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Deliverable 5.2

Quality Control Guidelines
Doc 4 technical paper for professionals

EMSPI: Energy Management Standardization in Printing Industry

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TABLE OF CONTENT

COMMUNICATION MATERIALS ABOUT QUALITY CONTROL (D5.2)

In the sector, quality control is a serious issue. Every manager understands the importance of it. Making the right product in the shortest time thus is a management steering mechanism.

Even nowadays entrepreneurs do not always realize the direct relation between quality control and energy savings, although to everybody outside the business it seems a clear relation. This is why AIDO - as WP leader of this topic – will take care about creating relevant empowering content.

EMSPI will point out very clearly that working on quality control, is working on energy savings.

The leading role for creating this part of the project is: KVGO DC

The full scaled technical paper for the professionals: 4 till 10 A4

Printing SMEs that are trying to increase their Energy Efficiency need guidelines that give knowledge and tools to the technicians of printing companies in order to implement validated printing processes using proper machines within a feasible monitoring system.

For obtaining proper printing performance, reducing the number of quality mistakes and the energy consumption accordingly, it is essential to implement all the processes related to the printing production with high technical thoroughness. It is necessary to apply techniques and values which have been internationally validated and accepted, both based on ISO standards and best practices. Based on the practical experience of hundreds of Printing SMEs we can summarize a set of guidelines which can ensure that Sheet Fed Offset printing companies control the quality of the production, not merely in a final control step but along all productive processes.

Possibly a lot of companies are familiar with them, but are they really implementing them?

Digital File Production

It´s the first step of the printing production. A lot of quality problems come from a bad configuration of the digital file to be printed.

Configuration of graphic design applications (DTP)

The setting of "Color Management" must be synchronized in all graphic design applications in all work places dedicated to the treatment of the digital file to be printed. There must be as many sets of color management settings as different final printing conditions.

The transformation between color spaces must be done through the use of the ICC origin profile embedded in the image and an output profile coherent with the established reference printing conditions. When an image is saved (after the process of creating or modifying it in the related applications), the ICC profile corresponding to the color space must be kept.

When importing or placing an RGB image in the page of the application and corresponding layout, the ICC profile that defines the data to be used in a subsequent color conversion must be kept. If a CMYK image is imported or placed, the ICC profile must not be kept. If a CMYK image is imported or placed on a page the ICC profile should not be kept.

Similarly, if the intended output is in CMYK, the image elements of the grey scale must not incorporate the ICC profile because its colorimetry corresponds to the black channel space of the intended output. In all cases where transformation between color spaces is performed in the screening process, i.e., in the RIP, the ICC profiles embedded in the source elements in the RGB color space must be used. The ICC output profile to make such conversions of color must match the intended final print output.

Characteristics of the digital file for printing

Digital native file variables included in table 1 must be controlled. Recommended target values of these variables are specified in the table.

Digital Native File Variables and Recommended Target Values
Image compression algorithms; Whenever possible, the images should be compressed, but this is not required. For images in color or grey scale: ZIP or JPEG (it´s recommended to use a compression level that is never less than 10). For monochrome images: CCITT Group 3 or 4. Unless otherwise agreed between the parties, algorithms LZW or JPEG2000 must never be used for color or grey scale images nor JBIG2 for monochrome images.
Conversion of direct colors in the vectorial images; If the intended output does not allow the use of direct inks, they must transformed into the output color space. It´s recommended that such conversion takes place in the DTP application using alternative CMYK values or preferably L*a*b* included in the application library.
Trapping in the vectorial elements; It may be ≥ 0,08 when applicable
Bleedbox, Trimbox; It may be ≥ 3 mm when applicable
Fonts; The character fonts used in the page must be included. For Type 1 fonts or PostScript, both the display fonts as well as the outlines (or printer) must be included.
Artificial Text Styles; In no case artificial text styles in DTP applications must be used. They must be obtained through the selection of the corresponding source.
Fonts model; TrueType, Type 1 (PostScript), OpenType or City. Source models Type 3 or Multiple Master must never be used

Table 1. Target values of the control variables of Native files

When a PDF file is used, the variables included in table 2 must, at least, be checked. Recommended target values of these variables are specified in the table.

