

SECTION 00 01 15
LIST OF DRAWING SHEETS

The drawings listed below accompanying this specification form a part of
the contract.

Drawing No.

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SECTION 01 00 00

GENERAL REQUIREMENTS

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SECTION 01 00 00

GENERAL REQUIREMENTS

1.1 GENERAL INTENTION

- A. Contractor shall completely prepare site for building operations, including demolition, and furnish labor and materials and perform work for VA Project No. 589-332, Construct Parking Structure, Department of Veterans' Affairs as required by drawings and specifications.
- B. Only one (1) site visit will be scheduled prior to the bid date. Attendance is highly recommended.
- C. Offices of Health Facilities Group, LLC, as Architect-Engineers, will render certain technical services during construction. Such services shall be considered as advisory to the Government and shall not be construed as expressing or implying a contractual act of the Government without affirmations by CO or his duly authorized representative. The A/E information is as follows:

Health Facilities Group, LLC
142 N. Mosley, Suite 300
Wichita, KS 67204
316-262-2500
Contact Person: Mark Crane

- D. Before placement and installation of work subject to tests by testing laboratory retained by Department of Veterans Affairs, the Contractor shall notify the COR in sufficient time to enable testing laboratory personnel to be present at the site in time for proper taking and testing of specimens and field inspection. Such prior notice shall be not less than three work days unless otherwise designated by the COR.
- E. All employees of general contractor and subcontractors shall comply with VA security management program and obtain permission of the VA police, be identified by project and employer, and restricted from unauthorized access.
- F. Prior to commencing work, general contractor shall provide proof that a OSHA designated "competent person" (CP) (29 CFR 1926.20(b)(2)) will maintain a presence at the work site whenever the general or subcontractors are present.
- G. Training:
 - 1. All employees of general contractor or subcontractors shall have the 10-hour certified Construction Safety course. and other relevant

competency training. The on-site supervisor(s) for the contractor shall have the 30-hour OSHA certified Construction Safety course.

2. Submit training records of all such employees for approval before the start of work.

H. VHA Directive 2011-36, Safety and Health during Construction, dated 9/22/2011 in its entirety is made a part of this section

I. Throughout the drawings and specifications, references to Contracting Officer shall be represented by the abbreviation "CO". References to Contracting Officer's Technical Representative or Contracting Officer's Representative shall be represented by the abbreviation "COR". The COR for this project shall be Ryan Brown.

1.2 STATEMENT OF BID ITEM(S)

A. **BID ITEM 1 (BASE BID)**: Work includes general construction of a new 549 stall parking garage and repaving and/or resurfacing of portions of the existing surface parking lot that remains, including alterations, roads, walks, grading, drainage, mechanical and electrical work, utility systems, elevators, and necessary removal of existing structures and construction and certain other items as defined in the drawings and specifications.

a. **BID ITEM 2 (DEDUCT)**: Includes everything in Bid Item 1 (Base Bid) with the exception of providing and installing precast architectural concrete panels and perforated architectural metal panels located at the west end of the south face of the parking garage. This would include omission of associated structural steel framing systems and/or structural steel embeds set into structural precast members of parking garage required to support the architectural panels in question.

b. **BID ITEM 3 (DEDUCT)**: Includes everything in Bid Item NO. 2 with the exception of providing and installing precast architectural concrete panels and perforated architectural metal panels located at the east end of the south face of the parking garage. This would include omission of associated structural steel framing systems and/or structural steel embeds set into structural precast members of parking garage required to support the architectural panels in question.

c. **BID ITEM 4 (DEDUCT)**: Includes everything in Bid Item NO. 3 with the exception of providing and installing Elevator Cab "P-20" and associated accessories and equipment. Elevator Shaft provided and installed in BASE BID shall still be sized to accommodate Elevator Cab "P-20" at a future date.

d. **BID ITEM 5 (DEDUCT)**: Includes everything in Bid Item NO. 4 with the exception of providing and installing 1/4" tinted glass in lieu of 1"

insulated tinted Low-E coated glass at glazed aluminum curtain wall at Stair Tower "A" and Stair Tower "B".

- e. **BID ITEM 6 (DEDUCT)**: Includes everything in Bid Item NO. 5 with the exception of providing and installing precast architectural concrete panels and perforated architectural metal panels located at the west end of the north face of the parking garage. This would include omission of associated structural steel framing systems and/or structural steel embeds set into structural precast members of parking garage required to support the architectural panels in question.
- f. **BID ITEM 7 (DEDUCT)**: Includes everything in Bid Item NO. 6 with the exception of providing and installing precast architectural concrete panels and perforated architectural metal panels located at the east end of the north face of the parking garage. This would include omission of associated structural steel framing systems and/or structural steel embeds set into structural precast members of parking garage required to support the architectural panels in question.
- g. **BID ITEM 8 (DEDUCT)**: Includes everything in Bid Item NO. 7 with the exception of providing and installing Pulse Start Metal Halide light fixtures as specified in lieu of LED light fixtures on light poles located at top parking deck level (poles, bases and accessories provided and install per base bid). Provide and install Fluorescent light fixtures specified in lieu of LED light fixtures at all parking deck levels except top parking deck level. No revision to circuiting schemes with lighting controls shall be required. Omit dual level driver for reduced LED fixture output (bi-level for zone based upon integral occupancy sensors) if alternate is accepted. No revision to the number of circuits shall be required regardless of load change.
- h. **BID ITEM 9 (DEDUCT)**: Includes everything in Bid Item NO. 8 with the exception of the reconstruction and expansion of the surface parking lot from the south edge of the proposed parking garage to the service drive will be removed from the contract. Items of work included as part of this deduct consist of removal of existing asphalt pavement and curbs, re-grading of site to match proposed parking garage entrances, asphalt paving, modular block wall with ornamental fencing on top, sidewalks, curb and gutter, accessible ramps, site stairs with handrails, storm sewers, asphalt seal coat, pavement striping, and landscaping.
- i. **BID ITEM 10 (DEDUCT)**: Includes everything in Bid Items NO. 9 with the exception of providing and installing the architectural precast ring beam located at the top of the parking garage structure. Structural precast columns shall be reduced in height, so that the top of columns match the top of precast spandrel beams at Level "P5". Chain-link fence

fall protection at Level "P5" shall be revised as indicated on drawings to accommodate the omission of architectural precast ring beam. The Overhead Aluminum Canopy located in front (south) of Level "P5" Elevator door openings shall be omitted, along with associated precast embed plates and reinforcements required for attachment of canopy to structural precast.

- j. **BID ITEM 11 (DEDUCT)**: Includes everything in Bid NO. 10 with the exception modifying the structure to construct a 4 story 406 stall parking garage by omitting parking garage Level "P4" and associated architectural, structural, plumbing, mechanical and electrical items from the project, including revisions to Stair Towers "A" and "B", and Elevator "P-19" and Elevator Shafts. Roof Level "P5" (base bid) will become Roof Level "P4" if this deduct alternate is accepted. Omit procurement and installation of the "VA" Logo Vinyl Appliqués to be applied over the exterior face of glazing at the north wall of Stair Tower "A", and the east wall of Stair Tower "B". If this bid item is selected the period of performance shall be 440.
- k. **Bid Item 12**: Shall be the cost for 1 year of guaranteed period services for 2 elevators as further defined in the specification. This service contract shall start after construction final completion and acceptance.
- a. **Bid Item 13 (Deduct)**: Includes everything in Bid Item 12 with the exception of providing guaranteed period of services for elevator "P-20". This Bid item will only be taken if Bid Item NO. 4 to 11 is taken.

1.3 PERIOD OF PERFORMANCE

- A. The Period of Performance for this project shall be **480 calendar days** for bid items 1 through 10, and 440 calendar days if Bid Item 11 is selected. The period of performance begins on the date of Notice to Proceed, and includes submittal review and product procurement, all construction services required, all punch list items reconciled, and ending once close-out services have been completed, and close-out documents have been distributed to the owner, including as-built drawings.

1.4 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

- B. Additional sets of drawings may be made by the Contractor, at Contractor's expense, from electronic copies furnished by Issuing Office.

1.5 CONSTRUCTION SECURITY REQUIREMENTS

- A. Security Plan:

1. The security plan defines both physical and administrative security procedures that will remain effective for the entire duration of the project.
2. The General Contractor is responsible for assuring that all sub-contractors working on the project and their employees also comply with these regulations.

B. Security Procedures:

1. General Contractor's employees shall not enter the project site without appropriate badge. They may also be subject to inspection of their personal effects when entering or leaving the project site.
2. For working outside the "regular hours" as defined in the contract, The General Contractor shall give 3 days notice to the CO so that arrangements can be provided for the employees. This notice is separate from any notices required for utility shutdown described later in this section.
3. No photography of VA premises is allowed without written permission of the CO.
4. VA reserves the right to close down or shut down the project site and order General Contractor's employees off the premises in the event of a national emergency. The General Contractor may return to the site only with the written approval of the CO.

C. Key Control:

1. The General Contractor shall provide duplicate keys and lock combinations to the COR for the purpose of security inspections of every area of project including tool boxes and parked machines.

E. Document Control:

1. Before starting any work, the General Contractor/Sub Contractors shall submit an electronic security memorandum describing the approach to following goals and maintaining confidentiality of "sensitive information".
2. The General Contractor is responsible for safekeeping of all drawings, project manual and other project information. This information shall be shared only with those with a specific need to accomplish the project.
3. Certain documents, sketches, videos or photographs and drawings may be marked "Law Enforcement Sensitive" or "Sensitive Unclassified". Secure such information in separate containers and limit the access to only those who will need it for the project. Return the information to the CO upon request.
4. These security documents shall not be removed or transmitted from the project site without the written approval of CO.

5. All paper waste or electronic media such as CD's and diskettes shall be shredded and destroyed in a manner acceptable to the VA.
6. Notify CO and Site Security Officer immediately when there is a loss or compromise of "sensitive information".
7. All electronic information shall be stored in specified location following VA standards and procedures using an Engineering Document Management Software (EDMS).
 - a. Security, access and maintenance of all project drawings, both scanned and electronic shall be performed and tracked through the EDMS system.
 - b. "Sensitive information" including drawings and other documents may be attached to e-mail provided all VA encryption procedures are followed.

F. Motor Vehicle Restrictions

1. Separate permits shall be issued for General Contractor and its employees for parking in designated areas only.

1.6 FIRE SAFETY

A. Applicable Publications: Publications listed below form part of this Article to extent referenced. Publications are referenced in text by basic designations only.

1. American Society for Testing and Materials (ASTM):
E84-2009.....Surface Burning Characteristics of Building
Materials
2. National Fire Protection Association (NFPA):
10-2010.....Standard for Portable Fire Extinguishers
30-2008.....Flammable and Combustible Liquids Code
51B-2009.....Standard for Fire Prevention During Welding,
Cutting and Other Hot Work
70-2011.....National Electrical Code
101-2012.....Life Safety Code
241-2009.....Standard for Safeguarding Construction,
Alteration, and Demolition Operations
3. Occupational Safety and Health Administration (OSHA):
29 CFR 1926.....Safety and Health Regulations for Construction
4. VHA Directive 2005-007

B. Fire Safety Plan: Establish and maintain a fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, including periodic status reports, and submit to COR for review for compliance with VHA Directive 2005-007, NFPA 101 and NFPA 241. Prior to beginning work, all employees of the contractor and/or any subcontractors shall undergo a

safety briefing provided by the general contractor's competent person per OSHA requirements. This briefing shall include information on the construction limits, VAMC safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of VAMC equipment, etc. Provide documentation to the COR that all construction workers have undergone contractor's safety briefing.

- C. Site and Building Access: Maintain free and unobstructed access to facility emergency services and for fire, police and other emergency response forces in accordance with NFPA 241.
- D. Separate temporary facilities, such as trailers, storage sheds, and dumpsters, from existing buildings and new construction by distances in accordance with NFPA 241. For small facilities with less than 6 m (20 feet) exposing overall length, separate by 3m (10 feet).
- E. Temporary Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.
- F. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with COR.
- G. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to COR.
- H. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
- I. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- J. Standpipes: Install and extend standpipes up with each floor in accordance with 29 CFR 1926 and NFPA 241.
- K. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with COR. Obtain permits from facility COR at least 48 hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.
- L. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to COR .
- M. Smoking: Smoking is prohibited by hospital policy in all buildings on site except the designated smoking areas. Anyone caught smoking in non-designated areas shall be removed from the site permanently.
- N. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily. Coordinate removal with COR in order to minimize impacts to facility.

- O. Perform other construction, alteration and demolition operations in accordance with 29 CFR 1926.
- P. NOTE: False fire alarms caused by inappropriate protection or action by the contractor will result in the government issuing fines to the contractor equal to the amount charged the government by the local fire department.
- Q. All construction activities not already covered above shall be in accordance with the latest edition of NFPA No. 241 Standard for Safeguarding Construction, Alteration, and Demolition Operations, in effect at time of contract award.

1.7 OPERATIONS AND STORAGE AREAS

- A. The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the CO. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.
- B. Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the CO and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work.
- C. The Contractor shall, under regulations prescribed by the CO, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the CO. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.

(FAR 52.236-10)

- C. Working space and space available for storing materials shall be located within the project limits as shown on the drawings.
- D. Workmen are subject to rules of Medical Center applicable to their conduct.
- E. Execute work so as to interfere as little as possible with normal functioning of Medical Center as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others.

1. Do not store materials and equipment in other than assigned areas.
 2. Provide unobstructed access to Medical Center areas required to remain in operation.
- F. Utilities Services: Where necessary to cut existing pipes, electrical wires, conduits, cables, etc., of utility services, or of fire protection systems or communications systems (except telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by COR. All such actions shall be coordinated with the Utility Company involved:
- G. Phasing: To insure such executions, Contractor shall furnish the COR with a schedule of approximate dates on which the Contractor intends to accomplish work in each specific area of site, building or portion thereof. In addition, Contractor shall notify the COR two weeks in advance of the proposed date of starting work in each specific area of site, building or portion thereof. Arrange such dates to insure accomplishment of this work in successive phases mutually agreeable to Medical Center Director, , COR and Contractor, as follows:

Phase I: Demolish existing and install new underground utility lines, vaults, casings and related work as indicated on drawings, and in the vicinity of the new parking garage to be constructed during Phase 2. The remainder of the existing surface parking lot not utilized for construction shall be designated for use by the Medical Center as parking space. Reference drawings for phasing plans.

Phase II: After Phase 1 work is complete, construct parking garage and associated vehicular access drives and site work as indicated on drawings. A portion of the existing surface parking lot shall be used for construction staging and contractor parking at this phase of construction. The remainder of the existing surface parking lot not utilized for construction purposes shall be designated for use by the Medical Center as parking space. Reference drawings for phasing plans.

Phase III: After Phase 2 work is complete, and the parking garage is available for use by the Medical Center, remaining portions of the existing surface parking lot shall be re-paved or resurfaced as required, and the surface parking lot re-striped as indicated on drawings. All Remaining site work not previously installed shall be constructed during this phase. Reference drawings for phasing plans.

- I. Construction Fence: Before construction operations begin, Contractor shall provide a chain link construction fence, 2.1m (seven feet) minimum height, around the construction area indicated on the drawings. Provide gates as required for access with necessary hardware, including hasps and padlocks. Fasten fence fabric to terminal posts with tension bands and to line posts and top and bottom rails with tie wires spaced at maximum 375mm (15 inches). Bottom of fences shall extend to 25mm (one inch) above grade. Remove the fence when directed by COR.
- J. Utilities Services: Maintain existing utility services for Medical Center at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, steam, gases, sewer or air pipes, or conduits, wires, cables, etc. of utility services or of fire protection systems and communications systems (including telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by COR.
1. No utility service such as water, gas, steam, sewers or electricity, or fire protection systems and communications systems may be interrupted without prior approval of COR. It is the contractor's responsibility to provide temporary utility hook ups in order to minimize any utility down times. Prior to any utility outages the contractor must provide a utility shut down request to the COR with a description of the proposed outage outlining the expected down time and actions that will be taken to minimize impact on the facility. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without the Medical Center Director's prior knowledge and written approval. Refer to specification Sections 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS and 27 05 11 REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS for additional requirements.
 2. Contractor shall submit a request to interrupt any such services to COR, in writing, 48 hours in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.
 3. Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations of Medical Center. Interruption time approved by Medical Center may occur at other than Contractor's normal working hours. Interruptions occurring at other than

- Contractor's normal working hours shall be at no additional cost to the government.
4. Major interruptions of any system must be requested, in writing, at least 15 calendar days prior to the desired time and shall be performed as directed by the COR. Major utility outages may have to be done on off hours to minimize the impact on the facility.
 5. In case of a contract construction emergency, service will be interrupted on approval of COR. Such approval will be confirmed in writing as soon as practical.
- K. Abandoned Lines: All service lines such as wires, cables, conduits, ducts, pipes and the like, and their hangers or supports, which are to be abandoned but are not required to be entirely removed, shall be sealed, capped or plugged.
- L. To minimize interference of construction activities with flow of Medical Center traffic, comply with the following:
1. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris and standing construction equipment and vehicles.
 2. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the COR.
- M. Coordinate the work for this contract with other construction operations as directed by COR. This includes the scheduling of traffic and the use of roadways, as specified in Article, USE OF ROADWAYS.
- N. **All deliveries to the construction site or Medical Center property associated with construction of this project must be scheduled and approved in advance by the COR.**
- O. Contractor shall have a supervisor on site at any/all time(s) that any contractor personnel or sub-contractor personnel are performing work of any kind. Submit this supervisor's qualifications to COR in writing for approval before work begins. At the beginning of the job, supervisor shall meet with COR first thing first day in the COR's office. Any time there is a lapse of one or more days (other than weekends/holidays) in contractor working on site, supervisor shall meet with COR in the COTR's office first thing first day back on the job.
- P. Contractor's on-site supervisor shall meet with COR early each day at a time mutually acceptable for the purpose of discussing the work to be performed that day. This meeting shall be held at the COR's office or other mutually agreeable location. If contractor's project manager is on-site daily then he/she shall attend these daily meetings. If contractor's project manager is not on-site daily then he/she shall be available for a once-a-week meeting at the COR's office.

- Q. The Contractor's on-site supervisor must be provided with a pager or cellular phone to ensure continuous contact by VA representatives while on the job site. This pager or cellular phone number must be provided to the COR at the Pre-Construction Meeting. This pager or cellular phone must use a Columbia, Missouri, local telephone number or a toll-free number (1-800-xxxx, 1-888-xxxx, etc.) and NOT require VA to initiate long distance telephone service in order to be reached.
- R. All contractor and sub-contractor employees must wear an identification badge at all times that the employee is on VA premises.
- S. The Contractor's Foreman shall, if/as necessary, be issued VA keys. These keys shall be returned to VA upon completion of the contract/project. If the Contractor fails to return any issued keys, the actual costs of re-keying all doors which use that key and/or replacing/reissuing keys to all personnel that possess that key shall be charged to the Contractor. Depending upon the number of doors and keys involved this could range from \$100 to several thousand dollars. This charge shall be made in the form of a deduct change order to the contract or bill of collection, at the option of the CO.
- T. The **Contractor's normal working hours** will be Monday through Friday from 7:30 am to 4:00 pm.
1. Regularly scheduled federal holidays are: New Years Day, Martin Luther King's Birthday, Presidents Day, Memorial Day, Independence Day, Labor Day, Columbus Day, Veterans' Day, Thanksgiving, and Christmas. No work will be permitted on any regularly scheduled federal holiday. No work will be permitted on any non-regularly scheduled holiday, whether the holiday comes about by Presidential decree, by Congressional decree, or by any other manner.
 2. In the event that it becomes necessary for the Contractor to work outside the normal business hours of the facility for reasons not determined to be for the convenience of the Government, said work will only be performed upon the approval of the CO. The Contractor will be assessed the overtime rate for all facility staff required to be present, who otherwise wouldn't be present, as deemed necessary by the CO. The contractor shall notify the COR 48 hours prior to performing the work.
 3. The Contractor is required to discontinue his work in sufficient time to allow for his clean up of all work areas before he leaves the site each workday. The area shall be returned to "normal condition" for VA use at the end of each workday, including proper secure storage of all equipment, tools, and materials, and the removal of all construction debris.

- U. Contractor shall turn in completed and signed daily logs no later than 11:00AM on the following workday.
- V. Job office trailers, job storage trailers, and parking are subject to VA approval and may be revoked at any time for any reason at no cost to the government. If the contractor is allowed by VA to place any storage trailer(s) or job office trailer(s) on VA grounds contractor shall be responsible for maintaining the area where such trailer is located. If such trailer is on pavement, contractor shall sweep as necessary under and around the trailer as often as necessary to maintain a neat appearance. If such trailer is on lawn area contractor shall mow and trim under and around the trailer at approximately the same interval as VA personnel mow and trim the surrounding lawn such that the lawn appearance is consistent throughout the area.
- W. All metal cutting operations shall be performed in locations approved by COR. All metal shavings must be removed from VA premises completely.

1.8 ALTERATIONS

- A. Survey: Before any work is started, the Contractor shall make a thorough survey with the COR of the site in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by both, to the CO. This report shall list the following: 1. Existence and conditions of items required by drawings to be either reused or relocated, or both. 2. Shall note any discrepancies between drawings and existing conditions at site.
- B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of COR, to be in such condition that their use is impossible or impractical, shall be furnished and/or replaced by Contractor with new items in accordance with specifications which will be furnished by Government. Provided the contract work is changed by reason of this subparagraph B, the contract will be modified accordingly, under provisions of clause entitled "DIFFERING SITE CONDITIONS" (FAR 52.236-2) and "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).
- C. Re-Survey: Thirty days before expected partial or final inspection date, the Contractor and COR together shall make a thorough re-survey of the areas of the site involved. They shall furnish a report on conditions then existing, of items noted on the condition re-survey report as compared with conditions of same as noted in first condition survey report: 1. Re-survey report shall also list any damage caused by Contractor to such items, despite protection measures; and, will form basis for determining extent of repair work required of Contractor to

restore damage caused by Contractor's workmen in executing work of this contract. D.Protection: Provide the following protective measures:

1. Temporary protection against damage for portions of existing structures and grounds where work is to be done, materials handled and equipment moved and/or relocated.

1.9 INFECTION PREVENTION MEASURES

- A. Implement the requirements of VAMC's Infection Control Risk Assessment (ICRA) program as defined in 01 00 10, MEDICAL CENTER REQUIREMENTS. ICRA Group may monitor dust in the vicinity of the construction work and require the Contractor to take corrective action immediately if the safe levels are exceeded.
- B. Establish and maintain a dust control program as part of the contractor's infection preventive measures in accordance with the guidelines provided by ICRA Group. Prior to start of work, prepare a plan detailing project-specific dust protection measures, including periodic status reports, and submit to COR and Facility ICRA team for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
 1. All personnel involved in the construction or renovation activity shall be educated and trained in infection prevention measures established by the medical center.
- C. Medical center Infection Control personnel shall monitor for airborne disease (e.g. aspergillosis) as appropriate during construction. A baseline of conditions may be established by the medical center prior to the start of work and periodically during the construction stage to determine impact of construction activities on indoor air quality. In addition:
 1. The COR and VAMC Infection Control personnel shall review pressure differential monitoring documentation to verify that pressure differentials in the construction zone and in the patient-care rooms are appropriate for their settings. The requirement for negative air pressure in the construction zone shall depend on the location and type of activity. Upon notification, the contractor shall implement corrective measures to restore proper pressure differentials as needed.
 2. In case of any problem, the medical center, along with assistance from the contractor, shall conduct an environmental assessment to find and eliminate the source.
- D. In general, following preventive measures shall be adopted during construction to keep down dust and prevent mold.

1. Dampen debris to keep down dust and provide temporary construction partitions in existing structures where directed by COR. Blank off ducts and diffusers to prevent circulation of dust into occupied areas during construction.
2. Do not perform dust producing tasks within occupied areas without the approval of the COR. For construction in any areas that will remain jointly occupied by the medical Center and Contractor's workers, the Contractor shall:
 - a. Provide dust proof one-hour fire-rated temporary drywall construction barriers to completely separate construction from the operational areas of the hospital in order to contain dirt debris and dust. Barriers shall be sealed and made presentable on hospital occupied side. Install a self-closing rated door in a metal frame, commensurate with the partition, to allow worker access. Maintain negative air at all times. A fire retardant polystyrene, 6-mil thick or greater plastic barrier meeting local fire codes may be used where dust control is the only hazard, and an agreement is reached with the COR and Medical Center.
 - b. HEPA filtration is required where the exhaust dust may reenter the breathing zone. Contractor shall verify that construction exhaust to exterior is not reintroduced to the medical center through intake vents, or building openings. Install HEPA (High Efficiency Particulate Accumulator) filter vacuum system rated at 95% capture of 0.3 microns including pollen, mold spores and dust particles. Insure continuous negative air pressures occurring within the work area. HEPA filters should have ASHRAE 85 or other prefilter to extend the useful life of the HEPA. Provide both primary and secondary filtrations units. Exhaust hoses shall be heavy duty, flexible steel reinforced and exhausted so that dust is not reintroduced to the medical center.
 - c. Adhesive Walk-off/Carpet Walk-off Mats, minimum 600mm x 900mm (24" x 36"), shall be used at all interior transitions from the construction area to occupied medical center area. These mats shall be changed as often as required to maintain clean work areas directly outside construction area at all times.
 - d. Vacuum and wet mop all transition areas from construction to the occupied medical center at the end of each workday. Vacuum shall utilize HEPA filtration. Maintain surrounding area frequently. Remove debris as they are created. Transport these outside the construction area in containers with tightly fitting lids.

- e. The contractor shall not haul debris through patient-care areas without prior approval of the COR and the Medical Center. When, approved, debris shall be hauled in enclosed dust proof containers or wrapped in plastic and sealed with duct tape. No sharp objects should be allowed to cut through the plastic. Wipe down the exterior of the containers with a damp rag to remove dust. All equipment, tools, material, etc. transported through occupied areas shall be made free from dust and moisture by vacuuming and wipe down.
 - f. Using a HEPA vacuum, clean inside the barrier and vacuum ceiling tile prior to replacement. Any ceiling access panels opened for investigation beyond sealed areas shall be sealed immediately when unattended.
 - g. There shall be no standing water during construction. This includes water in equipment drip pans and open containers within the construction areas. All accidental spills must be cleaned up and dried within 12 hours. Remove and dispose of porous materials that remain damp for more than 72 hours.
 - h. At completion, remove construction barriers and ceiling protection carefully, outside of normal work hours. Vacuum and clean all surfaces free of dust after the removal.
- E. Final Cleanup:
- 1. Upon completion of project, or as work progresses, remove all construction debris from above ceiling, vertical shafts and utility chases that have been part of the construction.
 - 2. Perform HEPA vacuum cleaning of all surfaces in the construction area. This includes walls, ceilings, cabinets, furniture (built-in or free standing), partitions, flooring, etc.
 - 3. All new air ducts shall be cleaned prior to final inspection.

1.10 DISPOSAL AND RETENTION

- A. Materials and equipment accruing from work removed and from demolition of buildings or structures, or parts thereof, shall be disposed of as follows:
 - 1. Reserved items which are to remain property of the Government are identified by attached tags or noted on drawings or in specifications as items to be stored. Items that remain property of the Government shall be removed or dislodged from present locations in such a manner as to prevent damage which would be detrimental to re-installation and reuse. Store such items where directed by COR.
 - 2. Items not reserved shall become property of the Contractor and be removed by Contractor from Medical Center.

1.11 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS

- A. The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the CO.
- B. The Contractor shall protect from damage all existing improvements and utilities at or near the work site and on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the CO may have the necessary work performed and charge the cost to the Contractor.

(FAR 52.236-9)

- C. Refer to Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS, for additional requirements on protecting vegetation, soils and the environment. Refer to Articles, "Alterations", "Restoration", and "Operations and Storage Areas" for additional instructions concerning repair of damage to structures and site improvements.
- D. Refer to FAR clause 52.236-7, "Permits and Responsibilities," which is included in General Conditions. A National Pollutant Discharge Elimination System (NPDES) permit is required for this project. The Contractor is considered an "operator" under the permit and has extensive responsibility for compliance with permit requirements. VA will make the permit application available at the (appropriate medical center) office. The apparent low bidder, contractor and affected subcontractors shall furnish all information and certifications that are required to comply with the permit process and permit requirements. Many of the permit requirements will be satisfied by completing construction as shown and specified. Some requirements involve the Contractor's method of operations and operations planning and the Contractor is

responsible for employing best management practices. The affected activities often include, but are not limited to the following:

- Designating areas for equipment maintenance and repair;
- Providing waste receptacles at convenient locations and provide regular collection of wastes;
- Locating equipment wash down areas on site, and provide appropriate control of wash-waters;
- Providing protected storage areas for chemicals, paints, solvents, fertilizers, and other potentially toxic materials; and
- Providing adequately maintained sanitary facilities.

1.12 RESTORATION

- A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work, and do not disturb any ducts, plumbing, steam, gas, or electric work without approval of the COR. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the Resident Engineer before it is disturbed. Materials and workmanship used in restoring work, shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.
- B. Upon completion of contract, deliver work complete and undamaged. Existing work (walls, ceilings, partitions, floors, mechanical and electrical work, lawns, paving, roads, walks, etc.) disturbed or removed as a result of performing required new work, shall be patched, repaired, reinstalled, or replaced with new work, and refinished and left in as good condition as existed before commencing work.
- C. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems (including telephone) which are indicated on drawings and which are not scheduled for discontinuance or abandonment.
- D. Expense of repairs to such utilities and systems not shown on drawings or locations of which are unknown will be covered by adjustment to contract time and price in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) and "DIFFERING SITE CONDITIONS" (FAR 52.236-2) of GENERAL CONDITIONS. These repairs shall be performed as soon as is practical.

1.13 PHYSICAL DATA

- A. Data and information furnished or referred to below is for the Contractor's information. The Government shall not be responsible for

any interpretation of or conclusion drawn from the data or information by the Contractor.

1. The indications of physical conditions on the drawings and in the specifications are the result of site investigations indicated in the soils report dated October 13, 2011 by Engineering Surveys and Services, 1113 Fay Street, Columbia, MO 65201..

(FAR 52.236-4)

- B. Subsurface conditions have been developed by core borings and test pits. Logs of subsurface exploration are shown diagrammatically on drawings.
- C. A copy of the soils report will be made available for inspection by bidders upon request to the COR at the VA Medical Center, 800 Hospital Drive, Columbia, MO 65201, and shall be considered part of the contract documents.
- D. Government does not guarantee that other materials will not be encountered nor that proportions, conditions or character of several materials will not vary from those indicated by explorations. Bidders are expected to examine site of work and logs of borings; and, after investigation, decide for themselves character of materials and make their bids accordingly. Upon proper application to Department of Veterans Affairs, bidders will be permitted to make subsurface explorations of their own at site.

1.14 PROFESSIONAL SURVEYING SERVICES

A registered professional land surveyor or registered civil engineer whose services are retained and paid for by the Contractor shall perform services specified herein and in other specification sections. The Contractor shall certify that the land surveyor or civil engineer is not one who is a regular employee of the Contractor, and that the land surveyor or civil engineer has no financial interest in this contract.

1.15 LAYOUT OF WORK

- A. The Contractor shall lay out the work from Government established base lines and bench marks, indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at Contractor's own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the CO. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the CO until authorized to remove them. If such marks are destroyed by the Contractor or through Contractor's negligence before their removal is authorized, the Contracting Officer may replace them and deduct the

expense of the replacement from any amounts due or to become due to the Contractor.

(FAR 52.236-17)

- B. Establish and plainly mark center lines for each building and/or addition to each existing building, and such other lines and grades that are reasonably necessary to properly assure that location, orientation, and elevations established for each such structure and/or addition, roads, parking lots, , are in accordance with lines and elevations shown on contract drawings.
- C. Following completion of general mass excavation and before any other permanent work is performed, establish and plainly mark (through use of appropriate batter boards or other means) sufficient additional survey control points or system of points as may be necessary to assure proper alignment, orientation, and grade of all major features of work. Survey shall include, but not be limited to, location of lines and grades of footings, exterior walls, center lines of columns in both directions, major utilities and elevations of floor slabs:
1. Such additional survey control points or system of points thus established shall be checked and certified by a registered land surveyor or registered civil engineer. Furnish such certification to the COR before any work (such as footings, floor slabs, columns, walls, utilities and other major controlling features) is placed.
- D. During progress of work, and particularly as work progresses from floor to floor, Contractor shall have line grades and plumbness of all major form work checked and certified by a registered land surveyor or registered civil engineer as meeting requirements of contract drawings. Furnish such certification to the COR before any major items of concrete work are placed. In addition, Contractor shall also furnish to the COR certificates from a registered land surveyor or registered civil engineer that the following work is complete in every respect as required by contract drawings.
1. Lines of each building and/or addition.
 2. Elevations of bottoms of footings and tops of floors of each building and/or addition.
 3. Lines and elevations of sewers and of all outside distribution systems.
 4. Lines and elevations of roads, streets and parking lots.
- E. Whenever changes from contract drawings are made in line or grading requiring certificates, record such changes on a reproducible drawing bearing the registered land surveyor or registered civil engineer seal, and forward these drawings upon completion of work to COR.

- F. The Contractor shall perform the surveying and layout work of this and other articles and specifications in accordance with the provisions of Article "Professional Surveying Services".

1.16 AS-BUILT DRAWINGS

- A. The contractor shall maintain two full size sets of as-built drawings which will be kept current during construction of the project, to include all contract changes, modifications and clarifications.
- B. All variations shall be shown in the same general detail as used in the contract drawings. To insure compliance, as-built drawings shall be made available for the COR's review, as often as requested.
- C. Contractor shall deliver two approved completed sets of as-built drawings to the COR within 15 calendar days after each completed phase and after the acceptance of the project by the COR.
- D. Paragraphs A, B, & C shall also apply to all shop drawings.

1.17 USE OF ROADWAYS

- A. For hauling, use only established public roads and roads on Medical Center property and, when authorized by the COR, such temporary roads which are necessary in the performance of contract work. Temporary roads shall be constructed by the Contractor at Contractor's expense. When necessary to cross curbing, sidewalks, or similar construction, they must be protected by well-constructed bridges.
- B. When new permanent roads are to be a part of this contract, Contractor may construct them immediately for use to facilitate building operations. These roads may be used by all who have business thereon within zone of building operations.
- C. When certain buildings (or parts of certain buildings) are required to be completed in advance of general date of completion, all roads leading thereto must be completed and available for use at time set for completion of such buildings or parts thereof.

1.18 TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Use of new installed mechanical and electrical equipment to provide heat, ventilation, plumbing, light and power will be permitted subject to compliance with the following provisions:
 - 1. Permission to use each unit or system must be given by COR. If the equipment is not installed and maintained in accordance with the following provisions, the COR will withdraw permission for use of the equipment.
 - 2. Electrical installations used by the equipment shall be completed in accordance with the drawings and specifications to prevent damage to the equipment and the electrical systems, i.e. transformers, relays, circuit breakers, fuses, conductors, motor controllers and their

overload elements shall be properly sized, coordinated and adjusted. Voltage supplied to each item of equipment shall be verified to be correct and it shall be determined that motors are not overloaded. The electrical equipment shall be thoroughly cleaned before using it and again immediately before final inspection including vacuum cleaning and wiping clean interior and exterior surfaces.

3. Units shall be properly lubricated, balanced, and aligned. Vibrations must be eliminated.
 4. Automatic temperature control systems for preheat coils shall function properly and all safety controls shall function to prevent coil freeze-up damage.
 5. The air filtering system utilized shall be that which is designed for the system when complete, and all filter elements shall be replaced at completion of construction and prior to testing and balancing of system.
 6. All components of heat production and distribution system, metering equipment, condensate returns, and other auxiliary facilities used in temporary service shall be cleaned prior to use; maintained to prevent corrosion internally and externally during use; and cleaned, maintained and inspected prior to acceptance by the Government.
- B. Prior to final inspection, the equipment or parts used which show wear and tear beyond normal, shall be replaced with identical replacements, at no additional cost to the Government.
- C. This paragraph shall not reduce the requirements of the mechanical and electrical specifications sections.

1.19 TEMPORARY USE OF NEW ELEVATORS

- A. The Contractor and his personnel shall be permitted use of new elevator(s) subject to the following provisions:
1. Contractor shall make arrangements with the COR for use of elevator(s). Contractor may obtain elevator(s) for exclusive use.
 2. Prior to the use of elevator(s), the Contractor shall have the elevator(s) inspected and accepted by an ASME accredited, certified elevator safety inspector. The acceptance report shall be submitted to the COR.
 3. Submit to the COR the schedule and procedures for maintaining equipment. Indicate the day or days of the week and total hours required for maintenance. A report shall be submitted to the COR monthly indicating the type of maintenance conducted, hours used, and any repairs made to the elevator(s).
 4. The Contractor shall be responsible for enforcing the maintenance procedures.

5. During temporary use of elevator(s) all repairs, equipment replacement and cost of maintenance shall be the responsibility of the Contractor.
6. Personnel for operating elevator(s) shall not be provided by the Department of Veterans Affairs.
7. Contractor shall cover and provide maximum protection of the entire elevator(s) installation.
8. The Contractor shall arrange for the elevator company to perform operation of the elevator(s) so that an ASME accredited, certified elevator safety inspector can evaluate the equipment. The Contractor shall be responsible for any costs of the elevator company.
9. All elevator(s) parts worn or damaged during temporary use shall be removed and replaced with new parts. This shall be determined by an ASME accredited certified elevator safety inspector after temporary use and before acceptance by the Government. Submit report to the COR for approval.
10. Elevator shall be tested as required by the testing section of the elevator(s) specifications before acceptance by the Department of Veterans Affairs.

1.20 TEMPORARY TOILETS

- A. Provide where directed, (for use of all Contractor's workmen) ample temporary sanitary toilet accommodations with suitable sewer and water connections; or, when approved by COR, provide suitable dry closets where directed. Keep such places clean and free from flies, and all connections and appliances connected therewith are to be removed prior to completion of contract, and premises left perfectly clean.

1.21 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the COR, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of electricity used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia.
- B. Contractor shall install meters at Contractor's expense and furnish the Medical Center a monthly record of the Contractor's usage of electricity as hereinafter specified.
- C. Heat: Furnish temporary heat necessary to prevent injury to work and materials through dampness and cold. Use of open salamanders or any temporary heating devices which may be fire hazards or may smoke and

damage finished work, will not be permitted. Maintain minimum temperatures as specified for various materials:

- D. Electricity (for Construction and Testing): Furnish all temporary electric services.
- E. Water (for Construction and Testing): Furnish temporary water service.
 - 1. Obtain water by connecting to the Medical Center water distribution system. Provide reduced pressure backflow preventer at each connection. Water is available at no cost to the Contractor.
 - 2. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation (at COR's discretion) of use of water from Medical Center's system.

1.22 NEW TELEPHONE EQUIPMENT

The contractor shall coordinate with the work of installation of telephone equipment by others. This work shall be completed before the building is turned over to VA.

1.23 TESTS

- A. Pre-test mechanical and electrical equipment and systems and make corrections required for proper operation of such systems before requesting final tests. Final test will not be conducted unless pre-tested.
- B. Conduct final tests required in various sections of specifications in presence of an authorized representative of the CO. Contractor shall furnish all labor, materials, equipment, instruments, and forms, to conduct and record such tests.
- C. Mechanical and electrical systems shall be balanced, controlled and coordinated. A system is defined as the entire complex which must be coordinated to work together during normal operation to produce results for which the system is designed. For example, air conditioning supply air is only one part of entire system which provides comfort conditions for a building. Other related components are return air, exhaust air, steam, chilled water, refrigerant, hot water, controls and electricity, etc. Another example of a complex which involves several components of different disciplines is a boiler installation. Efficient and acceptable boiler operation depends upon the coordination and proper operation of fuel, combustion air, controls, steam, feedwater, condensate and other related components.
- D. All related components as defined above shall be functioning when any system component is tested. Tests shall be completed within a reasonably short period of time during which operating and environmental conditions remain reasonably constant.

- E. Individual test result of any component, where required, will only be accepted when submitted with the test results of related components and of the entire system.

