



CCM Building Envelope System

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September 2008

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Details





CCM Building Envelope System

September 2008

SECTION 1 – Design Guidelines

PART I GENERAL

1.01 Building Envelope Description

- A. The object of the building envelope is to keep water out and allow thermal control within the building. It encompasses the entire exterior surface of a building, including roofs, walls, foundations and floor slabs that enclose the interior space and provides the thermal barrier between the indoor and outdoor environment. Building envelope design is a major factor in determining the amount of energy a building will use in its operation.
- B. Components of the CCM Building Envelope include below grade waterproofing, air and vapor barriers (including through-wall flashing), and single-ply roofing assemblies that inhibit moisture infiltration and resist wind loads. Information contained in Section 1, Design Guidelines, serve as criteria for specifiers to design a building envelope system.

1.02 Warranty

- A. A CCM NVELOP™ System encompassing roofing, waterproofing, air and vapor barrier, and through-wall flashing is available from Carlisle and differ in coverage and duration depending on the system selected. For a warranty example, refer to Warranty Exhibit following this section.
- B. Material and system warranty coverage for each of the subsystems included in the CCM NVELOP Warranty are outlined in individual sections of this specification.

1.03 Below Grade Waterproofing

- A. Various waterproofing systems suitable for the type of application are categorized in Part II, Paragraph 2.02. The selection of a suitable system is influenced by project and labor conditions and temperatures at the time of application.
- B. To ensure the long-term performance of a waterproofing system, water table and hydrostatic pressure should be evaluated and the appropriate waterproofing/drainage system selected.
- C. Installation of a CCM Waterproofing subsystem should be in accordance with CCW published specifications for products/systems contained in Part II, Paragraph 2.02 and shall be performed by a contractor that has been trained by the manufacturer.
- D. Abnormal site conditions, which may require modification to the CCW installation details, should be reviewed by the manufacturer and written approval is obtained prior to installation.

1.04 Cavity Wall Types

- A. The CCM Building Envelope System is based on 3 cavity wall types, which are outlined in the Building Envelope Details. Recommendations as to the type of cavity wall construction to be utilized are based on ASHRAE climatic zones outlined in Paragraph 1.06, Insulation R-Value Standards, and as described below.
- B. The various cavity wall types include the following:
 - 1. **Wall Type A** – Concrete block wall with insulated cavity and exterior cladding; used in all ASHRAE Climate Zones (U.S. Zones 1 – 8 and Canada Zones A – D).
 - 2. **Wall Type B** – Wood or metal stud wall with insulated cavity (no insulation between studs) and exterior cladding; used in all ASHRAE Climate Zones (U.S. Zones 1 – 8 and Canada Zones A – D).

3. **Wall Type C** – Wood or metal stud wall with no insulated cavity (insulation between the studs) and exterior cladding. The metal stud assembly is used in ASHRAE U.S. Climate Zones 1 – 3; the wood stud assembly is used in ASHRAE U.S. Climate Zones 1 – 5 and Canada Zone A only).

Note: See ASHRAE climatic zone maps outlined in Paragraph 1.06, Insulation R-Value Standards. For ASHRAE International Climate Zones refer to Table 1 on page 8.

- C. Various membrane air barriers and through-wall flashing options are outlined in Part 2, Paragraphs 2.03 to 2.05. The selection of a suitable option depends on wall configuration and substrate. Temperature at the time of application as well as labor preference may be a factor in the selection of the materials to be used.
- D. The air barrier/through-wall flashing system must be installed in strict accordance with the CCW published specifications and details and appropriate tie-ins must conform to the CCM Building Envelope Air and Vapor Barrier Details included in this binder.

1.05 Roofing

- A. The CCM Building Envelope System includes various Adhered Roofing Assemblies utilizing EPDM, TPO or PVC membranes. FleeceBACK EPDM and TPO options are also available. Refer to Part 2, Paragraph 2.06 for roofing system descriptions.
- B. Roofing assemblies utilized as part of the CCM building envelope must be installed by an authorized applicator and in strict accordance with specifications and details published by Carlisle SynTec Incorporated.
- C. In addition to the Carlisle SynTec published specification, design guidelines included herein must also be incorporated as part of the roofing assembly. Clarifications or approval of non-standard details/applications must be obtained in writing proper to commencement of the work.
- D. The use of a vapor barrier must be investigated not only based on occupancy-generated moisture but also due to construction processes, timing of construction, and possible moisture generation. In cold climate regions (ASHRAE Zones 4 through 8) the use of a vapor barrier is strongly recommended (as outlined below) to eliminate concerns with moisture generated during construction and the lack of or improper ventilation.

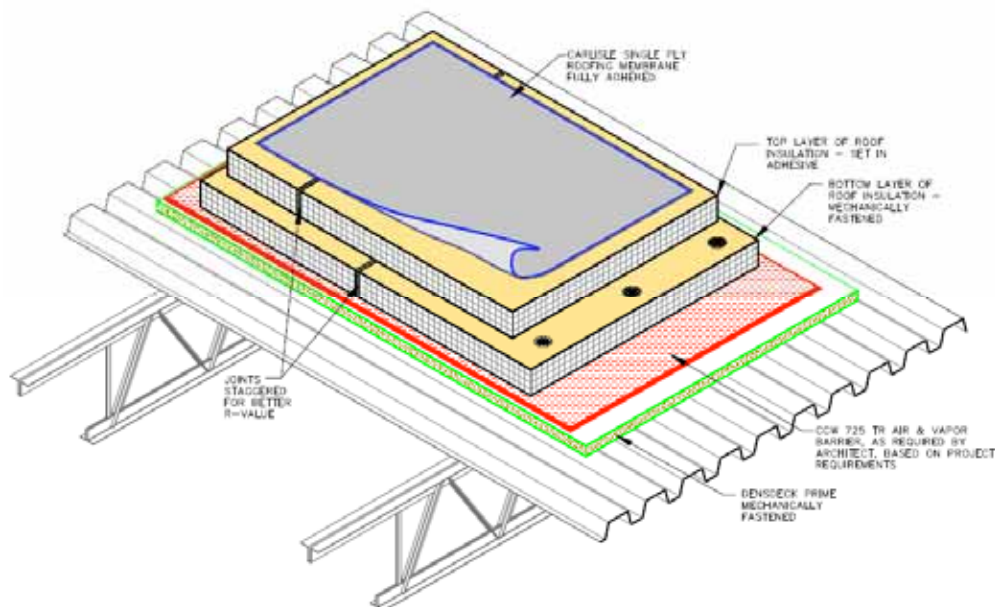
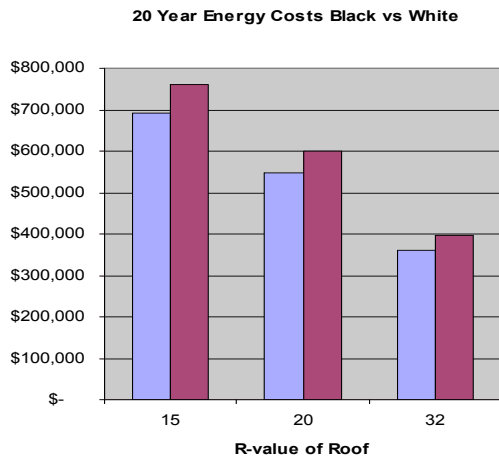


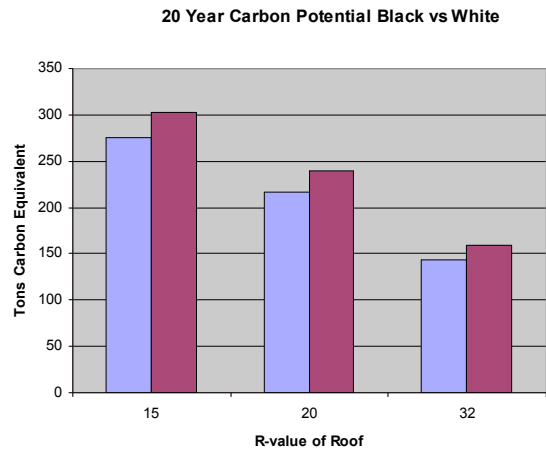
Fig. 1 – Typical Adhered Single-Ply Membrane Roofing Assembly

E. Roofing Membrane Color Selection

Depending on the geographic location, the color of the roofing membrane can contribute toward energy efficiency of a roofing assembly depending on the total R-value of the roofing assembly. The greater the R-value, the lesser the impact of the membrane color. Refer to Charts 1 and 2 below.



**Chart 1 – DOE Energy Comparisons
Charleston, WV**



**Chart 2 – Carbon Potential Comparison
Charleston, WV**

Black membranes in **cold climate regions** (ASHRAE Zones 4 through 8) will yield a positive savings in energy consumption and contribute to lower carbon emission. Likewise, reflective white roofs in **warm climate regions** (ASHRAE Zones 1 through 3) will deliver a savings.

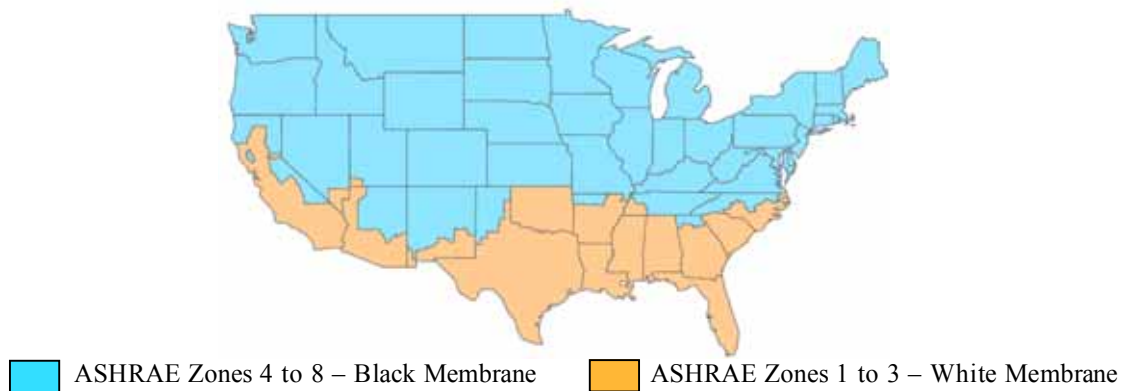


Fig. 2 – Map of White vs. Black Membrane

1.06 Insulation R-Value Standards

A. ANSI/ASHRAE/IESNA Standard 90.1 – 2007

1. An American National Standard (ANS) developed under the guidance of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and defined by the American National Standards Institute (ANSI). The purpose of the standard is to provide minimum requirements for the energy-efficient design of buildings (except low-rise residential buildings).
2. **Professional Organizations Reference**
 - a. **ANSI** – American National Standards Institute
 - b. **ASHRAE** – American Society of Heating, Refrigerating and Air-Conditioning Engineers
 - c. **IESNA** – Illuminating Engineering Society of North America

B. Roofing Insulation Guidelines

1. Use ASHRAE Standard 90.1 – 2007 as a baseline for minimum insulation R-values.
2. For energy efficiency and recommended insulation R-value, refer to Tables 2 and 3.
3. Insulation shall be installed in multiple layers with joints staggered between layers.
4. For increased insulation efficiency, insulation securement may be accomplished by fastening the first layer(s) and adhering subsequent layers.

C. Insulation R-Values

1. Portions of the ANSI/ASHRAE/IESNA Standard 90.1 – 2007 that pertain to the building envelope are included herein for reference.
2. To determine the minimum R-value required, the climate zone for the building envelope project must be established using one of the following:
 - a. **Figure 4 – ASHRAE Climate Zones for the United States** (for locations in the United States).
 - b. **Figure 5 – ASHRAE Climate Zones for Canada** (for locations in Canada).
 - c. **Table 1 – ASHRAE International Climate Zones** (for International cities grouped by country).
3. After the climate zone has been established, refer to **Tables 2 through 11** for the “ASHRAE minimum R-Value Standards” or the “Recommended R-Value.” The tables outline R-value standards for the following applications:
 - a. **Tables 2 - 3:** Roofs – Insulation Above Deck
 - b. **Tables 4 - 5:** Walls Above Grade
 - c. **Tables 6 - 7:** Walls Below Grade
 - d. **Tables 8 - 9:** Floors
 - e. **Tables 10 - 11:** Slab-on-Grade Floors

Note: “No Requirement,” when listed in the Tables, indicates no set ASHRAE standards apply; check with local jurisdictions.

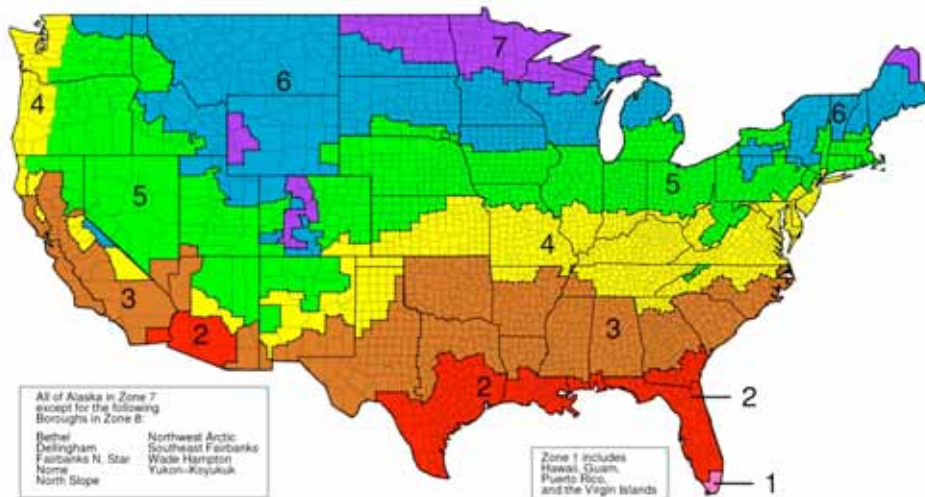


Fig. 3 – ASHRAE Climate Zones – U.S.