Digital PDF File Variables and Recommended Target Values
Boxes of page geometry; PDF must include a definition of the different areas of page through virtual boxes. Boxes of the final size of the page or *TrimBox/ ArtBox* and material or MediaBox must be, at least, defined. If the page has bleed area, it must be defined through the *BleedBox.* The visualization cutout area of page or *CropBox* must not be defined or this must have the same size as the *MediaBox*. All the geometry boxes must respect the defined order hierarchy, from inside to outside, *TrimBox/ArtBox*, *BleedBox, CropBox, MediaBox.*
Page scale factor; A PDF must not contain a page scale factor so that it can be guaranteed that the printing is done with the same size as indicated in the PDF viewfinder.
Use of transparencies; Unless there is a prior agreement between the parties, a PDF must not contain transparent objects. Transparency effects can also be achieved by prior coupling in the application of image processing or in the PDF production.
Font's models; Type 3 and Multiple Master source models must not be used, which in practice, only allows the use of Type 1, True Type and City source models. Unless there is a prior agreement between the parties, Open Type fonts must not be embedded. Open Type fonts can be used in DTP applications when embedding is performed as Type 1 or TrueType.
Fonts embedding; They should be inserted, at least, all the characters, metrics and encodings of each used source. Total embedding of the fonts is, therefore, optional.
Objects overprinting; A white object must not be marked to be overprinted, resulting in it disappearance when processing the PDF. For the same reason, a white text must not be marked for overprinting. Black text below 12 pt must not be marked for knockout in order to avoid a lack of register in the print.
Layers use; Unless there is a prior agreement between the parties, layers must not be used in the PDF.

Digital PDF File Variables and Recommended Target Values
Annotations use; Annotations must not be used, of any kind, within the *Trimbox* or *BleedBox* if they´re defined.
Intended output condition; All PDF must include the intended output condition related to the final print, that is, a PDF/X Output Intent object must be included, in which the recipient of the file is informed about what is the output print for which the color has been managed. The target profile of the Output Intent should be used as the destination for conversions for page objects requiring color management, for example RGB objects.
Color management of the page elements; All objects in a PDF whose color space is different from CMYK, Separation or Grey Scale (or that don´t use them to define their alternate color space or base) must include an origin ICC profile to provide the colorimetric definitions used for converting color. This, in practice, means that objects in RGB must include an ICC profile to be used in the color conversion to CMYK. In the color conversion the ICC profile embedded in each object must be used as the origin instead of being discarded and/ or using some other.
Using encryption; A PDF must not contain encryption of any kind.
Trapping Indicator; A PDF must indicate if it has been previously trapped or if it must be done later. This will be done indicating *True* or *False* in the key *Trapped*. Key Trapped must be *True* or *False* and never *Unknown*.
PDF/X Standardization level; The previous requirement are related with several PDF Standardization levels as included in the ISO 15930.

Table 1. Target values of the control variables of PDF files and its content

The next variables of PDF and native document, included in Table 3, must be controlled. Recommended target values of these variables are specified in the table.

Digital Native & PDF File Variables and Recommended Target Values
Objects outside de page; When exchanging production files, whether natives or PDF, no objects placed fully outside the page should exist.
Size and page orientation; Size and orientation must be the same for all the pages of a document, in order to facilitate the imposition tasks.
Use of empty pages Unless there is an agreement between the parties, pages that are fully empty in a document must not exist.
Sum of tonal value of the page objects < 330% Coated paper. The addition of the total ink of the overprinted objects is not considered < 300% Uncoated paper.The addition of the total ink of the overprinted objects is not considered
Nomenclature of direct colors; Direct colors used in the document must be defined according to the final printing condition. This means that the libraries of spot colors selected in the DTP application or the created objects in Separation, Device N or N Channel in the PDF must be those related to the paper type where the printing is going to be produced
Ambiguity of direct colors; A native document or a PDF must not contain direct colors whose definition is ambiguous. This means, having the same name but different alternative values and having the same alternative colors but different name
Minimum text size; Coated paper; If the text is composed by two or more colors, it should not contain text < 5 pt nor < 8pt Uncoated paper; If the text is composed by two or more colors, it should not contain text < 5 pt nor < 9pt
Minimum thickness of lines and surroundings Premium coated paper ISO 12647-2:2013 PC 1 > 0,124 pt Wood-free uncoated white paper (ISO 12647-2:2013 PC 5); > 0,14 pt

Image resolution; It must not be lower than 50%, nor should be lower than 75%, nor must be higher than 150% of the optimal resolution obtained with the next formula ***Resolution (ppi[1]) = 2 x Line Screening (lpi[2])*** *Example 150lpp = optimal 300ppp, minimum 225ppp (never lower than 150ppp), maximum 450ppp.*
Depth of bits of the images; The images in color or grey scale must not have a depth higher than 8 bits per channel

Table 2 Target Values of the control variables which applies both for a native document and a native PDF

COLOR PROOF PRODUCTION

Production of Color Proof

Color Proof production must be done by using the self-made or standardized output profile which is coherent with the reference printing conditions. The coincidence of the color proof with reference printing conditions may be controlled through a measurement of a color patch, within the recommended tolerances indicated in table 4.

