

Table of Contents

CHAPTER 1	GENERAL REQUIREMENTS	1
	INTRODUCTION	1
	GENERAL DESIGN PHILOSOPHY	1
.....		2
.....		5
	GENERAL DESIGN GUIDELINES	6
	EQUIPMENT SELECTION	7
CHAPTER 2	SCHEMATIC DESIGN REQUIREMENTS	9
	GENERAL	9
	ELEVATOR GROUP CRITERIA	9
CHAPTER 3	DESIGN DEVELOPMENT	12
	GENERAL	12
	RELATED WORK	12
	DESIGN DEVELOPMENT SUBMISSION REQUIREMENTS	16
CHAPTER 4	DEVELOPMENT OF CONSTRUCTION DOCUMENTS PART 1 -	
	GENERAL	18
	SPECIFICATION FORMAT	18
	DRAWING FORMAT	18
	RELATED WORK	18
	DEFINITIONS	18
	QUALITY ASSURANCE	19
CHAPTER 5	DEVELOPMENT OF CONSTRUCTION DOCUMENTS PART 2 -	
	PRODUCTS	26
	SUMMARY	26
	MATERIALS	31
	CAR PERFORMANCE	33
	GROUP PERFORMANCE	36
	OPERATION	36
	ADDITIONAL REQUIRED CONTROL FEATURES - TRACTION	
	ELEVATORS	40
	MACHINE ROOM EQUIPMENT	41
	HOISTWAY EQUIPMENT	42
	CAR EQUIPMENT	44
	HALL CONTROL STATIONS	46

CHAPTER 6 DEVELOPMENT OF CONSTRUCTION DOCUMENTS PART 3 -

EXECUTION	49
SITE CONDITION INSPECTION.....	49
PRODUCT DELIVERY, STORAGE, AND HANDLING	49
INSTALLATION	49
FIELD QUALITY CONTROL.....	49
ADJUSTMENTS	49
CLEANUP	50
ACCEPTANCE INSPECTION AND TESTS.....	50
INSTRUCTION TO UTK PERSONNEL	52
OWNER'S INFORMATION, MAINTENANCE MATERIALS AND TOOLS.....	53

CHAPTER 1

GENERAL REQUIREMENTS

INTRODUCTION

This Facilities Standards Manual is for use in the design and implementation of vertical transportation equipment in new and existing University of Tennessee, Knoxville multi-story campus structures. The implementation of these standards is required of both in-house and outside design and construction professionals.

The University currently has an outside vendor maintain the vertical transportation equipment on campus. One intent of these standards is to ensure that a high quality of equipment is provided so that it is maintainable by elevator mechanics of varying degrees of experience. Another aim is to provide continuity of equipment with regard to major component areas.

These Facilities Standards, for the most part, govern new construction. It is understood that requirements cannot be met on all renovations/modernizations. Where new equipment is provided, the applicable standards will apply. Where it is cost effective or required to retain existing equipment, said equipment shall be brought up to code and placed in like-new condition.

A diverse array of building types are planned for, and currently exist, on the campus of the University. Vertical transportation systems and their respective performance criteria will vary by building type. In all new multi-elevator buildings an elevating analysis must be performed and target group and individual car criteria specified.

Machine room less (MRL) products will be considered on a case by case basis. All proposed MRL bids must comply with the UT Design Guidelines for maintainability. Any special tools or diagnostic equipment must be provided to the Owner at final acceptance and becomes the property of the Owner.

GENERAL DESIGN PHILOSOPHY

The following equipment characteristics should be considered when designing and selecting equipment types for installation on the campus:

Design Quality: These standards (Chapter 4) list currently approved installers and major components. University approval must be garnered to deviate in any way from that which is listed. The standards also provide for quality assurance in material fabrication, material gauges, performance levels, noise levels, and workmanship. Any deviation in these areas will require the replacement of non-compliant equipment.

It is anticipated that the University will receive each approved manufacturers top-of-the-line or A Class A product. Second tier products will not be considered.

Maintainability: All equipment must be maintainable by industry trained elevator mechanics. Acceptance of new technologies will only be considered in conjunction with an intensive formal training program conducted by the equipment manufacturer/installer. Training shall parallel that provided to the installers technicians and include both classroom and field (hands-on) instruction. Reference Chapter 6 of these standards.

Maintainability requirements include the ability to procure replacement parts as well as special maintenance tools. The University will not consider equipment which requires special adjusting, troubleshooting, etc., tools that cannot be purchased through normal purchasing channels. Special tools provided to the University shall include all top-level, solid-state diagnostic tools and related software documentation which the equipment manufacturer and installer supplies to his adjusters and service personnel.

Life Expectancy: It is anticipated that any new installation or renovated installation will be capable of providing at least 20 years of dependable service before renovation is again considered. The above assumes that a quality, full maintenance program remains in effect throughout the life of the equipment.

Consistency of Standards: To ensure a consistent level of vertical transportation equipment quality, compliance with performance standards, quality workmanship, and compliance with contract documents, the University mandates that the elevator consulting engineering firm, such as Lerch Bates North America, Inc. be employed on all projects requiring the installation of vertical transportation equipment. The scope of services provided by the elevator consultant shall include the following:

New Installation

A. Schematic Design Phase

1. Attend meetings to consult with the Architect and/or University, and Design Team members to discuss the project program and establish design requirements. Unique requirements of the building or anticipated occupancy and their influence on the vertical transportation systems are identified at this time.
2. Establish the analysis design criteria.
3. Utilize the selected design criteria and projected populations to conduct a vertical transportation equipment analysis. Select and recommend the most-viable alternatives.

4. Submit a written report based upon the analysis and preliminary planning indicated on the schematic architectural drawings. Report shall include:
 - a. A definition of the selected design criteria and terms.
 - b. Establish criteria to obtain proper levels of vertical transportation service.
 - c. Results of computer and/or manual study and analysis calculations.
 - d. Recommended solutions.
 - e. Deviations from UT Facilities Standards covering vertical transportation equipment, if any.
5. Attend meetings to discuss the report and alternative solutions. Update the analysis and recommendations based upon the revised designs. Studies shall continue until a final design is selected by the University. Upon resolution and selection of final design, the following preliminary information shall be provided:
 - a. Basic elevator/escalator core dimensions and arrangements in a CADD format.
 - b. Outline specifications.
 - c. Equipment budget estimates.

B. Design Development Phase

6. Provide a final analysis report from the schematic design studies and final solutions.
7. Provide final outlines of equipment for budget pricing.
8. Provide detailed CADD generated design information and arrangements for the development plan selected. Information shall include:
 - a. Scaled general arrangement drawings in the format requested by UT.
 - b. Information for interface with other engineering disciplines; i.e., structural, electrical, and mechanical requirements.

- c. Information for interface with related work to be accomplished by other Trades.
- d. Drawings for special or unique applications.
- 9. Verify conformance with related codes.
- 10. Provide a final budget estimate of the equipment costs.

C. Construction Documents Phase

- 11. Provide architectural layout drawings for the vertical transportation equipment. Provide written comments along with advice, assistance or information on any items related to the drawings, as requested by the Architect.
- 12. Prepare a detailed and complete performance-based specification in the standard UT format. The specification shall include specific performance criteria, compliance with current codes, and establish the equipment quality level. Bid documents shall be configured to encourage competitive bidding.
- 13. Update equipment budget estimates to reflect the final designs.

D. Bidding and Negotiation Phase

- 14. Provide assistance on any bidding matter. Such assistance shall include:
 - a. Consultations on bidding procedure.
 - b. Evaluate the bids, clarify exceptions and ambiguities with the Bidders, and submit written recommendations.
 - c. Assist with contract negotiations.
 - d. Attend or conduct bid review meetings.
 - e. Establish and review the material/delivery construction schedule.

E. Construction Services Phase

- 15. Review shop drawings submitted by Elevator Contractor for code, UT Facilities Standards, and contract document compliance. Review comments shall be incorporated on one sepia and two blue line drawings.

16. Conduct periodic installation reviews to determine that work is proceeding in accordance with the Contract Documents, UT Facilities Standards, and in general conformity with the intent of the design concept. Submit written reports which shall include the following:
 - a. List items of nonconformity.
 - b. Percentage of equipment and components on the site and installed.
 - c. Percentage of overall completion of individual or groups of elevators/escalators.
 - d. Identify equipment or components not on the job site which could affect the installation schedule.
 - e. Review applicability of Temporary Acceptance forms.

Attend job site meetings to assist in resolution of installation problems.

Review and comment on progress billing and verify Change Orders.

17. Conduct a final installation review to document equipment compliance and performance with the contract requirements. Provide the Architect and University with a written report covering the measured performance data and itemized deficiencies. Make one additional review per elevator group to verify compliance with the deficiency report. (The job should then be substantially complete and operating in accordance with specified performance guarantees.) If additional reviews are required, they shall be billed as Additional Services.
18. Establish substantial completion and final completion dates.
19. Review contract close-out documents and warranties.

Modernization

Survey and Report

- A. Conduct a detailed survey of the present elevator equipment to determine its condition and potential for reuse in the modernization program.
- B. Perform a computerized elevator group data logger survey on elevator groups of three cars or more to determine the "before" modernization average system response times.