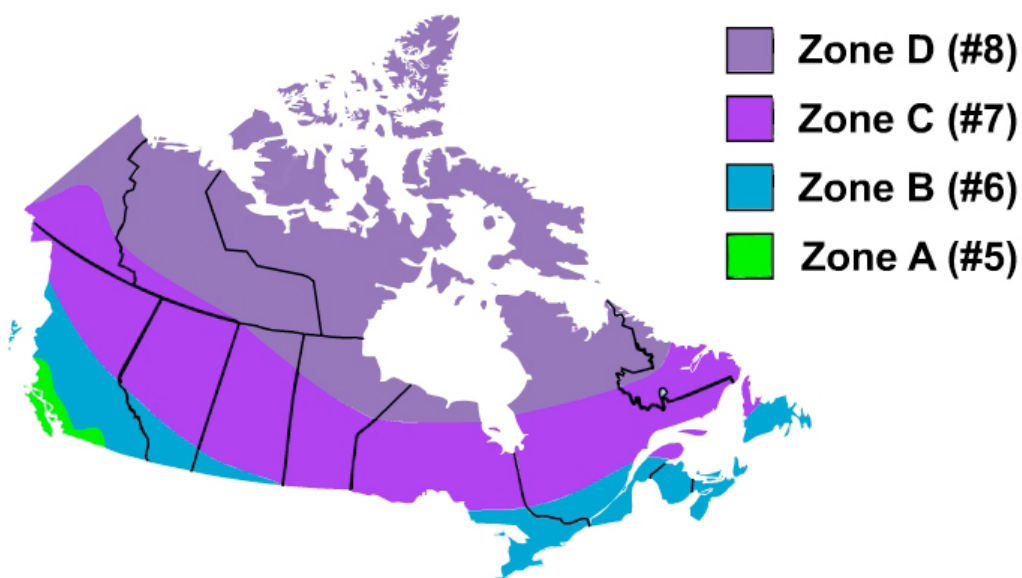


Fig. 4 –ASHRAE Climate Zones – Canada

Table 1
ASHRAE International Climate Zones
Listed by Country and City

Country City (Province or Region) Zone	Country City (Province or Region) Zone	Country City (Province or Region) Zone	Country City (Province or Region) Zone
Argentina Buenos Aires/Ezeiza 3 Cordoba 3 Tucuman/Pozo 2	Finland Helsinki/Seutula 7 France Lyon/Satolas 4 Marseille 4 Nantes 4 Nice 4 Paris/Le Bourget 4 Strasbourg 5 Germany Berlin/Schoenfeld 5 Hamburg 5 Hannover 5 Mannheim 5 Greece Souda (Crete) 3 Thessalonika/Mikra 4 Greenland Narsarsuaq 7 Hungary Budapest/Lorinc 5 Iceland Reykjavik 7 India Ahmedabad 1 Bangalore 1 Bombay/Santa Cruz 1 Calcutta/Dum Dum 1 Madras 1 Nagpur Sonagaon 1 New Delhi/Safdarjung 1 Indonesia Jakarta/Halimperda (Java) 1 Kupang Penfui (Sunda Island) 1 Makassar (Celebes) 1 Medan (Sumatra) 1 Palembang (Sumatra) 1 Surabaya Perak (Java) 1 Ireland Dublin Airport 5 Shannon Airport 4 Israel Jerusalem 3 Tel Aviv Port 2 Italy Milano/Linate 4 Napoli/Capodichino 4 Roma/Fiumicione 4 Jamaica Kingston/Manley 1 Montego Bay/Sangster 1	Japan Fukaura 5 Sapporo 5 Tokyo 3 Jordan Amman 3 Kenya Nairobi Airport 3 Korea Pyongyang 5 Seoul 5 Malaysia Kuala Lumpur 1 Penang/Bayan Lepas 1 Mexico Mexico City (Distrito Federal) 3 Guadalajara (Jalisco) 1 Monterrey (Nuevo Laredo) 3 Tampico (Tamaulipas) 1 Veracruz (Veracruz) 4 Merida (Yucatan) 1 Netherlands Amsterdam/Schiphol 5 New Zealand Auckland Airport Christchurch Wellington Norway Bergen/Florida 5 Oslo/Fornebu 6 Pakistan Karachi Airport 1 Papua New Guinea Port Moresby 1 Paraguay Asuncion/Stroessner 1 Peru LimaCallao/Chavez 2 San Juan de Marcona 2 Talara 2 Philippines Manila Airport (Luzon) 1 Poland Krakow/Balice 5 Romania Bucuresti/Bancasa 5 Russia Kaliningrad (East Prussia) 5 Krasnoarsk 7 Moscow Observatory 6 Petropavlovsk 7	(Russia cont.) RostovNaDonu 5 Vladivostok 6 Volgograd 6 Saudi Arabia Dhahran 1 Riyadh 1 Senegal Dakar/Yoff 1 Singapore Singapore/Changi 1 South Africa Cape Town/D F Malan 4 Johannesburg 4 Pretoria 3 Spain Barcelona 4 Madrid 4 Valencia/Manises 3 Sweden Stockholm/Arlanda 6 Switzerland Zurich 5 Syria Damascus Airport 3 Taiwan Tainan 1 Taipei 2 Tanzania Dar es Salaam 1 Thailand Bangkok 1 Tunisia Tunis/El Aouina 3 Turkey Adana 3 Ankara/Etimesgut 4 Istanbul/Yesilkoy 4 United Kingdom Birmingham (England) 5 Edinburgh (Scotland) 5 Glasgow Airport (Scotland) 5 London/Heathrow (England) 4 Uruguay Montevideo/Carrasco 3 Venezuela Caracas/Maiquetia 1 Vietnam Hanoi/Gialam 1 Saigon (Ho Chi Minh) 1

ROOFS – INSULATION ABOVE DECK

Table 2
ASHRAE Minimum R-Value

ASHRAE Zone	Non Residential	Semi-Heated
Zone 8	R-20 ci	R-15 ci
Zone 7	R-20 ci	R-10 ci
Zone 6	R-20 ci	R-10 ci
Zone 5	R-20 ci	R-7.6 ci
Zone 4	R-20 ci	R-5 ci
Zone 3	R-20 ci	R-5 ci
Zone 2	R-20 ci	R-3.8 ci
Zone 1	R-15 ci	R-3.8 ci

ci = continuous insulation required

Table 3
Recommended R-Value

ASHRAE Zone	Non Residential	Semi-Heated
Zone 8	R-35 ci	R-20 ci
Zone 7	R-35 ci	R-15 ci
Zone 6	R-30 ci	R-15 ci
Zone 5	R-25 ci	R-10 ci
Zone 4	R-25 ci	R-7.6 ci
Zone 3	R-25 ci	R-7.6 ci
Zone 2	R-25 ci	R-5 ci
Zone 1	R-20 ci	R-5 ci

ci = continuous insulation required

WALLS ABOVE GRADE

Table 4
ASHRAE Minimum R-Value

	Opaque Elements	Non Residential	Semi-Heated
Zone 8	Masonry	R-15.2 ci	R-9.5 ci
	Steel Framed	R-13 + R-7.5 ci	R-13 + R-3.8 ci
	Wood Framed	R-13 + R-15.6 ci	R-13
Zone 7	Masonry	R-15.2 ci	R-7.6 ci
	Steel Framed	R-13 + R-7.5 ci	R-13
	Wood Framed	R-13 + R-7.5 ci	R-13
Zone 6	Masonry	R-13.3 ci	R-5.7 ci
	Steel Framed	R-13 + R-7.5 ci	R-13
	Wood Framed	R-13 + R-7.5 ci	R-13
Zone 5	Masonry	R-11.4 ci	R-5.7 ci
	Steel Framed	R-13 + R-7.5 ci	R-13
	Wood Framed	R-13 + R-3.8 ci	R-13
Zone 4	Masonry	R-9.5 ci	No Requirement
	Steel Framed	R-13 + R-7.5ci	R-13
	Wood Framed	R-13	R-13
Zone 3	Masonry	R-7.6 ci	No Requirement
	Steel Framed	R-13 + R-3.8 ci	R-13
	Wood Framed	R-13	R-13
Zone 2	Masonry	R-5.7 ci	No Requirement
	Steel Framed	R-13	R-13
	Wood Framed	R-13	R-13
Zone 1	Masonry	No Requirement	No Requirement
	Steel Framed	R-13	No Requirement
	Wood Framed	R-13	No Requirement

ci = continuous insulation required

Table 5
Recommended R-Value

	Opaque Elements	Non Residential	Semi-Heated
Zone 8	Masonry	R-20 ci	R-13.3 ci
	Steel Framed	R-13 + R-10 ci	R-13 + R-7.5 ci
	Wood Framed	R-13 + R-10 ci	R-13 + R-3.8 ci
Zone 7	Masonry	R-20 ci	R-11.4 ci
	Steel Framed	R-13 + R-10 ci	R-13 + R-3.8 ci
	Wood Framed	R-13 + R-10 ci	R-13 + R-3.8 ci
Zone 6	Masonry	R-15.2 ci	R-9.5 ci
	Steel Framed	R-13 + R-10 ci	R-13 + R-3.8 ci
	Wood Framed	R-13 + R-10 ci	R-13 + R-3.8 ci
Zone 5	Masonry	R-13.3 ci	R-7.6 ci
	Steel Framed	R-13 + R-10 ci	R-13 + R-3.8 ci
	Wood Framed	R-13 + R-7.5 ci	R-13 + R-3.8 ci
Zone 4	Masonry	R-11.4 ci	R-5.7
	Steel Framed	R-13 + R-10 ci	R-13 + R-3.8 ci
	Wood Framed	R-13 + R-3.8 ci	R-13 + R-3.8 ci
Zone 3	Masonry	R-9.5 ci	R-5.7
	Steel Framed	R-13 + R-5.0 ci	R-13 + R-3.8 ci
	Wood Framed	R-13 + R-3.8 ci	R-13 + R-3.8 ci
Zone 2	Masonry	R-7.6 ci	R-5.7
	Steel Framed	R-13 + R-5.0 ci	R-13 + R-3.8 ci
	Wood Framed	R-13 + R-3.8 ci	R-13 + R-3.8 ci
Zone 1	Masonry	R-5.7	R-5.7
	Steel Framed	R-13 + R-5.0 ci	R-13
	Wood Framed	R-13 + R-3.8 ci	R-13

ci = continuous insulation required

WALLS BELOW GRADE

Table 6
ASHRAE Minimum R-Value

ASHRAE Zone	Non Residential	Semi-Heated
Zone 8	R-7.5 ci	No Requirement
Zone 7	R-7.5 ci	No Requirement
Zone 6	R-7.5 ci	No Requirement
Zone 5	R-7.5 ci	No Requirement
Zone 4	No Requirement	No Requirement
Zone 3	No Requirement	No Requirement
Zone 2	No Requirement	No Requirement
Zone 1	No Requirement	No Requirement

ci = continuous insulation required

Table 7
Recommended R-Value

ASHRAE Zone	Non Residential	Semi-Heated
Zone 8	R-10 ci	R-7.5 ci
Zone 7	R-10 ci	R-7.5 ci
Zone 6	R-10 ci	R-7.5 ci
Zone 5	R-10 ci	R-7.5 ci
Zone 4	R-7.5 ci	R-7.5 ci
Zone 3	No Requirement	No Requirement
Zone 2	No Requirement	No Requirement
Zone 1	No Requirement	No Requirement

ci = continuous insulation required

FLOORS

Table 8
ASHRAE Minimum R-Value

	Opaque Elements	Non Residential	Semi-Heated
Zone 8	Masonry	R-14.6 ci	R-8.3 ci
	Steel Framed	R-38	R-19
	Wood Framed	R-30	R-30
Zone 7	Masonry	R-12.5 ci	R-6.3 ci
	Steel Framed	R-30	R-19
	Wood Framed	R-30	R-19
Zone 6	Masonry	R-12.5 ci	R-4.2 ci
	Steel Framed	R-30	R-19
	Wood Framed	R-30	R-19
Zone 5	Masonry	R-10.4 ci	R-4.2 ci
	Steel Framed	R-30	R-19
	Wood Framed	R-30	R-19
Zone 4	Masonry	R-8.3 ci	R-4.2 ci
	Steel Framed	R-30	R-13
	Wood Framed	R-30	R-13
Zone 3	Masonry	R-6.3 ci	No Requirement
	Steel Framed	R-19	R-13
	Wood Framed	R-19	R-13
Zone 2	Masonry	R-6.3 ci	No Requirement
	Steel Framed	R-19	R-13
	Wood Framed	R-19	R-13
Zone 1	Masonry	No Requirement	No Requirement
	Steel Framed	No Requirement	No Requirement
	Wood Framed	No Requirement	No Requirement

ci = continuous insulation required

Table 9
Recommended R-Value

	Opaque Elements	Non Residential	Semi-Heated
Zone 8	Masonry	R-20 ci	R-12.5 ci
	Steel Framed	R-38 + R-12.5 ci	R-30
	Wood Framed	R-30 + R-7.5 ci	R-30 + R-7.5 ci
Zone 7	Masonry	R-20 ci	R-8.3 ci
	Steel Framed	R-38	R-30
	Wood Framed	R-30 + R-7.5 ci	R-30
Zone 6	Masonry	R-14.6 ci	R-6.3 ci
	Steel Framed	R-38	R-30
	Wood Framed	R-30 + R-7.5 ci	R-30
Zone 5	Masonry	R-12.5 ci	R-6.3 ci
	Steel Framed	R-38	R-30
	Wood Framed	R-30 + R-7.5 ci	R-30
Zone 4	Masonry	R-10.4 ci	R-6.3 ci
	Steel Framed	R-38	R-19
	Wood Framed	R-30 + R-7.5 ci	R-19
Zone 3	Masonry	R-6.3 ci	No Requirement
	Steel Framed	R-30	R-19
	Wood Framed	R-30	R-19
Zone 2	Masonry	R-6.3 ci	No Requirement
	Steel Framed	R-30	R-19
	Wood Framed	R-30	R-19
Zone 1	Masonry	R-4.2 ci	No Requirement
	Steel Framed	R-19	No Requirement
	Wood Framed	R-19	No Requirement

ci = continuous insulation required

SLAB-ON-GRADE FLOORS

Table 10

ASHRAE Minimum R-Value

	Opaque Elements	Non Residential	Semi-Heated
Zone 8	Unheated	R-15 for 24 in.	No Requirement
	Heated	R-20 for 48 in.	R-10 for 24 in.
Zone 7	Unheated	R-15 for 24 in.	No Requirement
	Heated	R-20 for 24 in.	R-10 for 24 in.
Zone 6	Unheated	R-10 for 24 in.	No Requirement
	Heated	R-15 for 24 in.	R-7.5 for 12 in.
Zone 5	Unheated	No Requirement	No Requirement
	Heated	R-15 for 24 in.	R-7.5 for 12 in.
Zone 4	Unheated	No Requirement	No Requirement
	Heated	R-15 for 24 in.	R-7.5 for 12 in.
Zone 3	Unheated	No Requirement	No Requirement
	Heated	R-10 for 24 in.	R-7.5 for 12 in.
Zone 2	Unheated	No Requirement	No Requirement
	Heated	R-7.5 for 12 in.	R-7.5 for 12 in.
Zone 1	Unheated	No Requirement	No Requirement
	Heated	R-7.5 for 12 in.	R-7.5 for 12 in.

ci = continuous insulation required

Table 11

Recommended R-Value

	Opaque Elements	Non Residential	Semi-Heated
Zone 8	Unheated	R-15 for 24 in. + R-5 ci below	R-10 for 24 in.
	Heated	R-20 for 36 in. + R-5 ci below	R-20 for 48 in.
Zone 7	Unheated	R-15 for 24 in. + R-5 ci below	R-10 for 24 in.
	Heated	R-20 for 36 in. + R-5 ci below	R-20 for 48 in.
Zone 6	Unheated	R-15 for 24 in.	R-10 for 24 in.
	Heated	R-15 for 36 in. + R-5 ci below	R-10 for 24 in.
Zone 5	Unheated	R-10 for 24 in.	R-10 for 24 in.
	Heated	R-15 for 36 in. + R-5 ci below	R-10 for 24 in.
Zone 4	Unheated	R-10 for 24 in.	R-10 for 24 in.
	Heated	R-10 for 24 in. + R-5 ci below	R-7.5 for 24 in.
Zone 3	Unheated	No Requirement	No Requirement
	Heated	R-7.5 for 12 in. + R-5 ci below	R-7.5 for 12 in.
Zone 2	Unheated	No Requirement	No Requirement
	Heated	R-7.5 for 12 in. + R-5 ci below	R-7.5 for 12 in.
Zone 1	Unheated	No Requirement	No Requirement
	Heated	R-7.5 for 12 in. + R-5 ci below	R-7.5 for 12 in.

1.07 Other Design Criteria

A. Consideration for Hail Zones

The map below (Figure 2) depicts areas of the United States that are more prone to hail storms. In areas of potential hail, the use of a thicker roofing membrane is recommended to provide greater puncture resistance.

1. FleeceBACK 115 or FleeceBACK AFX Plus are recommended for areas prone to large hail.
2. Large hail areas may also warrant the use of thicker conventional EPDM or TPO membrane in conjunction with a rigid membrane underlayment.
3. To eliminate possible damage of membranes, the substrate below the membrane should be adhered. Insulation fasteners and plates are not recommended for use directly beneath the membrane (except where used for membrane securement).
4. The use PVC membrane is not recommended in Hail Zones greater than 1 inch in diameter.

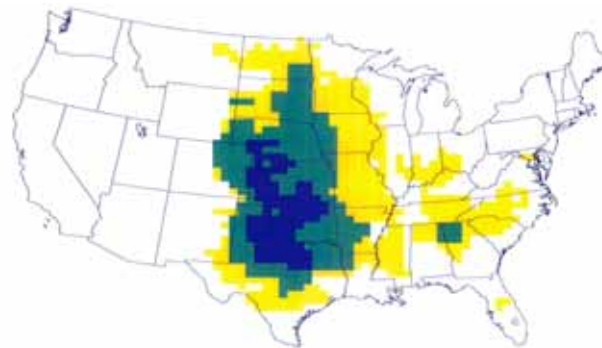


Fig. 5 – U.S. Hail Zone Map 0.5" – 1.0" Hail 1.0" – 2.0" Hail 2.0" – 4.0" Hail

B. Consideration for Radiant Exposure

Radiant exposure levels (measured in megajoules) vary based on geographic location, altitude, and cloud cover. Intensity increases at higher elevations and/or lack of cloud cover. Depending on latitude, certain regions are known for increased level of radiant exposure where the roofing material becomes exposed to higher levels of UV.

Areas with highest level of radiant exposure are Phoenix, AZ and Las Vegas, NV due to their latitude and lack of cloud cover. Denver, CO, due to its elevation above sea level, will also experience a higher level of radiant exposure.

Areas where radiant exposure level is in excess of 5800 MJ/m² should incorporate thicker membrane, 60-mil or greater, regardless of the specified warranty. The roofing assembly must also be designed with positive drainage and must be kept clean to reduce dirt accumulation and the subsequent increase in surface temperature.

