

*Experiences in SLD Projects for
Automotive Industry
Designing and Solutions*

Lauramid[®] / Lauramid Inject[®]

two different materials with same basement

- ◆ Lauramid[®] - Gravity casted material without pressure on monomers.

Monomers are nearly free of orientation and free of stress

- ◆ Lauramid Inject[®] - 100 % resign material out of scraps during machining

process of parts out of Lauramid[®]. No additional additives and combination

with other plastic materials

➔ Similar material characteristics like Lauramid[®]

Characteristics of Lauramid[®]

- ◆ Casted material absolutely without pressure on monomers
- ◆ High crystalline structure (about 45%)
- ◆ Lowest water absorption of all polyamides
- ◆ High dimension stability
- ◆ High wear resistance
- ◆ High chemical resistance
- ◆ Good constructions material (temp. Of -40°C up to + 120°C)
- ◆ High impact strength up to - 80°C
- ◆ Good absorbability
- ◆ High elasticity in return (memory effect)
- ◆ Very good creep resistance
- ◆ Lubrication not necessary, dry run possible



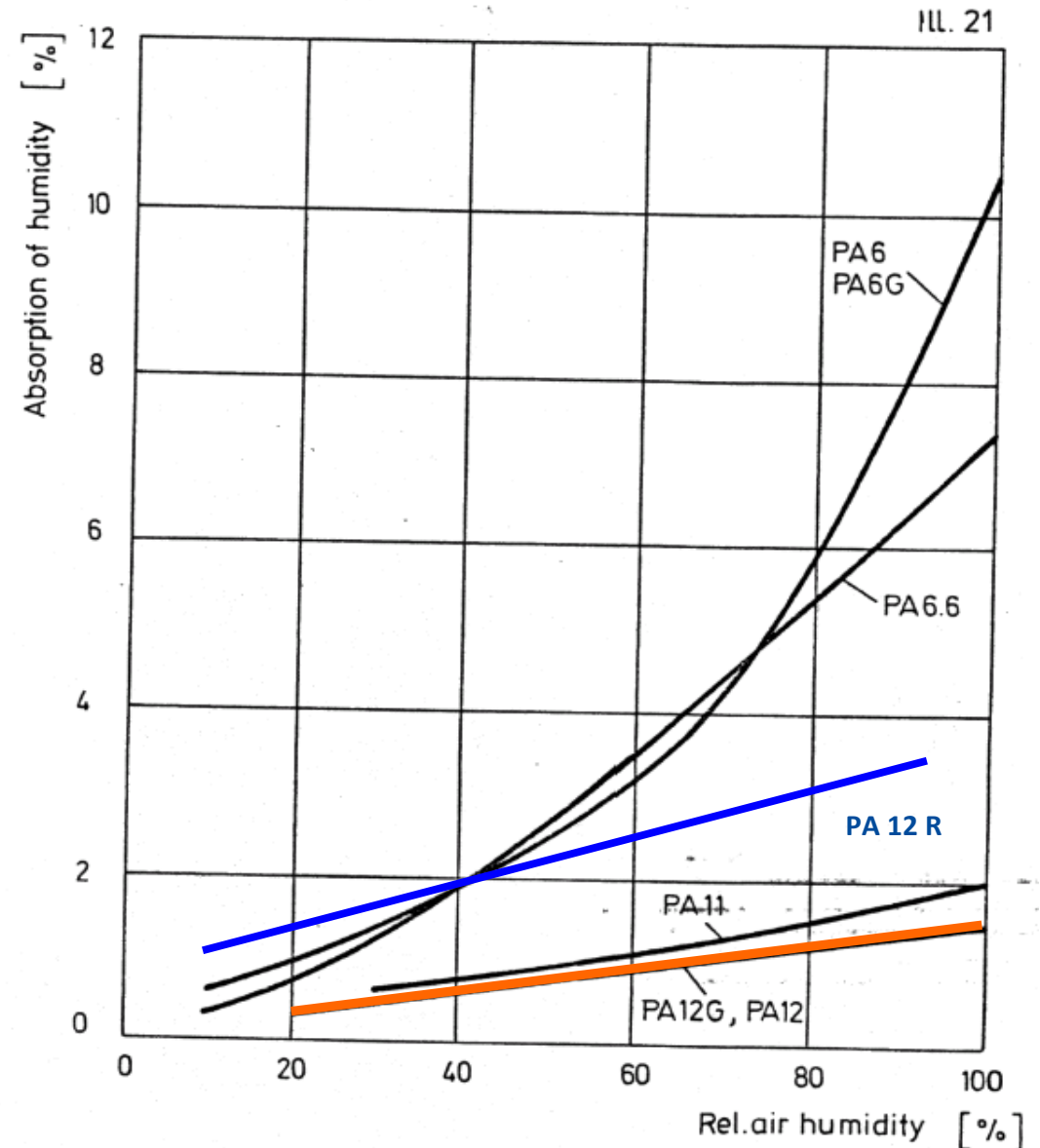
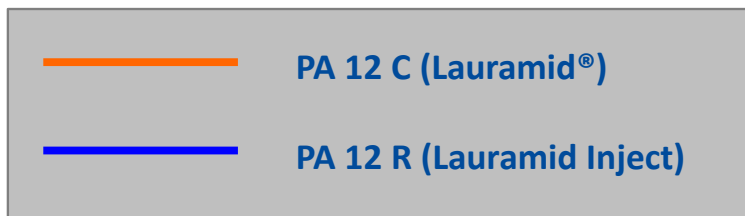
Material developed for injection moulding

