



ACCEPTANCE CRITERIA FOR GREASE DUCT ENCLOSURE ASSEMBLIES

AC101

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PREFACE

Evaluation reports issued by ICC Evaluation Service, Inc. (ICC-ES), are based upon performance features of the International family of codes and other widely adopted code families, including the Uniform Codes, the BOCA National Codes, and the SBCCI Standard Codes. Section 104.11 of the *International Building Code*[®] reads as follows:

The provisions of this code are not intended to prevent the installation of any materials or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety.

Similar provisions are contained in the Uniform Codes, the National Codes, and the Standard Codes.

This acceptance criteria has been issued to provide all interested parties with guidelines for demonstrating compliance with performance features of the applicable code(s) referenced in the acceptance criteria. The criteria was developed and adopted following public hearings conducted by the ICC-ES Evaluation Committee, and is effective on the date shown above. All reports issued or reissued on or after the effective date must comply with this criteria, while reports issued prior to this date may be in compliance with this criteria or with the previous edition. If the criteria is an updated version from the previous edition, a solid vertical line (|) in the margin within the criteria indicates a technical change, addition, or deletion from the previous edition. A deletion indicator (→) is provided in the margin where a paragraph has been deleted if the deletion involved a technical change. This criteria may be further revised as the need dictates.

ICC-ES may consider alternate criteria, provided the report applicant submits valid data demonstrating that the alternate criteria are at least equivalent to the criteria set forth in this document, and otherwise demonstrate compliance with the performance features of the codes. Notwithstanding that a product, material, or type or method of construction meets the requirements of the criteria set forth in this document, or that it can be demonstrated that valid alternate criteria are equivalent to the criteria in this document and otherwise demonstrate compliance with the performance features of the codes, ICC-ES retains the right to refuse to issue or renew an evaluation report, if the product, material, or type or method of construction is such that either unusual care with its installation or use must be exercised for satisfactory performance, or if malfunctioning is apt to cause unreasonable property damage or personal injury or sickness relative to the benefits to be achieved by the use of the product, material, or type or method of construction.

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1.0 INTRODUCTION

1.1 Scope: This acceptance criteria establishes the basis of recognition in ICC-ES evaluation reports of fire-resistive materials applied directly to grease ducts serving Type I kitchen hoods as an alternate to enclosure requirements in Section 506.3.10 of the *International Mechanical Code*[®] (IMC) and Section 507.6 of the ICBO *Uniform Mechanical Code*[™] (UMC). For recognition under the BOCA[®] *National Building Code/1999* (BNBC) and/or the 1999 *Standard Building Code*[®] (SBC), compliance under the IMC shall be established. The system may be installed with zero clearance from the insulating materials to combustibles.

1.2 Referenced Documents:

1.2.1 2003 *International Mechanical Code*[®] (IMC), International Code Council.

1.2.2 2003 *International Building Code*[®] (IBC), International Code Council.

1.2.3 BOCA[®] *National Building Code/1999* (BNBC).

1.2.4 1999 *Standard Building Code*[®] (SBC).

1.2.5 1997 *Uniform Building Code*[™] (UBC).

1.2.6 1997 ICBO *Uniform Mechanical Code*[®] (UMC).

1.2.7 ASTM C 518-04, Standard Test Method for Steady State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus, ASTM International.

1.2.8 ASTM E 119-00, Standard Test Methods for Fire Tests of Building Construction and Materials, ASTM International.

1.2.9 ASTM E 136-99^{e1}, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C, ASTM International.

1.3 Definitions:

1.3.1 Grease Duct Enclosure System: The system is a proprietary material, applied directly over a grease duct complying with IMC Section 506.3.10 and UMC Section 507.6, and serving a Type I kitchen hood to achieve a fire-resistive enclosure for the duct. The system consists of the duct, a proprietary enclosure material, a support and fastening system, and an access opening for duct cleaning. The system has zero clearance between the duct and enclosure material.

