IES TM-30-15: Overview and Program Implementation

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“Original”
“CRI = 80” Desaturated

Image courtesy of Randy Burkett Lighting Design
“CRI = 80” Saturated

Image courtesy of Randy Burkett Lighting Design

- **Fidelity Metric Only**
  - CIE CRI (1965/1974)

- **CIE 1964 U*V*W***
  - CIE CRI (1965/1974)
  - IES TM-30-15 (2015) CAM02-UCS (CIE CAM02)

- **8 color samples**
  - CIE CRI (1965/1974)
    - Uniform color space coverage
    - Spectral sensitivity neutral
    - Variety of real objects
  - Medium chroma/lightness
  - Spectral sensitivity varies
  - Munsell samples only

- **Ref Illuminant Step Function**
  - CIE CRI (1965/1974)
    - (Uses same reference sources, but blended between 4500 K and 5500 K)

- **No lower limit for scores and inconsistent scales**
  - CIE CRI (1965/1974)
  - IES TM-30-15 (2015) 0 to 100 scale (fidelity)
IES TM-30-15 Method

Core Calculation Engine
- Modern Color Science
- New Color Samples

High Level Average Values
- Fidelity Index ($R_f$)
- Gamut Index ($R_g$)

Graphical Representations
- Color Vector Graphic
- Color Distortion Graphic

Detailed Values
- Skin Fidelity ($R_{f,skin}$)
- Fidelity by Hue ($R_{f,h#}$)
- Chroma Change by Hue ($R_{g,h#}$)
- Fidelity by Sample ($R_{f,CES#}$)
TM-30-15 Color Evaluation Samples (CES)
The samples cover the area of all 14 CRI samples, as well as the area of the CQS samples. [Note charts only two dimensional representation]
TM-30-15 CES Wavelength Uniformity

![Graph showing sensitivity to SPD variations across different wavelengths.](image)

\[ F = k_1 \int \left( r'' - \left< r'' \right> \right) d\lambda + k_2 \int \left( r'' - \left< r'' \right> \right) d\lambda \]
Effect of Wavelength Uniformity

The artificial sensitivity of the CRI TCS is removed with TM-30 samples.

IES Method for Color Rendition

**Color Fidelity**
The accurate rendition of color so that they appear as they would under familiar (reference) illuminants.

**Fidelity Index** ($R_f$) (0-100)

**Color Gamut**
The average level of saturation relative to familiar (reference) illuminants.

**Gamut Index** ($R_g$)
~60-140 when $R_f > 60$

**Graphics**
Visual description of hue and saturation changes.

**Color Vector Graphic**
Fidelity Index: $R_f$

- Average similarity in appearance of test and reference sources
- Analogous to CIE $R_a$, greater accuracy
- Scores 0 to 100
- Scale similar to CIE $R_a$, but a tougher test
- Equal weight to all directions of shift
- Most important when trying to match the look of the reference source
- Perfect fidelity does not always mean the perfect source for the application
Relative Gamut Index: $R_g$

- An $R_g$ value greater than 100 indicates an average increase in saturation and an $R_g$ value less than 100 indicates an average decrease in saturation.
- Range of about $\sim$60-140 when $R_f > 60$. 
Color Vector Graphic

$R_f = 75 \mid R_g = 100 \mid \text{CCT} = 3500 \text{ K}$

- Decreased Saturation
- Reference
- Test Source

$R_f = 75 \mid R_g = 100 \mid \text{CCT} = 3500 \text{ K}$

- Increased Saturation
- Hue Shift
[Theoretical]
TM-30-15 Adoption

- **Specifiers**
  - Evaluate Sources
  - Philosophical Changes
  - Help Develop Criteria
    - “Pull”

- **Manufacturers**
  - Provide Data
  - Engineer New Sources
    - “Push”

- **Researchers**
  - Help Develop Criteria
  - Continue Improving Science

- **Codes and Programs**
  - Implement New Criteria
### Which Product is Better?

<table>
<thead>
<tr>
<th>Measure</th>
<th>Scale</th>
<th>Comparisons</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRI $R_a$</td>
<td>? – 100</td>
<td>Higher is &quot;better&quot;</td>
</tr>
<tr>
<td>TM-30 $R_f$</td>
<td>0 – 100</td>
<td>Higher is &quot;better&quot;</td>
</tr>
<tr>
<td>TM-30 $R_g$</td>
<td>60 – 140 (Approx.)</td>
<td>Varies</td>
</tr>
<tr>
<td>TM-30 Icon</td>
<td>None (Visual)</td>
<td>Varies</td>
</tr>
</tbody>
</table>
Which Product is Better?

Preliminary experimental data from one space.

More Liked  Less Liked