

GEOTECHNICAL EVALUATION  
BEEHIVE CREDIT UNION  
SEC 3600 WEST 13400 SOUTH  
RIVERTON, UTAH  
WT JOB NO. 2137JT072



**Western  
Technologies  
Inc.**

The Quality People  
Since 1955

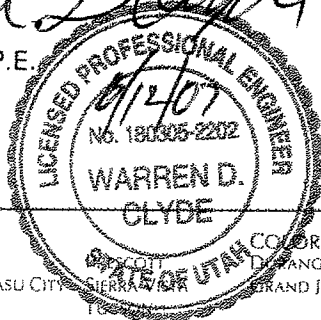
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Prepared for:

**BEEHIVE CREDIT UNION**

**JUNE 12, 2007**

Warren D. Clyde, P.E.  
Principal



Randolf H. Marwig  
Vice President

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June 12, 2007

Beehive Credit Union  
c/o NewGround  
15450 South Outer Forty Drive, Suite 300  
Chesterfield, MO 63017

Attn: Mr. Richard G. Willmann  
Project Development Manager

Re: Geotechnical Evaluation  
Beehive Credit Union  
South East Corner of 3600 South 13400 South  
Riverton, Utah

WT Job No. 2137JT072

Western Technologies, Inc. (WT) has completed the geotechnical evaluation for the proposed Beehive Credit Union to be located at South East Corner of 3600 West 13400 South in Riverton, Utah. This study was performed in general accordance with our proposal number 2137PT108, dated May 11, 2007. The results of our evaluation, including the boring location diagram, boring logs, laboratory test results, and geotechnical recommendations are attached.

We appreciate being of service to you in the geotechnical engineering phase of this project and are prepared to assist you during the construction phases as well. If design conditions change, or if you have any questions concerning this report or any of our materials testing, special inspection, or consulting services, please do not hesitate to contact us. We look forward to working with you on future projects.

Sincerely,  
WESTERN TECHNOLOGIES INC.  
Geotechnical Engineering Services

Warren D. Clyde, P.E.  
Principal

Copies to: Addressee ( 5 )

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## 6.0 RECOMMENDATIONS

### 6.1 General

Recommendations contained in this report are based on our understanding of the project criteria described in Section 2.0, Project Description, and the assumption that the soil and subsurface conditions are those disclosed by the borings. Others may change the plans, final elevations, number and type of structures, foundation loads, and floor levels during design or construction. Substantially different subsurface conditions from those described herein may be encountered or become known. Any changes in the project criteria or subsurface conditions shall be brought to our attention in writing.

### 6.2 Design Considerations

The borings indicate the presence of collapsible soils on the site. The soils may collapse with an increase in moisture content. Structures and related improvements situated on collapsible soils could be subject to relatively large movements if the foundation soils experience an increase in moisture content.

### 6.3 Foundations

Conventional spread-type footings may be used to support the proposed structure. Since the native soils exhibit substantial collapse potential to a depth of 8 to 9 feet below the existing site grades, the footings should bear on engineered fills achieved by removal and recompaction of the soils below footings and interior slabs. The depth and lateral extent of the engineered fills is presented in the **Earthwork** section of this report.

Alternative footing depths and allowable bearing capacities are presented in the following tabulation:

Footing Depth Below Finished Grade (ft)*	Allowable Bearing Capacity (psf)**
1.5 interior	1500
2.5 exterior	1500

\* Finished grade is the lowest adjacent grade for perimeter footings and floor level for interior footings.

\*\* Allowable bearing capacities assume fulfillment of **Earthwork** recommendations.



The allowable bearing capacities apply to dead loads plus design live load conditions. The allowable bearing capacity may be increased by one-third when considering total loads that include wind or seismic. Recommended minimum widths of column and wall footings are 24 inches and 16 inches, respectively.

As an alternate, a partial replacement, soil improvement system, such as stone columns or Geopiers may be used to support the proposed structure. These systems should extend to a minimum depth of 10 feet below the bottom of footings and or slabs. The Location and/or spacing of the columns/piers should be determined by the specialty contractor and structural engineer based upon the anticipated footing loads.

The existing fill on the site should not be used for support of foundations without removal and recompaction.

Thickened slab sections can be used to support interior partitions, provided that:

- loads do not exceed 900 plf,
- thickened sections have a minimum width of 12 inches, and
- thickness and reinforcement are consistent with structural requirements.
- the thickened sections are supported on engineered fill

We anticipate that the total and differential movement of the proposed structure, supported as recommended, should be less than 1 and ½ inch, respectively. Additional foundation movements could occur if water from any source infiltrates the foundation soils. Therefore, proper drainage should be provided in the final design and during construction.

All footings, stem walls, and masonry walls should be reinforced to reduce the potential for distress caused by differential foundation movements. The use of joints at openings or other discontinuities in masonry walls is recommended.

We recommend that the geotechnical engineer or his representative observe the footing excavations before reinforcing steel and concrete are placed. This observation is to assess whether the soils exposed are similar to those anticipated for support of the footings. Any soft, loose or unacceptable soils should be undercut to suitable materials and backfilled with approved fill materials or lean concrete. Soil backfill should be properly compacted.

#### **6.4 Lateral Design Criteria**

Lateral loads may be resisted by concrete interface friction and by passive resistance. For shallow foundations bearing on properly compacted fill at this site, we recommend the following lateral resistance criteria:



materials or conditions. If the owner is concerned about the potential for such contamination, other studies should be undertaken. We are available to discuss the scope of such studies with you.

This geotechnical engineering report includes a description of the project, a discussion of the field and laboratory testing programs, a discussion of the subsurface conditions, and design recommendations as required to satisfy the purpose previously described.

## **4.0 SITE CONDITIONS**

### **4.1 Surface**

The site had previously been stripped of topsoil for the most part. Fill piles were located in the northwest and southeast corners and along the west side of the site. Underground facilities such as septic tanks, cesspools, basements, utilities, and dry wells were not observed. The ground surface was relatively flat. Vegetation consisted of sparse weed cover. Site drainage trended to the south as sheet surface flow.

### **4.2 Subsurface**

As presented on Logs of the borings, surface soils to depths of 14 to 17.5 feet consist of sandy clay. Near surface soils, up to 9 feet had a pinhole structure. The materials underlying the surface soils and extending to the full depth of exploration consisted of interbedded layers of silty sand, clayey sand, and sand with gravel to the total depth explored of 31.5 feet. The existing fill on the site is in piles and appeared to be un-compacted. WT considers this fill to be undocumented.

### **4.3 Groundwater**

Groundwater was not encountered in the full depth of exploration of 31.5 feet at the time of exploration. These observations represent the groundwater conditions at the time of measurements and may not be indicative of other times. Groundwater levels can be expected to fluctuate with varying seasonal and weather conditions, groundwater withdrawal and recharge, local irrigation practices, and future development.

### **4.4 Geology**

The site is located in the Salt Lake Valley east of the Oquirrh Mountain range in the Wasatch Range section of the Middle Rocky Mountains Province. The Wasatch Range trends north-south and includes broad alluvial valley bottoms and low hills in the north and rugged mountains cut by deep valleys in the south. The Property is in an area bounded by the Great Salt Lake to the north, the Oquirrh Mountains to the west, and the



Wasatch Mountains to the east. Most of the area is a plane gently sloping down to the east. The site is located on Quaternary Provo Formation and Younger Shore Facies, which include chiefly sand and gravel, silts and clays in beach deposits, bars, spits, and deltas and possibly Alluvial Deposits consisting of stream alluvium, alluvial fans, and locally, mudflows (Utah Geological Survey, 1983).

#### 4.5 Geologic Hazards

The nearest fault is located approximately 7.5 miles to the east. The maximum credible earthquake that can be generated would have a magnitude of 7. Surface rupture is not expected at this site.

### 5.0 GEOTECHNICAL PROPERTIES & ANALYSIS

#### 5.1 Laboratory Tests

Laboratory test results (see **Appendix B**) indicate that native subsoils near shallow foundation level exhibit moderate compressibility at existing water contents. Significant additional compression occurs when the water content is increased.

Chemical tests were performed on representative samples of the sulfate exposure from the on-site soils is "Negligible" according to Table 4.3.1 *American Concrete Institute Building Code* (ACI 318) which is referenced in paragraph 1904.3 Sulfate Exposures of the *2006 International Building Code*. The tests were performed by American West Analytical Laboratories. The test results are presented in **Appendix B**.

#### 5.2 Field Tests

Native subsoils near shallow foundation level exhibited moderate to high resistance to penetration using the Ring-lined barrel sampling (ASTM D3550). These soils correlate to have moderate to high bearing capacity in their present condition. However, pinhole structure was observed in the samples. This structure is indicative of collapsible soils. Collapsible soils have a sudden settlement potential when a load is applied to the soil and the moisture content increases.

The boring log included in this report are indicators of subsurface conditions only at the specific location and date noted. Variations from the field conditions represented by the boring may become evident during construction. If variations appear, we should be contacted to re-evaluate our recommendations.





**GEOTECHNICAL EVALUATION  
BEEHIVE CREDIT UNION  
SEC 3600 WEST 13400 SOUTH  
RIVERTON, UTAH  
WT JOB NO. 2137JT072**

**1.0 PURPOSE**

This report contains the results of our geotechnical evaluation for the proposed Beehive Credit Union to be located on the South East Corner of 3600 West 13400 South in Riverton, Utah. The purpose of these services is to provide information and recommendations regarding:

- Foundation design parameters, including footing types, depths, allowable bearing capacities, and estimated settlements
- Lateral earth pressures
- Earthwork, including site preparation, fill placement, and suitability of existing soils for fill materials
- Drainage
- Pavements
- Seismic considerations
- Corrosivity
- Excavation conditions
- Slabs-on-grade
- Groundwater
- Geologic hazards
- Other requirements, as stated in the Request for Proposal

Our services included obtaining information on site conditions, performing field and laboratory testing, performing engineering analyses, providing recommendations for use in foundation, floor slab, and on-site pavement design, and presenting earthwork guidelines. Results of the field exploration, field tests, and laboratory tests are presented in the Appendices.

**2.0 PROJECT DESCRIPTION**

Project information supplied by Mr. Richard G. Willmann on May 11, 2007 indicates that the proposed building is to be a 3094 square foot, 1 to 2-story, slab-on-grade structure using wood frame and/or masonry construction. The maximum wall and column loads are assumed to be 2 to 5 kips per linear foot and 75 to 100 kips, respectively. We anticipate that the ground floor level will be at or slightly above existing site grade and that no extraordinary slab criteria are required. On-site asphalt paved areas for parking and driveways and rigid pavement sections for



loading and dumpster areas will be constructed. Final site grading plans were not available at the time of this report. Should our assumptions not be correct, we should be notified immediately.

### **3.0 SCOPE OF SERVICES**

#### **3.1 Field Exploration**

Three borings were drilled to depths ranging from 16.5 to 31.5 feet below existing grade in the proposed building area. In addition, three borings were drilled to depths of 6.5 feet in the proposed paved parking and drive areas. The borings were at the approximate locations shown on the attached Boring Location Diagram. A field log was prepared for each boring. These logs contain visual classifications of the materials encountered during drilling as well as interpolation of the subsurface conditions between samples. Final logs, included in Appendix A, represent our interpretation of the field logs and may include modifications based on laboratory observations and tests of the field samples. The final logs describe the materials encountered, their thicknesses, and the locations where samples were obtained.

The Unified Soil Classification System was used to classify soils. The soil classification symbols appear on the boring logs and are briefly described in Appendix A. Local and regional geologic characteristics were used to estimate the seismic design criteria and evaluate subsidence zones.

#### **3.2 Laboratory Analyses**

Laboratory analyses were performed on representative soil samples to aid in material classification and to estimate pertinent engineering properties of the on-site soils for preparation of this report. Testing was performed in general accordance with applicable ASTM test methods. The following tests were performed and the results are presented in Appendix B.

- Water Content
- Dry Density
- Consolidation/Collapse
- Minus #200 Sieve
- Plasticity
- pH
- Soluble Sulfates Content
- CBR-Value
- Gradation
- Moisture-Density Relationship

#### **3.3 Analyses and Report**

Analyses were performed and this report was prepared for the exclusive purpose of providing geotechnical engineering and/or testing information and recommendations. The scope of services for this project does not include, either specifically or by implication, any environmental assessment of the site or identification of contaminated or hazardous



- Coefficient of Friction..... 0.30
- Passive Pressure..... 250 psf/ft

The frictional resistance and the passive pressure may be combined without reduction in determining the total lateral resistance.

## 6.5 Seismic Considerations

For structural designs based upon the International Building Code 2006, the following criteria will apply. The soil site class is D.  $S_s$ , the spectral acceleration for short periods, is 1.103 g.  $S_1$ , the spectral acceleration for a 1-second period, is 0.445 g.  $F_a$  and  $F_v$ , in accordance with Table 1613.5.3 (1) and 1613.5.4 (2), are 1.04 and 1.44, respectively.

Liquefaction potential at the site is shown as "Very Low" according to the *Selected Critical Facilities and Geologic Hazards, Salt Lake County, Utah* map published by the Utah Geological Survey. Due to the presence of clay soils and dense sand soils observed in the upper 30 feet of soils at the site liquefaction is not a concern.

## 6.6 Conventional Slab-on-Grade Support

Floor slabs can be supported on properly placed and compacted fill or approved natural soils. The slab subgrade should be prepared by the procedures outlined in this report. A minimum 4-inch layer of base course or 3/8 to 3/4 inch clean gravel should be provided beneath all slabs to help prevent capillary rise and a damp slab.

For design of interior slabs-on-grade, we recommend using a modulus of subgrade reaction (k) of 150 pounds per cubic inch (pci) for the on-site re-compacted clay soil.

The use of vapor retarders is desirable for any slab-on-grade where the floor will be covered by products using water based adhesives, wood, vinyl backed carpet, impermeable floor coatings (urethane, epoxy, acrylic terrazzo, etc.) or where the floor will be in contact with moisture sensitive equipment or product. When used, the design and installation should be in accordance with the recommendation given in ACI 302.1R-96.

If moisture sensitive equipment, product, floor coverings, or impermeable floor coverings are to be placed on interior slabs-on-grade, consideration should be given to the use of a vapor retarder. Final determination on the use of a vapor retarder should be left to the slab designer.

All concrete placement and curing operations should follow the American Concrete Institute manual recommendations. Improper curing techniques and/or high slump (high water-cement ratio) could cause excessive shrinkage, cracking or curling. Concrete slabs should be allowed to cure adequately before placing vinyl or other moisture sensitive floor covering.

## 6.7 Drainage

The major cause of soil problems in this vicinity is moisture increase in soils below structures. Therefore, it is extremely important that positive drainage be provided during construction and maintained throughout the life of the proposed development. Infiltration of water into utility or foundation excavations must be prevented during construction. No planters or other surface features that could retain water adjacent to the building should be constructed.

In areas where sidewalks or paving do not immediately adjoin the structure, protective slopes should be provided with an outfall of about 5 percent for at least 10 feet from perimeter walls. Backfill against footings, exterior walls, and in utility and sprinkler line trenches should be well compacted and free of all construction debris to minimize the possibility of moisture infiltration.

If planters and/or landscaping are adjacent to or near the structure, we recommend the following:

- Planters should be sealed.
- Grades should slope away from the structure(s).
- Only shallow rooted landscaping should be used.
- Watering should be kept to a minimum.

## 6.8 Corrosivity

The chemical test results indicate that the sulfate exposure from the site soils is negligible for corrosion to concrete. However, in order to be consistent with standard local practice and for reasons of material availability, we recommend that Type II Portland cement be used for all concrete on and below grade.

## 6.9 Pavements

The on-site clay soils are considered as poor quality materials for support of pavements. The types of traffic anticipated to use the facility include passenger vehicles and small to medium size trucks. On this basis, a daily traffic value of 7 Equivalent 18-kip Single Axle Loads (ESAL) was estimated for passenger car parking and drives (light duty) and a daily traffic value of 20 ESALS were used for major access drives. Based on the California Bearing Ratio Tests performed on the near surface clay soil, a resilient modulus ( $M_r$ ) of 7500 pounds per square inch was assigned to the on-site soil. A reliability value of 85 percent was assigned to the facility that corresponds to occasional interruption of traffic for pavement repairs. Based upon these parameters, the resulting pavement sections according to the AASHTO procedure for a 20-year design life are:

Traffic Area	Asphalt Concrete Pavement (inches)	Untreated Base (inches)	Portland Cement Concrete (inches)	Untreated Base (inches)
Light Duty Parking	3	6	5	4
Major Drives/Drive through	3	8	6	4

The "design life" of a pavement is defined as the expected life at the end of which reconstruction of the pavement will need to occur. Normal maintenance, including crack sealing, slurry sealing, and/or chip sealing, should be performed during the life of the pavement.

Due to the high static loads imposed by parking trucks in loading and unloading areas and at dumpster locations, we recommend that a rigid pavement section be considered for these areas. A minimum 6 inch thick Portland cement concrete pavement over a minimum of 4 inches of untreated base is recommended.

Due to the freeze thaw conditions at the site, Portland cement concrete pavement should be designed with a minimum compressive strength (f'c) of 4000 psi with 6 ± 1% air entrainment.

Bituminous surfacing should be constructed of dense-graded, central plant-mix, asphalt concrete. Base course material should conform with specification requirements for Untreated Base, of the City of Riverton or the Utah Department of Transportation (UDOT) specifications.

Material and compaction requirements should conform to recommendations presented under **Earthwork**. The gradient of paved surfaces should ensure positive drainage. Water should not pond in areas directly adjoining paved sections.

## 7.0 EARTHWORK

### 7.1 General

The conclusions contained in this report for the proposed construction are contingent upon compliance with recommendations presented in this section. Any excavating, trenching, or disturbance that occurs after completion of the earthwork must be backfilled, compacted and tested in accordance with the recommendations contained herein. It is not reasonable to rely upon our conclusions and recommendations if any future unobserved and untested trenching, earthwork activities or backfilling occurs.



Although fills or underground facilities such as septic tanks, cesspools, basements, utilities, and dry wells were not observed, such features might be encountered during construction. These features should be demolished in accordance with the recommendations of the geotechnical engineer. Any loose or disturbed soils resulting from demolition should be removed or recompacted as engineered fill and any excavations should be backfilled in accordance with recommendations presented herein.

## 7.2 Site Clearing

Strip and remove any existing vegetation, organic topsoils, debris, fill and any other deleterious materials from the building and pavement areas. The building area is defined as that area within the building footprint plus 5 feet beyond the perimeter of the footprint. All exposed surfaces should be free of mounds and depressions that could prevent uniform compaction.

## 7.3 Excavation

We anticipate that excavations for shallow foundations and utility trenches for the proposed construction can be accomplished with conventional equipment.

On-site clayey soils will pump or become unworkable at high water contents. Workability may be improved by scarifying and drying. Overexcavation of wet zones and replacement with granular materials may be necessary. The use of lightweight excavation and compaction equipment may be required to minimize subgrade pumping. In addition, the onsite clay soils require tight moisture control in order to achieve the recommended relative densities.

## 7.4 Temporary Excavations and Slopes

Excavations into the on-site soils will encounter a variety of conditions. The individual contractor should be made responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. All excavations should be sloped or shored in the interest of safety following local, and federal regulations, including current OSHA excavation and trench safety standards.

If any excavation, including a utility trench, is extended to a depth of more than 20 feet, it will be necessary to have the side slopes designed by a professional engineer.

As a safety measure, it is recommended that all vehicles and soil piles be kept a minimum lateral distance back from the crest of the slope at least equal to the slope height. The exposed slope face should be protected against the elements.

We recommend that the contractor retain a geotechnical engineer to observe the soils exposed in all excavations and provide engineering design for the slopes. This will provide an opportunity to classify the soil types encountered, and to modify the excavation slopes as necessary. This also allows the opportunity to analyze the stability of the excavation slopes during construction.

#### **7.5 Building Pad Preparation**

Remove existing soils throughout the entire building area to a minimum depth of 9 feet below the existing grade. This includes both foundation and interior floor slab areas. Following the removal, scarify, moisten or dry as required, and recompact the bottom of the excavation to a minimum depth of 10 inches. Refill the excavation with properly compacted engineered fill material. The removal and replacement should extend laterally a minimum of 5 feet beyond the perimeter of the building.

#### **7.6 Foundation Preparation**

Specialized treatment of existing soils within foundation areas is not required where the building pad preparation recommendations are followed. Footings should bear upon properly placed and compacted, engineered fill. If partial soils replacement system is selected, the foundation design and site should be prepared according to the specialty contractors recommendations.

#### **7.7 Conventional Interior Slab Preparation**

Specialized treatment of existing soils within interior slab areas is not required where the building pad preparation recommendations are followed. Interior slabs should bear upon the minimum depth of untreated base or clean gravel over undisturbed, engineered fill. If partial soils replacement system is selected, the under slab soils should be prepared according to the specialty contractors recommendations.

#### **7.8 Exterior Slab Preparation**

Compacted clay subgrade soils may expand due to frost. Therefore, exterior concrete grade slabs may heave, resulting in cracking or vertical offsets. This potential would be greatest where slabs are placed on compacted clayey subgrade soils or in areas where the passage of construction equipment has inadvertently densified subsoils. To reduce the potential for damage, we recommend:

- Use of fill with low expansion potential
- Placement of effective control joints on relatively close centers
- Moisture-density control during placement of subgrade fills
- Provision for adequate drainage in areas adjoining the slabs

- Use of designs which allow vertical movement between the exterior slabs and adjoining structural elements

At doorways and in unheated vestibules where the walkways and interior slabs are at the same elevation, place a minimum of 12 inches of untreated base or  $\frac{3}{4}$  to 2 inch clean gravel under the exterior slabs. This gravel should extend a minimum of 5 feet outside of the doorway.

## 7.9 Pavement Preparation

In order to insure the pavements would not settle due to the collapsible soils on the site, the soils under the pavement sections should be over-excavated and re-compacted as specified for the building areas. However, if some pavement settlement can be tolerated, the collapsible soils beneath the pavement may be left in place and the settlement of the pavement may be minimized by improving only the upper 12 inches of the subgrade soils under the pavement section. After striping, the subgrade should be scarified, moisture conditioned as required, and recompacted for a minimum depth of 12 inches prior to placement of fill. In cut areas the scarification and re-compaction should take place after the cuts are made to the desired grades. Engineered fill can then be placed to bring the subgrade to the desired elevations prior to placement of the pavement sections. Pavement sections should be placed upon firm unyielding subgrades. Any soft or yielding subgrades should be over-excavated and moisture conditioned and re-compacted or be replaced with imported engineered fill materials.

## 7.10 Materials

Clean on-site native soils with low-expansive potentials may be used as fill material for the following:

- foundation areas
- interior slab areas
- pavement areas
- backfill

Granular imported soils may be used as fill for the following:

- pavement areas
- foundation areas and backfill, provided the imported granular soils have a minimum fines content of 35 percent in addition to the following minimum gradation recommendations below.





Imported soils should conform to the following:

- Gradation (ASTM C136):

6"	.....
4"	.....
3/4"	.....
No. 4 Sieve	.....
No. 200 Sieve	.....
50 (max)	.....
100	.....
85-100	.....
70-100	.....
50-100	.....
percent finer by weight	.....

The materials used in the upper 3 feet of the building pad should be reasonable free of rocks or lumps having a particle diameter greater than 6 inches. Acceptance of the quantity of oversize material shall be at the discretion of the geotechnical engineer.

## 7.11 Placement and Compaction

- Place and compact fill in horizontal lifts, using equipment and procedures that will produce recommended water contents and densities throughout the lift.

- Uncompacted fill lifts should not exceed 8 inches when using light compaction equipment and 10 inches with heavy equipment.

- Materials should be compacted to the following:

Minimum Percent	Material Compaction (ASTM D-1557)
95	On-site soil, reworked and fill:
95	Below footings
95	Below slabs-on-grade
95	Below pavement
95	Imported soil:
95	Below footings
95	Below slabs-on-grade
95	Below pavement
95	Below footings
95	Below slabs-on-grade
95	Below pavement
95	Aggregate base course below slabs-on-grade
95	Aggregate base below pavement
90	Nonstructural backfill

On-site clayey soils should be compacted within a water content range of 0 to 2 percent above optimum. Imported and on-site granular soils with low expansion potential should be compacted within a water content range of 3 percent below to 3 percent above optimum.

## 7.12 Compliance

Recommendations for slabs-on-grades, foundations, and pavement elements supported on compacted fills or prepared subgrade depend upon compliance with **Earthwork** recommendations. To assess compliance, observation and testing should be performed under the direction of a geotechnical engineer.

## 8.0 LIMITATIONS

This report has been prepared based on our understanding of the project criteria as described in Section 2.0. Others may make changes in the project criteria during design or construction, and substantially different subsurface conditions may be encountered or become known. The conclusions and recommendations presented herein shall not continue to be valid unless all variations are brought to our attention in writing, and we have had an opportunity to assess the effect such variations may have on our conclusions and recommendations and respond in writing.

The recommendations presented are based upon data derived from a limited number of samples obtained from widely spaced borings. The attached logs are indicators of subsurface conditions only at the specific locations and times noted. The geotechnical engineer necessarily makes assumptions as to the uniformity of the geology and soil structure between borings, but variations can exist. Accordingly, whenever any deviation or change is encountered or become known during design or construction, WT shall be notified in writing. WT shall review the matter, and issue a written response regarding the validity of the conclusions and recommendations presented herein.

This report does not provide information relative to construction methods or sequences. Any person reviewing this report must draw his/her own conclusions regarding site conditions as they relate to the employment or development of construction techniques. This report is valid for one year after the date of issuance unless there is a change in circumstances or discovered variations justifying an earlier expiration of validity. After expiration, no person or entity has any right to rely on this report without further review and reporting by WT under a separate contract. The recommendations contained herein may be based upon government regulations in effect at the time of this report. Future changes or modifications to these regulations may require modification of this report.

## 9.0 OTHER SERVICES

The geotechnical engineer should be retained for a general review of final plans and specifications to evaluate compliance with our recommendations.

The geotechnical engineer should also be retained to provide observation and testing services during excavation, earthwork operations, foundation and construction phases of the project. Observation of footing excavations should be performed prior to placement of reinforcing and concrete to confirm that satisfactory bearing materials are present.

## 10.0 CLOSURE

We prepared this report as an aid to the designers of the proposed project. The comments, statements, recommendations and conclusions set forth in this report reflect the opinions of the authors. These opinions are based upon conditions at the location of specific tests, observations, and data developed to satisfy the scope of services defined by the contract documents. Work on your project was performed in accordance with generally accepted industry standards and practices by other professionals providing similar services in this locality. No other warranty, express or implied, is made.

