Housings and Parts Manufactured by Polyurethane

Polyurethane (PUR) is a plastic product generated by a chemical reaction. Two Liquid components are mixed to generate various foamed plastics. The two components, Polyol and Isocyanate with different viscosities are injected into the mold as a mixture. When those two components are mixed and injected into a heated mold, an exothermic reaction begins to occur between the two components which then produces cell structures known as polyurethane. This process is known as Rim: Reaction Injection Molding.

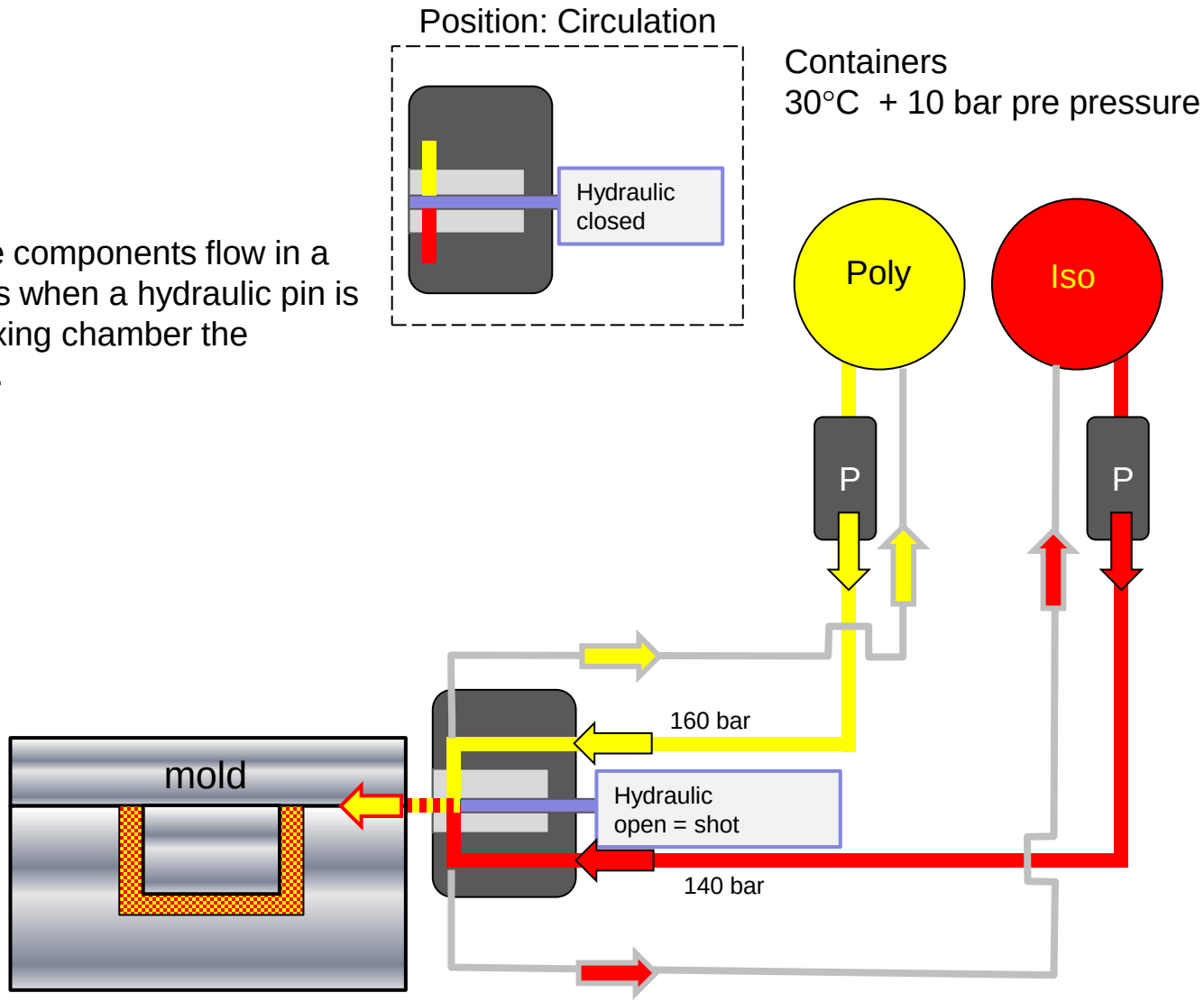
Both liquid components are stocked in containers by pressure of 10 bars and a temperature of about 30°C. The materials recirculate through a system of tubes and pipes as singular materials until such time a shot is called for. The materials are then introduced at the mixing head which is installed at the mold gating of the tool. Pumps generate a pressure of von 140 / 160 bars in the mixing head. Injected for a short time the mixture is pressure free inside the mold. Depending on the material system recipe, pressure grows up at most to 5 or 10 bars not more. The pressure inside the mold occurs out of the material itself by the expansion of cells which is driven by carbon dioxide. At this point, the liquid material changes from liquid to rigid (solid). Independent of gravity, we have to evacuate the air out of the mold in a very short time (10 to 60 seconds) . To do this, the molds need an extra split line to vent.

The mold is adapted to our mold carrier, a vertical press, which can tilt over a horizontal axis.
This allows the optimized position to get the best flow and venting for the part based on geometry.

Housings & Parts: Polyurethane & RIM

1 – Machines and Processing

Through tubes and pipes the components flow in a circulation. Injection happens when a hydraulic pin is pulled back. Through the mixing chamber the material flows into the cavity.

