

25 00 00 INTEGRATED AUTOMATION

General

1. All work shall be consistent with these standards for controls systems including all hardware, software and graphics. The controls contractors are expected to be fully conversant with these standards and shall allow for all measures required for the specified work to meet these standards.

The control system shall be fully electric / electronic except for remaining existing pneumatic controls. Special applications may require pneumatic activation.

2. New controls panels shall be the MACH Series controllers designed and built by Reliable Controls Corporation. Other products used shall be manufactured by Reliable Controls Corporation or, where they do not manufacture required products, the products used shall be as recommended by Reliable Controls Corporation for incorporation into their controls system.
3. Contractors are to provide modifications to the control system complete with all necessary components and connections to achieve the specified functions.
4. Contractors are to include for any required expansion of the existing DDC system to accommodate the required additional control inputs and outputs. All new outputs shall each have an integral HOA toggle switch.
5. Controllers must be capable of communicating with RCP protocol on both, main and sub network as well as BACnet. The exception is where Mach Series Revision 8 firmware controllers are to be installed.
6. The control system and all controllers and hardware including third party devices shall be BACnet Testing Laboratories (BTL) certified.
7. All third party devices non-native to Reliable Controls shall have some sort of heartbeat or handshaking routine. When communications become unresponsive, an alarm will trigger.
8. New controllers shall have a minimum 10% spare points at each location.
9. All control panels and components (except valves, dampers and sensors) shall be located in the mechanical rooms or in service rooms or spaces as acceptable to FMGT.
10. The Mechanical Consultant shall determine with the Electrical Consultant which systems shall be hard-wired under the electrical documents to shut down in the event of detection of a fire.
11. When a new controller is added or an existing controller is modified include hard and soft copies MSet configuration to UVIC.
12. Transmitter configuration and calibration settings, including signal range to the DDC, are to be provided at the field device.

25 10 00 INTEGRATED AUTOMATION NETWORK EQUIPMENT

Standby Power

1. System designers are to determine whether the controls system should be on standby/emergency power, or UPS, when central applications are controlled or the equipment being controlled is on

emergency power. The impact of power transfer to the control system needs to be considered, and whether a UPS system is appropriate.

2. Standard of Acceptance for a UPS is Eaton PW9130L700T

Electrical Components, Wiring and Conduit

1. Carrier System:
 - i. All wiring for 24 volts or less in mechanical service spaces, in stud walls or where exposed to view shall be run in EMT conduit except wiring to all operators and to all sensors subject to vibration shall be run in flexible metallic conduit for the final 900mm (3 feet).
 - ii. Provide conduits for all wiring between the fire alarm panel and the DDC panels.
 - iii. All wiring for over 24 volts shall be run in EMT conduit.
 - iv. Provide steel fittings with nylon throats for all conduit connections.
2. Wire:
 - i. Line voltage power or switched power wiring - #12 gauge copper wire minimum.
 - ii. Line voltage control wiring - #14 gauge copper wire, length not to exceed 50 meters; #12 gauge copper wire, lengths exceeding 50 meters.
 - iii. Low voltage – wire as directed by applicable electrical codes and requirements but minimum #20 gauge.
 - iv. All DDC wiring ran in ceiling spaces must be strapped every 3 feet, and not run through sharp edges or corners. Cables shall be run in a straight, organized fashion. Diagonally run cables are not acceptable.
 - v. All DDC wiring to have wire tags at both ends.
 - vi. Wires shall be organized using Panduit or similar.
 - vii. All Conduit containing control wiring should only be 75% full upon project completion

