

Basis of Design

This section applies to passenger and freight elevators.

Background

- The AHJ (Authority Having Jurisdiction) is Labor and Industries State Elevator Inspector. AHJ for Fire Safety is the Seattle Fire Department.

Programming

- Provide a traffic analysis to determine capacity and speed requirements. Where elevators are the primary means of access provide requirement that the waiting time not exceed 30 seconds.
- In multi-elevator situations, size and speed shall be such that with one elevator out of service, the other elevator(s) shall be able to handle 60% to 80% of the normal traffic load.
- Provide for a practical alternative for maintaining accessibility per ADA Title II when the primary elevator is out of service.
- Provide stops at mechanical penthouse(s) and basements.

Design Criteria

- Hydraulic elevators are restricted to a shaft length of 50 feet and five stops maximum. Telescoping hydraulic, hole-less hydraulic and roped hydraulic elevators are not acceptable. Do not use hydraulic type where the water table is high enough to be in contact with piston cylinder assembly.
- Provide traction elevators in buildings with more than five stops and in buildings with high traffic. AC elevators are not acceptable due to higher than acceptable total harmonic distortion.
- Dual-purpose freight/passenger elevators can be substituted for dedicated freight elevators in special situations or as a practical alternative as programming requirements indicate.
- Stair railing mounted wheelchair lifts are unacceptable. Wheelchair lifts are only allowed in specific, special circumstances. Coordinate with Campus Engineering and Project Manager.
- Renovated elevators shall be upgraded to meet current Elevator Code to the extent practical.
- Provide tamper/vandal resistant cab signals, hall call station signals and lighting systems.
- Car interior wall finishes shall be durable and low maintenance. Floor finishes shall be durable and non-slip. Ceiling finishes shall be durable and easily cleaned. Bright, mirror-like finish for stainless steel is not desired because of the difficulty with cleaning and repair.
- Size shaft/hoistway to accommodate all manufacturers for the type of elevator specified. Do not provide a shaft/hoistway that accommodates only one manufacturer's size of elevator.
- Provide seismic detectors.
- Pit shall have clearances under car for safety of workers in the pit. Access shall be by ladder or walk-in type of pit.
- Locate call buttons at 36 inches AFF from button nest centerline.
- Consider a reflective roof coating and an exhaust fan at machine room to maintain code mandated temperature and reduce energy consumption. Provide an analysis to confirm performance. If the coating and exhaust fan does not reduce heat gain, provide mechanical cooling.
- Response time for emergency by elevator contractor during warranty period shall be 2 hours minimum.

Electrical

- The most common power supply is 480Y/277 volt, 3 phase, 4 wire grounded; 208Y/120, 3 phase, 4 wire grounded power supply is acceptable.
- Lighting power supply is 208Y/120 volts. Provide a breaker disconnect in the machine room.
- Analyze power supply to address power quality, particularly total harmonic distortion. Refer to Elevators guide specification for specific requirements.
- Provide additional phone line to machine room for future remote controller interface.
- Connect passenger elevators to campus emergency power system and have automatic single service recall operation.
- Elevator pit(s) shall have a light for general illumination and a GFI outlet. Provide for required electrical power for testing and adjusting equipment.
- Emergency Power: Refer to Electrical – Emergency Power Systems.

Mechanical

- Provide machine room with temperature control and/or ventilation to maintain operating temperature as required by manufacturer for equipment operation.
- Provide shaft pressurization as required. Refer to Architectural - Roofing for roof-mounted equipment. Center closing doors perform best for maintain shaft pressure. Reduce the car/shaft gap when doors are open to maintain shaft pressure.

Design Evaluation

The following information is required for evaluation of the design:

- Schematic Design Phase: Provide description of type of use, traffic study outlining anticipated volume, type of traffic, and peak times of usage, disabled persons' accommodations, locations, security issues and access control issues.
- Design Development Phase: Provide layout of elevators, machine rooms and utility connections including emergency power, pressurization if provided, and fire alarm. Provide car layout with interior finishes and lobby and/or hall layout indicating location of all components. Provide structural design information regarding shaft construction, seismic consideration and related issues. Outline specification.
- Construction Document Phase: Completed design. Final specifications.

Construction Submittals

- Refer to attached Elevators guide specification.

Related Sections

- Facilities Services Design Guide - Finishes
- Facilities Services Design Guide - Interior Partitions
- Facilities Services Design Guide - Roofing – Roof-mounted equipment
- Facilities Services Design Guide - Electrical – Emergency Power Systems
- Facilities Services Design Guide - Mechanical – HVAC
- Facilities Services Design Guide - Nonstructural Component Seismic Design - Structural

Products, Materials and Equipment

- Refer to attached Elevators guide specification.

Installation, Fabrication and Construction

- Refer to attached Elevators guide specification.

END OF DESIGN GUIDE SECTION

GUIDE SPECIFICATION

The following Guide Specification is intended to be typed, generally verbatim, into the contract specification. An asterisk beside an item in the following indicates an item which is variable for each project. Where [] appear, this indicates requirements which are optional depending upon the type of elevator being provided. The handling of such items will be decided by consultation between the Project Manager, the A/E, Plant Engineering, and Environmental Health and Safety (EHS). The A/E is expected to modify other portions as necessary to accurately reflect conditions of the project.

ARCHITECTURAL – ELEVATORS

PART 1 - GENERAL

1.01 SCOPE

- A. Contractor shall provide all services and materials to furnish and install an [electric hydraulic] elevator, [passenger/freight elevator], or [passenger elevator with freight capability] as described by the contract documents.
1. General Conditions, Amendments to the General Conditions, Special Conditions, Instruction to Bidders, Division 1 and all addenda of these specifications are part of the Elevator Specifications.
 2. Applicable documents
 - a. Americans with Disabilities Act Accessibility Guidelines (ADAAG), and the equivalent Washington state codes, whichever are more stringent
 - b. Washington State regulations, including the following:
 - (1) Chapter 296-81 WAC, Safety Rules Governing Elevators, Dumbwaiters, Escalators and other Lifting Devices – Moving Walks
 - (2) Chapter 296-86 WAC, Regulations and fees for freight and passenger elevators, manlifts, dumbwaiters, escalators, moving walks, automobile parking elevators, personnel elevators, and other lifting devices
 - (3) Chapter 296-95 WAC, Rules and Regulations for electric elevator, direct plunger and roped hydraulic elevators, escalators used to transport passengers, electric and hand-powered dumbwaiters, and hand-powered elevators
 - (4) Within this section, these are referred to collectively as the Elevator Safety Code. Any reference herein to the Elevator Safety Code includes the applicable provisions of any and all of these chapters of WAC.
 - c. ASTM A167, Steel, Sheet Stainless
 - d. ASTM A366, Steel, Sheet, Carbon, Cold Rolled, Commercial Quality
 - e. AWS D1.1, Structural Welding Code - Steel
 - f. NFPA 70, National Electric Code

3. Permits and codes

- a. All equipment and installation work shall comply with requirements of the Elevator Safety Code, and other applicable codes of the State of Washington, County and City.
- b. Give necessary notices, obtain licenses and permits, and pay fees and other costs, including making arrangements for all inspections and tests required by regulating agencies, in accordance with the General Conditions as amended, the Supplemental Conditions, and Division 1 of this specification.
- c. File necessary plans, prepare documents, and obtain necessary approval of governmental departments having jurisdiction and required certificates of inspection for work, in accordance with the General Conditions as amended, the Supplemental Conditions, and Division 1 of this Specification, and deliver these to the Architect before requesting acceptance and final payment for work.
- d. Contractor is not relieved from furnishing and installing work shown or specified which may be beyond requirements of ordinances, laws, regulations and codes.

