ABBREVIATIONS

ACC	AIR COOLED CHILLER
ACCU	AIR COOLED CONDENSING UNIT
AD	ACCESS DOOR
AFG	ABOVE FINISHED GRADE
AFF	ABOVE FINISHED FLOOR
AHU	AIR HANDLING UNIT
AP	ACCESS PANEL
AS	AIR SEPARATOR
ATC	TEMPERATURE CONTROL CONTRACTOR
CFM	CUBIC FEET PER MINUTE
CU	CONDENSING UNIT
CUH	CABINET UNIT HEATER
CO	CLEAN OUT
CP	CONDENSATE PUMP
CV	CONVECTOR
DB	DRY BULB TEMP. DEGREES F.
DF	DESTRATIFICATION FAN
E	EXHAUST AIR DEVICE
EAT	ENTERING AIR TEMP. DEGREES F.
EC	ELECTRICAL CONTRACTOR
EF	EXHAUST FAN
ERU	ENERGY RECOVERY UNIT
EUH	ELECTRICAL UNIT HEATER
ET	EXPANSION TANK
EWT	ENTERING WATER TEMP. DEGREES F.
FCU	FANCOIL UNIT
FT	FINTUBE (RADITION)
GC	GENERAL CONTRACTOR
GPM	GALLONS PER MINUTE
GV	GRAVITY VENTILATOR
HVAC	HEATING, VENTILATING & AIR CONDITIONING CONTRACTOR
HUH	HORIZONTAL UNIT HEATER
LAT	LEAVING AIR TEMP. DEGREES F.
LWT	LEAVING WATER TEMP. DEGREES F.
MAU	MAKE-UP AIR UNIT
MAX	MAXIMUM
MIN	MINIMUM
OA	OUTSIDE AIR
P	PUMP
PC	PLUMBING CONTRACTOR
PD	PRESSURE DROP (FEET OF WATER)
PTAC	PACKAGED TERMINAL AIR CONDITIONER
R	RETURN AIR DEVICE
RF	RETURN FAN
RH	REHEAT COIL
RI	ROOF INTAKE
RP	RADIANT PANEL
RTU	ROOFTOP UNIT
S	SUPPLY AIR DEVICE
SA	SOUND ATTENUATOR
T	TRANSFER GRILLE
TB	TERMINAL BOX
VFD	VARIABLE FREQUENCY DRIVE
WB	WET BULB TEMP. DEGREES F.
WMS	WIRE MESH SCREEN

SHEETMETAL

DOUBLE LINE

- SUPPLY AIR DUCT TURN TOWARD
- SUPPLY AIR DUCT TURN AWAY
- RETURN / EXH. AIR DUCT TURN TOWARD
- RETURN / EXH. DUCT TURN AWAY
- VD — VOLUME DAMPER
- ACD — AUTOMATIC CONTROL DAMPER
- FD — FIRE DAMPER
- M — MOTORIZED DAMPER
- BRANCH TAKE OFF
- DUCT W/ 1" ACOUSTICAL LINER
- DUCT ELBOW W/ TURNING VANES
- UP / DN — DUCT OFFSET UP OR DOWN (ARROW INDICATES DIRECTION OF FLOW
- FLEXIBLE DUCT
- GRAPHIC BREAK &/OR CONTINUATION OF DUCT OR PIPING
- SUPPLY DIFFUSER OR GRILLE
- RETURN/EXHAUST REGISTER OR GRILLE
- VARIABLE AIR VOLUME TERMINAL BOX WITH HOT WATER REHEAT COIL
- S — DUCT MOUNTED SMOKE DETECTOR FURNISHED AND WIRED BY ELEC. CONT'R. INSTALLED BY MECHANICAL CONTRACTOR

PIPING

CHWS	CHILLED WATER SUPPLY
CHWR	CHILLED WATER RETURN
HWS	HOT WATER SUPPLY
HWR	HOT WATER RETURN
D	DRAIN
	PITCH DOWN IN DIRECTION OF ARROW
	DIRECTION OF FLOW
RL	REFRIGERANT LIQUID
RS	REFRIGERANT SUCTION

VALVES

- GATE VALVE
- GATE VALVE W/ HOSE BIBB END
- BALANCING VALVE
- BUTTERFLY VALVE
- 2-WAY CONTROL VALVE
- "Y" STRAINER
- "Y" STRAINER W/ BLOW DOWN, H.W. SYSTEMS
- PIPE ANCHOR
- PIPE GUIDE
- FD — FLOW MEASURING DEVICE
- AUTOMATIC AIR ELIMINATOR
- MANUAL AIR ELIMINATOR
- BALL VALVE
- PIPE TURN AWAY
- PIPE TURN TOWARDS
- UNION
- CONCENTRIC REDUCER
- ECCENTRIC REDUCER
- CAPPED PIPE
- SIDE CONNECTION
- BOTTOM CONNECTION 45 OR 90 DEGREES
- TOP CONNECTION 45 OR 90 DEGREES
- COMBINATION BALANCING SHUT-OFF
- EXPANSION COMPENSATOR

GENERAL

- EQUIPMENT DESIGNATION
- SECTION NO. / DWG. NO. — SECTION DESIGNATION
- T — THERMOSTAT - MOUNT 48" A.F.F.
- S — SENSOR THERMOSTAT - MOUNT 48" A.F.F.
- SP — REMOTE SET POINT SPACE TEMPERATURE CONTROLLER
- SP — STATIC PRESSURE SENSOR
- T R — REVERSE ACTING THERMOSTAT
- UCD — UNDERCUT DOOR

GENERAL MECHANICAL NOTES

APPLICABLE TO ALL DRAWINGS

1. THE HVAC SUBCONTRACTOR SHALL REFER TO THE ARCHITECTURAL DRAWINGS FOR THE CEILING HEIGHTS WHICH SHALL BE MAINTAINED.
2. THE HVAC SUBCONTRACTOR SHALL INVESTIGATE AVAILABLE SPACE FOR ALL EQUIPMENT IN CEILINGS BEFORE SUBMISSION OF SHOP DRAWINGS.
3. HVAC SUBCONTRACTOR SHALL COORDINATE ALL DIFFUSER, REGISTER AND GRILLE LOCATIONS WITH REFLECTED CEILING PLANS, AND ANY RELOCATIONS DUE TO FIELD CONDITIONS SHALL BE APPROVED BY THE ARCHITECT AND/OR ENGINEER.
4. ALL FIRE DAMPER RATINGS SHALL CORRESPOND TO THE FIRE RATING OF THE WALL IN WHICH THEY ARE LOCATED.
5. ADEQUATE SITE ACCESS PANELS SHALL BE FURNISHED AND INSTALLED FOR ALL EQUIPMENT REQUIRING SERVICE, MAINTENANCE AND REPLACEMENT FOR THE BALANCING OF VALVES AND FOR THE OPERATION OF HVAC SYSTEMS IN COORDINATION WITH THE GENERAL CONTRACTOR, AS PER THE SPECIFICATIONS.
6. ALL EQUIPMENT DRAIN POINTS SHALL BE PIPED TO THE NEAREST FLOOR DRAIN.
7. ALL PIPING RUNOUTS SHALL BE 3/4 INCH MINIMUM UNLESS OTHERWISE NOTED.
8. DUCT SIZES INDICATED ON THE DRAWINGS ARE TO BE NET FREE AREA. ALL DUCTWORK SHALL BE CONSTRUCTED, INSTALLED AND SEALED (CLASS A), PER THE LATEST SMACNA REQUIREMENTS.
9. ALL SQUARE ELBOWS AND BULLHEAD TEES SHALL HAVE TURNING VANES.
10. GENERAL CONTRACTOR SHALL PROVIDE CURBS AROUND ALL DUCTWORK PENETRATIONS THROUGH THE ROOF.
11. HVAC SUBCONTRACTOR SHALL SEAL THE DUCTWORK AND/OR PIPING PENETRATIONS THROUGH FIRE AND/OR SMOKE RATED WALLS WITH APPROVED FIRE STOP MATERIAL.
12. PARTICULAR ATTENTION SHOULD BE PAID TO ADDITIONAL NOTES SHOWN ON THE INDIVIDUAL DRAWINGS.
13. THE DUCTWORK AND PIPING SYSTEMS SHOWN ON THE DRAWINGS ARE SHOWN DIAGRAMMATICALLY WITHOUT EVERY OFFSET AND TRANSITION REQUIRED TO INSTALL THE WORK. OBVIOUS OFFSETS AND TRANSITIONS, AS RELATED TO HVAC, ARE SHOWN WHERE POSSIBLE WITHOUT AFFECTING THE CLARITY OF THE DRAWINGS.
14. ALL PIPING AND DUCTWORK SHALL BE RUN ABOVE THE CEILINGS UNLESS NOTED OTHERWISE.
15. ALL THERMOSTATS TO BE MOUNTED ABOVE LIGHT SWITCHES ON SAME CENTERLINE, 4'-0" ABOVE FINISHED FLOOR WHERE APPLICABLE, OR OTHERWISE NOTED. REFER TO ARCHITECTURAL DRAWINGS FOR EXACT LOCATION.
16. THE FIRST FOUR (4'-0") FEET OF DUCTWORK BEHIND ANY DIFFUSER, GRILLE OR REGISTER SHALL BE PAINTED FLAT BLACK.
17. ALL MATERIALS INSTALLED IN THIS WORK SHALL BE NEW UNLESS SPECIFICALLY NOTED FOR RE-USE.
18. ALL WORK PERFORMED SHALL BE GUARANTEED FREE FROM DEFECTS IN WORKMANSHIP AND MATERIALS FOR A PERIOD OF ONE (1) YEAR FROM DATE OF FINAL ACCEPTANCE BY THE OWNER, UNLESS SUCH DEFECTS ARE CLEARLY THE RESULT OF MISUSE OF EQUIPMENT BY PERSONS NOT UNDER THE CONTROL OF THE SUBCONTRACTOR.
19. THE HVAC SUBCONTRACTOR SHALL OBTAIN INSTALLATION INSTRUCTIONS ON EACH PIECE OF EQUIPMENT TO BE FURNISHED WHICH THE HVAC SUBCONTRACTOR IS REQUIRED TO INSTALL OR TO WHICH FINAL CONNECTIONS ARE TO BE MADE UNDER THE HVAC CONTRACT. THE HVAC SUBCONTRACTOR SHALL INSTALL AND MAKE FINAL CONNECTIONS PER THE MANUFACTURER'S INSTRUCTIONS AND RECOMMENDATIONS. THE CONTRACTOR SHALL DEMONSTRATE TO THE OWNER THAT THE INSTALLED EQUIPMENT OPERATES AS DESIGNED.
20. ALL WORK UNDER THIS SECTION SHALL BE COORDINATED WITH ALL OTHER TRADES BEFORE INSTALLATION IS MADE.
21. COORDINATE ALL MOTORS, STARTERS, DISCONNECT AND SMOKE DETECTOR REQUIREMENTS WITH ELECTRICAL SUBCONTRACTOR FOR ALL EQUIPMENT REQUIRING SAME.
22. ALL EQUIPMENT TO BE INSTALLED EXPOSED IN FINISHED AREAS (REGISTERS, GRILLES, DIFFUSERS, ETC.) SHALL BE LOCATED AS INDICATED ON THE ARCHITECTURAL DRAWINGS. FINAL LOCATIONS SHALL BE AS SELECTED BY THE ARCHITECT UNLESS OTHERWISE NOTED.
23. ALL EQUIPMENT TO BE INSTALLED EXPOSED IN FINISHED AREAS (REGISTERS, GRILLES, DIFFUSERS, ETC.) SHALL HAVE COLORS SELECTED BY THE ARCHITECT UNLESS OTHERWISE NOTED.
24. ALL HVAC EQUIPMENT SHALL BE INSTALLED, COORDINATED WITH ALL TRADES, IN SUCH A WAY SO THAT LIGHTS, CONDUITS, SPRINKLERS, SUPPLY AND/OR DRAIN PIPING DO NOT BLOCK ACCESS TO UNITS AND RELATED ACCESSORIES.
25. FOR LOCATION OF OPENINGS IN ROOF, SEE ARCHITECTURAL DRAWINGS. FINAL OPENING SIZES SHALL SUIT APPROVED SHOP DRAWINGS.
26. THE HVAC CONTRACTOR SHALL FURNISH ALL SUPPORT STEEL REQUIRED FOR THE INSTALLATION OF HVAC EQUIPMENT, UNLESS OTHERWISE INDICATED.
27. THE HVAC CONTRACTOR SHALL FIELD MEASURE ALL DUCT RUNS PRIOR TO FABRICATING DUCTWORK. FURNISH AND INSTALL ALL DUCT TRANSITIONS, ELBOWS, FITTINGS AND OFFSETS REQUIRED TO ACCOMMODATE FIELD CONDITIONS.
28. ALL PIPING ENCLOSED WITHIN WALLS, CEILINGS OR FLOORS SHALL BE LEAK TESTED PRIOR TO BEING CONCEALED.
29. THE HVAC CONTRACTOR SHALL BE RESPONSIBLE FOR ALL RIGGING AND STAGING REQUIRED FOR THE INSTALLATION OF THE HVAC SYSTEMS.
30. UNDERCUT DOORS AND DOOR LOUVERS ARE BY THE GENERAL CONTRACTOR.
31. ALL CEILING-MOUNTED EQUIPMENT SHALL BE INSTALLED IN SUCH A WAY THAT LIGHTS, PIPING AND DUCTWORK DO NOT BLOCK ACCESS TO UNITS AND RELATED ACCESSORIES.
32. HVAC CONTRACTOR SHALL BE RESPONSIBLE FOR ALL SHEETMETAL TRANSITIONS AT AIR TERMINAL UNITS, FANS, COILS AND OTHER SIMILAR HVAC EQUIPMENT.
33. THE HVAC CONTRACTOR SHALL PROVIDE REMOTE THERMOSTATS FOR EACH HORIZONTAL UNIT HEATER, CABINET UNIT HEATER, FINNED TUBE RADIATION, WALL HEATER, AND CONVECTOR. ALL THERMOSTATS INSTALLED IN PUBLIC AREAS SUCH AS CORRIDORS, TOILET ROOMS, STAIRWELLS AND ASSEMBLY SPACES SHALL BE PROTECTED BY A TAMPERPROOF GUARD.
34. FURNISH AND INSTALL FIRE DAMPERS AT ALL DUCT FLOOR PENETRATIONS.
35. FURNISH AND INSTALL FIRE DAMPERS AT ALL 2 HR FIRE RATED WALLS.
36. ALL ROOF O.A. INTAKES FOR HORIZONTAL UNIT VENTILATORS SHALL BE PROVIDED WITH A "LOW LEAK" AUTOMATIC CONTROL DAMPER MOUNTED IN THE DUCTWORK IMMEDIATELY BELOW THE ROOF.
37. HVAC EQUIPMENT WITH FANS TO BE PROVIDED WITH FLEXIBLE CONNECTIONS ON INLET AND DISCHARGE OF FAN TO DUCTWORK.
38. REFRIGERANT PIPE SIZES PER UNIT MANUFACTURERS RECOMMENDATIONS.
39. PROVIDE ACCESS PANELS AT ALL FIRE DAMPER LOCATIONS.
40. DUCT SIZES INDICATED ON DRAWINGS ARE TO BE NET FREE AREA.
41. PITCH ALL HORIZONTAL CONDENSATE DRAIN LINES 1/8" PER FOOT OF RUN.
42. ALL SQUARE ELBOWS AND BULL HEAD TEES TO HAVE TURNING VANES.
43. DROP CONDENSATE DRAIN PIPES DOWN IN WALL ON WARM SIDE OF INSULATION.
44. DUCT DIMENSIONS SHWON ON ACOUSTICALLY LINED DUCTWORK ARE FOR CLEAR INSIDE DIMENSION AFTER APPLICATION OF LINER.
45. ALL DIFFUSERS AND REGISTERS IN WET AREAS, (LOCKER ROOMS, TOILETS, SHOWERS, JAN. CLOSETS, ETC.) SHALL BE OF ALUMINUM CONSTRUCTION.
46. MECHANICAL CONTRACTOR SHALL INSTALL ALL NEW HVAC EQUIPMENT PER MANUFACTURER'S RECOMMENDATIONS AND SHALL MAINTAIN ALL REQUIRED SERVICE CLEARANCES.

DRAWING LIST

M0.1	MECHANICAL LEGEND
M1.04	LOWER LEVEL DUCTWORK PLAN ZONE 4 MECHANICAL
M1.11	FIRST FLOOR DUCTWORK PLAN ZONE 1A & 1B MECHANICAL
M1.12	FIRST FLOOR DUCTWORK PLAN ZONE 2 MECHANICAL
M1.13	FIRST FLOOR DUCTWORK PLAN ZONE 3 MECHANICAL
M1.14	FIRST FLOOR DUCTWORK PLAN ZONE 4 MECHANICAL
M1.21	SECOND FLOOR DUCTWORK PLAN ZONE 1A & 1B MECHANICAL
M1.22	SECOND FLOOR DUCTWORK PLAN ZONE 2 MECHANICAL
M1.23	SECOND FLOOR DUCTWORK PLAN ZONE 3 MECHANICAL
M1.24	SECOND FLOOR DUCTWORK PLAN ZONE 4 MECHANICAL
M1.31	THIRD FLOOR DUCTWORK PLAN ZONE 1A MECHANICAL
M1.32	THIRD FLOOR DUCTWORK PLAN ZONE 2 MECHANICAL
M1.33	THIRD FLOOR DUCTWORK PLAN ZONE 3 MECHANICAL
M1.41	FOURTH FLOOR DUCTWORK PLAN ZONE 1A MECHANICAL
M1.42	FOURTH FLOOR DUCTWORK PLAN ZONE 2 MECHANICAL
M1.43	FOURTH FLOOR DUCTWORK PLAN ZONE 3 MECHANICAL
M1.51	ROOF PLAN ZONES 1A, 1B AND 2
M1.52	ROOF PLAN ZONES 3 & 4
M2.04	LOWER LEVEL PIPING PLAN ZONE 4 MECHANICAL
M2.11	FIRST FLOOR PIPING PLAN ZONE 1A & 1B MECHANICAL
M2.12	FIRST FLOOR PIPING PLAN ZONE 2 MECHANICAL
M2.13	FIRST FLOOR PIPING PLAN ZONE 3 MECHANICAL
M2.14	FIRST FLOOR PIPING PLAN ZONE 4 MECHANICAL
M2.21	SECOND FLOOR PIPING PLAN ZONE 1A & 1B MECHANICAL
M2.22	SECOND FLOOR PIPING PLAN ZONE 2 MECHANICAL
M2.23	SECOND FLOOR PIPING PLAN ZONE 3 MECHANICAL
M2.24	SECOND FLOOR PIPING PLAN ZONE 4 MECHANICAL
M2.31	THIRD FLOOR PIPING PLAN ZONE 1A MECHANICAL
M2.32	THIRD FLOOR PIPING PLAN ZONE 2 MECHANICAL
M2.33	THIRD FLOOR PIPING PLAN ZONE 3 MECHANICAL
M2.41	FOURTH FLOOR PIPING PLAN ZONE 1A MECHANICAL
M2.42	FOURTH FLOOR PIPING PLAN ZONE 2 MECHANICAL
M2.43	FOURTH FLOOR PIPING PLAN ZONE 3 MECHANICAL
M3.1	MECHANICAL ROOM PART PLAN
M5.1	MECHANICAL SCHEDULES
M5.2	MECHANICAL SCHEDULES
M5.3	MECHANICAL SCHEDULES
M5.4	MECHANICAL SCHEDULES
M6.1	MECHANICAL DETAILS
M6.2	MECHANICAL DETAILS
M6.3	MECHANICAL DETAILS
M6.4	MECHANICAL DETAILS
M6.5	MECHANICAL DETAILS
M7.1	MECHANICAL CONTROL SEQUENCES
M7.2	MECHANICAL CONTROL SEQUENCES
M7.3	MECHANICAL CONTROL SEQUENCES
M7.4	MECHANICAL CONTROL SEQUENCES
M7.5	MECHANICAL CONTROL SEQUENCES

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KEYNOTE LEGEND:

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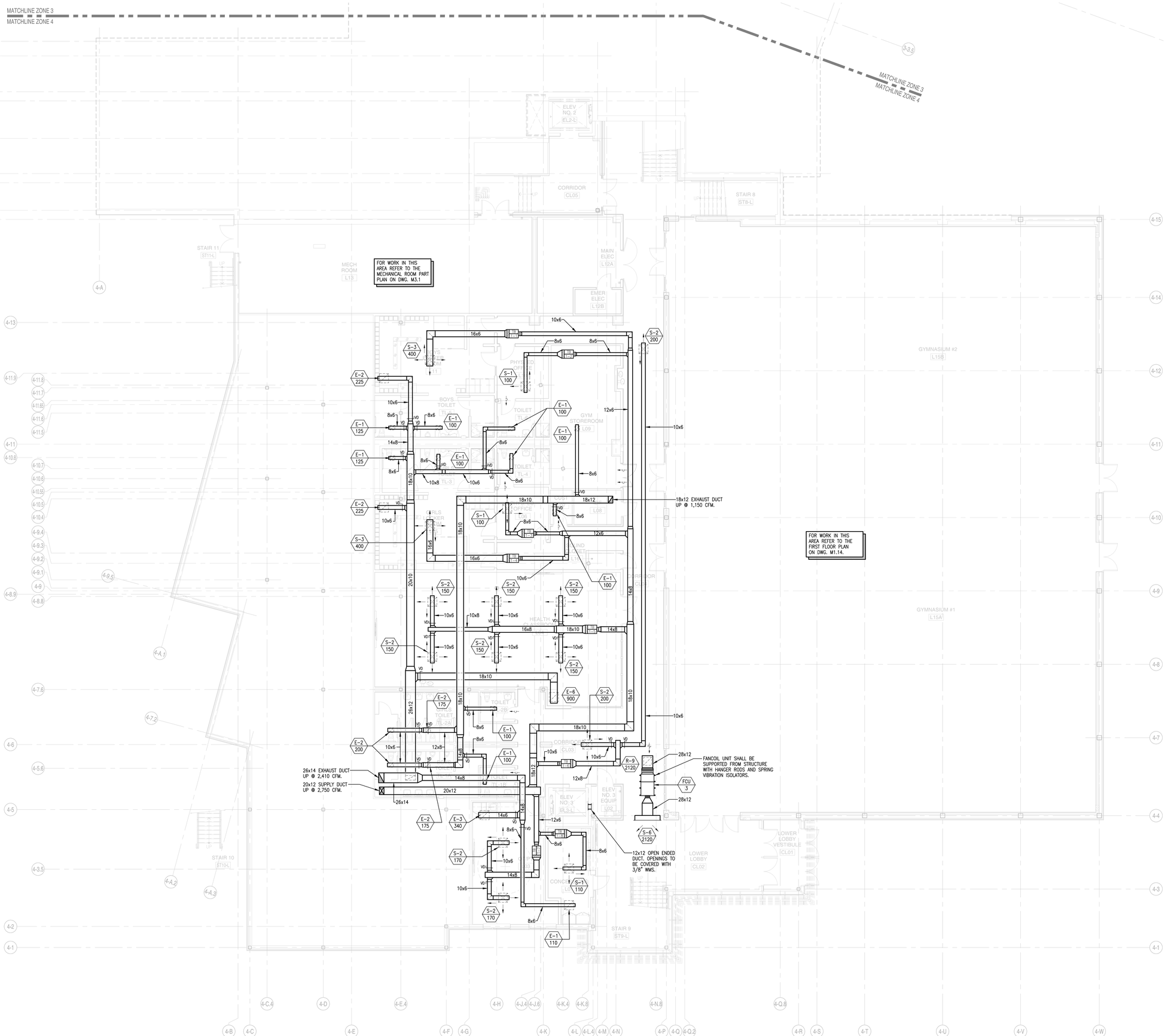
NORTH ARROW

KEYPLAN

DRAWING NAME:

MECHANICAL LEGEND & GENERAL NOTES

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	NONE
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M0.01



1 BASEMENT FLOOR PLAN - ZONE 4
1/8" = 1'-0"

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GENERAL NOTES:

1. ALL SUPPLY DUCTWORK DOWNSTREAM OF TERMINAL BOXES SHALL BE LINED WITH 1" THICK ACOUSTICAL INSULATION. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

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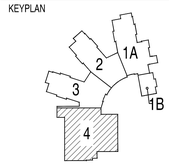
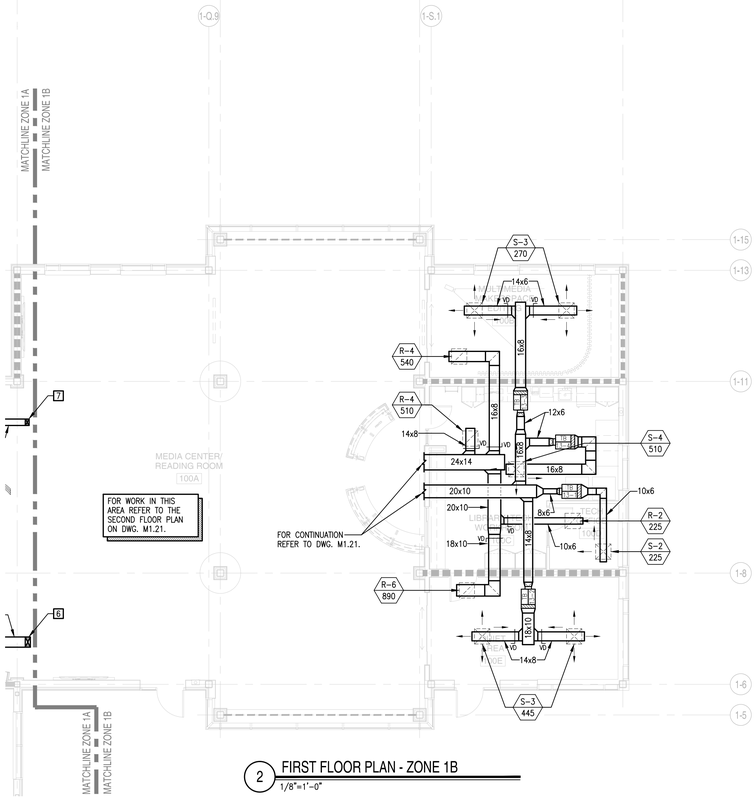
KEYPLAN



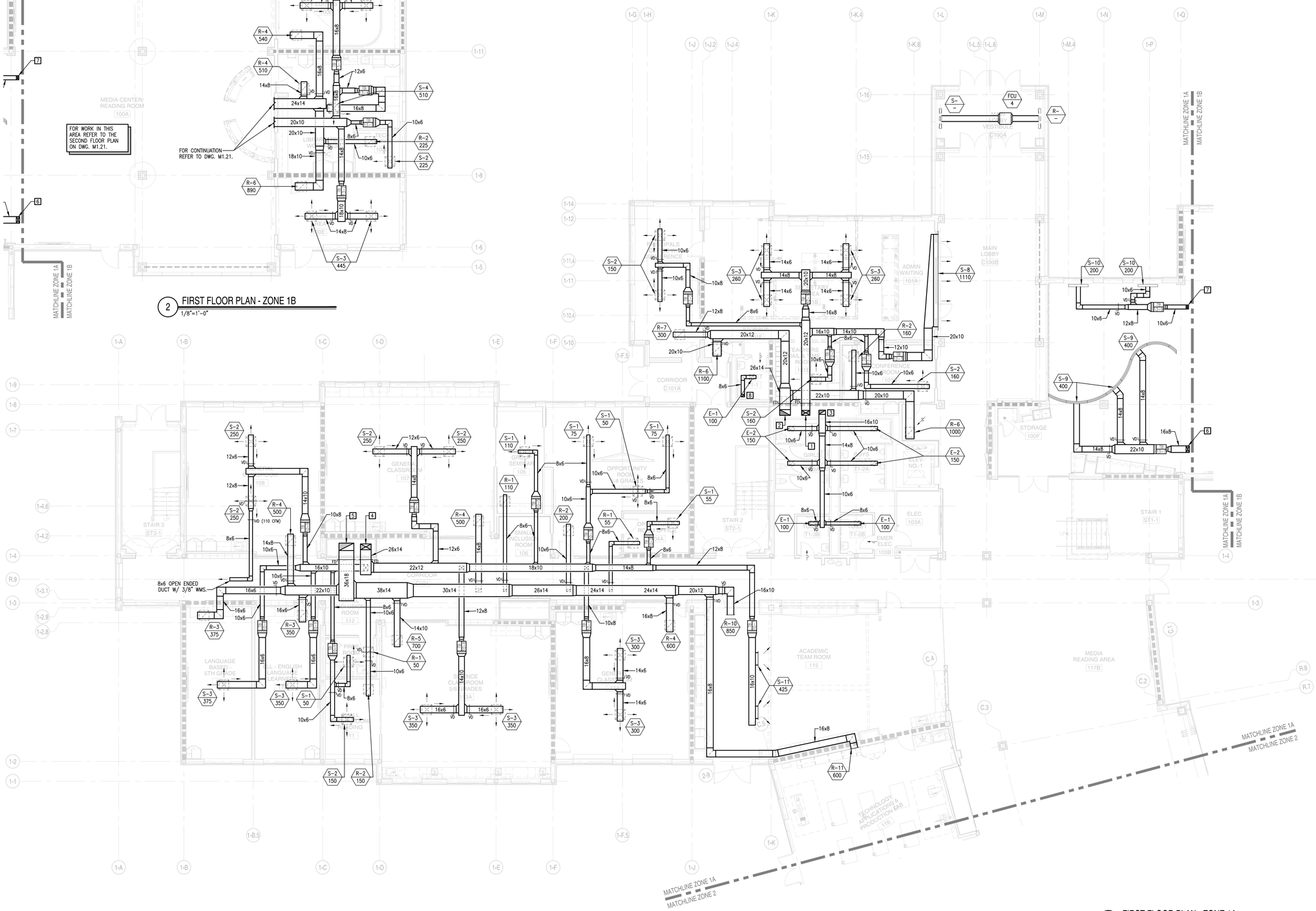
DRAWING NAME:

LOWER LEVEL DUCTWORK PLAN ZONE 4 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M1.04



2 FIRST FLOOR PLAN - ZONE 1B
1/8"=1'-0"



1 FIRST FLOOR PLAN - ZONE 1A
1/8"=1'-0"

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GENERAL NOTES:

1. ALL SUPPLY DUCTWORK DOWNSTREAM OF TERMINAL BOXES SHALL BE LINED WITH 1" THICK ACOUSTICAL INSULATION. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.
2. ALL EXPOSED SUPPLY DUCTWORK IN CORRIDORS WILL HAVE 1" THICK ACOUSTICAL INSULATION. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

KEYED NOTES: (THIS DWG. ONLY)

1. 20x12 SUPPLY DUCT UP @ 2,770 CFM
2. 26x14 RETURN DUCT UP @ 2,560 CFM
3. 16x10 EXHAUST DUCT UP @ 800 CFM
4. 26x14 SUPPLY DUCT UP @ 4,550 CFM
5. 36x18 RETURN DUCT UP @ 5,040 CFM
6. 16x8 SUPPLY DUCT UP @ 1,200 CFM
7. 10x6 SUPPLY DUCT UP @ 400 CFM
8. 8x6 EXHAUST DUCT UP @ 100 CFM

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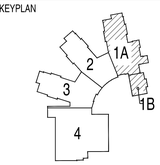
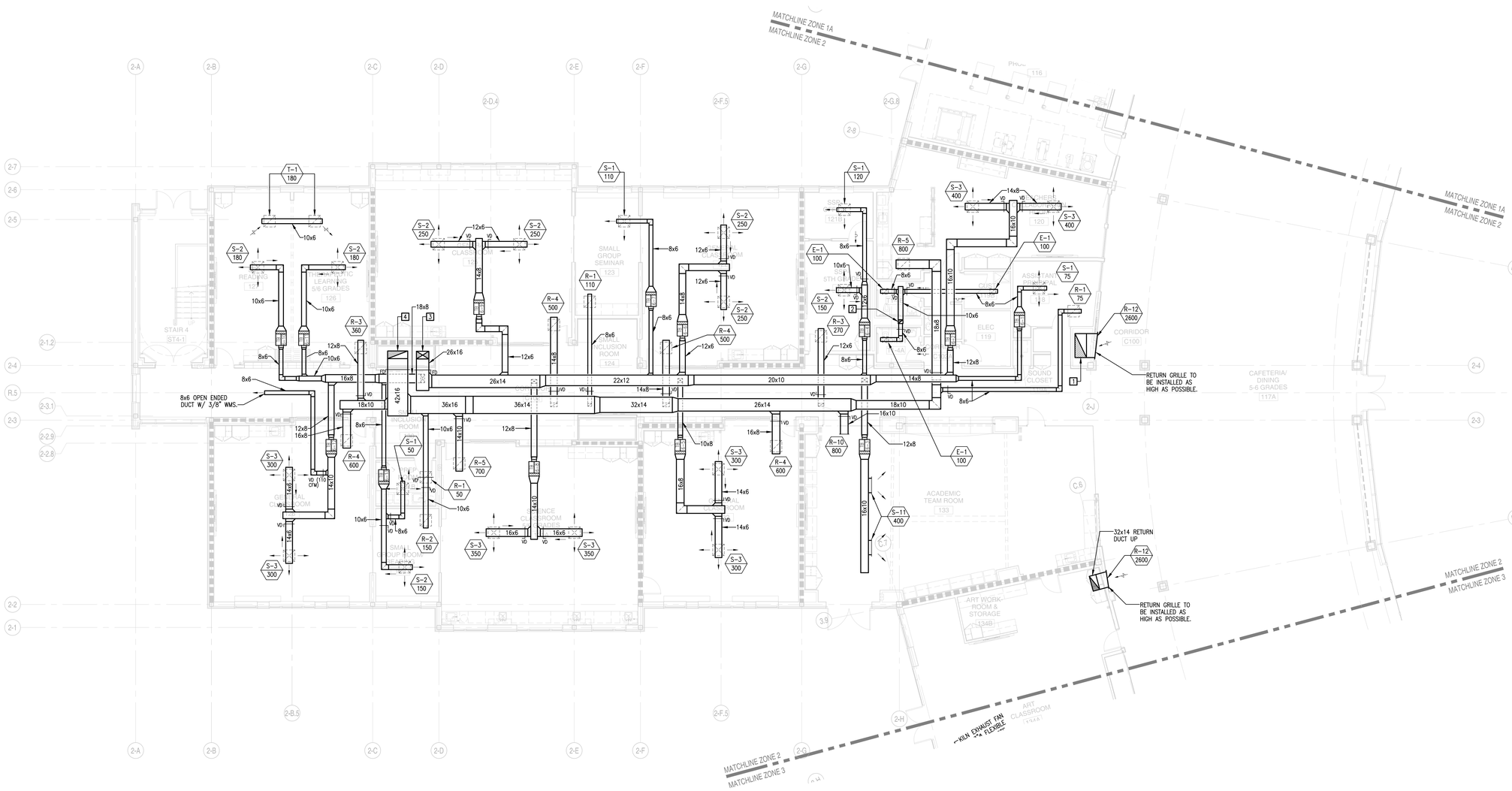
KEYPLAN



DRAWING NAME:

FIRST FLOOR DUCTWORK PLAN ZONES 1A & 1B MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE: As Noted	DRAWING NUMBER:
JOB NO.: 1403.00	M1.11
DATE: July 25, 2016	



1 FIRST FLOOR PLAN - ZONE 2
1/8"=1'-0"

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GENERAL NOTES:

1. ALL SUPPLY DUCTWORK DOWNSTREAM OF TERMINAL BOXES SHALL BE LINED WITH 1" THICK ACOUSTICAL INSULATION. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.
2. ALL EXPOSED SUPPLY DUCTWORK IN CORRIDORS WILL HAVE 1" THICK ACOUSTICAL INSULATION. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

KEYED NOTES: (THIS DWG. ONLY)

1. 50x24 RETURN DUCT UP @ 11,500 CFM
2. 10x8 EXHAUST DUCT UP @ 300 CFM
3. 26x16 SUPPLY DUCT UP @ 5,635 CFM
4. 42x16 RETURN DUCT UP @ 5,515 CFM

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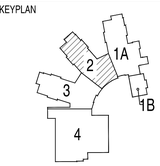
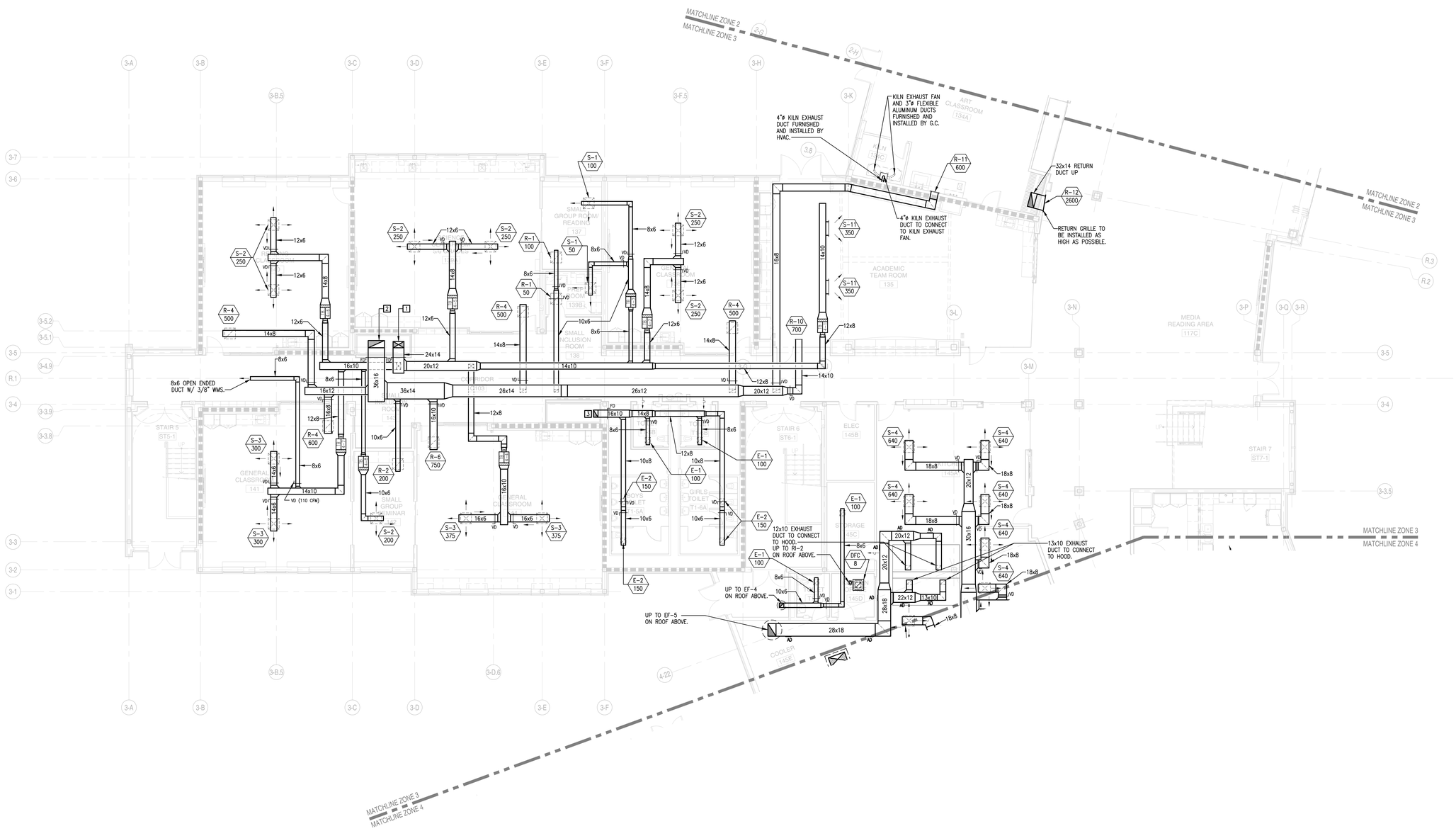
KEYPLAN



DRAWING NAME:

FIRST FLOOR DUCTWORK PLAN ZONE 2 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M1.12



1 FIRST FLOOR PLAN - ZONE 3
1/8"=1'-0"

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GENERAL NOTES:

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2. ALL EXPOSED SUPPLY DUCTWORK IN CORRIDORS WILL HAVE 1" THICK ACOUSTICAL INSULATION. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

KEYED NOTES: (THIS DWG. ONLY)

1. 24x14 SUPPLY DUCT UP @ 4,010 CFM
2. 36x16 RETURN DUCT UP @ 4,500 CFM
3. 16x10 EXHAUST DUCT UP @ 800 CFM

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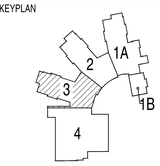
NORTH ARROW

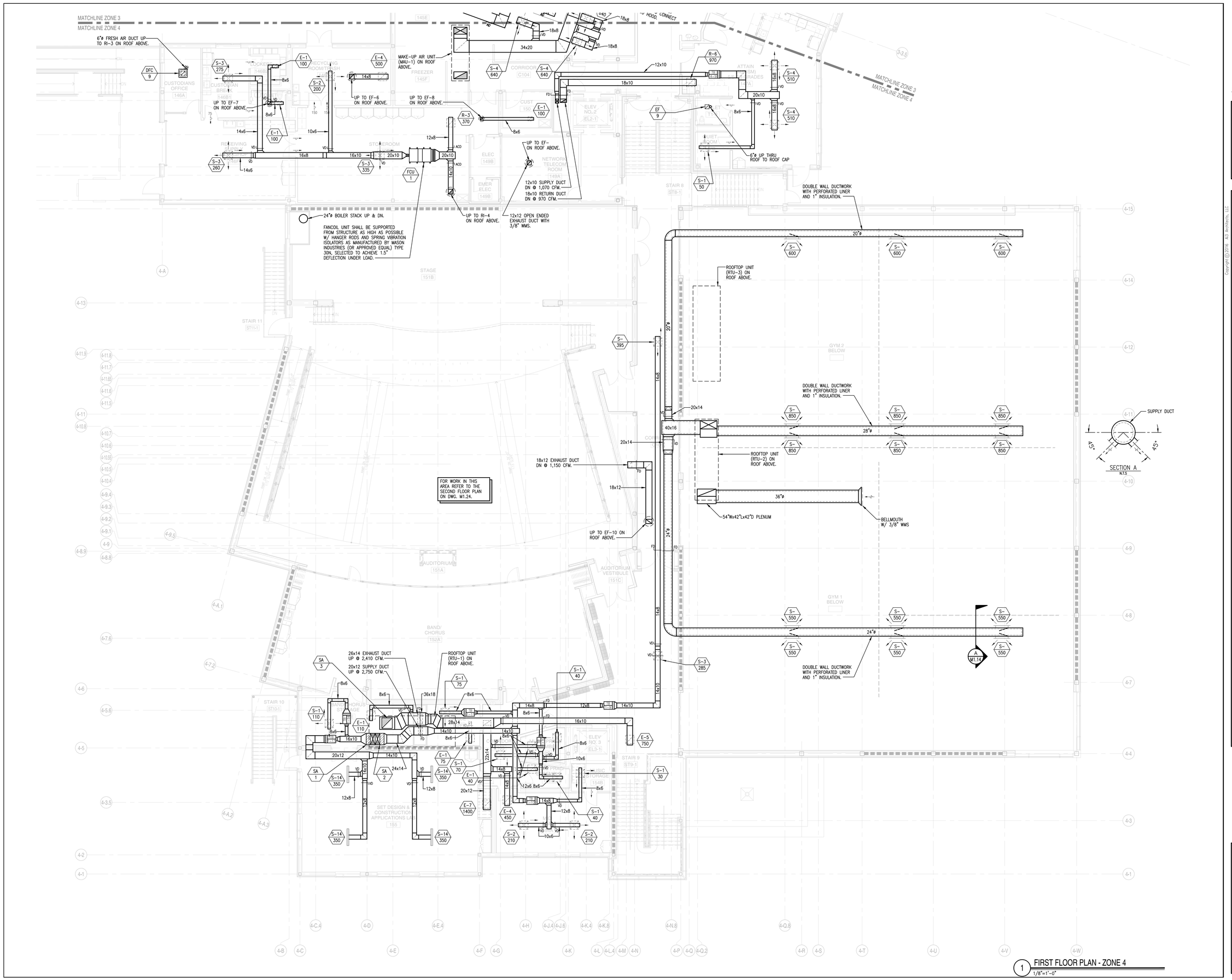
KEYPLAN



DRAWING NAME:

FIRST FLOOR DUCTWORK PLAN ZONE 3 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M1.13



1 FIRST FLOOR PLAN - ZONE 4
1/8"=1'-0"

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GENERAL NOTES:

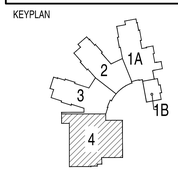
1. ALL SUPPLY DUCTWORK DOWNSTREAM OF TERMINAL BOXES SHALL BE LINED WITH 1" THICK ACOUSTICAL INSULATION. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.
2. ALL EXPOSED SUPPLY DUCTWORK IN CORRIDORS WILL HAVE 1" THICK ACOUSTICAL INSULATION. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

