

SECTION 13921

ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes electric-drive, split-case centrifugal fire pumps and the following:
 - 1. Full service fire-pump controllers and automatic transfer switches.
 - 2. Fire-pump accessories and specialties.
 - 3. Pressure-maintenance pumps, controllers, accessories, and specialties.
 - 4. Alarm panels.
 - 5. Flowmeter systems.
- B. Related Sections include the following:
 - 1. Division 2 Section "Water Distribution" for piping outside the building.
 - 2. Division 10 Section "Fire-Protection Specialties" for cabinets and fire extinguishers.
 - 3. Division 13 Section "Fire Alarm" for alarm devices not specified in this Section.
 - 4. Division 16 Section "Fire Alarm"

1.3 DEFINITIONS

- A. ANSI: American National Standards Institute
- B. ASME: American Society of Mechanical Engineers
- C. ASTM: American Society for Testing and Materials
- D. CR: Chlorosulfonated polyethylene synthetic rubber.
- E. Engineer: JBA Consulting Engineers
- F. FM: Factory Mutual
- G. FMG: Factory Mutual Global
- H. High-Pressure Piping System: Fire-suppression piping system designed to operate at working pressure higher than standard 175 psig (1200 kPa).

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- I. Owner: Clark County Department of Airports
- J. UL: Underwriter's Laboratory
- K. Underground Service-Entrance Piping: Underground service piping below the building.

1.4 PERFORMANCE REQUIREMENTS

- A. Pump, Equipment, Accessory, Specialty, and Piping Pressure Rating: 175-psig (1200-kPa) minimum working-pressure rating, unless otherwise indicated.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, certified pump performance curves with each selection point indicated, operating characteristics, and furnished accessories and specialties for each fire pump and pressure-maintenance pump.
- B. Shop Drawings: For fire pumps and drivers, fire-pump controllers, fire-pump accessories and specialties, pressure-maintenance pumps, pressure-maintenance-pump controllers, and pressure-maintenance-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Submit shop drawings and manufacturer's data as required to obtain the approval of all applicable local, state, federal, and insurance authorities.
 - 2. Submit one set of shop drawings and manufacturer's data bearing the review stamp of all applicable local, state, federal, and insurance authorities to the architect and owner.
 - 3. Contractor shall submit complete system packages. Partial system submittals will be rejected.
 - 4. When the plans are rejected because of incomplete or incorrect information, the Contractor shall be responsible for the Engineer's extra review time and expenses beyond one resubmittal. Such extra fees shall be paid by the Contractor directly to the engineer when the resubmittal is made. The Contractor is not responsible for the engineer's review time for the first submittal and first resubmittal, or for resubmittals because of project changes.
 - 5. Prepare shop drawings at minimum scale of 1/8-inch = 1-foot for plans, and 1/4-inch = 1-foot for details. Show all piping, hangers, type of pipe, tube connections, valves, bracing, roof construction, and occupancy of each area. When welding is planned, shop drawings shall indicate the sections to be shop welded and the type of welded fittings to be used.
 - 6. Shop Drawings shall include details of earthquake sway bracing.
 - 7. Design shall be based upon ☐ drawings ☐ actual surveys.

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8. Retain first subparagraph below if products are required to withstand specific design loads and design responsibilities have been delegated to Contractor or if structural data are required as another way to verify products' compliance with performance requirements. Professional engineer qualifications are specified in Division 1 Section "Quality Requirements."
 9. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Manufacturer Seismic Qualification Certification: Submit certification that fire pumps and drivers and fire-pump controllers, pressure-maintenance pumps, accessories, and specialties will withstand seismic forces defined in Division 15 Section "Mechanical Vibration and Seismic Controls." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Product Certificates: For each type of fire pump and fire-pump controller, signed by product manufacturer.
- E. Source quality-control test reports.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For fire pumps and drivers, pressure-maintenance pumps, controllers, accessories and specialties, alarm panels, and flowmeter systems to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Applicable Codes and Standards

