Bearing Clearance adjustment: 
Shims for Cost Reduction
Bearing Clearance adjustment: Shims for Cost Reduction

Shim Rings:

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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WHY IS MARTIN JOINING THE BRCE?

Searching to Create the Missing Link Between:

Bearing Manufacturers – Shim Manufacturers – Application Design and Assembly
Bearing Clearance adjustment: Shims for Cost Reduction

Cost Reduction Over the Whole Process Chain

DESIGN

MAINTENANCE

PURCHASING

LOGISTICS

(SHIM RING MANUFACTURING)

SUB ASSEMBLY + BEARING MOUNTING

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Bearing Clearance adjustment: Shims for Cost Reduction

Key information about Georg Martin GmbH

Adjusting the AGB LEAP1-B's conical torque.

Copyright: Thierry Mambert / Hispano-suiza / Safran

Caption: Adjusting the AGB LEAP1-B's conical torque at Hispano-Suiza Assembly Line in Colombes
Bearing Clearance adjustment:
Shims for Cost Reduction
Bearing Clearance adjustment:
Shims for Cost Reduction

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

Key information about Georg Martin GmbH

Founded: 1945
Family owned
100 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, SAFRAN, div. Gear Box Manf.
Certification: EN9100 (Aviation) & ISO14001 (Environment)
Bearing Clearance adjustment:
Shims for Cost Reduction

Example 1/2
Tapered Roller Bearings
In Metallurgical Work Rolls

Laminated Shim Ring Between Housing and Cover

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Bearing Clearance adjustment:
Shims for Cost Reduction

Example

Ball
Bearings
In
Gearboxes

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Assembly and Total Cost of Ownership
Assembly & TARGETS - Objectives

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Shims for Cost Reduction

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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Shims for Cost Reduction

Influences of Cost
Conclusion: Overall Approach & Choice

Technical Requirements

- Environment
- Loads
- Corrosion
- Light weight
- ...

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Bearing Clearance adjustment: Shims for Cost Reduction

Material Structures
Differentiate Aspects: P

M-Tech®P „Paket“ Pro’s:

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

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Bearing Clearance adjustment:
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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Bearing Clearance adjustment:
Shims for Cost Reduction

Material Structures
Differentiate Aspects: P

M-Tech® P “Paket“
Layer Connections:

✓ Historically: Edge Bonded
✓ New: Laser Welded
✓ Grouping With Cable Binder

“P“
Bearing Clearance adjustment: Shims for Cost Reduction

Material Structures Differenciate 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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Bearing Clearance adjustment: Shims for Cost Reduction

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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Bearing 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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Bearing Clearance adjustment: Shims for Cost Reduction

Material Structures
Differenciate Aspects: S

"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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Bearing Clearance adjustment: Shims for Cost Reduction

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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Shims for Cost Reduction

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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Design Tips for Assemblies
Where to Use Which Shim Type

Directly Near to the Bearing:
Can bring Wear 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 for Cost Reduction

Shims... a „last“ aid for designers ?? or...
Bearing Clearance adjustment: Shims for Cost Reduction

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

DESIGN

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Bearing Clearance adjustment:  
Shims for Cost Reduction

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
Bearing 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
Many Thanks for your Attention,

ENJOY YOURSELF 😊 REDUCING OVERALL PROCESS COSTS !
We are eager to exchange on your point of view!
We SEEK contact to
Bearing Manufacturers
&
Bearing Applicators to Join Knowledge And Forces

Mr. Christoph Martin
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www.Georg-Martin.de

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named owner or Georg Martin GmbH
ENJOY YOURSELF 😊 REDUCING OVERALL PROCESS COSTS!

Back Up Slides...

Back-Up Slides
- Material lists
- Mechanical pressure resistance information
- Example Calculation
- Temperature Information
Bearing Clearance adjustment:
Shims for Cost Reduction

Material Lists
Solid and Packed Materials


Laminated Materials:
# Bearing 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>✔️ (*)</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.
## Bearing 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>✓ /<em>(</em>)</td>
<td>✓ /<em>(</em>)</td>
</tr>
<tr>
<td>M-Tech®P and Lamivario®</td>
<td>✓ /<em>(</em>)</td>
<td>✓ /<em>(</em>)</td>
<td>/<em>(</em>)</td>
</tr>
</tbody>
</table>

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

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Bearing Clearance adjustment:
Shims for Cost Reduction

Pressure Resistance
For Different Material Structures

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

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Bearing Clearance adjustment:
Shims for Cost Reduction

Pressure Resistance
Example of Static Load Calculation

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

\(\ell_0\) = Height of sample 2,0 mm

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

\(E\) = Modul of M-Tech\(^{\text{®}}\)L Sample, stainless steel type C

\(\sigma_d\) = Yield point of M-Tech\(^{\text{®}}\)L, Type C

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

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

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

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