

# Sunlight, Weathering, & Light Stability



**PRIMEX** 

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# Durability of Plastics and Environmental Attack

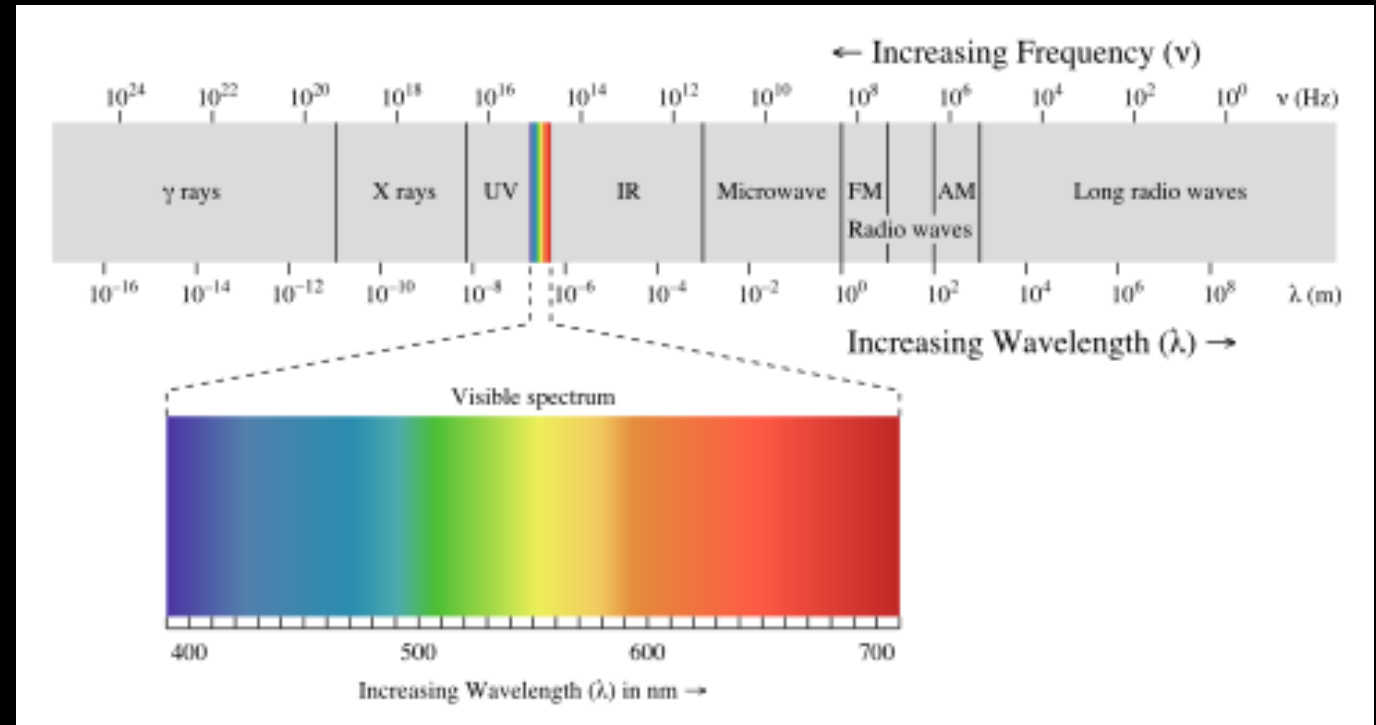
- Light fastness Terms
- Arizona, Florida, Other States
- Wet, Dry, Day, Night, Hot, Cold
- Accelerated versus Real World
- UVA, UVB, UVC, Xenon, Daylight
- UV Stabilizers
  - HDPE, HMWPE, PP, PS, ABS
- Case Studies
- O'Neil Recommendations

