

# HVAC - Owner's Project Requirements

Division 230000-2

Reference	Specification Requirements
Section 230593	<p>Specifications shall address the TAB (Testing, Adjusting and Balancing) Services procurement and specification requirements. See Section 230593 TAB Guide Specification.</p> <p><i>Comment: Generally, DECA will contract directly with a TAB agency. The consultant shall edit the guide specifications for both the installing contract and the TAB contract, clearly delineating the requirements of each party. The consultant shall prepare a separate procurement package for the TAB contract.</i></p>
	<p>Water treatment program specifications shall be included for all water systems requiring water treatment.</p> <p><i>Comment: Pay particular attention to specific component requirements. For example, modular boilers with aluminum heat exchangers cannot tolerate high-ph levels used on conventional boiler loop systems.</i></p>
	<p>For direct-expansion systems, provide for five-year compressor warranties corresponding with the initiation of the building warranty. Compressor warranties shall be parts-only for years 2 through 5.</p>
ANSI/ASME A13.1	<p>All piping and duct systems shall be painted and identified to the signage requirements of ANSI/ASME A13.1.</p> <p><i>Comment: This refers to identification and not necessarily painting of the entire piping or duct system, unless necessary for quick identification in case of emergency.</i></p>
	<p>All rotating equipment shall be balanced both statically and dynamically. When mounted, equipment shall not exceed a self-excited vibration velocity of 0.05 inches per second in the vertical, horizontal or axial directions.</p>
NEMA Standard HG_1-4.23	<p>All electrical motors shall comply with the balancing requirements of NEMA Standard HG_1-4.23 or the current equivalent standard.</p>
	<p>Demolition: refrigerant-bearing equipment shall be evacuated and disposed of per applicable codes / law unless the Owner specifically makes written request to remove and retain the refrigerant. The contractor is responsible for executing the written documentation of such removal and disposal using the Refrigerant Disposal Form provided by the Using Agency, if applicable.</p>
236414-1 and 236414-2	<p>For centrifugal and large screw-compressor chillers, DECA will typically pre-purchase the chillers using a life-cycle cost bidding method. Chiller specifications shall be per the guide specification presented in Section 236414-1 and Section 236414-2.</p> <p><i>Comment: DECA will prepare the actual specifications for the chiller procurement, and the consultant will follow the coordination items listed in the guide specifications.</i></p>

--	--

Reference	Systems Basis of Design Requirements
	Define summer and winter outdoor design conditions.
	Define summer and winter indoor design conditions by control zone.
	Define acceptable summer and winter part load conditions range by control zone.
	Define basis of HVAC load & energy analysis calculations.
2003 IECC & ASHRAE 90.1	Define minimum energy efficiency requirements.
ASHRAE 55-2004	Define Thermal Environmental Conditions.
ASHRAE Std.55.2	Define air filtration performance requirements.
ASHRAE Std. 15 & NFPA 101	Define Mechanical Equipment Room design requirements.
ASHRAE Std. 62 & 902 KAR Chapter 20	Indoor Air Quality & Ventilation Requirements.
	Define Building Systems operating set points.
	Define acceptable HVAC related sound levels.
	Define special equipment utility requirements.

Reference	Design Requirements
	<p>Ductwork shall be externally insulated. Internal insulation is not acceptable.</p> <p><i>Comment: Our experience has shown that we rarely get the craftsmanship required to properly install internal duct insulation. <b>Do not use internal ductwork</b>, except for short sections (e.g. 30 linear feet or less) for acoustic reasons.</i></p>
	<p>Boilers shall be configured so that at least two boilers are necessary to carry the fully building load, plus one boiler as a backup.</p> <p><i>Comment: The practice of using one large boiler for all building loads, plus one backup boiler of the same size, usually results in operational problems, as one large boiler typically cannot handle the range of loading required for such an application. We prefer to have at least two boilers for full load, with one more boiler as backup for either of the first two. Modular boiler arrays should have at least four total boilers, for maintenance and operating flexibility.</i></p>
	Boilers and chillers shall be located in separated mechanical rooms.

