

This is a guidance document with sample specification language intended to be inserted into project specifications on this subject as appropriate to the agency's environmental goals. Certain provisions, where indicated, are required for U.S. federal agency projects. Sample specification language is numbered to clearly distinguish it from advisory or discussion material. Each sample is preceded by identification of the typical location in a specification section where it would appear using the SectionFormat™ of the Construction Specifications Institute; the six digit section number cited is per CSI Masterformat™ 2004 and the five digit section number cited parenthetically is per CSI Masterformat™ 1995.

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**SECTION 23 70 00 (SECTION 15700) – CENTRAL HEATING, VENTILATING, & AIR  
CONDITIONING (HVAC) EQUIPMENT**

**SPECIFIER NOTE:**

*resource management:* The systems specified for energy use in a building can dramatically impact both the quantity of such resources used and the quality. Maximize passive opportunities to reduce HVAC load.

*toxicity/IEQ:* HVAC systems can contribute to poor IAQ by failing to provide enough ventilation to dilute indoor contaminants to acceptable levels, by spreading contaminants introduced from outside sources, and by generating contaminants within the HVAC system itself. The primary contaminants from HVAC systems are microbial contaminants and particulate contaminants. Design system to prevent water collection.

*Performance:* According to the Consortium for Energy Efficiency (CEE), light, commercial heating, ventilating, and air conditioning (HVAC) equipment has significant energy-savings potential. Space cooling accounts for 15.4 percent of electricity used in commercial buildings, second to lighting. According to the CEE, studies show that at least 25 percent of all rooftop units are oversized resulting in increased energy costs and increased equipment wear. Properly sized equipment dramatically cuts energy costs, increases the life of the equipment, cuts utility bills, and reduces pollution. Obviously, energy efficient systems require less energy to operate. Most perform the task for which they were designed comparably to the standard designs which they replace. Refer to "Greening Federal Facilities: An Energy, Environmental, and Economic Resource Guide for Federal Facility Managers and Designers" <http://www.eere.energy.gov/femp/pdfs/29267-0.pdf>

Because the green items may be different from the systems and materials with which the owner's personnel are familiar, education about the environmental qualities as well as the operation and maintenance requirements may be necessary. Refer to Section 01 79 11 (01821) – Environmental Demonstration and Training.

Refer to ASHRAE 15-2004 (or latest version) "Safety Standard for Refrigerant Systems" to learn about specifying safe design, construction, installation, and operation of refrigeration systems.

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. HVAC system(s).
- B. Related Sections:
  - 1. 01 91 00 (01810) – Commissioning.
  - 2. 23 30 00 (15800) – HVAC Air Distribution.

**1.2 SUBMITTALS**

- A. Product data. Unless otherwise indicated, submit the following for each type of product provided under work of this Section:

**SPECIFIER NOTE:**

Specifying local materials may help minimize transportation impacts; however it may not have a significant impact on reducing the overall embodied energy of a building material because of efficiencies of scale in some modes of transportation.

Green building rating systems frequently include credit for local materials. Transportation impacts include: fossil fuel consumption, air pollution, and labor.

USGBC-LEED™ v3 includes credits for materials extracted/harvested and manufactured within a 500 mile radius from the project site. Green Globes US also provides points for materials that are locally manufactured.

1. Local/Regional Materials:
  - a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
  - b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
  - c. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
  - d. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

**SPECIFIER NOTE:**

The EPA has developed minimum energy efficiency specifications for Energy Star labeled products. EPA Energy Star categories include: appliances, HVAC, residential equipment, office equipment, and lighting.

USGBC-LEED™ v3 includes credits for increasing levels of energy performance, referencing IESNA/ASHRAE 90.1 (without amendments) as the standard for establishing baseline performance. Energy systems addressed include: HVAC, service hot water, and interior lighting. Plug loads, exterior lighting, garage ventilation, and vertical transportation (elevators) are not included.

2. Energy Efficiency:
  - a. Indicate EER (Energy Efficiency Rating) for equipment provided under work of this Section.
  - b. Submit documentation for Energy Star qualifications for equipment provided under work of this Section.

