



# **Colour management with ISO 12647**

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# IGT Contents

- Standards
- ISO 12647
- Colour management
- Production chain
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# IGT IGT

- Since 1939 involved in paper, ink and print
- Specialist in printability
- Dynamic process simulation with ink and paper



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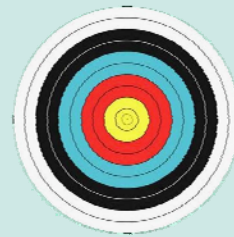
IGT, founded in 1939 is since that time involved in the research and development of test methods and process improvement in the paper-, the ink- and the printing industry. It has developed itself into the leading institute (now private company) in the area of printability.

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 simulants, 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.

# IGT 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

## IGT Private (In-house) Standard

Advantages	Disadvantages
Shows the best the organization can reach	Does not consider the rest of the chain
Perfectly adapted to the own possibilities and processes	Needs changes as soon as anything changes in the organization
Perfect communication within the organization	Nobody outside understands what is meant

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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: knock 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 or 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.

# IGT ISO (International) Standard

Advantages	Disadvantages
Gives strict rules, specifications and procedures	Does not account for superior capabilities of the single company
Considers the full chain	Larger tolerances than needed in one organization
Good way to communicate with other organizations	Standards difficult to read

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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.

## IGT ISO 12647 - structure

- Part -1: General specifications
- Part -2: Offset-lithographical processes, (sheetfed / web-fed), heatset
- Part -3: Offset-lithographical coldset processes (newsprint)
- Part -4: Gravure
- Part -5: Screen print
- Part -6: Flexographic processes
- Part -7: Proof systems

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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.

## IGT Why to manage colour?

- High customer demands (packaging)
- Branding (logo or house colours)
- Global sourcing (virtual enterprise)
- Security (fraud, illegal copies, expired)
- Traceability
  
- Difficulties in objective assessment
- Save time and money in production

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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 subjectiveness must be reduced if we want to talk about colour in different languages. It has to be transferred into numbers:  $L^*a^*b^*$ .



# IGT 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.

## IGT 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.

# IGT 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 excited by the UV content of the environmental light which influences the appearance of the image largely depending on the total covered print area.

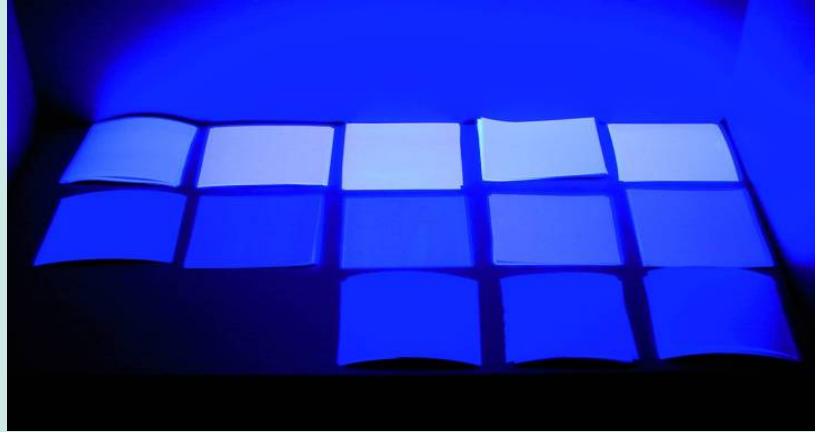
Environmental light: different light sources contain different colours and different levels of UV. Resulting in metamerism.

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 weak.

## IGT 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

# IGT 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.

# IGT Observation



Observation angle



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.

## IGT Issues with conversion

*The printed copy always differs from the original:*

- Photo paper # newsprint paper
- Inkjet ink # offset ink
- Non-contact print # contact print
- Camera image # printing form
- Observation inside # outside
- .....the one person # the other

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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.

## IGT Colour measurement factors

- Substrate: gloss, OBA-level
- Measurement light source: A, C, D50, D65
- Assessment angle 2 or 10 degrees
- Black, white or self backing

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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.