	<p><i>Comment: Boilers shall not be subject to ingesting refrigerant from a chiller leak. Likewise, chillers shall not be subject to unconditioned combustion air from outside.</i></p>
	<p>Chiller rooms shall be cooled / de-humidified to reduce piping and equipment surface condensation.</p>
	<p>Chilled water piping loop shall have valved stub-out piping (supply and return) through wall to building exterior with capped blind flange or Victaulic connections to accommodate future temporary chiller. Consider where a temporary chiller could be placed, with convenience to the mechanical room.</p>
	<p>Adequate mechanical space shall be provided, regardless of architectural programming constraints. The mechanical consultants are responsible for championing the need for adequate space as a part of the design process.</p> <p><i>Comment: "The architect wouldn't give me sufficient room" is not an acceptable excuse. If adequate room cannot be worked out internally within the design team, consult with DECA project management staff for resolution. The building systems will have to be maintained for the life of the building. Shortchanging those needs is a short-sighted process.</i></p>
	<p>Chiller sizing strategy – consider using two or more chillers to carry full load, plus one chiller for redundancy. This strategy can reduce the capital cost for the redundant chiller, since it need not be 100% of the full building load.</p>
	<p>Drawings shall show chiller tube pull space within the chiller room. Space must be adequate for both condenser and evaporator tube pulls. If necessary, overhead doors may be provided to allow pulling space.</p>
	<p>Chillers shall be located so that initial installation (and future replacement) can be accomplished without undue equipment disassembly or architectural demolition. Ideally, the chiller room shall open to an accessible outdoor area.</p> <p><i>Comment: We will typically pre-purchase large chillers with a target delivery date of approximately two months before temporary cooling operation is anticipated. We will not buy chiller(s) early to allow the contractor the luxury of building the building around them, while the warranty is expiring in the meantime.</i></p>
	<p>Coordinate chiller room requirements with architectural design to make sure adequate openings (e.g. overhead doors) are provided to allow ready chiller installation/replacement access. Verify that column spacing is adequate to allow passage of the largest chiller equipment.</p>
	<p>HVAC condensate drain lines shall be presented on drawings with pitch indication.</p>
	<p>HVAC condensate drain trap design shall be detailed with indication of depth. Make sure that the specified trap seal height can be achieved, particularly with regard to specified equipment pad height.</p> <p><i>Comment: Often, for high-pressure air handler systems, the required seal height exceeds what is available with the installed pad height. Draw each trap detail to</i></p>

	<i>scale to ensure proper installation.</i>
	HVAC Condensate drain line size shall be indicated
126414-1,2,3,and4	Address access, construction sequence and documentation requirements for all Owner pre-purchased equipment.
	Building service lines shall not be routed on the roof.
	Restroom exhaust requirements shall be by powered exhaust.
	Provide detail presenting access, drainage and support method for HVAC equipment installed above ceiling.
	Two pipe change-over heating and cooling systems shall not be considered for new construction and continued use in renovations requires written authorization by DECA.  <i>Comment: While formerly popular, such systems are not easily changed over from heating to cooling and vice-versa, which is totally unacceptable during swing seasons (spring and fall).</i>
	Utilization of gas as a direct heating source shall consider the requirements of ASHRAE 62.
	Piping system design shall present the method of initially cleaning, maintaining and treating the piping systems. All closed loop systems shall have side-stream filtration.  <i>Comment: As a practical matter, it is impossible to "flush" a large pipe with a garden hose. To get the water velocities needed to scour dirt and iron particles, a large pump (e.g. fire pump) is needed. As a result, debris remains in the piping, which will quickly foul heat exchangers on water-source heat pumps, for example. Thus, a positive method to filter the water stream is necessary.</i>
	All condensing water systems (cooling towers) shall include inline centrifugal separators.  <i>Comment: Removing dirt and organic matter from condenser water streams reduces heat exchanger fouling, and removes a food source for potential biological growth.</i>
	Provide detailed construction phase and performance testing check list for each piece of mechanical equipment to be commissioned.
	Make up water provisions for hydronic, geothermal and boiler applications shall include a totalizing meter ranging to 999,999 gallons and a re-settable meter ranging to 99,999 gallons. Provide multiple metering stations where systems can be isolated by zoning or control. When the building has a BAS, connect the meters to the control system.  <i>Comment: Daily tracking of makeup water consumption is crucial to maintaining geothermal systems. Awareness of leaks and prompt action can prevent high repair bills as well as excessive water usage.</i>