- ◆ Lower water absorption than other polyamides
- ◆ Good dimension stability
- ◆ Good wear resistance
- ◆ High chemical resistance
- ◆ Good construction material (temp. Of -40°C up to + 120°C)
- ◆ Good absorbability
- ◆ Good elasticity in return (memory effect)
- ◆ High creep resistance



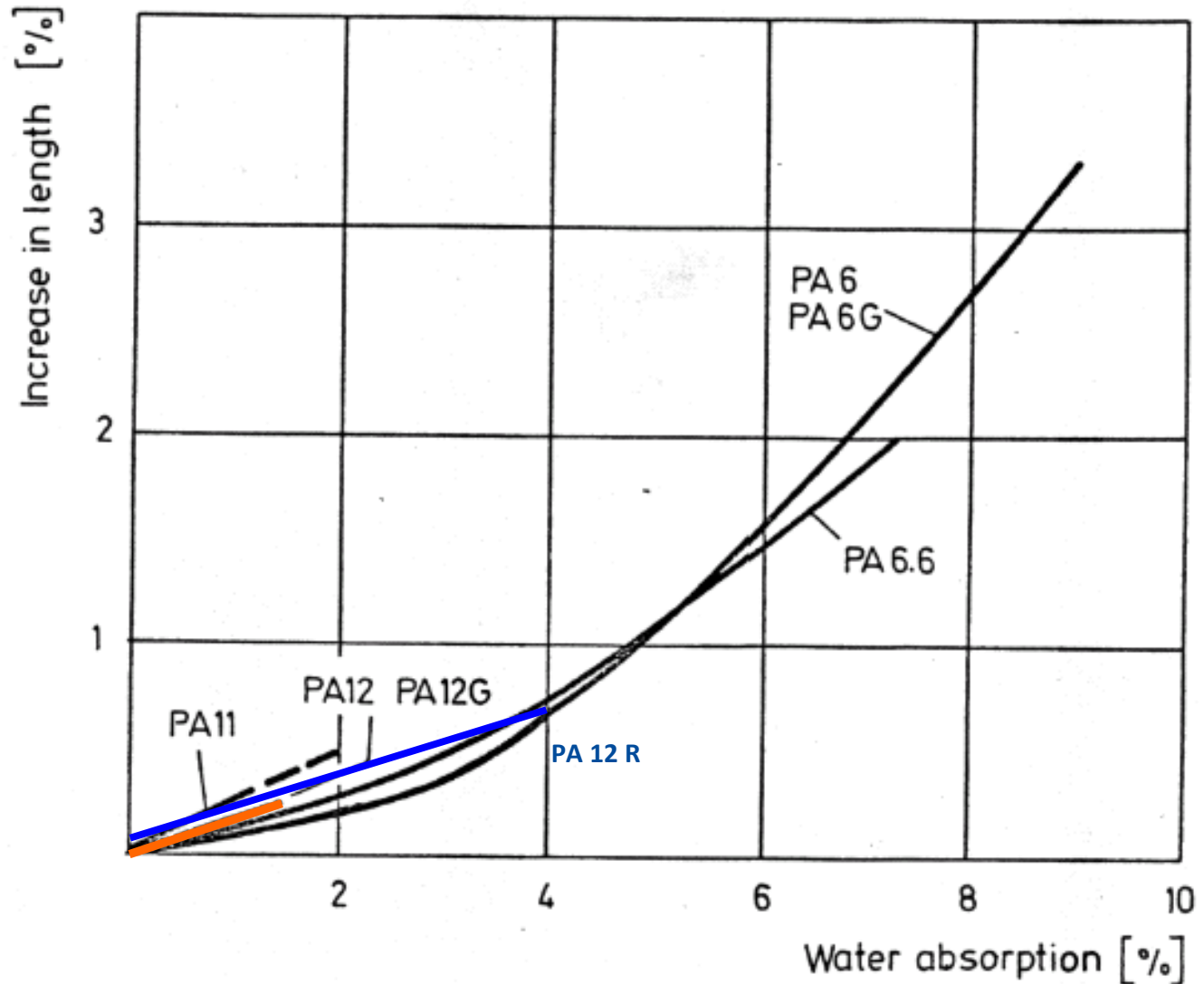
Physical properties of various Nylons (Polyamids) in comparison

Equilibrium - moisture contents of various Nylons (Polyamids) as function of the relative air humidity at ambient temperature



