INTERNATIONAL STANDARD

ISO 12642-1

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2011-07-15

Graphic technology — Input data for characterization of four-colour process printing —

Part 1: Initial data set

Technologie graphique — Données d'entrée pour caractérisation d'impression en quadrichromie —

Partie 1: Ensemble de données initiales

Reference number
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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 12642-1 was prepared by Technical Committee ISO/TC 130, *Graphic technology*.

This second edition cancels and replaces the first edition (ISO 12642-1:1996) and its Technical Corrigendum (ISO 12642-1:1996/Cor.1:2005) and introduces no change in the technical requirements. Subclause 4.4 and Annex B have been replaced by references to ISO 28178 which has been created to include the data exchange file format for this and other International Standards.

ISO 12642 consists of the following parts, under the general title *Graphic technology — Input data for characterization of four-colour process printing*:

— *Part 1: Initial data set*

— *Part 2: Expanded data set*

Introduction

0.1 General background

The technical content of this part of ISO 12642 is identical to ANSI IT8.7/3-1993. The ANSI document resulted from the joint efforts of an international industry group that included participants representing a broad range of prepress vendors, film manufacturers, and users. This group, initially identified as the DDES (Digital Data Exchange Standards) Committee, later became the founders of the ANSI IT8 (Image Technology) accredited standards committee which is responsible for electronic data exchange standards in graphic arts prepress.

In an environment in which colour information is passed between electronic publishing systems, it is essential for colour to be defined in an unambiguous manner. Substantial experimental evidence enables us to conclude that, for foveal vision, this can be achieved by specifying the mixture of three linearly independent stimuli required to match that colour. In 1931 a complete system of colour definition was developed by the CIE (Commission Internationale de l'Eclairage) based on experimental evidence published during the previous decade. This evidence confirmed the similarity between observers in making such a match. That system and its derivatives are now universally accepted for colour specification.

Many half-tone colour printing processes, however, require more than three colourants. There are two reasons for this. Generally the gamut of colours achievable with three printing inks is rather limited, and printing additional inks can extend the gamut significantly. Furthermore, the provision of extra inks can reduce the magnitude of the visual change caused by the variability in colour and register which arises in print production. By far the most common additional ink used is black, and four-colour process printing is accepted as the norm for most forms of printing.

The addition of an extra ink means that the production of a colour cannot, in general, be defined uniquely. As a result, different parts of a printed sheet can use varying ink combinations to achieve the same colour. For many practical purposes it is desirable to specify this combination directly, rather than encode it by rules, and this leads to the requirement to transfer data in a four-colour, device-specific mode. If the same data are to be used for other applications, or even if it needs to be modified for a different set of printing characteristics, some additional information is necessary to enable the receiver of the data to interpret it. This part of ISO 12642 has been developed to achieve this objective. It provides a data set which can be transmitted with an image to enable the receiver, if required, either to transform the data into a device-independent state or correct it for a different printing characteristic. An alternative application of the tools provided by this part of ISO 12642 is to enable the characterization of output systems; in this context, work has been undertaken by the committee to generate data for the major types of half-tone printing processes which have been specified internationally. This procedure is described in the application notes (Annex A) and the data will be published in future annexes.

The body of this part of ISO 12642 defines the ink values to be used for characterizing any four-colour (cyan, magenta, yellow, and black) half-tone printing process (including gravure). These ink values are defined as either digital data in a computer or half-tone tone values on film. This requires that particular care be taken in the preparation of film to ensure that the output device is properly “linearized” and the half-tone film values match the numerical data in the computer file. For some applications the film values used for linearization can be one or more generations removed from the film produced by the film writer. The measurement procedures and the data format to be used in determining and reporting tristimulus values (X,Y,Z) are also included.

While the technique employed in this part of ISO 12642 applies to all output processes, the data have been optimized for four-colour half-tone printing. For non-half-tone processes, or those which use colourants that are significantly different from typical printing inks, it is advisable that the reference data file be determined in such a way that it provides reasonably uniform colour differences when the data file is rendered. For a system which does not meet the criterion, the user-optional data set can be utilized. Suggestions for this are made in the application notes; however, they are not part of this part of ISO 12642.

Note that this part of ISO 12642 does not define the physical layout of the patches or their size. This is because any such decision depends on the printing device to be used, and the area required for colour measurement. It is anticipated that a specific layout will be produced to suit the needs of the user. However, in order to realize the colours necessary for the measurements of specific printing processes to be included as future annexes, it was necessary to produce a specific layout. This layout, composed of four groups of patches, has been adopted by both ANSI/CGATS and ISO/TC 130. Within TC 130 the digital data in the appropriate format are contained in images S7 to S10 of the Standard Colour Image Data (SCID), ISO 12640-1:1997. For the guidance of others, this layout is shown in Figure A.1.

0.2 Technical background

0.2.1 Printing characteristics

Various efforts have been made over the past 20 years to reduce the variation which occurs between printing presses. Initially, standards such as ISO 2846 were developed to specify the colour of printing inks. Subsequently, as a result of the lead of FOGRA/BVD in Germany, significant effort has been made in developing specifications which define constraints for the ink transfer onto paper. This is achieved by specifying either the reflection density or the tristimulus values of a uniform (solid) printed ink film, and by specifying tolerances on the optical density (i.e. dot value) of various half-tone dot values. Within the international printing community such specifications are widely recognized and have become, in many cases, de facto printing standards. For magazine and periodical printing, SWOP (in the USA) and FIPP (in Europe) are widely recognized standards. For commercial printing, the specifications of FOGRA and PIRA are widely known in Europe. Specifications are also evolving for newspaper and heat-set web production. Future annexes to this part of ISO 12642 might contain the colorimetric tristimulus values corresponding to these percent dot values when printed in accordance with a number of such printing specifications. Such data can be used as the basis for the conversion between ink values and tristimulus values.

Note that any characterization of the process takes account of all steps involved in print production. Thus it includes production of the separations, any contacting operations that might be required and platemaking. All of the printing specifications as referred to above include recommendations for maintaining consistency of such operations to ensure that validity of a characterization is maintained.

For characterizing printing conditions which differ from the published specifications, two options exist. Either the large palette of colours can be printed and measured, or the process can be modelled analytically. The analytical modelling approach has the advantage of requiring far fewer colour measurements; the disadvantages lie in the accuracy of prediction. For many applications, a satisfactory compromise is achieved by using modelling for the modification of published data. This is discussed in more detail in the application notes.

0.2.2 Choice of colour palette

It is generally agreed that measurement of a reasonably large number of colours is preferred for accurate characterization of any printing process. It is not possible to be precise about how many colours are required; the number will depend on many factors including the accuracy of colour rendition required, the uniformity of spacing of the samples in terms of colour, the type of modelling process used, and any nonlinear characteristics of a specific printing process. However, practical experience suggests that measuring all combinations of six levels each for cyan, magenta, yellow, and black, preferably weighted towards lower half-tone dot values, will frequently prove adequate. Generally, for higher levels of black, the number of samples can be considerably reduced, since the colour difference between samples is very small. With the addition of single colour scales which contain extra values to assist in defining local nonlinearity, the accuracy obtained for most printing processes is adequate.

