

Fire rated ducts and penetration seals. Is “mix and match” acceptable?

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PICK & BUILD



Learning objectives:

- 1) What are current requirements in UAE for fire rated ducts including kitchen ducts
- 2) Importance of proper fire rated seal around ducts penetrating walls/floors
- 3) How fire rated seals around ducts shall be tested
- 4) Specific requirements for testing of seals around kitchen extract ducts (kitchen grease ducts)
- 5) When mix and match approach is acceptable

Fire safety with smoke management system

Here are a few examples of smoke management systems:



Fire safety with smoke management system



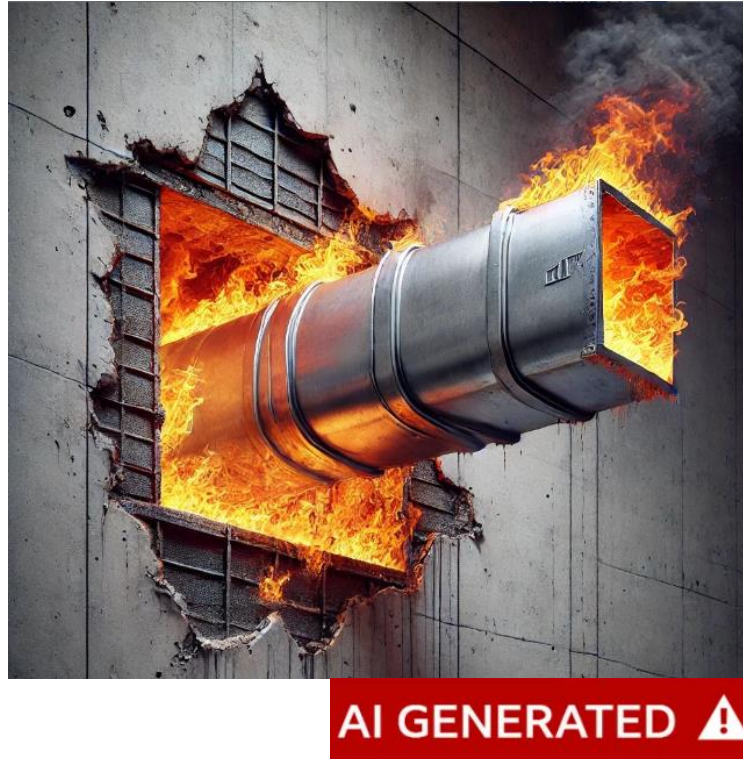
Fire rated
ducts

Fire-rated Ductworks

- What does it mean that ductwork is fire rated?
- Importance of the fire-rated duct
- Fire resistance and fire resistance rating
- Duct, components, or the whole system?
- Design of the fire-rated duct
- Fire exposure scenarios
- Fire testing requirement
- Criteria for successful test



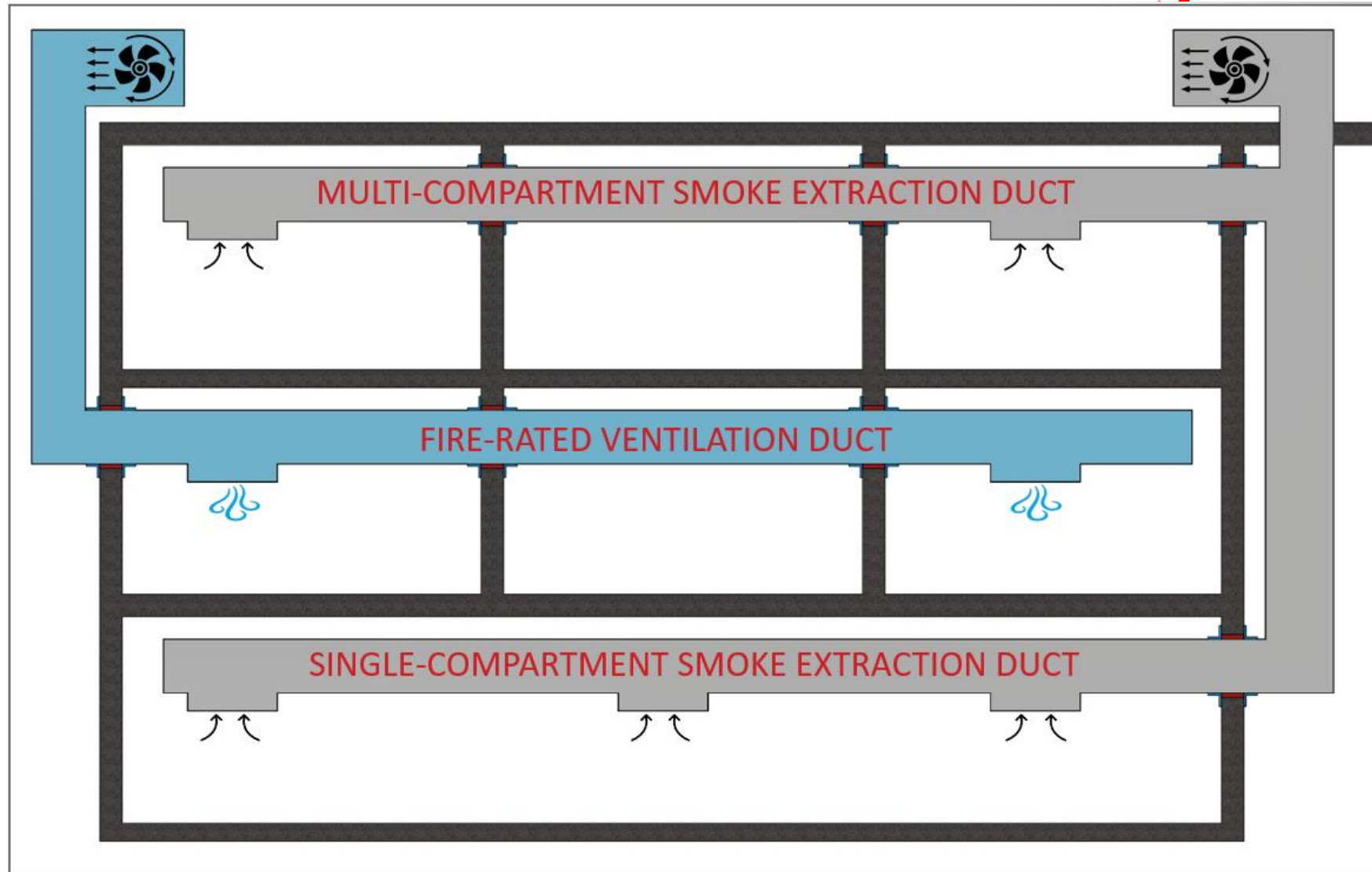
Importance of the fire-rated duct (and proper penetration seal around it)



Fire-rated ducts – what are we talking about?