Physical properties of various Nylons Polyamids in comparison

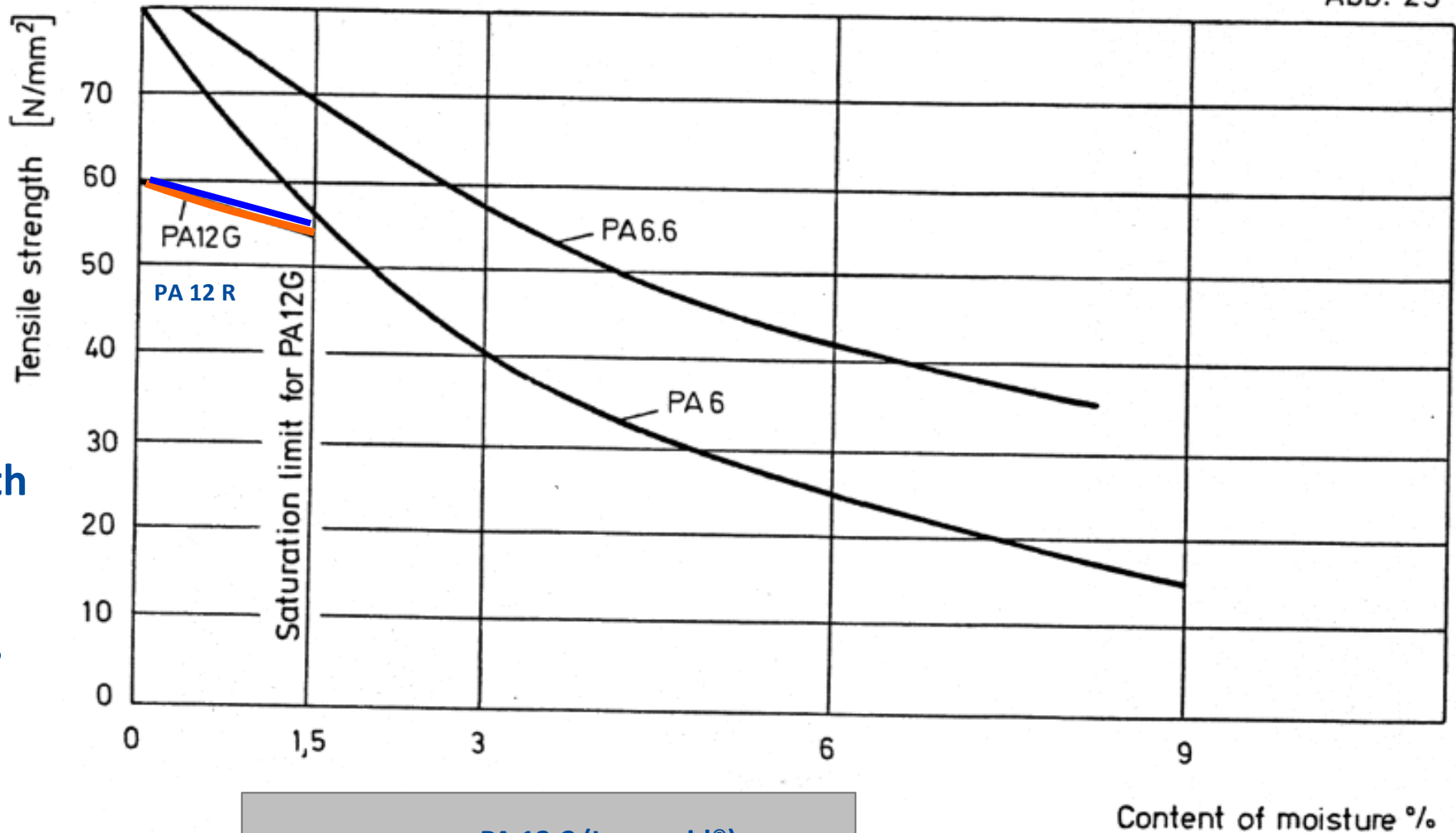
Percentage of increase in length of various Nylons (Polyamids) dependent on the percentage of water absorption (water with ambient temperature)



- PA 12 C (Lauramid®)
- PA 12 R (Lauramid Inject)

Physical properties of various Nylons (Polyamids) in comparison

Abb. 23



Tensile strength of various Nylons (Polyamids) as function of the content of moisture at 20°C



Physical properties of various Polyamides in comparison



	Einheit	PA 4.6	PA 6	Lauramid ⁵ Inject	Lauramid Type B
Density:	g/cm ³	1,18	1,14	1,02	1,03
Colour:		red brown	natural	black	natural
Humidity absorption:					
Reference atmosphere:	Gew.-%	3,7	3	≈ 2,7	0,9
Water absorption:	Gew.-%	14	9,5	≈ 3,8	1,4
Melting point temperature:	°C	295	220	275	193
Thermal conductance:	W/k·m	0,3	0,23		0,25
Heat distortion temperature A:	°C	160	65		190
Upper use temperature on air:					
Short time:	°C	200	180	150	150
Continuous:	°C	130	90	120	120
Minimal use temperature:	°C	-40	-40	-30	-40
Tensile stress at yield:	MPa	55-100*	45-80*	43	60
Break stress:	MPa	-	-	47	52
Elongation at yield stress:	%	-	4	24	8
Elongation at break:	%	25-100*	200-70*	>200	18
Tensile modulus:	MPa	1300-3300*	1000-3000*	1600-1700	2100
Izod notched impact strength at 23°C:	kJ/m ²	o.B.	5,5-o.B.*	o.B.*	o.B.
Charpy notched impact strength at 23°C:	kJ/m ³	8	35-5*	7,7	6
Ball pressure hardness:	N/mm ²	165	70-150*	154	110
Hardness Shore D:		90	68-82*		76
Coefficient of friction against steel:		0,20-0,45	0,20-0,45	0,25-0,40	0,30-,040
Volume resistivity:	Ω·cm	10 ¹² -10 ¹⁴ *	10 ¹⁰ -10 ¹³ *		10 ¹⁴
Surface resistivity	Ω	10 ¹² -10 ¹³ *	10 ¹⁰ -10 ¹³ *		10 ¹⁴
*1 value humid (50%), 2 value dry					
o.B. = no break					
Critical value					

Designing of Rollers out of Lauramid[®] and Lauramid Inject[®]

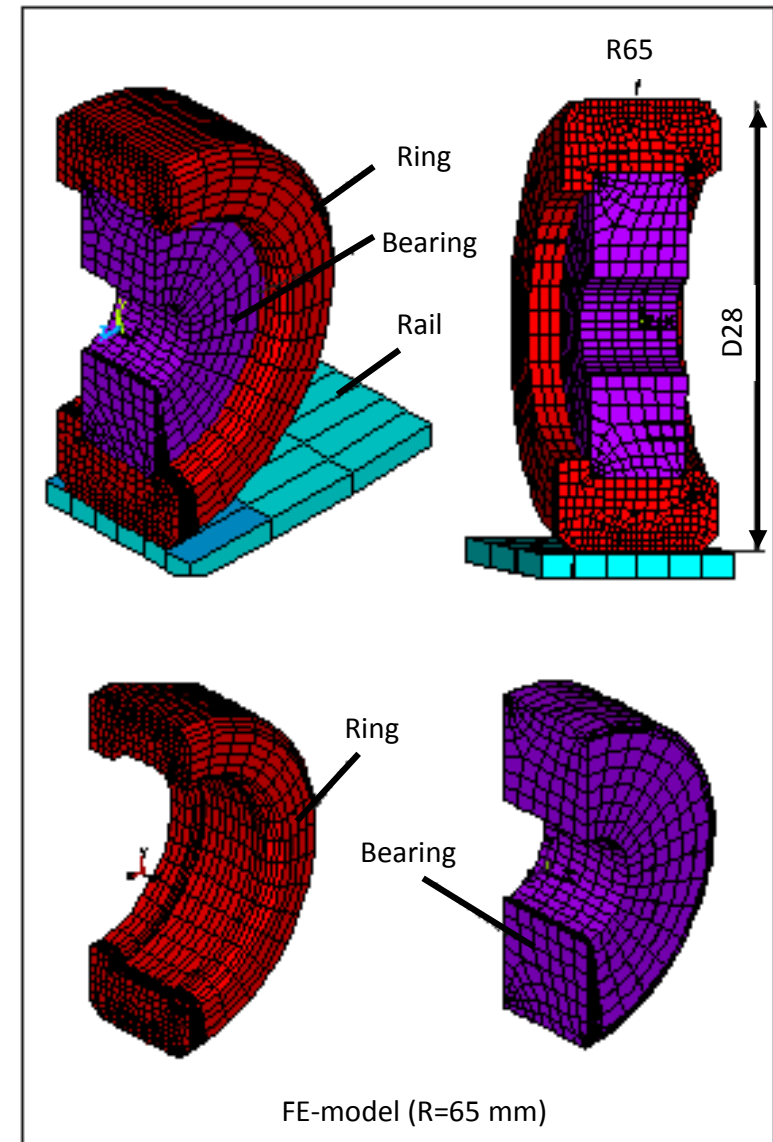


- ◆ Examination reports institute for material handling Technical University (TU) Berlin
- ◆ VDI-research reports # 313 / 353 / 492 / 601
- ◆ Characteristic lifetime diagrams for Lauramid[®]-rollers with $\varnothing = 80\text{mm}$
- ◆ No characteristic lifetime diagrams for Lauramid[®] and Lauramid Inject[®]- rollers with $\varnothing = 20 - 30\text{mm}$
- ◆ 18 years experience with Lauramid[®] rollers for sliding doors in the automotive industry
- ◆ Execution of FE-analysis and inspect the comparison strength at -40°C / 23°C / 80°C
- ◆ Evaluation of state of stress in the Lauramid[®] and Lauramid Inject[®]- ring
- ◆ Comparison with approved rollers in the automotive industry

Impact of the maximum load on Lauramid®-Loadrollers

1. Geometry

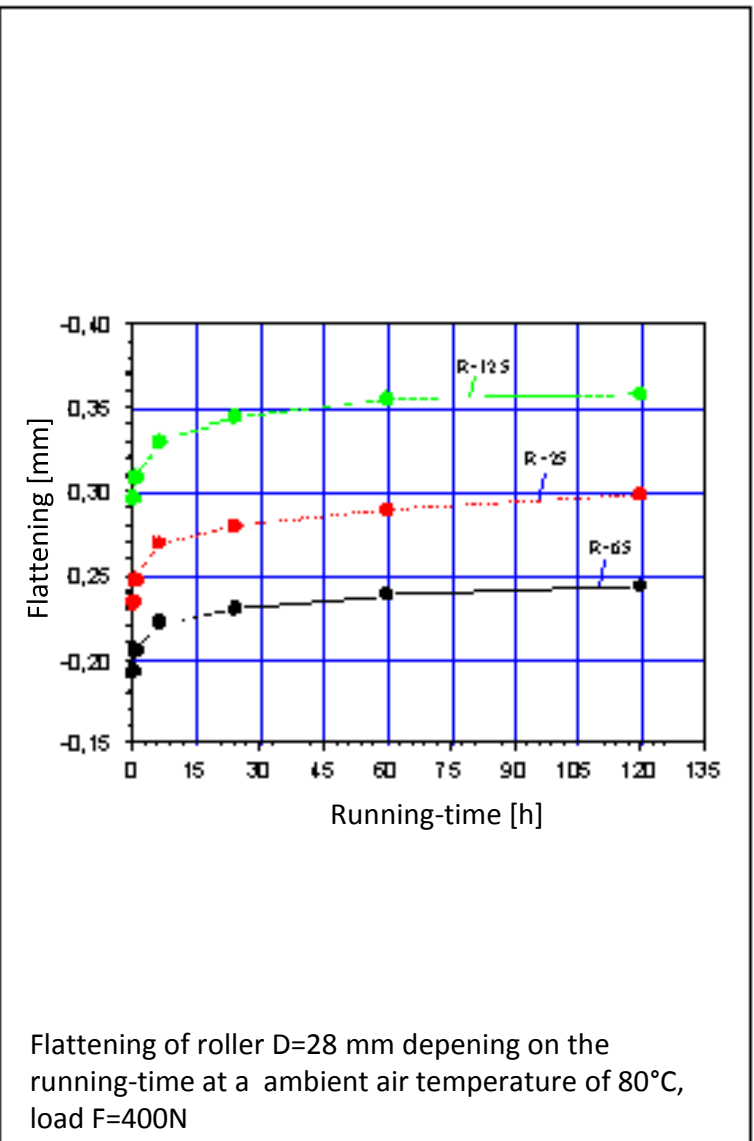
- ◆ Outside diameter
- ◆ Convexity radius
- ◆ Width of rollers (10mm)
- ◆ Wallthickness of Lauramid®-ring



Impact of the maximum load on Lauramid®-Loadrollers

1. Geometry

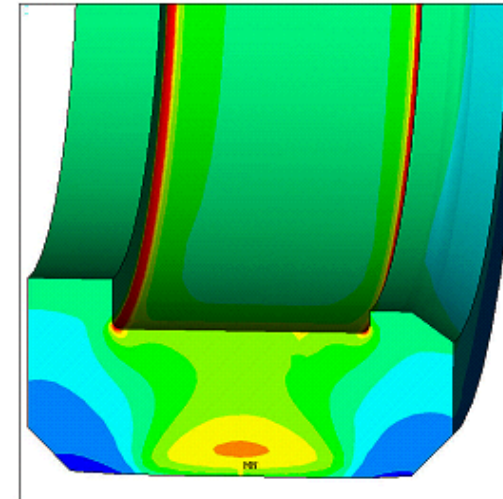
- ◆ Outside diameter
- ◆ Convexity radius



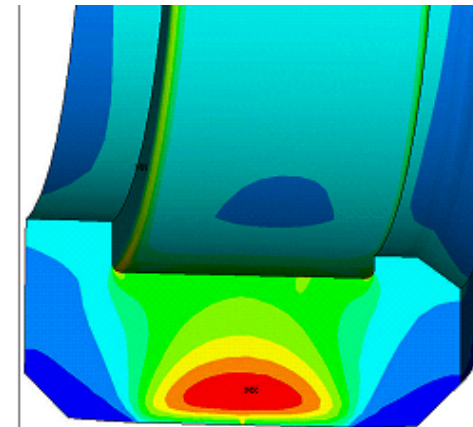
Impact of the maximum load on Lauramid®-Loadrollers

1. Geometry

- ◆ Outside diameter
- ◆ Convexity radius
- ◆ Width of rollers (10mm)



Comparison strength in the ring, D=26mm, W=10mm, $F_N=350N$, bearing seat width: 6 mm, press fit on the bearing seat: 0,2 mm, T= -30°C

