

# 2001 COMPANY

## WIND BLOWN DEBRIS RESISTANT ROOF ASSEMBLIES

### Hurricane 140 Mph And Tornado 250 Mph Wind Blown Debris

The Texas Tech “Wind Blown Debris Test” requires three impacts by the butt end of a 2 x 4” shot out of an air cannon at the three most vulnerable areas of a roof assembly.

First: a center deck joint. Second: a corner. Third: a roof assembly fastener.

## Texas Tech Hurricane and Tornado Shelter Testing

### Hurricane shelter for wind blown debris south Florida building code occupant protection:

The following Texas Tech wind blown debris roof assembly test series 1 – 8 meets or exceed the 9-lb 2 x 4” missile traveling horizontally at 34 mph required by south Florida Building code.

This test relates to a debris missile propelled by a 140 mph ground speed hurricane.

### Tornado shelter for FEMA 320 occupant protection: The Texas Tech debris test series 6,7, & 8

roof assemblies successfully resisted the 15-lb. 2 x 4” missile traveling horizontally at 100 mph into a vertically held roof assembly as required by Federal Emergency Management Association, FEMA, 320 for occupant protection. This speed relates to a missile propelled by 250 mph ground speed tornado.

### Optional roof waterproof integrity observation of the wind blown debris for hurricane

and tornado generated missiles tested roof assembly: In addition to the debris missile impact resistance for occupant protection, the 2001 Company roof assemblies were observed for watertight integrity which is not part of the south Florida Hurricane Building Code or FEMA 320 tornado flying debris missile impact test. Most 2001 wind vented roof systems remain watertight after debris testing.

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## Hurricane And Tornado Shelter Wind Blown Debris Impact Test

**Has 3 Categories:** 1. Moderate 34 mph.                      2. Severe 70 mph.                      3. Extreme 100 mph.

**1 Moderate:** A 9 foot long 2 x 4” as a 9 pound wind blown debris missile is shot horizontally at 34 mph directly into a roof assembly relates to a missile propelled by a **140 mph ground speed** during a hurricane wind event.

**2 Severe:** A 15 foot 2 x 4” as a 15 pound wind blown debris missile is shot horizontally at 70 mph directly into a roof assembly relates to a missile propelled by a **200 mph ground speed** during a hurricane approaching tornado and wind shear type wind events.

**3 Extreme:** A 15 foot 2 x 4” as a 15 pound wind blown debris missile is shot horizontally at 100 mph directly into a roof assembly relates to a missile propelled by a **250 mph ground speed** during a tornado wind event.

A water pressure test was not conducted. This criterion for the test pass/fail is as follows: 1) The test subject must be impacted by three missiles in areas of perceived vulnerability; 2) the missile may penetrate that test subject, but not perforate the safe side (back face) of the subject; 3) the test subject permanent deflection after impact must be less than 3-in.; 4) segments, spallings, or otherwise delaminated portions of the test subject, though still attached to the subject, may not extend into the safe compartment 3-in. or more; 5) segments of the test subject or appurtenances attached to the test subject must not be ejected or otherwise released into the safe compartment by impact force. This criterion is consistent with the guidelines of **FEMA 320, “Taking Shelter from the Storm.”**

# 2001 COMPANY

## Hurricane Debris Resistant Roof Assemblies

### Test 1: 45 mil C-EPDM reinforced 2001 Co. wind vented roof assembly:

Hurricane debris impact test 2 x 4" approximately 9 feet long, 9 pounds in weight, and shot at **34 mph**.

**Roof Deck:** Plywood sheathing 15/32" minimum installed on joists no greater than 17" on center.

**Deck Air Seal:** Joints of plywood deck are air sealed with 2001 construction adhesive

*(slow rise adhesive foam, EPDM paste sealant, or latex deck adhesive).*

**Insulation:** Poly Isocyanurate insulation 2" minimum loose laid or spot attached in construction adhesive.

**Cover Board:** gypsum wall board sheathing ½" minimum, "Dens Deck" or equal is loose laid over insulation. The joints of the gypsum are offset two feet in each direction from underlying insulation joints.

**Fastener Protection:** Any fasteners used under the roof membrane are covered by **2001 debris impact cover, patent pending**, solid washer over fastener head and abrasion pad over standard washer and fastener.