1.3.2 Fire-resistive Enclosure: An assembly that is assigned a fire-resistive rating when tested in accordance with ASTM E 119.

2.0 BASIC DATA

The applicant for an evaluation report concerning an enclosure system shall submit the following:

2.1 Product Information:

2.1.1 Information on the manufacturing process of the duct enclosure material.

2.1.2 Method of packaging and product identification.

2.1.3 Installation instructions.

2.1.4 Description of fasteners, including manufacturer's type and method of application.

2.2 Product Labeling: The insulation materials shall be labeled at regular intervals with the wording "FIRE-RESISTIVE ENCLOSURE, DO NOT REMOVE." The wording shall be visible in an installed condition. Product labels must also include reference to the ICC-ES evaluation report number.

2.3 Testing Laboratories: Testing laboratories shall comply with Section 2.0 of the ICC-ES Acceptance Criteria for Test Reports (AC85), and Section 4.2 of the ICC-ES Rules of Procedure for Evaluation Reports.

2.4 Test Reports: Test reports shall comply with AC85. Test reports shall include test specimen description; details of the test method; manner of testing; test results; calculated results; and photographs, when necessary. The test reports shall also include information required by the applicable ASTM standard.

2.5 Product Sampling: Test specimen sampling shall comply with Section 3.1 of AC85.

3.0 TEST AND PERFORMANCE REQUIREMENTS

The following data shall be submitted:

3.1.1 Report of noncombustibility tests. See Section 4.1 of this criteria for details.

3.1.2 Report of fire-resistance tests. See Section 4.2 of this criteria for details.

3.1.3 Report of durability tests. See Section 4.3 of this criteria for details.

3.1.4 Report of internal grease-duct fire tests. See Section 4.4 of this criteria for details.

3.1.5 Report of fire-engulfment tests. See Section 4.5 of this criteria for details.

4.0 TEST METHODS

4.1 Noncombustibility Tests: The duct-enclosure material shall be classified as noncombustible. See ASTM E 136.

4.2 Fire-resistance Tests: The fire-resistive enclosure system shall be tested in accordance with ASTM E 119 in a horizontal furnace, with the exterior side exposed to the furnace.

4.2.1 The test specimen configuration shall consist of a longitudinally bisected, code-complying grease duct forming a channel section. The enclosure test sample shall be a minimum of 12 feet (3658 mm) long and shall be as wide as the duct width sought for recognition in the evaluation report. The duct specimen shall be the minimum gage and type of steel desired for recognition. The test specimen shall include joints and clean-out openings representative of end-use conditions.

4.2.2 Type, location and installation of thermocouples shall meet the intent of ASTM E 119.

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4.2.3 The fire-endurance test on the sample shall be continued until failure occurs, or until the sample has sustained the test conditions for a period equal to that specified in the conditions of acceptance in ASTM E 119, Section 18.

4.2.4 The enclosure system test specimen shall sustain the hose-stream test specified in ASTM E 119, Section 11.

4.2.5 Alternate Fire-resistance Test: Testing the enclosure materials in a vertical furnace in accordance with ASTM E 119 is an acceptable alternate to the testing described in Sections 4.2.1 through 4.2.4. The test specimen configuration shall consist of steel studs, spaced a maximum of 30 inches (762 mm) on center, clad on the fire side with a single layer of sheet steel of the type and thickness for which recognition is sought. The exposed surface shall be covered with the flexible wrap system, held in place with impaling pins or with a rigid system attached in accordance with the manufacturer's instructions. The test specimen shall include joints and clean-out openings representative of end-use conditions.

The fire endurance test on the sample shall be continued until failure occurs, or until the sample has sustained the test conditions for a period of time equal to that specified in the conditions of acceptance in ASTM E 119, Section 18. The enclosure system test specimen shall sustain the hose-stream test specified in ASTM E 119, Section 11.