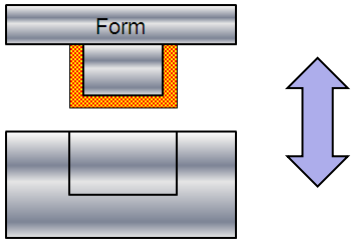


Housings & Parts: Polyurethane & RIM

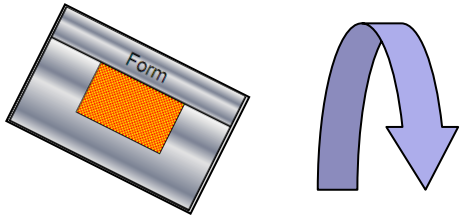
1 – Machines and processing

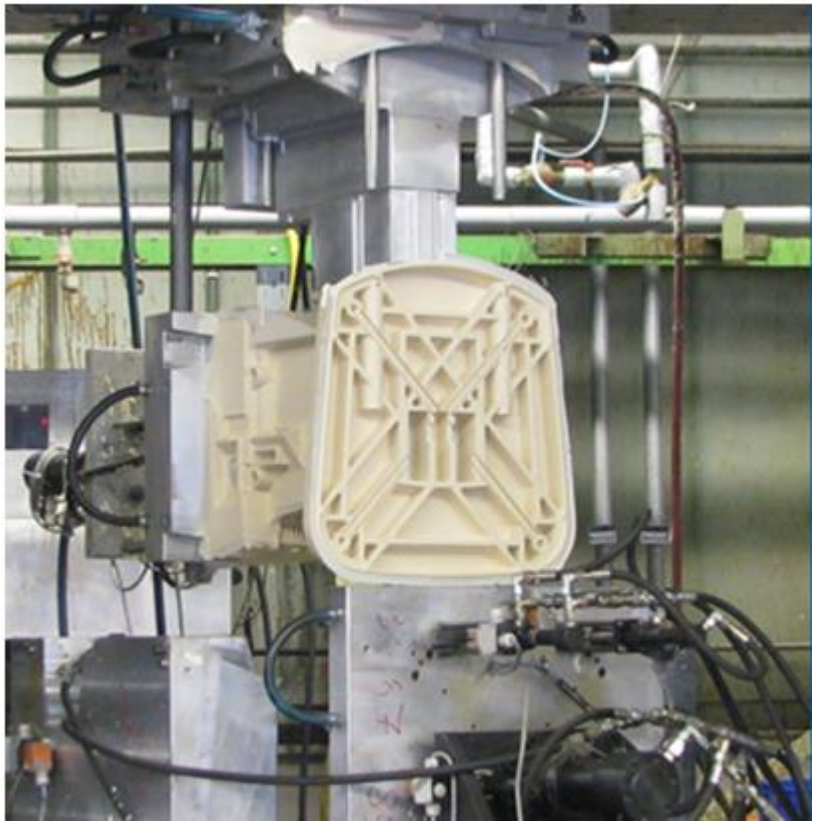
Mold Carrier in Action

Opening /
Closing operation



Rotating
Tilting





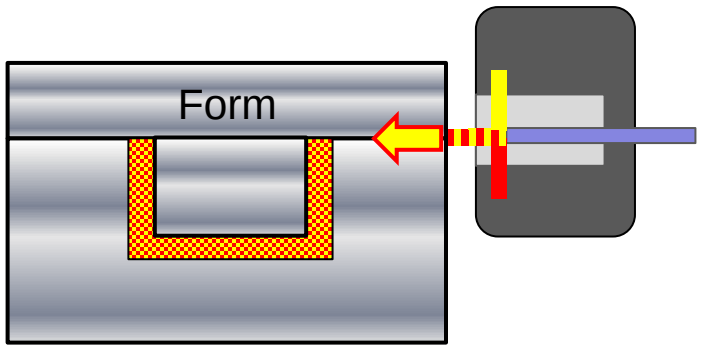
Housings & Parts: Polyurethane and RIM

1 – Machines and Processing

2 – Comparison: Polyurethane Vs. Traditional Injection Molding

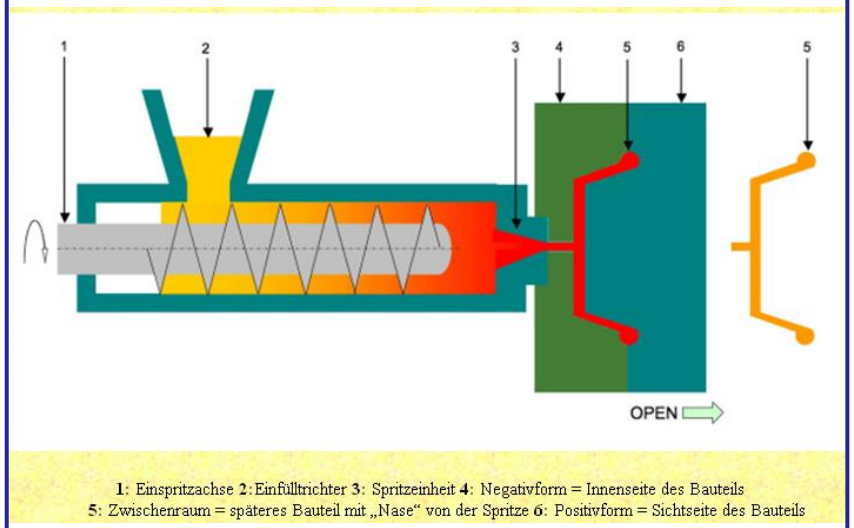
Polyurethane

- Chemical reaction
- Low in mold pressure by carbon dioxide – mixture is foaming
- In mold pressure of max. 10 bars is the same at any areas in the mold/part
- Mold temperature about 50°C to 60°C
- Part temperature by the chemical exothermic reaction inside may grow up to 140°C
- Mold temperature 50 to 60°C is relatively cooling the part
- Placed venting is needed and helps optimize quality.



