Related Commercial Resources

CHAPTER 23. FIRE AND EMT STATIONS AND TRAINING ACADEMIES

THIS chapter contains technical and environmental factors and considerations to help design engineers in the proper application of heating, ventilating, and air-conditioning systems and equipment for fire stations, EMT (ambulance) stations, and their respective training academies. For further information on specific HVAC systems mentioned in this chapter, see the relevant chapters in the 2020 *ASHRAE Handbook—Systems and Equipment*.

1. TERMINOLOGY

Apparatus. Vehicles used by fire and EMS personnel and housed in an apparatus bay of their stations.

EMS. Emergency medical service that includes EMTs and paramedics that provide medical services.

EMT. Emergency medical technicians who have been trained and certified to provide basic medical services.

Paramedic. EMT that has further training and certified to provide lifesaving services.

Fire district. An area within a city or county that provides firefighting services.

Ambulance district. An area within a city or county that provides emergency medical treatment and transports people to a hospital.

Fire station. A building that houses firefighters, apparatus, and all their equipment to put out fires. It may also house EMS and their apparatus and medical supplies needed to provide medical services.

EMT station. A building that houses EMS and their apparatus and medical supplies needed to provide medical services.

Training academy. A building or set of classrooms within a school or college that provides training for fire and EMS students and their apparatus.

Driving simulator. This is like a video game where the student sits behind a steering wheel and watches a screen, and controls a drive through a town or other place with a fire or ambulance apparatus.

2. GENERAL CRITERIA

To apply equipment properly, the construction of the space to be conditioned, its use and occupancy, the time of day at which the greatest occupancy occurs, physical building characteristics, and lighting layout must be known. The following must also be considered:

- Electric power and size of service
- Heating: availability of steam, hot water, gas, oil, and electricity
- Cooling: availability of chilled water, well water, city water, and water conservation equipment
- Internal heat gains
- Equipment locations
- Structural considerations
- Rigging and delivery of equipment
- Obstructions
- Ventilation: openings through the roof or wall for outdoor air ducts
- Exposures and number of doors and their types
- Orientation of the station
- Code requirements
- Utility rates and regulations
- Building and energy standards

- Seismic and wind speed map data for the facility's location

Specific design requirements, such as the increase of outdoor air required to make up for apparatus bay exhaust, must be considered. Ventilation requirements of ASHRAE *Standard* 62.1 must be followed. Objectionable odors from nearby sites may necessitate different locations of the outdoor intakes and special filtering.

Security requirements must be considered and included in the overall design and application. Minimum security considerations may require secure equipment rooms, secure air handling systems, and location of outdoor air intakes located on the roof or high on exterior walls. Equipment located on the ground outside the facility may require a secure fence around them. More extensive security measures may need to be developed based on facility design, owner requirements, and local authorities.

Load calculations should be made using the procedures outlined in Table 1 of this chapter and in Chapter 18 of the 2021 *ASHRAE Handbook—Fundamentals*.

HVAC systems are normally determined by economics. First cost is usually the determining factor especially for small stations and academies. For larger facilities, owning and operating costs are also considered. Life-cycle cost analysis may be required as well; see Chapter 38 for details on cost calculation.

3. ENERGY CONSERVATION

Almost all localities have some form of energy code in effect that establishes strict requirements for insulation, equipment efficiencies, system designs, etc., and places strict limits on fenestration and lighting. The requirements of ASHRAE *Standard* 90.1 must be met as a minimum guideline. In addition, ASHRAE *Standard* 189.1 provides guidance in achieving further energy savings.

4. DESIGN CONSIDERATIONS

Fire Stations

Fire stations house firefighting equipment, personnel, kitchen, dining/training/break areas, sleeping quarters, locker rooms, showers/toilet rooms separated by gender, offices (including a dispatcher), and storage for all the firefighting clothing and equipment. Most of these items are included in medium to large fire stations; small stations may only house a kitchen; day room; toilet, shower rooms, and sleeping rooms by gender; and firefighting equipment. Some small stations may have no permanent occupancy. These small stations are usually located in rural areas that usually have volunteer fire personnel. Other fire stations include EMS personnel, apparatus, equipment, and storage in addition to firefighting assets. Consult the owner and/or authority having jurisdiction (AHJ) to determine exactly what will be housed in the fire station, how many people will be included and their occupancy schedules.