1.02 CONSTRUCTION DRAWINGS

A. [If provided], Drawings are partly schematic in nature and do not attempt to show exact details.

1. The Contractor shall carefully check space requirements to ensure that equipment being provided can be installed in the spaces allotted.
2. No extra will be allowed for differences between actual measurements and scaled measurements or stationing.

B. [Alternate for renovation]

1. Drawings are partly schematic in nature.
 - a. The drawings show the best known location of existing equipment but do not attempt to show exact details.
 - b. The Contractor shall verify exact distances between points shown on the drawings by actual measurements at the site.
 - c. No extra will be allowed for differences between actual measurements and scaled measurements or stationing.

C. Cutting and patching: Openings required in the exterior of the existing structure shall be made by drilling or cutting. Contractor shall provide all pipe sleeves, anchor plates, hanger supports, inserts, and bolts required for this work. [Applicable to renovation only]

D. Demolition: Remove existing elevator and ancillary equipment. Remove all equipment to be disposed of from the site. [Applicable to renovation only]

E. Standard products: Unless otherwise indicated, the equipment to be furnished under these specifications shall be the standard products of manufacturers regularly engaged in its production.

1. Apparatus, equipment and systems furnished must be similar and equal with respect to quality, functional performance, capacity and efficiency.

2. Where the actual equipment furnished requires certain changes in pipe location, controls, electrical equipment and foundations, the Contractor shall coordinate such changes and submit them for approval.
- F. Submittals: Submit shop drawings for approval. They shall contain enough detailed information to determine that the equipment conforms to the requirements of this specification and not less than the following information:
1. Elevator diagrams showing service to each level of building
 2. Show location of machinery and controls in machine rooms, layout of the hoistway in plan and elevation and all other layout information and clearance dimensions required by the Elevator Safety Code.
 3. Arrange the elevator equipment in a neat and workman-like manner so that all valves, fittings, etc. are readily accessible.
 4. Submit layout drawings as required by WAC 296-86A-040 to the authority having jurisdiction (AHJ).
 5. Submittals to the AHJ shall have all information pertinent to the installation to determine whether the installation complies with all applicable codes.
 6. Provide shop drawings and catalog cuts for all contractor-furnished material and equipment, including but not limited to doors, frames, car enclosure, car frame, car and hall fixtures, controls, motors, guide rails, and brackets. Motor data must include temperature rise ratings in a form that can readily be measured in the field after installation.
 7. [Traction Elevators]¹ Arrangement and connection details of machine beams, deflector sheaves, and rails. Provide calculations and drawings for the City of Seattle, DCLU, structural evaluation.
 8. [Traction Elevators] Arrangement and connection details of pit equipment including buffers, compensating devices (if any), and pit ladder
 9. [Hydraulic Elevators] Coordination information including excavation requirements for the jacks; rail, buffer and jack beam reactions; and data as specified in Rule 300.7 and Rule 301.2 of the Elevator Safety Code
 10. Complete information on motor, electrical services, controls, and all other coordination information.
- G. Wiring diagrams: Provide complete and legible wiring and single line diagrams showing the electrical connections, functions, and sequence of operation of all apparatus connected with the elevators, both in the machine room and in the hoistway. Provide three sets laminated and bound into three-ring binders 12" x 18". Furnish one complete draft set for Owner review not later than two weeks after issue of the permanent state operating certificate.

¹ Usual practice is for the elevator contractor to provide the machine and sheave beams, the rails, and the connections of these to the structure. He is also required to provide data on the loads imposed on the pit floor by rails (safety application), buffers, and hydraulic jacks. Showing compliance with this chapter 24 of the Elevator Safety Code requires submission of drawings and calculations for review by the City of Seattle, and/or by the Architect/Engineer.

- H. Installation data: Provide "as installed" wireman's original pull sheets showing raceway, junction box, traveling cable wire nomenclature and origination and termination locations. Provide a legible copy of the adjuster's final control settings.
- I. Operations and maintenance manuals
1. Furnish an operation and maintenance manual covering the stipulated mechanical systems and equipment. The manual shall comply with all requirements indicated in the Project Closeout section of the specifications. Furnish one complete draft manual for Owner review not later than two weeks after issue of the permanent state operating certificate.
 2. The manual shall be complete in all respects for all equipment, controls, accessories and appurtenances stipulated. Include as a minimum the following:
 - a. Drawing or diagram showing equipment location
 - b. The original factory Adjuster's Manual used to adjust the specific installation (including "as-adjusted" field notes)
 - c. Step-by-step procedure for start-up, operation and shutdown
 - d. Maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides for all elevator equipment, including brakes and door equipment. [Hydraulic Elevators only] Include oil flow schematic diagrams and adjusting instructions for hydraulic valves and pumps. Include cross section of seals and retainer and procedures for packing hydraulic jack(s). Provide specification for hydraulic oil.
 - e. Preventative maintenance schedule
 - f. Lubrication schedule including type, grade, temperature, range and frequency
 - g. Safety precautions, including diagrams and illustrations as needed for clarity
 - h. Test procedures
 - i. Parts list, with manufacturers' names and catalog numbers. Lists shall be complete for the materials installed.
 - j. Serial number of each major piece of equipment
 - k. Service organizations and sources of spare parts with names, addresses, and telephone numbers
 - l. Provide all service and field technical bulletins or manuals normally supplied to the factory Adjuster including video tapes or other media.
 - m. Add the University of Washington Elevator Shop to the mailing list for receiving factory technical instruction publications.

1.03 MATERIAL AND EQUIPMENT

- A. General: Material and equipment shall be new, of the best quality used for the purposes in good commercial practice, the best of their respective kinds, and as specified. Equipment shall be standard products of reputable manufacturers. Where two or more units of the same class of equipment are required, those units shall be products of a single manufacturer. Furnish equipment

complete with all parts necessary for proper operation. Material and equipment shall be cleaned, free of corrosion, and selected to provide quiet operation.

- B. Type capacity, size and rating of all equipment shall be as indicated on the Drawings, and/or as specified in this section.
- C. Delivery and storage: Material and equipment shall be suitably protected against corrosion, dirt, mechanical damage, weather and chemical damage before and during installation as recommended by the manufacturer and as approved by the Architect. Replace defective and damaged equipment and materials.

1.04 ELEVATOR-ELECTRICAL

- A. Provide electrical components of the elevator equipment and systems, including motors, motor starters, controllers, control instruments, switches, conduit, wire, and relays under this Division as specified in this section and as necessary for complete and operable systems. Furnish interconnecting wiring for components of equipment as an integral part of the equipment. Interconnecting conduit and wiring connecting such assemblies shall conform with Division 16.
- B. Electrical equipment and wiring shall conform to applicable paragraphs of Electrical Specifications and National Electrical Code.
- C. For equipment with electrical components, provide UL label on each component for which published standards exist.

1.05 PAINTING

- A. All exposed metal work furnished in these specifications, except as otherwise specified, shall be properly painted after installation.

1.06 MAINTENANCE

- A. Provide maintenance service of the equipment for a period of twelve months after issue of the permanent state operating certificate.
 - 1. This service shall include regular systematic examinations of the installation by competent and trained employees of this Contractor; and shall include all necessary adjustments, lubrication, cleaning, supplies and parts to keep this equipment in operation, except such parts made necessary by misuse, accidents or negligence not caused by this Contractor.
 - 2. Provide written reports of each service call, whether routine or emergency, describing services performed.
 - 3. Basic service work shall be performed during regular working hours of regular working days. Emergency callback service shall be available on a 24-hour, 7-day basis. Response time shall be 2 hours maximum.

