

# Bearing Clearance adjustment: Shims for Cost Reduction



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# Bearing Clearance adjustment: Shims for Cost Reduction

## Shim Rings:

**Cost Reduction**  
Over the Whole Process Chain



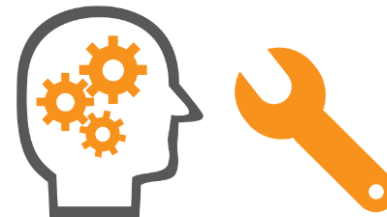
## FLEXIBLE Material Structures:

**Why to**  
Differentiate Shim Types



## Design Tips for Assemblies:

**Where to**  
Use Which Shim Type



# Bearing Clearance adjustment: Shims for Cost Reduction

## WHY IS MARTIN JOINING THE BRCE?

Searching to Create the Missing Link Between:

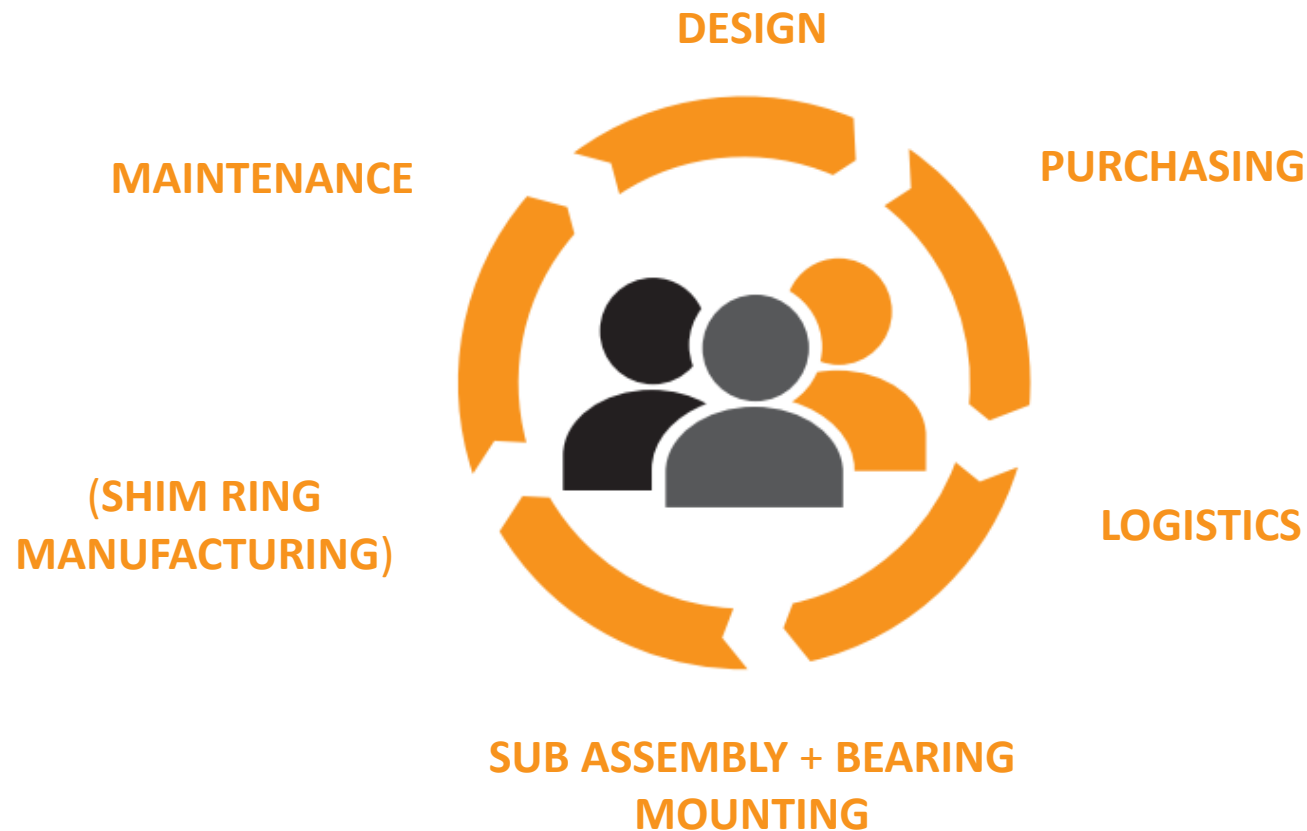


**Bearing Manufacturers – Shim Manufacturers – Application Design and Assembly**

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# Bearing Clearance adjustment: Shims for Cost Reduction

## Cost Reduction Over the Whole Process Chain



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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 Mamberti / Hispano-suiza / Safran

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

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# Bearing Clearance adjustment: Shims for Cost Reduction

Adjusting the AGB LEAP1-B's conical torque.



