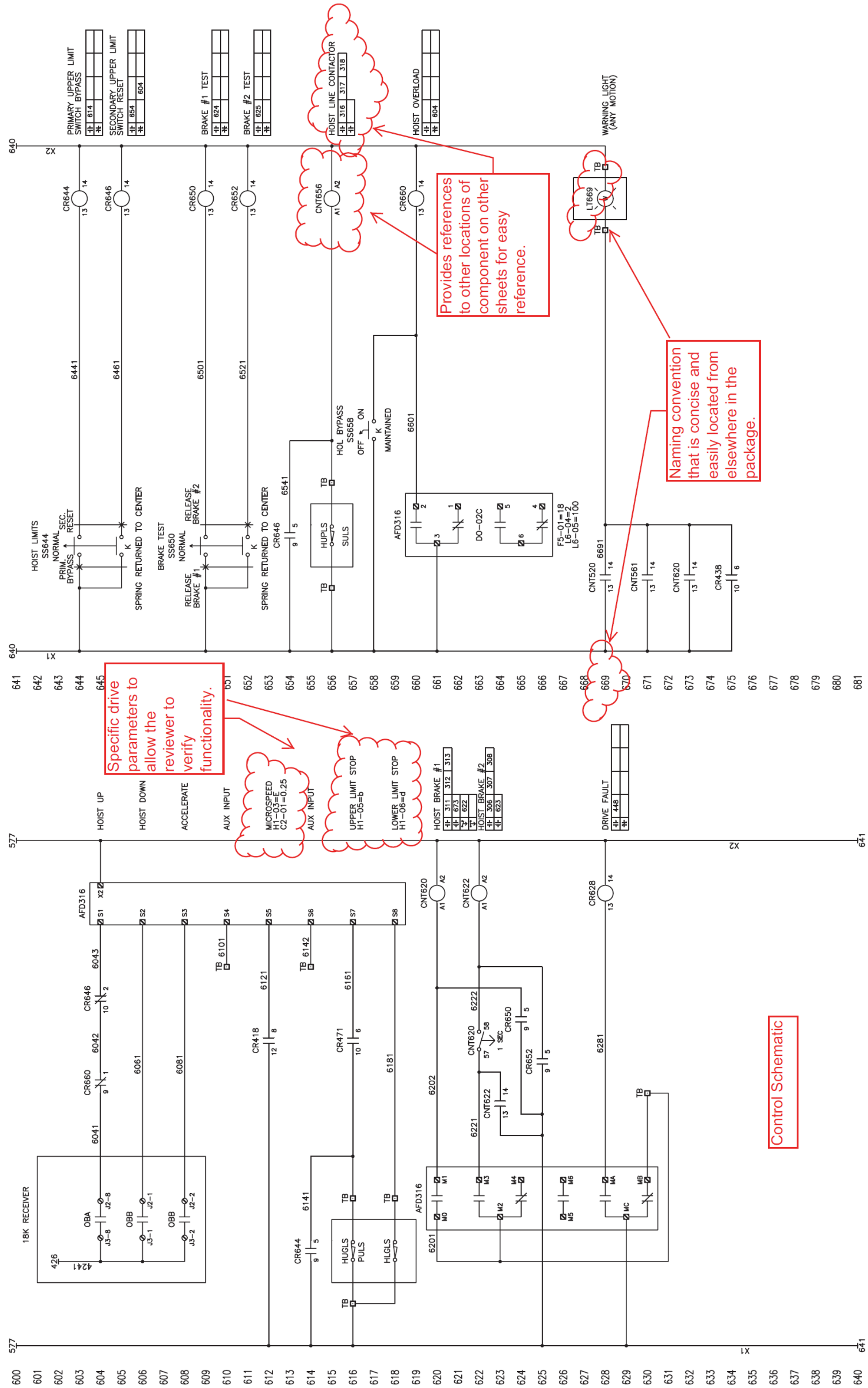
Please see the following pages for examples of electrical drawings.




One line diagram showing connections between all electrical components on the crane.

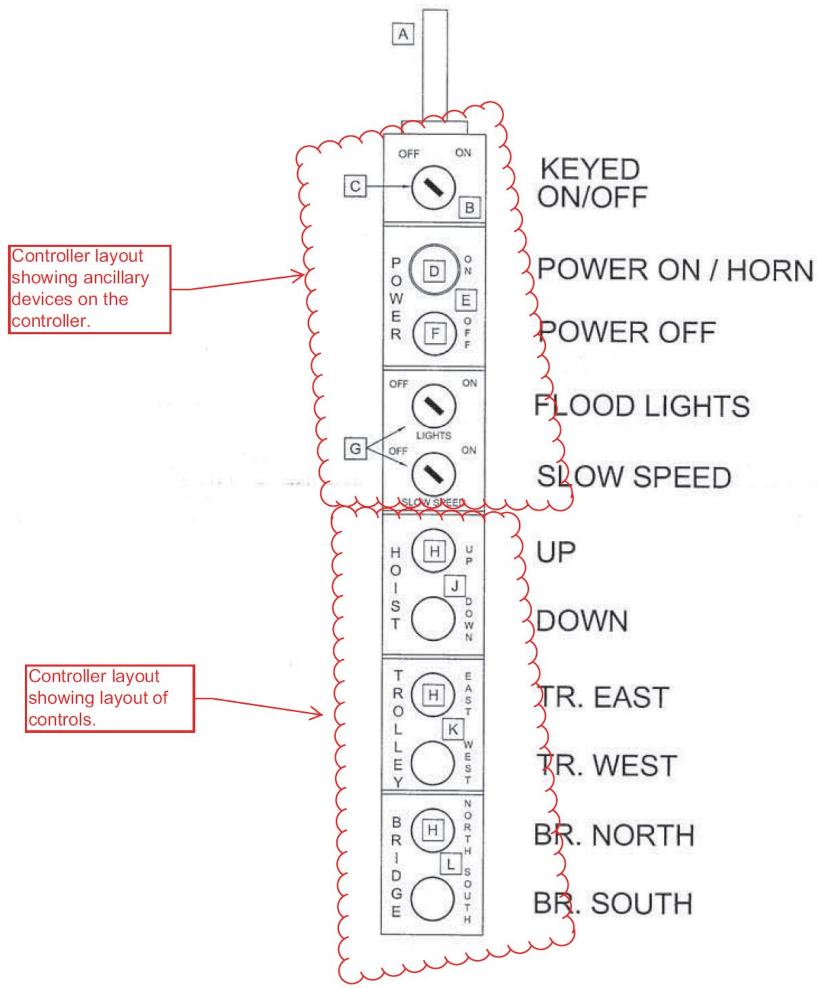

Wire type defined, newer specifications also required wire temperature rating.
NOTE: ALL LEAD WIRE THHN UNLESS OTHERWISE NOTED.
POWER CONDUCTORS-BLACK
CONTROL CONDUCTORS-RED 14 AWG.
CONTROL COMMON CONDUCTOR- WHITE 14 AWG.
Wire sizes labeled
Fuse type and size identified
Special instructions or descriptions to provide clarity.
CRANE FLOOD LIGHTS
POWER IN 480 V AC 3-PHASE 60-HERTZ


Motor Nameplate data provided on schematic.
These component names should be the same as the nameplates for the components on the crane.
Power Schematic
TROLLEY MOTOR NAMEPLATE
HP 2 @ 7.5
FLA 2 @ 9.9
RPM 1800
FRAME SIZE 213TC
VOLTAGE 460
PHASE 3
HERTZ 60
INSULATION CLASS H
TEMPERATURE RISE B
TIME RATING 60
ENCLOSURE TENV
TYPE WINDING SQUIRREL CAGE
SERVICE FACTOR
NEMA DESIGN B
HOIST MOTOR NAMEPLATE
HP 100
FLA 111
RPM 1800
FRAME SIZE 405T
VOLTAGE 460
PHASE 3
HERTZ 60
INSULATION CLASS H
TEMPERATURE RISE B
TIME RATING 60
ENCLOSURE TENV
TYPE WINDING SQUIRREL CAGE
SERVICE FACTOR
NEMA DESIGN B
TROLLEY 2 4031-G+S3
AFD1809
MAIN HOIST 2 4180-FVG+S3
AFD1827
MTR1806 7.5 HP 9.9 FLA
MTR1809 7.5 HP 9.9 FLA
MTR1827 100 HP 111 FLA
DBU1832 CDBR-4220B
DBR1832 EDB4155CHWLSS
DBR1814 EDB4027CTWLSS
MAIN HOIST 2 BRAKE #2
MAIN HOIST 2 BRAKE #1
CB1809 50A
CB1827 175A

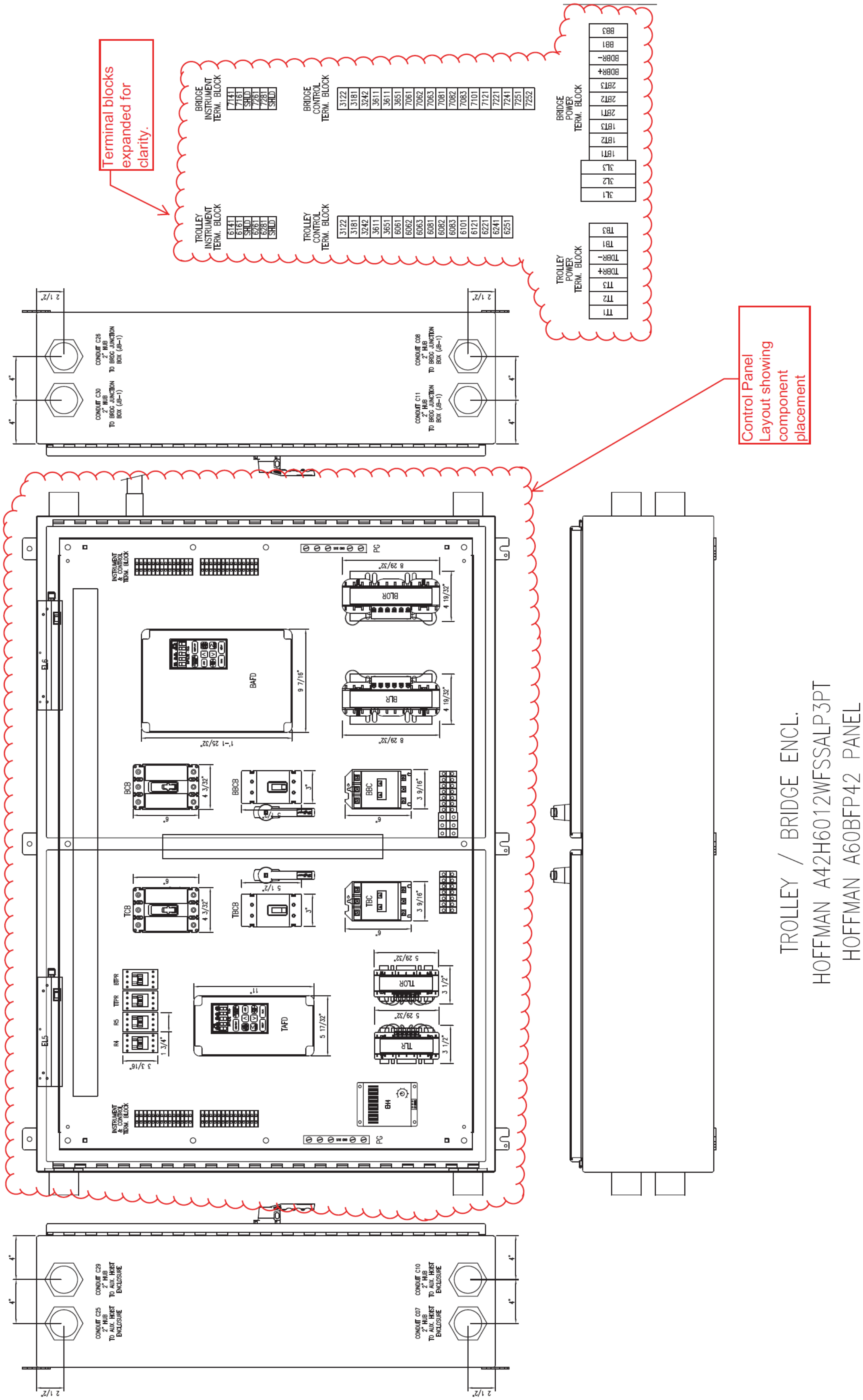


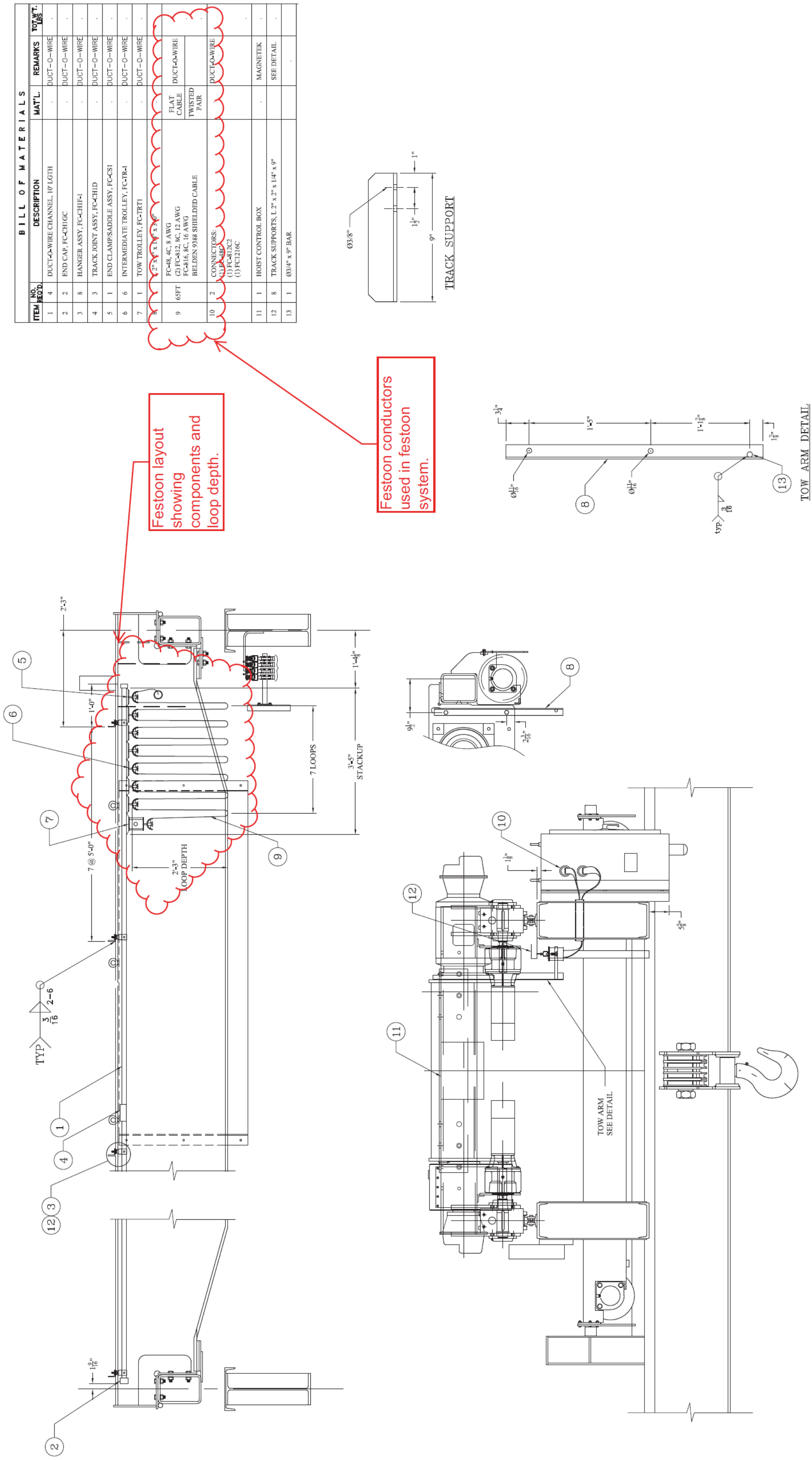

Control Schematic

## PUSHBUTTON LAYOUT



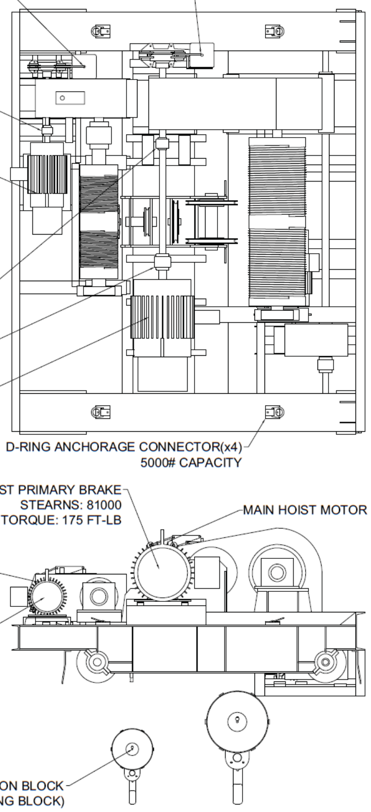

| ITEM | QTY | DESCRIPTION | MANUFACTURER |
|---|---|---|---|
| A | 1 | STAINLESS STEEL MESH KELLEM -074011251 | HUBBELL |
| B | 1 | PENDANT STATION ENCLOSURE- 10 BUTTON SKYP10 | SQUARE D |
| C | 1 | KEYED ON OFF SWITCH- 800T-J41A | ALLEN BRADLEY |
| D | 1 | MOMENTARY PUSHBUTTON BLACK FLUSH HEAD 800T-A2A | ALLEN BRADLEY |
| E | 1 | LEGEND PLATE POWER: ON-OFF SKN211 | SQUARE D |
| F | 1 | MAINTAINED PUSHBUTTON RED MUSHROOM HEAD 800T-FXT6A1 | ALLEN BRADLEY |
| G | 2 | MAINTAINED LEVER SWITCH -2 POSITION 800T-H2D1 | ALLEN BRADLEY |
| H | 3 | THREE SPEED WITH MOMENTARY INTERLOCK SKRU3 | SQUARE D |
| J | 1 | LEGEND PLATE HOIST UP DOWN SKN201 | SQUARE D |
| K | 1 | LEGEND PLATE TROLLEY EAST WEST SKN202 | SQUARE D |
| L | 1 | LEGEND PLATE BRIDGE NORTH SOUTH SKN207 | SQUARE D |


Terminal blocks expanded for clarity.
Control Panel Layout showing component placement
TROLLEY / BRIDGE ENCL.
HOFFMAN A42H6012WFSSALP3PT
HOFFMAN A60BFP42 PANEL
BRIDGE INSTRUMENT TERM. BLOCK
BRIDGE CONTROL TERM. BLOCK
BRIDGE POWER TERM. BLOCK
TROLLEY INSTRUMENT TERM. BLOCK
TROLLEY CONTROL TERM. BLOCK
TROLLEY POWER TERM. BLOCK


BILL OF MATERIALS
ITEM | NO. REQ'D. | DESCRIPTION | MAT'L. | REMARKS | TOT. W'T. LBS
1 | 4 | DUCT-O-WIRE CHANNEL, 10' LGTH | DUCT-O-WIRE
2 | 2 | END CAP, FC-CH1GC | DUCT-O-WIRE
3 | 8 | HANGER ASSY, FC-CH1F-1 | DUCT-O-WIRE
4 | 3 | TRACK JOINT ASSY, FC-CH1D | DUCT-O-WIRE
5 | 1 | END CLAMP/SADDLE ASSY, FC-CS1 | DUCT-O-WIRE
6 | 6 | INTERMEDIATE TROLLEY, FC-TR-1 | DUCT-O-WIRE
7 | 1 | TOW TROLLEY, FC-TRT1 | DUCT-O-WIRE
8
9 | 65FT | FC-48, 4C, 8 AWG (2) FC-812, 8C, 12 AWG FC-816, 8C, 16 AWG | FLAT CABLE | DUCT-O-WIRE
BELDEN 9388 SHIELDED CABLE | TWISTED PAIR
10 | 2 | CONNECTORS: (1) FC-812C2 (1) FC1216C | DUCT-O-WIRE
11 | 1 | HOIST CONTROL BOX | MAGNETEK
12 | 8 | TRACK SUPPORTS, L 2" x 2" x 1/4" x 9" | SEE DETAIL
13 | 1 | Ø3/4" x 9" BAR
Ø3/8"
TRACK SUPPORT
Festoon conductors used in festoon system.
Festoon layout showing components and loop depth.
TOW ARM DETAIL
7 LOOPS
STACKUP
LOOP DEPTH
TOW ARM SEE DETAIL
TYP

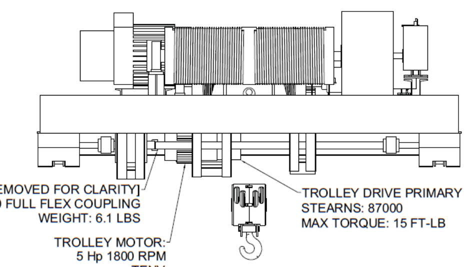
G. **Appendix G – Mechanical Drawings**

Please see the following page for a sample mechanical drawing.



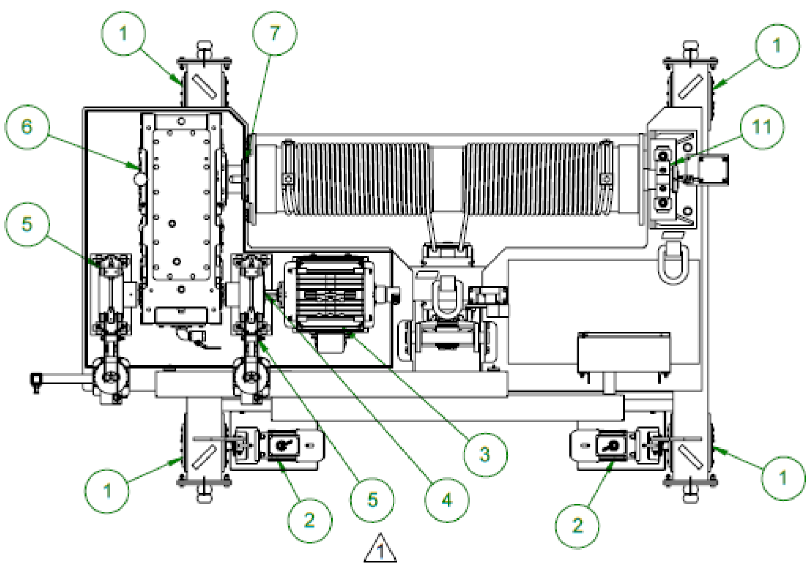

| COMPONENTS | BOLT SIZE | TORQUE VALUE |
|---|---|---|
| TROLLEY MOTOR | 3/8" GR. 8 | 46 FT-LBS |
| MAIN HOIST MOTOR | 5/8" GR. 8 | 225 FT-LBS |
| AUX HOIST MOTOR | 1/2" GR. 8 | 113 FT-LBS |
| MAIN HOIST SECONDARY BRAKE | 5/8" GR. 8 | 225 FT-LBS |
| AUX SECONDARY BRAKE | 3/8" GR. 8 | 46 FT-LBS |

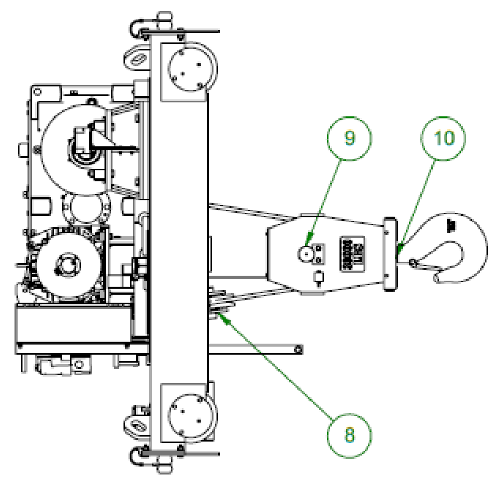
Trolley Component Layout

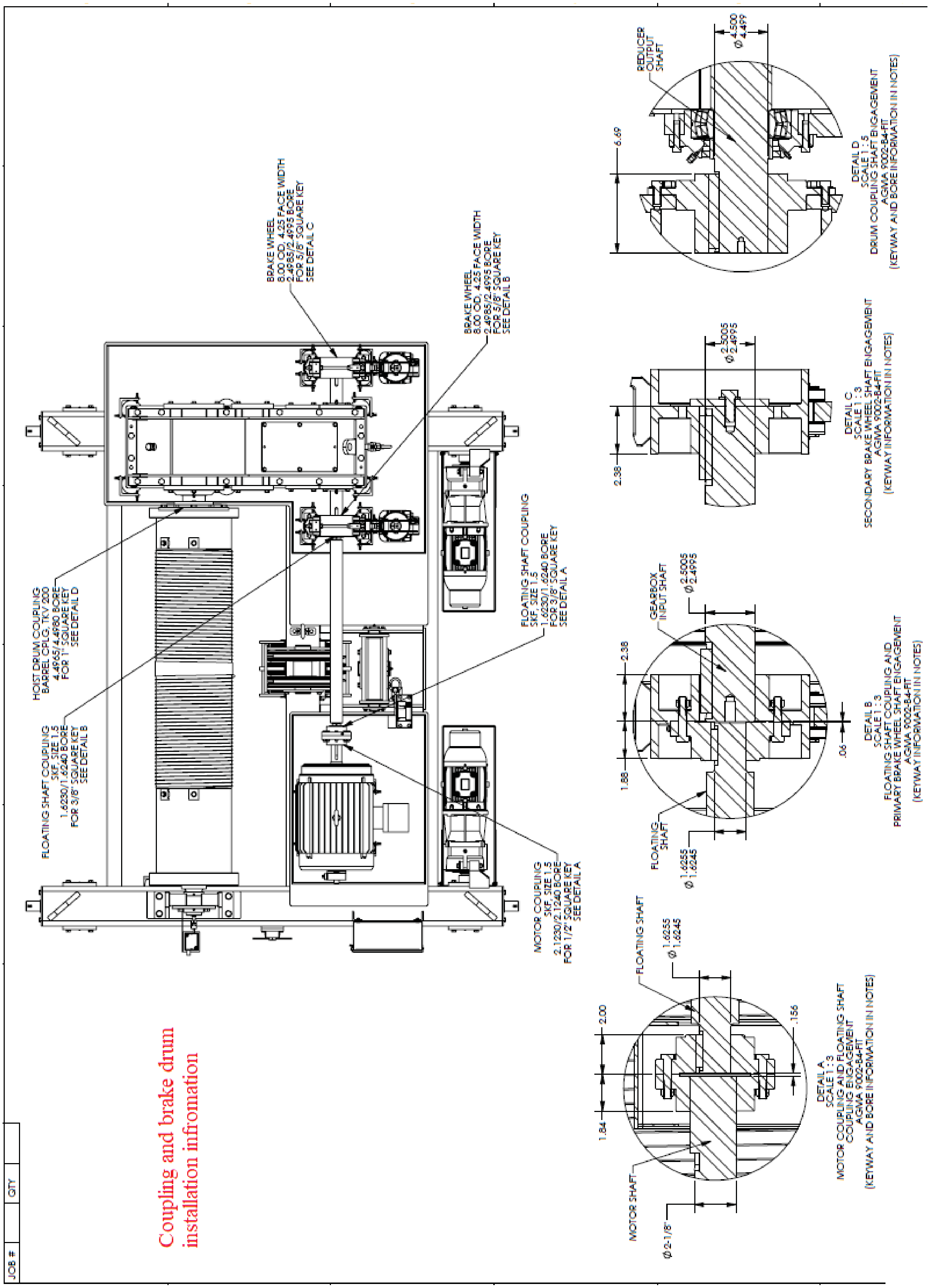


Lubrication information showing lubrication points, type of lubricant, quantity, and frequency

| Item | Part Description | Type of Lube | Lube Quantity | Frequency |
|---|---|---|---|---|
| 1 | Trolley Wheel Bearings | SKF LGEP 2 | NA (Sealed) | NA |
| 2 | Trolley Drive Motor | Mobilgear 600XP 320 | 1.00 qt. | 10,000 HRS. or 2 Years |
| 3 | Hoist Motor | Aeroshell 7 | 2.5 tsp. | 9,500 HRS. |
| 4 | Brake Wheel Coupling | Mobilux EP 111 | 0.03 qt. | 1 Year |
| 5 | Brake | Self-Lubricating | NA | NA |
| 6 | Hoist Gearbox | Mobilgear 600XP 320 | 11.0 gal. | 1 Year |
| 7 | Hoist Drum Coupling | KP 2 K GRADE | 0.16 qt. | 2,000 HRS. or 2 Years |
| 8 | Equalizer Sheave | Self-Lubricating Bushing | NA | NA |
| 9 | Sheave Bearings | Valvoline VV612 | 0.01 qt. | 6-12 Months |
| 10 | Hook Thrust Bearing | Valvoline VV612 | 0.01 qt. | 6-12 Months |
| 11 | Drum Pillow Block Bearing | Valvoline VV612 | 0.01 qt. | 3 Months |

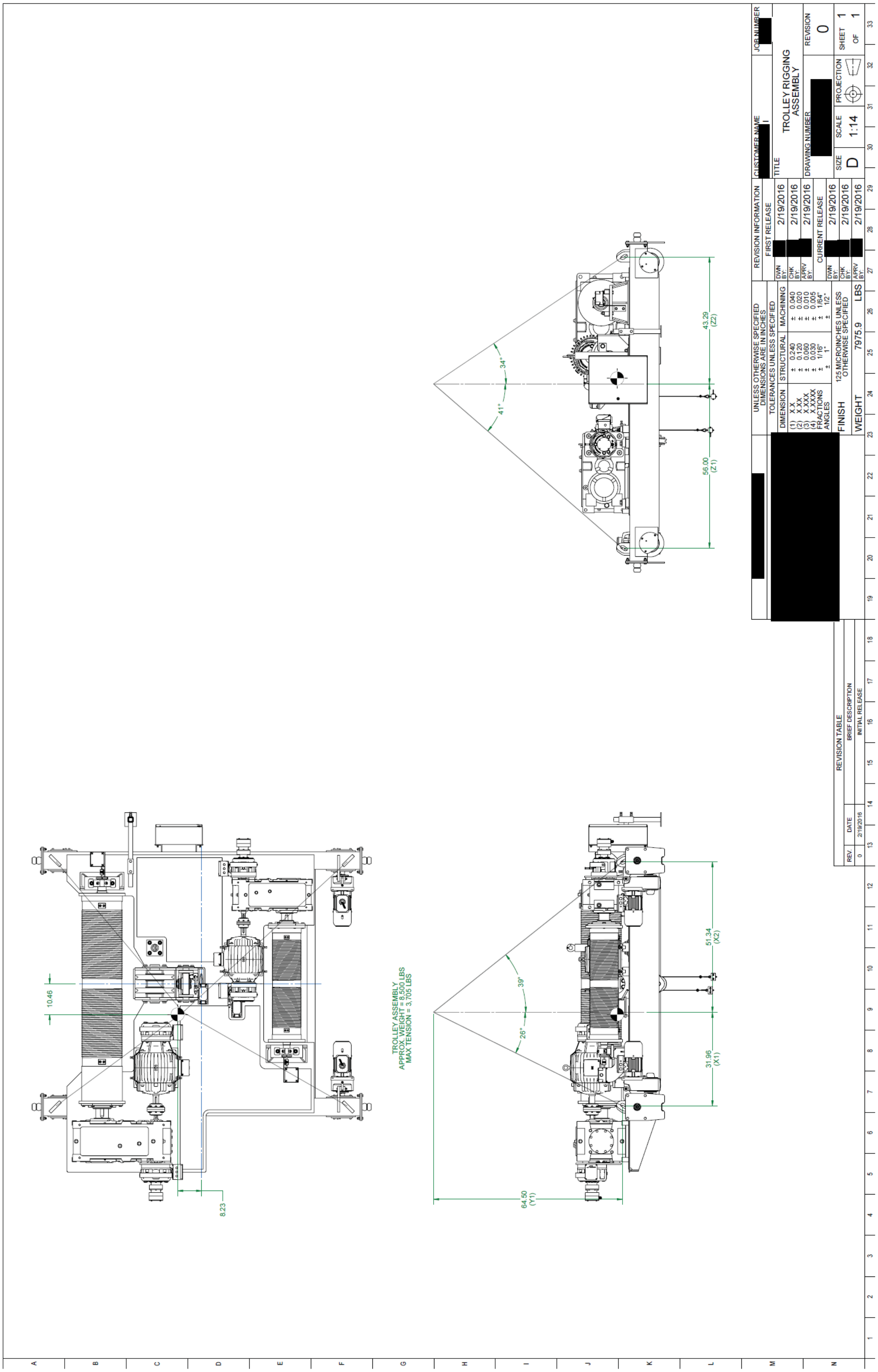


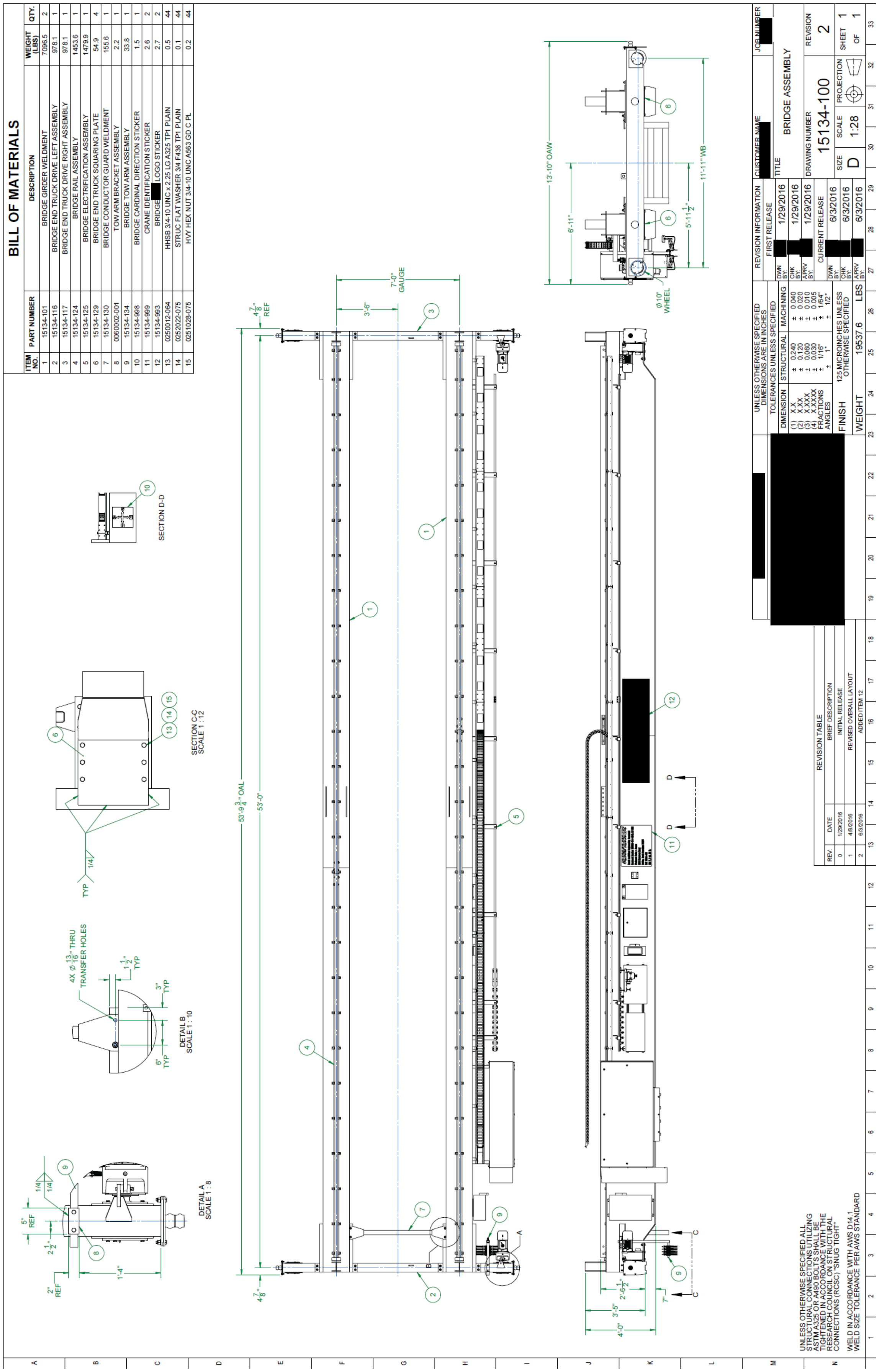




Coupling and brake drum installation infromation
BRAKE WHEEL 8.00 OD, 4.25 FACE WIDTH 2.4985/2.4995 BORE FOR 5/8" SQUARE KEY SEE DETAIL C
BRAKE WHEEL 8.00 OD, 4.25 FACE WIDTH 2.4985/2.4995 BORE FOR 5/8" SQUARE KEY SEE DETAIL B
HOIST DRUM COUPLING BARREL CPLG. TKV 200 4.4965/4.4980 BORE FOR 1" SQUARE KEY SEE DETAIL D
FLOATING SHAFT COUPLING SKF, SIZE 1.5 1.6230/1.6240 BORE FOR 3/8" SQUARE KEY SEE DETAIL B
FLOATING SHAFT COUPLING SKF, SIZE 1.5 1.6230/1.6240 BORE FOR 3/8" SQUARE KEY SEE DETAIL A
MOTOR COUPLING SKF, SIZE 1.5 2.1230/2.1240 BORE FOR 1/2" SQUARE KEY SEE DETAIL A
DETAIL D SCALE 1 : 5 DRUM COUPLING SHAFT ENGAGEMENT AGMA 9002-B4-FIT (KEYWAY AND BORE INFORMATION IN NOTES)
DETAIL C SCALE 1 : 3 SECONDARY BRAKE WHEEL SHAFT ENGAGEMENT AGMA 9002-B4-FIT (KEYWAY INFORMATION IN NOTES)
DETAIL B SCALE 1 : 3 FLOATING SHAFT COUPLING AND PRIMARY BRAKE WHEEL SHAFT ENGAGEMENT AGMA 9002-B4-FIT (KEYWAY INFORMATION IN NOTES)
DETAIL A SCALE 1 : 3 MOTOR COUPLING AND FLOATING SHAFT COUPLING ENGAGEMENT AGMA 9002-B4-FIT (KEYWAY AND BORE INFORMATION IN NOTES)
REDUCER OUTPUT SHAFT
GEARBOX INPUT SHAFT
FLOATING SHAFT
MOTOR SHAFT
JOB #
QTY

## H. Appendix H – Structural Drawings

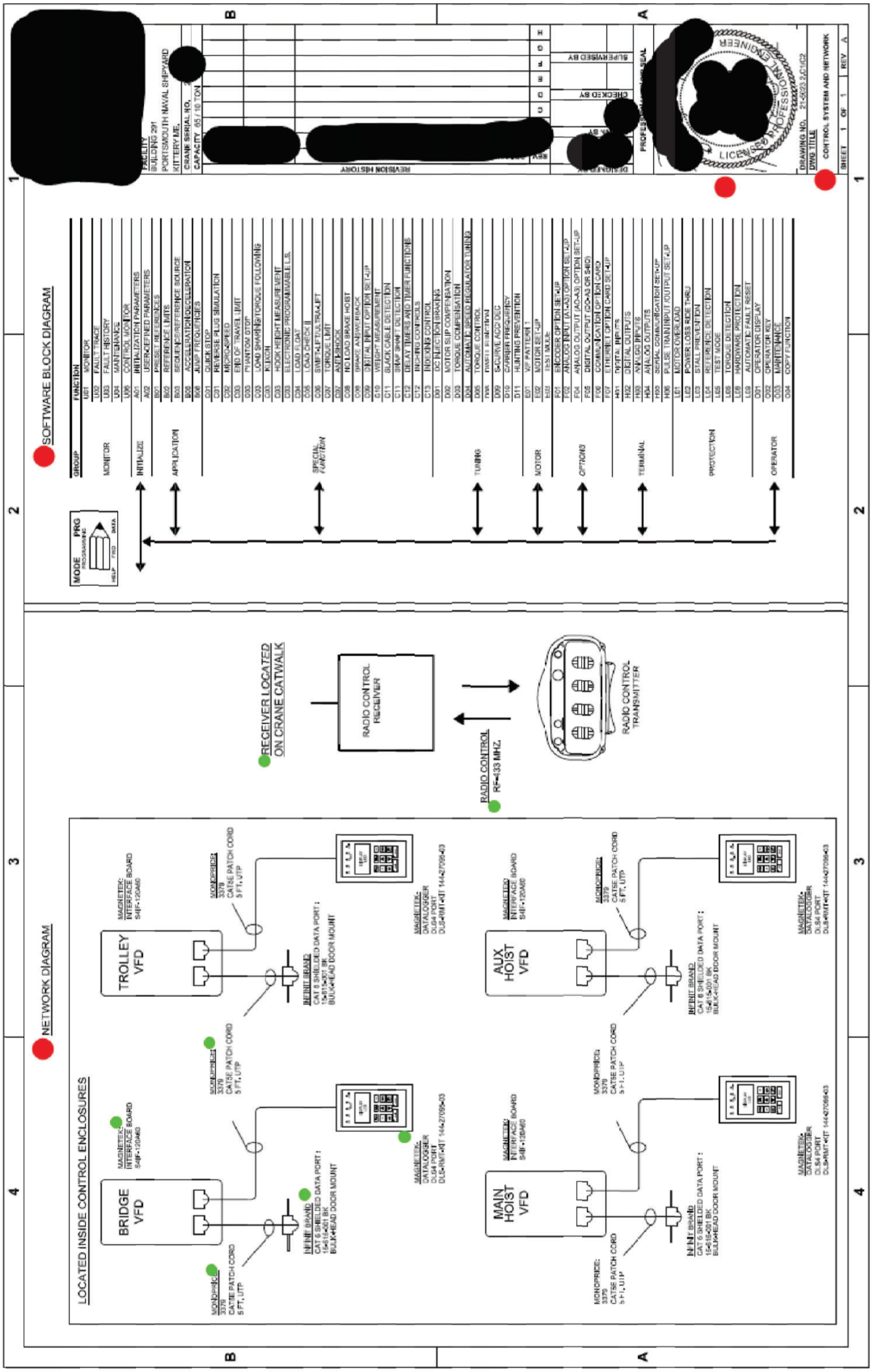
Please see following pages for sample structural drawings.


TROLLEY RIGGING ASSEMBLY
TROLLEY ASSEMBLY
APPROX. WEIGHT = 8,500 LBS
MAX TENSION = 3,705 LBS
43.29 (Z2)
56.00 (Z1)
51.34 (X2)
31.96 (X1)
64.50 (Y1)
10.46
8.23
34°
41°
39°
26°
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES UNLESS SPECIFIED
FINISH
125 MICROINCHES UNLESS OTHERWISE SPECIFIED
WEIGHT 7975.9 LBS
REVISION INFORMATION
FIRST RELEASE
CURRENT RELEASE
2/19/2016
SIZE D
SCALE 1:14
PROJECTION
REVISION 0
SHEET 1 OF 1
REVISION TABLE
REV.
DATE
BRIEF DESCRIPTION
0
2/19/2016
INITIAL RELEASE


BILL OF MATERIALS
ITEM NO. | PART NUMBER | DESCRIPTION | WEIGHT (LBS) | QTY.
1 | 15134-101 | BRIDGE GIRDER WELDMENT | 7096.5 | 2
2 | 15134-116 | BRIDGE END TRUCK DRIVE LEFT ASSEMBLY | 978.1 | 1
3 | 15134-117 | BRIDGE END TRUCK DRIVE RIGHT ASSEMBLY | 978.1 | 1
4 | 15134-124 | BRIDGE RAIL ASSEMBLY | 1453.6 | 1
5 | 15134-125 | BRIDGE ELECTRIFICATION ASSEMBLY | 1479.9 | 1
6 | 15134-129 | BRIDGE END TRUCK SQUARING PLATE | 54.9 | 4
7 | 15134-130 | BRIDGE CONDUCTOR GUARD WELDMENT | 155.6 | 1
8 | 0060002-001 | TOW ARM BRACKET ASSEMBLY | 2.2 | 1
9 | 15134-134 | BRIDGE TOW ARM ASSEMBLY | 33.8 | 1
10 | 15134-998 | BRIDGE CARDINAL DIRECTION STICKER | 1.5 | 1
11 | 15134-999 | CRANE IDENTIFICATION STICKER | 2.6 | 2
12 | 15134-993 | BRIDGE [redacted] LOGO STICKER | 2.7 | 2
13 | 0250012-064 | HHSB 3/4-10 UNC x 2.25 LG A325 TP1 PLAIN | 0.5 | 44
14 | 0252022-075 | STRUC FLAT WASHER 3/4 F436 TP1 PLAIN | 0.1 | 44
15 | 0251028-075 | HVY HEX NUT 3/4-10 UNC A563 GD C PL | 0.2 | 44
DETAIL A
SCALE 1 : 8
DETAIL B
SCALE 1 : 10
4X Ø 13/16" THRU
TRANSFER HOLES
SECTION C-C
SCALE 1 : 12
SECTION D-D
53'-9 3/4" OAL
53'-0"
7'-0" GAUGE
3'-6"
13'-10" OAW
6'-11"
5'-11 1/2"
11'-11" WB
Ø 10" WHEEL
UNLESS OTHERWISE SPECIFIED ALL STRUCTURAL CONNECTIONS UTILIZING ASTM A325 OR A490 BOLTS SHALL BE TIGHTENED IN ACCORDANCE WITH THE RESEARCH COUNCIL ON STRUCTURAL CONNECTIONS (RCSC) "SNUG TIGHT"
WELD IN ACCORDANCE WITH AWS D14.1
WELD SIZE TOLERANCE PER AWS STANDARD
REVISION TABLE
REV. | DATE | BRIEF DESCRIPTION
0 | 1/29/2016 | INITIAL RELEASE
1 | 4/8/2016 | REVISED OVERALL LAYOUT
2 | 6/3/2016 | ADDED ITEM 12
[redacted]
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES UNLESS SPECIFIED
DIMENSION | STRUCTURAL | MACHINING
(1) X.X | ± 0.240 | ± 0.040
(2) X.XX | ± 0.120 | ± 0.020
(3) X.XXX | ± 0.060 | ± 0.010
(4) X.XXXX | ± 0.030 | ± 0.005
FRACTIONS | ± 1/16" | ± 1/64"
ANGLES | ± 1° | ± 1/2°
FINISH 125 MICRONCHES UNLESS OTHERWISE SPECIFIED
WEIGHT 19537.6 LBS
REVISION INFORMATION
FIRST RELEASE
DWN BY: [redacted] 1/29/2016
CHK BY: [redacted] 1/29/2016
APRV BY: [redacted] 1/29/2016
CURRENT RELEASE
DWN BY: [redacted] 6/3/2016
CHK BY: [redacted] 6/3/2016
APRV BY: [redacted] 6/3/2016
CUSTOMER NAME [redacted]
JOB NUMBER [redacted]
TITLE BRIDGE ASSEMBLY
DRAWING NUMBER 15134-100
REVISION 2
SIZE D
SCALE 1:28
PROJECTION
SHEET 1 OF 1

## I. Appendix I – Cybersecurity Drawings

Please see the following pages for a sample of a cybersecurity drawing.


SOFTWARE BLOCK DIAGRAM
NETWORK DIAGRAM
LOCATED INSIDE CONTROL ENCLOSURES
BRIDGE VFD
TROLLEY VFD
MAIN HOIST VFD
AUX HOIST VFD
RECEIVER LOCATED ON CRANE CATWALK
RADIO CONTROL RECEIVER
RADIO CONTROL RF-433 MHZ
RADIO CONTROL TRANSMITTER
REVISION HISTORY
PORTSMOUTH NAVAL SHIPYARD
KITTERY ME.
CONTROL SYSTEM AND NETWORK

J. **Appendix J – Electrical Product Data**

Please see the following pages for examples of electrical product data.

SAMPLE LIMIT SWITCH CATALOG DATA

Uses schematic designation, such that catalog cut is easily referenced from the part on the crane and the schematic.

# Specialty Control Devices

## Limit Switches

## CR115E

Geared Rotary Limit Switches
15 Amperes Continuous
AC/DC

Hoist Geared Limit (HGL)
CR115E423102
80:1
115v
Woodruff Key

Complete Part #

CR115E geared rotary limit switch

### Application

CR115E geared rotary limit switch provides limit control on rotating-drive equipment. This worm and gear-reduction limit switch may be used in conjunction with motors to open and close overhead doors, to operate cable on cranes and hoists, limit the number of turns on thread-tapping equipment, and on other machine tool applications that require rotating-drive shaft control.

Switches are provided in NEMA Type 1, 4, 7, and 9 enclosures for adapting to specific environmental conditions. Forms having long-dwell cams may be ordered by description. Forms with various contact arrangements of snap-acting switches are listed.

### Features

—Long-life: switch equipped with rugged bearings and shaft extension on either or both sides.
—Flexible operation: gear ratios from 20:1 to 1280:1.
—Rapid reset: requires fewer turns to reset.
—Easy adjustment: trip points or operating cams can be quickly and easily adjusted independently with standard screwdriver.
—Versatility control: available with up to four precision snap-acting switches; each will control an independent function.
—Maximum input speed: 3600 RPM.

### Product Number Selection Instructions

1. Order limit switch by complete Product Number from pricing information table.
2. Select shaft extension (by type of shaft end and desired side) and substitute suffix number in place of ** in switch Product Number.
   Example: A NEMA Type 1 enclosed switch with 4 NO-4 NC snap-acting contacts, a 320:1 cam ratio, and a standard plain-end shaft extension on the left side is desired.
3. Order: CR115E146111 at **$636.00, GO-10G6.**

### Reference Publications

| Instructions | GEH-2458 |
|---|---|

# Specialty Control Devices
# Limit Switches



## CR115E
### Geared Rotary Limit Switches

### Snap-Acting Forms (0.020 in. contact gap) (INO-INC per switch unit)

| Nominal Input Shaft to Cam Ratio | Max. Number of Turns of Input Shaft to Trip Switch[1] | Min. Number of Turns of Input Shaft to Trip Switch | Overtravel Number of Turns of Input Shaft to Trip Switch[1] | Number of Turns of Input Shaft to Reset Switch | Contact Configuration | Pipe Tap Size (NPT) | Enclosure Type | Product Number | List Price[2] GO-10G6 |
|---|---|---|---|---|---|---|---|---|---|
| 20:1 | 19 (16 1/2) | 1 | 1/2 (3) | 1/3 | 2 NO-2 NC | 3/4 | NEMA Type 1 | CR115E1211** | **$231.00** |
| 20:1 | 19 (16 1/2) | 1 | 1/2 (3) | 1/3 | 4 NO-4 NC | 1 | NEMA Type 1 | CR115E1411** | **$435.00** |
| 40:1 | 38 (33) | 2 | 1 (6) | 2/3 | 2 NO-2 NC | 3/4 | NEMA Type 1 | CR115E1221** | **$231.00** |
| 40:1 | 38 (33) | 2 | 1 (6) | 2/3 | 4 NO-4 NC | 1 | NEMA Type 1 | CR115E1421** | **$435.00** |
| 80:1 | 75 (65) | 3 | 2 (12) | 1 | 2 NO-2 NC | 3/4 | NEMA Type 1 | CR115E1231** | **$231.00** |
| 80:1 | 75 (65) | 3 | 2 (12) | 1 | 4 NO-4 NC | 1 | NEMA Type 1 | CR115E1431** | **$435.00** |
| 111:1 | 104 (90) | 1 | 3 1/4 (17 1/4) | 1/3 | 2 NO-2 NC | 3/4 | NEMA Type 1 | CR115E1241** | **$231.00** |
| 111:1 | 104 (90) | 1 | 3 1/4 (17 1/4) | 1/3 | 4 NO-4 NC | 1 | NEMA Type 1 | CR115E1441** | **$435.00** |
| 222:1 | 208 (180) | 2 | 6 1/2 (34 1/2) | 2/3 | 2 NO-2 NC | 3/4 | NEMA Type 1 | CR115E1251** | **$432.00** |
| 222:1 | 208 (180) | 2 | 6 1/2 (34 1/2) | 2/3 | 4 NO-4 NC | 1 | NEMA Type 1 | CR115E1451** | **$636.00** |
| 320:1 | 300 (260) | 1 | 10 (50) | 1/3 | 2 NO-2 NC | 3/4 | NEMA Type 1 | CR115E1261** | **$432.00** |
| 320:1 | 300 (260) | 1 | 10 (50) | 1/3 | 4 NO-4 NC | 1 | NEMA Type 1 | CR115E1461** | **$636.00** |
| 445:1 | 415 (360) | 3 | 13 (68) | 1 | 2 NO-2 NC | 3/4 | NEMA Type 1 | CR115E1271** | **$432.00** |
| 445:1 | 415 (360) | 3 | 13 (68) | 1 | 4 NO-4 NC | 1 | NEMA Type 1 | CR115E1471** | **$636.00** |
| 640:1 | 600 (520) | 2 | 20 (100) | 2/3 | 2 NO-2 NC | 3/4 | NEMA Type 1 | CR115E1281** | **$432.00** |
| 640:1 | 600 (520) | 2 | 20 (100) | 2/3 | 4 NO-4 NC | 1 | NEMA Type 1 | CR115E1481** | **$636.00** |
| 1280:1 | 1200 (1040) | 3 | 40 (200) | 1 | 2 NO-2 NC | 3/4 | NEMA Type 1 | CR115E1291** | **$450.00** |
| 1280:1 | 1200 (1040) | 3 | 40 (200) | 1 | 4 NO-4 NC | 1 | NEMA Type 1 | CR115E1491** | **$654.00** |
| 20:1 | 19 (16 1/2) | 1 | 1/2 (3) | 1/3 | 2 NO-2 NC | 3/4 | NEMA Type 4 | CR115E4211** | **$261.00** |
| 20:1 | 19 (16 1/2) | 1 | 1/2 (3) | 1/3 | 4 NO-4 NC | 1 | NEMA Type 4 | CR115E4411** | **$465.00** |
| 40:1 | 38 (33) | 2 | 1 (6) | 2/3 | 2 NO-2 NC | 3/4 | NEMA Type 4 | CR115E4221** | **$261.00** |
| 40:1 | 38 (33) | 2 | 1 (6) | 2/3 | 4 NO-4 NC | 1 | NEMA Type 4 | CR115E4421** | **$465.00** |
| 80:1 | 75 (65) | 3 | 2 (12) | 1 | 2 NO-2 NC | 3/4 | NEMA Type 4 | CR115E4231** | **$261[illegible]** |
| 80:1 | 75 (65) | 3 | 2 (12) | 1 | 4 NO-4 NC | 1 | NEMA Type 4 | CR115E4431** | **$465[illegible]** |
| 111:1 | 104 (90) | 1 | 3 1/4 (17 1/4) | 1/3 | 2 NO-2 NC | 3/4 | NEMA Type 4 | CR115E4241** | **$261[illegible]** |
| 111:1 | 104 (90) | 1 | 3 1/4 (17 1/4) | 1/3 | 4 NO-4 NC | 1 | NEMA Type 4 | CR115E4441** | **$465.00** |
| 222:1 | 208 (180) | 2 | 6 1/2 (34 1/2) | 2/3 | 2 NO-2 NC | 3/4 | NEMA Type 4 | CR115E4251** | **$462.00** |
| 222:1 | 208 (180) | 2 | 6 1/2 (34 1/2) | 2/3 | 4 NO-4 NC | 1 | NEMA Type 4 | CR115E4451** | **$666.00** |
| 320:1 | 300 (260) | 1 | 10 (50) | 1/3 | 2 NO-2 NC | 3/4 | NEMA Type 4 | CR115E4261** | **$462.00** |
| 320:1 | 300 (260) | 1 | 10 (50) | 1/3 | 4 NO-4 NC | 1 | NEMA Type 4 | CR115E4461** | **$666.00** |
| 445:1 | 415 (360) | 3 | 13 (68) | 1 | 2 NO-2 NC | 3/4 | NEMA Type 4 | CR115E4271** | **$462.00** |
| 445:1 | 415 (360) | 3 | 13 (68) | 1 | 4 NO-4 NC | 1 | NEMA Type 4 | CR115E4471** | **$666.00** |
| 640:1 | 600 (520) | 2 | 20 (100) | 2/3 | 2 NO-2 NC | 3/4 | NEMA Type 4 | CR115E4281** | **$462.00** |
| 640:1 | 600 (520) | 2 | 20 (100) | 2/3 | 4 NO-4 NC | 1 | NEMA Type 4 | CR115E4481** | **$666.00** |
| 1280:1 | 1200 (1040) | 3 | 40 (200) | 1 | 2 NO-2 NC | 3/4 | NEMA Type 4 | CR115E4291** | **$480.00** |
| 1280:1 | 1200 (1040) | 3 | 40 (200) | 1 | 4 NO-4 NC | 1 | NEMA Type 4 | CR115E4491** | **$684.00** |
| 20:1 | 19 (16 1/2) | 1 | 1/2 (3) | 1/3 | 2 NO-2 NC | [illegible] | [illegible] | [illegible]115E7211** | **$630.00** |
| 20:1 | 19 (16 1/2) | 1 | 1/2 (3) | 1/3 | 4 NO-4 NC | [illegible] | [illegible] | [illegible]115E7411** | **$834.00** |
| 40:1 | 38 (33) | 2 | 1 (6) | 2/3 | 2 NO-2 NC | [illegible] | [illegible] | [illegible]115E7221** | **$630.00** |
| 40:1 | 38 (33) | 2 | 1 (6) | 2/3 | 4 NO-4 NC | 1 | NEMA Type 7-9 | CR115E7421** | **$834.00** |
| 80:1 | 75 (65) | 3 | 2 (12) | 1 | 2 NO-2 NC | 3/4 | NEMA Type 7-9 | CR115E7231** | **$630.00** |
| 80:1 | 75 (65) | 3 | 2 (12) | 1 | 4 NO-4 NC | 1 | NEMA Type 7-9 | CR115E7431** | **$834.00** |
| 111:1 | 104 (90) | 1 | 3 1/4 (17 1/4) | 1/3 | 2 NO-2 NC | 3/4 | NEMA Type 7-9 | CR115E7241** | **$630.00** |
| 111:1 | 104 (90) | 1 | 3 1/4 (17 1/4) | 1/3 | 4 NO-4 NC | 1 | NEMA Type 7-9 | CR115E7441** | **$834.00** |
| 222:1 | 208 (180) | 2 | 6 1/2 (34 1/2) | 2/3 | 2 NO-2 NC | 3/4 | NEMA Type 7-9 | CR115E7251** | **$828.00** |
| 222:1 | 208 (180) | 2 | 6 1/2 (34 1/2) | 2/3 | 4 NO-4 NC | 1 | NEMA Type 7-9 | CR115E7451** | **$1032.00** |
| 320:1 | 300 (260) | 1 | 10 (50) | 1/3 | 2 NO-2 NC | 3/4 | NEMA Type 7-9 | CR115E7261** | **$828.00** |
| 320:1 | 300 (260) | 1 | 10 (50) | 1/3 | 4 NO-4 NC | 1 | NEMA Type 7-9 | CR115E7461** | **$1032.00** |
| 445:1 | 415 (360) | 3 | 13 (68) | 1 | 2 NO-2 NC | 3/4 | NEMA Type 7-9 | CR115E7271** | **$828.00** |
| 445:1 | 415 (360) | 3 | 13 (68) | 1 | 4 NO-4 NC | 1 | NEMA Type 7-9 | CR115E7471** | **$1032.00** |
| 640:1 | 600 (520) | 2 | 20 (100) | 2/3 | 2 NO-2 NC | 3/4 | NEMA Type 7-9 | CR115E7281** | **$828.00** |
| 640:1 | 600 (520) | 2 | 20 (100) | 2/3 | 4 NO-4 NC | 1 | NEMA Type 7-9 | CR115E7481** | **$1032.00** |
| 1280:1 | 1200 (1040) | 3 | 40 (200) | 1 | 2 NO-2 NC | 3/4 | NEMA Type 7-9 | CR115E7291** | **$846.00** |
| 1280:1 | 1200 (1040) | 3 | 40 (200) | 1 | 4 NO-4 NC | 1 | NEMA Type 7-9 | CR115E7491** | **$1050.00** |

Hoist Geared Limit Switch (HGL)

Shows base part # and options.

Note: Insert number from Shaft Extension Type Table where ** appears to complete product number.

[1]Figures shown in parentheses are for long-dwell (45°) cam forms. Order by description. No price addition for long-dwell cam.
Contact nearest Representative for prices and data for 180° cam forms.

[2]Prices shown are for shaft extension on one side only. Add **$6.00**, **GO-10G6** for forms with shaft extensions on both sides.

### Shaft Extension Type

| Description (Type or Shaft End) | Shaft Extension On Right Side | Left Side | Both Sides[3] |
|---|---|---|---|
| Standard Plain-End Shaft | 01 | 11 | 21[3] |
| Woodruff Key-Type End Shaft (No. 3 Woodruff key is provided) | 02 | 12 | 22[3] |

[3]Prices shown in pricing information table are for shaft extension on one side only.
Add **$6.00**, **GO-10G6** for forms with shaft extensions on both sides.

# Specialty Control Devices
# Limit Switches

Section 11

## CR115E

Geared Rotary Limit Switches

### Contact Ratings[1]

**Alternating Current**
**Carry Continuous—15 Ampere**

| Volts | Make | Break |
|---|---|---|
| 115 | 40 amp | 15 amp |
| 230 | 20 amp | 10 amp |
| 460 | 10 amp | 6 amp |
| 575 | 8 amp | 5 amp |

**Direct Current**
**(SPDT Snap-Acting Forms)**

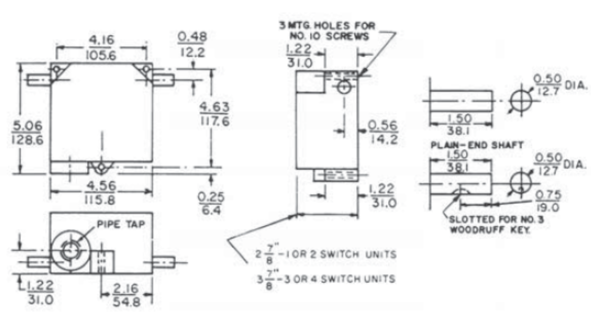
| Volts | Break |
|---|---|
| 120 | 0.25 amp |
| 240 | 0.10 amp |
| 600 | — |

[1]Double-throw circuits must be same polarity.

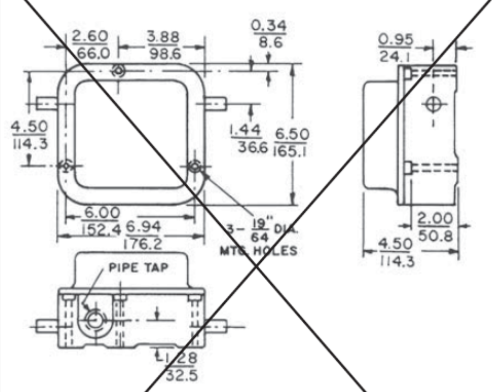
Shows specifics to part chosen.

Marked out parts of the catalog cut that are not appropriate to the part chosen.

### Outlines and Dimensions (in/mm) For Estimating Only




NEMA Type 1 and 4—Approx. shipping wt., 5 lbs.




NEMA Type 7—Approx. shipping wt., 19 lbs.

SAMPLE MOTOR CATALOG DATA

Includes all information required by NEC 430.7, including:
(a)Manufacturer's name
(b) Rated voltage and current
(c) Rates frequency and # of phases
(d) Rated full load speed
(e) Rated temperature rise and insulation class
(f) Time Rating
(g) Rate Horsepower

Hoist Motor (HM)

# Motor Data Sheet

LEYA

| MOTION | HOIST MOTOR |
|---|---|
| H.P. | 30 |
| R.P.M. | 1800 |
| FRAME SIZE | 286 |
| VOLTAGE | 460 |
| PHASE | 3 |
| HERTZ | 60 |
| F.L. AMPS | 34.2 |
| INSULATION CLASS | H |
| TEMP. RISE | F |
| TIME RATING | Cont |
| ENCLOSURE | A-TEFC |
| LEYA PART NO. | 449884-31 |
| TYPE WINDING | Flux Vector |
| NEMA DESIGN | B |
| SERVICE FACTOR | 1.00 |

Automatic Reset Temperature Activated Switch (in motor windings)
Vector Duty Motor with Pneuguys 1024 ppr Encoder
Mfg. LEYA Alum Frame
Note: The motor is going to have an auxiliary blower for cooling, the hoist motor comes with a Class F rise. This is considered a better motor than specified.
Aux blower motor is 0.33HP, 460V-3 phase-60Hz, 0.7A

Notes that show specific options that are utilized.

SAMPLE RUNWAY ELECTRIFICATION CATALOG DATA

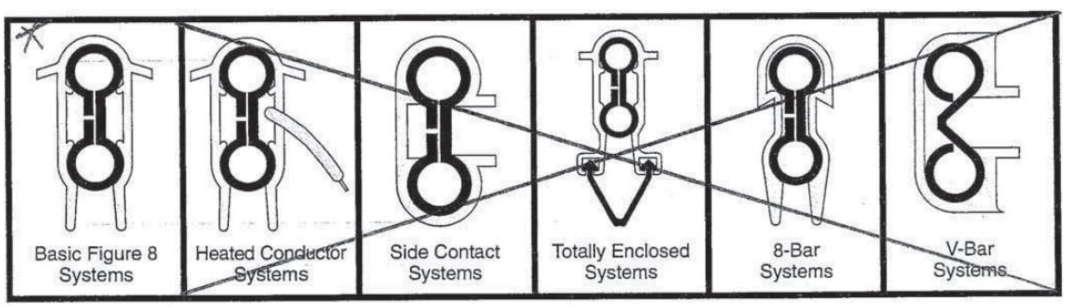
SD-3E4 1/5

# Magic-8 Bar Electrical Conductor Systems

## For Overhead Cranes, Trolleys, Monorails, Hoists, Conveyors, Automatic Stacker-Retrieval Systems… any Application that Requires a Reliable, Safe, and Economical Moving Power System.

- 90 AMP Rolled Galvanized Steel
- ~~110 AMP Rolled Galvanized Steel~~
- ~~160 AMP Rolled Stainless Steel —~~ Copper Laminated
- ~~250 AMP Rolled Copper — Steel Laminated~~
- ~~350 AMP Rolled Electrolytic Copper~~
- ~~500 AMP Extruded Electrolytic Copper~~

Submittal shows exactly what components are being used in runway system.




**CAUTION**

MAKE CERTAIN POWER SUPPLY IS DISCONNECTED BEFORE INSTALLING, REPAIRING, OR WORKING IN THE PROXIMITY OF ANY ELECTRICAL SYSTEM. ONLY QUALIFIED ELECTRICAL PERSONNEL SHOULD INSTALL OR REPAIR THESE PRODUCTS.

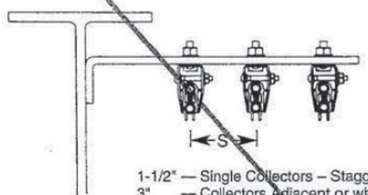
SD-3E4 2/5

## Typical Conductor Mounting

Note: ←S→ indicates minimum conductor spacing.

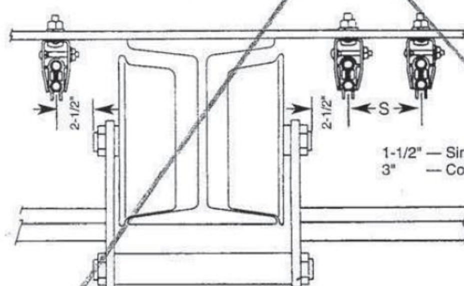
### Standard Vertical Mounted Conductors

3-Phase System • Bottom Contact • 5 Ft. Maximum Support Spacing



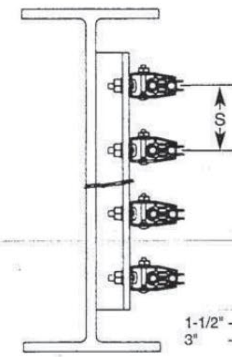

### Monorail Application

Install two conductors on one side of the beam and one conductor on the opposite side to balance the collector spring forces, particularly on light weight hoists.



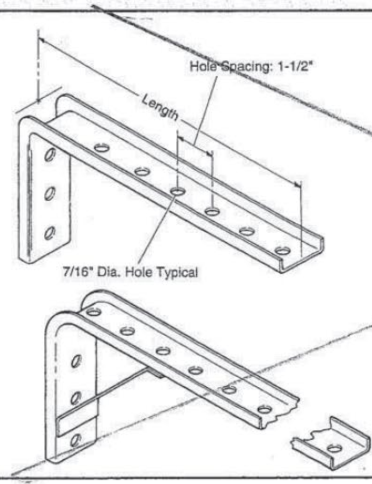

### Lateral Mounted Conductors

4 Ft. Maximum Support Spacing.
Use only Lateral (L) Model Collectors.

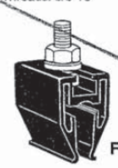
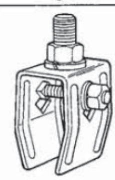
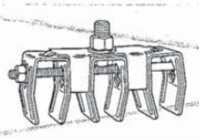
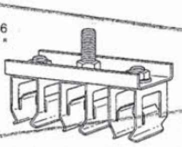



Clearly shows what mounting configuration will be used.

