



9 Washington Street  
Rutland, Vermont 05701  
Tel: 802-855-8091

## Killington Public Safety Facility

Killington Road  
Killington, Vermont

### Mechanical Systems Design Concept

November 13, 2018

## DIVISIONS 22 PLUMBING

### 1. Scope of Work:

#### a. Domestic Water:

- i. Provide piping from water tank including 2" fill line with pump in Apparatus bay for truck fill. The size of the water storage tank remains to be determined based on the fire protection storage requirements.
- ii. Provide domestic water entrance with hydro tank and well pump to all plumbing fixtures and water using equipment.
- iii. All domestic water piping to be insulated.
- iv. Provide domestic water heater system with water heater served from gas fired boiler with thermostatic mixing valve.
- v. Provide six exterior wall hydrants.

#### b. Sanitary Waste and Vent:

- i. Provide a complete sanitary waste and vent piping system for all plumbing fixtures including drainage for all owner supplied equipment.
- ii. Provide garage drain system consisting of a trench drain piped to an exterior oil/grit separator. The trench drain shall be run down the center of each apparatus bay.

#### c. Compressed Air Systems:

- i. Provide air compressor with piping drops within apparatus bays, parts shop and storage.
- ii. The owner to verify the amount of pressure needed.

#### d. General Services:

- i. Provide condensate drainage piping for all air conditioning equipment.
- ii. Provide new floor drains for all new public toilet rooms and lockers.
- iii. Provide floor drains in mechanical rooms, gear wash rooms, hose tower rooms.

2. Domestic Water System:

- a. Domestic Water Distribution piping shall be Type "L" hard temper copper tubing, ASTM B-88. Fittings shall be wrought copper solder joint type. Use "Silverbrite" lead free solder with suitable flux for joining pipe and fittings. Pro-press shall be approved as an alternate. Copper pipe fitting shall be wrought copper solder joints, ANSI B-16.22, streamlined pattern joints and shall be made with "Silverbrite" lead free solder with non-corrosive flux.
- b. Branch Run outs: Domestic water branch piping and run outs 3/4" and smaller, located within the units or truss spaces and not above corridors, shall be PEX tubing. Alternate PEX tubing shall be plumbed using Watts WaterPEX® cross-linked polyethylene pipe or approved equal, and all joints shall be made using Watts brass CrimpRing™ and/or poly-alloy CrimpRing™ fittings using either the Watts copper CrimpRing™ or stainless steel CinchClamp™ crimping methods as outlined in the Watts WaterPEX® Installation Guidelines. Tubing shall be rated 160psi @ 73.4°F. Tubing shall be color coded blue for cold water and red for hot water.
- c. Valves: shall be equal to Apollo, Milwaukee or Watts.
- d. Valves shall be provided to allow complete isolation of each toilet room from the main distribution system. All piping shall be provided with drain valves in the basement or west level to allow for complete drainage of each piping system.
- e. Domestic Water Piping Specialties: Provide the following piping specialties for installation in piping systems at locations shown or as required by installation requirements.
  - i. Provide a thermostatic mixing valves for all domestic water heaters.
  - ii. Provide trap primers for all floor drains.
  - iii. Provide new backflow preventer and meter for new water service.

3. Sanitary Waste and Vent Systems:

- a. Waste Piping for Fixtures: All new soil, waste and vent drainage piping shall be ASTM D-1785, and ASTM D-2665 schedule 40, PVC-DWV pipe. Fittings shall conform to ASTM D-2665 and shall be PVC-DWV fittings.
- b. Provide schedule 40 PVC condensate drainage piping from all air conditioning condensate drains.

4. Drainage Specialties:

- a. Line cleanouts: Zurn No. Z-1440, with raised hex head plug, DCCI.
- b. Wall cleanouts: Zurn No. Z-1447, bronze square access panel with vandal proof secured top, min. size 8" x 8" or as required for equipment. Provide raised hex plug behind cover.
- c. Cleanouts in waste piping 2" and under shall be screwed plugs to suit type of piping, i.e. copper, galvanized, etc.
- d. Floor cleanouts: Zurn Model Z-1400, "Level-trol" adjustable floor cleanout with polished bronze top.
- e. Floor Drains: Zurn Z-415, bronze type "B" strainer, 6" diameter with dura-coated cast iron body.
- f. Trench Drains: Field constructed in garage bays with removable grating.

#### 5. Pipe Hangers

- a. All piping shall be rigidly supported from the building structure by means of approved hangers and supports.
- b. Provide spring isolator hangers for all pipe hangers.