A reduced-size data set can be used if:

— a less accurate characterization is adequate;

— the process can be modelled accurately by one of the well-known models listed in the application notes;

— the aim of the measurement is to seek small corrections to an already accurate characterization.

The advantages of this approach are that the measurement effort is substantially lower and that the file size of the data is greatly reduced. This can be advantageous when images are compressed although, in general, even the larger file is small compared to most images.

The proposal accepted for this part of ISO 12642 defines a colour palette consisting of 928 combinations of cyan, magenta, yellow, and black ink values. It is this palette (hereafter called the extended ink value data set) which has been measured to provide colour characterization data on the major printing specifications.

Where such an extensive set of data is not required, a subset of this palette which consists of 182 colours (hereafter called the basic ink value data set) is specified. It provides data suited to a variety of modelling methods and generally provides excessive data for any specific method. It is sufficient for almost all published modelling methods.

For a characterization which cannot be achieved with the data sets defined in this part of ISO 12642, provision is made for a user-optional set of any size. The format of the data is defined in this part of ISO 12642.

It is anticipated that the basic data set will be the default file supplied in the header of image files to be exchanged, and that by prior agreement, one of the larger palettes can be provided when required. It is the intent of ANSI IT8/CGATS and of ISO/TC 130 to work with those organizations responsible for various printing definitions (SWOP, FOGRA, etc.) to develop tables of colour data that are agreed to be representative of the named printing conditions. When such data are available and published by ISO, they can be referenced as “named” data. Where such named data are identified, they can be used by the receiver and the file need not be sent. For many applications it is expected that the use of named data sets will suffice.

ISO 12642-2 is both a newer and larger data set and is currently preferred over this part of ISO 12642 for characterization of graphic arts printing. However, this part of ISO 12642 is essential for the documentation and validation of earlier characterization data.

Graphic technology — Input data for characterization of four-colour process printing —

Part 1: Initial data set

1 Scope

This part of ISO 12642 defines an input data file, a measurement procedure and an output data format for use in characterizing any four-colour printing 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 referenced document (including any amendments) applies.

ISO 13655, *Graphic technology — Spectral measurement and colorimetric computation for graphic arts images*

ISO 28178, *Graphic technology — Exchange format for colour and process control data using XML or ASCII text*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
CIE tristimulus values
amounts of the three reference colour stimuli, in the CIE-specified trichromatic system, required to match the colour of the stimulus considered

NOTE In the 1931 CIE standard colorimetric system, the tristimulus values are represented by the symbols X, Y, Z.

3.2
colour gamut
subset of perceivable colours reproducible by a device or medium

3.3
half-tone dots
dots which vary in spatial frequency or size, thereby producing an image of tonal gradation

NOTE Half-tone dots are normally quantified by the percentage area they cover. Measurement of dot area is normally made on film separations and is derived from the Murray-Davies equation.

3.4
keyword value file
file that makes use of predefined keywords and data tables to exchange data in an open extensible manner

3.5
process colour printing
reproducing colour images using three or more printing inks

NOTE The normal process inks consist of cyan, magenta, yellow, and black.

3.6
ink value
digital file value which represents the amount of a colourant required in a rendering process

NOTE For the half-tone printing process this is equivalent to the dot area of the half-tone film expressed as a percentage.

4 Requirements

4.1 Data set definition

4.1.1 General

Two sets of ink values are specified which span, with differing intervals, the colour space defined by combinations of cyan, magenta, yellow, and black dot area percentages. The basic data set, which is a subset of the extended data set, shall be the default set in the absence of any other information; the extended data set (or subsets of it) may be used if specified. The data are defined as digital data and does not exist as printed images (or sets of separations). However, the colorimetric values needed to produce the colour characterization data file may be determined by printing images which have been made from films containing half-tone values corresponding to the values in the ink value data set.

4.1.2 Basic ink value data set

The cyan, magenta, yellow, and black ink values specified in this set, and their identification (ID) numbers, shall be as listed in Table 1.

The sample location information included in Table 1 is based on the printing layout shown in Figure A.1 and is included for information only.

4.1.3 Extended ink value data set

The extended data set shall include the values of Table 1 as well as those of Table 2.

The sample location information included in Table 2 is based on the printing layout shown in Figure A.1 and is included for information only.

4.1.4 User-defined data set

For situations where it is deemed necessary to provide a larger or differently spaced ink value data set, the user may define a data set of his own. The ink values selected shall be provided using the data format specified in ISO 28178.

4.2 Colour measurement

Spectrophotometric measurement and calculation of colorimetric data of the printed sheet shall be made in accordance with ISO 13655. For the purposes of this part of ISO 12642, in those specific situations where a backing other than black is deemed more appropriate and is used in measurement, that shall be noted.

NOTE Additional measured or computed data can be reported as desired. The data file format defined in ISO 28178 provides for the typical densitometric and colorimetric data reported.

4.3 Data reporting

Colorimetric data, measured in accordance with 4.2, shall be reported as CIE tristimulus values to two decimal places using the data file format specified in ISO 28178.

The following additional data shall be provided to adequately define the measuring conditions:

a) originator of the data;

b) date of creation of data;

c) description of the purpose or contents of the data;

d) description of the instrumentation used, including, but not limited to, the brand and model number;

e) measurement source (light source and filter) conditions used;

f) wavelength interval used.