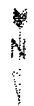






BEEHIVE CREDIT UNION	
Boring Location Diagram	
Western Technologies, Inc.	
Job No. 2137JT072	Plate: 2

Not to scale



Approximate  
Boring Location

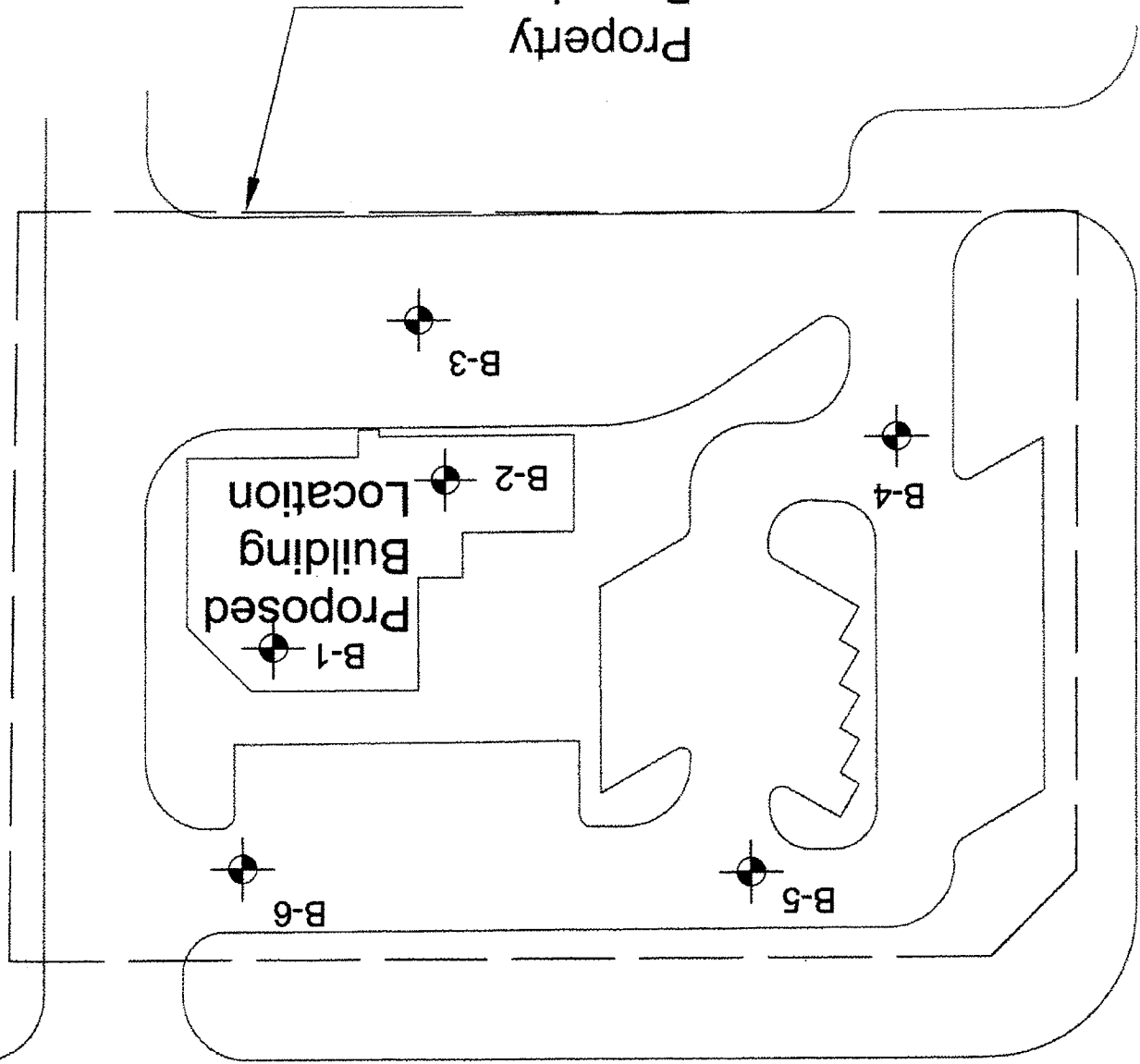


LEGEND

Property  
Boundary

3600 West Street

13400 South Street





<b>Allowable Soil Bearing Capacity</b>	The recommended maximum contact stress developed at the interface of the foundation element and the supporting material.
<b>Backfill</b>	A specified material placed and compacted in a confined area.
<b>Base Course</b>	A layer of specified material placed on a subgrade or subbase.
<b>Base Course Grade</b>	Top of base course.
<b>Bench</b>	A horizontal surface in a sloped deposit.
<b>Caisson</b>	A concrete foundation element cast in a circular excavation which may have an enlarged base. Sometimes referred to as a cast-in-place pier.
<b>Concrete Slabs-On-Grade</b>	A concrete surface layer cast directly upon a base, subbase or subgrade.
<b>Crushed Rock Base Course</b>	A base course composed of crushed rock of a specified gradation.
<b>Differential Settlement</b>	Unequal settlement between or within foundation elements of a structure.
<b>Engineered Fill</b>	Specified material placed and compacted to specified density and/or moisture conditions under observations of a representative of a soil engineer.
<b>Existing Fill</b>	Materials deposited through the action of man prior to exploration of the site.
<b>Existing Grade</b>	The ground surface at the time of field exploration.
<b>Expansive Potential</b>	The potential of a soil to expand (increase in volume) due to absorption of moisture.
<b>Fill</b>	Materials deposited by the actions of man.
<b>Finished Grade</b>	The final grade created as a part of the project.
<b>Gravel Base Course</b>	A base course composed of naturally occurring gravel with a specified gradation.
<b>Heave</b>	Upward movement
<b>Native Grade</b>	The naturally occurring ground surface.
<b>Native Soil</b>	Naturally occurring on-site soil.
<b>Rock</b>	A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting or other methods of extraordinary force for excavation.
<b>Sand and Gravel Base</b>	A base course of sand and gravel of a specified gradation.
<b>Sand Base Course</b>	A base course composed primarily of sand of a specified gradation.
<b>Scarcity</b>	To mechanically loosen soil or break down existing soil structure.
<b>Settlement</b>	Downward movement.
<b>Soil</b>	Any unconsolidated material composed of discrete solid particles, derived from the physical and/or chemical disintegration of vegetable or mineral matter, which can be separated by gentle mechanical means such as agitation in water.
<b>Strip</b>	To remove from present location.
<b>Subbase</b>	A layer of specified material placed to form a layer between the subgrade and base course.
<b>Subbase Grade</b>	Top of subbase.
<b>Subgrade</b>	Prepared native soil surface.

BEEHIVE CREDIT UNION

Definition of Terminology

Western Technologies Inc.

Job No.: 2137JT072 Plate: A-1

PLASTICITY INDEX	TERM
0	NON-PLASTIC
1 - 7	LOW
8 - 25	MEDIUM
Over 25	HIGH

### PLASTICITY OF FINE GRAINED SOILS

NOTE: Only sizes smaller than three inches are used to classify soils

COMPONENT	SIZE RANGE
BOULDERS	Above 12 in.
COBBLES	3 in. - 12 in.
GRAVEL	No. 4 - 3 in. 3/4 in. - 3 in. No. 4 - 3/4 in.
SAND	No. 200 - No. 4 No. 10 - No. 4 No. 40 - No. 10 No. 200 - No. 40
* Fines (Silt or Clay)	Below No. 200

### SOIL SIZES

NOTE: Coarse-grained soils receive dual symbols if they contain 5% to 12% fines (e.g., SW-SM, GP-GC).

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
GW	WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LESS THAN 5% FINES	GRAVELS
GP	POORLY-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LESS THAN 5% FINES	GRAVELS
GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, MORE THAN 12% FINES	GRAVELS
GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, MORE THAN 12% FINES	GRAVELS
SW	WELL-GRADED SANDS OR GRAVELLY SANDS, LESS THAN 5% FINES	SANDS
SP	POORLY-GRADED SANDS OR GRAVELLY SANDS, LESS THAN 5% FINES	SANDS
SM	SILTY SANDS, SAND-SILT MIXTURES, MORE THAN 12% FINES	SANDS
SC	CLAYEY SANDS, SAND-CLAY MIXTURES, MORE THAN 12% FINES	SANDS

### COARSE-GRAINED SOILS LESS THAN 50% FINES\*

NOTE: Fine-grained soils may receive dual classification based upon plasticity characteristics.

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
ML	INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS	SILTS AND CLAYS
CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	SILTS AND CLAYS
OL	ORGANIC SILTS OR ORGANIC SILT-CLAYS OF LOW PLASTICITY	SILTS AND CLAYS
MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDS OR SILTS, ELASTIC SILTS	SILTS AND CLAYS
CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	CLAYS
OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY	CLAYS
PT	PEAT, MUCK AND OTHER HIGHLY ORGANIC SOILS	HIGHLY ORGANIC SOILS

### FINE-GRAINED SOILS MORE THAN 50% FINES

SANDS & GRAVELS	BLOWS PER FOOT*
VERY LOOSE	0 - 4
LOOSE	4 - 10
MEDIUM DENSE	10 - 30
DENSE	30 - 50
VERY DENSE	Over 50

### RELATIVE DENSITY

CLAYS & SILTS	BLOWS PER FOOT*
VERY SOFT	0 - 2
SOFT	2 - 4
FIRM	4 - 8
STIFF	8 - 16
VERY STIFF	16 - 32
HARD	Over 32

### CONSISTENCY

\* Number of blows of 140 pound hammer falling 30 inches to drive a 2 inch O.D. (1 3/8 inch ID) split spoon (ASTM D1586).

### DEFINITION OF WATER CONTENT

DRY
SLIGHTLY DAMP
DAMP
MOIST
WET
SATURATED

BEEHIVE CREDIT UNION

Method of Classification

Western Technologies Inc.

Job No.: 2137JT072 Plate: A-2



Job No.: 2137JT072	Plate: A-3
Western Technologies Inc.	
Boring Log Notes	
BEEHIVE CREDIT UNION	

The number shown in "BORING NO." refers to the approximate location of the same number indicated on the "Boring Location Diagram" as positioned in the field by pacing from property lines and/or existing features.

"TYPE SIZE BORING" refers to the exploratory equipment used in the boring wherein HSA = hollow stem auger.

"N" in Blows/Foot" refers to the number of blows of a 140-pound weight, dropped 30 inches, required to advance a two-inch-outside diameter split-barrel sampler a distance of 1 foot. Standard Penetration Test (ASTM D1586). Refusal to penetration is defined as more than 100 blows per foot.

"R" in Blows/Foot" refers to the number of blows of a 140-pound weight, dropped 30 inches, required to advance a 2.42-inch-inside-diameter ring sampler a distance of 1 foot. Refusal to penetration is considered more than 50 blows per foot.

"Sample Type" refers to the form of sample recovery, in which N = Split-barrel sample, R = Ring sample, G = Grab Sample.

"Dry Density, pcf" refers to the laboratory-determined dry density in pounds per cubic foot. The symbol "NR" indicates that no sample was recovered. The symbol "DU" indicates that determination of dry density was not possible.

"Water Content, %" refers to the laboratory-determined moisture content in percent (ASTM D2216).

"Unified Classification" refers to the soil type as defined by "Method of Soil Classification". The soils were classified visually in the field and, where appropriate, classifications were modified by visual examination of samples in the laboratory and/or by appropriate tests.

These notes and boring logs are intended for use in conjunction with the purposes of our services defined in the text. Boring log data should not be construed as part of the construction plans nor as defining construction conditions.

Boring logs depict our interpretations of subsurface conditions at the locations and on the date(s) noted. Variations in subsurface conditions and soil characteristics may occur between borings. Groundwater levels may fluctuate due to seasonal variations and other factors.

The stratification lines shown on the boring logs represent our interpretation of the approximate boundary between soil types based upon visual field classification. The transition between materials is approximate and may be far more or less gradual than indicated.





DATE DRILLED: 05-22-2007						BORING NO. B-4						LOCATION: See Boring Location Diagram					
DRILL RIG TYPE: CME 55						FIELD ENGR: SC						ELEVATION: Not Determined					
BORING TYPE/SIZE: HSA/6"																	
WATER CONTENT (%)																	
DRY DENSITY (LBS/CU.FT)																	
SAMPLE TYPE																	
SAMPLE																	
BLOWS/FT.																	
DEPTH (FT.)																	
USCS																	
GRAPHIC																	
SOIL DESCRIPTION						CLAY; light brown, stiff to very stiff, dry to damp, pinholes, calcareous, iron oxide stains						Terminated At 6.5 Feet					

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

DATE DRILLED: 05-22-2007		BORING NO. B-1		LOCATION: See Boring Location Diagram																																																															
DRILL RIG TYPE: CME 55		BORING TYPE/SIZE: HSA/6"		FIELD ENGR: SC																																																															
ELEVATION: Not Determined																																																																			
<table border="1"> <thead> <tr> <th rowspan="2">WATER CONTENT (%)</th> <th rowspan="2">DRY DENSITY (LBS/CU.FT)</th> <th rowspan="2">SAMPLE TYPE</th> <th rowspan="2">SAMPLE</th> <th rowspan="2">BLOWS/FT.</th> <th rowspan="2">DEPTH (FT.)</th> <th rowspan="2">USCS</th> <th rowspan="2">GRAPHIC</th> <th rowspan="2">SOIL DESCRIPTION</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>CLAY; some sand, light brown, stiff to very stiff, dry to damp, pinholes</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Iron oxide stains</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>SILTY SAND; some gravel, light brown, medium dense, damp</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>GRAVELLY SAND; brown, very dense, damp</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Terminated At 31.5 Feet</td> </tr> </tbody> </table>						WATER CONTENT (%)	DRY DENSITY (LBS/CU.FT)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FT.)	USCS	GRAPHIC	SOIL DESCRIPTION																	CLAY; some sand, light brown, stiff to very stiff, dry to damp, pinholes									Iron oxide stains									SILTY SAND; some gravel, light brown, medium dense, damp									GRAVELLY SAND; brown, very dense, damp									Terminated At 31.5 Feet
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GROUNDWATER ENCOUNTERED		NO: <input checked="" type="checkbox"/> YES: <input type="checkbox"/>		DATE: 05-22-2007																																																															
NOTES		BEEHIVE CREDIT UNION																																																																	
		Boring Log																																																																	
		Western Technologies Inc.																																																																	
		Job No.: 2137JT072																																																																	
		Plate: A-4																																																																	



THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

DATE DRILLED: 05-22-2007		BORING NO. B-2		FIELD ENGR: SC	
DRILL RIG TYPE: CME 55		BORING TYPE/SIZE: HSA/6"		ELEVATION: Not Determined	
LOCATION: See Boring Location Diagram		SOIL DESCRIPTION		USCS	
WATER CONTENT (%)		DEPTH (FT.)		GRAPHIC	
DRY DENSITY (LBS/CU.FT.)		BLOWS/FT.		CL	
SAMPLE TYPE		N <sub>60</sub>		SC	
SAMPLE		C		SP	
R		29		CLAY; some sand, light brown, stiff to very stiff, dry to damp, pinholes	
R		19		CLAY; some sand, light brown, stiff to very stiff, dry to damp, pinholes	
R		41		CLAY; some sand, light brown, stiff to very stiff, dry to damp, pinholes	
R		18		CLAY; some sand, light brown, stiff to very stiff, dry to damp, pinholes	
R		22		CLAY; some sand, light brown, stiff to very stiff, dry to damp, pinholes	
R		31		CLAY; some sand, light brown, stiff to very stiff, dry to damp, pinholes	
R		17		CLAY; some sand, light brown, stiff to very stiff, dry to damp, pinholes	
R		50/5"		CLAY; some sand, light brown, stiff to very stiff, dry to damp, pinholes	
Terminated At 21.5 Feet		Terminated At 21.5 Feet		Terminated At 21.5 Feet	
BEEHIVE CREDIT UNION		Boring Log		Western Technologies Inc.	
ENCOUNTERED		NO: X YES:		DATE: 05-22-2007	
NOTES		Job No.: 2137JT072		Plate: A-5	



THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

DATE DRILLED: 05-22-2007		BORING NO. B-5		LOCATION: See Boring Location Diagram	
DRILL RIG TYPE: CME 55		FIELD ENGR: SC		ELEVATION: Not Determined	
BORING TYPE/SIZE: HSA/6"		SOIL DESCRIPTION			
WATER CONTENT (%)		* TOP OF BORING: TOPSOIL; sandy clay, organics			
DRY DENSITY (LBS/CU.FT)		CLAY; light brown, stiff to very stiff, dry to damp, pinholes, calcareous, iron oxide stains			
SAMPLE TYPE		Terminated At 6.5 Feet			
SAMPLE		CL			
BLOWS/FT.		USCS			
DEPTH (FT.)		GRAPHIC			
16		5			
25		40			

GROUNDWATER ENCOUNTERED		NO: X YES: _____		DATE: 05-22-2007	
BEEHIVE CREDIT UNION		Boring Log		Western Technologies Inc.	
Job No.: 2137JT072		Plate: A-8			



[illegible]

# SOIL PROPERTIES

Boring No.	Depth (ft.)	Soil Class.	Initial Dry Density (pcf)	Initial Water Content (%)	Consolidation			Plasticity		Particle Size Distribution (%) Passing by Weight					Remarks
					Surcharge (ksf)	Total Compression (%)		Liquid Limit	Plasticity Index	3/4"	#4	#10	#40	#200	
						In-Situ	After Saturation								
B-1	5	CL	87.2	7.2	0.4	-1.12		24	7	100	97	96	94	76.7	2
			0.8	-2.78											
			1.6	-3.38	-14.2										
			3.2		-17.8										
			6.4		-21.6										
			12.8		-25.0										
B-1	7.5	CL	72.2	8.1	6.4			26	10					79.2	
B-1	10	CL	91.1	7.7				32	11					75.5	
B-1	15	CL		32.2				32	14						
B-1	20	SM	100.8	9.5				NP	NP					29.8	
B-1	30	SP						NP	NP					4.6	

Note: Initial Dry Density and Initial Water Content are in-situ values unless otherwise noted.

NP = Non-Plastic

## Remarks

1. Compacted density (approx. 95% of ASTM D698 max. density at moisture content slightly below optimum.)
2. Submerged to approximate saturation.
3. Slight rebound after saturation.
4. Sample disturbance observed.

BEEHIVE CREDIT UNION

Soil Properties

WESTERN TECHNOLOGIES INC.

Job No. 2137JT072

Plate: B-1

# SOIL PROPERTIES

Boring No.	Depth (ft.)	Soil Class.	Initial Dry Density (pcf)	Initial Water Content (%)	Consolidation			Plasticity		Particle Size Distribution (%) Passing by Weight					Remarks	
					Surcharge (ksf)	Total Compression (%)		Liquid Limit	Plasticity Index	3/4"	#4	#10	#40	#200		
						In-Situ	After Saturation									
B-2	7.5	CL	82.61	13.9	0.4	-0.58		49	25						93.7	2
					0.8	-1.47										
					1.7	-2.39										
					3.3											
					6.7											
					13.3											
					6.7											
					3.3											
					1.7											
B-15	15	SC	99.8	16.7				30	10						91.2	
CBR Sample	0-5	CL	Max. Dry Density (pcf)	Opt. Moist. Content (%)	CBR Value											
			119.0	14.0	6											
			116.5	14.0	5.2											

Note: Initial Dry Density and Initial Water Content are in-situ values unless otherwise noted.

NP = Non-Plastic

## Remarks

1. Compacted density (approx. 95% of ASTM D698 max. density at moisture content slightly below optimum.)
2. Submerged to approximate saturation.
3. Slight rebound after saturation.
4. Sample disturbance observed.

BEEHIVE CREDIT UNION

Soil Properties

WESTERN TECHNOLOGIES INC.

Job No. 2137JT072 Plate: B-2





## INORGANIC ANALYSIS REPORT

Client: Western Technologies, Inc.  
Project ID: Beehive Credit Union / 2137JT072

Contact: Warren Clyde

**AMERICAN  
WEST  
ANALYTICAL  
LABORATORIES**

Lab Sample ID: L77984-01  
Field Sample ID: B-1 @ 5'  
Collected: 5/22/2007  
Received: 5/24/2007

463 West 3600 South  
Salt Lake City, Utah  
84115

Analytical Results	Units	Date Analyzed	Method Used	Reporting Limit	Analytical Result
pH @ 25° C	pH units	5/24/2007 10:10:00 AM	9045D	0	7.15 H
Sulfate	mg/kg-dry	5/24/2007 10:00:00 AM	9038	14	52 *

\* Analysis is performed on a 1:1 DI water extract for soils.

H - Sample was received outside of holding time.

(801) 263-8686  
Toll Free (888) 263-8686  
Fax (801) 263-8687  
Email: awal@awal-Labs.com

Kyle F. Gross  
Laboratory Director

Peggy McNicol  
QA Officer





NEWGROUND\*

DESIGN

# ARCHITECT'S SUPPLEMENTAL INSTRUCTIONS

<b>Project:</b>	<b>Riverton, UT</b>	<b>ASI No.:</b>	<b>2</b>
<b>Location:</b>	Beehive Credit Union	<b>Date Of Issuance:</b>	October 29, 2007
<b>Client:</b>	Scott Jorgensen President & CEO	<b>Architect Of Record:</b>	Thomas D. Auer, NCARB
<b>To (Contractor):</b>	Mike O'Donnell, PM NewGround	<b>Project Architect</b>	Y. Chan
<b>Contract Documents Dated:</b>	9/14/07	<b>Project No.</b>	2358

The Work shall be carried out in accordance with the following supplemental instructions issued in accordance with the Contract Documents.

- |   |   |  |
|---|---|--|
| <input type="checkbox"/> Owner Request          | <input checked="" type="checkbox"/> Code Review Requirement | <input type="checkbox"/> RFI # _____           |
| <input type="checkbox"/> Discontinued Item      | <input type="checkbox"/> Civil Engineering Coordination     | <input type="checkbox"/> Unforeseen Conditions |
| <input type="checkbox"/> Document Clarification | <input type="checkbox"/> Structural/MEP Eng. Coordination   | <input type="checkbox"/> Field Observation     |

**Description:** Response to city plan review comments dated 9/27/07 received 10/17/07. Please incorporate the following change into the Project.

## SPECIFICATIONS

### Section 07531

1. Add 2.6.B as follows:

**B. Carlisle G2 Base Sheet (2 layers) or Carlisle FR Base Sheet 2S (2 layers) over plywood/wood deck.**

2. Add 2.7 as follows:

### **2.7 INSULATION MATERIALS**

**A. Insulation: Polyisocyanurate rigid board, top and bottom side finished with fiber glass mat top facer, tapered to slope, conforming to FM4450, Apache (800) 845-3080 "Pyrox" and approved by membrane manufacturer.**

3. Add 3.3.A and 3.4.A-H as follows and renumber subsequent paragraphs appropriately:

### **3.2 BASE SHEET APPLICATION**

**A. Place base sheet directly over wood substrate prior to insulation application. Lap and offset layers per manufacturer's instructions.**

### **3.3 INSULATION APPLICATION**

- A. Place one layer of insulation in accordance with insulation manufacturer's instructions. Lay second layer of insulation with joints staggered from first layer.
- B. Lay insulation boards to moderate contact without forcing joints. Cut insulation to fit neatly to perimeter blocking and around protrusions through roof.
- C. Lay tapered boards for a distance of 24 inches back from roof drains for positive drainage.
- D. Lay tapered board to establish pitch to drains.
- E. Mechanically fasten insulation boards over roof surfaces to obtain FM rating listed.
- F. Tape joints of insulation in accordance with insulation manufacturer's instructions.
- G. Install cant strips to internal corners by adhesive.
- H. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

### **ARCHITECTURAL**

#### Drawing A1

- 1. Added Note pertaining to deferred submittals.

### **MECHANICAL**

#### Drawings M4 and M5

- 1. Added tempering valves.

### **ELECTRICAL**

#### Drawing E4: Power and Systems Plan

- 1. Delete four (4) duct detector remote annunciators from Hallway 124.

#### Drawing E5: Roof Plan

- 1. Delete four (4) duct detectors from RTU's on roof.

**ATTACHMENTS:** Specification Section 07531, Drawings A1, M4, M5, E4 and E5

**ISSUED BY:** Mike Neff, Mike Frank, Mike Lyons, Joe Carter

## SECTION 07531

### SINGLE PLY ROOFING - FULLY ADHERED

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Mechanically fastened insulation with fully adhered membrane roofing system, and flexible flashings for roofs.

##### 1.2 REFERENCES

- A. FM 4470 (Factory Mutual Engineering Corporation) - Roof Assembly Classifications.
- B. UL 790 - Fire Hazard Classifications.

##### 1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 01300.
- B. Product Data: For sheet membrane, elastic flashing, joint cover sheet, and joint and crack sealants, with temperature range for application of membrane.
- C. Shop Drawings: Detailing special joint or termination conditions and conditions of interface with other materials. Provide diagram indicating layout of tapered insulation, and paver pattern.

##### 1.4 SUBMITTALS FOR INFORMATION

- A. Submit under provisions of Section 01300.
- B. Manufacturer's Installation Instructions: Indicating typical details and directions, including special precautions required for seaming membrane.
- C. Manufacturer's Certificates: Letter certifying that products meet or exceed specified requirements. Letter of approval of installer. Both letters on manufacturer's letterhead, signed by an officer of the company.
- D. Manufacturer's Field Reports: Submit under provisions of Section 01400.
- E. Reports: Indicate procedures followed, ambient air and surface temperatures, humidity, wind velocity during application, and installation deficiencies.

##### 1.5 QUALITY ASSURANCE

- A. Applicator: Company specializing in installation of sheet roofing membranes with three years documented experience, approved by membrane manufacturer.

- B. Perform Work in accordance with manufacturer's instructions.
- C. Water to freely drain completely from roof surfaces without ponding.

#### 1.6 WARRANTY

- A. Provide manufacturer's 20 year Total System Warranty covering both labor and material with no dollar limitation. Certification is required with bid submittal indicating the manufacturer has reviewed and agreed to all current wind regulations.
- B. Pro-rated System Warranties shall not be accepted.
- C. Evidence of the manufacturer's warranty reserve shall be included as part of the project submittals for the specifier's approval.

#### 1.7 PREINSTALLATION CONFERENCE

- A. Convene a preinstallation conference one week prior to commencing work of this Section.
- B. Require attendance of parties directly affecting work of this Section
- C. Review conditions of installation, installation procedures, and coordination required with related work.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store products on site under provisions of Section 01600.
- B. Store materials in weather protected environment clear of ground and moisture. Protect foam board from direct sunlight exposure.

#### 1.9 ENVIRONMENTAL REQUIREMENTS

- A. Section 01600 - Material and Equipment: Environmental conditions affecting products on site.
- B. Do not apply roofing membrane during inclement weather and ambient temperatures below 40 degrees F or above 90 degrees F.
- C. Do not apply roofing membrane to damp or frozen deck surface.
- D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

#### 1.10 COORDINATION

- A. Coordinate the work with the installation of associated metal flashings, as the work of this section proceeds.