1. NFPA 13, *Standard for the Installation of Sprinkler System*

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2. NFPA 14, *Standard for the Installation of Standpipe Systems*
 3. NFPA 15, *Water Spray Fixed Systems for Fire Protection*
 4. NFPA 20, *Stationary Pumps for Fire Protection*
 5. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."
 6. NFPA 25, *Standard for the Inspection, Testing and Maintenance of Water Based Fire Protection Systems*
 7. NFPA 72, *National Fire Alarm Code*
 8. NFPA 230, *Fire Protection of Storage*
 9. NFPA 415, *Standard on Airport Terminal Buildings, Fueling Ramp Drainage and Loading Walkways*
- B. Governmental Jurisdiction: All work and materials shall conform to all Federal, State and local codes and regulations governing this installation including the current editions of the International Building Code and the Uniform Fire Code as modified or interpreted by the Clark County Building and/or Fire Department.
- C. Code Conflict: If there is a conflict between the referenced NFPA standards, Federal, State and local codes and this specification, it shall be the Contractor's responsibility to bring the conflict to the attention of the Owner for resolution.
- D. Source Limitations: Obtain fire pumps, pressure-maintenance pumps, and controllers through one source from a single manufacturer for each type of equipment.
- E. Product Options: Drawings indicate size, profiles, and dimensional requirements of fire pumps, pressure-maintenance pumps, and controllers and are based on specific systems indicated. Refer to Division 1 Section "Product Requirements."
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- G. Comply with standards of authorities having jurisdiction pertaining to materials, hose threads, and installation.
- H. Comply with NFPA 20, "Stationary Pumps for Fire Protection," for fire pumps, drivers, controllers, accessories, and their installation.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 CENTRIFUGAL FIRE PUMPS

- A. Description, General: UL 448, factory-assembled and -tested, electric-drive, centrifugal fire pumps capable of furnishing not less than 150 percent of rated capacity at not less than 65 percent of total rated head and with shutoff head limited to 140 percent of total rated head.
 - 1. Design shall be based on 100 percent of pump rated capacity per Clark County Fire Department Guidelines..
 - 2. Finish: Manufacturer's standard red paint applied to factory-assembled and -tested unit before shipping.
 - 3. Nameplate: Complete with capacities, characteristics, and other pertinent data.
- B. Fabricate base and attachment to fire pumps, pressure-maintenance pumps, and controllers with reinforcement to resist movement of pumps and controllers during a seismic event when their bases are anchored to building structure.
- C. Single-Stage, Horizontally Mounted, Split-Case Fire Pumps: Double-suction type with pump and driver mounted on same base and connected with coupling.
 - 1. Manufacturers:
 - a. A-C Pump; ITT Industries.
 - b. Armstrong Darling, Inc.
 - c. Aurora Pump; Pentair Pump Group.
 - d. Fairbanks Morse; Pentair Pump Group.
 - e. Patterson Pump Company.
 - f. Sterling Peerless Pump; Sterling Fluid Systems Group.
 - 2. Pump: Axially split cast-iron casing with suction and discharge flanges machined to ASME B16.1, Class 125 dimensions, unless otherwise indicated.

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- a. Impeller: Cast bronze of construction to match fire pump, statically and dynamically balanced, and keyed to shaft.
 - b. Wear Rings: Replaceable, bronze.
 - c. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - 1) Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
 - 2) Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
 - 3. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
 - 4. Driver: UL-listed, NEMA MG 1, open-dripproof, squirrel-cage, induction motor complying with NFPA 20 and NFPA 70. Include wiring compatible with controller used.
 - a. Manufacturers:
 - 1) Emerson; U.S. Electrical Motors.
 - 2) Lincoln Electric Company (The).
 - 3) Marathon Electric, Inc.
- D. Multistage, Horizontally Mounted, Split-Case Fire Pumps: Two-stage, single-suction type with pump and driver mounted on same base and connected with coupling.
- 1. Manufacturers:
 - a. A-C Pump; ITT Industries.
 - b. Armstrong Darling, Inc.
 - c. Aurora Pump; Pentair Pump Group.
 - d. Fairbanks Morse; Pentair Pump Group.
 - e. Patterson Pump Company.
 - f. Sterling Peerless Pump; Sterling Fluid Systems Group.
 - 2. Pump: Axially split cast-iron casing with suction and discharge flanges machined to ASME B16.1, Class 125 dimensions, unless otherwise indicated.
 - a. Impeller: Cast bronze of construction to match fire pump, statically and dynamically balanced, and keyed to shaft.
 - b. Wear Rings: Replaceable, bronze.
 - c. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - 1) Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
 - 2) Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
 - 3. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.

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4. Driver: UL-listed, NEMA MG 1, open-dripproof, squirrel-cage, induction motor complying with NFPA 20 and NFPA 70. Include wiring compatible with controller used.

