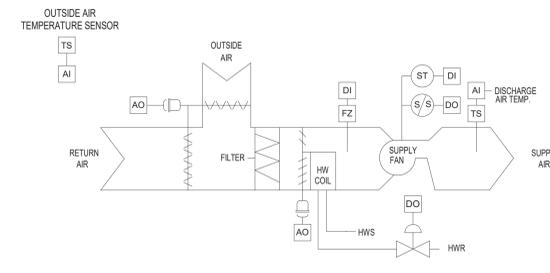


**AIR HANDLING UNIT - MULTI-ZONE, HOT WATER (WITH LAB HOOD EXHAUST) - SEQUENCE OF OPERATIONS:**

- NOTE: FOR TEMPERATURE CONTROL SEQUENCE, REFER TO 4IAM701
- WHEN A LAB HOOD EXHAUST FAN (F-16HS, 17HS) IS ENERGIZED, MANUALLY VIA SWITCH ON HOOD, THE F-9HS VFD SHALL RAMP DOWN LINEARLY TO ACHIEVE THE FOLLOWING AIRFLOW QUANTITIES WHICH SHALL BE DETERMINED DURING THE AIR BALANCING PROCESS.
  - 1 LAB HOOD FAN ON, F-9HS EXHAUST FLOW: 2230 CFM
  - 2 LAB HOOD FANS ON, F-9HS EXHAUST AIR FLOW: 1360 CFM

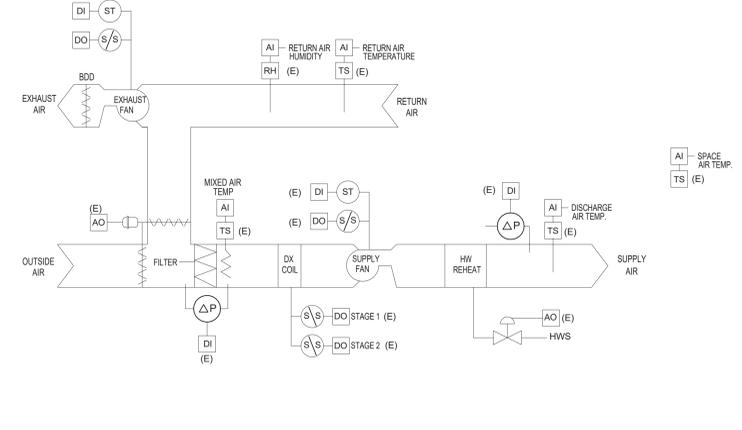
**6 AHU - Multizone Classroom Unit Chemistry Room**  
NTS



**UNIT VENTILATOR - HOT WATER - FACE AND BY-PASS - SEQUENCE OF OPERATIONS:**

- OCCUPIED MODE:**
  - SUPPLY FAN AND ASSOCIATED EXHAUST FAN SHALL RUN CONTINUOUSLY.
  - THE OUTSIDE AIR DAMPER SHALL OPEN TO THE POSITION REQUIRED TO MAINTAIN THE MINIMUM OUTSIDE AIR QUANTITY INDICATED. OUTSIDE AIR DAMPER SHALL NEVER BE POSITIONED BELOW THIS MINIMUM POSITION EXCEPT IN CASE OF ALARM.
  - WHEN THE OUTSIDE AIR TEMPERATURE IS 65 DEG. F. OR LOWER (ADJ.), OPEN HOT WATER VALVE TO ALLOW FLOW THROUGH THE COIL.
  - THE FACE AND BY-PASS DAMPER SHALL MODULATE TO MAINTAIN SPACE HEATING SETPOINT SUBJECT TO DISCHARGE HIGH LIMIT OF 110 DEG. F (ADJUSTABLE) AND DISCHARGE LOW LIMIT OF 40 DEG. F (ADJUSTABLE).
  - WHEN THE SPACE TEMPERATURE RISES 3 DEG. F (ADJUSTABLE) ABOVE THE SPACE HEATING SETPOINT, AND THE OUTSIDE AIR TEMPERATURE IS LOWER THAN THE SPACE TEMPERATURE, THE OUTSIDE AIR DAMPER SHALL MODULATE OPEN TO MAINTAIN THE OCCUPIED SETPOINT. THIS SHALL BE DONE SUBJECT TO DISCHARGE LOW LIMIT OF 55 DEG. F (ADJUSTABLE), AND WITH THE FACE AND BY-PASS DAMPER POSITIONED TO FULL BY-PASS OF THE COIL. CLOSE 2-WAY, 2-POSITION VALVE DURING ECONOMIZER SEQUENCE.
- UNOCCUPIED MODE:**
  - SUPPLY FAN AND ASSOCIATED EXHAUST FAN SHALL BE OFF.
  - THE OUTSIDE AIR DAMPER AND THE ASSOCIATED RELIEF/EXHAUST AIR DAMPER SHALL BE CLOSED.
  - MODULATE FINNED TUBE RADIATION VALVE, WHERE APPLICABLE, TO MAINTAIN ROOM TEMPERATURE SETPOINT.
  - UPON A DROP IN SPACE TEMPERATURE, BELOW UNOCCUPIED SETPOINT, START FAN AND MODULATE FACE AND BYPASS DAMPER AS REQUIRED UNTIL SETPOINT IS ACHIEVED. USE A 5 DEG. (ADJ.) DEADBAND TO MINIMIZE SHORT CYCLING.
  - A TIMED LOCAL OVERRIDE CONTROL SHALL ALLOW AN OCCUPANT TO OVERRIDE THE SCHEDULE AND PLACE THE UNIT INTO OCCUPIED MODE FOR 1 HOUR (ADJ.). AT EXPIRATION OF THIS TIME, CONTROL OF THE UNIT SHALL AUTOMATICALLY RETURN TO THE SCHEDULE.
- WARM-UP MODE:**
  - THE UNIT SHALL START PER AN OPTIMUM START PROGRAM.
  - THE OUTSIDE AIR DAMPER AND THE ASSOCIATED EXHAUST AIR DAMPER SHALL BE CLOSED AND EXHAUST FAN SHALL BE OFF.
  - THE SUPPLY FAN SHALL RUN AND THE FACE AND BY-PASS DAMPER SHALL MODULATE TO MAINTAIN OCCUPIED SPACE HEATING SETPOINT SUBJECT TO DISCHARGE HIGH LIMIT OF 110 DEG. F (ADJUSTABLE) AND DISCHARGE LOW LIMIT OF 70 DEG. F (ADJ.).
- SAFETIES / ALARMS**
  - A SEPARATE LOW LIMIT FREEZE STAT WITH AUTOMATIC RESET SHALL BE INSTALLED WITH SENSING ELEMENT SERPENTINED ACROSS THE FACE OF THE COIL. WHENEVER COIL FREEZE-UP CONDITIONS OCCUR (36 DEG. F., ADJ.) THE SUPPLY FAN SHALL STOP, THE OUTSIDE AIR DAMPER SHALL CLOSE AND THE FACE AND BYPASS DAMPER SHALL BE POSITIONED TO FULL FACE TO THE COIL. AN ALARM SHALL ALSO BE ACTIVATED.
  - FAN STATUS IS OFF WHEN SCHEDULED TO RUN.