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

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# **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**

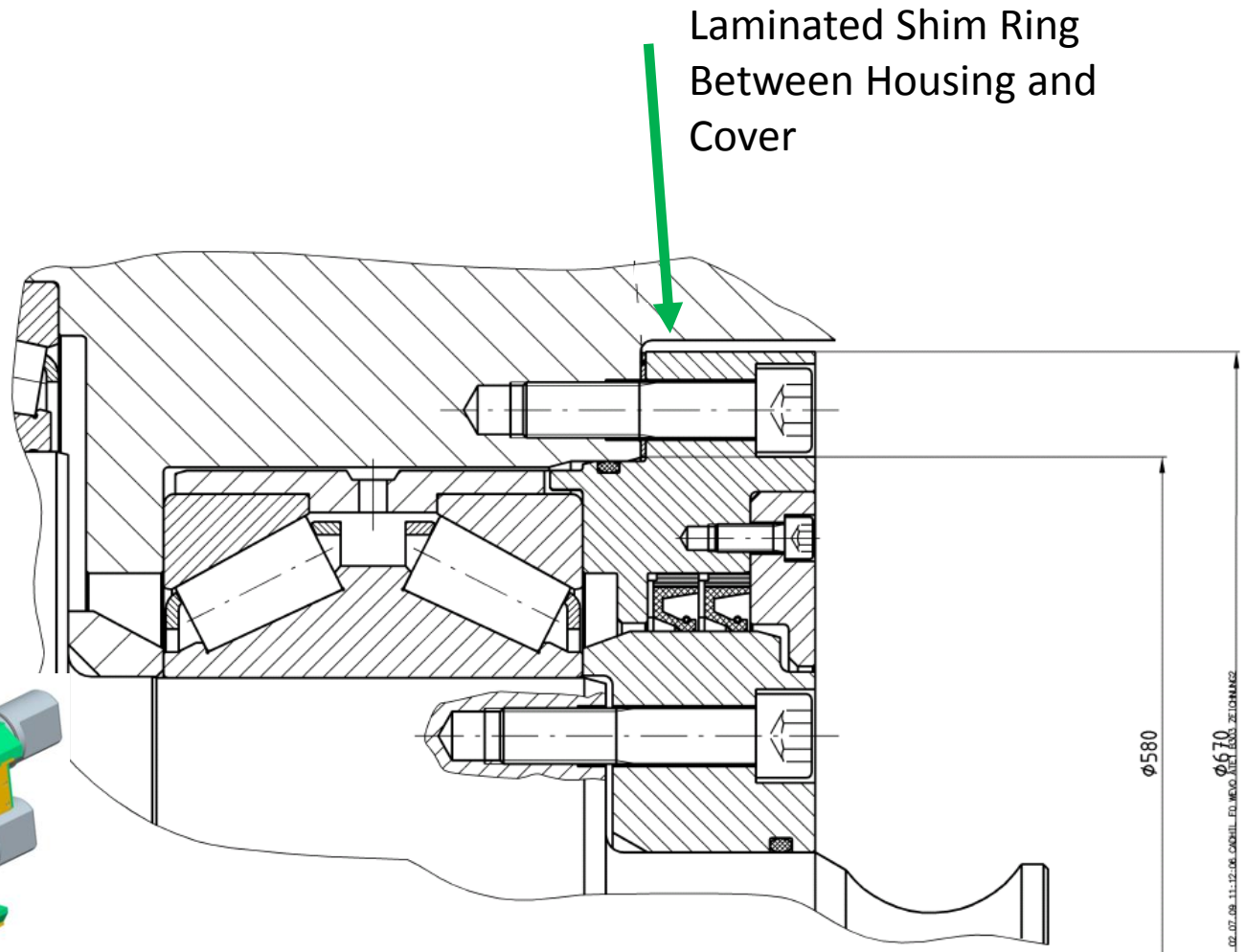
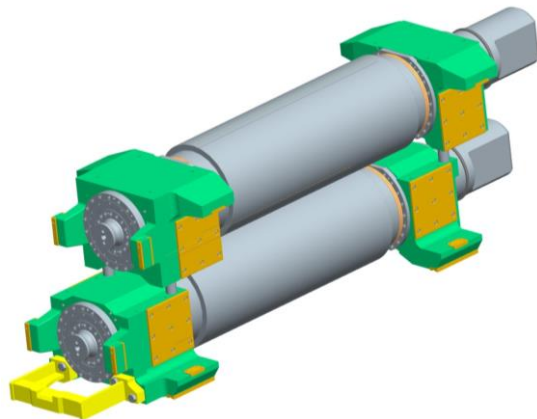
**Approvals: AIRBUS GROUP, Rolls Royce, SAFRAN, div. Gear Box Manf.**

