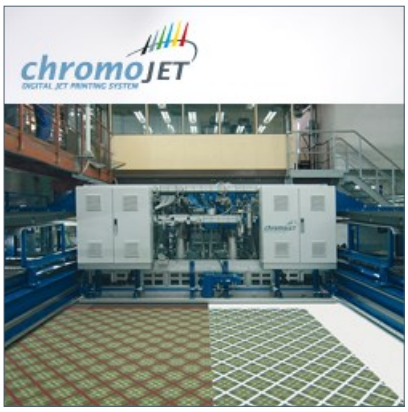
CARPET AND PILE PRODUCT PRINTING

SEVERAL TECHNOLOGIES ARE AVAILABLE TO PRINT CARPET AND OTHER PILE PRODUCTS.



CHROMOJET.SPOT COLOR PRINTING

25 dpi resolution

The color is pre-mixed

CHROMOJET.PROCESS COLOR PRINTING

50 or 76 dpi resolution

The shade is mixed on the carpet out of a number of basic colors

COLARIS^3.INKJET PRINTING TECHNOLOGY

Industrial InkJET technology with high resolution is used to print the proper shade out of a number of base colors

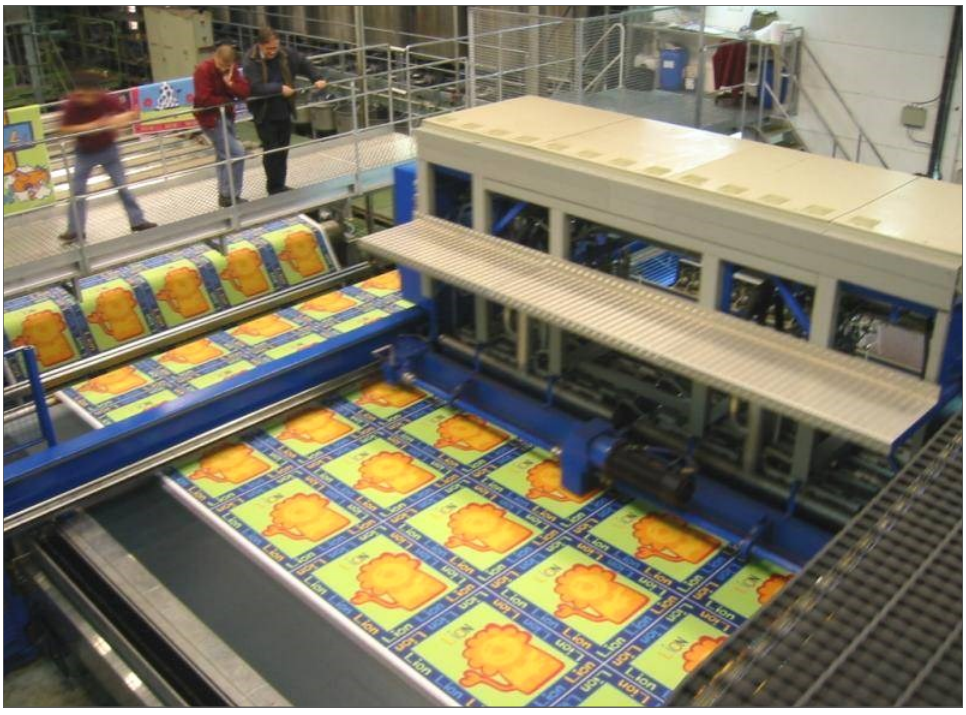
CHROMOJET

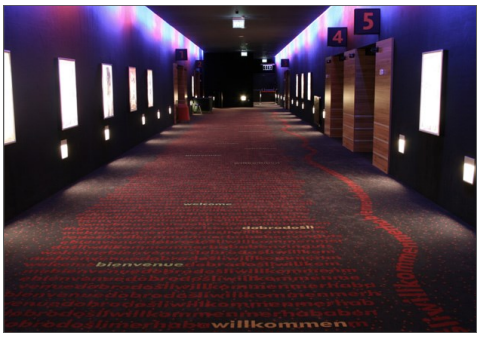
25 DPI SPOT COLOR PRINTING

25 dpi printing is the most common digital carpet printing technology. The dye with the pre-mixed shade is sprayed into the pile using HSV400 type valves.

+ Printer works with up to 16 pre-mixed colors (dye pastes)
+ Very rich, full and saturated colors
+ Special dyes (neon, with special wash or light fastness,…) can be used for special purposes
+ Perfect and equal penetration of all colors
+ High printing speed of up to 12 m/min at 4 m width

– A color change requires washing of the system
– Some waste of dye
– Print definition is not as good as on 50/76 dpi printers