**4 UV - Hot Water - Face and Bypass Control**  
NTS

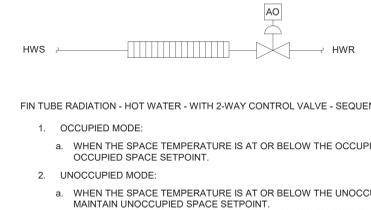


**ROOFTOP UNIT - AUDITORIUM - SEQUENCE OF OPERATIONS:**

NOTE: ALL POINTS DESIGNATED AS (E) ARE EXISTING. REMOVE UNIT MOUNTED CONTROL DEVICES, SENSORS, ETC. FROM EXISTING RTU AND SAVE FOR REUSE. INSTALL EXISTING REMOVED DEVICES AND SENSORS FOLLOWING INSTALLATION OF NEW ROOFTOP UNITS. PROVIDE CONTROL FOR UNIT MOUNTED EXHAUST FAN AS INDICATED.

- EXISTING SEQUENCE OF OPERATION SHALL REMAIN IN PLACE.
- RTU EXHAUST FAN SHALL RUN WHENEVER SUPPLY FAN RUNS.

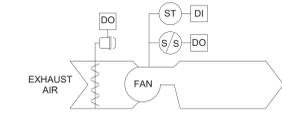
**5 Auditorium Rooftop Unit Control**  
NTS



**FIN TUBE RADIATION - HOT WATER - WITH 2-WAY CONTROL VALVE - SEQUENCE OF OPERATIONS:**

- OCCUPIED MODE:**
  - WHEN THE SPACE TEMPERATURE IS AT OR BELOW THE OCCUPIED HEATING SETPOINT, THE CONTROL VALVE SHALL MODULATE TO MAINTAIN OCCUPIED SPACE SETPOINT.
- UNOCCUPIED MODE:**
  - WHEN THE SPACE TEMPERATURE IS AT OR BELOW THE UNOCCUPIED HEATING SETPOINT, THE CONTROL VALVE SHALL MODULATE TO MAINTAIN UNOCCUPIED SPACE SETPOINT.
  - A TIMED LOCAL OVERRIDE CONTROL SHALL ALLOW AN OCCUPANT TO OVERRIDE THE SCHEDULE AND PLACE THE UNIT IN OCCUPIED MODE FOR 1 HOUR (ADJUSTABLE). AT EXPIRATION OF THIS TIME, CONTROL OF THE UNIT SHALL AUTOMATICALLY RETURN TO THE SCHEDULE.
- WARM-UP MODE:**
  - WHEN THE SPACE TEMPERATURE IS AT OR BELOW THE OCCUPIED HEATING SETPOINT, THE CONTROL VALVE SHALL MODULATE TO MAINTAIN OCCUPIED SPACE SETPOINT.
- SAFETIES:**
  - IF THE SPACE TEMPERATURE IS LESS THAN THE HEATING SETPOINT BY 10 DEG. F (ADJUSTABLE), THE CONTROL VALVE SHALL OPEN 100%. AN ALARM SHALL BE ACTIVATED.

**1 Fin Tube Radiation - Hot Water With Two Way Control Valve**  
NTS

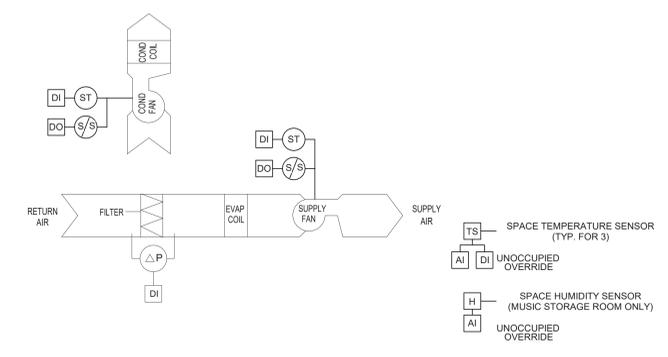


**EXHAUST FAN - CONSTANT SPEED - SEQUENCE OF OPERATIONS:**

INTERLOCK THE OPERATION OF THE EXHAUST FANS AND AUTOMATIC DAMPERS WITH THEIR RESPECTIVE HEATING AND COOLING EQUIPMENT.

- OCCUPIED MODE:**
  - THE EXHAUST FAN SHALL RUN CONTINUOUSLY AND THE AUTOMATIC AIR DAMPER SHALL OPEN.
- UNOCCUPIED MODE:**
  - THE EXHAUST FAN SHALL BE OFF AND THE AUTOMATIC AIR DAMPER SHALL BE CLOSED.
- WARM-UP MODE:**
  - THE EXHAUST FAN SHALL BE OFF AND THE AUTOMATIC AIR DAMPER SHALL BE CLOSED.
- SAFETIES:**
  - UPON A FAILURE OF THE FAN, AS SENSED BY A CURRENT SENSING STATUS SWITCH, AN ALARM SHALL BE ACTIVATED.

