Clearance adjustment:
Shims for Cost Reduction

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Shims for Cost Reduction

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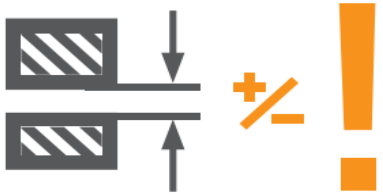
Content of Presentation

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

Clearance adjustment:
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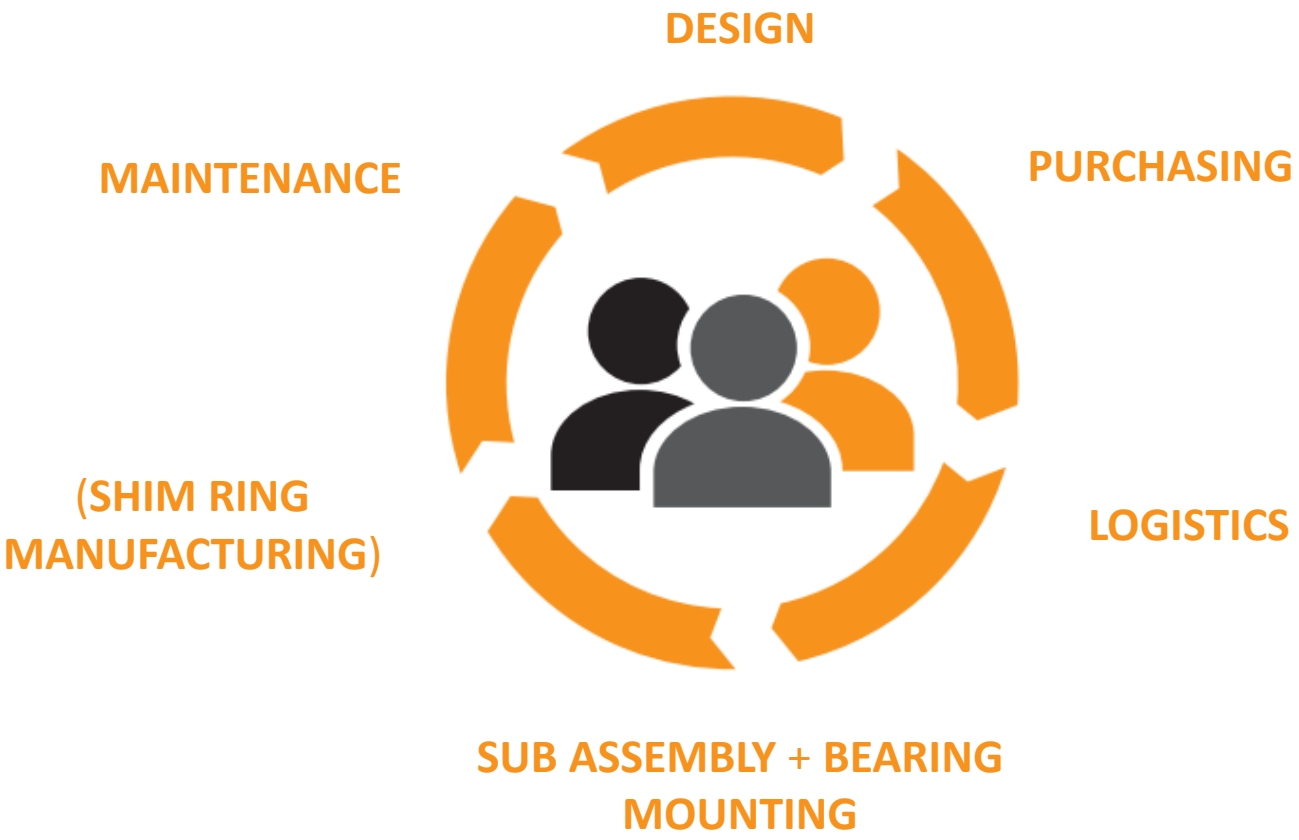
Cost Reduction
Over the Whole Process Chain



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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.