- B. The final elevator installation shall be maintainable by a trained elevator mechanic without the need to purchase or lease additional tools or software to diagnose problems and/or change operational parameters of the elevator system.
1. All tools and software necessary to diagnose problems and/or change operational parameters of the elevator system shall be retained by the Owner and shall function for the life of the installed equipment.
 2. Hardware and software needed for diagnosis and operating parameter modification shall be products offered as standard by the manufacturer of the control system.
 3. No substitutions of proprietary circuit boards, EPROMS, hardware locks, software passwords or coding shall be allowed.
 4. As a condition of the installation, the original equipment manufacturer shall guarantee to sell and deliver, on a timely basis, replacement parts and software updates to the University and to a third-party elevator maintenance company [medical center elevators] at a fair market price.

1.07 SPARE PARTS

- A. Provide new spare parts required for maintenance of the elevator, including a complete set of fuses and contacts for all control equipment. The spare parts shall be placed in a cabinet, approximately 36 inches wide, 18 inches deep and 42 inches tall, provided by the Contractor, with doors equipped with a lock and two keys. No University of Washington spare parts will be available to the contractor for use during the warranty period. The cabinet shall be mounted in the machinery room as directed. The minimum spare parts are as follows:
1. One door operator motor
 2. One of each type of door operator circuit board for each three cars or fraction
 3. One set of car door hanger sheaves for each car
 4. One set of hoistway doors hanger sheaves for each five hoistway doors or fraction
 5. One set of door pickup rollers
 6. One complete door interlocks for each five hoistway doors or fraction
 7. One car gate switch per five cars or fraction
 8. Cables and circuit boards for door protective devices, one of each type
 9. Spare printed circuit board of each type in the controller and power supply, one set per 5 cars or fraction. Included, but not limited to, spare circuit boards for the following: Controller, button nest, car top, hoistway, hallway, machine room and all boards in the variable voltage AC or SCR drive(s)
 10. Three spare lamps of each size and type per car
 11. One set of each type of car guide rollers per 5 cars or fraction
 12. Two hoistway limit switches
 13. One terminal landing button assembly for each two assemblies installed.

14. One intermediate landing button assembly for each five assemblies or fraction installed
 15. One set of each type of counterweight guide rollers per five counterweights or fraction
 16. The following shall apply to hydraulic elevators only:
 - a. One replacement valve assembly for each type
 - b. One complete set of pump and jack seals and gaskets
- B. Deliver the spare parts not later than two weeks after issue of the permanent state operating certificate.
1. Conduct an inventory with the elevator shop.
 2. Schedule the inventory not less than one week in advance.
- C. Diagnostic tools and any necessary software shall be delivered to the elevator shop not later than two weeks after issue of the permanent state operating certificate.

1.08 WARRANTY

- A. Warrant the completed elevator(s) in accordance with Washington State law and regulation, but in no case less than complete coverage of parts and labor for one year after issue, by the State, of the permanent operating permit.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The completed elevator installation shall conform to the Elevator Safety Code except as specifically otherwise indicated or specified.
1. The installation, including equipment, material, workmanship, design, and tests shall be in accordance with the standards, rules and specifications referenced.
 2. All material and equipment shall be new.
 3. Electrical materials shall meet and bear evidence of meeting the requirements of Underwriter's Laboratories or Factory Mutual Systems.
 4. The equipment shall be the product of a manufacturer regularly engaged in the manufacture and installation of this type of equipment.
 5. Working parts shall be accessible for inspection, servicing and repair.
 6. Adequate means shall be provided for the lubrication of all wearing parts that require lubrication.

B. DESCRIPTION AND PERFORMANCE: Installation will be in accordance with the following details and consist of:

- | | |
|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Quantity and type | [] New Electric [Traction, Hydraulic] Elevator(s) |
| 2. Load (capacity) ² | [] Pounds |
| 3. Car speed | [] Feet per minute |
| 4. Leveling | +/- ³ / ₈ inch with any load |
| 5. Operation | Passenger or dual purpose elevators: Selective Collective Automatic as normal mode, Car-Switch Automatic Floor-Stop mode or functional equivalent selectable by switch. [Freight Elevators] Car-Switch Automatic Floor-Stop mode or functional equivalent. |
| 6. Performance, floor-to-floor ³ | [] seconds for [] feet rise |
| 7. Control | Solid state microprocessor |
| 8. Power supply | Primary power to be [208, 480] volts, 3 phase, 60 hertz, secondary power supply (to traction motors) to be solid state. ⁴ |
| 9. Rise | [] feet |
| 10. Number of stops | [] |
| 11. Number of openings | [] at front of hoistway, [] at rear. |
| 12. Lighting supply | 120 volts, 1 phase, 60 hertz |
| 13. Clear car inside ⁵ | Not less than [] square feet clear floor area |
| 14. Type of doors for car and entrances | [Single speed, two speed] ⁶ hoistway
[center opening, side opening] |
| 15. Hoistway entrance and car opening size | [] wide X [] high |

2.02

² In specifying the load limits of freight or dual-purpose elevators, consideration should be given to the potential for misuse. For example, if paper or other dense material is to be moved from floor to floor, the potential for overload should be considered. If a forklift truck or other heavy-lift vehicles are to be used or readily available around the elevator, Class C machines should be considered.

³ This is defined as the start of door movement to close until 90% open at the next landing. Standards are about 6 seconds for traction machines, more for hydraulic. This item is important only in buildings with heavy dependence on elevators.

⁴ Add any emergency power requirements for one or more cars.

⁵ If programming indicates a need for special inside car dimensions (e.g. for a particular size of supply cart) put the requirements here. This will apply to inside height as well as clear floor dimensions.

⁶ For heavily used elevators, single-speed center opening doors are preferred. In all installations, no more than two panels per opening are preferred.

GENERAL MATERIALS

- A. Where stainless steel is specified, it shall be corrosion resisting steel, Type 304 with 150-grit finish on exposed surfaces. Stainless steel shall have the grain of belting in the direction of the longest dimension. All surfaces shall be smooth and without waves. . Bright, mirror-like finish for stainless steel is not acceptable because of the difficulty with cleaning and repair.
- B. Where cold-rolled steel is specified, it shall be low carbon steel rolled to stretcher level standard flatness, commercial quality, Class 1, matte finish, complying with ASTM A 366.
- C. Tamper-proof screws shall be used throughout for all face plates.
- D. All light globes shall be 5,000-hour long-life, minimum.
- E. All elevator keys shall be installed to match the University standards, Elevator Products Company #2, as manufactured by Chicago Lock Company, for fireman's control switch key, and Elevator Products Co. #1 for all other keys, except hatch access shall be EPCO 27. Coordinate with building manager for specific keyed floor call locations. All lockout calls shall be overridden by Fire Service. Provide three keys of each type per elevator.

THE FOLLOWING IS FOR TRACTION ELEVATORS⁷

2.03 ELEVATOR MACHINERY

- A. Machine
 - 1. A [geared, gearless] traction machine, designed and manufactured to meet or exceed the requirements of the specified duty, shall be furnished.
 - a. It shall include driving motor, direct current electro-mechanical brake, [steel worm, bronze gear,] and traction sheave, all mounted on a base or bedplate.
 - b. [The worm shall be high grade steel and the worm gear shall be phosphor bronze of best quality.
 - c. The end thrust of worm shaft shall be taken by high grade self-aligning ball bearings, in both directions.]
 - d. The traction sheave shall be of heavy alloy iron, accurately turned and grooved for the hoist ropes.
 - e. The traction sheave shall have seismic rope retainers, and dust proof bearings with suitable means for ample lubrication [and adjustable supporting shaft for proper alignment of the worm and gear.]
 - f. [Soundproofing shall be provided for the geared machine, designed to minimize the transmission of noise and vibration to the building structure.]
 - g. Safety guards on exposed rotating equipment and cable guards on new and existing equipment shall be provided.

