

DUCTWORK TAKES THE HEAT

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Wynn Las Vegas, the newest hotel and casino on the Las Vegas strip, opened its doors to the public on April 28, 2005. Climbing 50 stories, the 88-ha (217-acre) complex features an 18-hole golf course, retail operations, and eight fine-dining restaurants, each served by fire protection grease ducts that vent fumes from cooking hoods to the roof. These ducts were installed with zero clearance to surrounding combustible surfaces, and insulated with fire protection wrap, in accordance with the 2006 International Mechanical Code (IMC) and National Fire Protection Association (NFPA) 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations. Both code adoptions, intended for shaft alternative grease duct systems, are based on ASTM International E 2336-04, Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.

Commercial kitchen grease duct fires commonly result from a flare-up at the stove or grill top, and annually cause more than \$100 million in direct U.S. property damage. Without suppression, a stovetop fire can spread quickly into the vent system, sometimes resulting in hidden grease duct fires that burn undetected until the fuel source is depleted. Duct temperatures can spike dramatically under these circumstances, causing a fire if the duct is not protected properly—an effective fire-resistive enclosure can therefore protect the building structure as well as its occupants.

Traditionally, grease duct insulation consisted of a steel frame around the metal grease duct, covered by a double-layer of fire-rated gypsum wallboard with an air gap of not less than 76 mm (3 in.) between the duct and drywall, as per IMC. Such shafts occupy valuable building space and can be complicated to build and support, particularly along horizontal runs and in confined spaces; however, as a code-compliant application, they are still commonly employed. The gypsum in a grease duct chase is subject to day-to-day temperatures higher than the manufacturer's recommended 52°C (125°F) exposure limit, and these constantly-elevated temperatures can cause gypsum wallboard to release its chemically bound water and weaken.

SHAFT ALTERNATIVE GREASE DUCTS

Unlike earlier methods, shaft alternative systems protect grease ducts directly and allow them to be placed with zero clearance to surrounding combustible surfaces, even at the roof exit point. Kitchen grease duct runs in Wynn Las Vegas range in length from 6 to 37 m (20 to 120 ft), and most of the runs have substantial horizontal segments across kitchen and restaurant ceilings leading to vertical risers. Specifying zero-clearance duct insulation made it possible for designers to eliminate the construction space otherwise required for gypsum wallboard shafts around each duct. This installation method consists of a double layer of an Underwriters

Laboratories (UL)-listed foil-encapsulated, high-temperature insulation, held in place with metal bands on small- to medium-diameter ducts. No additional structure is required to support the insulation (figure 1).

Zero-clearance duct wrap can be installed in far less time than a conventional gypsum chase. Scheduling on a project can be simplified because duct wrapping and fastening are done as a single-step process, while shaft construction requires a metal frame be built and supported first, then covered with a double layer of fire-rated gypsum. On the Wynn Las Vegas project, the insulator wrapped and banded grease ducts with two layers of a UL-listed, foil-encapsulated alkaline-earth silicate wool insulation, fire-rated at 1093°C (2000°F). This proprietary, low bio-persistence (i.e. body-soluble) insulation maintains flexibility with age and prolonged exposure to high temperatures. Unlike mineral wool-based insulations, the material does not shrink or become brittle during high-temperature exposures, which could negate the fire rating. Where grease ducts penetrate fire-rated floors and walls, the insulator applied a fire-rated silicone sealant around the periphery of the insulated duct to maintain the integrity of the one- or two-hour rated assembly.

A mineral wool-based grease duct wrap product with somewhat lower temperature capabilities had been specified for initial construction stages of Wynn Las Vegas; however, crews found it less flexible, heavier, and more difficult to wrap around square metal ducts. Changing the product specification ultimately saved time and simplified work for installers.

STANDARD ISSUES

Before current codes came into effect, shaft alternative grease duct systems were required to meet an ambiguous "nationally recognized test standard" (2003 IMC, Section 506.3.10, Grease Duct Enclosures, Exception 1). This terminology was confusing and left designers and local inspectors to discern proper performance standards. The more specific grease duct performance requirements listed in 2006 IMC and NFPA 96 simplify the specification process and clarify inspection standards for this method.

Grease duct construction standards in IMC call for an approved automatic fire-suppression system for ducts serving Type I hoods, and fire-resistive access openings in ducts for inspection and cleanout. Crews on the Wynn Las Vegas project fabricated doors for each of these openings and insulated them with kits provided by the duct wrap supplier as insulation work progressed.

Moving out of the kitchen Foil-encapsulated, zero-clearance insulation was also used in two non-kitchen air-duct applications. In the first case, a duct delivers fresh air under pressure to stairwells in the hotel's restaurant and casino center area to prevent smoke infiltration. Another duct exhausts fumes to the roof from a basement storage space where the swimming pool chemicals are stored.

Like the kitchen grease ducts, these round, 305- and 406-mm (12- and 16-in.) diameter duct runs were installed with zero clearance to other construction elements. They were wrapped with two layers of 38-mm (1.5-in.) thick insulation encapsulated in foil, and fire-rated for temperatures up to 1093°C (2000°F). The crew was able to

insulate these ducts quickly using two overlapped layers of foil-wrapped insulation with steel banding to secure the material.

This zero-clearance insulation is often considered more expensive than gypsum wallboard chase construction, so the shaft approach for insulating kitchen grease ducts and other building air ducts is typically specified and purchased at the beginning of construction projects. According to insulation estimator Herb Swanson, of F. Rodgers Insulation, this traditional method sometimes proved unacceptable because of space limitations or performance concerns, in which case bids would be left for an alternative process. When zero-clearance insulation is purchased through vendors after a project begins, the price can be prohibitive; however, should it be specified at the outset, the material cost can be much more competitive.

SPECIFYING WITH STYLE

Wynn Las Vegas also includes more than two dozen high-end shops and boutiques for hotel guests and casino visitors, including a Jean Paul Gaultier boutique that markets apparel, accessories, and fragrances. The boutique's decorative wall system called for 557 m² (6000 ft.²) of padded, tufted wall panels, and required aesthetically pleasing materials that were code-compliant for non-combustible construction without a need for outside testing of completed assemblies, which would have been time-consuming and cost-prohibitive. The wall panels vary slightly in size, typically measuring 559 x 660 mm (22 x 26 in.).

High-temperature, alkaline-earth silicate wool insulation blanket was specified to serve as both padding and fire protection material for the wall panels. Segments of the insulation blanket were cut to the panel's size and mitered around the periphery and in the tufted center to achieve a 'pillow edge' effect. Panel units consist of fire-resistant medium density fiberboard (MDF), faced with the insulation blanket and wrapped with taffeta fabric, which is stapled on the back side (figure 2). Each removable panel is mounted on the underlying gypsum wallboard with hook-and-loop fasteners.

The fire-protection blanket is commonly used as a refractory liner in high-temperature furnaces, so there was no question of its performance as a construction substrate. The design choice complies with provisions outlined in Chapter 8 of the International Building Code (IBC).

The success of the Wynn Las Vegas fire protection system demonstrates how new, high-performance materials can improve construction efficiency and meet challenging building design requirements, all the while satisfying the often strict demands of current building codes.