Table 1 — Basic ink value data set

Sample		% Dot				Sample		% Dot				Sample		% Dot			
ID	Location[a]	C	M	Y	K	ID	Location[a]	C	M	Y	K	ID	Location[a]	C	M	Y	K
1	0A01	100	0	0	0	62	0E10	0	0	15	0	123	0J06	100	85	85	80
2	0A02	0	100	0	0	63	0E11	0	0	10	0	124	0J07	100	85	85	60
3	0A03	0	0	100	0	64	0E12	0	0	7	0	125	0J08	80	65	65	100
4	0A04	100	100	0	0	65	0E13	0	0	3	0	126	0J09	80	65	65	80
5	0A05	100	0	100	0	66	0F01	0	0	0	90	127	0J10	80	65	65	60
6	0A06	0	100	100	0	67	0F02	0	0	0	80	128	0J11	80	65	65	40
7	0A07	100	100	100	0	68	0F03	0	0	0	70	129	0J12	60	45	45	100
8	0A08	70	70	0	0	69	0F04	0	0	0	60	130	0J13	60	45	45	80
9	0A09	70	0	70	0	70	0F05	0	0	0	50	131	0K01	60	45	45	60
10	0A10	0	70	70	0	71	0F06	0	0	0	40	132	0K02	60	45	45	40
11	0A11	40	40	0	0	72	0F07	0	0	0	30	133	0K03	60	45	45	20
12	0A12	0	40	40	0	73	0F08	0	0	0	25	134	0K04	40	27	27	100
13	0A13	40	40	40	0	74	0F09	0	0	0	20	135	0K05	40	27	27	80
14	0B01	40	0	40	0	75	0F10	0	0	0	15	136	0K06	40	27	27	60
15	0B02	20	20	0	0	76	0F11	0	0	0	10	137	0K07	40	27	27	40
16	0B03	20	0	20	0	77	0F12	0	0	0	7	138	0K08	40	27	27	20
17	0B04	0	20	20	0	78	0F13	0	0	0	3	139	0K09	40	27	27	10
18	0B05	100	0	0	100	79	0G01	40	100	0	0	140	0K10	20	12	12	100
19	0B06	0	100	0	100	80	0G02	40	100	40	0	141	0K11	20	12	12	80
20	0B07	0	0	100	100	81	0G03	0	100	40	0	142	0K12	20	12	12	60
21	0B08	100	100	0	100	82	0G04	40	100	100	0	143	0K13	20	12	12	40
22	0B09	100	0	100	100	83	0G05	0	40	100	0	144	0L01	20	12	12	20
23	0B10	0	100	100	100	84	0G06	40	40	100	0	145	0L02	20	12	12	10
24	0B11	100	100	100	100	85	0G07	70	70	70	0	146	0L03	10	6	6	100
25	0B12	0	0	0	100	86	0G08	40	0	100	0	147	0L04	10	6	6	80
26	0B13	0	0	0	0	87	0G09	100	40	100	0	148	0L05	10	6	6	60
27	0C01	90	0	0	0	88	0G10	100	0	40	0	149	0L06	10	6	6	40
28	0C02	80	0	0	0	89	0G11	100	40	40	0	150	0L07	10	6	6	20
29	0C03	70	0	0	0	90	0G12	100	40	0	0	151	0L08	10	6	6	10
30	0C04	60	0	0	0	91	0G13	100	100	40	0	152	0L09	100	85	85	0
31	0C05	50	0	0	0	92	0H01	70	100	20	0	153	0L10	80	65	65	0
32	0C06	40	0	0	0	93	0H02	20	70	20	0	154	0L11	60	45	45	0
33	0C07	30	0	0	0	94	0H03	20	70	40	0	155	0L12	40	27	27	0
34	0C08	25	0	0	0	95	0H04	20	100	70	0	156	0L13	20	12	12	0
35	0C09	20	0	0	0	96	0H05	20	70	70	0	157	0M01	10	6	6	0
36	0C10	15	0	0	0	97	0H06	20	70	100	0	158	0M02	5	3	3	0
37	0C11	10	0	0	0	98	0H07	20	20	70	0	159	0M03	100	0	0	20
38	0C12	7	0	0	0	99	0H08	70	20	100	0	160	0M04	0	100	0	20
39	0C13	3	0	0	0	100	0H09	70	20	70	0	161	0M05	0	0	100	20
40	0D01	0	90	0	0	101	0H10	100	20	70	0	162	0M06	100	100	0	20
41	0D02	0	80	0	0	102	0H11	70	20	20	0	163	0M07	100	0	100	20
42	0D03	0	70	0	0	103	0H12	100	70	20	0	164	0M08	0	100	100	20
43	0D04	0	60	0	0	104	0H13	70	70	20	0	165	0M09	40	40	0	20
44	0D05	0	50	0	0	105	0I01	70	100	70	0	166	0M10	40	0	40	20
45	0D06	0	40	0	0	106	0I02	40	70	40	0	167	0M11	0	40	40	20
46	0D07	0	30	0	0	107	0I03	20	40	20	0	168	0M12	100	100	0	40
47	0D08	0	25	0	0	108	0I04	70	100	100	0	169	0M13	100	0	100	40
48	0D09	0	20	0	0	109	0I05	20	40	40	0	170	0N01	0	100	100	40
49	0D10	0	15	0	0	110	0I06	70	70	100	0	171	0N02	40	40	0	40
50	0D11	0	10	0	0	111	0I07	40	40	70	0	172	0N03	40	0	40	40
51	0D12	0	7	0	0	112	0I08	20	20	40	0	173	0N04	0	40	40	40
52	0D13	0	3	0	0	113	0I09	20	20	20	0	174	0N05	100	0	0	70
53	0E01	0	0	90	0	114	0I10	100	70	100	0	175	0N06	0	100	0	70
54	0E02	0	0	80	0	115	0I11	70	40	70	0	176	0N07	0	0	100	70
55	0E03	0	0	70	0	116	0I12	40	20	40	0	177	0N08	100	100	0	70
56	0E04	0	0	60	0	117	0I13	100	70	70	0	178	0N09	100	0	100	70
57	0E05	0	0	50	0	118	0J01	40	40	20	0	179	0N10	0	100	100	70
58	0E06	0	0	40	0	119	0J02	100	100	70	0	180	0N11	40	40	0	70
59	0E07	0	0	30	0	120	0J03	40	20	20	0	181	0N12	40	0	40	70
60	0E08	0	0	25	0	121	0J04	70	40	40	0	182	0N13	0	40	40	70
61	0E09	0	0	20	0	122	0J05	100	85	85	100						

[a] Location data are included for information only.

