Colour management with ISO 12647

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IGT, founded in 1939 is since that time involved in the research and development of test methods and process improvement in the paper-, the ink- and the printing industry. It has developed itself into the leading institute (now private company) in the area of printability.

The focus is on dynamic process simulation with ink and paper, so using the real materials to print under printing circumstances like pressure and movement. Sometimes using symulants, most times using production inks.

Involved in the development of international standards (ISO) for the graphic arts and the paper industry and supporting the printing industry with consultancy and research regarding the application of colour and process management in the chain.

Aim of standards

- Communication between market parties
- Optimal quality, constant high quality
- Predictable quality on different printing presses and/or in different print houses
- Controlled production costs
- Reduced make-ready
- Decrease costs of failure
- Predictable production time
- More jobs in the same time
- Customer satisfaction

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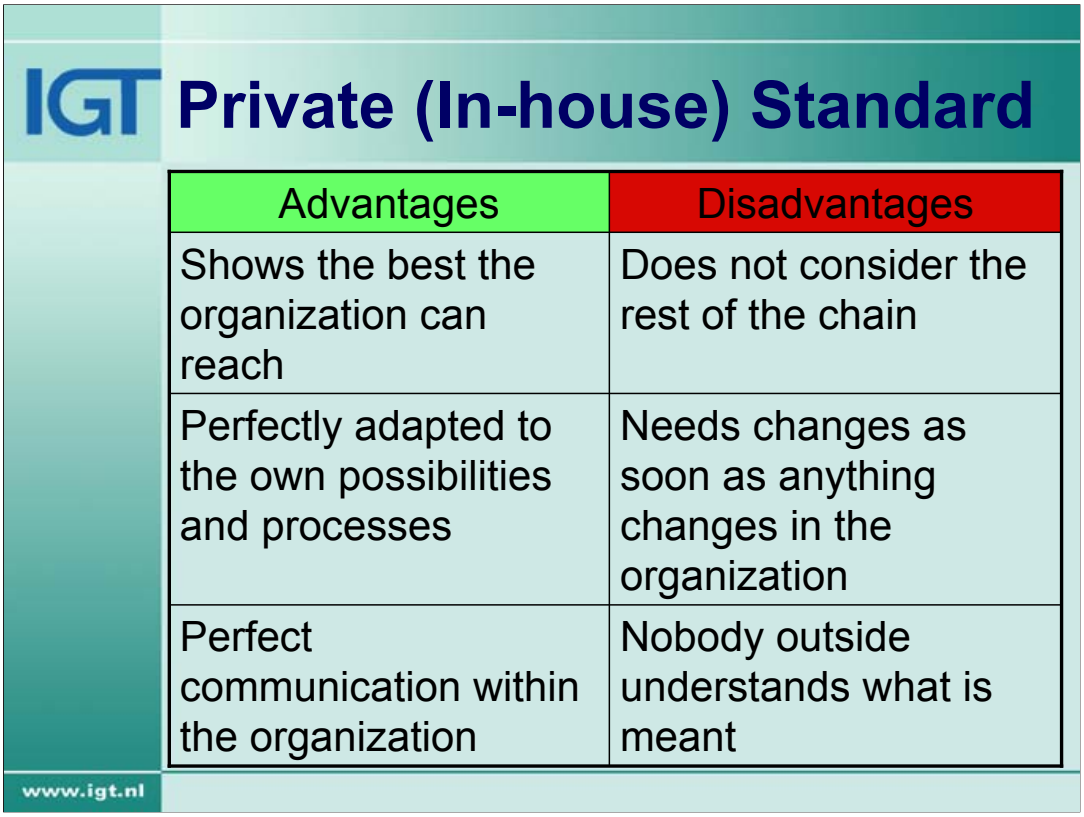
Standards have a number of different purposes, all depends on the source, place of application, market and many more factors. In technical matters one can summarize the purpose of standards as on this sheet. Main issues are COMMUNICATION, QUALITY, COST REDUCTION

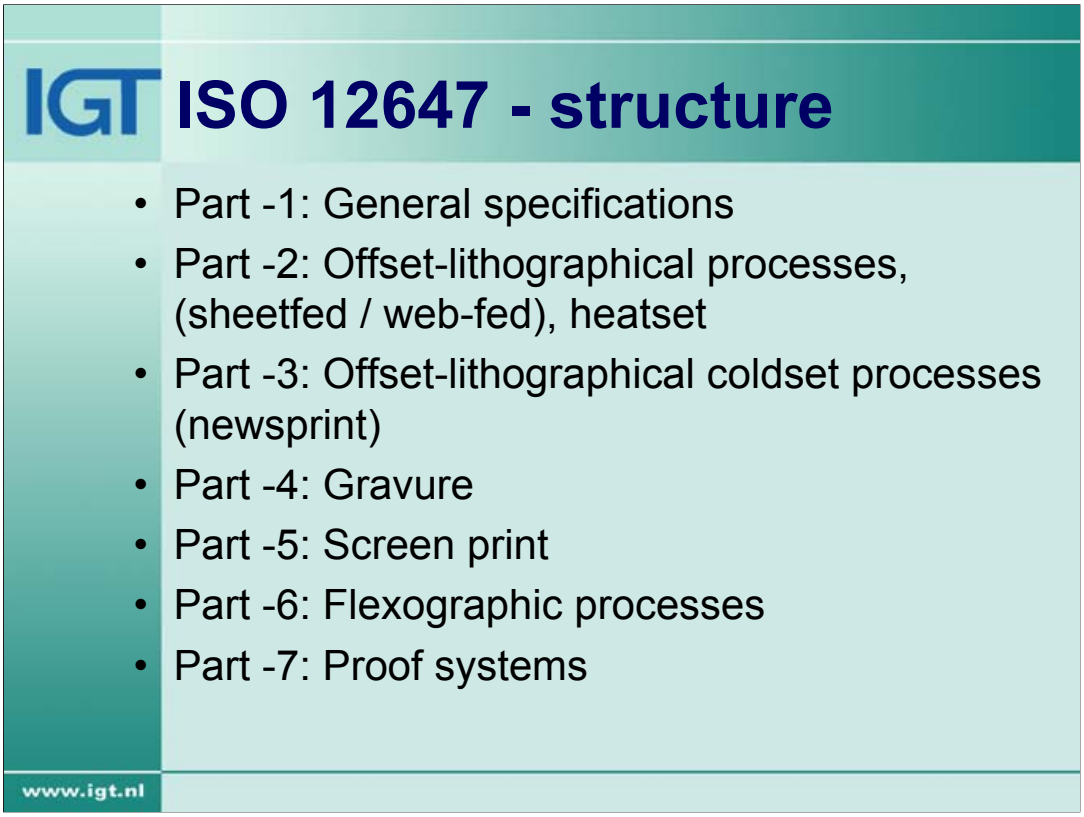


Everyone uses standards, even if not each of you calls it a standard or it is not written in a fool proof way as an ISO standard. Simple example: nock on the door before entering a room and present yourself shaking hands is a " western standard", in Asea it is not common to shake hands, there the " standard" is to make a small bend.

Each and every company uses its own standards or rules or directives. These we call in-house or private standards if you want. Big companies can force their customers of suppliers to use their in-house standards which become after a while defacto standards and will often be used as a basis for international standards like ISO or Branche organizations standards e.g. like PSO in Germany or Gracol in the US.

International standards are more focused on communication and, in accordance to the ISO directives, to reduce trade barriers.

An International Standard is based on wide consensus within the worldwide stakeholders, this can be the printing industry, but also print buyers, environmentalists, government organizations, postal organizations and many more. Consequence is that this standard is never perfect for all parties, so one will often see specific modifications per company or per region.



