November 29, 2000

MEMORANDUM TO: Docket File

FROM: Kimberley Rico, General Engineer KAR
License Renewal and Standardization Branch
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

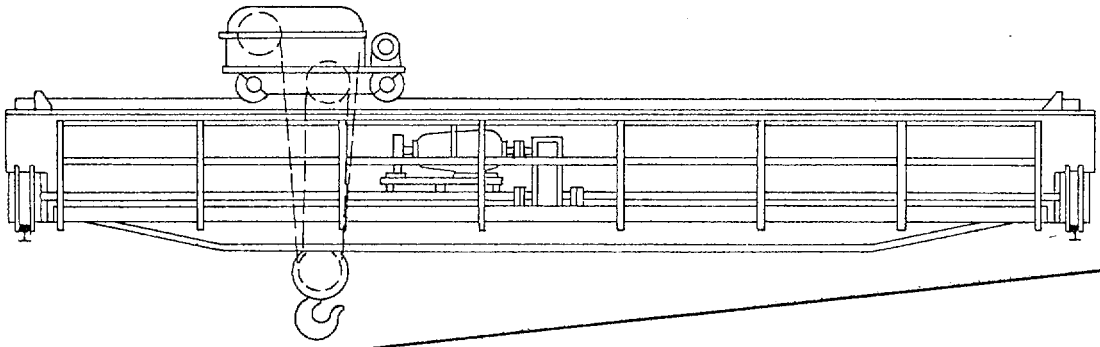
SUBJECT: NUCLEAR ENERGY INSTITUTE (NEI) ADDITIONAL COMMENTS ON GENERIC AGING LESSONS LEARNED (GALL) REPORT - MECHANICAL SYSTEMS

On November 28, 2000, I received mail from Mr. Doug Walters of NEI, providing additional comments on Chapter VII of the draft GALL report, as a result of the public meeting on November 15, 2000. (See Enclosure 1) The staff plans on considering this information in developing the draft Gall report.

Project No. 690

Enclosure: As stated

cc: PUBLIC



specifications

for ELECTRIC OVERHEAD TRAVELING CRANES

C.M.A.A. SPECIFICATION #70

supersedes
E.O.C.I. specification #61

CRANE MANUFACTURERS ASSOCIATION OF AMERICA INC.
C.M.A.A.

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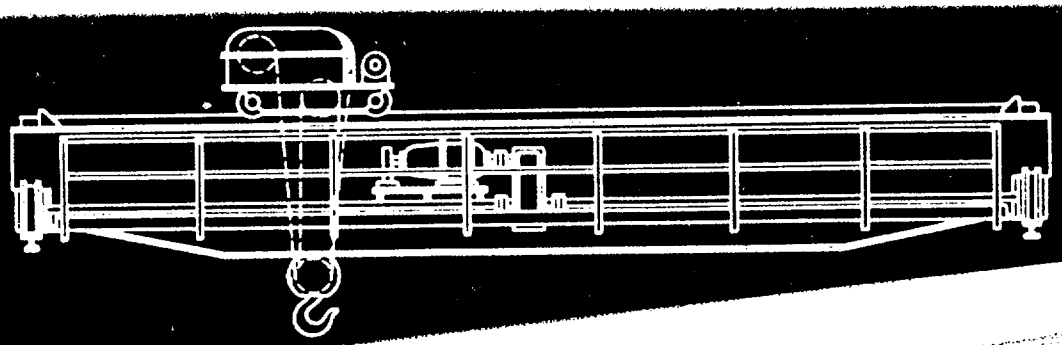

E.O.C.I. SPECIFICATION #61

specifications

for ELECTRIC OVERHEAD TRAVELING CRANES

prepared and published by

THE ELECTRIC OVERHEAD CRANE INSTITUTE, Inc.
One Thomas Circle, N.W., Washington 5, D. C.

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ELECTRIC OVERHEAD CRANE INSTITUTE

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INTRODUCTION

This specification has been developed by an organization of the leading electric overhead traveling crane manufacturers of the United States for the purpose of promoting standardization and providing a basis for uniform quality and performance. The use of this specification should not limit the ingenuity of the individual manufacturer but should provide a basis of economical procedure.

In addition to providing specifications, the publication contains information which should be helpful to the purchasers of cranes and to the engineering and architectural professions. While much of this information must be of general nature, it will serve as a basis for arriving at conclusions which may be checked with the individual manufacturer.

These specifications consist of six sections, as follows:

1. General Specifications
2. Structural Design
3. Mechanical Design
4. Electrical Equipment
5. Appendixes
6. Glossary

GENERAL SPECIFICATIONS

1. SCOPE

A. This specification shall be known as the "Specifications for Electric Overhead Traveling Cranes – EOCI Specification #61."

B. The specifications and information contained in this publication apply to all types of top running multiple girder electric overhead traveling cranes with the exception of mill cranes of the type covered by the Association of Iron and Steel Engineers (AISE) specifications. It should be understood that in covering this wide field, the specifications are general in nature and must be modified in agreement between the purchaser and and the manufacturer to suit each specific installation.

C. This specification outlines in Appendix "A" six different classes of crane service as a guide for determining the service requirements of the individual application. It must be recognized that in many cases there is no clear cut category of service in which a particular crane operation might fall, and that the selection of the proper crane can only be made through a discussion of service requirements and crane details with the crane manufacturer. In addition, the service requirements of each motion of the crane – bridge, trolley, main hoist, auxiliary hoist – may not fall into the same service class and must be reconciled to give the most efficient and economical selection.

D. Service conditions have an important influence on the life of the wearing parts of a crane such as wheels, gears, bearings, wire rope, electrical equipment, etc. Providing the crane manufacturer with complete information regarding service requirements allows the manufacturer to offer a crane designed and built to provide maximum life.

E. In selecting overhead crane equipment, it is important that the purchaser consider not only present but future operations which may increase loading and service requirements, and that he be certain to select equipment which will be satisfactory for future increased service conditions.

2. BUILDING DESIGN

A. The building in which an overhead crane is to be installed must be designed with consideration given to the following points:

1. The distance from the floor to the lowest overhead obstruction must be such as to allow for the required hook lift plus the distance from the saddle or palm of the hook in its highest position to the high point on the crane plus clearance to the lowest overhead obstruction.
2. In addition, the distance from the floor to the lowest overhead obstruction must be such that the lowest point on the crane will clear all machinery or when necessary provide railroad clearance under the crane.
3. After determination of the building height, based on the factors above, the crane runway must be located with the top of the runway rail at a distance below the lowest overhead obstruction equal to the height of the crane plus clearance.
4. Lights, pipes, or any other objects projecting below the lowest point on the building truss must be considered in the determination of the lowest overhead obstruction.
5. The building knee braces must be designed to permit the required hook approaches.