Measurement	Recommended Tolerance
ΔE Substrate	≤ 3
ΔE Average of all patches	≤ 3
Maximum ΔE of all patches	≤ 6
Maximum ΔE of Primary Colors	≤ 5
Saturation Difference (Maximum ΔH of Primary Colors)	≤ 2,5
Saturation Average (ΔH Average)	≤ 2,5
Grey Patches in 3 colors	≤ 1,5

Table 4. Tolerances applicable to the color proof

Two ICC profiles, or a similar mechanism, must be used in the RIP of the color proof production system for managing the color. One corresponding to the proof device and other profile relative to the final printing through a self-made or standardized ICC profile, according to the reference printing conditions. These two profiles will be needed in order to allow the RIP of the color proof production system to emulate the color of the printing condition. Therefore, the same number of configurations is needed as there are different final printing conditions to be emulated.

[1] Pixels per Inch
[2] Lines per Inch

If the Color Proof is not done with the same substrate as used in the final print, it is necessary that the color of the final substrate is also emulated. All Color Proof must incorporate a control patch with, at least, the elements or patches defined in Table 5. There are commercial control patches adapted to this purpose. The coincidence of the color proof with the reference printing conditions must be controlled through the colorimetric measurement of the control patch, including the recommended tolerances indicated in Table 5.

Measurement	Tolerance
ΔE^*_{ab} Substrate	≤ 3
Average ΔE^*_{ab} of all patches	≤ 3
Maximum ΔE^*_{ab} all patches	≤ 6
Maximum ΔE^*_{ab} primary colors	≤ 5
Tone difference (max. ΔH primary colors)	≤ 2,5
Average ΔE^*_{ab} tertiary patches	≤ 4
Average ΔH Grey balance	≤ 1,5

Table 5. Coincidence of the color proof with the reference printing conditions

Visualization conditions of the Color Proof

There must be, at least, a properly cabin in the facilities of the organization for the visualization of color proofs and prints, with the characteristics indicated in Table 6.

Variable	Recommended Target Value
Visualization environment and support surface	Neutral and matte (surface not reflectant)
Illuminance of the visualization area	2000 ± 500 lx
Temperature of the reference illuminant	5000 ± 500 K

Table 6. Conditions of Color Proof visualization

PRODUCTION OF PRINTING FORM. CTP SYSTEM

RIP Configuration

For dot structures without principal axis (round dot, square, etc.), CMK screen angles must be separated 30° and Y 15º in respect to other colors. According to that, it´s a normal practice to configure the angles as follows; C 15º, M 75º, Y 0º, K 45º.

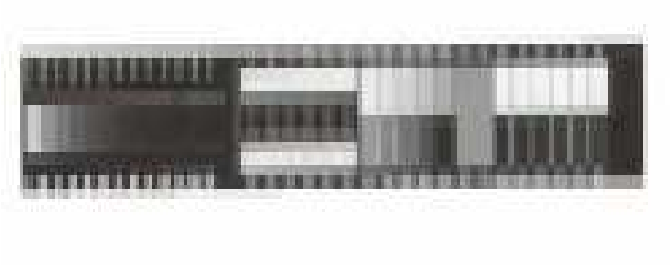
For dot structures with a principal axis (elliptic dot), the screening angles of CMY must be separated 60º and Y 15º in respect to other color. Dominant color must be 45º or 135º in respect to the reference direction.

When the dot gain obtained in printing is, by itself, outside the deviation tolerances established in one or more colors, compensation curves must be applied for achieving the targeted tone value.

The same number of compensation curves must exist as there are sets of screening parameters used in the rendering of the digital data. A set of screening parameters is a group of values used in the RIP configuration for defining the line screen, resolution, structure or modulation point (AM or FM) of the created screen. The use of different values for these parameters produces, as a consequence, different printing dot gain and, therefore, it´s necessary to have the same number of curves as sets of screening parameters

Production control

Printing forms must be visually controlled with a determined frequency using a control patch with at least Resolution elements, Half-Tone Scales and Microlines.



The plate must include, at least, an element with 25%, 50% and 75% of tone that could be placed outside the printing area. This element must be measured, with a determined frequency, through colorimetry, densitometry or microscopy (1 bit image) in order to check the quality of the plate for doing a proper printing process and/or for controlling the CTP system calibration.