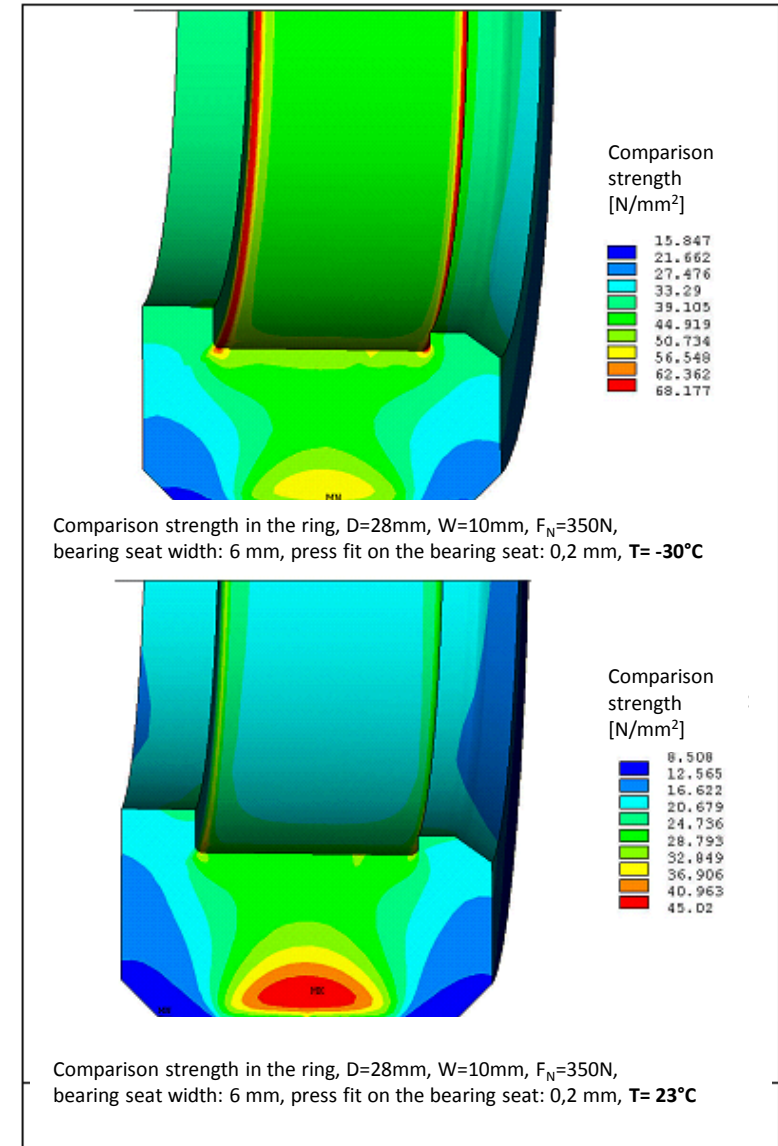


Comparison strength in the ring, D=26mm, W=10mm, $F_N=350N$, bearing seat width: 6 mm, press fit on the bearing seat: 0,2 mm, T= 23°C

Impact of the maximum load on Lauramid®-Loadrollers

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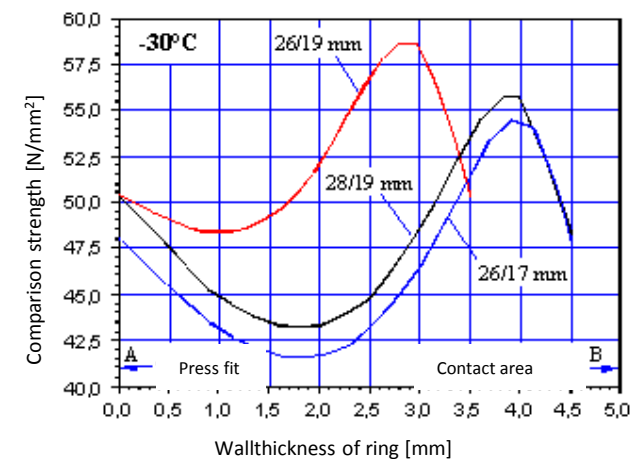
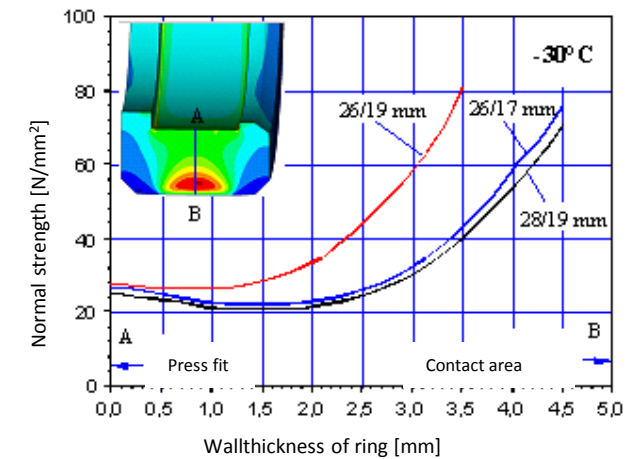
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Impact of the maximum load on Lauramid®-Loadrollers

1. Geometry

- ◆ Outside diameter
- ◆ Convexity radius
- ◆ Width of rollers (10mm)
- ◆ Wallthickness of Lauramid®-ring