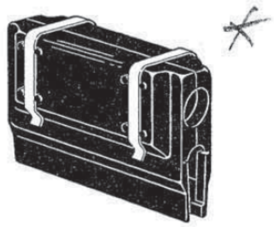
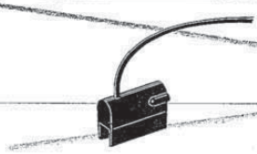
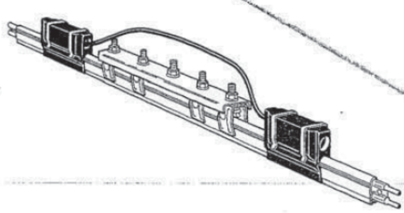
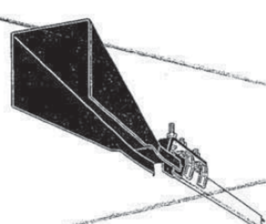
# Figure 8 (FE) Components

| | Catalog Number | Weight Pounds | Description |
|---|---|---|---|
|  | | | **Angle Brackets for Web Mounting**<br>*Brackets are galvanized 12 gage rolled steel channel. Hangers are priced separately, but will be factory installed at no charge when hanger locations are shown on sketch.* |
| | **B-100-BR1A** | 1.0 | Bracket — 11-1/4" long. |
| | **B-100-BR7A** | 1.12 | Bracket — 15-3/4" long. |
| | **B-100-BR7B** | 1.18 | Bracket with gusset support — 15-3/4" long. |
| | **B-100-BR13A** | 1.5 | Bracket — 20-1/4" long. |
| | **B-100-BR13B** | 1.57 | Bracket with gusset support — 20-1/4" long. |

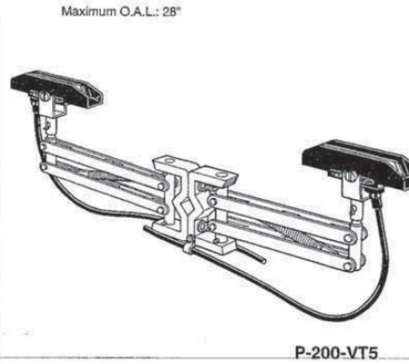
SD-3E4 3/5

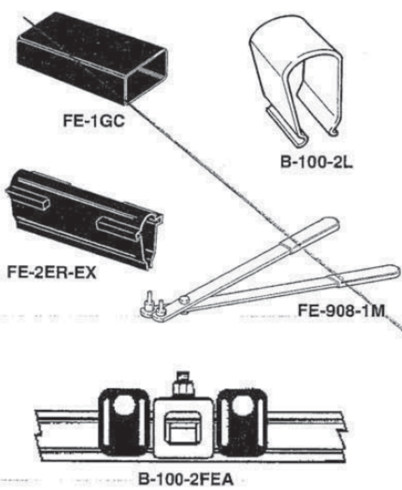
| | Catalog Number | Weight Pounds | Description |
|---|---|---|---|
| Threads: 3/8-16  FE-908-2PF  FE-908-2SF | FE-908-2PF<br>FE-908-2PFS<br><br>FE-908-2SF<br>FE-908-2SFE<br>FE-908-2SFS | .10<br>.10<br><br>.11<br>.11<br>.11 | **Snap-In Type Hanger Assemblies**<br>*These hangers are not recommended for curves, switches or short runs unless separate anchors are used. Refer to the Figure 8 Installation Instructions.*<br>Nylon Insulating Hanger.<br>Nylon Insulating Hanger with Stainless Steel Hardware.<br>*DO NOT USE nylon hangers in temperatures higher than 230°F. DO NOT exceed 4 lb. per foot torque when tightening nut on mounting bolt.*<br>Zinc Plated Steel Hanger.<br>Epoxy Coated Steel Hanger.<br>Stainless Steel Hanger with Stainless Steel Hardware. |
| Threads: 3/8-16  | FE-908-2SFG<br>FE-908-2SFFG<br>FE-908-2SFSG | .20<br>.20<br>.20 | **Snap-In Type Spring Hanger and Insulator Assemblies for Outdoor, Wet and Dirty Applications**<br>Zinc Plated Steel Hanger with Insulator.<br>Epoxy Coated Steel Hanger with Insulator.<br>Stainless Steel Hanger with Insulator and Stainless Steel Hardware. |
| Threads: 3/8-16  | B-100-2FF<br>~~B-100-2FFE~~<br><br>~~B-100-2FFS~~ | .19<br>~~.19~~<br><br>.19 | **Clamp Type Hanger Assemblies for All Conductor Systems**<br>Zinc Plated Steel Hanger.<br>Epoxy Coated Steel Hanger. For special environments.<br>Stainless Steel Hanger with Stainless Steel Hardware. For special environments. |
| Threads: 3/8-16  | B-100-2FG<br>B-100-2FFG<br>B-100-2FSG | .30<br>.30<br>.30 | **Clamp Type Hanger and Insulator Assemblies for Outdoor, Wet and Dirty Applications.**<br>Zinc Plated Steel Hanger with Insulator.<br>Epoxy Coated Steel Hanger with Insulator.<br>Stainless Steel Hanger with Stainless Steel Hardware. |
| Threads: 3/8-16   | B-100-2F2<br><br><br>B-100-2F3 | .40<br><br><br>.59 | **Clamp Type Special Hanger Assemblies**<br>Zinc Plated Steel Twin Hanger Assembly. 1-1/2" centers. For indoor applications. Staggered Collectors.<br>Zinc Plated Steel Triple Hanger Assembly. 1-1/2" centers. For indoor dry applications only. Staggered Collectors. |
| Threads: 3/8-16<br>Centers: 1-1/2"  FE-908-2SF3 | FE-908-2PF3<br>FE-908-2SF3<br>FE-908-2SF4<br>FE-908-2SF5 | .50<br>.53<br>.72<br>.93 | **Snap-In Type Special Hanger Assemblies**<br>Plastic Triple Hanger Assembly.<br>Zinc Plated Steel Triple Hanger Assembly.<br>Zinc Plated Steel Four-Gang Hanger Assembly.<br>Zinc Plated Steel Five-Gang Hanger Assembly. |
| Threads: 3/8-16  | B-100-1G | .12 | **Mushroom Insulators with Hardware**<br>30% Glass-filled Nylon — 400°F rated. Suitable for chemical or oil-laden atmospheres. |

SD-3E4 4/5

| | Catalog Number | Weight Pounds | Description |
|---|---|---|---|
|  * | | | **Power Feeds with Insulating Case** |
| | FE-908-2CP | .25 | 90 Amp Rated — Steel. For FE-758-2 systems. Will accept up to # 4 AWG cable. |
| | ~~FE-1158-2CP~~ | ~~.26~~ | ~~110 Amp Rated — Copper. For FE-908-2~~ systems. Will accept up to # 2 AWG cable. |
| | ~~FE-2008-2CP~~ | ~~.63~~ | ~~250 Amp Rated — Bronze. For FE-1608-2 and~~ FE-2008-2 systems. Will accept up to # 1/0 AWG cable. |
| | ~~FE-3008-2CP~~ | ~~1.10~~ | ~~350 Amp Rated — Cast Bronze. For FE-3008-2~~ systems. Will accept up to # 3/0 cable. |
|  | | | **End Power Feeds** |
| | FE-758-GCTP | .14 | 40 Amp Rated. For all systems with FE-758 conductor bar. |
| | FE-908-GCTP | .14 | 40 Amp Rated. For all systems with FE-908, FE-1608, FE-2008, and FE-3008 conductor bar. |
|  Anchor sets and connector pins are included with the hardware package. | | | **Expansion Gap Assemblies** *Each assembly consists of a ten-foot conductor bar, insulating cover, connector pins for one end, guide assembly, two power feeds with a jumper cable and hanger set. Refer to the Figure 8 Installation Instructions.* |
| | FE-758-2H10 | 7.0 | For Indoor System FE-758-2. |
| | FE-758-2H10-SC | 7.0 | For Outdoor System FE-758-2-SC. |
| | FE-758-2H10XT | 7.0 | For High Temperature System FE-758-2XHT. |
| | FE-908-2H10 | 9.0 | For Indoor System FE-908-2. |
| | FE-908-2H10-SC | 9.0 | For Outdoor System FE-908-2-SC. |
| | FE-908-2H10XT | 9.0 | For High Temperature System FE-908-2XHT. |
| | FE-1608-2H10 | 10.5 | For Indoor System FE-1608-2. |
| | FE-1608-2H10-SC | 10.5 | For Outdoor System FE-1608-2-SC. |
| | FE-1608-2H10XT | 10.5 | For High Temperature System FE-1608-2XHT. |
| | FE-2008-2H10 | 10.0 | For Indoor System FE-2008-2. |
| | FE-2008-2H10-SC | 10.0 | For Outdoor System FE-2008-2-SC. |
| | FE-2008-2H10XT | 10.0 | For High Temperature System FE-2008-2XHT. |
| | FE-3008-2H10 | 12.5 | For Indoor System FE-3008-2. |
| | FE-3008-2H10-SC | 12.5 | For Outdoor System FE-3008-2-SC. |
| | FE-3008-2H10XT | 12.5 | For High Temperature System FE-3008-2XHT. |
| | FE-5008-2H10 | 16.5 | For Indoor System FE-5008-2. |
| | FE-5008-2H10-SC | 16.5 | For Outdoor System FE-5008-2-SC. |
| | FE-5008-2H10XT | 16.5 | For High Temperature System FE-5008-2XHT. |
|  | | | **Special Application Components** |
| | FE-2JNN3 | 3.75 | Pickup Guide Assembly — 3" wide. Includes clamps and two foot section of system conductor. Specify conductor system. |
| | FE-2JNN4 | 4.50 | Pickup Guide Assembly — 4" wide. Includes clamps and two foot section of system conductor. Specify conductor system. |

SD-3E4 5/5



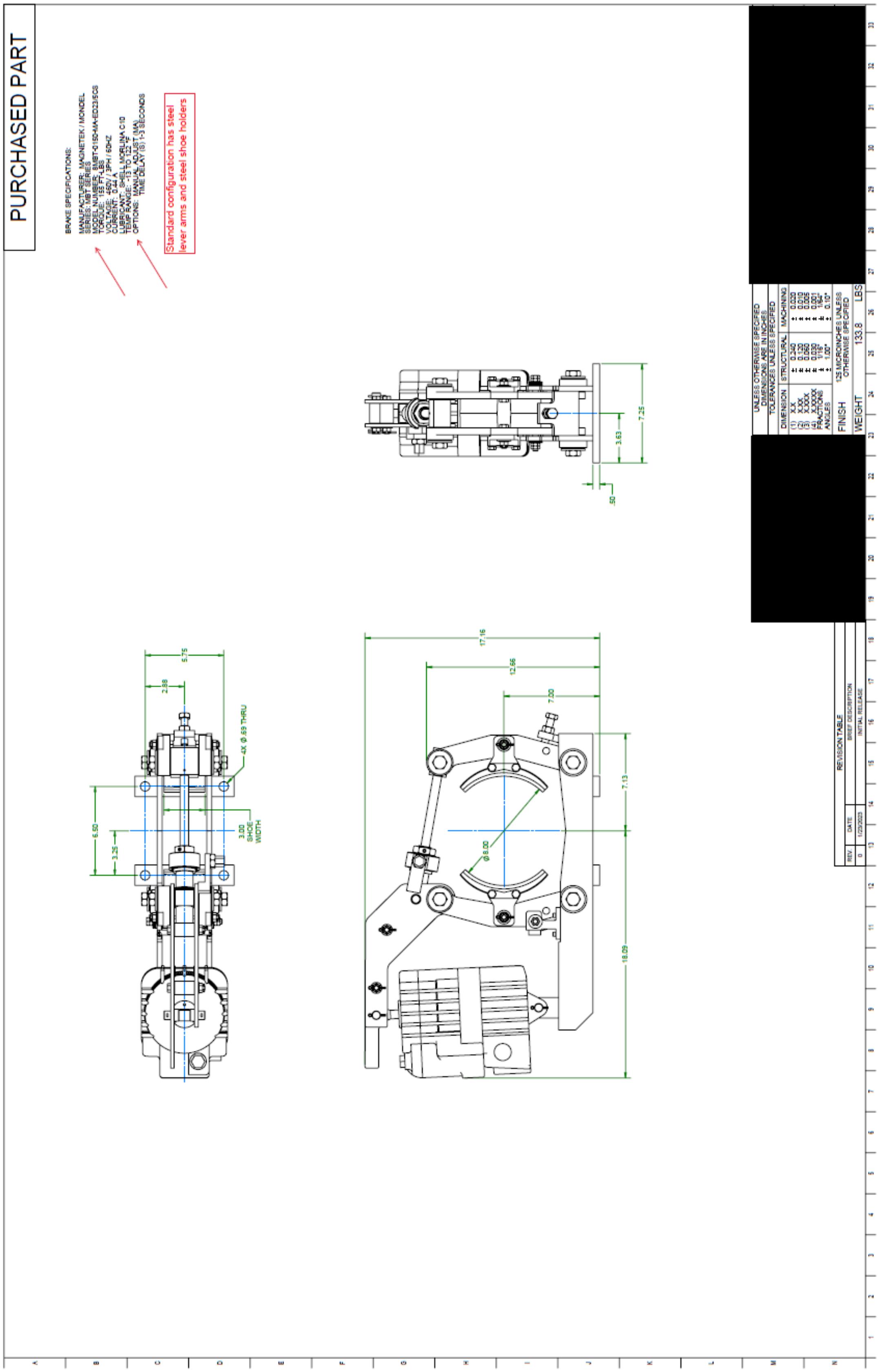




| Catalog Number | Weight Pounds | Description |
|---|---|---|
| | | **P-Series Collector Assemblies (cont.)** |
| ~~P-80-VT3~~ | ~~4.34~~ | ~~80 Amp Collector — double shoe. Vertical mount.~~ |
| P-80-LT3 | 4.35 | 80 Amp Collector — double shoe. Lateral mount. |
| ~~P-80-ST3~~ | ~~4.5~~ | ~~80 Amp Collector — double shoe. Self-centering.~~ |
| ~~P-200-VT5~~ | ~~5.0~~ | ~~200 Amp Collector — double shoe. Vertical mount.~~ |
| ~~P-200-LT5~~ | ~~4.63~~ | ~~200 Amp Collector — double shoe. Lateral mount.~~ |
| ~~P-200-ST5~~ | ~~4.6~~ | ~~200 Amp Collector — double shoe. Self-centering.~~ |
| | | **Additional Components** |
| B-100-2L | .03 | Spring Cover Clip — Zinc Plated Steel. Used only to ensure alignment of the cover on laterally mounted systems. Placed midway between hangers. |
| B-100-2FEA | .30 | Clamp Hanger Set — 2 pieces. Clamps both sides of hanger. |
| FE-1GC | .04 | Flexible PVC End Cap. For all Figure 8 conductor bars. |
| FE-908-A | .02 | Nylon Anchor Pin. For drilled anchoring. Two required at each hanger. |
| FE-908-1M | 2.88 | Connector Tool. One tool usually ordered for each new system. Used to pull two sections of bar together. |
| FE-908-1MB | .10 | Connector Tool Pins — Pair. |
| FE-2ER-EX | .05 | Splice Cover — Standard black. Use this part number when ordering extra splice covers. |
| C-40-B3-SC | | Carborendium Insert |
| C-100-B5-SC | | Cleaning Shoe |
| | | **Conductor Bar Cleaning Accessories** |
| | | *Contact the factory for application.* |
| C-100-VCT | 1.80 | Complete C-Series Collector with cleaning head. Vertical mount. |
| P-100-VCT | 2.19 | Complete P-Series Collector with cleaning head. Vertical mount. |
| C-100-2ACT | .50 | Cleaning Head only for C-Series or B-Series Collectors. |
| P-100-2ACT | .57 | Cleaning Head only for P-Series Collector. |
| B-40-2B3-CI | .17 | Cast Iron Cleaning Shoe — 3" long x 1/4" wide. |
| B-100-2B5-CI | .26 | Cast Iron Cleaning Shoe — 5" long x 1/4" wide. |
| C-100-CT | .14 | Cleaning Brush — Stainless Steel. |
| B-100-TT | .08 | Micro Hone — 1/4" x 4". |

K. **Appendix K – Mechanical Product Data**

Please see the following for examples of mechanical product data.

i. Brakes


PURCHASED PART
Standard configuration has steel lever arms and steel shoe holders

| INTERNAL TORQUE SPRING | | EXTERNAL TORQUE SPRING | | DIMENSIONS (INCHES) | | | | | | | | | | | | | | | | | SPECIFICATIONS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BRAKE SIZE (MBT) | [redacted] PART NUMBER | BRAKE SIZE (MBTE) | [redacted] PART NUMBER | A | B | C | D | E | F | G | H | J | K | L | M | N | Q | R | T | U | TORQUE (LB-FT) | POWER (W) | WEIGHT (LBS) |
| 5" MBT-ED23 | 0083011-001 | 5" MBTE-ED23 | 0083011-101 | 4.19 | 2.44 | 2.75 | 5.00 | 0.44 | 4.06 | 6.38 | 0.63 | 5.88 | 6.00 | 16.00 | 4.50 | 0.50 | 7.69 | 15.50 | 4.69 | 4.56 | 50.00 | 165 | 70 |
| 8" MBT-ED23 | 0083011-002 | 8" MBTE-ED23 | 0083011-102 | 3.25 | 2.88 | 3.25 | 8.00 | 0.69 | 7.00 | 6.38 | 0.75 | 7.25 | 7.25 | 18.00 | 5.38 | 0.75 | 12.63 | 15.50 | 6.88 | 7.00 | 155.00 | 165 | 95 |
| 10" MBT-ED23 | 0083011-003 | 10" MBTE-ED23 | 0083011-103 | 4.00 | 3.13 | 3.75 | 10.00 | 0.69 | 8.38 | 6.38 | 0.88 | 8.00 | 9.88 | 22.00 | 5.88 | 0.75 | 15.44 | 19.13 | 8.35 | 8.63 | 220.00 | 165 | 115 |
| 10" MBT-ED30 | 0083011-004 | 10" MBTE-ED30 | 0083011-104 | 4.00 | 3.13 | 3.75 | 10.00 | 0.69 | 8.38 | 6.38 | 0.88 | 8.00 | 9.88 | 22.00 | 5.88 | 0.75 | 15.44 | 19.13 | 8.35 | 8.63 | 260.00 | 200 | 125 |
| 13" MBT-ED30 | 0083011-005 | 13" MBTE-ED30 | 0083011-105 | 5.75 | 4.50 | 5.75 | 13.00 | 0.81 | 9.88 | 7.75 | 1.00 | 11.00 | 12.50 | 24.00 | 8.56 | 0.88 | 19.00 | 23.13 | 10.84 | 11.25 | 400.00 | 200 | 200 |
| 13" MBT-ED50 | 0083011-006 | 13" MBTE-ED50 | 0083011-106 | 5.75 | 4.50 | 5.75 | 13.00 | 0.81 | 9.88 | 7.75 | 1.00 | 11.00 | 12.50 | 24.00 | 8.56 | 0.88 | 19.00 | 23.13 | 10.84 | 11.25 | 550.00 | 260 | 235 |
| 13" MBT-ED80 | 0083011-007 | 13" MBTE-ED80 | 0083011-107 | 5.75 | 4.50 | 5.75 | 13.00 | 0.81 | 9.88 | 7.75 | 1.00 | 11.00 | 12.50 | 24.00 | 8.56 | 0.88 | 19.00 | 23.13 | 10.84 | 11.25 | 660.00 | 330 | 240 |
| 16" MBT-ED30 | 0083011-008 | 16" MBTE-ED30 | 0083011-108 | 7.50 | 5.38 | 6.75 | 16.00 | 1.06 | 12.13 | 9.50 | 1.25 | 13.25 | 15.25 | 30.00 | 10.00 | 1.00 | 23.06 | 31.75 | 13.63 | 13.88 | 500.00 | 260 | 430 |
| 16" MBT-ED50 | 0083011-009 | 16" MBTE-ED50 | 0083011-109 | 7.50 | 5.38 | 6.75 | 16.00 | 1.06 | 12.13 | 9.50 | 1.25 | 13.25 | 15.25 | 30.00 | 10.00 | 1.00 | 23.06 | 31.75 | 13.63 | 13.88 | 750.00 | 260 | 450 |
| 16" MBT-ED80 | 0083011-010 | 16" MBTE-ED80 | 0083011-110 | 7.50 | 5.38 | 6.75 | 16.00 | 1.06 | 12.13 | 9.50 | 1.25 | 13.25 | 15.25 | 30.00 | 10.00 | 1.00 | 23.06 | 31.75 | 13.63 | 13.88 | 1,150.00 | 330 | 455 |
| 16" MBT-ED121 | 0083011-011 | 16" MBTE-ED121 | 0083011-111 | 7.50 | 5.38 | 6.75 | 16.00 | 1.06 | 12.13 | 9.50 | 1.25 | 13.25 | 15.25 | 30.00 | 10.00 | 1.00 | 23.06 | 31.75 | 13.63 | 13.88 | 1,400.00 | 330 | 475 |
| 19" MBT-ED80 | 0083011-012 | 19" MBTE-ED80 | 0083011-112 | 9.25 | 6.50 | 8.75 | 19.00 | 1.06 | 13.25 | 9.50 | 1.75 | 15.63 | 20.25 | 33.00 | 13.00 | 1.13 | 26.25 | 33.00 | 18.50 | 16.63 | 1,500.00 | 330 | 960 |
| 19" MBT-ED121 | 0083011-013 | 19" MBTE-ED121 | 0083011-113 | 9.25 | 6.50 | 8.75 | 19.00 | 1.06 | 13.25 | 9.50 | 1.75 | 15.63 | 20.25 | 33.00 | 13.00 | 1.13 | 26.25 | 33.00 | 18.50 | 16.63 | 2,100.00 | 330 | 990 |
| 19" MBT-ED201 | 0083011-014 | 19" MBTE-ED201 | 0083011-114 | 9.25 | 6.50 | 8.75 | 19.00 | 1.06 | 13.25 | 9.50 | 1.75 | 15.63 | 20.25 | 33.00 | 13.00 | 1.13 | 26.25 | 33.00 | 18.50 | 16.63 | 2,650.00 | 450 | 990 |
| 23" MBT-ED80 | 0083011-015 | 23" MBTE-ED80 | 0083011-115 | 11.75 | 8.00 | 11.25 | 23.00 | 1.31 | 15.88 | 9.50 | 1.75 | 19.50 | 21.50 | 38.00 | 16.13 | 1.13 | 31.16 | 38.50 | 19.75 | 19.50 | 1,750.00 | 330 | 1050 |
| 23" MBT-ED121 | 0083011-016 | 23" MBTE-ED121 | 0083011-116 | 11.75 | 8.00 | 11.25 | 23.00 | 1.31 | 15.88 | 9.50 | 1.75 | 19.50 | 21.50 | 38.00 | 16.13 | 1.13 | 31.16 | 38.50 | 19.75 | 19.50 | 3,000.00 | 330 | 1080 |
| 23" MBT-ED201 | 0083011-017 | 23" MBTE-ED201 | 0083011-117 | 11.75 | 8.00 | 11.25 | 23.00 | 1.31 | 15.88 | 9.50 | 1.75 | 19.50 | 21.50 | 38.00 | 16.13 | 1.13 | 31.16 | 38.50 | 19.75 | 19.50 | 4,000.00 | 450 | 1080 |
| 23" MBT-ED301 | 0083011-018 | 23" MBTE-ED301 | 0083011-118 | 11.75 | 8.00 | 11.25 | 23.00 | 1.31 | 15.88 | 9.50 | 1.75 | 19.50 | 21.50 | 38.00 | 16.13 | 1.13 | 31.16 | 38.50 | 19.75 | 19.50 | 5,000.00 | 550 | 1080 |
| 30" MBT-ED121 | 0083011-019 | 30" MBTE-ED121 | 0083011-119 | 15.00 | 9.50 | 14.25 | 30.00 | 1.56 | 20.75 | 9.50 | 2.50 | 23.00 | 27.50 | 44.00 | 20.20 | 1.38 | 40.75 | 44.00 | 26.75 | 25.50 | 3,500.00 | 330 | 1510 |
| 30" MBT-ED201 | 0083011-020 | 30" MBTE-ED201 | 0083011-120 | 15.00 | 9.50 | 14.25 | 30.00 | 1.56 | 20.75 | 9.50 | 2.50 | 23.00 | 27.50 | 44.00 | 20.20 | 1.38 | 40.75 | 44.00 | 26.75 | 25.50 | 6,750.00 | 450 | 1510 |
| 30" MBT-ED301 | 0083011-021 | 30" MBTE-ED301 | 0083011-121 | 15.00 | 9.50 | 14.25 | 30.00 | 1.56 | 20.75 | 9.50 | 2.50 | 23.00 | 27.50 | 44.00 | 20.20 | 1.38 | 40.75 | 44.00 | 26.75 | 25.50 | 11,000.00 | 550 | 1510 |

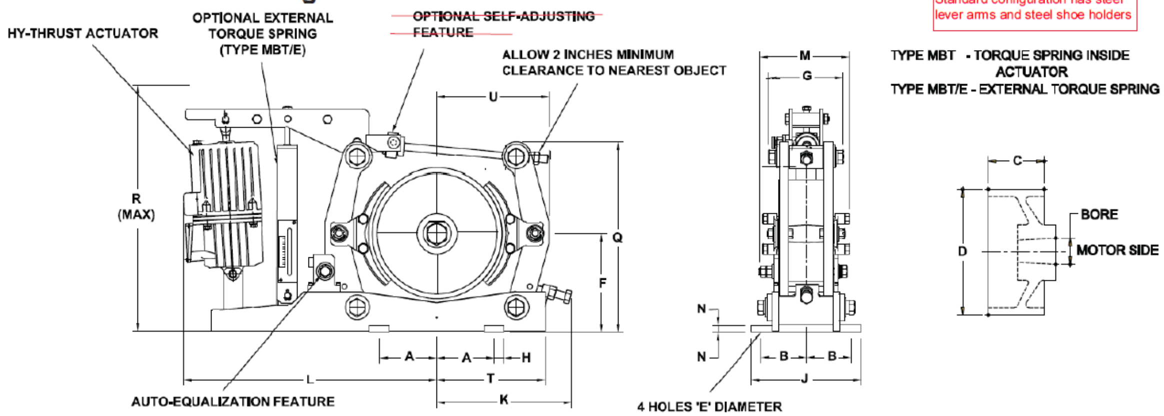
## PURCHASED PART

PURCHASED PART INFO:

MANUFACTURER: MAGNETEK / MONDEL
BRAKE SERIES: 300M MILL DUTY SHOE BRAKES
BRAKE TYPES: MBT AND MBTE
MBT TYPE: INTERNAL TORQUE SPRING (STANDARD)
- PRE-SET TORQUE SETTINGS
- TORQUE MAY BE REDUCED TO 60% OF MAXIMUM RATING
MBTE TYPE: EXTERNAL TORQUE SPRING (OPTIONAL)
- PROVIDES STEPLESS TORQUE ADJUSTMENT
- TORQUE MAY BE REDUCED TO 40% OF MAXIMUM RATING
VOLTAGE: 230V-460V / 3PH / 60HZ
INSULATION: CLASS F STANDARD (CLASS H OPTIONAL)
TEMPERATURE RANGE: -13° F THROUGH 122° F

SEE TABLE FOR BRAKE DIMENSIONS AND SPECIFICATIONS

## Dimensions and Ratings




Standard configuration has steel lever arms and steel shoe holders

TYPE MBT - TORQUE SPRING INSIDE ACTUATOR
TYPE MBT/E - EXTERNAL TORQUE SPRING

| REVISION TABLE | | |
|---|---|---|
| REV. | DATE | BRIEF DESCRIPTION |
| 0 | 8/29/2014 | INITIAL RELEASE |

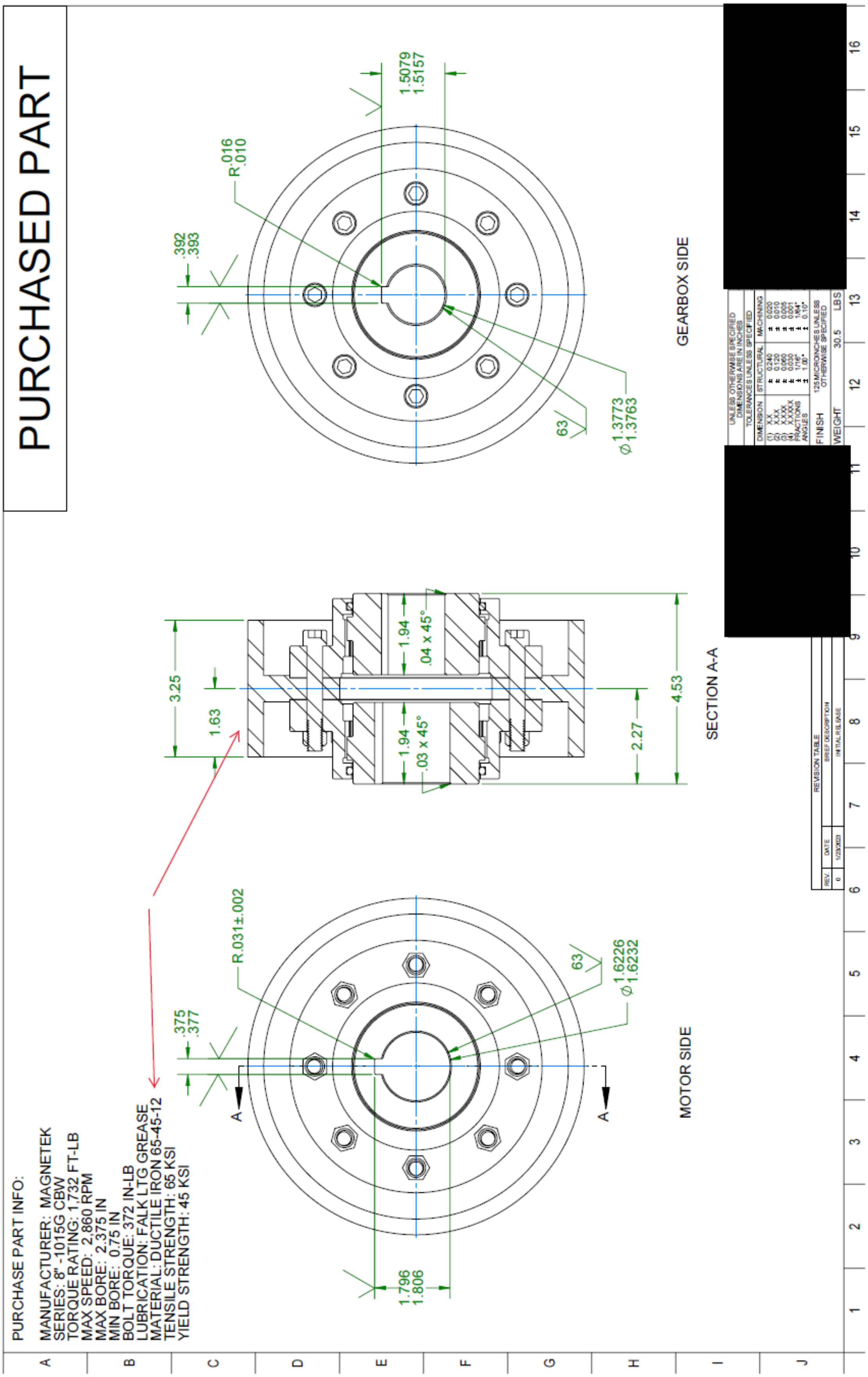
[redacted]

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES UNLESS SPECIFIED

| DIMENSION | STRUCTURAL | MACHINING |
|---|---|---|
| (1) .XX | ± 0.240 | ± 0.040 |
| (2) .XXX | ± 0.120 | ± 0.020 |
| (3) .XXXX | ± 0.060 | ± 0.010 |
| (4) .XXXXX | ± 0.030 | ± 0.005 |
| FRACTIONS | ± 1/16" | ± 1/64" |
| ANGLES | ± 1° | ± 1/2° |

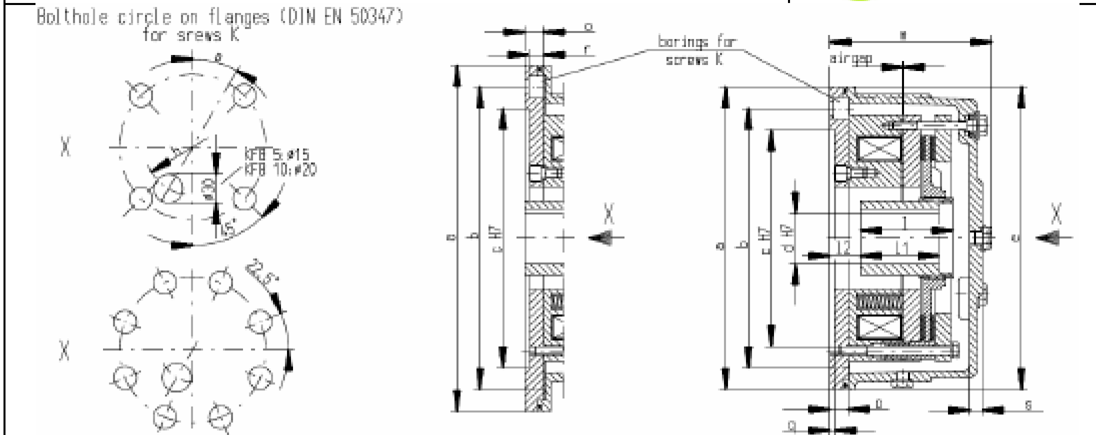
FINISH: 125 MICROINCHES UNLESS OTHERWISE SPECIFIED
WEIGHT: SEE TABLE LBS

[redacted]


PURCHASED PART
PURCHASE PART INFO:
MANUFACTURER: MAGNETEK
SERIES: 8" -1015G CBW
TORQUE RATING: 1,732 FT-LB
MAX SPEED: 2,860 RPM
MAX BORE: 2.375 IN
MIN BORE: 0.75 IN
BOLT TORQUE: 372 IN-LB
LUBRICATION: FALK LTG GREASE
MATERIAL: DUCTILE IRON 65-45-12
TENSILE STRENGTH: 65 KSI
YIELD STRENGTH: 45 KSI
MOTOR SIDE
SECTION A-A
GEARBOX SIDE
[redacted]
[redacted]
WEIGHT 30.5 LBS

# KFB
## Electromagnetic Double-Disc Spring-Applied Brake

DELLNER BUBENZER




| Brake size | | | KFB 5 | KFB 10 | KFB 16 | KFB 25 | KFB 30 | KFB 40 | KFB 63 | KFB 100 | KFB 160 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Brake torque M2 )[1] dynamic acc. to DIN VDE 0580 | | Nm | 50 | 100 | 160 | 250 | 300 | 400 | 630 | 1000 | 1600 |
| Mass moment of inertia | | $kgm^2$ | 0,0010 | 0,0017 | 0,0037 | 0,0048 | 0,0055 | 0,0068 | 0,0175 | 0,036 | 0,050 |
| Mass (weight) | | kg | 15 | 19 | 25 | 42 | 47 | 52 | 72 | 104 | 150 |
| max. idle speed | | $min^{-1}$ | 6000 | 6000 | 6000 | 6000 | 6000 | 5500 | 4700 | 4000 | 3600 |
| Coil at 20°C | Nominal voltage | V DC | 110 | 110 | 110 | 110 | 110 | 110 | 110 | 110 | 110 |
| | Nominal power | W | 79 | 93 | 128 | 158 | 133 | 196 | 220 | 307 | 344 |
| | Nominal current | A | 0,72 | 0,84 | 1,16 | 1,44 | 1,20 | 1,78 | 2,00 | 2,79 | 3,13 |
| Airgap OFF | normal | mm | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 0,4 | 0,4 | 0,4 |
| | maximum | mm | 0,8 | 1,0 | 1,0 | 1,2 | 0,9 | 1,2 | 1,3 | 1,5 | 1,7 |
| Diameter mm | B-Side | d pilot bore | 8 | 26 | 26 | 36 | 26 | 36 | 36 | 36 | 36 |
| | | $d^{H7}$ preferential bore | 15 | 28 | 28 | 38 | 32 | 38 | 42 | 60 | 60 |
| | | | 20 | 32 | 32 | 42 | 38 | 42 | 48 | 65 | 65 |
| | | | | 38 | 38 | 48 | 42 | 48 | 55 | 75 | 75 |
| | | | | | | | | | | | |
| | | $d^{H7}$ maximum | 25 | 42 | 42 | 55 | 45 | 55 | 60 | 80 | 80 |
| | | e | 160/200 | 200/250 | 253/303 | 300/350 | 250/300 | 303/350 | 350/400 | 400/450 | 450 |
| | | h | 93 | 106 | 144 | 194 | 144 | 194 | 214 | 267 | 300 |
| Length mm | | l | 60 | 110 | 96 | 117 | 137 | 117 | 142 | 148 | 155 |
| | | $l_1$ standard | 60 | 110 | 96 | 117 | 137 | 117 | 142 | 142 | 142 |
| | | $l_1$ with tacho | 53 | 107 | 93 | 114 | 132 | 114 | 138 | 138 | 142 |
| | | $l_2$ | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | m | 145 | 154 | 141 | 165 | 175 | 175 | 187 | 196 | 218 |
| | | s | 13 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 17 |
| Angle | | α° | 22,5 | 30 | 30 | 30 | 67,5 | 30 | 30 | 30 | 30 |
| Suitable standard intermediate flanges | | | A160 | A200 | A250-1 | A300-1 | A250-1 | A300-1 | A350 | A400-1 | A450-1 |
| | | | A200 | A250 | A300 | A350 | A300-1 | A350 | A400 | A450 | A550 |

)[1]: Measured at 1m/s; Values are only achieved after running-in process; other brake torque on request

### Dimensions of standard intermediate flanges

| Standard flange | | A160 | A200 | A250 | A250-1 | A300 | A300-1 | A350 | A400 | A400-1 | A450 | A450-1 | A550 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diameter mm | a | 160 | 200 | 250 | 250 | 300 | 300 | 350 | 400 | 400 | 450 | 450 | 550 |
| | b | 130 | 165 | 215 | 218 | 265 | 265 | 300 | 350 | 350 | 400 | 400 | 500 |
| | c H7 | 110 | 130 | 180 | 180 | 230 | 230 | 250 | 300 | 300 | 350 | 350 | 450 |
| Length mm | o | 18 | 18 | 18 | 20 | 20 | 22 | 22 | 22 | 29 | 29 | 31 | 31 |
| | q | 5 | 5 | 5 | 5 | 5 | 5 | 6 | 6 | 6 | 6 | 6 | 6 |
| | r | 11 | 11 | 13 | 13 | 13 | 13 | 17,5 | 17,5 | 17,5 | 17,5 | 17,5 | 17,5 |
| Screws k | | 4xM8 | 4xM10 | 4xM12 | 4xM12 | 4xM12 | 4xM12 | 4xM16 | 4xM16 | 4xM16 | 8xM16 | 8xM16 | 8xM16 |

Keyways for keys acc. to DIN 6885/1; width accuracy P9
Protection IP67

Trolley Motor Brake

Subject to change without notice

| Version | | Datum | Name | | |
|---|---|---|---|---|---|
| H/8-THO21016 | Erstellt | 10.06.2021 | THO | 8-A01100400953 | Blatt 1 von 1 |
| | Geprüft | 14.06.2021 | THO | | |
| | Freigegeben | 17.06.2021 | DIR | | |

Trolley Motor
Stearns Brake

DELLNER BUBENZER

REF: Q117799

Nidec Avtron Automation
243 Tuxedo Ave
Brooklyn Heights, OH 44131

The items in the referenced quote are as follows and contains the below features:

| | |
|---|---|
| 81-902854064251: | KFB 25 Brake |
| 81-001473320214: | Pinion for KFB 25 |
| 81-008361211249: | Half Wave Rectifier |
| 81-NID002.11779: | NEMA Adapter Plate |

| | |
|---|---|
| Brake Coil Voltage: | 207 VDC |
| Brake Coil Amperage: | 0.77 A |
| Brake Rated Torque: | 180 Nm (133 ft-lbs) |
| Manual Release: | |
| Momentary: | Hand lever that when pulled achieves 80-90% release of brake |
| Brake Housing: | Cast GG-20 (EN-GJL-200) → ASTM 200/225 |
| Junction Box: | Aluminum with salt water protectant |
| Paint Finish: | 2 coats of epoxy primer, 1 coat of finished paint |
| Inspection: | (3) ports on side cover for inspection of air gap |
| Adjustment: | Only cover must be removed to adjust air gap (brake can operate without cover) |
| Features of Brake: | |
| Air Gap: | Sensor onboard to monitor air gap (pad wear) |
| On/Off: | Sensor onboard to monitor on/off position of brake |
| Heater: | Anti-Condensation heater in coil – 115 VAC, 40 W – Needs thermostat to control |
| IP Rating: | IP67 |
| Option: | Brake is prepared for encoder if one must be added in the future |
| Pinion: | Bored for a 1.625" motor shaft |
| Half Wave Rectifier: | Rated to receive 460 VAC and Convert to 207 VDC<br>Located within the junction box on the brake |
| NEMA Adapter Plate: | Converts supplied IEC A300 bolt pattern to NEMA AK 12.5", AJ 11"<br>AISI 1026 |

Brake cover, junction box and all associated mounting components, and IEC flange (S355JS2+N) receive the paint finish detailed above. The NEMA adapter plate will be raw steel.

# 3 Layout and function

## 3.1 View of the product

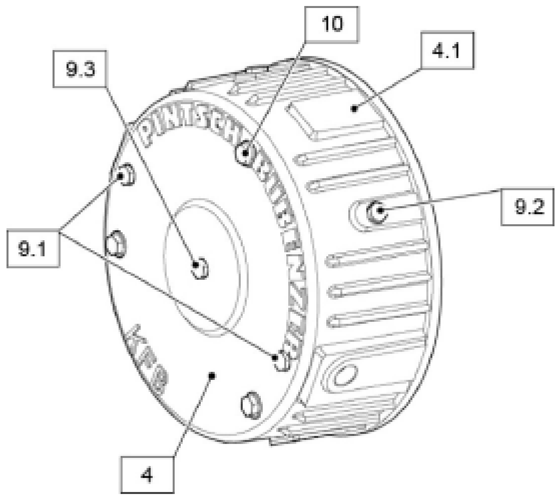



Fig. 1: Exterior view

| | | | |
|---|---|---|---|
| 4 | Housing | 9.2 | Air gap micrometre (3 pcs) |
| 4.1 | Rating plate | 9.3 | Condensate drain plug for vertical attachment |
| 9.1 | Manual ventilation screws below locking screws | 10 | Fastening screw below locking screw |

Tab. 1: Legend of exterior view

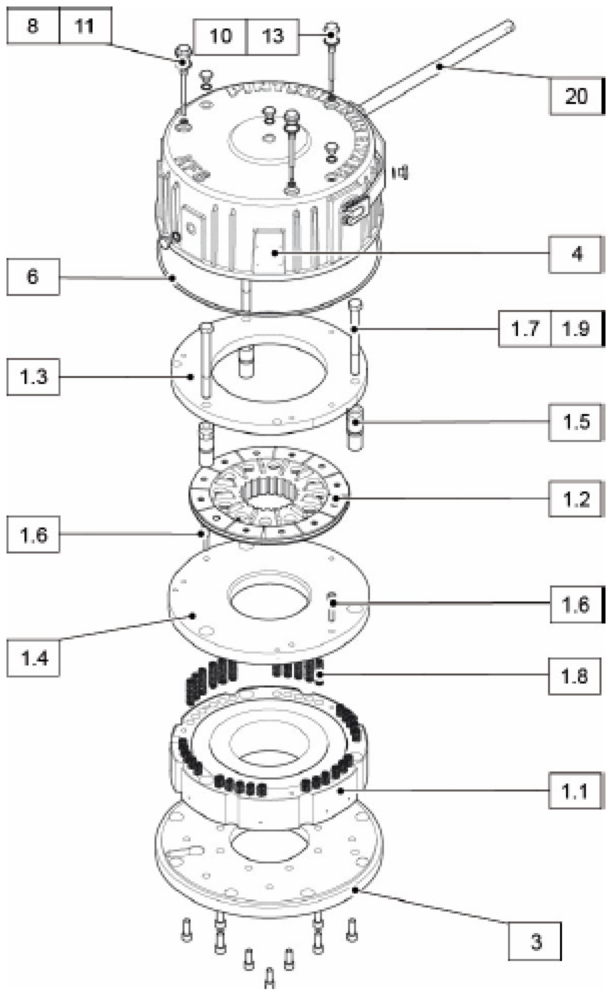



Fig. 2: Interior view

| | | | |
|---|---|---|---|
| 1.1 | Coil body group | 1.9, 11 | Detent-edged ring |
| 1.2 | Friction lining support group | 3 | Intermediate flange |
| 1.3 | Brake flange | 4 | Housing |
| 1.4 | Armature plate | 6 | O-ring |
| 1.5 | Setting screw | 8 | Cheese-head screw |
| 1.6 | Manual ventilation screws | 10 | Locking screw |
| 1.7 | Hexagon screws | 13 | Sealing ring |
| 1.8 | Compression coil spring | 20 | Manual ventilation lever (optional) |

Tab. 2: Legend of interior view

### Brake ventilation

**_CAUTION!_**

***Danger from dropping loads***

***Persons must not be in the vicinity of the load.***

Manual ventilation is done with the help of the hand lever.

- Slowly and carefully pull the hand lever (1) in the direction of the arrow.
  The armature plate is pulled to the coil body group. The friction lining support group can now be swivelled freely.
  The brake action is voided.
  **NOTE:** Be mindful of any possibly attached load during brake ventilation.
- Lower the load gently.
  The lowering speed of the load is accelerated by pulling the hand lever.
- Set down the load. Subsequently lock the hand lever or put the brake in operational state.

**Locking the hand lever**

The hand lever provides the possibility to void the brake action permanently.

- Continue to hold the hand lever (1) pulled up to end position.
- Screw in the hexagon head screw (2) in the hand lever (1) by rotating to the right until it touches the housing.
- Secure the hexagon head screw (2) with the lock-nut.

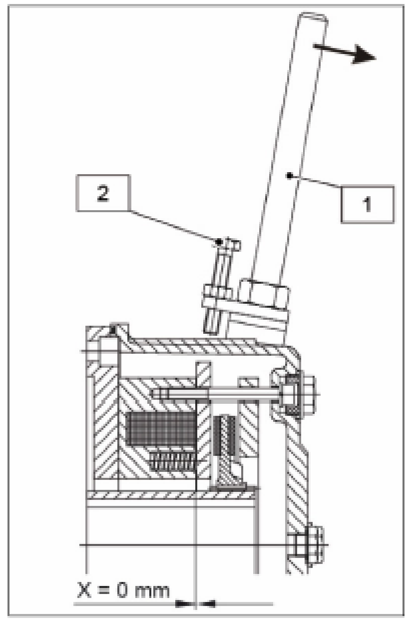



Fig. 25: Pulling the hand lever

### Cancelling manual ventilation

- Release the hand lever (1). The hand lever will return to the starting position on its own.
- Check the air gap (see 5.3).

**NOTE:** After setting down the load, you must put the brake in operational state immediately. The brake is operational only if the latching is released and the hand lever is in vertical position.

### Establishing operational state

Putting the brake in operational state again absolutely requires cancelling the locking of the hand lever.

- The locking is cancelled by turning the hexagon head screw (2) to the left. Unscrew the screw until it no longer touches the housing when you move the hand lever.

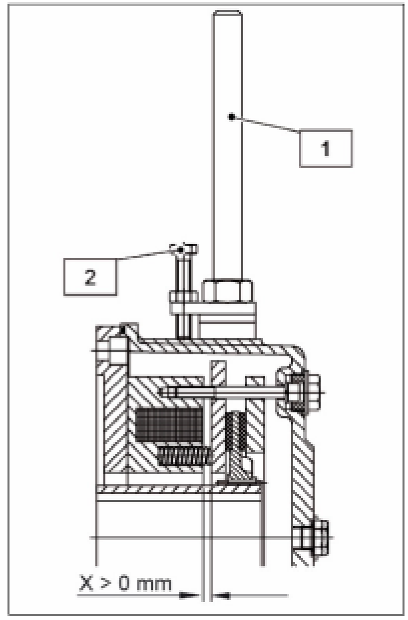



Fig. 26: Releasing the hand lever

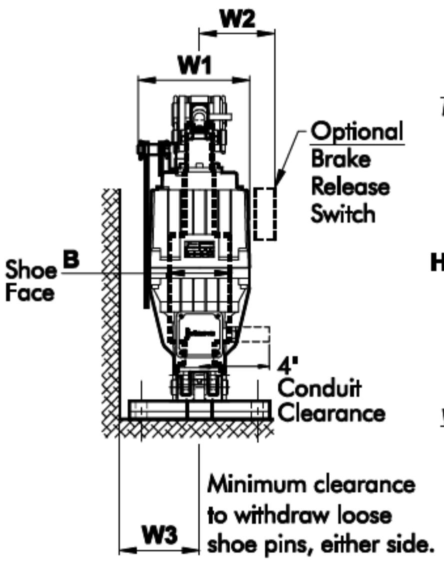
---

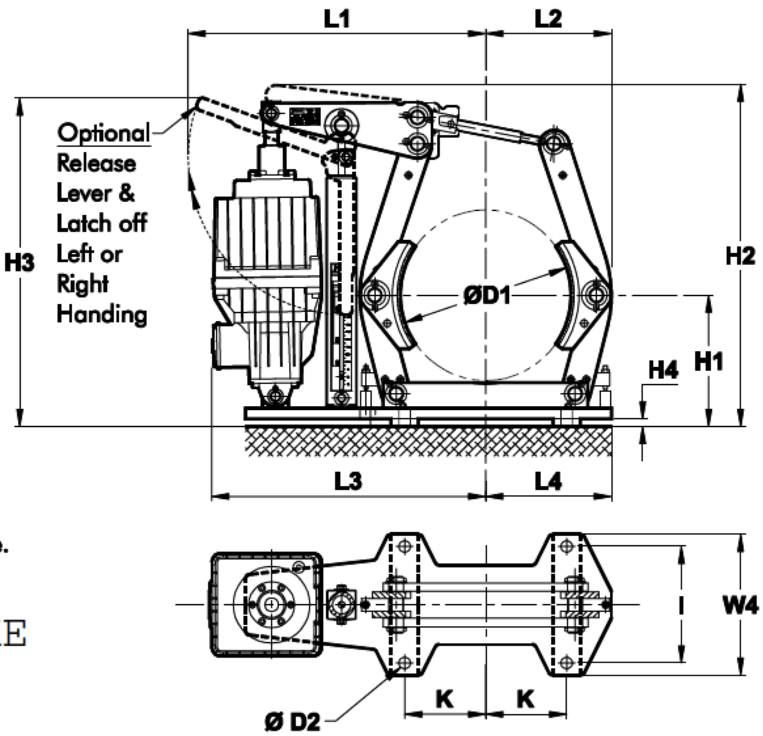
***NOTE***

***If lockability of the hand lever is not required, the hexagon head screw (2, see Fig. 25) must be removed.***

---

# SMLB SERIES THRUSTER DRUM BRAKES




SECONDARY BRAKE

Add:
Optional steel lever arms
Optional steel shoe holders

## SPECIFICATIONS

| BRAKE MODEL NUMBER | DRUM SIZE D1 | MAX. TORQUE LB-FT. | THRUSTER POWER KVA | NETT WEIGHT LB | IMPERIAL DIMENSIONS (in.) as AISE | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | B | D2 | H1 | H2 | H3 | H4 | I | K | L1 | L2 | L3 | L4 | W1 | W2 | W3 | W4 |
| SMLB06-EJ023/5 | 6 | 180 | 0.20 | 60 | 2.13 | 0.433 | 4.724 | 14.7 | 13.6 | 0 | 3.00 | 4.00 | 14.8 | 5.00 | 15.5 | 5.50 | 7.62 | 5.15 | 3.3 | 4.0 |
| SMLB08-EJ023/5<br>-EJ030/5 | 8 | 220<br>290 | 0.20<br>0.20 | 75<br>75 | 2.76 | 0.669 | 7.008 | 16.6<br>19.1 | 15.8<br>17.3 | 0.51 | 5.75 | 3.25 | 16.0 | 6.34 | 16.8 | 6.87 | 7.62 | 5.15 | 4.2 | 7.4 |
| -EJ023/5<br>SMLB10-EJ030/5<br>-EJ050/6 | 10 | 240<br>320<br>530 | 0.20<br>0.20<br>0.20 | 95<br>100<br>125 | 3.54 | 0.669 | 8.386 | 19.9<br>19.9<br>22.7 | 19.0<br>19.1<br>20.3 | 0.59 | 6.25 | 4.00 | 17.3 | 7.68 | 18.7<br>18.7<br>19.8 | 7.90 | 7.62<br>7.62<br>8.80 | 5.15<br>5.15<br>6.75 | 5.0 | 7.9 |
| -EJ030/5<br>SMLB13-EJ050/6<br>-EJ080/6 | 13 | 380<br>640<br>1140 | 0.20<br>0.20<br>0.48 | 145<br>175<br>180 | 4.33 | 0.827 | 9.882 | 24.3 | 24.5<br>24.0<br>24.5 | 0.51 | 9.00 | 5.75 | 25.7 | 9.82 | 21.6<br>22.7<br>22.7 | 10.00 | 8.10<br>9.10<br>9.10 | 5.15<br>6.75<br>6.75 | 6.1 | 11.0 |
| -EJ050/6<br>SMLB16-EJ080/6<br>-EJ121/6 | 16 | 630<br>1190<br>1960 | 0.20<br>0.48<br>0.48 | 240<br>245<br>280 | 5.51 | 1.063 | 12.126 | 29.9<br>29.9<br>31.5 | 29.6<br>29.9<br>30.9 | 0.71 | 10.75 | 7.50 | 27.5 | 11.61 | 25.3 | 11.73 | 9.41<br>9.41<br>11.34 | 6.75<br>6.75<br>7.75 | 7.40 | 13.0 |
| -EJ080/6<br>SMLB19-EJ121/6<br>-EJ201/6 | 19 | 1180<br>2140<br>3850 | 0.48<br>0.48<br>0.52 | 290<br>325<br>325 | 7.09 | 1.063 | 13.268 | 31.9 | 32.0 | 0 | 13 | 9.25 | 38.9 | 13.84 | 28.0 | 14.00 | 8.80<br>11.14<br>11.14 | 6.75<br>7.75<br>7.75 | 9.3 | 15.8 |

*** ALWAYS CHECK AVAILABLE SPACE WHEN REPLACING EXISTING BRAKES ***

- A FULL RANGE OF THRUSTERS AND FRICTION LININGS ARE AVAILABLE TO SUIT PARTICULAR TORQUE REQUIREMENTS
- COLD STATIC TORQUE VALUES MUST BE DOWN RATED BY AT LEAST 20 PERCENT
- MAX. DYNAMIC TORQUE IS BASED ON MINIMUM AIR GAP, LARGEST SPRING AND FRICTION COEFFICIENT OF 0.42
- CUSTOM MOTOR MOUNTING HARDWARE AVAILABLE

THE ABOVE SPECIFICATIONS ARE FOR ESTIMATING PURPOSES ONLY AND MAY BE CHANGED WITHOUT NOTICE. MORE COMPLETE DETAILS AND CERTIFIED DRAWINGS ARE AVAILABLE UPON REQUEST. PLEASE SPECIFY CALIPER "BRAKE MODEL NUMBER" WHEN INQUIRING OR ORDERING. WE PREFER TO QUOTE EACH SPECIFIC APPLICATION TO ENSURE THE SUITABILITY OF A DRUM BRAKE SELECTION. SPECIAL PURPOSE BRAKES INCLUDING EXPLOSION PROOF, IF NOT ALREADY AVAILABLE, MAY BE DESIGNED TO SUIT CUSTOMER REQUIREMENTS.

johnson industries / elevanja ltd
Vancouver BC Canada -- Tel: 604 940 4555 Fax: 604 940 4565
Toronto ON Canada -- Tel: 416 213 9991 Fax: 416 213 9992
Bridgwater SOM England -- Tel: 01278 456411 Fax: 01278 429949

**SMLB THRUSTER DRUM BRAKES**
SPRING APPLIED ELECTRICALLY RELEASED

| | | |
|---|---|---|
| BY: DJ | DATE: 12/10/2002 | DWG. NO. |
| SC: | REV.: (2) DJ50707 | SMLB-01.2 |
| PATH: drm/sls/smlb.dwg | | |

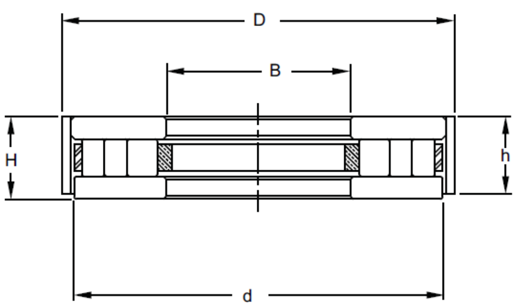
ii. Bearings

# THRUST BEARINGS

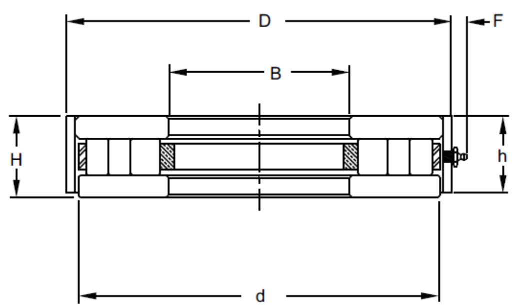
### CYLINDRICAL ROLLER THRUST BEARINGS

## *Cylindrical Roller Thrust Crane Hook Series With and Without Grease Fitting...*

- Special Design for Crane Hook Applications.
- Designed to Fit Standard Hook Shanks.
- Steel "Weathershed" to Keep Out Contaminants.
- Available With or Without Grease Fittings.
- Bearing Capacity is the Static Load Rating Based on a Permanent Deformation of .0002 inch per inch of Roller Diameter.




**CT Type**




**WCT Type**

Hook Bearing

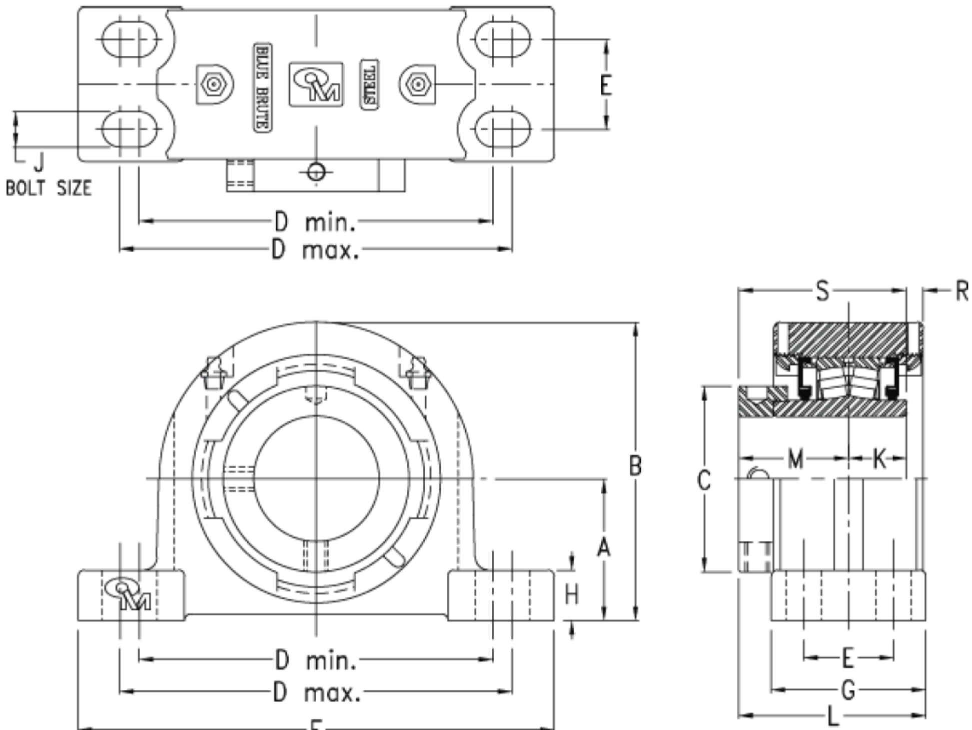
| Basic Bearing Number | | Designed Hook Shank | Bore | Outside Diameter D | | Height H | Internal Dimensions | | Bearing Capacity |
|---|---|---|---|---|---|---|---|---|---|
| Grease Fitting | | | | | | | | | |
| None | Installed | | B | CT | WCT * | | d | h | |
| CT-11 | WCT-11 | 1 5/8 | 1.640 | 3.093 | 3.343 | 0.812 | 2.95 | 0.69 | 36,890 |
| CT-16 | WCT-16 | 1 15/16 | 1.952 | 3.468 | 3.593 | 0.812 | 3.22 | 0.69 | 65,310 |
| CT-17 | WCT-17 | 2 | 2.015 | 3.937 | 4.000 | 1.000 | 3.60 | 0.88 | 73,210 |
| CT-19 | WCT-19 | 2 1/4 | 2.265 | 4.000 | 4.250 | 1.000 | 3.86 | 0.88 | 72,970 |
| CT-20-C | WCT-20-C | 2 1/4 | 2.265 | 4.250 | 4.375 | 1.000 | 3.98 | 0.88 | 88,600 |
| CT-23 | WCT-23 | 2 3/4 | 2.765 | 4.750 | 4.843 | 1.000 | 4.45 | 0.88 | 93,820 |
| CT-24-A | WCT-24-A | 2 3/4 | 2.765 | 4.875 | 5.156 | 1.250 | 4.76 | 1.13 | 121,300 |
| CT-27-A | WCT-27-A | 3 1/4 | 3.265 | 6.125 | 6.250 | 1.500 | 5.85 | 1.38 | 180,810 |
| CT-27-C | WCT-27-C | 3 1/4 | 3.265 | 6.187 | 6.375 | 1.750 | 5.97 | 1.63 | 212,960 |
| CT-27-B | WCT-27-B | 3 1/2 | 3.515 | 6.156 | 6.375 | 1.625 | 5.97 | 1.50 | 203,410 |
| CT-28-A | WCT-28-A | 3 1/2 | 3.515 | 6.750 | 6.937 | 1.625 | 6.54 | 1.50 | 245,110 |
| CT-34-A | WCT-34-A | 3 3/4 | 3.765 | 7.125 | 7.250 | 1.875 | 6.86 | 1.75 | 288,080 |
| CT-35-A | WCT-35-A | 4 1/4 | 4.265 | 8.171 | 8.375 | 2.000 | 7.97 | 1.88 | 369,200 |
| CT-38-A | WCT-38-A | 4 1/2 | 4.515 | 8.125 | 8.312 | 2.000 | 7.91 | 1.88 | 390,910 |
| CT-39-A | WCT-39-A | 5 | 5.015 | 9.156 | 9.375 | 2.250 | 8.97 | 2.13 | 628,470 |
| CT-44-A | WCT-44-A | 5 1/2 | 5.515 | 10.500 | 10.500 | 2.500 | 10.10 | 2.38 | 628,470 |
| CT-45-A | WCT-45-A | 6 | 6.015 | 11.156 | 11.375 | 3.000 | 10.97 | 2.75 | 923,160 |
| CT-49-A | WCT-49-A | 6 13/16 | 6.827 | 12.750 | 12.750 | 2.500 | 12.34 | 2.38 | 1,004,880 |

* Dimension Fx2 must be added to bearing O.D. for determining overall O.D. on WCT type.
F = .41 inch (approx.) for all sizes.

Drum Pillow Block Bearing

# QMPF13J207S

All Steel Housing




| Shaft Size | Bearing Designation |
|---|---|
| 2-7/16" | 22213 |

## QMPF13J207S Dimensions (in)

| A | B | C | $D_{Min}$ | $D_{Max}$ | E | F | G | H | J | K | L | M | R | S | WT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.750 | 5.800 | 3.62 | 6.880 | 7.630 | 1.750 | 9.250 | 3 | 0.98 | 5/8 | 1.24 | 3.63 | 2.13 | 0.210 | 3.37 | 20 |

## QMPF13J207S Thrust and Radial Factors

| Basic C Rating | Static $C_0$ Rating | e | Y1 | Y2 |
|---|---|---|---|---|
| 39790 | 48560 | 0.25 | 2.69 | 4.00 |

## QMPF13J207S Load Ratings

| Life (Hours) | 50 RPM | 100 RPM | 200 RPM | 500 RPM | 1000 RPM | 1200 RPM | 1500 RPM | 1800 RPM | 2100 RPM | 2400 RPM | 2700 RPM | 3000 RPM | 3200 RPM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | |
| **5000** | 17658 | 14343 | 11650 | 8850 | 7189 | 6806 | 6365 | 6026 | 5754 | 5528 | 5336 | 5170 | 5071 |
| **10000** | 14343 | 11650 | 9463 | 7189 | 5839 | 5528 | 5170 | 4895 | 4674 | 4490 | 4334 | 4199 | 4119 |
| **20000** | 11650 | 9463 | 7686 | 5839 | 4743 | 4490 | 4199 | 3976 | 3796 | 3647 | 3521 | 3411 | 3346 |
| **50000** | 8850 | 7189 | 5839 | 4436 | 3603 | 3411 | 3190 | 3020 | 2884 | 2771 | 2674 | 2591 | 2542 |
| **100000** | 7189 | 5839 | 4743 | 3603 | 2926 | 2771 | 2591 | 2453 | 2342 | 2250 | 2172 | 2105 | 2064 |

*Note: Blue Brute Bearings are made of cast steel; therefore, Blue Brute Bearings pillow block units are designed to accept housing load up to 'Static $C_0$ Rating' at any angle from P0 to P180.

| Oil Lubrication | | | Grease Lubrication | | |
|---|---|---|---|---|---|
| **M/N Seal** | **T/ML Seal** | **B/C/O Seal** | **M/N Seal** | **T/ML Seal** | **B/C/O Seal** |
| 1800 | 3200 | 1500 | 1800 | 2800 | 1500 |

## QMPF13J207S Shaft Tolerance

| Shaft Tolerance |
|---|
| +0.00 / -0.0015 |

## QMPF13J207S Amount of Float per One Rotation of External housing Nut

| Float |
|---|
| 0.083 |

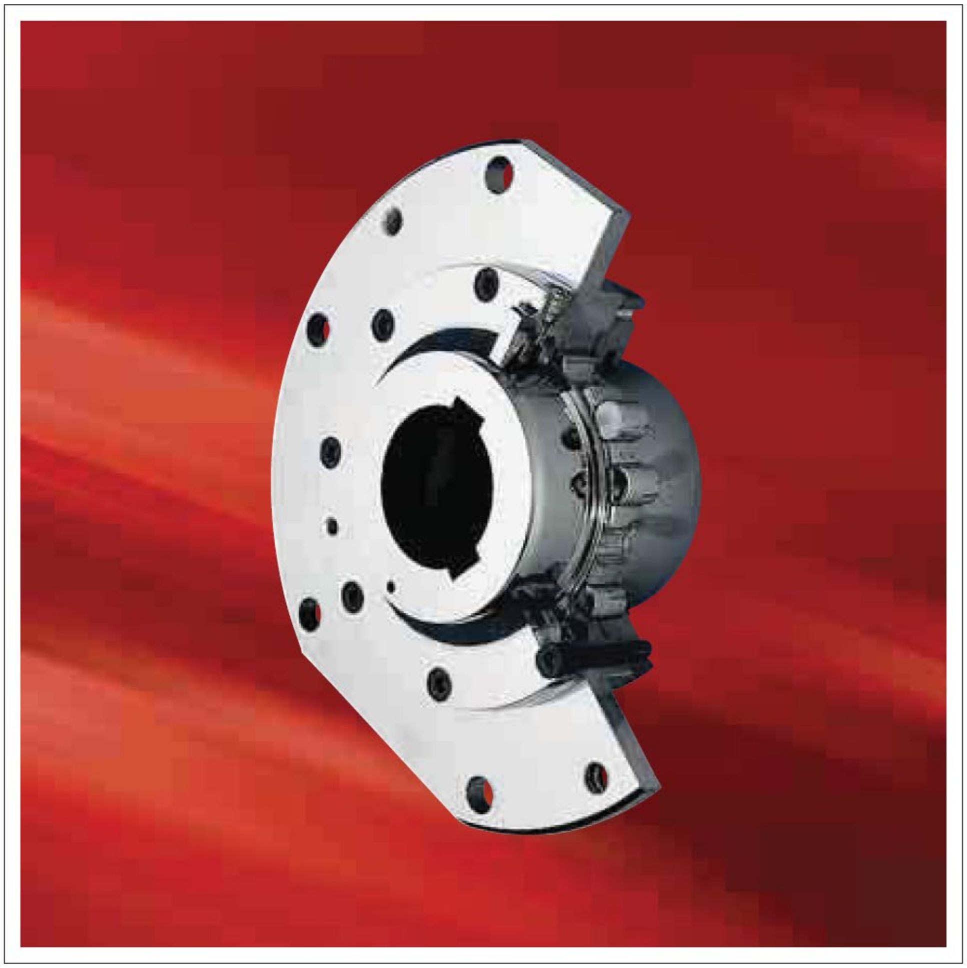
ISO 9001:2000

20398:800464

iii. Couplings

Hoist Drum Coupling

# Barrel coupling
## TCB type



# Application

TCB barrel couplings are recommended for installation in crane lifting mechanisms, to connect the cable drum with the gearbox output shaft, as well as in winch conveyors and platform hoists.

When the gearbox output shaft is rigidly connected to the drum in a lifting mechanism, supported between points (Fig. 1), this originates a statically indeterminate case.

This type of mounting requires special care in alignment and levelling, which is difficult to achieve in practice.

Mounting inaccuracies, as well as deformation in structures and wear in moving parts, lead to enormous additional forces, above all in the gearbox output shaft, which as a result of alternative bending loads can lead to breakage due to fatigue and faults in bearings and gear wheels.

In the recommended mounting (Fig. 2) the barrel coupling, which is installed between the gearbox and cable drum, performs the function of an articulated joint, thus making the connection statically determinate and avoiding the occurrence of high bending moments.

Figure 4 shows the mounting of the barrel coupling in a lifting mechanism. Considering the fact that this coupling allows axial displacement, a self-adjusting bearing must be mounted, fixed laterally, at the opposite end of the drum shaft in order to withstand the axial forces that may be generated.

As a special application, the TCB barrel coupling can be designed as an articulated joint that withstands axial forces by itself (type TCBA, see page 15).

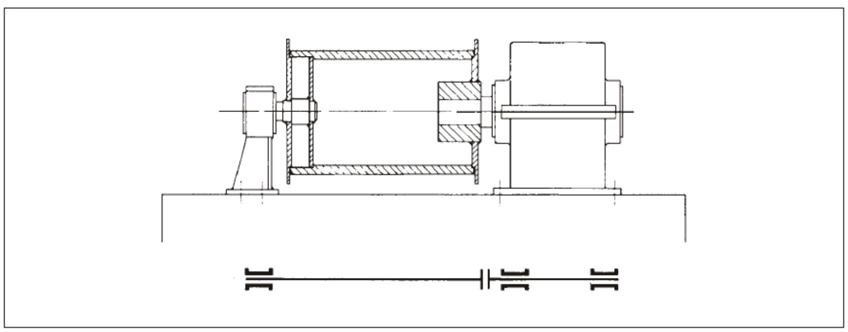


**Fig. 1**
Rigid mounting of gearbox-drum connection
Support at three points.

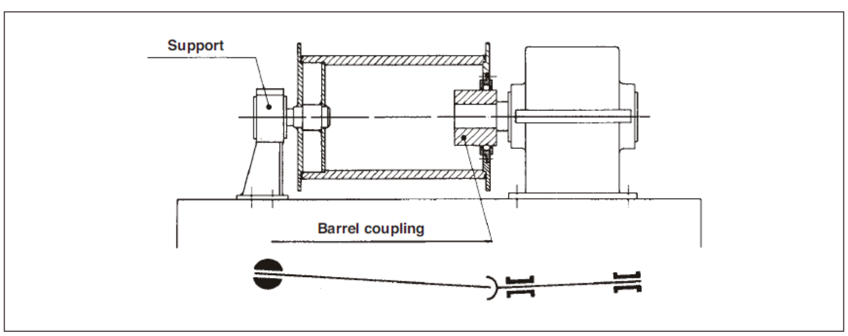
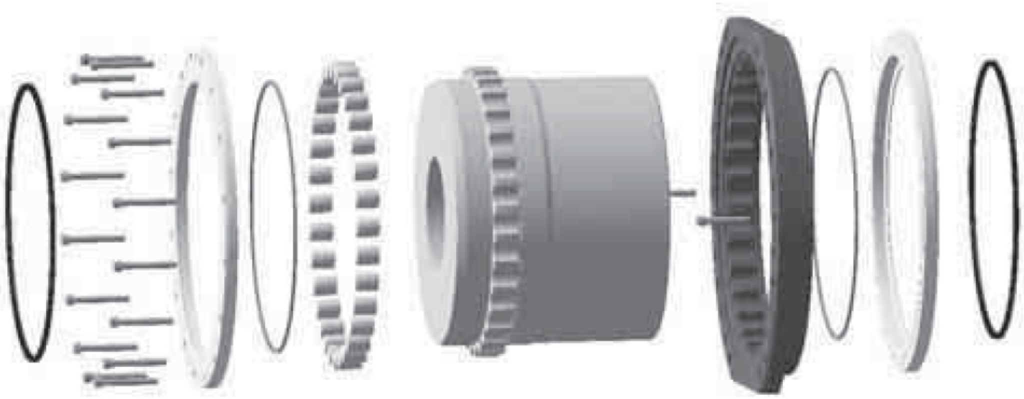



**Fig. 2**
Mounting with barrel coupling.

# Part List



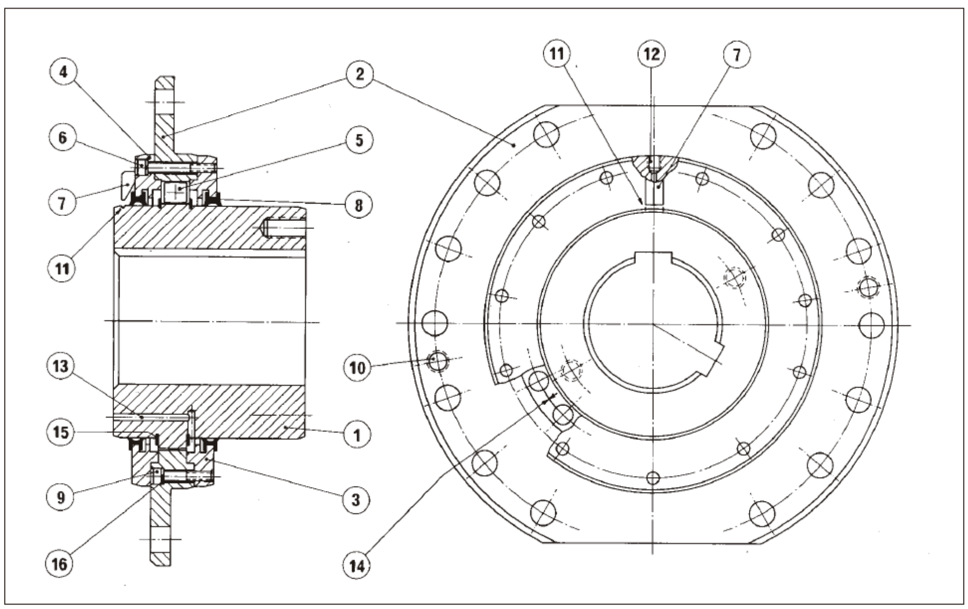



Fig. 3

1. Hub
2. Sleeve
3. Inner cover
4. Outer cover
5. Barrel
6. Allen screw
7. Wear and axial adjustment indicator
8. Special seal
9. Allen screw
10. Threaded holes for disassembly
11. Wear limit grooves
12. Grease connection
13. Grease overflow
14. Assembly reference
15. Barrel guide rings
16. Grower washer

# Description and characteristics

The barrel coupling consists of a sleeve provided with semicircular toothing around its internal diameter and a hub that is externally toothed in a similar way. A series of cylindrical barrels, of hardened steel, are inserted in the holes formed by this toothing to act as power transmission elements.

Covers with their corresponding special seals serve to assure the perfect tightness of the inner zone, preventing the penetration of dust and guaranteeing the continuity of the necessary lubrication. Two double-lamina elastic rings mounted on the hub, one on each side of the toothing, limit the axial displacement of the barrels.

The convex shape of the barrels and the internal spaces of the toothing allows the oscillation of the hub relative to the sleeve, compensating angular misalignments of ± 1° 30' and an axial displacement that varies between ± 3 mm and ± 8 mm (see Table 4, page 8).

Torque is transmitted to the drum's receiving flange, generally by two diametrically opposed flat driving surfaces, located at the periphery of the coupling flange, and also by means of a series of bolts which, at the same time, serve as connection with the drum.

Other connection systems, such as adjusted spring pins or similar, can also be used following the adequate preparation of the flanges (see TCB with special flange on page 15).

The described design is appropriate for bearing large radial loads, as these are distributed over large barrel support surfaces. In the same way, this design also minimises the effect of alternative bending of the torque on the toothing, the latter being robust thanks to its low height and large bottom section. In addition to this, due to the effect of a "crush polishing" of the hardened barrel on the tooth profile, its wear resistance is appreciably improved.

An indicator located on the outer cover (Pos. 7, Fig. 3), which moves relative to the marks provided on the hub as a function of wear, permits control of internal wear of the toothing without the need to disassemble any part of the coupling. The same indicator also serves to control the axial position of the sleeve relative to the hub.

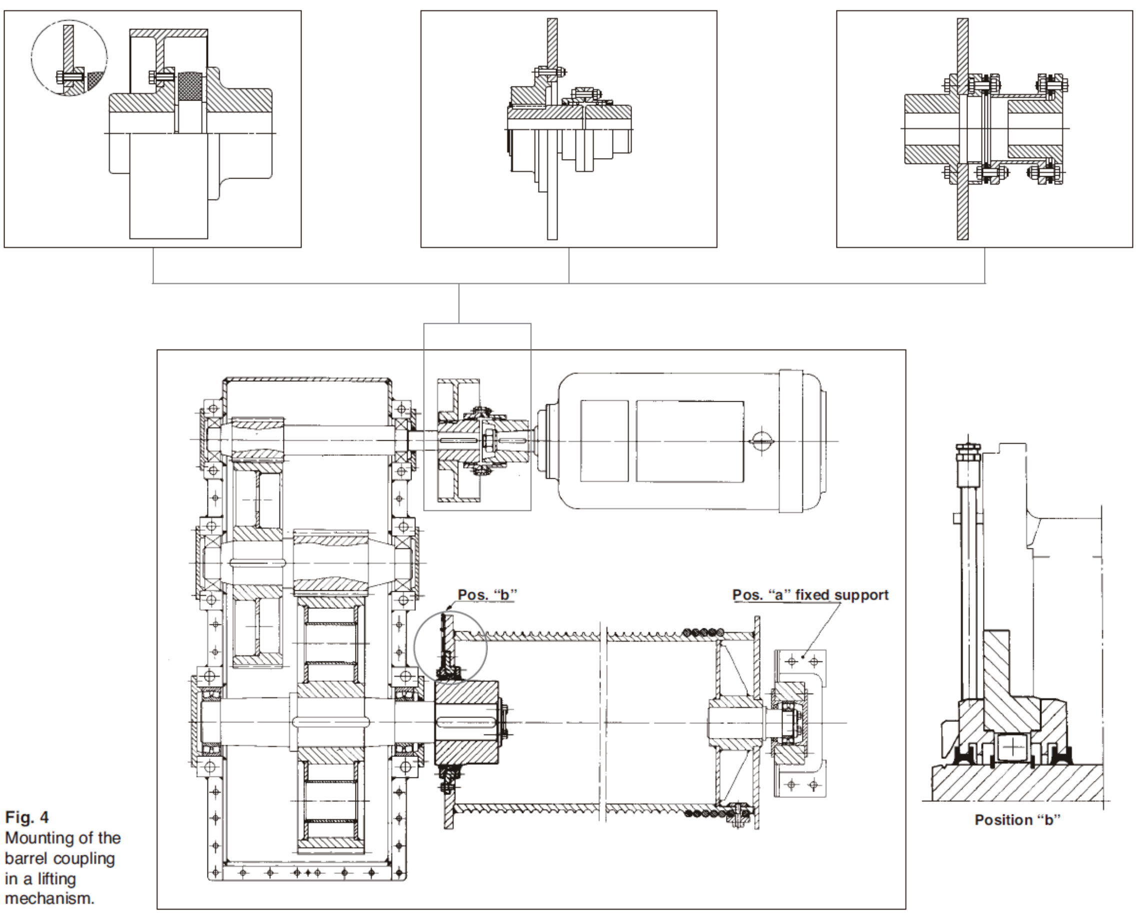



**Fig. 4**
Mounting of the barrel coupling in a lifting mechanism.

# Diameters and parameters

## Standard TCB

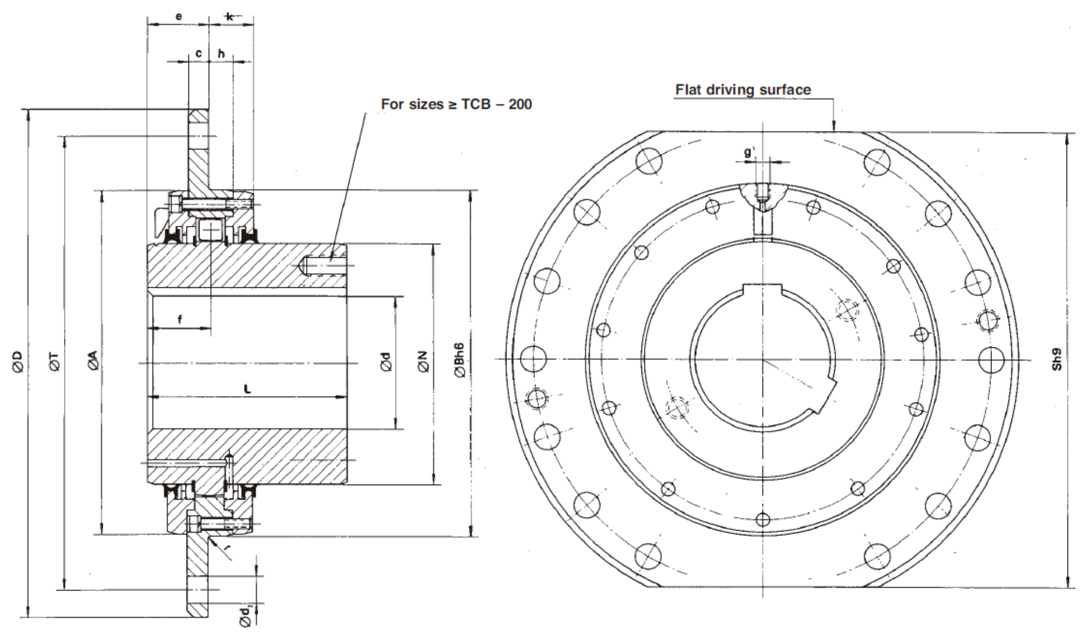



Fig. 9

**Table 4.** Technical data and general dimensions of the standard TCB

| TCB SIZE | TN (Nm) (1) | Fr (N) | d max. (2) | d min. | D | L | L min. | N | A | B | S | e | f | c | r | h | k | T | $d_1$ | Max. axial ± | Wt. (Kg) | J (Kg/m²) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 4.500 | 14.500 | 65 | 38 | 250 | 95 | 85 | 95 | 159 | 160 | 220 | 42 | 44 | 12 | 2,5 | 16 | 31 | 220 | 15 | 3 | 12 | 0,06 |
| 50 | 6.000 | 16.500 | 75 | 48 | 280 | 100 | 85 | 110 | 179 | 180 | 250 | 42 | 44 | 12 | 2,5 | 16 | 31 | 250 | 15 | 3 | 19 | 0,13 |
| 75 | 7.500 | 18.500 | 85 | 58 | 320 | 110 | 95 | 125 | 199 | 200 | 280 | 45 | 46 | 15 | 2,5 | 17 | 32 | 280 | 19 | 4 | 23 | 0,17 |
| 100 | 9.000 | 20.000 | 95 | 58 | 340 | 125 | 95 | 140 | 219 | 220 | 300 | 45 | 46 | 15 | 2,5 | 17 | 32 | 300 | 19 | 4 | 27 | 0,25 |
| 130 | 15.500 | 31.000 | 110 | 78 | 360 | 130 | 95 | 160 | 239 | 240 | 320 | 45 | 47 | 15 | 2,5 | 19 | 34 | 320 | 19 | 4 | 33 | 0,36 |
| 160 | 19.500 | 35.000 | 125 | 78 | 380 | 145 | 95 | 180 | 259 | 250 | 340 | 45 | 47 | 15 | 2,5 | 19 | 34 | 340 | 19 | 4 | 42 | 0,48 |
| 200 | 24.000 | 38.500 | 135 | 98 | 400 | 170 | 95 | 200 | 279 | 280 | 360 | 45 | 47 | 15 | 2,5 | 19 | 34 | 360 | 19 | 4 | 54 | 0,66 |
| 300 | 28.000 | 42.000 | 150 | 98 | 420 | 175 | 95 | 220 | 309 | 310 | 380 | 45 | 47 | 15 | 2,5 | 19 | 34 | 380 | 19 | 4 | 70 | 0,93 |
| 400 | 38.000 | 49.000 | 185 | 98 | 450 | 185 | 120 | 260 | 339 | 340 | 400 | 60 | 61 | 20 | 2,5 | 22 | 40 | 400 | 24 | 4 | 95 | 1,45 |
| 500 | 61.400 | 92.000 | 215 | 98 | 510 | 220 | 125 | 300 | 399 | 400 | 460 | 60 | 61 | 20 | 2,5 | 22 | 40 | 460 | 24 | 6 | 146 | 2,86 |
| 600 | 70.000 | 115.000 | 235 | 118 | 550 | 240 | 125 | 312 | 419 | 420 | 500 | 60 | 61 | 20 | 2,5 | 22 | 40 | 500 | 24 | 6 | 162 | 3,93 |
| 1.000 | 120.000 | 125.000 | 250 | 138 | 580 | 260 | 130 | 351 | 449 | 450 | 530 | 60 | 61 | 20 | 2,5 | 22 | 40 | 530 | 24 | 6 | 195 | 5,63 |
| 1.500 | 180.000 | 150.000 | 295 | 158 | 650 | 315 | 140 | 415 | 529 | 530 | 580 | 65 | 66 | 25 | 2,5 | 27 | 45 | 600 | 24 | 6 | 305 | 11 |
| 2.100 | 250.000 | 221.000 | 305 | 168 | 665 | 330 | 145 | 428 | 542 | 545 | 590 | 65 | 68 | 25 | 2,5 | 31 | 49 | 615 | 24 | 6 | 320 | 12,2 |
| 2.600 | 310.000 | 250.000 | 315 | 168 | 680 | 350 | 145 | 443 | 558 | 560 | 600 | 65 | 69,5 | 25 | 4 | 34 | 52 | 630 | 24 | 6 | 360 | 16 |
| 3.400 | 400.000 | 300.000 | 340 | 198 | 710 | 380 | 165 | 475 | 599 | 600 | 640 | 81 | 85,5 | 35 | 4 | 34 | 58 | 660 | 28 | 8 | 408 | 20 |
| 4.200 | 500.000 | 340.000 | 385 | 228 | 780 | 410 | 165 | 539 | 669 | 670 | 700 | 81 | 85,5 | 35 | 4 | 34 | 58 | 730 | 28 | 8 | 580 | 34 |
| 6.200 | 685.000 | 380.000 | 430 | 258 | 850 | 450 | 165 | 603 | 729 | 730 | 760 | 81 | 85,5 | 35 | 4 | 34 | 58 | 800 | 28 | 8 | 715 | 52 |

1) During start-up, couplings can admit 200% of nominal torque capacity.
2) Maximum bore diameters for execution with keyways according to DIN 6885/1. For other types of connections consult our Technical Department.
Maximum angular displacement of axes: ± 1° 30’
g = lubrication point
Up to size 160: R. 1/8” Gas, after size 200: R. 1/4” Gas.

Hoist Trolley and Bridge Couplings
Refer to drawings for configurations

# Gear Couplings

## ADVANTAGES:

**IMPROVED SOFT SEAL** offers superior sealing under misaligned conditions.

**UNIQUE TOOTH FORM** using a 40° pressure angle, distributes the load over a larger area than couplings which use a 20° pressure angle.

**FULL TOOTH ENGAGEMENT** reduces uneven wear on teeth that results in longer life plus improved performance.

**QUALITY EXPOSED FASTENERS** consists of SAE Grade 5 bolts with hex nuts and lock washers. Installation is simple, without special tools. Shrouded bolts optional.

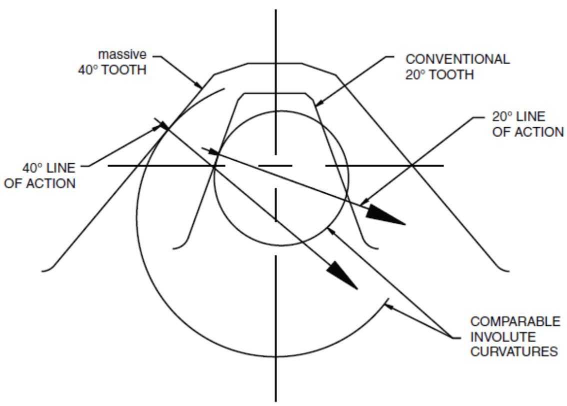
**CLEAR RUST INHIBITIVE AND CORROSION RESISTANT FINISH** protects coupling in normal industrial environments.

**AVAILABLE OFF-THE-SHELF** in reborables with large bore capabilities or stock finish bored.

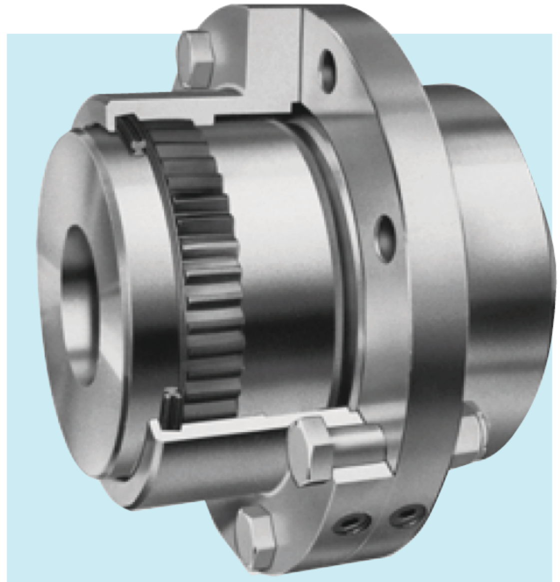
**OPTIONAL PILOT RINGS** provides positive register between identical halves. Eliminates selective assembly required in male, female sleeves.