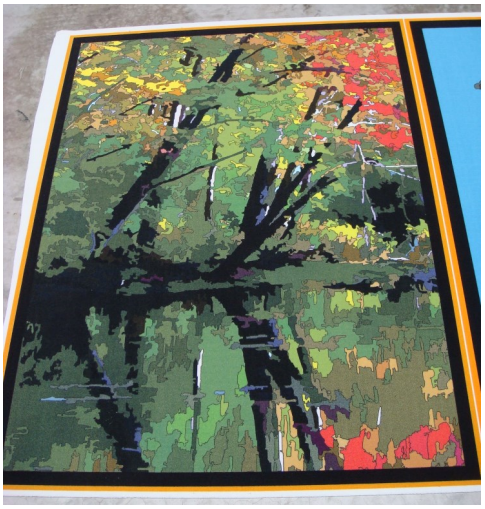
CHROMOJET

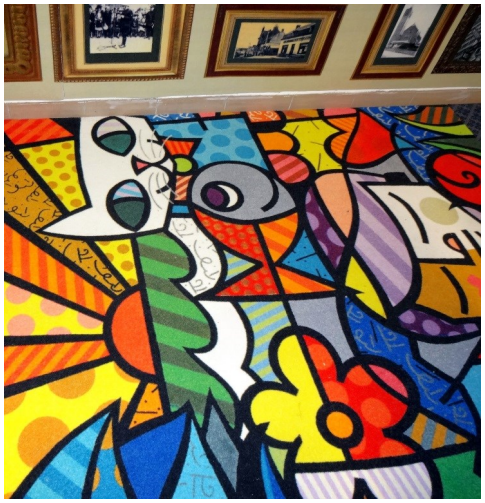
50/76 DPI PROCESS COLOR PRINTING

76 dpi printing is the most flexible digital carpet printing technology.
Up to 16 process colors are sprayed into the pile using HSV800 type valves.
The shade is actually mixed on the surface of the carpet.

+ Almost no waste of dye
+ Variable resolution of 50 or 76 dpi
+ No washing before color change
+ Almost unlimited number of shades which are mixed on the carpet
+ Newly developed press station enhances penetration dramatically on high pile carpets
+ Energy and water saving
+ Easy and fast sampling

– Printing speed is lower in comparison to 25 dpi spot color printing
– Light shades have lower penetration in comparison to dark shades





SUPRA**PRESS**.

MINIMIZE DYE PICK-UP AT MAXIMUM PENETRATION

The SUPRA**PRESS** is one of the most important developments in the last years. It enables the printing of high pile products with a minimum amount of ink or dye and reaching full penetration.

*SUPRA**PRESS** with additional pull roller and spreading roller in combination with a **CHROMOJET** polyester blanket printer.*

Function:

The carpet or textile is squeezed in between 2 rollers which press the dye or ink from the top of the pile into the pile. The challenge is to have the same pressure force and gap all over the width and to avoid any smearing or ghost printing.

The SUPRA**PRESS** is installed directly behind the printing unit, before steamer or dryer.

In case of Polyester printing it is a must to use the SUPRA**PRESS** system to minimize drying time.

+ Little space needed - can be elevated or on ground floor
+ Can work with constant gap or on constant pressure
+ Amount of pick-up can be reduced by about 80% - saves thickener, chemicals and energy
+ Maximum penetration also on high pile products
+ No frosting - undyed fibers are dipped into the dye
+ No smearing or ghost printing - rollers are washed and dried continuously
+ Minimum maintenance required
+ Available for **CHROMOJET** as well as for **COLARIS**
+ In case of Polyester printing pick-up is minimized

76 dpi print before pressing

This picture shows a stripped polyester needle-felt carpet printed on **COLARIS** using disperse inks, pressed by a SUPRA**PRESS** system and fixed by a HT steamer.

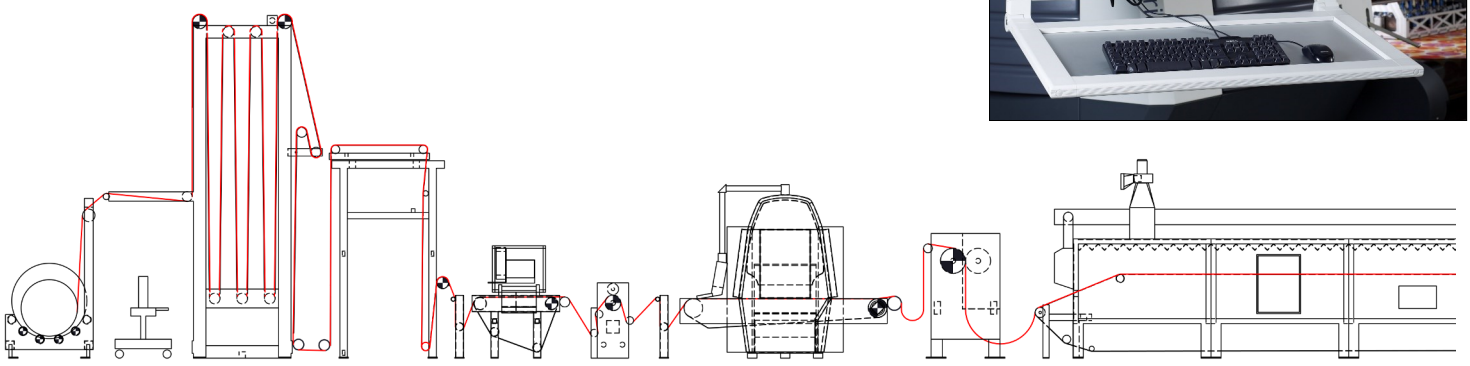
76 dpi print after pressing

COLARIS³.DIGITAL INKJET PRINTING
ON TEXTILE AND PILE PRODUCTS

Inkjet printing is new on pile products but has a huge potential. The required penetration can be achieved by application of the pre-coat and using the SUPRA**PRESS** technology to push the tiny amount of high concentrated ink deep into the pile.