1.24 INSTRUCTIONS

- A. Contractor shall furnish Maintenance and Operating manuals (hard copies and electronic) and verbal instructions when required by the various sections of the specifications and as hereinafter specified.
- B. Manuals: Maintenance and operating manuals and one compact disc (four hard copies and one electronic copy each) for each separate piece of equipment shall be delivered to the COR coincidental with the delivery of the equipment to the job site. Manuals shall be complete, detailed guides for the maintenance and operation of equipment. They shall include complete information necessary for starting, adjusting, maintaining in continuous operation for long periods of time and dismantling and reassembling of the complete units and sub-assembly components. Manuals shall include an index covering all component parts clearly cross-referenced to diagrams and illustrations. Illustrations shall include "exploded" views showing and identifying each separate item. Emphasis shall be placed on the use of special tools and instruments. The function of each piece of equipment, component, accessory and control shall be clearly and thoroughly explained. All necessary precautions for the operation of the equipment and the reason for each precaution shall be clearly set forth. Manuals must reference the exact model, style and size of the piece of equipment and system being furnished. Manuals referencing equipment similar to but of a different model, style, and size than that furnished will not be accepted.
- C. Instructions: Contractor shall provide qualified, factory-trained manufacturers' representatives to give detailed instructions to assigned Department of Veterans Affairs personnel in the operation and complete maintenance for each piece of equipment. All such training will be at the job site. These requirements are more specifically detailed in the various technical sections. Instructions for different items of equipment that are component parts of a complete system, shall be given in an integrated, progressive manner. All instructors for every piece of component equipment in a system shall be available until instructions for all items included in the system have been completed. This is to assure proper instruction in the operation of inter-related systems. All instruction periods shall be at such times as scheduled by the COR and shall be considered concluded only when the COR is satisfied in regard to complete and thorough coverage. The Department of Veterans Affairs

reserves the right to request the removal of, and substitution for, any instructor who, in the opinion of the COR, does not demonstrate sufficient qualifications in accordance with requirements for instructors above.

1.25 RELOCATED ITEMS

- A. Contractor shall disconnect, dismantle as necessary, remove and reinstall in new location, all existing items indicated by symbol "R" or otherwise shown to be relocated by the Contractor.
- B. Perform relocation of such items at such times and in such a manner as directed by the COR.
- C. Suitably cap existing service lines, such as steam, condensate return, water, drain, gas, air, vacuum and/or electrical, whenever such lines are disconnected from equipment to be relocated. Remove abandoned lines in finished areas and cap as specified herein before under paragraph "Abandoned Lines".
- D. Provide all mechanical and electrical service connections, fittings, fastenings and any other materials necessary for assembly and installation of relocated items; and leave such items in proper operating condition.
- E. All service lines such as noted above for relocated items shall be in place at point of relocation ready for use before any existing item is disconnected. Make relocated existing item ready for operation or use immediately after reinstallation.

Estimated Cost		No. of Photographs
Up to	\$250,000	50 to 100
" "	\$500,000	100 to 150
" "	\$1,000,000	150 to 200
" "	\$2,000,000	200 to 250
" "	\$5,000,000	250 to 300
" "	\$10,000,000	300 to 400
More than	\$10,000,000	400 to 500

1.26 PHOTOGRAPHIC DOCUMENTATION

- A. During the construction period through completion, provide photographic documentation of construction progress and at selected milestones including electronic indexing, navigation, storage and remote access to the documentation, as per these specifications. The commercial photographer or the subcontractor used for this work shall meet the following qualifications:
 - 1. Demonstrable minimum experience of three (3) years in operation providing documentation and advanced indexing/navigation systems

including a representative portfolio of construction projects of similar type, size, duration and complexity as the Project.

2. Demonstrable ability to service projects throughout North America, which shall be demonstrated by a representative portfolio of active projects of similar type, size, duration and complexity as the Project.

B. Photographic documentation elements:

1. Each digital image shall be taken with a professional grade camera with minimum size of 6 megapixels (MP) capable of producing 200x250mm (8 x 10 inch) prints with a minimum of 2272 x 1704 pixels and 400x500mm (16 x 20 inch) prints with a minimum 2592 x 1944 pixels.
2. Indexing and navigation system shall utilize actual AUTOCAD construction drawings, making such drawings interactive on an on-line interface. For all documentation referenced herein, indexing and navigation must be organized by both time (date-stamped) and location throughout the project.
3. Documentation shall combine indexing and navigation system with inspection-grade digital photography designed to capture actual conditions throughout construction and at critical milestones. Documentation shall be accessible on-line through use of an internet connection. Documentation shall allow for secure multiple-user access, simultaneously, on-line.
4. Before construction, the building pad, adjacent streets, roadways, parkways, driveways, curbs, sidewalks, landscaping, adjacent utilities and adjacent structures surrounding the building pad and site shall be documented. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive architectural drawings. If site work or pad preparation is extensive, this documentation may be required immediately before construction and at several pre-determined intervals before building work commences.
5. Construction progress for all trades shall be tracked at pre-determined intervals, but not less than once every thirty (30) calendar days ("Progressions"). Progression documentation shall track both the exterior and interior construction of the building. Exterior Progressions shall track 360 degrees around the site and each building.
6. As-built condition of pre-slab utilities and site utilities shall be documented prior to pouring slabs, placing concrete and/or backfilling. This process shall include all underground and in-slab utilities within the building(s) envelope(s) and utility runs in the

- immediate vicinity of the building(s) envelope(s). This may also include utilities enclosed in slab-on-deck in multi-story buildings. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive site utility plans.
7. As-built conditions of mechanical, electrical, plumbing and all other systems shall be documented post-inspection and pre-insulation, sheet rock or dry wall installation. This process shall include all finished systems located in the walls and ceilings of all buildings at the Project. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive architectural drawings.
 8. As-built conditions of exterior skin and elevations shall be documented with an increased concentration of digital photographs as directed by the COR in order to capture pre-determined focal points, such as waterproofing, flashing conditions, and architectural detailing. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive elevations or elevation details.
 9. As-built finished conditions of the interior of each building including floors, ceilings and walls shall be documented at certificate of occupancy or equivalent, or just prior to occupancy, or both, as directed by the COR. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive architectural drawings.
 10. Miscellaneous events that occur during any Contractor site visit, or events captured by the Department of Veterans Affairs independently, shall be dated, labeled and inserted into a Section in the navigation structure entitled "Slideshows," allowing this information to be stored in the same "place" as the formal scope.
 11. Customizable project-specific digital photographic documentation of other details or milestones. Indexing and navigation accomplished through interactive architectural plans.
 12. Monthly (29 max) exterior progressions (360 degrees around the project) and slideshows (all elevations and building envelope). The slideshows allow for the inclusion of Department of Veterans Affairs pictures, aerial photographs, and timely images which do not fit into any regular monthly photopath.
 13. Weekly (21 Max) Site Progressions - Photographic documentation capturing the project at different stages of construction. These progressions shall capture underground utilities, excavation,

- grading, backfill, landscaping and road construction throughout the duration of the project.
14. Regular (8 max) interior progressions of all walls of the entire project to begin at time of substantial framed or as directed by the COR through to completion.
 15. Detailed Exact-Built of all Slabs for all project slab pours just prior to placing concrete or as directed by the COR.
 16. Detailed Interior exact built overlapping photos of the entire building to include documentation of all mechanical, electrical and plumbing systems in every wall and ceiling, to be conducted after rough-ins are complete, just prior to insulation and or drywall, or as directed by COR.
 17. Finished detailed Interior exact built overlapping photos of all walls, ceilings, and floors to be scheduled by COR prior to occupancy.
 18. In event a greater or lesser number of images than specified above are required by the COR, adjustment in contract price will be made in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).
- C. Images shall be taken by a commercial photographer and must show distinctly, at as large a scale as possible, all parts of work embraced in the picture.
 - D. Coordination of photo shoots is accomplished through the COR. Contractor shall also attend construction team meetings as necessary. Contractor's operations team shall provide regular updates regarding the status of the documentation, including photo shoots concluded, the availability of new Progressions or Exact-Built viewable on-line and anticipated future shoot dates.
 - E. Contractor shall provide all on-line domain/web hosting, security measures, and redundant server back-up of the documentation.
 - F. Contractor shall provide technical support related to using the system or service.
 - G. Upon completion of the project, final copies of the documentation (the "Permanent Record") with the indexing and navigation system embedded (and active) shall be provided in an electronic media format, typically a DVD or external hard-drive. Permanent Record shall have Building Information Modeling (BIM) interface capabilities. On-line access terminates upon delivery of the Permanent Record.

1.27 FINAL ELEVATION DIGITAL IMAGES

- A. A minimum of four (4) images of each elevation shall be taken with a minimum 6 MP camera, by a professional photographer with different

settings to allow the COR to select the image to be printed. All images are provided to the COR on a CD.

- B. Photographs shall be taken upon completion, including landscaping. They shall be taken on a clear sunny day to obtain sufficient detail to show depth and to provide clear, sharp pictures. Pictures shall be 400 mm x 500 mm (16 by 20 inches), printed on regular weight paper, matte finish archival grade photographic paper and produced by a RA4 process from the digital image with a minimum 300 PPI. Identifying data shall be carried on label affixed to back of photograph without damage to photograph and shall be similar to that provided for final construction photographs.
- C. Furnish six (6) 400 mm x 500 mm (16 by 20 inch) color prints of the following buildings constructed under this project (elevations as selected by the COR from the images taken above). Photographs shall be artistically composed showing full front elevations. All images shall become property of the Government. Each of the selected six prints shall be place in a frame with a minimum of 2 inches of appropriate matting as a border. Provide a selection of a minimum of 3 different frames from which the COR will select one style to frame all six prints. Photographs with frames shall be delivered to the COR in boxes suitable for shipping.
 - 1. CMOVAMC Parking Garage.

1.28 HISTORIC PRESERVATION

Where the Contractor or any of the Contractor's employees, prior to, or during the construction work, are advised of or discover any possible archeological, historical and/or cultural resources, the Contractor shall immediately notify the COR verbally, and then with a written follow up.

1.29 VA PROJECT MANAGEMENT SOFTWARE

- A. VA contractors, selected by award to perform work, are required to get access to the SubmittalExchange or equal website service designed specifically for transmitting submittals, RFI's (Requests for Information), RFP's (Request for Proposals), cost proposals, change orders, daily logs, contractor & subcontractor payrolls, construction progress photographs, correspondences, meeting minutes, and site visit reports, between all construction team members.

The contractor is solely responsible for acquiring access to the Submittal Exchange.

To gain access to the Submittal Exchange the contractor is encouraged to contact Submittal Exchange at www.submittalexchange.com or at 1-800-714-0024.

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Fabricators and erectors intending to bid Project shall attend Pre-Bid Conference. See Section "Invitation to Bid and Instructions to Bidders," heading "Pre-Bid Conference."
 - 1. This Section specifies cast-in-place concrete, including form-work, reinforcement, concrete materials, mixture proportions, placement procedures, finishes, and other miscellaneous items related to cast-in-place concrete.
- B. Cast-in-place concrete includes project requirements specified herein and on the drawings:
 - 1. Water/cementitious materials ratio: See General Notes on Drawings.
 - 2. Entrained air: See General Notes on Drawings.
 - 3. Water Reducing Admixture: See Part 2 Article "Admixtures."
 - 4. High strength: See General Notes on Drawings.
- C. Work in other Sections related to Cast-in-Place Concrete:
 - 1. Division 3 Section "Precast Structural Concrete."
 - 2. Division 7 Section "Traffic Coatings."
 - 3. Division 7 Section "Traffic Bearing Water Repellants."
 - 4. Division 7 Section "Expansion Joint Assemblies."
 - 5. Division 7 Section "Concrete Joint Sealants."
 - 6. Division 9 Section "Painting."
 - 7. Division 32 Section "Pavement Marking."

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.4 SUBMITTALS

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- A. Make submittals in accordance with requirements of Division 01 Section, "Submittal Procedures:"
1. See requirements of Division 01 Section, "Submittal Procedures," Part 1 heading, "Submittal Procedures," for limits to resubmittals.
 2. See requirements of Division 01 Section, "Submittal Procedures," Part 2 heading, "Requests for Information," for RFI constraints.
- B. Submittals and Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including the cost of Engineer's services made necessary to review such additional resubmittals. Owner will in turn reimburse Engineer.
- C. Requests For Information
1. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the contract documents.
- D. Submit Product data for concrete component materials and other concrete related items, including, but not limited to:
1. Material Certificates: Signed by Manufacturer that each of the following items complies with requirements:
 - a. Cementitious materials and aggregates
 - b. Admixtures
 - c. Form materials and form-release agents
 - d. Steel reinforcement and accessories
 - e. Mechanical and chemical anchors
 - f. Epoxy coating
 - g. Fiber reinforcement
 - h. Waterstops
 - i. Joint filler
 - j. Curing materials
 - k. Vapor retarders/reducer
 - l. Repair materials
 2. Submit certification that curing compound or evaporation reducer, if used, is compatible with sealer specified in Division 7 Section "Traffic Bearing Water Repellants", traffic topping specified in Division 7 section "Traffic Coatings", sealant specified in Division 7 Sections "Concrete Joint Sealants" and "Architec-

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- tural Joint Sealants", and expansion joint assemblies specified in Division 7 Section "Expansion Joint Assemblies."
3. Submit certification that curing compound or evaporation reducer is compatible with pavement markings specified in Division 9 Section "Painting."
- E. Submit materials certificates in lieu of materials laboratory test reports when permitted by Engineer. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.
- F. Submit concrete mixture proportions to Engineer for each concrete mixture. Submit alternate mixture proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
1. Provide mixture proportions not less than four weeks before placing concrete and not less than one week before pre-installation conference (pre-concrete meeting).
 2. Proportion mixtures as defined in ACI 301 Section 4 header "Proportioning," Mixtures shall be proportioned by party other than Testing Agency responsible for testing Project concrete.
 3. Proportion mixtures to minimize effects of thermal and drying shrinkage. See Part 2 heading "Concrete Mixtures" header "Shrinkage" for drying shrinkage limit.
 4. Use mixture proportions submission form at end of this Section for each concrete mixture, which identifies the following:
 - a. Mixture Proportions Identification and use.
 - b. Method used for documentation of required average compressive strength, (ACI 301 Section 4 - *Field test data or Trial mixtures*).
 - c. Gradation of fine and coarse aggregates.
 - d. Proportions of all ingredients including all admixtures added either at time of batching or at job site.
 - e. Water/cementitious materials ratio.
 - f. Slump, ASTM C143.
 - g. Certification of the chloride content of admixtures.
 - h. Air Content:
 - 1) Of freshly mixed concrete by pressure method, ASTM C231, or volumetric method, ASTM C173.
 - 2) Of hardened concrete by microscopical determination, including parameters of air-void system, ASTM C457.
 - i. Freeze-thaw resistance, ASTM C457 and C666. If superplasticized concrete cannot meet hardened air content requirements of Part 2, ASTM C666 laboratory test result of

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specimens with concrete mixture proportions similar to proposed mixture for project shall be submitted for review to Engineer. Report air void parameters (spacing and specific surface area in accordance with ASTM C457) (at point of placement) of specimens tested. Test specimens shall contain specified air system (within plus or minus 1.5 percent) and high-range water-reducer (superplasticizer) used in concrete for project. Report relative durability factor of concrete for specimens tested in accordance with Procedure A of ASTM C666. Acceptable concrete durability factor greater than 90 percent (> 90%) at 300 test cycles. Relative durability factor of concrete containing superplasticizer greater than or equal to 80 percent ($\geq 80\%$) compared with reference.

- j. Density (Unit weight) of concrete, ASTM C138.
 - k. Strength at 7 and 28 days, ASTM C39.
 - l. Water soluble chloride ion content of concrete: ASTM C 1218.
 - m. Certificate of analysis of coal fly ash or processed ultra fine fly ash: Comply with ASTM C618, Class C or F:
- G. Testing Agency: Promptly report all field concrete test results to Resident Engineer, Engineer, Contractor and Concrete Supplier. Include following information:
- 1. See Article "Quality Assurance."
 - 2. Density (unit weight) of concrete, ASTM C 138.
 - 3. Slump, ASTM C 143.
 - 4. Slump Flow, ASTM C 1611 (for SCC).
 - 5. Air content of freshly mixed concrete by pressure method, ASTM C 231 or volumetric method, ASTM C 173.
 - 6. Air content and parameters of air-void system, ASTM C 457.
 - 7. Concrete temperature at placement time. ASTM C 1064.
 - 8. Air temperature at placement time.
 - 9. Strength determined in accordance with ASTM C 39.
- H. Contractor: Submit grout temperature limitations with grout submittal.
- I. Submit current certification of welders.
- J. Submit shop drawings for steel reinforcement:
- 1. Prepare placing drawings that detail fabrication, bending, and placement of concrete reinforcement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement. Comply with ACI SP-66, "ACI Detailing Manual." Include special reinforcement required for openings through concrete structures, elevations of all walls and columns with locations of all splices and couplers.

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- K. Submit shop drawings for architectural finishes for specific exposed finish concrete surfaces. Show form construction including jointing, special form joint or reveals, location and pattern of form tie placement, and other items that affect exposed concrete visually.
- L. Submit samples of materials as requested by Engineer, including names, sources, and descriptions as follows:
 - 1. Normal weight aggregates.
 - 2. Fibrous reinforcement.
 - 3. Reglets.
 - 4. Waterstops.
 - 5. Vapor retarder.
- M. Submit laboratory test reports for concrete materials and mixtures.
- N. Submit Minutes of concrete pre-installation conference.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Manufacturer Qualification: An experienced supplier who is experienced in manufacturing ready-mixed concrete products complying with ASTM C94 requirement for production facilities and equipment. Manufacturer shall also be certified according to the National Ready Mixed Concrete Association's Certifications of Ready Mixed Concrete Production Facilities.
- C. Codes and Standards: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:
 - 1. ACI 301, "Specifications for Structural Concrete."
 - 2. ACI 318, "Building Code Requirements for Structural Concrete and Commentary."
 - 3. ACI 117, "Standard Specifications for Tolerances for Concrete Construction and Materials."
 - 4. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice."
- D. Materials and installed work may require retesting at any time during progress of work. Tests, including retesting of rejected materials for installed work, shall be done at Contractor's expense.

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- E. At least 35 days prior to scheduled start of concrete construction, contractor shall conduct meeting to review proposed mixture proportions and methods and procedures to achieve required concrete quality. Contractor shall send pre-concrete conference agenda to all attendees 20 days prior to scheduled date of conference indicating review requirements. Representatives of each entity directly concerned with cast-in-place concrete shall attend conference, including, but not limited to, the following:
1. Contractor's superintendent.
 2. Agency (laboratory) responsible for concrete mixture proportions).
 3. Agency (laboratory) responsible for field quality control.
 4. Ready-mixed concrete producer.
 5. Concrete subcontractor.
 6. Primary admixture manufacturers.
 7. Engineer or Owner's representative.
 8. At the pre-concrete meeting the contractor shall provide a summary of concrete procedures to protect fresh concrete from rain.

The minutes shall include a statement by the Concrete Contractor indicating that the proposed mixture proportions and placing/finishing/curing techniques can produce the concrete quality required by these specifications.

- F. Structural properties of permanent steel formwork shall be determined in accordance with AISI "Specifications for the Design of Cold-Formed Steel Structural Members."
- G. Welders and welding procedures for permanent steel formwork shall conform to requirements or AWS D1.1.
- H. Welders and welding procedures shall conform to requirements of AWS D1.4. Except where shown on Drawings, welding of reinforcing steel is prohibited unless accepted by Engineer in writing.
- I. Submit steel producer's certificates of mill analysis, tensile tests, and bend tests for reinforcing steel. Coordinate with welders and welding procedures.
- J. Epoxy coated reinforcement, ASTM A775 and A884:
1. Coating applicator shall have quality control program to assure that coated reinforcement comply with requirements of Specifications.
 2. Submit proof of current certification for rebar coating plant from Concrete Reinforcing Steel Institute.

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- K. Inspection of steel reinforcement is required in accordance with IBC Section 110. Inspections shall be conducted by an inspection agency employed by Contractor and approved by Resident Engineer. Inspector shall provide report in approved format to Resident Engineer with copy to Engineer and Contractor. Inspection agency has authority to reject reinforcing not meeting Contract Documents. Inspections for all reinforcing steel for conformance to shop drawings and Contract Documents shall be completed prior to concrete placement.
- L. Submit following information on Inspection of Reinforcement unless modified in writing by Resident Engineer.
1. Project name and location.
 2. Contractor's name.
 3. Inspection Agency's name, address, and phone number.
 4. Date and time of inspection.
 5. Inspection Agency technician's name.
 6. Fabricator's name.
 7. Weather data:
 - a. Air Temperatures.
 - b. Weather.
 - c. Wind speed.
 8. Inspection location within structure.
 9. Reinforcement inspection data (including but not limited to):
 - a. Bar size, spacing, cover, and grade.
 - b. Splices, bends, anchorages, welding.
 - c. Epoxy coating or galvanizing as required.
 - d. Support methods and construction sequencing.
 10. Diary of general progress of Work.
- M. Testing Agency Qualifications:
1. Independent agency, acceptable to Resident Engineer, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 2. Testing laboratory shall submit documented proof of ability to perform required tests.
 3. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 4, according to ACI CP-1 or an equivalent certification program.
- N. Testing Agency is responsible for conducting, monitoring and reporting results of all tests required under this Section. Testing Agency shall immediately report test results showing properties that do not conform to Project Specification requirements to General Contractor's authorized on-site representative and to Resident Engineer, and Engineer.

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- O. Submit following Field Test information for Project Concrete unless modified in writing by Resident Engineer:
1. Project name and location.
 2. Contractor's name.
 3. Testing Agency's name, address, and phone number.
 4. Concrete supplier.
 5. Date of testing.
 6. Testing Agency technician's name (sampling and testing).
 7. Placement location within structure.
 8. Time of batching.
 9. Time of testing.
 10. Elapsed time from batching at plant to discharge from truck at site.
 11. Concrete mixture data (quantity and type):
 - a. Cement.
 - b. Fine aggregates.
 - c. Coarse aggregates.
 - d. Water.
 - e. Air entraining admixtures.
 - f. Water-reducing admixture and high-range water-reducing admixture.
 - g. Other admixtures, including supplementary cementitious materials.
 - h. Supplementary cementitious materials.
 12. Weather data:
 - a. Air temperatures.
 - b. Weather.
 - c. Wind speed.
 13. Field test data:
 - a. Date, time and place of test.
 - b. Slump.
 - c. Concrete Temperature.
 - d. Slump flow (for SCC).
 - e. Air content.
 - f. Density (Unit weight).
 14. Compressive test data:
 - a. Cylinder number.
 - b. Age of concrete when tested.
 - c. Date and time of cylinder test.
 - d. Curing time (field and lab).
 - e. Cross-sectional area of cylinder.
 - f. Compressive strength.

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- g. Type of failure (at break).
- P. Provide certification that curing compound conforms to requirements of ASTM C 1315.
- Q. All concrete flatwork finishers on Project shall hold current ACI Concrete Flatwork Finisher certification. Submit certification for each concrete flatwork finisher at Concrete Pre-construction Conference and obtain Engineer's written acceptance.
- R. Mockups: Before casting concrete, build mockups to verify selections made under sample submittals and to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build two acceptable test panels approximately 600 sq. ft. for flatwork in parking drive areas slab-on-grade. Submit a request for acceptance of the proposed location at the project site. See additional requirements for test panels in specification article "Finishing Floors and Slabs."
 - 2. Demonstrate curing, cleaning, and protecting of cast-in-place concrete, finishes, and control/construction joints, as applicable.
- S. Coal fly ash and processed ultra fine fly ash supplier shall make available qualified individual, experienced in placement of fly ash concrete, to aid Contractor. Qualification of supplier's representative shall be acceptable to Owner. Representative shall attend pre-construction meeting, and shall be present for all trial placements, initial startup and then as required by Owner.
- T. At all times during high-evaporation conditions, maintain adequate supply of evaporation reducer at site. Do not use evaporation reducer as finishing aid. See Part 3.
- U. Testing Agency: Identify those trucks of concrete supplier's which meet requirements of NRMCA Quality Control Manual. Permit only those trucks to deliver concrete to Project.

1.6 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. AASHTO, "Standard Specifications for Highway Bridges."
 - 2. AASHTO T 318, "Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying."

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B. American Concrete Institute (ACI):

1. ACI 117, "Standard Specifications for Tolerances for Concrete Construction and Materials."
2. ACI 214R, "Evaluation of Strength Test Results of Concrete."
3. ACI 301, "Specifications for Structural Concrete."
4. ACI 302.1R, "Guide for Concrete Floor and Slab Construction."
5. ACI 305R, "Hot Weather Concreting."
6. ACI 306.1, "Cold Weather Concreting."
7. ACI 308R, "Guide to Curing Concrete."
8. ACI 308.1, "Standard Specifications for Curing Concrete."
9. ACI 318, "Building Code Requirements for Structural Concrete & Commentary."
10. ACI 347, "Guide to Formwork for Concrete."
11. ACI 347.2 "Guide to Shoring/Reshoring of Concrete Multistory Buildings."
12. ACI 362.1, "Guide for the Design of Durable Parking Structures."
13. ACI SP15, "Field Reference Manual."

C. American Iron and Steel Institute (AISI):

1. AISI, "Specification for the Design of Cold-Formed Steel Structural Members."

D. American Society for Testing and Materials (ASTM):

1. ASTM A 36, "Standard Specification for Carbon Structural Steel."
2. ASTM A 185, "Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete Reinforcement."
3. ASTM A 497, "Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete Reinforcement."
4. ASTM A 615, "Standard Specification for Deformed and Plain Carbon -Steel Bars for Concrete Reinforcement."
5. ASTM A 706, "Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement."
6. ASTM A 775, "Standard Specification for Epoxy-Coated Steel Reinforcing Bars."
7. ASTM A 884, "Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement for Reinforcement."
8. ASTM A 934/A 934M, "Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars."
9. ASTM B 633, "Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel."
10. ASTM C 31, "Standard Practice of Making and Curing Concrete Test Specimens in the Field."
11. ASTM C 33, "Standard Specification for Concrete Aggregates."
12. ASTM C 39, "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens."
13. ASTM C 94, "Standard Specification for Ready-Mixed Concrete."
14. ASTM C 109, "Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)."

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15. ASTM C 138, "Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete."
16. ASTM C 143, "Standard Test Method for Slump of Hydraulic Cement Concrete."
17. ASTM C 150, "Standard Specification for Portland Cement."
18. ASTM C 157, "Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete."
19. ASTM C 171, "Standard Specification for Sheet Materials for Curing Concrete."
20. ASTM C 172, "Standard Practice for Sampling Freshly Mixed Concrete."
21. ASTM C 173, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method."
22. ASTM C 231, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method."
23. ASTM C 260, "Standard Specification for Air-Entraining Admixtures for Concrete."
24. ASTM C 309, "Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete."
25. ASTM C 311, "Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete."
26. ASTM C 330, "Standard Specification for Lightweight Aggregates for Structural Concrete."
27. ASTM C 457, "Standard Test Method for Microscopical Determination of Air-Void Content and Parameters of the Air-Void System in Hardened Concrete."
28. ASTM C 494, "Standard Specifications for Chemical Admixtures for Concrete."
29. ASTM C 567, "Standard Test Method for Determining the Density of Structural Lightweight Concrete."
30. ASTM C 595, "Standard Specification for Blended Hydraulic Cements."
31. ASTM C 618, "Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete."
32. ASTM C 666, "Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing."
33. ASTM C 672, "Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals."
34. ASTM C 989, "Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars."
35. ASTM C 1064/C 1064M "Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete."
36. ASTM C 1077, "Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation."
37. ASTM C 1116, "Standard Specification for Fiber-Reinforced Concrete and Shotcrete."
38. ASTM C 1202, "Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration."

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39. ASTM C 1218, "Standard Test Method for Water Soluble Chloride Ion in Mortar and Concrete."
40. ASTM C 1240, "Standard Specification for Silica Fume Used in Cementitious Mixtures."
41. ASTM C 1260, "Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar Bar Method)."
42. ASTM C 1293, "Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction."
43. ASTM C 1315, "Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete."
44. ASTM C 1567, "Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerate Mortar Bar Method)."
45. ASTM C 1602/C 1602M, "Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete."
46. ASTM C 1610/C 1610M, "Standard Test Method for Static Segregation of Self-Consolidating Concrete Using Column Technique."
47. ASTM C 1611/C 1611M, "Standard Test Method for Slump Flow of Self-Consolidating Concrete."
48. ASTM C 1621/C 1621M, "Standard Test Method for Passing Ability of Self-Consolidating Concrete by J-Ring."
49. ASTM D 448, "Standard Classification for Sizes of Aggregate for Road and Bridge Construction."
50. ASTM D 3963/D 3963M, "Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars."
51. ASTM E 96/E 96M, "Standard Test Methods for Water Vapor Transmission of Materials."
52. ASTM E 1643, "Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs."
53. ASTM E 1745 "Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs."
54. ASTM F1637 02, "Standard Practice for Safe Walking Surfaces."

E. American Welding Society (AWS):

1. AWS D1.1, "Structural Welding Code-Steel."
2. AWS D1.4, "Structural Welding Code-Reinforcing Steel."

F. Concrete Reinforcing Steel Institute (CRSI):

1. CRSI MSP, "Manual of Standard Practice."

G. US Army Corps of Engineers (CE):

1. CE CRD-C 513 "Specifications for Rubber Waterstops."
2. CE CRD-C 572 "Specifications for Polyvinyl Chloride Waterstops."

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3. CE CRD-C 662 "Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture and Aggregate (Accelerated Mortar Bar Method.)"

H. Prestressed Concrete Institute (PCI):

1. PCI MNL 116, "Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products."
2. PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."
3. PCI MNL 120, "Design Handbook Precast Prestressed Concrete."
4. PCI MNL 122, "Architectural Precast Design Handbook."
5. PCI MNL 129, "Parking Structures-Recommended Practice for Design and Construction."
6. PCI MNL 135, "Tolerances for Precast and Prestressed Concrete Construction."
7. PCI "Code of Standard Practice for Precast Concrete."

I. Contractor shall have following ACI publications at Project construction site:

1. ACI SP-15, "Field Reference Manual: Standard Specifications for Structural Concrete ACI 301 with selected ACI References."
2. ACI 302.1R, "Guide for Concrete Floor and Slab Construction."
3. ACI 305R, "Hot Weather Concreting."
4. ACI 306.1, "Cold Weather Concreting."

J. Accessibility Requirements:

1. "Americans with Disabilities - Act Accessibility Guidelines for Buildings and Facilities", as published by U.S. Architectural & Transportation Barriers Compliance Board, 1331 F Street, N.W., Suite 1000, Washington, DC 20004-1111, 1-800-872-2253, <http://www.access-board.gov/adaag/ADAAG.pdf>

K. International Code Council (ICC):

1. IBC, "International Building Code 2009"
2. IPMC, "International Property Maintenance Code."
3. IFC, "International Fire Code."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store all formwork and formwork materials clear of ground, protected, to preclude damage.
- B. Deliver reinforcement to Project site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.

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- C. Store concrete reinforcement materials at site to prevent damage and accumulation of dirt or excessive rust.
- D. Avoid damaging coatings on epoxy coated reinforcement:
 - 1. Contact areas of handling and hoisting systems shall be padded or be made of nylon or other acceptable material.
 - 2. Use spreader bars to lift bundles of coated bars to prevent bar-to-bar abrasion.
 - 3. Pad bundling bands or fabricate of nylon or other acceptable material.
 - 4. Store coated bars on padded or wooden cribbing.
 - 5. Do not drag coated bars.
 - 6. After placement, restrict traffic on coated bars to prevent damage.
 - 7. Repair damaged epoxy coatings according to ASTM D 3963.
- E. Concrete transported by truck mixer or agitator shall be completely discharged within one and one half-hours (one hour for hot weather concreting) after water has been added to cement or cement has been added to aggregates. Schedule deliveries to allow for delays due to weather, traffic, etc.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

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1. Corrugated concrete form material providing temporary support of concrete walls or beams and slabs above expansive soils.
 2. Products include all corrugated cardboard void forms that temporarily support concrete walls, grade beams, structural concrete slabs and top portion of concrete piers; includes filling the circular section where required.
 - a. Related accessory products include seam caps, end caps and protective cover boards or any other product to maintain above general products.
 - b. Submit all product data and manufacturer's installation instructions under provisions of this Section, based on the design loads specified in contract documents and depth and width indicated.
- D. Form Coatings: Provide commercial formulation form-coating compounds with a maximum VOC of 350 grams/liter that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces, including but not limited to water-curing, curing compound, stains or paints.
- E. Form Ties: Factory - fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units that will leave no metal closer than 1.5 in. to exposed surface.
 1. Provide ties that, when removed, will leave holes not larger than 1 in. diameter in concrete surface.
- F. Chamfer strips: Wood, metal, PVC, or rubber strips. 0.75 in. by 0.75 in. min. unless noted otherwise.

2.2 STEEL REINFORCEMENT

- A. Provide in Bid 2 additional tons of placed reinforcement bars or welded wire reinforcement for inclusion in Project as Engineer directs.
- B. Reinforcement Bars: ASTM A 615, deformed, yield strength: as noted on Drawings.
- C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.
- D. Epoxy-Coated Fabricated Reinforcing Bars: ASTM A775, and as follows:
 1. Steel Reinforcement: ASTM A 615, Grade 60, deformed bars.
 2. Steel Reinforcement: ASTM A 706, deformed bars.

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- E. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
 - 1. Welded wire reinforcement: provide in mats only. Roll stock prohibited.
- F. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884, Class A, plain steel.
 - 1. Welded wire reinforcement: provide in mats only. Roll stock prohibited.

2.3 REINFORCEMENT ACCESSORIES

- A. Bar supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from all plastic of greater compressive strength than concrete, and as follows:
 - 1. In manner acceptable to Resident Engineer solely, bar and welded wire reinforcement supports shall be color-coded to visually differentiate supports by height and shall be fabricated to resist overturning during construction operations.
 - 2. For slabs on ground, use all-plastic supports with sand plates or horizontal runners where base materials will not support chair legs. All supports shall have sufficient surface area in contact with ground so that they shall not allow clearance loss when reinforcement installed or concrete placed.
 - 3. For concrete surfaces exposed to view where bar supports contact forms, supports shall have minimal contact, shall not cause voids and shall not cause damage to surrounding concrete. Use all-plastic supports conforming to CRSI Class 1 protection requirements.
 - 4. Chairs shall be sized and spaced to prevent cover loss during construction operations.
 - 5. For epoxy-coated reinforcement, use all-plastic bar supports.
 - 6. Acceptable manufacturers:
 - a. Aztec Concrete Accessories, Inc.
 - b. General Technologies, Inc.
 - c. Accepted equivalent.
 - 7. For welded wire reinforcement, provide continuous bar supports spaced at 2 feet o.c., maximum."
- B. Epoxy Coating Materials for Reinforcement: ASTM A 775 and A 884:

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1. Supplier shall be certified currently under CRSI Fusion Bonded Epoxy Coating Applicator Plant Certification Program.
 2. Provide one of following epoxy coatings for reinforcement and steel accessories as noted on Drawings:
 - a. "Scotchkote 413," 3M Company.
 - b. "Nap-Gard 7-2709," DuPont Powder Coatings, USA, Inc.
 - c. "Epoxiplate R346 or R349," Armstrong Products Company.
 3. Use patching material recommended by epoxy powder manufacturer, compatible with epoxy coating and inert in concrete. Acceptable:
 - a. "Scotchkote 413 PC," 3M Company.
 - b. "Armatec 110," Sika Corporation.
 - c. "EMACO P22," BASF Construction Chemicals, LLC.
 - d. "Corr Bond, or Duralprep AC," The Euclid Chemical Company.
- C. Epoxy Coating for Existing Exposed Non-prestressed Steel Reinforcement or Welded Wire Reinforcement:
1. Provide one of following epoxy coatings:
 - a. "Sikadur 32 Hi-Mod," Sika Chemical Corp.
 - b. "Concessive Liquid LPL," BASF Construction Chemicals, LLC.
 - c. "Scotchkote 413 PC," 3M Company.
 - d. "Euco 452," The Euclid Chemical Company.
 - e. "Resi-Bond (J-58)," Dayton Superior Corporation.
- D. For mechanical tension splices of reinforcement:
1. All splices to develop 125 percent of specified yield strength of bars, or of smaller bar in transition splices. Acceptable products:
 - a. Bar-Lock Rebar Coupler, by Dayton Superior.
 - b. Bar-Grip or Grip-Twist, by Barsplice Products, Inc.
 - c. Extender Coupler, by Headed Reinforcement.
 - d. Splice Sleeve, by NMB.
 - e. LENTON Splices, by Erico.
- E. Compression splices: Mechanically coupled splices in accordance with ACI 318, Chapter 12.

2.4 CONCRETE MATERIALS

- A. Ready Mixed Concrete: Obtain concrete from plant with current certification from:
1. Concrete Materials Engineering Council.

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2. Missouri Department of Transportation.
 3. National Ready Mixed Concrete Association.
- B. Portland Cement (ACI 301, Section 4 header "Cementitious Materials"):
1. Portland cement, Type I, ASTM C 150. Use one cement supplier throughout project. No change in brand or supplier without prior written acceptance from Engineer.
 2. Portland cement, Type I/II, ASTM C 150. Where concrete is exposed to earth. Use one cement supplier throughout project. No change in brand or supplier without prior written acceptance from Engineer.
- C. Normal Weight Aggregates (ACI 301, Section 4 header "Aggregates"):
1. Normal weight concrete aggregates:
 - a. Coarse aggregate: Crushed and graded limestone or approved equivalent conforming to ASTM C33 except as noted here, minimum class designations as listed below:
 - 1) Below grade construction and below frost line: Class 1S.
 - 2) Walls not exposed to public view: Class 3S.
 - 3) Walls exposed to public view: Class 5S.
 - 4) Slabs on ground: Class 4S.
 - 5) All other concrete: Class 5S.
 - b. No deleterious materials such as, but not limited to, chert or opaline.
 - c. Fine aggregate: Natural sand conforming to ASTM C 33 and having preferred grading shown for normal weight aggregate in ACI 302.1R, Table 5.1.
 - d. Coarse Aggregate shall not contain crushed hydraulic-cement concrete.
 2. Combined Aggregate Gradation: Well graded from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 sieve, and less than 8 percent may be retained on sieves finer than No. 50.
 3. Coarse aggregate: Nominal maximum sizes indicated below, conforming to ASTM C 33, Table 2:
 - a. Footings/Foundations: Size number 57 or 357.
 - b. Toppings and washes less than 3 in. thick: Size number 7 or 67.
 - c. Slab on grade: Size number 57.
 - d. All other members: Size number 67.

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- 4. Chloride Ion Level: ASTM C 1218. Chloride ion content of cement, aggregates and all other ingredients: tested by laboratory making trial mixes.
- D. Lightweight Aggregates: ASTM C 330.
- E. Water: Comply with ASTM C 1602.
- F. Storage of Materials (ACI 301, Section 4 header "Materials Storage and Handling").

2.5 ADMIXTURES

- A. Use water-reducing admixture, mid-range water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete as required for placement and workability.
- B. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg. F as required for schedule.
- C. Use high-range water-reducing admixture (HRWR) in pumped concrete, and for concrete with water/cementitious ratio of less than or equal to 0.45. Use high-range or mid-range water-reducing admixtures in pumped concrete and normal or mid-range water reducing admixtures for concrete with water/cementitious ratios greater than 0.45.
- D. Self-consolidating concrete (SCC) may be used where placement due to either dense reinforcement or form design requires both a high level of workability (horizontal slump flow greater than 24 in. diameter) and the water/cementitious ratio is less than or equal to 0.45.
- E. Use air-entraining admixture in exterior exposed concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1.5 percent within limits shown on Drawings.
- F. Only admixture manufacturers listed acceptable. Do not submit alternate manufacturers.
- G. Concrete supplier and manufacturer shall verify via trial mixes and certify compatibility (no adverse effect on workability, strength, durability, entrained air content, etc.) of all ingredients in each Mixture. Use admixtures in strict accordance with manufacturer's recommendations.
- H. Prohibited Admixtures: Calcium chloride or admixtures containing intentionally added chlorides shall not be used.