## PART 2 PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS - MEMBRANE

- A. Carlisle Design "A"
- B. Firestone "Adhered"
- C. Substitutions: Under provisions of Section 01600.

### 2.2 MEMBRANE MATERIALS

- A. Membrane: .060 inch thick EPDM, maximum width available rolls.
- B. Seaming Materials: As recommended by membrane manufacturer.

### 2.3 ADHESIVE MATERIALS

- A. Surface Conditioner and Membrane Adhesives: As recommended by membrane manufacturer.
- B. Thinner and Cleaner: As recommended by adhesive manufacturer, compatible with sheet membrane.

### 2.4 SEAM SPLICE TAPE

- A. Splice tape as recommended by membrane manufacturer.

### 2.5 FLASHINGS

- A. Flexible Flashing: 60 mil thick EPDM; tensile strength of 1200 psi; elasticity of 50 percent with full recovery without set; black color; manufactured by roofing manufacturer.
- B. Prefabricated Control or Expansion Joint Flashing: Closed cell foam backing, including sheet counterflashings, as recommended by membrane manufacturer.

### 2.6 ACCESSORIES

- A. Sealants: As recommended by membrane manufacturer.
- B. **Carlisle G2 Base Sheet (2 layers) or Carlisle FR Base Sheet 2S (2 layers) over plywood/wood deck.**

### 2.7 INSULATION MATERIALS

- A. **Insulation: Polyisocyanurate rigid board, top and bottom side finished with fiber glass mat top facer, tapered to slope, conforming to FM4450, Apache (800) 845-3080 "Pyrox" and approved by membrane manufacturer.**

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify deck is clean and smooth, free of depressions, waves, or projections, properly sloped to drain. Verify flutes of steel deck are clean and dry.
- B. Verify roof openings and penetrating elements through roof are solidly set, wood nailing strips are in place. Verify deck is supported and secured.
- C. Verify deck surfaces are dry and free of snow or ice.
- D. Beginning installation means acceptance of substrate.

### **3.2 MEMBRANE INSTALLATION**

- A. Install membrane in accordance with manufacturer's instructions.
- B. Seal to adjoining surfaces.
- C. Continue membrane up vertical surfaces minimum 6 inches and over tops of parapets, unless otherwise noted.

### **3.3 BASE SHEET APPLICATION**

- A. Place base sheet directly over wood substrate prior to insulation application. Lap and offset layers per manufacturer's instructions.

### **3.4 INSULATION APPLICATION**

- A. Place one layer of insulation in accordance with insulation manufacturer's instructions. Lay second layer of insulation with joints staggered from first layer.
- B. Lay insulation boards to moderate contact without forcing joints. Cut insulation to fit neatly to perimeter blocking and around protrusions through roof.
- C. Lay tapered boards for a distance of 24 inches back from roof drains for positive drainage.
- D. Lay tapered board to establish pitch to drains.
- E. Mechanically fasten insulation boards over roof surfaces to obtain FM rating listed.
- F. Tape joints of insulation in accordance with insulation manufacturer's instructions.
- G. Install cant strips to internal corners by adhesive.



- H. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

### 3.5 FLASHING INSTALLATION

- A. Seal items penetrating membrane with counterflashing membrane material.
- B. Install flashings. Seal watertight to membrane.
- C. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or moving.

### 3.6 PROTECTION

- A. Protect finished installation under provisions of Section 01500.
- B. After installation, close off area to prevent unauthorized traffic.

### 3.7 MANUFACTURER'S FIELD QUALITY CONTROL SERVICES

- A. Perform field inspections under provisions of Section 01400.
- B. Provide manufacturer's field representative services to inspect and approve substrate surfaces, materials' application, and finished installation.

END OF SECTION

## Riverton City Plan Correction List

### 2006 International Building Code Plan Review

9/28/07	1st Review Received 9/27/07
Business Name	Beehive Credit Union
Building Address	3600 West & 13400 South
Building Area	3,879 square feet main floor 896 square feet Drive through Canopy
Total building area	1,296 square feet Covered Entry Canopy
Stories	1
Const, Type	V-B
Height	14 feet
Fire Sprinklered	No
Occupancy	B
Occupant load	38
Separated uses	No
Use	Credit Union

Owner	Beehive Credit Union	
Architect	Thomas Auer Architects	636-898=8100
Engineer	Cowell Engineering	314-644=4002

The following items were found to be in violation of codes, unclear, missing from plans or need further explanation. Please make corrections on plans and prepare a plan review response letter indicating where on plans and what type of corrective action was taken. When all corrections have been made, the plans will be approved and the plan correction list will be attached to the approved plans and become part of the approved construction documents. Provide two complete sets of plans with all corrections for final approval.

#### Site Plan

- ✓1 Provide soils report
- ✓2. Show on site plan the location of accessible route from accessible building entrance to accessible parking area and to public way. .
- ✓3; Show slope and cross slope of sidewalks , walkways, accessible route, ( 1-20 max slope and 1-48 cross slope also the slope and cross slope ( 1-48 ) for the accessible access aisle, accessible parking stalls, Show the slopes not just elevations or percentages
- ✓4. Provide curb ramp section
- ✓6. Provide a level landing with not more than a 2 % slope on the exterior side of all exterior exit discharge doors

- ✓ 7. Provide one 11 feet in width van accessible parking stall with a 5 feet in width access aisle  
Any other combination is not acceptable other than 8 feet access aisle and 8 feet van accessible stall
- ✓ 8. Provide van accessible and accessible stall with accessible signs and posts
- ✓ 9. Provide 5 x 5 level landing and access clearance for second exit door from credit union.

#### Plan review

- ✓ 10. Provide name of manufacturer's water resistive barrier to be installed
- ✓ 11. Provide a vestibule at exterior exit discharge door ( 2<sup>nd</sup> exit ) to the exterior unless it can be shown that the room or space is less than 3,000 square feet as per the Comcheck for this building. 2006 IECC or as an option latest addition of ASHRAE 90.1 2004 Edition which does not require vestibules in buildings under 4 stories
- ✓ 12. Provide 30 inch minimum coverage for all footings
- ✓ 13. Show all wood framing sill plates stud walls etc 8 inches above the earth or show alternative protection method as allowed by 2006 IBC
- ✓ 14. Provide tempered water to all wash basins included lunch room. Provide ICC listed mixing valve or water temperature limiting device or mixing valve 2003 IPC 607.1
- ✓ 15. Provide mechanical connection from roof top equipment to roof structure not just roof curb or roof sheathing capable of resisting all subject loads
- ✓ 16. Show or verify a 42 inch parapet wall measured from roof surface has been provided at roof edge by roof hatch and all roof top equipment that is less than 10 feet from roof edge 2006 IMC .
- ✓ 17. Weather protect any exposed gas line on exterior of building
- ✓ 18. Provide detail of gas line connection to each gas appliance showing the sediment trap and if a 2lb system a gas regulator and test tee
- ✓ 19. Provide the name and UL listed class C roof covering assembly for structure. Such assembly include both the membrane roofing and foam plastic roof insulation which both must be tested together as an assembly.
- ✓ 20. Provide flashing details for EIFS, cultured stone veneer, stone veneer, EIFS and their intersections as prescribed by the 2006 IBC Base, windows, ledgers
- ✓ 21. Provide name and type of water resistive barrier to be installed behind stone & brick veneer, EIFS

22. Provide ICC Evaluation report for cultured stone veneer if installed and provide installation detail to show correct application
23. Provide ICC Evaluation Report EIFS to be installed and manufacture to provided detailed installation for any horizontal applications EIFS adhesively installed must have special inspection
- ✓ 24. Suspended ceilings must have seismic bracing for suspended ceilings as per ASCE 7 requirements . List or show all requirements
25. Provide insulation thickness and R value of all duct insulation above suspended ceiling and all other various insulation that is to be installed through out the building .
26. Provide foundation base flashing and weep screed or both for cultured stone veneer or stone veneer and install in a manner that will allow water to escape As shown detail is not acceptable 2 A6 A 6
28. Provide ICC ES Report for EIFS system to be installed and provide special inspection if system is to be direct applied or adhesively applied? Show water drainage drip fittings or flashings at all vertical wall terminations of EIFS systems , Provide report and verify that report or direct applied application requires special inspection and provide name of special inspection agency
31. Any exposed insulation with combustible facings must show that facings meet a flame spread rating of 50 and smoke development of 450 2/A.6 A 6
32. Architect to list all requested deferred submittals on title page of plans.
- ✓ 33. Provide duct detector shut down in all duct systems with over 2000 CFM unless other wise justified .
- 35 Provide all exterior window ,door and storefront manufactures installation and flashing & caulking details
36. Any recessed light installed in the building exterior envelope must be ICC approved and gasketed etc for IECC requirements. Show design envelope
- ✓ 37. Provide name of approved fabricator for all welded or fabricator structural components for this structure.
- ✓ 38. Provide uffer ground for electrical system
- ✓ 43. Show all exterior electrical receptacles to have bubble covers.
- ✓ 44. Provide trap primers for all restroom floor drains
- ✓ 45. Provide engineer stamped truss detail at or before framing inspection

Resubmit.

Thank you

Jody L. Hilton

Cell 801-557-6843



CARLISLE'S  
**SURE-SEAL**

# **Code Approval Guide**

**Underwriters Laboratories  
Factory Mutual**

January 2007

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# **CARLISLE SYNTEC INCORPORATED**

## **CODE APPROVAL GUIDE**

January 2007

### **INTRODUCTION**

This Code Approval Guide addresses both general information pertaining to Underwriters Laboratories (UL) and Factory Mutual (FM) test criteria as well as specific UL and FM code approvals achieved with Carlisle's Design "A" Adhered, Design "B" Ballasted and Mechanically-Fastened EPDM Roofing Systems. Various independent test laboratory results along with national building code approvals are also identified in this guide. Code approvals available with Carlisle's FleeceBACK™, Hot Mopped and Sure-Weld™ Roofing Systems are identified in separately published Code Approval Guides.

Code ratings are categorized by roof system type (Adhered, Ballasted, Mechanically-Fastened) and are separated into 2 sections; UL Approvals and FM Approvals. Underwriters Laboratories rated roof assemblies are grouped according to deck type (non-combustible or combustible) and are further categorized by the severity of fire exposure (Class A, B or C). Factory Mutual approved assemblies are categorized according to deck type and the specific type of construction (new, tear-off or retrofit). These ratings can also be found at the Factory Mutual web site using RoofNAV (free subscription) at <http://roofnav.fmglobal.com/roofnav/login.aspx>. In addition to the standard requirements needed to obtain specific FM ratings, various enhancements, which are also required for strict FM compliance are also included in this guide (i.e., additional perimeter insulation securement for Adhered Roofing Systems and additional perimeter membrane securement for Mechanically-Fastened Systems).

The listed assemblies contained in this guide are grouped generically based on deck classification. Specific substrate requirements for each Carlisle Roofing System can be identified in the respective Carlisle Specifications.

In the UL and FM Approvals throughout this guide, when multiple layers of insulation are referenced, the product listed first identifies the insulation directly below the membrane. For example; a listing of HP Recovery Board/Polyisocyanurate indicates the HP Recovery Board is installed directly under the membrane. A listing of Gypsum Board/Polystyrene indicates the Gypsum Board is installed directly under the membrane.

The Table of Contents on the following page identifies the sections contained in this publication.

# Code Approval Guide

January 2007

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# General Guidelines for Underwriters Laboratories and Factory Mutual Code Compliance

These guidelines are intended to focus on the essential criteria to be followed when an Underwriters Laboratories (UL) and/or Factory Mutual (FM) approved assembly is specified. Generally, the Carlisle published specifications reflect the minimum requirements necessary to obtain the applicable Carlisle warranty. **Code requirements are not specifically covered in the Carlisle specifications and are considered to be above and beyond the provisions of the Carlisle warranty.**

Individuals specifying an approved assembly or selecting various products to achieve a specific UL/FM rating must recognize the importance of ensuring proper component selection to fully comply with the most current listings published. **All materials used in the roofing system must be UL and/or FM approved and must have been tested together as part of a complete roofing assembly.**

Individual components may be UL and/or FM approved but may not have been tested together as part of a rated roofing assembly. As an example, not all FM approved fasteners are approved with all FM approved insulations on fully adhered roofing systems. Only those components, which have been tested together, in conjunction with a specific roofing assembly, can be used to obtain a UL and/or FM rating.

In addition to the code approval listings in this guide, information pertaining to approved assemblies can also be referenced in the following directories:

1. *Underwriters Laboratories Roofing Materials and Systems Directory* (for external Class A, B and C fire ratings)
2. *Underwriters Laboratories Fire Resistance Directory* (for internal hourly fire ratings - P Numbers)
3. *Factory Mutual Approval Guide* (Class 1-60, 75, 90, 105, 120, 135, 150, 165, 180, etc.)

**Note:** If Factory Mutual is the insurance underwriter for a project, the local FM office must be contacted for specific system requirements.

## Underwriters Laboratories and Factory Mutual Clarifications/Enhancements:

### A. Underwriters Laboratories

1. The criteria required to obtain **UL external fire ratings** (Class A, B or C) can be identified in this guide and/or the current published *UL Roofing Materials and Systems Directory*. UL ratings approved for use on combustible decks are also acceptable on non-combustible decks.
2. For **UL internal fire ratings** (hourly constructions - P Numbers), the current published UL Fire Resistance Directory **must be referenced for specific criteria on insulation types, thermal barrier requirements, ceiling protection, etc.**

### B. Factory Mutual

Prior to the purchase of any component, consult the respective manufacturer to verify their current approval status with FM. Some manufacturers rely on multiple sources to supply a specific product and all of their sources may not carry FM approval. To ensure FM compliance, the product must have been supplied by an FM approved source or manufacturer and must be approved by FM as part of the assembly.

Specific information concerning **structural deck requirements** (brand name, span capacity, securement criteria, etc.) **must be referenced in the current Factory Mutual RoofNAV program and FM Loss Prevention Data Sheet 1-29.** In general, all fasteners used for the securement of roof insulation and membrane must penetrate the top flutes of the steel deck. On Mechanically-Fastened Roofing Systems, field sheets shall be oriented perpendicular to the steel roof deck flutes. Standard steel decks cannot be less than 22 gauge. Other insulated assemblies which are less than 22 gauge are identified in the current published FM Approval Guide.

## SUMMARY

Due to complexity of the code documents and the variety of information that must be reviewed, it is important to consult with Carlisle and other respective manufacturers concerning the most current available approvals.

- **Prior to project bid** - Products specified by the architect must be thoroughly investigated to determine if the specified rating can be achieved and local building codes must be consulted regarding any additional requirements.
- **Prior to installation** - Project managers should review the code requirements with field construction personnel to ensure compliance with project requirements.

**Upon completion of the roofing installation, each project is inspected by a Carlisle Technical Representative to ensure compliance with Carlisle's current specification requirements for the issuance of the applicable warranty. However, this inspection is not for the purpose of verifying code compliance.**

## Underwriters Laboratories Approvals Design "A" Adhered Roofing Systems

UL Class "A"							
Deck Type	Insulation (3)(4) (UL Classified)	Insulation Thickness	Bonding Adhesive	Maximum Slope/Membrane Type (1)(2)			
				FR .045", .060" or .090"	Std. Reinf. Or Sure- Tough	FR Reinf.	Sure- White .060"
<b>Non-Combustible and Combustible</b> (For combustible decks, gypsum board must be installed beneath insulation listed) (5)	Carlisle HP Recovery Board	1/2"-3"	90-8-30A	1"	3/4"	2-1/2"	1-1/2"
			Aqua Base 120		1"		
	Carlisle HP Recovery Board/Polyiso	1/2" Min./ Any	90-8-30A	1"	3/4"	2-1/2"	1-1/2"
			Aqua Base 120		1"		
	Carlisle HP Recovery Board/Polystyrene (6)	1/2" Min./ Any	90-8-30A	1"	3/4"	1"	1"
			Aqua Base 120		1"		
	OSB or OSB/Polyiso	7/16"/Any	90-8-30A	1"	3/4"	2-1/2"	2-1/2"
	OSB/Polystyrene/ Gypsum Board (6)	7/16"/Any/ 1/2"	90-8-30A	1"	3/4"	2"	1"
	Carlisle Polyiso HP-H, HP-DWD	Any	90-8-30A	1/2"	1/2"	3/4"	1/2"
			Aqua Base 120				
	Hunter Panels H-Shield, H-Shield-DWD	Any	90-8-30A Aqua Base 120	1/2"	1/2"	3/4"	1/2"
<b>Non-Combustible</b> Existing Roof to remain (7)	None	N/A	90-8-30A	1/2"	1/2"	1/2"	1/2"
<b>New Construction:</b> Approved Cellular Concrete, Poured Structural Concrete Pre-Cast Concrete with Grouted Joints	None	N/A	90-8-30A	Any	3/4"	4"	1-1/2"
			Aqua Base 120	1"	1"	2-1/2"	1/2"
<b>Combustible</b>	Carlisle Polyiso HP-DWD (8)	3" Min	90-8-30A	1/2"	1/2"	3/4"	1/2"
			Aqua Base 120				
	Hunter Panels H-Shield- DWD (8)	3" Min	90-8-30A				
			Aqua Base 120				
	Polyiso listed above over 2- layers Carlisle FR Base Sheet 2S	Any/ 2-layers	90-8-30A	1/2"	1/2"	3/4"	1/2"
	Carlisle Dens-Deck Prime	1/4" Min.	90-8-30A	Any	3/4"	4"	1-1/2"
			Aqua Base 120	2"	2"	3"	1"
	Carlisle Dens-Deck Prime/Polyiso	1/4" Min./ Any	90-8-30A	Any	3/4"	4"	1-1/2"
			Aqua Base 120	2"	2"	3"	1"
	Carlisle Dens-Deck Prime/ Polystyrene	1/4" Min./ Any	90-8-30A	Any	3/4"	4"	1"
			Aqua Base 120	2"	2"	3"	

**Notes:**

- (1) The specified membrane may be coated with EM-8 Hypalon® Coating in accordance with Carlisle's Specifications. The deck slope is limited to a 3-1/2" maximum **or the maximum slope specified for construction without coating**, whichever is less.
- (2) The specified membrane may be coated with a maximum of two coats of Sure-Seal Acrylic Coating applied at the rate of 1-1/2 gal/sq/coat and maintain the slope of the uncoated assembly.
- (3) Insulation may be mechanically fastened, attached with FAST™ Adhesive, Type III or IV hot asphalt or UL approved cold adhesive.
- (4) 7/16" thick non-veneer, APA rated oriented strand board (OSB) may be substituted for Carlisle HP Recovery Board in all listed assemblies. The fastening pattern for the OSB must conform with Carlisle Detail A-27-D.
- (5) Minimum 1/2" thick gypsum board can be a classified or unclassified material with a minimum weight of 1.84 pounds per square foot. 1/4" thick Georgia Pacific Dens-Deck, Sound Deadening Board (minimum weight of 1.09 pounds per sq. ft.) or 2-layers of Carlisle FR Base Sheet 2S(max. slope can not exceed 2") may be substituted for 1/2" thick gypsum board **beneath the insulation. On Retrofit/No Tearoff projects, where the existing roof is Class A rated, the gypsum board can be eliminated.** Existing roofs that are Class B or C rated require use of gypsum board to achieve a Class A rating, otherwise, the roofing system will retain the existing UL rating.
- (6) Assembly not permitted on combustible decks even with gypsum board or 2 layers of Carlisle FR Base Sheet 2S underneath.
- (7) Min. Class C rated type III or IV Smooth Asphalt BUR, Modified Bitumen or Mineral Surfaced Cap Sheet to remain.
- (8) Insulation joints (bottom layer) must be staggered a minimum of 6 inches from joints in wood deck.

## Underwriters Laboratories Approvals Design "A" Adhered Roofing Systems

UL Class "B"							
Deck Type	Insulation (3)(4)(5)	Insulation Thickness	Bonding Adhesive	Maximum Slope/Membrane Type (1)(2)			
				FR .045", .060" or .090"	Std. Reinf. or Sure-Tough	FR Reinf.	Sure-White .060"
<b>Combustible</b>	Polyiso listed on previous page/G2 Base Sheet (6)	1-1/2" Min./ G2 Base Sheet	90-8-30A	1/2"	1/4"	1"	1/2"
	<b>Carlisle</b> HP Recovery Board/Polyiso/ G2 Base Sheet (6)	1/2" Min./ 1" Min./ G2 Base Sheet	90-8-30A	1"	3/4"	1"	1"
	<b>Carlisle</b> HP Recovery Board/G2 Base Sheet (6)	1" Min./ G2 Base Sheet	90-8-30A				
	<b>Carlisle</b> HP-DWD	1.9" Min.	90-8-30A	1/2"	1/2"	1/2"	1/2"
	<b>Hunter Panels</b> H-Shield-DWD						

**Notes:**

- (1) The specified membrane may be coated with EM-8 Hypalon® Coating in accordance with Carlisle's Specifications.
- (2) The specified membrane may be coated with a maximum of two coats of Sure-Seal Acrylic Coating applied at the rate of 1-1/2 gal/sq/coat and maintain the slope of the uncoated assembly
- (3) Insulation may be mechanically fastened, attached with FAST Adhesive, Type III or IV hot asphalt or UL approved cold adhesive.
- (4) 7/16" thick non-veneer, APA rated oriented strand board (OSB) may be substituted for Carlisle HP Recovery Board in all listed assemblies. The fastening pattern for the OSB must conform to Carlisle Detail A-27-D.
- (5) Insulation joints (bottom layer) are to be staggered a minimum of 6" from joints in the wood deck.
- (6) Acceptable G2 Base Sheets can be one of the following: Celotex Type G2 Vaporbar GB, GAF Gafglas No. 75 Base Sheet, Manville Glasbase, Owens Corning Perma Ply No. 28, Tamko Glass Base. Carlisle FR Base Sheet 2S is also acceptable.

Existing UL Rating To Remain				
Deck Type	Insulation	Insulation Thickness	Bonding Adhesive	Maximum Slope FR .045", .060" or .090" and Sure-White Membrane
<b>Combustible</b> - Minimum Class "C" rated Type III or IV Smooth Asphalt BUR, Mineral Cap or Modified Bitumen to remain	None	N/A	90-8-30A	1/2"

# Factory Mutual Approvals Design "A" Adhered Roofing Systems

## Insulation Mechanically Attached

Deck Type (1)	Insulation (2)(3)(4)(5)	FM Class 1A-60 Thickness	FM Class 1A-90 Thickness	Bonding Adhesive	Maximum Slope/Membrane Type			
					FR .045", .060" or .090"	Std. Reinf. or Sure- Tough	FR Reinf	Sure- White .060"
<b>New Construction or Tearoff:</b> Steel (Min. 22 ga.) Struct. Concrete Wood (6) Tectum (7) Gypsum (Tearoff only) (8)  <b>Retrofit- No Tearoff (9):</b> Struct. Concrete Gypsum (8)	<b>Carlisle Polyiso HP-H</b>  <b>Hunter Panels H-Shield</b>	1"-12"	1"-12"	90-8-30A	1/2"	1/2"	2"	1/2"
				Aqua Base 120	3/4"		1"	

## FM Class 1A-150

### Insulation Mechanically Attached (10)

Deck Type	Insulation (2)(3)(4)(5)	Thickness (11)	Bonding Adhesive	Maximum Slope/Membrane Type			
				FR .045", .060" or .090"	Std. Reinf. or Sure-Tough	FR Reinf	Sure-White .060"
<b>New Construction or Tearoff</b> Steel (Min. 22 ga.)	<b>Carlisle</b> Polyiso HP-H	2" - 12"	90-8-30A	1/2"	1/2"	2"	1/2"

#### Notes:

- (1) Specific information concerning structural deck requirements (brand names, span capacity, securement criteria, etc.) must be referenced in the current FM Approval Guide and FM Loss Prevention Data Sheet 1-29.
- (2) Additional insulation fastening is required at perimeters and corners in accordance with FM Loss Prevention Data Sheets 1-28 and 1-29.
- (3) In lieu of mechanical securement, insulation may be attached with Sure-Seal FAST 100 Adhesive to new/tearoff structural concrete or FM approved Tectum decks. Refer to page 7 -9 for FM ratings using FAST 100 Adhesive.
- (4) For FM approvals using hot asphalt for insulation attachment, refer to page 10 for applicable requirements.
- (5) For FM approvals using Versigrip or OlyBond 500 BA Insulation Adhesive, refer to page 11-15 for applicable requirements.
- (6) On FM approved wood decks, minimum 1/4" thick gypsum board must be installed beneath the insulations listed.
- (7) FM approved Tectum decks must be minimum 2" thick. Fasteners must penetrate the deck a minimum of 1-1/2" for Class 1-60 and 2" for Class 1-90.
- (8) Existing gypsum decks must be FM approved. Fasteners must penetrate the deck a minimum of 1-1/2" for Class 1-60 and 1-90.
- (9) Existing roof must be FM Class 1 rated.
- (10) Insulation fastened with 20 fasteners and plates per 4' x 8' insulation board in the field of the roof.
- (11) Top layer must be 2" thick.