Injection Molding

- Physical process
- Melted plastic is injected by the machine with about 2.000 bars
- Pressure at the injecting point is high in a further distance lower
- During molding, plastic is melted and the machine can create an after pressure to optimize part quality (packing),



Housings & Parts: Polyurethane & RIM

3 - Recipes

	Density g/cm³	Wall thickness from	UL94 V0 from ... mm
Baydur 60	0,6	6....25	ab 6
Baydur 110	10,5	3.....9	ab 3,1

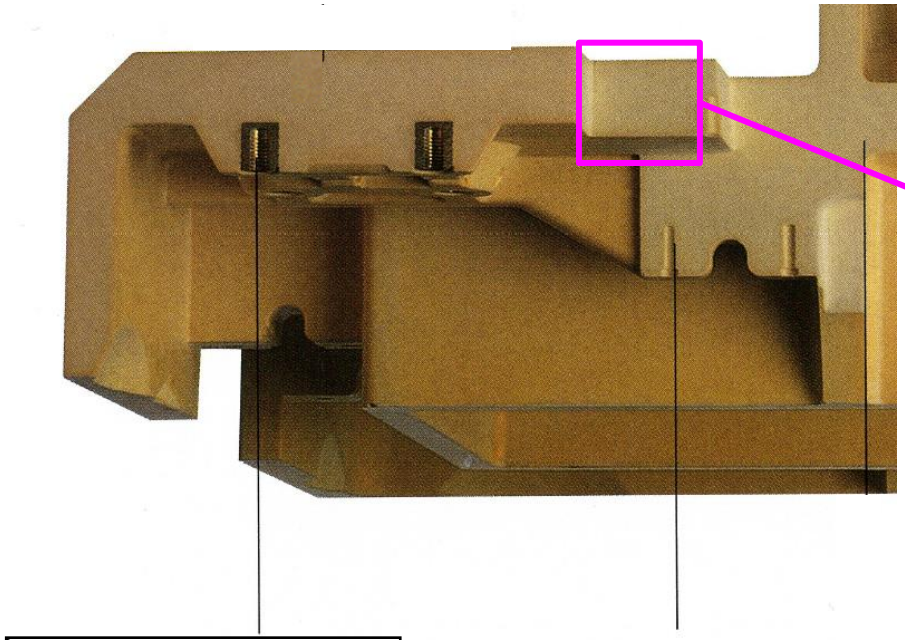
Our main recipes shrinkages

Wall thickness [mm]	IHS 001 - 003 005		Difference according to 100 mm		K 110 L 036 037 038		Difference according to 100 mm
2				2	%		
3				3	0,45	100%	0,00
4	%			4	0,50	111%	0,05
5	0,30	100%	0,00	5	0,55	122%	0,10
6	0,35	117%	0,05	6	0,60	133%	0,15
8	0,40	133%	0,10	8	0,65	144%	0,20
10	0,45	150%	0,15	10			
12	0,50	167%	0,20	12			
15	0,55	183%	0,25	15			
20	0,65	217%	0,35	20			
30	0,70	233%	0,40				
40	0,75	250%	0,45				
50							
60							

Housings & Parts: Polyurethane & RIM

3 - Recipes

	Density g/cm³	Wall thickness from	UL94 V0 from ... mm	
Baydur 60	0,6	6....25	ab 6	**Baydur 60**
Baydur 110	10,5	3.....9	ab 3,1	



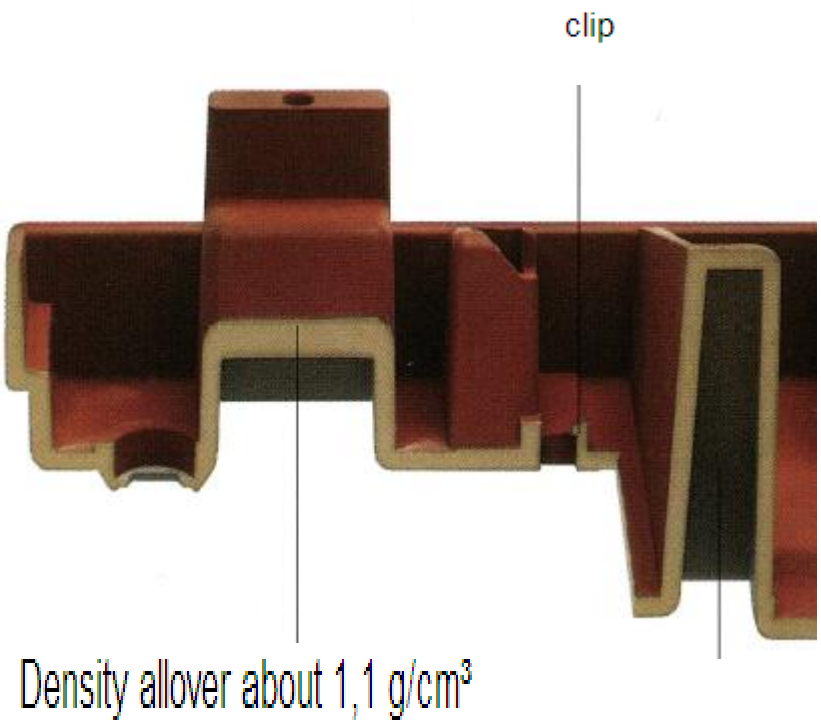
- Creating a sandwich structure by itself
- Outside design in side function
- Stiff parts which are light
- Inserts can be molded in
- Core hole for self-tapping screws

