G7® Master &
G7® Process Control Master
Pass/Fail
Requirements
G7® Master Program & G7® PC Master Program Pass/Fail Requirements

Table of Contents

G7® Master Program & G7® PC Master Program Pass/Fail Requirements ...1
Scope: .........................................................................................................................2

1.0 Introduction ...........................................................................................................2
1.1 Non-Standard Substrates .......................................................................................3

2.0 Sample Submission Requirements .......................................................................3
2.1 Basic Target Submission Requirements (all G7 compliance levels/G7 Master and G7 PC Master) .........................................................................................................................4
2.2 Additional Target Submission Requirements (G7 Targeted/G7 PC Master) .................................................................................................................................4
2.3 Additional Target Submission Requirements (G7 Colorspace/G7 PC Master) .................................................................................................................................4
2.4 Target Submission Requirements (multi-page G7 Proofs) .....................................4
2.5 Pre-verifying Submitted Samples ...........................................................................4

3.0 G7® Grayscale Pass/Fail Requirements ................................................................4
3.1 NPDC (CMY and K-only scales) ...........................................................................5
3.2 Gray Balance (CMY scale only) ...........................................................................6
3.3 Spatial Uniformity .................................................................................................6
3.4 Exceptions Based on Print Process ......................................................................6

4.0 G7® Targeted Pass/Fail Requirements ................................................................7

5.0 G7® Colorspace Pass/Fail Requirements ............................................................7
5.1 IT8.7/4 Print Tolerances ......................................................................................8
5.2 IT8.7/4 Proof Tolerances ....................................................................................8

6.0 Verification of Print or Proof Condition ................................................................8

7.0 Color Measurement Method .............................................................................9

8.0 Failure of Samples ............................................................................................9
Scope:

This document specifies the criteria for assessing conformance to G7 Master and G7 Process Control Master.

G7 Master Qualification and G7 Process Control Master Qualification demonstrate G7 Grayscale, Targeted or Colorspace conformance.

The scope of the document is limited to assessment of deviation by the supplied sample print, press sheet or proof from recognized colorimetric target or characterization dataset values. Assessment of variation during production is not covered by this program.

1.0 Conformance Introduction

1. Idealliance Certified G7 Expert or G7 Process Control Experts submit an application and supporting data to the relevant program auditor as specified in the procedural documents:

   a. “G7 Master Printer Qualification RIT Submission Procedures _2015.pdf”
   
   b. “G7 Process Control Master Printer Qualification Cal Poly Submission Procedures _r1.pdf”

2. The G7 Expert/G7 Process Control Expert supervises preparation by the candidate Master site of the press sheets and proofs with the specified test targets. The Expert completes an on-line application and uploads local measurements of the key targets in CGATS.txt form with the on-line application, then the sample prints, proofs or press sheets are shipped to the IDEAlliance auditor for analysis.

3. The samples are analyzed to determine if they are within tolerance using the criteria outlined in this document.

4. For G7 Targeted or Colorspace submissions the measurement data must match relevant specification or CRPC.

5. For G7 Grayscale submissions, the printed samples should ideally aim at the most appropriate specification or CRPC for that printing process, if one exists.
6. All of the colorimetric values or specifications used in this document are based on ISO 13655. ‘Spectral measurement and colorimetric computation for graphic arts images’. All Auditor measurements are taken using the M0 or M1 measurement mode.

7. $DC_h$ (Delta Ch) in this document was formerly referred to as $DF^*$ (Delta F-star). The formulae are the same, the only change is the name of the formula which more clearly indicates the combined analysis of $C$ (chroma) and $h$ (hue).

1.1 Non-Standard Substrates

1. Where the printing substrate to be used has a color that differs from the characterized reference printing condition by more than 2 but less than 5 $\Delta E_{00}$ the characterization data of the reference print condition may be adapted using the substrate relative method. The method for calculating substrate relativity is described in the downloadable Substrate_Relative_Calculator_Kit_20120604.zip.

1. Where the difference in substrate color is greater than 5 $\Delta E_{00}$ this correction may be used but the user is cautioned that special color characterization data might be required.

2. This creates a new sub-category of qualified conditions known, for example, as “GRACoL Targeted Relative” or “GRACoL Colorspace Relative”.

   Note that a “Relative” reproduction will look different to the eye from an “Absolute” reproduction, but is still valid for qualification purposes.