- a. Manufacturers:
 - 1) Emerson; U.S. Electrical Motors.
 - 2) Lincoln Electric Company (The).
 - 3) Marathon Electric, Inc.

E. Fire-Pump Characteristics and Specialty Data:

1. Fire-Pump Plan No.: **<Insert designation used on Drawings.>**
 - a. Rated Capacity: **<Insert value.>**
 - b. Total Rated Head: **<Insert value.>**
 - c. Inlet Size: **<Insert value.>**
 - d. Outlet Size: **<Insert value.>**
 - e. Outlet Flange Class: **[125] [250].**
2. Speed: Same as driver.
3. Electric-Motor Driver: hp, **[1750] [3500] <Insert other>** rpm, 480 volt, 3 phase, 60 Hz.
 - a. Full-Load Amperes: **<Insert value.>**
 - b. Minimum Circuit Ampacity: **<Insert value.>**
 - c. Maximum Overcurrent Protection: **<Insert value.>**
4. Test Header Size: **<Insert value.>**
 - a. Hose Valves Required: **[One] [Two] [Three] [Four] [Six] [Eight].**
 - b. Hose Valve Size: **NPS 2-1/2 (DN 65).**
5. Relief Valve Size: **<Insert value.>**
6. Cone Size: **<Insert value.>**

2.3 FIRE-PUMP CONTROLLERS

- A. Fire-Pump Controllers, General: UL 218 and NFPA 20; listed for electric-drive, fire-pump service and service entrance; combined automatic and manual operation; factory assembled and wired; and factory tested for capacities and electrical characteristics.

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1. Manufacturers
 - a. Cutler-Hammer.
 - b. Firetrol, Inc.
 - c. Hubbell Industrial Controls, Inc.
 - d. Joslyn Clark.
 - e. Master Control Systems, Inc.
 - f. Metron, Inc.
2. Rate controllers for scheduled fire-pump horsepower and short-circuit withstand rating at least equal to short-circuit current available at controller location. Take into account cable size and distance from substation or supply transformers.
3. Enclosure: UL 50, Type 2, dripproof, indoor, unless special-purpose enclosure is indicated. Include manufacturer's standard red paint applied to factory-assembled and -tested unit before shipping.
4. Controls, devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used, and specific items listed.
 - a. Isolating means and circuit breaker.
 - b. "Power on" pilot lamp.
 - c. Fire-alarm system connections for indicating motor running condition, loss-of-line power, and line-power phase reversal.
 - d. Automatic and manual operation, and minimum run-time relay to prevent short cycling.
 - e. Water-pressure-actuated switch with independent high and low calibrated adjustments responsive to water pressure in fire-suppression piping.
 - f. Automatic and manual shutdown.
 - g. System pressure recorder, electric ac driven with spring backup.
5. Nameplate: Complete with capacity, characteristics, approvals and listings, and other pertinent data.
6. Controller Sensing Pipes: Fabricate pipe and fittings according to NFPA 20 with nonferrous-metal sensing piping, NPS 1/2 (DN 15), with globe valves for testing controller mechanism from system to pump controller as indicated. Include bronze check valve with 3/32-inch (2.4-mm) orifice in clapper or ground-face union with noncorrosive diaphragm having 3/32-inch (2.4-mm) orifice.

B. Full-Service Fire-Pump Controllers:

1. Type Starting: Reduced voltage.
2. Mounting: **Wall** type for field electrical connections.
3. Automatic Transfer Switches: UL 218 and UL 1008 and requirements for and attached to fire-pump controllers. Include enclosure complying with UL 50, Type 2, with automatic

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transfer switch with rating at least equal to fire-pump driver-motor horsepower. Include ampere rating not less than 115 percent of motor full-load current and suitable for switching motor-locked rotor current.