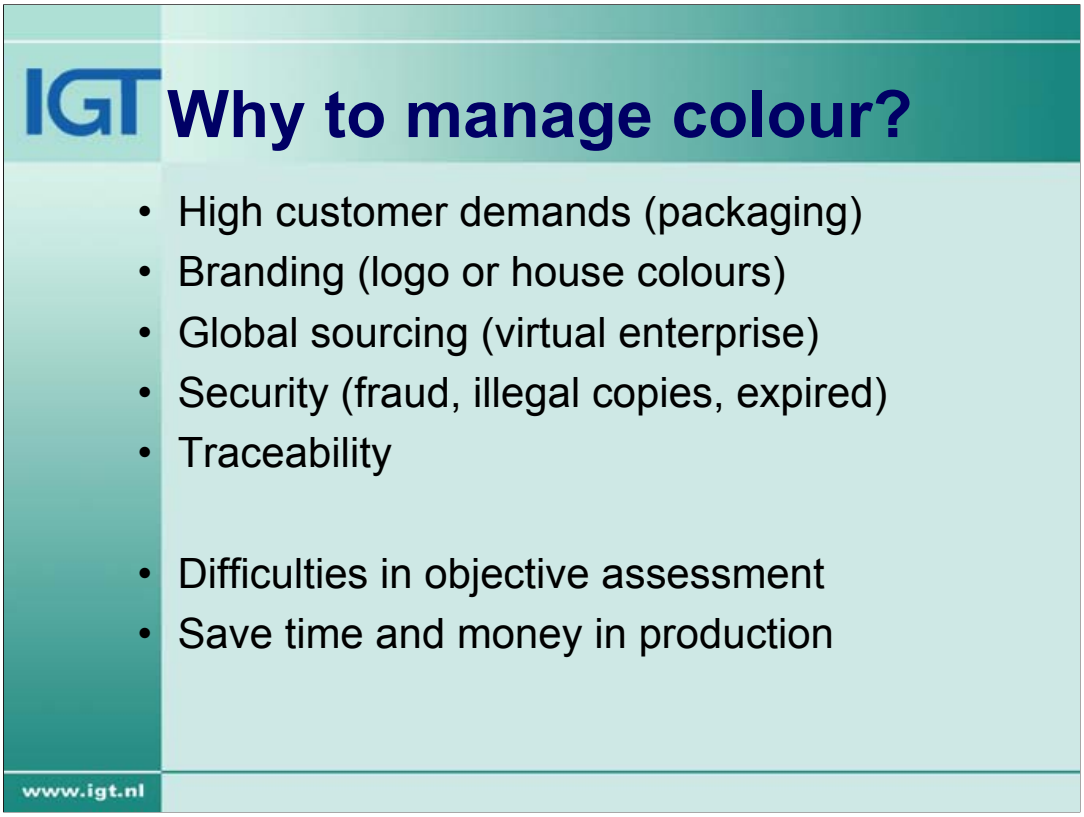
A set of process standards used in the printing industry to communicate specifications for colour, tone value, tone value increase, register, film specs etc. for offset printing, news print, gravure printing, screen print, flexographic printing and for the production of contract proofs.

Part 1 gives general specifications for all other parts and describes measurement modes, calculation methods and reporting.

The other parts specify in detail the values to be realized on the contract proof, on the OK sheet and in average during the print run. Details will be shown later in the presentation.

Purpose of this set of standards was to create a world-wide agreement for the colours to be printed in these processes and to reduce the difference in colour between the different processes.

Using the specifications from this standard the printer will be able to print within tight tolerances the specified colour from a print job which is supplied in conformance with the standards, certified PDF and certified Proof. With that a print buyer must be able to order a the same job from different sources, e.g. different regions, with, within reasonable tolerances, the same colour.



Colour is life, colour is a sensation, a feeling. Bad colour however looks kitsch, fake, ugly. Due to the high colour fidelity of the modern instruments like TV, video, magazines, etc. people are used to bright colours. Because the human eye is extremely sensitive to colour and even more to colour differences we do not accept errors anymore. Go to a supermarket, look at the shelves: probably you will not find two the same products with a slightly different colour next to each other, but if you would find one look at the date, most probably the off-colour package will probably be much older. Even you would not pick that item.

For brand protection and security it is also a requirement to keep colours in tight tolerances, sometimes even so tight that it cannot be printed in 4C and special colours like PMS or house colours are used.

As colour is a sensation and everyone “senses” it differently, we speak about warm red, cold blue and not about orange-red and reddish-blue, there is no absolute colour. This subjectivenes must be reduces if we want to talk about colour in different languages. It has to be transferred into numbers: L*a*b*.

High customer demands

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Here you see a number of packages printed in different processes, on different materials. It seems obvious that NESQUIK blue bottom right and top right should be the same, as well as the red MAGGI balloon on the 6 bottom left packages.

Colour matching / Ink formulation

Branding through specific colours or inks
e.g. PMS, OBA, magnetic

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There where important for security, pharmaceutical packages, or for brand protection, alcoholics, perfumes, CDs etc. special features are used to prevent copying the printed product.

Colour sensation factors

- Ink: colour, layer thickness, transparency
- Substrate: colour, gloss, structure, OBA-level
- Environmental light
- Assessment angle of light incidence, gloss
- Surrounding light: scatter, walls, dressing
- **Observer**

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Substrate colour and OBA-level: Ink is (normally) transparent, the substrate colour is visible through the ink, depending on the thickness of the ink layer. Also due to the fact that most processes use halve tones to build an image there is a lot of base paper colour visible between the printed dots. The OBAs in the paper coating are excitated by the UV content of the environmental light which influences the appearance of the image largely depending on the total covered print area.

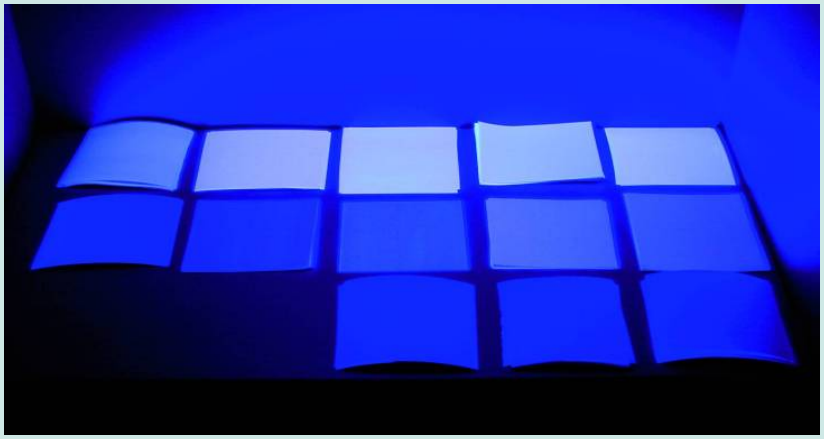
Environmental light: different light sources contain different colours and different levels of UV. Resulting in metamerism.

Assessment angle of light incidence: gloss of the substrate and gloss of the print influences the appearance of the image strongly depending on the angle of incidence of the light source.

Surrounding light scatter, walls, dressing: reflection on shiny surfaces, colour of the walls and colour of the observers clothes influence the appearance of the image

Observer: the eye of the observer is the most critical but also the most unreliable measuring device. Highest colour resolution, but also the fastest adaption to changing circumstances. Imagination is very strong. Objectiveness is very week.

Fluorescence OBA content



Chemical agents in the paper (coating), Optical Brightening Agents (OBA) generate a blue colour if excited by UV radiation

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Put different papers under UV black light and you will see the effect of the OBAs

Dressing

Red reflection on the image

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In this case the company colour red is a bad choice for the press operator who does the colour judgment by the naked eye.