If the control element is affected by the compensation curve, its value will not be 1:1 (linear). In such a case, it must be a table which can transform the estimated tone value for this control element according to the used compensation curve.

Environmental Conditions

Temperature and Humidity of the room where the printing form is produced should be stable and controlled, preferably 23º C ± 2ºC and 55% ± 5 % HR.

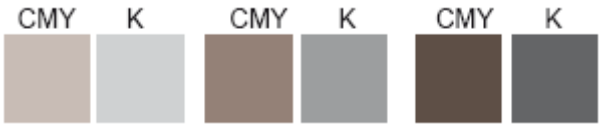
PRINTING

Printing preparation

Printing sequence must be the same as the reference printing condition. Changing this sequence in the printing device would have the consequence of obtaining secondary and tertiary colors that are very different from the intended ones, mainly due to acceptance differences between overprinted chromatic inks (trapping).

All prints must include a control patch with a enough patch size which allows density and dot gain measurements. It must be placed perpendicularly to the machine direction. This control element must contain, at least, Full tone primary colors: C, M, Y, K; Full tone secondary colors: C+M, C+Y, M+Y; Full tone C+M+Y; Half-tone (40% and 80%) or (50% and 70%) of each primary ink; Grey Balance.

There are no Grey Balance values that are compatible with all the printing conditions. Grey balance depends largely on the dot gain and order of machine cylinders. Even so, and only as visual reference, there are tertiary combinations of CMY values which should have an approximately neutral aspect.



The organization must use a printing reference for adjusting each production, which could be an internal color proof, an external color proof, a sample, a previous OK Sheet or reference colorimetric values. Densitometry values could be used when the printing condition remains the same.

Printing dot gain must be within tolerance values accepted by the reference. The difference of dot gain between C, M and Y should be ≤ 5%. This means that, whatever dot gain should not be higher than 5%.

The printing form screening, whatever the technology by which it was created, must be transferred to the print in a consistent and homogenous way.

The register deviation must be controlled and it should be ≤ 0,1 mm.

Regarding the horizontal homogeneity of the sheet, it could be considered correct if the difference of density in the primary colors is ≤ 10 % among any dot of the sheet.

Colorimetry of the OK Sheet should be coincident with the colorimetry reference with a tolerance limit of about 5 ΔE*ab (CIE1976). If densitometry reference values are used, the deviation tolerance should not be higher than 0,05 D.

Environmental conditions

Temperature and humidity of the printing area should be stable and controlled. Recommended values are 23º C ± 2ºC and 55% ± 5 % HR.

Printing production control

Densitometry values of primary the colors of the most of prints must be coincident with those of the OK Sheet with a recommended deviation tolerance lower than 0,05 D. No color differences in respect to OK Sheet should exceed half of the deviation tolerance specified in Table 7.

Parameter	Color			
	Black	Cian[a]	Magenta[a]	Yellow[a]
Deviation tolerance	5	5	5	5
Variation tolerance	4	4	4	5
[a] *The contribution of the tone difference must not exceed to 2,5*				

Tabla 7. Production deviation tolerances

EQUIPMENT CONTROL PROCESSES

Preventive Maintenance

A Maintenance Plan must be defined for the equipment participating in the productive processes consisting of at least: Equipment identification, Maintenance actions, Frequency of completion of each maintenance action, Responsible of completion of each maintenance action. When the maintenance is done by an external technician, it will also define the internal responsible person who will control the maintenance implementation.

Management of Monitors

Monitors used for the visualization of digital files, should have the characteristics involved in table 7

Variable	Target Value
Resolution	≥ 1280 x 1024 pixels
Screen size	≥ 19 inches

Table 7. Monitor characteristics

The organization must determine target values for White Point, Brightness and Gamma parameters and they must be used in all the monitors used for visualization. Monitors used should have adjusted the Point, Brightness and Gamma parameters according to the target values given in table 8.

Variable	Target Value
White point	5000 - 5800 Kelvin
Brightness	120 - 160 cd/m2
Gamma	1,8 – 2,4

Table 8. Monitor parameters values

Management of Measurement Devices

The setting of the measurement devices used in the productive processes must be determined. When colorimeters, spectrophotometers, spectrodensitometers or plate densitomers are used, the parameters given in table 9. must be determined, depending on the magnitude to be measured.

Magnitude	Parameter	Value
Density	Status	E
	Filter	Polarized
	Geometry	45/0 0/45
	Kind of measurement	Relative
Color	Status	E
	Filter	Without filter
	Geometry	45/0 0/45
	Observer	2º
	Illuminant	D50
	Calculus method	ΔE ab
	Color space	L*a*b*

More information

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