

Mechanical Specifications

General

1. Immediately notify the Engineer of any discrepancies.
2. It shall be assumed that all subcontractors are experienced and thoroughly knowledgeable in their respective areas of the construction industry and shall perform in a responsible manner in an appropriate construction sequence.
3. Do not scale drawings. Verify dimensions in field prior to commencement of work.
4. It is the intent of these drawings and specifications to establish a standard of quality. The Engineer reserves the right to take exceptions to approve methods and materials not reflected herein.
5. Failure to order, or release order, for materials and/or equipment will not be accepted as a reason to substitute alternate materials, equipment, or installation methods.
6. Work shall be performed in a workmanlike manner to the satisfaction of the Architect & the Engineer.
7. Labor, materials, and equipment shall conform to the latest applicable editions of local, State of Colorado, and National Codes and ordinances. If conflict between those publications exists, the most stringent requirement shall apply.
8. Provide record drawings to architect. Drawings shall include all addendum items, change orders, alterations, re-routings, etc.
9. The drawings show the intent of the mechanical systems but do not show all details required. It is the responsibility of the Contractors to install complete & operable systems, which conform to the manufacturers' installations instructions & industry standards.
10. Systems shall be tested for proper operation. If tests show work is defective, Contractor shall make corrections necessary at no cost to Owner.
11. It is the Contractors' and manufacturers' responsibility to assure themselves that the code authorities will approve any product to be installed on the project.
12. Systems shall be professionally labeled. Piping shall be labeled with color coded commercial grade labels indicating piping service and flow direction. Equipment, fans, pumps, valves, switches and controls shall be labeled with engraved plastic or metal tags and an equipment/valve schedule shall be provided and mounted on the mechanical room wall. Equipment labels shall follow the same nomenclature as the mechanical drawings.
13. Offset piping, ductwork, etc. as necessary to accommodate structure, beams, columns, and existing equipment.

Electrical

14. Contractor must carefully verify electrical service voltage and phase available before ordering any equipment.
15. The following are to be furnished by MC and wired by EC: equipment motors, magnetic starters, line voltage thermostats, factory disconnect switches (if specified as part of factory wired equipment) resistance heaters, fire and smoke detectors.
16. The following are to be furnished and wired by EC: disconnect switches, thermal overload switches, manual operating switches and contactors.
17. The following are to be furnished and wired by MC: low voltage thermostats, control transformers, control relays, control panels, motorized valves, motorized dampers, pilot lights, multi-speed switches and interlocks.

Remodel, Demolition & Unforeseen Conditions

18. Visit site prior to bid and verify the conditions. Include in the bid, costs required to make work meet existing conditions, whether indicated or not.
19. Provide mechanical demolition required. Refer to architectural demolition drawings for location and extent of demolition required. Visit site prior to bid to determine extent of work involved. Provide labor and materials as required to maintain and/or restore continuity of service to existing systems.
20. In as much as design for remodel, renovation and/or rehabilitation requires that certain assumptions be made regarding existing conditions and because some of these assumptions cannot be verified without destroying otherwise adequate or serviceable portions of the building, the Engineer cannot assure the Owner or the Contractor that the professional consulting services herein encompass all contingencies. Field coordination during construction is imperative. Contractors bidding this work must make reasonable allowances for unseen conditions and should include associated allowances in their bids noted as such.
21. Be responsible to field verify existing equipment or ductwork remaining to be reconnected to new or existing systems. Provide ductwork, piping, controls, diffusers, etc., as required to restore continuity to system(s).
22. All new ductwork, piping, equipment, etc. is shown with dark lineweight. All existing ductwork, piping, equipment, etc. is shown with light lineweight.
23. All removed piping, ductwork, equipment, etc. are to be disposed of by Contractor unless noted otherwise.
24. All existing support rods and straps now supporting ducts, pipes, air tubing, electrical conduit, etc. that are removed to allow room for installation of new equipment shall be relocated and reinstalled, or replaced if damaged.
25. New hot and cold water branches to be routed from nearest hot water and cold water of line size equal to or greater than new branch - typical.