Table 2 — Extended ink value data set

Sample		% Dot				Sample		% Dot				Sample		% Dot			
ID	Location[a]	C	M	Y	K	ID	Location[a]	C	M	Y	K	ID	Location[a]	C	M	Y	K
183	1A1	0	0	0	0	253	2F5	100	70	10	0	323	4F3	100	20	40	0
184	1A2	0	10	0	0	254	2F6	100	100	10	0	324	4F4	100	40	40	0
185	1A3	0	20	0	0	255	3A1	0	0	20	0	325	4F5	100	70	40	0
186	1A4	0	40	0	0	256	3A2	0	10	20	0	326	4F6	100	100	40	0
187	1A5	0	70	0	0	257	3A3	0	20	20	0	327	5A1	0	0	70	0
188	1A6	0	100	0	0	258	3A4	0	40	20	0	328	5A2	0	10	70	0
189	1B1	10	0	0	0	259	3A5	0	70	20	0	329	5A3	0	20	70	0
190	1B2	10	10	0	0	260	3A6	0	100	20	0	330	5A4	0	40	70	0
191	1B3	10	20	0	0	261	3B1	10	0	20	0	331	5A5	0	70	70	0
192	1B4	10	40	0	0	262	3B2	10	10	20	0	332	5A6	0	100	70	0
193	1B5	10	70	0	0	263	3B3	10	20	20	0	333	5B1	10	0	70	0
194	1B6	10	100	0	0	264	3B4	10	40	20	0	334	5B2	10	10	70	0
195	1C1	20	0	0	0	265	3B5	10	70	20	0	335	5B3	10	20	70	0
196	1C2	20	10	0	0	266	3B6	10	100	20	0	336	5B4	10	40	70	0
197	1C3	20	20	0	0	267	3C1	20	0	20	0	337	5B5	10	70	70	0
198	1C4	20	40	0	0	268	3C2	20	10	20	0	338	5B6	10	100	70	0
199	1C5	20	70	0	0	269	3C3	20	20	20	0	339	5C1	20	0	70	0
200	1C6	20	100	0	0	270	3C4	20	40	20	0	340	5C2	20	10	70	0
201	1D1	40	0	0	0	271	3C5	20	70	20	0	341	5C3	20	20	70	0
202	1D2	40	10	0	0	272	3C6	20	100	20	0	342	5C4	20	40	70	0
203	1D3	40	20	0	0	273	3D1	40	0	20	0	343	5C5	20	70	70	0
204	1D4	40	40	0	0	274	3D2	40	10	20	0	344	5C6	20	100	70	0
205	1D5	40	70	0	0	275	3D3	40	20	20	0	345	5D1	40	0	70	0
206	1D6	40	100	0	0	276	3D4	40	40	20	0	346	5D2	40	10	70	0
207	1E1	70	0	0	0	277	3D5	40	70	20	0	347	5D3	40	20	70	0
208	1E2	70	10	0	0	278	3D6	40	100	20	0	348	5D4	40	40	70	0
209	1E3	70	20	0	0	279	3E1	70	0	20	0	349	5D5	40	70	70	0
210	1E4	70	40	0	0	280	3E2	70	10	20	0	350	5D6	40	100	70	0
211	1E5	70	70	0	0	281	3E3	70	20	20	0	351	5E1	70	0	70	0
212	1E6	70	100	0	0	282	3E4	70	40	20	0	352	5E2	70	10	70	0
213	1F1	100	0	0	0	283	3E5	70	70	20	0	353	5E3	70	20	70	0
214	1F2	100	10	0	0	284	3E6	70	100	20	0	354	5E4	70	40	70	0
215	1F3	100	20	0	0	285	3F1	100	0	20	0	355	5E5	70	70	70	0
216	1F4	100	40	0	0	286	3F2	100	10	20	0	356	5E6	70	100	70	0
217	1F5	100	70	0	0	287	3F3	100	20	20	0	357	5F1	100	0	70	0
218	1F6	100	100	0	0	288	3F4	100	40	20	0	358	5F2	100	10	70	0
219	2A1	0	0	10	0	289	3F5	100	70	20	0	359	5F3	100	20	70	0
220	2A2	0	10	10	0	290	3F6	100	100	20	0	360	5F4	100	40	70	0
221	2A3	0	20	10	0	291	4A1	0	0	40	0	361	5F5	100	70	70	0
222	2A4	0	40	10	0	292	4A2	0	10	40	0	362	5F6	100	100	70	0
223	2A5	0	70	10	0	293	4A3	0	20	40	0	363	6A1	0	0	100	0
224	2A6	0	100	10	0	294	4A4	0	40	40	0	364	6A2	0	10	100	0
225	2B1	10	0	10	0	295	4A5	0	70	40	0	365	6A3	0	20	100	0
226	2B2	10	10	10	0	296	4A6	0	100	40	0	366	6A4	0	40	100	0
227	2B3	10	20	10	0	297	4B1	10	0	40	0	367	6A5	0	70	100	0
228	2B4	10	40	10	0	298	4B2	10	10	40	0	368	6A6	0	100	100	0
229	2B5	10	70	10	0	299	4B3	10	20	40	0	369	6B1	10	0	100	0
230	2B6	10	100	10	0	300	4B4	10	40	40	0	370	6B2	10	10	100	0
231	2C1	20	0	10	0	301	4B5	10	70	40	0	371	6B3	10	20	100	0
232	2C2	20	10	10	0	302	4B6	10	100	40	0	372	6B4	10	40	100	0
233	2C3	20	20	10	0	303	4C1	20	0	40	0	373	6B5	10	70	100	0
234	2C4	20	40	10	0	304	4C2	20	10	40	0	374	6B6	10	100	100	0
235	2C5	20	70	10	0	305	4C3	20	20	40	0	375	6C1	20	0	100	0
236	2C6	20	100	10	0	306	4C4	20	40	40	0	376	6C2	20	10	100	0
237	2D1	40	0	10	0	307	4C5	20	70	40	0	377	6C3	20	20	100	0
238	2D2	40	10	10	0	308	4C6	20	100	40	0	378	6C4	20	40	100	0
239	2D3	40	20	10	0	309	4D1	40	0	40	0	379	6C5	20	70	100	0
240	2D4	40	40	10	0	310	4D2	40	10	40	0	380	6C6	20	100	100	0
241	2D5	40	70	10	0	311	4D3	40	20	40	0	381	6D1	40	0	100	0
242	2D6	40	100	10	0	312	4D4	40	40	40	0	382	6D2	40	10	100	0
243	2E1	70	0	10	0	313	4D5	40	70	40	0	383	6D3	40	20	100	0
244	2E2	70	10	10	0	314	4D6	40	100	40	0	384	6D4	40	40	100	0
245	2E3	70	20	10	0	315	4E1	70	0	40	0	385	6D5	40	70	100	0
246	2E4	70	40	10	0	316	4E2	70	10	40	0	386	6D6	40	100	100	0
247	2E5	70	70	10	0	317	4E3	70	20	40	0	387	6E1	70	0	100	0
248	2E6	70	100	10	0	318	4E4	70	40	40	0	388	6E2	70	10	100	0
249	2F1	100	0	10	0	319	4E5	70	70	40	0	389	6E3	70	20	100	0
250	2F2	100	10	10	0	320	4E6	70	100	40	0	390	6E4	70	40	100	0
251	2F3	100	20	10	0	321	4F1	100	0	40	0	391	6E5	70	70	100	0
252	2F4	100	40	10	0	322	4F2	100	10	40	0	392	6E6	70	100	100	0

Table 2 (*continued*)

