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Graphic technology — Process control for the production of half-tone colour separations, proofs and production prints —

Part 4: Publication gravure printing

Technologie graphique — Contrôle des processus de confection de sélections couleurs tramées, d'épreuves et de tirages —

Partie 4: Processus de gravure

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 12647-4 was prepared by Technical Committee ISO/TC 130, *Graphic technology*.

ISO 12647 consists of the following parts, under the general title *Graphic technology — Process control for the production of half-tone colour separations, proofs and production prints*:

— *Part 1: Parameters and measurement methods*

— *Part 2: Offset lithographic processes*

— *Part 3: Coldset offset lithography on newsprint*

— *Part 4: Publication gravure printing*

— *Part 5: Screen printing*

— *Part 6: Flexographic printing*

— *Part 7: Off-press proofing process working directly from digital data*

Introduction

The purposes of ISO 12647-1 are

- to list and explain the minimum set of primary process parameters required to uniquely define the visual characteristics and related technical properties of a half-tone proof or production print produced from digital data directly or via a set of half-tone separation films;
- to give the definitions for the general terms necessary for process control;
- to describe the measurement methods and the requirements for reporting the results.

This part of ISO 12647 lists values or sets of values of the primary parameters specified in ISO 12647-1 and related technical properties of a gravure publication print. Where deemed useful, secondary parameters are also specified.

The purpose of a proof print is to simulate the visual characteristics of the finished print product as closely as possible. In order to visually match a particular print, off-press proofing processes may require values for solid tone coloration and tone value increase which are different from those of the printing process they are meant to simulate. This is caused by differences in phenomena such as gloss, light scatter (within the print substrate or the colorant), metamerism and transparency. Such differences are likely for those off-press proofing processes in which the print substrate, the colorants and the technology for applying them are significantly different from gravure press printing. In such cases the user or the supplier should ensure that appropriate corrections are specified. Another problem area is the matching of a digital off-press proof to a double-sided print on a less-than-opaque, lightweight printing paper as used in publication gravure printing. If it is deemed necessary, for image quality reasons, to proof with colour management profiles based on measurements with substrate backing rather than black backing, there will be an unavoidable difference between proof and production prints. This fact needs to be communicated to all parties concerned.

Graphic technology — Process control for the production of half-tone colour separations, proofs and production prints —

Part 4: Publication gravure printing

1 Scope

This part of ISO 12647 specifies a number of process parameters and their values to be applied to four-colour publication gravure printing. The parameters and values are chosen in view of the complete process covering the process stages “colour separation”, “making of the printing forme”, “proof production” and “production printing”.

This part of ISO 12647 is applicable

— directly, to publication gravure printing, including magazines, catalogues and commercial materials;

— directly, to halftone and continuous tone proofing processes that predict the colorimetric results of gravure printing;

— by analogy, to process-colour gravure package printing.

It is not applicable to the specifics of the transformations necessary to relate digital input data to the data used to create the cylinder engraving data and/or the proofing process.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the reference document (including any amendments) applies.

ISO 8254-1:1999, *Paper and board — Measurement of specular gloss — Part 1: 75 degree gloss with a converging beam, TAPPI method*

ISO 12639:2004, *Graphic technology — Prepress digital data exchange — Tag image file format for image technology (TIFF/IT)*

ISO 12642-1, *Graphic technology — Input data for characterization of 4-colour process printing — Part 1: Initial data set*

ISO 12647-1:2004, *Graphic technology — Process control for the production of half-tone colour separations, proof and production prints — Part 1: Parameters and measurement methods*

ISO 15930-4:2003, *Graphic technology — Prepress digital data exchange using PDF — Part 4: Complete exchange of CMYK and spot colour printing data using PDF 1.4 (PDF/X-1a)*

ISO 15930-5:2003, *Graphic technology — Prepress digital data exchange using PDF — Part 5: Partial exchange of printing data using PDF 1.4 (PDF/X-2)*

ISO 15930-6:2003, *Graphic technology — Prepress digital data exchange using PDF — Part 6: Complete exchange of printing data suitable for colour-managed workflows using PDF 1.4 (PDF/X-3)*

Specification ICC:1, *File format for Color profIles (Version 4.1.0)*, International Color Consortium, 1899 Preston White Drive, Reston, VA 20191, USA

3 Terms and definitions

For the purposes of this document, the definitions given in ISO 12647-1 and the following apply.

3.1
improved newsprint
paper with, compared to ordinary newsprint, a higher smoothness, a higher brightness and a filler content up to 20 %

3.2
engraving pitch
P
reciprocal of average cell spacing on a gravure cylinder, evaluated from the following formula:

$$P = \frac{1}{\sqrt{a \times b}}$$

where

a is the distance between the same points on two adjacent cells in the printing direction;

b is the distance between adjacent circumferencial tracks of the engraving stylus.