Observation

Observation angle

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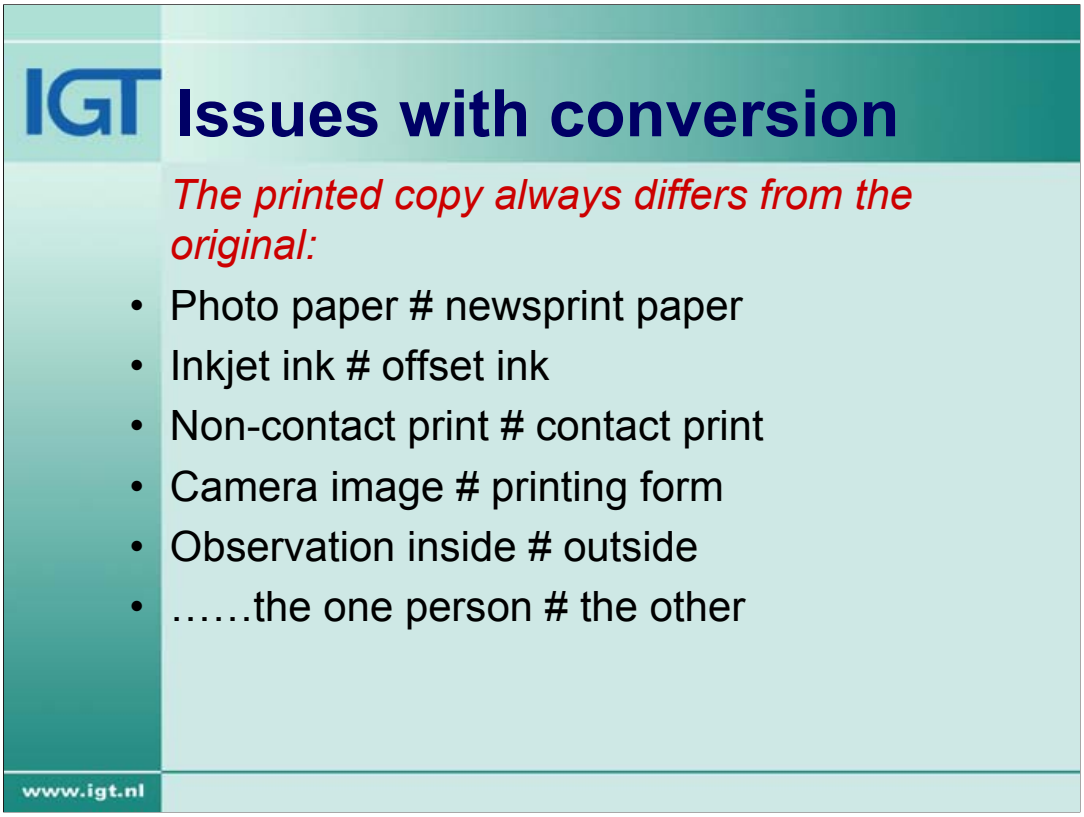
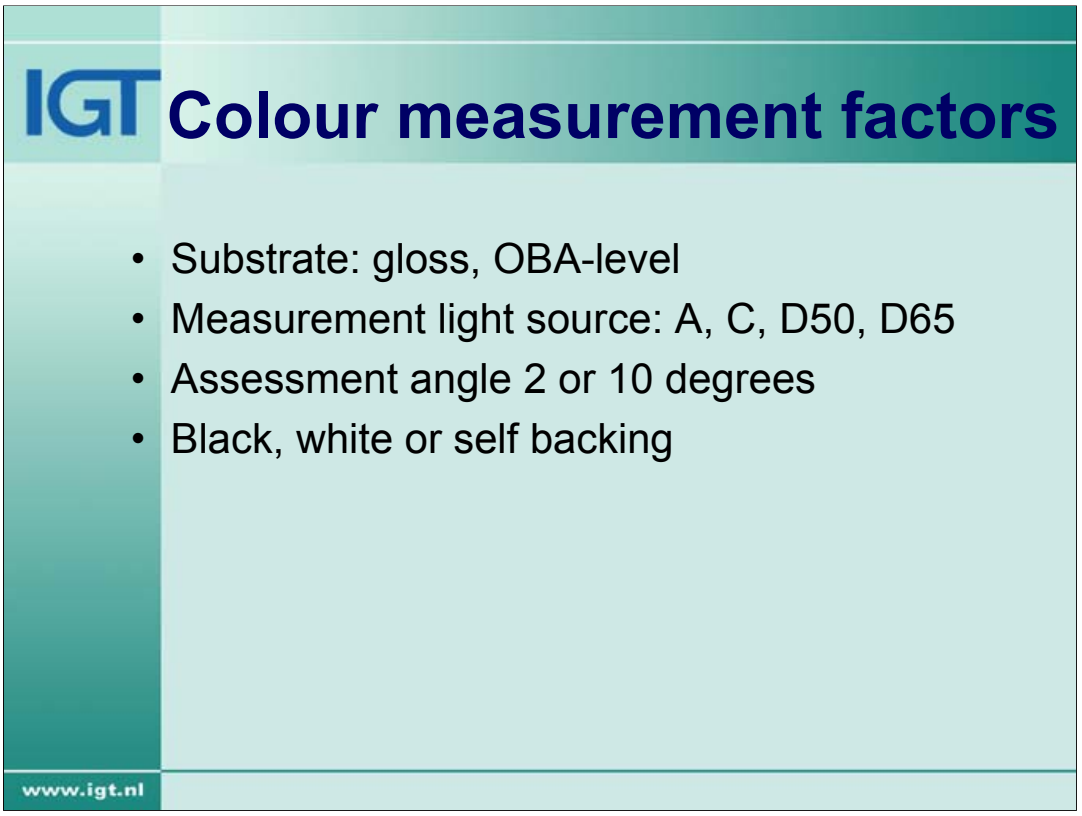
The observation angle is changed to get an optimum view on the subject, gloss and scattering, close or far from the lamp gives a large difference.



We should also consider the original, and see the differences on reproduction method and material. A nice smooth coated glossy photo paper will never look the same as newsprint stock. Inkjet inks are very different in consistency from offset inks. Non contact printing methods like inkjet or toner systems have different properties and difficulties than contact prints.

An image seen through the lens of a camera is not the image you get on your memory stick. The human eye adapts very easy to different light sources and the brain helps to convert the colour cast image into the colour corrected image in our imagination. And again imagination…

So for all different circumstances a correction, called conversion must be done, except for the imagination.



Depending on the measuring devices used some of these issues are not important, you however have to know and be aware of it.

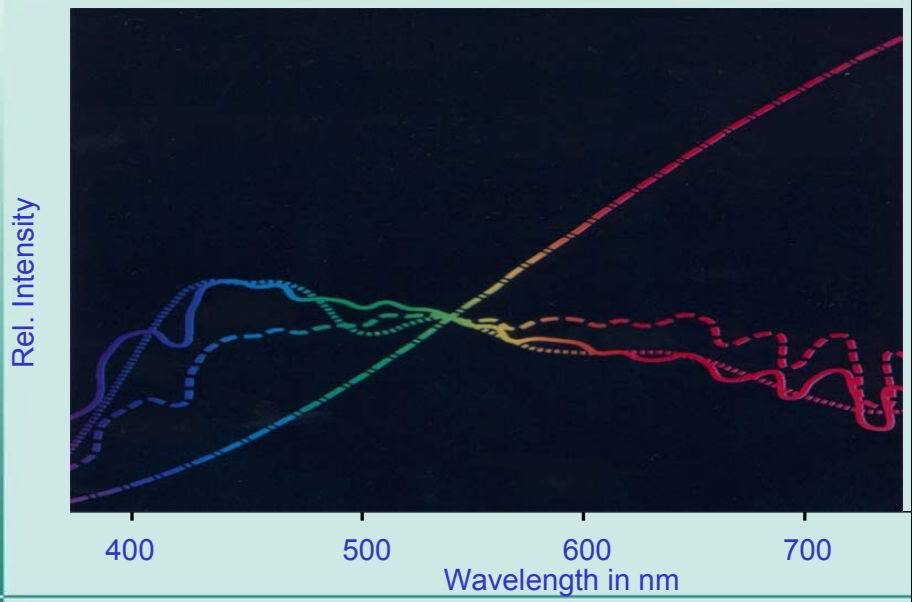
The gloss and the OBA level of the substrate normally influence the measurements very strong. Measuring a halftone are with e.g. 50% coverage, TV=50%, leaves 50% of the unprinted paper uncovered. This results in a difference in gloss between the printed and the unprinted area, and it makes the OBAs of this 50% react on the UV content of the lamp of the measuring device.

The measurement light source should not be confused with the set light source on the spectrophotometer. The measurement light source is the physical lamp inside the device, this can be a tungsten incandescent lamp or a xenon flash light. The latter one can be calibrated normally for its UV content, the tungsten lamps cannot, mainly because there is insufficient UV in its spectrum.

The assessment angle (opening) gives a small difference in reading

The type of backing used to measure gives a substantial error in the reading. Even the print on the back of a proof may result in an error.

Normed Light sources



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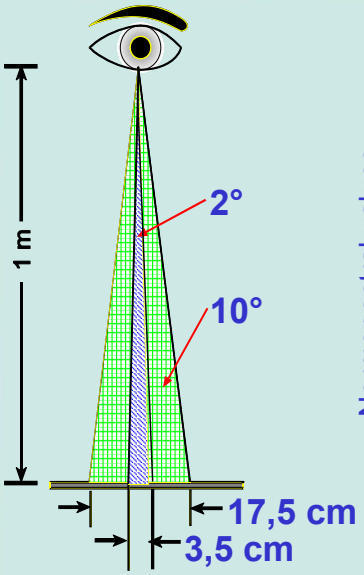
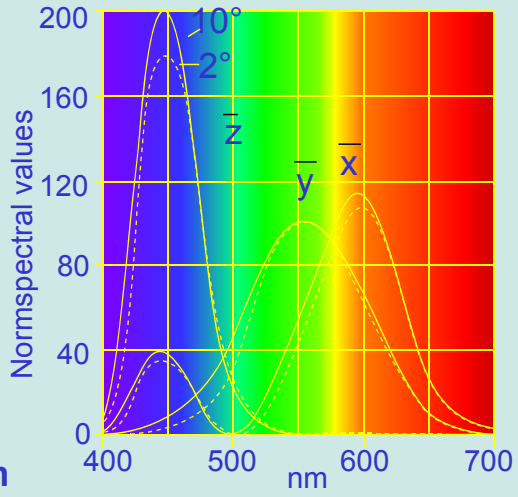
Normal Observer





