

01 79 00 – Demonstration and Training

1. Introduction

A. This section includes administrative and procedural requirements for instructing University personnel on the following demonstrations and training as a part of renovation or new construction projects:

1. Demonstration of operation of systems, subsystems and equipment.
2. Training in operation and maintenance of systems, subsystems and equipment.
3. **General System training:**
 - a. General training involves an overview by the applicable installing contractor and includes a walkthrough of all related systems and components. General training shall encompass but not be limited to an entire building walkthrough, surveying main system equipment and components; main and branch hydronic system isolation valves, electrical and control panels and providing access to these components, general repairs, etc.
 - b. The General System training should be a scheduled as a separate session and is not to be combined with any other training category.
4. **On-Site Factory Training:**
 - a. Contractor shall provide a factory representative (Technical Rep) to provide comprehensive system training.
 - b. Training shall include elements of the General Training overview section, system and component operation, location(s) of all control/equipment components, review of local controls, how to perform preventative maintenance, review of any software to interact with equipment or the system, etc.
5. **Programming & Sequence Review Training (SOO):**
 - a. Training shall focus on BAS system control and interconnections. Contractor shall provide a factory representative to provide detailed sequence of operations programming training on applicable system(s).
 - b. The training shall include but not be limited to a detailed system review of controls and operation, BAS interconnection, BAS system graphics, location of main equipment and control system component locations, etc.

6. Off-Site Training:

- a. Comprehensive training to include off-site visit to the system/component factory for up to three (3) University representatives. The training shall encompass but not be limited to intended system/component operation, how to properly operate the system/components, how to perform preventative maintenance, in depth project specific troubleshooting and system operation, review of any software to interact with equipment or systems, etc.
- b. Any proposed off-site training shall be coordinated with the University prior to final construction documents.

2. Instruction Program

- A. Contractors should be prepared to provide hand-outs for all training sessions, unless instructed otherwise by the Owner.
- B. Hand-out material shall include but not be limited to applicable system or equipment information, product data, control drawings, system single-line drawings, sequence of operations information, operations and maintenance manuals, etc. This note applies to all training scenarios: General, On-Site, Programming & Sequence Review Training and Off-Site.
- C. Program Structure: Develop an instruction program that includes an individual training agenda for each system, subsystem and equipment. Develop an instruction program for equipment that is not part of a system or subsystem as required by individual Specification Sections, and as follows:
- D. Training Agenda: Develop a learning objective and teaching outline for each agenda. Submit the agenda 45 calendar days prior to the request for Substantial Completion inspection. For each module, include instructions for the following:
 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem and equipment descriptions.
 - b. Performance and design criteria if the Contractor has delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.

- g. Limiting conditions.
 - h. Performance curves.
2. Documentation: Review the following items in detail:
- a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Hazards/Material Safety Data Sheets.
 - g. Warranties and bonds.
 - h. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
- a. Instruction on meanings of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
- a. Start-up procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety protocol.
 - g. Instructions on stopping.

- h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventative maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on the use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
 - b. Repair instructions.

- c. Disassembly; component removal, repair, and replacement; and re-assembly instructions.
- d. Instructions for identifying parts and components.
- e. Review of spare parts needed for operation and maintenance.

3. Instruction Preparation

- A. Assemble educational materials necessary for instruction, including documentation and training module(s). Assemble training agenda into a combined training manual.
- B. Provide conditioned space with tables and chairs for conducting the classroom portion of all training sessions.
- C. Contractor to provide all necessary instructional equipment at instruction location.

4. Instructor Qualifications

- D. Facilitator: Engage a qualified facilitator to prepare the instruction program and training agenda, to coordinate instructors, and to coordinate between the Contractor and the University for the number of participants, instruction times and locations.
- E. Engage qualified instructors to advise University personnel on how to adjust, operate and maintain systems, subsystems and equipment not part of a system.
 - 1. Furnish an approved instructor to describe the basis of each system designed for the project, operational requirements, criteria and regulatory requirements.
 - 2. The University will provide an estimate of the number of staff that will attend each training session, and the Contractor is to document attendance with a sign-in sheet. The sign-in sheet is to be submitted by the Contractor as a part of the record document.