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- I. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
1. Products: Subject to compliance with requirements, provide one of following:
- a. "Catexol AE 260," Axim Concrete Technologies.
 - b. "Air-Mix," "Eucon Air-Series" or "AEA-92," Euclid Chemical Co.
 - c. "Daravair Series" or "Darex Series," W.R. Grace & Co.
 - d. "Micro-Air," or "MB-VR," or "MBAE-90," BASF Construction Chemicals.
 - e. "Sika AEA Series," or "Sika AIR Series" Sika Corporation.
 - f. "Polychem "VR" or "VRC" or "Polychem AE," General Resource Technology.
 - g. "RSA-10," Russ Tech Admixtures, Inc.
- J. Normal Water-Reducing Admixture: ASTM C 494, Type A.
1. Products: Subject to compliance with requirements, provide one of following:
- a. "Eucon Series," Euclid Chemical Co.
 - b. "WRDA Series," W.R. Grace & Co.
 - c. "Pozzolith Series," or "PolyHeed Series," BASF Construction Chemicals.
 - d. "Plastocrete Series", Sika Corporation.
 - e. "Catexol 1000 N," Axim Concrete Technologies.
 - f. "Polychem Series" or "KB Series," General Resource Technology.
 - g. "LC-400 Series" or "LC-500 Series," Russ Tech Admixtures, Inc.
- K. Mid Range Water-Reducing Admixture: ASTM C 494, Type A.
1. Subject to compliance with requirements, provide one of following:
- a. "Eucon MR" or "Eucon X-15 and X-20," Euclid Chemical Co.
 - b. "Daracem Series" or "MIRA Series," W.R. Grace & Co.
 - c. "PolyHeed Series," BASF Construction Chemicals.
 - d. "Sikaplast Series" or "Plastocrete Series", Sika Corporation.
 - e. "Catexol 2000 NI," Axim Concrete Technologies.
 - f. "Polychem 1000" or "KB Series," General Resource Technology.
 - g. "Finishease-NC," Russ Tech Admixtures, Inc.
- L. High Range Water-Reducing Admixture (Superplasticizer): ASTM C 494, Type F.

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1. Products: Subject to compliance with requirements, provide one of following:
 - a. "Eucon 37" or "Eucon SP-Series" or "Plastol Series," Euclid Chemical Co.
 - b. "Daracem Series" or "ADVA Series," W.R. Grace & Co.
 - c. "Rheobuild 1000", "PS 1466" or "Glenium Series," BASF Construction Chemicals.
 - d. "Sikament Series" or "Sika ViscoCrete Series," Sika Corporation.
 - e. "Catexol 1000 SP-MN," Axim Concrete Technologies.
 - f. "Melchem Series," General Resource Technology.
 - g. "Superflo 443" or "Superflo 2000 Series," Russ Tech Admixtures, Inc.

- M. High Range water reducing retarding (superplasticizer), ASTM C 494 Type G:
 1. Products: Subject to compliance with requirements, provide one of following:
 - a. "Eucon 537 or RD2," Euclid Chemical Co.
 - b. "Daracem 100," W.R. Grace & Co.

- N. Non-Chloride, Non-Corrosive Water-Reducing, Accelerating Admixture: ASTM C 494, Type C or E.
 1. Products: Subject to compliance with requirements, provide one of following:
 - a. "Eucon AcN-Series," "Accelguard 80," "Accelguard NCA," or "Accelguard 90," Euclid Chemical Co.
 - b. "DCI," "PolaraSet," "Lubricon NCA," or "Gilco," W.R. Grace & Co.
 - c. "Pozzutec 20+" or "Pozzolith NC 534," BASF Construction Chemicals.
 - d. "Sika Set NC," "Plastocrete 161FL", or "Sika Rapid-1," Sika Corporation.
 - e. "Catexol 2000 RHE," Axim Concrete Technologies.

- O. Water-Reducing or retarding Admixture: ASTM C 494, Type D or B.
 1. Products: Subject to compliance with requirements, provide one of following:
 - a. "Eucon Retarder-75", "Eucon DS" or "Eucon W.O." Euclid Chemical Co.
 - b. "Daratard-17" or "Recover," W.R. Grace & Co.
 - c. "Pozzolith Series" or "Delvo Series," BASF Construction Chemicals.

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- d. "Sikatard Series," or "Plastiment Series" or "Plastocrete Series," Sika Corporation.
- P. Corrosion Inhibiting Admixture capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Eucon CIA" or "Eucon BCN," Euclid Chemical Company.
 - b. "DCI" or "DCI-S," W.R. Grace.
 - c. "Rheocrete CNI," BASF Construction Chemicals.
 - d. "Sika CNI," Sika Corporation.
 - e. "Catexol 1000 CN-CI," Axim Concrete Technologies.
 - f. "Polychem CI," General Resource Technology.
 - g. "Russ Tech RCI," Russ Tech Admixtures, Inc.
 - 2. Add at rate of 3 gal/cu yd of concrete, which shall inhibit corrosion to 9.9 lb of chloride ions per cu. yd. of concrete. Calcium Nitrite based corrosion inhibitor shall have a concentration of 30 percent, plus or minus 2 percent of solids content.
 - 3. Show calcium nitrite as an Add Alternate on Bid Form.

2.6 WATERSTOPS

- A. Flexible Rubber Waterstops: CE CRD-C 513, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
 - 1. Profile: Flat, dumbbell without center bulb.
- B. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
 - 1. Profile: Flat, dumbbell without center bulb.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Rubber Waterstops:
 - a. Greenstreak.
 - b. Progress Unlimited Inc.
 - c. Williams Products, Inc.
 - 2. PVC Waterstops:
 - a. Greenstreak.
 - b. Meadows: W.R. Meadows, Inc.

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- c. Progress Unlimited Inc.
- d. Sternson Group.

2.7 VAPOR RETARDERS

- A. Vapor Retarder: Provide vapor retarder which conforms to ASTM E 1745, Class A. The membrane shall have a water-vapor transmission rate less than or equal to 0.008 gr./ft²/hr when tested, in accordance with ASTM E96. Vapor retarder shall be no less than 15 mils thick. The vapor retarder shall be placed over prepared base material where indicated below slabs on ground.
 - 1. New ISO certified virgin resins, polyolefin based maximum.
 - 2. Available Product: Subject to compliance with requirements, a product that may be incorporated into the Work includes, but is not limited to "Griffolyn Vaporguard" by Reef Industries, Inc., Stego Wrap (15-Mil) Vapor Barrier by Stego Industries LLC, Perminator (15 Mil) Underground Vapor Retarder by W.R. Meadows or, Viper Vaporcheck II (15 mil) Vapor Retarder by Insulation Solutions Inc.
- B. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a No. 4 sieve and 10 to 30 percent passing a No. 100 sieve; meeting deleterious substance limits of ASTM C 33 for fine aggregates.
- C. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

2.8 CURING MATERIALS

- A. Evaporation Reducer: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 - 1. Evaporation Retarder:
 - a. Cimfilm; Axim Concrete Technologies.
 - b. Aquafilm; Conspec Marketing & Manufacturing Co., Inc.
 - c. Eucobar; Euclid Chemical Co.
 - d. E-Con; L&M Construction Chemicals, Inc.
 - e. Confilm; BASF Construction Chemicals, LLC.
 - f. SikaFilm; Sika Corporation.
 - g. Sure-Film (J-74); Dayton Superior Corporation.
 - h. "EVRT", Russ Tech Admixtures, Inc.

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- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Curing Compound (VOC Compliant, less than 350 g/l): Comply with ASTM C 309, Type 1, Class A or B. Moisture loss shall be not more than 0.55 kg/m² when applied at 200 sq. ft/gal. Manufacturer's certification is required. Silicate based compounds prohibited.
 - 1. Subject to project requirements provide one of the following products:
 - a. "Kurez DR VOX" or "Kurez RC," or "Kurez RC Off," Euclid Chemical Company.
 - b. "RxCure WB," or "RxCure VOC" or "W.B. Cure VOC," Conspec Marketing & Manufacturing.
 - c. "MasterKure CC 200 WB" or "MasterKure CC 160 WB" BASF Construction Chemicals.
 - d. "Sealtight 1100-Clear" W.R. Meadows.
 - 2. Additional requirements:
 - a. With product submittal provide plan and procedures for removal of residual curing compound prior to application of sealers, coatings, stains, pavement markings and other finishes.
 - b. Provide a summary of testing to show adequate surface preparation for successful application of sealers, coatings, stains, pavement markings, and other finishes.

2.9 RELATED MATERIALS

- A. Bonding Additive: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- B. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:
 - 1. Type II, non-load bearing, for bonding freshly mixed concrete to hardened concrete.
 - 2. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
 - 3. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

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- C. Reglets: Fabricate reglets of not less than 0.0217-inch- thick galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- D. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.
- E. Mechanical and chemical anchors shall be manufactured by Hilti Fastening Systems, Tulsa Oklahoma, ITW Ramset/Red Head, Wood Dale, IL, Simpson Anchor Systems, Columbus, OH, Powers Fasteners, Brewster, NY, or accepted equivalent. Anchor bolt composition shall be from one or more of carbon steel and stainless steel, lead, Zamac alloy, nylon, plastic, polypropylene, and jute fiber.
1. Strength of all anchors shall comply with ICC-ES-AC 58CR or ICC-ES AC308 and ACI 318-05 Appendix D.
 2. Carbon steel anchors shall be either zinc plated in accordance with ASTM B 633, or hot-dipped galvanized in accordance with ASTM A-153-78. Provide mill test reports and manufacturer's quality control certification upon Engineer's request.
 3. Stainless steel anchors shall be manufactured from ASTM A304, or A663 stainless steel. Provide mill test reports and manufacturer's quality control certification upon Engineer's request.
 4. Plastic, lead, or Zamac alloy anchors shall not be used for overhead applications Chemical anchors shall not be used to resist pullout forces in overhead and wall installations unless proper consideration is given to fire conditions. For chemical anchors, consult with manufacturer's engineer.
 5. Safety Factors: Static loads 4:1 minimum. Static load safety factors shall be per manufacturer's published data. Critical load (vibratory, overhead, etc. or more) safety factors shall be 10:1 minimum. Chemical anchors are not permitted for critical loads and where resistance to direct sustained tension is required.
 - a. If necessary for purposes of determining tensile and/or shear capacity in questionable base material, testing shall be done prior to actual anchor installation. A maximum of five tension and/or shear tests shall be performed by manufacturer's engineer. Anchors shall be proof loaded in tension and/or shear to assure that working load capacity is within specified allowable load limit as published by manufacturer.
 6. Anchor spacing and edge distance per manufacturer's limits. Loading and cluster spacing shall be as established by minimum industry standards for anchors, except as follows: Anchor loading, cluster spacing and edge distances shall be as published in manufacturer's literature. Consult with manufacturer's engineer for specific requirements.

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7. Anchor installation shall be as required by manufacturers written instructions.

F. Inserts and Coil Rods:

1. Yield strength: 65,000 psi minimum.
2. Galvanizing: Where indicated, electrodeposited zinc coating, ASTM B 633, Service condition 1, Type III.
3. Epoxy coating: Where indicated.
4. Acceptable manufacturers:
 - a. Dayton/Richmond Concrete Accessories, Inc., Miamisburg, OH.
5. Details shown on drawings are based on Dayton/Richmond Concrete Accessories, Inc. products and their respective capacities. Other products may be used only if contractor submits calculations, sealed by professional engineer or structural engineer licensed in Missouri, substantiating strength of connection with other product. Calculations are subject to Engineer's acceptance before fabrication is to proceed.

G. Joint Filler:

1. Joint filler in slabs and curbs: Asphalt impregnated fiber board; as shown on Drawings. Acceptable products:
 - a. "Flexcell," Knight-Celotex Corp.
 - b. "Fibre Expansion Joint," W.R. Meadows, Inc.
2. Joint filler used vertically to isolate walls from columns or other walls: White molded polystyrene beadboard type.
3. Joint cover used to bridge gap between columns and grade walls, retaining walls, or basement walls: Minimum width: Gap width plus 4 in. For gaps over 3 in. wide, protect cover with protection board sized to span gap satisfactorily. Acceptable products:
 - a. "Sealtight Premoulded Membrane Vapor Seal," W.R. Meadows, Inc., Elgin, Illinois.
 - b. "Sealtight Melgard," W.R. Meadows, Inc., Elgin, Illinois and shall be applied according to manufacturer's instructions.

H. Slide Bearing System at Expansion Joints:

1. Provide slide bearing system as shown and detailed on Drawings:
 - a. Beam and double tee bearings shall be reinforced PTFE: 100 percent virgin tetrafluoroethylene polymer and ground glass fiber reinforcing aggregate, prebonded to stainless steel and/or preformed fabric (Section "Plant Precast Structural

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Concrete," Part 2 Article "Materials," paragraph "Bearing Pads") bearing pads. Acceptable slide bearing systems:

- 1) "Fluorogold," Seismic Energy Products, L.P. Pine Brook, New Jersey.
 - 2) "Balco," Balco, Inc., Wichita, Kansas.
 - 3) "Alert 15175 Shock Pads with TFE," Alert Manufacturing and Supply Co. Chicago, Illinois.
 - 4) "Dura-Slide," Tobi Engineering, Inc., Elk Grove Village, Illinois.
 - 5) "Dynalon Slide Bearings with Masticord," JVI, Inc., Skokie Illinois.
- b. Slab and plank bearings shall be ultrahigh molecular weight, high-density polyethylene resin: Acceptable material:
- 1) "Korolath PE," Korolath Corporation, Hudson, Mass.
 - 2) "Tivar-1000," Poly-Hi/Menasha Corporation, Fort Wayne, Indiana.
 - 3) "UHMW Econ-o-Shim," Deslausiers, Inc., Bellwood IL.
2. Backing materials for reinforced PTFE slide bearing systems as shown on Drawings:
- a. Galvanized steel.
 - b. Stainless steel.
 - c. Reinforced elastomer, having durometer hardness of 90 +/- 5 and meeting requirements of Article 2.10.3(L) of AASHTO Standard Specifications for Highway Bridges (1983).

2.10 REPAIR MATERIALS

A. Acceptable repair materials:

1. Bonding Admixture:
 - a. "SBR Latex" or "Flexcon," or AKKRO-7T, Euclid Chemical Co.
 - b. "Acryl 60," BASF Construction Chemicals, LLC.
 - c. "Sika Latex R," Sika Corporation.
2. Epoxy Adhesive: 2 component, 100 percent solids, 100 percent reactive compound or Epoxy-Cement suitable for use on dry or damp surfaces:
 - a. "Euco Epoxy #452 Series," "Duralcrete Series," or "Eucopoly Injection Resin," "Duralprep AC", Euclid Chemical Co.
 - b. "Concresive Liquid LPL," BASF Construction Chemicals, LLC
 - c. "Sikadur Hi-Mod" or "Armatec 110," Sika Corp.

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3. Patching Mortar: Polymer-modified cementitious mortar.
 - a. "Thin Top Supreme," or Speed Crete Red Line" or "Verticoat Supreme," Euclid Chemical Corp.
 - b. "EMACO R Series," BASF Construction Chemicals, LLC.
 - c. "SikaRepair 222 with Latex R," Sika Corp.

4. Repair Topping: Self-leveling, polymer-modified high strength topping
 - a. "Thin Top Supreme," or "Tammspatch II," Euclid Chemical Co.
 - b. "Mastertop Topping 112, BASF Construction Chemicals, LLC.
 - c. "SikaTop 111 Plus," Sika Corp.

5. Repair Topping for horizontal areas greater than 1-inch depth: Flowable one-part, high strength silica fume modified repair mortar with 0.375 in. aggregate. The product shall achieve 8000 psi at 28 days at a 9-inch slump:
 - a. "Eucocrete," The Euclid Chemical Company.
 - b. "Sika Repair 224," Sika Corp.
 - c. "EMACO S66 CI," BASF Construction Chemicals, LLC.
 - 1) For depths greater than 1.5 in. use preplaced aggregate. Emaco S77 CI.

2.11 CONCRETE MIXTURES

- A. Proportion mixtures determined by either laboratory trial mix or field test data bases, as follows:
 1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
 2. Proportion lightweight structural concrete according to ACI 211.2 and ACI 301.
 3. Provide different mixtures as the season warrants, as well as each type and strength of concrete or for different placing methods.

- B. Use a qualified independent testing agency for preparing and reporting proposed Mixture Proportions for the laboratory trial mix basis.

- C. Requirements for normal-weight concrete mix are shown on Drawings:
 1. Compressive strength
 2. Slump
 3. Water-cementitious materials ratio
 4. Air content

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5. Calculated Equilibrium Unit Weight: 115 lb/cu. Ft. plus or minus 3 lb/cu. Ft. as determined by ASTM C 567.
 6. Calculated Equilibrium Unit Weight: 110 lb/cu. Ft. plus or minus 3 lb/cu. Ft. as determined by ASTM C 567.
 7. Calculated Equilibrium Unit Weight: 105 lb/cu. Ft. plus or minus 3 lb/cu. Ft. as determined by ASTM C 567.
- D. Supplementary cementitious materials: For concrete exposed to deicers, limit percentage, by weight, of cementitious materials according to ACI 318 requirements.
- E. Air Entrainment:
1. See General Notes on Drawings for total average air content (percent by volume).
 2. Average air content shall exceed value stated in General Notes on Drawings.
 3. Permissible variation for any one test result from specified average total air content: plus or minus 1.5 percent.
 4. Hardened concrete shall have an air void spacing factor of 0.0080 in. maximum. Specific surface (surface area of air voids) shall be 600 in² per cu in. of air-void volume, or greater. Concrete mixes not meeting these values as determined by ASTM C 457 may require adjustments unless accepted in writing by Engineer. Refer to Part 1 Article "Submittals."
- F. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use high range water-reducing admixture in pumped concrete, concrete for parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio of 0.45 or less. Use normal or mid-range water reducing admixture for concrete with water-cementitious materials ratio greater than 0.45.
- G. When concrete mixture contains calcium nitrite admixture, (or other ionic salts that affect the chloride permeability test), perform rapid chloride permeability test for submitted mixture and for control sample. Control sample shall have the same mixture and water-cementitious materials ratio as submitted mixture, except calcium nitrite admixture shall not be used.
- H. Slump (ACI 301, Part 4 header "Slump"):
1. Maximum slump for concrete is indicated on Drawings. Where field conditions require slump to exceed that shown, increased slump shall be obtained by use of high range water reducers (superplasticizers) only, and Contractor shall obtain written acceptance from Engineer who may require an adjustment to mix.

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2. All concrete containing high-range water-reducing admixture (superplasticizer) shall have a verified initial slump of 2- 3 in. Final slump after the addition of the superplasticizer shall be 6-9 in. as required by the contractor to properly place the concrete. Before permission for plant addition of superplasticizer to be granted by Engineer, fulfill following requirements:

- a. Submit letter from testing laboratory which developed original mixture proportions, for each superplasticized mixture, certifying volume of mix water which will produce specified slump and water/cement ratio, taking into account aggregate moisture content.
- b. Submit plant computer printout of mixture ingredients for each truckload of superplasticized concrete with delivery of that truckload. Mix water volume greater than that certified shall be cause for concrete rejection.
- c. Over-retarding or crusting of flatwork surface: cause for concrete rejection.
- d. Segregation or rapid slump loss (superplasticizer life) due to incompatibility or under-dosing: cause for concrete rejection.

I. Engineer's acceptance of mixture proportions shall not relieve Contractor from responsibility for any variation from requirements of Contract Documents unless Contractor has in writing called Engineer's attention to each such variation at time of submission and Engineer has given written approval of each such variation.

J. Adjustment to Concrete Mixtures: Adjustments to mixture proportions may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Engineer. Laboratory test data for revised mixture and strength results shall be submitted to and accepted by Engineer before using in work.

2.12 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information. Truck mixing prohibited. Mix at plant.

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1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Provide plant-printed batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mixture identification number, date, time of batching, mixing time, quantity and details of materials, amount of water introduced and water permitted by plant to be added, if any.
- C. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.
 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least one and one-half minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
 2. For mixer capacity larger than 1 cu. yd. increase mixing time by 15 seconds for each additional 1 cu. yd.
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, mixture identification number, date, time of batching, mixing time, quantity and details of materials, and amount of water added. Record approximate location of final placement in structure.

2.14 TOOLS

- A. Slab Jointing
 1. Concrete groovers: For tooled joints in concrete:
 - a. For concrete not exceeding 4 in. thickness, use groover with 1 in. deep v-cut bit, 0.5 in. surface width and 3/16 in. to 1/4 in. edge radius.
 - b. For concrete exceeding 4 in. thickness, use groover with 1.5 in. deep v-cut bit, 0.5 in. surface width and 3/16 in. to 1/4 in. edge radius.
 2. Saw Cut Joints:
 - a. Acceptable for slab on grade only. Not allowed for topping slabs.
 - b. Acceptable tool: "Soff-Cut Saw Model 310" or "Model G2000," Soff-Cut International, Corona, CA.

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- 1) Cut joint as soon as concrete will support weight of operator and saw without deforming.
- 2) Joint shall be 1 in. deep for concrete thickness of 4 in. or less. Joint shall be 1.5 in. deep for concrete exceeding 4 in. thickness. Do not cut reinforcement.
- 3) Extend joint to adjacent vertical surface within 30 minutes of cutting.
- 4) Retool or grind sawcut joint before installing sealant to provide equivalent dimensions, shape and volume as joint obtained by tooled joint. Surface width shall be 0.5 in. with 3/16 to 1/4 in. edge radius.
- 5) All joints subject to acceptance by sealant installer. Rework rejected joints until acceptable to sealant installer.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads and in accordance with Article 1.5 "Contractor's Professional Services - Performance and Design Criteria".
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117, except as modified below:
 1. Drilled Pier Caps and Pile Caps:
 - a. Variation of center from specified plan location: 0.5 in.
 - b. Variation of bearing surface from specified location: Plus or minus 0.5 in.
 - c. Variation from specified dimensions in plan: Plus 2 in. minus 0 in.
 - d. Variation decrease from specified thickness: 0.5 in.
 2. Footings:
 - a. Footings other than those to receive masonry construction: Variation of bearing surface from specified elevation: Plus or minus 0.5 in.
 - b. Footings to Receive Masonry Construction:
 - 1) Variation of center from specified location in plan: Plus or minus 0.25 in. in any 10 ft but not to exceed plus or minus 0.5 in.

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- 2) Variation of bearing surfaces for specified elevation:
Plus or minus 0.25 in. in any 10 ft but not to exceed
plus or minus 0.5 in.
 3. Piers, Columns, Walls, Beams, and Slabs:
 - a. Variation in cross-sectional dimensions of piers, beams and columns and in thickness of walls and slabs: 12 in. or less: Plus 0.375 in., minus 0.25 in. Greater than 12 in.: Plus 0.5 in., minus 0.375 in.
 - b. Variation in elevation from specified elevation for piers, columns and walls: Plus or minus 0.5 in.
 4. Anchor bolts: concrete contractor shall place anchor bolts within tolerances stated under heading "Anchor Bolts and Bearing Plates" of PCI "Code of Standard Practice for Precast Concrete."
- C. Void Forms:
1. Prepare ground surface on level plane.
 2. Protect all forms from moisture prior to concrete placement.
 3. Install all forms and accessories in accordance with manufacturer's recommendations.
 4. Protect all forms from puncture and moisture during concrete placement including accessories such as taped joints, seam pads and end caps.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
1. Install keyways, reglets, recesses, and the like, for easy removal.
 2. Kerf wood inserts for easy removal.
 3. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

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- H. Chamfer exterior corners and edges of permanently exposed concrete where indicated on drawings.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor bolts, accurately located, to elevations required.
 - 2. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 3. Install dovetail anchor slots in concrete structures as indicated.

3.3 VAPOR RETARDER

- A. Vapor Retarder: Place, protect, and repair vapor-retarder or vapor sheets according to ASTM E 1643 and manufacturer's written instructions. Provide vapor retarder under grade slab where indicated on the drawings.
- B. Fine-Graded Granular Material: Cover vapor retarder with fine-graded granular material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus $\frac{3}{4}$ inch.
- C. Granular Fill: Cover vapor retarder with granular fill, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus $\frac{3}{4}$ inch.
 - 1. Place and compact a $\frac{1}{2}$ -inch- thick layer of fine-graded granular material over granular fill.

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3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain specified concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Shop- or field-weld reinforcement according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on continuous bar supports spaced at 2 ft o.c., maximum. Lap edges and ends of adjoining sheets per ACI 318 and as follows:
 - 1. Length of overlap measured between outermost cross wires of each sheet shall not be less than one spacing of cross wires plus two inches nor less than one and one-half times the development length nor 6 in. minimum where development length is calculated per section 12.8 of ACI 318.
 - 2. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
- F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963.
 - 1. Rest epoxy coated steel member supported from formwork on coated wire bar supports, or on bar supports made of dielectric material or other suitable material.
 - 2. Coat wire bar supports with dielectric material for minimum distance of 2 in. from point of contact with coated steel member.
 - 3. Fasten epoxy-coated steel members with nylon-, epoxy-, or plastic-coated tie wire, or other suitable material acceptable to Engineer.
 - 4. Mechanical connections, when required, shall be installed in accordance with splice device manufacturer's recommendations. Repair any damage to coating.

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5. All parts of mechanical connections on epoxy-coated steel, including steel splice sleeves, bolts, and nuts shall be coated with same material used for repair of coating damage.
6. Repair all damage to epoxy coating to bars, welded wire reinforcement and all other epoxy coated items. Use a mirror to view undersides of all items for possible damage so it can be repaired.
7. Do not cut epoxy-coated steel unless permitted by Engineer. When cut, coat ends with material used for repair of coating damage.
8. All welding of epoxy-coated steel shall conform to AWS D1.4.
9. Adequate ventilation shall be provided when welding epoxy-coated steel.
10. After welding, repair coating damage as specified in Part 3 heading "Quality Control Testing During Construction."

G. Splices:

1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements of ACI 318 for minimum lap of spliced bars.
2. For mechanical tension splices of reinforcement:
 - a. Column bar lengths shall not exceed 30 ft between splices. In any bar, no splices shall occur at any floor level.
 - b. Exercise care to assure that no reduction of cross-sectional area of reinforcement occurs.
 - c. For all mechanical splices, perform splicing in strict accordance with manufacturer's requirements and instructions.
 - d. Stagger splices in adjacent bars.
 - e. Except where shown on Drawings, welding of reinforcement prohibited without prior written authorization by Engineer.
3. Compression splices: Mechanically coupled splices in accordance with ACI 318, Chapter 12.
4. Welded wire reinforcement shall not extend through contraction joints.

3.5 JOINTS

A. Joints in Concrete (ACI 301, Section 5):

1. Construction, control and isolation joints are located and detailed on Drawings:
 - a. Tool joints at time of finishing. Tool: Part 2 Article "Tools."
 - b. Saw Cut Joints:
 - 1) Permitted in slab on grade only.

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- 2) Cut joint as soon as concrete will support weight of operator and saw without deforming.
 - 3) Joint shall be 1 in. deep for concrete thickness of 4 in. or less. Joint shall be 1.5 in. deep for concrete exceeding 4 in. thickness. Do not cut reinforcement.
 - 4) Extend joint to adjacent vertical surface within 30 minutes of cutting.
 - 5) Retool or grind saw cut joint before installing sealant to provide equivalent dimensions, shape, and volume as joint obtained by tooled joint. Surface width shall be 0.5 in. with 3/16 in. to 1/4 in. edge radius.
 - 6) All joints subject to acceptance by sealant installer. Rework rejected joints until acceptable to sealant installer.
- c. Isolation joints: Interrupt structural continuity resulting from bond, reinforcement or keyway.
- d. Construction and control joints in walls: Space joints at 20 ft on center unless smaller spacing is shown on Drawings.
- e. Construction or control joints in floor slabs on ground: Maximum slab area controlled by jointing 400 sq ft. Space joints at 20 ft on center maximum unless different spacing is shown on Drawings.
- f. Coordinate configuration of tooled joints with control joint sealants.
- B. Provide keyways at least 1-1/2 in. deep in construction joints in walls and slabs. Accepted bulkheads designed for this purpose may be used for slabs.
- C. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as otherwise indicated. Do not continue reinforcement through sides of strip placements.
- D. Use bonding grout, containing the specified bonding admixture, on existing concrete surfaces that will be joined with fresh concrete.
- E. Contraction (Control) Joints in Slabs-on-Ground: Construct contraction joints in slabs-on-ground to form panels of patterns as shown.
1. Tool contraction joints.
 2. If joint pattern not shown, provide joints not exceeding 20 ft in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).
- F. Joint sealant material is specified in Division 7 Sections.

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3.6 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints as indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of Work. Field-fabricate joints in waterstops according to manufacturer's written instructions.

3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by Engineer/Architect.
- C. Before placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mix.
- D. Check air content after any site addition of admixtures to increase slump.
- E. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.
- F. Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.
 - 1. Consolidate placed concrete with mechanical vibrating equipment. Use plastic or rubber-tipped vibrators when concrete reinforcement is epoxy-coated.
 - 2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically (in thin slabs vibrator may be inserted at angle or horizontally to keep vibrator head completely immersed) inserted at uniformly spaced locations no farther than 1.5 times action radius so area visibly affected by vibrator overlaps adjacent previously vibrated area by 3-4 inches. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.

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At each insertion, limit duration (usually 5 to 15 seconds) of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

- G. Deposit and consolidate concrete for toppings and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate placed concrete with mechanical vibrating equipment. Use plastic or rubber-tipped vibrators when concrete reinforcement is epoxy-coated. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge or motor driven vibrating screed and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using highway bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- H. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Use only the specified non-corrosive accelerator. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mixture proportions.
- I. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

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2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.8 FINISHING FORMED SURFACES

- A. As-Cast Finishes: As-cast concrete texture imparted by form-facing material in accordance with ACI 301 and as specified below in accordance with Class of Finish:
 1. Rough Form Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding limits for class of surface specified.
 - a. Provide class C finish as described in ACI 347, for surfaces permanently concealed from public view, unless otherwise noted in the Contract Documents. Class C permits gradual or abrupt irregularities of 1/2 inch.
 - b. Provide class D finish as described in ACI 347, for surfaces permanently concealed from public view. Class D permits gradual or abrupt irregularities of 1 inch.
 2. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding limits for class of surface specified.
 - a. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.
 - b. Provide Class A finish as described in ACI 347. Class A permits gradual or abrupt irregularities of 1/8 inch.
 - c. Provide class B finish as described in ACI 347. Class B permits gradual or abrupt irregularities of 1/4 inch.
- B. Rubbed Finish: Apply the following to smooth-formed finished concrete:
 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

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2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part Portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding agent and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part Portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.
- D. Architectural Finishes: Produce architectural finishes including special textured finishes, and exposed aggregate finish in Accordance with ACI 301 section 6.
1. Provide Class A finish as described in ACI 347 for Architectural finishes. Class A permits gradual or abrupt irregularities of 1/8 inch.
 2. Exposed aggregate finish:
 3. Special Finishes:
- E. Mock-Up: Provide a full scale mock-up for all finishes exposed to view as described in article "Quality Assurance".

3.9 FINISHING FLOORS AND SLABS

- A. Flatwork in Parking and Drive Areas (SWIRL Finish, ACI 301, Section 5 header "Float Finish"):
1. Begin bull floating after bleeding of water through surface of concrete has been completed and water sheen has disappeared from surface of concrete and concrete has stiffened sufficiently to allow operation (ACI 302.1R, Chapter 8).
 2. Give slab surfaces rough, swirl texture finish. Swirl ridges shall not be allowed to exceed 0.25 in. in height. Texture shall be as accepted by Engineer from sample panels. No refloating required.

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3. Finishing tolerance: ACI 301, Section 5 header "Measuring Tolerances for Slabs" and ACI 117, paragraph 4.5.7: The gap at any point between the straightedge and the floor (and between the high spots) shall not exceed 0.5 in. In addition, floor surface shall not vary more than plus or minus 0.75 in. from elevation noted on Drawings anywhere on floor surface.
 4. Before installation of flatwork and after submittal, review, and approval of concrete Mixture Proportions, Contractor shall fabricate two acceptable test panels simulating finishing techniques and final appearance to be expected and used on Project. Test panels shall be a minimum of 20 ft. by 30 ft. in area and shall be reinforced and cast to thickness of typical parking and drive area wearing surface in Project. (Maximum thickness of test panels need not exceed 6 in.) Test panels shall be cast from concrete supplied by similar concrete batch, both immediately after addition of superplasticizer or water-reducing admixture, and at maximum allowed time for use of admixture-treated concrete in accordance with Specifications. Intent of test panels is to simulate both high and low workability mixes, with approximate slump at time of casting of test panels to be 6 in. and 3 in., respectively. Contractor shall finish panels following requirements of paragraphs above, and shall adjust panels finishing techniques to duplicate appearance of concrete surface of each panel. Finished panels (one or both) may be rejected by Engineer, in which case Contractor shall repeat procedure on rejected panel(s) until Engineer acceptance is obtained. Accepted test panels shall be cured in accordance with Specifications and may be incorporated into Project. Accepted test panels shall serve as basis for acceptance/rejection of final finished surfaces of all flatwork.
 5. Finish all concrete slabs to proper elevations to ensure that all surface moisture will drain freely to floor drains, and that no puddle areas exist. This Contractor shall bear cost of any corrections to provide for positive drainage.
- B. Flatwork in Enclosed, Finished Areas (Float Finish, ACI 301, Paragraph 5.3.4.2.b):
1. Give slab floated finish. Texture shall be as accepted by Engineer from sample panels.
 2. Finishing tolerance ACI 301, Section 5 header "Measuring Tolerances for Slabs" and ACI 117, paragraph 4.5.7: The gap at any point between the straightedge and the floor (and between the high spots) shall not exceed 0.5 in. In addition, floor surface shall not vary more than plus or minus 3/8 in. from elevation noted on Drawings anywhere on floor surface.
- C. Flatwork in Stairtowers, Lobbies, and Parking Garage floor subject to pedestrian traffic:

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1. Concrete surfaces at all walking areas subject to pedestrian traffic shall provide a smooth, slip resistant walking surface for pedestrians with these minimum requirements:
 - a. Shall provide walking surfaces in accordance with ASTM - F 1637 Standard Practice for Safe Walking Surfaces and "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)".
 - b. Adjoining walkway surfaces shall be flush and meet the following minimum requirements:
 - 1) Changes in level of less than $\frac{1}{4}$ inch in height may be without edge treatment as shown in ADA Figure 303.2 and on the Drawings.
 - 2) Changes in Level between $\frac{1}{4}$ inch and $\frac{1}{2}$ inch in height shall be beveled with a slope no greater than 1:2 as shown in ADA Figure 303.3 and on the Drawings.
 - 3) Changes in level greater than $\frac{1}{2}$ inch in height are not permitted unless they can be transitioned by means of a ramp with minimum requirements shown on the Drawings.
 - 4) Openings in floor or ground surfaces shall not allow passage of a sphere more than $\frac{1}{2}$ inch diameter except as allowed for elevators and platform lifts as shown in ADA Figure 302.3 and on the Drawings.
 - c. Walkway surfaces shall provide a slip resistant surface.
 - 1) Concrete surfaces shall be troweled and finished to provide a slip resistant finish.
 - 2) Contractor shall provide sample area with slip resistant surface finish.

3.10 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still workable and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

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3.11 CONCRETE PROTECTION AND CURING

- A. General: Comply with ACI 308.1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.
- B. Evaporation Reducer: Apply evaporation reducer to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft./h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing. Do not finish immediately after evaporation reducer applied. Wait until after (green, if Confilm used - pink, if Eucobar used) film disappears.
- C. Formed Surfaces: Cure formed concrete surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:
 - 1. Curing Compound: After Moisture or Moisture-Retaining-Cover Curing, apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Apply two separate coats with first allowed to become tacky before applying second. Direction of second application shall be at right angles to direction of first.
 - b. Curing compound prohibited when concrete has specified water-cementitious materials ratio less than or equal to 0.40 or air temperature above 80 deg F. Use moist cure instead.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Tepid (within 20 deg F of concrete temperature) water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest

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practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

- a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.
3. Curing Compound: Where permitted, apply uniformly in continuous operation by power spray or roller immediately after final finishing and the absence of surface moisture, according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
- a. Apply two separate coats with first allowed to become tacky before applying second. Direction of second application shall be at right angles to direction of first.
 - b. Curing compound prohibited when concrete has specified water-cementitious ratio less than or equal to 0.40 or air temperature above 80 deg F. Use moist cure instead.

3.12 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer/Architect. Remove and replace concrete that cannot be repaired and patched to Engineer/Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing. Use this repair procedure only with Engineer/Architect approval.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than ½ inch in any dimension in solid concrete but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with specified bonding agent. Fill and compact

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with specified patching mortar before specified bonding agent has dried. Fill form-tie voids with specified patching mortar or cone plugs secured in place with specified bonding agent.

2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area on mockup, or if none, at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer/Architect.
 4. Repair isolated random cracks that have little movement and single holes not over 1 in. in diameter in accordance with procedures and materials specified in Division 7 Section "Concrete Joint Sealants." Receive Engineer's written acceptance of methods and materials selected prior to application.
 - a. Repair isolated random horizontal cracks less than 0.01 in. wide, using silane sealer product specified in Division 7 "Water Repellants"
 - b. Repair isolated random horizontal cracks 0.01 in. to less than 0.03 in. wide, using crack sealer product specified in Division 7 "Water Repellants."
 - c. Repair isolated random horizontal cracks 0.03 in. to 0.06 in. wide: route and seal with specified sealant product in Division 7 "Concrete Joint Sealants."
 - d. Repair isolated random vertical cracks more than 0.01 in. wide, using epoxy injection product specified in part 2 heading "Related Materials" of this section.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, pop-outs, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written

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- instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of $\frac{1}{4}$ inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete or latex modified concrete as approved by the Engineer. Remove defective areas with clean, square cuts and expose steel reinforcement with at least $\frac{3}{4}$ inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair single holes 1 inch or less in diameter with patching mortar. Cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
 8. Repair isolated random cracks that have little movement and single holes not over 1 in. in diameter in accordance with procedures and materials specified in Division 7 Section "Concrete Joint Sealants." Receive Engineer's written acceptance of methods and materials selected prior to application.
 - a. Repair isolated random horizontal cracks less than 0.01 in. wide, using silane sealer product specified in Division 7 "Water Repellants"
 - b. Repair isolated random horizontal cracks 0.01 in. to less than 0.03 in. wide, using crack sealer product specified in Division 7 "Water Repellants."
 - c. Repair isolated random horizontal cracks 0.03 in. to 0.06 in. wide: route and seal with specified sealant product in Division 7 "Concrete Joint Sealants."
 - d. Repair isolated random vertical cracks more than 0.01 in. wide, using epoxy injection product specified in part 2 heading "Related Materials" of this section.
- E. Perform structural repairs of concrete, subject to Engineer/Architect's approval, using epoxy adhesive and patching mortar, latex modified concrete or other materials as approved by the Engineer.
- F. Repair materials and installation not specified above may be used, subject to Engineer/Architect's approval.

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3.13 FIELD QUALITY CONTROL

- A. Contractor will employ a testing laboratory to perform tests and to submit test reports.
- B. Sample concrete in accordance with ASTM C 172.
- C. Epoxy Coated Material:
 - 1. Perform field inspection of installed epoxy coated material under provisions of Division 1 Section "Quality Control."
 - 2. Repair all epoxy coating damage due to fabrication and handling, using a mirror to find any damage on undersides.
 - 3. Repair all damaged areas using manufacturer's recommended patching material and method.
 - 4. No damaged area shall be left uncorrected.
 - 5. Epoxy coated welded wire reinforcement with consistent visible holes in epoxy coating (particularly at mesh intersections): unacceptable. Remove from project.
- D. Temperature:
 - 1. Test temperature of concrete in accordance with ASTM C 1064/C 1064M and ACI 301 each time cylinders are taken or as directed by the Engineer.
- E. Slump Test:
 - 1. Conduct one slump test in accordance with ASTM C 143/C 143M per truck load of ready-mixed concrete delivered to Project at truck for superstructure concrete.
 - 2. Conduct slump test in accordance with ASTM C143/C 143M and ACI 301 for foundation concrete.
 - 3. When high-range water-reducing admixture (superplasticizer) is used, initial slump must be verified by Testing Agency.
- F. Slump Flow Test (SCC):
 - 1. Conduct one slump flow test in accordance with ASTM C 1611/C 1611M per truck load of ready mixed concrete delivered to Project at truck for superstructure concrete.
 - 2. Conduct slump flow test in accordance with ASTM C1611/C 1611M and ACI 301 for foundation concrete.
- G. Air Content:
 - 1. General Contractor: Coordinate all parties involved to produce conforming concrete.
 - 2. Sample freshly-mixed concrete at point of final placement in accordance with ASTM C 172 and conduct one air content test in ac-

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cordance with ASTM C 231 or ASTM C 173 for each truck of ready-mix, air entrained concrete delivered to Project. After good concrete quality control has been established and maintained as determined by Resident Engineer, test the first truck and every 20 m³ (25 cubic yards) thereafter each day.