90% CONSTRUCTION DOCUMENTS

NOT FOR CONSTRUCTION

NORTH ARROW

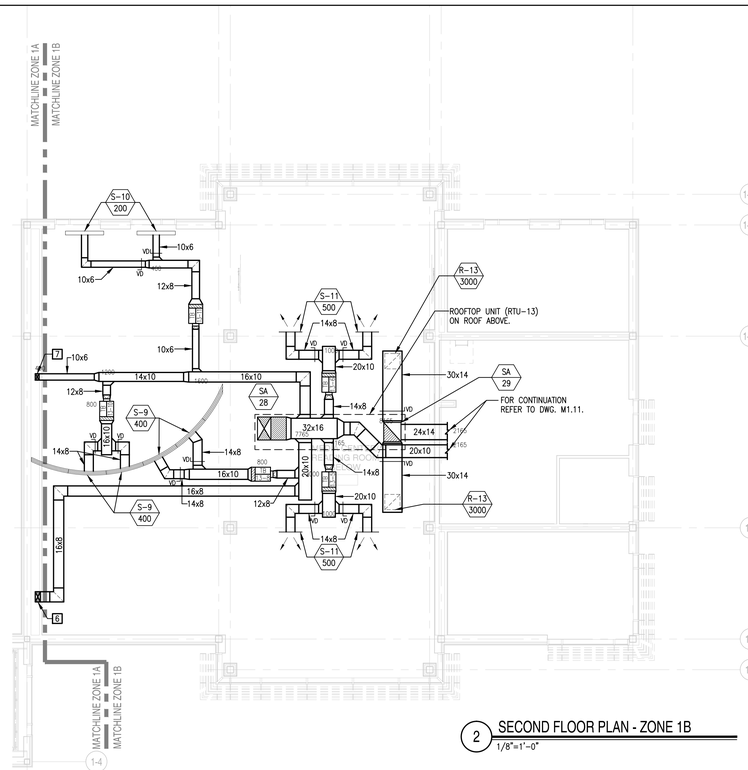
KEYPLAN



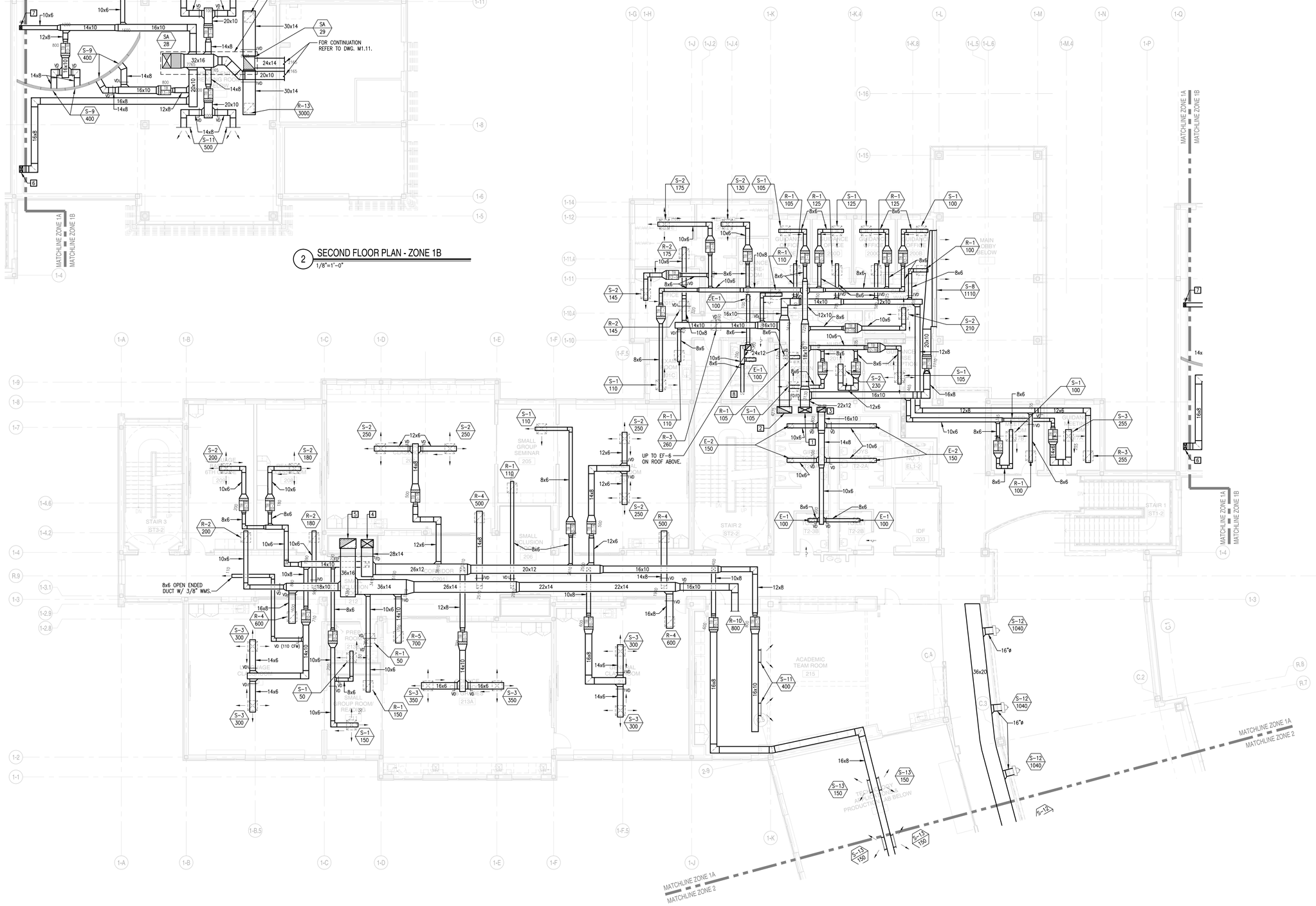
DRAWING NAME:

FIRST FLOOR DUCTWORK PLAN ZONE 4 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M1.14



2 SECOND FLOOR PLAN - ZONE 1B
1/8"=1'-0"



1 SECOND FLOOR PLAN - ZONE 1A
1/8"=1'-0"

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2. ALL EXPOSED SUPPLY DUCTWORK IN CORRIDORS WILL HAVE 1" THICK ACOUSTICAL INSULATION. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

KEYED NOTES: (THIS DWG. ONLY)

1. 32x14 SUPPLY DUCT UP @ 5,900 CFM & 20x12 SUPPLY DUCT DN @ 2,770 CFM
2. 36x16 RETURN DUCT UP @ 4,275 CFM & 26x14 RETURN DUCT DN @ 2,560 CFM
3. 22x12 EXHAUST DUCT UP @ 1,600 CFM & 16x10 EXHAUST DUCT DN @ 800 CFM
4. 30x20 SUPPLY DUCT UP @ 9,650 CFM & 26x14 SUPPLY DUCT DN @ 4,550 CFM
5. 42x24 RETURN DUCT UP @ 9,430 CFM & 36x18 RETURN DUCT DN @ 5,040 CFM
6. 16x8 SUPPLY DUCT DN @ 1,200 CFM
7. 10x6 SUPPLY DUCT DN @ 400 CFM
8. 8x6 EXHAUST DUCT DN @ 100 CFM

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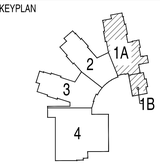
NORTH ARROW

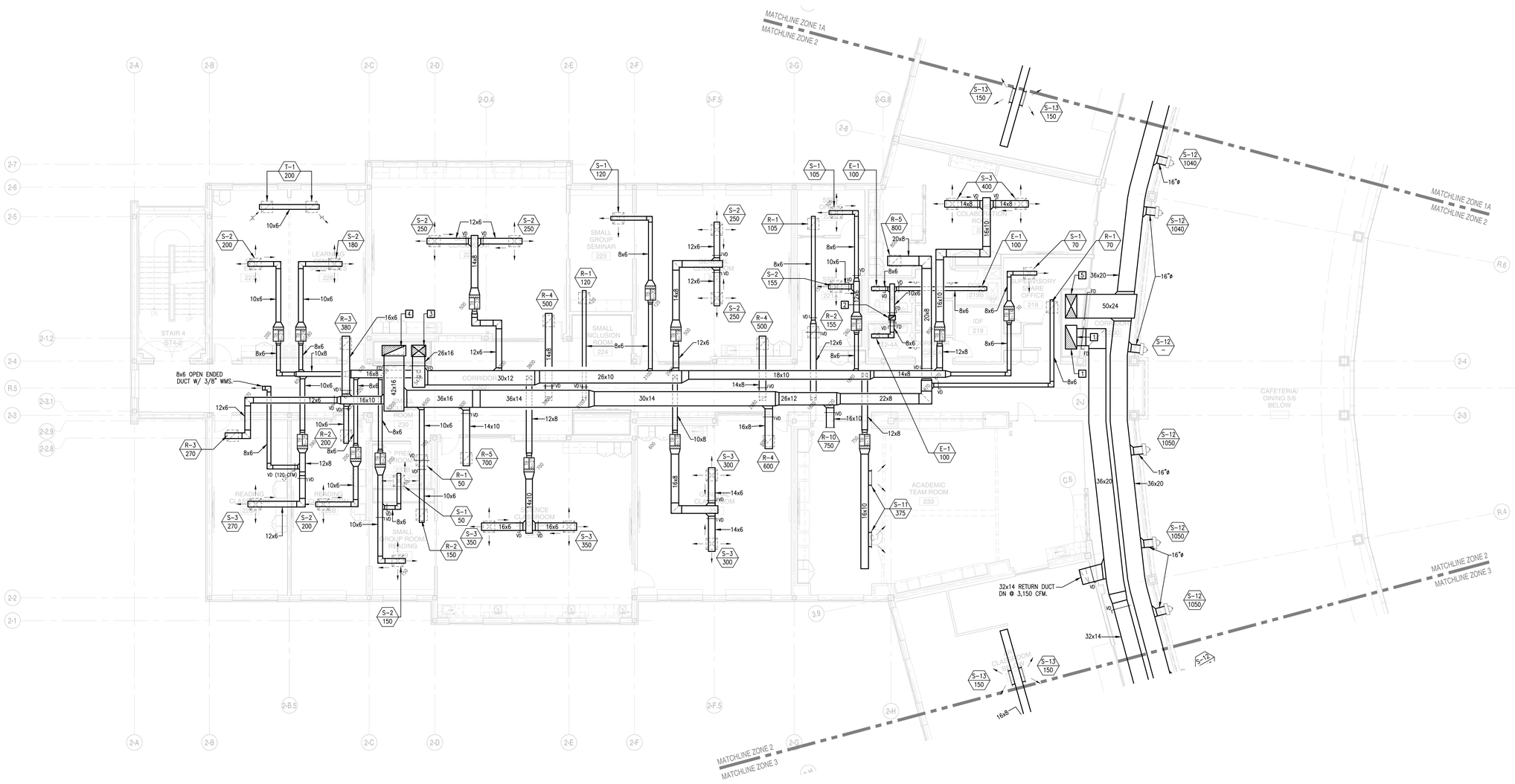
KEYPLAN



DRAWING NAME:

SECOND FLOOR DUCTWORK PLAN ZONES 1A & 1B MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M1.21



1 SECOND FLOOR PLAN - ZONE 2
1/8"=1'-0"

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2. ALL EXPOSED SUPPLY DUCTWORK IN CORRIDORS WILL HAVE 1" THICK ACOUSTICAL INSULATION. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

KEYED NOTES: (THIS DWG. ONLY)

1. 50x24 RETURN DUCT UP & DN @ 11,500 CFM
2. 14x10 EXHAUST DUCT UP @ 600 CFM & 10x8 EXHAUST DUCT DN @ 300 CFM
3. 28x26 SUPPLY DUCT UP @ 11,105 CFM & 26x16 SUPPLY DUCT DN @ 5,635 CFM
4. 50x22 RETURN DUCT UP @ 10,865 CFM & 42x16 RETURN DUCT DN @ 5,515 CFM
5. 50x24 SUPPLY DUCT UP @ 11,500 CFM

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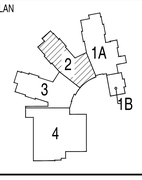
NORTH ARROW

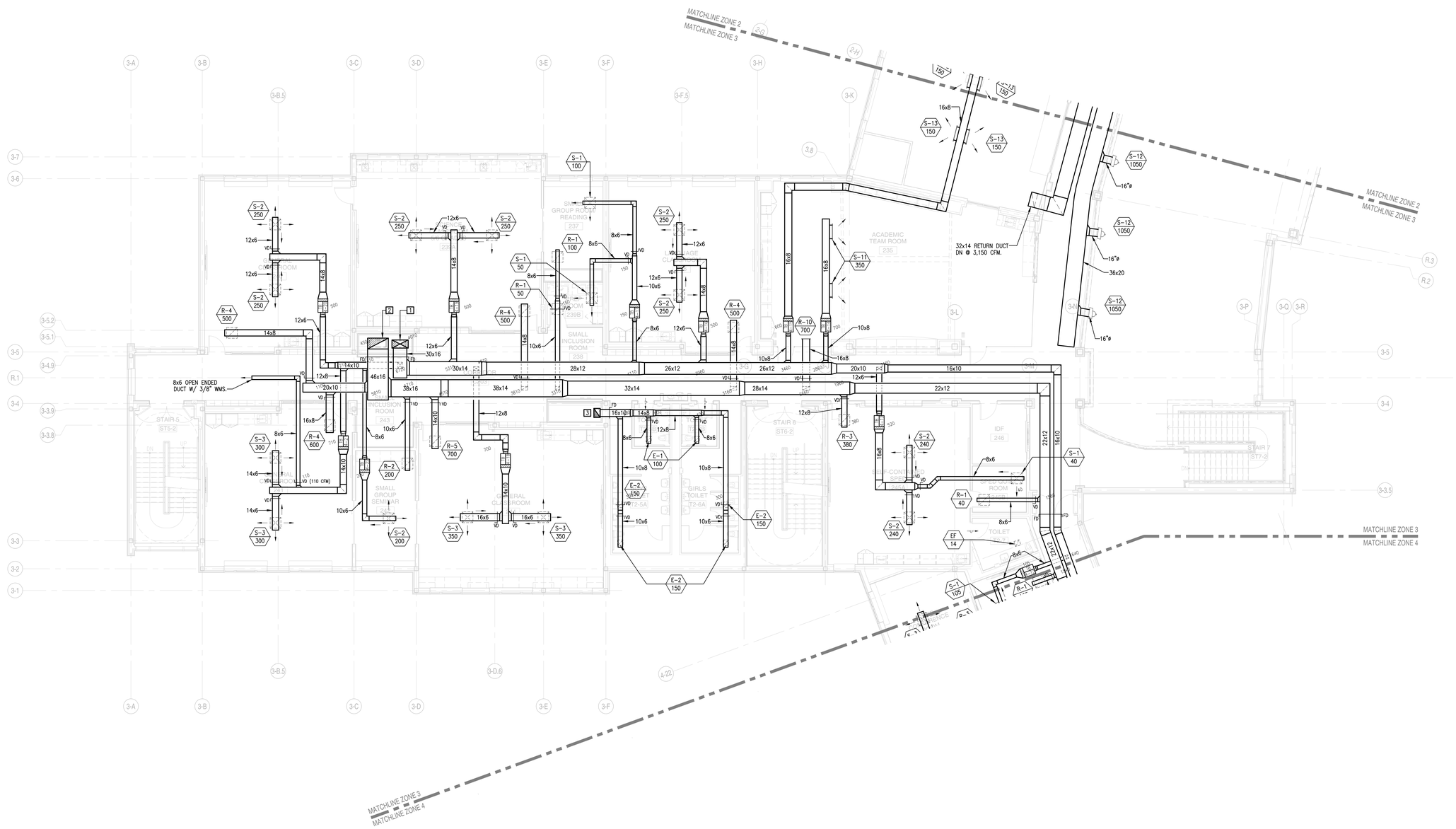
KEYPLAN



DRAWING NAME:

SECOND FLOOR DUCTWORK PLAN ZONE 2 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M1.22



1 SECOND FLOOR PLAN - ZONE 3
1/8"=1'-0"

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2. ALL EXPOSED SUPPLY DUCTWORK IN CORRIDORS WILL HAVE 1" THICK ACOUSTICAL INSULATION. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

KEYED NOTES: (THIS DWG. ONLY)

1. 36x18 SUPPLY DUCT UP @ 10,730 CFM & 24x14 SUPPLY DUCT DN @ 4,010 CFM
2. 46x24 RETURN DUCT UP @ 10,310 CFM & 36x16 RETURN DUCT DN @ 4,500 CFM
3. 20x14 EXHAUST DUCT UP @ 1,600 CFM & 16x10 EXHAUST DUCT DN @ 800 CFM

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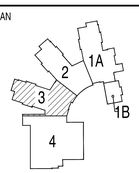
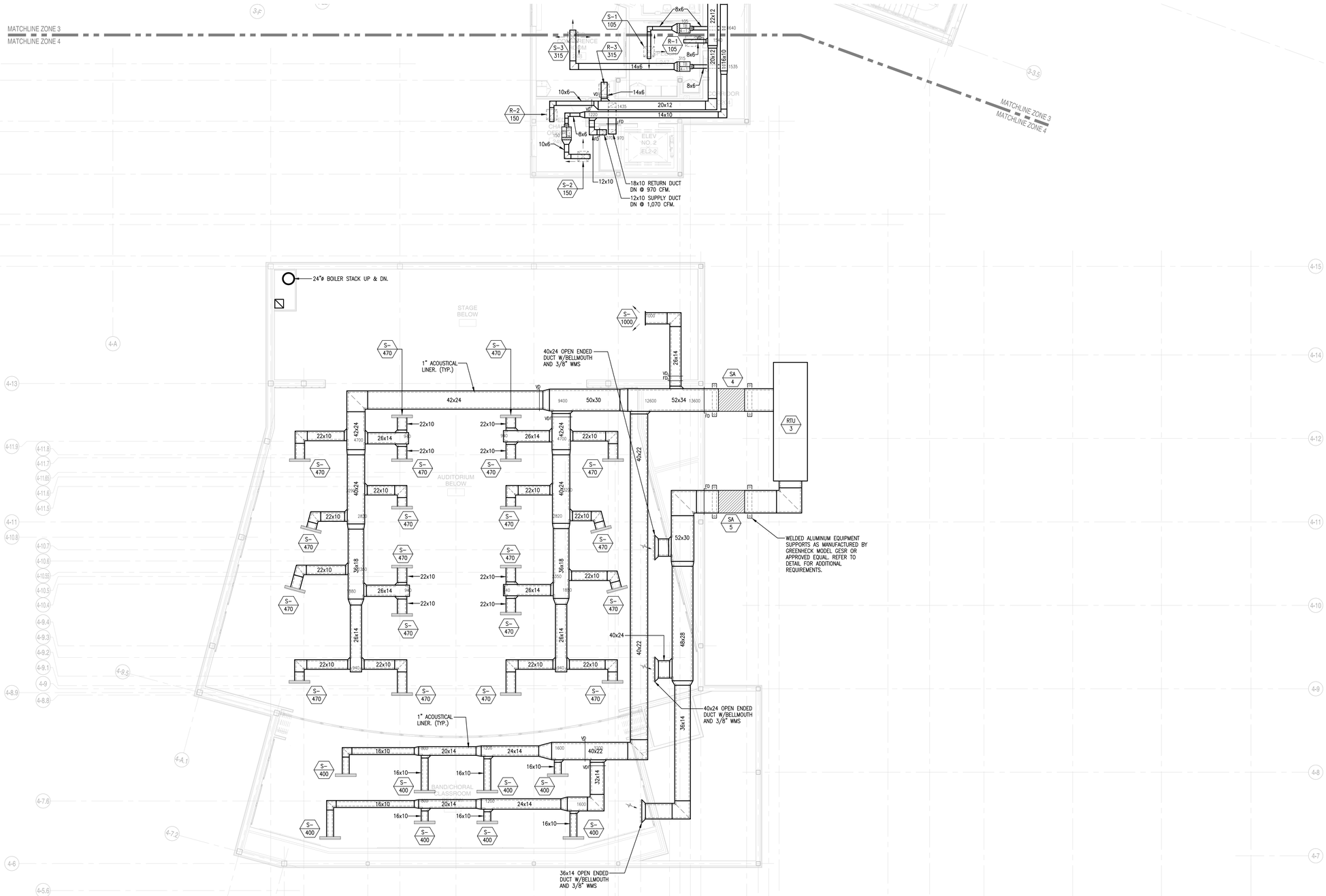
KEYPLAN



DRAWING NAME:

SECOND FLOOR DUCTWORK PLAN ZONE 3 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M1.23



1 SECOND FLOOR PLAN - ZONE 4
1/8"=1'-0"

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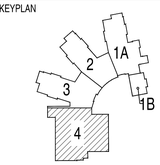
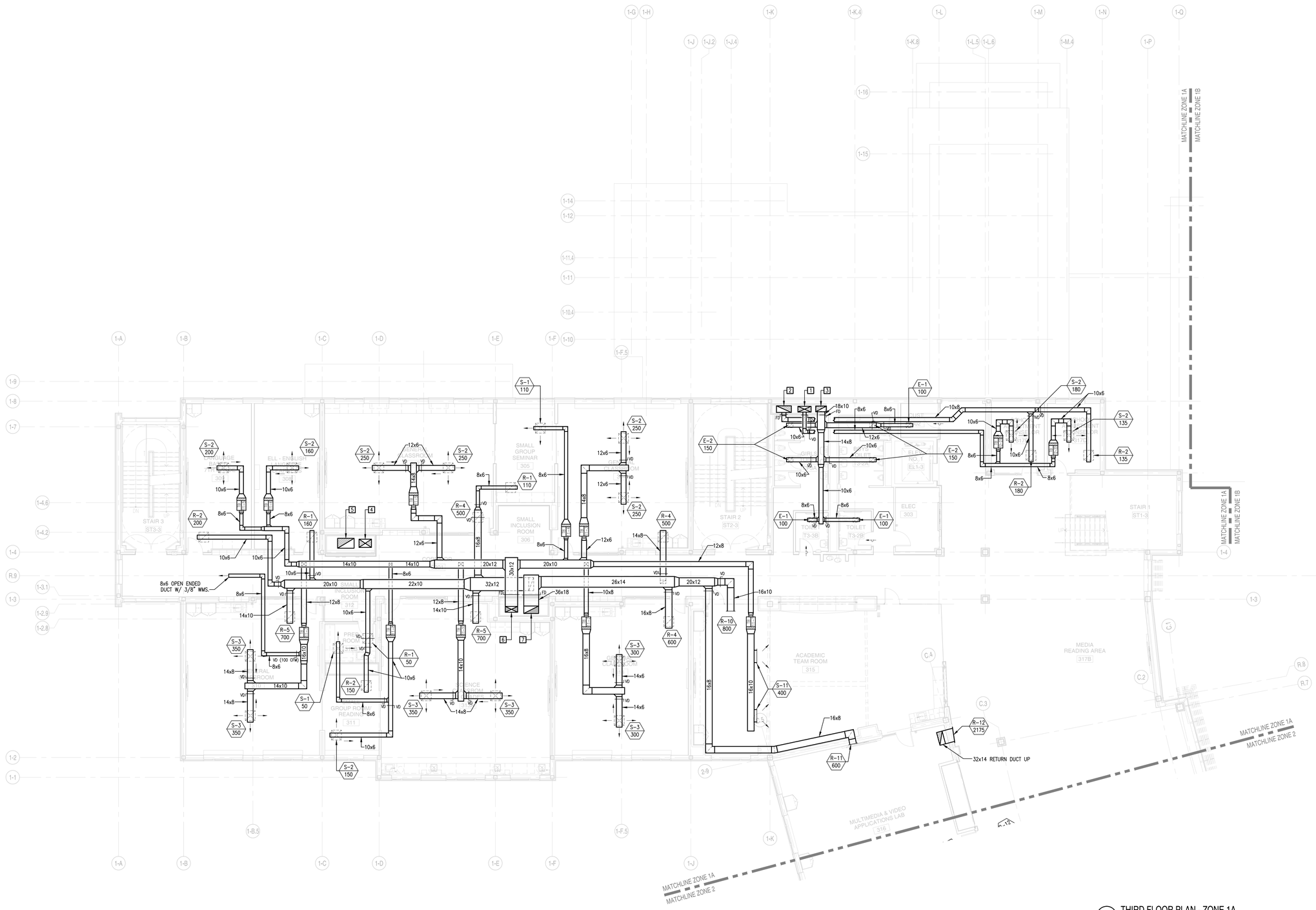
KEYPLAN



DRAWING NAME:

SECOND FLOOR DUCTWORK PLAN ZONE 4 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M1.24



1 THIRD FLOOR PLAN - ZONE 1A
1/8"=1'-0"

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KEYED NOTES: (THIS DWG. ONLY)

1. 32x14 SUPPLY DUCT UP @ 6,215 CFM & 32x14 SUPPLY DUCT DN @ 5,900 CFM
2. 36x16 RETURN DUCT UP @ 4,590 CFM & 36x16 RETURN DUCT DN @ 4,275 CFM
3. 26x14 EXHAUST DUCT UP @ 2,500 CFM & 22x12 EXHAUST DUCT DN @ 1,600 CFM
4. 30x20 SUPPLY DUCT UP & DN @ 9,050 CFM
5. 40x24 RETURN DUCT UP & DN @ 8,830 CFM
6. 30x12 SUPPLY DUCT UP @ 4,570 CFM
7. 36x18 RETURN DUCT UP @ 5,070 CFM

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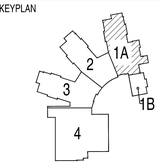
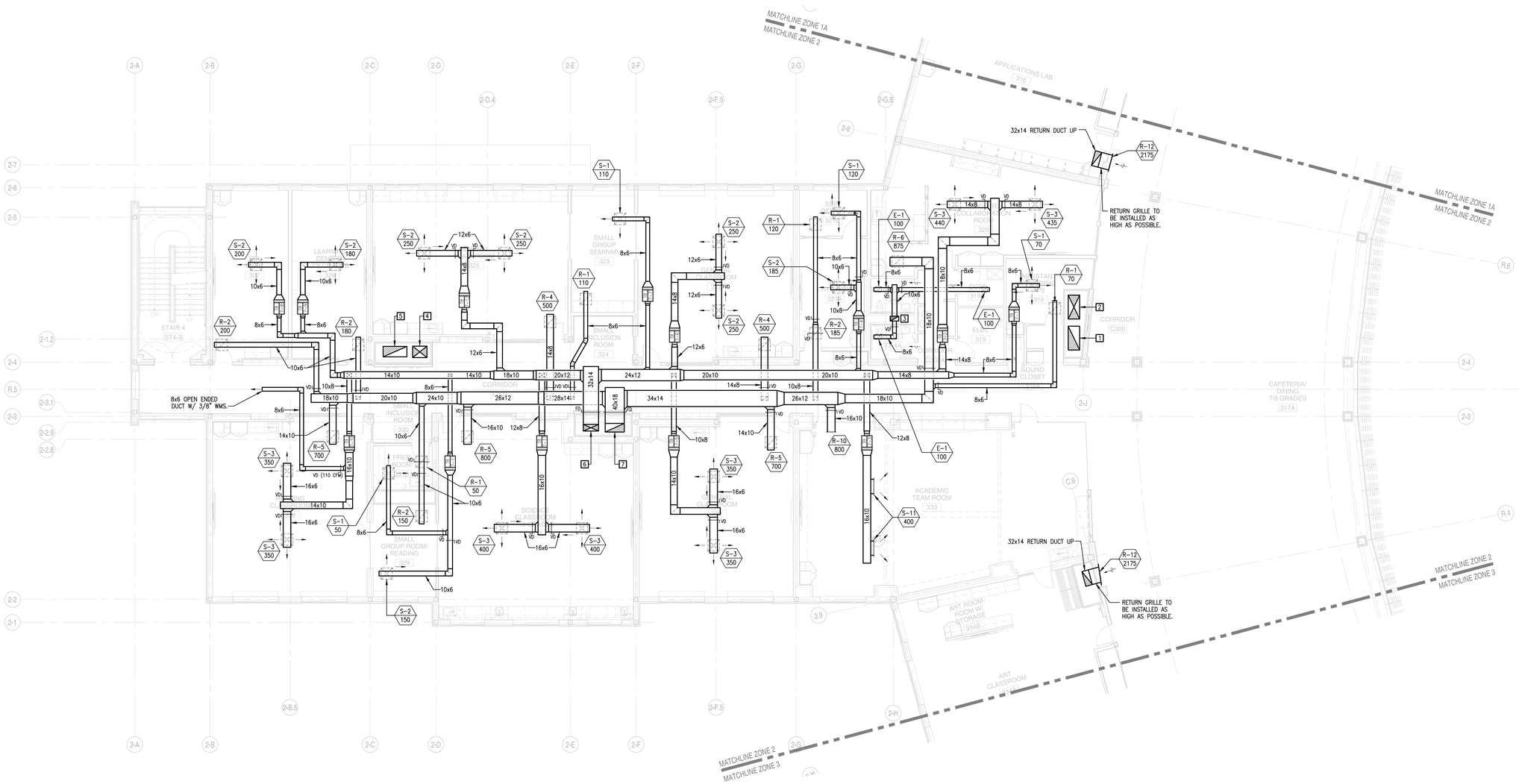
KEYPLAN



DRAWING NAME:

THIRD FLOOR DUCTWORK PLAN ZONE 1A MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M1.31



1 THIRD FLOOR PLAN - ZONE 2
1/8"=1'-0"

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2. ALL EXPOSED SUPPLY DUCTWORK IN CORRIDORS WILL HAVE 1" THICK ACOUSTICAL INSULATION. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

KEYED NOTES: (THIS DWG. ONLY)

1. 50x24 RETURN DUCT UP & DN @ 11,500 CFM
2. 50x24 SUPPLY DUCT UP & DN @ 11,500 CFM
3. 18x10 EXHAUST DUCT UP @ 900 CFM & 14x10 EXHAUST DUCT DN @ 600 CFM
4. 28x26 SUPPLY DUCT UP & DN @ 11,105 CFM
5. 50x22 RETURN DUCT UP & DN @ 10,865 CFM
6. 32x14 SUPPLY DUCT UP @ 6,050 CFM
7. 40x18 RETURN DUCT UP @ 5,940 CFM

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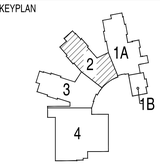
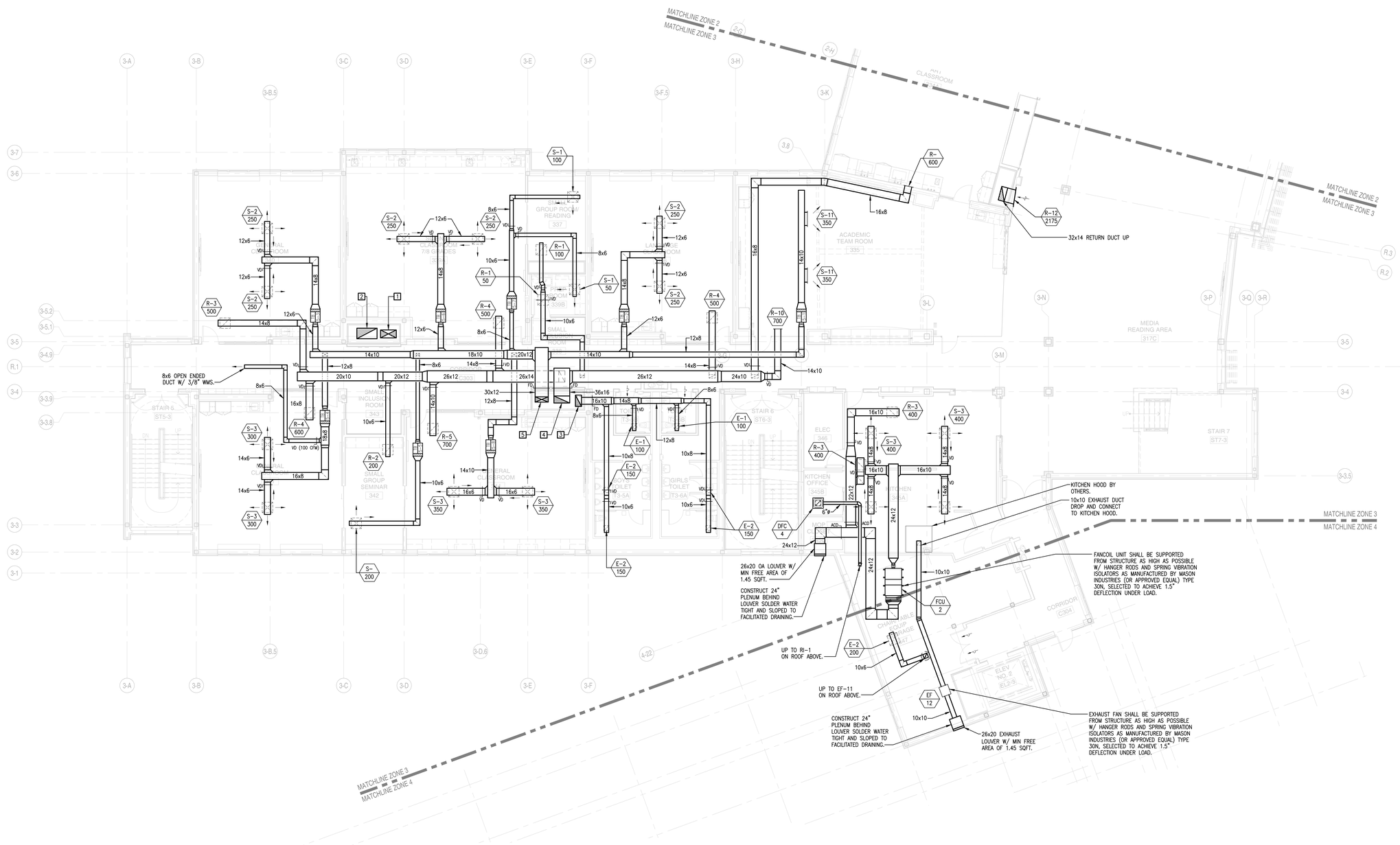
KEYPLAN



DRAWING NAME:

THIRD FLOOR DUCTWORK PLAN ZONE 2 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE: As Noted	DRAWING NUMBER:
JOB NO.: 1403.00	M1.32
DATE: July 25, 2016	



1 THIRD FLOOR PLAN - ZONE 3
1/8"=1'-0"

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KEYED NOTES: (THIS DWG. ONLY)

1. 36x18 SUPPLY DUCT UP & DN @ 10,630 CFM
2. 46x24 RETURN DUCT UP & DN @ 10,160 CFM
3. 26x14 EXHAUST DUCT UP @ 2,400 CFM & 20x14 EXHAUST DUCT DN @ 1,600 CFM
4. 36x16 RETURN DUCT UP @ 4,450 CFM
5. 26x12 SUPPLY DUCT UP @ 3,950 CFM

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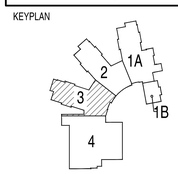
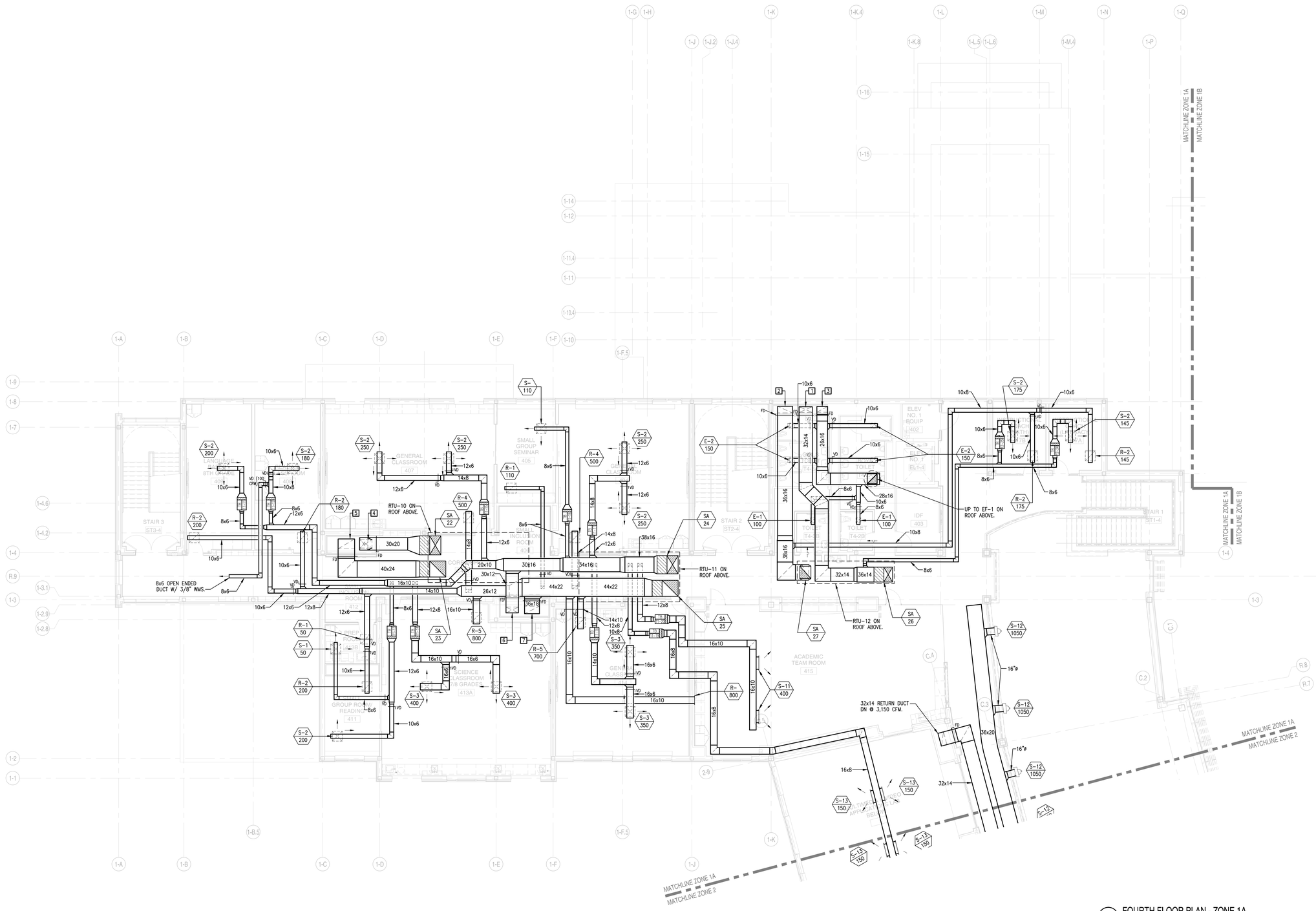
KEYPLAN



DRAWING NAME:

THIRD FLOOR DUCTWORK PLAN ZONE 3 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M1.33



1 FOURTH FLOOR PLAN - ZONE 1A
1/8"=1'-0"

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2. ALL EXPOSED SUPPLY DUCTWORK IN CORRIDORS WILL HAVE 1" THICK ACOUSTICAL INSULATION. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

KEYED NOTES: (THIS DWG. ONLY)

1. 32x14 SUPPLY DUCT DN @ 6,215 CFM
2. 36x16 RETURN DUCT DN @ 4,590 CFM
3. 26x14 EXHAUST DUCT DN @ 2,500 CFM
4. 30x20 SUPPLY DUCT DN @ 9,050 CFM
5. 40x24 RETURN DUCT DN @ 8,830 CFM
6. 30x12 SUPPLY DUCT DN @ 4,570 CFM
7. 36x18 RETURN DUCT DN @ 5,070 CFM

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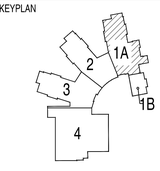
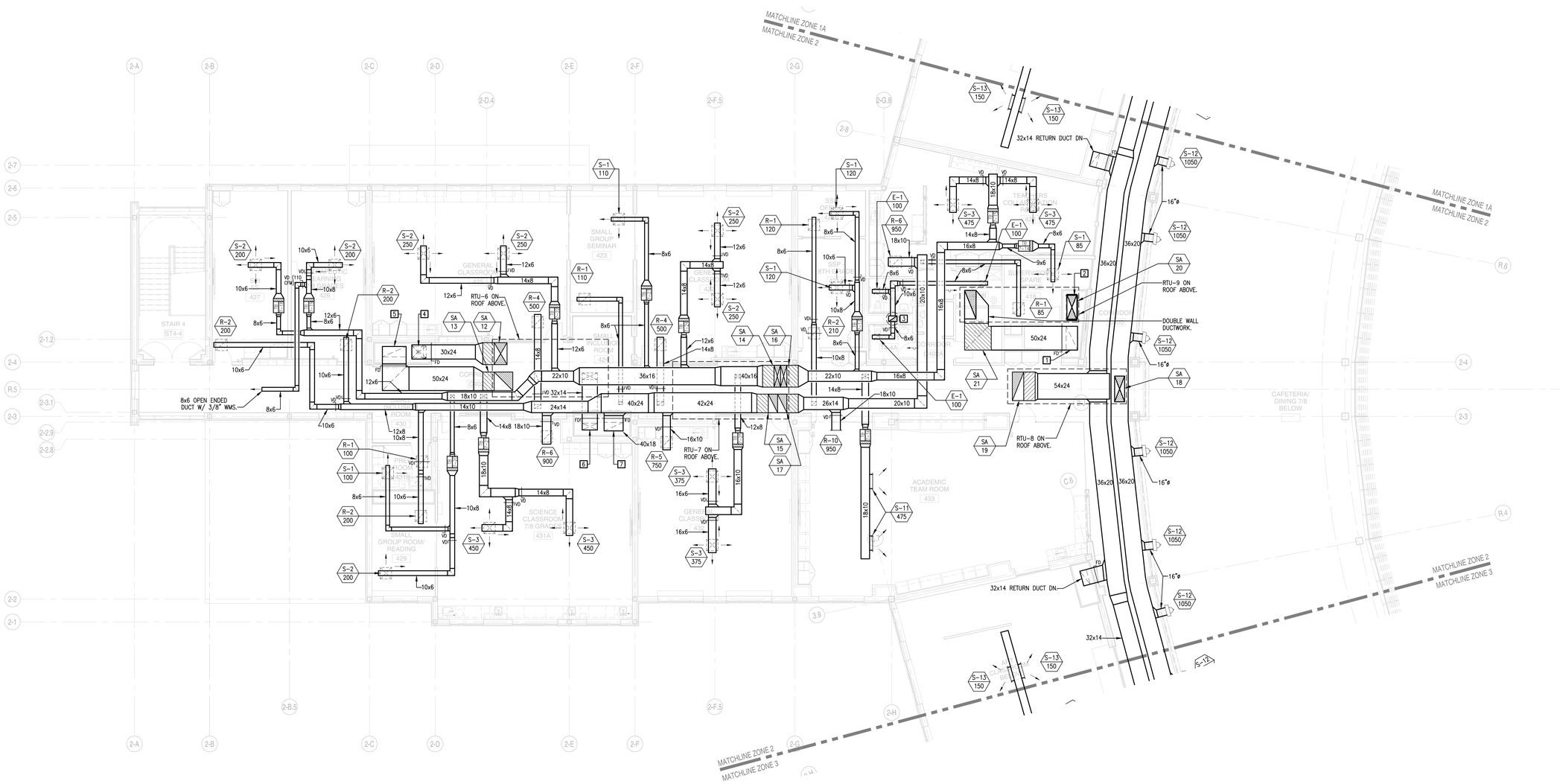
KEYPLAN



DRAWING NAME:

FOURTH FLOOR DUCTWORK PLAN ZONE 1A MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M1.41



1 FOURTH FLOOR PLAN - ZONE 2
1/8"=1'-0"

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2. ALL EXPOSED SUPPLY DUCTWORK IN CORRIDORS WILL HAVE 1" THICK ACOUSTICAL INSULATION. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

KEYED NOTES: (THIS DWG. ONLY)

1. 50x24 RETURN DUCT DN @ 11,500 CFM
2. 50x24 SUPPLY DUCT DN @ 11,500 CFM
3. 18x12 EXHAUST DUCT UP TO EF-2 @ 1,200 CFM &1 8x10 EXHAUST DUCT DN @ 900 CFM
4. 28x26 SUPPLY DUCT DN @ 11,105 CFM
5. 50x22 RETURN DUCT DN @ 10,865 CFM
6. 32x14 SUPPLY DUCT DN @ 6,050 CFM
7. 40x18 RETURN DUCT DN @ 5,940 CFM

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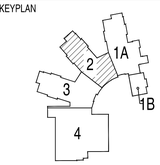
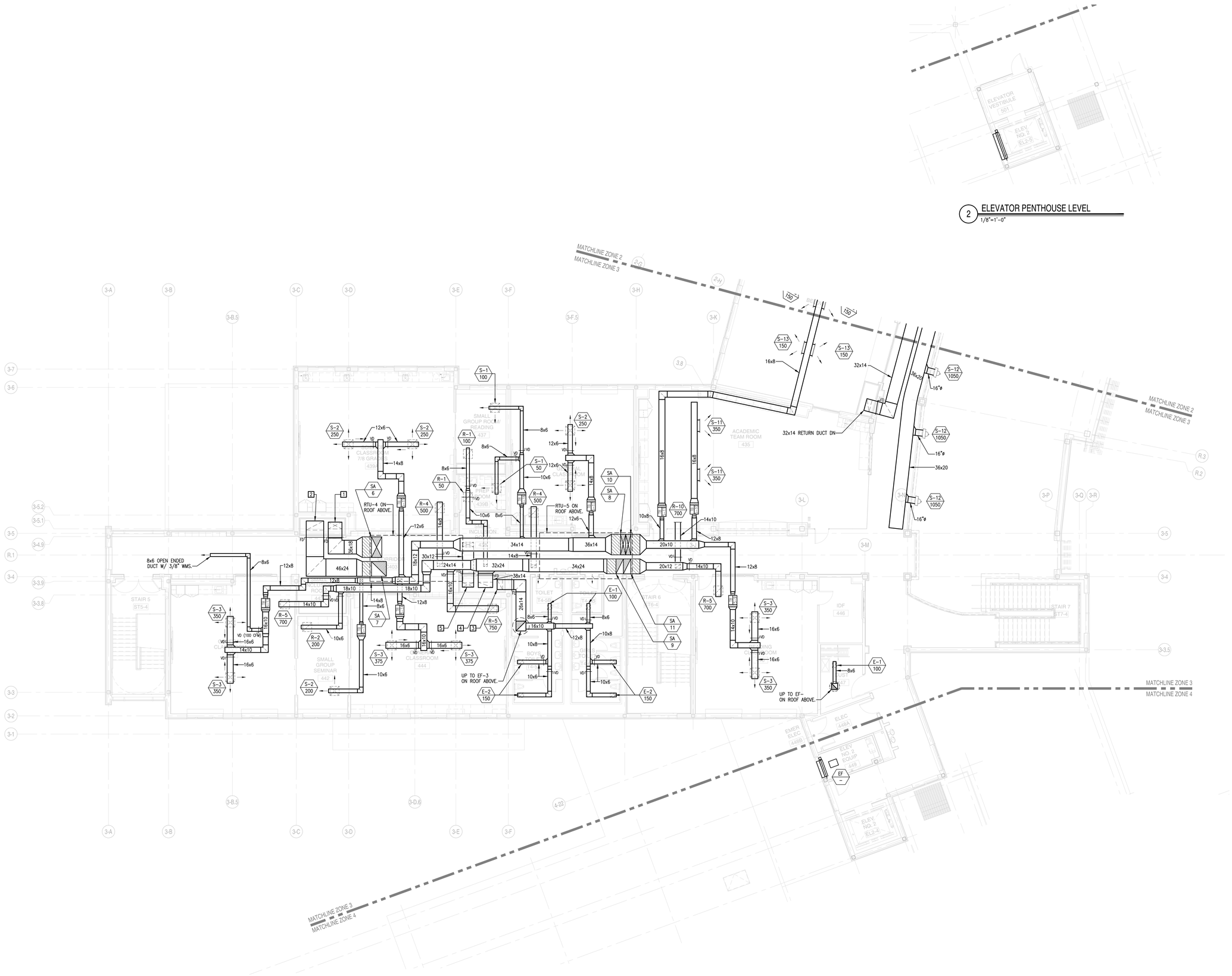
KEYPLAN



