Hot Forming

Diffusion Bonding

Highly efficient space structures from Ti-alloys

Werner Beck, Sabine Wagner, FormTech GmbH, Germany
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FormTech GmbH, Mittelwendung 26, D-28844 Weyhe
Tel: +49 (0)4203 8045 -0, Fax: +49 (0)4203 8045 -29, Email: info@formtech.de

Mission

Affordable sheet metal metal parts from Titanium alloys

Small qty up to industrial qty: 1 to ~ 30.000 parts/anno

Hot forming, Hot deep drawing, Superplastic Forming (SPF)

„Sandwich-like“ parts with Diffusion bonding/ Superplastic Forming (SPF/DB)

Current key acitivity

- Heat shields
- Tanks for fuel and hi-pressurized gas
- Noise reduction
- Laminar flow
- Hybrid structures

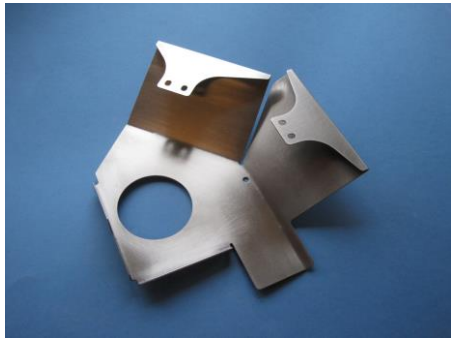
Topics

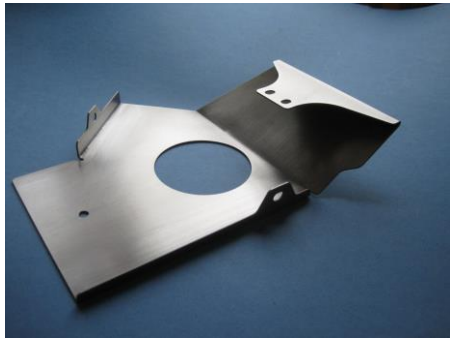
- Hot forming of heat shields
- Hemispheres for tank production
- Hi-strength „Tie rods“
- Sheet metal parts from TiAl
- Lightweight sandwich structures

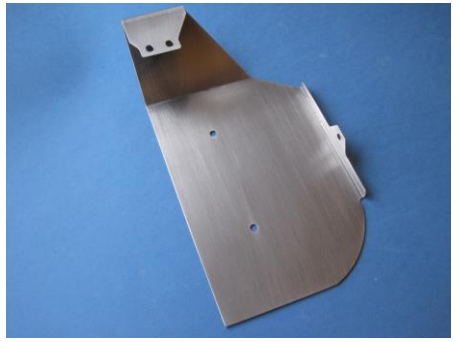
Heat shields Ti6-4

Important material saving compared to machining
Hot bending tools are good for universal application
Design guideline:

- Complex shapes built up from linear bends
- Design: Access to bend zone necessary
- Bending length <150mm
- Bending angles 30, 90, 120, 150° validated







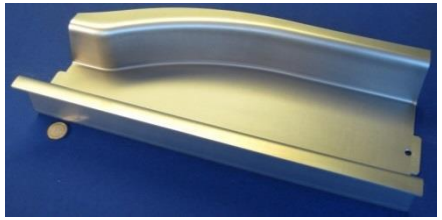
Hot Deep Drawing

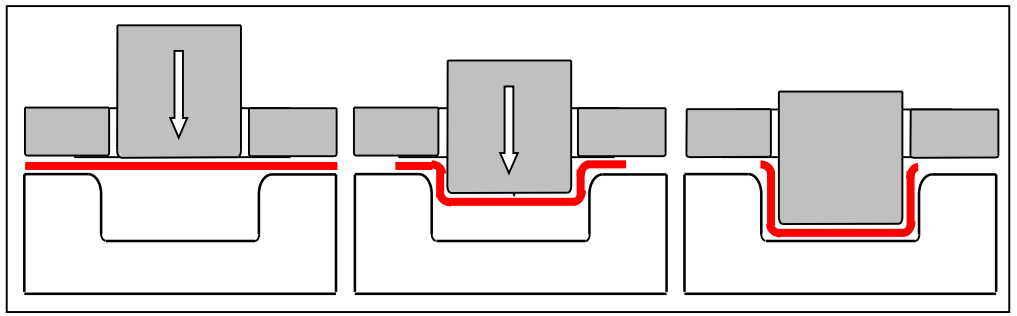
→ Ti- alloys not really cold formable z.B. Ti6-4, Ti6-2-4-2, Tibeta21S, etc