Sample		% Dot				Sample		% Dot				Sample		% Dot			
ID	Location[a]	C	M	Y	K	ID	Location[a]	C	M	Y	K	ID	Location[a]	C	M	Y	K
393	6F1	100	0	100	0	463	8E5	70	70	10	20	533	10E3	70	20	40	20
394	6F2	100	10	100	0	464	8E6	70	100	10	20	534	10E4	70	40	40	20
395	6F3	100	20	100	0	465	8F1	100	0	10	20	535	10E5	70	70	40	20
396	6F4	100	40	100	0	466	8F2	100	10	10	20	536	10E6	70	100	40	20
397	6F5	100	70	100	0	467	8F3	100	20	10	20	537	10F1	100	0	40	20
398	6F6	100	100	100	0	468	8F4	100	40	10	20	538	10F2	100	10	40	20
399	7A1	0	0	0	20	469	8F5	100	70	10	20	539	10F3	100	20	40	20
400	7A2	0	10	0	20	470	8F6	100	100	10	20	540	10F4	100	40	40	20
401	7A3	0	20	0	20	471	9A1	0	0	20	20	541	10F5	100	70	40	20
402	7A4	0	40	0	20	472	9A2	0	10	20	20	542	10F6	100	100	40	20
403	7A5	0	70	0	20	473	9A3	0	20	20	20	543	11A1	0	0	70	20
404	7A6	0	100	0	20	474	9A4	0	40	20	20	544	11A2	0	10	70	20
405	7B1	10	0	0	20	475	9A5	0	70	20	20	545	11A3	0	20	70	20
406	7B2	10	10	0	20	476	9A6	0	100	20	20	546	11A4	0	40	70	20
407	7B3	10	20	0	20	477	9B1	10	0	20	20	547	11A5	0	70	70	20
408	7B4	10	40	0	20	478	9B2	10	10	20	20	548	11A6	0	100	70	20
409	7B5	10	70	0	20	479	9B3	10	20	20	20	549	11B1	10	0	70	20
410	7B6	10	100	0	20	480	9B4	10	40	20	20	550	11B2	10	10	70	20
411	7C1	20	0	0	20	481	9B5	10	70	20	20	551	11B3	10	20	70	20
412	7C2	20	10	0	20	482	9B6	10	100	20	20	552	11B4	10	40	70	20
413	7C3	20	20	0	20	483	9C1	20	0	20	20	553	11B5	10	70	70	20
414	7C4	20	40	0	20	484	9C2	20	10	20	20	554	11B6	10	100	70	20
415	7C5	20	70	0	20	485	9C3	20	20	20	20	555	11C1	20	0	70	20
416	7C6	20	100	0	20	486	9C4	20	40	20	20	556	11C2	20	10	70	20
417	7D1	40	0	0	20	487	9C5	20	70	20	20	557	11C3	20	20	70	20
418	7D2	40	10	0	20	488	9C6	20	100	20	20	558	11C4	20	40	70	20
419	7D3	40	20	0	20	489	9D1	40	0	20	20	559	11C5	20	70	70	20
420	7D4	40	40	0	20	490	9D2	40	10	20	20	560	11C6	20	100	70	20
421	7D5	40	70	0	20	491	9D3	40	20	20	20	561	11D1	40	0	70	20
422	7D6	40	100	0	20	492	9D4	40	40	20	20	562	11D2	40	10	70	20
423	7E1	70	0	0	20	493	9D5	40	70	20	20	563	11D3	40	20	70	20
424	7E2	70	10	0	20	494	9D6	40	100	20	20	564	11D4	40	40	70	20
425	7E3	70	20	0	20	495	9E1	70	0	20	20	565	11D5	40	70	70	20
426	7E4	70	40	0	20	496	9E2	70	10	20	20	566	11D6	40	100	70	20
427	7E5	70	70	0	20	497	9E3	70	20	20	20	567	11E1	70	0	70	20
428	7E6	70	100	0	20	498	9E4	70	40	20	20	568	11E2	70	10	70	20
429	7F1	100	0	0	20	499	9E5	70	70	20	20	569	11E3	70	20	70	20
430	7F2	100	10	0	20	500	9E6	70	100	20	20	570	11E4	70	40	70	20
431	7F3	100	20	0	20	501	9F1	100	0	20	20	571	11E5	70	70	70	20
432	7F4	100	40	0	20	502	9F2	100	10	20	20	572	11E6	70	100	70	20
433	7F5	100	70	0	20	503	9F3	100	20	20	20	573	11F1	100	0	70	20
434	7F6	100	100	0	20	504	9F4	100	40	20	20	574	11F2	100	10	70	20
435	8A1	0	0	10	20	505	9F5	100	70	20	20	575	11F3	100	20	70	20
436	8A2	0	10	10	20	506	9F6	100	100	20	20	576	11F4	100	40	70	20
437	8A3	0	20	10	20	507	10A1	0	0	40	20	577	11F5	100	70	70	20
438	8A4	0	40	10	20	508	10A2	0	10	40	20	578	11F6	100	100	70	20
439	8A5	0	70	10	20	509	10A3	0	20	40	20	579	12A1	0	0	100	20
440	8A6	0	100	10	20	510	10A4	0	40	40	20	580	12A2	0	10	100	20
441	8B1	10	0	10	20	511	10A5	0	70	40	20	581	12A3	0	20	100	20
442	8B2	10	10	10	20	512	10A6	0	100	40	20	582	12A4	0	40	100	20
443	8B3	10	20	10	20	513	10B1	10	0	40	20	583	12A5	0	70	100	20
444	8B4	10	40	10	20	514	10B2	10	10	40	20	584	12A6	0	100	100	20
445	8B5	10	70	10	20	515	10B3	10	20	40	20	585	12B1	10	0	100	20
446	8B6	10	100	10	20	516	10B4	10	40	40	20	586	12B2	10	10	100	20
447	8C1	20	0	10	20	517	10B5	10	70	40	20	587	12B3	10	20	100	20
448	8C2	20	10	10	20	518	10B6	10	100	40	20	588	12B4	10	40	100	20
449	8C3	20	20	10	20	519	10C1	20	0	40	20	589	12B5	10	70	100	20
450	8C4	20	40	10	20	520	10C2	20	10	40	20	590	12B6	10	100	100	20
451	8C5	20	70	10	20	521	10C3	20	20	40	20	591	12C1	20	0	100	20
452	8C6	20	100	10	20	522	10C4	20	40	40	20	592	12C2	20	10	100	20
453	8D1	40	0	10	20	523	10C5	20	70	40	20	593	12C3	20	20	100	20
454	8D2	40	10	10	20	524	10C6	20	100	40	20	594	12C4	20	40	100	20
455	8D3	40	20	10	20	525	10D1	40	0	40	20	595	12C5	20	70	100	20
456	8D4	40	40	10	20	526	10D2	40	10	40	20	596	12C6	20	100	100	20
457	8D5	40	70	10	20	527	10D3	40	20	40	20	597	12D1	40	0	100	20
458	8D6	40	100	10	20	528	10D4	40	40	40	20	598	12D2	40	10	100	20
459	8E1	70	0	10	20	529	10D5	40	70	40	20	599	12D3	40	20	100	20
460	8E2	70	10	10	20	530	10D6	40	100	40	20	600	12D4	40	40	100	20
461	8E3	70	20	10	20	531	10E1	70	0	40	20	601	12D5	40	70	100	20
462	8E4	70	40	10	20	532	10E2	70	10	40	20	602	12D6	40	100	100	20

Table 2 (*continued*)