- C. Investigate the building requirements for elevator service and analyze the needs of the present and projected tenants.
- D. Provide the University with a written report documenting the survey and analysis results. The report shall contain:
 - 1. Recommendations on the types of equipment needed for modernization.
 - 2. A summary of the present equipment that can be retained.
 - 3. Modernization options.
 - 4. Identify current Code requirements, non-code complying building conditions, and disabled accessibility requirements.
 - 5. Identify related work required by other Trades.
 - 6. Provide a cost estimate for the recommended elevator modernization program.
 - 7. Provide a schedule for the modernization activities.
- E. Meet with the Client to discuss the report and the recommended modernization program.

Preparation of bid documents, bid procedures and construction services shall then be performed as detailed for new installations.

GENERAL DESIGN GUIDELINES

Architectural

Elevator core locations shall be coordinated with the horizontal traffic flow and with the means of ingress and egress. Passenger elevators must be located on a major path of travel as required by the Americans with Disabilities Act (ADA).

Elevator lobbies should be designed to accommodate the movement of pedestrian traffic to other parts of the building. Should elevators face one another, the minimum width between entrances shall be 10 feet. Elements which create queues, such as exhibits, directories, etc., shall not be placed in elevator lobbies.

Wheelchair lifts shall not be used in new construction.

EQUIPMENT SELECTION

Selection of geared traction, gearless traction, or hydraulic elevators shall be determined by elevating analysis as well as estimated equipment costs. The elevator capacity shall be determined via the elevating analysis studies. At a minimum, platform sizes shall meet disabled access requirements and provide the capability of carrying a medical stretcher 24 inches wide and 78 inches long.

Hydraulic Elevators

Direct plunger hydraulic elevators may be employed for travel distances up to 45 feet with the following considerations:

- A. Contract speed shall not exceed 150 feet per minute (f.p.m.).
- B. Elevating analysis must demonstrate that a hydraulic application will meet the UT criteria for good elevator service.
- C. Calculations to determine anticipated up-starts per hour shall accompany the elevating analysis reports. Up-starts per hour shall not exceed 120.
- D. Machine rooms, where possible, shall be located at the bottom terminal floor, adjacent to the hoistway.

Holeless hydraulic equipment meeting the above criteria may be considered with the following clarifications:

- A. Cantilevered units will not be considered. Dual jacks will be provided on all installations.
- B. Telescoping jacks will not be considered.
- C. Travel distances shall not exceed 45 feet.

Traction Elevators

Most Campus structures in excess of four stories will require the application of geared traction equipment. Overhead machine rooms are preferred. The following criteria shall be met when selecting geared equipment.

- A. Travel distance shall not exceed 160 feet.
- B. Speed shall be limited to 450 f.p.m.

- C. AC VVVF motor control shall have at least a five year track record of proven, successful service.

CHAPTER 2 SCHEMATIC DESIGN REQUIREMENTS

GENERAL

During Schematic Design, Vertical Transportation requirements are discussed and analyzed. Each type of campus structure will have unique needs for both passenger movement and, perhaps, service functions (material movement).

Analysis results will provide for the proper selection of the number of vertical transportation units, location of units, capacity and speed. Submittals so indicating shall be prepared and submitted for UT review.

Preliminary Design Data shall include hoistway and pit plans, hoistway sections, and machine room layouts. Information necessary for coordination with other disciplines should also be provided at this time.

ELEVATOR GROUP CRITERIA

Passenger Elevators

The following table provides minimum acceptable elevating criteria to be used as a basis for design in the various types of campus structures:

MINIMUM CRITERIA FOR ELEVATORING NEW CAMPUS STRUCTURES				
Building Type	Peak Period	Traffic Flow	Average Interval (Seconds)	Minimum Handling Capacity (%)
Administrative Offices	AM up-peak	One-way	25-30	12-13
Professorial Offices	AM up-peak	Two-way	30-35	8-10
Classroom Building	Hourly	Two-way	35-40	6-8
Housing	PM (dinner)	Two-way	35-40	6-8
Parking Structure	AM up-peak	Two-way	40-45	8-10

Average Interval is the average-time increment between elevator departures from the terminal floor during a heavy-traffic period.

Handling Capacity is the number of persons or percentage of building population that can be transported by vertical systems during this same period of heavy traffic.

It is extremely important that the basis of any elevating calculations be included in all analysis reports. This is especially true of any population determinations when not predetermined by the University. Analysis results must be revisited as information and architectural drawings develop.

If it can be anticipated, future building use should also be considered at this time. The possibility of change in the type of building occupancy and reassignment of building area that would result in a greater volume of passenger traffic shall be investigated. Potential building expansion should be considered. When possibilities exist, the building framing shall be arranged to permit future installation of an additional elevator to handle a future increase in traffic volume.

Service/Freight Elevators

Service Elevators. Most structures built on the UT campus will not require a dedicated service elevator. In any event, service needs should be analyzed and presented for University review.

The following criteria will apply to the use of service elevators:

- A. Any office building with a total gross floor area approaching 250,000 sq. ft. should be designed to include one dedicated service elevator.
- B. An additional service elevator should be recommended for each additional 350,000 sq. ft. gross floor area.
- C. Classroom buildings, especially those containing labs, should be considered on an individual basis.
- D. Service elevators should be hospital shaped with a minimum capacity of 4,000-4,500 lbs. They should be applied with a minimum 10'-0" clear high car enclosure and 4'-0" wide x 8'-0" high, two-speed, side-opening doors.

In situations which demand the application of a swing passenger/service elevator:

- A. It is imperative that the swing car be in group operation during peak traffic periods. This shall be accomplished via automatic time clock.

- B. Anticipate that the interior finishes of the designated swing car will be damaged by freight handlers and not present a good appearance to passengers. Durable textured stainless steel finishes shall be employed.
- C. The best application for a swing car is to have reverse openings in service lobbies at all floors or at least the first floor lobby. This keeps freight out of the main lobbies, restricts passenger usage of the elevator and eliminates false corridor call registration which will occur if the normal front passenger doors are also used for freight.
- D. Swing service cars should be considered in dormitories of five or more stories.

Freight Elevators

At campus settings, true freight elevators are usually considered to support food service functions or transport palletized materials. Due to cost and space considerations, analysis reports shall provide thorough justification for this type of installation.

CHAPTER 3 DESIGN DEVELOPMENT

GENERAL

At this stage of design, the number and arrangement of vertical transportation equipment should be virtually set. Work should continue to refine machine room layout and location and develop the information necessary to prepare performance based technical specifications. It is especially important that coordination between different engineering disciplines occur early in the Design Development Stage.

The majority of the coordination issues should be addressed within the Elevator Consultant's Design Data (layouts). This includes the sizing of equipment areas, power data, equipment heat emission data, and structural forces. All structural data for UT projects shall account for seismic forces, where applicable.

RELATED WORK

The Project Architect shall ensure that all work related to the installation of elevators (that which is not going to be installed by the Elevator Contractor) is included in the proper specification section. Related work can include the following:

- A. Legal Hoistway and Pit:
 - 1. Clear, plumb, substantially flush hoistway with variations not to exceed 1" at any point.
 - 2. Bevel cants not less than 75E with the horizontal on any rear or side wall ledges and beams that project or recess 2" or more into the hoistway. Not required on hoistway divider beams.
 - 3. Divider beams between adjacent elevators at each floor, pit and overhead. Additional car and counterweight rail supports where floor heights exceed 14'-0". Building supports not to exceed deflection of 1/8".
 - 4. Installation of guide rail bracket supports in concrete. Inserts or embeds, if used, will be furnished by the Elevator Contractor.
 - 5. Wall blockouts and fire rated backing for control and signal fixture boxes which penetrate walls.
 - 6. Cutting and patching walls and floors.

7. Wall pockets and/or structural beams for support of machine, sheave, and dead-end hitch beams. Support beam deflection shall not exceed 1/1666 of span under static load. Machine hold down means for hoist machines mounted beside or below hoistway.
8. Erect front hoistway wall after elevator entrances installed.
9. Grout around hoistway entrances and sills.
10. Lockable, self-closing, fire-rated pit door.
11. Pit access ladder for each elevator and pit divider screen. Structural supports for car buffer impact loads, and rail loads.
12. Structural support for car and counterweight buffer impact loads, guide rail loads, and compensation sheave tie-down upthrust.
13. Waterproof pit. Indirect waste drain and sump with flush grate and pump.
14. Protect open hoistways and entrances during construction per OSHA Regulations.
15. Protect car enclosure, hoistway entrance assemblies and special metal finishes from damage after installation.
16. Hoistway venting or pressurization to prevent accumulation of smoke and gas as required by Local Building Code.
17. Structural steel channel frames, floor to building beam above, header and angle sills for vertical Bi-parting-parting hoistway entrances.
18. Stone entrance frames at main lobby floor. (Set after elevator subframe is installed.)
19. Seal fireproofing to prevent flaking.
20. Glass enclosed hoistways. Laminated glass to meet the requirements of ANSI Z97.1 and California Title 8 and 24. Interior ledges created by glass mullions shall not exceed 2".
21. Continuous vertical car and counterweight guide rail support required full height of hoistway.

22. Partition between machine room and hoistway where hoist machine mounted beside hoistway.
23. 3'-0" square hole in pit floor for Elevator Contractor to install protective, secondary containment casing. Fill hole with concrete after jack and membrane installation. Seal pit with non-permeable epoxy.
24. Pit support framing for jack cylinder and buffer loads.
25. Opening in hoistway wall for hydraulic piping. Trench and backfill underground piping.

