

High Performance & Cost Effective Recuperator for Micro-Gas Turbines

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RSAB Recuperator
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RSAB Recuperator

- **Owned by**

Volvo Technology Transfer Corp.	(64%)
Avesta Polarit	(33%)
Volvo Aero Corporation	(3%)

- **Founded in 1998**
- **Completely welded primary surface recuperator design, successfully developed in 2001**
- **Commercial serial production, scheduled in Spring 2003**
- **International patent applications filed**

Development Goal

A competitive recuperator design concept
for fully automated & cost-effective
mass production

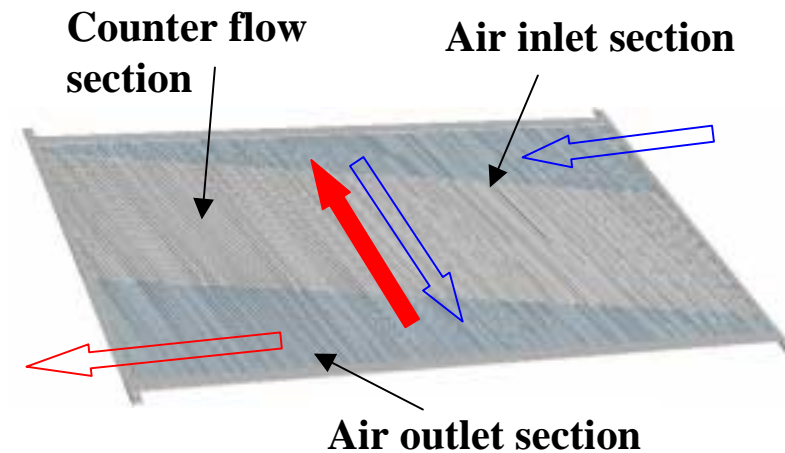
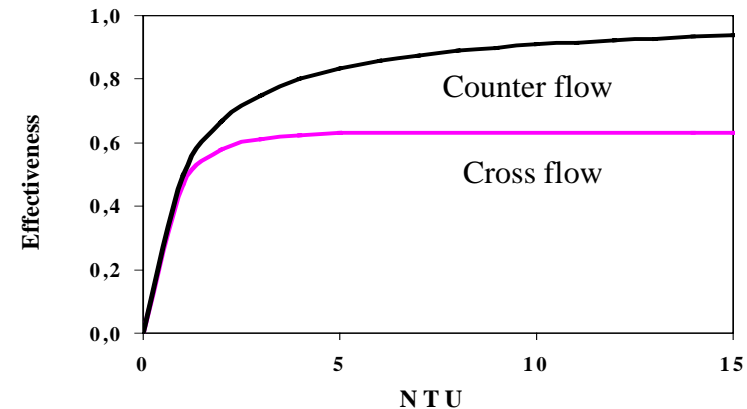
High performance & durability