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

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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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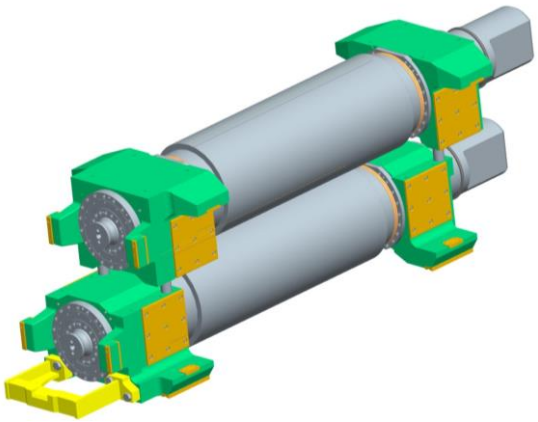
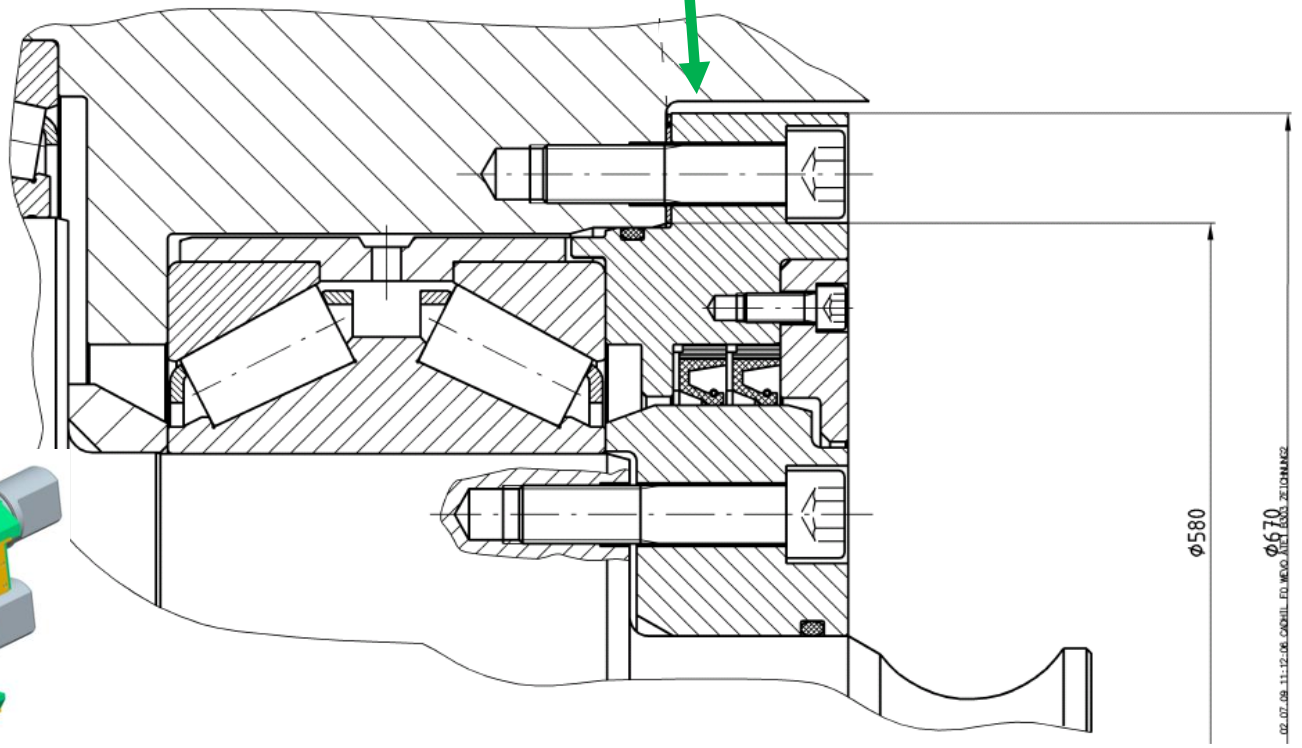
Example 1/2
Tapered Roller Bearings
In Metallurgical Work Rolls





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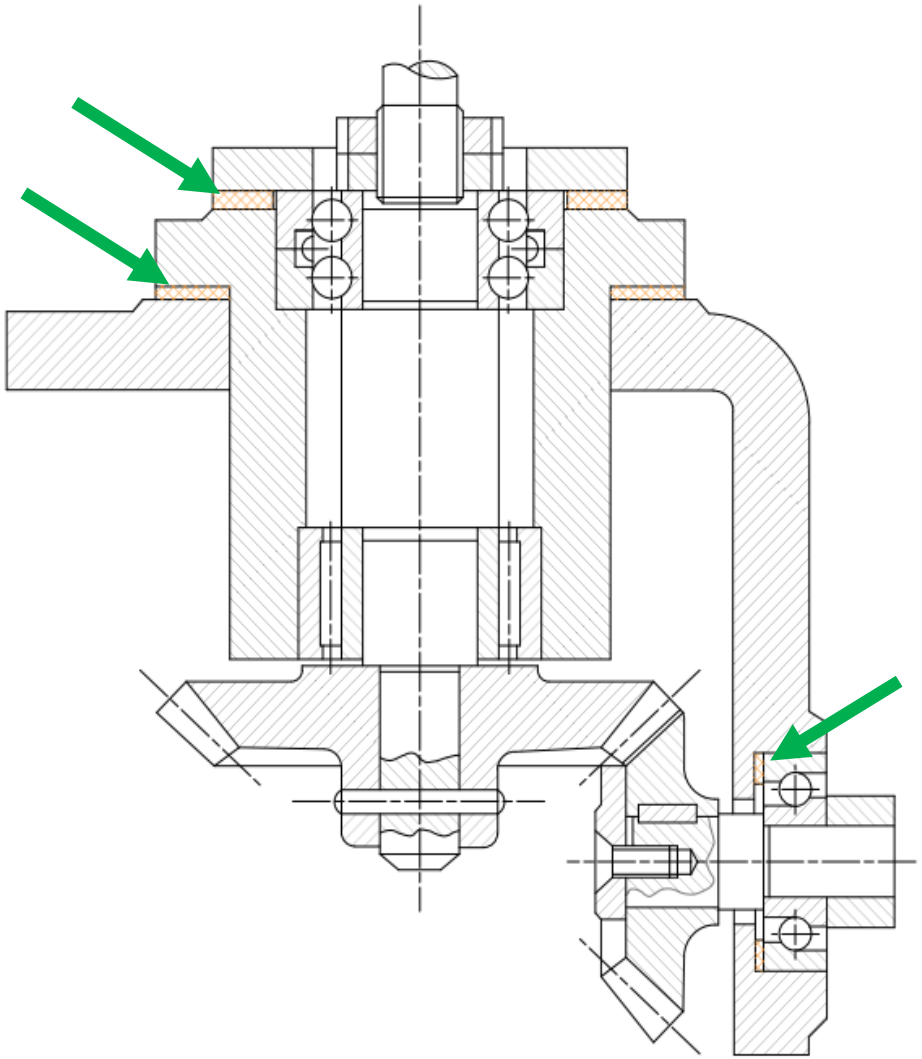
Example
2/2
Ball
Bearings
In
Gearboxes



