

Structured sheet metal

Part II: Applications

Editor's Note: This article is Part II of a two-part series discussing structured sheet metal and different structuring processes. Part I, which appeared in the May issue, compared different structuring processes.

This column was prepared by Michael Mirtsch and Ajay Yadav of the Engineering Research Center for Net Shape Manufacturing (ERC/NSM), The Ohio State University; Taylan Altan, professor and director.

Structured sheets have enhanced mechanical properties such as high rigidity, so they often are used in lightweight structural components. Structured sheet also finds a range of applications because of its improved thermal properties, acoustic performance, glare-free light-reflecting capability, and aesthetic appearance.

The Vault-structuring™ technique does not change the sheet's surface quality because there is no direct tool surface contact with the sheet surface. Vault-structured sheets undergo very little strain hardening during structuring, so they can be deformed further into desired shapes.

Structural Applications

Cans and Containers. Structuring or beading the wall of cans increases their rigidity, thus allowing wall thickness reduction to decrease weight and save material. Use of structured high-strength materials has helped reduce wall thickness by 29 percent in the last 24 years. With the vault-structuring technique, an additional reduction of 24 percent in

sheet thickness can be obtained.

A honeycomb-structured can body called "Hexacan" increases axial stiffness about 15 percent and radial stiffness about 50 percent as compared with a creased can body (see **Figure 1**). High-strength materials that cannot be structured conventionally because of low formability can be Vault-structured, which induces relatively little plastic deformation.

Washing Machine Drums. Washing machine drums are designed for high-speed rotations of up to 1,800 revolutions per minute. Structuring of the drum surface increases its rigidity. **Figure 2** shows a washing machine drum made from hexagonally vault-structured stainless steel. The staggered and soft-curved hexagonal structure is designed to help improve fluid flow behavior

both for gentle and quick washing.

Thin-walled Detector Tubes in Particle Accelerators. For high accuracy, aluminum detector tubes, used in particle accelerators, are designed to be as thin as possible. These tubes are maintained under high internal vacuum. The thin-walled tubes must be very rigid to avoid collapsing under atmospheric pressure. Additionally, these tubes undergo thermal stresses caused by temperature changes.

The walls of the detector tubes can be strengthened by vault structuring, which ensures rigidity to prevent collapsing under vacuum and high axial flexibility to accommodate thermal expansion.

Thermal Applications

In many automotive, aerospace, and construction applications, it is necessary to weld sheet metal onto a frame. The induced heat of welding causes the sheet to expand thermally. As a consequence, wrinkles occur in the welded sheet as it cools.

Structured sheet does not wrinkle under thermal stresses. This is because structured sheet shows highly elastic behavior in the plane of the sheet. A solar heat absorber can be

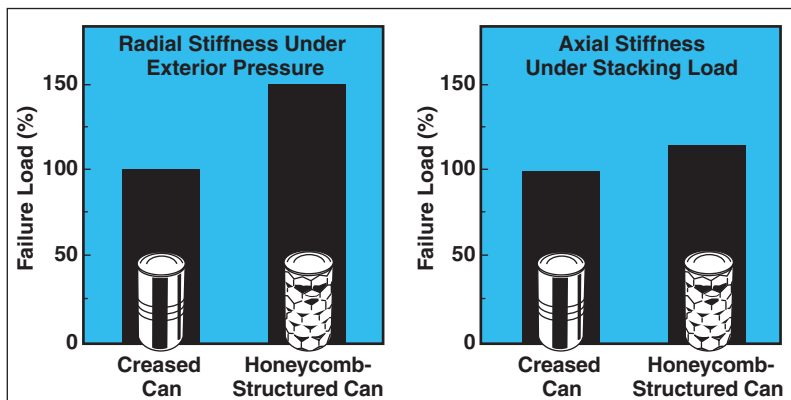


Figure 1

A honeycomb-structured can body called "Hexacan" increases axial stiffness about 15 percent and radial stiffness about 50 percent as compared with a creased can body.

Source: F. Mirtsch, "Bionic-Method of Efficient Light-Weight Production," in proceedings from Global Conference Sustainable Products, 9/29/2004 -10/1/2004, p. 97.



Figure 2

Vault structuring a washing machine drum improves flow and rigidity and provides an attractive design.

Source: Miele press release No. 057/2002, www.miele.de.

manufactured by welding two vault-structured metal sheets into a conduit (absorber). Fluid flow occurring within the conduit is turbulent


because of the presence of structures on the exchanger walls.

The same effect also can be obtained by various rolling or embossing techniques used in fin manufacturing. The turbulence improves convective heat transfer, thus increasing heat exchanger efficiency.¹

Structured aluminium-alloy sheets also can be used as heat shields to reduce heat flow across the structure.²

Light Reflector Application

A mirroring layer is initially applied on the surface of sheet metal by anodizing. This sheet then is Vault-structured. The structuring process does not influence the surface finish of the sheet material.

Every hexagonal structure on the sheet surface acts like a single mirror. This scattering of light reduces the glare. The increased rigidity eliminates the need for an additional housing or casing. 

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Notes

1. *Robinson Fins*, www.robfin.com.
2. *Rieter-ALUX Technology™*, www.rieter.com.

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