**2 Exhaust Fan - Constant Speed**  
NTS



**HEAT PUMP UNIT (FAN COIL UNIT) - SEQUENCE OF OPERATIONS:**

- OCCUPIED MODE:**
  - UNIT SHALL MAINTAIN A 75 DEG. F. (ADJ.) COOLING SETPOINT.
  - UNIT SHALL MAINTAIN A 70 DEG. F. (ADJ.) HEATING SETPOINT.
- UNOCCUPIED MODE:**
  - UNIT SHALL MAINTAIN A 75 DEG. F. (ADJ.) COOLING SETPOINT.
  - UNIT SHALL MAINTAIN A 55 DEG. F. (ADJ.) HEATING SETPOINT.
- FAN:** THE FAN SHALL RUN ANY TIME THE UNIT IS COMMANDED TO RUN UNLESS SHUTDOWN ON SAFETIES.
- HEATING AND COOLING:** THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND CYCLE THE COMPRESSOR TO MAINTAIN ITS SETPOINT. TO PREVENT SHORT CYCLING, THE STAGE SHALL HAVE A USER DEFINABLE, ADJUSTABLE MINIMUM RUNTIME. THE COMPRESSOR SHALL RUN SUBJECT TO ITS OWN INTERNAL SAFETIES AND CONTROLS.
  - ON MODE CHANGE, THE COMPRESSOR SHALL BE DISABLED AND REMAIN OFF UNTIL AFTER THE REVERSING MINIMUM HAS CHANGED POSITION.
  - FINNED TUBE RADIATION, WHERE APPLICABLE WILL PROVIDE FIRST STAGE OF HEATING.
- THE CONTROLLER SHALL MONITOR ALARMS AS FOLLOWS:
  - FAN FAILURE ALARM: COMMANDED ON BUT STATUS IS OFF.
  - FILTER STATUS.
- THE CORRESPONDING DOAS UNIT SHALL WORK IN CONJUNCTION WITH SPACE FCU'S WHEN INDEXING BETWEEN HEATING AND COOLING.

**3 Heat Pump (FCU) Control**  
NTS

**TEMPERATURE CONTROLS SYMBOLS LIST**

- [AI] ANALOG IN
- [AO] ANALOG OUT
- [COM] COMMUNICATIONS PORT
- [CS] AIRBORNE CONTAMINANT SENSOR
- [DI] DIGITAL IN
- [DM] DAMPER MOTOR
- [DO] DIGITAL OUT
- [EMCS] ENERGY MANAGEMENT CONTROL SYSTEM
- [F] FLOW (WATER/AIR)
- [FM] FLOW METER
- [FS] AIR FLOW SENSOR
- [FZ] FREEZE STAT
- [H] HUMIDITY SENSOR
- [HL] HIGH LIMIT
- [KWH] KILOWATT HOUR METER
- [LL] LOW LIMIT
- [M/S] MANUAL SWITCH STOP / START
- [P] PRESSURE SENSOR
- [DP] DIFFERENTIAL PRESSURE
- [PS] POSITION SENSOR
- [S/S] STOP / START
- [SD] SMOKE DETECTOR
- [ST] STATUS
- [START] STARTER
- [T] ADJUSTABLE THERMOSTAT
- [TS] TEMPERATURE SENSOR
- [VFD] VARIABLE FREQUENCY DRIVE
- [WS] WATER SENSOR
- [%] PERCENT
- [ES] END SWITCH
- [VAV] VAV AIRFLOW SENSOR
- TEMPERATURE SENSOR CAPILLARY TUBE

S.E.D. Control No. 48-01-01-06-0-004-020

Rev. No.: Date: Description:



complex world | CLEAR SOLUTIONS

Tetra Tech Engineers, Architects & Landscape Architects, P.C.

**BID SET**

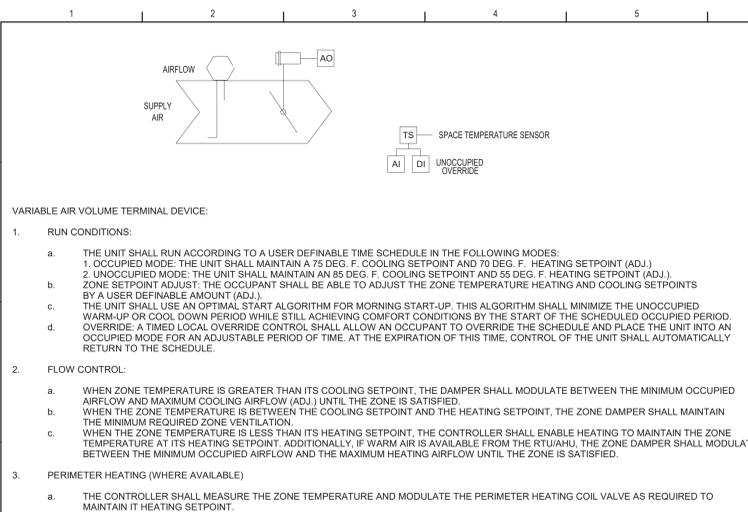
**TETRA TECH ARCHITECTS & ENGINEERS**

Mahopac Central School District  
Mahopac, NY

Reconstruction To:  
Mahopac High School

Controls

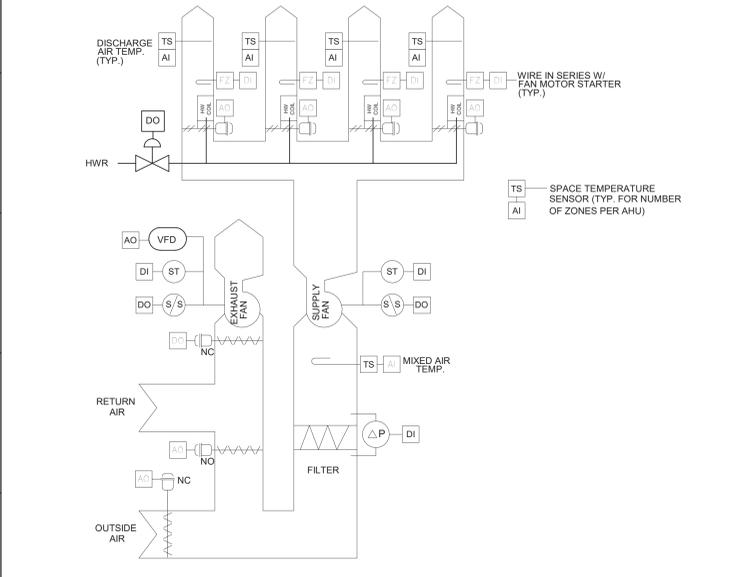
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Project No.:	AM700	
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**VARIABLE AIR VOLUME TERMINAL DEVICE:**