# Factory Mutual Approvals Design "A" Adhered Roofing Systems

## Insulation Mechanically Attached

Deck Type (1)	Insulation (2)(3)(4)(5)(6)	FM Class 1A-60 & 1A-90 Thickness	Bonding Adhesive	Maximum Slope/Membrane Type			
				FR .045", .060" or .090"	Std. Reinf. Or Sure-Tough	FR Reinf.	Sure-White .060"
<b>New Construction or Tearoff:</b> Steel (Min. 22 ga.) Struct. Concrete Wood (9) Tectum (10) Gypsum (11) (Tearoff only)  <b>Retrofit- No Tearoff (12):</b> Struct. Concrete Gypsum (11)	<b>Carlisle HP Recovery Board</b>  <b>Carlisle Deck Prime (13)</b>  Min. 1/2" <b>HP Recovery Board</b> or Min. 1/4" <b>Carlisle Dens-Deck Prime (12)</b> Over: Polyisocyanurate UCI Thermapink 18 or 25 (7) DOW Styrofoam(7) Contour Taper Tile EPS (7)(8) Perform 1,2 or Plus EPS(7)(8) Arcor FM-1 or MB EPS(7)(8) Dylite EPS (1 lb.)(7)(8) Dylite EPS (1.25 lb.)(7)(8) Styropor EPS (1 lb.)(7)(8) Styropor EPS (1.25 lb)(7)(8) Huntsman EPS(7)(8)	1/2" Min.	90-8-30A	1-1/2"	3/4"	3-1/2"	1-1/2"
		1/4" Min.					
		Previous Page 3/4" - 12" 3/4" -10.5" 1/2" - 8" 1" - 8" 2" - 4.5" 1" - 8" 1" - 6.5" 2" - 6.25" 2" - 5" 1" - 8"	Aqua Base 120	1-3/4"	1"	2-1/2"	1-3/4"
<b>Retrofit- No Tearoff (12):</b> Steel (Min. 22 ga.) Wood (9) Tectum (10)	<b>Carlisle HP Recovery Board</b> (No additional insulation permitted)	1/2" - 1"	90-8-30A	1-1/2"	3/4"	3-1/2"	1-1/2"
			Aqua Base 120	1-3/4"	1"	2-1/2"	1-3/4"
	<b>Carlisle Polyiso HP-H</b>	1" max	90-8-30A	1/2"	1/2"	2"	1/2"
			Aqua Base 120	3/4"		1"	

**Notes:**

- (1) Specific information concerning structural deck requirements (brand names, span capacity, securement criteria, etc.) must be referenced in the current FM Approval Guide and FM Loss Prevention Data Sheet 1-29.
- (2) Additional insulation fastening is required at perimeters and corners in accordance with FM Loss Prevention Data Sheets 1-28 and 1-29.
- (3) In lieu of mechanical securement, insulation may be attached with Sure-Seal FAST 100 Adhesive to new/tearoff structural concrete or FM approved Tectum decks. Refer to page 7 -9 for FM ratings using FAST 100 Adhesive.
- (4) For FM approvals using hot asphalt for insulation attachment, refer to page 10 for applicable requirements.
- (5) For FM approvals using Versigrip or OlyBond 500 BA Insulation Adhesive, refer to page 11-15 for applicable requirements.
- (6) 7/16" thick non-veneer, APA rated oriented strand board (OSB) may be substituted for Carlisle HP Recovery Board in all assemblies. For applications directly over steel decks, a thermal barrier of 3/4" thick perlite or 5/8" thick Type "X" gypsum board is required beneath OSB.
- (7) On steel decks, a thermal barrier of FM approved perlite or gypsum board (Type "X" or Type "C") is required under these insulations. For specific thermal barrier requirements, consult the respective insulation manufacturer or refer to the current published FM Approval Guide.
- (8) EPS insulation must be supplied by FM approved AFM, ARCO, BASF or Huntsman bead manufacturer.
- (9) On FM approved wood decks, minimum 1/4" thick gypsum board must be installed beneath the insulations listed. Polystyrene insulations must incorporate 1/4" gypsum board in addition to standard thermal barrier requirements.
- (10) FM approved Tectum decks must be minimum 2" thick. Fasteners must penetrate the deck a minimum of 1-1/2" for Class 1-60 and 2" for Class 1-90.
- (11) Existing gypsum decks must be FM approved. Fasteners must penetrate the deck a minimum of 1-1/2" for Class 1-60 and 1-90.
- (12) Existing roof must be FM Class 1 rated.
- (13) Direct application is acceptable only over Wood Decks. Application over wood deck does not require 2 layers of gypsum board.

## Factory Mutual Approvals Design "A" Adhered Roofing Systems

### FM Class 1A-660 Rating - Insulation Attachment to Structural Concrete with FAST 100 Adhesive

Deck Type	Insulation	Insulation Thickness	Maximum Slope			
			FR .045", .060" or .090"	Std. Reinf or Sure- Tough	FR Reinf.	Sure- White .060"
New Construction/ Tearoff: Structural Concrete	Carlisle Polyiso HP-H	1"-12"	1/2"	1/2"	2"	1/2"
	Hunter Panels H-Shield	1" - 12"				
	Carlisle HP Recovery Board Carlisle HP Recovery Board over Polyiso Carlisle HP Recovery Board over Extruded Polystyrene(1)  Carlisle Dens-Deck Prime over Polyiso or Extruded Polystyrene (1)	1/2" Min. 1/2" Min/ See above 1/2" Min./ (See FM Approval Guide) 1/4" Min./See Above	1-1/2"	3/4"	3-1/2"	1-1/2"

### FM Class 1A-660 Rating – Utilizing Carlisle 725 Vapor Retarder/Primer Insulation Attachment to Structural Concrete with FAST 100 Adhesive

Deck Type	Insulation	Maximum Slope			
		FR .045", .060" or .090"	Std. Reinf or Sure-Tough	FR Reinf.	Sure-White .060"
New Construction/ Tearoff: Structural Concrete	Polyisocyanurate (thickness listed above) set in FAST Adhesive over Carlisle 725 Vapor Retarder (2)(3)	1/2"	1/2"	2"	1/2"
	1/2" HP Recovery Board over Polyisocyanurate (thickness listed above) set in FAST Adhesive over Carlisle 725 Vapor Retarder (2)(3)	1-1/2"	3/4"	3-1/2"	1-1/2"

### FM Class 1A-645 Ratings Insulation Attachment to Structural Concrete with FAST 100 Adhesive

Deck Type	Insulation	Insulation Thickness	Maximum Slope			
			FR .045", .060" or .090"	Std. Reinf or Sure-Tough	FR Reinf.	Sure- White .060"
New Construction/ Tearoff: Structural Concrete	Carlisle HP Recovery Board /EPS *	1/2"/FM Approved	1-1/2"	3/4"	3-1/2"	1-1/2"
	Dens-Deck Prime/EPS *	Min. 1/4"/FM Approved				

\* EPS must be FM approved and manufactured from BASF, Huntsman or Nova Beads.

**Notes:**

- (1) Extruded Polystyrene must be Owens Corning Foamular, Dow Styrofoam or Pactiv GreenGuard (unfaced).
- (2) Prior to installing Carlisle 725 Vapor retarder, apply Carlisle 702 Primer as outlined in Carlisle's most current Specifications.
- (3) Approved Polyiso insulation includes Carlisle Polyiso HP-H or Hunter H-Shield.

# Factory Mutual Approvals Design "A" Adhered Roofing Systems

## FM Class 1A-375 Ratings

OSB Composite Insulation Adhered to Structural Concrete with **FAST 100 Adhesive**

Deck Type	Insulation	Insulation Thickness	Maximum Slope			
			FR .045", .060" or .090"	Std. Reinf or Sure-Tough	FR Reinf.	Sure- White .060"
<b>New Construction/ Tearoff:</b> Structural Concrete	<b>Carlisle</b> Polyiso HP-H/ OSB Composite	1.9" - 4"	1-1/2"	3/4"	3-1/2"	1-1/2"
	<b>Hunter</b> H-Shield NB (Polyiso/OSB Composite)					

## FM Class 1A-150 Rating

Insulation Attachment to Tectum with **FAST 100 Adhesive**

Deck Type (1)	Insulation	Insulation Thickness	Maximum Slope			
			FR .045", .060" or .090"	Std. Reinf or Sure- Tough	FR Reinf.	Sure- White .060"
<b>New Construction/ Tearoff:</b> Tectum (2" min. deck thickness)	<b>Carlisle</b> Polyiso HP-H	1" - 12"	1/2"	1/2"	2"	1/2"
	<b>Hunter</b> H-Shield	1" - 12"				

**Notes:**

- (1) FM approved minimum 2" thick by 31" wide Tectum deck secured to minimum 1/4" thick steel supports spaced a maximum of 3' on center with two Construction Fasteners, Inc. 2" diameter metal plates and #14 Dekfast Fasteners per panel per support. Screws are driven into 7/32" diameter pilot holes and are spaced 7-1/2" from panel edges. Additional deck fastening required at perimeters and corners per FM Loss Prevention Data Sheet 1-28.



## Factory Mutual Approvals Design "A" Adhered Roofing Systems

<b>FM Class 1A-90 Ratings</b> <b>Base Layer Insulation Mechanically Fastened;</b> <b>Top Layer of Insulation Attached with FAST 100 Adhesive (1)</b>					
Deck Type (2)	Insulation	Maximum Slope			
		FR .045", .060" or .090"	Standard Reinforced or Sure- Tough	FR Reinforced	Sure-White .060"
<b>New Construction or Tearoff:</b> Steel (Min. 22 gauge) Wood (3) Tectum (4) Gypsum (5) (Tearoff Only)	<b>Base layer</b> of 1/2" thick Dens-Deck/Dens-Deck Prime (6) or FM approved Polyisocyanurate insulation (minimum thickness listed on previous page) mechanically fastened to the deck per standard FM Class 1-90 requirements (including enhancements at perimeters and corners).	1-1/2" with top layer of HP Recovery Board or Dens-Deck Prime	3/4" with top layer of HP Recovery Board or Dens-Deck Prime	3-1/2" with top layer of HP Recovery Board or Dens-Deck Prime	1-1/2" with top layer of HP Recovery Board or Dens-Deck Prime
	<b>Top Layer</b> of minimum 1/2" thick Carlisle HP Recovery Board or 1/4" thick Dens-Deck Prime or FM Approved Polyisocyanurate (from page 5) secured over base layer with FAST Adhesive	1/2" with top layer of Polyiso	1/2" with top layer of Polyiso	2" with top layer of Polyiso	1/2" with top layer of Polyiso

**Notes:**

- (1) FAST Adhesive shall be applied in accordance with Carlisle Specifications.
- (2) Specific information concerning structural deck requirements (brand names, span capacity, securement criteria, etc.) must be referenced in the current FM Approval Guide and FM Loss Prevention Data Sheet 1-29.
- (3) On FM approved wood decks, minimum 1/4" thick gypsum board must be installed beneath the insulation listed.
- (4) FM approved Tectum decks must be minimum 2" thick. Insulation fasteners must penetrate the deck a minimum 1-1/2" for FM 1-60 ratings.
- (5) Existing gypsum decks must be FM approved. Insulation fasteners must penetrate the deck a minimum of 1-1/2".
- (6) 1/2" Dens-Deck Prime must be fastened to the deck at 1 per 2 square feet.

## Factory Mutual Approvals Design "A" Adhered Roofing Systems

**FM Class 1A-300 Rating - Insulation Attachment with Hot Asphalt (1)**

Deck Type	Insulation	Insulation Thickness	Maximum Slope			
			FR .045", .060" or .090"	Std.Reinf or Sure-Tough	FR Reinf.	Sure-White .060"
<b>New Construction/ Tearoff:</b> Structural Concrete	<b>Carlisle Polyiso HP-H</b>	1"-12"	1/2"	1/2"	2"	1/2"
	<b>Hunter Panels H-Shield</b>	1" - 12"				
	<b>Carlisle HP Recovery Board</b>	1/2" Min.	1-1/2"	3/4"	3-1/2"	1-1/2"
	<b>Carlisle HP Recovery Board over Polyiso</b>	1/2" Min/ See above				
	<b>Carlisle Dens-Deck Prime over Polyiso</b>	1/2" Min/ See Above				

**FM Class 1A-90 Ratings  
Base Layer Insulation Mechanically Fastened;  
Top Layer of Insulation Attached with Hot Asphalt (1)**

Deck Type (2)	Insulation	Maximum Slope			
		FR .045", .060" or .090"	Standard Reinforced or Sure-Tough	FR Reinforced	Sure-White .060"
<b>New Construction or Tearoff:</b> Steel (Min. 22 gauge) Wood (3) Tectum (4) Gypsum (5) (Tearoff Only)	<b>Base layer</b> of 1/2" thick Dens-Deck/Dens-Deck Prime (6) or FM approved Polyisocyanurate insulation (minimum thickness listed above) mechanically fastened to the deck per standard FM Class 1-90 requirements (including enhancements at perimeters and corners).	1-1/2" with top layer of HP Recovery Board or Dens-Deck Prime	3/4" with top layer of HP Recovery Board or Dens-Deck Prime	3-1/2" with top layer of HP Recovery Board or Dens-Deck Prime	1-1/2" with top layer of HP Recovery Board or Dens-Deck Prime
	<b>Top Layer</b> of minimum 1/2" thick Carlisle HP Recovery Board, Dens-Deck Prime or FM Approved Polyisocyanurate (listed above) secured over base layer with hot asphalt	1/2" with top layer of Polyiso	1/2" with top layer of Polyiso	2" with top layer of Polyiso	1/2" with top layer of Polyiso

**Notes:**

- (1) Hot asphalt must be Type III or IV applied at a temperature within 25° F of EVT at the rate of 20-25 pounds per square.
- (2) Specific information concerning structural deck requirements (brand names, span capacity, securement criteria, etc.) must be referenced in the current FM Approval Guide and FM Loss Prevention Data Sheet 1-29.
- (3) On FM approved wood decks, minimum 1/4" thick gypsum board must be installed beneath the insulations listed.
- (4) FM approved Tectum decks must be minimum 2" thick. Fasteners must penetrate the deck a minimum 2".
- (5) Existing gypsum decks must be FM approved. Insulation fasteners must penetrate the deck a minimum of 1-1/2".
- (6) 1/2" thick Dens-Deck or Dens-Deck Prime must be fastened to the deck at 1 per 2 square feet.

# Factory Mutual Approvals

## Design "A" Adhered Roofing Systems

### FM Class 1A-210 Rating

#### Insulation Attachment to Structural Concrete with Versigrip Insulation Adhesive (1)

Deck Type	Insulation	Insulation Thickness	Maximum Slope			
			FR .045", .060" or .090"	Std. Reinf or Sure-Tough	FR Reinf.	Sure-White .060"
New Construction/ Tearoff: Structural Concrete	Carlisle Polyiso HP-H	1.5"-12"	1/2"	1/2"	2"	1/2"
	Hunter H-Shield	1.5"-12"				

### FM Class 1A-210 Ratings

#### Insulation Attachment to Structural Concrete with Versigrip Insulation Adhesive (1)

Deck Type	Insulation	Insulation Thickness	Maximum Slope			
			FR .045", .060" or .090"	Std. Reinf or Sure-Tough	FR Reinf.	Sure-White .060"
New Construction/ Tearoff: Structural Concrete	Carlisle HP Recovery Board	1/2"	1-1/2"	3/4"	3-1/2"	1-1/2"
	Carlisle HP Recovery Board/Polyiso	1/2"/See above				
	Carlisle Dens-Deck Prime	Min. 1/4"				
	Carlisle Dens-Deck Prime/Polyiso	Min. 1/4"/See above				

### FM Class 1A-135 Ratings

#### Insulation Attachment to Structural Concrete with Versigrip Insulation Adhesive (1)

Deck Type	Insulation	Insulation Thickness	Maximum Slope			
			FR .045", .060" or .090"	Std. Reinf or Sure-Tough	FR Reinf.	Sure-White .060"
New Construction/ Tearoff: Structural Concrete	Carlisle HP Recovery Board /EPS *	1/2"/FM Approved	1-1/2"	3/4"	3-1/2"	1-1/2"
	Carlisle Dens-Deck Prime/EPS *	Min. 1/4"/FM Approved				

\* EPS must be FM approved AFM Contour Taper Tile or Perform 1 EPS

#### Notes:

- 1) Versigrip Insulation Adhesive is applied in continuous 1/2" wide beads spaced a maximum of 12" on center to the substrate in the field of the roof. Insulation is placed over adhesive and walked into place.

# Factory Mutual Approvals Design "A" Adhered Roofing Systems

## FM Class 1A-240 Rating

### Insulation Attachment to Structural Concrete with OlyBond 500 BA Insulation Adhesive (1)

Deck Type	Insulation	Insulation Thickness	Maximum Slope			
			FR .045", .060" or .090"	Std.Reinf or Sure- Tough	FR Reinf.	Sure- White .060"
New Construction/ Tearoff: Structural Concrete	Carlisle Polyiso HP-H	1.5"-12"	1/2"	1/2"	2"	1/2"
	Hunter H-Shield	1.5"-12"				
	Carlisle Dens-Deck Prime Over Polyisocyanurate	Min. 1/4"/ See Above	1-1/2"	3/4"	3-1/2"	1-1/2"

## FM Class 1A-555 Ratings

### Insulation Attachment to Structural Concrete with OlyBond 500 BA Insulation Adhesive (1)

Deck Type	Insulation	Insulation Thickness	Maximum Slope			
			FR .045", .060" or .090"	Std. Reinf or Sure-Tough	FR Reinf.	Sure- White .060"
New Construction/ Tearoff: Structural Concrete	Carlisle Dens-Deck Prime/Extruded Polystyrene (2)	Min. 1/4"/FM Approved	1-1/2"	3/4"	3-1/2"	1-1/2"

## FM Class 1A-240 Ratings

### Insulation Attachment to Structural Concrete with OlyBond 500 BA Insulation Adhesive (1)

Deck Type	Insulation	Insulation Thickness	Maximum Slope			
			FR .045", .060" or .090"	Std. Reinf or Sure-Tough	FR Reinf.	Sure- White .060"
New Construction/ Tearoff: Structural Concrete	Carlisle HP Recovery Board	1/2"	1-1/2"	3/4"	3-1/2"	1-1/2"
	Min. 1/2" Carlisle HP Recovery Board over: Polyisocyanurate Extruded Polystyrene (2) EPS *	See Page 12 FM Approved FM Approved				
	Carlisle Dens-Deck Prime/EPS *	Min. 1/4"/FM Approved				

\* EPS must be FM approved and manufactured from Western Insulfoam or Western EPS (Min. 2" thick).

#### Notes:

- OlyBond 500 BA Insulation Adhesive is applied in continuous 3/4" wide beads spaced a maximum of 12" on center to the substrate in the field of the roof. Insulation is placed into adhesive after it is allowed to rise and string prior to walking and rolling the board into place. Reference Carlisle's Technical Data Bulletin (TDB) for installation requirements.
- Extruded Polystyrene must be Owens Corning Foamular 250 (Min. 1" thick)

## Factory Mutual Approvals Design "A" Adhered Roofing Systems

### FM Class 1A-90 Rating - Insulation Attachment to Tectum with OlyBond 500 BA Insulation Adhesive (1)

Deck Type (2)	Insulation	Insulation Thickness	Maximum Slope			
			FR .045", .060" or .090"	Std.Reinf or Sure- Tough	FR Reinf.	Sure- White .060"
<b>New Construction/ Tearoff:</b> Tectum (2" min. deck thickness)	<b>Carlisle Polyiso HP-H</b>	1.5" - 12"	1/2"	1/2"	2"	1/2"
	<b>Hunter Panels H-Shield</b>	1.5" - 12"				
	<b>Carlisle HP Recovery Board</b>	1/2" Min.	1-1/2"	3/4"	3-1/2"	1-1/2"
	Min. 1/2" <b>Carlisle HP</b> Recovery Board or Min. 1/4" <b>Carlisle Dens-Deck Prime</b> Over: Polyisocyanurate Extruded Polystyrene(3) Expanded Polystyrene*	See Above FM Approved FM Approved				

\* EPS must be FM approved and manufactured from Western Insulfoam or Western EPS (Min. 2" thick).

**Notes:**

- (1) OlyBond 500 BA Insulation Adhesive is applied in continuous 1/2" wide beads spaced a maximum of 12" on center to the substrate in the field of the roof. Insulation is placed into adhesive after it is allowed to rise and string prior to walking and rolling the board into place. Reference Carlisle's Technical Data Bulletin (TDB) for installation requirements.
- (2) FM approved minimum 2" thick by 31" wide Tectum deck secured to minimum 1/4" thick steel supports spaced a maximum of 3' on center with two Construction Fasteners, Inc. 2" diameter metal plates and #14 Dekfast Fasteners per panel per support. Screws are driven into 7/32" diameter pilot holes and are spaced 7-1/2" from panel edges. Additional deck fastening required at perimeters and corners per FM Loss Prevention Data Sheet 1-28.
- (3) Extruded Polystyrene must be Owens Corning Foamular (Min. 2" thick).

# Factory Mutual Approvals Design "A" Adhered Roofing Systems

## FM Class 1A-90 Ratings

### Base Layer Insulation Mechanically Fastened;

### Top Layer of Insulation Attached with OlyBond 500 BA Insulation Adhesive (1)

Deck Type (2)	Insulation	Maximum Slope			
		FR .045", .060" or .090"	Standard Reinforced or Sure- Tough	FR Reinforced	Sure-White .060"
<b>New Construction or Tearoff:</b> Steel (Min. 22 gauge) Wood (3) Tectum (4) Gypsum (5) (Tearoff Only)	<b>Base layer</b> of 1/2" thick Dens-Deck/Dens-Deck Prime (6) or FM approved Polyisocyanurate insulation (minimum thickness listed above) mechanically fastened to the deck per standard FM Class 1-90 requirements (including enhancements at perimeters and corners).	1-1/2" with top layer of HP Recovery Board or Dens-Deck Prime	3/4" with top layer of HP Recovery Board pr Dens-Deck Prime	3-1/2" with top layer of HP Recovery Board or Dens-Deck Prime	1-1/2" with top layer of HP Recovery Board or Dens-Deck Prime
	<b>Top Layer</b> of minimum 1/2" thick Carlisle HP Recovery Board or 1/4" thick Dens-Deck Prime FM Approved Polyisocyanurate (See Page 12) secured over base layer with OlyBond 500 BA Adhesive	1/2" with top layer of Polyiso	1/2" with top layer of Polyiso	2" with top layer of Polyiso	1/2" with top layer of Polyiso

**Notes:**

- (1) OlyBond 500 BA Adhesive shall be applied in accordance with Carlisle Specifications.
- (2) Specific information concerning structural deck requirements (brand names, span capacity, securement criteria, etc.) must be referenced in the current FM Approval Guide and FM Loss Prevention Data Sheet 1-29.
- (3) On FM approved wood decks, minimum 1/4" thick gypsum board must be installed beneath the insulations listed.
- (4) FM approved Tectum decks must be minimum 2" thick. Fasteners must penetrate the deck a minimum 2".
- (5) Existing gypsum decks must be FM approved. Insulation fasteners must penetrate the deck a minimum of 1-1/2".
- (6) 1/2" thick Dens-Deck or Dens-Deck Prime must be fastened to the deck at 1 per 2 square feet (enhancements required at perimeters and corners).

## Sure-Seal/Sure-White Adhered Roofing Systems Factory Mutual (FM) 1-165 Wind Uplift Equivalency Ratings

**Membrane Type:**    **Sure-Seal/Sure-White .060" Non-Reinforced EPDM Membrane**  
                               **Sure-Seal .045" or .060" Reinforced EPDM Membrane**  
                               **Sure-Tough Reinforced EPDM Membrane**

Wind uplift testing has been completed in accordance with the Factory Mutual FM 4470 Test Procedure which was witnessed and certified by Architectural Testing, Incorporated, an industry recognized Independent Testing Laboratory. Over a 22 gauge steel roof deck, the following results were obtained. Performance Test Reports are on file and available from Carlisle.

165 psf Uplift Resistance (FM 1-165 Approval Equivalency on 12' X 24' Table) (1)(2)(3)	
Insulation	Insulation Fastening Density
FM approved Polyisocyanurate insulation overlaid with minimum 7/16" thick APA grade non-veneer oriented strand board (OSB).	17 fasteners per 4' X 8' board per Carlisle Detail A-27-D

**Notes:**

1. Testing conducted on 22 gauge steel roof deck secured to the structural steel supports having a maximum span of 6' on center. The deck is fastened to the minimum 1/4" thick steel supports with ITW Buildex Traxx/5 fasteners spaced a maximum of 6" on center. Deck side laps are secured with Traxx/1 Fasteners spaced a maximum of 30" on center. Additional deck fasteners are required at perimeters and corners as identified in the current Factory Mutual Approval Guide and FM Loss Prevention Data Sheet 1-29.
2. Additional insulation fastening is required at perimeters and corners in accordance with FM Loss Prevention Data Sheets 1-28 and 1-29.
3. Failure occurred upon pressurization at 180 psf. System passed 165 psf resistance cycle.

## Underwriters Laboratories Approvals Design "B" Loose Laid Ballasted Roofing System (1)(2)

**Membrane Type:** .045" or .060" thick Non-Reinforced EPDM Membrane  
.060" thick Reinforced EPDM Membrane  
Sure-Tough Reinforced EPDM Membrane

UL Class "A"			
Deck Type	Insulation (UL Classified)	Insulation Thickness	Maximum Slope
Non-Combustible and Combustible	Any UL Classified Insulation	Any	2"
New Construction: Approved Lightweight Insulating Concrete	None or HP Protective Mat (Refer to Carlisle Specifications for requirements)	N/A	2"

**Notes:**

- (1) Ballast to be nominal 1-1/2" diameter river washed stone at a minimum 10 pounds per square foot. Individual concrete pavers (minimum 18 pounds per square foot) or approved lightweight interlocking pavers (minimum 10 pounds per square foot) may also be used. 1/8" maximum spacing between pavers is permitted.
- (2) Carlisle HP Protective Mat may be used between the ballast and the membrane without altering the rating.

## Factory Mutual Research Calorimeter Tests for the Design "B" Ballasted Roofing System

All constructions listed in the Factory Mutual (FM) Approval Guide are Class 1 A, B or C fire rated and minimum Class 60 uplift rated.

Because of the nature of the uplift testing (pressurizing the underside of the deck to minimum 60 pounds per square foot), ballasted systems cannot be tested. If the ballasted system was tested, it would only require approximately 10-15 pounds per square foot of uplift pressure before movement of the stone and membrane would occur. In reality, ballasted systems are capable of resisting much higher wind forces.

Although ballasted systems are not formally FM approved, Factory Mutual conducted research fire tests on Carlisle's Sure-Seal Design "B" Ballasted Roofing System. Two (2) test panels were constructed which consisted of a 22 gauge steel deck, 5/8" thick Type X core gypsum board, 0.0015" aluminum vapor retarder and 4-1/4" Sure-Seal EPS insulation. The following results were obtained.

### Maximum Average Rate of Fuel Contribution (Btu/Square Feet/Minutes) for various intervals of time

	3 Minutes	5 Minutes	10 Minutes	Average
FM Class 1 Standard	385	365	340	270
Allowable Deviation	+25	+25	20	+15
Test Panel No. 2 *	124	103	88	31

\* The fuel contribution rates developed for Test Panel No. 2 were equivalent to Test Panel No. 1

The conclusion of the research report was that the Ballasted System panels had met the fire hazard requirement for Class 1 insulated steel deck roof construction.

Additionally, Factory Mutual has published Loss Prevention Data Sheet 1-29, Above Deck Roof components that outlines general guidelines for ballast criteria depending on project conditions (building height, parapet height, location, etc.). According to this bulletin, Factory Mutual's loss experience has been very favorable for single-ply Ballasted Roofing Systems when designed in accordance with this published criteria.

Although FM does not formally approve Ballasted Systems, job-by-job acceptance can be obtained when Factory Mutual is the insurance underwriter by contacting the local FM office for requirements.