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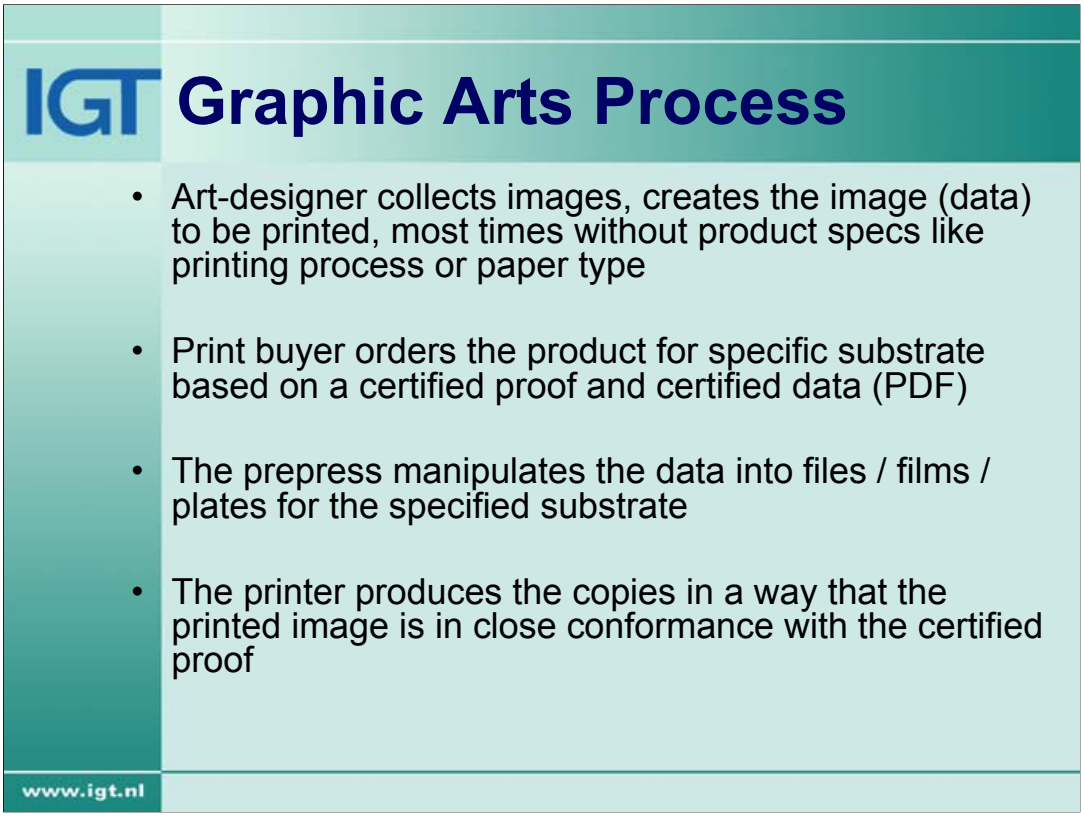
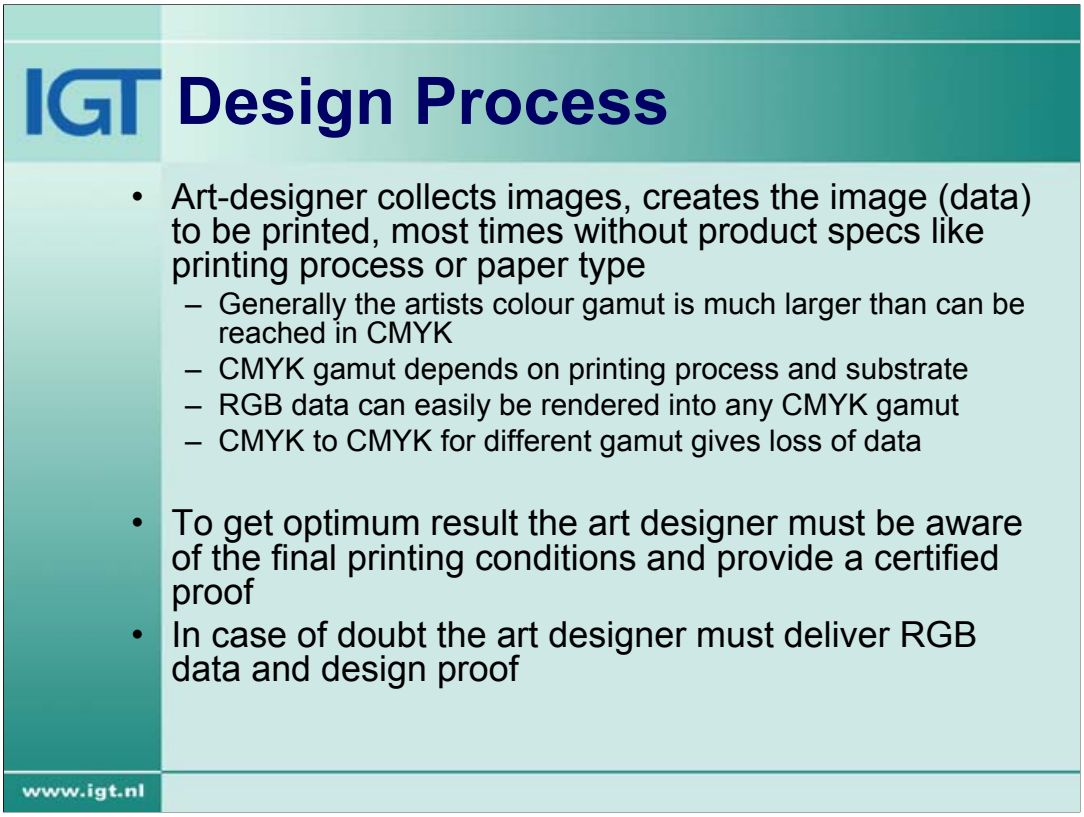


Basically these are the four principle process steps to produce printed matter. In the following slides these steps will be detailed.



The art designer is often the weak point in the chain. More artist then engineer, not aware of the final product, printing technology or substrate, he can only do his best to create the most beautiful image and hope the end product on which it is used is capable to bear the gamut he made. He should however, be aware of the fact that for sure 90% or more of his designs are finally (also) printed on materials with a much smaller gamut then his original design. Best is a good communication between the print buyer and the art designer to create understanding of this potential problem and to solve it at the source.

Why different standards?

CIELAB coordinates, gloss, ISO brightness and tolerances for typical paper types						
	L*	a*	b*	Gloss	ISO brightness	Mass per area
Paper type	1	1	1	%	%	g/m²
1: Gloss-coated, wood-free	93 (95)	0 (0)	-3 (-2)	65	89	115
2: Matte-coated, wood-free	92 (94)	0 (0)	-3 (-2)	38	89	115
3: Gloss-coated, web	87 (92)	−1 (0)	3 (5)	55	70	70
4: Uncoated, white	92 (95)	0 (0)	-3 (-2)	6	93	115
5: Uncoated, slightly yellowish	88 (90)	−3 (-2)	6 (9)	6	73	115
Tolerance	± 3	± 2	± 2	± 5		
Reference paper	94,8	-0,9	2,7	70-80	78	150

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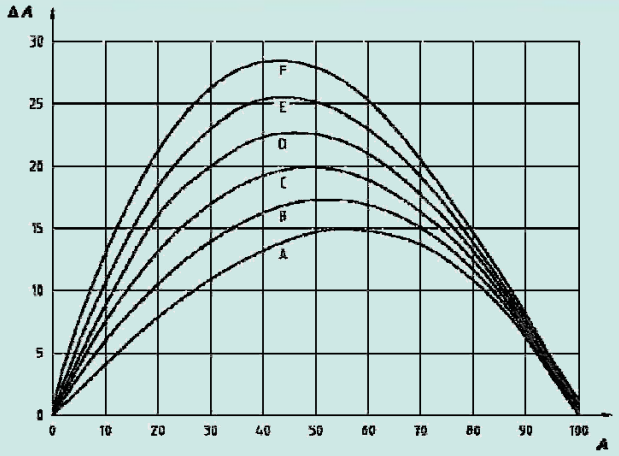
Look at the different more or less standard types of paper and their basic specifications for L*a*b*, gloss and brightness. These need obvious a very different profile for colour separation.