	Flexible water hoses supplying appliances or HVAC equipment shall be protected and reinforced with metal braiding of a material appropriate for the application.
	HVAC equipment with drain pans shall include provisions for pitched drainage and extended life materials of construction.
ASHRAE 62 & ASHRAE 90.1	De-humidification and reheat provisions shall conform to the applicable version of ASHRAE 62 and ASHRAE 90.1.
	Geothermal well locations shall be permanently located by appropriate means.
	Geothermal wells shall be valved so that individual wells can be isolated and bypassed.
	Geothermal wells shall have fittings for pressure and flow testing at each well.
	Geothermal wells shall be arranged with adequate spacing between wells to prevent long-term ground heat buildup.  <i>Comment: Geothermal systems work best when seasonal heating and cooling loads are somewhat balanced. Buildings with predominant cooling loads can be problematic. Be sure to calculate the multi-year accumulative ground heating effect for the well performance design.</i>
	Geothermal systems shall have at least one test well installed and thermally tested at the early part of Phase B design. Well fields shall be designed based on the actual performance of the test well(s) and not on assumed values.
	Variable-Refrigerant Systems shall include a five-year comprehensive parts and labor warranty on the entire refrigerant system, including field-installed piping. The system(s) installation, including piping, shall be fully commissioned.  <i>Comment: Most of the problems we have seen with these systems tend to come from improperly-installed piping connections. This often results in finger-pointing between the installing contractor and the equipment vendor. The warranty requirement will hopefully encourage the contractor to follow proper installation procedures.</i>
	Variable-Refrigerant Systems shall be installed by personnel certified by the equipment manufacturer. Verify the certification documentation at a pre-installation commissioning meeting.  <i>Comment: Improper flare connections for refrigerant piping seem to be a common problem. Technicians may not know how to make a proper flare connection, or may use traditional SAE flaring tools to make a metric flare connection, for example.</i>
	Provide concrete inertia and housekeeping pads for all major floor mounted equipment subject to vibration.
	Provide parallel float and thermostatic traps with isolation valves on steam to hot water converters.

	<p>For unitary systems (variable-refrigerant, fan coils, heat pumps, etc., outdoor air must be supplied by dedicated outdoor unit(s) that will introduce outdoor air at room-neutral conditions. Do not supply unconditioned outside air directly to a room or room terminal unit.</p> <p><i>Comment: Outdoor air systems usually run constantly, even when individual units are not running. Introducing extremely cold or hot/humid air to spaces is unacceptable. In addition, unitary equipment may not be able to handle institutionally-required outdoor air requirements.</i></p>
Using Agency BAS Standards	<p>Coordinate control system requirements with the User Agency as scheduled in the Design Deliverables Check List. Certain agencies will have specific BAS standards (e.g., KCTCS).</p>
DECA CEMCS Interface Standards (latest version)	<p>Building Automation Systems (BAS) shall conform to the latest version of the DECA standards for interfacing with the Commonwealth Energy Management and Control System (CEMCS), a statewide energy reporting and analysis project that became operational in 2012.</p> <p><i>Comment: BAS trend data will be collected and transmitted to CEMCS servers for energy tabulation and operational analysis. Adherence to the CEMCS interface standard will simplify the implementation.</i></p>
	<p>HVAC control sequences shall be written and presented with the Phase A schematic drawings and P&amp;ID diagrams.</p> <p><i>Comment: Unfortunately, it is all too common within the design profession to write the control sequences at the last minute and/or let the control vendor write them. The control sequences are the responsibility of the design engineer and can, and indeed MUST be developed during schematic design. One cannot design a system if it is not known how it will be controlled and operated.</i></p>
	<p>Packaged pump systems shall not use proprietary controllers. We prefer to use control modules from the same vendor as the Building Automation System, where feasible.</p> <p><i>Comment: Proprietary/locked controls are unacceptable. The design engineer, commissioning agent and operating staff all need the ability to look at control logic and make changes (e.g. PID loop tuning) as necessary. In addition, we have not been particularly successful in integrating proprietary controls to BAS systems.</i></p>
	<p>Utilization of plastic piping components within a building is not permitted without written authorization from DECA.</p> <p><i>Comment: This does not necessarily preclude the use of piping for certain applications. It <u>does</u> require that the proposed application be discussed with DECA and written approval is obtained.</i></p>
	<p>Provide dielectric couplings where dissimilar metals are joined or in contact with metal wall penetrations. Dielectric unions are not acceptable.</p>
	<p>Boiler blow down and drain lines shall be routed to an appropriate drain fixture without creating traffic or safety hazard.</p> <p><i>Comment: Surface-run piping across aisle or walkways is not acceptable. "Pipe</i></p>