# Lightfastness Terms

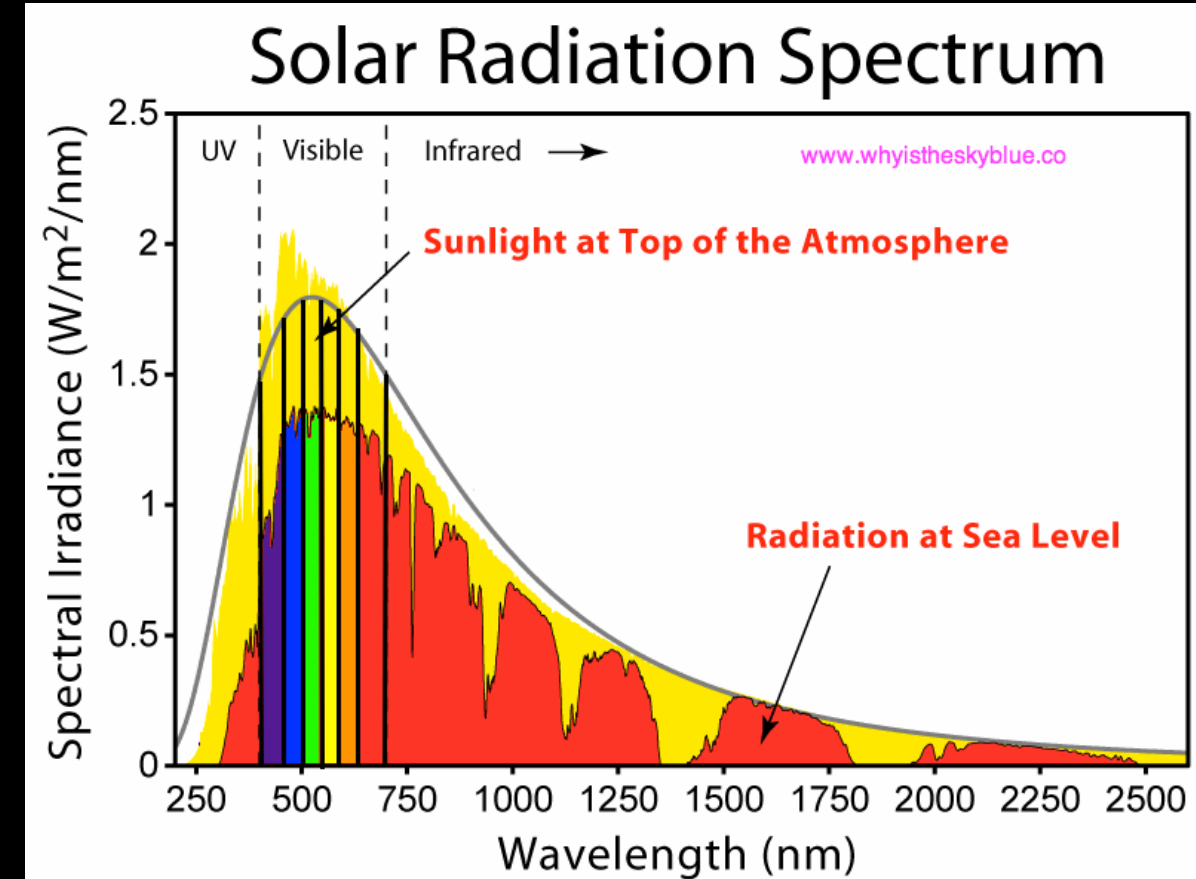
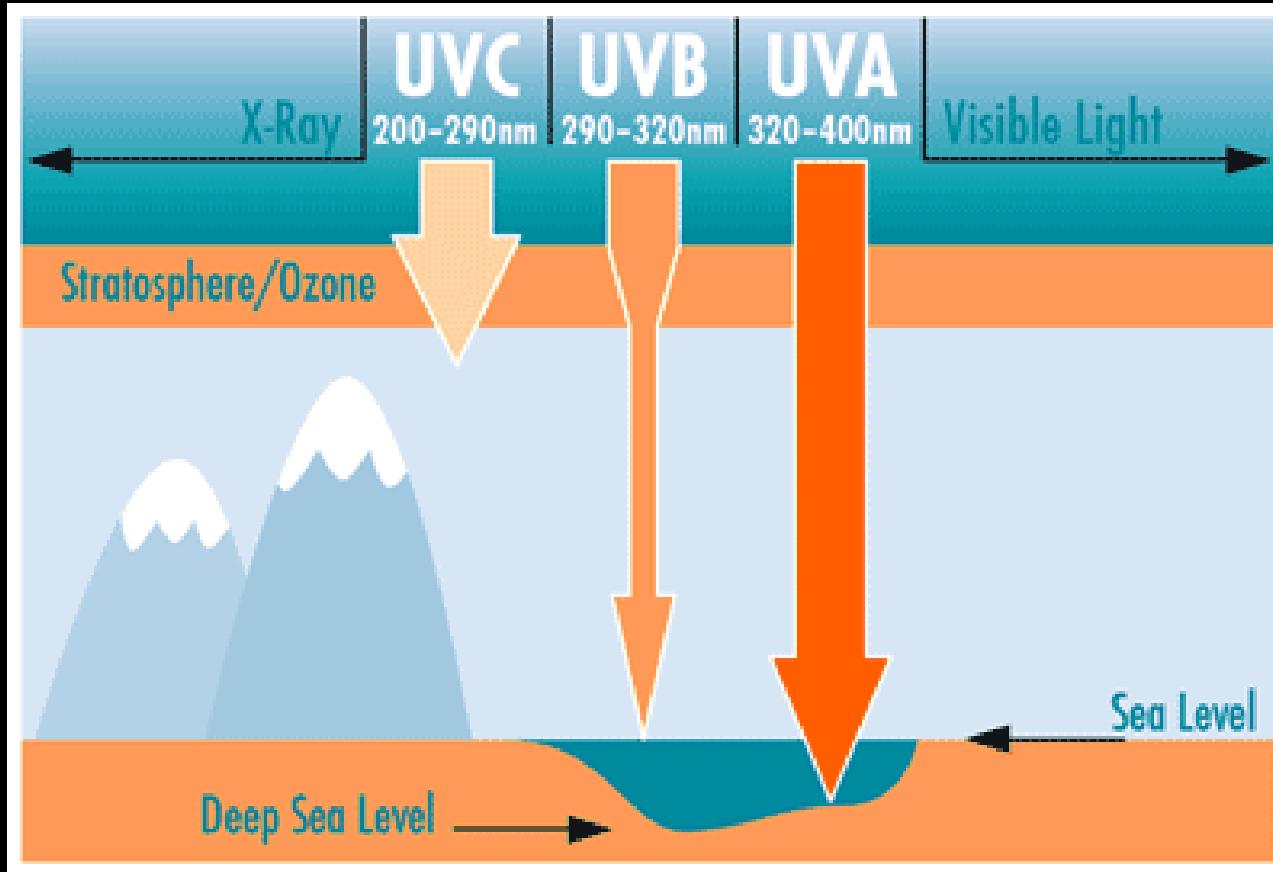
- Irradiance
  - The rate at which light energy falls on a surface in  $\text{W/m}^2$
- Spectral Power Distribution
  - The distribution of irradiance with respect to wavelength
- Radiant Dosage
  - The accumulated light energy which has fallen on a surface in a given time in  $\text{J/m}^2$
- Joule
  - An amount of energy equal to 1W times 1 second.
- Total UV (TUV)
  - The radiant dosage of light wavelengths shorter than 385nm, in  $\text{J/m}^2$
- QUV Test
  - A method of testing, using high-intensity ultraviolet light, moisture, and heat to simulate weathering, to determine an exposed samples rate of aging
- Xenon Test
  - A method of testing, using high-intensity imitation daylight, moisture, and heat to simulate weathering, to determine an exposed samples rate of aging