# **Underwriters Laboratories Approvals** **Design "C" Loose Laid Protected Roofing System (1)(2)**

**Membrane Type:** .045" or .060" thick Non-Reinforced EPDM Membrane  
.060" thick Reinforced EPDM Membrane  
Sure-Tough Reinforced EPDM Membrane

UL Class "A"			
Deck Type	Insulation (3)	Insulation Thickness	Maximum Slope
Non-Combustible and Combustible	Foamular 404	8" Max.	2"
	Dow Styrofoam Roofmate or Plazamate	4" Max.	2"

**Notes:**

- (1) Ballast to be nominal 1-1/2" diameter river washed stone at a minimum 10 pounds per square foot. Individual concrete pavers (minimum 18 pounds per square foot) or approved lightweight interlocking pavers (minimum 10 pounds per square foot) may also be used. 1/8" maximum spacing between pavers is permitted.
- (2) Carlisle HP Protective Mat must be used between the ballast and the extruded polystyrene insulation.
- (3) Insulation products listed are for use above the EPDM membrane. One layer of any UL classified insulation may be added below the membrane without altering the rating.

## Underwriters Laboratories Approvals Sure-Seal Mechanically-Fastened Roofing System

**Membrane Type:** .045 or .060 inch thick Standard or FR Reinforced EPDM Membrane (1)(2)  
Sure-Tough Reinforced EPDM Membrane (1)(2)

UL Class "A"				
Deck Type	Insulation (UL Classified)	Insulation Thickness	Maximum Slope	
			Std. Reinf. or Sure-Tough Reinf.	FR Reinf.
<b>Non-Combustible And Combustible</b> (For combustible decks, gypsum board must be installed beneath the insulations listed) (3)	<b>Carlisle</b> HP Recovery Board	1/2"-3"	3/4"	2-1/2"
	<b>Carlisle</b> HP Recovery Board/Polyisocyanurate	1/2" Min./Any	3/4"	2-1/2"
	<b>Carlisle</b> HP Recovery Board/Polystyrene(4)	1/2" Min./Any	3/4"	1"
	<b>Carlisle</b> DuraPink (4)(5)	1" Max.	N/A	1"
	<b>Carlisle</b> DuraPink (4)(5) w/G2 Base Sheet on Top (Refer to the following page for G2 Base Sheet manufacturers)	G2 Base Sheet/ 1" Max.	3/4"	1"
	<b>Carlisle</b> Polyiso HP-H, HP-DWD <b>Hunter Panels</b> H-Shield, H-Shield-DWD	Any	1/2"	3/4"
	<b>Tenneco</b> PB-6 over min. Class C Type III or IV Asphalt BUR or Cap Sheet	Min. 3/8"	N/A	1"
<b>New Construction:</b> Lightweight Insulating Concrete or Gypsum (Grouted Joints)	None	N/A	3/4"	4"
<b>Combustible</b>	<b>Carlisle</b> HP-DWD (6)	3" Min.	1/2"	2"
	<b>Hunter</b> H-Shield (6)			
	Two layers of <b>Carlisle</b> FR Base Sheet 2S	2 layers	1/2"	1/2"
	Polyisocyanurate listed above over 2-layers FR Base Sheet 2S	Any/2-layers	1/2"	3/4"
	Gypsum Board	1/2" Min.	3/4"	4"
	Gypsum Board/Polyisocyanurate	1/2" Min./Any	3/4"	4"
	Gypsum Board/Polystyrene	1/2" Min./Any	3/4"	4"

**Notes:**

- (1) The specified membrane may be coated with EM-8 Hypalon Coating in accordance with Carlisle's Specifications.
- (2) The specified membrane may be coated with a maximum of two coats of Sure-Seal Acrylic Coating applied at the rate of 1-1/2 gal/sq/coat and maintain the slope of the uncoated assembly
- (3) Minimum 1/2" thick gypsum board can be a classified or unclassified material with a minimum weight of 1.84 pounds per square foot. 1/4" thick Georgia Pacific Dens-Deck, Sound Deadening Board with a minimum weight of 1.09 pounds per square foot or 2 layers of Carlisle FR Base Sheet 2S (max. slope can not exceed 1-1/2") may be substituted for 1/2" thick gypsum board (not for use directly over existing roofing membrane). On **Reroof/No Tearoff** projects, where the existing roof is UL Class A rated, the gypsum board may be eliminated. Existing roofs that are Class B or C rated will require the use of gypsum board to achieve a Class A rating, otherwise, the new roofing system will retain the existing UL rating.
- (4) Assembly not permitted on combustible decks, even with gypsum board underneath. Gypsum board must be installed over polystyrene as identified in combustible deck listing.
- (5) Durapink insulation can only be used on recovery projects as a single layer directly over the existing membrane. Refer to Carlisle Specifications for additional requirements.
- (6) Insulation joints (bottom layer) must be staggered a minimum of 6 inches from joints in wood deck.

## Underwriters Laboratories Approvals Sure-Seal Mechanically-Fastened Roofing System

**Membrane Type: .045" or .060" thick Standard or FR Reinforced EPDM Membrane (1)(2)  
Sure-Tough Reinforced EPDM Membrane (1)(2)**

UL Class "B"				
Deck Type	Insulation (UL Classified)	Insulation Thickness	Maximum Slope	
			Std. Reinf. or Sure-Tough Reinf.	FR Reinf.
<b>Combustible</b>	Polyisocyanurate listed on previous page/G2 Base Sheet (4)	1-1/2" Min./ G2 Base Sheet	1/4"	1"
	Carlisle HP Recovery Board/Polyisocyanurate/G2 Base Sheet (4)	1/2" Min./1" Min/G2 Base Sheet	3/4"	1"
	Carlisle HP Recovery Board/G2 Base Sheet (4)	1"/ G2 Base Sheet	3/4"	1"
	Carlisle HP-DWD (5) Hunter H-Shield-DWD (5)	1.9" Min.	1/2"	1/2"
<b>Non-Combustible and Combustible</b> New wood deck construction or over minimum Class "B" smooth surfaced BUR	Carlisle FR Base Sheet 2S 25 Pound (G2) Glass Base Sheet Celotex Type G2 Vaporbar GB GAF Gafglas No. 75 Base Sheet Manville Glasbase Owens Corning Perma Ply No. 28 Tamko Glass Base	N/A	1"	1"
	Carlisle HP-DWD Hunter H-Shield-DWD	1.9" Min.	1/2"	1/2"

UL Class "B"				
Deck Type	Insulation (UL Classified)	Insulation Thickness	Maximum Slope	
			Std. Reinf. or Sure-Tough Reinf.	FR Reinf.
<b>Non-Combustible and Combustible</b> (For combustible decks, gypsum board must be installed beneath the insulations listed) (3)	Carlisle HP Recovery Board	1/2"-3"	N/A	4"
	Carlisle HP Recovery Board/Polyisocyanurate	1/2" Min./Any	N/A	4"
<b>New Construction:</b> Lightweight Insulating Concrete and Gypsum (grouted joints)	None	N/A	N/A	4"
<b>Combustible</b>	Gypsum Board	1/2"	N/A	4"
	Gypsum Board/Polyisocyanurate	1/2"/Any	N/A	4"

**Notes:**

- (1) The specified membrane may be coated with EM-8 Hypalon Coating in accordance with Carlisle's Specifications.
- (2) The specified membrane may be coated with a maximum of two coats of Sure-Seal Acrylic Coating applied at the rate of 1-1/2 gal/sq/coat and maintain the slope of the uncoated assembly.
- (3) Minimum 1/2" thick gypsum wallboard can be a classified or unclassified material with a minimum weight of 1.84 pounds per square foot. 1/4" thick Georgia Pacific Dens-Deck or Sound Deadening Board with a minimum weight of 1.09 pounds per square foot may be substituted for 1/2" thick gypsum wallboard (not for use directly over existing roofing membrane). On **Retrofit/No Tearoff projects**, where the existing roof is Class B or C rated, the gypsum board may be eliminated and the new roofing system will retain the existing UL rating or achieve the new system rating, **whichever is less** (i.e., existing Class B roof is overlaid with new Class B system - resultant rating will be Class B without the requirement for gypsum board; existing Class C roof is overlaid with new Class B system - resultant rating will be Class C without the requirement for gypsum board).
- (4) Acceptable G2 Base Sheets can be one of the following; Celotex Type G2 Vaporbar GB, GAF Gafglas No. 75 Base Sheet, Manville Glasbase, Owens Corning Perma Ply No. 28, Tamko Glass Base. Carlisle FR Base Sheet 2S is also acceptable.
- (5) Insulation joints (bottom layer) must be staggered a minimum of 6 inches from joints in wood deck.

## Underwriters Laboratories Approvals Sure-Seal Mechanically-Fastened Roofing System

**Membrane Type:** .045" or .060" Thick Standard or FR Reinforced EPDM Membrane (1)(2)  
Sure-Tough Reinforced EPDM Membrane (1)(2)

UL Class "C"				
Deck Type	Insulation (UL Classified)	Insulation Thickness	Maximum Slope	
			Std. Reinf. or Sure-Tough Reinf.	FR Reinf.
<b>Non-Combustible and Combustible</b> (For combustible decks, gypsum board must be installed beneath the insulations listed) (3)	<b>Carlisle HP Recovery Board/Polyisocyanurate</b>	1/2" Min./ 1-1/2" Max.	3"	3"
	<b>Carlisle DuraPink (4)</b>	1" Max.	1"	1"

**Notes:**

- (1) The specified membrane may be coated with EM-8 Hypalon Coating in accordance with Carlisle's Specifications.
- (2) The specified membrane may be coated with a maximum of two coats of Sure-Seal Acrylic Coating applied at the rate of 1-1/2 gal/sq/coat and maintain the slope of the uncoated assembly.
- (3) Minimum 1/2" thick gypsum wallboard can be a classified or unclassified material with a minimum weight of 1.84 pounds per square foot. 1/4" thick Georgia Pacific Dens-Deck or Sound Deadening Board with a minimum weight of 1.09 pounds per square foot may be substituted for 1/2" thick gypsum wallboard (not for use directly over existing roofing membrane). On **Retrofit/No Tearoff projects**, where the existing roof is Class B or C rated, the gypsum board may be eliminated and the new roofing system will retain the existing UL rating or achieve the new system rating, **whichever is less** (i.e., existing Class B roof is overlaid with new Class B system -resultant rating will be Class B without the requirement for gypsum board; existing Class C roof is overlaid with new Class B system - resultant rating will be Class C without the requirement for gypsum board).
- (4) Durapink™ insulation can only be used on recovery projects as a single layer directly over the existing membrane. Not for use on combustible decks, even with gypsum board underneath. Refer to Carlisle Specifications for additional requirements.

Existing UL Rating to Remain				
Deck Type	Insulation (UL Classified)	Insulation Thickness	Maximum Slope	
			Std. Reinf. or Sure-Tough Reinf.	FR Reinf.
<b>Non-Combustible and Combustible</b> (Minimum Class "C" rated Type III or IV Smooth Asphalt BUR, Mineral Cap or Modified Bitumen to remain)	G2 Base Sheet	Slip Sheet	1/2"	1/2"
	None	N/A		
<b>Non-Combustible and Combustible</b> (Min. Class "C" rated adhered or mechanically fastened single-ply system (excluding PVC))	G2 Base Sheet	Slip Sheet	1/2"	1/2"

## Factory Mutual Approvals

### Sure-Seal Mechanically-Fastened Roofing System

**Membrane Type: .045" or .060" Thick Standard or FR Reinforced EPDM Membrane  
Sure-Tough Reinforced EPDM Membrane**

FM Approved Deck Type (1)	Field Sheet Width	Max. Fastener Spacing	Required Fastening Plates	Carlisle Fastener	FM Uplift Rating (2)
Steel (min. 22 gauge), Wood or Structural Concrete	7'	12" o.c.	Polymer	HP Fasteners (steel/wood); CD-10 or HD 14-10 (concrete)	1-60
Wood or Structural Concrete	10'	6" o.c.	Seam Fastening Plates	HP Fasteners (wood); CD-10 or HD 14-10 (concrete)	
Grade E Steel (4) or Structural Concrete	8'	12" o.c.	Polymer	HP Fasteners (wood); CD-10 or HD 14-10 (concrete)	
Tectum (3)	7'	6" o.c.	2" diameter plate provided with fastener	HP Lightweight Deck Fasteners	
Steel (min. 22 gauge), Wood or Structural Concrete	10'	6" o.c.	Polymer	HP Fasteners (steel/wood); CD-10 or HD 14-10 (concrete)	1-90
Tectum (3)	4-1/2'	6" o.c.	2" diameter plate provided with fastener	HP Lightweight Deck Fasteners	
Grade E Steel (4) or Structural Concrete	10'	6" o.c.	Polymer	HP Fasteners (steel); CD-10 or HD 14-10 (concrete)	1-105
Steel (min. 22 gauge)	10' Sure-Tough only	6" o.c.	Polymer	HP Fastener	1-105
Steel (min. 22 gauge) or Structural Concrete	8'	6" o.c.	Polymer	HP Fasteners (steel/wood); CD-10 or HD 14-10 (concrete)	1-105
Grade E Steel (4) or Structural Concrete	10' Sure-Tough only	6" o.c.	Polymer	HP Fasteners (steel); CD-10 or HD 14-10 (concrete)	1-120
		12" o.c.			1-60

**Notes:**

- (1) Specific information concerning structural deck requirements (brand names, span capacity, securement criteria, etc.) must be referenced in the current FM Approval Guide and FM Loss Prevention Data Sheet 1-29.
- (2) Refer to the following pages for insulation requirements, maximum roof slopes and acceptable roof construction types (new, tearoff or retrofit).
- (3) A minimum fastener penetration of 2" is required into Tectum decks.
- (4) Testing conducted on FM approved 22 gauge Grade E steel decking meeting ASTM A653 or A446 Grade 80.

## Factory Mutual Approvals Sure-Seal Mechanically-Fastened Roofing System

**Membrane Type: .045" or .060" Thick Standard or FR Reinforced EPDM Membrane  
Sure-Tough Reinforced EPDM Membrane**

FM Approved Deck Type	Field Sheet Width	Max. Fastener Spacing	FM Uplift Rating (5)		Carlisle Fastener With ST Fastening Bars
			Grade E Steel Decks (1)(4) or Structural Concrete	Steel (Min.22 gauge) Decks (2)(4)	
Steel (4) (type noted) or Structural Concrete	10'	12" o.c.	1-90	1-60	Sure-Tite Fasteners (steel decks); CD-10 or HD 14-10 (Concrete Decks)
	10'	6" o.c.	1-120	1-105	
	8'	12" o.c.	1-105	1-90	
	8'	6" o.c.	1-120	1-120	
	7'	12" o.c.	1-90	1-90	
	7'	6" o.c.	1-150	1-135	
Steel (18 gauge) (3) (4) or Structural Concrete	10'	12"	1-90		Sure-Tite Fasteners (Steel Decks) CD-10 or HD 14-10 (Concrete Decks)

FM Approved Deck Type	Field Sheet Width	Max. Fastener Spacing	FM Uplift Rating (5)		Carlisle HP-X Fastener With Polymer Batten or Metal Fastening Bars
			Grade E Steel Decks (1)(4) or Structural Concrete	Steel (Min.22 gauge) Decks (2)(4)	
Steel (4) (type noted) or Structural Concrete	10'	6" o.c.	1-90	1-90	HP-X Fasteners (steel decks); CD-10 or HD 14-10 (Concrete Decks)
	8'	6" o.c.	1-120	1-120	
	8'	12" o.c.	1-60	1-60	
	7'	12" o.c.	1-60	1-60	
	7'	6" o.c.	1-135	1-135	

**Notes:**

- (1) Steel decking shall be FM approved, minimum 22 gauge meeting ASTM designation A611 Grade E or A653 Grade 80. T
- (2) Testing conducted on standard FM approved 22 gauge steel decking secured as outlined in the FM Approval Guide and FM Loss Prevention Data Sheet 1-29.
- (3) Testing conducted on standard FM approved 18 gauge steel decking secured as outlined in the FM Approval Guide and FM Loss Prevention Data Sheet 1-29.
- (4) For FM 1-90 ratings, deck securement requirements are outlined in the FM Approval Guide under the respective deck manufacturer approval listing.
- (5) Refer to the following pages for insulation requirements, maximum roof slopes, approved insulation and acceptable roof construction types (new, tearoff or retrofit).

## Factory Mutual Approvals (1)

### Sure-Seal Mechanically-Fastened Roofing System

**Membrane Type:** .045" or .060" Thick Standard or FR Reinforced EPDM Membrane  
**Sure-Tough Reinforced EPDM Membrane**

Deck Type (2)	Insulation	Thickness	Maximum Slope (ASTM E-108 Class A)	
			STD Reinf. or Sure-Tough Reinf.	FR Reinf.
<b>New Construction or Tearoff:</b> Steel (Min. 22 gauge) Structural Concrete Wood (5) Tectum  <b>Retrofit-No Tearoff (7):</b> Structural Concrete	<b>Carlisle HP Recovery Board</b>  <b>Carlisle HP Recovery Board (min. 1/2") or Carlisle (min. 1/4") Dens-Deck or Dens-Deck Prime over:</b> Polyisocyanurate UCI Thermapink 18 or 25 (3) DOW Styrofoam (3) Contour Taper Tile EPS (3)(4) Perform 1,2 or Plus EPS (3)(4) Arcor FM-1 or MB EPS (3)(4) Dylite EPS (1 lb. density) (3)(4) Dylite EPS (1.25 lb. density) (3)(4) Styropor EPS (1 lb. density) (3)(4) Styropor EPS (1.25 lb. density) (3)(4) Huntsman EPS (3)(4)	1/2" Min.   See Below 3/4" - 12" 3/4" - 10.5" 1/2" - 8" 1" - 8" 2" - 4.5" 1" - 8" 1" - 6.5" 2" - 6.25" 2" - 5" 1" - 8"	1"	3-1/2"
	<b>Carlisle Polyisocyanurate HP-H</b>	1" - 12"	1/2"	2"
	<b>Hunter Panels H-Shield</b>	1" - 12"	1/2"	2"
	<b>Carlisle DuraPink (6)</b>	2" Max.	N/A	1-1/2"

#### Notes:

- (1) FM uplift ratings are determined by width of field membrane sheets, fastener spacing, deck type and the Carlisle Fastening Plate or Bar and Fastener utilized. Additional perimeter/corner membrane securement and insulation fastening is also required in accordance with FM Loss Prevention Data Sheets 1-28 and 1-29.
- (2) Specific information concerning structural deck requirements (brand names, span capacity, securement criteria, etc.) must be referenced in the current FM Approval Guide and FM Loss Prevention Data Sheet 1-29.
- (3) On steel decks, a thermal barrier of FM approved perlite or gypsum board (Type "X" or Type "C") is required under these insulations. For specific thermal barrier requirements, consult the respective insulation manufacturer or current published FM Approval Guide.
- (4) EPS insulation must be supplied by FM approved AFM, ARCO, BASF, or Huntsman bead manufacturers.
- (5) On FM approved wood decks, minimum 1/4" thick gypsum board must be installed beneath the insulations listed. Polystyrene insulations must incorporate 1/4" gypsum board in addition to standard thermal barrier requirements.
- (6) Durapink™ insulation can only be used on recovery projects as a single layer directly over the existing membrane. Refer to Carlisle Specifications for additional requirements.
- (7) Existing roof must be FM Class 1 rated.

## Factory Mutual Approvals (1)

### Sure-Seal Mechanically-Fastened Roofing System

**Membrane Type:** .045" or .060" Thick Standard or FR Reinforced EPDM Membrane  
Sure-Tough Reinforced EPDM Membrane

Deck Type (2)	Insulation	Thickness	Maximum Slope (ASTM E-108 Class A)	
			Std. Reinf. or Sure-Tough Reinf.	FR Reinf.
<b>Retrofit-No Tearoff (3):</b> Steel (Min. 22 gauge) Wood (4) Tectum	Carlisle HP Recovery Board	1/2"-1"	1"	3-1/2"
	Carlisle Polyisocyanurate HP-H	1" Max	1/2"	2"
	Hunter H-Shield			
	Carlisle DuraPink (5)	1" Max.	N/A	1-1/2"

**Notes:**

- (1) FM uplift ratings are determined by width of field membrane sheets, fastener spacing, deck type and the Carlisle Fastening Plate or Bar and Fastener utilized. Additional perimeter/corner membrane securement and insulation fastening is also required in accordance with FM Loss Prevention Data Sheets 1-28 and 1-29.
- (2) Specific information concerning structural deck requirements (brand names, span capacity, securement criteria, etc.) must be referenced in the current FM Approval Guide and FM Loss Prevention Data Sheet 1-29.
- (3) Existing roof must be FM Class 1 rated.
- (4) On FM approved wood decks, minimum 1/4" thick gypsum board must be installed beneath the insulations listed. Polystyrene insulations must incorporate 1/4" gypsum board in addition to standard thermal barrier requirements.
- (5) DuraPink™ insulation can only be used on recovery projects as a single layer directly over the existing membrane. Refer to Carlisle Specifications for additional requirements.



## Sure-Seal Mechanically-Fastened Roofing Systems Factory Mutual (FM) 1-120 Wind Uplift Equivalency Ratings\*

Wind uplift testing has been completed in accordance with the Factory Mutual FM 4470 Test Procedure which was witnessed and certified by Architectural Testing, Incorporated, an industry recognized Independent Testing Laboratory. Over a 22 gauge steel roof deck, the following results were obtained. (Performance Test Report is on file and available from Carlisle.)

### Membrane Requirements:

**Maximum 7 foot wide Sure-Seal .060" thick reinforced EPDM membrane with Carlisle HP Fasteners and 2" diameter Polymer Seam Plates spaced 6" on center. \***

120 psf Uplift Resistance* (FM 1-120 Approval Equivalency on 12' X 24' Table) (1) (3)		
Insulation	Minimum Thickness	Insulation Fastening Density
Any FM approved insulation	Minimum FM Approved Thickness (2)	1 per 8 square feet (4)

### Notes:

1. Testing conducted on minimum 22 gauge steel roof deck secured to the structural steel supports having a maximum span of 6' on center. The deck is fastened to the minimum 1/4" thick steel supports with ITW Buildex Traxx/5 fasteners spaced a maximum of 6" on center. Deck side laps are secured with Traxx/1 Fasteners spaced a maximum of 30" on center.

Additional deck fasteners are required at perimeters and corners as identified in the current Factory Mutual Approval Guide and FM Loss Prevention Data Sheet 1-29.

2. 1/2" thick HP Recovery Board cannot be installed as a single layer directly over wide rib (type B) or intermediate rib (type F) steel decks. For flute spanability criteria with Polyisocyanurate insulation, contact the respective insulation manufacturer.
3. Additional perimeter/corner membrane securement is required in accordance with FM Loss Prevention Data Sheets 1-28 and 1-29.
4. Insulation by others must be secured to the deck at the minimum rate of 1 per 4 square feet unless otherwise recommended in writing by the respective manufacturer.

- \* **A formal Factory Mutual (FM) Class 1-120 rating is available using 10-foot wide Sure-Tough Reinforced EPDM membrane and HP Fasteners/Polymer Plates. In addition, formal FM 1-120, 1-135 and 1-150 ratings are available when Sure-Tite Fasteners/ST Fastening Bars are used for membrane securement. Refer to pages 22 and 23 for requirements.**

## **SURE-SEAL METAL RETROFIT ROOFING SYSTEM**

### **UNDERWRITERS LABORATORIES (UL) APPROVALS**

The UL ratings achieved with the Metal Retrofit Roofing System are identical to the approvals listed for the Sure-Seal Mechanically-Fastened Roofing System over non-combustible decks depending on the membrane selected (Standard Reinforced or FR Reinforced EPDM). These ratings are listed on pages 19-21.

### **FACTORY MUTUAL (FM) APPROVALS**

As referenced in Factory Mutual Loss Prevention Data Sheet 1-31, the method of recovering an existing metal roof system with a single-ply mechanically fastened roofing system where the membrane is secured through the existing metal roof directly to the structural purlins is recognized as an appropriate recovery system when installed per the recommendations of FM.

Factory Mutual has accepted the securement of Carlisle's reinforced EPDM membrane with RUSS (Reinforced Universal Securement Strip) as an alternate to "in-seam fastening" as used in our Sure-Seal Mechanically-Fastened Roofing System. As such, the wind uplift resistance of the Sure-Seal Metal Retrofit Roofing System will be equivalent to an FM 1-90 system when structural purlins are spaced a maximum of 6-1/2' on center and the RUSS is secured with Carlisle HP or Purlin Fasteners and Polymer Seam Plates a maximum of 6" on center into the purlins. For FM Class 60 wind uplift equivalency, the purlins could be spaced a maximum of 6-1/2' on center with the RUSS secured with Carlisle Fasteners and 2" diameter Polymer Seam Plates spaced a maximum of 12" on center into the purlins.

As a standard Factory Mutual requirement, additional membrane and insulation securement is necessary in the corner and/or perimeter areas as outlined in FM Loss Prevention Data Sheets 1-28, 1-29 and 1-31. These bulletins should be reviewed in their entirety for specific requirements concerning insulation types, fastening enhancements and other items that may be necessary.

# FM Perimeter Securement Enhancement Requirements

## Adhered and Mechanically-Fastened EPDM Roofing Systems

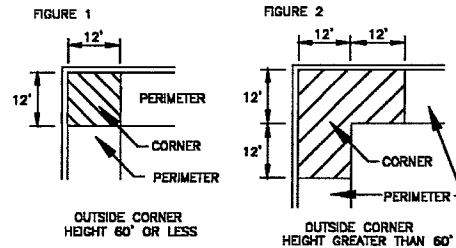
This section outlines Factory Mutual's fastening enhancements at roof perimeters and corners as required by FM Loss Prevention Data Sheets 1-28 (Design Wind Loads) and 1-29 (Above-Deck Roof Components) available on Factory Mutual's RooNAV web-site (free subscription) <http://roofnav.fmglobal.com/roofnav/login.aspx>. To account for higher wind uplift forces at perimeters and corners, Factory Mutual requires additional insulation fastening or membrane securement on Adhered Roofing Systems and additional membrane securement on Mechanically-Fastened Roofing Systems. Additional insulation fastening for Mechanically-Fastened Systems is no longer required for assemblies not incorporating a vapor retarder or air barrier. Refer to the following pages for specific criteria.

- Perimeter and Corner Identification** - In accordance with the FM Data Sheets 1-28 and 1-29, the width of roof perimeters and corners for all FM approved roofing systems is equal to:

- 0.4 times the building height or
- 0.1 times the buildings lesser plan dimension, whichever is smaller

**Notes:**

- The minimum perimeter/corner width shall be 4% of the building width but not less than 3'.
- For buildings over 60' in height, .4 x building height is not applicable for calculating perimeter/corner areas. Also, minimum corner dimension shall be 3' (4% of building width is not applicable).