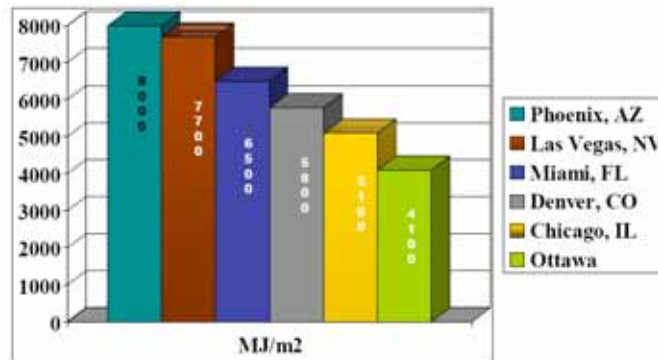


Fig. 6 – Radiant Exposure Levels

C. Consideration for Building Orientation

Buildings, depending on their orientation and design features, may subject the roofing membrane to concentrated levels

of UV and elevated temperatures. This can be experienced on projects with multiple roof levels where sun rays may be deflected from large glass windows or reflective curtain walls. Similar reflection can also be experienced on buildings with high reflective wall flashings. Roof top equipment and ducts with shiny surfaces can also intensify heat exposure and prematurely subject membrane to aging.

1. Regardless of location, where reflective membranes are required for heat island reduction or to meet local codes, wall flashing should be limited in height or flashing material with dull, non-reflective surface shall be used.
2. Where sun is deflected for prolonged periods from glass and other higher surfaces, thicker membrane or a protective layer must be utilized in the affected area. Consult Carlisle for recommendations.
3. In hot climate regions with high radiant exposure levels, membranes thicker than 60-mil may be used in affected areas or over the entire roof.
4. Projects may be submitted for CCM's review and evaluation to determine the best possible option.

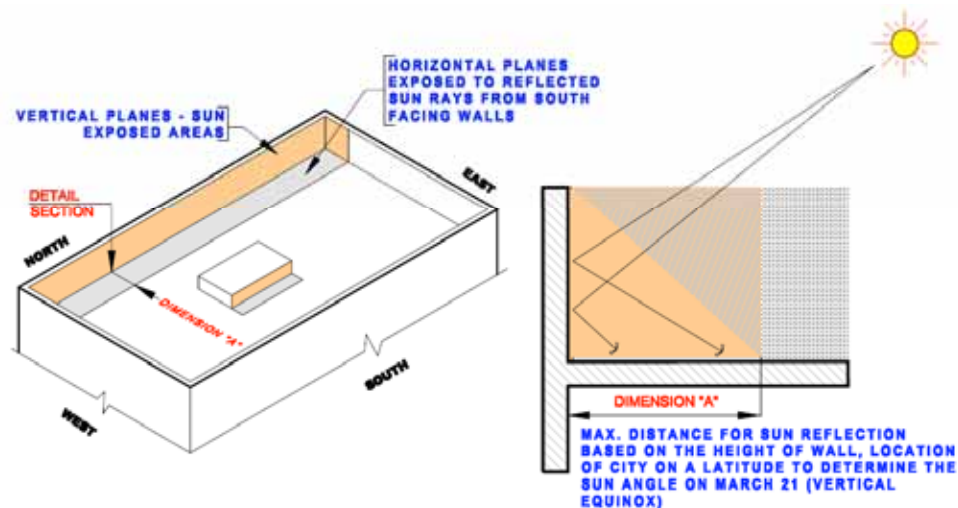


Fig. 7 – Orientation and Sun Deflection

D. Consideration for High Wind Locations

1. The specified Adhered Roofing System must have been successfully tested by a qualified testing agency to resist the design uplift pressures calculated according to:
 American Society of Civil Engineers (ASCE 7)
 International Building Code (IBC)
 ANSI/SPRI WD-1 “Wind Design Standard Practice for Roofing Assemblies”
2. Depending on the building height and wind zone, conventional adhered membrane assemblies may utilize oriented strand (OSB) or 5/8 inch DensDeck Prime as the membrane underlayment to deliver the highest uplift performance.
3. Conventional adhered membrane assemblies may be installed directly over SecurShield Polysio for peak gust wind resistance of 90 and 100 mph depending on the compressive strength of the board.
4. FleeceBACK adhered membrane assemblies may be installed directly over SecurShield Polysio for peak gust wind resistance of 100 to 120 mph depending on the compressive strength of the board.
5. The use of thicker membrane is strongly recommended to improve puncture resistance during a windstorm, minimizing damage that could occur from air borne debris.
6. Special consideration should be given to the perimeter edge/coping detail to incorporate metals which meets ES-1 standards. Carlisle metal edgings and copings meet this standard and, when utilized, will extend the warranty coverage beyond the roofing membrane.

Contact Carlisle SynTec Incorporated for wind loading analysis to determine specific enhancements that may be necessary to comply with the International Building Code (IBC).

1.08 Quality Assurance

- A. CCM recommends the use of Carlisle supplied products for use with the various components of the building envelope system. The performance or integrity of products by others, **when selected by the specifier and accepted as compatible by CCM**, is not the responsibility of Carlisle and is **disclaimed** by the Carlisle Warranty.
- B. The specified assemblies must be installed by an applicator experienced in applying the same or similar materials and shall be specifically approved in writing by the manufacturer.
- C. There must be no deviations made from Carlisle's specification or Carlisle's approved drawings (where applicable) without the **PRIOR WRITTEN APPROVAL** of Carlisle.

1.09 Code Approvals

- A. Building codes are above and beyond the intended purpose of this specification. The specifier should consult local codes for applicable requirements or contact Carlisle for additional clarification.
- B. For code approvals achieved with the Carlisle single-ply membrane roofing systems, refer to the respective Carlisle Code Approval Guide, Factory Mutual (FM) Approval Guide or Underwriters Laboratories (UL) Fire Resistance or Roofing Materials and Systems Directories.

PART II PRODUCT GUIDELINES

2.01 General

- A. Among a long list of products and components offered by CCM, outlined below are the most suited products for the specific applications listed.
- B. **Manufacturer:** Building Envelope products contained in this section are manufactured by:
 1. Carlisle Coatings & Waterproofing Incorporated, 900 Hensley Lane, Wylie, Texas 75098, Phone: (800) 527-7092.
 2. Carlisle SynTec Incorporated, P.O. Box 7000, Carlisle, PA 17013-0925, Phone: (800) 479-6832

2.02 CCW Waterproofing Systems

Application	System Products	System Description
Foundation Walls Smooth Surface	Membrane: MiraDRI 860/861 Engineered Drainage Composite: MiraDRAIN 6200XL	<ul style="list-style-type: none"> • 60-mil thick self-adhering sheet waterproofing membrane bonded to substrate. • Engineered drainage composite bonded over membrane. • Backfill against drainage composite.
Foundation Walls Irregular Surface	Membrane: Barricoat-S Engineered Drainage Composite: MiraDRAIN 6200XL	<ul style="list-style-type: none"> • Minimum 60-mil thick spray-applied, rubberized asphalt waterproofing membrane bonded to substrate. • Engineered drainage composite bonded over membrane. • Backfill against drainage composite.
Balconies and Small Decks	Membrane: CCW-860P Engineered Drainage Composite: MiraDRAIN 9000	<ul style="list-style-type: none"> • Minimum 60-mil thick, liquid-applied, 2-part polyurethane waterproofing membrane bonded to substrate. • 60-mil thick self-adhering sheet waterproofing membrane bonded over polyurethane membrane. • Engineered drainage composite placed over sheet waterproofing membrane. • Balcony or deck surface installed over drainage composite.
Below Slab Waterproofing	Membrane: MiraCLAY (Bentonite)	<ul style="list-style-type: none"> • Engineered drainage composite placed fabric-side down in soil. • Bentonite composite sheet waterproofing membrane

Application	System Products	System Description
	Engineered Drainage Composite: MiraDRAIN 9800	placed over drainage composite. <ul style="list-style-type: none"> Concrete slab poured over membrane.
Below Slab Waterproofing and Vapor-proofing	Protection Course: CCW 300 HV Protection Fabric Membrane: Sure-Seal Butyl Engineered Drainage Composite: MiraDRAIN 9800	<ul style="list-style-type: none"> Engineered drainage composite placed fabric-side down in soil. Minimum 60-mil thick butyl sheet waterproofing membrane placed over drainage composite. Protection course placed over membrane. Concrete slab poured over protection course.
Tunnels	Membrane: Sure-Seal Butyl Engineered Drainage Composite: MiraDRAIN 6200XL	<ul style="list-style-type: none"> Minimum 60-mil thick butyl sheet waterproofing membrane bonded to substrate. Engineered drainage composite bonded over membrane. Backfill over/against drainage composite.
Split Slab and Plaza Deck Waterproofing	Membrane: CCW-500R Protection Course #1: Protection Board-HS Engineered Drainage Composite: MiraDRAIN 9900 Insulation: Min. 60 psi extruded polystyrene Protection Course #2: CCW 300HV Protection Fabric Finish Course: Pavers provided by CCW or Wearing Slab	<ul style="list-style-type: none"> Minimum 215-mil thick, reinforced hot, liquid rubberized asphalt membrane applied over structural slab. Protection course #1 placed over membrane. Engineered drainage composite placed over protection course. Board insulation placed over drainage composite. Protection course #2 placed over board insulation. Finish course applied over protection course.
Waterproofing Lagging Walls, Blind Side and Zero Lot Line	Membrane: MiraCLAY (Bentonite) Engineered Drainage Composite: MiraDRAIN 6000XL	<ul style="list-style-type: none"> Engineered drainage composite fastened with fabric side against lagging. Bentonite composite sheet waterproofing membrane fastened over drainage composite. Concrete foundation wall poured against membrane.
Waterproofing Planters	Membrane: CCW- 525R Root Barrier: CCW Root-Barrier Engineered Drainage Composite: MiraDRAIN 9800	<ul style="list-style-type: none"> Minimum 90-mil thick, reinforced, liquid-applied, modified polyurethane waterproofing membrane bonded to substrate. 16-mil reinforced polyolefin root barrier placed over membrane. Engineered drainage composite placed over root barrier. Soil fill and planting installed over drainage composite.
Planted Roof Top Systems	Membrane: CCW-500R Protection Course: Protection Board-HS Root Barrier: CCW Root-Barrier Engineered Drainage Composite #1: MiraDRAIN 9000 Insulation: Extruded polystyrene provided by CCW Water Retention Layer: CCW Moisture-Mat Engineered Drainage Composite #2: MiraDRAIN GR9200 Soil & Plants: Carlisle Engineered Growth Media and Planting OR CCW GreenGrid Pre-Planted Trays	<ul style="list-style-type: none"> Minimum 215-mil thick, reinforced hot, liquid rubberized asphalt membrane bonded to substrate. Protection course placed over membrane. 16-mil reinforced polyolefin root barrier placed over protection course. Engineered drainage composite #1 placed over root barrier. Board insulation placed over drainage composite. Water retention layer placed over board insulation. Engineered drainage composite #2 placed over water retention layer. Soil and plants installed over drainage composite.

2.03 CCW Membrane Air Barrier Systems – For Exterior Walls

Application	System Products	System Description
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Application	System Products	System Description
Air, Water and Vapor Barrier on Sheathing-over-Stud Exterior Walls	CCW-705	<ul style="list-style-type: none"> 40-mil thick self-adhering sheet membrane air barrier bonded to substrate. Board insulation installed over membrane. Brick, stucco, siding, paneling or other exterior cladding system installed over insulation.
Air, Water and Vapor Barrier directly behind Metal Cladding	CCW-705 HT	<ul style="list-style-type: none"> 40-mil thick, high-temperature resistant, self-adhering sheet membrane air barrier bonded to substrate Exterior metal cladding system installed over membrane.
Air, Water & Vapor Barrier on Concrete Block Exterior Walls	Barriseal-S	<ul style="list-style-type: none"> Minimum 40-mil thick spray-applied, rubberized asphalt membrane air barrier bonded to substrate. Board insulation installed over membrane. Brick, stucco, siding, paneling or other exterior cladding system installed over membrane.
Vapor-Permeable Air and Water Barrier on Exterior Walls	Barritech VP	<ul style="list-style-type: none"> Minimum 40-mil thick spray-applied, acrylic polymer membrane air barrier bonded to substrate. Brick, stucco, siding, paneling or other exterior cladding system installed over membrane.

2.04 Carlisle SynTec Air Barrier System – For Roofs

Application	System Products	System Description
At roof deck level	725TR Air & Vapor Barrier/Temporary Roof	<ul style="list-style-type: none"> 40-mil composite consisting of 35-mil thick self-adhering rubberized asphalt laminated to 5-mil thick polyethylene film. Used on concrete, exterior gypsum, DensDeck Prime, Securock, or other approved substrates.

2.05 CCW Through-Wall Flashing Systems

Application	System Products	System Description
Cavity Wall: Concrete Block Wall with Brick Veneer	Flashing: CCW Pre-Kleened EPDM TWF	<ul style="list-style-type: none"> 40-mil thick EPDM flexible flashing built into block wall. Flashing then built into brick veneer.
Cavity Wall: Sheathing-Over-Stud Wall with Brick Veneer	Flashing: CCW-705 TWF Termination Bar: Sure-Seal Termination Bar	<ul style="list-style-type: none"> Minimum 40-mil thick self-adhering flexible flashing bonded to wall surface and secured with termination bar. Flashing then built into brick veneer.

2.06 Cavity Wall Insulation

A. Increases in ASHRAE Standard 90.1-2007 now require greater R-value that results in thicker insulation and subsequently will increase the thickness of walls, flashing and trimming around openings.

B. Insulation Types

1. **Insulfoam R-Tech CW (Cavity Wall):** a high-performance, rigid insulation consisting of a superior closed-cell, lightweight and resilient expanded polystyrene (EPS) with advanced polymeric laminate facers. It is available with factory laminated MR (metallic-reflective) facers, white facers, or a combination of the two. The R-Tech facers shed water to reduce moisture build-up in the cavity wall. It is available in 4' x 8' panels with thicknesses ranging from 1/2" to 4-1/2". Meets or exceeds the requirements of ASTM C578.

2. **Hunter Panels H-Shield F:** a rigid insulation panel composed of a closed cell polyisocyanurate foam core bonded on each side to trilaminate foil facers. It is available in 4' x 4' and 4' x 8' panels and in thicknesses of 1" to 4". Meets ASTM-C 1289-06, Type II, Class 2, Grade 2 (20 psi) or Grade 3 (30 psi).

3. Related Product

Hardcast Foil-Grip 1402 Indoor/Outdoor Duct Sealing Rolled Sealant: a 17mil thick general-purpose sealant tape that can be used to provide a continuous seal for protection of the polyisocyanurate core of the H-Shield F polyisocyanurate insulation.

2.07 Adhered Roofing Assemblies

EPDM, TPO and PVC single-ply roofing membranes are available in various thicknesses, types and colors (and used in specific roofing systems) as outlined below:

	Brand Name	Type	Color	Thickness	Fully Adhered Application Method
EPDM	Sure-Seal	Non-Reinforced	Black	60- and 90-mil	Contact adhesive
	Sure-White	Non-Reinforced	White-on-Black	60-mil	Contact adhesive
	Sure-Tough	Reinforced	Black	60- and 75-mil	Contact adhesive
	Sure-Seal FleeceBACK	Fleece-Backed	Black	100-, 115-, and 145-mil	Low rise foam adhesive
	Sure-White FleeceBACK	Fleece-Backed	White	100- and 115-mil	Low rise foam adhesive
	Sure-Seal AFX	Fleece-Backed	Black	90- and 105-mil	Hot asphalt
TPO	Sure-Weld	Reinforced	White, Tan or Gray	60-, 72- and 80-mil	Contact adhesive
	Sure-Weld FleeceBACK	Fleece-Backed	White, Tan or Gray	100- and 115-mil	Low rise foam adhesive
	Sure-Weld AFX	Fleece-Backed	White	120- and 135-mil	Hot asphalt
PVC	Sure-Flex	Reinforced	White or Gray	50-, 60- and 80-mil	Contact adhesive

PART III EXECUTION GUIDELINES

3.01 Project Conditions

- A. Apply materials within the range of ambient and substrate temperatures recommended by the applicable Carlisle specification. Do not apply waterproofing to a damp or wet substrate. Do not apply waterproofing in snow, rain, fog or mist.
- B. Maintain adequate ventilation during preparation and application of waterproofing materials.

END OF SECTION

Building Envelope
"Attachment 1.1"
Warranty Sample

September 2008

Carlisle Construction Materials



Building Envelope System Warranty

Serial No:

Date of Issue:

Building Owner:

Name of Building:

Building Address:

Date of Completion of the CCM Building Envelope Barrier System:

Date of Acceptance by CCM:

Carlisle Construction Materials (CCM) warrants to the Building Owner (Owner) of the above described building that; subject to the terms, conditions and limitations stated in this Warranty, CCM will

1. Fulfill its obligations under the individual CCM sub-system warranties referenced in Exhibit A.
2. Repair any water leak through the transitions of the CCM sub-systems, indicated in Exhibit B, for a period of () years commencing with the date of CCM's acceptance of the System installation.

