SMOKE MANAGEMENT SYSTEM COMMISSION TESTING and ACCEPTANCE CRITERIA UTILIZED BY THE TOWN OF VAIL FIRE DEPARTMENT

This criteria is provided as a guide for testing and commissioning of the smoke management systems in Town of Vail projects. The commission testing criteria is provided based on criteria and requirements established by the adopted building and fire code, memorandum of understanding or administrative modification. In any event the commission testing of either a smoke control or smoke management system is to be done in accordance with this guideline.

Prior to any commission testing of a smoke control/management system by either the building commissioning agent or the Town of Vail Fire Department ‘ALL’ components of the system must be installed and operational. This includes all fans, dampers, fire alarm control devices, fire alarm programming, fire resistive separation and assemblies, doors including smoke seals, closure and latching device and any other components essential to the operation of the smoke control/management system. All construction in the areas of smoke control/management testing must be complete. This includes enclosure of the building envelop. During the commissioning and testing of the system there shall be no other construction occurring in the area of the smoke control/management systems. There can be no programming of the building automation system or fire alarm system occurring during the commissioning and testing.

Below are some specific IBC/IFC Code References that guide the Smoke Control/Management Commissioning and Testing:

1. Verify all equipment related to the smoke control/management system as required shall be inspected according to installation standards in Section 909.10 of the 2003 IBC. Equipment such as, but not limited to, fans, ducts, automatic dampers, and balance dampers, shall be suitable for its intended use, suitable for the probable exposure temperatures that the rational analysis indicates, and as approved by the building official.
   - **Exhaust Fans.** Components of exhaust fans shall be rated and certified by the manufacturer for the probable temperature rise to which the components will be exposed in accordance with the approved design.
   - **Makeup air system.** For systems with makeup air supplied by fans (related to smoke control/management system), if required verify that supply fan actuation is sequenced with exhaust fan activation.
   - **Pressurization Fans.** Components of the pressurization fans shall be verified as the specified fan type and fan size in accordance with the approved design.
   - **Ducts.** Duct materials and joints related to the smoke control/management system shall be capable of withstanding the probable temperatures and pressures. Ducts shall be constructed and supported in accordance with the *International Mechanical Code*. Ducts shall be leak tested to 1.5 times the maximum design pressure in accordance with nationally accepted practices. Measured leakage shall not exceed 5 percent of design flow. Ducts shall be supported directly from fire-resistance-rated structural elements of the building by substantial, noncombustible supports. Ducts intended to convey smoke and the duct materials shall conform to NFPA 90A, and other NFPA documents.
   - **Equipment, inlets and outlets.** Equipment shall be located so as to not expose uninvolved portions of the building to an additional fire hazard. Outside air inlets shall be located so as to minimize the potential for introducing smoke or flame into the building from outside sources.
• **Automatic dampers.** Where required automatic dampers shall be verified as listed and conform to the requirements of approved, recognized standards. Smoke and fire dampers should be listed in accordance with UL 555S and 555.

• **Fans.** Verify belt-driven fans on site have complied with the requirement for 1.5 times the number of belts required for the design duty, with the minimum number of belts being two. Fans shall be supported and restrained by noncombustible devices in accordance with the requirements of Chapter 16 of the IBC. Motor driving fans shall not be operated beyond their nameplate horsepower (kilowatts).

• Verify the smoke management system shall activate individual components, such as dampers and fans, in sequence as necessary to avoid physical damage to the equipment.

2. **Power Systems.** The smoke control system shall be supplied with two sources of power. Primary power shall the normal building power systems. Secondary power shall be from an approved standby source. The standby power source shall be enclosed in a room constructed of not less than 1-hour fire-resistance-rated fire barriers ventilated directly to and from the exterior.

  • Power distribution from the two sources shall be by independent routes.
  • Transfer to full standby power shall be automatic and within 60 seconds of failure of the primary power.
  • The systems shall comply with the Electrical Code.

3. **Fire Alarm Detection and control systems.** Verify fire detection systems providing control input or output signals to mechanical smoke control systems or elements thereof shall comply with the requirements of Section 907. Such systems shall be equipped with a control unit complying with UL 864 and listed as smoke control equipment as specified.

  • This section requires that fire detection elements used in mechanical smoke control systems comply with Chapter 9 of the IBC/IFC and NFPA 72. Specific to smoke control systems the requirement for a control unit complying with UL 864 that is listed as smoke control equipment to be used. UL 864 has a subcategory specific to fire alarm control panels. (UUKL).

  • In addition to meeting requirements of the Electrical Code, all wiring, regardless of voltage, shall be fully enclosed within continuous raceways and/or conduit.

  • The control system shall fully coordinate the smoke management system, interlocks and interface with other related systems will be verified.

  • Operating controls utilizing the HVAC system as a component of the smoke control/management system shall accommodate the smoke management mode, which shall have the highest priority over all other control modes.

  • Verify manual control of smoke management and fire alarm system is provided at the fire department approved location.

  • Verify that a means of indicating a trouble condition if the system does not operate as intended when activated.

4. **Control air tubing.** When control air tubing is present for the smoke control/management system, it shall be inspected and pressure tested according to section 909.13 of the 2003 IBC requirements.

  • Control air tubing shall be of sufficient size to meet the required response times. Tubing shall be flushed clean and dry prior to final connections and shall be adequately supported and protected from damage. Tubing passing through concrete or masonry shall be sleeved and protected from abrasion and electrolytic action.