+ Printer works with 4, 6 or 8 base colors (inks)
+ Almost no waste of ink
+ Variable resolution of 400*400; 400*800; 400*1,200 and 400*1,600 dpi
+ Best penetration on pile weights from 100 to 800 g/m²
+ No washing of the system before color change
+ Unlimited number of shades which are mixed on the carpet
+ Newly developed press station enhances penetration dramatically on high pile carpets
+ High printing speed and moderate investment
+ No color kitchen needed

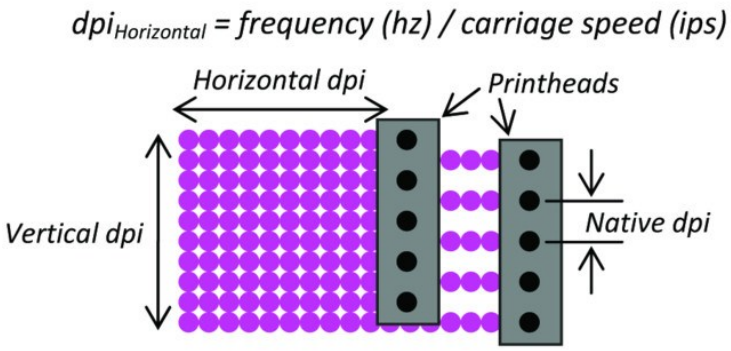
– Light shades have lower penetration in comparison to dark shades
– Not all dye families are available
– Change between dye families (i.e. between disperse and acid) is not simple and takes time and money
– Ink price is higher in comparison to dye used on **CHROMOJET**



BASICS.INKJET

RESOLUTION

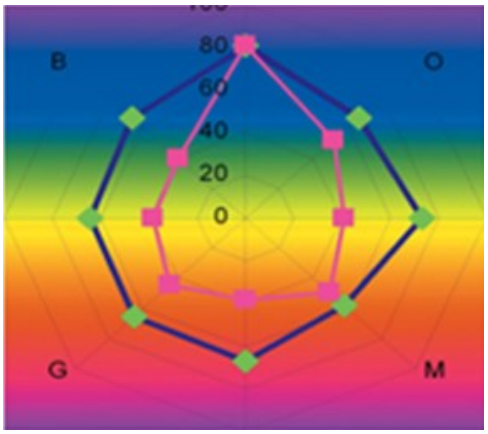
- Resolution higher than 200 dpi cannot be recognized on carpets.
- There is a native resolution of the print head and a print resolution which can be higher in most cases.
- To get a higher resolution in x or y axis the number of passes is increased.
- Higher print resolution means more ink, slower speed and higher cost.
- Resolution should not be higher than needed!



The resolution is the main parameter to control ink pick-up.
Higher resolution means more droplets and therefore higher pick-up at a lower speed.

NUMBER.BASE COLORS

- Minimum 4 colors (CMYK or RGBK) are needed.
- In textile and paper printing image quality is further improved with additional light colors.
- A 200 dpi 8 color design looks the same as a 4 color design at 400 dpi.
- As long as for the dark and light shades the same pigments or dyes are used as long no wider color gamut can be achieved - it just looks better - especially in the light shades and tones.
- For special applications also CMYK + Orange, Purple, Red and Blue can be used.
- For pile products CMYK or RGBK is sufficient.
- But with additional light CMYK a better penetration on light shades can be achieved. This might make sense on higher pile carpets and floor products.

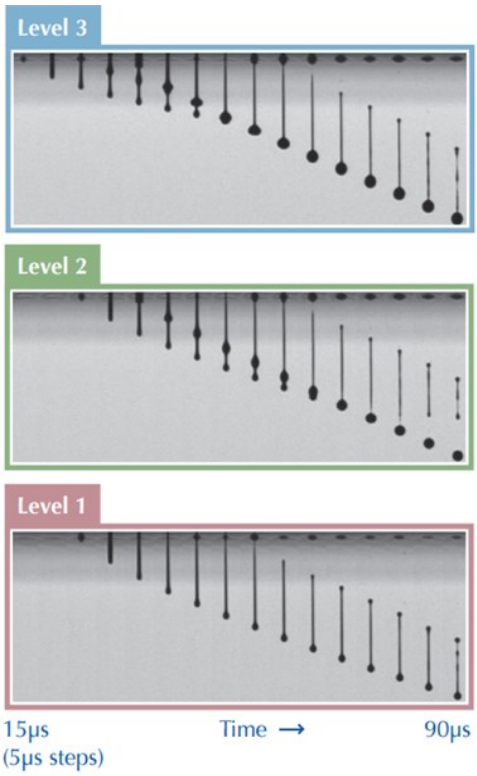


DROPSIZE

Inkjet works with individual droplets generated by a piezo actuator.
For pile products the most important parameter is the amount of ink needed to achieve good penetration and saturated and rich colors.