4.3 Durability Tests: Aging-tests simulate the effects of long-term exposure of typical in-service conditions on the thermal transmission qualities of the duct enclosure materials.

4.3.1 A total of eight samples of the duct enclosure material are needed in the thickness intended for use, and the length and width of the test specimen must comply with ASTM C 518. All specimens are conditioned at 75°F ± 5°F (23.8°C ± 2.7°C) with a relative humidity of 50 ± 5 percent. Specimens are conditioned for 24 hours prior to testing.

4.3.2 Four samples are exposed to the effects of temperature aging to determine changes, if any, in thermal transmission properties. An additional four samples are used as a base reference for comparison.

The temperature-aging samples are placed on a rack in a vertical position, with a clearance, between samples, of between 3/8 and 3/4 inch (9.5 to 19.1 mm). The rack is placed into an oven that has been preheated to a temperature of 300°F (149°C). After 12 hours, the oven is shut off and the specimens are allowed to cool for 12 hours. This cycle is repeated 10 times.

On completion of the final cycle, the specimens are removed from the oven and allowed to cool for a period of two hours at standard atmospheric conditions.

4.3.3 Thermal conductivity properties of temperature-aged samples and control samples are determined in accordance with ASTM C 518. The average thermal conductivity of the heat-treated samples shall be reported as a percentage of the average thermal conductivity of untreated samples.

4.3.4 Thermal conductivity shall not have an increase greater than 10 percent.

4.4 Internal Grease-duct Fire Tests:

4.4.1 General: Internal grease-duct fire tests, which simulate the effects of a grease fire occurring inside a grease duct, shall be conducted on a metal duct complying with IMC Section 506.3.10 and UMC Section 507.6 that is protected with the proprietary duct enclosure system. The purpose of the test is to determine the temperatures on the unexposed surface of the system when the interior of the grease duct is exposed to a standard fire exposure.

Test specimens shall be installed in accordance with the manufacturer's instructions, with the enclosure material surrounding a rectangular metal duct having the largest width and cross-sectional area for which recognition is desired. A successful test will qualify the duct enclosure for use on rectangular ducts with equal or less widths and equal or less cross-sectional areas, and round ducts with equal or less cross-sectional areas.

The metal duct shall have at least two joints, and shall comply with the minimum requirements of IMC Section 506.3 and UMC Section 507.3. The grease duct assembly shall be supported in accordance with the manufacturer's recommendations, and shall have the dimensions shown in Figure 1. An access opening in the enclosure system shall be aligned with the metal duct access openings. Conditions of recognition will be determined by the test conditions.

Tests shall be conducted indoors, and environmental conditions, such as air temperature and air velocity at time of test, shall comply with ASTM E 119. Unexposed thermocouples and thermocouple pads on the unexposed side of the specimen shall comply with ASTM E 119.

4.4.2 Thermocouple Locations: Thermocouple locations shall be determined by the laboratory to represent the locations least resistant to thermal transmission, and shall be installed following the guidelines illustrated in Figures 3 and 4, and as follows:

1. Four thermocouples located inside the duct to measure the furnace temperature mid-length of the duct and either immersed 12 inches into each face of the heated metal duct or one-fourth of the distance between the face of the metal duct and its parallel, opposing face, whichever is least. (Thermocouples 1 through 4.)

2. The unexposed surface thermocouples (Thermocouples 5 through 22) are installed downstream from Thermocouples 1 through 4.

3. Two thermocouples mounted on each unexposed face, for a total of eight thermocouples. (Thermocouples 5 through 12.)

4. Two thermocouples mounted on the unexposed surface over vertical joints of the enclosure materials. (Thermocouples 13 and 14.)

5. Two thermocouples mounted on the unexposed surface over horizontal joints of the enclosure materials. (Thermocouples 15 and 16.)

6. Two thermocouples between the test duct enclosure and enclosure support system, for informational purposes only. (Thermocouples 17 and 18.)