Standard of Acceptance for data transmission cable is Cat. 6 cable

3. Control Panels:
 - i. All control panel enclosures shall be accessible with 1m working distance in front, with no obstructions. Ceiling mounted enclosures shall have accessible T-Bar removable panel and room to place a ladder below.
 - ii. Panels are to be identified with a panel legend, proper wire tagging, a panel identifier on the outside of the panel, and the panels are to be maximum 75% full when complete to allow room for future expansion.
 - iii. Fiberglass or polycarbonate boxes with a Nema level 4 rating shall be used. Outdoor panels shall be weatherproof fiberglass type with quick release fitting and have a breather plug installed.
 - iv. Preferred Weatherproof fiberglass junction box for DDC controls outside. Quick release fittings.
 - v. All DDC controllers which are networked together must be accompanied with a network map.
4. RS-485 Communication Cabling Shielding and Drain Wires
 - i. All drain wires must be installed with clear spaghetti tubing to prevent the drains from coming in contact with ground. (See figure 25 10 00-1)
 - ii. All communications cables must be installed with clear heat shrink to prevent the cable shield for coming into contact with ground. (See figure 25 10 00-2)
 - iii. DDC communications terminal end (eg. terminating at DDC) to have drain wire wrapped back over cable sheath cable end to be dressed with 3/8" clear heat shrink to prevent drain wire and shield from contact with ground. (See figure 25 10 00-3)

- iv. DDC controller serial drops should be installed as per the following figure below. (See figure 25 10 00-4)
- viii. The communications network needs to come into contact with ground at only one point as close as possible to the ground grid point of origin. (See figure 25 20 00-4) This network ground should be identified with a label, eg. "DDC Network Ground" etc. If more than one drain / shield points of the system come into contact with electrical equipment grounds, the difference in potential between the locations will cause sheath currents (Eddy Currents) to flow in the RS-485 network. This will cause communications errors to occur in the network.
- v. The contractor will supply a drawing of the RS-485 cable routing to each of the DDC controllers including which room(s) they reside in as well as the DDC control panel numbers. The end of line controller(s) will also need to be identified especially if a spur type topology is implemented.
- vi. Joints or splices of the cable will not be permitted throughout the entire length of the communications system. Damage to the cable sheath must be repaired properly to ensure that the shield does not come into contact with electrical ground.
- vii. Proper strain relief connectors are to be used when entering into a control enclosure. If required mechanical protection may also be required. (Conduit, flexible conduit).
- viii. The color coding of the insulation for the two Belden cable conductors shall be white with a blue tracer and blue with a white tracer. The cable conductor size of the Belden shall be 18 AWG solid. All cabling must be approved for communications application complete with cable shield and drain.