Insulation

26. Insulate all new refrigerant suction piping & condensate piping with flexible, closed-cell elastomeric insulation, 1" thick. Insulation shall have a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when test in accordance with ASTM E 84, latest revision.
27. Elastomeric insulation: Slip insulation over pipe before assembly so that there are no length wide seams. Where lengths of insulation are butted together, use factory recommended adhesive. Glue the butt ends of insulation to each other to form a homogenous membrane maintaining the vapor barrier. Exterior elastomeric insulation shall be installed with the longitudinal seam on the bottom of the pipe and shall be protected with an ultra violet resistive paint. Elastomeric insulation shall be covered with two coats of paint manufactured specifically for covering Elastomeric insulation, Armaflex WB Finish or equal.
28. Insulate all new heating water, domestic hot water and domestic hot water recirculation with U.L. approved, white, all service, glass fiber, snap-on, pipe insulation, 1-1/2" thick on piping $\leq 1.5"$ in diameter and 2" thick on piping $> 1.5"$. Insulate fittings with glass fiber blanket insulation and premolded PVC covers. Provide deduct alternate price to insulate with Armaflex.
29. Insulation for all types of piping shall be carried full size through pipe hangers or pipes shall be supported with vibration clamps.
30. Externally wrap all unlined ductwork with 2" thick insulation with a continuous vapor barrier. Minimum R-Value of 6.0.

Piping

31. Heating Water Piping, Snowmelt Water Piping, Domestic Hot, Cold & Recirculation piping inside building - Type 'L' copper water tube, wrought copper fittings and no lead solder. Provide alternate pricing for PEX tubing (no oxygen diffusion barrier necessary). Unless otherwise noted, piping on plans has been sized for copper, and if ASTM PEX piping is used, increase size of piping one nominal size from size shown on plans, i.e. Plans call for a 3/4" line & PEX is to be substituted, a 1" PEX line shall be installed.
32. PEX piping shall be supported by continuous cradles supplied by the manufacturer.
33. Domestic Hot, Cold & Recirculation piping inside building - Type 'L' copper water tube, wrought copper fittings and no lead solder. Provide alternate pricing for PEX tubing (no oxygen diffusion barrier necessary). Unless otherwise noted, piping on plans has been sized for copper, and if ASTM PEX piping is used, increase size of piping one nominal size from size shown on plans, i.e. Plans call for a 3/4" line & PEX is to be substituted, a 1" PEX line shall be installed.

34. Waste lines may be standard weight, C.I. soil pipe, and fittings, or hubless, C.I. soil pipe and fittings. Up through 2-1/2" may be standard weight, galvanized steel pipe with black, C.I. drainage fittings.
35. Vent lines may be Schedule 40 ABS-DWV plastic pipe and fittings (ASTM D2661) or Schedule 40 PVC-DWV plastic pipe and fittings (ASTM D2665). All pipe and fittings shall bear NFS-DWV mark and shall be joined with solvent weld joints as recommended by the manufacturer.
36. Refrigeration Piping - Type 'L', ACR Grade copper, cleaned, dehydrated, capped and charged with clean nitrogen at the factory. Valves and specialties shall be standard brass or bronze valves for refrigeration service.
37. Drain Pan piping - Type 'M' copper, wrought copper fittings, and no lead solder. Drain pan piping may also be PEX or Schedule 40 ABS-DWV plastic pipe and fittings (ASTM D2661) or Schedule 40 PVC-DWV plastic pipe and fittings (ASTM D2665).
38. Condensing Boiler Condensate shall be neutralized via a neutralization basin before discharge into building drainage system. Condensate piping shall be PVC or other approved material suitable for pH levels of 3.
39. Gas Piping - Schedule 40 black steel pipe, 150 lb. malleable iron screwed fittings on above ground pipe, welded fittings with all piping coated and wrapped on buried pipe. Welded gas piping shall be pressure tested at a minimum of 60 psi per Town of Vail amendment to the 2009 IFGC, section 406.4.1. CSST pipe is permitted for final connections only.
40. Gas Valves - Lubricated plug valve 175 lb. W.O.G. iron screwed or flanged.
41. Copper pipe Valves and Specialties:

Gate Valves: Bronze, Class 125, 200 lb. W.O.G.
Ball Valves: Bronze, Class 125, 200 lb. W.O.G.
Check Valves: Bronze, Class 125, 200 lb. W.O.G.
Balancing Valves: 125 psig w.p. for 250F service tight shut-off, Illinois dual-purpose, balancing/shut-off valve, Hoffman, Sarco, or equivalent.

