Clearance adjustment:
Shims for Cost Reduction

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Clearance adjustment: Shims for Cost Reduction

Content of Presentation

Shim Rings:

Explanation of Cost Reduction Over the Whole Process Chain

FLEXIBLE Material Structures:

Why to Differentiate Shim Types

Design Tips for Assemblies:

Where to Use Which Shim Type

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Cost Reduction
Over the Whole Process Chain

DESIGN

MAINTENANCE

PURCHASING

LOGISTICS

(SHIM RING MANUFACTURING)

SUB ASSEMBLY + BEARING MOUNTING

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Key information about  
Georg Martin GmbH

Adjusting the AGB LEAP1-B’s conical torque.

Copyright:  
Thierry Mamberti / Hispano-suiza / Safran

Caption:  
Adjusting the AGB LEAP1-B’s conical torque at Hispano-Suiza Assembly Line in Colombes

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Adjusting the AGB LEAP1-B's conical torque.
# Clearance adjustment: Shims for Cost Reduction

## Key information about Georg Martin GmbH

- **Founded:** 1945
- **Family owned**
- **95 Employees**
- **Turnover:** 10.6 Million Euro
- **Product & Services:** Metal Forming Parts, Sub Assemblies And Shims
- **USP:** Laminated Shim Manufacturing Germany
- **Industry Sectors:** General Industries, Mechanical Power Transmission & Aviation
- **Approvals:** AIRBUS GROUP, Rolls Royce, UTC, SAFRAN, Voith, div. Gear Box Manf.
- **Certifications:** EN 9100 (Aviation) & ISO 14001 (Environment)

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Example 1/2
Tapered Roller Bearings
In Metallurgical Work Rolls

Laminated Shim Ring Between Housing and Cover

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Example
2/2
Ball Bearings
In Gearboxes

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Assembly and Total Cost of Ownership
Assembly & TARGETS - Objectives

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Assembly and TCO
Choice of Material Structures →
Assembly TARGETS

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Practical Design
TCO / Complete Life Cycle Cost

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Logistic (& Manufacturing) Costs
Over the Whole Process Chain

Solid Shim Rings
With Fixed Thicknesses:

- Stock Control
- Chaotic Consumption
  (ConsumptionDriven)
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Manufacturing and Logistic Cost Over the Whole Process Chain

Pre-Assembly & Final Assembly + Production Planning
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Manufacturing Cost Over the Whole Process Chain

Pre-Assembly & Final Assembly + Production Planning

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Influences of Cost
Conclusion: Overall Approach & Choice

Technical Requirements

➢ Environment
➢ Loads
➢ Corrosion
➢ Light weight
➢ ...

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Material Structures
Differentiate Aspects: "P"

M-Tech® "P" „Paket“
Pro’s:

- Lift Foils With Fingers
- High temperatures
- Fast Handling
- Free Combinations
- Different Materials
- Different Thicknesses
- Min. 0,025
- Curved Surfaces
- Demand Driven
- One Piece Flow

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Shims for Cost Reduction

Material Structures
Differentiate Aspects: P

M-Tech® P „Packet“

Con‘s:
- Sealing aspect
- Very Tough Load conditions
- Shear forces

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Shims for Cost Reduction

Material Structures
Differentiate Aspects: P

M-Tech® P "Paket"
Layer Connections:

✓ New:
Laser Welded Connection

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Material Structures
Different Aspects: L

M-Tech®L „Laminated“
Pro’s:

✓ MARTIN Peel Tool®
✓ Sealing Advantages
✓ Demand Driven
✓ High Reliability
✓ Solid Sections Possible
✓ Different Foils Possible
✓ Min. Foils: 0.010mm
✓ Easy to Measure
✓ Demand Driven
✓ One Piece Flow

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Material Structures
Differenciate Aspects: L

M-Tech®L „Laminated“

Con‘s:
- Dynamic Loads
- Temperature >> 200°C
- Harsh Friction
- Intense Shear Forces

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Clearance adjustment:
Shims for Cost Reduction

Material Structures
Differenciate Aspects: L

M-Tech®L „Laminated“ Layer Connections:

- Fully Laminated for Temporarily Connection
- Glued for Permanent Connections Between Laminated Sections On Solid Rings Elements

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Clearance adjustment: Shims for Cost Reduction

Material Structures 
Differenciate Aspects: S

M-Tech®S „Solid“

Pro‘s:

✓ All mechanical Load Types
✓ Temperatures >> 200°C
✓ Parallelity Demands
✓ Shear Forces
✓ Single Foils Thickness min. 5 µm

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Material Structures
Differenciate Aspects: S

M-Tech®S „Solid“
Con‘s

- Process Costs
- Maintenance Processes
- Hidden Costs
- Foil Handling in Assembly
- Measuring Foils
- Consumption Driven
- Or Expensive Single Piece Production

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Design Tips for Assemblies
Where to Use Which Shim Type

One (or Several) Washer
Or Shim

One Full Shim Ring
Or
One Split Shim Ring

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Shims for Cost Reduction

Design Tips for Assemblies
Where to Use Which Shim Type

Directly Near to the Bearing:
Can Bring Wear and Friction Problems Over Life Time
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Design Tips for Assemblies
Where to Use Which Shim Type

Ideal Placement
With No Friction
As Almost Static
Load Condition.
No Interference
With Bearing.