⁷ Alternate sections are presented for conventional traction and direct-action hydraulic machines.

B. Motor

1. The motor shall be especially designed for elevator service. It shall have torque and speed capability ample for the specified duty when operated with the solid-state power supply and control system furnished.

C. Sheaves

1. Deflecting sheaves shall be of heavy alloy iron, accurately grooved to fit ropes, of suitable size according to conditions, and fitted with heavy steel shaft. Finished installation shall include seismic roper retainers.

D. Beams

1. The hoist machine and sheaves shall be supported by structural beam(s).

E. Governor

1. The car over-speed controls and safety shall be operated by a centrifugal speed governor located at the top of the hoistway in the machine room. Provide Hollister – Whitney, with no substitutions.

F. Buffers

1. [Oil buffers, spring buffers] shall be installed in the pit as a means for stopping the car and counterweight at the bottom limits of travel. Provide for adequate working space below car when the car is at the lowest level of travel.

G. Guide rails

1. Steel guide rails that meet the requirements of the Elevator Safety Code shall be provided for each car and counterweight.

H. Roller guides

1. Polyurethane roller guides, ElSCO, or approved substitution, shall be provided for each car and counterweight. Car rollers shall have a minimum diameter of 6 inches. Finished installation shall include seismic roller retainers.

I. Counterweight

1. A counterweight with steel frame and filler weights restrained as required by the Elevator Safety Code shall be furnished.

J. Counterweight guard

1. A metal counterweight guard shall be furnished and installed at the bottom of the hoistway.

K. Ropes

1. The hoist ropes shall be elevator rope as required by the Elevator Safety Code.

THE FOLLOWING IS FOR HYDRAULIC ELEVATORS⁸

2.03 ELEVATOR MACHINERY

- A. Each elevator shall have a positive displacement hydraulic pump driven by an electric motor and operating a hydraulic cylinder with direct plunger. The machine and all its components shall meet the requirements of the Elevator Safety Code.

2.03.1 POWER UNIT

- A. Each elevator shall include a power unit consisting of the motor, pump, drive assembly, oil control unit, oil reservoir, and oil drip pan, all mounted on a structural steel base and supports. Each power unit shall have the capability of delivering oil pressure and volume to lift the assembled elevator with rated load at rated speed. Volume of each oil reservoir shall be sufficient to lift its elevator through the rise specified, plus normal overtravel. Each power unit shall have a muffler in the discharge oil line near the pump and an enclosure of steel panels lined with sound-absorbing material.
- B. Maximum sound generation of 60 dbA within the range of 20 Hz to 20 KHz, measured within the machine room

2.03.2 HYDRAULIC PUMP

- A. The pump shall be a submerged self-contained power unit or a discrete pump-motor set mounted outside the oil reservoir. The pump shall be designed and manufactured for oil-hydraulic elevator service. It shall provide steady discharge with minimum pulsations, and its output shall not vary more than 10% between no-load and full-load conditions of the elevator car.

2.03.3 PUMP MOTOR

- A. The pump motor shall be designed for oil-hydraulic elevator service, of standard manufacture, and of duty rating to provide the service specified herein.

2.03.4 DRIVE ASSEMBLY

- A. Drive assembly shall be either direct coupling or multiple V-belts and sheaves. The number and size of belts and sheaves shall be sufficient to assure continued safe operation with a single belt failure.

2.03.5 OIL CONTROL UNIT

- A. The oil control unit shall include the necessary valves all built into a single housing; welded manifolds with separate valves for each function will not be accepted. All adjustments shall be accessible and shall be made without removing the assembly from the oil line.
 - 1. Relief valve shall be externally adjustable and shall be capable of bypassing the total oil flow without increasing back pressure more than 50% above working pressure.
 - 2. Up start and stop valve shall be externally adjustable, and designed to bypass oil flow during start and stop of the motor pump assembly. Valve shall close slowly, insuring smooth up starts and stops.

⁸ Machine-room-less, hole-less and roped hydraulic elevators are unacceptable.

3. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.
4. Lowering valve and leveling valve shall be externally adjustable for drop-away speed, lowering speed, leveling speed and stopping speed to insure smooth down starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling when slowdown is initiated.

2.03.6 HYDRAULIC JACK

- A. A hydraulic jack assembly that meets the requirements of the Elevator Safety Code shall be mounted under the car platform.
 1. Cylinder shall be formed from seamless or drawn-on-mandrel steel tube, protected on the exterior with triple fiberglass wrapping sealed with epoxy resin. The cylinder may be provided in sections, provided they are factory assembled, inspected and approved for alignment, and marked for proper reassembly at the site. Length of each cylinder shall be sufficient to accommodate the matching plungers. Diameter of each cylinder shall be sufficient for sleeving at some future time.
 2. Plunger shall be polished seamless steel tubing or pipe. Length of each plunger shall be sufficient to lift its car through the rise specified, plus normal overtravel. Plunger shall be provided in sections not exceeding 16 feet per section, joined with internal threaded couplings. It shall be factory polished while assembled and marked for proper reassembly at the project site.

2.03.7 PIPE AND FITTINGS

- A. Provide pipe and fittings of the size, type and weight recommended by the manufacturer. Provide two manual gate or ball valves in line for each elevator, one adjacent to pump and one adjacent to the jack.
- B. SAFETY VALVE: Provide a safety (rupture) valve in each oil hydraulic line in accordance with Rule 2410.6.

2.03.8 BUFFERS

- A. Spring buffers shall be installed in the pit as a means for stopping the car at the bottom limits of travel. Provide for adequate working space below car when car is at the lowest level of travel.

2.03.9 GUIDE RAILS

- A. Provide steel guide rails that meet the requirements of the Elevator Safety Code.

2.03.10 LOW OIL INDICATOR

- A. Provide indicator light on controller to indicate that reservoir is low on oil.

2.03.11 HYDRAULIC OIL

- A. Provide hydraulic fluid that meets the requirements of the elevator manufacturer with minimum flammability.

2.04 ELEVATOR CAR

- A. CAR FRAME, PLATFORM, AND SAFETY: Provide a car frame and platform fabricated from steel with a safety plank with [Type A, Type B, Type C] car safeties. [Traction and roped hydraulic machines only]
- B. SLING ISOLATION: [Traction machines] Each car shall include a means to isolate the complete car enclosure from the sounds and vibrations transmitted from the machine room through the hoist ropes. The preferred method is spring isolation of the complete car sling and enclosure assembly from the hoist rope terminations at the car sling. Acceptable alternates include:
1. A rubber mounted hitch plate
 2. A platform mounted on rubber pads
- C. CAR ENCLOSURE: The car enclosure shall be steel and shall comply with the Elevator Safety Code. Exterior of car enclosure shall receive a sound-deadening material coating.
1. CAR FRONT: Return panels with integral entrance columns of 14 ge minimum satin finish stainless steel shall extend from finished floor to underside of the dome. Return panel(s) shall be arranged for the mounting of applied fixtures.
 2. CAR TOP: The car top shall not be thinner than 14 ge cold-rolled steel suitably reinforced. Finish shall be [matte white painted or as selected for the specific project].
 3. HANDRAILS ON SIDES AND REAR: 1 ½-inch round handrails [stainless steel or as selected for the specific project] shall be provided on the two sides [and at the rear of the car enclosure, single-door cars only].
 3. WALL AND FLOOR FINISH: Furnish and install [stainless steel and laminate interiors of the style offered as standard by the car manufacturer, or as selected for the specific project. Freight cabs will usually be painted steel]. Furnish and install [sheet vinyl floors, or as selected for the specific project, on passenger and dual purpose cars][2-inch tongue-and-groove, kiln-dried oak flooring, or steel with embossed nonskid pattern, or as otherwise selected, on freight cars]. Ceramic tile or other brittle, non-resilient material is not to be used, except by specific direction of the University. Colors will be selected by the Owner from samples offered as standard by the car manufacturer.
 4. PROTECTIVE PAD HOOKS AND PADS [for passenger elevators that may occasionally be used to move furniture or small quantities of construction materials]: Protective pad hooks [of stainless steel or as selected for the specific project] and fire retardant protective pads of quilted canvas duck shall be provided at all walls except the entrance walls. [If a group of two or more elevators, select one of the group for this provision].
 5. EXHAUST FAN: A two-speed exhaust fan, Nylube X12F9, or approved substitution, shall be mounted on the car top.
 - a. [Alternate] EXHAUST FAN AND HEATER: A two-speed exhaust fan, Nylube X12F9, or approved substitution, shall be mounted on the car top. A fan-forced electric heater with selectable 800-watt and 1200-watt elements shall be mounted in the front wall or side wall near the car operating panel, exact location to be approved by the Architect.