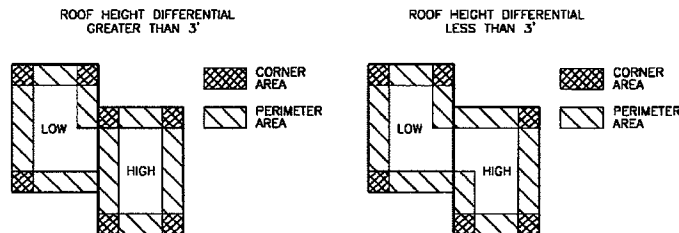
**Example:** A 50 foot high building has overall plan dimensions of 120' X 300':

$$50' (\text{building height}) \times 0.4 = 20' \quad \text{or} \quad 120' (\text{lesser plan dimension}) \times 0.1 = 12'$$

Therefore, FM defines the width of perimeter as a 12' wide area around the entire building. For buildings 60' high or less, outside corners are square areas equal to calculated dimensions (12' X 12' areas. See Figure 1 above). For buildings greater than 60' in height, outside corners are "L" shaped with dimensions twice as long as the calculated corner area. See Figure 2 above. Inside corners are considered roof perimeters.

**Notes:**

- Where multi-level roofs meet at a common wall, the adjacent edge of the upper roof is treated as a perimeter requiring enhanced fastening only if the difference in height is greater than 3'. FM does not require fastening enhancement at the lower roof area adjacent to the higher building wall regardless of height differential.
- On Adhered Systems, any whole or partial insulation board located within the calculated perimeter/ corner areas must have increased fastening (described below) applied over entire board width.



## 2. Adhered Roofing Systems Perimeter/Corner Fastening Enhancements

### A. Maximum 1-75 rating or Building (less than 75' high) located in a 90 mph wind zone

At the calculated perimeter and corner areas, insulation fastening on Adhered Systems must be increased over the approved field fastening density specified in Factory Mutual's RoofNAV system:

- At roof perimeters, a 50% increase in insulation fasteners (1.5 times as many fasteners as the field of the roof with a minimum fastener/plate density of 1 every 2 square feet) is required.
- At roof corners, a 100% increase in insulation fasteners (2 times as many fasteners as the field of the roof with a minimum fastener/plate density of 1 every 1 square foot) is required for buildings with a parapet height less than 3'. For roofs with a 3' or higher parapet continuous around the entire building, a 50% increase in fasteners at corners is required (refer to the above perimeter requirements)

**B. Minimum 1-90 rating**

1. If the calculated field pressure is greater than 75 psf, install either an adhered or mechanically fastened roofing assembly in the perimeter and corner areas that meets the wind uplift rating requirements specified in Table 1 on page 5 of the FM Loss Prevention Data Sheet 1-29. As an example, a 1-90 rating requires a 1-90 tested assembly to be used in the field of the roof, a 1-150 tested assembly in the perimeters and a 1-225 tested assembly in the corners.
2. Use a mechanically fastened assembly in the perimeter and corner areas following the guidelines specified in Section 2.2.7.2 of the FM Loss Prevention Data Sheet 1-29. As an example, assume a 1-90 rating is specified. The tested adhered assembly is installed in the field of the roof. The perimeter and corner fastening layout is determined using any mechanically fastened assembly that has passed 1-90 uplift testing. The perimeter and corner row spacing will be a maximum of 60% and 40% of the tested spacing respectively. For this example, the perimeter row-to-row spacing would be a maximum 5.7' and the corner row-to-row spacing would be a maximum 3.8', all with fasteners spaced 6" on center. If desired the membrane can be adhered across the entire roof area, with the mechanical attachments in the perimeters and corners installed through the top of the membrane.

**3. Mechanically Fastened Roofing Systems Perimeter/Corner Fastening Enhancements**

The perimeter and corner row spacing will be a maximum of 60% and 40% of the tested field spacing. For example, a 10' wide field sheet rating fastened at 6" o.c. would require a maximum perimeter sheet width of 5.7' and a maximum corner sheet width of 3.8' both fastened at the same rate using the same fastener/plate combination as the approved field assembly. If the required rating is above 1-75, all rows of securement must be perpendicular to the steel deck flutes. Refer to Factory Mutual's Loss Prevention Data Bulletin 1-29 for addition information regarding perimeter and corner membrane securement.

**4. Insulation/Fastener Reference - Sure-Seal/Sure-White Adhered Roofing Systems**

The following charts indicate fasteners approved with various insulation manufacturers based on type of roof deck.

**a. Tectum or Gypsum Decks**

Insulation	Fastener Manufacturers
All Insulations Listed in FM Approval Section	Carlisle HP-NTB or HP Lightweight Deck Fasteners Olympic NTB Magnum or GTL Rawl Rawlite

**b. Steel or FM Approved Wood Decks**

Insulation	Approved Fastener Manufacturer * Refer to specific brand names below
Carlisle Polyisocyanurate HP-H Hunter Panels H-Shield	Construction Fasteners, ITW Buildex, Olympic, Rawl, SFS or TruFast
Carlisle HP Recovery Board	Carlisle, ITW Buildex, Olympic or Rawl
<p><b>* FM approved fastener brand names.</b>  <b>Carlisle</b> - HP Fasteners, InsulFast Fasteners; see note below for Carlisle ASAP Pre-Assembled Fasteners.  <b>RAWL</b> - Rawl #12, #14  <b>ITW Buildex</b> - Roofgrip #12, #14, #15; AccuTrac; Hextra  <b>Construction Fasteners</b> - Deckfast #12, #14, #15; Stainless; Omega  <b>Olympic</b> - Olympic #10, #12, #14; Stainless #12; HexHead #12, #14  <b>SFS</b> - Insulfixx #12, #14; System ES-1  <b>TruFAST</b> - TruFast TP, DP, Ultra, S.S., HD, DL; Pre-Assembled</p>	
<p><b>Note:</b> Carlisle Pre-Assembled ASAP Fasteners (plastic plates) are approved with insulations approved with Olympic Fasteners (ASAP Fasteners cannot be used for FM 1-90 reduced insulation fastening with 2" thick Carlisle Polyisocyanurate HP-H Insulation; maximum FM 1-75 is available.</p>	

**c. Structural Concrete Decks**

Insulation	Approved Fastener Manufacturer * Refer to specific brand names below								
Carlisle Polyisocyanurate HP-H Hunter Panels H-Shield	Construction Fasteners, ITW Buildex, Olympic, Rawl, SFS or TruFast								
Carlisle HP Recovery Board	Carlisle, Construction Fasteners, Olympic, Rawl or SFS								
<p><b>* FM approved fastener brand names.</b></p> <table border="0"> <tr> <td><b>Carlisle</b> – CD-10 Fasteners; HD 14-10 Fasteners; Concrete Spikes</td><td><b>Rawl</b> - Spike; T-Spike</td></tr> <tr> <td><b>ITW Buildex</b> - Roofgrip #14, #15</td><td><b>SFS</b> - Insulfixx #14; ES-1 #14</td></tr> <tr> <td><b>Construction Fasteners</b> - Deckfast #14, #15; Dekspike; Stainless</td><td><b>TruFAST</b> - TruFast HD, DL,CF, CF Tap</td></tr> <tr> <td><b>Olympic</b> – Olympic #14; HexHead #12, #14; CD-10; Fluted Nail</td><td>Grip; Ultra</td></tr> </table>		<b>Carlisle</b> – CD-10 Fasteners; HD 14-10 Fasteners; Concrete Spikes	<b>Rawl</b> - Spike; T-Spike	<b>ITW Buildex</b> - Roofgrip #14, #15	<b>SFS</b> - Insulfixx #14; ES-1 #14	<b>Construction Fasteners</b> - Deckfast #14, #15; Dekspike; Stainless	<b>TruFAST</b> - TruFast HD, DL,CF, CF Tap	<b>Olympic</b> – Olympic #14; HexHead #12, #14; CD-10; Fluted Nail	Grip; Ultra
<b>Carlisle</b> – CD-10 Fasteners; HD 14-10 Fasteners; Concrete Spikes	<b>Rawl</b> - Spike; T-Spike								
<b>ITW Buildex</b> - Roofgrip #14, #15	<b>SFS</b> - Insulfixx #14; ES-1 #14								
<b>Construction Fasteners</b> - Deckfast #14, #15; Dekspike; Stainless	<b>TruFAST</b> - TruFast HD, DL,CF, CF Tap								
<b>Olympic</b> – Olympic #14; HexHead #12, #14; CD-10; Fluted Nail	Grip; Ultra								

# UNDERWRITERS LABORATORIES

## EXTERNAL FIRE TEST CRITERIA

Most Building Code agencies require flat roofs to have minimum performance requirements when exposed to external fire situations. The most recognized test procedure for evaluating this performance is the Underwriters Laboratories UL 790 procedure (Tests for Fire Resistance of Roof Covering Materials). This test is judged to be equivalent to the ASTM E108 procedure which is referenced in most building codes.

Under the UL 790 Test, roof coverings are rated Class "A", "B", or "C". Class "A" is the highest rating and is defined as being "effective against severe fire exposures". The type of roof deck upon which the membrane and insulation is applied determines the type of tests required under the UL 790 procedures.

**Non-Combustible Decks** - Steel, Concrete, Gypsum or Fibrous Cement (minimum 2 " thick) - Require only Spread of Flame Test.

**Combustible Decks** - Wood Planks (minimum 3/4" thick), Plywood (minimum 15/32" thick), Oriented Strand Board - OSB (minimum 7/16" thick) or Fibrous Cement (less than 2" thick) - Require Spread of Flame Test plus Intermittent Flame and Burning Brand penetration tests.

The basic criteria for determining the performance rating under each of these tests are as follows:

### SPREAD OF FLAME TEST

Class A (10 minutes exposure) - 6'-0" maximum flame spread.  
Class B (10 minutes exposure) - 8'-0" maximum flame spread.  
Class C (4 minutes exposure) - 13'-0" maximum flame spread.

In all cases, there can be no significant lateral flame spread (burning off the sides of the deck) and the deck must not be exposed upon completion of the test.

### INTERMITTENT FLAME TEST

Class A - (15 cycles, 2 minutes on, 2 minutes off)  
Class B - (8 cycles, 2 minutes on, 2 minutes off)  
Class C - (3 cycles, 1 minute on, 2 minutes off)

### BURNING BRAND TEST

Class A Brand - 2000 grams (approximately 4.5 pounds)  
Class B Brand - 500 grams (approximately 1.1 pounds)  
Class C Brand - 9.25 grams (approximately 0.3 ounces)

At no time during or upon completion of the test can there be any sustained flaming on the underside of the deck and the deck must not be exposed.

It is important to remember that it is the complete assembly that is being evaluated including the deck type, insulation type and thickness, membrane type and surface treatment, if any. Mixing components which have not been tested together will void the rating. Assemblies classified for use over combustible decks may be used over non-combustible decks to achieve the same rating.

## UNDERWRITERS LABORATORIES

### INTERNAL FIRE RESISTANCE TEST CRITERIA AND RATINGS

The **P-Series/Hourly Construction** ratings identify the length of time a certain building construction, consisting of specified materials, will contain a fire and retain its structural integrity. The ratings are given in hours and are identified in the current published *UL Fire Resistance Directory*.

The test method used is UL 263 (ASTM E119) "Fire Test of Building Construction and Materials". In this test, the roof-ceiling assembly is exposed to fire from the inside for the stipulated time period.

TEST CRITERIA	
Internal steel temperature	1100° F Average Maximum 1300° F at any location
External surface temperature	250° F Average Increase Maximum 350° F Maximum at any one location

Listed below are the general groups of numbers in the **P-Series** constructions and what the **internal fire protection** consist of. The type of interior protection is used to determine what P-Series number is applicable:

P-SERIES NUMBER	TYPE OF INTERIOR PROTECTION
000 - 099	Concealed Grid Systems (drop ceilings)
100 - 199	For Future Use
200 - 299	Exposed Grid Systems (drop ceilings)
300 - 399	For Future Use
400 - 499	Metal Lathe (plaster ceilings)
500 - 599	Gypsum Board Ceiling Systems
600 - 699	Direct Applied Protection – Miscellaneous
700 – 799	Direct Applied Protection – Cementitious
800 – 899	Direct Applied Protection - Sprayed Fiber
900 – 999	Precast Concrete or Steel/Concrete Decks (unprotected deck)

**Underwriters Laboratories  
Internal Fire Ratings  
Construction/Systems Chart**

P#	System (1)	P#	System (1)	P#	System (1)
P211	B	P713* (2)	A,B,MF	P818* (2)	A,B,MF
P215*	A,B,MF	P715*	A,B,MF	P819* (2)	A,B,MF
P216*	A,B,MF	P717* (2)	A,B,MF	P822*	A,B,MF
P224*	A,B,MF	P718* (2)	A,B,MF	P823*	A,B,MF
P225*	A,B,MF	P719* (2)	A,B,MF	P824* (2)	A,B,MF
P227*	A,B,MF	P720* (2)	A, B,MF	P825*	A,B,MF
P229*	B,C	P721*	A,B,MF	P826*	A,B,MF
P230*	A,B,MF	P722* (2)	A,B,MF	P827* (2)	A,B,MF
P231*	A,B,MF	P723* (2)	A,B,MF	P902*	A,B,C,MF
P232*	A,B,MF	P724*	A,B,MF	P903*	A,B,MF
P233*	A,B,MF	P725*	A,B,MF	P904*	A,B,C,MF
P235*	B,C	P726*	A,B,MF	P905*	A,B,MF
P237	B	P727* (2)	A,B,MF	P906*	A,B,MF
P241	B	P728* (2)	A,B,MF	P907*	A,B,C,MF
P242*	A,B,MF	P729* (2)	A,B,MF	P908*	A,B,C,MF
P246*	A,B,MF	P730* (2)	A,B,MF	P909*	A,B,C,MF
P251*	A,B,MF	P731* (2)	A,B,MF	P910*	A,B,MF
P252*	A,B,MF	P732* (2)	A,B,MF	P911*	A,B,MF
P257*	A,B,MF	P733*	A,B,MF	P912*	A,B,MF
P259*	A,B,MF	P734*	A,B,MF	P913*	A,B,C,MF
P405*	A,B,MF	P735*	A,B,MF	P914*	A,B,MF
P406*	A,B,MF	P736*	A,B,MF	P915*	A,B,C,MF
P407*	A,B,MF	P737*	A,B,MF	P916*	A,B,MF
P410*	A,B,MF	P738*	A,B,MF	P917*	A,B,MF
P411	B	P739* (2)	A,B,MF	P918*	A,B,MF
P505*	B,C	P741* (2)	A,B,MF A,B,MF	P919*	A,B,MF
P507*	B,C	P742* (2)	A,B,C,MF	P920*	A,B,MF
P508*	A,B,MF	P801* (2)	A,B,MF	P921*	A,B,MF
P510*	A,B,MF	P802*	A,B,C,MF	P922*	A,B,MF
P511*	A,B,MF	P803*	A,B,MF	P923*	A,B,MF
P513*	A,B,C,MF	P804*	A,B,C,MF	P924*	A,B,MF
P514*	A,B,MF	P805*	A,B,MF	P925*	A,B,MF
P519*	A,B,MF	P810*	B,C	P926*	A,B,MF
P701* (2)	A,B,C,MF	P811*	B,C	P927*	A,B,MF
P708*	A,B,MF	P813*	A,B,C,MF	P928*	A,B,MF
P709*	A,B,MF	P814* (2)	A,B,MF	P929*	A,B,MF
P710* (2)	A,B,MF	P815* (2)	A,B,MF	P930*	A,B,MF
P711*	A,B,MF	P816*	A,B,MF	P931*	A,B,MF
P712*	A,B,MF	P817*			

(1) A = Sure-Seal/Sure-White Design "A" Adhered Roofing Systems

B = Design "B" Loose Laid Ballasted Roofing System

C = Design "C" Loose Laid Protected Roofing System

MF = Sure-Seal Mechanically-Fastened and Metal Retrofit Roofing Systems

- \* These constructions approve the use of 1/2" thick HP Recovery Board, approved high density wood fiberboard or 7/16" thick non-veneer, APA rated oriented strand board (OSB) over whatever insulation is required without affecting the rating.

(2) These constructions allow the use of Carlisle's FAST 100 Adhesive for insulation attachment (or gypsum board). The maximum hourly rating is 2 hours.

- For 1 hour ratings, the thickness of sprayed-on fireproofing (underside of steel deck) referenced in the UL Fire Resistance Directory is acceptable.
- For 1-1/2 hour ratings, the thickness of fireproofing referenced in the UL Fire Resistance Directory must be increased by 1/16".
- For 1 hour ratings, the thickness of fireproofing referenced in the UL Fire Resistance Directory must be increased by 1/4".

**The current published *UL Fire Resistance Directory* must be referenced for specific criteria (insulation and thermal barrier requirements, ceiling protection, etc.) needed to obtain these fire ratings.**



## **FACTORY MUTUAL APPROVAL TEST CRITERIA**

Factory Mutual approval for a roof construction requires that the system pass tests related to combustibility, wind resistance, hail resistance, water leakage, resistance to foot traffic and corrosion resistance (FM Approval Standards 4450 and 4470). All of these tests must be successfully completed and will result in a roofing assembly being classified as a 1-60, 1-75, 1-90, 1-105, 1-120, 1-135, 1-150, 1-165, 1-180, etc. (in 15 psf increments) rated assembly. The assembly must also be tested for external fire resistance, in accordance with ASTM E-108 test procedures, and is issued a Class A, B or C rating.

Briefly, the test criteria consists of the following:

### **Combustibility**

#### **A. Above the deck - External**

The test method utilized is the ASTM E-108 and results in a Class A, B or C external fire rating. The description can be found under the "UL External Fire Test Criteria" on page 45 in this guide. The minimum combustible deck thickness FM approves is 3/4" thick tongue and groove FR treated plywood (refer to the current published FM Approval Guide for specific deck requirements).

#### **B. Below the deck - Fuel Contribution (Calorimeter)**

The complete roof assembly is exposed to an internal fire source for a period of 30 minutes. The heat input is carefully controlled such that fuel contribution from the roof assembly itself can be accurately measured at 3, 5, 10 and 30 minute intervals. At no time can this additional fuel contribution exceed certain predetermined levels.

### **Wind Resistance**

#### **A. Fully Adhered Roofing Systems**

For maximum FM 1-90 ratings, a test panel approximately 5' X 9' comprising a roof deck, insulation, fasteners (at selected spacing) and roof covering is exposed to air pressure from below. To achieve an FM Class 1-60 rating, the assembly must withstand the effect of 60 psf of uplift pressure for a period of 1 minute. For an FM Class 1-75 or 1-90 rating, a pressure of 75 or 90 psf respectively must be withstood for 1 minute.

#### **B. Mechanically Fastened Roofing Systems**

Effective July 1, 1993, Factory Mutual revised their test procedures with respect to wind uplift resistance. As a result, all mechanically fastened roofing systems (with field membrane securement exceeding 4 feet) had to be tested on a 12' X 24' uplift table to retain their FM approval.

#### **C. "Enhanced Wind Uplift Resistant Roof Classifications" (greater than 1-90 ratings) Adhered and Mechanically-Fastened Roofing Systems resisting the noted pressures when tested on the 12' X 24' Table.**

To determine the wind uplift rating (1-60, 1-90, etc.) appropriate for a given building, refer to the current FM Loss Prevention Data Sheets 1-28 and 1-29.

### **Hail Resistance**

A simulated test to evaluate the performance of the roof covering and substrate against damage by hail. Failure results if cracking, puncturing or tearing of the membrane and/or substrate occurs. Factory Mutual rates systems as either meeting SH (severe hail) or MH (moderate hail) criteria. All of Carlisle's FM approved EPDM roofing systems are rated SH and are approved for use anywhere in the United States. Refer to FM Loss Prevention Data Sheet 1-34, Hail Damage for additional information.

Factory Mutual Approval Test Criteria continued...

### **Water Leakage**

A simulated test to evaluate the performance of a field applied seam when subjected to ponded water for a 7 day period. Failure results if any sign of leakage is observed.

### **Resistance to Foot Traffic**

A simulated test to evaluate the performance of the roof covering when subjected to a 200 pound load a minimum of 5 times over the same area. Failure results if cracking, puncturing or tearing occurs.

### **Corrosion Resistance (Kesternich Test)**

A simulated test to evaluate the corrosion resistance of metal components when exposed to sulfurous acid (acid rain) over a 15 day (cycle) period. Failure results if more than 15% rust develops.

### **Additional Information**

In addition to the above referenced test criteria, **Factory Mutual** also references numerous **Loss Prevention Data Sheets** which include recommendations for items such as deck securement, perimeter nailer attachment methods, additional insulation fastening for adhered systems and additional insulation and membrane fastening for mechanically fastened systems at roof perimeters and corners. **These sheets must be referenced when Factory Mutual is the insuring agent or when a strict FM rating is required.** Some of the necessary Loss Prevention Data Sheets include:

1-22	Criteria for Maximum Foreseeable Loss Fire Walls
1-28	Design Wind Loads
1-29	Above-Roof Deck Components
1-28R/1-29R	Roof Systems - Reference Document
1-30	Repair of Wind Damaged Roof Systems
1-31	Metal Roof System - Applicable for Metal Retrofit Systems
1-34	Hail Damage
1-49	Perimeter Flashing
1-52	Field Uplift Tests
1-54	Roof Loads for New Construction

## Code Body Summary

### BOCA – Building Officials & Code Administrators

<b>Territory</b>	East of Mississippi River and North of Mason Dixon Line
<b>Code Reference</b>	<b>BOCA National Building Code</b>
<b>Wind Uplift Requirement</b>	Calculate per code or follow ASCE 7
<b>Minimum Slope</b>	1/4" (1/8" for Coal Tar Pitch)
<b>Foam Plastic Insulation Requirement for Roofing</b>	Thermal Barrier requirement based on UL 1256 or FM 4450
<b>External Fire Requirement</b>	Class A, B or C (dependent upon type of construction)

### ICBO – International Conference of Building Officials

<b>Territory</b>	West of Mississippi River
<b>Code Reference</b>	Uniform Building Code
<b>Wind Uplift Requirement</b>	Follow ASCE 7
<b>Minimum Slope</b>	1/4"
<b>Foam Plastic Insulation Requirement for Roofing</b>	Thermal barrier requirement on test requirements for insulate roof decks
<b>External Fire Requirement</b>	Class A, B or C (dependent upon type of construction)

### SBCCI – Southern Building Code Congress International

<b>Territory</b>	West of Mississippi River and South of Mason Dixon Line
<b>Code Reference</b>	<b>Standard Building Code</b>
<b>Wind Uplift Requirement</b>	Calculate per code for maximum 60' or follow ASCE 7 for any height
<b>Minimum Slope</b>	1/4" (1/8" for Coal Tar Pitch)
<b>Foam Plastic Insulation Requirement for Roofing</b>	Thermal Barrier requirement based on UL 1256 or FM 4450
<b>External Fire Requirement</b>	Class A, B or C

### ICC – International Code Council

<b>Territory</b>	United States
<b>Code Reference</b>	International Building Code
<b>Wind Uplift Requirement</b>	Calculate per code for maximum 60' or follow ASCE 7 for any height
<b>Minimum Slope</b>	1/4" (1/8" for Coal Tar Pitch)
<b>Foam Plastic Insulation Requirement for Roofing</b>	Thermal barrier requirement based on UL 1256 or FM 4450
<b>External Fire Requirement</b>	Class A, B or C (dependent upon type of construction)

## NATIONAL, STATE & CITY BUILDING CODE APPROVALS

Authority	Approval	Approved Systems
ICC - International Code Council	Report ESR-1184 Report NER-575	"B" "A" and "MF"
SBCCI	These Code Bodies merged to form ICC as of March 2003 Refer to ICC approval	"B"
BOCA		"B"
NES – National Evaluation Service, Inc.		"B" "A" and "MF"
ICBO		"B" "A" and "MF"

### Metropolitan Dade County, Florida Building Code Compliance Product Control Notice of Acceptance

Deck Type	Acceptance No.	Expires
Cementitious Wood Fiber	06-0331.03	6/28/11
Concrete	06-0403.03	6/28/11
Gypsum	06-0403.02	6/28/11
Lightweight Concrete	06-0403.04	6/28/11
Steel	06-0403.05	6/28/11
Wood	06-0403.01	6/28/11
Recover	06-0331.02	6/28/11

### New York City Material and Equipment Acceptance (MEA) Certificates

MEA Number	Design	Membrane	Bonding Adhesive
10-80-M Vol. III	"B"	Sure-Seal	NA
9-86-M Vol. II	"A"	Sure-Seal FR	90-8-30A
9/86-M Vol. III	"A"	Sure-Seal FR	B-500
296-89-M Vol. II	"MF"	Sure-Seal Reinforced	NA
298-89-M Vol. II	"MF"	Sure-Seal FR Reinforced	NA
413-89-M Vol. II	"A"	Sure-Seal Reinforced	90-8-30A
413-89-M Vol. III	"A"	Sure-Seal Reinforced	B-500
415-89-M Vol. II	"A"	Sure-Seal FR Reinforced	90-8-30A
415-89-M Vol. III	"A"	Sure-Seal FR Reinforced	B-500
316-97-M	"A"	Sure-White	90-8-30A
317-97-M	"A"	Sure-White	B-500
318-97-M	"A"	Sure-Tough Reinforced	90-8-30A
319-97-M	"A"	Sure-Tough Reinforced	B-500
322-97-M	"MF"	Sure-Tough Reinforced	NA

**Carlisle SynTec Incorporated, P. O. Box 7000, Carlisle, PA 17013  
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**DIVISION: 07—THERMAL AND MOISTURE PROTECTION**  
**Section: 07240—Exterior Insulation and Finish System**

**REPORT HOLDER:**

**DRYVIT SYSTEMS, INC.**  
**ONE ENERGY WAY**  
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**(401) 822-4100 ext. 434**  
[www.dryvit.com](http://www.dryvit.com)  
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**EVALUATION SUBJECT:**

**DRYVIT OUTSULATION PLUS EXTERIOR INSULATION  
AND FINISH SYSTEM (EIFS)**

**1.0 EVALUATION SCOPE**

**Compliance with the following codes:**

- 2003 *International Building Code*® (IBC)
- 2003 *International Residential Code*® (IRC)
- BOCA® *National Building Code*/1999 (BNBC)
- 1999 *Standard Building Code*® (SBC)
- 1997 *Uniform Building Code*™ (UBC)

**Properties evaluated:**

- Noncombustible construction
- Ignition resistance
- Surface burning characteristics
- Fire-resistance-rated construction
- Structural—transverse wind load resistance
- Weather resistance
- Water drainage

**2.0 USES**

Dryvit Outsulation Plus is used as an insulation and exterior wall finish on buildings of all construction types and to provide water drainage from behind the EPS board.