Great modular ability

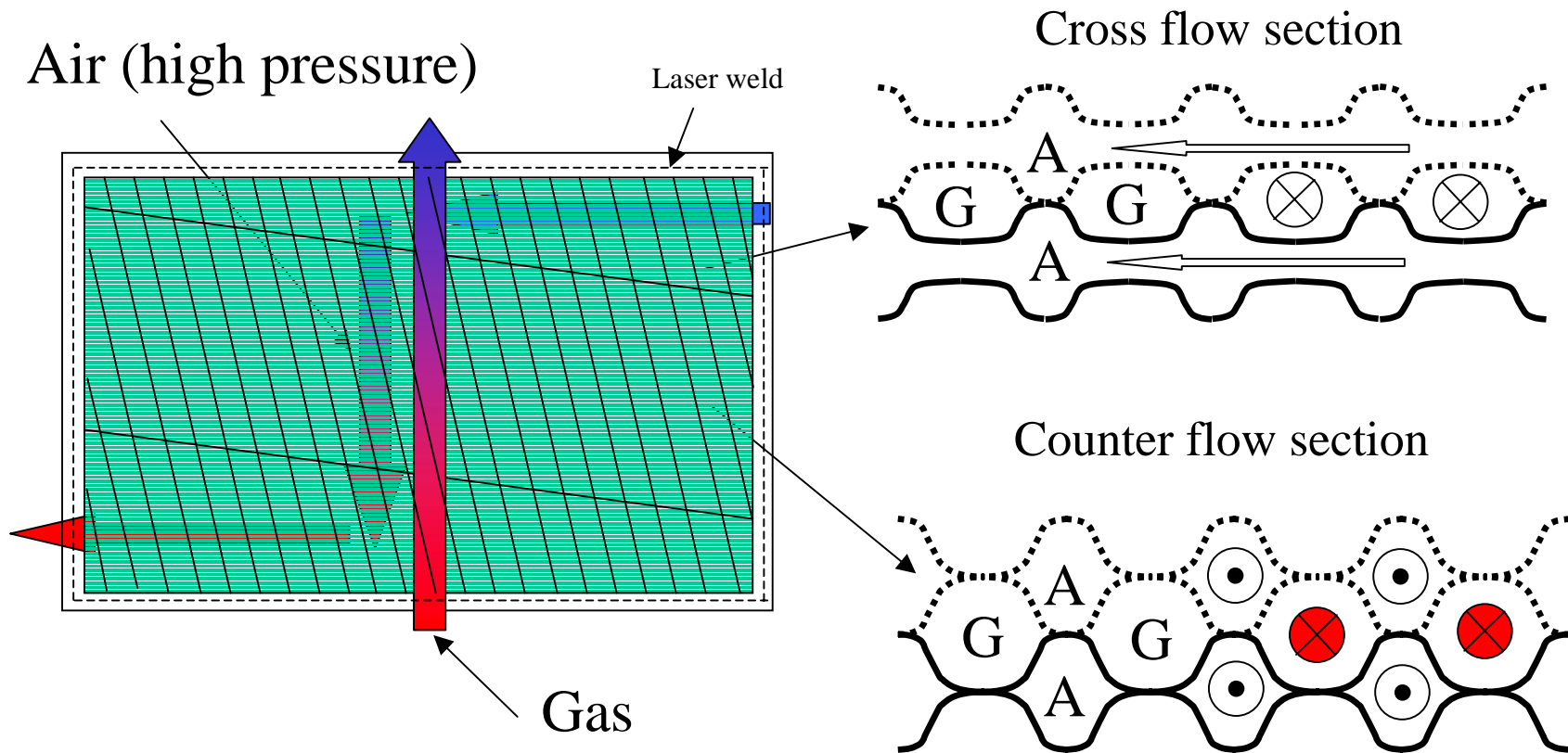
Low product cost

Design concept: High Performance

- **Counter flow type**
- **Cross corrugated pattern**
Pattern angle
Air & gas flow channel geometry
- **Asymmetric air inlet/outlet**
Optimised distribution
- **Laser-welded cells**
Minimal deformations
- **Laser-welded cell stack**