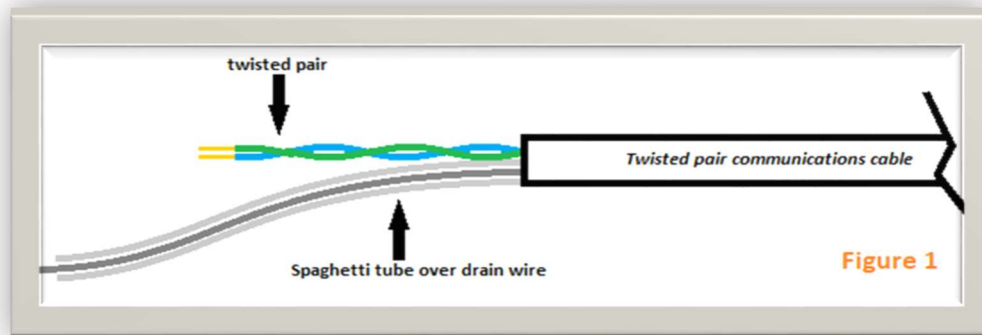


Figure 25 10 00-1

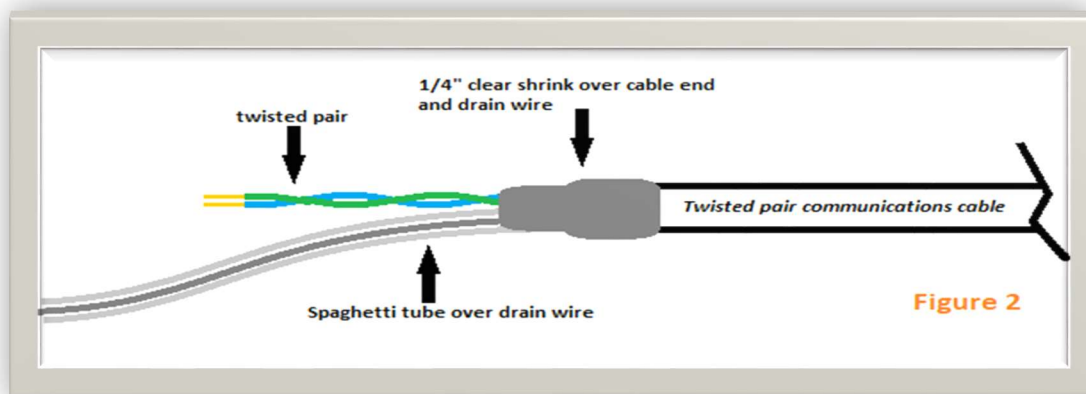


Figure 25 10 00-2

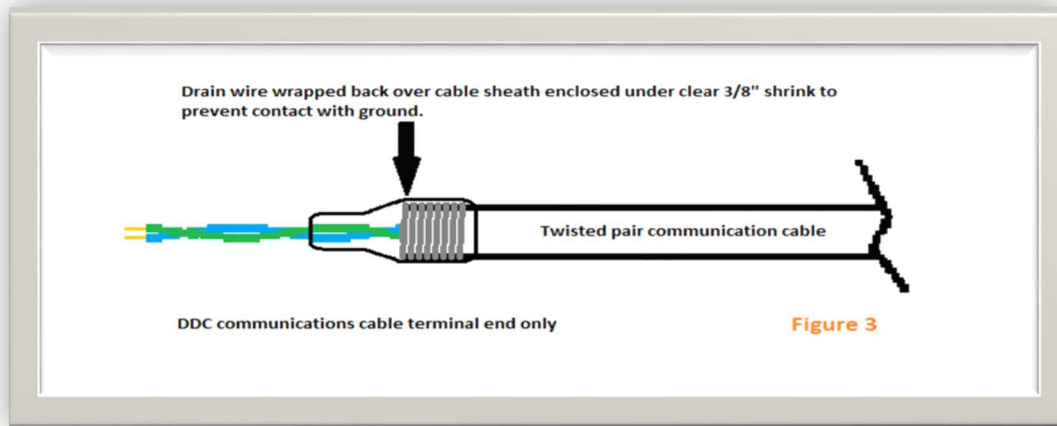


Figure 25 10 00-3

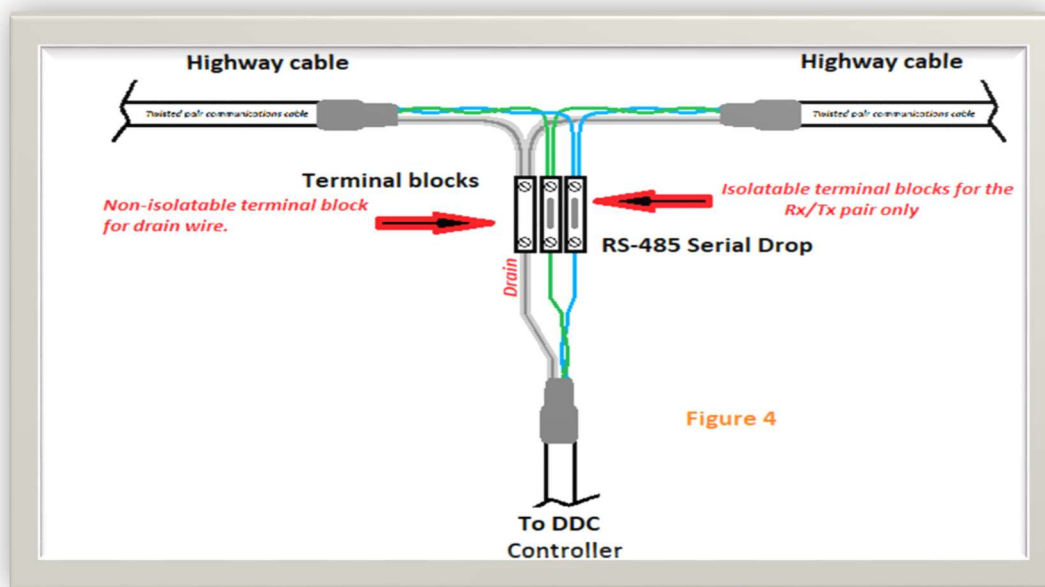


Figure 25 10 00-4

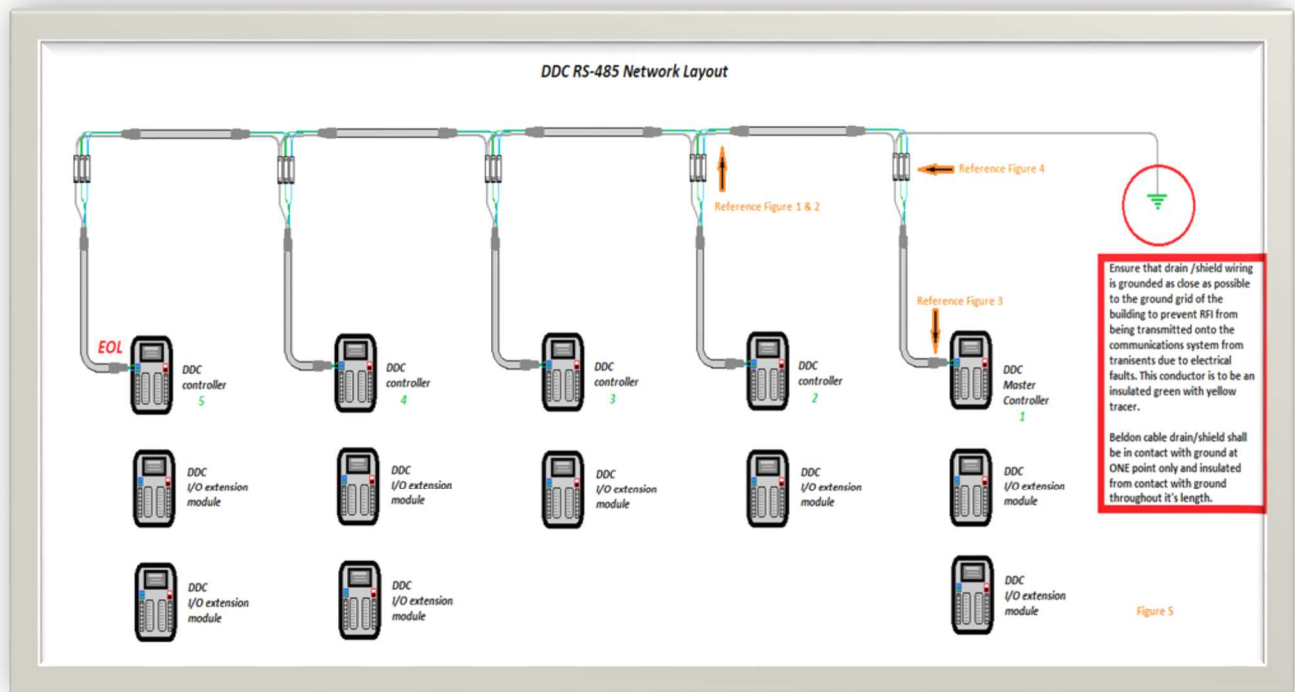


Figure 25 10 00-5

Transformers

1. Secondary side of transformers (24VAC) side should be grounded, as directed in the Reliable Controls manuals.

Identification

1. Label and identify all panels and points with a numbering system consistent with UVic's DDC network numbering system.
2. Identify all controls with symbols relating directly to the control diagram. Use plasticized tags, engraved brass, aluminum, metal-photo, or laminated plastic labels and secure them to, or adjacent to the control devices with key chains.
3. Paint junction box covers to UVic standard colours. For DDC Junction boxes, the colour shall be blue.
4. Use colour coded conductors, white for neutral.
5. All manual switches, unless they come with standard nameplates, shall be labelled with engraved plastic laminate nameplates to clearly indicate the service. Wording on nameplates shall be subject to approval by FMGT.
6. Identify all DDC panels and associated devices with symbols relating directly to the control diagram. Provide plastic labels for each input and output point with the following information:
 - i. Point descriptor.
 - ii. Point type and channel number.
 - iii. Corresponding DDC panel number.