3. CLEARANCE

A. In the case of narrow width buildings where truss sag may be ignored, a minimum clearance of 3 inches between the highest point of the crane and the lowest overhead obstruction should be provided. For wider buildings where truss sag becomes a factor, this clearance should be increased to 6 inches.

B. The clearance between the end of the crane and the building columns, knee braces or any other obstructions should be not less than 2 inches. For wide buildings or where heavy capacity cranes are used, not less than 3 inches clearance should be provided. Pipes, conduits, etc., must not reduce this clearance.

4. RUNWAY

A. The crane runway, runway rails, and crane stops shall be furnished by the purchaser unless otherwise specified. The crane stops furnished by the purchaser shall be designed to suit the specific crane to be installed.

B. The runway rails shall be straight, parallel, level, at the same elevation and the exact distance center to center as specified by the purchaser to the crane manufacturer. The runway rails should be standard rail sections of a proper size for the crane to be installed and must be provided with proper rail splices.

C. The crane runway shall be designed with sufficient strength and rigidity to prevent undue lateral or vertical deflection.

5. RUNWAY CONDUCTORS

A. The runway conductors shall be wires, angles, rails or other types to suit the particular installation and shall be furnished by the purchaser unless otherwise specified. They shall be properly supported and installed and have sufficient capacity to carry the required current to the crane, or cranes, when operating with rated load.

B. Current supplied by the runway conductors at the point of collector contact shall be not less than 95% of the voltage for which the crane is designed.

C. The crane inquiry should specifly the type and location of the runway conductors to be used.

6. RATED CAPACITY

A. The rated capacity of the crane shall be that load for which the crane is designed and as specified by the manufacturer and shown in tons of 2,000 pounds on the capacity plates attached to the crane. In determining the rated capacity, all handling devices such as buckets, magnets, grabs, etc. shall be included as a part of the load to be handled.

7. DESIGN STRESSES

A. Materials shall be properly selected for the stresses to which they will be subjected. Load carrying parts, except girders and hoisting ropes, shall be designed so that the calculated static stress in the material, based on rated load, shall not exceed 20% of the assumed average ultimate strength of the material. This limitation of stress provides a margin of strength to allow for variations in the properties of materials, manufacturing and operating conditions, and design assumptions, and under no condition should imply authorization or protection for users loading the crane beyond rated capacity. Girders shall be designed in accordance with the data given in Paragraph 18. Hoisting ropes shall be in accordance with Paragraph 24.

8. GENERAL

A. All apparatus covered by this specification shall be constructed in a thorough and workmanlike manner. Due regard shall be given in the design for safety of operation, accessibility, interchangeability and durability of parts.

9. PAINTING

A. Before shipment, the crane shall be cleaned and painted with the crane manufacturer's standard paint, unless otherwise specified.

10. ASSEMBLY AND PREPARATION FOR SHIPMENT

A. The crane shall be assembled in the manufacturer's plant and taken apart only to the extent necessary for shipment. All parts shall be carefully match marked when taken apart for shipment. All exposed finished parts shall be properly coated with compound before shipment.

11. TESTING

A. Testing shall be conducted according to the manufacturer's commercial testing procedure.

12. DRAWINGS

A. Two copies of the manufacturer's clearance diagrams shall be submitted for approval. One copy shall be approved by the purchaser and returned to the crane manufacturer. Operating instructions and spare parts information shall be furnished. Detail drawings shall not be submitted.

13. ERECTION

A. The crane or cranes shall be erected (including assembly, field wiring, installation and starting) by the purchaser. Deviations from this practice will be negotiated separately between the purchaser and the manufacturer.

14. LUBRICATION

A. The crane shall be provided with all necessary lubrication fittings. Before putting the crane in operation, the purchaser shall lubricate all bearings, gears, etc. in accordance with the crane manufacturer's recommendations.

15. WARRANTY

A. For warranty, refer to the manufacturer's literature or proposal forms.

STRUCTURAL DESIGN

16. MATERIAL

A. All structural steel used shall conform to ASTM-A7 specifications or shall be an accepted type for the purpose for which the steel is to be used and for the operations to be performed on it. Other suitable materials may be used provided parts are proportioned to give comparable design factors.

17. WELDING

A. All welding design and procedures shall conform with American Welding Society (AWS) recommendations.

18. GIRDERS

A. General

1. The crane girders shall be structural steel box sections, welded or riveted, wide flange beams, standard "I" Beams, reinforced beams, or box sections fabricated from structural shapes. The manufacturer shall specify the type and construction of the girders to be furnished.

B. Loadings

1. Crane girders shall be proportioned to resist all vertical, lateral and torsional forces combined as specified in Paragraph 18.B.2. and as defined below.

   a. Vertical Forces

      (1) Dead Load: The weight of all effective parts of the bridge structure, the machinery parts, and the fixed equipment supported by the structure.

      (2) Live Load: The weight of the trolley and the lifted load (rated capacity) shall be considered as concentrated moving loads at the wheels and located in such positions as to produce the maximum moment and shear.

      (3) Impact Allowance: For cranes operating on runways as described in Paragraph 4.B., the minimum impact allowance shall be 15% of the rated capacity. For bucket and magnet cranes, the impact allowance shall be 50% of the total load. Total load, for this purpose, is defined as the combined weight of the bucket or magnet plus its load.

   b. Lateral Forces

      (1) Lateral load due to acceleration or deceleration shall be considered as 5% of the live load and the crane bridge, exclusive of end trucks and end ties. The live load shall be considered as a concentrated load, located in the same position as when calculating the vertical moment. The lateral moment shall be equally divided between the two girders and the moment of inertia of the entire girder section about its vertical axis shall be used to determine the stresses due to the lateral forces.

      (2) Lateral load due to wind shall be considered as 10 pounds per square foot of projected area. The wind load on the trolley shall be considered as equally divided between the two girders.

   c. Torsional Forces

      (1) The twisting moment due to starting and stopping of the bridge motor shall be considered as the starting torque of the bridge motor at 200% of full load torque multiplied by the gear ratio between the motor and the cross shaft.

(2) The twisting moments due to overhanging loads on the side of the girder shall be taken as their respective weights multiplied by the horizontal distances between the respective centers of gravity and the center of gravity of the girder section.

(3) The twisting moments due to lateral forces acting eccentric to the horizontal neutral axis of the girder shall be considered as those forces multiplied by the vertical distance between the center line of force and the center of gravity of the girder.

