The Eye Listens Too

Simultaneous Colour and Gloss Measurement for Hi-Fi Components Using the color-guide gloss

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A uniform colour and an even gloss count as decorative quality features and play a key role in purchasing decisions. To supply a full description of the appearance of a plastic surface, or to precisely analyse the reason for visual differences being perceptible, it is necessary to determine both the surface colour and the surface gloss.

The days of purely visual, and hence subjective, sampling of plastics parts are now gone. The results were always influenced by individual appraisals and the personal experience of the test engineer. Added to this came varying ambient conditions and people's inability to communicate and document the colour and gloss values.

With the rapid developments taking place in metrology at present, these interference effects are a thing of the past. Today, state-of-the-art technologies make it possible to unite the different measuring systems for colour and gloss in a just a single unit. This means that reliable, easy-to-operate and inexpensive measuring units are now available for quality assurance to ISO 9000. This is particularly important if different parts making up the finished products are manufactured in different production shops within a company or even come from different suppliers. Despite this, the finished part is still ultimately required to have a harmonious appearance.

Color-guide gloss for Quality Assurance

The advantages of the innovative color-guide gloss system for quality assurance are also being exploited by the Philips Assembly Centre in Hungary. Each year around 10 million video, CD and DVD recorders are produced in Székesfehérvár by some 12 000 employees, on premises totalling 22 000 m². In order to secure the company's global lead in consumer electronics for the future too, Philips has been using the color-guide gloss in Székesfehérvár since last year. A harmonious appearance is a key quality characteristic for hi-fi equipment, since end users often stack a number of individual units to form a tower. A further problem is that individual units also incorporate different assemblies, such as knobs and flaps. These parts come from different suppliers, however, and are then assembled at Philips. Ninety percent of the housings for the video and DVD recorders and televisions are in black-pigmented ABS, painted in the desired colour. If the injection moulding machines are not correctly set, then this will influence the layer thickness of the paint that is applied. If an insufficiently thick coat is applied, the dark substrate may even shine through in some cases and have a detrimental impact on the colour shade.

Before the decision was taken to purchase the color-guide gloss, quality control was performed on a purely visual basis. This was a highly subjective appraisal and led to discussions in a number of cases. These are now a thing of the past. With the aid of the color-guide gloss, Philips was able to set up an objective quality control system, since the company's key suppliers also use this unit.

CIELab System for Specifying the Target Colour

A painted plastic plaque is used to specify the target colour, which is then measured and stored on the color-guide gloss (Fig. 1). Both the suppliers and Philips can then compare the parts supplied with this "master standard". Use is made of the widespread CIELab colour system. This comprises axes a* and b*, which are at right angles to each other and define the colour shade. The third axis denotes the brightness L*. This is perpendicular to the a*b* surface (Fig. 2). The target colour is precisely defined through coordinates L*a*b*, enabling the parts produced to be compared on this basis.

In many cases, only the overall colour distance dE* is employed to assess a colour deviation. In order to establish the cause of the deviation, however, it is important to make use of the individual components of da*, db* and dL*: da* provides information on greener/redder, db* assesses blue/yellow and dL* indicates whether lighter/darker.

Philips has specified limit values, known as tolerances, to enable a good/bad statement to be made. These are the maximum permitted deviations. They can be saved in the color-guide gloss together with the standard, enabling the unit to perform the good/bad evaluation on an automatic basis. It is not therefore necessary to be a colour or gloss measurement expert, since the unit is very easy to handle and can be reduced to just a small number of options. In order to achieve a representative statement on the part being tested, measurements are generally conducted at several different points – up to ten in all – as a function of part size. The number of measuring points is specified in the color-guide gloss, and the unit automatically establishes the mean value. In this way, a check can also be conducted on the uniformity of the coat of paint.

Colour and Gloss Measurement in a Single Unit

The degree of gloss is also checked by Philips in the same way as the colour. Gloss is the term used to denote the image forming quality of a surface, i.e. the ability to reflect objects in a recognisable manner. On flat, perfectly smooth, polished surfaces, the images are reflected distinctly. Rough surfaces, by contrast, do not have such a high reproduction capacity, and a reflected object will not be clear but blurred instead.

Both colour and gloss influence the visual impression. Figure 3 shows a black plastic plate made of the same material, i.e. with identical pigmentation, but dif-

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ferent gloss levels. It is evident that the side with the higher degree of gloss appears darker and more saturated to the human eye than the matt side. This is why it is so important to measure the two criteria separately. Otherwise, there is a danger of this visually perceptible difference being interpreted as a difference in the colour shade, even though it is actually due to a different degree of gloss. This would be fatal, since a completely different approach would need to be adopted to rectify the difference.

The portable color-guide gloss provides the plastics processor with a new, state-of-the-art aid, which performs a colour and 60° gloss measurement at one and the same time, in conformity with international standards. In this way, the reason for a deviation can be determined on a precise basis, and the measuring and evaluation time is also halved.

Table 1 shows both the colour and the gloss values for the matt and glossy surface of the plate in Fig. 3. It is clear from the figures given that there is no deviation in colour shade. The overall colour distance of dE* is virtually non-existent, at 0.10. The visually perceptible difference is due solely to the gloss differential of some five units.

Opacity Measurement for Acrylic Glass Components

A further field of application for the color-guide gloss on hi-fi components is in the field of front panels. These are frequently made of acrylic sheet, which is partially printed on the rear. This is designed to give transparent and covered areas. In order to check the degree of cover achieved with the coating, its opacity (hiding power) is determined (Fig. 4). To do this, the panel being checked is placed on a black-and-white contrast card and the extent to which the substrate shines through is measured. The ratio between the lightness on top of black and the lightness on top of white gives the opacity as a percentage. An ideally-covering product has an opacity of 100 %, in other words, there is no visually perceptible difference between the black and a white background. The lower this value, the more the background shines through. Apart from attaining a certain covering power, it is also important for the values to remain constant over the entire width of the panel. Figure 5 shows the opacity measurement results at ten different measurement points. Opacity can very readily be tested with the color-guide gloss. All that needs to be done is for the opacity mode to be set, and the user is then guided through the measurement routine – measurement on black and measurement on white. The unit connects up directly to the MS-Excel program, permitting rapid and professional documentation. The results can be further processed as required.

Thanks to the color-guide gloss, Philips/Hungary is in a position to ensure that its high-grade hi-fi products offer a uniform appearance. By having a simultaneous colour and gloss measurement performed by a single unit, the evaluation time is halved and hence the control of incoming parts greatly improved. Company suppliers who use a color-guide gloss are also able to improve their production control and – as a result of this – reduce the number of complaints. A quality control system can only function if both ends of the chain speak the same objective language. color-guide gloss constitutes an appropriate aid here.

	Glossy	Matt	Differences
color-guide gloss			
L*	28.12	28.22	0.10
a*	0.05	0.08	0.02
b*	0.06	0.04	0.01
			dE* = 0.10
60° gloss	8.6	3.3	

Table 1. From the colour and gloss values for the matt and glossy surfaces, it is evident that there is no deviation in colour shade

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Fig. 1. Objective quality control using the color-guide gloss

Fig. 2. The frequently-used CIELab system

Fig. 3. The glossier surface appears darker and more saturated

Fig. 4. Color-guide gloss for checking hiding power

Fig. 5. Direct transfer of the measured data to Excel Opazität = Opacity, Messstellen = Measurement points