DIN 33871-1: Rebuilding of Used Inkjet Printheads and Compatibles for Inkjet Printers

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Abstract

A great deal of testing is necessary in the field of inkjet products. Since no useful official standards for the testing of inkjet printers and consumables are available, each company and test institute is developing its own test methods and test charts. As a consequence, we are seeing an uncontrolled growth of test procedures. It is thus impossible to compare results.

This was the reason behind the decision of the "Information Technology - Office Equipment Committee" (NI28) of the German Institute for Standardization (DIN) to start the development of standards in this field. The first project in this area was a standard for the rebuilding of used inkjet printheads and ink cartridges.

This paper explains the motivation for the test standard. Furthermore, an outline of the DIN 33871-1 standard is given with all definitions, a description of the minimum requirements for the refill process, product signatures, etc. Special emphasis is directed to the test charts for quality and yield measurements. The elements of the test charts are described and a comparison of several test results is presented. The test method for the light fastness is discussed as an example.

Introduction

Inkjet products have been a fast-growing market for more than 20 years. Many companies are interested in inkjet printers, ink, special papers, transparencies, ink cartridges and other consumables. In the development of these products great efforts have been made to optimize the performance and quality. To this end, very many tests are carried out during the development and production phases. Later, if these products enter the market, test magazines, test institutes and consumer associations will conduct further investigations. They examine the products thoroughly and present the results in the form of a comparison.

However, since no comprehensive standards exist, each test institute develops its own testing program. This has produced countless different test procedures from which the individual results are not comparable.

The German industrial standard presented within the framework of this lecture should offer a remedy for a specific range of products. DIN 33871-1 deals with the refurbishment of used inkjet printheads and ink cartridges. This is the first step towards gradually developing more general standards for the field of inkjet printers and their related consumables.

History

The "Dr. Grauert" letter is well known in the print technologies sector. It is used in many different ways. Yield information, for example, is often given in terms of Dr. Grauert pages. The sharpness of letters and the start-up behavior of inkjet printheads is also often tested on the basis of the Dr. Grauert letter.

Originally, however, the Dr. Grauert letter was developed to determine the writing speed of typewriters and textmachines[1] and as an example of a business letter in A4 format[2]. It is widely thought that the Dr. Grauert letter has an area coverage of 5%. Investigations have shown that this is not the case, however. Moreover, the font for the printing of Dr. Grauert is not defined at all. As a font specification the standard contains only a division of 2.54 mm (10 cpi) and a line spacing of 4.23 mm.

No applicable standards are available at all for many other test criteria which are important for inkjet consumables. Every tester therefore specifies his own internal procedure. So, for example, some test magazines contain statements about the saliva and perspiration sensitivity of inkjet printouts. The testing of these criteria is meaningful and necessary. Since everybody imposes individual methods, however, no uniform and comparable quality predicate can be established.

Different groups are thus developing standards for inkjet printers, but each of these deals only with single method.[3-6] Moreover, in most cases these are test standards which do not relate to a quality specification for a product. But for the customer, product quality is important. A quality standard for a product group is therefore needed.

These conditions prompted the NI28 standards committee to compile uniform quality and test standards for the "consumables for inkjet printers" field. After a standard for the remanufacture of toner modules,[7] the "remanufacture of inkjet printheads and ink cartridges" project was tackled. It is true that the area of application of this standard is limited to the refurbishment of used inkjet compatibles and

printheads, but the quality definitions and test methods described are fully applicable to new original consumables.

The first inkjet standard from the NI28 group was compiled and discussed for a period of more than three years. In addition to Pelikan Hardcopy International, the work involved numerous other renowned manufacturers of inkjet consumables, corresponding test institutes and consumer organizations. DIN 33871-1[8] is due to be published in July 2003 as an official standard. As the designation "-1" would indicate, it should become the first standard of a series.

Objective of DIN 33871-1

Different aims were pursued during the development of DIN 33871-1. One of these was to define technical terms which are usual in the inkjet field. Only when there is a regulation in unambiguous language do results become comparable. Since the remanufacture of used ink printheads and ink cartridges is treated in the standard, minimum requirements for the preparation process should also be defined. Compliance with these requirements is the only way in which to guarantee optimum product function.