2. The combined bending stress shall be taken as the larger of:

   a. The sum of the maximum stresses due to dead load, weight of trolley, rated load and impact allowance.

   b. The sum of the maximum stresses due to dead load, weight of trolley, rated load and lateral forces.

3. The combined shear stress shall be taken as the sum of the maximum shears due to dead load, weight of trolley, rated load, impact allowance and net twisting moment.

C. Design Limitations

1. *Welded box girders* shall be fabricated of structural steel with continuous longitudinal welds running the full length of the girder. All welds shall be ample to develop the beam section for the maximum shear and bending. Weld stresses shall not exceed 20% of the average ultimate strength of the weld material.

   a. Proportions

   l/b shall not exceed 55

   b/c shall not exceed 60

   h/t shall not exceed 240 or the amount, whichever is smaller, given by the formula:

$$85\,(k+1)\sqrt{\frac{16000}{f_c}}$$

   unless longitudinal stiffeners are used in the compression area of the web plates.

   Where:

   l = Span in inches
   b = Distance between web plates in inches
   c = Thickness of top cover plate in inches
   f_c = Maximum compressive stress (p.s.i.)
   f_t = Maximum tensile stress (p.s.i.)
   h = Depth of web in inches
   k = f_t / f_c
   t = Thickness of web in inches

   b. Maximum Allowable Combined Stresses

   Tension = 16,000 p.s.i.

   Compression = 16,000 p.s.i. or when b/c exceeds 41 the compressive stress in the top flange shall be reduced as follows:

b/c = 43:	f_c = 15000	b/c = 52:	f_c = 10000
b/c = 46:	f_c = 13000	b/c = 55:	f_c = 9000
b/c = 50:	f_c = 11000	b/c = 60:	f_c = 7000

   Shear – The maximum unit shear on the area of the web plates shall not exceed 12,000 p.s.i.

c. Diaphragms and Vertical Stiffeners

The spacing of the vertical web stiffeners in inches shall not exceed the amount given by the formula:

$$\frac{11{,}000t}{\sqrt{v}}$$

Where:

t = Thickness of web in inches
v = shear stress in web plates (p.s.i.)

Full depth diaphragms may be included as vertical web stiffeners toward meeting this requirement.

The distance between full depth diaphragms shall not exceed 72″ except for girders with web depths greater than 72″ when the distance between full depth diaghragms may be a maximum equal to the web depth.

Web plates shall be suitably reinforced with full depth diaphragms or stiffeners at all major load points.

All diaphragms shall bear against the top cover plate and shall be welded to the web plates. The diaphragm section and weld shall be adequate to transfer the maximum trolley wheel load to the web plates.

Short diaphragms shall be placed between full depth diaphragms so that the maximum distance between adjacent diaphragms will not exceed

$$\frac{108{,}000\ S}{W}$$

Where:

S = Section modulus of bridge rail in inches^3
W = Maximum trolley wheel load in pounds, excluding impact

d. Deflection and Camber

(1) The maximum vertical deflection of the girder produced by the dead load, the weight of the trolley and the rated load shall not exceed .00125″ per inch of span. Impact shall not be considered in determining deflection.

(2) Girders shall be cambered an amount equal to the dead load deflection plus one-half the live load deflection.

2. *Riveted box girders* shall be fabricated of structural steel plates and angles with riveted chord construction. Diaphragms and splices shall be riveted or welded. Riveted or welded connections shall be designed for the full strength of the material. Where possible, all rivets shall be machine driven.

a. Proportions

l/b shall not exceed 65

w/c shall not exceed 60

h/t shall not exceed 240 or the amount, whichever is smaller, given by the formula:

$$85\ (k+1)\ \sqrt{\frac{16000}{f_c}}$$

unless longitudinal stiffeners are used in the compression area of the web plates.

Where:

l = Span in inches
b = Distance between web plates in inches
c = Thickness of top cover plate in inches
f_c = Maximum compressive stress (p.s.i.)
f_t = Maximum tensile stress (p.s.i.)
h = Clear depth of web in inches (distance from toe to toe of the vertical legs of flange angles)
$k = f_t / f_c$
t = Thickness of web in inches
w = Width between top flange rivets in inches

b. Maximum Allowable Combined Stresses

Tension (net section) = 16,000 psi

Compression = 16,000 psi or when w/c exceeds 41 the compressive stress in the top flange shall be reduced as follows:

w/c = 43:	f_c = 15000	w/c = 52:	f_c = 10000
w/c = 46:	f_c = 13000	w/c = 55:	f_c = 9000
w/c = 50:	f_c = 11000	w/c = 60:	f_c = 7000

Shear – The maximum unit shear on the area of the web plates shall not exceed 12,000 p.s.i.

c. Diaphragms and Vertical Stiffeners

The spacing of vertical web stiffeners in inches shall not exceed the amount given by the formula:

$$\frac{11{,}000t}{\sqrt{v}}$$

Where:

t = Thickness of web in inches
v = Shear stress in web plates (p.s.i.)

Full depth diaphragms may be included as vertical web stiffeners toward meeting this requirement.

The distance between full depth diaphragms shall not exceed 72″ except for girders with web depths greater than 72″ when the distance between full depth diaphragms may be a maximum equal to the web depth.

Web plates shall be suitably reinforced with full depth diaphragms or stiffeners at all major load points.

All diaphragms shall bear against the top cover plate and shall be welded or riveted to the web plates. The diaphragm section and weld or rivets shall be adequate to transfer the maximum trolley wheel load to the web plates.

Short diaphragms shall be placed between full depth diaphragms so that the maximum distance between adjacent diaphragms will not exceed:

$$\frac{108{,}000\ S}{W}$$

Where:

S = Section modulus of bridge rail in inches^3
W = Maximum trolley wheel load in pounds, excluding impact

d. Deflection and Camber

(1) The maximum vertical deflection of the girder produced by the dead load, the weight of the trolley and the rated load shall not exceed .00125″ per inch of span. Impact shall not be considered in determining deflection.

(2) Girders shall be cambered an amount equal to the dead load deflection plus one-half the live load deflection.

3. *I-beam girders* shall be wide flange beams, standard I-beams, or beams reinforced with plate, angles, or channels. An auxiliary girder or other suitable means shall be provided to support over-hanging loads to prevent undue torsional and lateral deflections.

The maximum vertical deflection of the girder produced by the dead load, the weight of the trolley and the rated load shall not exceed .00125″ per inch of span. Impact shall not be considered in determining deflection.