Fire-rated ducts – what are we talking about?





Kitchen extract ducts (grease ducts)



Kitchen extract ducts (grease ducts)



Kitchen extract ducts (grease ducts)

Region	Number of Incidents	Common Causes	Injuries	Fatalities	Economic Loss (USD)
USA	~5,900	Grease fires , cooking equipment failures	~75	~10	\$172 million
Europe	~4,200	Electrical faults, gas leaks, grease fires	~60	~7	\$120 million
Asia	~7,000	Poor maintenance, grease fires , faulty equipment	~95	~15	\$200 million
India	~2,500	Electrical faults, poor ventilation, grease fires	~60	~12	\$90 million

Kitchen extract ducts (grease ducts)

How can we act to avoid kitchen duct fires?

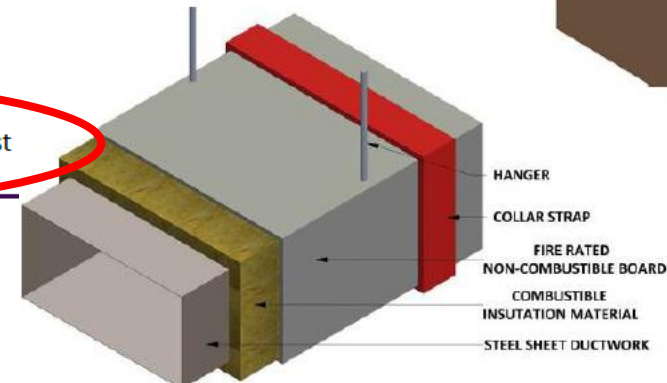
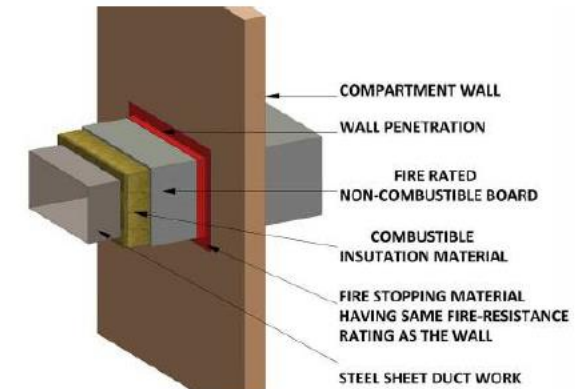
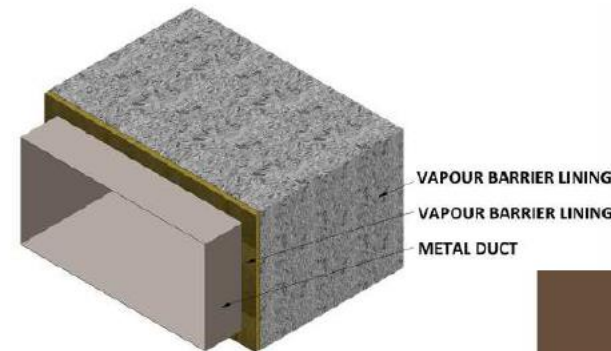
Frequency	Task	Details
Daily/Weekly	Surface Cleaning	Clean visible surfaces and filters.
Monthly/Quarterly	Inspection & Cleaning	Inspect and clean internal ducts, depending on use.
Annually	Full System Inspection	Comprehensive inspection and professional cleaning.

Frequency	Type or Volume of Cooking
Monthly	Systems serving solid fuel cooking operations
Quarterly	Systems serving high-volume cooking operations, such as 24-hour cooking, charbroiling, or wok cooking
Semi-Annually	Systems serving low-volume cooking operations
Annually	Systems serving low-volume cooking operations, such as churches, day camps, seasonal businesses, or senior lefts

What are current requirements in UAE for fire rated ducts including kitchen ducts (and penetration seals around ducts)

Table 10.1.: Components of Smoke Control and HVAC Systems

ITEMS	REQUIREMENTS
3. DUCTS	<p>2. SMOKE CONTROL SYSTEM DUCTS</p> <p>i. Ductwork for Smoke Control Systems (both exhaust and make-up air ducts) shall be of at least 1 hour fire resistance rated in sprinklered buildings and 2 hour fire resistance rated in non sprinklered buildings, approved and listed in accordance with Section 6.1.12.</p> <p>ii. Where a duct passes through other fire compartments of higher rating, the duct shall be constructed to have the same rating of that compartment. The rating shall apply to fire exposure from both interior and exterior of the duct or structure.</p> <p>iii. Such fire rating of smoke control system ducts shall be evaluated and approved for fire rating as well as for Stability, Integrity and Insulation Criteria for fire rating.</p> <p>iv. The complete duct system including supports, hangers, joints, gaskets, sealant etc. shall be tested as assembly and in compliance with the approved test standards, in accordance with Section 6.</p>



What are current requirements in UAE for fire rated ducts including kitchen ducts (and penetration seals around ducts)

Smoke Management Ducts

دكتات التحكم بالدخان

According to UAE life and Safety code accepted test standards for smoke duct (Make-up or Exhaust Duct) with mandatory rating for 120min for each criteria (Stability, Integrity and Insulation) are:

: بحسب قوانين وتشريعات كود دولة الإمارات العربية المتحدة للوقاية من الحريق فإن المعايير المعتمدة لمجاري أنظمة الدخان (ضخ الهواء/ سحب الدخان) بمقاومة حريق لا تقل عن 120 دقيقة لكل معيار (الاستقرار والنزاهة والعزل). هي:

British-standards:

BS 476 part 24, Duct A and B and cross-sectional retention of 75% for both conditions.

