free operation. Both requirements were achieved by careful selection of materials, surface treatment and graded hardness.

A 1.2343 ESU steel with a hardness of 50 HRC with a high elasticity and core strength was chosen at the stationary mould half, and a 1.2767 ESU steel with a hardness of 53 HRC was selected for the moving half. Lubricant-free operation of the demoulding mechanism is achieved by using nitrided ejectors. One of the angled slides was plasma nitrided with 950 HV. This results in low wear as a result of interaction with the stationary half.

Until now, multiple individual temperature-control units were needed for heating and dissipating excess heat. The thermal management system used here (Fig. 5) allows conformal heating and cooling with one temperature-control unit, and so achieves efficient cycle times.

Summary

The preliminary work paid off. Such a precise result could not have been achieved without the use of the latest simulation models. Only in this way is it possible to achieve the ever shorter times required for realising a project.

The company is proud to have received an award from the Society of Plastics Engineers (SPE) for this achievement. Weber received the award in the "Body Interior" category for successful implementation of the functional and decorative parts of the rear-seat mobile entertainment system in July 2006 at the SPE Award Night in Neuss/Germany. ■

Manufacturer Cooling

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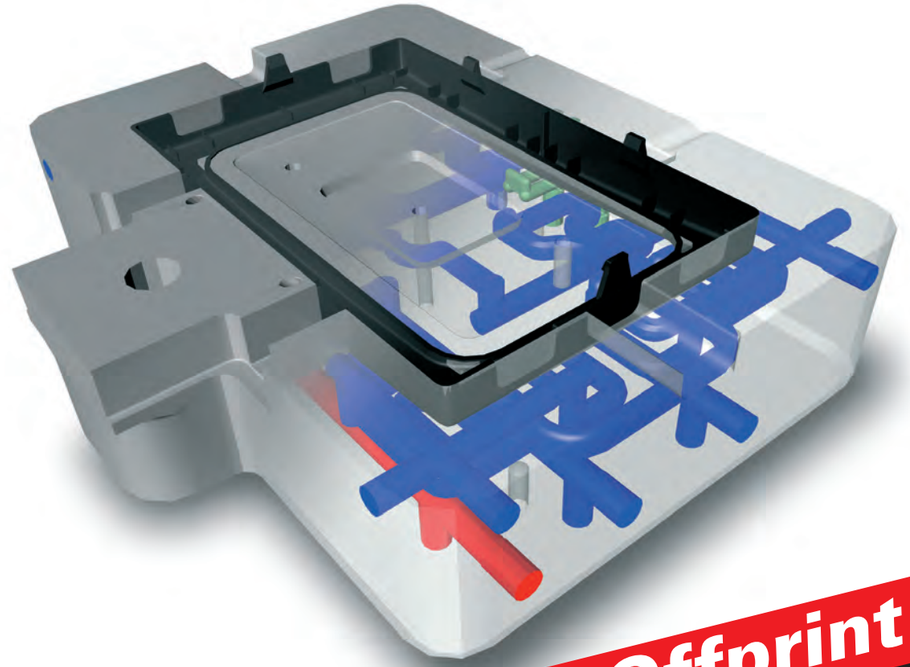
A Mirror Finish with no Visible Weld Seams



Offprint

Injection Moulding. For the monitor frame for the Mercedes Benz S and R classes, Weber Kunststofftechnik took the strategy of concealing weld seams by conformal thermal management. This places strict demands on the highly polished mould.

A Mirror Finish with no Visible Weld Seams

THOMAS CRONAU
HENNING SCHMIDT

Rear passengers in the Mercedes-Benz S and R Classes can watch movies or play computer games on seven-inch monitors in the headrests on the driver and front passenger seats. As supplier for this rear-seat entertainment system (Fig. 1), the automotive supplier Johnson Controls chose Weber Kunststofftechnik, of Dillenburg/Germany, the specialist for in-car cinematic entertainment.

Fig. 1. The in-car entertainment system of the Mercedes S and R classes: the monitors are built into the headrests of the front seats (photos: Weber Kunststofftechnik)

Entertainment Program for Back-Seat Passengers

Weber has supplied high-quality painted and laminated finished plastic parts since 2005. The project comprised 3D development of mechanical parts and integration of the CAD data for the assembly. The development services also included FE analysis to verify the results. Since the design makes high requirements on the surface quality, the entertainment system styling employed high-gloss surfaces, soft coatings and lamination with leather and PVC film:

- The mould and process technology for the high-gloss monitor frame were planned to avoid visible welds.
- Attractive surfaces are obtained by laminating the three-dimensional contours.

Weber has built up an extensive range of in-house skills in special processing technologies.

The system chassis is a hybrid part comprising a metal frame and high-strength polymer. This combination meets mechanical requirements from load-bearing through to crash properties, and includes precise bearing and mounting points for the pivotable monitor and fittings.

Conformal Thermal Management

Realisation of the mould for the high-gloss monitor frame posed a severe challenge. The options extended from surface treatment with piano lacquer, through in-mould decoration, to injection moulding in a mirror-polished mould. The last-mentioned process was the clear favourite on price, but it was quickly found that the frame will have a weld seam if is to be produced economically, i. e. without subsequent cutting off and polishing of the gate region. The question then had to be answered of how the weld can be made reliably invisible with this frame geometry.

The Moldflow filling simulation software was used in the early phases of development of the monitor frame. This achieved:

- calculated choice of gate points,
- analysis of the effects of flow aids,
- reduction of the filling pressure by 20 %, and
- localisation of the expected welds.