- B. Submit environmental data in accordance with Table 1 of ASTM E2129 for products provided under work of this Section.

- C. Reports for aquatic toxicity testing of lubricants in accordance with ASTM D6081.

### 1.3 QUALITY ASSURANCE

- A. Energy Efficiency: Meet or exceed ASHRAE 90.1.

- B. Indoor Environmental Quality:

1. Ventilation: Meet or exceed ASHRAE 62 and all published addenda.
2. Filtration: Meet or exceed ASHRAE 52.
3. Thermal Comfort: Meet or exceed ASHRAE 55.
4. Maintain positive pressure within the building.

## PART 2 PRODUCTS

### SPECIFIER NOTE:

EO 13423 includes requirements for Federal Agencies to "... improve energy efficiency and reduce greenhouse gas emissions ... by (i) 3 percent annually through the end of fiscal year 2015, or (ii) 30 percent by the end of fiscal year 2015, relative to the baseline of ... year 2003"

Specifically, under the Sustainable Building requirements per Guiding Principle #2 Optimize Energy Performance, EO 13423 directs Federal Agencies to "design to earn the Energy Star targets for new construction and major renovation" and, for "new construction, reduce the energy cost budget by 30 percent compared to the baseline building performance rating per the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., (ASHRAE) and the Illuminating Engineering Society of North America (IESNA) Standard 90.1-2004, Energy Standard for Buildings Except Low-Rise Residential. For major renovations, reduce the energy cost budget by 20 percent below pre-renovations 2003 baseline."

And, Federal Agencies must meet the current ASHRAE Standard 55-2004, Thermal Environmental Conditions for Human Occupancy, including continuous humidity control within established ranges per climate zone, and ASHRAE Standard 62.1-2007, Ventilation for Acceptable Indoor Air Quality.

Executive Order 13514; *Federal Leadership in Environmental, Energy, and Economic Performance*; was signed on October 5, 2009. <http://www.ofee.gov/execorders.asp> It expands upon the environmental performance requirements of EO 13423. [http://www1.eere.energy.gov/femp/regulations/printable\\_versions/eo13423.html](http://www1.eere.energy.gov/femp/regulations/printable_versions/eo13423.html)

EO 13514 sets numerous federal requirements in several areas, including sustainable buildings and communities. Federal agencies must implement high performance sustainable federal building design, construction, operation and management, maintenance, and deconstruction, including:

- Ensuring all new Federal buildings, entering the design phase in 2020 or later, are designed to achieve zero net energy by 2030.
- Ensuring all new construction, major renovations, or repair or alteration of Federal buildings comply with the Guiding Principles of Federal Leadership in High Performance and Sustainable Buildings <http://www1.eere.energy.gov/femp/pdfs/mouhighperfsustainfedfac.pdf>
- Ensuring at least 15% of existing agency buildings and leases (above 5,000 gross square feet) meet the Guiding Principles by fiscal year 2015 and that the agency makes annual progress towards 100% compliance across its building inventory.

## 2.1 EQUIPMENT

### SPECIFIER NOTE:

To build on the success of ENERGY STAR qualified residential HVAC products, ENERGY STAR has recently introduced light commercial equipment, including air-source air conditioners, air-source heat pumps, and packaged units.

The Federal Energy Management Program (FEMP) provides procurement guidelines with efficiency recommendations for products. Decisions as to appropriateness of equipment design are dependent upon project goals and location. Refer to [http://www1.eere.energy.gov/femp/technologies/procuring\\_eeproducts.html](http://www1.eere.energy.gov/femp/technologies/procuring_eeproducts.html)

EER (energy efficiency ratio) is the cooling capacity (in Btu/hour) of the unit divided by its electrical input (in watts) at standard peak rating conditions. SEER (seasonal energy efficiency ratio) and IPLV (integrated part-load value) are similar to EER, but weigh performance during the cooling season. COP (Coefficient of Performance) is the heating capacity (in Btu/h) at standard heating conditions divided by its electrical input (also in Btu/h). HSPF (Heating Seasonal Performance Factor), like SEER, weighs heating performance at various conditions. Integrated

part load value (IPLV) is a weighted average of efficiency measurements at various part-load conditions, as described in ARI Standard 550/590-98. These weightings have changed substantially from the previous standard, ARI 550-92, lowering IPLV ratings by 10-15% for the same equipment.

