DC 2.7 v10.02
Summary of Changes

1. Para 2.7.2.2: The requirements stated in the paragraph are still applicable by the NEC but it should not be necessary to identify the specific year and paragraphs that would change for later editions of the NEC.

2. Para 2.7.2.3: This paragraph calls for providing a good coating on the mechanical equipment coils/fin and cabinets to provide better protection from corrosion and deterioration. The specific coatings specified have a reputation for providing good performance except that it creates a sole source procurement situation. Other coating products believed to provide comparable performance have been added to eliminate the sole source procurement situation.

3. Para 2.7.3.2: The requirement for a sloped or crowned roof on horizontal ducts exposed to the weather is to minimize ponding of water which in turn could result in accelerated spot corrosion of the ducts. An option for using round ducts if practical for the situation would avoid ponding of water, eliminate need for any crowned roof, minimize personnel walking on the ducts and would require less sheet metal to handle the same air flow requirements.

4. Para 2.7.3.3: Fire, smoke or fire/smoke dampers were required on numerous projects to be added by change orders. In some cases a fire damper had to be removed and replaced by a fire/smoke damper which required rework of the ceiling, ductwork, insulation and providing electrical power (fire dampers are typically mechanical devices requiring no electrical power). The identification of smoke barrier walls, fire barrier walls or combination fire/smoke barrier walls may not always be clearly defined. This requirement is highlighted as a means to minimize future design problems of this nature and the associated additional cost for change orders.

5. Para 2.7.3.4: The more commonly available Type 304 stainless steel ducts and fume hoods were installed in a laboratory where hydrochloric acid was handled. Although this type of installation is required for few projects, the cost to replace the deteriorated ducts and fume hoods with the proper materials required rework at a high cost.

6. Para 2.7.5.4: Some steel pipelines, particularly outdoors and exposed to wet weather or near cooling towers discharges has resulted in accelerated corrosion on the pipes or valves. It may be possible that valves in particular only have the standard factory coating and the pipelines less than satisfactory coating systems. The 3 coat inorganic zinc epoxy primer (with good surface preparation), polyamide epoxy intermediate coat and polyurethane top coat system has been used successfully on fuel pipelines and fuel storage tanks where leakage is of great concern to the Environmental Protection Agency. The specified coating system has been in use for a long time but there may be equal or better coating system alternatives today. The main objective is to have these steel materials provided with a satisfactory coating system to avoid premature corrosion/deterioration of the valves and piping.

7. Para 2.7.5.5: Fiberglass pipe insulation on chilled water piping was commonly specified for many years. More recently, low moisture absorbent insulation like cellular glass has been specified for chilled water piping located outdoors. A breach in the vapor barrier jacket surrounding the fiberglass insulation could allow humid outdoor air to enter the insulation and cause condensation to form and collect inside of the insulation/vapor barrier jacket. The wetting of the insulation causes the insulation value (R) to decrease and chilled water to

gain heat (temperature rise). Formation of condensation inside of the insulation can eventually drip out and cause damage or water stains to the ceilings below if located indoors in ceiling spaces. Chilled water piping with fiberglass insulation inside of an air conditioned building is less likely to have this problem unless the properties of the air inside of the ceiling space has higher humidity conditions than in the conditioned space below. The field investigation phase for the replacement of air handlers for the Kalanimoku building has revealed some instances of dripping condensate from the fiberglass insulation. (Note: The Naval Engineering Command Pacific in general does not allow fiberglass insulation on chilled water pipes even with the wicking feature to be used in tropical areas such as Hawaii and Guam).

8. Para 2.7.9:Drawings for a project under construction does not show power supply wiring on the floor plans or any electrical panel circuits for electrical power for variable air volume (VAV) boxes. Specification descriptions appear to more clearly define the requirements for control signals than for power. On other project designs the description of the controls have some discrepancies between the specifications, DDC points list and diagrams on the drawings. Drawings and specifications should be consistent and the requirements for power supply and control/monitoring input/output/analog/digital signals should be made clear for every mechanical systems equipment or components.

2.7.1 Mechanical Equipment Room (MER) and Mechanical Equipment Enclosures: Approximately 5% of the floor area shall be allocated for air conditioning equipment in new facilities. Coordinate room size and location with the architect based on the worst-case equipment selection.

2.7.1.1 MER or ceiling spaces or any other spaces are NOT to be used as outside air plenums for any reason. All air quantities shall be ducted continuously to/from equipment and air devices. MER with air-cooled condensers shall have supply and exhaust air ducted directly to/from the outdoors through exterior wall louvers located in adjacent walls or through the roof with a gooseneck to prevent recirculation of hot exhaust air. If MER has an exterior door, provide nominal 50 CFM (conditioned) supply air to pressurize MER. Locate all AC equipment at floor level do not hang equipment. MER shall have sufficient space to allow two feet minimum clear area (or more as required by equipment manufacturer) all around each piece of equipment for access to perform maintenance service, parts replacement or repair work. Also provide sufficient space and access provisions for future replacement of all equipment in MER.