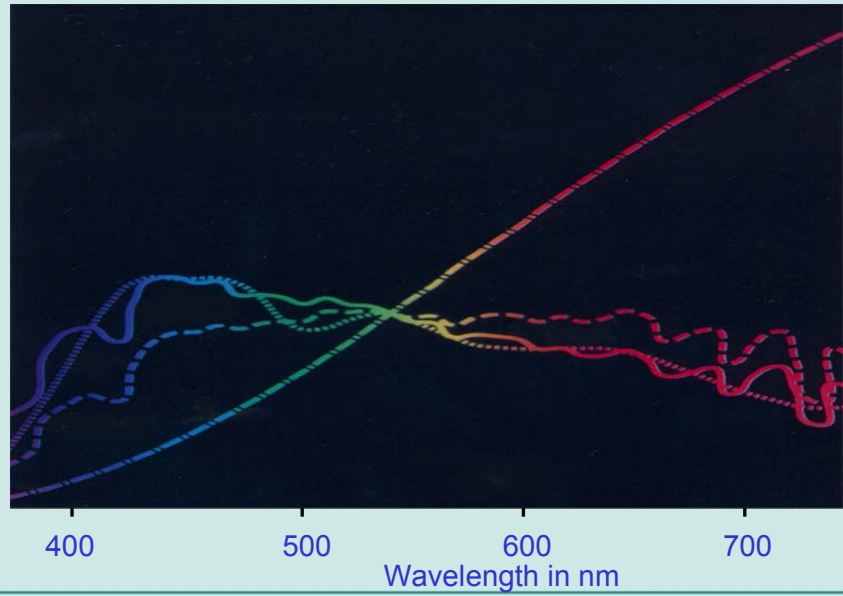
The assessment angle (opening) gives a small difference in reading

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.



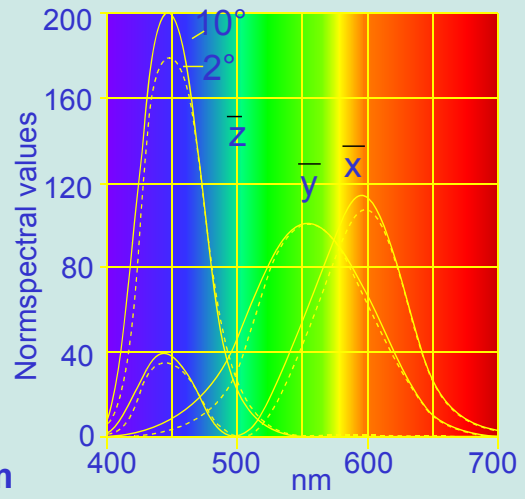
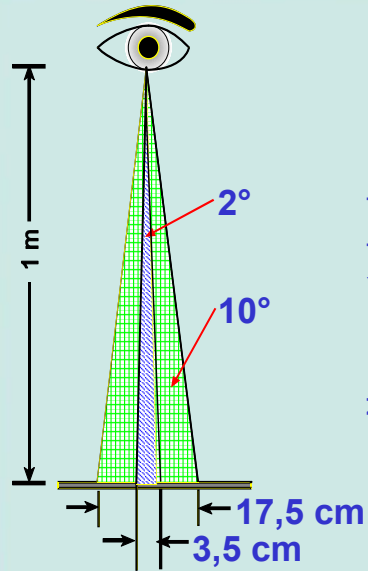
# IGT Normed Light sources

Rel. Intensity



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# IGT Normal Observer



# IGT Graphic Arts Process

- Art-designer collects images, creates the image (data) to be printed, most times without product specs like printing process or paper type
- Print buyer orders the product for specific substrate based on a certified proof and certified data (PDF)
- The prepress manipulates the data into files / films / plates for the specified substrate
- The printer produces the copies in a way that the printed image is in close conformance with the certified proof

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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.

## IGT Design Process

- Art-designer collects images, creates the image (data) to be printed, most times without product specs like printing process or paper type
  - Generally the artists colour gamut is much larger than can be reached in CMYK
  - CMYK gamut depends on printing process and substrate
  - RGB data can easily be rendered into any CMYK gamut
  - CMYK to CMYK for different gamut gives loss of data
- To get optimum result the art designer must be aware of the final printing conditions and provide a certified proof
- In case of doubt the art designer must deliver RGB data and design proof

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The art designer is often the weak point in the chain. More artist than 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 than 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.

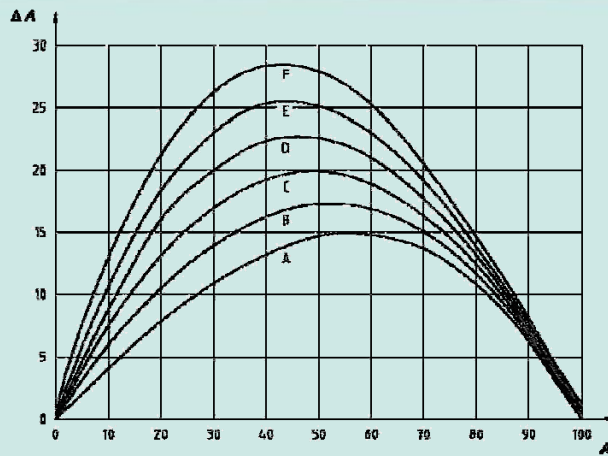
# IGT Why different standards?