6. **CAR OPERATING PANELS:** A two-segment car operating panel shall be furnished inside the car; by EPCO; no substitutions. A car top operating station shall be furnished. The inside panels shall be configured as follows:
 - a. An accessible panel segment shall contain a bank of illuminated, tamper-resistant buttons marked to correspond to the landings served, an emergency call button, keyed stop switch, and door-open button. The emergency call button shall be connected to a bell that serves as an emergency signal. Raised Braille markings which comply with requirements for the handicapped shall be furnished for the car buttons. Locate the center of each button cluster at 42 inches above the finished floor.
 - b. Provide an auxiliary panel with call buttons at the opposite return on larger cars with center-opening doors. Provide an auxiliary panel with call buttons at the rear door of two-door cars. For large, two-door cars, center-opening doors, in high-volume service, consider three auxiliary panels, so that there are call buttons on each of the four door returns.
 - c. An access-controlled panel segment shall contain light switch, utility outlet, fan switch, and switch for operating mode selection. [Add any special switches such as in-car heater, access control]. Access shall be limited by a door or panel with lock keyed to EPCO.
7. **TELEPHONE CABINET:** A Ramtel Corp. Model RR733-924M security telephone shall be mounted beneath the car operating panel.
 - a. Necessary wires shall be included in the car traveling cables.
 - b. The phone shall be mounted inside a cabinet in the primary car operating panel or flush mounted with a [stainless steel or other material to match the car interior] face plate. Phone shall be mounted such that it is easily removable for servicing.
8. **INTERCOM:** Provide a flush mounted J Phillips LLC, or equal, intercom with a stainless face-plate for communication between the car and the Phase 1 fire service recall landing.
9. **INTERIOR CAR LIGHTING:**
 - a. [Passenger and dual-purpose cars] Lighting shall be [indirect, with one 48-inch fluorescent lamp on each side arranged to project light efficiently onto the ceiling and protected with a satin finish stainless steel cove reflector, or as selected for the specific project]. Provide fluorescent lighting with 4-foot T-8 lamps and ballasts that comply with University standards. Adjust light level by specifying the appropriate "ballast factor."
 - b. [Freight Cars, Enclosed] Lighting fixtures shall be for fluorescent lamps and shall be recessed, with the bottom of the fixture flush with the car ceiling. Provide at least two 48-inch fluorescent lamps per car up to 40 square feet platform area. Provide one additional 48-inch lamp per 30 square feet or fraction over 40 square feet.
 - c. [Freight Cars, Open] Lighting fixtures shall be porcelain lamp holders for incandescent lamps, not fewer than two per car. Provide metal-cage guards for each lamp.
10. **EMERGENCY CAR LIGHTING:** A Nylube Products Model EL-SS emergency power unit shall be provided to illuminate the elevator car and provide current to the alarm bell in the event of power failure. No substitutions.
 - a. If emergency power circuit is available, car lighting and alarm bell also shall be connected to the X-Panel of the building.

11. EXTERIOR CAR LIGHTING AND POWER: Provide a work light with switch and a duplex GFCI type utility outlet on the car top. The light shall be located to illuminate the cartop operating station, the hoistway door mechanisms, the car locator mechanism, and limit switches.
12. ALARM BELL: Provide a Nylube Model ELB-6 alarm bell. No substitutions.
13. TRAVELING CABLES: A traveling cable shall be provided for electrical connections between each car and its hoistway.
 - a. Each cable shall have adequate conductor capacity for all control, communication and lighting functions specified herein. Provide two spare lighting/utility circuits, and four spare communications circuits in each cable.
 - b. Each cable shall have flame retarding and moisture resisting outer cover. Cables shall be flexible and shall be suitably suspended to relieve strains in the individual conductors.
 - c. Terminate all conductors on a terminal board with permanent identification matching that used in schematic and wiring diagrams.

2.05 POWER AND CONTROL DEVICES

- A. [Electric Traction Elevators] Solid state power supply and logic control
 1. Provide solid state power supply I-Box from Motion Control Engineering System 12, CEC/Swift Futura, or O. Thompson Ultra 2000 DC⁹ output with voltage and current capability ample to operate the elevator at the specified conditions. No substitutions.
 2. Provide modem and interface with controller for remote diagnostics and monitoring. Provide a dedicated telephone line to the elevator machine room for use with the remote monitoring modem provided with the elevator controls.
 3. The maximum Total RMS Harmonic Distortion (THD) contribution to the building power distribution network, from the elevator drive and hoist system, shall be restricted for voltage (THDV) and current (ampere) (THDI). The RMS total harmonic distortion is defined as the amount of harmonic distortion as a percentage of the rms value of waveforms at all frequencies (fundamental and harmonic). The following THD criteria is to be understood as RMS unless otherwise noted:
 - a. THD will be measured and compared to the building THD. The building THD will be measured with the new elevator systems disconnected from the building power distribution system.
 - b. The building THDV and THDI, with the elevator disconnected, will be measured at each elevator's feeder disconnecting means.
 - c. The elevator THDV and THDI will be measured at each elevator's feeder disconnecting means located in the elevator equipment room. Individual measurements will be taken with each elevator operating at 0%, 25%, 50%, 75% and 100% of the full rated load at contract speed in the up and down direction.

⁹ AC systems are unacceptable due to higher than acceptable total harmonic distortion. Only solid-state drives are acceptable (no motor-generators).

