# THE NEW INDUSTRIAL UV INKJET, GALLUS LABELFIRE 'TUBE EDITION'

## Dieter Finna, founder of pack.consult, discusses the product development of Gallus Ferd. Ruesch AG's new printing system and explains the steps it took to get there

Printing on tube laminates using UV inkjet printing poses several application-specific challenges. The tubes, which are bent and crushed during squeezing, require a flexible ink film. The film must adhere well to the substrate, without cracking during handling and needs to meet all compliance requirements. In addition, the cost-intensive substrate requires a machine design that includes the shortest possible web paths as well as the option of print finishing.

Fortunately, Gallus Ferd. Ruesch AG was able to adopt some of the solutions from the results of another development project. On folding cartons, where the solids extend beyond the ink edges, there are comparable requirements for the flexibility of UV inkjet inks as for tube laminates. The challenge lies in preventing the UV inkjet film from cracking under mechanical stress. For a long time, the only way to avoid this was to not use solids that extended beyond the folds in the packaging design.


*Digitally printed tube designs with flexible UV inkjet ink*

### UVF01 INK SYSTEM

For this reason, at the beginning of 2019, Gallus launched the 'Flexible UV Inkjet Ink' project for folding carton printing along with a well-known brand manufacturer. This complex development project took three years to complete, including all the development steps, suitability tests and six months of ink qualification. For product qualification, the brand manufacturer printed more than 900km of board on a Gallus Labelfire 340 and produced around eight million blanks.

***"During the tests, we found that the adhesion and flexibility of the new flexible UV inkjet ink showed good values. The digitally printed tube material could be processed in the same way as conventionally printed material"***

The criteria required that the ink film be fully cured at a printing speed of 70m/min together with a scratch-resistant, flexible ink film. In the packer test, blanks printed over the entire surface needed to be processed at 1,000 packs/min without ink cracking. In addition, the UV inkjet printing ink had to pass the sensory test programme in the tobacco sector and fulfil all the requirements in the Regulatory Compliance

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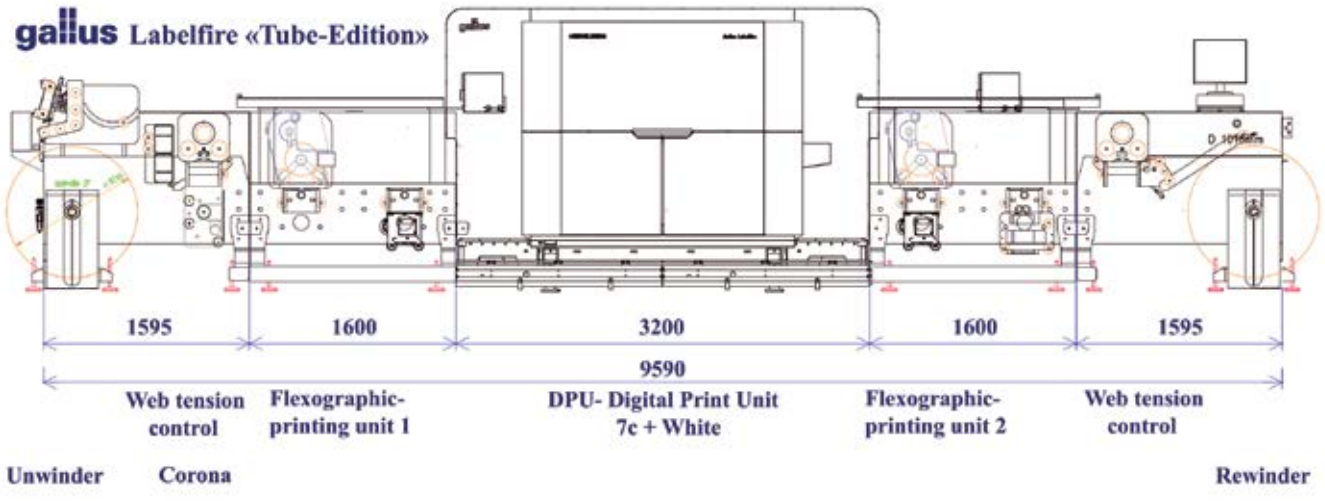



*The press layout of the Gallus Labelfire 'Tube Edition' shows the centrally-located UV inkjet digital-printing unit DPU with an upstream and a downstream flexographic printing unit*

### PERMAPACK AG

The family-owned company, founded in 1958 and headquartered in Rorschach, Switzerland, is divided into 'Labels & Flexible Packaging' and 'Construction, Industry, Retail'. Labels and packaging are printed in the in-house print division, with a growing share of laminate films for tube production. The target markets are the non-food, food and cosmetics sectors.