Housings & Parts: Polyurethane & RIM

3 - Recipes

	Density g/cm³	Wall thickness from	UL94 V0 from ... mm
Baydur 60	0,6	6....25	ab 6
Baydur 110	10,5	3.....9	ab 3,1

Baydur 110



- Thin wall, compact structure (solid)
- Wall thickness/flow-path is very good
- Geometries close to injection plastic parts
- Clips are possible
- Inserts are preferably post molded

Housings and Parts: polyurethane & RIM

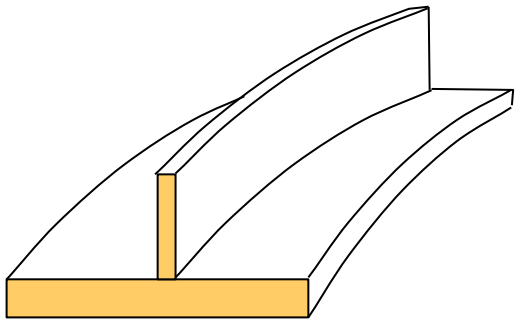
4 – Part Construction Guidelines

You have to think about which of the following facts are applicable to your part …..

….a flat part is critical, warp could occur
….a flat part with ribs reduces possibility of warp
….a deep box like geometry is stiff
….which wall thicknesses do you need => choose recipe

Baydur 66…Density 0,6
Wall thickness 6 up to 20 mm
Thermal Isolation properties & sound absorption
Stiff by sandwich construction: (HD Sides with LD Inner Core)
Different wall thicknesses are possible in one part, no sink or distortion

Baydur 110…Density 1,05 – 1,1 g/mm³
Wall thickness 3 up to 6 mm
Higher impact resistance
Less differences in wall thicknesses are possible in one part



Partial higher wall thicknesses are possible
Baydur is better in such differences than plastic injection process but there are limits.
Differences in wall thicknesses create warping by different shrinkages.
Baydur 110 shrinks more than Baydur 66

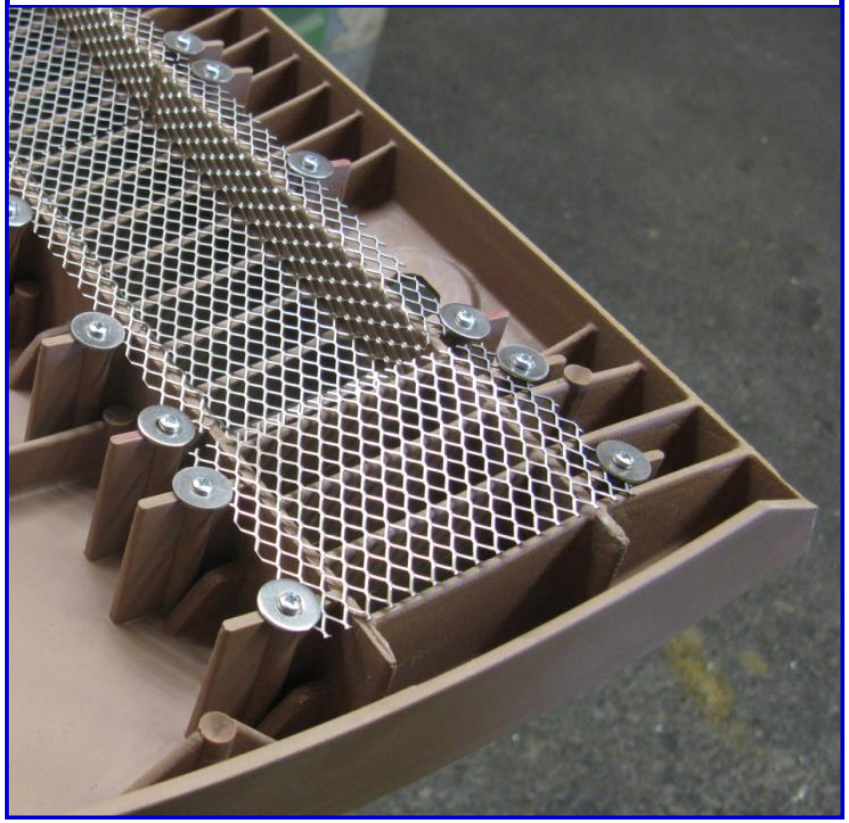
Housings and Parts: Polyurethane & RIM

4 – Part Construction Guidelines

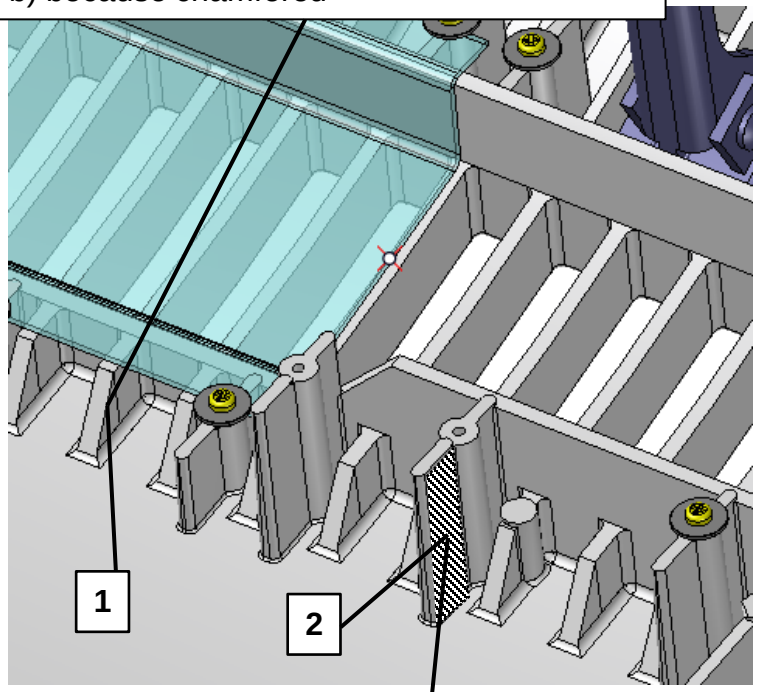
Because the PUR mixture is virtually without pressure at injection, long material flows are possible. Good flow can be enhanced by using radius and chamfered edges.
Target is to have a completely filled core hole and rib/stud.

