Over 20 yrs of Proven Performance

1 Billion sq.ft installed every year.

~25,000 miles of welds – that’s once around the Earth!!
13yr old EverGuard 45 mil in Las Vegas
Closer Look Confirms It’s In Good Shape
Industry Studies with questionable data presentation:

- Many claim they’re the best but data shown might be “cherry picked”
- One competitor’s sell sheet shows samples failing at different durations (Testing at 275F)
- There is a competitor’s study that is incomplete... only showing results of certain samples for certain tests; not every sample in every test
- There is a study showing quantity of ingredients in their membrane, without showing if/how it affects membrane performance
  - Claiming more total ingredients is better; and ignoring ingredient quality
- Some studies make blanket claims of superiority without showing actual test data
- One study suggests that cracking in heat aged samples shouldn’t be the only mode of failure to look for; weight loss should also be monitored.

Take away = all studies need to be reviewed with a critical eye for inconsistencies and validity.
Perceived Bias...

Internal testing
Used old competitive material
Didn’t present performance data
Didn’t always show all samples
Cherry picked your own material
Not using the right measurement

There’s NO Independent 3rd Party Testing!
## Ideal Study

| √ | Recent product  |
|   | • Produced in similar time frame  |
| √ | Produced in all plants |
| √ | Multiple rolls |
| √ | Different days production |
| √ | All manufacturers |
| √ | Testing by reputable firm |
Until Now...

In 2013, GAF hired SRI

SRI obtained material independently

GAF, Firestone, Carlisle, & JM were all tested
- 5 rolls from each TPO plant
- Product was made at various times throughout 2013
- Tested over 165 samples
- All 60 mil product
About SRI

Led by Rene Dupuis

– Highly respected; recognized as very independent
– Very active in the MRCA and NRCA
– Sits on several ASTM roofing committees
– Material testing of roofing products for building owners, industry associations, and other consultants.
– Factory Mutual Contractor Approval Standard TF Committee
– Has served as an NRCA Gold Circle Award judge since 1997.
– SRI is recognized as being among the nation’s leading structural engineering experts
Extensive Sampling

Manufacturer/Product

Plant 1
- Roll 1
- Roll 2
- Roll 3
- Roll 4
- Roll 5

Plant 2
- Roll 1
- Roll 2
- Roll 3
- Roll 4
- Roll 5
What We’re Talking About... In Context

Carlisle
- Plant 1
  - Roll 1
  - Roll 2
  - Roll 3
  - Roll 4
  - Roll 5
- Plant 2
  - Roll 1
  - Roll 2
  - Roll 3
  - Roll 4
  - Roll 5

Firestone
- Plant 1
  - Roll 1
  - Roll 2
  - Roll 3
  - Roll 4
  - Roll 5
- Plant 2
  - Roll 1
  - Roll 2
  - Roll 3
  - Roll 4
  - Roll 5

GAF 60 mil
- Plant 1
  - Roll 1
  - Roll 2
  - Roll 3
  - Roll 4
  - Roll 5
- Plant 2
  - Roll 1
  - Roll 2
  - Roll 3
  - Roll 4
  - Roll 5

GAF 50 mil EX
- Plant 1
  - Roll 1
  - Roll 2
  - Roll 3
  - Roll 4
  - Roll 5
- Plant 2
  - Roll 1
  - Roll 2
  - Roll 3
  - Roll 4
  - Roll 5

JM
- Plant 1
  - Roll 1
  - Roll 2
  - Roll 3
  - Roll 4
  - Roll 5
Extensive Testing Included...

Over 400 samples tested and over 6,000 measurements were taken.
Not a Big Difference in Physical Properties...
Not a Big Difference in Physical Properties…
Thickness Above Scrim
60 mil Thickness Above Scrim

ASTM min=18 mils on 60 mil
Thickness – Total
  – Everyone’s the same!