B. Legal Machine Room:

1. Enclosure with access ships ladder or stair with guard railing. Include similar access to overhead machinery space.
2. Self-closing and locking access door.
3. Constant cooling and heating to maintain temperature range between 65 and 85 degrees F. Maximum relative humidity 85% non-condensing.
4. Paint walls, ceiling and floor.
5. Class ABC fire extinguisher.
6. Self-closing and locking governor access door and access means.
7. Fire sprinklers.
8. Coordinate secondary containment of tank with elevator installer.

C. Electrical Service, Conductors and Devices:

1. Lighting and GFCI convenience outlet in pit, machine room and overhead machinery space.
2. Conduit from the closest hoistway of each elevator group or single elevator to the firefighters' control room and/or main control console. Coordinate size, number and location of conduits.
3. Three-phase mainline copper power feeder to terminals of each elevator controller in the machine room with protected, lockable "off," disconnect. Auxiliary disconnects in multi-level machine room.

5. Single phase copper power feeder to each elevator controller for lighting and exhaust blower with individual protected, lockable "off," disconnect switch located in machine room.
6. Single phase power feeders to machine room elevator group control panel and VGA with single-phase, protected, lockable "off," disconnect switch.
7. Firefighters' telephone jack and announcement speaker in car with connection to individual elevator control panels in elevator machine room and elevator control panel in firefighters' control room.
8. Emergency public telephone service with dedicated line to individual elevator control panel in elevator machine room.
9. Products-of-combustion sensor (NFPA No. 72, Chapter 5-3) in each elevator lobby, for each group of elevators or single elevator and machine room to initiate firefighters' return feature. Detector at top of hoistway if sprinklered. Provide means for service access from outside the hoistway. Provide sensor signal wiring from hoistway or machine room connection point to controller terminals.
10. Temporary power and illumination to install, test and adjust elevator equipment.
11. Means to automatically disconnect power to affected elevator drive unit and controller prior to activation of machine room overhead fire sprinkler system, and/or hoistway overhead fire sprinkler system.
12. Power feeders to main control console and firefighters' control panel VGA.
13. Power feeder to elevator intercom amplifier located in the elevator machine room.
14. Three phase power feeder to each freight elevator power door controller in machine room with protected, lockable "off," disconnect switch.
15. Copper power feeder to each elevator controller in machine room for elevator car heating and air conditioning unit.

D. Standby Power Provision:

1. Standby power of the same voltage characteristics via normal electrical feeder to run one elevator at a time in each elevator group, and/or single elevator unit, at full-rated car speed and capacity.
2. Conductor from auxiliary form "C" dry contacts, located in the standby power transfer switch to a single designated elevator control panel in each elevator bank and/or single elevator unit. (Provide a time delay of approximately 30-45 seconds for pre-transfer signal in either direction.)
3. Standby single-phase power to group controller, and each elevator controller for lighting, exhaust blower, emergency call bell, intercom amplifier, hoist machine cooling fan, car heating and air conditioning unit.
4. Means for absorbing regenerated power during an overhauling load condition, per NEC 620-101. Elevator will employ SCR drive, presenting a non-linear active load.

DESIGN DEVELOPMENT SUBMISSION REQUIREMENTS

A. Final Design Concepts

1. Final elevating analysis updated to reflect any changes occurring since previous reports were submitted. Changes to population, building square usable footage, travel distances, and floors served shall be reflected in the revised summary report.
2. Drawings showing the approximate locations and dimensions of equipment. Machine room layouts shall reflect equipment dimensions for the Aworst case≅ pre-approved products and their resulting clearances.

B. Design Development

1. Floor plans showing final locations and dimensions of equipment, machine rooms, hoistways (including minimum and design overhead dimensions), and pit dimensions.
2. Floor plans showing power, lighting, telephone, and HVAC provisions relating to the elevator installation.

C. Intermediate Submission

1. The initial draft of the project specifications.

2. Sufficiently developed working drawings as follows:
 - a. Floor plans updated to indicate corrections and developments since the initial Design Development Submittal.
 - b. Machine room details.
 - c. Hoistway and hoistway entrance details.
 - d. Hoistway vent details.
 - e. Pit details, including pit ladder or door.

D. Construction Documentation

1. Completed plans, sections, elevations, and details as mentioned above. Incorporate all corrections required by the University and Consultant.
2. The final draft of the project specifications. All related work shall be listed in Division 14 and identified as A Related Work Specified Elsewhere.≡ Each item of related work shall identify the specification section in which it can be located.

CHAPTER 4
DEVELOPMENT OF CONSTRUCTION DOCUMENTS
PART 1 - GENERAL

SPECIFICATION FORMAT

Specifications shall be produced according to the CSI division format. Each page shall be numbered, dated, and properly identify the project.

Specifications must be carefully coordinated with drawings to ensure that everything shown on the drawings is specified. The specifications prepared for each project shall be job specific. Information not pertaining to the specific project shall not appear.

DRAWING FORMAT

Deliverables to UT shall be 1 reproducible vellum and 3 bluelines 30" x 42" format. For addendums, design sketches and other miscellaneous submittals 11" x 17" or 8.5" x 11" formats are acceptable. Drawings should be prepared using CADD and translatable into common file type such as .DXF for possible future delivery to UT. Drawings units will be imperial (feet and inches). Abbreviations used in drawings shall be listed on drawings. Fonts for typical text shall be 3/32" minimum height ROMANS, drawing titles shall be 3/16" minimum height ROMAND, and sheet titles shall be 1/4" minimum height HLVFILL. Equivalents to these fonts will be acceptable. Minimum drawings included shall be a hoistway, pit and machine room plan and hoistway section for each elevator or core, cab interior elevations and details for each elevator type, sill and entrance details and other details as are necessary for clear delineation of the project. Architectural drawings and consultant drawings for structural, mechanical, electrical and other necessary disciplines shall incorporate and coordinate information contained in the vertical transportation consultant's information package. Revisions shall be clouded with a delta reference to the date of revision.

RELATED WORK

See Chapter 3.

DEFINITIONS

Elevator terms used shall be as defined in the latest edition of the Safety Code for Elevators and Escalators, ASME A17.1.

QUALITY ASSURANCE

Pre-approved products, model numbers, manufacturers, and installers shall be listed in every Division 14 specification. The following are currently approved:

A. Approved Elevator Installers

1. Geared and gearless elevators:
 - a. ThyssenKrupp
 - b. Otis
 - c. KONE
 - d. Schindler
2. Hydraulic Elevators
 - a. ThyssenKrupp
 - b. Otis
 - c. KONE
 - d. Schindler

B. Approved Car Enclosure

1. Brice-Southern
2. Hauenstein & Burmeister (H&B)
3. Schindler
4. Southwest
5. Tyler
6. KONE
7. National Elevator Supply

C. Approved Hoistway Entrances

1. Brice-Southern

2. Hauenstein & Burmeister (H&B)
3. Schindler
4. Tyler
5. KONE

D. Approved Signal Fixtures

1. Pushbuttons:
 - a. Adams
 - b. Epco
 - c. Elevator Research Manufacturing
 - d. Innovation Industries
 - e. Otis
 - f. ThyssenKrupp
 - g. Monitor Controls
2. Indicators and Gongs:
 - a. C.E. Electronics
 - b. Innovation Industries
3. Approved Vertical Bi-Parting Doors:
 - a. Courion
 - b. Peelle
 - c. EMS

E. Approved SCR Digital Drives

1. Magnatek DSD 412
2. MCE System 12
3. KONE Ultron
4. Otis
5. ThyssenKrupp

F. Acceptable Hydraulic Controls

1. Motion Control Engineering HMC-1000
2. KONE Miprom
3. Schindler
4. Thompson
5. ThyssenKrupp
6. Otis

G. Acceptable Hydraulic Valves

1. Maxton
2. EECO

H. Acceptable Infrared Reopening Device

1. Microscan II by T.L. Jones
2. PanaEighty by Janus Products
3. The Edge by KONE, Inc.
4. Elite Model EZE-R3 by Tri-Tronics Company, Inc.
5. Smart Edge by Innovation Industries

6. Lambda by Otis
I. Acceptable Door Operators

High-speed, heavy-duty, master door operator capable of opening doors at no less than 2-1/2 f.p.s. Accomplish reversal in no more than 2-1/2" of door movement. Open doors automatically when car arrives at a floor.

1. Acceptable closed-loop door operators:
 - a. DHP by Moline Accessories Company
 - b. QKS-14 or QKS-15 by Schindler Elevator Company (15 is for heavy door).
 - c. LV4K or KV4K by Mitsubishi Elevator Company. Provide LV4K through CO 8'-0", KV4K all other.
 - d. HPLIM by Otis
 - e. HD93 by Kone Elevator
 - f. MOVFR by GAL
 - g. 2000 by ECI
 - h. SMARTRAQ by MCI
2. Acceptable open-loop door operators
 - a. M.O.H. by G.A.L.
 - b. HPM SSC by Moline Accessories Company
 - c. HD91 by Kone Elevator
 - d. Model 1000 by Elevator Components Incorporated

J. Approved Microprocessor-based, Group Dispatch, Car and Motion Control Systems (Geared, Gearless)

1. ThyssenKrupp TAC 50

2. Otis Elevonic
3. KONE KCM831
4. Schindler TX
5. Swift Futura
6. MCE IMC or PTC

The Quality Assurance section of the specifications shall also list the prevailing local Codes and Authorities as well as the National Elevator Code, ASME A17.1. Compliance with the latest editions and supplements of these codes is mandatory. Where conflicts exist, the most stringent requirement shall be adhered to.