2.7.1.2 Paint all EXPOSED mechanical work selected work in MER may be painted. Confirm with the User and Project Coordinator. Color shall be as selected by the architect or to match the color scheme for the adjacent area.

2.7.1.3 Where floor space is not available (e.g. existing building), AC equipment located outdoors shall be located within a security enclosure (cage) of sufficiently size and height for a person to easily stand, with a single or double leaf gate depending on equipment size for removal or replacement and with heavy-duty key padlock. The interior space requirements apply as for MER's. The equipment shall be mounted on spring vibration isolators and secured with stainless-steel bolts to the unit and to a (4" high minimum) concrete pad sized

six inches all around larger than the unit. The space between the concrete pad and the enclosure shall have root barrier material with crushed gravel cover. The wall and gate enclosure material shall be such that it withstands corrosion, allows air transfer through it and/or provides some sound attenuation if required, and prevents climbing on it. The roof enclosure material shall be such that it is sloped, withstands corrosion, allows air transfer through it if required, safely supports that weight of an adult person, and prevents access to the associated building's roof, balcony, windows, etc. If a condensate drain drywell is required, it shall be located within enclosure. Equipment disconnect switch shall be stainless steel NEMA-4X and also be located within to prevent vandalism or unauthorized use.

2.7.1.4 Provide adequate sized openings to permit removal of existing and installation of replacement equipment.

2.7.1.5 Provide fire-resistive wall construction where required by code to separate the heater room from the rest of the building.

2.7.1.6 Provide ventilation for rooms containing heaters, boilers, compressors and transformers which generate heat. Provide makeup air for combustion in accordance with the Uniform Plumbing Code or the manufacturer's recommendations whichever is larger.

2.7.1.7 Clearances for boilers, water heaters and unfired pressure vessels shall meet the requirements of the State of Hawaii, Department of Labor and Industrial Relations (i.e. boiler inspector).

2.7.1.8 Noise generating equipment shall be located and treated to preclude disturbing users and neighbor and in accordance with the Department of Health noise regulations.

2.7.2 Mechanical Equipment

2.7.2.1 Locate and provide air conditioning equipment with noise levels which will not impact on the function/use of a facility, i.e., locating water cooling towers, outdoor package units, fans and any other noise generating equipment sufficient distance from classrooms and buildings where the noise levels will not impact on the function/use of the facility. Noise levels of air conditioning equipment inside the facility (rooms) should not exceed 35 decibels (A-weighted sound levels and/or 15 decibels below the ambient room noise level whichever is lower (quieter). Achieve by a combination of equipment selection, distance from buildings or selection of building materials for noise attenuation.

2.7.2.2 Do not locate air handling units, fans, piping and other water containing equipment directly over electrical equipment, panel boxes, controls, switches and other energized electrical devices. ~~The~~ **NEC** Electric Code ~~**[NEC 1999 110-26 (f)(1)(a)]**~~ does not allow placement of piping, equipment, ducts and other hardware over electrical panels, switchboards and other panels under its jurisdiction. Do not route piping and ductwork and do not locate mechanical equipment in elevator equipment room, electric rooms, electric vaults and electric closets. Designer shall provide coordinated drawings to DAGS prior to final drawings. Specifications shall require contractor to submit coordination drawings showing all existing conditions and new work.

2.7.2.3 Specify locally applied corrosion protection coating on the inside and outside of all outdoor installed AC equipment and for replacement AC equipment located

in existing open outdoor air or mixed air plenums. (If possible, replacement projects shall be revise per item 2.7.1.1 above.) All air-cooled condenser coils and evaporator coils that ~~supply more than 50%~~processes outdoor air, shall be coated with locally applied corrosion protection coating. Equipment coatings shall be **~~Epoxy or Polysiloxane~~** similar to "Ameron PSX-700" **epoxy siloxane, "Adsil Microguard AD35 Coil-Fin-Cabinet" or "HVACGUARD Panel Guard"**. Copper tube with copper fin coils (Cu-Cu) **~~shall be coated with an "E-Coat", or Epoxy, or Phenolic thermosetting resinous coating through a dip and bake process similar to "Heresite". C~~ and c**opper tube with aluminum fin coils (Cu-Al) shall be coated with **~~Aluminum Polyurethane spray paint~~ a** coating **~~with a three year written warranty~~** similar to Blygold "Polual", **"Adsil Microguard AD35" or "HVACGUARD Coil Guard" rated for a minimum 4000 hours salt spray test in accordance with ASTM B117**. All protective coatings shall be applied in accordance with the manufacturer's recommendations and by manufacturer's certified/approved applicators.