5. **Marking and identification.** Verify the detection and control system is marked at all junctions, accesses and terminations.

  • This includes all applicable fire alarm-initiating devices, junction boxes, all data-gathering panels and fire alarm control panels.

  • Additionally, all components of the smoke control system, which are not considered a fire detections system, are required to be properly identified and marked. This would include all applicable junction boxes, control tubing, temperature control modules, relays, damper sensors, automatic door sensors and air movement sensors.

6. **Control diagrams.** Verify that identical control diagrams showing all devices in the system and identifying their location and function shall be maintained current and kept on file with the building official, the fire department and in the fire command center in format and manner approved by the fire chief.
7. **Fire-fighters smoke control panel.** Verify the approved fire-fighter’s smoke control panel for fire department emergency response purposes has been provided with manual control or override of automatic control for mechanical smoke control systems.
   - **Smoke control system.** Fans within the building shall be located on the fire-fighter’s control panel. A clear indication of the direction of airflow and relationship of components shall be displayed. Status indicators shall be provided for all smoke control equipment, annunciated by fan and zone, and by pilot-lamp type indicators as follows:
     1. Fans, dampers and other operating equipment in their normal status.
     2. Fans, dampers and other operating equipment in their off or closed status.
     3. Fans, dampers and other operating equipment in their on or open status.
     4. Fans, dampers and other operating equipment in a fault status.
   - **Smoke control panel.** The fire-fighter’s control panel shall provide control capability over the complete smoke-control system equipment with the building as follows:
     1. ON-AUTO-OFF control over each individual piece of operating smoke control equipment that can also be controlled from other sources within the building.
     2. OPEN-AUTO-CLOSED control over individual dampers relating to smoke control and that are also controlled from other sources within the building.
     3. ON-OFF or OPEN-CLOSED control over smoke control and other critical equipment associated with a fire or smoke emergency and that can only be controlled from the fire-fighter’s control panel.

8. **System response time.** Verify the smoke-control system activation is initiated immediately after receipt of an appropriate automatic or manual activation command.
   - The total response time, including that necessary for detection, shutdown of operating equipment and smoke control system startup, shall allow for full operational mode to be achieved before the conditions in the space exceed the design smoke condition.
   - 30 seconds – Fire alarm system activation delay and activation of smoke control panel.
   - 30 seconds – Delay in opening the make-up air doors.
   - 30 seconds – Delay in exhaust fans reaching full capacity.

9. **Acceptance testing.** Devices, equipment, components and sequences shall be individually tested. These tests, in addition to those required by other provisions of this code, shall consist of determination of function, sequence and, where applicable, capacity of their installed condition.
   - In order to achieve a certain level of performance, the smoke control system needs to be thoroughly tested.
   - Testing shall include verification of airflow in both maximum and minimum conditions.
   - Door opening forces to the exterior exit doors shall be confirmed to not exceed 30 pounds of opening force when the shaft is pressurized. All hinged doors opening into the pressurized shafts will be required to latch when closed from a full open position, with the exception of the exterior door at grade level swing out of the stairways.
   - **Detection Devices.** Smoke or fire detectors, beam smoke detectors, water flow detectors, and specific manual pull stations that are a part of a smoke control system shall be tested in accordance with Chapter 9 in their installed condition. When applicable, this testing shall include verification of airflow in both minimum and maximum conditions.
   - **Duct.** Ducts that are part of a smoke control system shall be traversed using generally accepted practices to determine actual air quantities.
   - **Dampers.** Dampers shall be tested for function in their installed condition.
   - **Inlets and outlets.** Inlets and outlets shall be read using generally accepted practices to determine air quantities.
   - **Fans.** Fans shall be examined for correct rotation. Measurements of voltage, amperage, revolutions per minute (rpm), and belt tension shall be made.
   - **Controls.** Each smoke zone, equipped with an automatic-initiation device, shall be put into operation by the actuation of one such device. Each additional device within the zone shall be verified to cause the same sequence without requiring the operation of fan motors in order to prevent damage.
   - **Special inspections for smoke control.** Smoke control system shall be tested by a special inspector. The special inspector shall be a registered professional engineer (Fire Protection Engineer).
   - **Scope of testing.** Special inspections shall be conducted in accordance with the following:
     1. During erection of ductwork and prior to concealment for the purposes of leakage testing and recording of device location.
     2. Prior to occupancy and after sufficient completion for the purposes of flow measurements, and detection and control verification.
   - **Qualifications.** Special inspection agencies for smoke control shall have expertise in fire protection engineering, mechanical engineering and certification as air balancers.
• **Reports.** A complete report of testing shall be prepared by the special inspector or special inspection agency. The report shall include identification of all devices by manufacturer, nameplate data, design values, measured values and identification tag or mark. The report shall be review by the responsible registered design professional and, when satisfied that the design intent has been achieved, the responsible registered design professional shall seal, sign and date the report.

10. **System acceptance.** Buildings, or portions thereof, required by this code to comply with this section shall not be issued a certificate of occupancy until such time that the fire official in conjunction with the building official determines that the provisions of this section have been fully complied with, and that the fire department has received satisfactory instruction on the operation, both automatic and manual, of the system. The completion of the of the smoke management system just one component of the fire protection and life safety systems that must be completed before a certificate of occupancy can be issued. In buildings of phased construction, a temporary certificate of occupancy, as approved by the building and fire official, shall be permitted provided that those portions of the building to be occupied meet the requirements of this section and that the remainder of the building does not pose a significant hazard to the safety of the proposed occupied areas.