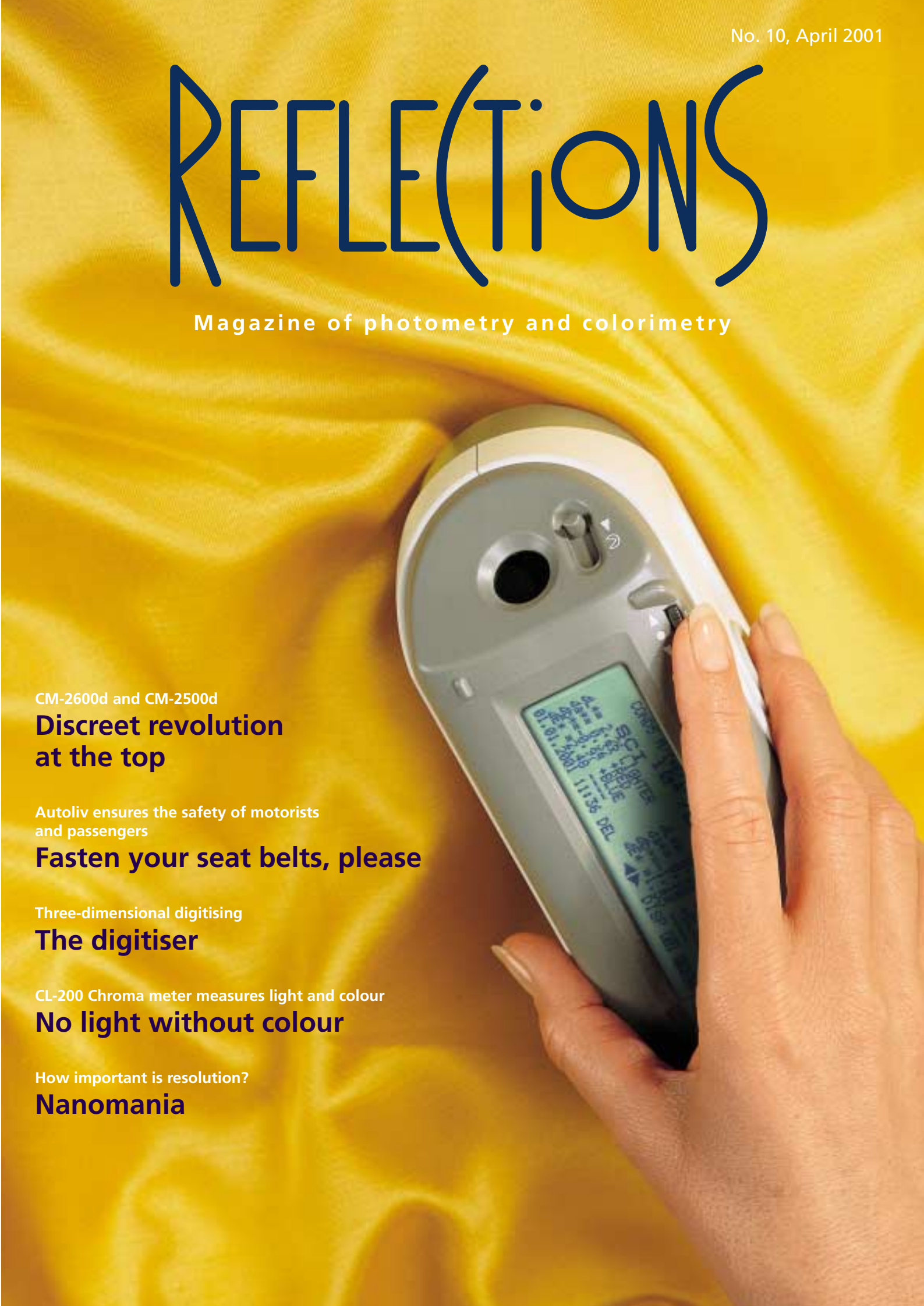
No. 10, April 2001

REFLECTIONS

Magazine of photometry and colorimetry



CM-2600d and CM-2500d

Discreet revolution at the top

Autoliv ensures the safety of motorists and passengers

Fasten your seat belts, please

Three-dimensional digitising

The digitiser

CL-200 Chroma meter measures light and colour

No light without colour

How important is resolution?

Nanomania

The portable CM-2600d and CM-2500d spectrophotometers replace the CM-500 series

Discreet revolution at the top

Unlimited application horizon thanks to top features.

Eight years ago, Minolta set new standards of precision and quality with its portable spectrophotometers of the CM-500 series. These standards continue to be applicable today and the CM-500 series is still regarded as the reference in portable colorimetry. Nevertheless, there is room for improvement even with the best equipment.

Our engineers faced a major challenge when it came to developing the new generation of spectrophotometers. Replacement of a successful product line always involves a risk. An optimum balance had to be found between revolution and evolution, firstly in response to the trend for more compact and lightweight, more flexible and less expensive equipment and secondly to maintain Minolta's legendary standards of precision and quality. The result: two new portable spectrophotometers with model designations CM-2600d and CM-2500d which have redefined Minolta's claim to leadership in colorimetry.

As the designations of the models imply, the new equipment is based on the laboratory spectrophotometer CM-3600d. This technology is now also available in portable equipment.

CM-2600d and CM-2500d

The most striking change is in the new design. Only two keys are visible. A measurement key and the navigation wheel used to select and activate all functions. A low weight of only 670 g, ergonomically optimised operation with only one hand and an intuitive user guide show that the development program focused essentially on practical aspects rather than on trying to make a superficial impact by introducing elaborate features.

The unique specimen viewing point is accommodated under a small slider: it is illuminated directly by the sphere and a small LED to produce daylight brightness in any situation. The CM-2600d model also allows the measurement aperture to be switched over from 8 to 3 mm. The large display (240 x 64 pixels) presents the results for specimen and reference values simultaneously in both numerical and graphical form, as absolute or difference values or with the specular component included (SCI) or excluded (SCE). A choice of six languages (English, German, French, Italian, Spanish and Japanese) facilitates the interpretation of the results on the basis of colour difference descriptions in plain language such as brighter or greener and is also available for the menu guide.

SpectraMagic at the user's service

The quality control software known as SpectraMagic opens up further options: reference data records (target values), box or elliptical tolerances and alphanumeric designations can be downloaded onto the meter for local availability. These values can then be called up in order to evaluate entire series of results.

Thanks to the task function, complex routine measurements comprising several work steps can be easily performed even by staff with no more than on-the-job training. Such measurements are

Single-handed operation and all information at a glance.

also standard practice in the automotive industry for the final inspection of the colours of various components and construction materials. When a measurement routine has been set up on the monitor (also with SpectraMagic), the unit guides the user through a maximum of six tasks. Each task can comprise up to ten steps, if desired with text instructions such as "Measure left door".

A portable CM-3600d

The model designation already indicates that the new equipment is based on the laboratory spectrophotometer CM-3600d. Both models use the techniques of the Minolta Innovative Optical System with numerical gloss control, whereas the top-of-the-range model CM-2600d additionally offers a numerical UV control (NUVC). The CM-2600d is the world's first portable spectrophotometer using patented technology designed to measure optically brightened specimens such as textiles, papers, detergents and plastics.

Both models feature a 52-mm d/8° Ulbricht sphere and a flashlight with high luminous power for optimised absolute and repeat accuracy even for dark specimens. The newly designed ultra-compact monolithic grid monochromator with a silicon diode strip has a measurement range of between 360 and 740 nm at a resolution of 10 nm for the reference and specimen beams. Each measurement is performed simultaneously via two flashlights with and without gloss inclusion and with no mechanically moving parts. The improved agreement between this meter and the stationary models of the CM-3600 series guarantees hitherto unattained accuracy in the exchange of colour data between the various plants of a company or between manufacturers and their customers.

Compact and lightweight, with optimised ergonomics, ultra-simple operation, state-of-the-art technology and an outstanding price-performance ratio: these features ensure that the new generation of spectrophotometers will rapidly achieve success in top-of-the-range applications.

A detailed brochure on these new spectrophotometers may be obtained by quoting code no. 66.

The digitiser

Minolta has been monitoring and researching market trends for many years in order to develop, manufacture and market hardware and software solutions for newly emerging needs and applications in good time.

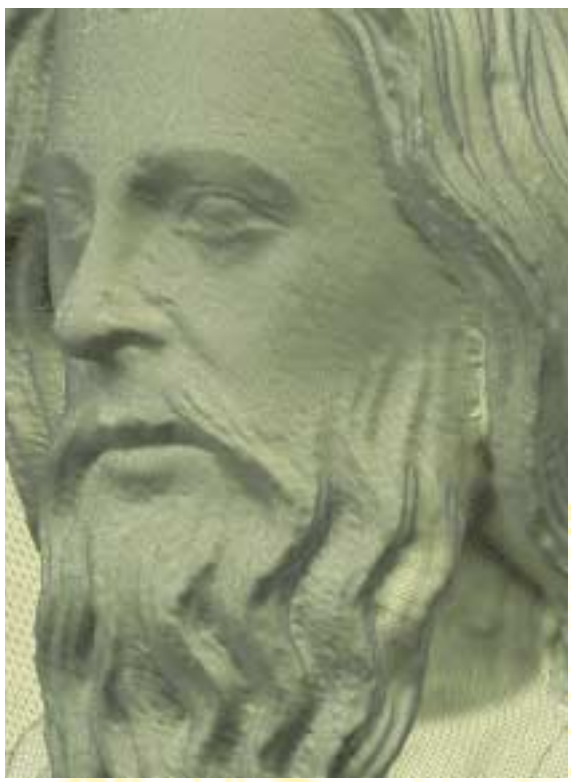
The ongoing trend towards e-commerce is generating great demand for simple ways of displaying products three-dimensionally on the Internet. Web users should be able to rotate the product image around 360 degrees with the mouse, both on-line and in real-time. They can thus inspect a pair of trainers or a car not only from the side, but also from behind and from the front. However, the size of the file must also be minimized while maintaining a high viewing quality from every angle.

A logical step

The development and manufacture of 3D recording equipment was a logical step towards extending Minolta's core expertise and product range in the sectors of colorimetry and optometry. The 3D camera 1500 generates 360-degree models and stores them with high-resolution texture in the form of Web-capable models. These can then be viewed on computers throughout the world with the aid of streaming technology.

The laser digitisers from Minolta are positioned at the very beginning of the CAD/CAM process chain. After the digitising step, the 3D scan data can be edited by CAD

Architects and restorers work with 3D digitisers from Minolta in Pompeii, in Rome's Colosseum, in the cathedral of Notre-Dame in Paris and in the caves of Altamira in Spain.



software to create a physical prototype by means of CNC milling or CAM stages. This can then be used as the basis for the development and series manufacture of the end-products.

Numerous applications

Architects, archaeologists, paleontologists and restorers use 3D digitisers from Minolta in order to record the form and colour of historical sites. The processed data provides information about the building methods of earlier times, generates a database to document the decay process and can be viewed worldwide in the form of VRML Web models.

The medical sector has an insatiable demand for digitising three-dimensional objects. Minolta supplies high-precision 3D digitiser systems based on laser technology, such as the VI-700, which are used in cases such as the pre-operative planning of oral and facial surgery. Forensic medicine is concerned with the 3D analysis of bullet holes, serious cuts and bone fractures. And in criminology, the evidence and the scene of the crime are increasingly simulated on large computers in order to determine the likely sequence of events.

The product range

The 3D product range comprises hardware and matching processing software for a wide range of sophisticated digital applications. The 3D camera 1500 projects several parallel bands of coloured light onto an object. The reflected light is interpreted by the software, which calculates the x, y and z coordinates.

The VI-300, VI-700 and VI-900 digitisers operate on the principle of laser triangulation. The entry-level model VI-300 records measured geometrical points within 0.6 seconds and simultaneously generates a colour image which may also be placed as a texture over the model. The VI-700 also has a zoom function, a storage-card drive for stand-alone operation and an LCD. It records 40,000 measured points with a geometrical point density of 0.11 mm over a range of 70 x 70 mm (with zoom up to 1100 x 1100 mm). The most recent development, the VI-900 digitiser, sets new standards for the recording of 3D data: 307,000 measured points can be recorded in two seconds over a range of 111 x 84 mm with an accuracy of 0.2 mm. Larger scan ranges may also be covered with the aid of exchangeable objectives.

Minolta offers professional advice to its customers for the most varied 3D applications thanks to experienced staff at its European branches and also maintains partnerships with hardware and software companies. Complete 3D solutions thus save time and money and also open up new opportunities and markets.

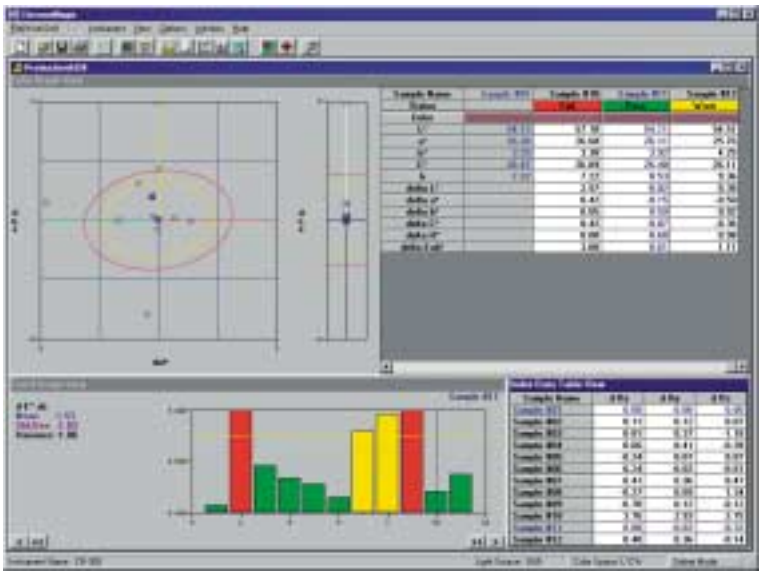
More information on 3D products from Minolta may be obtained by quoting code no. 67.

Whether toys, trainers or a bicycle saddle: the design of consumer products is becoming ever more diversified, the production process faster, the product life shorter. To keep up with these trends, design departments are increasingly using 3D software in order to remain competitive.

Single scans taken from different angles are merged together to become a complete "water-tight" three-dimensional picture.

New quality control software for the Chroma meters

It's ChromaMagic!



The Chroma meters from Minolta have become indispensable test equipment for checking the colour of quality products in many sectors of industry. Minolta is now bringing out ChromaMagic for Windows as a successor to the ChromaControl C quality control software successfully used in thousands of applications.

Extremely versatile and simple to operate

Like its predecessor, ChromaMagic also focuses on simple and yet extremely flexible operation. The display screen can be subdivided into up to four segments at a click of the mouse so that all information is visible at a glance. However, every field (colour graphs showing the numerical results, numerical tables, trend graphs with bar or line charts, tables with indices) can also be displayed individually in full size. The selection criteria in the numerical table are unique. Every colorimetric measure, every index and every measurement parameter can be displayed in a separate column.

But there are no limits to defining and monitoring the tolerances either: whether these are right-angled (symmetrical or asymmetrical), elliptical (with manual definition or automatic calculation) or as an overall colour difference: ChromaMagic offers the perfect solution for every task. In addition to well-known colour systems such as CIELAB, L*a*b*, L*C*h, L*u*v*, Hunter Lab, XYZ, Yxy, Pass/Fail CIE94 and CMC, ChromaMagic offers over twenty sector-specific indices which reflect the broad application range of the Chroma meters.

The core: a database system

The core of ChromaMagic is the database system. Individual results are stored in a work-group file, so that each file may be assigned individually set presentation and measurement conditions. Results may be copied from one work-group file to another by a click of the mouse so that they are available for further evaluations.

Additional database files in which work-group files are combined in a logical way can be generated at a keystroke. This allows the operator to work with a separate database for each specific task. An import-export function rounds off the performance profile. A conversion program is available for upgraders from ChromaControl C to ChromaMagic.

A data sheet for the ChromaMagic software may be obtained by quoting code no. 68.

Individual settings for full graphical and numerical colour data information.

The CL-200 Chroma meter measures light and colour

No light without colour

A luxmeter which can also measure colour – that's the new CL-200 Chroma meter from Minolta. The design and accessories of this meter permit hitherto unattainable flexibility and versatility in research, development and production – indeed wherever coloured light sources need to be measured: from dimensioning lighting in the workplace or streets via the adjustment of projectors and beamers up to the monitoring of lighting cabinets.

The CL-200 replaces the successful xy-1 and CL-100 models by combining the benefits of both and supplementing them with new functions. In addition to the luminous intensity in lux and footcandles, it measures the colour location in XZ, xy und u'v' coordinates, specifies colour temperatures and can also calculate differences between various measurements. The results are output on a background-illuminated LC display and to a PC or printer via the RS-232 interface.

A brochure on the CL-200 may be obtained by quoting code no. 69.

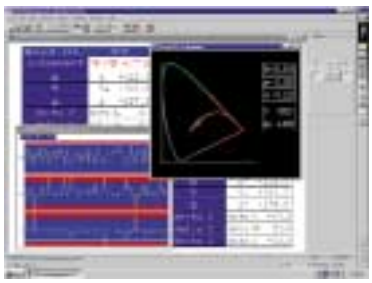
Simple, flexible, extendable

The CL-200 may be operated either via power adapters or by standard or rechargeable batteries. Although only slightly larger than a mobile phone, it is simpler to operate. The large trigger mounted on the side can be operated with only one hand, whereas three other keys control the most important functions. Another control panel with less frequently required functions is accommodated under a cover.

The meter is automatically calibrated after turn-on together with the range selection.

Among the most important features of the CL-200 are the flexibility and extendibility of its measuring heads. As with its predecessor, the T-10, up to thirty measuring heads can be connected to a CL-200 via standard LAN cables. This permits flexible operation at locations which are difficult to access and the dimensioning of large areas, such as for (video) projectors. The measurement head and evaluation unit of the CL-200 may be separated from each other by up to 100 metres.

The CL-200 may also be controlled by a PC via the RS-232 serial interface, a particularly useful option for automatic measurement routines or when several measurement heads are used. For this purpose, Minolta offers the CL-S1w software as an option. It permits a range of functions, including the graphical and tabular display of the results, the input of tolerances and porting into other programs such as Excel.



The optional software CL-S1w enables various data information display.

Autoliv endeavours to safeguard motorists and their passengers

Fasten your seat belts, please

With over half a million deaths and almost ten times as many injuries, road traffic presents a gloomy global balance. Legislators, insurance companies and the automobile industry are making great efforts to minimise road deaths: it's been a long haul from the classical safety belt of the mid-fifties to the integrated safety systems of today.

Autoliv Inc. is a worldwide leader in the sector of restraining and passenger-protection systems. In around eighty manufacturing facilities on all continents, the company works closely together with all leading automobile manufacturers on the design, development and integration of complete systems.

Safety should be inconspicuous

Passenger protection systems are designed to save the lives of passengers and drivers and to protect them from serious injury. In addition, they should remain discreet or even completely out of sight in order not to tarnish the car's glossy image. Specifically, this means that everything must be integrated seamlessly into the aesthetics of the design, colours and materials. Visible safety systems must consequently satisfy the same visual quality requirements as the rest of the interior fittings. The VDA recommendations specify the criteria for instrumental colour tests for plastics, textiles and paints with the aim of defining colour communication, test equipment, tolerance limits and acceptance criteria between manufacturers and suppliers.

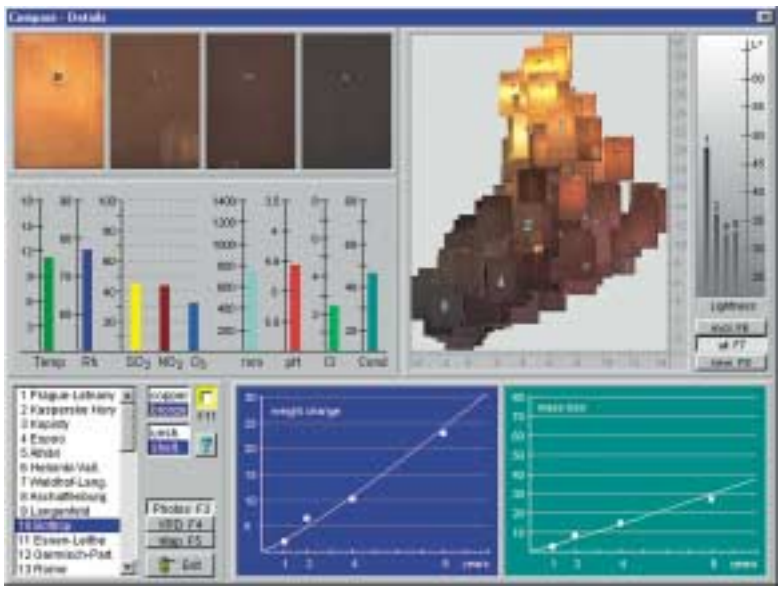
Minolta figures prominently in quality assurance

"Assuring colour quality has been a permanent feature of our quality control concept for many years", says Mr Szigeti of Autoliv in Elmshorn, Germany. Portable spectrophotometers from Minolta are used for all materials and components in the visible area (plastic and metal parts, textile strips in the safety-belt system). They are integrated into the production routines and are used on-site in the manufacturing process.

The standard deep-black colour as well as various surface structures make tough demands on absolute and repeat precision. The outstanding luminous power of the xenon flashlamp offers decisive benefits for this application compared with equipment using halogen lamps. Customers increasingly insist on matching to individual colour choices, so that Autoliv is planning to purchase a CM-3610d laboratory spectrophotometer specifically for its research and development sector.

In wind and weather

The Central Laboratory of the Bavarian State Office for the Maintenance of Historic Monuments is investigating the corrosion of metal objects in the open air. A major criterion for the condition of bronze monuments is their surface, which becomes increasingly coarse under the influence of sulphur dioxide and acid rain, subsequently acquires fissures and is ultimately destroyed by pitting. The final colours range from deep black via grimy grey up to the familiar green produced by the effects of sulphur dioxide and chloride.



The specially developed software for data collection of various parameters.

Large-scale international trial

In order to better understand the effects of the environment on the corrosion of copper and its alloys, the Bavarian State Office has been taking part since 1987 in the large-scale international trial known as the "UN/ECE International co-operative programme on effects on materials, including historic and cultural monuments". In this trial, four identical sets of stone, metal, glass and plastic specimens as well as of protective wood and steel coatings in 39 locations in 15 countries were exposed to the environment and examined in the laboratory after one, two, four and eight years. In addition to cities such as Moscow, Lisbon, Madrid and Rome, the trial also examined locations characterized by particularly high levels of sulphur dioxide pollution (such as Kopisty in the Czech Republic and Bottrop in Germany's Ruhr industrial area) or which enjoy particularly clean air (such as Aspvreten in Sweden and Ähtäri in Finland).

An object of interest in the survey: the Menden fountain in Leipzig.

Colour measurements with the CM-508d

The Compare software was developed to ensure the transparent presentation of the results. It supplies extensive information: the exposure location with its environmental data, the exposed material, a display of mass loss, specimen photos after one, two, four and eight years, colour charts with a* and b* values as well as brightness L* – everything is accommodated on a single display screen.

The yellow and red components of new copper specimens with values a* 16.2 / b* 21.7 / L* 78.2 decline with time. Whereas in the normal case copper becomes more or less brown, the specimens from Kopisty, which are exposed to extremely high SO_2 levels, acquire a grimy yellowish coating (a* 0 / b* 12) after eight years. Bronze (a* 7.0 / b* 23.8 / L* 70.0) becomes more or less brown, colourless or greenish with time. The Bavarian State Office for the Maintenance of Historic Monuments uses a portable spectrophotometer CM-508d from Minolta for all these measurements.

How important is resolution when selecting a spectrophotometer?

Nanomania

When it comes to measuring body colour, spectrophotometers have ousted three-filter meters into a niche position. This is because of their higher absolute accuracy in the face of increasing requirements on colour quality and above all due to their much lower prices. But these meters are also becoming ever more compact as well as more powerful and convenient to use thanks to developments in microelectronics. Whoever needs a colour meter today is faced with a wide choice of models and suppliers – and that can be a real headache.

The quality of some of the components is difficult to quantify and cannot be adequately described in a brochure.

What criteria should the decision be based on? The most obvious would seem to be price and features: the number of displayed colour spaces, the size and ease of handling of the equipment, the accessories... But accuracy is even more important – and this is where the confusion already begins.

The first spectral sensor chip built into the portable CM-2000 series was developed by Minolta in the late 80s. It had a 10-nm pitch interval and an array with 31 diodes. Two bands of interference filters covered the spectrum from 400 to 700 nm.

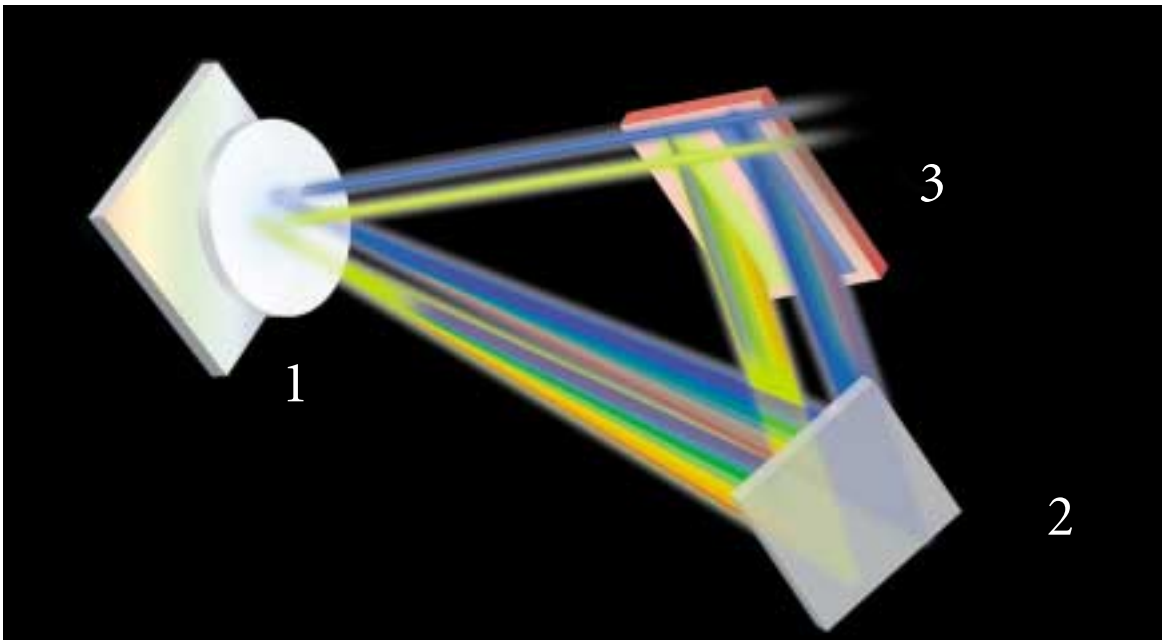
More important than resolution…

A spectrophotometer measures the spectrum of a colour, or rather the spectral reflection of the specimen to be measured in the visible light range. So the accuracy depends on the spectral sensor. But this is only half the story. The illumination, the geometry (e. g. symmetry and opening ratio of the Ulbricht sphere) and the optics have a considerable effect, especially on the absolute accuracy and on agreement between different meters. However, the quality of these factors is difficult to quantify and cannot be easily described in a brochure.

In contrast, the sensor performance can be easily expressed in figures. The spectral resolution in particular is often highlighted as the essential quality feature. But this is quite wrong: with otherwise identical meters and sensors a better resolution will certainly also yield more accurate results. But no manufacturer offers the same meter with different sensors. So the comparison must always be made between the meters as a whole.

…is the accuracy of measurement

The spectral reflection of the specimen is defined as the percentage of the reflected radiation at various wavelengths. The accuracy with which this spectral curve is determined reflects the accuracy of the colour measurement. Each point on the curve has two coordinates: its wavelength in nm and its degree of reflection in percent (fig. 1). It is important for both these coordinates to be measured with precision and above all with repeatable accur-



Latest models such as the CM-3600d and CM-2600d series offer a newly developed monolithic grating system. In a very compact body, the grating (1), a light separating device (2) and a dual silicon diode array (3), one each for the sample- and the reference light, provide 10 nm pitch resolution at a full wavelength range from 360 to 740 nm.

acy. The spectral resolution (the number of points at which the measurement is made) is less important than the accuracy with which these points are determined. What is the point of a high resolution if the wavelengths shift from one measurement to another or the degree of reflection fluctuates in the tenths of a percent range?

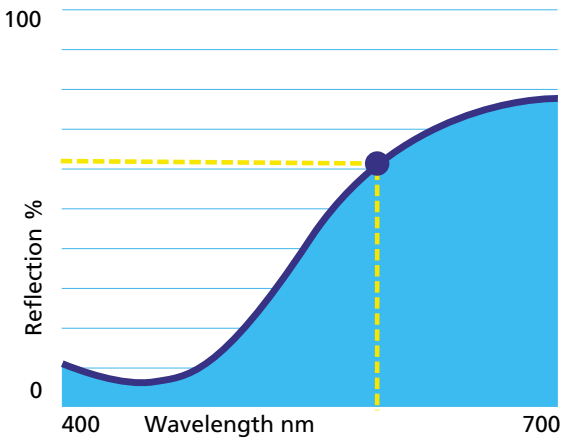
Only if these parameters are determined with high accuracy does the resolution also become important. But the required resolution also depends on the steepness of the curve. A value of 10 nm is completely sufficient for measurements of body-colour reflection, and even 20 nm are enough as a rule. In contrast, higher resolutions are required for transmission measurements (e. g. filter glass) and for chemical analyses or photometry. Minolta has developed a colorimeter for these applications: with a resolution of 0.9 nm (the CS-1000), it can also measure the discontinuous spectra of fluorescent lamps. However, spectra of this kind do not occur in body-colour measurements.

A value of 10 nm is completely sufficient for measurements of body-colour reflection, and normally even 20 nm are enough.

Is the half-intensity bandwidth of the monochromator correct?

The monochromator resolves the light reflected by the specimen into its spectral components and the sensor then converts it into electrical signals. So the monochromator is responsible for the spectral resolution, while the sensor determines the accuracy of the signal measurement, i. e. the degree of reflection. The number of sensors behind the monochromator determines the spectral resolution as specified in the brochure. But does the monochromator actually reach this resolution? This can be determined by the half-intensity width which specifies the degree of "smudge" with which a wavelength is resolved by the monochromator. It should be of the same order of magnitude as the sensor resolution. A resolution of 3 nm is of little use if the pre-connected monochromator can only manage 10 nm. This would be rather like designing a standard car engine with the power of a Formula-1 engine.

In practice, however, these rather academic differences hardly play any part at all. The accuracy of measurement depends rather on the colour and surface fluctuations of the specimen or of application problems at small or highly curved surfaces than on the resolution. That's why the quality cannot be expressed in mere figures. The true quality of a spectrometer is only brought to light by a practical test with real specimens.



Only the accuracy of both coordinate points, the reflection (R%) and the wavelength (nm) over the whole spectral range make up the quality level of repeatability of a spectrophotometer.

Customer mirror

Otto Versand (Germany)

This well-known mail-order company from Hamburg has simplified and improved its colour quality control and communications system with textile suppliers throughout the world. Optimal quality is now ensured by the portable Minolta spectrophotometer as well as QTEX, a quality control software developed by our partner company Treepoint.

TECchannel and PC-Magazin

Two of Germany's leading computer magazines have acquired the versatile IA-1200 Image Analyser for their benchmark tests of computer monitors (picture tubes and LCDs). This test instrument is specialized for production and laboratory use, simultaneously measures the geometry, linearity and convergence of an image and allows rapid testing of the picture geometry.

Rehau (Germany)

This leading international plastics manufacturer produces over 40,000 different components. The group, with worldwide operations in the sectors of thermoplastics, elastomers and duroplastics, opted for the CM-3600d desktop spectrophotometer which is used as a worldwide reference instrument for quality assurance and colour matching.

Kalon Decorative Products (UK)

The member of the Sigma-Kalon group has recently installed a large number of units of the Minolta CECF-9 at various trade outlets throughout the UK. This is an ongoing project to equip all outlets supplying Kalon paint with the latest, truly portable colour-searching system.

Maxit (Germany)

This leading manufacturer of plaster and building paints with over 40 facilities in Europe and overseas has begun renovating its colour-matching system in conjunction with Minolta. In the course of standardizing the group's IT operations, the new system is now being introduced in the recently restructured east German sales region of Thuringia.

Caparol (Germany)

Caparol Farben is introducing the portable and simple-to-operate colour reader CR-15 at its sales departments in order to expand its European sales network. A display featuring the well-known Caparol elephant was developed specifically for this compact colorimeter.

PECHINEY (France)

The worldwide #3 in packaging is, among other fields, specialised in the area of food packaging. For the online colour control of bottle caps the company relies on the portable spectrophotometers of the CM-500 series.

MINOLTA

Masthead

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