3. Sample fresh concrete immediately following placement and screeding and conduct air content tests in accordance with ASTM C 231 or ASTM C 173 at rate of one for every 10 truck loads of ready-mix, air-entrained concrete delivered to Project. For small or half-loads, obtain Engineer's acceptance of procedure 2 weeks before situation arises.

H. Concrete Compressive Strength:

1. Mold test cylinders in accordance with ASTM C 31 and test in accordance with ASTM C 31 as follows:
 - a. Take minimum of six for each 100 cu yd or fraction thereof, of each Mixture of concrete placed in any one day.
 - b. Additional cylinders shall be taken under conditions of cold weather concreting.
 - c. Testing Agency: Provide and maintain site cure box for cylinders.
2. Sample plastic concrete for testing at point of final placement, in accordance with ASTM C 172. Engineer will select sampling locations which may include points where plastic concrete has already been screeded and floated.
3. Cover specimens properly, immediately after finishing. Protect outside surfaces of cardboard molds, if used, from contact with sources of water for first 24 hours after molding.
4. Cure test cylinders per ASTM C 31 as follows:
 - a. To verify compressive strength prior to form removal or for additional test cylinders required due to cold weather concreting conditions:
 - 1) Store test specimens on structure as near to point of sampling as possible and protect from elements in same manner as that given to portion of structure as specimen represents.
 - 2) Transport to test laboratory no more than 4 hours before testing. Remove molds from specimens immediately before testing.
 - b. To verify 28-day compressive strength:
 - 1) During first 24 hours after molding, store test specimens under conditions that maintain temperature immedi-

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- ately adjacent to specimens in range of 60 to 80 degrees F. and prevent loss of moisture from specimens.
- 2) Remove test specimens from molds at end of 20 +/- 4 hours and store in moist condition at 73.4 +/- 3 degrees F until moment of test. Laboratory moist rooms shall meet requirements of ASTM C 511.
5. Compression test for concrete:
 - a. Test 2 cylinders at 7 days.
 - b. Test 2 cylinders at 28 days.
 - c. Hold 2 cylinders in reserve for use as Engineer/Architect directs.
 6. Unless notified by Engineer, reserve cylinders may be discarded without being tested after 56 days.
- I. Report all nonconforming test results to Engineer, Resident Engineer, and others on distribution lists via fax or email. Follow up with colored paper copies to flag the non-conformances.
 - J. Monthly, submit a graph showing distribution of compressive strength test results and air content test results.

3.14 EVALUATION AND ACCEPTANCE OF CONCRETE

- A. Concrete Compression test will be evaluated by Engineer in accordance with ACI 301. If number of tests conducted is inadequate for evaluation of concrete or test results for any type of concrete fail to meet specified strength requirements, core tests may be required as directed by Engineer. Air content and parameters of air-void system shall meet requirements of this Section.
- B. Core tests, when required, in accordance with ASTM C42 and ACI 301.
- C. Should tested hardened concrete meet Specifications, Owner will pay for coring and testing of hardened concrete. Should tested hardened concrete not meet Specifications or should concrete have to be tested because Contractor did not conform to Project specifications, Contractor shall pay for coring and testing of hardened concrete and for any corrective action required for unaccepted concrete.

3.15 ACCEPTANCE OF STRUCTURE

- A. Acceptance of completed concrete Work will be according to provisions of ACI 301.
- B. "RAPIDLOAD" testing is acceptable, by Structural Preservation Systems, Baltimore, MD.

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- C. Concrete rejected due to entrained air content below specified limit will be accepted if any of following conditions are met:
1. ASTM C 457: Three concrete specimens tested in accordance with ASTM C 457 meet air void parameters of Part 2.
 2. ASTM C 457: Three concrete specimens tested shall meet air void parameters of concrete reported and approved by Engineer in Part 1.
 3. ASTM C 666, Test Procedure A: Test three concrete specimens removed from structure Concrete specimens tested shall have durability characteristics similar to that reported in Part 1.

- - - E N D - - -

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #
Project Name:

I. GENERAL INFORMATION:	
Project:	City:
General Contractor:	
Concrete Supplier:	
Mixture Identification No.:	Concrete Grade:
Use (Describe) ¹ :	

¹ example: Footings, interior flatwork, floor slabs, topping, columns, etc.

II. MIXTURE PROPORTIONING DATA:		
Proportioning Based on (Check only one):		
Standard Deviation Analysis: _____ (see section VIII) or Trial Mix Test Data: _____ (see Section IX)		
Mixture Characteristics: (see Mixtures in Drawings General Notes)	Density: _____ pcf;	Air: _____ % specified
	Slump _____ in. before superplasticizer	Slump _____ in. after superplasticizer Or for SCC: Spread _____ in.
	Strength: _____ psi (28 day);	

_____ WALKER SUBMITTAL STAMP

CONTRACTOR
SUBMITTAL STAMP

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #
Project Name:

III. MATERIALS:		
Aggregates: (size; type; source; gradation report; specification)		
Coarse:		
Fine:		
Other Materials:	<u>Type</u>	<u>Product-Manufacturer (Source)</u>
Cement:		
Flyash, slag, or other pozzolan:		
Silica Fume		
Processed Ultra Fine Fly Ash		
HRM		
Air Entraining Agent:		
Water Reducer		
High Range Water Reducer (HRWR / superplasticizer)		
Non-Corrosive Accelerator		
Retarder		
Fibers		
Other(s):		

IV. MIX PROPORTIONS ⁽²⁾		
	WEIGHT (lbs.) (per yd³)	ABSOLUTE VOL. (cu. ft.) (per yd³)
Cement:		
Fine Aggregate: ⁽³⁾		
Coarse Aggregate: ⁽³⁾		
Flyash, slag, or other pozzolan:		
Silica Fume		
Processes Ultra Fine Fly Ash		
HRM		
Water: ⁽⁴⁾ (gals. & lbs)		
Entrained Air: (oz.)		
Fibers:		
(Other) _____:		

TOTALS:		
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NOTES:
⁽²⁾ Mix proportions indicated shall be based on data used in section VII or IX.
⁽³⁾ Based on saturated surface dry weights of aggregates.
⁽⁴⁾ Includes ALL WATER, including added water and free water contained on aggregates.

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #
Project Name:

<u>V. RATIOS</u>	<u>VI. SPECIFIC GRAVITIES</u>
Water ⁽¹⁾ = _____ lb = _____	Fine Aggregate:
Cementitious Material ⁽²⁾ = _____ lb = _____	Coarse Aggregate:
Fine Agg. = _____ lb = _____	
Total Agg. = _____ lb = _____	
NOTES: ⁽¹⁾ Includes ALL water, including added water and free water contained on aggregates. ⁽²⁾ Cementitious materials include cement, fly ash, slag, silica fume, HRM, Processed Ultra Fine Fly Ash or other pozzolan.	

<u>VII. ADMIXTURES</u>				
Air Entraining Agent (A.E.A.):	___ oz.	per yd ³	___ oz.	per 100# cement
Superplasticizer	___ oz.	per yd ³	___ oz.	per 100# cement
Water Reducer	___ oz.	per yd ³	___ oz.	per 100# cement
Non-corrosive Accelerator	___ oz.	per yd ³	___ oz.	per 100# cement
Retarder	___ oz.	per yd ³	___ oz.	per 100# cement
Other	___ oz.	per yd ³	___ oz.	per 100# cement
Lithium Nitrate	___ gal.	per yd ³		

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture # _____
Project Name: _____

VIII. <u>STANDARD DEVIATION ANALYSIS:</u>		<u>Yes</u>	<u>N/A</u>
(Complete this section only if Mixture was developed using standard deviation analysis of previous project test results. If other method was used, check "N/A".)			
<u>Number of Tests Evaluated:</u> (One test is average of two cylinder breaks)	<u>Standard Deviation:</u> (Single Group)		
<u>Attach copy of test data considered:</u>	<u>Standard Deviation:</u> (Two Groups)		
Required average compressive strength: $f'_{cr} = f'_c +$ _____ psi			
NOTE: Mixture shall be proportioned in accordance with ACI 301 section 4.2.3 to achieve average compressive strength f'_{cr} equal to or greater than the larger of one of the following equations: (4.-3) $f'_{cr} = f'_c + 1.34ks$ [s= calculated standard deviation] or (4-4) $f'_{cr} = f'_c + 2.33ks - 500$ or (4-5) $f'_{cr} = 0.9f'_c + 2.33ks$ (for $f'_c > 5,000$ psi) (Refer to ACI 301 for required average when data are not available to establish standard deviation. For post-tensioning projects, see also special requirements for strength required to apply initial post-tensioning.)			
MIXTURE CHARACTERISTICS (As shown on drawings)			
Slump = _____ in.	Air Content = _____ %		
Unit Wet Wt. = _____ pcf	Unit Dry Wt. = _____ pcf		
MIXTURE CHARACTERISTICS (Based on proportioning data)			
Initial Slump = _____ in.	Final Slump _____ in.		
Unit Wet Wt.= _____ pcf.	Unit Dry Wt. = _____ pcf.		
Air Content = _____ %			

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #
Project Name:

IX. <u>TRIAL MIXTURE TEST DATA:</u>		<u>Yes</u>	<u>N/A</u>
(Complete this section only if Mixture Proportion is based on data from trial test mixture(s) batched by testing agency or Contractor. If other method was used, check "N/A".)			
<u>Age</u> (days)	<u>Mix #1</u> (comp. str.)	<u>Mix #2</u> (comp. str.)	<u>Mix #3</u> (comp. str.)
<u>7</u>			
<u>7</u>			
<u>28</u>			
<u>28</u>			
<u>28</u>			
<u>28</u> day average compressive strength, psi			
<p>NOTE: Mixture shall be proportioned in accordance with ACI 301 section 4.2.3 to achieve average compressive strength f'_{cr} equal to or greater than the larger of one of the following equations:</p> <p>(Less than 3000) $f'_{cr} = f'_c + 1000$ or (3000 to 5000) $f'_{cr} = f'_c + 1200$ or (Over 5000) $f'_{cr} = 1.1f'_c + 700$</p> <p>For post-tensioning projects, see also special requirements for strength required to apply initial post-tensioning.</p>			
MIXTURE CHARACTERISTICS (as shown on drawings)			
Slump = _____ in.		Air Content = _____ %	
Unit Wet Wt. = _____ pcf		Unit Dry Wt. = _____ pcf	
MIXTURE CHARACTERISTICS (Based on proportioning data)			
Initial Slump = _____ in.		Final Slump _____ in.	
Unit Wet Wt.= _____ pcf.		Unit Dry Wt. = _____ pcf.	
Air Content = _____ %			

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #
Project Name:

<u>X. OTHER REQUIRED TESTS</u>		
Water Soluble Chloride Ion Content of mix:	_____ % (by weight of cement)	ASTM C 1218
Hardened Air Content (per ASTM C457):		
Air content: _____%	Air void spacing Factor _____ in.	Specific surface: _____ in ² /in ³
Chloride Ion Content of Concrete Mixture: ASTM C 1218		
Shrinkage (Length Change, Average) per ASTM C157:		
_____ % @ 4 days	_____ % @ 7 days	_____ % @ 14 days
_____ % @ 21 days	_____ % @ 28 days	

<u>XI. Remarks:</u>

Ready Mix Concrete Supplier Information
Name:
Address:
Phone Number:
Date:
Main Plant Location:
Miles from Project Site:
Secondary or Backup Plant Location:
Miles from Project Site:

My signature below certifies that I have read, understood, and will comply with the requirements of this Section.
Signature _____

Typed or Printed Name

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #
Project Name:

REQUIRED ATTACHMENTS	
	Coarse aggregate grading report
	Fine aggregate grading report
	Concrete compressive strength data used for calculation of required average strength and for calculation of standard deviation
	Chloride ion data and related calculations
	Admixture compatibility certification letter
	Shrinkage information per ASTM C157
	ASTM C 457
	Alkali Content Data and Calculations OR ASTM C1293, ASTM C1260, ASTM C 1567 or CE CRD-C662 Test report for each aggregate

SECTION 07 52 16
STYRENE-BUTADIENE-STYRENE MODIFIED BITUMINOUS MEMBRANE ROOFING, HOT-APPLIED

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section specifies modified bituminous sheet roofing and base flashing installed using hot-applied asphalt on new construction with solar reflective granular coating.
- B. Repairs and alteration work, including temporary roofs.

1.2 RELATED WORK:

- B. Wood cants, blocking and wood edge strips: Section 06 10 00, ROUGH CARPENTRY.
- C. Roof Insulation under Membrane: Section 07 22 00, ROOF AND DECK INSULATION.
- D. Vapor barrier: Section 07 22 00, ROOF AND DECK INSULATION.
- E. Sheet metal components and wind uplift requirements for roof-edge design: Section 07 60 00, FLASHING AND SHEET METAL.

1.3 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only. Editions of applicable publications current on date of issue of bidding documents apply unless otherwise indicated.
- B. American National Standards Institute/Single-Ply Roofing Institute (ANSI/SPRI):
ANSI/SPRI ES-1-03.....Wind Design Standard for Edge Systems Used with
Low Slope Roofing Systems
- C. American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI):
ASCE/SEI-7-10.....Minimum Design Loads for Buildings and Other
Structures
- D. Asphalt Roofing Manufacturers Association/National Roofing Contractors Association (ARMA/NRCA): Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing
- E. ASTM International (ASTM):
C67-09.....Standard Test Methods for Sampling and Testing
Brick and Structural Clay Tile

STYRENE-BUTADIENE-STYRENE MODIFIED BITUMINOUS MEMBRANE ROOFING, HOT APPLIED

- C140-09.....Standard Test Methods for Sampling and Testing
Concrete Masonry Units and Related Units
- C1370-00 (R2005).....Standard Test Method for Determining the
Chemical Resistance of Aggregates for Use in
Chemical-Resistant Sulfur Polymer Cement
Concrete and Other Chemical-Resistant Polymer
Concretes
- D146-04.....Standard Test Methods for Sampling and Testing
Bitumen-Saturated Felts and Woven Fabrics for
Roofing and Waterproofing
- D312-00 (R2006).....Standard Specification for Asphalt Used in
Roofing
- D1644-01 (R2006).....Standard Test Methods for Nonvolatile Content of
Varnishes
- D2523-00 (R2006).....Standard Practice for Testing Load-Strain
Properties of Roofing Membranes
- D3960-05.....Standard Practice for Determining Volatile
Organic Compound (VOC) Content of Paints and
Related Coatings
- D4073-06.....Standard Test Method for Tensile-Tear Strength
of Bituminous Roofing Membranes
- D4263-83 (R2005).....Standard Test Method for Indicating Moisture in
Concrete by the Plastic Sheet Method
- D4586-07.....Asphalt Roof Cement, Asbestos Free
- D4601-04.....Standard Specification for Asphalt-Coated Glass
Fiber Base Sheet Used in Roofing
- D4897-01.....Asphalt Coated Glass Fiber Venting Base Sheet
Used in Roofing
- D5147-07.....Standard Test Methods for Sampling and Testing
Modified Bituminous Sheet Material
- D5201-05 (R2010).....Standard Practice for Calculating Formulation
Physical Constants of Paints and Coatings
- D6162-00 (R2008).....Styrene Butadiene Styrene (SBS) Modified
Bituminous Sheet Materials Using a Combination
of Polyester and Glass Fiber Reinforcements
- D6163-00 (R2008).....Styrene Butadiene Styrene (SBS) Modified
Bituminous Sheet Materials Using Glass Fiber
Reinforcements

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- D6164-05.....Styrene Butadiene Styrene (SBS) Modified
Bituminous Sheet Materials Using Polyester
Reinforcements
- D6511-06.....Standard Test Methods for Solvent Bearing
Bituminous Compounds
- E108-10.....Standard Test Methods for Fire Tests of Roof
Coverings

- 1-29-09.....Loss Prevention Data Sheet: Above-Deck Roof
Components
- 1-49-09.....Loss Prevention Data Sheet: Perimeter Flashing
- F. National Roofing Contractors Association: Roofing and Waterproofing
Manual
- G.U.S. Department of Energy (DoE): Roof Products Qualified Product List,
www.energystar.gov

1.4 PERFORMANCE REQUIREMENTS

- A. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
- B. Roofing Membrane System Load-Strain Properties: Provide a roofing membrane identical to component systems that have been successfully tested by a qualified independent testing and inspecting agency to meet the following minimum load-strain properties at membrane failure when tested according to ASTM D2523:
 - 1. Tensile strain at failure, at 0 deg F (-18 deg C): 600 lbf(2.67 kN) cross machine direction, minimum; 4.0 to 5.5 percent elongation at break.

1.5 QUALITY CONTROL:

- A. Installer Qualifications:
 - 1. Licensed or approved in writing by manufacturer to perform work under warranty requirements of this Section.
 - 2. Employ full-time supervisors knowledgeable and experienced in roofing of similar types and scopes, and able to communicate with owner and workers.
- B. Inspector Qualifications: Inspection of work by third-party technical inspector or technical representative of manufacturer experienced in the installation and maintenance of the specified roofing system, qualified STYRENE-BUTADIENE-STYRENE MODIFIED BITUMINOUS MEMBRANE ROOFING, HOT APPLIED

to perform roofing observation and inspection specified in Field Quality Control Article, to determine Installer's compliance with the requirements of this Project, and approved by the manufacturer to issue warranty certification. The Roofing Inspector shall be one of the following:

1. An authorized full-time technical employee of the manufacturer, not engaged in the sale of products.
2. An independent party certified as a Registered Roof Observer by the Roof Consultants Institute (RCI), retained by the Contractor or the Manufacturer and approved by the Manufacturer.

C. Product/Material Requirements:

1. Obtain products from single manufacturer or from sources recommended by manufacturer for use with roofing system and incorporated in manufacturer's warranty.
2. Provide manufacturer's label on each container or certification with each load of bulk bitumen, indicating Flash Point (FP), Finished Blowing Temperature (FBT), Softening Point (SP), Equiviscous Temperature (EVT).
3. Provide manufacturer's certification that field applied bituminous coatings and mastics, and field applied roof coatings comply with limits for Volatile Organic Compounds (VOC) per the National Volatile Organic Compound Emission Standards for Architectural Coatings pursuant to Section 183(e) of the Clean Air Act with limits as follows:
 - a. Bituminous Coatings and Mastics: 500 g/l (4.2 lb/gal.).
 - b. Roof Coatings: 250 g/l (2.1 lb/gal.).

D. Roofing system design standard requirements:

1. Recommendations of the NRCA "Roofing and Waterproofing Manual" applicable to modified bituminous sheet roofing for storage, handling and application.
2. Recommendations of FM Approvals 1-49 Loss Prevention Data Sheet for Perimeter Flashings.
3. Recommendations of ANSI/SPRI ES-1 for roof edge design.
4. Roofing System Design: Provide roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.
 - a. Reference structural drawings for wind design criteria.

5. FM Approvals Listing: Provide roofing membrane, base flashing, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a roofing system and that are listed in FM Approvals "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.
 - a. Fire/Windstorm Classification: Class 1A-90.
 - b. Hail Resistance: SH.

E. Pre-Roofing Meeting:

1. Upon completion of roof deck installation and prior to any roofing application, hold a pre-roofing meeting arranged by the Contractor and attended by the Roofing Inspector, Material Manufacturers Technical Representative, Roofing Applicator, Contractor, and COR.
2. Discuss specific expectations and responsibilities, construction procedures, specification requirements, application, environmental conditions, job and surface readiness, material storage, and protection.
3. Inspect roof deck at this time to:
 - a. Verify that work of other trades which penetrates roof deck is completed.
 - b. Determine adequacy of deck anchorage, presence of foreign material, moisture and unlevel surfaces, or other conditions that would prevent application of roofing system from commencing or cause a roof failure.
 - c. Examine samples and installation instructions of manufacturer.

1.6 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, SAMPLES.
- B. Product Data:
 1. Asphalt and adhesive materials.
 2. Modified bituminous sheet roofing and flashing membrane.
 3. Roofing cement.
 4. Roof walkway.
 5. Fastening requirements.
 6. Application instructions.
- C. Samples:
 1. Nails and fasteners, each type.
- D. Shop Drawings: Include plans, sections, details, and attachments.

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1. Base flashings and terminations.
- E. Certificates:
 1. Indicating materials and method of application of roofing system meets requirements of FM Approvals "RoofNav" for specified fire/windstorm classification.
 2. Indicating compliance with load/strain properties requirement.
- F. Warranty: As specified.
- G. Documentation of supervisors' and inspectors' qualifications.
- H. Field reports of roofing inspector.
- I. Contract Close-out Submittals:
 1. Maintenance Manuals.
 2. Warranty signed by installer and manufacturer.

1.7 DELIVERY, STORAGE AND MARKING:

- A. Comply with the recommendations of the NRCA "Roofing and Waterproofing Manual" applicable to built-up roofing for storage, handling and installation.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.
- B. Environmental Controls: Refer to Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.9 WARRANTY:

- A. Construction Warranty: Installer shall warranty roofing work for a period of one (1) year from date of installation and final acceptance by the Government in accordance with the FAR clause 52.246-21, "Warranty of Construction".
- B. Manufacturer Warranty: Manufacturer shall warranty their roofing membrane system for a minimum of ten (10) years from date of installation and final acceptance by the Government. Submit manufacturer warranty during the submittal process.

PART 2 - PRODUCTS

2.1 ADHESIVE AND ASPHALT MATERIALS:

- A. General: Adhesive and sealant materials recommended by roofing system manufacturer for intended use, identical to materials utilized in approved listed roofing system, and compatible with roofing membrane. STYRENE-BUTADIENE-STYRENE MODIFIED BITUMINOUS MEMBRANE ROOFING, HOT APPLIED

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
- B. Water-Based Asphalt Primer: Water-based, polymer modified, asphalt primer with the following physical properties:
 1. Asbestos Content, EPA 600/R13/116: None.
 2. Non-Volatile Content, minimum, ASTM D 2823: 30 percent.
 3. Volatile Organic Compounds (VOC), maximum, ASTM D 3960: 65 g/L.
- C. Asphalt: ASTM D312, Type III or IV for roof membrane.
- D. Cold-Applied Adhesive for membrane flashing: One-part, cold-applied adhesive specially formulated for compatibility and use with specified roofing membranes and flashings, with the following physical properties:
 1. Asbestos Content, EPA 600 R13/116: None.
 2. Volatile Organic Compounds (VOC), maximum, ASTM D 6511: <250 g/L.
 3. Nonvolatile Content, minimum, ASTM D 6511: 75 percent.
 4. Uniformity and Consistency, ASTM D 6511: Pass.
- E. Roof Cement: ASTM D4586, Type II.

2.2 MEMBRANE AND SHEET MATERIALS:

- A. Membrane Materials, General: Provide combination of base, ply, and cap sheet materials that have been tested in combination and comply with load/strain properties performance requirement in Part 1 of this Section.
- B. Base Sheet: ASTM D 4601, Type II, nonperforated, asphalt-impregnated and coated glass-fiber sheet dusted with fine mineral surfacing on both sides, with the following properties:
 1. Breaking Strength, minimum, ASTM D 146: cross machine direction, 12.2 kN/m (70 lbf/in).
 2. Pliability, 12.7 mm (1/2 inch) radius bend, ASTM D 146: No failures.
- C. Membrane Ply Sheet: ASTM D6163, Grade S, Type II or III, glass-fiber-reinforced, SBS/SEBS-modified asphalt sheet, or ASTM D6162, Grade S, Type II or III, SBS/SEBS-modified asphalt sheet; smooth surfaced; suitable for application method specified, with the following minimum properties:
 1. Tensile Strength at 23 deg. C (73 deg. F), minimum, ASTM D 5147: cross machine direction, 21 kN/m (120 lbf/in).
 2. Tear Strength at 23 deg. C (73 deg. F), minimum, ASTM D 5147: cross machine direction 890 N (200 lbf).
 3. Elongation at 23 deg. C (73 deg. F), minimum, at 5 percent maximum load ASTM D 5147: cross machine direction, 40 percent.

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- D. Membrane Cap Sheet: ASTM D6163, Grade G, Type II, glass-fiber-reinforced, SBS/SEBS/SIS modified asphalt sheet; granular surfaced; and as follows:
1. Exterior Fire-Test Exposure, ASTM E108: Class A.
 2. Tensile Strength at 23 deg. C (73 deg. F), minimum, cross machine direction, ASTM D5147: 24 kN/m (140 lbf/in).
 3. Tear Strength at 23 deg. C (73 deg. F), minimum, cross machine direction, ASTM D5147: 880 N (200 lbf).
 4. Elongation at 23 deg. C (73 deg. F), minimum, cross machine direction, at 5 percent maximum load ASTM D5147: 40 percent.
 5. Low Temperature Flex, maximum, ASTM D5147: -31 deg. C (-25 deg. F).
- E. Base Flashing Backer Sheet: ASTM D4601, Type II, asphalt-impregnated and coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.
- F. Base Flashing Sheet: ASTM D6164, Grade G, Type II, polyester-reinforced, SBS-modified asphalt sheet; granular surfaced; Granule Color: White.

2.3 FASTENERS:

- A. Roofing Fasteners: Factory-coated steel fasteners and metal or plastic plates, where applicable, meeting requirements of FM Approvals 4470, tested by fastener manufacturer for required pullout strength, and recommended by roofing manufacturer for application.
- B. Accessory Fasteners: Corrosion-resistant fasteners compatible with adjacent materials and recommended for application by manufacturer of component to be fastened.

2.4 ROOF WALKWAY:

- A. Prefabricated asphalt plank consisting of a homogeneous core of asphalt, plasticizers and inert fillers, bonded by heat and pressure between two saturated and coated sheets of felt:
1. Top side of plank surfaced with ceramic granules. Granule Color: White.
 2. Size: Minimum 13 mm (1/2-inch) thick, manufacturer's standard size, but not less than 300 mm (12 inches) in least dimension and 600 mm (24 inches) in length.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine substrates and conditions with roofing Installer and roofing inspector to verify compliance with project requirements and suitability to accept subsequent roofing work. Correct unsatisfactory conditions before proceeding with roofing work.
- B. Do not apply roofing if roof surface will be used for subsequent work platform, storage of materials, or staging or scaffolding will be erected thereon unless system is protected.

3.2 PREPARATION

- A. Complete roof deck construction prior to commencing roofing work:
 - 1. Install curbs, blocking, edge strips, nailers, cantos, and other components where insulation, roofing, and base flashing is attached to, in place ready to receive insulation and roofing.
 - 2. Complete deck and insulation to provide designed drainage to working **gutter and downspout.**
 - 3. Document installation of related materials to be concealed prior to installing roofing work.
- B. Dry out surfaces, including the flutes of metal deck that become wet from any cause during progress of the work before roofing work is resumed. Apply materials to dry substrates.
- C. Sweep decks to broom clean condition. Remove all dust, dirt or debris.
- D. Remove projections that might damage materials.
- E. Concrete Decks, except Insulating Concrete:
 - 1. Test concrete decks for moisture prior to application of roofing materials. Test for capillary moisture by plastic sheet method according to ASTM D4263.
 - 2. Test concrete decks for moisture by pouring one pint of hot bitumen at 204 degrees C (400 degrees F.) or EVT on deck at start of each day's Work and at start of each new roof area or plane. Do not proceed if test sample foams or can be easily (cleanly) stripped after cooling.
 - 3. Prime concrete decks, including precast units, with primer as specified. Keep primer back four inches from joints in precast units.
 - 4. Allow primer to dry before application of bitumen.

3.3 HEATING BITUMEN

- A. Heat the asphalt to the equiviscous temperature plus or minus -4 deg. C (25 deg. F) at the time of application:
 - 1. Do not heat asphalt greater than 38 deg. C (100 deg. F) above the equiviscous temperature.
 - 2. When the equiviscous temperature is not furnished by the asphalt manufacturer, do not heat asphalt above 275 deg. C (525 deg. F) for Type III and IV with temperature not less than 250 deg. C (475 deg. F) at time of application.
- B. Do not heat bitumen above the flash point temperature.
- C. Provide heating kettles with a thermometer kept in operating condition. Attend kettle during heating to insure that the bitumens are heated within the temperatures specified.
- D. Use type III and Type IV asphalt between plies.
- E. Do not mix different type of asphalt in kettle.

3.4 TEMPORARY PROTECTION

- A. Install temporary protection at the end of day's work and when work is halted for an indefinite period or work is stopped when precipitation is imminent. Comply with approved temporary protection plan.
- B. Install temporary cap flashing over the top of base flashings where permanent flashings are not in place to provide protection against moisture entering the roof system through or behind the base flashing. Securely anchor in place to prevent blow off and damage by construction activities.
 - 1. Glaze coat exposed surfaces of felts to seal within the bitumen coating. Do not leave felt surfaces or edges exposed.
- C. Provide for removal of water or drainage of water away from the work.
- D. Provide temporary protection over installed roofing by means of duckboard walkways, plywood platforms, or other materials, as approved by COR, for roof areas that are to remain intact, and that are subject to foot traffic and damage. Provide notches in sleepers to permit free drainage.

3.5 INSTALLATION, GENERAL

- A. FM Approvals Installation Standard: Install roofing membrane, base flashings, wood cants, blocking, curbs, and nailers, and component materials in compliance with requirements in FMG 4450 and FMG 4470 as part of a membrane roofing system as listed in FM Approval's "RoofNav"

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for fire/windstorm classification indicated. Comply with recommendations in FM Approvals' Loss Prevention Data Sheet 1-49, including requirements for wood nailers and cants.

- B. NRCA Installation Standard: Install roofing system in accordance with applicable NRCA Manual Plates and NRCA recommendations, including ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing"
- C. Manufacturer Recommendations: Comply with roofing system manufacturer's written installation recommendations.
- D. Coordination with related work: Coordinate roof operations with roof insulation and sheet metal work so that insulation and flashings are installed concurrently to permit continuous roofing operations.
- E. Installation Conditions:
 - 1. Apply dry roofing materials. Apply roofing work over dry substrates and materials.
 - 2. Apply materials within temperature range and surface and ambient conditions recommended by manufacturer.
 - 3. Except for temporary protection, do not apply materials during damp or rainy weather, during excessive wind conditions, nor while moisture (dew, snow, ice, fog or frost) is present in any amount in or on the materials to be covered or installed:
 - a. Do not apply materials when the temperature is below 4 deg. C (40 deg. F).
 - b. Do not apply materials to substrate having temperature of 4 deg. C (40 deg. F) or less.

3.6 INSTALLATION OF MODIFIED BITUMEN MEMBRANE:

- A. Primer: Apply primer to substrates where recommended by roofing manufacturer, in application quantities recommended by roofing manufacturer.
- B. Hot Roofing Asphalt: Apply hot roofing asphalt in quantities required, immediately followed by membrane materials embedded therein before bitumen cools below the application temperature limit.
 - 1. Do not apply more material than can be covered at one time except for glaze coats.
 - 2. Recoat cooled areas.
 - 3. Application rate between substrate and sheets: 7 to 11 Kg (15 to 25 pounds) per square.
 - 4. Application rate for glaze coats: 7 to 11 Kg (15 to 25 pounds).

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C. Membrane Sheets:

1. Number of Plies: 2, minimum, including base sheet and cap sheet, and additional plies as required to meet load/strain properties specified in Part 1 of this Section.
2. Commence the laying of sheets at the low points.
3. Roll sheets into hot roofing asphalt brushing down to firmly embed, free of wrinkles, fish mouths, blisters, bubbles, voids, air pockets or other defects that prevent complete adhesion:
4. Cut to fit closely around pipes, roof drains, bitumen stops, and similar roof projections.
5. Lap sheets shingle fashion starting with starter strips at right angles to slope of roof.
6. Laps for Top Sheet and Base Sheet:
 - a. Base sheet, lapped 75 mm (three inches).
 - b. Use 450 mm (18 inch) starting widths, lap top sheet 475 mm (19 inches).
 - c. Lap end joints of sheet 150 mm (six inches). Stagger end joints in relation to end joints in adjacent and proceeding plies.

D. Roof edges and terminations:

1. Where nailers occur at roof edges under gravel stops or penetrations to receive metal base flashing, apply a continuous strip of underlayment over the nailers before the first ply sheet is applied. Strip shall be installed on top of venting base sheet if any.
2. After membrane is installed, turn the underlayment back over the roofing, and secure in place with hot roofing asphalt before gravel stops or other metal flanges extending out onto the membrane are installed.
3. Where cants occur at vertical surfaces, cut off roofing sheets two inches above top of cant strips, except at prefabricated curbs, scuttles and other roof accessories having integral cants, extend membrane over cant and up vertical surface to top of curb or nailer as shown.
4. Where fascia-cant occurs at roof edges, extend membrane beyond outside cant face and cut off at outside after base flashing is installed.
5. Where reglet occurs at vertical surfaces, extend plies roofing sheets up into reglet the full depth of the reglet.

3.7 BASE FLASHING:

- A. Provide built-up base flashing over cants and as necessary to make work watertight.
- B. Prime vertical surfaces of masonry and concrete with asphalt primer except where vented base sheet is required to provide edge venting.
- C. Apply flashing on top of roofing, up face of cant and up the face of the vertical surface, at least 200 mm (eight inches) above the roofing but not more than 350 mm (14 inches) above the roofing, generally full height beneath counter flashing or top of curb flashing.
 - 1. At fascia-cants, extend to top of cant and cut off at top of cant.
 - 2. At reglet, extend full depth into the reglet.
 - 3. Where venting base sheet is used with insulating concrete, do not seal edges of venting base sheet with bitumen; allow for venting.
- D. Use two plies of modified bituminous sheet.
 - 1. Extend the first ply 100 mm (four inches) out on the roofing, and the second ply 75 mm (three inches) beyond the first ply. Lap ends 75 mm (three inches) with joints broken 450 mm (18 inches) in each ply. Use smooth surface modified bituminous sheet for first ply.
 - 2. Use granular surfaced modified bitumen cap sheet.
- E. Set base flashing either in Type III or IV asphalt.
 - 1. Embed each sheet in asphalt so sheets do not touch.
 - 2. Set cap sheet in cold-applied adhesive with laps sealed with cold-applied adhesive.
 - 3. Except for venting roof edges, seal the top edge of the base flashing with roof cement.
- F. Except at metal fascia cants, secure top edge of base flashing with nails on a line approximately 25 mm (one inch) below top edge, spaced not more than 200 mm (eight inches) on center.
 - 1. Cover nail heads with roof cement.
 - 2. Cover the top of the base flashing with counterflashing as specified in Section 07 60 00, FLASHING AND SHEET METAL. At the fascia cants secure the top edge of the flashing with fascia compression clamp as specified in Section 07 60 00, FLASHING AND SHEET METAL.

3.8 STRIPPING:

- A. Coordinate to set flanges of metal flashing in roof cement on top sheet of the modified bituminous roofing and mailing to blocking with Section 07 60 00, FLASHING AND SHEET METAL.

- B. Cover that portion of the horizontal flanges of metal base flashings, gravel stops, and other flanges extending out onto the roofing with modified bituminous sheet.
- C. Extend the sheet out on the roofing 150 mm six inches beyond the edge of the metal flange. Cut edge to fit tight against vertical members of flange.
- D. Prime flange before stripping, embed sheet in cold-applied adhesive.

3.9 ROOF WALKWAYS

- A. Install roof walkways where indicated.
- B. Set prefabricated planks in solid application of cold-applied adhesive. Maintain 75 mm (three inch) to 150 mm (six-inch) space between planks.

3.10 FIELD QUALITY CONTROL:

- A. Roofing Inspector: Contractor shall engage a qualified roofing inspector for a minimum of 5 full-time days on site to perform roof tests and inspections and to prepare start up, interim, and final reports. Roofing Inspector's quality assurance inspections shall comply with criteria established in ARMA/NRCA's "Quality Control Guidelines for the Application of Built-up Roofing."
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
 - 1. Notify Architect and Owner 48 hours in advance of date and time of inspection.
- C. Repair or remove and replace components of roofing work where test results or inspections indicate that they do not comply with specified requirements.
 - 1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.13 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of acceptance by Owner.

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C. Clean overspray and spillage from adjacent construction. Clean membrane and restore surface to like-new condition meeting solar reflectance requirements.

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SECTION 08 44 13
GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Section specifies glazed aluminum curtain wall system.
 - 1. Thermally isolated, pressure equalized on interior.
 - 2. Type: Unit system to include following:
 - a. Glass.
 - b. Integral reinforcing.
 - c. Closures, trim, subsills and flashings.
 - d. Column covers.
 - e. Fasteners, anchors, and related reinforcement.

1.2 RELATED WORK

- A. Miscellaneous metal members: Section 05 50 00, METAL FABRICATIONS.
- B. Firestopping between curtain wall and structure: Section 07 84 00, FIRESTOPPING.
- C. Sheet metal flashing and trim: Section 07 60 00, FLASHING AND SHEET METAL.
 - a. Joint sealants: Section 07 92 00, JOINT SEALANTS.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Approval is required of products or service of proposed manufacturer, suppliers and installers, and will be based upon submission by Contractor of certification that:
 - a. Manufacturers Qualifications: Manufacturer with five (5) years continuous documented experience in fabrication and installation of glazed aluminum curtain wall systems of type and size required for that project.
 - b. Installer: Manufacturer approved in writing. Continuously installed glazed aluminum curtain walls systems for previous five (5) years.
 - c. Manufacturer shall provide technical field representation at project site, as a minimum, at start of project, during middle, towards end of project, and during field testing of field mockup panel.
 - d. Testing Laboratory: Contractor retained. Engage an AAMA accredited commercial testing laboratory to perform tests specified. Submit information regarding testing laboratory's facilities and qualifications of technical personnel to perform testing specified in this section.

GLAZED ALUMINUM CURTAIN WALLS

e. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of glazed aluminum curtain wall system. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, one another, and adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, or in-service performance.

1) Do not modify intended aesthetic effects. If modifications are proposed, submit comprehensive explanatory data for review.

f. Qualification of Welders:

1) Welding shall be performed by certified welders qualified in accordance with AWS D1.2, using procedures, materials, and equipment of the type required for this work.

B. Mockup

1. Construct, at job site, full size typical wall unit which incorporates horizontal and vertical joints, framing, window units, panels, glazing, sealants, and other accessories as detailed and specified. Mock-up wall unit location, size and design shall be as indicated. Orient mockup to be facing full sun when constructed. Mockup may be a portion of actual curtain wall installation with prior approval from architect.

2. Performance Test

a. Conduct performance test after approval of visual aspects has been obtained. Finished work shall match approved mock-up.

b. Refer to Performance Requirements and Field Quality Control Articles, included hereinafter, for testing requirements.

3. Approved Mock-up

a. After completion and approval of job site mockup, as directed, approved mock-up panel shall be used as minimum standard of comparison for entire curtain wall system.

C. Pre-Installation Conference

1. Prior to starting installation of glazed curtain wall system schedule conference with CO to ensure following:

a. Clear understanding of drawings and specifications.

b. Onsite inspection and acceptance of structural and pertinent structural details relating to curtain wall system.

c. Coordination of work of various trades involved in providing system. Conference shall be attended by Contractor; personnel directly responsible for installation of curtain wall system,

flashing and sheet metal work, firestopping system and curtain wall manufacturer and their Technical Field Representatives. Conflicts shall be resolved and confirmed in writing.

1.4 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Product Data:
 - 1. Manufacturer's standard details and fabrication methods.
 - 2. Data on finishing, components, and accessories.
 - 3. Instructions: Submit descriptive literature, detail specifications, available performance test data and instructions for installation, and adjustments.
 - 4. Recommendations for maintenance and cleaning of exterior surfaces.
- C. Shop Drawings:
 - 1. Show elevations of glazed curtain wall system at 1:50 (1/4 inch) scale, metal gages, details of construction, methods of anchorage, glazing details, and details of installation.
 - 2. Submit for curtain wall system, accessories, and mock-up. Tentative approval of drawings shall be received before fabrication of mock-up. Final approval of drawings shall be deferred pending approval of mock-up and accessories. Drawings shall indicate in detail all system parts including elevations, full size sections, framing, jointing, panels, types and thickness of metal anchorage details, flashing and coping details, field connections, weep and drainage system, finishes, sealing methods, glazing, glass sizes and details, firestopping insulation materials, and erection details.
 - 3. Operation and Maintenance Manuals
 - a. Submit cleaning and maintenance instructions.
- D. Samples: Not Required for clear anodized finish.
- E. Glass:
 - 1. Specified in Section 08 80 00, GLAZING.
- F. Quality Control Submittals:
 - 1. Design Data:
 - a. Submit structural and thermal calculations for complete wall assembly. Structural calculations and design shop drawings shall be signed and sealed by a structural engineer registered in state in which project is to be located.
 - 2. Factory Test Reports:
 - a. Test Reports: Provide certified test reports, for each of following listed tests, from a qualified independent testing laboratory showing that glazed aluminum curtain wall system

assembly has been tested in accordance with specified test procedures and complies with performance characteristics as indicated by manufacturer's testing procedures. Manufacturer shall submit appropriate testing numbers for specific tests indicated below.