• المعايير - البريطانية:

BS 476-24 ، الدكت A والدكت B مع الاحتفاظ بمقطع عرضي بنسبة 75% لكلا الدكتين.

European-standards:

Requires all the below tests for EN13501-4 classification. EN 1366- 8 for Duct C for Multi compartments. Duct cross-sectional retention of 90%. EN 1366- 9 for single compartment -low temperature exposure (600°C) and must comply leakage.

• المعايير - الأوروبية:

تتطلب جميع الاختبارات التالية لتصنيف EN13501-4. EN 1366-8 لمجاري الهواء نوع C التي تمر عبر جدار مقاوم للحريق، حيث لا بد أن يحتفظ الدكت بمقطع عرضي بنسبة 90%. EN 1366-9 للتعرض لدرجات حرارة منخفضة للمقصورة الواحدة (600 درجة مئوية) ويجب أن يتوافق مع التسرب.

What are current requirements in UAE for fire rated ducts including kitchen ducts (and penetration seals around ducts)

Kitchen Extraction Duct

دكتات المطابخ

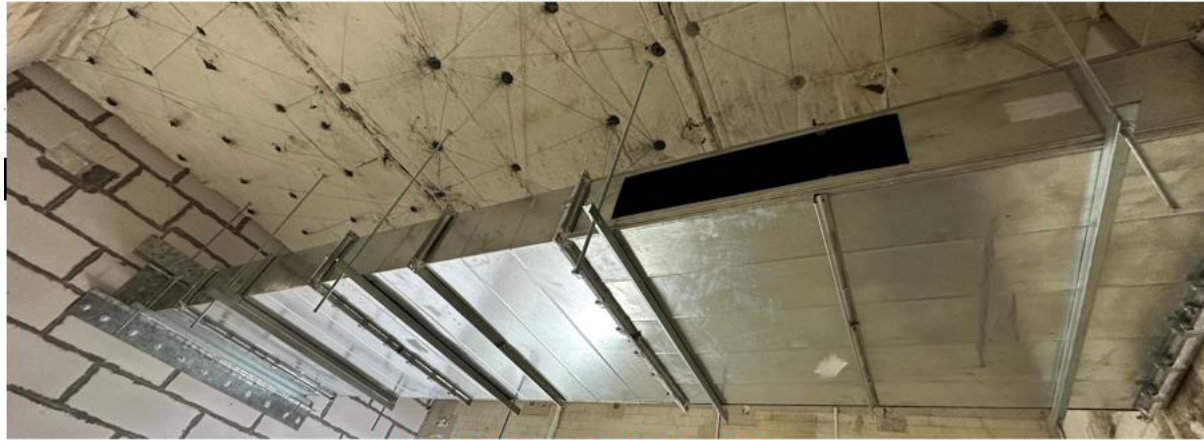
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| <p>1 According to the UAE life and Safety code, NFPA 96 is the only accepted practice to construct Kitchen Grease duct. NFPA 96 provides preventive and operative fire safety requirements intended to reduce the potential fire hazard of both public and private commercial cooking operations.</p> <p>3 The accepted test standards for Kitchen ducts with mandatory rating for 120 minutes are:</p> <ul style="list-style-type: none">• ASTM E2336-20 Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.• UL 2221-20 Standard for Tests of Fire Resistive Grease Duct Enclosure Assemblies <p>4 Mandatory rating for Smoke duct are:</p> <ul style="list-style-type: none">• 120minutes-Duct• 120minutes-Insulation <p>5 BS 476-24 does not comply with NFPA 96 requirements. NFPA 96 asks for the insulation criteria to meet ASTM E 2336.</p> | <p>1 بحسب قوانين وتشريعات كود دولة الإمارات العربية المتحدة للوقاية من الحريق، فإن المعيار NFPA 96 هو الممارسة الوحيدة المقبولة لإنشاء مجاري سحب دخان المطابخ. حيث يوفر المعيار NFPA 96 العديد من المتطلبات الوقائية والتشغيلية للسلامة من الحرائق، وتهدف إلى الحد من مخاطر الحرائق المحتملة لعمليات الطهي التجارية العامة والخاصة على حد سواء.</p> <p>3 معايير الاختبار المقبولة لدكتات سحب دخان المطابخ ذات التصنيف الإلزامي لمدة 120 دقيقة هي:</p> <ul style="list-style-type: none">• ASTM E2336-20 Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.• UL 2221-20 Standard for Tests of Fire Resistive Grease Duct Enclosure Assemblies <p>4 التصنيف الإلزامي لمجاري ودكتات المطابخ هي:</p> <ul style="list-style-type: none">• 120 دقيقة – الدكتات• 120 دقيقة – العزل <p>5 لا يتوافق معيار BS 476-24 مع المعيار NFPA 96 ومتطلباته. حيث يتطلب معيار ال NFPA 96 اختبار العزل لمعيار ال ASTM E 2336.</p> |
|--|--|

To test or not to test?

that is the question...

Duct testing

BEFORE FIRE TEST...



AFTER FIRE TEST...

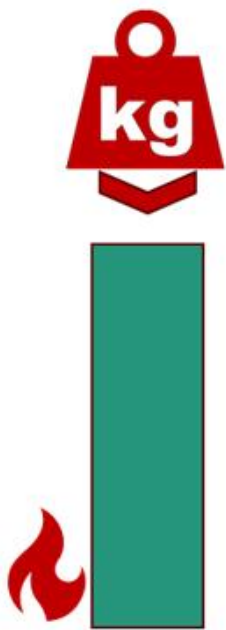


How to test?