7. Mount an input-output legend sheet within each DDC panel. This sheet shall include the name of the points connected to each controller, the end device manufacture, part number, model number and shall describe the I/O range. If an I/O module is remotely located, a separate legend sheet for that module shall be included at both locations.
8. All Relays to be labeled and have wire tags.

25 35 16 INTEGRATED AUTOMATION SENSORS AND TRANSMITTERS

General

1. All instruments, transmitter's pressure switches, sensors, are expected to be reachable by ordinary means. All installed devices should incorporate future maintenance in mind. Mounting a device that has pipework in the way or makes it inaccessible is not permitted.
2. Occupancy sensors, temperature transmitters (sensors), CO2 detectors must be verified, an initial calibration should not be required if factory calibrated. Refer to manufactures recommendation as a minimum. If the device is not within specification, it should be noted on the commissioning documents and corrected. If a reoccurrence or drift error occurs within the warranty period, it shall be replaced.
3. All Sensors Gauges and Transmitters shall be installed to be operated within 75% of their capacity.

Current Sensors

4. Provide current sensors for all motor-driven equipment except small fan-coils, unit heaters, force flow heaters, washroom exhaust fans for individual washrooms, and other minor, non-critical equipment.

Temperature Sensors

1. Room temperature sensors in staff areas (non-student, non-public areas) – two-wire type with up/down temperature adjust.
2. Room temperature sensors in student or public areas – no user interface input.
3. Room temperature sensors shall be mounted 6 inches below any other sensors to prevent false readings due to heat from these sensors.
4. The end-to-end accuracy for all DDC monitored temperature sensors shall be ± 0.5 °C unless otherwise specified.

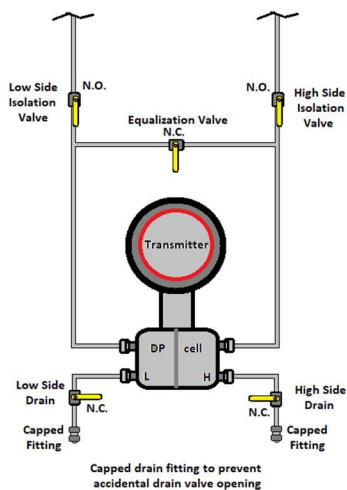
Relative Humidity Sensors

1. Overall accuracy of +/- 3 % reading from 0 to 95 % RH unless the individual application requires higher accuracy.
2. Operating temperature range of - 20 °C. to 80 °C.
3. Long term stability with less than 1% drift per year.
4. Sensitivity of 0.5%RH.
5. Complete with built in transmitter for 4-20 mA output proportional to RH to the DDC. Sensor to be fully compatible with DDC.

6. Humidity sensor shall be replaceable.

Pressure Sensors

1. All differential pressure sensors/transmitters are to be installed as per figure 25 35 16-1 in an accessible location to allow for easy maintenance and calibration.. Transmitters to be mounted 90 degrees to the top of pipe to prevent scale and other debris from being deposited in the system. For Orifice flow installations locate flange as per figure 25 35 16-2 For probe type pressure transmitter install as per figure 25 35 16-3.



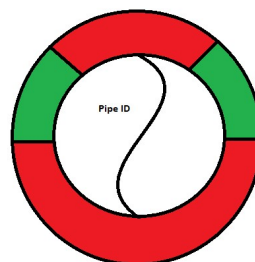
Drain fittings will allow us to flush the cell body and allow us access to puff up the cell to perform calibration checks.