Application: Screw in a grid

Studs with core holes for self tapping screws .
Connected to neighboring ribs for good fill and to stabilize the studs.



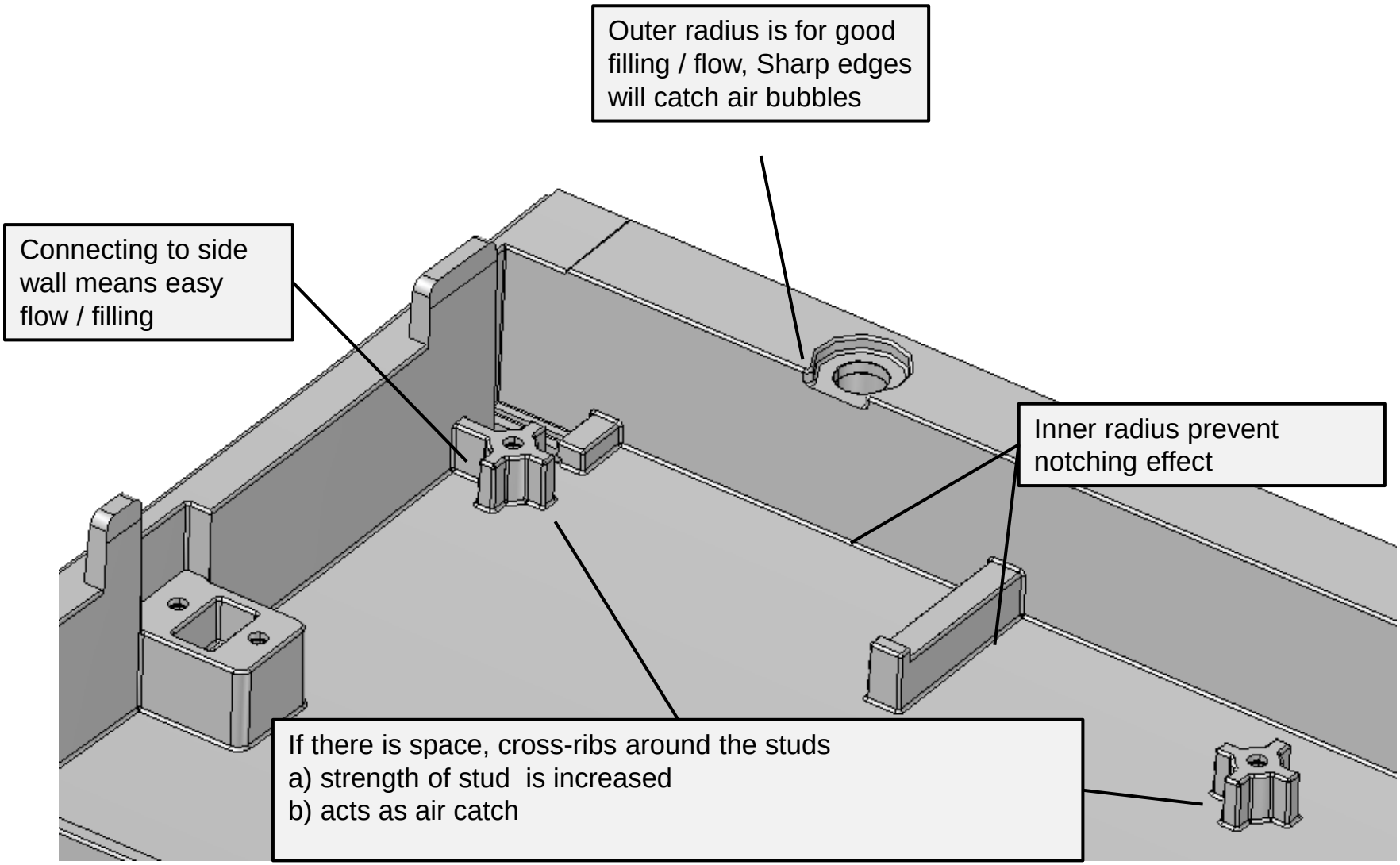
1 – Chamfered support ribs..... easy flow.
a) because connected with the rib
b) because chamfered



2 – Air catching rib..... is a reservoir. An imperfect filling condition.
Function to hold the screw is secured.

