FM 100 Hue Color Vision Test and Scoring Software Training
The Information You Need for Color Vision Testing & Scoring
This presentation gives you information about using the Farnsworth-Munsell 100 Hue Test and highlights the new features available in the FM 100 Hue Test Scoring Software.

Scoring Software
The scoring software is available for purchase in a bundle with the FM 100 Hue Test or as a separate package. This ensures scores produced with an FM 100 Hue Test are within certification and that test results are valid.
How Well Do You See Color?

Color is integral to the products you design and produce. So good color vision is essential for anyone making color decisions.

For over 50 years, the Farnsworth-Munsell 100 Hue Test has been the standard for testing color discrimination—the ability to discriminate between various shades of a given color.
What is the FM 100 Hue Test

The FM 100 Hue Test shows you if you’re low, average or superior at discriminating color.

Here’s how it works:
• Arrange four trays of colored caps in hue order.
• For each tray, the closer you are to the correct sequence, the better your color discrimination.

The results tell you two things:
• For normal color vision, it reveals how well you discriminate different colors.
• It indicates if you have a color vision defect and identifies where your color confusion lies.
The FM 100 Hue Test is one of the most widely used tests in industries where color decisions are critical. The test is used to separate persons with normal color vision into classes of superior, average and low color discrimination. It also measures the zones of color confusion for people with color defects. Examples of its use are:

- Examination of inspectors of color goods, color graders and color matchers.
- Testing for type and degree of color defectiveness.
- Detection of poor color vision in sales people.
- Selection of applicants for vocational training.
- Design of specialized tests for color vision.
- Independent control on validity of other color vision tests.
- Determining the affects of various pharmaceuticals on color vision.
- Clinical applications for the study of ocular disease and other medical conditions such as diabetes and Parkinson’s disease.
Following are the general test procedures.

1. The test must be given under the daylight conditions. Similar to what is provided by our Macbeth Lighting SpectraLight® and Judge® viewing booths.

2. Place the tray so that it is close to the individual, with the movable caps removed. The trays may be given in any order. Arrange the caps in random order before giving them to the individual.

3. Provide instructions on taking the test, explaining that the object of the test is the arrange the caps in order according to color—transferring caps from one tray to the other. It should take about two minutes per tray. However, accuracy is more important than speed—so when the two minutes are up, tell them, but allow them to continue working.

4. Allow the individual time to arrange the caps in an order that they are satisfied with.

5. Score the data using the FM 100 Hue Test Scoring Software. The results will show if the individual has average, superior or low color discrimination.
Superior Color Discrimination
About 16% of the population make 0 to 4 transpositions on the first test, or total error scores of zero to 16. This is a superior range of competence for color discrimination.

Average Color Discrimination
About 68% of the population score between 20 and 100 on first tests. This is a normal range of competence for color discrimination.

Low Color Discrimination
About 16% of the population make total error scores of more than 100. The first retest may show improvement, but further retests do not significantly affect the score.
The test indicates if you have a color vision defect and identifies where your color confusion lies.

**Average Color Vision, but High Error Scores**
Error scores by people with average color vision often exceed those with color defects, yet these individuals don’t show color blindness indications on this test. Such scores occur because the FM 100 Hue Test evaluates color aptitude or ability to make color discrimination.

**Color Discrimination**
General color discrimination is independent of color defectiveness so it’s possible for some people with average scores to have poorer color discrimination than those with color vision defects. People with average scores may have good or poor color discrimination; those with color defects may have good or poor discrimination.
• **Unselected** shows the errors which may be expected from each percentile of an unselected group of people aged 15 to 45.

• **In-Plant Applications** represents 300 tests of employees applying for promotion to positions of color control in a paint manufacturing plant—shader trainees, laboratory testers and laboratory technicians.

• **Experienced** is compiled from tests on 150 personnel with three to 20 years experience in control labs of manufacturers of dyes, rugs, plastics, textiles and paints. The personnel includes shaders, matchers, mixers, inspectors, passers, dyers and titration testers.

The table shows the distribution of initial error scores:

<table>
<thead>
<tr>
<th>Percentage of Group</th>
<th>Expected To Make Total Error Scores of, or Less Than</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unselected</td>
</tr>
<tr>
<td>90 pc, upper 10%</td>
<td>12</td>
</tr>
<tr>
<td>80 pc, upper 20%</td>
<td>20</td>
</tr>
<tr>
<td>70 pc, upper 30%</td>
<td>28</td>
</tr>
<tr>
<td>60 pc, upper 40%</td>
<td>36</td>
</tr>
<tr>
<td>50 pc, upper 50%</td>
<td>46</td>
</tr>
<tr>
<td>40 pc, upper 60%</td>
<td>60</td>
</tr>
<tr>
<td>30 pc, upper 70%</td>
<td>75</td>
</tr>
<tr>
<td>20 pc, upper 80%</td>
<td>95</td>
</tr>
<tr>
<td>10 pc, upper 90%</td>
<td>120</td>
</tr>
</tbody>
</table>
There is an average reduction of 30% in total error scores between the first test and retest but little average improvement on the third test.