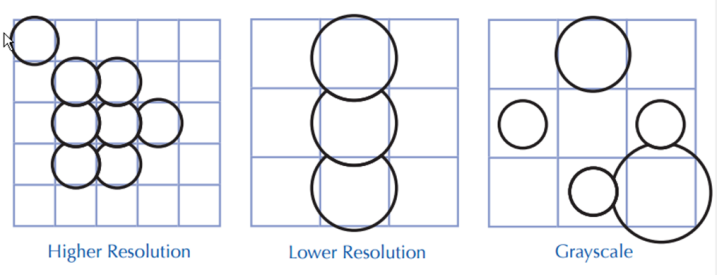
- The dropsize is an important factor - it directly influences the ink lay-down.
- Dropsizes range from 2 to 250 picoliter - depending on printhead.
- The bigger the dropsize the more ink can be applied in a single pass.
- If the dropsize is too big for the substrate, doting or dithering may result.

So the dropsize is greatly influencing the print speed, definition, dithering and finally also the cost of print.



GRAYSCALE.PRINTING

Variable drop sizes are combined to achieve maximum definition and productivity:



INK.LAY-DOWN OR INK.PICK-UP

The total amount of ink lay down (= pick-up) to the substrate is calculated as follows:

Pick-up (ml/m²) = x-dpi * y-dpi * 1,000/25.4 * 1,000/25.4 * dropsize(pl)/ 1E9
= x-dpi * y-dpi * dropsize * 1,550 / 1E9
= **x-dpi * y-dpi * dropsize / 650,000**

If you compare the performance of inkjet printers you should always use a printed sample and compare print quality, penetration and the speed achieved on this sample.

The theoretical print speed using a single pass is in most cases not sufficient to reach a good quality.

INFLUENCE.DROPSIZE ON SPEED

To get 30 ml/m² ink lay-down on a printer with 400 * 400 dpi native resolution at different drop sizes, the following number of passes is required:

Dropsize (pl)	Passes	Production speed
160	1	100 %
60	2	50 %
40	3	33 %

BASICS.INKJET

PRE-TREATMENT

On traditional printing but also on **CHROMOJET** printing all chemicals are included in the print paste.

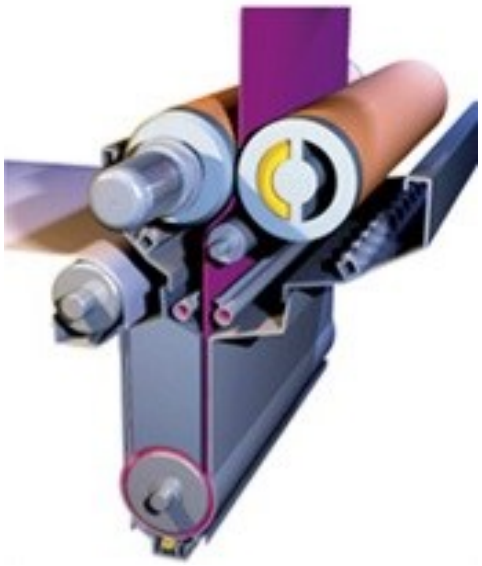
On inkjet printing this is not possible for the following reasons:

- Printheads are working only in a very narrow range of viscosity
- Liquid must be very pure and within a certain pH range of about 6-8

In inkjet printing these chemicals must be applied before printing.

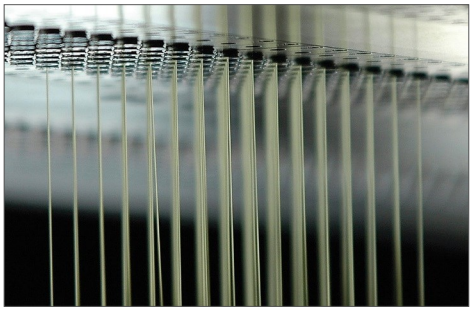
In carpet printing the pre-coat has the following function:

- It helps to distribute and carry the dyestuff to the fibers and allows penetration
- Thickener prevents the low viscosity ink from running through the carpet pile to the back
- Acid is speeding up the fixation process on PA and wool
- Wetting agents improve penetration



APPLICATION.TECHNOLOGIES

Padder	difficult to control, pre-coat is applied also on the back side of the carpet
Screen	low penetration and limited pick-up; not so easy to control; eventually for high speed applications
CHROMOJET	digital system; wide range of applications; closed system, independent from speed



PRINT HEAD SELECTION

High Performance industrial InkJET print heads

- **StarFire™ SG1024/SA**
- **StarFire™ SG1024/MA**
- **StarFire™ SG1024/LA**

OVERVIEW

ZIMMER AUSTRIA offers 3 different models of the new high-performance industrial inkjet print heads from FUJI-Dimatix (ex Spectra). The **StarFire™ SG1024 (SA/MA/LA)** is a compact, self-contained unit built to withstand demanding industrial textile and other applications. It uses field proven materials to deliver consistent output over a long service life with continuous ink recirculation and single color operation at 400 dpi. Equipped with a single replaceable metal nozzle plate that is designed to withstand abrasion and resist damage.