Tone Value Increase



A Tone Value Increase is specified for different processes / paper types

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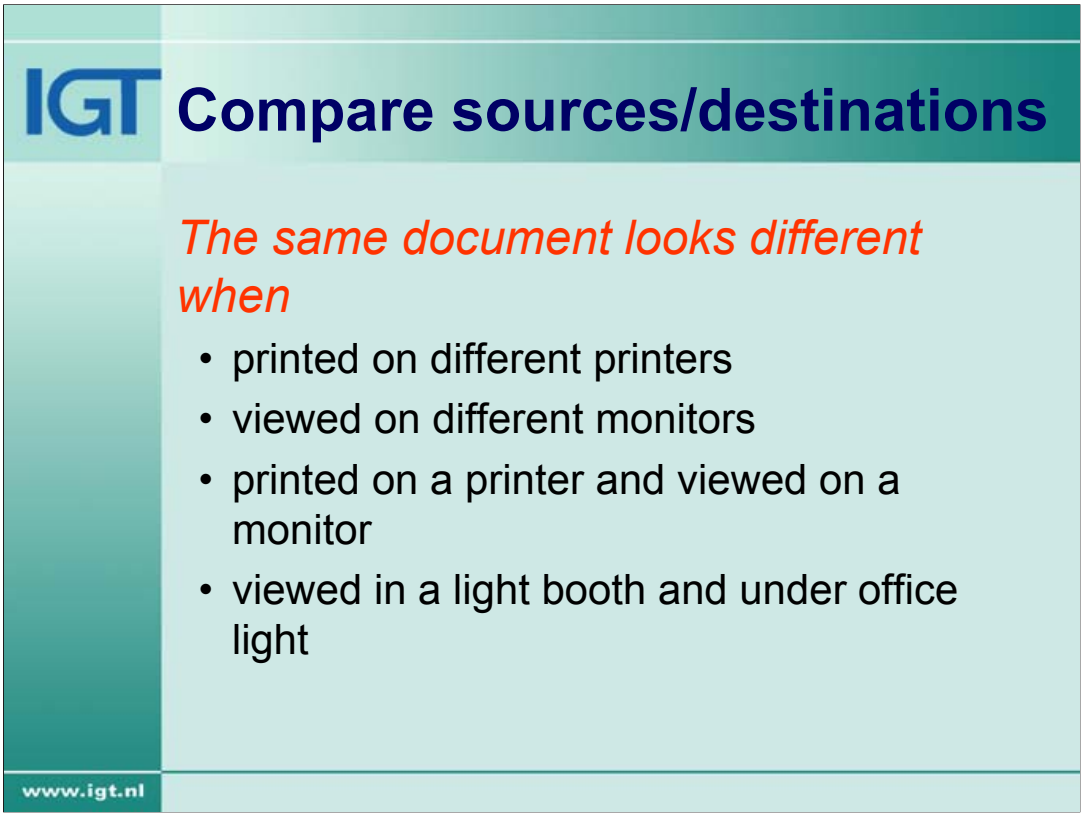
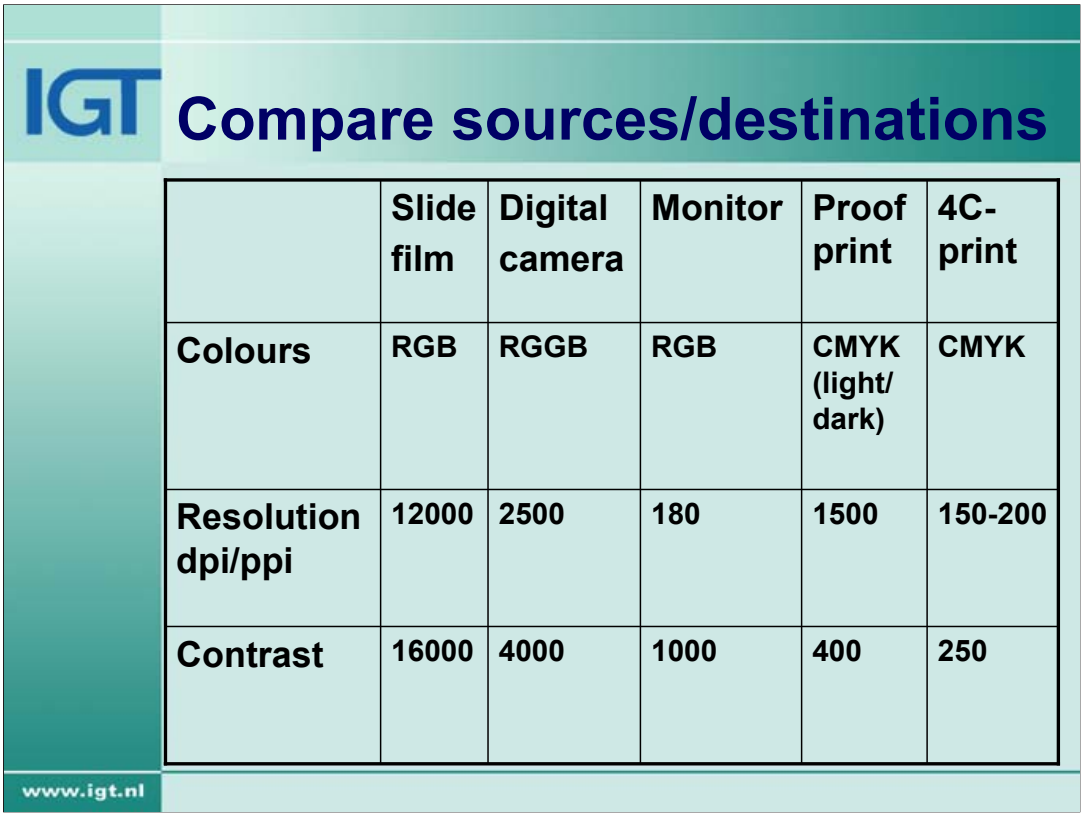
The same is valid for the Tone Value Increase curves.

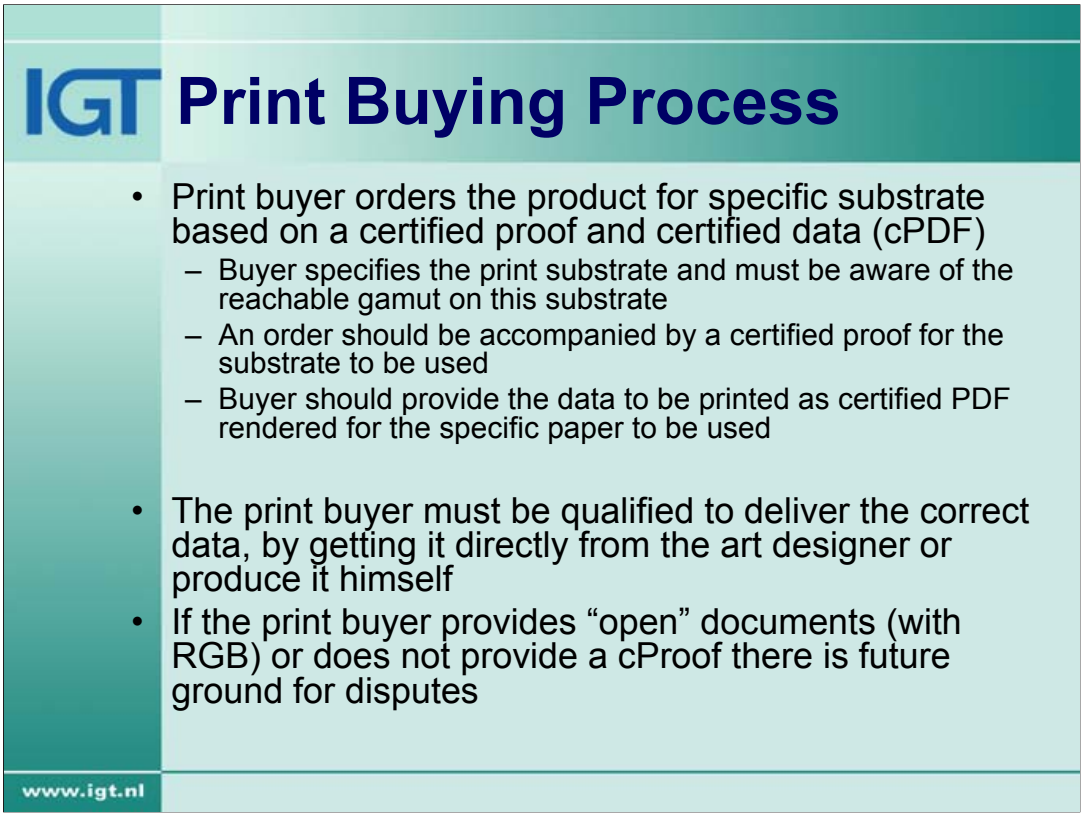


If nothing else is changed the document is seen by different people on different monitors, possibly printed on different printers/plotters or compared under otherwise differing circumstances. If these are not calibrated the same way and according to the same standard the final difference in colour which is viewed by each individual can vary dramatically.