3.3
process colour solid
printed area that corresponds to the maximum cell volume identified for the combination of gravure engraving parameters

4 Requirements

4.1 General

Subclauses 4.2 and 4.3 are based on the assumption that input for gravure printing comprises digital data that defines the data tone values (equivalent to the film tone values in a traditional offset process). These data, wherever practical, represent the characteristics associated with the relationship between the digital data provided and the printed image. The specifics of the transformations necessary to relate these data to the data used to create the cylinder engraving data and/or the proofing process are the responsibility of the organization involved and are not specified in this part of ISO 12647.

The four substrate categories of gravure printing, identified by the paper principally used, defined for this part of ISO 12647, are as follows:

— substrate category S1 (coated paper of 70 g/m^2 or greater);

— substrate category S2 (lightweight coated paper);

— substrate category S3 (super-calendered paper);

— substrate category S4 (improved or enhanced newsprint).

While these substrate categories of gravure printing are identified in terms of the paper principally used, they may be used on any stock for which the printer is capable of achieving the colours specified in Tables A.1 or A.2, see also Figures A.1 and A.2, and thus the associated colour gamut.

Where appropriate, the applicable clauses of ISO 12647-1 are referenced for the definition of the data and measurement conditions.

Subclauses 4.2 and 4.3 are arranged according to the order set out in ISO 12647-1; they also depend on it for the general principles, the definition of the data, the measurement conditions and the reporting style.

4.2 Data file and printing forme

4.2.1 Digital Data

Digital data files supplied for printing shall conform to latest edition of ISO 15930, parts 4, 5 and 6 or to ISO 12639.

Supplied data files conforming to ISO 12639 shall also include an identification of the intended printing condition. Where the intended printing condition is a printing condition included in the registry of characterizations maintained by the ICC, as described in ICC.1, the name used in the ICC registry may be used as the identification. If the intended printing condition is not included in the ICC registry, characterization data specified using the target defined in ISO 12642, or an ICC output profile derived from it, shall be included. An ICC output profile derived from the appropriate characterization data should also be included in all cases. In any situations where the rendering of the data, when printed, is intended to be other than colorimetric (as specified in ICC.1) an ICC output profile derived from the appropriate characterization data shall be included.

All continuous tone raster data shall be at a resolution that equals or exceeds 120 cm^{-1}. If line work raster data are provided, they shall be at a resolution of three to six times that of the continuous tone data. If text is provided as CT data it should be anti-aliased.

A proof print may accompany digital data and where provided it shall conform to the indicated printing condition.

4.2.2 Separation films

Where data are exchanged using half-tone separation films, they shall be accompanied by a proof print that simulates the intended printing condition and that conforms to 4.3. This fact shall be verifiable by measuring well-specified control patches that are printed on the proof print along with the subject.

Where the proof has been prepared directly from the separations the following control patches shall be included as a minimum:

a) solid primary and secondary colours (including black);

b) at least one half-tone control patch of each of the primary colours (including black) with tone values between 40 % and 70 %; the tone values used shall be the same for each colour;

c) a tertiary colour control patch composed of 100 % each of the primary colours (or with magenta and yellow reduced to better approximate a grey);

d) at least one tertiary colour patch composed of the same tone values as defined in b) (or with magenta and yellow reduced to better approximate a grey).

Where the proof is a simulation of the intended printing condition, and where it has been produced directly from the data used to prepare the separations, the control patches provided shall, as a minimum, simulate the control patches listed above.

4.2.3 Engraving pitch

For four-colour work, the ranges of engraving pitch shall be :

— 54 cm^{-1} to 70 cm^{-1} for yellow;

— 60 cm^{-1} to 80 cm^{-1} for cyan and for magenta;

— 60 cm^{-1} to 100 cm^{-1} for black.

4.2.4 Screen angle

There is no specification.

4.2.5 Cell shape

There is no specification.

4.2.6 Image size tolerance

See 4.3.4.

4.2.7 Tone value sum

Unless otherwise specified, the maximum tone value sum should be 340 %.

NOTE Smaller values can be used but this applies to a lesser extent to uncoated papers.

4.2.8 Grey balance

A single grey balance condition is usually not sufficient to ensure an achromatic colour for all print substrates, black compositions and printing inks that may be used with a given printing process. The correct grey balance may be determined from the pertinent colour management profile, it may depend on the black composition.