**2001 Company Water Proofing Membrane:** 45 mil reinforced C-EPDM loose laid over the cover board, is air seal terminated at perimeters and penetrations.

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## Test 1 Continued

**Equalizer Valves:** The roof assembly is wind up lift vented in the wind vortex intensity areas on corners and perimeters with 2001 Company one-way valves for increased wind up lift resistance and to provide continuous venting of moisture and condensation out of the roof assembly.

**Waterproof Integrity Observation:** 1 ¼” tears took place in the reinforced 45 mil C-EPDM membrane from the 9 foot 2 x 4” at **34 miles** per hour impact. Reinforced membrane does not elongate on debris impact; its waterproof integrity is breached in the area of the blunted impact of the 2 x 4” and will leak.

## **Debris Resistance Evaluation**

**Thin mil reinforced membranes are die cut by the blunt end of a 2 x 4” on impact. Mechanically fastened and adhered membranes are held taught and cannot elongate; they are damaged from the 2 x 4”’s impact 34 miles per hour moderate impact.**

**Non-reinforced EPDM that is loose laid** can elongate and adsorb the 2 x 4” impact with less puncture damage than reinforced waterproofing membranes.

# 2001 COMPANY

## Hurricane Debris Resistant Roof Assemblies

### Test 2: 90 mil C-EPDM Non-Reinforced 2001 wind vented roof assembly:

Hurricane debris impact test approximately 9 feet long, 9 pound 2 x 4", and shot at **34 mph**.

**Roof Deck:** Plywood sheathing 15/32" minimum installed on joist no greater than 17" on center.

**Deck Air Seal:** Joints of plywood deck are air sealed with 2001 construction adhesive

*(slow rise adhesive foam, EPDM paste sealant, or latex deck adhesive).*

**Insulation:** Poly Isocyanurate insulation 2" minimum loose laid or spot attached in construction adhesive.

**Cover Board:** gypsum wall board sheathing 1/2" minimum, "Dens Deck" or equal is loose laid over insulation. The joints of the gypsum are offset two feet in each direction from underlying insulation.

**Fastener Protection:** Any fasteners used under the roof membrane are covered by **2001 debris impact cover, patent pending**, solid washer over fastener head and abrasion pad over standard washer and fastener.

**2001 Company Water Proofing Membrane:** 90 mil C-EPDM non-reinforced membrane is loose laid over the cover boards, and air seal terminated at perimeters and penetrations.

**Equalizer Valves:** The roof assembly is wind up lift vented in the wind vortex intensity areas, on corners and perimeters, with 2001 Company one-way valves for increased wind up lift resistance and to provide continuous venting of moisture and condensation out of the roof assembly.

# 2001 COMPANY

## Test 2 Continued

**Waterproof Integrity Observation:** A slight surface scratching took place on the 90 mil non-reinforced C-EPDM membrane where the four corners of the blunt end of the 9 foot 2 x 4" impacted the test assembly at **34 mph**. The 90 mil C-EPDM roof membrane remained watertight.

## Debris Resistance Evaluation

Non-reinforced 90 mil C-EPDM over ½" gypsum and 2" ISO acts like a trampoline skin absorbing with flying debris impact like a catcher's mitt without damage. The patent pending fastener protection impact cover protects the 90 mil from underside debris impact abrasion.

**The watertight integrity of the non-reinforced 90 mil C-EPDM membrane remains intact on a moderate 34 mph impact and severe 70 mph impact**

# 2001 COMPANY

## Hurricane Debris Resistant Roof Assemblies

### Test 3: 80 mil CPA Reinforced 2001 wind vented roof assembly:

Hurricane debris impact test approximately 9 feet long, 9 pound 2 x 4", and shot at **34 mph**.

**Roof Deck:** 22 gauge corrugated steel deck. Type "B"

**Deck Air Seal:** Joints of the metal deck, welds, fasteners, perimeters, and through roof penetrations are air sealed with 2001 Company construction adhesive (*slow rise adhesive foam and or term bar tape*).

**Insulation:** Poly Isocyanurate, two layers of 1 ½" minimum, installed with 2001 Co. construction adhesive or loose laid and the joints of the top layer are staggered 2 feet in each direction over the bottom layer.

**Cover Board:** gypsum wall board sheeting ½" minimum, "Dens Deck" or equal is loose laid over insulation. The joints of the gypsum are off set two feet in each direction over underlying insulation boards.