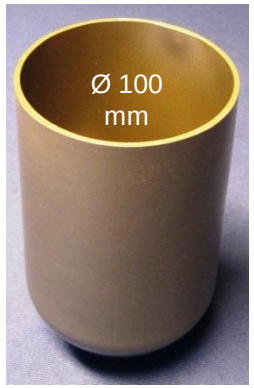
→ Hot deep drawing allows complex shape in one draw

Cost saving issues

- Material saving compared to machining from plate → ca. 90%
- Constant wall thickness
- No residual stress, no spring back
- Cycle time short

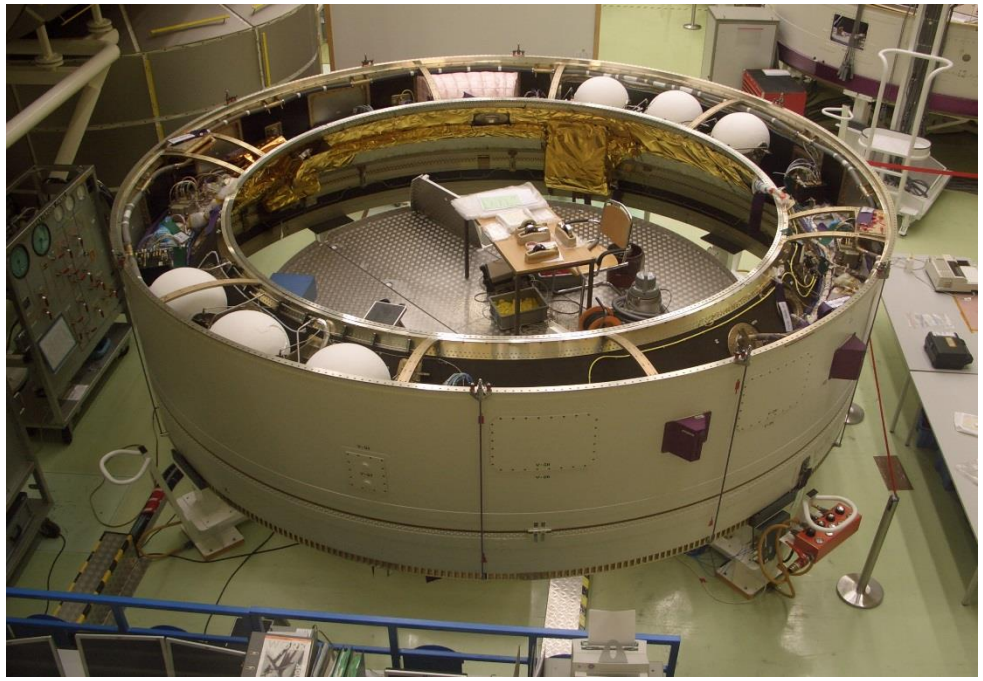


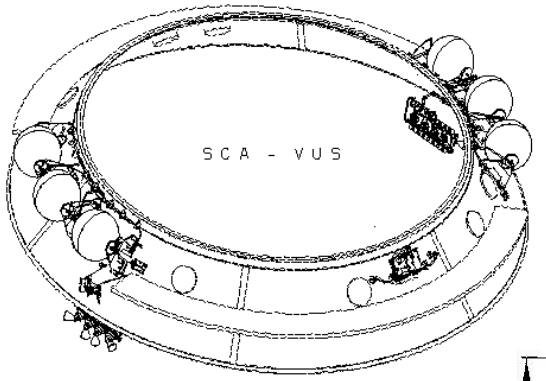


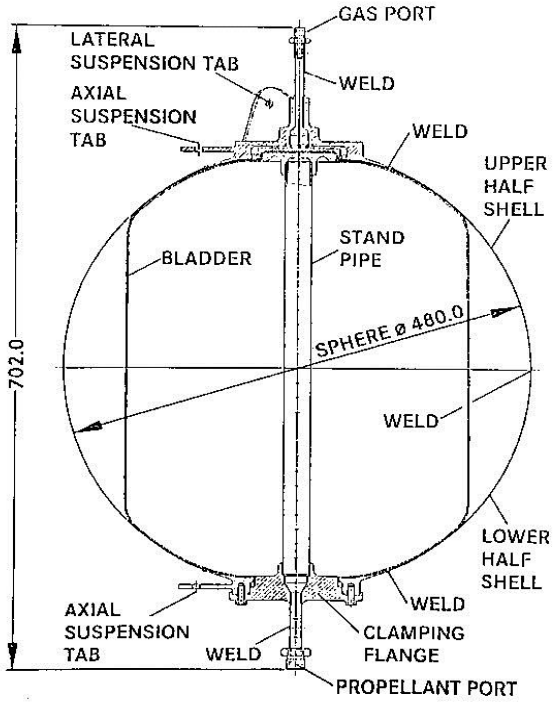


ARIANE 5 lift-off

SCA-P2, ATV launch, ARIANE 5







- Final assembly of ARIANE 5, SCA- P2 with six tanks
- Tank cover with „PROSIAL“ as heat protection for re-entry-passivation