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/m <sup>2</sup>
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.

# IGT Tone Value Increase



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

The same is valid for the Tone Value Increase curves.

## IGT Compare sources/destinations

*The same document looks different when*

- printed on different printers
- viewed on different monitors
- printed on a printer and viewed on a monitor
- viewed in a light booth and under office light

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.

# IGT Compare sources/destinations

	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

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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.



## IGT Print Buying Process

- Print buyer orders the product for specific substrate based on a certified proof and certified data (cPDF)
  - Buyer specifies the print substrate and must be aware of the reachable gamut on this substrate
  - An order should be accompanied by a certified proof for the substrate to be used
  - Buyer should provide the data to be printed as certified PDF rendered for the specific paper to be used
- The print buyer must be qualified to deliver the correct data, by getting it directly from the art designer or produce it himself
- If the print buyer provides “open” documents (with RGB) or does not provide a cProof there is future ground for disputes

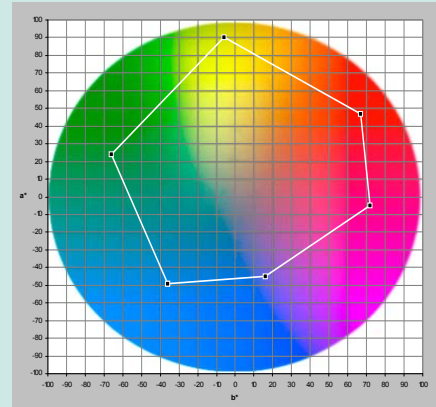
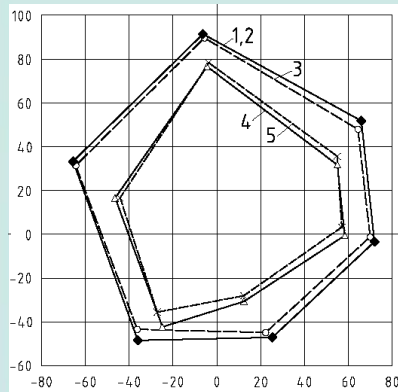
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Normally the print buyer knows what he needs or wants. The printer may have some influence by offering a for him standard paper with the same (similar) look and feel. This choice determines to a large extent if the gamut of the original image can be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

# IGT ISO 12647-2 colour gamut

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



PT1

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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.

# IGT Four Rendering Intents

- **Relative colorimetric**
  - white point of the **actual medium** is mapped to white point of the reference illuminant (i.e.  $L^*a^*b^* = 100, 0, 0$  for the medium). The colours map accordingly.
- **Absolute colorimetric**
  - white-point of the **illuminant** maps to white point of the reference illuminant (i.e.  $L^*a^*b^* = 100, 0, 0$  for D50). The colours map accordingly.
- **Perceptual**
  - full gamut of the image is compressed or expanded to fill gamut of the destination device. Grey balance is usually preserved, but colorimetric accuracy might not be.
- **Saturation**
  - saturation of the pixels in the image is preserved, perhaps at the expense of accuracy in hue and lightness.

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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.

# IGT UGRA/Fogra Media wedge

- Print UGRA/Fogra Media wedge (v2 or v3) on cProof
- 46 L\*a\*b\* colours determined in profile
- Allowed tolerances for certified Proof:
  - CMYK max < 5  $\Delta E$
  - Paper colour max < 3  $\Delta E$
  - Over all 46 colours max < 10  $\Delta E$ , mean < 4  $\Delta E$



Ugra/fogra-Medienkeil CMYK-EPS V2.1

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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.

# IGT Prepress Process

- The prepress manipulates the data into files / films / plates for the specified substrate
  - Always check (preflight) if the incoming data is cPDF for the correct printing condition
  - In cooperation with the buyer corrections can be made
  - Make sure a provide contract proof is in conformance with the PDF
  - Keep tight control of the processing of plates and films
  - Keep track of correction curves for each printing press from the finger printing of the press
  - Keep all involved instruments within tight control of calibration (plotter, monitor, measuring instruments, viewing booths)
  - Reduce TOC (total ink coverage)
- If no cPDF available make it self and have it confirmed by buyer
- If no cProof provided make one and have it confirmed by the buyer

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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.