The non-toxicity of inkjet inks is a recurring topic. This area, together with environmental aspects, should thus be addressed by the standard. Another requirement of the users of inkjet consumables is unambiguous product labeling. Attention was also given to this area.

The most important purpose of DIN 33871-1, however, is the definition of test methods for various qualitative and functional aspects of inkjet consumables. Only by having clearly specified test procedures is it possible to achieve comparability for different specimens. A great deal of effort was also devoted to the feasibility of the tests.

It should be possible for the end user to reproduce the reported results without undue expenditure. Visual comparisons, for example, were thus imposed normatively for color reproduction, while the color-metric procedure is described in the appendix and must be applied only in the case of certain tests and in the event of disparity.

Where the test methods are concerned, particular value was attached to the measurement of the yield, the different print quality criteria and the long-term stability of product and printout. A master was even created for the test report in order to produce effectively comparable results.

Almost all tests were defined as comparative tests, i.e. product “A” is compared to a similar product “B” with regard to a certain characteristic. Therefore only relative statements are made. Setting up an absolute test would require the definition of many additional parameters and it would thus become considerably more complicated. With relative measurement, the definition of these necessary parameters can be reduced to a minimum. Furthermore, such absolute information is not necessary for the remanufacture of inkjet printheads and ink cartridges. The original printhead or ink cartridge is always used as a benchmark. This has been standard practice in the past within the remanufacturing industry.

Content of DIN 33871-1

In order to reach the goals described above, DIN 33871-1 comprises the following chapters:

1. Scope of the standard
2. Normative references
3. Definition of the terms, that are used in the standard
4. Process definition for the remanufacture of inkjet printheads and ink cartridges
5. Requirements for remanufactured inkjet printheads and ink cartridges
6. Procedure for sampling
7. Execution of the tests
8. Test report
9. Required labeling on product and packaging
10. Type of packaging and storage instructions

The description of the tests occupies the largest part of the standard. Two test charts have been developed for use in the individual experiments. The standard also describes clearly how and under what environmental conditions the methods must be executed. The type of paper, driver adjustments, etc. are also prescribed so that a reproducible experiment can be carried out. In this sense the following tests are described:

1. Mechanical function
2. Start-up behavior
3. Material compatibility
4. Ink-mixing ability
5. Storage stability
6. Yield
7. Color reproduction
8. Light fastness
9. Smear resistance
10. Staining (offset)
11. Water drop solidity
12. Strike through
13. Bleeding
14. Feathering
15. Banding
16. Starvation
17. Cockling

Ideally, an individual test pattern would be developed for each of these tests. However, this would massively expand the scope of the standard and complicate the methods. For this reason, an attempt has been made to manage with two test charts. Test chart 1 (Figure 1) contains all elements that are necessary for the quality tests. Test chart 2 (Figure 2) is intended for functional tests and determining yield. Test chart 1 contains seven different elements. The individual methods describe clearly which of these elements is to be used for which test. This framework becomes clearer if we examine an example of a described test procedure in more detail. Let us therefore take a closer look at the way in which light fastness is determined.