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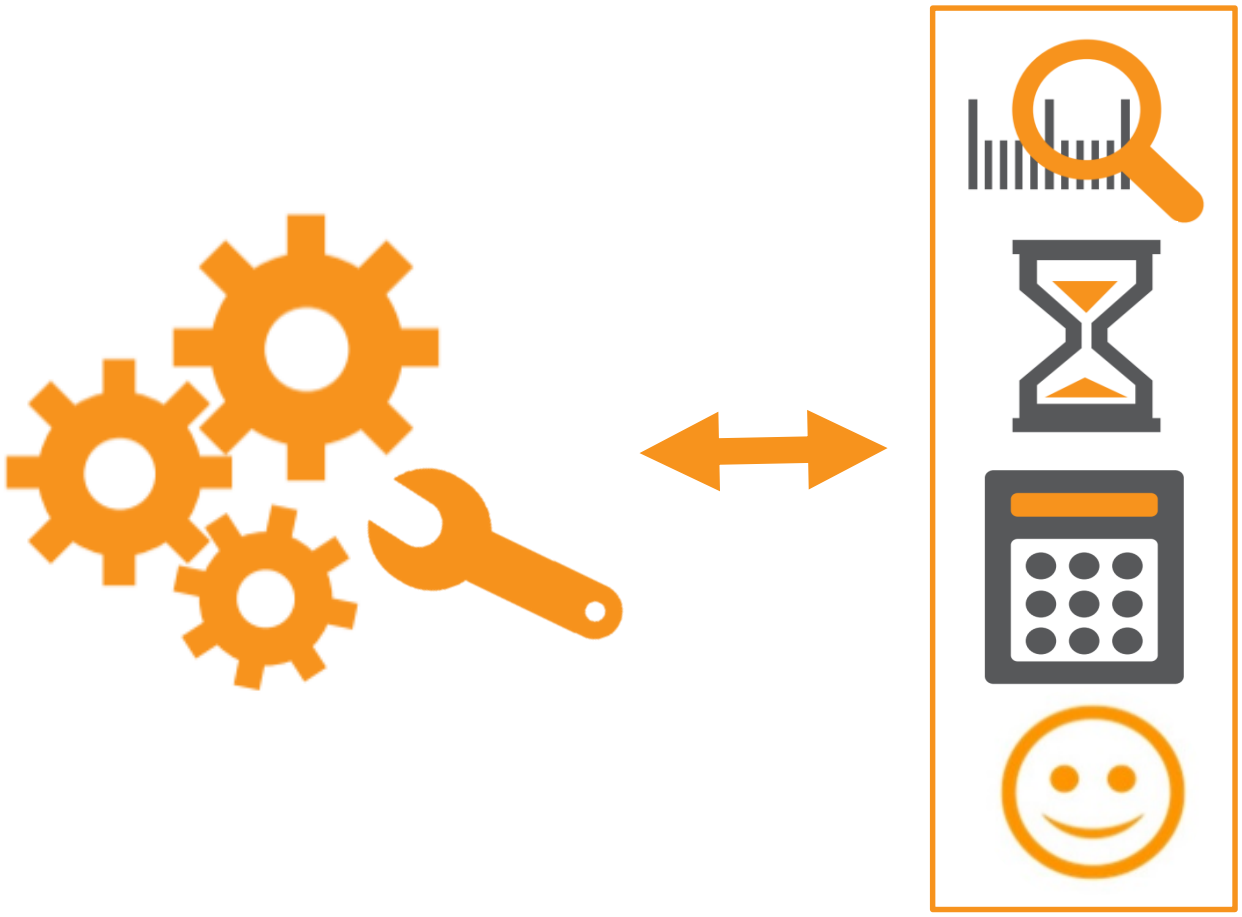
Assembly and Total Cost of Ownership
Assembly & TARGETS - Objectives