Housings and Parts: Polyurethane & RIM

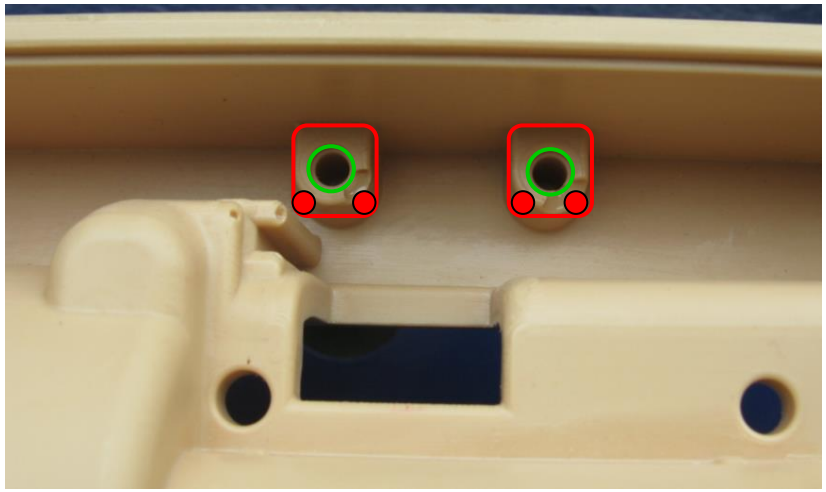
4 – Part Construction Guidelines

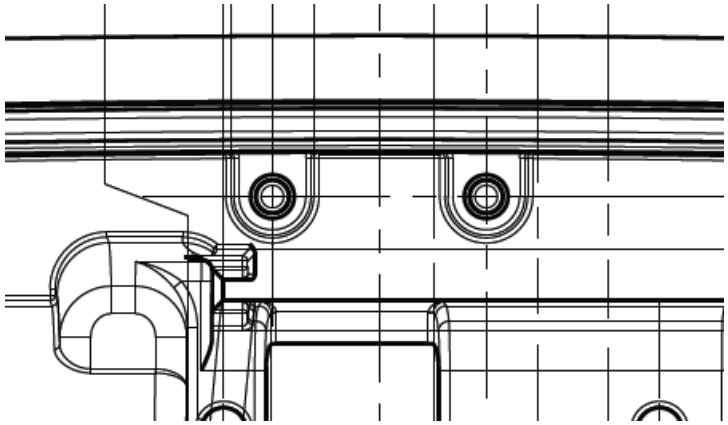


Housings and Parts: Polyurethane & RIM

4 – Part Construction Guidelines

Adapt profiles of studs to get space for air catch-pins.
Effect:
Core hole is 100 %
in function

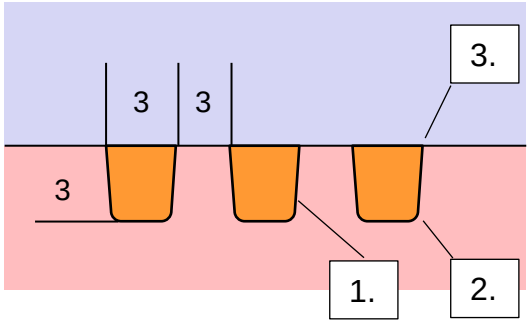




Housings and Parts: Polyurethane & RIM

4 – Part Construction Guidelines

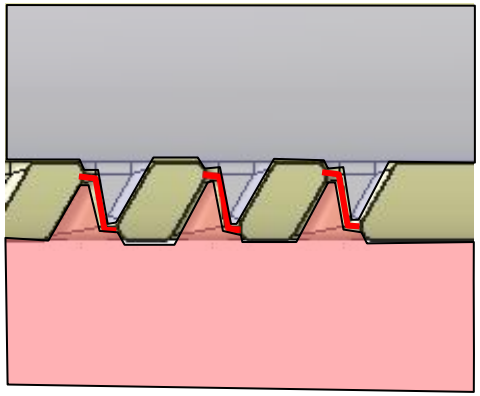
General / Standard:

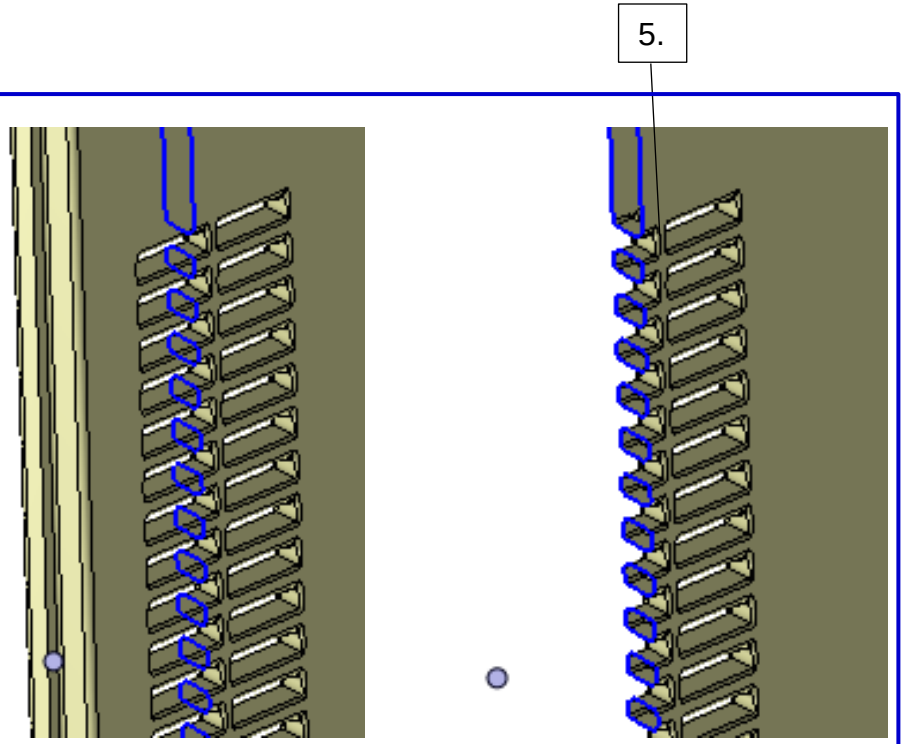


1. 2 – 3° draft each side
2. Edges in visible area with radius (filling an adhesion of paint)
3. Inside without radius (split line)
4. Ribs not to thin
5. Long ribs need a connection rib to stabilize