The CCM NVELOP™ System (the System) consists of the sub-systems indicated in Exhibit A and their transitions indicated in Exhibit B. Sub-systems and their transitions must be installed by CCM-approved applicators, in accordance with the provisions of their individual warranties and applicable CCM specifications and details. Transitions of the sub-systems shall be inspected and approved by an entity qualified by CCM.

Terms, Conditions, Limitations

1. Owner shall provide CCM with written notice within thirty (30) days of the discovery of any water leak in the System. Owner should send written notice of the leak to CCM's Warranty Services Department at the address set forth at the bottom of this Warranty. By notifying CCM, the Owner authorizes CCM or its designee to investigate the cause of the leak. Should the investigation reveal the cause of the leak to be outside the scope of this Warranty, investigation and repair costs for this service shall be paid by the Owner.
2. If, upon inspection, CCM determines that the leak is caused by a defect in the System's materials or workmanship of the CCM Authorized Applicators in installing same, Owner's remedies and CCM's liability shall be limited to CCM's repair of the leak.
3. During the term of the Warranty, CCM shall have free access to the System during regular business hours.

4. Any and all costs or expenses associated with the removal, excavation or replacement of concrete, soil, building cladding or other materials incurred to test, inspect, repair, remove or replace the System or any of its components shall be the responsibility of the Owner.
5. The Warranty shall not be applicable if, upon CCM's inspection, CCM determines that any of the following has occurred:
 - a. Any of the System components were substituted or omitted.
 - b. The System is damaged by natural disasters including but not limited to lightning, fire, pests, insect infestations, earthquake, tornados, hail or hurricanes, and winds of peak gust speeds of () mph or higher measured at 10 meters above ground.
 - c. After installation, the System is damaged by alteration or repairs to the building including but not limited to addition of structures, fixtures or utilities.
 - d. The System is damaged by intentional or negligent acts, accidents, misuse, abuse, vandalism, civil disobedience or the like.
 - e. Deterioration or failure of building components, or inadequate or faulty structural design.
 - f. A substantive change has occurred in principal use of the building
 - g. Cracks in the structural base exceed 1/16 inch
 - h. Acids, oils or harmful chemicals and the like come in contact with the System and cause a leak or otherwise damage the System.
6. The Warranty shall be null and void if after installation of the System, the building undergoes alterations or repairs that affect the continuity or integrity of the System such as, but not limited to: building additions, removal and replacement of the roof or cladding.
7. CCM shall have no obligation under this Warranty while any bills for installation, supplies, service and warranty charges have not been paid in full to the CCM authorized applicators, CCM or material suppliers.
8. CCM's failure at any time to enforce any of the terms or conditions stated herein shall not be construed to be a waiver to such provision.
9. CCM shall have no liability under any theory of law for any claims, repairs, restoration or other damages including but not limited to, consequential or incidental damages relating, directly or indirectly, to the presence of any irritants, contaminants, vapors, fumes, molds, fungi, bacteria, spores, mycotoxins, or the like in the building or in the air, land and water serving the building.
10. This Warranty is not assignable by operation of law or otherwise. Application may be made by a new building Owner for reissuance of the Warranty during the original Warranty period. Certain procedures including, but not limited to, an inspection of the System by a CCM representative and fees will apply to any reissuance. CCM reserves the right at its sole discretion, to refuse to reissue this Warranty.

CCM DOES NOT WARRANT PRODUCTS UTILIZED IN THIS INSTALLATION WHICH IT HAS NOT FURNISHED; AND SPECIFICALLY DISCLAIMS LIABILITY, UNDER ANY THEORY OF LAW, ARISING OUT OF THE INSTALLATION AND PERFORMANCE OR, OR DAMAGES SUSTAINED BY, PRODUCTS NOT FURNISHED BY CCM.

THE REMEDIES STATED HEREIN ARE THE SOLE AND EXCLUSIVE REMEDIES FOR FIALURE OF THE CCM SYSTEM OR ITS COMPONENTS. THERE ARE NO WARRANTIES EITHER EXPRESSED OR IMPLIED, INCLUDING THE IMPLIED WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY, WHICH EXTEND BEYOND THE FACE HEREOF. CCM SHALL NOT BE LIABLE FOR DIRECT, INCIDENTAL, CONSEQUENTIAL OR OTHER DAMAGES INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS OR DAMAGE TO THE BUILDING OR ITS CONTENTS UNDER ANY THEORY OF LAW.

Exhibit A CCM Sub-Systems

Roofing by Carlisle SynTec Incorporated

System	Warranty	Warranty Serial No.

Membrane Air Barrier by Carlisle Coatings & Waterproofing Incorporated

System	Warranty	Warranty Serial No.

Through-Wall Flashing by Carlisle Coatings & Waterproofing Incorporated

System	Warranty	Warranty Serial No.

Waterproofing by Carlisle Coatings & Waterproofing Incorporated

System	Warranty	Warranty Serial No.

Insulation by Insulfoam LLC

System	Warranty	Warranty Serial No.

Exhibit B
CCM Sub-System Transitions

Sub-System 1 (Name and Warranty No.)	Sub-System 2 (Name and Warranty No.)	Description of Transition

SAMPLE

SECTION 2 – Below Grade Waterproofing

This section of the CCM Building Envelope System contains various options for below grade waterproofing applications. More in depth technical information on the specific system selected, design criteria, installation details, and application procedures can be found in the **CCW Technical Manual** or their website.

PART I GENERAL

1.01 DESCRIPTION

- A. This section applies to the application of below grade waterproofing and associated drainage aggregates. Applications include foundation walls, split slab waterproofing, tunnels, earth shelters, mud slabs, below slab, plaza decks, split slab, elevator pits, and “blind side” waterproofing.
- B. The waterproofing system shall be tied into the building’s air and vapor barriers, through-wall flashings and roofing systems to form a complete building envelope.
- C. Air and vapor barrier materials shall be installed to bridge and seal the following air leakage pathways and gaps:
 - 1. Connections of the walls to the roof air barrier
 - 2. Connections of the walls to the foundations
 - 3. Seismic and expansion joints
 - 4. Openings and penetrations of window frames, door frames, store front and curtain wall
 - 5. Barrier pre-cast concrete and other envelope systems
 - 6. Door frames, piping, conduit, duct and similar penetrations
 - 7. Masonry ties, screws, bolts and similar penetrations
 - 8. All other air leakage pathways through the opaque walls

1.02 WARRANTY

- A. A 5-year material warranty is available from the manufacturer for Self-Adhering Sheet Waterproofing, Hot Fluid-Applied Rubberized Asphalt Waterproofing, Cold Fluid-Applied Waterproofing and Bentonite Composite Sheet Waterproofing.
- B. A 20-year material warranty is available from the manufacturer for Elastomeric Sheet Waterproofing (Sure-Seal Butyl membrane).

PART II PRODUCTS

2.01 GENERAL

Manufacturer: All Waterproofing products contained in this section are manufactured by Carlisle Coatings & Waterproofing Incorporated, 900 Hensley Lane, Wylie, Texas 75098, Phone: (800) 527-7092.

2.02 MATERIALS

A. Self-Adhering Sheet Waterproofing

- 1. **CCW MiraDRI 860/861:** A self-adhering sheet membrane that consists of a 56-mil (1.4 mm) thick rubberized asphalt membrane laminated to a 4-mil (0.1 mm) thick, cross-laminated polyethylene film to form a minimum 60-mil (1.5 mm) thick membrane. The combination of the two excellent waterproofing materials provides a high-performance, extremely durable waterproofing barrier.
 - a. **CCW MiraDRI 860:** A summer grade material that is suitable for installations where the ambient temperature is 40°F (4°C) or above.
 - b. **CCW MiraDRI 861:** Used for applications between 25°F (-4°C) and 65°F (18°C).

2. Typical Uses

- a. Used for vertical and horizontal waterproofing on structural foundation walls and decks as well as for below-grade foundation walls, tunnels, split slabs, plaza decks and parking decks.
- b. Can also be used in interior areas such as mechanical rooms, laboratories, kitchens and bathrooms.

Note: CCW MiraDRI 860/861 should be covered with either CCW 200V/300H Protection Course, CCW Protection Board, or CCW MiraDRAIN drainage composites.

3. Related Carlisle Products

a. Liquid Mastic

CCW LM-800XL: A fast-drying, elastomeric, single component, cold-applied liquid material. It is used as a fillet and reinforcement under CCW MiraDRI 860/861 membranes at footing foundation wall junctures or other inside corners and between footing and foundations when tying in slab waterproofing with the foundation wall. Other applications include terminations and flashing to protrusions from horizontal and vertical surfaces, terminations at drains, and detailing of the substrate prior to CCW MiraDRI 860/861 membrane application.

B. Elastomeric Sheet Waterproofing

1. Sure-Seal Butyl Membrane: A minimum 60-mil (1.5 mm) thick Isobutylene and Isoprene sheet.

The butyl membrane is virtually impermeable to water and water vapor. The membrane has excellent puncture resistance coupled with outstanding elongation and tensile strength that make the membrane system able to withstand ponding water and building movement.

The membrane shall meet or exceed the following requirements:

- a. Tensile Strength: 1200 psi minimum, ASTM D 412
- b. Ultimate Elongation: 300% minimum, ASTM D 412
- c. Thickness Tolerance: $\pm 10\%$, ASTM D 412
- d. Hardness: 60 ± 10 Shore A, ASTM D 2240
- e. Tear Resistance: 150 lbf/in minimum, ASTM D 624
- f. Brittleness Temperature: -40°F (-40°C) maximum, ASTM D 746
- g. Water Absorption: 2% maximum, ASTM D 471, 7d at 158°F (70°C)
- h. Puncture Resistance: 95 lbs. minimum, ASTM E-154
- i. Permeance: 0.0025 Perm maximum, ASTM E-96 B
- j. Resistance to Soil Burial: 10% maximum change from original, ASTM D 3083 (modified)
- k. Factory Seam Strength: membrane rupture, ASTM D 816
- l. Resistance to Heat Aging: Properties after 168 hrs. at 240°F (116°C), ASTM D 573:
 - Tensile Strength: 1200 psi minimum
 - Ultimate Elongation: 300% minimum
 - Linear Dimensional Change: 2 mass % maximum
- m. Ozone Resistance: No cracks after 55 ppm ozone, 100 hrs at 104°F (40°C), 20% strain, ASTM D 1149
- n. ASTM D 6134 Type II: Passed
- o. ASTM D 5843: Passed

2. Typical Uses

- a. Wall and foundation waterproofing, earth shelter, and tunnels.
- b. Waterproofing beneath shower pans, thickset mortar, kitchens, toilet facilities, and janitorial rooms.
- c. Waterproofing promenades and plaza decks.
- d. Split-slab waterproofing of multilevel parking facilities.
- e. Waterproofing of sub-grade construction (over mud slabs or sand beds).
- f. Railroad bridge decks.
- g. Lining interior fountains.

C. Hot Fluid-Applied Rubberized Asphalt Waterproofing

1. CCW-500R System: A 215-mil (5 mm) thick Hot Applied Membrane

CCW-500 Hot Applied Liquid Membrane is applied in a thick, monolithic coating utilizing CCW-500 Reinforcing Fabric, which allows for a wide variety of substrate conditions.

a. Products:

- 1) **Hot applied liquid membrane:** CCW-500 Hot Applied Liquid Membrane, a single-component, rubberized asphalt compound that forms a tough, flexible, thick waterproofing membrane that meets or exceeds the requirements of CGSB-37.50-M89.
- 2) **Reinforcing fabric:** CCW-500 Reinforcing Fabric, a 1.35 oz/square yard spunbonded polyester fabric used as the reinforcing layer in the CCW-500R Hot Applied Liquid Membrane System.

b. Typical Uses

Plaza decks, planted rooftops, split-slab waterproofing, and various horizontal surfaces.

c. Related Carlisle Products

CCW-550 Reinforcing Fabric: A 9-mil thick spun-bonded polyester fabric used as the reinforcing layer in the CCW-500R Hot Fluid-Applied Rubberized Asphalt Waterproofing System. It is available in 36" (91 cm) and 59" (150 cm) wide rolls.

2. Vapor-Lock System: A 215-mil (5 mm) thick Hot Applied Membrane

The first course consists of CCW-711-90 sheet membrane, a self-adhering rubberized asphalt membrane, applied to the substrate. The second course is the application of CCW-500 that forms a tough, flexible, monolithic membrane over the CCW-711-90.

a. Products:

- 1) **Pre-formed sheet membrane:** CCW-711-90, a 90-mil (2 mm) thick composite consisting of a self-adhering rubberized asphalt membrane laminated to a high strength, heat resistant woven polypropylene fabric reinforcement.
- 2) **Hot applied liquid membrane:** CCW-500 Hot Applied Membrane, a single-component, rubberized asphalt compound that forms a tough, flexible, thick waterproofing membrane that meets or exceeds the requirements of CGSB-37.50-M89.

b. Typical Uses

Plaza decks, planted rooftops, split-slab waterproofing, and various horizontal surfaces. The base course of CCW-711-90 allows application on more substrates than the CW-500R (hot applied membrane) System.

D. Cold Fluid-Applied Waterproofing

1. Roller or Squeegee Applied:

- a. **CCW-525:** A liquid-applied, single-component, moisture cured, elastomeric, coal-tar free, modified polyurethane which cures to form a flexible, monolithic, waterproof membrane on vertical or horizontal surfaces, above or below grade. The membrane has tenacious adhesion to concrete substrates preventing lateral water migration. The inherent toughness and resilience of CCW-525 membrane enables it to bridge structural or shrinkage cracks which may develop in the substrate. Available in two viscosities (H & V).

b. Typical Uses

Used between the structural slab and the wearing course on parking garages, plaza decks, balconies, roof decks, terraces, mechanical equipment rooms, fountains, kitchens, wetrooms, malls and shower stalls. They are ideally suited for waterproofing on below grade foundation walls, tunnels, planters

and other areas where seamless, elastomeric waterproofing is required.

2. **Spray Applied:**

a. **Barricoat-S:** A water-based, asphalt emulsion modified with a blend of synthetic rubbers and special additives. It cures rapidly to create a monolithic, highly flexible waterproofing membrane.

b. **Typical Uses**

Designed to be a waterproofing and vapor barrier membrane. It can be applied to concrete, concrete block, wood and metal and is useful for a variety of applications including foundations and retaining walls.

E. **Bentonite Composite Sheet Waterproofing**

MiraCLAY is designed for waterproofing below grade structural slabs as well as construction methods that incorporate lagging, concrete caisson or shotcrete retention walls. It is also very effective in rehab waterproofing and zero clearance property line construction.

1. **Products:**

a. **CCW MiraCLAY** (standard formula): A uniform layer of sodium bentonite clay sandwiched between a durable puncture resistant non-woven polypropylene fabric and a high tensile strength woven polypropylene fabric.

b. **CCW MiraCLAY EF** (enhanced formula): A uniform layer of sodium bentonite clay sandwiched between a durable puncture resistant non-woven polypropylene fabric and a high tensile strength woven polypropylene fabric. It is used where ground water is contaminated with either salt, chemicals or other foreign substances

c. **CCW MiraCLAY GM** (with geomembrane): A needle punched, thermally reinforced composite of a uniform layer of sodium bentonite clay sandwiched between a durable puncture resistant non-woven geotextile and a slit film woven geotextile. The needle punched fiber are thermally fused to the woven geotextile to enhance the reinforcing bond and an H.D.P.E. film is applied to the woven surface to lower the hydraulic conductivity. It has the ability to expand and seal minor cracks in concrete and has a polyethylene membrane attached for added waterproofing protection.

2. **Typical Uses**

CCW MiraCLAY is designed for waterproofing below grade structural slabs as well as construction methods that incorporate lagging, concrete caisson or shotcrete retention walls. It is also very effective in rehab waterproofing and zero clearance property line construction.

3. **Advantages**

CCW MiraCLAY has the ability to heal itself if ripped or punctured. It also has the ability to expand and seal cracks in concrete. In a hydrated state, the bentonite clay has tremendous impermeability and excellent resistance to chemicals (i.e., acids, bases and hydrocarbons).

2.03 RELATED CARLISLE MATERIALS

A. **Through-Wall Flashing**

1. Through-wall flashing shall be durably integrated with the wall assembly's water resistive barrier and cavity drainage system. It shall perform as a liquid water drainage plane to discharge incidental condensation or water penetration to the exterior through the cavity drainage system.