	Slide film	Digital camera	Monitor	Proof print	4C-print
Colours	RGB	RGGB	RGB	CMYK (light/ dark)	CMYK
Resolution dpi/ppi	12000	2500	180	1500	150-200
Contrast	16000	4000	1000	400	250

Just a rough impression of the capabilities of different processes from image creation, analogue camera, digital camera, monitor, printer and printing press. To compare things all are recalculated into ppi or dpi. This shows that it is simply not possible to get the same sensation from an image from a slide compared to a monitor image or 4C printed copy.

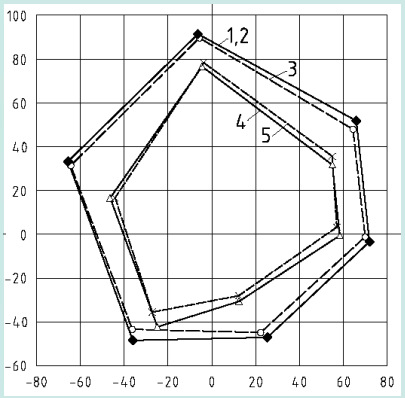


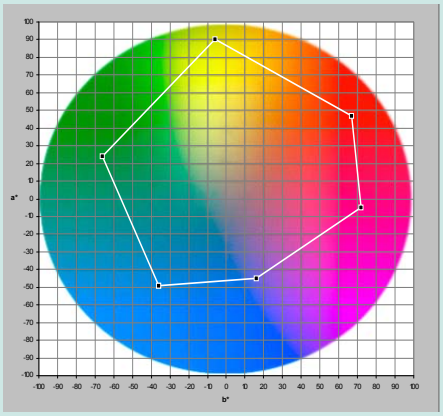
Normally the print buyer knows what he needs or wants. The printer may have some influence by offering a for him standard paper with the same (similar) look and feel. This choice determines to a large extent if the gamut of the original image can be reached.

The printer should demand a certified proof, or make a contract proof himself to be accepted by the print buyer, for the paper type to be used. If the printer works in conformance with ISO 12647 and the paper type in close to the proof specifications of this standard he will be able to print the run well within the specifications.

ISO 12647-2 colour gamut

Specifies the colour gamut which must be printed on a number of papers





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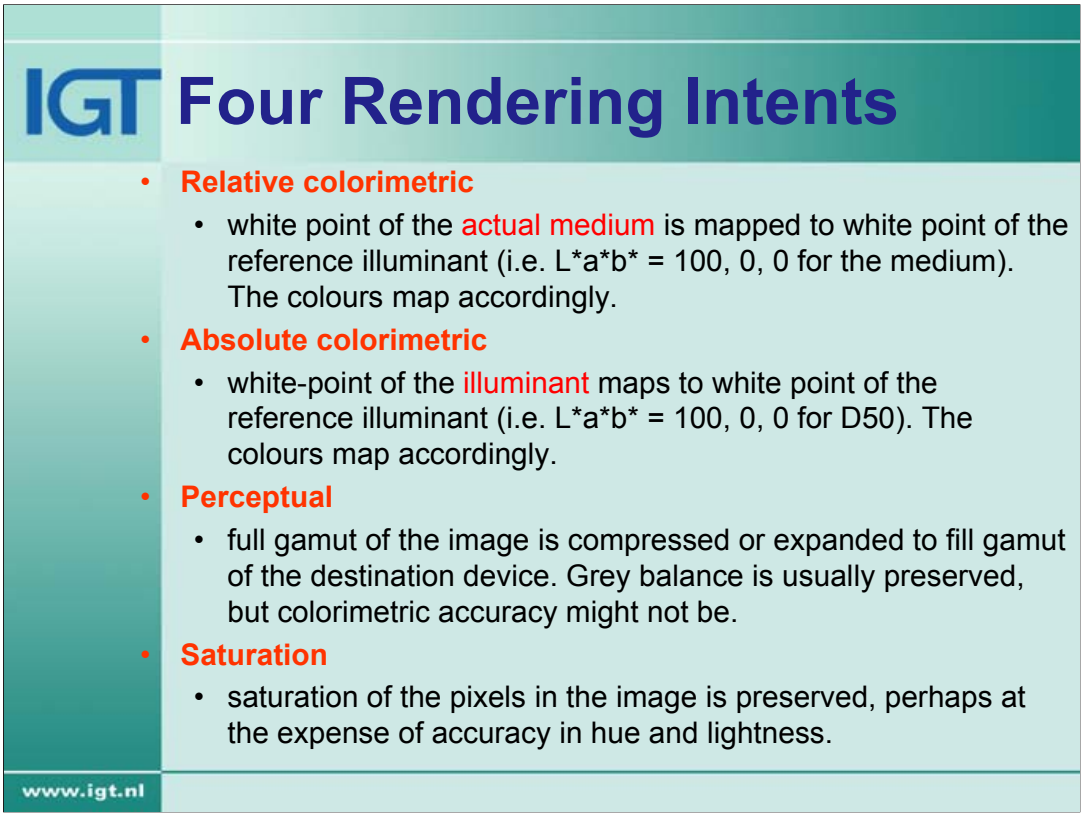
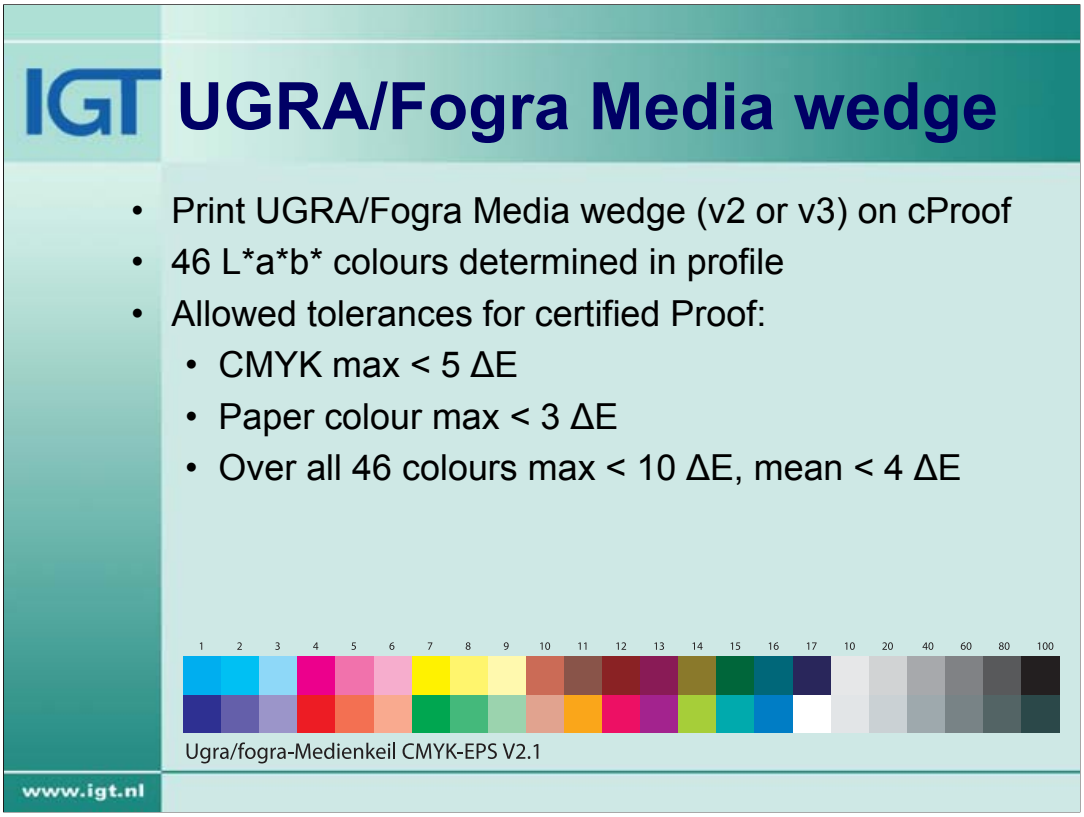
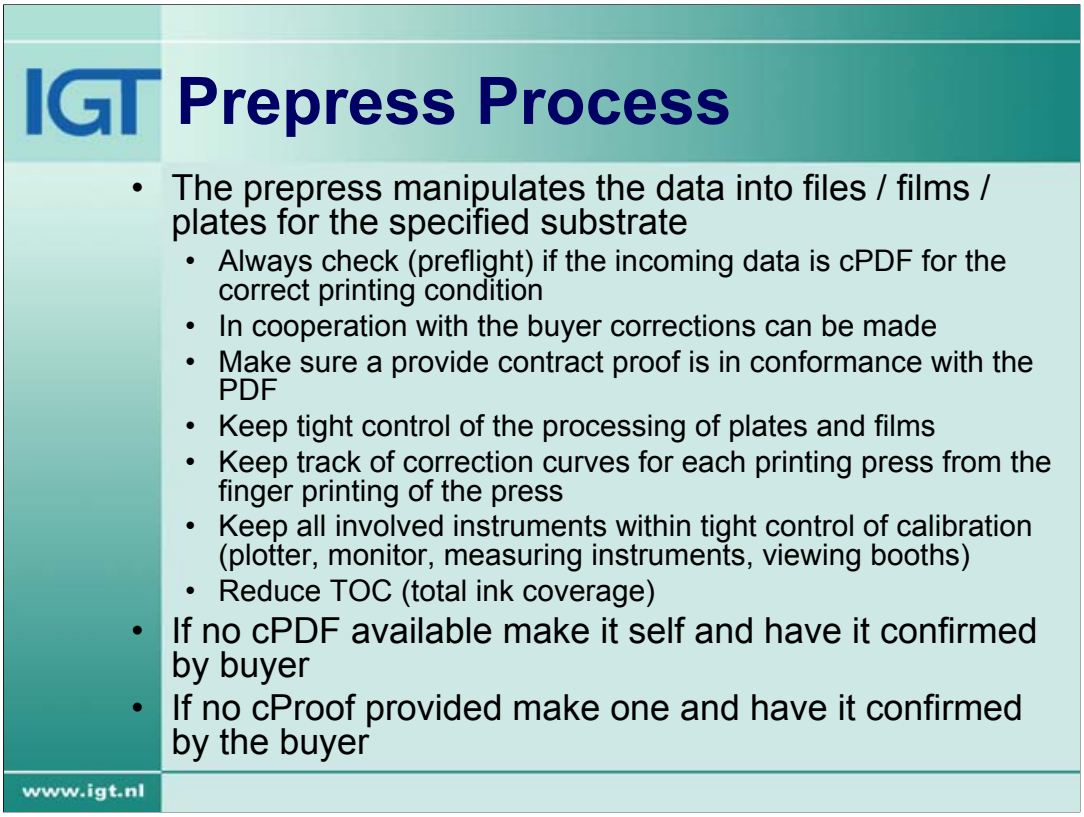
Here a view of the four different gamuts used in the current version of ISO 12646 for sheetfed papers. It is obvious that the printed images of type 1, 2 and 3 will never match with those of type 4 or 5.