- d. The maximum allowable THDV and THDI will be the calculated difference between the building THDV and THDI measurements and the elevator THDV and THDI measurements respectively.
- e. Maximum allowable THDV from each elevator motor drive is 3% or the value of the building THDV measured in part b above, whichever is greater.
- f. Maximum allowable THDI from each elevator motor drive is 15%. No individual current harmonic shall exceed 10% relative to the fundamental (THDI-F). THDI-F defines the amount of harmonic distortion as a percentage of the fundamental frequency current.
- g. Measurements shall be taken upon substantial completion by an independent firm.
 - (1) The above criteria will be the result of the average of three readings for each measurement with a minimum 10-minute interval between each reading.
 - (2) The metering equipment shall be a Fluke 41 System Analyzer or approved substitution.
 - (3) Provide safe access to open electrical equipment and the assistance of one qualified electrician for taking the readings.
- 4. Harmonic distortion control may be accomplished by integral design techniques of the elevator control system, adding internal equipment/devices, or adding external equipment/devices.
 - a. Harmonic filtering separate from the elevator controls may be accomplished using a "Capaci-Trap" filter manufactured by the Myron Zucker company, or approved substitution.
 - b. A representative for Myron Zucker equipment may be reached at (248) 543-2277 for pertinent application information.
- 5. Solid state power control: Provide a solid state power controller to operate the hoist motor, brake, and other electromechanical devices.
 - a. The controller shall include interfacing pilot electromechanical devices as required for accepting the necessary elevator hoistway switches and operating switches.
 - b. These include, as a minimum, terminal slowdown devices, overtravel limit switches, solid state magnetic leveling switches, inspection operating pushbuttons, emergency stop switches and governor over-speed switches.
- 6. Microprocessor elevator logic control: The operation shall be accomplished utilizing microprocessor computer logic control.
 - a. The elevator control program shall be contained in nonvolatile, programmable, read-only memory.
 - b. The control shall be constructed such that future alterations in elevator operation including changes of operating parameters (including but not limited to speed, acceleration, jerk, pre-opening, door speed, door dwell, floor counts for leveling, and car zoning) readily be made as part of normal maintenance and service. If a separate, detachable device is required, it shall be furnished.
 - c. Safety circuits shall be monitored and controlled by the programmable logic control with redundant protection. The microprocessor elevator logic control shall be contained in a NEMA 1 cabinet.

7. Fault diagnosis: Provide capability to diagnose faults to the level of individual circuit boards and individual discreet major components for both the solid state power controller and the elevator logic controller. (Capability to diagnose faults within an individual circuit board is not required.)
 - a. If fault diagnosis requires a separate, detachable device, it shall be furnished.
- B. [Hydraulic Elevators] Solid state logic control: Provide a reduced voltage motor starter and solid state logic controller from Motion Control Engineering PHC 1000, or O. Thompson Microflight Series 90 2000-H with voltage and current capability ample to operate the elevator at the specified conditions. Provide modem and interface with controller for remote diagnostics and monitoring.
 1. Solid state power control: Provide a solid state logic controller to operate the pump motor, valves, and other electromechanical devices.
 - a. The controller shall include interfacing pilot electromechanical devices as required for accepting the necessary elevator hoistway switches and operating switches.
 - b. These include, as a minimum, terminal slowdown devices, over-travel limit switches, solid state magnetic leveling switches, inspection operating pushbuttons, and emergency stop switch.
 2. Microprocessor elevator logic control: Accomplish the operation utilizing microprocessor computer logic control.
 - a. The elevator control program shall be contained in nonvolatile, programmable, read-only memory.
 - b. Construct the control such that future alterations in elevator operation, including changes of operating parameters (including but not limited to speed, acceleration, jerk, pre-opening, door speed, door dwell, floor counts for leveling, and car zoning) readily be made as part of normal maintenance and service.
 - c. If a separate, detachable device is required, it shall be furnished.
 - d. Monitor and control safety circuits by the programmable logic control with redundant protection.
 - e. Contain the microprocessor elevator logic control in a NEMA 1 cabinet.
 3. Fault diagnosis: Provide capability to diagnose faults to the level of individual circuit boards and individual discreet major components for both the solid state power controller and the elevator logic controller. (Capability to diagnose faults within an individual circuit board is not required.)
 - a. If fault diagnosis requires a separate, detachable device, it shall be furnished.
- C. Emergency power operation: For new controllers, provide the capability of emergency power operation as follows: Upon loss of normal building power, the elevators shall switch to emergency power operation.
 1. [For single elevators:]
 - a. Upon transfer to emergency power, the elevators shall stop and return to the nearest landing and shut down with doors open.

- b. Following return to the nearest landing, the elevator shall have the capability of being reactivated on emergency power by key switch in the car operating panel.
 2. [For elevator groups or high rises:]
 - a. Upon transfer to emergency power, the elevators shall stop and return, one at a time sequentially, to the Phase I primary recall landing, and shut down with doors open.
 - b. Following return to the Phase I primary landing, the elevator shall have the capability of being reactivated on emergency power by key switch in the car operating panel.
 3. Firefighter service shall have the ability to override the emergency power recall landing. If the lobby detector on the primary landing level has activated and power transferred to emergency, the elevators shall return to the alternate firefighter recall level rather than the primary.
- D. Firefighters' service: Provide all elevator control functions, car operating devices, and hall operating devices necessary for "firefighters service - automatic elevators" as required by the Elevator Safety Code.
 1. The "designated level" shall be [],¹⁰ and the "alternate level" shall be []
 2. Provide a key box for each recall station and for each elevator machine room door, the box locks to match the Seattle Fire Department standard key.
- E. Terminal limit switches: Provide terminal limit switches in the hoistway designed to automatically stop the car at terminal landings.
 1. Design the final hoistway limit switches to automatically cut off the power and apply the brake, should the car travel beyond either terminal landing.
- F. AUTOMATIC LEVELING DEVICE: Provide the elevator with a two-way automatic maintaining leveling device.
- G. CAR AND HALL POSITION INDICATORS: Provide LED car position indicator integrated with the main operating panel [On two-door cars only:
 1. Provide a LED car position indicator near the rear door]. [A hall position indicator shall be installed at the main floor landing.]¹¹
- H. HALL BUTTONS: At each terminal landing, provide a recessed, tamper resistant signal push button, designed to accommodate serial boards together in the same removable unit by EPCO, with no substitutions.
 1. At each intermediate landing, provide a button fixture containing recessed, tamper resistant "UP" and "DOWN" push buttons.
 2. Locate each single button and/or the center of each button pair 36 inches above the finished floor.

¹⁰ Recall levels to be determined during design and included herein. Confirm the recall levels with the University's Environmental Health and Safety Department and the Seattle Fire Department.

¹¹ Hall position indicators are not warranted on low-rise machines, and should be limited to one at the main floor in high-rise machines buildings. Additional position indicators must have specific justification and approval.

3. Provide an elevator use-control switch with lock keyed as specified in Paragraph 2.02, E; coordinate location with the University Elevator Shop.
 4. The "ON" position shall allow any specified operating mode, and the "OFF" position shall cause the car to park at the bottom terminal landing.
 5. Furnish raised Braille markings which comply with requirements for the handicapped for the car buttons.
 6. CAR DIRECTION LANTERNS AND SOUND SIGNALS: Provide direction lanterns in each car adjacent to or integrated with the car position indicator.
 7. A chime shall also be furnished on the car which will sound once for the "UP" direction and twice for the "DOWN" direction as the doors are opening.
 8. By C E Electronics Inc., no substitutions
- I. HALL DIRECTION LANTERNS AND SOUND SIGNALS:¹² [For groups of two or more cars] Provide direction lanterns above each hoistway door.
1. Provide a gong or chime for each hoistway door. Interconnect lanterns and gongs/chimes with the car controllers to provide advance notice of car arrival.
 2. By C E Electronics Inc., no substitutions
 3. [For single-car installations and two-car groups with limited traffic] Provide direction lanterns recessed in the car back panel.
 - a. Provide a gong or chime, readily audible from the landing, that sounds as the doors begin to open.

2.06 ENTRANCES

- A. HOISTWAY ENTRANCES: [Passenger and Dual Purpose Elevators] Provide new UL labeled metal doors and hoistway door frames.
1. Doors shall be [stainless steel, cold-rolled steel].¹³
 2. Provide bottom of doors with removable phenolic guides which run in the sill slots with minimum clearance.
 3. [Where pressurization will be included
 - a. Design doors to accommodate hoistway pressurization of 0.10 inches water column while remaining fully operational.
 - b. Design doors for low air leakage under pressurization.]¹⁴

¹² For heavily used car groups, the intent is to provide direction lantern and sound systems that work with group dispatch controller for better service. This feature is rarely warranted on one-car installations and be of marginal value on some two-car groups.