2.4 FIRE-PUMP ACCESSORIES AND SPECIALTIES

- A. Match fire-pump suction and discharge ratings as required for fire-pump capacity rating. Include the following:
1. Automatic air-release valve.
 2. Circulation relief valve.
 3. Suction and discharge pressure gages.
 4. Eccentric-tapered reducer at suction inlet.
 5. Concentric-tapered reducer at discharge outlet.
 6. Test-Header Manifold: Ductile-iron or brass body for hose valves. Include nozzle outlets arranged in single line; horizontal, flush-wall mounting attachment; and rectangular, **polished chrome-plated** brass finish escutcheon plate with lettering equivalent to "PUMP TEST CONNECTION."
 7. Test-Header Manifold: Ferrous body for hose valves. Manufacturer's standard finish. Include bronze or cast-iron, exposed-type valve header with nozzle outlets; and round, brass escutcheon plate with lettering equivalent to "PUMP TEST CONNECTION."
 8. Hose Valves: UL 668, straightway pattern, and bronze with cap and chain. Include NFPA 1963 hose thread that complies with local fire department standards and finish same as for test-header-manifold escutcheon plate.
 9. Ball Drip Valve: UL 1726.
 10. Main Relief Valve: UL 1478, **pilot operated**.
 11. Discharge Cone: Closed type.
 12. Finish: Manufacturer's standard factory-applied red paint unless brass or other finish is specified.

2.5 PRESSURE-MAINTENANCE PUMPS

- A. Pressure-Maintenance Pumps, General: Factory-assembled and -tested pumps with electric-motor driver, controller, and accessories and specialties. Include cast-iron or stainless-steel casing and bronze or stainless-steel impellers, mechanical seals, and suction and discharge flanges machined to ASME B16.1, Class 125 dimensions unless Class 250 flanges are

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indicated and except that connections may be threaded in sizes where flanges are not available.

1. Finish: Manufacturer's standard color paint applied to factory-assembled and -tested unit before shipping.
 2. Nameplate: Complete with capacity, characteristics, and other pertinent data.
- B. Multistage, Pressure-Maintenance Pumps: Multiple-impeller type complying with HI 1.1-1.2 and HI 1.3 requirements for multistage centrifugal pumps. Include base.
1. Manufacturers:
 - a. A-C Pump; ITT Industries.
 - b. Grundfos Pumps Corp.
 - c. Jacuzzi Brothers.
 - d. Paco Pumps, Inc.
 - e. Sterling Peerless Pump; Sterling Fluid Systems Group.
 - f. Taco, Inc.
 2. Driver: NEMA MG 1, open-drip-proof, squirrel-cage, induction motor complying with NFPA 20 and NFPA 70. Include wiring compatible with controller used.
- C. Controllers: UL 508; factory-assembled, -wired, and -tested, across-the-line type for combined automatic and manual operation.
1. Manufacturers:
 - a. Cutler-Hammer.
 - b. Firetrol, Inc.
 - c. Hubbell Industrial Controls, Inc.
 - d. Joslyn Clark.
 - e. Master Control Systems, Inc.
 - f. Metron, Inc.
 2. Enclosure: UL 508 and NEMA 250, Type 2, wall-mounting type for field electrical wiring.
 - a. Finish: Manufacturer's standard color paint applied to factory-assembled and -tested unit before shipping.
 3. Rate controller for scheduled horsepower and include the following:
 - a. Fusible disconnect switch.
 - b. Pressure switch.
 - c. Hand-off-auto selector switch.

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- d. Pilot light.
 - e. Running period timer.
- D. Accessories and Specialties: Match pressure-maintenance-pump suction and discharge ratings as required for pump capacity rating. Include the following:
 - 1. Circulation relief valve.
 - 2. Suction and discharge pressure gages.
- E. Pressure-Maintenance-Pump Characteristics and Specialty Data:
 - 1. Plan No.: **<Insert designation used on Drawings.>**
 - 2. Rated Capacity: At least 15 gpm.
 - 3. Total Rated Head: **<Insert value.>**
 - 4. Pump Speed: **[1750] [3500]** rpm.
 - 5. Electric-Motor Driver Size: **<Insert value>** hp, **[1750] [3500]** rpm, 480 volt, 3 phase, 60 Hz.
 - a. Full-Load Amperes: **<Insert value.>**
 - b. Minimum Circuit Ampacity: **<Insert value.>**
 - c. Maximum Overcurrent Protection: **<Insert value.>**

2.6 ALARM PANELS

- A. Description: Factory-assembled and -wired remote panel complying with UL 508 and requirements in NFPA 20. Include audible and visible alarms matching controller type.
 - 1. Manufacturers:
 - a. Cutler-Hammer.
 - b. Firetrol, Inc.
 - c. Hubbell Industrial Controls, Inc.
 - d. Joslyn Clark.
 - e. Master Control Systems, Inc.
 - f. Metron, Inc.
 - 2. Enclosure: NEMA 250, Type 2, remote wall-mounting type.
 - a. Finish: Manufacturer's standard red paint applied to factory-assembled and -tested unit before shipping.

