The challenge – designing a flexible connection between outside insulated gas turbine and inside isolated diffuser.

Design Specifics

An expansion joint between the outside insulated turbine and inside isolated diffuser has to perform following tasks:

- Compensating axial thermal expansion resulting from the turbine and pipe system
- Isolating vibrations
- Compensating of differing radial expansion of the hot stainless steel GT connection and the cooler carbon steel diffuser. The temperature exposure of those materials is different due to the change from outside insulation to inside insulation. In addition, stainless steel has a higher expansion coefficient than carbon steel.

The kompaflex solution – conical multiply bellows:

Conical multiply bellows, an unique kompaflex invention, can compensate all above mentioned movements thanks to its special shape. This includes the different radial expansions of the GT connection and diffuser.
FEM CALCULATION
A detailed FEM calculation using ANSYS 11 with typical GT parameters (650°C operating temperature, axial movement -160 mm with design life 10'000 cycles, lateral movement 5 mm) was performed in order to optimize the design. In addition critical matters as performance peaks, vibrations and the oscillation of the protection sheet were successfully checked.

DESIGN PARAMETER
- 650°C operating temperature
- Axial movement -160 mm
- Design life 10'000 cycles
- Lateral movement 5 mm
- Radial difference of 38 mm from the SS connector and CS diffuser

THERMAL ANALYSIS
The analysis at different stages of starting and stopping, restart and trip of the engine

MISES STRESSES DISPLAY
DEFLECTIONS
Are evaluated and show the movement caused by the different thermal expansion of the SS connector and CS diffuser.
A WORLD FIRST MULTIPLY CONCIAL EXPANSION JOINTS
The bellows consist of multiple steel layers made of 1.4878. kompaflex has a great experience with multiply bellows for GT applications. Our multiply GT designs have been running reliable since over 15 years.

CUSTOMER BENEFITS OF A CONICAL BELLOWS
- Technical superior solution
- Low spring rates
- Economic better solution than previous designs
- No maintenance necessary
- Very high life time = plant life
Design Specifics

WORLD UNIQUE RECTANGULAR EXPANSION JOINTS
kompaflex is worldwide the only company being able to manufacture multiply rectangular expansion joints. Also in big dimensions. Thus providing the advantages of the multiply bellows concept for rectangular shapes. There are no welding seams in the corner parts, an important technical advantage in a critical area.

References / Projects

ALSTOM POWER – THERMAL POWER STATIONS
Delivery of over 800 rectangular expansion joints pieces since 1989. Different dimensions up to 2500 x 6500 mm. Some of the thermal power stations are:
- Belchatow
- Bexbach
- Boxberg
- Dünrohr
- Eemshaven
- Goldenberg
- Grosskraftwerk Mannheim GKM
- Heilbronn
- Jänschwalde
- Ledvice
- Maritza
- Mehrum
- Neurath
- Niederaussem
- Oxyfuel
- RDK8
- Schwarzpe Pumpe
- Westfalen
- and many more

PROVEN QUALITY
kompaflex designs and manufactures rectangular multiply expansion joints since 1984. On the right below an example of a rectangular GT expansion joint for a Solar Turbine. Due to the superior design, the operational time of the multiply expansion joints is hugely increased.

PROVEN CALCULATIONS
The kompaflex design of rectangular expansion joints was fully verified by FEM calculations using ANSYS. For example kompaflex designs all rectangular 3320 x 3240 mm universal bellows connecting the ITER vacuum vessel and cryostat at the fusion research project in Cadarache.

SOLAR TURBINES / TURBOMACH
kompaflex delivered over 60 rectangular expansion joints to Turbomach since 1997
Design Specifics

HIGH TEMPERATURES AND EXHAUST VELOCITIES

Kompaflex fabric expansion joints are designed and optimized with the help of FEM calculations. This guarantees a reliable GT operation also under high temperatures and exhaust gas velocities. A special focus is laid on the insulation for high-temperature applications.