**Fastener Protection:** Any fasteners used under the membrane are covered by **2001 debris impact cover, patent pending**, solid washer over fastener head and abrasion pad over standard washer and fastener.

**2001 Company Water Proofing Membrane:** 80 mil CPA reinforced is loose laid over the cover board, air seal terminated at perimeters and penetrations.

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## Test 3 Continued

**Equalizer Valves:** The roof assembly is wind up lift vented in the wind vortex intensity areas with 2001 Company one-way valves for increased wind up lift resistance and to provide continuous venting of moisture and condensation out of the roof assembly.

**Waterproof Integrity Observation:** A slight surface scratching took place on the membrane where the four corners of the blunt end of the 9 foot 2 x 4" impacted the 80 mil reinforced CPA at **34 mph**. The roof assembly remains watertight.

## **Debris Resistance Evaluation**

The loose laid nature of the wind vented roof assembly allowed sufficient membrane to be drawn into the impact area like a trampoline skin to catch the flying debris impact like a catcher's mitt and not cut through the 80 mil CPA roof membrane. The 80 mil thickness of a reinforced roofing membrane is necessary to resist impact damage of the blunt end of a 2 x 4" die cutting the membrane.

**The roofs water tight integrity remained intact with 80 mil CPA on gypsum and ISO even though the 1/2" gypsum and ISO insulation are crushed under the direct impact area at 34 mph impact.**

If the 80 mil CPA was restrained by mechanical attachment or totally adhered the flying 2 x 4" would directly cut through the membrane.



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## Hurricane Wind Blown Debris Resistant Roof

### Test 4: 60 mil C-EPDM Non-Reinforced 2001 wind vented roof assembly:

Hurricane debris impact test approximately 9 feet long, 9 pound 2 x 4", and shot at **34 mph**.

**Roof Deck:** Plywood sheathing 15/32" minimum installed on joist no greater than 17" on center.

**Deck Air Seal:** Joints of plywood deck are air sealed with 2001 construction adhesive

*(slow rise adhesive foam, EPDM paste sealant, or latex deck adhesive).*

**Insulation:** Poly Isocyanurate insulation 2" minimum loose laid or adhered in construction adhesive.

**Cover Board:** gypsum wallboard sheathing 1/2" minimum, "Dens Deck" or equal is loose laid over insulation.

The joints of the gypsum are offset two feet in each direction from underlying insulation joints.

**Fastener Protection:** Any fasteners used under the membrane are covered by **2001 debris impact cover, patent pending**, solid washer over fastener head and abrasion pad over standard washer and fastener.

**2001 Company Water Proofing Membrane:** 60 mil C-EPDM non-reinforced loose laid over the cover boards, air seal terminated at perimeters and penetrations.

**Equalizer Valves:** The roof assembly is wind up lift vented in the wind vortex intensity areas, at corners and perimeters, with 2001 Company one-way valves for increased wind up lift resistance and to provide continuous venting of moisture and condensation out of the roof assembly.

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## Test 4 Continued

**Waterproof Integrity Observation:** A slight surface scratching took place on the membrane where the four corners of the blunt end of the 9 foot 2 x 4" impacted the non-reinforced 60 mil C-EPDM at **34 mph**. The 60 mil C-EPDM is not punctured by the flying debris and remained watertight.

## Debris Resistance Evaluation

Non-reinforced 60 mil C-EPDM, over ½" gypsum and 2" ISO, acts like a trampoline skin to catch the flying debris impact like a catcher's mitt and not cut through the roof membrane. The 60 mil C-EPDM non-reinforced membrane loose laid over loose gypsum boards has better resistance to debris puncture damage than membranes that are reinforced or membranes that are restrained by being totally adhered or mechanically fastened in a roof assembly.

**The watertight integrity of the non-reinforced 60 mil C-EPDM membrane remains intact in a moderate 34 mph hurricane wind blown debris impact test loose laid on ½" gypsum and 2" ISO on a wood deck.**

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## Hurricane Wind Blown Debris Resistant Roof

### Test 5: 80 mil PVC Reinforced wind vented roof assembly:

Hurricane debris impact test approximately 9 feet long, 9 pound 2 x 4", and shot at **34 mph**.