The figures suggest the second trial produces the more important score. Some test-retest unreliability is to be expected and would be eliminated by discarding the first score. If the norms of the second trial alone are used, the following conditions must be met:
- Everyone must be given the second test
- The first test must be taken as seriously as the second
- Test and retest should be separated by a period of hours or days

While total error scores represent the color discrimination of the individual at that time, they don’t show that color discrimination ability may not improve over time as a result of training and experience.

Individuals that are familiar with the test generally show no difference in score with a re-test.

The test-retest reliabilities shown in the table are taken from routine tests of applicants for promotion in a paint factory. Retests were usually taken within a few days of the first test.

<table>
<thead>
<tr>
<th>Test / Retest Reliability</th>
<th>Test</th>
<th>Retest</th>
<th>2nd Retest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Retest</td>
<td>32.02</td>
<td>22.68</td>
<td>20.55</td>
</tr>
<tr>
<td>Mean °</td>
<td>29.02</td>
<td>23.08</td>
<td>23.44</td>
</tr>
<tr>
<td>N</td>
<td>196</td>
<td>196</td>
<td>137</td>
</tr>
</tbody>
</table>
The pattern of color defectiveness is identified by bi-polarity, a clustering of maximum errors in two regions which are nearly opposite. The regions where the errors are made can be used to identify the type of color defectiveness.

Examples of color defects:
- Protans are weak in red color discrimination.
- Deutans are weak in green color discrimination.
- Tritans are weak in blue color discrimination.
The test consists of four trays containing a total of 85 removable color reference caps (incremental hue variation) spanning the visible spectrum.

- The four trays are boxed in a convenient carrying case.
- FM 100 Hue Test Scoring Software is included with test purchase.

**Note:** Please protect the caps from extreme exposure to sunlight and from becoming severely damaged or smudged. If the caps become damaged, they may be replaced individually or as a complete set.
To ensure accuracy and compliance, the colored test caps of the FM 100 Hue Test are certified for two years. At the end of the two year certification, we recommend replacing the caps.

**Why Re-Certification is Important**

Why is it imperative that the caps of the FM 100 Hue Test be replaced every two years? When all of the tests as a group are maintained to the proper color quality, the results from the different tests around the world or within a supply chain can be compared for accurate evaluation.
FM 100 Hue Test is mentioned in the following Standards, to be used for evaluating individuals to be Color Evaluators:

- ASTM 1729-96 Standard practice for Visual appraisal of colors and color differences of diffusely-illuminated opaque materials
- SPI PB-1 Visual Evaluation of Reflected Color
- SAE J 361 Procedure for Visual Evaluation of Interior and Exterior Automotive Trim
- TAPPI T515 Visual Grading and Color Matching of Paper – references ASTM1729
Easier and Faster for You

The new version of the FM 100 Hue Test Scoring Software has been updated and enhanced to streamline the scoring and analysis of the test results.

The following screens provide information you’ll need to use the software as well as an overview of the new features.
The 3.0 version of the FM 100 Hue Test Scoring Software is compatible with Multiple Operating Systems:

- Windows® systems 98, XP, 2000 & Vista
- Mac OS X operating platform

Network enabled—Access the software from your server to score the test.
User Friendly Database

The updated software features a more versatile and expanded database. You’ll find:

- Expanded data fields to track information about the person taking the test.
- Enhanced data search features provide more flexibility.
- Recall one or multiple tests for evaluation.
- Easy to access—get information simply by double clicking on the individual item.
Enhanced Analysis, Display and Output Options

- PDF file generation of test results
- Standard printing capabilities
- Cut and Paste test results directly into a word document.
- Test validity will be printed whether the test is within Certification or not.
- Add your company logo and name to the test results printout.
Translation Support

Translation support is available in the following languages:

- **Software Menu Languages**
  German, Italian, Spanish, Portuguese and Traditional Chinese

- **Online Help Languages**
  German, Italian, Spanish, Portuguese and Traditional Chinese
Certification Tracking

When your FM 100 Hue Test is shipped, it’s assigned a certification label certifying that it’s been inspected and meets our Quality practices.

- The label is also the expiration date for the certification of the test caps.
- The certification report prints as part of the test results verifying that the FM 100 Hue Test used was within certification.
- When first using a new FM 100 Hue Test, please fill in the date on the label that is found under the tray.
Thank you for reviewing the FM 100 Hue Color Vision Test and Scoring Software Training presentation.