DRAWING NAME:

FOURTH FLOOR DUCTWORK PLAN ZONE 2 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M1.42



1 FOURTH FLOOR PLAN - ZONE 3
1/8"=1'-0"

2 ELEVATOR PENTHOUSE LEVEL
1/8"=1'-0"

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GENERAL NOTES:

1. ALL SUPPLY DUCTWORK DOWNSTREAM OF TERMINAL BOXES SHALL BE LINED WITH 1" THICK ACOUSTICAL INSULATION. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.
2. ALL EXPOSED SUPPLY DUCTWORK IN CORRIDORS WILL HAVE 1" THICK ACOUSTICAL INSULATION. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

KEYED NOTES: (THIS DWG. ONLY)

1. 36x18 SUPPLY DUCT DN @ 10,630 CFM
2. 46x24 RETURN DUCT DN @ 10,160 CFM
3. 26x14 EXHAUST DUCT DN @ 2,400 CFM
4. 36x16 RETURN DUCT DN @ 4,450 CFM
5. 26x12 SUPPLY DUCT DN @ 3,950 CFM

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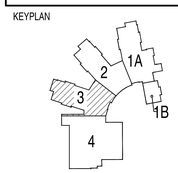
NORTH ARROW

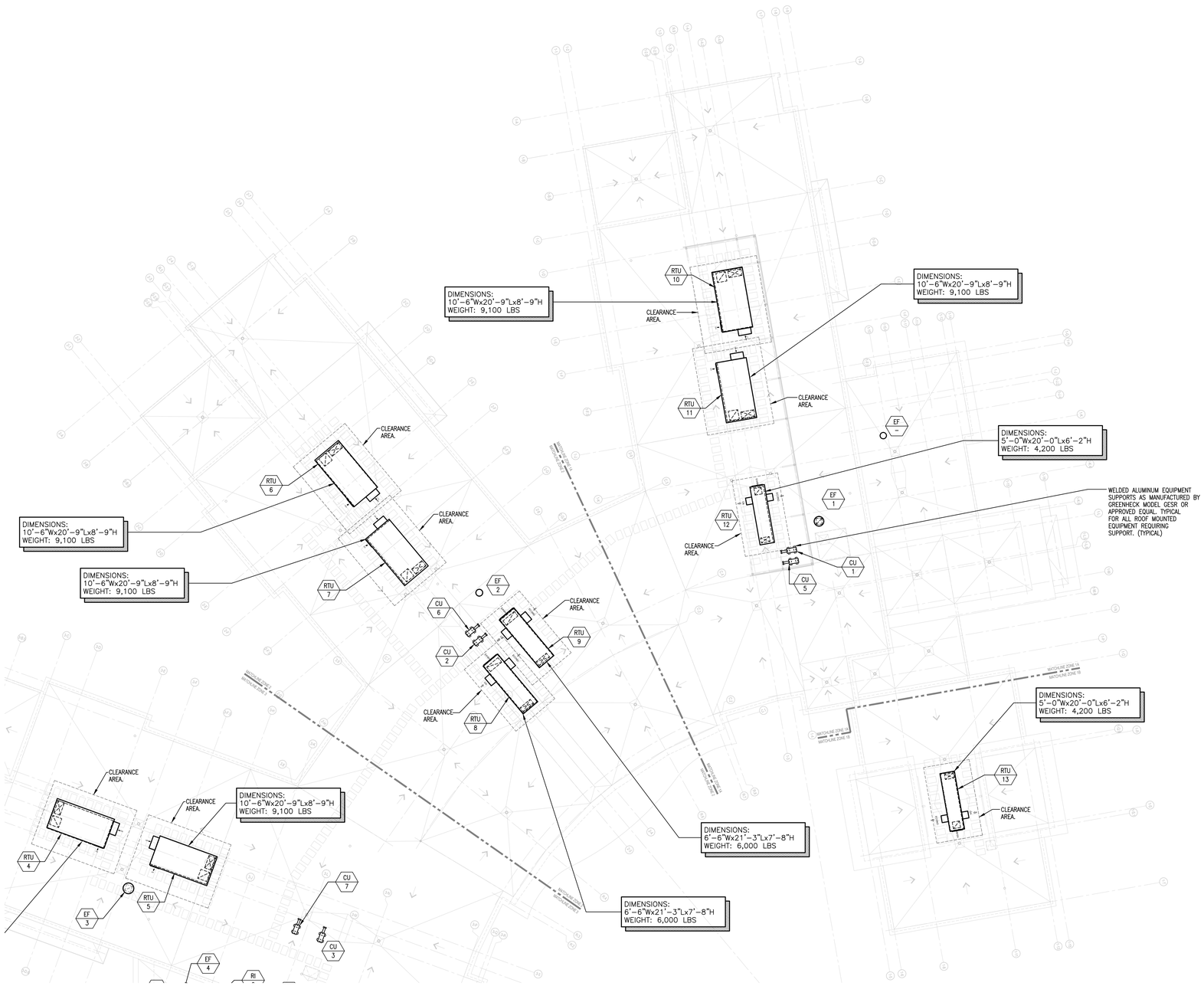
KEYPLAN



DRAWING NAME:

FOURTH FLOOR DUCTWORK PLAN ZONE 3 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M1.43



1 ROOF PLAN - ZONE 1A, 1B & 2
1/16" = 1'-0"

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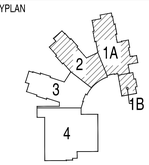
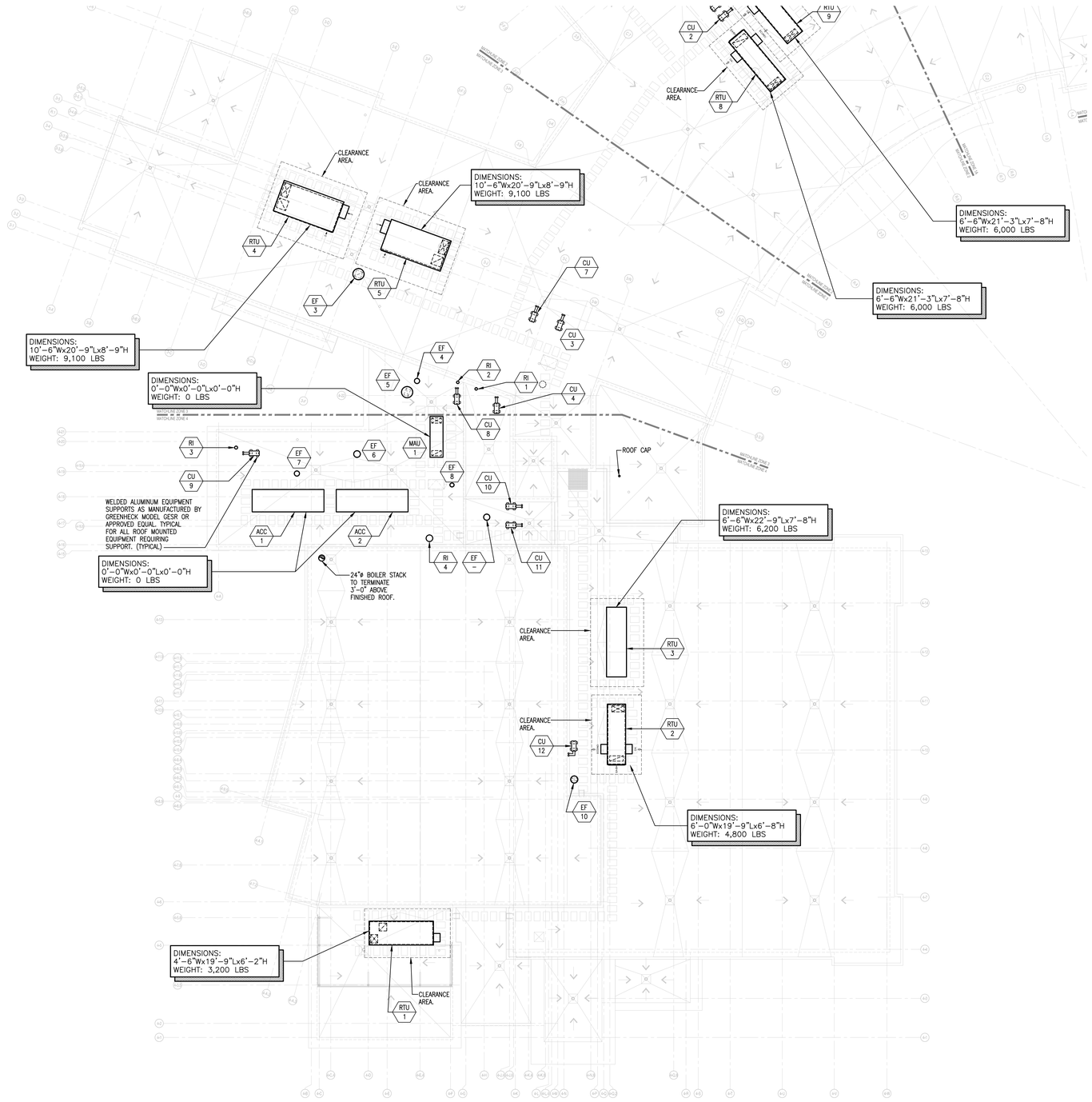


DRAWING NAME:

ROOF PLAN ZONE 1A, 1B & 2 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M1.51



1 ROOF PLAN - ZONE 3 & 4
1/16" = 1'-0"

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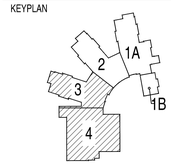
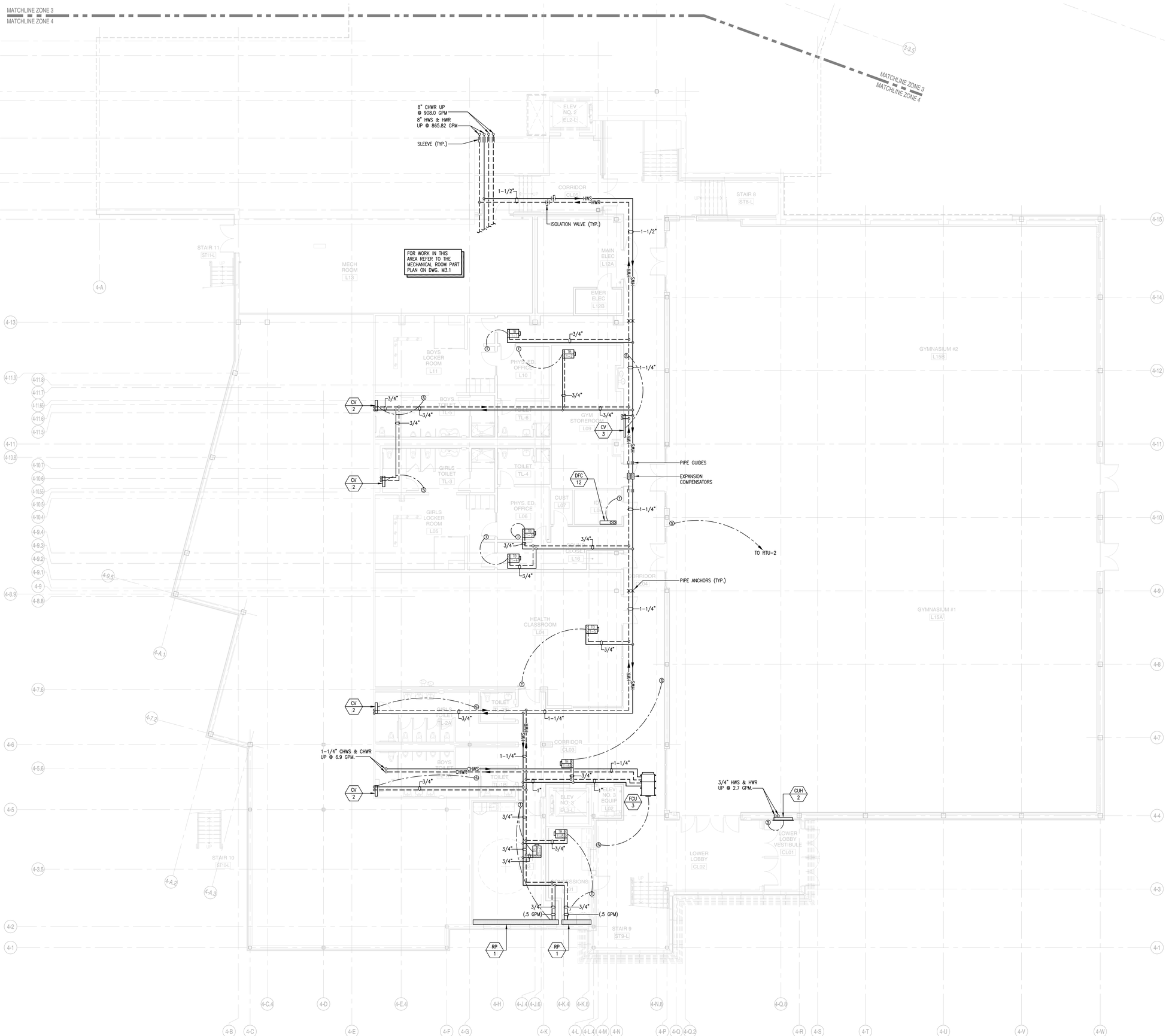


DRAWING NAME:
ROOF PLAN ZONE 3 & 4 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M1.52



1 BASEMENT FLOOR PLAN - ZONE 4
1/8" = 1'-0"

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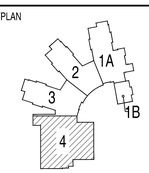
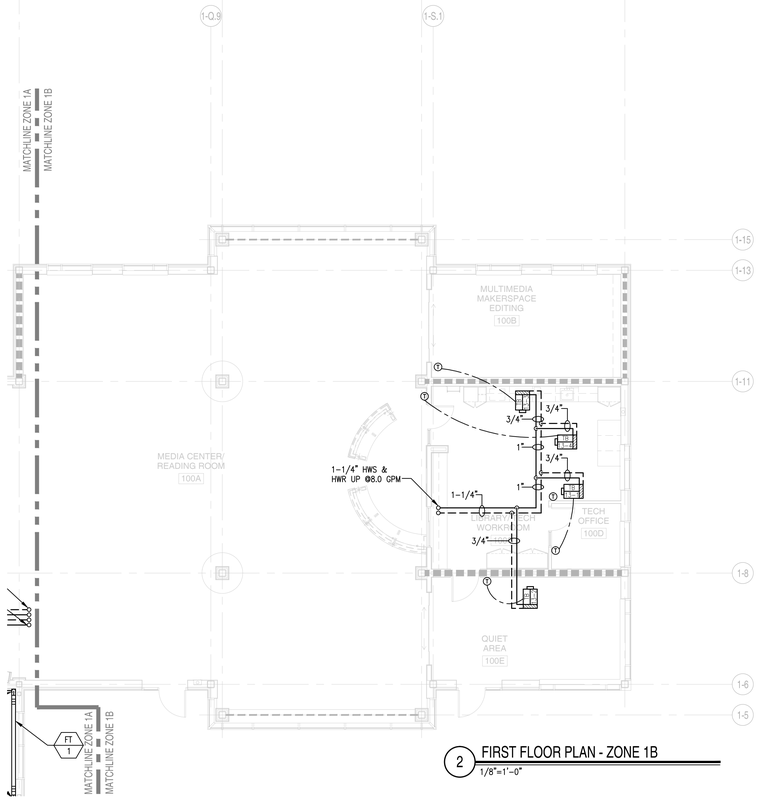


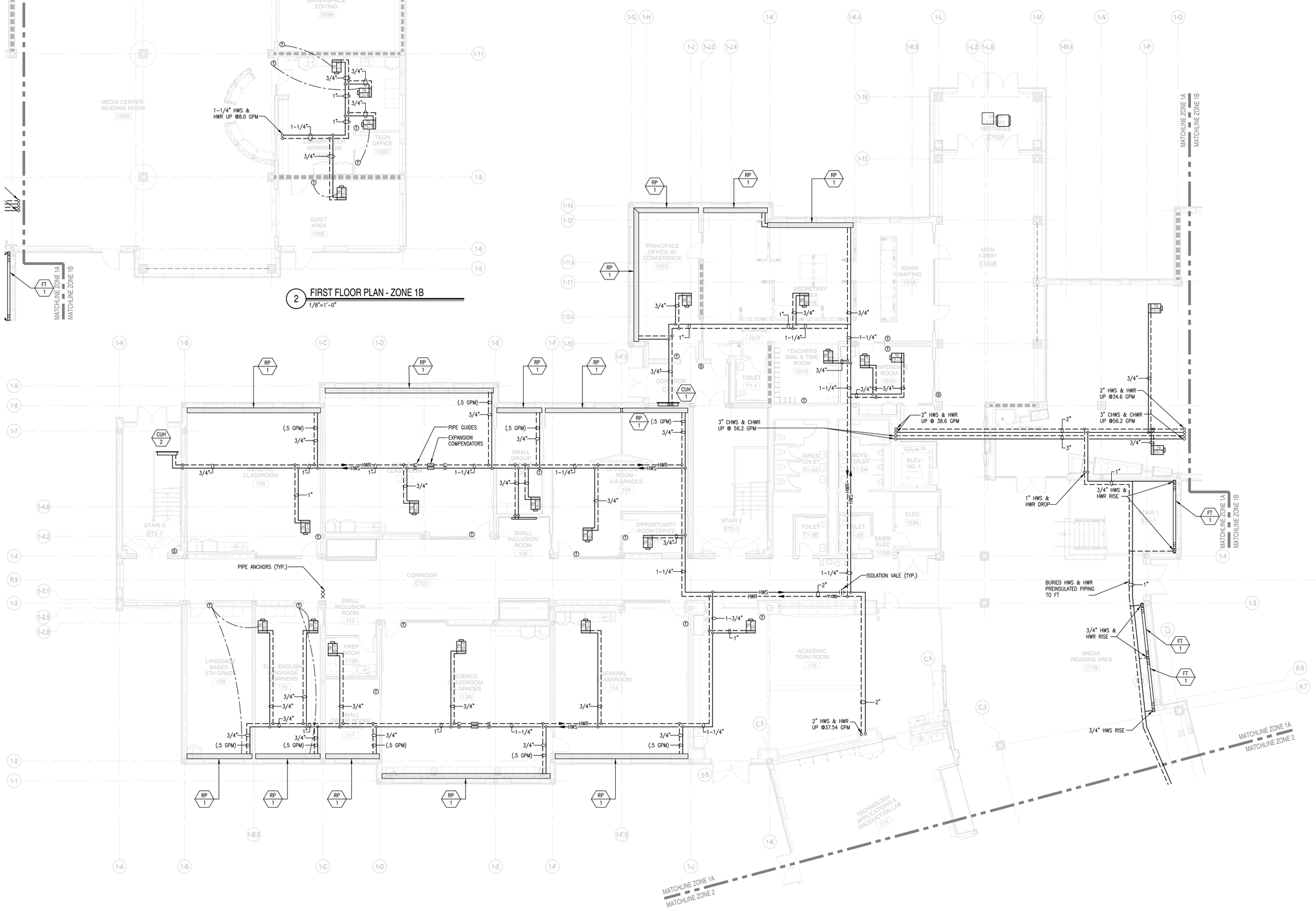
DRAWING NAME:

LOWER LEVEL PIPING PLAN ZONE 4 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M2.04



2 FIRST FLOOR PLAN - ZONE 1B
1/8"=1'-0"



1 FIRST FLOOR PLAN - ZONE 1A
1/8"=1'-0"

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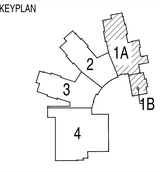
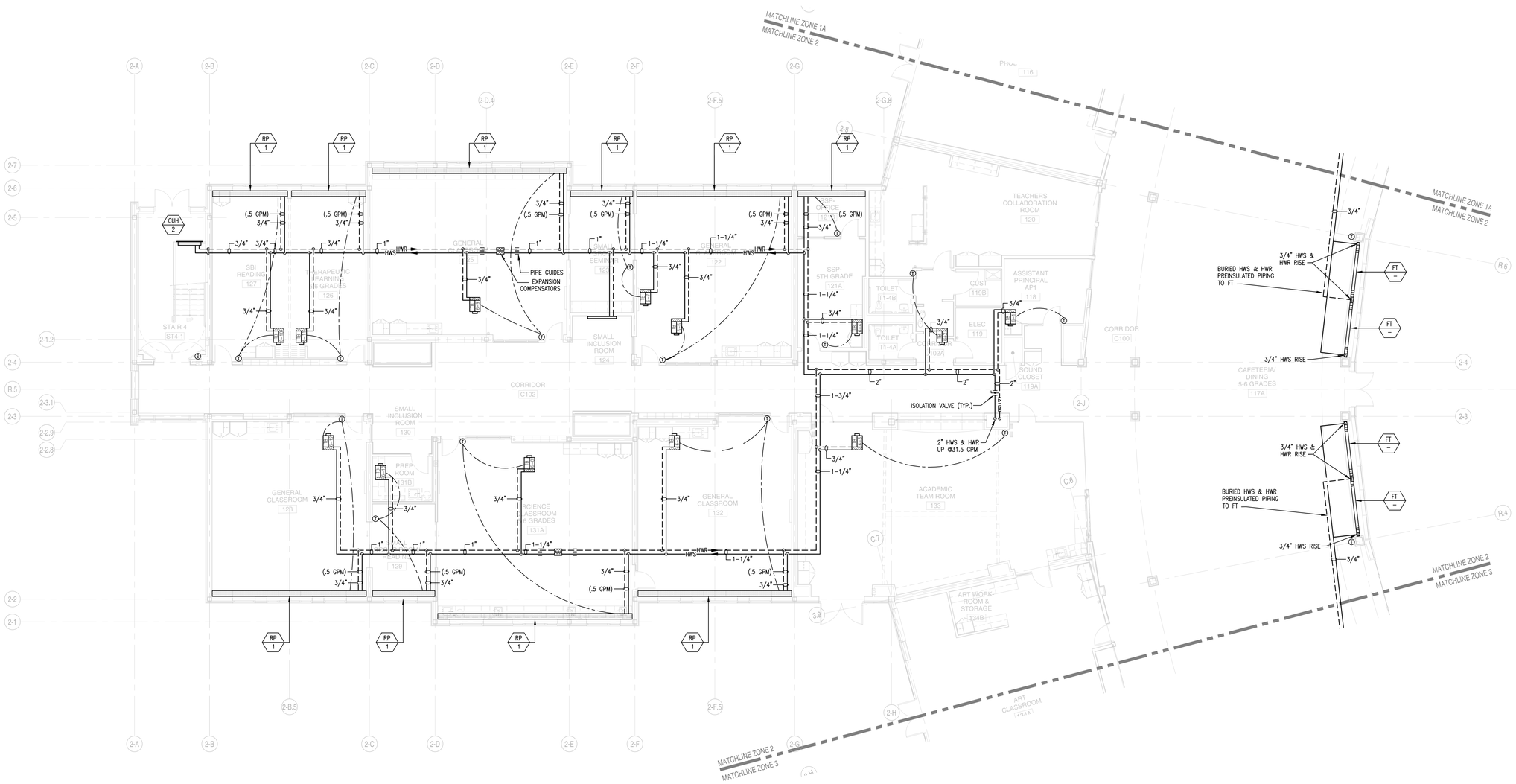
KEYPLAN



DRAWING NAME:

FIRST FLOOR PIPING PLAN ZONES 1A & 1B MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M2.11



1 FIRST FLOOR PLAN - ZONE 2
1/8"=1'-0"

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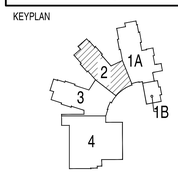
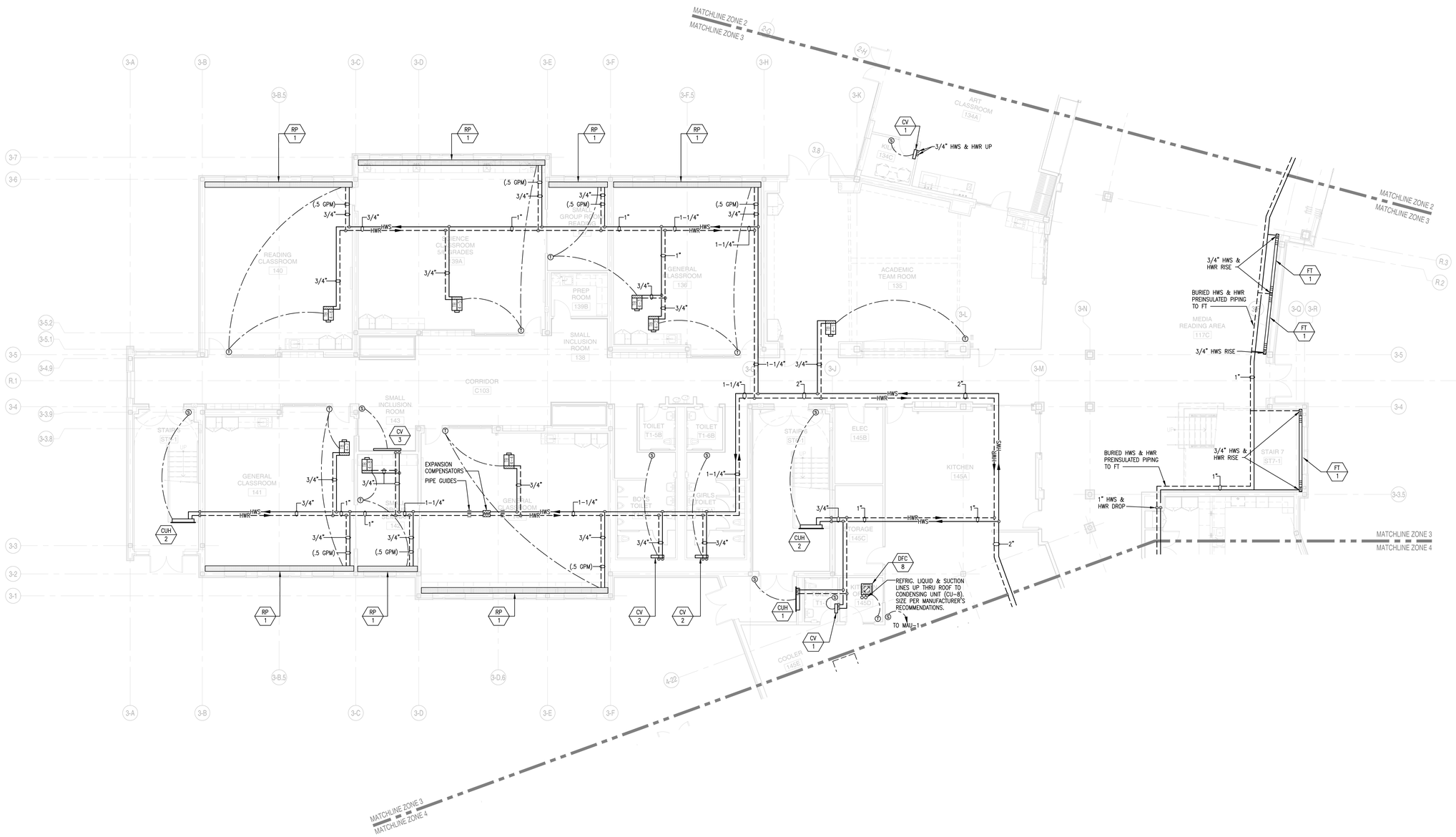


DRAWING NAME:

FIRST FLOOR PIPING PLAN ZONE 2 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M2.12



1 FIRST FLOOR PLAN - ZONE 3
1/8"=1'-0"

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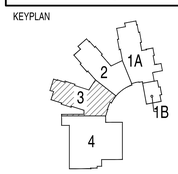
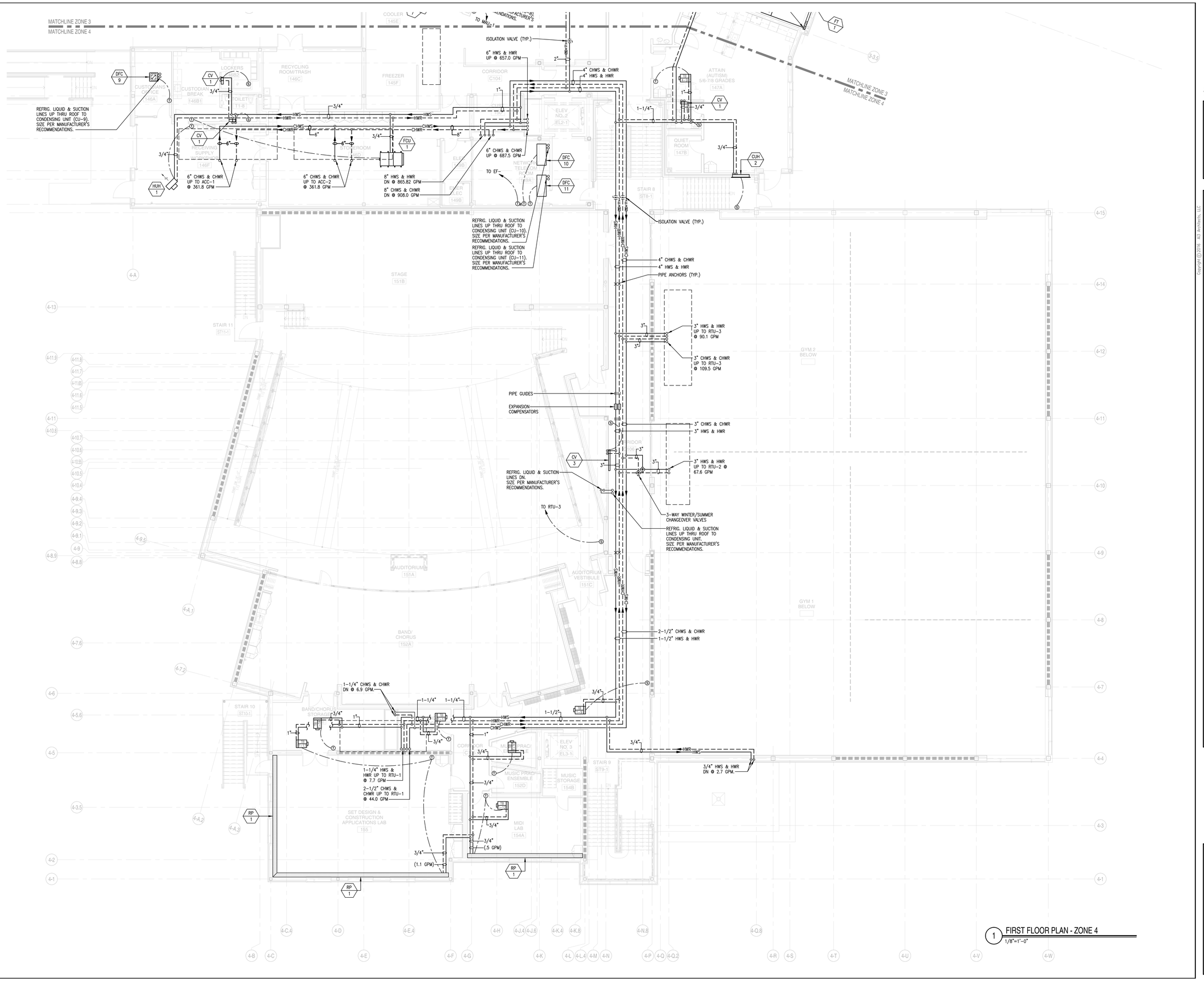
KEYPLAN



DRAWING NAME:

FIRST FLOOR PIPING PLAN ZONE 3 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M2.13



1 FIRST FLOOR PLAN - ZONE 4
1/8"=1'-0"

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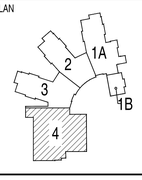
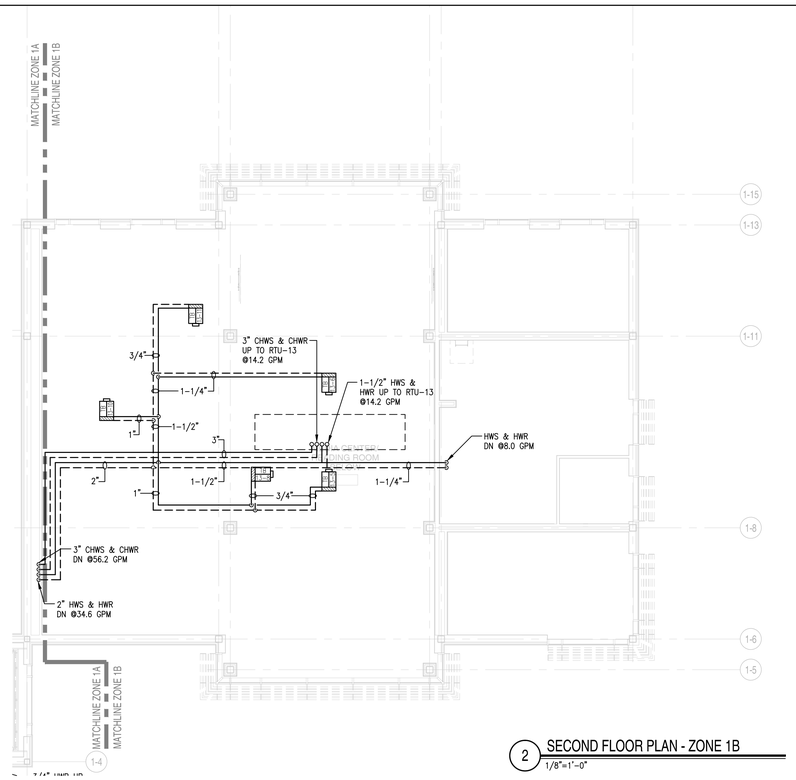


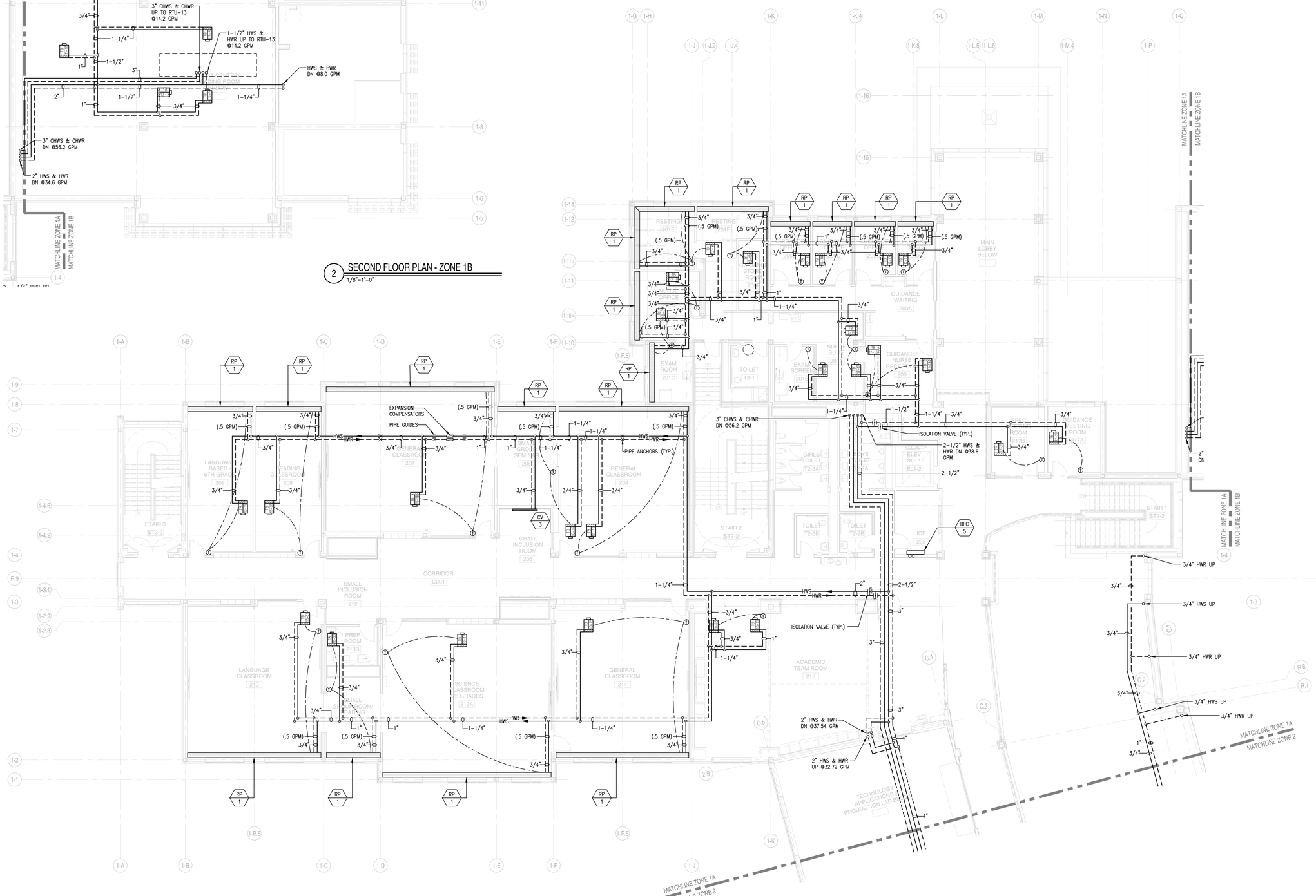
DRAWING NAME:

FIRST FLOOR PIPING PLAN ZONE 4 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M2.14



2 SECOND FLOOR PLAN - ZONE 1B
1/8"=1'-0"



1 SECOND FLOOR PLAN - ZONE 1A
1/8"=1'-0"

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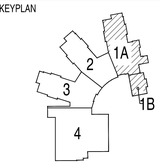
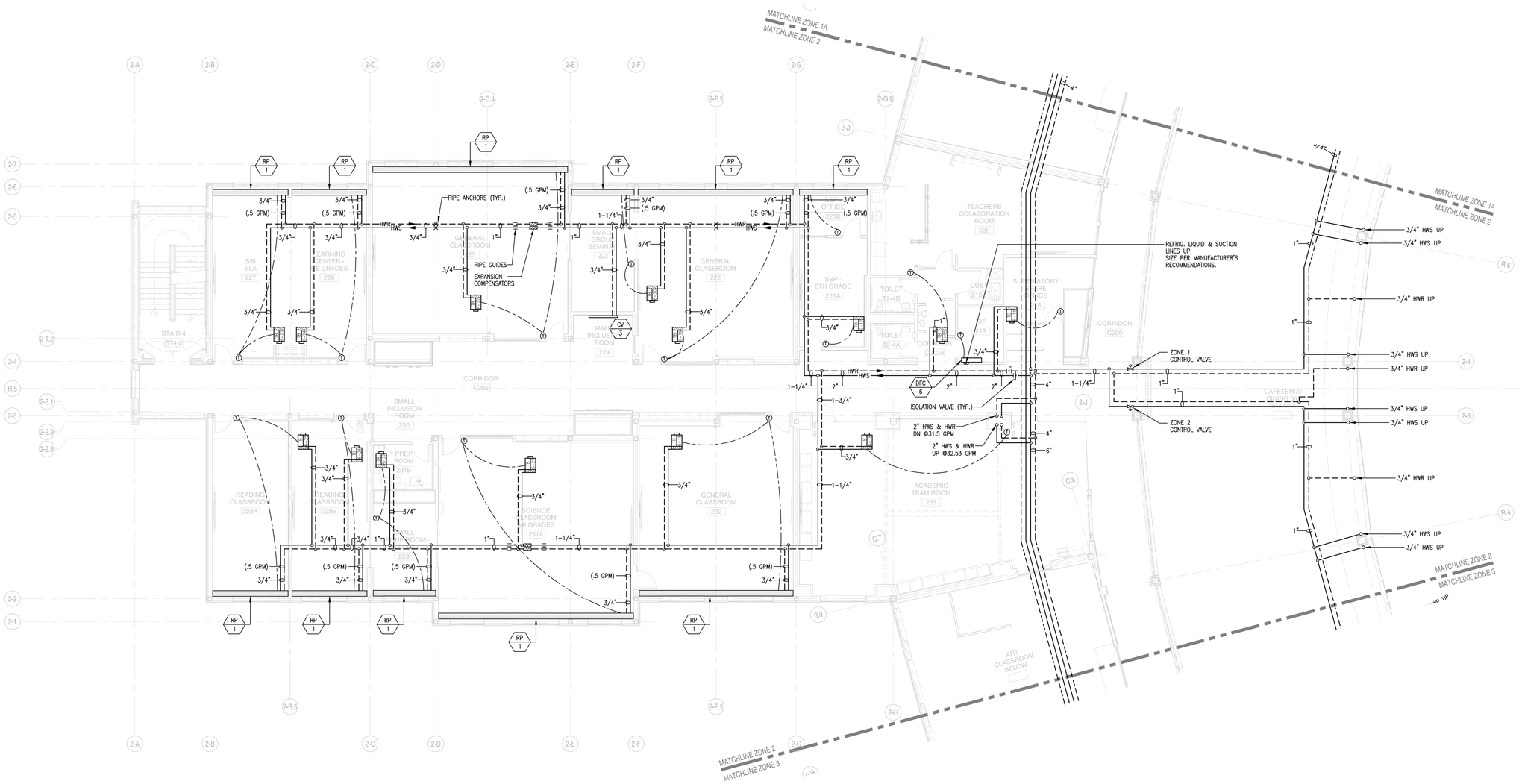


DRAWING NAME:
SECOND FLOOR PIPING PLAN ZONES 1A & 1B MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M2.21



1 SECOND FLOOR PLAN - ZONE 2
1/8"=1'-0"

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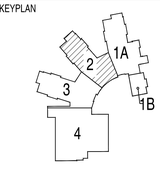
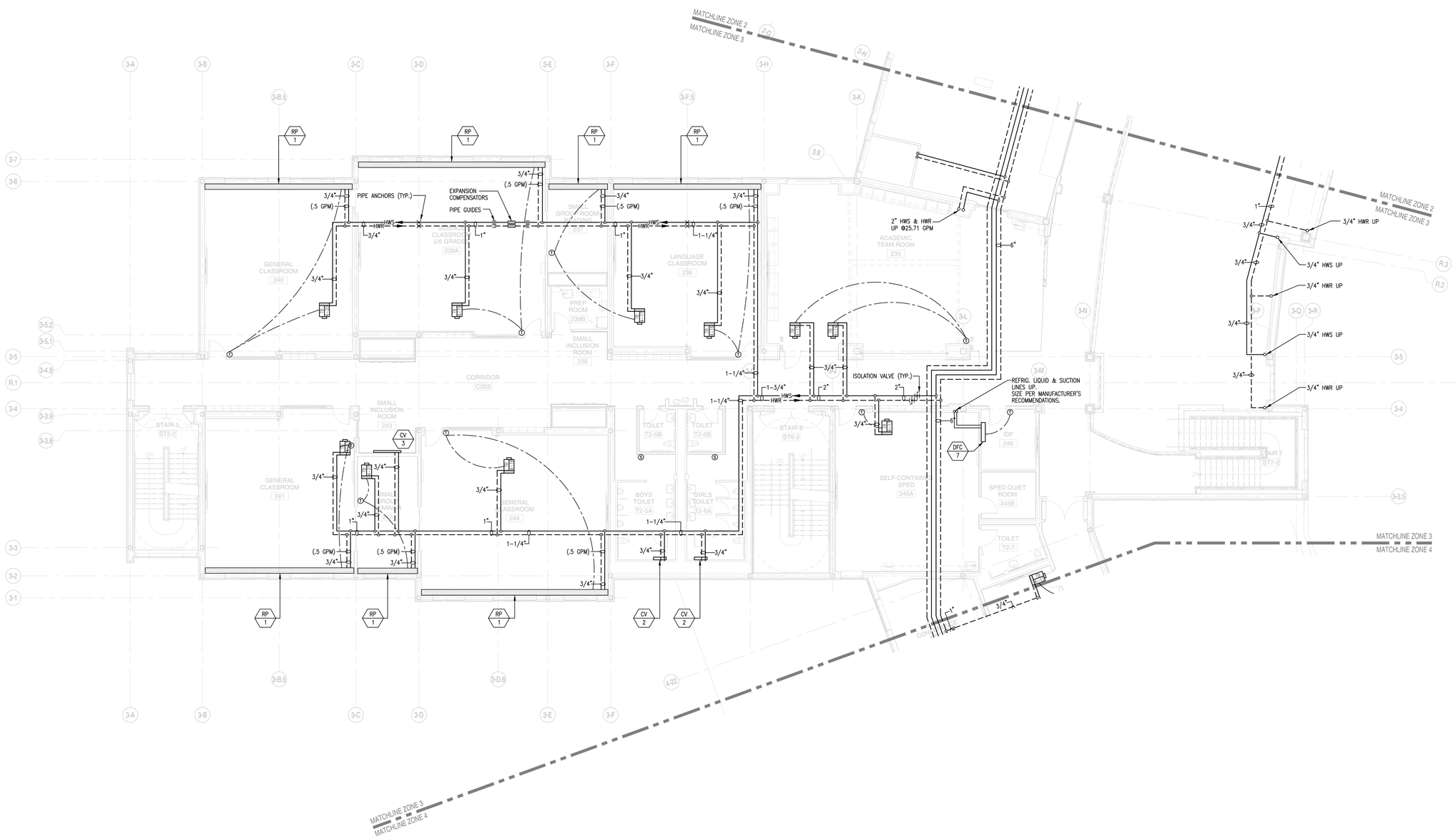


DRAWING NAME:

SECOND FLOOR PIPING PLAN ZONE 2 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M2.22



1 SECOND FLOOR PLAN - ZONE 3
1/8"=1'-0"

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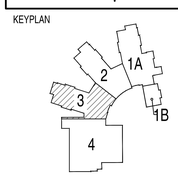
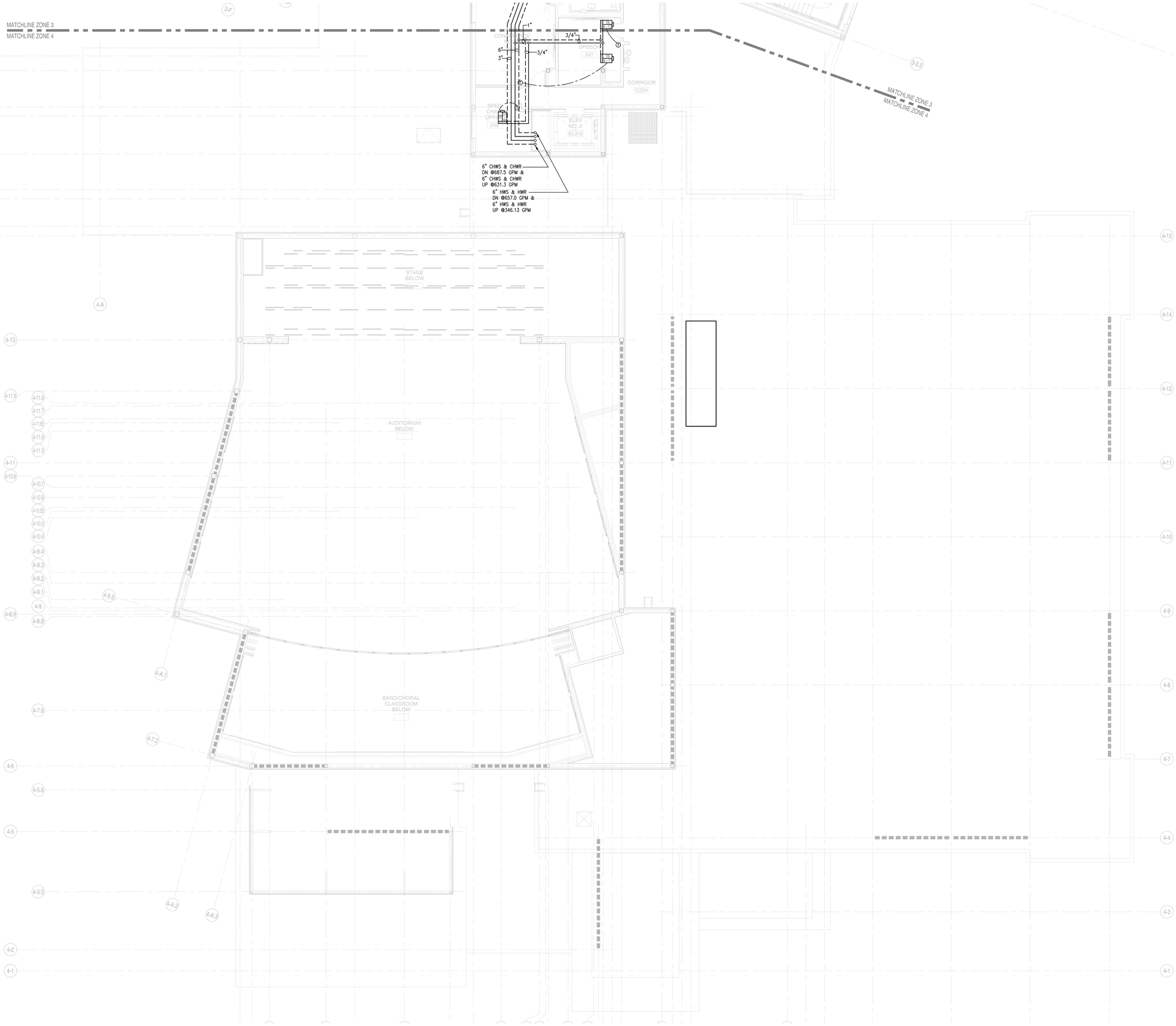
KEYPLAN



DRAWING NAME:

SECOND FLOOR PIPING PLAN ZONE 3 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M2.23



1 SECOND FLOOR PLAN - ZONE 4
1/8"=1'-0"

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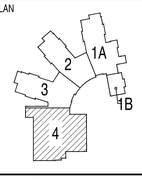
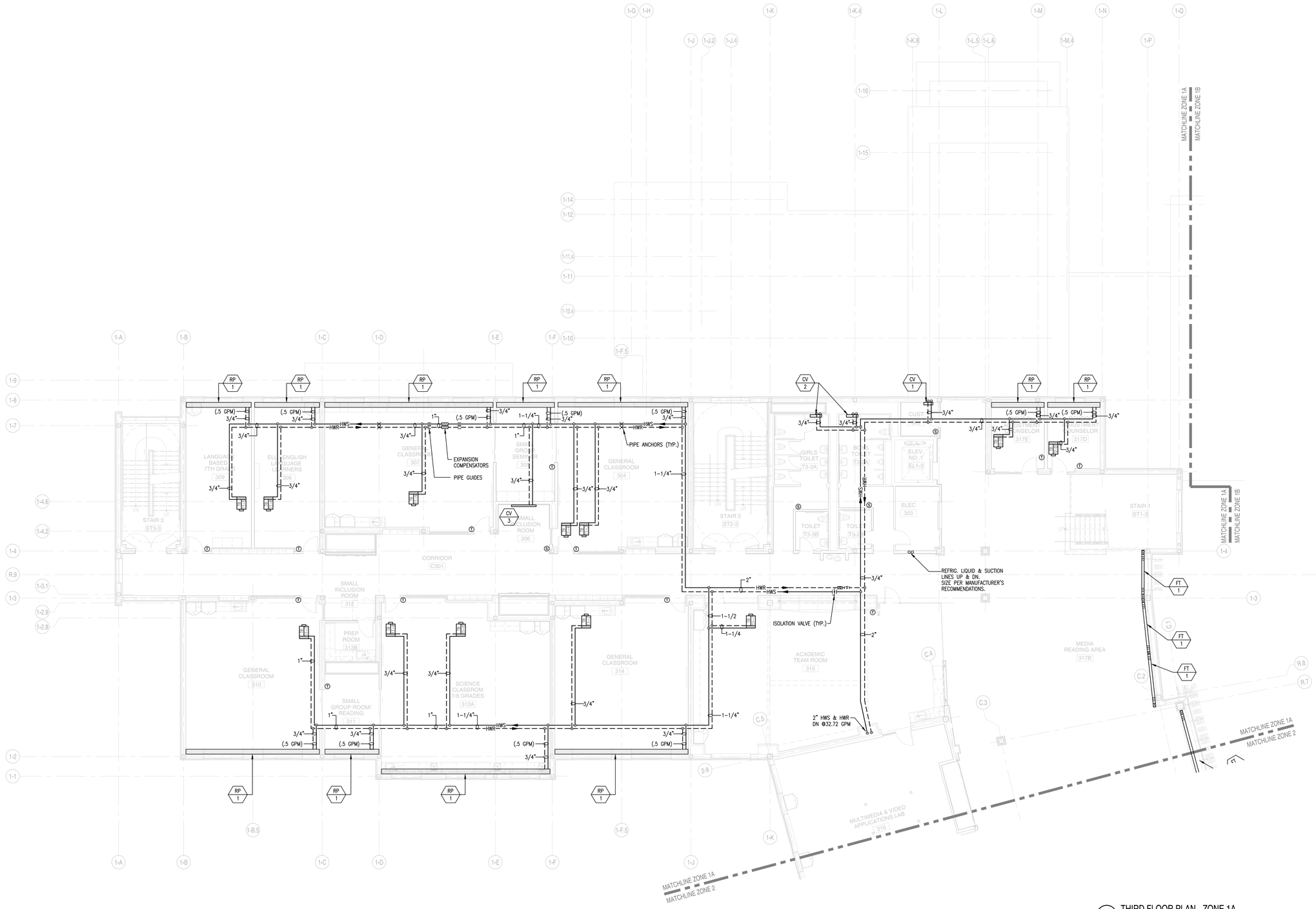


DRAWING NAME:

SECOND FLOOR PIPING PLAN ZONE 4 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M2.24



1 THIRD FLOOR PLAN - ZONE 1A
1/8"=1'-0"

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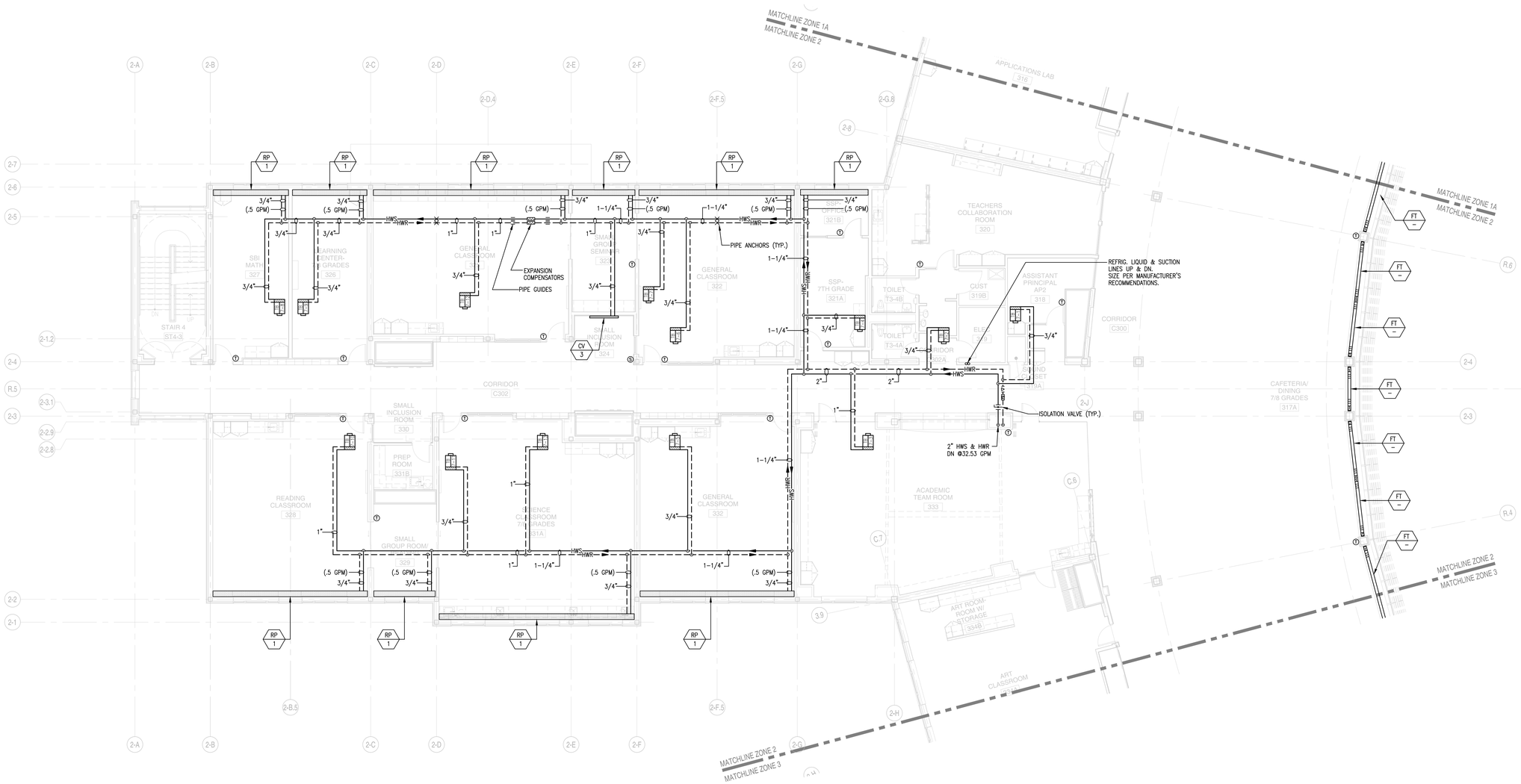
KEYPLAN

DRAWING NAME:

THIRD FLOOR PIPING PLAN ZONE 1A MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M2.31



1 THIRD FLOOR PLAN - ZONE 2
1/8"=1'-0"

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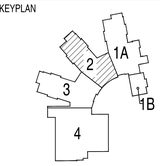
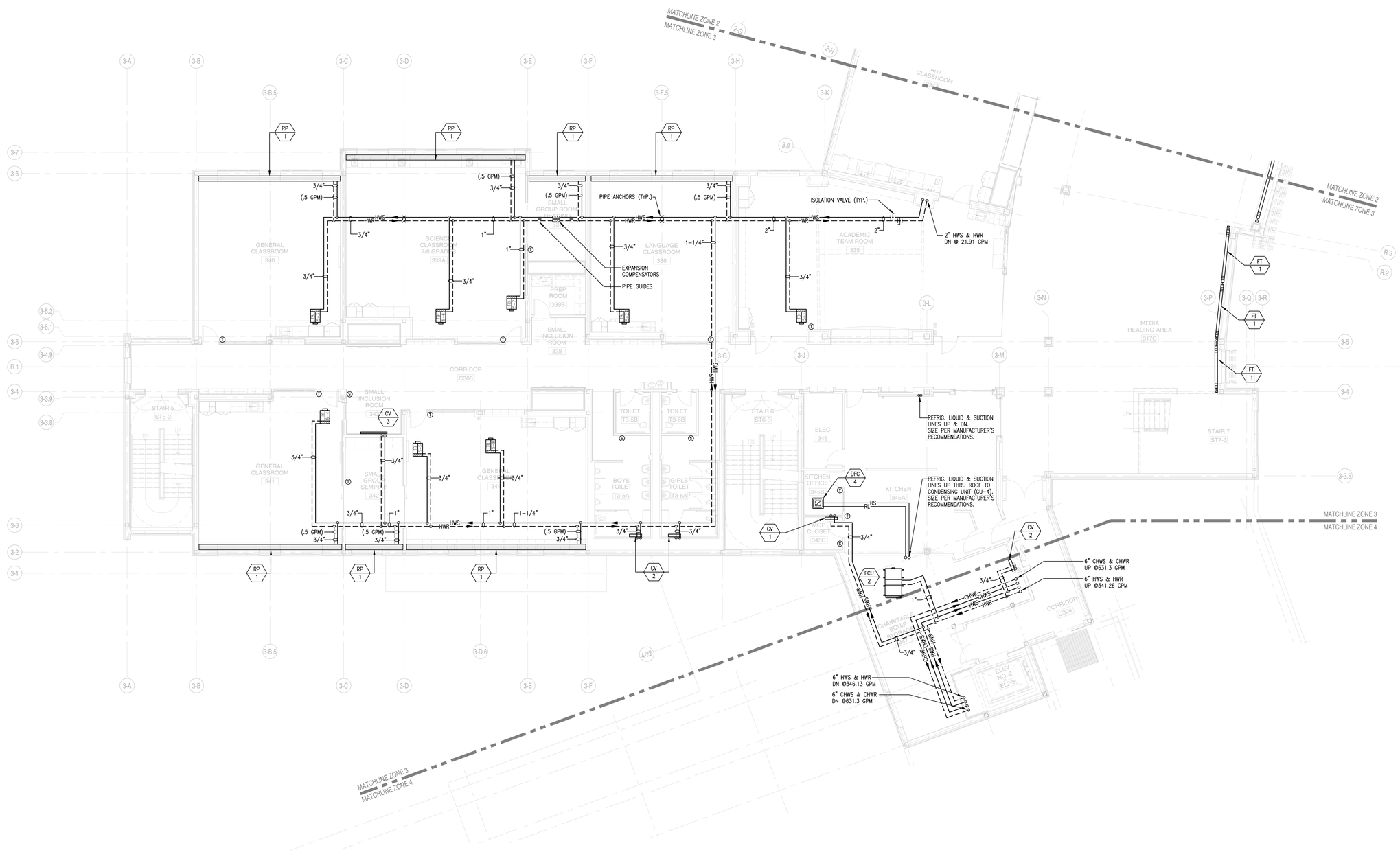
KEYPLAN



DRAWING NAME:

THIRD FLOOR PIPING PLAN ZONE 2 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M2.32



1 THIRD FLOOR PLAN - ZONE 3
1/8"=1'-0"

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BEVERLY MIDDLE SCHOOL

CABOT STREET
BEVERLY, MA 01915

GENERAL NOTES:

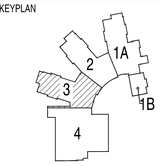
1. ALL PIPING RUNOUTS TO BE 3/4" UNLESS NOTED OTHERWISE.

90% CONSTRUCTION DOCUMENTS

NOT FOR CONSTRUCTION

NORTH ARROW

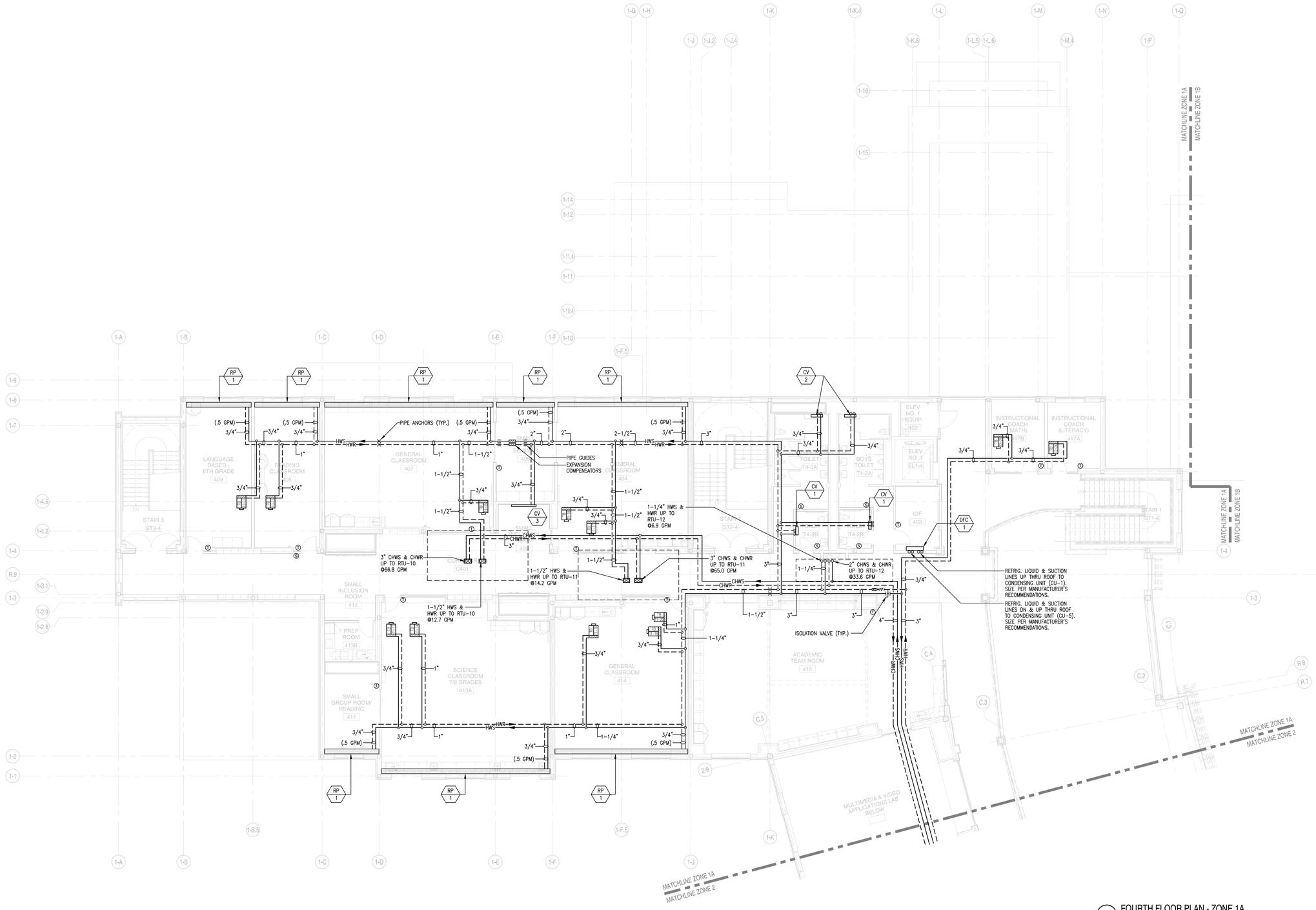
KEYPLAN



DRAWING NAME:

THIRD FLOOR PIPING PLAN ZONE 3 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M2.33



1 FOURTH FLOOR PLAN - ZONE 1A
1/8"=1'-0"

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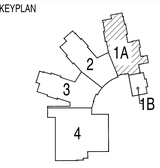
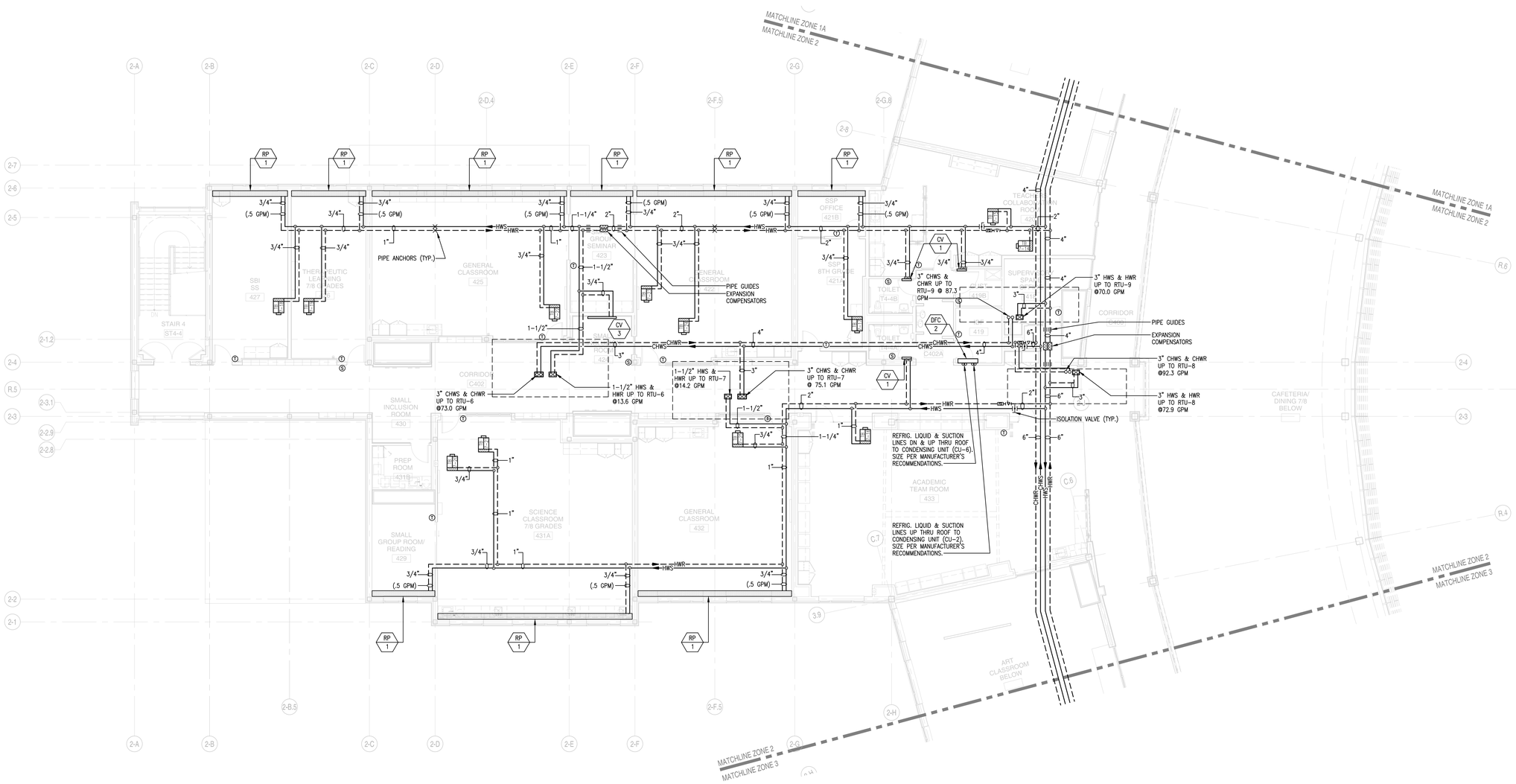
KEYPLAN



DRAWING NAME:

FOURTH FLOOR PIPING PLAN ZONE 1A MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M2.41



1 FOURTH FLOOR PLAN - ZONE 2
1/8"=1'-0"

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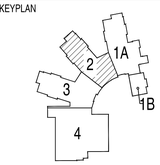
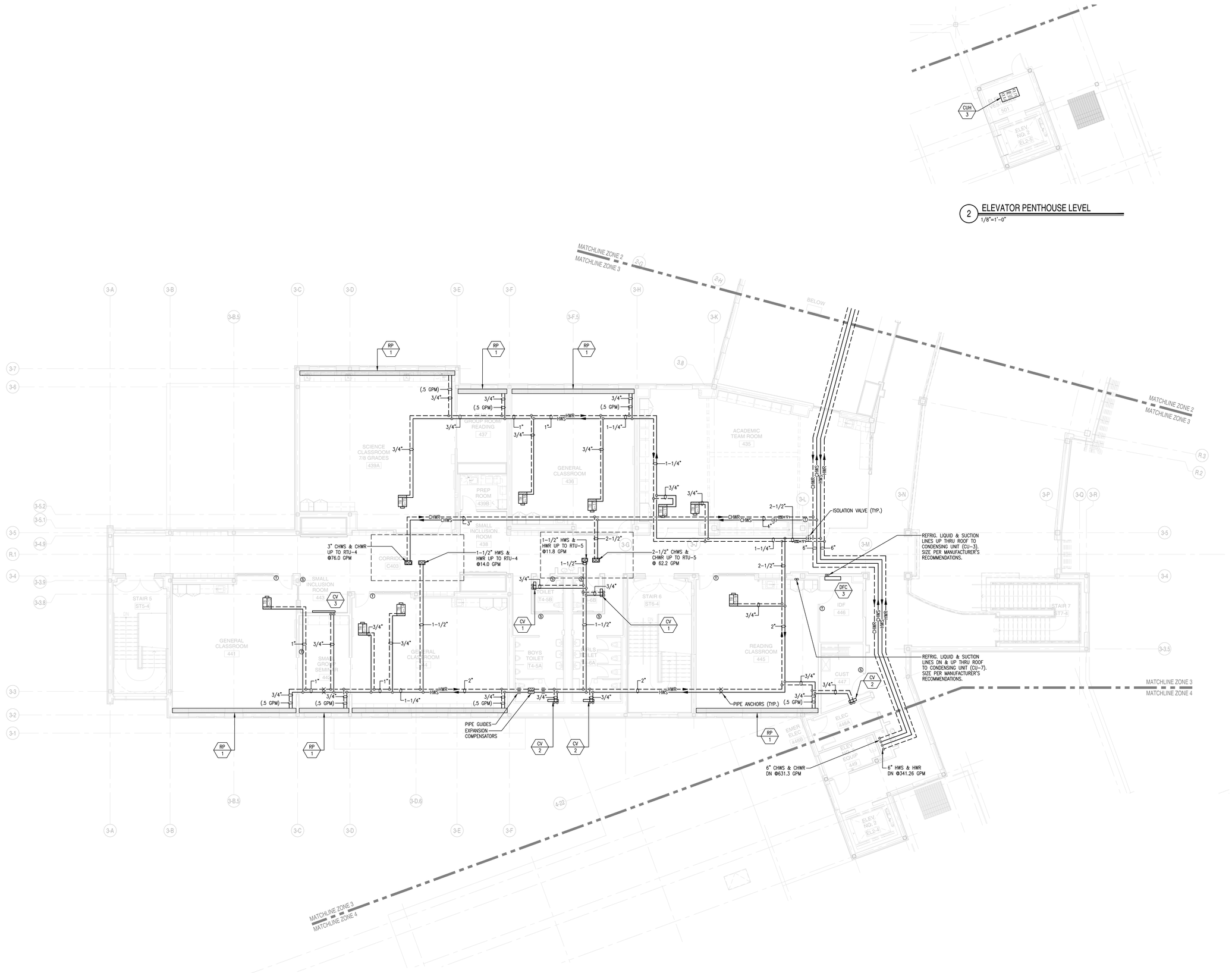
KEYPLAN



DRAWING NAME:

FOURTH FLOOR PIPING PLAN ZONE 2 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M2.42



2 ELEVATOR PENTHOUSE LEVEL
1/8"=1'-0"

1 FOURTH FLOOR PLAN - ZONE 3
1/8"=1'-0"

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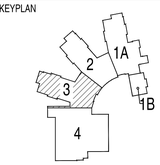
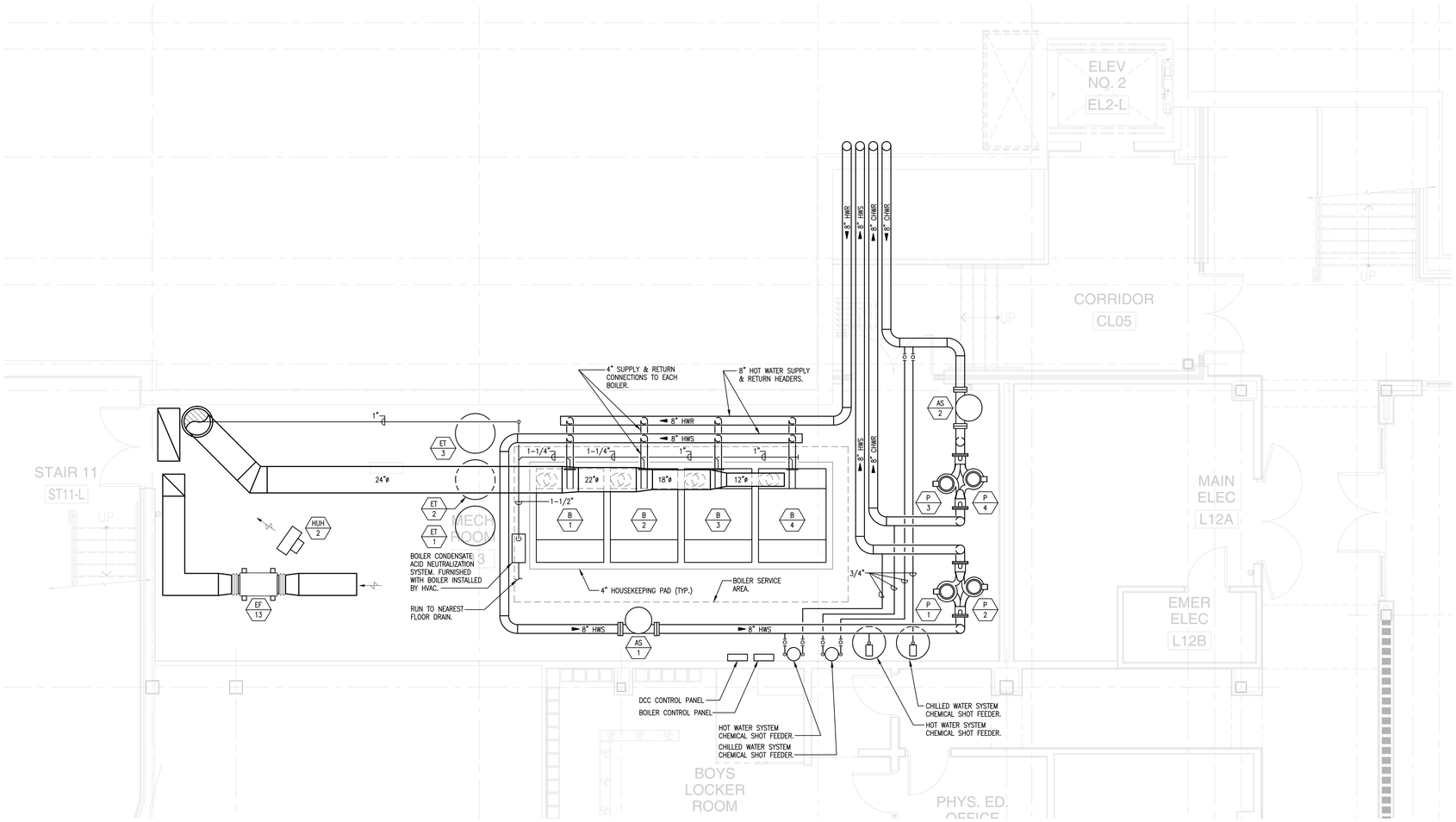
KEYPLAN



DRAWING NAME:

FOURTH FLOOR PIPING PLAN ZONE 3 MECHANICAL

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M2.43



1 MECHANICAL ROOM PART PLAN - ZONE 1
1/4" = 1'-0"

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KEYNOTE LEGEND:

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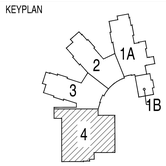

DRAWING NAME:

MECHANICAL ROOM PART PLAN ZONE 4

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	As Noted
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M3.1

ROOFTOP UNIT SCHEDULE

ITEM	MFG'R (2)	MODEL	SERVICE	CFM SUPPLY	CFM RETURN	CFM O.A.	ELECTRICAL VOLTS	ELECTRICAL PH	ELECTRICAL HZ.	ELECTRICAL MCA	ELECTRICAL MOCP	SUPPLY FAN RPM	SUPPLY FAN E.S.P.	SUPPLY FAN H.P.	EXHAUST FAN RPM	EXHAUST FAN E.S.P.	EXHAUST FAN H.P.	ENERGY RECOVERY WHEEL SUMMER CONDITIONS SUPPLY LAT DB	ENERGY RECOVERY WHEEL SUMMER CONDITIONS SUPPLY LAT WB	ENERGY RECOVERY WHEEL WINTER CONDITIONS SUPPLY LAT DB	ENERGY RECOVERY WHEEL WINTER CONDITIONS SUPPLY LAT WB	MIN. EFF. PERCENTAGE	HEATING COIL DATA E.A.T.	HEATING COIL DATA L.A.T.	HEATING COIL DATA CAP. MBH	HEATING COIL DATA GPM	HEATING COIL DATA EWT	HEATING COIL DATA LWT	HEATING COIL DATA PD WTR	HEATING COIL DATA PD AIR	CHILLED WATER COOLING COIL DATA E.A.T.	CHILLED WATER COOLING COIL DATA L.A.T.	CHILLED WATER COOLING COIL DATA SEN. MBH	CHILLED WATER COOLING COIL DATA TOT. MBH	CHILLED WATER COOLING COIL DATA EWT	CHILLED WATER COOLING COIL DATA LWT	CHILLED WATER COOLING COIL DATA GPM	CHILLED WATER COOLING COIL DATA PD WTR	CHILLED WATER COOLING COIL DATA PD AIR	CHILLED WATER COOLING COIL DATA MAX FACE VEL. FPM	FILTER DATA TYPE PRE/FINAL	FILTER DATA THICKNESS	REMARKS
RTU-1	ANNEXAIR	CUSTOM	SHOPS/LOCKERS	6,670	6,670	6,670	460	3	60	20	25	1800	1.1"	7.5	1800	1.3"	5.0	79.0°F	66.4°F	56.9°F	45.4°F	70%	56.9°F	66.9°F	73.0	7.7	160°F	130°F	9.19'	0.41"	79.0/66.4	55/54	173	253	44°F	56°F	44.0	11.3'	0.63"	500	MERV 8/MERV 13	2"/4"	
RTU-2	ANNEXAIR	CUSTOM	GYM	10,000	10,000	5,700	460	3	60	11	15	1800	1.1"	5.0	1800	1.3"	3.0	–	–	–	–	–	35.0°F	95°F	648.0	67.6	160°F	130°F	9.19'	0.41"	–	–	–	–	–	–	–	–	–	500	MERV 8/MERV 13	2"/4"	
RTU-3	ANNEXAIR	CUSTOM	AUDITORIUM	13,600	13,600	7,500	460	3	60	41	50	1800	1.1"	(2) 10	1800	1.3"	(2) 5	–	–	–	–	–	36.2°F	95°F	864.0	90.1	160°F	130°F	9.19'	0.41"	83.9/68.8	55/54	425	630	44°F	56°F	109.5	11.3'	0.63"	500	MERV 8/MERV 13	2"/4"	
RTU-4	ANNEXAIR	CUSTOM	CLASSROOMS	12,880	12,880	7,870	460	3	60	56	70	1800	2.3"	(2) 10	1800	1.3"	20	79.3°F	66.7°F	55.8°F	44.6°F	70%	62.2°F	72.2°F	140.0	14.6	160°F	130°F	0.75'	0.15"	77.7/65.3	55/54	316	437	44°F	56°F	76.0	13.79'	0.95"	500	MERV 8/MERV 13	2"/4"	
RTU-5	ANNEXAIR	CUSTOM	CLASSROOMS	10,400	10,400	7,015	460	3	60	48	60	1800	2.3"	(2) 10	1800	1.3"	15	79.1°F	66.5°F	56.7°F	45.2°F	70%	61.7°F	71.7°F	113.0	11.8	160°F	130°F	0.75'	0.15"	77.8/65.4	55/54	257	358	44°F	56°F	62.2	13.79'	0.95"	500	MERV 8/MERV 13	2"/4"	
RTU-6	ANNEXAIR	CUSTOM	CLASSROOMS	12,010	12,010	8,185	460	3	60	48	60	1800	2.3"	(2) 10	1800	1.3"	15	79.3°F	66.7°F	55.5°F	44.4°F	70%	60.8°F	70.8°F	130.0	13.6	160°F	130°F	0.75'	0.15"	78.0/65.6	55/54	299	420	44°F	56°F	73.0	13.79'	0.95"	500	MERV 8/MERV 13	2"/4"	
RTU-7	ANNEXAIR	CUSTOM	CLASSROOMS	12,560	12,560	8,020	460	3	60	48	60	1800	2.3"	(2) 10	1800	1.3"	15	79.3°F	66.7°F	55.7°F	44.5°F	70%	61.6°F	71.6°F	136.0	14.2	160°F	130°F	0.75'	0.15"	77.8/65.4	55/54	310	432	44°F	56°F	75.1	13.79'	0.95"	500	MERV 8/MERV 13	2"/4"	
RTU-8	ANNEXAIR	CUSTOM	UPPER CAFETERIA	12,600	12,600	5,500	460	3	60	41	50	1800	1.1"	(2) 10	1800	1.3"	(2) 5	–	–	–	–	–	43.7°F	95°F	699.0	72.9	160°F	130°F	9.19'	0.41"	82.0/67.6	55/54	368	531	44°F	56°F	92.3	11.3'	0.63"	500	MERV 8/MERV 13	2"/4"	
RTU-9	ANNEXAIR	CUSTOM	LOWER CAFETERIA	11,500	11,500	5,500	460	3	60	41	50	1800	1.1"	(2) 10	1800	1.3"	(2) 5	–	–	–	–	–	41.0°F	95°F	671.0	70.0	160°F	130°F	9.19'	0.41"	82.7/68.0	55/54	345	502	44°F	56°F	87.3	11.3'	0.63"	500	MERV 8/MERV 13	2"/4"	
RTU-10	ANNEXAIR	CUSTOM	CLASSROOMS	11,185	11,185	7,090	460	3	60	39	50	1800	2.3"	(2) 10	1800	1.3"	7.5	79.1°F	66.5°F	56.6°F	45.2°F	70%	62.3°F	72.3°F	121.0	12.7	160°F	130°F	0.75'	0.15"	77.6/65.4	55/54	274	384	44°F	56°F	66.8	13.79'	0.95"	500	MERV 8/MERV 13	2"/4"	
RTU-11	ANNEXAIR	CUSTOM	CLASSROOMS	10,925	10,925	6,840	460	3	60	26	35	1800	2.3"	10	1800	1.3"	7.5	79.1°F	66.4°F	56.8°F	45.3°F	70%	62.5°F	72.3°F	117.9	11.8	160°F	130°F	0.75'	0.15"	77.6/65.3	55/54	267	374	44°F	56°F	65.0	13.79'	0.95"	500	MERV 8/MERV 13	2"/4"	
RTU-12	ANNEXAIR	CUSTOM	ADMINISTRATION	6,050	6,050	925	460	3	60	22	30	1800	1.1"	10	1800	1.3"	5.0	–	–	–	–	–	62.1°F	72.3°F	66	6.9	160°F	130°F	9.19'	0.41"	77.5/64.7	55/54	148	193	44°F	56°F	33.6	11.3'	0.63"	500	MERV 8/MERV 13	2"/4"	
RTU-13	ANNEXAIR	CUSTOM	MEDIA CENTER	7,765	7,765	2,100	460	3	60	22	30	1800	1.1"	10	1800	1.3"	5.0	–	–	–	–	–	54.5°F	64.5°F	84	8.8	160°F	130°F	9.19'	0.41"	79.4/65.9	55/54	205	281	44°F	56°F	56.2	11.3'	0.63"	500	MERV 8/MERV 13	2"/4"	

(1) UNIT SHALL BE PROVIDED WITH INTERNAL RECIRCULATING AIR DAMPER, 20kW FROST CONTROL PREHEATER AND VFD CONTROLLED ENERGY RECOVERY WHEEL.
(2) ACCEPTABLE ALT. MANUFACTURERS: HAKKON, SEASONS FOUR OR APPROVED EQUAL.
(3) COIL PERFORMANCE BASED ON 30% PROPYLENE GLYCOL.

FAN COIL UNIT SCHEDULE

ITEM	MFG'R	MODEL	ARRANGEMENT	CFM	O.A. CFM	EXT. S.P.	HP	HEATING COIL DATA (2) EDB	LDB	MBH	E.W.T. °F	L.W.T. °F	GPM	WPD	NO. ROWS	COOLING COIL DATA EDB °F	EWB °F	LDB °F	LWB °F	MBH TOT.	MBH SENS.	SST	PD AIR	NO. ROWS	ELECTRICAL V.	PH.	HZ.	FILTER DATA TYPE	SIZE	MFG'R	REMARKS
FCU-1	TRANE	BCHD036	HORIZONTAL	1070	485	1.0"	0.5	37.9°F	100°F	68.02	160°F	107.7°F	2.61	2.0'	2	–	–	–	–	–	–	–	–	–	120	1	60	MERV 13	2"	FARR	
FCU-2	TRANE	BCHD054	HORIZONTAL	1600	800	1.0"	1.0	35.1°F	95°F	103.9	160°F	116.0°F	4.73	0.4'	2	–	–	–	–	–	–	–	–	–	120	1	60	MERV 13	2"	FARR	
FCU-3	TRANE	BCHD054	HORIZONTAL	1600	–	1.0"	1.0	55.0°F	95°F	91.6	160°F	116.0°F	4.58	0.4'	2	83.4°F	68.0°F	56.1°F	54.7°F	66.4	47.9	45°F	0.31"	3	120	1	60	MERV 13	2"	FARR	

(1) ACCEPTABLE ALT. MANUFACTURERS: NAILOR, CARRIER, AIRTHERM OR APPROVED EQUAL.
(2) BASED ON 30% PROPYLENE GLYCOL.

AIR COOLED CHILLER UNIT SCHEDULE

ITEM	MFG'R (1)	MODEL	CAPACITY TONS	AMBIENT TEMP.	REFRIG. TYPE	COMPRESSOR DATA NO.	RLA	LRA	CONDENSER FAN DATA NO.	LRA (EA)	FLA (EA)	CHILLED WATER GPM	EWT	LWT	PD	ELECTRICAL DATA VOLTS	ø	HZ	INPUT kW	UNIT MCA	UNIT MOCP	IPLV (EER)	CHILLER FULL LOAD SOUND PRESS. dB(A) @ 30' 63	125	250	500	1K	2K	4K	8K	REMARKS
ACC-1	DAIKIN	AWS190CDS	173	95°F	R-134A	2	130/159	–	12	14.0	3.4	361.8	56°F	44°F	13.4'	460	3	60	205.8	369.6	500	17.7	75	65	64	62	61	54	50	44	(2)(3)
ACC-2	DAIKIN	AWS190CDS	173	95°F	R-134A	2	130/159	–	12	14.0	3.4	361.8	56°F	44°F	13.4'	460	3	60	205.8	369.6	500	17.7	75	65	64	62	61	54	50	44	(2)(3)

(1) ACCEPTABLE ALT. MANUFACTURERS: YORK, TRANE OR APPROVED EQUAL. (2) CHILLER PERFORMANCE BASED ON 30% PROPYLENE GLYCOL.
(3) CHILLER SHALL BE FURNISHED WITH SOUND ENHANCEMENT PACKAGE WITH WEATHER PROOF COMPRESSOR ENCLOSURE AND LOW SOUND CONDENSER FANS.

DUCTLESS SPLIT-TYPE AIR CONDITIONER SCHEDULE

ITEM	MFG'R (3)	INDOOR UNIT/ OUTDOOR UNIT MODEL	COOLING CAP. TOTAL MBH	INDOOR FAN DATA FLA	INDOOR FAN DATA MOTOR MAX.	INDOOR ELEC. DATA VOLTS	ø	Hz	OUTDOOR COMP. DATA MOCP	MCA	OUTDOOR FAN DATA FLA	OUTDOOR ELEC. DATA VOLTS	ø	Hz	SEER	REMARKS
DFC-1/CU-1	MITSUBISHI	PKA-A36KA6/PUY-A36NHA6	34.2	0.57	920 MAX.	208	1	60	40	25	0.75	208	1	60	14.0	IDF 403 (1)(2)
DFC-2/CU-2	MITSUBISHI	PKA-A36KA6/PUY-A36NHA6	34.2	0.57	920 MAX.	208	1	60	40	25	0.75	208	1	60	14.0	IDF 419 (1)(2)
DFC-3/CU-3	MITSUBISHI	PKA-A36KA6/PUY-A36NHA6	34.2	0.57	920 MAX.	208	1	60	40	25	0.75	208	1	60	14.0	IDF 446 (1)(2)
DFC-4/CU-4	MITSUBISHI	SLZ-KA09NA/SUZ-KA09NA	8.4	0.23	350 MAX.	208	1	60	15	12	0.50	208	1	60	15.0	KITCHEN OFFICE 345B
DFC-5/CU-5	MITSUBISHI	PKA-A36KA6/PUY-A36NHA6	34.2	0.57	920 MAX.	208	1	60	40	25	0.75	208	1	60	14.0	IDF 203 (1)(2)
DFC-6/CU-6	MITSUBISHI	PKA-A36KA6/PUY-A36NHA6	34.2	0.57	920 MAX.	208	1	60	40	25	0.75	208	1	60	14.0	IDF 219 (1)(2)
DFC-7/CU-7	MITSUBISHI	PKA-A36KA6/PUY-A36NHA6	34.2	0.57	920 MAX.	208	1	60	40	25	0.75	208	1	60	14.0	IDF 246 (2)
DFC-8/CU-8	MITSUBISHI	SLZ-KA09NA/SUZ-KA09NA	8.4	0.23	350 MAX.	208	1	60	15	12	0.50	208	1	60	15.0	KITCHEN OFFICE 145D
DFC-9/CU-9	MITSUBISHI	SLZ-KA09NA/SUZ-KA09NA	8.4	0.23	350 MAX.	208	1	60	15	12	0.50	208	1	60	15.0	CUSTODIAN OFFICE 146A
DFC-10/CU-10	MITSUBISHI	PLA-A42BA6/PUY-42NHA6	42.0	1.0	1,090 MAX.	208	1	60	40	25	0.75	208	1	60	14.4	NETWORK/TELECOM ROOM 149A (2)
DFC-11/CU-11	MITSUBISHI	PLA-A42BA6/PUY-42NHA6	42.0	1.0	1,090 MAX.	208	1	60	40	25	0.75	208	1	60	14.4	NETWORK/TELECOM ROOM 149A (2)
DFC-12/CU-12	MITSUBISHI	PKA-A36KA6/PUY-A36NHA6	34.2	0.57	920 MAX.	208	1	60	40	25	0.75	208	1	60	14.0	IDF L08 (1)(2)

(1) UNITS TO BE FURNISHED WITH CONDENSATE DRAIN PUMP.
(2) UNITS TO BE FURNISHED WITH LOW AMBIENT OPERATION CAPABILITY.
(3) ACCEPTABLE ALT. MANUFACTURERS: DAIKIN, SANYO OR APPROVED EQUAL.

MAKE-UP AIR UNIT SCHEDULE

ITEM	MFG'R	MODEL	AREA SERVED	TOTAL CFM	O.A. CFM	MBH INPUT	MBH OUTPUT	TEMP. RISE	E.S.P. (INCHES)	FAN HP	FAN VOLT	FAN PH	FILTER DATA TYPE	SIZE	MFG'R	REMARKS
MAU-1	REZNOR	RPBL 700	CULINARY KITCH.	6490	6490	700	560	70.5	1.5"	5.0	480	3	MERV 13	2"	FARR	

(1) MANUFACTURER LISTED IS BASIS OF DESIGN. REFER TO SPECIFICATION FOR ACCEPTABLE ALTERNATE MANUFACTURER'S OR APPROVED EQUAL.

VARIABLE FREQUENCY DRIVE SCHEDULE

ITEM	MFG'R. (1)	MODEL	SERVICE	MOTOR DATA HP	VOLTS	ø	MAX. OUTPUT CURRENT	MOUNT	CONTROL INPUT	BY-PASS	REMARKS
VFD-1	–	–	–	–	–	–	–	–	–	–	
VFD-2	–	–	–	–	–	–	–	–	–	–	
VFD-3	–	–	–	–	–	–	–	–	–	–	
VFD-4	–	–	–	–	–	–	–	–	–	–	

(1) ACCEPTABLE ALT. MANUFACTURERS: ABB, DANFOSS OR APPROVED EQUAL.

AIR SEPARATOR SCHEDULE

ITEM	MFG'R (1)	MODEL	GPM	SIZE	LOCATION	SERVICE	REMARKS
AS-1	ARMSTRONG	DAS-8	765	8"	BOILER ROOM	HOT WATER	
AS-2	ARMSTRONG	DAS-8	725	8"	BOILER ROOM	CHILLED WATER	

(1) ACCEPTABLE ALT. MANUFACTURERS: BELL & GOSSETT, SPIROTHERM OR APPROVED EQUAL.

EXPANSION TANK SCHEDULE

ITEM	MFG'R (1)	MODEL	GAL. CAP.	TANK DIA.	TANK HEIGHT	SYS. TEMP. (°F) MIN.	MAX	D.O.V.	REMARKS
ET-1	ARMSTRONG	1400L-HP	370	36"	99"	60°F	180°F	0.75"	HOT WATER SERVICE
ET-2	ARMSTRONG	1400L-HP	370	36"	99"	60°F	180°F	0.75"	HOT WATER SERVICE
ET-3	ARMSTRONG	600L-HP	158	30"	65"	44°F	70°F	0.75"	CHILLED WATER SERVICE

(1) ACCEPTABLE ALT. MANUFACTURERS: BELL & GOSSETT, WESSELS OR APPROVED EQUAL.

HORIZONTAL UNIT HEATER SCHEDULE

ITEM	MFG'R. (1)	MODEL	CFM	MBH	EWT °F	LWT °F	GPM	PD. FT. WG	MOTOR HP	MOTOR RPM	ELECTRICAL V	PH	HZ	REMARKS
HUH-1	STERLING	HS-24	450	12.4	160°F	130°F	1.2	0.14	9W	1550	120	1	60	
HUH-2	STERLING	HS-300	5000	148.0	160°F	130°F	13.6	0.8	1/3	1140	120	1	60	
HUH-3	STERLING	HS-36	550	18.6	160°F	130°F	1.9	0.09	25W	1550	120	1	60	

(1) ACCEPTABLE ALT. MANUFACTURERS: VULCAN, RITTLING, ROSEMEX OR APPROVED EQUAL.
(2) COIL PERFORMANCE BASED ON 30% PROPYLENE GLYCOL.

CABINET UNIT HEATER SCHEDULE

ITEM	MFG'R. (1)	MODEL	ARRANGEMENT	SIZE	CFM	MBH	GPM	HP	VOLT	PH	REMARKS
CUH-1	STERLING	RW	1120	03	335/270	22.8	2.1	1/15	115	1	
CUH-2	STERLING	RW	1120	04	430/345	29.8	2.7	1/10	115	1	
CUH-3	STERLING	RC	1200	04	430/345	29.8	2.7	1/10	115	1	
CUH-4	STERLING	RW	1120	14	1410/1130	56.1	5.6	1/10	115	1	

(1) ACCEPTABLE ALT. MANUFACTURERS: VULCAN, RITTLING, ROSEMEX OR APPROVED EQUAL.
(2) COIL PERFORMANCE BASED ON 30% PROPYLENE GLYCOL.

BOILER SCHEDULE

ITEM	MFG'R. (1)	MODEL	FUEL INPUT NAT. GAS (CFH)	OUTPUT MBH	EFF.	ELEC. DATA WATTS	V	ø	AMPS	REMARKS
B-1	CLEAVER-BROOKS	CFC-3300	3300	3168	96%	2200	208	3	6.9	
B-2	CLEAVER-BROOKS	CFC-3300	3300	3168	96%	2200	208	3	6.9	
B-3	CLEAVER-BROOKS	CFC-3300	3300	3168	96%	2200	208	3	6.9	
B-4	CLEAVER-BROOKS	CFC-3300	3300	3168	96%	2200	208	3	6.9	

(1) ACCEPTABLE ALT. MANUFACTURERS: VIESSMANN, BUDERUS OR APPROVED EQUAL.

PUMP SCHEDULE

ITEM	MFG'R. (1)	MODEL	SERIES	SIZE	GPM	HEAD FEET	MOTOR DATA HP	V	ø	RPM	SERVICE	REMARKS
P-1 & 2	ARMSTRONG	0811-030.0	4302	8x8x13.5	765	90'	30	480	3	1750	HOT WATER	PRIMARY
P-3 & 4	ARMSTRONG	0811-030.0	4302	8x8x13.5	725	90'	30	480	3	1750	CHILLED WATER	STAND-BY

(1) ACCEPTABLE ALT. MANUFACTURERS: BELL & GOSSETT, TACO OR APPROVED EQUAL.

CONVECTOR SCHEDULE

ITEM	MFG'R (1)	MODEL	MBH	GPM	HEIGHT	LENGTH	DEPTH	REMARKS
CV-1	STERLING	SR-A	1.1	.11	18"	20"	4"	
CV-2	STERLING	SR-A	1.4	.14	18"	24"	4"	
CV-3	STERLING	SR-A	5.3	.53	24"	60"	4"	

(1) ACCEPTABLE ALT. MANUFACTURERS: VULCAN, RITTLING, ROSEMEX OR APPROVED EQUAL.
(2) COIL PERFORMANCE BASED ON 30% PROPYLENE GLYCOL.

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BEVERLY MIDDLE SCHOOL

CABOT STREET
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KEYNOTE LEGEND:

90% CONSTRUCTION DOCUMENTS

NOT FOR CONSTRUCTION

NORTH ARROW

KEYPLAN

DRAWING NAME:

MECHANICAL SCHEDULES

DRAWN BY: JAJ
REVIEWED BY: DAH
SCALE: NONE
JOB NO.: 1403.00
DATE: July 25, 2016
DRAWING NUMBER: M5.1

SOUND ATTENUATOR SCHEDULE

ITEM	MFG'R (1)	MODEL	CFM	TOTAL LENGTH FT.	INLET DIMENSIONS W X H	OUTLET DIMENSIONS W X H	FACE VELOCITY FPM	SILENCER P.D. IN. W.G.	HORIZ. CENTERLINE LENGTH	VERT. CENTERLINE LENGTH	P.D. WITH SYSTEM EFFECT	DYNAMIC INSERTION LOSS Hz 63	125	250	500	1K	2K	4K	8K	REMARKS
SA-1	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	FURNISH WITH HTL CASINGS
SA-2	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	FURNISH WITH HTL CASINGS
SA-3	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
SA-4	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
SA-5	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	FURNISH WITH HTL CASINGS
SA-6	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	FURNISH WITH HTL CASINGS
SA-7	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
SA-8	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
SA-9	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	FURNISH WITH HTL CASINGS
SA-10	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	FURNISH WITH HTL CASINGS
SA-11	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
SA-12	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
SA-13	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	FURNISH WITH HTL CASINGS
SA-14	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	FURNISH WITH HTL CASINGS
SA-15	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
SA-16	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
SA-17	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	FURNISH WITH HTL CASINGS
SA-18	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	FURNISH WITH HTL CASINGS
SA-19	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
SA-20	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
SA-21	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	FURNISH WITH HTL CASINGS
SA-22	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	FURNISH WITH HTL CASINGS
SA-23	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
SA-24	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
SA-25	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	FURNISH WITH HTL CASINGS
SA-26	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	FURNISH WITH HTL CASINGS
SA-27	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	FURNISH WITH HTL CASINGS
SA-28	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	FURNISH WITH HTL CASINGS
SA-29	VIBRO-ACOUSTICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	FURNISH WITH HTL CASINGS

(1) ACCEPTABLE ALT. MANUFACTURERS: VAW, IAC OR APPROVED EQUAL.

RETURN/EXHAUST FAN SCHEDULE

ITEM	MFG'R. (6)	MODEL	DRIVE	SERVICE	INTERLOCK	CFM	SP IN. WC.	HP	FAN RPM	ELECTRICAL DATA V	PH	HZ	SONES	REMARKS
EF-1	GREENHECK	GB-161-15	BELT	TOILETS	BMS	3,300	0.75"	1-1/2	1375	460	3	60	18.0	(3)
EF-2	GREENHECK	GB-101-5	BELT	TOILETS	BMS	1,200	0.75"	1/2	1793	208	3	60	10.9	(3)
EF-3	GREENHECK	GB-161-15	BELT	TOILETS	BMS	3,200	0.75"	1-1/2	1347	460	3	60	17.5	(3)
EF-4	GREENHECK	G-080-VG	DIRECT	TOILET/STORAGE	BMS	200	0.5"	1/6	1501	115	1	60	7.3	(4)
EF-5	GREENHECK	CUBE-200-30	BELT	KITCHEN HOOD	LOCAL SWITCH	5,500	0.75"	3	1173	208	3	60	22.0	(1)
EF-6	GREENHECK	GB-091-3	BELT	TRASH/RECYCLING	BMS	500	0.5"	1/3	1171	115	1	60	7.1	(3)
EF-7	GREENHECK	G-080-VG	DIRECT	TOILETS	BMS	200	0.5"	1/6	1501	115	1	60	7.3	(4)
EF-8	GREENHECK	G-097-VG	DIRECT	GENERAL	BMS	100	0.5"	1/4	1121	115	1	60	4.5	(4)
EF-9	GREENHECK	SP-B150	DIRECT	TOILET	LIGHT SWITCH	100	0.25"	128W	706	115	1	60	0.6	
EF-10	GREENHECK	GB-101-5	BELT	TOILETS	BMS	1,150	0.5"	1/2	1624	208	3	60	9.9	(3)
EF-11	GREENHECK	G-080-VG	DIRECT	GENERAL	BMS	200	0.5"	1/6	1501	115	1	60	7.3	(4)
EF-12	GREENHECK	BSQ-90-10	BELT	KITCHEN HOOD	LOCAL SWITCH	1,215	0.5"	1	2280	460	3	60	22	
EF-13	GREENHECK	QEI-15II-15	BELT	BOILER ROOM	REV. ACTING T-STAT	2,500	1.5"	1-1/2	1687	460	3	60	15.3	
EF-14	GREENHECK	SP-B150	DIRECT	TOILET	LIGHT SWITCH	100	0.5"	128W	814	115	1	60	2.0	
EF-15	GREENHECK	–	–	–	–	–	–	–	–	–	–	60	–	
EF-16	GREENHECK	–	–	–	–	–	–	–	–	–	–	60	–	
EF-17	GREENHECK	–	–	–	–	–	–	–	–	–	–	60	–	
EF-18	GREENHECK	–	–	–	–	–	–	–	–	–	–	60	–	
EF-19	GREENHECK	–	–	–	–	–	–	–	–	–	–	60	–	
EF-20	GREENHECK	–	–	–	–	–	–	–	–	–	–	60	–	

(1) FAN TO BE FURNISHED WITH GREASE TRAP, VENTED CURB EXTENSION & HINGING KIT TO MEET NFPA96. FAN SHALL HAVE U.L. 762 LISTING.
(2) FAN TO BE FURNISHED WITH INVERTER RATED MOTOR AND DISCONNECT SWITCH (FACTORY MOUNTED AND WIRED).
(3) PROVIDE WITH ROOF CURB, BIRDSCREEN, MOTORIZED DAMPER & DISCONNECT SWITCH (FACTORY MOUNTED AND WIRED).
(4) PROVIDE WITH ROOF CURB, BIRDSCREEN, MOTORIZED DAMPER, EC MOTOR, FACTORY MOUNTED AND WIRED POTENTIOMETER, AND FACTORY MOUNTED AND WIRED DISCONNECT SWITCH.
(5) FAN SHALL BE FURNISHED WITH FLUSH EXTERIOR WALL HOUSING W/OSHA GUARD AND MOTORIZED DAMPER.
(6) ACCEPTABLE ALT. MANUFACTURERS: PENN VENTILATOR CORP., COOK OR APPROVED EQUAL.

DIFFUSER, REGISTER & GRILLE SCHEDULE

ITEM	MFG'R (1)	MODEL	SIZE	NECK	CFM MAX.	THROW	BORDER TYPE	REMARKS
S-1	TITUS	TDC	6x6	6x6	125	SEE PLANS	1, 3	
S-2	TITUS	TDC	9x9	9x9	250	SEE PLANS	1, 3	
S-3	TITUS	TDC	12x12	12x12	500	SEE PLANS	1, 3	
S-4	TITUS	TDC	15x15	15x15	750	SEE PLANS	1, 3	
S-5	TITUS	TDC	18x18	18x18	1125	SEE PLANS	1, 3	
S-6	TITUS	300RL	48x12	48x12	2120	–	–	
S-7	TITUS	DL	20x12	20x12	850	40° DN	–	
S-8	TITUS	FL-10-HT	1 SLOT	–	1110	HORIZONTAL	66	20'-0" CONTINUOUS SLOT
S-9	TITUS	FL-30-HT	4'-0" 1 SLOT	12"OVAL	400	HORIZONTAL	66	FURNISH W/MFGR'S PLENUM MODEL FBPI-30 (2)
S-10	TITUS	EOS	4'-0"	N/A	200	–		3° TEMP. SPAN BETWEEN COOLING & HEATING (3)
S-11	TITUS	300RL	30x6	30x6	500	22.5° DN	–	
S-12	TITUS	TND-AA	16	–	1050	–	–	
S-13	TITUS	300RL	8x6	8x6	150	22.5° DN	–	
S-14	TITUS	FL-30-HT	4'-0" 1 SLOT	12"OVAL	400	HORIZONTAL	66	FURNISH W/MFGR'S PLENUM MODEL FBPI-30
R-1	TITUS	50F	6x6	6x6	125	N/A	1, 3	
R-2	TITUS	50F	8x8	8x8	250	N/A	1, 3	
R-3	TITUS	50F	10x10	10x10	400	N/A	1, 3	
R-4	TITUS	50F	12x12	12x12	600	N/A	1, 3	
R-5	TITUS	50F	14x14	14x14	850	N/A	1, 3	
R-6	TITUS	50F	16x16	16x16	1100	N/A	1, 3	
R-7	TITUS	50F	18x18	18x18	1450	N/A	1, 3	
R-8	TITUS	50F	20x20	20x20	1800	N/A	1, 3	
R-9	TITUS	50F	22x22	22x22	2200	N/A	1, 3	
R-10	TITUS	350RL	24x12	24x12	950	N/A	1	
R-11	TITUS	350RL	30x6	30x6	600	N/A	1	SIDEWALL
R-12	TITUS	350RL	42x20	42x20	2600	N/A	1	SIDEWALL
R-13	TITUS	350RL	42x24	42x24	3000	N/A	1	
E-1	TITUS	50F	6x6	6x6	125	N/A	1, 3	
E-2	TITUS	50F	8x8	8x8	250	N/A	1, 3	
E-3	TITUS	50F	10x10	10x10	400	N/A	1, 3	
E-4	TITUS	50F	12x12	12x12	600	N/A	1, 3	
E-5	TITUS	50F	14x14	14x14	850	N/A	1, 3	
E-6	TITUS	50F	16x16	16x16	1100	N/A	1, 3	
E-7	TITUS	50F	18x18	18x18	1450	N/A	1, 3	
T-1	TITUS	50F	8x8	8x8	250	N/A	3	NO DAMPER
T-2	TITUS	50F	18x18	18x18	1400	N/A	3	NO DAMPER
T-3	TITUS	50F	24x24	24x24	1500	N/A	3	NO DAMPER

(1) ACCEPTABLE ALT. MANUFACTURERS: METAL-AIRE, PRICE, NAILOR OR APPROVED EQUAL.
(2) CONTINUOUS CURVED SLOT DIFFUSERS.
(3) PROVIDE WITH 10" INLET.

ROOF INTAKE & RELIEF VENT SCHEDULE

ITEM	MFG'R (1)	MODEL	CFM MAX.	THROAT AREA SQ. FT.	SP MAX	CURB HEIGHT	REMARKS
RI-1	GREENHECK	GRSI-8	50	0.37	0.003"	16"	FURNISH WITH WELDED ALUMINUM CURB AND MOTORIZED DAMPER
RI-2	GREENHECK	GRSI-8	50	0.37	0.003"	16"	FURNISH WITH WELDED ALUMINUM CURB AND MOTORIZED DAMPER
RI-3	GREENHECK	GRSI-8	50	0.37	0.003"	16"	FURNISH WITH WELDED ALUMINUM CURB AND MOTORIZED DAMPER
RI-4	GREENHECK	GRSI-12	700	0.82	0.122"	16"	FURNISH WITH WELDED ALUMINUM CURB AND MOTORIZED DAMPER

(1) ACCEPTABLE ALT. MANUFACTURERS: PENN VENTILATOR CORP., COOK OR APPROVED EQUAL.

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KEYNOTE LEGEND:

90% CONSTRUCTION DOCUMENTS

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NORTH ARROW

KEYPLAN

DRAWING NAME:

MECHANICAL SCHEDULES

DRAWN BY: JAJ
REVIEWED BY: DAH
SCALE: NONE
JOB NO.: 1403.00
DATE: July 25, 2016
DRAWING NUMBER: M5.2

Single Duct Terminal Unit Schedule

Tag	AHU	Room	Model	Size		CFM		Static Pressure			NC Levels		Hot Water Heat Coil										
	Tag			Unit	Outlet	Max	Min	Inlet	Down	Min	Rad	Dis	CFM	MBH	EAT	EWT	LAT	APd	GPM	LWT	WPd	Rows	FPI
TB-01-01			DESV	08	12x10	400	200	0.5	0.25	0.12	15	15	200	10	55	160	101.1	0.11	1.1	141.2	0.38	2-RH	10
TB-01-02			DESV	05	12x8	100	50	0.5	0.25	0.02	-	-	50	2.7	55	160	105.2	0.01	0.6	149.8	0.27	1-RH	10
TB-01-03			DESV	05	12x8	100	50	0.5	0.25	0.02	-	-	50	2.7	55	160	105.2	0.01	0.6	149.8	0.27	1-RH	10
TB-01-04			DESV	08	12x10	400	200	0.5	0.25	0.12	15	15	200	10	55	160	101.1	0.11	1.1	141.2	0.38	2-RH	10
TB-01-05			DESV	12	16x15	900	450	0.5	0.25	0.15	17	15	450	20.2	55	160	96.5	0.14	1.7	134.6	0.42	2-RH	10
TB-01-06			DESV	08	12x10	400	200	0.5	0.25	0.12	15	15	200	10	55	160	101.1	0.11	1.1	141.2	0.38	2-RH	10
TB-01-07			DESV	06	12x8	340	170	0.5	0.25	0.23	18	15	170	8.1	55	160	99.2	0.14	1.1	144.7	0.28	2-RH	10
TB-01-08			DESV	05	12x8	110	55	0.5	0.25	0.02	-	10	55	2.9	55	160	102.9	0.01	0.6	149.3	0.27	1-RH	10
TB-01-09			DESV	09	14x12.5	680	340	0.5	0.25	0.18	17	17	340	15.6	55	160	97.3	0.15	1.7	140.5	0.38	2-RH	10
TB-01-10			DESV	05	12x8	150	75	0.5	0.25	0.02	10	14	75	3.3	55	160	95.7	0.01	0.6	147.6	0.28	1-RH	10
TB-01-11			DESV	04	12x8	75	40	0.5	0.25	0.01	-	13	40	2.4	55	160	110.7	0	0.6	150.9	0.27	1-RH	10
TB-01-12			DESV	08	12x10	450	225	0.5	0.25	0.15	17	17	225	10.5	55	160	98	0.14	1.1	140.3	0.38	2-RH	10
TB-01-13			DESV	16	24x18	1700	700	0.5	0.25	0.23	14	11	700	35.4	55	160	101.7	0.22	3.3	137.6	0.87	2-RH	10
TB-01-14			DESV	05	12x8	110	55	0.5	0.25	0.02	-	10	55	2.9	55	160	102.9	0.01	0.6	149.3	0.27	1-RH	10
TB-04-01			DESV	12	16x15	700	175	0.5	0.25	0.1	15	17	700	30.4	55	160	95	0.09	2.7	136.8	0.9	2-RH	10
TB-04-02			DESV	09	14x12.5	500	125	0.5	0.25	0.11	13	11	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-04-03			DESV	07	12x10	150	40	0.5	0.25	0.02	-	11	150	6.5	55	160	95	0.01	1.2	148.9	0.94	1-RH	10
TB-04-04			DESV	12	16x15	750	190	0.5	0.25	0.11	15	14	750	32.5	55	160	95	0.1	3	137.6	1.04	2-RH	10
TB-04-05			DESV	10	14x12.5	500	125	0.5	0.25	0.1	18	15	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-04-06			DESV	10	14x12.5	500	125	0.5	0.25	0.1	18	15	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-04-07			DESV	12	16x15	710	180	0.5	0.25	0.1	15	14	710	30.8	55	160	95	0.09	2.8	137	0.93	2-RH	10
TB-04-08			DESV	06	12x8	200	50	0.5	0.25	0.09	11	-	200	8.7	55	160	95.1	0.06	1.1	143.7	0.28	2-RH	10
TB-04-09			DESV	14	20x17.5	1070	270	0.5	0.25	0.11	16	11	1070	46.4	55	160	95	0.1	4	135.8	0.96	2-RH	10
TB-04-10			DESV	07	12x10	150	40	0.5	0.25	0.02	-	11	150	6.5	55	160	95	0.01	1.2	148.9	0.94	1-RH	10
TB-04-11			DESV	08	12x10	315	80	0.5	0.25	0.09	13	14	315	13.7	55	160	95	0.08	1.5	140.3	0.58	2-RH	10
TB-04-12			DESV	05	12x8	105	30	0.5	0.25	0.02	-	10	105	4.6	55	160	95	0.01	1	150.1	0.6	1-RH	10
TB-04-13			DESV	09	14x12.5	520	130	0.5	0.25	0.11	13	13	520	22.6	55	160	95	0.09	2.6	141.7	0.73	2-RH	10
TB-04-14			DESV	12	16x15	700	175	0.5	0.25	0.1	15	17	700	30.4	55	160	95	0.09	2.7	136.8	0.9	2-RH	10
TB-04-15			DESV	09	14x12.5	600	150	0.5	0.25	0.14	14	15	600	26	55	160	95	0.12	3.2	143.1	0.94	2-RH	10
TB-04-16			DESV	09	14x12.5	500	125	0.5	0.25	0.11	13	11	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-04-17			DESV	07	12x10	150	40	0.5	0.25	0.02	-	11	150	6.5	55	160	95	0.01	1.2	148.9	0.94	1-RH	10
TB-04-18			DESV	12	16x15	700	175	0.5	0.25	0.1	15	17	700	30.4	55	160	95	0.09	2.7	136.8	0.9	2-RH	10
TB-04-19			DESV	10	14x12.5	500	125	0.5	0.25	0.1	18	15	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-04-20			DESV	10	14x12.5	500	125	0.5	0.25	0.1	18	15	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-04-21			DESV	12	16x15	710	180	0.5	0.25	0.1	15	14	710	30.8	55	160	95	0.09	2.8	137	0.93	2-RH	10
TB-04-22			DESV	08	12x10	200	50	0.5	0.25	0.05	-	14	200	10	55	160	101.1	0.04	1.1	141.2	0.38	2-RH	10
TB-05-01			DESV	12	16x15	700	175	0.5	0.25	0.1	15	17	700	30.4	55	160	95	0.09	2.7	136.8	0.9	2-RH	10
TB-05-02			DESV	09	14x12.5	500	125	0.5	0.25	0.11	13	11	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-05-03			DESV	09	14x12.5	500	125	0.5	0.25	0.11	13	11	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-05-04			DESV	12	16x15	700	175	0.5	0.25	0.1	15	17	700	30.4	55	160	95	0.09	2.7	136.8	0.9	2-RH	10
TB-05-05			DESV	06	12x8	200	50	0.5	0.25	0.09	11	-	200	8.7	55	160	95.1	0.06	1.1	143.7	0.28	2-RH	10
TB-05-06			DESV	09	14x12.5	500	125	0.5	0.25	0.11	13	11	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-05-07			DESV	06	12x8	150	40	0.5	0.25	0.03	-	-	150	6.5	55	160	95	0.01	5	157.3	9.81	1-RH	10
TB-05-08			DESV	12	16x15	700	175	0.5	0.25	0.1	15	17	700	30.4	55	160	95	0.09	2.7	136.8	0.9	2-RH	10
TB-05-09			DESV	12	16x15	700	175	0.5	0.25	0.1	15	17	700	30.4	55	160	95	0.09	2.7	136.8	0.9	2-RH	10
TB-05-10			DESV	12	16x15	700	175	0.5	0.25	0.1	15	17	700	30.4	55	160	95	0.09	2.7	136.8	0.9	2-RH	10
TB-05-11			DESV	09	14x12.5	600	150	0.5	0.25	0.14	14	15	600	26	55	160	95	0.12	3.2	143.1	0.94	2-RH	10
TB-05-12			DESV	12	16x15	800	200	0.5	0.25	0.12	17	15	800	34.7	55	160	95	0.11	3.4	138.4	1.16	2-RH	10
TB-05-13			DESV	06	12x8	200	50	0.5	0.25	0.09	11	-	200	8.7	55	160	95.1	0.06	1.1	143.7	0.28	2-RH	10
TB-05-14			DESV	12	16x15	750	190	0.5	0.25	0.11	15	14	750	32.5	55	160	95	0.1	3	137.6	1.04	2-RH	10
TB-05-15			DESV	09	14x12.5	500	125	0.5	0.25	0.11	13	11	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-05-16			DESV	07	12x10	150	40	0.5	0.25	0.02	-	11	150	6.5	55	160	95	0.01	1.2	148.9	0.94	1-RH	10
TB-05-17			DESV	09	14x12.5	500	125	0.5	0.25	0.11	13	11	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-06-01			DESV	05	12x8	75	20	0.5	0.25	0.01	-	-	75	3.3	55	160	95.7	0	0.6	147.6	0.28	1-RH	10
TB-06-02			DESV	12	16x15	800	200	0.5	0.25	0.12	17	15	800	34.7	55	160	95	0.11	3.4	138.4	1.16	2-RH	10
TB-06-03			DESV	12	16x15	800	200	0.5	0.25	0.12	17	15	800	34.7	55	160	95	0.11	3.4	138.4	1.16	2-RH	10
TB-06-04			DESV	06	12x8	270	70	0.5	0.25	0.16	15	13	270	11.7	55	160	95	0.1	1.6	145.1	0.51	2-RH	10
TB-06-05			DESV	09	14x12.5	600	150	0.5	0.25	0.14	14	15	600	26	55	160	95	0.12	3.2	143.1	0.94	2-RH	10
TB-06-06			DESV	09	14x12.5	500	125	0.5	0.25	0.11	13	11	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-06-07			DESV	04	12x8	110	30	0.5	0.25	0.03	14	17	110	4.8	55	160	95	0.01	1	150.5	0.65	1-RH	10
TB-06-08			DESV	12	16x15	700	175	0.5	0.25	0.1	15	17	700	30.4	55	160	95	0.09	2.7	136.8	0.9	2-RH	10
TB-06-09			DESV	09	14x12.5	500	125	0.5	0.25	0.11	13	11	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-06-10			DESV	06	12x8	180	45	0.5	0.25	0.08	10	-	180	8.3	55	160	97.7	0.05	1.1	144.3	0.28	2-RH	10
TB-06-11			DESV	06	12x8	180	45	0.5	0.25	0.08	10	-	180	8.3	55	160	97.7	0.05	1.1	144.3	0.28	2-RH	10
TB-06-12			DESV	12	16x15	720	180	0.5	0.25	0.11	15	14	720	31.2	55	160	95	0.1	2.9	137.1	0.96	2-RH	10
TB-06-13			DESV	06	12x8	200	50	0.5	0.25	0.09	11	-	200	8.7	55	160	95.1	0.06	1.1	143.7	0.28	2-RH	10
TB-06-14			DESV	05	12x8	70	20	0.5	0.25	0.01	-	-	70	3.2	55	160	97.2	0	0.6	148	0.28	1-RH	10
TB-06-15			DESV	12	16x15	800	200	0.5	0.25	0.12	17	15	800	34.7	55	160	95	0.11	3.4	138.4	1.16	2-RH	10
TB-06-16			DESV	12	16x15	750	190	0.5	0.25	0.11	15	14	750	32.5	55	160	95	0.1	3	137.6	1.04	2-RH	10
TB-06-17			DESV	06	12x8	260	65	0.5	0.25	0.14	14	12	260	11.3	55	160	95	0.09	1.6	144.8	0.47	2-RH	10
TB-06-18			DESV	09	14x12.5	600	150	0.5	0.25	0.14	14	15	600	26	55	160	95	0.12	3.2	143.1	0.94	2-RH	10
TB-06-19			DESV	09	14x12.5	500	125	0.5	0.25	0.11	13	11	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-06-20			DESV	05	12x8	120	30	0.5	0.25	0.02	-	11	120	5.2	55	160	95	0.01	1.4	152.1	0.88	1-RH	10
TB-06-21			DESV	12	16x15	700	175	0.5	0.25	0.1	15	17	700	30.4	55	160	95	0.09	2.7	136.8	0.9	2-RH	10
TB-06-22			DESV	09	14x12.5	500	125	0.5	0.25	0.11	13	11	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-06-23			DESV	06	12x8	200	50	0.5	0.25	0.09	11	-	200	8.7	55	160	95.1	0.06	1.1	143.7	0.28	2-RH	10
TB-06-24			DESV	06	12x8	180	45	0.5	0.25	0.08	10	-	180	8.3	55	160	97.7	0.05	1.1	144.3	0.28	2-RH	10
TB-06-25			DESV	09	14x12.5	390	100	0.5	0.25	0.07	11	-	390	16.9	55	160	95	0.06	1.8	139.9	0.42	2-RH	10
TB-06-26			DESV	06	12x8	200	50	0.5	0.25	0.09	11	-	200	8.7	55	160	95.1	0.06	1.1	143.7	0.28	2-RH	10
TB-06-27			DESV	06	12x8	200	50	0.5	0.25	0.09	11	-	200	8.7	55	160	95.1	0.06	1.1	143.7	0.28	2-RH	10
TB-07-01			DESV	05	12x8	70	20	0.5	0.25	0.01	-	-	70	3.2	55	160	97.2	0	0.6	148	0.28	1-RH	10
TB-07-02			DESV	14	20x17.5	875	220	0.5	0.25	0.08	14	10	875	38	55	160	95	0.07	3	133.6	0.62	2-RH	10
TB-07-03			DESV	12	16x15	800	200	0.5	0.25	0.12	17	15	800	34.7	55	160	95	0.11	3.4	138.4	1.16	2-RH	10
TB-07-04			DESV	07	12x10	305	80	0.5	0.25	0.1	15	13	305	13.2	55	160	95	0.07	1.4	140.1	0.54	2-RH	10
TB-07-05			DESV	12	16x15	700	175	0.5	0.25	0.1	15	17	700	30.4	55	160	95	0.09	2.7	136.8	0.9	2-RH	10
TB-07-06			DESV	09	14x12.5	500	125	0.5	0.25	0.11	13	11	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-07-07			DESV	05	12x8	110	30	0.5	0.25	0.02	-	10	110	4.8	55	160	95	0.01	1	150.5	0.65	1-RH	10
TB-07-08			DESV	06	12x8	200	50	0.5	0.25	0.09	11	-	200	8.7	55	160	95.1	0.06	1.1	143.7	0.28	2-RH	10
TB-07-09			DESV	06	12x8	180	45	0.5	0.25	0.08	10	-	180	8.3	55	160	97.7	0.05	1.1	144.3	0.28	2-RH	10
TB-07-10			DESV	12	16x15	810	205	0.5	0.25	0.13	17	15	810	35.1	55	160	95	0.12	3.4	138.4	1.18	2-RH	10
TB-07-11			DESV	06	12x8	200	50	0.5	0.25	0.09	11	-	200	8.7	55	160	95.1	0.06	1.1	143.7	0.28	2-RH	10
TB-07-12			DESV	09	14x12.5	500	125	0.5	0.25	0.11	13	11	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-07-13			DESV	12	16x15	800	200	0.5	0.25	0.12	17	15	800	34.7	55	160	95	0.11	3.4	138.4	1.16	2-RH	10
TB-07-14			DESV	06	12x8	85	25	0.5	0.25	0.02	-	-	85	3.7	55	160	95	0.01	0.6	148.1	0.35	1-RH	10
TB-07-15			DESV	14	20x17.5	950	240	0.5	0.25	0.09	15	11	950	41.2	55	160	95	0.08	3.4	134.4	0.74	2-RH	10
TB-07-16			DESV	14	20x17.5	950	240	0.5	0.25	0.09	15	11	950	41.2	55	160	95	0.08	3.4	134.4	0.74	2-RH	10
TB-07-17			DESV	08	12x10	330	85	0.5	0.25	0.09	14	14	330	14.3	55	160	95	0.08	1.6	140.7	0.63	2-RH	10
TB-07-18			DESV	06	12x8	200	50	0.5	0.25	0.09	11	-	200	8.7	55	160	95.1	0.06	1.1	143.7	0.28	2-RH	10
TB-07-19			DESV	08	12x10	315	80	0.5	0.25	0.09	13	14	315	13.7	55	160	95	0.08	1.5	140.3	0.58	2-RH	10
TB-07-20			DESV	07	12x10	300	75	0.5	0.25	0.1	15	13	300	13	55	160	95	0.07	1.4	140	0.52	2-RH	10
TB-07-21			DESV	16	24x18	900	225	0.5	0.25	0.09	-	-	900	39.7	55	160	95.6	0.08	3.3	135	0.87	2-RH	10
TB-07-22			DESV	09	14x12.5	500	125	0.5	0.25	0.11	13	11	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-07-23			DESV	05	12x8	110	30	0.5	0.25	0.02	-	10	110	4.8	55	160	95	0.01	1	150.5	0.65	1-RH	10
TB-07-24			DESV	09	14x12.5	500	125	0.5	0.25	0.11	13	11	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-07-25			DESV	12	16x15	750	190	0.5	0.25	0.11	15	14	750	32.5	55	160	95	0.1	3	137.6	1.04	2-RH	10
TB-10-01			DESV	12	16x15	850	220	0.5	0.25	0.14	17	15	850	36.9	55	160	95	0.13	3.8	139.5	1.24	2-RH	10
TB-10-02			DESV	04	12x8	55	15	0.5	0.25	0.01	-	-	55	2.9	55	160	102.9	0	0.6	149.3	0.27	1-RH	10
TB-10-03			DESV	06	12x8	200	50	0.5	0.25	0.09	11	-	200	8.7	55	160	95.1	0.06	1.1	143.7	0.28	2-RH	10
TB-10-04			DESV	09	14x12.5	600	150	0.5	0.25	0.14	14	15	600	26	55	160	95	0.12	3.2	143.1	0.94	2-RH	10
TB-10-05			DESV	05	12x8	110	30	0.5	0.25	0.02	-	10	110	4.8	55	160	95	0.01	1	150.5	0.65	1-RH	10
TB-10-06			DESV	12	16x15	700	175	0.5	0.25	0.1	15	17	700	30.4	55	160	95	0.09	2.7	136.8	0.9	2-RH	10
TB-10-07			DESV	09	14x12.5	500	125	0.5	0.25	0.11	13	11	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-10-08			DESV	09	14x12.5	375	95	0.5	0.25	0.06	10	-	375	16.3	55	160	95	0.05	1.7	139.8	0.39	2-RH	10
TB-10-09			DESV	09	14x12.5	610	155	0.5	0.25	0.14	15	15	610	26.5	55	160	95	0.12	3.3	143.1	0.96	2-RH	10
TB-10-10			DESV	08	12x10	350	90	0.5	0.25	0.1	14	14	350	15.2	55	160	95	0.09	1.7	141.2	0.71	2-RH	10
TB-10-11			DESV	06	12x8	200	50	0.5	0.25	0.09	11	-	200	8.7	55	160	95.1	0.06	1.1	143.7	0.28	2-RH	10
TB-10-12			DESV	12	16x15	800	200	0.5	0.25	0.12	17	15	800	34.7	55	160	95	0.11	3.4	138.4	1.16	2-RH	10
TB-10-13			DESV	09	14x12.5	600	150	0.5	0.25	0.14	14	15	600	26	55	160	95	0.12	3.2	143.1	0.94	2-RH	10
TB-10-14			DESV	09	14x12.5	500	125	0.5	0.25	0.11	13	11	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-10-15			DESV	09	14x12.5	600	150	0.5	0.25	0.14	14	15	600	26	55	160	95	0.12	3.2	143.1	0.94	2-RH	10
TB-10-16			DESV	12	16x15	750	190	0.5	0.25	0.11	15	14	750	32.5	55	160	95	0.1	3	137.6	1.04	2-RH	10
TB-10-17			DESV	12	16x15	700	175	0.5	0.25	0.1	15	17	700	30.4	55	160	95	0.09	2.7	136.8	0.9	2-RH	10
TB-10-18			DESV	09	14x12.5	500	125	0.5	0.25	0.11	13	11	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10

Single Duct Terminal Unit Schedule

Tag	AHU	Room	Model	Size		CFM		Static Pressure			NC Levels		Hot Water Heat Coil										
	Tag			Unit	Outlet	Max	Min	Inlet	Down	Min	Rad	Dis	CFM	MBH	EAT	EWT	LAT	APd	GPM	LWT	WPd	Rows	FPI
TB-10-19			DESV	06	12x8	200	50	0.5	0.25	0.09	11	-	200	8.7	55	160	95.1	0.06	1.1	143.7	0.28	2-RH	10
TB-10-20			DESV	06	12x8	180	45	0.5	0.25	0.08	10	-	180	8.3	55	160	97.7	0.05	1.1	144.3	0.28	2-RH	10
TB-10-21			DESV	12	16x15	710	180	0.5	0.25	0.1	15	14	710	30.8	55	160	95	0.09	2.8	137	0.93	2-RH	10
TB-10-22			DESV	06	12x8	200	50	0.5	0.25	0.09	11	-	200	8.7	55	160	95.1	0.06	1.1	143.7	0.28	2-RH	10
TB-11-01			DESV	09	14x12.5	800	200	0.5	0.25	0.23	19	17	800	34.7	55	160	95	0.19	6.6	149	2.8	2-RH	10
TB-11-02			DESV	09	14x12.5	600	150	0.5	0.25	0.14	14	15	600	26	55	160	95	0.12	3.2	143.1	0.94	2-RH	10
TB-11-03			DESV	09	14x12.5	500	125	0.5	0.25	0.11	13	11	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-11-04			DESV	05	12x8	110	30	0.5	0.25	0.02	-	10	110	4.8	55	160	95	0.01	1	150.5	0.65	1-RH	10
TB-11-05			DESV	06	12x8	200	50	0.5	0.25	0.09	11	-	200	8.7	55	160	95.1	0.06	1.1	143.7	0.28	2-RH	10
TB-11-06			DESV	06	12x8	160	40	0.5	0.25	0.06	-	-	160	7.9	55	160	100.7	0.04	1.1	145.1	0.28	2-RH	10
TB-11-07			DESV	12	16x15	800	200	0.5	0.25	0.12	17	15	800	34.7	55	160	95	0.11	3.4	138.4	1.16	2-RH	10
TB-11-08			DESV	06	12x8	200	50	0.5	0.25	0.09	11	-	200	8.7	55	160	95.1	0.06	1.1	143.7	0.28	2-RH	10
TB-11-09			DESV	09	14x12.5	500	125	0.5	0.25	0.11	13	11	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-11-10			DESV	12	16x15	700	175	0.5	0.25	0.1	15	17	700	30.4	55	160	95	0.09	2.7	136.8	0.9	2-RH	10
TB-11-11			DESV	06	12x8	200	50	0.5	0.25	0.09	11	-	200	8.7	55	160	95.1	0.06	1.1	143.7	0.28	2-RH	10
TB-11-12			DESV	06	12x8	280	70	0.5	0.25	0.16	15	14	280	12.2	55	160	95	0.1	1.7	145.3	0.55	2-RH	10
TB-11-13			DESV	08	12x10	250	65	0.5	0.25	0.06	10	15	250	11	55	160	95.4	0.05	1.1	139.4	0.38	2-RH	10
TB-11-14			DESV	12	16x15	800	200	0.5	0.25	0.12	17	15	800	34.7	55	160	95	0.11	3.4	138.4	1.16	2-RH	10
TB-11-15			DESV	09	14x12.5	500	125	0.5	0.25	0.11	13	11	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-11-16			DESV	05	12x8	110	30	0.5	0.25	0.02	-	10	110	4.8	55	160	95	0.01	1	150.5	0.65	1-RH	10
TB-11-17			DESV	09	14x12.5	500	125	0.5	0.25	0.11	13	11	500	21.7	55	160	95	0.09	2.4	141.3	0.67	2-RH	10
TB-11-18			DESV	12	16x15	700	175	0.5	0.25	0.1	15	17	700	30.4	55	160	95	0.09	2.7	136.8	0.9	2-RH	10
TB-11-19			DESV	09	14x12.5	600	150	0.5	0.25	0.14	14	15	600	26	55	160	95	0.12	3.2	143.1	0.94	2-RH	10
TB-11-20			DESV	12	16x15	800	200	0.5	0.25	0.12	17	15	800	34.7	55	160	95	0.11	3.4	138.4	1.16	2-RH	10
TB-12-01			DESV	12	16x15	1040	520	0.5	0.25	0.19	18	17	520	22.6	55	160	95	0.18	1.8	134.4	0.5	2-RH	10
TB-12-02			DESV	08	12x10	300	150	0.5	0.25	0.04	13	13	150	6.5	55	160	95	0.03	1.2	148.9	0.94	1-RH	10
TB-12-03			DESV	12	16x15	1110	555	0.5	0.25	0.21	19	18	555	24.1	55	160	95	0.2	2	134.8	0.57	2-RH	10
TB-12-04			DESV	06	12x8	160	80	0.5	0.25	0.04	-	-	80	3.5	55	160	95	0.02	0.6	147.6	0.3	1-RH	10
TB-12-05			DESV	06	12x8	160	80	0.5	0.25	0.04	-	-	80	3.5	55	160	95	0.02	0.6	147.6	0.3	1-RH	10
TB-12-06			DESV	05	12x8	105	50	0.5	0.25	0.02	-	10	50	2.7	55	160	105.2	0.01	0.6	149.8	0.27	1-RH	10
TB-12-07			DESV	04	12x8	110	55	0.5	0.25	0.03	14	17	55	2.9	55	160	102.9	0.01	0.6	149.3	0.27	1-RH	10
TB-12-08			DESV	05	12x8	175	90	0.5	0.25	0.03	12	15	90	3.9	55	160	95	0.02	0.7	148.5	0.4	1-RH	10
TB-12-09			DESV	05	12x8	145	75	0.5	0.25	0.02	10	14	75	3.3	55	160	95.7	0.01	0.6	147.6	0.28	1-RH	10
TB-12-10			DESV	04	12x8	130	65	0.5	0.25	0.04	17	19	65	3.1	55	160	98.9	0.01	0.6	148.4	0.27	1-RH	10
TB-12-11			DESV	05	12x8	100	50	0.5	0.25	0.02	-	-	50	2.7	55	160	105.2	0.01	0.6	149.8	0.27	1-RH	10
TB-12-12			DESV	05	12x8	125	65	0.5	0.25	0.02	-	11	65	3.1	55	160	98.9	0.01	0.6	148.4	0.27	1-RH	10
TB-12-13			DESV	05	12x8	125	65	0.5	0.25	0.02	-	11	65	3.1	55	160	98.9	0.01	0.6	148.4	0.27	1-RH	10
TB-12-14			DESV	07	12x10	210	105	0.5	0.25	0.04	11	14	105	4.6	55	160	95	0.02	0.6	144.5	0.43	1-RH	10
TB-12-15			DESV	06	12x8	105	55	0.5	0.25	0.02	-	-	55	2.9	55	160	102.9	0.01	0.6	149.3	0.27	1-RH	10
TB-12-16			DESV	07	12x10	230	115	0.5	0.25	0.04	13	14	115	5	55	160	95	0.02	0.7	145.3	0.54	1-RH	10
TB-12-17			DESV	05	12x8	105	55	0.5	0.25	0.02	-	10	55	2.9	55	160	102.9	0.01	0.6	149.3	0.27	1-RH	10
TB-12-18			DESV	12	16x15	1110	555	0.5	0.25	0.21	19	18	555	24.1	55	160	95	0.2	2	134.8	0.57	2-RH	10
TB-12-19			DESV	06	12x8	255	130	0.5	0.25	0.09	14	12	130	5.6	55	160	95	0.04	1.9	153.9	1.62	1-RH	10
TB-12-20			DESV	06	12x8	100	50	0.5	0.25	0.02	-	-	50	2.7	55	160	105.2	0.01	0.6	149.8	0.27	1-RH	10
TB-12-21			DESV	06	12x8	135	70	0.5	0.25	0.02	-	-	70	3.2	55	160	97.2	0.01	0.6	148	0.28	1-RH	10
TB-12-22			DESV	06	12x8	180	90	0.5	0.25	0.05	10	-	90	3.9	55	160	95	0.02	0.7	148.5	0.4	1-RH	10
TB-12-23			DESV	06	12x8	145	75	0.5	0.25	0.03	-	-	75	3.3	55	160	95.7	0.01	0.6	147.6	0.28	1-RH	10
TB-12-24			DESV	06	12x8	175	90	0.5	0.25	0.04	10	-	90	3.9	55	160	95	0.02	0.7	148.5	0.4	1-RH	10
TB-13-01			DESV	06	12x8	225	115	0.5	0.25	0.07	13	10	115	5	55	160	95	0.03	1.2	151.3	0.7	1-RH	10
TB-13-02			DESV	10	14x12.5	890	445	0.5	0.25	0.24	22	19	445	19.3	55	160	95	0.23	2.1	140.5	0.54	2-RH	10
TB-13-03			DESV	12	16x15	540	270	0.5	0.25	0.05	13	14	270	11.7	55	160	95	0.04	2.3	149	0.95	1-RH	10
TB-13-04			DESV	12	16x15	510	255	0.5	0.25	0.04	11	14	255	11.1	55	160	95	0.03	1.8	146.9	0.6	1-RH	10
TB-13-05			DESV	12	16x15	1000	500	0.5	0.25	0.17	18	17	500	21.7	55	160	95	0.16	1.8	134.2	0.46	2-RH	10
TB-13-06			DESV	14	20x17.5	1000	500	0.5	0.25	0.07	15	11	500	21.7	55	160	95	0.06	9	154.9	7.68	1-RH	10
TB-13-07			DESV	14	20x17.5	1200	600	0.5	0.25	0.13	16	13	600	28.2	55	160	98.3	0.12	2.2	133.5	0.37	2-RH	10
TB-13-08			DESV	12	16x15	800	400	0.5	0.25	0.12	17	15	400	19.3	55	160	99.5	0.11	1.7	135.8	0.42	2-RH	10
TB-13-09			DESV	09	14x12.5	400	200	0.5	0.25	0.03	11	-	200	8.7	55	160	95	0.02	1.8	150	0.5	1-RH	10
TB-13-10			DESV	14	20x17.5	800	400	0.5	0.25	0.05	13	10	400	17.4	55	160	95	0.04	3.5	149.6	1.78	1-RH	10
TB-13-11			DESV	09	14x12.5	400	200	0.5	0.25	0.03	11	-	200	8.7	55	160	95	0.02	1.8	150	0.5	1-RH	10

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BEVERLY MIDDLE SCHOOL

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KEYNOTE LEGEND:

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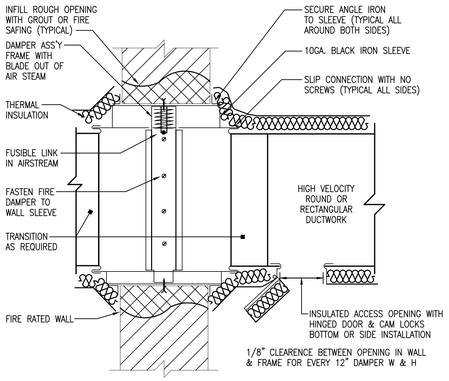
NORTH ARROW

KEYPLAN

DRAWING NAME:

MECHANICAL SCHEDULES

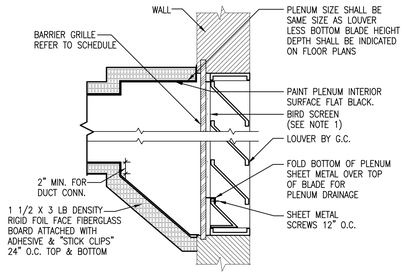
DRAWN BY: JAJ
REVIEWED BY: DAH
SCALE: NONE
JOB NO.: 1403.00
DATE: July 25, 2016
DRAWING NUMBER: M5.3



1. FIRE DAMPER FOR FLOOR PENERTRATIONS TO BE SPRING LOADED

FIRE DAMPER DETAIL

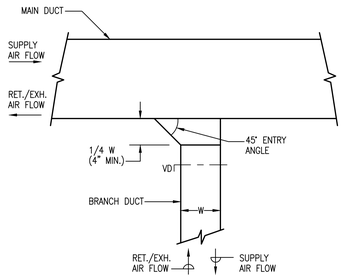
N.T.S.



NOTE:
1. COVER INSIDE FACE OF LOUVER WITH 1/2" MESH ALUMINUM BIRD SCREEN SCREWED IN PLACE.
2. INSULATE UNUSED PORTION OF LOUVER WITH 1 1/2" GLASS FIBER INSULATING BOARD.
3. SEAL ALL PLENUM SEAMS WATERTIGHT WITH SILICONE SEALANT.
4. TYPICAL FOR SUPPLY AND EXHAUST PLENUMS.

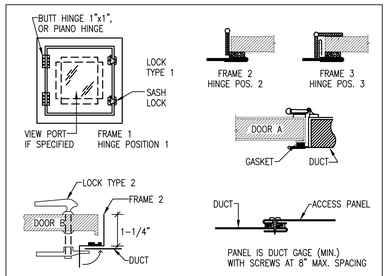
INTAKE AND EXHAUST LOUVER INSTALLATION DETAIL

N.T.S.



DETAIL OF BRANCH DUCT TAKE-OFF

N.T.S.

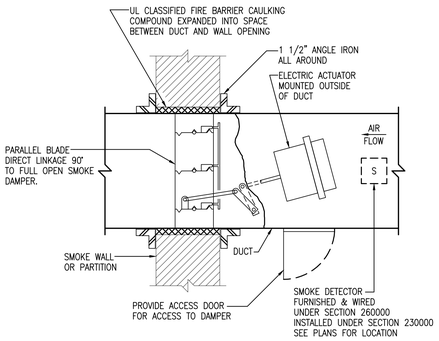


NOTE: CONSTRUCTION AND AIRTIGHTNESS MUST BE SUITABLE FOR THE DUCT PRESSURE CLASS USED.

	DOOR SIZE	No. HINGES	No. LOCKS	METAL GAGE		
				FRAME	DOOR	BACK
2"w.g STATIC and LESS	12"x12"	2	1-S	24	26	26
	16"x20"	2	2-S	22	24	26
	24"x24"	3	2-S	22	22	26
3"w.g STATIC	12"x12"	2	1-S	22	22	26
	16"x20"	2	1-S,1-T,1-B	20	20	26
	24"x24"	3	2-S,1-T,1-B	20	20	24
4" w.g TO 10"w.g	12"x12"	2	1-S	20	20	26
	16"x20"	3	1-S,1-T,1-B	20	18	24
	24"x24"	3	2-S,2-T,2-B	18	18	24
S = SIDE OPPOSITE HINGES, T = TOP, B = BOTTOM						

DUCT ACCESS DOORS

N.T.S.

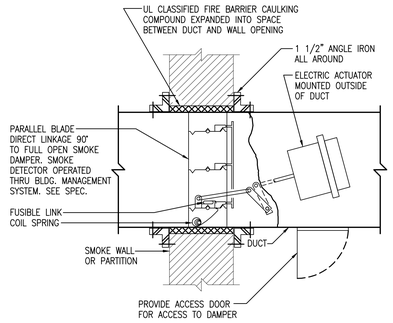


NOTES:

1. PROVIDE SEALING AROUND DUCTWORK AT ALL PENETRATIONS THROUGH SMOKE WALLS.
2. MAXIMUM PRESSURE DROP ACROSS SMOKE DAMPERS SHOULD NOT EXCEED 0.1 INCHES OF WATER. DAMPER MANUFACTURER SHALL SUBMIT PRESSURE DROP FOR MAXIMUM AIR FLOW REQUIRED IN ASSOCIATED DUCT AND SHALL RESIZE SMOKE DAMPER AS REQUIRED TO MEET MAXIMUM PRESSURE DROP AND SHALL WORK WITH HVAC CONTRACTOR TO COORDINATE INSTALLATION.
3. HVAC CONTRACTOR SHALL PROVIDE DUCT TRANSITIONS AT SMOKE DAMPERS AS REQUIRED TO ACCOMMODATE REQUIRED SMOKE DAMPER SIZE.
4. SMOKE DAMPERS SHALL BE SQUARE OR RECTANGULAR WITH WIDTH AND HEIGHT IN ACCORDANCE WITH MANUFACTURER'S STANDARD SIZES, BUT IN NO CASE LESS THAN WIDTH AND HEIGHT OF ASSOCIATED DUCT SIZE OR SUCH THAT MAXIMUM ALLOWED PRESSURE DROP IS EXCEEDED.

SMOKE DAMPER DETAIL

N.T.S.

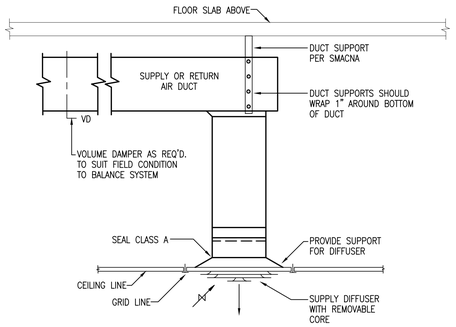


NOTES:

1. PROVIDE SEALING AROUND DUCTWORK AT ALL PENETRATIONS THROUGH SMOKE WALLS.
2. MAXIMUM PRESSURE DROP ACROSS SMOKE DAMPERS SHOULD NOT EXCEED 0.1 INCHES OF WATER. DAMPER MANUFACTURER SHALL SUBMIT PRESSURE DROP FOR MAXIMUM AIR FLOW REQUIRED IN ASSOCIATED DUCT AND SHALL RESIZE SMOKE DAMPER AS REQUIRED TO MEET MAXIMUM PRESSURE DROP AND SHALL WORK WITH HVAC CONTRACTOR TO COORDINATE INSTALLATION.
3. HVAC CONTRACTOR SHALL PROVIDE DUCT TRANSITIONS AT SMOKE DAMPERS AS REQUIRED TO ACCOMMODATE REQUIRED SMOKE DAMPER SIZE.
4. SMOKE DAMPERS SHALL BE SQUARE OR RECTANGULAR WITH WIDTH AND HEIGHT IN ACCORDANCE WITH MANUFACTURER'S STANDARD SIZES, BUT IN NO CASE LESS THAN WIDTH AND HEIGHT OF ASSOCIATED DUCT SIZE OR SUCH THAT MAXIMUM ALLOWED PRESSURE DROP IS EXCEEDED.

SMOKE AND FIRE DAMPER DETAIL

N.T.S.



TYPICAL SUPPLY DIFFUSER OR RETURN REGISTER DETAIL

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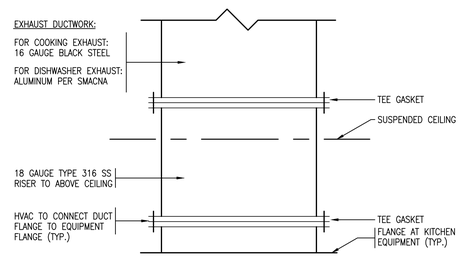

DUCTWORK CONNECTIONS AT KITCHEN EQUIPMENT

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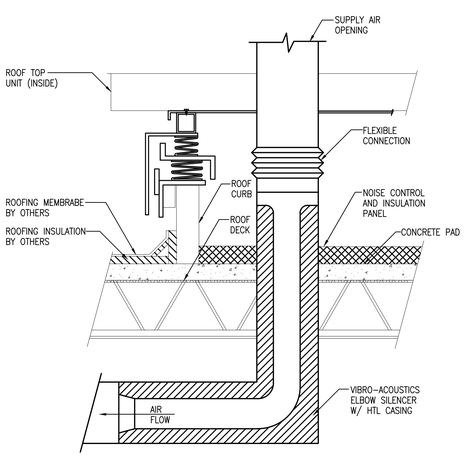

ELBOW SILENCER DETAIL

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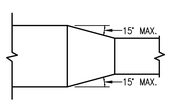
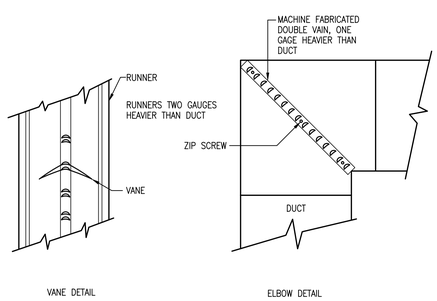


PLAN OR SIDE VIEW

DUCT TRANSITION DETAIL

N.T.S.



VANES FOR SQUARE ELBOWS DETAIL

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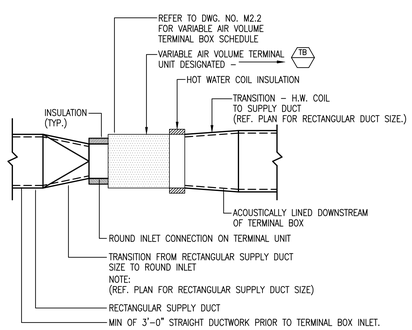

VARIABLE AIR VOLUME TERMINAL BOX DUCT CONN. DETAIL

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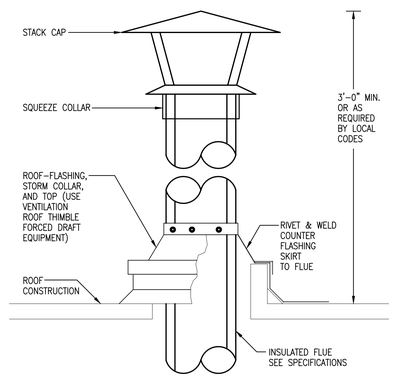

BOILER FLUE PIPING ROOF PENETRATION DETAIL

N.T.S.

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BEVERLY MIDDLE SCHOOL

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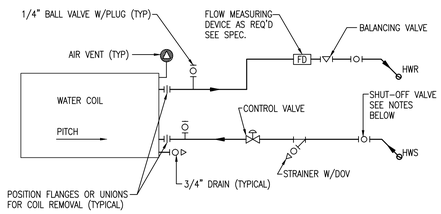
NORTH ARROW

KEYPLAN

DRAWING NAME:

MECHANICAL DETAILS

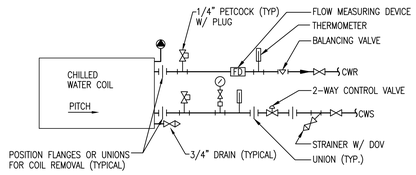
DRAWN BY: JAJ
REVIEWED BY: DAH
SCALE: NONE
JOB NO.: 1403.00
DATE: July 25, 2016
DRAWING NUMBER: M6.1



NOTES:
1. COIL TO BE PIPED COUNTER FLOW TO AIR FLOW
2. VALVES UP TO 2" SHALL BE BALL VALVES
3. VALVES 2 1/2" & LARGER SHALL BE GATE VALVES

TYPICAL ONE SECTION HIGH WATER HEATING OR REHEAT COIL PIPING DETAIL W/ TWO – WAY VALVE

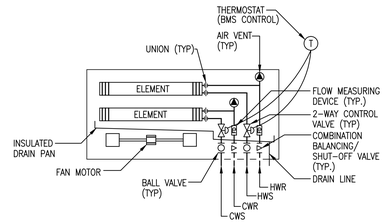
N.T.S.



NOTES:
1. COIL TO BE PIPED COUNTER FLOW TO AIR FLOW
2. VALVES UP TO 2" SHALL BE BALL VALVES
3. VALVES 2 1/2" & LARGER SHALL BE BUTTERFLY VALVES

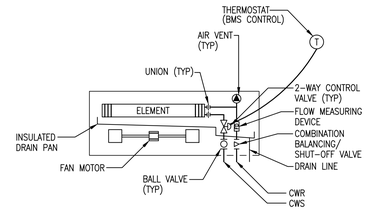
CHILLED WATER COIL PIPING DETAIL

N.T.S.



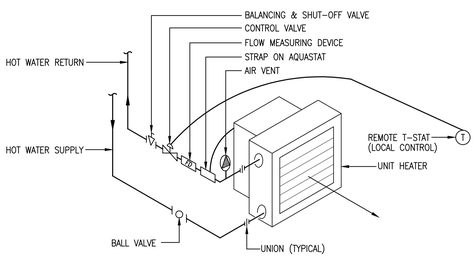
FOUR PIPE FAN COIL UNIT PIPING DETAIL

N.T.S.



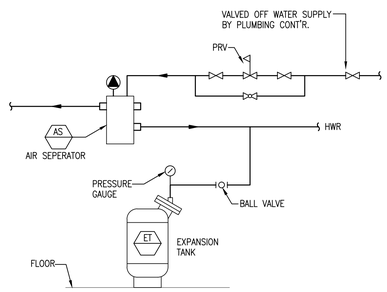
TWO PIPE FAN COIL UNIT PIPING DETAIL

N.T.S.



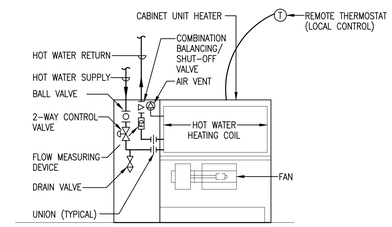
HORIZONTAL UNIT HEATER PIPING DETAIL

N.T.S.



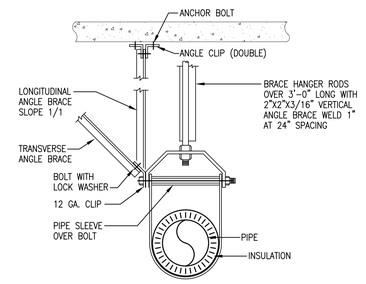
EXPANSION TANK PIPING DETAIL

N.T.S.



PIPING TO CABINET UNIT HEATER DETAIL

N.T.S.

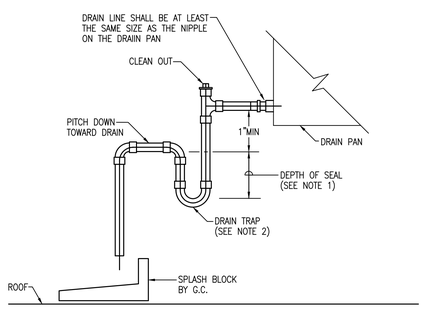


PIPE SIZE	* ANGLE BRACE	BOLT TO ANGLE	ANGLE CLIP	ANCHOR BOLT OR INSERT
2 1/2"	2"X2" 16 GA.	3/8"	3"X3"X1/4	3/8
3", 4"	2 1/2"X2 1/2" 16 GA.	3/8"	3"X3"X1/4	1/2
5", 6"	2 1/2"X2 1/2" 16 GA.	1/2"	5"X3"X1/2	3/4
8"	3"X3" 12 GA.	5/8"	2-5"X3"X1/2	2-5/8
10"	3"X3" 12 GA.	3/4"	2-5"X3"X1/2	2-3/4

* 1 5/8 X 1 5/8 X 12 GAGE CHANNEL MAY BE USED.

TYPICAL SEISMIC BRACING FOR PIPE DETAIL

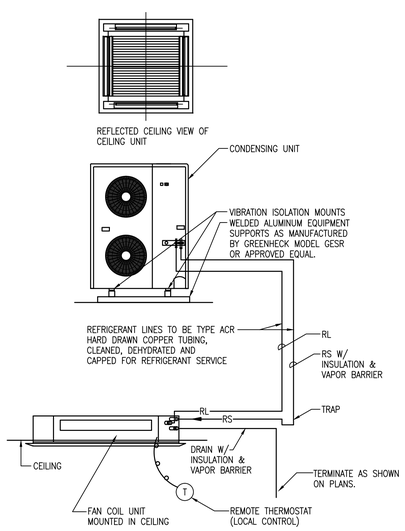
N.T.S.



NOTE:
1. THE DEPTH OF THE SEAL SHALL BE A MINIMUM OF THE ROOFTOP AIR HANDLING UNIT'S TOTAL STATIC PRESSURE IN INCHES OF WATER PLUS 3".
2. MANUALLY PRIME FILL TRAP PRIOR TO START-UP OF UNIT.

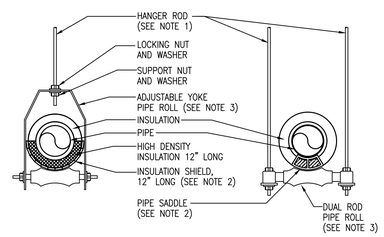
ROOFTOP AIR HANDLING UNIT COOLING COIL DRAIN TRAP DETAIL

N.T.S.



DUCTLESS FAN COIL AIR CONDITIONING UNIT & PIPING DETAIL

N.T.S.



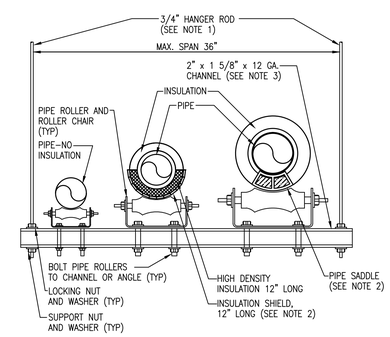
HANGER ROD SCHEDULE	
PIPE SIZE	ROD SIZE
4"	5/8" DIA.
5"	5/8" DIA.
6"	3/4" DIA.
8"	7/8" DIA.
10"	7/8" DIA.
12"	7/8" DIA.

HANGER ROD SPACING	
PIPE SIZE	MAX. ALLOWABLE SPACING
4"	10'
5"	10'
6"	10'
8"	10'
10"	10'
12"	10'

NOTE:
1. REFER TO "TYPICAL METHOD OF SECURING HANGER RODS DETAIL" FOR ATTACHING HANGERS TO THE STRUCTURE.
2. PROVIDE INSULATION SHIELD OR PIPE SADDLE BASED ON THE PIPING SYSTEM AND PIPE SIZE AS INDICATED IN THE SPECIFICATIONS.
3. ADJUSTABLE YOKE PIPE ROLL SHALL BE USED ON 4" AND 5" PIPING. ON ALL PIPING 6" AND LARGER USE DUAL ROD PIPE ROLL.

PIPE ROLL TYPE PIPE HANGER INSTALLATION DETAIL

N.T.S.



NOTE:
1. REFER TO "TYPICAL METHOD OF SECURING HANGER RODS DETAIL" FOR ATTACHING HANGERS TO THE STRUCTURE.
2. PROVIDE INSULATION SHIELD OR PIPE SADDLE BASED ON THE PIPING SYSTEM AND PIPE SIZE AS INDICATED IN THE SPECIFICATIONS.
3. TRAPEZE TYPE HANGER SHALL BE USED FOR A MAXIMUM 1000 LB. UNIFORM LOAD.

TRAPEZE TYPE PIPE HANGER INSTALLATION DETAIL

N.T.S.

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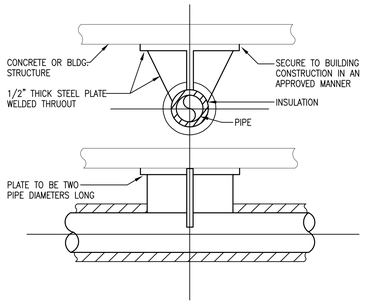
KEYPLAN

DRAWING NAME:

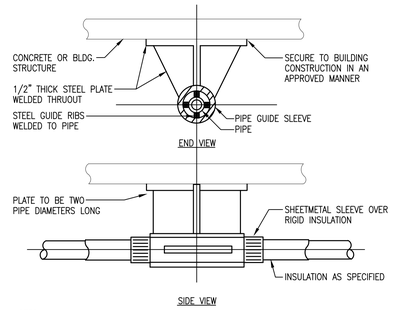
MECHANICAL DETAILS

DRAWN BY: JAJ
REVIEWED BY: DAH
SCALE: NONE
JOB NO.: 1403.00
DATE: July 25, 2016
DRAWING NUMBER: M6.2



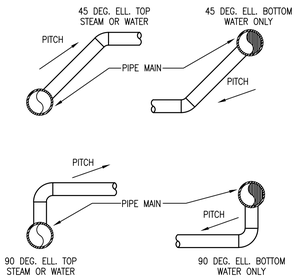
NOTES:
1. CONCRETE ATTACHMENTS SHALL BE HILTI OR APPROVED EQUAL
2. STEEL ATTACHMENTS SHALL BE WELDED OR BOLTED
3. FOR PIPES W/ CENTERLINE LESS THAN 18" BELOW SLAB OR BEAM

PIPE ANCHOR DETAIL
N.T.S.



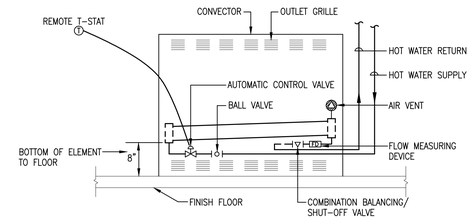
NOTES:
1. CONCRETE ATTACHMENTS SHALL BE HILTI OR APPROVED EQUAL.
2. STEEL ATTACHMENTS SHALL BE WELDED OR BOLTED.
3. FOR PIPES W/ CENTERLINE LESS THAN 18" BELOW SLAB OR BEAM.

PIPE GUIDE DETAIL
N.T.S.



TYPICAL FOR ALL WATER PIPING SYSTEMS

TYPICAL BRANCH PIPE TAKE-OFF DETAIL
N.T.S.



HOT WATER CONVECTOR PIPING DETAIL
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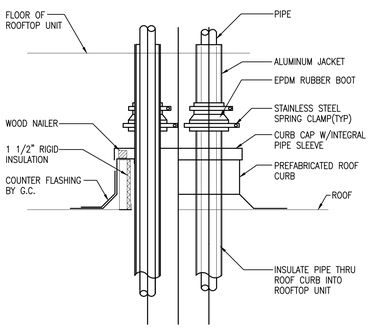
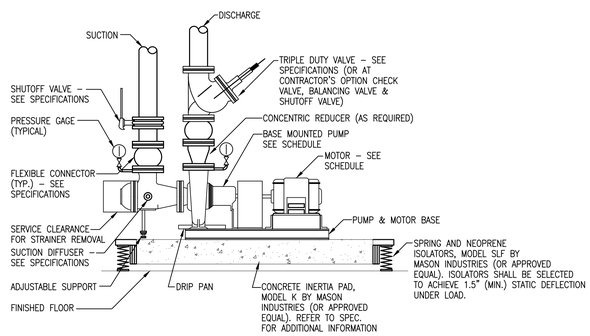
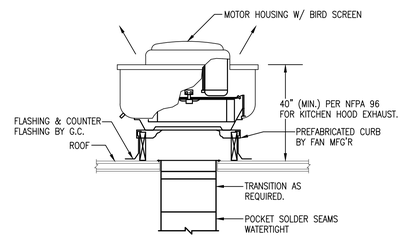


PIPING ROOF PENETRATION
N.T.S.

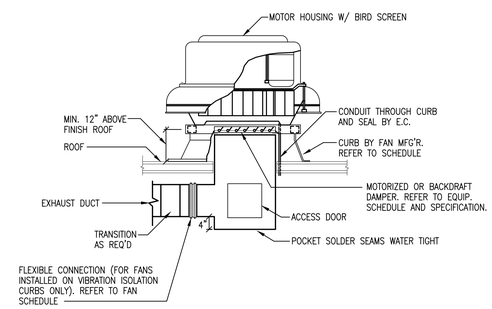


END SUCTION PUMP DETAIL
N.T.S.

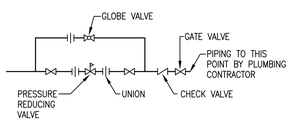


NOTE: KITCHEN HOOD EXHAUST FANS SHALL BE PROVIDED WITH VENTED CURB EXTENSION AS REQUIRED BY NFPA 96.

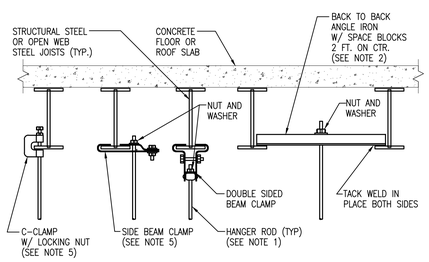
TOP DISCHARGE CENTRIFUGAL ROOF EXHAUSTER DETAIL
N.T.S.



CENTRIFUGAL ROOF EXHAUSTER DETAIL WITH PREFABRICATED CURB
N.T.S.

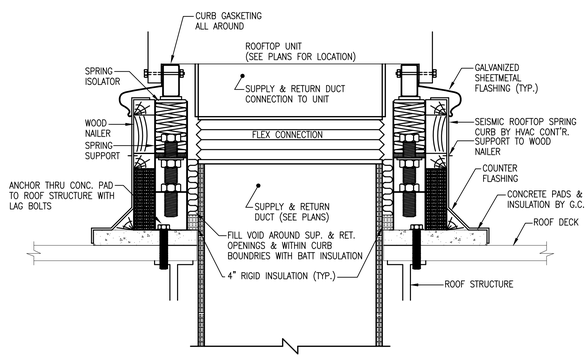


COLD WATER MAKE UP STATION
N.T.S.

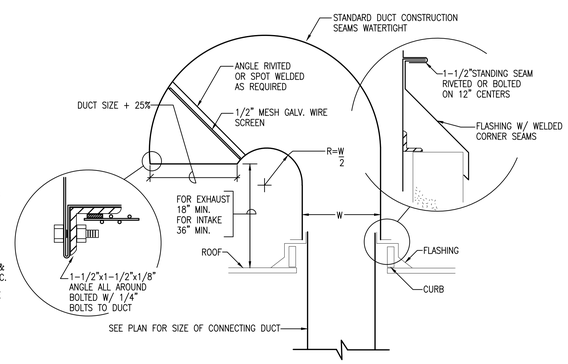


1. REFER TO PIPE HANGER DETAIL FOR HANGER ROD SIZE. FOR CEILING SUSPENDED EQUIPMENT PROVIDE MIN. 3/8" DIA. HANGER ROD (REFER TO MANUFACTURER'S INSTALLATION INSTRUCTIONS).
2. FOR PIPES UNDER 2" USE A SINGLE 1-1/2"x1-1/2"x1/4" ANGLE IRON WITH C-CLAMP. FOR PIPES 2-1/2" AND LARGER USE 3"x3"x1/4" ANGLE IRON BACK TO BACK AS SHOWN.
3. REFER TO "TYPICAL METHOD OF SECURING HANGER RODS TO CONCRETE DECK DETAIL" FOR ATTACHING HANGER RODS TO CONCRETE DECK.
4. REPAIR OF FIREPROOFING IN ORDER TO FACILLITATE THE INSTALLATION OF HANGER RODS IN EXISTING CONSTRUCTION SHALL BE BY THE G.C.
5. USE OF C-CLAMPS AND SIDE BEAM CLAMPS IS LIMITED TO PIPING 2-1/2" AND UNDER.

TYPICAL METHODS OF SECURING HANGER RODS TO STRUCTURL STEEL DETAIL
N.T.S.

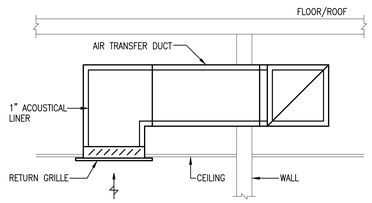


ROOFTOP UNIT CURB DETAIL
N.T.S.

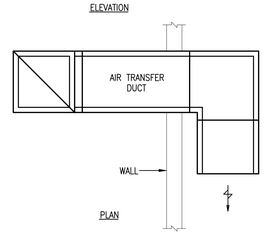


NOTES:
1. SEE ARCHITECTURAL DRAWINGS &/OR SPECIFACATIONS FOR CURB, FLASHING & ROOFING
2. WHEN WOOD PLATE IS PROVIDED AROUND TOP OF CURB, SECURE FLASHING & GOOSENECK TO WOOD PLATE WITH 3/8" CADMIUM PLATED LAG BOLTS NOT OVER 12" ON CENTERS
3. WHEN PREFAB. METAL CURB IS USED, SECURE FLASHING & GOOSENECK WITH SHEET METAL SCREWS AS REQUIRED FOR TIGHT JOINTS & RIGID INSULATION

RECTANGULAR GOOSENECK DETAIL
N.T.S.



ELEVATION



PLAN

NOTE: AIR TRANSFER DUCT SIZE SHALL BE BASED ON A MAXIMUM DUCT VELOCITY OF 500 FPM

AIR TRANSFER DUCT DETAIL
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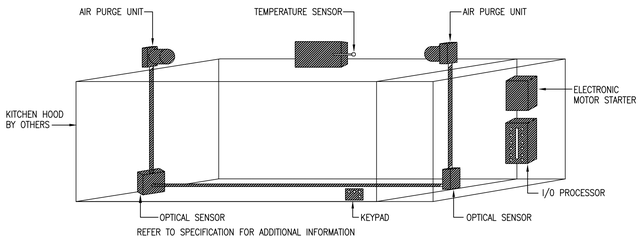
DRAWING NAME:

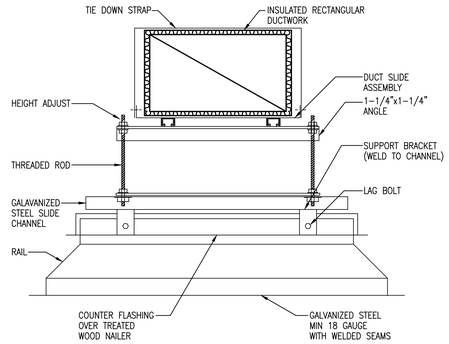
MECHANICAL DETAILS

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	NONE
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M6.3



KITCHEN HOOD EXHAUST CONTROL DETAIL

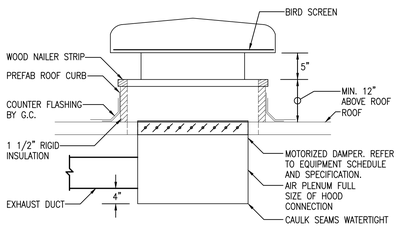
N.T.S.



NOTE:
1. ALL EXPOSED METAL TO BE PRIMED & PAINTED

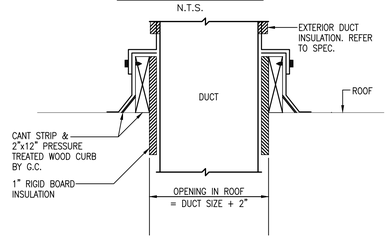
ROOF MOUNTED DUCT SUPPORT DETAIL

N.T.S.



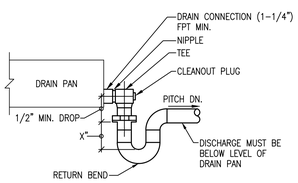
ROOF VENT INSTALLATION DETAIL

N.T.S.



DUCTWORK ROOF PENETRATION DETAIL

N.T.S.

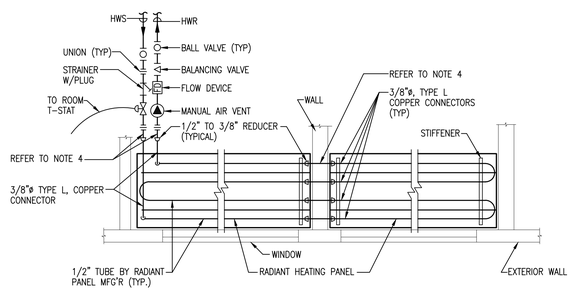


X= TOTAL STATIC PRESSURE OF FAN

NOTES:
1. ALLOW SUFFICENT SPACE BELOW DRAIN PAN FOR TRAP.
2. PITCH DRAIN FOR PROPER RUNOFF.
3. MANUALLY PRIME FILL TRAP BEFORE STARTUP TO FORM INITIAL DRAIN SEAL.
4. SUPPORT LENGTHY DRAINS LINES TO PREVENT SAG AND CONDENSATE OVERFLOW.

DRAIN PAN WATER SEAL PIPING DETAIL

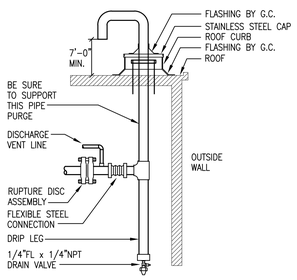
N.T.S.



NOTES:
1. INSTALL 1-1/2" THICK GLASS FIBER PAD (DENSITY 0.75 LB/SQ. FT) ABOVE RADIANT PANELS INSULATION SHALL BE TAPED AND SECURED TO PANELS.
2. PROVIDE HANGERS AND SUPPORTS PER MFGR'S RECOMMENDATIONS.
3. PROVIDE PLASTER FRAME AS REQUIRED FOR SETTING IN GWB OR PLASTER CEILINGS.
4. 3 FOOT LONG, 1/2" FLEXIBLE HOSES; WITH SYNTHETIC POLYMER CORE; WITH AN OUTER RATED COVERING OF GALVANIZED STEEL; WITH STEEL FITTINGS, MPT CONNECTIONS AND DIELECTRIC COUPLINGS. FIRE RATED ASSEMBLY MEETS UL 94 AND ASTM 84.

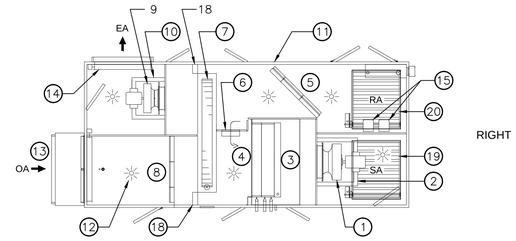
TYPICAL RADIANT HEATING PANEL PIPING DETAIL

N.T.S.

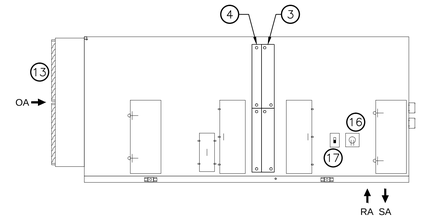


REFRIGERANT VENT PIPING DETAIL

N.T.S.



PLAN VIEW - FRONT



UNIT ELEVATION

NOTE: REFER TO SPECIFICATION FOR ADDITIONAL INFORMATION

1. SUPPLY FAN SECTION. PLENUM FAN WITH INLET AIR FLOW STATION.
2. STRUCTURAL STEEL FAN ISOLATION BASE. FAN SHALL BE ISOLATED FROM OUTER CASING WITH FACTORY INSTALLED 2" DEFLECTION SPRING VIBRATION/SEISMIC ISOLATORS SIMILAR TO MODEL SLRS BY MASON INDUSTRIES.
3. CHILLED WATER COOLING COILS WITH STAINLESS STEEL CASING AND STAINLESS STEEL DRAIN PAN.
4. HOT WATER HEATING COIL.
5. EXHAUST FILTER SECTION WITH MERV 8 PRE-FILTERS AND MERV 13 FINAL FILTERS.
6. RECIRCULATION AIR DAMPER.
7. TOTAL ENTHALPY ENERGY WHEEL.
8. SUPPLY FILTER SECTION WITH MERV 8 PRE-FILTERS AND MERV 13 FINAL FILTERS.
9. EXHAUST FAN SECTION. PLENUM FAN WITH INLET AIRFLOW STATIONS.
10. STRUCTURAL STEEL FAN ISOLATION BASE. FAN SHALL BE ISOLATED FROM OUTER CASING WITH FACTORY INSTALLED 2" DEFLECTION SPRING VIBRATION/SEISMIC ISOLATORS SIMILAR TO MODEL SLRS BY MASON INDUSTRIES.
11. DOUBLE WALL CASING.
12. MARINE LIGHT. ALL LIGHTS SHALL BE CONTROLLED BY A SINGLE WEATHERPROOF LIGHT SWITCH. TYPICAL IN ALL ACCESSIBLE SECTIONS.
13. FRESH AIR INTAKE WITH RAIN HOOD. FRESH AIR INTAKE SHALL BE FURNISHED WITH MINIMUM OUTSIDE AIR DAMPER WITH INTERGAL AIR FLOW STATION (EBTRON AIR-IQ OR APPROVED EQUAL) DAMPER SHALL BE SIZED FOR AN AIR VELOCITY OF 1000 FPM.
14. EXHAUST AIR DAMPER.
15. FACTORY MOUNTED AND WIRED VFD FOR SUPPLY AND EXHAUST FANS.
16. WEATHER PROOF DUPLEX OUTLET.
17. WEATHER PROOF LIGHT SWITCH.
18. ENERGY WHEEL BYPASS DAMPERS.
19. SUPPLY SMOKE DAMPER FURNISHED & INSTALLED BY UNIT MANUFACTURER. SIZE TO MATCH UNIT SUPPLY AIR OPENING. SMOKE DAMPER NOT REQUIRED ON ERU-3.
20. RETURN SMOKE DAMPER FURNISHED & INSTALLED BY UNIT MANUFACTURER. SIZE TO MATCH UNIT RETURN AIR OPENING. SMOKE DAMPER NOT REQUIRED ON ERU-3.

ENERGY RECOVERY UNIT DETAIL (TYPICAL FOR RTU-)

N.T.S.

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KEYPLAN

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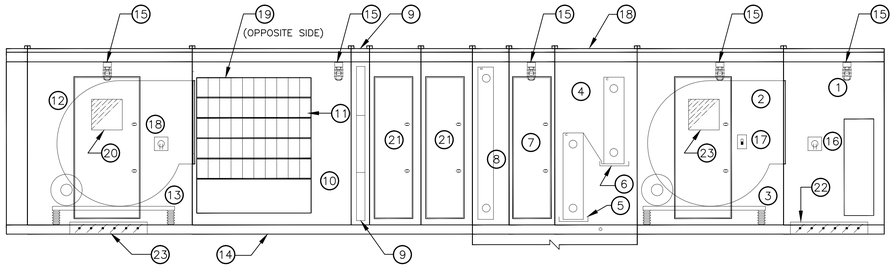
DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	NONE
JOB NO.:	1403.00
DATE:	July 25, 2016

DRAWING NUMBER: M6.4



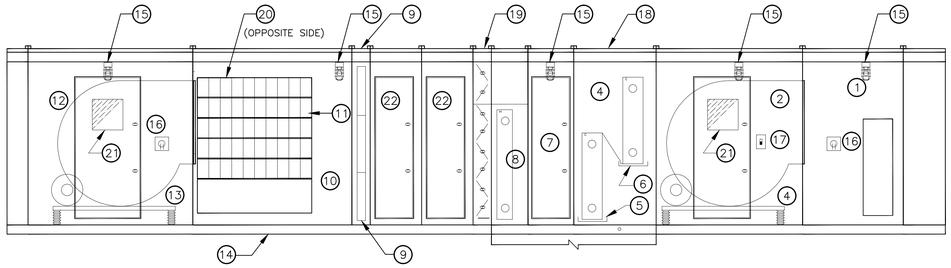
UNIT ELEVATION

NOTE: REFER TO SPECIFICATION FOR ADDITIONAL INFORMATION

1. DISCHARGE PLENUM SECTION. DOUBLE WALL CONSTRUCTION WITH 20 GAUGE PERFORATED GALVANIZED STEEL LINER.
2. SUPPLY FAN SECTION. DOUBLE WIDTH, DOUBLE INLET, AIRFOIL FAN. FAN SHALL BE FURNISHED WITH FAN INLET AIR FLOW STATION. (EBTRON GOLD SERIES OR APPROVED EQUAL).
3. STRUCTURAL STEEL FAN ISOLATION BASE. FAN SHALL BE ISOLATED FROM OUTER CASING WITH FACTORY INSTALLED 2" DEFLECTION SPRING VIBRATION/SEISMIC ISOLATORS SIMILAR TO MODEL SLRS BY MASON INDUSTRIES.
4. CHILLED WATER COOLING COIL SECTION. W/ STAINLESS STEEL CASING.
5. STAINLESS STEEL COOLING COIL DRAIN PAN.
6. STAINLESS STEEL COOLING COIL INTERMEDIATE DRAIN PAN.
7. ACCESS SECTION.
8. HOT WATER PREHEAT COIL SECTION.
9. 4" MERV 13 FILTERS.
10. EXHAUST/MIXING BOX SECTION.
11. EXHAUST AIR OUTLET. FRESH AIR INTAKE ON OPPOSITE SIDE OF UNIT.
12. RETURN FAN SECTION. DOUBLE WIDTH, DOUBLE INLET, AIRFOIL FAN. RETURN FAN SECTION SHALL BE DOUBLE WALL CONSTRUCTION WITH 20 GAUGE PERFORATED GALVANIZED STEEL LINER. FAN SHALL BE FURNISHED WITH FAN INLET AIR FLOW STATION. (EBTRON GOLD SERIES OR APPROVED EQUAL).
13. STRUCTURAL STEEL FAN ISOLATION BASE. FAN SHALL BE ISOLATED FROM OUTER CASING WITH FACTORY INSTALLED 2" DEFLECTION SPRING VIBRATION/SEISMIC ISOLATORS SIMILAR TO MODEL SLRS BY MASON INDUSTRIES.
14. UNIT BASE RAIL.
15. MARINE LIGHT.
16. WEATHER PROOF DUPLEX OUTLET.
17. WEATHER PROOF LIGHT SWITCH. ONE SWITCH SHALL CONTROL ALL INTERIOR LIGHTS.
18. PIPE VESTIBULE. PIPE VESTIBULE SHALL EXTEND DOWN TO ROOF CURB. PIPE VESTIBULE SHALL ENCLOSE HOT WATER SUPPLY & RETURN PIPING FOR PREHEAT COIL AS WELL AS CHILLED WATER SUPPLY & RETURN PIPING. PIPE VESTIBULE TO BE PROVIDED WITH DOUBLE WALL, INSULATED AND GASKETED DOORS SUITABLE FOR PRACTICAL ACCESS TO VALVES AND PIPING.
19. FRESH AIR INTAKE WITH RAIN HOOD. FRESH AIR INTAKE SHALL BE FURNISHED WITH MINIMUM OUTSIDE AIR DAMPER WITH INTERGAL AIR FLOW STATION (EBTRON AIR-IQ OR APPROVED EQUAL) DAMPER SHALL BE SIZED FOR AN AIR VELOCITY OF 1000 FPM.
20. VIEW PORT.
21. CONTROL ENCLOSURE WITH FACTORY MOUNTED AND WIRED VFD'S FOR SUPPLY AND RETURN FANS.
22. SUPPLY SMOKE DAMPER FURNISHED & INSTALLED BY UNIT MANUFACTURER. SIZE TO MATCH UNIT SUPPLY AIR OPENING. SMOKE DAMPER REQUIRED ON RTU-1 ONLY.
23. RETURN SMOKE DAMPER FURNISHED & INSTALLED BY UNIT MANUFACTURER. SIZE TO MATCH UNIT RETURN AIR OPENING. SMOKE DAMPER REQUIRED ON RTU-1 ONLY.

ROOFTOP UNIT DETAIL (TYPICAL FOR RTU-)

N.T.S.



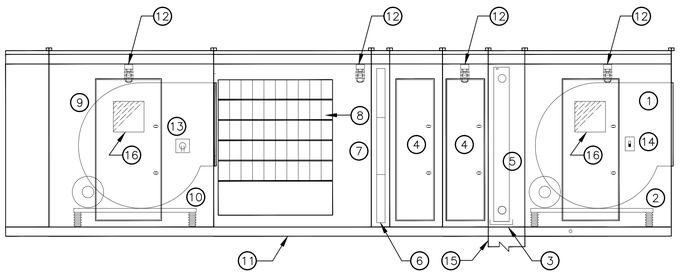
UNIT ELEVATION

NOTE: REFER TO SPECIFICATION FOR ADDITIONAL INFORMATION

1. DISCHARGE PLENUM SECTION. DOUBLE CONSTRUCTION WITH 20 GAUGE PERFORATED GALVANIZED STEEL LINER.
2. SUPPLY FAN SECTION. DOUBLE WIDTH, DOUBLE INLET, AIRFOIL FAN. FAN SHALL BE FURNISHED WITH FAN INLET AIR FLOW STATION
3. STRUCTURAL STEEL FAN ISOLATION BASE. FAN SHALL BE ISOLATED FROM OUTER CASING WITH FACTORY INSTALLED 2" DEFLECTION SPRING VIBRATION/SEISMIC ISOLATORS.
4. CHILLED WATER COOLING COIL SECTION.
5. STAINLESS STEEL COOLING COIL DRAIN PAN.
6. STAINLESS STEEL COOLING COIL INTERMEDIATE DRAIN PAN.
7. ACCESS SECTION.
8. HOT WATER PREHEAT COIL SECTION.
9. MERV 13 FILTERS
10. EXHAUST/MIXING BOX SECTION.
11. EXHAUST AIR OUTLET. FRESH AIR INTAKE ON OPPOSITE SIDE OF UNIT.
12. RETURN FAN SECTION. DOUBLE WIDTH, DOUBLE INLET, AIRFOIL FAN. RETURN FAN SECTION SHALL BE DOUBLE WALL CONSTRUCTION WITH 20 GAUGE PERFORATED GALVANIZED STEEL LINER. FAN SHALL BE FURNISHED WITH FAN INLET AIR FLOW STATION
13. STRUCTURAL STEEL FAN ISOLATION BASE. FAN SHALL BE ISOLATED FROM OUTER CASING WITH FACTORY INSTALLED 2" DEFLECTION SPRING VIBRATION/SEISMIC ISOLATORS.
14. UNIT BASE RAIL.
15. MARINE LIGHT.
16. WEATHER PROOF DUPLEX OUTLET.
17. WEATHER PROOF LIGHT SWITCH. ONE SWITCH SHALL CONTROL ALL INTERIOR LIGHTS.
18. PIPE VESTIBULE. PIPE VESTIBULE SHALL EXTEND DOWN TO ROOF CURB. PIPE VESTIBULE SHALL ENCLOSE HOT WATER SUPPLY & RETURN PIPING FOR PREHEAT COIL AS WELL AS CHILLED WATER SUPPLY & RETURN PIPING. PIPE VESTIBULE TO BE PROVIDED WITH DOUBLE WALL, INSULATED AND GASKETED DOORS SUITABLE FOR PRACTICAL ACCESS TO VALVES AND PIPING.
19. INTERNAL FACE & BYPASS DAMPERS.
20. FRESH AIR INTAKE WITH RAIN HOOD. FRESH AIR INTAKE SHALL BE FURNISHED WITH MINIMUM OUTSIDE AIR DAMPER WITH INTERGAL AIR FLOW STATION (RUSKIN AMS-60 OR APPROVED EQUAL) DAMPER SHALL BE SIZED FOR AN AIR VELOCITY OF 1000 FPM.
21. VIEW PORT
22. CONTROL ENCLOSURE WITH FACTORY MOUNTED AND WIRED VFD'S FOR SUPPLY AND RETURN FANS.

ROOFTOP UNIT DETAIL (TYPICAL FOR RTU-)

N.T.S.



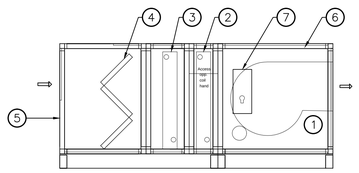
UNIT ELEVATION

NOTE: REFER TO SPECIFICATION FOR ADDITIONAL INFORMATION

1. SUPPLY FAN SECTION. DOUBLE WIDTH, DOUBLE INLET, AIRFOIL FAN.
2. STRUCTURAL STEEL FAN ISOLATION BASE. FAN SHALL BE ISOLATED FROM OUTER CASING WITH FACTORY INSTALLED 2" DEFLECTION SPRING VIBRATION/SEISMIC ISOLATORS SIMILAR TO MODEL SLRS BY MASON INDUSTRIES.
3. STAINLESS STEEL COIL DRAIN PAN.
4. CONTROL ENCLOSURE WITH FACTORY MOUNTED AND WIRED VFD'S FOR SUPPLY AND RETURN FANS.
5. HOT WATER PREHEAT COIL SECTION.
6. 4" MERV 13 FILTERS.
7. EXHAUST/MIXING BOX SECTION.
8. EXHAUST AIR OUTLET. FRESH AIR INTAKE ON OPPOSITE SIDE OF UNIT.
9. RETURN FAN SECTION. DOUBLE WIDTH, DOUBLE INLET, AIRFOIL FAN. RETURN FAN SECTION SHALL BE DOUBLE WALL CONSTRUCTION WITH 20 GAUGE PERFORATED GALVANIZED STEEL LINER.
10. STRUCTURAL STEEL FAN ISOLATION BASE. FAN SHALL BE ISOLATED FROM OUTER CASING WITH FACTORY INSTALLED 2" DEFLECTION SPRING VIBRATION/SEISMIC ISOLATORS SIMILAR TO MODEL SLRS BY MASON INDUSTRIES.
11. UNIT BASE RAIL.
12. MARINE LIGHT.
13. WEATHER PROOF DUPLEY OUTLET.
14. WEATHER PROOF LIGHT SWITCH. ONE SWITCH SHALL CONTROL ALL INTERIOR LIGHTS.
15. PIPE VESTIBULE. PIPE VESTIBULE SHALL EXTEND DOWN TO ROOF CURB. PIPE VESTIBULE SHALL ENCLOSE HOT WATER SUPPLY & RETURN PIPING FOR PREHEAT COIL AS WELL AS CHILLED WATER SUPPLY & RETURN PIPING. PIPE VESTIBULE TO BE PROVIDED WITH DOUBLE WALL, INSULATED AND GASKETED DOORS SUITABLE FOR PRACTICAL ACCESS TO VALVES AND PIPING.
16. VIEW PORT

ROOFTOP UNIT DETAIL (TYPICAL FOR RTU-)

N.T.S.



UNIT ELEVATION

NOTE: REFER TO SPECIFICATION FOR ADDITIONAL INFORMATION

1. SUPPLY FAN SECTION:
   - DOUBLE WIDTH DOUBLE INLET FORWARD CURVED FAN
   - STRUCTURAL STEEL FAN BASE WITH VIBRATION SPRING ISOLATORS.
2. CHILLED WATER HEATING COIL.
3. HOT WATER HEATING COIL.
4. ANGLE FILTERS:
   - 2" MERV 11 PRE-FILTERS
5. RETURN AIR CONNECTION
6. DOUBLE WALL UNIT CASING.
7. FACTORY MOUNTED AND WIRED DISCONNECT BY UNIT MANUFACTURER.

AIR HANDLING UNIT DETAIL (AHU-)

N.T.S.

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BEVERLY MIDDLE SCHOOL

CABOT STREET
BEVERLY, MA 01915

KEYNOTE LEGEND:

90% CONSTRUCTION DOCUMENTS

NOT FOR CONSTRUCTION

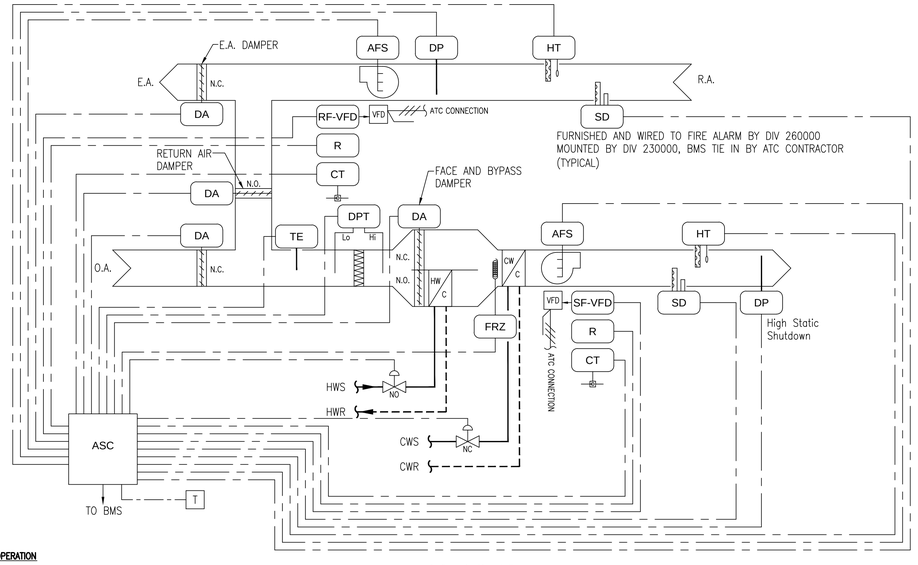
NORTH ARROW

KEYPLAN

DRAWING NAME:

MECHANICAL DETAILS

DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	NONE
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M6.5



SEQUENCE OF OPERATION

Install NFPA approved smoke detectors, provided under Specifications Section 26 00 00, in each supply air and return air duct to each HVAC unit. The smoke detectors shall de-energize their respective units through direct hard wired relays and activate all audio/visual indicating devices on sensing smoke in the air stream.

Provide smoke dampers in the supply air and return air ductwork to all HVAC systems conveying 15,000 CFM or more. These dampers shall close on receiving a signal from the duct mounted smoke detectors and shall simultaneously de-energize the equipment.

Interlock with the integral return/exhaust fan serving the relevant space(s) such that the appropriate return/exhaust fan(s) enter the necessary operational cycle concurrently with their interlocked supply air fan(s).

The return fan shall be modulated to track airflow as sensed by fan inlet air flow measuring stations (supply and return). The DDC system shall monitor supply CFM and calculate a return airflow set point by subtracting a fixed offset, which is difference between supply and return CFM (refer to equipment schedule). The calculated return air set point shall be maintained by modulating the speed of the return air fan via its variable frequency drive, increasing fan speed on a drop in airflow as sensed by the air sensor.

Provide high static and low static pressure controllers at the supply fan and at the return/exhaust fan to stop the system and signal an alarm if limit conditions are exceeded.

Occupied/Unoccupied modes will be as scheduled through the operator's workstation.

Heating cycle - "Morning Warm-Up":

1. Morning warm-up shall be initiated by an optimum start algorithm based on outside air temperature. The optimum start algorithm shall be based on a straight line ramp function such that morning warm-up occurs 2 hour (adj.) prior to the occupied mode when outdoor air temp. is 0°F and ½ hour (adj.) prior to occupied mode when outdoor air temp is 60°F. Optimum start can be overridden at the OWS by manually scheduling the morning warm-up if preferred by facilities personnel.
2. Supply and return fan run continuously. Unit operates for return air temperature set point of 72°F.
3. On a call for heating, unit operates on 100% return air (outdoor & exhaust air damper closed). If outdoor air is less then 40°F, heating coil valve opens 100% and face & bypass dampers modulates to maintain return air temperature set point. If outdoor air is greater then 40°F, face & bypass dampers position for full flow across the heating coil and heating coil valve modulates to maintain return air temperature set point.

Heating cycle - "Occupied":

1. The supply air fan and the return/exhaust air fan shall run continuously. The fresh air damper (s) shall open to introduce the scheduled minimum air volume flow rate to the Rooftop air handling unit from outdoor air. The return air damper(s) shall open to return the scheduled maximum of the air volume flow rate to the Rooftop air handling unit from the space.
2. The exhaust damper (s) shall open 100% to allow exhaust of the scheduled minimum outdoor air volume flow rate supplied to the Rooftop air handling unit, to prevent over pressurization.
3. Heating coil valve shall modulate to maintain room temperature set point. If outdoor air temperature is less than 40°F, heating coil valve opens 100% and face & bypass dampers modulate to maintain discharge air temperature set point.

Heating cycle - "Unoccupied":

1. Unoccupied heating shall be initiated by the room(s) temperature sensor that is furthest from setback set point temperature.
2. The supply air fan and the return/exhaust air fan shall run only upon demand from the setback set point controller. The fresh air damper(s) and the exhaust air damper(s) shall remain 100% closed. The return air damper(s) shall open to return 100% of the air volume flow rate to the Rooftop air handling unit from the space.
3. Remote duct mounted proportional signal temperature sensor shall modulate the heating water control valve to maintain discharge air set point temperature (55°F ADJ.). If outdoor air temperature is less than 40°F, heating coil valve opens 100% and face & bypass dampers modulate to maintain discharge air temperature set point.

Freeze Protection cycle:

1. Provide an automatic reset type freeze-stat at the discharge of the heating coil.
2. On sensing a discharge air temperature of 35°F (adjustable) or below, the supply air fan and the return air fan shall be de-energized. The fresh air dampers and the exhaust air dampers shall close 100%, the return air dampers shall open 100% and all audio/visual alarm devices shall initiate.
3. The heating and coiling coil(s) shall receive full respected water flow until the air temperature sensed by the freeze-stat rises above the low limit temperature sensor set point. The automatic reset freeze-stat shall reset and the unit shall initialize to the appropriate sequence.
4. The BMS shall limit the automatic reset function to a total of two "trips" and resets. Upon a third trip, the reset must be executed through the BMS.

Morning Cool down:

1. Morning cool down shall be initiated by an optimum start algorithm based on outside air temperature. The optimum start algorithm shall be based on a straight line ramp function such that morning cool down occurs 2 hour (adj.) prior to the occupied mode when outdoor air temp. is 95°F and ½ hour (adj.) prior to occupied mode when outdoor air temp is 80°F. Optimum start can be overridden at the OWS by manually scheduling the morning cool down if preferred by facilities personnel.
2. The supply fan shall run continuously, the return fan shall be de-energized, the outside air damper and exhaust air damper shall be closed, and the recirculation damper shall be open.
3. The chilled water control valve shall modulate open as directed by the remote space mounted temperature sensor until the return air temperature reaches the "occupied" space temperature set point.

Cooling cycle - "Occupied":

1. The supply air fan and the return/exhaust air fan shall run continuously. The fresh air damper(s) shall open to introduce the scheduled minimum air volume flow rate to the Rooftop air handling unit form outdoor air. The return air damper(s) shall open to return the scheduled maximum of the air volume flow rate to the Rooftop air handling unit from the space. The exhaust air damper (s) shall open 100% to allow exhaust of the scheduled minimum outdoor air volume flow rate supplied to the Rooftop air handling unit, to prevent over pressurization.
2. Reference enthalpy based economizer control shall compare outside air enthalpy with return air enthalpy and use outside air for cooling upon sensing that the ambient enthalpy is sufficient to meet the cooling requirements. During economizer mode, unit's outside air, return air and exhaust air dampers shall modulate towards the 100% outside air condition (return air damper closed 100%, exhaust air damper and outside air damper open 100%). Economizer mixed air low limit shall be implemented to prevent economizer operation when economizer mixed air temperature is below 45°F (adj.).
3. On sensing that the ambient air is not appropriate to meet the cooling requirements, the chilled water control valve shall modulate as required (in addition to economizer under suitable conditions) to meet the discharge air temperature set point.

Cooling cycle - "Unoccupied":

1. The system shall remain de-energized. The fresh air damper(s) and the exhaust air damper(s) shall remain 100% closed, the return air damper(s) shall open 100%.

Minimum Outside Air Ventilation - Carbon Dioxide (CO2) Control:

1. When in the occupied mode, the controller shall monitor zone CO2 levels served by this air handling unit. The controller shall take the highest zone CO2 level and modulate the outside air dampers open on rising CO2 concentrations, overriding normal damper operation to maintain a CO2 setpoint of 800 ppm (adj.).

Zone Temperature Control:

1. The controller shall measure the zone temperature and shall modulate the supply fan VFD speed to maintain zone temperature setpoint. The fan speed shall increase as the zone temperature rises above cooling setpoint, or as the zone temperature drops below heating setpoint. The supply fan VFD speed shall not drop below 30% (adj.)

Static Pressure Reset Control:

1. ATC contractor shall provide static pressure reset control which shall reset the discharge static pressure set point when facility is in unoccupied mode and terminal box dampers are closed. During unoccupied mode, unit supply static pressure set point shall be reset from maximum setting established during balancing (typically 2.0" max. adj.) down to 0.5" (adj.).

Frost Control:

1. Frost control is initiated when O.A. temperature drops below the set point and pressure drop across the wheel increases, which indicates frosting.
2. When frosting is indicated, the factory mounted and wired pre-heater shall be energized to heat O.A. to energy wheel frost threshold.

Emergency Power Operation:

1. Return fan lockout on emergency power: Upon switch over to emergency power, the return fan shall be de-energized, the return air damper shall open 100%, the exhaust damper and outside air dampers shall close 100%.

Static Safeties:

1. High static pressure safety will stop supply and return fans, close outdoor/exhaust dampers and open heating coil valve 100% when pressure rises above set point. The set point is adjustable at the device. A manual reset is required at the device to restart the unit.
2. Low static pressure safety will stop supply and return fans, close outdoor/exhaust dampers and open heating coil valve 100% when pressure drops below set point. The set point is adjustable at the device. A manual reset is required at the device to restart the unit.

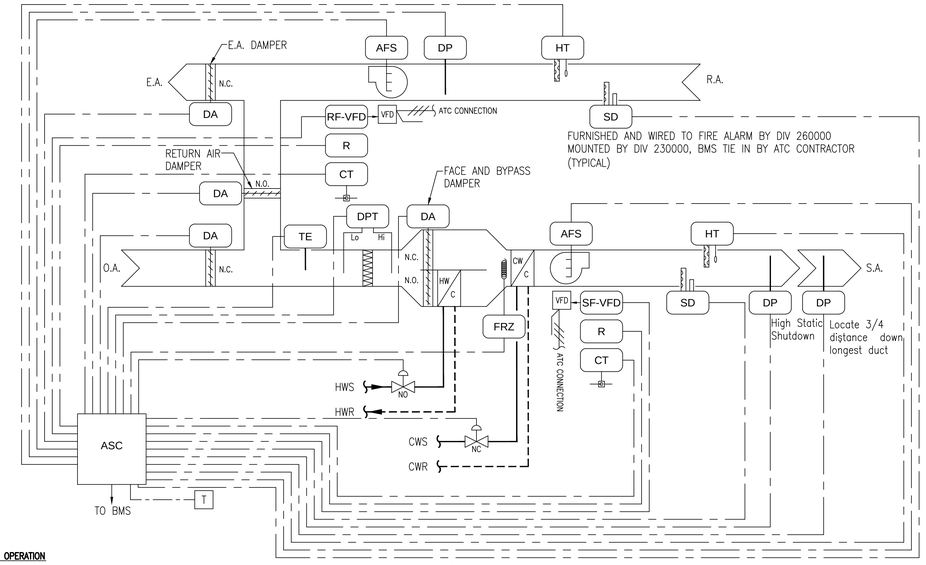
Alarms: The following alarms will annunciate at the workstation:

1. If the supply or return fan status is not indicated within 30sec of start command, a fan failure alarm is generated.
2. If filter differential pressure exceeds the normal pressure setting for the rooftop unit's filters, a dirty filter alarm is generated.
3. Low temperature detector below 35°F.
4. Low static pressure safeties. If the supply air static pressure is 25% (adj.) less than setpoint.
5. High static pressure safeties. If the supply air static pressure is 25% (adj.) greater than setpoint.
6. Discharge air temperature is +/- 5°F form set point during occupied mode.
7. High Zone Carbon Dioxide Concentration: If the highest zone CO2 concentration is greater than 1000 ppm (adj.).

Unoccupied Override:

1. If during the unoccupied mode of the facility, an override button on a thermostat(s) associated with this rooftop unit is activated, the unit shall temporarily return to the occupied mode for the pre-programmed amount of time, typically 2 hours (adj.).

ROOFTOP UNIT W/HOT WATER HEAT AND CHILLED WATER COOLING (RTU-3,8, and 9)



SEQUENCE OF OPERATION

Install NFPA approved smoke detectors, provided under Specifications Section 26 00 00, in each supply air and return air duct to each HVAC unit. The smoke detectors shall de-energize their respective units through direct hard wired relays and activate all audio/visual indicating devices on sensing smoke in the air stream.

Provide smoke dampers in the supply air and return air ductwork to all HVAC systems conveying 15,000 CFM or more. These dampers shall close on receiving a signal from the duct mounted smoke detectors and shall simultaneously de-energize the equipment.

Interlock with the integral return/exhaust fan serving the relevant space(s) such that the appropriate return/exhaust fan(s) enter the necessary operational cycle concurrently with their interlocked supply air fan(s).

Provide a static pressure controller two-thirds (2/3) of the distance downstream in the effectively longest duct run. The pressure sensor shall provide the error offset signal to its corresponding adjustable frequency AC drive P.I.D. controller. The controller shall adjust the drive output signal, varying the supply fan speed to maintain the proper system pressure.

The return fan shall be modulated to track airflow as sensed by fan inlet air flow measuring stations (supply and return). The DDC system shall monitor supply CFM and calculate a return airflow set point by subtracting a fixed offset, which is difference between supply and return CFM (refer to equipment schedule). The calculated return air set point shall be maintained by modulating the speed of the return air fan via its variable frequency drive, increasing fan speed on a drop in airflow as sensed by the air sensor.

Provide high static and low static pressure controllers at the supply fan and at the return/exhaust fan to stop the system and signal an alarm if limit conditions are exceeded.

Occupied/Unoccupied modes will be as scheduled through the operator's workstation.

Heating cycle - "Morning Warm-Up":

1. Morning warm-up shall be initiated by an optimum start algorithm based on outside air temperature. The optimum start algorithm shall be based on a straight line ramp function such that morning warm-up occurs 2 hour (adj.) prior to the occupied mode when outdoor air temp. is 0°F and ½ hour (adj.) prior to occupied mode when outdoor air temp is 60°F. Optimum start can be overridden at the OWS by manually scheduling the morning warm-up if preferred by facilities personnel.
2. Supply and return fan run continuously. Unit operates for return air temperature set point of 72°F.
3. On a call for heating, unit operates on 100% return air (outdoor & exhaust air damper closed). If outdoor air is less then 40°F, heating coil valve opens 100% and face & bypass dampers modulates to maintain return air temperature set point. If outdoor air is greater then 40°F, face & bypass dampers position for full flow across the heating coil and heating coil valve modulates to maintain return air temperature set point.

Heating cycle - "Occupied":

1. The supply air fan and the return/exhaust air fan shall run continuously. The fresh air damper (s) shall open to introduce the scheduled minimum air volume flow rate to the Rooftop air handling unit from outdoor air. The return air damper(s) shall open to return the scheduled maximum of the air volume flow rate to the Rooftop air handling unit from the space.
2. The exhaust damper (s) shall open 100% to allow exhaust of the scheduled minimum outdoor air volume flow rate supplied to the Rooftop air handling unit, to prevent over pressurization.
3. Remote duct mounted proportional signal temperature sensor shall modulate the heating water control valve to maintain discharge air set point temperature. (55°F ADJ.). If outdoor air temperature is less than 40°F, heating coil valve opens 100% and face & bypass dampers modulate to maintain discharge air temperature set point.

Heating cycle - "Unoccupied":

1. Unoccupied heating shall be initiated by the room(s) temperature sensor that is furthest from setback set point temperature.
2. The supply air fan and the return/exhaust air fan shall run only upon demand from the setback set point controller. The fresh air damper(s) and the exhaust air damper(s) shall remain 100% closed. The return air damper(s) shall open to return 100% of the air volume flow rate to the Rooftop air handling unit from the space.
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Freeze Protection cycle:

1. Provide an automatic reset type freeze-stat at the discharge of the heating coil.
2. On sensing a discharge air temperature of 35°F (adjustable) or below, the supply air fan and the return air fan shall be de-energized. The fresh air dampers and the exhaust air dampers shall close 100%, the return air dampers shall open 100% and all audio/visual alarm devices shall initiate.
3. The heating and coiling coil(s) shall receive full respected water flow until the air temperature sensed by the freeze-stat rises above the low limit temperature sensor set point. The automatic reset freeze-stat shall reset and the unit shall initialize to the appropriate sequence.
4. The BMS shall limit the automatic reset function to a total of two "trips" and resets. Upon a third trip, the reset must be executed through the BMS.

Morning Cool down:

1. Morning cool down shall be initiated by an optimum start algorithm based on outside air temperature. The optimum start algorithm shall be based on a straight line ramp function such that morning cool down occurs 2 hour (adj.) prior to the occupied mode when outdoor air temp. is 95°F and ½ hour (adj.) prior to occupied mode when outdoor air temp is 80°F. Optimum start can be overridden at the OWS by manually scheduling the morning cool down if preferred by facilities personnel.
2. The supply fan shall run continuously, the return fan shall be de-energized, the outside air damper and exhaust air damper shall be closed, and the recirculation damper shall be open.
3. The chilled water control valve shall modulate open as directed by the remote space mounted temperature sensor until the return air temperature reaches the "occupied" space temperature set point.

Cooling cycle - "Occupied":

1. The supply air fan and the return/exhaust air fan shall run continuously. The fresh air damper(s) shall open to introduce the scheduled minimum air volume flow rate to the Rooftop air handling unit form outdoor air. The return air damper(s) shall open to return the scheduled maximum of the air volume flow rate to the Rooftop air handling unit from the space. The exhaust air damper (s) shall open 100% to allow exhaust of the scheduled minimum outdoor air volume flow rate supplied to the Rooftop air handling unit, to prevent over pressurization.
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3. On sensing that the ambient air is not appropriate to meet the cooling requirements, the chilled water control valve shall modulate as required (in addition to economizer under suitable conditions) to meet the discharge air temperature set point.

Cooling cycle - "Unoccupied":

1. The system shall remain de-energized. The fresh air damper(s) and the exhaust air damper(s) shall remain 100% closed, the return air damper(s) shall open 100%.

Minimum Outside Air Ventilation - Carbon Dioxide (CO2) Control:

1. When in the occupied mode, the controller shall monitor zone CO2 levels served by this air handling unit. The controller shall take the highest zone CO2 level and modulate the outside air dampers open on rising CO2 concentrations, overriding normal damper operation to maintain a CO2 setpoint of 800 ppm (adj.).

Discharge Air Temperature Reset Control (Cooling Cycle, Occupied Mode):

1. The ATC contractor shall furnish and install sensors and controls to enable space temperature based reset of discharge air temperature (adj.) to prevent sub-cooling of spaces.
2. The Building Management System sense return air temperature and shall reset the supply air temperature set point according to the straight line ramp function defined herein:

Return Air Temp.	Supply Air Temp. Set Point
75°F	55°F (adj.)
70°F	60°F (adj.)

Static Pressure Reset Control:

1. ATC contractor shall provide static pressure reset control which shall reset the discharge static pressure set point when facility is in unoccupied mode and terminal box dampers are closed. During unoccupied mode, unit supply static pressure set point shall be reset from maximum setting established during balancing (typically 2.0" max. adj.) down to 0.5" (adj.).

Frost Control:

1. Frost control is initiated when O.A. temperature drops below the set point and pressure drop across the wheel increases, which indicates frosting.
2. When frosting is indicated, the factory mounted and wired pre-heater shall be energized to heat O.A. to energy wheel frost threshold.

Emergency Power Operation:

1. Return fan lockout on emergency power: Upon switch over to emergency power, the return fan shall be de-energized, the return air damper shall open 100%, the exhaust damper and outside air dampers shall close 100%.

Static Safeties:

1. High static pressure safety will stop supply and return fans, close outdoor/exhaust dampers and open heating coil valve 100% when pressure rises above set point. The set point is adjustable at the device. A manual reset is required at the device to restart the unit.
2. Low static pressure safety will stop supply and return fans, close outdoor/exhaust dampers and open heating coil valve 100% when pressure drops below set point. The set point is adjustable at the device. A manual reset is required at the device to restart the unit.

Alarms: The following alarms will annunciate at the workstation:

1. If the supply or return fan status is not indicated within 30sec of start command, a fan failure alarm is generated.
2. If filter differential pressure exceeds the normal pressure setting for the rooftop unit's filters, a dirty filter alarm is generated.
3. Low temperature detector below 35°F.
4. Low static pressure safeties. If the supply air static pressure is 25% (adj.) less than setpoint.
5. High static pressure safeties. If the supply air static pressure is 25% (adj.) greater than setpoint.
6. Discharge air temperature is +/- 5°F form set point during occupied mode.
7. High Zone Carbon Dioxide Concentration: If the highest zone CO2 concentration is greater than 1000 ppm (adj.).

Unoccupied Override:

1. If during the unoccupied mode of the facility, an override button on a thermostat(s) associated with this rooftop unit is activated, the unit shall temporarily return to the occupied mode for the pre-programmed amount of time, typically 2 hours (adj.).

VAV ROOFTOP UNIT W/HOT WATER HEAT AND CHILLED WATER COOLING (RTU-13)

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BEVERLY MIDDLE SCHOOL

CABOT STREET
BEVERLY, MA 01915

KEYNOTE LEGEND:

90% CONSTRUCTION DOCUMENTS

NOT FOR CONSTRUCTION

NORTH ARROW

KEYPLAN

DRAWING NAME:

MECHANICAL CONTROL SEQUENCES

DRAWN BY: JAJ

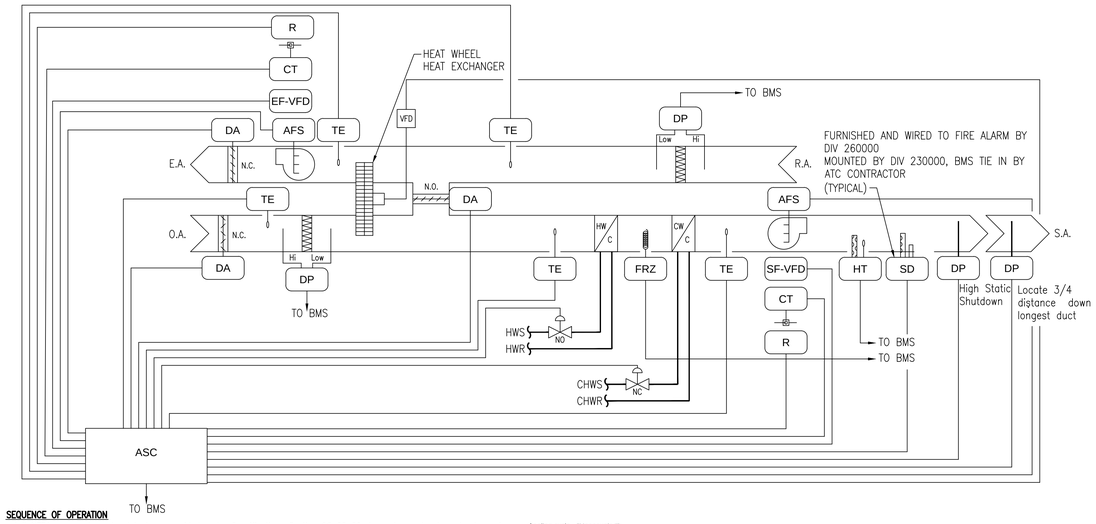
REVIEWED BY: DAH

SCALE: NONE

JOB NO.: 1403.00

DATE: July 25, 2016

DRAWING NUMBER: M7.1



SEQUENCE OF OPERATION

Install NFPA approved smoke detectors, provided under Specifications Section 26 00 00, in each supply air and return air duct to each HVAC unit. The smoke detectors shall de-energize their respective units through direct hard wired relays and activate all audio/visual indicating devices on sensing smoke in the air stream.

Provide smoke dampers in the supply air and return air ductwork to all HVAC systems conveying 15,000 CFM or more. These dampers shall close on receiving a signal from the duct mounted smoke detectors and shall simultaneously de-energize the equipment.

Interlock with the integral return/exhaust fan serving the relevant space(s) such that the appropriate return/exhaust fan(s) enter the necessary operational cycle concurrently with their interlocked supply air fan(s).

Provide a static pressure controller two-thirds (2/3) of the distance downstream in the effectively longest duct run. The pressure sensor shall provide the error offset signal to its corresponding adjustable frequency AC drive P.I.D. controller. The controller shall adjust the drive output signal, varying the supply fan speed to maintain the proper system pressure.

The return/exhaust fan shall be modulated to track airflow as sensed by fan inlet air flow measuring stations (supply and return). The DDC system shall monitor supply CFM and calculate a return airflow set point by subtracting a fixed offset, which is difference between supply and return CFM (refer to equipment schedule). The calculated return air set point shall be maintained by modulating the speed of the return/exhaust air fan via its variable frequency drive, increasing fan speed on a drop in airflow as sensed by the air sensor.

Provide high static and low static pressure controllers at the supply fan and at the return/exhaust fan to stop the system and signal an alarm if limit conditions are exceeded.

Unit controls shall be compatible with BMS through BACnet, LON, or N2 connection as required to suit the automatic temperature control system.

Occupied/Unoccupied modes will be as scheduled through the operator's workstation.

Morning Warm-up:

1. Morning warm-up shall be initiated by an optimum start algorithm based on outside air temperature. The optimum start algorithm shall be based on a straight line ramp function such that morning warm-up occurs 2 hour (adj.) prior to the occupied mode when outdoor air temp. is 0°F and ½ hour (adj.) prior to occupied mode when outdoor air temp is 60°F. Optimum start can be overridden at the OWS by manually scheduling the morning warm-up if preferred by facilities personnel.
2. The supply fan shall run continuously, the exhaust fan shall be de-energized, the energy recover wheel shall be de-energized, the outside air damper and exhaust air damper shall be closed, and the recirculation damper shall be open.
3. The hot water control valve shall modulate open as directed by the remote space mounted temperature sensor until the return air temperature reaches the "occupied" space temperature set point.

Heating Cycle - "Occupied":

1. The supply and exhaust fan shall run continuously. The fresh air damper and exhaust air damper shall open. The recirculation damper shall close.
2. The hot water control valve shall modulate as directed by the remote duct mounted temperature sensor to maintain a discharge air temperature of 60°F (adj.).

Heating Cycle - "Unoccupied":

1. The supply fan shall run only upon demand from the setback set point controller, the exhaust fan and the energy recover wheel shall remain de-energized. The fresh air damper and exhaust air damper shall remain closed and the recirculation damper shall remain open.
2. The hot water control valve shall modulate as directed by the remote duct mounted temperature sensor to maintain a discharge air temperature of 60°F (adj.).
3. Hot water control valve shall remain 30% open whenever unit is off and outdoor ambient temperature is below 38°F.

Freeze Protection cycle:

1. Provide an automatic reset type freeze-stat at the discharge of the heating coil.
2. On sensing a discharge air temperature of 35°F (adjustable) or below, the supply air fan and the return air fan shall be de-energized. The fresh air dampers and the exhaust air dampers shall close 100%, the return air dampers shall open 100% and all audio/visual alarm devices shall initiate.
3. The heating and coiling coil(s) shall receive full respected water flow until the air temperature sensed by the freeze-stat rises above the low limit temperature sensor set point. The automatic reset freeze-stat shall reset and the unit shall initialize to the appropriate sequence.
4. The BMS shall limit the automatic reset function to a total of two "trips" and resets. Upon a third trip, the reset must be executed through the BMS.

Morning Cool down:

1. Morning cool down shall be initiated by an optimum start algorithm based on outside air temperature. The optimum start algorithm shall be based on a straight line ramp function such that morning cool down occurs 2 hour (adj.) prior to the occupied mode when outdoor air temp. is 95°F and ½ hour (adj.) prior to occupied mode when outdoor air temp is 80°F. Optimum start can be overridden at the OWS by manually scheduling the morning cool down if preferred by facilities personnel.
2. The supply fan shall run continuously, the exhaust fan shall be de-energized, the energy recover wheel shall be de-energized, the outside air damper and exhaust air damper shall be closed, and the recirculation damper shall be open.
3. The chilled water control valve shall modulate open as directed by the remote space mounted temperature sensor until the return air temperature reaches the "occupied" space temperature set point.

Cooling cycle - "Occupied":

1. The supply air fan and the return/exhaust air fan shall run continuously. The fresh air damper(s) shall open to introduce the scheduled minimum air volume flow rate to the Rooftop air handling unit form outdoor air. The return air damper(s) shall open to return the scheduled maximum of the air volume flow rate to the Rooftop air handling unit from the space. The exhaust air damper (s) shall open 100% to allow exhaust of the scheduled minimum outdoor air volume flow rate supplied to the Rooftop air handling unit, to prevent over pressurization.
2. Reference enthalpy based economizer control shall compare outside air enthalpy with return air enthalpy and use outside air for cooling upon sensing that the ambient enthalpy is sufficient to meet the cooling requirements. During economizer mode, unit's outside air, return air and exhaust air dampers shall modulate towards the 100% outside air condition (return air damper closed 100%, exhaust air damper and outside air damper open 100%). Economizer mixed air low limit shall be implemented to prevent economizer operation when economizer mixed air temperature is below 45°F (adj.).
3. On sensing that the ambient air is not appropriate to meet the cooling requirements, the chilled water control valve shall modulate as required (in addition to economizer under suitable conditions) to meet the discharge air temperature set point.

Cooling cycle - "Unoccupied":

1. The system shall remain de-energized. The fresh air damper(s) and the exhaust air damper(s) shall remain 100% closed, the return air damper(s) shall open 100%.

Heat Recovery Wheel - Variable Speed:

1. The controller shall modulate the heat recovery wheel for energy recovery as follows.

Cooling Recovery Mode:
The controller shall measure the heat wheel discharge air temperature and modulate the heat wheel speed to maintain a setpoint 2°F (adj.) less than the unit supply air temperature setpoint. The heat wheel shall run for cool recovery whenever:

The unit return air temperature is 5°F (adj.) or more below the outside air temperature.
AND the unit is in a cooling mode.
AND the economizer (if present) is off.
AND the supply fan is on.

Heating Recovery Mode:
The controller shall measure the heat wheel discharge air temperature and modulate the heat wheel speed to maintain a setpoint 2°F (adj.) greater than the unit supply air temperature setpoint. The heat wheel shall run for heat recovery whenever:

The unit return air temperature is 5°F (adj.) or more above the outside air temperature.
AND the unit is in a heating mode.
AND the economizer (if present) is off.
AND the supply fan is on.

Periodic Self-Cleaning:

1. The heat wheel shall run at 5% speed (adj.) for 10sec (adj.) every 4hr (adj.) the unit runs.

Frost Protection:

1. The heat wheel shall run at 5% speed (adj.) whenever:
   Outside air temperature drops below 15°F (adj.)
   OR the exhaust air temperature drops below 20°F (adj.).

The heat wheel bypass dampers will open whenever the heat wheel is disabled.

Minimum Outside Air Ventilation - Carbon Dioxide (CO2) Control:

1. When in the occupied mode, the controller shall monitor zone CO2 levels served by this air handling unit. The controller shall take the highest zone CO2 level and modulate the outside air dampers open on rising CO2 concentrations, overriding normal damper operation to maintain a CO2 setpoint of 800 ppm (adj.).

Discharge Air Temperature Reset Control (Cooling Cycle, Occupied Mode):

1. The ATC contractor shall furnish and install sensors and controls to enable space temperature based reset of discharge air temperature (adj.) to prevent sub-cooling of spaces.
2. The Building Management System sense return air temperature and shall reset the supply air temperature set point according to the straight line ramp function defined herein:

Return Air Temp.	Supply Air Temp. Set Point
75°F	55°F (adj.)
70°F	60°F (adj.)

Static Pressure Reset Control:

1. ATC contractor shall provide static pressure reset control which shall reset the discharge static pressure set point when facility is in unoccupied mode and terminal box dampers are closed. During unoccupied mode, unit supply static pressure set point shall be reset from maximum setting established during balancing (typically 2.0" max. adj.) down to 0.5" (adj.).

Frost Control:

1. Frost control is initiated when O.A. temperature drops below the set point and pressure drop across the wheel increases, which indicates frosting.
2. When frosting is indicated, the factory mounted and wired pre-heater shall be energized to heat O.A. to energy wheel frost threshold.

Emergency Power Operation:

1. Return fan lockout on emergency power: Upon switch over to emergency power, the return fan shall be de-energized, the return air damper shall open 100%, the exhaust damper and outside air dampers shall close 100%.

Static Safeties:

1. High static pressure safety will stop supply and return fans, close outdoor/exhaust dampers and open heating coil valve 100% when pressure rises above set point. The set point is adjustable at the device. A manual reset is required at the device to restart the unit.
2. Low static pressure safety will stop supply and return fans, close outdoor/exhaust dampers and open heating coil valve 100% when pressure drops below set point. The set point is adjustable at the device. A manual reset is required at the device to restart the unit.

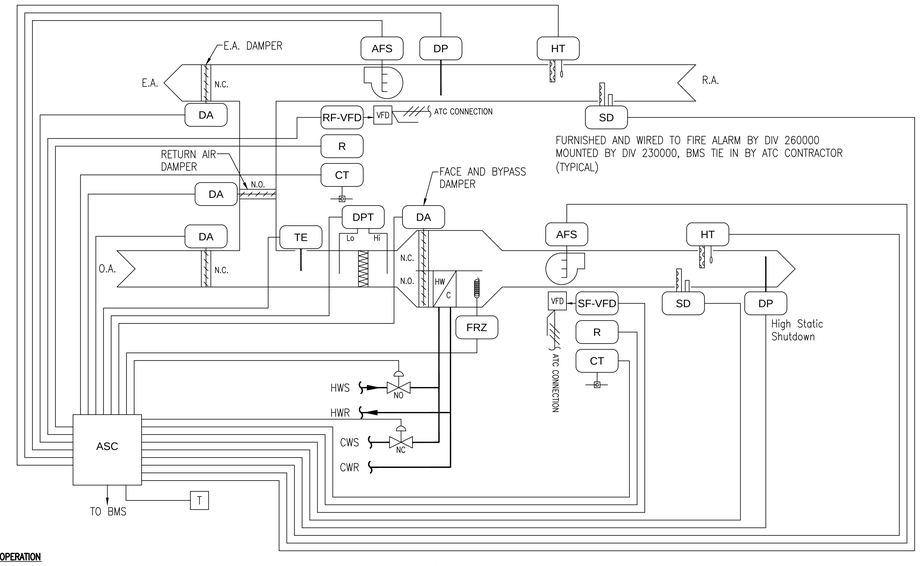
Alarms: The following alarms will annunciate at the workstation:

1. If the supply or exhaust fan status is not indicated within 30sec of start command, a fan failure alarm is generated.
2. If filter differential pressure exceeds the normal pressure setting for the rooftop unit's filters, a dirty filter alarm is generated.
3. Low temperature detector below 35°F.
4. Low static pressure safeties. If the supply air static pressure is 25% (adj.) less than setpoint.
5. High static pressure safeties. If the supply air static pressure is 25% (adj.) greater than setpoint.
6. Discharge air temperature is +/- 5°F form set point during occupied mode.
7. High Zone Carbon Dioxide Concentration: If the highest zone CO2 concentration is greater than 1000 ppm (adj.).

Unoccupied Override:

1. If during the unoccupied mode of the facility, an override button on a thermostat(s) associated with this rooftop unit is activated, the unit shall temporarily return to the occupied mode for the pre-programmed amount of time, typically 2 hours (adj.).

ROOFTOP UNIT W/ ENERGY RECOVERY UNIT
HOT WATER HEATING & CHILLED WATER COOLING (RTU 1,4,5,6,7,10,11)



SEQUENCE OF OPERATION

Install NFPA approved smoke detectors, provided under Specifications Section 26 00 00, in each supply air and return air duct to each HVAC unit. The smoke detectors shall de-energize their respective units through direct hard wired relays and activate all audio/visual indicating devices on sensing smoke in the air stream.

Provide smoke dampers in the supply air and return air ductwork to all HVAC systems conveying 15,000 CFM or more. These dampers shall close on receiving a signal from the duct mounted smoke detectors and shall simultaneously de-energize the equipment.

Interlock with the integral return/exhaust fan serving the relevant space(s) such that the appropriate return/exhaust fan(s) enter the necessary operational cycle concurrently with their interlocked supply air fan(s).

The return fan shall be modulated to track airflow as sensed by fan inlet air flow measuring stations (supply and return). The DDC system shall monitor supply CFM and calculate a return airflow set point by subtracting a fixed offset, which is difference between supply and return CFM (refer to equipment schedule). The calculated return air set point shall be maintained by modulating the speed of the return air fan via its variable frequency drive, increasing fan speed on a drop in airflow as sensed by the air sensor.

Provide high static and low static pressure controllers at the supply fan and at the return/exhaust fan to stop the system and signal an alarm if limit conditions are exceeded.

Occupied/Unoccupied modes will be as scheduled through the operator's workstation.

Heating cycle - "Morning Warm-Up":

1. Morning warm-up shall be initiated by an optimum start algorithm based on outside air temperature. The optimum start algorithm shall be based on a straight line ramp function such that morning warm-up occurs 2 hour (adj.) prior to the occupied mode when outdoor air temp. is 0°F and ½ hour (adj.) prior to occupied mode when outdoor air temp is 60°F. Optimum start can be overridden at the OWS by manually scheduling the morning warm-up if preferred by facilities personnel.
2. Supply and return fan run continuously. Unit operates for return air temperature set point of 72°F.
3. On a call for heating, unit operates on 100% return air (outdoor & exhaust air damper closed). If outdoor air is less then 40°F, heating coil valve opens 100% and face & bypass dampers modulates to maintain return air temperature set point. If outdoor air is greater then 40°F, face & bypass dampers position for full flow across the heating coil and heating coil valve modulates to maintain return air temperature set point.