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Shims... a „last“ aid for designers ?? or...

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Shims...
Are A Strategic Approach to Reduce Over all Process Costs!

DESIGN

MAINTENANCE

(PHIM RING MANUFACTURING)

PURCHASING

LOGISTICS

SUB ASSEMBLY + BEARING MOUNTING

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Reasons for Laminated and Paketed Rings

Sum – Up 1/2:

- Practical and Easy Design Processes
- Sum Tolerances of Bearings and Housing Will be Nullified
- Without Increasing the Production Cost of the Other Components
- Non-Automated Assemblies Will be Fast and Easy
- Assembly Process Can Take Place Regardless of the Location
Clearance adjustment:
Shims for Cost Reduction

Reasons for
Laminated and Paketed Rings

Sum – Up 2/2:

- No Invest in Machines
- Indirect Labor and Process Cost Reduced
- One Piece Flow
- Demand Driven instead Consumption (Chaotic) Driven Demand
- Easy Maintenance Assembly Processes
- Customer Satisfaction by Down-Time Reduction
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Shims for Cost Reduction

Many Thanks for your Attention,

ENJOY YOURSELF 😊 REDUCING OVERALL PROCESS COSTS !

Mr. Christoph Martin
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Back-Up Slides...

Back-Up Slides

- Material lists
- Mechanical pressure resistance information
- Example Calculation
- Temperature Information

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Material Lists
Solid and Packed Materials

Laminated Materials:
## Clearance adjustment: Shims for Cost Reduction

### Appropriate Pressure Load Types

<table>
<thead>
<tr>
<th>Mechan. Load / Product type</th>
<th>Static</th>
<th>Dynamically swelling</th>
<th>Dynamically alternating</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-Tech®L and Laminum®</td>
<td>✓</td>
<td>✓</td>
<td>–</td>
</tr>
<tr>
<td>M-Tech®S</td>
<td>✓</td>
<td>✓</td>
<td>✓ (*&gt;)</td>
</tr>
<tr>
<td>M-Tech®P and Lamivario®</td>
<td>✓</td>
<td>✓</td>
<td>✓ (*)</td>
</tr>
</tbody>
</table>

Subject to Changes. Depending On Assembly Conditions Tests Are Imperatively Suggested.
**Clearance adjustment:**

**Shims for Cost Reduction**

**Temperature Indications**

**For Different Material Structures**

<table>
<thead>
<tr>
<th>Temperature / Product type</th>
<th>Up to 100°C</th>
<th>Up to 200°C</th>
<th>Over 200°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-Tech®L and Laminum®</td>
<td>✓</td>
<td>✓ Only steel types</td>
<td>-</td>
</tr>
<tr>
<td>M-Tech®S</td>
<td>✓</td>
<td>✓/(*)</td>
<td>✓/(*)</td>
</tr>
<tr>
<td>M-Tech®P and Lamivario®</td>
<td>✓/(*)</td>
<td>✓/(*)</td>
<td>/(*)</td>
</tr>
</tbody>
</table>

Subject to changes. Depending on assembly conditions tests are imperatively suggested.

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Pressure Resistance 
For Different Material Structures

http://www.georg-martin.de/uploads/Produktspezifikationen/ENG/02%20martin_strength_values.pdf

Subject to changes. Depending on assembly conditions tests are imperatively suggested.
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Pressure Resistance
Example of Static Load Calculation

http://www.georg-martin.de/uploads/Produktspezifikationen/ENG/02%20martin_strength_values.pdf

\[ \varepsilon_d = \frac{\Delta \ell}{\ell_0} = \frac{\ell_0 - \ell}{\ell_0} = \frac{\sigma_d}{E} = \frac{F_d}{E A} \]

\( \ell_0 \) = Height of sample 2.0 mm

\( \Delta \ell \) = Deformation by compression (searched)

\( E \) = E-Modul of M-Tech\(^\circ\)L Sample, stainless steel type C

\( \sigma_d \) = Yield point of M-Tech\(^\circ\)L, Type C

\[ \varepsilon_d \text{ M-Tech}\(^\circ\)L = \frac{\sigma_d}{E} = \frac{192 \text{ MPa}}{29.137 \text{ MPa}} = 0.0066 \]

\[ \varepsilon_d = \frac{\Delta \ell}{\ell_0} \Rightarrow \varepsilon_d \times \ell_0 = 0.0132 \text{ mm deformation by compression} \]

Subject to changes. Depending on assembly conditions tests are imperatively suggested.

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