Figure 25 35 16-1

Differential Pressure Transmitter Flange Tap Locations for Orifice Flows

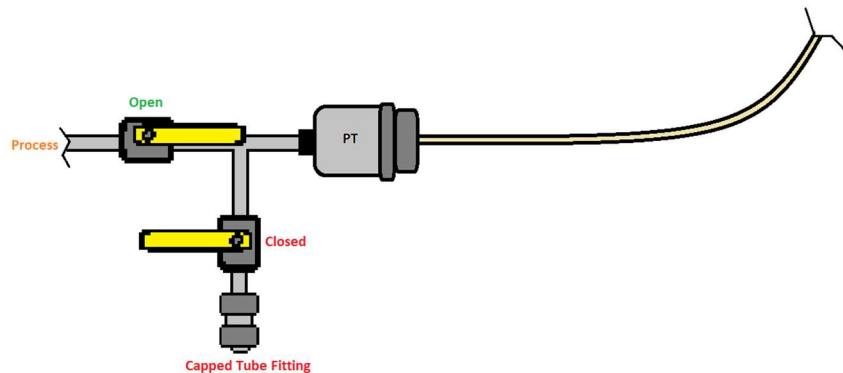
Green Indicates appropriate locations

Red sections will allow entrained gas to enter the system or allow sedimentation to plug the lines.



25 35 16-2

This tubing/valving layout will allow the technician to replace the transmitter, zero the transmitter, use a pressure source to calibrate and verify the transmitter.



25 35 16-3

Flow Transmitters

1. All flow transmitters and flow switches are at minimum to be installed with manufactures recommended upstream and downstream piping requirements.

25 35 19 INTEGRATED AUTOMATION CONTROL VALVES

Control Valves and Actuators

1. Standard of acceptance: Belimo ball valve, B200 series with stainless steel ball and characterizing disc in the inlet of 2-way valves and in the control ports of 3-way valves.
2. Consider whether spring return or fail to last controlled position is desired for each valve.
3. Control valves on campus heating mains shall be selected to operate continuously at 121°C (250°F).
4. Acceptable Products: Johnson Controls, Honeywell, Siemens.

25 35 23 INTEGRATED AUTOMATION CONTROL DAMPERS

Control Dampers

1. Provide differential pressure, monitoring across major air filter banks.
2. Provide differential pressure or current sensors across pumps.
3. Provide an independent output for each of the return air damper, the outdoor air damper and the relief damper on mixed air systems.
4. Low leakage type with blade and frame seals.
5. Blades shall be horizontal in vertical mounted dampers.

6. Acceptable Products: Ruskin CD-36, TAMCO Series 1000 (T.A. Morrison), Johnson Controls, Honeywell.

Control Damper Actuators

1. Electric/Electronic Damper Actuators shall be direct coupled and spring return. Standard of acceptance is Belimo, or Siemens .

25 55 00 INTEGRATED AUTOMATION CONTROL OF HVAC

Existing Controls

1. Most of the older buildings have pneumatic controls but almost all have a central DDC system that was retrofitted in the 1990's. When these buildings are renovated, replace the local pneumatic controls within the renovation area and provide all new controls within the renovation area with compatible electronic sensors, actuators and control valves controlled by the DDC system. Provide additional control panel capacity as required for the controls. Note the requirement for new controls outputs to have an HOA switch on each output. Modify the controls sequence to suit. Update the controls graphics to include all new and modified controls.
2. Remove all reasonably accessible redundant pneumatic tubing and all redundant pneumatic controls components and tightly cap all remaining pneumatic tubing ends.
3. Remove all reasonably accessible redundant controls conduit, wiring and equipment.
4. The long term objective is to eliminate the pneumatic controls except where required for special applications.