To convert from a wide gamut RGB image into a smaller gamut CMY image there are a number of rendering intents. Most common for maximum colour relation to the original are Relative colorimetric or Perceptual. Going back from CMY to RGB, e.g. to convert into another gamut, will result in considerable data loss.



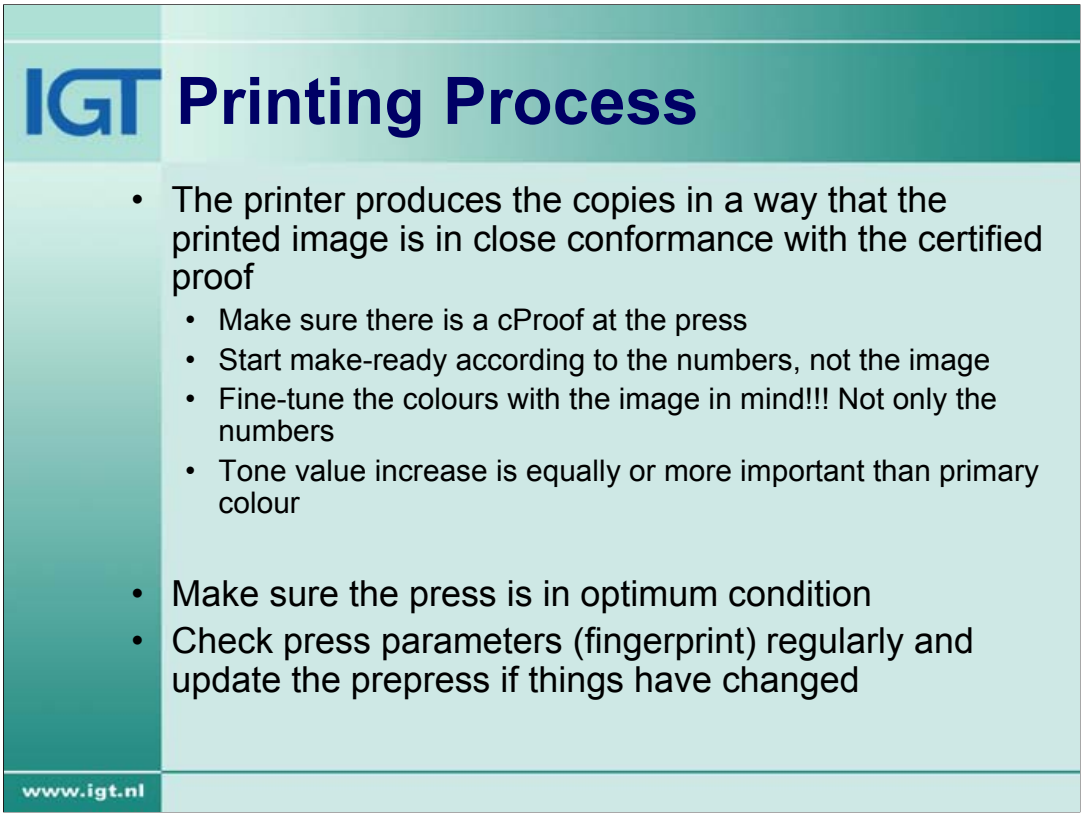
To provide a good total view of the proof colours on every proof a test strip is printed. This can be the UGRA/Fogra media wedge, or any other type with similar sets of colours. The v3 has even more patches for even higher colour accuracy.



A preflight of flight check is a minimum requirement on incoming data. Any error in the PDF should be corrected before going further into the process. Sometimes this can be done by the prepress department, this however should always be done in close cooperation with the print buyer.

After the data is fully correct and a perfect certified PDF is generated, certified proof is printed or received, the separations can be made.

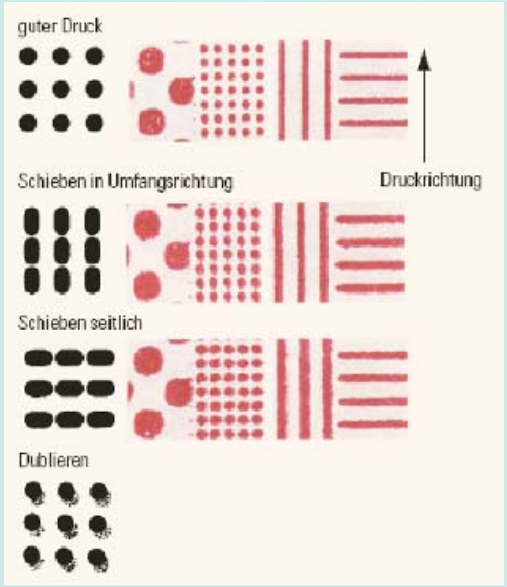
The prepress is responsible for the correct adaption of the rip to the printing press and for the quality of the produced plates.



This is all too obvious to mention, just these obvious things are forgotten too easily!

Print problems - offset

- Colour
  - Ink film thickness
  - Tone value
- Dot change
  - Dot gain / reduction
  - Slur
    - Lateral / Across
  - Doubling
- Fitting and Register differences
- Ghosting, chemical, mechanical
- Ink/substrate interaction
  - Trapping,
  - Ink rejection
  - Scumming
- Picking
- Waves/folds
- Piling