2.7.2.4 Ceiling-hung AC equipment are not preferred and should be avoided. However, if it's the ONLY solution, specify sloped auxiliary drain pan under unit and coil piping connections (6" all around beyond unit) with drain connection to unit condensate drain piping. In addition, include a pan water alarm device with hard-wired power supply (batteries not acceptable), remote mounted alarm and control panel with silence button located convenient for user, identify circuit number and electrical panel, adequate lighting and adequate space for equipment (maintenance, repair and replacement) on a safe platform and with easy access (stair, ladder, etc.).

2.7.2.5 All outdoor AC equipment shall be specified with sloped or crowned roofs. If the equipment manufacturers refuse to accommodate, specify that the contractor provides a sloped or crowned cover with corrosion protection coating on all surfaces and is to be securely attached to the equipment. The cover installation shall accommodate any vertical air discharge arrangement and shall not allow any standing water on the top surfaces of the unit.

2.7.2.6 Specify that AC equipment to be considered for bid purposes must be from a manufacturer that has a local representative vendor who sells the equipment, stocks spare parts, provides start-up and support services and has the support of a service organization, reasonably convenient to the site of installation, which has serviced manufacturer's equipment of comparable type, size and capacity as those specified. The manufacturer must have other equipment of comparable type, size and capacity installed and operating satisfactorily in the State of Hawaii for a minimum of two year prior to bid opening. The manufacturer shall provide a list of locations in Hawaii with addresses and telephone numbers when requested by the State Contracting Officer. Specify that the Contractor must purchase the equipment from the manufacturer's local representative vendor and not a mainland vendor.

2.7.2.7 All AC and ventilating equipment shall be specified with voltage and phase protection devices and re-start relay device for electrical power problems and power outages. The devices shall protect against single phasing, phase unbalance, phase reversal, and high and low voltage problems. If the manufacturer does not supply the equipment with the device as standard or optional, then the Contractor shall field install them properly so as to not defeat the equipment manufacturer's safety control devices. EXCEPTION: all low horsepower motors up to 5 HP but excluding compressor motors.

2.7.3 Ductwork

2.7.3.1 Supply, return and fresh air ducts which requires insulation shall have exterior wrapped duct insulation (interior duct lining is not allowed). Outdoor insulated ductwork shall have protective jackets applied on all surfaces. Jacket material can be aluminum, stainless steel, painted galvanized steel, PVC or approved equal by the State. For duct sound attenuation purposes, use duct attenuators/sound traps only when required. We prefer to use of other means to reduce equipment noise. Use of duct attenuators/sound traps with "two to three feet of inorganic mineral or glass fiber and packed not less than 5% compression..." or like material should be avoided and/or minimized if other means of sound attenuation can be achieved. Although the fill material must be inert, vermin and moisture proof; moisture, bacteria and algae can still reside on the fill material. If used, access for inspection, cleaning and replacement must be provided when feasible and cost effective. These guidelines apply to large AHUs and small AHUs (FCUs).

2.7.3.2 All outdoor horizontal AC ductwork whether insulated or not, shall be specified with a sloped or crowned sheet metal rain cover with corrosion protection coating on all surfaces and is to be securely attached to the duct vertical supports. The covers shall NOT be secured to the ductwork or insulation and shall not allow any standing water on the top surfaces of the ducts. **Round ductwork should be evaluated as an alternate method.**

2.7.3.3 Insure fire, smoke or fire/smoke dampers are installed at all duct penetrations through fire resistance rated and/or smoke barrier walls as required by the applicable fire code or as directed by the authority having jurisdiction. Insure that detectors, electrical power and signals to the fire alarm system, if necessary, are provided.

2.7.3.4 Insure that the material of construction for fume hoods, ducts and exhaust fans are corrosion resistant or compatible with the chemicals, vapors or materials to be handled (e.g. certain grades of stainless steel are not compatible with hydrochloric or sulfuric acids).

2.7.4 Air Distribution

2.7.4.1 Consultant shall verify air quantities on a room-to-room distribution basis and on a total air-handling unit and total building basis. Air quantities shall balance with respect to supply air, return air, fresh air intake and exhaust, and/or relief air. Consultant shall verify air balance for minimum pressurization and/or as required. Each room and total floor or building shall have appropriate means for relief of excess air to prevent over pressurization.