Document Verification. Bidders shall be required to review all Contract Documents for compatibility with their respective products. Review shall include structural, architectural, electrical, and mechanical drawings. Should specific exceptions or clarifications develop, these must be submitted at bid time.

Submittals. The specifications shall dictate the submittals required and when - usually 60 days after award. Division 14 should also reference the Division I requirements for submittals. The following submittals are required on all UT new construction projects:

- A. Scaled or Fully Dimensioned Layout: Plan of pit, hoistway, and machine room indicating equipment arrangement, elevation section of hoistway, details of car enclosures, hoistway entrances, and car/hall signal fixtures.
- B. Design Information: Indicate equipment lists, reactions, and design information on layouts.
- C. Power Confirmation Sheets: Include motor horsepower, code letter, starting current, full-load running current, and demand factor for applicable motors.
- D. Fixtures: Cuts, samples or shop drawings.
- E. Finish Material: Submit 3" x 12" samples or 12" lengths of actual finished material for review of color, pattern and texture by Architect. Compliance with other requirements is the exclusive responsibility of the Provider. Include, if requested, signal fixtures, lights, graphics, Braille plates and mounting provisions.

The Elevator Contractor shall be required to acknowledge and/or respond to drawing comments within 14 days of return and promptly incorporate required changes due to inaccurate data or incomplete definition so that delivery and installation schedules are not

affected. Revision response time shall not be justification for equipment delivery or installation delay.

Permits, Tests, and Inspections. The Elevator Contractor shall be required to:

- A. Obtain and pay for permit, license and inspection fee necessary to complete the installation.
- B. Perform test required by Governing Authority in accordance with procedure described in ASME A17.2 Inspectors' Manual for Elevators and Escalators in the presence of Authorized Representative.
- C. Supply personnel and equipment for test and final review required by consultant, as indicated in Part 3.

Maintenance. The following forms of elevator preventive maintenance are required on each UT project:

- A. Interim:
 - 1. When one or more elevators are near completion and ready for service, the Purchaser or General Contractor may accept elevators for interim use and place in service before entire installation of all elevators has been completed and accepted.
 - 2. During this period Purchaser or General Contractor may pay a mutually agreed amount per elevator for preventive maintenance. Indicate amount per unit per month with bid.
 - 3. Temporary acceptance form must be acceptable to Purchaser or General Contractor and signed prior to use.
 - 4. User must provide or pay for temporary hoistway and car enclosures; protect installed equipment and finishes; and pay for all cleaning, repairs, and replacement of materials necessary to restore elevator to "as-new" condition prior to final acceptance by UT.

B. Warranty Maintenance:

1. Provide preventive maintenance and 24-hour emergency call-back service for of one year commencing on date of final acceptance by UT. Systematically examine, adjust, clean and lubricate all equipment. Repair or replace defective parts using parts produced by the Manufacturer of installed equipment. Maintain elevator machine room, hoistway, and pit in clean condition.
2. Use competent personnel, acceptable to the UT, supervised and employed by the Provider.
3. UT, retains the option to delete cost of warranty maintenance from new equipment contract and remit 12 equal installments directly to Provider during period in which work is being accomplished.

CHAPTER 5
DEVELOPMENT OF CONSTRUCTION DOCUMENTS
PART 2 - PRODUCTS

Part 2 of the Division 14 specifications shall include an outline of the required equipment followed by a detailed narrative addressing each major component area, required performance levels, and quality level.

The outline or summary section shall identify the type and number of elevators and their specific physical characteristics. At a minimum the following shall be covered:

SUMMARY

- A. The type or intended usage of elevators shall be clearly defined. For example, Low-Rise, Geared Passenger Elevators. A separate summary shall be provided for each type of elevator on the project.

NUMBER:	Indicate the quantity of elevators of this type.
CAPACITY:	Indicate the elevator capacity in pounds.
SPEED:	Indicate the elevator speed in feet per minute.
ROPING:	1:1 roping is preferred on all geared installations.
SUPERVISORY CONTROL:	Approved supervisory control systems shall be clearly defined.
OPERATIONAL CONTROL:	Approved operational control systems shall be clearly defined.
MOTOR CONTROL:	Approved motor control systems shall be clearly defined.
POWER CHARACTERISTICS:	Typically 480V, 3-Phase, 60 Hertz. Power characteristics should be carefully confirmed on all modernization projects.
STOPS:	Indicate the number of floors served.

OPENINGS:	Indicate the number of openings served.
FLOORS SERVED:	Provide the names of the floors served.
TRAVEL:	Indicate the overall travel distance.
PLATFORM SIZE:	Preferably a standard configuration based upon a standard capacity.
MINIMUM INSIDE CLEAR SIZE:	Ensure compliance with Code.
ENTRANCE SIZE:	Minimum of 3'-6" wide x 7'-0" high.
ENTRANCE TYPE:	Single-speed, center opening for passenger elevators; two-speed, side opening for service elevators.
DOOR OPERATION:	Reference Approved Products List.
DOOR PROTECTION:	Infrared curtain units only. Reference Approved Products List.
MACHINE:	Geared or Gearless.
MACHINE LOCATION:	Overhead.
SAFETY:	Type B only. Provide counterweight safety if occupied space exists beneath pit.
GUIDE RAILS:	Planed steel tees. Guide rails shall be sized to meet bracket spans indicated on drawings.
BUFFERS:	Oil at speeds over 200 f.p.m.
COMPENSATION:	Encapsulated chain at speeds up to 500 f.p.m. Wire rope at speeds above 500 f.p.m. Pit guide sheaves shall be provided in all cases.

CAR ENCLOSURE:

Car finishes shall be of durable material. Decorative drop ceilings shall not be used. Lighting shall be flush with canopy and vandal-resistant. Service elevators shall be finished in textured stainless steel. Minimum car height shall be 8'-0" for passenger cars and 10'-0" for service cars. Base car construction shall be of a 14 gauge steel shell and 12 gauge steel canopy. Front returns shall be of 14 gauge stainless steel.

SIGNALS:

REGISTRATION LIGHTS:

A single hall button riser shall be provided for groups up to three elevators. Single car stations shall be provided. All car and corridor fixtures shall be vandal-resistant, and illuminated L.E.D.s.

POSITION INDICATOR:

Digital with direction arrows. Locate as directed by Architect.

HALL LANTERNS:

On all elevators serving three or more landings. Provide with stainless steel faceplate and adjustable electronic chime or tone.

IN-CAR LANTERNS:

Can be provided on two-stop units only.

HALL CAR POSITION INDICATOR:

Digital with direction arrows. Provide at ground floor entrance of service elevators only.

COMMUNICATION SYSTEM:

ADA compliant. Self-dialing, vandal-resistant, push to talk, two-way communication system with

recall, tracking and voiceless communication.

FIXTURE SUBMITTAL:

Submit brochures depicting Manufacturers proposed design with bid.

ADDITIONAL FEATURES:

Car and counterweight roller guides - maximum 350 r.p.m.

Car top inspection station - mount on 4'-0" extension cord

Firefighters' service, including Phase I, Phase II, and alternate floor return feature. Provide code required instruction engraving

Standby power transfer (automatic to main floor) with manual override in fire control panel where required by code

ADA and emergency medical services access and signage

Stationary car return panels

Jamb mounted hoistway access switches, top and bottom floor

Independent service feature

Platform isolation

Load-weighing device

Anti-nuisance feature on units serving 6 or more landings

Security control panel and remote wiring where required

Firefighters' control panel and remote wiring where required

Tamper-resistant fasteners for signal fixture faceplates

Sill support angles

One year warranty maintenance with 24-hour callback service

Firefighters' telephone jack where required

Emergency paging speaker installation where required

Machine, power conversion unit, and controller sound isolation

Seismic devices and operation. Provide dual derailment devices and a dual axis seismic switch. Provide seismic safety valves on all hydraulic installations

Pad buttons and vinyl-covered pads for dormitory passenger elevators

Prime finish temporary car doors for use during construction

Card reader provisions where required

CCTV provisions where required

Dual-mode operation for swing/service elevators

Battery pack, vandal-resistant emergency car lighting. Provide separate constant pressure test button in car service compartment. Locate inconspicuously flush in car canopy

Signage engraving filled with black paint

No visible company name or logo

Wiring diagrams, operating instructions, and parts ordering information

System diagnostic means and instructions

Non-proprietary (maintainable) control system and diagnostics provisions

MATERIALS

The following material standards shall be met on all UT projects:

A. Steel:

1. Sheet Steel (Furniture Steel for Exposed Work): Stretcher-leveled, cold-rolled, commercial-quality carbon steel, complying with ASTM A366, matte finish.
2. Sheet Steel (for Unexposed Work): Hot-rolled, commercial-quality carbon steel, pickled and oiled, complying with ASTM A568 and A569.
3. Structural Steel Shapes and Plates: ASTM A7, ASTM and A36.

B. Stainless Steel: Type 302 or 304 complying with ASTM A167, with standard tempers and hardness required for fabrication, strength and durability. Apply mechanical finish on fabricated work in the locations shown or specified, (Federal Standard and NAAMM nomenclature), with texture and reflectivity required to match Architect's sample. Protect with adhesive-paper covering.

1. No. 4: Bright directional polish (satin finish). Graining directions as shown or, if not shown, in longest dimension.
2. No. 8: Reflective polish (mirror finish).