2. The through-wall flashing shall be tied into the building's air and vapor barriers that are subsequently tied into the building's roofing and waterproofing systems to form a complete building envelope.

3. Through-wall flashing shall be installed in cavity wall construction in the following locations:

- a. Wall bases
- b. Windowsills
- c. Heads of openings

- d. Shelf angles
- e. Tops of walls
- f. Parapets
- g. Above projections such as bay windows
- h. At other discontinuities in the cavity

4. **Products:**

Manufacturer: All Through Wall Flashing products contained in this section are manufactured by Carlisle Coatings & Waterproofing Incorporated, 900 Hensley Lane, Wylie, Texas 75098, Phone: (800) 527-7092.

a. **Rubber Sheet Flashing**

Pre-Kleened™ EPDM Through-Wall Flashing: A 40-mil (1 mm) thick, pre-washed, cured, dimensionally stable, non-reinforced, EPDM membrane that is available in 12" (30 cm), 18" (46 cm), 24" (61 cm) and 36" (91 cm) wide rolls and meets the following requirements:

Requirement	Result	Test Method
Tensile Strength	Not less than 1,600 psi	ASTM D 412
Tensile Elongation	Not less than 500 percent	ASTM D 412
Brittleness Temperature	Not more than minus 65 degrees F	ASTM D 746
Tear Resistance	Not less than 200 lbf	ASTM D 624, Die C
Resistance to Water	Not more 2 percent volume change after 7 days immersion at 158 degrees F	ASTM D 741
Water Vapor Permeance	Not more than 0.06 Perm	ASTM E-96, Method B
Resistance to UV	No cracks	ASTM D 4637
Ozone Resistance	No cracks	ASTM D 1149

b. **Self-Adhering Sheet Flashing**

CCW-705-TWF: A 40-mil (1 mm) thick composite that consists of a 32-mil (0.80 mm) thick self-adhering rubberized asphalt membrane laminated to an 8-mil (0.20 mm) thick, cross-laminated, high-density polyethylene (HDPE) film; available in 12" (30 cm), 18" (46 cm), 24" (61 cm) and 36" (91 cm) wide rolls.

The self-adhering product permits easy installation on concrete, masonry, gypsum, steel and wood substrates and meets the following requirements:

Requirement	Result	Test Method
Tensile Strength	Not less than 900 psi	ASTM D-412
Puncture Resistance	Not less than 80 lb.	ASTM E 154
Low Temperature Flexibility	Unaffected at minus 25 degrees F, 0.063 inch mandrel	ASTM D 146
Peel Adhesion	Not less than 5 lb per inch width on concrete prepared with contact adhesive	ASTM D 903
Lap Adhesion	Not less than 5 lb. per inch width	ASTM D 1876
Water Vapor Permeance	Not more than 0.05 Perm	ASTM E-96, Method B
Water Absorption	Not more than 0.12 percent by weight	ASTM D 570

B. **Drainage Aggregate (Drainage Composites)**

Drainage composites are a necessary part of waterproofing systems. They should always be placed directly against the waterproofing membrane with the filter fabric facing the soil.

1. **CCW MiraDRAIN:** A prefabricated, 3-dimensional, dimpled polystyrene or PVC core and geotextile fabric drainage composite that provides a drainage path in diverse below-grade waterproofing applications. The filter fabric is bonded to the dimpled polystyrene or PVC core to minimize fabric intrusion into the flow channels caused by backfill pressure. The fabric also prevents the passage of soil particles into the core, while allowing water to pass freely.

2. **Types and Typical Uses**

- a. **CCW MiraDRAIN 6000XL/6200XL:** High-performance, high-strength, 0.40" (10 mm) thick, drainage composites consisting of a three-dimensional, high-impact polystyrene core, and a superior high-strength non-woven filter fabric. CCW MiraDRAIN 6200XL has the added benefit of a polymeric sheet adhered to the back of the core to prevent the drainage core from die cutting the waterproofing membrane.

Typical Uses:

Designed for use in high-flow, high-compressive strength, vertical drainage applications where single-sided subsurface drainage is needed. The high-strength polymeric film adhered to the flat side of the drainage core provides additional factors of safety from potential die cutting into the waterproofing membrane. It is ideal for foundation walls, retaining walls, bridge abutments, and other similar structures. They also serve as protection courses over CCW waterproofing membranes.

- b. **CCW MiraDRAIN 9000:** A high-performance, high-strength, 0.40" (10 mm) thick, drainage composite consisting of a three-dimensional, high-impact polystyrene core and a woven filter fabric. Its woven monofilament fabric withstands high abrasion from applied overburden and prevents intrusion into the drainage channel due to its low elongation characteristics. The woven fabric is better suited to receive a directly poured concrete topping than non-woven geotextile fabrics.

Typical Uses:

Designed for use in horizontal plaza, roof deck and between-slab drainage applications where single-sided subsurface drainage is required and serves as a protection course when used in conjunction with CCW waterproofing membranes.

- c. **CCW MiraDRAIN 9800:** A high-performance, high-strength, 0.40" (10 mm) thick, drainage composite consisting of a three-dimensional, high-impact polystyrene core and a superior heavy weight non-woven filter fabric.

Typical Uses:

Designed for use in high-flow, high-compressive strength, horizontal and vertical drainage applications where maximum filtration is required for subsurface drainage. It is ideal for planter, green roof and foundation wall applications. It also serves as a protection course when used in conjunction with CCW waterproofing membranes.

C. Protection Boards

1. **CCW Protection Board-H:** A heavy-duty, asphalt impregnated, 1/8" (3 mm) thick, organic mat with a fine mineral applied to the surface to prevent sticking in the roll. It is used as a protection course on horizontal surfaces to protect the waterproofing membrane from damage by foot traffic and physical abuse from other trades.

Typical Uses:

Uses include plaza decks, roof terrace decks, parking decks, and any other horizontal surface to which waterproofing membrane has been applied.

2. **CCW Protection Board-V:** A lightweight, high density, rigid, 1/4" (6 mm) thick, extruded polystyrene foam designed to provide protection for waterproofing membrane on vertical walls. It is not affected by moisture or most soil chemicals and remains in place to provide long-term protection to the waterproofing membrane.

Typical Uses:

Used to protect waterproofing membranes that have been applied to vertical, below grade foundation walls. It protects the membrane from damage or aggregate shock during backfilling operations. It is also suitable for use in planters as a vertical protection course for the waterproofing membrane.

3. **CCW Protection Board-HS:** A heavy-duty, modified bitumen, 90-mil (2 mm) thick, protection board that consists of a medium weight fiberglass mat with high-quality SBS (Styrene-Butadiene-Styrene) rubber and asphalt blend. The elastomeric asphaltic blend lends elasticity and flexibility to the sheet. The inorganic fiberglass reinforcing provides high tensile strength, dimensional stability and tear resistance.

It is designed to be installed as a protection course in the CCW-500R System and protects the membrane system from damage by foot traffic and physical abuse from other trades.

Typical Uses:

Uses include plaza decks, inverted roofing systems, parking decks with asphalt overlayments, and other horizontal surfaces to which waterproofing membranes have been applied.

D. Protection Fabrics

1. **CCW 200V:** A tough, non-woven, 90-mil (2 mm) thick, polypropylene cushioning fabric specifically designed to cushion and protect the CCW MiraDRI 860/861 and CCW Butyl waterproofing membranes in vertical applications.
2. **CCW 300HV:** A tough, non-woven, 150-mil (4 mm) thick, polypropylene cushioning fabric that provides protection for horizontal applications. It is designed to be placed over CCW MiraDRI 860/861 and CCW Butyl waterproofing membranes in horizontal and vertical applications. It is also used as a moisture retention element in roof garden systems.

E. Mastic

CCW-704: A solvent based, rubberized bitumen mastic that is used as a secondary seal on seams, T-joints, overlaps and other terminations/penetrations of the CCW sheet membrane system (MiraDRI 806/861, CCW-500R and Vapor-Lock System). It is for use on the top surface and edges of the CCW sheet membrane and shall not be used below the membrane.

F. Root Barrier

CCW Root-Barrier is a high strength, 16-mil (0.40 mm) thick membrane that consists of a layer of tightly woven HDPE scrim with a continuous 2-mil (0.05) thick polymeric coating on both sides. It is a specially formulated membrane that contains no plasticizers that could migrate to the surface and attack some asphalt-based materials.

Typical Uses:

Used in planter, CCW-500R System, and roof garden applications to prevent root migration into the waterproofing system. It is installed directly over a CCW Protection Board.

PART III EXECUTION**3.01 EXAMINATION**

- A. Examine substrates and conditions for compliance with the requirements of the applicable Carlisle Coatings and Waterproofing product specification.
 - 1. Verify concrete has cured, aged and is visibly dry and free of moisture.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

- A. Clean, prepare, and treat substrates in accordance with the written instructions of Carlisle Coatings and Waterproofing. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- C. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- D. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks.

3.03 PROTECTION AND CLEANING

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during construction period.
- C. Clean spillage and soiling from adjacent construction.

3.04 BELOW GRADE WATERPROOFING APPLICATION

- A. Install below grade waterproofing in accordance with the written instructions of Carlisle Coatings and Waterproofing for the material specified.
- B. Install below grade waterproofing and auxiliary materials to tie into adjacent waterproofing.
- C. Refer to CCW technical manual for specific installation details pertaining to the waterproofing system selected.

END OF SECTION

SECTION 3 – Air and Vapor Barrier

This section of the CCM Building Envelope System contains various options for air and vapor barrier applications. More in depth technical information on the specific system selected, design criteria, installation details, and application procedures can be found in the **CCW Technical Manual** or their website.

PART I GENERAL

1.01 DESCRIPTION

- A. This section applies to the application of products and accessories that constitute an air barrier assembly, which shall be air-tight, durable and continuous, as described in Commonwealth of Massachusetts Building Code requirements: 780 CMR Chapter 13, Paragraphs 1304.3.1 Air Barriers and 1304.3.2 Air Barrier Penetrations.
- B. The air and vapor barrier shall be tied into the building's through-wall flashing, roofing and waterproofing systems to form a complete building envelope.
- C. Air and vapor barrier materials shall be installed to bridge and seal the following air leakage pathways and gaps:
 - 1. Connections of the walls to the roof air barrier
 - 2. Connections of the walls to the foundations
 - 3. Seismic and expansion joints
 - 4. Openings and penetrations of window frames, door frames, store front and curtain wall
 - 5. Barrier pre-cast concrete and other envelope systems
 - 6. Door frames, piping, conduit, duct and similar penetrations
 - 7. Masonry ties, screws, bolts and similar penetrations
 - 8. All other air leakage pathways through the opaque walls

1.02 WARRANTY

A 5-year material warranty is available from the manufacturer.

PART II PRODUCTS

2.01 GENERAL

Manufacturer: All Air and Vapor Retarder products contained in this section are manufactured by Carlisle Coatings & Waterproofing Incorporated, 900 Hensley Lane, Wylie, Texas 75098, Phone: (800) 527-7092.

2.02 MATERIALS

A. Modified Bituminous Sheet Air Barriers

The use of a Modified Bituminous Sheet Air Barrier provides a complete barrier to moisture and air when adhered to an above grade substrate. It can be applied horizontally or vertically over the full surface area and can be easily adhered to concrete, masonry, gypsum, steel and wood substrates.

1. Types:

- a. **CCW-705:** A 40-mil (1 mm) thick, composite membrane that consists of a rubberized asphalt adhesive laminated to a tough cross-laminated polyethylene (HDPE) film.

Designed for installation at temperatures above 40°F (4°C). Not for use in areas where the membrane will be subjected to temperatures in above 150°F (66°C).

- b. **CCW-705 LT:** A 40-mil (1 mm) thick, composite membrane that consists of a highly tacky rubberized asphalt adhesive laminated to a tough cross-laminated high density polyethylene (HDPE) film. The product has a tackier adhesive formula to enable application at low temperature.

Designed for installation at temperatures between 25°F (-4°C) and 60°F (16°C).

- c. **CCW-705 HT:** A 40-mil (1 mm) thick, composite membrane that consists of a high-temperature

resistant modified asphalt adhesive laminated to a tough cross-laminated polyethylene (HDPE) film. It is suitable for use directly behind metal cladding.

Designed to resist temperatures up to 240°F (116°C) without degradation or flow of the adhesive.

2. **Related Carlisle Products**

Air and Vapor Barrier Strips: Available in 4" (10 cm), 6" (15 cm), 9" (23 cm) and 12" (30 cm) wide rolls. The Air and Vapor Barrier Strips are used for wall flashing applications such as window and door openings and joints.

- a. **CCW-705 Air and Vapor Barrier Strips:** A 40-mil (1 mm) thick, composite membrane that consists of a rubberized asphalt adhesive laminated to a tough cross-laminated polyethylene (HDPE) film.
- b. **CCW-705 LT Air and Vapor Barrier Strips:** A 40-mil (1 mm) thick, composite membrane that consists of a highly tacky rubberized asphalt adhesive laminated to a tough cross-laminated high density polyethylene (HDPE) film. The product has a tackier adhesive formula and is designed for installation at low temperatures between 25°F (-4°C) and 60°F (16°C).

B. **Fluid-Applied Membrane Air Barriers**

1. **Barriseal**

- a. A water-based, asphalt emulsion modified with a blend of synthetic rubbers and special additives. It cures to form a 40-mil (1 mm) thick, flexible, monolithic membrane for use as an air, vapor and water barrier in diverse wall assemblies.

1) **Spray Grade – Barriseal-S:** Pourable consistency; applied using special spray equipment.

2) **Roller Grade – Barriseal-R:** Paste consistency; applied with a roller or a brush.

- b. **Typical Uses**

Designed to be used as an air barrier, moisture vapor barrier, waterproofing membrane and wall system drainage plane. Typical applications include concrete, concrete block, or exterior finish wall systems. It is ideally suited for projects where the use of a self-adhering air barrier would be difficult or costly.

2. **Barritech VP:** A fluid-applied, vapor-permeable air barrier

- a. A fluid-applied membrane applied to exterior wall assemblies where it functions as an air barrier and a water resistive barrier. It is a single component, air-drying product that can be spray or roller applied at a minimum 40-mil (1 mm) dry film thickness. The high film thickness and flexible, elastic properties enable Barritech VP to bridge cracks and seal around penetrations to create a continuous, monolithic air and water barrier.

- b. **Typical Uses**

It can be applied to concrete, concrete block, exterior gypsum sheathing, plywood, oriented strand board (OSB) and many other common building materials. It provides an air and liquid-moisture barrier while allowing water vapor to pass through it.

3. **Related Carlisle Products**

- a. **Air and Vapor Barrier Strips:** Available in a 4" (10 cm) wide roll. The Air and Vapor Barrier Strips are used for wall flashing applications such as window and door openings and joints.
- b. **Barritape:** A 20-mil thick self-adhering flashing that consists of a flexible, dimensionally stable polypropylene film laminated with an aggressively tacky, rubber-modified, asphalt adhesive. It can span sheathing joints up to 1/4" wide and can be applied over most common exterior sheathing surfaces including gypsum board, insulation board, water-resistant facers on gypsum or insulation board, oriented strand board (OSB) or plywood.
- c. **Scrim Reinforcement**

- 1) **AB-151:** A self-adhering fiberglass mesh tape used for sheathing joint reinforcement in fluid-applied membrane air barrier systems. Available in 3" (8 cm) wide rolls, it can be applied over all types of exterior sheathing.
- 2) **DCH Reinforcing Fabric:** A polyester fabric used to cover and reinforce inside and outside corners, cracks and joints in fluid-applied membrane air barriers systems. Available in 4" (10 cm), 6" (15 cm), 12" (30 cm) and 40" (102 cm) wide rolls.

2.03 OTHER CARLISLE MATERIALS

A. Mastic

1. **CCW-704:** A solvent based, rubberized bitumen mastic that is used as a secondary seal on seams, T-joints, overlaps and other terminations/penetrations of the CCW sheet membrane system (CCW-705, CCW-705 LT and CCW-705 HT). It is for use on the top surface and edges of the CCW sheet membrane and shall not be used below the membrane.

PART III EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with the requirements of the applicable Carlisle Coatings and Waterproofing product specification.
 1. Verify substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 2. Verify concrete has cured, aged and is visibly dry and free of moisture.
 3. Verify masonry joints are flush and completely filled with mortar.
 4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

- A. Clean, prepare, and treat substrates in accordance with the written instructions of Carlisle Coatings and Waterproofing. Provide clean, dust-free, and dry substrates for air barrier application.
- B. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- C. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- D. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks.