Fire resistance testing – various methods

- ASTM 2336/UL 1998
- BS 476-24
- EN 1366-1/-8/-9
- ASTM E2816
- ISO 6944 (not in 2018 UAE Fire and Life Safety Code)
- UL 181 (not in 2018 UAE Fire and Life Safety Code)

Test Results

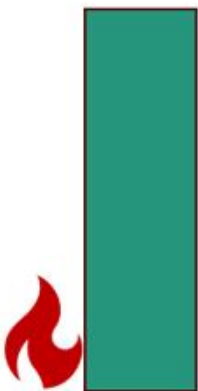


Mechanical Stability

Collapsing of the duct
Reduction of cross-section area
Maintain intended function

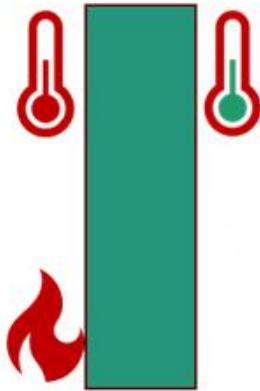


Rating is expressed as time



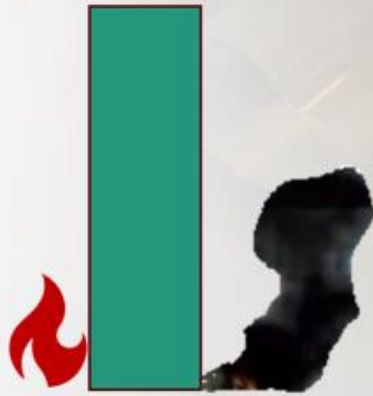
Integrity

Effectiveness of the duct
system to stop spreading fire
into or from the duct



Insulation

Effectiveness in stopping
temperature rise through the
duct system



Smoke Leakage

Effectiveness in stopping
smoke leakage

Fire resistance testing – fire scenarios

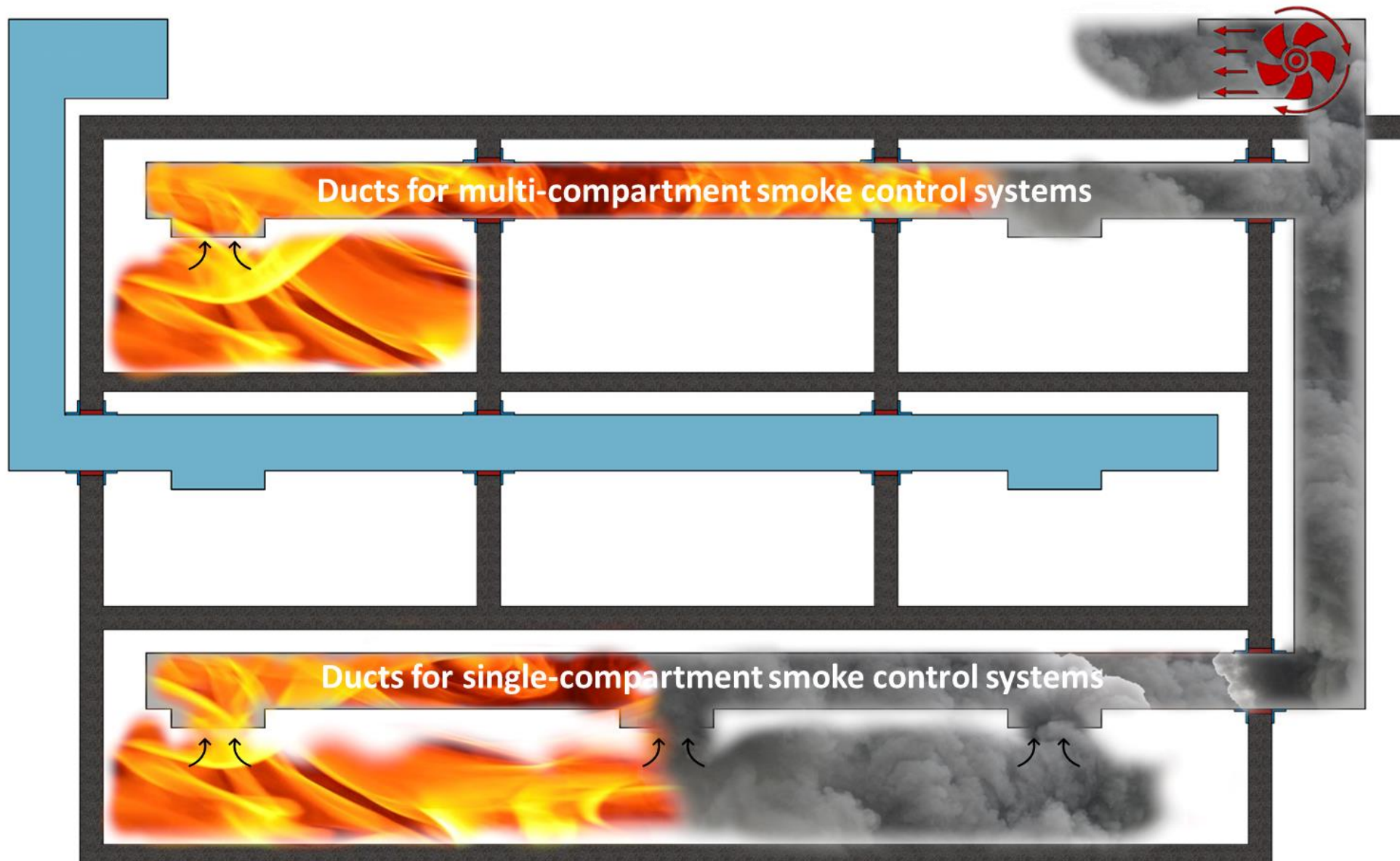
Internal fire

- Fire inside the duct

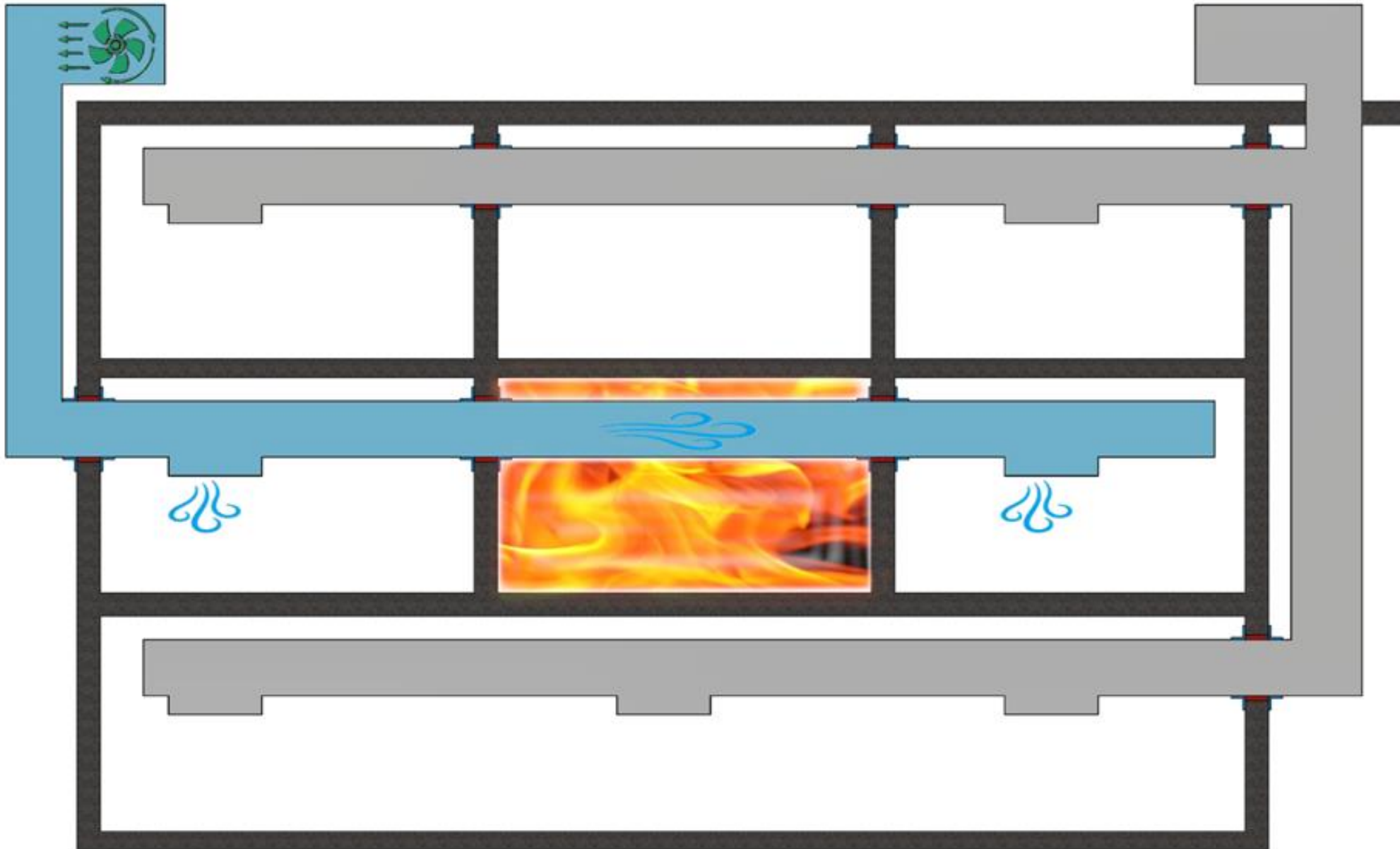