The maximum fibre stresses with combined loading shall not exceed:

Tension (net section) – 16000 p.s.i.

Compression: $\dfrac{12{,}000{,}000}{\dfrac{ld}{bt}}$ with maximum of 16000 p.s.i.

Where:

l = Span in inches
b = Width of compression flange in inches
t = Thickness of compression flange in inches
d = Depth of beam in inches

Shear – 12000 p.s.i. maximum

4. *Box section girders* built up of two beams, either with or without reinforcing flange plates, shall be designed according to the same design data as for I-beam girder cranes.

19. BRIDGE END TRUCKS

A. The crane bridge shall be carried on end trucks and double flanged wheels of ample size to carry the rated load when lifted at one end of the crane bridge. The wheel base of the end truck shall be 1/7 of the span or greater.

B. End trucks may be of the rotating axle or fixed axle type as specified by the crane manufacturer.

C. The bridge end trucks shall be constructed of structural steel providing a rigid structure. Provision shall be made to prevent excessive drop in case of axle failure. Substantial guards shall be provided in front of each wheel and shall project below the top of the runway rail.

20. FOOTWALKS AND HANDRAILS

A. A footwalk with a substantial handrail shall be provided where required and specified. The handrail shall be at least 42 inches high and provided with an intermediate railing. The footwalk may be wood, anti-slip plate, expanded metal or grating as specified by the crane manufacturer. It shall be protected on all exposed edges by a suitable toe guard.

21. OPERATOR'S CAB

A. The standard location of the operator's cab will be be at one end of the crane bridge on the driving girder side. It shall be so located as not to interfere with the hook approach. The operator's cab shall be open type for indoor service unless otherwise specified.

B. Provision shall be made in the operator's cab for the manually operated controllers or master switches, main line disconnect switch, bridge brake foot lever, and all necessary wiring and fittings.

C. The controllers or their operating handles shall be located as shown in Appendix "C" for the cab location specified. If any other arrangement of the controllers is required, it shall be specified by the purchaser.

22. TROLLEY FRAMES

A. The trolley frame shall be welded or cast steel construction or a combination of both. It shall be of rigid construction designed to transmit the load to the bridge rails without undue deflection.

MECHANICAL DESIGN

23. LOAD BLOCKS

A. The load block frames shall be of steel construction. The hook shall be of forged steel, supported on a ball or roller thrust bearing. The hook shall rotate freely on this bearing.

24. HOISTING ROPES

A. The hoisting ropes shall be of proper design and construction for crane service. The rated capacity load divided by the number of parts of rope shall not exceed 20% of the published breaking strength of the rope.

25. SHEAVES

A. The sheaves shall be steel or cast iron as specified by the crane manufacturer.

B. The pitch diameter of the running sheaves shall be not less than 24 times the rope diameter when 6 x 37 rope is furnished or 30 times the rope diameter when 6 x 19 rope is furnished.

C. The pitch diameter of idler sheaves shall be not less than one-half of the diameter of running sheaves.

D. When special clearance and lift or low headroom is required or when "packaged" hoist units are used, it may be necessary to deviate from these limitations.

26. DRUM

A. The drum shall be made of high grade cast iron or equal material, designed to withstand maximum bending and crushing loads.

B. The drum shall be so designed that not less than two complete wraps of hoisting rope will remain in the grooves when the hook is at the lowest position for the lift specified, and not require overlapping of the rope when the hook is in its highest position.

C. Drum grooves shall be machined. Grooving shall be right and left hand unless otherwise specified by the crane manufacturer.

D. The pitch diameter of the drum shall be not less than 24 times the rope diameter when 6 x 37 rope is furnished or 30 times the rope diameter when 6 x 19 rope is furnished.

E. When special clearance and lift or low headroom is required or when "packaged" hoist units are used, it may be necessary to deviate from these limitations.

27. GEARING

A. All gears and pinions shall be steel or other material of equal strength and durability.

B. The type of gearing to be furnished shall be as specified by the crane manufacturer.

C. All gearing shall be guarded. All high speed gearing shall operate in an oil bath or in grease.

28. SHAFTS

A. All shafts except the bridge cross-shaft sections which do not carry gears, shall be machined at bearing and gear fits. Intermediate bridge cross-shafts may be commercial shafting.

29. COUPLINGS

A. Bridge cross-shaft couplings shall be compression, sleeve or flange type. Couplings shall be provided at each end truck and each side of the motor gear reducer.

B. Motor couplings shall be as specified by the crane manufacturer.

30. BEARINGS

A. The type of bearing shall be as specified by the crane manufacturer.

B. Anti-friction bearings shall be selected to give a minimum life expectancy based on full rated speed as follows:

	B-10 Life	Average Life
Classes A & B	1,000 hours	5,000 hours
Class C	2,000 hours	10,000 hours
Class D	5,000 hours	25,000 hours
Class E	10,000 hours or 10 years for the service specified, whichever is greater.	50,000 hours or 50 years for the service specified, whichever is greater.

For typical applications, bearing loads for life computation purposes may be assumed equal to 75% of maximum for bridge bearings and 65% of maximum for trolley and hoist bearings.

C. Bronze Sleeve Bearings

1. Bronze sleeve bearings, other than track wheel bearings, shall have an allowable unit bearing pressure of 1000 p.s.i. of projected area.
2. Bronze sleeve bearings for track wheel axle application shall not exceed the following values:

Class A & B	– 1200 p.s.i. of projected area	Class D	– 900 p.s.i. of projected area
Class C	– 1050 p.s.i. of projected area	Class E	– 750 p.s.i. of projected area

D. All bearings shall be provided with proper lubrication or means of lubrication. Bearing enclosures will be designed as far as practicable to exclude dirt and prevent leakage of oil or grease.

31. BRAKES

A. Bridge

1. Cab Control
   a. When the cab is located on the bridge, the bridge travel shall be provided with a minimum 100% torque brake.
   b. When the cab is located on the trolley, the bridge travel shall be provided with a minimum 50% torque brake.

2. Floor Control
   a. The bridge travel shall be provided with a minimum 50% torque brake.

B. Hoist

1. Each hoisting unit shall be provided with two means of braking. One brake shall be directly applied to the hoist motor shaft or other shaft in the hoist gear reduction and shall automatically set when current is cut off from the hoist motor. The other braking method may be either mechanical or electrical.
   a. A mechanical load brake, if furnished, shall automatically control the speed during lowering so as to prevent undue acceleration.
   b. Electrical dynamic lowering control or electrical braking control shall regulate the speed during lowering so as to prevent undue acceleration.