3. Textured: 5WL pattern with .050 inches mean pattern depth with bright directional polish (satin finish).
 4. Non-directional, random swirl pattern.
- C. Bronze: Stretcher-leveled, re-squared sheets composed of 60% copper and 40% zinc similar to Muntz Metal, Alloy Group 2, with standard temper and hardness required for fabrication, strength and durability. Clean and treat bronze surfaces before mechanical finish. After completion of the final mechanical finish on the fabricated work, use a chemical cleaner to produce finish (Federal Standard and NAAMM nomenclature) matching Architect's sample:
1. Polished Bronze: M21-C12-06X, bright-polished bronze, clear-coated (US9) finish with clear-organic lacquer coating recommended by Fabricator.
 2. Fine Satin (Brushed) Bronze: M31-C12-06X, fine-satin bronze, clear-coated (US10) with clear-organic coating recommended by Fabricator. Provide graining direction as shown or, if not shown, in longest dimension.
 3. Acid-Etched Pattern: Provide an M21-C12-C5X-06X bright-polished (US9) background selectively acid-etched, matte-textured, custom pattern as shown. Acid selection and dilution (if required) recommended by Fabricator. After final finishing, coat bronze with clear-organic lacquer coating recommended by Fabricator.
- D. Aluminum: Extrusions per ASTM B221; sheet and plate per ASTM B209.
- E. Plastic Laminate: ASTM E84 Class A and NEMA LD3.1, Fire-Rated Grade (GP-50), Type 7, 0.050" ∇ .005" thick; color and texture as follows:
1. Exposed Surfaces: Color and texture selected by Architect.
 2. Concealed Surfaces: Manufacturer's standard color and finish.
- F. Fire-Retardant Treated Particle-Board Panels: Minimum 3/4" thick backup for natural finished wood and plastic laminate veneered panels, edged and faced as shown, provided with suitable anti-warp backing; meet ASTM E84 Class "I" rating with a flame-spread rating of 25 or less, registered with Local Authorities for elevator finish materials.

- G. Natural Finish Wood Veneer: Standard thickness, 1/40" thoroughly dried conforming to ASME/HPMA HP-1983, Premium Grade. Place veneer, tapeless spliced with grain running in direction shown, belt and polish sanded, book-matched. Species and finish designated and approved by Architect.
- H. Paint: Clean exposed metal of oil, grease, scale and other foreign matter and factory paint one shop coat of Manufacturer's standard rust-resistant primer. After erection, provide one finish coat of Industrial enamel paint. Galvanized metal need not be painted.
- I. Prime Finish: Clean all surfaces receiving a baked enamel finish of oil, grease and scale. Apply one coat of rust-resistant mineral paint followed by a filler coat over uneven surfaces. Sand smooth and apply final coat of mineral paint.
- J. Baked Enamel: Prime finish per above. Apply and bake 3 additional coats of enamel in the selected solid color.
- K. Marble: Refer to appropriate Specification Section.
- L. Carpet: Refer to appropriate Specification Section.
- M. Glass: Laminated safety glass, minimum 9/16" thick, conforming to ANSI Z97.1.

CAR PERFORMANCE

- A. Speed:
 - 1. Traction Elevators: ∇ 3% of contract speed under any loading condition.
 - 2. Hydraulic Elevators: ∇ 10% of contract speed under a full load up condition.
- B. Capacity: Safely lower, stop and hold up to 125% of rated load.
- C. Stopping Accuracy:
 - 1. Traction Elevators: ∇ 1/4" under any loading condition.
 - 2. Hydraulic Elevators: ∇ 3/8" under any loading condition.

D. Door Opening Time*: Seconds from start of opening to fully open:

1. 3'-6" wide, single-speed, center opening doors:
 - a. Traction: 1.6 seconds.
 - b. Hydraulic: 2.1 seconds.
2. 4'-0" wide, single-speed, center opening doors:
 - a. Traction: 1.7 seconds.
 - b. Hydraulic: 2.2 seconds.
3. 3'-6" wide, side opening doors:
 - a. Traction: 2.3 seconds.
 - b. Hydraulic: 3.1 seconds.
4. 4'-0" wide, side opening doors:
 - a. Traction: 2.5 seconds.
 - b. Hydraulic: 3.5 seconds.
5. 4'-6" wide, side opening doors (all elevators): 2.7 seconds.

*Values based on 7'-0" to 7'-6" high doors. For 7'-6" to 8'-6" high doors, add the following factor to door open and door close time: .5 seconds for widths up to 42" and 1 second for widths over 42".

E. Door Closing Time: Seconds from start of closing to fully closed: Door closing time shall be adjusted within Code limits. Shop drawings provided by installer shall indicate pertinent weight data and door close time calculations.

F. Start-to-Stop Motion Time*: Seconds from start of hoist machine motion until machine motion comes to a complete stop with car level and stopped at next successive floor under any loading condition or travel direction (12'-0" typical floor height; adjust .2 seconds per foot of travel on traction equipment and .5 seconds on hydraulic equipment):

1. Traction at 200 f.p.m.: 6.5 seconds.
2. Traction at 350 f.p.m.: 5.6 seconds.
3. Traction at 450 f.p.m.: 5.2 seconds.

*Values are based upon 3'-6" wide, center opening doors. If necessary, adjust per D above.

G. Floor-to-Floor Performance Time*: Seconds from start of doors closing until doors are 3/4 open (2 open for side opening doors) and car level and stopped at next successive floor under any loading condition or travel direction (12'-0" typical floor height; adjust .2 seconds per foot of travel on traction equipment and .5 seconds on hydraulic equipment):

1. Hydraulic at 100 f.p.m.: 14.0 seconds.
2. Hydraulic at 125 f.p.m.: 13.0 seconds.
3. Hydraulic at 150 f.p.m.: 12.5 seconds.
4. Traction at 200 f.p.m.: 10.0 seconds.
5. Traction at 350 f.p.m.: 9.1 seconds.
6. Traction at 450 f.p.m.: 8.7 seconds.

*Values are based upon 3'-6" wide, center opening doors. If necessary, adjust per D above.

H. Ride Quality (Geared Traction):

1. Horizontal acceleration within car during all riding and door operating conditions: Not more than 15 mg peak to peak in the 1-10 Hz range.
2. Acceleration and Deceleration: Smooth constant and not more than 3 feet/second/second with an initial ramp between 0.5 and 0.75 second.
3. Sustained Jerk: Not more than 6 feet/second/second squared.

I. Airborne Noise: Measured noise level of elevator equipment and its operation shall not exceed 50 dBa in elevator lobbies and 60 dBa inside

elevator car under any condition including door operation and car ventilation exhaust blower on its highest speed.

GROUP PERFORMANCE

- A. System-Response Time: Meet the following criteria during any 60-minute peak period as measured by duration of all hall call registration times:
1. System-Response Time: Not more than 20 seconds.
 2. Hall Calls Answered within 30 Seconds: Not less than 75%.
 3. Hall Calls Answered within 60 Seconds: Not less than 98%.

Base above performance on not more than 250 hall calls being registered within 60 minute period, all cars in group operation during test period, and floors not served by all elevators not included in test.

OPERATION

All operational and group dispatch control systems shall be microprocessor-based. Groups of three cars or more shall be provided with artificial intelligence and fuzzy logic features. The following strategies may be used on UT projects, where applicable:

- A. Two-stop collective (single cars serving two landings):

Operate elevator without attendant from buttons in car and located at each landing. Dispatch car when the car or hall button for a landing is pressed. Retain calls registered when car is in transit, allow time for passenger transfer, then dispatch to another hall call.

Illuminate pushbutton when call is registered; extinguish light when call is answered.

- B. Selective Collective (single car serving more than two landings):

Operate elevator without attendant from buttons in car and located at each floor. When car is available, automatically start car and dispatch it to floor corresponding to registered car or hall call. Once car starts, respond to registered calls in direction of travel in order floors are reached.

Do not reverse car direction 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 for a hall call, automatically cancel hall call. Cancel car calls in same manner. Hold car at arrival floor an adjustable time interval to allow passenger transfer.

Answer calls corresponding to travel direction of car unless call in the opposite direction is highest or lowest call registered.

Illuminate appropriate button to indicate call registration. Extinguish light when call is answered.

C. Duplex Selective Collective (two-car groups - hydraulic):

Operate elevators without attendants from buttons in cars and located at each floor. When cars are available, park one car at main floor ("home" car). Park other car where last used ("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 direction of travel and in the order the floors are reached.

Do not reverse 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 cars and stop 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 hall call. Cancel car calls in the same manner. Hold car at arrival floor an adjustable time interval to allow passenger transfer.

Answer calls corresponding to direction in which car is traveling unless call in the opposite direction is the highest (or lowest) call registered.

When the free car is clearing calls, start home car to respond to:

1. A call registered on home car buttons.
2. An up hall call registered below free car.

3. An up or a down call registered above free car while free car is traveling down.
4. A hall call when free car is delayed in its normal operation for a predetermined period.

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 main floor. Should last service required bring both cars to main floor, the first arriving car becomes the free car.

Illuminate floor button to indicate call registration. Extinguish light when call is answered.

Answer lower floor calls with the "home" car unless free car is parked at floor where the call occurs. If no car is parked at main level, answer calls below main floor using the first car traveling down. Do not stop cars traveling to or from levels below main floor at main floor unless there are calls registered for service at that floor.