42. Provide expansion joints or loops on all heating water piping runs in excess of 50'.
43. Dielectric Unions - Furnish and install a dielectric union at all connections where non-ferrous material is in contact with ferrous material and fluid is not protected with corrosion inhibitors.
44. Grade and valve all heating water piping with 3/4" hose end valves to permit drainage of the system. Vent all high points in equipment rooms as necessary with automatic air vents piped to convenient drain. All high points in system outside of equipment rooms with manual air vents as required to relieve air in the system.
40. Support pipe with rod and clevis or clamps. No pipe tape allowed.
41. Install plumbing clean-outs as required by applicable codes.
42. All piping penetrations through fire-rated assemblies shall be metallic piping and fire caulked per code.

Boiler Flue & Combustion Air Piping

43. Boiler flue piping shall be a polypropylene venting system, listed in accordance with ULC-S636, and rated for flue gas venting systems. Flue shall be Centrotherm InnoFlue, Duravent PolyPro or equal.
44. Boiler combustion air piping shall be PVC, complying with ASTM D1785.

Antifreeze Solutions

45. DILUTION WATER QUALITY: Contractor shall be responsible for testing the water and submitting a report to the Owner & Engineer, prior to system fill. "Hard" water shall not be used. The water used to dilute the concentrated inhibited glycol-based heat transfer fluid must be either distilled, deionized, or contain less than 25 ppm of chloride, 25 ppm of sulfate, 50 ppm of calcium, and 50 ppm of magnesium, with a total hardness not to exceed 100 ppm. If good quality water is unavailable, the manufacturer of the glycol product will provide the heat transfer fluid and water to meet the specifications of the system.
46. Fill heating water system with 50% propylene glycol / 50% water solution, by volume, for freeze protection to -28°F and burst protection to -60°F. Include corrosion inhibitors.

Ductwork

47. Duct sizes shown on drawings are outside (sheet metal) dimensions.
48. All ductwork shall be sealed airtight with duct mastic. Duct tape is prohibited.
49. Seal all ductwork joints and vapor barrier penetrations at all exterior walls.
47. Provide 1/4" galvanized mesh screen on all combustion air ducts or openings.
48. Ducts and piping penetrating through roof shall have roof flashing with caulk type counter flashing sleeve or by method acceptable by roofing manufacturer. Installation shall be watertight.
49. Provide backdraft dampers at any and all ductwork penetrations through exterior wall (except outside air and combustion air ductwork).
50. All ductwork or surfaces which are visible behind a grille, register, diffuser or louver shall be painted flat black.
51. Sheet metal and fittings to be pursuant to SMACNA and ASHRAE standards.
52. All ducts shall be 26 gauge minimum. Duct gauge and construction shall conform to SMACNA HVAC Duct Construction Standards.
53. Contractor to coordinate exact location of grilles and registers before installation.
54. Seal off all ducts during construction.

55. Back Draft Dampers: Furnish and install, at locations on plans or in accordance with schedules, dampers meeting the following specifications: Dampers shall be of the two-blade design with separate axles. Blades shall be retained in closed position with tensioned spring. Spring shall be easily field adjustable for any orientation mounting. Spring adjustment will allow for field setting of pressure to open damper. Frame shall include rolled stiffener beads to allow easy sealing to spiral ductwork joints. Dampers shall include vinyl foam blade seal. Frames shall have no holes or openings to allow air through damper frame. Damper shall in all respects be equivalent to Ruskin model BDR2.