4.3 Proof or production print

4.3.1 General

To define the appearance of a print or proof it is necessary, as a minimum, to specify the gloss and colorimetric characteristics of the substrate and inks used for printing, when the inks are printed at the appropriate concentration. These characteristics are defined in 4.3.2 to 4.3.5.

NOTE Printing and measuring the image specified in ISO 12642, basic set, when measured in the 'absolute' colorimetric mode (i.e. relative to the perfect reflecting diffuser), provides the data to ensure conformance with the characteristics specified in 4.3.2.1, 4.3.2.3, 4.3.3 and 4.3.5.

4.3.2 Visual characteristics of image components

4.3.2.1 Print substrate colour

The print substrate used for proofing should be identical to that of the production printing. If this is not possible, the properties of the print substrate should be a close match to that of the production in terms of colour, gloss, type of surface (coated, uncoated, super-calendered, etc.) and mass per area. Table 1 provides aim values for colour as well as other attributes for the substrate categories mentioned in 4.1.

Table 1 — CIELAB coordinates, gloss, roughness and tolerances for the substrate categories.

Substrate category	L^* [a,b]	a^* [a]	b^* [a]	Gloss [c] %	Roughness [d] %	Mass per area [b] g/m^2
S1: coated	88 (91) [e]	0 (0)	– 3 (– 3)	65	0,9	80
S2: lightweight coated (LWC)	86 (88) [e]	0 (1))	2 (3)	55	1,1	51
S3: super-calendered	86 (89) [e]	– 1 (0)	3 (4)	20	1,5	52
S4: improved newsprint	83 (84) [e]	– 1 (0)	3 (4)	< 10	3,5	50
Tolerances	[e]	± 2	± 2	± 10	—	—

[a] Measurement in accordance with ISO 12647-1: D50 illuminant, 2° observer, 0/45 or 45/0 geometry, black backing. Values for white backing conditions are included in brackets.

[b] Informative only.

[c] Measurement in accordance with ISO 8254-1, TAPPI method, informative only.

[d] Measurement in accordance with ISO 8791-4 [5], Parker Print-surf, clamping pressure 980 kPa, soft backing, informative only.

[e] The informative L^* value given represents a minimum value.

4.3.2.2 Print substrate gloss

The gloss of the print substrate used for proofing should be a close match to that of the production print substrate. If this is not possible, press proofing may be carried out on the closest match selected from the substrate categories listed in 4.3.2.1.

4.3.2.3 Ink set colours

For proof and production printing, the aim value set shall be selected either from the gamut type 1 set or the gamut type 2 set. Both sets are specified in Annex A for four substrate categories, see Tables A.1 and A.2 and Figures A.1 and A.2.

For the digital proof print, the CIELAB ΔE^*_{ab} deviation of the primary colour solids from the corresponding colours of the chosen set, defined by Tables A.1 or A.2 shall not exceed 4.

For the OK print, the CIELAB ΔE^*_{ab} deviation of the primary colours from the corresponding colours of the chosen set, defined by Tables A.1 or A.2 shall not exceed 5.

NOTE 1 If the tolerances of the primary colours of the proof and those of the production prints are being exploited in opposite directions, the maximum ΔE^*_{ab} between them might be 9.

For the production run, the variability of the primary colour solids is restricted by the following condition. For at least 68 % of the production prints, the colour differences from the OK sheet shall not exceed, and should not exceed one half of, the appropriate variation tolerance specified in Table 2.

NOTE 2 The distribution of ΔE^*_{ab} values is not gaussian but skewed. For reasons of consistency, the variation tolerance is defined here as the upper limit for 68 % of the production copies. This is in analogy with a gaussian distribution where 68 % are within plus or minus one standard deviation of the mean.

Table 2 — CIELAB ΔE^*_{ab} variation tolerances for the solids of the process colours

unit: 1

	Black	Cyan	Magenta	Yellow
Variation tolerance	3,5	3,5	3,5	4,5

4.3.2.4 Ink set gloss

The gloss of solid tone colours may be specified if deemed necessary.

NOTE The gloss of the shadow parts of an image increases with increasing tone value sum.

The specular gloss of the print substrate or ink set single print solid areas shall be measured with light incident at 75° (15° from the plane of the print substrate) and measured at 75°. The instrument used shall conform to ISO 8254-1. Report values in percent, quoting “ISO 8254-1” as the method.

4.3.3 Tone value reproduction limits

Tone values within the following limits (measured on the print) shall be printable in a consistent and spatially uniform manner:

3 % to 95 %.

No significant image parts shall rely on tone values outside of the above tone value reproduction limits.

