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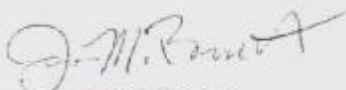
FIRE PERFORMANCE EVALUATION OF YODER AND SONS, LLC'S FLEX-C-MENT™ WALL MIX TESTED IN ACCORDANCE WITH ASTM E 119, "STANDARD TEST METHODS FOR FIRE TESTS OF BUILDING CONSTRUCTION AND MATERIALS"

FINAL REPORT
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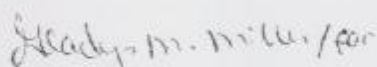
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ABSTRACT

A non-load bearing wall assembly was tested by Southwest Research Institute's[®] (SwRI[®]) Department of Fire Technology, located in San Antonio Texas, on October 28, 2005 and November 16, 2005. The wall assembly was exposed to the temperature conditions specified in ASTM E 119, "Standard Test Methods For Fire Tests of Building Construction and Materials" for 1 hr.

Two identical 12 × 9-ft non-load bearing wall assemblies, identified by Yoder and Sons, LLC as "F-WMG", were constructed. The wall assemblies consisted of 18-gauge, 3-5/8-in. steel studs spaced 16 in. on center, 3-1/2-in. Owens Corning R-13 fiberglass insulation within the stud cavity, 5/8-in. Type X gypsum wallboard fastened to both sides of the steel stud framing, and nominal 1/2-in. Flex-C-Ment™ Wall Mix applied to one side of the wall assembly, considered to be the exterior side. The gypsum wallboard sheets were fastened with 1-in. self-tapping drywall screws spaced 8 in. on center along the perimeter and 12 in. on center in the field of the wallboard. All joints were taped and treated with joint compound and all fastener heads were covered with joint compound. Yoder and Sons, LLC contracted the preparation and installation of their proprietary finish, Flex-C-Ment™ Wall Mix, to Mr. Steve Lacy of Team Enterprises on September 19 and 20, 2005. The wall assemblies were allowed to cure for a minimum of 28 days.

One non-load bearing wall assembly was mounted to SwRI's large vertical furnace. Instrumentation connections were verified and the wall was tested on October 28, 2005, at an ambient temperature of 75°F. The fire exposure was terminated at 60 min, at which time the average unexposed surface temperature was 183°F, representing a 108°F rise above ambient conditions. The maximum unexposed surface temperature was 200°F, representing a 125°F rise above ambient conditions. There was no significant change in the appearance of the unexposed side of the wall during the 1-hr fire exposure. An unsuccessful hose stream test was performed immediately after the 1-hr fire exposure.

An identical sample was exposed to similar furnace conditions on November 16, 2005, for the purposes of conducting a hose stream retest. The duplicate sample was exposed for 30 min (1/2 of the 1-hr desired fire resistance rating) and was immediately subjected to a 30-psi hose stream for 65 sec. The assembly did not allow the passage of water during the hose stream test.

Prior to the application of the Flex-C-Ment™ Wall Mix to the wall assembly tested on October 28, 2005, additional instrumentation was installed at the Flex-C-Ment™ Wall Mix and gypsum wallboard interface to determine the thermal barrier index of the Flex-C-Ment™ Wall Mix. The Flex-C-Ment™ Wall Mix acted as a thermal barrier for 7 min. After 7 min, the maximum single point temperature rise of 325°F above the initial temperature at the thermal barrier-gypsum wallboard interface was exceeded.

The non-load bearing wall assembly was fire and hose stream tested exposing only the exterior side of the wall assembly. The wall assembly successfully obtained a 1-hr rating from the exterior side.

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1.0 INTRODUCTION

The ASTM E 119, "Standard Test Methods For Fire Tests of Building Construction and Materials", is intended to evaluate the duration for which the described assembly will contain a fire, or retain its structural integrity, or display both properties dependent upon the type of assembly involved, during a predetermined fire test exposure.

This test measures the response of the assembly to exposure in terms of the transmission of heat and hot gases through the assembly. This standard should be used to measure and describe the properties of materials, products, or assemblies in response to heat and flame under controlled laboratory conditions and should not be used to describe or appraise the fire hazard or fire risk of materials, products, or assemblies under actual fire conditions. However, results of this test may be used as elements of a fire risk assessment, which takes into account all the factors that are pertinent to an assessment of the fire hazard of a particular end use.

