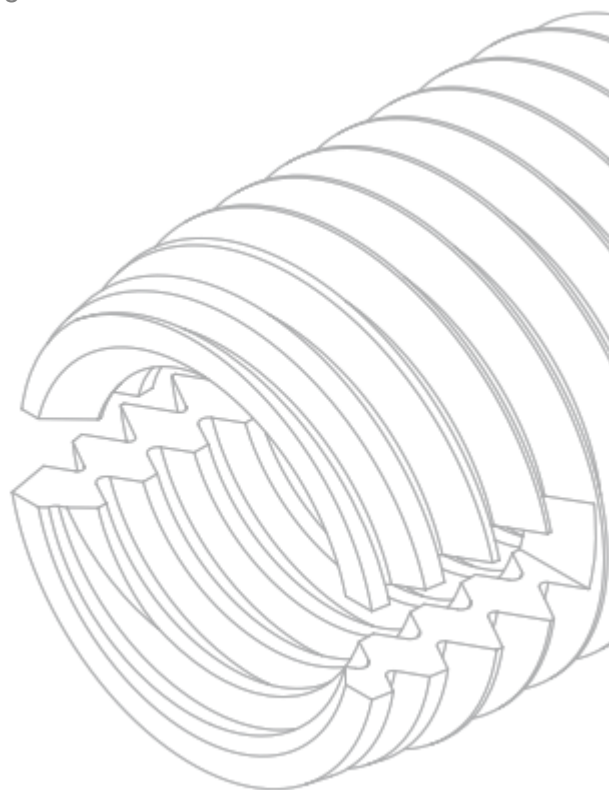


Technical Report



Ensat®

Comparative tightness tests on **Ensat®** self-threading bushings on different types of plastic sheets

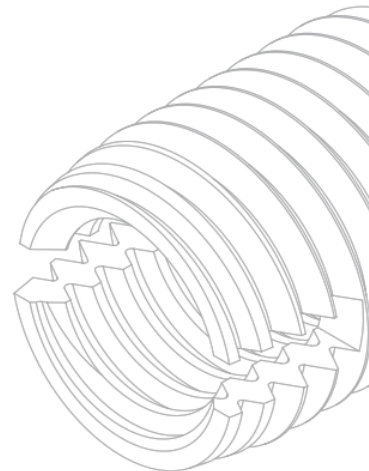


Ensat®

The Ensat® is a self-tapping metal insert, with internal and external thread and slots or holes providing a tapping effect.

The Ensat® bush is inserted into materials with low resistance (all types of plastics, thermosets, thermoplastics, fibreglass, reinforced plastics and resins) requiring threaded seats with high specifications of resistance and wear. It can also be inserted into metals (such as light alloys, castings). Refer to the Ensat® catalogue for the specifications of these applications. Can also be used for re-tapping worn thread.

The Ensat® bush can be used for all machining and processing of plastics. The Ensat® bush has a large cutting surface and therefore offers greater resistance to traction. It can be inserted into the finished item, which means higher efficiency for machining centres and the elimination of positioning errors or material deposited in the thread. A casting hole or tool with standard tolerances is all that is needed to fit Ensat® bushes. Its fast and easy fitting make the system extremely cost effective.



Ensat® Installation guide

PREPARATION OF THE SEAT

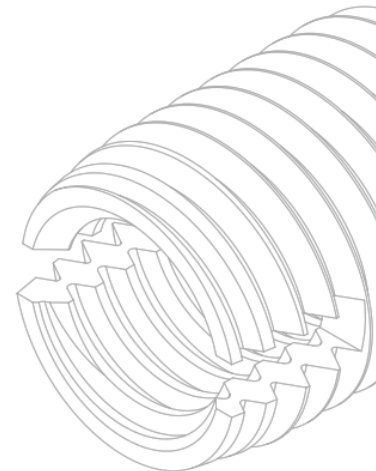
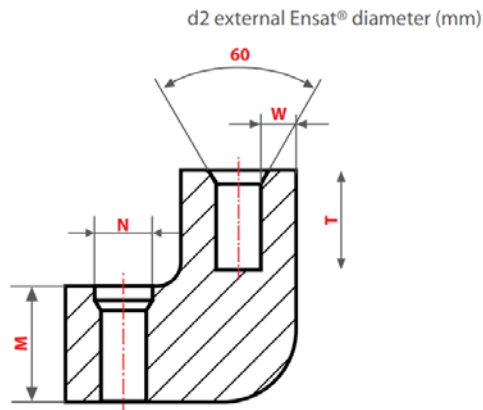
The hole can be created during moulding or by a machine tool. In order to prevent cracks or marks, prepare the lead-in area of the hole as follows:

- for soft plastics, flare by 60°
- for hard or fragile plastics, create a groove
 $N = d2 + 0,2$ at 0,4 mm.

The depth must be the same as the pitch of the external thread, or more. Take care not to alter the shape of the surface of the item when inserting the Ensat®

<i>Passing hole</i>	the length of the Ensat® must not exceed the thickness of the material (M).
<i>Dummy hole</i>	the minimum depth (T) is indicated in the datasheet for each product.
<i>Hole walls</i>	the minimum thickness required (W) depends on the envisaged load and the elasticity of the material where the Ensat® bush is inserted.
<i>Hole diameter</i>	hard, resistant materials require larger holes compared to soft, elastic materials. The specifications are indicated on the datasheets for each product. The Ensat® bush must be fitted at least 0,1-0,2 mm below the assembly surface. The perforation diameter is calculated according to the material and the Ensat® bush. Larger holes mean easier insertion but can be detrimental for resistance to traction. Testing the assembly is therefore recommended

APPROXIMATE W VALUES FOR PLASTICS greater/equal 0,25 at 0,9 d2



INSTALLATION

The installation of the Ensat bushes® takes place through the use of specific equipment and can be carried out both by hand and by machine.

For more specifics, see product catalog available on www.specialinsert.it

Ensat®

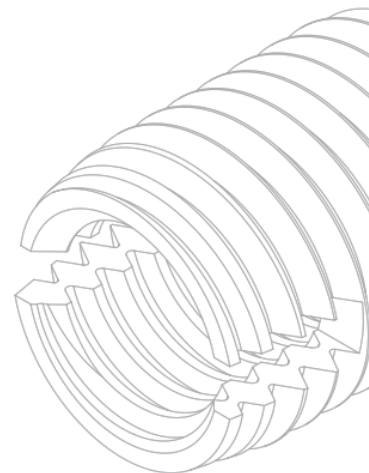
Test objective

The aim of this report is to provide an indication to the end user of which Ensat® bush is most suitable based on different types of plastic materials.

Tested inserts

Among the wide range of Ensat® bushes available in our the catalog, the following have been chosen for the test:

Code	Characteristics
Series 302	Bush characterized by special external thread with fine pitch and sharp slits. Ideal for soft materials with low cut resistance. Recommended for applications on thermosetting, thermoplastic, reinforced plastic materials, resins, castings.
Series 305	Bush with lengthwise grooves. Supports high loads thanks to its special section. Preferably for use with thermosets.
Series 309	Bush characterized by an external thread with specific profile and pitch for particularly soft materials.





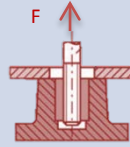
Tested Plastic Sheet

The criteria for choosing the tested plastic materials took into consideration their mechanical characteristics and their wide use on an industrial scale.