TECHNICAL.FEATURES

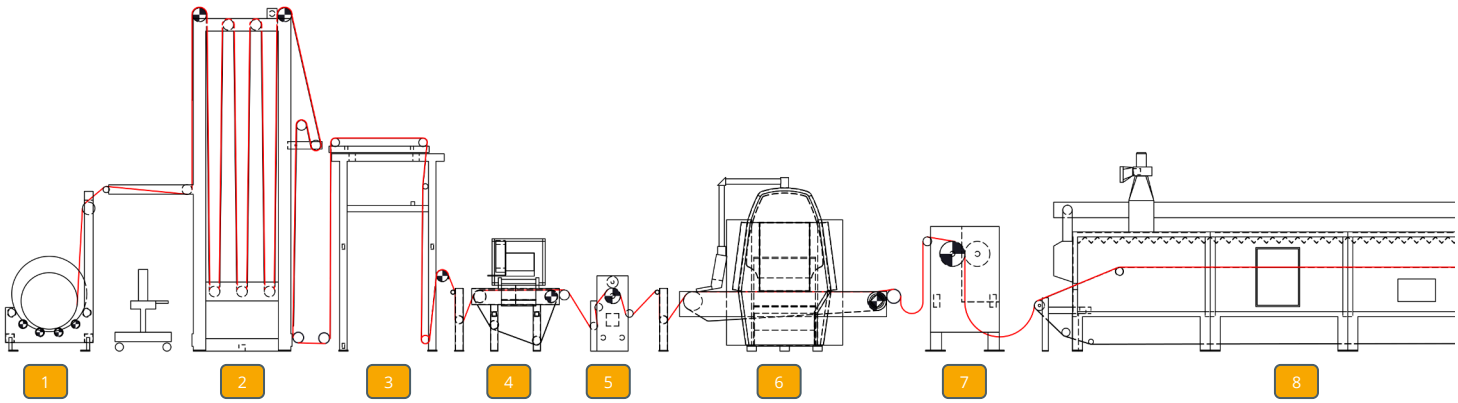
- 3 types of interchangeable print heads with different dropsizes for a wide range of applications
- Robust and reliable construction for industrial use
- Metal nozzle plate - highly resistant
- Nozzle plate and 256 jet segments can be replaced
- **VersaDrop™** Incorporated binary and greyscale jetting modes
- **RediJet™**- Continuous ink recirculation system to avoid nozzle blockage and to reduce ink waste from spitting and purging
- High firing frequency - for high productivity
- High drop velocity - distance between printhead and nozzle can be up to 10 mm

InkJET is moving from an experimental stage into industrial stage!

It is not so important who has the highest resolution or the lowest cost - the winner will be who has the most reliable, stable and flexible system!

PRINT HEAD MODELS	StarFire™ SG1024/SA	StarFire™ SG1024/MA	StarFire™ SG1024/LA
number of addressable jets	1,024	1,024	1,024
waveform & fluid dependent drop size	12 - 35 pl	30 - 75 pl	75 - 180 pl
applications	**Light & medium fabrics** i.e. fashion, home textiles, flags & banners, …	**Heavy textiles** i.e. velour, plush, terry products, nonwoven, ...	**Voluminous substrates** i.e. carpet, fur, blankets, ...

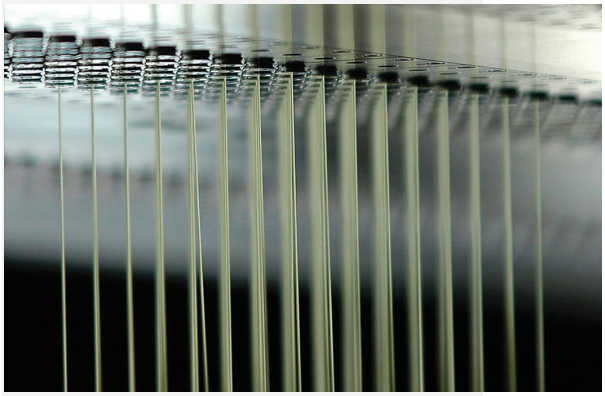
COLARIS^{3}.INDUSTRIAL INKJET PRINTING ON CARPET



COLARIS^{3}.LINE - WITH **CHROMOJET** INLINE DIGITAL PRE-TREATMENT

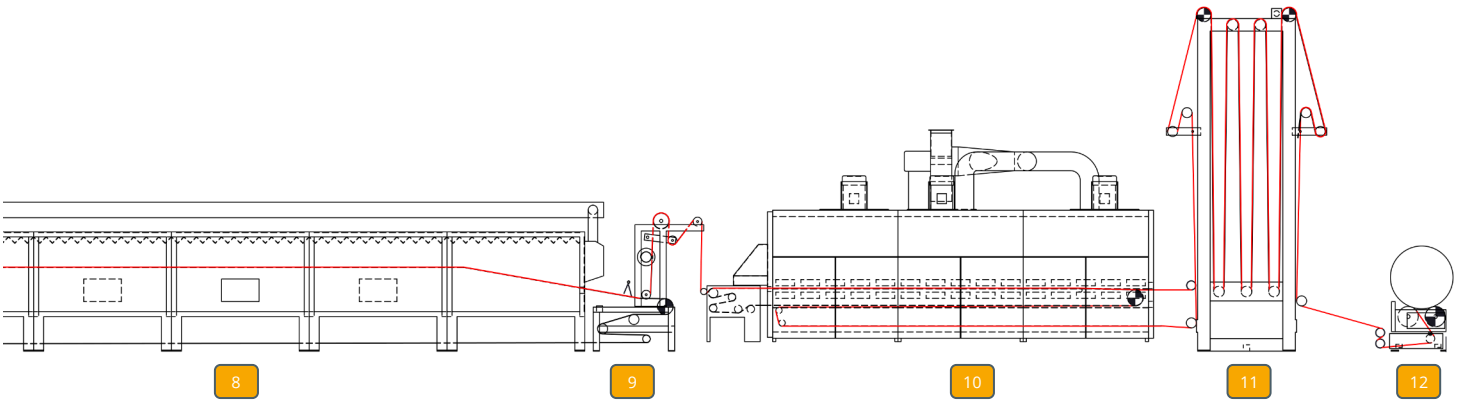
A combining of the **CHROMOJET** valve based digital INKJET printing line, successfully used in the carpet printing industry for many years, with the **COLARIS**^{3} digital piezo based INKJET printer makes it possible to push the print resolution beyond any limit known so far.