External fire

- Fire outside the duct

Fire resistance testing – Internal fire scenario

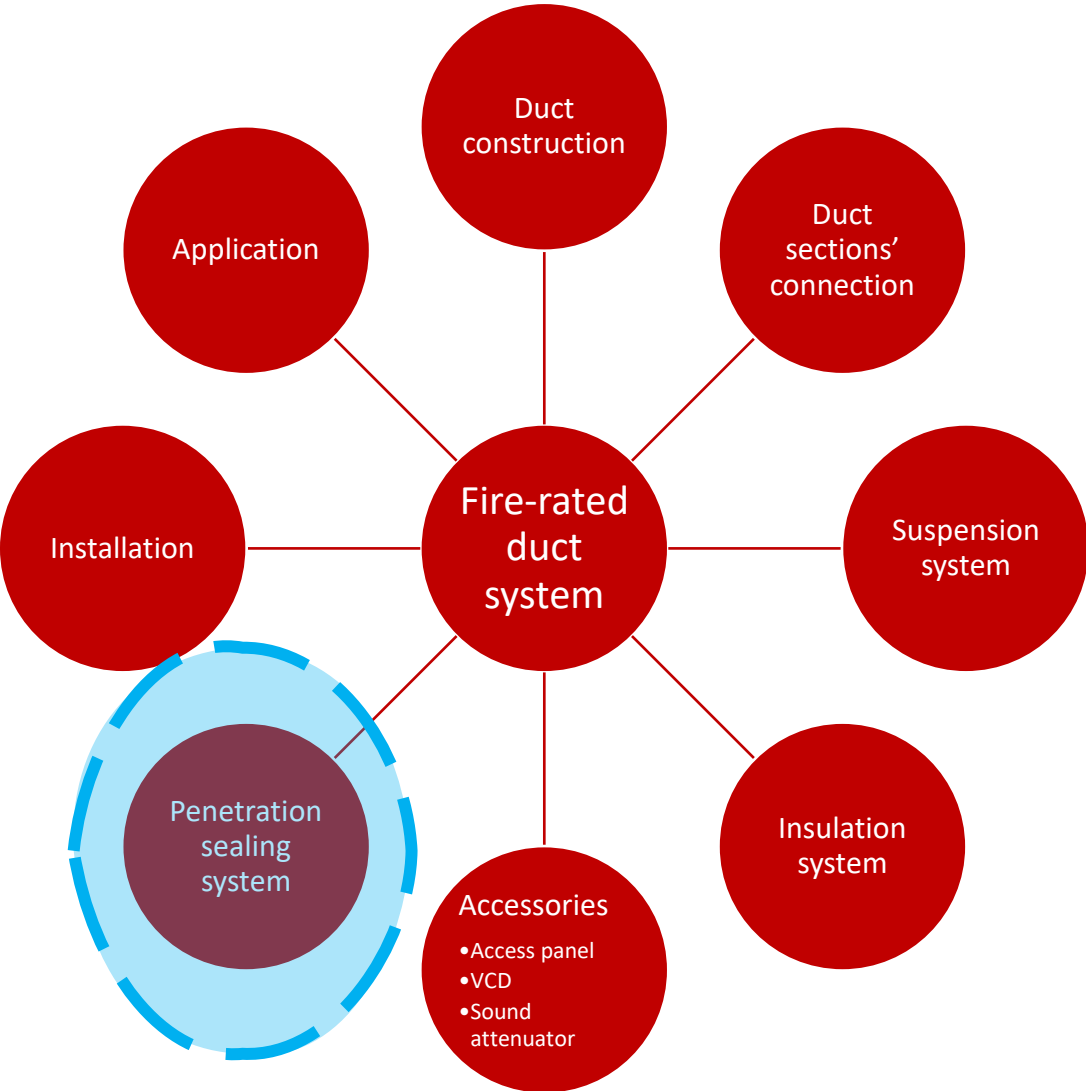


Fire resistance testing – External fire scenario

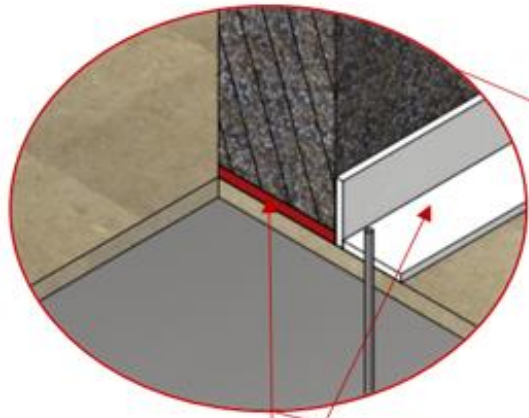


What to test?

Components of fire-rated duct system



Fire-rated duct construction

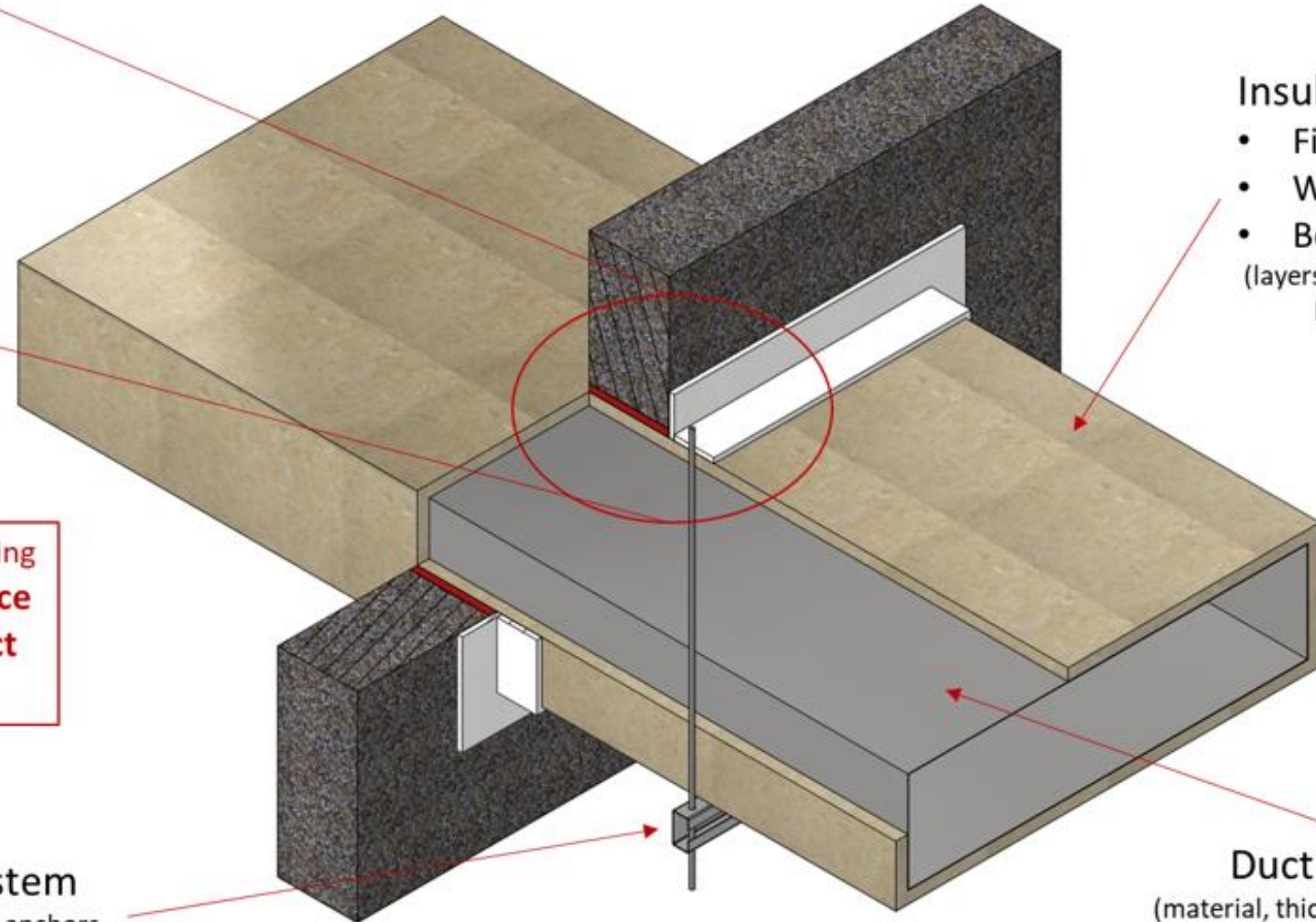


Penetration sealing system

(filling material, type, density, additional protection)