A. Commercial Boiler:

**SPECIFIER NOTE:**

The Federal Energy Management Program (FEMP) provides procurement guidelines with efficiency recommendations for products as indicated below.

FEMP Efficiency Recommendation			
Product Type (Fuel/ Heat Medium)	Rated Capacity (Btu/h)	Recommended Thermal Efficiency (e <sub>t</sub> )	Best Available Thermal Efficiency (e <sub>t</sub> )
Natural Gas Water	300,000 - 2,500,000	80% e <sub>t</sub>	86.7% e <sub>t</sub>
	2,500,001 - 10,000,000	80% e <sub>t</sub>	83.2% e <sub>t</sub>
Natural Gas Steam	300,000 - 2,500,000	79% e <sub>t</sub>	81.9% e <sub>t</sub>
	2,500,001 - 10,000,000	80% e <sub>t</sub>	81.2% e <sub>t</sub>
#2 Oil Water	300,000 - 2,500,000	83% e <sub>t</sub>	87.7% e <sub>t</sub>
	2,500,001 - 10,000,000	83% e <sub>t</sub>	85.5% e <sub>t</sub>
#2 Oil Steam	300,000 - 2,500,000	83% e <sub>t</sub>	83.9% e <sub>t</sub>
	2,500,001 - 10,000,000	83% e <sub>t</sub>	84.2% e <sub>t</sub>

B. Water-Cooled Chiller:

**SPECIFIER NOTE:**

The Federal Energy Management Program (FEMP) provides procurement guidelines with efficiency recommendations for products as indicated below.

Because, most chillers spend over 95% of their operating hours at part load, part load performance can be the most important energy efficiency consideration for many applications. FEMP factsheet on "How to Buy an Energy-Efficient Water-Cooled Chiller" states that "Depending on the application, buyers should specify chiller efficiency using either full-load or integrated part-load values."

Edit below to require full or part load (IPLV) or both values as appropriate to project.

FEMP Efficiency Recommendation		
Compressor Type and Capacity	Part Load Optimized Chillers	
	Recommended IPLV (kW/ton)	Best Available IPLV (kW/ton)
Centrifugal (150 - 299 tons)	0.52 or less	0.47
Centrifugal (300 - 2,000 tons)	0.45 or less	0.38
Rotary Screw >= 150 tons	0.49 or less	0.46

Compressor Type and Capacity	Full Load Optimized Chillers	
	Recommended Full-Load (kW/ton)	Best Available Full-Load (kW/ton)
Centrifugal (150 - 299 tons)	0.59 or less	0.50
Centrifugal (300 - 2,000 tons)	0.56 or less	0.47
Rotary Screw >= 150 tons	0.64 or less	0.58

C. Ground Source Heat Pump:

**SPECIFIER NOTE:**

The Federal Energy Management Program (FEMP) provides procurement guidelines with efficiency recommendations for products as indicated below.

FEMP Efficiency Recommendation				
Product Type	Recommended		Best Available	
	EER	COP	EER	COP
Closed Loop	14.1 or more	3.3 or more	25.8	4.9
Open Loop	16.2 or more	3.6 or more	31.1	5.5

D. Commercial Heat Pump:

**SPECIFIER NOTE:**

The Federal Energy Management Program (FEMP) provides procurement guidelines with efficiency recommendations for products as indicated below.

FEMP Efficiency Recommendation		
Product Type and Size	Recommended Level	Best Available
Air Source < 65 MBtu/h	12.0 SEER or more 7.7 HSPF or more	13.2 SEER 8.5 HSPF
Air-Source 65 – 135 MBtu/h	10.1 EER or more 10.4 IPLV or more 3.2 COP or more	11.5 EER 13.4 IPLV 4.0 COP
Air-Source 136 – 240 MBtu/h	9.3 EER or more 9.5 IPLV or more 3.1 COP or more	10.5 EER 12.4 IPLV 3.3 COP
Water-Source 65 – 135 MBtu/h	12.8 EER or more 4.5 COP or more	14.5 EER 5.0 COP

E. Air-Cooled Electric Chillers:

**SPECIFIER NOTE:**

The Federal Energy Management Program (FEMP) provides procurement guidelines with efficiency recommendations for products as indicated below.