Venting slots

Here a complex version of slots tilt ribs to make sure no liquids will flow inside the housing



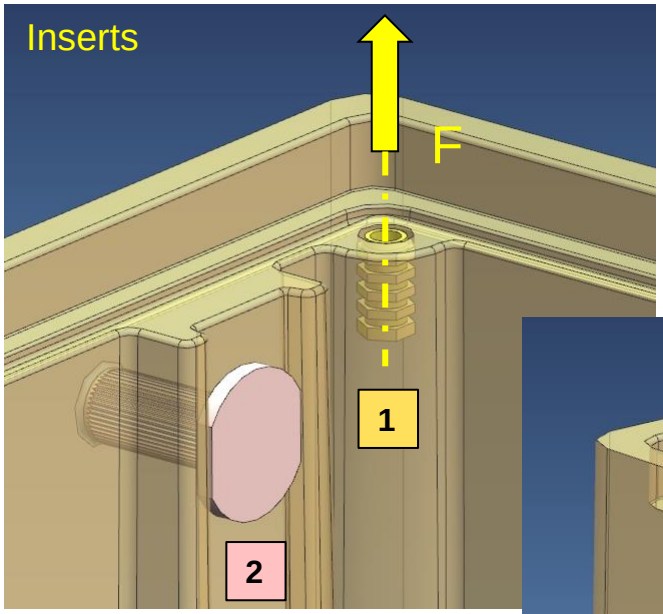


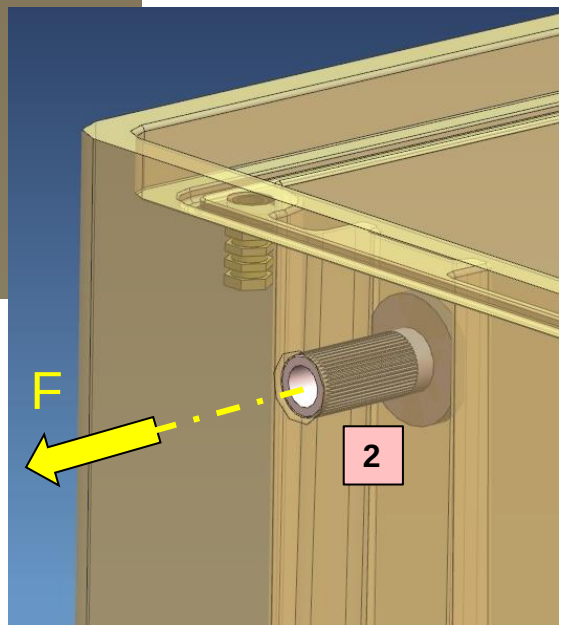
Housings and Parts: Polyurethane & RIM

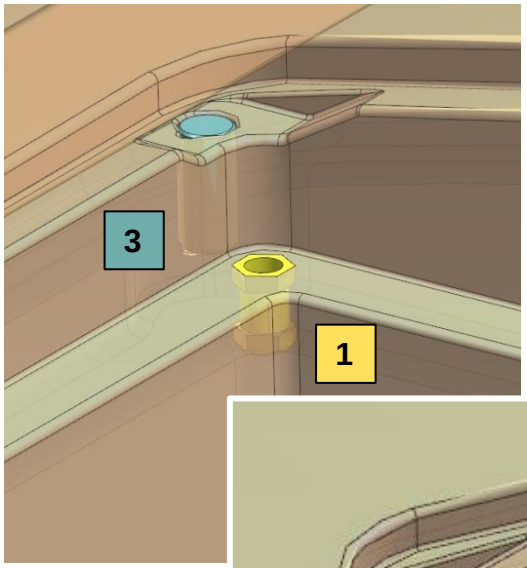
4 – Part Construction Guidelines

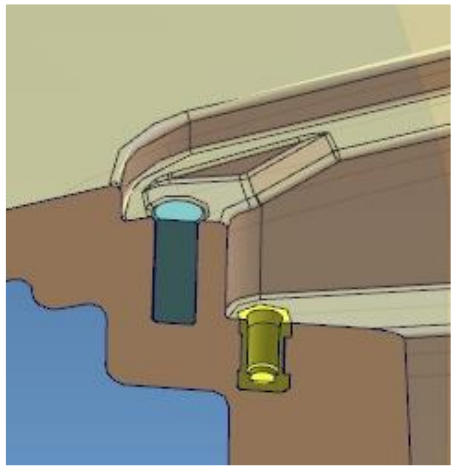
Inserts may be assembled in different ways

- Molded in gives best strength
  Different types are available
- Flanged bushings make sense, sometimes
  Those are asembled directly after part is demolded
- Assembling sample: Magnet is glued in