#### 6. Pipe Sleeves and Fire Stopping

- a. Furnish and set sleeves to accommodate pipes passing through foundations, walls, floors, furring and ceilings. Cooperate with other Contractors in setting all sleeves. Sleeves shall be full thickness of construction. Fill annular space between pipe and sleeve with U. L. approved fire retarding packing, rated for 1 hour minimum. For PVC pipe provide approved fire stop collars.
- b. Sleeves through exterior walls below grade, through foundation walls, shall be watertight construction. Use "Link-seal", compression type neoprene link seals installed in sleeve or core drilled hole.

#### 7. Insulation:

- a. All new copper hot and cold water; hot water recirculating piping shall be insulated with Armaflex closed cell pipe insulation. Thickness to be as follows:

Cold Water: (Domestic)	
All sizes: (With Vapor Barrier)	1/2"
Hot Water: (Domestic)	
1 1/2" and smaller:	1 1/2"
2" and larger:	2"
Recirculating Hot Water: (Domestic)	
All sizes:	1 1/2"
Condensate Drainage Piping:	
All sizes:	1/2"

## 8. Access Panels:

- a. Provide access panels in ceilings and in walls to permit access to concealed valves, etc. Panels shall be of sufficient size to permit access to concealed equipment. Valve access panels shall be 12" by 12" minimum and shall be fire rated where required.

## 9. Plumbing Fixtures:

- a. General Requirements: Angle stops, straight stops, stops integral with the faucets, or concealed type of lock shield, wheel handle stops for supplies shall be furnished and installed with fixtures as specified below. Exposed traps and supply pipes for all fixtures and equipment shall be chrome plated and connected to the rough piping systems at the wall. Wall escutcheons shall be chromium plated or nickel plated brass with polished, bright surfaces. Fixtures shall be as specified or approved equal.

P-1 Water closet: Flush Valve 1.28 GPF, manual operated flush valve elongated bowl, floor mounted. Provide elongated seat less cover.

P-1A Accessible Water closet: Flush Valve 1.28 GPF, manual operated flush valve, elongated bowl, ADA compliant, bowl height, floor mounted. Provide elongated seat less cover. Mount per ADA requirements.

P-2 Lavatory: Counter mounted sink with, mounted for ADA accessibility. Provide single lever faucet. Provide chrome plated wall supplies with wheel handled stop. Provide grid drain and chrome plated brass P-trap. Provide grid drain and chrome plated brass P-trap. Provide PVC insulation kit on all exposed piping. Mount per ADA requirements.

P-3 Urinal: Wall hung, vitreous china, top spud, wall carrier. Flush valve to be a chrome plated, manual flush valve, 0.125 GPF.

P-4 Drinking Fountain: High-efficiency electric, Bi-level refrigerated water cooler with bottle filling station.

P-5 Shower: Shower to be one-piece gel coated fiberglass shower, built-in corner shelves, 36" chrome shower curtain, chrome recessed soap, white vinyl shower curtain with stainless steel hooks. Provide shower valve assembly, with pressure balanced mixing valve with integral service stops and 2.5 GPM shower head.

P-5A Accessible Shower: Shower to be a transfer shower, one-piece, gel coat fiberglass shower with top corner shelves, 36" chrome shower curtain, chrome recessed soap, 36" white vinyl shower curtain with stainless steel hooks. Outside dimension: 38 3/4" L. x 39"W. x 78 3/4 "H. Provide factory mounted ADA compliant Grab bar, fold-up phenolic seat and drain. Provide factory mounted slide bar for shower compatible with the specified shower. Provide factory mounted slide bar for shower compatible with the specified shower. Provide shower valve assembly pressure balanced mixing valve with integral service stops, hand held head, Standard shower head, diverting valve, and slide bar mounting, clear-flo shower head and diverting valve. Contractor to grout base of tub/shower per manufacturer's instructions using multi-purpose thin set, to prevent deflection.

P-6 Janitor's Sink: Provide 24"x24" molded stone mop basin with service faucet with stainless steel wall surround.

P-7 Emergency Shower and Eyewash: Combination Drench Shower/Eyewash Floor Mount Shower/Eyewash Unit, all stainless steel construction with 10 3/4" diameter

corrosion-resistant stainless steel bowl, twin soft-flow eyewash heads with protective covers, hand-operated ½" NPT stay-open ball valve with safety yellow PVC handle, 1 ¼" drain fitting, 1 ¼" NPT supply. Mounting height = 42" above finished floor to eyewash head outlets. Provide high performance corrosion resistant stainless steel showerhead with integral 22 GPM flow control, Mounting height 86 ¾" to showerhead connection. Provide Emergency Thermostatic Mixing Valve with recessed stainless steel valve box.