- Thickness: $t_{equator}$=1,8mm, t_{pole} =1,6mm, $t_{membrane=}$0,9mm

Ti6-4 hemispheres

Dia 485mm

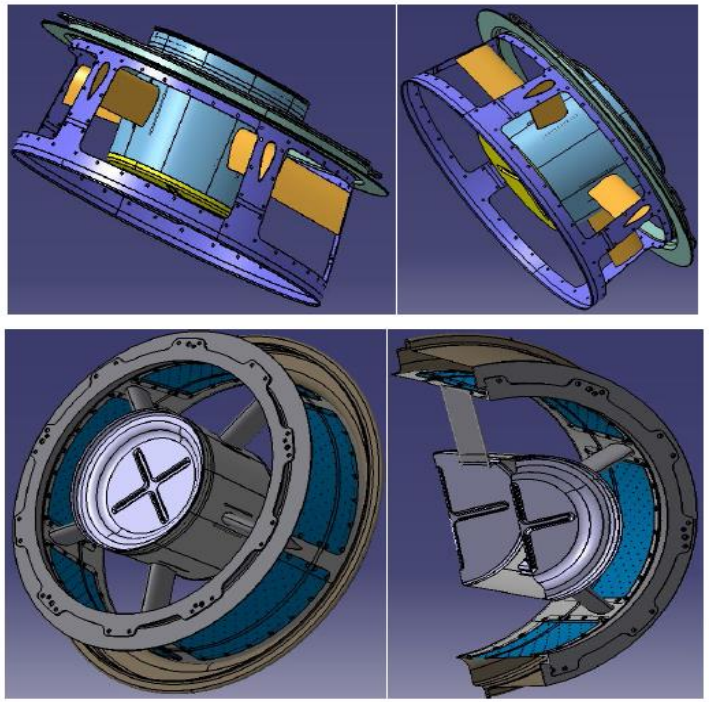
Dia 748mm

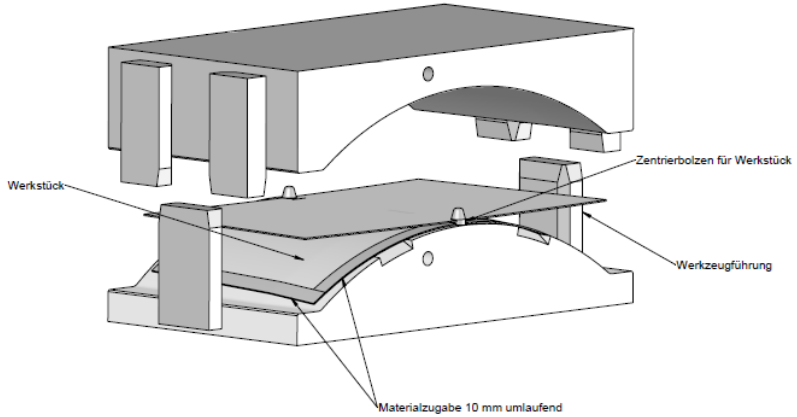
Hemispheres 100 to 748 mm

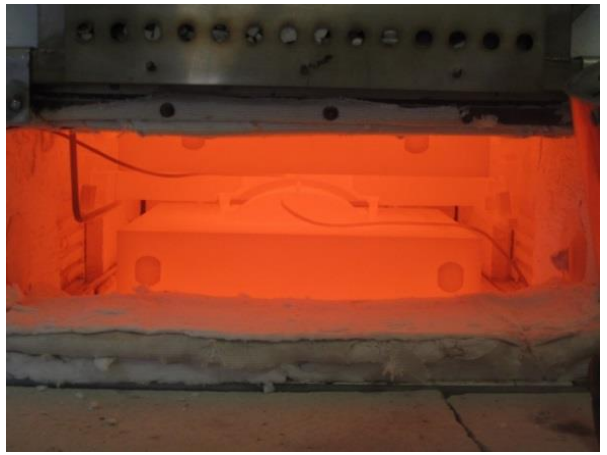
- SPF tank shell hemispheres, formed to final shape without machining
- Tank assembled with circumferential weld
- Hemispheres also for metal liners, laminated with composites for high pressure gas storage tanks
- Dia 100 to 748mm validated