- 1. RUN CONDITIONS:**
  - THE UNIT SHALL RUN ACCORDING TO A USER DEFINABLE TIME SCHEDULE IN THE FOLLOWING MODES:
    1. OCCUPIED MODE: THE UNIT SHALL MAINTAIN A 75 DEG. F. COOLING SETPOINT AND 70 DEG. F. HEATING SETPOINT (ADJ.)
    2. UNOCCUPIED MODE: THE UNIT SHALL MAINTAIN AN 85 DEG. F. COOLING SETPOINT AND 55 DEG. F. HEATING SETPOINT (ADJ.)
  - ZONE SETPOINT ADJUST: THE OCCUPANT SHALL BE ABLE TO ADJUST THE ZONE TEMPERATURE HEATING AND COOLING SETPOINTS BY A USER DEFINABLE AMOUNT (ADJ.)
  - THE UNIT SHALL USE AN OPTIMAL START ALGORITHM FOR MORNING START-UP. THIS ALGORITHM SHALL MINIMIZE THE UNOCCUPIED WARM-UP OR COOL-DOWN PERIOD WHILE STILL ACHIEVING COMFORT CONDITIONS BY THE START OF THE SCHEDULED OCCUPIED PERIOD. OVERRIDE: A TIMED LOCAL OVERRIDE CONTROL SHALL ALLOW AN OCCUPANT TO OVERRIDE THE SCHEDULE AND PLACE THE UNIT INTO AN OCCUPIED MODE FOR AN ADJUSTABLE PERIOD OF TIME. AT THE EXPIRATION OF THIS TIME, CONTROL OF THE UNIT SHALL AUTOMATICALLY RETURN TO THE SCHEDULE.
- 2. FLOW CONTROL:**
  - WHEN ZONE TEMPERATURE IS GREATER THAN ITS COOLING SETPOINT, THE DAMPER SHALL MODULATE BETWEEN THE MINIMUM OCCUPIED AIRFLOW AND MAXIMUM COOLING AIRFLOW (ADJ.) UNTIL THE ZONE IS SATISFIED.
  - WHEN THE ZONE TEMPERATURE IS BETWEEN THE COOLING SETPOINT AND THE HEATING SETPOINT, THE ZONE DAMPER SHALL MAINTAIN THE MINIMUM REQUIRED ZONE VENTILATION.
  - WHEN THE ZONE TEMPERATURE IS LESS THAN ITS HEATING SETPOINT, THE CONTROLLER SHALL ENABLE HEATING TO MAINTAIN THE ZONE TEMPERATURE AT ITS HEATING SETPOINT. ADDITIONALLY, IF WARM AIR IS AVAILABLE FROM THE RTU/AHU, THE ZONE DAMPER SHALL MODULATE BETWEEN THE MINIMUM OCCUPIED AIRFLOW AND THE MAXIMUM HEATING AIRFLOW UNTIL THE ZONE IS SATISFIED.
- 3. PERIMETER HEATING (WHERE AVAILABLE)**
  - THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND MODULATE THE PERIMETER HEATING COIL VALVE AS REQUIRED TO MAINTAIN IT HEATING SETPOINT.