3.03 PROTECTION AND CLEANING

- A. Protect the Air Barrier system from damage during application and the remainder of the construction period.

Protect Air Barrier from exposure to UV light and harmful weather exposure. Remove and replace air barrier exposed to these conditions for more than 30 days.

- B. Clean spills, stains, and soiling from adjacent construction.

3.04 AIR BARRIER APPLICATION

- A. Install air barrier in accordance with the written instructions of Carlisle Coatings and Waterproofing for the material specified.
- B. Install air barrier to form a seal with transition strips and through wall flashing to achieve a continuous air barrier.
- C. Install air barrier and auxiliary materials to tie into adjacent waterproofing.
- D. Refer to CCW technical manual for specific installation details pertaining to the air barrier system selected.

END OF SECTION

SECTION 4 – Roofing

This section of the CCM Building Envelope System contains various options for roofing applications. More in depth technical information on the specific system selected, design criteria, installation details, and application procedures can be found in the **Carlisle SynTec** or **EcoStar Technical Manuals** or their website.

PART I GENERAL

1.01 DESCRIPTION

- A. This section applies to the application of single-ply EPDM, TPO or PVC membrane roofing systems as well as EcoStar synthetic slate and cedar shake steep slope roofing tiles.
- B. The single-ply membrane roofing system and the related products for the EcoStar steep slope roofing tiles shall be tied into the building's air and vapor barriers, through-wall flashings and waterproofing system to form a complete building envelope.
- C. The single-ply membrane roofing system shall be a Fully Adhered Roofing System that will perform as an air barrier.

1.02 DESIGN GUIDELINES

A. Fully Adhered Roofing Systems

An acceptable insulation is mechanically fastened to the roof deck or adhered with Carlisle supplied urethane-based insulation adhesive or hot asphalt and the roofing membrane is fully adhered to the insulation with the appropriate adhesive. There are no maximum slope restrictions for the application of this roofing system.

B. EcoStar Steep Slope Roofing Tiles

EcoStar Steep Slope Roofing Tiles are synthetic polymeric roofing tiles that are designed for steep slope roofing (minimum slope 3 in 12) and available in slate and cedar shake profiles.

1.03 WARRANTY

A. Single-Ply Roofing System Warranties

1. Available Warranties

Depending on the type of roofing system assembly to be specified, a 10-, 15- or 20-year warranty is available from the manufacturer. Refer to the corresponding Carlisle SynTec Incorporated specification for more information.

2. Hail Coverage

Additional warranty coverage for Hail is available with the following single-ply roofing assemblies:

- 1) Adhered 90-mil non-reinforced black EPDM
- 2) Adhered 100-, 115- and 145-mil black EPDM FleeceBACK
- 3) Adhered 100- and 115-mil white EPDM FleeceBACK
- 4) Adhered 100- and 115-mil TPO FleeceBACK
- 5) Hot Mopped 90- and 105-mil AFX EPDM FleeceBACK
- 6) Hot Mopped 120- and 135-mil AFX TPO FleeceBACK

Note: Refer to **Section 1, Part I, Paragraph 1.03.E, U.S. Hail Zones**, on page 7, for a map of areas of the United States that are more prone to hail storms.

B. EcoStar Steep Slope Roofing Warranty

A 50-year limited labor and material warranty is available from the manufacturer.

PART II PRODUCTS

2.01 GENERAL – MANUFACTURERS

- A. The Single-Ply Roofing products contained in this section are manufactured by Carlisle SynTec Incorporated, P.O. Box 7000, Carlisle, PA 17013-0925, Phone: (800) 479-6832.
- B. The EcoStar synthetic slate and cedar shake steep slope roofing tiles contained in this section are manufactured by EcoStar, a division of Carlisle SynTec Incorporated, P.O. Box 7000, Carlisle, PA 17013-0925, Phone: (800) 211-7170.

2.02 MATERIALS

A. Insulation

1. General

- a. Roof insulation thickness must be determined by the thermal value required for each project and may be subject to code approval limitations. ASHRAE Publication 90.1 2007, which contains minimum R-values for various geographic locations throughout North America, shall be referenced to improve thermal efficiency and reduce carbon footprint. For recommended R-Values, refer to **Tables 2 and 3 in Section 1, Part I, Paragraph 1.04.B, Insulation R-Values**, on page 11.
- b. On projects where a vapor retarder is used, the specifier must calculate insulation thickness to ensure the temperature at the vapor retarder will not fall below the calculated dew point.
- c. For new construction projects in cold climate regions, the use of vapor retarders or air barriers is strongly recommended to safeguard against moisture generated during construction.
- d. Multiple layers of insulation are recommended with all joints staggered between layers.

2. Restrictions

- a. Carlisle Roofing Systems cannot be specified in conjunction with Phenolic Insulation.
- b. Fiberglass insulation cannot be specified, even if overlaid with additional insulation.
- c. Other restrictions may apply depending on the roofing system type specified. Refer to the applicable roofing system specification for any additional restrictions.

3. Insulation Types

- a. **HP Recovery Board** – a high-density wood fiberboard with asphalt-coated facer; available in thicknesses of 1/2" and 1". It can be installed as a separator layer over an existing roofing system or as an insulation overlayment. It is UL and FM approved as a system component in certain Carlisle roofing assemblies.
- b. **Insulfoam SP** – a superior closed-cell, lightweight and resilient expanded polystyrene (EPS) with a durable and stable, factory-laminated fiberglass facer. It has a nominal density of 1.25 lbs/ft³ (pcf) and meets or exceeds the requirements of ASTM C578, Type VIII. It is used in conjunction with a cover board.
- c. **Sure-Seal EPS Composite Board** – an expanded polystyrene/wood fiber composite with asphalt coated facer (HP Recovery Board).

- d. **Polyisocyanurate HP-H** – a foam core insulation board covered on both sides with a medium weight fiber-reinforced felt facer. It is a dimensionally stable and durable insulation that offers maximum thermal efficiency; available with compressive strengths of 20 or 25 psi.
- e. **SecurShield™ Polyiso** – a rigid, roof insulation panel composed of a closed-cell polyisocyanurate foam core laminated to coated glass fiber mat facers. The premium facer improves fire resistance, moisture resistance and dimensional stability.
- f. **DensDeck and DensDeck Prime** – (supplied by Carlisle) water resistant gypsum boards with glass mat facings on the top and bottom. DensDeck Prime utilizes a non-asphaltic primer applied to the top glass mat facer. Both products conform to ASTM C 1177. It is used over insulations such as extruded or expanded polystyrene or polyisocyanurate when additional compressive strength is desired for roofs subjected to increased foot traffic or for increased resistance to hail damage. It is also used in wood deck constructions to achieve various fire ratings.
- g. **Securock** – (supplied by Carlisle) impact-resistant, nonstructural, specially engineered gypsum and cellulose fiber panel with 95% certified recycled content. Uniform water-resistance throughout core and surface. It is used over insulations such as extruded or expanded polystyrene or polyisocyanurate when additional compressive strength is desired for roofs subjected to increased foot traffic or for increased resistance to hail damage. It is also used in wood deck constructions to achieve various fire ratings.
- h. **Foamular® Insulations** (supplied by Carlisle): extruded polystyrene, closed-cell foam panels with continuous as-extruded skin on the face and back surfaces; conforms to the minimum physical requirements of ASTM C-578 and must be used with a cover board. Available in various compressive strengths as noted below:
 - 1) **Thermapink 18** – 18 psi compressive strength.
 - 2) **Thermapink 25** – 25 psi compressive strength.
 - 3) **Durapink** – 18 and 25 psi compressive strengths.
 - 4) **Foamular 400** – For use primarily with waterproofing installations; 40 psi compressive strength.
 - 5) **Foamular 600** – For use primarily with waterproofing installations; 60 psi compressive strength.
- i. **DOW Styrofoam Deckmate Plus** (supplied by Carlisle): extruded polystyrene insulation that conforms to the minimum physical requirements of ASTM C-578. It has a 25 psi compressive strength and must be used with a cover board.

B. Single-Ply Roofing Membrane

- 1. **EPDM** – Ethylene, Propylene, Diene Terpolymer (for physical properties, refer to “Attachment I – EPDM Membrane Physical Properties”).
 - a. **Non-Reinforced EPDM Membrane** (adhered using contact adhesive)
 - 1) **Sure-Seal (black) 45-, 60- and 90-mil thick** – maximum 50' wide, maximum 100' long (additional lengths available dependent on membrane thickness and width). Conforms to ASTM D4637, Type I (non-reinforced).
 - 2) **Sure-White (white-on-black) 60-mil thick** – maximum 10' wide, maximum 100' long, which meets ASTM D4637, Type I (non-reinforced).
 - b. **Reinforced EPDM Membrane** (adhered using contact adhesive)
 - 1) **Sure-Tough (black) 45- and 60-mil thick** – 4-1/2', 8' or 10' wide, maximum 100' long, polyester fabric reinforced membrane (10' wide 45-mil thick membrane is also available in lengths of 200') with polyester fabric. Conforms to ASTM D4637, Type II (reinforced).
 - 2) **Sure-Tough (black) 75-mil thick** - 10' wide by 100' long polyester fabric reinforced

membrane offering enhanced puncture, tear and wind uplift resistance. Conforms to ASTM D4637, Type II (reinforced).

c. **Fleece-Backed EPDM Membrane**

- 1) **Sure-Seal (black) FleeceBACK 100, 115 and 145** – 45-, 60- or 90-mil thick Sure-Seal (black) non-reinforced EPDM laminated to a 55-mil non-woven polyester fleece-backing resulting in a total finished sheet thickness of 100 or 115-mils. Membrane is available in widths of 10' and lengths of 50' or 100' and conforms to ASTM Standard D 4637-96, Type III (fabric-backed membrane). Adhered using low rise foam adhesive.
- 2) **Sure-White (white-on-black) FleeceBACK 100 and 115** – 45- or 60-mil thick Sure-White (white-on-black) non-reinforced EPDM laminated to a 55-mil non-woven polyester fleece-backing resulting in a total finished sheet thickness of 100 or 115-mils. Membrane is available in widths of 10' and lengths of 50' or 100' and conforms to ASTM Standard D 4637-96, Type III (fabric-backed membrane). Adhered using low rise foam adhesive.
- 3) **Sure-Seal (black) AFX 90 and 105** – 45- or 60-mil Sure-Seal (black) non-reinforced EPDM laminated to 7.5 ounce per square yard, non-woven polyester, polypropylene blended fleece resulting in a total finished sheet thickness of 90-mils or 105-mils. Membrane is available in widths of 10' wide and lengths of 50' or 100' and conforms to ASTM Standard D 4637-95, Type III (fabric-backed membrane). Adhered using hot asphalt.

2. **TPO – Thermoplastic Polyolefin** (for physical properties, refer to “Attachment II – TPO Membrane Physical Properties”).

- a. **Sure-Weld TPO Membrane** – 45-, 60-, 72- or 80-mil thick Reinforced Thermoplastic Polyolefin (TPO) membrane. Field membrane sheets are available in rolls 12', 10' or 8' wide by 100' long. Perimeter membrane sheets are available in widths of 6' (used with 12' and 10' wide field sheets) or 4' (used with 8' wide field sheets) by 100' long. Sure-Weld Membrane is available in white, gray or tan. Adhered using contact adhesive.

b. **Fleece-Backed TPO Membrane**

- 1) **Sure-Weld FleeceBACK 100 and 115** – 45- or 60-mil thick Thermoplastic Polyolefin (TPO) membrane laminated to a 55-mil non-woven fleece backing resulting in a total finished sheet thickness of 100 or 115- mils. Membrane sheets are available in rolls 12' or 6' wide by 50' or 100' long. Sure-Weld FleeceBACK Membrane is available in white, gray or tan. Adhered using low rise foam adhesive.
- 2) **Sure-Weld AFX 120 and 135** – 45- or 60-mil thick (white) reinforced Thermoplastic Polyolefin (TPO) laminated to 10 ounce per square yard, non-woven polyester, polypropylene blended fleece resulting in a total finished sheet thickness of 120- or 135-mils. Membrane is available in a width of 12' and a length of 75'. Sure-Weld AFX Membrane is available in white only. Adhered using hot asphalt.

3. **PVC – Polyvinyl Chloride Membrane** (for physical properties, refer to “Attachment III – PVC Membrane Physical Properties”).

Sure-Flex PVC Membrane is available in 50-mil, 60-mil or 80-mil thicknesses.

Membrane sheets are packaged in rolls 40.5" and 81" wide. 50-mil thick membrane is available in lengths of 100', 60-mil is available in 80' lengths (for maximum 15-year warranty) and 80-mil is available in 65' lengths (for maximum 20-year warranty). Adhered using contact adhesive.

a. **Sure-Flex Reinforced PVC Membrane**

Physical properties of the membrane are enhanced by a strong, polyester fabric that is encapsulated between the PVC based top and bottom plies. The combination of the fabric and PVC plies provide Sure-Flex Reinforced PVC membranes with high breaking strength, tearing strength, and puncture resistance. Sure-Flex Membrane is available in white or gray.

b. **Sure-Flex Reinforced FRS PVC Membrane**

Dimensional stability of the membrane is enhanced by fiberglass that is encapsulated between the PVC based top and bottom plies. The combination of fiberglass and PVC plies provide Sure-Flex FRS PVC membranes with enhanced dimensional stability for fully adhered roofing systems using liquid applied bonding adhesives. Sure-Flex Reinforced FRS PVC Membrane is available in white or gray.

C. **EcoStar Steep Slope Roofing Tiles**

Imitation slate or cedar shake tiles that emulate the look and feel of natural slate; made from recycled TPO and EPDM polymers and meet the following properties:

UL Class A or C Fire Resistance
Class 4 Impact Resistance: UL 2218
Nail Pull Through: ASTM D 3163
Prolonged UV Exposure: ASTM G 26-95
Operating Range: -25 to 200° F
Tensile Strength (ASTM D 412): 500 psi
Water Absorption (ASTM D 570): 0% by weight

1. **Majestic Slate Traditional** – 1/4" thick traditional square edge tile that is available in 9 colors and two widths (10" and 12").
2. **EcoStar Designer Series** – 1/4" thick tile with 3 different edge designs (Beaver Tail, Beveled Edge, and Chisel Point) that is available in 9 colors and a 12" width.
3. **Seneca Cedar Shake Tiles** – 3/8" or 3/4" thick wood shake style that is available in 9 colors and 6", 9", and 12" widths.

PART III EXECUTION

3.01 GENERAL

- A. A proper substrate shall be provided by the building owner. The structure shall be sufficient to withstand normal construction loads and live loads.
- B. When feasible, for single-ply membrane applications, begin application at highest roof level and work to lowest point to prevent moisture infiltration and minimize construction traffic on completed sections. This will include completion of all flashings and terminations.

3.02 ROOFING APPLICATION

A. **Single-Ply Roofing Membranes**

1. Install Single-Ply Membrane Roofing in accordance with the written instructions of Carlisle SynTec Incorporated for the material specified.
2. Install Below Grade Waterproofing and auxiliary materials to tie into adjacent waterproofing.
3. Refer to CCW technical manual for specific installation details pertaining to the waterproofing system selected.
 - a. Multiple layers of insulation are recommended with all joints staggered between layers.
 - b. Do not install more insulation/underlayment than can be covered by membrane in the same day.

- c. All insulation boards must be butted together with no gaps greater than 1/4". Gaps greater than 1/4" are not acceptable.
- d. On phased roofing, temporary closures should be provided to prevent moisture infiltration.

B. EcoStar Steep Slope Roofing Tiles

1. Install Steep Slope Roofing Tiles in accordance with the written instructions of EcoStar for the material specified.
2. Refer to CCW technical manual for specific installation details pertaining to the waterproofing system selected.
 - a. Steep Slope Roofing Tiles should only be installed on minimum 1/2" thick plywood, minimum 7/16" thick oriented strand board (OSB), or minimum 1" solid or plank wood decking. Steep Slope Roofing Tiles should not be applied over existing roofing materials. Existing roofing materials must be removed to expose the roof deck prior to installation.
 - b. Prior to installation of the Steep Slope Roofing Tiles, EcoStar's approved underlayment must be installed over the entire deck area, with the exception of all roofedges, valleys, ridges, or hips and any roof projection where EcoStar's ice and water shield must be applied.

END OF SECTION

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Barricoat, Barriseal, Barritech VP, Carlisle, EcoStar, Elastoform Flashing, FleeceBACK, Foil-Grip, Hunter Panels, Insulfoam, Majestic Slate, MiraCLAY, MiraDRAIN, MiraDRI, Pre-Kleened, QuickDRAIN, R-Tech, SecurShield, Seneca Cedar Shake Tiles, Sure-Flex, Sure-Seal, Sure-Weld and Vapor-Lock System are Trademarks of Carlisle Corporation.