4.3.4 Tolerance for image positioning

The maximum deviation between the image centres of any two printed colours shall not be larger than 0,2 mm and the image size deviation between any two printed colours due to cylinder making and printing shall not exceed 0,2 mm.

4.3.5 Tone value increase

Both proof print and production print shall work with the same colour management profile for the intended printing condition. The tone value increases of both prints – calculated from the colorimetric data using the method described in 5.3.2 of ISO 12647-1:2004 – shall be within 2 % of the profile data. Informative values of the densitometric tone value increase are given in Table 3 for the benefit of film-based workflows.

Table 3 — Typical tone value increase values
(informative only)

Unit: %

Tone value	Tone value increase
25	13
40	17
50	18
70	15
75	13
80	11

5 Reporting of printing conditions

Reference to the printing conditions as specified by this part of ISO 12647 in Tables 1, 3, A.1 and A.2 for the purposes of colour management, such as in colour management characterization tables or colour management profiles based on them, should be made in the following form.

Printing according to ISO 12647-4, <printing process>, <substrate category>, <gamut type>.

The printing process is publication gravure, in short form “PG”.

The substrate categories are “coated paper above 70 g/m^2”, “lightweight coated”, “super calendered”, “Improved newsprint”, in short form “S1”, “S2”, “S3”, “S4”.

EXAMPLE:

Printing according to ISO 12647-4, publication gravure, substrate category S3, gamut type 1. For use in profile names, “PG_S3_GT1”.

Annex A
(normative)

Gamut types

A.1 General

Due to differing requirements in some geographical areas, two different gamut types have evolved, based on two different ink sets:

- gamut type 1, see Table A.1 and Figure A.1, achievable with inks in accordance with ISO 2846-3[3].
- gamut type 2, see Table A.2 and Figure A.2 preferred in Europe.

NOTE 1 The ink colours that produce gamut type 1, especially for substrate category S2, are similar to those specified in ISO 12647-2 [6] for offset printing.

NOTE 2 A definition of the ink set for gamut type 2 is planned to be included in a future revision of ISO 2846-3 [3].

In A.2, no density values are specified. Such values can be very valuable for process control during a print run, where the densitometer, the ink and the print substrate remain the same, see ISO 13656 [2]. However, in a general situation, density values do not define a colour to the required degree. Following ISO 13656 [2], the production press operator should first achieve the correct colour of the solids on the press, then read the densities with the densitometer from the OK print. These densities may then be used as aim values for process control during the production run.