Thickness over scrim
  – No clear winner; differences are very small!
Extreme Heat Aging 275°F

- Samples were removed periodically and measured
  - Samples were bent over a 3” mandrel
  - 7x eyepiece was used to see if there was a failure

- 3 samples from each sheet were tested
  - All samples were taken from 30”, 60”, and 90” across sheet

- Same samples were tested each time...some samples were bent over 22 times before failure
It’s About Performance!

- Heat aging isn’t just about high heat situations
- Xenon Arc isn’t just about areas that get high levels of UV
- Accelerated Aging is Established Science!

You Want Your Roof to Perform
• So, let's look at the data...

• How do we define membrane failure?

• When it cracks!
What Cracking Means...

Test Sample

Real World
Time Before Failure Begins (Cracking)

Note: Actual roof life will depend on operating conditions, method of attachment, maintenance, and other factors.
NEW Learning From Study

SRI brought to the table...

• Weight Loss

• It’s not just about cracking

• JM has been an advocate of using weight loss
<table>
<thead>
<tr>
<th>Why Test?</th>
<th>As products weather they lose polymer</th>
</tr>
</thead>
<tbody>
<tr>
<td>What does it mean?</td>
<td>TPO loses weight when it’s not formulated correctly</td>
</tr>
<tr>
<td>How to talk about it?</td>
<td>The more weight you lose, the less material you have to protect your roof</td>
</tr>
</tbody>
</table>

Competitive learning of eroding membrane
Someone’s been doing repairs...

Let’s get closer to this....
Weight Loss Can Lead To...
An Extremely

How A Good Membrane Should Perform

Each shape represents a sample

Weight Loss, %

Heat Exposure, Days

15 samples
Same Failure Just Not Very Good

15 samples
Lots of variation… which product will I get???

Inconsistent

30 samples
Lots of variation... which product will I get???
More Consistent but loses weight quickly

Johns Manville

Weight Loss, %

Heat Exposure, Days

15 samples
Maintains low weight loss for a long period of time

30 samples
GAF EverGuard 60 mil

Maintains low weight loss for a long period of time

30 samples
GAF Extreme 50 mil

Maintains low weight loss for 200+ days

15 samples
Maintains low weight loss for 200+ days only loses up to 2% >200 days

15 samples
2 failure modes...

Cracking and Weight Loss

Doesn’t matter which happens first

Lets look at the weakest link...
Time Before Failure Begins (>1.5% wt. loss **OR** cracking)

<table>
<thead>
<tr>
<th>Material</th>
<th>Days to Failure at 275°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme 60 mil</td>
<td>200</td>
</tr>
<tr>
<td>Extreme 50 mil</td>
<td>150</td>
</tr>
<tr>
<td>GAF EverGuard</td>
<td>100</td>
</tr>
<tr>
<td>Firestone</td>
<td>50</td>
</tr>
<tr>
<td>Carlisle</td>
<td>60</td>
</tr>
<tr>
<td>JM</td>
<td>50</td>
</tr>
</tbody>
</table>

ASTM 6878 Equivalent standard
Time Before Failure Begins (>1.5% wt. loss OR cracking)

Note: Actual roof life will depend on operating conditions, method of attachment, maintenance, and other factors.
## Categorizing & Specifying

<table>
<thead>
<tr>
<th>TPO Grade</th>
<th>Heat Aging, days to failure</th>
<th>Weather Resistance kJ/(m².nm) @ 340 nm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>240°F</td>
<td>275°F</td>
</tr>
<tr>
<td>1 – utility grade</td>
<td>224</td>
<td>27</td>
</tr>
<tr>
<td>2 – standard grade</td>
<td>490</td>
<td>90</td>
</tr>
<tr>
<td>3 – premium grade</td>
<td>750</td>
<td>150</td>
</tr>
</tbody>
</table>

Failure = cracking using 7x eye piece or weight loss > 1.5%
Conclusions

- All TPO exceeds the ASTM specification
- Physical properties are all similar
- Large differences exist in terms of predicted weathering
- GAF has the 3 best TPOs
- Extreme is the ONLY high performance TPO
- EverGuard outperforms all other regular TPOs