Apparatus Bay

The apparatus bay is a large area that houses the vehicles used by the firefighters and chiefs. Bay size is determined by the size and number of vehicles and usually has a high ceiling. The size of the vehicles depends on the area the station would serve. The fire chiefs may have SUV-type vehicles and, if the station is large enough, may have a command vehicle that is much like a motorhome. The fire engines have diesel engines and are usually started and idled when called upon and waiting for all the firefighters to get on board. Each bay will have an overhead garage-type door that opens either by a control within the vehicle and/or a manual wall switch, much like those in residential garages.

Apparatus Exhaust Systems

Since the diesel fire engines spend time idling, the bays need to have an exhaust system to evacuate carbon monoxide from these engines. This system varies by the size and number of vehicles. Some stations have a detachable exhaust system attached to the floor and/or ceiling, depending on the location of the vehicles' exhaust. Each exhaust hose is attached to an exhaust pipe and will automatically detach when the vehicle leaves the bay. The exhaust fan will continue to operate for an adjustable period of time. All the exhaust hoses are connected to exhaust ducts, which connect to an exhaust fan on the roof or high on an exterior wall. Floor-mounted exhaust ducts are located under the floor and the flexible exhaust pipe duct is rail-mounted to travel with the vehicle for some distance before detaching.

Medium and small station bays could be exhausted by a wall-mounted propeller fan and/or with ducts from a roof-mounted fan; these ducts run down the back wall behind the vehicles to the floor, with low and high inlets. This type of system can be automatically controlled by a garage door switch or manually by a wall switch, with a timer to control fan operation time after the vehicle(s) have left. This type of system also needs to have an intake louver(s) with automatic dampers to open while the fan is operating. The louvers should be secured from the outside and mounted high enough so they are not covered by snow drifts, and should be secured for security reasons.

Both of these systems could be automatically operated by a carbon monoxide sensor(s) mounted on the back wall of the bay within 2 ft from the floor. These sensors have a limited life and will need to be replaced from time to time.

HVAC Systems and Equipment

Heating systems to be considered for the apparatus bay could be hot-water, gas/propane fired, or electric unit heaters mounted above the vehicles near the back wall and pointed toward the garage doors. Other options include gas/propane-fired or electric infrared heaters mounted near the ceiling in between the vehicles, or in-floor hot-water or electric radiant heating. Each of these systems are controlled by wall-mounted thermostats.

Usually, the bays are not air conditioned but may be if the facility is in a warm and humid climate. If so, dedicated air conditioning units would be needed for heating, cooling, dehumidification, and ventilation. This units would most likely be roof mounted but could be located in a mechanical room or outside in a secure area adjacent to the building. Some stations may also want an extra cooling coil for dehumidifying the apparatus after post-fire washing and/or cooling the firefighters and their clothing. This coil would have its own thermostat control.

For ventilating the bay, medium and small stations could use a bay exterior wall or roof-mounted exhaust fan. The system could be controlled manually or by a thermostat. Some or all the bay doors may need to be open when this system is operating, or wall louvers and dampers will need to be installed in exterior walls and interlocked with the fan. These louvers need to be mounted high enough for security and to not be covered by snow.

Ceiling fans with a reverse function switch could be installed for cooling effect during warm weather and to bring down warm stratified air during cool weather.

For stations with HVAC systems, all areas except the bay would use that unit for its HVAC needs. See specific chapters of the 2020 *ASHRAE Handbook—HVAC Systems and Equipment* for guidance on the various types of systems suited for bay applications.

Accessibility for maintenance is important for all HVAC equipment (e.g., providing an interior ladder and roof hatch for accessing roof-mounted equipment). Floor-mounted interior HVAC equipment needs to be installed in a mechanical room with ample service space around the equipment.