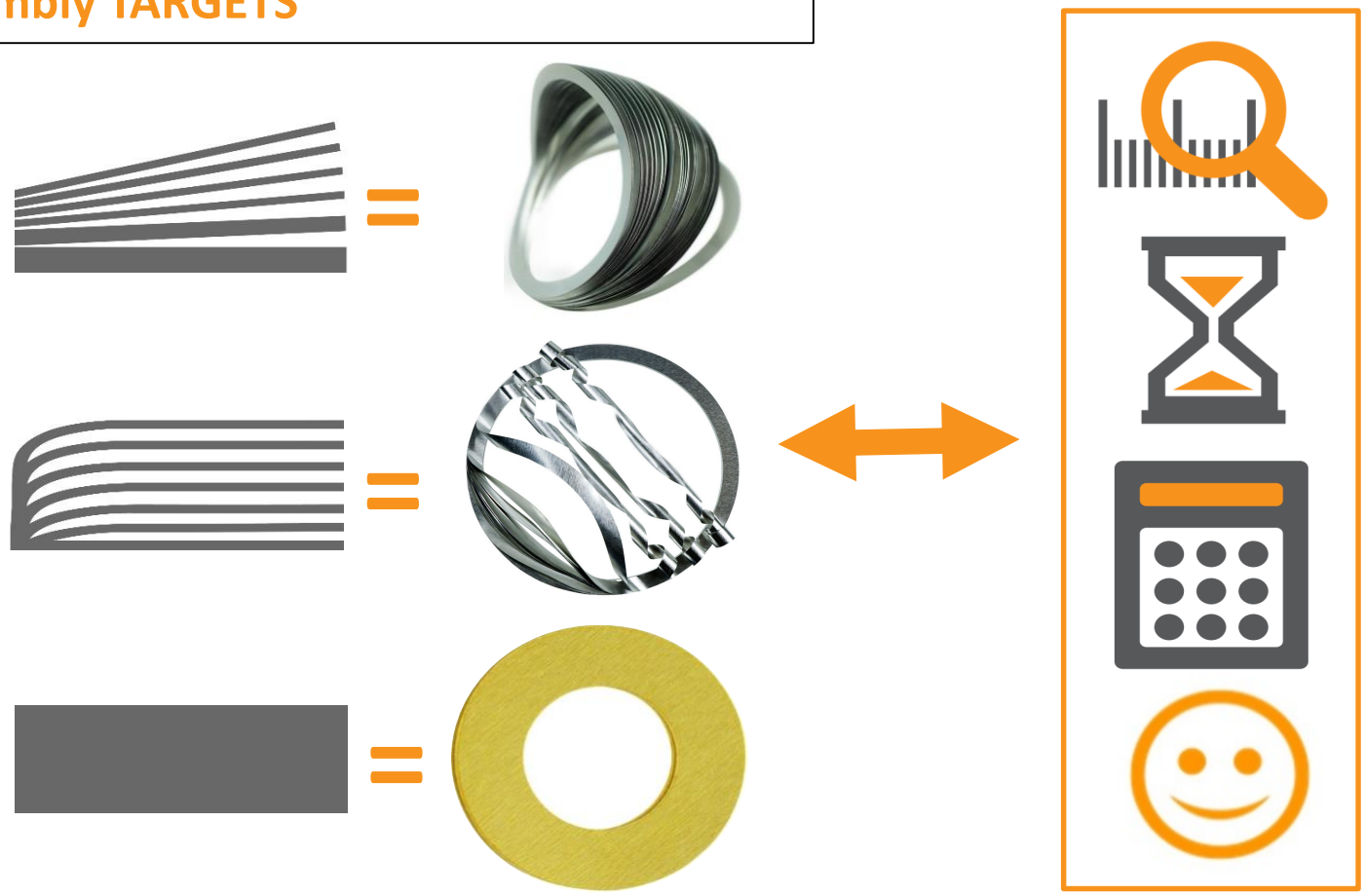


Clearance adjustment:
Shims for Cost Reduction

Assembly and TCO

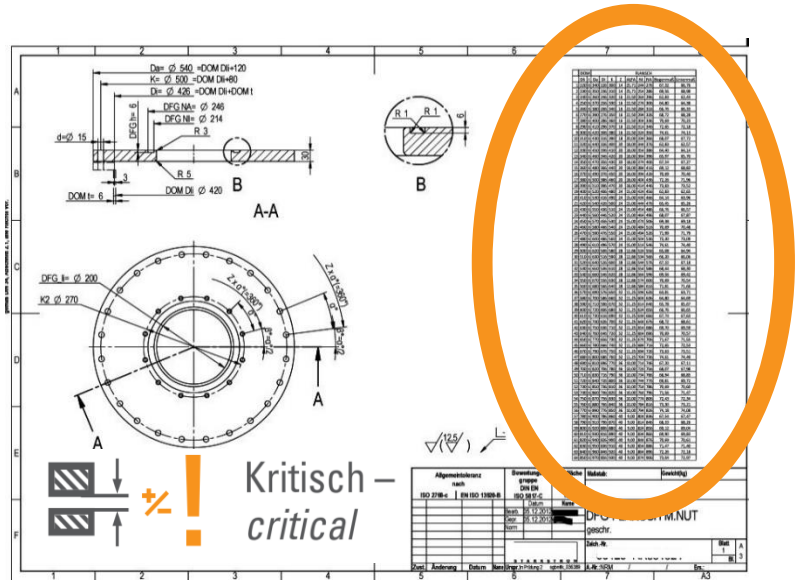
Choice of Material Structures →

Assembly TARGETS



Clearance adjustment:
Shims for Cost Reduction

Practical Design
TCO / Complete Life Cylce Cost



CHEAP?

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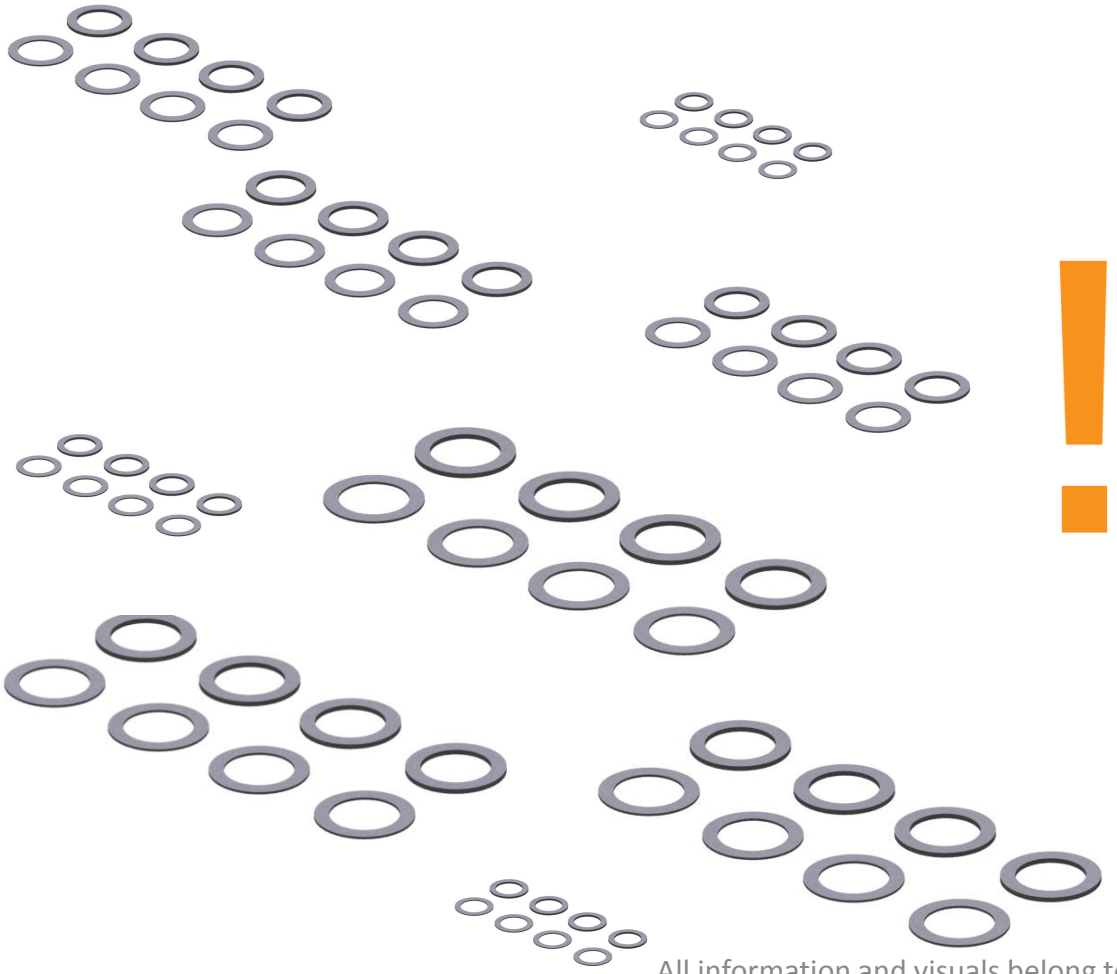
Logistic (& Manufacturing) Costs
Over the Whole Process Chain