- 1) Deflection and structural tests.
- 2) Water penetration tests.
- 3) Air infiltration tests.
- 4) Delamination tests.
- 5) Thermal conductance tests.
- 6) Sound transmission loss test.
- 7) Submit factory tests required except that where a curtain wall system or component of similar type, size, and design as specified for this project has been previously tested within last year, under conditions specified herein, resulting test reports may be submitted in lieu of listed testing.

G. Manufacturer's Certificates:

1. Submit Certificates of Compliance, with specification requirements, for the following:
 - a. Metal extrusions.
 - b. Metal accessories.
 - c. Stating that aluminum has been given specified thickness of anodizing or organic coating finish.
 - d. Indicating manufacturer's and installer's meet qualifications as specified.
 - e. Submit list of equivalent size installations, for both manufacturer and installer, which have had satisfactory and efficient operation.

H. Manufacturer's Field Reports:

1. Submit field reports of manufacturer's field representative observations of curtain wall installation indicating observations made during inspection at beginning of project, during middle of installation and at conclusion of project. Indicate results of field testing of mockup field panel, and any directions given Contractor for corrective action.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to AAMA CW 10 for care and handling of architectural aluminum from shop to site.
- B. Prior to packaging for shipment from factory, mark wall components to correspond with shop and erection drawings and their placement location and erection.

- C. Prior to shipment from factory, place knocked-down lineal members in cardboard containers and cover finished surfaces of members with protective covering of adhesive paper, waterproof tape, or strippable plastic. Do not cover metal surfaces that will be in contact with sealants after installation.
- D. Inspect materials delivered to site for damage; unload and store with ventilation, free from heavy dust, not subject to combustion products or sources of water, and shall permit easy access for inspection and handling. Sealing and caulking compounds, including handling, shall be in accordance with requirements of Section 07 92 00 JOINT SEALANTS.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Where glazed aluminum curtain wall systems are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying Work.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referred to in text by basic designation only.
- B. American Architectural Manufacturers Association (AAMA):
 - MCWM-1-89.....Metal Curtain Wall Manual
 - CW 10-04.....Care and Handling of Architectural Aluminum from Shop to Site
 - CW 11-85.....Design Windloads for Buildings and Boundary Layer Wind Tunnel Testing
 - CW 13-85.....Structural Sealant Glazing Systems (A Design Guide)
 - CWG 1-89.....Installation of Aluminum Curtain Walls
 - TIR A1-04.....Sound Control for Fenestration Products
 - TIR A8-08.....Structural Performance of Composite Thermal Barrier Framing Systems
 - TIR A9-91.....Metal Curtain Wall Fasteners
 - TIR A11-04.....Maximum Allowable Deflection of Framing Systems for Building Cladding Components of Design Wind Loads
 - 101/I.S.2/A440-08.....Windows, Doors and Unit Skylights
 - 501-05.....Methods of Test for Exterior Walls
 - 503-08.....Field Testing of Metal Storefronts, Curtain walls and Sloped Glazing Systems

- 2605-98.....High Performance Organic Coatings on
Architectural Extrusions and Panels
- 1503-09.....Thermal Transmission and Condensation Resistance
of Windows, Doors and Glazed Wall Sections
- C. American National Standards Institute (ANSI):
 - Z97.1-09.....Glazing Materials Used in Buildings, Safety
Performance Specifications and Methods of Test
- D. American Society of Civil Engineers (ASCE):
 - ASCE 7-10.....Minimum Design Loads for Buildings and Other
Structures
- E. American Society for Testing and Materials (ASTM):
 - A36/A36M-08.....Structural Steel
 - A123-09.....Zinc (Hot-Dip Galvanized) Coatings on Iron and
Steel Products
 - A193-10.....Alloy-Steel and Stainless Steel Bolting
Materials for High Temperature Service
 - A307-10.....Carbon Steel Bolts and Studs, 60,000 PSI Tensile
Strength
 - B209-10.....Aluminum and Aluminum Alloy Sheet and Plate
 - B211-03.....Aluminum and Aluminum Alloy Bar, Rod, Wire
 - B221/B221M-08.....Aluminum and Aluminum Alloy Extruded Bars, Rods,
Wire, Shapes and Tubes
 - B316/B316M-10.....Aluminum and Aluminum Alloy Rivet and Cold-
Heading, Wire, and Rods
 - C578-10.....Rigid Cellular Polystyrene Thermal Insulation
 - C612-10.....Mineral Fiber Block and Board Thermal Insulation
 - C920-11.....Elastomeric Joint Sealants
 - C794-10.....Standard Test Method for Adhesion-In-Peel of
Elastomeric Joint Sealants.
 - C1363-05.....Thermal Performance of Building Materials and
Envelope Assemblies by Means of a Hot Box
Apparatus
 - D1037-06.....Evaluating the Properties of Wood-Base Fibers
and Particle Panel Materials
 - E84-10.....Surface Burning Characteristics of Building
Materials
 - E90-09.....Laboratory Measurement of Airborne Sound
Transmission Loss of Building Partitions and
Elements
 - E283-04.....Determining Rate of Air Leakage Through Exterior
Windows, Curtain Walls, and Doors under

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- Specified Pressure Difference Across this
Specification
- E330-02 (R2010).....Structural Performance of Exterior Windows,
Curtain Walls, and Doors by Uniform Static Air
Pressure Difference
- E331-00 (R2009).....Water Penetration of Exterior Windows, Curtain
Walls, and Doors By Uniform Static Air Pressure
Difference
- E413-10.....Classification for Rating Sound Insulation
- E783-02 (R2010).....Test Method for Field Measurement of Air Leakage
Through Installed Exterior Windows and Doors.
- E1105-00 (R2008).....Field Determination of Water Penetration of
Installed Exterior Windows, Curtain Walls, and
Doors By Uniform or Cyclic Static Air Pressure
Differences
- F. American Welding Society, Inc. (AWS):
D1.2-08.....Structural Welding Code-Aluminum
- G. Consumer Product Safety Commission (CPSC):
16 CFR 1201.....Architectural Glazing Standards and Related
Material
- H. Federal Specifications (FS):
TT-P-645B-90.....Primer, Paint, Zinc-Molybdate, Alkyd Type
- I. Glass Association of North America (GANA):
2010 Edition.....GANA Glazing Manual
2008 Edition.....GANA Sealant Manual
2009 Edition.....GANA Laminated Glazing Reference Manual
2008 Edition.....Tempered Glass Engineering Standard Manual
- J. Military Specifications (MIL):
MIL-C-18480.....(Rev. B) Coating Compound, Bituminous Solvent,
Coal Tar Base
- K. National Association of Architectural Metal Manufacturers (NAAMM):
500 Series (2006).....Metal Finishes Manual.
- L. Steel Structures Painting Council (SSPC)
Paint 25-97 (2004).....Red Iron Oxide Raw Linseed Oil and Alkyd Primer
(Without Lead and Chromate Pigments)

1.8 WARRANTY

- A. Construction Warranty: Installer shall warranty their installation of
Curtain Wall System for a period of one (1) year from date of
installation and final acceptance by the Government in accordance with
the FAR clause 52.246-21, "Warranty of Construction".

- B. Manufacturer Warranty: Submit manufacturer's written warranty for materials, installation and weathertightness for a minimum of five (5) years from the date of installation and final acceptance by the Government. Submit manufacturer warranty during the submittal process.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Design Requirements:

1. Curtain Wall System: Tubular aluminum sections with thermal break condition, supplementary support framing, factory prefinished, vision glass, spandrel infill,; related flashings, anchorage and attachment devices.
2. System Assembly: Shop unitized assembly.
3. No curtain wall framing member shall deflect, in a direction normal to plane of wall, more than 1/175 of its clear span or 20 mm (3/4 inch), whichever is less, when designed in accordance with requirements of TIR All and tested in accordance with ASTM E330, except that when a gypsum wallboard surface will be affected, deflection shall not exceed 1/360 of span. No framing member shall have a permanent deformation in excess of 0.2 percent of its clear span when tested in accordance with ASTM E330 for a minimum test period of 10 seconds at 1.5 times design wind pressures indicated as part of structural drawing wind load requirements. No glass breakage, damage to fasteners, hardware or accessories shall be permitted due to deformation stated above:
 - a. Provide system complete with framing, mullions, trim, fasteners, anchors, accessories, concealed auxiliary members, and attachment devices for securing wall to structure as specified or indicated. Unless noted otherwise, comply with MCWM-1.
 - b. Curtain wall system components shall be furnished by one manufacturer or fabricator; however, all components need not be products of same manufacturer.
 - c. Fully coordinate system accessories directly incorporated, and adjacent to contiguous related work and insure materials compatibility, deflection limitations, thermal movements, and clearances and tolerances as indicated or specified.
 - d. Provide system with adequate allowances for expansion and contraction of components and fastenings to prevent buckling damage, joint seal failure, glass breakage, undue stress on fastenings or other detrimental effects. For design purposes, base provisions for thermal movement on assumed ambient temperature

range of from -18 degrees C to 49 degrees C (0 degrees F to 120 degrees F).

- e. Provide wall system to accommodate tolerances in building frame and other contiguous work as indicated or specified.
- B. Manufacturer's Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of kind indicated. Engineering services are defined as those performed for installations of curtain walls that are similar to those indicated for this Project in material, design, and extent.
- C. Performance Requirements:
1. System shall meet or exceed all performance requirements specified.
 2. Curtain wall components shall have been tested in accordance with requirements below and shall meet performance requirements specified:
 3. System Design: Design and size components to withstand dead loads and live loads caused by positive and negative wind loads acting normal to plane of wall as calculated in accordance with ASCE 7-Minimum Design Loads for Buildings and Other Structures (with local amendments as required).
 4. Seismic Loads: Design and size components per structural information indicated on drawings.
 5. Water Penetration:
 - a. No water penetration shall occur when wall is tested in accordance with ASTM E331 at a differential static test pressure of 20 percent of inward acting design wind pressure as indicated on structural drawings, but not less than 479 Pa (10 psf).
 - b. Make provision in wall construction for adequate drainage to outside of water leakage or condensation that occurs within outer face of wall. Leave drainage and weep openings in members and wall open during test.
 6. Air Infiltration: Test glazed aluminum curtain wall system according to AAMA 503, which requires testing according to ASTM E783
 - a. Static-Air-Differential: 75 Pa (1.57 lbf/sq. ft.) minimum.
 - b. Air Leakage: 0.03 L/s per sq. m (0.06 cfm/sq ft) of surface maximum.
 7. Deflections Test: ASTM E330, Procedure B:
 - a. No member shall deflect in a direction parallel to plane of wall, when carrying its full design load, more than an amount which will reduce edge cover or glass bite below 75 percent of design dimension. No member after deflection under full design load, shall have a clearance between itself and top of panel, glass,

sash, or other part immediately below it less than 3 mm (1/8 inch); clearance between member and an operable window or door shall be minimum 1.5 mm (1/16 inch).

8. Thermal Conductance Tests: ASTM C236.

- a. The thermal transmittance of opaque panels shall not exceed a U-value, Btu/hr/sq ft/ degree F, as required and indicated on contract drawings for exterior wall system, when tested in accordance with ASTM C236. Average calculated thermal transmittance of complete wall assembly including panels, windows, and all other components shall not exceed a U-value of 0.66

2.2 MATERIALS

- A. Extruded Aluminum Framing Members: ASTM B221M; 6063-T5 extruded aluminum for non-structural components or 6063-T6 extruded aluminum for structural members; temper and alloy as recommended by manufacturer.
- B. Sheet Aluminum: ASTM B209M; 6065-T5 temper and alloy as recommended by manufacturer.
 1. Formed flashing and closures: Minimum 1.58 mm (0.062 inch) thick aluminum, in finish as selected.
 2. Extruded sill members: Minimum 1.58 mm (0.062 inch) thick aluminum, in finish as selected.
- C. Steel Sections: ASTM A36M.
- D. Primer: TS TT-P-645; red, for shop application and field touch-up.
- E. Fasteners:
 1. For Exterior Cap Retainers: ASTM A193 B8 300 series, stainless steel screws.
 2. For Framework Connections: ASTM B211M 2024-T4 aluminum, ASTM A193 B8 300 series, stainless steel, and ASTM B316 aluminum rivets, as required by connection.
 3. For Anchoring Glazed Aluminum Curtain Wall to Support Structure: ASTM A307 zinc plated steel fasteners.
- F. Shims: Metal or plastic.
- G. Joint Sealants and Accessories:
 1. In accordance with requirements specified in Section 07 92 00, JOINT SEALANTS.
 2. Structural Flush Glazed Joints: High performance silicone sealant applied in accordance with manufacturer's recommendations.
 3. Non-structural Flush Glazed Joints and Weather Seal Joints: Silicone sealants applied in accordance with manufacturer's recommendations.
 5. Comply with recommendations of sealant manufacturer for specific sealant selections.

6. Provide only sealants that have been tested per ASTM C794 to exhibit adequate adhesion to samples of glass and metal equivalent to those required for project.
7. Exposed metal to metal joints: Silicone sealant selected from manufacturer's standard colors.

H. Glazing Materials:

1. As specified under Section 08 80 00, GLAZING.
2. Glazing Gaskets:
 - a. Exterior: Continuous EPDM gaskets at each glass and spandrel panel.
 - b. Interior: Continuous, closed cell PVC foam sealant tape, sealed at corners.
3. Glass Sizes and Clearances:
 - a. Accommodate up to 25 mm (1 inch) glazing.
 - b. Sizes indicated are nominal. Verify actual sizes required by measuring frames. Coordinate dimensions for glass and glass holding members to meet applicable minimum clearances as recommended by glass manufacturer. Do not nip glass to remove flares or to reduce oversized dimensions. All cutting shall occur in factory.
4. Glass Setting Materials:
 - a. Provide head bead and drive wedge required for glass installation to suit curtain wall system in accordance with manufacturer's recommendations.

2.3 FABRICATION

- A. Curtain wall components shall be of materials and thickness indicated or specified. Details indicated are representative of required design and profiles. Maintain sightlines indicated on drawings. Unless specifically indicated or specified otherwise, methods of fabrication and assembly shall be at discretion of curtain wall manufacturer. Perform fitting and assembling of components in shop to maximum extent practicable. Anchorage devices shall permit adjustment in three directions. There shall be no exposed fasteners.
- B. Joints: Joints exceeding +1.5 mm (+1/16") shall be mechanically fastened.
- C. Ventilation and Drainage: Direct water leakage to exterior by means of concealed drainage system and weeps. Flashings and other materials used internally shall be nonstaining, noncorrosive, and nonbleeding.
- D. Protection and Treatment of Metals:
 1. Remove from metal surfaces lubricants used in fabrication and clean off other extraneous material before leaving shop.

2. Provide protection against galvanic action wherever dissimilar metals are in contact, except in case of aluminum in permanent contact with galvanized steel, zinc, stainless steel, or relatively small areas of white bronze. Paint contact surfaces with one coat bituminous paint conforming to MIL-C-18480 or apply appropriate caulking material or nonabsorptive, noncorrosive, and nonstaining tape or gasket between contact surfaces.

E. Metal sills and Closures: Fabricate accessories, spandrel panels, trim closures of sizes and shapes indicated from similar materials and finish as specified for wall system.

2.4 PROTECTION

A. Provide protection for aluminum against galvanic action, wherever dissimilar materials are in contact, by painting contact surfaces of dissimilar material with a heavy coat of bituminous paint (complete coverage), or by separating contact surfaces with a preformed neoprene tape having pressure sensitive adhesive coating on one side.

2.5 METAL FINISHES

- A. In accordance with NAAMM AMP500 series.
- B. Anodized Aluminum:
 - 1. AA-C22A41 Chemically etched medium matte, with clear anodic coating, Class 1 Architectural, 0.7-mil thick.
- C. Concealed Steel Items: Galvanized in accordance with ASTM A123 to 610 2.0 oz/sq ft. Primed with iron oxide paint.
- D. Apply bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to installation of glazed curtain wall system, arrange for representative(s) of manufacturer to examine structure and substrate to determine that they are properly prepared, and ready to receive glazed curtain wall work included herein.
- B. Verifying Conditions and Adjacent Surfaces: After establishment of lines and grades and prior to system installation examine supporting structural elements. Verify governing dimensions, including floor elevations, floor to floor heights, minimum clearances between curtain wall and structural frames, and other permissible dimensional tolerances in building frame.

3.2 PREPARATION

- A. Take field dimensions and examine condition of substrates, supports, and other conditions under which work of this section is to be performed to

verify that work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.

- B. Contact between aluminum and dissimilar metals shall receive a protective coating of asphaltic paint for prevention of electrolytic action and corrosion.

3.3 INSTALLATION

- A. Installation and erection of glazed curtain wall system and all components shall be in accordance with written directions of curtain wall manufacturer. Match profiles, sizes, and spacing indicated on approved shop drawings.
- B. Bench Marks and Reference Points: Establish and permanently mark bench marks for elevations and building line offsets for alignment at convenient points on each floor level. Should any error or discrepancy be discovered in location of marks, stop erection work in that area until discrepancies have been corrected.
- C. Ensure that drainage system operates properly in accord with AAMA 501 procedures.
- D. Do not proceed with structural silicone work when metal temperature is below 0 degrees C (32 degrees F).
- E. Isolate between aluminum and dissimilar metals with protective coating or plastic strip to prevent electrolytic corrosion.
- F. Install glazed aluminum curtain wall system so as to maintain a virtually flat face cap, with no visible bowing.
- G. Install entire system so that fasteners are not visible.
- H. Tolerances:
 - 1. Maximum variation from plane or location shown on approved shop drawings: 3 mm per 3600 mm (1/8 inch per 12 feet) of length up to not more than 13 mm (1/2 inch) in any total length.
 - 2. Maximum offset from true alignment between two identical members abutting end to end in line: 0.8 mm (1/32 inch).
 - 3. Sealant Space Between Curtain Wall Mullion and Adjacent Construction: Maximum of 19 mm (3/4 inch) and minimum of 6 mm (1/4 inch).
- I. Joint Sealants:
 - 1. Joint Sealants: Shall be in accordance with requirements of Section 07 92 00, JOINT SEALANTS.
 - 2. Surfaces to be primed and sealed shall be clean, dry to touch, free from frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter. Enclose joints on three sides. Clean out grooves to proper depth. Joint dimensions shall conform to approved detail drawings with a tolerance of plus 3 mm (1/8 inch). Do not apply compound unless ambient temperature is between 5 and 35 degrees C (40

- and 90 degrees F). Clean out loose particles and mortar just before sealing. Remove protective coatings or coverings from surfaces in contact with sealants before applying sealants or tapes. Solvents used to remove coatings shall be of type that leave no residue on metals.
3. Match approved sample. Force compound into grooves with sufficient pressure to fill grooves solidly. Sealing compound shall be uniformly smooth and free of wrinkles and, unless indicated otherwise, shall be tooled and left sufficiently convex to result in a flush joint when dry. Do not trim edges of sealing material after joints are tooled. Mix only amount of multi-component sealant which can be installed within four hours, but at no time shall this amount exceed 19 liters (5 gallons).
 4. Apply primer to masonry, concrete, wood, and other surfaces as recommended by sealant manufacturer. Do not apply primer to surfaces which will be exposed after caulking is completed.
 5. Tightly pack backing in bottom of joints which are over 13 mm (1/2 inch) in depth with specified backing material to depth indicated or specified. Roll backing material of hose or rod stock into joints to prevent lengthwise stretching.
 6. Install bond preventive material at back or bottom of joint cavities in which no backstop material is required, covering full width and length of joint cavities.
 7. Remove compound smears from surfaces of materials adjacent to sealed joints as work progresses. Use masking tape on each side of joint where texture of adjacent material will be difficult to clean. Remove masking tape immediately after filling joint. Scrape off fresh compound from adjacent surfaces immediately and rub clean with approved solvent. Upon completion of caulking and sealing, remove remaining smears, stains, and other soiling, and leave work in clean neat condition.

J. Glass:

1. Refer to Section 08 80 00, GLAZING, and drawing for glass types. Install in accordance with manufacturer's recommendations as modified herein.
2. Before installing glass, inspect sash and frames to receive glass for defects such as dimensional variations, glass clearances, open joints, or other conditions that will prevent satisfactory glass installation. Do not proceed with installation until defects have been corrected.

3. Clean sealing surfaces at perimeter of glass and sealing surfaces of rebates and stop beads before applying glazing compound, sealing compound, glazing tape, or gaskets. Use only approved solvents and cleaning agents recommended by compound or gasket manufacturer. All sashes shall be designed for outside glazing. Provide continuous snap in glazing beads to suit glass as specified.
4. Insulating and tempered glass, and glass of other types that exceed 100 united inches in size: Provide void space at head and jamb to allow glass to expand or move without exuding sealant. Perimeter frames and ventilator sections shall have glazing rebates providing an unobstructed glazing surface 19 mm (3/4 inch) in height. Glazing rebate surfaces must be sloped to shed water.
5. Provide adequate means to weep incidental water and condensation away from sealed edges of insulated glass units and out of wall system. Weeping of lock-strip gaskets should be in accordance with recommendation of glass manufacturer.

K. Metal Copings:

1. Refer to Section 07 60 00, FLASHING AND SHEET METAL for requirements of metal copings when they are not a part of glazed curtain wall system work.
2. Coordinate curtain wall installation with metal coping detail on contract drawings. Provide watertight seal to meet criteria set forth in this section regarding air and water penetration.

3.4 CLEANING

- A. Install curtain wall frame and associated metal to avoid soiling or smudging finish.
- B. Clean metal surfaces promptly after installation, exercising care to avoid damage to coatings.
- C. Remove excess glazing and sealant compounds, dirt, and other substances.
- D. Follow recommendations of manufacturer in selection of cleaning agents. Do not use cleaning agents containing ammonia or other compounds that might damage finished metal surfaces.
- E. Replace cracked, broken, and defective glass with new glass at no additional cost to Government. Just prior to final acceptance of curtain wall system clean glass surfaces on both sides, remove labels, paint spots, compounds, and other defacements, and clean metal fixed panels. Remove and replace components that cannot be cleaned successfully.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage an AAMA accredited commercial qualified independent testing and inspecting agency to perform field quality-control tests specified, and to prepare test reports: Submit

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information regarding testing laboratory's facilities and qualifications of technical personnel to CO for approval.

- B. Conduct field check test for water leakage on designated wall areas after erection to comply with MCWM-1. Conduct test on two wall areas, two bays wide by two stories high where directed. Conduct test and take necessary remedial action as directed by CO.
- C. Test Specimen:
 - 1. Test specimen shall include curtain wall assembly and construction. Test chamber shall be affixed to exterior side of test specimen and test shall be conducted using positive static air pressure.
 - 2. Test specimens shall be selected by CO after curtain wall system has been installed in accordance with contract drawings and specification.
- D. Sealant Adhesion Tests: Test installed sealant, in presence of sealant manufacturer's field representative, in a minimum of two areas and as follows:
 - 1. Test structural silicone sealant according to field adhesion test method described in AAMA CW 13, "Structural Sealant Glazing Systems (A Design Guide)." 2. Test weatherseal sealant as recommended in writing by sealant manufacturer.
- E. Air Infiltration: Test glazed aluminum curtain wall system according to AAMA 503, which requires testing according to ASTM E783.
 - 1. Field air leakage testing is not required for continuous curtain wall systems.
 - 2. Static-Air-Pressure Differential: 75 Pa (1.57 lbf/sq. ft.) minimum.
 - 3. Air Leakage: 0.03 L/s per sq. m (0.06 cfm/sq. ft.) of surface maximum.
- F. Water Penetration: Test glazed aluminum curtain wall system for compliance with requirements according to AAMA 503, which requires testing according to ASTM E1105.
 - 1. Uniform Static-Air-Pressure Difference: 20 percent of positive design wind load, but not less than 479 Pa (10 psf). No uncontrolled water shall be present.
- G. Retesting:
 - 1. Should system fail field test, system may be modified or repaired, and retested.
 - 2. Should system fail second field test, system may be additionally modified or repaired, and retested.
 - 3. All modifications and repairs made to tested areas shall be recorded, and same modifications and repairs made to all system and adjacent construction on project.

4. Should second test fail, CO may require testing of additional areas of the curtain wall.

H. Rejection:

1. Failure of any of specimens to meet test requirements of third test shall be cause for rejection of wall system and adjacent construction on project.

3.6 PROTECTION

A. After installation, protect windows, and other exposed surfaces from disfiguration, contamination, contact with harmful materials, and from other construction hazards that will interfere with their operation, or damage their appearance or finish. Protection methods shall be in accordance with recommendations of product manufacturers or of respective trade association. Remove paper or tape factory applied protection immediately after installation. Clean surfaces of mortar, plaster, paint, smears of sealants, and other foreign matter to present neat appearance and prevent fouling of operation. In addition, wash with a stiff fiber brush, soap and water, and thoroughly rinse. Where surfaces become stained or discolored, clean or restore finish in accordance with recommendations of product manufacturer or respective trade association.

- - - END - - -

SECTION 08 80 00
GLAZING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies glass, plastic, related glazing materials and accessories. Glazing products specified apply to factory or field glazed items.
- B. Provide 1/4" tinted glass at all locations where 1" insulated tinted glass with Low-E coating is specified if Bid Item 5 (Deduct) is accepted.**

1.2 RELATED WORK

- A. Factory glazed by manufacturer in following units:
 - 1. Section 08 44 13, GLAZED ALUMINUM CURTAIN WALLS.

1.3 LABELS

- A. Temporary labels:
 - 1. Provide temporary label on each light of glass identifying manufacturer or brand and glass type, quality and nominal thickness.
 - 2. Label in accordance with NFRC (National Fenestration Rating Council) label requirements.
 - 3. Temporary labels shall remain intact until glass is approved by COR.
- B. Permanent labels:
 - 1. Locate in corner for each pane.
 - 2. Label in accordance with ANSI Z97.1 and SGCC (Safety Glass Certification Council) label requirements.
 - a. Tempered glass.
 - b. Laminated glass or have certificate for panes without permanent label.
 - c. Organic coated glass.

1.4 PERFORMANCE REQUIREMENTS

- A. Building Enclosure Vapor Retarder and Air Barrier:
 - 1. Utilize the inner pane of multiple pane sealed units for the continuity of the air barrier and vapor retarder seal.
 - 2. Maintain a continuous air barrier and vapor retarder throughout the glazed assembly from glass pane to heel bead of glazing sealant.
- B. Glass Thickness:

1. Select thickness of exterior glass to withstand dead loads and wind loads acting normal to plane of glass at design pressures calculated in accordance with ASCE 7 (with local amendments as required).
2. Test in accordance with ASTM E 1300.
3. Thicknesses listed are minimum. Coordinate thicknesses with framing system manufacturers.

1.5 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Certificates:
 1. Certificates stating that wire glass, meets requirements for safety glazing material as specified in ANSI Z97.1.
 2. Certificate on shading coefficient.
 3. Certificate on "R" value when value is specified.
- C. Warranty: Submit written guaranty, conforming to General Condition requirements, and to "Warranty of Construction" Article in this Section.
- D. Manufacturer's Literature and Data:
 1. Glass, each kind required.
 2. Insulating glass units.
 3. Glazing cushion.
 4. Sealing compound.
- E. Samples:
 1. Size: 150 mm by 150 mm (6 inches by 6 inches).
 2. Tinted glass.
- F. Preconstruction Adhesion and Compatibility Test Report: Submit glazing sealant manufacturer's test report indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Schedule delivery to coincide with glazing schedules so minimum handling of crates is required. Do not open crates except as required for inspection for shipping damage.
- B. Storage: Store cases according to printed instructions on case, in areas least subject to traffic or falling objects. Keep storage area clean and dry.

- C. Handling: Unpack cases following printed instructions on case. Stack individual windows on edge leaned slightly against upright supports with separators between each.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Field measure openings before ordering tempered glass products. Be responsible for proper fit of field measured products.

1.8 WARRANTY

- A. Construction Warranty: Installer shall warranty their installation of Sealed Glazing Units for a period of one (1) year from date of installation and final acceptance by the Government in accordance with the FAR clause 52.246-21, "Warranty of Construction".
- B. Manufacturer Warranty: Provide warranty against seal failure of sealed glazing units, interpane dusting or misting, and replacement of same, for a minimum of ten (10) years from the date of installation and final acceptance by the Government. Submit manufacturer warranty during the submittal process.

1.9 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American National Standards Institute (ANSI):
 - Z97.1-09.....Safety Glazing Material Used in Building - Safety Performance Specifications and Methods of Test.
- C. American Society for Testing and Materials (ASTM):
 - C542-05.....Lock-Strip Gaskets
 - C716-06.....Installing Lock-Strip Gaskets and Infill Glazing Materials.
 - C794-10.....Adhesion-in-Peel of Elastomeric Joint Sealants
 - C864-05.....Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
 - C920-11.....Elastomeric Joint Sealants
 - C964-07.....Standard Guide for Lock-Strip Gasket Glazing
 - C1036-06.....Flat Glass
 - C1048-12.....Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.

- C1376-10.....Pyrolytic and Vacuum Deposition Coatings on Flat Glass
- E84-10.....Surface Burning Characteristics of Building Materials
- E119-10.....Standard Test Methods for Fire Test of Building Construction and Material
- E2190-10.....Insulating Glass Unit
- D. Code of Federal Regulations (CFR):
 - 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; 2010
- E. National Fenestration Rating Council (NFRC)
- F. Safety Glazing Certification Council (SGCC) 2012:
Certified Products Directory (Issued Semi-Annually).
- G. Underwriters Laboratories, Inc. (UL):
- H. Glass Association of North America (GANA):
Glazing Manual (Latest Edition)
Sealant Manual (2009)
- I. American Society of Civil Engineers (ASCE):
ASCE 7-10.....Wind Load Provisions

PART 2 - PRODUCT

2.1 GLASS

- A. Use thickness stated unless specified otherwise in assemblies.
- B. Clear Glass:
 - 1. ASTM C1036, Type I, Class 1, Quality q3.
 - 2. Thickness, 6 mm (1/4 inch) unless as indicated otherwise.
 - 3. Coordinate color/tint/coating to accommodate required security monitoring.
- C. Tinted Heat reflective and low emissivity coated glass:
 - 1. ASTM C1036, Type I, Class 2, Quality q3.
 - 2. Color: Gray (match existing glass tint found at Medical Center facility).
 - 3. Thickness, 6 mm (1/4 inch) unless as indicated otherwise.

2.2 HEAT-TREATED GLASS

- A. Clear Tempered Glass:
 - 1. ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality q3.
 - 2. Thickness, 6 mm (1/4 inch) unless as indicated otherwise.
- B. Tinted Tempered Glass.
 - 1. ASTM C1048, Kind FT, Condition A, Type I, Class 2, Quality q3.
 - 2. Color: Gray (match existing glass tint found at Medical Center facility).

GLAZING

3. Thickness, 6 mm (1/4 inch) unless as indicated otherwise.

2.3 COATED GLASS

A. Spandrel Glass:

1. ASTM C1048, Kind HS, Condition B, Type I.
2. Thickness, 6 mm (1/4 inch) unless as indicated otherwise.

B. Low-E Tempered Glass:

1. ASTM C1048, Kind FT, Condition C, Type I, Class 1, Quality q3 with low emissivity pyrolytic coating having an E of 0.15.
2. Apply coating to secondsurface of insulating glass units.
3. Thickness, 6 mm (1/4 inch) unless as indicated otherwise.

2.4 INSULATING GLASS UNITS

- #### A. Provide factory fabricated, hermetically sealed glass unit consisting of two panes of glass separated by a dehydrated air space and comply with ASTM E2190.

B. Sealed Edge Units (SEU):

1. Insulating Glass Unit Makeup

a. Outboard Lite

1. Glass type: Tinted.
2. Glass Tint: Gray (match existing glass tint found at Medical Center facility).
3. Nominal Thickness: 1/4"
4. Glass Strength: (Annealed or Tempered)
5. Coating Orientation: (Surface #2)

b. Spacer

1. Nominal Thickness:
2. Gas Fill: (Air)

c. Inboard Lite

1. Glass Type:
2. Glass Tint: Clear
3. Nominal Thickness: 1/4"
4. Glass Strength: (Annealed or Tempered)
5. Coating Orientation: (N/A)

2. Performance Characteristics (Center of Glass)

- a. Visible Transmittance: 35%
- b. Visible Reflectance: 6%
- c. Winter U-factor (U-value): 0.29
- d. Shading Coefficient (SC): 0.29
- e. Solar heat Gain Coefficient (SHGC): 0.25

3. Glass shall be annealed or tempered as required by codes, or as required to meet thermal stress and wind loads.
4. Glass heat-treated by horizontal (roller hearth) process with inherent roller wave distortion parallel to the bottom edge of the glass as installed when specified.

2.05 GLAZING ACCESSORIES

- A. As required to supplement the accessories provided with the items to be glazed and to provide a complete installation. Ferrous metal accessories exposed in the finished work shall have a finish that will not corrode or stain while in service.
- B. Setting Blocks: ASTM C864:
 1. Channel shape; having 6 mm (1/4 inch) internal depth.
 2. Shore a hardness of 80 to 90 Durometer.
 3. Block lengths: 50 mm (two inches) except 100 to 150 mm (four to six inches) for insulating glass.
 4. Block width: Approximately 1.6 mm (1/16 inch) less than the full width of the rabbet.
 5. Block thickness: Minimum 4.8 mm (3/16 inch). Thickness sized for rabbet depth as required.
- C. Spacers: ASTM C864:
 1. Channel shape having a 6 mm (1/4 inch) internal depth.
 2. Flanges not less 2.4 mm (3/32 inch) thick and web 3 mm (1/8 inch) thick.
 3. Lengths: One to 25 to 76 mm (one to three inches).
 4. Shore a hardness of 40 to 50 Durometer.
- D. Sealing Tapes:
 1. Semi-solid polymeric based material exhibiting pressure-sensitive adhesion and withstanding exposure to sunlight, moisture, heat, cold, and aging.
 2. Shape, size and degree of softness and strength suitable for use in glazing application to prevent water infiltration.
- E. Glazing Points (Sprigs): Pure zinc stock, thin, flat, triangular or diamond shaped pieces, 6 mm (1/4 inch) minimum size.
- F. Glazing Gaskets: ASTM C864:
 1. Firm dense wedge shape for locking in sash.
 2. Soft, closed cell with locking key for sash key.
 3. Flanges may terminate above the glazing-beads or terminate flush with top of beads.

- G. Lock-Strip Glazing Gaskets: ASTM C542, shape, size, and mounting as indicated.
- H. Glazing Sealants: ASTM C920, silicone neutral cure:
 - 1. Type S.
 - 2. Class 25
 - 3. Grade NS.
 - 4. Shore A hardness of 25 to 30 Durometer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 - 1. Examine openings for glass and glazing units; determine they are proper size; plumb; square; and level before installation is started.
 - 2. Verify that glazing openings conform with details, dimensions and tolerances indicated on manufacturer's approved shop drawings.
- B. Advise Contractor of conditions which may adversely affect glass and glazing unit installation, prior to commencement of installation: Do not proceed with installation until unsatisfactory conditions have been corrected.
- C. Verify that wash down of adjacent masonry is completed prior to erection of glass and glazing units to prevent damage to glass and glazing units by cleaning materials.

3.2 PREPARATION

- A. For sealant glazing, prepare glazing surfaces in accordance with GANA-02 Sealant Manual.
- B. Determine glazing unit size and edge clearances by measuring the actual unit to receive the glazing.
- C. Shop fabricate and cut glass with smooth, straight edges of full size required by openings to provide GANA recommended edge clearances.
- D. Verify that components used are compatible.
- E. Clean and dry glazing surfaces.
- F. Prime surfaces scheduled to receive sealants, as determined by preconstruction sealant-substrate testing.

3.3 INSTALLATION - GENERAL

- A. Install in accordance with GANA-01 Glazing Manual and GANA-02 Sealant Manual unless specified otherwise.

- B. Glaze in accordance with recommendations of glazing and framing manufacturers, and as required to meet the Performance Test Requirements specified in other applicable sections of specifications.
- C. Set glazing without bending, twisting, or forcing of units.
- D. Do not allow glass to rest on or contact any framing member.
- E. Glaze doors and operable sash, in a securely fixed or closed and locked position, until sealant, glazing compound, or putty has thoroughly set.
- F. Tempered Glass: Install with roller distortions in horizontal position unless otherwise directed.
- G. Insulating Glass Units:
 - 1. Glaze in compliance with glass manufacturer's written instructions.
 - 2. When glazing gaskets are used, they shall be of sufficient size and depth to cover glass seal or metal channel frame completely.
 - 3. Do not use putty or glazing compounds.
 - 4. Do not grind, nip, cut, or otherwise alter edges and corners of fused glass units after shipping from factory.
 - 5. Install with tape or gunnable sealant in wood sash.

3.4 INSTALLATION - DRY METHOD (TAPE AND GASKET SPLINE GLAZING)

- A. Cut glazing tape or spline to length; install on glazing pane. Seal corners by butting and sealing junctions with butyl sealant.
- B. Place setting blocks at 1/4 points with edge block no more than 150 mm (6 inches) from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
- D. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Trim protruding tape edge.

3.5 INSTALLATION - INTERIOR WET METHOD (COMPOUND AND COMPOUND)

- A. Install glazing resting on setting blocks. Install applied stop and center pane by use of spacer shims at 600 mm (24 inch) centers, kept 6 mm (1/4 inch) below sight line.
- B. Locate and secure glazing pane using glazers' clips or spring wire clips.
- C. Fill gaps between glazing and stops with glazing compound until flush with sight line. Tool surface to straight line.

3.6 REPLACEMENT AND CLEANING

- A. Clean new glass surfaces removing temporary labels, paint spots, and defacement after approval by COR.
- B. Replace cracked, broken, and imperfect glass, or glass which has been installed improperly.
- C. Leave glass, putty, and other setting material in clean, whole, and acceptable condition.

3.7 PROTECTION

- A. Protect finished surfaces from damage during erection, and after completion of work. Strippable plastic coatings on colored anodized finish are not acceptable.

3.8 GLAZING SCHEDULE

- A. Tempered Glass:
 - 1. Use SEU Low-E tinted tempered in exterior pane and clear tempered glass in interior pane in and curtain wall - reference drawings for locations.
- B. Clear Glass:
 - 1. Interior pane of dual glazed windows not receiving tempered, laminated or organic coated glass, or other special glass indicated or specified.
- C. Tinted Glass: Exterior pane of dual glazed windows not receiving tinted tempered glass.
- D. Insulating Glass:
 - 1. Install SEU tinted glass (annealed or tempered) and clear glass (annealed or tempered) in curtain wall as required per glass manufacturer and/or fabricator. Reference drawings for safety glazing locations.

- - - E N D - - -

SECTION 10 14 00
SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes following types of signs:
1. Reflective vehicular directional and information signs (V-Signs).
 2. Retroreflective regulatory signs (R- Signs).
 3. Non-reflective pedestrian directional and informational signs (PP- Signs).
 4. PVC Pipe Clearance Signs (PVC- Signs).
 5. Dimensional Characters (D- Signs)
 6. Brailled ADA Compliant Identification Signs (A-Signs).
 7. Internally-Illuminated Signs (I- Signs).
- B. Related Sections include following:
1. Division 01 Section "Temporary Facilities & Controls" for temporary project identification signs.
 2. Division 09 Sections "Exterior Painting" or "Interior Painting" for painting by others of surfaces to which signs specified herein may be applied. Painting of signs is included in this Section.
 3. Division 11 for occupancy counting systems which interface with Internally-Illuminated signs.
 4. Division 14 Section "Elevators" for elevator door jamb markings and "In Case of Fire..." signage.
 5. Division 23 Section "Common Work Results for HVAC" for labels, tags, and nameplates for mechanical equipment.
 6. Division 26 Section "Common Work Results for Electrical Transmissions, Lighting, and Control Devices" for labels, tags, and nameplates for electrical equipment. (Room destination signage is included herein.)
 7. Division 26 Section "Interior Lighting" for illuminated exit signs.
 8. See Division 26 Sections for electrical service and connections for electrified and/or illuminated signs and/or letters.