2.0 Sample Submission Requirements

The G7 Expert or G7 Process Control Expert must ensure that the candidate G7 Master site provides valid print samples which are to be measured by the IDEAlliance designated auditor, as follows.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Charts</th>
</tr>
</thead>
<tbody>
<tr>
<td>G7 Grayscale</td>
<td>P2P25 or P2P51</td>
</tr>
<tr>
<td>G7 Targeted</td>
<td>P2P25 or P2P51</td>
</tr>
<tr>
<td>-------------</td>
<td>---------------</td>
</tr>
<tr>
<td>G7 Colorspace</td>
<td>P2P25 or P2P51 and IT8,7/4</td>
</tr>
</tbody>
</table>

2.1 Basic Target Submission Requirements (G7 Master/G7 Grayscale)

1. Either a standard P2P25x target or a custom target containing identical CMYK patch values to columns 4 and 5 of the P2P25 target, and CMYK solids and RGB Overprints. Never reduce or enlarge the standard P2P25x target image.

2. If a custom target is supplied (not the standard P2P25x) the original electronic version must also be supplied (e.g. in TIFF format) along with an approved CGATS.txt reference file to enable measurement by the auditor. Custom target requires prior approval from Idealliance.

2.2 Target Submission Requirements for Hard Copy Proofs

1. Proofs must meet G7 Colorspace aims. Use 2.3 requirements for G7 Colorspace for proofing.

2.3 Pre-verifying Submitted Samples

The G7 Expert should analyze the sample proofs or press sheets, or identical copies, before their submission, using either the candidate’s or the G7 Expert’s own measuring equipment. *(See section 6.0)*

3.0 G7 Master (Grayscale) Pass/Fail Requirements

The G7 Grayscale compliance level is intended to allow any print process that can take NPDC calibrations to be recognized for achieving G7 Grayscale Calibration. G7 Grayscale is defined when “A device or process is calibrated to the basic G7 definition of constant neutral Grayscale appearance as defined in ANSI/CGATS TR015, but does not necessarily use standard colorants or match a standard or specified color space”.
**IMPORTANT NOTE:** All G7 Grayscale measurements (for NPDC and gray balance compliance) are based on the 23 center patches (excluding 0 and 100) of the two 25-step Gray scales (CMY and K-only) listed in the G7 Specification.

3.1 NPDC (CMY and K-only scales)

Average Weighted Delta L* (wDL*) = 1.5  
Peak wDL* = 3.0.

*Where;*

\[ DL^* = ((L^*_{sample} - L^*_{target})^2)^{1/2} \]

*And;*

\[ wDL^* = DL^* \times (1 - \max(0, (\% - 50)/50 \times 0.75)) \]

The Weighted Delta L* formula reduces the significance of the Delta L* measurement above a Grayscale percentage (%) value of 50% on a linear scale beginning at 100% significance when % = 0 through 50 and terminating at 25% significance when % = 100.

The goal of the weighting function is to minimize the significance of hard-to-control lightness errors in very dark grays which are usually less noticeable to the eye than L* errors in lighter tones.

Weighted Delta L* can be calculated through the use of various software solutions available in the marketplace.

*Note: these are the tolerances necessary to achieve a passing designation for G7 Grayscale. While achieving G7 Grayscale compliance indicates that the given press should be able to reproduce a targeted color space in general appearance, it does not necessarily indicate a close reproduction of any specific colors in the targeted space has actually been achieved. For more accurate color control, the user should target their output to a complete color space as in G7 Targeted or G7 Colorspace, where the whole color space is reproduced more accurately.**
the weighting function be reduced by at least 50% from the current G7 Grayscale weighting. While G7 Grayscale is an acceptable first step, the G7 Process Control Master Qualification Program uses these tighter tolerances.

3.2 Gray Balance (CMY scale only)

Average Weighted Delta $C_h$ ($wDCh$) = 1.5.

Peak $wDCh$ = 3.0.

Where;

$$DC_h = ((a_{sample}^{*} - a_{target}^{*})^2 + (b_{sample}^{*} - b_{target}^{*})^2)^{1/2}$$

And;

$$wDCh = DC_h \times (1 - \max(0, (c\% - 50)/50 \times 0.75))$$

The Weighted Delta $C_h$ formula is similar to the Weighted Delta $L^*$ function, reducing the significance of the Delta $C_h$ measurement above a cyan percentage ($c\%$) value of 50% on a linear scale beginning at 100% significance when $c\% = 0$ through 50 and terminating at 25% significance when $c\% = 100$. The goal of the weighting function is to minimize the significance of hard-to-control gray balance errors in very dark CMY grays that are usually covered by black ink.