	<i>to nearest floor drain” is not acceptable direction to the contractor.</i>
	Provide floor drains adjacent to all equipment subject to nuisance leaks (e.g. boilers, pumps) and/or condensation (e.g. chilled water pumps).
	Present pipe header elevation drawings, demonstrating service breaks, for equipment requiring tube / coil removal or cleaning provisions.
	Present water treatment equipment and fitting locations on drawings.
	Modular HVAC equipment systems shall be piped in a manner to facilitate removal of one module without disabling operation of the system.
	<p>Drawings shall present main steam piping system expansion loops, expansion joints, anchors and guides. Run outs to terminal equipment may be presented by appropriate typical drawings or details.</p> <p><i>Comment: It is not the responsibility of the installing contractor or piping vendor to engineer expansion requirements and anchoring methods. The designer shall clearly show anchoring, expansion provisions, and other details necessary for proper operation.</i></p>
	Steam supply piping shall be minimum schedule 40 welded steel. Condensate return piping shall be minimum schedule 80 welded steel.
	Buried building service piping shall be protected from external corrosion. Insulation covering buried piping shall be water tight.
	<p>Use of direct expansion refrigerant lines exceeding 50 ft. in length requires written authorization from DECA.</p> <p><i>Comment: The designer is responsible for designing and specifying the sizing and layout of the DX piping, not the equipment manufacturer.</i></p>
	Present P & ID (piping and instrumentation diagrams) per the provisions of the Adm. Doc. Requirements.
	<p>All closed-loop piping systems shall have pressure/temperature probe ports (e.g. “Pete’s Plug”) at the inlet and outlet of each major system component. Show the locations of such ports on the P&amp;ID diagram.</p> <p><i>Comment: Troubleshooting system performance is much easier when provisions to measure temperature and pressure drops are provided, and tests can be easily accomplished. Permanently-installed instruments are often unreliable.</i></p>
	<p>All closed-loop piping systems shall have a flow measurement station, e.g. flow orifice, triple-duty valve, balancing valve or other reliable means.</p> <p><i>Comment: Troubleshooting often involves flow verification. Trying to use a portable ultrasonic flow meter is often impractical, due to insulation and/or lack of straight pipe sections.</i></p>
	Present System Airflow Diagram and Air Balance Schedule per the provisions of the Adm. Doc. Requirements.

	<p>Welds for pressure-rated, pre-insulated piping must be inspected at the point of manufacture, by the Authority having jurisdiction, and prior to applying the insulating material. This applies to pressure piping systems that fall under the Kentucky Boiler Code. Specifically, the manufacturer must make arrangements for, and pay costs associated with, a boiler inspector for the KY Department of Housing, Building &amp; Construction to travel to the factory to inspect and/or witness all factory welds.</p> <p><i>Comment: Inexplicably, pre-insulated piping system manufacturers are often unaware of this requirement. If the welds are not approved by HBC via factory inspections, it is much more cumbersome to inspect and approve in the field. Make sure the specifications include this requirement.</i></p>
<p>KRS 56.770-782  <a href="http://www.lrc.ky.gov">www.lrc.ky.gov</a>            Example Reports</p>	<p>Provide calculations for Energy Savings Through Design Practices, comparing appropriate HVAC System alternatives against 2003 IECC / ASHRAE 90.1 baseline systems.</p> <p><i>Comment: This is not required for buildings designed under the Kentucky High Performance Building Standards. The LEED energy calculations will suffice for this requirement. Example reports are included in this manual for reference.</i></p>

Reference	Functional Requirements
	Water piping shall not be exposed to freezing conditions without proper protection agreed to by the User Agency operating staff, through DECA.
	All piping system elements shall be accessible for service without unreasonable damage to building or grounds.
	Provide floor drains in spaces subject to spills, drainage or heavy cleaning.
	All piping systems shall include provisions for proper draining and venting. All floor drains and open receptacles shall be provided with trap primers.
	Open water circuits for cooling towers, etc. shall provide for continuous particulate filtration and a continuous water treatment program.
	<p>Closed loop water systems shall provide for startup filtration and a continuous water treatment program.</p> <p><i>Comment: Make sure that water treatment is covered during startup, commissioning (i.e. by contractor) and after substantial completion (i.e. by Using Agency). It is very easy for this to be overlooked.</i></p>
	All water systems shall include a detailed flushing and cleaning procedure which protects the project equipment.
	Water meters shall be installed to all HVAC makeup water systems.
ASHRAE 62	Filtration levels shall be established at levels to maintain Indoor Air Quality per ASHRAE 62.