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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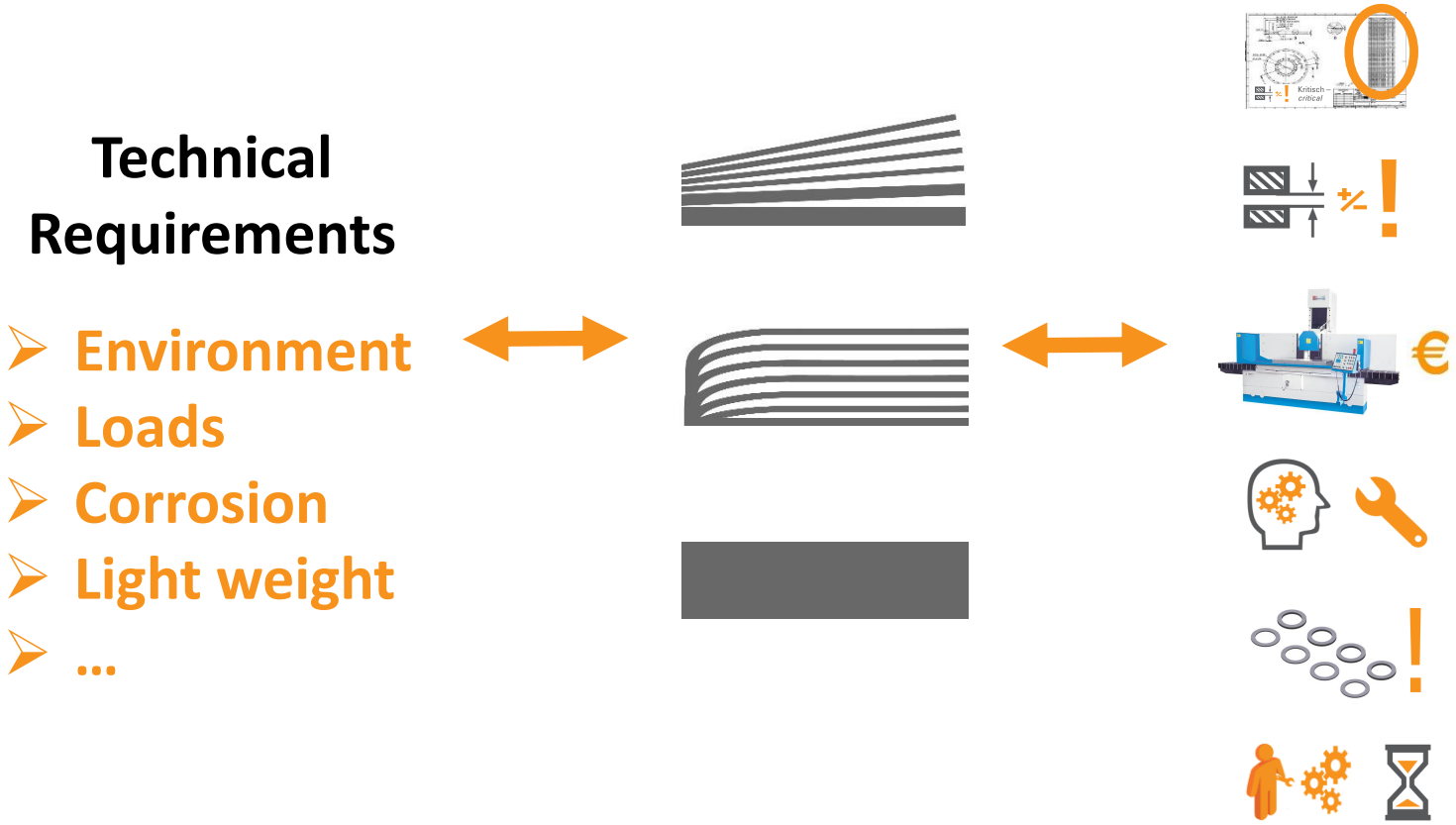
Influences of Cost