- D. Group Automatic (two-car traction groups and all groups of three cars or more):
1. Approved microprocessor-based, group dispatch with Artificial Intelligence and Fuzzy Logic. As follows including, as a minimum, provide the features described hereafter.
 - a. Operate elevators as a group capable of balancing service and provide continuity of group operation with one or more cars removed from the system.
 - b.. Operate elevators from buttons located at each floor and in each car. Slow down and automatically stop cars at landings corresponding to registered calls. Make stops at successive floors for each direction of travel irrespective of order in which calls are registered except when bypassing hall calls to balance and improve overall service; stop only one car in response to particular hall call. Simultaneous to initiation of slow down of a car for a hall call, cancel that call. Render hall button ineffective until car doors begin to close after passenger transfer. Cancel car calls in the same manner. Give priority to coincidental car and hall calls in car assignment.

- c. Operate system to meet changing traffic conditions on a service demand basis. Include provisions for handling traffic which may be heavier in either direction, intermittent or very light. As traffic demands change, automatically and continually modify group and individual car response to provide the most-effective means to handle current traffic conditions. Hall calls shall receive immediate assignment to individual cars and hall lantern shall sound and illuminate. Hall lantern shall sound again and illumination shall pulse just prior to car arrival. Give priority to coincidental car and hall calls in hall call assignment and accomplish car direction reversal without closing and reopening doors.
- d. Use easily re-programmable system software. Design basic algorithm to optimize service based on equalizing system's response to registered hall calls and equalizing passenger trip time at shortest possible time.
- e. Serve floors below main floor in a manner which logically minimizes delay in passing or stopping at main floor in both directions of travel. Provide manual means to force a stop at the main floor when passing to or from lower levels.
- f. Control systems shall include on or more of the following approaches to maximizing the interfloor traffic performance of the group of elevators and reducing the number of long wait calls.
 - (1) Incorporate fuzzy logic type rule sets in an expert system rule base. Provide a short term learning function and a knowledge base of predicted traffic patterns and car movements.
 - (2) A long term learning function that utilizes historical building traffic patterns for assignment and pre-positioning of cars. Minimize stops by inferring likely traffic patterns and arrival /departure rates at different floors during different times of the day.
 - (3) A destination hall call registration system that anticipates traffic demands before they occur.

- g. Required Failure Features:
 - (1) Dispatch Protection: Backup dispatching shall function in the same manner as the primary dispatching.
 - (2) Delayed Car Removal: Automatically remove delayed car from group operation.
 - (3) Position Sensing: Update car position when passing or stopping at each landing.
 - (4) Hall Button Failure: Multiple power sources for button risers.
 - (5) Duplicate communication link; all group and individual car computers.

ADDITIONAL REQUIRED CONTROL FEATURES - TRACTION ELEVATORS

- A. Load weighing device to initiate hall call bypass, anti-nuisance feature and initiate hoist motor pre-torque.
- B. Anti-nuisance feature.
- C. Independent service.
- D. Firefighters Service: Provide Phase I, Phase II, and alternate floor return feature on all hydraulic and traction elevators.
- E. Dual-Mode Operation for swing/service elevators.
- F. Standby Power Transfer where applicable.
- G. System Monitoring on groups of three or more.
- H. Security systems where dictated by UT Facilities Planning and Management. Security systems may include:
 - 1. Floor lock-off switches.
 - 2. Car button actuated systems.
 - 3. Card/proximity reader systems.

4. Camera provisions.

Motion Control. Traction elevator motion control systems shall be microprocessor-based DC variable voltage or AC variable voltage, variable frequency with digitally encoded closed-loop velocity feedback.

Door Operation. Provide differential timing feature. Door dwell time shall be adjustable from 3-5 seconds for car calls and 5-8 seconds for hall calls. Provide nudging feature set between 20 and 30 seconds.

MACHINE ROOM EQUIPMENT

Geared Machine.

- A. Worm geared traction type with motor, brake, gear, drive shaft, deflector sheave, and gear case mounted in proper alignment on an isolated bedplate. Provide blocking to elevate deflector sheave above machine room floor.
- B. Provide a direct drive, digital, closed-loop velocity encoder on hoist machine.
- C. Provide hoist machine drip pans to collect lubricant seepage.
- D. Provide machine bedplate mounted deflector sheave A-frame and/or supporting steel beams, and fastenings to mount deflector sheaves to building structure. Provide minimum 16-gauge easily removable sheet metal closures in wall opening around machine between the machine room and hoistway on basement or semi-basement applications.

Pump Unit. Assembled unit consisting of positive displacement pump, induction motor, master-type control valves combining safety features, holding, direction, bypass, stopping and manual lowering functions, shut off valve, oil reservoir with protected vent opening, oil gauge and outlet strainer, drip pan and connections all mounted on isolating pads. Provide thermal unit or comparable means to maintain oil at operating temperature. Enclose with removable sheet steel panels lined with sound-absorbing material. Provide secondary containment with monitoring.

Solid-State Power Conversion and Regulation Unit. Traction elevators shall be provided with silicon controlled rectifiers. Generator field control is not acceptable.

Starting Switches. Hydraulic elevators shall be provided with SCR (Nordic) soft start.

Encoder. Digital encoders shall provide positioning on all traction equipment.

Hydraulic Piping and Oil. Provide piping, connections and oil for the system. Buried piping shall be secondarily contained and monitored with watertight Schedule 40 PVC sleeves between elevator machine room and pit. A minimum of two sound isolation couplings shall be provided between the pump unit and oil line and the oil line and jack unit. Provide pipe stands or hangers as required.

Controller. See pre-approved product listing. All controllers shall carry a UL or CSA label.

Isolation and Noise Reduction. All equipment shall be physically and electronically isolated from the building. Reference should be made to the acoustical section of the specifications.

HOISTWAY EQUIPMENT

Guide Rails. Planed steel T-sections suitable for the application, car weight, counterweight, and seismic reactions, with brackets for attachment to building structure. Provide car rail backing and intermediate counterweight tie brackets to meet Code requirements. Provide double bracketing, i.e. top and bottom of floor beam.

Sheaves. Machined grooves with sealed bearings. Provide mounting means to machine beams, machine bedplate, car and counterweight structural members, etc.

Hydraulic Cylinder, Plunger, and Well Hole.

- A. Cylinder: Seamless steel pipe. Design head to receive unit type packing and provide means to collect oil at cylinder head and return to oil reservoir. Provide secondary containment and monitoring provisions, per C.C.R. Title 23.
- B. Plunger: Polished seamless steel tubing or pipe. If plunger length exceeds 24', provide two or more sections not exceeding 16' in length, or coordinate installation of longer unit at the job site. Join section by internal threaded couplings. Multiple section jack units shall be factory polished while assembled and marked for proper future reassembly. Isolate plunger from car sling.
- C. Well Hole, Casing: Well hole is to be provided by elevator contractor. No extra will be allowed for unforeseen conditions of any kind or spoil removal. Install steel outer casing minimum 18" diameter. Install watertight PVC sleeve for secondary containment over jack assembly prior to insertion into the outer casing. Extend PVC sleeve through pit floor slab to underside of jack support beams and seal with non-permeable

membrane. I.D. of PVC sleeve shall be capable of containing 110% of system capacity. Seal well opening at the pit floor with hydraulic quick setting cement.

Seismic Safety Valve. Provide on all hydraulic installations. Conform to ASME A17.1, Rule 2410.6.

Electrical Wiring and Wiring Connections.

- A. Conductors and Connections: Copper throughout with individual wires coded and connections on identified studs or terminal blocks. Use no splices or similar connections in wiring except at terminal blocks, control compartments, junction boxes, or condulets. Provide 10% spare conductors throughout. Run spare wires from car connection points to individual elevator controllers in the machine room. Provide four pairs of spare shielded communication wires in addition to those required to connect specified items. Tag spares in machine room.
- B. Conduit: Painted or galvanized steel conduit and duct. Conduit size, 1/2" minimum. Flexible conduit not to exceed 36" in length. Flexible heavy-duty service cord may be used between fixed car wiring and car door switches for door protective devices.
- C. Traveling Cables: Type ET flame and moisture-resistant outer cover. Prevent traveling cable from rubbing or chafing against hoistway or equipment within hoistway. Provide 2 RG-59 coaxial CCTV cables within traveling cable from car controller to car top.
- D. Auxiliary wiring: Connect smoke sensors, emergency telephone system, firefighters' phone jack, paging speaker, CCTV, card reader, intercom, and Muzak in each car controller in machine room.

Hoistway Entrances. Entrance assemblies shall be provided with U.L. fire labels.

Frames. Hollow metal, bolted flush head to jamb connection assembly fabricated from not less than 14-gauge material. Permanently attach, rear mounted, cast, Arabic floor designation plates at 60" above finished floor on both side jambs. Provide main egress landing plates with "Star" designation. For designated emergency elevator, provide rear mounted, cast "Star of Life" designation plate at height of 78"-84" above finished floor on both side jambs. Braille indications shall be to the left of Arabic floor designation. Provide 14 gauge subframe for special Architectural overlay finishes. Size frames and doors at least 4" wider and 2" higher than clear opening dimensions.

Door Panels - Car and Hoistway. Panels: 16-gauge steel, sandwich construction without binder angles. Provide leading edges of center-opening doors with rubber astragals. Provide a minimum of two gibs per panel, one at leading and one at trailing edge with gibs in the sill groove their entire length of travel. Construct doors higher than 7'-0" with interlocking, stiffening ribs.

Sills. Extruded aluminum. Sill support angles shall be provided and installed by the Elevator Contractor.

Fascia. Fascia, toe guards, and hanger covers shall be hoistway width and fabricated of 14 gauge material. Paint with flat black enamel.