# UVA, UVB, UVC, Xenon, Daylight

- Total Spectrum Gamma, X, UV, to IR
- What Reaches the Earth?

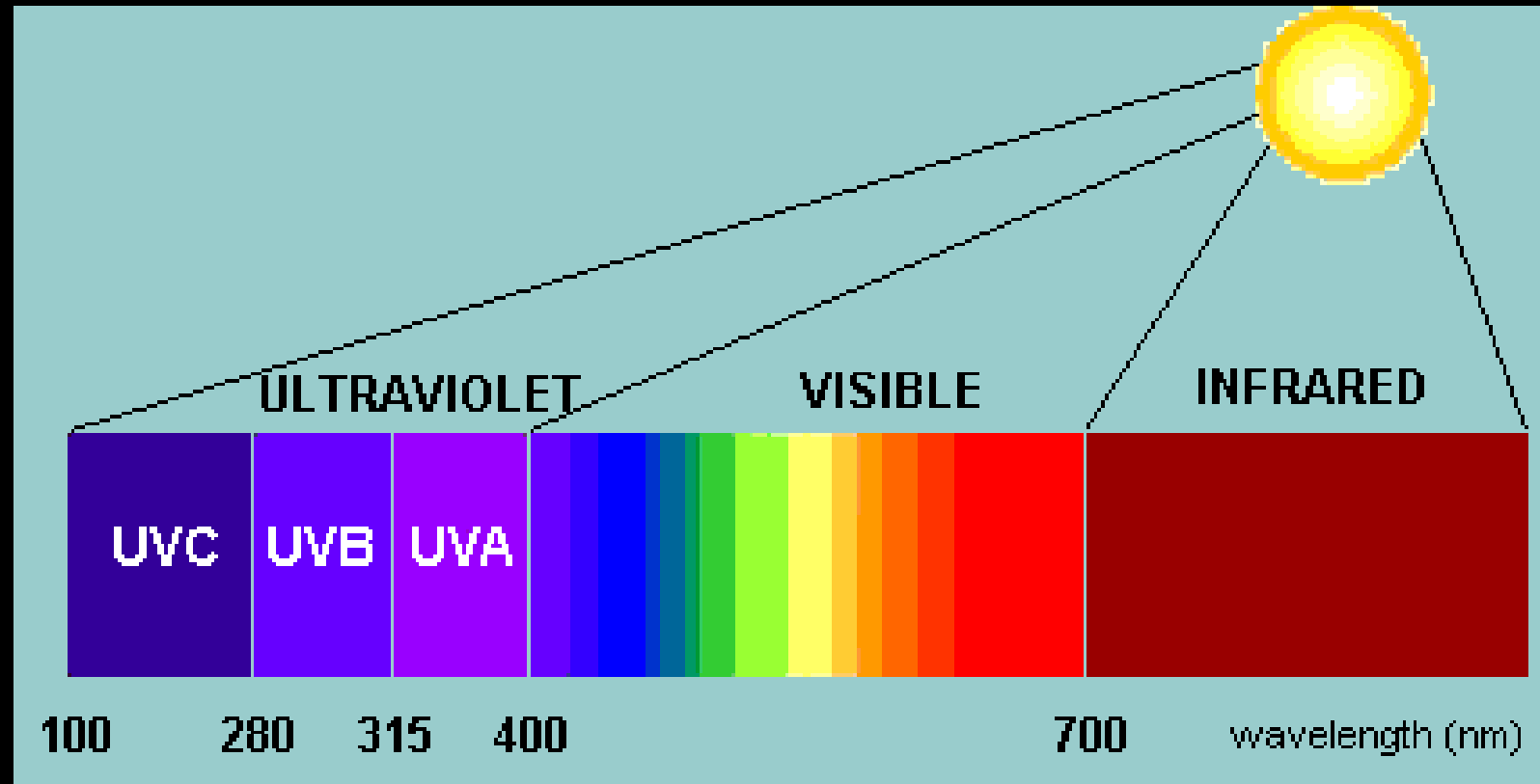


# Terrestrial and Extra-Terrestrial Wavelengths



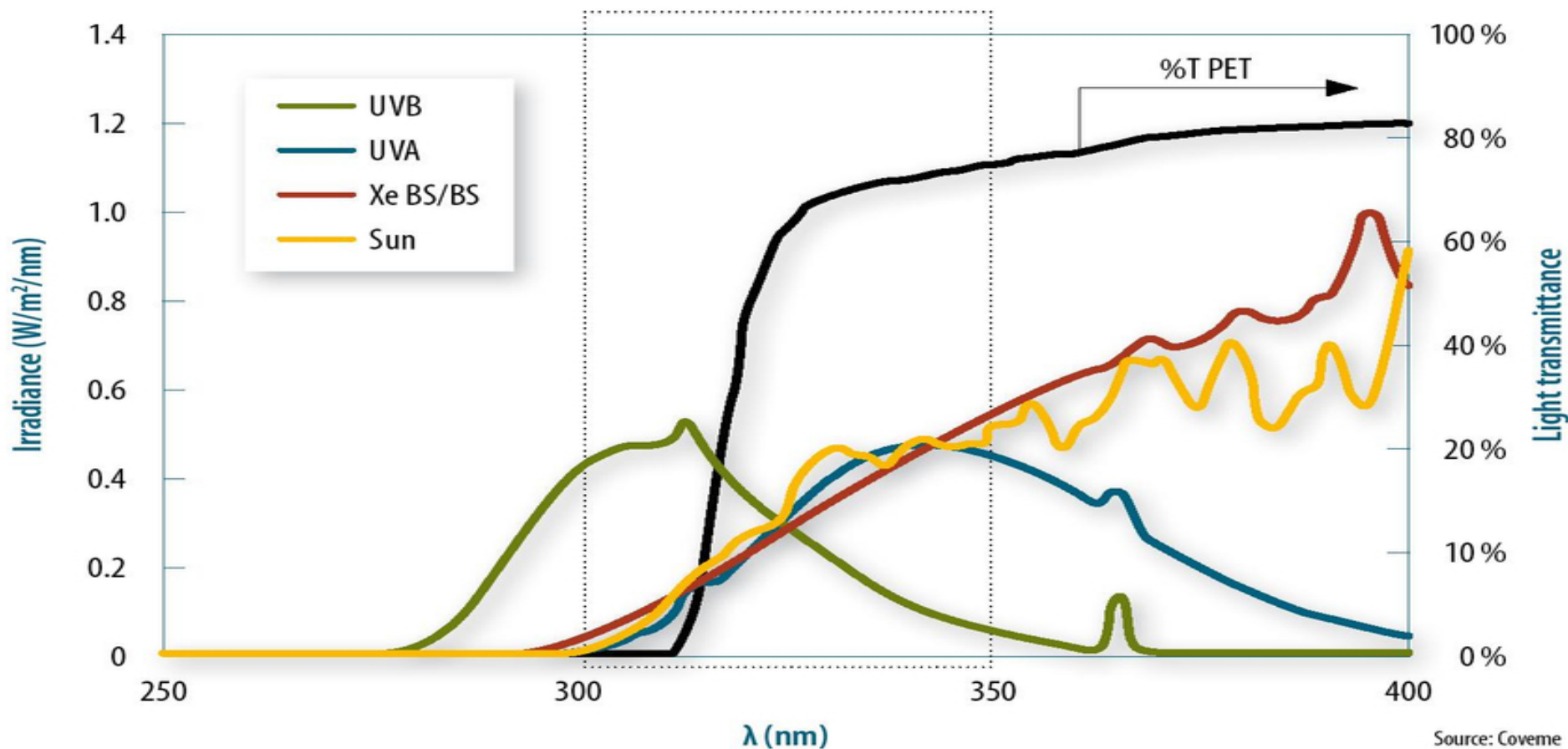
# UVA, UVB, UVC

Not perfect agreement in the scientific community



# Accelerated Weathering And Daylight

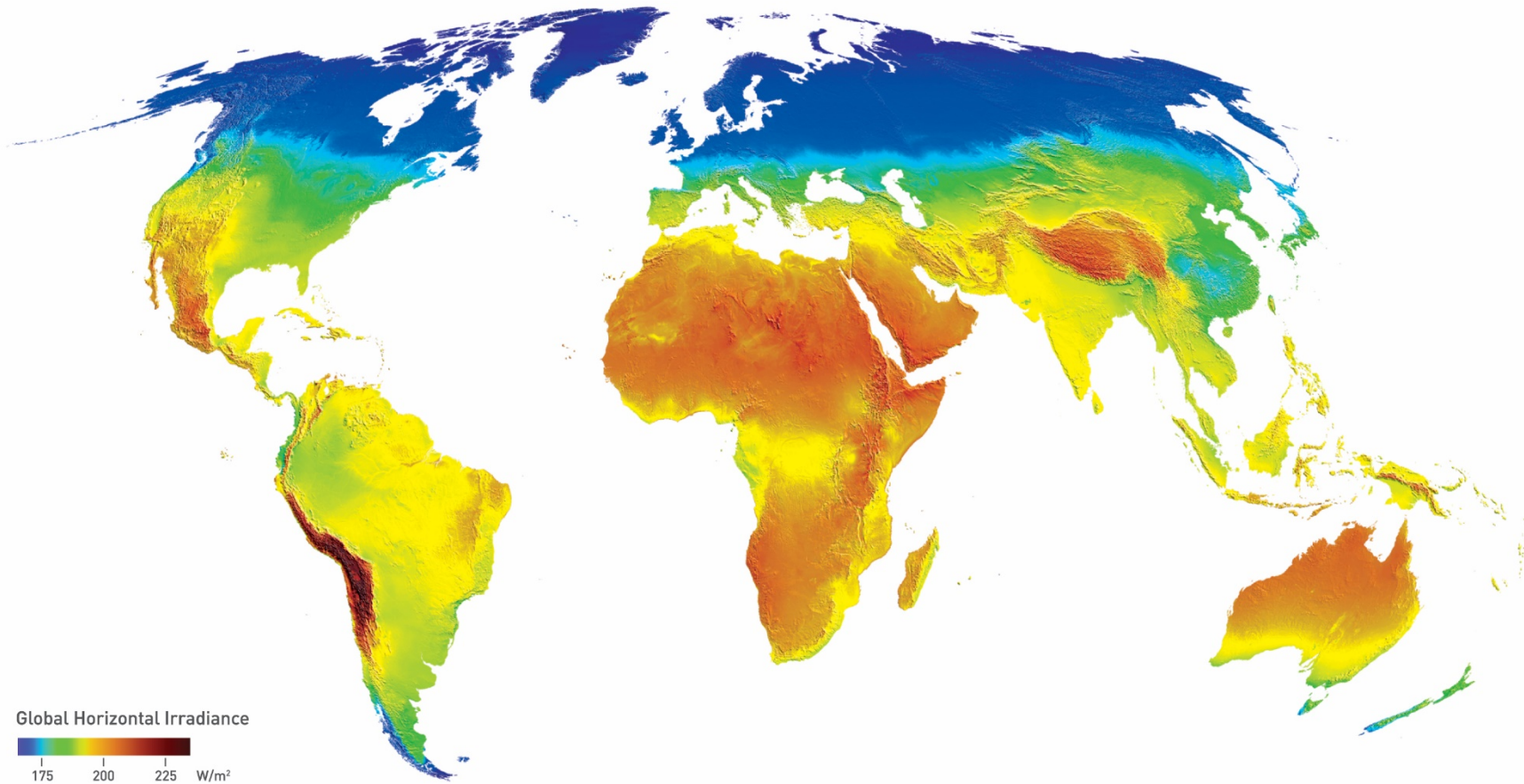
Irradiance and light transmission







# Global Mean Solar Irradiance



Map developed by 3TIER | [www.3tier.com](http://www.3tier.com) | © 2011 3TIER Inc.



# Considering Heat and Moisture

- Heat

- Vertical cooler than Horizontal
- Insulated back or frame hotter than unbacked
- Center Hotter than edges