**INTERCHANGEABLE** by half coupling with competitive coupling designs.

**HIGHER MISALIGNMENT CAPABILITY** sizes 1-7 compensate for up to ±1 1/2° static angular misalignment per gear mesh.




**20° vs. 40° Tooth Comparison on the same pitch diameter**



**Size 1-7**

**Advantages of the 40° Pressure Angle Tooth**

- **STRONGER TOOTH**
  The line of action of the force exerted at the pitch line of the new Performance Profile crosses the root circle near the center of the tooth rather than outside the tooth, as in the case of conventional gear teeth. The result is an appreciable reduction in root stress which helps protect against tooth failure.

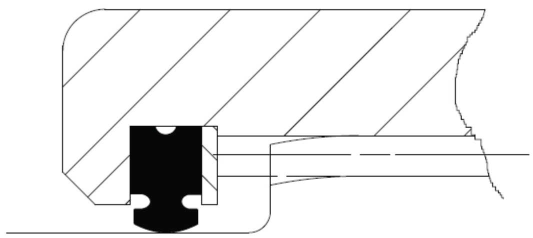
- **GREATER TOOTH CONTACT AREA**
  The profile of the tooth is significantly flatter due to the large involute radius of curvature. This causes the load to be distributed over a larger area. As a result, compressive stresses, lubricant film pressure and tooth wear are minimized.

- **GREATER SLEEVE CENTERING ABILITY**
  The 40° pressure angle tooth produces greater radial forces which helps to maintain sleeve concentricity with respect to the axis of rotation. As a result, inherent unbalance and centrifugal forces are minimized and a smooth and efficient operation is imparted to the coupling.

- **INCREASED ARC OF CONTACT**
  With the 40° pressure angle tooth there is less tendency for some of the teeth to lose contact during misalignment. This prevents a drastic reduction in torque rating with increased misalignment.

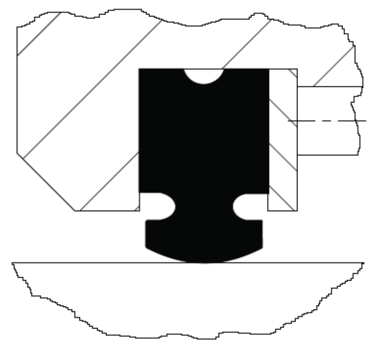
- **INCREASED STRENGTH AND DURABILITY**
  Under maximum loading and misaligned conditions, the stronger tooth, the greater intimacy between the teeth and the increased arc of contact all combine to produce a coupling unit that is additionally rugged and efficiently useful for longer periods of time.

## FULL ENGAGEMENT TEETH



The gear coupling has been designed with full length tooth engagement with the inherent result of longer life and improved performance.

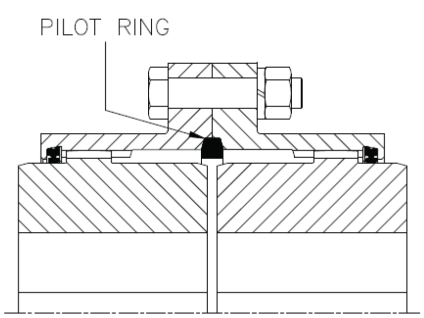
## HIGH MISALIGNMENT SEAL



Competitive gear couplings incorporate an O-ring seal. In order to conform with today's high misalignment capacities, this O-ring must fit into a groove that is larger than the ring. couplings use a truly high misalignment seal that seals remarkably under misaligned conditions.

## Optional Pilot Rings

The standard coupling consists of two identical half couplings. Optional precision steel pilot rings are available when more accurate centering of the two sleeves is required.

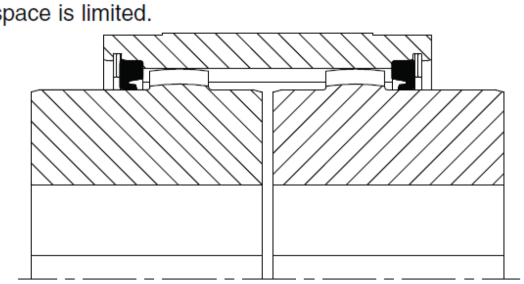



| Basic Coupling Size | Pilot Ring Part No. | Wt. (lb.) |
|---|---|---|
| 1 | 1W PR | .06 |
| 1 1/2 | 1 1/2W PR | .09 |
| 2 | 2W PR | .12 |
| 2 1/2 | 2 1/2W PR | .21 |
| 3 | 3W PR | .25 |
| 3 1/2 | 3 1/2W PR | .25 |
| 4 | 4W PR | .98 |
| 4 1/2 | 4 1/2W PR | 1.1 |
| 5 | 5W PR | 1.2 |
| 5 1/2 | 5 1/2W PR | 1.5 |
| 6 | 6W PR | 1.9 |
| 7 | 7W PR | 2.9 |

## POWERLIGN

This flangeless design transmits identical torques as the standard Coupling. Having a smaller outside diameter, however, it is more compact, lighter, and can run at greater speeds.

This alternative may be selected for applications where space is limited.



# Service Factors

Values listed are intended only as a general guide, and are typical of usual service requirements. For systems which frequently utilize the peak torque capability of the power source, verify that the magnitude of this peak torque does not exceed the 1.0 Service Factor Rating of the coupling selected. Applications which involve extreme repetitive shock or high-energy load absorption characteristics should be referred — with full particulars — to

Values contained in the table are to be applied to smooth power sources such as electric motors and steam turbines. For drives involving internal combustion engines of four or five cylinders, add 1.0 to the values listed; for six or more cylinders, add 0.5 to the values listed. For systems utilizing AC or DC Mill Motors as the prime mover, refer to Note (1).

**⚠CAUTION** All peoplemoving applications must be referred to engineering.

| Application | Typical Service Factor |
|---|---|
| **AGITATORS** | |
| Pure Liquids | 1.0 |
| Liquids & Solids | 1.25 |
| Liquids — Variable Density | 1.25 |
| **BLOWERS** | |
| Centrifugal | 1.0 |
| Lobe | 1.5 |
| Vane | 1.25 |
| **BRIQUETTE MACHINES** | 2.0 |
| **CAR PULLERS** — Intermittent Duty | 1.5 |
| **COMPRESSORS** | |
| Centrifugal | 1.0 |
| Centriaxial | 1.25 |
| Lobe | 1.5 |
| Reciprocating — Multi-Cylinder | 2.0 |
| **CONVEYORS — LIGHT DUTY UNIFORMLY FED** | |
| Apron, Bucket, Chain, Flight, Screw | 1.25 |
| Assembly, Belt | 1.0 |
| Oven | 1.5 |
| **CONVEYORS — HEAVY DUTY NOT UNIFORMLY FED** | |
| Apron, Bucket, Chain, Flight, Oven | 1.5 |
| Assembly, Belt | 1.25 |
| Reciprocating, Shaker | 2.5 |
| **CRANES AND HOISTS (NOTE 1 and 2)** | |
| Main hoists, Reversing | 2.5 |
| Skip Hoists, Trolley & Bridge Drives | 2.0 |
| Slope | 2.0 |
| **CRUSHERS** | |
| Ore, Stone | 3.0 |
| **DREDGES** | |
| Cable Reels | 1.75 |
| Conveyors | 1.5 |
| Cutter Head Jig Drives | 2.5 |
| Maneuvering Winches | 1.75 |
| Pumps | 1.75 |
| Screen Drives | 1.75 |
| Stackers | 1.75 |
| Utility Winches | 1.5 |
| **ELEVATORS (NOTE 2)** | |
| Bucket | 1.75 |
| Centrifugal & Gravity Discharge | 1.5 |
| Escalators | 1.5 |
| Freight | 2.5 |
| **FANS** | |
| Centrifugal | 1.0 |
| Cooling Towers | 1.5 |
| Forced Draft | 1.5 |
| Induced Draft without Damper Control | 2.0 |
| **FEEDERS** | |
| Apron, Belt, Disc, Screw | 1.25 |
| Reciprocating | 2.5 |

| Application | Typical Service Factor |
|---|---|
| **GENERATORS** — (Not Welding) | 1.0 |
| **HAMMER MILLS** | 2.0 |
| **LAUNDRY WASHERS** — Reversing | 2.0 |
| **LAUNDRY TUMBLERS** | 2.0 |
| **LINE SHAFT** | 1.5 |
| **LUMBER INDUSTRY** | |
| Barkers — Drum Type | 2.0 |
| Edger Feed | 2.0 |
| Live Rolls | 2.0 |
| Log Haul — Incline | 2.0 |
| Log Haul — Well type | 2.0 |
| Off Bearing Rolls | 2.0 |
| Planer Feed Chains | 1.75 |
| Planer Floor Chains | 1.75 |
| Planer Tilting Hoist | 1.75 |
| Slab Conveyor | 1.5 |
| Sorting Table | 1.5 |
| Trimmer Feed | 1.75 |
| **MARINE PROPULSION** | |
| Main Drives | 2.0 |
| **MACHINE TOOLS** | |
| Bending Roll | 2.0 |
| Plate Planer | 1.5 |
| Punch Press — Gear Driven | 2.0 |
| Tapping Machines | 2.5 |
| Other Machine Tools | |
| Main Drives | 1.5 |
| Auxiliary Drives | 1.25 |
| **METAL MILLS** | |
| Draw Bench — Carriage | 2.0 |
| Draw Bench — Main Drive | 2.0 |
| Forming Machines | 2.0 |
| Slitters | 1.5 |
| Table Conveyors | |
| Non-Reversing | 2.25 |
| Reversing | 2.5 |
| Wire Drawing & Flattening Machine | 2.0 |
| Wire Winding Machine | 1.75 |
| **METAL ROLLING MILLS (NOTE 1)** | |
| Blooming Mills | * |
| Coilers, hot mill | 2.0 |
| Coilers, cold mill | 1.25 |
| Cold Mills | 2.0 |
| Cooling Beds | 1.75 |
| Door Openers | 2.0 |
| Draw Benches | 2.0 |
| Edger Drives | 1.75 |
| Feed Rolls, Reversing Mills | 3.5 |
| Furnace Pushers | 2.5 |
| Hot Mills | 3.0 |
| Ingot Cars | 2.5 |
| Kick-outs | 2.5 |
| Manipulators | 3.0 |
| Merchant Mills | 3.0 |
| Piercers | 3.0 |
| Pusher Rams | 2.5 |
| Reel Drives | 1.75 |
| Reel Drums | 2.0 |
| Reelers | 3.0 |
| Rod and Bar Mills | 1.5 |
| Roughing Mill Delivery Table | 3.0 |
| Runout Tables | |
| Reversing | 3.0 |
| Non-Reversing | 2.0 |
| Saws, hot & cold | 2.5 |
| Screwdown Drives | 3.0 |
| Skelp Mills | 3.0 |
| Slitters | 3.0 |
| Slabbing Mills | 3.0 |
| Soaking Pit Cover Drives | 3.0 |
| Straighteners | 2.5 |
| Tables, transfer & runout | 2.0 |
| Thrust Block | 3.0 |
| Traction Drive | 3.0 |
| Tube Conveyor Rolls | 2.5 |
| Unscramblers | 2.5 |
| Wire Drawing | 1.5 |
| **MILLS, ROTARY TYPE** | |
| Ball | 2.25 |
| Dryers & Coolers | 2.0 |
| Hammer | 1.75 |
| Kilns | 2.0 |

| Application | Typical Service Factor |
|---|---|
| Pebble & Rod | 2.0 |
| Pug | 1.75 |
| Tumbling Barrels | 2.0 |
| **MIXERS** | |
| Concrete Mixers | 1.75 |
| Drum Type | 1.5 |
| **OIL INDUSTRY** | |
| Chillers | 1.25 |
| Paraffin Filter Press | 1.75 |
| **PAPER MILLS** | |
| Barker Auxiliaries, Hydraulic | 2.0 |
| Barker, Mechanical | 2.0 |
| Barking Drum Spur Gear Only | 2.25 |
| Beater & Pulper | 1.75 |
| Bleacher | 1.0 |
| Calenders | 2.0 |
| Chippers | 2.5 |
| Coaters | 1.0 |
| Converting Machines, except Cutters, Platers | 1.5 |
| Couch Roll | 1.75 |
| Cutters, Platers | 2.0 |
| Cylinders | 1.75 |
| Disc Refiners | 1.75 |
| Dryers | 1.75 |
| Felt Stretcher | 1.25 |
| Felt Whipper | 2.0 |
| Jordans | 1.75 |
| Line Shaft | 1.5 |
| Log Haul | 2.0 |
| Pulp Grinder | 1.75 |
| Press Roll | 2.0 |
| Reel | 1.5 |
| Stock Chests | 1.5 |
| Suction Roll | 1.75 |
| Washers & Thickeners | 1.5 |
| Winders | 1.5 |
| **PRINTING PRESSES** | 1.5 |
| **PULLERS** — Barge Haul | 2.0 |
| **PUMPS** | |
| Centrifugal | 1.0 |
| Boiler Feed | 1.5 |
| Reciprocating | |
| Single Acting | |
| 1 or 2 Cylinders | 2.25 |
| 3 or more Cylinders | 1.75 |
| Double Acting | 2.0 |
| Rotary, Gear, Lobe, Vane | 1.5 |
| **RUBBER INDUSTRY** | |
| Mixer — Banbury | 2.5 |
| Rubber Calendar | 2.0 |
| Rubber Mill (2 or more) | 2.25 |
| Sheeter | 2.0 |
| Tire Building Machines | 2.5 |
| Tire & Tube Press Openers | 1.0 |
| Tubers & Strainers | 2.0 |
| **SCREENS** | |
| Air Washing | 1.0 |
| Grizzly | 2.0 |
| Rotary — Stone or Gravel | 1.5 |
| Traveling Water Intake | 1.25 |
| Vibrating | 2.5 |
| **SEWAGE DISPOSAL EQUIPMENT** | |
| Bar Screens | 1.25 |
| Chemical Feeders | 1.25 |
| Collectors, Circuline or Straightline | 1.25 |
| Dewatering Screens | 1.25 |
| Grit Collectors | 1.25 |
| Scum Breakers | 1.25 |
| Slow or Rapid Mixers | 1.25 |
| Sludge Collectors | 1.25 |
| Thickeners | 1.25 |
| Vacuum Filters | 1.25 |
| **STEERING GEAR** | 1.0 |
| **STOKERS** | 1.0 |
| **WINCH** | 1.5 |
| **WINDLASS** | 1.75 |

* Refer to KOP-FLEX

NOTES
(1) Maximum Torque at the coupling must not exceed Rated Torque of the coupling.
(2) Check local and industrial safety codes.

# Selection Procedure

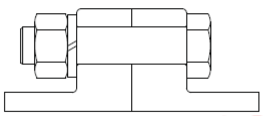
1. **Select Coupling Based on Bore Capacity.** Select the coupling size that has a maximum bore capacity equal to or larger than the larger of the two shafts. For interference fits larger than AGMA standards, consult KOP-FLEX.
2. **Verify Coupling Size Based on Load Rating.**
   a. Select the appropriate Service Factor from the Table on page 194.
   b. Calculate required HP / 100 RPM:

   $$\frac{\text{HP x Service Factor x 100}}{\text{RPM}} = \text{HP / 100 RPM}$$

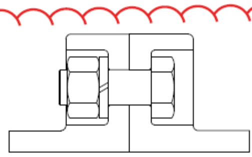
   c. Verify that the selected coupling has a rating greater than or equal to the required HP / 100 RPM.
3. **Check Balance Requirements.** Consult the Dynamic Balancing Guide on page 163 to help determine if balancing is required. Verify that the maximum operating speed does not exceed the maximum speed rating of the coupling. The maximum speed rating does not consider lateral critical speed considerations for floating shaft applications. WALDRON® couplings are available component balanced only.

**Note: Care must be exercised on proper selection of any shaft coupling. The Users must assure themselves that the design of the shaft to coupling hub connection is adequate for the duty intended.**

# Fastener Data



TYPE EB - EXPOSED BOLTS



TYPE SB - SHROUDED BOLTS

| Coupling Size | Type EB Exposed Bolt | | | Type SB Shrouded Bolt | | |
|---|---|---|---|---|---|---|
| | Qty. | Size & Length | Bolt Circle | Qty. | Size & Length | Bolt Circle |
| 1 | 6 | 1/4 x 1 1/2 | 3 3/4 | 6 | 1/4 x 7/8 | 3 3/4 |
| 1 1/2 | 8 | 3/8 x 2 | 4 13/16 | 8 | 3/8 x 1 | 4 13/16 |
| 2 | 6 | 1/2 x 2 1/2 | 5 7/8 | 10 | 3/8 x 1 | 5 13/16 |
| 2 1/2 | 6 | 5/8 x 2 3/4 | 7 1/8 | 10 | 1/2 x 1 5/16 | 7 |
| 3 | 8 | 5/8 x 2 3/4 | 8 1/8 | 12 | 1/2 x 1 5/16 | 8 |
| 3 1/2 | 8 | 3/4 x 3 3/8 | 9 1/2 | 12 | 5/8 x 1 5/8 | 9 9/32 |
| 4 | 8 | 3/4 x 3 3/8 | 11 | 14 | 5/8 x 1 5/8 | 10 5/8 |
| 4 1/2 | 10 | 3/4 x 3 3/8 | 12 | 14 | 5/8 x 1 5/8 | 11 3/4 |
| 5 | 8 | 7/8 x 4 1/4 | 13 1/2 | 14 | 3/4 x 2 1/8 | 13 3/16 |
| 5 1/2* | 14 | 7/8 x 3 1/4 | 14 1/2 | - | - | - |
| 6* | 14 | 7/8 x 3 1/4 | 15 3/4 | - | - | - |
| 7* | 16 | 1 x 3 5/8 | 18 1/4 | - | - | - |

Sizes #5 1/2 and larger are available in exposed bolts only.

# HOW TO ORDER

## PART NUMBER EXPLANATION
## Complete Rough Bore Coupling

| | |
|---|---|
| Coupling Size | (1 to 7) |
| Coupling Style | (W = Waldron) |
| Bolt Type | (EB = Exposed Bolt<br>SB = Shrouded Bolt) |
| Coupling Type | (FF = Full Flex<br>FR = Flex Rigid<br>SSFF = Short Slide Full Flex<br>MSFF = Medium Slide Full Flex) |

1 1/2W EB FF

## Coupling Parts

Description

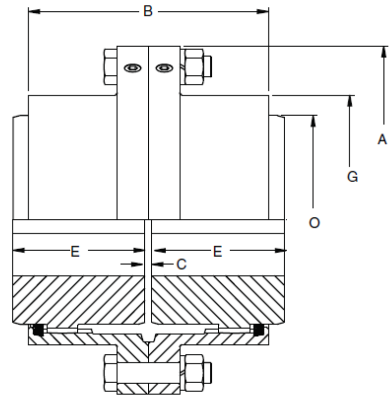
*FHUB = Flex Hub
*VHUB = Vertical Hub
*RHUB = Rigid Hub
SLEEVE = Standard Sleeve
FS = Fastener Set (w/gasket)
LEFD = LEF Disk
SPRxxx = Spacer for x.xx shaft separation
SP = Stop Plate for Slide Couplings
VP = Vertical Plate

* For finish bored hubs, add FB and bore size. All finish bores and keyways per AGMA 9002-A86 with interference fits. Clearance bores are available on request with one setscrew over keyway.

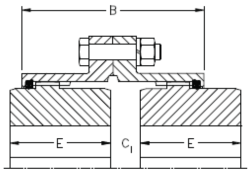
1 1/2W FHUB FB

Hoist coupling

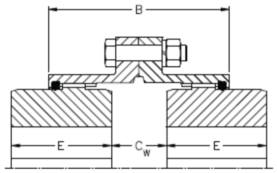
## Full Flex Coupling Size 1-7




A conventional 4-bearing system has two bearings on the driving shaft and two bearings on the driven shaft. Both angular and offset shaft misalignment will be present to some degree and a full flex coupling is mandatory. The full flex coupling is the standard coupling having two gear ring sets, one set per half coupling. For selection procedure see page 195.




ONE HUB REVERSED




TWO HUBS REVERSED

| Coupling Size | Maximum Bore with Standard Key | Rating HP / 100 RPM | Torque Rating (lb.-in.) | Peak Torque Rating (lb.-in.) | Maximum Speed (RPM) | Dimensions | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | A | B | C | $C_I$ | $C_W$ | E | G | O |
| 1 | 1 5/8 | 10 | 6300 | 12600 | 10000 | 4 9/16 | 3 3/16 | 1/8 | 3/8 | 5/8 | 1 11/16 | 3 | 2 5/16 |
| 1 1/2 | 2 3/16 | 24 | 15100 | 30200 | 7400 | 6 | 3 7/8 | 1/8 | 9/16 | 1 | 2 1/16 | 3 13/16 | 3 1/8 |
| 2 | 2 3/4 | 50 | 31500 | 63000 | 5900 | 7 | 4 5/8 | 1/8 | 13/16 | 1 1/2 | 2 7/16 | 4 13/16 | 4 |
| 2 1/2 | 3 1/4 | 90 | 56700 | 113400 | 5000 | 8 3/8 | 5 11/16 | 3/16 | 29/32 | 1 5/8 | 3 1/32 | 5 23/32 | 4 23/32 |
| 3 | 4 | 150 | 94500 | 189000 | 4300 | 9 7/16 | 6 9/16 | 3/16 | 1 1/32 | 1 7/8 | 3 19/32 | 6 23/32 | 5 5/8 |
| 3 1/2 | 4 3/4 | 230 | 145000 | 290000 | 3900 | 11 | 7 5/8 | 1/4 | 1 5/16 | 2 3/8 | 4 3/16 | 7 3/4 | 6 5/8 |
| 4 | 5 3/8 | 350 | 221000 | 442000 | 3500 | 12 1/2 | 8 5/8 | 1/4 | 1 7/16 | 2 5/8 | 4 3/4 | 8 31/32 | 7 1/2 |
| 4 1/2 | 6 | 480 | 300000 | 600000 | 3200 | 13 5/8 | 9 5/8 | 5/16 | 1 5/8 | 2 15/16 | 5 3/8 | 10 1/8 | 8 1/2 |
| 5 | 6 3/4 | 650 | 410000 | 820000 | 2900 | 15 5/16 | 10 13/16 | 5/16 | 1 11/16 | 3 1/16 | 6 1/8 | 11 3/8 | 9 1/2 |
| 5 1/2* | 7 1/2 | 850 | 536000 | 1072000 | 2700 | 16 3/4 | 11 5/8 | 5/16 | 1 7/8 | 3 7/16 | 6 5/8 | 12 9/16 | 10 27/64 |
| 6* | 8 1/4 | 1100 | 693000 | 1386000 | 2500 | 18 | 13 1/4 | 5/16 | 2 5/16 | 4 5/16 | 7 3/8 | 13 7/8 | 11 3/4 |
| 7* | 9 1/4 | 1600 | 1010000 | 2020000 | 2200 | 20 3/4 | 14 3/4 | 3/8 | 2 3/16 | 4 | 8 11/16 | 15 3/4 | 13 1/4 |

* Sizes 5 1/2, 6 and 7 are only available with exposed bolt sleeves. Type EB exposed bolt sleeves are standard.

### Coupling Type EB (Exposed Bolts) Part Numbers

| Coupling Size | Full Flex Coupling | | | Fastener Set (Includes Gasket) | | Sleeve | | Flex Hub | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No Bore Part No. | Wt. | Finish Bore① Part No. | Part No. | Wt. | Part No. | Wt. | No Bore Part No. | Wt. | Finish Bore① Part No. |
| 1 | 1W EB FF | 10 | 1W EB FF FB | 1 EB FS | 1 | 1W EB SLEEVE | 2 | 1W FHUB | 3 | 1W FHUB FB |
| 1 1/2 | 1 1/2W EB FF | 19 | 1 1/2W EB FF FB | 1 1/2 EB FS | 1 | 1 1/2W EB SLEEVE | 6 | 1 1/2W FHUB | 3 | 1 1/2W FHUB FB |
| 2 | 2W EB FF | 30 | 2W EB FF FB | 2 EB FS | 1 | 2W EB SLEEVE | 8 | 2W FHUB | 7 | 2W FHUB FB |
| 2 1/2 | 2 1/2W EB FF | 52 | 2 1/2W EB FF FB | 2 1/2 EB FS | 2 | 2 1/2W EB SLEEVE | 14 | 2 1/2W FHUB | 12 | 2 1/2W FHUB FB |
| 3 | 3W EB FF | 76 | 3W EB FF FB | 3 EB FS | 3 | 3W EB SLEEVE | 17 | 3W FHUB | 20 | 3W FHUB FB |
| 3 1/2 | 3 1/2W EB FF | 117 | 3 1/2W EB FF FB | 3 1/2 EB FS | 5 | 3 1/2W EB SLEEVE | 28 | 3 1/2W FHUB | 28 | 3 1/2W FHUB FB |
| 4 | 4W EB FF | 180 | 4W EB FF FB | 4 EB FS | 5 | 4W EB SLEEVE | 41 | 4W FHUB | 47 | 4W FHUB FB |
| 4 1/2 | 4 1/2W EB FF | 244 | 4 1/2W EB FF FB | 4 1/2 EB FS | 7 | 4 1/2W EB SLEEVE | 53 | 4 1/2W FHUB | 66 | 4 1/2W FHUB FB |
| 5 | 5W EB FF | 361 | 5W EB FF FB | 5 EB FS | 9 | 5W EB SLEEVE | 80 | 5W FHUB | 96 | 5W FHUB FB |
| 5 1/2 | 5 1/2W EB FF | 422 | 5 1/2W EB FF FB | 5 1/2 EB FS | 14 | 5 1/2W EB SLEEVE | 89 | 5 1/2W FHUB | 115 | 5 1/2W FHUB FB |
| 6 | 6W EB FF | 494 | 6W EB FF FB | 6 EB FS | 14 | 6W EB SLEEVE | 100 | 6W FHUB | 140 | 6W FHUB FB |
| 7 | 7W EB FF | 822 | 7W EB FF FB | 7 EB FS | 22 | 7W EB SLEEVE | 160 | 7W FHUB | 240 | 7W FHUB FB |

① All finish bores and keyways per AGMA 9002-A86 commercial standard tolerances with interference fit bores. Clearance fit bores are available on request and include one setscrew over keyway.

### Coupling Type SB (Shrouded Bolts) Part Numbers

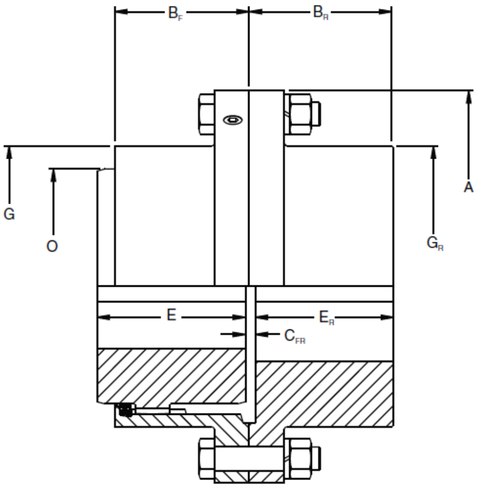
| Coupling Size | Full Flex Coupling | | | Fastener Set (Includes Gasket) | | Sleeve | | Flex Hub | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No Bore Part No. | Wt. | Finish Bore① Part No. | Part No. | Wt. | Part No. | Wt. | No Bore Part No. | Wt. | Finish Bore① Part No. |
| 1 | 1W SB FF | 10 | 1W SB FF FB | 1 SB FS | 1 | 1W SB SLEEVE | 2 | 1W FHUB | 3 | 1W FHUB FB |
| 1 1/2 | 1 1/2W SB FF | 19 | 1 1/2W SB FF FB | 1 1/2 SB FS | 1 | 1 1/2W SB SLEEVE | 6 | 1 1/2W FHUB | 3 | 1 1/2W FHUB FB |
| 2 | 2W SB FF | 30 | 2W SB FF FB | 2 SB FS | 1 | 2W SB SLEEVE | 8 | 2W FHUB | 7 | 2W FHUB FB |
| 2 1/2 | 2 1/2W SB FF | 52 | 2 1/2W SB FF FB | 2 1/2 SB FS | 2 | 2 1/2W SB SLEEVE | 13 | 2 1/2W FHUB | 12 | 2 1/2W FHUB FB |
| 3 | 3W SB FF | 76 | 3W SB FF FB | 3 SB FS | 2 | 3W SB SLEEVE | 15 | 3W FHUB | 20 | 3W FHUB FB |
| 3 1/2 | 3 1/2W SB FF | 117 | 3 1/2W SB FF FB | 3 1/2 SB FS | 4 | 3 1/2W SB SLEEVE | 26 | 3 1/2W FHUB | 28 | 3 1/2W FHUB FB |
| 4 | 4W SB FF | 180 | 4W SB FF FB | 4 SB FS | 4 | 4W SB SLEEVE | 37 | 4W FHUB | 47 | 4W FHUB FB |
| 4 1/2 | 4 1/2W SB FF | 244 | 4 1/2W SB FF FB | 4 1/2 SB FS | 4 | 4 1/2W SB SLEEVE | 50 | 4 1/2W FHUB | 66 | 4 1/2W FHUB FB |
| 5 | 5W SB FF | 361 | 5W SB FF FB | 5 SB FS | 7 | 5W SB SLEEVE | 72 | 5W FHUB | 96 | 5W FHUB FB |

① All finish bores and keyways per AGMA 9002-A86 commercial standard tolerances with interference fit bores. Clearance fit bores are available on request and include one setscrew over keyway.

Bridge and trolley couplings

# Flex Rigid and Floating Shaft Couplings
## Size 1- 7

When driving and driven shafts are widely separated, an unsupported or floating shaft is used to span the gap. The two couplings required at each end of that shaft consist of one half of a standard coupling bolted to a Rigid Hub, each unit called a Flex-Rigid Coupling. Usually, the rigid hubs are mounted on the driving and driven shafts so that the flex halves on the floating shaft may be replaced without disturbing the connected equipment.




### Coupling Type EB (Exposed Bolts) Part Numbers

| Coupling Size | Flex Rigid Coupling | | | Rigid Hub② | | |
|---|---|---|---|---|---|---|
| | No Bore Part No. | Wt. | Finish Bore① Part No. | No Bore Part No. | Wt. | Finish Bore① Part No. |
| 1 | 1W EB FR | 10 | 1W EB FR FB | 1 EB RHUB | 5 | 1 EB RHUB FB |
| 1 1/2 | 1 1/2W EB FR | 19 | 1 1/2W EB FR FB | 1 1/2 EB RHUB | 9 | 1 1/2 EB RHUB FB |
| 2 | 2W EB FR | 31 | 2W EB FR FB | 2 EB RHUB | 15 | 2 EB RHUB FB |
| 2 1/2 | 2 1/2W EB FR | 55 | 2 1/2W EB FR FB | 2 1/2 EB RHUB | 27 | 2 1/2 EB RHUB FB |
| 3 | 3W EB FR | 83 | 3W EB FR FB | 3 EB RHUB | 40 | 3 EB RHUB FB |
| 3 1/2 | 3 1/2W EB FR | 126 | 3 1/2W EB FR FB | 3 1/2 EB RHUB | 65 | 3 1/2 EB RHUB FB |
| 4 | 4W EB FR | 184 | 4W EB FR FB | 4 EB RHUB | 90 | 4 EB RHUB FB |
| 4 1/2 | 4 1/2W EB FR | 252 | 4 1/2W EB FR FB | 4 1/2 EB RHUB | 124 | 4 1/2 EB RHUB FB |
| 5 | 5W EB FR | 371 | 5W EB FR FB | 5 EB RHUB | 119 | 5 EB RHUB FB |
| 5 1/2 | 5 1/2W EB FR | 418 | 5 1/2W EB FR FB | 5 1/2 EB RHUB | 200 | 5 1/2 EB RHUB FB |
| 6 | 6W EB FR | 504 | 6W EB FR FB | 6 EB RHUB | 250 | 6 EB RHUB FB |
| 7 | 7W EB FR | 792 | 7W EB FR FB | 7 EB RHUB | 370 | 7 EB RHUB FB |

### Coupling Type SB (Shrouded Bolts) Part Numbers

| Coupling Size | Flex Rigid Coupling | | | Rigid Hub② | | |
|---|---|---|---|---|---|---|
| | No Bore Part No. | Wt. | Finish Bore① Part No. | No Bore Part No. | Wt. | Finish Bore① Part No. |
| 1 | 1W SB FR | 10 | 1W SB FR FB | 1 SB RHUB | 5 | 1 SB RHUB FB |
| 1 1/2 | 1 1/2W SB FR | 19 | 1 1/2W SB FR FB | 1 1/2 SB RHUB | 9 | 1 1/2 SB RHUB FB |
| 2 | 2W SB FR | 31 | 2W SB FR FB | 2 SB RHUB | 15 | 2 SB RHUB FB |
| 2 1/2 | 2 1/2W SB FR | 55 | 2 1/2W SB FR FB | 2 1/2 SB RHUB | 27 | 2 1/2 SB RHUB FB |
| 3 | 3W SB FR | 83 | 3W SB FR FB | 3 SB RHUB | 40 | 3 SB RHUB FB |
| 3 1/2 | 3 1/2W SB FR | 126 | 3 1/2W SB FR FB | 3 1/2 SB RHUB | 65 | 3 1/2 SB RHUB FB |
| 4 | 4W SB FR | 184 | 4W SB FR FB | 4 SB RHUB | 90 | 4 SB RHUB FB |
| 4 1/2 | 4 1/2W SB FR | 252 | 4 1/2W SB FR FB | 4 1/2 SB RHUB | 124 | 4 1/2 SB RHUB FB |
| 5 | 5W SB FR | 371 | 5W SB FR FB | 5 SB RHUB | 119 | 5 SB RHUB FB |

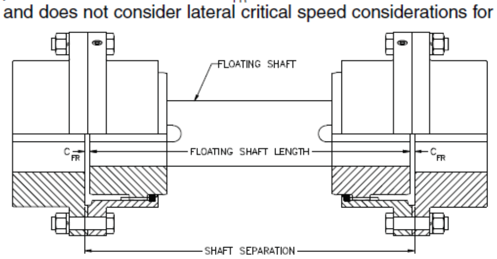
① All finish bores and keyways per AGMA 9002-A86 commercial standard tolerances.
② Rigid hubs are furnished less fasteners.

### Flex-Rigid Coupling Data

| Coupling Size | Maximum Bore with Standard Keyway | | Rating HP / 100 RPM | Torque Rating (lb.-in.) | Peak Torque Rating (lb.-in.) | Maximum Speed (RPM) ② | Dimensions | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flex | Rigid | | | | | A | $B_F$ | $B_R$ | $C_{FR}$ ① | E | $E_R$ | $G_R$ |
| 1 | 1 5/8 | 2 1/4 | 10 | 6300 | 12600 | 10000 | 4 9/16 | 1 19/32 | 1 21/32 | 5/32 | 1 11/16 | 1 9/16 | 3 |
| 1 1/2 | 2 3/16 | 2 11/16 | 24 | 15100 | 30200 | 7400 | 6 | 1 15/16 | 1 15/16 | 5/32 | 2 1/16 | 1 27/32 | 3 13/16 |
| 2 | 2 3/4 | 3 3/8 | 50 | 31500 | 63000 | 5900 | 7 | 4 5/8 | 2 3/8 | 5/32 | 2 7/16 | 2 9/32 | 4 13/16 |
| 2 1/2 | 3 1/4 | 4 | 90 | 56700 | 113400 | 5000 | 8 3/8 | 5 11/16 | 3 | 3/16 | 3 1/32 | 2 29/32 | 5 3/4 |
| 3 | 4 | 4 3/4 | 150 | 94500 | 189000 | 4300 | 9 7/16 | 6 9/16 | 3 9/16 | 3/16 | 3 19/32 | 3 15/32 | 6 3/4 |
| 3 1/2 | 4 3/4 | 5 1/2 | 230 | 145000 | 290000 | 3900 | 11 | 7 5/8 | 4 1/8 | 7/32 | 4 3/16 | 4 1/32 | 7 3/4 |
| 4 | 5 3/8 | 6 3/8 | 350 | 221000 | 442000 | 3500 | 12 1/2 | 8 5/8 | 4 5/8 | 5/16 | 4 3/4 | 4 7/16 | 9 |
| 4 1/2 | 6 | 7 1/4 | 480 | 300000 | 600000 | 3200 | 13 5/8 | 9 5/8 | 5 1/4 | 11/32 | 5 3/8 | 5 1/16 | 10 1/8 |
| 5 | 6 3/4 | 8 1/2 | 650 | 410000 | 820000 | 2900 | 15 5/16 | 10 13/16 | 5 7/8 | 11/32 | 6 1/8 | 5 11/16 | 11 3/8 |
| 5 1/2* | 7 1/2 | 8 | 850 | 536000 | 1072000 | 2700 | 16 3/4 | 11 5/8 | 7 5/32 | 11/32 | 6 5/8 | 6 31/32 | 10 3/4 |
| 6* | 8 1/4 | 8 3/4 | 1100 | 693000 | 1386000 | 2500 | 18 | 13 1/4 | 7 21/32 | 11/32 | 7 3/8 | 7 15/32 | 11 1/2 |
| 7* | 9 1/4 | 10 | 1600 | 1010000 | 2020000 | 2200 | 20 3/4 | 14 3/4 | 9 | 7/16 | 8 11/16 | 8 3/4 | 13 3/8 |

* Sizes 5 1/2, 6 and 7 are only available with exposed bolts. Type EB exposed bolts are standard.
① Floating shaft length is equal to the shaft separation minus 2 times the $C_{FR}$ dimension.
② Max. speed is based on flange stress limits and does not consider lateral critical speed considerations for floating shaft applications.

FLOATING SHAFT ASSEMBLY




**Ordering Instructions:** **When ordering floating shaft couplings, be sure to include hp and rpm, shaft separation, and equipment shaft sizes. Applications with very large shaft separations and/or high speeds may require tubular floating shafts due to lateral critical speed concerns.**

**Important:** Care must be exercised in proper selection of any shaft coupling. The Users must assure themselves that the design of the shaft to coupling hub connection is adequate for the duty intended.

**198**

iv. Gearboxes

# Speed Reducers: designed for dependability

## Advanced Features

Hoist Gearbox

All-steel housings and components, generous plate thicknesses for rigid alignment.

Clean, smart-looking exterior with high-stability base design.

Top and bottom lifting lugs for handling case.

Splash-and-trough lubrication — simple, effective, reliable.

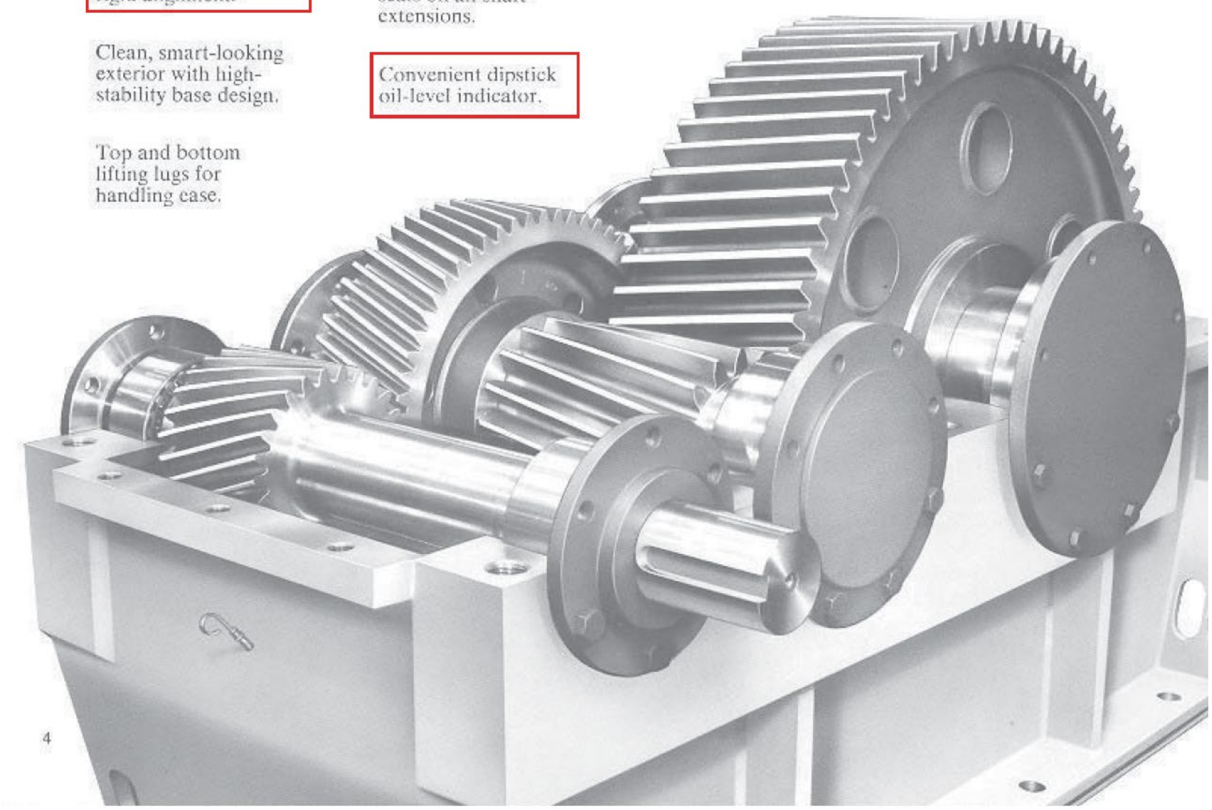
Spring-loaded dual-lip seals on all shaft extensions.

Convenient dipstick oil-level indicator.

Husky shafts for minimum deflection under heavy loads.

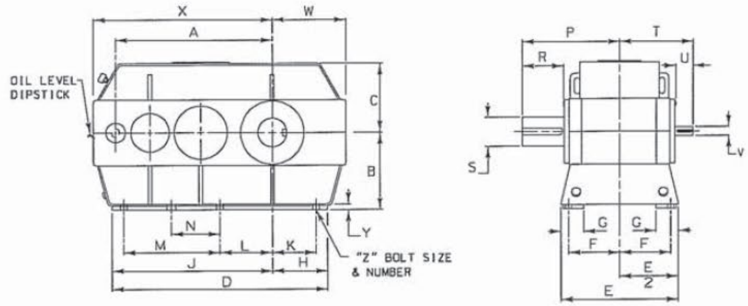
Antifriction tapered roller bearings on all shafts.

Thru-hardened, high-strength alloy steel helical gearing with high face contact.



4

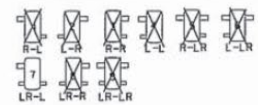
# DIMENSIONS – TRIPLE REDUCTION HELICAL SPEED REDUCER




ALL KEYSEATS WILL HAVE THE FOLLOWING FILLET RADII

| KEYSEAT WIDTH | r |
|---|---|
| 3/8 TO 1/2 | 1/32 |
| 9/16 TO 1 | 1/16 |
| 1 1/16 TO 2 | 3/32 |
| 2 1/16 & UP | 1/8 |

PLAN VIEW OF ASSEMBLIES




ALL DIMENSIONS IN INCHES
"B" DIMENSION TOLERANCE – PLUS .000 MINUS .030
ALL SHAFT TOLERANCE – 1 1/2 DIA. & LESS – PLUS .0000 MINUS .0005
OVER 1 1/2 DIA. – PLUS .000 MINUS .001

AGMA ASSEMBLY DESIGNATIONS ARE SHOWN BELOW NUMBERED ASSEMBLIES – EITHER ASSEMBLY NUMBER OR AGMA DESIGNATION MUST BE SPECIFIED WHEN ORDERING.

| SIZE | A | B | C | D | E | F | G | H | J | K | L | M | N | P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 80T | 17 1/2 | 9 1/2 | 8 | 24 3/4 | 16 | 6 7/8 | 3 1/4 | 6 1/2 | 18 1/4 | 5 | 5 7/8 | 10 7/8 | ~ | 12 3/4 |

| R | S | S-KEYSEAT | T | U | V | V-KEYSEAT | W | X | Y | Z | NET WEIGHT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 3 1/4 | 3/4 X 3/8 X 4 7/8 | 10 | 2 1/4 | 1 | 1/4 X 1/8 X 2 1/8 | 9 | 20 3/4 | 1 | 3/4-6 | 830 |

CERTIFIED DRAWING

P. O. NO. 216417800

HOIST DRIVE
2 – TRIPLE REDUCTION HELICAL SPEED REDUCER
SIZE: CUSTOM 80-T
RATIO: 115.98:1 ASSEMBLY NO: 7
MESH RATINGS PER AGMA STANDARD 6010.E88
AGMA CALCULATED RATING: 13.30 HP @ 1800 RPM
NAMEPLATE SERVICE RATING: 7.50 HP @ 1800 RPM SERVICE FACTOR: 1.77
MOTOR: 7.50 HP @ 1800 RPM
WELDED STEEL HOUSING; ANTIFRICTION BEARINGS; SPLASH LUBRICATION
OIL LEVEL: 2.69" BELOW HOUSING SPLIT
OIL CAPACITY: 7.0 GAL RECOMMENDED LUBRICANT: AGMA# 5/1000 SSU @ 100'F
CERTIFIED DIMENSIONS PER DRAWING: B-16477
SERIAL NO: P-6884
3/17/92

CAD/CAM

TOLERANCES FOR MACHINED SURFACES– UNLESS OTHERWISE SPECIFIED
2 PLACE DECIMAL DIMENSIONS ± .010
3 PLACE DECIMAL DIMENSIONS ± .003
ANGULAR DIMENSIONS ± 1°
BASE HOLE CENTERS ± .020
TOLERANCES, FOR UNMACHINED SURFACES– UNLESS OTHERWISE SPECIFIED ± .062

B.O.M. NO. 6054

NO.

FINISH SYMBOLS
16 POLISH
32 GRIND
63 FINE MACH.
125 SEMI-FINE
250 MEDIUM
500 ROUGH

TRI

DATE PLOTTED SC

3-

Trolley and Bridge Gearmotors

# Gearmotors

Again we add to our motor (and brakemotor) technology, this time with reducers to offer the gearmotor.

Numerous reducer configurations are available.

**Right angle single worm.** It's available with flange or foot mounts, each with solid (single or double) or hollowshaft. Torque arm mounts are available with the hollowshaft.

Ratings: ¼–30hp
Ratio: 5.1–60:1
Output torque: up to 10,000 in. lbs.

**Combination helical/right angle worm.** It's available with flange or foot mounts, each with solid (single or double) or hollowshaft. Torque arm mounts are available with the hollowshaft.

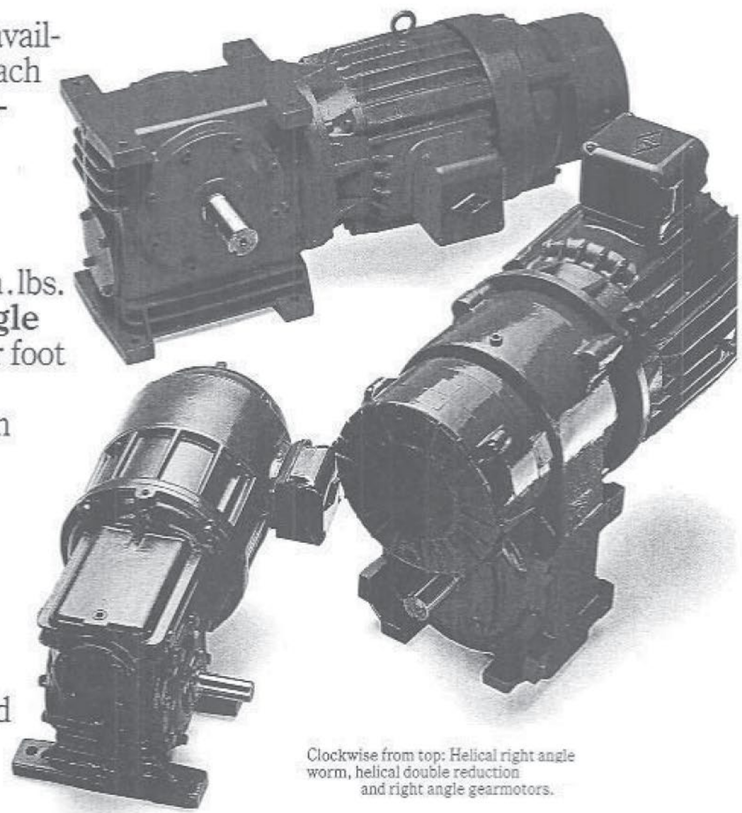
Ratings: ⅓–10hp
Ratio: 7.2:1–372:1
Output torque: up to 18,000 in. lbs.

**Helical bevel.** It's available with flange or foot mounts, each offered with solid (single or double) or hollowshaft.

Ratings: ⅜–150hp
Ratio: 10:1–160:1
Output torque: up to 350,000 in. lbs.

**Helical parallel and concentric shaft.** These gearmotors are available with single, double and triple reduction gears, and foot or flange mount, and single solid shaft.

Ratings: ½–150hp
Ratio: 1.5:1–1800:1
Output torque: up to 130,000 in. lbs.



Clockwise from top: Helical right angle worm, helical double reduction and right angle gearmotors.

**Helical parallel shaft**

It's available in solid (single and double) hollowshaft with torque arm mount. Three integral sets of mounting feet allow versatility in mounting, without adaptions.

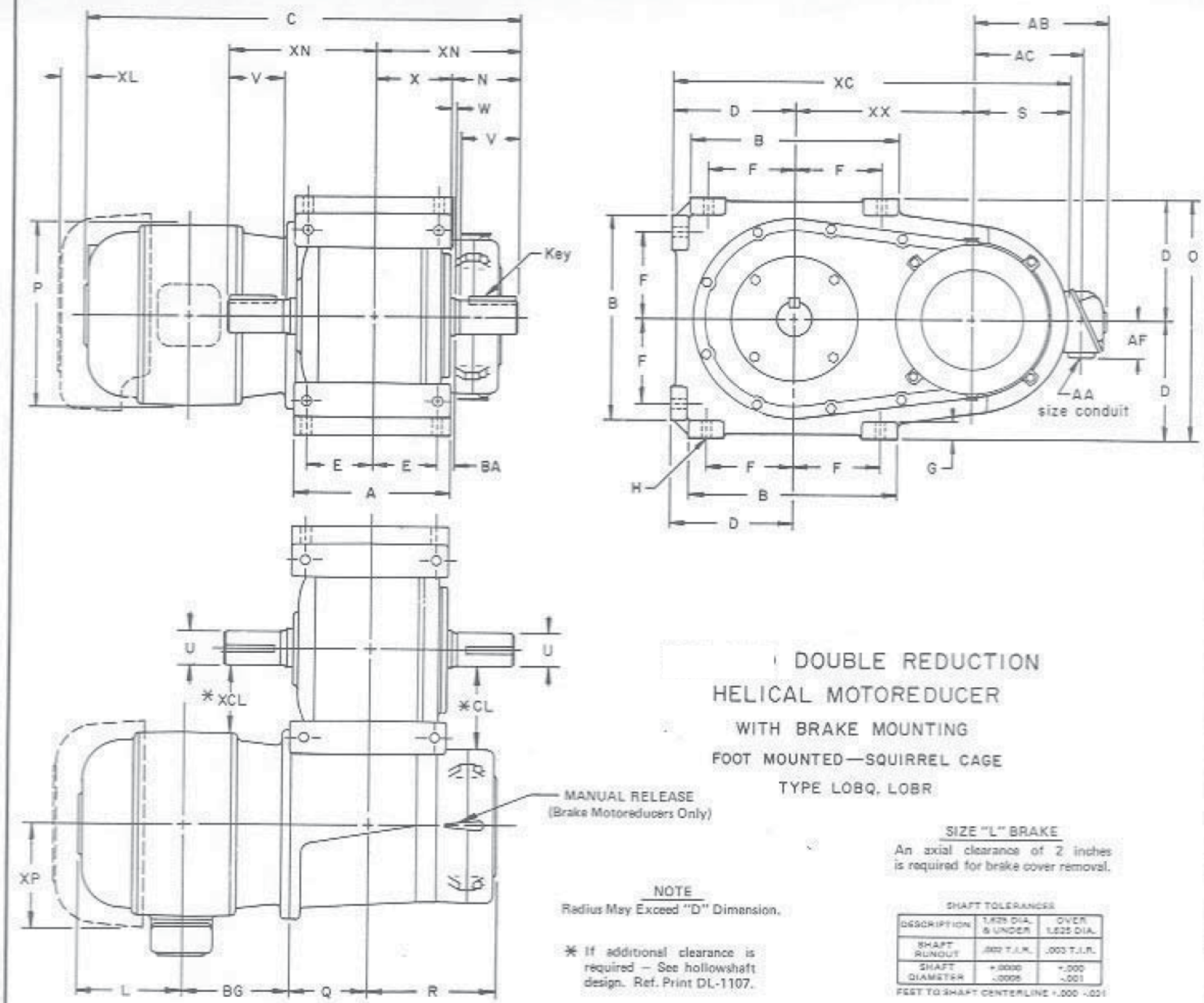
Ratings: ½–10hp
Ratio: 4:1–190:1
Output torque: up to 9,075 in. lbs.

| Item | Qty. | Description |
|---|---|---|
| 1H | 1 | 7.5 HP, 1800 RPM, 256U Frame, 480V/3Ph/60Hz, TENV, continuous duty, Flux Vector motor with 1024 encoder, single output shaft Assy A101-F1. The motor minimum insulation shall be Class H with a class B temperature rise, motor thermal protection required, less brake (Reference 92-3474A, note changes above) |
| 2 T | 1 | .25 HP, 1800 RPM, 213 Frame, 480V/3Ph/60Hz, TENV, continuous duty, VFD motor, the motor minimum insulation shall be Class H with a class B temperature rise, motor thermal protection required, double shaft “QB” reducer ratio 125.40:1 with 480V/3Ph/60Hz 3 ft/lb brake adjustable down to 2.5 ft/lb or less, mounted on 5:1 first reduction with manual release (Reference 92-3474B, note changes above) |
| 3B | 1 | .25 HP, 1800 RPM, 213 Frame, 480V/3Ph/60Hz, TENV, continuous duty, VFD motor, the motor minimum insulation shall be Class H with a class B temperature rise, motor thermal protection required, double shaft “QB” reducer ratio 157.17:1 with 480V/3Ph/60Hz 3 ft/lb brake adjustable down to 2.5 ft/lb or less, mounted on 5:1 first reduction with manual release (Reference 91-1364G, note changes above) |

Required Design Info:

a. Standard motor speed torque curves
b. Motor nameplate data (including all information called for in NFPA 70, Section 430.7) Nameplates shall not be mounted, they will be shipped loose, do not add any holes to the drives for the nameplates.
c. Certified drawings
d. Gear reducer ratings
e. Certification materials meet the requirements of the specifications
f. Certification of Conformance

Built to NAVY specifications.




DOUBLE REDUCTION
HELICAL MOTOREDUCER
WITH BRAKE MOUNTING
FOOT MOUNTED—SQUIRREL CAGE
TYPE LOBQ, LOBR

SIZE "L" BRAKE
An axial clearance of 2 inches is required for brake cover removal.

NOTE
Radius May Exceed "D" Dimension.

* If additional clearance is required — See hollowshaft design. Ref. Print DL-1107.

SHAFT TOLERANCES

| DESCRIPTION | 1.625 DIA. & UNDER | OVER 1.625 DIA. |
|---|---|---|
| SHAFT RUNOUT | .002 T.I.R. | .003 T.I.R. |
| SHAFT DIAMETER | +.0000 -.0005 | +.000 -.001 |

FEET TO SHAFT CENTERLINE +.000 -.031

| Frame | L | P | AA | AB | AC | AF | BG | XL | ΔXP |
|---|---|---|---|---|---|---|---|---|---|
| 182 | 4.88 | 9.00 | .75 | 7.06 | 5.75 | 1.94 | 5.00 | 1.69 | 5.00 |
| 184 | 5.38 | 9.00 | .75 | 7.06 | 5.75 | 1.94 | 5.50 | 1.69 | 5.00 |
| 213 | 6.12 | 10.25 | .75 | 7.94 | 6.56 | 1.94 | 6.25 | 1.19 | 5.88 |
| 215 | 6.88 | 10.25 | .75 | 7.94 | 6.56 | 1.94 | 7.00 | 1.19 | 5.88 |
| 254 | 8.12 | 10.25 | .75 | 7.88 | 6.50 | 1.94 | 8.25 | 1.19 | 5.88 |
| 254U | 8.12 | 12.25 | 1.00 | 9.81 | 7.94 | 2.75 | 7.94 | 1.38 | 6.88 |
| 256U | 9.00 | 12.25 | 1.00 | 9.81 | 7.94 | 2.75 | 8.81 | 1.38 | 6.88 |
| 284U | 9.31 | 13.88 | 1.25 | 10.75 | 8.88 | 2.75 | 9.12 | 1.38 | 7.88 |
| 286U | 10.06 | 13.88 | 1.25 | 10.75 | 8.88 | 2.75 | 9.88 | 1.38 | 7.88 |

Gear Size "Q"

| C | ●CL | ●XCL |
|---|---|---|
| 18.88 | 2.31 | 2.31 |
| 19.88 | 2.31 | 2.31 |
| 21.38 | 2.31 | 1.69 |
| 22.88 | 2.31 | 1.69 |
| 25.38 | 2.31 | 1.69 |
| - | - | - |
| - | - | - |
| - | - | - |
| - | - | - |

Gear Size "R"

| C | ●CL | ●XCL |
|---|---|---|
| 22.56 | 4.75 | 4.75 |
| 23.56 | 4.75 | 4.75 |
| 25.06 | 4.75 | 4.12 |
| 26.56 | 4.75 | 4.12 |
| 29.06 | 4.75 | 4.12 |
| 28.75 | 4.75 | 3.12 |
| 30.50 | 4.75 | 3.12 |
| 31.12 | 4.75 | 2.31 |
| 32.62 | 4.75 | 2.31 |

| Gear Size | TYPE | A | B | D | E | F | G | H | N | XN | O | Q | R | S | U | Sq.Key | V | W | X | BA | XC | XX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| "Q" | LOBQ | 7.12 | 7.50 | 5.25 | 3.00 | 3.00 | .75 | 9/16 | 2.50 | 6.00 | 10.50 | 3.00 | 7.00 | 5.50 | 1.3750 | 5/16 | 2.19 | .06 | 3.50 | .56 | 18.25 | 7.500 |
| "R" | LOBR | 9.00 | 12.00 | 7.00 | 3.75 | 5.00 | 1.00 | 9/16 | 3.75 | 8.25 | 14.00 | 4.44 | 7.69 | 5.50 | 2.000 | 1/2 | 3.25 | .25 | 4.50 | .94 | 22.75 | 10.250 |

(1) duo centric rotor STYLE

| | DRIP PROOF | TENV | TEFC |
|---|---|---|---|
| | AVO | AEO | AFO |
| (1) | DVO | DEO | DFO |

♦ Revised
● Added
Revision D
4/30/71
DL-1101

## PARALLEL SHAFT HELICAL GEAR REDUCER
## SIZE "QB" – TRIPLE REDUCTION
### (Double Reduction Size "Q" with Size "B" Single Reduction Helical Input)

| APPROX. FULL LOAD INPUT RPM | F.L. OUTPUT RPM DESIGN "B" MOTOR | DESIGN "D" MOTOR | FLUID SHAFT WOUND ROTOR | TOTAL GEAR RATIO | FIRST REDUCTION SIZE "B" GEAR | SECOND REDUCTION SIZE "Q" GEAR | THIRD REDUCTION SIZE "Q" GEAR | OUTPUT TORQUE – POUNDS INCHES AND RATED SERVICE FACTOR — HORSEPOWER RATING .5 | .75 | 1 | 1.5 | 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DESIGN B 1740 DESIGN D 1700 | 46 | 45 | 44 | 37.41 | 2.7 | 2.05 | 6.76 | 657-3 | 986-3 | 1315-3 | 1972-2 | 2630-1 |
| | 37 | 36 | 35 | 46.18 | 2.7 | 2.53 | 6.76 | 817-3 | 1226-3 | 1635-2 | 2452-1 | |
| | 31 | 30 | 29 | 55.48 | 2.7 | 3.04 | 6.76 | 975-3 | 1463-2 | 1951-1 | | |
| | 26 | 25 | 24 | 67.72 | 2.7 | 3.71 | 6.76 | 1163-3 | 1745-2 | 2327-1 | | |
| | 21 | 20 | 19 | 85.51 | 5 | 2.53 | 6.76 | 1440-2 | 2160-1 | | | |
| | 17 | 16 | 16 | 102.75 | 5 | 3.04 | 6.76 | 1779-2 | 2669-1 | | | |
| | 14 | 14 | 13 | 125.40 | 5 | 3.71 | 6.76 | 2160-1 | | | | |
| | 11 | 11 | 10 | 157.17 | 5 | 4.65 | 6.76 | 2750-1 | | | | |

NET WEIGHT: 130 lbs. (approx.)

LOAD CAPACITY:
2400 lbs. - Overhung load capacity at middle of standard shaft extension.
2000 lbs. - Thrust load capacity on output shaft.
The allowable loads are based on Class I Service and an average bearing life of 25,000 hours.
The total radial load on both output shaft extensions and/or the total radial and thrust load should not exceed 1800 lbs.

*Ratings marked -1 are for Maximum Class I Service = Service Factor 1.0
Ratings marked -2 are for Maximum Class II Service = Service Factor 1.4
Ratings marked -3 are for Maximum Class III Service = Service Factor 2.0

Size "QB" Gear available in the following frame sizes: 224, 225, 254, 213, 215, and 23.

*See Engineering Data Pages 1300, 1301, and 1302 for application classification data.

v. Packaged Hoist

# SERIES 800

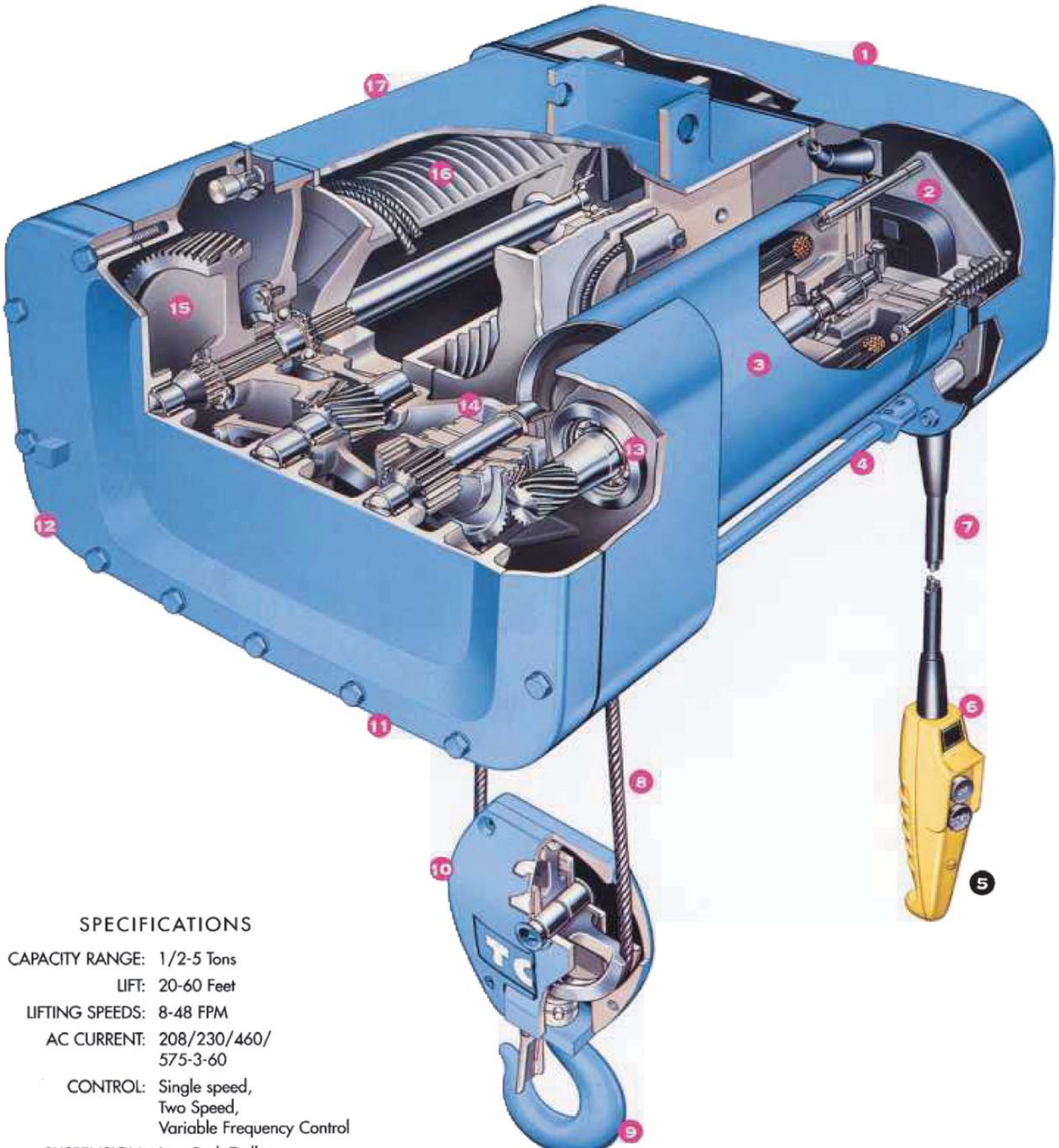
800 Series wire rope hoists are ideally suited for virtually any lifting application of up to five tons. Their modular design and versatility provide a wide range of capacities, lifts, hoisting speeds, and control options, making it possible to select the most efficient hoist for the job without wasted capacity or overkill.

The compact design and closer end approaches of the standard 800 Series hoist allows an unusually high hook lift, as compared to many so-called low headroom hoists, without resorting to design compromises. 800 Series hoists maximize hook coverage within an existing facility, reducing or eliminating the need for costly rebuilding or remodeling.

800 Series hoists are available in two basic models: single reeved and true vertical lift, with either air or electric power. The heavy-duty wire rope and drum-type hoist line has a steel mounting lug integral with the one-piece welded frame, and is designed for stationary mounting from an overhead structure, or with any of our monorail trolley options. Standard features of this rugged hoist line include a heavy welded steel frame, powerful drive motor, totally enclosed oil bath lubricated drive train, and dual brake reliability.


## FEATURES

1. Easily accessible control enclosure facilitates maintenance
2. D.C. disc motor brake for smooth braking action
3. High torque, heavy-duty hoist motor for smooth hoisting action
4. Block operated upper limit stop to limit upward hook travel
5. Convenient one-handed push-button control for easy operation of all motions
6. 115 volts at push button for operator safety
7. Push-button cable with built-in strain reliever cable as used on single speed hoist applications. (All others use a separate steel strain reliever cable.)
8. Improved plow steel pre-formed cable for maximum strength and life
9. Full-swiveling, heat-treated forged steel hook with spring loaded latch
10. Shrouded lower block to help prevent pinched fingers
11. Alloy aluminum gear case and cover is lightweight yet rugged
12. Oil level plug permits easy inspection of oil level
13. Anti-friction bearings throughout for a long lasting hoist drive train
14. Positive action mechanical load lowering control brake, also acts as a part of the hoist holding brake system
15. Triple reduction helical/spur gearing operates in oil bath lube for maximum gearing life
16. Deep grooved, large diameter rope drum helps prevent rope overwrap for longer wire rope life
17. Heavy welded steel frame ensures precise fit for long hoisting machinery life




SPECIFICATIONS

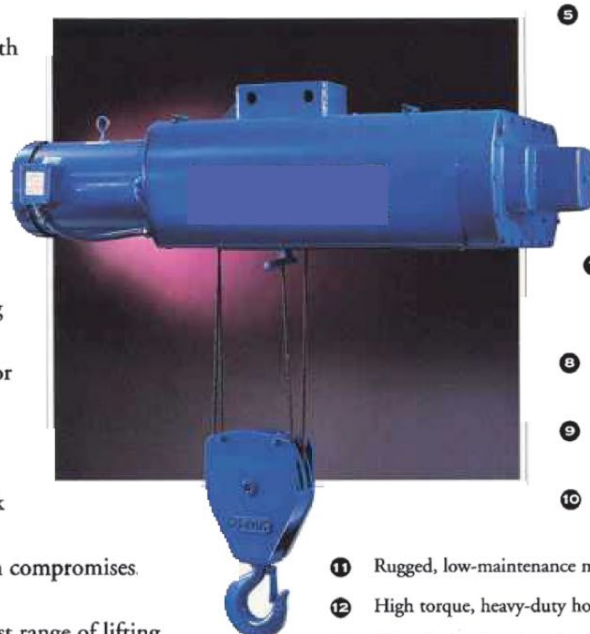
| | |
|---|---|
| CAPACITY RANGE: | 1/2-5 Tons |
| LIFT: | 20-60 Feet |
| LIFTING SPEEDS: | 8-48 FPM |
| AC CURRENT: | 208/230/460/ 575-3-60 |
| CONTROL: | Single speed, Two Speed, Variable Frequency Control |
| SUSPENSION: | Lug, Push Trolley, Hand Geared Trolley and Motor Driven Trolley |

# SERIES 700

700 Series wire rope hoists are designed and manufactured for heavy-duty service. This workhorse is built to deliver, day-in and day-out, under tough operating conditions. 700 Series hoists are built to take even the most demanding job cycles in stride, yet can be relied upon to handle your most delicate loads with precision control.

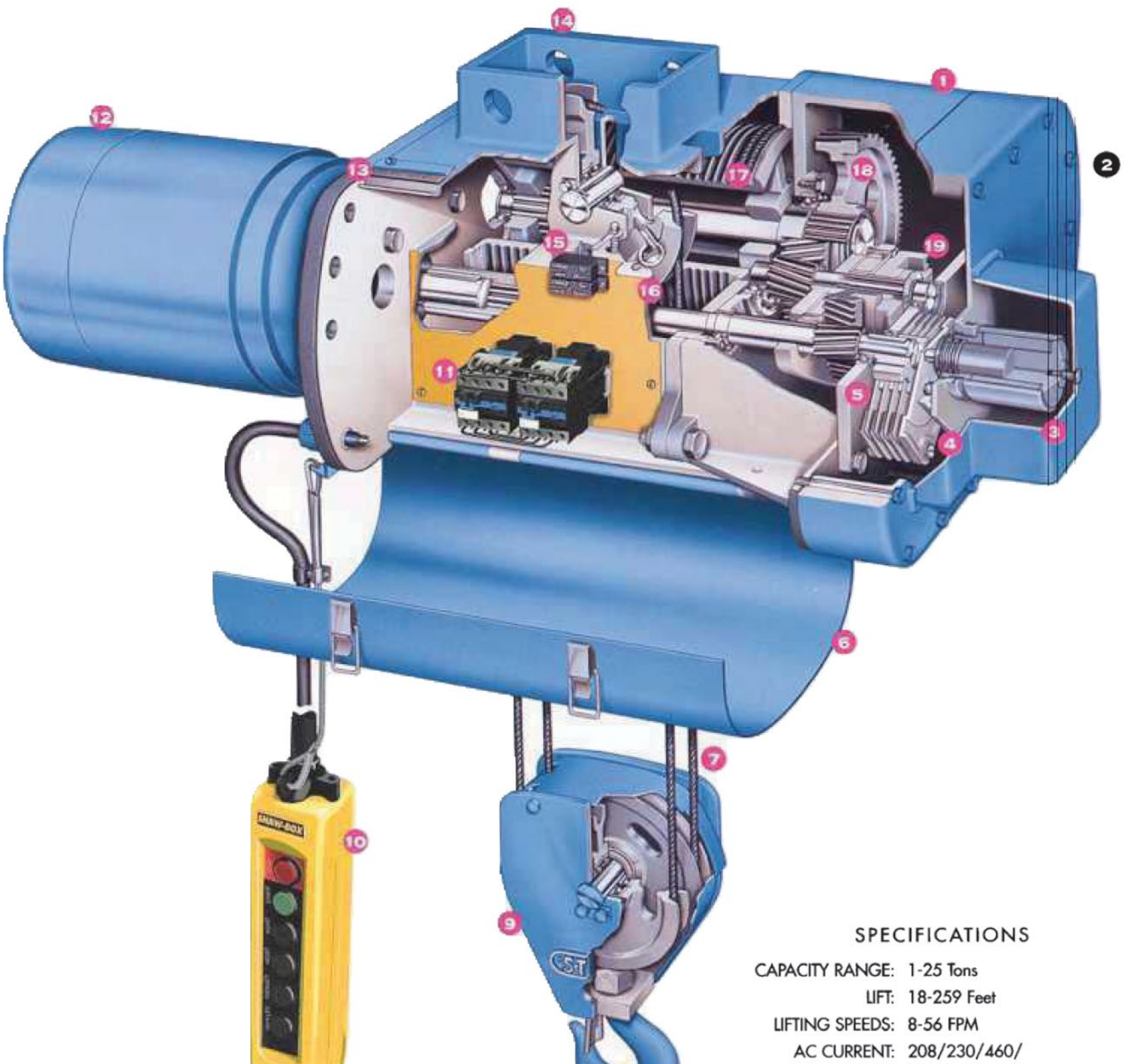
Their compact design, with high hook lift and closer end approaches, maximizes hook coverage within an existing facility, reducing or eliminating the need for costly rebuilding or remodeling. 700 Series hoists achieve an unusually high hook lift, without resorting to design compromises.

This line offers the greatest range of lifting speeds, controls, headroom and mounting options of any hoists on the market today. 700 Series hoists are available in both electric and air powered models. Options include standard and low headroom, deck and base mounted models, with a choice of single reeving or true vertical lift. The lug is integral with the all-steel, one-piece welded frame, and is designed for stationary mounting from an overhead structure or with any of our trolley options.



## FEATURES

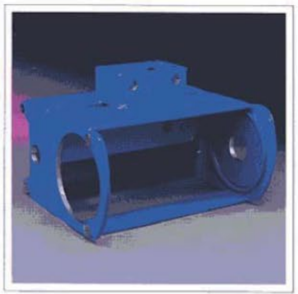
1. One-piece welded steel frame ensures precise fit and long hoisting machinery life
2. Alloy aluminum gear case and cover is lightweight yet rugged
3. Direct acting D.C. brake solenoid for smooth braking action
4. Multiple disc motor brake for long life and maximum braking efficiency
5. Bearings supported in an independent gear case spider give a precise fit, and allow removal of the gear case cover without disassembly of the gearing
6. Hinged control panel cover permits easy access to the control components
7. Improved plow steel preformed wire rope for maximum strength and life
8. Full-swiveling, heat-treated forged steel hook with spring loaded latch
9. Shrouded lower block to help prevent pinched fingers
10. Push-button control pendant for easy one-handed operation
11. Rugged, low-maintenance magnetic contactor control
12. High torque, heavy-duty hoist motor for smooth load handling
13. Watershed and gaskets for tight frame cover seal and protection of internal components
14. Integrally welded mounting lug permits various trolley attachment options
15. Block operated limit switch limits upward hook travel
16. Rope anchor, easily accessible for inspection and maintenance
17. Deep grooved, large diameter rope drum helps prevent rope overwrap for longer rope life
18. Double reduction helical gearing provides a smooth, quiet drive train
19. Positive action mechanical load lowering control brake, also acts as a part of the hoist holding brake system




SPECIFICATIONS

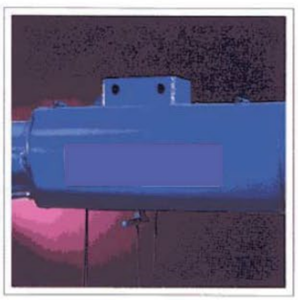
| | |
|---|---|
| CAPACITY RANGE: | 1-25 Tons |
| LIFT: | 18-259 Feet |
| LIFTING SPEEDS: | 8-56 FPM |
| AC CURRENT: | 208/230/460/<br>575-3-60 |
| CONTROL: | Single speed,<br>Two speed,<br>Variable Frequency Control |
| SUSPENSION: | Lug, Push Trolley,<br>Hand Geared Trolley,<br>Motor Driven Trolley, |

# SERIES 700/800 STANDARD FEATURES



**Welded Steel Frame**

*One-piece welded frame, fabricated from rolled steel sections, precision machined for long life and accurate bearing and component alignment. (700 Series frame illustrated)*



**Lug Suspension**

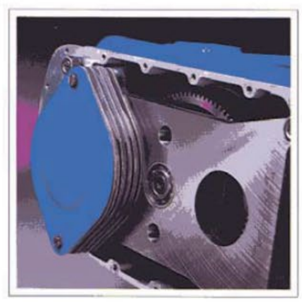
*Permits the hoist to be mounted in a permanent location. (Mounting hardware not included)*

**Precision Machined Gearing**

*For uniform tooth mesh and large contact surface. Operates in a totally enclosed, oil bath lubricated gear case. Gear trains consist of two or three reductions, using helical and/or spur gearing.*

**Automatic Load Brake**

*Weston self-adjusting type, operates in the oil bath of the hoist gear case for smooth lowering control. Capable of holding the load independent of the hoist motor brake. (700 Series load brake illustrated)*



**Hoist Motor Brake**

*Short stroke, 150% torque spring-set D.C. rectified disc type brake provides quiet operation and long life. (700 Series multiple disc brake illustrated)*

**Machined Rope Drum**

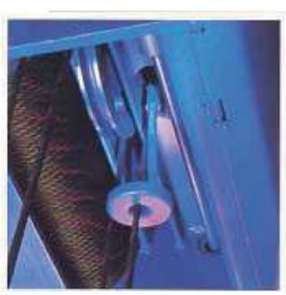
*Large diameter, welded construction — deep grooved and precision machined to give maximum rope life. Pictured is a right and left hand grooved true vertical lift drum.*

**Dead End Rope Anchor**

*Used on single reeved hoists. Easily accessible and part of the one-piece welded frame, it securely anchors the rope compression thimble fitting which is swaged to the rope ends. True vertical lift hoists have both ends of the steel rope dead ended to the rope drum.*

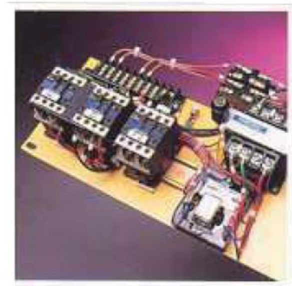
**Shrouded Lower Block**

*Helps prevent fingers from being pinched between rope and sheaves and prevents dirt buildup. All hooks are provided with spring loaded safety latches.*



**Block Operated Limit Switch**

*For additional protection of operator, hoist, and load. Positive acting, momentarily reverses the hoisting motion if lower block drifts too high. (700 Series block limit switch illustrated)*



**Heavy-Duty Controls**

*Designed for a clean, open layout to maximize performance and ease of maintenance. Contactors are oversized for increased life. Panels are housed in a dust resistant compartment designed for easy access and serviceability. (700 Series hoist control illustrated)*

**Hoist Motors**

*High starting torque type, designed specifically for hoisting, with permanently lubricated ball bearings. Motors are totally enclosed, non-ventilated (T.E.N.V.) with class F insulation, and provided with an automatic reset, temperature actuated switch in the windings to provide over current protection.*

**Convenient Push-Button Control**

*All motions can be controlled from a convenient, easy to operate push-button control station suspended from the hoist. An external strain reliever cable extends cable life and prevents pulling the control cable from the hoist electrical connection on four button and larger stations.*

# SERIES 700/800 OPTIONAL FEATURES

**Push Trolley Suspension**

*Push trolleys are used for mounting hoists on monorails or single girder crane bridges. Operator can quickly move loads by pushing on the load.*

**Hand Geared Trolley Suspension**

*For moving loads where accurate spotting is essential or when operator should not touch the load.*

**Motor Driven Trolley Suspension**

*Used for moving loads quickly over long distances and where accurate load spotting is needed. Control push buttons can be suspended from hoist or crane bridge.*

**Deck Mounted Hoists**

*Used for applications that require a stationary hoist, or for construction of a top-running trolley.*

**Top Running Double Girder Trolleys**

*Provides a combination of lower headroom, higher hook lift, and closer end approaches. Maximizes hook coverage within existing facility, without costly remodeling or rebuilding.*

**Air Operated Hoists**

*Air operation is available for all SHAW-BOX hoists where precise spotting or slow hoisting speeds are required, or where an electrically powered hoist may not be suitable. (Illustrated is an air-piston motor driven 700 Series hoist)*


**Explosion Proof Hoists**

*In addition to normal operating conditions, all SHAW-BOX hoists may be customized for operation in hazardous locations. Lift-Tech designs each hazardous location hoist to meet or exceed National Electrical Code standards. (800 Series explosion proof hoist illustrated)*

**Spark Resistant Features**

*Bronze and high bronze alloys incorporated in key components such as hooks, lower blocks and wheels, along with stainless steel wire rope, help prevent incidental sparking in hazardous locations.*

**Special Application Motors**

*For special applications such as 60 minute rating, mill and chemical duty, and tropical proofing are available on many hoist models.*

**Variable Frequency Control**

*Can be provided for any SHAW-BOX hoist or trolley motion where precise spotting or slow hoisting speeds are required. Available in two, three, or five step control, or two step infinitely variable.*

**Weight Watcher Overload Control**

*A factory set mechanical overload clutch built into the hoist drive train prevents lifting excessive overloads. (700 Series overload clutch illustrated with the cover removed)*

**Other Options:**

- *Low Headroom Hoists*
- *Radio Control*
- *Screw Type Limit Switches*
- *Power Circuit Limit Switches*
- *Hot Metal Applications*
- *Magnet Applications*
- *Epoxy Paint*
- *NEMA 12, 3R, or 4 Control Enclosures*
- *Panel Heaters*
- *Motor Heaters*
- *Over Capacity Lift Protection*
- *Warning Lights/Horns*
- *Patented Track Wheels*
- *Double Hook Hoists*

Photos shown are for illustrative purposes only. The actual products may vary in color and design.