This report describes the testing and analysis of a distinct wall assembly, and includes descriptions of the test procedure followed, assembly tested, and the results obtained. The results presented in this report apply only to the assembly tested, in the manner tested, and not to any similar constructions or material combinations.

2.0 TEST PROCEDURE

The test exposes a wall assembly to standard fire conditions controlled to achieve specified temperatures throughout a specified time period. The fire exposure is typically followed by a standard hose stream test, which subjects the specimen to the impact, erosion, and cooling effects of the water stream.

2.1. ASTM E 119 FIRE EXPOSURE

The furnace exposure is described in Section 5 of the standard, and is used to regulate the furnace environment throughout the duration of the exposure period. Points on the standard time/temperature curve are shown in Table 1 on the following page.

Table 1. Points on the Time/Temperature Curve.

TIME	TEMPERATURE
0 min	Ambient
5 min	1000°F (538°C)
10 min	1300°F (704°C)
30 min	1550°F (843°C)
45 min	1638°F (892°C)
60 min	1700°F (927°C)
2 hrs	1850°F (1010°C)
3 hrs	1925°F (1052°C)
4 hrs	2000°F (1093°C)

2.2. ASTM E 119 HOSE STREAM TEST

Where required by conditions of acceptance, the specimen is subjected to the impact, erosion, and cooling effects of a water stream directed first at the middle and then at all parts of the exposed face. The hose stream test is usually conducted immediately following the fire exposure. In some cases, the hose stream test is conducted on a separate wall assembly that has been subjected to a fire exposure equal to one-half of the rated fire exposure. The water stream is applied from a distance of 20 ft and delivered through a 2-1/2-in. hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8-in. discharge tip of the standard-taper, smooth-bore pattern. The water pressure and duration are outlined in Table 2 below.

Table 2. Conditions for Hose Stream Test.

RESISTANCE PERIOD (hr)	WATER PRESSURE AT BASE OF NOZZLE Psi (kPa)	DURATION OF APPLICATION Min/100 ft ² (Min/9.3 m ²)
4 and over, if less than 8	45 (310)	5
2 and over, if less than 4	30 (207)	2½
1½ and over, if less than 2	30 (207)	1½
1 and over, if less than 1½	30 (207)	1
Less than 1, if desired	30 (207)	1

2.3. THERMAL BARRIER TEST

The purpose of this test is to evaluate the thermal transmission performance of the Flex-C-Ment™ Wall Mix, as a thermal barrier, when the assembly is subjected to the fire exposure conditions mentioned above. The thermal barrier test is performed concurrently with the ASTM E 119 fire exposure.

2.4. TEST SETUP

Southwest Research Institute's® (SwRI's®) vertical furnace is capable of exposing a maximum test specimen of 12-1/2 ft high and 12-1/2 ft wide. The 30-in. deep furnace is equipped with nine flat-flame burners symmetrically placed across the back wall, which are controlled by a variable air-gas ratio regulator.

The conduct of the fire test is controlled according to the standard time/temperature curve, as indicated by the average temperature obtained from the readings of nine thermocouples symmetrically located across the face of the specimen, 6 in. away. The thermocouples are enclosed in protection tubes of such material and dimensions that the time constant of the thermocouple assembly lies between 5.0 and 7.2 min, as required by the standard. The furnace temperature during a test is controlled such that the area under the time/temperature curve is within 10% of the corresponding area under the standard time/temperature curve for tests of 1 hr or less, 7-1/2% for those less than 2 hr, and 5% for those tests of 2 hr or more duration.

2.5. INSTRUMENTATION AND DOCUMENTATION

2.5.1. Unexposed Surface Temperature

The unexposed surface temperature is monitored using nine symmetrically placed thermocouples. Temperatures of unexposed surfaces are measured with No. 20 B & S gage, Type K (Chromel-Alumel) welded thermocouples, placed under flexible, dry, felted mineral fiber pads. The wire leads of the thermocouple terminate under the pad and are in contact with the unexposed surface. The pads are attached firmly to the surface to minimize any heat loss from the sides. Temperature levels are monitored continuously throughout the test and recorded with computer data acquisition equipment for subsequent data reduction.

2.5.2. Thermal Barrier Temperature

The thermal barrier-gypsum wallboard interface temperature is monitored using nine symmetrically placed thermocouples. Temperatures are measured with No. 20 B & S gage, Type K (Chromel-Alumel) welded exposed bead thermocouples. The wire leads of the thermocouple are fastened to the gypsum wallboard and the thermal barrier is applied over the thermocouples. Temperature levels are monitored continuously throughout the test and recorded with computer data acquisition equipment for subsequent data reduction.