C. Trolley

1. Cab control crane
   a. When the cab is located on the bridge, the trolley travel may be provided, when specified, with a minimum 50% torque brake.
   b. When the cab is located on the trolley, the trolley travel shall be provided with a minimum 100% torque brake.
2. Floor control
   a. The trolley may be, when specified, provided with a minimum 50% torque brake.

32. WHEELS

A. The wheels shall be double flanged with treads accurately machined or ground to size in pairs. Proper clearance shall be allowed between the wheel flanges and the rail head.

B. Wheels shall be chilled car wheel iron, rolled, forged or cast steel.

C. Wheels shall be designed to carry the rated load under normal conditions without undue wear. Under such conditions, Appendix "D" may be used as a guide for wheel sizes. For unusual conditions, consideration should be given to other factors which are not included in the simple formula on which the table is based.

D. Tapered tread wheels for the bridge may be furnished when recommended by the crane manufacturer.

E. When rotating axles are used, wheels shall be pressed on, or drawn on to a taper fit, and driver wheels shall be keyed to the axles.

ELECTRICAL EQUIPMENT

33. GENERAL

A. The crane manufacturer shall furnish and mount all electrical equipment on the crane including motors, control and conduit. All wire on the crane shall be furnished by the crane manufacturer, cut to length, tagged and installed as far as practicable for shipment.

B. The crane manufacturer shall establish and state in his proposal the make, type, style, degree of enclosure and rating of the motors, brakes and control to be furnished for each motion.

C. The installation of electrical equipment shall be made in a workmanlike manner and in accordance with the requirements of Article 610 of the latest issue of the National Electrical Code.

34. MOTORS, ALTERNATING CURRENT AND DIRECT CURRENT

A. Motors shall be provided with anti-friction bearings.

B. Motors shall be rated on not less than a 30 minute basis with temperature rises in accordance with the latest NEMA standards for the class of insulation and enclosure used, unless otherwise specified.

NEMA Permissible Motor Temperature Rise, Above Ambient of 40° Centigrade, Measured by Thermometer

Insulation Class	Open Motors	Enclosed Motors
A	50°C	55°C
B	70°C	75°C
H	110°C	115°C

C. The crane manufacturer shall state motor windings (series, compound or shunt wound) on direct current cranes.

35. HOIST MOTOR BRAKES, ALTERNATING CURRENT AND DIRECT CURRENT

A. The hoist motor electric brake shall be applied automatically when power is interrupted.

B. The rated torque of the brake shall be not less than the full load torque of the motor.

36. CONTROLLERS, ALTERNATING CURRENT AND DIRECT CURRENT

A. Manual controllers shall provide at least four steps of speed regulation in each direction of operation with a minimum of five steps for motors over 10 horsepower.

B. Manual controllers and masters for magnetic controllers shall have a suitable device to indicate definitely the "off" position of the controller.

C. Controllers to be operated from the floor by pendant control shall be arranged for spring return to the "off" position.

D. Unless otherwise specified, hoist controllers shall be plain reversing type suitable for use with a mechanical load brake. Electrical braking systems which eliminate the mechanical load brake may be specified.

E. Unless otherwise specified by the crane manufacturer, the minimum size of magnetic contactors shall be in accordance with the tables below.

AC Controllers

NEMA Size of Contactor	8 Hours Open Rating, Amps.	Crane Rating, Amps.	Horsepower at 220V	Horsepower at 440V & 550V
00	10	10	1½	2
0	20	20	3	5
1	30	30	7½	10
2	50	67	20	40
3	100	133	40	75
4	150	200	60	125
5	300	400	150	300
6	600	800	300	600
7	900	1200	450	900
8	1350	1800	600	1200

Primary contactors shall be rated on the basis of horsepower. Secondary contactors shall be rated on the basis of full load secondary current. The rating of a three pole accelerating contactor connected with poles in delta shall be 1½ times its crane rating.

DC Controllers

NEMA Size of Contactor	8 Hours Open Rating, Amps.	Crane Rating, Amps.	Horsepower at 230 Volts
1	30	30	7½
2	50	67	15
3	100	133	35
4	150	200	55
5	300	400	110
6	600	800	225
7	900	1200	330
8	1350	1800	500

The eight hour rating of a line contactor used on protective equipment shall be not less than 50% of the combined crane rating amperes of all motors, nor less than 75% of the sum of the crane rating amperes of the motors required for any single motion.

F. Unless otherwise specified, magnetic control panels shall be enclosed. The type of enclosure shall be determined by agreement between the purchaser and the crane manufacturer.

37. RESISTORS

A. Resistors (except those in permanent sections) shall have a thermal capacity of not less than Class 150 series for EOCI Crane Service Classes A, B, C and D and not less than Class 160 series for EOCI Crane Service Class E.

38. PROTECTION

A. Undervoltage and overload protection shall be provided for each motor either as a function of each controller or by an enclosed protective panel.

B. A main line externally operated isolating switch shall be furnished. This shall open all main conductors and have provision for locking in the open position. This can be furnished as a separate switch or as part of the crane protective panel.

39. HOIST LIMIT SWITCH

A. The hoist limit switch shall limit the upward travel of the hoist block by removing power from the motor and applying the brake. The limit switch shall be either power circuit or control circuit type.

B. Interruption of the hoist motion shall not interfere with the lowering motion. Lowering of the block shall automatically reset the limit switch.

C. The crane manufacturer shall specify the type of limit switch to be furnished.

40. CRANE WIRING

A. The crane shall be wired in accordance with the requirements of Article 610 of the latest issue of the National Electrical Code.

41. BRIDGE CONDUCTORS

A. The current conductors shall be hard drawn copper wire, steel or other suitable conducting material. If enclosed conductors are required to meet local conditions, the crane inquiry shall so specify.

B. The size of the conductors shall be proportioned to limit the total voltage drop in the conductors, with full load current on the individual motors, to a maximum of 3% of the supply voltage.

C. The crane manufacturer shall specify the type of conductors to be furnished.

42. RUNWAY CONDUCTORS

A. Refer to Paragraph 5 of General Specifications for information on Runway Conductors.

43. CURRENT COLLECTORS

A. Trolley and main line current collectors shall be provided to suit the type of conductors used and shall be proportioned to provide adequate current carrying capacity.

Appendix A

E.O.C.I. CRANE SERVICE CLASSIFICATION

Class A. **(STANDBY SERVICE)** For such use as powerhouse, pump rooms, motor rooms, transformer repair, etc., where the crane is used very infrequently. These cranes must be substantially designed to handle expensive loads.