TiAl for exhaust sections

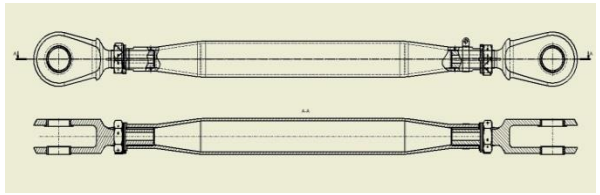
- „HEXENOR“: Forming of TiAl „patches“
- TiAl material can replace heavy Ni-based alloys

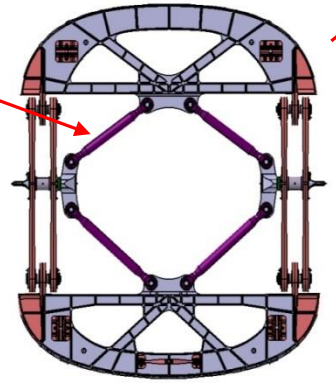






Titanium 6-4 „tie rods“





~50% weight saving with Ti-alloys compared to steel

Tensile strength level much better than Al

Titanium is maintenance-free. No corrosion hazard.

Light weight structures

SPF-DB for sandwich-like construction

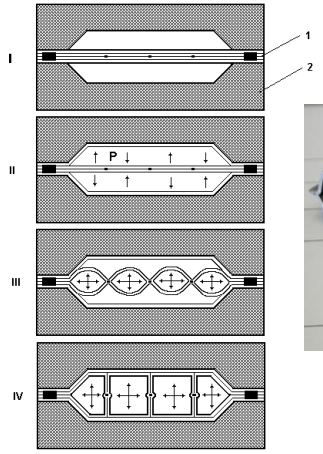
<u>Advantages</u>

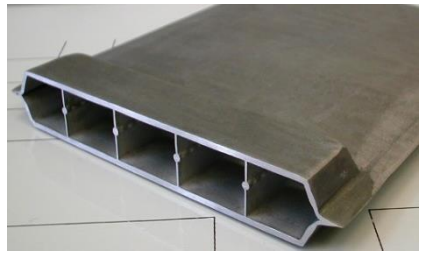
- Weight reduction and performance optimisation
- Cost reduction

Applications

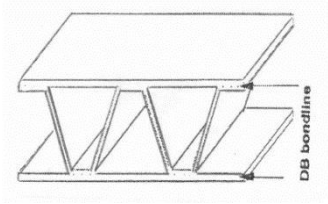
- Hollow fan blades or guide vanes
- Integrally stiffened ducts
- Panels for noise abatement
- Thermal insulation
- Laminar Flow Control

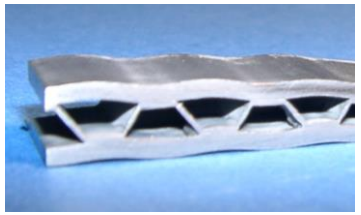
2 sheet design



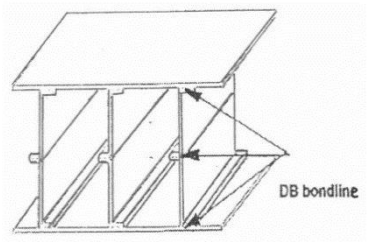


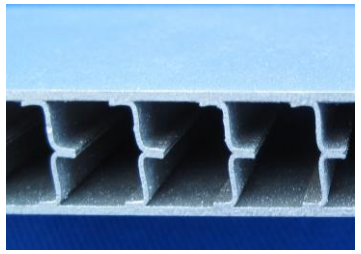
3 sheet design





4 sheet design





Summary

- Titanium alloys have superior properties
- Typical: Hi-temp material, resistance against hydrazine. etc
- Titanium structures offer huge benefit for specific space parts
- FT offers solutions for sheet metal parts/ built-up structures
- Space Tech Bremen: Stand E 31

Thank you very much for your attention

FormTech GmbH
Mittelwendung 26
D-28844 Weyhe
Germany

Phone: +49-4203-8045-0
Fax: +49-4203-8045-29
Email: info@formtech.de
Homepage: www.formtech.de