7. Two thermocouples around the edges of the cleanout access cover: one top, one side, at joints between the cover and side panel. (Thermocouples 19 and 20.)

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8. Two thermocouples between the sides of the metal duct and the inside face of the test duct enclosure, for informational purposes only. (Thermocouples 21 and 22.)

Thermocouples on the exposed side of the assembly shall not be heavier than No. 18 Type S or K or shall be $1/16$ -inch-diameter (1.6 mm) Inconel[®] stainless steel-sheathed, and shall project $1/2$ inch (12.7 mm) from the inner ends of support tubes.

4.4.3 Combustion Chamber: The combustion chamber shall be configured as illustrated in Figure 2.

4.4.4 Conduct of Test: The temperature inside the metal duct shall be raised from room temperature to at least 500°F (260°C) on average for readings from Thermocouples 1 through 4, as shown in Figure 4. This average temperature shall be maintained for at least four hours. Data shall be recorded at maximum five-minute intervals. The minimum burner heat input (Btu/h) shall be at least 925 times the area of the grease duct (inches²) during the four-hour period. The temperature shall then be increased to 2000°F (1093°C) within 15 minutes as recorded by the thermocouples inside the metal duct. The average temperature recorded by Thermocouples 1 through 4 (inside the metal duct) shall be at least 2000°F (1093°C) at each recording interval for the remaining 30 minutes of the test. Temperatures shall be recorded at intervals not exceeding 30 seconds. The minimum burner heat input (Btu/h) shall be at least 4025 times the area of the duct (inches²) during the 30-minute period.

For rectangular ducts, the cross-sectional area shall be modified when determining the minimum heat input. For rectangular ducts, an equivalent diameter (D_E) and the equivalent cross-sectional area shall be determined.

$$D_E = 1.30(ab)^{0.625} / (a + b)^{0.25}$$

where:

- a = length of one side of duct
- b = length of adjacent side of duct

and

$$\text{Equivalent Area} = \pi (D_E/2)^2$$

4.4.5 Conditions of Acceptance:

1. Transmission of heat through the system during the internal grease duct fire test shall not raise the temperature of any thermocouple on the unexposed surface of the duct enclosure more than 117°F (65°C) above ambient when the temperature inside the metal duct is 500°F (260°C).

2. At no time during the test shall transmission of heat through the duct enclosure raise the average temperature of the thermocouples on the unexposed surface more than 250°F (138°C) above ambient, or the temperature of any individual thermocouple more than 325°F (180°C) above ambient.

→ 3. The proprietary system shall remain in place without the occurrence of any openings.

4.5 Fire-engulfment Test: The purpose of the fire-engulfment test is to simulate exposure of the enclosure system to fire occurring from an outside source, and to establish the structural integrity of the duct system and supports under fire-exposure conditions.

4.5.1 The test specimen shall consist of complete sections of the grease duct enclosure system, including an elbow and all of the necessary supports, assembled in an L-shape in accordance with the manufacturer's instructions. The specimen shall be a minimum of 10 feet (3048 mm) long and 4 feet (1219 mm) high. The assembly shall be capped at the horizontal end of the specimen, and the vertical termination, extending a minimum of 2 feet (610 mm) above the slab, shall be open to the atmosphere. The grease duct enclosure system subjected to tests in accordance with this section shall be representative of the assemblies for which recognition is sought. This includes duct size, insulation thickness of enclosure materials, and type and spacing of duct supports. See Figure 5.

4.5.2 The assembly shall be installed in a horizontal furnace capable of creating the conditions required by ASTM E 119. The assembly shall be centered in the furnace, with a minimum distance of 12 inches (305 mm) between the sample and the furnace wall.

4.5.3 The assembly shall be suspended from a floor/ceiling assembly having a fire-resistance greater than the intended rating of the duct enclosure system. The penetration between the vertical duct section and the test slab shall be sealed with a through-penetration fire-stop system specified by the manufacturer.