**Roof Deck:** Plywood sheathing 15/32" minimum installed on joist no greater than 17" on center.

**Deck Air Seal:** Joints of the plywood deck are air sealed with 2001 construction adhesive

*(slow rise adhesive foam, EPDM paste sealant, or latex deck adhesive).*

**Insulation:** Poly Isocyanurate, two layers of 1 1/2" minimum, are loose laid or spot adhered with construction adhesive. The joints of the top layer of insulation are staggered 2 feet in each direction over the bottom layer.

**Cover Board:** gypsum wallboard sheathing 1/2" minimum, "Dens Deck" or equal is loose laid over insulation. The joints of the gypsum are off set two feet in each direction over underlying insulation board.

**Fastener Protection:** Any fasteners used under the membrane are covered by **2001 debris impact cover, patent pending**, solid washer over fastener head and abrasion pad over standard washer and fastener.

**2001 Company Water Proofing Membrane:** 80 mil PVC reinforced loose laid over the cover board, air seal terminated at perimeters and penetrations.

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**Equalizer Valves:** The roof assembly is wind up lift vented in the wind vortex intensity areas, at corners and perimeters, with 2001 Company one-way valves for increased wind up lift resistance and to provide continuous venting of moisture and condensation out of the roof assembly.

## **Test 5 Continued**

**Waterproof Integrity Observation:** A slight surface scratching took place on the membrane where the four corners of the blunt end of the 9 foot 2 x 4" impacted the 80 mil reinforced PVC, at **34 mph**. but the roof membrane remains watertight.

## **Debris Resistance Evaluation**

The loose laid nature of the 2001 Company wind vented roof assembly allowed sufficient membrane to be drawn into the impact area like a trampoline skin to absorb the flying debris impact like a catcher's mitt and resist the 2 x 4" blunt end debris from cutting through the 80 mil PVC membrane.

**The roofs water tight integrity remained intact with 80 mil CPA on gypsum and 2" ISO insulation with a moderate 34 mph hurricane wind blown debris impact test.**

# 2001 COMPANY

## Tornado Debris Resistant Roof Assemblies

### These Roof Assemblies Qualify For FEMA 320 Tornado Shelter For Human Occupancy Protection From 250 mph Ground Speed Tornado Debris

A 15 pound 2 x 4" approximately 15 feet long missile is shot horizontally into a vertically held test roof at **100 miles per hour** as required by **FEMA 320** (Federal Emergency Management Association).

This speed relates to a debris missile propelled at **250 mph ground speed during a tornado wind event** impacting a roof assembly.

These wind blown debris tests are designed to keep the people inside a building from being hit by flying debris going through a building roof and into the building interior space.

At 70 mph and 100 mph a 15' long 2 x 4" will go through a 10" concrete block wall, 22 gauge sheet metal, and ½" plywood and enter into the building interior to endanger human life.

Installing a 2001 Company roof assembly of 3" rigid roof insulation, ½" gypsum without fasteners and thick 2001 Company loose laid membrane that can act like a **trampoline – catcher's mitt** to absorb flying debris to protect human life is the unique and novel patented approach of the following 2001 Wind Blown Debris roof assemblies.

A water pressure test was not conducted. This criterion for the test pass/fail is as follows: 1) The test subject must be impacted by three missiles in areas of perceived vulnerability; 2) the missile may penetrate that test subject, by not perforate the safe side (back face) of the subject; 3) the test subject permanent deflection after impact must be less than 3-in.; 4) segments, splittings, or otherwise delaminated portions of the test subject, though still attached to the subject, may not extend into the safe compartment 3-in. or more; 5) segments of the test subject or appurtenances attached to the test subject must not be ejected or otherwise released into the safe compartment by impact force. This criterion is consistent with the guidelines of FEMA 320, "Taking Shelter from the Storm."

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## **Test 6: Tornado Debris Resistant Roof Assemblies**

### **100 mph Tornado Flying Debris Testing a 2001 Assembly Adhered To A Concrete 90 Mil C-EPDM Primary Waterproofing Membrane Adhered On Concrete Deck With A Second Debris Absorbing 80 mil PVC Membrane Roof Assembly:**

Tornado debris impact test using a 15-foot long 2 x 4", weighing 15 pounds, is shot at **100 mph** at a roof assembly test deck to simulate flying debris propelled by a **250 mph tornado winds**.

**Deck:** Concrete roof deck is prepared to a smooth and clean surface (rough and uneven surfaces are protected by an additional layer of EPDM membrane or polyester mat) adhered to the concrete roof deck.