10. Water Heater:

- a. SuperStor model 80-SSU commercial models, 80 gallon. Unit shall include a fin cupronickel heat exchanger and insulated tank. Insulation shall be 2" thick polyurethane insulation. Unit shall include a 316C stainless steel tank and high impact polyethylene outer jacket.
- b. Provide thermostatic mixing valve, thermostatic expansion tank, pressure and temperature relief valves and other valve and specialties as detailed.
- c. Provide hot water recirculation pump for domestic hot water system with flow sensor timer and aquastat controls.

## MECHANICAL SYSTEMS

### 1. Scope of Work:

#### a. Heating System:

##### i. Boiler System:

1. Provide two (2) gas fired condensing boilers to provide heating for the entire building.
2. Boiler shall be located in the mechanical room.
3. Boilers shall also provide domestic hot water using an indirect fired water heater located in the boiler room.

##### ii. Apparatus Bays:

1. Provide a hot water in-floor hot water radiant heating system.
2. Provide zoning of system including a zone for the apparatus Bay 1B, hose tower, Search and Rescue, Storage and Wash, compressor, EMS equipment Storage, Gear Wash and Parts.
3. Provide supplemental hot water unit heaters in Apparatus bays.

##### iii. Police Station and Office Area:

1. Provide high temperature hot water heating system with baseboard radiation.
2. System shall be zoned to provide individual room controls.

#### b. Ventilation Systems:

##### i. Apparatus Bays:

1. Provide a CO, NO<sub>2</sub> and combustible gas detection system with intake and exhaust fans to provide 0.75 CFM/SF when gas levels reach threshold required by code.
2. Provide humidistat in apparatus bays to automatically start ventilation system if room humidity levels exceed 45%.
3. Provide overhead vehicle collection system with exhaust fans, ductwork and overhead pick-up hoses for each vehicle.

- ii. Apparatus Bay Support Spaces
  - 1. Provide air to air heat recovery unit to provide ventilation of these spaces.
- iii. Compressor Room:
  - 1. Provide exhaust fan with intake and cooling thermostat to maintain room at maximum of 10 deg. F above outdoor ambient conditions.
- iv. Fire Pump Room:
  - 1. Provide exhaust fan with intake and cooling thermostat to maintain room at maximum of 10 deg. F above outdoor ambient conditions.
- v. Kitchen and Break Room:
  - 1. Provide a UL listed grease hood with UL listed exhaust fan and duct system for the kitchen.
  - 2. Provide make-up air unit for hood system.
  - 3. Provide dry chemical hood suppression system.
- vi. Police Station and Office Area:
  - 1. Provide air to air heat recovery ventilation systems to provide a dedicated ventilation system for this area of the building. Provide three systems as follows:
    - a. Multipurpose Room: shall be provided with a separate unit to allow this system to be shut down when the space is not being used.
    - b. Fire Department Spaces and Gear Turn Out.
    - c. Police Spaces and Support
  - 2. CO2 sensors shall be provided to allow for demand controls of the ventilation systems.
- c. Air Conditioning Systems:
  - i. General: Provide a VRF, ductless air conditioning system for all office area spaces. Each space shall be provided with a ductless air condition unit to provide cooling.

- ii. The IT server room and Communication Closet shall be provided with a dedicated a low ambient cooling unit to provide year-round cooling independent of the primary building cooling system.

## 2. Boilers:

- a. Provide high efficiency propane fired gas fired condensing boiler system to provide heat and hot water for the facility. Boiler Efficiency Target Efficiency: 97% AFUE
- b. Pumping systems shall include primary back-up pumping units with integral VFD's to maintain constant system pressure.
- c. Domestic water shall be heated from the boilers.
- d. Police Station and Office Areas shall be heated using hot water baseboard heat. Baseboard shall be sized for average water temperature of 150 deg. F to allow the boiler system to operate in condensing mode resulting in a 5-10% improvement in operating efficiency.

## 3. Heating Piping and Fittings

- a. Interior Hydronic Heating System Pipe and Tubing: Hydronic heating and cooling system piping 1 1/2" and smaller shall be type "L" hard copper tubing with wrought copper fittings for solder fitting assembly. Copper pipe fitting shall be wrought copper solder joints, ANSI B-16.22, streamlined pattern joints and shall be made with "Silverbrite" lead free solder with non-corrosive flux. "Pro-Press" shall also be permitted.
- b. Interior Hydronic heating System Piping 2" and larger shall be schedule 10 black steel piping with Victaulic fittings.
- c. To prevent corrosion caused by dissimilar materials provide dielectric unions equal to Watts Series 3000, with materials to match piping system. Flanged dielectric fittings shall be equal to Watts Series 3100 with materials to match piping system.