Sample		% Dot				Sample		% Dot				Sample		% Dot			
ID	Location[a]	C	M	Y	K	ID	Location[a]	C	M	Y	K	ID	Location[a]	C	M	Y	K
603	12E1	70	0	100	20	673	15B4	20	70	40	40	743	18A4	0	70	0	60
604	12E2	70	10	100	20	674	15B5	20	100	40	40	744	18A5	0	100	0	60
605	12E3	70	20	100	20	675	15C1	40	0	40	40	745	18B1	20	0	0	60
606	12E4	70	40	100	20	676	15C2	40	20	40	40	746	18B2	20	20	0	60
607	12E5	70	70	100	20	677	15C3	40	40	40	40	747	18B3	20	40	0	60
608	12E6	70	100	100	20	678	15C4	40	70	40	40	748	18B4	20	70	0	60
609	12F1	100	0	100	20	679	15C5	40	100	40	40	749	18B5	20	100	0	60
610	12F2	100	10	100	20	680	15D1	70	0	40	40	750	18C1	40	0	0	60
611	12F3	100	20	100	20	681	15D2	70	20	40	40	751	18C2	40	20	0	60
612	12F4	100	40	100	20	682	15D3	70	40	40	40	752	18C3	40	40	0	60
613	12F5	100	70	100	20	683	15D4	70	70	40	40	753	18C4	40	70	0	60
614	12F6	100	100	100	20	684	15D5	70	100	40	40	754	18C5	40	100	0	60
615	13A1	0	0	0	40	685	15E1	100	0	40	40	755	18D1	70	0	0	60
616	13A2	0	20	0	40	686	15E2	100	20	40	40	756	18D2	70	20	0	60
617	13A3	0	40	0	40	687	15E3	100	40	40	40	757	18D3	70	40	0	60
618	13A4	0	70	0	40	688	15E4	100	70	40	40	758	18D4	70	70	0	60
619	13A5	0	100	0	40	689	15E5	100	100	40	40	759	18D5	70	100	0	60
620	13B1	20	0	0	40	690	16A1	0	0	70	40	760	18E1	100	0	0	60
621	13B2	20	20	0	40	691	16A2	0	20	70	40	761	18E2	100	20	0	60
622	13B3	20	40	0	40	692	16A3	0	40	70	40	762	18E3	100	40	0	60
623	13B4	20	70	0	40	693	16A4	0	70	70	40	763	18E4	100	70	0	60
624	13B5	20	100	0	40	694	16A5	0	100	70	40	764	18E5	100	100	0	60
625	13C1	40	0	0	40	695	16B1	20	0	70	40	765	19A1	0	0	20	60
626	13C2	40	20	0	40	696	16B2	20	20	70	40	766	19A2	0	20	20	60
627	13C3	40	40	0	40	697	16B3	20	40	70	40	767	19A3	0	40	20	60
628	13C4	40	70	0	40	698	16B4	20	70	70	40	768	19A4	0	70	20	60
629	13C5	40	100	0	40	699	16B5	20	100	70	40	769	19A5	0	100	20	60
630	13D1	70	0	0	40	700	16C1	40	0	70	40	770	19B1	20	0	20	60
631	13D2	70	20	0	40	701	16C2	40	20	70	40	771	19B2	20	20	20	60
632	13D3	70	40	0	40	702	16C3	40	40	70	40	772	19B3	20	40	20	60
633	13D4	70	70	0	40	703	16C4	40	70	70	40	773	19B4	20	70	20	60
634	13D5	70	100	0	40	704	16C5	40	100	70	40	774	19B5	20	100	20	60
635	13E1	100	0	0	40	705	16D1	70	0	70	40	775	19C1	40	0	20	60
636	13E2	100	20	0	40	706	16D2	70	20	70	40	776	19C2	40	20	20	60
637	13E3	100	40	0	40	707	16D3	70	40	70	40	777	19C3	40	40	20	60
638	13E4	100	70	0	40	708	16D4	70	70	70	40	778	19C4	40	70	20	60
639	13E5	100	100	0	40	709	16D5	70	100	70	40	779	19C5	40	100	20	60
640	14A1	0	0	20	40	710	16E1	100	0	70	40	780	19D1	70	0	20	60
641	14A2	0	20	20	40	711	16E2	100	20	70	40	781	19D2	70	20	20	60
642	14A3	0	40	20	40	712	16E3	100	40	70	40	782	19D3	70	40	20	60
643	14A4	0	70	20	40	713	16E4	100	70	70	40	783	19D4	70	70	20	60
644	14A5	0	100	20	40	714	16E5	100	100	70	40	784	19D5	70	100	20	60
645	14B1	20	0	20	40	715	17A1	0	0	100	40	785	19E1	100	0	20	60
646	14B2	20	20	20	40	716	17A2	0	20	100	40	786	19E2	100	20	20	60
647	14B3	20	40	20	40	717	17A3	0	40	100	40	787	19E3	100	40	20	60
648	14B4	20	70	20	40	718	17A4	0	70	100	40	788	19E4	100	70	20	60
649	14B5	20	100	20	40	719	17A5	0	100	100	40	789	19E5	100	100	20	60
650	14C1	40	0	20	40	720	17B1	20	0	100	40	790	20A1	0	0	40	60
651	14C2	40	20	20	40	721	17B2	20	20	100	40	791	20A2	0	20	40	60
652	14C3	40	40	20	40	722	17B3	20	40	100	40	792	20A3	0	40	40	60
653	14C4	40	70	20	40	723	17B4	20	70	100	40	793	20A4	0	70	40	60
654	14C5	40	100	20	40	724	17B5	20	100	100	40	794	20A5	0	100	40	60
655	14D1	70	0	20	40	725	17C1	40	0	100	40	795	20B1	20	0	40	60
656	14D2	70	20	20	40	726	17C2	40	20	100	40	796	20B2	20	20	40	60
657	14D3	70	40	20	40	727	17C3	40	40	100	40	797	20B3	20	40	40	60
658	14D4	70	70	20	40	728	17C4	40	70	100	40	798	20B4	20	70	40	60
659	14D5	70	100	20	40	729	17C5	40	100	100	40	799	20B5	20	100	40	60
660	14E1	100	0	20	40	730	17D1	70	0	100	40	800	20C1	40	0	40	60
661	14E2	100	20	20	40	731	17D2	70	20	100	40	801	20C2	40	20	40	60
662	14E3	100	40	20	40	732	17D3	70	40	100	40	802	20C3	40	40	40	60
663	14E4	100	70	20	40	733	17D4	70	70	100	40	803	20C4	40	70	40	60
664	14E5	100	100	20	40	734	17D5	70	100	100	40	804	20C5	40	100	40	60
665	15A1	0	0	40	40	735	17E1	100	0	100	40	805	20D1	70	0	40	60
666	15A2	0	20	40	40	736	17E2	100	20	100	40	806	20D2	70	20	40	60
667	15A3	0	40	40	40	737	17E3	100	40	100	40	807	20D3	70	40	40	60
668	15A4	0	70	40	40	738	17E4	100	70	100	40	808	20D4	70	70	40	60
669	15A5	0	100	40	40	739	17E5	100	100	100	40	809	20D5	70	100	40	60
670	15B1	20	0	40	40	740	18A1	0	0	0	60	810	20E1	100	0	40	60
671	15B2	20	20	40	40	741	18A2	0	20	0	60	811	20E2	100	20	40	60
672	15B3	20	40	40	40	742	18A3	0	40	0	60	812	20E3	100	40	40	60

Table 2 (*continued*)