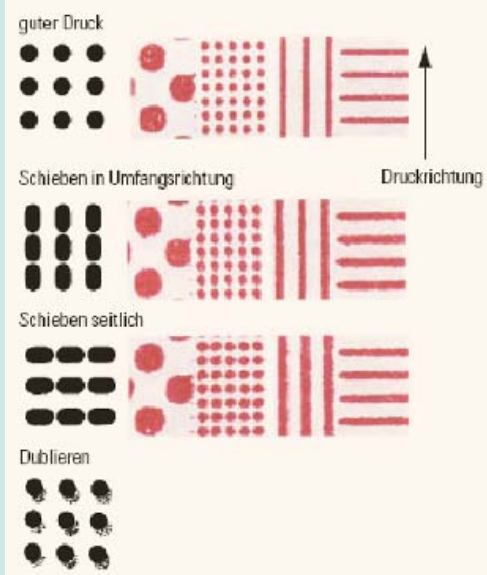
# IGT Printing Process

- The printer produces the copies in a way that the printed image is in close conformance with the certified proof
  - Make sure there is a cProof at the press
  - Start make-ready according to the numbers, not the image
  - Fine-tune the colours with the image in mind!!! Not only the numbers
  - Tone value increase is equally or more important than primary colour
- Make sure the press is in optimum condition
- Check press parameters (fingerprint) regularly and update the prepress if things have changed

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

# IGT 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



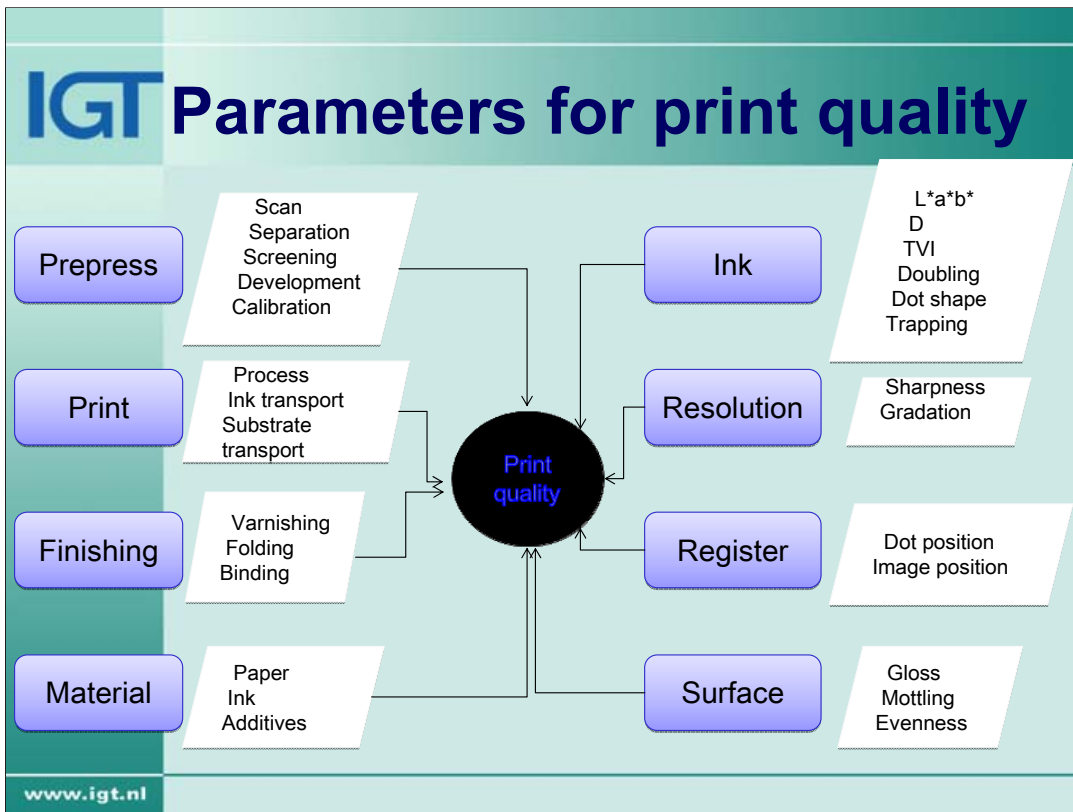
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WE don't have these problems.....

# IGT Summary

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





A more extensive listing of the parameters influencing print quality

## IGT Reason for tolerances

- Measuring equipment:
  - Geometry, Light source, Settings
- Material variations:
  - Ink, Substrate, Plates, Blankets
- Process variations:
  - Temperature, Humidity, Water hardness
- Printing Press:
  - Brand, Type, Speed,
- Regional differences in set-up and operation

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.

# IGT Practical Problems

- Printers measure the density, colour and TVI for OK and later during the production run on **ONE** sheet each time!
- Paper makers sheet their reels 3-11 simultaneously!
- Specifications of paper makers are based on statistical relevance, randomized and multiple measurements

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

# IGT 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

# IGT 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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