The "fire-stopping" – penetration sealing system – **shall be as used in practice and shall be specified by the duct Manufacturer.**

Suspension system
(bearers, threaded rods, anchors, spacing)



Insulation system

- Fire sprays
- Wrapping system
- Boards/slabs
(layers, thickness, density, Manufacturer)

Duct design
(material, thickness, joint type, flanges, stiffeners)

Fire stopping in various standards

The fire-stopping shall be as used in practice following established manuals of good practice for field installation, and shall be specified by the manufacturer. If the width of the gap for fire-stopping around the duct at the furnace penetration point is not specified, a width of 20 mm shall be used.

BS 476-24 : 1987

7.4 Fire stopping

The fire stopping of the penetration through the supporting construction shall be as intended in practice. The maximum width of the gap between the duct and the wall shall be accommodated as used in practice.

EN 1366-1:2014+A1:2020

duct system

complete system, consisting of the duct sections, duct joints, suspensions and penetration seals

7.4.11 Install the enclosure material using the test sponsor's installation instructions documented in 7.4. The space created around the vertical grease duct section and the horizontal fire-separating element shall be sealed with a through-penetration fire-stop system specified by the test sponsor. Install through-penetration fire stop in accordance with the test sponsor's instructions. Document the test sponsor's through-penetration fire-stop system and its method of installation.

ASTM E2336-20

Fire stopping in various standards

6.2.2 Integrity and leakage

Integrity at the penetration point of supporting constructions

The integrity at the penetration point of supporting constructions, i.e. where ducts pass through walls and floors, may be adversely affected due to the deflection of the duct walls, formation of gaps and cracks between the duct surfaces and the adjacent supporting constructions and is lost with increasing width of gaps and cracks.

EN 15882-1:2011+A1:2017
Extended application of results from fire resistance tests for service installations. Ducts

NOTE 1 The integrity at the penetration point may be affected also by damages of the fire stopping due to the thermal elongation of the duct.

Fire stopping in various standards

EN 15882-1:2011+A1:2017
Extended application of results
from fire resistance tests for
service installations. Ducts

4.4 Specific constructional parameters and factors

Table 3 — Factors relating to Specific constructional parameters

Line	Parameter and rule reference	Factor
a	Thickness of protection	Greater or less than tested
b	Distance between joints/stiffeners	Greater or less than tested
c	Number of protective layers	Greater or less than tested
d	Change in penetration/sealing system around duct	Dependant on test data available

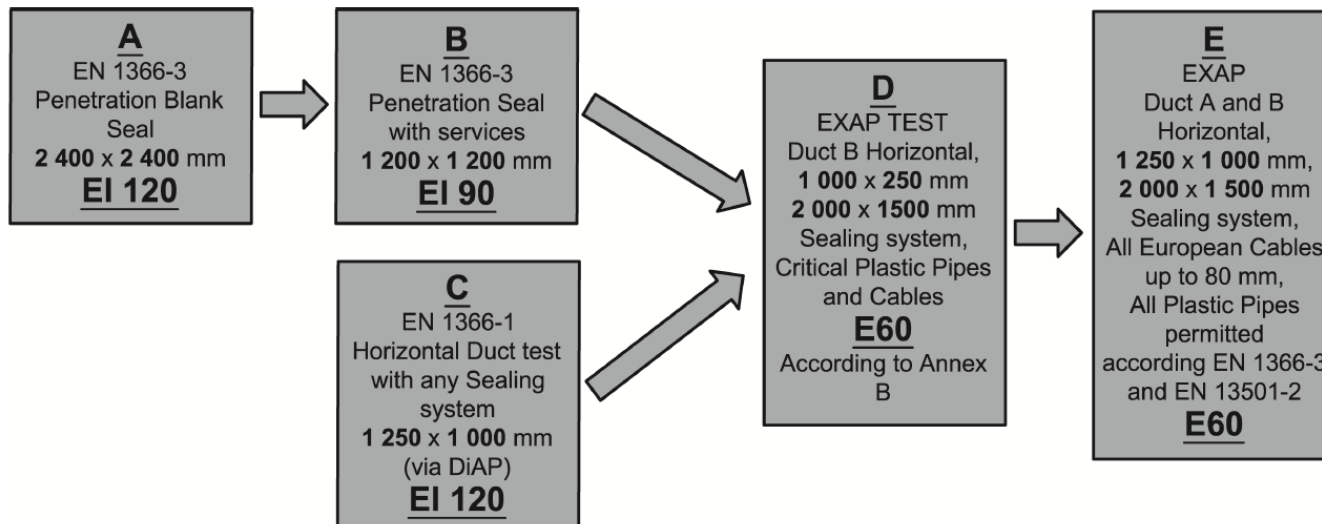
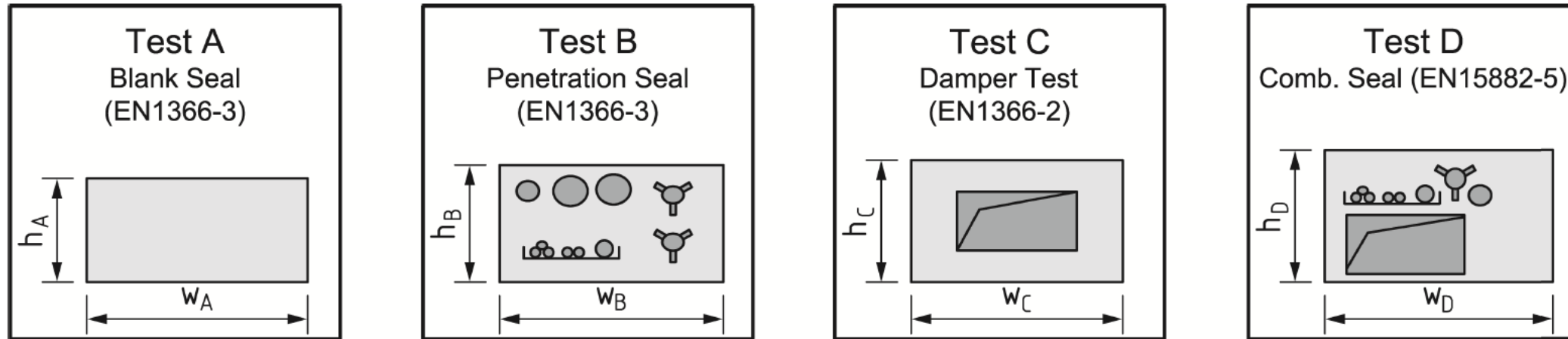
different arrangement and/or orientation of
strips or other material at the penetration
sealing