Conclusion: Overall Approach & Choice

Technical Requirements

- Environment
- Loads
- Corrosion
- Light weight
- …



Clearance adjustment:
Shims for Cost Reduction

Material Structures
Differentiate Aspects: P

„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

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**

Clearance adjustment:
Shims for Cost Reduction

Material Structures
Differentiate Aspects: P

„P“

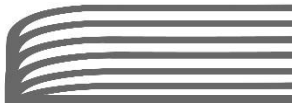
M-Tech®P „Paket“
Layer Connections:

✓ **New:**
Laser Welded Connection

Clearance adjustment:
Shims for Cost Reduction

Material Structures
Differenciate Aspects: L

„L“



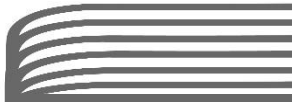
M-Tech®L „Laminated“
Pro‘s:

- ✓ MARTIN Peel Tool®
- ✓ Sealing Advantages
- ✓ Demand Driven
- ✓ High Reliablity
- ✓ Solid Sections Possible
- ✓ Different Foils Possible
- ✓ Min. Foils: 0,010mm
- ✓ Easy to Measure
- ✓ Demand Driven
- ✓ One Piece Flow

Clearance adjustment:
Shims for Cost Reduction

Material Structures
Differenciate Aspects: L

„L“



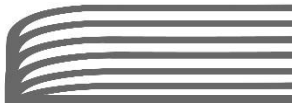
M-Tech®L „Laminated“
Con‘s:

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

Clearance adjustment:
Shims for Cost Reduction

Material Structures
Differenciate 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**