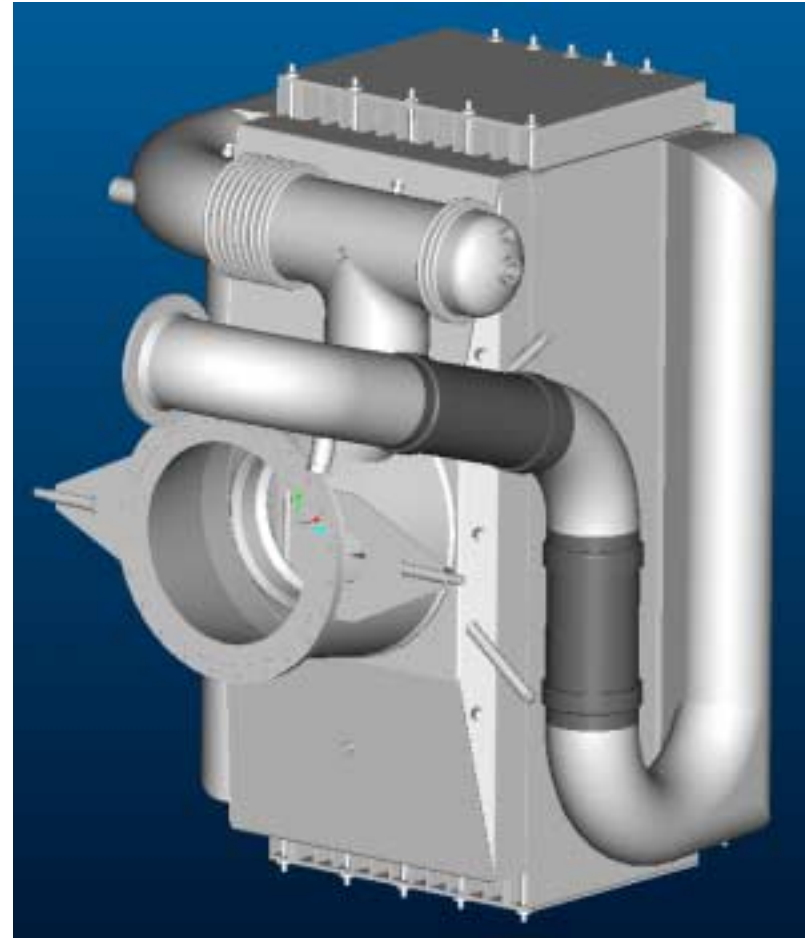


Air cell: Corrugation pattern



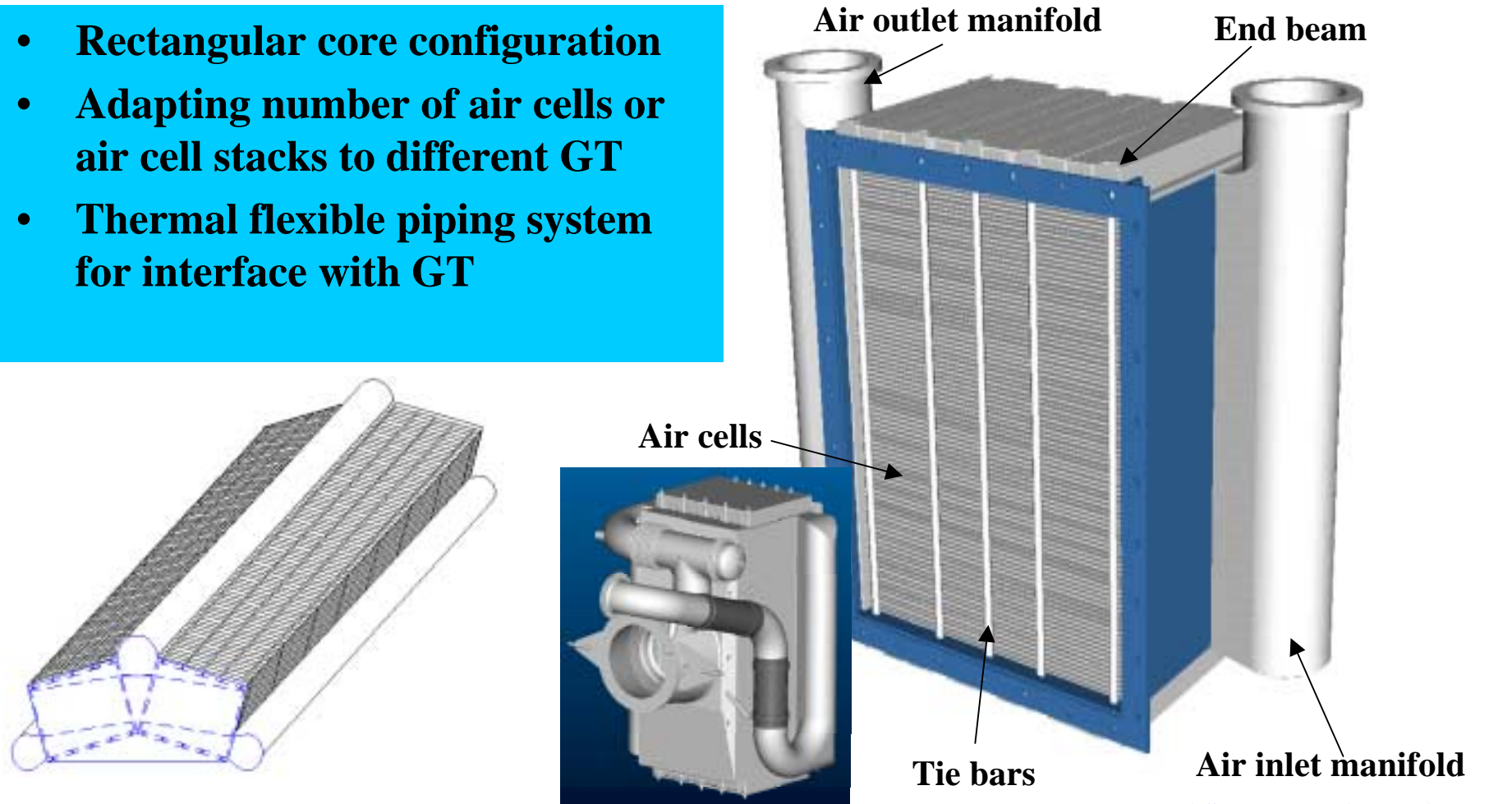
Design concept: **High Durability**

- **Thermal flexible design**
- **Few parts**
- **Completely welded**
- **Oxidation/corrosion resistant stainless steel**
- **Compatible material**