see rule

Additional test necessary; changes on the penetration
sealing system lead to a different duct systems

Fire stopping in various standards

EN 158825:2021. Extended application of results from fire resistance tests for service installations. Part 5: Combined penetration seals



Fire stopping in various standards

1.1 These test methods evaluate the fire-resistive metallic HVAC duct system's fire resistance and fire-engulfment with horizontal and vertical through-penetration firestops.

The fire-engulfment test also provides a means to test a through-penetration firestop to determine its compatibility with the HVAC duct when mounted in a horizontal or vertical fire-separating element. A hose stream test is also performed on the test assembly in accordance with the provisions in Practice E2226.

5.2.2 Ability of the firestops to meet the requirements of Test Method E814 when used as part of a HVAC duct system.

ASTM E2816

ASTM E2336-20 - Fire-Engulfment Test

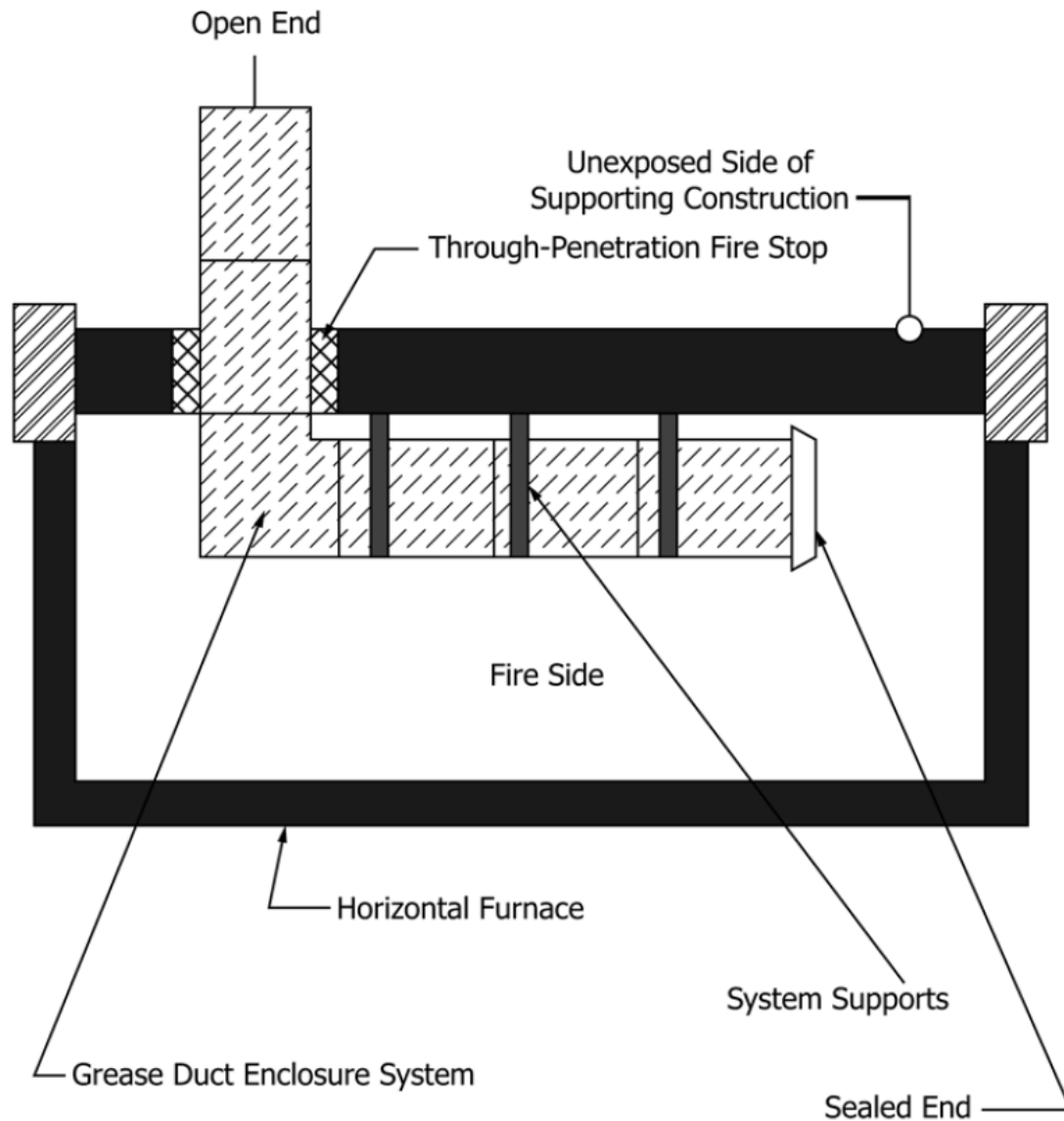


FIG. 6 Fire-Engulfment Test Arrangement

Conclusions on proposed Learning objectives:

- 1) What are current requirements in UAE for fire rated ducts including kitchen ducts
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Thank you