Class B. **(LIGHT SERVICE)** For such use as repair shops, light assembly work, service buildings, and light warehouse service. Use of this type of crane should be confined to operations where service is relatively infrequent and full loads are handled infrequently.

Class C. **(MODERATE SERVICE)** For such use as machine shops, assembly floors, foundries, fabricating shops, paper mill machine rooms, etc. where service requirements are medium.

Class D. **(HEAVY DUTY SERVICE)** For such use as heavy machine shops, foundries, fabricating plants, stamping plants, steel warehouses, standard duty, bucket, magnet and lumber plant cranes, etc. where heavy duty production service is required.

Class E. **(SEVERE DUTY CYCLE SERVICE)** Critical duty cycle bucket or magnet cranes or magnet-bucket combinations; severe duty scrap yard cranes and lumber handling cranes; applications where minimum down-time is a prime consideration. Specify cycle of operation required for each motion.

Class F. **(AISE SPEC.)** Classification covered by the current issue of the Association of Iron and Steel Enginers Specifications for Electric Overhead Traveling Cranes for Steel Mill Service.

Appendix B

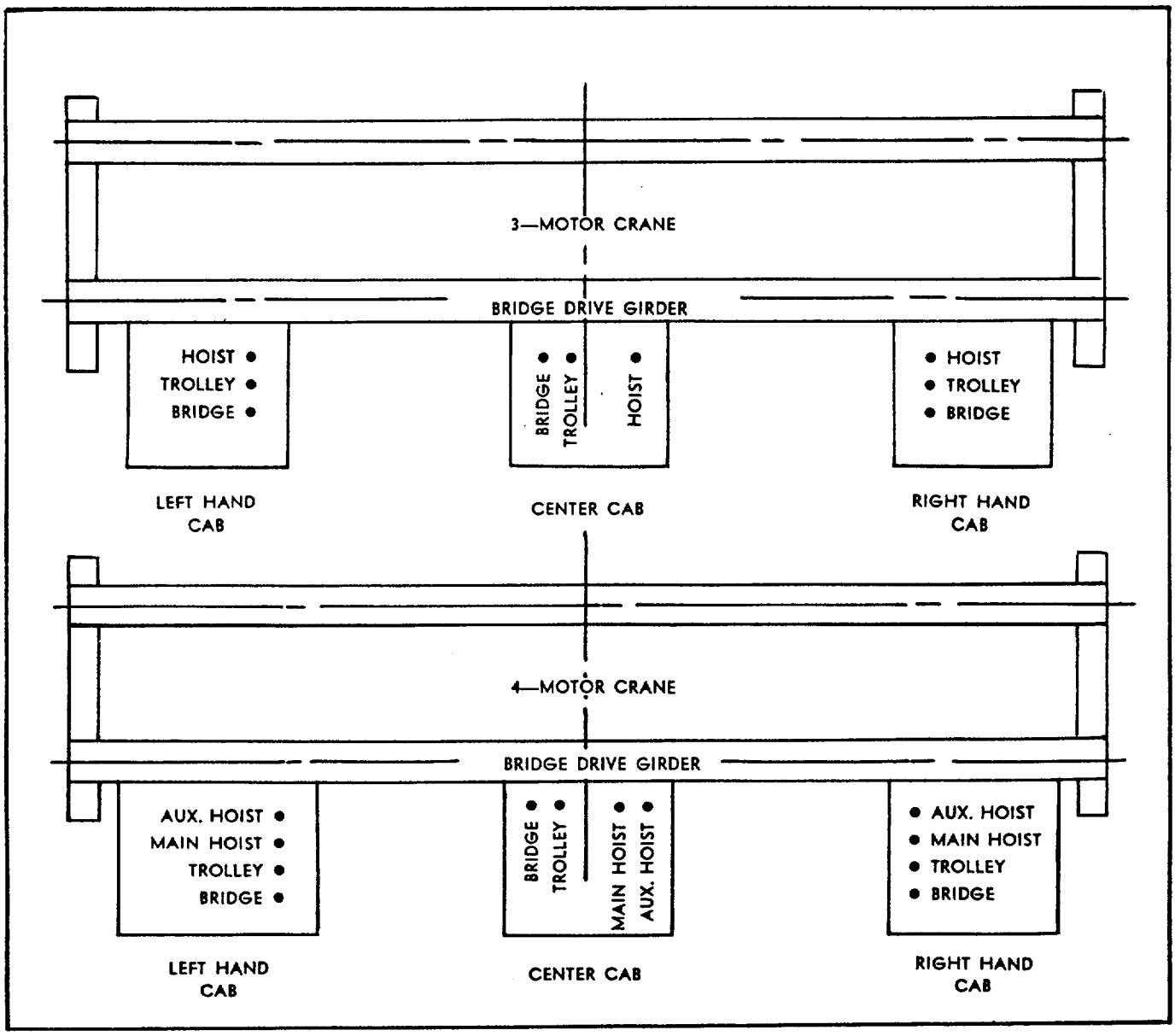
SUGGESTED APPROXIMATE OPERATING SPEEDS

FEET PER MINUTE

Capacity In Tons	HOIST			TROLLEY			BRIDGE		
	Slow	Medium	Fast	Slow	Medium	Fast	Slow	Medium	Fast
3	20	35	70	125	150	200	200	300	400
5	20	35	70	125	150	200	200	300	400
7½	20	35	70	125	150	200	200	300	400
10	20	30	60	125	150	200	200	300	400
15	15	30	50	125	150	200	200	300	400
20	15	25	40	125	150	200	200	300	400
25	15	25	30	100	150	175	200	300	400
30	15	25	30	100	125	175	150	250	350
35	10	15	25	100	125	150	150	250	350
40	8	15	25	100	125	150	150	250	350
50	5	10	20	75	125	150	100	200	300
60	5	10	20	75	100	150	100	200	300
75	5	10	18	50	100	125	75	150	200

NOTE: For floor controlled cranes, it is recommended that trolley and bridge speeds not exceed those given in the "slow" columns.

Appendix C



The above sketches show the standard arrangement of controllers in the operator's cab of three and four motor cranes. The controllers will be arranged in these relative positions unless a different arrangement is specified by the purchaser or special conditions require a different arrangement. In cases where more than one crane operates on a runway particular attention should be given to the controller arrangement.

The purpose of the above diagram is to show the relative sequence of controllers in relation to the crane hook and is not intended to indicate the exact location of the controllers.