- **Flexible supports, GT**
- **Quality assured manufacturing**



Design concept: High Modular ability

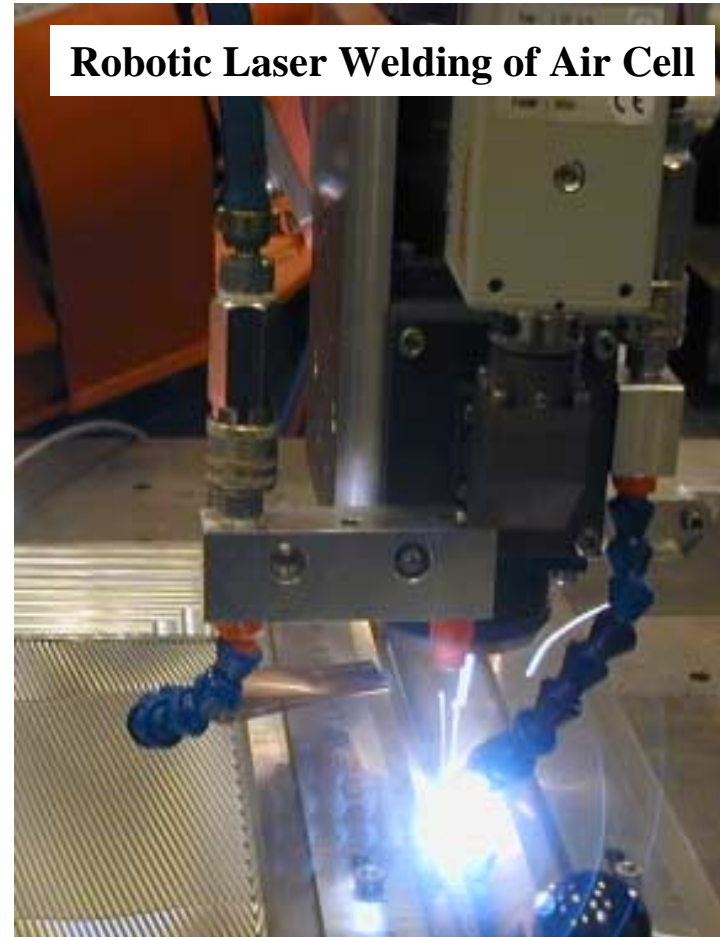
- Rectangular core configuration
- Adapting number of air cells or air cell stacks to different GT
- Thermal flexible piping system for interface with GT