4.5.4 The assembly shall be exposed to fire-exposure conditions in accordance with ASTM E 119. The fire-endurance test shall be continued until failure occurs or until the assembly has sustained the test conditions for a period equal to that specified in the conditions of acceptance in ASTM E 119, Section 18. Environmental conditions at the start of the test shall comply with ASTM E 119, Section 12.

4.5.5 The assembly shall be subjected to the hose-stream test specified in ASTM E 119, Section 11.

4.5.6 Conditions of Acceptance: There shall be no structural collapse, failure or opening of the duct cavity or through-penetration fire-stop during the fire-exposure test or the hose-stream test.

5.0 QUALITY CONTROL

5.1 The duct enclosure system shall be manufactured under an approved quality control program with inspections by an inspection agency accredited by the International Accreditation Service (IAS) or otherwise acceptable to ICC-ES.

5.2 A quality control manual complying with the ICC-ES Acceptance Criteria for Quality Control Manuals (AC10) shall be submitted. ■

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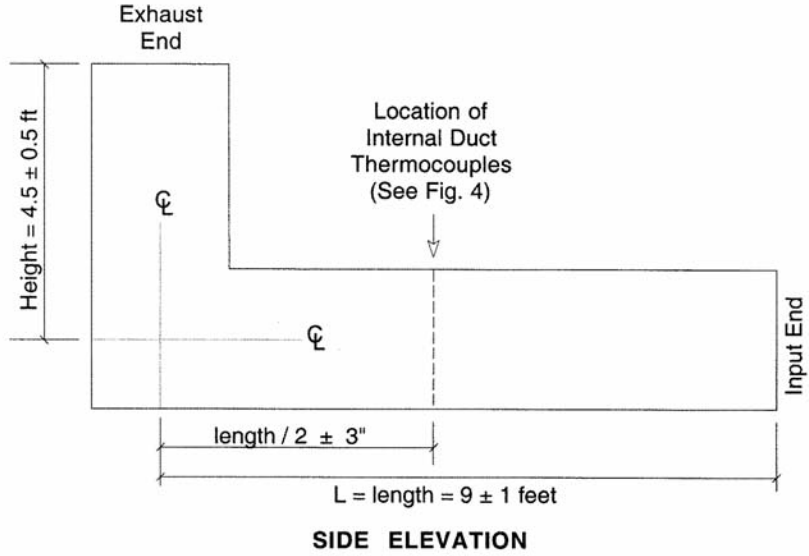