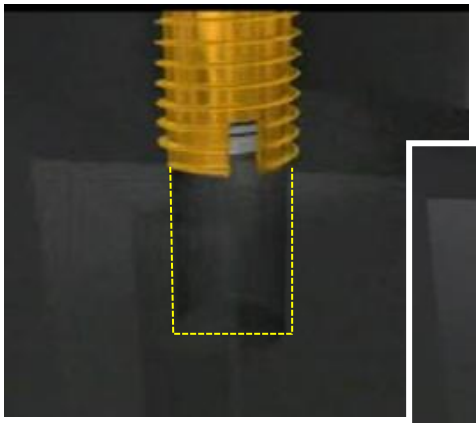


Housings and Parts: Polyurethane & RIM

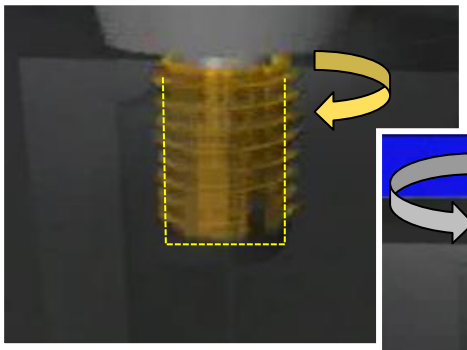
4 – Part Construction Guidelines

Inserts may be assembled in different ways

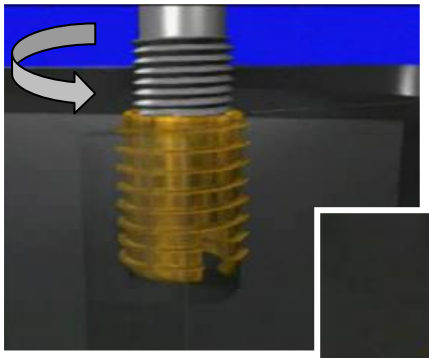
1. Post mounted inserts into molded core holes.



Molded core hole



Assemble with drill in machine



Assembling thread drilled out

Assembled

Pictures: Böllhoff

Housings and Parts: Polyurethane & RIM

4 – Part Construction Guidelines

Basics:

You can design nearly everything in PUR. The question is, what makes sense financially, part performance and design and the value propositions associated with realizing the part(s) RIM and PUR. .
Our experience out of more than 4.000 realized projects and molds gives us a large experience base to draw from. Mold price and part price can be kept to a minimum if you follow some basic rules.
If possible …….

- Draft standard 1°, if agreed 0,5°
- No sharp edges. Outer radius for filling inner radius against notch effect.
- Watch Thieme Tolerances especially if two parts get in correspondence together.
- CAD files in middle of tolerance.
- Consider paint. Coating may be 0,15 mm to 0,2 mm each shift. Don’t over tolerance.
- If inserts are needed, be sure wall thickness around the core hole is sufficient.

Housings and Parts: Polyurethane & RIM

4 – Part Construction Guidelines

Engineering and Design:

Generally we can confirm only our tolerances according to our process.
Thieme tolerances consider the fitting of parts during your product lifetime. Parts can be exchanged between different lots.

A forward-looking design engineering study will show you critical details.

We prefer that you contact us as early as possible in the part design phase to provide you our support.

THIEME Norm 2013

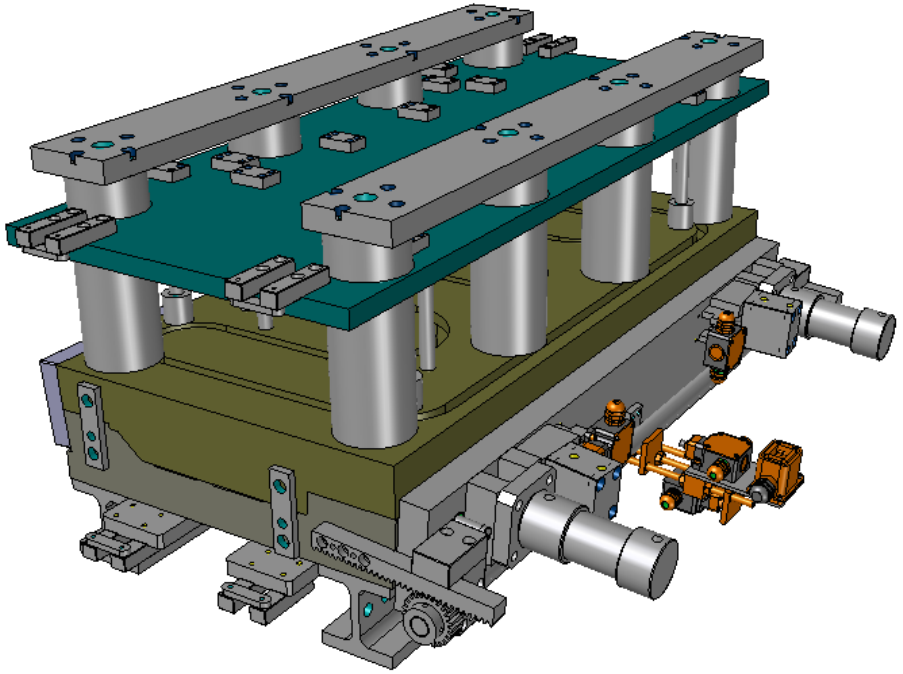
THIEME

Nennmaß

über...	0	15	50	120	180	315	400	500	630	800	1000	1500	2000
bis...	15	50	120	180	315	400	500	630	800	1000	1500	2000	3000
Längentoleranz +/-	0,1	0,2	0,3	0,4	0,5	0,7	0,9	1,1	1,3	1,5	2,0	3,0	4,0

Housings and Parts: Polyurethane & RIM

5 - Molds



We offer:

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Experience of nearly 4000 projects

•Tools are still running that were built in 1973

•THIEME = standard quality in mold design

•All our tooling partners are evaluated and audited for quality and Thieme design standards.

•Tools are built with all aluminum billets and can have temperature controls, hydraulics, moveable components, sliders and other automation.

•

Quality in design and construction in the mold base for safe processing in series production.