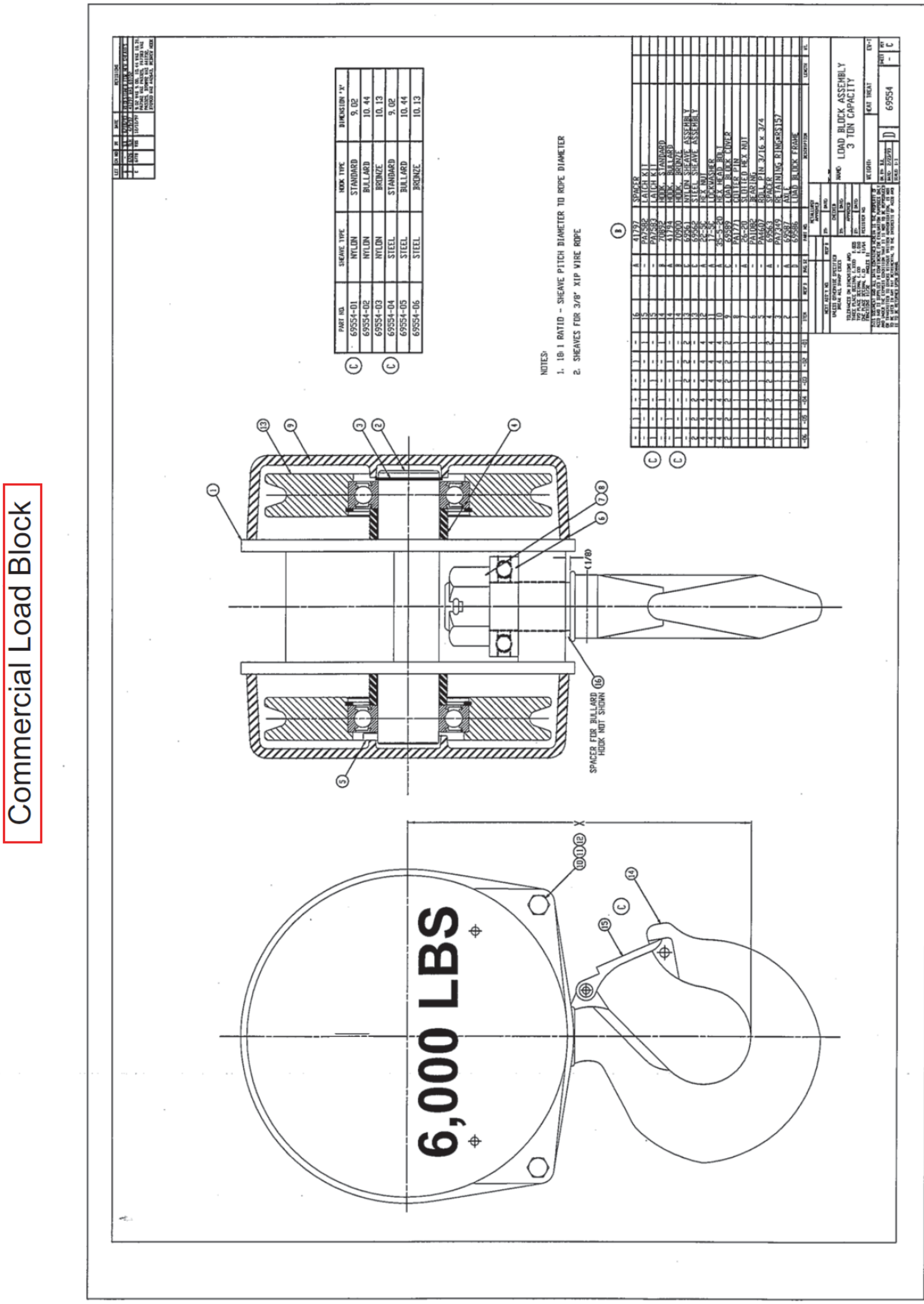
**Base Mount 700 Series Wire Rope Hoist.**

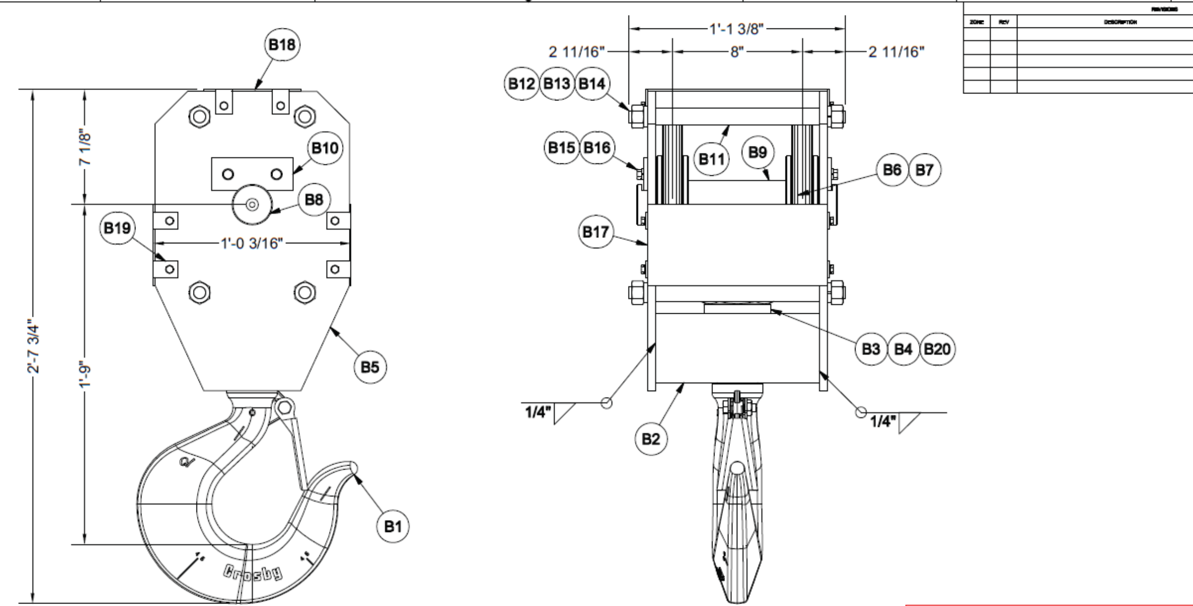
**Hoist Cat. # 72B05-035D27-1-SPX**

- **Capacity: 5 U.S. Ton**
- **Gage:** Unknown
- **Lift:** 27'-0" TVL
- **Pendant Drop:** No push button station
- **Hoist Speed:** 27 fpm
- **Hoist Motor:** 10 hp
- **Rope:** 6 PD 5/16"
- **Trolley Speed:** N.A.
- **Trolley Motor:** N.A.
- **Top of hoist to mounting feet:** Approx. 18"
- Customer to supply Variable Frequency controls.
- Hoist motor to be inverter duty, 60 minute rated, Class "H" insulation.
- Junction box is not provided.
- Upper block and upper/lower rotary-geared limit switches.
- Steel sheaves in both upper and lower block assemblies.
- Hoist will not be load tested prior to shipment.
- **Power supply:** 460v 3ph 60hz
- **Equipment rated for "H4" Service**
- **Approx. weight:** 1,300 lbs.

Additional information showing the packaged hoist meets specification

vi. Hook Block






TOTAL WEIGHT: 315 LBS

BoM

| ITEM | QTY | PART NAME | DESCRIPTION | MATERIAL | MANUFACTURER | WEIGHT (LBS) |
|---|---|---|---|---|---|---|
| B1 | 1 | LOAD HOOK | S319 (O) W/ SS-4055 LATCH | CARBON | CROSBY | 75 |
| B2 | 1 | TRUNNION | 4 1/4" X 4 7/8" X 10 1/8" | A36 | MCB | 59 |
| B3 | 1 | THRUST BEARING | RT621 | --- | INA | 5 |
| B4 | 1 | HOOK NUT | 2 1/2 - 8 UN HH | --- | --- | 5 |
| B5 | 2 | SIDE PLATE | 1/2" X 12" X 1'-6 1/2" PLATE | A36 | MCB | 31 |
| B6 | 2 | SHEAVE BEARING | MR48 - MI40 | --- | McGILL | 4 |
| B7 | 2 | SHEAVE | 11 1/2" DIA X 2" | A36 | MCB | 33 |
| B8 | 1 | SHEAVE PIN | 2 1/2" DIA X 12 5/8" | 1018 CR | MCB | 17 |
| B9 | 1 | SHEAVE SPACER | 3" O.D. 2 17/32" I.D. X 6" | A36 | MCB | 4 |
| B10 | 2 | SHEAVE PIN KEEPER | 1/4" X 2" FLAT X 5" | A36 | MCB | 1 |
| B11 | 4 | SPACER PIPE | 3/4 SCH 40 PIPE X 10 1/8" | --- | MCB | 1 |
| B12 | 4 | SPACER ROD | 3/4" THREADED ROD X 1'-1 3/8" | GR. 8 | MCB | 1 |
| B13 | 4 | SPACER NUT | 3/4 - 10 UNC HHCS | GR. 8 | --- | --- |
| B14 | 4 | SPACER LOCK WASHER | 3/4" LOCK WASHER | F436 | --- | --- |
| B15 | 4 | KEEPER BOLT | 1/2 - 13 UNC HHCS X 3/4" | GR. 5 | --- | --- |
| B16 | 4 | KEEPER LOCK WASHER | 1/2" LOCK WASHER | F436 | --- | --- |
| B17 | 2 | SIDE COVER | 12 GAUGE SHEET 5" X 11 1/8" | A36 | MCB | 2 |
| B18 | 1 | TOP COVER | 12 GAUGE SHEET 6" X 11 1/8" | A36 | MCB | 2 |
| B19 | 12 | COVER TAB | 12 GAUGE SHEET 1 X 1 1/2" | A36 | MCB | --- |
| B20 | 1 | ROLL PIN | 3/8" DIA X 3 7/8" | --- | --- | --- |

NAVY CRANE CENTER

10 TON OET CRANE

BLOCK DIMENSION & COMPONENTS

SIZE D

SCALE AS NOTED

SHEET 1 OF 1

vii. Wire Rope

## Standard Wire Ropes

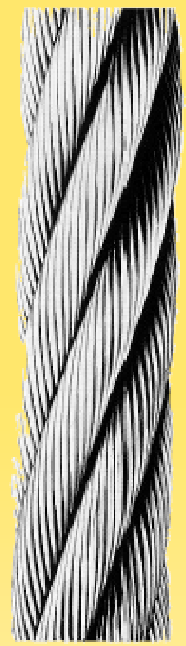
# 6x19 and 6x36 Classes Technical Data

### 6x19 Class

6x19 Seale
6x19 Warrington
6x21 Filler Wire Type U
6x21 Seale
6x25 Filler Wire Type W
6x25 Seale
6x26 Warrington Seale

| Rope Diameter | | Approx. Weight (lb./ft.) | | Nominal Strength*, tons (bright or drawn galvanized**) | | |
|---|---|---|---|---|---|---|
| | | | | Royal Purple | Purple Plus | |
| inches | mm. | Fiber Core | IWRC | IWRC | Fiber Core | IWRC |
| 1/4 | 6.5 | 0.11 | 0.12 | 3.74 | 3.01 | 3.40 |
| 5/16 | 8.0 | 0.16 | 0.18 | 5.80 | 4.69 | 5.27 |
| 3/8 | 9.5 | 0.24 | 0.26 | 8.30 | 6.71 | 7.55 |
| 7/16 | 11.0 | 0.32 | 0.35 | 11.2 | 9.10 | 10.2 |
| 1/2 | 13.0 | 0.42 | 0.46 | 14.6 | 11.8 | 13.3 |
| 9/16 | 14.5 | 0.53 | 0.58 | 18.5 | 14.9 | 16.8 |
| 5/8 | 16.0 | 0.66 | 0.72 | 22.7 | 18.4 | 20.6 |
| 3/4 | 19.0 | 0.95 | 1.04 | 32.4 | 26.2 | 29.4 |
| 7/8 | 22.0 | 1.29 | 1.41 | 43.8 | 35.4 | 39.8 |
| 1 | 26.0 | 1.68 | 1.85 | 56.9 | 46.0 | 51.7 |
| 1-1/8 | 29.0 | 2.13 | 2.34 | 71.5 | 57.9 | 65.0 |
| 1-1/4 | 32.0 | 2.63 | 2.89 | 87.9 | 71.1 | 79.9 |
| 1-3/8 | 35.0 | 3.18 | 3.49 | 106 | 85.5 | 96 |
| 1-1/2 | 38.0 | 3.78 | 4.16 | 125 | 101 | 114 |
| 1-5/8 | 42.0 | 4.44 | 4.88 | 146 | 118 | 132 |
| 1-3/4 | 45.0 | 5.15 | 5.66 | 169 | 136 | 153 |
| 1-7/8 | 48.0 | 5.91 | 6.49 | 192 | 155 | 174 |
| 2 | 52.0 | 6.73 | 7.39 | 217 | 176 | 198 |
| 2-1/8 | 54.0 | 7.60 | 8.34 | 243 | 197 | 221 |
| 2-1/4 | 58.0 | 8.52 | 9.35 | 272 | 220 | 247 |
| 2-3/8 | 60.0 | 9.49 | 10.4 | 301 | 244 | 274 |
| 2-1/2 | 64.0 | 10.5 | 11.6 | 332 | 269 | 302 |
| 2-3/4 | 70.0 | 12.7 | 14.0 | 397 | 321 | 361 |

**Galvanizing: For Class A galvanized wire rope (EIP grade only), deduct 10% from the nominal strength shown.



### 6x36 Class

6x31 Warrington Seale
6x33
6x36 Warrington Seale
6x41 Warrington Seale
6x43 Filler Wire Seale
6x49 Filler Wire Seale

Technical data for the above listed constructions are the same and are detailed in the table. For further information on additional constructions and diameters, contact WW's customer service department.

L. **Appendix L – Structural Product Data**

Please see the following for examples of structural product data.

i. End Trucks

SAMPLE END TRUCK CATALOG DATA

# Rotating Axle End Trucks
## Single Girder Top Running

8"Ø CMAA Class "D" Hardened Wheels (400 BHN)

| Capacity Tons | Speed HP | Max Span | Wheel Base | Actual Wheel Load w/o Impact | | Weight Pounds | Single Speed w/o Soft Start (**) | Variable Frequency |
|---|---|---|---|---|---|---|---|---|
| | | | | 30# Rail | 40# Rail | | Model | Model |
| Up to 10 Tons | 80 FPM 2 @ 1.0 | 36' - 0" | 4' - 6" | 15,000 | 17,600 | 1,600 | R08TSW17054-D | R08TSW17054-F |
| | | 48' - 0" | 6' - 0" | 15,000 | 17,600 | 1,800 | R08TSW17072-D | R08TSW17072-F |
| | | 60' - 0" | 7' - 6" | 15,000 | 17,600 | 2,000 | R08TSW17090-D | R08TSW17090-F |
| | 120 FPM 2 @ 1.5 | 36' - 0" | 4' - 6" | 15,000 | 17,600 | 1,600 | R08TSW18054-D | R08TSW18054-F |
| | | 48' - 0" | 6' - 0" | 15,000 | 17,600 | 1,800 | R08TSW18072-D | R08TSW18072-F |
| | | 60' - 0" | 7' - 6" | 15,000 | 17,600 | 2,000 | R08TSW18090-D | R08TSW18090-F |

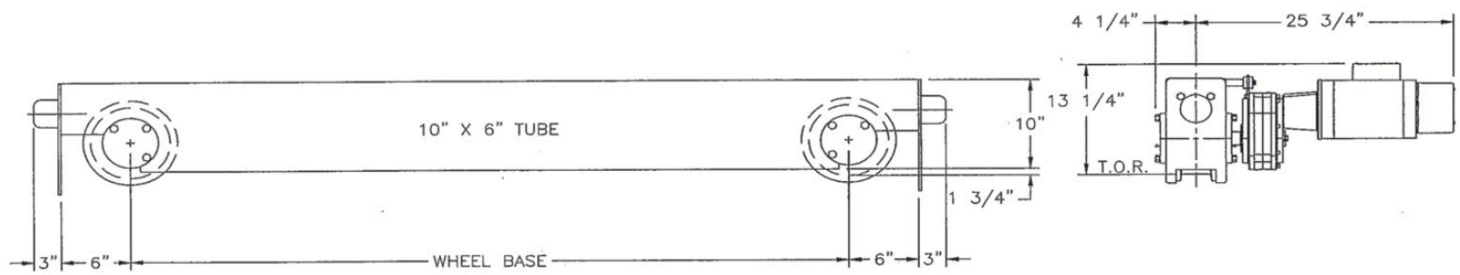
All data is furnished for estimating purposes only and is subject to change without notice

Complete Part #

(**) SOFT START IS RECOMMENDED FOR SINGLE SPEED APPLICATIONS
FOR 165 FPM SPEED CONSULT FACTORY

Standard control is 460 volt, Nema 12 and includes control transformer, mainline and disconnect (30 amp).

For options see modification section, pages 70 & 71.

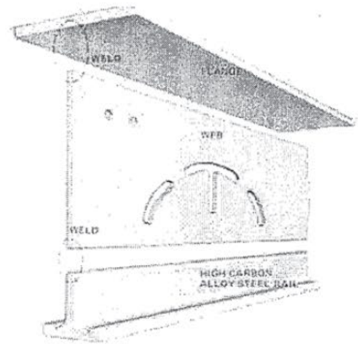



* Actual ... wheel load must not exceed tabulated wheel load.
* (Tabul... 's are based on CMAA $K_{wl}$ minimums)

ii. Patented Track

SAMPLE PATENTED TRACK CATALOG DATA

## [redacted]™ AND [redacted]™ RUNWAYS AND MONORAILS




| Track Type | [redacted]™ | | [redacted]™ |
|---|---|---|---|
| Track Series | 4200 thru 4600 Series | 5100 thru 6201 Series | 8050 Series and Larger |
| Rail Width | 3-1/4″ | 3-1/4″ | 4-1/2″ |
| Rail Tread Thickness | 13/32″ | 5/8″ | 1″ |
| Maximum Wheel Diameter | 5″ | 7″ | 9-1/2″ |
| Maximum Load Per Pair of Wheels | 4000 lb. | 7500 lb. | 10,500 lb. |
| Maximum Equivalent Center Load | See Page 5 | See Page 5 | See Page 7 |
| General Use | Medium and Heavy-Duty Monorail and Crane Service | | Exceptionally Heavy Loads and Heavy-Duty Service |
| Operating Power | Hand or Electrically Operated | | Electrically Operated |

### Features and Benefits

- **Maximum Strength with Minimum Weight**
  [redacted]™ and [redacted]™ track has been engineered to attain maximum strength with minimum weight, consisting of a compound section of A36 steel flange, web, and specially rolled high carbon steel rail. These parts are welded under carefully controlled conditions to form a combined section, free of stress concentrations. The parts are carefully proportioned to produce a balanced design for loads under varying conditions.
- **Wide Selection**
  [redacted]™ and [redacted]™ track is fabricated in a large number of standard sizes for economical use for the great majority of monorail and crane applications. [redacted]™ track dimensions match with former [redacted]™ Arch Beam dimensions, permitting extension of all systems now in service.
- **Minimal Superstructure Requirement**
  Frequently, ceiling or overhead conditions are such that independent structural work must be erected to provide track supports at short spacings. The balanced design of [redacted]™ and [redacted]™ tracks allows for increased unsupported lengths which reduces the number of required superstructure supports.
- **Ease of Installation**
  Erection of a monorail or crane system using [redacted]™ or [redacted]™ track requires much less time than any other type of track. As all steps of manufacture are under careful control, dimensions are accurate and tracks are uniformly straighter and truer than mill-beam tolerances.

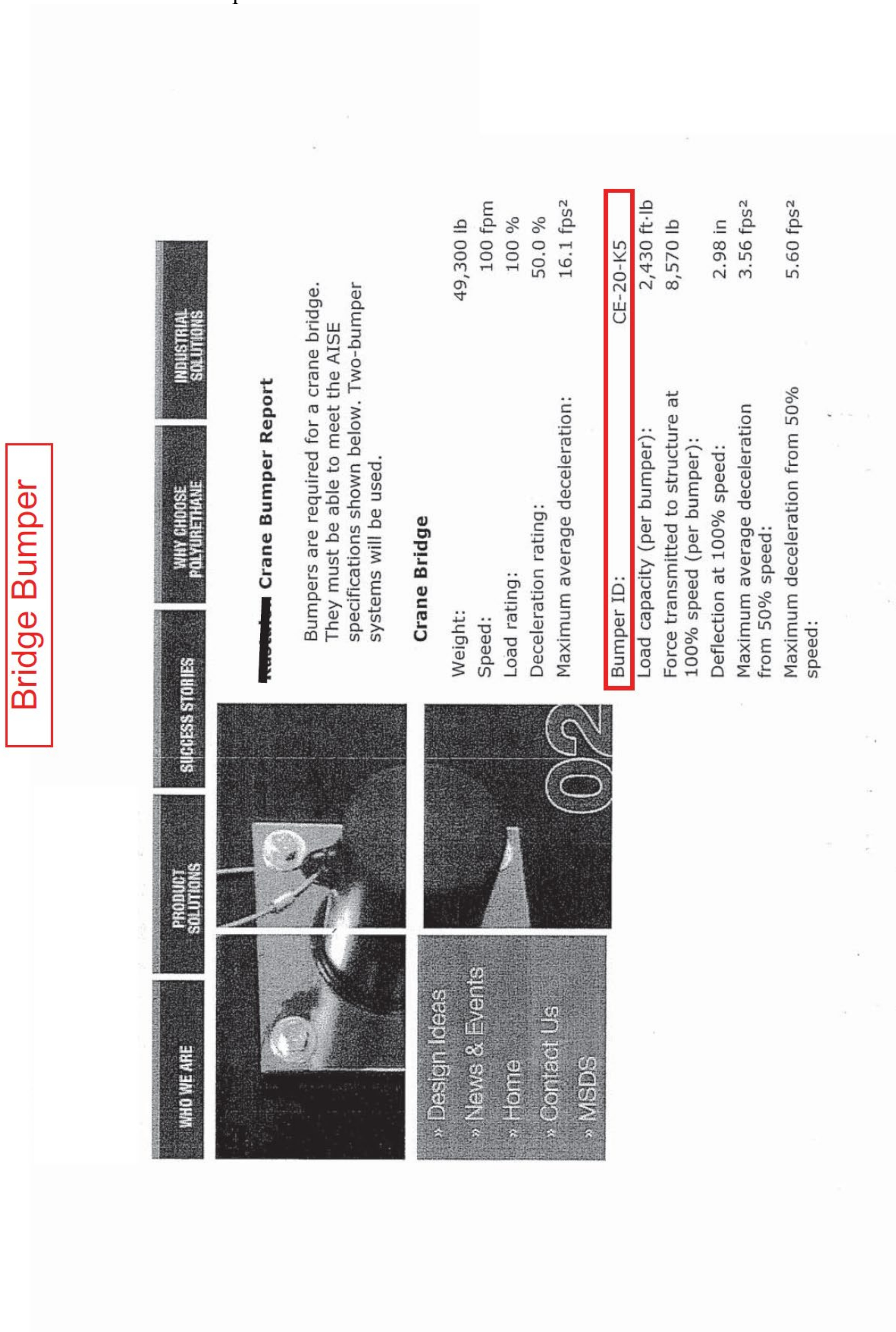
### Track Selection Factors

Selection of track for a monorail or underhung crane system is based on a combination of load and span with consideration given to severity of service. The following factors should all be considered when selecting track:

- **Determine the Live Load**
  Determine the maximum shape, size, and weight of the load to be carried. Since experience indicates that loads often increase as time passes, thought should be given to those increases which may occur in the future.
- **Select the Load Carrying Components**
  Select the hoist and carrier because the weight of these components must be added to the live load in determining the capacity required in the track and support system. *Impact allowance should be taken into consideration based on application.*
- **Calculate the Total Load**
  Combine the total live load, the weight of the load carrying components, and the impact allowance.
- **Determine Layout of System**
  Determine the track system layout based on considerations for the flow of material. Other factors to be considered are headroom, clearance over and under obstructions, side clearance, transfer points, and switch locations when required.
- **Suspension Locations**
  Crane runways and monorails are suspended on hanger rods supported by the building superstructure. Thus, spacing of the hanger rods is normally determined by the structural members in the building. The size of the track must be selected to span these distances without exceeding maximum approved deflection and stresses under full moving load conditions.
- **Select the Track and Fittings**
  For safety with maximum economy, choose track whose load capacity just exceeds the maximum load requirement. Select the appropriate support system and fittings after determining the maximum loads at each suspension point.

Identification of component

iii. Bumpers


Bridge Bumper

WHO WE ARE | PRODUCT SOLUTIONS | SUCCESS STORIES | WHY CHOOSE POLYURETHANE | INDUSTRIAL SOLUTIONS

» Design Ideas
» News & Events
» Home
» Contact Us
» MSDS

02

**[redacted] Crane Bumper Report**

Bumpers are required for a crane bridge. They must be able to meet the AISE specifications shown below. Two-bumper systems will be used.

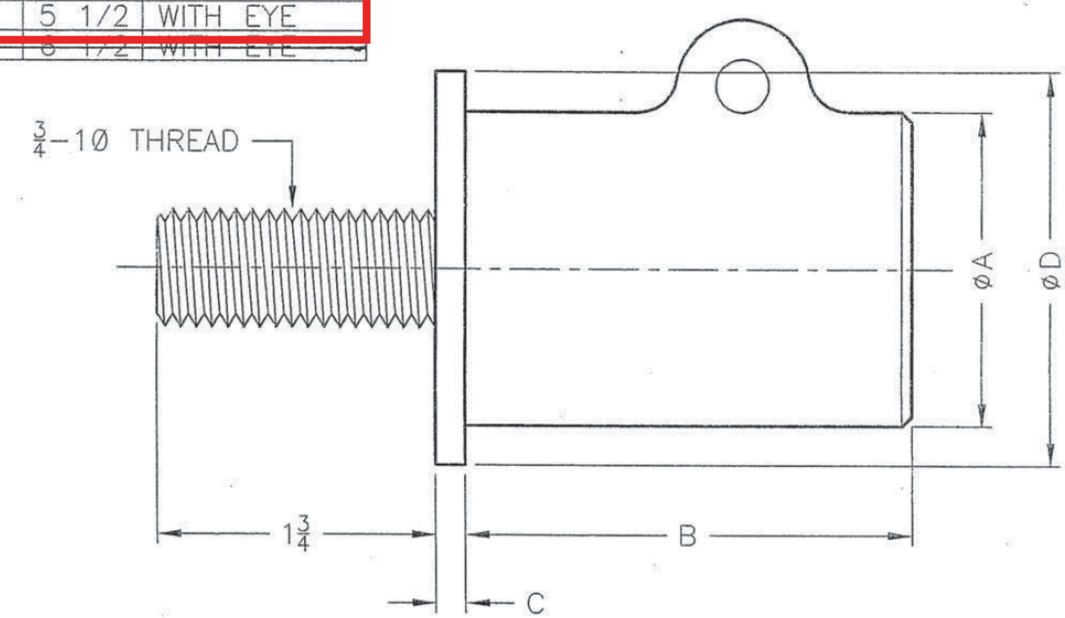
**Crane Bridge**

| | |
|---|---|
| Weight: | 49,300 lb |
| Speed: | 100 fpm |
| Load rating: | 100 % |
| Deceleration rating: | 50.0 % |
| Maximum average deceleration: | 16.1 fps² |
| Bumper ID: | CE-20-K5 |
| Load capacity (per bumper): | 2,430 ft·lb |
| Force transmitted to structure at 100% speed (per bumper): | 8,570 lb |
| Deflection at 100% speed: | 2.98 in |
| Maximum average deceleration from 50% speed: | 3.56 fps² |
| Maximum deceleration from 50% speed: | 5.60 fps² |

| PART NO. | A | B | C | D | DESCRIPTION |
|---|---|---|---|---|---|
| CE-K2-SD | 2 | 2.92 | 3/16 | 2 1/2 | WITHOUT EYE |
| CE-K3-SD | 3 | 4.22 | 3/16 | 3 1/2 | WITHOUT EYE |
| CE-K4-SD | 4 | 5.73 | 3/16 | 4 1/2 | WITHOUT EYE |
| CE-K5-SD | 5 | 7.22 | 1/4 | 5 1/2 | WITHOUT EYE |
| CE-K6-SD | 6 | 8.74 | 1/4 | 6 1/2 | WITHOUT EYE |
| CE-K2-SD-WE | 2 | 2.92 | 3/16 | 2 1/2 | WITH EYE |
| CE-K3-SD-WE | 3 | 4.22 | 3/16 | 3 1/2 | WITH EYE |
| CE-K4-SD-WE | 4 | 5.73 | 3/16 | 4 1/2 | WITH EYE |
| CE-K5-SD-WE | 5 | 7.22 | 1/4 | 5 1/2 | WITH EYE |
| CE-K6-SD-WE | 6 | 8.74 | 1/4 | 6 1/2 | WITH EYE |

a

| LVL | DATE | REVISION |
|---|---|---|
| Ø | 3-13-03 | REDRAWN ON CAD WAS SKETCH 6202-SK |
| 1 | 3-13-03 | a REVISED B DIMS. |
| 2 | 4-9-03 | b REMOVED EYE |
| 3 | 4-17-06 | c ADDED -WE DETAILS |



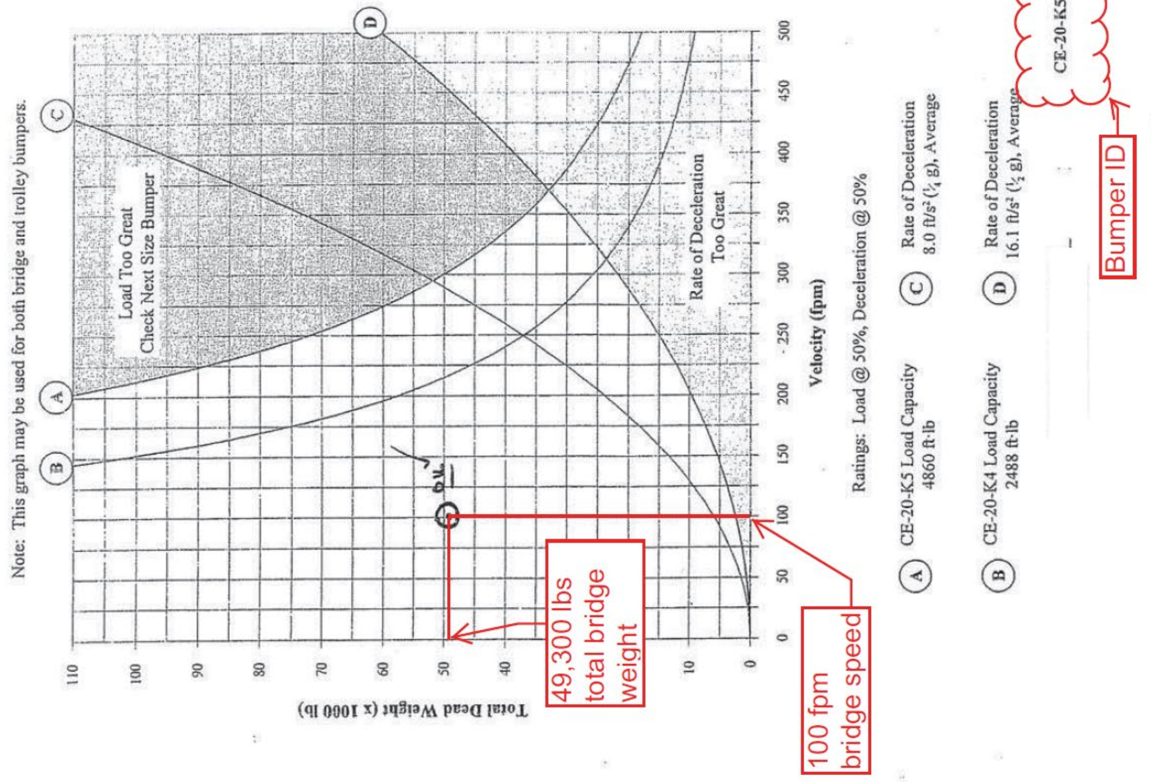

UNLESS OTHERWISE SPECIFIED, TOLERANCES ARE AS FOLLOWS:

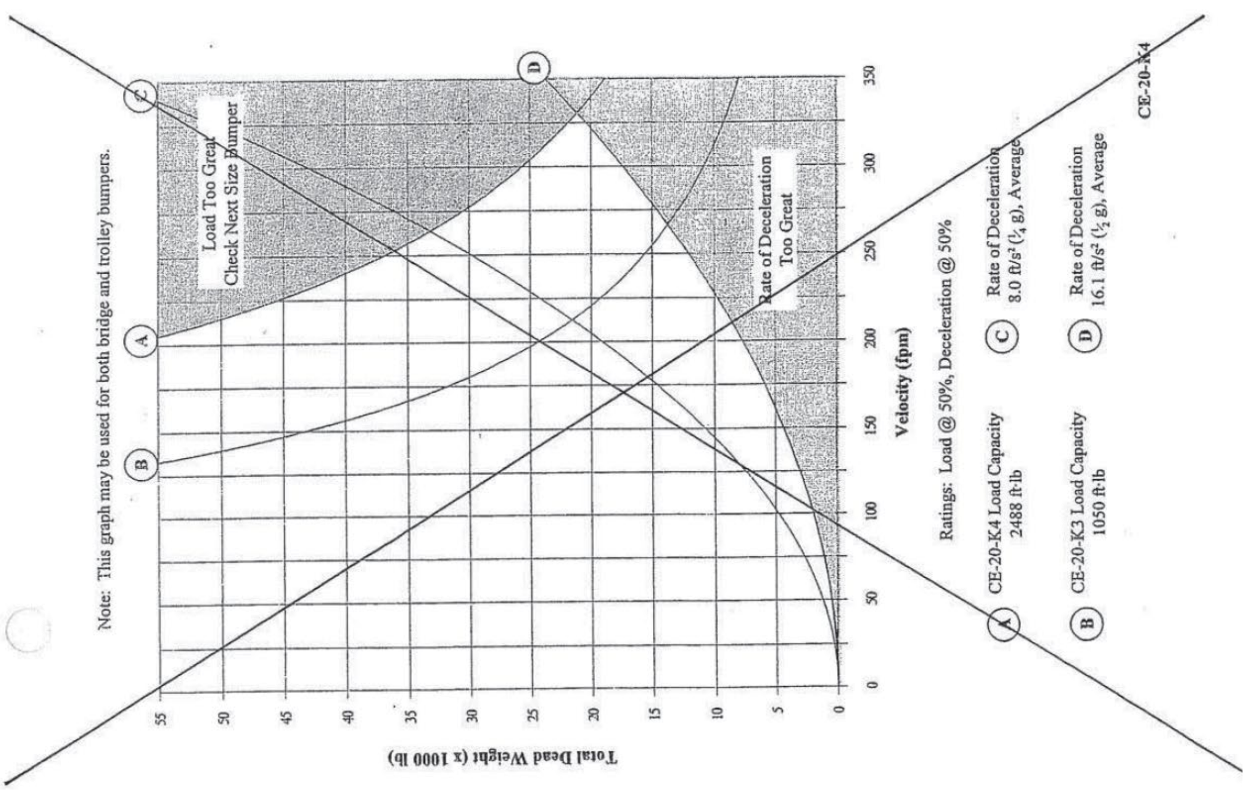
FRACTIONAL
METAL MAX( ±1/32, ±.33%)
POLYURETHANE MAX( ±1/32, ±.50%)

DECIMAL
X.XX ±.020
X.XXX ±.005
X.XXXX ±.0005

HARDNESS
SHORE "A" ±5 SHORE "D" ±5

PART NO.: AS SHOWN
PART NAME: CE-K-SD STUD BUMPERS
MATL: STEEL
RED POLYURETHANE 90 SHORE "A"
DRAWN BY:
SCALE: FULL
CHECKED BY:
DATE: 3-13-03
CAGE: 2A197
DRAWING NO.: A303031A
REV.: 3


Note: This graph may be used for both bridge and trolley bumpers.
Load Too Great
Check Next Size Bumper
Rate of Deceleration
Too Great
Velocity (fpm)
Total Dead Weight (x 1000 lb)
49,300 lbs
total bridge
weight
100 fpm
bridge speed
ok
Ratings: Load @ 50%, Deceleration @ 50%
A CE-20-K5 Load Capacity
4860 ft·lb
B CE-20-K4 Load Capacity
2488 ft·lb
C Rate of Deceleration
8.0 ft/s² (¼ g), Average
D Rate of Deceleration
16.1 ft/s² (½ g), Average
CE-20-K5
Bumper ID


Note: This graph may be used for both bridge and trolley bumpers.
Load Too Great
Check Next Size Bumper
Rate of Deceleration
Too Great
Velocity (fpm)
Total Dead Weight (x 1000 lb)
Ratings: Load @ 50%, Deceleration @ 50%
A CE-20-K4 Load Capacity
2488 ft·lb
B CE-20-K3 Load Capacity
1050 ft·lb
C Rate of Deceleration
8.0 ft/s² (¼ g), Average
D Rate of Deceleration
16.1 ft/s² (½ g), Average
CE-20-K4

iv. Coating System

# COATING SYSTEM SUMMARY FORM

Complete summary form for each system to be used on project. Indicate location(s) system will be used in remarks section.

Contract No. XXXX-XX-X-XXXX

Contractor Crane Parts Manufacturers

Submittal Date 07/16/2010

(Sub)Contractor Performing Paint Application Let's Paint It! Inc.

Surfaces will be cleaned and prepared to:

- ☑ SSPC-SP1, Solvent Cleaning
- ☑ SSPC-SP2, Hand Tool Cleaning
- ☐ SSPC-SP3, Power Tool Cleaning
- ☐ SSPC-SP6, Commercial Blast Cleaning
- ☐ SSPC-SP10, Near-White Metal Blast Cleaning
- ☐ SSPC-SP5, White Metal Blast Cleaning
- ☐ Other (please specify): ______

Surface Profile: 1.5 mils - 4 mils

*Note that SSPC-SP1 is a predecessor to other SSPC surface preparation standards.*

Number of Coatings 3

Coating Products Manufacturer Koat Rite Inc.

If zinc-rich product is used, what percentage by weight in dry film? _____ %

| Coat | Product | Dry Film Thickness Range (mils) | Application Method | Color(s) |
|---|---|---|---|---|
| Primer | Koat-Rite Alkyd Primer 300Z | 4-6 | Spray Gun | Brown |
| Inter-mediate | Koat-Rite Alkyd Enamel 317 | 4-6 | Spray Gun | Grey |
| Top Coat | Koat-Rite Alkyd Enamel 317 | 4-6 | Spray Gun | Yellow |

*Mark "N/A" where coat is not used.*

Remarks:

M. **Appendix M – Control System and Network Product Data**

Please see the following pages for examples of control system and network product data.


# IMPULSE®•G+ & VG+ Series 4

## Adjustable Frequency/Vector Crane Controls
## Technical Manual

MAGNETEK

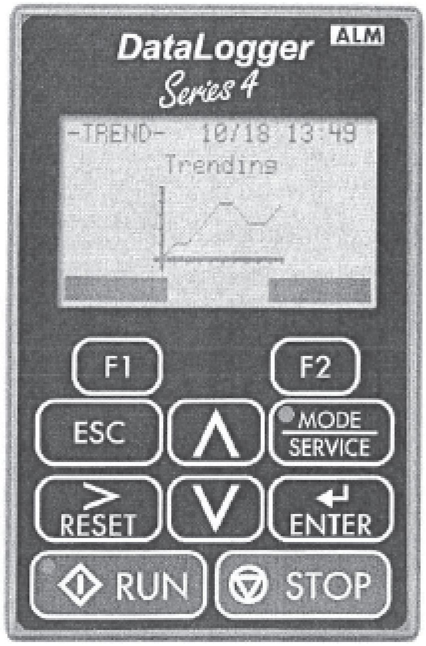
VFD Firmware: 14707 & 14750
Part Number: 144-23910 R7
November 2020

## 1.3 Specifications

**Table 1-2: Specification Values and Information - Heavy Duty**

| 230 V | | | 460 V | | | 575 V | | |
|---|---|---|---|---|---|---|---|---|
| Model (-G+/ VG+S4) | Rated Output Current (A) | Output Capacity (kVA) | Model (-G+/ VG+S4) | Rated Output Current (A) | Output Capacity (kVA) | Model (-G+/ VG+S4) | Rated Output Current (A) | Output Capacity (kVA) |
| 2003 | 3.2 | 1.2 | 4001 | 1.8 | 1.4 | 5001 | 1.7 | 1.7 |
| 2005 | 5.0 | 1.9 | 4003 | 3.4 | 2.6 | 5003 | 3.5 | 3.5 |
| 2007 | 6.9 | 2.6 | 4004 | 4.8 | 3.7 | 5004 | 4.1 | 4.1 |
| 2008 | 8.0 | 3.0 | Trlly 4005 | 5.5 | 4.2 | 5006 | 6.3 | 6.3 |
| 2011 | 11.0 | 4.2 | Brdg 4007 | 7.2 | 5.5 | 5009 | 9.8 | 9.8 |
| 2014 | 14.0 | 5.3 | 4009 | 9.2 | 7.0 | 5012 | 12.5 | 12.5 |
| 2017 | 17.5 | 6.7 | 4014 | 14.8 | 11.3 | 5017 | 17.0 | 17.0 |
| 2025 | 25.0 | 9.5 | 4018 | 18.0 | 13.7 | 5022 | 22.0 | 22.0 |
| 2033 | 33.0 | 12.6 | Aux 4024 | 24.0 | 18.3 | 5027 | 27.0 | 27.0 |
| 2047 | 47.0 | 17.9 | 4031 | 31.0 | 24.0 | 5032 | 32.0 | 32.0 |
| 2060 | 60.0 | 23.0 | 4039 | 39.0 | 30.0 | 5041 | 41.0 | 41.0 |
| 2075 | 75.0 | 29.0 | Main 4045 | 45.0 | 34.0 | 5052 | 52.0 | 52.0 |
| 2085 | 85.0 | 32.0 | 4060 | 60.0 | 48.0 | 5062 | 62.0 | 62.0 |
| 2115 | 115 | 44.0 | 4075 | 75.0 | 57.0 | 5077 | 77.0 | 77.0 |
| 2145 | 145 | 55.0 | 4091 | 91.0 | 69.0 | 5099 | 99.0 | 99.0 |
| 2180 | 180 | 69.0 | 4112 | 112 | 85.0 | 5130 | 130 | 129 |
| 2215 | 215 | 82.0 | 4150 | 150 | 114 | 5172 | 172 | 171 |
| 2283 | 283 | 108 | 4180 | 180 | 137 | 5200 | 200 | 199 |
| 2346 | 346 | 132 | 4216 | 216 | 165 | - | - | - |
| 2415 | 415 | 158 | 4260 | 260 | 198 | - | - | - |
| - | - | - | 4304 | 304 | 232 | - | - | - |
| - | - | - | 4370 | 370 | 282 | - | - | - |
| - | - | - | 4450 | 450 | 343 | - | - | - |
| - | - | - | 4605 | 605 | 461 | - | - | - |
| - | - | - | 4810 | 810 | 617 | - | - | - |
| - | - | - | 41090 | 1090 | 831 | - | - | - |

NCC note to contractors:
Information submitted for Control System and Network product data will be identical to the information submitted for the electrical product data. The intent is to have them in their own sections so they are readily accessible when needed.




# DataLogger Series 4

## Technical Manual

MAGNETEK

Part Number: 144-27097 R1
January 2021

# MLTX
## Wireless Controls

IDEAL FOR
CRANE & HOIST / FLUID POWER / SURFACE MINING
APPLICATIONS


## COMFORT. DURABILITY. FLEXIBILITY. THAT'S MLTX.

Our compact MLTX bellybox transmitter incorporates the latest polymer technology in a lightweight, comfortably contoured, yet durable case. It's available with many options to meet the needs of a variety of applications and industries.

## COMFORTABLE AND LIGHTWEIGHT

- Ergonomically designed contoured case is more comfortable for the user
- One of the lightest bellybox transmitters available today—50% lighter than other bellybox transmitters
- Easy to use, angled lever or joystick controls enhance operator comfort

## RUGGED AND RELIABLE

- Rugged, super-tough nylon housing is made to withstand shock
- Rated NEMA 4 (IP66), sealed to withstand harsh, industrial environments
- Synthesized frequency generation enhances reliability
- Dual access code system provides peace-of-mind, as the signal only operates the intended equipment
- Designed to minimize power consumption, providing one of the longest life batteries in the industry today - rechargable NiMH battery pack standard
- Military grade auxiliary function switches

## VERSATILE AND FLEXIBLE

- Choose up to 7 levers or 2 joysticks
- Side mounted key switch and code plug
- Choose up to 6 toggles; mushroom E-stop
- Available proportional, 1, 2, 3, or 5 speeds in a non-detent lever or joystick
- Customize MLTX to meet your requirements, or select a pre-engineered, off-the-shelf system
- Backward compatible with most existing systems
- Up to 4 selectable licensed frequencies
- Optional certification for use in hazardous locations requiring ISA 12.12.01 Class I and Class II, Division 2, Group A, B, C, D, E, F and G
- Synthesized RF technology available for:
  - Unlicensed (FCC Part 15/RSS-210)
  - Licensed (FCC Part 90/RSS-119)

MAGNETEK WIRELESS CONTROLS ARE MADE IN THE USA
MAGNETEK

MLTX
Wireless Controls

# IDEAL FOR USE IN A VARIETY OF APPLICATIONS

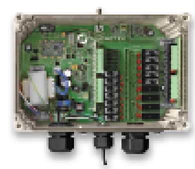
The MLTX's standard pre-engineered system offers flexibility not found in most of-the shelf systems. Also available are innovative, cost-effective, custom engineered wireless communication packages, complete with hydraulic or crane interface controls. These are designed to your specifications, reducing internal engineering and manufacturing costs, improving time to market, and enhancing equipment performance. We offer complete plug-and-play control packages designed specifically for your equipment, manufactured and tested on our panel assembly line.

**Packaged system options include:**

- VFDs, PLCs, and contractor controls
- I/O modules supporting various types of machine sensors and valves
- Custom programming as the application requires
- NEMA 4 and stainless steel enclosures
- Pre-wired cables with valve connectors of choice
- Collision avoidance

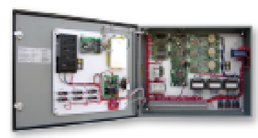
# COMPATIBLE WITH SEVERAL RECEIVERS

**in*tele*Smart2 Receiver**



- Custom output mapping via a USB
- Available in 14, 22, or 30 outputs
- Synthesized RF technology available for:
  - Unlicensed (FCC Part 15/RSS-210)
  - Licensed (FCC Part 90/RSS-119)
- Group coding – easily allows transmitter to control multiple cranes in various configurations

**18K Receiver**



- Modular construction for ease of configuration and maintenance
- Up to 64 programmable outputs
- Pitch & Catch, Multibox operation options
- Synthesized RF technology available for:
  - Unlicensed (FCC Part 15/RSS-210)
  - Licensed (FCC Part 90/RSS-119)

**CAN-6 Receiver**

- Easily integrated into CAN based products and products with J1939 communications
- Can be connected to other devices that require an analog voltage input
- 8 analog outputs, 8 digital outputs, and 2 CAN-bus ports
- Designed for outdoor use and sealed to IP66 specifications
- Synthesized RF technology available for:
  - Unlicensed (FCC Part 15/RSS-210)
  - Licensed (FCC Part 90/RSS-119)

**For more information, contact your local Magnetek Sales Representative, Sales@ErgonomicPartners.com, or the Magnetek location nearest you.**

MAGNETEK

www.ErgonomicPartners.com | Sales@ErgonomicPartners.com

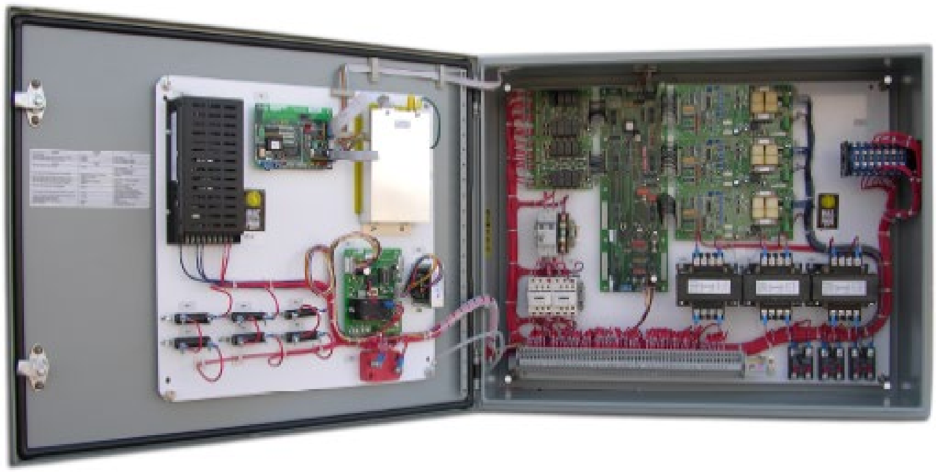
HEADQUARTERS
N49 W13650 Campbell Drive
Menomonee Falls, WI 53051

Distributed by Ergonomic Partners
Sales@ErgonomicPartners.com
www.ErgonomicPartners.com
Tel: (314) 884-8884

Distributed by Tri-State Equipment Company
sales@tsoverheadcrane.com
www.tsoverheadcrane.com
Tel: (314) 869-7200



7/17



# Telemotive®
# Series 18K Receiver

Radio Control Equipment

# Instruction Manual

TC18K-0 Rev. S June 2009
Part Number 24559T

# Section 13 – 18K Static Stepless Output Boards (Continued)

## 13-6. Adjustments.

There six output voltage adjustments on the unit. They are as follows:

Hz – Maximum possible output voltage. Maximum output with function lever at maximum. Upper limit to motor input.

VOUT – High reference voltage. The voltage for the speed desired at full lever travel equal to above or less.

F1 and F2 – Float Direction 1 and 2 respectively. Used for the float function for those units designed with this feature only. Usually with Teltec or Laser Guard on the bridge output. If the control lever is held at maximum and an input to the system is received from a Teltec or Laser Guard, the system will then decrease the output to points that are set by F1 and F2.

D1 and D2 – Offset Direction 1 and 2 respectively. Some systems require an offset that is done with D2 and D1.

## 13-7. Level Setting.

To adjust outputs:

1.) Remove connectors for directional output module (J3).

2.) Start system.

3.) Measuring output on stepless module move lever switch to maximum and adjust R95 for maximum output.

4.) Lever still at maximum adjust VOUT for desired high level output.

5.) Move lever to directionals only and adjust D1 and D2 for 0 Volts output. If an offset voltage is required set to that voltage.

NOTE: Some cranes require 4 Volts for the hoist up function with just the directional activated.

6.) F1 and F2 if your system utilizes float, adjust F3 output when float 1 is inputted to the output module (this is done with speed at maximum). Adjust F4 when float 2 is inputted.

## 13-8. Indicators.

The indicators S1, S2, S4 and S8 count up in a binary sequence as the transmitter lever is moved up. D1, D2, F1 and F2 indicate the activation of directionals (D) and floats (F) 1 and 2 respectively.

## 13-9. Special Power Supply.

For some static stepless boards a negative 12VDC output from the power supply is required as well as a plus 12 VDC. Depending on the mains, the following power supplies are used in lieu of the standard supply in static stepless systems:

| | |
|---|---|
| 10-40 Volts AC or DC | **A5664** |
| 40-90 Volts AC or DC | **A5670** |
| 90-300 Volts AC or DC | **A8505** |

SD-03.C1
HARDWARE LIST

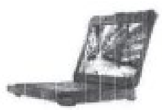


< Back to Customize (/en-us/work/shop/dell-laptops-and-notebooks/latitude-5424-rugged-laptop/spd/latitude-14-5424-laptop/xctol542414us?selectionState=eyJPQyl6InhjdG9sNTQyNDE0dXMiLCJNb2RzljpbeyJJZCI6NywiT3B0cyl6W3siSWQiOiJHTVlHNEMwIn1dfSx7IklkIjo4LCJPcHRzIjpbeyJJZCI

# Latitude 5424 Rugged Laptop Summary

List Price
Total Savings

Dell Business Credit
As low as $63/mo.* (//www.dell.com/en-us/work/shop/help/cp/dell-business-credit#tab-3) | Apply (//www.dell.com/Financing/Comm/dbcmarcom?dtype=dbc&dfsref=dbc&returnurl=https%3A%2F%2Fwww.dell.com%2Fen-us%2Fwork%2Fshop%2Fpdr%2Flatitude-14-5424-laptop%2Fxctol542414us%3FselectionState%3DeyJPQyl6InhjdG9sNTQyNDE0dXMiLCJNb2RzljpbeyJJZCI6NywiT3B0cyl6W3siSWQiOiJHTVlHNEMwIn1dfSx7Iklkl
View Delivery Dates ()



## Customize

| Option | Selection | SKU / Product Code | Quantity | | | |
|---|---|---|---|---|---|---|
| 8th Gen Intel® Core™ i5-8350U Processor (Quad Core, 6M Cache, 1.7GHz,15W, vPro) | [379-BDHC] / GF8Y6OR | 1 | Processor | 8th Gen Intel® Core™ i5-8350U Processor (Quad Core, 6M Cache, 1.7GHz,15W, vPro) | [379-BDHC] / GF8Y6OR | 1 |
| Windows 10 Pro 64bit English, French, Spanish | [619-AHKN] / GF48XA1 | 1 | Operating System | Windows 10 Pro 64bit English, French, Spanish | [619-AHKN] / GF48XA1 | 1 |
| No Windows AutoPilot | [340-CKSZ] / GYEO2AP | 1 | Windows AutoPilot | No Windows AutoPilot | [340-CKSZ] / GYEO2AP | 1 |
| Intel® Core™ i5-8350U Processor Base with Integrated Intel UHD 620 Graphics | [338-BPVI] / GBGF479 | 1 | Processor | Intel® Core™ i5-8350U Processor Base with Integrated Intel UHD 620 Graphics | [338-BPVI] / GBGF479 | 1 |
| No Out-of-Band Systems Management - vPro Disabled | [631-ABWH] / GRQX26P | 1 | Systems Management | No Out-of-Band Systems Management - vPro Disabled | [631-ABWH] / GRQX26P | 1 |

| Option | Selection | SKU / Product Code | Quantity | | | |
|---|---|---|---|---|---|---|
| 8GB, 2x4GB, 2666MHz DDR4 Non-ECC | [370-AEVI] / GL0092T | 1 | Memory | 8GB, 2x4GB, 2666MHz DDR4 Non-ECC | [370-AEVI] / GL0092T | 1 |
| Cyberlink Media Suite Essentials for Windows 10 and DVD drive (without Media) | [658-BBTV] / GWNM30Y | 1 | Optical Software | Cyberlink Media Suite Essentials for Windows 10 and DVD drive (without Media) | [658-BBTV] / GWNM30Y | 1 |
| M.2 256GB PCIe NVMe Class 40 Opal 2.0 Self Encrypting Solid State Drive | [400-BBTX] / GGURV91 | 1 | Hard Drive | M.2 256GB PCIe NVMe Class 40 Opal 2.0 Self Encrypting Solid State Drive | [400-BBTX] / GGURV91 | 1 |
| No Additional Hard Drive | [401-AADF] / GNTOSJ7 | 1 | Secondary Hard Drive | No Additional Hard Drive | [401-AADF] / GNTOSJ7 | 1 |
| 14" FHD WVA (1920 x 1080) Anti-Glare Non-Touch | [391-BDXO] / G7N85ZW | 1 | Display | 14" FHD WVA (1920 x 1080) Anti-Glare Non-Touch | [391-BDXO] / G7N85ZW | 1 |
| Sealed Internal Non-Backlit Keyboard | [389-DOPO][580-AFDC] / G3F9CS4 | 1 | Keyboard | Sealed Internal Non-Backlit Keyboard | [389-DOPO] [580-AFDC] / G3F9CS4 | 1 |
| No Security Options | [346-BEVG] / G98LKW2 | 1 | Security Options | No Security Options | [346-BEVG] / G98LKW2 | 1 |
| No Wireless LAN Card | [555-BBCX] / GE6JT4X | 1 | Wireless | No Wireless LAN Card | [555-BBCX] / GE6JT4X | 1 |
| No Mobile Broadband Card | [362-BBBB] / GLAU7Q1 | 1 | Mobile Broadband | No Mobile Broadband Card | [362-BBBB] / GLAU7Q1 | 1 |
| 3 Cell 51Whr ExpressCharge Capable Battery | [451-BCHG] / GFDTJ5M | 1 | Primary Battery | 3 Cell 51Whr ExpressCharge Capable Battery | [451-BCHG] / GFDTJ5M | 1 |
| 90W Rugged AC Adapter, 7.4mm Elbow Barrel | [492-BCNQ] / GXQ6M2N | 1 | Power Supply | 90W Rugged AC Adapter, 7.4mm Elbow Barrel | [492-BCNQ] / GXQ6M2N | 1 |
| Factory Installed Rigid handle for the tied sku | [540-BCIH] / GX931ZA | 1 | Accessories | Factory Installed Rigid handle for the tied sku | [540-BCIH] / GX931ZA | 1 |
| Dummy Airbay Cover | [325-BDEH] / GFLEPJ1 | 1 | Second Battery | Dummy Airbay Cover | [325-BDEH] / GFLEPJ1 | 1 |
| ENERGY STAR Qualified | [387-BBNJ] / GIHL264 | 1 | ENERGY STAR | ENERGY STAR Qualified | [387-BBNJ] / GIHL264 | 1 |
| Standard Shipment | [800-BBGF] / GF6RVZ0 | 1 | Transportation from ODM to region | Standard Shipment | [800-BBGF] / GF6RVZ0 | 1 |

| Option | Selection | SKU / Product Code | Quantity | | | |
|---|---|---|---|---|---|---|
| Additional RJ45, Serial | [590-TEYO] / GB2S8LR | 1 | Serial Port | Additional RJ45, Serial | [590-TEYO] / GB2S8LR | 1 |
| No Additional Hard Drive | [401-AADF] / GNTOSJ7 | 1 | 3rd Hard Drive | No Additional Hard Drive | [401-AADF] / GNTOSJ7 | 1 |
| 8X DVD+/-RW 9.5mm Optical Drive | [429-ABHV] / GYMWT1A | 1 | Optical Drive | 8X DVD+/-RW 9.5mm Optical Drive | [429-ABHV] / GYMWT1A | 1 |
| No Option Included | [340-ACQQ] / GKGSY4C | 1 | GPS Solutions (Tied) | No Option Included | [340-ACQQ] / GKGSY4C | 1 |
| No Camera or Microphone | [319-BBGG] / G75WE1D | 1 | Camera | No Camera or Microphone | [319-BBGG] / G75WE1D | 1 |
| PCMCIA Card | [590-TEYI] / GER9KQA | 1 | Network Card | PCMCIA Card | [590-TEYI] / GER9KQA | 1 |

## Warranty and Services

| Option | Selection | SKU / Product Code | Quantity | | | |
|---|---|---|---|---|---|---|
| 3 Years Ltd Hware Warranty: Mail-in; Customer supplies box, Dell pays shipping | [808-6805][808-6806] / MI3 | 1 | Warranty | 3 Years Ltd Hware Warranty: Mail-in; Customer supplies box, Dell pays shipping | [808-6805] [808-6806] / MI3 | 1 |
| None | | | Accidental Damage | None | | |
| None | | | Need help installing? We can help! | None | | |
| None | | | Keep Your Hard Drive | None | | |
| None | | | Extended Battery Service | None | | |
| None | | | ProDeploy Client Suite | None | | |

## Software

| Option | Selection | SKU / Product Code | Quantity | |
|---|---|---|---|---|
| None | | | Microsoft Office 365 (Word, Excel, Powerpoint, Outlook & more) | None |

| Option | Selection | SKU / Product Code | Quantity | | | |
|---|---|---|---|---|---|---|
| Microsoft Office 30 Day Trial | [658-BCSB] / GC70FJV | 1 | Microsoft Office | Microsoft Office 30 Day Trial | [658-BCSB] / GC70FJV | 1 |
| McAfee® Small Business Security 30 Day Free Trial | [650-0028] / GNB49S6 | 1 | Security Software | McAfee® Small Business Security 30 Day Free Trial | [650-0028] / GNB49S6 | 1 |
| None | | | PDF Solutions | None | | |
| Dell Encryption Personal, 1 Year | [421-9984][954-3455] / PDPE1Y | 1 | Dell Endpoint Security | Dell Encryption Personal, 1 Year | [421-9984] [954-3455] / PDPE1Y | 1 |
| None | | | Laplink PCmover | None | | |
| OS-Windows Media Not Included | [620-AALW] / GLA9OQ1 | 1 | Operating System Recovery Options | OS-Windows Media Not Included | [620-AALW] / GLA9OQ1 | 1 |

## Accessories

| Option | Selection | SKU / Product Code | Quantity | |
|---|---|---|---|---|
| None | | | Absolute Security - Standard | None |

### Also included in this system

The following options and default selections are included with your order.

No TAA
Single Primary HD & ODD Brackets, 5424

### Additional Summary Information

Date Created: Tue Mar 10 2020 14:14:51 GMT-0400 (Eastern Daylight Time)

< Back to Customize (/en-us/work/shop/dell-laptops-and-notebooks/latitude-5424-rugged-laptop/spd/latitude-14-5424-laptop/xctol542414us?selectionState=eyJPQyl6InhjdG9sNTQyNDE0dXMiLCJNb2RzIjpbeyJJZCI6NywiT3B0cyI6W3siSWQiOiJHTVlHNEMwIn1dfSx7IklkIjo4LCJPcHRzIjpbeyJJZCI

Fast, Easy Financing.*
Update your technology with great financing offers from Dell Business Credit.*

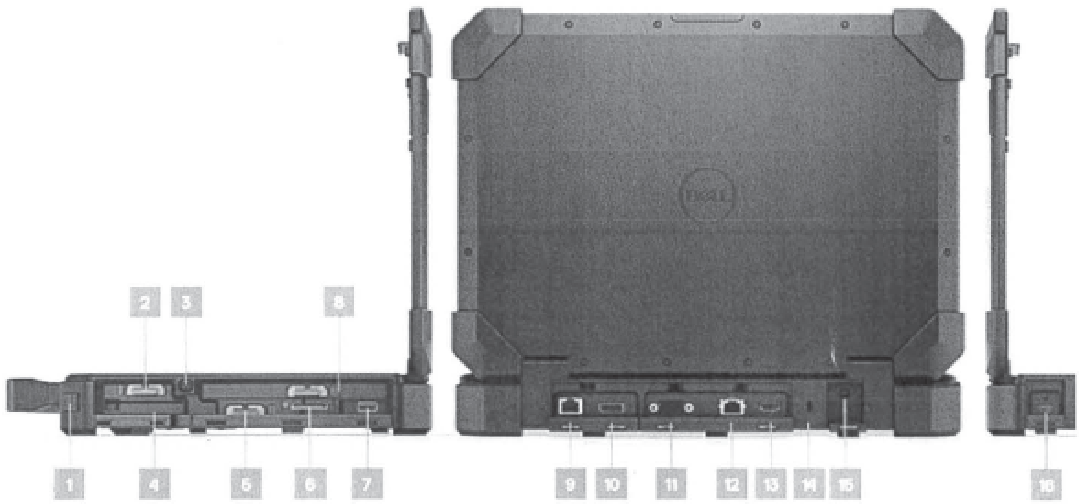
(//www.dell.com/en-us/work/shop/help/cp/dell-business-credit#tab-1?ref=stpvalueprops)

Dell Rewards
Join for free and get up to 6% back in rewards* and free expedited delivery*

(//www.dell.com/en-us/work/shop/dell-rewards/cp/dell-rewards?ref=stpvalueprops)

Free Shipping & Easy Returns
Enjoy free shipping and no-hassle returns*. It's shopping made simple.

(//www.dell.com/en-us/work/shop/dell-experience/cp/dell-experience?ref=stpvalueprops)




# Ports & Slots

1. Anchors (straps optional) | 2. Removable Secondary SATA Storage Bay (Optional) | 3. Stylus | 4. Smart Card Reader (Optional) | 5. Removable Primary PCIe Storage Bay | 6. SD and SIM card Slot | 7. USB 3.0 Type A | 8. Blu-ray+R/W or DVD+R/W or Removable Third SATA Storage Bay (Optional) | 9. RJ-45 gigabit Ethernet network connector (Optional) | 10. Serial, VGA, or Display Port (Optional) | 11. Native Serial | 12. RJ-45 gigabit Ethernet network connector | 13. HDMI | 14. Lock slot | 15. Power in | 16. USB 3.0 Type C™: Power and Display | 17. USB 3.0 Type A | 18. USB 3.0 Type A | 19. Universal Audio Jack

**Additional Optional Slots:**
ExpressCard or PCMCIA
Contacted and Contactless Smartcard
Fingerprint Reader

# Cabling — Dell 7424

| | | |
|---|---|---|
| 90 watt AC Adapter | 492-BCNQ | Dell |
| E5 Power Cord | 537-BBBD | Dell |
| USB-A to Serial Adapter (DB9) | 6726030000413 | Tripp-Lite |
| DB9 to RJ45 | 15-109-148 | Show Me Cables |
| Cat5e Patch Cord 10 ft. UTP | 3388 | Monoprice |

Tripp Lite
1111 W. 35th Street
Chicago, IL 60609 USA
Telephone: 773.869.1234
www.tripplite.com

# USA-A to Serial Adapter (DB9) - Keyspan, High-Speed (M/M), Detachable Cable, TAA

MODEL NUMBER: **USA-19HS**

...nnect devices with a 9-pin serial port, such as switches, routers, barcode scanners and network storage devices, to the USB Type-A port on your computer or laptop.

## Description

The USA-19HS Keyspan® High-Speed USB-to-Serial Adapter allows you to connect a serial device to a computer or laptop with a USB Type-A port. Widely recommended by serial device manufacturers, the USA-19HS attaches to switches, routers, barcode scanners, GPS units, point-of-sale devices, lab equipment, network storage devices and other devices with a 9-pin serial port. The included 3-foot detachable cable supports data transfer speeds up to 230 Kbps—twice as fast as a built-in serial port. The USA-19HS works with any USB cable up to 16 feet. An LED indicates data activity. This adapter requires no external power and, at just 2 ounces, packs away easily in your laptop bag for use on the go. Windows line monitor and data trace software included. Easy to upgrade with free software downloads. Works with Windows (up to 10) and Mac OS X (up to and including 10.14). Compliant with the Federal Trade Agreements Act (TAA) for GSA Schedule purchases.

## Features

**Works with DB9 Serial Devices**Connects to switches, routers, barcode scanners, GPS units, point-of-sale devices, lab equipment, network storage devices, modems, graphics tablets and other devices with a 9-pin serial portSupports data transfer speeds up to 230 Kbps—twice as fast as a built-in serial port
**Easy to Set Up and Use**No external power supply neededWeighs just 2 oz. for convenient transport in your backpack or laptop bagIncludes detachable 3-ft. USB Type-A cableWorks with any USB cable up to 16 ft.
**Compatible with Most Systems**Works with Windows (up to 10) and Mac OS X (up to 10.13), as well as Apple Sandbox applicationsUpgradeable with free software downloadsIncludes Windows line monitor and data trace software
**TAA-Compliant**Compliant with the Federal Trade Agreements Act (TAA) for GSA Schedule purchases

## Highlights

- Connects 9-pin serial device to computer or laptop USB-A port
- Supports data transfer speeds up to 230 Kbps
- Detachable 3-foot USB cable included
- No external power source required
- Works with Windows (up to 10) and Mac OS X (up to and including 10.14)

## System Requirements

- USB port
- Compatible with Windows 2000, XP, Vista, 7, 8, 8.1, 10, Server 2008 R2, Server 2012, Server 2012 R2, Server 2016
- Compatible with Mac OS X 10.6, 10.7, 10.8, 10.9, 10.10, 10.11, 10.12, 10.13, 10.14

## Package Includes

- USA-19HS Keyspan High-Speed USB-to-Serial Adapter
- USB Type-A cable, 3 ft.
- CD with driver software and Owner's Manual

# Specifications

| OVERVIEW | |
| --- | --- |
| UPC Code | 672603000413 |

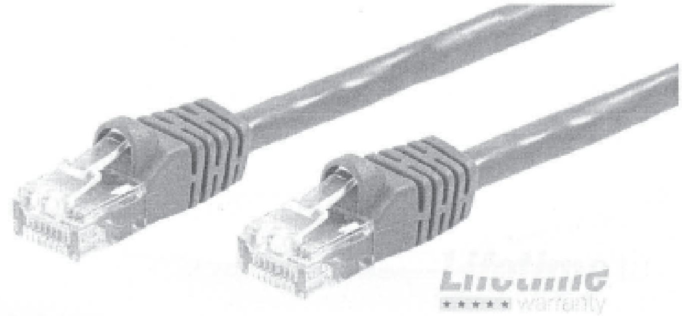
TRIPP·LITE

Tripp Lite
1111 W. 35th Street
Chicago, IL 60609 USA
Telephone: 773.869.1234
www.tripplite.com

| PHYSICAL | |
|---|---|
| Shipping Dimensions (hwd / in.) | 3.00 x 9.00 x 6.00 |
| Shipping Dimensions (hwd / cm) | 7.62 x 22.86 x 15.24 |
| Shipping Weight (lbs.) | 0.35 |
| Shipping Weight (kg) | 0.16 |
| Unit Dimensions (hwd / in.) | 1 x 1.6 x 3.1 |
| Unit Dimensions (hwd / cm) | 2.54 x 4.06 x 7.87 |
| Color | Black |
| **CONNECTIONS** | |
| Side A - Connector 1 | USB A (MALE) |
| Side B - Connector 1 | DB9 (MALE) |
| **FEATURES & SPECIFICATIONS** | |
| ·echnology | Serial (RS232); USB |
| **CERTIFICATIONS** | |
| Certifications | Tested to comply with RoHS, REACH, CE, FCC |
| **WARRANTY** | |
| Product Warranty Period (Worldwide) | 3-year limited warranty |

MONOPRICE

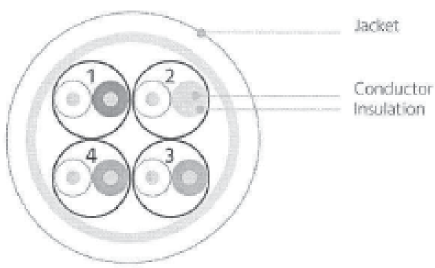
# CAT5e 24AWG UTP
## Ethernet Patch Cable




For more information or to order, please contact **Monoprice Sales Representative** or **sales@monoprice.com**

### Construction

| | |
|---|---|
| **Conductor** | 24AWG |
| Material: | BC |
| Nom. OD: | 7/0.19±0.008mm |
| **Insulation:** | PE |
| Nominal Thickness: | 0.18mm Min: 0.02mm |
| Nom. OD: | 0.97±0.05mm |
| **Jacket** | PVC |
| Nominal Thickness: | 0.55mm Min: 0.05mm |
| Nom. OD: | 5.4±0.02mm |




### Wire Connection

| | | | |
|---|---|---|---|
| Pair 1 | White + Blue | Pair 3 | White + Green |
| Pair 2 | White + Orange | Pair 4 | White + Brown |

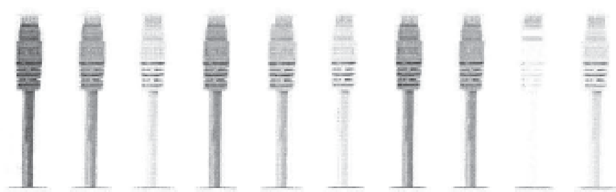
### Electrical Characteristics

Conductor Resistance@20 °C ≤ 87.6 Ohms/km

| | LOSS | NEXT | RL | ACR-N | ACR-F | PS NEXT | PS ACR-N | PS ACR-F |
|---|---|---|---|---|---|---|---|---|
| MHz | dB | dB | dB | dB | dB | dB | dB | dB |
| 1 | 3.0 | 60 | 17 | 57 | 57.4 | 57 | 54 | 54.4 |
| 4 | 4.5 | 53.5 | 17 | 49.1 | 45.4 | 50.5 | 46.1 | 42.4 |
| 8 | 6.3 | 48.6 | 17 | 42.3 | 39.3 | 45.6 | 39.3 | 36.3 |
| 10 | 7.1 | 47 | 17 | 39.9 | 37.4 | 44 | 36.9 | 34.4 |
| 16 | 9.1 | 43.6 | 17 | 34.5 | 33.3 | 40.6 | 31.5 | 30.3 |
| 20 | 10.2 | 42 | 17 | 31.8 | 31.4 | 39 | 28.8 | 28.4 |
| 25 | 11.4 | 40.3 | 16 | 28.9 | 29.4 | 37.3 | 25.9 | 26.4 |
| 31.25 | 12.9 | 38.7 | 15.1 | 25.9 | 27.5 | 35.7 | 22.9 | 24.5 |
| 62.5 | 18.6 | 33.6 | 12.1 | 15 | 21.5 | 30.6 | 12 | 18.5 |
| 100 | 24.0 | 30.1 | 10 | 6.1 | 17.4 | 27.1 | 3.1 | 14.4 |

### Mechanical Characteristics

| | |
|---|---|
| Storage Temperature Range | 0 °C to 45 °C |
| Installation Temperature Range | 0 °C to 75 °C |
| Maximum Pulling Force | 100 lbs. |



**Colors:** Black, Blue, Gray, Green, Orange, Pink, Purple, Red, White, and Yellow

**Lengths:** 0.5, 1, 2, 3, 5, 7, 10, 14, 20, 25, 30, 50, 75, and 100 feet

c UL us LISTED    RoHS COMPLIANT

### Ratings/Certifications

UL, RoHS, REACH

**Jacket Marking:** MONOPRICE TYPE CM 24AWG 4PR 75°C (UL) E467139 ANSI/TIA-568-C.2 CAT.5E UTP 100MHz RoHS COMPLIANCE



MONOPRICE | www.monoprice.com

## SOFTWARE DELL 5424

WINDOWS 10 PRO 64 ENGLISH, FRENCH, SPANISH- INSTALLED

MICROSOFT OFFICE 365 -NONE

MICROSOFT OFFICE 30 DAY TRIAL – NONE- TO BE DELETED AFTER PURCHASE

McAfee SMALL BUSINESS 30 DAY TRIAL – NONE- TO BE DELETED AFTER PURCHASE

DELL RECOVERY ENVIRONMENT- INSTALLED

DELL ENCRYPTION PERSONAL -INSTALLED

OS-WINDOWS MEDIA – NONE

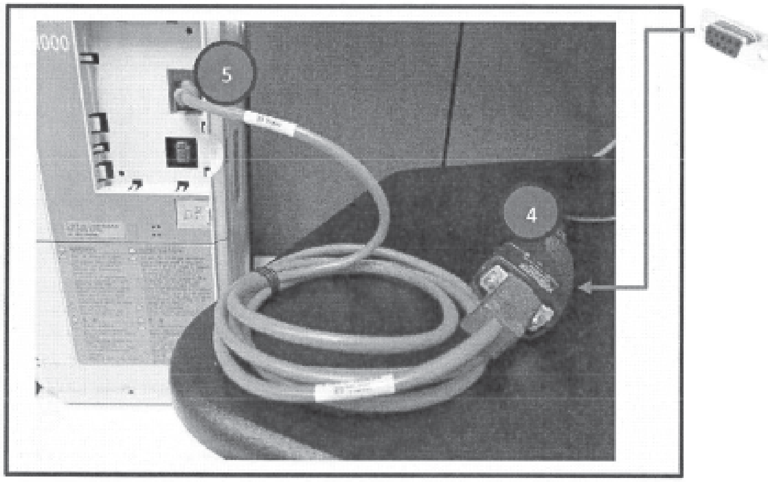
IMPLULSE LINK 4.1 BASIC – MAGNETEK - INSTALLED


# IMPULSE®•Link 5

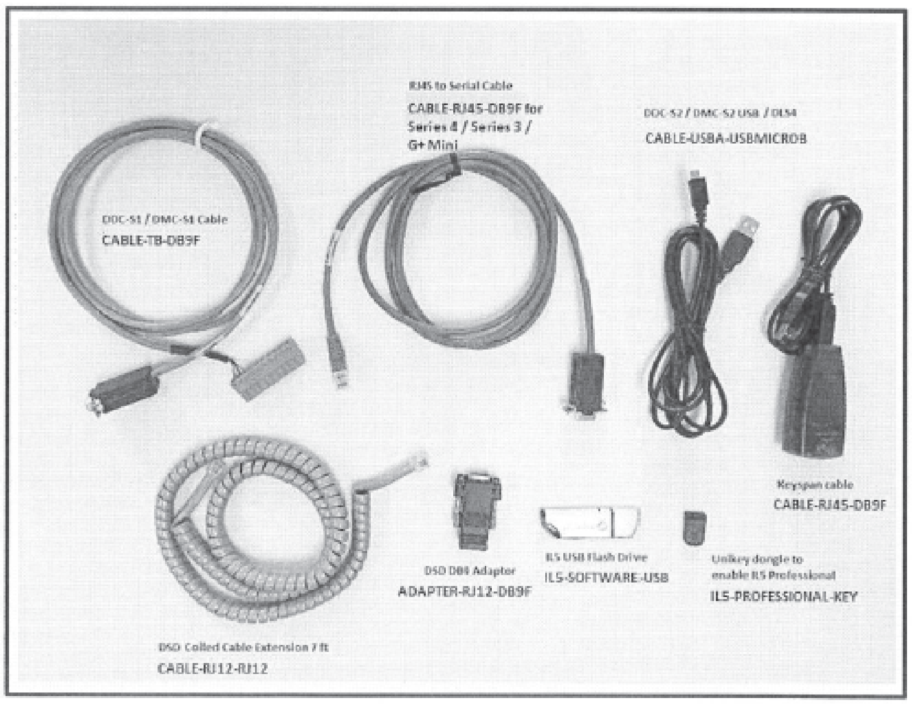
## Viewer and Professional User Manual

MAGNETEK
MATERIAL HANDLING

April 2020
Part Number: 144-18171 R2




### IL5 Professional kit contents:



PROJECT NUMBER [redacted]

| SD-03.C1 HARDWARE LIST | MANUFACTURE | MODEL | LOCATION CRANE SERIAL # | KEY TECHNICAL RATING | SERIAL NUMBER | MAC ADDRESSES | IP ADRESSES |
|---|---|---|---|---|---|---|---|
| VFD | MAGNETEK | SERIES 4 G / VG+ | 21-5023 | | TBD | NOT APPLICABLE | NOT IN NETWORK |
| DATA LOGGER | MAGNETEK | SERIES 4 | 21-5023 | | NOT APPLICABLE | NOT APPLICABLE | NOT APPLICABLE |
| RADIO CONTROL | MAGNETEK | TRANS- MLTX / REC. 18K | 21-5023 | | TBD | NOT APPLICABLE | NOT IN NETWORK |
| PLC | NOT APPLICABLE | | | | | | |
| RTU | NOT APPLICABLE | | | | | | |
| SUPERVISORY CONTROLLER | NOT APPLICABLE | | | | | | |

| SD-03.C2 SOFTWARE LIST | MANUFACTURE | VERSION/ SUBVERSION | LOCATION/ DEVICE CRANE SERIAL # | USED NETWORK PORTS /PROTOCOLS / SERVICES |
|---|---|---|---|---|
| VFD MODEL G+4 | MAGNETK | FLASH 14707A | 21-5023 | CAT 6 e / MALE - FEMALE |
| VFD MODEL VG+4 | MAGNETEK | FLASH 14707 | 21-5023 | CAT 6 e /MALE - FEMALE |
| DATA LOGGER | MAGNETK | IMPULSE LINK 5 V 5.3.0 | 21-5023 | USB MICRO |
| RADIO CONTROL | MAGNETEK | RCP | 21-5023 | USB MINI |
| PLC | NOT APPLICABLE | | | |
| RTU | NOT APPLICABLE | | | |
| SUPERVISORY CONTROLLER | NOT APPLICABLE | | | |

SD-03.C3 LIST AND DISCUSSION OF ALL SECURTITY FEATURES OF CONTRACTOR HARDWARTE AND SOFTWARE
ALL CONTROL COMPONENTS ARE IN A LIMITED NETWORK RELATIONSHIP. CURRENT DESIGN AND CON FIGURATION ISOLATES ALL FUNCTIONALITY TO THE CRANE ITSELF.