- A joule in the center of an insulated backed sample is twice as damaging as at the edge
- Color, Black is Hotter than White
- Cannot communicate just in Joules or Hours

- Moisture

- is H<sub>2</sub>O, from dew, rain, lawn sprinklers, humidity, etc.
- The oxygen in H<sub>2</sub>O helps oxidize a sample
- Moisture alone does not degrade a sample lets call that X
- UV degrades a sample lets call that 2X
- Moisture and UV is 10X
- Again Hours or Joules do not tell the story

# Wet, Dry, Day, Night, Hot, Cold

- Conditions
  - Truck Bed
    - Horizontal, UV, Dew, Rain, Surface Abraded, Garage?, Bed Cap?
  - Outdoor Display Sign
    - Vertical, UV, Dew, Rain
  - Clear Fruit Cup
    - Contents Protection, Indoor Light, Shelf life
  - Spa Shell
    - Chlorine Attack, UV, Wet, Hot, Tan Oil,
  - RV Panel
    - Vertical, UV, Rain, Dew, Gasoline
  - Auto Interior
    - LTHA, UV, UV Filter in glass,
  - Auto Exterior
    - Horizontal, Vertical, UV, Rain, Snow, etc.

# Accelerated versus Real World

- So how do we accurately express Accelerated Exposure or Real World Exposure?
  - By a specification for e.g. ASTM G155 or J1885 or South Florida at 45 degrees, and a duration or number of Kilojoules
- Equivalency
  - 1250 Hours is 1 year?
  - 2000 KJ is 1 year?
  - Anyone that answers this off the cuff doesn't know what they're talking about!