Controls

56. Install emergency gas shutoff switch inside mechanical rooms containing boilers. Switch plate shall be red in color and labeled "GAS BURNER EMERGENCY SWITCH". Switch shall be compliant with Section 1006.8 of the 2009 IMC. Refer to electrical drawings for additional information.
57. See Sequence of Operation for additional control information.

Balancing

58. Air and water flows must be balanced, and fan belts, pumps, and drive systems adjusted as required. Balance Contractor shall furnish subsequent air balances after acceptance of the building.
59. Submit a written balance report. Balancing procedures shall be in accordance with NEBB or AABC guidelines for proportional balance. Submit report on standard NEBB forms.
60. Ainside measurements shall include all motor amperage, voltage readings, motor RPM, fan RPM, fan CFM, fan inlet static pressure, fan outlet static pressure, and exhaust grille CFM.
61. Hydronic measurements shall include circuit setters, all motor amperage, voltage readings, motor RPM, pump RPM, pump GPM as calculated from the pump curve, inlet and outlet pressures at pumps, and temperature and pressure drop at all coils.

62. Adjust flows to within 10% of required quantity. If actual quantity is less than 90% of design, investigate cause, attempt to rectify and notify Engineer. Submittal of balance report with less than required flows without explanation is cause for rejection of report.
63. Submit three copies of all submittals in addition to any required by the Contractor. These copies shall be retained by the Owner, Contractor and Engineer.