Appendix D

GUIDE FOR MAXIMUM BRIDGE AND TROLLEY WHEEL LOADINGS, LBS. (P)

E. O. C. I. Service Class	Wheel Dia. (D) Inches	RAIL SECTION										
		ASCE 20#	ASCE 25#	ASCE 30#	ASCE 40#	ARA-A 90#	ASCE 60 & 70# ARA-B 100#	ASCE 80 & 85# ARA-A 100# Beth. 104# C. I. 105#	ASCE 100#	Carnegie Illinois 135#	Carnegie Illinois 175#	Bethlehem 171#
Class A STANDBY SERVICE	6	8100	9600	10200	12000							
	7	9450	11200	11910	14000							
	8	10800	12800	13610	16000							
Class B LIGHT SERVICE	9	12150	14400	15310	18000	23900	25200					
	10	13500	16000	17010	20000	26600	28000					
	12		19200	20410	24000	31900	33600	36000	40800			
Class C MODERATE SERVICE	15			25510	30000	39800	42000	45000	51000			
	18			30610	36000	47800	50400	54000	61200			
	21				42000	55800	58800	63000	71400	75600	105000	117600
	24					63800	67200	72000	81600	86400	120000	134400
P = 1600 WD	27							81000	91800	97200	135000	151200
	30							90000	102000	108000	150000	168000
Class D HEAVY DUTY SERVICE	6	7090	8400	8930	10500							
	7	8270	9800	10420	12250							
	8	9450	11200	11900	14000							
	9	10630	12600	13390	15750	20900	22050					
	10	11820	14000	14880	17500	23200	24500					
	12		16800	17860	21000	27900	29400	31500	35700			
	15			22320	26250	34900	36750	39380	44630			
P = 1400 WD	18			26790	31500	41800	44100	47250	53550			
	21				36750	48800	51450	55130	62480	66150	91880	102900
	24					55800	58800	63000	71400	75600	105000	117600
	27							70880	80330	85050	118130	132300
	30							78750	89250	94500	131250	147000
Class E SEVERE DUTY-CYCLE SERVICE	6	6080	7200	7650	9000				NOTE: The loading limits for Class E are also recommended wherever travel speeds exceed 400 f.p.m.			
	7	7090	8400	8930	10500							
	8	8100	9600	10200	12000							
	9	9120	10800	11480	13500	17900	18900					
	10	10130	12000	12760	15000	19900	21000					
	12		14400	15310	18000	23900	25200	27000	30600			
	15			19130	22500	29900	31500	33750	38250			
	18			22960	27000	35900	37800	40500	45900			
P = 1200 WD	21				31500	41800	44100	47250	53550	56700	78750	88200
	24					47800	50400	54000	61200	64800	90000	100800
	27							60750	68850	72900	101250	113400
	30							67500	76500	81000	112500	126000
Effective Width of Rail Head (W) Inches (Top of head minus corner radii)		.844	1.000	1.063	1.250	1.656	1.750	1.875	2.125	2.250	3.125	3.500

Spec. No.....

CRANE INQUIRY DATA SHEET

Date.....

Data Sheet No.....

---

1. Number Cranes Required.....
2. Capacity: Main Hoist.....Tons Aux. Hoist.....Tons.
3. Span: Center to Center Runway Rails.....Ft. .....In.
4. Lift of Hook(s) (Max. Including Pits or Wells Below Floor Elevation) Main Hoist.....Ft. .....In.

   Aux. Hoist.....Ft. .....In.
5. Floor to Top Runway Rail: Ft..... In.....
6. Top Runway Rail to Low Point of Roof Truss. (Allow for Truss Sag) .....Ft. .....In.
7. Center of Runway Rail to Face of Building Column: .....Ft. .....In.
8. Approximate Length of Runway: Ft..... Size Runway Rail:.....
9. Number of Cranes on Runway:.....
10. Service Information:

    Main Hoist: E.O.C.I. Class..... (See Appendix "A")

    Number of Lifts per Hour..... Per Day.....Hours per Day..... Year.....

    Hook..... Magnet..... Bucket.....

    Give Size and Weight of Magnet or Bucket.....

    Aux. Hoist: E.O.C.I. Class..... (See Appendix "A")

    Number of Lifts per Hour..... Per Day..... Hours per Day..... Year.....

    Hook..... Magnet..... Bucket.....

    Give Size and Weight of Magnet or Bucket.....

    Bridge: E.O.C.I. Class..... (See Appendix "A")

    Number Moves per Hour..... Hours per Day..... Year..... Average Movement.....Ft.

    Trolley: E.O.C.I. Class ..... (See Appendix "A")

    Number Moves per Hour..... Hours per Day..... Year..... Average Movement.....Ft.

11. Furnish complete information regarding special conditions such as acid fumes, steam, high temperatures, high altitudes, excessive dust or moisture, very severe duty, special or fine handling.....

.....

12. Ambient Temperature in Building: Max..... Min.....

13. Material Handled ..... Dept.....

14. Speeds Required: Main Hoist.....FPM Bridge .....FPM

Aux. Hoist.....FPM Trolley.....FPM

15. Crane to Operate: Indoors..... Outdoors..... Both.....

16. Current: Volts..... Phase..... Cycle.....A.C. Volts.....D.C.

17. Method of Control: Cab..... Floor..... Remote.....

18. Location of Control: End of Crane..... Center..... On Trolley..... Other.....

19. Type of Control: (Give complete information)

Drum Radial Lever..... Full Magnetic..... Other .....

20. Type of Control Enclosure: .....

21. Type of Motors: (Give complete information) .....

.....

22. Must wiring comply with Special Conditions or Codes .....

Describe briefly (See Items 11 and 12).....

.....

23. Are Runway Conductors to be included.....

Type: Loose Wires..... Rigid Wires..... Angles..... Other .....

24. List any Special Equipment or Accessories Desired .....

.....

25. Specify when double hook cranes, double trolley cranes, or special cranes are required giving detailed information on hook spacing, etc. .....

.....

26. If knee braces, pipes, lights, or any other items interfere with crane clearance, enclose sketch. If there are any obstructions underneath the crane which the underside of the girder or the cab might interfere with, give complete information.

GLOSSARY

AUXILIARY GIRDER. A girder arranged parallel to the main girder for supporting the platform, motor base, operator's cab, control panels, etc., to reduce the torsional forces such loads would otherwise impose on the main girder.

BOX SECTION. The rectangular cross section of girders, trucks or other members enclosed on four sides.

BRIDGE. That part of an overhead crane consisting of girders, trucks, end ties, walkway and drive mechanism which carries the trolley and travels in a direction parallel to the runway.

BRIDGE RAIL. The rail supported by the bridge girders on which the trolley travels.

CAMBER. The slight vertical curve given to girders to compensate partially for deflection due to hook load and weight of the crane.