1.3 SUBMITTALS

- A. General: Submit following in accordance with Conditions of Contract and Division 01 Specification Sections.
- B. Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.
- C. Shop Drawings: Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, mounting heights, anchors, grounds, reinforcement, accessories, layout, spacing, dimensions and installation details.
 - 1. Provide message list, typestyles, graphic elements, including tactile characters and Braille and artwork as shown on drawings, and layout of lettering. Include large scale details of sign layout.
 - 2. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.
 - 3. Wiring Diagrams from manufacturer of electrified signs for power, signal and control wiring.
- D. Samples: Provide following samples of each sign component for verification of compliance with requirements indicated.
 - 1. Samples of each sign material type (V-, R-, PP-, VR-, etc), on not less than 6-in. squares of extrusion, sheet or plate, showing full range of colors to be provided.
 - 2. Dimensional characters and castings: Full size sample showing character, material, texture, finish, color, style and attachment method.
 - 3. Brailled Copy: Sample of ADA compliant sign showing raised image text, brailled copy and colors.
- E. Maintenance Data: For signage cleaning and maintenance requirements to be included in maintenance manual.

1.4 QUALITY ASSURANCE

- A. Where warranties are required, manufacturer and/or installers shall be authorized by the entity providing the warranty.
- B. All completed signs shall be free from defects in materials and workmanship and effectively present specified or permitted message under both day and night viewing conditions. Sign faces shall be reasonably smooth, shall exhibit uniform color and brightness over entire background surface and shall not appear mottled, streaked, or stained when viewed either in ordinary daylight or incidental beams of automobile headlamps.
- C. Support structures for signs that are free-standing or extending from any exterior surface of the building, including but not limited to the

roof level parking signs on cantilever supports, shall be designed by a licensed professional engineer in the State of Missouri in accordance with ASCE 7-10's requirements for wind loads.

- D. Internally illuminated or electrified sign cases (I): Housing shall be waterproof and shall comply with NEMA Standards Publication 250-Enclosures for Electrical Equipment, for Type 4 enclosures.
- E. Electrical Components, Devices and Accessories: All components shall be listed and labeled by UL and shall comply with NEMA and NFPA standards.
- F. Electrical Service: Sign contractor shall review electrical drawings and coordinate with electrical contractor for any minor changes to design and installation of equipment and/or electrical service for powering signs and/or illumination thereof. If change order(s) are possible, use the Request for Information process.
- G. Electrical Service: Sign contractor shall be responsible for design and installation of all electrical equipment for powering signs, and for design and installation of necessary electrical service from panel boards to signs.
- H. Regulatory Requirements:
 - 1. Comply with Americans with Disabilities Act (ADA) and state and local codes as adopted by authorities having jurisdiction. Signs affected, may include, but not be limited to:
 - a. Illuminated Exit Signs: Refer to Division 26.
 - b. Permanently Designated Rooms and Spaces: A- Signs.
 - c. Standpipe location.
 - d. Fire Extinguisher location
 - e. Elevator Signs.
 - f. Stairway Identification.
 - 2. MUTCD:
 - a. Regulatory R- signs shall be fully compliant with all requirements of the Manual on Uniform Traffic Control Devices (MUTCD) except that sign size may be modified due to space constraints.
- I. Single-Source Responsibility: For each separate required type of sign as defined herein, obtain signs from a single firm specializing in this type of work so that there will be undivided responsibility for such work.
- J. Design Criteria: Drawings indicate sizes, profiles, and dimensional requirements of signs. Other signs with deviations from indicated dimensions and profiles may be considered, provided deviations do not change design concept. Burden of proof of equality is on proposer.
- K. Coordinate sign placement with structural configuration and lighting location. Before sign installation, arrange meeting with

Engineer/Architect and lighting installer at site to review sign placement. Additional compensation not allowed for relocating signs after installation if relocation required due to conflicts with lighting or structure.

- L. Trade Names: Do not display manufacturer's name, trade name, trademarks, or similar markings on exterior or visible surfaces.
- M. Sign Quantity Count: Sign Fabricator shall be responsible for determining the final quantity count of all signs, as indicated on the Signage Schedule and Location Plans, prior to fabrication.
- N. Provide written 5 year full replacement manufacturer warranty to Owner that all signage will be free of material defects including, but not limited to, fading, peeling, and delamination. Provide written 1 year full replacement warranty to Owner that all signage will be free of defects due to installation. With no additional cost to Owner, repair all defects that develop during warranty period and all damage to other Work due to such defects. NOTE: Additional warranties apply to specific sign types and products, as specified herein.
- O. Finishes Warranty: Submit five-year written warranty, signed by the Contractor and Manufacturer, warranting that the architectural signage finishes will not develop excessive fading or excessive non-uniformity of color or shade and will not crack, peel, pit or corrode or otherwise fail as a result in defects, within the warranty period. Make necessary repairs or replacement at the convenience of the owner or facility's management.
 - 1. "Excessive Fading": A change in appearance which is perceptible and objectionable as determined by the Designer when visually compared with the original color range standards.
 - 2. "Excessive Non-Uniformity": Non-Uniform fading during the period of the guarantee, to the extent that adjacent panels have a color difference greater than the original acceptance range of color.
 - 3. "Will Not Pit or Otherwise Corrode": No Pitting or other type of corrosion discernible from a distance of 10'-0", resulting from the natural elements in the atmosphere at the project site.
- P. Replacement or Repairs: The owner or facilities management shall have the right to continue use of the defective part until such time that the part is replaced or repaired without loss or inconvenience to the owner or facility's management. Warranties shall also state that the replaced or repaired part shall have a warranty period equal to the remaining warranty period for the replaced or repaired part plus an additional one year.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting and mounting. Where sizes of signs may be affected by dimensions of surfaces on which they are installed, verify dimensions by field measurement. Show

recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

1.6 COORDINATION

- A. For signs to be supported by or anchored to permanent construction, provide installers with specific requirements for anchorage devices. Furnish templates for installation.
- B. Coordinate location of remote transformers with building construction. Ensure that transformers are accessible after completion of Work.

1.7 MAINTENANCE

- A. Maintenance Instruction: Furnish maintenance manual to instruct the owner or facility's management personnel in procedures to be followed in cleaning and maintaining the signage. Provide manufacturer's brochures describing the actual materials used in the Work, including metal alloys and finishes.
 - 1. Include a list of cleaning materials appropriate for continued cleaning of signs. Include written instructions for proper maintenance, service access, replacement procedures, etc. Include recommended methods for removal of residual adhesives from wall surfaces after removal of adhesive mounted signs.
- B. Extra Materials: Deliver to the owner or facility's management in manufacturer's original packaging and store at the project site where directed.
 - 1. Furnish one quart of each finish paint color for touch-up purposes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Product: Where named products are specified, subject to compliance with requirements specific to this project, provide either named product or an equivalent product by other manufacturers specified.
- B. Manufacturers: Subject to compliance with requirements specific to this project, accepted manufacturers listed in Part 2 are considered to have been prequalified in conformance with paragraph 1.4.A and B of this section. Acceptable manufacturers include, but are not limited to the following:
 - 1. Manufacturers of panel signs, including V-,R-, PP-,VR- and, D-signs:

- a. ABC Architectural Signing System, Division of Nelson-Harkins Industries.
 - b. Alcan Composites, Benton, KY.
 - c. Allenite, A Division of Allen Marking Products, Inc.
 - d. Andco Industries Corp.
 - e. APCO Graphics, Inc.
 - f. Architectural Graphics, Inc.
 - g. ASI Sign Systems, Inc.
 - h. Best Manufacturing Co.
 - i. Interstate Highway Sign Corp.
 - j. Henry Graphics.
 - k. Jarob Design, Inc.
 - l. Pannier Graphics.
 - m. Tapco.
 - n. Vomar.
2. Manufacturers of Brailled Signs (A-):
 - a. Supersine Company.
 - b. Jet Signs.
 3. Manufacturers of I- signs:
 - a. Andco Industries Corp.
 - b. ASI Sign Systems, Inc.
 - c. Interstate Highway Sign Company.
 - d. Vomar.
 4. Manufacturers of "VA" Logo Appliqué in Frosted Vinyl:
 - a. Products by 3M; or "Tru-Etch" by Universal Products; or product #8510 or #8810 by Oracal.
 - b. Apply to first surface of glazing.
 - c. Reference drawings for installation locations.
 - d. **Omitted per BID ITEM 11 (DEDUCT). Reference 01 00 00, GENERAL REQUIREMENTS.**

2.2 MATERIALS

A. Graphics:

1. Graphics shall be highest quality with sharp lines and smooth curves. Images shall be uniform colors and free from streaks or spotting.
2. Content and Style: Provide sign copy that complies with requirements indicated for size, style, spacing, content, position, material, finishes, and colors of letters, numbers, and other graphic devices. Notations contained within the comments section of the sign schedule indicate additional text required on sign such as street name, etc. Notations contained within parenthesis () in the sign schedule and instructions for logos or symbols that are to be included on the sign, as shown on the

design drawings. Refer to the sign schedule for copy, description of signs, and reference to sign types.

3. Silk screening: Where specified or permitted, silk screening shall be highest quality, with sharp lines, no sawtooths, or uneven ink coverage.
 - a. Screens shall be photographically reproduced.
 - b. Background ink shall be process inks as recommended by manufacturer of substrate employed.
 - c. Ink application through screens: 1 flood pass and 1 print pass. Images: uniform color and ink thickness; free from squeegee marks and lines.
 - d. Signs: dry in adequate racks with 2 in. spacing for ample air flow and forced air drying and curing.
 - e. Package signs only after they have dried completely per ink manufacturer's time allowances.
 - f. Where reflective messages are specified or permitted to be reverse silk-screened with a non-reflective, opaque background, the sheeting material shall be 3M Scotchlite Engineer Grade Reflective Sheeting Series 3200 or equivalent meeting US Department of Transportation Standard Specification for Construction of Roads and Bridges on Federal Highway Products, 1985 FP-85, Type II, Section 718.01.
 - g. Where reflective messages are specified or permitted to be reverse silk-screened with a reflective, transparent background, the sheeting material shall be 3M Scotchlite High Intensity Grade Sheeting Series 3930 or equivalent meeting US Department of Transportation Standard Specification for Construction of Roads and Bridges on Federal Highway Products, 1985 FP-85, Type IIIA, Section 718.01.
4. Pressure applied graphics:
 - a. Where pressure-applied graphics applied to a painted background are specified or permitted, the paint shall be flat, opaque acrylic polyurethane as recommended by manufacturer of substrate and graphic media.
 - b. Where pressure-applied, reflective graphics on an opaque painted background are specified or permitted, letters shall be digitally produced, and cut by electronic cutting machines from 3M Scotchlite Electrocut Engineer Grade Sheeting Series 3260 material, colors as noted on drawings or equivalent. Edges shall be sealed per manufacturer recommendation.
 - c. Where pressure-applied, reflective graphics on a reflective background are specified or permitted, the sheeting material shall be 3930 Hi Intensity Prismatic or equivalent meeting US Department of Transportation Standard Specification for Construction of Roads and Bridges on Federal Highway Products, 1985 FP-85, Type IIIA, Section 718.01. The letters shall be digitally produced, and cut by electronic cutting machines from 3M Scotchlite Electronic Cuttable Film Series 1170, colors as noted on drawings or equivalent.
 - d. Where pressure-applied, non-reflective graphics are specified, letters shall be digitally produced, and cut by

- computer-driven processes from 3M Scotchcal Electrocut 7725 film.
- e. Where electronically cut letters and symbols are specified, the inside corners shall be rounded using the largest radius consistent with acceptable appearance. Minimum radius shall be 1/8 inch on a 3 inch letter. Use prespacing tape as recommended by manufacturer of sheeting as a carrier for letters, numerals and symbols.
5. Digital Imaging: Where digital imaging for original art and multicolored graphics are specified.
 - a. Where first surface, reflective graphics are specified, the image shall be electronically produced and electrostatically printed onto the transfer media and then heat transferred onto 3M Scotchlite Plus Sheeting Series 680 using IJ680-10 technology. Image to be protected with 3M recommended graphic protective clear coating. Not to be used for regulatory signs.
 - b. Where first surface non-reflective graphics are required, the image shall be electronically produced and electrostatically printed onto the transfer media and then heat transferred onto 3M Scotchprint flexible reflective graphic film IJ180-10 technology. Image to be protected with 3M recommended graphic protective clear coating.
 - c. Where second surface, non-reflective graphics are required, the image shall be produced using 3M Scotchprint Electronic Graphics System using Scotchcal 7725 marking film and lamination.
 6. Where specified, dry film transfer shall be produced digitally using computer-driven Dry Thermal Transfer system over 3M high intensity reflective vinyl substrates.
 7. All products specified to employ 3M sheeting, films, or other components shall be guaranteed and backed by 3M MCS Warranty or equivalent.
- B. Inks and Paints:
1. All inks and paints shall be a type made for surface material to which it is applied, and recommended by manufacturer. Exact identification shall be noted on shop drawings, with data describing application method, if other than air-drying. Prohibited: paint or ink that will fade, discolor, or delaminate due to UV or heat exposure.
 2. All colors for which color match specified shall be approved by Engineer/Architect prior to production.
 3. Acceptable manufacturers and suppliers of inks for silk-screening shall be only those materials recommended by the manufacturer of the sheeting and as required for 3M MCS warranty, or equivalent, where applicable.
 4. Paints: all materials best quality. Products of DuPont DeNemours & Company, Pittsburgh Plate Glass Company, Glidden, Matthews or Sherwin-Williams acceptable.

- a. Opaque background for pressure applied graphics: Two part acrylic polyurethane, low gloss. Care shall be taken to provide proper curing so that outgassing does not occur after application of sheeting and/or graphics.
 - b. Painted finish on Sintra panels: Types of paints known compatible with Sintra material.
 - 1) Vinyls
 - 2) Acrylic Lacquers
 - 3) Two part polyurethanes
 - 4) Surface preparation:
 - a) Surface to be painted must remain dry, clean and grease free.
 - b) Surface to be cleaned with a rag moistened with isopropyl alcohol prior to painting.
 - 5) Apply with a brush, roller or conventional air spray equipment.
 - 6) Vinyl and Vinyl/acrylic solvent based Screen printing inks are very compatible.
 - c. Painted graphics on steel doors: Refer to Painting specification section 09910.3.6.C. Ferrous metal paint selection for door base. Graphics paint to be compatible with base paint.
 - d. Base for painted graphics on concrete, stucco, masonry and concrete masonry units to be prepared per Paint specifications. Graphics two part acrylic polyurethane, low gloss.
 - e. High gloss enamel base: Graphics medium to be determined by installer. Primer may be required.
5. Applied color whether ink or paint shall conform to color and accelerated weathering requirements of FP-79 and shall not be removable when tested by Film Adhesion Test and by Film Hardness Test.
- C. Blank Panels: Comply with requirements indicated for materials, thickness, finish, color, design, shape, size, and details of construction.
1. General:
 - a. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 0.0625 in. measured diagonally.
 - b. The back side and edges of all panel signs shall be painted with acrylic polyurethane, color to match the specified background color.
 - c. Edge Condition: Square cut.
 - d. Corner Condition: Square cut for all signs except Regulatory and Warning signs. Regulatory and Warning sign corners shall be rounded per MUTCD.

2. Fiberglass reinforced plastic (FRP) panels.
 - a. Panels shall be manufactured of clear resin or UV stabilized, acrylic-modified polyester resin reinforced with high solubility, chopped strand fiberglass mat. Glass fibers shall not be readily discernable on sign face. In addition sign shall have a glass content of no less than 28% of total sign weight. FRP panels which outgas and cause bubbling of sheeting will not be accepted. Sign shall meet following:
 - 1) Ambient temperature range of -50° F to +300° F.
 - 2) Minimum Barcol hardness of 50, tensile strength of 12,000 psi, compressive strength of 20000 psi and flexural strength of 18000 psi.
 - 3) Minimum impact strength of 6 ft lbs/in notch with fire resistance of 500 degree F.
3. Aluminum:
 - a. Provide aluminum sheet of 6061-T6 or 5052-H38 alloys and temper recommended by aluminum producer or finisher for use type and finish indicated, and with not less than strength and durability properties specified in ASTM B209 for 5005-H15.
 - b. Aluminum extrusions shall be of alloy and temper recommended by aluminum producer for type of use and finish and with not less than strength and durability properties specified in ASTM B221 for 6063-T5.
 - c. Panels shall be etched, degreased, flat, and free of ragged edges. Radius corners by stamping. All signs of same size shall be totally uniform in size. Surface shall be completely clear of dust and dirt before finishes applied.
 - d. Panels to receive 3M sheeting and/or paint shall be treated with an anodizing conversion coating to provide resistance to corrosion and white rust formation. Conversion coating may be:
 - 1) Chromate, meeting ASTM B449 class 2. Coating weight should be 10 to 35 mg per sq ft with a median of 25 mg per square foot. Coating shall not be dusty and shall be tightly bonded within itself and to the aluminum substrate.
 - 2) Non-chromate coatings must meet the requirements for ASTM B449 class 1 chromate coatings. The non-chrome coating shall be adherent and non-powdery. Adhesion of air dried acrylic coating shall meet ASTM D 3359 or ASTM D 4541 and must be equivalent to that of the coating on chromate coated aluminum of the same alloy.
 - e. Fabricate aluminum signs with adequately sized, full-length stiffener members as indicated on Drawings.
4. DiBond (T.M.); or approved equal.

- a. Provide aluminum composite panel, one or both sides platinum white stove-lacquered or one side metallic-aluminum, reverse mill finish.
 - 1) Outer layers are aluminum, inner core is polyethylene.
 - b. Provide sign panels with overall thickness in accordance with the following:
 - 1) Wall or Column surface mounted signs: 2mm (0.079").
 - 2) Overhead signs less than 5'-0" long: 3 mm (0.12").
 - 3) Overhead signs greater than 5'-0" long: 4mm (0.16").
 - c. Product shall be compatible with temperature ranges varying from -50°C to +80°C.
 - d. Product shall have a minimum modulus of elasticity of 70,000 N/mm².
 - e. Product shall have water absorption in % according to Din 53 495-0, 01.
 - f. Product shall have linear thermal expansion dimensional change of 2.4 mm/m at 100k temperature difference.
 - g. Manufacturer/Supplier - Alcan Composites USA, Inc.
 - 208 W. 5th Street
 - P.O. Box 507
 - Benton, KY 42025
5. Sintra (T.M.); or approved equal.
- a. Provide a foamed, closed cell polyvinyl chloride (PVC) product.
 - b. Provide sign panels in accordance with the following thicknesses:
 - 1) Wall or column surface mounted signs: min. 6mm (0.236").
 - 2) Overhead signs less than 5'-6" long: min. 13mm (0.512").
 - 3) Overhead signs greater than 5'-6" long min 19mm (0.748").
 - c. Foamed PVC panels are NOT to be used in areas exposed to direct sunlight.
 - d. Primer and paint used shall be as recommended by the manufacturer. Paint finish shall be an "eggshell" finish.
 - e. Material Identification and Information:

<u>Material</u>	<u>Percent % by Weight</u>
Polyvinyl Chloride	75-85%
Antimony Trioxide	<3.0%
Cadmium Compounds	<1.0%
Lead Compounds	<2.0%
Titanium Dioxide	<5.0%
Calcium Carbonate	<5.0%
Other	5-10%

Melting Point >350 degrees F.

- f. Manufacturer/Supplier- Alcan Composites USA, Inc.,
208 W. 5th Street
P.O. Box 507
Benton, KY 42025,

D. V- Signs: Vehicular signs with reflective graphics and retroreflective message on an opaque background.

1. Base materials:

- a. Aluminum with either reverse silk screened graphics or pressure-applied retroreflective letters.
- b. DiBond with either reverse silk screened graphics or pressure applied retroreflective letters.
- c. Sintra with either reverse silk screened graphics or pressure-applied retroreflective letters.
- d. FRP, but only with painted background and pressure applied retroreflective letters.

2. Background color for all V- Signs, vehicular directional signs, to meet MUTCD standard green, pantone color 342.

3. Graphics and Copy: Any of the following methods of producing graphics and copy may be employed.

- a. Pressure applied retroreflective white letters/symbols. Use 3M High Intensity Prismatic White Sheeting 3930.
- b. Silk screened; background inks shall be opaque, with retroreflective message.

E. R- Regulatory and W- Warning vehicular signs with retroreflective graphics and message on a retroreflective background.

1. All regulatory and warning signs to fully comply with MUTCD standards.

2. Base material: Aluminum.

3. R and W signs shall have retroreflective messages and retroreflective background using either silk screening or pressure applied retroreflective letters and symbols.

4. Retroreflective colors determined by 23 CFR Appendix to Subpart F of Part 655, Alternate Method to Determining the Color of Retroreflective Sign Materials and pavement marking materials.

- a. Federal Highway Authority (FHWA) Reflective Sheeting Identification Guide using ASTM D 4956-04.
- b. Sheeting Types I through IX.
- c. The daytime color of non-fluorescent retroreflective materials may be measured in accordance with ASTM Method E 1349, Standard Test Method for Reflectance Factor and Color by Spectrophotometry using Bi-directional Geometry of ASTM Test Method E 1347. Standard Test Method for Color and Color-Difference Measurement by Tristimulus Colorimetry.

- d. The geometric conditions to be used in both test methods are 0/45 or 45/0 circumferential illumination or viewing. The CIE standard illuminant used in computing the colorimetric coordinates shall be D 65.
- e. For fluorescent retroreflective materials ASTM E991 may be used to determine the chromaticity provided that the D65 illumination meets the requirements for E 991.
- f. The following 3M Diamond Grade DG³ Reflective Sheeting materials meet the MUTCD retroreflective requirements:
 - 1) White - DG³4090
 - 2) Red - DG³ 4092
 - 3) Blue - DG³ 4095
 - 4) Yellow - DG³ 4091
 - 5) Green - DG³ 4097
 - 6) Brown - DG³ 4099
 - 7) Fluorescent Yellow - DG³ 4081
 - 8) Fluorescent Yellow Green - DG³ 4083
 - 9) Fluorescent Orange - DG³ 4084

F. PP- Pedestrian Panel Wayfinding and Directional Signs.

1. Base materials:

- a. Aluminum with either reverse silk screened graphics or pressure-applied letters.
- b. Di-Bond with either reverse silk screened graphics or pressure applied letters.
- c. Sintra with either reverse silk screened graphics or pressure-applied letters.
- d. FRP, but only with painted background and pressure applied letters.

2. Background color for all PP signs, pedestrian directional signs, to meet MUTCD standard blue, pantone color 294.

3. For level designation sign colors refer to the list of MUTCD pantone colors:

a. Pantone Matching Colors and General MUTCD Meanings:

- 1) Brown (469) - Recreational and cultural interest are guidance.
- 2) Green (342) - Indicated movements permitted, directional guidance.
- 3) Blue (294) - Road user services guidance, tourist information, and evacuation route.

Color coding can be used for floor designations except red (187), yellow (116) and orange (52) per MUTCD.

4. Graphics and Copy: Any of the following methods of producing graphics and copy may be employed:

- a. Pressure applied non-reflective letters/symbols.

- b. Silk screened over a flat opaque background.
 - c. Original art and/or multi-color graphics shall be digitally produced on graphic media.
- G. PVC- Signs: PVC pipe clearance signs shall have pressure applied decals on black PVC pipe, rectangular retroreflective yellow base sticker 3M Diamond Grade yellow sheeting DG³ 4091 with black border, rounded corners, and black text. See drawings.
1. Electronically cut letters: 3M Scotchlite 3840 reflective sheeting.
 2. 10 in. diameter, Schedule 40 PVC pipe, Corrosion Fluid Products Corporation, Addison, IL, or accepted equivalent. Color black.
 3. If black PVC is not available, Paint: "Spraylat" Lacryl B No. 482 High Hiding Black. Meet Lacryl system specifications for painting on PVC.
- H. Dimensional Characters (D-Signs):
1. Aluminum Castings: Provide aluminum castings of alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated. Finish shall be color anodic finish, integrally colored or electrolytically deposited color coating, 0.018 mm or thicker in color specified on schedule, with a satin mechanical finish.
 2. Characters shall have smooth flat faces, sharp corners and precisely formed lines and profiles, free from pits scale, sand holes and other defects. Cast lugs into back of characters and tap to receive threaded mounting studs.
- I. A- Signs: All signs required to be brailled in compliance with ADA requirements for designating permanent rooms and spaces shall comply with ADA Accessibility Guidelines (ADAAG) as published by the Architectural and Transportation Barriers Compliance Board and ICC/ANSI A117.1. latest editions.
1. Aluminum:
 - a. Text to be produced with Supersine process die-cut raised letters and brailled copy.
 2. Phenolic-Backed Photopolymer Sheet, "Jet-388 Phenolic Signage" by JetUSA or equivalent. Provide light sensitive, water-wash photopolymer face layer bonded to a phenolic base layer to produce composite sheet with overall thickness of 0.15 inches, and substrate thickness of 0.12 inches and a Type D Shore Durometer hardness of 95.
 3. Lettering and Grade II brailled to be raised 1/32". Lettering to be painted white matte finish. Grade II brailled to be painted out with matte finish background in color shown on drawings. Edges painted same as face.
 4. Produce precisely formed characters with square cut edges free from burrs and cut marks.
 5. Fasteners shall be mechanical, concealed and tamper proof.
- J. Internally Illuminated Signs (I Signs):

1. Sign design, construction fabrication and assembly shall be contractor responsibility, subject to Engineer's review. Fiberglass reinforced plastic (FRP), DiBond or aluminum cabinets are acceptable. Colors shall be as specified on drawings.
2. Aluminum panels, when proposed, to be extruded, anodized aluminum with welded corners and aluminum tube framing as required for straight profiles. Case shall be finished with baked enamel or duranodic in color as shown on the drawings. Illuminated messages, where required, shall be precision cut and filled with translucent material. Illuminated graphics shall be integral and flush with sign face for flat appearance. Raised letters or those projecting beyond sign face will not be accepted.
3. DiBond panels, where proposed shall be assembled into final configurations following the manufacturer's recommendations for cutting, drilling, punching, joining, etc. Acceptable joining materials for connecting panels are aluminum, plastic or stainless steel. All other joining materials are prohibited. DiBond panels may be fastened using threaded fasteners, rivets or adhesives as recommended by the manufacturer. All final assemblies shall accommodate thermal expansion movements as recommended by the manufacturer. The final assembly shall be supported as required by aluminum framework. Illuminated messages, where required, shall be precision cut and filled with translucent material. Illuminated graphics shall be integral and flush with sign face for flat appearance. Raised letters or those projecting beyond sign face will not be accepted.
4. Fiberglass panels, where proposed, shall be 3/16 inches with integral molded side returns mounted to an aluminum casing supported by aluminum framework. Posts to match specified cabinet color. Illuminated message shall be subsurface printed, and integral with sign face. Illuminated single color messages without original art may be translucent. Multi-color messages or signs with original art shall be digitally produced using 3M Electronic Graphics system and Scotchcal marking films. Provide matte UV and vandal resistant overcoat.
5. Non-illuminated messages, where specified, shall employ any of the following methods:
 - a. Pressure applied non-reflective letters/symbols.
 - b. Silk screened.
 - c. Digitally produced graphic media.
6. Full message where shown shall be white **[LED, Fiber Optic]** letters. Full message shall not be readable when turned off. Full message shall be controlled by PARCS system.
7. No buckling, weaving, or oil canning of face panels.
8. Sign mounting shall be as noted as drawings from among following:
 - a. Wall or ceiling mount: Provide mounting channel brackets as required by sign size and location.
 - b. Post mount: Sign to be mounted on aluminum posts at both ends, with base plate bolted to concrete foundation to below local frost depth or a minimum of 1/3 the pole height which ever is greater. Coordinate anchor bolt locations with general contractor.

- c. Concrete pedestal mount. Sign to be mounted on concrete pedestal as detailed on drawings. Coordinate anchor bolt, post sleeves and concealed electrical connections with pedestal contractor.
 - d. Aluminum pedestal mount: Provide aluminum pedestal cover per drawings. Coordinate anchor bolt, post sleeves and concealed electrical connections with pedestal contractor.
9. All fasteners and brackets shall be non-corrosive.
 10. All electrical connections shall be concealed but accessible and serviceable.
 11. Interior of cabinet to be primed and painted white with acrylic polyurethane, high gloss finish.
 12. Illumination shall be designed by contractor. Incandescent light sources will not be accepted. Each sign shall contain terminal board with adequate wiring. Lamps to be spaced to prevent shadows and hot spots. Uneven illumination will be rejected. Ballast shall be appropriate to temperature ranges at project site. Minimum luminance of sign message shall be 10 cd/m² at night and 30 cd/m² during the day.

K. Fasteners and Supports:

1. Bolts, nylon insert lock nuts: ASTM A 320, Grade B stainless steel.
2. Rivets for signs: ASTM B 316, Alloy 6063-T61 or equivalent. Aluminum alloy blind rivets of self-plugging variety may be substituted for solid aluminum alloy rivets, subject to acceptance by Engineer/Architect.
3. Use concealed fasteners fabricated from metals not corrosive to sign material and mounting surface.
4. Anchors and Inserts: Use nonferrous metal or hot dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled in place anchors. Furnish inserts, as required, to be set into concrete or masonry work.
5. Sign posts: ASTM A 499 Grade 60 or ASTM A 576, Grade 1080 and meeting mechanical properties specified in ASTM A 499 for Grade 60 steel.
6. Posts shall be zinc coated per ASTM A 123. Posts shall be straight, with smooth, uniform finish, free from defects affecting strength, durability, or appearance. Punch bolt holes such that post face shall be smooth and even. All holes and ends shall be burr free. After all fabrication, flow coat posts with durable, exterior type, rust inhibiting paint. Paint color: black, unless otherwise indicated on Drawings.
7. Adhesives, where used for wall mounted signs, shall be per the sign material manufacturer's recommendations.
8. For DiBond signs, fasteners and mountings shall follow manufacturer's recommendations. Minimum edge distance of 0.75" or 2.5 times the diameter of the fastener being used is recommended as the distance from the center of the hole to the edge of the panel. Large flat washers shall be used to prevent crushing of the sign material.

L. Cantilever Sign Supports:

1. Pipe for poles and arms: steel pipe, ASTM A53, Grade B, Type E or S.
2. Gusset, flange, and base plates: ASTM A 36.
3. Castings: Free of sharp edges and irregularities. Pole top and end cap castings: ASTM A 126, Class A.
4. Bolts: Connect arm connection flanges with galvanized high strength steel bolts, nuts, and washers per ASTM A 325. Hot dip galvanize fasteners per ASTM A 153. Galvanized nuts shall be tapped oversized per ASTM A 563, and Supplementary requirement S1, "Lubricant and Test for Coated Nuts."
5. Welding: Applicable requirements of Sections of Division 05.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION OF SUBSTRATE FOR PAINTED SIGNS

- A. Prepare and clean in strict accordance with paint manufacturer's instructions and as specified here, for each substrate condition.
- B. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so contaminants from cleaning process will not fall onto wet, newly painted surfaces.
- C. Cementitious Surfaces:
 1. Prepare surfaces to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, and, by roughening as required, glaze.
 2. Determine alkalinity and moisture content of surfaces to be painted by appropriate testing. If surfaces found to be sufficiently alkaline to cause blistering and burring of finish paint, correct before painting. Do not paint on surfaces with moisture content exceeds manufacturer's limits.
- D. Ferrous Metals: Clean uncoated ferrous surfaces of oil, grease, dirt, loose mill scale, and other foreign substances by solvent or mechanical cleaning. Clean previously coated metals in accordance with manufacturer recommendation.

3.2 MATERIALS PREPARATION FOR PAINTED SIGNS

- A. Mix and prepare painting materials per manufacturer's directions.
- B. Store materials not in use in tightly covered containers. Keep all containers clean, free of foreign materials and residue.
- C. Stir materials before applying to produce uniform mixture, and stir as required during application. Do not stir surface film into material. Remove film and strain material before using if necessary.

3.3 INSTALLATION

- A. General: Locate signs where shown using mounting methods of type described and in compliance with manufacturer's instructions. Install sign units level, plumb, and at height shown, with sign surfaces free from appearance defects.
- B. For drilled anchors in concrete, verify location of embedded reinforcing steel, post-tensioning, or pre-stressing cables prior to installation.
- C. Wall Mounted Panel Signs: Attach to wall surfaces with Hilti "Hit" anchors or ITW Ramset/Red Head Hammer Set anchors into concrete or masonry surfaces as shown on Drawings. DO NOT OVERDRIVE anchors, as overdriven anchors will damage sign faces and spall concrete.
- D. Bracket Mounted Units: Provide manufacturer's standard brackets, fittings, and hardware as appropriate for mounting signs which project at right angles from walls or ceilings. Attach brackets securely to walls or ceilings with concealed fasteners and anchors per manufacturer's directions.
- E. Installation of signs shall conform to requirements of Americans with Disabilities Act (ADA) and/or state or local accessibility standards.

3.4 CLEANING AND PROTECTION

- A. At completion of installation, clean soiled sign surfaces in accordance with manufacturer's instructions. Protect units from damage until acceptance by Owner.
- B. Cleanup: During progress of Work, remove from site all discarded materials and rubbish at end of each day.
- C. Upon completion of painting, clean all paint spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.
- D. Protection: Protect work of other trades, whether to be painted or not, against damage by painting and finishing. Correct any damage by cleaning, repairing, or replacing, and repainting, as acceptable to Engineer/Architect.
- E. Provide "Wet Paint" signs as required.

- - - E N D - - -

SECTION 14 21 00
ELECTRIC TRACTION ELEVATORS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section specifies the engineering, furnishing and installation of complete and ready for operation electric traction machine room-less elevator systems described herein and as indicated on the contract drawings. **Note: Elevator cabs P-19 and P-20 are provided and installed per BID ITEM 1 (BASE BID), but only Elevator cab P-19 is provided and installed if BID ITEM 4 (DEDUCT) is accepted (reference 01 00 00, GENERAL REQUIREMENTS). Elevator shaft provided and installed in BID ITEM 1 (BASE BID) shall be sized to accommodate both elevators.**
- B. Items listed in the singular apply to each and every elevator in this specification except where noted.
- C. Passenger Elevators No. P-19 and P-20 shall be overhead gearless traction type; with Variable Voltage Variable Frequency (VVVF) microprocessor based control system with regenerative drive duplex selective collective automatic and power operated single-speed center opening car and hoistway doors. Elevators shall have Class "A" loading. **Please note that a fully glazed back elevator cab panel, provided and installed by elevator manufacturer/supplier, will be required in lieu of conventional back elevator panel construction.**

1.2 RELATED WORK

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES (FAR 52.236-21) and, SPECIAL NOTES (VAAR 852.236-91), in GENERAL CONDITIONS.
- B. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire-rated construction.
- C. SECTION 09 65 16, RESILIENT SHEET FLOORING: Finish material for floor of elevator cabs.D.Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section.
- D. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low Voltage power and lighting wiring.
- E. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

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- F. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for cables and wiring.
- G. Section 26 22 00, LOW-VOLTAGE TRANSFORMERS: Low voltage transformers.
- H. Section 26 24 16, PANELBOARDS: Low voltage panelboards.
- I. Section 26 43 13, SURGE PROTECTIVE DEVICES: Surge suppressors installed in panelboards.
- J. Section 26 51 00, INTERIOR LIGHTING: Fixture and ballast type for interior lighting.
- K. VA Barrier Free Design Handbook (H-18-13)

1.3 QUALIFICATIONS

- A. Approval by the CO is required for products and services of proposed manufacturers, suppliers and installers and shall be contingent upon submission by Contractor of certificates stating the following:
 - 1. Elevator contractor is currently and regularly engaged in the installation of elevator equipment as one of his principal products.
 - 2. Elevator contractor shall have three years of successful experience, trained supervisory personnel, and facilities to install elevator equipment specified herein.
 - 3. The installers shall be Certified Elevator Mechanics with technical qualifications of at least five years of successful experience and Apprentices actively pursuing certified mechanic status. Certificates shall be submitted for all workers employed in this capacity.
 - 4. Elevator contractor shall submit a list of two or more prior hospital installations where all the elevator equipment he proposes to furnish for this project functioned satisfactorily to serve varying hospital traffic and material handling demands. Provide a list of hospitals that have the equipment in operation for two years preceding the date of this specification. Provide the names and addresses of the Medical Centers and the names and telephone numbers of the Medical Center Administrators.
- B. Approval of Elevator Contractor's equipment will be contingent upon their identifying an elevator maintenance service provider that shall render services within two hours of receipt of notification, together with certification that the quantity and quality of replacement parts stock is sufficient to warranty continued operation of the elevator installation.

ELECTRIC TRACTION ELEVATORS

- C. Approval will not be given to elevator contractors and manufacturers who have established on prior projects, either government, municipal, or commercial, a record for unsatisfactory elevator installations, have failed to complete awarded contracts within the contract period, and do not have the requisite record of satisfactorily performing elevator installations of similar type and magnitude.
- D. All electric traction elevators shall be the product of the same manufacturer.
- E. The Contractor shall provide and install only those types of safety devices that have been subjected to tests witnessed and certified by an independent professional testing laboratory that is not a subsidiary of the firm that manufactures supplies or installs the equipment.
- F. Welding at the project site shall be made by welders and welding operators who have previously qualified by test as prescribed in American Welding Society Publications AWS D1.1 to perform the type of work required. Certificates shall be submitted for all workers employed in this capacity. A welding or hot work permit is required for each day and shall be obtained from the COR of safety department. Request permit one day in advance.
- G. Electrical work shall be performed by Licensed Electricians as requirements by NEC. Certificates shall be submitted for all workers employed in this capacity.