The **CHROMOJET** technology is used as a digital applicator for INKJET pre-treatment. The applied pre-treatment, equally distributed in the pile fabric by a penetration roller is subsequently printed with the **COLARIS**^{3}.INKJET piezo printer in a wet on wet process.



This specially developed process combines the advantages of both systems: perfect penetration by **CHROMOJET** technology and high resolution printing by **COLARIS**^{3}.INKJET piezo printer.

Print resolution can be 800 dpi or more. A large color gamut with highest image quality including fine degradation of colors are the benefits. This makes the reproduction of photographic images much easier by using a real four-color printing with CMYK process colors.



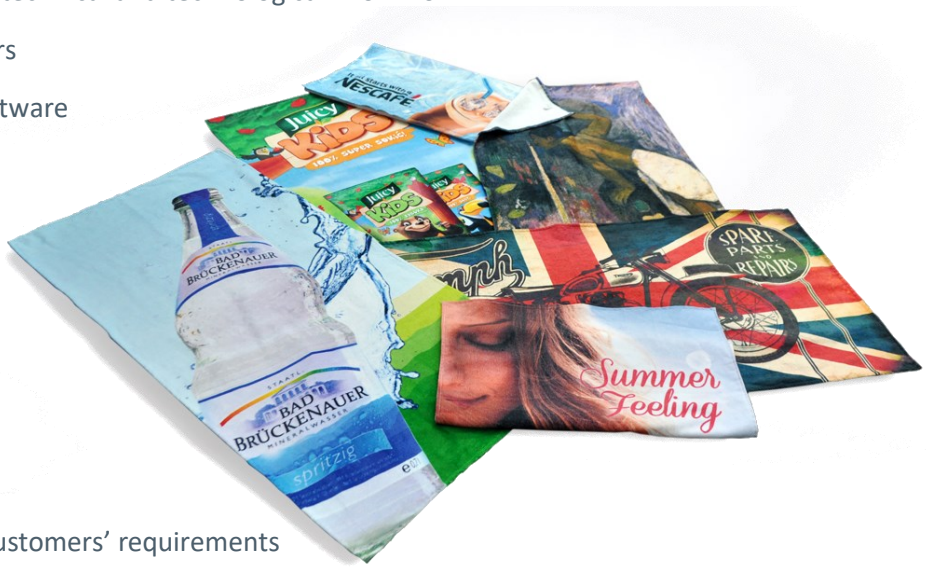
COLARIS³.FINISHING LINE - STEAMING, WASHING, DRYING

The layout of a typical PA carpet printing line for loop or cut-pile carpets will be based on the well-proven components from a **CHROMOJET** print plant.

1. Fabric unrolling
2. Roller compensator
   - (pre-steamer or pre-washer)
3. Carpet centering device
4. **CHROMOJET.**DPT applicator for inline pre-treatment of the carpet
5. Distribution & penetration roller
6. **COLARIS³** digital inkjet piezo printer
7. Press station for enhanced penetration of the print
8. Horizontal inline steamer
9. Carpet washer with vacuum extraction
   - (carpet pile impregnation)
10. High capacity nozzle dryer or stenter dryer
11. Roller compensator
    - Inspection table
12. Re-rolling

COLARIS^3.ADVANTAGES

- High-capacity industrial ink jet printing system for textiles and carpets
- Built for 24/7 operation
- Print head failure does not stop production - printing continues at reduced speed
- Suitable for light weight silk to heavy velour terry towels and carpets
- Recommended inks ensure excellent fastness properties and Oeko-Tex® Standard 100
- Open ink system – any ink approved by **ZIMMER AUSTRIA** can be used
- Open to various RIP Software. i.e. Caldera®, Inedit®, and others.
- Fully assembled printer for easy shipment and quick start-up
- Multilingual user interface
- **ZIMMER AUSTRIA** gives full support with technical and technological know-how
- Customer support by local service partners
- Simple and easy upgrade of hard- and software
- Remote maintenance system included