CAR EQUIPMENT

Car Frame. Welded or bolted steel channel construction.

Platforms. Construct of steel or wood which is fireproofed on the underside.

Guide Shoes. Roller guides must be spring dampened.

Door Operators. Reference approved products listing.

Door Reversal Devices. Reference approved products listing.

Fixtures. Reference approved products listing. All Code required and specified engraving shall be provided. Photo etching and/or stick-on signage will not be accepted.

Service Cabinet. Provide a lockable service cabinet. Cabinet shall contain:

1. Inspection switch.
2. Light switch.
3. 3-speed exhaust blower switch.
4. Independent service switch.
5. Constant pressure test button for battery pack emergency lighting.
6. 120-volt, AC, GFCI protected electrical convenience outlet.
7. Card reader override switch.

Car Top Control Station. Provide with 4'-0" long, permanently attached, extension cord for remote operation.

Work Light and Duplex Plug Receptacle. GFCI protected outlet top and bottom of elevator car. Include on-off switch and grounded metal lamp guard.

Communication System.

- A. "Push to Talk," two-way communication instrument in car with automatic dialing, tracking and recall features with shielded wiring to car controller in machine room. Provide dialer with automatic roll over capability with minimum four numbers.
 - 1. "Push to Talk" button or adjacent light jewel shall illuminate and flash when call is acknowledged. Button shall match floor pushbutton design. Provide uppercase "Push to Call," "Help on the Way" engraved signage Sans Serif or simple Serif type.
 - 2. Provide "Push to Talk" button tactile symbol engraved signage and Braille adjacent to button.
- B. Firefighters' telephone jack in car and Firefighters' panel, with four shielded wires to machine room junction box. Jack bezel shall match adjacent controls.
- C. Install remote speaker provided by Life Safety Contractor behind front return panel with shielded wiring to machine room junction box.

Car Enclosure. Finish details shall be shown on Architectural Drawings.

Shell. 14 gauge furniture steel with baked enamel finish. Service elevator pan sections shall not exceed 18".

Canopy. 12 gauge furniture steel with baked enamel finish.

Front Return Panels. Stationary type of 14 gauge stainless steel or textured stainless steel.

Transom. 14 gauge stainless or textured stainless steel running full enclosure width.

Base. Baked enamel or stainless steel. All elevators shall be provided with base ventilation. Passenger elevator vent slots shall be hidden.

Ventilation. Three-speed, Morrison Products, Model AA exhaust blower isolated from canopy on rubber grommets.

Lighting. Fluorescent fixtures, flush mounted in canopy with protective diffuser and steel guard over fixtures on car top.

Handrails. Meet ADA requirements for grab bars. Service elevators shall also be provided with a 4" x 3/8" solid stainless steel guard bar 8" above car floor.

HALL CONTROL STATIONS

Pushbutton Stations. Faceplates shall be flush with surrounding surfaces. Buttons shall be vandal-resistant (see pre-qualified products) and meet the requirements of CBC Title 24. Inconspicuous pushbutton risers shall also meet CBC Title 24 and include freight service jewels. Provide with L.E.D. illumination.

Hall Lanterns. Indicators shall be no less than 2-1/2" in their smallest dimension. Illumination shall be via L.E.D. clusters. Double gong and illumination is required when announcing down direction travel. Sound level shall be adjustable from 20-80 dBA. Provide advanced notification to comply with ADA corridor call notification time. Traction groups of three or more cars shall be provided with predictive lanterns.

Firefighters Control Panel. Locate in building fire control room. Fixture faceplate, No. 4 brushed finish stainless steel, including the following features:

- A. Car position and direction indicator (digital-readout or color VGA display type). Identify position indicator with car number.
- B. Indicator showing operating status of elevator.
- C. Wiring to panel. Conduit from closest elevator hoistway of each group by others.
- D. Manual car standby power selection switch and power status indicator.
- E. Firefighters' telephone jack.

Machine Room Interactive Device. Provide a control panel and color VGA with the capability to activate display and monitor the following functions. Provide conduit and wiring to panel. Provide keyboard and printer.

- A. On/off means to place elevator in our out of service. When placed in Aoff≅ position, return elevators to nonstopto designated floor and park with doors open.

- B. Car operating on normal/standby power.
- C. Car position and direction of travel.
- D. Car calls.
- E. Hall calls.
- F. Door status.
- G. Delayed car.
- H. Load weigh and by-pass.
- I. Car to lobby feature.
- J. Car in/out of service.
- K. Seismic operation.
- L. Secured floor access.
- M. Distress signal.
- N. Secured after-hours split bank operation.
- O. Card reader override.

CHAPTER 6
DEVELOPMENT OF CONSTRUCTION DOCUMENTS
PART 3 - EXECUTION

SITE CONDITION INSPECTION

Elevator Contractor shall verify that site conditions conform to project requirements prior to beginning work.

PRODUCT DELIVERY, STORAGE, AND HANDLING

The Elevator Contractor shall be provided with suitable storage at the job site. Storage area shall be secure and protect stored equipment from damage.

INSTALLATION

Equipment shall be installed per Manufacturers instructions, code, specifications, and approved submittals. Installed equipment shall be easily removable for maintenance and repair. Any damage occurring during construction shall be repaired.

FIELD QUALITY CONTROL

Work at the job site will be checked during construction. Full cooperation with reviewing personnel is mandatory. Accomplish corrective work required prior to performing further installation. Have Code Authority acceptance inspection performed and complete corrective work.

ADJUSTMENTS

- A. Install rails plumb and align vertically with tolerance of 1/16" in 100'-0". Secure joints without gaps and file any irregularities to a smooth surface.
- B. Static balance car to equalize pressure of guide shoes on guide rails.
- C. Lubricate all equipment in accordance with Manufacturer's instructions.
- D. Adjust motors, power conversion unit, brake, controllers, valves, pumps, leveling switches, limit switches, stopping switches, door operators, interlocks and safety devices to achieve required performance levels.

CLEANUP

- A. Keep work areas orderly and free from debris during progress of project. Remove packaging materials on a daily basis.
- B. Remove all loose materials and filings resulting from work.
- C. Clean machine room equipment and floor.
- D. Clean hoistways, car, car enclosure, entrances, operating and signal fixtures.

ACCEPTANCE INSPECTION AND TESTS

- A. General: Furnish labor, materials, and equipment necessary for tests. Notify Consultant 5 days in advance when ready for final review of elevator unit or group. Final acceptance of installation will be made only after all field-quality control reviews have been completed, identified deficiencies have been corrected, all Owner's information and certificates have been received, and the following items have been completed to satisfaction of Purchaser and Consultant.
 - 1. Workmanship and equipment comply with specification.
 - 2. Contract speed, capacity, floor-to-floor, and door performance comply with specification.
 - 3. Performance of following are satisfactory:
 - a. Starting, accelerating, running
 - b. Decelerating, stopping accuracy
 - c. Door operation and closing force
 - d. Equipment noise levels
 - e. Signal fixture utility
 - f. Overall ride quality
 - g. Performance of door control devices
 - h. Operation of Phase I and II Firefighters' Operations

- i. Operations of Standby Power transfer Operations
 - j. Operations of special security operation and floor lock-off provisions.
 - 4. Test Results:
 - a. In all test conditions, obtain specified speed, performance times, stopping accuracy without re-leveling, and ride quality to satisfaction of the Owner and Consultant.
 - b. Temperature rise in motor windings limited to 50E Celsius above ambient. A full-capacity, 1-hour running test, stopping at each floor for 10 seconds in up and down directions, may be required.
- B. Performance Guarantee: Should tests reveal defects, poor workmanship, variance or noncompliance with requirements of specified Codes and/or ordinances, or variance or noncompliance with the requirements of specification, complete corrective work to satisfaction of Purchaser and Consultant at no cost:
 - 1. Replace equipment that does not meet Code or specification requirements.
 - 2. Perform work and furnish labor, materials and equipment necessary to meet specified operation and performance.
 - 3. Perform and assume cost for retesting required by Governing Code Authority, Purchaser and Consultant to verify specified operation and/or performance.
- C. Field Review Scheduling: Schedule progress and final equipment reviews with Consultant. Reply promptly, in writing, to corrective work indicated on Consultant's progress and/or final review reports, indicating status, schedule for completion, and questions. Consultant anticipates scheduled appointments will be met. Contract price will be reduced to reimburse Consultant at normal billing rates for appointments not kept, or for additional follow-up reviews required due to gross non-compliance with previous review requirements.

INSTRUCTION TO UT PERSONNEL

The following instruction requirements will apply to all equipment installed at UT where technologies or equipment new to the UT maintenance staff is being provided. The depth of, and need for, instruction must be confirmed and adjusted by the UT facilities department prior to issuance of bid documents. Where required, the following training shall be provided:

- A. Training During Final Adjustments: UT may assign a maximum of four (4) UT elevator mechanics to observe during the final adjustment of one of each type of elevator. Elevator Contractor's adjusters shall explain the procedures for adjusting the elevator and answer all questions. These mechanics can be from another elevator company that is serving as the elevator maintenance contractor for the Campus.