**Certification: EN9100 (Aviation) & ISO14001 (Environment)**



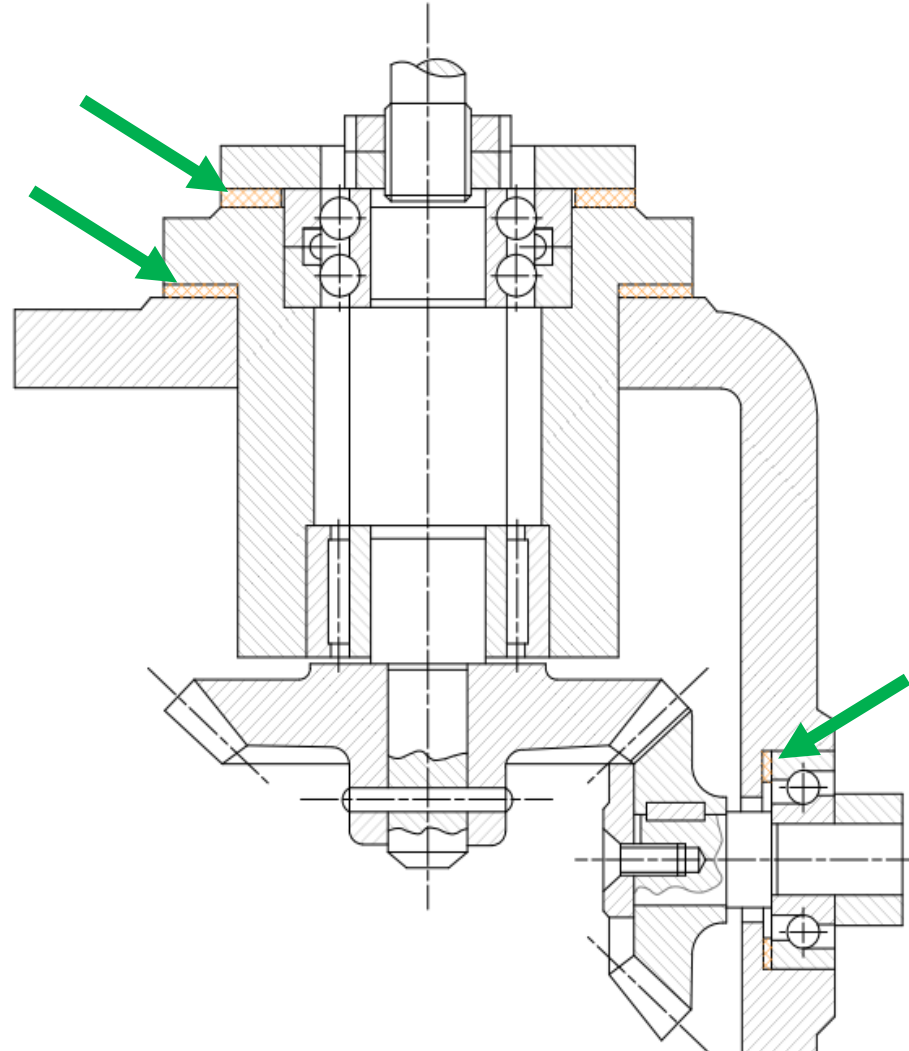
# Bearing Clearance adjustment: Shims for Cost Reduction

Example 1/2  
**Tapered  
Roller  
Bearings**  
In  
Metallurgical  
Work Rolls



# Bearing Clearance adjustment: Shims for Cost Reduction

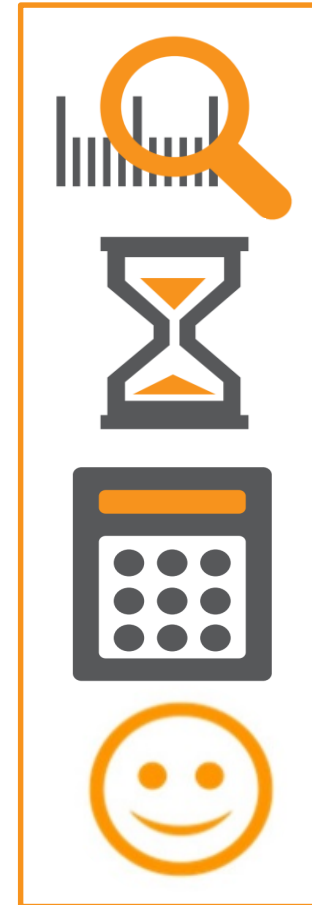
Example  
2/2  
**Ball  
Bearings  
In  
Gearboxes**



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# Bearing Clearance adjustment: Shims for Cost Reduction

**Assembly and Total Cost of Ownership**  
**Assembly & TARGETS - Objectives**



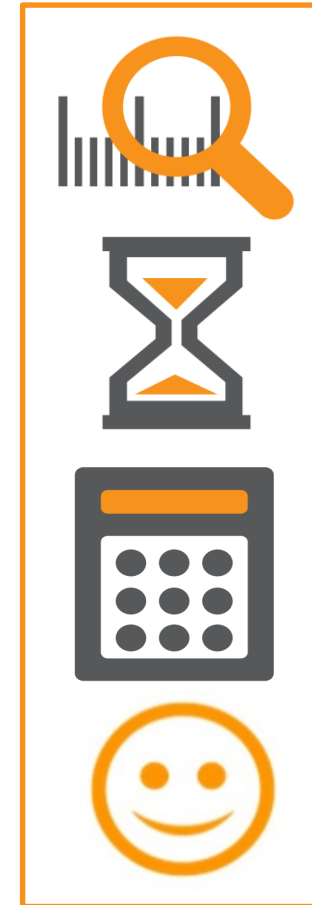
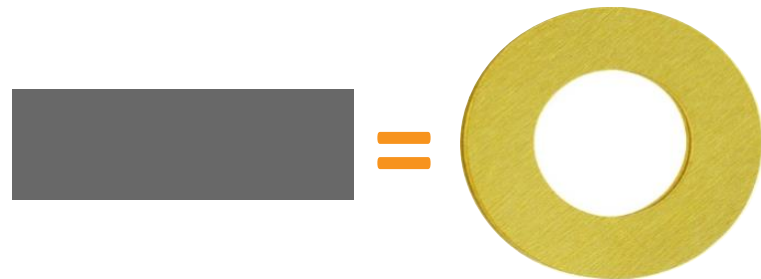
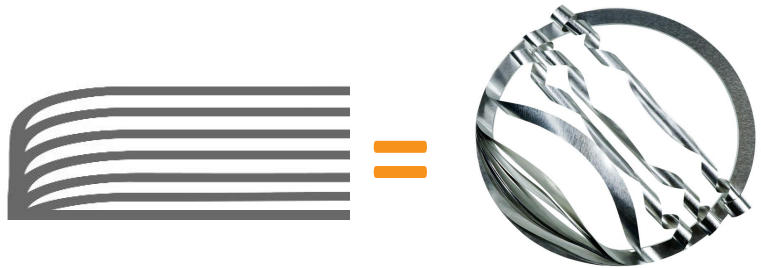
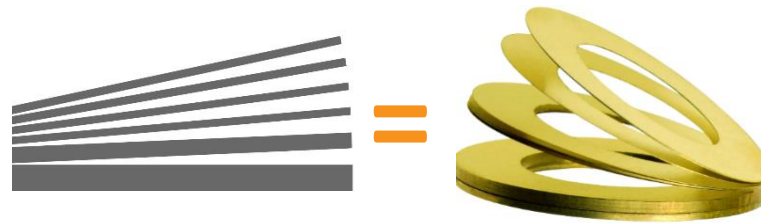
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# Bearing Clearance adjustment: Shims for Cost Reduction