Sample		% Dot				Sample		% Dot				Sample		% Dot			
ID	Location[a]	C	M	Y	K	ID	Location[a]	C	M	Y	K	ID	Location[a]	C	M	Y	K
813	20E4	100	70	40	60	852	22C3	40	40	100	60	891	24C3	70	70	40	80
814	20E5	100	100	40	60	853	22C4	40	70	100	60	892	24C4	70	100	40	80
815	21A1	0	0	70	60	854	22C5	40	100	100	60	893	24D1	100	0	40	80
816	21A2	0	20	70	60	855	22D1	70	0	100	60	894	24D2	100	40	40	80
817	21A3	0	40	70	60	856	22D2	70	20	100	60	895	24D3	100	70	40	80
818	21A4	0	70	70	60	857	22D3	70	40	100	60	896	24D4	100	100	40	80
819	21A5	0	100	70	60	858	22D4	70	70	100	60	897	25A1	0	0	70	80
820	21B1	20	0	70	60	859	22D5	70	100	100	60	898	25A2	0	40	70	80
821	21B2	20	20	70	60	860	22E1	100	0	100	60	899	25A3	0	70	70	80
822	21B3	20	40	70	60	861	22E2	100	20	100	60	900	25A4	0	100	70	80
823	21B4	20	70	70	60	862	22E3	100	40	100	60	901	25B1	40	0	70	80
824	21B5	20	100	70	60	863	22E4	100	70	100	60	902	25B2	40	40	70	80
825	21C1	40	0	70	60	864	22E5	100	100	100	60	903	25B3	40	70	70	80
826	21C2	40	20	70	60	865	23A1	0	0	0	80	904	25B4	40	100	70	80
827	21C3	40	40	70	60	866	23A2	0	40	0	80	905	25C1	70	0	70	80
828	21C4	40	70	70	60	867	23A3	0	70	0	80	906	25C2	70	40	70	80
829	21C5	40	100	70	60	868	23A4	0	100	0	80	907	25C3	70	70	70	80
830	21D1	70	0	70	60	869	23B1	40	0	0	80	908	25C4	70	100	70	80
831	21D2	70	20	70	60	870	23B2	40	40	0	80	909	25D1	100	0	70	80
832	21D3	70	40	70	60	871	23B3	40	70	0	80	910	25D2	100	40	70	80
833	21D4	70	70	70	60	872	23B4	40	100	0	80	911	25D3	100	70	70	80
834	21D5	70	100	70	60	873	23C1	70	0	0	80	912	25D4	100	100	70	80
835	21E1	100	0	70	60	874	23C2	70	40	0	80	913	26A1	0	0	100	80
836	21E2	100	20	70	60	875	23C3	70	70	0	80	914	26A2	0	40	100	80
837	21E3	100	40	70	60	876	23C4	70	100	0	80	915	26A3	0	70	100	80
838	21E4	100	70	70	60	877	23D1	100	0	0	80	916	26A4	0	100	100	80
839	21E5	100	100	70	60	878	23D2	100	40	0	80	917	26B1	40	0	100	80
840	22A1	0	0	100	60	879	23D3	100	70	0	80	918	26B2	40	40	100	80
841	22A2	0	20	100	60	880	23D4	100	100	0	80	919	26B3	40	70	100	80
842	22A3	0	40	100	60	881	24A1	0	0	40	80	920	26B4	40	100	100	80
843	22A4	0	70	100	60	882	24A2	0	40	40	80	921	26C1	70	0	100	80
844	22A5	0	100	100	60	883	24A3	0	70	40	80	922	26C2	70	40	100	80
845	22B1	20	0	100	60	884	24A4	0	100	40	80	923	26C3	70	70	100	80
846	22B2	20	20	100	60	885	24B1	40	0	40	80	924	26C4	70	100	100	80
847	22B3	20	40	100	60	886	24B2	40	40	40	80	925	26D1	100	0	100	80
848	22B4	20	70	100	60	887	24B3	40	70	40	80	926	26D2	100	40	100	80
849	22B5	20	100	100	60	888	24B4	40	100	40	80	927	26D3	100	70	100	80
850	22C1	40	0	100	60	889	24C1	70	0	40	80	928	26D4	100	100	100	80
851	22C2	40	20	100	60	890	24C2	70	40	40	80						

[a] Location data are included for information only.

Annex A
(informative)

Application notes

A.1 General considerations

The primary purpose of this part of ISO 12642 is to enable a user to define a colour characterization data file consisting of a fixed set of CMYK ink values and their associated colorimetric tristimulus values (XYZ), which can be used to characterize a printing process. A different file may be produced for each process, if necessary. The objective is that every CMYK image, transmitted between systems, can have a file included with it that provides the characterization data for the intended printing process. In the event that a transformation is required for a different printing process or substrate, this file may be used to enable that transformation. Note that for this application the colour conversion need only be from CMYK to XYZ (or a derivative) or CMYK to C'M'Y'K'.

A secondary use of this part of ISO 12642 is to define a fixed set of ink values which can be used to characterize any rendering process. By printing the values listed in Tables 1 and 2 and measuring them, data are obtained by which the characterization may be determined for that process. When the colour conversion is from CMYK to XYZ, the procedure is identical to that defined above. However, the same data may also be used for computing the reverse transformation, thereby enabling an image encoded in XYZ (or some derivative) to be printed. However, these data may not be adequate for all applications. Where additional data are desired, the data sets defined in this part of ISO 12642 can be used as a starting point and are not intended to be the only option that can be used. The user-optional data set defined in 4.1.3 is intended for those situations where other data arrangements are desired.

Rendering the values as an image which can be measured is straightforward. Since this part of ISO 12642 is not intended to define the size and layout of an image, the final choice is left to the user. Considerations such as size of output recorder, measurement aperture, number of samples to be averaged, and uniformity of the printer will govern this. The ultimate responsibility of the user is to ensure that a data file is produced in the correct format; how that task is achieved is not relevant.

The values specified in this part of ISO 12642 have been used to generate a series of digital images which are included as images S7 to S10 of ISO 12640-1. A layout has been proposed for this data set which results in a patch size of 1 cm by 1 cm when output is at 16 lines/mm for the primary data set or 12 lines/mm for the alternate data set. In many cases, it is anticipated that users will render this image for general characterization. However, the SCID layouts can be reduced to approximately 60 % of their size and rearranged (including rotation of SCID image S9) to fit on a single 8½ in × 11 in or A4 page. This layout is shown in Figure A.1. Such a layout will permit measurement with a small area spectrophotometer and also enable a number of copies of the image to be printed on the same sheet. This is useful for averaging purposes.

A.2 Output device characterization

A.2.1 General

Various approaches may be used to characterize devices. One extreme is to measure every reproducible combination of inks and define a table in which the colour value is listed for every combination of ink values. While this provides the most accurate method, it is clearly impractical given that in excess of four thousand million combinations can be defined with a 32-bit system producing 8 bits per channel. A reduced size table with interpolation for intermediate points is necessary to produce a workable system.

At the other extreme the process can be modelled by using first order equations obtained by measuring the colour of the four solid ink patches and a limited number of ink values in each colour to convert ink values to colorimetric density. Such a model is easy to determine but is not very accurate.

Somewhere between the two extremes one can measure a number of colours with interpolation, or model from a more limited number. The two ink value data sets defined in this part of ISO 12642 attempt to allow such options. As an alternative, a user-optional set may be defined by a user.

A.2.2 Basic data set

The ink value combinations in the basic data set have been selected for the purposes of modelling the colour transformation; see Table 1.

The selection of these values included the following considerations.

— Data for the Neugebauer equations can be obtained from patches 1 to 7 (A1 to A7) and patches 18 to 26 (B5 to B13).