	The HVAC system shall maintain space conditions within the Systems Basis of Design parameters during the full annual cycle.
	HVAC system selection shall provide individual thermal zone control at a minimum and where economics allow, individual room control."
	HVAC system selection shall include a life cycle economics evaluation.
	Major mechanical equipment shall be located in a restricted access area on the ground level of the building.
Clean Air Act of 1990 & ASHRAE 15	HVAC refrigeration systems and equipment shall be selected considering the requirements of the Clean Air Act of 1990, ARI/ASHRAE Standard 15, long term availability of refrigerants and economics."
	HVAC equipment shall automatically restart after power interruption unless operating requirements dictate.
	Mechanical equipment placement and elevation shall consider ease of inspection and repair procedures.
	HVAC equipment / systems shall utilize industry standard filter sizes unless authorized otherwise by the Using Agency through DECA.
	<p>Roof mounted equipment will not be acceptable without written authorization from DECA. Preferably, all HVAC equipment shall be located within the envelope of the building.</p> <p><i>Comment: This does not preclude the use of roof-mounted equipment, per se. It does mean that the proposed equipment shall be discussed during early design with DECA and written approval obtained. Concerns include roof access for maintenance, and the ability to replace the roof system with the equipment intact.</i></p>
	<p>Packaged rooftop unitary heating and cooling systems are strongly discouraged, and shall not be used without written approval from DECA.</p> <p><i>Comment: While these units are appropriate for many commercial applications, we have found that they are typically unsuitable for state-owned buildings which have a long funding cycle between HVAC renovations. Such equipment is usually economically useable for no more than 15-20 years, and is not robustly constructed. In addition, servicing roof-mounted equipment is difficult and in many cases, routine service may be delayed or eliminated. That said, there may be unusual circumstances that lend themselves to such equipment. If so, discuss with the DECA PM and obtain written approval.</i></p>
	Mechanical air intake, exhaust and relief openings shall be configured to avoid weather elements, animals / pest and debris from entering the system or building. Security considerations shall be per the requirements of the Owner.
	Utilizing gas as a source of direct heat or reheat shall consider the Owner's maintenance preferences.
	All recirculating piping systems shall have provisions to maintain and initially

	clean and treat the contained fluids.
	Provide for a formalized water treatment program for all appropriate water and steam systems.
	The Using Agency shall be furnished with a comprehensive listing of the filter requirements and location of all air filtered devices on a floor plan in the Systems Manual.
	HVAC systems and related control systems shall be fully operational prior to substantial completion, including: operating sequences, functional performance test, graphical interfaces, and owner training.
	Develop a comprehensive owner training program for the HVAC and control systems.
DECA Fume Hood Design Guidelines 232816	Fume hoods (i.e. laboratory) shall follow detailed design requirements. Refer to DECA documentation.

<b>Reference</b>	<b>Administrative Documents Requirements</b>
KAR56.770 - 782	Energy Design Evaluation per KY Regulations (56.770 - 56.782).
230000-4	Coal Utilization Evaluation. <i>Comment: Required for heating systems over 3.0 MBTUH.</i>
Record Drawings	Record serial numbers, model numbers, nameplate data, etc. for all mechanical equipment for use by Using Agency, with a particular goal of transfer to an automated work order system. Soft (computer) format (e.g. Excel spreadsheet) is preferred. <i>Comment: When commissioning is used, this data may be gathered as a part of the functional performance testing.</i>
Record Drawings	Mechanical schedules shall include data, including electrical parameters, for as-installed equipment in lieu of as-specified equipment.
Record Drawings	HVAC control sequences and P&ID diagrams shall be included on the as-built drawings. Placing control sequences in the specifications is unacceptable. <i>Comment: This information is most vital to operating staff, both initially and in the future, who wish to become familiar with the building's HVAC system. While drawings tend to be kept around somehow, specifications are often lost and are usually unavailable to building staff.</i>
	Refrigerant Removal Form provided by the Using Agency.
Kentucky Boiler Inspector	KY Boiler Code Approvals. <i>Comment: May include pressure heating water piping – check code requirements.</i>

	Permitting Requirements.
230000-5	P & ID (Piping & Instrumentation Diagram) Requirements.
230000-5	System Airflow Diagram and Air Balance Schedule Requirements.