**Deck Air Seal:** Deck joints and through roof penetrations are air sealed with 2001 Co., slow rise adhesive foam construction adhesive or totally adhered, 16 inch minimum wide, strips of 90 mil C-EPDM.

**2001 Company Primary Waterproofing Membrane:** 90 mil C-EPDM is totally adhered to concrete deck and flashed to all perimeters and penetrations with rubber-to-rubber bonding adhesive.

**Tornado Debris Energy Absorbing Second Roof Assembly:** Is installed over the adhered to the deck 90 mil C-EPDM primary waterproofing membrane to protect it from flying debris consists of the following:

1. **Insulation:** Poly Isocyanurate, two layers of 1 ½" minimum, are loose laid or spot adhered with slow rise spray foam or latex construction adhesive over the primary waterproofing membrane.
2. The joints of the top layer of insulation are staggered 2 feet in each direction over the bottom layer.

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## Test 6 Tornado Resistant Roof Continued

3. **Cover Board:** gypsum wallboard sheeting, ½” minimum, “Dens Deck” or equal, is loose laid over the insulation to ballast in place.

4. Joints of cover board are off set 2 feet in each direction over underlying insulation boards.

5. **2001 Co., Secondary Water Proofing Membrane:** 80 mil reinforced PVC is loose laid over the cover board, and air seal terminated at perimeters and penetrations.

**Note:** C-EPDM, modified bitumen, and thermoplastic thinner mil membranes can be substituted for the 80 mil reinforced PVC.

6. **Equalizer Valves:** The roof assembly is wind up lift vented in the wind vortex intensity areas, of the perimeters and corners, with 2001 Company one-way valves for increased wind up lift resistance and to provide continuous venting of moisture and condensation out of the roof assembly.

7. **Waterproof Integrity Observation:** The 80 mil reinforced PVC second roof membrane, gypsum and insulation assembly are instantly die cut by the blunt end of the 2 x 4” upon **100 miles per hour impact.**

The primary waterproofing 90 mil C-EPDM installed on the roof deck is only slightly surfaced scratched by the 100 mile per hour 2 x 4” by the flying debris **Energy Absorbing** second roof assembly.

### Debris Resistance Evaluation

The 80 mil PVC, ½” gypsum, and 3” of ISO insulation was up on the but end of the 2 x 4” and provide a cushion of material to keep the 90 mil non-reinforced C-EPDM primary waterproofing membrane adhered on the roof deck from being damaged by 2 x 4” **100 mph** debris impact.

Although, the secondary PVC surface waterproofing membrane is compromised, the 90 mil C-EPDM totally adhered to the deck, as the primary, waterproofing membrane keeps the building waterproof.

The secondary 80 mil PVC roof system can be easily patched after the wind event storm. The 2001 wind vented roof assembly will naturally dry the wet roof components of the secondary debris absorbing roof assembly once patched.

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## Test 7: Tornado Debris Resistant Roof Assemblies

100 mph Tornado Flying Debris Testing – A 2001 Assembly Loose Laid On A Concrete Deck

90 mil C-EPDM Primary Waterproofing Membrane Loose Laid

On A Concrete Deck With Wind Blown Debris Absorbing 80 Mil PVC Membrane Roof Assembly

Loose Laid Over The Primary Waterproofing Membrane On Smooth Concrete Surface:

causes slight abrasion of primary waterproofing membrane.

Tornado debris impact test using a 15 foot long 2 x 4" weighing 15 pounds is shot at **100 mph** into a roof assembly test sample to simulate flying debris propelled by a **250 mph tornado winds**.

**Deck:** Concrete roof deck smooth surface: primary waterproofing membrane 90 mil C-EPDM, was loose laid over the concrete deck.

**Deck Air Seal:** Deck joints, through roof penetrations, and vertical walls intersecting the roof deck are air sealed with 2001 Company slow rise adhesive spray foam, urethane construction sealant or totally adhered, 16 inch minimum wide, strips of 90 mil C-EPDM.

**Primary Waterproofing Membrane:** 90 mil C-EPDM is loose laid on the smooth surface concrete deck and flashed to the all perimeters and penetrations.