FIGURE 1—DUCT DETAILS

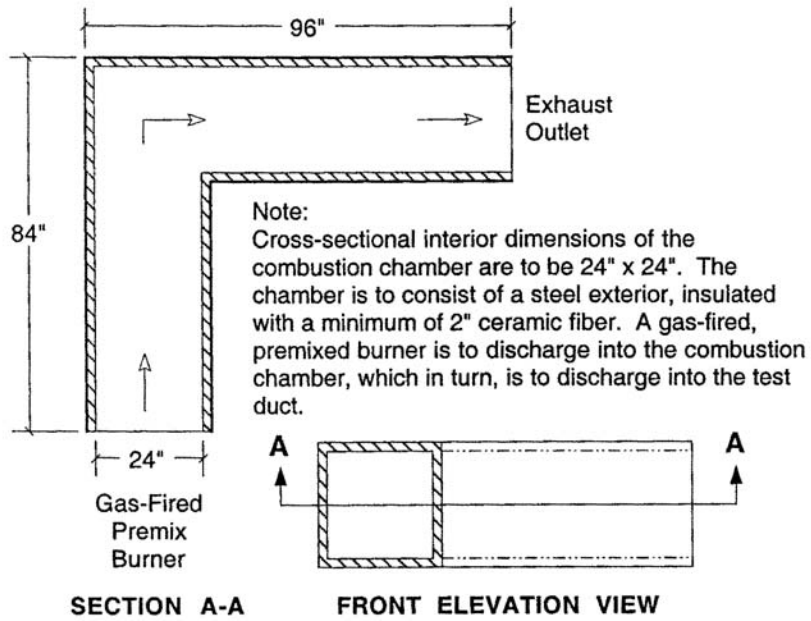


FIGURE 2—COMBUSTIBLE CHAMBER DETAILS

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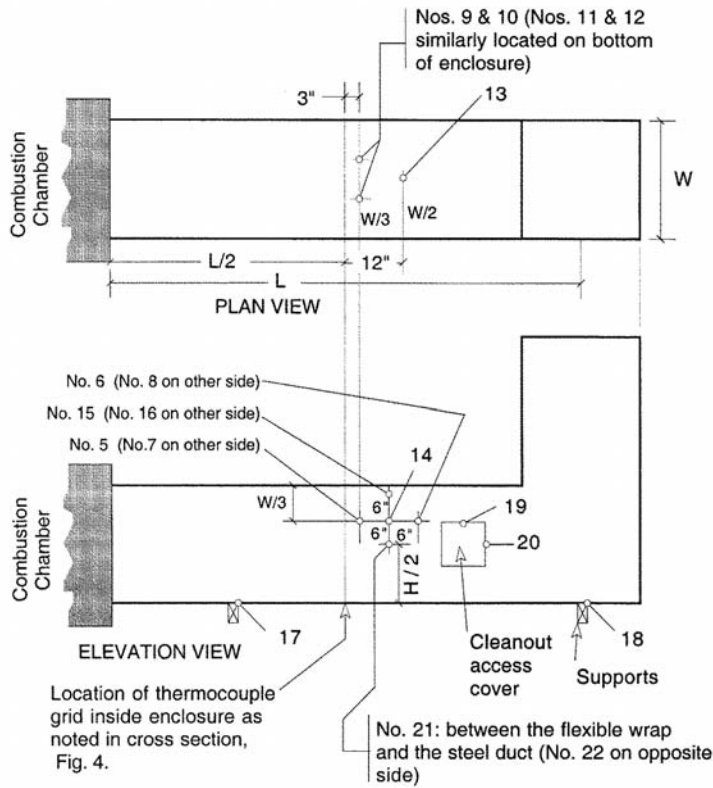