Weighted Delta $C_h$ can be calculated through the use of various software solutions available in the marketplace.

3.3 Spatial Uniformity Informative

The sheet should exhibit ink evenness. If the sheet has two (2) measureable targets (P2P, IT8.7/4, or other custom targets that curves can be built from) then the CMYK solids on all targets should pass. IDEAlliance International Affiliates have the ability to modify this clause based on their region/market.

3.4 Exceptions Based on Print Process

IDEAlliance provides certain exceptions when qualifying printing processes whose inherent characteristics may cause them to fail normal G7 compliance tests. These print processes include flexo, screen printing and any system that cannot achieve a near-neutral 300% CMY patch due to unusual colorants or process limitations. These exceptions are covered in Addenda to this document.
4.0 G7® Master and G7® Process Control Master/G7 Targeted Pass/Fail Requirements

A printing process is in “G7 Targeted compliance” when it is G7 Grayscale calibrated and meets the color of the primary and secondary inks described in ISO 12647-2 or any referenced printing condition (RPC) using either absolute or substrate-relative condition. For example: a commercial sheetfed offset press is in “G7 GRACoL Targeted compliance” when it is G7 Grayscale calibrated and meets the specified colorimetric aims for substrate and colorants for GRACoL, or the GRACoL Relative condition created by modifying the GRACoL data by the substrate relative method. The same can apply for SWOP or any other Reference Print Condition.

1. Must meet G7 Grayscale requirements (see above section 3.0).
2. Must identify a G7 based reference print condition (targeted color space) consisting of a CGATS specification (Technical Report) or proposed ISO Standard reference print condition.
3. Solid CMY patches must be less than or equal to 3.5 \(\Delta E_{00}\), of the target print condition's substrate-relative CIELAB aim values. (refer to section 5.1); while solid K patch must be less than or equal to 5 \(\Delta E_{00}\)
4. Two-color (RGB) overprint solid patches must meet the target print condition's substrate-relative CIELAB aim values less than or equal to 4.2 \(\Delta E_{00}\). (refer to section 5.1) The solid CMYK and 2/color overprint CIELAB target values can be either the absolute values from the reference data set or the substrate-relative versions of the aims.
5. The sheet should exhibit evenness. (See above section 3.3)

5.0 G7® Master and G7® PC Master / G7® Colorspace Pass/Fail Requirements

Must meet G7 Targeted requirements (section 4.0).
The IT8.7/4 target must meet or exceed the tolerances listed below.
5.1 IT8.7/4 Sheetfed Offset Print Tolerances

Note: These tolerances are relative to the absolute or substrate-relative aim CIELAB values.

<table>
<thead>
<tr>
<th>Target</th>
<th>Tolerance $\Delta E_{00}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substrate</td>
<td>$\Delta E_{00} \leq 3$</td>
</tr>
<tr>
<td>CMY Solids</td>
<td>$\Delta E_{00} \leq 3.5$</td>
</tr>
<tr>
<td>K Solid</td>
<td>$\Delta E_{00} \leq 5$</td>
</tr>
<tr>
<td>Solids of RGB</td>
<td>Max $\Delta E_{00} \leq 4.2$</td>
</tr>
</tbody>
</table>
| All patches of IT8.7/4          | Average $\Delta E_{00} \leq 3.5$  
                              | 95th percentile $\Delta E_{00} \leq 5$ |

5.2 IT8.7/4 Proof Tolerances

<table>
<thead>
<tr>
<th>Target</th>
<th>Tolerance $\Delta E_{00}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substrate</td>
<td>$\Delta E_{00} \leq 1.5$</td>
</tr>
<tr>
<td>CMY Solids</td>
<td>$\Delta E_{00} \leq 3.5$</td>
</tr>
<tr>
<td>K Solid</td>
<td>$\Delta E_{00} \leq 5$</td>
</tr>
<tr>
<td>Solids of RGB</td>
<td>Max $\Delta E_{00} \leq 4.2$</td>
</tr>
</tbody>
</table>
| All patches of IT8.7/4          | Average $\Delta E_{00} \leq 2$  
                              | 95th percentile $\Delta E_{00} \leq 5$ |

Note: These tolerances are relative to the absolute or substrate-relative aim CIELAB values.