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## **Tornado Debris Energy Absorbing Second Roof Assembly:** of 80 mil

PVC ½” gypsum and 3” ISO insulation is Loose laid and wind vented over 90 mil C-EPDM primary waterproofing membrane to protect it from flying debris consists of the following:

### **Test 7 Tornado Resistant Roof Continued**

1. **Insulation:** Poly Isocyanurate, two layers of 1 ½” minimum, are loose laid or spot adhered with construction adhesive or slow rise adhesive foam to the primary waterproofing membrane.

The joints of the top layer of insulation are staggered 2 feet in each direction over the bottom layer.

2. **Cover Board:** gypsum wall board sheeting ½” minimum, “Dens Deck” or equal, is loose laid over insulation to weight it in place.

4. The joints of the gypsum boards are off set 2 feet in each direction over underlying insulation boards.

5 **2001 Company Water Proofing Membrane:** 80 mil PVC reinforced loose laid over the gypsum cover board, air seal terminated at perimeters and penetrations. Note: C-EPDM , modified bitumen, and thermoplastic thinner mill membranes can be substituted for 80 mil reinforced PVC.

6. **Equalizer Valves:** The roof assembly is wind up lift vented in the wind vortex intensity areas, of the corner and perimeters, with 2001 Company one-way valves for increased wind up lift resistance and to provide continuous venting of moisture and condensation out of the roof assembly.

7. **Waterproof Integrity Observation:** Impact missile immediately cut through 80 mil PVC second roof and was able to slide on smooth concrete and non-adhered 90 mil C-EPDM causing a ¼” abrasion cut in the primary waterproofing membrane and this would cause leaks to occur in the primary waterproofing membrane.

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## Debris Resistance Evaluation

Three 15 foot 2 x 4's are shot at a test assembly, only one missile of three made a ¼" cut through the 90 mil membrane. The adhered 90 mil C-EPDM to the roof deck is more impact resistant to maintain the building in a waterproof condition.

## Tornado Debris Resistant Roof Assemblies

### 100 mph Tornado Flying Debris Testing 2001 Assembly On 22 Gauge Steel Deck

### Test 8: 22 Gauge Steel Deck, 2" ISO, ½" Gypsum, and 80 mil PVC

### Passed FEMA 320 Tornado Shelter Guide lines:

For human occupant protection from flying debris generated by tornados.

A tornado debris impact test using a 15 feet long 2x 4" weighing 15 pounds is shot at **100 mph** at the roof assembly test sample to simulate **flying debris propelled by a 250 mph tornado winds.**

**Roof Deck:** 22 gauge Type "B" steel deck (fastened with 2001 Co. "Cowboy Hat Washer", patent pending, and nut runner self-tapping screws into the structural joists).

**Deck Air Seal:** Metal deck joints, fastening points, perimeters, and through roof penetrations air sealed with 2001 Company slow rise spray foam adhesive.

**Insulation:** Poly Isocyanurate insulation 2" minimum loose laid or adhered to deck with 2001 Company slow rise spray foam adhesive.

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**Cover Board:** gypsum wallboard sheeting ½” minimum, “Dens Deck” or equal is spot adhered with slow rise adhesive foam or loose laid over insulation. The joints of the gypsum are offset two feet in each direction from underlying insulation board joints.

## **Test 8 Tornado Resistant Roof Continued**

**Fastener Protection:** Any fasteners used under the membrane are covered by **2001 debris impact cover, patent pending**, solid washer over fastener head and abrasion pad over standard washer and fastener.

**2001 Company Water Proofing Membrane:** 90 mil C-EPDM non-reinforced is loose laid over the cover boards and air seal terminated at perimeters and penetrations.

**Equalizer Valves:** The roof assembly is wind up lift vented in the wind vortex intensity areas, of the building’s corners and perimeters, with 2001 Company one-way valves for increased wind up lift resistance and to provide continuous venting of moisture and condensation out of the roof assembly.

**Waterproof Integrity Observation:** Waterproofing does not exist. The roof assembly was completely penetrated by the 2 x 4” missile at **100 mph**. But the roof assembly stopped the missile from cutting through the 22 gauge metal deck and penetrating the interior building space.

## **Debris Resistance Evaluation**

The wadding of loose membrane, gypsum, and ISO on the front of the 2 x 4” into the 22 gauge corrugated metal deck stops the 2 x 4” from going through the 22 gauge steel deck and **protects the human occupants from flying debris hitting them inside the building**. This assembly meets FEMA 320 Criteria for tornado and hurricane shelter safety, but the roof will leak.