Because, most chillers spend over 95% of their operating hours at part load, part load performance can be the most important energy efficiency consideration for many applications. FEMP factsheet on "How to Buy an Energy-Efficient Air-Cooled Chiller" states that "Depending on the application, buyers should specify chiller efficiency using either full-load or integrated part-load values."

Edit below to require full or part load (IPLV) or both values as appropriate to project.

FEMP Efficiency Recommendation	
Compressor Type and Capacity	Part Load Optimized Chillers

	Recommended IPLV (kW/ton)	Best Available IPLV (kW/ton)
Scroll (30 - 60 tons)	0.86 or less	0.83
Reciprocating (30 - 150 tons)	0.90 or less	0.80
Screw (70 - 200 tons)	0.98 or less	0.83
Compressor Type and Capacity	Full Load Optimized Chillers	
	Recommended Full Load (kW/ton)	Best Available Full Load (kW/ton)
Scroll (30 - 60 tons)	1.23 or less	1.10
Reciprocating (30 - 150 tons)	1.23 or less	1.00
Screw (70 - 200 tons)	1.23 or less	0.94

**SPECIFIER NOTE:**

Green Seal's Standard for Electric Chillers (GS-31) establishes environmental performance requirements for 60 Hz, 3-phase, electric motor driven, vapor compression-type water-chilling packages or systems of 150 tons up to 2,000 tons in rated cooling capacity. These systems are commonly referred to as "chillers."

Rated Chiller Capacity	Full Load (kW/Ton) at ARI Conditions	IPLV (kW/Ton) at ARI Conditions
Centrifugal 150-299 tons	0.59	0.52
Centrifugal 300-2000 tons	0.56	0.44
Rotary Screw " 150 tons	0.64	0.49

**2.2 ACCESSORIES**

**A. Refrigerants:**

**SPECIFIER NOTE:**

USGBC-LEED™ v3 includes a prerequisite for elimination of CFC-based refrigerants. It also includes credit for refrigeration systems and fire suppression systems that eliminate HCFCs and halons. However, USGBC, through a Credit Interpretation Ruling (CIR), has decided to provide credit (EA-4) for the use of HCFC refrigerants in applications that are energy efficient and leak-tight due to their beneficial contribution to greenhouse gas reductions.

EPA, per the Significant New Alternative Policy rule (59 FR 13044), reviews refrigerant substitutes on the basis of ozone depletion potential, global warming potential, toxicity, flammability, and exposure potential. Lists of acceptable and unacceptable substitutes are updated several times each year. A chronological list of SNAP updates is available at <http://www.epa.gov/ozone/snap/refrigerants/lists/index.html> or from the stratospheric ozone information hotline at 1 (800) 296-1996.

1. Refrigerant Selection:
  - a. CFC-based refrigerants are not permitted.
  - b. Refrigerant shall be one of the approved alternative refrigerants based on EPA's Significant New Alternative Policy (SNAP) listing.

**B. Filters: As specified in Section 23 30 00 (15800) – HVAC Air Distribution.**

**SPECIFIER NOTE:**

Most lubricants and lubricant components are difficult to evaluate in toxicity tests because they are mixtures of chemical compounds with varying and usually poor solubility in water. ASTM D6081 establishes procedures for aquatic toxicity testing of lubricants.

C. Lubricants:

1. Toxicity: Assess potential effects on the establishment and maintenance of aquatic organisms in accordance with ASTM D6081.

