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Foam Injection Molding. Visual field measurement is a standard examination at the optometrist's. The heart of the Octopus Perimeter instrument employed for this is a semi-spherical concave dome. The production process, especially the injection molding and coating, has to satisfy high quality requirements.

Untrammeled All-Round Vision

PATRICK F. SCHNEIDER

Perimetry is the systematic measurement of the visual field in eye medicine (ophthalmology). Goal of the examination is to determine on one hand the external and internal peripheral extents of the visual field and on the other the sensitivity of the visual system in perceived space. During the examination, a succession of optical stimuli are presented at various places in the visual field. The perception of these stimuli is recorded as a function of position and strength. In order that the spatial ratio of the test positions may be maintained, the examined eye must gaze fixedly at a central point. A map of the visual field can then be compiled from the examination records [1].

Automated visual field examination with the Octopus Perimeter is particularly used for checking the progress of glaucoma. One eye is covered with an eye flap, while the other one gazes fixedly at the center of a hemisphere. Light spots of different brightness are presented to the patient at different positions on the hemisphere (a concave dome). The patient then presses a button to indicate that they have noticed the light spot.

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Light Stimuli in a Hemisphere

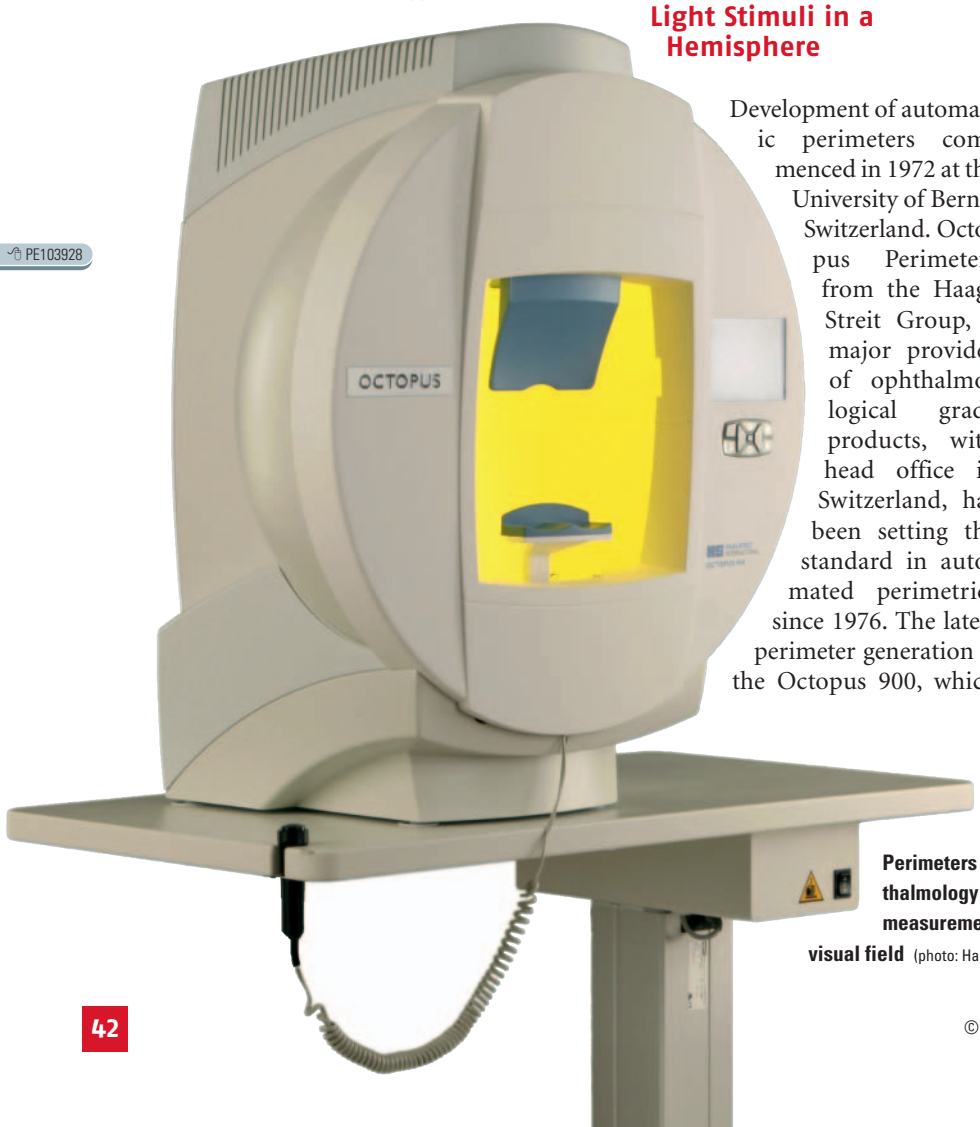
Development of automatic perimeters commenced in 1972 at the University of Berne, Switzerland. Octopus Perimeters from the Haag-Streit Group, a major provider of ophthalmological grade products, with head office in Switzerland, has been setting the standard in automated perimetrics since 1976. The latest perimeter generation is the Octopus 900, which contains six plastic parts. The instrument was devised by Haag-Streit in close collaboration with Red Design GmbH and Fried Kunststofftechnik GmbH. Experience gained in handling and use provided a number of specific requirements for the design of the Perimeter, which Fried performed on the basis of a draft design specified by Haag-Streit and the design and engineering office Red Design.

All molded parts must remain dimensionally stable over the life time of the perimeter. The surfaces of the plastic parts, which must be insensitive to cleaning and disinfectants, may not have visible sink marks. Clean, uniform shadow joints between the plastic parts require high fitting accuracy by the individual parts to each other. Front cover and hood must be designed such that the heat generated in the instrument can be dissipated without active cooling. It must be possible for one person to carry the perimeter and, naturally, parts of the housing may not thereby become detached. Mechanical modules must retain positional stability in the event of any transport stress.

A high-impact, flame-resistant polystyrene is used for the production of the plastic parts. In order that the requisite accuracy of fit as well as the uniformity of the shadow joints could be achieved, special attention was paid to the shrinkage behavior of the polymer.

Maximum Precision During Production

The surface and shape of the concave dome especially require maximum precision during production. The geometry of the injection molded part must come very close to the ideal sphere. Coating of the inner surface of the concave dome must occur under defined purity conditions and yield a homogeneous coat. Concave dome and housing parts must not generate joint



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Perimeters are used in ophthalmology for the systematic measurement of a patient's visual field (photo: Haag-Streit)

For reasons of functionality, the geometry of the concave dome must approximate an ideal sphere very closely (photo: Fried)

stress during installation.The parts, all of which are manufactured by foam injection molding, fulfill the requirements for strength, dimensional stability and surface accuracy. This is a particularly economical manufacturing method and lends itself to small runs for the production of flat, thick-walled, dimensionally stable injection molded parts that offer extreme torsional stiffness. By lowering the viscosity of the melt and foaming during injection, the blowing agent admixed to the granules makes for complete mold filling and the development of a foam structure inside the housing parts.

The concrete dome, which has a diameter of 600 mm and a shot weight of approximately 9.5 kg, is made in a cycle time of four-and-a-half to five minutes on a ES 23050/1300 Duo machine (clamping force: 13,000 kN; manufacturer: Engel Austria GmbH). The spherical shape of the concave dome is examined by means of a test device that was developed particularly for this purpose.

Coating of the parts was optimized in a continuous process. The high requirements imposed on the internal surface of the concave dome require special measures to be adopted during coating. If examination of the unfinished part reveals a deviation from ideal geometry and surface finish, the irregularities are eliminated carefully by manual grinding.

Before priming takes place, all impurities are removed from the housing, including the concave dome. Blowing off with air is inadequate on its own, and so a dust-binding cloth is used. The paint gun is thoroughly cleaned, and the paint is screened before application. The external coating is a two-component textured finish while the internal coating is a smooth matte finish. Prior to interior finishing, each housing is checked for any unevenness, which is then removed by fine grinding.

The coating is applied only when it is certain that the surface is perfectly smooth and clean. Application of the desired coating thickness requires rigorous observance of atomizer pressure and spraying distance. This requires a high measure of experience and ability on the part of the painter. The coated part is dried and handled with great care. Each housing is examined in detail as regards the degree of gloss, the surface finish and the locating of inclusions. Areas where inclusions are permissible are exactly defined in terms of number and size.

The latest equipment generation, the Octopus 900, contains six plastic parts (photo: Fried)

Development Partners

Haag-Streit AG
Gartenstadtstraße 10
CH-3098 Köniz
Switzerland
www.haag-streit.com

Red Design GmbH
Webereistraße 71
CH-8134 Adliswil
Switzerland
www.reddesign.ch

Fried Kunststofftechnik GmbH
Wasenstraße 90
D-73660 Urbach
Germany
www.fried.de

Summary

It is possible to develop complex, highly functionalized parts with demanding contours that lend themselves to injection molding. No complex, cost-intensive machining, such as deburring or re-milling, is required. This is a precondition for an accelerated sequence of downstream processes, e.g. for surface refinement. ■

REFERENCES

1 Excerpt from on-line encyclopedia Wikipedia

THE AUTHOR

ECONOMICS ENGINEER PATRICK F. SCHNEIDER, born in 1965, is head of marketing and sales at Fried Kunststofftechnik GmbH, Urbach, Germany.

FRIED Kunststofftechnik

FRIED Kunststofftechnik GmbH
Wasenstraße 90 · D-73660 Urbach
Telefon 07181 8000-0 · Fax 07181 8000-15
info@fried.de · www.fried.de