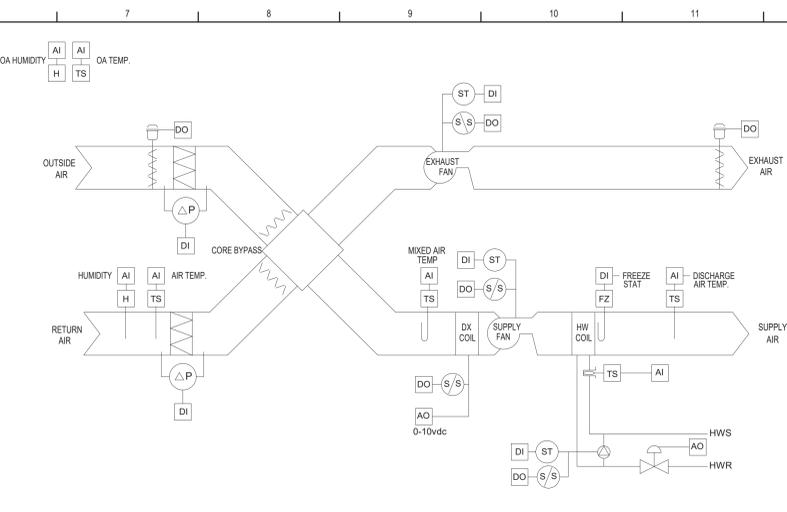
**3 VAV Terminal Device**  
NTS



**AIR HANDLING UNIT - MULTI-ZONE, HOT WATER - SEQUENCE OF OPERATIONS:**

- 1. OCCUPIED MODE:**
  - THE SUPPLY AND EXHAUST FANS SHALL RUN CONTINUOUSLY BASED UPON AN OPERATOR ADJUSTABLE SCHEDULE.
  - WHEN SCHEDULED, OPEN THE OUTSIDE AIR DAMPER AND RETURN AIR DAMPERS TO THE POSITIONS REQUIRED TO MAINTAIN THE MINIMUM OUTSIDE AIR QUANTITY INDICATED. OPEN EXHAUST AIR DAMPER AND MODULATE EXHAUST FAN VFD TO EQUAL MINIMUM OUTSIDE AIR QUANTITIES AS SCHEDULED. THE OUTSIDE AIR DAMPER SHALL NEVER BE POSITIONED BELOW THIS MINIMUM POSITION EXCEPT IN CASE OF ALARM.
  - OPEN THE HOT WATER 2-WAY VALVE WHEN THE OUTSIDE AIR TEMPERATURE IS 50 DEG. F. (ADJ.).
  - UPON A CALL FOR HEAT, THE RESPECTIVE ZONE DAMPER SHALL MODULATE OPEN TO THE HEATING COIL WITH BYPASS DAMPER ACTING LINEARLY TO CLOSE.
  - MODULATE THE THE FACE AND BYPASS DAMPERS AS REQUIRED TO MAINTAIN SPACE TEMPERATURE SETPOINT.
- 2. ECONOMIZER:**
  - WHEN THE AVERAGE SPACE TEMPERATURE RISES 3 DEG. F. (ADJ.) ABOVE THE SPACE HEATING SETPOINT AND THE OUTSIDE AIR TEMPERATURE IS LOWER THAN THE AVERAGE SPACE TEMPERATURE, OPEN THE OUTSIDE AIR DAMPER BEYOND MINIMUM POSITION, CLOSE RETURN AIR DAMPER, RAMP EXHAUST FAN SPEED TO 100% AND BEGIN ECONOMIZER COOLING AND MODULATE FACE AND BYPASS DAMPER TO BYPASS POSITION.
- 3. UNOCCUPIED MODE:**
  - THE SUPPLY AND EXHAUST FAN SHALL BE OFF.
  - THE OUTSIDE AIR DAMPER SHALL BE FULLY CLOSED AND THE RETURN AIR DAMPER SHALL BE FULLY OPEN.
  - WHERE SPACE HAS FINNED TUBE RADIATION, RADIATION SHALL PROVIDE FIRST STAGE UNOCCUPIED HEATING.
  - ON DROP IN SPACE TEMPERATURE BELOW THE UNOCCUPIED HEATING SETPOINT, CYCLE THE FAN ON AND MODULATE THE FACE AND BYPASS DAMPER TO MAINTAIN SPACE HEATING SETPOINT.
  - A TIMED LOCAL OVERRIDE CONTROL SHALL ALLOW AN OCCUPANT TO OVERRIDE THE SCHEDULE AND PLACE THE UNIT INTO OCCUPIED MODE FOR 1 HOUR (ADJUSTABLE). AT EXPIRATION OF THIS TIME, CONTROL OF THE UNIT SHALL AUTOMATICALLY RETURN TO THE SCHEDULE.
- 4. MORNING PURGE:**
  - ONE HOUR PRIOR TO MORNING WARM UP, THE UNIT SHALL PERFORM A 30 MINUTE PURGE SEQUENCE
    - OPEN OUTSIDE AND EXHAUST DAMPERS
    - START SUPPLY AND EXHAUST FAN (FULL SPEED)
    - MAINTAIN UNOCCUPIED TEMPERATURE CONDITIONS.
- 5. WARM-UP MODE:**
  - THE UNIT SHALL START PER AN OPTIMUM START PROGRAM.
  - THE UNIT SHALL START PRIOR TO SCHEDULED OCCUPANCY BASED ON THE TIME NECESSARY FOR THE ZONES TO REACH THEIR OCCUPIED SETPOINTS. THE START TIME SHALL AUTOMATICALLY ADJUST BASED ON CHANGES IN OUTSIDE AIR TEMPERATURE AND ZONE TEMPERATURES.
  - THE OUTSIDE AIR DAMPER SHALL BE FULLY CLOSED AND THE RETURN AIR DAMPER SHALL BE FULLY OPEN. THE RESPECTIVE EXHAUST FAN SHALL BE OFF.
- 6. SAFETIES:**
  - DIFFERENTIAL PRESSURE ACROSS THE AIR FILTERS SHALL GENERATE AN ALARM WHENEVER THE DIFFERENTIAL PRESSURE EXCEEDS ITS ADJUSTABLE SETPOINT.
  - A SEPARATE LOW LIMIT FREEZE STAT WITH AUTOMATIC RESET SHALL BE INSTALLED WITH SENSING ELEMENT SERPENTINED ACROSS THE DISCHARGE FACE OF THE COIL. WHENEVER COIL FREEZE-UP CONDITIONS ARISE (36 DEG. F. ADJUSTABLE), THE SUPPLY FAN SHALL STOP. THE OUTSIDE AIR DAMPER SHALL CLOSE 100%, AND THE FACE DAMPER SHALL OPEN 100% TO HEATING COIL. AN ALARM SHALL BE ACTIVATED.
  - ALARMS SHALL BE PROVIDED AS FOLLOWS:
    - SUPPLY FAN FAILURE: ON, BUT STATUS IS OFF.
    - SUPPLY FAN IN HAND, COMMANDED OFF BUT STATUS IS ON.
    - EXHAUST FAN FAILURE: ON, BUT STATUS IS OFF.
    - EXHAUST FAN IN HAND, COMMANDED OFF BUT STATUS IS ON.
    - HIGH HEATING SUPPLY AIR TEMPERATURE: IF HEATING SUPPLY AIR TEMPERATURE IS GREATER THAN 120 DEG. F. (ADJ.)
    - LOW HEATING SUPPLY AIR TEMPERATURE: IF THE HEATING SUPPLY AIR TEMPERATURE IS 10 DEG. F. BELOW SETPOINT FOR 5 MINUTES (ADJ.)
    - FIRE ALARM SIGNAL SHALL SHUT SUPPLY AND EXHAUST FAN OFF, CLOSE OUTSIDE AND EXHAUST AIR DAMPERS.