Thermocouples are placed in a symmetric pattern on the unexposed surface and at the thermal barrier-gypsum wallboard interface. The location of the thermocouples is provided in Appendix A, Test Assembly Drawings.

2.5.3. *Photographic and Video Documentation*

Photographic and video documentation of the fire exposure and hose stream tests are conducted. Photographic documentation is provided in Appendix B and video documentation of the fire and hose stream tests accompany this report.

3.0 TEST ASSEMBLY

Two identical 12 × 9-ft non-load bearing wall assemblies, identified by Yoder and Sons, LLC as "F-WMG", were constructed. The wall assemblies consisted of 18-gauge, 3-5/8-in. steel studs spaced 16 in. on center, 3-1/2-in. Owens Corning R-13 fiberglass insulation within the stud cavity, 5/8-in. Type X gypsum wallboard fastened to both sides of the steel stud framing, and nominal 1/2-in. Flex-C-Ment™ Wall Mix applied to one side of the wall assembly, considered to be the exterior side. The gypsum wallboard sheets were fastened with 1-in. self-tapping drywall screws spaced 8 in. on center along the perimeter and 12 in. on center in the field of the wallboard. All joints were taped and treated with joint compound and all fastener heads were covered with joint compound. Yoder and Sons, LLC contracted the preparation and installation of their proprietary finish, Flex-C-Ment™ Wall Mix, to Mr. Steve Lacy of Team Enterprises on September 19 and 20, 2005. The wall assemblies were allowed to cure for a minimum of 28 days. The batch recipe for the Flex-C-Ment™ Wall Mix, supplied by Yoder and Sons, LLC, can be located in Appendix D.

4.0 TEST RESULTS

One non-load bearing wall assembly was mounted to SwRI's large vertical furnace. Instrumentation connections were verified and the wall was tested on October 28, 2005, at an ambient temperature of 75°F and relative humidity of 33%.

4.1. ASTM E 119 FIRE EXPOSURE TEST RESULTS

The fire exposure was terminated at 60 min, at which time the average unexposed surface temperature was 183°F, representing a 108°F rise above ambient conditions. The maximum unexposed surface temperature was 200°F, representing a 125°F rise above ambient conditions.

There was no significant change in the appearance of the unexposed side of the wall during the 1-hr fire exposure. Visual observations of the test are summarized in Table 3 on the following page.

Table 3. Visual Observations.

TIME (min:sec)	OBSERVATION
0:00	Test initiated at an average unexposed temperature of 75°F.
5:00	No smoke or flames observed on the unexposed side.
9:50	Smoke emitting from top corners.
15:30	Smoke emitting from bottom-middle of sample.
48:00	No smoke or flames observed on the unexposed side.
54:30	No flaming and light smoke observed on exposed side.
56:30	Crack developed on unexposed gypsum wallboard in the top-left corner. No flames through.
60:00	Test concluded with no flaming on unexposed side.
+60:00	Flaming was observed at the top-left perimeter of the assembly after the termination of the fire endurance period.

4.2. ASTM E 119 HOSE STREAM TEST RESULTS

Immediately following the 1-hr fire endurance test, a hose stream test was performed. The wall assembly failed to limit the passage of water to the unexposed side. An identical sample was exposed to similar furnace conditions on November 16, 2005, for the purposes of conducting a hose stream retest. The duplicate sample was exposed to the fire conditions for 30 min (1/2 of the 1-hr desired fire resistance rating) and was immediately subjected to a 30-psi water hose stream for 65 sec. The assembly did not allow the passage of water during the hose stream test.

4.3. THERMAL BARRIER TEST RESULTS

The Flex-C-Ment™ acted as a thermal barrier for 7 min. After 7 min, the maximum allowable single point temperature rise of 325°F above the initial temperature at the thermal barrier-gypsum wallboard interface was exceeded. After 8 min 45 sec, the maximum allowable average temperature rise of 250°F above the initial temperature at the thermal barrier-gypsum wallboard interface was exceeded.

5.0 CONCLUSION

A non-load bearing wall assembly was tested by Southwest Research Institute's® (SwRI®) Department of Fire Technology, located in San Antonio Texas, on October 28, 2005 and November 16, 2005. The wall assemblies were exposed to the temperature conditions specified in ASTM E 119, "Standard Test Methods For Fire Tests of Building Construction and Materials" for 1 hr.

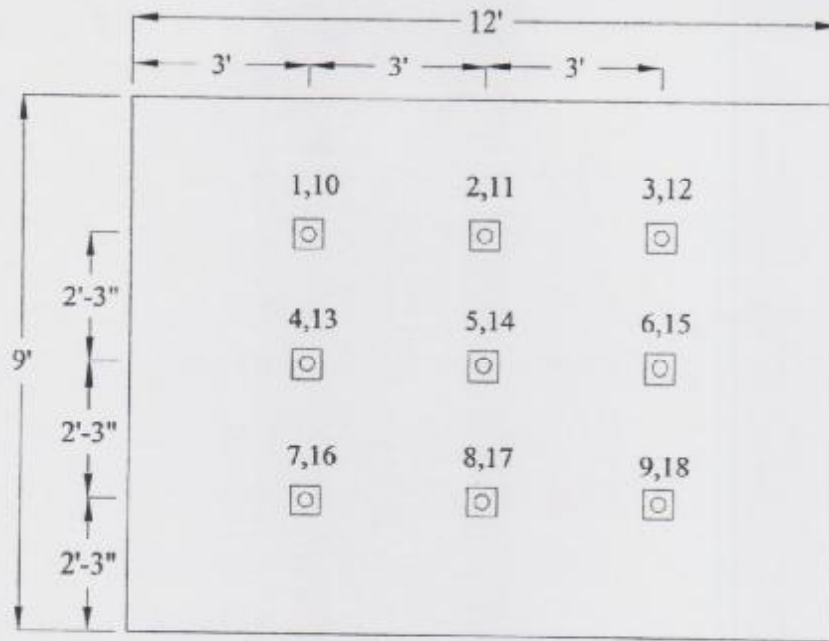
Prior to the application of the Flex-C-Ment™ Wall Mix to the wall assembly tested on October 28, 2005, additional instrumentation was installed at the Flex-C-Ment™ Wall Mix and gypsum wallboard interface to determine the thermal barrier index of the Flex-C-Ment™ Wall Mix. The Flex-C-Ment™ Wall Mix acted as a thermal barrier for 7 min. After 7 min, the maximum single point temperature rise of 325°F above the initial temperature at the thermal barrier-gypsum wallboard interface was exceeded.

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The non-load bearing wall assembly was fire and hose stream tested exposing only the exterior side of the wall assembly. The wall assembly successfully obtained a 1-hr rating from the exterior side.

APPENDIX A
TEST ASSEMBLY DRAWINGS
(CONSISTING OF 1 PAGE)



- ASTM Unexposed Surface TCs 1-9
- Thermal Barrier TCs 10-18

Figure A-1. Unexposed Face Thermocouple Layout.

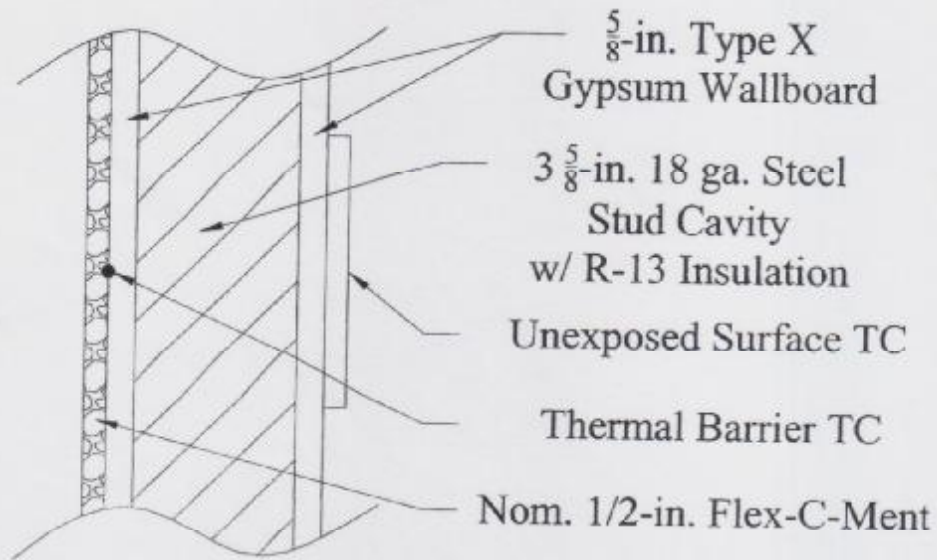


Figure A-2. Wall Assembly Section View.