NCC note to contractors:
This example contains the hardware list, software list, and security features as required by the technical specification. In addition to an actual list, ctalog cut sheets are also required.

N. **Appendix N – Electrical Calculations**

Please see the following sheets for examples of electrical calculations.

i. Motor

## Traverse Motor Horsepower

The bridge acceleration factor ($K_a$) is calculated according to CMAA #70 5.2.9.1.2.1

$$K_a = \frac{f + \left(\frac{2000aC_r}{gE}\right)}{33000K_t} \left(\frac{N_r}{N_F}\right) = 0.0007$$

| | | | | | | |
|---|---|---|---|---|---|---|
| Where | f | = | Rolling friction for 8" wheels<br>CMAA 70, Table 5.2.9.1.2-D | = | 16 | lbs/ ton |
| | a | = | Average acceleration<br>CMAA 70, Table 5.2.9.1.2-A | = | 0.25 | $ft / s^2$ |
| | $C_r$ | = | Rotational inertia factor<br>CMAA 70, 5.2.9.1.2.1 | = | 1.083 | |
| | g | = | Gravity constant | | 32.2 | $ft / s^2$ |
| | E | = | Mechanical efficiency (Mfg. data) | = | 0.93 | |
| | $K_t$ | = | Equivalent steady state torque relative to rated motor torque<br>CMAA 70, Table 5.2.9.1.2-C | = | 1.5 | |
| | $N_r/N_F$ | | | = | 1 | Worst Case Scenario (Assumption) |
| | $N_r$ | = | Rated speed of motor in rpm at full load | | | |
| | $N_F$ | = | Free running rpm of motor when driving at speed V | | | |

Required bridge motor horsepower is calculated according to CMAA #70, 5.2.8.1.1

$$HP = K_aWVK_S = \underline{\mathbf{0.21\ hp}}$$

| | | | | | | |
|---|---|---|---|---|---|---|
| Where | W | = | $2(EL_{BRIDGE,\ CASE\ 3})$ +TRL | = | 13.5 | tons |
| | $EL_{BRIDGE,\ CASE\ 3}$ | | Load Combination, Case 3 | | 6.32 | tons |
| | TRL | = | Bridge end truck weight | = | 0.9 | tons |
| | V | = | Rated drive speed in ft/min. | = | 21 | fpm |
| | $K_S$ | = | Service factor<br>CMAA 70, Table 5.2.9.1.2-E | = | 1.1 | |

The bridge motor drive uses a single 0.25 hp motor which exceeds the required horsepower needed to move the bridge crane.

## Hoist Motor

From *CMAA #70, 5.2.9.1.1.1*,

$$\text{Required Hoist Mechanical HP} = \frac{W(V)}{33000[(E_G)^N(E_S)^M}$$

| | | | | | |
|---|---|---|---|---|---|
| Where | W | = | Weight to be lifted by hoist rope system | = | 10,150 lbs |
| | V | = | Hoist Lift Speed | = | 21 fpm |
| | $E_G$ | = | Efficiency per gear reduction | = | 0.97<br>CMAA 70, Table 5.2.9.1.1.1-1 |
| | $E_S$ | = | Rope system efficiency per rotating sheave | = | 0.99<br>CMAA 70, Table 5.2.9.1.1.1-1 |
| | N | = | Number of gear reduction | = | 3<br>Horsburgh-Scott 80T |
| | M | = | Number of rotating sheaves Between the drum and equalizer passed over by each part of the moving rope attached to the drum | = | 1 |

$$\text{Required Hoist Mechanical HP} = \frac{10{,}150\text{ lbs }(21\text{ fpm})}{33000[(0.97)^3(0.99)^1} = \underline{\mathbf{7.15\ HP}}$$

From *CMAA #70, 5.2.9.1.1.2,*

Required Hoist Motor HP = Required Hoist Mechanical HP ($K_C$)

| | | | | | |
|---|---|---|---|---|---|
| Where | $K_C$ | = | Control factor, which is a correction value that accounts for the effects the control has on motor torque and speed | = | 1 |

Required Hoist Motor HP = **<u>7.15 HP</u>**

The proposed hoist motor is rated as 7.5 HP.

ii. Overcurrent Protection

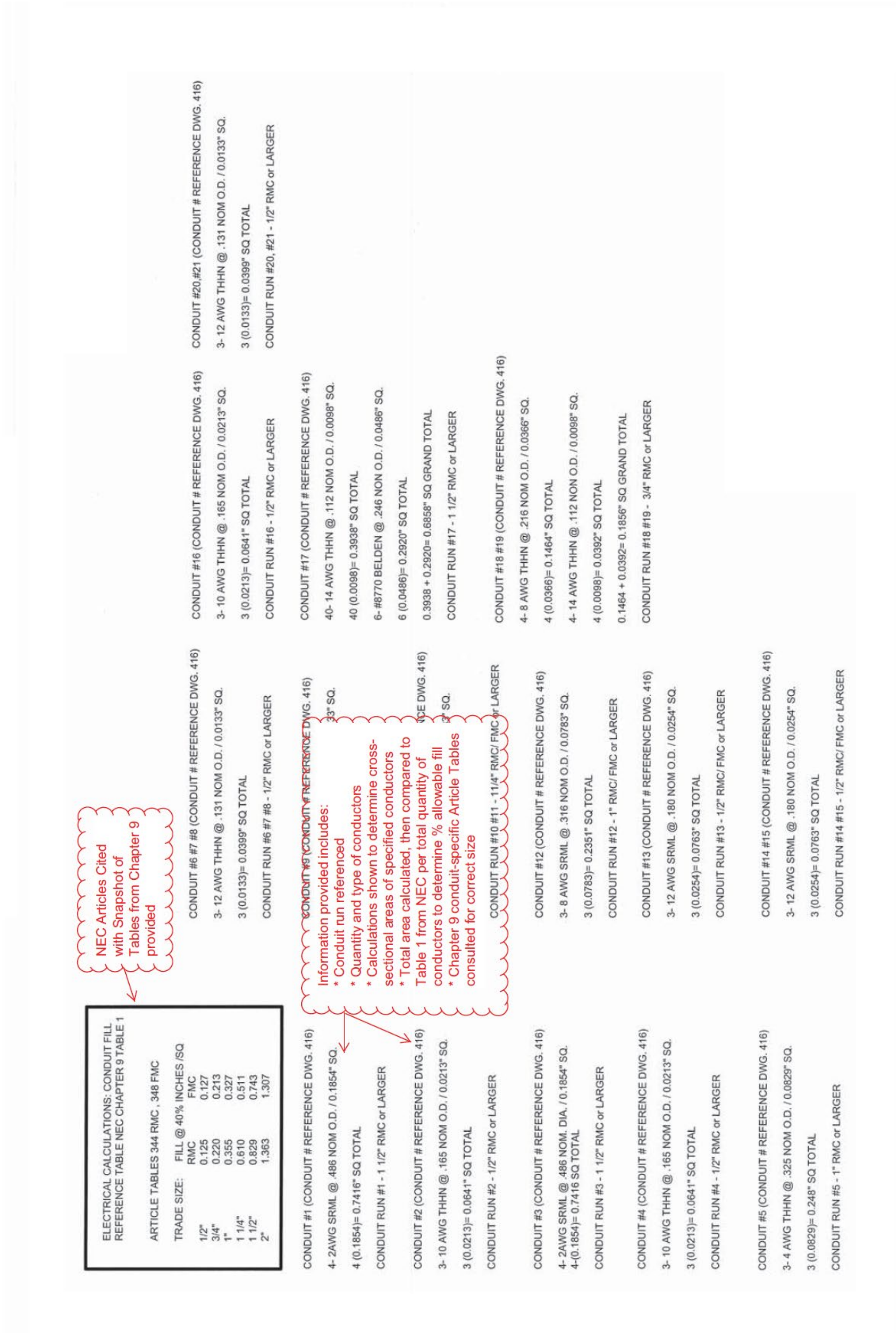
# OVERCURRENT PROTECTIVE DEVICE CALCULATIONS

Overcurrent calculations for each applicable device with NEC references cited

OVERCURRENT PROTECTION

| | | | |
|---|---|---|---|
| 1. CRANE OVERCURRENT PROTECTION | | | |
| Largest Branch Device: | 80 | Aac | |
| Other Loads: | | | |
| Bridge | 8.2 | Aac | |
| Trolley | 4.4 | Aac | |
| Hoist | 34.2 | Aac | |
| Other (service, fields, control xfmr, etc) | 6.9 | Aac | |
| TOTAL = | 53.7 | Aac | |
| Main Disconnect Selected: | 100 | Amp | Ref: NEC 610-41 |
| 2. HOIST BRANCH OVERCURRENT PROTECTION | | | |
| (A) Hoist Load | 34.2 | Aac | |
| Maximum Allowable breaker: | | | |
| (A) x 2.5 | 85.5 | Aac | |
| Branch Circuit Breaker Selected: | 80 | Amp | Ref: NEC 610-42 |
| 3. TROLLEY BRANCH OVERCURRENT PROTECTION | | | |
| (A) Trolley Load | 4.4 | Aac | |
| Maximum Allowable breaker: | | | |
| (A) x 2.5 | 11.0 | Aac | |
| Branch Circuit Breaker Selected: | 10 | Amp | Ref: NEC 610-42 |
| 4. BRIDGE BRANCH OVERCURRENT PROTECTION | | | |
| (A) Bridge Load | 8.2 | Aac | |
| Maximum Allowable breaker: | | | |
| (A) x 2.5 | 20.5 | Aac | |
| Branch Circuit Breaker Selected: | 20 | Amp | Ref: NEC 610-42 |
| 5. CRANE CONTROL TRANSFORMER XMR109 | | | |
| Transformer VA | 2000 | VA | |
| (A) Primary Current = (VA/460V) | 4.34 | Amps | |
| (B) Max Fuse Size: (A) x 2.5 = | 10.85 | Amps | Ref: NEC 450-3(b), NEC 430-72(C4) |
| Selected Protection: Class CC Time Delay Fuses | 10.00 | Amps | Ref: NEC 450-3(b) |
| (C) Secondary Current = (VA/115V) | 17.39 | Amps | |
| (D) Max Secondary Fuse Size: (C) x 1.25 = | 21.74 | Amps | Ref: NEC 450-3(b) |
| Selected Protection: Type ATQ Time Delay Fuses | 25 | Amps | Ref: NEC 450-3(b) |
| 6. HOIST BLOWER MOTOR OVERCURRENT PROTECTION | | | |
| (A) Blower Motor Load | 0.7 | Aac | |
| Maximum Allowable breaker: | | | |
| (A) x 2.5 | 1.75 | Aac | |
| Branch Circuit Breaker Selected: | 2 | Amp | Ref: NEC 610-42 |
| 7. POWER AVAILABLE LIGHT TRANSFORMER XMR118 | | | |
| Transformer VA | 150 | VA | |
| (A) Primary Current = (VA/460V) | 0.33 | Amps | |
| (B) Max Fuse Size: (A) x 2.5 = | 0.82 | Amps | Ref: NEC 450-3(b) |
| Selected Protection: Class CC Time Delay Fuses | 0.8 | Amps | Ref: NEC 450-3(b) |
| (C) Secondary Current = (VA/115V) | 1.3 | Amps | |
| (D) Max Secondary Fuse Size: (C) x 1.67 = | 2.17 | Amps | Ref: NEC 450-3(b) |
| Selected Protection: Type ATQ Time Delay Fuses | 2.0 | Amps | Ref: NEC 450-3(b) |

iii. Conduit Fill



CONDUIT FILL CALCULATION SUBMITTALS

NEC Articles Cited with Snapshot of Tables from Chapter 9 provided

ELECTRICAL CALCULATIONS: CONDUIT FILL
REFERENCE TABLE NEC CHAPTER 9 TABLE 1

ARTICLE TABLES 344 RMC , 348 FMC

| TRADE SIZE: | FILL @ 40% INCHES /SQ RMC | FMC |
|---|---|---|
| 1/2" | 0.125 | 0.127 |
| 3/4" | 0.220 | 0.213 |
| 1" | 0.355 | 0.327 |
| 1 1/4" | 0.610 | 0.511 |
| 1 1/2" | 0.829 | 0.743 |
| 2" | 1.363 | 1.307 |

Information provided includes:
* Conduit run referenced
* Quantity and type of conductors
* Calculations shown to determine cross-sectional areas of specified conductors
* Total area calculated, then compared to Table 1 from NEC per total quantity of conductors to determine % allowable fill
* Chapter 9 conduit-specific Article Tables consulted for correct size

CONDUIT #1 (CONDUIT # REFERENCE DWG. 416)
4- 2AWG SRML @ .486 NOM O.D. / 0.1854" SQ.
4 (0.1854)= 0.7416" SQ TOTAL
CONDUIT RUN #1 - 1 1/2" RMC or LARGER

CONDUIT #2 (CONDUIT # REFERENCE DWG. 416)
3- 10 AWG THHN @ .165 NOM O.D. / 0.0213" SQ.
3 (0.0213)= 0.0641" SQ TOTAL
CONDUIT RUN #2 - 1/2" RMC or LARGER

CONDUIT #3 (CONDUIT # REFERENCE DWG. 416)
4- 2AWG SRML @ .486 NOM. DIA. / 0.1854" SQ.
4-(0.1854)= 0.7416 SQ TOTAL
CONDUIT RUN #3 - 1 1/2" RMC or LARGER

CONDUIT #4 (CONDUIT # REFERENCE DWG. 416)
3- 10 AWG THHN @ .165 NOM O.D. / 0.0213" SQ.
3 (0.0213)= 0.0641" SQ TOTAL
CONDUIT RUN #4 - 1/2" RMC or LARGER

CONDUIT #5 (CONDUIT # REFERENCE DWG. 416)
3- 4 AWG THHN @ .325 NOM O.D. / 0.0829" SQ.
3 (0.0829)= 0.248" SQ TOTAL
CONDUIT RUN #5 - 1" RMC or LARGER

CONDUIT #6 #7 #8 (CONDUIT # REFERENCE DWG. 416)
3- 12 AWG THHN @ .131 NOM O.D. / 0.0133" SQ.
3 (0.0133)= 0.0399" SQ TOTAL
CONDUIT RUN #6 #7 #8 - 1/2" RMC or LARGER

CONDUIT #9 (CONDUIT # REFERENCE DWG. 416)
33" SQ.

CE DWG. 416)
3" SQ.
CONDUIT RUN #10 #11 - 11/4" RMC/ FMC or LARGER

CONDUIT #12 (CONDUIT # REFERENCE DWG. 416)
3- 8 AWG SRML @ .316 NOM O.D. / 0.0783" SQ.
3 (0.0783)= 0.2351" SQ TOTAL
CONDUIT RUN #12 - 1" RMC/ FMC or LARGER

CONDUIT #13 (CONDUIT # REFERENCE DWG. 416)
3- 12 AWG SRML @ .180 NOM O.D. / 0.0254" SQ.
3 (0.0254)= 0.0763" SQ TOTAL
CONDUIT RUN #13 - 1/2" RMC/ FMC or LARGER

CONDUIT #14 #15 (CONDUIT # REFERENCE DWG. 416)
3- 12 AWG SRML @ .180 NOM O.D. / 0.0254" SQ.
3 (0.0254)= 0.0763" SQ TOTAL
CONDUIT RUN #14 #15 - 1/2" RMC/ FMC or LARGER

CONDUIT #16 (CONDUIT # REFERENCE DWG. 416)
3- 10 AWG THHN @ .165 NOM O.D. / 0.0213" SQ.
3 (0.0213)= 0.0641" SQ TOTAL
CONDUIT RUN #16 - 1/2" RMC or LARGER

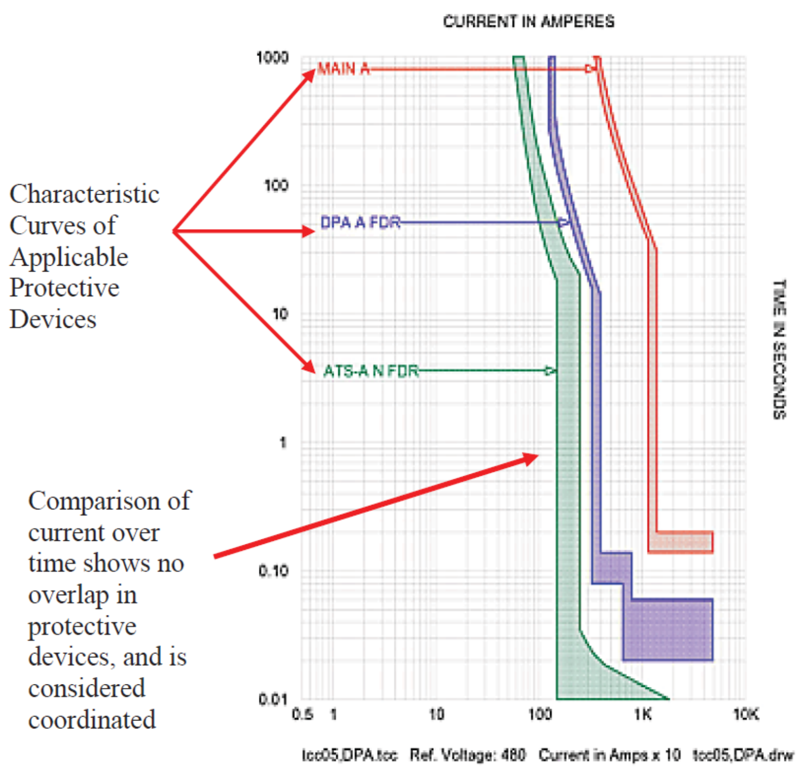
CONDUIT #17 (CONDUIT # REFERENCE DWG. 416)
40- 14 AWG THHN @ .112 NOM O.D. / 0.0098" SQ.
40 (0.0098)= 0.3938" SQ TOTAL
6- #8770 BELDEN @ .246 NON O.D. / 0.0486" SQ.
6 (0.0486)= 0.2920" SQ TOTAL
0.3938 + 0.2920= 0.6858" SQ GRAND TOTAL
CONDUIT RUN #17 - 1 1/2" RMC or LARGER

CONDUIT #18 #19 (CONDUIT # REFERENCE DWG. 416)
4- 8 AWG THHN @ .216 NOM O.D. / 0.0366" SQ.
4 (0.0366)= 0.1464" SQ TOTAL
4- 14 AWG THHN @ .112 NON O.D. / 0.0098" SQ.
4 (0.0098)= 0.0392" SQ TOTAL
0.1464 + 0.0392= 0.1856" SQ GRAND TOTAL
CONDUIT RUN #18 #19 - 3/4" RMC or LARGER

CONDUIT #20,#21 (CONDUIT # REFERENCE DWG. 416)
3- 12 AWG THHN @ .131 NOM O.D. / 0.0133" SQ.
3 (0.0133)= 0.0399" SQ TOTAL
CONDUIT RUN #20, #21 - 1/2" RMC or LARGER

iv. Protective Device Coordination Study

PROTECTIVE DEVICE COORDINATION STUDY EXAMPLE




- Characteristic curve information is available from all protective device manufacturers.
- Coordination study software is available, but typical studies can be hand-drawn provided that scales are kept consistent and accurate.
- Coordination of protective devices is accepted when the study provides proof that, given an overcurrent situation, only the intended unit will be removed from service, and that no other upstream equipment will be affected.

v. Lighting

Appropriate Light Loss Factor chosen

| Luminaire Schedule | | | | |
|---|---|---|---|---|
| **Symbol** | **Qty** | **Description** | **Lumens** | **LLF** |
| ▫ | 9 | | 23144 | 0.700 |

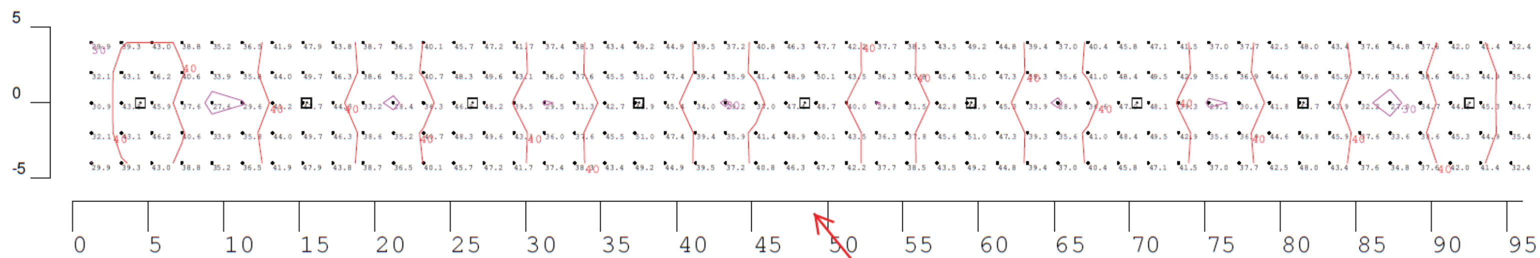
**Calculation Summary**

| Label | CalcType | Units | Avg | Max | Min | Max/Min |
|---|---|---|---|---|---|---|
| CalcPts | Illuminance | Fc | 41.07 | 51.0 | 27.0 | 1.89 |

For this example, 40 foot-candles (Fc) were desired. With the chosen lamp size, an average of 41.07 Fc has been met.

**Luminaire Location Summary**

| LumNo | Label | X | Y | Z |
|---|---|---|---|---|
| 1 | Q1000PMF | 4.5 | 0 | 40 |
| 2 | Q1000PMF | 15.5 | 0 | 40 |
| 3 | Q1000PMF | 26.5 | 0 | 40 |
| 4 | Q1000PMF | 37.5 | 0 | 40 |
| 5 | Q1000PMF | 48.5 | 0 | 40 |
| 6 | Q1000PMF | 59.5 | 0 | 40 |
| 7 | Q1000PMF | 70.5 | 0 | 40 |
| 8 | Q1000PMF | 81.5 | 0 | 40 |
| 9 | Q1000PMF | 92.5 | 0 | 40 |




Typical diagram of affected area showing proposed layout to provide symmetrical light distribution

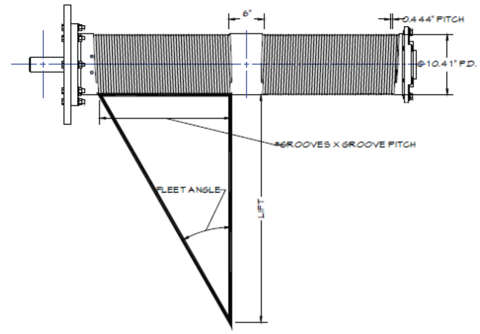
O. **Appendix O – Mechanical Calculations**

Please see the following pages for mechanical calculations.

i. Non-commercial Items

1. Drums

Fleet Angle Calculation



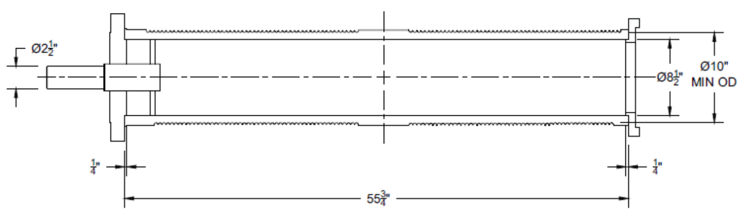

$$\text{Fleet Angle} = \arctan\left[\frac{\#\text{Grooves(Groove Pitch)}}{\text{Lift}}\right] = \arctan\left[\frac{52(0.444)}{64(12)}\right] = \underline{\mathbf{1.722^\circ}}$$

From *CMAA #70, 4.4.3.1*, the maximum allowed fleet angle is 4°.

---

The stress analysis of the drum weldment will be done in several sections.

1. Radial forces against the drum shell.
2. Determination of the drum shell thickness.
3. Determination of the end plate thickness and stresses.




## Radial Force Against the Drum

In this analysis, we are using the analysis approach from *Design of Weldments* by Omar Blodgett where the turns of the wire rope are treated as a shell. The tensile force in the wire rope (F), creates a uniform inward radial force (p) against the drum shell about which it is wound.

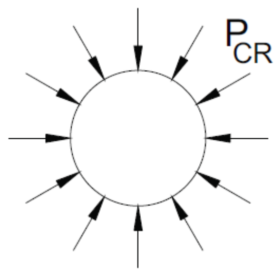
$$F = \frac{(1 + HLF)(TF)(LL) + LB}{n} = 3811 \text{ lbs}$$

| | | | | | |
|---|---|---|---|---|---|
| Where | F | = | Tensile force in wire rope | | |
| | LL | = | Design Capacity | = | 10000 lbs |
| | n | = | Number of parts of rope | = | 4 |
| | HLF | = | Hoist Load Factor | = | 0.15 |
| | TF | = | Test Factor | = | 1.3125 |
| | LB | = | Load Block | = | 150 lbs (est.) |

$$P = \frac{F}{R_M B} = 1717 \text{ psi}$$

| | | | | | |
|---|---|---|---|---|---|
| Where | P | = | Uniform internal radial pressure | | |
| | $R_M$ | = | Mean radius of the wire rope on the drum shell | = | 5” |
| | B | = | Width of drum per turn = groove pitch | = | 0.444” |

Consider the drum shell as long open ended tube with no allowances for the stiffening effects of the end plates. For steel, the critical buckling pressure for the drum shell is

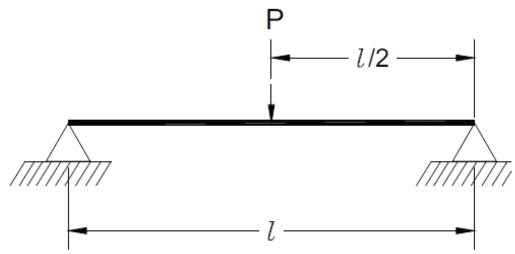



$$P_{CR} = \frac{Et^3}{4(1-\nu^2)R^3} = 34615 \text{ psi}$$

| | | | | | |
|---|---|---|---|---|---|
| Where | $P_{CR}$ | = | Critical buckling pressure pressure | | |
| | R | = | Mean radius of the shell | = | 4.63” |
| | $\nu$ | = | Poisson’s Ratio for steel | = | .292 |
| | E | = | Young’s Modulus for steel | = | $3 \times 10^7$ psi |
| | t | = | Tube wall thickness | = | 0.75” |

Since, $P \ll P_{CR}$, the possibility of the drum shell collapsing under pressure is minimal.

We can also analyze the drum shell in bending as a simply supported beam with a single load at mid-span. From *AISC Steel Construction Manual, 13th Edition, Table 3-23, Case 7 (Simple Beam – Concentrated Load at Center).* This would be equivalent to a load that has been raised to the maximum height with both wire ropes approximately at the center of the drum.




$$M_{MAX} = \frac{Pl}{4} = \frac{0.5[(1+HLF)(TF)LL + LB]l}{4} = 107275 \text{ in-lbs}$$

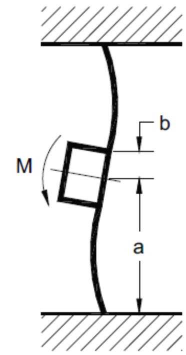
| | | | | | |
|---|---|---|---|---|---|
| Where | LL | = | Design Capacity | = | 10000 lbs |
| | $l$ | = | Drum shell length | = | 55.75" |
| | HLF | = | Hoist Load Factor | = | 0.15 |
| | TF | = | Test Factor | = | 1.3125 |
| | LB | = | Load Block | = | 150 lbs (est.) |

$$\sigma_{MAX} = \frac{(M_{MAX})\,c}{I} = \mathbf{2036\ psi}$$

| | | | | | |
|---|---|---|---|---|---|
| Where | c | = | Drum shell radius | = | 5". |
| | $I_B$ | = | Moment of inertia | = | 263.5 $in^4$ |

---

To determine the stress in the trunnion shaft and end plate, we will use a plate formula from Roark's *Formulas for Stress and Strain* (Table 24, case 21, 5th Edition) for a fixed round flat plate with a central couple load located at the center.




$$\sigma_B = \frac{\beta M}{bt^2} = \underline{\mathbf{2985\ psi}}$$

| | | | | | |
|---|---|---|---|---|---|
| Where | $\sigma_B$ | = | Stress at the shaft to plate joint | | |
| | M | = | Moment load | = | 107275 in-lbs |
| | $\beta$ | = | Tabulated value for b/a = .706 | = | 0.467” |
| | b | = | Shaft radius | = | 1.5” |
| | a | = | Drum inside radius | = | 4.25” |
| | t | = | End plate thickness | = | 2” |

$$\sigma_A = \frac{\beta R_O M}{a^2 t^2} = \underline{\mathbf{2947\ psi}}$$

| | | | | | |
|---|---|---|---|---|---|
| Where | $\sigma_A$ | = | Stress at the drum shell to plate joint | | |
| | M | = | Moment load | = | 107275 in-lbs |
| | $\beta$ | = | Tabulated value for b/a | = | 0.467” |
| | $R_O$ | = | Drum inside radius | = | 4.25” |
| | a | = | Drum inside radius | = | 4.25” |
| | t | = | End plate thickness | = | 2” |

$\sigma_A$ should be the same for each end plate. There should not be any drum shell to end plate stresses for the end plate that houses the barrel coupling.

Each end plate has a ¼” raised step that is inserted inside the drum shell. The purpose of the raised step is primarily for locating the endplates during assembly. The shear and bearing stress on the raised step are,

$$\tau_{AVG} = \frac{4V}{3A_S} = \frac{4[0.5[(1+HLF)(TF)LL] + LB]}{3A_S} = 100 \text{ psi}$$

$$\sigma_{BEARING} = \frac{0.5[(1+HLF)(TF)LL + LB]}{dt} = \underline{\mathbf{3552\ psi}}$$

| | | | | | |
|---|---|---|---|---|---|
| Where | LL | = | Design Capacity | = | 10000 lbs |
| | HLF | = | Hoist Load Factor | = | 0.15 |
| | TF | = | Test Factor | = | 1.3125 |
| | LB | = | Load Block | = | 150 lbs (est.) |
| | $A_S$ | = | Shear area = $\pi d^2/4$ | = | 53.5 $in^2$ |
| | t | = | Raised step thickness | = | 0.25” |
| | d | = | Drum shell ID | = | 8.5” |

2. Bearings

| Title: Bridge Wheel Bearing | | Sheet No. of: 1 of 1 |
|---|---|---|
| By BRS / / | Chk. / / | Job No. 09-5035 |

Bridge Endtruck Wheel Bearing

- MWL = 16,579 lbs
- Min W.L. = 5011 lbs
- BW = 20,462 lbs
- TW = 3042 lbs
- LL = 20,000 lbs
- X = 554"
- Span = 580"
- f = X/span = .96
- Bearing = SB 22216
- Dynamic Rating = 39,600 lbf
- Wheel RPM = 21

$$kw = \frac{(.75)(20462) + (.96)(20000) + (.5)(3042) - (.5)(.96)(3042)}{(.75)(20462) + (1.5)(.96)(20000)} = .78$$

Effective Load = 16,579 · .78 = 12,932 lbs / 2 bearings
= 6,466 lbs

$$L_{10} = \frac{1000000}{60 \cdot 21\,RPM} \cdot \left(\frac{39600}{6466}\right)^{10/3} = 333{,}550 \text{ hours}$$

Class C req = 5,000 hours ch✓

| Title: Trolley Wheel Bearing | | Sheet No. 1 of 1 |
|---|---|---|
| By BRS / / | Chk. / / | Job No. 09-5030 |

Trolley Wheel Bearing

- UCF211-35
- Dynamic Rating = 9,757 lbs
- Wheel RPM = 31,067
- Max Load = ½ · M. W.L. = ½ · 7027 = 3,514 lbs
- Min Load = ½ · Min W.L = ½ · 923 = 462 lbs
- Trolley Weight = 3042 lbs

$$K_{wtw} = \frac{(2)(26")(20000)/(52) + (1.5)(3042)}{(3)(26")(20,000)/(52) + (1.5)(3042)} = .71$$

Effective Load = 3514 · .71 = 2495 lbs

$$L_{10} = \frac{(1)(16,700)}{31,067\ RPM} \cdot \left(\frac{9757}{2495}\right)^3 = 32,148 \text{ hours}$$

Class C req = 5000 hours ok

| Title Drum Pillow Block | | Sheet No. 1 of 1 |
|---|---|---|
| By BRS / / | Chk. / / | Job No. 09-5030 |

Drum Pillow Block

- SUCSP 210-31
  - SUC 210-31 Bearing Insert
  - SP210 Housing (stainless Steel)
  - Dynamic Rating = 7,895 lbf
- Drum RPM = 16.34
- Drum Tail End Reaction = 5,400 lbs = max Load
- ½ Drum W + (Block + Rope) / 4 = min Load
  $= \frac{1}{2}(504) + (315 + 62)/4 = 349$ lbs = min Load

$$kv = \frac{(2)(5{,}400) + (349)}{(3)(5{,}400)} = .69$$

Effective Load = 5400 · .69 = 3,726 lbs

$$L_{10} = \frac{(1)(16{,}700)}{(16.34\,RPM)} \cdot \left(\frac{7895}{3726}\right)^3 = 9{,}723 \text{ hours}$$

Class C Req = 5000 hours chv

| Title Block Bearings | | Sheet No. 1 of 1 |
|---|---|---|
| By BRS / / | Chk. / / | Job No. 09-5030 |

Block Sheave Bearing

MR56 - MI48

- Dynamic Rating = 35,900 lbf

Dynamic Rope Load = 5145 ⇒ Max Load = 10,290 lbs

Block Weight = 315 lbs ⇒ 315/4 parts = 79 lbs ⇒ Min Load = 158 lbs

Drum RPM = 16.34

$$K_W = \frac{(2)(10,290) + (158)}{(3)(10,290)} = .67$$

Effective Load = 10,290 • .67 = 6,894 lbs

$$L_{10} = \frac{16,666}{16.34\ RPM} \cdot \left(\frac{35,900}{6894}\right)^{10/3} = 249,645 \text{ hours}$$

Class C min hours = 5,000 ok✓

Block Thrust Bearing

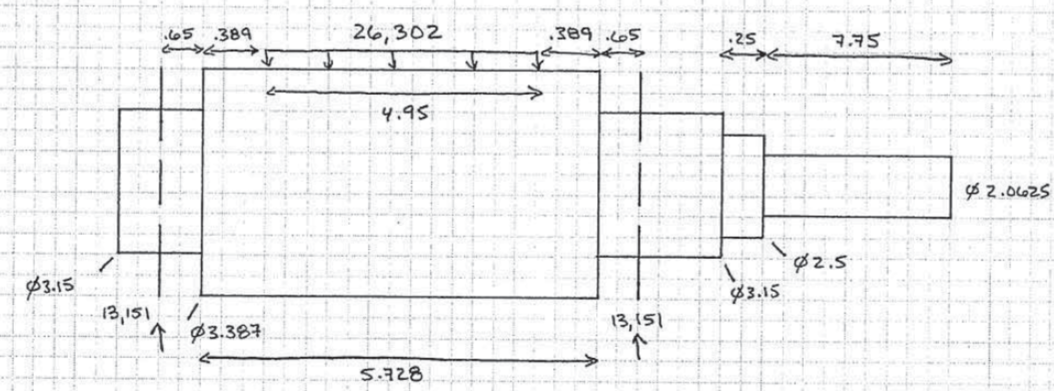
RT621 static Rating = 111,000 lbf

Load = 20,000 lbs < 111,000 lbs ok✓

3. Shafts

| Title | Sheet No. 1 of 2 |
|---|---|
| TROLLEY DRIVE SHAFT | |
| By MJW / / — Chk. / / | 09.5025/26 Job No. |

MATL: 1045 CR w/ ULT. TENSILE 91 KSI MIN.




$M_x = R_1 x - \frac{w(x-a)^2}{2} = 13{,}151(3.514) - \frac{\left(\frac{26{,}302}{4.95}\right)(3.514 - 1.039)^2}{2} = 29{,}938$ IN-LBS

$r = 3.387/2 = 1.6935$ IN

$S_x = \pi d^3/32 = \pi(3.387^3)/32 = 3.815$ IN$^3$

$\delta_b = M/S = 29{,}938/3.815 = 7{,}847$ PSI OK ✓ ALLOWABLE: $91{,}000/5 = 18{,}200$ PSI

$J = \pi d^4/32 = \pi(3.387^4)/32 = 12.92$ IN$^4$

$\tau_T = Tr/J = 5257(1.6935)/12.92 = 689$ PSI

$\tau_V = 1.33 V/A = 1.33(13{,}151)/\pi(1.6935^2) = 1{,}941$ PSI

$\tau_\Sigma = \tau_T + \tau_V = 689 + 1{,}941 = 2{,}630$ PSI OK ✓ ALLOWABLE: $91{,}000/5\sqrt{3} = 10{,}508$ PSI

$\delta_{COMB}: \sqrt{\delta_\Sigma^2 + 3(\tau_T)^2} \leq \delta_u/5$

$= \sqrt{7{,}847^2 + 3(689)^2} \leq 91{,}000/5$  $7{,}937 \leq 18{,}200$ PSI OK ✓

KEYWAY STRESS

$K_{tB}: 2.42$  $K_S: 1.71$  $\delta_e = .36\,\delta_{um} K_{sc}$  $\delta_{um} = 91{,}000$  $K_{sc} = .75$  $K_c = 1.06$

$\delta_{F_\Sigma}: K_{tB}\,\delta_b \leq \delta_e/K_c$

$= 2.42(7{,}847) \leq \frac{.36(91{,}000)(.75)}{1.06}$  $18{,}990 \leq 23{,}179$ OK ✓

$\tau_{F_\Sigma} = K_{sT}\tau_T + K_{sV}\tau_V \leq \delta_e/K_c\sqrt{3}$

$= 1.71(689) + 1.71(1{,}941) \leq \frac{.36(91{,}000)(.75)}{1.06(\sqrt{3})}$  $4{,}497 \leq 13{,}383$ OK ✓

| Title TROLLEY DRIVE SHAFT | | Sheet No. 2 of 2 |
|---|---|---|
| By NJW / / | Chk. / / | 09.5025/26 Job No. |

STRESS @ BEARING STEP

$M(x@.65) = R_1 x = 13,151(.65) = 8,548$ IN-LBS

$r = 3.15/2 = 1.575$ IN

$S_x = \pi d^3/32 = \pi(3.15^3)/32 = 3.069$ IN$^3$

$\delta_b = M/S = 8,548/3.069 = 2,785$ PSI OK✓ ALLOWABLE: $91,000/5 = 18,200$ PSI

$J = \pi d^4/32 = \pi(3.15^4)/32 = 9.666$ IN$^4$

$\tau_T = Tr/J = 5257(1.575)/9.666 = 857$ PSI

$\tau_V = 1.33V/A = 1.33(13,151)/\pi(1.575^2) = 2,244$ PSI

$\tau_\Sigma = 857 + 2,244 = 3,101$ PSI OK✓ ALLOWABLE: $91,000/5\sqrt{3} = 10,508$ PSI

$\delta_{COMB}: \sqrt{\delta_\Sigma^2 + 3(\tau_T)^2} \le \delta_o/5$

$= \sqrt{2,785^2 + 3(857^2)} \le 91,000/5$ $3,156 \le 18,200$ OK✓

STEP BENDING FACTORS

$K_t = 1.93$ TORSION FACTOR $= 1.3$

$\delta_{F_\Sigma} = K_{t_b}\delta_b \le \delta_e/K_c$ $1.93(2,785) \le 23,179$ $5,375 \le 23,179$ OK✓

$\tau_{F_\Sigma} = K_t\tau_T + K_t\tau_V \le \delta_e/K_c\sqrt{3}$ $1.3(857) + 1.3(2,244) \le 13,383$ $4,031 \le 13,383$ OK✓

MOTOR STEPS

$D_1 = \phi 3.15$ $D_2 = \phi 2.5$ $D_3 = \phi 2.0625$ $r = .125$

$r/D_3 = .06$ $r/D_2 = .05$ $r/D_3 = .04$

$J_{D_2} = \pi d^4/32 = \pi(2.5^4)/32 = 3.835$ IN$^4$

$J_{D_3} = \pi d^4/32 = \pi(2.0625^4)/32 = 1.777$ IN$^4$

$D_2$: $Tr/J = 5257(1.25)/3.835 = 1,713$ PSI OK✓ ALLOWABLE: 10,508 PSI

$D_3$: $Tr/J = 5257(1.03125)/1.777 = 3,051$ PSI OK✓

STEP TORSION FACTOR: $D_2 = 1.6$ $D_3 = 1.68$

$D_2$: $\tau_{F_\Sigma} = K_t\tau_T \le \delta_e/K_c\sqrt{3}$

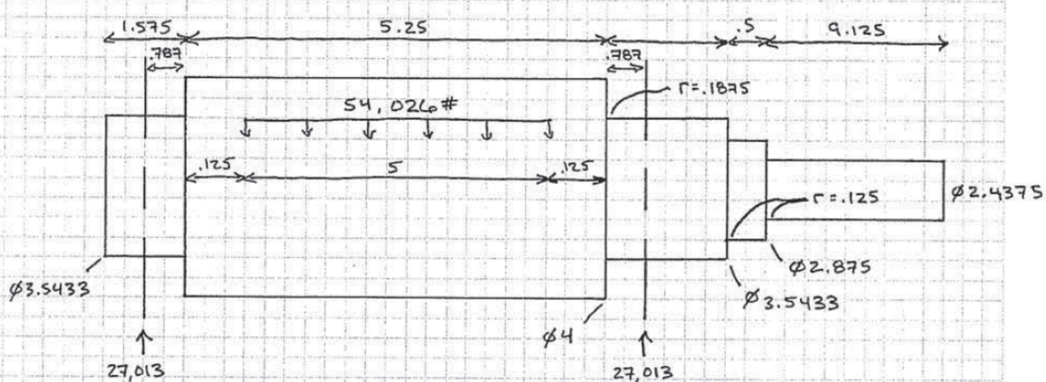
$= 1.6(1,713) \le 13,382$ $2,741 \le 13,382$ OK✓

$D_3$: $\tau_{F_\Sigma} = K_t\tau_T \le \delta_e/K_c\sqrt{3}$

$= 1.68(3,051) \le 13,382$ $5,126 \le 13,382$ OK✓

| Title: BRIDGE DRIVE SHAFT | | Sheet No. 1 of 2 |
|---|---|---|
| By NJW / / | Chk. / / | 09.5025/26 Job No. |

MATL: 1045 CR w/ ULT. TENSILE 91 KSI MIN.




$M_x = R_1 x - \frac{w(x-a)^2}{2} = 27{,}013(3.412) - \frac{\left(\frac{54{,}026}{5}\right)(3.412-.912)^2}{2} = 58{,}402$ IN·LBS

$r = 2''$

$S_x = \pi d^3/32 = \pi(4^3)/32 = 6.283\ \text{in}^3$

$\delta_b = M/S = 58{,}402/6.283 = 9{,}295$ PSI OK ✓ ALLOWABLE $= 91{,}000/5 = 18{,}200$ PSI

$J = \pi d^4/32 = \pi(4^4)/32 = 25.133\ \text{in}^4$

$\tau_T = Tr/J = 7{,}567(2)/25.133 = 602$ PSI

$\tau_V = 1.33V/A = 1.33(27{,}013)/\pi(2^2) = 2{,}859$ PSI

$\tau_\Sigma = \tau_T + \tau_V = 602 + 2{,}859 = 3{,}461$ PSI OK ✓

ALLOWABLE: $\delta_U/(5\sqrt{3}) = 91{,}000/5\sqrt{3} = 10{,}508$ PSI

$\delta_{COMB} = \sqrt{\delta_\Sigma^2 + 3(\tau_T)^2} \leq \delta_U/5$

$= \sqrt{9{,}295^2 + 3(602)^2} \leq 91{,}000/5 \Rightarrow 9{,}353 \leq 18{,}200$ OK ✓

KEYWAY STRESS

$K_{t_B}: 2.42$ $K_S: 1.71$ $\delta_e = .36\,\delta_{UM} K_{SC}$ $\delta_{UM}$ = MIN. TENSILE = 91,000 $K_{SC} = .75$ $K_c = 1.06$

$\delta_{F_\Sigma} = K_{T_B}\,\delta_b \leq \delta_e/K_c$

$= 2.42(9{,}295) = 22{,}494$ PSI $\leq .36(91{,}000)(0.75)/1.06 = 23{,}179$ OK ✓

$\tau_{F_\Sigma} = K_{S_T}\tau_T + K_{S_V}\tau_V \leq \delta_e/K_c\sqrt{3}$

$= 1.71(602) + 1.71(2859) = 5{,}918 \leq .36(91{,}000)(.75)/1.06(\sqrt{3}) = 13{,}382$ PSI OK ✓

| Title: BRIDGE DRIVE SHAFT | | Sheet No. 2 of 7 |
|---|---|---|
| By HJW / / | Chk. / / | 09.5025/26 Job No. |

STRESS @ BEARING STEP

$M(x @ .787) = R_1 x = 27,013(.787) = 21,259$ IN-LBS

$r = 3.5433/2 = 1.772"$

$S_x = \pi d^3/32 = \pi(3.5433^3)/32 = 4.367$ IN$^3$

$\delta_b = M/S = 21,259/4.367 = 4,868$ PSI    ALLOWABLE: 91,000/5 = 18,200 PSI OK ✓

$J = \pi d^4/32 = \pi(3.5433^4)/32 = 15.475$ IN$^4$

$\tau_T = Tr/J = 7,567(1.772)/15.475 = 866$ PSI

$\tau_V = 1.33V/A = 1.33(27,013)/\pi(1.772^2) = 3,650$ PSI

$\tau_\Sigma = \tau_T + \tau_V = 866 + 3,650 = 4,516$ PSI    ALLOWABLE = 91,000/5 = 18,200 PSI OK ✓

$\delta_{COMB} = \sqrt{\delta_\Sigma^{\,2} + 3(\tau_T)^2} \le \delta_u/5$

$= \sqrt{4,868^2 + 3(866)^2} \le 91,000/5 = 5,094 \le 18,200$ PSI OK ✓

STEP BENDING FACTORS

$K_t = 1.93$    TORSION FACTOR = 1.3

$\delta_{F_\Sigma} = K_{t_B}\delta_b \le \delta_e/K_c$    $1.93(4,868) \le 23,179$    $9,395 \le 23,179$ OK ✓

$\tau_{F_\Sigma} = K_t\tau_T + K_t\tau_V \le \delta_e/K_c\sqrt{3}$    $1.3(866) + 1.3(3,650) \le 13,382$    $5,871 \le 13,382$ OK ✓

MOTOR SHAFT STEPS

$D_1 = 3.5433$    $D_2 = 2.875$    $D_3 = 2.4375$    $r = .125$

$r/d_3 = .05$    $r/d_2 = .04$    $D_1/D_2 = 1.23$    $D_2/D_3 = 1.18$

$J_{D_2} = \pi d^4/32 = \pi(2.875^4)/32 = 6.707$ IN$^4$

$J_{D_3} = \pi d^4/32 = \pi(2.4375^4)/32 = 3.466$ IN$^4$

$D_2$: $Tr/J = 7,567(1.4375)/6.707 = 1,622$ PSI $(\tau_T)$ OK ✓

ALLOWABLE: $91,000/5\sqrt{3} = 10,508$ PSI

$D_3$: $Tr/J = 7,567(1.219)/3.466 = 2,661$ PSI OK ✓

STEP TORSION FACTOR: $D_2 = 1.67$    $D_3 = 1.58$

$D_2$: $\tau_{F_\Sigma} = K_t\tau_T \le \delta_e/K_c\sqrt{3}$    $1.67(1,622) \le 13,382$    $2,709 \le 13,382$ OK ✓

$D_3$: $\tau_{F_\Sigma} = K_t\tau_T \le \delta_e/K_c\sqrt{3}$    $1.58(2,661) \le 13,382$    $4,204 \le 13,382$ OK ✓

ii. Brakes

**Brake Selections**

Full load motor torque T in ft-lbs is calculated by the following formula:

$$T = \frac{5{,}252xHP}{RPM}$$

**1. Hoist Brakes**

**Requirements:** Each hoist shall be equipped with two electro-mechanical brakes, each with a minimum torque rating of 130% of the rated motor torque.

**Components**:

Main hoist motor: 30HP 1,800 RPM

Main hoist brakes: Primary 125 ft-lbs Starels , and secondary 180 ft-lbs Jamison Industries

Aux hoist motor: 5HP 1,750 RPM

Aux hoist brakes: Primary 15 ft-lbs Starels , and secondary 20 ft-lbs Jamison Industries

| | Motor | | | Brakes | | | |
|---|---|---|---|---|---|---|---|
| | HP | RPM | Calculated Motor Torque (ft-lbs) | Torque Required (ft-lbs) | Supplied Brake Torque (ft-lbs) | | Selection |
| **Main Hoist** | 30 | 1,800 | 87.5 | 113.8 | Primary | 125 | OK |
| | | | | | Secondary | 180 | OK |
| **Aux Hoist** | 3 | 1,750 | 9.0 | 11.7 | Primary | 15 | OK |
| | | | | | Secondary | 20 | OK |

**Note:** If hoist requires one brake and a mechanical load brake, NA the secondary brake cells.

**2. Travel Brakes**

**Requirements:** Each brake shall have a minimum torque rating equal to 50% of the drive motor rated torque.

**Components**

Bridge motor: 3HP 1,800 RPM

Bridge brake: 10 ft-lbs Starels

Trolley motor: 1.5HP 1,800 RPM

Trolley brake: 3 ft-lbs Starels

| | Motor | | | Brakes | | |
|---|---|---|---|---|---|---|
| | HP | RPM | Calculated Motor Torque (ft-lbs) | Torque Required (ft-lbs) | Supplied Brake Torque (ft-lbs) | Selection |
| **Bridge** | 3 | 1,800 | 8.75 | 4.4 | 10 | OK |
| **Trolley** | 1.5 | 1,800 | 4.4 | 2.2 | 3 | OK |

iii. Couplings

**Coupling Selections**

**Gear Couplings**

Gear coupling minimum torque rating T required in in-lbs is calculated by the following formula:

$$T = \frac{63{,}000.(Motor\ Horse\ Power).(Service\ Factor)}{Motor\ RPM}$$

**Components**:

**Main Hoist**

Motor: 30HP, 1800 RPM max shaft diameter 3.375"

Coupling: 6,150 in-lbs torque rating, max speed 3,300 RPM, max bore capacity 3.625"

**Aux Hoist**

Motor: 3HP, 1800 RPM max shaft diameter 2.00"

Coupling: 4,125 in-lbs torque rating, max speed 3,300 RPM, max bore capacity 3.000"

**Bridge**

Motor: 3HP, 1800 RPM max shaft diameter 2.00"

Coupling: There is no coupling for bridge drive.

**Trolley**

Motor: 1.5HP, 1800 RPM max shaft diameter 2.00"

Trolley coupling: 4,125 in-lbs torque rating, max speed 3,300 RPM, and bore capacity 3.000"

| | **Motor** | | | Calculated Transmitted Torque (in-lbs) | **Coupling** | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | HP | RPM | Max Shaft Diameter (in) | | Service Factor | Torque Rating (in-lbs) | Max Speed Rating (RPM) | Max bore Capacity (in) | Selection |
| **Main Hoist** | 30 | 1,800 | 3.375 | 2,100 | 2 | 6,150 | 3,300 | 3.625 | OK |
| **Aux Hoist** | 3 | 1,750 | 2.000 | 216 | 2 | 4,125 | 3,300 | 2.125 | OK |
| **Bridge** | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Trolley** | 1.5 | 1,800 | 1.125 | 92 | 1.75 | 4,125 | 3,300 | 2.125 | OK |

**Notes:** 1. Service factor for drives are given by the coupling manufacturing.

2. Max shaft diameter refers to the larger shaft in the connection

3. NA cells those are not applicable.

**Drum Barrel Couplings** (provide one for each hoist as applicable)

| | | | |
|---|---|---|---|
| Load to be Lifted, **Q** (lbs) | 67,450 | Hoist Tackle Reduction, $\mathbf{i_r}$ | 4 |
| Hoist Weight, **G** (lbs) | 2,250 | Operating factor, $\mathbf{K_1}$ | 1.6 |
| Drum and Cable Weight, **w** (lbs) | 3150 | Drum and Hoist Efficiency, $\mathbf{K_2}$ | 0.95 |
| Motor Power, $\mathbf{P_i}$ (HP) | 40 | Rope to Coupling Distance, **b** (in) | 16 |
| Hoist Rated Speed $\mathbf{V_r}$ (fpm) | 16 | Drum Length, **l** (in) | 48 |
| Drum Turning Rate, **n** (rpm) | 8 | Gearbox Output Shaft Length, **d** (in) | 8 |
| Drum Diameter, **D** (in) | 32 | Coupling Compensation Factor**, C** | 3.7 |

**1. Calculation of Nominal Transmission Torque T (lb-ft)**

Transmission torque T in ft-lbs based on installed power $P_i$ is calculated by the formula

$$T = \frac{5{,}252.P_i.K_1}{n} = \frac{5{,}252.(40).(1.6)}{8} = 42{,}016 \text{ ft-lbs}$$

Preselected coupling size maximum torque rating $T_N$ = 51,629 ft-lbs higher than the torque calculated by means of installed power above.

Selection OK

**2. Calculation of Radial Load F to be withstood by the Coupling:**

$$F = \left[F_p.\left(1 - \frac{b}{l}\right)\right] + \frac{w}{2} = \left[18{,}344.\left(1 - \frac{16}{48}\right)\right] + \frac{3{,}150}{2} = 13{,}804 \text{ lbs}$$

Where $F_p$ = the static pull of the drum including efficiencies

The preselected coupling size withstands a radial load $F_r$= 25,850 lbs, higher than 13,804 lbs**.**
Selection OK

**Corrected Radial Load $\mathbf{F_A}$ (Optional)**

Let's suppose that the calculated radial load F turns out to be 30,000 lbs, higher than manufacture preliminary selection data $F_r$= 25,850 lbs. In this case, it is possible to make a second check by means of the corrected radial load $F_A$, prior to selecting a larger coupling size.

$$F_A = F_r + \left[(T_N - T).(C)\right] = 25{,}852 + \left[(15{,}736 - 11{,}678).(3.7)\right] = 40{,}866 \text{ lbs}$$

The coupling could withstand a radial load of up to 40,866 lbs > 30,000 lbs.

Selection OK

**3. Geometric check of gearbox shaft:**

According to the manufacture data, $d_{max}$ = 8.5 inches > 8.0 inches (existing shaft diameter). Selection OK

## P. Appendix P – Structural Calculations

Please see the following pages for examples of structural calculations.

**1) Table of Contents:**



**2) Design Criteria:**

| | |
|---|---|
| CMAA Service Class: | C |
| Span: | $L := 72 \cdot ft$ |
| Crane Capacity: | $LL := 120000 \cdot lbf$ |
| Bridge Speed: | $S_b := 180 \cdot \frac{ft}{min}$ |
| Hoist Speed: | $S_h := 25 \cdot \frac{ft}{min}$ |
| Trolley Speed: | $S_t := 100 \cdot \frac{ft}{min}$ |
| Trolley Weight: | $TL := 34000 \cdot lbf$ |
| Trolley Wheel Base: | $l_t := 12 \cdot ft$ |
| Bridge Drive Deceleration Rate: | $a_{bd} := 0.55 \cdot \frac{ft}{sec^2}$ |
| End Truck Weight: | $W_{et} := 2850 \cdot lbf$ |
| End Truck Wheel Base: | $l_{et} := 13 \cdot ft$ |
| Spacing Between Girders | $l_g := 9 \cdot ft$ |

Walkway Weight: $W_{cw} := 30 \cdot \frac{lbf}{ft}$

Bridge Drive Machinery: $W_{dm} := 15 \cdot \frac{lbf}{ft}$

Steel Yeild Stress: $\sigma_{yp} := 50 \cdot ksi$

**3) Load Cases and Dynamic Load Factors**

Bridge Dead Load Factor:
(CMAA 70, 3.3.2.1.4.1)

$$DLF_b := \max\left(1.1, min\left(1.05 + \frac{S_b}{2000 \cdot \frac{ft}{min}}, 1.2\right)\right) \qquad DLF_b = 1.14$$

Trolley Dead Load Factor:
(CMAA 70, 3.3.2.1.4.1)

$$DLF_t := \max\left(1.1, min\left(1.05 + \frac{S_t}{2000 \cdot \frac{ft}{min}}, 1.2\right)\right) \qquad DLF_t = 1.1$$

Hoist Load Factor:
(CMAA 70, 3.3.2.1.4.2)

$$HLF := \max\left(0.15, min\left(\frac{0.005 \cdot S_h}{\frac{ft}{min}}, 0.5\right)\right) \qquad HLF = 0.15$$

Inertial Forces from Drives:
(CMAA 70, 3.3.2.1.5)

$$IFD_{factor} := \max\left(\frac{0.078 \cdot a_{bd}}{\frac{ft}{s^2}}, 0.025\right) \qquad IFD_{factor} = 0.043$$

Skewing Coefficient
(Span:End Truck Wheel Base Ratio=5.5)
(CMAA 70, 3.3.2.2.2)

$$S_{sk} := 0.10$$

**4) Box Girder Basic Dimensional Design Limitations:**

Minimum Girder Width:
(CMAA 70, 3.5.1)

$$b_g := \frac{L}{65} \qquad b_g = 13.292\ in$$

Minimum Girder Height:
(CMAA 70, 3.5.1)

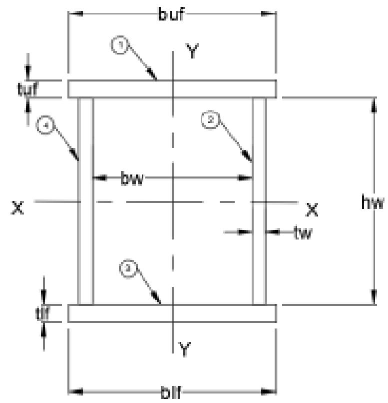
$$h_g := \frac{L}{25} \qquad h_g = 34.56\ in$$

Maximum Allowable Web Height to Thickness Ratio:
(CMAA 70, 3.5.1)

*Longitudinal Stiffeners are not provided.

$$\alpha := \max\left(\frac{1000}{\sqrt{\sigma_{yp}}} \cdot psi^{0.5}, 775 \cdot \sqrt{1.67}\right) \qquad \alpha = 1001.521$$

**5) Box Girder Sectional Properties:**




Section Properties:

Girder Web Height: $h_w := 56 \cdot in$ Must be > hg

Girder Web Thickness: $t_w := 0.375 \cdot in$

Upper Flange Width: $b_{uf} := 22 \cdot in$

Upper Flange Thickness: $t_{uf} := 1 \cdot in$

Lower Flange Width: $b_{lf} := 22 \cdot in$

Lower Flange Thickness: $t_{lf} := 1 \cdot in$

Distance Between Webs: $b_w := 20 \cdot in$ Must be > bg

Cross Section Area:

$A_1 := b_{uf} \cdot t_{uf}$ $\quad A_2 := h_w \cdot t_w$ $\quad A_3 := b_{lf} \cdot t_{lf}$ $\quad A_4 := h_w \cdot t_w$

$A := A_1 + A_2 + A_3 + A_4$ $\qquad A = 86\ in^2$

Find Location of Neutral Axis:
(As measured from upper surface of top flange)

$$Y_{bar} := \frac{A_1 \cdot \frac{t_{uf}}{2} + A_2 \cdot \left(t_{uf} + \frac{h_w}{2}\right) + A_3 \cdot \left(t_{uf} + h_w + \frac{t_{lf}}{2}\right) + A_4 \cdot \left(t_{uf} + \frac{h_w}{2}\right)}{A} \qquad Y_{bar} = 29\ in$$

Major Axis Moment of Inertia:

$$I_1 := \frac{b_{uf} \cdot t_{uf}^3}{12} \qquad I_2 := \frac{t_w \cdot h_w^3}{12} \qquad I_3 := \frac{b_{lf} \cdot t_{lf}^3}{3} \qquad I_4 := I_2$$

Parallel Axis:

$$I_{pa1} := A_1 \cdot \left(Y_{bar} - \frac{t_{uf}}{2}\right)^2 \qquad I_{pa2} := A_2 \cdot \left(\left(Y_{bar} - \left(t_{uf} + \frac{h_w}{2}\right)\right)^2\right)$$

$$I_{pa3} := A_3 \cdot \left(Y_{bar} - \left(t_{uf} + h_w + \frac{t_{lf}}{2}\right)\right)^2 \qquad I_{pa4} := A_4 \cdot \left(Y_{bar} - \left(t_{uf} + \frac{h_w}{2}\right)\right)^2$$

Total Moment of Inertia about X-Axis:

$$I_x := I_1 + I_2 + I_3 + I_4 + I_{pa1} + I_{pa2} + I_{pa3} + I_{pa4} \qquad I_x = 46724.167\ in^4$$

Minor Axis Moment of Inertia:

$$I_1 := \frac{b_{uf}^3 \cdot t_{uf}}{12} \qquad I_2 := \frac{t_w^3 \cdot h_w}{12} \qquad I_3 := \frac{b_{lf}^3 \cdot t_{lf}}{12} \qquad I_4 := I_2$$

Parallel Axis:

$$I_{pa2} := A_2 \cdot \left(\frac{b_w}{2} + \frac{t_w}{2}\right)^2 \qquad I_{pa4} := I_{pa2}$$

Total Moment of Inertia about Y-Axis:

$$I_y := I_1 + I_2 + I_3 + I_4 + I_{pa2} + I_{pa4} \qquad I_y = 6134.135\ in^4$$

Major Axis Section Modulus:

$$S_{xtop} := \frac{I_x}{Y_{bar}} \qquad S_{xtop} = 1611.178\ in^3$$

$$S_{xbot} := \frac{I_x}{(t_{uf} + h_w + t_{lf} - Y_{bar})} \qquad S_{xbot} = 1611.178\ in^3$$

Minor Axis Section Modulus:

$$S_y := \frac{I_y}{\frac{1}{2} \cdot \max(b_{uf}, b_{lf})} \qquad S_y = 557.649\ in^3$$

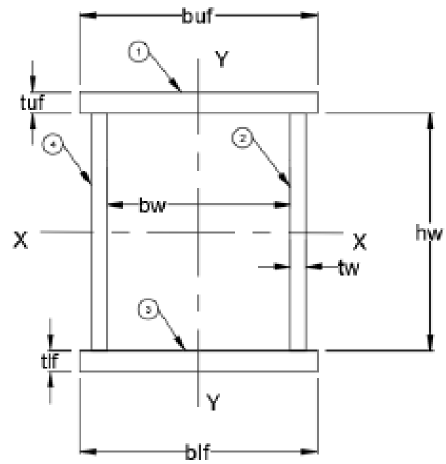
Girder Weight:

$$w_{girder} := A \cdot 490 \cdot \frac{lbf}{ft^3} \qquad w_{girder} = 292.639\ \frac{lbf}{ft}$$

Check Web Height to Thickness Ratio to Confirm it does not exceed the limit $\alpha$ found on page 2:

$$\frac{h_w}{t_w} = 149.333 \ < \quad \alpha = 1001.521 \quad \therefore \text{OK.}$$

## 6) End Truck Sectional Properties:




<u>Section Properties:</u>

End Truck Web Height: $h_w := 16\ in$

End Truck Web Thickness: $t_w := 0.5 \cdot in$

Upper Flange Width: $b_{uf} := 12 \cdot in$

Upper Flange Thickness: $t_{uf} := 0.75 \cdot in$

Lower Flange Width: $b_{lf} := 12 \cdot in$

Lower Flange Thickness: $t_{lf} := 0.75 \cdot in$

Distance Between Webs: $b_w := 10 \cdot in$

Cross Section Area:

$A_1 := b_{uf} \cdot t_{uf} \qquad A_2 := h_w \cdot t_w \qquad A_3 := b_{lf} \cdot t_{lf} \qquad A_4 := h_w \cdot t_w$

$A_{et} := A_1 + A_2 + A_3 + A_4 \qquad A_{et} = 34\ in^2$

Find Location of Neutral Axis:
(As measured from upper surface of top flange)

$$Y_{bar} := \frac{A_1 \cdot \frac{t_{uf}}{2} + A_2 \cdot \left(t_{uf} + \frac{h_w}{2}\right) + A_3 \cdot \left(t_{uf} + h_w + \frac{t_{lf}}{2}\right) + A_4 \cdot \left(t_{uf} + \frac{h_w}{2}\right)}{A} \qquad Y_{bar} = 3.459\ in$$

<u>Major Axis Moment of Inertia:</u>

$$I_1 := \frac{b_{uf} \cdot t_{uf}^{\ 3}}{12} \qquad I_2 := \frac{t_w \cdot h_w^{\ 3}}{12} \qquad I_3 := \frac{b_{lf} \cdot t_{lf}^{\ 3}}{3} \qquad I_4 := I_2$$

Parallel Axis:

$$I_{pa1} := A_1 \cdot \left(Y_{bar} - \frac{t_{uf}}{2}\right)^2 \qquad I_{pa2} := A_2 \cdot \left(\left(Y_{bar} - \left(t_{uf} + \frac{h_w}{2}\right)\right)^2\right)$$

$$I_{pa3} := A_3 \cdot \left(Y_{bar} - \left(t_{uf} + h_w + \frac{t_{lf}}{2}\right)\right)^2 \qquad I_{pa4} := A_4 \cdot \left(Y_{bar} - \left(t_{uf} + \frac{h_w}{2}\right)\right)^2$$

Total Moment of Inertia about X-Axis:

$$I_{xet} := I_1 + I_2 + I_3 + I_4 + I_{pa1} + I_{pa2} + I_{pa3} + I_{pa4} \qquad I_{xet} = 2557.684\ in^4$$

Minor Axis Moment of Inertia:

$$I_1 := \frac{b_{uf}^{\ 3} \cdot t_{uf}}{12} \qquad I_2 := \frac{t_w^{\ 3} \cdot h_w}{12} \qquad I_3 := \frac{b_{lf}^{\ 3} \cdot t_{lf}}{12} \qquad I_4 := I_2$$

Parallel Axis:

$$I_{pa2} := A_2 \cdot \left(\frac{b_w}{2} + \frac{t_w}{2}\right)^2 \qquad I_{pa4} := I_{pa2}$$

Total Moment of Inertia about Y-Axis:

$$I_{yet} := I_1 + I_2 + I_3 + I_4 + I_{pa2} + I_{pa4} \qquad I_{yet} = 657.333\ in^4$$

Major Axis Section Modulus:

$$S_{xtopet} := \frac{I_x}{Y_{bar}} \qquad S_{xtopet} = 13506.818\ in^3$$

$$S_{xbotet} := \frac{I_x}{(t_{uf} + h_w + t_{lf} - Y_{bar})} \qquad S_{xbotet} = 3327.767\ in^3$$

Minor Axis Section Modulus:

$$S_{yet} := \frac{I_y}{\frac{1}{2} \cdot \max\left(b_{uf}, b_{lf}\right)} \qquad S_y = 557.649\ in^3$$

End Truck Weight:

$$w_{et} := A_{et} \cdot 490 \cdot \frac{lbf}{ft^3} \qquad w_{et} = 115.694\ \frac{lbf}{ft}$$

$$W'_{et} := w_{et} \cdot l_{et} \qquad W'_{et} = 1504.028\ lbf$$

NOTE: This weight does not include weight of wheels, drive motors, stiffeners and diaphrams.
The total end truck weight (Wet) is used for subsequent calculations

**7) Inertial Drive Forces:**
(CMAA 70, 3.3.2.1.5)

Distributed Dead Load: $dist\_weight := (2 \cdot w_{girder} \cdot 1.15 + W_{cw} + W_{dm})$

Concentrated Loads: $conc\_weight := LL + TL$

$$IFD_{distributed} := IFD_{factor} \cdot \frac{dist\_weight}{2} \qquad IFD_{distributed} = 15.403\ \frac{lbf}{ft}$$

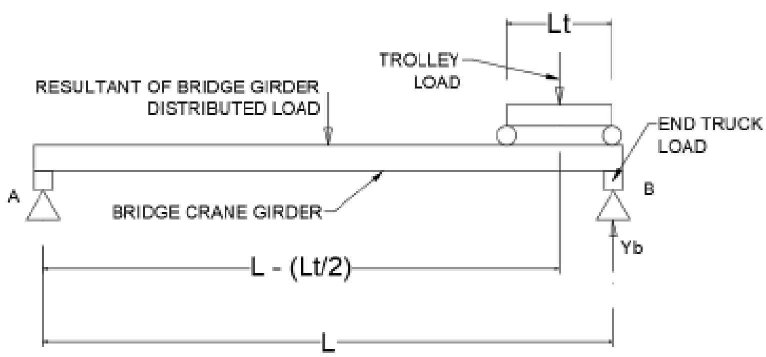
$$IFD_{concentrated} := IFD_{factor} \cdot \frac{conc\_weight}{2} \qquad IFD_{concentrated} = 3303.3\ lbf$$

Dividing load evenly between both girders

Note: A factor of 1.15 was added to girder weight to account for the additional weight of stiffeners and diaphrams. This will be confirmed in the subsequent calculations.

**8) Skewing Forces:**

Determine Wheel Loads




Sum of Forces About Left Support:

$$\Sigma M_a = -\left(DLF_b \cdot (2 \cdot w_{girder} + W_{cw} + W_{dm}) \cdot \frac{L^2}{2}\right) - (DLF_t \cdot TL + LL \cdot (1 + HLF)) \cdot \left(L - \frac{l_t}{2}\right) + Y_b \cdot L - W_{et} \cdot L = 0$$

$$Y_{b1} := \frac{\left(DLF_b \cdot (2 \cdot w_{girder} + W_{cw} + W_{dm}) \cdot \frac{L^2}{2}\right) + (DLF_t \cdot TL + LL \cdot (1 + HLF)) \cdot \left(L - \frac{l_t}{2}\right) + W_{et} \cdot L}{L}$$

Right Hand Reaction and Maximum Reaction Force: $Y_{b1} = 189499.933\ \mathbf{lbf}$

Load Per Wheel, Assuming 2 Wheels: $L_{wheel} := \frac{Y_{b1}}{2}$ $L_{wheel} = 94749.967\ \mathbf{lbf}$

Skewing Forces on Each Wheel: $F_{skew} := S_{sk} \cdot L_{wheel}$ $F_{skew} = 9474.997\ \mathbf{lbf}$

NOTE: This lateral force will be appled to each end truck wheel in the direction perpendicular to the rail, such that each end truck is loaded with a force couple with maginitude equal to this skewing force, and a distance equal to the end truck wheel base.

## 9) Required Girder Bending Moment and Shear

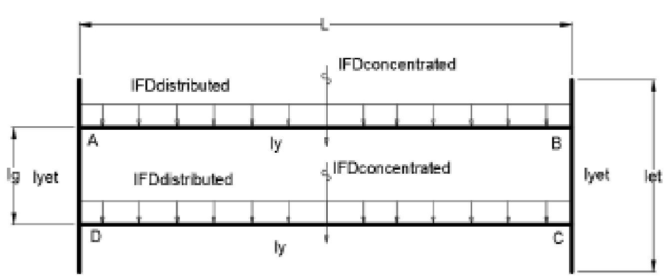
Required girder bending moment:
(Assuming trolley is centered-this moment is resisted by BOTH girders)

CMAA Load Case 1: $DL\ (DLF_B) + TL\ (DLF_T) + LL\ (1 + HLF) + IFD$

$$M_{x1} := \left( \frac{DLF_b \cdot (w_{girder} + W_{cw} + W_{dm}) \cdot L^2}{8} + \frac{(DLF_t \cdot TL + LL \cdot (1 + HLF)) \cdot L}{4} \right) \qquad M_{x1} = 3406620.6\ \mathbf{lbf \cdot ft}$$

Find My1 Which results from Inertial Drive Forces (IFD) Using Indeterminate Frame Analysis:

Frame analysis is conducted on the structural model shown below. All resulting flexural forces within the end trucks are assumed to be resisted between the girder connection points. The cantilevered end truck ends (which contain the wheels) are assumed to be free for the purpose of this specific analsyis since the small amount of lateral play between the rail head and end truck wheel flanges will allow the end truck ends to deflect under IFD loads. This results in conservatively higher flexural demands on the portion of the end truck that is between the girders.



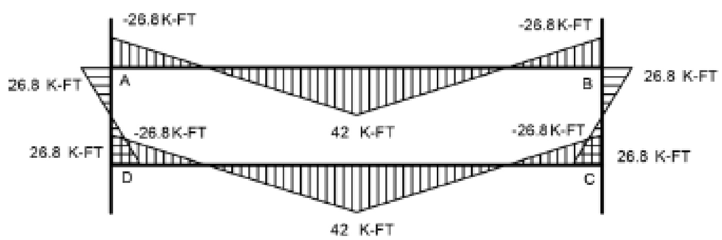
For this example, the indeterminate structural analysis that was needed to find the resulting flexural moments for the IFD loads was performed using Moment Distribution (a classic hand-calculation method). In practice, this analysis would most likely be conducted using comercial structural analysis software. For brevity, the specific Moment Distribution computations have been ommited in this example, however the inputs and outputs have been fully defined so as to allow an independent reviewer the ability to duplicate the analysis as a means for checking the work.

<u>The moments at the joints are approximately 26.8 k-ft, and the maximum girder moment at mid-span (My1) was found to be approximately 42 k-ft. See result plot below.</u>

Fixed End Moments-Girder: $FEM := \frac{IFD_{distributed} \cdot L^2}{12} + \frac{IFD_{concentrated} \cdot L}{8}$

$FEM = 36.384\ kip \cdot ft$

Resulting Bending Moment Diagram Due to IFD Forces:




The resulting maximum girder moment about the Y-Axis from IFD force structural analysis: $M_{y1} := 42000 \cdot lbf \cdot ft$

<u>CMAA Load Case 2:</u> $DL\,(DLF_B) + TL\,(DLF_T) + LL\,(1 + HLF) + IFD + SK$

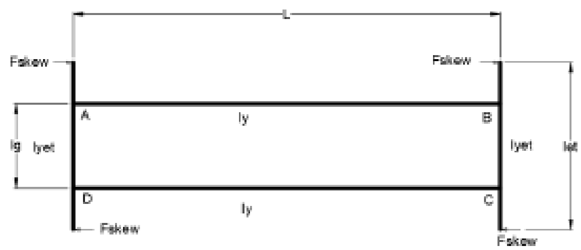
Major Axis Bending Moment:

$M_{x2} := M_{x1}$

Find the minor axis bending moment for Load Case 2 (My2) which results from IFD and Skewing forces Using Indeterminate Frame Analysis:

Frame analysis is conducted on the structural model shown below for skewing forces. Moment Distribution is used for analysis. The resulting moments due to the skewing forces are added to the moments found due to IFD forces (in Load Case #1). Unlike the analysis for IFD forces, the entire length of the end truck is used since the skewing forces enter the crane structure through the wheels.

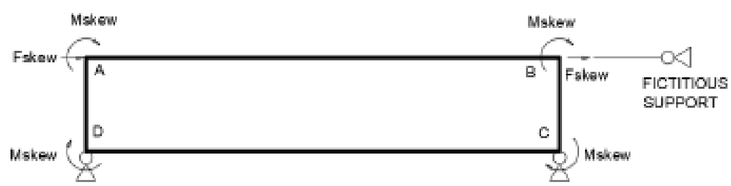
Load Case 2 Skewing Forces:



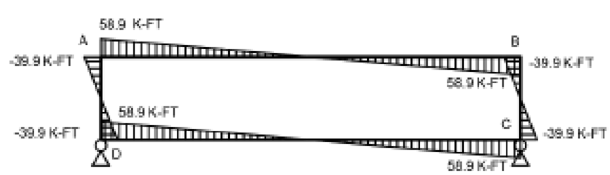

Moment Arm From Girder to Wheel Axle where Fskew is Applied: $a := \frac{l_{et} - l_g}{2}$ $a = 2\ ft$

Moment Applied by Fskew:
(This will be distributed into the remaining structure via Moment Distribution) $M_{skew} := a \cdot F_{skew}$ $M_{skew} = 18.95\ kip \cdot ft$

The bending moments were found in the frame shown below using Moment Distribution. NOTE: The fictitious support was needed for this racking analysis to separate the moments that were caused by Fskew from those that were caused by Mskew. All of the moments were summed together at the end (with the fictitious support removed) in order to reach the final moment diagram for skewing forces. See below.




Final Racking Moments Due to Skewing Forces:




NOTE: The moments at the joints are not equal and oposite because there is an additional -18.95 kip-ft from the cantilevered portion of the end trucks (Mskew) that isn't shown. Once this is added each joint is in equalibrium.