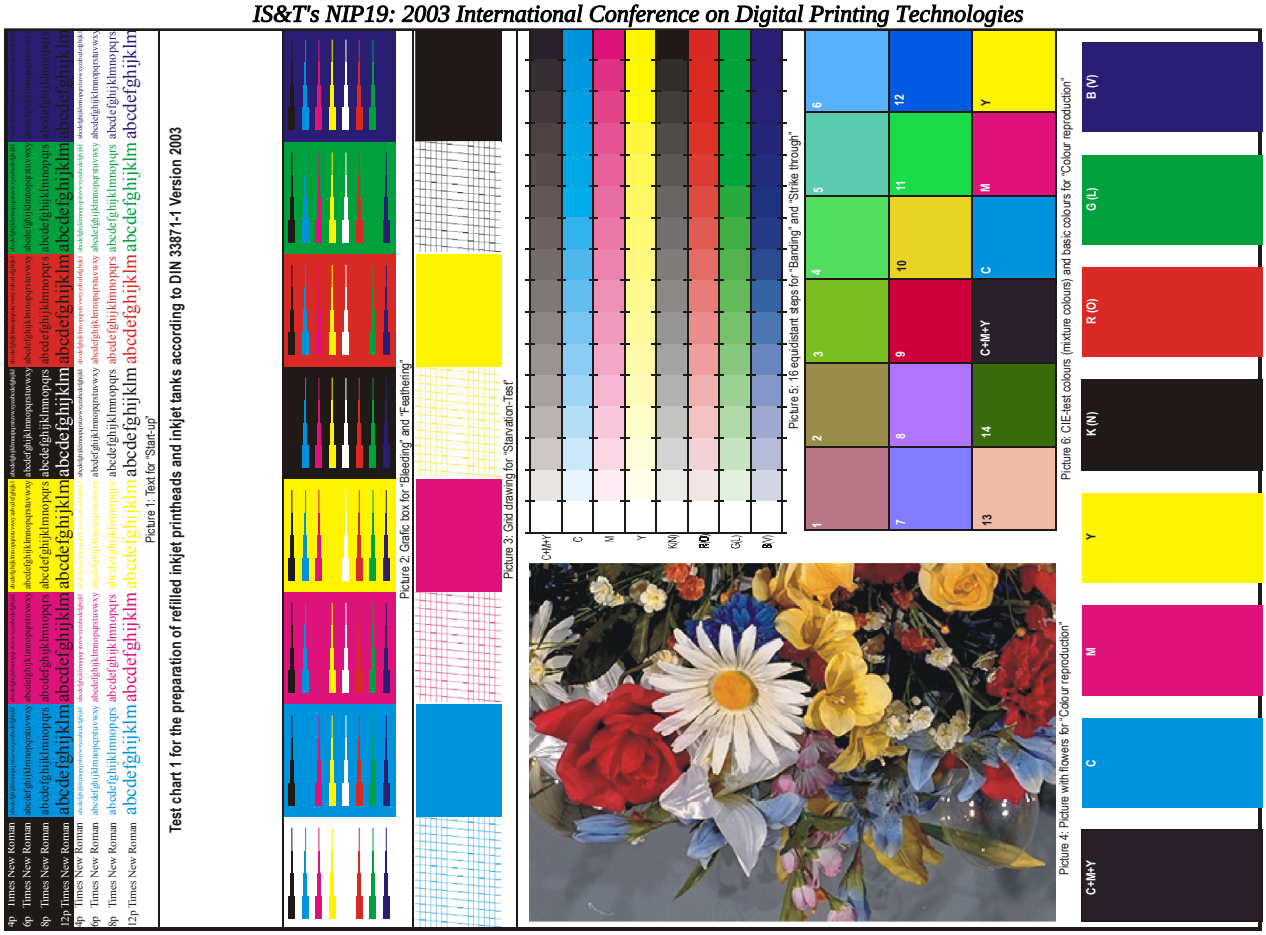

Figure 1: Test chart 1 for quality test procedures

Figure 2: Test chart 2 for yield measurements

Light Fastness

Light fastness tests are well known from sectors such as the textile industry.[9] DIN 33871-1 uses several aspects of these available methods and adapts them in simple form to the field of inkjet consumables. Also the appliances of the existing standards are used, albeit in a slightly different process.

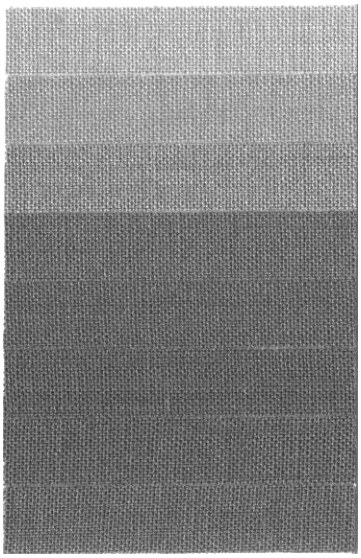

Figure 3. Wool scale according to ISO 105-B02

This experiment requires printouts of picture 7 in test chart 1. Other resources needed are a strong light source, a wool scale[10] (Figure 3) and a grey standard[11] (Figure 4).