**3.0 DESCRIPTION**

**3.1 General:**

The Outsulation Plus System is an exterior insulation and finish system (EIFS) that is applied to wood- or steel-framed exterior walls covered with either plywood sheathing, gypsum sheathing, or cement board or to exterior walls constructed of unglazed brick, concrete, or masonry. The system is an EIFS clad drainage wall assembly. The system consists of six components that are applied to the substrate: a proprietary liquid-applied water-resistive barrier; an adhesive; foam-

plastic insulation board; a double layer of polymer-containing a base coat; glass-fiber reinforcing fabric; and a finish coat. See Figure 1 for details of the Outsulation Plus System.

**3.2 Materials:**

**3.2.1 Structural Substrate:** Substrates shall be one of the following:

- a. Exterior-grade gypsum sheathing complying with the requirements of ASTM C 79 for water-resistant core board. Minimum thickness of the sheathing shall be  $\frac{1}{2}$  inch (12.7 mm), except that when the system is installed on a wall that is required to be a fire-resistance-rated assembly, the gypsum sheathing shall be Type X and the minimum thickness shall be  $\frac{5}{8}$  inch (15.9 mm).
- b. Dens-Glass® Gold Gypsum Board is recognized in ER-4305 and NER-574. The board shall have a minimum thickness of  $\frac{1}{2}$  inch (12.7 mm).
- c. GlasRoc™ Sheathing Board is recognized in NER-674. The board shall have a minimum thickness of  $\frac{1}{2}$  inch (12.7 mm).
- d. Exterior Cement Board, which is a noncombustible portland-cement product. The boards shall have an aggregated-portland-cement core with a polymer-coated glass-fiber mesh embedded in both surfaces. Minimum board thickness is a nominal  $\frac{1}{2}$  inch (12.7 mm), and the nominal weight is 3 pounds per square foot (14.6 kg/m<sup>2</sup>). Boards shall be supplied in sizes up to 4 feet (1219 mm) wide and 10 feet (3048 mm) long. The boards shall comply with ANSI A118.9.
- e. Plywood sheathing shall be APA Exterior or Exposure 1 rated plywood, Grade C-D, four-ply complying with DOC PS-1. The plywood shall have a minimum  $\frac{1}{2}$  inch (13 mm) nominal thickness.
- f. Unglazed brick, cement plaster, concrete, or concrete masonry shall comply with the applicable code.

**3.2.2 Water-resistive Barrier:** The approved water-resistive barrier shall consist of the following components:

- a. Dryvit Backstop NT-Smooth, or Dryvit Backstop NT-Textured Water-resistive Coating. The Backstop NT-Smooth and Dryvit Backstop NT-Textured are premixed, fully formulated, noncementitious, polymer-based coatings. All coatings are recognized for application over the substrates described in Section 3.2.1 of this evaluation report.
- b. Dryvit Grid Tape, an open-weave fiberglass mesh tape with pressure-sensitive adhesive.
- c. Dryvit Flashing Tape, a high-density, polyethylene-backed tape with rubberized asphalt adhesive.
- d. Dryvit Flashing Tape Surface Conditioner, a water-based surface conditioner and adhesive promoter for the Dryvit Flashing Tape.

- e. Dryvit AquaFlash and Aquaflash Mesh, a flexible, waterproof, water-based polymer material used in conjunction with AquaFlash Mesh to seal substrates around windows, doors, and other openings.

The Backstop NT-Smooth and NT-Texture coatings are packaged in 5-gallon (19 L) pails and are ready to use without additives. The shelf life of the Dryvit Backstop NT, Grid Tape, Flashing Tape Surface Conditioner, Flashing Tape and AquaFlash is two years.

**3.2.3 Dryvit AP Adhesive™:** This is a moisture-cured, urethane-based adhesive used to adhere the Dryvit Drainage Strip. The adhesive is packaged in 29-ounce cartridges that have a shelf life of one year.

**3.2.4 Dryvit Starter Track™:** This is a UV-treated, polyvinyl chloride J-channel with weep holes. Tracks are manufactured from rigid exterior-grade PVC conforming to ASTM D 1784.

**3.2.5 Dryvit Drainage Strip™:** This is a 0.024-inch-thick-by-2<sup>7</sup>/<sub>8</sub>-inch-wide (0.6 mm by 73 mm), high-impact polystyrene material formed with 1<sup>1</sup>/<sub>8</sub>-inch-deep (3 mm) corrugations with channels running vertically when installed on the wall to provide drainage.

**3.2.6 Dryvit Adhesive/Base Coat:** The adhesive/base coat material is used to adhere the insulation board to the water-resistive barrier and to embed the reinforcing mesh in the face of the insulation board. The adhesive/base coat material is available as a wet mix or dry mix. Genesis, a fiber-reinforced, acrylic-modified product, and Primus, an acrylic-polymer product, are wet mix materials packaged in 60-pound (27.2 kg) pails and mixed with Type I or Type II portland cement complying with ASTM C 150 in a 1:1 ratio by weight. Genesis DM, a fiber-reinforced dry mix material is packaged in 50-pound (22.66 kg) bags and is mixed with clean potable water.

The wet products have a shelf life of two years and the dry products have a shelf life of one year when protected from extreme heat and freezing for extended periods. Storage temperatures shall be within the range of 40°F to 120°F (4.4°C to 48.9°C).

**3.2.7 Dryvit Reinforcing Mesh:** The Dryvit reinforcing fabric consists of glass fiber mesh treated for alkali resistance and for compatibility with Dryvit products. Seven grades of mesh are available; refer to Table 1 of this report. Rolls shall not be stored on end or in direct sunlight.

**3.2.8 Thermal Insulation Board:** The Dryvit EPS foam-plastic thermal insulation board is manufactured from expanded polystyrene and has a nominal density of 1 lb/ft<sup>3</sup> (16.0 kg/m<sup>3</sup>), and a flame-spread index of not more than 25 and a smoke-developed index of not more than 450 when tested in accordance with ASTM E 84 (UBC Standard 8-1). The boards comply with ASTM C 578, Type I, board. Minimum insulation board thickness is 1 inch (25.4 mm), and the maximum dimensions of the insulation board are 2 feet by 4 feet (610 mm by 1219 mm). For applications to buildings that are required to be noncombustible construction, the foam plastic shall have a maximum thickness of 4 inches (102 mm).

In jurisdictions enforcing the IBC, the following dimensional limitations for the foam plastic formed shapes shall be observed:

- a. Percentage of wall area covered by the foam plastic formed shapes shall not be greater than 15 percent.
- b. In every 20-square-foot wall area the combustible content of the foam plastic shall not exceed an average potential heat content of 6,000 Btu/ft<sup>2</sup> (68.2 MJ/m<sup>2</sup>) of wall area.

- c. Total foam plastic thickness shall not exceed 12 inches (305 mm) at any point, including the thickness of the wall insulation.
- d. Vertical bands shall not exceed 8 feet (2438 mm) in height or 2 feet (610 mm) in width.
- e. In shapes containing more than one segment of foam plastic, each segment shall be limited to a maximum length of 4 feet (1219 mm) and a maximum width of 2 feet (610 mm).

**3.2.9 Dryvit Synthetic Finishes:** The Dryvit finish is composed of natural mineral aggregates and fillers, colored pigments, and an acrylic latex emulsion. The products have a shelf life of two years when protected from freezing and extreme heat for extended periods. Storage temperatures shall be within the range of 40°F to 120°F (4.4°C to 48.9°C).

**3.2.10 Sealants:** Sealant shall be compatible with the EIFS components and be recommended by Dryvit Systems, Inc. Evidence shall be submitted to the code official showing that the EIFS manufacturer-recommended sealant is Type S or M, minimum grade NS, minimum Class 25 and use O sealant complying with ASTM C 920. Under the use O Classification, the sealant shall be qualified for each material to which sealant is applied. The details for sealant installation, including the width and thickness of the sealant, shall be designed by the registered design professional, designer, builder or Dryvit Systems, Inc., in that order, to the satisfaction of the code official.

## 4.0 INSTALLATION

### 4.1 General:

The Dryvit Outsulation Plus System shall be installed by contractors recognized by Dryvit Systems, Inc. All exposed edges of the insulation board shall be wrapped with the reinforcing fabric and embedded in the base coat.

The manufacturer's published installation instructions and this report shall be strictly adhered to, and a copy of the instructions shall be available at all times on the jobsite during installation. The instructions within this report shall govern if there are any conflicts between the manufacturer's instructions and this report.

The Dryvit Outsulation Plus drainage system shall be installed as an exterior wall cladding on buildings of any construction type. For IBC Type V (combustible) construction (SBC Type VI, BNBC Type 5, UBC Type V) and IRC construction, the framing members shall be either solid-sawn lumber or C-shaped steel studs having a minimum thickness and maximum spacing as specified in Section 4.5 of this report. For IBC Types I, II, III and IV (noncombustible) construction (SBC Types I, II, III, IV and V; BNBC Types 1, 2, 3 and 4; UBC Types I, II, III and IV) construction, the framing members shall be C-shaped steel studs as described in Section 4.3 of this report. Framing members shall be designed to resist all positive and negative transverse loads with a maximum allowable deflection of  $1/240$  of the span.

When the system is applied to buildings required to be of combustible construction, the sheathing material shall be one of the sheathings specified in Section 3.2.1. Sheathing substrates shall be fastened to the wood or steel studs using minimum No. 6, 1<sup>5</sup>/<sub>8</sub>-inch-long (41.3 mm), self-drilling, buglehead Type W screws (for wood framing) and Type S screws (for steel framing), having 18 threads per inch. The screws shall be installed a maximum of 6 inches (152 mm) on center along all framing members. When the system is applied to buildings required to be of noncombustible construction, the sheathing shall be gypsum sheathing board as described in Sections 3.2.1 and 4.3.

No additives, such as sand, aggregates, rapid binders, antifreeze or accelerators, are permitted to be added to any Dryvit material recognized in this report.

For installations regulated by the IBC, the following requirements shall be met:

- a. Flashing shall be installed in accordance with IBC Section 1405.3.
- b. Protection against condensation in the exterior wall assembly shall be provided in accordance with the 2003 *International Energy Conservation Code*®.
- c. An approved interior noncorrodible vapor retarder shall be provided in accordance with IBC Section 1403.3.

For installations regulated by the IRC, the EIFS shall be terminated not less than 6 inches (152 mm) above the finished ground level in accordance with Section R703.9, flashing shall be installed in accordance with Section R703.9.2, and a vapor retarder shall be installed in accordance with Section R318.

Refer to Figures 2 through 9 for typical details of the Outsulation Plus System.

## 4.2 Application:

### 4.2.1 Application of Water-resistive Barrier—Dryvit Backstop NT-Smooth and Backstop NT-Texture:

**4.2.1.1 General:** Before application of Backstop NT-Smooth or NT-Texture water-resistive barriers, the substrate shall be checked to ensure that it is structurally sound and free of loose material, voids, projections, or other conditions that may interfere with the installation of the Dryvit materials. The substrate surface shall have no planar irregularities greater than 1/4 inch (6.4 mm) within any 48-inch (1219 mm) radius. Additionally, if there are gaps or any damage in the sheathing substrate exceeding 1/4 inch (6.4 mm) in any direction, the substrate shall be replaced. The wall surface and ambient temperatures shall be above 40°F (4°C), and rising, at the time of application of Dryvit materials.

The following components are necessary to complete the water-resistive barrier coating:

- a. Dryvit Grid Tape
- b. Dryvit Backstop NT-Smooth and/or NT-Texture
- c. Dryvit Flashing Tape or Dryvit AquaFlash

**4.2.1.2 Dryvit Grid Tape:** The Dryvit Grid Tape shall be applied along all joints in sheathing, inside corners, and at edges of terminations that will not be covered with Dryvit Flashing Tape or Dryvit AquaFlash. The grid tape shall be centered at joints and pressed into position with hand pressure. The Backstop NT-Texture material shall be applied over the installed grid tape and all fastener heads. The material shall cure until dry to the touch.

**4.2.1.3 Backstop NT-Smooth or Backstop NT-Texture:** Backstop NT-Smooth or NT-Texture shall be applied over the surface of the substrate to form a continuous film. Backstop NT-Smooth and NT-Texture is ready to use; however, the material shall be mixed to a smooth homogeneous consistency in accordance with the manufacturer's application instructions, Dryvit publications DS181 and DS177, respectively.

**4.2.1.4 Dryvit Flashing Tape or AquaFlash:** Dryvit Flashing Tape or AquaFlash shall be installed onto framing edges at discontinuities and terminations, such as openings, expansion joints, and top of parapets. The surface to receive the Flashing Tape or AquaFlash shall be clean, dry, smooth, and free of conditions that hinder adhesion.

**4.2.1.4.1 Dryvit Flashing Tape:** When Flashing Tape is used, if adhesion cannot be achieved, the surface shall be primed with Dryvit Flashing Tape Surface Conditioner. The wall surface shall be prepared and the conditioner applied in accordance with the manufacturer's application instructions, Dryvit publication DS218. After the conditioner is dry and slightly tacky, the Dryvit Flashing Tape is applied. The release paper on the backside of the tape is removed to expose the rubberized asphalt adhesive. The tape is aligned into position such that it covers the Backstop NT coating a minimum of 2 inches (51 mm), and the remainder is turned into the opening. If wrinkles develop during installation, the tape shall be removed and replaced. The tape is installed with constant pressure to ensure continuous contact with the surface. End laps that occur shall maintain a minimum overlap of 2 inches (51 mm). The Flashing Tape shall be applied so that it completely covers the stud edges to the inside edge of the opening.

**4.2.1.4.2 Dryvit AquaFlash:** Using a brush or 3/4-inch nap roller, a liberal coat of AquaFlash material is applied to the substrate surface. AquaFlash Mesh is immediately embedded into the wet material. Additional AquaFlash material is added and smoothed out to remove any wrinkles and fully embed the mesh. The material is allowed to set a minimum of 15 minutes, and then a second liberal coat of AquaFlash material is applied and smoothed out to ensure a uniform continuous film free of voids, pinholes or other discontinuities.

**4.2.2 Application of Dryvit Starter Track and Drainage Strip:** The Dryvit Starter Track or the Dryvit Drainage Strip shall be installed at the base of the wall. It shall be attached to the wall surface by applying a continuous bead of Dryvit's AP Adhesive on the wall side of the track's nailing flange. The track with adhesive shall be pressed firmly against the wall substrate. It shall be installed such that there is continuous contact between the track and the wall. A continuous bead of the AP Adhesive shall be applied along the top edge of the track and where tracks abut each other, to provide a continuous seal. The Dryvit Drainage Strip shall be installed at the heads of all penetrations and at expansion/control joints. Dabs of AP Adhesive shall be applied 12 inches (305 mm) on center on the installed Backstop NT weather barrier surface, and the strip shall be pressed firmly against the substrate to ensure contact between the strip/adhesive/wall surface.

**4.2.3 Application of Thermal Insulation Board:** Before the thermal insulation boards are installed, the perimeters of all openings, penetrations, and other system terminations shall be prepared for the backwrapping of the thermal insulation boards by stapling or adhering the Dryvit Detail Mesh around the openings and other terminations. The mesh shall be attached through the Drainage Strip and into the substrate using corrosion-resistant staples or adhesive. The mesh shall be fastened approximately every 12 inches (305 mm), to maintain position during foam plastic insulation board installation.

Foam-plastic insulation board shall have a minimum thickness of 1 inch (25.4 mm) when installed on combustible construction; and shall have a minimum thickness of 1 inch (25.4 mm) and a maximum thickness of 4 inches (102 mm) when installed on noncombustible construction. The thermal insulation boards shall be adhered to the water-resistive barrier using either Genesis, Primus or Genesis DM material described in Section 3.2.6. Before the Genesis or Primus material is split and mixed with portland cement, it shall be thoroughly premixed using a Wind-Lock B-M1 or B-M8, or equivalent, mixing blade powered by a 1/2-inch (12.7 mm) drill, at 700-1000 rpm. If the material is not premixed, air entrapment and product damage may occur when the material is mixed with the portland cement, resulting in



workability and performance problems. The premixed Genesis or Primus material shall be field-mixed in a 1:1 ratio, by weight, with portland cement. Clean, potable water may be added to the mixture to adjust workability. The material shall be mixed in such batches as can be used during a work period.

A notched trowel,  $\frac{3}{8}$  inch wide by  $\frac{1}{2}$  inch deep (9.5 mm by 12.7 mm) with notches spaced  $1\frac{1}{2}$  inches (38 mm) on center, shall be used to apply the adhesive/base-coat material in straight ribbons to the back side of each insulation board. The insulation boards shall be installed such that the adhesive/base-coat material ribbons run vertically when the insulation boards are adhered to the wall substrate. Uniform pressure shall be applied over the entire insulation board surface to ensure uniform contact. Beginning at the base of the wall, the insulation boards shall be applied over the water-resistive barrier in a running bond pattern, with the long edge horizontal. Vertical insulation board joints shall be staggered a minimum of 12 inches (305 mm), with all insulation board joints offset a minimum of 8 inches (203 mm) from sheathing board joints. At wall corners, the edges of the insulation boards shall be interlocked. All board joints shall be tightly butted. Any gaps of  $\frac{1}{16}$  inch (1.6 mm) or more shall be filled with insulation pieces. The base-coat material adhering the installed insulation boards shall cure at least 24 hours before installation of the reinforcing mesh.

**4.2.4 Application of Reinforcing Mesh:** The Genesis, Primus or Genesis DM base-coat material shall be used to install the reinforcing mesh fabric on the wall. The Genesis, Primus or Genesis DM mixture shall be prepared in accordance with the manufacturer's application instructions (refer to Dryvit publication DS218—Outsulation Plus Application Instructions). A stainless steel trowel shall be used to apply the Genesis, Primus or Genesis DM base-coat mixture on the surface of the insulation board in a uniform thickness of approximately  $\frac{1}{16}$  inch (1.6 mm). The reinforcing mesh shall be placed with the curve of the mesh against the wall and troweled into the wet Genesis, Primus or Genesis DM mixture until the mesh is fully embedded and not visible. Application of the fabric shall be continuous across corners and shall be lapped a minimum of  $2\frac{1}{2}$  inches (63.5 mm) at seams. A second layer of Genesis, Primus or Genesis DM base-coat material shall be troweled over the first coat to fully cover the reinforcing mesh. The base coat shall be cured at least 24 hours before application of the finish coat.

**4.2.5 Application of Finish Coat:** The finish coat material shall be prepared and mixed in accordance with Dryvit's application instructions (refer to Dryvit publication DS218—Outsulation Plus Application Instructions). Dryvit finish shall be applied with the desired finish pattern being no thicker than the size of the largest aggregate of the material. The finish coat shall be allowed to cure at least three days before the sealant is applied.

#### 4.3 Types I, II, III, and IV (Noncombustible) Construction:

This section applies to Types I, II, III and IV construction under the IBC (Types 1, 2, 3 and 4 under the NBBC; Types I, II, III, IV and V under the SBC; and Types I, II, III and IV under the UBC). When the Dryvit Outsulation Plus EIFS is installed as an exterior wall cladding on buildings required to be of noncombustible construction, the wall assembly shall comply with the following:

- a. Interior wall finish: One layer of  $\frac{5}{8}$ -inch-thick (15.9 mm), Type X gypsum wallboard, complying with ASTM C 36, shall be installed vertically, attached with minimum No. 6,  $1\frac{1}{4}$ -inch-long (31.7 mm), buglehead, self-drilling Type S screws at a maximum of 8 inches (203 mm) on center at board joints and 12 inches (305 mm) on center at intermediate framing. All joints shall be taped and treated

with joint compound. Intermediate fastener heads shall be treated with compound.

- b. Steel stud framing: Minimum  $3\frac{5}{8}$ -inch-deep (92 mm), minimum 0.033-inch-thick [0.84 mm (No. 20 gage)] steel studs, spaced a maximum of 16 inches (406 mm) on center.
- c. Stud cavities: At floor levels, Thermafiber insulation (evaluation report ER-2331) is fitted between studs. Insulation density shall be a nominal 4 pounds per cubic foot (64 kg/m<sup>3</sup>). Batts shall be 6 to 8 inches (152 to 203 mm) wide. The insulation shall be friction-fitted.
- d. Openings: Wall openings shall be framed with minimum 0.0428-inch-thick (1.09 mm) aluminum or steel framing.
- e. Exterior sheathing: One layer of minimum  $\frac{1}{2}$ -inch-thick (12.7 mm), water-resistant core gypsum sheathing shall be applied horizontally to framing and attached using minimum No. 8,  $1\frac{1}{4}$ -inch-long (31.7 mm), self-drilling Type S screws spaced maximum 8 inches (203 mm) on center along all studs.
- f. Exterior wall cladding: Outsulation Plus EIFS as described in this evaluation report shall be installed over the gypsum sheathing in accordance with Section 4.2. The maximum thickness of foam plastic insulation shall be 4 inches (102 mm), except as noted in Section 3.2.8 for foam plastic formed shapes.

#### 4.4 One-hour Fire-resistance-rated Construction:

##### 4.4.1 Combustible Fire-resistance-rated Construction:

Outsulation Plus may be applied to the exterior surface of a load-bearing or nonload-bearing, fire-resistance-rated wall in a building classified as combustible construction without affecting the assigned hourly rating of the wall, provided it is constructed as described in Table 720.1(2) of the IBC (Table 7-B of the UBC) and Section 4.3 of this report.

##### 4.4.2 Noncombustible Fire-resistance-rated Construction:

Outsulation Plus is permitted to be adhered to the surface of a nonload-bearing, one-hour fire-resistance-rated wall in a building classified as noncombustible construction without affecting the fire resistance of the wall. As a minimum, the wall shall be constructed as described in assembly WP-1200 of the GA600-00 Gypsum Association's *Fire Resistance Design Manual*, 16th edition.

#### 4.5 Wind Design:

The following Dryvit Outsulation Plus EIFS assemblies are assigned allowable negative and positive design wind pressures transverse loads:

**4.5.1 Assembly 1:** Structural framing consists of minimum 2-by-4 No. 2 hem-fir ( $G = 0.43$ ) wood studs, spaced a maximum of 16 inches (406 mm) on center. Sheathing material referenced in Section 3.2.1 of this evaluation report shall be mechanically fastened to the studs with minimum  $1\frac{5}{8}$ -inch-long (41.3 mm), No. 6, self-drilling screws spaced a maximum of 6 inches (152 mm) on center at all studs and top and bottom plates. Outsulation Plus EIFS shall be adhered to the water-resistive barrier in accordance with this report. The maximum allowable positive and negative design wind pressure transverse loads for this assembly shall be 50 psf and 40 psf (2.39 and 1.92 kN/m<sup>2</sup>), respectively.

**4.5.2 Assembly 2:** Structural framing shall be minimum  $3\frac{5}{8}$ -inch-deep (92 mm), No. 18 gage [0.044 inch base-metal thickness (1.12 mm)], C-shaped metal studs, spaced a maximum of 16 inches (406 mm) on center. Sheathing material referenced in Section 3.2.1 shall be mechanically fastened to the studs with minimum  $1\frac{5}{8}$ -inch-long (41.3 mm), No. 6, self-drilling screws spaced a maximum of 6 inches

(152 mm) on center at all studs and at the top and bottom plates. Outsulation Plus EIFS shall be adhered to the water-resistive barrier in accordance with this report. The maximum allowable positive and negative design wind pressure transverse loads for this assembly shall be 60 psf and 40 psf (2.87 and 1.92 kN/m<sup>2</sup>), respectively.

**4.5.3 Assembly 3:** Substrate shall be either unglazed brick, cement plaster, concrete, or concrete masonry. The Outsulation Plus EIFS shall be adhered to the water-resistive barrier in accordance with this report. The maximum allowable positive design wind pressure transverse load is governed by the structural capacity of the substrates, and the negative transverse load shall be 70 psf (3.4 kN/m<sup>2</sup>).

#### 4.6 Special Inspection:

In jurisdictions enforcing the IBC, IRC and BNBC, special inspections are required at the jobsite in accordance with IBC Sections 1704.1 and 1704.12, which also apply to the IRC, or Sections 1705.1 and 1705.13 of the BNBC, for the water-resistive barrier applied over framed walls. Duties of the special inspector shall include verifying field preparation of materials, expiration dates, installation of components, curing of components, installation of joints and sealant, applied dry-film thickness and interface of coating material with flashing.

#### 5.0 CONDITIONS OF USE

The Dryvit Outsulation Plus™ System as described in this report complies with, or is a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

- 5.1 This evaluation report and the application instructions, when required by the code official, shall be submitted at the time of permit application.
- 5.2 The Dryvit Outsulation Plus system shall be installed only by contractors recognized by Dryvit Systems, Inc., as being trained to perform installation of the Outsulation Plus system.
- 5.3 The insulation board used in the finish system shall be separated from the building interior with a thermal barrier complying with Section 2603.4 of the IBC or Section R314.1.2 of the IRC (Section 2602.4 of the UBC, Section 2603.4 of the BNBC, Section 2603.5 of the SBC).
- 5.4 The design transverse wind load pressures shall not exceed the allowable design wind pressures indicated in Section 4.5 of this report.
- 5.5 The finish systems shall not be used as exterior stud wall bracing. Wall bracing shall be provided in

accordance with Section 2308.9.3 of the IBC and Section R602.10 of the IRC (Section 2305.8.1 of the BNBC, Section 2320.11.3 of the UBC, Section 2308.2.2 of the SBC).

- 5.6 The Dryvit Outsulation Plus system may be installed on buildings of any type construction. When installed on buildings of noncombustible construction, the wall shall be constructed as described in Section 4.3 of this report.
- 5.7 The Dryvit Outsulation Plus system shall be limited to nonfire-resistive-rated construction except as provided for in Section 4.4 of this report.
- 5.8 Termination of the system shall not be less than 6 inches (152 mm) above finished grade, in accordance with Section 2304.1.4 of the SBC and Section R320.4 of the IRC.
- 5.9 Installation cards, such as those shown in Figures 17, 18 and 19, shall be completed by the EIFS applicator (Figure 18), the sealant installer (Figure 17) and the water-resistive coating contractor (Figure 19), and shall be presented to the code official at the completion of each project.

#### 6.0 EVIDENCE SUBMITTED

- 6.1 Data in accordance with the ICC-ES Acceptance Criteria for EIFS Clad Drainage Assemblies (AC235), dated October 2004.
- 6.2 Data in accordance with the ICC-ES Acceptance Criteria for Water-resistive Coatings Used as Water-resistive Barriers over Exterior Sheathing (AC212), dated February 2005.
- 6.3 Data in accordance with the ICC-ES Acceptance Criteria for Flashing Materials (AC148), dated July 2001.

#### 7.0 IDENTIFICATION

Each container or package of material used as a part of the Dryvit Outsulation Plus™ system covered by this report shall be labeled with the manufacturer's name (Dryvit Systems, Inc.), address and telephone number; the product trade name; and the evaluation report number (ESR-1543).