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

Clearance adjustment:
Shims for Cost Reduction

Material Structures
Differenciate Aspects: S

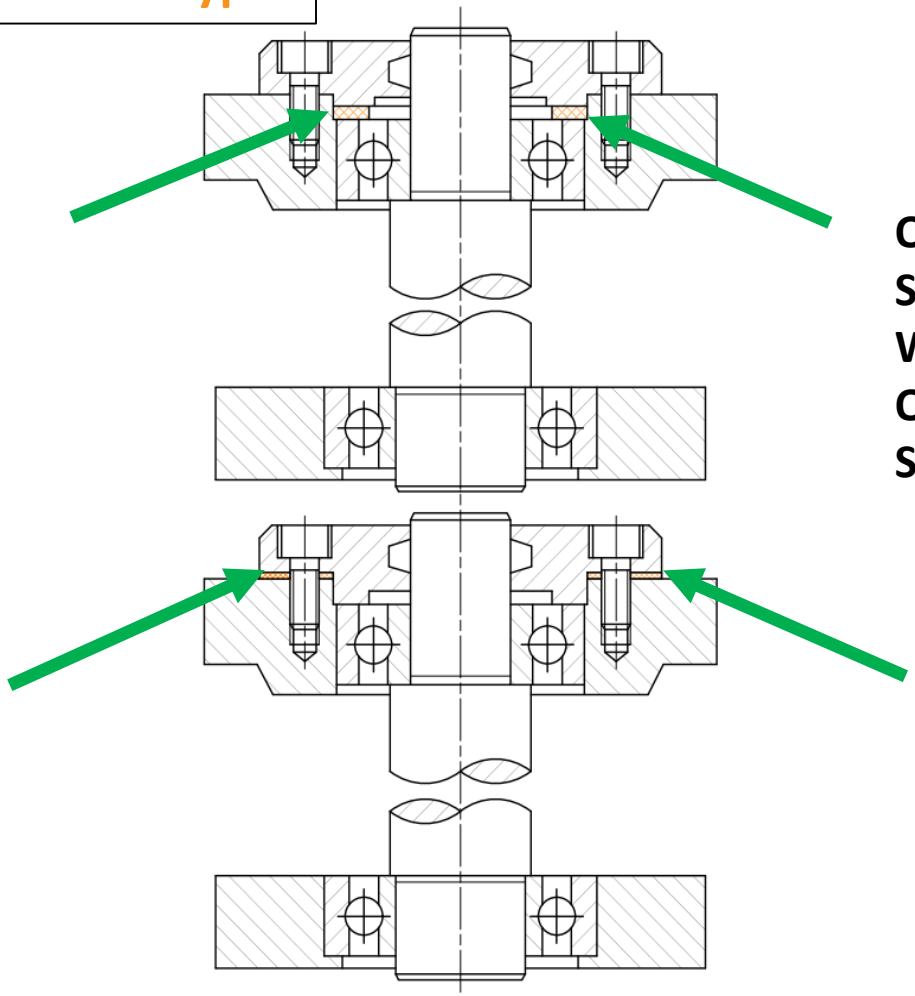
„S“

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**

Clearance adjustment:
Shims for Cost Reduction

Design Tips for Assemblies
Where to Use Which Shim Type

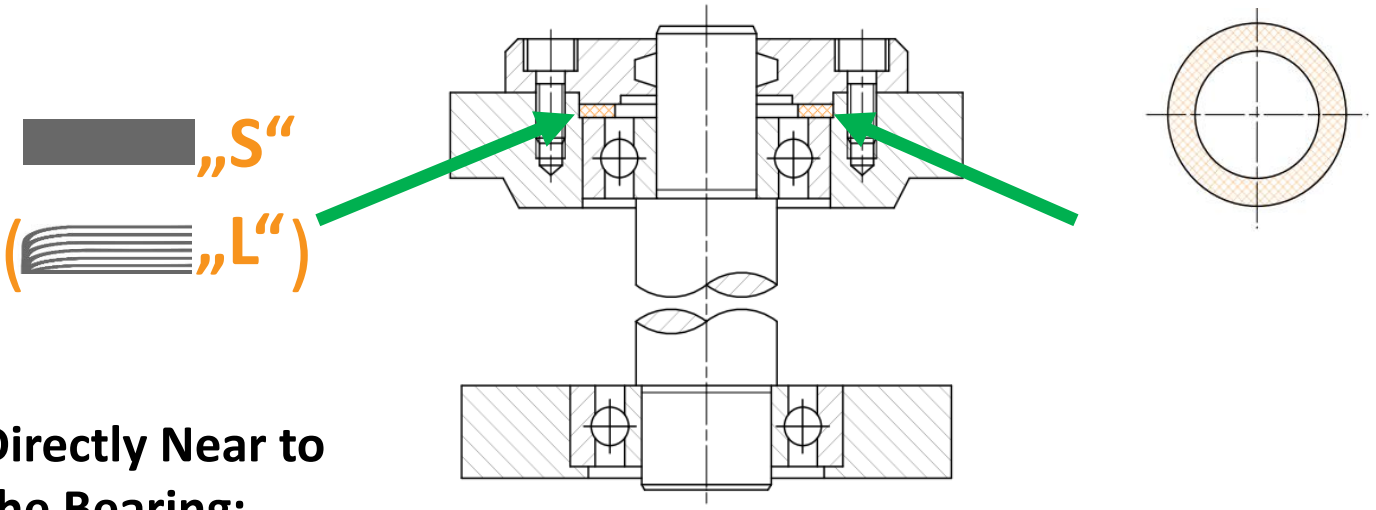


One (or
Several)
Washer
Or
Shim

One Full Shim Ring
Or
One Split Shim Ring

Clearance adjustment:
Shims for Cost Reduction

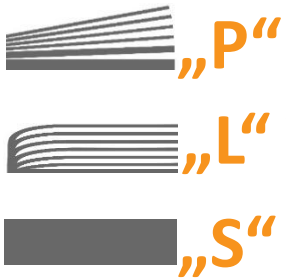
Design Tips for Assemblies
Where to Use Which Shim Type



Directly Near to the Bearing: Can Bring Wear and Friction Problems Over Life Time

Clearance adjustment:
Shims for Cost Reduction

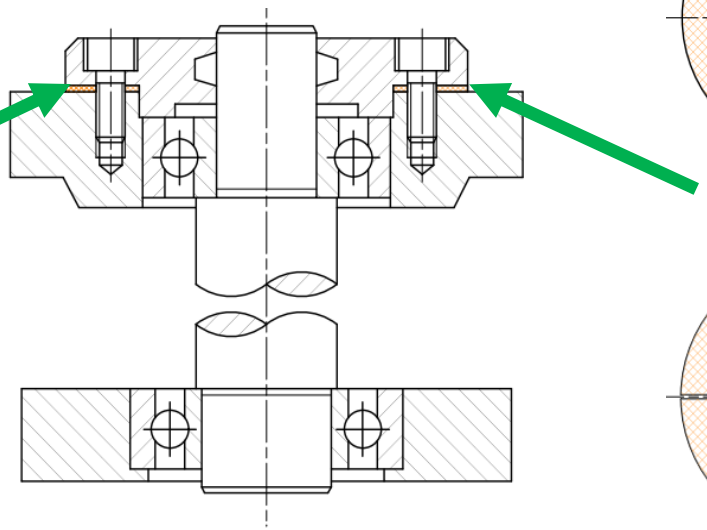
Design Tips for Assemblies
Where to Use Which Shim Type