## 4. Valves

- a. Valves shall be equal to Apollo, Milwaukee or Watts. Valve type and numbers noted herein establish standard of type and quality. Valves shall have soldered joint ends for copper tube piping. Provide valves for services listed below and of the following types:
  - i. Check Valve: Watts Series LFCVS, lead-free brass, 200 lb. W.O.G.
  - ii. Ball Valves: Watts Series LFB6001, brass body, 600 lb. W.O.G., PTFE seat and seals and sweat ends. Provide handle extensions where pipe insulation thickness is 1" or greater.
  - iii. Drain Valves: Watts Model No. LFB-6001, sweat ends with 3/4" hose connection with cap and chain.

- iv. Balancing Valves: Terminal Balancing valves for all terminal heating units and branch heating mains shall be equal to Tour and Anderson Model STA, sizes 1/2 to 2" with memory stop, bronze body, 300 psig, NPT models, 200 psig, sweat or threaded ends to match installation requirements. Size units based on terminal flow rate.
- v. Provide strainers in each heating circuit. Strainers shall be Wye Type, as manufactured by Armstrong or approved equal, designed for 125 psi, WSP minimum and shall be cast iron for 3" and larger, malleable iron or bronze with threaded ends for 2-1/2" and smaller. Mesh shall be stainless steel. Strainers shall be provided with blow-down valve, with cap and chain.

#### 5. Thermometers and Gauges

- a. General: Provide pressure gauges on the inlet and discharge lines for each pump. Provide thermometers for hot water supply and return line for each circuit leaving the boiler room.
- b. Thermometers shall be H.O. Trerice Catalog No. A40507 or approved equal, with 9" scale, adjustable angle, and separable socket.
- c. Thermometers shall be installed so as to be easily read while standing on the floor.
- d. Furnish and install pressure gauges where specified and/or shown on the Drawings. Gauges shall be Trerice No. 450B with 4-1/2" dial, range as shown or approved equal to U.S. Gage or Crosby-Ashton. Each gauge shall be provided with a gauge cock. Gauges shall be installed so as to be easily read while standing on the floor. Provide pulsation dampener.

#### 6. Pipe Insulation

- a. All hydronic heating and cooling system piping shall be insulated with Manville fiberglass pipe insulation, Owens-Corning fiberglass, or approved equal. The insulation shall have an average thermal conductivity not to exceed .25 BTU in. per sq. ft. per F. per hour at a mean temperature of 75 degrees F. Thickness of the insulation shall be as scheduled below. Jacket shall be ASJ. Longitudinal jacket laps and the butt strips shall be smoothly secured with self-sealing longitudinal lap joints.
- b. Thickness shall meet the 2015 energy standard.

#### 7. Hydronic Specialties

- a. Provide hydronic heating specialties for installation in piping system:
  - i. Expansion Tank: Taco model CA, fabricated steel shell, ASME rated and labeled per Section VII, Div. 1 for 125 psig, replaceable bladder.
  - ii. Air Separator: Spiro Vent size 4". Provide high capacity vent.

iii. Manual air vents shall be coin style vents with manual shut-off.

8. Hot Water In-line Pumps

- a. In-line circulator pumps for the primary heating circuits and unit heating shall be ECM type equal to Wilo Stratus, flanged wet rotor circulator with EC motor and automatic capacity adjustment with on-board control electronics for variable speed pumping.
- b. Boiler Injection circulators shall be Wilo model Top-S, single stage wet rotor pump, PSC motor with flanged connection. Pre-selectable speed stages for capacity adjustment.