Kitchen

The kitchen area is used by the occupants who want to cook their own meals; the appliances need to be available as much as possible for multiple meal preparation and storage. Providing multiple stove/ovens, microwave ovens, coffee makers, toasters or toaster ovens, and refrigerators/freezers is standard. Usually, these appliances are residential grade. The stoves usually are not provided with exhaust hoods, but check with local codes and/or AHJ, or a manually controlled roof or wall exhaust vent may be considered to capture and exhaust most of the airborne smoke and grease. See Chapter 34 for details on commercial kitchen ventilation.

For medium and large stations, the kitchen should be under a small negative pressure in relation to other spaces.

Dining/Training/Break Area(s)

This area is usually located near the kitchen. It may contain a TV and a small library, especially training books, vending machines, and perhaps a laptops for training purposes. The highest occupancy of this area would most likely be the total number of station occupants. In some cases, separate areas are provided for each occupation, with different spaces for dining, training, and taking breaks.

Offices

Offices are for the chief and/or assistant chiefs; the dispatcher may also have a separate office. They may be constructed with walls to the roof for privacy. Supply and return air ducts should be attenuated for these spaces.

Sleeping Quarters

For large multistory stations, sleeping quarters are usually located on the 2nd floor with easy access to the apparatus bay. See Table 1 for the HVAC design criteria.

The HVAC systems could be a single unit serving only these quarters or be part of a larger system that serves other areas such as the offices. They could also be through the wall units such as found in motel rooms if there are exterior walls in this area or duct free split systems. Other systems could be two or four pipe fan coil units or two pipe units with electric heat. If a larger system serves other areas, they could also have VAV boxes with hot water or electric heat. Most of all, the HVAC systems for this area should be quiet. Small rural stations may not have sleeping quarters if they are using volunteers.

Table 1 Fire and EMT Station Indoor Design Criteria[a]

	Winter		Summer			
Area	Temperature, °F	Relative Humidity,[b] %	Temperature, °F	Relative Humidity,[b] %	Ventilation[c]	Exhaust[d]

Apparatus bay	65 to 74	30 to 35	74 to 85	50 to 60	Varies	Varies
Offices	68 to 74	30 to 35	74 to 78	40 to 60	10 cfm PP[g]	—
Kitchen	68 to 74	30 to 35	74 to 78	40 to 60	10 cfm PP[g]	Varies
Training/dining/break	68 to 74	30 to 35	74 to 78	40 to 60	10 cfm PP[g]	—
Sleeping	68 to 74	30 to 35	74 to 78	40 to 60	10 cfm PP[g]	—
Lockers	68 to 74	33 to 35	74 to 78	None	—	0.5 cfm/ft^2
Toilets/showers	68 to 74	—	74 to 78	—	—	70 cfm

Notes:

[a] This table should not be the only source for design criteria. Data contained here can be determined from volumes of the *ASHRAE Handbook* and standards and governing local codes.

[b] Minimum recommended humidity.

[c] Per ASHRAE *Standard* 62.1-2016.

[d] Air exhausted from the toilet/locker space serves sleeping rooms.

[e] Minimum per ASHRAE *Standard* 52.2 (MERV = minimum efficiency reporting values).

[f] Per Chapter 7.

[g] PP = per person.

Locker/Showers/Toilet Areas

Building codes in the United States require that these areas be exhausted directly to the outside when they contain only toilets and/or showers. They are usually heated and ventilated only. These areas require makeup air and exhaust systems. Where applicable, energy recovery systems can be considered.

5. EMT STATIONS

EMT stations are similar to fire stations except for the apparatus bay. The ambulances do not idle but immediately drive off site after starting, so a special carbon monoxide exhaust is not required. The rest of the fire station design criteria can be used for the EMT station.

6. TRAINING ACADEMIES

Fire Training Academies

These facilities could be at the local fire station itself (generally for small stations) or a separate building with classrooms, break room, and vending area (more common for large cities and/or counties). This type of academy could serve several small communities around it. These criteria should be discussed with the owner and/or the AHJ.

Stand-Alone Academies. The stand-alone academies are usually found in large cities or counties. Courses run for several weeks at different times of the year so they may not be fully occupied all the time. Occupancy schedules need to be coordinated with the owner or AHJ. They also may serve as EMT training academies.