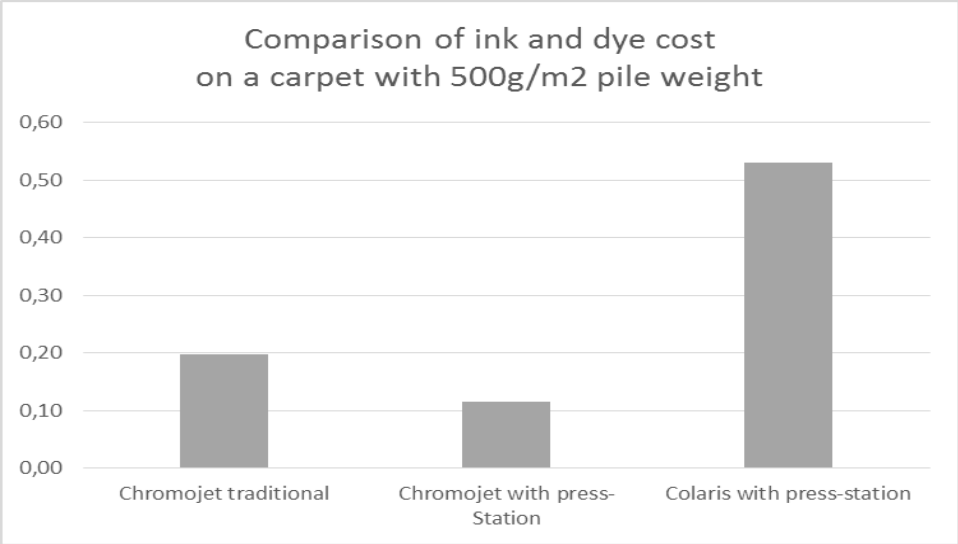


MODULAR.LAYOUT

- Fabric feeding device built according to customers' requirements (A-frame, small batch unrolling, lattice guiding for elastic fabrics, etc…)
- Patented inline pre-treatment by **MAGNOROLL** application system or **DPT** (**D**igital inline **p**re-**t**reatment) with a **CHROMOJET** printer
- Suitable for any fabric structure incl. woven, circular and flat knits, flock, velvets, velour terry fabrics, nonwoven, tufted and many more
- The already existing printing widths 1,800; 2,600 and 3,200 mm have been completed with 4,200 mm width to cover the demand of digital carpet printing
- Ink setup for CMYK, CMYK+2 or CMYK+4 or with 2 x CMYK for double speed printing
- Efficient head cleaning
- Permanent ink circulation system for reduced maintenance costs and reduced ink consumption
- Ink storage tanks with large capacity, allowing refill from any canister size without production stoppage
- Various post-treatment equipment available

COST.DIGITAL PRINTING IN COMPARISON

INK AND **DYE** COST IN COMPARISON



The following parameters were used:

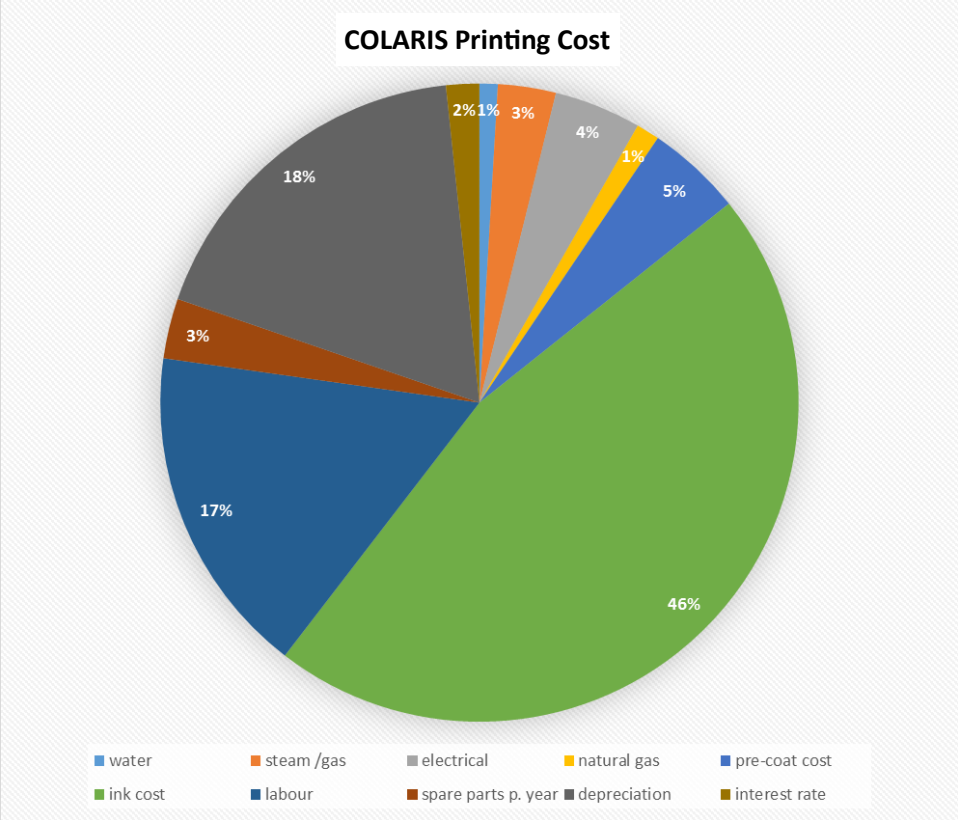
Dye cost	EUR 25,-/kg
Ink cost	EUR 20,-/kg
Dye consumption	1.5% of pile weight
Ink consumption	0.5% of pile weight
Thickener cost	EUR 20,-/kg
Thickener usage	4 g/kg

COST.FACTORS OF INKJET PRINTING

- Investment cost and depreciation
- Cost of energy and utilities (air, water, …)
- Labour cost
- Cost of printheads
- Cost of pre-coat (thickener, chemicals, …)
- Ink cost

In practice there are 3 important cost factors:
Ink, labour and depreciation.