Controls Points

1. Provide current sensors for all motor-driven equipment except small fan-coils, unit heaters, force flow heaters, washroom exhaust fans for individual washrooms, and other minor, non-critical equipment.
2. Monitor supply air temperature downstream of every VAV box with a heating coil.
3. Determine in advance with FMGT whether every office should have its own independent temperature control or if offices are to be grouped under a single temperature control.
4. Monitor the building incoming domestic water pressure before the premise backflow prevention and after the building PRV.
5. Provide pressure differential, monitoring across major air filter banks.
6. Provide differential pressure or current sensors across pumps.
7. Provide an independent output for each of the return air damper, the outdoor air damper and the relief damper on mixed air systems.
8. Monitor all equipment remote alarm contacts.
9. For variable frequency drives provide output to control ON/OFF and speed and monitor ON/OFF status, run speed, alarm contact.
10. Provide ON/OFF control for all motor-driven equipment unless manually operated.

11. Provide control and operating schedule for DHC recirculation pumps.
12. Provide hard wired low-temperature shutdown (freeze protection) for air handling systems and monitor its status.
13. Generally provide control of all mechanical equipment but not to override or replace integral equipment controls and safeties (e.g. boiler enable/disable but not burner ON/OFF).
14. Monitor the temperature of any electrically freeze-protected piping or equipment.
15. Monitor the status of regular/emergency/standby electrical power.
16. Monitor the status of automated glycol make-up systems and glycol tank level alarm.
17. Monitor closed pipe systems pressure at or hydraulically near the expansion tank.
18. Monitor DHW temperature. Where DHW heating is by heating water, control the heating.
19. Monitor the pneumatic controls air pressure.
20. Monitor campus heating mains water temperature to and from the building heat exchanger and monitor the flow to it to provide energy monitoring and totalization. Consider use of manufactured energy monitoring equipment.
21. Provide a campus mains two-way control valve in the return from the building heat exchanger.
22. Provide a small control valve (c_v between 1.5 and 2.0) between the campus mains supply and return pipes (prevent thermal shock if main valves closes for extended period).
23. Provide temperature monitoring of the building heating mains and of each individually pumped heating circuit.
24. Provide alternating control of duty and standby equipment.
25. Monitor all mass and energy meters provided with contacts for remote monitoring.

Alarms

1. Software alarms shall be identified as regular or critical. Critical alarms shall be connected from the DDC system to the campus alarm system for monitoring and response by Campus Traffic and Security.

Graphics

1. All graphics to be completed and fully functioning prior to turnover completion.
2. Pumps and motors should show horsepower ratings and voltage on graphics.
3. All air handler\pump graphics to show Status, runtime, amperage, etc.

All pressure transmitters to be setup in kPa and all temperature sensors to utilize Celsius. SI units to be used unless otherwise designated.

Testing, Commissioning and Acceptance Procedures

1. All devices to be commissioned and calibrated to manufacturers specs and there should be a commissioning document showing that when a device is changed, or added we should have proof it was calibrated or verified.
2. Consider whether the system warrants a comprehensive seven day test.
3. All end devices must have a calibration report showing proper operation and commissioning. This report will show a minimum 3 point verification for pressure transmitters.
4. A summary print out of each group of point types for each panel shall be printed after commissioning and calibration. Each sheet shall be signed by the Controls Contractor's Commissioning Person, and FMGT Representative. If any changes are noted during spot checks they shall be manually written on the original print out with the date and signature of person noting changes.
5. All end devices to have a calibration tag, which shall include I/O information, room number, device type, date, contractor name, technician name. In the event of a room temperature sensor or an occupancy sensor, a sticker is acceptable.

Demonstration to Owner

1. The Controls Contractor shall demonstrate to FMGT's Designated Personnel the adjustment, operation and maintenance, including pertinent safety requirements, of the controls equipment and system provided to the satisfaction of FMGT's Representative.

As Builts

1. All as built drawings to be stamped and signed by contractor with pertinent redline drawings on PNIDS completed. Any change made must be illustrated by a "bubble" with the represented change inside the bubble. All changes to be done in red ink for submittal, with an AS BUILT stamp, dated and signed.
2. A copy of each graphical screen page, both new and modified existing shall be signed off and dated by the Controls Contractor and the FMGT Representative. Any changes shall be noted. This signed set shall be left on site as the "record drawings".