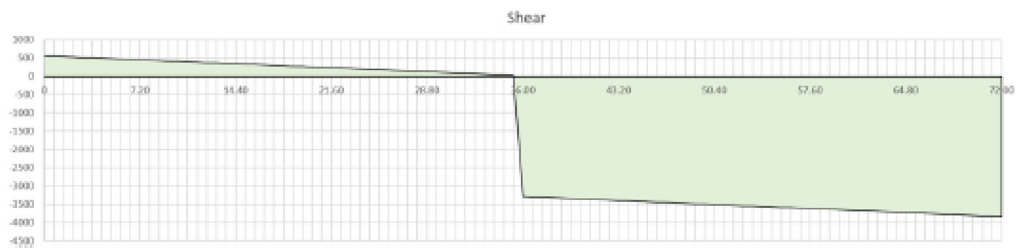
Now combine the girder moments due to IFD forces with the girder moments due to skewing forces to get a final Load Case 2 bending moment diagram about the vertical axis (minor axis bending). For Girder AB (Girder CD is similar), the combined end moments:

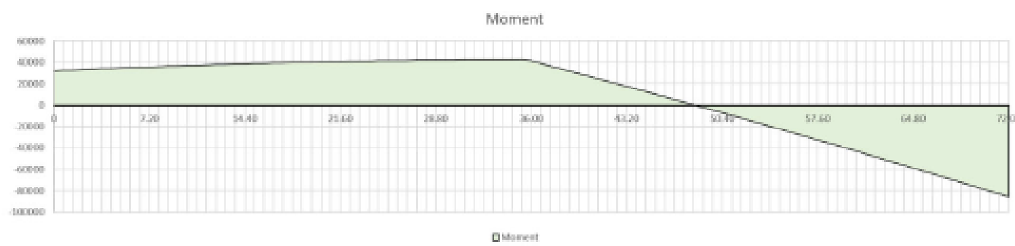
At A is: $58.9 \cdot kip \cdot ft - 26.8 \cdot kip \cdot ft = 32.1\ kip \cdot ft$

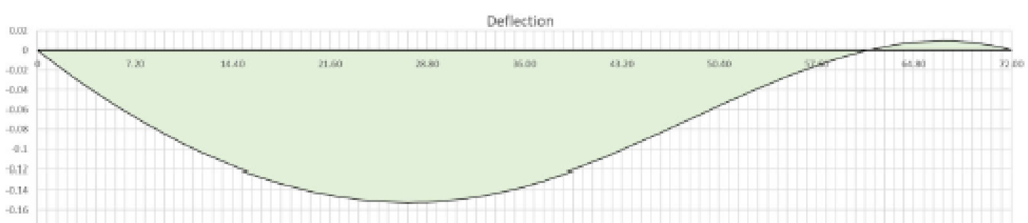
At B is: $58.9 \cdot kip \cdot ft + 26.8 \cdot kip \cdot ft = 85.7\ kip \cdot ft$

Girder Minor Axis Shear, Bending Moment and Deflection Due To Combined Inertial Drive Forces and Skewing Forces for Computation of Combined Stresses for CMAA Load Case 2:

| Node Location (ft) | Nodal Loads (lbs) | First Moment of load from A | Shear (lbs) | Moment (lb-ft) | Moment Area (lb-in^2) | First Moment of Moment Area from A | First Moment of Moment Area from B | | Deflection |
|---|---|---|---|---|---|---|---|---|---|
| Totals and Maximums: | 4396 | 158649.48 | 3839.576111 | 42374.47525 | 94503999.72 | -47552327141 | 1.39196E+11 | | -0.152386632 |
| | | | MIN. | -85708.47525 | | | | | |




NOTE: The Moment Distribution sign convention is that clockwise moments on the beam ends are positive. Therefore Girder AD above has clockwise moments acting on it at each end. Meanwhile the sign convention for the moment diagram shown above differs in that positive moments are concave-up beam curvature. As a result, the Moment Distribution results show a positive moment on each end, while the diagram shows one postive and one negative end moment.

From these results, there are two locations that should be considered:

1. Mid-Span where the bending moment due to gravity loads are at a maximum and bending moments due to horizontal loads (IFD and Skewing) are at a local maxima.
2. At the right end (Joints B and C) where the bending moment due to horizontal loads are at a maximum.

$$M_{y2\_midspan} := 41.2 \cdot kip \cdot ft$$

$$M_{y2\_end} := 85.7 \cdot kip \cdot ft$$

Test Load Case 3 for a 125% Test Load:
(NOTE: Load Combination Varies by Contract-See Specification)

$$DL\left(DLF_b\right) + TL \cdot \left(DLF_t\right) + 1.25\ LL + (1 + HLF) \cdot IFD + SK + WLO$$

NOTES:

1. The crane considered in this example is an indoor crane therefore WLO is taken as zero.
2. All other loads are equivalent to previous load cases except that the Lifted Load will be increased by a factor of 1.25, and the resulting IFD and Skewing Forces must also be increased accordingly. Since this is linear eleastic analysis, the bending moments from Load Case #2 can be increased by a factor which is the ratio of the IFD and Skewing moments found in Load Case #3 divided by the IFD and Skewing moments found in Load Case #2.

Increased IFD Forces:

Determine Wheel Loads

Distributed Dead Load: $dist\_weight := \left(2 \cdot w_{girder} \cdot 1.15 + W_{cw} + W_{dm}\right)$

Concentrated Loads: $conc\_weight := 1.25\ LL + TL$

$$IFD_{distributed} := IFD_{factor} \cdot \frac{dist\_weight}{2} \qquad IFD_{distributed} = 15.403\ \frac{lbf}{ft}$$

$$IFD_{concentrated} := IFD_{factor} \cdot \frac{conc\_weight}{2} \qquad IFD_{concentrated} = 3946.8\ lbf$$

Dividing load evenly between both girders

Note: A factor of 1.15 was added to girder weight to account for the additional weight of stiffeners and diaphrams. This will be confirmed in the subsequent calculations.

Fixed End Moments-Girder:

$$FEM := \frac{IFD_{distributed} \cdot L^2}{12} + \frac{IFD_{concentrated} \cdot L}{8}$$

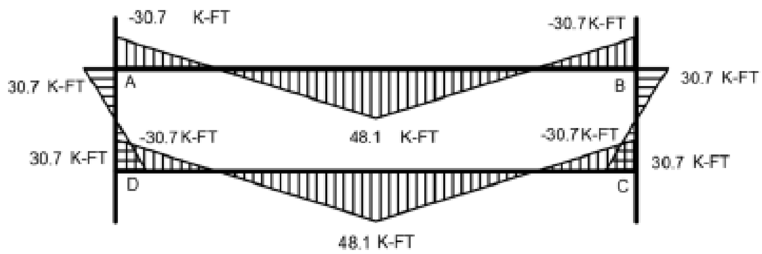
$$FEM = 42.175\ kip \cdot ft$$

The fixed-end moments for IFD forces in Load Case #2 were found to be 36.38kip-ft, which resulted in bending moments of -26.8kip-ft (at the ends) and 42 kip-ft (mid span). See pages 8-9. The bending moments due to IFD for Load Case #3 are therefore proportionately increased to account for the increased test load:

Negative Moment : $-26.8 \cdot kip \cdot ft \cdot \dfrac{FEM}{36.8 \cdot kip \cdot ft} = -30.714\ (kip \cdot ft)$

Positive Moment: $42 \cdot kip \cdot ft \cdot \dfrac{FEM}{36.8 \cdot kip \cdot ft} = 48.135\ (kip \cdot ft)$

<u>Case 3 IFD Moments:</u>




Increased Skewing Forces:

$$Y_{b3} := \frac{\left(DLF_b \cdot (2 \cdot w_{girder} + W_{cw} + W_{dm}) \cdot \frac{L^2}{2}\right) + (DLF_t \cdot TL + 1.25 \cdot LL \cdot (1 + HLF)) \cdot \left(L - \frac{l_t}{2}\right) + W_{et} \cdot L}{L}$$

Right Hand Reaction and Maximum Reaction Force: $Y_{b3} = 221124.933\ lbf$

Load Per Wheel, Assuming 2 Wheels: $L_{wheel} := \dfrac{Y_{b3}}{2}$ $L_{wheel} = 110562.467\ lbf$

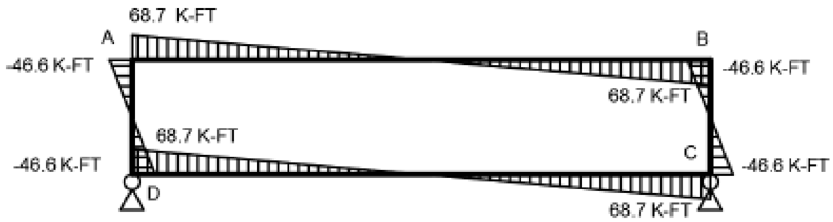
Skewing Forces on Each Wheel: $F_{skew} := S_{sk} \cdot L_{wheel}$ $F_{skew} = 11056.247\ lbf$

The increased Skewing Force (Fskew) for Load Case #3 is 11,056 lbs verses 9,475 lbs found in Load Case #2. The skewing moments for Load Case #3 will therefore be proportionately increased from those found for Load Case #2 skewing moments as follows:

Negative Moment : $-39.9 \cdot kip \cdot ft \cdot \dfrac{F_{skew}}{9475 \cdot lbf} = -46.559\ (kip \cdot ft)$

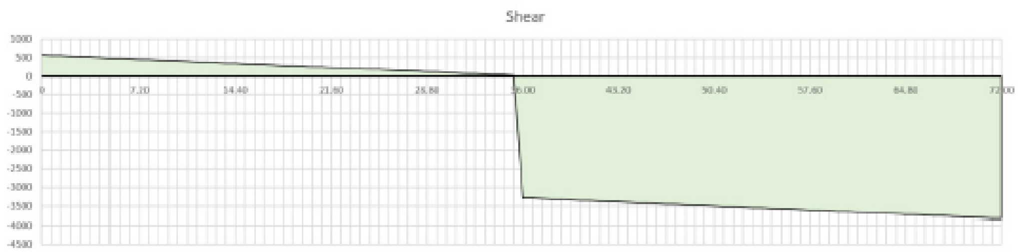
Positive Moment: $58.9 \cdot kip \cdot ft \cdot \dfrac{F_{skew}}{9475 \cdot lbf} = 68.73\ (kip \cdot ft)$

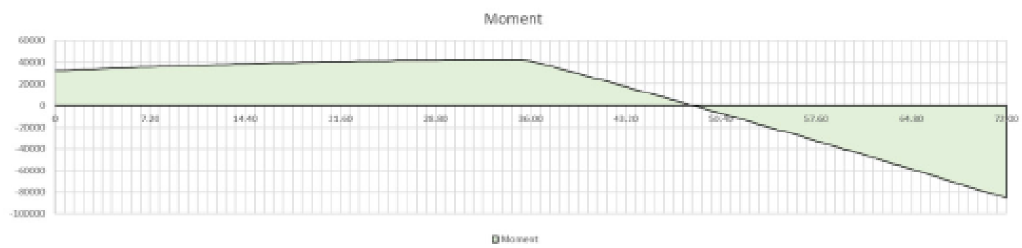
Case 3 Skewing Moments:

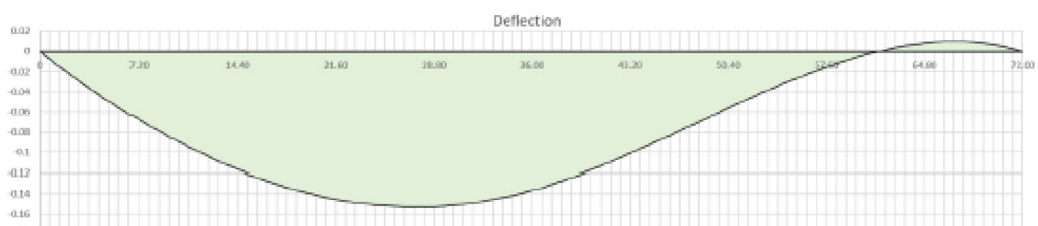



Combined Shear, Bending, and Deflection for Case 3 IFD and Skewing Forces:

| Node Location (ft) | Nodal Loads (lbs) | First Moment of load from A | Shear (lbs) | Moment (lb-ft) | Moment Area (lb-in^2) | First Moment of Moment Area from A | First Moment of Moment Area from B | Slope | Deflection |
|---|---|---|---|---|---|---|---|---|---|
| 72.00 | 10.93 | 786.96 | -4427.298333 | -99407.9604 | -10143207.39 | -8719478680 | -433848807.84 | -0.000375545 | -2.54E-05 |
| Totals and Maximums: | 5099 | 181797.48 | 4433.298333 | 50013.24752 | 113465148 | -54076906059 | 1.52103E+11 | | -0.17976032 |
| | | | MIN. | -99407.9604 | | | | | |



From these results, there are two locations that should be considered:

1. Mid-Span where the bending moment due to gravity loads are at a maximum and bending moments due to horizontal loads (IFD and Skewing) are at a local maxima.
2. At the right end (Joints B and C) where the bending moment due to horizontal loads are at a maximum.

$M_{y3\_midspan} := 48.7 \cdot kip \cdot ft$

$M_{y3\_end} := 99.4 \cdot kip \cdot ft$

Load Case 3 Major Axis Bending:

$$M_{x3} := \left( \frac{DLF_b \cdot (w_{girder} + W_{cw} + W_{dm}) \cdot L^2}{8} + \frac{(DLF_t \cdot TL + 1.25\ LL \cdot (1 + HLF)) \cdot L}{4} \right)$$

$M_{x3} = 4027620.6\ lbf \cdot ft$

Summary of Bending Moments on the Girder for Load Cases 1, 2, and 3:
(All values in kip-ft)

| | Major Axis | Minor Axis Mid-Span | Minor Axis-End |
|---|---|---|---|
| Load Case #1 | 3379 | 42 | 26.8 |
| Load Case #2 | 3379 | 42 | 85.7 |
| Load Case #3 | 4000 | 48.7 | 99.4 |

**10) Girder Bending Stress:**

Load Case 1:

Allowable Tension/Compression Stress for Yielding: $\sigma_{all1} := 0.6 \cdot 50 \cdot ksi$
(CMAA 70 Table 3.4-1)

$\sigma_{all1} = 30\ ksi$

Top Flange Stress:

$$\sigma_{t1} := \frac{M_{x1}}{S_{xtop}} + \frac{M_{y1}}{S_y}$$

$\sigma_{t1} = 26.276\ ksi$ ∴ < allowable. OK.

Bottom Flange Stress:

$$\sigma_{b1} := \frac{M_{x1}}{S_{xbot}} + \frac{M_{y1}}{S_y}$$

$\sigma_{b1} = 26.276\ ksi$ ∴ < allowable. OK.

Load Case 2:

Allowable Tension/Compression Stress for Yielding:
(CMAA 70 Table 3.4-1)

$\sigma_{all2} := 0.66 \cdot 50 \cdot ksi$

$\sigma_{all2} = 33\ ksi$

Top Flange Stress:

$\sigma_{t2} := \frac{M_{x2}}{S_{xtop}} + \frac{M_{y2\_midspan}}{S_y}$ $\sigma_{t2} = 26.259\ ksi$ ∴ < allowable. OK.

Bottom Flange Stress:

$\sigma_{b2} := \frac{M_{x2}}{S_{xbot}} + \frac{M_{y2\_midspan}}{S_y}$ $\sigma_{b2} = 26.259\ ksi$ ∴ < allowable. OK.

Minor Axis Bending at Beam Girder:

$\sigma_{y2\_end} := \frac{M_{y2\_end}}{S_y}$ $\sigma_{y2\_end} = 1.844\ ksi$ ∴ < allowable. OK.

Load Case 3:

Allowable Tension/Compression Stress for Yielding:
(CMAA 70 Table 3.4-1)

$\sigma_{all3} := 0.75 \cdot 50 \cdot ksi$

$\sigma_{all3} = 37.5\ ksi$

Top Flange Stress:

$\sigma_{t3} := \frac{M_{x3}}{S_{xtop}} + \frac{M_{y3\_midspan}}{S_y}$ $\sigma_{t3} = 31.046\ ksi$ ∴ < allowable. OK.

Bottom Flange Stress:

$\sigma_{b3} := \frac{M_{x3}}{S_{xbot}} + \frac{M_{y3\_midspan}}{S_y}$ $\sigma_{b3} = 31.046\ ksi$ ∴ < allowable. OK.

Minor Axis Bending at Beam Girder:

$\sigma_{y3\_end} := \frac{M_{y3\_end}}{S_y}$ $\sigma_{y3\_end} = 2.139\ ksi$ ∴ < allowable. OK.

**11) Girder Shear Stress:**

Load Case 1:

Allowable Shear Stress for Yielding:
(CMAA 70 Table 3.4-1)

$\tau_{all1} := 0.36 \cdot 50 \cdot ksi$

$\tau_{all1} = 18\ ksi$

Controlling Girder Web Shear: $V_{y1} := Y_{b1} - W_{et}$  $V_{y1} = 186.65\ kip$

Girder Web Shear Stress: $\tau_{y1w} := \dfrac{V_{y1}}{2 \cdot h_w \cdot t_w}$  $\tau_{y1w} = 11.666\ ksi$ ∴ < allowable. OK.

Controlling Girder Flange Shear: $V_{x1} := 4.275 \cdot kip$  See Page 10-IFD Shear

Girder Flange Shear Stress: $\tau_{y1f} := \dfrac{V_{x1}}{b_{uf} \cdot t_{uf} + b_{lf} \cdot t_{lf}}$  $\tau_{y1f} = 0.238\ ksi$ ∴ < allowable. OK.

Load Case 2:

Allowable Shear Stress for Yielding:
(CMAA 70 Table 3.4-1)

$\tau_{all2} := 0.4 \cdot 50 \cdot ksi$

$\tau_{all2} = 20\ ksi$

Controlling Girder Web Shear: $V_{y2} := Y_{b1} - W_{et}$  $V_{y2} = 186.65\ kip$

Girder Web Shear Stress: $\tau_{y2w} := \dfrac{V_{y1}}{2 \cdot h_w \cdot t_w}$  $\tau_{y2w} = 11.666\ ksi$ ∴ < allowable. OK.

Controlling Girder Flange Shear: $V_{x2} := 6.355 \cdot kip$  See Page 15-IFD & Skewing Shear Forces Combined

Girder Flange Shear Stress: $\tau_{y2f} := \dfrac{V_{x2}}{b_{uf} \cdot t_{uf} + b_{lf} \cdot t_{lf}}$  $\tau_{y2f} = 0.353\ ksi$ ∴ < allowable. OK.

Load Case 3:

Allowable Shear Stress for Yielding:
(CMAA 70 Table 3.4-1)

$\tau_{all2} := 0.45 \cdot 50 \cdot ksi$

$\tau_{all2} = 22.5\ ksi$

Controlling Girder Web Shear: $V_{y3} := Y_{b3} - W_{et}$  $V_{y3} = 218.275\ kip$

Girder Web Shear Stress: $\tau_{y3w} := \frac{V_{y3}}{2 \cdot h_w \cdot t_w}$ $\tau_{y3w} = 13.642\ ksi$ ∴ < allowable. OK.

Controlling Girder Flange Shear: $V_{x3} := 7.337 \cdot kip$ See Page 18-IFD & Skewing Shear Forces Combined

Girder Flange Shear Stress: $\tau_{x3f} := \frac{V_{x3}}{b_{uf} \cdot t_{uf} + b_{lf} \cdot t_{lf}}$ $\tau_{x3f} = 0.408\ ksi$ ∴ < allowable. OK.

**12) Girder Requirements for Diaphrams, Transverse Stiffeners for Web Buckling**

Web Height to Thickness Ratio Limit, CMAA 3.5.4.1:

$\frac{h_w}{t_w} = 32$ < $240 \cdot \sqrt{\tau_{y3w}} \cdot \left(\frac{1}{psi^{0.5}}\right) = 28031.942$ < 150 ∴ OK. Additional Full Height siffieners not required unless required by CMAA 3.4.8

Find Spacing For Transverse Web Stiffeners to Meet Section 3.4.8 Requirements:

Transverse Stiffeners Spacing: $a := L$ $a = 864\ in$

$\alpha := \frac{a}{h_w}$ $\alpha = 54$

Euller Buckling Stress (CMAA 70, 3.4.8.2): $\sigma_e := \frac{\pi^2 \cdot 29000 \cdot ksi}{12 \cdot (1 - 0.3^2)} \cdot \left(\frac{t_w}{h_w}\right)^2$ $\sigma_e = 25.596\ ksi$

Web Buckling Due to Shear and Normal Stress:
(Using Case 3 and 4 of Table 3.4.8.2-1)

Shear Stress for Load Cases 1,2 and 3: $\tau := \begin{bmatrix} \tau_{y1w} \\ \tau_{y2w} \\ \tau_{y3w} \end{bmatrix}$

Normal Stress for Load Cases 1,2 and 3: $\sigma := \begin{bmatrix} \sigma_{t1} \\ \sigma_{t2} \\ \sigma_{t3} \end{bmatrix}$

See CMAA 70, Table 3.4.8.2-1: $K_\tau := 5.34 + \frac{4}{\alpha^2}$ $K_\tau = 5.341$

$\tau_k := K_\tau \cdot \sigma_e$ $\tau_k = 136.719\ ksi$

$K_\sigma := 23.9$

$\sigma_k := K_\sigma \cdot \sigma_e$ $\sigma_k = 611.749\ ksi$

$\psi := \frac{\sigma_{b3}}{\sigma_{t3}}$

Critical Comparison Stress:

$$\sigma_{1k} := \frac{\sqrt{\sigma^2 + 3 \cdot \tau^2}}{\left(\frac{1+\psi}{4}\right) \cdot \left(\frac{\sigma}{\sigma_k}\right) + \sqrt{\left(\frac{(3-\psi) \cdot \sigma}{4 \cdot \sigma_k}\right)^2 + \left(\frac{\tau}{\tau_k}\right)^2}}$$

$\sigma_{1k} = \begin{bmatrix} 302.81 \\ 302.734 \\ 304.012 \end{bmatrix} ksi$ Above elastic limit, therefore used reduced Critical Comparison Stress:

Reduced Critical Comparison Stress:

$$\sigma_{1kR} := \frac{\sigma_{yp} \cdot (\sigma_{1k})^2}{0.1836 \cdot (\sigma_{yp})^2 + (\sigma_{1k})^2} \qquad \sigma_{1kR} = \begin{bmatrix} 49.751 \\ 49.751 \\ 49.753 \end{bmatrix} ksi$$

Buckling Factor:

$$v_b := \frac{\sigma_{1kR}}{\sqrt{\sigma^2 + 3 \cdot \tau^2}} \qquad v_b = \begin{bmatrix} 1.501 \\ 1.502 \\ 1.275 \end{bmatrix}$$

> 1.35 for Case 1 ∴ OK.
> 1.25 for Case 2 ∴ OK.
> 1.20 for Case 3 ∴ OK.

∴ No transverse stiffeners are required for the webs.

### 13) Girder Short Diaphram Spacing and Sizing:

Short Diaphrams are needed directly below the top girder flange in order to support the trolley rail (and possibly to stiffen the top flange for buckling stress).

Find Short Diaphram Spacing using CMAA 70, Section: 3.5.4.6:

Section Modulus of Trolley Rail: (ASCE #60 Rail w/ 18" Trolley Wheels 320 BHN per Table 4.13.3-4) $S_{x\_trail} := 6.6 \cdot in^3$

Trolley Wheel Load: $P_{trolley} := \dfrac{TL + LL}{4}$ $P_{trolley} = 38500\ lbf$

Short Diaphram Spacing: $s := 18 \cdot in$

Trolley Rail Stress: $\dfrac{P_{trolley} \cdot s}{6 \cdot S_{x\_trail}} = 17.5\ ksi$ < 18 ksi ∴ OK.

Check Bearing Stress on Short Diaphram Due to Trolley Loads:

Trolley Wheel Load with VIF: $$P_{trolley\_vif} := \begin{bmatrix} \dfrac{TL \cdot DLF_t + LL \cdot (1 + HLF)}{4} \\ \dfrac{TL \cdot (DLF_t) + 1.25 \cdot LL \cdot (1 + HLF)}{4} \end{bmatrix}$$

Width of Rail: $b_{rail} := 4.25 \cdot in$

Bearing Width: $b_{bearing} := b_{rail} + 2 \cdot t_{uf}$ $b_{bearing} = 5.75\ in$

Allowable Bearing Stress Cases 1 & 3: $\sigma_{BrgALL} := \begin{bmatrix} 0.8 \cdot \sigma_{yp} \\ \sigma_{yp} \end{bmatrix}$

Required Short Diaphram Thickness to Meet Bearing Pressure Requirements:

$$t_{sd} := \frac{P_{trolley\_vif}}{\sigma_{BrgALL} \cdot b_{bearing}} \qquad t_{sd} = \begin{bmatrix} 0.191 \\ 0.183 \end{bmatrix} in$$

Size Short Diaphrams for Shear Strength:

Short Diaphram Thickness: $t_{sd} := 0.25 \cdot in$

Required Shear Forces: $v_{sd} := \frac{P_{trolley\_vif}}{2}$

Allowable Shear Stress Cases 1 &3: $\tau_{ALL} := \begin{bmatrix} 0.36 \cdot \sigma_{yp} \\ 0.45 \cdot \sigma_{yp} \end{bmatrix}$

Required Short Diaphram Height: $h_{sd} := \frac{v_{sd}}{\tau_{ALL} \cdot t_{sd}}$ $h_{sd} = \begin{bmatrix} 4.872 \\ 4.664 \end{bmatrix} in$

Check Short Diaphram for Flexural Strength:

Set Short Diaphram Height: $h_{sd} := 10 \cdot in$

Required Bending Moment: $M_{sd} := \frac{P_{trolley\_vif} \cdot b_w}{4}$

Section Modulus: $S_{sd} := \frac{t_{sd} \cdot h_{sd}^{\ 2}}{6}$

Allowable Stress: $\sigma_{ALL} := \begin{bmatrix} 0.6 \cdot \sigma_{yp} \\ 0.75 \cdot \sigma_{yp} \end{bmatrix}$ $\sigma_{ALL} = \begin{bmatrix} 30 \\ 37.5 \end{bmatrix} ksi$

Resulting Bending Stress: $\sigma_{sd} := \frac{M_{sd}}{S_{sd}}$ $\sigma_{sd} = \begin{bmatrix} 26.31 \\ 31.485 \end{bmatrix} ksi$ $< \sigma_{ALL}$ OK.

Conclusion:

Short Diaphram Spacing: 18"
Short Diaphram Height: 10"
Short Diaphram Thickness 0.25"

### 14) Girder Top Flange Allowable Compressive Stress:

Compute Buckling Stress From CMAA 70 Table 3.4.8.2-1

$\alpha := \frac{s}{b_w}$ $\alpha = 1.8$

$\psi := 1.0$

Euller Buckling Stress (CMAA 70, 3.4.8.2): $\sigma_e := \frac{\pi^2 \cdot 29000 \cdot ksi}{12 \cdot (1 - 0.3^2)} \cdot \left(\frac{t_{uf}}{s}\right)^2$ $\sigma_e = 45.504\ ksi$

<u>Top Flange Buckling Due to Normal Stress:</u>
<u>(Using Case 3 of Table 3.4.8.2-1)</u>

Normal Stress for Load Cases 1,2 and 3: $\sigma := \begin{bmatrix} \sigma_{t1} \\ \sigma_{t2} \\ \sigma_{t3} \end{bmatrix}$

See CMAA 70, Table 3.4.8.2-1 Case 3: $K_\sigma := \frac{8.4}{\psi + 1.1}$ $K_\tau = 5.341$

$\sigma_k := K_\sigma \cdot \sigma_e$ $\sigma_k = 182.017\ ksi$

Critical Comparison Stress: $\sigma_{1k} := \sigma_k$ $\sigma_{1k} = 182.017\ ksi$

Above elastic limit, therefore used reduced Critical Comparison Stress:

Reduced Critical Comparison Stress: $\sigma_{1kR} := \frac{\sigma_{yp} \cdot (\sigma_{1k})^2}{0.1836 \cdot (\sigma_{yp})^2 + (\sigma_{1k})^2}$ $\sigma_{1kR} = 49.317\ ksi$

Buckling Factor: $\upsilon_b := \frac{\sigma_{1kR}}{\sigma}$ $\upsilon_b = \begin{bmatrix} 1.877 \\ 1.878 \\ 1.589 \end{bmatrix}$

> 1.35 for Case 1 ∴ OK.
> 1.25 for Case 2 ∴ OK.
> 1.20 for Case 3 ∴ OK.

**The following sections have been ommited from this example for the sake of limiting the size of the example document. In an actual design, these sections as well as other case-specific sections should be included in order to document a complete design.**

Girder Deflection
Girder Camber
End Truck Design
Trolley Design
Connections & Fatigue
Rail Stop and Bummpers
Crane Lifting Point Design
Fall Protection Anchorage Design

Q. **Appendix Q – Hook Non-Destructive Test (NDT) Report**

Please see the following pages for sample NDT report information.

**Navy message on acceptable Hook NDT practice:**

Subject: Crane Hook and Nut NDT Quality Assurance Requirements

Ref A: NAVFAC P-307

Date: June 1, 2003

1. Ref A, Appendix E, Paragraph 1.4.4 provides nondestructive test (NDT) quality assurance requirements for hooks, retaining nuts, and/or eye pins. These assurance requirements include provisions that the commercial NDT vendor supply a letter certifying that the vendor meets the requirements of ASTM E-543 and that the vendor develop and submit for review, procedures that are specific to the types, shapes and sizes of the parts being examined. For the magnetic particle inspection (MT) method, the procedures shall adequately describe the orientation of the hook, nut, or pin with the magnetizing equipment.

   Additionally, the procedures shall be reviewed by a Level III Examiner who is independent of the vendor and is certified in the applicable NDT method.

2. NCC has received letters of compliance to ASTM E-543 and MT procedures from two hook manufacturers. The manufacturers are the Crosby Group and Gunnebo Johnson. NCC has had the MT procedures reviewed by an independent Level III Examiner and the procedures have been found to be in agreement with Ref A requirements. NCC will retain this documentation in accordance with Ref A.

3. Activities that receive hooks and hook nuts with initial NDT reports from the Crosby Group or Gunnebo Johnson are not required to obtain letters of conformance or MT procedures from these vendors since these documents are retained by NCC. Activities are required to retain hook and hook nut NDT reports in the equipment history file in accordance with Ref A. Initial NDT reports received from Crosby or Gunnebo Johnson, subsequent to the issuance of this message, shall specifically reference the applicable Control Procedure No. 0120, revision 16 and Technique Sheet No. 319N, Rev 1. For Gunnebo Johnson, the NDT report shall reference Gunnebo Johnson Quality System Procedure QSP-69, Revision A.

4. When NDT of the hook is required, activities are reminded that purchase orders or contracts should clearly state that the NDT of hooks and hook nuts shall be in accordance with Ref A. Crosby and Gunnebo Johnson have indicated that the applicable MT procedures will only be invoked when NDT in accordance with Ref A is specified on the purchase order or contract.

5. NCC will contact other hook vendors and invite them to submit NDT procedures for approval to the requirements of Ref A. Any questions concerning NDT quality assurance requirements should be directed to NCC.

theCrosby group, inc.

# THE CROSBY GROUP, INC.

# QUALITY CONTROL

# PROCEDURE NO. 0120

**FOR: MAGNETIC PARTICLE INSPECTION**

REVISION IV - JUNE 16, 1989
REVISION V - JULY 11, 1989
REVISION VI - JULY 10, 1990
REVISION VII - AUGUST 15, 1991
REVISION VIII - JUNE 26, 1992
REVISION IX - MARCH 18, 1993
REVISION X - JULY 28, 1994
REVISION XI - SEPTEMBER 13, 1994
REVISION XII - JULY 18, 2000
REVISION XIII - October 30, 2000
REVISION XIIII-August 14, 2002
REVISION 15- September 23, 2002
**REVISION 16 - September 15, 2003**
7 PAGES

UNCONTROLLED

PREPARED BY: Don Conner DATE: 9/15/03

APPROVED BY: Paul Boettjer DATE: 9/15/03

## 1.01 SCOPE

**1.1** This procedure is to be used for magnetic particle inspection using either the wet fluorescent or dry powder method.

## 2.0 PURPOSE

**2.1** The inspection process provides for the detection of cracks and other discontinuities and shall be applicable only to ferromagnetic materials.

**2.1.1** The sensitivity of the test is greatest for surface discontinuities and diminishes rapidly with depth below the surface.

**2.1.2** For the detection of subsurface discontinuities, other inspection methods may be required.

## 3.0 REFERENCE STANDARDS

**3.1** ASTM E709
**3.2** AWS D1.1
**3.3** MIL-STD-271 (Crosby McKissick only, See 5.1.2.1)
**3.4** NAVSEA T 9074-AS-GIB-010/271**, with appropriate technique sheet**

## 4.0 PERSONNEL QUALIFICATION

**4.1** Personnel performing and interpreting magnetic particle testing shall be trained and qualified per the Crosby Group Quality Procedure 4500 NDE, meeting or exceeding the requirements of SNT-TC-1A, Level II.

## 5.0 EQUIPMENT AND MATERIALS

### 5.1 Equipment

**5.1.1** The types of equipment to be used are wet stationary horizontal units, **and DC Yokes.**

**5.1.2** Equipment shall be calibrated annually by a means traceable to the National Institute of Standards and Technology. Comparative readings shall be taken at a minimum of three (3) output levels encompassing the usable range. The equipment readings shall not deviate by more than ± 10% of full scale.

**5.1.2.1** Crosby McKissick equipment shall be calibrated every six (6) months, and shall be traceable to the National Institute of Standards and Technology. **Amp meter accuracy shall be ±5%.**

## 5.2 Magnetic Particles

**5.2.1** The magnetic particle powder used in the dry powder method shall be type Magnaflux #3 black or equivalent. Examination shall be performed in an area with sufficient lighting to aid in observing the powder patterns.

**5.2.2** The magnetic particle powder used in the wet method shall be type 14-A Magnaglow Powder or equivalent. The examination shall be conducted in a darkened area using a filtered black light.

**5.2.3** The carrier shall be water based.

## 5.3 Black Light

**5.3.1** The black light will be allowed to warm up a minimum of five (5) minutes prior to use.

**5.3.2** The black light intensity shall be measured once a day and documented. The black light intensity at the examination surface (15 inches minimum from the face of the lens filter) shall not be less than 1000 $\mu W/cm^2$.

## 5.4 Batch Concentration

**5.4.1** Bath concentration shall be checked daily and documented. The settling volume shall be 0.1 to 0.4 mL in a 100mL batch sample.

**5.4.2** The suspension shall be run for at least 30 minutes before sampling. The 100 mL suspension sample shall be taken in an Test Method D96, pear-shaped centrifuge tube with a 1 mL stem and allowed to settle for approximately 30 minutes.

**5.4.3** If the settled particles appear to be loose agglomerates rather than a solid layer, take a second sample. If still agglomerated, replace the suspension.

**5.5 Suspension Vehicles**

**5.5.1** Suspension vehicles shall be conditioned water having good wetting characteristics, good dispersibility, and is non-corrosive.

**5.5.2** The viscosity should not exceed $5mm^2$ (5.0cSt) when tested in accordance with test method D445.

**5.5.3** The pH of the conditioned water bath should be between 6.0 and 10.5 as determined by a suitable pH meter.

## 6.0 Surface Preparation

**6.1** The surface of the part to be examined shall be essentially clean, dry and free of contaminants such as oil, grease, rust, loose sand, loose scale, lint, galvanizing, thick paint, welding flux and weld splatter. Thin non-conductive coatings in the order of 2 mils (0.5mm) need not be removed except at the point(s) of electrical contact.

**6.2** As-welded, as-cast, as-forged, as-rolled or machined surfaces are satisfactory. When cleaning is required, the test surface may be cleaned by detergent, organic solvents, or mechanical means. Cast steel products shall be sand blasted or shot blasted prior to performing magnetic particle inspection.

## 7.0 Magnetizing Current

**7.1** Magnetic particle inspection may be performed with equipment utilizing direct current (DC), alternating current (AC), half-wave rectified current (HW) or full wave rectified current (FWDC).

## 8.0 Part Magnetization

**8.1** Parts shall be inspected using the Continuous Magnetization Technique.

**8.1.1** Parts may be magnetized by passing the current directly through the part (direct magnetization) or by inducing a magnetic field in the part (indirect magnetization).

**8.1.2** Parts shall be magnetized and examined in at least two (2) directions with the magnetic fields approximately 90° apart.

**8.2** Dry magnetic powders shall be applied by hand powder applicators in such a manner that a light uniform, dust-like coating settles upon the surface of the test part. The technique will suspend the particles in the air so they reach the part surface in a uniform cloud with a minimum of force.

**8.3** Before turning off the current, the excess dry powder is removed by a dry air current of sufficient force without disturbing any particles attracted by a flux leakage field.

**8.4** Wet magnetic particles are to be flowed over the test piece until completely covered and the bath application cut off before removing the magnetizing current.

## 9.0 MAGNETIC FIELD STRENGTH

### 9.1 Circular Magnetization - Head and Tailstock Clamps

**9.1.1** DC, FWDC, or HW current shall be used from 700 to 900 A/inches on parts diameters up to 5 inches, from 500 to 700 A/inches on diameters over 5 inches and up to 15 inches, and from 100 to 300 A/inches on diameters over 15 inches.

**9.1.2** Optimum current setting shall be determined by use of a magnetic field indicator.

### 9.2 Yokes

**9.2.1 DC Yokes shall have a lifting force of 40 Lbs. minimum**

### 9.3 Longitudinal Magnetization

**9.3.1** Longitudinal magnetization may be accomplished by use of a fixed coil. The effective field extends on either side of the coil a distance equal to the radius of the coil (R) being employed. The effective field length shall not exceed 9 inches either side of the coil.

**9.3.2** The magnetizing amperage required for longitudinal magnetization shall be calculated from the following equations:

$$I = \frac{NI}{N} = \frac{45000}{L/D} (\pm 10\%)$$

Where:

**I** = Coil current to be used, amperes
**N** = Number of turns in the coil
**L** = Part length, inches
**D** = Part diameter, inches.
**NI** = Ampere turns
**R** = Coil Radius

**9.3.2.1** For L/D ratios less that 3, a ferromagnetic pole piece, approximately the same diameter as the part, should be used to increase the L/D ratio, or an alternate magnetization method used.

**9.3.2.2** For L/D ratios greater than 15, a maximum L/D value of 15 should be used.

**9.3.3** A magnetic field indicator (pie gage) **shall** be used to determine and assure the optimum current setting.

**9.3.4** Procedure qualification shall be in accordance with MIL.-STD-271, paragraph 4.3.1.2. And NAVSEA Technical Publication T 9074-AS-GIB-010/271, Paragraph 4.3.1.2

## 10.0 DEMAGNETIZATION

10.1 Demagnetization is not required unless specified on the drawings, specifications, or purchase order. When required, the acceptable level of residual magnetization usually not exceeding 3 gauss, and the measuring method shall also be specified.

## 11.0 POST CLEANING

11.1 The removal of the magnetic particle powders is not required, unless otherwise specified on the drawing or purchase order.

11.2 Unless otherwise specified on the drawing or purchase order, magnetic particle powder removal, when specified, shall be accomplished with compressed air and / or solvent.

## 12.0 INTERPRETATION OF INDICATIONS

12.1 All indications shall be investigated to determine if they are of a relevant or non-relevant nature. The surface of the part shall be reconditioned by grinding and then re-examined in accordance with this procedure. The grinding shall be parallel to the contour of the part to produce a smooth surface. Gouge grinding is not allowed.

## 13.0 ACCEPTANCE LEVELS

**13.1** Production forgings shall be evaluated in accordance with specific product Quality Control Procedures and / or nondestructive testing (N.D.T.) Product drawings.

**13.2** Customer specified magnetic particle inspected products shall be evaluated in accordance with the acceptance criteria per the drawing requirements or as specified on the purchase order.

## 14.0 MATERIAL REPAIR

**14.1** This specification may be used for the localized inspection of excavated areas of castings prior to weld repair, and the evaluation of the area shall be no indications allowed.

the Crosby group, inc.
P.O. Box 3128
2801 Dawson Road
Tulsa, OK 74101-3128

No. 319 N Rev. 1 Date: 10/30/02

Subject: Magnetic Particle Examination Technique Sheet

01. This Technique Sheet is to be used in conjunction with Crosby Group Magnetic Particle inspection procedure number 0120.

02. Identification of items for inspection:
Shank Hoist Hook and Nut (Hex / Round)

03. Whether wet or dry method:
Wet Method

04. Sequence of examination and required coverage: Head shot – 100% coverage (Hook and Nut)
Coil Shot – 100% coverage (Hook)

05. Method of particle application and removal: Application: Hose Bath

Inspection Removal: None

Final Removal: Air Hose

06. Sketches or chart showing the typical inspection grid: S0319MP0001

07. Type of magnetic particles: 14-A Magnaglow Powder or Equivalent

08. Equipment: Wet Stationary Horizontal Unit **HWDC**

09. Direction of magnetization and current levels: Will be verified with field indicator.
9.1 Circular Magnetization (Head Shot): See Table 1

9.2 Longitudinal Magnetization (Coil Shot): See Table 2
9.2.1 Low, Intermediate or High-Fill Factor Coil: Low

9.3 Central Conductor Magnetization: N/A

10. Magnetizing current type (continuous or residual): Continuous

11. Test for concentration of particle suspension: Test Method D96

12. Demagnetization of particle suspension: N/A

13. Acceptance ~~Criteria~~: Mil-Std-2035 - No indications greater than 1/16".
**Indications believed to be non-relevant shall be inspected for relevancy by removing 10% of the surface roughness thought to have caused the indications. If inspection by MT after surface roughness removal shows any indication. All remaining indications shall be considered relevant.**

Approval Don Conner Date 6/12/03

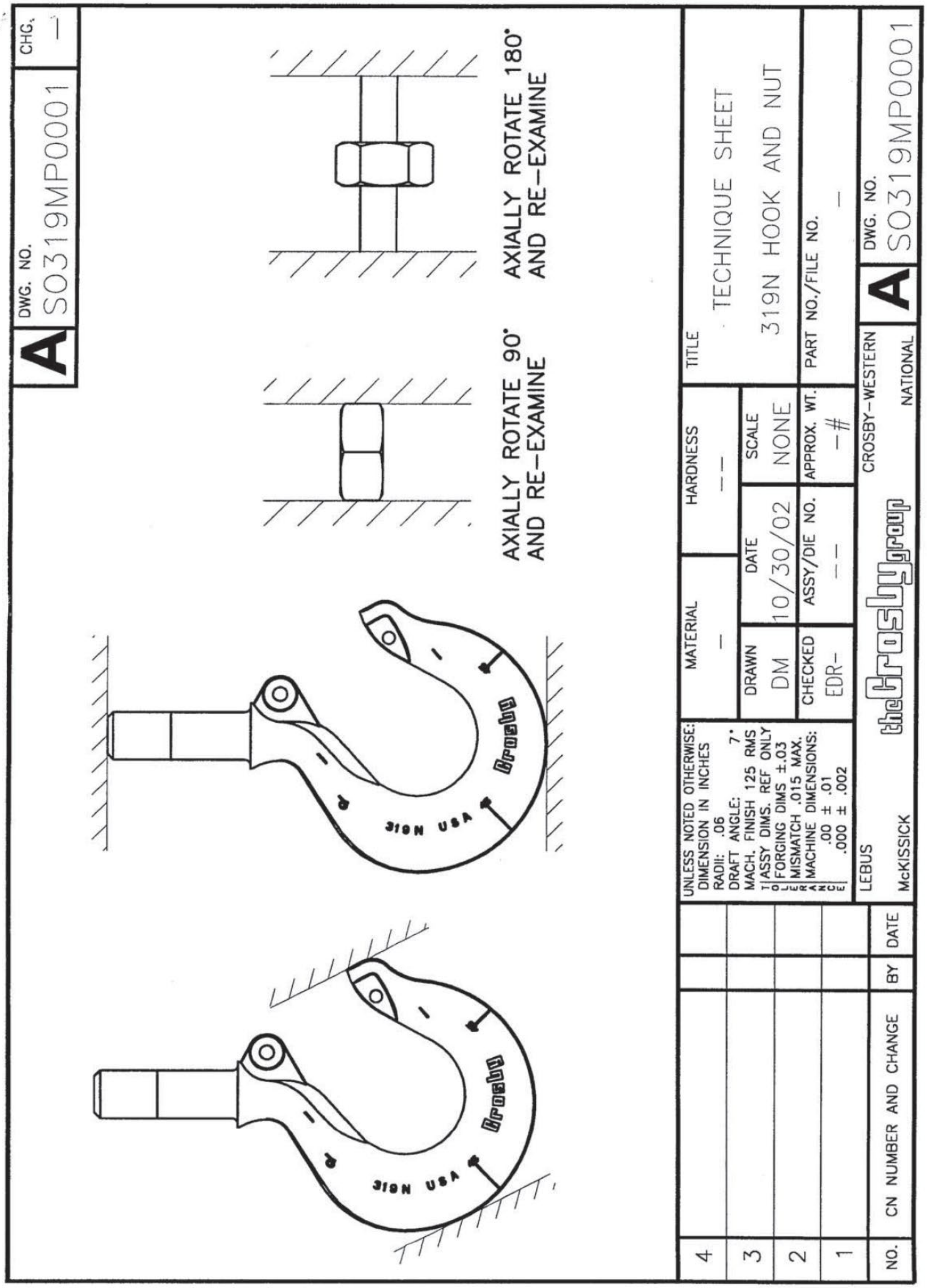
Qc procedures/magnetic particle examination technique sheet.doc

TABLE 1 HEAD SHOT

| Frame Size | Hook | Thread Size | Nut |
|---|---|---|---|
| D | 565 –730 Amps | 1/2" | 525 – 675 Amps |
| F | 660 – 845 Amps | 5/8" | 660 – 845 Amps |
| G | 810 – 1045 Amps | 5/8" | 660 – 845 Amps |
| H | 915 – 1180 Amps | 3/4" | 790 – 1015 Amps |
| I | 1140 – 1465 Amps | 7/8" | 875 – 1125 Amps |
| J | 1440 – 1855 Amps | 1 1/8" | 1140 – 1465 Amps |
| K | 1840 – 2365 Amps | 1 1/4" | 1265 – 1630 Amps |
| L | 2060 – 2645 Amps | 1 5/8" | 1750 – 2250 Amps |
| N | 2450 – 3150 Amps | 2" | 2190 – 2815 Amps |

TABLE 2 COIL SHOT (+ / - 10%)

| Frame Size | Hook | Shot |
|---|---|---|
| D | 1420 Amps | 1 |
| F | 1490 Amps | 1 |
| G | 1645 Amps | 1 |
| H | 1650 Amps | 1 |
| I | 1700 Amps | 1 |
| J | 1780 Amps | 1 |
| K | 1890 Amps | 1 |
| L | 1965 Amps | 1 |
| N | 1890 Amps | 1 |


A DWG. NO. S0319MP0001
CHG. —
319N USA
Crosby
AXIALLY ROTATE 90° AND RE-EXAMINE
AXIALLY ROTATE 180° AND RE-EXAMINE
UNLESS NOTED OTHERWISE: DIMENSION IN INCHES
RADII: .06
DRAFT ANGLE: 7°
MACH. FINISH 125 RMS
ASSY DIMS. REF ONLY
TOLERANCE FORGING DIMS ±.03
MISMATCH .015 MAX.
MACHINE DIMENSIONS: .00 ± .01 .000 ± .002
MATERIAL —
HARDNESS — —
TITLE TECHNIQUE SHEET 319N HOOK AND NUT
DRAWN DM
DATE 10/30/02
SCALE NONE
CHECKED EDR-
ASSY/DIE NO. — —
APPROX. WT. —#
PART NO./FILE NO. —
LEBUS
McKISSICK
the Crosby group
CROSBY-WESTERN
NATIONAL
A DWG. NO. S0319MP0001
4
3
2
1
NO.
CN NUMBER AND CHANGE
BY
DATE

10-21-2002 15:00 CROSBY GROUP 918 834 9447 P.10/11

# GLOBE X-RAY SERVICES, INC.

8441 SOUTH UNION TULSA, OKLAHOMA 74132

GLOBE X-RAY SERVICES

N.R.C. 435-15194-01

For Services or Information
Pertaining To: NDE SERVICES & SCHEDULING
NDE LEVEL III SERVICES & SCHOOL FOR LEVEL II
Contact: DAVID POTTER, LEVEL III
TONY OZMUN, LEVEL III
PHONE: (918) 446-1696 FAX: (918) 446-3314

Date: 10-21-02

Review for approval: The Crosby Group
Magnetic Particle Procedure 0120, Rev. 15
With attached technique for 319N, 320N, 322N Style Hoist Hooks

Compliance Requirements: NAVSEA T 9074-AS-GIB-010/271
Mil-Std-2035 Acceptance

__✓__Approved

______Not Approved

ASNT Level III David Potter
David Potter ASNT MM-1855

ULTRASONIC, GAMMA RAY, COBOLT, X-RAY, PENETRANT,
FAA CS2R753K, HELIUM TESTING, T GAUGE, HARDNESS TESTING, OPTICAL EMISSIONS
POSITIVE MATERIAL IDENTIFICATION, LEVEL III SERVICES, ASNT LEVEL II NDE SCHOOL, MAGNETIC PARTICLE

Fax from : 9188349447 07-08-09 16:13 Pg: 1

the Crosby group, inc.

Group Engineering Department
Mailing: P.O. Box 3128 (74101-3128)
Shipping: 2801 Dawson Road (74110-5052)
Tulsa, Oklahoma
Phone: 918.834.4611
Facsimile: 918.834.9447

DNV Certification, Inc. USA — ACCREDITED REGISTRAR — ANSI-RAB — DNV — DNV MSC The Netherlands Accredited by the RvA
ISO 9001 REGISTERED FIRM

# Facsimile

| | |
|---|---|
| To: Scott Gridley | Date: July 8, 2009 |
| Company: Navy Crane Center | From: dconner<br>Title: |
| Fax Number: 757-396-1772 | Number of Pages: 1 |

Reference: Program C of C

**This is to certify that The Crosby Group Nondestructive Testing Program meets the requirements specified in ASTM E-543-99.**

**Respectfully,**
**Don Conner**
**Group QA Mgr.**

**Reference Crosby QCP 0120, Rev. 16, dated September 15, 2003**
**Technical Data Sheet 319N, Rev. 1**

Document4

## R. Appendix R – Wire Rope Certificate

Please see the following page for an example wire rope certificate.

GENERIC WIRE ROPE CO.

09/07/2008

Crane Parts Manufacturers
123 Crane Center Way
Portsmouth, VA 23709

| | |
|---|---|
| Contract Number: | NXXXXX-XX-X-XXXX |
| Job Location: | Anytown, US |
| Crane Serial Number: | XX-XXXXX |
| CDRL: | XXXX |

Required identifying information.

INSPECTION-CERTIFICATE acc. EN-10204-3.1

| | | | | | |
|---|---|---|---|---|---|
| Your order-no. | : | 78694 | date | : | 09.10.2007 |
| our order-no. | : | 17431329 | delivery-no | : | 18441090 |
| Invoice-no. | : | 18451131 | LOT# | : | 6618A+B; 6619A+B |

The technical details of the ropes are the following:

| | | | |
|---|---|---|---|
| 1. | lay | : | regular right ordinary lay (RHOL)<br>swaged - greased |
| 2. | length | : | LOT # 6618A = 1.015 m; LOT # 6618B = 2.020 m<br>LOT # 6619A = 1.010 m LOT # 6619B = 2.160 m |
| 3. | nominal rope diameter | : | 10,0 mm |
| 4. | construction | : | PYTHON-LOGGING 6WS-V |
| 5. | material | : | bright |
| 6. | tensile strength | : | 2160 N/mm² |
| 7. | minimum breaking load<br>actual breaking load | :<br>: | 96,08 kN<br>115,45 kN |
| 8. | weight total | : | 3.197 kg |

Required information.

*Joe Generic*
Joe Generic
Customer Service

Signature of responsible person.

456 Wire Way
Portsmouth, VA 23709
Phone: 555-897-1212
Fax: 555-897-1213

## S. Appendix S – Not Used

T. **Appendix T – Crane Runway Rail Certificate & Survey**

Please see the following pages for a sample runway rail certification and survey.

Crane Parts Manufacturers

2 - 19- 10

*Date*

Contract No.: NXXXX-XX-X-XXXX
Job Location: Shipyard ABC
Crane Serial No.: XX-XXXXX

Required identifying information.

Certification of Rail Survey - CDRL – XXXX
*CDRL #*

Crane Parts Manufacturers (CPM) has reviewed the runway survey provided by the Navy Crane Center for the Naval Shipyard Building ABC. The span, straightness and rail elevation are all within the tolerances provided within CMAA #70. The rail to rail elevation exceeds the CMAA #70 tolerance at one point by 1/6”.

CPM concludes that the rail is not in compliance with CMAA #70 runway standards. The new crane furnished under this contract will perform on this runway without any corrections to the runway.

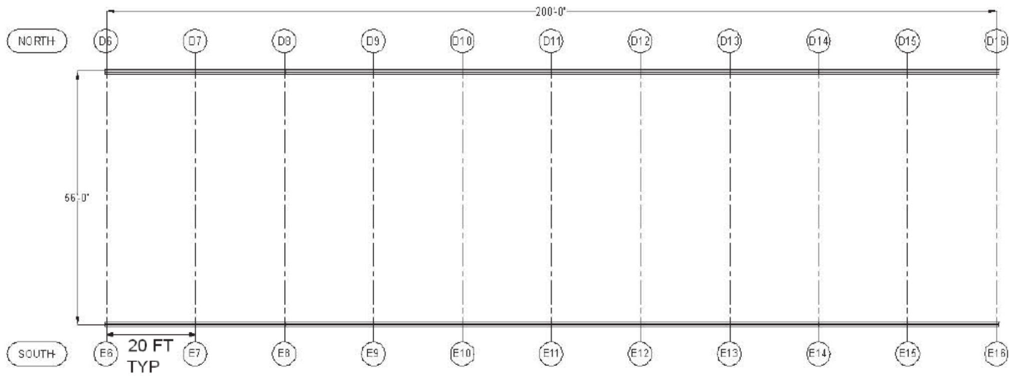
Jane Smith
*Signature*

Vice President
*Title*

Required signature of responsible person.

123 Crane Center Way, Portsmouth, VA 23709
Phone (555) 123-4567 Fax (555) 123-5678

# Rail Survey for Crane 123 in Building ABCD




| Crane Span | | | | | |
|---|---|---|---|---|---|
| Column Line | Span (L) Nominal 672 in | Span Difference in | Allowable L>100' 0.375 in | Rate of Change in | Allowable Rate of Change 1/4" in 20' |
| D6/E6 | 672.00 | 0.00 | | | |
| D7/E7 | 672.15 | 0.15 | | -0.15 | |
| D8/E8 | 672.30 | 0.30 | | -0.15 | |
| D9/E9 | 672.25 | 0.25 | | 0.05 | |
| D10/E10 | 672.15 | 0.15 | | 0.10 | |
| D11/E11 | 672.38 | 0.38 | EXCEED | -0.23 | |
| D12/E12 | 672.12 | 0.12 | | 0.26 | EXCEED |
| D13/E13 | 672.15 | 0.15 | | -0.03 | |
| D14/E14 | 672.35 | 0.35 | | -0.20 | |
| D15/E15 | 672.13 | 0.13 | | 0.22 | |
| D16/E16 | 672.00 | 0.00 | | 0.13 | |

| Rail-to-Rail Elevation | | | | |
|---|---|---|---|---|
| Column Line | Elevation Difference (D) in | Allowable L>100' 0.375 in | Rate of Change in | Allowable Rate of Change 1/4" in 20' |
| D6/E6 | 0.25 | | | |
| D7/E7 | 0.36 | | -0.11 | |
| D8/E8 | 0.15 | | 0.21 | |
| D9/E9 | 0.4 | EXCEED | -0.25 | |
| D10/E10 | 0.25 | | 0.15 | |
| D11/E11 | 0.15 | | 0.1 | |
| D12/E12 | 0 | | 0.15 | |
| D13/E13 | 0.1 | | -0.1 | |
| D14/E14 | 0.25 | | -0.15 | |
| D15/E15 | 0.38 | EXCEED | -0.13 | |
| D16/E16 | 0.15 | | 0.23 | |

| Straightness | | | | |
|---|---|---|---|---|
| Column Line | Straightness | Allowable 0.375 in | Rate of Change in | Allowable Rate of Change 1/4" in 20' |
| D6 | 0.15 | | | |
| D7 | -0.15 | | 0.30 | EXCEED |
| D8 | 0.10 | | -0.25 | |
| D9 | 0.15 | | -0.05 | |
| D10 | 0.05 | | 0.10 | |
| D11 | 0 | | 0.05 | |
| D12 | -0.10 | | 0.10 | |
| D13 | -0.05 | | -0.05 | |
| D14 | -0.10 | | 0.05 | |
| D15 | 0.10 | | -0.20 | |
| D16 | 0.15 | | -0.05 | |

| Straightness | | | | |
|---|---|---|---|---|
| Column Line | Straightness | Allowable 0.375 in | Rate of Change in | Allowable Rate of Change 1/4" in 20' |
| E6 | 0.10 | | | |
| E7 | 0.05 | | 0.05 | |
| E8 | 0.10 | | -0.05 | |
| E9 | 0.15 | | -0.05 | |
| E10 | 0.05 | | 0.10 | |
| E11 | 0 | | 0.05 | |
| E12 | -0.10 | | 0.10 | |
| E13 | -0.05 | | -0.05 | |
| E14 | 0.05 | | -0.10 | |
| E15 | 0.15 | | -0.10 | |
| E16 | 0.2 | | -0.05 | |

| Elevation | | | | |
|---|---|---|---|---|
| Column Line | Elevation | Allowable<br>0.375 in | Rate of Change<br>in | Allowable Rate of Change<br>1/4" in 20' |
| D6 | 0.15 | | | |
| D7 | -0.15 | | 0.30 | EXCEED |
| D8 | 0.10 | | -0.25 | |
| D9 | 0.15 | | -0.05 | |
| D10 | 0.05 | | 0.10 | |
| D11 | 0 | | 0.05 | |
| D12 | -0.10 | | 0.10 | |
| D13 | -0.05 | | -0.05 | |
| D14 | -0.10 | | 0.05 | |
| D15 | 0.10 | | -0.20 | |
| D16 | 0.15 | | -0.05 | |

| Elevation | | | | |
|---|---|---|---|---|
| Column Line | Elevation | Allowable<br>0.375 in | Rate of Change<br>in | Allowable Rate of Change<br>1/4" in 20' |
| E6 | 0.10 | | | |
| E7 | 0.05 | | 0.05 | |
| E8 | 0.10 | | -0.05 | |
| E9 | 0.15 | | -0.05 | |
| E10 | 0.05 | | 0.10 | |
| E11 | 0 | | 0.05 | |
| E12 | -0.10 | | 0.10 | |
| E13 | -0.05 | | -0.05 | |
| E14 | 0.05 | | -0.10 | |
| E15 | 0.15 | | -0.10 | |
| E16 | 0.2 | | -0.05 | |

U. **Appendix U – Hazardous Material Certificate**

See the following pages for a sample hazardous material certificate.

Crane Parts
Manufacturers

Required identifying information.

**_Hazardous Material Certification – CDRL xxxx_**

**Contract Number**: NXXXXX-XX-X-XXXX Delivery Order XXXX
**Job Location**: Anywheresville Shipyard, Building 1232, Portsmouth, VA
**Crane Serial No.**: XX-XXXX

Statement must include all hazardous material listed in specification.

***Crane Parts Manufacturers certifies that the X Ton Crane system contains no asbestos, lead paint or elemental mercury.***

Jane Smith

*Approved By*: Jane Smith
*Title*: Vice President

2 - 18 - 10

*Date*

Required signature of responsible person.

123 Crane Center Way, Portsmouth, VA 23709
Phone (555) 123-4567 Fax (555) 123-5678

## V. Appendix V – Loss of Power Test Certificate

Please see the following page to find a sample loss of power test certificate.

Crane Parts Manufacturers

2 - 19 - 10

Required idenifying information.

Contract No.: NXXXX-XX-X-XXXX
Job Location: Anytown, US
Crane Serial No.: XX-XXXX

Certification of Loss of Power Test - CDRL – XXXX

Dear NAVCRANECEN,

A sudden loss of power to the crane such as an emergency stop condition will not have detrimental effects to the crane.

Jane Smith

Jane Smith
Vice President

Required signature of responsible person.

123 Crane Center Way, Portsmouth, VA 23709
Phone (555) 123-4567 Fax (555) 123-5678

W. **Appendix W – Coupling Alignment Certificate**

Please see the following pages for sample coupling alignment certificates.

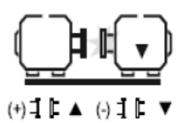
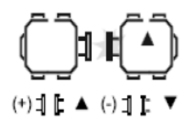
Contract Number: [redacted] Crane Manufacturer: [redacted]

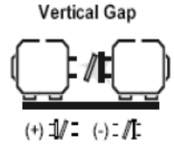
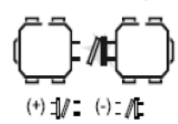
Crane Capacity: [redacted] Crane Serial Number: [redacted]

## Shaft/Coupling Alignment Data Sheet

**Equipment (check one):** ☑ **Main Hoist Drive** ☐ **Aux Hoist Drive** ☐ **Other:** ____________

| **Coupling Manufacturer/Type/Size** | [redacted] | |
|---|---|---|
| **Alignment Method and Equipment Used** | Laser | |
| | **Manufacturer's Allowable** | **Actual (Installed)** |
| **Coupling End Gap (inches)** | 0.19 in | 0.19 in |

| | **Parallel (inches)** | |
|---|---|---|
| **Manufacturer's Allowable Misalignment (Installation)** | 0.004" | |
| **Manufacturer's Allowable Misalignment (Operating)** | 0.038" | |
| | Vertical Offset   | Horizontal Offset   |
| **Actual (inches)** NOTE: This shall be less than installation tolerance. | -0.0008" | 0.0011" |

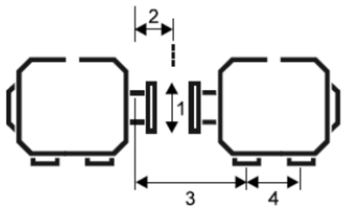
| | **Angular (inches)** | |
|---|---|---|
| **Manufacturer's Allowable Misalignment (Installation)** | 0.011" | |
| **Manufacturer's Allowable Misalignment (Operating)** | 0.108" | |
| | Vertical Gap   | Horizontal Gap   |
| **Actual (inches)** NOTE: This shall be less than installation tolerance. | 0.0003" | -0.0003" |

Alignment Verified By: [redacted] Date 8/16/2022

Navy Crane Center Form 09-001 Coupling Data Sheet (Feb 2013)

Contract Number: [redacted] Crane Manufacturer: [redacted]

Crane Capacity: [redacted] Crane Serial Number: [redacted]



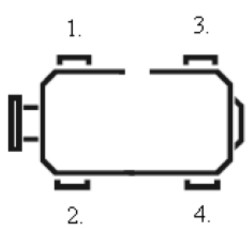

| | | |
|---|---|---|
| **Actual diameter of coupling** | **1.** | 4.875" |
| **Laser to center of coupling** | **2.** | 5" |
| **Laser to front foot** | **3.** | 21" |
| **Front foot to back foot** | **4.** | 16.5" |

**Shimming Record:**

Shims: Start with 0.100" under each foot. No more than four shims shall be placed under each foot.
Bolts are shall be installed with lubrication.

| Bolt # | Bolt Size | Torque Value | Number of Shims | Total Shim Thickness |
|---|---|---|---|---|
| **1** | 3/4-10 | 200 FT-LBS | 2 | 0.280" |
| **2** | 3/4-10 | 200 FT-LBS | 2 | 0.290" |
| **3** | 3/4-10 | 200 FT-LBS | 3 | 0.240" |
| **4** | 3/4-10 | 200 FT-LBS | 3 | 0.290" |

**Soft Foot Record** (maximum 0.002 inches allowable):




| | |
|---|---|
| **Foot 1.** | 0.0005" |
| **Foot 2.** | 0.000" |
| **Foot 3.** | 0.0011" |
| **Foot 4.** | 0.0012 |

Alignment Verified By: [redacted] Date 8/16/2022

Navy Crane Center Form 09-001 Coupling Data Sheet (Feb 2013)

Contract Number: [redacted] Crane Manufacturer: [redacted]

Crane Capacity: [redacted] Crane Serial Number: [redacted]

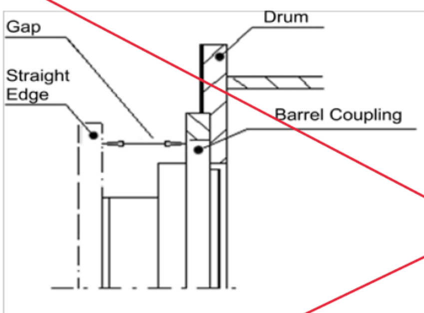
# Drum Barrel Alignment Data Sheet

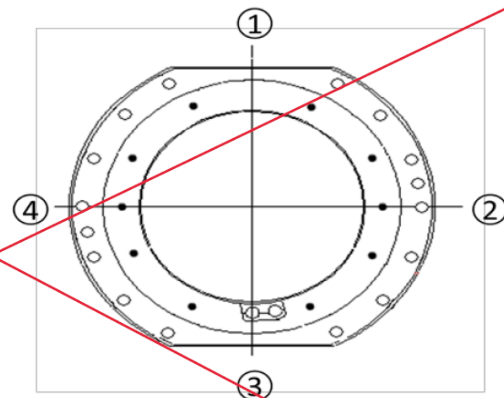
**Equipment (check one):** ☑ **Main Hoist Drive** ☐ **Aux Hoist Drive** ☐ **Other:** ____________

| | |
|---|---|
| **Coupling Manufacturer** | [redacted] |
| **Coupling Type/Size** | [redacted] |
| | **Angular (inches)** |
| **Manufacturer's Allowable Misalignment** | 0.0316 in |

**Alignment Method (check one):** ☐ **Straight Edge** ☑ **Laser**

**Straight Edge Alignment**




| Position: | 1 | 2 | 3 | 4 | Δ |
|---|---|---|---|---|---|
| Measurement at Gap: | | | | | |

Note: Position 1 is always opposite of the wear indicator.

**Laser Alignment**

Horizontal Gap: 0.0034" Vertical Gap: 0.0093"

**Bolting Requirements**

| **Coupling to Drum** | | | **Coupling Halves** | | |
|---|---|---|---|---|---|
| Number of Bolts | Bolt Size | Torque Value | Number of Bolts | Bolt Size | Torque Value |
| 26 | M20 | 428 FT-LBS | 10 | 1/2 | 65 FT-LBS |
| **Pillow Block Torque Record** | | | **Pillow Block Shimming Record** | | |
| Bolt # | Bolt Size | Torque Value | Number of Shims | | Total Shim Thickness |
| 1 | 1 1/4-6 (x2) | 840 FT-LBS | 1 Per Bolt | | 0.125" |
| 2 | 1 1/4-6 (x2) | 840 FT-LBS | 1 Per Bolt | | 0.125" |

Alignment Verified By: [redacted] Date 8/16/2022

Navy Crane Center Form 13-001 Coupling Data Sheet (April 2013)

## X. Appendix X – Hook and Hook Nut Proof Test Certificate

Please see the following page for a sample hook proof test certificate.

International Hook Corp.

April 30, 2010

Crane Parts Manufacturers
123 Crane Center Way
Portsmouth, VA 23709

**INSPECTION REPORT**

| | |
|---|---|
| Contract No.: | NXXXX-XX-X-XXXX |
| Job Loacation: | Facility, Anytown, US |
| Crane Serial No.: | XX-XXXX |
| CDRL: | XXXX |

Required identifying information.

On April 23, 2010, International Hook Corp.'s Physical Testing Department received one (1) 20 ton crane hook and nut assembly identified as S/N 095030 H & N for proof load testing per ASME B30.10-2005 at two (2) times the rated load. The samples were tested using our Baldwin 300,000 pound testing machine NDT Control 332.

Required statement that testing meets ASME B30.10.

Following are the results:

| Sample ID | Rated Load Pounds | Proof Load Pounds | Hold Time Min. | Initial Throat Measurement Inches | After Proof Load – Inches | Comments |
|---|---|---|---|---|---|---|
| 095030 H & N | 40,000 | 80,000 | 10 | 6.56 | 6.57 | No Visible Damage |
| Intake Throat Opening = 6.56". Final Throat Opening = 6.57" | | | | | | |

Required information: Test load Test duration Lack of deformation

*Jean-Pierre Vincent*
Jean-Pierre Vincent
Laboratory Supervisor

Required signature of responsible person.

811 Hook Pkwy
Anytown, US 99999

## Y. Appendix Y – Welding Certifications

Please see the following pages for sample welding certification.

iv. Welding Certification

Crane Parts Manufacturers

July 16, 2010

Navy Contract No.: NXXXX-XX-X-XXXX
CDRL: XXXX
Crane Serial No.: XX-XXXX
Crane Location: Navy Facility, Anytown, US

Required identifying information.

**WELDING CERTIFICATIONS**

We certify that all welders, welding operators, weld inspector(s) and welding procedure (qualification) meet the requirements of AWS D 14.1 for all work performed in manufacturing this crane.

We certify that all welders, welding operators, weld inspector(s), and welding procedure (qualification) meet the requirements of AWS D 1.1 and for all work performed in installing/welding parts supporting the crane at/to building interfaces.

*Jane Smith*
Jane Smith
Vice President

07/12/2010
Date

Statements of meeting required standards.

Required signature of responsible person.

123 Crane Center Way, Portsmouth, VA 23709
Phone (555) 123-4567 Fax (555) 123-5678

## v. Special Purpose Service Welding Certification

Contract # [redacted]
CDRL # A010 Certification, Welding (Welder Qualifications 7.16)

[redacted]

### WELDER, WELDING OPERATOR, OR TACK WELDER QUALIFICATION TEST RECORD

Type of Welder
Welder's name [redacted]
Welding Procedure Specification I10B

Certificate ref. no.
Identification No. 2422
Rev 0 Date 6/7/13

| Variables | Actual Values Used In Qualification | | Qualification Range | |
|---|---|---|---|---|
| Process[Table 4.12, Item (1)] | FCAW | | FCAW | |
| Type [Table 4.12, Item (1)] | Semi-Auto | | Semi-Auto | |
| Electrode (single or multiple)[Table 4.12, Item (7)] | Single | | Single | |
| Current/Polarity | DCEP | | | |
| Joint Type | CJP Butt | | | |
| Positions [Table 4.12, Item (4)] | 3G | | Plate-Groove: F,V,H<br>Pipe-Butt: (F,V,H) (Dia>24in[600mm])<br>Pipe-TYK-PJP: (F,V,H) (Dia>24in[600mm],Groove angle>30deg)<br>Box Tube-Butt-CJP: (F,V,H) (Table 4.10 d)<br>Box Tube-Butt-PJP: F,V,H<br>Box Tube-TYK-PJP: (F,V,H) (Groove angle>30deg)<br>Fillet: (F,V,H) (Table 4.10 h) | |
| Weld Progression [Table 4.12, Item(5)] | Uphill | | Uphill | |
| Backing (YES/NO) [Table 4.12, Item (6)] | Yes | | Yes | |
| Material/Spec. | A36 | to A36 | Any Approved | |
| Base Metal | | | | |
| Thickness: (Plate) | | | | |
| Groove | 25.4 | | 3.0 | - |
| Fillet | | | 0.0 | - |
| Thickness: (Pipe/Tube) | | | | |
| Groove | | | | - |
| Fillet | | | 0.0 | - |
| Diameter: (Pipe) | | | | |
| Groove | | | | - |
| Fillet | | | | - |
| Fillet Metal [Table 4.12] | | | | |
| Spec. No. | A5.29 | | | |
| Class | E81T1-1 | | | |
| F-No. [Table 4.12, Item (2)] | | | | |
| Type of fuel gas (OFW) | C-25 | | | |
| Other | | | | |

**VISUAL INSPECTION (4.8.1)**

Acceptable YES or NO yes

**Guided Bend Test Result (4.30.5)**

| Type | Result | Type | Result |
|---|---|---|---|
| Side Bend | Pass | | |
| Side Bend | Pass | | |

**Fillet Test Results (4.30.2.3 and 4.30.4.1)**

Appearance
Fracture Test Root Penetration

Fillet Size
Macroetch

Inspected By [redacted]
Organization [redacted] .

Test Number
Date 6/7/13

**RADIOGRAPHIC TEST RESULTS (4.30.3.2)**

| Film Identification Number | Result | Remarks | Film Indentification NMumber | Result | Remarks |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |

Interpreted by
Organization

Test Number
Date

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Section 4 of AWS D1.1/D1.1M, 2010Structural Welding Code - Steel.

Manufacturer or Contractor

Date 3/19
Authorized By [redacted] [redacted]

6 month signature

| Date | Sign | Last name | Expiry |
|---|---|---|---|
| 12/9/20 | [redacted] | [redacted] | 6/9/21 |

Index no.: 57573 [redacted]

[redacted]

**AWS Welding Procedure Specification X**
**Prequalified Qualified by testing**
**AWS Procedure Qualfication Record**

Proc. no. [redacted] Main Chord/P
Ref.:
Date: 12/7/22 Rev.: 01

Company [redacted]
Welding process FCAW

Type: Manual / Machine / Semi-Automatic X / Automatic

SUPPORTING PQR NO.
[redacted] test #1 [redacted] Test#1 PJP

**Joint design**

| | | | |
|---|---|---|---|
| Joint type | BTC-P4-GF | | |
| Single/Double | Single X | Double | |
| Backing (Yes/No): | Yes | No X | |
| Backing material | N/A | | |
| Back gouging | No | | |
| Root opening | 0.000 - 0.062 | | in |
| Root face dimension | 0.062 - 0.188 | | in |
| Groove angle | 40 - 55 | | ° |
| Radius (J-U) | - | | in |

**BASE METALS**

| | | | |
|---|---|---|---|
| Material spec. | ASTM 513 | A572 | |
| Type/Grade (A/B): | ST52V | Gr. 50 | |
| Thickness Groove | 0.125-0.625 | 0.125-0.625 | in |
| Thickness Fillet | - | - | in |
| Diameter | 6.625- | 6.625- | in |

**POSITIONS**

| | |
|---|---|
| Position of groove | All |
| Position of fillet | All |
| Welding Progression | Up X Down |

**ELECTRICAL CHARACTERISTICS**

Mode of Metal Transfer for GMAW: Short-circuiting / Globular X / Spray
Current [AC/DC]: AC / DCEP X / DCEN / Pulsed
Tungsten Electrode Size N/A in
Equipment CV
Other

**TECHNIQUE**

| | |
|---|---|
| String or Weave Bead: | Stinger |
| Multiple or single pass (per side) | Multi |
| Single or Multiple Electrodes | Single |
| Electrode spacing Longitudinal | - in |
| Electrode spacing Lateral | - in |
| Torch angle | 10 ° |
| Work angle | ° |
| Wire angle | ° |
| Contact Tube to Work Distance | 0.750 in |
| ESO | 0.750 in |
| Peening: | No |
| Interpass cleaning | Yes/ Mechanical |

**FILLER METAL**

| Index | Trade name | AWS Specification | AWS Classification |
|---|---|---|---|
| 1 | [redacted] | A5.20 | E71T1-12M JH4 |
| 2 | | | |
| 3 | | | |

**Shielding**

| Shielding gas type | Composition |
|---|---|
| C25 | Argon/CO2 |

| | | |
|---|---|---|
| Flow rate | 32.0- 50.0 | CFH |
| Orifice or Gas Cup Size | 0.62 | in |
| Flux Trade Name | N/A | |
| Electrode-flux (Class) | N/A | |

**PREHEAT**

| | | | |
|---|---|---|---|
| Preheat Temp.Min. | 65 | | °F |
| Interpass temp. min./max. | 65 | - 250 | °F |

**POSTWELD HEAT TREATMENT**

| | | |
|---|---|---|
| Temperature | - | °F |
| Time | - | Hour |

Per AWS D1.1: 2015, Table 9.10, Note "C". CJP groove weld qualification on any thickness or diameter shall qualify any size fillet or PJP groove weld for any thickness or diameter. Changes in groove design shall be in line with Item 33 in AWS D1.1:2015, Table 4.5.

**Welding Parameters**

| Weld layer(s) | Welding process | Filler metal Class | Filler metal Dia. [in] | Current Polarity | Current Amp. [A] | Wire feed speed [ipm] | Volt [V] | Travel Speed [ipm] | Heat input [kJ/in] |
|---|---|---|---|---|---|---|---|---|---|
| All | FCAW | E71T-12M JH4 | 0.052 | DCEP | 200-240 | 225.-275.0 | 23.5-26.5 | 7.5-15.0 | 18.8-50.9 |
| | | | | | - | - | - | - | - |
| | | | | | - | - | - | - | - |
| | | | | | - | - | - | - | - |
| | | | | | - | - | - | - | - |
| | | | | | - | - | - | - | - |
| | | | | | - | - | - | - | - |
| | | | | | - | - | - | - | - |
| | | | | | - | - | - | - | - |

Date/Signature: 12/7/22 [redacted] Approved: 12/7/22 [redacted]

Index no. 1001423988 Page 1 of 1

[redacted]

**AWS Welding Procedure Specification**
**Prequalified Qualified by testing**
**AWS Procedure Qualification Record X**

Proc. no [redacted] Test#1 PJP
Ref.:
Date: 12/7/22 Rev.: 00

Company [redacted]
Welding process [redacted]

Type Manual Semi-Automatic X
Machine Automatic

SUPPORTING WP NO.

**Joint design**

| | | |
|---|---|---|
| Joint type | Butt | |
| Single/Double | Single X | Double |
| Backing (Yes/No): | Yes | No X |
| Backing material | N/A | |
| Back gouging | No | |
| Root opening | 0.000 | in |
| Root face dimension | 0.062 | in |
| Groove angle | 45 | ° |
| Radius (J-U) | | in |

**BASE METALS**

| | | | |
|---|---|---|---|
| Material spec. | A572<br>ASTM 513 | | |
| Type/Grade (A/B): | Gr.50<br>ST52V | | |
| Thickness Groove | 0.312 | 0.500 | in |
| Fillet | | | in |
| Diameter | 6.000 | | in |

**POSITIONS**

Position of groove 6G
Position of fillet
Welding Progression Up X Down

**ELECTRICAL CHARACTERISTICS**

Mode of Metal Transfer for GMAW:
Short-circuiting Globular Spray X
Current [AC/DC]: AC DCEP X DCEN Pulsed
Tungsten Electrode Size N/A in
Equipment

Other

**TECHNIQUE**

String or Weave Bead: Stringer
Multiple or single pass (per side) Multiple
Single or Multiple Electrodes Single
Electrode spacing Longitudinal in
Lateral in
Torch angle 10 ° Work angle ° Wire angle °
Contact Tube to Work Distance 0.750 in ESO 0.750 in
Peening: No
Interpass cleaning Yes

**FILLER METAL**

| Index | Trade name | AWS Specification | AWS Classification |
|---|---|---|---|
| 1 | [redacted] | A5.20 | E71T1-12M JH4 |
| 2 | | | |
| 3 | | | |

**Shielding**

| Shielding gas type | Composition |
|---|---|
| C25 | Ar/Co2 |

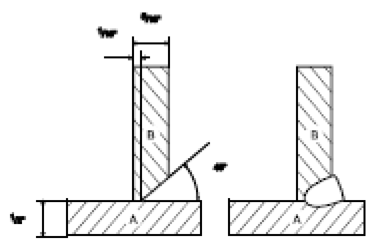
Flow rate 40.0- CFH
Orifice or Gas Cup Size 0.62 in
Flux Trade Name
Electrode-flux (Class)

**PREHEAT**

Preheat Temp.Min. 65 °F
Interpass temp. min./max. 65 - 150 °F

**POSTWELD HEAT TREATMENT**

Temperature °F
Time Hour




**Welding Parameters**

| Weld layer(s) | Welding process | Filler metal Class | Dia. [in] | Current Polarity | Amp. [A] | Wire feed speed [ipm] | Volt [V] | Travel Speed [ipm] | Heat input [kJ/in] |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | - | - | - | - | - |
| | | | | | - | - | - | - | - |
| | | | | | - | - | - | - | - |
| | | | | | - | - | - | - | - |
| | | | | | - | - | - | - | - |
| | | | | | - | - | - | - | - |
| | | | | | - | - | - | - | - |
| | | | | | - | - | - | - | - |
| | | | | | - | - | - | - | - |

Index no. 1001424444 Page 1 of 5 [redacted]

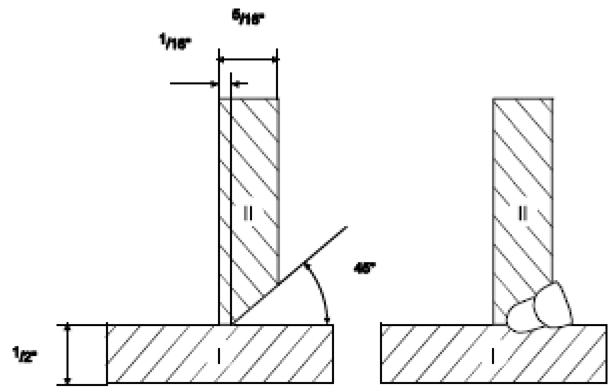
[redacted]

## OBSERVATION FORM

| | |
|---|---|
| WPQR No: [redacted] | Test#1 PJP |
| Ref.: | |
| Date: 12/7/22 | Rev: 00 |
| Sheet: 1 of | of 1 |

| | | | |
|---|---|---|---|
| Welding process | 1: FCAW | 2: | 3: |
| Parent metal | I: Gr.50 | II: ST52V | |
| Heat no. | I: 813U64430 | II: 4181652 | |
| Filler metal | 1: [redacted] | 2: | 3: |
| Batch no. | 1: 1542D | 2: | 3: |

| | |
|---|---|
| Project | |
| Position | 6G |
| Tungsten elec. | |
| Welders | [redacted] |
| Diameter | 6.000 in |
| Thickness | 0.312 in 0.500 in |
| Shielding gas | C25 |
| Purging gas | |
| Preheat | Min. 65.0 °F |
| Interpass temp. | Max. 150.0 °F |
| Start | Date:<br>Hour: |
| Stop | Date:<br>Hour: |
| Equipment | |
| Comments | |




Sign.: [redacted]

| Pass no./ Pos. | Filler | Dia. [in] Wire feed [ipm] | AC DC- DC+ | Weaving [in] | Shield gas | Purge gas | Temp. [°F] | Current [A] | Voltage [V] | Melt time [s] | Run Out Length | Welding speed [ipm] | Heat input [kJ/in] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1<br>6G | | 0.052<br>240 | DCEP | | | | 65.0 | 235 -235 | 24.4 -24.4 | 150 | 18.9 | 7.6 -7.6 | 45.3-45.3 |
| 2<br>6G | | 0.052<br>221 | DCEP | | | | 150.0 | 220 -220 | 24.4 -24.4 | 151 | 18.9 | 7.5 -7.5 | 42.9-42.9 |

[redacted] WELDING PROCEDURE QUALIFICATION RECORD (WPQR)

Test results    WPQR no [redacted] Test#1 PJP

## TENSILE TESTS

| Specimen N. | Width [mm] | Thickness [mm] | Area [in²] | Ultimate tensile load [lbf] | Ultimate unit stress [ksi] | Type of failure & location | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

## GUIDED BEND TESTS

| Test no. | Type and figure no. | Result | Remarks |
|---|---|---|---|
| | | | |

## CHEMISTRY TEST

| C | Mn | Si | P | S | Ni | Cr | Mo | V | Ti | Zr | Al | Cu | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | |

Other Elements

## IMPACT TESTS

| Type | Temperature [°F] | Test results [ft-lbf] 1 | 2 | 3 | 4 | 5 | Average | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

## VISUAL INSPECTION

Appearance: Acceptable
Undercut: None
Piping porosity: None
Convexity: Acceptable
Test date: 11/3/22
Witnessed by: [redacted]
Hydrogen testing
Report no.    Result    ml/100g

Other tests

Weld size verification macros acceptable.