The facility will usually have would have classrooms, break area for eating or snacking and may have vending machines in it, gymnasium with, perhaps, a running track, weight room, toilets, lockers, showers for both males and females, and offices. It also could have its own apparatus and bay. Some facilities could also contain a room that has a driving simulator for their fire apparatus. This facility may serve other areas around it. These facilities are similar to school design criteria. For recommended design criteria for the various HVAC systems, room temperatures, humidity, ventilation, filtration, filter efficiencies, and noise control see Tables 6, 7, and 8 in Chapter 8 of this volume and system-specific chapters of the 2020 *ASHRAE Handbook—HVAC Systems and Equipment* for the various types of systems that would best be used for the facilities size and needs.

Other Academies. Small to medium fire districts may train their firefighters in their own stations rather than sending them to an academy in a large city near them.

EMT Training Academies

Stand-alone EMT training academies are like stand-alone fire academies. They could have a classroom where they perform medical treatments (e.g., CPR) on dummies, so the occupants may have higher latent loads.

Training for non-stand-alone academies usually occurs at local state or community colleges. EMT and paramedic medical courses and certification are also available online.

7. PANDEMIC HVAC DESIGN

For information on design considerations concerning controlling virus and bacteria and providing a clean and healthy facility follow the guidelines of the ASHRAE Pandemic Task Force (www.ashrae.org/technical-resources/resources).

New Construction

If the facility will be partially or fully occupied during a pandemic event, allow the space and pressure drop for new HVAC system components to help to filter and sterilize components in the HVAC unit and its ductwork. Standard system design usually does not include features such as MERV-13 high efficient filters, UV-C lights, and additional outdoor air volume, but should allow for these features to be added when necessary.

Existing Facilities

HVAC systems for the existing facilities need to be tested for pressure drops and flow volume to determine if replacement and addition of specific items (e.g., MERV-13 high efficient filters, UV-C lights, additional outdoor air volume) for the systems would be needed to provide a safe and clean environment during a pandemic event if the facility would remain at least partially occupied. If the facility will be unoccupied, the spaces and HVAC systems will need to be sanitized before reoccupation.

8. UEISMIC AND WIND BRACING

Refer to the current version of state or local codes or the *International Building Code®*, which also references a current version of ASCE *Standard* 7, which states that fire stations are essential facilities that require seismic and/or wind restraint of nonstructural components (HVAC equipment) to ensure continuous service. EMT stations are not specifically mentioned in the codes, but providing similar seismic and wind restraint bracing seems to be common sense.

HVAC systems and components need to be braced in accordance with adopted codes and the AHJ's requirements. See Chapter 56, ASHRAE (2012), and Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA 2008) for details.

Use the S1 map found in the code books or Tables 4 and 5 and the seismic equations in Chapter 56 of this volume to determine the seismic forces in the facility's location to establish whether seismic bracing on the nonstructural (HVAC) equipment is needed. This must be discussed with the project's structural engineer as well as the owner and/or the AHJ.

Use the wind speed map in the codes or in Chapter 56 of this volume and the wind load equations to determine whether the wind loads for the facility's location are also a concern or not. This too must be discussed with the project structural engineer, owner, and/or the AHJ.

Bracing devices should be tested in accordance with ASHRAE *Standard* 171.

For additional seismic installation guidance, see FEMA 412 (2002) and 414 (2004).

9. COMMISSIONING

Commissioning new and existing facilities is a quality assurance process from predesign to design, construction, and operation. Before beginning commissioning, consult with the owner and/or the AHJ to ensure this process is desired. For some small and medium stations, the cost of this process may be too much for the project budget.

See Chapter 44 for details about the commissioning process.

REFERENCES

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ASHRAE. 2017. Method of testing general ventilation air-cleaning devices for removal efficiency by particle size. *Standard* 52.2-2017.

ASHRAE. 2022. Ventilation for acceptable indoor air quality. *Standard* 62.1-2022.

ASHRAE. 2022. Energy standard for buildings except low-rise residential buildings. *Standard* 190.1-2022.

ASHRAE. 2017. Method of testing seismic restraint devices for HVAC&R equipment. *Standard* 171-2017.

ASHRAE. 2023. Standard for the design of high-performance green buildings. *Standard* 189.1-2014.

ASHRAE. (Forthcoming). *A practical guide to seismic restraint*, 3rd ed.

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