9. Heat Recovery Units:

- a. Units shall be indoor rooftop air-to-air heat recovery ventilators as manufactured by RENEW-AIRE or approved equal. Unit to include aluminum flat plate exchanger, supply air and exhaust air blowers, motors with starters and relays, outside air filters, adjustable defrost control, recirculation defrost controls.
- b. Units shall have a welded structural steel base with structural supports under blowers and components. Frame shall be 12 gauge galvanized steel. Lifting lugs shall be an integral part of the base. Unit floor shall be minimum 20 gauge galvanized steel.
- c. Unit housings shall be of formed heavy gauge galvanized steel supports (20 gauge min). Panels to be 20 gauge galvanized steel with 1" thick 3# density hardboard fiberglass insulation with galvanized lining secured and sealed to provide a complete vapor barrier and non-contaminating surface to all air streams. Framing and panels of dissimilar metals that could create a galvanic effect are not allowed. Unit shall have a drain pan, minimum 3" deep, with FPT drains on supply and exhaust air plenums minimum.
- d. Units shall be provided with a structural base rail.
- e. All exchanger surfaces, blowers, motors, filters shall be accessible through double wall gasketed access doors held closed by adjustable cam-lock latches. Continuous hollow rubber gasket shall be applied to all access openings to provide water and air-tight seals. Access door hinges shall be hot dipped galvanized for maximum protection from corrosion.
- f. Unit shall have a sensible and latent heat exchanger as manufactured by RENEW-AIRE. Exchanger shall be static type.
- g. Blowers shall be forward curved DWDI class I for quiet efficient operation arranged in a draw through configuration relative to exchanger. Direct drive motors shall be efficient multi-speed PSC type with internal thermal overload protection. Motor and blower shall be mounted on common frame and isolated from unit case with RIS isolators and flexible duct connections. Motors and blowers shall have V-belt drives with variable pitch sheaves. Belt drive fans shall have a hollow rubber gasket around the fan discharge to provide an air tight seal while allowing for easy removal and replacement of the fan

without screws or permanent fasteners. The discharge gasket shall isolate the fan from the unit casing and eliminate the requirement for an expansion duct fitting.

- h. Electrical controls include motor starters with overloads, fuses, control transformer for low voltage controls, service switch and terminal points.
  - i. Outdoor air and/or return air filters shall be 2" pleated 35% filters. Filters shall be mounted within unit in galvanized holding frames upstream of exchanger and accessible through access panels. Provide one spare set of filters for each unit; replace filters prior to final inspection.
  - j. Unit to include a proportional/integral controller with defrost sensor mounted in the exhaust air stream leaving the heat exchanger core and an economizer sensor mounted to measure outside air temperature. These controls shall be mounted in the unit control panel. In defrost mode the controller shall operate the supply fan VFD damper for heating and economizer modes. Set points shall be adjustable.
10. VRF Air Conditioning System:
- a. Provide a variable capacity, air conditioning system shall be equal to a Daikin Variable Refrigerant Flow, split system air conditioning system pump
  - b. The system shall consist of outdoor unit, multiple indoor units. The sum of connected capacity of all indoor air handlers shall range from 50% to 130% of outdoor rated capacity.
  - c. Systems shall be manufactured by Daikin or approved equal by Mitsubishi.
  - d. Provide controls to allow the system to allow system to be controlled using a field installed control system.
11. Air Distribution Ductwork:
- a. Duct construction shall be in accordance with best practices and latest SMACNA requirements for metal gauges, joints, reinforcing, and supports except where specified otherwise in these specifications. All exposed ductwork shall be constructed and hung to provide a neat, smooth, finished appearance. Cadmium plated sheet metal screws shall be used on all exposed ductwork. Ducts shall be free from thumping or rattling when fans are turned on or off. All ductwork shall be air sealed.
12. Ductwork Insulation
- a. All Supply and Return ductwork located in ceiling spaces shall be insulated with 3" thick one pound density duct wrap with factory applied reinforced aluminum jacket, insulation shall be equal to Knauf Duct Wrap with FSK facing. Product shall not exceed 25 flame spread, and 50 smoke development. Apply with 3" wide pressure sensitive tape and sealing tool, for ducts over 18" wide secure insulation to duct with mechanical fasteners spaced on 18" centers. Limit average compression to 25% or less. All ductwork in attics

or cold spaces shall be insulated with 6" of duct wrap or with Insulation equivalent to the thermal insulation of the building.

13. Controls:

- a. The control system for the building shall be designed with a web based DDC control system.
- b. HVAC System Controls shall include:
  - i. Boilers monitoring of factory staging and controls
  - ii. Pump Start-Stop
  - iii. Baseboard and radiant heating system controls.
  - iv. Heating pumps start-stop, VFD controls, lead-lag, status and alarms
  - v. Water heating pumps start-stop, VFD controls, lead-lag, status and alarms
  - vi. Heat Recovery Units, VFD, Start-stop, alarms, heat and cooling coils, freezestat, demand controls.
  - vii. Demand control CO2 sensors in rooms indicated with motorized damper and HRU fan VFD control top maintain constant duct pressure.
  - viii. Hot water re-circulation pump control.
  - ix. Gas detection and humidity controls for Apparatus Bay areas.
  - x. Water heater controls for pumps and aquastats.
  - xi. Integration of VRF cooling systems with space sensors, so that each zone has one thermostat to control both heat and cooling within the zone.