**4 AHU - Multizone Classroom Units**  
NTS

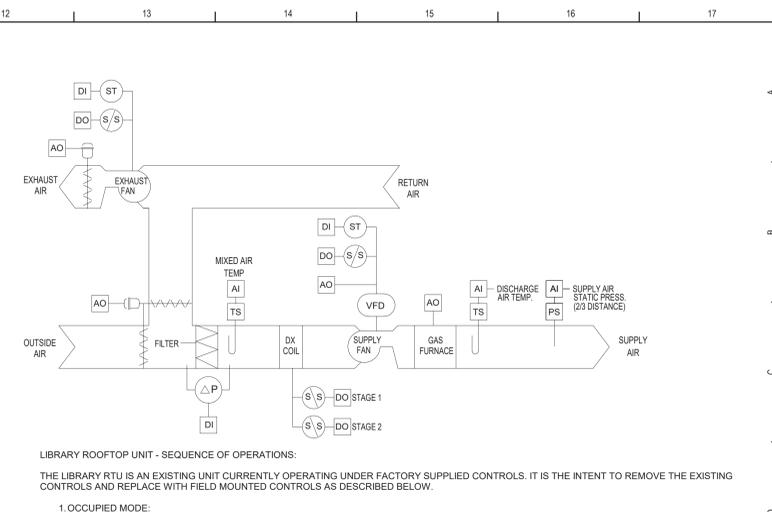


**MUSIC ROOMS DOAS ROOFTOP UNIT - SEQUENCE OF OPERATIONS:**

- 1. OCCUPIED MODE:**
  - THE SUPPLY AND EXHAUST FAN SHALL RUN CONTINUOUSLY.
  - THE UNIT SHALL SHUT DOWN AND GENERATE AN ALARM UPON RECEIVING AND EMERGENCY SHUTDOWN SIGNAL.
  - ALARMS SHALL BE PROVIDED AS FOLLOWS:
    1. SUPPLY FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
    2. SUPPLY FAN IN HAND: COMMANDED OFF BUT STATUS IS ON.
- 2. UNOCCUPIED MODE:**

THE SUPPLY AND EXHAUST FAN SHALL BE OFF. THE OUTSIDE AIR DAMPER AND THE ASSOCIATED EXHAUST DAMPER SHALL BE FULLY CLOSED. A TIMED LOCAL OVERRIDE CONTROL SHALL ALLOW AN OCCUPANT TO OVERRIDE THE SCHEDULE AND PLACE THE UNIT IN OCCUPIED MODE FOR 1 HOUR (ADJUSTABLE). AT EXPIRATION OF THIS TIME, CONTROL OF THE UNIT SHALL AUTOMATICALLY RETURN TO THE SCHEDULE.
- 3. SUPPLY AIR TEMPERATURE SETPOINT - OPTIMIZED:**
  - HEATING SHALL BE ENABLED WHENEVER:
    - OUTSIDE AIR TEMPERATURE IS LESS THAN 65 DEG. F. (ADJ.)
    - SUPPLY FAN STATUS IS ON.
    - COOLING IS NOT ACTIVE.
  - COOLING SHALL BE ENABLED WHENEVER:
    - OUTSIDE AIR TEMPERATURE IS GREATER THAN 60 DEG. F. (ADJ.)
    - ECONOMIZER IS DISABLED.
    - SUPPLY FAN STATUS IS ON.
    - HEATING IS NOT ACTIVE.
  - WHEN THE OUTSIDE AIR TEMPERATURE IS LESS THAN 65 DEG. F. (ADJ.), START THE HOT WATER COIL PUMP.
    - MODULATE THE HEATING COIL HOT WATER VALVE AS REQUIRED TO MAINTAIN THE HEATING SUPPLY AIR TEMPERATURES AS DESCRIBED BELOW.
  - UPON A CALL FOR COOLING, MODULATE THE COOLING AS REQUIRED TO MAINTAIN THE COOLING SUPPLY AIR TEMPERATURES AS DESCRIBED BELOW.
  - THE CONTROLLER SHALL MONITOR THE SUPPLY AIR TEMPERATURE AND SHALL MAINTAIN A SUPPLY AIR TEMPERATURE SETPOINT RESET BASED ON ZONE COOLING AND HEATING REQUIREMENTS.
  - THE SUPPLY AIR TEMPERATURE SETPOINT SHALL BE RESET FOR COOLING BASED ON ZONE COOLING REQUIREMENTS AS FOLLOWS:
    - INITIAL SUPPLY AIR TEMPERATURE SETPOINT SHALL BE 55 DEG. F. (ADJ.)
    - AS COOLING INCREASES, THE SETPOINT SHALL INCREMENTALLY RESET DOWN TO A MINIMUM OF 53 DEG. F. (ADJ.)
    - AS COOLING DEMAND DECREASES, THE SETPOINT SHALL INCREMENTALLY BE RESET UPWARD TO A MAXIMUM OF 72 DEG. F. (ADJ.)
  - IF MORE ZONES NEED HEATING THAN COOLING, THE SUPPLY AIR TEMPERATURE SETPOINT SHALL BE RESET FOR HEATING AS FOLLOWS:
    - THE INITIAL SUPPLY AIR TEMPERATURE SETPOINT SHALL BE 82 DEG. F. (ADJ.)
    - AS HEATING DEMAND INCREASES, THE SETPOINT SHALL INCREMENTALLY RESET UP TO A MAXIMUM OF 85 DEG. F. (ADJ.)
    - AS HEATING DEMAND DECREASES, THE SETPOINT SHALL INCREMENTALLY RESET DOWN TO A MINIMUM OF 72 DEG. F. (ADJ.)
- 4. ECONOMIZER (BYPASS):**
  - WHEN THE OUTSIDE AIR ENTHALPY IS BELOW THE RETURN AIR ENTHALPY, THE ECONOMIZER WILL MODULATE TO BYPASS AIR AROUND THE ENERGY RECOVERY CORE.
  - DURING NORMAL OPERATION, THE BYPASS DAMPER SHALL REMAIN CLOSED AND THE AIR WILL PASS THRU THE ENERGY RECOVERY CORE.
  - THE ECONOMIZER SHALL BE ENABLED WHENEVER:
    - THE OUTSIDE AIR TEMPERATURE IS LESS THAN 65 DEG. F. (ADJ.)
    - AND THE OUTSIDE AIR TEMPERATURE IS LESS THAN THE RETURN AIR TEMPERATURE.
    - AND THE SUPPLY FAN IS ON.
  - THE ECONOMIZER SHALL BE DISABLED WHENEVER:
    - THE MIXED AIR TEMPERATURE DROPS FROM 40 TO 35 DEG. F. (ADJ.)
    - SUPPLY FAN IS OFF.
- 5. MORNING PURGE:**
  - ONE HOUR PRIOR TO SCHEDULED OCCUPANCY, THE UNIT SHALL PERFORM A 30 MINUTE DURATION PURGE SEQUENCE.
    - OPEN OUTSIDE AND EXHAUST DAMPERS
    - OPEN BYPASS DAMPER
    - START SUPPLY AND EXHAUST FANS.
    - MAINTAIN UNOCCUPIED SETBACK TEMPERATURE CONDITIONS.
- 6. SAFETIES AND ALARMS:**
  - AN AUTOMATIC RESET FREEZE/STAT SET AT 38 DEG. F. SHALL DISABLE THE SUPPLY AND EXHAUST FAN, CLOSE THE OUTSIDE AND EXHAUST DAMPERS AND OPEN THE TWO-WAY HEATING VALVE. 100% FREEZE/STAT SHALL BE WIRED IN SERIES WITH FAN MOTOR STARTER.
  - SUPPLY WATER TEMPERATURE TO HOT WATER COIL FALLS BELOW 90 DEG. F. (ADJ.) WITH VALVE OPEN SHALL DISABLE THE SUPPLY AND EXHAUST FAN AND CLOSE THE OUTSIDE AND EXHAUST DAMPERS.
  - HIGH SUPPLY AIR TEMPERATURE ALARM: 120 DEG. F. (ADJ.) SUPPLY AIR TEMPERATURE.
  - FIRE ALARM SIGNAL SHALL DISABLE THE UNIT.
  - SUPPLY FAN, EXHAUST FAN, PUMP ALARM:
    - FAILURE: COMMANDED ON BUT STATUS IS OFF.
    - UNIT IN HAND: COMMANDED OFF BUT STATUS IS ON.
  - RETURN OR OUTSIDE AIR FILTER PRESSURE DIFFERENTIAL EXCEEDS SETPOINT.