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification. Elevator installation shall meet the requirements of the latest editions published and adopted by the United States Department of Veterans Affairs on the date contract is signed.
- B. Federal Specifications (Fed. Spec.):
 - J-C-30B.....Cable and Wire, Electrical (Power, Fixed Installation)
 - W-C-596F.....Connector, Plug, Electrical; Connector, Receptacle, Electrical
 - W-F-406E.....Fittings for Cable, Power, Electrical and Conduit, Metal, Flexible
 - HH-I-558C.....Insulation, Blankets, Thermal (Mineral Fiber, Industrial Type)

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- W-F-408E.....Fittings for Conduit, Metal, Rigid (Thick- Wall
and Thin-wall (EMT) Type)
- RR-W-410.....Wire Rope and Strand
- TT-E-489J.....Enamel, Alkyd, Gloss, Low VOC Content
- QQ-S-766Steel, Stainless and Heat Resisting, Alloys,
Plate, Sheet and Strip
- C. International Building Code (IBC)
- D. American Society of Mechanical Engineers (ASME):
 - A17.1-07.....Safety Code for Elevators and Escalators
 - A17.2-07.....Inspectors Manual for Electric Elevators and Escalators
- E. National Fire Protection Association:
 - NFPA 13-10.....Standard for the Installation of Sprinkler Systems
 - NFPA 70-11.....National Electrical Code (NEC)
 - NFPA 72-10.....National Fire Alarm and Signaling Code
 - NFPA 101-09.....Life Safety Code
 - NFPA 252-08.....Fire Test of Door Assemblies
- F. American Society for Testing and Materials (ASTM):
 - A1008/A1008M-10.....Steel, Sheet, Cold Rolled, Carbon, Structural,
High-Strength Low-Alloy and High Strength Low-
Alloy with Improved Farability
 - E1042-02 (R2008).....Acoustically Absorptive Materials Applied by
Trowel or Spray
- G. Society of Automotive Engineers, Inc. (SAE)
 - J517-10.....Hydraulic Hose, Standard
- H. Gauges:
 - For Sheet and Plate: U.S. Standard (USS)
 - For Wire: American Wire Gauge (AWG)
- I. American Welding Society (AWS):
 - D1.1-10.....Structured Welding Code Steel
- J. National Electrical Manufacturers Association (NEMA):
 - LD-3-05.....High-Pressure Decorative Laminates
- K. Underwriter's Laboratories (UL):
 - 486A-03.....Safety Wire Connectors for Copper Conductors
 - 797-07.....Safety Electrical Metallic Tubing
- L. Institute of Electrical and Electronic Engineers (IEEE)
- M. Regulatory Standards:
 - Uniform Federal Accessibility Standards

ELECTRIC TRACTION ELEVATORS

Americans with Disabilities Act

1.5 SUBMITTALS

- A. Submit in accordance with Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Before execution of work, furnish information to evidence full compliance with contract requirements for proposed items. Such information shall include, as required: Manufacturer's Name, Trade Names, Model or Catalog Number, Nameplate Data (size, capacity, and rating) and corresponding specification reference (Federal or project specification number and paragraph). All submitted drawings and related elevator material shall be forwarded to the CO.
- C. Shop Drawings:
 - 1. Complete dimensioned layout in plan and section view showing the arrangement of equipment and all details of each and every elevator unit specified including:
 - a. Hoisting machines, controllers, power conversion devices, governors, and all other components located in machine room.
 - b. Car, counterweight, sheaves, supporting beams, guide rails, brackets, buffers, size of car platform, car frame members, and other components located in hoistway.
 - c. Rail bracket spacing and maximum vertical forces on guide rails in accordance with ASME A17.1 Section 2.23 and Section 8.4.8 for Seismic Risk Zone 2 or greater.
 - d. Reactions at points of supports and buffer impact loads.
 - e. Weights of principal parts.
 - f. Top and bottom clearances and over travel of car and counterweight.
 - g. Location of shunt trip circuit breaker, switchboard panel, light switch, and feeder extension points in the machine room.
 - 2. Drawings of hoistway entrances and doors showing details of construction and method of fastening to the structural members of the building.
 - a. If drywall construction is used to enclose hoistway, submit details of interface fastenings between entrance frames and drywall.
 - b. Sill details including sill support.
- D. Samples:

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1. One each of stainless steel, 75 mm x 125 mm (3 in. x 5 in.).
 2. One each of baked enamel, 75 mm x 125 mm (3 in. x 5 in.).
 3. One each of color vinyl floor tile.
 4. One each of protection pads, 75 mm x 125 mm (3 in. x 5 in.) if used.
 5. One each car and hoistway Braille plate sample.
 6. One each car and hall button sample.
 7. One each car and hall lantern/position indicator sample.
 8. One each wall and ceiling material finish sample.
 9. One each car lighting sample.
 10. No other samples of materials specified shall be submitted unless specifically requested after submission of manufacturer's name. If additional samples are furnished pursuant to request, adjustment in contract price and time will be made as provided in Section 00 72 00, GENERAL CONDITIONS.
- E. Name of manufacturer, type or style designation, and applicable data of the following equipment shall be shown on the elevator layouts:
1. Hoisting Machine.
 2. Hoisting Machine Motor, HP and RPM ratings, Voltage, Starting and Full Load Ampere, and Number of Phases.
 3. Controller
 4. Starters and Overload Current Protection Devices.
 5. Car Safety Device; maximum and minimum rated loads and rated speeds.
 6. Governor
 7. Electric Door Operator; HP and RPM ratings, Voltage and Ampere rating of motor.
 8. Hoistway Door Interlocks.
 9. Car and Counterweight Buffers; maximum and minimum rated loads, maximum rated striking speed and stroke.
 10. Hoist and Compensation Ropes; ultimate breaking strength, allowable working load, and actual working load.
 11. Cab Ventilation Unit; HP rating and CFM rating.
- F. Complete construction drawings of elevator car enclosure, showing dimensioned details of construction, fastenings to platform, car lighting, ventilation, ceiling framing, top exits, and location of car equipment.
- G. Complete dimensioned detail of vibration isolating foundations for traction hoisting machines.

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- H. Dimensioned drawings showing details of:
 - 1. All signal and operating fixtures.
 - 2. Car and counterweight roller guides.
 - 3. Hoistway door tracks, hangers, and sills.
 - 4. Door operator, infrared curtain units.
- I. Drawings showing details of controllers and supervisory panels.
- J. Furnish certificates as required under: Paragraph "QUALIFICATIONS".

1.6 WIRING DIAGRAMS

- A. Provide three complete sets of field wiring and straight line wiring diagrams showing all electrical circuits in the hoistway, control room and fixtures. Install one set coated with an approved plastic sealer and mounted in the elevator control room as directed by the COR.
- B. In the event field modifications are necessary during installation, diagrams shall be revised to include all corrections made prior to and during the final inspection. Corrected diagrams shall be delivered to the COR within thirty (30) days of final acceptance.
- C. Provide the following information relating to the specific type of microprocessor controls installed:
 - 1. Owner's information manual, containing job specific data on major components, maintenance, and adjustment.
 - 2. System logic description.
 - 3. Complete wiring diagrams needed for field troubleshooting, adjustment, repair and replacement of components. Diagrams shall be base diagrams, containing all changes and additions made to the equipment during the design and construction period.
 - 4. Changes made during the warranty period shall be noted on the drawings in adequate time to have the finalized drawings reproduced for mounting in the machine room no later than six months prior to the expiration of the warranty period.

1.7 ADDITIONAL EQUIPMENT

- A. Additional equipment required to operate the specified equipment manufactured and supplied for this installation shall be furnished and installed by the contractor. The cost of the equipment shall be included in the base bid.
- B. Equipment not required by specification, which would improve the operation, may be installed in conjunction with the specified equipment

by the contractor at his option at no additional cost to the Government, provided prior approval is obtained from the COR.

1.8 TOOL CABINET

- A. Provide a metal parts/tool cabinet, having two shelves and hinged doors. Cabinet size shall be 1220 mm (48 in.) high, 762 mm (30 in.) wide, and 457 mm (18 in.) deep.

1.9 PERFORMANCE STANDARDS

- A. The elevators shall be capable of meeting the highest standards of the industry and specifically the following:
 - 1. Contract speed is high speed in either direction of travel with rated capacity load in the elevator. Speed variation under all load conditions, regardless of direction of travel, shall not vary more than three (3) percent.
 - 2. The controlled rate of change of acceleration and retardation of the car shall not exceed 0.1G per second and the maximum acceleration and retardation shall not exceed 0.2G per second.
 - 3. Starting, stopping, and leveling shall be smooth and comfortable without appreciable steps of acceleration and deceleration.
- B. The door operator shall open the car door and hoistway door simultaneously at 2.5-feet per second and close at 1-foot per second.
- C. Elevator control system shall be capable of starting the car without noticeable "roll-back" of hoisting machine sheave, regardless of load condition in car, location of car, or direction of travel.
- D. Floor level stopping accuracy shall be within 3 mm (1/8 in.) above or below the floor, regardless of load condition.
- E. Noise and Vibration Isolation: All elevator equipment including their supports and fastenings to the building, shall be mechanically and electrically isolated from the building structure to minimize objectionable noise and vibration transmission to car, building structure, or adjacent occupied areas of building.
- F. Sound Isolation: Noise level relating to elevator equipment operation in control room shall not exceed 80 dBA. All dBA readings shall be taken three (3) feet off the floor and three (3) feet from equipment.
- G. Airborne Noise: Measured noise level of elevator equipment during operation shall not exceed 50 dBA in elevator lobbies and 60 dBA inside car under any condition including door operation and car ventilation exhaust blower on its highest speed.

ELECTRIC TRACTION ELEVATORS

1.10 WARRANTY

- A. Submit all labor and materials furnished in connection with elevator system and installation to terms of "Warranty of Construction" articles of FAR clause 52.246-21. The one year Warranty shall commence after final inspection, completion of performance test, and upon full acceptance of the installation and shall concur with the guarantee period of service.
- B. During warranty period if a device is not functioning properly or in accordance with specification requirements, or if in the opinion of the COR, excessive maintenance and attention must be employed to keep device operational, device shall be removed and a new device meeting all requirements shall be installed as part of work until satisfactory operation of installation is obtained. Period of warranty shall start anew for such parts from date of completion of each new installation performed, in accordance with foregoing requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Where stainless steel is specified, it shall be corrosion resisting steel complying with Federal Specification QQ-S-766, Class 302 or 304, Condition A with Number 4 finish on exposed surfaces. Stainless steel shall have the grain of belting in the direction of the longest dimension and surfaces shall be smooth and without waves. During installation all stainless steel surfaces shall be protected with suitable material.
- B. Where cold rolled steel is specified, it shall be low-carbon steel rolled to stretcher leveled standard flatness, complying with ASTM A109.

2.2 MANUFACTURED PRODUCTS

- A. Materials, devices, and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items. Items not meeting this requirement, but meet technical specifications which can be established through reliable test reports or physical examination of representative samples, will be considered.
- B. When two or more devices of the same class of materials or equipment are required, these units shall be products of one manufacturer.

- C. Manufacturers of equipment assemblies which include components made by others shall assume complete responsibility for the final assembled unit.
 - 1. Individual components of assembled units shall be products of the same manufacturers.
 - 2. Parts which are alike shall be the product of a single manufacturer.
 - 3. Components shall be compatible with each other and with the total assembly for the intended service.
- D. Motor nameplates shall state manufacturers' name, rated horsepower, speed, volts, starting and full load amperes, and other characteristics required by NEMA Standards and shall be securely attached to the item of equipment in a conspicuous location.
- E. The elevator equipment, including controllers, door operators, and supervisory system shall be the product of manufacturers of established reputation, provided such items are capably engineered and produced under coordinated specifications to ensure compatibility with the total operating system. Mixing of manufactures related to a single system or group of components shall be identified in the submittals.
- F. Where key operated switches are furnished in conjunction with any component of this elevator installation, furnish four (4) keys for each individual switch or lock. Provide different key tumblers for different switch and lock functions. Each and every key shall have a tag bearing a stamped or etched legend identifying its purpose. Barrel key switches are not acceptable, except where required by code.
- G. If the elevator equipment to be installed is not known to the COR, the Contractor shall submit drawings in triplicate for approval to the COR, CO, and VA CFM Elevator Engineer showing all details and demonstrate that the equipment to be installed is in strict accordance with the specifications.

2.3 CAPACITY, SIZE, SPEED, AND TRAVEL

- A. Each and every elevator shall have the capacity to lift and lower the live load, including the weight of the car and cables, at the speed specified in the following schedule:

ELEVATOR SCHEDULE	
Elevator Number	P-19, P-20 (two cabs)

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ELEVATOR SCHEDULE	
Rated Load - kg (lb)	1,360 (3,000)
Contract Speed - m/s (fpm)	1.78 (350)
Total Travel - m (f)	14.22 (46.667)
Number of Stops	5
Number of Openings (per elevator)	1
Entrance Type and Size	Center-Opening, 3'-6"w x 7'-0"h

2.4 POWER SUPPLY

- A. For power supply in control room, see Electrical specifications, and Electrical drawings.
- B. It shall be the Electrical contractor's responsibility to supply the labor and materials for the installation of the following:
 - 1. Feeders from the power source indicated on the drawings to each elevator controller.
 - 2. Shunt Trip Circuit Breaker for each controller shall be located inside control room at the strike side of the control room door and lockable in the "Off" position.
 - 3. Provide Surge Suppressors to protect the elevator equipment.
- C. Power for auxiliary operation of elevator as specified shall be available from auxiliary power generator, including wiring connection to the elevator control system.

2.5 CONDUIT AND WIREWAY

- A. Unless otherwise specified or approved, install electrical conductors, except traveling cable connections to the car, in rigid zinc-coated steel or aluminum conduit, electrical metallic tubing or metal wireways. Rigid conduit smaller than 3/4 inch or electrical metallic tubing smaller than 1/2 inch electrical trade size shall not be used. All raceways completely embedded in concrete slabs, walls, or floor fill shall be rigid steel conduit. Wireway (duct) shall be installed in the hoistway and to the controller and between similar apparatus in the elevator control room. Fully protect self-supporting connections, where approved, from abrasion or other mechanical injury. Flexible metal conduit not less than 3/8 inch electrical trade size may be used, not exceeding 18 inches in length unsupported, for short connections

between risers and limit switches, interlocks, and for other applications permitted by NEC.

- B. All conduits terminating in steel cabinets, junction boxes, wireways, switch boxes, outlet boxes and similar locations shall have approved insulation bushings. Install a steel lock nut under the bushings if they are constructed completely of insulating materials. Protect the conductors at ends of conduits not terminating in steel cabinets or boxes by terminal fittings having an insulated opening for the conductors.
- C. Rigid conduit and EMT fittings using set screws or indentations as a means of attachment shall not be used. All fittings shall be steel or malleable iron.
- D. Connect motor or other items subject to movement, vibration or removal to the conduit or EMT systems with flexible, steel conduits.

2.6 CONDUCTORS

- A. Unless otherwise specified, conductors, excluding the traveling cables, shall be stranded or solid coated annealed copper in accordance with Federal Specification J-C-30B for Type RHW or THW. Where 16 and 18 AWG are permitted by NEC, single conductors or multiple conductor cables in accordance with Federal Specification J-C-580 for Type TF may be used provided the insulation of single conductor cable and outer jacket of multiple conductor cable is flame retardant and moisture resistant. Multiple conductor cable shall have color or number coding for each conductor. Conductors for control boards shall be in accordance with NEC. Joints or splices are not permitted in wiring except at outlets. Tap connectors may be used in wireways provided they meet all UL requirements.
- B. Provide all conduit and wiring between control room, hoistway and fixtures.
- C. All wiring must test free from short circuits or ground faults. Insulation resistance between individual external conductors and between conductors and ground shall be a minimum of one megohm.
- D. Where size of conductor is not given, voltage and amperes shall not exceed limits set by NEC.
- E. Provide equipment grounding. Ground the conduits, supports, controller enclosure, motor, platform and car frame, and all other non-current conducting metal enclosures for electrical equipment in accordance with

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NEC. The ground wires shall be copper, green insulated and sized as required by NEC. Bond the grounding wires to all junction boxes, cabinets, and wire raceways.

- F. Terminal connections for all conductors used for external wiring between various items of elevator equipment shall be solderless pressure wire connectors in accordance with Federal Specification W-S-610. The Elevator Contractor may, at his option, make these terminal connections on 10 gauge or smaller conductors with approved terminal eyelets set on the conductor with a special setting tool, or with an approved pressure type terminal block. Terminal blocks using pierce-through serrated washers are not acceptable.

2.7 TRAVELING CABLES

- A. All conductors to the car shall consist of flexible traveling cables conforming to the requirements of NEC. Traveling cables shall run from the junction box on the car directly to the controller. Junction boxes on the car shall be equipped with terminal blocks. Terminal blocks having pressure wire connectors of the clamp type that meet UL 486A requirements for stranded wire may be used in lieu of terminal eyelet connections. Terminal blocks shall have permanent indelible identifying numbers for each connection. Cables shall be securely anchored to avoid strain on individual terminal connections. Flame and moisture resistant outer covering must remain intact between junction boxes. Abrupt bending, twisting and distortion of the cables shall not be permitted.
- B. Provide spare conductors equal to 10 percent of the total number of conductors furnished, but not less than 5 spare conductors in each traveling cable.
- C. Provide shielded wires for the auto dial telephone system within the traveling cable. Add 5 pair shielded wires for card reader, 2 RG-6/U coaxial CCTV cables, and 2 pair 14 gauge wires for CCTV power as needed.
- D. If traveling cables come into contact with the hoistway or elevator due to sway or change in position, provide shields or pads to the elevator and hoistway to prevent damage to the traveling cables.
- E. Hardware cloth wide may be installed from the hoistway suspension point downward to the elevator pit to prevent traveling cables from rubbing or chafing. Hardware cloth shall be securely fastened and tensioned to

prevent buckling. Hardware cloth is not required when traveling cable is hung against a flat wall.

2.8 CONTROLLER AND SUPERVISORY PANEL

- A. UL/CSA Labeled Controller: Mount all assemblies, power supplies, chassis switches, and relays on a self-supporting steel frame. Completely enclose the equipment and provide a means to control the temperature. Solid state components shall be designed to operate between 32 to 104 degrees Fahrenheit, humidity non-condensing up to 85 percent.
- B. All controller switches and relays shall have contacts of design and material to ensure maximum conductivity, long life and reliable operation without overheating or excessive wear, and shall provide a wiping action to prevent sticking due to fusion. Switches carrying highly inductive currents shall be provided with arc shields or suppressors.
- C. Where time delay relays are used in the circuits, they shall be of acceptable design, adjustable, reliable, and consistent such as condenser timing or electronic timing circuits.
- D. Properly identify each device on all panels by name, letter, or standard symbol which shall be neatly stencil painted or decaled in an indelible and legible manner. Identification markings shall be coordinated with identical markings used on wiring diagrams. The ampere rating shall be marked adjacent to all fuse holders. All spare conductors to controller and supervisory panel shall be neatly formed, laced, and identified.

2.9 MICROPROCESSOR CONTROL SYSTEM

- A. Provide a microprocessor based system with absolute position/speed feedback encoded tape to control the hoisting machine and signal functions in accordance with these specifications. Complete details of the components and printed circuit boards, together with a complete operational description, shall be submitted for approval.
 - 1. All controllers shall be non-proprietary.
 - 2. Proprietary tools shall not be necessary for adjusting, maintenance, repair, and testing of equipment.
 - 3. Controller manufacturer shall provide factory training, engineering and technical support, including all manuals and wiring diagrams to

the VA Medical Center's designated Elevator Maintenance Service Provider.

4. Replacement parts shall be shipped overnight within 48 hours of an order being received.
- B. All controller assemblies shall provide smooth, step-less acceleration and deceleration of the elevator, automatically and irrespective of the load in the car. All control equipment shall be enclosed in metal cabinets with lockable, hinged door(s) and shall be provided with a means of ventilation. All non-conducting metal parts in the machine room shall be grounded in accordance with NEC. Cabinet shall be securely attached to the building structure.
- C. Circuit boards for the control of each and every elevator system; dispatching, signals, door operation and special operation shall be installed in a NEMA Type 1 General Purpose Enclosure. Circuit boards shall be moisture resistant, non-corrosive, non-conductive, fabricated of non-combustible material and adequate thickness to support the components mounted thereon. Mounting racks shall be spaced to prevent accidental contact between individual circuit boards and modules.
- D. Modules shall be the type that plug into pre-wired mounting racks. Field wiring or alteration shall not be necessary in order to replace defective modules.
- E. Each device, module and fuse (with voltage and ampere rating) shall be identified by name, letter or standard symbol in an approved indelible and legible manner on the device or panel. Coordinate identification markings with identical markings on wiring diagrams.
- F. The electrical connections between the printed circuit boards (modules) and the circuit connectors incorporated in the mounting racks shall be made through individual tabs which shall be an integral part of each module. The tabs shall be nickel-gold plated or other approved metal of equal electrical characteristics. Modules shall be keyed or notched to prevent insertion of the modules in the inverted position.
- G. Light emitting diodes (LED) shall be for visual monitoring of individual modules.
- H. Components shall have interlocking circuits to assure fail-safe operation and to prevent elevator movement should a component malfunction.

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- I. Method of wire wrapping from point to point with connections on the mounting racks shall be submitted for approval.
- J. Field wiring changes required during construction shall be made only to the mounting rack connection points and not to the individual module circuitry or components. If it is necessary to alter individual modules they shall be returned to the factory where design changes shall be made and module design records changed so correct replacement units will be available.
- K. All logic symbols and circuitry designations shall be in accordance with ASME and NEC Standards.
- L. Solid state components shall be designed to operate within a temperature range of 32 to 104 degrees Fahrenheit, humidity non-condensing up to 85 percent.
- M. Wiring connections for operating circuits and for external control circuits shall be brought to terminal blocks mounted in an accessible location within the controller cabinet. Terminal blocks using pierce through serrated washers shall not be used.

2.10 VVVF AC MOTOR CONTROL WITH REGENERATIVE DRIVE

- A. Variable Voltage Variable Frequency Motor Control:
 - 1. Elevator control shall be affected by means of a compact solid state motor control unit for each and every elevator with electrical characteristics to suit the power supply. The system shall consist of the necessary three phase, full-wave bridge rectifiers and be equipped with regenerative drive.
 - 2. Solid state motor control unit shall operate with high efficiency and low power consumption, have the capacity to handle peak currents typical of elevator service and contain a balanced, coordinated fault protection system which shall accomplish the following:
 - a. Protect the complete power circuit and specifically the power semi-conductors from failure under short circuit (bolted fault) conditions.
 - b. Protect against limited faults arising from partial grounds, partial shorts in the motor armature or in the power unit itself.
 - c. Protect the drive motor against sustained overloads. A solid state overload circuit shall be used.
 - d. Protect motor and power unit against instantaneous peak overload.
 - e. Provide semi-conductor transient protection.

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- f. Provide phase sequence protection to ensure incoming line is phased properly.
- g. Removable printed circuit boards shall be provided for the VVVF control. Design tabs so boards cannot be reversed.

2.11 AUXILIARY POWER OPERATION

- A. The control system for Elevators P-19 and P-20 shall provide for the operation of both cars on auxiliary power upon failure of the normal power supply.
- B. Auxiliary power supply, its starting means, transfer switch for transfer of elevator supply from normal to auxiliary power, two pair of conductors in a conduit from an auxiliary contact on the transfer switch (open or close contacts as required by Controller Manufacturer) to terminals in the group elevator controller and other related work shall be provided by the Electrical Contractor.
- C. Auxiliary equipment on elevator controllers, wiring between associated elevator controllers and wiring between elevator controllers and remote selector panel as required to permit the elevators to operate as detailed, shall be provided by the Elevator Contractor.
- D. Upon loss of normal power supply there shall be a delay before transferring to auxiliary power of 10 seconds minimum to 45 seconds maximum, the delay shall be accomplished through an adjustable timing device.
- E. Prior to the return of normal power an adjustable timed circuit shall be activated that will cause all cars to remain at a floor if already there or stop and remain at the next floor if in flight. Actual transfer of power from auxiliary power to normal building power shall take place after all cars are stopped at a floor with their doors open.
- F. Car lighting circuits shall be connected to the auxiliary power panel.

2.12A SINGLE CAR SELECTIVE COLLECTIVE AUTOMATIC OPERATION

- A. **Provide Single Car Selective Collective Automatic Operation, for passenger elevator P-19 only if BID ITEM 4 (DEDUCT) is accepted.** Reference 2.12B, DUPLEX SELECTIVE COLLECTIVE AUTOMATIC OPERATION for elevator P-19 per base bid.
- B. Operate car without attendant from push buttons inside the car and located at each floor adjacent to the elevator entrance. When car is available, automatically start car and dispatch it to the floor corresponding to registered car or hall call. Once car starts it shall

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respond to registered calls in the direction of travel in the order floors are reached. Do not reverse car directions until all car calls have been answered or until all hall calls ahead of car and corresponding to direction of car travel have been answered. Slow car and stop automatically at floors corresponding to registered calls, in the order in which they are approached in either direction of travel. As slowdown is initiated, automatically cancel the hall call and car call. Hold car at arrival floor an adjustable time interval to allow passenger transfer. Illuminate appropriate push button to indicate call registration. Extinguish light when call is answered.

- C. When all calls in the system have been satisfied, the elevator shall shut down at the last landing served with the car and hoistway doors closed. Registration of a call at the landing where the car is parked shall automatically open the car and hoistway doors. Provide a predetermined time delay to permit passengers entering the parked car to register the call of their choice and establish direction of travel before the system can respond to landing calls registered to the same time above or below the parked car.
- D. Auxiliary Landing Call Operation: In the event of corridor call button circuit failure, elevators are to service each floor in both directions in a predetermined pattern without registration of a call within the elevator. Provide an illuminated signal in the controller to indicate that emergency dispatch operation is in effect. Restoration of the landing call button system shall cause normal operation to resume.
- E. Car lights and fan in the elevator shall not shut off when elevator is idle. Arrange circuits so that power to the lights and outlets on top and bottom of car shall not be interrupted.

2.12B DUPLEX SELECTIVE COLLECTIVE AUTOMATIC OPERATION

- A. Provide duplex selective collective automatic operation, for passenger elevators P-19 and P-20 per base bid. **Reference 2.12A, SINGLE CAR SELECTIVE COLLECTIVE AUTOMATIC OPERATION, for elevator P-19 only if BID ITEM 4 (DEDUCT) is accepted.**
- B. Operate elevators from push buttons inside the cars and located at each and every floor between elevators. When cars are available, park one car at main floor (home car) and the other car at last call (free car). Respond to car calls and hall calls above main floor using the "free" car. Once a car has started, respond to registered calls in the

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direction of travel and in the order the floors are reached. Do not reverse the car direction until all car calls have been answered, or until all hall calls ahead of the car and corresponding to the direction of car travel have been answered.

Slow and stop elevators automatically at floors corresponding to registered calls in the order in which they are approached in each direction of travel. As slowdown is initiated, automatically cancel the hall call and car call. Hold car at arrival floor an adjustable time interval to allow passenger transfer.

When the "free" car is clearing calls, the "home" car shall respond to the following:

1. Calls registered on "home" car push buttons.
 2. Up hall calls registered below "free" car.
 3. Up or down calls registered above "free" car while "free" car is traveling down.
 4. Hall calls when "free" car is delayed in its normal operation for a predetermined period.
- C. When both cars are clearing calls, stop only one car in response to any registered hall call. Return the first car to clear its calls to the main floor. Should last service required bring both cars to main floor, the first arriving car becomes the "free" car. Illuminate floor push button to indicate call registration. Extinguish light when call is answered.
- D. If a landing button is operated while the car and hoistway doors are closing at that floor, the call shall be registered for the next available elevator. Calls registered shall be canceled if closing doors are reopened by means of "DOOR OPEN" button or infrared curtain unit.
- E. When an elevator is delayed for a predetermined time interval or shuts down after it receives a start signal, the system shall automatically permit the remaining car in the group to respond to hall calls and to be dispatched in normal manner. When cause of delay is corrected, car shall automatically resume normal operation unless it has been manually removed from the system.
- F. Auxiliary Landing Call Operation: In the event of corridor call button circuit failure, elevators are to service each floor in both directions in a predetermined pattern without registration of a call within the elevators. Provide illuminated signal in each the controller to

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indicate that emergency dispatch operation is in effect. Restoration of the landing call button system shall cause normal operation to resume.

- G. Car lights and fan in the elevator shall not shut off when elevator is idle. Arrange circuits so that power to lights and outlets on top and bottom of car shall not be interrupted.

2.13 LOAD WEIGHING

- A. Provide means for weighing car load for each and every elevator. When load in a car reaches an adjustable predetermined level of the rated capacity, that car shall bypass registered landing calls until the load in the car drops below the predetermined level. Calls bypassed in this manner shall remain registered for the next car. The initial adjustment of the load weighting bypass setting shall be 60 to 100 percent.

2.14 ANTI-NUISANCE FEATURE

- A. If weight in the car is not commensurate with the number of registered car calls, cancel car calls. Systems that employ either load weighing or door protective device for activation of this feature are acceptable.

2.15 FIREFIGHTERS' SERVICE

- A. Provide Firefighters' Service as per ASME A17.1 Section 2.27.
- B. Smoke Detectors:
1. Smoke detection devices that are designated for actuation of Elevator Phase I "FIRE SERVICE" response in each elevator lobby, top of hoistway, and machine room shall be provided by others.
 - a. Elevator lobby smoke detectors shall activate only the elevators sharing the corresponding or common lobby.
 - b. Top of hoistway smoke detectors shall activate fire recall and the top of hoistway motorized vent.
 - c. Elevator or group of elevators serving separate isolated areas of the same floor shall have an independent smoke detection system.
 - d. Control room smoke detectors shall activate fire recall for each and every elevator with equipment located in that control room.
 - e. Hoistway ventilation, provided by others, located at the top of hoistway for elevators that penetrate more than three floors and meets the requirements of ASME A17.1 Section 2.1.4 and IBC Section 3004. The vent shall stay closed under power. When the top of hoistway smoke detector is activated, the power is removed

from the vent and the vent shall open. When the smoke detector is reset, the vent shall close by power.

2.16 ELEVATOR MACHINE BEAMS

A. Overhead beams shall meet the requirements of ASME A17.1 Section 2.9 to support machines and machinery in place to prevent any part from becoming loose or displaced under the conditions imposed in service. Machine beams shall be designed as follows:

1. The load resting on the beams and supports shall include the complete weight of the machine, sheaves, controller, governor, and any other equipment.
2. Two times the sum of the tensions in all wire ropes supported by the beams with rated load in the car.

2.17 GEARLESS TRACTION MACHINE

A. Gearless Traction Hoist Machine:

1. Gearless traction machine with an AC motor, brake, drive sheave, and deflector sheave mounted in proper alignment on an isolated bedplate.
2. Provide hoist machine mounted direct drive, digital, closed-loop velocity encoder.
3. Armature must be electrically balanced and together with motor coupling and brake, mechanically balanced.
4. The structural design of the motor shall ensure perfect alignment of bearings. The rotating elements shall be dynamically balanced to minimize vibration.
5. Hoist machine shaft shall be supported by two bearings mounted on a bedplate or integral with machine frame. Shaft shall be of forged steel or close grain electric furnace cast steel.
6. Drive sheaves shall be free from cracks, sand holes, and other imperfections that would tend to injure the hoist ropes. Sheave shall be turned smooth and true with rope grooves of proper design to ensure maximum traction and maximum life of the hoist ropes. Traction sheave shall be mechanically coupled to the hoist motor shaft centered in a positive manner.
7. Hoisting machine brake shall be drum or disc type and shall have the capacity to hold the elevator with 125 percent of rated load. Arrange brake circuits so that no current shall be applied to the brake coil prior to the establishment of the hoistway door interlock

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circuit, except during leveling, re-leveling, and hoistway access operation.

2.18 SHEAVES

- A. Provide deflector sheaves with a metal basket type guard mounted below the sheave and a guard to prevent ropes from jumping out of grooves. Securely fasten guard to sheave beams.
- B. Two-to-one idler sheaves on car and counterweight, if used, shall be provided with metal guards that shall prevent foreign objects from falling between ropes and sheave grooves and accidental contact or injury to workers on top of the car. Fabricate sheave guards from not less than 10-gauge thick steel and install with minimum clearance between guard and cables to prevent ropes from jumping out of grooves.

2.19 HOIST ROPES

- A. Provide elevator with the required number and size of ropes to ensure adequate traction for the range of loads with a factor of safety not less than that required by ASME A17.1 Section 2.20. Hoisting ropes shall be preformed 8 x 19 or 8 x 25 traction steel, conforming to Federal Specification RR-W-410 with minimum nominal diameter of 0.50 inch. For machines located overhead, 6 x 19 preformed traction steel hoisting ropes may be used in lieu of 8 x 19 that meet the requirements of the sheave manufacturer, at the elevator contractor's option.
- B. Securely attach a corrosion resistant metal data tag to one hoisting rope fastening on top of the elevator.
- C. Provide wedge type shackles.

2.20 HOIST ROPE COMPENSATION

- A. Provide compensation when required by controller manufacturer for elevators with travel of 15.15 m (50ft) or more. Compensation shall consist of a necessary number and size of encapsulated chains or whisper flex attached to the underside of car and counterweight frames. Hoist rope compensation shall meet the requirements of ASME A17.1 Rule 2.21.4.
 - 1. Provide pit guide to minimize chain sway.
 - 2. Provide take-up to compensate for hoist rope stretch.
 - 3. Pad areas where compensation may strike car or hoistway items.

2.21 GOVERNOR ROPE

- A. Governor Rope shall be 6 x 19 or 8 x 19 wire rope, preformed traction steel, uncoated, fiber core, conforming to Federal Specification RR-W-410 with minimum nominal diameter of 0.375 inch having a minimum safety factor of 5. Tiller rope construction is not acceptable.
- B. Under normal operation rope shall run free and clear of governor jaws, rope guards, and other stationary parts.
- C. Securely attach governor rope tag to governor rope releasing carrier. Data tag shall be corrosion-resisting metal and bear data as required by ASME A17.1 Section 2.18.

2.22 SPEED GOVERNOR

- A. Provide Centrifugal type car driven governor, in accordance with ASME A17.1 Section 2.18, to operate the car safety device. Governor shall be complete with weighted pit tension sheave, governor release carrier and mounting base with protected cable sleeves.
- B. Furnish overspeed switch and speed reducing switches when required.
- C. The governor rope clamping device shall be designed so that no appreciable damage to or deformation of the governor rope shall result from the stopping action of the device in operating the safety.
- D. Provide anti-friction metal bearings for the governor and pit tension sheaves. Bearing shall be either self-oiling or Zerk fitting type connections. Ball or roller bearings may be used in lieu of sleeve type.
- E. Provide metal guard over top of governor rope and sheaves.
- F. Governor, with the exception of finished surfaces, screw threads, etc., shall be factory painted and shall operate freely. Field painting of governor parts shall be permitted in accordance with ASME A17.1 Rule 2.18.3.1.
- G. Where the elevator travel does not exceed 100 feet, the weight tension sheave may be mounted on a pivoted steel arm in lieu of operating in steel guides.

2.23 ASCENDING CAR OVERSPEED PROTECTION

- A. Provide a device to prevent ascending over speed and unintended motion away from the landing when the doors are not locked in accordance with ASME A17.1 Section 2.19.

2.24 CAR AND COUNTERWEIGHT BUFFERS

- A. Provide a minimum of two buffers for each car and one for each counterweight that meet the requirements of ASME A17.1 Section 2.22. Securely fasten buffers and supports to the pit channels and in the alignment with striker plates on car and counterweight. Each installed buffer shall have a permanently attached metal plate indicating its stroke and load rating. Buffer anchorage shall not puncture pit waterproofing.
- B. Design and install buffers to provide minimum car runby required by ASME A17.1 Rule 2.4.2.
- C. Furnish pipe stanchions and struts as required to properly support the buffer.

2.25 COUNTERWEIGHTS

- A. Elevator shall be counterweighted with the weight of the car plus 40-50 percent of the rated capacity load as required by the controller manufacturer.
- B. Furnish two (2) tie rods with cotter pins and double nuts at top and bottom. Install counterweight retainer plates or other approved means on tie rods to prevent counterweight sub-weights from jumping and/or rattling. Both ends of tie-rods shall be visible and accessible.
- C. Provide counterweight guards in the pit in accordance with ASME A17.1 Section 2.3.

2.26 CAR AND COUNTERWEIGHT ROLLER/SLIDE GUIDES

- A. Provide car and counterweight with adjustable roller guides.
- B. Each guide shall be of an approved type consisting of not less than three (3) wheels, each with a durable, resilient oil-resistant material tire rotating on ball bearings having sealed-in lubrication. Assemble rollers on a substantial metal base and mount to provide continuous spring pressure contact of all wheels with the corresponding rail surfaces under all conditions of loading and operation. Secure the roller guides at top and bottom on each side of car frame and counterweight frame. All mounting bolts shall be fitted with nuts, flat washers, split lock washers, and if required, beveled washers.
- C. Provide sheet metal guards to protect wheels on top of car and counterweight.
- D. Minimum diameter of car rollers shall be 150 mm (6 in.) unless the six wheel roller type is used. The entire elevator car shall be properly

balanced to equalize pressure on all guide rollers. Cars shall be balanced in post-wise and front-to-back directions. Test for this balanced condition shall be witnessed at time of final inspection.

- E. Properly balance counterweight frame to equalize pressure on all guide rollers. The Contractor shall have the option of furnishing, for counterweight only, mechanically adjusted roller guide in lieu of spring loaded roller guides as specified.
- F. Equip all cars and counterweight with an auxiliary guiding device for each guide shoe which shall prevent the car or counterweight from leaving the rails in the event that the normal guides are fractured. These auxiliary guides shall not, during normal operation, touch the guiding surfaces of the rails. Fabricate the auxiliary guides from hot rolled steel plate and mount between the normal guide shoes and the car and counterweight frames. The auxiliary guides may be an extension of the normal guide shoe mounting plate if that plate is fabricated from hot rolled steel. The portion of the auxiliary guide which shall come in contact with the rail guiding surfaces in the event of loss of the normal guides shall be lined with an approved bearing material to minimize damage to the rail guiding surfaces.

2.27 GUIDE RAILS, SUPPORTS AND FASTENINGS

- A. Guide rails shall conform to ASME A17.1 Section 2.23.
- B. Guide rails for car shall be planed steel T-sections in weight/foot as recommended by elevator manufacturer. Guide rails for counterweight shall be planed steel T-sections in weight/foot as recommended by elevator manufacturer.
- C. Securely fasten guide rails to the brackets or other supports by heavy duty steel rail clips.
- D. Provide necessary car and counterweight rail brackets and counterweight spreader brackets of sufficient size and design to secure substantial rigidity to prevent spreading or distortion of rails under any condition.
 - 1. Slotted or oversized holes shall be fitted with flat washers and shall conform to ASME A17.1 Rule 2.23.10.3.
 - 2. Where fastenings are over 4.2 m (14 ft) apart, rails shall be reinforced with 228 mm (9 in.) channel or approved equal backing to secure the rigidity required.

- E. Rail joints and fishplates shall be in accordance with ASME A17.1 Rule 2.23.7. Rail joints shall not interfere with clamps and brackets. Design rail alignment shims to remain in place if fastenings become loose.
- F. Guide rails shall extend from channels on pit floor to within 76 mm (3 in.) of the underside of the concrete slab or grating at top of hoistway with a maximum deviation of 3.2 mm (1/8 in.) from plumb in all directions. Provide a minimum of 19 mm (3/4 in.) clearance between bottom of rails and top of pit channels.
- G. Guide rail anchorages in pit shall be made in a manner that will not reduce effectiveness of the pit waterproofing.
- H. In the event inserts or bond blocks are required for the attachment of guide rails, the Contractor shall furnish such inserts or bond blocks and shall install them in the forms before the concrete is poured. Use inserts or bond blocks only in concrete or block work where steel framing is not available for support of guide rails. Expansion-type bolting for guide rail brackets will not be permitted.
- I. Guide rails shall be clean and free of any signs of rust, grease, or abrasion before final inspection. Paint the shank and base of the T-section with two field coats of manufacturer's standard enamel.
- J. After completion of car safety testing during final inspection, all marks left on rails by application of car safety shall be filed smooth.

2.28 NORMAL AND FINAL TERMINAL STOPPING DEVICES

- A. Normal and final terminal stopping devices shall conform to ASME A17.1 Section 2.25.
- B. Mount terminal slowdown switches and direction limit switches on the elevator or in hoistway to reduce speed and bring car to an automatic stop at the terminal landings.
 - 1. Switches shall function with any load up to and including 125 percent of rated elevator capacity at any speed obtained in normal operation.
 - 2. Switches, when opened, shall permit operation of elevator in reverse direction of travel.
- C. Mount final terminal stopping switches in the hoistway.
 - 1. Switches shall be positively opened should the car travel beyond the terminal direction limit switches.
 - 2. Switches shall be independent of other stopping devices.

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3. Switches, when opened, shall remove power from hoist motor, apply hoist machine brake, and prevent operation of car in either direction.

D. After final stopping switches have been adjusted, through bolt switches to guide rail.

2.29 CROSSHEAD DATA PLATE AND CODE DATA PLATE

A. Permanently attach a Data Plate, made of non-corrosive material, to car crosshead. Data plate shall bear information required by ASME A17.1 Section 2.16.3 and 2.20.2.1.

B. Permanently attach a Code Data Plate, in plain view, to the controller, ASME A17.1 Section 8.9.

2.30 WORKMAN'S LIGHTS AND OUTLETS

A. Provide duplex GFCI protected type receptacles and lamps with guards on top of each elevator car and beneath the platform. The receptacles shall be in accordance with Fed. Spec. W-C-596 for Type D7, 2-pole, 3-wire grounded type, rated for 15 amperes and 125 volts.

2.31 TOP-OF-THE CAR OPERATING DEVICE

A. Provide a cartop operating device that meets the requirements of ASME A17.1 Section 2.26.

B. The device shall be activated by a push/pull or toggle switch mounted in the device. The switch shall be clearly marked "INSPECTION" and "NORMAL" on the faceplate, with 6 mm (1/4 in.) letters.

C. Movement of the elevator shall be accomplished by the continuous pressure on a direction button and a safety button.

D. Provide an emergency stop toggle type switch.

E. Provide permanent identification for the operation of all components in the device.

F. The device shall be permanently attached to the elevator crosshead on the side of the elevator nearest to the hoistway doors used for accessing the top of the car.

2.32 CAR LEVELING DEVICE

A. Car shall be equipped with a two-way leveling device to automatically bring the car to within 3 mm (1/8 in.) of exact level with the landing for which a stop is initiated regardless of load in car or direction.