5. Instruction Process

- A. Scheduling: Provide instruction at mutually agreed upon times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
 - 1. Schedule training with the University with at least 15 days' advance calendar notice.
 - 2. Submit a daily training agenda (module) for review and approval for each system or equipment no later than 15 calendar days prior to the scheduled date for system or equipment commissioning and turnover. After obtaining approval of the training agenda, the Contractor is to submit a list of proposed dates, times and locations for the training. The University will respond to confirm the selected dates, times and locations or to request alternates.

- B. Demonstration and Training Video: Record the instruction of the University’s personnel in the operation and maintenance of equipment and systems. Edit video to remove non-instructional conversation. Videographer shall select vantage points to best show equipment, systems, and procedures demonstrated. Provide movie file of each unique training session in its entirety. Record video at a recording quality equal to a standard DVD.
 - 1. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids.
 - 2. At the beginning of each training module, record each document containing the learning objective and lesson outline.
- C. Cleanup: Collect used and leftover educational materials and remove them from the instruction area. Remove instructional equipment. Restore systems and equipment to existing condition prior to training use.

6. Training Matrix

Duke University System Training Matrix

Systems/Equipment	General Overview	On-site Factory Training	Programming and Sequence Review	Off-Site Training
Mechanical System Training				
Modular Air Handling Units	X		(2)	
Custom Air Handling Units	X	X	(2)	
Specialty Air Handling Units	X	X	(2)	X
General Exhaust Fans	X		(2)	
Specialty Exhaust Fan Systems	X	X	(2)	X
Heating Hot Water System	X	X	(2)	
Chilled Water System	X	X	(2)	
Cooling Towers	X	X	(2)	
Process Cooling Water System	X	X	(2)	
Micro-Environments	X	X	(2)	X
Fume Hoods	X	X	(2)	
Bio-Safety Cabinets	X	X	(2)	
Computer Room AC units	X	X	(2)	X
Boilers	X	X	(2)	X
Lab Module Controls	X	X	(2)	
BAS Controls	X	(2)(C)	(2)(C)	
Electrical System Training				
Switchgear	X	X	(2)	
Automatic Transfer Switch	X	X	(2)	
Uninterruptable Power Supply	X	X	(2)	X

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Systems/Equipment	General Overview	On-site Factory Training	Programming and Sequence Review	Off-Site Training
Photovoltaics	X	X	(2)	X
Generators	X	X	(2)	X
Inverters	X	X	(2)	X
Lighting Control Systems	X	(1), (2)	(2)	X
Programmable Light Fixture	X	(3)		
Equipment with Local Controls	X	X		
Blind Shades	X	X	(2)	
Car Chargers	X	X		
Security Systems				
Access Control Systems				
Sound Systems				
Audio/Visual Systems				
Plumbing System Training				
Reclaim System	X	X	(2)	
Rain Water Harvesting	X	X		
Sensor Faucet	X	X		
Instantaneous Water Heater	X	X		
Solar Hot Water System	X	X	(2)	
Hot Water Converter	X	X	(2)	
City Water Booster Pump Package	X	X	(2)	
RODI System	X	X	(2)	
Process lab Air	X	X		
Process Vacuum	X	X	(2)	
Fire Pump	X	X		
Specialty/Structural System Training				
Spas and Pools	(2)	(2)		X
Water Fountains	X	X		
Motorized/Movable Wall Systems	X	(2)		
Sound Panel Systems	X	X		
Ceiling Panel Systems	(2)	(2)		
Electronic/Automatic Doors	X	(2)		
Paint Finishes & Concrete Coatings	X			
Interior and Exterior Glass Systems	X			
Specialty Handrails	X			
Exterior and Interior Door Hardware	X			
Specialty Cabinet Hardware	X			
Cabinet and Counter Installations	X			
Bathroom Partitions and Hardware	X			
Office Partitions and Hardware	X			
Shelving Systems	X			
Tormax Automatic Door System	X	(2)		

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Systems/Equipment	General Overview	On-site Factory Training	Programming and Sequence Review	Off-Site Training
Roll-up Doors	X	(2)		
Interior and Exterior Masonry Systems	X			
Elevator/Escalator/Lift Systems				
Notes: (C) Classroom Training (1) Manufacturer (2) Installing Contractor (3) Witness Programming During Install				