## Assembly and TCO

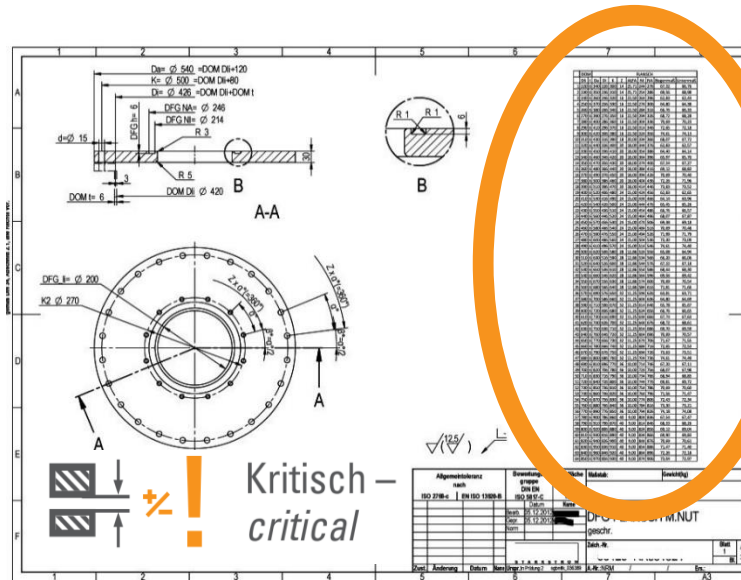
Choice of Material Structures →  
Assembly TARGETS



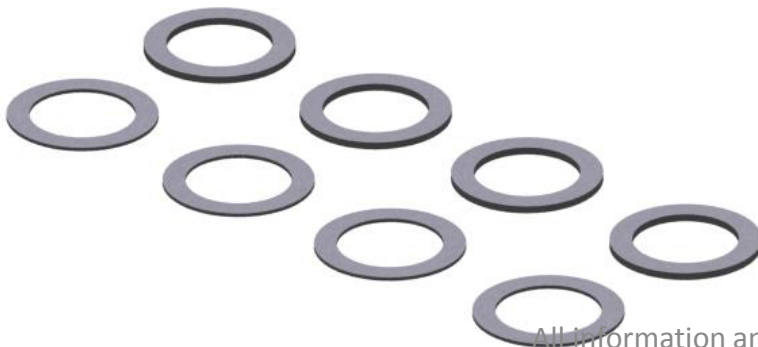
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# Bearing Clearance adjustment: Shims for Cost Reduction