B. If the car stops short or travels beyond the floor, the leveling device, within its zone shall automatically correct this condition and

maintain the car within 3 mm (1/8 in.) of level with the floor landing regardless of the load carried.

- C. Provide encoded steel tape, steel tape with magnets or steel vanes with magnetic switches. Submit design for approval.

2.33 EMERGENCY STOP SWITCHES

- A. Provide an emergency stop switch for each top-of-car device, pit, machine spaces, service panel and firefighters' control panel inside the elevator. Mount stop switches in the pit adjacent to pit access door, at top of the pit ladder 1220 mm (48 in.) above the bottom landing sill and 1220 mm (48 in.) above the pit floor adjacent to the pit ladder.
- B. Each stop switch shall be red in color and shall have "STOP" and "RUN" positions legibly and indelibly identified.

2.34 MAIN CAR OPERATING PANEL

- A. Locate the main car operating panel in the car enclosure on the front return panel. The top floor car call push button shall not be more than 1220 mm (48 in.) above the finished floor. Car call push buttons and indicator lights shall be round with a minimum diameter of 25 mm (1 in.), LED white light illuminated.
- B. One piece front faceplate, with edges beveled 15 degrees, shall have the firefighters' service panel recessed into the upper section and the service operation panel recessed into the lower section, fitted with hinged doors. Doors shall have concealed hinges, be in the same front plane as the faceplate and fitted with cylinder type key operated locks. Secure the faceplate with stainless steel tamperproof screws.
- C. All terminology on the main car operating panel shall be raised or engraved. Use 6 mm (1/4 in.) letters to identify all devices in upper section of the main car operating panel. The handicapped markings with contrasting background shall be recessed .030 inch in the faceplate, square or rectangular in shape, with the finished face of the 12 mm (1/2 in.) numerals and markings flush with the faceplates. Surface mounted plates are not acceptable.
- D. The upper section shall contain the following items in order listed from top to bottom:
 - 1. Engrave elevator number, 25 mm (1 in.) high with black paint for contrast.

2. Engrave capacity plate information with black paint for contrast with freight loading class and number of passengers allowed.
3. Emergency car lighting system consisting of a rechargeable battery, charger, controls, and LED illuminated light fixture. The system shall automatically provide emergency light in the car upon failure or interruption of the normal car lighting service, and function irrespective of the position of the light control switch in the car. The system shall be capable of maintaining a minimum illumination of 1.0 foot-candle when measured 1220 mm (48 in.) above the car floor and approximately 305 mm (12 in.) in front of the car operating panel, for not less than four (4) hours.
4. LED illuminated digital car position indicator with direction arrows. Digital display floor numbers and direction arrows shall be a minimum of 50mm (2 in.) high.
5. Firefighters' Emergency Operation Panel shall conform to the requirements of ASME A17.1 Section 2.27. Firefighters' Panel shall be 1676 mm (66 in.) minimum to 1830 mm (72 in.) maximum to the top of the panel above finished floor.
6. Firefighters' Emergency Indicator Light shall be round with a minimum diameter of 25 mm (1 in.).
7. Complete set of round car call push buttons, minimum diameter of 25 mm (1 in.), and LED white light illuminated, corresponding to the floors served. Car call buttons shall be legibly and indelibly identified by a floor number and/or letter not less than 12mm (1/2 in.) high in the face of the call button. Stack buttons in a single vertical column for low rise buildings up to six floors with front openings only.
8. Door Open and Door Close buttons shall be located below the car call buttons. They shall have "OPEN" and "CLOSE" legibly and indelibly identified by letters in the face of the respective button. The Door Open button shall be located closest to the door jamb as required by ADA.
9. Red Emergency Alarm button that shall be located below the car operating buttons. Mount the emergency alarm button not lower than 890 mm (35 in.) above the finished floor. It shall be connected to audible signaling devices as required by A17.1 Rule 2.27.1.2. Provide audible signaling devices including the necessary wiring.

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10. Emergency Help push button shall activate two way communications between elevator cabs and the Medical Center's telephone operators as required by ASME A17.1 Rule 2.27.1.1.3. Help button shall be LED white light illuminated and flash when call is acknowledged. Legibly and indelibly label the button "HELP" in the face of the button with 12 mm (1/2 in.) high letters.
 11. Provide a corresponding Braille plate on the left side of each button. The handicapped markings with contrasting background shall be recessed .030 inch in the faceplate, square or rectangular in shape, with the finished face of the 12 mm (1/2 in.) numerals and markings flush with the faceplates. Surface mounted plates are not acceptable.
- E. The service operation panel, in the lower section shall contain the following items:
1. Light switch labeled "LIGHTS" for controlling interior car lighting with its two positions marked "ON" and "OFF".
 2. Inspection switch that will disconnect normal operation and activate hoistway access switches at terminal landings. Switch shall be labeled "INSPECTION" with its two positions marked "ON" and "OFF".
 3. Three position switch labeled "FAN" with its positions marked "HIGH", "LOW" and "OFF" for controlling car ventilating blower.
 4. Two position, spring return, toggle switch or push button to test the emergency light and alarm device. It shall be labeled "TEST EMERGENCY LIGHT AND ALARM".
 5. Two position emergency stop switch (located within service panel), when operated, shall interrupt power supply and stop the elevator independently of regular operating devices. Emergency stop switch shall be marked "PULL TO STOP" and "PUSH TO RUN".

2.35 CAR POSITION INDICATOR

- A. Provide an alpha-numeric digital car position indicator in the main car operating panel, consisting of numerals and arrows not less than 50 mm (2 in.) high, to indicate position of car and direction of car travel. Locate position indicator at the top of the main car operating panel, illuminated by light emitting diodes.

2.36 AUDIO VOICE SYSTEM

- A. Provide digitized audio voice system activated by stopping at a floor. Audio voice shall announce floor designations, direction of travel, and

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special announcements. The voice announcement system shall be a natural sounding human voice that receives messages and shall comply with ADA requirements for audible car position indicators. The voice announcer shall have two separate volume controls, one for the floor designations and direction of travel, and another for special announcements. The voice announcer shall have a full range loud speaker, located on top of the cab. The audio voice unit shall contain the number of ports necessary to accommodate the number of floors, direction messages, and special announcements. Install voice announcer per manufacturer's recommendations and instructions. The voice system shall be the product of a manufacturer of established reputation. Provide manufacturer literature and list of voice messages.

1. Fire Service Message
2. "Please do not block doors"
3. Provide special messages as directed by CORCOR.

2.37 CORRIDOR OPERATING DEVICE FACEPLATES

- A. Fabricate faceplates for elevator operating and signal devices from not less than 3 mm (1/8 in.) thick flat stainless steel with all edges beveled 15 degrees. Install all faceplates flush with surface on which they are mounted.
- B. Corridor push button faceplates shall be at least 127 mm (5 in.) wide by 305 mm (12 in.) high. The centerline of the landing push buttons shall be 1067 mm (42 in.) above the corridor floor.
- C. Elevator Corridor Call Station Pictograph shall be engraved in the faceplate.
- D. Fasten all car and corridor operating device and signal device faceplates with stainless steel tamperproof screws.
- E. Design corridor push button faceplates so that pressure on push buttons shall be independent of pressure on push button contacts.
- F. Engraved legends in faceplates shall have lettering 6 mm (1/4 in.) high filled with black paint.
- G. Provide a corresponding Braille plate on the left side of each button. The handicapped markings with contrasting background shall be recessed .030 inch in the faceplate, square or rectangular in shape, with the finished face of the 12 mm (1/2 in.) numerals and markings flush with the faceplates. Surface mounted plates are not acceptable.

2.38 CORRIDOR OPERATING DEVICES FOR PASSENGER ELEVATORS

- A. Provide oneriser of landing call buttons located as recommended by elevator manufacturer.
- B. Fixtures for intermediate landings shall contain "UP" and "DOWN" buttons. Fixtures for terminal landings shall contain a single "UP" or "DOWN" button.
- C. Each button shall contain an integral registration LED white light which shall illuminate upon registration of a call and shall extinguish when that call is answered.
- D. The direction of each button shall be legibly and indelibly identified by arrows not less than 12 mm (1/2 in.) high in the face of each button.
- E. Landing push buttons shall not re-open the doors while the car and hoistway doors are closing at that floor, the call shall be registered for the next available elevator. Calls registered shall be canceled if closing doors are re-opened by means of "DOOR OPEN" button or infrared curtain unit.

2.39 DIGITAL CORRIDOR LANTERN/POSITION INDICATOR

- A. Provide each car with combination corridor lantern/position indicator digital display mounted over the hoistway entrances at each and every floor. Provide each terminal landing with "UP" or "DOWN", minimum 64 mm (2 1/2 in.) high digital arrow lanterns and each intermediate landing with "UP" and "DOWN" digital arrow lanterns. Each lens shall be LED illuminated of proper intensity, so shielded to illuminate individual lens only. The lenses in each lantern shall be illuminated green to indicate "UP" travel and red to indicate "DOWN" travel. Lanterns shall signal in advance of car arrival at the landing indicating the direction of travel whether or not corridor button has been operated at that floor. Hall calls shall receive immediate assignment to individual cars and hall lantern shall sound and illuminate. Corridor lanterns shall not be illuminated when a car passes a floor without stopping. Each lantern shall be equipped with a clearly audible electronic chime which shall sound once for "UPWARD" bound car and twice for "DOWNWARD" bound car. Audible signal shall not sound when a car passes the floor without stopping. Provide adjustable sound level on audible signal. Car riding lanterns are not acceptable.

- B. Provide alpha-numeric digital position indicators directly over hoistway landing entranceways between the arrival lanterns at each and every floor. Indicator faceplate shall be stainless steel. Numerals shall be not less than 50 mm (2 in.) high with direction arrows. Cover plates shall be readily removable for re-lamping. The appropriate direction arrow shall be illuminated during entire travel of car in corresponding direction.
- C. Provide LED illumination in each compartment to indicate the position and direction the car is traveling by illuminating the proper alpha-numeric symbol. When the car is standing at a landing without direction established, arrows shall not be illuminated.

2.40 HOISTWAY ACCESS SWITCHES

- A. Provide hoistway access switches for elevator at top terminal landing to permit access to top of car, and at bottom terminal landing to permit access to pit. Elevators with center opening doors, mount the access key switch 1830 mm (6 ft) above the corridor floor next to the hoistway entrance jamb. Exposed portion of each access switch or its faceplate shall have legible, indelible legends to indicate "UP", "DOWN", and "OFF" positions. Submit design and location of access switches for approval. Each access switch shall be a constant pressure cylinder type lock having not less than five pins or five stainless steel disc combination with key removable only when switch is in the "OFF" position. Lock shall not be operable by any other key which will operate any other lock or device used for any other purpose at the VA Medical Center. Arrange the hoistway switch to initiate and maintain movement of the car. When the elevator is operated in the down direction from the top terminal landing, limit the zone of travel to a distance not greater than the top of the car crosshead level with the top floor.
- B. Provide emergency access for all hoistway entrances, keyways for passenger and service elevators and locked door release system (key access) for freight elevators.

2.41 HOISTWAY ENTRANCES: PASSENGER ELEVATORS

- A. Provide entrances of metal construction using cold rolled steel. Door frames shall be constructed of stainless steel. Complete entrances with sills, hanger supports, hangers, tracks, angle struts, unit frames,

door panels, fascia plates, toe guards, hardware, bumpers, sight guards, and wall anchors.

- B. Provide one piece extruded aluminum sills with non-slip wearing surface, grooved for door guides and recessed for fascia plates. Sills shall have overall height of not less than 19 mm (3/4 in.), set true, straight, and level, with hoistway edges plumb over each other, and top surfaces flush with finished floor. Grout sills full length after installation.
- C. Construct hanger supports of not less than 4.5 mm (3/16 in.) thick steel plate, and bolted to strut angles.
- D. Structural steel angles (if required) shall extend from top of sill to bottom of floor beam above, and shall be securely fastened at maximum 457 mm (18 in.) on center and at each end with two bolts.
- E. Provide jambs and head soffits, of not less than 14-gauge stainless steel, for entrances. Jambs and head soffits shall be bolted or welded construction, and provided with three anchors each side. Side jambs shall be square type, and outside corners shall have a slight radius and/or no sharp edges. Head jamb shall be square type, and shall overhang corridor face of side jambs by 6 mm (1/4 in.). Rigidly fasten jambs and head soffits to building structure. Provide jambs with protective covering. After installation, protect jambs and head soffits with wood framing to prevent damage to finish during construction. Solidly grout jambs.
- F. Provide 14-gauge sheet steel fascia plates in hoistway to extend vertically from head of hanger support housing to sill above. Plates shall be the same width as the door opening of elevator and adequately reinforced to prevent waves and buckles. Below bottom terminal landing and over upper terminal landing provide shear guards beveled back to and fastened to the wall.
- G. Provide hoistway entrance with flush center opening hoistway doors for Elevators P-19 and P-20. Door panels shall be not less than 16-gauge stainless steel, flush type construction, and not less than 32 mm (1 1/4 in.) thick. Wrap stainless steel around the leading and trailing edges of the door panel. Top and bottom of door panels shall have continuous stiffener channels welded in place. Reinforcement of the door panels shall be approximately 1.0 mm (0.04 in.) in thickness and of the hat section type. At bottom of each and every panel, provide two

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removable laminated phenolic gibs or other approved material guides and a separate fire gib. Reinforce each door panel for hangers, interlock mechanism, drive assembly, and closer. One door panel for each entrance shall bear a BOCA label, Underwriters' label, or in lieu of this, labels from other accredited test laboratories may be furnished provided they are based on fire test reports and factory inspection procedures acceptable to the COR. Fasten sight guard of 14-gauge stainless steel, extending full height of panel, to leading edge of each panel of center opening doors.

- H. Provide hangers for hoistway door panels and provide relating devices to transmit motion from one door panel to the other. Fasten the hangers to the door sections. Provide reinforcements at the point of attachment. The hanger shall have provisions for vertical and lateral adjustments. Hang doors on two-point suspension hangers having sealed ball-bearing sheaves not less than 76 mm (3 in.) in diameter, with rubber or non-metallic sound-reducing tires mounted on a malleable iron or steel bracket. The hanger sheaves shall operate at a relatively low rotational speed, and shall roll on a high-carbon, cold-rolled or drawn steel track shaped to permit free movement of sheaves without regard to vertical adjustment of sheave, bracket or housing. Beneath the track and each hanger sheave, provide a hardened steel up-thrust roller capable of withstanding a vertical thrust equal to the carrying capacity of adjacent upper sheave. The up-thrust shall have fine vertical adjustments, and the face of the roller shaped so as to permit free movement of the hanger sheave. The up-thrust roller shall have ball or roller bearings. Provide the hanger sheaves with steel fire stops to prevent disengagement from tracks.
- I. Do not use hangers that are constructed integrally with the door panels.
- J. Provide raised numerals on cast, rear mounted plates for all openings. Numerals shall be a minimum of 50 mm (2 in.) high, located on each side of entrance frame, with centerline of 1524 mm (5 ft) above the landing sill. The number plates shall contain Braille.
- K. Provide unique car number on every elevator entrance at designated main fire service floor level, minimum 76 mm (3 in.) in height.

2.42 ELECTRIC INTERLOCKS

- A. Equip each hoistway door with an interlock, functioning as hoistway unit system, to prevent operation of car until all hoistway doors are locked in closed position. Hoistway door interlocks shall not be accepted unless they meet the requirements of ASME A17.1 Section 2.12.
- B. Equip car doors with electric contact that prevents operation of car until doors are closed unless car is operating in leveling zone or hoistway access switch is used. Locate door contact to prevent its being tampered with from inside of car. Car door contact shall not be accepted unless it meets the requirements of ASME A17.1 Section 2.12.
- C. Wiring installed from the hoistway riser to each door interlock shall be NEC type SF-2 or equivalent.
 - 1. Type SF-2 cable terminations in the interlock housing shall be sleeved with glass braid fillers or equivalent.
- D. Provide devices, either mechanical or electrical, that shall prevent operation of the elevator in event of damaged or defective door equipment that has permitted an independent car or hoistway door panel to remain in the "unclosed" and "unlocked" position.

2.43 CAR FRAME: PASSENGER ELEVATORS

- A. Car frame shall conform to the requirements of ASME A17.1 Section 2.15, constructed of steel plates and structural shapes securely riveted, bolted, or welded together. Iron casting shall not be permitted. The entire assembly shall be rugged construction, and amply braced to withstand unequal loading of platform. Car frame members shall be constructed to relieve the car enclosure of all strains. Balance car front to back and side to side. Provide balancing weights and frames, properly located, to achieve the required true balance.

2.44 CAR PLATFORM: PASSENGER ELEVATORS

- A. Construct the car platform to comply with all the requirements of ASME A17.1 Section 2.15.5. The platform shall be designed to withstand the forces developed under the loading conditions specified. Provide car entrances with extruded aluminum sill or better with machined or extruded guide grooves. Cover underside and all exposed edges of wood filled platform with sheet metal of not less than 27-gauge, with all exposed joints and edges folded under. Fire resistant paint is not acceptable. Platform shall have flexible composition flooring not less than 3 mm (1/8 in.) thick (by others - as specified in 09 65 16,

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RESILIENT SHEET FLOORING). Adhesive material shall be type recommended by manufacturer of flooring. Lay flooring flush with threshold plate and base.

- B. Provide a platform guard (toe guard) that meets the requirements of ASME A17.1 Section 2.15.9, of not less than 12-gauge sheet-steel on the entrance side, extend 76 mm (3 in.) beyond each side of entrance jamb. Securely brace platform guard to car platform, and bevel bottom edge at a 60-75 degree angle from horizontal. Install platform in the hoistway, so that the clearance between front edge and landing threshold shall not exceed 32 mm (1 1/4 in.).
- C. Isolate the platform from the car frame by approved rubber pads or other equally effective means.
- D. Provide adjustable diagonal brace rods to hold platform firmly within car suspension frame.
- E. Provide a bonding wire between frame and platform.

2.45 CAR ENCLOSURE: PASSENGER ELEVATORS

- A. Car enclosure shall have a dome height inside the cab of 2440 mm (8 ft).
- B. Securely fasten car enclosure to platform by through bolts located at intervals of not more than 457 mm (18 in.) running through an angle at the base of panels to underside of platform. Provide 6 mm (1/4 in.) bolts with nuts and lock washers.
- C. Car enclosure base shall be of 14-gauge stainless steel, 152 mm (6 in.) high. Provide straight type base at front return sides. Vertical face of base at sides and rear shall be flush with or recessed behind the wainscot directly above the base. There shall be no exposed fastenings in base. Provide natural ventilation openings divided equally between the bottom and top of the car enclosure that shall provide a minimum 3.5 percent of the inside car floor area.
- D. Construct canopy of not less than 12-gauge steel.
- E. Car top railings that meet the requirement of ASME A17.1 Rules 2.14.1.7 and 2.10.2.
- F. Front return wall panel, entrance columns, rear corner columns, entrance head-jamb and transom shall be 14-gauge stainless steel full height of car. **Rear wall shall be fully glazed with clear glazing materials, provided and installed by elevator manufacturer/supplier, and meeting industry requirements for operation and safety.** Side walls

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from top of base to top of panel shall be constructed of 14-gauge cold rolled steel. Side walls up to 1220 mm (48 in.) above finished floor shall be covered with stainless steel. Side walls from 1220 (48 in.) to the ceiling shall be covered with stainless steel. Apply directly to the cab walls or to 13 mm (1/2 in.) plywood/particle board that meets requirements of ASTM E 84, UL 723, and CAN/ULC-S102.2, whichever is applicable. Submit a method of fastening plywood/particle board to steel walls. It shall be flush with the face of the bottom section of the stainless steel. Interior shall be flush panel construction with angles welded on exterior to ensure adequate rigidity. Coat exterior of panels with mastic sound insulation material approximately 2.5 mm (3/32 in.) thick followed by a prime coat of paint. Mastic material shall conform to ASTM E1042.

- G. Provide a hinged top emergency exit cover. Exit shall be unobstructed when open and shall have mechanical stops on the cover. Provide a code approved exit switch to prevent operation of the elevator when the emergency exit is open.
- H. Provide duplex, GFCI protected type receptacle in car. Locate flush-mounted receptacle on the centerline of the main car operating panel, 150 mm (6 in.) above the car floor.
- I. Lighting for passenger elevators:
 - 1. Provide aluminum hanging ceiling frame. Construct frame of 1/8 in. x 1 1/2 in. x 1 1/2 in. "T" and "L" sections, divide ceiling into six panels.
 - 2. Provide fluorescent or LED illuminated car light fixtures above the ceiling panels. See Specification 265100, Interior Lighting for fixture and ballast type. Maintain a minimum light level of 50-foot candles at 914 mm (36 in.) above the finished floor.
- J. Provide a blower unit arranged to exhaust through an opening in the canopy. Provide a stainless or chrome plated fan grill around the opening. Provide 2-speed fan, capable of rated free delivery air displacement of approximately 380 and 700 cfm at respective speeds. Mount fan on top of car with rubber isolation to prevent transmission of vibration to car structure. Provide screening over intake and exhaust end of blower. Provide a 3-position switch to control the unit in the service panel.
- K. Provide car enclosure with two sets of stainless steel handrails.

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1. 75 mm (3 in.) wide x 9 mm (3/8 in.) thick flatstock located with centerlines 750 mm and 1050 mm (30 in. and 42 in.) above the car floor.
 2. Locate handrails 38 mm (1 1/2 in.) from cab wall. Install handrails on two side and rear walls. Curve ends of handrails to walls. Conceal all handrail fastenings. Handrails shall be removable from inside the car enclosure.
- L. Provide car entrance with single speed center opening horizontal sliding car doors, of same type as hoistway doors for Elevators P-19 and P-20. Construct door panels to be flush hollow metal construction, not less than 32 mm (1 1/4 in.) thick, consisting of one continuous piece 16-gauge stainless steel on car side face wrapped around the leading and trailing edges. Reinforce panels as required for installation of hangers, power-operating and door-opening devices. Hang doors on two-point suspension hangers having sealed ball-bearing sheaves not less than 76 mm (3 in.) in diameter, with rubber or non-metallic sound-reducing tires. Equip hangers with adjustable ball-bearing rollers to take upward thrust of panels. Upthrust rollers shall be capable of being locked in position after adjustment to a maximum of .38 mm (1/64 in.) clearance. Provide two laminated phenolic gibs on each door panel. Gibs shall be replaceable without removal of door panel. Provide door drive assembly, restrictor, gate switch, header, track, arms, and all related door hardware.

2.46 POWER DOOR OPERATORS: PASSENGER ELEVATORS

- A. Provide a high-speed heavy duty door operator to automatically open the car and hoistway doors simultaneously when the car is level with the floor, and automatically close the doors simultaneously at the expiration of the door-open time. Provide solid-state door control with closed loop circuitry to constantly monitor and automatically adjust door operation based upon velocity, position, and motor current. Motor shall be of the high-internal resistance type, capable of withstanding high currents resulting from stall without damage to the motor. The door operator shall be capable of opening a car door and hoistway door simultaneously, at a speed of .762 m (2.5 ft) per second. The closing speed of the doors shall be .3 m (1 ft) per second. A reversal of direction of the doors from the closing to opening operation, whether initiated by obstruction of the infrared curtain or the door "OPEN"

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button, shall be accomplished within 38 mm (1.5 in.) maximum of door movement. Emphasis is placed on obtaining quiet interlock and door operation; smooth, fast, dynamic braking for door reversals, stopping of the door reversal, and stopping of the doors at extremes of travel. Construct all levers and drive arms operating the doors, of heavy steel members, and all pivot points shall have ball or roller bearings. Auxiliary automatic door closers required under ASME A17.1 Section 2.11.3 shall be torsion spring type.

- B. Hoistway doors shall be manually operable in an emergency without disconnecting the power door operating equipment unless the car is outside the unlocking zone.
 - 1. It shall not be possible for the doors to open by power unless the elevator is within the leveling zone.
 - 2. Provide infrared curtain unit. The device shall cause the car and hoistway doors to reverse automatically to the fully-open position should the unit be actuated while the doors are closing. Unit shall function at all times when the doors are not closed, irrespective of all other operating features. The leading edge of the unit shall have an approved black finish.
- C. Should the doors be prevented from closing for more than a predetermined adjustable interval of 20 to 60 seconds by operation of the curtain unit, the doors shall stay open, the audio voice message and a buzzer located on the car shall sound only on automatic operation. **Do not provide door nudging.**
 - 1. If an obstruction of the doors should not activate the photo-electric door control device and prevent the doors from closing for more than a predetermined adjustable interval of 15 to 30 seconds, the doors shall reverse to the fully open position and remain open until the "Door Close" button re-establishes the closing cycle.
- D. Provide door "OPEN" and "CLOSE" buttons. When the door "OPEN" button is pressed and held, the doors, if in the open position, shall remain open and if the doors are closing, they shall stop, reverse and re-open. Momentary pressure of the door "CLOSE" button shall initiate the closing of the doors prior to the expiration of the normal door open time.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine work of other trades on which the work of this Section depends. Report defects to the COR in writing that may affect the work of this trade or equipment operation dimensions from site for preparation of shop drawings.
- B. Ensure that shafts and openings for moving equipment are plumb, level and in line, and that pit is to proper depth, waterproofed and drained with necessary access doors, ladder and guard.
- C. Before fabrication, take necessary job site measurements, and verify where work is governed by other trades. Check measurement of space for equipment, and means of access for installation and operation. Obtain dimensions from site for preparation of shop drawings.
- D. Ensure the following preparatory work, provided under other sections of the specification has been provided. If the Elevator Contractor requires changes in size or location of trolley beams or their supports and trap doors, etc., to accomplish their work, he must make arrangements, subject to approval of the CO, and include additional cost in their bid. Where applicable, locate controller near and visible to its respective hoisting machinery. Work required prior to the completion of the elevator installation:
 - 1. Supply of electric feeder wires to the terminals of the elevator control panel, including circuit breaker.
 - 2. Provide light and GFCI outlets in the elevator pit and control room.
 - 3. Furnish electric power for testing and adjusting elevator equipment.
 - 4. Furnish circuit breaker panel in control room for car and hoistway lights and receptacles.
 - 5. Supply power for cablighting and ventilation from an emergency power panel specified in Division 26, ELECTRICAL.
 - 6. Control room enclosed and protected from moisture, with self closing, self locking door.
- E. Supply for installation, inserts, anchors, bearing plates, brackets, supports and bracing including all setting templates and diagrams for placement.

3.2 SPACE CONDITIONS

- A. Attention is called to overhead clearance, pit clearances, overall space in control room, and construction conditions at building site in

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connection with elevator work. Addition or revision of space requirements, or construction changes that may be required for the complete installation of the elevators must be arranged for and obtained by the Contractor, subject to approval by CORCOR. Include cost of changes in bid that become a part of the contract. Provide proper, code legal installation of equipment, including all construction, accessories and devices in connecting with elevator, mechanical and electrical work specified.

- B. Where concrete beams, floor slabs, or other building construction protrude more than 50 mm (2 in.) into hoistway, bevel all top surfaces of projections to an angle of at 75 degrees with the horizontal.

3.3 INSTALLATION

- A. Perform work with competent Certified Elevator Mechanics and Apprentices skilled in this work and under the direct supervision of the Elevator Contractor's experienced foreman.
- B. Set hoistway entrances in alignment with car openings, and true with plumb sill lines.
- C. Erect hoistway sills, headers and frames prior to erection of rough walls and doors. Erect fascias and toe guards after rough walls are finished.
- D. Install machinery, guides, controls, car and all equipment and accessories in accordance with manufacturer's instructions, applicable codes and standards.
- E. Isolate and dampen machine vibration with properly sized sound-reducing anti-vibration pads.
- F. Grout sills and hoistway entrance frames.

3.4 ARRANGEMENT OF EQUIPMENT

- A. Clearance around elevator, mechanical and electrical equipment shall comply with applicable provisions of NEC. Arrange equipment in control room so that major equipment components can be removed for repair or replacement without dismantling or removing other equipment in the same control room.

3.5 WORKMANSHIP AND PROTECTION

- A. Installations shall be performed by Certified Elevator Mechanics and Apprentices to best possible industry standards. Details of the installation shall be mechanically and electrically correct. Materials and equipment shall be new and without imperfections.

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- B. Recesses, cutouts, slots, holes, patching, grouting, refinishing to accommodate installation of equipment shall be included in the Contractor's work. All new holes in concrete shall be core drilled.
- C. Structural members shall not be cut or altered. Work in place that is damaged or defaced shall be restored equal to original new condition.
- D. Finished work shall be straight, plumb, level, and square with smooth surfaces and lines. All machinery and equipment shall be protected against dirt, water, or mechanical injury. At final completion, all work shall be thoroughly cleaned and delivered in perfect unblemished condition.
- E. Beams, slabs, or other building construction protruding more than four inches into the hoistway, all top surfaces shall be beveled at an angle of at least 75 degrees to the horizontal.
- F. Sleeves for conduit and other small holes shall project 50 mm (2 in.) above concrete slabs.
- G. Hoist cables that are exposed to accidental contact in the pit shall be completely enclosed with 16-gauge sheet metal or expanded metal or guards.
- H. Exposed gears, sprockets, and sheaves shall be guarded from accidental contact in accordance with ASME A17.1 Section 2.10.

3.6 CLEANING

- A. Clean control room and equipment.
- B. Perform hoistway clean down.
- C. Prior to final acceptance; remove protective coverings from finished or ornamental surfaces. Clean and polish surfaces with regard to type of material.

3.7 PAINTING AND FINISHING

- A. Hoist machine, motor, shall be factory painted with manufacturer's standard finish and color.
- B. Controller, sheave, car frame and platform, counterweight, beams, rails and buffers, except their machined surfaces, cams, brackets and all other uncoated ferrous metal items shall be painted one factory priming coat or approved equal.
- C. Upon completion of installation and prior to final inspection, all equipment shall be thoroughly cleaned of grease, oil, cement, plaster and other debris. All equipment, except that otherwise specified as to

architectural finish, shall then be given two coats of paint of approved color, conforming to manufacturer's standard.

- D. Field painting of governors shall be in accordance with ASME A17.1 Rule 2.18.3.1.
- E. Stencil or apply decal floor designations not less than 100 mm (4 in.) high on hoistway doors, fascias or walls within door restrictor areas as required by ASME A17.1 Rule 2.29.2. The color of paint used shall contrast with the color of the surfaces to which it is applied.
- F. Elevator hoisting machine, controller, governor, main line shunt trip circuit breaker, safety plank, and cross head of car shall be identified by 100 mm (4 in.) high numerals and letters located as directed. Numerals shall contrast with surrounding color and shall be stenciled or decaled.
- G. Hoistway Entrances of Passenger Elevators:
 - 1. Door panels shall be parkerized or given equivalent rust resistant treatment and a factory finish of one coat of baked-on primer and one factory finish coat of baked-on enamel.
 - 2. Fascia plates, top and bottom shear guards, dust covers, hanger covers, and other metalwork, including built-in or hidden work and structural metal, (except stainless steel entrance frames and surfaces to receive baked enamel finish) shall be given one approved prime coat in the shop, and one field coat of paint of approved color.
- H. Elevator Cabs for Passenger Elevators:
 - 1. Interior and exterior steel surfaces shall be parkerized or given equivalent rust resistant treatment before finish is applied.
 - 2. Interior steel surfaces shall be factory finished with one coat of baked on enamel or proxylin lacquer or as recommended by manufacturer.
 - 3. Give exterior faces of car doors one finish coat of paint of medium gray color.

3.8 PRE-TESTS AND TESTS

- A. Pre-test the elevators and related equipment in the presence of the COR or his authorized representative for proper operation before requesting final inspection. Conduct final inspection at other than normal working hours, if required by COR.

1. Procedure outlined in the Inspectors Manual for Electric Elevators, ASME A17.2 shall apply.
 - a. Final test shall be conducted in the presence of and witnessed by an ASME QEI-1 Certified Elevator Inspector.
 - b. Government shall furnish electric power including necessary current for starting, testing, and operating machinery of each elevator.
2. Contractor shall furnish the following test instruments and materials on-site and at the designated time of inspection: properly marked test weights, voltmeter, amp probe, thermometers, direct reading tachometer, megohm meter, vibration meter, sound meter, light meter, stop watch, and a means of two-way communication.
- B. Inspect workmanship, equipment furnished, and installation for compliance with specification.
- C. Balance Tests: The percent of counterbalance shall be checked by placing test weights in car until the car and counterweight are equal in weight when located at the mid-point of travel. If the actual percent of counter balance does not conform to the specification, the amount of counterweight shall be adjusted until conformance is reached.
- D. Full-Load Run Test: Elevators shall be tested for a period of one hour continuous run with full contract load in the car. The test run shall consist of the elevator stopping at all floors, in either direction of travel, for not less than five or more than ten seconds per floor.
- E. Speed Test: The actual speed of the elevator shall be determined in both directions of travel with full contract load, balanced load and no load in the elevator. Speed shall be determined by applying a certified tachometer to the car hoisting ropes or governor rope. The actual measured speed of the elevator with all loads in either direction shall be within three (3) percent of specified rated speed. Full speed runs shall be quiet and free from vibration and sway.
- F. Temperature Rise Test: The temperature rise of the hoisting motor shall be determined during the full load test run. Temperatures shall be measured by the use of thermometers. Under these conditions, the temperature rise of the equipment shall not exceed 50 degrees Centigrade above ambient temperature. Test shall start when all machine room equipment is within five (5) degrees Centigrade of the ambient

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temperature. Other tests for heat runs on motors shall be performed as prescribed by the Institute of Electrical and Electronic Engineers.

- G. Car Leveling Test: Elevator car leveling devices shall be tested for accuracy of leveling at all floors with no load in car, balanced load in car, and with contract load in car, in both directions of travel. Accuracy of floor level shall be within plus or minus 3 mm (1/8 in.) of level with any landing floor for which the stop has been initiated regardless of load in car or direction of travel. The car leveling device shall automatically correct over travel as well as under travel and shall maintain the car floor within plus or minus 3 mm (1/8 in.) of level with the landing floor regardless of change in load.
- H. Brake Test: The action of the brake shall be prompt and a smooth stop shall result in the up and down directions of travel with no load and rated load in the elevator. Down stopping shall be tested with 125 percent of rated load in the elevator.
- I. Insulation Resistance Test: The elevator's complete wiring system shall be free from short circuits and ground faults and the insulation resistance of the system shall be determined by use of megohm meter, at the discretion of the Elevator Inspector conducting the test.
- J. Safety Devices and Governor Tests: The safety devices and governor shall be tested as required by ASME A17.1 Section 8.10.
- K. Overload Devices: Test all overload current protection devices in the system at final inspection.
- L. Limit Stops:
1. The position of the car when stopped by each of the normal limit stops with no load and with contract load in the car shall be accurately measured.
 2. Final position of the elevator relative to the terminal landings shall be determined when the elevator has been stopped by the final limits. The lower limit stop shall be made with contract load in the elevator. Elevator shall be operated at inspection speed for both tests. Normal limit stopping devices shall be inoperative for the tests.
- M. Oil Buffer Tests: These tests shall be conducted with operating device and limit stops inoperative and with contract load in the elevator for the car buffer and with no load in the elevator for the counterweight buffer. Preliminary test shall be made at the lowest (leveling) speed.

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- Final tests shall be conducted at contract speed. Buffers shall compress and return to the fully extended position without oil leakage.
- N. Setting of Car Door Contacts: The position of the car door at which the elevator may be started shall be measured. The distance from full closure shall not exceed that required by ASME A17.1. The test shall be made with the hoistway doors closed or the hoistway door contact inoperative.
 - O. Setting of Interlocks: The position of the hoistway door at which the elevator may be started shall be measured and shall not exceed ASME A17.1 requirements.
 - P. Operating and Signal System: The elevator shall be operated by the operating devices provided and the operation signals and automatic floor leveling shall function in accordance with requirements specified. Starting, stopping and leveling shall be smooth and comfortable without appreciable steps of acceleration or deceleration.
 - Q. Performance of the Elevator supervisory system shall be witnessed and approved by the representative of the COR.
 - R. Evidence of malfunction in any tested system or parts of equipment that occurs during the testing shall be corrected, repaired, or replaced at no additional cost to the Government, and the test repeated.
 - S. If equipment fails test requirements and a re-inspection is required, the Contractor shall be responsible for the cost of re-inspection; salaries, transportation expenses, and per-diem expenses incurred by the representative of the COR.

3.9 INSTRUCTION OF VA PERSONNEL

- A. Provide competent instruction to VA personnel regarding the operation of equipment and accessories installed under this contract, for a period equal to one eight hour day. Instruction shall commence after completion of all work and at the time and place directed by the COR.
- B. Written instructions in triplicate relative to care, adjustments and operation of all equipment and accessories shall be furnished and delivered to the COR in independently bound folders. DVD recordings will also be acceptable. Written instructions shall include correct and legible wiring diagrams, nomenclature sheet of all electrical apparatus including location of each device, complete and comprehensive sequence of operation, complete replacement parts list with descriptive literature, and identification and diagrammatic cuts of equipment and

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parts. Information shall also include electrical operation characteristics of all circuits, relays, timers, and electronic devices, as well as R.P.M. values and related characteristics for all rotating equipment.

- C. Provide supplementary instruction for any new equipment that may become necessary because of changes, modifications or replacement of equipment or operation under requirements of paragraph entitled "Warranty of Construction".

3.10 INSPECTIONS AND SERVICE: GUARANTEE PERIOD OF SERVICE

- A. **Reference BID ITEMS 12 and 13 in Section 01 00 00, GENERAL REQUIREMENTS.**

- B. Furnish complete inspection and maintenance service on entire elevator installation for a period of one (1) year after completion and acceptance of all the elevators in this specification by the COR. This maintenance service shall run concurrently with the warranty.

Maintenance work shall be performed by Certified Elevator Mechanics and Apprentices employed and supervised by the company that is providing guaranteed period of service on the elevator equipment specified herein.

- C. This contract will cover full maintenance including emergency call back service, inspections, and servicing the elevators listed in the schedule of elevators. The Elevator Contractor shall perform the following:

1. Bi-weekly systematic examination of equipment.
2. During each maintenance visit the Elevator Contractor shall clean, lubricate, adjust, repair and replace all parts as necessary to keep the equipment in first class condition and proper working order.
3. Furnishing all lubricant, cleaning materials, parts and tools necessary to perform the work required. Lubricants shall be only those products recommended by the manufacturer of the equipment.
4. Equalizing tension, shorten or renew hoisting ropes where necessary to maintain the safety factor.
5. As required, motors, controllers, selectors, leveling devices, operating devices, switches on cars and in hoistways, hoistway doors and car doors or gate operating device, interlock contacts, guide shoes, guide rails, car door sills, hangers for doors, car doors or

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- gates, signal system, car safety device, governors, tension and sheaves in pit shall be cleaned, lubricated and adjusted.
6. Guide rails, overhead sheaves and beams, counterweight frames, and bottom of platforms shall be cleaned every three months. Car tops and machine room floors shall be cleaned monthly. Accumulated rubbish shall be removed from the pits monthly. A general cleaning of the entire installation including all machine room equipment and hoistway equipment shall be accomplished quarterly. Cleaning supplies and vacuum cleaner shall be furnished by the Contractor.
 7. Maintain the performance standards set forth in this specification.
 8. The operational system shall be maintained to the standards specified hereinafter including any changes or adjustments required to meet varying conditions of hospital occupancy.
 9. Maintain smooth starting and stopping and accurate leveling at all times.
- D. Maintenance service shall not include the performance of work required as a result of improper use, accidents, and negligence for which the Elevator Contractor is not directly responsible.
- E. Provide 24 hour emergency call-back service that shall consist of promptly responding to calls within two hours for emergency service should a shutdown or emergency develop between regular examinations. Overtime emergency call-back service shall be limited to minor adjustments and repairs required to protect the immediate safety of the equipment and persons in and about the elevator.
- F. Service and emergency personnel shall report to the COR or his authorized representative upon arrival at the hospital and again upon completion of the required work. A copy of the work ticket containing a complete description of the work performed shall be given to the COR or his authorized representative.
- G. The Elevator Contractor shall maintain a log book in the control room. The log shall list the date and time of all weekly examinations and all trouble calls. Each trouble call shall be fully described including the nature of the call, necessary correction performed or parts replaced.
- H. Written "Maintenance Control Program" shall be in place to maintain the equipment in compliance with ASME A17.1 Section 8.6.

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