¹³ Programming requirements dictate stronger doors, particularly on passenger machines with frequent freight use.

¹⁴ The shaft pressurization fan, when required, must be carefully sized in order to adequately pressurize the shaft (0.10 inch water ga with respect to atmosphere; 0.15 inch water ga in non-sprinklered buildings) without causing the elevator doors to malfunction due to over-pressurization. The gap between the

4. Provide manual access with lunar key or other approved device at each entrance.
 5. [Freight Elevators] Provide new UL labeled hoistway door frames and [manually] [power-] operated bi-parting door assemblies, complete with guides and accessories for proper operation.
 - a. Design doors so that upper and lower panels counterbalance each other.
 - b. Provide the lower edge of the upper door section with a fire-resistive safety astragal with non-shearing and non-crushing properties with respect to foreign objects, up to ³/₄-inches thick, upon which the two door sections close. Provide rubber bumpers on the lower edge of the upper panel frame near each jamb, mounted to provide the astragal safety action specified. The rubber bumpers and safety astragal shall be designed for replacement.
 - c. Equip the upper edge of the lower door section with a metal sill designed to be level with the landing when the doors are fully open. The sills shall be of sufficient size and strength to bridge the space between the building sill and the car platform and to support a trucking load commensurate with the load class of the elevator car. The sill shall extend the full width of the door opening.
 - d. If powered doors are used, the hoistway doors and car doors shall be actuated by separate door operators.
 - e. [Where pressurization will be included, design doors to accommodate hoistway pressurization of 0.10 inches water column while remaining fully operational. Design doors for low air leakage under pressurization.]
 - f. Provide manual access with lunar key or other approved device at each entrance.
- B. FASCIA PLATES: Provide fascia plates, fabricated from 14 ge steel, to be fastened to the header and the sill above. Fascia plates shall have manufacturer's standard enamel finish.
- C. LANDING SILLS
1. [Passenger Elevators] Provide extruded nickel sills¹⁵ together with all necessary supports and hardware for installation.
 - a. Install in accordance with manufacturer's recommendations.
 - b. Grout sills solidly their full length after installation.
 2. [Freight and dual purpose Elevators] Provide steel sills to match the doors selected, together with all necessary supports and hardware for installation.
 - a. Install in accordance with manufacturer's recommendations.
 - b. Grout sills solidly their full length after installation.

elevator car and the shaft wall must be maintained at relatively small size to prevent malfunction of the doors when the fan is operating.

¹⁵ Nickel, silver, bronze, steel, or other material may be used if justified for specific installations.

- D. DOOR HANGERS AND TRACKS: Provide MAC or approved substitution tracks, hangers, and hanger sheaves at each car and hoistway entrance.
1. Tracks shall be of bar steel with the working surface contoured to match the sheaves.
 2. Design the hangers for power operation and have provisions for vertical and lateral adjustment.
 3. Design hangers for two-point suspension of the door panel.
 4. Hanger sheaves shall be polyurethane with pre-lubricated and sealed bearings.
- E. DUST COVER
1. Provide dust covers, fabricated from 14 ga steel, at each landing.
 2. Dust covers shall have manufacturer's standard enamel finish.
- F. CAR DOORS
1. [Passenger and Dual Purpose Elevators] The car entrance shall be provided with doors of minimum 16 ga facing into the car [stainless steel, or as selected for the specific project], extending around the leading door edges, and suitably reinforced.
 - a. The doors shall have astragals designed for easy replacement.
 - b. Provide bottom of doors with removable phenolic guides which run in the sill slots with minimum clearance.
 - c. MAC zone restrictors (included in 2.06, G), designed to prevent car doors from being opened when the car is outside a landing zone, shall be included in all car doors.
 2. [Freight Elevators] The car entrance shall be provided with [manually] [power] operated biparting doors compatible with the hoistway doors
 - a. Design doors so that upper and lower panels counterbalance each other for ease of operation.
- G. DOOR OPERATOR: [Passenger and Dual Purpose Elevators] Provide A MAC door operator with 104 board control package with direct current motor to open and close the car and hoistway doors simultaneously.
1. The package shall include the following: lifting rods, pickup rollers, clutch assembly, interlocks, gate lock and all related installation hardware.
 2. Opening speed shall not be less than 2½ feet per second.
 3. Closing speed shall not exceed the limitations set by the Elevator Safety Code.
- H. DOOR EDGE PROTECTIVE DEVICE: Provide each passenger car door with a Janus Elevator Products "Pana 194" Slimline, or approved substitution, infrared type reopening device extending the full height.
- I. TOE GUARD: Provide toe guards, fabricated from 14-ga steel, a) at the lowest landing of each hoistway, and b) on each car sill. Toe guards shall have manufacturer's standard enamel finish.

- J. FINISHES: Structural members and other components for which finish is not otherwise specified shall have prime coat finish.
- K. HOISTWAY ACCESS SWITCHES: Provide hoistway access switches, keyed as to EPCO 27, at upper and lower terminal landing.

2.07 PIT AND MACHINE ROOM

- A. EMERGENCY STOP SWITCH: In each elevator pit, provide an emergency stop switch accessible from the pit access opening.

PART 3 - EXECUTION

3.01 INSTALLATION OF ELEVATOR SYSTEMS

- A. GENERAL: Comply with manufacturer's instructions and the Elevator Safety Code for work required during installation.
- B. Before beginning the installation, examine the hoistway and machine room to verify conditions and provide written notice of any conditions which would substantially hinder or prevent proper execution of the work. Do not proceed with the installation until the cited conditions have been corrected.
- C. PREINSTALLATION MEETING: Prior to installation of any elevator equipment, hold a meeting of Contractor, Elevator Subcontractor, University's Construction Coordinator, and Elevator Shop Superintendent to review installation approach and identify any special circumstances pertaining to this installation.
- D. BEAM INSTALLATION
 - 1. [Traction elevators only]: Install the machine beams and any sheave beams in accordance with a design approved by Architect and the City of Seattle.
- E. JACK INSTALLATION
 - 1. Hydraulic elevators only]: Install the jack in a hole excavated, cased and lined to accommodate it.
 - a. Casing shall be steel, not less than ¼-inch in thickness, and with interior diameter not less than 8 inches larger than the outside diameter of the wrapped jack cylinder.
 - b. Prior to insertion of the cylinder, line the casing with plastic in such a manner as to prevent ground contamination with leaking hydraulic fluid. If the cylinder is shipped in sections, wrap joint areas with triple fiberglass sealed with epoxy resin prior to insertion.
 - c. Install cylinder plumb and true with the hoistway. Following installation, backfill between the liner and the jack with clean, dry, salt-free sand in such a manner that alignment of the jack is not disturbed.
 - d. The Architect and the Owner, including the Elevator Shop Superintendent, shall be given prior notice of the arrival of each jack at the job site. Give them ample opportunity to inspect each jack before it is installed.

F. RAILS

1. Install rail brackets as needed to meet the requirements of the Elevator Safety Code.
2. Align rails plumb and accurately centered for elevator car position and travel.

G. DOORS

1. Install doors to provide smooth operation under normal conditions and to provide reliable operation under pressurized-hoistway conditions.
2. Install hoistway doors in such a manner that air leakage is minimized under pressurized-hoistway conditions.

H. WELDED CONSTRUCTION: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance and replacement of worn parts.

1. Comply with standards of AWS D1.1 for workmanship and for qualifications of welding operators.

I. ELECTRICAL WORK: All work shall conform to the requirements of Division 16 and the University's Electrical Standards. Requirements specific to elevators include:

1. Mark each component, including but not limited to relays, switches, timers, fuses and overload devices, with permanent identification that corresponds with the nomenclature of the wiring diagrams and the operations and maintenance manuals specified in paragraphs 1.02.A.5 and 1.02.A.7 of this section.
2. Terminate all field wiring at each control cabinet on terminal strips suitable for the use. Field wiring shall not terminate on the studs of relays or other devices and equipment.

J. COORDINATION: Coordinate elevator work with work of other trades for proper time and sequence to avoid construction delays.

1. Use benchmarks, lines and levels to ensure dimensional coordination of the work.
2. Coordinate installation of hoistway entrances with installation of elevator guide rails, for accurate alignment of entrances with cars.
3. Where possible, delay final adjustment of sills and doors until car is operable in shaft.
4. Reduce clearances to minimum, safe, workable dimension at each landing.
5. Coordinate the following often overlooked items with other divisions:
 - a. Hoistway ledge cants or screening for all exposed ledges inside the hoistway deeper than 2 inches
 - b. Provide pit ladders for hoistways without walk-in pits.
 - c. Elevator pit sumps and sump pumps
 - d. Fire sprinklers for elevator machine rooms, pits, and tops of hoistways in accordance with DCLU Directors Rule 3-91. Provide shunt trip devices for disconnection of elevator power when sprinklers are required for elevator machine rooms.

- e. Appropriate lighting in the elevator pit, cab and elevator machine room. Provide a minimum of two light fixtures inside the elevator cab.
 - f. Permanent non-combustible access stairs or ladders for elevator machine rooms and machinery spaces
 - g. Provide FGCI receptacles in the elevator machine rooms, secondary sheave platforms, cars, and pits.
 - h. Hoistway venting, elevator lobbies or hoistway pressurization
 - i. Smoke detectors for elevator lobbies, elevator machine room and tops of hoistways for elevator firefighter service as required by the Seattle Fire Department, University Environmental Health and Safety Department, State of Washington Department of Labor and Industries Elevator Inspection Division and Seattle Department of Construction and Land Use. Coordinate zoning and fire alarm control panel requirements with the University Signal Shop.
 - j. Only elevator and directly related equipment are allowed in elevator machine rooms, and hoistways.
 - k. 7-foot minimum clear headroom in elevator machine rooms
 - l. Machine rooms are required by Labor & Industries Dept. to be below 100 degrees. Consider a reflective roof coating and an exhaust fan at machine room to maintain temperature at 100 degrees or less. Provide an analysis to confirm performance. If the coating and exhaust fan does not reduce heat gain, provide mechanical cooling.
- K. **SOUND ISOLATION:** Mount rotating and vibrating elevator equipment and components on vibration-absorption mounts, designed to effectively prevent transmission of vibrations to structure, and thereby eliminate sources of structure-borne noise from elevator system.
- L. **LUBRICATION:** Lubricate operating parts of systems, including ropes, if any, as recommended by manufacturers.

3.02 FIELD QUALITY CONTROL

- A. **COMPLIANCE TESTING:** Upon nominal completion of each elevator installation, and before permitting use of elevator (either temporary or permanent), perform acceptance tests as required and recommended by Code and governing regulations or agencies.
- 1. Advise Contractor, Owner, Architect, and inspection departments of governing agencies, in advance, of dates and times tests are to be performed on elevators.
 - 2. Advise Contractor, Owner, and Architect, in advance, of dates and times for inspections by governing agencies.
 - 3. University Elevator Shop personnel shall be notified in advance of these tests, and shall be given ample opportunity to be present.
- B. **ACCEPTANCE TESTS:** Conduct operational test of each car within 2 weeks of issue of the permanent operating certificate. Schedule an Elevator Shop observer with not less than 1 week's notice.

1. Running test: Load each elevator to its rated capacity and operate continuously for 30 minutes over its full travel distance, stopping at each level and proceeding immediately to the next.
 - a. Record temperature rise of motor during 30-minute test period.
 - b. Record speed up and down and leveling relative to landing sills at the end of the period.
 - c. Requirements are as follows:
 - (1) Motor temperature rise within manufacturer's tolerances
 - (2) Speed within 10% of specified speed
 - (3) Leveling within $\pm \frac{3}{8}$ inch. Record failures of elevator to perform as required.
 2. Power quality tests: Load each elevator to its rated capacity, and conduct tests of each elevator as follows:
 - a. Measure voltage, current, total voltage harmonic distortion, total current harmonic distortion at the elevator disconnect in the machine room.
 - (1) Express voltage and current distortion as percentages of the fundamental.
 - b. Test two conditions with each elevator
 - (1) Elevators of the group turned off
 - (2) The subject elevator operated at rated speed in the up direction, with all other elevators of the group turned off
 3. When a hoist motor is replaced and prior to final coupling to gearcase, align motor shaft with brake coupling to within 0.002 inches radial runout as measured by dial indicators on each half of the coupling. The dial indicator test shall be witnessed by a representative of the University Elevator shop. Notify the University Elevator Shop Supervisor at least 2 working days in advance to schedule the dial indicator test.
 4. Provide copy of 5-year Safety Test to UW Elevator Shop and State of Washington Department of Labor and Industries.
- C. PROTECTION: At time of final completion of elevator work (or portion thereof), provide suitable protective coverings, barriers, devices, signs or such other methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period. Repair or replace, to the Owner's satisfaction, any components worn significantly or damaged before the Owner obtains beneficial use.

3.03 INSTRUCTION AND MAINTENANCE

- A. Instruct Owner's personnel in proper use, operations and maintenance of elevators.
1. Instruction shall be directed to an audience of experienced elevator mechanics.
 2. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation.
 3. Train Owner's personnel in use of fault diagnosis and reprogramming hardware and software.

4. Provide 2 sessions, 6 hours in length, of classroom and machine room training for UW Elevator Shop personnel or pay for tuition for 2 UW Elevator Shop personnel to attend the factory training school of the controller manufacturer.
 5. Training to be completed or training school tuition paid prior to application for substantial completion payment.
- B. Provide table(s) of floor locator settings from the final adjustment, including acceleration and deceleration settings.

3.04 CONDITIONS PRECEDENT TO FINAL ACCEPTANCE

- A. Instructions to operators: Instruction of the designated employees of the Owner in the operation and care of equipment and systems shall have been completed.
- B. Code compliance: All code compliance tests shall have been performed and acceptance certified by the authorities having jurisdiction and permanent elevator operating permit issued to the University.
- C. Acceptance tests: All acceptance tests shall have been completed and compliance certified by the University's Elevator Shop.
- D. Submittal of maintenance manuals: All manuals shall have been submitted as provided in Section 1.02 and approved by the University's Elevator Shop.
- E. Submittal of construction record drawings: Construction drawings of the work shall have been marked to show changes and actual installation conditions, sufficient to form a complete record for Owner's purposes. Give particular attention to work which will be concealed and difficult to measure and record at a later date, particularly items which require servicing or replacement during the life of the projects, such as valves, traps, dampers, etc. Site utilities drawings shall indicate exact locations and elevations of pipe and utilities.
- F. Final check: Make a final check of each elevator operation, with Owner's personnel present and just prior to date of substantial completion to determine that control systems and operating devices are functioning properly. Any and all damage and/or significant wear shall have been repaired.
- G. Cleaning: The work site shall be clean. Clear away all debris, surplus materials, etc., resulting from work or operations, leaving the job and equipment furnished in a clean, first-class condition.
- H. Punchlist: All items on the punchlist shall be completed to the satisfaction of the Owner and the Engineer.
- I. Spare parts: Spare parts shall be delivered and accepted by the University Elevator Shop in accordance with Section 1.07.

END OF GUIDE SPECIFICATION SECTION