This diagram shows the cost distribution based on a total print cost of about EUR 1.3/m² on 400 g carpet, output about 1 mio m² per year on 2 shift operation, ink cost of EUR 25,-



COMPARISON.DIGITAL PRINTING TECHNOLOGIES

	CHROMOJET 25 dpi spot color printer	**CHROMOJET 50/76 dpi process color printer**	**COLARIS^3 INKJET printer**
System	Spot or pre-mixed color printing using magnetic valves	Process color printing using magnetic valves	Process color printing using piezo inkjet printheads
Resolution	25 dpi	50/76 dpi	400 * 800 dpi 400 * 1,200 dpi
Ink and dye lay-down	500 - 5,000 g/m²	300 - 3,000 g/m²	10 - 200 g/m²
Dye and ink systems	• Acid and pre-met for polyamide, wool and silk • Disperse for polyester • Reactive for cellulose and cotton • Cationic for acrylic and cationic dyeable polyester • Direct for cotton • VAT for cotton		• Acid • Disperse • Reactive • N/A • N/A • N/A
Process	All chemicals and thickener are included in the dye paste		Chemicals and thickener are applied separately from ink
Production speed	Up to 12 m/min at 6 colors and in 4 m width	Up to 3 m/min at 8 colors in 4 m width	Up to 4 m/min at 400 * 800 dpi; 2 passes, 16 heads, in 4 m width
Printing Process			
Polyamide and wool using acid and pre-met dyes **Cationic dyeable Polyester using cationic dyes**	• Printing with about 300 % pickup • Steaming at 100°C for about 3 - 8 minutes • Washing • Drying		• Pre-coating with thickener and acid • Printing with about 5 % pick-up • Pressing • Steaming at 100°C for 3-8 minutes • Washing • Drying
Polyester process using disperse dyes	• Printing with about 75 % dye pick-up • SUPRA**PRESS** • Drying • High temperature fixation at 180°C for 1 minute using steam or hot air • Reductive washing • Drying		• Pre-coating with thickener • Inkjet printing with about 5 % ink pick-up • SUPRA**PRESS** for maximum penetration • Drying • Fixation at 180°C for 1 minute • Reductive washing • Drying

	CHROMOJET 25 dpi spot color printer	**CHROMOJET 50/76 dpi process color printer**	**COLARIS^3 INKJET printer**
Applications			
	• Rugs • Mats with full penetration • Contract carpet	• Rugs and mats • Promotion carpets • Carpet tiles • Polyester / acrylic blankets	• Mats • Promotion, event and exhibition carpets • Carpet tiles
Carpet constructions	• Loop and cut pile from 250 g/m² up to 1,500 g/m² • With SUPRA**PRESS** up to 2,500 g/m²		• Needle-felt • Flocked floorcoverings • Flat weave constructions • Loop and cut pile up to 1,000 g/m²
Advantages / Disadvantages in carpet printing			
	+ Full penetration + Relatively simple process + All types of dyes can be used + Low-cost dyes from many suppliers – More difficult to adjust color shades – A new shade requires a color change – Limited number of shades and colors	+ Full penetration + Almost unlimited number of shades + All types of dyes can be used + Low cost dyes from many suppliers – More difficult to adjust color shades	+ Highest flexibility + Low pick-up + Only 4 colors + No color kitchen – Limited penetration – Limited selection of inks – Limited chance to repair a printhead – Printer must be operated in a clean and controlled environment
Resumee	• **For low to high pile products** • **For medium to long runs** • **For special dyes and effects**	• **For low to high pile carpet in combination with** SUPRA**PRESS** • **For short to medium runs** • **Also for prints on woven carpet** • **Perfect for polyester printing**	• **For low to medium pile weights** • **For small to medium runs** • **Perfect for the promotion and event industry** • **'Web to Print' may be realized**

TRENDS.IN CARPET PRINTING

- DIGITAL PRINTING
- PROCESS COLOR TECHNOLOGY
- **CHROMOJET** OR **COLARIS**^{3}.INKJET TECHNOLOGY
- PRINTING ON POLYESTER
- PRINTING ON WOVEN CARPETS
- ENVIRONMENTAL FRIENDLY PROCESS AND RECYCLABLE CARPETS AND RUGS
- MORE EXPERIMENTAL AND INDIVIDUAL DESIGNS
- SPECIAL CONSTRUCTIONS AND MATERIALS
- SHORTEST RUNS
- SAMPLING WITHIN A DAY
- SHORT DELIVERY TIME OF A FEW DAYS

Zimmer AUSTRIA

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