CLEARANCE. Minimum distance from the extremity of a crane to the nearest obstruction.

COLLECTORS. Contacting devices for collecting current from the runway or bridge conductors.

Main Line Collectors. The collectors mounted on the bridge used to transmit current from the runway conductors.

Trolley Collectors. The collectors mounted on the trolley used to transmit current from the bridge conductors.

CONTROLLER. A device for regulating in a pre-determined way the power delivered to the motor or other equipment.

COVER PLATE. The top or bottom plate of a box girder.

CRANE STOP. A block secured to the runway to limit movement of the crane.

CROSS SHAFT. The shaft extending across the bridge, used to transmit torque from motor to bridge drive wheels.

DEAD LOADS. The loads on a structure which remain in a fixed position relative to the structure. On a crane bridge such loads include the girders, footwalk, cross shaft, drive units, panels, etc.

DEFLECTION. Displacement due to bending or twisting.

Vertical Deflection. Deflection due to vertical forces.

Lateral Deflection. Deflection due to lateral forces.

Live Load Deflection. Deflection resulting from imposed live loads.

Dead Load Deflection. Deflection resulting from imposed dead loads.

DIAPHRAGM. A plate or partition between opposite parts of a member, serving a definite purpose in the structural design of the member.

DRIVE GIRDER. The girder on which the bridge drive machinery is mounted.

DRUM GROOVES. Helical grooves cut in the periphery of the drum to guide the hoisting rope.

DYNAMIC LOWERING. A method of control by which the hoist motor is so connected in the lowering direction, that when it is overhauled by the load, it acts as a generator and forces current either through the resistors or back into the line.

EOCI. Electric Overhead Crane Institute.

ELECTRIC OVERHEAD TRAVELING CRANE. An electrically operated machine for lifting, lowering and transporting loads, consisting of a movable bridge carrying a fixed or movable hoisting mechanism and traveling on an overhead runway structure.

ENCLOSED CONDUCTOR. A conductor or group of conductors substantially enclosed to prevent accidental contact.

END TIE. A structural member other than the end truck which connects the ends of the girders to maintain the squareness of the bridge.

END TRUCK. The unit consisting of truck frame, wheels, bearings, axles, etc. which supports the bridge girders.

FIELD WIRING. The wiring required after erection of the crane.

FIXED AXLE. An axle which is fixed in the truck and on which the wheel revolves.

FOOTWALK. The walkway with handrail, attached to the bridge or trolley for access purposes.

GIRDER. The principal horizontal beam of the crane bridge which supports the trolley and is supported by the end trucks or end ties.

HOOK APPROACH. The minimum horizontal distance between the center of the runway rail and the hook.

IDLER SHEAVE. A sheave used to equalize tension in opposite parts of a rope. Because of its slight movement, it is not termed a running sheave.

IMPACT ALLOWANCE. Additional hook load assumed to result from the dynamic effect of the live load.

KNEE BRACE. The diagonal structural member joining the building column and roof truss.

LIFT. Maximum safe vertical distance through which the hook, magnet, or bucket can move.

LIFTING MAGNET. An electro-magnetic device for attracting and holding ferrous materials for hoisting.

LIMIT SWITCH. A device designed to cut off the power automatically at or near the limit of travel for the crane motion.

Power Circuit Limit Switch. A switch which interrupts the motor power circuit directly.

Control Circuit Limit Switch. A switch which indirectly interrupts the power circuit through a contactor in its control circuit.

LIVE LOAD. A load which moves relative to the structure under consideration.

LOAD CARRYING PART. Any part of the crane in which the induced stress is influenced by the load on the hook.

LOAD BLOCK. The assembly of hook, swivel, bearing, sheaves, pins and frame suspended by the hoisting ropes.

MAGNETIC CONTROLLER. A device or system of devices having all basic functions operated by electromagnets.

MAIN LINE DISCONNECT SWITCH. A switch which breaks the power lines leading from the main line collectors.

MASTER SWITCH. A manually operated device which serves to govern the operation of contactors and auxiliary devices of an electric controller.

MATCH MARKING. Identification of non-interchangeable parts for reassembly after shipment.

MECHANICAL LOAD BRAKE. An automatic type of brake used for controlling loads in the lowering direction when simple reversing control is used. The brake remains released as long as the motor is driving in the down direction but automatically sets to provide braking action when the load begins to overhaul the motor.

MULTIPLE GIRDER CRANE. A crane which has two or more girders for supporting the live load.

NEMA. National Electrical Manufacturers Association.

OPERATOR'S CAB. The operator's compartment from which movements of the crane are controlled.

OVERLOAD PROTECTION (OVERCURRENT). A device operative on excessive current to cause and maintain the interruption or reduction of current flow to the equipment governed.

PENDANT CONTROL. Means suspended from the crane for operating the controllers from the floor or other level beneath the crane.

PITCH DIAMETER. Distance through the center of a drum or sheave from center to center of a rope passed about the periphery.

PLAIN REVERSING CONTROLLER. A reversing controller which has identical steps for both directions of motor rotation.

RATED LOAD. The maximum load which the crane is designed to handle safely.

RESISTOR RATING. Rating established by NEMA which classifies resistors according to per cent of full load current on first point and duty cycle. For example, Class 152 denotes 50% full load current on first point and a duty cycle of 15 seconds on out of each minute.

ROTATING AXLE. An axle which rotates with the wheel.

RUNNING SHEAVE. A sheave which rotates as hook is raised or lowered.

RUNWAY. The rails, beams, brackets and framework on which the crane operates.

RUNWAY CONDUCTORS. The conductors mounted on or parallel to the runway which supply current to the crane.

RUNWAY RAIL. The rail supported by the runway beams on which the bridge travels.

SPAN. Distance from center of the two rails of a crane runway.

TOE BOARD. A vertical projection above a platform or walkway to prevent objects from falling over the edge.

TORQUE, FULL LOAD. The torque necessary for a motor to produce its rated horsepower at full-load speed.

TROLLEY. The unit carrying the hoisting mechanism which travels on the bridge rails.

TROLLEY FRAME. The basic structure of the trolley on which are mounted the hoisting and traversing mechanisms.

UNDERVOLTAGE PROTECTION. A device operative on the reduction or failure of voltage to cause and maintain the interruption of power in the main circuit.

WEB PLATE. The vertical plate connecting the upper and lower flanges or cover plates of a girder.

WHEEL BASE. Distance from center to center of outermost wheels.

WHEEL LOAD. The load on any wheel with the trolley and lifted load (rated capacity) positioned on the bridge to give maximum loading.