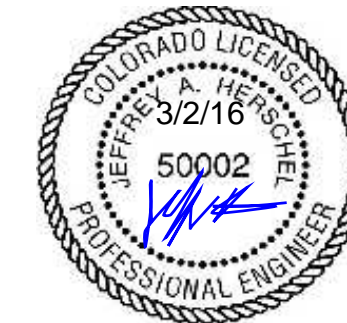
Sequence of Operation

1. **FC-1, 2, 3, & 4 & HP-1**
 - a. Fan coils shall be controlled by integral Mitsubishi controls.
 - b. COOLING: Upon a call for cooling, associated fan coil blower shall start and HP-1 heat pump shall run as directed by Mitsubishi controls to meet the cooling demand.
 - c. HEATING: Upon a call for heating, associated fan coil blower shall start and HP-1 heat pump shall run as directed by Mitsubishi controls to meet the heating demand.
2. **FC-5, 6, & 7 & HP-2**
 - a. Fan coils shall be controlled by integral Mitsubishi controls.
 - b. COOLING: Upon a call for cooling, associated fan coil blower shall start and HP-2 heat pump shall run as directed by Mitsubishi controls to meet the cooling demand.
 - c. HEATING: Upon a call for heating, associated fan coil blower shall start and HP-2 heat pump shall run as directed by Mitsubishi controls to meet the heating demand.
3. **Fans**
 - a. EF-1 boot drying room exhaust fan shall be controlled by an wall mounted 12 hour timer switch.
 - b. ERV-1 energy recovery ventilator shall be controlled by an on/off wall switch.
 - c. ERV-2 energy recovery ventilator shall be controlled by a master control (Renewaire PT-L Percent Timer Control Lighted) which shall control the percent of unit operation per hour (adjustable from 0 to 100%).
 - d. SF-1 mechanical room supply fan shall be controlled by a wall mounted line voltage cooling thermostat.
4. **CUH-1 & CUH-2 Electric Cabinet Unit Heaters**
 - a. Cabinet unit heaters shall each be controlled by an integral thermostat.
5. **B-1, 2, 3, & 4 Boilers**
 - a. Boilers shall be modulated, staged and rotated by integral Lochinvar boiler controls.
 - b. Boilers shall be staged to maintain HWS setpoint at temperature sensor **TS-1**. HWS setpoint shall be reset based on outdoor temperatures (160°F @ -20°F to 120°F @ 70°F).
 - c. HWS setpoint shall be ramped up to 180°F on any call for domestic hot water heating.
 - d. HWS setpoint shall be ramped up to 160°F on any call for snowmelting.
 - e. P-1, P-2, P-3, or P-4 boiler pumps shall run whenever associated boiler is called to fire.
6. **WH-1, 2, 3, & 4 Water Heaters**
 - a. Upon a call for heating from temperature sensor **TS-2** at WH-1, P-5 water heater pump shall start.
 - b. Upon a call for heating from temperature sensor **TS-3** at WH-2, P-6 water heater pump shall start.
 - c. Upon a call for heating from temperature sensor **TS-4** at WH-3, P-7 water heater pump shall start.
 - d. Upon a call for heating from temperature sensor **TS-5** at WH-4, P-8 water heater pump shall start.
 - e. P-12 domestic hot water recirculation pump shall be controlled by integral controls. Provide a manual shut-off switch for unoccupied periods.
 - f. TMV-2 thermostatic mixing valve shall be set for 120°F (adj).
7. **Snowmelting**
 - a. Provide an automatic snowmelting control, Tekmar 667 or equal.
 - b. Provide new **Tekmar 090/091** snow/ice sensor and socket.
 - c. Upon a call for snowmelting from new snow/ice sensor, boilers shall be enabled, existing snowmelt pump shall start, and P-9 Snowmelt Injection Pump shall start. P-9 pump speed shall be varied by Tekmar control to maintain snowmelt supply temperature of 120°F (adj) at **TS-6** temperature sensor.
 - e. Provide an Auto/On/Off switch in the mechanical room for manual override.
 - f. Tekmar control shall be setup for WWSD (warm weather shut down) at approximately 40°F (adj). System shall not operate if outdoor temperature is above this setting.
8. **HX-1 Spa Heat Exchanger**
 - a. Upon a call for heating from **TS-7** temperature sensor, normally closed control valve shall open, end switch shall signal P-10 pump to start, and B-1, B-2, B-3 & B-4 boilers shall be enabled.
9. **HX-2 Pool Heat Exchanger**
 - a. Upon a call for heating from **TS-8** temperature sensor, P-11 pump shall start, and B-1, B-2, B-3 & B-4 boilers shall be enabled.
10. **Pumps**
 - a. P-1 Boiler Pump shall run whenever B-1 Boiler is called to fire.
 - b. P-2 Boiler Pump shall run whenever B-2 Boiler is called to fire.
 - c. P-3 Boiler Pump shall run whenever B-3 Boiler is called to fire.
 - d. P-4 Boiler Pump shall run whenever B-4 Boiler is called to fire.
 - e. P-5 Water Heater Pumps shall run whenever there is a call for heat from TS-2 temperature sensor.
 - f. P-6 Water Heater Pumps shall run whenever there is a call for heat from TS-3 temperature sensor.
 - g. P-7 Water Heater Pumps shall run whenever there is a call for heat from TS-4 temperature sensor.
 - h. P-8 Water Heater Pumps shall run whenever there is a call for heat from TS-5 temperature sensor.
 - i. P-9 Snowmelt Injection Pump shall run whenever there is a call for heat from TS-6 temperature sensor.
 - j. P-10 HX-1 Spa Heat Exchanger Pump shall run whenever there is a call for heat from TS-7 temperature sensor.
 - k. P-11 HX-2 Pool Heat Exchanger Pump shall run whenever there is a call for heat from TS-8 temperature sensor.
 - l. P-12 Domestic Hot Water Re-circulation Pump shall be controlled by integral controls. Provide a manual shut-off switch for unoccupied periods.

Town of Vail Stamp



FE Stamp



NORTHWOODS RENAISSANCE BUILDING B
600 VAIL VALLEY DRIVE
VAIL, COLORADO 81657

Issued For		
No.	Date	Comment
3	5/1/15	PERMIT
4	6/18/15	PERMIT REVISION
5	7/24/15	COORDINATION
6	7/30/15	PERMIT REVISION 2
7	8/31/15	REVISION 3
8	9/28/15	REVISION 4
9	3/2/16	REVISION 5

MECHANICAL SPECIFICATIONS AND SEQUENCE OF OPERATION

Project No.	Scale:
15011.00	N/A
Drawn By:	Checked By:
JAH	JDR

M4.0

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