Heating cycle - "Occupied":

1. The supply air fan and the return/exhaust air fan shall run continuously. The fresh air damper (s) shall open to introduce the scheduled minimum air volume flow rate to the Rooftop air handling unit from outdoor air. The return air damper(s) shall open to return the scheduled maximum of the air volume flow rate to the Rooftop air handling unit from the space.
2. The exhaust damper (s) shall open 100% to allow exhaust of the scheduled minimum outdoor air volume flow rate supplied to the Rooftop air handling unit, to prevent over pressurization.
3. Heating coil valve shall modulate to maintain room temperature set point. If outdoor air temperature is less than 40°F, heating coil valve opens 100% and face & bypass dampers modulate to maintain discharge air temperature set point.

Heating cycle - "Unoccupied":

1. Unoccupied heating shall be initiated by the room(s) temperature sensor that is furthest from setback set point temperature.
2. The supply air fan and the return/exhaust air fan shall run only upon demand from the setback set point controller. The fresh air damper(s) and the exhaust air damper(s) shall remain 100% closed. The return air damper(s) shall open to return 100% of the air volume flow rate to the Rooftop air handling unit from the space.
3. Remote duct mounted proportional signal temperature sensor shall modulate the heating water control valve to maintain discharge air set point temperature (55°F ADJ.). If outdoor air temperature is less than 40°F, heating coil valve opens 100% and face & bypass dampers modulate to maintain discharge air temperature set point.

Freeze Protection cycle:

1. Provide an automatic reset type freeze-stat at the discharge of the heating coil.
2. On sensing a discharge air temperature of 35°F (adjustable) or below, the supply air fan and the return air fan shall be de-energized. The fresh air dampers and the exhaust air dampers shall close 100%, the return air dampers shall open 100% and all audio/visual alarm devices shall initiate.
3. The heating and coiling coil(s) shall receive full respected water flow until the air temperature sensed by the freeze-stat rises above the low limit temperature sensor set point. The automatic reset freeze-stat shall reset and the unit shall initialize to the appropriate sequence.
4. The BMS shall limit the automatic reset function to a total of two "trips" and resets. Upon a third trip, the reset must be executed through the BMS.

Morning Cool down:

1. Morning cool down shall be initiated by an optimum start algorithm based on outside air temperature. The optimum start algorithm shall be based on a straight line ramp function such that morning cool down occurs 2 hour (adj.) prior to the occupied mode when outdoor air temp. is 95°F and ½ hour (adj.) prior to occupied mode when outdoor air temp is 80°F. Optimum start can be overridden at the OWS by manually scheduling the morning cool down if preferred by facilities personnel.
2. The supply fan shall run continuously, the return fan shall be de-energized, the outside air damper and exhaust air damper shall be closed, and the recirculation damper shall be open.
3. The chilled water control valve shall modulate open as directed by the remote space mounted temperature sensor until the return air temperature reaches the "occupied" space temperature set point.

Cooling cycle - "Occupied":

1. The supply air fan and the return/exhaust air fan shall run continuously. The fresh air damper(s) shall open to introduce the scheduled minimum air volume flow rate to the Rooftop air handling unit form outdoor air. The return air damper(s) shall open to return the scheduled maximum of the air volume flow rate to the Rooftop air handling unit from the space. The exhaust air damper (s) shall open 100% to allow exhaust of the scheduled minimum outdoor air volume flow rate supplied to the Rooftop air handling unit, to prevent over pressurization.
2. Reference enthalpy based economizer control shall compare outside air enthalpy with return air enthalpy and use outside air for cooling upon sensing that the ambient enthalpy is sufficient to meet the cooling requirements. During economizer mode, unit's outside air, return air and exhaust air dampers shall modulate towards the 100% outside air condition (return air damper closed 100%, exhaust air damper and outside air damper open 100%). Economizer mixed air low limit shall be implemented to prevent economizer operation when economizer mixed air temperature is below 45°F (adj.).
3. On sensing that the ambient air is not appropriate to meet the cooling requirements, the chilled water control valve shall modulate as required (in addition to economizer under suitable conditions) to meet the discharge air temperature set point.

Cooling cycle - "Unoccupied":

1. The system shall remain de-energized. The fresh air damper(s) and the exhaust air damper(s) shall remain 100% closed, the return air damper(s) shall open 100%.

Minimum Outside Air Ventilation - Carbon Dioxide (CO2) Control:

1. When in the occupied mode, the controller shall monitor zone CO2 levels served by this air handling unit. The controller shall take the highest zone CO2 level and modulate the outside air dampers open on rising CO2 concentrations, overriding normal damper operation to maintain a CO2 setpoint of 800 ppm (adj.).

Zone Temperature Control:

1. The controller shall measure the zone temperature and shall modulate the supply fan VFD speed to maintain zone temperature setpoint. The fan speed shall increase as the zone temperature rises above cooling setpoint, or as the zone temperature drops below heating setpoint. The supply fan VFD speed shall not drop below 30% (adj.)

Static Pressure Reset Control:

1. ATC contractor shall provide static pressure reset control which shall reset the discharge static pressure set point when facility is in unoccupied mode and terminal box dampers are closed. During unoccupied mode, unit supply static pressure set point shall be reset from maximum setting established during balancing (typically 2.0" max. adj.) down to 0.5" (adj.).

Frost Control:

1. Frost control is initiated when O.A. temperature drops below the set point and pressure drop across the wheel increases, which indicates frosting.
2. When frosting is indicated, the factory mounted and wired pre-heater shall be energized to heat O.A. to energy wheel frost threshold.

Emergency Power Operation:

1. Return fan lockout on emergency power: Upon switch over to emergency power, the return fan shall be de-energized, the return air damper shall open 100%, the exhaust damper and outside air dampers shall close 100%.

Static Safeties:

1. High static pressure safety will stop supply and return fans, close outdoor/exhaust dampers and open heating coil valve 100% when pressure rises above set point. The set point is adjustable at the device. A manual reset is required at the device to restart the unit.
2. Low static pressure safety will stop supply and return fans, close outdoor/exhaust dampers and open heating coil valve 100% when pressure drops below set point. The set point is adjustable at the device. A manual reset is required at the device to restart the unit.

Alarms: The following alarms will annunciate at the workstation:

1. If the supply or return fan status is not indicated within 30sec of start command, a fan failure alarm is generated.
2. If filter differential pressure exceeds the normal pressure setting for the rooftop unit's filters, a dirty filter alarm is generated.
3. Low temperature detector below 35°F.
4. Low static pressure safeties. If the supply air static pressure is 25% (adj.) less than setpoint.
5. High static pressure safeties. If the supply air static pressure is 25% (adj.) greater than setpoint.
6. Discharge air temperature is +/- 5°F form set point during occupied mode.
7. High Zone Carbon Dioxide Concentration: If the highest zone CO2 concentration is greater than 1000 ppm (adj.).

Unoccupied Override:

1. If during the unoccupied mode of the facility, an override button on a thermostat(s) associated with this rooftop unit is activated, the unit shall temporarily return to the occupied mode for the pre-programmed amount of time, typically 2 hours (adj.).

ROOFTOP UNIT W/HOT WATER HEAT AND CHILLED WATER COOLING (RTU-2)

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CABOT STREET
BEVERLY, MA 01915

KEYNOTE LEGEND:

90% CONSTRUCTION DOCUMENTS

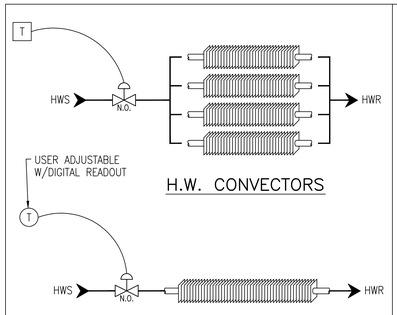
NOT FOR CONSTRUCTION

NORTH ARROW

KEYPLAN

DRAWING NAME:
MECHANICAL CONTROL SEQUENCES

DRAWN BY: JAJ
REVIEWED BY: DAH
SCALE: NONE
JOB NO.: 1403.00
DATE: July 25, 2016
DRAWING NUMBER: M7.2

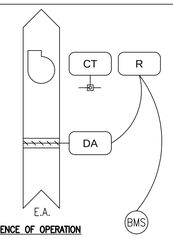


SEQUENCE OF OPERATION
H.W. CONVECTORS & FINTUBE RADIATION:

Occupied:
On a drop in space temperature, below the "Occupied" temperature set point, the 2-position control valve will open. On a rise in space temperature the valve will close to maintain the "Occupied" space temperature set point.

Unoccupied:
The "Unoccupied" mode will determined by the B.M.S. On a drop in space temperature, below the "Unoccupied" temperature set point, the 2-position control valve will open. On a rise in space temperature the valve will close to maintain the setback "Unoccupied" space temperature set point.

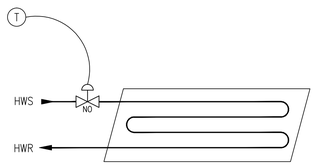
Any time that power is lost to hot water control valve the valve will fail in the open position through spring action.



SEQUENCE OF OPERATION

General exhaust and toilet exhaust fans shall be energized during the "occupied" mode and de-energized during the "unoccupied" mode as scheduled through the BMS.

GENERAL EXHAUST & TOILET EXHAUST

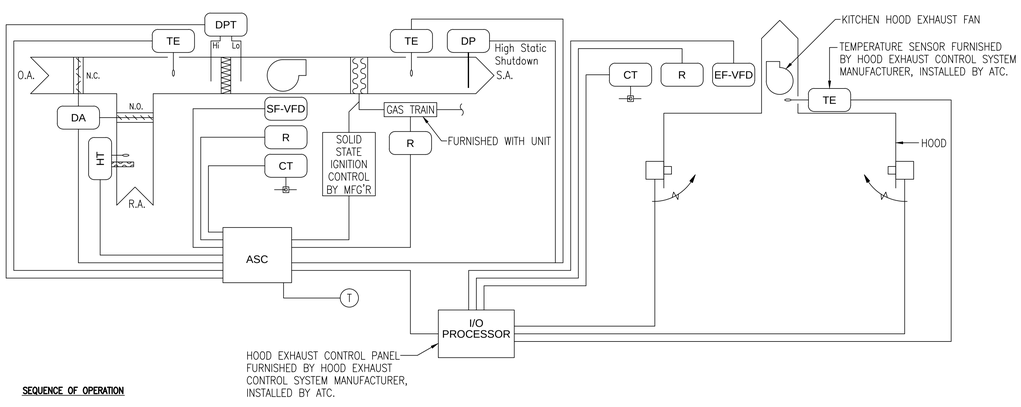


SEQUENCE OF OPERATION

Occupied:
On a drop in space temperature, below the "Occupied" temperature set point, the 2-position control valve will open. On a rise in space temperature the valve will close to maintain the "Occupied" space temperature set point.

Unoccupied:
The "Unoccupied" mode will determined by the B.M.S. On a drop in space temperature, below the "Unoccupied" temperature set point, the 2-position control valve will open. On a rise in space temperature the valve will close to maintain the setback "Unoccupied" space temperature set point.

Any time that power is lost to hot water control valve the valve will fail in the open position through spring action.



SEQUENCE OF OPERATION

Kitchen Make-Up Air Unit (MAU-1):

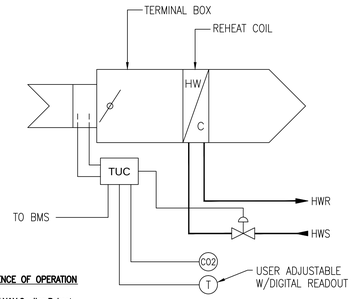
1. Sheet Metal Contractor shall install NFPA approved smoke detector, provided under Specification Section 260000, in the supply air duct from all HVAC units conveying 2,000 CFM or more. The ATC Contractor shall interlock the smoke detector to de-energize its respective unit and activate all BMS audio/visual indicating devices on sensing smoke in the air stream. Fire alarm interconnections form the smoke detectors shall remain the responsibility of Division 16.
2. Provide high static and low static pressure controllers at the supply fan to stop the system and signal all BMS and audio/visual alarms if limit conditions are exceeded.
3. Interlock the kitchen make-up air unit and kitchen hood exhaust fan such that de-energizing the make-up air unit will indicate on the control panel, located at the kitchen exhaust hood. The kitchen hood exhaust fan shall remain energized until manually de-energized.
4. Provide a duct mounted discharge air temperature sensor in the supply air ductwork for all HVAC systems conveying 3,000 CFM or more. This discharge air temperature sensor shall act as a heating and/or cooling anticipator to prevent room temperature overshoot.
5. Heating cycle - Morning Warm-Up:
   a. The make-up air unit supply air fan shall run continuously. The fresh air damper(s) shall remain 100% closed, the return air damper (s) shall open to return 100% of the respective air volume flow rates to the make-up air unit from the space. The kitchen hood exhaust fan shall be de-energized.
   b. The BMS shall issue an "Enable" signal to the kitchen make-up air unit's gas train to initialize for combustion. The unit mounted controls shall stage and fire the burners, as required, to raise the space temperature to the space set point temperature.
6. Heating cycle - Occupied No Cooking:
   a. The make-up air unit supply air fan shall run continuously. The fresh air dampers shall open to introduce the scheduled minimum of the respective air volume flow rates to the make-up air unit from outdoor air. The return air dampers shall open to return the scheduled maximum of the respective air volume flow rates to the rooftop air handling unit form the space. The kitchen hood exhaust fan shall energize and run on low speed via the fan's variable frequency drive.
   b. Upon proof of airflow, the BMS shall issue an "Enable" signal to the kitchen make-up air unit's gas train to initialize for combustion. The unit mounted controls shall stage and fire the burners, as required, to maintain the space set point temperatures.
   c. On sensing a room temperature above the room set point temperature, the unit mounted controls shall de-energize the burner gas train and initiate the post purge cycle. Following successful completion of the post-purge cycles, the outside air dampers shall modulate open to introduce up to 100% outside air for ventilation cooling.
7. Heating cycle - Occupied with Cooking
   a. The make-up air unit supply air fan shall be interlocked with the kitchen hood exhaust fan such that the supply fan speed will track the kitchen hood exhaust fan by a fixed offset to maintain proper space pressurization. The fresh air dampers and return air dampers shall modulate as required to maintain proper space pressurization.
   c. Upon proof of airflow, the BMS shall issue an "Enable" signal to the kitchen make-up air unit's gas train to initialize for combustion. The unit mounted controls shall stage and fire the burners, as required, to maintain the space set point temperature.
   d. On sensing a room temperature above the room set point temperature, the unit mounted controls shall de-energize the burner gas train and initiate the post purge cycle. Following successful completion of the post-purge cycle, the outside air dampers shall modulate open to introduce up to 100% outside air for ventilation cooling.
8. Heating cycle - Unoccupied:
   a. The supply air fan shall run only upon demand from the setback set point controller. The fresh air dampers shall remain 100% closed, the return air dampers shall open to return 100% of the respective air volume flow rates to the make-up unit from the space. The kitchen hood exhaust fans shall remain de-energized
   b. Upon proof of airflow, the BMS shall issue an "Enable" signal to the kitchen make-up air unit's gas train to initialize for combustion. The unit mounted controls shall stage and fire the burners to full capacity to bring space temperature up to setback set point.
   c. On sensing a room temperature above the room setback set point temperature, the unit mounted controls shall de-energize the burner gas train and initiate the post purge cycle. Following successful completion of the post-purge cycle, the outside air dampers shall modulate open to introduce up to 100% outside air for ventilation cooling.
9. Fire Emergency:
   a. During any fire emergency during which the kitchen hood fire suppression system discharges, the make-up air unit shall be de-energized and the gas main solenoid valve shall fully close.
10. Kitchen Pressurization Control:
   a. The make-up air unit's supply fan speed, outside air damper and return air damper shall modulate in response to the exhaust fan speed in order to maintain proper kitchen pressurization.
11. Flame Protection Cycle:
   a. Provide a manual reset type firestat at the discharge of the heat exchanger.
   b. On sensing a discharge air temperature of 165°F or above, the supply air fan shall be de-energized, the fresh air dampers shall close 100%, the return air dampers shall open 100% and all BMS and audio/visual alarms shall activate.

Kitchen Hood Exhaust Fan:

1. The ATC Contractor shall furnish and install all interlock wiring for the kitchen hood exhaust control system as specified by the kitchen consultant.
2. The kitchen hood exhaust fan operation shall be enabled/disabled through local on/off switch as permitted by the schedule within the BMS.
3. Interlock the exhaust fan with the gas fired make-up air unit and with the solenoid gas valve serving the gas fired cooking equipment, such that all gas usage is interrupted in the event of a failure of the exhaust fan.
4. The kitchen hood exhaust fan shall remain energized during any fire emergency during which the kitchen hood fire suppression system discharges.
5. The kitchen hood exhaust fan speed shall vary in response to a signal from the optic sensor located in the hood and/or temperature sensor located in the exhaust duct connection. The exhaust fan speed shall be controlled by a variable frequency drive furnished by kitchen hood exhaust control system manufacturer.
   a. Upon detection of any smoke/vapors inside the hood, optic sensors shall send a signal to the I/O processor to ramp the fans up to full speed until all effluent is removed from the airstream.
   b. Upon detection of excessive heat in the exhaust air stream, the temperature sensor shall send a signal to the I/O processor to ramp the fans up to full speed until temperature drops to the default temperature (75°F –90°F).

Economizer Cooling: Reference enthalpy based economizer control shall compare outside air enthalpy with return air enthalpy and use outside air for cooling upon sensing that the ambient enthalpy is sufficient to meet the cooling requirements. During economizer mode, unit's outside air, return air and exhaust air dampers shall modulate towards the 100% outside air condition (return air damper closed 100%, exhaust air damper and outside air damper open 100%).

KITCHEN VENTILATION & EXHAUST



SEQUENCE OF OPERATION

Typical VAV Cooling Reheat:
Pressure independent VAV box operates on a "occupied/unoccupied" schedule.

During Occupied Mode: VAV damper modulates from minimum to maximum CFM setpoints to maintain room temperature set point. On a call for cooling, damper modulates towards the maximum CFM setting. On a call for heating, damper modulates towards the minimum CFM setting and the reheat coil hot water control valve shall modulate to maintain space heating temperature set point.

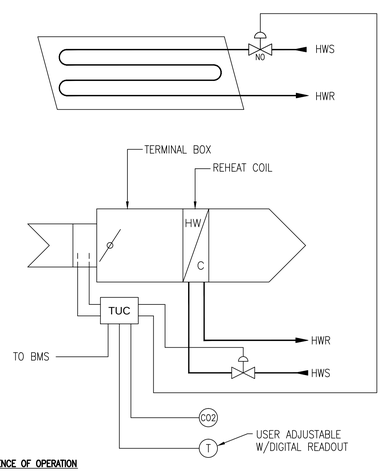
Unoccupied: VAV box damper remains closed. If room temperature drops below the night temperature set point, damper modulates to minimum CFM setting and reheat coil hot water control valve shall modulate open to satisfy night set point. When pushbutton on room temperature sensor is pressed, VAV box switches to occupied mode for 2 hours (ADJ).

Room Thermostat: Occupied set point is adjustable at the room thermostat with a +/– 2 degf warmer / cooler adjustment. Thermostats for classrooms, offices and similar spaces shall be provided with a override function to allow use of space outside of the normal occupied schedule.

Room Occupancy Sensor: The VAV terminal boxes shall be interlocked with the room occupancy sensor (furnished and installed by the electrical contractor) via automatic temperature controls. Upon sensing an absence of movement for 10 minutes (adj.), the occupancy sensor shall reset the terminal box to the unoccupied mode and the damper shall modulate closed. Damper and control valve shall modulate to maintain space temperature set back condition. Should this occur during the occupied mode of the school, the space temperature setpoint shall be reset +5°F during the cooling season and –5°F during the heating season. When occupancy is again sensed, VAV terminal box shall return to occupied mode.

Classroom CO2 Sensor: Each classroom shall be furnished with a CO2 sensor which shall be interlocked with its associated terminal box such that when the occupied space temperature set point is satisfied and the CO2 level is below 600 ppm (adj.), the terminal box damper shall modulate towards the closed position. Upon sensing a CO2 level of 800 ppm the terminal box damper shall modulate open to the minimum position (25% min. (adj.)). If CO2 level is below 600 ppm and space temperature deviates from set point, the terminal box shall return to space temperature control.

VAV TERMINAL BOXES WITH REHEAT



SEQUENCE OF OPERATION

Typical VAV Cooling Reheat:
Pressure independent VAV box operates on a "occupied/unoccupied" schedule.

During Occupied Mode: VAV damper modulates from minimum to maximum CFM setpoints to maintain room temperature set point. On a call for cooling, damper modulates towards the maximum CFM setting. On a call for heating, damper modulates towards the minimum CFM setting and the radiant panel hot water control valve shall modulate open to maintain space heating temperature set point. Upon a further drop in space temperature, the reheat coil hot water control valve shall modulate open to maintain space heating temperature set point.

Unoccupied: VAV box damper remains closed. If room temperature drops below the night temperature set point, damper modulates to minimum CFM setting and reheat coil hot water control valve shall modulate open to satisfy night set point. When pushbutton on room temperature sensor is pressed, VAV box switches to occupied mode for 2 hours (ADJ).

Morning Warm-up: VAV box damper shall open to minimum position during morning warm-up mode.

Room Thermostat: Occupied set point is adjustable at the room thermostat with a +/– 2 degf warmer / cooler adjustment. Thermostats for classrooms, offices and similar spaces shall be provided with a override function to allow use of space outside of the normal occupied schedule.

Room Occupancy Sensor: The VAV terminal boxes shall be interlocked with the room occupancy sensor (furnished and installed by the electrical contractor) via automatic temperature controls. Upon sensing an absence of movement for 10 minutes (adj.), the occupancy sensor shall reset the terminal box to the unoccupied mode and the damper shall modulate closed. Damper and control valve shall modulate to maintain space temperature set back condition. Should this occur during the occupied mode of the school, the space temperature setpoint shall be reset +5°F during the cooling season and –5°F during the heating season. When occupancy is again sensed, VAV terminal box shall return to occupied mode.

Classroom CO2 Sensor: Each classroom shall be furnished with a CO2 sensor which shall be interlocked with its associated terminal box such that when the occupied space temperature set point is satisfied and the CO2 level is below 600 ppm (adj.), the terminal box damper shall modulate towards the closed position (25% min. (adj.)). Upon sensing a CO2 level of 800 ppm the terminal box damper shall modulate open to the minimum position. If CO2 level is below 600 ppm and space temperature deviates from set point, the terminal box shall return to space temperature control.

VAV TERMINAL BOXES WITH REHEAT & RADIANT PANELS

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BEVERLY MIDDLE SCHOOL

CABOT STREET
BEVERLY, MA 01915

KEYNOTE LEGEND:

90% CONSTRUCTION DOCUMENTS

NOT FOR CONSTRUCTION

NORTH ARROW

KEYPLAN

DRAWING NAME:
MECHANICAL CONTROL SEQUENCES

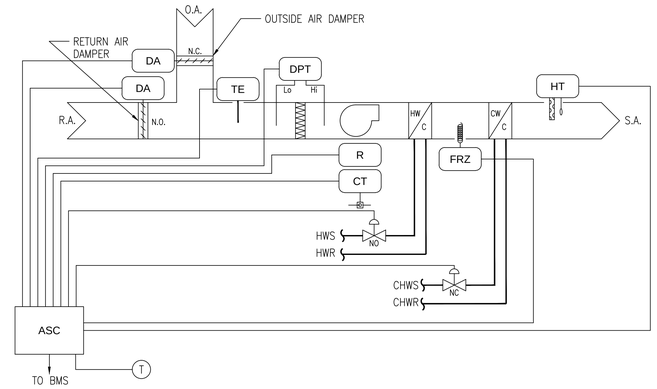
DRAWN BY:	JAJ
REVIEWED BY:	DAH
SCALE:	NONE
JOB NO.:	1403.00
DATE:	July 25, 2016
DRAWING NUMBER:	M7.3

ABBREVIATIONS

AFS	AIR FLOW STATION
ATC	TEMPERATURE CONTROL CONTRACTOR
BMS	BUILDING MANAGEMENT SYSTEM
CT	CURRENT TRANSDUCER
CW	CHILLED WATER
CWC	CHILLED WATER COIL
DA	DAMPER ACTUATOR
DPT	DIFFRENCAL PRESSURE
DP	DUCT PRESSURE
FRZ	FREEZE STAT
HT	HUMIDITY/TEMPERATURE
HW	HOT WATER
HWC	HOT WATER COIL
NC	NORMAL CLOSED
NO	NORMAL OPEN
OA	OUTSIDE AIR
SD	SMOKE DETECTOR
TE	TEMPERATURE

DESIGN SETPOINTS

PROJECT LOCATION	COILING DATA				HEATING DATA	
	OUTSIDE		INSIDE		OUTSIDE	INSIDE
	DB	WB	DB	WB	DB	DB
BEVERLY, MA	91	73	75	–	7	72



SEQUENCE OF OPERATION

Warmup: Morning warm-up shall be initiated by an optimum start algorithm based on outside air temperature. The optimum start algorithm shall be based on a straight line ramp function such that morning warm-up occurs 2 hour (adj.) prior to the occupied mode when outdoor air temp. is 0°F and ½ hour (adj.) prior to occupied mode when outdoor air temp is 60°F. Optimum start can be overridden at the OWS by manually scheduling the morning warm-up if preferred by facilities personnel.
Supply fan runs continuously. Unit operates for return air temperature set point of 72°F. On a call for heating, unit operates on 100% return air. Heating coil valve shall modulate to maintain return air temperature set point.

Occupied: Supply fan runs continuously. Outdoor air damper shall open to introduce schedule minimum air quantity to maintain minimum fresh air CFM set point. Unit operates to maintain room temperature set point of 68°F, with a discharge temperature low limit of 55°F.

Heating: The heating coil valve modulates to maintain room temperature set point. 68°F (adj.)

Cooling: Reference enthalpy based economizer control shall compare outside air enthalpy with return air enthalpy and use outside air for cooling upon sensing that the ambient enthalpy is sufficient to meet the cooling requirements. Economizer mixed air low limit shall be implemented to prevent economizer operation when economizer mixed air temperature is below 45°F (adj.). If outside air ambient conditions are unsuitable for cooling, remote duct mounted proportional signal temperature sensor shall modulate the chilled water control valve (in addition to economizer under suitable conditions) as required to satisfy the discharge air temperature set point.

Unoccupied: Fancoil unit shall be "off". When the room temperature sensors in the area served by the associated fancoil unit drop below 60°F, the supply fan shall start. The outdoor damper shall be closed, with the unit operating on full return air.

The heating coil valve modulates to maintain unoccupied heating discharge temperature set point.

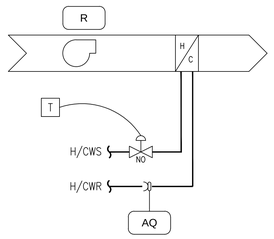
When room temperature rises above 64°F, the supply fans are off.

Freeze Protection:
1. Provide an automatic reset type freeze-stat at the discharge of the heating coil.
2. On sensing a discharge air temperature of 35°F (adjustable) or below, the supply air fan shall be de-energized. The fresh air damper shall close 100%, the return air dampers shall open 100% and all audio/visual alarm devices shall initiate.
3. The heating coil(s) shall receive full hot water flow until the air temperature sensed by the freeze-stat rises above the low limit temperature sensor set point. The automatic reset freeze-stat shall reset and the unit shall initialize to the appropriate sequence.
4. The BMS shall limit the automatic reset function to a total of two "trips" and resets. Upon a third trip, the reset must be executed through the BMS.

Alarms: The following alarms will annunciate at the workstation:
1. If the supply fan status is not indicated within 30sec of start command, a fan failure alarm is generated.
2. If filter differential pressure exceeds the normal pressure setting for the rooftop unit's filters, a dirty filter alarm is generated.
3. Low temperature detector below 35°F.
4. Discharge air temperature is +/- 5°F form set point during occupied mode.

Unoccupied Mode Override: When push-button on room thermostat is pressed, unit switches to the occupied mode for 2 hours (adjustable).

FANCOIL UNIT



SEQUENCE OF OPERATION

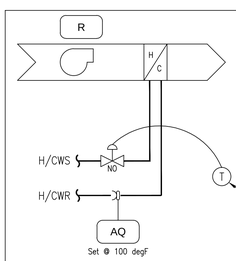
H.W. CABINET UNIT HEATERS

As the space temperature drops below the space temperature set point of 70degF (ADJ.) the 2-position hot water control valve will open. When the Return Water Aquastat senses hot water the Cabinet Unit Heater Fan will be energized. Once the space temperature rises above the space temperature set point the valve will close, and the fan will shut-down, to maintain the space temperature set point.

Any time that power is lost to the hot water control valve the valve will fail in the open position through spring action.

un-occupied space temperature setpoint shall be 60°f (adj.).

CABINET UNIT HEATERS



SEQUENCE OF OPERATION

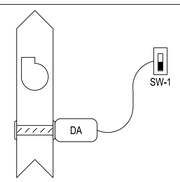
H.W. UNIT HEATERS

As the space temperature drops below the space temperature set point of 70degF (ADJ.) the 2-position hot water control valve will open. When the Return Water Aquastat senses hot water the Unit Heater Fan will be energized. Once the space temperature rises above the space temperature set point the valve will close, and the fan will shut-down, to maintain the space temperature set point.

un-occupied space temperature setpoint shall be 60°f (adj.).

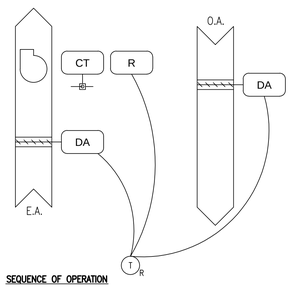
STAND ALONE THERMOSTAT

UNIT HEATERS



NOTE: Dishwasher controlled from local on/off switch furnished & installed by job E.C.

DISHWASHER EXHAUST

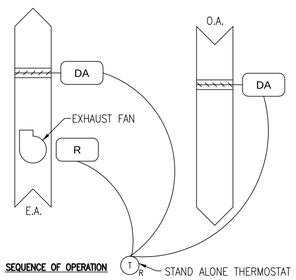


SEQUENCE OF OPERATION

Upon a rise in space temperature above setpoint (ADJ.) as sensed by the remote space mounted reverse acting thermostat, the outside air and exhaust air dampers shall open and the exhaust fan shall start. Upon a drop in space temperature, the reverse shall occur.

Upon sensing a space temperature of 104°F (ADJ.) or above, an alarm shall register at the operator's workstation.

ELECTRIC ROOM VENTILATION



SEQUENCE OF OPERATION

Upon a rise in space temperature above set point (ADJ.) as sensed by the remote space mounted reverse acting thermostat, the combustion air and exhaust air dampers shall open and the exhaust fan EF-30 shall start. Upon a drop in space temperature, the reverse shall occur.

MECHANICAL ROOM VENTILATION

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BEVERLY MIDDLE SCHOOL

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BEVERLY, MA 01915

KEYNOTE LEGEND:

90% CONSTRUCTION DOCUMENTS

NOT FOR CONSTRUCTION

NORTH ARROW

KEYPLAN

DRAWING NAME:
MECHANICAL CONTROL SEQUENCES

DRAWN BY: JAJ
REVIEWED BY: DAH
SCALE: NONE
JOB NO.: 1403.00
DATE: July 25, 2016
DRAWING NUMBER: M7.4

GLYCOL MAKE-UP FILL TANK SCHEDULE & SEQUENCE OF OPERATIONS

BASIS OF DESIGN: WESSELS COMPANY

TANK NO.	LOCATION	MODEL#	MAKE-UP CAPACITY (GPM @ PSI)	PRESSURE RANGE (PSI)	SOLUTION CONTAINER (GAL)	DIMENSION (IN INCHES)		ELECTRIC DATA				APPROX. WEIGHT (LBS)	REMARKS
						A	B	HP	VOLT	ø	Hz		
TK-1	BOILER ROOM	GMP-13050	1.8 @ 50	10 - 50	50	42	28	1.5	460	3	60	150	GMP SERIES OR EQUAL

GLYCOL MAKE-UP PACKAGE

FULLY AUTOMATED AND AUTONOMOUS. COMPLETE WITH: LOW LEVEL CUT-OFF AND ALARM ARRANGEMENT, INCLUDING A 110V SIGNAL FOR REMOTE ALARM, ISOLATION VALVES, STRAINER, PRESSURE TANK WITH PRESSURE CONTROL, PRESSURE REDUCING VALVE AND GAUGE, TRANSLUCENT POLYETHYLENE SOLUTION CONTAINER WITH LID DESIGNED TO ACCOMODATE RELIEF VALVE PIPING, MAGNETIC STARTER, 110V,60 HZ MOTOR AND CONTROLS. ALL MOUNTED ON A STURDY STEEL FRAME WITH 1/2" SYSTEM CONNECTION AND FACTORY PRESET 12 PSIG (FIELD ADJUSTABLE) DISCHARGE.

SEQUENCE OF OPERATION FOR GLYCOL PACKAGE SYSTEM

(1) WHEN THE PRESSURE IN THE GLYCOL SYSTEM DECREASES TO THE MINIMUM ALLOWABLE PRESSURE (OR FILL PRESSURE +/-): THE "PRV" PRESSURE REDUCING VALVE OPENS.

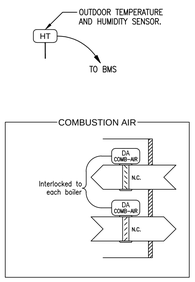
(2) THE GLYCOL STORED IN THE PRESSURE TANK WILL FLOW INTO THE SYSTEM. THE PRESSURE WILL CONTINUE TO DECREASE ON THE SUPPLY SIDE OF THE PRV, UNTIL THE PUMP CUT-IN PRESSURE IS REACHED. THE PRESSURE SWITCH WILL SEND A SIGNAL TO THE PUMP TO START AND MAINTAIN GLYCOL IN THE SYSTEM AND PRESSURE TANK SO THAT THE PRV IS NOT DEPRIVED.

(3) THE PUMP WILL RUN UNTIL ALL THE FOLLOWING CONDITIONS WILL BE ATTAINED.

1) THE PRESSURE IN THE GLYCOL SYSTEM REACHES AND STAYS AT OR ABOVE THE PRV SETTING.

2) THE VOLUME OF THE GLYCOL SOLUTION IN THE PRESSURE TANK INCREASES UNTIL THE PUMP CUT-OUT PRESSURE IS DETECTED BY THE PRESSURE SWITCH. IF THE PRESSURE IN THE COOLING GLYCOL SYSTEM DECREASES AGAIN, STEP 1, STEP 2, AND STEP 3 WILL BE FOLLOWED AGAIN.

(4) SHOULD THE PACKAGE RUN OUT OF GLYCOL SOLUTION, THE "LOW LEVEL CONTROL ALARM" WILL CUT OFF THE PUMP AND ACTIVATE AN AUDIBLE- VISUAL ALARM (INCLUDING THE REMOTE ALARM IF CONNECTED).



Sequence of Operation

Note: The automatic temperature control contractor shall refer to the boiler sequencing and control system in the boiler section of the specification for additional requirements.

Boilers and Trim:

1. Provide an outside air sensor (adjustable) to act as a heat starter.
2. Upon sensing an outdoor ambient temperature of 60°F (adjustable) or below, the boiler sequencing and control system shall initialize to the Winter cycle.
   a. The BMS shall energize the hydronic system pumps and the boilers sequencing control panel, upon sensing an outdoor ambient temperature of 60°F or below. Upon a call for heat from the building, boilers shall be staged and cycled as required to maintain the temperature set point. Automatic rotation of the boilers' firing shall be orchestrated by the sequencing and control system to assure equal run time of module.
   b. The boiler sequencing panel shall provide an "Enable" signal to the appropriate boiler's burner and to the boiler room combustion air system.
   c. The panel shall energize the Lead boiler on sensing a system temperature below the system temperature set point. The boiler sequencing and control system shall stage the boilers' firings as required to meet the demand. Upon sensing a system temperature satisfying the system temperature set point, the boiler sequencing and control system shall sequentially de-energize the boilers and reset for the next cycle.
   d. As each boiler is initiated by the boiler sequencing and control system, its associated boiler pump shall be energized. Upon proof of flow, boiler combustion sequence shall commence.
   e. The boiler sequencing and control system shall sense outdoor ambient conditions and shall reset the supply water temperature according to the straight line ramp function defined herein:

Ambient	set point
0°F	160°F
60°F	90°F

3. Upon sensing an outdoor ambient temperature of 60°F or above, the boiler sequencing and control system shall initialize to the Summer cycle.
   a. The boiler sequencing and control system shall de-energize the boilers.
4. Each manual reset low water cutoff control shall de-energize its appropriate boiler should the water level drop below the controller's set point. Control must be physically reset to restart the boiler after a shutdown instituted by this control.

Boiler Room Combustion Air Cycle:

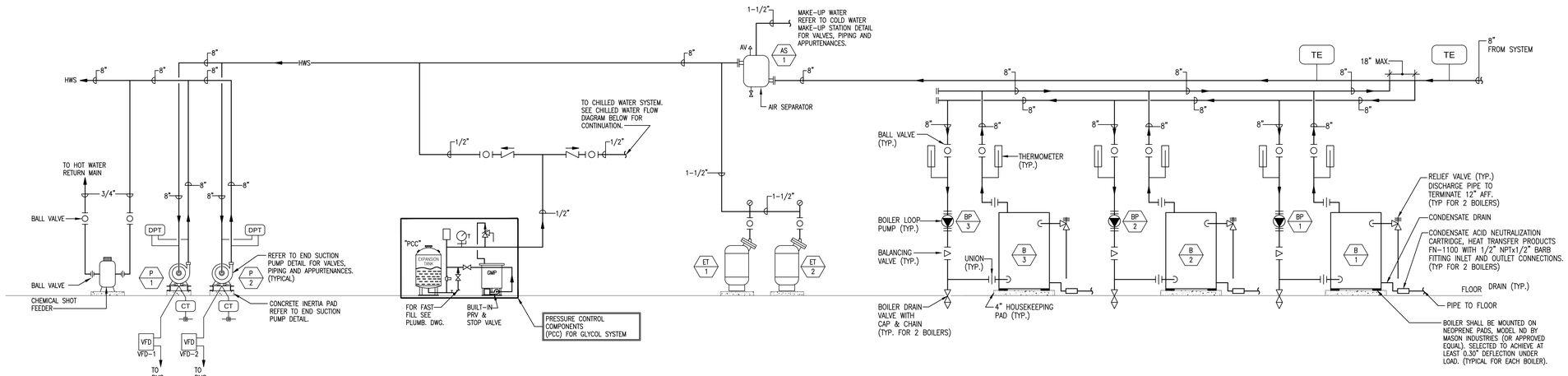
1. Interlock the combustion air dampers with the boilers and domestic hot water heaters such that, upon a call for heat from either system, the dampers shall open and a damper position proving switch shall enable the respective system to operate.

Hot Water Pumps Differential Pressure Control:

1. Hot water pumps shall operate continuously on a primary/standby basis. If the primary pump does not provide flow on demand, the standby pump shall automatically start and all Building Management System audio-visual alarms shall be initiated.
2. Provide a differential pressure sensor for each hot water pump. The pressure sensor shall provide a "Proof-of-Flow" signal to the Building Management System to confirm proper operation.
3. Provide a differential pressure controller for the hot water system. The pressure controller shall signal the pump variable frequency drive to maintain the proper system pressure. Differential pressure controller shall be field located near end of run.
4. Provide high pressure and low pressure controllers at the pumps to stop the system if preset conditions are exceeded.

General Note:

1. If boiler plant has been secured for a period 24 hours continuously at conclusion of heating season, the BMS shall allow all hot water control valves to remain full open.
2. Upon start-up of hot water heating system, the hot water control valves shall return to BMS control.



Sequence of Operation

Air-Cooled Chiller (ACC-1)

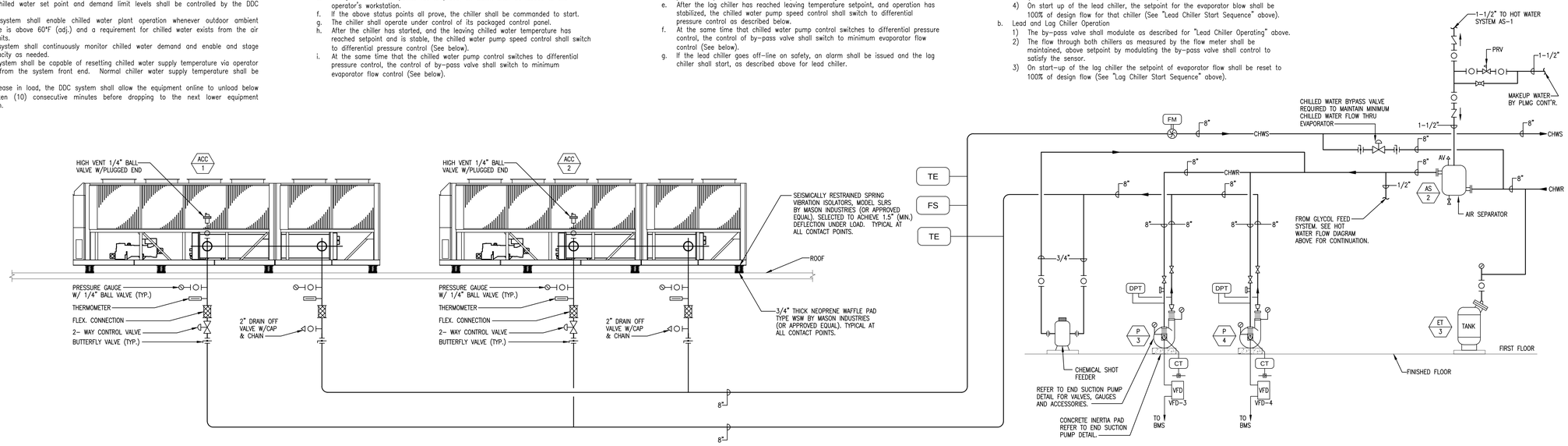
1. The chiller plant shall be controlled by a networked DDC system. Functions shall include chiller sequencing, chilled water pump speed control and monitoring of all sensors.
2. All set points given in written sequence(s) of operation shall be field adjustable and subject to software reset.
3. Local chiller control panel provided by the chiller manufacturer shall control all operating functions associated with starting, stopping and unloading of the chiller. All safety and high/low limits shall be interlocked within the local chiller control panels.
4. Communication between BMS and chiller shall be via BACnet interface to the chillers' digital control panels. Chiller shall be brought on line via a signal from the DDC system in addition, chilled water set point and demand limit levels shall be controlled by the DDC system.
5. The DDC system shall enable chilled water plant operation whenever outdoor ambient temperature is above 60°F (adj.) and a requirement for chilled water exists from the air handling units.
6. The DDC system shall continuously monitor chilled water demand and enable and stage chiller capacity as needed.
7. The DDC system shall be capable of resetting chilled water supply temperature via operator command from the system front end. Normal chiller water supply temperature shall be 44°F.
8. On a decrease in load, the DDC system shall allow the equipment online to unload below 40% for ten (10) consecutive minutes before dropping to the next lower equipment combination.

2. **Lead Chiller Start Sequence:**
   a. When the lead chiller (ACC-1) is brought online, its 2-way control valve shall modulate open.
   b. The chilled water pump shall start and ramp up to 100% speed via its associated variable frequency drive.
   c. By-pass control valve shall modulate open as necessary to maintain 100% design flow rate through the lead chiller as sensed by flow meter. Refer to "Minimum Evaporator Control" below.
   d. Chillers chilled water D/P switch must prove "ON" to enable chiller.
   e. If any of the status points fail to prove, an alarm shall be issued to the operator's workstation.
   f. If the above status points all prove, the chiller shall be commanded to start.
   g. The chiller shall operate under control of its packaged control panel.
   h. After the chiller has started, and the leaving chilled water temperature has reached setpoint and is stable, the chilled water pump speed control shall switch to differential pressure control (See below).
   i. At the same time that the chilled water pump control switches to differential pressure control, the control of by-pass valve shall switch to minimum evaporator flow control (See below).

3. **Lag Chiller Start Sequence:**
   a. The lag chiller shall be brought on line whenever the lead chiller flow rate as measured by the flow meter exceeds the flow setpoint for the lead chiller. The lead chiller flow setpoint shall be 480 GPM (adj.).
   b. When the lag chiller (ACC-2) is brought on line, its 2-way control valve shall modulate open and the chilled water pump shall speed up to 100%.
   c. Simultaneously, as the chilled water pump speeds up to 100%, the by-pass control valve shall begin to modulate open.
   d. After flow has been proven through the lag chiller (chilled water D/P switch proves "ON") and all safeties have proven, the lag chiller shall start.
   e. After the lag chiller has reached leaving temperature setpoint, and operation has stabilized, the chilled water pump speed control shall switch to differential pressure control as described below.
   f. At the same time that chilled water pump control switches to differential pressure control, the control of by-pass valve shall switch to minimum evaporator flow control (See below).
   g. If the lead chiller goes off-line on safety, an alarm shall be issued and the lag chiller shall start, as described above for lead chiller.

4. **Minimum Evaporator Flow Control:**
   a. Lead Chiller Operation
      1) After setpoint is achieved and chilled water temperature is stable, the by-pass valve shall modulate to maintain minimum chilled water flow through the evaporator of the lead chiller, as verified by chiller manufacturer. The flow rate shall be measured by the flow meter.
      2) On a drop below minimum flow setpoint, the by-pass valve shall modulate open.
      3) If the by-pass valve reaches 100% open position and the flow rate remains below setpoint, differential pressure setpoints shall be reset to their initial settings (See "Differential Pressure Control" below).
      4) On start up of the lead chiller, the setpoint for the evaporator blow shall be 100% of design flow for that chiller (See "Lead Chiller Start Sequence" above).
   b. Lead and Lag Chiller Operation
      1) The by-pass valve shall modulate as described for "Lead Chiller Operating" above.
      2) The flow through both chillers as measured by the flow meter shall be maintained, above setpoint by modulating the by-pass valve shall control to satisfy the sensor.
      3) On start-up of the lag chiller the setpoint of evaporator flow shall be reset to 100% of design flow (See "Lag Chiller Start Sequence" above).

5. **Chilled Water Pump Differential Pressure Control:**
   a. Differential pressure sensors located at the ends of the chilled water mains shall be the basis chilled water pump control.
   b. The differential pressure sensor shall have a distinct set point to be determined during testing and balancing and confirmed during the commissioning phase of the project (Initially 10 psi).
   c. The chilled water pump speed shall be modulated via its associated variable frequency drive to maintain the sensor (As defined above) at its setpoint.



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BEVERLY, MA 01915

KEYNOTE LEGEND:

90% CONSTRUCTION DOCUMENTS

NOT FOR CONSTRUCTION

NORTH ARROW

KEYPLAN

DRAWING NAME:

MECHANICAL CONTROL SEQUENCES

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