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3. Features: Include manufacturer's standard features and the following:
 - a. Motor-operating condition.
 - b. Loss-of-line power.
 - c. Phase reversal.
 - d. Low-water alarm.

2.7 FLOWMETER SYSTEMS

- A. Description: Fire-pump flowmeter system that indicates flow to not less than 175 percent of fire-pump rated capacity. Include sensor of size to match pipe, tubing, flowmeter, and fittings.
 1. FMG-Approved Manufacturers:
 - a. Dieterich Standard Inc.
 - b. Gerand Engineering Co.
 - c. Hyspan Precision Products, Inc.
 - d. Meriam Instruments Div.; Scott Fetzer Co.
 - e. Preso Meters Corporation.
 - f. Reddy-Bufferaloes Pump Co.
 2. UL-Listed Manufacturers:
 - a. Fire Research Corp.
 - b. Reddy-Bufferaloes Pump Co.
 3. Pressure Rating: 175-psig (1200-kPa) minimum.
 4. Sensor: Venturi, annubar probe, or orifice plate, unless otherwise indicated.
 5. Flowmeter: Compatible with flow sensor with dial not less than 4-1/2 inches (115 mm) in diameter or manufacturer's equivalent size.
 6. Permanently Mounted Flowmeter: Suitable for wall mounting with copper tubing to connect to flow sensor.
 7. Portable Flowmeter: With two 12-foot (3.7-m) hoses, in carrying case.

2.8 PRESSURE GAGES

- A. Description: UL 393, 3-1/2- to 4-1/2-inch- (90- to 115-mm-) diameter dial with range of [0- to 250-psig (0- to 1725-kPa)] [0- to 300-psig (0- to 2070-kPa)] minimum. Include caption "WATER" on dial face.

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1. Manufacturers:
 - a. AGF Manufacturing Co.
 - b. AMETEK, Inc.; U.S. Gauge.
 - c. Brecco Corporation.
 - d. Dresser Equipment Group; Instruments Div.
 - e. Marsh Bellofram.
 - f. WIKA Instrument Corporation.
2. Suction pressure gages shall be compound pressure and vacuum gauges with a minimum 3-1/2 inch diameter dial with a pressure rating to two (2) times the maximum suction pressure.

2.9 GROUT

- A. Description: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

2.10 SOURCE QUALITY CONTROL

- A. Test and inspect fire pumps with their controllers according to NFPA 20 for certified shop tests.
- B. Verification of Performance: Rate fire pumps according to requirements indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, concrete bases, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of fire pumps.
- B. Examine roughing-in for fire-suppression piping to verify actual locations of piping connections before fire-pump installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 CONCRETE BASES

- A. Install concrete bases of dimensions indicated for fire pumps, pressure-maintenance pumps, and controllers. Refer to Division 15 Section "Basic Mechanical Materials and Methods."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Cast-in-place concrete materials and placement requirements are specified in Division 3.

3.3 INSTALLATION

- A. Install and align fire pump, pressure-maintenance pump, and controller according to NFPA 20.
- B. Install pumps and controllers to provide access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- C. Set base-mounting-type pumps on concrete bases. Disconnect coupling halves before setting. Do not reconnect couplings until alignment operations have been completed.
 - 1. Support pump baseplate on rectangular metal blocks and shims or on metal wedges having small taper, at points near anchor bolts, to provide 3/4- to 1-1/2-inch (19- to 38-mm) gap between pump base and concrete base for grouting.
 - 2. Adjust metal supports or wedges until pump and driver shafts are level. Verify that coupling faces and pump suction and discharge flanges are level and plumb.
- D. Install suction and discharge piping equal to or greater than diameter of fire-pump nozzles.
- E. Install valves that are same size as piping connecting fire pumps, bypasses, test headers, and other piping systems.
- F. Install pressure gages on fire-pump suction and discharge at pressure-gage tapings.
- G. Support pumps and piping separately so weight of piping does not rest on pumps.
- H. Install piping accessories, hangers and supports, anchors, valves, meters and gages, and equipment supports.

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- I. Install flowmeters and sensors where indicated. Install flowmeter-system components and make connections according to manufacturer's written instructions.
- J. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.