Dryvit EPS insulation boards are delivered in sealed polyethylene bags bearing the word "Dryvit," the plant identification number of the block molder, and the name of the inspection agency [RADCO (AA-650)], and the evaluation report number (ESR-1543). In addition, one board in each bag shall bear these same label markings on each face.

TABLE 1—DIMENSIONS AND WEIGHTS OF DRYVIT REINFORCEMENT MESHES FOR DRYVIT OUTSULATION PLUS SYSTEMS

REINFORCING MESH GRADE	WEIGHT (oz/yd <sup>2</sup> )	ROLL WIDTH BY LENGTH
Standard	4.3	48" by 150' 72" by 150'
Standard Plus	6.0	48" by 150'
Intermediate	12.0	48" by 150'
Panzer 15	15.0	48" by 75'
Panzer 20	20.5	48" by 75'
Corner	7.2	9 1/4" by 150'
Detail	4.3	9 1/2" by 150'

For SI: 1 inch = 25.4 mm; 1 oz/yd<sup>2</sup> = 0.012kg/m<sup>2</sup>; 1 ft = 305 mm.

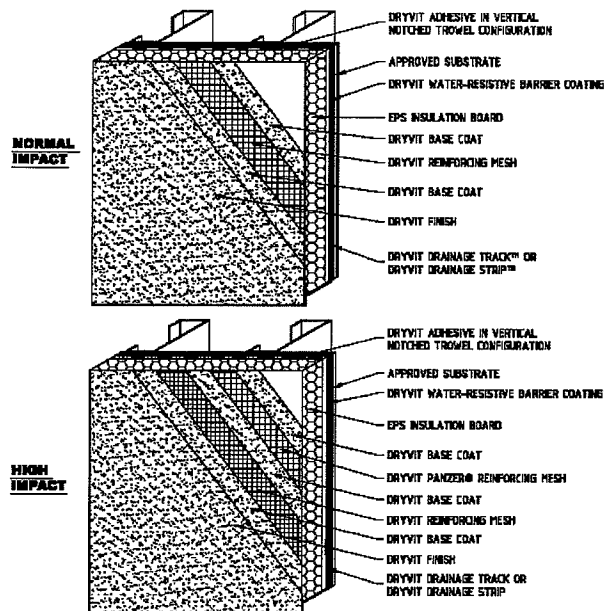


FIGURE 1

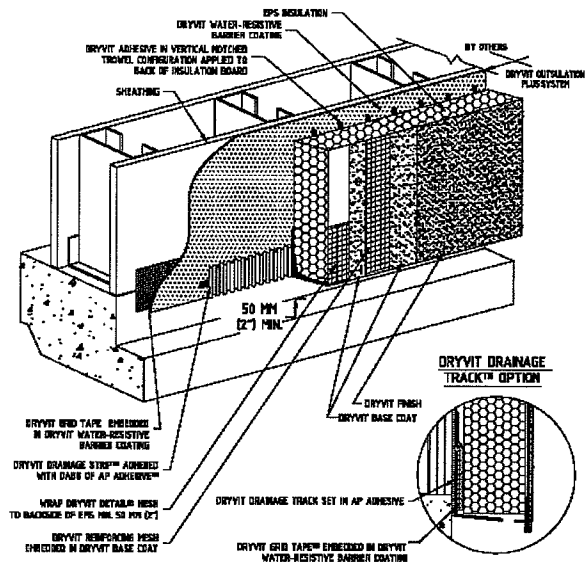


FIGURE 2

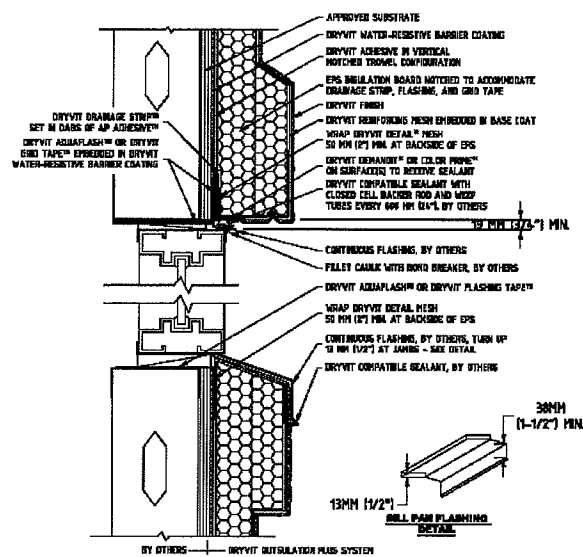


FIGURE 3

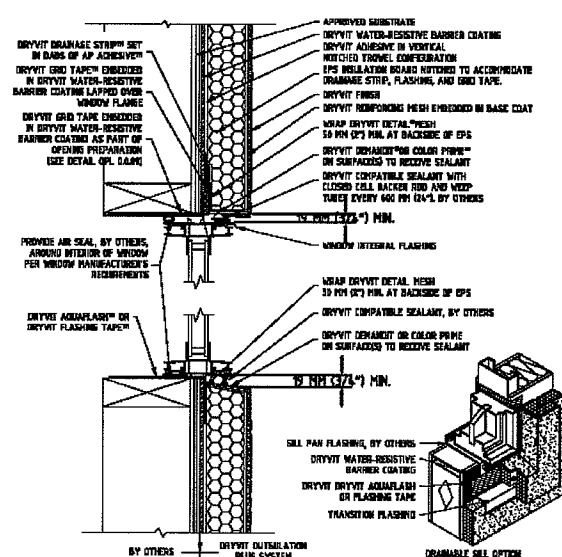


FIGURE 4

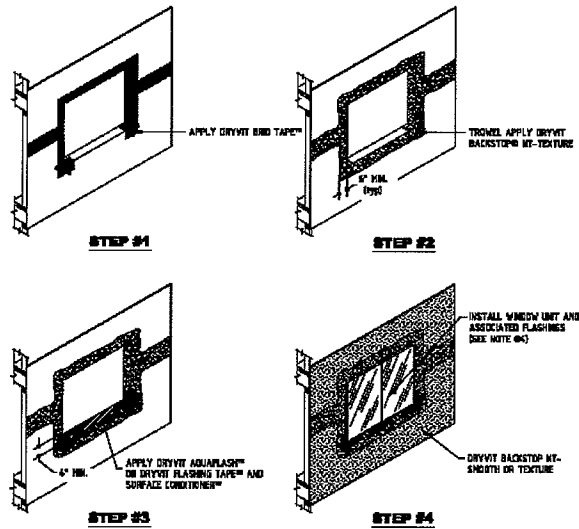


FIGURE 5

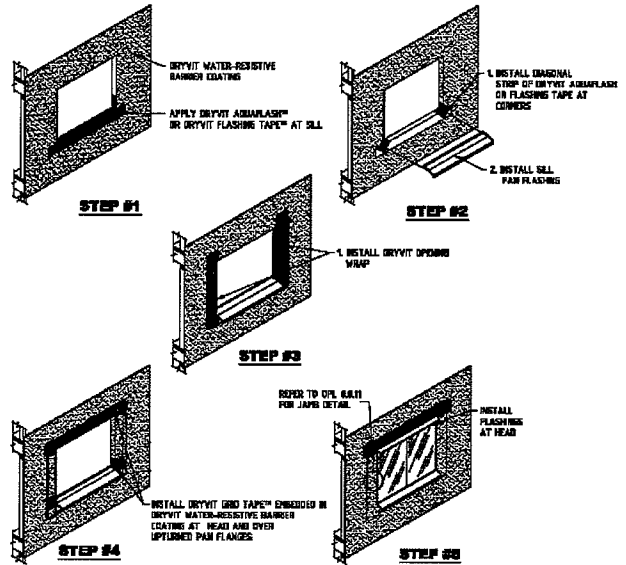


FIGURE 6

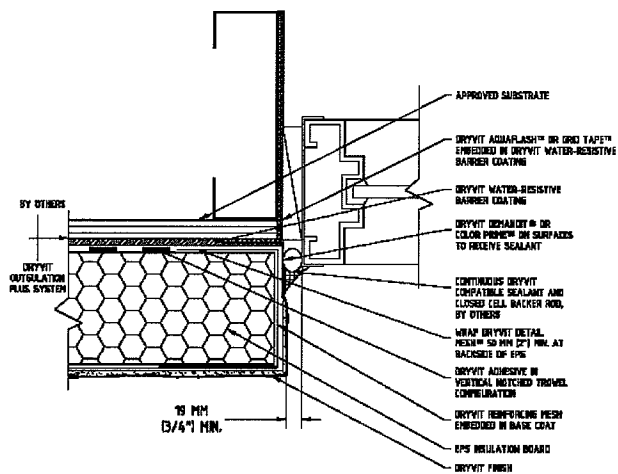


FIGURE 7

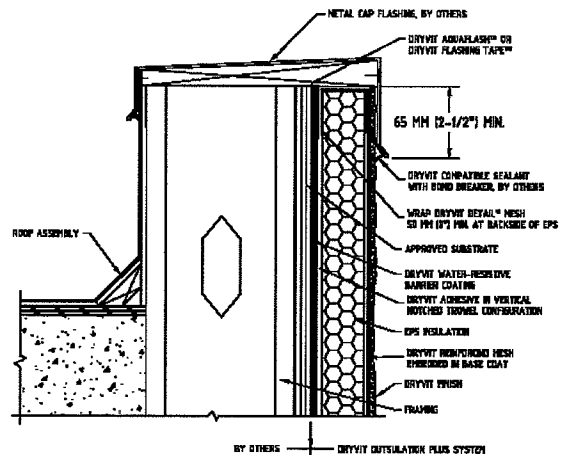


FIGURE 8

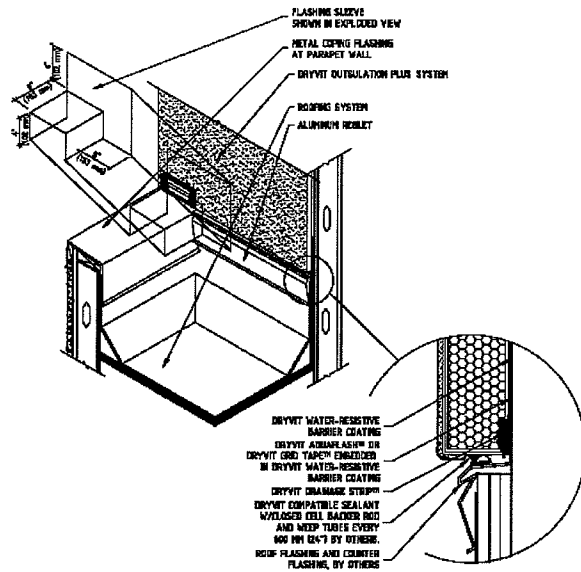


FIGURE 9

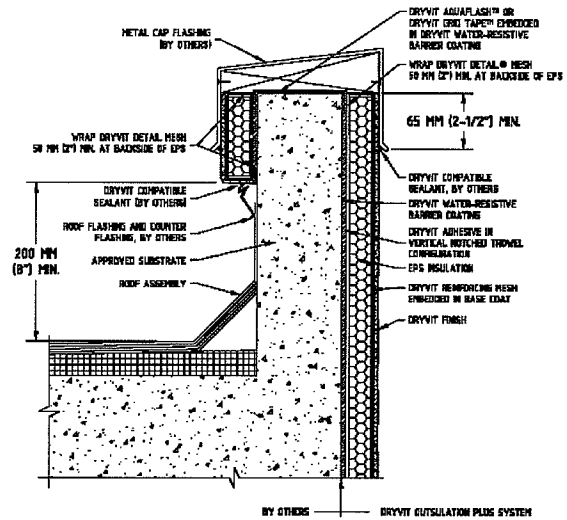


FIGURE 10

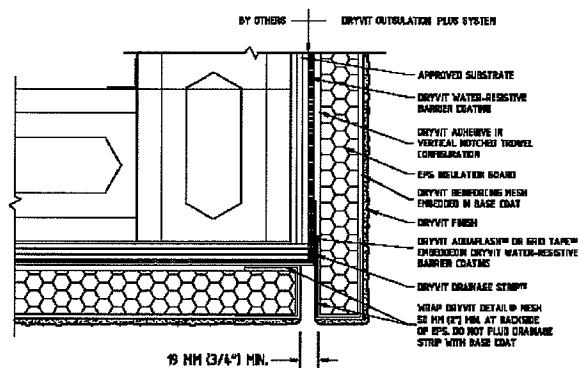


FIGURE 11

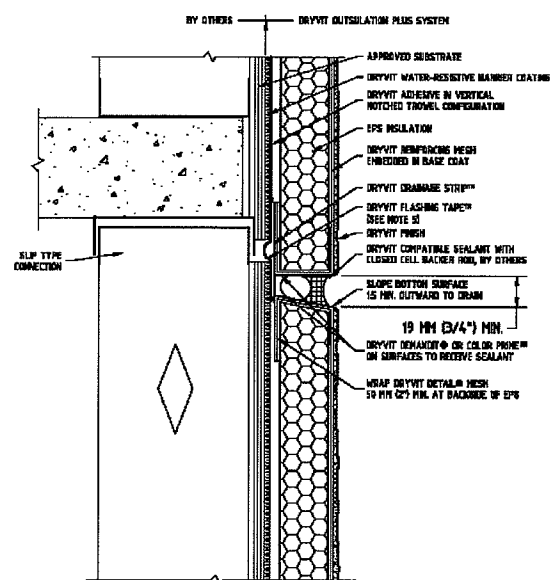


FIGURE 12

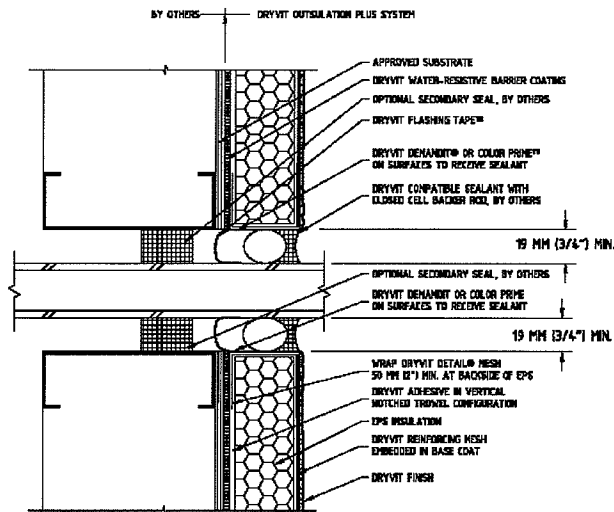


FIGURE 13

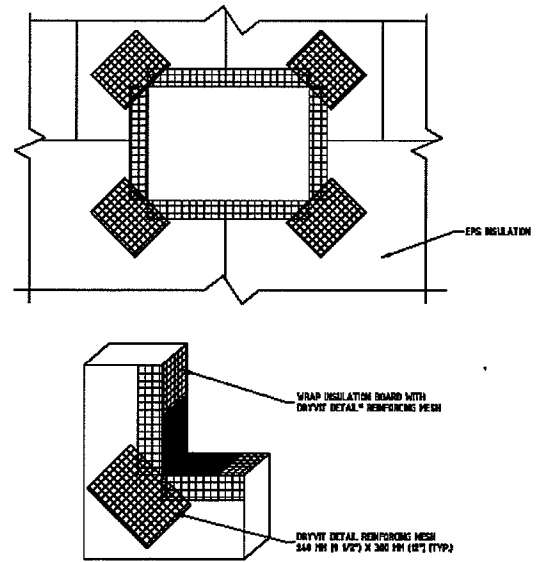


FIGURE 14

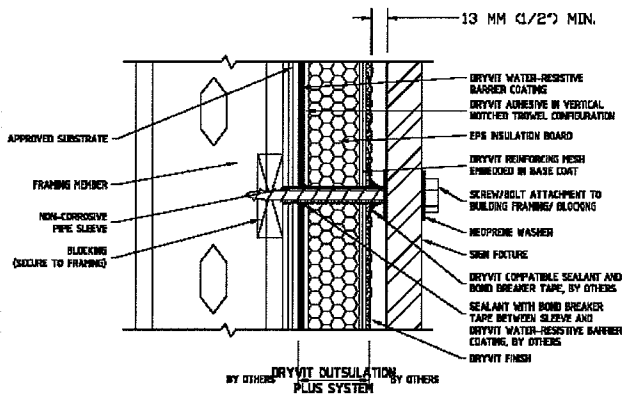


FIGURE 15

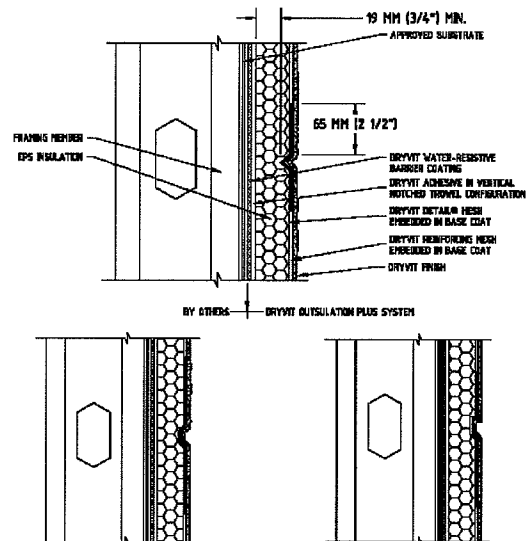


FIGURE 16

[SEALANT INSTALLER NAME]

Completion Date: \_\_\_\_\_

THE SEALANT INSTALLED IN CONJUNCTION WITH AN EXTERIOR INSULATION AND FINISH SYSTEM (EIFS clad drainage wall assembly) INSTALLED ON THE STRUCTURE LOCATED AT THE ADDRESS INDICATED BELOW:

CONFORMS \_\_\_\_\_

TO [EIFS MANUFACTURER NAME] AND [SEALANT MANUFACTURER'S NAME] RECOMMENDED INSTALLATION PRACTICES AND SECTION(S) \_\_\_\_\_ OF ICC-ES, INC., EVALUATION REPORT ESR-\_\_\_\_\_.

Address of Structure:

Product Component Names:

_____	Primer(s)	_____
_____	Sealers	_____
_____	Bond Breakers	_____
_____	Sealant Materials	_____

INSTALLATION

CONFORMS

- A. Designer's requirements, details and instructions  
 B. Sealant manufacturer's details and requirements  
 C. Exterior insulation manufacturer's requirements

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

- D. The information entered above is offered in testimony that the Sealant installation conforms with the sealant manufacturer's installation methods and procedures, and the EIFS manufacturer's evaluation report.

Sealant Installer Company Name and Address:

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Signature of Responsible Officer: \_\_\_\_\_

Typed Name and Title of Officer: \_\_\_\_\_

Telephone Number: (\_\_\_\_) \_\_\_\_\_

cc:	Original:	Building Department	(Shall be submitted with EIFS contractor declaration.)
	Copies:	EIFS Manufacturer	
		EIFS Contractor	
		Sealant Manufacturer	

FIGURE 17—SEALANT INSTALLER CARD

[EIFS CONTRACTOR NAME]

Completion Date: \_\_\_\_\_

THE EXTERIOR INSULATION AND FINISH SYSTEM (EIFS) INSTALLED ON THE STRUCTURE LOCATED AT THE ADDRESS INDICATED BELOW:

\_\_\_\_\_ CONFORMS

TO [EIFS MANUFACTURER NAME] RECOMMENDED INSTALLATION PRACTICES AND SECTION (S) \_\_\_\_\_ OF ICC-ES, INC., EVALUATION REPORT ESR-\_\_\_\_\_.

Address of Structure:

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Product Component Names:

Adhesive(s) \_\_\_\_\_  
 Fasteners (mech) \_\_\_\_\_  
 Base Coat \_\_\_\_\_  
 Reinforcing Mesh \_\_\_\_\_  
 Finish Coat(s) \_\_\_\_\_

INSTALLATION

CONFORMS

- A. Substrate Type and Tolerance \_\_\_\_\_
- B. Weather-resistive Barrier \_\_\_\_\_
- C. EIFS
1. Adhesive and/or Fasteners \_\_\_\_\_
  2. Insulation \_\_\_\_\_
  3. Reinforcing Mesh \_\_\_\_\_
  4. Base Coat \_\_\_\_\_
  5. Finish \_\_\_\_\_

- D. The information entered above is offered in testimony that the EIFS installation conforms with the EIFS manufacturer's installation methods and procedures, and the EIFS manufacturer's ES report.

NOTE: An installation card shall be received from the Sealant Installer indicating that the sealant installation conforms with the EIFS evaluation report and sealant manufacturer's installation methods and procedures shall accompany this declaration.

EIFS

Contractor Company Name and Address:

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Signature of Responsible Officer: \_\_\_\_\_

Typed Name and Title of Officer: \_\_\_\_\_

Telephone Number: (\_\_\_\_) \_\_\_\_\_

cc: Original: Building Department (Shall be submitted with sealant  
 Copy: EIFS Manufacturer installer declaration.)

FIGURE 18—EIFS CONTRACTOR CARD



(WATER-RESISTIVE COATING CONTRACTOR NAME)

Completion Date: \_\_\_\_\_

THE WATER-RESISTIVE COATING INSTALLED ON THE STRUCTURE LOCATED AT THE ADDRESS INDICATED BELOW:

\_\_\_\_\_ CONFORMS

TO (WATER-RESISTIVE COATING MANUFACTURER NAME) RECOMMENDED INSTALLATION PRACTICES AND SECTION (S) \_\_\_\_\_ OF EVALUATION REPORT ESR-\_\_\_\_\_.

Address of Structure:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Product Component Names:

Reinforcing Fabric \_\_\_\_\_  
Coating \_\_\_\_\_

## INSTALLATION

## CONFORMS

- A. Substrate Type and Tolerance \_\_\_\_\_
- B. Water-resistive Coating \_\_\_\_\_
- C. The information entered above is offered in testimony that the water-resistive coating application conforms with the manufacturer's installation methods and procedures, and the water-resistive coating manufacturer's evaluation report.

NOTE: An installation card shall be received from the water-resistive coating installer indicating that the water-resistive coating application conforms with the water-resistive coating evaluation report and water-resistive coating manufacturer's installation methods and procedures must accompany this declaration.

Water-resistive Coating Contractor Company Name and Address:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Signature of responsible Officer: \_\_\_\_\_

Typed Name and Title of Officer: \_\_\_\_\_

Telephone Number: (\_\_\_\_\_) \_\_\_\_\_

cc: Original: Building Department  
Copy: Water-resistive Coating Manufacturer

FIGURE 19—WATER-RESISTIVE COATING CONTRACTOR CARD

**1704.11.4 Density.** The density of the sprayed fire-resistant material shall not be less than the density specified in the approved fire-resistant design. Density of the sprayed fire-resistant material shall be determined in accordance with ASTM E 605.

**1704.11.5 Bond strength.** The cohesive/adhesive bond strength of the cured sprayed fire-resistant material applied to structural elements shall not be less than 150 pounds per square foot (psf) (7.18 kN/m<sup>2</sup>). The cohesive/adhesive bond strength shall be determined in accordance with the field test specified in ASTM E 736 by testing in-place samples of the sprayed fire-resistant material selected in accordance with Sections 1704.11.5.1 and 1704.11.5.2.

**1704.11.5.1 Floor, roof and wall assemblies.** The test samples for determining the cohesive/adhesive bond strength of the sprayed fire-resistant materials shall be selected from each floor, roof and wall assembly at the rate of not less than one sample for every 10,000 square feet (929 m<sup>2</sup>) or part thereof of the sprayed area in each story.

**1704.11.5.2 Structural framing members.** The test samples for determining the cohesive/adhesive bond strength of the sprayed fire-resistant materials shall be selected from beams, girders, joists, trusses and columns at the rate of not less than one sample for each type of structural framing member for each 10,000 square feet (929 m<sup>2</sup>) of floor area or part thereof in each story.

**1704.12 Exterior insulation and finish systems (EIFS).** Special inspections shall be required for all EIFS applications.

**Exceptions:**

1. Special inspections shall not be required for EIFS applications installed over a water-resistive barrier with a means of draining moisture to the exterior.
2. Special inspections shall not be required for EIFS applications installed over masonry or concrete walls.

**1704.13 Special cases.** Special inspections shall be required for proposed work that is, in the opinion of the building official, unusual in its nature, such as, but not limited to, the following examples:

1. Construction materials and systems that are alternatives to materials and systems prescribed by this code.
2. Unusual design applications of materials described in this code.
3. Materials and systems required to be installed in accordance with additional manufacturer's instructions that prescribe requirements not contained in this code or in standards referenced by this code.

**1704.14 Special inspection for smoke control.** Smoke control systems shall be tested by a special inspector.

**1704.14.1 Testing scope.** The test scope shall be as follows:

1. During erection of ductwork and prior to concealment for the purposes of leakage testing and recording of device location.

2. Prior to occupancy and after sufficient completion for the purposes of pressure difference testing, flow measurements and detection and control verification.

**1704.14.2 Qualifications.** Special inspection agencies for smoke control shall have expertise in fire protection engineering, mechanical engineering and certification as air balancers.

## SECTION 1705

### QUALITY ASSURANCE FOR SEISMIC RESISTANCE

**1705.1 Scope.** A quality assurance plan for seismic requirements shall be provided in accordance with Section 1705.2 for the following:

1. The seismic-force-resisting systems in structures assigned to Seismic Design Category C, D, E or F, in accordance with Section 1616.
2. Designated seismic systems in structures assigned to Seismic Design Category D, E or F.
3. The following additional systems in structures assigned to Seismic Design Category C:
  - 3.1. Heating, ventilating and air-conditioning (HVAC) ductwork containing hazardous materials and anchorage of such ductwork.
  - 3.2. Piping systems and mechanical units containing flammable, combustible or highly toxic materials.
  - 3.3. Anchorage of electrical equipment used for emergency or standby power systems.
4. The following additional systems in structures assigned to Seismic Design Category D:
  - 4.1. Systems required for Seismic Design Category C.
  - 4.2. Exterior wall panels and their anchorage.
  - 4.3. Suspended ceiling systems and their anchorage.
  - 4.4. Access floors and their anchorage.
  - 4.5. Steel storage racks and their anchorage, where the factor,  $I_p$ , determined in Section 9.6.1.5 of ASCE 7, is equal to 1.5.
5. The following additional systems in structures assigned to Seismic Design Category E or F:
  - 5.1. Systems required for Seismic Design Categories C and D.
  - 5.2. Electrical equipment.

**Exceptions:**

1. A quality assurance plan is not required for structures designed and constructed in accordance with the conventional construction provisions of Section 2308.
2. A quality assurance plan is not required for structures designed and constructed in accordance with the following:
  - 2.1. The structure is constructed of light wood framing or light framed cold-formed steel; the design spectral response acceleration at short periods,  $S_{DS}$ , as determined in Section 1615.1,