Further information, contact: max.xie@volvo.com

Design concept: **Low Product Cost**

- **Stamping**
Primary heat transfer surface
- **Laser welding**
Air cells & Core
- **High productivity**
- **Full automation**
- **Quality assurance**
- **Mass production**



Recuperator developed for a 100kW(e)CHP

Operating conditions

Mass flow: 0.78 kg/s

Inlet temperature:

Air 210 °C

Gas 650 °C

Inlet pressure:

Air 450 kPa(a)

Gas 110 kPa(a)

Performance requirement

Effectiveness: min. 89%

Relative pressure loss:

Air max. 2%

Gas max. 2.5%



Recuperator developed for a 100kW(e)CHP



Air cell stack

- 390 air cells
- 886 (h) x 420 (w) x 295 (d) mm
- 140 kg



Performance test: Full load

	Test	Req.
Effectiveness	89.1%	89%
Pressure loss		
Air	1.4%	2.0%
Gas	<u>2.1%</u>	<u>2.5%</u>
Total	3.5%	4.5%

Conclusion:

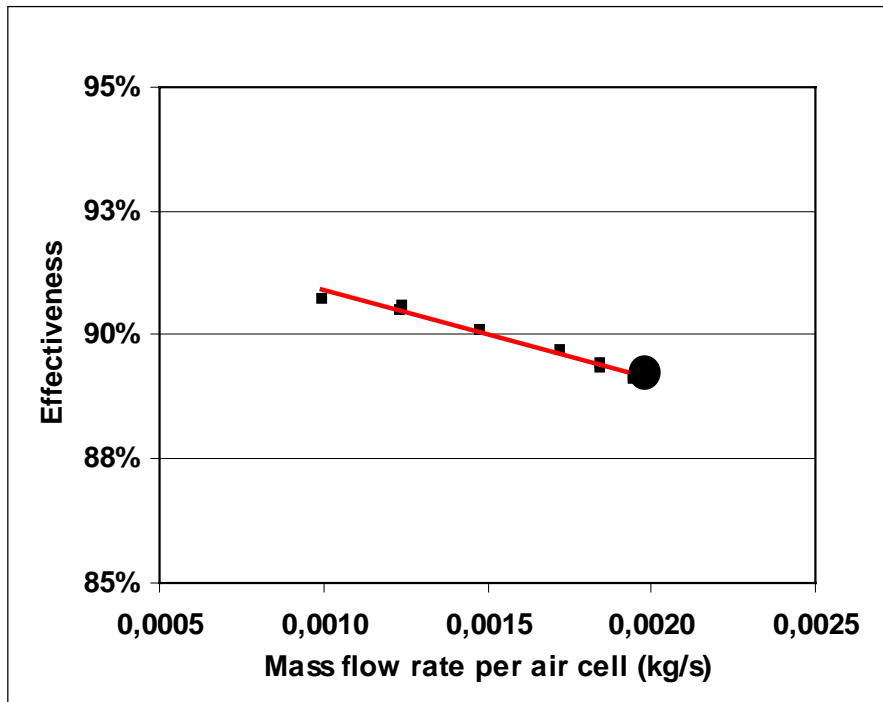
High performance achieved.