3.4 ALIGNMENT

- A. Align split-case fire-pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.
- B. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.
- C. Align piping connections.
- D. Align pump and driver shafts for angular and parallel alignment according to HI 1.4 and to tolerances specified by manufacturer.
- E. Align vertically mounted, split-case pump and driver shafts after complete unit has been made plumb on concrete base, grout has set, and anchor bolts have been tightened.

3.5 CONNECTIONS

- A. Piping installation requirements are specified in Division 13 Section "Fire-Suppression Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps and equipment to allow service and maintenance.
- C. Connect water supply and discharge piping to fire pumps. Connect water supply and discharge piping to pressure-maintenance pumps.
- D. Connect relief-valve discharge to point of disposal.
- E. Connect flowmeter-system sensors and meters according to manufacturer's written instructions.
- F. Connect controllers to pumps.
- G. Connect fire-pump controllers to building fire-alarm system. Refer to Division 13 Section "Fire Alarm."
- H. Ground equipment according to Division 16 Section "Grounding and Bonding."
- I. Connect wiring according to Division 16 Section "Conductors and Cables."

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3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect test, and adjust field-assembled components and equipment installation, including connections and to assist in field testing. Report results in writing.
- B. Perform field tests for each fire pump when installation is complete. Comply with operating instructions and procedures in NFPA 20 to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment that cannot be satisfactorily corrected or that does not perform as indicated, then retest to demonstrate compliance. Verify that each fire pump performs as indicated.
- C. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Final Checks before Startup: Perform the following preventive-maintenance operations and checks:
 - a. Lubricate oil-lubrication-type bearings.
 - b. Remove grease-lubrication-type bearing covers, flush bearings with kerosene, and clean thoroughly. Fill with new lubricant according to manufacturer's written instructions.
 - c. Disconnect coupling and check electric motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.
 - d. Verify that pump is free to rotate by hand. If pump is bound or if it drags even slightly, do not operate until cause of trouble is determined and corrected.
 - 3. Starting procedure for pumps is as follows:
 - a. Prime pump by opening suction valve and closing drains, and prepare pump for operation.
 - b. Open sealing-liquid supply valves if pump is so fitted.
 - c. Start motor.
 - d. Open discharge valve slowly.
 - e. Observe leakage from stuffing boxes and adjust sealing-liquid valve for proper flow to ensure lubrication of packing. Do not tighten gland immediately, but let packing run in before reducing leakage through stuffing boxes.
 - f. Check general mechanical operation of pump and motor.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 5. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Fire hoses are for field-acceptance tests only and are not property of Owner.

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3.7 FIRE PUMP ACCEPTANCE TESTING

- A. Upon completion of installation, CONTRACTOR shall perform and document on an approved format, system tests as described herein. All acceptance tests shall be performed in the presence of OWNER or designated representative.
1. Pump Acceptance Tests:
 - a. Pump acceptance tests shall be performed in accordance with NFPA 20 and the requirements of the Clark County Fire Department.
 - b. CONTRACTOR shall perform the pump acceptance tests in the presence of OWNER, AHJ, and the pump manufacturer's representative.
 - c. CONTRACTOR shall notify OWNER and AHJ at least one week prior to all tests.
 - d. CONTRACTOR shall provide an accurate and acceptable method of measuring the discharge flow.
 - e. Tests shall assure that the units and appurtenances have been installed correctly, that there is not objectionable heating, vibration, or noise from any parts, and that all manual and automatic controls function properly. If any deficiencies are revealed during any tests, such deficiencies shall be corrected and a retest shall be conducted.
 2. Controller Acceptance Tests:
 - a. The controller acceptance tests shall be performed in accordance with NFPA 20.
 - b. The tests shall demonstrate proper operation of the controllers for a minimum of 10 automatic starts and 10 manual starts. At least half of the automatic starts and half of the manual starts shall be performed while the pump is connected to the emergency power system.
 - c. Loss of normal power shall be simulated while the pump is operating at full load to demonstrate proper transfer to the emergency power system.
- B. CONTRACTOR shall be responsible for obtaining the services and paying any fees or other expenses of a representative of the fire pump manufacturer to conduct all fire pump acceptance tests, including all tests required by NFPA 20.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire pumps, drivers, controllers, and pressure-maintenance pumps. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION