



COMMERCIAL TESTING COMPANY

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Standard Method of Test for
Surface Burning Characteristics of Building Materials

ASTM E 84-09

SK-D10 Foil Exposed

Report Number 09-06082

Test Number 4081-6920
June 5, 2009

SAMMIN Industrial Co., Ltd.
Siheung-Si, Gyeonggi-Do, Korea

Commercial Testing Company

(Authorized Signature)

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INTRODUCTION

This report is a presentation of results of a surface flammability test on a material submitted by SAMMIN Industrial Co., Ltd., Siheung-Si, Gyeonggi-Do, Korea.

The test was conducted in accordance with the ASTM International fire test response standard E 84-09, *Surface Burning Characteristics of Building Materials*, sometimes referred to as the Steiner tunnel test. This test is applicable to exposed surfaces such as walls and ceilings. The test is conducted with the specimen in the ceiling position with the surface to be evaluated exposed face down to the ignition source. The ASTM E 84 test method is the technical equivalent of NFPA No. 255 and UL No. 723.

This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire-hazard or fire-risk assessment of materials, products, or assemblies under actual fire conditions.

PURPOSE

The purpose of the test is to provide only the comparative measurements of surface flame spread and smoke development of materials with that of select grade red oak and fiber-reinforced cement board, Grade II, under specific fire exposure conditions. The test exposes a nominal 24-foot long by 20-inch wide test specimen to a controlled air flow and flaming fire adjusted to spread the flame along the entire length of a red oak specimen in 5.50 minutes. During the 10-minute test duration, flamespread over the specimen surface and density of the resulting smoke are measured and recorded. Test results are calculated relative to red oak, which has an arbitrary rating of 100, and fiber-reinforced cement board, Grade II, which has a rating of 0.

The test results are expressed as Flame Spread Index and Smoke Developed Index. The Flame Spread Index is defined in ASTM E 176 as "a number or classification indicating a comparative measure derived from observations made during the progress of the boundary of a zone of flame under defined test conditions." The Smoke Developed Index, a term specific to ASTM E 84, is defined as "a number or classification indicating a comparative measure derived from smoke obscuration data collected during the test for surface burning characteristics." There is not necessarily a relationship between the two measurements.

The method does not provide for measurement of heat transmission through the surface tested, the effect of aggravated flame spread behavior of an assembly resulting from the proximity of combustible walls and ceilings, or classifying a material as noncombustible solely by means of a Flame Spread Index.

The zero reference and other parameters critical to furnace operation are verified on the day of the test by conducting a 10-minute test using 1/4-inch fiber-reinforced cement board, Grade II. Periodic tests using NOFMA certified 23/32-inch select grade red oak flooring provide data for the 100 reference.

TEST SAMPLE

The test sample, selected by the client, was identified as **SK-D10 Foil Exposed**, a vapor barrier more fully described below. The material was conditioned to equilibrium in an atmosphere with the temperature maintained at $71 \pm 2^\circ\text{F}$ and the relative humidity at 50 ± 5 percent. For testing, one length of the vapor barrier, measuring 2 feet wide by 24 feet in length, was free laid over a 2-inch hexagonal wire mesh supported by 1/4-inch diameter steel rods spanning the ledges of the tunnel furnace at 24-inch intervals. The test was conducted with the foil side exposed to the flame. This method of auxiliary sample support is described in Appendix X1 of the E 84 standard, Guide to Mounting Methods, Sections X1.1.2.2(a) and X1.1.2.3.

SAMPLE DESCRIPTION

Identification: SK-D10 Foil Exposed
Composition: Aluminum Foil (7 micron) + Glass Fiber Yarn + Kraft Paper (53 g/m²)
Total Weight: 2.6 ounces per square yard
Thickness: 0.005 inch

TEST RESULTS

The test results, calculated on the basis of observed flame propagation and the integrated area under the recorded smoke density curve, are presented below. The Flame Spread Index obtained in E 84 is rounded to the nearest number divisible by five. Smoke Developed Indices are rounded to the nearest number divisible by five unless the Index is greater than 200. In that case, the Smoke Developed Index is rounded to the nearest 50 points. The flame spread and smoke development data are presented graphically at the end of this report.

Test Specimen	Flame Spread Index	Smoke Developed Index
Fiber-Reinforced Cement Board, Grade II	0	0
Red Oak Flooring	100	100
SK-D10 Foil Exposed	0	0

OBSERVATIONS

Specimen ignition over the burners occurred at 4.70 minutes. Surface flame spread was observed to a maximum distance of 0.62 feet beyond the zero point at 5.50 minutes. The maximum temperature recorded during the test was 553°F.

CLASSIFICATION

The Flame Spread Index and Smoke Developed Index values obtained by ASTM E 84 tests are frequently used by code officials and regulatory agencies in the acceptance of interior finish materials for various applications. The most widely accepted classification system is described in the National Fire Protection Association publication NFPA 101 *Life Safety Code*, where:

Class A	0 - 25	Flame Spread Index	0 - 450	Smoke Developed Index
Class B	26 - 75	Flame Spread Index	0 - 450	Smoke Developed Index
Class C	76 - 200	Flame Spread Index	0 - 450	Smoke Developed Index

Class A, B, and C correspond to Type I, II, and III respectively in other codes. They do not preclude a material being otherwise classified by the authority of jurisdiction.

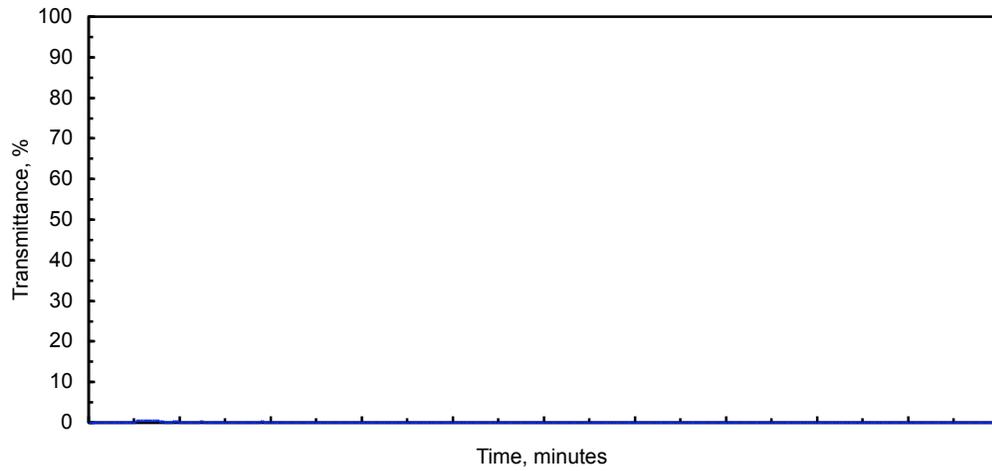
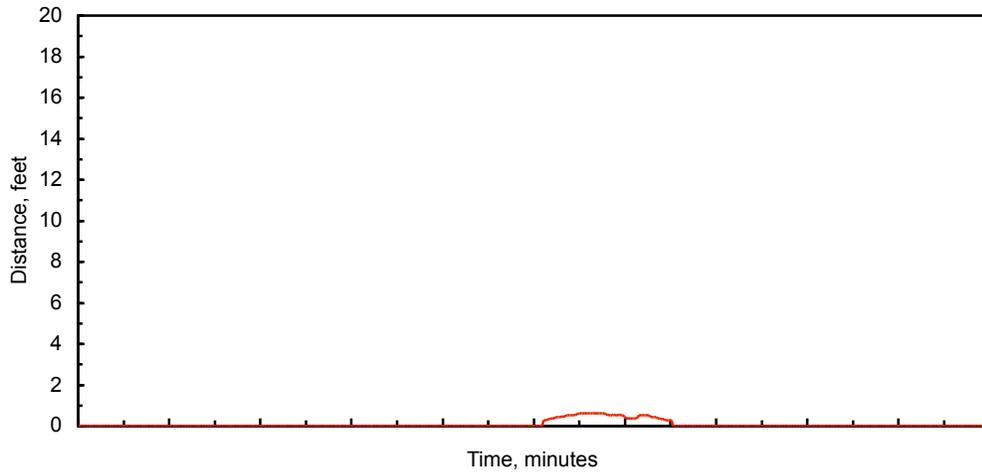
ASTM E 84 TEST DATA

Client: SAMMIN Industrial Co., Ltd.
Test Number: 4081-6920
Material Tested: SK-D10 Foil Exposed
Date: June 5, 2009

Test Results:

Time to Ignition = 04.70 minutes
Maximum Flamespread Distance = 00.62 feet
Time to Maximum Spread = 05.50 minutes

Flame Spread Index = 0
Smoke Developed Index = 0





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Standard Method of Test for
Surface Burning Characteristics of Building Materials

ASTM E 84-09

SK-D10 Kraft Exposed

Report Number 09-06083

Test Number 4081-6921
June 5, 2009

SAMMIN Industrial Co., Ltd.
Siheung-Si, Gyeonggi-Do, Korea

Commercial Testing Company

(Authorized Signature)

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This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire-hazard or fire-risk assessment of materials, products, or assemblies under actual fire conditions.

PURPOSE

The purpose of the test is to provide only the comparative measurements of surface flame spread and smoke development of materials with that of select grade red oak and fiber-reinforced cement board, Grade II, under specific fire exposure conditions. The test exposes a nominal 24-foot long by 20-inch wide test specimen to a controlled air flow and flaming fire adjusted to spread the flame along the entire length of a red oak specimen in 5.50 minutes. During the 10-minute test duration, flamespread over the specimen surface and density of the resulting smoke are measured and recorded. Test results are calculated relative to red oak, which has an arbitrary rating of 100, and fiber-reinforced cement board, Grade II, which has a rating of 0.

The test results are expressed as Flame Spread Index and Smoke Developed Index. The Flame Spread Index is defined in ASTM E 176 as "a number or classification indicating a comparative measure derived from observations made during the progress of the boundary of a zone of flame under defined test conditions." The Smoke Developed Index, a term specific to ASTM E 84, is defined as "a number or classification indicating a comparative measure derived from smoke obscuration data collected during the test for surface burning characteristics." There is not necessarily a relationship between the two measurements.

The method does not provide for measurement of heat transmission through the surface tested, the effect of aggravated flame spread behavior of an assembly resulting from the proximity of combustible walls and ceilings, or classifying a material as noncombustible solely by means of a Flame Spread Index.

The zero reference and other parameters critical to furnace operation are verified on the day of the test by conducting a 10-minute test using 1/4-inch fiber-reinforced cement board, Grade II. Periodic tests using NOFMA certified 23/32-inch select grade red oak flooring provide data for the 100 reference.

TEST SAMPLE

The test sample, selected by the client, was identified as **SK-D10 Kraft Exposed**, a vapor barrier more fully described below. The material was conditioned to equilibrium in an atmosphere with the temperature maintained at $71 \pm 2^\circ\text{F}$ and the relative humidity at 50 ± 5 percent. For testing, one length of the vapor barrier, measuring 2 feet wide by 24 feet in length, was free laid over a 2-inch hexagonal wire mesh supported by 1/4-inch diameter steel rods spanning the ledges of the tunnel furnace at 24-inch intervals. The test was conducted with the kraft side exposed to the flame. This method of auxiliary sample support is described in Appendix X1 of the E 84 standard, Guide to Mounting Methods, Sections X1.1.2.2(a) and X1.1.2.3.

SAMPLE DESCRIPTION

Identification: SK-D10 Kraft Exposed
Composition: Aluminum Foil (7 micron) + Glass Fiber Yarn + Kraft Paper (53 g/m²)
Total Weight: 2.6 ounces per square yard
Thickness: 0.005 inch

TEST RESULTS

The test results, calculated on the basis of observed flame propagation and the integrated area under the recorded smoke density curve, are presented below. The Flame Spread Index obtained in E 84 is rounded to the nearest number divisible by five. Smoke Developed Indices are rounded to the nearest number divisible by five unless the Index is greater than 200. In that case, the Smoke Developed Index is rounded to the nearest 50 points. The flame spread and smoke development data are presented graphically at the end of this report.

Test Specimen	Flame Spread Index	Smoke Developed Index
Fiber-Reinforced Cement Board, Grade II	0	0
Red Oak Flooring	100	100
SK-D10 Kraft Exposed	20	5

OBSERVATIONS

Specimen ignition over the burners occurred at 0.03 minute. Surface flame spread was observed to a maximum distance of 4.31 feet beyond the zero point at 0.20 minute. The maximum temperature recorded during the test was 541°F.

CLASSIFICATION

The Flame Spread Index and Smoke Developed Index values obtained by ASTM E 84 tests are frequently used by code officials and regulatory agencies in the acceptance of interior finish materials for various applications. The most widely accepted classification system is described in the National Fire Protection Association publication NFPA 101 *Life Safety Code*, where:

Class A	0 - 25	Flame Spread Index	0 - 450	Smoke Developed Index
Class B	26 - 75	Flame Spread Index	0 - 450	Smoke Developed Index
Class C	76 - 200	Flame Spread Index	0 - 450	Smoke Developed Index

Class A, B, and C correspond to Type I, II, and III respectively in other codes. They do not preclude a material being otherwise classified by the authority of jurisdiction.

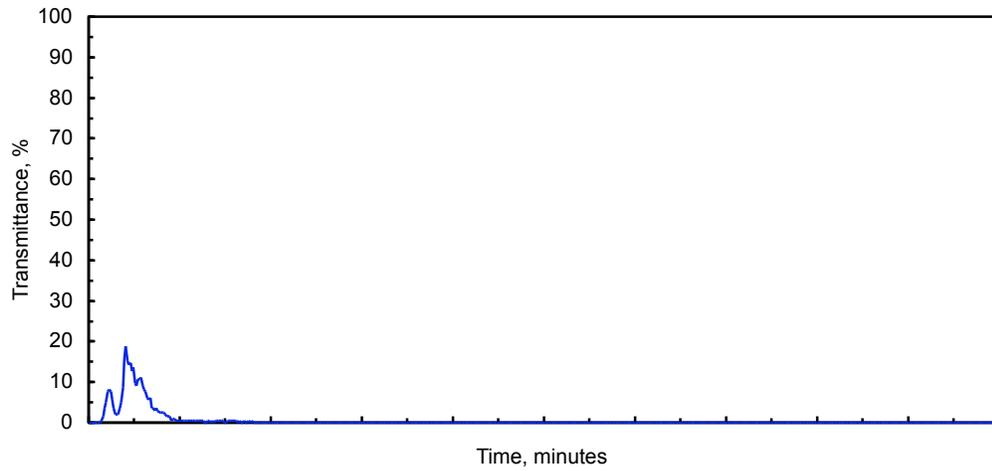
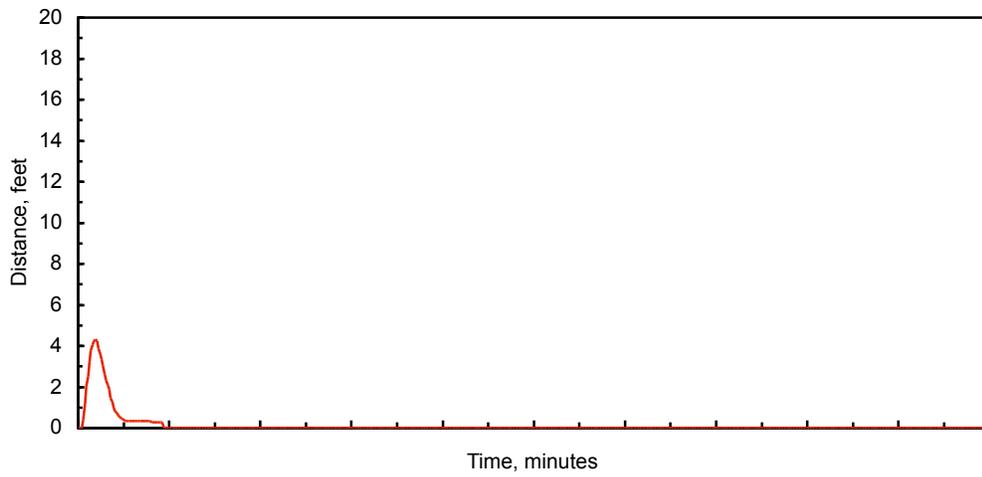
ASTM E 84 TEST DATA

Client: SAMMIN Industrial Co., Ltd.
Test Number: 4081-6921
Material Tested: SK-D10 Kraft Exposed
Date: June 5, 2009

Test Results:

Time to Ignition = 00.03 minutes
Maximum Flamespread Distance = 04.31 feet
Time to Maximum Spread = 00.20 minutes

Flame Spread Index = 20
Smoke Developed Index = 5





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Standard Method of Test for
Surface Burning Characteristics of Building Materials

ASTM E 84-09

ST-D1 Foil Exposed

Report Number 09-06084

Test Number 4081-6922
June 5, 2009

SAMMIN Industrial Co., Ltd.
Siheung-Si, Gyeonggi-Do, Korea

Commercial Testing Company

(Authorized Signature)

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INTRODUCTION

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The test was conducted in accordance with the ASTM International fire test response standard E 84-09, *Surface Burning Characteristics of Building Materials*, sometimes referred to as the Steiner tunnel test. This test is applicable to exposed surfaces such as walls and ceilings. The test is conducted with the specimen in the ceiling position with the surface to be evaluated exposed face down to the ignition source. The ASTM E 84 test method is the technical equivalent of NFPA No. 255 and UL No. 723.

This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire-hazard or fire-risk assessment of materials, products, or assemblies under actual fire conditions.

PURPOSE

The purpose of the test is to provide only the comparative measurements of surface flame spread and smoke development of materials with that of select grade red oak and fiber-reinforced cement board, Grade II, under specific fire exposure conditions. The test exposes a nominal 24-foot long by 20-inch wide test specimen to a controlled air flow and flaming fire adjusted to spread the flame along the entire length of a red oak specimen in 5.50 minutes. During the 10-minute test duration, flamespread over the specimen surface and density of the resulting smoke are measured and recorded. Test results are calculated relative to red oak, which has an arbitrary rating of 100, and fiber-reinforced cement board, Grade II, which has a rating of 0.

The test results are expressed as Flame Spread Index and Smoke Developed Index. The Flame Spread Index is defined in ASTM E 176 as "a number or classification indicating a comparative measure derived from observations made during the progress of the boundary of a zone of flame under defined test conditions." The Smoke Developed Index, a term specific to ASTM E 84, is defined as "a number or classification indicating a comparative measure derived from smoke obscuration data collected during the test for surface burning characteristics." There is not necessarily a relationship between the two measurements.

The method does not provide for measurement of heat transmission through the surface tested, the effect of aggravated flame spread behavior of an assembly resulting from the proximity of combustible walls and ceilings, or classifying a material as noncombustible solely by means of a Flame Spread Index.

The zero reference and other parameters critical to furnace operation are verified on the day of the test by conducting a 10-minute test using 1/4-inch fiber-reinforced cement board, Grade II. Periodic tests using NOFMA certified 23/32-inch select grade red oak flooring provide data for the 100 reference.

TEST SAMPLE

The test sample, selected by the client, was identified as **ST-D1 Foil Exposed**, a vapor barrier more fully described below. The material was conditioned to equilibrium in an atmosphere with the temperature maintained at $71 \pm 2^\circ\text{F}$ and the relative humidity at 50 ± 5 percent. For testing, one length of the vapor barrier, measuring 2 feet wide by 24 feet in length, was free laid over a 2-inch hexagonal wire mesh supported by 1/4-inch diameter steel rods spanning the ledges of the tunnel furnace at 24-inch intervals. The test was conducted with the foil side exposed to the flame. This method of auxiliary sample support is described in Appendix X1 of the E 84 standard, Guide to Mounting Methods, Sections X1.1.2.2(a) and X1.1.2.3.

SAMPLE DESCRIPTION

Identification: ST-D1 Foil Exposed
Composition: Aluminum Foil (9 micron) + Glass Fiber Yarn + Polyester Film
Total Weight: 1.9 ounces per square yard
Thickness: 0.004 inch

TEST RESULTS

The test results, calculated on the basis of observed flame propagation and the integrated area under the recorded smoke density curve, are presented below. The Flame Spread Index obtained in E 84 is rounded to the nearest number divisible by five. Smoke Developed Indices are rounded to the nearest number divisible by five unless the Index is greater than 200. In that case, the Smoke Developed Index is rounded to the nearest 50 points. The flame spread and smoke development data are presented graphically at the end of this report.

Test Specimen	Flame Spread Index	Smoke Developed Index
Fiber-Reinforced Cement Board, Grade II	0	0
Red Oak Flooring	100	100
ST-D1 Foil Exposed	0	0

OBSERVATIONS

Specimen ignition over the burners occurred at 9.50 minutes. Surface flame spread was observed to a maximum distance of 0.00 feet beyond the zero point at 0.00 minute. The maximum temperature recorded during the test was 509°F.

CLASSIFICATION

The Flame Spread Index and Smoke Developed Index values obtained by ASTM E 84 tests are frequently used by code officials and regulatory agencies in the acceptance of interior finish materials for various applications. The most widely accepted classification system is described in the National Fire Protection Association publication NFPA 101 *Life Safety Code*, where:

Class A	0 - 25	Flame Spread Index	0 - 450	Smoke Developed Index
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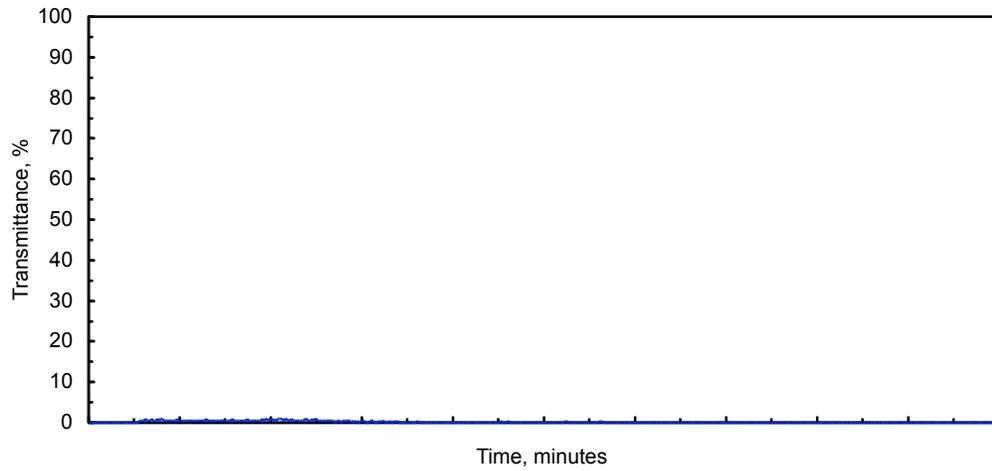
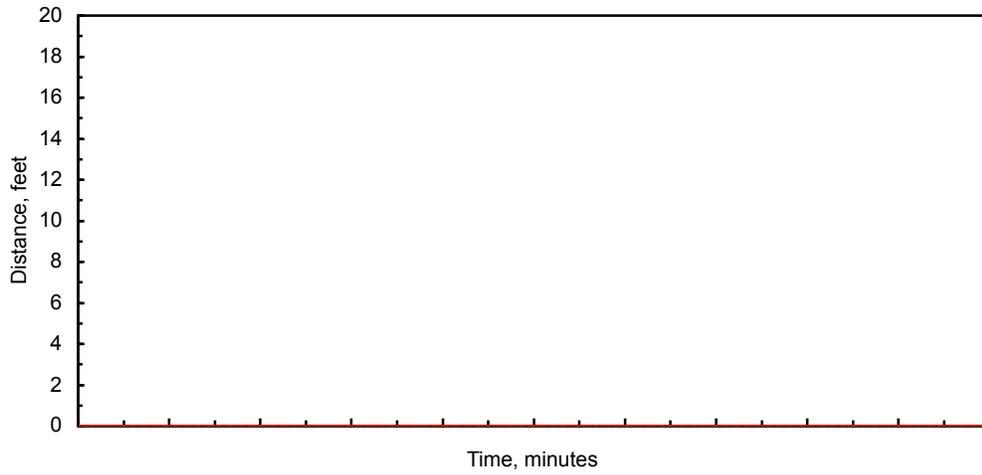
ASTM E 84 TEST DATA

Client: SAMMIN Industrial Co., Ltd.
Test Number: 4081-6922
Material Tested: ST-D1 Foil Exposed
Date: June 5, 2009

Test Results:

Time to Ignition = 09.50 minutes
Maximum Flamespread Distance = 0 feet
Time to Maximum Spread = 00:00 minutes

Flame Spread Index = 0
Smoke Developed Index = 0





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Standard Method of Test for
Surface Burning Characteristics of Building Materials

ASTM E 84-09

ST-D1 Polyester Exposed

Report Number 09-06085

Test Number 4081-6923
June 5, 2009

SAMMIN Industrial Co., Ltd.
Siheung-Si, Gyeonggi-Do, Korea

Commercial Testing Company

(Authorized Signature)

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This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire-hazard or fire-risk assessment of materials, products, or assemblies under actual fire conditions.

PURPOSE

The purpose of the test is to provide only the comparative measurements of surface flame spread and smoke development of materials with that of select grade red oak and fiber-reinforced cement board, Grade II, under specific fire exposure conditions. The test exposes a nominal 24-foot long by 20-inch wide test specimen to a controlled air flow and flaming fire adjusted to spread the flame along the entire length of a red oak specimen in 5.50 minutes. During the 10-minute test duration, flamespread over the specimen surface and density of the resulting smoke are measured and recorded. Test results are calculated relative to red oak, which has an arbitrary rating of 100, and fiber-reinforced cement board, Grade II, which has a rating of 0.

The test results are expressed as Flame Spread Index and Smoke Developed Index. The Flame Spread Index is defined in ASTM E 176 as "a number or classification indicating a comparative measure derived from observations made during the progress of the boundary of a zone of flame under defined test conditions." The Smoke Developed Index, a term specific to ASTM E 84, is defined as "a number or classification indicating a comparative measure derived from smoke obscuration data collected during the test for surface burning characteristics." There is not necessarily a relationship between the two measurements.

The method does not provide for measurement of heat transmission through the surface tested, the effect of aggravated flame spread behavior of an assembly resulting from the proximity of combustible walls and ceilings, or classifying a material as noncombustible solely by means of a Flame Spread Index.

The zero reference and other parameters critical to furnace operation are verified on the day of the test by conducting a 10-minute test using 1/4-inch fiber-reinforced cement board, Grade II. Periodic tests using NOFMA certified 23/32-inch select grade red oak flooring provide data for the 100 reference.

TEST SAMPLE

The test sample, selected by the client, was identified as **ST-D1 Polyester Exposed**, a vapor barrier more fully described below. The material was conditioned to equilibrium in an atmosphere with the temperature maintained at $71 \pm 2^\circ\text{F}$ and the relative humidity at 50 ± 5 percent. For testing, one length of the vapor barrier, measuring 2 feet wide by 24 feet in length, was free laid over a 2-inch hexagonal wire mesh supported by 1/4-inch diameter steel rods spanning the ledges of the tunnel furnace at 24-inch intervals. The test was conducted with the polyester side exposed to the flame. This method of auxiliary sample support is described in Appendix X1 of the E 84 standard, Guide to Mounting Methods, Sections X1.1.2.2(a) and X1.1.2.3.

SAMPLE DESCRIPTION

Identification: ST-D1 Polyester Exposed
Composition: Aluminum Foil (9 micron) + Glass Fiber Yarn + Polyester Film
Total Weight: 1.9 ounces per square yard
Thickness: 0.004 inch

TEST RESULTS

The test results, calculated on the basis of observed flame propagation and the integrated area under the recorded smoke density curve, are presented below. The Flame Spread Index obtained in E 84 is rounded to the nearest number divisible by five. Smoke Developed Indices are rounded to the nearest number divisible by five unless the Index is greater than 200. In that case, the Smoke Developed Index is rounded to the nearest 50 points. The flame spread and smoke development data are presented graphically at the end of this report.

Test Specimen	Flame Spread Index	Smoke Developed Index
Fiber-Reinforced Cement Board, Grade II	0	0
Red Oak Flooring	100	100
ST-D1 Polyester Exposed	20	10

OBSERVATIONS

Specimen ignition over the burners occurred at 0.07 minute. Surface flame spread was observed to a maximum distance of 3.55 feet beyond the zero point at 0.23 minute. The maximum temperature recorded during the test was 535°F.

CLASSIFICATION

The Flame Spread Index and Smoke Developed Index values obtained by ASTM E 84 tests are frequently used by code officials and regulatory agencies in the acceptance of interior finish materials for various applications. The most widely accepted classification system is described in the National Fire Protection Association publication NFPA 101 *Life Safety Code*, where:

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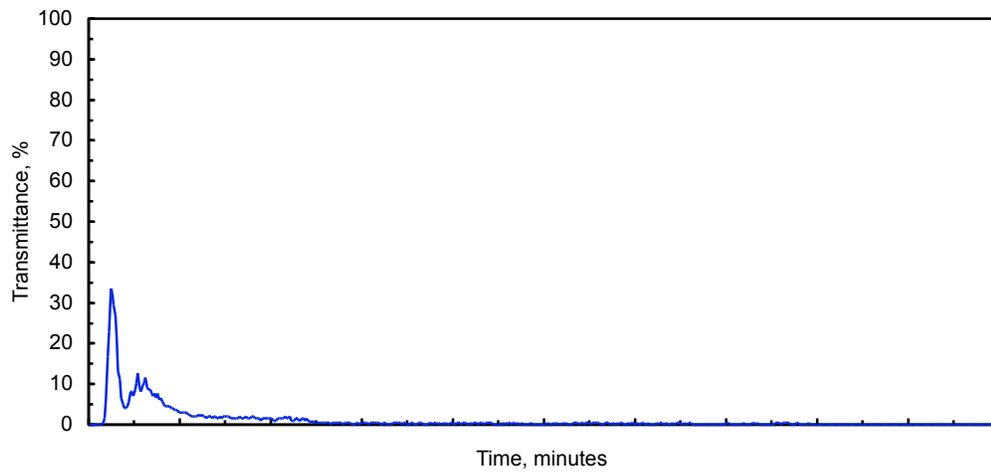
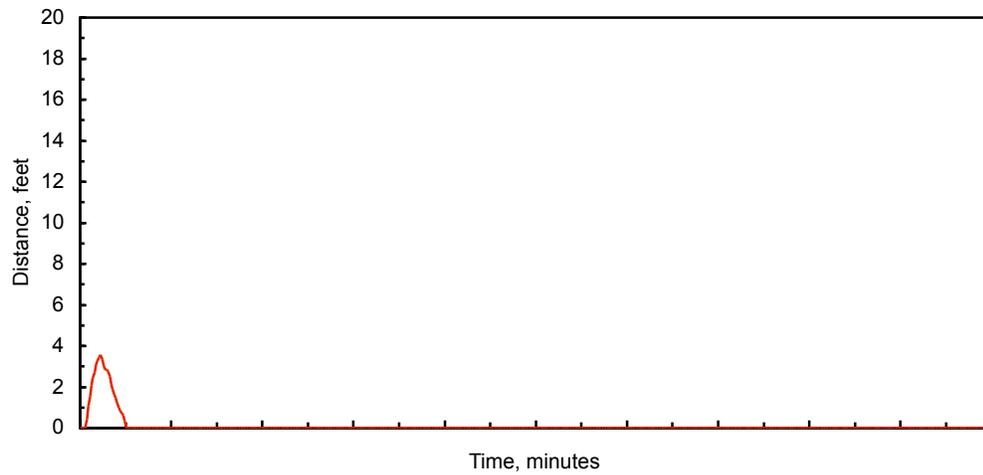
ASTM E 84 TEST DATA

Client: SAMMIN Industrial Co., Ltd.
Test Number: 4081-6923
Material Tested: ST-D1 Polyester Exposed
Date: June 5, 2009

Test Results:

Time to Ignition = 00.07 minutes
Maximum Flamespread Distance = 03.55 feet
Time to Maximum Spread = 00.23 minutes

Flame Spread Index = 20
Smoke Developed Index = 10





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Standard Method of Test for
Surface Burning Characteristics of Building Materials

ASTM E 84-09

SWK-DN2 Foil Exposed

Report Number 09-06086

Test Number 4081-6924
June 5, 2009

SAMMIN Industrial Co., Ltd.
Siheung-Si, Gyeonggi-Do, Korea

Commercial Testing Company

(Authorized Signature)

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The zero reference and other parameters critical to furnace operation are verified on the day of the test by conducting a 10-minute test using 1/4-inch fiber-reinforced cement board, Grade II. Periodic tests using NOFMA certified 23/32-inch select grade red oak flooring provide data for the 100 reference.

TEST SAMPLE

The test sample, selected by the client, was identified as **SWK-DN2 Foil Exposed**, a vapor barrier more fully described below. The material was conditioned to equilibrium in an atmosphere with the temperature maintained at $71 \pm 2^\circ\text{F}$ and the relative humidity at 50 ± 5 percent. For testing, one length of the vapor barrier, measuring 2 feet wide by 24 feet in length, was free laid over a 2-inch hexagonal wire mesh supported by 1/4-inch diameter steel rods spanning the ledges of the tunnel furnace at 24-inch intervals. The test was conducted with the foil side exposed to the flame. This method of auxiliary sample support is described in Appendix X1 of the E 84 standard, Guide to Mounting Methods, Sections X1.1.2.2(a) and X1.1.2.3.

SAMPLE DESCRIPTION

Identification: SWK-DN2 Foil Exposed
Composition: Aluminum Foil (9 micron) + Glass Fiber Yarn + White Kraft Paper (75 g/m²)
Total Weight: 3.4 ounces per square yard
Thickness: 0.007 inch

TEST RESULTS

The test results, calculated on the basis of observed flame propagation and the integrated area under the recorded smoke density curve, are presented below. The Flame Spread Index obtained in E 84 is rounded to the nearest number divisible by five. Smoke Developed Indices are rounded to the nearest number divisible by five unless the Index is greater than 200. In that case, the Smoke Developed Index is rounded to the nearest 50 points. The flame spread and smoke development data are presented graphically at the end of this report.

Test Specimen	Flame Spread Index	Smoke Developed Index
Fiber-Reinforced Cement Board, Grade II	0	0
Red Oak Flooring	100	100
SWK-DN2 Foil Exposed	0	0

OBSERVATIONS

The specimen did not ignite. Surface flame spread was observed to a maximum distance of 0.00 feet beyond the zero point at 0.00 minute. The maximum temperature recorded during the test was 547°F.

CLASSIFICATION

The Flame Spread Index and Smoke Developed Index values obtained by ASTM E 84 tests are frequently used by code officials and regulatory agencies in the acceptance of interior finish materials for various applications. The most widely accepted classification system is described in the National Fire Protection Association publication NFPA 101 *Life Safety Code*, where:

Class A	0 - 25	Flame Spread Index	0 - 450	Smoke Developed Index
Class B	26 - 75	Flame Spread Index	0 - 450	Smoke Developed Index
Class C	76 - 200	Flame Spread Index	0 - 450	Smoke Developed Index

Class A, B, and C correspond to Type I, II, and III respectively in other codes. They do not preclude a material being otherwise classified by the authority of jurisdiction.

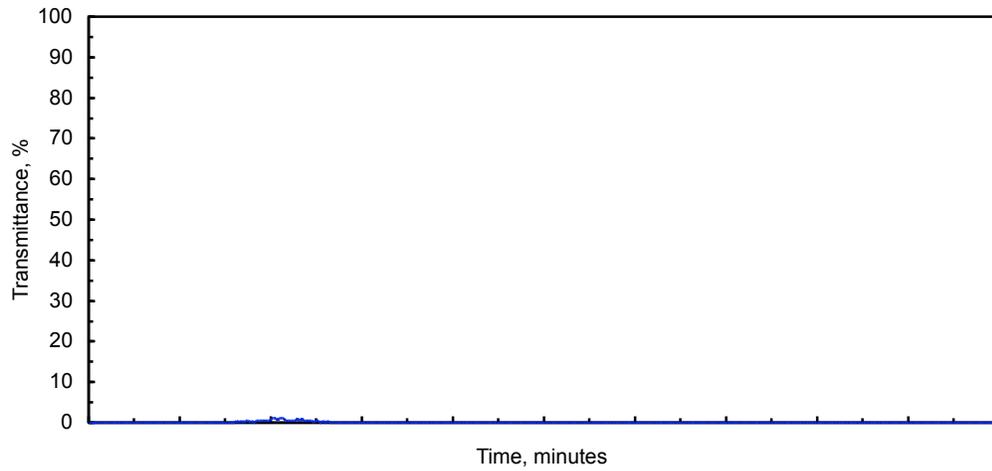
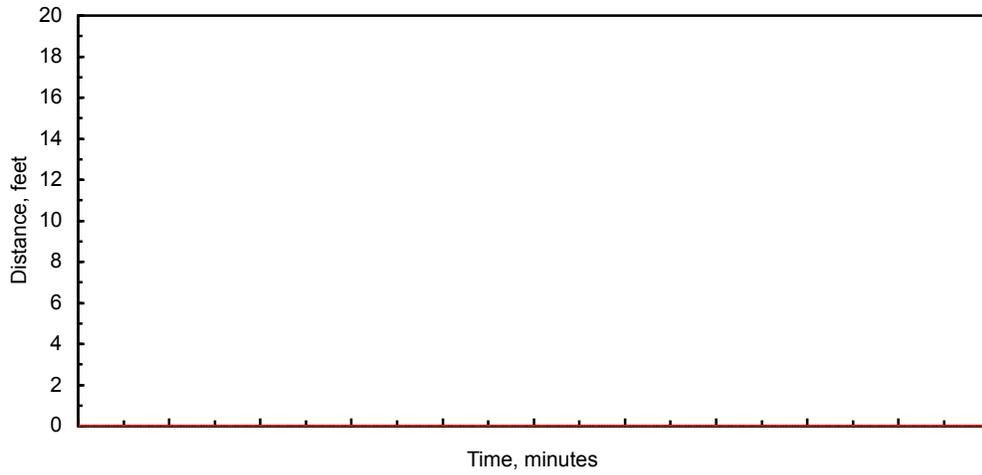
ASTM E 84 TEST DATA

Client: SAMMIN Industrial Co., Ltd.
Test Number: 4081-6924
Material Tested: SWK-DN2 Foil Exposed
Date: June 5, 2009

Test Results:

Time to Ignition = 0:00 minutes
Maximum Flamespread Distance = 0 feet
Time to Maximum Spread = 00:00 minutes

Flame Spread Index = 0
Smoke Developed Index = 0





COMMERCIAL TESTING COMPANY

1215 South Hamilton Street • Post Office Box 985 • Dalton, GA 30722
Telephone (706) 278-3935 • Facsimile (706) 278-3936

Standard Method of Test for
Surface Burning Characteristics of Building Materials

ASTM E 84-09

SWK-DN2 Kraft Exposed

Report Number 09-07136

Test Number 4087-7190
July 16, 2009

SAMMIN Industrial Co., Ltd.
Siheung-Si, Gyeonggi-Do, Korea

Commercial Testing Company

(Authorized Signature)

This report is provided for the exclusive use of the client to whom it is addressed. It may be used in its entirety to gain product acceptance from duly constituted authorities. The test results presented in this report apply only to the samples tested and are not necessarily indicative of apparent identical or similar materials. Sample selection and identification were provided by the client. A sampling plan, if described in the referenced test procedure, was not necessarily followed. This report, or the name of Commercial Testing Company, shall not be used under any circumstance in advertising to the general public.

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INTRODUCTION

This report is a presentation of results of a surface flammability test on a material submitted by SAMMIN Industrial Co., Ltd., Siheung-Si, Gyeonggi-Do, Korea.

The test was conducted in accordance with the ASTM International fire test response standard E 84-09, *Surface Burning Characteristics of Building Materials*, sometimes referred to as the Steiner tunnel test. This test is applicable to exposed surfaces such as walls and ceilings. The test is conducted with the specimen in the ceiling position with the surface to be evaluated exposed face down to the ignition source. The ASTM E 84 test method is the technical equivalent of NFPA No. 255 and UL No. 723.

This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire-hazard or fire-risk assessment of materials, products, or assemblies under actual fire conditions.

PURPOSE

The purpose of the test is to provide only the comparative measurements of surface flame spread and smoke development of materials with that of select grade red oak and fiber-reinforced cement board, Grade II, under specific fire exposure conditions. The test exposes a nominal 24-foot long by 20-inch wide test specimen to a controlled air flow and flaming fire adjusted to spread the flame along the entire length of a red oak specimen in 5.50 minutes. During the 10-minute test duration, flamespread over the specimen surface and density of the resulting smoke are measured and recorded. Test results are calculated relative to red oak, which has an arbitrary rating of 100, and fiber-reinforced cement board, Grade II, which has a rating of 0.

The test results are expressed as Flame Spread Index and Smoke Developed Index. The Flame Spread Index is defined in ASTM E 176 as "a number or classification indicating a comparative measure derived from observations made during the progress of the boundary of a zone of flame under defined test conditions." The Smoke Developed Index, a term specific to ASTM E 84, is defined as "a number or classification indicating a comparative measure derived from smoke obscuration data collected during the test for surface burning characteristics." There is not necessarily a relationship between the two measurements.

The method does not provide for measurement of heat transmission through the surface tested, the effect of aggravated flame spread behavior of an assembly resulting from the proximity of combustible walls and ceilings, or classifying a material as noncombustible solely by means of a Flame Spread Index.

The zero reference and other parameters critical to furnace operation are verified on the day of the test by conducting a 10-minute test using 1/4-inch fiber-reinforced cement board, Grade II. Periodic tests using NOFMA certified 23/32-inch select grade red oak flooring provide data for the 100 reference.

TEST SAMPLE

The test sample, selected by the client, was identified as **SWK-DN2 Kraft Exposed**, a vapor barrier more fully described below. The material was conditioned to equilibrium in an atmosphere with the temperature maintained at $71 \pm 2^\circ\text{F}$ and the relative humidity at 50 ± 5 percent. For testing, one length of the vapor barrier, measuring 2 feet wide by 24 feet in length, was free laid over a 2-inch hexagonal wire mesh supported by 1/4-inch diameter steel rods spanning the ledges of the tunnel furnace at 24-inch intervals. The test was conducted with the kraft side exposed to the flame. This method of auxiliary sample support is described in Appendix X1 of the E 84 standard, Guide to Mounting Methods, Sections X1.1.2.2(a) and X1.1.2.3.

SAMPLE DESCRIPTION

Identification: SWK-DN2 Kraft Exposed

Composition: Aluminum (9 micron) + Glass Fiber Yarn + White Kraft Paper (75 g/m²)

Total Weight: 4.3 ounces per square yard

TEST RESULTS

The test results, calculated on the basis of observed flame propagation and the integrated area under the recorded smoke density curve, are presented below. The Flame Spread Index obtained in E 84 is rounded to the nearest number divisible by five. Smoke Developed Indices are rounded to the nearest number divisible by five unless the Index is greater than 200. In that case, the Smoke Developed Index is rounded to the nearest 50 points. The flame spread and smoke development data are presented graphically at the end of this report.

Test Specimen	Flame Spread Index	Smoke Developed Index
Fiber-Reinforced Cement Board, Grade II	0	0
Red Oak Flooring	100	100
SWK-DN2 Kraft Exposed	20	15

OBSERVATIONS

Specimen ignition over the burners occurred at 0.08 minute. Surface flame spread was observed to a maximum distance of 4.02 feet beyond the zero point at 0.20 minute. The maximum temperature recorded during the test was 499°F.

CLASSIFICATION

The Flame Spread Index and Smoke Developed Index values obtained by ASTM E 84 tests are frequently used by code officials and regulatory agencies in the acceptance of interior finish materials for various applications. The most widely accepted classification system is described in the National Fire Protection Association publication NFPA 101 *Life Safety Code*, where:

Class A	0 - 25	Flame Spread Index	0 - 450	Smoke Developed Index
Class B	26 - 75	Flame Spread Index	0 - 450	Smoke Developed Index
Class C	76 - 200	Flame Spread Index	0 - 450	Smoke Developed Index

Class A, B, and C correspond to Type I, II, and III respectively in other codes. They do not preclude a material being otherwise classified by the authority of jurisdiction.

ASTM E 84 TEST DATA

Client: SAMMIN Industrial Co., Ltd.
Test Number: 4087-7190
Material Tested: SWK-DN2 Kraft Exposed
Date: July 16, 2009

Test Results:

Time to Ignition = 00.08 minutes
Maximum Flamespread Distance = 04.02 feet
Time to Maximum Spread = 00.20 minutes

Flame Spread Index = 20
Smoke Developed Index = 15