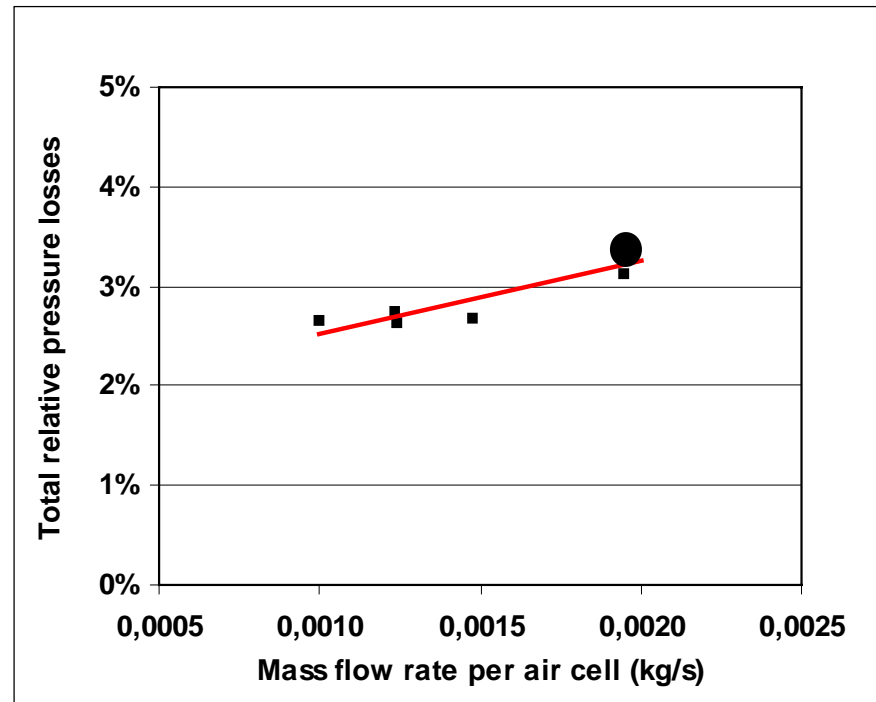
RSAB recuperator

Performance test: Partial loads

Effectiveness



Total relative pressure losses

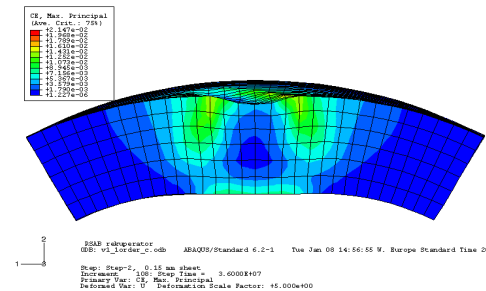
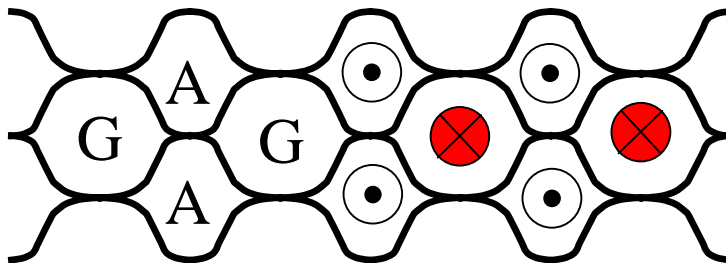
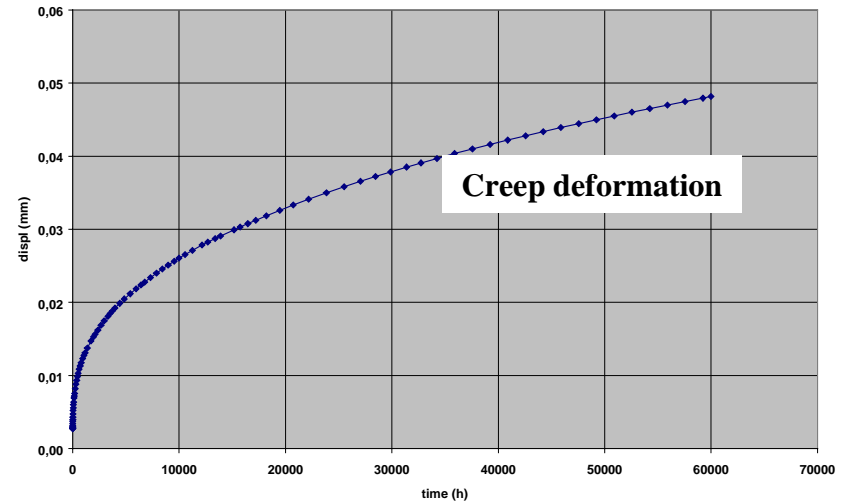


Durability: FEM Calculation

Creep Deformation, Corrugation Patterns

Conclusions:

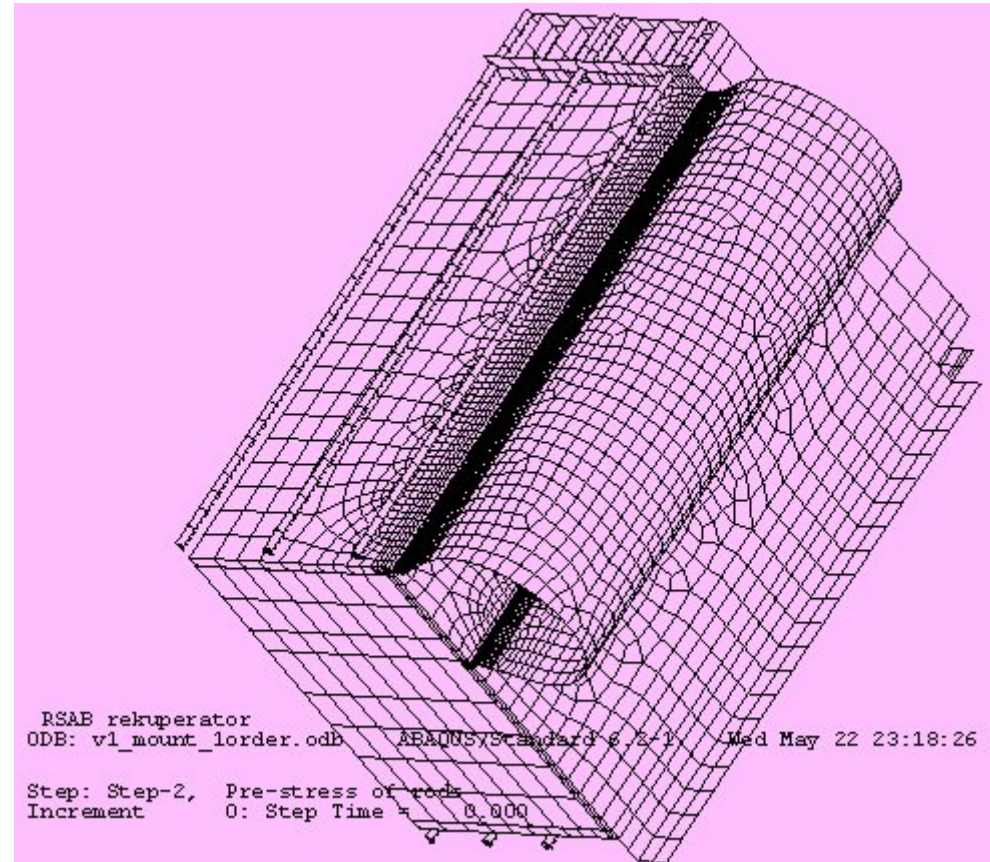
- Deformation, mainly at contact points
- Sufficient creep resistance to meet service requirement, 60000 operating hours.



Durability: FEM Calculation

Low Cycle Fatigue, Air manifolds/Core

- Thermal & mechanical models
- Thermal-mechanical stresses between core and air manifolds
- Analysis on-going
- A comprehensive cycle life test program, Sept. 2002



Conclusions: Design Concept

- **Stamped primary heat transfer surface**
- **Completely laser welded air cells & cell stack**
- **Thermal flexible design**
- **High performance achieved**
- **High durability ensured**
- **Great modular ability obtained**
- **Fully automated & Cost-effective mass production possible**