## Practical Design TCO / Complete Life Cycle Cost



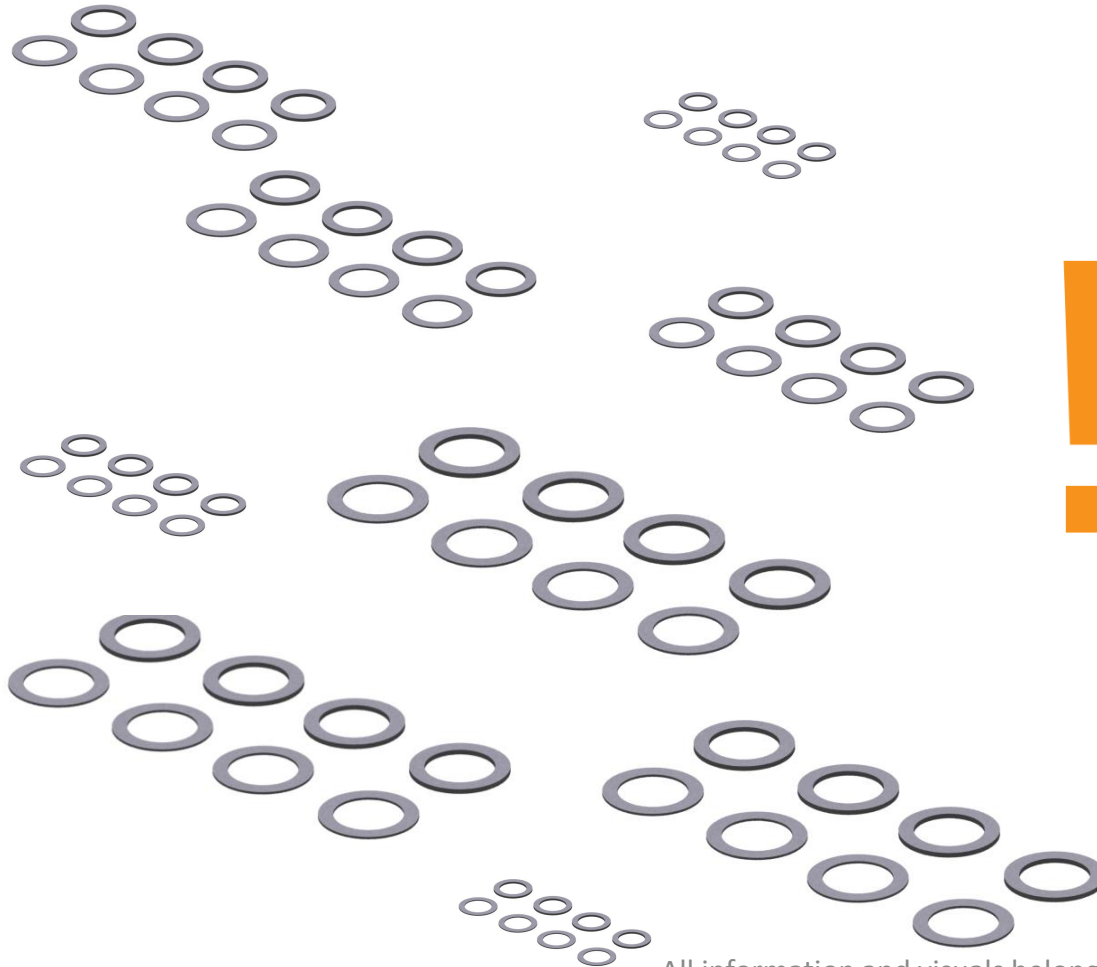
**CHEAP?**



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# Bearing Clearance adjustment: Shims for Cost Reduction

## Logistic (& Manufacturing) Costs Over the Whole Process Chain



### Solid Shim Rings With Fixed Thicknesses:

- Stock Control
- Chaotic Consumption  
(ConsumptionDriven)

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# Bearing Clearance adjustment: Shims for Cost Reduction

## Manufacturing and Logistic Cost Over the Whole Process Chain



**Pre-Assembly  
&  
Final Assembly**



**Production  
Planning**



# Bearing Clearance adjustment: Shims for Cost Reduction

**Manufacturing Cost  
Over the Whole Process Chain**



**Pre-Assembly  
&  
Final Assembly**



**Production  
Planning**



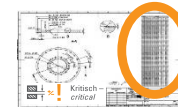
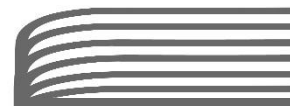
# Bearing Clearance adjustment: Shims for Cost Reduction

## Influences of Cost

**Conclusion: Overall Approach & Choice**

### Technical Requirements

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





# Bearing Clearance adjustment: Shims for Cost Reduction

## Material Structures Differentiate Aspects: P



„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

# Bearing Clearance adjustment: Shims for Cost Reduction

## Material Structures Differentiate Aspects: P



„P“



**M-Tech®P „Packet“**

**Con's:**

- Sealing aspect
- Very Tough Load conditions
- Shear forces

# Bearing Clearance adjustment: Shims for Cost Reduction

## Material Structures Differentiate Aspects: P



„P“



### M-Tech®P „Paket“ Layer Connections:

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

# Bearing Clearance adjustment: Shims for Cost Reduction

## Material Structures Differentiate Aspects: L



„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**

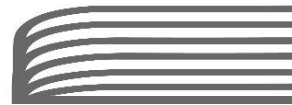


# Bearing Clearance adjustment: Shims for Cost Reduction

## Material Structures Differentiate Aspects: L



„L“



**M-Tech®L „Laminated“**  
Con's:

- Dynamic Loads
- Temperature >> 200°C
- Harsh Friction
- Intense Shear Forces

# Bearing Clearance adjustment: Shims for Cost Reduction

## Material Structures Differentiate Aspects: L



„L“

### M-Tech®L „Laminated“ Layer Connections:

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

# Bearing Clearance adjustment: Shims for Cost Reduction

## Material Structures Differentiate Aspects: S



„S“

**M-Tech®S** „Solid“  
Pro's:

- ✓ All mechanical Load Types
- ✓ Temperatures  $\gg 200^{\circ}\text{C}$
- ✓ Parallelity Demands
- ✓ Shear Forces
- ✓ Single Foils Thickness  
min. 5  $\mu\text{m}$