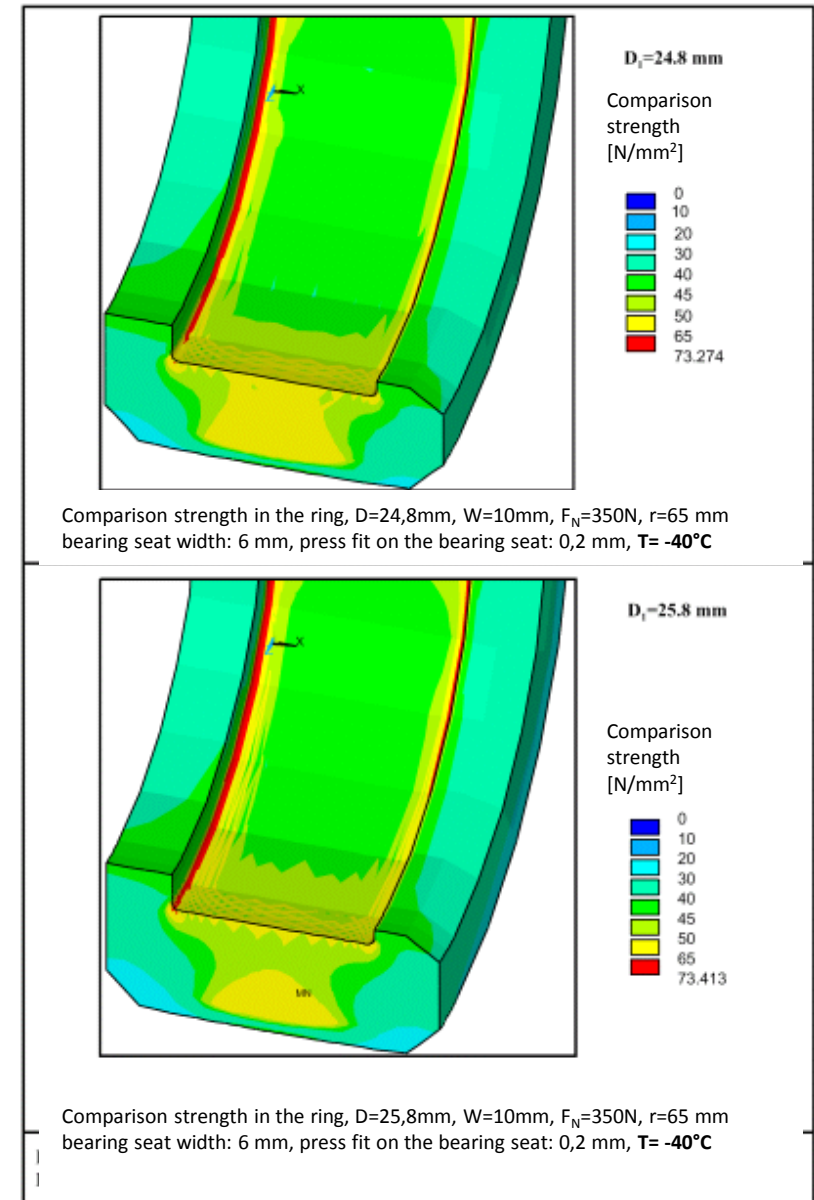


Load in the ring, $W=10mm$, $F_N=350N$, $r=65mm$
bearing seat width: 6 mm, press fit on the bearing seat: 0,2 mm

Impact of the maximum load on Lauramid®-Loadrollers

1. Geometry

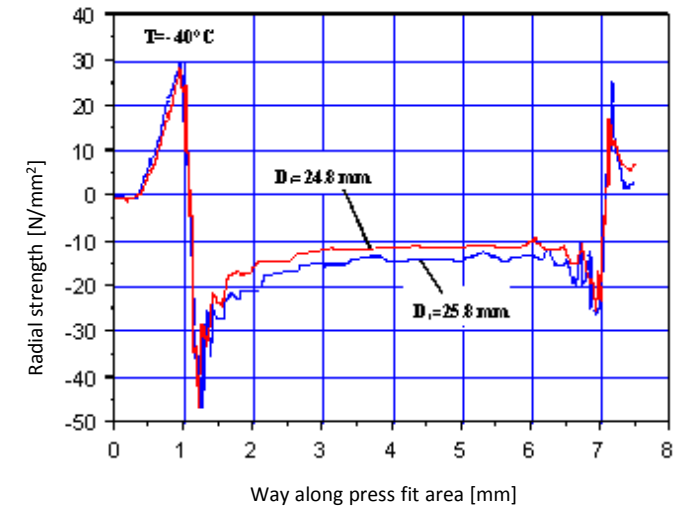
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Impact of the maximum load on Lauramid[®]-Loadrollers

1. Geometry

- ◆ Outside diameter
- ◆ Convexity radius
- ◆ Width of rollers (10mm)
- ◆ Wallthickness of Lauramid[®]-ring



Radial strength (initial load) in the press fit area between ring and bearing,
 $F_N=350\text{N}$, $T=-40^\circ\text{C}$

Demands on the ring at $T=-40^\circ\text{C}$, $W=10\text{mm}$, $F_N=350\text{N}$, $r=65\text{mm}$
bearing seat width: 6 mm, press fit on the bearing seat: 0,2 mm