- B. Formal Training: Provide formal training (consisting of a minimum of three (3) days, eight (8) hours each day) in the adjustment, troubleshooting and repair of the complete elevator control and drive system. Class duration and content shall be similar to that received by the equipment manufacturer's and Elevator Contractor's field personnel.
 - 1. Class size shall be limited to four (4) UT elevator mechanics.
 - 2. Instructor shall be a trained instructor possessing complete knowledge of the elevator system.
 - 3. Training shall be provided within two (2) months following acceptance of the elevators.
 - 4. Training shall be during normal business hours at a local site agreeable to both parties.
 - 5. Approximately one half the time shall be classroom instruction and the remainder shall be "hands on" at the job site.
 - 6. Training manuals shall be provided to each student covering all aspects of the equipment.
 - 7. UT reserves the right to video tape or audio tape the classroom sessions. Tapes shall be used for UT training purposes only.
 - 8. These mechanics and personnel being trained can be from another elevator company that is serving as the elevator maintenance contractor for the Campus.

B. Training During the Warranty Period:

1. Elevator Contractor's adjusters and service personnel, while troubleshooting, adjusting or repairing during the warranty period, shall provide training and answer questions regarding the procedures used. These mechanics can be from another elevator company that is serving as the elevator maintenance contractor for the Campus.

OWNER'S INFORMATION, MAINTENANCE MATERIALS AND TOOLS

- A. General: Within thirty (30) days following final acceptance of the elevator installation, provide all wiring diagrams, written information, supplemental data, spare parts and diagnostic tools necessary for proper maintenance and adjustment of the equipment, including the following: (Materials must be job-specific for this project.)

B. Wiring Diagrams:

1. Provide two (2) copies and one (1) mylar reproducible transparency of all wiring diagrams, including straight-line wiring diagrams of all "As Built and Installed" elevator electrical circuits, complete with an index of the location and function of all components. **NOTE:** Mylar reproducibles shall be Photographic Grade, 5 mil thickness, matted both sides and printed on back side. Provide photographic negatives for all drawings.
2. Leave one (1) complete set of "final" corrected installation diagrams and adjustor's wiring dope sheets on the job, for each unit.

- C. Shop Drawings: Provide two (2) copies of all final corrected construction and installation drawings.

- D. Operation and Maintenance (O&M) Manuals: Provide three (3) neatly bound and indexed sets of O&M manuals containing the following:

1. Sequence of operation and/or flow charts of the motion and supervisory control panels and related operating equipment. Include logic diagrams for all individual and group microprocessors.
2. Operation and maintenance instructions, consisting of detailed application data and instructions for all equipment components, including car, corridor and remote signal/control fixtures.

3. Lubrication program, including recommended procedures and grades of cleaners and lubricants to be used.
4. Parts catalogs for all replaceable parts, including ordering forms and instructions. **NOTE:** If a given component is made up of smaller parts, the smaller parts shall also be clearly identified by number.
5. Summary of contract data for each type of equipment furnished, including quantities and part numbers.
6. Step-by-step installation and adjusting procedures, as used by equipment manufacturer's and installer's field personnel, for each type of equipment furnished. This shall include, but not be limited to, complete data and settings for the following:
 - a. Motion controllers:
 - (1) Power conversion and drive unit adjustments, including relay air gaps, current operated relays, overload relays, timed circuits, acceleration and deceleration patterns and all other field-adjustable settings.
 - (2) Overload relays, timed circuits, and all other field-adjustable settings.
 - b. Dispatching controller: Electronic devices, timed circuits, etc., including data and procedure to change field-programmable microprocessor settings.
 - c. Motors: Air gap, compounding, neutral setting and all other necessary adjustments.
 - d. Machine brake: Shoe clearance, core clearance, brake switch, and all other adjustments necessary to give a satisfactory functioning brake.
 - e. Selectors, encoders, tach generators, etc.
 - f. Governor: Over-speed switch and jaw trip settings, rope pull-through adjustment.
 - g. Hoistway switches, inductors, transducers, vanes, cams, etc.

- h. Terminal landing slow-down device.
 - i. Leveling/re-leveling units.
 - j. Load weighing device: Settings and load compensation adjustments.
 - k. Safeties: Clearance to rails, releasing carrier pull-out in pounds and adjustment of safety-operated switch.
 - l. Guide shoes: Roller guide spring tension and stop settings.
 - m. Door operator: Door operator motor, control switches, cams, rheostats, potentiometers and resistors.
 - n. Car and Hoistway doors: Door closers, door and gate locks, clutches or bayonets, pick-up and drive rollers, door unlocking cam, and car door restrictors.
 - o. Door protective devices: Focusing, testing, adjusting and maintenance procedures.
 - p. Communications, annunciating, monitoring and security systems.
 - q. Pump flow and leveling control valves, relief valves and jack packing gland.
- E. Supplemental Data: The following supplemental data will be required by UT for all projects:
- 1. List of necessary tools, instruments and other equipment used in the adjusting procedure, including the techniques for incorporating them in procedures.
 - 2. Final adjusting data for each elevator unit, including settings for the following:
 - a. Load compensating switches, in pounds.
 - b. Selectors/encoders.
 - c. Brakes: Shoe running clearance and brake coil current.

- d. Hoist motor brush spring tension.
 - e. Hoistway switches, inductors, transducers, etc.
 - f. Door operator control switch settings.
 - g. Safety device: Full-load, full-speed test data.
 - h. Full-load starting and running current.
 - i. Current settings of current-operated relays.
 - j. Motor field resistance settings.
 - k. Timers: Time delay settings, including method and equipment needed to program microprocessor.
 - l. Electronic power supply voltages necessary for correct functioning of equipment and from where measured.
- 3. During the warranty period and for a period of not less than two (2) years following expiration of warranty, provide UT with any and all supplementary bulletins or correspondence, issued by either the equipment manufacturer, supplier or installer, relative to any improved replacement parts and any revised procedures for maintenance, trouble shooting and adjustment on any and all equipment installed.
 - 4. Provide any and all additional data required or requested by UT to facilitate equipment maintenance and adjustment.

F. Maintenance Materials:

- 1. Expendable parts: The Elevator Contractor shall provide one or more secure metal cabinets containing expendable parts normally required for maintenance and repairs during the warranty period. Locate cabinet(s) in machine room(s) as directed by UT Representative. All parts utilized for warranty repairs shall be promptly replaced by the Elevator Contractor. All parts utilized for maintenance or repairs not covered by warranty shall be promptly replaced by UT. Parts cabinet(s) and all parts contained therein shall become property of UT and shall not be removed at the expiration of the warranty period. As a minimum, provide the following items:

- a. One (1) set of renewal contacts and operating coil for each type of motor starter and main contactor installed.
- b. Two (2) resistors and two capacitors of each size and value installed.
- c. One (1) complete set of SCRs, Triacs, power transistors and/or similar devices for each type of power convertor/drive unit installed.
- d. Two (2) control relays of each type and voltage installed.
- e. One (1) complete key-operated switch, including individually keyed lock cylinders for each function, of each type installed.
- f. One (1) complete set of hoist motor brushes for each type installed.
- g. Twenty-four (24) lamps of each type and voltage installed.
- h. One (1) car and corridor pushbutton for each function, with identical graphics, of each type installed.
- i. Ten (10) fuses of each type and size installed.
- j. One (1) control circuit board of each type and part number installed.
- k. One (1) set of backup PROMs, programmed for each group supervisory controller and for each individual elevator unit.
- l. One (1) set of door operator belts/chains of each type installed.
- m. Two (2) complete sets of hoistway door interlock contacts for each type installed.
- n. Two (2) sheaves for each type of car and hoistway door hanger assembly installed.
- o. One (1) set of pump unit drive belts of each size and type installed.

- p. One (1) set of packing for each size and type jack assembly installed.
 - q. Any other parts required for prompt replacement.
2. Replacement Parts: The Elevator Contractor shall maintain the following parts in a warehouse within 50 miles of the UT campus:
- a. One (1) door operator motor of each type installed.
 - b. One (1) transformer and choke coil of each type installed.
 - c. One (1) set of hoist motor and sheave bearings of each type installed.
 - d. Parts for door protective devices of each type installed.
 - e. Such other parts as are necessary to ensure prompt replacement in the event of an individual elevator shutdown or group system failure.
- G. Maintenance Tools and Software Documentation: Provide all tools designed specifically for tasks associated with the examination, maintenance, trouble shooting, repair, and adjustment of the elevator equipment installed, which are not readily available through normal purchasing channels. These shall include all top-level, solid-state diagnostic tools and related software documentation which the Equipment Manufacturer and Installer supplies to his adjusters and service personnel.
- 1. Diagnostic tools may be hand-held or built into controller system and shall be of the type not requiring periodic recharging or reprogramming, nor be of the automatic destruct type.
 - 2. Diagnostic tools and supporting software may be programmed so as to operate only with this Projects identification serial number(s).
 - 3. Compact diskettes with software programs used for each group supervisory controller and for each individual elevator unit.
 - 4. Special tools and software documentation shall become the property of UT. **NOTE:** If individual microprocessor or group supervisory diagnostic equipment and tools are not available for sale, Elevator Contractor shall quote UT on lease of this equipment. Terms of lease must be acceptable to UT. Quote as a separate item.

5. Any Contractor providing elevator equipment will provide 3 laminated sets of as installed wiring diagrams, Owners Manuals, Parts Manuals. (These will be provided for any type equipment) OEM equipment shall have complete onboard diagnostics or a job specific diagnostic tool capable of complete trouble shooting. The diagnostic tool becomes the property of UTK and the Installer shall be responsible for any and all updating and calibration for a period of 10 years from the date the contract changes, at no cost to the Maintenance Contractor or UTK, except in the case of vandalism and in that case it shall be the contractors responsibility. Turnaround time for updating and calibration will not exceed 72 hours.