The method is explained as follows: "The light fastness of colored printouts is examined in the three color surfaces with the basic colors C, M, Y in picture 7 of test chart 1. These colored areas are exposed alongside the light fastness types as set out in ISO 105-B02 and under the same conditions to a light source as described in 7.1.4 Half of all elements are under a lightproof cover. They continue to be exposed to the light, with the covering occasionally removed in order to judge the changes on the wool scale. When there is a contrast between the unexposed and the exposed part of the light fastness type 5 of the wool scale corresponding to number 4 of the 5-stage grey scale standard as per ISO 105-A02, exposure is complete. The contrast is then determined according to 7.5.2.1" (Figure 5).

The wool scale is used as the calibration method. Under the terms of the standard, different sources of light may be used. The grey scale serves to define the duration of illumination. Compared to a lamp with higher light density, a weak lamp needs a longer exposure time to achieve the required decolorization of the wool scale.

Decolorization of the printed areas is also judged visually with the help of the grey scale. However, the test result is not this decolorization but the comparative values of test product and reference product.

It is clear that, in addition to exposure to light, there are other factors which affect this test: Humidity, temperature, ozone concentration in the air, etc. For an absolute test it would be necessary to fix and maintain these and many further parameters. In order to avoid this expenditure, the described method is comparative. The test and reference product are tested simultaneously and the "uncontrolled" parameters are therefore the same for both. The final result of the test is also represented only relatively, as it demonstrates the extent to which the test product is better or worse than the comparison product.

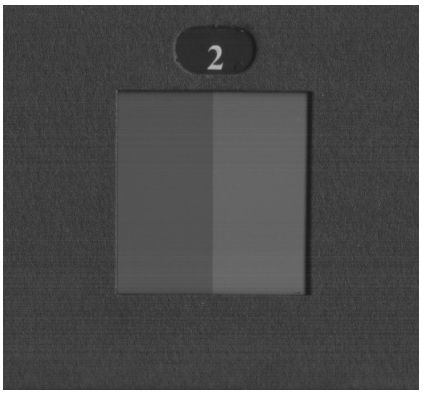

Figure 4.Grey standard according to ISO 105-A02

Obviously the test product and benchmark may react differently to the uncontrolled parameters. For example, a rise in air humidity will not necessarily have the same effect on the test and reference product. Test results might therefore diverge as a result of major changes in the uncontrolled parameters. For this reason, in accordance with the standard, the value of these parameters must be documented during the test.

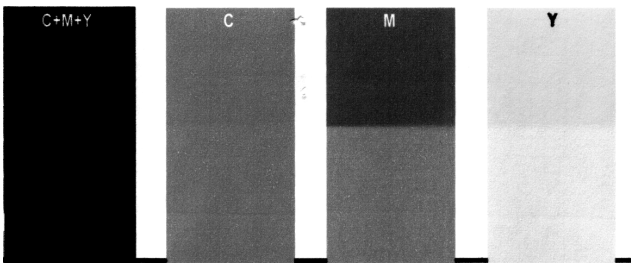

Figure 5. Printed areas of picture 7 after the light stability test

This is only one example of 17 described test methods which must be carried out in the analysis of a remanufactured inkjet product. Only if all 17 tests are passed within a certain tolerance can the product be distributed as produced in accordance with DIN 33871-1. These tests are not restricted to the development stage of the product – the quality of each individual product that reaches the market must fulfill the criteria described in the standard.

It is beyond the scope of this paper to look into all of the separate tests and criteria. The example described here serves as illustration of the approach. For a more detailed description of test methods and parameters, please refer DIN 33871-1 itself.

Conclusion

DIN 33871-1 was compiled by the NI28 standards committee of the German Institute for Standardization to harmonize the test methods for inkjet consumables. For this reason and others, 17 comparative testing methods have been defined which enable both the qualitative and functional characteristics of remanufactured inkjet printheads and ink cartridges to be examined. This is intended to be the start of a series of standards that harmonize testing methods for inkjet consumables and give quality criteria for inkjet printheads and ink cartridges.

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Biography

Joachim Kretschmer is manager of the Inkjet R&D department at Pelikan Hardcopy Production AG, Egg, Switzerland. He joined the company in May 1993 and is involved in new product development, test infrastructure, printhead analysis, product and print quality.

He previously worked for four years at Mannesmann Tally, Germany, a major printer manufacturer. During this time he gained experience in inkjet printing and electrophotography.

As a physicist, he gained his degree from the University of Ulm, Germany. Mr. Kretschmer is author of several patents and publications in the inkjet and electrophotography fields.