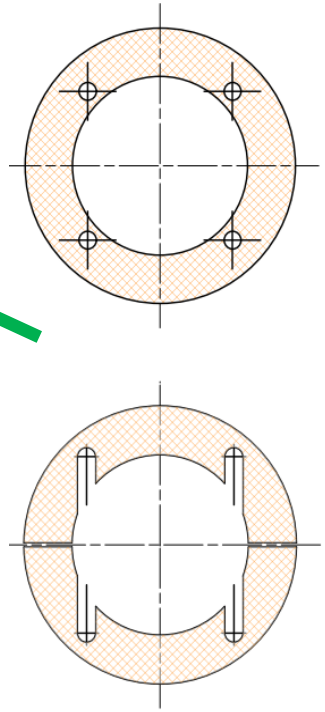


„P“

„L“

„S“





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…

Clearance adjustment:
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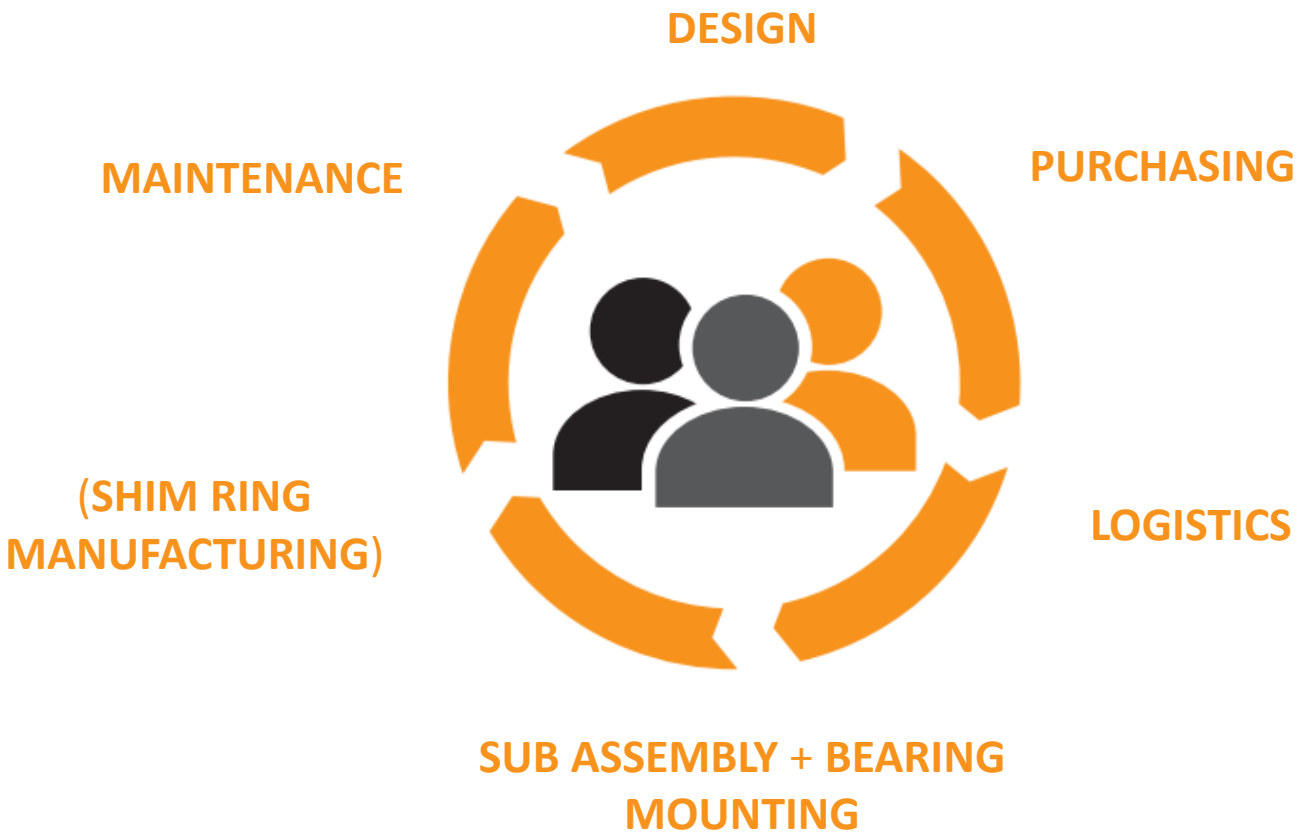
Shims…

Are A Strategic Approach to Reduce Over all Process Costs !



Clearance adjustment:
Shims for Cost Reduction

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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

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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**

Clearance adjustment:
Shims for Cost Reduction

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Many Thanks for your Attention,

ENJOY YOURSELF ☺ REDUCING OVERALL PROCESS COSTS !

Mr. Christoph Martin
+ 49 151 16142488
C.Martin@Georg-Martin.de
www.Georg-Martin.de

Clearance adjustment:
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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

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

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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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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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Pressure Resistance
For Different Material Structures

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

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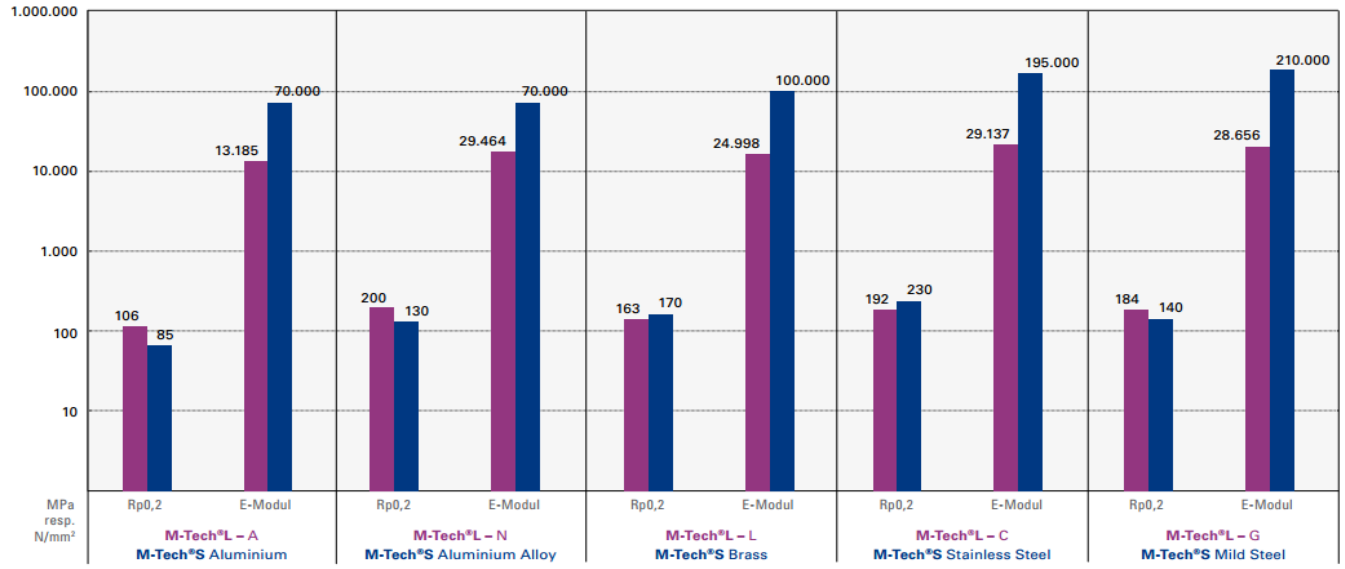
Page 2/4

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. R*m* values
Test executed by the Staatlichen Materialprüfungsanstalt in Darmstadt, Germany (23.04.2008)

* Technical information is subjected to change at all times



DATUM/DATE: 23.03.2011 © GEORG MARTIN GMBH – WWW.GEORG-MARTIN.DE

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

$$\varepsilon_d = \frac{\Delta\ell}{\ell_0} = \frac{\ell_0 - \ell}{\ell_0} = \frac{\sigma_d}{E} = \frac{F_d}{E\,A}$$

ℓ_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

σ_d = Yield point of M-Tech®L, Type C

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

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

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