6.0 Verification of Print or Proof Condition

The G7 Expert consultant should validate the print condition prior to submitting samples through one or more of the following methods:
1. Use of a certified G7® System software that can verify the above conditions. [Click Here for a list of G7® Certified Systems](#)

2. Manual measurement analysis by other means (e.g. custom spreadsheet).

3. Use of the free IDEAlliance G7 FanGraph available at: [www.idealliance.org](http://www.idealliance.org) Note: Use of the G7 FanGraph method is for Grayscale compliance only.

4. 

**7.0 Color Measurement Method**

All targets are to be submitted in a layout and size readable by the X-Rite i1iSis2 (M0 or M1 measurement mode) or X-Rite i1iO II (M0 or M1 measurement mode), in i1Profiler. If custom targets are provided, the target and related reference file must be pre-approved and readable using an X-Rite i1iSis2 or X-Rite i1iO II in i1Profiler. Materials that are too thick to be read by an i1iSis2 will be read using an i1iO II. The IDEAlliance designated auditor reserves the right to reject these materials if measurement is impractical. Note: All targets must be reproduced at 100% of their original size.

**8.0 Affidavit**

G7 Expert is required to provide an affidavit attesting to completion of G7 Master candidates training requirements. The affidavit must be signed by both a designated representative of the G7 Master candidate company and the G7 Expert. Failure to complete this affidavit honestly and accurately may result in suspension of G7 Master company and G7 Expert.

**9.0 Failure of Samples**

In the event of failure the expert will have 60 days beyond the initial submission to resubmit the sheets. There is an additional charge for resubmission of sheets to allow for the additional reading and analysis.
Annex A: Screen Print

Scope
Annex A specifies the criteria for assessing G7 Master applications involving Screen Printing.

1.0 Introduction

This Annex is necessary because exceptions to the basic G7 compliance levels offset printing do not apply to screen printing. The key areas include:

1.1 Screen Printing compliance for G7 Grey Balance.
1.2 Non Typical LPI
1.3 Tonal range is compensated due to non-typical TVI metrics from linear input when compared to ISO 12647-2.
1.4 Expanded tolerances:
   1.4.1 \( \Delta L^* \) and Peak \( \Delta L^* \)
   1.4.1.1 Minimizes the need for multiple NPDC curves
   1.4.1.2 Ink film thickness is not static across the press form
   1.4.1.3 Screen Printing has limited print station control points
   1.4.2 \( \Delta F^* \) and Peak \( \Delta F^* \)
   1.4.2.1 The tonal range of the 3 color overprints are not neutral at the suggested G7 (a*,b*) values of (0,0)

2.0 Sample Submission Requirements

The G7® Expert Consultant must ensure that the candidate G7® Master site provides valid print samples from which measurements can be obtained by an auditor, as follows.

3.0 Minimum Target Submission Requirements
3.1 Submit at least three of the following:
   3.1.1 IDEAlliance 12647-5 screen print control wedge
   3.1.2 The standard P2P25x target.
   3.1.3 A custom target containing identical CMYK patch values to columns 4 and 5 of the P2P25 target as well as solid C, M, Y and K patches. If a custom target is supplied (not the standard P2P25) the original electronic version must
also be supplied (e.g. in TIFF format) along with suitable reference files.

4.0 Pre-verifying Submitted Samples

It is recommended that the G7® Expert analyze the samples submitted for compliance evaluation, or identical copies, before their submission, using either the candidate site’s or the G7® Expert’s own measuring equipment. (See section 6.0)

5.0 Pass/Fail Requirements for G7® Grayscale Compliance for Screen Printing

The G7® Grayscale compliance level is intended to allow screen printing to be recognized for achieving G7® Grayscale Calibration. G7® Grayscale is defined when “A device or process is calibrated to the basic G7® definition of constant neutral Grayscale appearance, but does not necessarily use standard colorants or match a standard or specified color space”.

All NPDC calculations for screen printing are based on the following seven control points of rows 4 & 5 from the P2P25 target or a custom target containing identical CMY & K patch values:
0, 10, 25, 50 75, 90, 100

6.0 NPDC (CMY and K-only scales)

Average Weighted DL* (wDL*) = 2.5
Peak wDL* = 5.0

7.0 Grey Balance (CMY scale only)

Average Weighted DCh (wDCh) = 3.0
Peak wDCh = 7.0.

Note: These tolerances are extremely generous and represent only a vague visual compliance with the expected “shared neutral appearance” of G7. It is strongly recommended to try and reach tighter tolerances and/or to use maximum GCR in production work to minimize the effects of unstable gray balance.