2.7.4.2 Checks above should minimize the occurrence of stuffy room(s) with many occupants. The condition usually occurs in confined spaces with 15 and more occupants where doors are not opened and closed for intervals of 45 minutes and longer, (e.g. classrooms, small and large conference rooms, and other areas of assembly and confinement).

2.7.5 Mechanical Piping

2.7.5.1 Specify AHUs/FCUs be provided with "P"-traps ("V" or running traps are not allowed), be installed on spring vibration isolators secured with stainless-steel bolts to the unit and to a raised concrete pads of sufficient (4" minimum) height

to accommodate the "P"-trap, and to include a cleanout at the "P"-trap and at each 90° change in direction in the adequately sloped condensate drain line.

2.7.5.2 If there is no floor drain or plumbing close by and the AC condensate drain must go to a drywell, specify that the drywell shall have a heavy-duty vandal-proof access cover flush with grade, the outdoor exposed drain pipe must be kept to a minimum, and shall terminate with a down turned elbow whose outlet is located 3" minimum clear space above the gravel rocks.

2.7.5.3 Central Plant AC systems with underground chilled water distribution piping shall be specified with isolation or sectionalizing valves, high and low point locations; spaced throughout the system for shut-off, air vents and drain valves respectively; all within manhole access enclosures. Gasketed push-joint pipe system is not allowed. Specify welded, soldered or brazed joint system for chilled water and welded, soldered, brazed or solvent joint system for condenser water. Provide concrete thrust blocks at all elbows and tees, and floor flanges with embedded anchor bolts at entrance to buildings where required to prevent pullout at joints. Include two Board of Water Supply approved water meters, one on the make-up water line to the cooling towers and one on the bleed off line to the sanitary sewer, a valved 5-gallon bypass chemical feeder for the chilled water and one year supply of corrosion and inhibitor chemicals to initially charge the system to a residual of between 800 - 1200 PPM and to test and maintain that residual every six months including submission of written reports for each occasion to DAGS-CSD.

2.7.5.4 Coat steel pipelines exposed to the weather with a 3 coat inorganic zinc epoxy primer, polyamide epoxy intermediate coat and polyurethane top coat or another comparable corrosion resistant coating system. Ferrous body valves and attached operators should be provided with some type of corrosion resistant coating instead of the standard factory finish if used near cooling towers or exposed to the weather.

2.7.5.5 Use low moisture absorbent pipe insulation material such as cellular glass for chilled water pipelines located outdoors, in spaces exposed to outside air or air with dewpoint temperatures higher than the exterior surface temperature of the chilled water pipe encased by insulation similar to fiberglass (assumption that the exterior vapor barrier covering will over time allow outside air to enter the insulation and come into contact with the exterior surface of the pipe).

2.7.6 Cooling of Elevator Machine Rooms

2.7.6.1 Temperature and humidity control and cleanliness for machine rooms with electronic or digital elevator control equipment shall be evaluated and provided where recommended by the elevator manufacturer. Conditioned air which would have been exhausted out of the building for fresh air change may be transferred into elevator machine room and then exhausted from the building. Evaluate if air filtering is needed on a site specific basis. Use of outside air for ventilation can provide temperature control but not humidity control.

2.7.6.2 When required, electronic elevator control equipment may be air conditioned but only in buildings with four floors or more and if the control equipment is installed in a separate room or enclosure from the elevator machinery. Cooling requirements shall be obtained from the elevator manufacturer.

2.7.7 Cooling of Reproduction Equipment

2.7.7.1 Specify that copying or reproduction type equipment be located together in a common room and be locally exhausted and ducted directly outdoors. Provide make-up air into the room housing the equipment.

2.7.8 Maintenance Service Contract for New Equipment

2.7.8.1 See TG Z1040.01 Startup and Adjustment for Maintenance Service Contract for Mechanical Equipment. Project specifications shall include a one-year maintenance service contract whenever mechanical equipment such as air conditioning equipment, compressors, motors, etc. are used.

2.7.9 Electrical Power and Controls for Mechanical Systems Equipment

2.7.9.1 Insure the electrical drawings show the required electrical power supply to all mechanical systems equipment and components (e.g. air handlers, damper motors, variable air volume terminal boxes, two-way valves, DDC panels, smoke detectors, etc.)

2.7.9.2 Insure the mechanical drawings, electrical drawings and specifications are coordinated in describing the power supply and controls requirements in terms of location of components, voltage, wire gauges, need for voltage step down transformers and DDC points table showing analog/digital/input/output characteristics for monitoring and control. Provide ladder diagrams or schematics to illustrate the voltage/transformer requirements, contactors, switches, coils, sensors, overload protection, indication of connection of input/output control signals to/from a controller device, etc. for all mechanical systems equipment or components.