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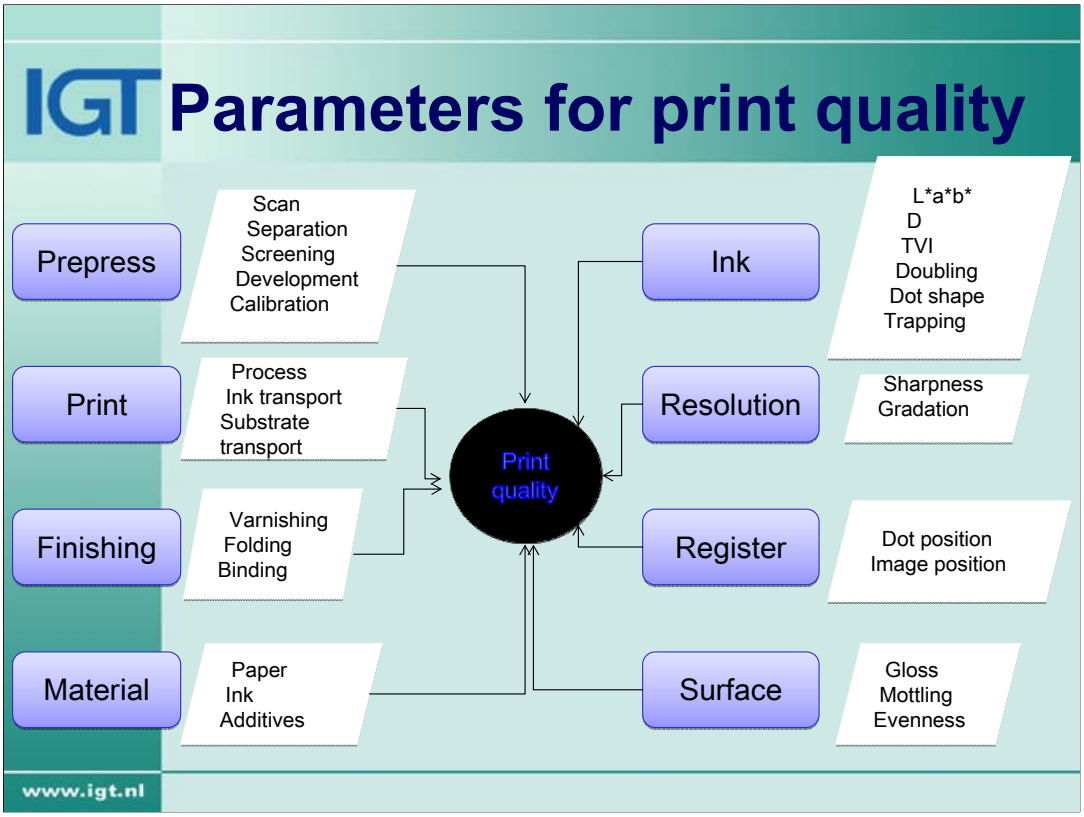
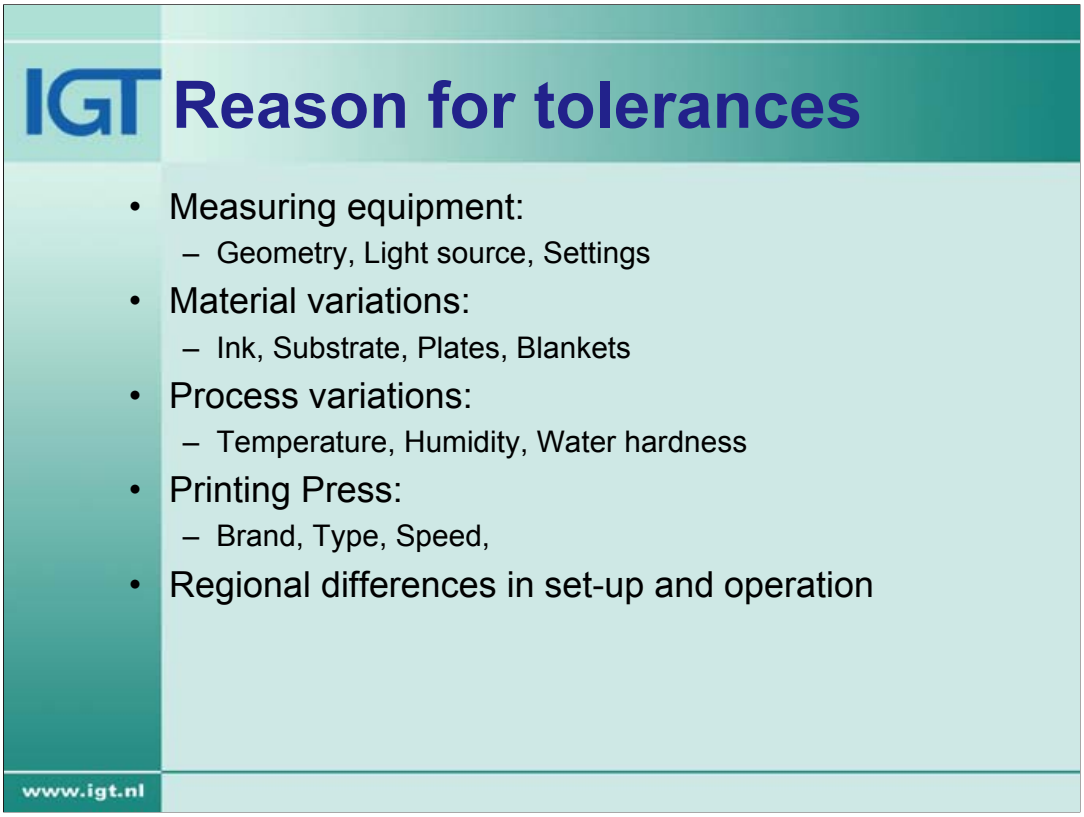
WE don't have these problems…….

Summary

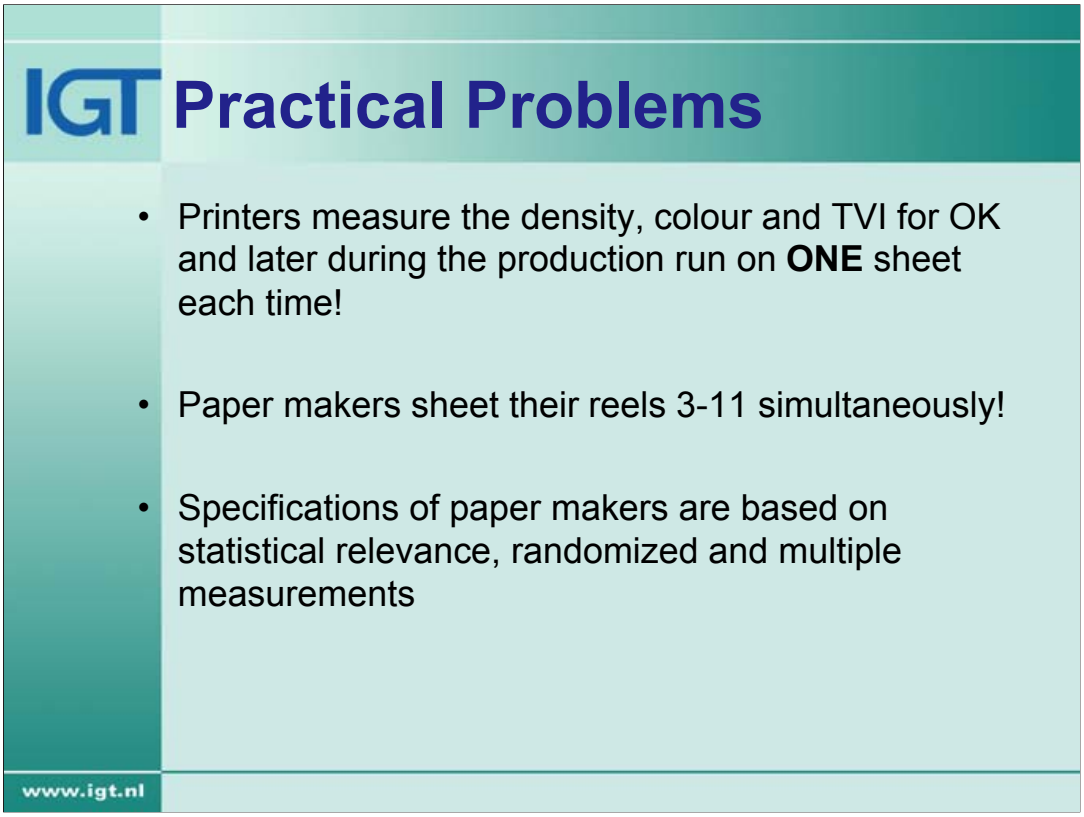
- Parameter overview
- Reason for tolerances
- Practical problems
- Understanding
- **MANAGEMENT**



A more extensive listing of the parameters influencing print quality



A world without tolerances is an utopia. The offset process is a very complex process with many parameters, each with its own tolerances. Some are larger, some are smaller, some are fixed values once a choice is made others vary during the printing process. You certainly cannot assume that the tolerance or the accuracy is +/- one last digit, it may be 10-20%, under circumstances even more.



Be aware of what you do, and learn to read and interpret the numbers and estimate the value of a number.

Create Understanding

YOU are the managers of tomorrow!
It is YOUR job to:

- Inform art creators and print buyers about the limitations of the printing process and the printing materials
- Inform print buyers about the costs of remake and corrections
- Inform printers about the limitations of the substrates and the measuring methods used in its production
- Use ISO 12647 as a guideline for your production, it's a tool not a target

MANAGEMENT

Management is communication!

- Do not focus only on the technical process
- Keep a helicopter-view on the full organization
- Involve ALL departments in the process of standardized production
- Make sure the sales department is aware of the process capabilities and sells only these

For more information

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