## Radiographic - ultrasonic examination

RT report no.    Result
UT report no.    Result

## FILLET WELD TEST RESULTS

Minimum size multiple pass    Maximum size single pass
Macroetch    Macroetch

## All-weld-metal tension test

Tension strength
Yield point/strength
Elongation in 2 in.
Laboratory test no.

Welder's name [redacted]    Clock N 2896    Stamp N

Tests conducted by [redacted]    Laboratory Test N
Per

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in conformance with the requirements of Section 4 of AWS D1.1/D1.1M, 2015 Structural Welding Code - Steel.

Remarks

Signed [redacted]
By [redacted]
Title
Date 12/7/22

[redacted]

Index no. 1001424444    Page 3 of 5

[redacted]

QUALITY ASSURANCE REPORT OF TEST AND ANALYSIS

[redacted]

| SHIPMENT NO. | DATE SHIPPED | CAR OR VEHICLE NO. | | |
|---|---|---|---|---|
| [redacted] | 08-16-21 | CSS-CHGO-WSOR | LMIC 066033 | PAGE 7 |

SOLD TO: [redacted]

SHIP TO: [redacted]

| NOTE | SERIAL NUMBER | PAT NO. | HEAT NUMBER | NO. PCS. | SIZE AND QUANTITY THICKNESS | WIDTH OR DIA. | LENGTH | WEIGHT | YIELD POINT | TENSILE STRENGTH | AF FRAC. ELONG | | RED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | INCHES | INCHES | INCHES | POUNDS | PSI | PSI | IN | % | % |
| | | | 813U64430 | 4 | 1/2 | 120 | 480 | 32672 | 53700 | 74000 | 8 | 25 | |
| | | | | | | | | | 54300 | 74400 | 8 | 23 | |

QUALITY STEEL MELTED & MANUFACTURED IN THE U. S. A.
PLATES - CSA G40.21-13 GR 50W KLD FINE GRAIN
PRAC, ASTM A709-18 GR 50 TYPE 2,
ASTM A572-21 GR 50 TYPE 2, ASME
SA572 GR 50 2019 EDITION --- IN
ACCORDANCE WITH EN 10204:2004 TYPE
3.1 10204:2004 TYPE 3.1
NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)
CO# V24321-88571 GH 875-8715A
MERCURY IN ANY FORM HAS NOT BEEN USED IN THE PRODUCTION OF THIS ORDER

(M55)MFST REF#:050120480A572-50

Q-QUENCH TEMPERATURE T-TEMPER TEMPERATURE N-NORMALIZE TEMPERATURE

| SERIAL NUMBER | PAT NO. | HEAT NUMBER | HARD BHN | BEND | THICKNESS | TYPE | SIZE | DIR | TEST TEMP | CHARPY IMPACT ENERGY FT LBS 1 | 2 | 3 | SHEAR(%) 1 | 2 | 3 | LAT. EXP MILS 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | INCHES | | | | F | | | | | | | | | |

| HEAT NUMBER | CHEMICAL ANALYSIS C | Mn | P | S | Si | Cu | Ni | Cr | Mo | V | Ti | Al | B | Cb | N | Sn | MCQUAID GRAIN SIZE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

813U64430 .12 1.20 .014 .005 .303.019 .01 .03.006.054.002.033.0002 .002.005.003

[redacted] SUPV QUALITY ASSURANCE
Form BHPLTRPT TIF [redacted]

[redacted]

# Material Test Report

Customer Order No [redacted] [redacted] Order No: [redacted]

[redacted]

Material Supplier:
Part Number: 943-5733-80
[redacted] Rec. No: [redacted]

| | | |
|---|---|---|
| Heat Number: 4181652 | Grade: St52V | Dimensions: 6.625" OD 6.000" ID |
| [redacted] Spec: MS-1547 | ASTM Spec: A513 | Other Spec: |

Description: ERW * DOM * Stress Relieve Annealed * Micro-alloyed Steel Mechanical Tubing NDT TESTED YIELD @ .2% OFFSET METHOD

## Chemical Analysis

| C | Mn | P | S | Si | Cu | Ni | Cr | Mo | Sn | Al | V |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 1.43 | 0.02 | 0.002 | 0.25 | 0.04 | 0.03 | 0.05 | 0.01 | 0.005 | 0.032 | 0.087 |
| Cb | Ti | B | Ca | N | | | | | | | |
| 0.001 | 0.021 | 0.0001 | 0.0027 | 0.0034 | | | | | | | |

## Mechanical Test Results

| Yield Strength:(PSI) | Tensile Strength:(PSI) | Elongation:(%) in 2" G.L. | ROA:(%) | Hardness |
|---|---|---|---|---|
| 95700 | 107800 | 18 | | 98 (HRB) |

## Charpy Impact Energy

| | Energy ( ) | | | | Shear Area (%) | | | |
|---|---|---|---|---|---|---|---|---|
| Temp | 1 | 2 | 3 | Avg | 1 | 2 | 3 | Avg |
| | | | | | | | | |

| Eddy Current |
|---|
| |

[redacted]

[redacted]
Quality Assurance
01/28/21

[redacted]

## CERTIFICATE OF CONFORMANCE & CERTIFIED MATERIAL TEST REPORT

47629869 ES-ZNBK [redacted] 2,937 lbs.

**Supplied To:** [redacted]

**Customer PO:** [redacted]
**Q3 Lot®:** 1542D
**Heat:** 520778

This material was manufactured under lot control in accordance with ASME Section II Part C SFA 5.01, lot class T4, and tested per Schedule I to the requirements of SFA 5.20 classification E71T-12M JH4 and in accordance with the requirements of [redacted] Material and testing in accordance with ASME Section II Part C, 2021 Edition. No weld splicing with filler material was conducted on this product. This product was manufactured in the U.S.A.

This product was supplied in accordance with [redacted] Quality System Manual [redacted] Rev. S dated 1/30/20. [redacted] Quality System meets the requirements of ASME NCA-3800, conforms to all applicable requirements of 10CFR 50 Appendix B, and meets the basic requirements of NQA-1. 10CFR Part 21 and 10CFR 50.55(e) apply to this order.

The product stated herein was manufactured and tested in accordance with the Quality System Program of [redacted] as outlined in our Quality Assurance Manual. The Quality System Program of [redacted] has been accredited by ASME as evidenced by Certificate Nos. [redacted] which expire on March 30, 2023, and is certified to ISO 9001 as evidenced by Certificate No. [redacted]

**Test Conditions**

| | |
|---|---|
| Electrode Size (Inches) | .052 |
| Process / Electrode Polarity | FCAW-G / DCEP |
| CTWD (Inches) | 1 |
| Current (Amps) | 275 |
| Arc Voltage (Volts) | 27 |
| Heat Input (kJ/inch) | 37 |
| Passes/Layers | 15 / 7 |
| Preheat/Interpass Temp. (°F) | 75 / 300 |
| Gas Type | 75% Argon/25% $CO_2$ |
| Plate ID | 22666 |

[redacted]

| As-Welded Mechanical Properties[1] | Plate 22666 | SFA 5.20 |
|---|---|---|
| Yield Strength (psi), .2% Offset Method | 76,000 | 58,000 psi minimum |
| Ultimate Tensile Strength (psi) | 87,000 | 70,000 – 90,000 psi |
| % Elongation | 29 | 22% minimum |

[1] The strength and elongation properties were obtained from a tensile specimen artificially aged at 105°C (220°F) for 48 hours.

| As-Welded Impact Properties | Plate 22666 | SFA 5.20 |
|---|---|---|
| CVN ft. lbs. @ -60°F | 75, 84, 80 = 80 Avg. | 20 ft-lbs. minimum Average |
| Lateral Expansion (mils) | 61, 64, 64 | Not Required |
| % Shear | 62, 56, 56 | Not Required |

1

[redacted]

| Deposit Chemistry | Plate 22666 | SFA 5.20 |
|---|---|---|
| % Carbon | 0.06 | .12 max. |
| % Manganese | 1.45 | 1.75 max. |
| % Silicon | 0.46 | .90 max. |
| % Sulfur | 0.01 | .03 max. |
| % Phosphorus | 0.01 | .03 max. |
| % Chromium | 0.03 | .20 max. |
| % Nickel | 0.01 | .50 max. |
| % Molybdenum | < 0.01 | .30 max. |
| % Vanadium | < 0.01 | .08 max. |
| % Copper | 0.03 | .35 max. |

| Diffusible Hydrogen | | |
|---|---|---|
| mL/100g of Weld Deposit | 3.0, 3.3, 2.9, 2.9 = 3.0 Avg. | 4.0mL/100g maximum |

**Radiographic Inspection Results:** Met Requirements

This is to certify that the contents of this report are correct and accurate and that all test results and operations performed by [redacted] or its subcontractors are in compliance with the requirements of the material specification and the specific applicable requirements of the Code as specified by the customer. We do not use mercury in the design and formulation of our consumable products. In the manufacturing and testing of our products, our equipment meets mercury exclusion requirements.

[redacted] 4 Aug. 2022
DATE
Manager, Quality Assurance

[redacted] 4 Aug. 2022
DATE
Manager, Specials and Test

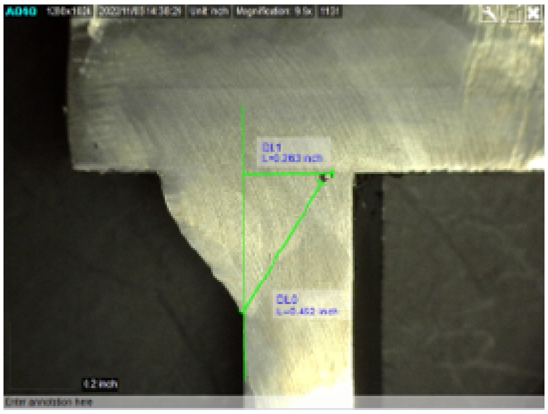
[redacted]

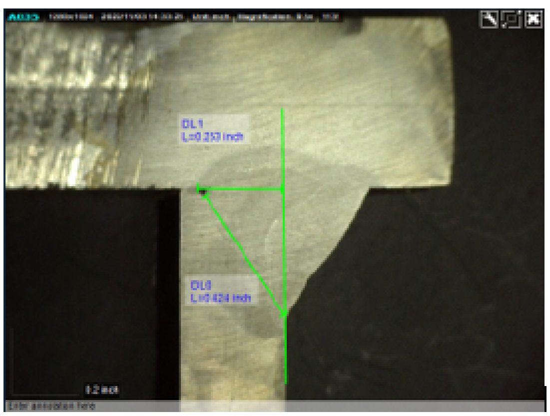
[redacted]

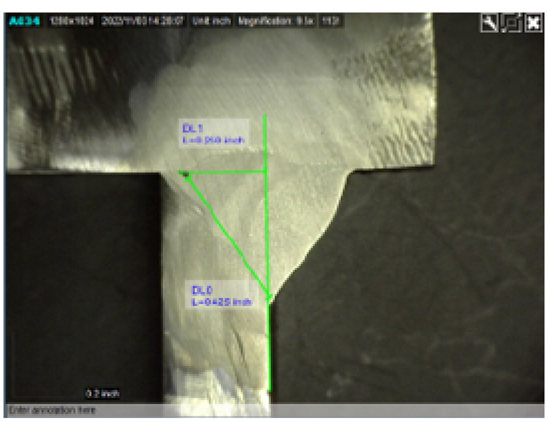
2

[redacted]

| **Additional Page** | Proc. no.: | [redacted] Test#1 PJP | | |
|---|---|---|---|---|
| PJP Verification | Ref.: | | | |
| | Date: | 12/7/22 | Rev.: | 00 |







Macros completed to satisfy **AWS D1.1:2015, Clause 4.11.3 Verification of CJP Groove WPS by Macroetch.** When a WPS has been qualified for CJP groove weld and is applied to the welding conditions of a PJP groove weld, three macroetch cross section test specimens shall be required to demonstrate that the specified weld size shall be equal or exceeded.

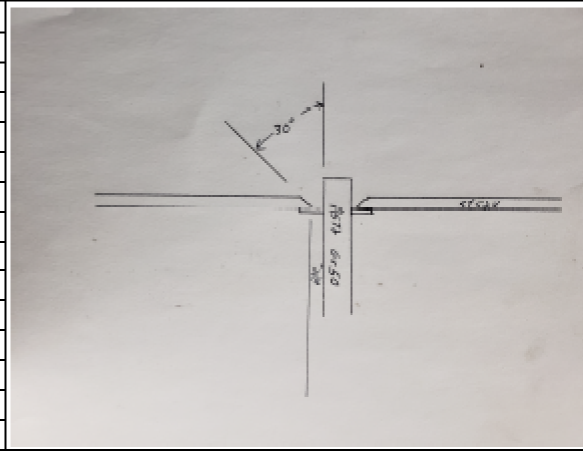
Index: 10014244444-5 Page 5 of 5 [redacted]

| | | |
|---|---|---|
| [redacted] | **WELDING PROCEDURE QUALIFICATION RECORD (WPQR)** | **WPQR No:** [redacted] test #1<br>Ref.:<br>Date: 8/29/22 Rev: 00 |

| | | | | | |
|---|---|---|---|---|---|
| Prod. by: | [redacted] | Client: | [redacted] | Ref. stand: | AWS D1.1 |
| Project: | Boom | Ref. spec.: | | Exam. body: | |
| Location: | [redacted] | Ref. Proc.: | | | |

| | 1 | | 2 | | 3 | |
|---|---|---|---|---|---|---|
| Welding process | | FCAW | | | | |
| Shielding gas type | | C25 | | | | |
| Weaving (yes/no) | | No max: mm | | max: mm | | max: mm |

| | |
|---|---|
| Purging gas type | N/A l/min |
| Welding positions | 6G |
| Joint type | Butt |
| Joint preparation | Single Bevel |
| Cleaning method | Yes/ Mechanical |
| Backing | Backing Ring |
| Single/Double | Single |
| Back gouging | No |
| Flux designation | N/A |
| Flux handling | N/A |
| Tungsten electrode | N/A mm |
| Torch angle | 10 ° |
| Stand off distance | .75 mm |
| Nozzle diameter(s) | .625 mm |
| Tack welding proc. | Rev: |




**Identification of parent metal** I: CE: C: PCM: II: CE: C: PCM:

| Part | Name/Grade | Standard | Group | Delivery cond. | Heat no. | Thickness [in] | Diameter [in] |
|---|---|---|---|---|---|---|---|
| I | ASTM 513/ST52V | | | Pipe | 4181652 | 0.312 | 6.625 |
| II | A 572 Grade 50 | | II | Plate | 813u64430 | 0.500 | |

**Identification of filler metal**

| Index | Trade name | Classification | Group | Filler handling |
|---|---|---|---|---|
| 1 | [redacted] | E71T1-12M JH4 | | |
| 2 | | | | |
| 3 | | | | |

**Welding Parameters** Equipment: CV Power Supply

| Pass no. | Index | Dia. [in] | Welding process | Wire feed speed [ipm] | Current [A] | Voltage [V] | Current / Polarity | Welding speed [ipm] | Run Out Length [mm] | Gas [l/min] | Heat input [kJ/in] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | - | - | - | | - | | | - |
| | | | | - | - | - | | - | | | - |
| | | | | - | - | - | | - | | | - |
| | | | | - | - | - | | - | | | - |
| | | | | - | - | - | | - | | | - |
| | | | | - | - | - | | - | | | - |
| | | | | - | - | - | | - | | | - |
| | | | | - | - | - | | - | | | - |
| | | | | - | - | - | | - | | | - |

**Heat treatment** Method:

Preheat min: 70 °F Interpass temp. max: 250 °F Heat treatment proc.: N/A Temp. control:

PWHT min: °F max: °F Soaking: min/in min Heating rate: °F/h Cooling rate: °F/h

| Remarks: | Name of welder | Stamp | Additional info enclosed (Yes/No): |
|---|---|---|---|
| | [redacted] | | [redacted] |

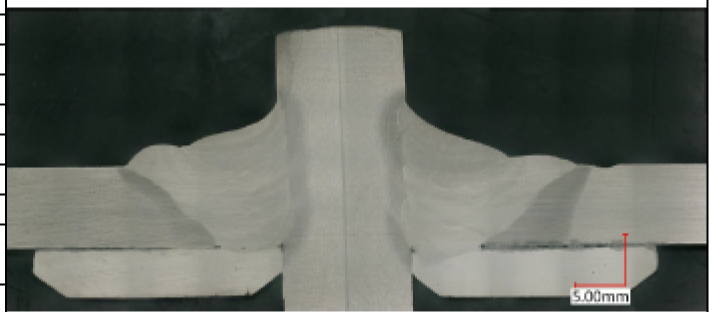
Index no. 1001423958 Page 1 of 4

[redacted]

# OBSERVATION FORM

**WPQR No:** [redacted] test #1
Ref.:
Date: 8/29/22 Rev: 00
Sheet: 1 of of 2

| | | | |
|---|---|---|---|
| Welding process | 1: FCAW | 2: | 3: |
| Parent metal | I: ASTM 513/ST52V | II: A 572 Grade 50 | |
| Heat no. | I: 4181652 | II: 813u64430 | |
| Filler metal | 1: [redacted] | 2: | 3: |
| Batch no. | 1: 1525Y | 2: | 3: |
| Project | Boom | | |
| Position | 6G | | |
| Tungsten elec. | | | |
| Welders | [redacted] | | |
| Diameter | 6.625 in | | |
| Thickness | 0.312 in 0.500 in | | |
| Shielding gas | C25 | | |
| Purging gas | N/A | | |
| Preheat | Min. 70.0 °F | | |
| Interpass temp. | Max. 250.0 °F | | |
| Start | Date: <br> Hour: | | |
| Stop | Date: <br> Hour: | | |
| Equipment | | | |
| Comments | | | |




Sign.:

| Pass no./ Pos. | Filler | Dia. [in] Wire feed [ipm] | AC DC- DC+ | Weaving [in] | Shield gas | Purge gas | Temp. [°F] | Current [A] | Voltage [V] | Melt time [s] | Run Out Length | Welding speed [ipm] | Heat input [kJ/in] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 6G | y | 0.052 250 | DCEP | | 40 | No | | 215 -215 | 25.0 -25.0 | 129 | 20.81 | 9.7 - 9.7 | 33.2-33.2 |
| 2 6G | Y | 0.052 250 | DCEP | | 40 | No | | 212 -212 | 25.0 -25.0 | 91 | 20.81 | 13.7- 13.7 | 23.2-23.2 |
| 3 6G | y | 0.052 250 | DCEP | | 40 | No | | 210 -210 | 25.0 -25.0 | 111 | 20.81 | 11.2- 11.2 | 28.1-28.1 |
| 4 6G | y | 0.052 250 | DCEP | | 40 | No | | 212 -212 | 25.0 -25.0 | 91 | 20.81 | 13.7- 13.7 | 23.2-23.2 |
| 5 6G | Y | 0.052 250 | DCEP | | 40 | No | | 218 -218 | 25.0 -25.0 | 100 | 20.81 | 12.5- 12.5 | 26.2-26.2 |
| 6 6G | Y | 0.052 250 | DCEP | | 40 | no | | 209 -209 | 25.0 -25.0 | 152 | 20.81 | 8.2 - 8.2 | 38.2-38.2 |
| 7 6G | Y | 0.052 250 | DCEP | | 40 | No | | 216 -216 | 25.0 -25.0 | 117 | 20.81 | 10.7- 10.7 | 30.3-30.3 |
| 8 6G | Y | 0.052 250 | DCEP | | 40 | No | | 214 -214 | 25.0 -25.0 | 96 | 20.81 | 13.0- 13.0 | 24.7-24.7 |
| 9 6G | Y | 0.052 250 | DCEP | | 40 | No | | 217 -217 | 25.0 -25.0 | 111 | 20.81 | 11.2- 11.2 | 29.1-29.1 |

[redacted]

## OBSERVATION FORM

**WPQR No:** 175 test #1
Ref.:
Date: 8/29/22 Rev: 00
Sheet: 2 of of 2

| Pass no./ Pos. | Filler | Dia. [in] Wire feed [ipm] | AC DC- DC+ | Weaving [in] | Shield gas | Purge gas | Temp. [°F] | Current [A] | Voltage [V] | Melt time [s] | Run Out Length | Welding speed [ipm] | Heat input [kJ/in] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 6G | Y | 0.052 250 | DCEP | | 40 | No | | 220 -220 | 25.0 -25.0 | 118 | 20.81 | 10.6- 10.6 | 31.1-31.1 |
| 11 6G | Y | 0.052 250 | DCEP | | 40 | No | | 224 -224 | 25.0 -25.0 | 130 | 20.81 | 9.6 - 9.6 | 35.0-35.0 |

[redacted]

# Material Test Report

Customer Order No [redacted] [redacted] Order No: [redacted]

[redacted]

Material Supplier:
Part Number: 943-5733-80
[redacted] Rec. No: [redacted]

| | | |
|---|---|---|
| Heat Number: 4181652 | Grade: St52V | Dimensions: 6.625" OD 6.000" ID |
| [redacted] Spec: MS-1547 | ASTM Spec: A513 | Other Spec: |

Description: ERW * DOM * Stress Relieve Annealed * Micro-alloyed Steel Mechanical Tubing NDT
TESTED YIELD @ .2% OFFSET METHOD

## Chemical Analysis

| C | Mn | P | S | Si | Cu | Ni | Cr | Mo | Sn | Al | V |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 1.43 | 0.02 | 0.002 | 0.25 | 0.04 | 0.03 | 0.05 | 0.01 | 0.005 | 0.032 | 0.087 |
| Cb | Ti | B | Ca | N | | | | | | | |
| 0.001 | 0.021 | 0.0001 | 0.0027 | 0.0034 | | | | | | | |

## Mechanical Test Results

| Yield Strength:(PSI) | Tensile Strength:(PSI) | Elongation:(%) in 2" G.L. | ROA:(%) | Hardness |
|---|---|---|---|---|
| 95700 | 107800 | 18 | | 98(HRB) |

## Charpy Impact Energy

| Temp | Energy ( ) 1 | 2 | 3 | Avg | Shear Area (%) 1 | 2 | 3 | Avg |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

| Eddy Current |
|---|
| |

[redacted]

[redacted]

Quality Assurance
01/28/21

[redacted]

[redacted]

[redacted]

**TEST CERTIFICATE –** [redacted]

Date: August 12, 2022
P.O. No.: [redacted]
Report No.: [redacted]

Subject: Weld Procedure Qualification Testing – AWS D1.1

### Summary of Sample Identification and Process Information

| | | |
|---|---|---|
| **Identification** | : | Test #1 |
| **Material** | : | 0.31 inch thick ST52V pipe to 0.5 inch thick A572 Gr 50 plate |
| **Filler Metal** | : | 0.052 [redacted] |
| **Joint Configuration** | : | Single Bevel with 30° included angle |
| **Test Specifications** | : | AWS D1.1/D1.1M:2020 |

### Summary of Testing and Results

The weld procedure qualification test pipe was submitted for evaluation to the requirements of AWS D1.1/D1.1M:2020. The test pipe is presented as received in Figure 1. The weld pipe passed a visual inspection to the requirements of AWS D1.1/D1.1M:2020 Section 6.10.1.1. Additionally, impact testing and a macroetch specimen were requested. The results of the tests performed are included in Tables 1 through 3 and a photomicrograph the macroetch specimen is shown in Figure 2. The results of the bend and tensile testing conformed to the requirements of AWS D1.1. No requirements were provided for the impact testing or the macroetch examination.

[redacted]

Page 1 of 4

[redacted]

**Table 1**
**Guided Bend Test Results**

| Sample | Notes |
|---|---|
| Face Bend 1 | 0.166" Crack. – Unacceptable; Retests issued |
| Face Bend 2 | No visually evident flaws or anomalies. – Acceptable |
| Root Bend 1 | No visually evident flaws or anomalies. – Acceptable |
| Root Bend 2 | No visually evident flaws or anomalies. – Acceptable |
| Face Bend 3 (retest) | 0.063" Crack. – Acceptable |
| Face Bend 4 (retest) | No visually evident flaws or anomalies. – Acceptable |
| Bend Diameter (in) | 2.5 |
| **Test Disposition** | **PASS** |

Tested in accordance with AWS D1.1/D1.1M:2020, Clause 6, Paragraph 6.10.3.1.

Acceptance criteria per AWS D1.1/D1.1M:2020, Clause 6, Paragraph 6.10.3.3.

**Table 2**
**Tensile Test Results**

| Property | T1 | T2 |
|---|---|---|
| Width, in. | 0.751 | 0.751 |
| Thickness, in. | 0.257 | 0.267 |
| Original area, in.$^2$ | 0.193 | 0.201 |
| Gage length, in. | 2.0 | 2.0 |
| Tensile load, lbs. | 15,720 | 16,100 |
| Tensile strength, ksi | 81.5 | 80.5 |
| Yield strength, 0.2% offset, ksi | 67.0 | 66.0 |
| Elongation, % | 11 | 11 |
| Fracture location | Plate | Plate |
| **Test Disposition** | **PASS** (1) | |

Tested in accordance with AWS D1.1/D1.1M:2020, Clause 6, Paragraph 6.10.3.4.

(1): The referenced test specification requires that the tensile strength of the test specimens shall be no less than the minimum specified tensile range of the weaker base material used (65 ksi per A572 Gr 50).

[redacted]

[redacted]

Table 3
CVN Impact Test Results

| Notch Location | Specimen | Impact Energy, ft-lbf | Lateral Expansion (mils) |
|---|---|---|---|
| Weld | A | 61 | 60 |
| | B | 69 | 71 |
| | C | 75 | 72 |
| | Average | 68 | — |
| ST52V HAZ | D | 64 | 56 |
| | E | 29 | 31 |
| | F | 90 | 79 |
| | Average | 61 | — |
| A572 HAZ | G | 6 | 6 |
| | H | 11 | 9 |
| | I | 5 | 3 |
| | Average | 7 | — |

| | |
|---|---|
| **Test Temperature, °F** | -40 |
| **Energy Range, ft-lbf** | 0 – 300 |
| **Specimen Size, mm** | 10 X 7.5 |
| **Notch Type** | V-Notch |
| **Striker Radius, mm** | 8 |

Tested in accordance with ASTM A370 and ASTM E23.

--- Not applicable

No requirements were specified for the impact testing.

[redacted]


Fig. 1 The pipe is shown as received. The scale is in inches.

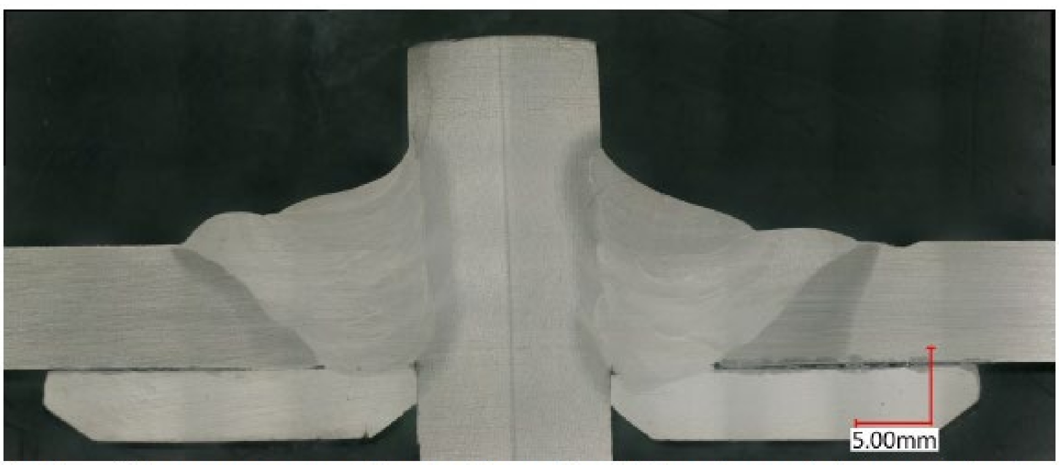



Fig. 2 The macro cross-section is shown after etching to reveal the macrostructure. 10% Nital.

[redacted]

[redacted]

**CERTIFICATE OF CONFORMANCE**
**&**
**CERTIFIED MATERIAL TEST REPORT**

47357553 ES-ZNBK [redacted] 5,445 lbs.

**Supplied To:** [redacted]

**Customer PO:** [redacted]
**Q3 Lot®:** 1525Y
**Heat:** 611818

This material was manufactured under lot control in accordance with ASME Section II Part C SFA 5.01, lot class T4, and tested per Schedule I to the requirements of SFA 5.20 classification E71T-12M JH4 and in accordance with the requirements of [redacted] Material and testing in accordance with ASME Section II Part C, 2021 Edition. No weld splicing with filler material was conducted on this product. This product was manufactured in the U.S.A.

This product was supplied in accordance with [redacted] Quality System Manual [redacted] Rev. S dated 1/30/20. [redacted] Quality System meets the requirements of ASME NCA-3800, conforms to all applicable requirements of 10CFR 50 Appendix B, and meets the basic requirements of NQA-1. 10CFR Part 21 and 10CFR 50.55(e) apply to this order.

The product stated herein was manufactured and tested in accordance with the Quality System Program of [redacted] as outlined in our Quality Assurance Manual. The Quality System Program of [redacted] has been accredited by ASME as evidenced by Certificate Nos. [redacted] which expire on March 30, 2023, and is certified to ISO 9001 as evidenced by Certificate No. [redacted]

**Test Conditions**

| | |
|---|---|
| Electrode Size (Inches) | .052 |
| Process / Electrode Polarity | FCAW-G / DCEP |
| CTWD (Inches) | 1 |
| Current (Amps) | 275 |
| Arc Voltage (Volts) | 27 |
| Heat Input (kJ/inch) | 36 |
| Passes/Layers | 15 / 7 |
| Preheat/Interpass Temp. (°F) | 75 / 300 |
| Gas Type | 75% Argon/25% $CO_2$ |
| Plate ID | 20191 |

| As-Welded Mechanical Properties[1] | Plate 20191 | SFA 5.20 |
|---|---|---|
| Yield Strength (psi), .2% Offset Method | 74,000 | 58,000 psi minimum |
| Ultimate Tensile Strength (psi) | 84,000 | 70,000 – 90,000 psi |
| % Elongation | 30 | 22% minimum |

[1] The strength and elongation properties were obtained from a tensile specimen artificially aged at 105°C (220°F) for 48 hours.

| As-Welded Impact Properties | Plate 20191 | SFA 5.20 |
|---|---|---|
| CVN ft. lbs. @ -60°F | 94, 95, 89 = 93 Avg. | 20 ft-lbs. minimum Average |
| Lateral Expansion (mils) | 73, 72, 69 = 71 Avg. | Not Required |
| % Shear | 56, 56, 56 = 56 Avg. | Not Required |

[redacted]

| Deposit Chemistry | Plate 20191 | SFA 5.20 |
|---|---|---|
| % Carbon | 0.06 | .12 max. |
| % Manganese | 1.48 | 1.75 max. |
| % Silicon | 0.45 | .90 max. |
| % Sulfur | 0.01 | .03 max. |
| % Phosphorus | 0.01 | .03 max. |
| % Chromium | 0.04 | .20 max. |
| % Nickel | 0.01 | .50 max. |
| % Molybdenum | < 0.01 | .30 max. |
| % Vanadium | < 0.01 | .08 max. |
| % Copper | 0.03 | .35 max. |

**Diffusible Hydrogen**

| | | |
|---|---|---|
| mL/100g of Weld Deposit | 1.4, 1.3, 1.2, 1.4 = 1.3 Avg. | 4.0mL/100g maximum |

**Radiographic Inspection Results**: Met Requirements

[redacted]

This is to certify that the contents of this report are correct and accurate and that all test results and operations performed by [redacted] its subcontractors are in compliance with the requirements of the material specification and the specific applicable requirements of the Code as specified by the customer. We do not use mercury in the design and formulation of our consumable products. In the manufacturing and testing of our products, our equipment meets mercury exclusion requirements.

[redacted] 26 Apr 2022
DATE
Manager, Quality Assurance

[redacted] 26 Apr 2022
DATE
Manager, Specials and Test

"Note: The recording of false, fictitious or fraudulent statements or entries on this document may be punished as a felony under Federal Statutes including Federal Law, Title 18, Chapter 47."

2

[redacted]

QUALITY ASSURANCE REPORT OF TEST AND ANALYSIS

[redacted]

| SHIPMENT NO. | DATE SHIPPED | CAR OR VEHICLE NO. | | PAGE |
| --- | --- | --- | --- | --- |
| [redacted] | 08-16-21 | CSS-CHGO-WSOR | LMIC 066033 | 7 |

SOLD TO [redacted]

SHIP TO [redacted]

| SERIAL NUMBER | PAT NO. | HEAT NUMBER | NO. PCS. | THICKNESS | WIDTH OR DIA. | LENGTH | WEIGHT | YIELD POINT | TENSILE STRENGTH | AF FRAC. ELONG | | RED |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | | | INCHES | INCHES | INCHES | POUNDS | PSI | PSI | IN | % | % |

QUALITY STEEL MELTED & MANUFACTURED IN THE U. S. A.
PLATES - CSA G40.21-13 GR 50W KLD FINE GRAIN
PRAC, ASTM A709-18 GR 50 TYPE 2,
ASTM A572-21 GR 50 TYPE 2, ASME
SA572 GR 50 2019 EDITION --- IN
ACCORDANCE WITH EN 10204:2004 TYPE
3.1 10204:2004 TYPE 3.1
NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)
CO# V24321-88571 GH 875-8715A
MERCURY IN ANY FORM HAS NOT BEEN USED IN THE PRODUCTION OF THIS ORDER

| | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | 813U64430 | 4 | 1/2 | 120 | 480 | 32672 | 53700 | 74000 | 8 | 25 | |
| | | | | | | | | 54300 | 74400 | 8 | 23 | |

(M55)MFST REF#:050120480A572-50

Q-QUENCH TEMPERATURE | T-TEMPER TEMPERATURE | N-NORMALIZE TEMPERATURE

| SERIAL NUMBER | PAT NO. | HEAT NUMBER | HARD BHN | BEND | THICKNESS INCHES | TYPE | SIZE | DIR | TEST TEMP F | CHARPY IMPACT ENERGY FT LBS 1 | 2 | 3 | SHEAR(%) 1 | 2 | 3 | LAT. EXP MILS 1 | 2 | 3 |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

| HEAT NUMBER | CHEMICAL ANALYSIS C | Mn | P | S | Si | Cu | Ni | Cr | Mo | V | Ti | Al | B | Cb | N | Sn | MCQUAID GRAIN SIZE |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

813U64430 .12 1.20 .014 .005 .303.019 .01 .03.006.054.002.033.0002 .002.005.003

[redacted]

UPV QUALITY ASSURANCE
Form BHPLTRPT TIF

[redacted]

Contract # [redacted]
CLIN # [redacted]
CDRL # A021 Certification, Non-Destructive Testing

[redacted] PO# [redacted]

[redacted]

## MAGNETIC PARTICLE EXAMINATION REPORT

[redacted]

Form: MT-1106-001M Rev. 4

| | | | |
|---|---|---|---|
| W.O. NO.: [redacted] | DATE: 5-20-20 | Page: 1 of 1 | |
| CUSTOMER: [redacted] | ADDRESS: [redacted] | | |
| Purchase Order Number: [redacted] | Plan or Drawing Number: [redacted] | Part Number: [redacted] | |
| Item Description: Lower Boom | Dimensions: Dimensions per drawing [redacted] | | |
| Product form / Material Type: Carbon Steel | Surface Condition: As Welded | | |
| Examination Code / Spec: AWS D1.1 | [redacted] Procedure No.: [redacted] | Acceptance Standard: AWS D1.1 | |

### TECHNIQUE

| | | |
|---|---|---|
| Pre-clean Method: Dry Wipe | Material: N/A | Batch Number: N/A |
| Equipment Make: Parker | Model: P2 | Serial No: 2117 |
| Particle Type / Batch No. 8A red | Vehicle / Batch No.: 19L031 | |

| CIRCULAR MAGNETIZATION: | LONGITUDINAL MAGNETIZATION: | YOKE METHOD: |
|---|---|---|
| AC Current: - AMPS | AC Current: - AMPS | Current: 4 AMPS |
| DC Current: - AMPS | DC Current: - AMPS | Spacing: 4 - 6 INCHES |
| Contact Type: - | Cable Size: - | YOKE METHOD: |
| (Head Shot, Central Conductor, Clamps etc.) | Coil / Solenoid Turns: - | Spacing: 4-6 INCHES |

| | | |
|---|---|---|
| Continuous Method: X | DEMAGNETIZATION: | COMMENTS: |
| | Method: N/A | Yoke method AC magnetization |
| Residual Method: | Residual Field: Gauss | |
| Post Clean Method: N/A | Material: N/A | Batch No.: N/A |

**Additional Lighting if required:**

Light source used: N/A S/N: NA 100fc Minimum White light, 1000 µw/cm² UV light at inspection surface Reading: NA

### DISPOSITION

| Piece / Serial Number | Qty. ACCEPT | Qty. REJECT | Remarks |
|---|---|---|---|
| SRI Lower Boom | | | Inspection was performed on one Lower Boom Weldment accordance with [redacted] procedure [redacted] rev 4. No indications were noted on the critical welds listed. Welding was found to be acceptable to AWS D1.1. |
| Job# [redacted] | | | |
| Critical welds 1,2,3,4 | 4 | 0 | |
| [redacted] | | | |
| TOTALS: | 4 | 0 | |

| Inspector's Name: | Inspector's Signature: | MT Level: | Date: |
|---|---|---|---|
| [redacted] | [redacted] | II | 5/20/20 |

[redacted]

Z. **Appendix Z – Public Domain Software Certificate**

Please see the following page for an example public domain software certificate.

Crane Contractor letterhead

# Certification
# No Public Domain Software

Crane Contractor certifies that the public domain software (e.g., freeware, shareware) is not used in this system.

Sincerely,

Signature here

John Doe, P.E.
Engineering division
Crane Contractor, LLC

## AA. Appendix AA – Software and Services Certificate

Please see the following page for a sample software and services certificate.

# Crane Contractor Letterhead

## SD-07.xx Certification
## Software and Services

Crane contractor certifies that all software and services not required for operation and/or maintenance of the product has been removed and/or disabled.

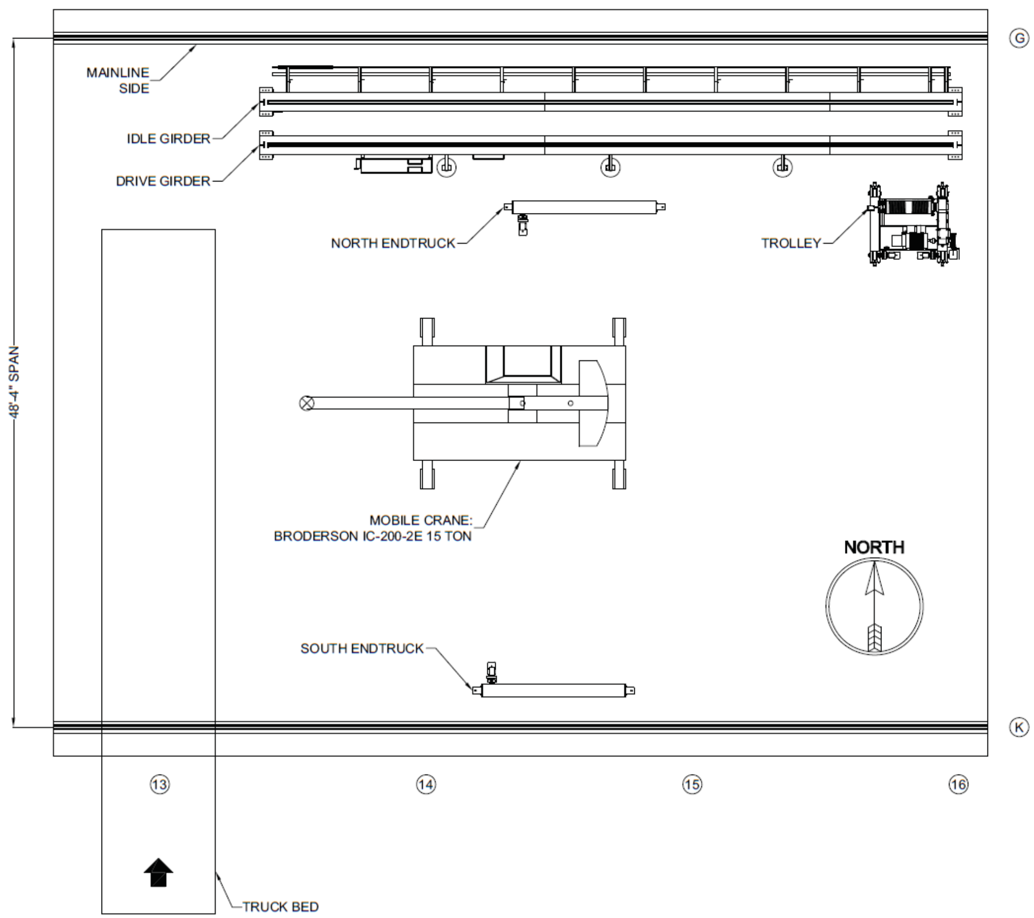
Sincerely,

signature here

John Doe, P.E.
Engineering Division
Crane Contractor, LLC.

## BB. **Appendix BB – Crane Installation Plan**

Please see the following pages for a sample crane installation plan.




PREFACE:

BEFORE ANY WORK IS PERFORMED, CRANE CONTRACTOR WILL BRIEF ALL WORKERS ON THE MANDATORY SITE SAFETY PLAN AND REGULATIONS. THIS WILL INCLUDE, BUT NOT BE LIMITED TO:

- EMERGENCY EXITS AND ROUTES
- PROPER SAFETY GEAR (PPE)
- WORK AREA (MARKING AREAS AS NEEDED)
- OPERATION OF EQUIPMENT
- REVIEW OF SITE SAFETY REGULATIONS AND RESPONSIBILITIES

- THIS PLAN SHALL DISCUSS AND LAY OUT THE WORK NECESSARY TO INSTALL (1) 10 TON CRANE.

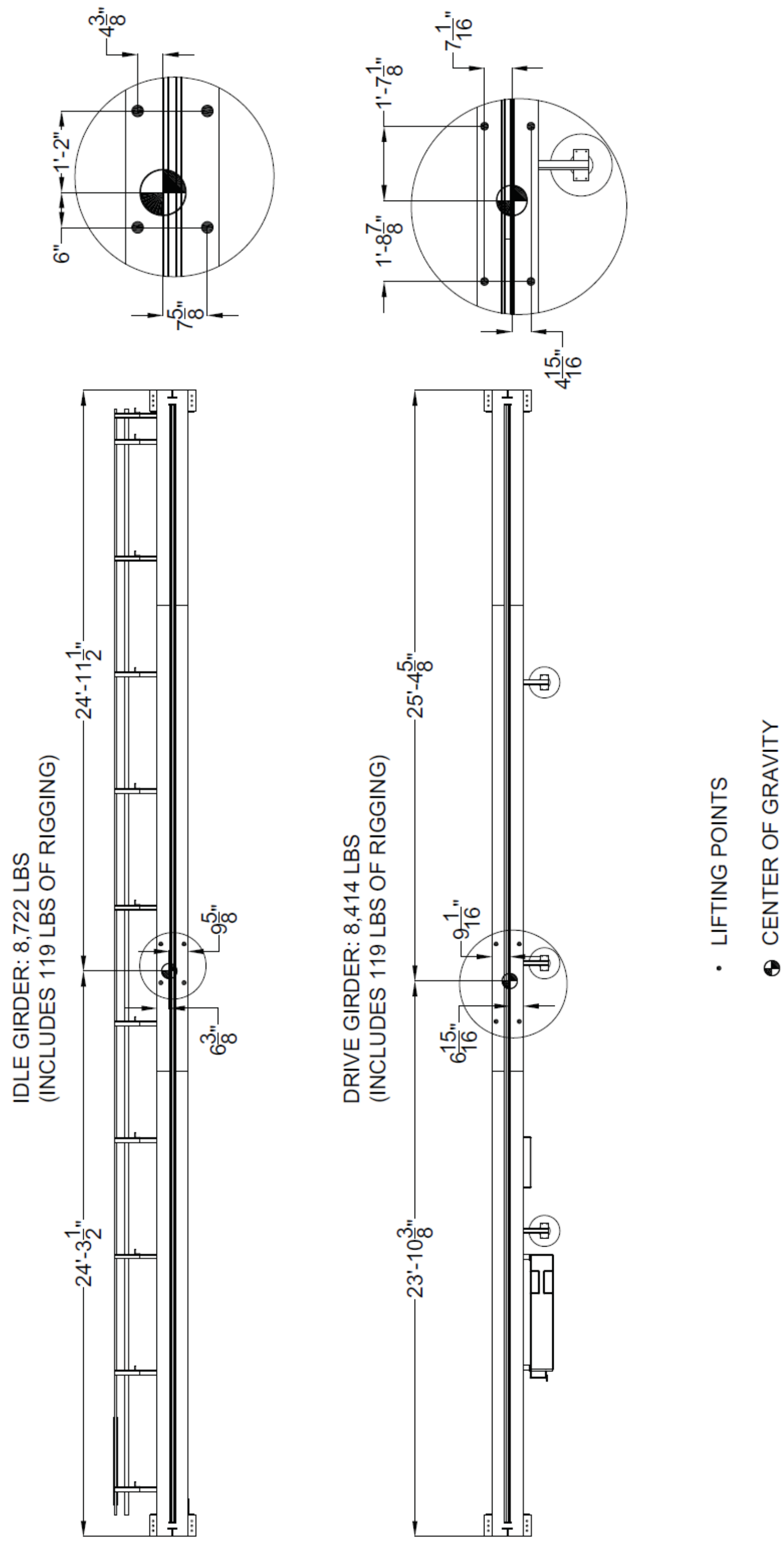
- THE LIFT DIRECTOR SHALL ISSUE ALL INSTRUCTIONS TO THE WORKERS AND OPERATORS USING BOTH VERBAL AND HAND SIGNALS AS IS NECESSARY. THE SPEED OF THE EQUIPMENT SHALL BE WHAT IS PRACTICAL TO ENSURE A MINIMUM OF SWING AND SHIFTING OF THE LOAD BEING HANDLED. THE USE OF GUIDE ROPES AND THEIR PLACEMENT SHALL BE AT THE LIFT DIRECTORS DISCRETION PER THE DETAILED LIFT PLAN. IF THERE IS CAUSE FOR MODIFICATION OF THE APPROVED LIFT PLAN, NCC CONCURRENCE SHALL BE REQUIRED BEFORE COMMENCING WORK.

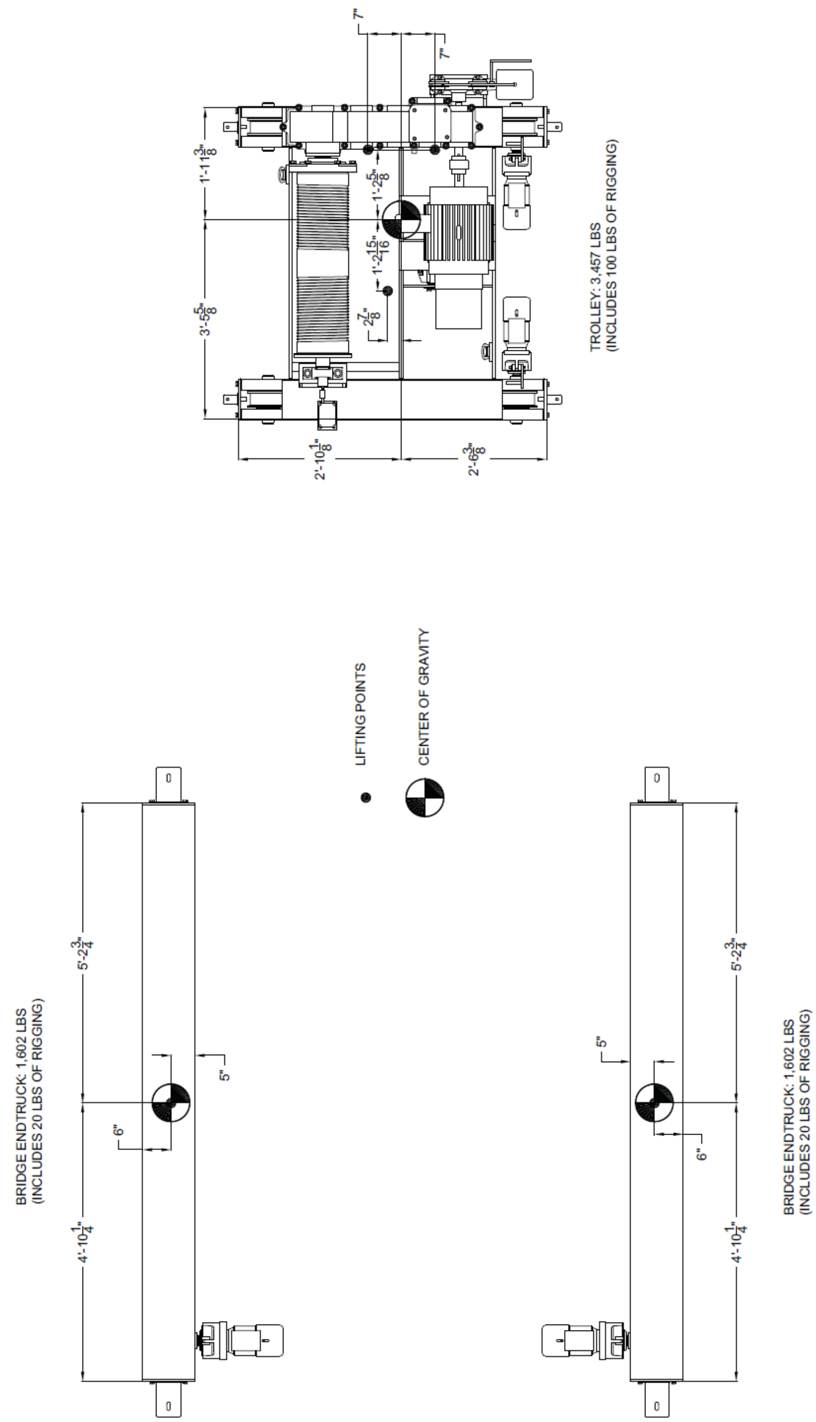
- BEFORE ANY WORK BEGINS, THE LIFT DIRECTOR SHALL REVIEW AND ENFORCE THE SUPPLIED APP ELECTRICAL TAGOUT AND CLEARANCE PROCEDURES, AS WELL AS THE LOCAL FACILITY TAGOUT AND CLEARANCE PROCEDURES. THE SHUT-DOWN OF CRANE RUNWAY ELECTRIFICATION SHALL BE COORDINATED WITH FACILITY PERSONNEL.

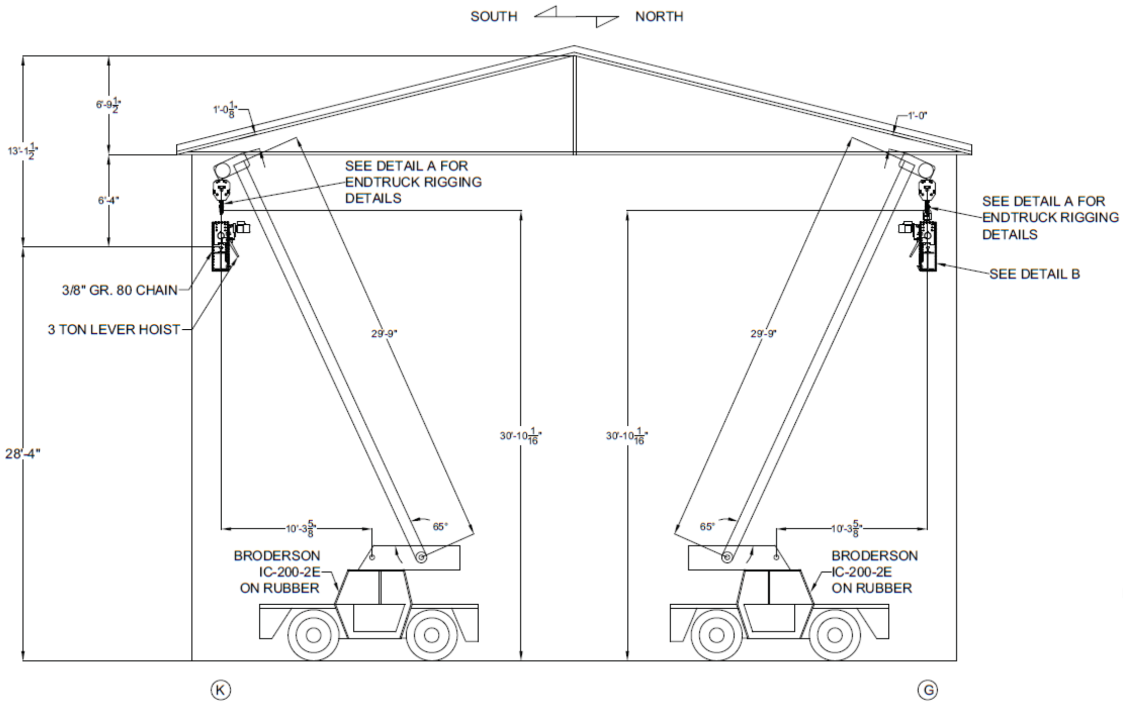
MATERIAL LIST:

* THIS LIST SHALL BE MODIFIED AS NEW EQUIPMENT NEEDS BECOME KNOWN

(1) - BRODERSON IC-200-2E 15 TON OR EQUAL
(4) - 10,000 LB SWIVEL HOIST RING (TORQUE = 230 FT-LBS)
(1) - 15,000 LB SWIVEL HOIST RING (TORQUE = 470 FT-LBS)
(2) - Ø3/8" GR.100 X 12' CHAIN W/ GRAB HOOKS
(2) - 3 TON LEVER HOIST (MINIMUM OF 2 PCS)
(1) - GANGBOX W/ VARIOUS HANDTOOLS AND RIGGING EQUIPMENT


4 3/8"
1'-2"
6"
7 5/8"
1'-7 1/8"
1'-8 7/8"
7 1/16"
4 15/16"
IDLE GIRDER: 8,722 LBS
(INCLUDES 119 LBS OF RIGGING)
24'-11 1/2"
24'-3 1/2"
9 5/8"
6 3/8"
DRIVE GIRDER: 8,414 LBS
(INCLUDES 119 LBS OF RIGGING)
25'-4 5/8"
23'-10 3/8"
9 1/16"
6 15/16"
LIFTING POINTS
CENTER OF GRAVITY


TROLLEY: 3,457 LBS
(INCLUDES 100 LBS OF RIGGING)
LIFTING POINTS
CENTER OF GRAVITY
BRIDGE ENDTRUCK: 1,602 LBS
(INCLUDES 20 LBS OF RIGGING)
BRIDGE ENDTRUCK: 1,602 LBS
(INCLUDES 20 LBS OF RIGGING)




## INSTRUCTIONS

1) The lift director shall instruct the mobile crane operator to position the equipment as shown in the plan details. Crane boom must be located between trusses before proceeding.

2) The lift director shall direct the workers to install the rigging on the first endtruck as shown in the plan Detail A.

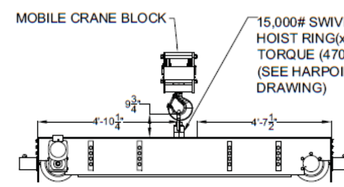
3) The crane operator shall maneuver the block over the rigging. The workers shall attach the rigging to the mobile crane as shown in the plan details.

4) The operator shall raise the endtruck to the runway level while maintaining clearance with trusses and other obstructions. The workers shall use guide ropes during this process to control the motion of the endtruck while being lifted. The quantity and placement of the guide ropes shall be at the lift director's discretion.

5) The operator shall maneuver the endtruck over the runway. Once the bridge wheels are aligned with the runway rail, the operator shall slowly lower the endtruck until it is resting on the runway rail.

6) Once the load is resting on the rail, the workers shall secure the endtruck to the runway using a lever hoist and angle as shown in detail B. When secure, remove the rigging to the mobile crane. The operator shall return the mobile crane to floor level for and prepare for the next pick.

7) Repeat steps 1-6 for the second endtruck.




DETAIL A

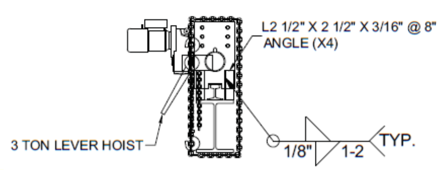
MAX LIFTED LOAD

- MAX LIFTED LOAD BASED ON CONFIGURATIONS / LIMITS FOR BRODERSON IC-200-2E:
  - 30' BOOM
  - 12 FT LOAD RADIUS
  - 65° BOOM ANGLE
  - MAX LIFTED LOAD ON RUBBER 8,100 LBS

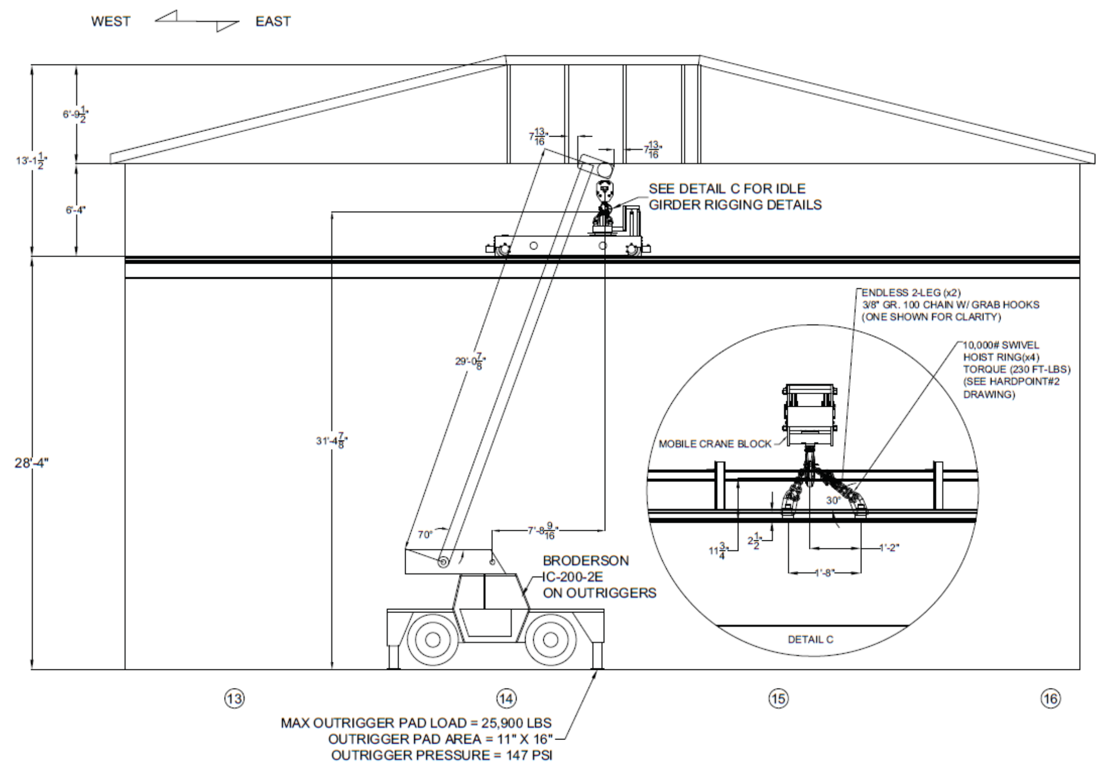
- MAX LIFTED LOAD BASED ON RIGGING CONFIGURATION
  - 15,000# HOIST RING: 15,000 LBS MAX LIFTED LOAD

- ENDTRUCK WEIGHT **MUST** BE UNDER THE 8,100 LB LIMIT BEFORE PROCEEDING WITH FULL LIFT

- ENDTRUCK WEIGHT (INCLUDING RIGGING) - 1,602 LBS




DETAIL B




<u>MAX LIFTED LOAD</u>

- MAX LIFTED LOAD BASED ON CONFIGURATIONS / LIMITS FOR BRODERSON IC-200-2E:
  - 30' BOOM
  - 8 FT LOAD RADIUS
  - 70° BOOM ANGLE
  - MAX LIFTED LOAD ON OUTRIGGERS 24,000 LBS

- MAX LIFTED LOAD BASED ON RIGGING CONFIGURATION
  - USING Ø3/8" GR. 100 LIFTING CHAIN: 14,098 LBS MAX LIFTED LOAD

- IDLE GIRDER WEIGHT **MUST** BE UNDER THE 14,098 LB LIMIT BEFORE PROCEEDING WITH FULL LIFT

- IDLE GIRDER WEIGHT (INCLUDING RIGGING) - 8,722 LBS

<u>INSTRUCTIONS</u>

8) The lift director shall instruct the mobile crane operator to position the equipment as shown in the plan Detail C.

9) The lift director shall direct the workers to install the rigging on the idle girder as shown in the plan details. The rigging shall be installed such that the chain is not bound up on itself or caught on any other obstacles. Verify that the chain does not have any twists before proceeding.

10) The crane operator shall maneuver the block over the rigging. The workers shall attach the rigging to the mobile crane as shown in the plan details.

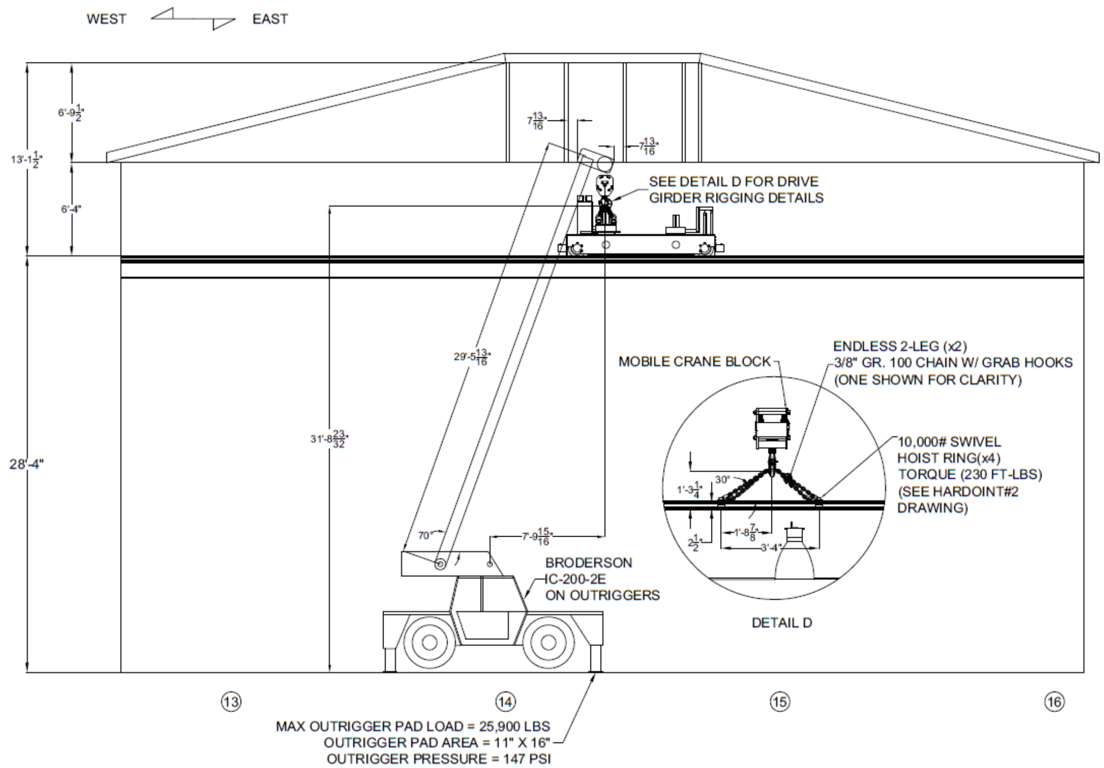
11) Once the rigging is set, the lift director shall perform a test pick. If the lift is deemed to be unsatisfactory, the lift director shall instruct the operator to lower the idle girder back to floor level.

12) The lift director shall perform test picks and re-adjustments of the rigging until a satisfactory pick is achieved. A satisfactory pick is when one end of the girder does not dip down more than one foot from level.

13) Once the pick is satisfactory, the operator shall raise the idle girder to the runway level. The workers shall use guide ropes during this process to control the motion of the idle girder while being lifted. The quantity and placement of the guide ropes shall be at the lift director's discretion.

14) The operator shall maneuver the idle girder over the endtrucks. Once the girder is positioned over the endtrucks, the operator shall slowly lower the idle girder until it is resting on the endtrucks.

15) Once the load is resting on the endtrucks, the workers shall secure the idle girder to the endtrucks. Remove the rigging from the idle girder, lever hoist and angle from endtrucks. The operator shall return the mobile crane to floor level for and prepare for the next pick.




MAX LIFTED LOAD

- MAX LIFTED LOAD BASED ON CONFIGURATIONS / LIMITS FOR BRODERSON IC-200-2E:
  - 30' BOOM
  - 8 FT LOAD RADIUS
  - 70° BOOM ANGLE
  - MAX LIFTED LOAD ON OUTRIGGERS 24,000 LBS

- MAX LIFTED LOAD BASED ON RIGGING CONFIGURATION
  - USING Ø3/8" GR. 100 LIFTING CHAIN: 12,688 LBS MAX LIFTED LOAD

- DRIVE GIRDER WEIGHT **MUST** BE UNDER THE 12,688 LB LIMIT BEFORE PROCEEDING WITH FULL LIFT

- DRIVE GIRDER WEIGHT (INCLUDING RIGGING) - 8,414 LBS

INSTRUCTIONS

16) The lift director shall instruct the mobile crane operator to position the equipment as shown in the plan Detail D.

17) The lift director shall direct the workers to install the rigging on the drive girder as shown in the plan details. The rigging shall be installed such that the chain is not bound up on itself or caught on any other obstacles. Verify that the chain does not have any twists before proceeding.

18) The crane operator shall maneuver the block over the rigging. The workers shall attach the rigging to the mobile crane as shown in the plan details.

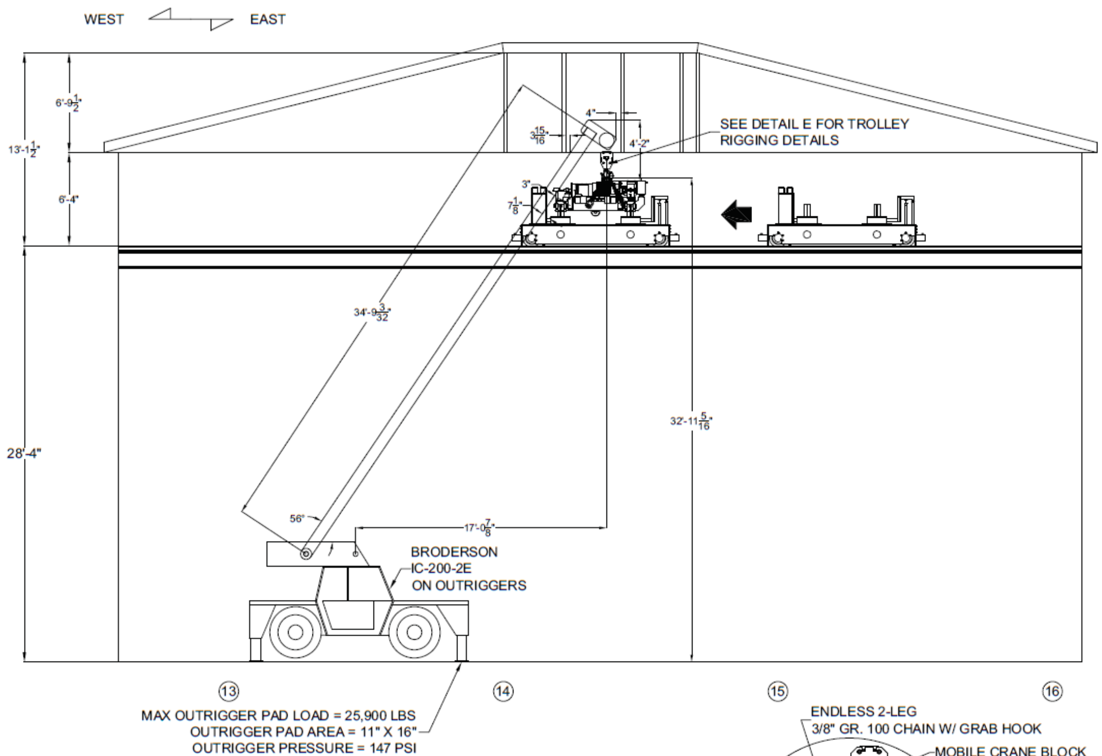
19) Once the rigging is set, the lift director shall perform a test pick. If the lift is deemed to be unsatisfactory, the lift director shall instruct the operator to lower the drive girder back to floor level.

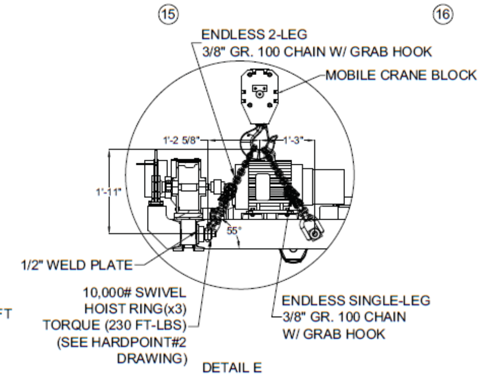
20) The lift director shall perform test picks and re-adjustments of the rigging until a satisfactory pick is achieved. A satisfactory pick is when one end of the girder does not dip down more than one foot from level.

21) Once the pick is satisfactory, the operator shall raise the drive girder to the runway level. The workers shall use guide ropes during this process to control the motion of the drive girder while being lifted. The quantity and placement of the guide ropes shall be at the lift director's discretion.

22) The operator shall maneuver the drive girder over the endtrucks. Once the girder is positioned over the endtrucks, the operator shall slowly lower the drive girder until it is resting on the endtrucks.

23) Once the load is resting on the endtrucks, the workers shall secure the drive girder to the endtrucks and remove the rigging. The operator shall return the mobile crane to floor level for and prepare for the next pick.



DETAIL E

MAX LIFTED LOAD
- MAX LIFTED LOAD BASED ON CONFIGURATIONS / LIMITS FOR BRODERSON IC-200-2E:
  - 35' BOOM
  - 18 FT LOAD RADIUS
  - 56° BOOM ANGLE
  - MAX LIFTED LOAD ON OUTRIGGERS 10,000 LBS

- MAX LIFTED LOAD BASED ON RIGGING CONFIGURATION
  - USING Ø3/8" GR. 100 LIFTING CHAIN: 8,996 LBS MAX LIFTED LOAD

- TROLLEY WEIGHT **MUST** BE UNDER THE 8,996 LB LIMIT BEFORE PROCEEDING WITH FULL LIFT

- TROLLEY WEIGHT (INCLUDING RIGGING) - 3,457 LBS

INSTRUCTIONS

24) The lift director shall instruct the mobile crane operator to position the equipment as shown in the plan Detail E.

25) The lift director shall direct the workers to install the rigging on the trolley as shown in the plan details. The rigging shall be installed such that the chain is not bound up on itself or caught on any other obstacles. Verify that the chain does not have any twists before proceeding.

26) The crane operator shall maneuver the block over the rigging. The workers shall attach the rigging to the mobile crane as shown in the plan details.

27) Once the rigging is set, the lift director shall perform a test pick. If the lift is deemed to be unsatisfactory, the lift director shall instruct the operator to lower the trolley back to floor level.

28) The lift director shall perform test picks and re-adjustments of the rigging until a satisfactory pick is achieved. A satisfactory pick is when the trolley is 5 degrees or less from level.

29) Once the pick is satisfactory, the operator shall raise the trolley to the runway level. The workers shall use guide ropes during this process to control the motion of the trolley while being lifted. The quantity and placement of the guide ropes shall be at the lift director's discretion.

30) The operator shall raise the trolley over the height of the girders. Bridge brakes will be released. Bridge will then be carefully rolled under resting trolley. Once the trolley is positioned over the girder rails, the operator shall slowly lower the trolley until it is resting on the girder rails.

31) Once the Trolley is resting on the girder rails, the workers shall remove the rigging. The operator shall return the mobile crane to floor level.

# IC-200-2E Preliminary Information

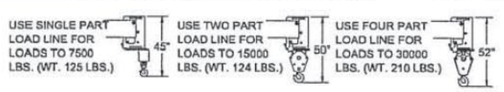
1. Endtrucks
2. Idle Girder
3. Drive Girder
4. Trolley

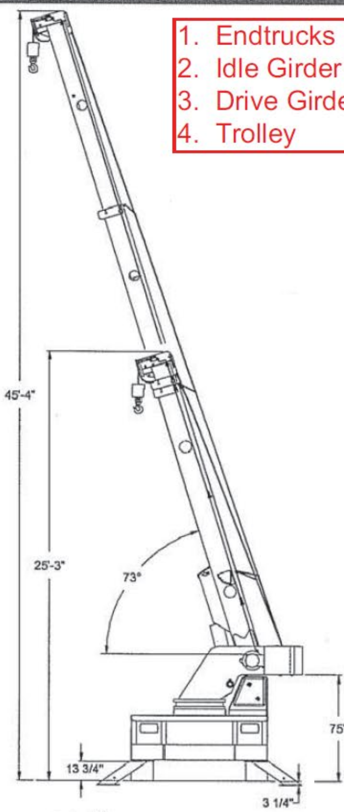
| | CAPACITIES APPLY TO OPERATION ON FIRM LEVEL SURFACE | | | | |
|---|---|---|---|---|---|
| | LOAD RADIUS FEET | MAIN BOOM OR EXTENSION CAPACITIES IN POUNDS | | | |
| | | 360° ROTATION | | OVER FRONT | |
| | | ON RUBBER | ON OUTRIGGERS | ON RUBBER | ON OUTRIGGERS |
| MAIN BOOM | 6 | 16200 | 30000 | 17000 | 30000 |
| | 8 | 13200 | 2. 24000 3. | 13800 | 24000 |
| | 10 | 11000 | 19800 | 11500 | 19800 |
| | 12 | 1. 8100 | 16100 | 9600 | 16100 |
| | 14 | 6250 | 13500 | 7900 | 13500 |
| | 16 | 5000 | 11200 | 6300 | 11200 |
| | 18 | 4100 | 4. 10000 | 5100 | 10000 |
| | 20 | 3400 | 8800 | 4300 | 8800 |
| | 22 | 2850 | 7700 | 3600 | 7800 |
| | 24 | 2400 | 6600 | 3000 | 6900 |
| | 26 | 2100 | 5750 | 2600 | 6200 |
| | 28 | 1850 | 5150 | 2300 | 5700 |
| | 30 | 1650 | 4650 | 2100 | 5300 |
| | 32 | 1450 | 4200 | 1850 | 4900 |
| | 36 | 1150 | 3400 | 1500 | 4200 |
| 15' BOOM EXT. | 40 | 900 | 3050 | 1200 | 3600 |
| | 44 | 650 | 2600 | 950 | 3100 |
| | 48 | 450 | 2200 | 750 | 2700 |
| | 51 | 250 | 1900 | 600 | 2400 |

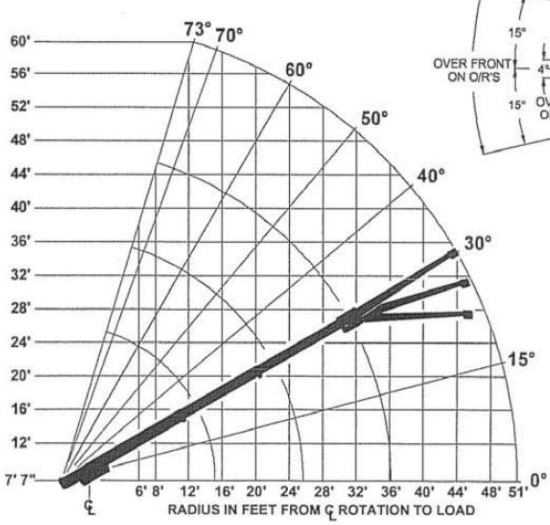
| BOOM EXTENSION ANGLE | 15-FOOT BOOM EXTENSION - STRAIGHT OR OFFSET | | | | | | |
|---|---|---|---|---|---|---|---|
| | MAIN BOOM ANGLE | | | | | | |
| | 0° | 15° | 30° | 40° | 50° | 60° | 70° |
| 0° | --- | 3100 | 3450 | 3900 | 4650 | 6000 | 7500 |
| 15° | --- | 3000 | 3100 | 3300 | 3650 | 4250 | 5200 |
| 30° | --- | --- | 3000 | 3050 | 3200 | 3450 | 3900 |

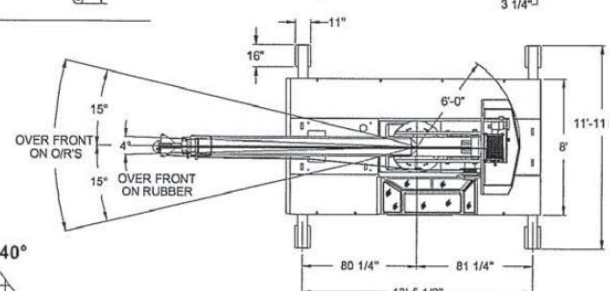
CAUTION BOOM EXTENSION LOADS MUST NOT EXCEED MAIN BOOM CAPACITY.
BOOM EXTENSION MAY ONLY CARRY LOADS WITH OUTRIGGERS DOWN.

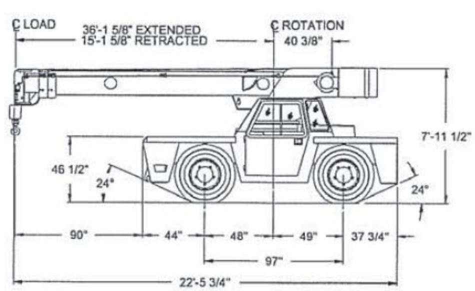
BOOM EXTENSION DEDUCT: 400 POUNDS WHEN STOWED ON BASE BOOM.
800 POUNDS IN WORK POSITION WITH LOAD ON MAIN BOOM.