Round and Rectangular fabric expansion joints for a GT application in Moscow

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>MEDIUM</th>
<th>TEMPERATURE</th>
<th>PRESSURE</th>
<th>DIMENSIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Painipat, India</td>
<td>Exhaust gases</td>
<td>+510°C</td>
<td>-300 Pa</td>
<td>5905 x 10337 mm</td>
</tr>
<tr>
<td>Borsodchem, Hungary</td>
<td>Exhaust gases</td>
<td>+480°C</td>
<td>7580 Pa</td>
<td>8300 x 3300 mm, 3555 x 3075 mm</td>
</tr>
<tr>
<td>HRSG in Michelin, UK</td>
<td>Exhaust gases</td>
<td>+620°C</td>
<td>+/- 5 kPa</td>
<td>Ø 3760 mm</td>
</tr>
<tr>
<td>HRSG in Blackburn</td>
<td>Exhaust gases</td>
<td>+300°C</td>
<td>5 kPa</td>
<td>618 x 618 mm, L = 11900 mm</td>
</tr>
<tr>
<td>KW Niederassem, Germany</td>
<td>Fresh air</td>
<td>+ 40 °C</td>
<td>-30 / + 20 mbar</td>
<td>8150 x 3650 mm, BL = 350 mm</td>
</tr>
<tr>
<td>SÖK Salzburg, Austria</td>
<td>Exhaust gases</td>
<td>+250°C</td>
<td>35 mbar</td>
<td>Ø 2172 mm, 3232 x 1482 mm</td>
</tr>
<tr>
<td>HRSG Moskau, Russia</td>
<td>Exhaust gases</td>
<td>+650°C</td>
<td>+/-5 kPa</td>
<td>3575 x 4535 mm, Ø 3575 mm</td>
</tr>
<tr>
<td>Kakanj</td>
<td>Exhaust gases</td>
<td>+550°C</td>
<td>+/-5 kPa</td>
<td>6512 x 382 mm, Ø 500 mm</td>
</tr>
<tr>
<td>Kispest</td>
<td>Exhaust gases</td>
<td>+650°C</td>
<td>+/-5 kPa</td>
<td>Ø 3400 mm, 3727 x 6635 mm</td>
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<tr>
<td>MHKw Solingen, Germany</td>
<td>Exhaust gases</td>
<td>+450°C</td>
<td>+/-50 mbar</td>
<td>1688 x 3788 mm</td>
</tr>
<tr>
<td>HRSG Runcorn, UK</td>
<td>Exhaust gases</td>
<td>+500°C</td>
<td>12 kPa</td>
<td>1360 x 1060 mm, 1160 x 3960 mm</td>
</tr>
<tr>
<td>TPP1 Riga, Latvia</td>
<td>Exhaust gases</td>
<td>+150°C</td>
<td>86 mbar</td>
<td>12928 x 3658 mm, Ø 3000 mm</td>
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<tr>
<td>HPP Sandeuth, Germany</td>
<td>Exhaust gases</td>
<td>+620°C</td>
<td>6 kPa</td>
<td>3724 x 4676 mm, Ø 3440 mm</td>
</tr>
<tr>
<td>Nürnberg</td>
<td>Exhaust gases</td>
<td>+620°C</td>
<td>6 kPa</td>
<td>Ø 3440 mm, 3724 x 4676 mm</td>
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<tr>
<td>GKM Manheim, Block 6, Germany</td>
<td>Exhaust gases</td>
<td>+420°C</td>
<td>-70/+40 mbar</td>
<td>9850 x 5050 mm, 3490 x 11467 mm</td>
</tr>
<tr>
<td>Kelenföld II., Hungary</td>
<td>Exhaust gases</td>
<td>+400°C</td>
<td>5.6 kPa</td>
<td>4052 x 2945 mm, Ø 2010 mm</td>
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<tr>
<td>RYA Göteborg, Sweden</td>
<td>Exhaust gases</td>
<td>+620°C</td>
<td>+/-5 kPa</td>
<td>13275 x 3875 mm, Ø 3100 mm</td>
</tr>
<tr>
<td>USS Smederevo, Serbia</td>
<td>Exhaust gases, Air</td>
<td>+200°C</td>
<td>5 kPa</td>
<td>2960 x 3070 mm</td>
</tr>
<tr>
<td>Bucuresti VEST CHPP, Rumania</td>
<td>Exhaust gases</td>
<td>610°C</td>
<td>6 kPa</td>
<td>8204 x 3817 mm</td>
</tr>
</tbody>
</table>
Design Specifics

LARGE MULTIPLY STEEL GT EXPANSION JOINTS FOR SIEMENS

kompaflex ag is proud to be the main supplier for GT expansion joints for Siemens. Our proven robust design has been flawlessly in operation since over 15 years. The advantages of a multiply steel GT expansion joints are:

- Long-lasting, no breakdowns during plant life
- No maintenance work / replacements needed compared to fabric expansion joints
- Low spring rates
- Compact design
- Thus the most economic solution

FEM-CALCULATIONS FOR GT EXPANSION JOINTS

The conventional solution is a kompaflex multiply double bellows. The expansion joint and bellows has been fully calculated by FE. The successful on-going operation of over 300 expansion joints in the field confirm the kompaflex calculations.
References / Projects

All major power generation companies like Siemens, Alstom and GE rely on kompaflex expansion joints. We have an experience of over 30 years in this field.

SIEMENS - GAS TURBINES DELIVERIES
kompaflex delivery of over 300 GT expansion joints for Siemens gas turbines such as SGT-4000 and SGT-8000. Sizes from DN 2390 to DN 4469. Just a few examples of deliveries for Siemens GT's:

• Chania, Kreta
• Nahuenco, Chile
• Peterhead, Scotland
• Seabank, England
• Donaustadt, Austria
• Jebel Ali, Dubai
• Shuweihat, Abu Dhabi
• Gezer, Haifa
• Kuo Kuang, Taiwan
• Ribatejo, Portugal
• Rinjmond, Netherlands
• Chonburi, Thailand
• Palos de la Frontera, Spain
• Shidongkou, China
• Zhengzhou, China
• Ras-Laffan, Qatar
• BASF Antwerpen
• Senkang, Singapore
• Antalya, Turkey
• Misurata, Libya
• Irsching, Germany
• and many more

SIEMENS - PRESSURE BALANCED EXPANSION JOINTS
kompaflex provides Siemens also with corner balanced expansion joints for GT application. These expansion joints are usually installed on the turbine. There are various dimensions and expansion joints type available.

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