Collaboration with Gallus in the print sector dates back to the company's early days and continues to find expression in innovative products. To this end, Permapack's printing experts make use of the technical possibilities offered by the company's modern machinery and creation of highly unusual designs and products. The European Tube Manufacturers Association (ETMA) named Permapack's paper tube 'Tube of the year 2021' in the sustainability category

& Toxical Assessment. The UV inkjet ink system developed in the project – 'UVF01' – passed the tests and has been released for commercial production in the brand manufacturer's folding box production since the beginning of 2022. These results provided the prerequisites needed for a tube-laminate printing solution.

## MODIFICATIONS NEEDED

Modifications to the drying technology and web guide of the Gallus Labelfire 340 were necessary to use the UVF01 ink system. The latter had to be designed for the shortest possible web paths for the cost-intensive substrate.

In the Gallus Labelfire version for the new flexible UV ink system, UV-LED curing systems replace the mercury vapour lamps. The advantage of UV-LED technology is that the energy penetrates the ink layers more effectively due to the high intensity of the UV-A beams. This results in more uniform curing.

## HEAT-FREE DRYING AND CURING

Due to the high intensity of the UV LEDs, the use of boosters to intensify drying is no longer required. This means that the temperature-sensitive tube laminate can be processed without heat effects. Inert gas is used for fast and complete curing of the ink film so that cross-linking in the inert chambers takes place in the absence of oxygen. Nitrogen is used instead in the sealed environment. The oxygen content in the inert chambers is continually monitored by sensors and kept below 500ppm. The increase in curing performance achieved, as well as the reactivity of the photo initiators, results in complete curing of the ink film at a printing speed of 70m/min. Additionally, a very good adhesion of the ink to the substrate is achieved without the use of primers.

## OPTIMISATION

The machine layout of the modular Gallus Labelfire 'Tube Edition' was designed to keep the web path in the machine as short as possible. Therefore, only a single rewinder is used instead of a double. When selecting the flexographic printing units, Gallus opted for the ECS series. The main advantage of these printing units is that they have an ultra-short web path of just 1.1m from printing nip to printing nip, which significantly reduces waste during make-ready and production. Given the high material costs of tube laminates, this is a major factor for increased profitability in the printing process.

***"The Gallus Labelfire 'Tube Edition', together with the flexible UVF01 inkjet ink, presents itself as a pioneering alternative to purely conventional tube printing"***

The servo-driven Gallus ECS printing units also allow for maximum substrate flexibility when using different thicknesses of laminates. The press layout of the Gallus Labelfire 'Tube Edition' features the centrally arranged UV inkjet digital-printing unit DEU (Digital Embellishment Unit), with an upstream and a downstream flexographic printing unit. The arrangement combines high print quality in digital printing, with the cost benefits of flexographic printing, even for motifs with high ink coverage. The upstream printing unit is used to apply spot colours, cold foil or a primer (if required), while the downstream unit is used to apply the protective coating over the entire surface. At the user's request, the digital-production system can be supplemented with an additional cold foil unit.

**PBL (Plastic Barrier Laminate)**
**Made of plastic in several layers and contains a barrier layer of EVOH (Ethylene Vinyl Alcohol).**

**ABL (Aluminium Barrier Laminate)**
**Between the plastic layers, the laminate has a thin aluminium layer and is often used for high-quality pharmaceutical products and cosmetics.**

**Paper (Paper Tube)**
**It consists of a paper composite with over 2/3 cardboard or cellulose, with a barrier on the inside.**

**PP (Polypropylene)**
**Is used as a pure material and can be completely recycled after use.**

*Structure and properties of the tested tube laminates*

## DIGITAL AND CONVENTIONAL SAMPLING

Once the press concept and the ink series were available, the next step in the project was a practical comparison of digitally and conventionally printed tubes. This allowed an evaluation as to whether, or to what extent, differences between the designs were recognisable based on defined quality criteria. To this end, Permapack AG contributed its printing expertise in laminate printing to the project, producing the conventionally-printed tube samples. These were printed on a Gallus RCS 330 as a benchmark for digital printing and joint assessment.