**2 Music Rooms - DOAS Rooftop Unit**  
NTS



**LIBRARY ROOFTOP UNIT - SEQUENCE OF OPERATIONS:**

- THE LIBRARY RTU IS AN EXISTING UNIT CURRENTLY OPERATING UNDER FACTORY SUPPLIED CONTROLS. IT IS THE INTENT TO REMOVE THE EXISTING CONTROLS AND REPLACE WITH FIELD MOUNTED CONTROLS AS DESCRIBED BELOW.
- 1. OCCUPIED MODE:**
    - THE SUPPLY AND EXHAUST FAN SHALL RUN CONTINUOUSLY OR A DEFINABLE NUMBER OF UNOCCUPIED ZONES NEED HEATING OR COOLING.
    - OPEN OUTSIDE, AND RETURN AIR DAMPER TO MINIMUM POSITION AS SCHEDULED. DURING OCCUPIED PERIODS, THE OA DAMPER SHALL NEVER FALL BELOW THE MINIMUM POSITION.
    - THE UNIT SHALL SHUT DOWN AND GENERATE AN ALARM UPON RECEIVING AN EMERGENCY SHUTDOWN SIGNAL.
    - THE UNIT SHALL SHUT DOWN AND GENERATE AN ALARM UPON RECEIVING A HIGH STATIC SHUTDOWN SIGNAL (25% GREATER THAN SETPOINT).
    - ALARMS SHALL BE PROVIDED AS FOLLOWS:
      1. SUPPLY FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
      2. SUPPLY FAN IN HAND: COMMANDED OFF BUT STATUS IS ON.
  - 2. UNOCCUPIED MODE:**
    - THE SUPPLY AND ASSOCIATED EXHAUST FAN SHALL BE OFF.
    - THE OUTSIDE AIR DAMPER AND THE ASSOCIATED EXHAUST DAMPER SHALL BE FULLY CLOSED AND THE RETURN AIR DAMPER SHALL BE FULLY OPEN.
    - WHERE SPACE HAS FINNED TUBE RADIATION, RADIATION SHALL PROVIDE FIRST STAGE UNOCCUPIED HEATING.
    - ON DROP IN SPACE TEMPERATURE BELOW THE UNOCCUPIED HEATING SETPOINT, CYCLE THE FAN ON AND THE GAS FURNACE SHALL FIRE AT THE FULL FIRING RATE TO MAINTAIN REDUCED SPACE TEMPERATURE. USE 5 DEG. F. (ADJUSTABLE) DEADBAND TO MINIMIZE SHORT CYCLING.
    - A TIMED LOCAL OVERRIDE CONTROL SHALL ALLOW AN OCCUPANT TO OVERRIDE THE SCHEDULE AND PLACE THE UNIT IN OCCUPIED MODE FOR 1 HOUR (ADJUSTABLE). AT EXPIRATION OF THIS TIME, CONTROL OF THE UNIT SHALL AUTOMATICALLY RETURN TO THE SCHEDULE.
  - 3. SUPPLY AIR DUCT STATIC PRESSURE CONTROL:**
    - THE CONTROLLER SHALL MEASURE DUCT STATIC PRESSURE VIA SENSOR MOUNTED 25' DOWNSTREAM OF SUPPLY FAN AND MODULATE THE SUPPLY FAN VFD SPEED TO MAINTAIN A DUCT STATIC PRESSURE SETPOINT SUBJECT TO THE MINIMUM FAN SPEED REQUIRED TO DELIVER THE MINIMUM AMOUNT OF OUTDOOR AIR AS SCHEDULED.
    - THE STATIC PRESSURE SETPOINT SHALL BE RESET BASED UPON THE POSITION OF THE ZONE DAMPERS WITH A GOAL OF REDUCING THE STATIC PRESSURE UNTIL AT LEAST ONE ZONE DAMPER IS NEARLY WIDE OPEN.
      1. INITIAL DUCT STATIC PRESSURE SETPOINT SHALL BE 1.5 IN. WC. (ADJ.)
      2. IF NO ZONE DAMPER IS NEARLY WIDE OPEN, THE SETPOINT SHALL INCREMENTALLY RESET DOWN TO A MINIMUM OF 1.3 IN. WC. (ADJ.)
      3. AS ONE OR MORE DAMPERS NEARS THE WIDE OPEN POSITION, THE SETPOINT SHALL INCREMENTALLY RESET UP TO A MAXIMUM OF 1.8 IN. WC. (ADJ.)
  - 4. SUPPLY AIR TEMPERATURE SETPOINT - OPTIMIZED:**
    - HEATING SHALL BE ENABLED WHENEVER:
      - OUTSIDE AIR TEMPERATURE IS LESS THAN 60 DEG. F. (ADJ.)
      - SUPPLY FAN STATUS IS ON.
      - COOLING IS NOT ACTIVE.
    - COOLING SHALL BE ENABLED WHENEVER:
      - OUTSIDE AIR TEMPERATURE IS GREATER THAN 65 DEG. F. (ADJ.)
      - ECONOMIZER IS DISABLED.
      - SUPPLY FAN STATUS IS ON.
      - HEATING IS NOT ACTIVE.