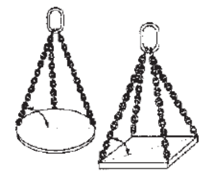
Max Outrigger Load

## Outrigger Load Tables

| MAXIMUM OUTRIGGER LOADS | | | | | | |
|---|---|---|---|---|---|---|
| CRANE MODEL | TYPICAL CRANE WEIGHT (POUNDS) | MAXIMUM CONDITION LOAD (POUNDS) | MAXIMUM CONDITION RADIUS (FEET) | MAXIMUM OUTRIGGER PAD LOAD (POUNDS) | PAD SIZE (INCHES) | GROUND PRESSURE (PSI) |
| ~~IC-20-1B, 1C,1D~~ | ~~6300~~ | ~~5000~~ | ~~4~~ | ~~6620~~ | ~~6 x 6.5~~ | ~~170~~ |
| IC-20-1E,1F | 6400 | 5000 | 4 | 7250 | 6 x 6.5 | 186 |
| IC-35-2 | 7700 | 8000 | 4 | 7620 | 6 x 8 | 159 |
| IC-40-2 | 8800 | 2850 | 12 | 7500 | 6 x 8 | 156 |
| IC-80-1 | 16900 | 17000 | 5 | 15030 | 9 x 12 | 139 |
| IC-80-2 | 17100 | 17000 | 5 | 15120 | 9 x 12 | 140 |
| IC-80-3 | 17500 | 17000 | 5 | 15270 | 9 x 12 | 141 |
| ~~IC-200-1~~ | ~~28400~~ | ~~20000~~ | ~~10~~ | ~~25790~~ | ~~11 x 16~~ | ~~147~~ |
| IC-200-2 | 28900 | 19800 | 10 | 25900 | 11 x 16 | 147 |
| ~~IC-200-3~~ | ~~31300~~ | ~~30000~~ | ~~6~~ | ~~26150~~ | ~~11 x 16~~ | ~~149~~ |
| IC-250-3 OUT & DOWN | 38600 | 13500 | 20 | 31020 | 9 x 9 | 383 |
| IC-250-3 IN & DOWN | 38600 | 25050 | 8 | 31370 | 9 x 9 | 387 |
| RT-200-3 | 30900 | 30000 | 6 | 27780 | 12 x 16 | 145 |
| ~~RT-300-2~~ | ~~45300~~ | ~~25950~~ | ~~14~~ | ~~40440~~ | ~~16 x 17~~ | ~~149~~ |

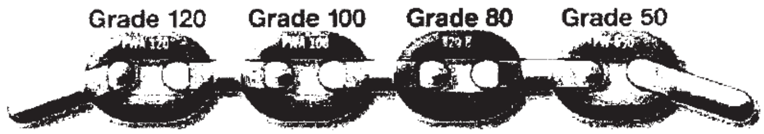
| OUTRIGGER LOAD EXAMPLES AT 10 FOOT LOAD RADIUS | | | | |
|---|---|---|---|---|
| CRANE MODEL | RATED 360° LOAD @10 FT LOAD RADIUS | OUTRIGGER LOAD @RATED LOAD @10 FT RADIUS | OUTRIGGER LOAD @1/2 RATED LOAD @10 FT RADIUS | OUTRIGGER LOAD W/EMPTY HOOK FT RADIUS |

## Maximum Work Load of Various Chain Sling Applications

| Design Factor | | 1-leg-Slings | 2-leg-slings | | | 3-leg slings and 4-leg slings | | | |
|---|---|---|---|---|---|---|---|---|---|
| 4:1 | |  |  | | |  | | | |
| Angle | | 90 degrees | 60 degrees | 45 degrees | 30 degrees | 60 degrees | 45 degrees | 30 degrees | |
| Load Factor | | 1 | 1.7 | 1.4 | 1 | 2.6 | 2.1 | 1.5 | |
| **Grade 120 Alloy** | | | | | | | | | **Temperature Limitations** |
| Ni 720 | 9/32" | 5200 | 9000 | 7400 | 5200 | 13500 | 11000 | 7800 | Retains 100% of work load limit at minus 40-400 degrees F. Not for temperatures over 400 degrees F. |
| Ni 1020 | 3/8" | 10600 | 18400 | 15000 | 10600 | 27500 | 22500 | 15900 | |
| NI 1320 | 1/2" | 17900 | 31000 | 25300 | 17900 | 46500 | 38000 | 26900 | |
| **Grade 100 Alloy** | | | | | | | | | |
| NI 5.50 | 7/32" | 2700 | 4700 | 3800 | 2700 | 7000 | 5700 | 4000 | Retains 100% of work load limit at minus 40-400 degrees F. Not for temperatures over 400 degrees F.<br><br>Special 6100 750 F chain for elevated temperature available. Call for details |
| NI 70 | 9/32" | 4300 | 7400 | 6100 | 4300 | 11200 | 9100 | 6400 | |
| NI 80 | 5/16" | 5700 | 9900 | 8100 | 5700 | 14800 | 12100 | 8500 | |
| NI 100 | 3/8" | 8800 | 15200 | 12400 | 8800 | 22900 | 18700 | 13200 | |
| NI 130 | 1/2" | 15000 | 26000 | 21200 | 15000 | 39000 | 31800 | 22500 | |
| NI 160 | 5/8" | 22600 | 39100 | 32000 | 22600 | 58700 | 47900 | 33900 | |
| NI 200 | 3/4" | 35300 | 61100 | 49900 | 35300 | 91700 | 74900 | 53000 | |
| NI 220 | 7/8" | 42700 | 74000 | 60400 | 42700 | 110900 | 90600 | 64000 | |
| NI 260 | 1" | 59700 | 103400 | 84400 | 59700 | 155100 | 126600 | 89550 | |
| **Grade 80 Alloy** | | | | | | | | | |
| NI 5.5 | 7/32" | 2100 | 3600 | 3000 | 2100 | 5500 | 4400 | 3200 | Retains 100% of work load limit at minus 40-400 degrees F, 90% at 400-570 degrees F, and 75% at 570-750 degrees F. Not for temperatures over 750 degrees F. |
| NI 7 | 9/32" | 3500 | 6100 | 4900 | 3500 | 9100 | 7400 | 5200 | |
| NI 8 | 5/16" | 4500 | 7800 | 6400 | 4500 | 11700 | 9500 | 6800 | |
| NI 10 | 3/8" | 7100 | 12300 | 10000 | 7100 | 18400 | 15100 | 10600 | |
| NI 13 | 1/2" | 12000 | 20800 | 17000 | 12000 | 31200 | 25500 | 18000 | |
| NI 16 | 5/8" | 18100 | 31300 | 25600 | 18100 | 47000 | 38400 | 27100 | |
| NI 20 | 3/4" | 28300 | 49000 | 40000 | 28300 | 73500 | 60000 | 42400 | |
| NI 22 | 7/8" | 34200 | 59200 | 48400 | 34200 | 88900 | 72500 | 51300 | |
| NI 26 | 1" | 47700 | 82600 | 67400 | 47700 | 123900 | 101200 | 71500 | |
| NI 32 | 1-1/4 | 72300 | 125200 | 102200 | 72300 | 187800 | 153400 | 108400 | |
| **Grade 50 Stainless Steel** | | | | | | | | | |
| Nik 5 | 3/16" | 1100 | 1900 | 1600 | 1100 | 2900 | 2300 | 1700 | Retains 100% of work load limit at minus 50-750 degrees F, 75% at 750-1100 degrees F, and 50% at 1100-1290 degrees F, not for temperatures over 1290 degrees F. |
| Nik7 | 9/32" | 2200 | 3800 | 3100 | 2200 | 5700 | 4600 | 3300 | |
| Nik 10 | 3/8" | 4400 | 7500 | 6200 | 4400 | 11500 | 9300 | 6600 | |
| Nik 13 | 1/2" | 7100 | 12100 | 10000 | 7100 | 18500 | 14900 | 10700 | |
| *Nik 16 | 5/8" | 11000 | 18700 | 15600 | 11000 | 23100 | 23100 | 16500 | |

*Sling work load limits are reduced 10% when the HSK16 eye sling hook is used.

7

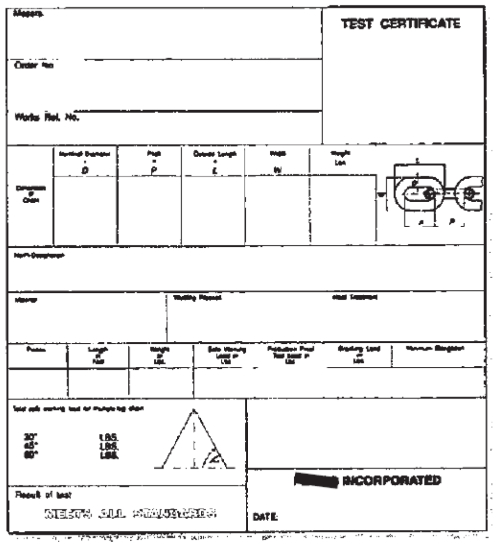



## Identification & Testing

[redacted] lifting chain and fitings are marked with a batch identification number and the manfaturer's identification marking: the number "120" or "12" to indicate Grade 120 Alloy, "100", "10" or "V" to indicate Grade 100 Alloy, "8" to indicate Grade 80 Alloy and "50" to indicate grade 50 Stainless.

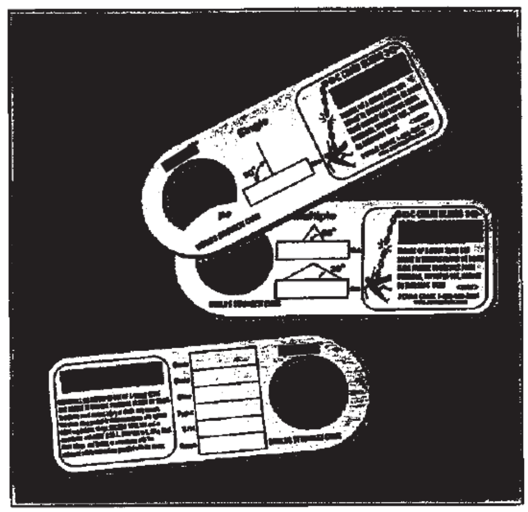
All Alloy chains are 100% tested to 2 times the working load values and are furnished with a test certificate to this effect.

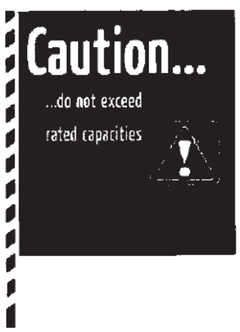
Every chain sling manufactured by [redacted] is supplied with a steel tag and test certificate as shown.


TEST CERTIFICATE

[redacted] INCORPORATED

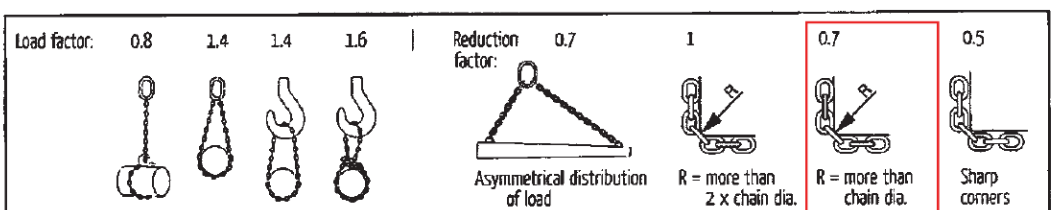
DATE






## Reduction Factors

To be used for various slinging methods and conditions without shock loads.




8800 lbs x 0.7 =
6160 lbs

## Heavy Duty® Hoist Rings

**Material:** Forged alloy steel with minimum tensile strength of 180,000 psi.

**Design Factor:** Minimum Safety Factor = 5:1, 100% magnetic particle inspected, Hoist Rings retain the same rated load from 0 to 90 degrees from the bolt axis

**Range of Movement:** Pivot 180°, Swivel 360°

**Specifications:** Meets Military Specification No. MIL-STD 209C, Meets ANSI/ASME B30.26

**Finish:** Black Oxide Finish for corrosion resistance, * Also available in a wide range of plating - e.g Cadmium, Titanium-Cadmium, Nickel, etc.

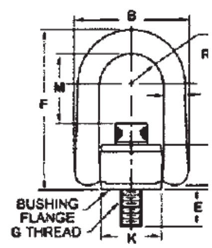
**Typical Applications:** ADB's HEAVY DUTY® Hoist Rings are specified and used in nuclear energy equipment

**Patent:** #4,570,987***, #4,641,985***, #5,405,210, Other Patents Pending

All dimensions approximate variations do not effect use or design factor.

Safety Instructions

Click Image to Enlarge




**Heavy Duty® Hoist Rings**

| Part No. | Rated Load (lbs) | A | B | C | D | E | F | G | K | L | M | TL *ft-lbs | WT. lbs. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 33101 | 8000 | 1.40 | 5.10 | 2.05 | 1.00 | 1.20 | 7.37 | 7/8-9 | 2.81 | 0.18 | 3.32 | 160 | 7.33 |
| •33161 | 8000 | 1.40 | 5.10 | 2.05 | 1.00 | 1.20 | 9.00 | 7/8-9 | 2.81 | 0.18 | 4.82 | 160 | 8.06 |
| 33105 | 10000 | 1.40 | 5.10 | 2.05 | 1.00 | 1.45 | 7.37 | 1" - 8 | 2.81 | 0.18 | 3.20 | 230 | 7.57 |
| •33165 | 10000 | 1.40 | 5.10 | 2.05 | 1.00 | 1.45 | 9.00 | 1" - 8 | 2.81 | 0.18 | 4.82 | 230 | 8.30 |
| 33106 | 10000 | 1.40 | 5.10 | 2.05 | 1.00 | 1.20 | 7.37 | 1" - 8 | 2.81 | 0.18 | 3.20 | 230 | 7.63 |
| •33166 | 10000 | 1.40 | 5.10 | 2.05 | 1.00 | 1.20 | 9.00 | 1" - 8 | 2.81 | 0.18 | 4.82 | 230 | 8.36 |
| 33107 | 10000 | 1.40 | 5.10 | 2.05 | 1.00 | 2.20 | 7.37 | 1" - 8 | 2.81 | 0.18 | 3.20 | 230 | 7.81 |
| •33167 | 10000 | 1.40 | 5.10 | 2.05 | 1.00 | 2.20 | 9.00 | 1" - 8 | 2.81 | 0.18 | 4.2 | 230 | 8.54 |
| 33402 | 15000 | 2.00 | 6.75 | 2.87 | 1.25 | 1.88 | 9.22 | 1 1/4" - 7 | 3.88 | 0.18 | 3.74 | 470 | 15.74 |
| 33401 | 15000 | 2.00 | 6.75 | 2.87 | 1.25 | 2.63 | 9.22 | 1 1/4" - 7 | 3.88 | 0.18 | 3.74 | 470 | 16.0 |
| †33420 | 20000 | 2.00 | 6.75 | 2.87 | 1.25 | 2.63 | 9.22 | 1 3/8" - 6 | 3.88 | 0.32 | 3.62 | 670 | 17.2 |
| 33424 | 24000 | 2.00 | 6.75 | 2.87 | 1.25 | 2.63 | 9.22 | 1 1/2" - 6 | 3.88 | 0.32 | 3.49 | 800 | 18.1 |
| †33427 | 30000 | 2.00 | 6.75 | 2.87 | 1.25 | 2.96 | 9.22 | 2-4" - 1/2 | 3.88 | 0.32 | 3.49 | 800 | 22.9 |
| †33432 | 30000 | 2.00 | 6.75 | 2.87 | 1.25 | 2.96 | 9.22 | 2" - 8 | 3.88 | 0.32 | 3.49 | 800 | 22.9 |

Girders and Trolleys

Bridge endtrucks

† Supplied with stud and nut • Long Bar Models * Recommended Torque Load

For load ranges of 50,000 to 250,000 lbs. refer to our Safety Engineered Hoist Rings.

Heavy Duty® Hoist Rings are completely interchangeable with Safety Engineered Hoist Rings.

*** Patent Expired

**Ingress/Egress Route**

CC. **Appendix CC – Accident Prevention Plan (APP)**

Please see the following pages to find an example accident prevention plan.

Following are examples of some of the items required to be included in the Accident Prevention Plan:

- Project Overview
  - Description

Crane Parts Manufacturers

**Contract Number: NXXXXX-XX-X-XXXX**
**Project #: NXXXX-XX-X-XXXXX**
**Project Description: Procurement of one 50 ton overhead electric travelling crane for Shipyard Facility ABC**
**Description of Work to be Performed: Offload and Installation of 50 Ton Overhead Electric Traveling Crane**
**Location: Shipyard Facility ABC, Norfolk, VA**

  - Contacts

Crane Parts Manufacturers

| | | |
|---|---|---|
| **Plan Preparer:** | **Jim Jones, Safety Manager** | **Office Number: 555-444-3210**<br>**Cell Number: 555-678-9012** |
| **Signature:** | Jim Jones | |
| **Approved:** | **Jane Smith, Vice President** | **Office Number: 555-444-4321**<br>**Cell Number: 555-678-5678** |
| **Signature:** | Jane Smith | |
| **Concurrence:** | **Bill Smith, Quality Assurance** | **Office Number: 555-444-8765**<br>**Cell Number: 555-678-1289** |
| **Signature:** | Bill Smith | |

## ❖ Responsibilities & Lines of Authority

1. Project Manager
   a. Has the responsibility for the safety and the results that are achieved.
   b. Assigned authority for the implementation of the safety program.
   c. Holds supervisors accountable for a high level of performance.
   d. Measures results of performance.
   e. Approves safety policies formulated by the Safety Committee, staff or others.
   f. Sets the proper example in safety for all employees.
   g. Demands safety adherence and compliance with the Company safety program from all employees and subcontractors.
2. Job Supervisor and Safety Coordinator
   a. Inspects work areas and equipment for compliance with work rules and safety standards.
   b. Conducts daily safety meetings.
   c. Instructs employees on the hazards of the job, how to work safely and according to operating procedures, and on applicable safety and health regulations.
   d. Reports all accidents and injuries promptly ***to NCC or site contact.***
   e. Analyzes all processes, operations and facilities for hazards and changes or eliminates the hazards.
   f. Compliments safe workers in the presence of co-workers.
   g. Sets the proper example for safety by complying with the safety program and displaying a positive attitude toward the program.
   h. Maintains a safe and healthful work place, proper housekeeping, proper illumination and ventilation, and ensures the use of personal protective equipment as required by each job.
   i. Prior to each job, ensures that Company and subcontractor employees are aware of the safety requirements and practices applicable to the job.
   j. Investigates all accidents and injuries and completes the required reports within the allotted time.
   k. Posts required and pertinent safety signs, posters and information.
   l. Serves on the Safety Committee.
   m. Serves on accident investigation committee, if requested.
   n. Ensures that all injured employees receive prompt medical attention.
   o. Instructs all employees on job-site specific emergency procedures.
   p. Reports to the Project Manager
   q. Will be present on-site.
   r. Smoking will only be allowed in site approved locations.
3. Employees
   a. Work in accordance with safe job practices and comply with Company, owner and governmental safety rules.
   b. Use required personal protective equipment.
   c. Report all unsafe conditions or practices.
   d. Make safety suggestions.
   e. Cooperate during the investigation of any accidents that occur.
   f. Take an active part and participate in safety meetings or training.
   g. Only perform jobs or operations for which they have been trained or checked out on.
   h. Serve on safety committee, if requested.
   i. Promptly report to supervisor all accidents and injuries.
   j. Complete an employee accident form when involved in an accident.
   k. Report directly to the Site Supervisor
4. Lines of authority in order:
   a. Project Manager > Site Supervisor > Employees/Subcontractors

- Subcontractors and Suppliers

Subcontractor and Supplier names and responsibilities will be provided as they are hired to the Contracting Officer and the Government Quality Assurance Representative prior to the operation of any equipment on-site.
Sub-contractors will receive Crane Parts Manufacturers Company Safety Training prior to on-site work and will be held responsible for all safety procedures set forth in the Crane Parts Manufacturers Company Safety manual and this site safety plan.

Current Subcontractors and Suppliers:
Company XYZ
LMNOP, Inc.

- Statement of Safety and Health Policy

It is the policy of Crane Parts Manufacturers (CPM) to provide a safe and healthful work environment for our employees. The personal safety and health of each employee of the Company is of primary importance. Our objective is a safety and health program that will reduce the number of injuries and illnesses. Our goal is zero accidents and injuries.

- Accident Reporting

The Crane Parts Manufacturer Project Manager shall be required to:
Report all accidents as soon as possible but not more than 24 hours afterwards to the Contracting Officer/Representative (CO/COR).

The Project Manager shall thoroughly investigate the accident and submit the findings of the investigation along with appropriate corrective actions to the CO/COR in the prescribed format as soon as possible but no later than five (5) working days following the accident.

Corrective actions will be implemented as soon as reasonably possible.

## ❖ Training

The Site Supervisor will conduct safety orientation/training for each new employee prior to work and job-site assignment. The supervisor will document the names of the attendees and the topics reviewed, and provide the information to the on-site government quality assurance representative.

The safety orientation will consist, as a minimum, of the following topics:

- Personal protective equipment requirements.
- Hazardous substances being used.
- Specific site safety requirements.
- Unusual conditions (e.g., excavating/trenching).
- Emergency telephone numbers and location of nearest phone.
- Location of closest medical treatment facility.
- Location of fire fighting equipment.
- Qualified first aid/CPR persons on site.
- Accident reporting.
- Housekeeping.

All equipment operators will be properly qualified. Equipment will be operated only by a qualified operator that has passed a practical examination and is certified or trained for operation of that specific type of equipment.
The project manager and supervision will ensure that all personnel are properly trained and instructed for all jobs which require specific training and/or competency to meet all applicable OSHA regulations, state and federal law, and activity requirements.

## ❖ Activity Hazard Analysis (AHA)

| Principle Steps | Potential Hazards | Recommended Controls |
|---|---|---|
| • Off Load of Crane at Site<br>• Erection of Crane at Facilities<br>• Certified Load Testing | Falling Tools/Hardware/Other | • Area of work will be roped off or marked to prevent pedestrian traffic.<br>• Only qualified personnel will operate the equipment<br>• Operators will be instructed to not lift over pedestrian traffic.<br>• Rigging will be performed by qualified personnel only<br>• Do not remove tie down chains until load has been supported by forklift or mobile crane |
| • Installation of Electrical Conductors<br>• Start-up of Crane<br>• Testing of Crane | Electric Shock | • Discuss building power with General Contractor<br>• The floor mounted disconnect will be locked out while CPM is on site until crane is ready to operate<br>• Personnel will follow guidelines for lockout/tagout procedures. |
| • Mounting Electrical Conductor Brackets.<br>• Miscellaneous Components During Assembly of Crane. | Fire/Welding/Hotwork<br>Fall Hazard | • Burn blankets will be used during cutting/welding procedures to catch slag/sparks and to protect existing structures<br>• Fire extinguishers will be placed in the vicinity and in surrounding areas of the "hotwork" prior to start of work<br>• Emergency phone number for the Fire Department will be posted at the designated location on-site and in Appendix K of the Accident Prevention Plan<br>• 100% tie off required in manlift |

## DD. Appendix DD – Training Course Outline

Please see the following pages to find an example training course outline.

Crane Training Outline

vi. Safety Training (2 hrs) – Maximum Class Size 10 Personnel
1. General Crane Terminology
2. Safe Operating Procedures
3. OSHA Requirements for Cranes and Hoists
4. Pre-use inspection of equipment.
5. Safety features on Crane

vii. Operational Training (2 hours) – Maximum Class Size 10 Personnel
1. Operator / Rigger Communication Using Hand Signals
2. Crane Operators Pre-Use Inspection
3. Safe Practices
4. Operation
a. Hoist
b. Trolley
c. Bridge
5. Shut Down
6. Radio Control
7. Emergency Stop Buttons
8. Warning Devices

viii. Troubleshooting and Maintenance (4 hours) – Maximum Class Size 8 Personnel
1. Maintenance Manual Review
a. Lubrication
b. Brake Adjustment
c. Preventative Maintenance
2. Drive Manual Review
3. Review of Electrical Drawings
4. Crane VFD Review and Minor Programming Features
5. Required OSHA Inspections and Proper Documentation

EE. **Appendix EE – Brake Adjustment Report**

Please see the following page for a sample brake adjustment report.

Contract Number: ______________ Crane Manufacturer: ______________ Rev 1

Crane Capacity: ______________ Crane Serial Number: ______________

| | Manufacturer | Model # | Serial # |
|---|---|---|---|
| Main Hoist Primary Brake | Magnetek/Mondel | 415-10001 8MST-ED23-MA | 897392.1 |
| Main Hoist Secondary Brake | Magnetek/Mondel | 415-15218 8MST-ED23S-MA | 897392.2 |
| Aux Hoist Primary Brake | - | - | - |
| Aux Hoist Secondary Brake | - | - | - |
| Trolley Brake #1 | Nord | BRE5 | 203408964-100 80 51871231 |
| Trolley Brake #2 | Nord | BRE5 | 203408964-200 80 51871233 |
| Bridge Brake #1 | Nord | BRE20 | 203408663-100 80 51693809 |
| Bridge Brake #2 | Nord | BRE20 | 203408663-200 80 51693810 |
| | | | |
| | | | |

| | | Main Hoist Primary Brake | Main Hoist Secondary Brake | Aux Hoist Primary Brake | Aux Hoist Secondary Brake | Trolley Brake #1 | Trolley Brake #2 | Bridge Brake #1 | Bridge Brake #2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Brake Nameplate Torque | | 230 lb. ft. | 230 lb. ft. | - | - | 5 Nm | 5 Nm | 20 Nm | 20 Nm | | [illegible] |
| Brake Adjusted Torque | | 120 lb. ft. | 120 lb. ft. | - | - | 2 Nm | 2 Nm | 20 Nm | 20 Nm | | [illegible] |
| Spring Length | Min | - | - | - | - | - | - | - | - | | |
| | Actual | - | - | - | - | - | - | - | - | | |
| | Max | - | - | - | - | - | - | - | - | | |
| Plunger Stroke or Air Gap | Min | 0.70" | 0.70" | - | - | 0.008" | 0.008" | 0.012" | 0.012" | | [illegible] |
| | Actual | 0.708" | 0.710" | - | - | 0.008" | 0.009" | 0.014" | 0.012" | | [illegible] |
| | Max | 0.89" | 0.89" | - | - | 0.024" | 0.024" | 0.031" | 0.031" | | [illegible] |
| Friction Material Thickness | Actual | 0.302" | 0.301" | - | - | 0.293" | 0.294" | 0.491" | 0.493" | | [illegible] |
| | Min | 0.0625" | 0.0625" | - | - | 0.177" | 0.177" | 0.295" | 0.295" | | [illegible] |
| Contact Percentage | | 60% | 60% | - | - | - | - | - | - | | [illegible] |
| Wheel Diameter or Caliper Thickness | Actual | 8.004" | 8.005" | - | - | - | - | - | - | | [illegible] |
| | Min | 7.940" | 7.940" | - | - | - | - | - | - | | [illegible] |
| Inspector Initials | | | | | | | | | | | |

Inspector: [illegible] Date: ______________

NOTES:
1. Any change to brake settings voids the signature and requires resubmittal of Brake Adjustment Record Form.
2. Contact percentage is only applicable to shoe and caliper disc brakes.
3. Wheel diameter is only applicable to shoe brakes.
4. Measurements should be made and recorded using OEMs given settings. (ie if OEM Spring Length is given in fractions, measurements should be taken and recorded in fractions)

NAVY CRANE CENTER FORM 09-002 Brake Adjustment Record Form (February 2013)

FF. **Appendix FF – Shop Test Deficient Items List**

Please see following page for a sample shop test deficient items list.

# Shop Test Sign-In

| | |
|---|---|
| Date(s): | |
| Contractor: | |
| Project Name: | |
| Contract Number: | |

| Organization | Name | Phone Number | Signature | Initial |
|---|---|---|---|---|
| Crane Contractor Representative | | | | |
| Supported Command Representative (if present) | | | | |
| NCC Representative | | | | |

| Organization | Name | Phone Number | Signature | Initial |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

## NCC CRANE

| | |
|---|---|
| Data as of: | [redacted] |
| Contract # | [redacted] |
| Crane | [redacted] |

S = SAT/Comment Closed, Complete
U = UNSAT/Comment Open, Incomplete

| Worksheet | Rework Type: Hardware S | Hardware U | Drawing S | Drawing U | Document & CCRF S | Document & CCRF U | Total Number of Rework Items | Total Open |
|---|---|---|---|---|---|---|---|---|
| Pre Shop Test | | | | 2 | | 2 | 4 | 4 |
| Structural | | | | | | | 31 | 31 |
| Electrical | | | | | | | 92 | 91 |
| Mechanical | 1 | | | | | | 8 | 7 |
| Shop Test | 1 | | | | | | 3 | 2 |
| Field Test | | | | | | | | |
| **Total** | 2 | | | 2 | | 2 | 138 | 135 |

The contractor, NAVCRANECEN, and Customer representatives (if applicable) shall initial each page of the punch list items.

Structural - Items found during the structural inspection of the crane

Contract # [redacted]
Crane
Data as of:

H Equipment Change/ Verification
D Drawing Change
O Documentation/CCRF Required/Record of Condition

| ITEM | DATE FOUND | FOUND BY | DESCRIPTION/COMMENTS | Type of Rework | RESOLUTION | DATE VERIFIED | VERIFIED BY | STATUS |
|---|---|---|---|---|---|---|---|---|
| S-001 | 7/13/22 | DB | The ladder rungs are spaced 10" apart. Section 5.1 of ANSI A14.3 requires ladder rung spacing to be 12". Section 2.3.1.6 of the specification requires all ladders to meet the requirements of ANSI A14.3. | | | | | UNSAT |
| S-002 | 7/13/22 | DB | The fasteners securing the ladder are not ASTM A325 bolts as shown in drawing 21057-174. Fasteners for ladders shall be considered commerical connections per section 2.3.1.6 of the specification. | | | | | UNSAT |
| S-003 | 7/13/22 | DB | Two rail clips on the North side of the South girder do not appear to be securing the rail (i.e. they are tilted upward). 7th clip from the West end of the girder and 5th clip from the East end of the girder. | | | | | UNSAT |
| S-004 | 7/13/22 | DB | The fasteners securing both of the swing gates are not ASTM A325 bolts as shown in drawing 21057-125 Rev 3. Fasteners for swing gates shall be considered structural connections per section 2.3.1.6 of the specification. | | | | | UNSAT |
| S-005 | 7/13/22 | DB | North side of South girder, weld between top flange and web, approximately 10.5' from the West end has porocity that appears to exceed the allowance in section 10.6 of AWS D14.1:2005, as required by section 2.3.1.2 of the specification. | | | | | UNSAT |
| S-006 | 7/13/22 | DB | At the east end of the bridge walkway, the toeboard (where diamond plate is bent up to form a corner) is not welded as shown in drawing 21057-130 Rev 0 | | | | | UNSAT |
| S-007 | 7/13/22 | DB | At the West end of the bridge walkway, neither of the toeboard corners (where the diamond plate is bent up to form a corner) are welded, as shown in drawing 21057-130 Rev 0. | | | | | UNSAT |
| S-008 | 7/13/22 | DB | On the underside of the trolley, the welds at the ends of the tapered I beam (item 4 on drawing 21057-201 Rev 0) appear to have convexity and overlap. Please verify the welds meet the profile requirements of section 10.7.1 of AWS D14.1:2005, as required by section 2.3.1.2 of the specification. | | | | | UNSAT |
| S-009 | 7/13/22 | DB | On the underside of the trolley, near the equalizer, the top corner of the weld that connects the full-height stiffener to the tapered I beam (connection of item 8 to item 4 on drawing 21057-201) on the North side looks like it could have a crack. Please verify there are no cracks, as required by section 10.6 of AWS D14.1:2005 and section 2.3.1.2 of the specificaton. | | | | | UNSAT |
| S-010 | 7/13/22 | DB | On the underside of the trolley, near the equalizer, the top corner of the weld that connects the stiffener to the tapered I beam (connection of item 5 to item 4 on drawing 21057-201) on the North side looks like it could have a crack. Please verify there are no cracks, as required by section 10.6 of AWS D14.1:2005 and section 2.3.1.2 of the specification. | | | | | UNSAT |

Rev 1/2019

DB
JL

5 of 20

Typically completed by Government during Shop Test

Deficient Items List

**Structural - Items found during the structural inspection of the crane**

Contract # [redacted]
Crane
Data as of:

**H** Equipment Change / Verification
**D** Drawing Change
**O** Documentation/CCRF Required/ Record of Condition

| ITEM | DATE FOUND | FOUND BY | DESCRIPTION/COMMENTS | Type of Rework | RESOLUTION | DATE VERIFIED | VERIFIED BY | STATUS |
|---|---|---|---|---|---|---|---|---|
| S-001 | 7/13/22 | DB | The ladder rungs are spaced 10" apart. Section 5.1 of ANSI A14.3 requires ladder rung spacing to be 12". Section 2.3.1.6 of the specification requires all ladders to meet the requirements of ANSI A14.3. | H | PH&C: New ladder will be fabricated.<br><br>NCC: New S-032 was added to track required drawing update. | | | UNSAT |
| S-002 | 7/13/22 | DB | The fasteners securing the ladder are not ASTM A325 bolts as shown in drawing 21057-174. Fasteners for ladders shall be considered commerical connections per section 2.3.1.6 of the specification. | H | PH&C: Mechanical fasteners used for shop test knowing that it will be dis-assembled for shipping. Structural hardware will be used at install | | | UNSAT |
| S-003 | 7/13/22 | DB | Two rail clips on the North side of the South girder do not appear to be securing the rail (i.e. they are tilted upward). 7th clip from the West end of the girder and 5th clip from the East end of the girder. | H | PH&C: Clips have been replaced | | | UNSAT |
| S-004 | 7/13/22 | DB | The fasteners securing both of the swing gates are not ASTM A325 bolts as shown in drawing 21057-125 Rev 3. Fasteners for swing gates shall be considered structural connections per section 2.3.1.6 of the specification. | H | PH&C: Mechanical fasteners used for shop test knowing that it will be dis-assembled for shipping. Structural hardware will be used at install | | | UNSAT |
| S-005 | 7/13/22 | DB | North side of South girder, weld between top flange and web, approximately 10.5" from the West end has porocity that appears to exceed the allowance in section 10.6 of AWS D14.1:2005, as required by section 2.3.1.2 of the specification. | H | PH&C: Weld has been repaired | | | UNSAT |
| S-006 | 7/13/22 | DB | At the east end of the bridge walkway, the toeboard (where diamond plate is bent up to form a corner) is not welded as shown in drawing 21057-130 Rev 0. | D | PH&C: Drawing has been updated | | | UNSAT |
| S-007 | 7/13/22 | DB | At the West end of the bridge walkway, neither of the toeboard corners (where the diamond plate is bent up to form a corner) are welded, as shown in drawing 21057-130 Rev 0. | D | PH&C: Drawing has been updated | | | UNSAT |
| S-008 | 7/13/22 | DB | On the underside of the trolley, the welds at the ends of the tapered I beam (Item 4 on drawing 21057-201 Rev 0) appear to have convexity and overlap. Please verify the welds meet the profile requirements of section 10.7.1 of AWS D14.1:2005, as required by section 2.3.1.2 of the specification. | H | PH&C: Weld has been repaired | | | UNSAT |
| S-009 | 7/13/22 | DB | On the underside of the trolley, near the equalizer, the top corner of the weld that connects the full-height stiffener to the tapered I beam (connection of Item 8 to Item 4 on drawing 21057-201) on the North side looks like it could have a crack. Please verify there are no cracks, as required by section 10.6 of AWS D14.1:2005 and section 2.3.1.2 of the specificaion. | O | PH&C: Weld has been inspected by CWI and is approved. Determined to be insufficient paint.<br><br>NCC will field verify all areas have been painted per paragraph 2.7.2 of the specification; this will be tracked via Item S-030. | 8/3/22 | DB | SAT |

Rev 1/2019

5 of 21

**Updated Deficient Items List**

**Typically completed by Contractor after Shop Test. Typically required prior to Government approval of the Request to Ship.**

## GG. Appendix GG – Operation and Maintenance Data

Please see the following pages to find requirements for operation and maintenance data.

Operating and Maintenance Manual

ix. The Operation and Maintenance Manual shall have a table of contents. The table of contents shall include:
1. Operation instruction
2. Preventive Maintenance
3. Parts information
4. Drawing list
5. Supply list
6. Catalog cuts
7. Photographs
8. Calculations

x. The body of the manuals shall include the following:
1. Detailed written procedures
2. Operation instructions
3. Preventive maintenance information
4. Drawings
5. Parts information
6. Supplies needed
7. Catalog cuts
8. Photographs
9. Calculations

xi. Operation
1. Operation information shall include the following:
a. Detailed crane operations
b. Safety device functions
c. Load handling safety instructions
d. Special precautions for starting/stopping

xii. Maintenance
1. Maintenance information shall include recommended maintenance procedures and manufacturer's installation and maintenance manuals (for purchased components) and lubrication instructions.
2. Also include the following:
a. Maintenance and programming instructions for the drives.
b. Maintenance instructions including maintenance, alignment, adjustment, and calibration instructions for commercial components and parts lists.
c. Preventive maintenance instructions including location of lubrication points, type of lubricant to be used, and the frequency of lubrication, which shall agree with the lubrication drawing provided.
d. A complete listing of all control system parameters with an explanation of their functions.

3. Parts information shall include all information on all contractor-designed parts, all purchased sub-assemblies and components including the manufacturer’s part number. The information shall be broken-out to the smallest replacement part. Also, include a recommended spare parts list.
4. Drawings shall be the as-built construction drawings.
5. Catalog cuts of the approved design.
6. Photographs, if applicable.
7. Approved calculations.

HH. **Appendix HH – Control System Parameter Record**

Please see the following pages for an example of the control system parameter record.

Model: 4045 G+ Series 3, Flash ID: 8001.5
Customer Name:
Application:
Order Number:

# SNAPSHOT OF CONTROL SYSTEM PARAMETER LIST

| Parameter | Description | Setting | Unit | Mod |
|---|---|---|---|---|
| A1-00 | Select Language | 0:English | | |
| A1-01 | Access Level | 2:Advanced Level | | |
| A1-02 | Control Method | 0:V/F Control | | * |
| A1-03 | Motion | 0:Traverse | | * |
| A1-04 | Speed Ref | 5:Uni-Polar analog | | * |
| A1-05 | Init Parameters | 0:No Initialize | | |
| A1-06 | Enter Password 1 | Unlocked | | |
| A1-08 | Enter Password 2 | Locked | | |
| A2-01 | User Param 1 | No User Data | | |
| A2-02 | User Param 2 | No User Data | | |
| A2-03 | User Param 3 | No User Data | | |
| A2-04 | User Param 4 | No User Data | | |
| A2-05 | User Param 5 | No User Data | | |
| A2-06 | User Param 6 | No User Data | | |
| A2-07 | User Param 7 | No User Data | | |
| A2-08 | User Param 8 | No User Data | | |
| A2-09 | User Param 9 | No User Data | | |
| A2-10 | User Param 10 | No User Data | | |
| A2-11 | User Param 11 | No User Data | | |
| A2-12 | User Param 12 | No User Data | | |
| A2-13 | User Param 13 | No User Data | | |
| A2-14 | User Param 14 | No User Data | | |
| A2-15 | User Param 15 | No User Data | | |
| A2-16 | User Param 16 | No User Data | | |
| A2-17 | User Param 17 | No User Data | | |
| A2-18 | User Param 18 | No User Data | | |
| A2-19 | User Param 19 | No User Data | | |
| A2-20 | User Param 20 | No User Data | | |
| A2-21 | User Param 21 | No User Data | | |
| A2-22 | User Param 22 | No User Data | | |
| A2-23 | User Param 23 | No User Data | | |
| A2-24 | User Param 24 | No User Data | | |
| A2-25 | User Param 25 | No User Data | | |
| A2-26 | User Param 26 | No User Data | | |
| A2-27 | User Param 27 | No User Data | | |
| A2-28 | User Param 28 | No User Data | | |
| A2-29 | User Param 29 | No User Data | | |
| A2-30 | User Param 30 | No User Data | | |
| A2-31 | User Param 31 | No User Data | | |
| A2-32 | User Param 32 | No User Data | | |
| B1-01 | Reference 1 | 0.00 | Hz | |
| B1-02 | Reference 2 | 0.00 | Hz | |
| B1-03 | Reference 3 | 0.00 | Hz | |
| B1-04 | Reference 4 | 0.00 | Hz | |
| B1-05 | Reference 5 | 0.00 | Hz | |
| B1-06 | Reference 6 | 0.00 | Hz | |
| B1-07 | Reference 7 | 0.00 | Hz | |
| B1-08 | Reference 8 | 0.00 | Hz | |
| B1-09 | Reference 9 | 0.00 | Hz | |



'*' indicates a modified constant

| Parameter | Description | Setting | Unit | Mod |
|---|---|---|---|---|
| B1-10 | Reference 10 | 0.00 | Hz | |
| B1-11 | Reference 11 | 0.00 | Hz | |
| B1-12 | Reference 12 | 0.00 | Hz | |
| B1-13 | Reference 13 | 0.00 | Hz | |
| B1-14 | Reference 14 | 0.00 | Hz | |
| B1-15 | Reference 15 | 0.00 | Hz | |
| B1-16 | Reference 16 | 0.00 | Hz | |
| B1-17 | Jog Reference | 6.00 | Hz | |
| B1-18 | Ref Priority | 1:Analog Ref Only | | |
| B2-01 | Ref Upper Limit | 100.0 | % | |
| B2-02 | Ref Lower Limit | 0.0 | % | |
| B2-03 | Ref1 Lower Limit | 2.0 | % | |
| B2-04 | Alt Upper Limit | 100.0 | % | |
| B3-01 | Reference Source | 1:Terminals | | |
| B3-02 | Run Source | 1:Terminals | | |
| B3-03 | Stopping Method | 0:Decel to Stop | | |
| B3-04 | Change Rotation | 0:Normal Rotation | | |
| B3-06 | Cntl Input Scans | 1:5mS - 2 Scans | | |
| B3-07 | LOC/REM RUN Sel | 0:Cycle Extrn RUN | | |
| B3-08 | RUN CMD at PRG | 0:Disabled | | |
| B3-10 | AllowRun@Powerup | 0:Disabled | | |
| B4-01 | MOP Ref Memory | 0:Disabled | | |
| B4-02 | Trim Control Lvl | 10 | % | |
| B5-01 | Accel Time 1 | 7.0 | sec | * |
| B5-02 | Decel Time 1 | 8.0 | sec | * |
| B5-03 | Accel Time 2 | 2.0 | sec | |
| B5-04 | Decel Time 2 | 2.0 | sec | |
| B5-05 | Acc Time N Chg | 2.0 | sec | |
| B5-06 | Dec Time N Chg | 2.0 | sec | |
| B5-08 | Fast Stop Time | 0.5 | sec | |
| B5-09 | Acc/Dec Units | 1:0.1 Seconds | | |
| B5-10 | Acc/Dec SW Freq | 120.0 | Hz | |
| B5-11 | SW Freq. Compare | 1:Upper SW Freq | | |
| B5-12 | Accel Time 3 | 3.0 | sec | |
| B5-13 | Decel Time 3 | 3.0 | sec | |
| B5-14 | Accel Time 4 | 3.0 | sec | |
| B5-15 | Decel Time 4 | 3.0 | sec | |
| B6-01 | SpdSrch at Start | 2:Spdsrchl Disable | | |
| B6-02 | SpdSrch Current | 120 | % | |
| B6-03 | SpdSrch Dec Time | 2.0 | sec | |
| B6-05 | Search Delay | 0.2 | sec | |
| B6-10 | Srch Detect Comp | 1.10 | | |
| B6-14 | Bidir Search Sel | 1:Enabled | | |
| B8-01 | Jump Freq 1 | 0.0 | Hz | |
| B8-02 | Jump Freq 2 | 0.0 | Hz | |
| B8-03 | Jump Freq 3 | 0.0 | Hz | |
| B8-04 | Jump Bandwidth | 1.0 | Hz | |
| B9-01 | Field-Weak Lvl | 80 | % | |
| B9-02 | Field-Weak Freq | 0.0 | Hz | |
| C1-01 | Quick Stop 0/1 | 0:Disabled | | |
| C1-02 | Quick Stop Time | 1.0 | sec | |
| C1-03 | Reverse Plug 0/1 | 1:Enabled | | * |
| C1-04 | Rev-Plg Dec Time | 8.0 | sec | * |

II. **Appendix II – List of Parameters and Crane OEM's Approved Crane Range**

Please see the following sheet for an example of the list of parameters and crane OEM's approved crane range.

## List of Paramaters and Crane OEM's Approved Crane Range

*( Complete one form for each drive on the crane, identify Parameter Identification, Crane Design Range, Current Setting and Drive OEM Range for all parameters used, identify all parameters not used as "Not Applicable".)*

**Crane Drive Usage**

**Date** 5-10-10

| | |
|---|---|
| Crane | 20/5T PNSY |
| Function (Hoist / Bridge / Trolley) | HOIST |

**Manufacturer and Drive**

| | |
|---|---|
| Drive Manufacturer | NCC DRIVE |
| Drive Type | HD+3 |

**Acceleration and Deceleration Times** *(Identify the range for any acceleration and deceleration rates of the drive)*

| Function | Parameter ID | Drive OEM Range | Crane Range | Current Setting | Applicable |
|---|---|---|---|---|---|
| Acceleration Time 1 | A-01 | 0-25 SEC | 2-10 SEC | 3.5 SEC | Y |
| Deceleration Time 1 | D-01 | 0-25 SEC | 1.5-10 SEC | 2 SEC | Y |
| Acceleration Time 2 (If multiple acceleration rates are required) | A-02 | 0-25 SEC | N/A | N/A | N |
| Deceleration Time 2 (If multiple decceleration rates are required) | D-02 | 0-25 SEC | N/A | N/A | N |

**Emergency Stop/ Quick Stop/ Reverse Plugging Simulation** *(Identify if a quick stop, emergency stop, simulated plugging or other function which causes an increased acceleration or deceleration rate can be activated and provide acceptable ranges of deceleration and acceleration (as applicable)*

| Function | Parameter ID | Drive OEM Range | Crane Range | Current Setting | Applicable |
|---|---|---|---|---|---|
| Emergey Stop/ Quick Stop Enable | ES-01 | 0-1 | N/A | N/A | N |
| Emergency Stop/ Quick Stop Deceleration time | ES-02 | 0-25 SEC | N/A | N/A | N |
| Reverse Plug Enable | RP-01 | 0-1 | 0-1 | 1 | Y |
| Reverse Plug Decel Time | RP-02 | 0-25 SEC | 1.5-10 SEC | 1.5 SEC | Y |
| Reverse Plug Accel Time | RP-03 | 0-25 SEC | 2-10 SEC | 2 SEC | Y |

**Micro Speed/ Slow Speed/Ultra Lift/Quick Lift** *(Identify if a function that can limit the speed to below 60 HZ or allow speeds greater than 60 HZ can be activated and provide the acceptable speed ranges for these functions.)*

| Function | Parameter ID | Drive OEM Range | Crane Range | Current Setting | Applicable |
|---|---|---|---|---|---|
| Micro Speed/Slow Speed Enable | MS-01 | 0-1 | 0-1 | 1 | Y |
| Micro Speed/Slow Speed Gain Multiplier | MS-011 | 0-100% | 3-100% | 25% | Y |
| Ultra Lift/Quick Lift/Fast Lift Enable | QL-01 | 0-1 | 0-1 | 1 | Y |
| Ultra Lift/Quick Lift/Fast Lift Maximum Frequency Forward | QL-02 | 0-150 HZ | 60-120 HZ | 120 HZ | Y |
| Ultra Lift/Quick Lift/Fast Lift Maximum Frequency Reverse | QL-03 | 0-150 HZ | 60-120 HZ | 120 HZ | Y |
| Ultra Lift/Quick Lift/Fast Lift Maximum Torque Allowed Fast Speed Forward | QL-04 | 0-100% | 0-8.5% | 7% | Y |
| Ultra Lift/Quick Lift/Fast Lift Maximum Torque Allowed Fast Speed Reverse | QL-05 | 0-100% | 0-8.5% | 7% | Y |
| Maximum Frequency Of Operation At Fast Speed | QL-06 | 40-150 HZ | 40-120 HZ | 120 HZ | Y |

- 100% load = 85% DRIVE TOR
- 10% limit for Quick lift
  yield .1 x 85% = 8.5%

**No-Load Brake Start/Stop** *(Indentify for Hoist Functions without load brakes the maximum duration of load float)*

| Function | Parameter ID | Drive OEM Range | Crane Range | Current Setting | Applicable |
|---|---|---|---|---|---|
| Load Float Time | LF-01 | 0-255 sec | 0-5 sec. | 3 sec. | Y |

**Speed Points** *(For Functions with unique speed points identify the speeds each speed point can be set.)*

| Function | Parameter ID | Drive OEM Range | Crane Range | Current Setting | Applicable |
|---|---|---|---|---|---|
| Speed Point 1 | S-01 | 0-60 HZ | N/A | N/A | N |
| Speed Point 2 | S-02 | 0-60 HZ | N/A | N/A | N |
| Speed Point 3 | S-03 | 0-60 HZ | N/A | N/A | N |
| Speed Point 4 | S-04 | 0-60 HZ | N/A | N/A | N |
| Speed Point 5 | S-05 | 0-60 HZ | N/A | N/A | N |

APPENDIX F

JJ. **Appendix JJ – Frequency Allocation Application**

Please see the following sheets for an example of the frequency allocation application.

| APPLICATION FOR EQUIPMENT FREQUENCY ALLOCATION | CLASSIFICATION<br>UNCLASSIFIED | DATE<br>3/12/2010 | FORM APPROVED<br>OMB No. 0704-0188<br>1 of 7 Pages |
|---|---|---|---|

**DOD GENERAL INFORMATION**

| TO | FROM |
|---|---|
| Department of the Navy<br>Navy Marine Corp Spectrum Center<br>2461 Eisenhower Avenue Suite 1202<br>Alexandria, VA 22331-1400 | Company Name and Address |

1. APPLICATION TITLE Manufacturer of the equipment

2. SYSTEM NOMENCLATURE MLTX Series

3. STAGE OF ALLOCATION *(X one)*
- [ ] a. STAGE 1 CONCEPTUAL
- [ ] b. STAGE 2 EXPERIMENTAL
- [ ] c. STAGE 3 DEVELOPMENTAL
- [x] d. STAGE 4 OPERATIONAL

4. FREQUENCY REQUIREMENTS
   a. FREQUENCY(IES) 430 to 439.8 MHz
   b. EMISSION DESIGNATOR(S) TX = 224KF1D RX = 224KF1D

5. TARGET STARTING DATE FOR SUBSEQUENT STAGES

| a. STAGE 2 | b. STAGE 3 | c. STAGE 4 |
|---|---|---|
| | | 3/26/2010 |

6. EXTENT OF USE
   INTERMITTENT

7. GEOGRAPHICAL AREA FOR
   a. STAGE 2
   b. STAGE 3
   c. STAGE 4

8. NUMBER OF UNITS

| a. STAGE 2 | b. STAGE 3 | c. STAGE 4 |
|---|---|---|
| | | Two (2) Transmitters |

Government representatives' info here

9. NUMBER OF UNITS OPERATING … ME ENVIRONMENT: ONE (1) ONLY

10 OTHER J/F 12 APPLICATION NUM…
- [ ] a. SUPERSEDED J/F 12/
- [ ] b. RELATED J/F 12/

11. IS THERE ANY OPERATIONAL REQUIREMENT AS DESCRIBED IN THE INSTRUCTIONS FOR PARAGRAPH 11?
- [ ] a. YES
- [ ] b. NO
- [ ] c. NAvail

12. NAMES AND TELEPHONE NUMBERS

| | (1) COMMERCIAL | (2) AUTOVON |
|---|---|---|
| a. PROGRAM MANAGER | Work phone # | DSN |
| b. PROJECT ENGINEER | Work phone # | DSN |

13. REMARKS

| DOWNGRADING INSTRUCTIONS | CLASSIFICATION | |
|---|---|---|
| N/A | UNCLASSIFIED | |

DD Form 1494, AUG 96

| CLASSIFICATION | PAGE |
|---|---|
| UNCLASSIFIED | 2 of 7 Pages |

**TRANSMITTER EQUIPMENT CHARACTERISTICS**

| | |
|---|---|
| 1. NOMENCLATURE, MANUFACTURER'S MODEL NO.<br>MLTX transmitter Unlicensed (Part 15) | 2. MANUFACTURER'S NAME<br>Manufacturer's name here (also on other sheets) |
| 3. TRANSMITTER INSTALLATION<br>Man-portable carried by crane operator | 4. TRANSMITTER TYPE<br>FSK UHF Solid State Digital |
| 5. TUNING RANGE<br>430 to 439.8MHz | 6. METHOD OF TUNING<br>Synthesized PLL |
| 7. RF CHANNELING CAPABILITY<br>430.0, 432.4, 436.0 to 439.8MHz in 200kHz increments, 20 channels, 433.125 to 434.725MHz in 200kHz increments, 9 channels | 8. EMISSION DESIGNATOR(S)<br>224KF1D |
| 9. FREQUENCY TOLERANCE<br>+/- 10ppm | |
| 10. FILTER EMPLOYED *(X one)*<br>☒ a. YES ☐ b. NO | |
| 11. SPREAD SPECTRUM *(X one)*<br>☐ a. YES ☒ b. NO | 12. EMISSION BANDWIDTH *(X and complete as applicable)*<br>☐ CALCULATED ☒ MEASURED |
| 13. MAXIMUM BIT RATE<br>9600 bps | a. -3dB = 80.5kHz<br>b. -20dB = 123.5kHz |
| 14. MODULATION TECHNIQUES AND CODING<br>BFSK Digital Telemetry Data with CRC | c. -40dB = NA<br>d. -60dB = 760kHz<br>e. OC-BW = 223.8kHz<br>15. MAXIMUM MODULATION FREQUENCY 9.6kHz |
| 16. PRE-EMPHASIS *(X one)*<br>☐ a. YES ☒ b. NO | 17. DEVIATION RATIO<br>8.333 |
| | 18. PULSE CHARACTERISTICS |
| 19. POWER | a. RATE NA |
| a. MEAN 4.0mW | b. WIDTH |
| b. PEP N/A | c. RISE TIME |
| 20. OUTPUT DEVICE<br>Transistor, Chipcon CC1020 | d. FALL TIME<br>e. COMP RATIO<br>21. HARMONIC LEVEL |
| 22. SPURIOUS LEVEL<br>-79.6dBc | a. 2nd<br>-62.9dBc |
| 23. FCC TYPE ACCEPTANCE NO.<br>TNE-430MLTX | b. 3rd<br>-60.6dBc<br>c. OTHER<br>-55.5dBc @ 1720MHz |
| 24. REMARKS | |

| CLASSIFICATION | |
|---|---|
| UNCLASSIFIED | |

DD Form 1494, AUG 96

| CLASSIFICATION | PAGE |
|---|---|
| UNCLASSIFIED | 3 of 7 Pages |

## RECEIVER EQUIPMENT CHARACTERISTICS

| | |
|---|---|
| 1. NOMENCLATURE, MANUFACTURER'S MODEL NO.<br>Part 15 receiver, 46S03947 | 2. MANUFACTURER'S NAME |
| 3. RECEIVER INSTALLATION<br>Overhead Cranes | 4. RECEIVER TYPE<br>Single Conversion, Superheterodyne |
| 5. TUNING RANGE<br>430 to 439.8 MHz | 6. METHOD OF TUNING<br>Synthesizer, fixed crystal |
| 7. RF CHANNELING CAPABILITY<br>430.0, 432.4, 436.0 to 439.8MHz in 200kHz increments, 20 channels, 433.125 to 434.725MHz in 200kHz increments, 9 channels | 8. EMISSION DESIGNATOR(S)<br>224KF1D |
| 9. FREQUENCY TOLERANCE<br>+/- 10ppm | |

| 10. IF SELECTIVITY | 1st | 2nd | 3rd |
|---|---|---|---|
| a. -3 dB | 307.2kHz | | |
| b. -20 dB | 307.2kHz | | |
| c. -60 dB | 307.2kHz | | |

11. RF SELECTIVITY (X and complete as applicable)

☐ CALCULATED ☒ MEASURED

| | |
|---|---|
| a. -3 dB | 21.3MHz |
| b. -20 dB | 26.4MHz |
| c. -60 dB | 36.6MHz |
| d. Preselection Type | SAW filter |

| 12. IF FREQUENCY | |
|---|---|
| a. 1st | 307.2 MHz |
| b. 2nd | N/A |
| c. 3rd | N/A |

| | |
|---|---|
| 13. MAXIMUM POST DETECTION FREQUENCY | 4900Hz |
| 14. MINIMUM POST DETECTION FREQUENCY | 900Hz |
| 16. MAXIMUM BIT RATE | 9600 bps |

| 15. OSCILLATOR TUNED | 1st | 2nd | 3rd |
|---|---|---|---|
| a. ABOVE TUNED FREQUENCY | X | | |
| b. BELOW TUNED FREQUENCY | | | |
| c. EITHER ABOVE OR BELOW THE FREQUENCY | | | |

| 17. SENSITIVITY | |
|---|---|
| a. SENSITIVITY | -105 dBm |
| b. CRITERIA | BER test |
| c. NOISE FIG | 7dB |
| d. NOISE TEMP | NA |

18. DE-EMPHASIS *(X one)*

☐ a. YES ☒ b. NO

19. IMAGE REJECTION 30.9 dB

20. SPURIOUS REJECTION 52dB

21. REMARKS

DD Form 1494, AUG 96

| CLASSIFICATION | PAGE |
|---|---|
| UNCLASSIFIED | 4 of 7 Pages |

## ANTENNA EQUIPMENT CHARACTERISTICS

1. ☒ a. TRANSMITTING ☐ b. RECEIVING ☐ c. TRANSMITTING AND RECEIVING

| | |
|---|---|
| 2. NOMENCLATURE, MANUFACTURER'S MODEL NO. | 3. MANUFACTURER'S NAME |
| 4. FREQUENCY RANGE<br>430 to 439.8 MHz | 5. TYPE<br>Inverted F PCB |
| 6. POLARIZATION<br>Vertical | 7. SCAN CHARACTERISTICS<br>a. TYPE<br>Fixed |
| 8. GAIN | b. VERTICAL SCAN |
| a. MAIN BEAM<br>-12.3dBi | (1) Max Elev<br>N/A |
| b. 1st MAJOR SIDE LOBE<br>None, Omni directional | (2) Min Elev<br>N/A<br>(3) Scan Rate<br>N/A |
| 9. BEAMWIDTH | c. HORIZONTAL SCAN |
| a. HORIZONTAL<br>150° | (1) Sector Scanned<br>N/A |
| b. VERTICAL<br>180° | (2) Scan Rate<br>N/A<br>d. SECTOR BLANKING *(X one)*<br>☐ (1) YES ☒ (2) NO |

10. REMARKS

| | |
|---|---|
| CLASSIFICATION<br>UNCLASSIFIED | |

DD Form 1494, AUG 96

Manufacturer's information, including models number entered here

| CLASSIFICATION | PAGE |
|---|---|
| UNCLASSIFIED | 5 of 7 Pages |

## ANTENNA EQUIPMENT CHARACTERISTICS

1. ☐ a. TRANSMITTING ☒ b. RECEIVING ☐ c. TRANSMITTING AND RECEIVING

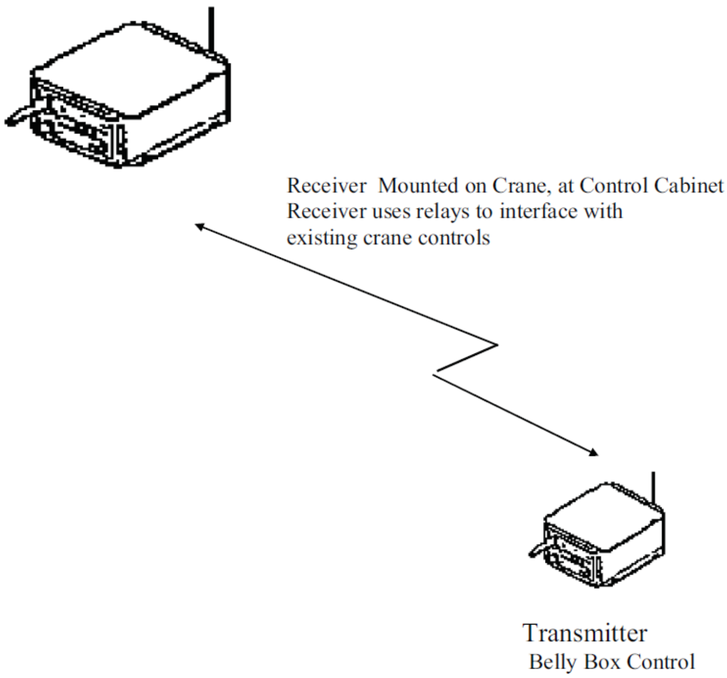
| | |
|---|---|
| 2. NOMENCLATURE, MANUFACTURER'S MODEL NO. | 3. MANUFACTURER'S NAME |
| 4. FREQUENCY RANGE<br>430 to 439.8 MHz | 5. TYPE<br>½ Wave monopole |
| 6. POLARIZATION<br>Vertical | 7. SCAN CHARACTERISTICS |
| | a. TYPE<br>Fixed |
| 8. GAIN | b. VERTICAL SCAN |
| a. MAIN BEAM<br>6.1dBi | (1) Max Elev<br>N/A |
| b. 1st MAJOR SIDE LOBE<br>None, Omni directional | (2) Min Elev<br>N/A |
| | (3) Scan Rate<br>N/A |
| 9. BEAMWIDTH | c. HORIZONTAL SCAN |
| a. HORIZONTAL<br>360° | (1) Sector Scanned<br>N/A |
| b. VERTICAL<br>180° | (2) Scan Rate<br>N/A |
| | d. SECTOR BLANKING *(X one)*<br>☐ (1) YES ☒ (2) NO |

10. REMARKS

| CLASSIFICATION | |
|---|---|
| UNCLASSIFIED | |

DD Form 1494, AUG 96

## SAMPLE LINE DIAGRAM




The entire system is configured to operate within shipyard buildings, with a nominal effective range of less than 300 ft. The transmitter unit is a “Belly Box” that is carried by the Crane Operator, and weighs about 3 lbs. The receiver unit is mounted on the bridge crane, and interfaces with existing control circuitry to permit remote operation of the crane without use of a wired pendant control station or having an operator located in a cab on the crane.

| APPLICATION FOR SPECTRUM REVIEW | CLASSIFICATION: **UNCLASSIFIED** | PAGE 7 of 7 Pages |
|---|---|---|

**NTIA GENERAL INFORMATION**

1. APPLICATION TITLE

2. SYSTEM NOMENCLATURE

3. STAGE OF ALLOCATION *(X one)*
   ☐ a. STAGE 1 CONCEPTUAL ☐ b. STAGE 2 EXPERIMENTAL ☐ c. STAGE 3 DEVELOPMENTAL ☐ d. STAGE 4 OPERATIONAL

4. FREQUENCY REQUIREMENTS
   a. FREQUENCY(IES) 430 to 439.8 MHz
   b. EMISSION DESIGNATOR(S) TX = 224KF1D RX = 224KF1D

5. PURPOSE OF SYSTEM, OPERATIONAL AND SYSTEM CONCEPTS (WARTIME USE) *(X one)* ☐ a. YES ☐ b. NO

6. INFORMATION TRANSFER REQUIREMENTS

7. ESTIMATED INITIAL COST OF THE SYSTEM

8. TARGET DATE FOR

| a. APPLICATION APPROVAL | b. SYSTEM ACTIVATION | c. SYSTEM TERMINATION |
|---|---|---|

9. SYSTEM RELATIONSHIP AND ESSENTIALITY

10. REPLACEMENT INFORMATION

11. RELATED ANALYSIS AND/OR TEST DATA

12. NUMBER OF MOBILE UNITS

13. GEOGRAPHICAL AREA FOR
    a. STAGE 2
    b. STAGE 3
    c. STAGE 4

| 14. LINE DIAGRAM<br>See page(s) | 15. SPACE SYSTEMS<br>See page(s) |
|---|---|
| 16. TYPE OF SERVICE(S) FOR STAGE 4 | 17. STATION CLASS(ES) FOR STAGE 4 |

18. REMARKS

| DOWNGRADING INSTRUCTIONS | CLASSIFICATION | |
|---|---|---|
| N/A | UNCLASSIFIED | |

DD Form 1494, AUG 96

## KK. Appendix KK – Control System and Network Submittals

The following sheets provide more information for control system and network submittals.

- **SD-11.7 Disabled Ports Connectors Interfaces and Know Vulnerabilities**
  See provided SD-11.7 Appendix which provides documentation of all ports. Disabled Ports have been indicated.
  There are no known methods for bypassing computer authentication in this product.
  See provided SD-11.7 Appendix showing DELL response to request for information. At the time of turn-over to the government, the laptop had no known back doors. The computer as provided by DELL included no known back doors. Crane Contractors created no back doors during set-up and installation of required Magnetek software.

- **SD-11.8 Network-Capable Devices**
  (a) Original Firmware - Not Available from Vendor
  (b) Original Firmware hash - Not Available from Vendor
  (c) SOP for application of firmware updates/patches
  - Not Available from Vendor
  (d) POC or website for firmware updates/patches
  - dell.com/support/home/en-us//Products?app=drivers
  (e) Count of Interfaces and Types - Not Available from Vendor
  (f) Protocols in use, per interface - Not Available from Vendor
  (g) Configuration file - Not Available from Vendor
  (h) SOP for configuration - Not Available from Vendor

- **SD-11.9 Engineering Workstation**
  (a) SOP for application of software updates/patches
  - Windows 10: go to settings>update&security>windows update
  (b) POC or website for software updates/patches
  - Windows 10
  - support.microfsoft.com/en-us/windows/update-windows-10
  (c) Protocols in use, per interface - Not Available from Vendor
  (d) SOP for configuration - Not Available from Vendor
  (e) PLC programming; other crane interface software & licensing
  - Not Available from Vendor
  (f) Other compatible software - Not Available from Vendor

NOTE: Files for CDs/DVDs for SD-11.8 & SD-11.9 are not available

- **SD-11.10 Control System Access Control.**
  This Dell laptop has system access VIA a password protection. Multiple accounts can be generated, please reference SD-11.10 appendix for procedure. Upon the booting up of the Dell Laptop the Password screen launched. The Cranes SN# is 19-5050. The provided Laptop has a password of 19-5050.The password is entered in the provided screen and will proceed to the Home page. Also, the Magnetek Software is Pass-Key protected. The software key needs to be installed in a USB port before the Magnetek software is enabled.

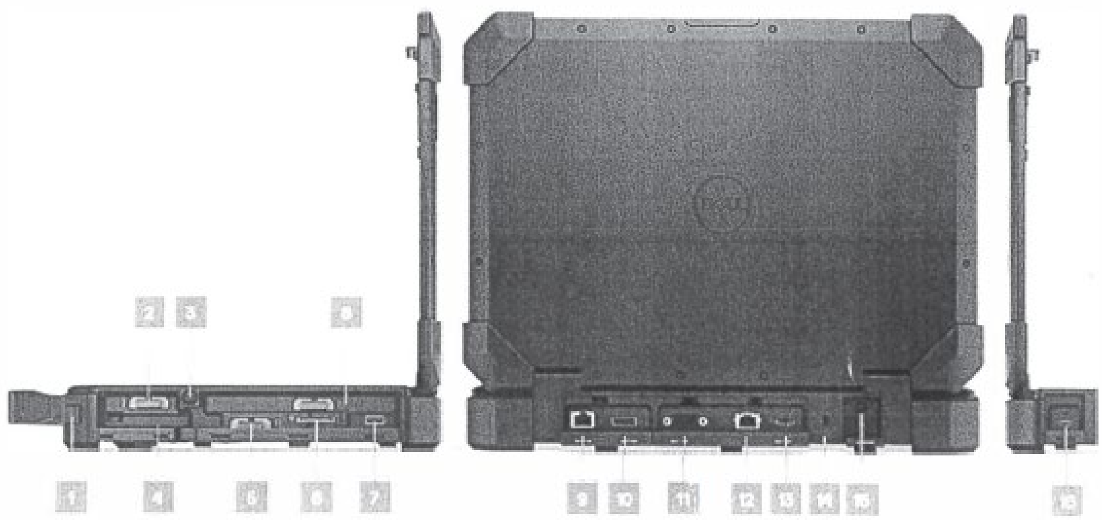
- **SD-11.11 Control Systems Account Management**
  Laptop as provided has only one account that is accessed using the 19-5050 password. Only one active account is needed for proper operation.

- **SD-11.12 Patch Management and Updates.**
  The Dell laptop is a closed loop computer system. In the occurrence of a required Patch or Update, the presentation of the revised software will have be provided VIA a flash drive and a USB port. Since this is a working closed system, no patch management is required.

- **SD-11.13 Malware Detection and Protection.**
  The Dell laptop is provided with standard Microsoft Windows malware and corruption protection software protocols.

- **SD-11.14 Wireless Technology Provisions.**
  Not applicable.

SD-11.7 APPENDIX



# Ports & Slots

1. Anchors (straps optional) | ~~2. Removable Secondary SATA Storage Bay (Optional)~~ | ~~3. Stylus~~ | 4. Smart Card Reader (Optional) | 5. Removable Primary PCIe Storage Bay | 6. SD and SIM card Slot | 7. USB 3.0 Type A | 8. Blu-ray+R/W or DVD+R/W or Removable Third SATA Storage Bay (Optional) | ~~9. RJ-45 gigabit Ethernet network connector (Optional)~~ | 10. Serial, VGA, or Display Port (Optional) | 11. Native Serial | 12. RJ-45 gigabit Ethernet network connector | 13. HDMI | 14. Lock slot | 15. Power in | 16. USB 3.0 Type C™: Power and Display | 17. USB 3.0 Type A | 18. USB 3.0 Type A | 19. Universal Audio Jack

**Additional Optional Slots:**
ExpressCard or PCMCIA
Contacted and Contactless Smartcard
Fingerprint Reader

Additional Items not provided

Note:
Complete Control System and
Network Product Data Available
SD-03.C1- C3

SD-11.7 APPENDIX

**John Doe**

**From:** Jane Doe
**Sent:** Wednesday, August xx, 2022 xx:55 AM
**To:** John Doe, Crane Doe
**Subject:** FW: Dell Support: SR# 10680090xx from Comp rep [ ref:_00D0bGaMp._5002R1LyDVz:ref ]

**From:** Dell Tech Support <technical_support@help.dell.com>
**Sent:** Wednesday, August xx, 2022 11:30 AM
**To:** Jane Doe <janedoe@crane.contractor.com>
**Subject:** RE: Dell Support: SR# 10680090xx from Comp rep [ ref:_00D0bGaMp._5002R1LyDVz:ref ]

CAUTION: **This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.**

Hi Jane,

Greetings for the day!

I am sorry but all-encompassing statement requested is not possible.

A backdoor in many aspects will only be tested or detected once the computer has been setup. Once out of the box, the responsibility falls on the user. At that point, the user can install any and all programs he believes he needs for the job - at any rate, we can't validate that the computer or any of the programs installed at the time they used it for the Navy project are even secure Or if those will pass the said standards.

In terms of security, we release BIOS, driver and FW updates as soon as Dell is made aware of such vulnerabilities but at that point where the laptop is being used who knows if the customer installed any of them?

If you wish, you can either get in touch with their account manager or Dell legal team, create a HAC request if you feel it is necessary.

Thank you for choosing Dell!

Thanks and Regards,
Company Representative
Technical Support Supervisor

1

SD-11.10 APPENDIX

# Create a local user or administrator account in Windows 10

*Windows 10*

You can create a local user account (an offline account) for anyone who will frequently use your PC. The best option in most cases, though, is for everyone who uses your PC to have a Microsoft account.

If needed, the local user account can have administrator permissions; however, it's better to just create a local user account whenever possible.

**Caution:** A user with an administrator account can access anything on the system, and any malware they encounter can use the administrator permissions to potentially infect or damage any files on the system. Only grant that level of access when absolutely necessary and to people you trust.

SD-11.10 APPENDIX

As you create an account, remember that choosing a password and keeping it safe are essential steps. Because we don't know your password, if you forget it or lose it, we can't recover it for you.

If you're using Windows 10, version 1803 and later, you can add security questions as you'll see in step 4 under **Create a local user account**. With answers to your security questions, you can reset your Windows 10 local account password. Not sure which version you have? You can check your version.

### Create a local user account

1. Select **Start** > **Settings** > **Accounts** and then select **Family & other users.** (In some versions of Windows you'll see **Other users**.)
2. Select **Add someone else to this PC**.
3. Select **I don't have this person's sign-in information**, and on the next page, select **Add a user without a Microsoft account**.
4. Enter a user name, password, or password hint—or choose security questions—and then select **Next**.

Open Settings and create another account

SD-11.10 APPENDIX

## Change a local user account to an administrator account

1. Select **Start** > **Settings** > **Accounts** .
2. Under **Family & other users**, select the account owner name (you should see "Local Account" below the name), then select **Change account type**.

   **Note:** If you choose an account that shows an email address or doesn't say "Local account", then you're giving administrator permissions to a Microsoft account, not a local account.

3. Under **Account type**, select **Administrator**, and then select **OK**.
4. Sign in with the new administrator account

## LL. **Appendix LL – Control System Inventory**

Please see the following sheets for an example control system inventory.

| The Control System Inventory shall include the following attributes, in tabular format as applicable: | | | | |
|---|---|---|---|---|
| **General Information** | **Location Information** | **Hardware Details** | **Operating system and Platform** | **Network Information (Actual Function, not potential function)** |
| Unique ID | Facility Name | Device Type | Embedded OS (Yes/No) | MAC Address(es) |
| NA | NNSY | Computer | Yes | NA |
| Barcode or Identifier | NFAID | Device Sub-Type | OS Contractor | IP Address(es) |
| NA | na | Laptop | Microsoft | NA |
| Region | Commodity | Device Function | Operating System (O/S) | Upstream Device |
| NA | M140 #5 | Crane Controls | Windows | NA |
| Installation | Floor | Manufacturer | O/S Version | Protocols In Use |
| NA | NA | Panasonic | 10 | NA |
| Special Area (Option DNA1) | Alcove | Product Line | Platform Contractor | Host Name |
| NA | Alcove | Tuffbook | NA | NA |
| | Location | Model # | Platform Product Line | |
| | NA | FZ-55A0601VM | NA | |
| | System Type | Serial # | Platform | |
| | Computer | 2ATTA214xx | NA | |
| | Functional System or Equipment Control | Remote Connectivity: (Wired/Wireless/None) | Platform Version | |
| | Control | None | NA | |
| | | Network Type Used:(Serial/Ethernet/Both/None) | | |
| | | None | | |

| The Control System Inventory shall include the following attributes, in tabular format as applicable: | | | | |
|---|---|---|---|---|
| **General Information** | **Location Information** | **Hardware Details** | **Operating system and Platform** | **Network Information (Actual Function, not potential function)** |
| Unique ID | Facility Name | Device Type | Embedded OS (Yes/No) | MAC Address(es) |
| NA | NNSY | VFD | Yes | NA |
| Barcode or Identifier | NFAID | Device Sub-Type | OS Contractor | IP Address(es) |
| NA | NA | VFD | Magnetek | NA |
| Region | Commodity | Device Function | Operating System (O/S) | Upstream Device |
| NA | M140 #5 | Hoist Controls | NA | NA |
| Installation | Floor | Manufacturer | O/S Version | Protocols In Use |
| NA | NA | Magnetek | NA | NA |
| Special Area (Option DNA1) | Alcove | Product Line | Platform Contractor | Host Name |
| NA | Alcove | 4014-VG+S4 | NA | NA |
| | Location | Model # | Platform Product Line | |
| | NA | CIMR-AU4A0018FAA | NA | |
| | System Type | Serial # | Platform | |
| | OET CRANE | 1W21735989700xx | NA | |
| | Functional System or Equipment Control | Remote Connectivity: (Wired/Wireless/None) | Platform Version | |
| | Control | NONE | NA | |
| | | Network Type Used:(Serial/Ethernet/Both/None) | | |
| | | None | | |

| The Control System Inventory shall include the following attributes, in tabular format as applicable: | | | | |
|---|---|---|---|---|
| **General Information** | **Location Information** | **Hardware Details** | **Operating system and Platform** | **Network Information (Actual Function, not potential function)** |
| Unique ID | Facility Name | Device Type | Embedded OS (Yes/No) | MAC Address(es) |
| NA | NNSY | VFD | Yes | NA |
| Barcode or Identifier | NFAID | Device Sub-Type | OS Contractor | IP Address(es) |
| NA | NA | VFD | Magnetek | NA |
| Region | Commodity | Device Function | Operating System (O/S) | Upstream Device |
| NA | M140 #5 | Bridge Controls | NA | NA |
| Installation | Floor | Manufacturer | O/S Version | Protocols In Use |
| NA | NA | Magnetek | NA | NA |
| Special Area (Option DNA1) | Alcove | Product Line | Platform Contractor | Host Name |
| NA | Alcove | 4005-VG+S4 | NA | NA |
| | Location | Model # | Platform Product Line | |
| | NA | CIMR-AU4A0007FAA | NA | |
| | System Type | Serial # | Platform | |
| | OET CRANE | 1W21735933600xx | NA | |
| | Functional System or Equipment Control | Remote Connectivity: (Wired/Wireless/None) | Platform Version | |
| | Control | NONE | NA | |
| | | Network Type Used:(Serial/Ethernet/Both/None) | | |
| | | None | | |

The Control System Inventory shall include the following attributes, in tabular format as applicable:

| **General Information** | **Location Information** | **Hardware Details** | **Operating system and Platform** | **Network Information (Actual Function, not potential function)** |
|---|---|---|---|---|
| Unique ID | Facility Name | Device Type | Embedded OS (Yes/No) | MAC Address(es) |
| NA | NNSY | VFD | Yes | NA |
| Barcode or Identifier | NFAID | Device Sub-Type | OS Contractor | IP Address(es) |
| NA | NA | VFD | Magnetek | NA |
| Region | Commodity | Device Function | Operating System (O/S) | Upstream Device |
| NA | M140 #5 | Trolley Controls | NA | NA |
| Installation | Floor | Manufacturer | O/S Version | Protocols In Use |
| NA | NA | Magnetek | NA | NA |
| Special Area (Option DNA1) | Alcove | Product Line | Platform Contractor | Host Name |
| NA | Alcove | 4003-VG+S4 | NA | NA |
| | Location | Model # | Platform Product Line | |
| | NA | CIMR-AU4A0004FAA | NA | |
| | System Type | Serial # | Platform | |
| | OET CRANE | 1W21735986100xx | NA | |
| | Functional System or Equipment Control | Remote Connectivity: (Wired/Wireless/None) | Platform Version | |
| | Control | NONE | NA | |
| | | Network Type Used:(Serial/Ethernet/Both/None) | | |
| | | None | | |

MM. **Appendix MM – Evaluation Status of Hardware and Software**

Please see the following sheet for an example of this item.

Crane Contractor letterhead

# Evaluation Status of Hardware and Software (SD-11.1xx)

Status of Hardware:

- Intel Core i5-8350U Processor
  - Not Evaluated
- Intel Core i5-8350U Processor Base with UHD 620 Graphics Card
  - Not Evaluated
- M.2 256GB PCIe NVMe Class 40  Opal 2.0 Self Encrypting Solid State Drive
  - Not Evaluated
- 8GB DDR4 Non-ECC Memory
  - Not Evaluated

Status of Software:

- Micorsoft Windows 10
  - NIAP evaluated on 2019.10.26 (PASS)
- Cyberlink Media Suite Essentials for windows 10 and DVD Drive
  - Not Evaluated
- McAfee Small Business Security 30 Day Trial
  - Not Evaluated
- Dell Encryption Personal
  - Common Criteria evaluated on 2017.10.02 (PASS)

Sincerely,

Signature here

John Doe, P.E.
Engineering Division
Crane Contractor, LLC

# End of Document