The digital benchmark samples were printed on a Gallus Labelfire 340 running in industrial use, equipped with the UVF01 inkjet series and modified dryer technology. The designs for the benchmark and the

| | Abrasion | Adhesion Tape Test | Scratch Test | Water Crease Test | Aceton Test | Ageing 1 5x 180 degree | Ageing 2 10x sharp edge |
|---|---|---|---|---|---|---|---|
| PBL¦350µ¦ White Gallus Labelfire | 1 –very good | 1 –very good | 1 –very good | 1 –very good | 1 –very good | 3¦3 | 1 –very good |
| ABL¦350µ¦ Silver Gallus Labelfire | 1 –very good | 1 –very good | 1 –very good | 1 –very good | 1 –very good | 2¦3 | 1 –very good |
| Paper¦333µ¦White Gallus Labelfire | 1 –very good | 1 –very good | 1 –very good | 1 –very good | 1 –very good | 2 | 1 –very good |
| | | | | | | | |
| PP*¦ 300µ¦ Trans Gallus Labelfire | 1 –very good | 1 –very good | 1 –very good | 1 –very good | 1 –very good | 4 | 1 –very good |

*PP substrates are UV radiation sensitive: will become brittle with too heavy UV radiation dose => application development required

*Fastness properties of the UV inkjet ink series UVF01 on various laminates*

different tube laminates were selected according to typical market requirements.

The test results with the UVF01 inkjet ink showed excellent results across all fastness requirements for the tube laminates PBL and ABL. These are predominantly used in the market, as well as on paper laminate. The evaluations exclusively show results in the '1 – very good' range.

"During the tests, we found that the adhesion and flexibility of the new flexible UV inkjet ink showed good values. The digitally-printed tube material could be processed in the same way as conventionally-printed material," commented Günther Forster, Prepress Manager, Business Unit Printing Product Manager Cosmetics at Permapack AG. Only the digitally-printed PP laminate, which is used to a very limited extent on the market, showed a deviation in the ageing test. With PP laminates, printing conditions and inkjet inks still needing some modification.

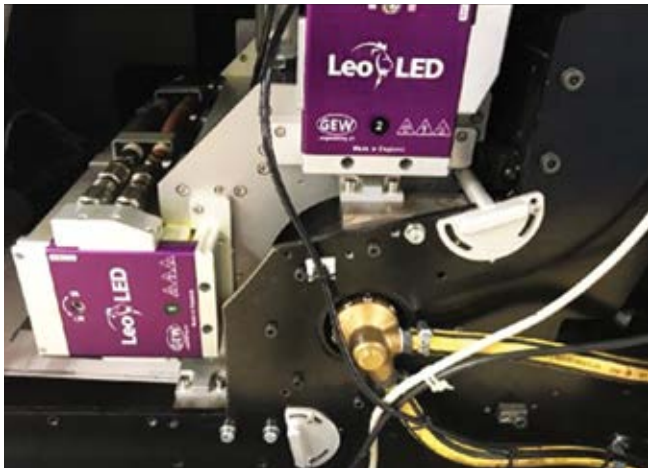
## CONCLUSION

The Gallus Labelfire 'Tube Edition', together with the flexible UVF01 inkjet ink, presents a pioneering alternative to purely conventional tube printing. Thanks to the high native resolution of 1200x1200dpi, digital printing can score points in terms of print quality by outperforming the motifs usually printed in 54 screens in flexographic printing.

Besides print quality, the economic efficiency of a production system is the decisive criterion for its industrial use. Here, the machine system meets a commercial situation in which run lengths in the tube market are declining. In short to medium run lengths digital printing demonstrates its strengths. A break-even analysis of the costs of the print samples, shows that the digitally, conventionally-printed runs – up to a length of approximately 5,000 running metres – are cheaper to produce than purely conventionally-printed tubes. With a standard tube of 200ml, this corresponds roughly to a quantity of 53,000 tubes and is considered an average run length in tube printing.

This project provided all of the evidence that qualifies the flexible UV inkjet ink for use in tube printing. This means that the Gallus Labelfire 'Tube Edition' and the UVF01 inkjet series are now ready for use in industrial laminate printing. ■

***Dieter Finna is the Founder of pack.consult***




*UV-LED curing systems are used for printing tube laminate*

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