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Building Envelope

"Attachment 4.1"

EPDM Membrane Physical Properties

September 2008

A. Sure-Seal (Black) 45 and 60-mil Thick Non-Reinforced EPDM Membrane – Standard and Fire Retardant (FR)

Physical Property	Test Method	ASTM SPEC. (Pass)	Typical	
			45-mil Standard	60-mil FR
Tolerance on Nominal Thickness, %	ASTM D 412	±10	±10	±10
Tensile Strength, min, psi (MPa)	ASTM D 412	1305 (9)	1550 (10.7)	1550 (10.7)
Elongation, Ultimate, min, %	ASTM D 412	300	480	480
Tear Resistance, min, lbf/in (kN/m)	ASTM D 624 (Die C)	150 (26.3)	200 (35.0)	200 (35.0)
Factory Seam Strength, min.	Modified ASTM D 816	Membrane Rupture	Membrane Rupture	Membrane Rupture
Resistance to Heat Aging* Properties after 4 weeks @ 240°F (116°C)	ASTM D 573			
Tensile Strength, min, psi (MPa)	ASTM D 412	1205 (8.3)	1500 (10.3)	1500 (10.3)
Elongation, Ultimate, min, %	ASTM D 412	200	225	225
Tear Resistance, min, lbf/in (kN/m)	ASTM D 624	125 (21.9)	215 (37.6)	215 (37.6)
Linear Dimensional Change, max, %	ASTM D 1204	±1.0	-0.4	-0.4
Ozone Resistance* Condition after exposure to 100 pphm Ozone in air for 168 hours @ 104°F (40°C) Specimen is at 50% strain	ASTM D 1149	No Cracks	No Cracks	No Cracks
Brittleness Temp., max, deg. F (deg. C)*	ASTM D 746	-49 (-45)	-67 (-55)	-67 (-55)
Resistance to Water Absorption* After 7 days immersion @ 158°F (70°C) Change in mass, max, %	ASTM D 471	+8.0, -2.0	+2.0	+2.0
Water Vapor Permeance* max, perm	ASTM E 96 (Proc. B or BW)	0.1	.05	.05
Resistance to Outdoor (Ultraviolet) Weathering* Xenon-Arc, 7560 kJ/m ² total radiant exposure at .70 W/m ² irradiance, 176°F (80°C) black panel temp.	ASTM D 4637 Conditions	No Cracks No Cracking	No Cracks No Cracking	No Cracks No Cracking
* Not a Quality Control Test due to the time required for the test or the complexity of the test. However, all tests are run on a statistical basis to ensure overall long-term performance of the sheeting.				

B. Sure-White (White-on-Black) 60-mil Thick Non-Reinforced EPDM Membrane

Physical Property	Test Method	ASTM SPEC. (Pass)	Typical
Tolerance on Nominal Thickness, %	ASTM D 412	±10	±10
Tensile Strength, min, psi (MPa)	ASTM D 412	1305 (9)	1685 (11.6)
Elongation, Ultimate, min, %	ASTM D 412	300	480
Tear Resistance, min, lbf/in (kN/m)	ASTM D 624 (Die C)	150 (26.3)	200 (35.0)
Factory Seam Strength, min.	Modified ASTM D 816	Membrane Rupture	Membrane Rupture
Resistance to Heat Aging* Properties after 1 week @ 240°F (116°C) Tensile Strength, min, psi (MPa) Elongation, Ultimate, min, % Tear Resistance, min, lbf/in (kN/m) Linear Dimensional Change, max, %	ASTM D 573 ASTM D 412 ASTM D 412 ASTM D 624 ASTM D 1204	 1205 (8.3) 200 125 (21.9) ±1.0	 1550 (10.7) 250 185 (32.4) -0.5
Ozone Resistance* Condition after exposure to 100 pphm Ozone in air for 168 hours @ 104°F (40°C) Specimen is at 50% strain	ASTM D 1149	No Cracks	No Cracks
Brittleness Temp., max, deg. F (deg. C)*	ASTM D 746	-49 (-45)	-67 (-55)
Resistance to Water Absorption* After 7 days immersion @ 158°F (70°C) Change in mass, max, %	ASTM D 471	+8.0, -2.0	+3.6
Water Vapor Permeance* max., perms	ASTM E 96 (Proc. B)	0.1	.05
Resistance to Outdoor (Ultraviolet) Weathering* Xenon-Arc, 7560 kJ/m ² total radiant exposure at .70 W/m ² irradiance, 176°F (80°C) black panel temperature	ASTM D 4637 Conditions	No Cracks No Cracking	No Cracks No Cracking
* Not a Quality Control Test due to the time required for the test or the complexity of the test. However, all tests are run on a statistical basis to ensure overall long-term performance of the sheeting.			

C. Sure-Seal (black) 90-mil Thick

Physical Property	Test Method	SPEC.(Pass)	Typical
Tolerance on Nominal Thickness, %	ASTM D 412	±10	±10
Tensile Strength, min, psi (MPa)	ASTM D 412	1305 (9)	1650 (11.3)
Elongation, Ultimate, min, %	ASTM D 412	300	480
Tear Resistance, min, lbf/in (kN/m)	ASTM D 624 (Die C)	150 (26.3)	195 (34.2)
Resistance to Heat Aging* Properties after 4 weeks @ 240°F (116°C)	ASTM D 573		
Tensile Strength, min, psi (MPa)	ASTM D 412	1205 (8.3)	1500 (10.3)
Elongation, Ultimate, min, %	ASTM D 412	200	225
Tear Resistance, min, lbf/in (kN/m)	ASTM D 624	125 (21.9)	215 (37.6)
Linear Dimensional Change, max, %	ASTM D 1204	±1.0	-0.4
Ozone Resistance* Condition after exposure to 100 pphm Ozone in air for 168 hours @ 104°F (40°C) Specimen is at 50% strain	ASTM D 1149	No Cracks	No Cracks
Brittleness Temp., max, deg. F (deg. C)*	ASTM D 746	-49 (-45)	-67 (-55)
Resistance to Water Absorption* After 7 days immersion @ 158°F (70°C) Change in mass, max, %	ASTM D 471	+8.0, -2.0	+2.0
Water Vapor Permeance* max, perm	ASTM E 96 (Proc. B or BW)	0.10	0.05
Resistance to Outdoor (Ultraviolet) Weathering* Xenon-Arc, 7560 kJ/m2 total radiant exposure at .70 W/m2 irradiance, 176°F (80° C) black panel temp.	ASTM G 155	No Cracks No Crazing	No Cracks No Crazing
* Not a Quality Control Test due to the time required for the test or the complexity of the test. However, all tests are run on a statistical basis to ensure overall long-term performance of the sheeting.			

D. **Sure-Tough (black) 45- and 60-mil Thick**

Physical Property	Test Method	ASTM SPEC. (Pass)	Typical
Tolerance on Nominal Thickness, %	ASTM D 751	±10	±10
Thickness Over Scrim, min, in. (mm)	ASTM D 4637 Annex	.015 (.381)	.045"-.016 (.406) .060"-.020 (.508)
Breaking Strength, min, lbf (N)	ASTM D 751 Grab Method	90 (400)	180 (800)
Elongation, Ultimate, min, %	ASTM D 751 Grab Method	250 **	480 **
Tear Strength, min, lbf (N)	ASTM D 751 B Tongue Tear	10 (45)	30 (132)
Brittleness Temp., max, deg. F (deg. C) *	ASTM D 2137	-49 (-45)	-60 (-51)
Resistance to Heat Aging * Properties after 4 weeks @ 240°F	ASTM D 573		
Breaking Strength, min, lbf (N)	ASTM D 751	80 (355)	200 (890)
Elongation, Ultimate, min, %	ASTM D 751	200 **	250 **
Linear Dimensional Change, max, %	ASTM D 1204	±1.0	-0.7
Ozone Resistance* Condition after exposure to 100 pphm Ozone in air for 168 hours @ 104° F Specimen wrapped around 3" mandrel	ASTM D 1149	No Cracks	No Cracks
Resistance to Water Absorption* After 7 days immersion @ 158°F (70°C) Change in mass, max, %	ASTM D 471	+8.0, -2.0 **	+2.0 **
Resistance to Outdoor (Ultraviolet) Weathering* Xenon-Arc, 7560 kJ/m ² total radiant exposure at .70 W/m ² irradiance, 176°F (80°C) black panel temperature	ASTM D 4637 Conditions	No Cracks No Crazing	No Cracks No Crazing
* Not a Quality Control Test due to the time required for the test or the complexity of the test. However, all tests are run on a statistical basis to ensure overall long-term performance of the sheeting.			
** Specimens to be prepared from coating rubber compound, vulcanized in a similar method to the reinforced product.			

E. **Sure-Tough (black) 75-mil Thick**

Physical Property	Test Method	ASTM SPEC.(Pass)	Typical
Tolerance on Nominal Thickness, %	ASTM D 751	±10	±10
Thickness Over Scrim, min, in. (mm)	ASTM D 4637 Annex	.015 (.381)	.020 (0.508)
Color	N/A	N/A	Gray/Black
Breaking Strength, min, lbf (N)	ASTM D 412 Grab Method	90 (400)	230 (1023)
Elongation, Ultimate, min, %	ASTM D 751 Grab Method	250 **	500 **
Tear Strength, min, lbf (N)	ASTM D 751 B Tongue Tear	10 (45)	70 (311)
Brittleness Temp., max, deg. F (deg. C) *	ASTM D 2137	-49 (-45)	-60 (-51)
Resistance to Heat Aging * Properties after 4 weeks @ 240°F Breaking Strength, min, lbf (N) Elongation, Ultimate, min, % Linear Dimensional Change, max, %	ASTM D 573 ASTM D 751 ASTM D 751 ASTM D 1204	 80 (355) 200 ** ±1.0	 250 (1112) 250 ** -0.7
Ozone Resistance* Condition after exposure to 100 pphm Ozone in air for 168 hours @ 104° F Specimen wrapped around 3" mandrel	ASTM D 1149	No Cracks	No Cracks
Resistance to Water Absorption* After 7 days immersion @ 158°F (70°C) Change in mass, max, %	ASTM D 471	+8.0, -2.0 **	+2.0 **
Hydrostatic Resistance, (min) psi (MPa)	ASTM D 751	380 (2.6)	440 (3.0)
Static Puncture Resistance, lbf (N)	FTM 2031	N/A	>250 (1112)
Resistance to Outdoor (Ultraviolet) Weathering* Xenon-Arc, 7560 kJ/m ² total radiant exposure at .70 W/m ² irradiance, 176°F (80°C) black panel temperature	ASTM D 4637 Conditions	No Cracks No Cracking	No Cracks No Cracking
* Not a Quality Control Test due to the time required for the test or the complexity of the test. However, all tests are run on a statistical basis to ensure overall long-term performance of the sheeting.			
** Specimens to be prepared from coating rubber compound, vulcanized in a similar method to the reinforced product.			

F. **Sure-Seal (black)/Sure-White (white-on-black) FleeceBACK 110 or 115 Membrane**

Physical Property	Test Method	SPEC. (Pass)	Sure-Seal Typical	Sure-White Typical
Tolerance on Nominal Thickness, %	ASTM D 751	±10	±10	±10
Thickness over Fleece, min, in. (mm) 100 mil (2.54 mm) 115 mil (2.92 mm)	ASTM D4637 Annex	.030 (.762) .030 (.762)	.045 (1.143) .060 (1.524)	.045(1.143) .060 (1.524)
Weight 1b/ft ² (kg/m ²) 100 mil (2.54 mm) 115 mil (2.92 mm)			0.29 (1.4) 0.38 (1.9)	0.33 (1.6) 0.42 (2.1)
Breaking Strength, min, lbf(N)	ASTM D751 Grab Method	90 (400)	200 (890)	200 (890)
Elongation, Ultimate, min, %	ASTM D 412	300 **	500 **	500 **
Tearing Strength, min, lbf(N)	ASTM D 751 B Tongue Tear	10 (45)	45 (200)	45 (200)
Brittleness point, max, °F (°C)	ASTM D 2137	-49 (-45)	-75 (-59)	-75 (-59)
Resistance to Heat Aging * Properties after 4 weeks @ 240° F (116°C) for Sure-Seal Properties after 1 week @ 240° F for Sure-White Breaking Strength, min, lbf(N) Elongation, Ultimate, min, % Linear Dimensional Change, max, %	ASTM D 573 ASTM D 751 ASTM D 412 ASTM D 1204	 80 (355) 200 ** ±1.0	 200 (890) 310 ** -0.7	 200 (890) 250 ** -0.7
Ozone Resistance * Condition after exposure to 100 pphm Ozone in air for 168 hours @ 104°F (40°C) Specimen wrapped around 3 inch (7.5 cm) mandrel	ASTM D 1149	No Cracks	No Cracks	No Cracks
Resistance to Water Absorption * After 7 days immersion @ 158°F (70°C) Change in mass, max, %	ASTM D 471	4.0**	2.0 **	3.6 **
Resistance to Outdoor (Ultraviolet) Weathering * Xenon-Arc, 7560 kJ/m ² total radiant exposure at 0.70 W/m ² irradiance 176° F (80°C) black panel temperature	ASTM G 155	No Cracks No Cracking	No Cracks No Cracking	No Cracks No Cracking
* Not a Quality Control Test due to the time required for the test or the complexity of the test. However, all tests are run on a statistical basis to ensure overall long-term performance of the sheeting.				
** Specimens prepared from coating rubber compound.				

G. **Sure-Seal (black) FleeceBACK 145 Membrane**

Physical Property	Test Method	SPEC. (Pass)	Sure-Seal Typical
Tolerance on Nominal Thickness, %	ASTM D 751	±10	±10
Thickness over Fleece, min, in. (mm) 145 mil (3.68 mm)	ASTM D4637 Annex	.080 (2.03)	.090 (2.28)
Weight 1b/ft ² (kg/m ²) 145 mil (3.68 mm)			0.59 (2.37)
Breaking Strength, min, lbf (N)	ASTM D751 Grab Method	90 (400)	250 (1112)
Elongation, Ultimate, min, %	ASTM D 412	300 **	480 **
Tearing Strength, min, lbf (N)	ASTM D 751 B Tongue Tear	10 (45)	60 (266)
Brittleness point, max, °F (°C)	ASTM D 2137	-49 (-45)	-67 (-55)
Resistance to Heat Aging *	ASTM D 573		
Properties after 4 weeks @ 240° F (116°C)			
Breaking Strength, min, lbf (N)	ASTM D 751	80 (355)	200 (890)
Elongation, Ultimate, min, %	ASTM D 412	200 **	255 **
Linear Dimensional Change, max, %	ASTM D 1204	±1.0	-0.7
Ozone Resistance *			
Condition after exposure to 100 pphm Ozone in air for 168 hours @ 104°F (40°C) Specimen wrapped around 3 inch (7.5 cm) mandrel	ASTM D 1149	No Cracks	No Cracks
Resistance to Water Absorption *			
After 7 days immersion @ 158°F (70°C) Change in mass, max, %	ASTM D 471	4.0**	2.0 **
Resistance to Outdoor (Ultraviolet) Weathering *			
Xenon-Arc, 17,640 kJ/m ² total radiant exposure at 0.70 W/m ² irradiance 176° F (80°C) black panel temperature	ASTM G 155 ASTM D 4637 Conditions	No Cracks No Crazing	No Cracks No Crazing
* Not a Quality Control Test due to the time required for the test or the complexity of the test. However, all tests are run on a statistical basis to ensure overall long-term performance of the sheeting.			
** Specimens prepared from coating rubber compound.			