# Bearing Clearance adjustment: Shims for Cost Reduction

## Material Structures Differentiate Aspects: S



„S“



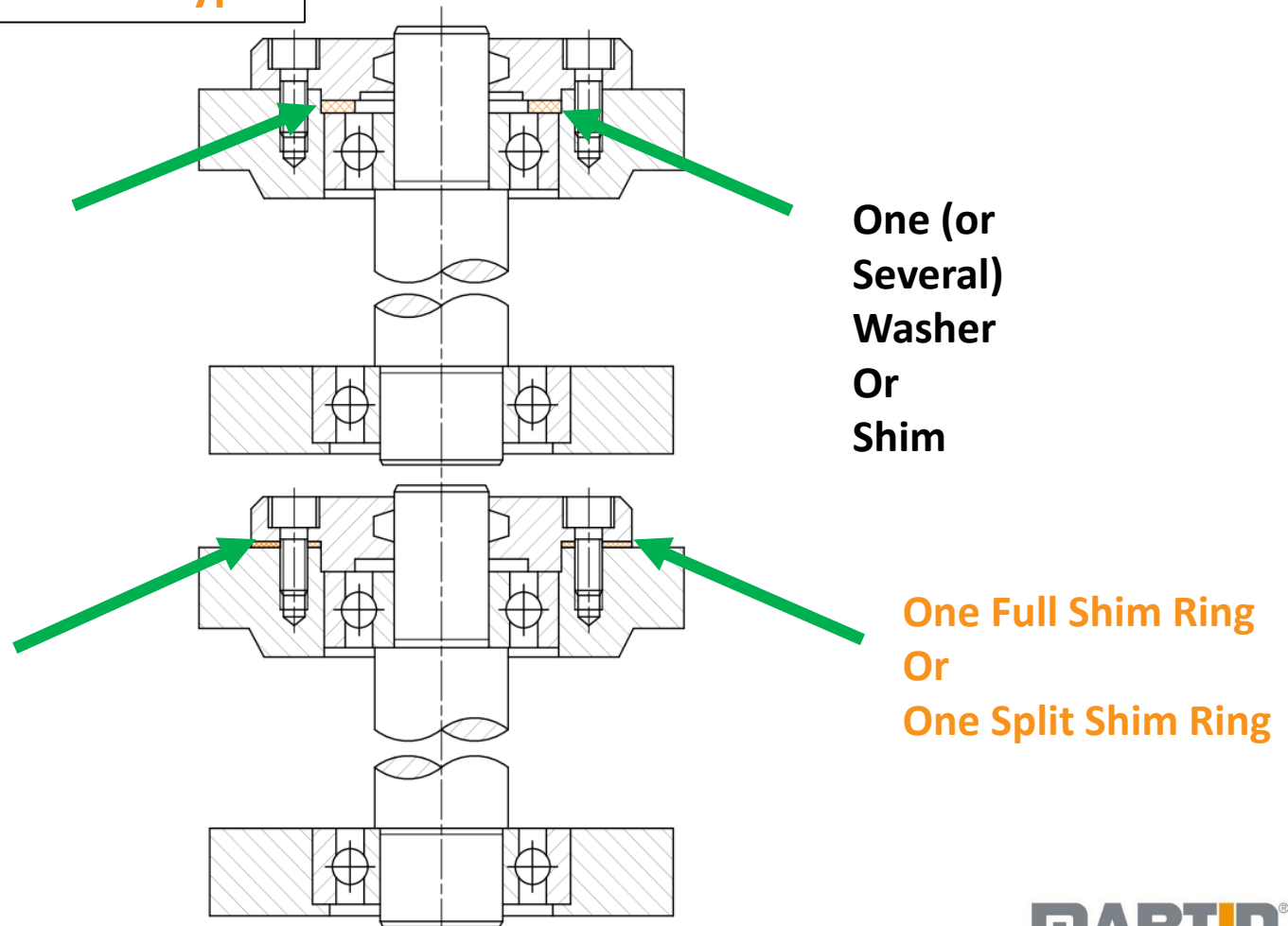
M-Tech®S „Solid“  
Con's

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



# Bearing Clearance adjustment: Shims for Cost Reduction

## Design Tips for Assemblies Where to Use Which Shim Type



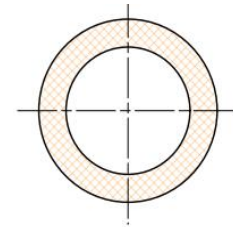
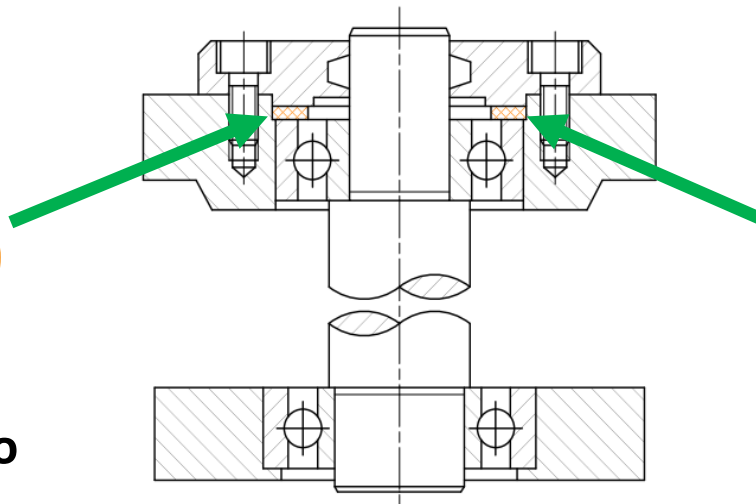
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# Bearing Clearance adjustment: Shims for Cost Reduction

## Design Tips for Assemblies Where to Use Which Shim Type

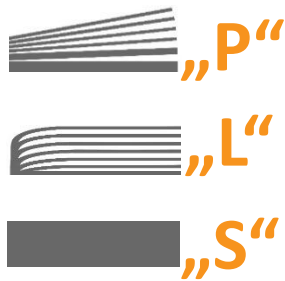


**Directly Near to  
the Bearing:  
Can bring Wear  
Problems Over  
Life Time**

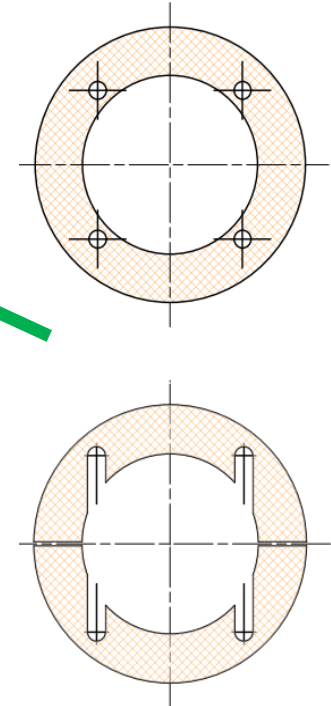
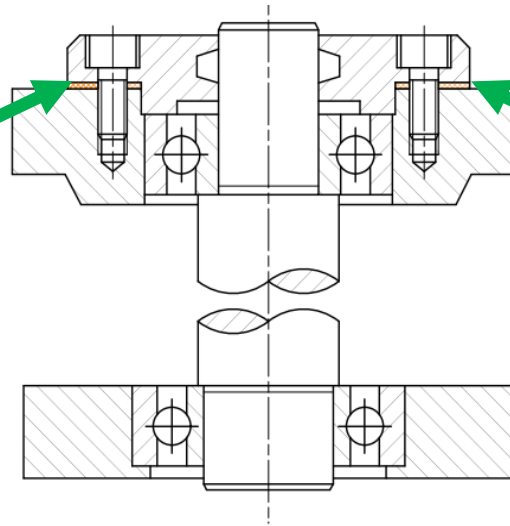


# Bearing Clearance adjustment: Shims for Cost Reduction

## Design Tips for Assemblies Where to Use Which Shim Type



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



# Bearing Clearance adjustment: Shims for Cost Reduction

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



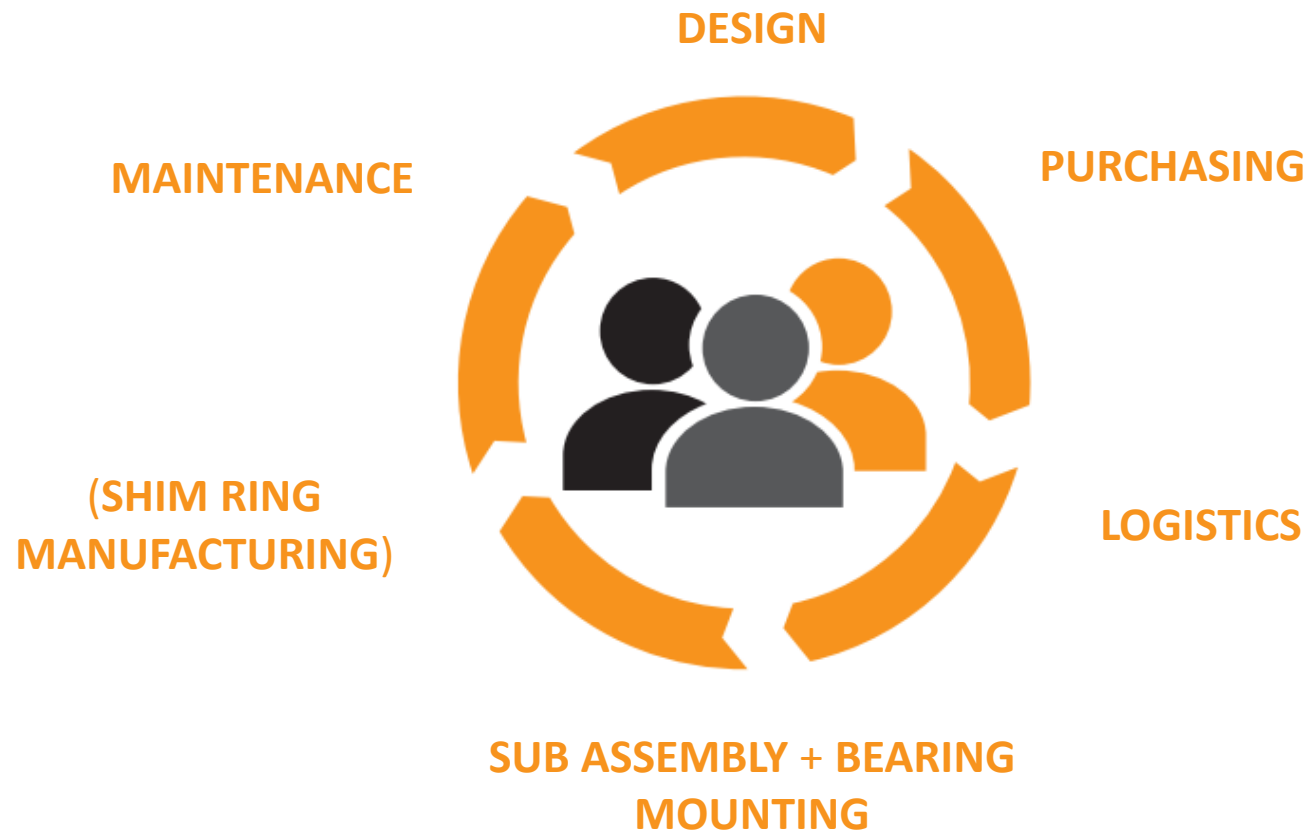
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# Bearing Clearance adjustment: Shims for Cost Reduction

**Shims...**

**Are A Strategic Approach to Reduce Over all Process Costs !**



## **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

## Bearing Clearance adjustment: Shims for Cost 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**

**+ 49 151 16142488**

**[C.Martin@Georg-Martin.de](mailto:C.Martin@Georg-Martin.de)**

**[www.Georg-Martin.de](http://www.Georg-Martin.de)**

# Bearing Clearance adjustment: Shims for Cost Reduction

**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

[http://www.georg-martin.de/uploads/Produktspezifikationen/04%20Materialspezifikation\\_M-Tech\\_S.pdf](http://www.georg-martin.de/uploads/Produktspezifikationen/04%20Materialspezifikation_M-Tech_S.pdf)

### Laminated Materials:

[http://www.georg-martin.de/uploads/Produktspezifikationen/05%20Materialspezifikationen\\_M-Tech\\_L.pdf](http://www.georg-martin.de/uploads/Produktspezifikationen/05%20Materialspezifikationen_M-Tech_L.pdf)



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# Bearing Clearance adjustment: Shims for Cost Reduction

## Appropriate Pressure Load Types

Mechan. Load / Product type	Static	Dynamically swelling	Dynamically alternating
M-Tech®L and Laminum®	✓	✓	-
M-Tech®S	✓	✓	✓ (*)
M-Tech®P and Lamivario®	✓	✓	✓ (*)

Subject to Changes. Depending On Assembly Conditions Tests Are  
Imperatively Suggested.

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## Bearing Clearance adjustment: Shims for Cost Reduction

## Temperature Indications For Different Material Structures

Temperature / Product type	Up to 100°C	Up to 200°C	Over 200°C
M-Tech®L and Laminum®	✓	✓ Only steel types	—
M-Tech®S	✓	✓ / (*)	✓ / (*)
M-Tech®P and Lamivario®	✓ / (*)	✓ / (*)	/ (*)

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

### MECHANICAL STRENGTH VALUES \*

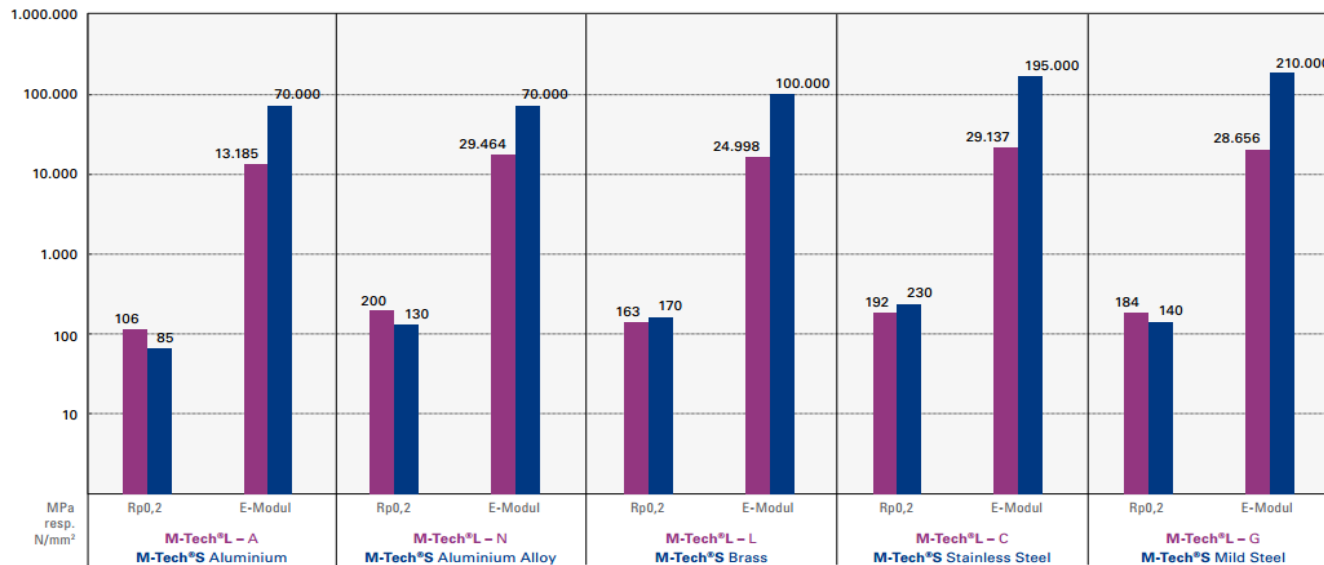
**M-Tech® Laminated sheets with foil thickness of 0.05 mm**

Page 2/4

**COMPARISON:** M-Tech®L 2,0 mm (foil thickness 0.05 mm) / M-Tech®S 2,0 mm (hard-rolled), see Page 4 for Rp0,2 resp. Rm values  
Test executed by the Staatlichen Materialprüfungsanstalt in Darmstadt, Germany (23.04.2008)

\* Technical information is subjected to change at all times

**MARTIN®**  
Your Partner for Precision.



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

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**MARTIN®**  
Partner for Precision.

# Bearing Clearance adjustment:

## Shims for Cost Reduction

### Pressure Resistance

#### Example of Static Load Calculation

[http://www.georg-martin.de/uploads/Produktspezifikationen/ENG/02%20martin\\_strength\\_values.pdf](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®L Sample, stainless steel type C

$\sigma_d$  = Yield point of M-Tech®L, Type C

$$\varepsilon_{d \text{ M-Tech}^\circ\text{L}} = \frac{\sigma_d}{E} = \frac{192 \text{ MPa}}{29.137 \text{ Mpa}} = 0,0066$$

$$\varepsilon_d = \frac{\Delta \ell}{\ell_0} \Rightarrow \varepsilon_d \times \ell_0 = 0,0132 \text{ mm deformation by compression}$$

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

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