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With a reliable definition of the melt-front advance, the Weber engineers were able to take calculated measures to minimise the weld on the high-gloss monitor frame (Fig. 2)

In practice, no significant weld occurred between the two gate points. In the region where a weld was unavoidable, the cooling channels were located within a few millimetres of the part contour in order to conceal the weld. The conformal mould inserts shown in Fig. 3 were used for this (manufacturer: Contura MTC GmbH, Menden/Germany). The temperature control process consists of a short heating phase and the subsequent cooling phase. Precise changeover between the two phases was determined by the point at which the melt streams converge. This is regulated by the Promold temperature-control system, which is connected to the injection moulding machine control system. Each injection moulding cycle is regulated by conformal temperature sensors and a pressure transducer.

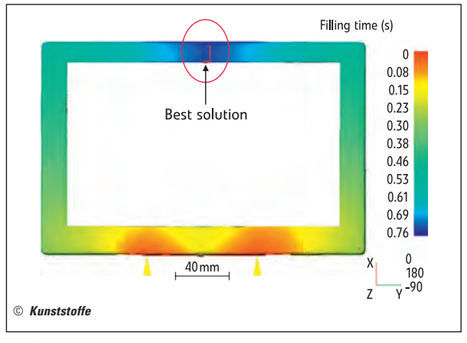

Fig. 2. Position of the welds with optimised gating

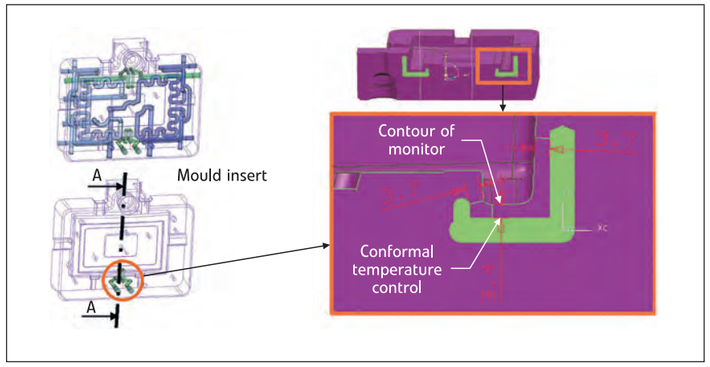

Fig. 3. The conformal mould cooling conceals the weld in the exposed high-gloss area

Gloss on the High-quality Surface

As a full-service contractor, Weber designed the mould and completed it within 14 weeks. Before handing it over to the tool makers, the personnel with responsibility for mould making, design and production subjected the complex design to a qualified test under the direction of the project manager. The tool data were then transferred online to the mould maker for direct processing.

During mould production the demanding mirror finish was achieved by means of a structure that was finely EDM-machined with graphite electrodes and then high-gloss polished with subsequent surface coating. Special attention was paid to the rib/wall thickness ratios to reliably eliminate sink marks. A special X/Y centring in the mould centre was chosen to prevent the mould platens becoming misaligned during the injection and holding pressure phases.

The thickness of the mould platens was designed to meet the cavity pressures, which were determined by Moldflow analysis. The compressive loading to be expected during the holding pressure phase was compared with empirical values from similar projects and set at a correspondingly high level. A mould that has been mechanically reliably dimensioned thus ensures a flash-free mirror finish without sink marks.

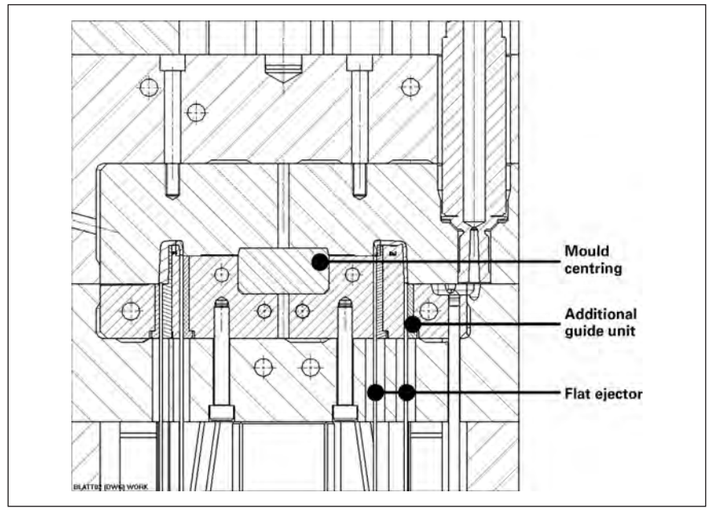

Fig. 4. Section view through the mould with flat ejector, including centring

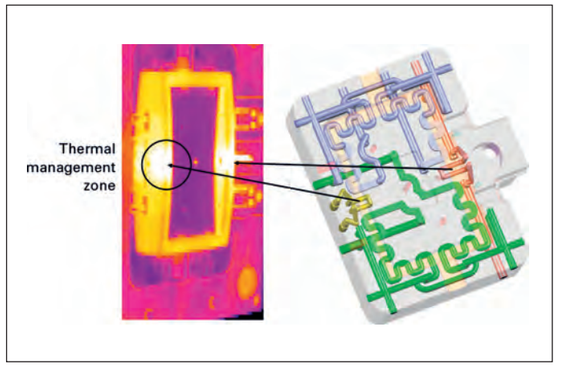

Fig. 5. Infrared thermograph of the mould insert for thermal management

The injection mould with angled slides, which is designed for precision and production stability, counteracts the expected high holding pressure with large-area, flat ejectors below the perpendicular wall of the part (Fig. 4). Other requirements are a long service life and reliable dry running of the entire mould mechanism, a prerequisite for lubricant-

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