Impact of the maximum load on Lauramid[®]-Loadrollers

2. Temperatures -40°C up to + 120°C

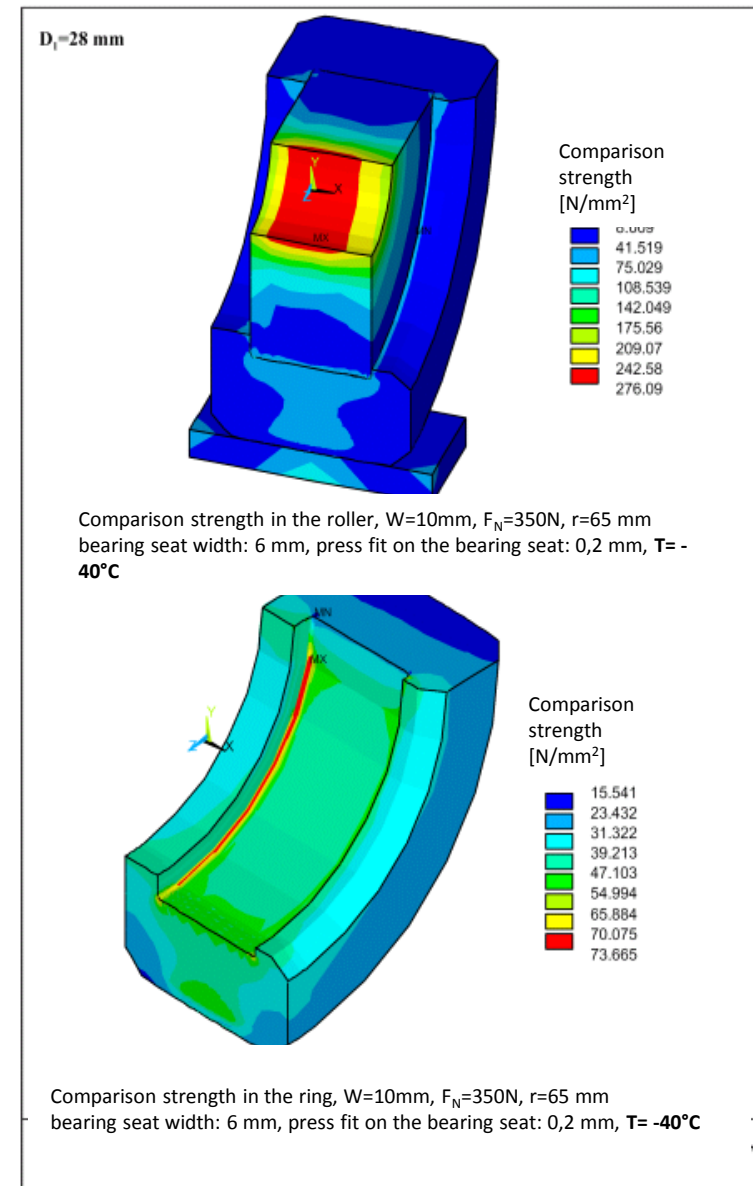
Requirements on the Lauramid[®]-ring

- ◆ not loose fitting at high temperatures (+80°C)

→ slip effect

- ◆ not break at deep temperatures (-40°C)

→ increasing in comparison strength at -40°C



Max. using force for carrier rollers out of Lauramid[®] and Lauramid Inject[®]



Lauramid[®]

max. normal force [N]	$\varnothing_{\text{Outside}}$ [mm]	Width of roller [mm]	$\varnothing_{\text{Outside}}$ Outer ring [mm]
250	25	10	19
300	26	10	19
350	28	10	19

Lauramid Inject[®]

max. normal force [N]	$\varnothing_{\text{Outside}}$ [mm]	Width of roller [mm]	$\varnothing_{\text{Outside}}$ Outer ring [mm]
200	25	10	19
250	26	10	19
300	28	10	19



Bearing: 607 2RS

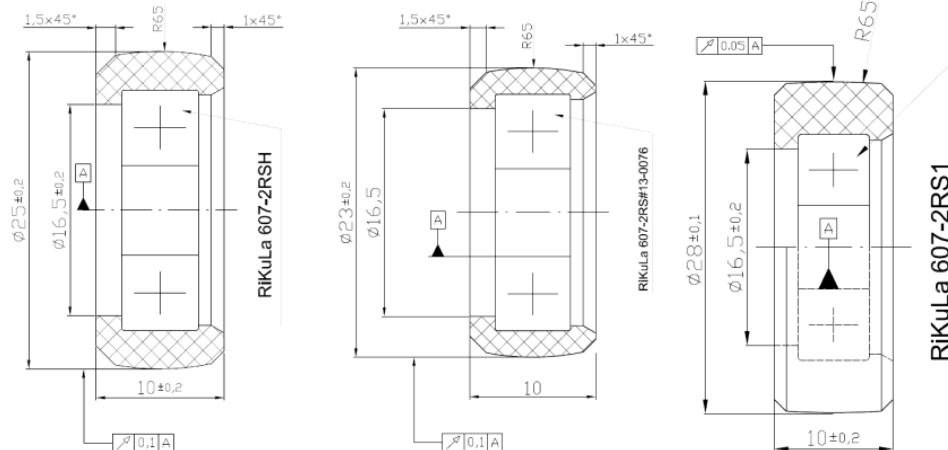
Force to press out the bearing out of the Lauramid®/Lauramid Inject®-Carrierroller

◆ Testing conditions

- Test speed [10 mm/min]

- Temperature: 23°C

Roller 300926 Ø 25 x 10	Roller 301976 Ø 23 x 10	Roller 301534 Ø 28 x 10
min. force	min. force	min. force
2100 N	1350 N	2220 N



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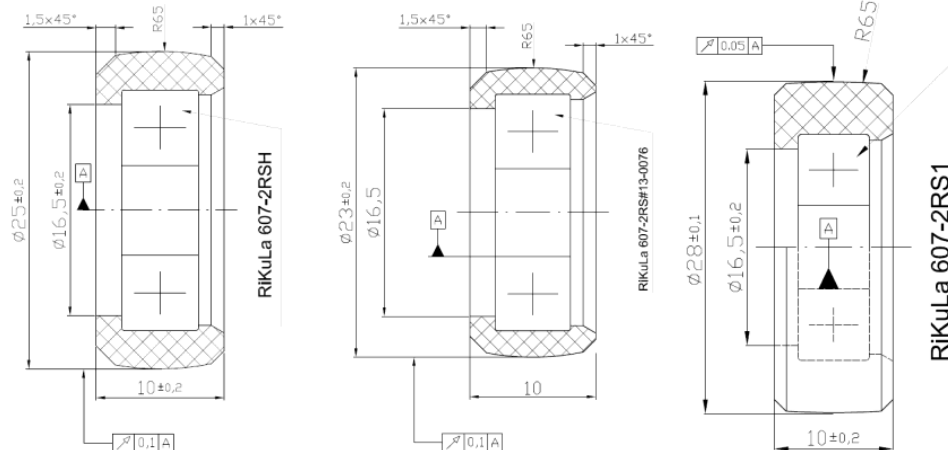
Force to press out the bearing out of the Lauramid®/Lauramid Inject®-Carrierroller



◆ Testing conditions

- Test speed [10 mm/min]
- Temperature: 80°C

Roller 300926 Ø 25 x 10	Roller 301976 Ø 23 x 10	Roller 301534 Ø 28 x 10
min. force	min. force	min. force
1040 N	600 N	1085 N



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