Annex B: Flexo Printing

Scope
Annex B specifies the criteria for assessing G7 Master Status applications involving flexographic (flexo) printing.

8.0 Introduction

This Annex is necessary because flexo printing can sometimes not achieve basic G7 compliance within the same tolerances as offset printing. The key areas include:

8.1 Tonal accuracy (compliance with the standard G7 NPDC curves) is compromised in lighter tones by mechanical and screening limitations of traditional flexo plates.

9.0 Sample Submission Requirements

The G7® Expert Consultant must ensure that the candidate G7® Master site provides valid print samples from which measurements can be obtained by an auditor, as follows.

10.0 Minimum Target Submission Requirements

10.1 Either: at least three P2P25x targets.
10.2 Or: at least three custom targets containing identical CMYK patch values to columns 4 and 5 of the P2P25 target as well as solid C, M, Y and K patches. If a custom target is supplied (not the standard P2P25) the original electronic version must also be supplied (e.g. in TIFF format) along with suitable reference files.

11.0 Pre-verifying Submitted Samples

It is recommended that the G7® Expert analyze the samples submitted for compliance evaluation, or identical copies, before their submission, using either the candidate site’s or the G7® Expert’s own measuring equipment. (See section 6.0)

12.0 Pass/Fail Requirements for G7® Grayscale Compliance for Flexo Print

The G7® Grayscale compliance level is intended to allow Screen Print to be recognized for achieving G7® Grayscale Calibration. G7® Grayscale is defined when “A device or process is calibrated to the basic G7® definition of constant neutral Grayscale appearance, but does not necessarily use standard colorants or match a standard or specified color space”.

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Special Exception for Flexo Printing

If not using modern flexo platemaking technology IDEAlliance will consider making an exemption for areas under 25% highlights. Per request, pending evaluation of the print sample flexo printing may not be subject to the G7 gray requirements.
Annex C: G7 Native CMY

Scope

Annex C specifies the criteria for assessing G7 Master Status applications for printing processes that cannot achieve near-neutrality at 300% CMY.

13.0 Introduction

1.1 Certain printing processes (e.g. dry-ink electro-photography) cannot achieve G7 compliance “natively” (without color management) due to the G7 requirement that 300% CMY must be “neutral” (0.0 a* and b*). These printing systems are effectively excluded from G7 compliance unless they use color management, which is contrary to the intention that G7 should be equally available to all printing systems.

1.2 Some printing systems that can achieve G7 compliance with very aggressive calibration curves exhibit unacceptable shadow contrast in one or more of the CMY channels, which can lead to inferior ICC characterization and/or unacceptable banding or sudden tone jumps in highly saturated color areas such as blue skies.

1.3 The arbitrary G7 requirement for a neutral 300% CMY point came from G7’s origins in photography, where color slide film and printing paper always produce a nearly-neutral black with just three CMY dyes. No such requirement exists in CMYK printing, because the black ink hides non-neutral gray balance in darker CMY values. More importantly, 300% CMY is seldom ever printed in a CMYK system.

1.4 In the above case the “G7 Native CMY Annex” may be used to bypass “neutral 300% CMY” rule.

14.0 G7 Native CMY Annex and Compliance

1.5 “G7 Native CMY” is similar to G7 Grayscale, except that the target a* and b* values for CMY gray levels darker than 50% cyan are gradually adjusted along a trajectory that ends at the native a* and b* values of that device’s 300% CMY level.

1.6 Target a*, b* algorithm:
   Given: a*_s, b*_s (s = substrate) and a*_300, b*_300; For Index percentage values 0 to 100;
   a*_tgt = a*_s x (1-C/100) + a*_300 x if(C < 50, 0, ((C - 50)/50)^4)
   b*_tgt = b*_s x (1-C/100) + b*_300 x if(C < 50, 0, ((C - 50)/50)^4)

1.7 The example graph below shows the “target” a* (red) and b* (blue) for a device whose paper is 1 a*, -3 b* and native 300% is 6 a*, -10 b*.
G7 Native CMY gray balance when 300% CMY = 6.0 a*, -10 b*

1.8 G7 Native CMY maintains G7’s original neutrality up to approximately 75% because CMY gray balance only deviates from legacy G7 in tonal areas normally covered by high amounts of black ink.

15.0 IMPORTANT: Printing systems that can achieve neutral 300% CMY (e.g. offset) should continue to aim for neutral 300% CMY, especially when the goal is G7 Targeted or G7 Colorspace compliance.