FIGURE 3—UNEXPOSED SURFACE THERMOCOUPLES

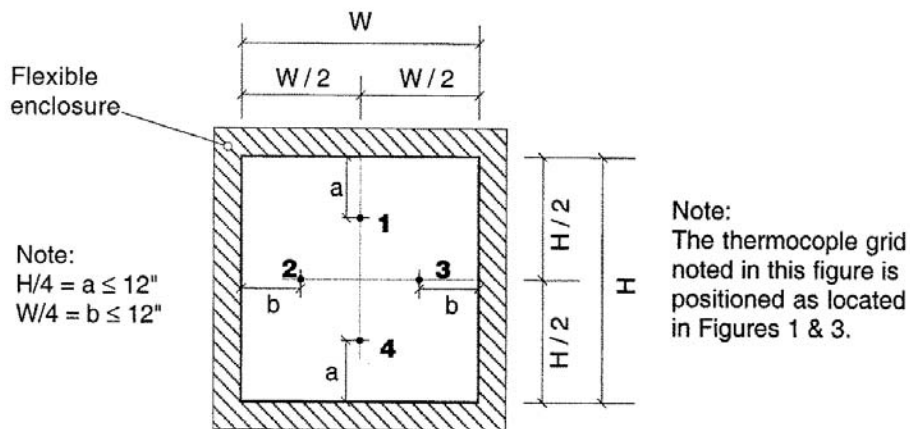


FIGURE 4—GREASE DUCT ENCLOSURE CROSS-SECTION AT FLUE GAS TEMPERATURE THERMOCOUPLES

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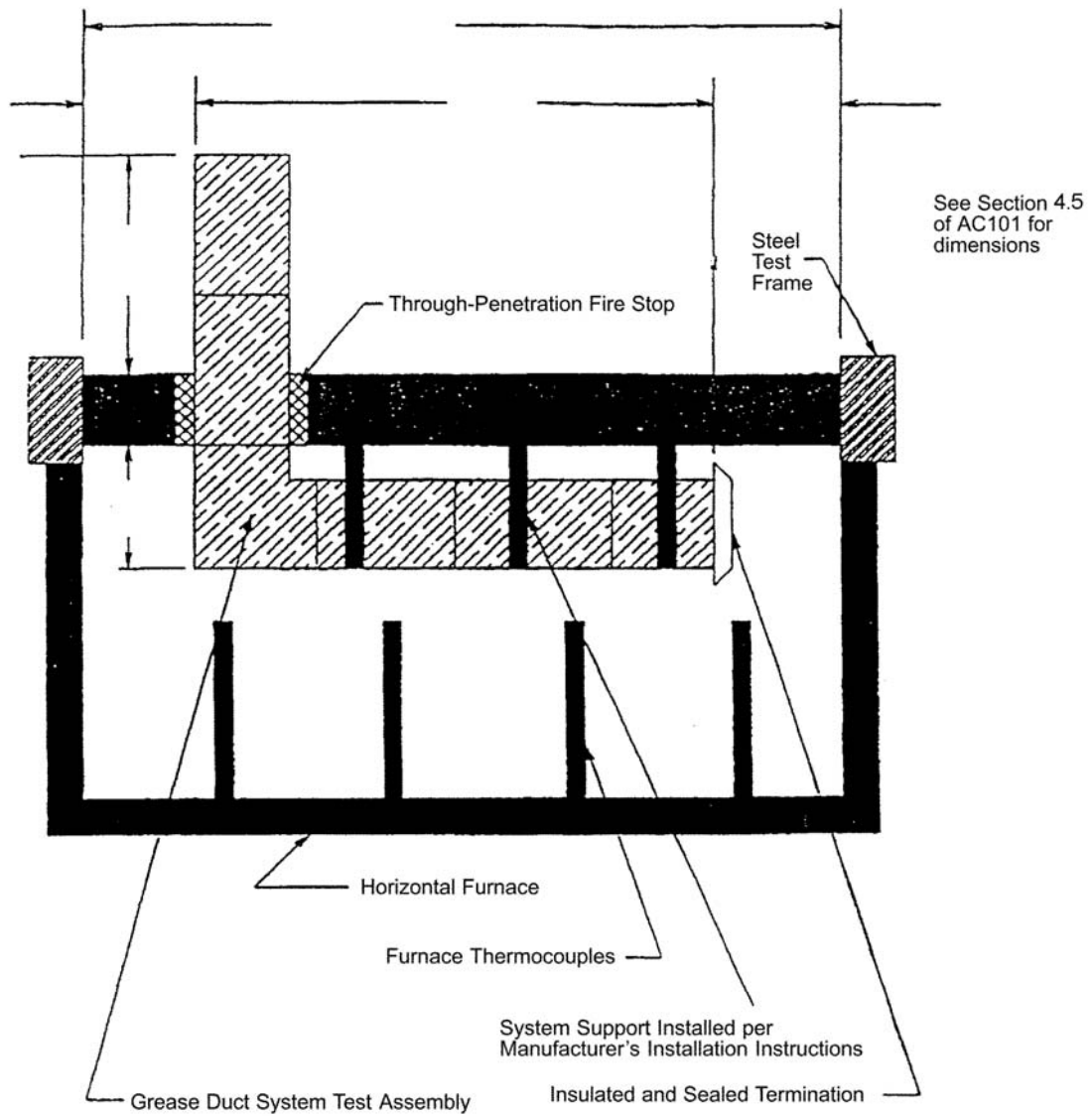


FIGURE 5—FIRE-ENGULFMENT TEST