    - THE CONTROLLER SHALL MONITOR THE SUPPLY AIR TEMPERATURE AND SHALL MAINTAIN A SUPPLY AIR TEMPERATURE SETPOINT RESET BASED ON ZONE COOLING AND HEATING REQUIREMENTS.
    - THE SUPPLY AIR TEMPERATURE SETPOINT SHALL BE RESET FOR COOLING BASED ON ZONE COOLING REQUIREMENTS AS FOLLOWS:
      - INITIAL SUPPLY AIR TEMPERATURE SETPOINT SHALL BE 55 DEG. F. (ADJ.)
      - AS COOLING INCREASES, THE SETPOINT SHALL INCREMENTALLY RESET DOWN TO A MINIMUM OF 53 DEG. F. (ADJ.)
      - AS COOLING DEMAND DECREASES, THE SETPOINT SHALL INCREMENTALLY BE RESET UPWARD TO A MAXIMUM OF 72 DEG. F. (ADJ.)
    - IF MORE ZONES NEED HEATING THAN COOLING, THE SUPPLY AIR TEMPERATURE SETPOINT SHALL BE RESET FOR HEATING AS FOLLOWS:
      - THE INITIAL SUPPLY AIR TEMPERATURE SETPOINT SHALL BE 82 DEG. F. (ADJ.)
      - AS HEATING DEMAND INCREASES, THE SETPOINT SHALL INCREMENTALLY RESET UP TO A MAXIMUM OF 85 DEG. F. (ADJ.)
      - AS HEATING DEMAND DECREASES, THE SETPOINT SHALL INCREMENTALLY RESET DOWN TO A MINIMUM OF 72 DEG. F. (ADJ.)
  - 5. ECONOMIZER:**
    - THE CONTROLLER SHALL MEASURE THE MIXED AIR TEMPERATURE AND MODULATE THE OA/SA DAMPERS IN SEQUENCE TO MAINTAIN A SETPOINT 2 DEG. F. LESS THAN THE SUPPLY AIR TEMPERATURE SETPOINT. THE OUTSIDE AIR DAMPER SHALL MAINTAIN A MINIMUM POSITION AS SCHEDULED WHENEVER OCCUPIED.
    - THE ECONOMIZER SHALL BE ENABLED WHENEVER:
      - THE OUTSIDE AIR TEMPERATURE IS LESS THAN 65 DEG. F. (ADJ.)
      - AND THE OUTSIDE AIR TEMPERATURE IS LESS THAN THE AVERAGE OF THE OCCUPIED ZONES.
      - AND THE SUPPLY FAN IS ON.
    - THE ECONOMIZER SHALL BE DISABLED WHENEVER:
      - THE MIXED AIR TEMPERATURE DROPS FROM 40 TO 35 DEG. F. (ADJ.)
      - SUPPLY FAN IS OFF.
  - 5. MORNING PURGE:**
    - ONE HOUR PRIOR TO MORNING WARM-UP SEQUENCE, THE UNIT SHALL PERFORM A 30 MINUTE DURATION PURGE SEQUENCE.
      - OPEN OUTSIDE AND EXHAUST DAMPERS
      - CLOSE RETURN DAMPER
      - START SUPPLY AND EXHAUST FANS.
      - MAINTAIN UNOCCUPIED SETBACK TEMPERATURE CONDITIONS.
  - 6. WARM-UP:**
    - THE UNIT SHALL START PER AN OPTIMUM START PROGRAM.
    - THE OUTSIDE AIR DAMPER AND EXHAUST DAMPER SHALL BE FULLY CLOSED, THE RETURN AIR DAMPER SHALL BE FULLY OPEN, AND THE ASSOCIATED EXHAUST FAN SHALL BE OFF.
    - THE SUPPLY FAN SHALL RUN AND THE GAS FURNACE SHALL MODULATE TO MAINTAIN OCCUPIED SETPOINT.
  - 7. SAFETIES:**
    - DIFFERENTIAL PRESSURE ACROSS THE AIR FILTERS SHALL GENERATE AN ALARM WHENEVER THE DIFFERENTIAL PRESSURE EXCEEDS ITS ADJUSTABLE SETPOINT.
    - IF THE DISCHARGE AIR TEMPERATURE DROPS BELOW 35 DEG. F. (ADJUSTABLE), THE SUPPLY FAN SHALL TURN OFF AND SHALL BE LOCKED OUT, AND AN ALARM SHALL BE ACTIVATED.
    - IF THE DISCHARGE AIR TEMPERATURE RISES ABOVE 120 DEG. F. (ADJUSTABLE), THE GAS FURNACE SHALL TURN OFF AND AN ALARM SHALL BE ACTIVATED.

**1 VAV Rooftop Unit**  
NTS

S.E.D. Control No. 48-01-01-06-0-004-020

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Mahopac Central School District  
 Mahopac, NY

Reconstruction To:  
 Mahopac High School

Controls

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