A.2 Gamut type 1

Table A.1 — CIELAB coordinates of solid colours for gamut type 1

Unit: 1

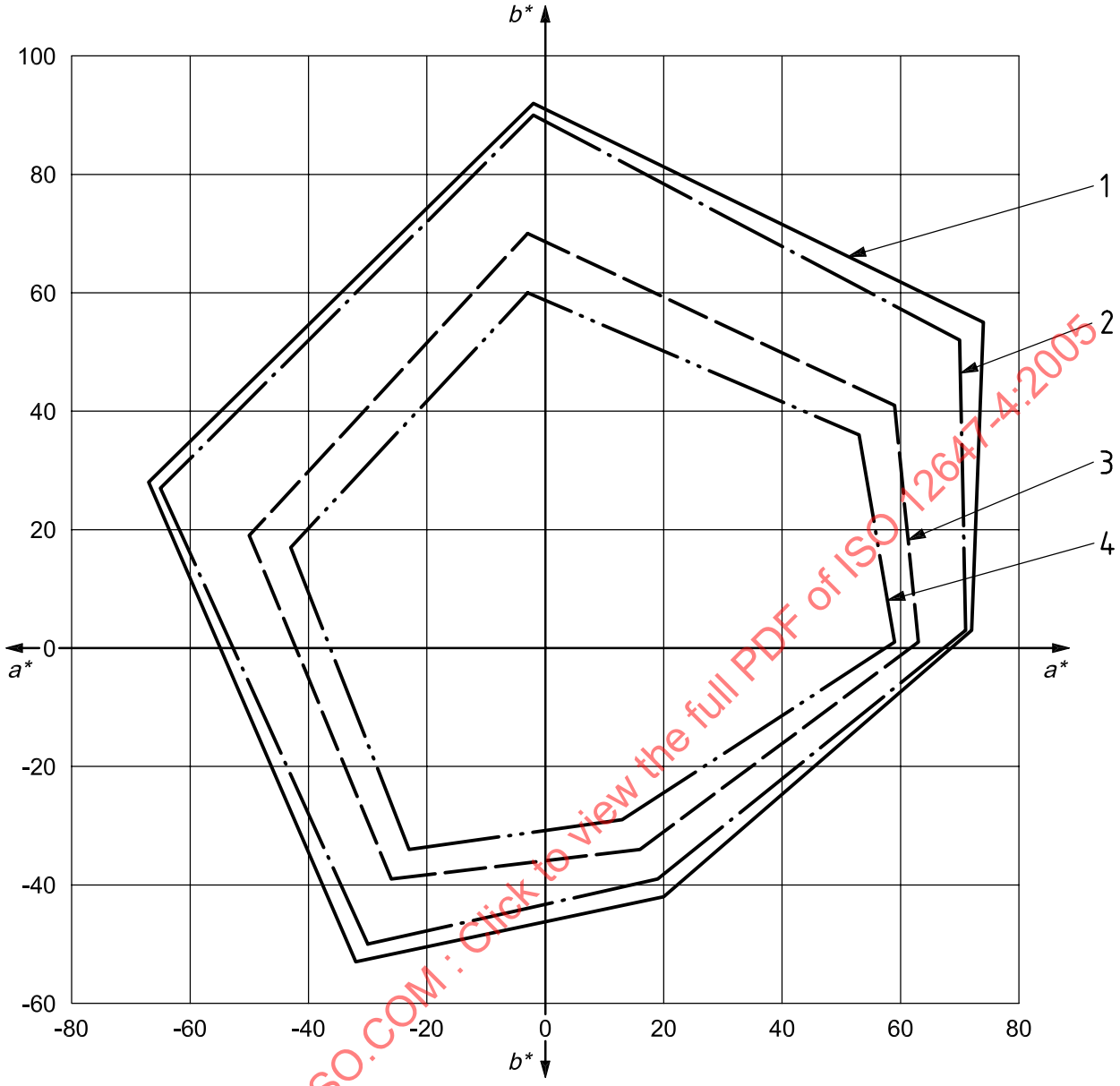
Substrate category [a]	S1			S2			S3			S4		
	L^* [b]	a^* [b]	b^* [b]	L^* [b]	a^* [b]	b^* [b]	L^* [b]	a^* [b]	b^* [b]	L^* [b]	a^* [b]	b^* [b]
Black	12	0	0	13	0	0	16	1	1	22	1	2
	0,0	0,0	0,0	0,8	0,2	0,3	0,9	0,2	0,5	0,8	0,2	0,3
Cyan	47	– 32	– 53	47	– 30	– 50	46	– 26	– 39	49	– 23	– 34
	1,0	– 0,1	– 0,2	1,4	– 0,1	– 0,2	1,6	– 0,3	0,3	1,4	– 0,1	– 0,2
Magenta	46	72	3	46	71	3	46	63	1	47	59	1
	1,0	2,2	0,4	1,3	2,0	0,4	1,5	2,1	0,9	1,3	2,0	0,4
Yellow	87	– 2	92	86	-2	90	80	– 3	70	79	– 3	60
	2,0	0,9	2,1	2,1	0,8	2,3	2,3	0,7	2,8	2,1	0,8	2,3
Red [c]	46	74	55	45	70	52	44	59	41	46	53	36
	1,0	2,1	1,3	1,2	1,9	1,4	1,4	1,9	1,5	0,9	0,6	– 0,2
Green [c]	41	– 67	28	42	– 65	27	38	– 50	19	46	– 43	17
	1,0	2,1	1,3	1,2	– 0,5	1,0	1,4	– 0,7	1,3	1,2	– 0,5	1,0
Blue [c]	14	20	– 42	15	19	– 39	16	16	– 34	27	13	– 29
	0,0	0,6	– 0,2	0,9	0,6	– 0,2	0,9	0,7	– 0,2	1,2	1,9	1,4
Overprint [c] C+M+Y	12	0	0	14	0	0	15	0	– 1	15	0	– 1
	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,5	0,1	0,2

NOTE The secondary colours red, green, blue might vary depending on conditions that include the printing sequence, the mechanics of the press, the surface characteristics of the print substrate and the rheological and transparency properties of the inks. Thus, conformance of the primaries C, M, Y to this table is not sufficient for the conformance of the secondary colours to this table.

[a] Substrate categories according to 4.3.2.1.

[b] Measurements with D50 illuminant, 2° observer, 0/45 or 45/0 geometry. Upper row values are measured over black, see ISO 12647-1. Lower row: measurement over white ($C^* < 3,0$; $L^* > 92,0$) minus measurement over black.

[c] Printing sequence: yellow, magenta, cyan; these values are informative only.



Key

1 S1
2 S2
3 S3
4 S4

NOTE See Table A.1 for values of a^* and b^*.

Figure A.1 — Gamut type 1: Gamuts for substrate categories