*2800 KJ at 340nm and .35 w/m<sup>2</sup>  
ASTM G155  
2200 Xenon Light Hours is 1 Year*

# So, what are the key questions?

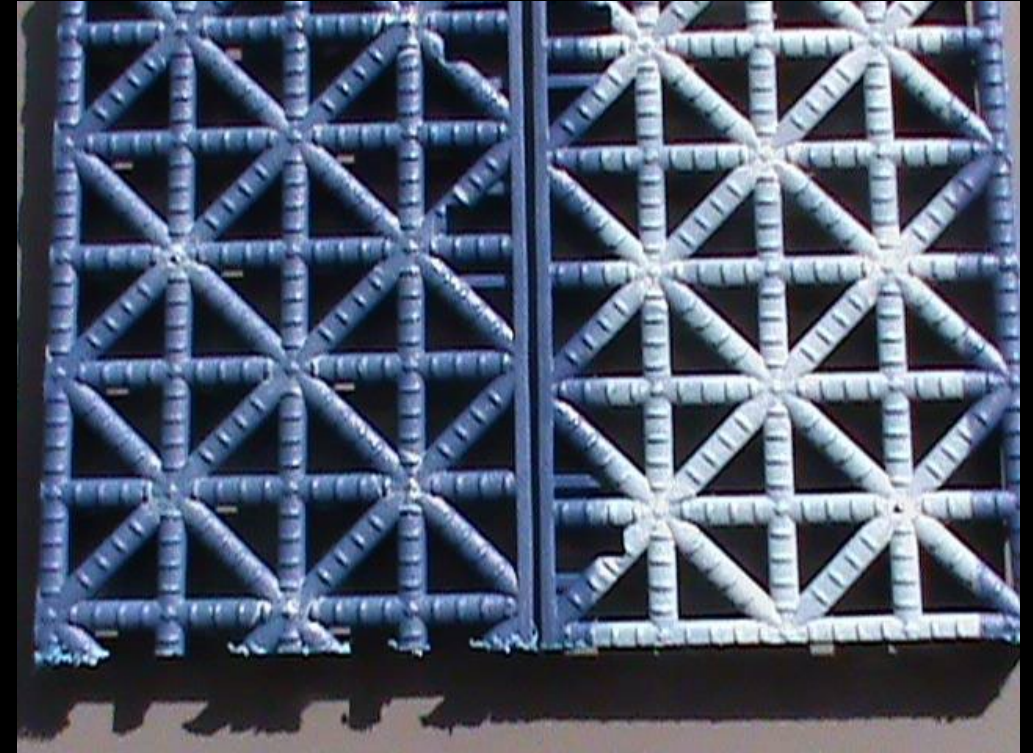
- What is the application? Color(s)?
- How is it used? Vertical? Horizontal?
- What are the conditions of the environment? Wet? Dry? Chemical attack?
- What part of the country or world?
- Or just as importantly how will you test our sheet to verify compliance?
- What is the Irradiance and Spectral Power Distribution? And testing Specification?

# UV Stabilizers by Polymer

- HDPE
  - 1111111C
- HMWPE
  - 1111111C
- PP
  - 1111111C
- PS
  - 1111111C
- ABS
  - 1111111C
- TPO
  - In the compound
- TPE
  - In the compound

# Case Studies

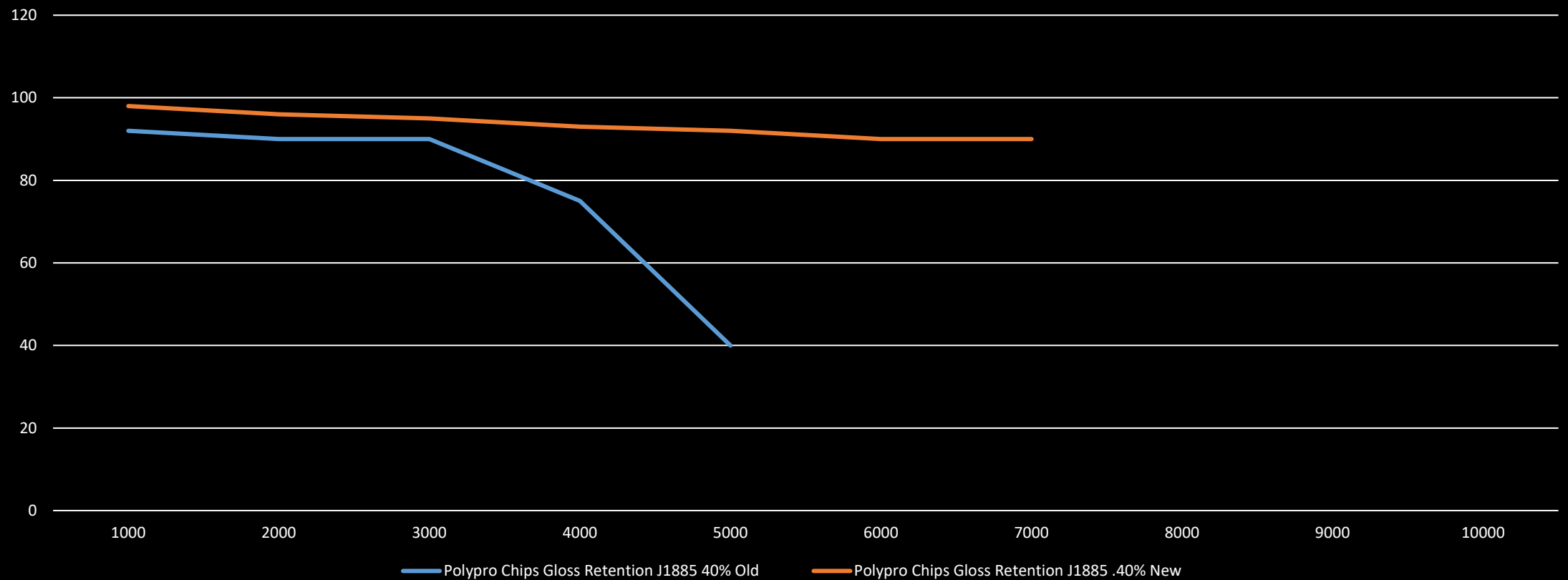
- Sheet
- House Siding
- Molded Chip
- Sport Floor