H. Sure-Seal (black) AFX 90 and 105 Membrane

Physical Property	Test Method	SPEC.(Pass)	Typical
Tolerance on Nominal Thickness, %	ASTM D 751	±10	±10
Thickness over Fleece, min, in. (mm) 90 mil (2.286 mm) 105 mil (2.667 mm)	ASTM D4637 Annex	.030 (.762) .045 (1.143)	.045 (1.143) .060 (1.524)
Weight 1b/ft ² (kg/m ²) 90 mil (2.286 mm) 105 mil (2.667 mm)			0.29 (1.4) 0.38 (1.9)
Breaking Strength, min, lbf (N)	ASTM D751 Grab Method	90 (400)	200 (890)
Elongation, Ultimate, min, %	ASTM D 412	300 **	480 **
Tearing Strength, min, lbf (N)	ASTM D 751 B Tongue Tear	10 (45)	45 (200)
Brittleness point, max, °F (°C)	ASTM D 2137	-49 (-45)	-67 (-55)
Resistance to Heat Aging * Properties after 4 weeks @ 240°F (116°C) for Sure-Seal Breaking Strength, min, lbf (N) Elongation, Ultimate, min, % Linear Dimensional Change, max, %	ASTM D 573ASTM D 751 ASTM D 412 ASTM D 1204	80 (355) 200 ** ±1.0	250 (1112) 225 ** -0.7
Ozone Resistance * Condition after exposure to 100 pphm Ozone in air for 168 hours @ 104°F (40°C) Specimen wrapped around 3 inch (7.5 cm) mandrel	ASTM D 1149	No Cracks	No Cracks
Resistance to Water Absorption * After 7 days immersion @ 158°F (70°C) Change in mass, max, %	ASTM D 471	+8.0, -2.0 **	2.0 **
Resistance to Outdoor (Ultraviolet) Weathering * Xenon-Arc, 7560 kJ/m ² total radiant exposure at 0.70 W/m ² , 176°F (80°C) black panel temperature	ASTM G 155	No Cracks No Crazing	No Cracks No Crazing
<p>* Not a Quality Control Test due to the time required for the test or the complexity of the test. However, all tests are run on a statistical basis to ensure overall long-term performance of the sheeting.</p> <p>** Specimens prepared from coating rubber compound.</p>			

Building Envelope

"Attachment 4.2"

TPO Membrane Physical Properties

September 2008

A. Sure-Weld 45- and 60-mil thick TPO Membrane

Property (Metric-SI Units)	Test Method	Property of Unaged Sheet 45 or 60-mil	Property After Aging ⁽¹⁾ 28 days @ 240° F 45 or 60-mil
Tolerance on Nominal Thickness, %	ASTM D 751	±10	
Thickness Over Scrim, in. (mm) 45-mil 60-mil	ASTM D 6878 Optical Method (avg. of 3 areas)	Typical 0.018 (0.457) ±10% 0.024 (0.610) ±10%	
Breaking Strength, min, lbf (kN)	ASTM D 751 Grab Method	225 (1.0) min. 45-mil 320 (1.4) typical 45-mil 250 (1.1) min. 60-mil 360 (1.6) typical 60-mil	225 (1.0) min. 45-mil 320 (1.4) typical 45-mil 250 (1.1) min. 60-mil 360 (1.6) typical 60-mil
Elongation at Break of Fabric, min, %	ASTM D 751	25 typical	25 typical
Tearing Strength, min, lbf (N) 8" by 8" specimen	ASTM D 751 B Tongue Tear	55 (245) min. 130 (578) typical	55 (245) min. 130 (578) typical
Brittleness Point, max, °F (°C)	ASTM D 2137	-40 (-40) min. -50 (-46) typical	
Linear Dimensional Change (shrinkage), % After 6 hours at 158°F (70°C)	ASTM D 1204	+/- .05 max. -0.2 typical	
Ozone Resistance, 100 pphm, 168 hours	ASTM D 1149	No Cracks	No Cracks
Resistance to Water Absorption After 7 days immersion @ 158°F (70°C) Change in mass, max, %	ASTM D 471 (top surface only)	4.0 max. 2.0 typical	
Resistance to microbial surface growth, rating (1 is very poor, 10 is no growth)	ASTM D 3274 2 yr. S. Florida	9 – 10 typical	
Field seam strength, lbf/in. (kN/m) Seam tested in peel	ASTM D1876	25 (4.4) min. 60 (10.5) typical.	
Water vapor permeance, Perms	ASTM E 96	0.10 max. 0.05 typical	
Puncture resistance, lbf (kN) (see supplemental section for additional puncture data)	FTM 101C Method 2031	250 (1.1) min. 45-mil 325 (1.4) typical 45-mil 300(1.3) min. 60-mil 350 (1.6) typ 60-mil	
Resistance to xenon-arc weathering (2) Xenon-Arc, 17,640 kJ/m ² total radiant exposure, Visual condition at 10X	ASTM G 155 0.70 W/m ² 80°C B.P.T.	No Cracks No loss of breaking or tearing strength	
(1) Aging conditions are 28 days at 240° F (116° C) equivalent to 400 days at 176° F (80° C) for breaking strength, elongation, tearing strength, ozone and puncture resistance.			
(2) Approximately equivalent to 14,000 hours exposure at 0.35W/m ² .			

B. Sure-Weld 72- and 80-mil thick TPO Membrane

Property (Metric-SI Units)	Test Method	Property of Unaged Sheet 72 or 80-mil	Property After Aging ⁽¹⁾ 28 days @ 240° F 72 or 80-mil
Tolerance on Nominal Thickness, %	ASTM D 751	±10	
Thickness Over Scrim, min, in. (mm) 72-mil 80-mil	ASTM D 6878 Optical Method (avg. of 3 areas)	Typical 0.030 (0.762) ±10% 0.034 (0.864) ±10%	
Breaking Strength, min, lbf (kN)	ASTM D 751 Grab Method	350 (1.6) min. 72-mil 400 (1.8) typical 72-mil 350 (1.6) min. 80-mil 425 (1.9) typical 80-mil	350 (1.6) min. 72-mil 400 (1.8) typical 72-mil 350 (1.6) min. 80-mil 425 (1.9) typical 80-mil
Elongation at Break of Fabric, min, %	ASTM D 751	25 typical	25 typical
Tearing Strength, min, lbf (N) 8" by 8" specimen	ASTM D 751 B Tongue Tear	55 (245) min. 130 (578) typical	55 (245) min. 130 (578) typical
Brittleness Point, max, °F (°C)	ASTM D 2137	-40 (-40) min. -50 (-46) typical	
Linear Dimensional Change (shrinkage), % After 6 hours at 158°F (70°C)	ASTM D 1204	+/- .05 max. -0.2 typical	
Ozone Resistance, 100 pphm, 168 hours	ASTM D 1149	No Cracks	No Cracks
Resistance to Water Absorption After 7 days immersion @ 158°F (70°C) Change in mass, max, %	ASTM D 471 (top surface only)	4.0 max. 2.0 typical	
Resistance to microbial surface growth, rating (1 is very poor, 10 is no growth)	ASTM D 3274 2 yr. S. Florida	9 – 10 typical	
Field seam strength, lbf/in. (kN/m) Seam tested in peel	ASTM D1876	40 (7.0) min. 60 (10.5) typical	
Water vapor permeance, Perms	ASTM E 96	0.10 max. 0.05 typical	
Puncture resistance, lbf (kN) (see supplemental section for additional puncture data)	FTM 101C Method 2031	350 (1.6) min. 72-mil 400 (1.8) typical 72-mil 400 (1.8) min. 80-mil 450 (2.0) typical 80-mil	
Resistance to xenon-arc weathering (2) Xenon-Arc, 17,640 kJ/m ² total radiant exposure, Visual condition at 10X	ASTM G 155 0.70 W/m ² 80°C B.P.T.	No Cracks No loss of breaking or tearing strength	
(1) Aging conditions are 28 days at 240° F (116° C) equivalent to 400 days at 176° F (80° C) for breaking strength, elongation, tearing strength, ozone and puncture resistance.			
(2) Approximately equivalent to 14,000 hours exposure at 0.35W/m ² .			

C. Sure-Weld FleeceBACK 100 and 115 Membrane

Property	Test Method	Property of Unaged Sheet	Property After Aging (1) 28 days @ 240° F
Thickness of reinforced sheet over fleece, in. (mm) tolerance is ±10	ASTM D 751	0.045 (1.14) – FB 100 0.060 (1.52) – FB 115	
Breaking Strength, min, lbf (kN)	ASTM D 751 Grab Method	300 (1.3) min. - FB100 400 (1.8) typical - FB100 400 (1.8) min. FB115 500 (2.2) typical FB115	300 (1.3) min. - FB100 400 (1.8) typical - FB100 400 (1.8) min. FB115 500 (2.2) typical FB115
Elongation at break of internal fabric, %	ASTM D 751	25 typical	25 typical
Tearing Strength, min, lbf (N) 8" by 8" specimen	ASTM D 751 B Tongue Tear	55 (245) min. 130 (578) typical	55 (245) min. 130 (578) typical
Brittleness Point, °F (°C)	ASTM D 2137	-40 (-40) min. -50 (-46) typical	
Linear Dimensional Change (shrinkage), % After 6 hours at 158°F (70°C)	ASTM D 1204	+/- 0.5 max. -0.2 typical	
Ozone Resistance, 100 pphm, 168 hours	ASTM D 1149	No Cracks	No Cracks
Resistance to Water Absorption After 7 days immersion @ 158°F (70°C) Change in mass, %	ASTM D 471 (fleece removed, edges sealed)	4.0 max. 2.0 typical	
Resistance to microbial surface growth, rating (1 is very poor, 10 is no growth)	ASTM D 3274 2 yr. S. Florida	9 – 10 typical	
Field seam strength, lbf/in. (kN/m) Seam tested in peel	ASTM D1876	40 (7.0) min. 60 (10.5) typical	
Water vapor permeance, Perms	ASTM E 96	0.10 max. 0.05 typical	
Puncture resistance, lbf (kN) (see supplemental section for additional data)	FTM 101C Method 2031	350(1.6) min. - FB100 450 (2.0) typical - FB100 400 (1.8) min. FB115 500 (2.2) typical FB115	350(1.6) min. - FB100 450 (2.0) typical - FB100 400 (1.8) min. FB115 500 (2.2) typical FB115
Resistance to xenon-arc weathering (2) Xenon-Arc, 17,640 kJ/m ² total radiant exposure visual condition at 10X	ASTM G 155 0.70 W/m ² 80°C B.P.T.	No Cracks No loss of breaking or tearing strength	
(1) Aging conditions are 28 days at 240° F (116° C) equivalent to 400 days at 176° F (80° C) for breaking strength, elongation, tearing strength, ozone and puncture resistance.			
(2) Approximately equivalent to 14,000 hours exposure at 0.35 W/m ² irradiance. B.P.T. is black panel temperature.			

D. Sure-Weld FleeceBACK 120 and 135 AFX Membrane

Physical Property	Test Method	Property of Unaged Sheet	Property After Aging ² 28 days @ 240°F
Thickness of reinforced sheet over fleece, in. (mm) (tolerance $\pm 10\%$)	ASTM D 751	.045 (1.143) – AFX 120 .060 (1.524) – AFX 135	
Breaking Strength, min, lbf (N)	ASTM D 751 Grab Method	400 (1.8) min. 500 (2.2) typical	400 (1.8) min. 500 (2.2) typical
Elongation, Ultimate, min, %	ASTM D 751	25 typical	25 typical
Tearing Strength, min, lbf (N) 8 in x 8 in specimen	ASTM D 751 B Tongue Tear	55 (245) min. 130 (578) typical	55 (245) min. 130 (578) typical
Brittleness point, max, °F (°C)	ASTM D 2137	-40 (-40) max. -50 (-46) typical	
Linear Dimensional Change (shrinkage), % After 6 hours at 158°F (70°C) Change in mass, %	ASTM D 1204	+/- 0.5 max. -0.2 typical	
Ozone Resistance*, 100 pphm, 168 hours	ASTM D 1149	No Cracks	No Cracks
Resistance to Water Absorption After 7 days immersion @ 158°F (70°C) Change in mass, max, %	ASTM D 471 (fleece removed, edges sealed)	4.0 max. 2.0 typical	
Resistance to microbial surface growth, rating (1 is very poor, 10 is no growth)	ASTM D 3274 2 yrs. S. Florida	9-10 typical	
Field seam strength, lbf/in. (kN/m) Seam tested in peel	ASTM D 1876	40 (7.0) min. 60 (10.5) typical	
Water vapor permeance, Perms	ASTM E 96	0.10 max. 0.05 typical	
Puncture resistance, lbf (kN) (see supplemental section for additional puncture data)	FTM 101C Method 2031	500 (2.2) min. 615 (2.7) typ. – AFX 120 700 (3.1) typ. – AFX 135	
Resistance to xenon-arc weathering ² Xenon-Arc, 17,640 kJ/m ² total radiant Exposure, visual condition at 10X	ASTM G 26 0.70 W/m ² 80°C B.P.T	No cracks No loss of breaking or tearing strength	
¹ Aging conditions are 28 days at 240°F (116°C) equivalent to 400 days at 176°F (80°C) for breaking strength, elongation, tearing strength, ozone, and puncture resistance. ² Approximately equivalent to 14,000 hours exposure to 0.35 W/m ² irradiance. B.P.T. is black panel temperature.			

Building Envelope

"Attachment 4.3"

PVC Membrane Physical Properties

September 2008

A. Sure-Flex Reinforced PVC Membrane

Sure-Flex Reinforced PVC Membrane			
Physical Property	Test Method	Property of Unaged Sheet	Property After ASTM D3045 aging 56 days @ 176° F
Tolerance on Nominal Thickness, %	ASTM D 751	± 10	
Thickness over scrim, in. (mm) 50-mil & 60-mil 80-mil	ASTM D 4434 Optical Method (avg. of 3 areas)	0.016 (0.406) min. 0.025 (0.635) min.	
Breaking Strength, lbf/in. (kN/m)	ASTM D 751 (Grab Method)	200 (35) min. 300 (53) typical	90% min. retention of original breaking strength
Elongation at Break of fabric, %	ASTM D 751	15 min. 25 typical	90% min. retention of original elongation
Tearing Strength, lbf (N) 8 x 8 in. specimen	ASTM D 751 (B-Tongue Tear)	45 (200) min. 100 (445) typical	
Low Temperature Bend, ° F (° C)	ASTM D 2136	-40 (-40) max. -50 (-46) typical	
Linear Dimensional Change (shrinkage), % After 6 hours at 176° F (80° C)	ASTM D 1204	+/- 0.5 max. -0.3 typical	
Ozone resistance, 100 pphm, 168 hours	ASTM D1149	No cracks	
Resistance to water absorption After 7 days immersion 158° F (70° C) Change in mass, %	ASTM D 570	3.0 max. 2.0 typical	
Field seam strength lbf/in. (kN/m) Seam tested in peel after welding	ASTM D1876	25 (4.4) min. 60 (10.5) typical	
Water vapor permeance, Perms	ASTM E 96	0.10 max. 0.05 typical	
Puncture resistance, lbf (N) (see supplemental section for additional puncture data)	FTM 101C Method 2031	250 (1110) min. 280 (1245) typical 50-mil 320 (1423) typical 60-mil 380 (1690) typical 80-mil	
Resistance to xenon-arc weathering Xenon-Arc, 12,600 kJ/m² total radiant exposure, visual condition at 10X (ASTM D 4434 light & spray cycle)	ASTM G155 0.35 W/m² 63°C B.P.T. (10,000 hours)	No cracks No crazing	
B.P.T. is black panel temperature			

B. Sure-Flex Reinforced FRS PVC Membrane

Sure-Flex Reinforced FRS PVC Membrane			
Physical Property	Test Method	Property of Unaged Sheet	Property After ASTM D3045 aging 56 days @ 176° F
Tolerance on Nominal Thickness, %	ASTM D 638	± 10	
Thickness over scrim, in. (mm) 50-mil & 60-mil 80-mil	ASTM D 4434 Optical Method (avg. of 3 areas)	0.016 (0.406) min. 0.025 (0.635) min.	
Tensile Strength, psi (MPa) (machine & cross-machine direction)	ASTM D 638 (Grab Method)	1500 (10.4) min. 1900 (13.1) typical	90% min. retention of original breaking strength
Elongation at Break, % Machine direction Cross-machine direction	ASTM D 638	250 min. (270 typical) 220 min. (250 typical)	90% min. retention of original elongation
Tear Resistance, lbf(N)	ASTM D 1004	10 (45) min. 12 (53) typical	
Low Temperature Bend at -40° F (-40° C)	ASTM D 2136	Pass	
Linear Dimensional Change (shrinkage), % After 6 hours at 176° F (80° C)	ASTM D 1204	+/- 0.1 max. 0.5 typical	
Ozone resistance, 100 pphm, 168 hours	ASTM D1149	No cracks	
Resistance to water absorption After 7 days immersion 158° F (70° C) Change in mass, %	ASTM D 570	3.0 max. 0.5 typical	
Seam strength, % of tensile strength	ASTM D638	75 min. 80 typical	
Water vapor permeance, Perms	ASTM E 96	0.10 max. 0.05 typical	
Puncture resistance (see supplemental section for additional puncture data)			
Resistance to xenon-arc weathering Xenon-Arc, 12,600 kJ/m ² total radiant exposure, visual condition at 10X (ASTM D 4434 light & spray cycle)	ASTM G155 0.35 W/m ² 63°C B.P.T. (10,000 hours)	No cracks No crazing	
B.P.T. is black panel temperature			