SPECIFIER NOTE:

Installation contractors' labeling of HVAC components is an inexpensive and effective method for helping facilities personnel properly operate and maintain the HVAC systems. The labels should be easy to read when standing next to the equipment, and durable to match the life of the equipment to which they are attached. Refer to the EPA IAQ Design Tools for Schools <http://www.epa.gov/iaq/schooldesign/>

D. Labels: Provide labels for Central Station Air Handling Units (AHUs). Include the following information on each label:

1. The identification number or name of the AHU.
2. The outdoor air, supply air, return air, and exhaust or relief air connections to the AHU, each with arrows noting proper airflow direction.
3. The access door(s) for the air filters and the minimum filter dust-spot (or MERV) efficiency.
4. The filter pressure gauge and the recommended filter change pressure.
5. The access door(s) for the condensate drain pan.
6. Other pertinent access doors such as to energy recovery ventilation wheels or plates.
7. The minimum amount of outdoor air for each AHU; indicate minimum CFM during occupied times.
8. The outdoor air damper, with special marks noting when the damper is in the fully closed, fully opened, and minimum designed position.
  - a. If a motorized relief damper is installed, note the same positions as above.
9. The access door to any outdoor air controls, including: damper position adjustments, outdoor airflow measuring stations, resets, fuses, and switches.
10. Breakers for exhaust fans, AHU, and unit ventilators.
11. Access doors for inspection and maintenance of air ducts.
12. Dampers and controls for air side economizers.
13. The identification number or name of all exhaust fans, including the air quantity exhausted.

SPECIFIER NOTE:

HVAC components can affect the IAQ for the building. Refer to <http://www.epa.gov/iaq/schooldesign/hvac.html> EPA IAQ Design Tools for Schools recommend the following:

- Double-sloped drain pan - A double-sloped pan prevents water from standing and stagnating in the pan.
- Non-corroding drain pan - Made from stainless steel or plastic. Prevents corrosion that would cause water to leak inside the AHU.
- Easy access doors - All access doors are hinged and use quick release latches that do not require tools to open. Easy access to filters, drain pans, and cooling coils is imperative. Due to security procedures at Federal facilities, this may or may not be an option.
- Double wall cabinet - The inner wall protects the insulation from moisture and mechanical damage, increases sound dampening, and is easier to clean.
- Tightly sealed cabinet - Small yet continuous air leaks in and out of the AHU cabinet can affect IAQ and energy. The greatest pressure differentials driving leaks occur at the AHU.

- Double wall doors with gaskets - Double wall doors provide better thermal and acoustic insulation, and will remain flatter, allowing a better seal against door frame gaskets
- Minimum 2 inch thick filter slots - For better protection of the indoor environment, as well as the equipment and ducts, the filters slots should be able to accommodate 2 inch or thicker filters. Note: Many types of terminal equipment, such as fan-coil units, water-source heat pumps and unit ventilators, only have a 1 inch slot. There are, however, 1-inch filters with MERV 6 and 8 ratings which is similar in efficiency to 2 inch pleated media filters.
- Extended surface area filter bank - To reduce the frequency of filter maintenance and the cost of fan energy, the bank is designed to allow more filter area, such as the deep V approach or bags.
- Air filter assemblies (racks & housings) designed for minimum leakage - The filter bank should have gaskets and sealants at all points where air could easily bypass the air filters, such as between the filter rack and the access door. Use properly gasketed manufacturer supplied filter rack spacers.
- Air filter monitor - A differential pressure gauge to indicate the static pressure drop across the filter bank. This feature could easily be installed as an option in the field.
- Corrosion resistant dampers & links - All moving parts such as pivot pins, damper actuators, and linkages are able to withstand weather and moisture-induced corrosion for the full life of the system.

D. Drain Pan: Double-sloped; Non-corroding, fabricated from stainless steel or plastic.

E. Dampers and links: Corrosion resistant.

### PART 3 - EXECUTION

#### 3.X SITE ENVIRONMENTAL PROCEDURES

A. Commissioning: The project will have selected building systems commissioned. Coordinate with commissioning as specified in Section 01 91 00 (01810) - Commissioning.

B. Resource Management:

1. Energy Efficiency: Verify equipment is properly installed, connected, and adjusted. Verify that equipment is operating as specified.

END OF SECTION