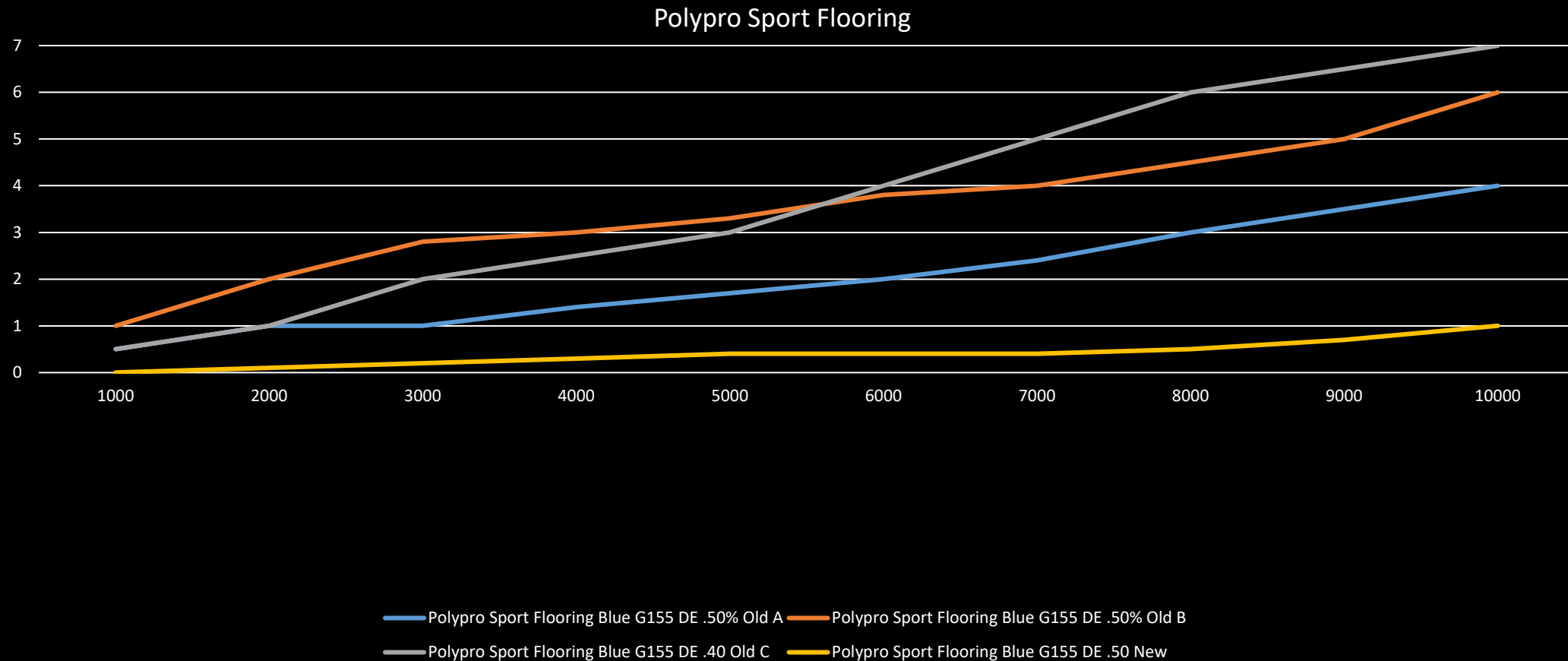


# Primex Recommendations

Homo Polypro Blue Chips Gloss Retention

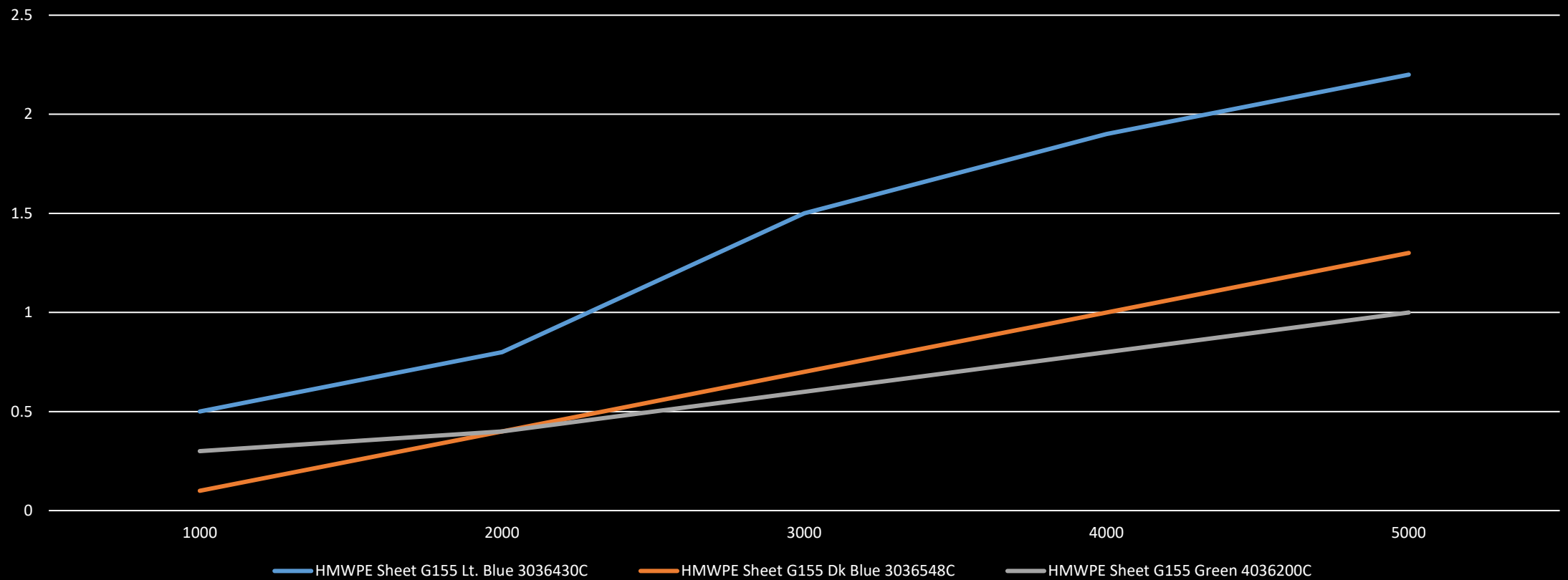


# Primex Recommendations