— Data for fitting polynomial functions can be obtained from patches 1 to 26, 79 to 121 (rows A,B,G,H,I and J1 to J4).

— Patches 27 to 78 (rows C to F) enable characterization of single colour scales for both of the above modelling procedures.

— Patches 122 to 182 (J5 to N13) provide additional information which may be used for more accurate calculation of the results of adding black and ensuring that good reproduction of neutrals is obtained (grey balance).

For information on the Neugebauer equations, the user is referred to texts on the subject of graphic arts colour calibration. A number of research papers have also been published describing enhancements to the basic models. Reference [3] provides an excellent set of references to many of these papers.

A.2.3 Extended data set

The ink value combinations in the extended data set have been selected based on the needs of data interpolation; see Table 1. The values given in Table 2 were generated using the following levels and combinations of ink values and colours.

The first group, patches 183-398, includes all combinations of the following ink values in cyan, magenta, and yellow: 0 %, 10 %, 20 %, 40 %, 70 %, 100 %. The second group, patches 399 to 614, includes these same combinations of cyan, magenta, and yellow with the addition of 20 % black.

In the third and fourth groups, patches 615 to 739 and 740 to 864, the 10 % value is dropped in cyan, magenta, and yellow. The remaining combinations then have black added at a value of 40 % and 60 % respectively.

The fifth group, patches 865-928, consists of all combinations of 0 %, 40 %, 70 % and 100 % in cyan, magenta, and yellow with 80 % black.

Note that 100 % black is used with 0 % and 100 % combinations of the three coloured inks in patches 18 to 25.

While the printed results from the extended data set may be used for modelling, they are more likely to be used for table look-up and interpolation. The procedure for this is straightforward and will not be described in detail. It can be summarized by three steps.

a) Determine 16 ink value combinations, available in the data set, which surround the ink value to be characterized.

b) Look up the tristimulus values for each of the ink values.

c) Interpolate between the ink values to obtain the resultant tristimulus values. Interpolation may be linear or of higher order, and in any sequence, as required by the data set. Various techniques are possible, and no general recommendation can be made. The user is referred to texts on the subject if simple linear interpolation is inadequate. While it depends upon the data set used, some benefit is usually gained by conversion to a uniform colour space such as CIELAB prior to interpolation, particularly for simple interpolation methods.

A.3 Characterizing non-half-tone devices

The principle described in A.2 is applicable to any output device. A limited number of samples are rendered on the device and the colours measured. The colour transformation from tristimulus values to device colourant amounts is then computed using methods similar to those described for ink values in printing. However, the reason that the data of Tables 1 and 2 may not be applicable to non-half-tone devices is related to the possible lack of uniformity in colour differences of samples produced with the data intervals specified. If this non-uniformity is severe, the interpolation is likely to be inaccurate.

In such a situation, the users may generate their own data set in accordance with 4.1.3. Such data should be reported using the optional procedures of 4.1.4 in which both the data values used to render the samples and the measured colorimetric data are specified. The number of samples shown in Tables 1 and 2 provide a general guide to the size and distribution of the data set which should be generated. A useful procedure for checking the uniformity is to measure a number of steps in each colourant, and compute the colour difference between them. Values which correspond to approximately equal colour differences can then be selected.

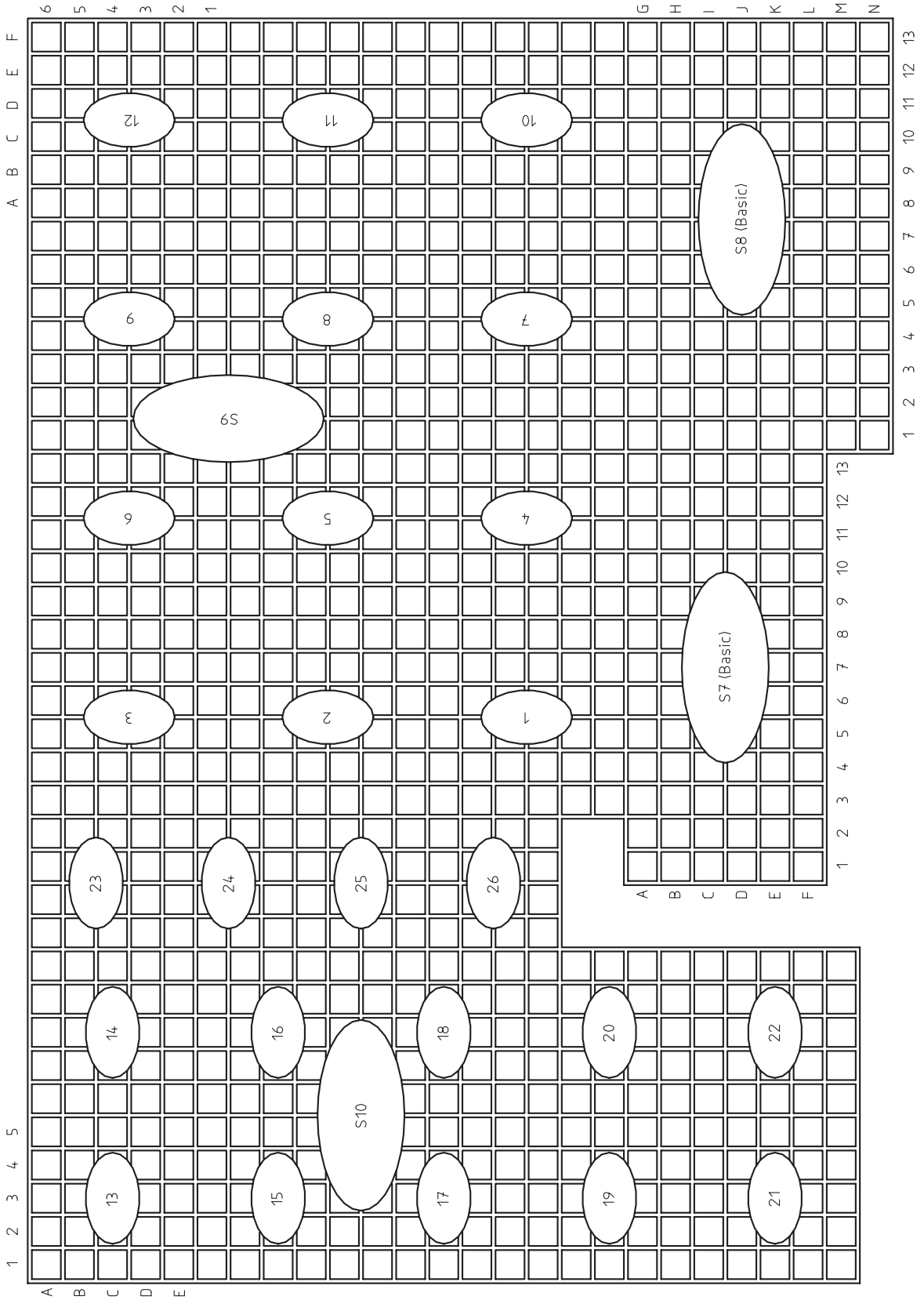

Figure A.1 — Suggested single-page layout

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