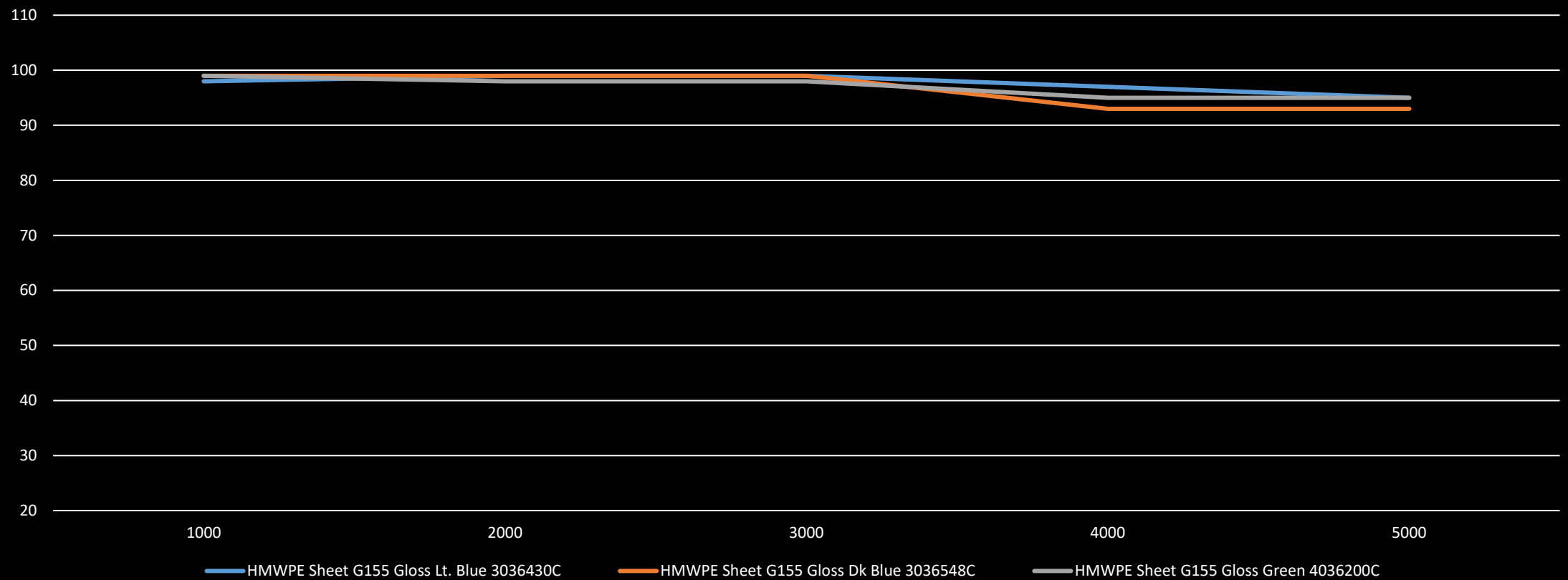
# Primex Recommendations

HMWPE Sheet Results Total DE



# Primex Recommendations

HMWPE Sheet Gloss



# Extrusion

One Company/One Direction/One Solution