Material	Main Characteristics
COMPACT POLYPROPYLENE	Polypropylene (or polypropene, abbreviated as PP) is a thermoplastic polymer. The most interesting product from the commercial point of view is the isotactic one: it is a semi-crystalline polymer characterized by a high breaking load, a low density, a good thermal and abrasion resistance.
COMPACT POLYCARBONATE	Compact polycarbonate (commonly called Lexan®) is an easily workable, moldable and thermoformable thermoplastic polymer. Unlike most thermoplastic materials, polycarbonate can undergo large plastic deformations without cracks or breaks and is sensitive to notching. Of fundamental importance for polycarbonate applications is its high toughness. Is used in various fields of application: optics, transport, construction, military, aeronautics, electric lighting and in the medical field.
ABS	ABS (Acrylonitrile-Butadiene-Styrene) is a thermoplastic polymer with a high hardness and impact resistance. Easily workable, it resists ultraviolet rays and solvents, alkalis, hydrochloric acid and phosphoric acid. Used to create light and rigid objects such as pipes, parts or entire automotive bodies, as well as a container for assembling electrical and electronic components.
NYLON (PA 6)	Nylon PA6 is a semi-crystalline polyamide polymer with an excellent combination of mechanical properties, rigidity, tenacity, mechanical damping and wear resistance. Good electrical insulation capacity and chemical resistance to organic and inorganic compounds, poor acid and humidity as it is hygroscopic. It has a high attenuation power and is preferred in many uses in the metalworking sector for gears, pulleys, wheels, guide profiles, threaded rods. On the other hand, the use in the electrical sector is limited given the variation in its characteristics as a function of humidity.
COMPACT METHACRYLATE (Cast)	Cast methacrylate (commonly called Plexiglass®) is a plastic material made from polymers of methyl methacrylate. Used in construction, modern architecture, boating, lighting, but also in industry, in relation to its excellent aesthetic qualities of transparency, colorability, thermoformability, flatness and optical purity. It has poor qualities of mechanical and chemical resistance, it does not resist shocks.

Methodology:

For each of the three types of inserts (Series 302, Series 305, Series 309) the following performances were evaluated:

Test type	Measuring Tool	Representative image
Maximum moment during installation	Torque wrench Values in Nm	
Maximum torque resistance peak	Torque wrench Values in Nm	
Maximum pull out force resistance peak	Tension tester Values in Kg	

Threads

For each series the threads M3, M4, M5, M6 have been examined:

Material and Finishing

Series 302	Zinc-plated steel
Series 305	Brass in its natural state
Series 309	Brass in its natural state

Sheet thickness

Tests were carried out on plastic sheet materials. The thickness of the support is always greater than the total length of the bush.

Results

Maximum moment allowed
Values in **Nm**

Ensat®
SERIE 302

CODE	M	HOLE DIAMETER	POLYPROPYLENE	POLYCARBONATE	ABS	NYLON PA6	CAST METHACRYLATE
302 0030.16	M 3	4,6 mm	< 2,00	< 2,00	< 2,00	< 2,00	< 2,00
302 0040.16	M 4	6,0 mm	< 2,00	< 2,00	< 2,00	< 2,00	3,50
302 0050.16	M 5	7,4 mm	3,50	5,50	4,50	< 2,00	8,00
302 0060.16	M 6	9,0 mm	3,50	10,00	13,00	3,75	22,00

Ensat®
SERIE 305

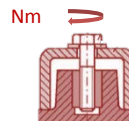
CODE	M	HOLE DIAMETER	POLYPROPYLENE	POLYCARBONATE	ABS	NYLON PA6	CAST METHACRYLATE
305 0030.80	M 3	4,6 mm	< 2,00	< 2,00	< 2,00	< 2,00	< 2,00
305 0040.80	M 4	6,0 mm	< 2,00	2,50	< 2,00	< 2,00	3,80
305 0050.80	M 5	5,9 mm	< 2,00	5,30	< 2,00	2,60	7,00
305 0060.80	M 6	9,0 mm	3,30	12,40	4,90	4,30	12,40

Ensat®
SERIE 309

CODE	M	HOLE DIAMETER	POLYPROPYLENE	POLYCARBONATE	ABS	NYLON PA6	CAST METHACRYLATE
309 0030.80	M 3	4,2 mm	< 2,00	< 2,00	< 2,00	< 2,00	**
309 0040.80	M 4	5,2 mm	< 2,00	7,60	4,20	3,20	**
309 0050.80	M 5	6,7 mm	2,80	11,60	5,20	4,50	**
309 0060.80	M 6	7,7 mm	4,40	14,00	6,50	5,00	**

** in all the tests carried out, the material has reached the critical breaking point, therefore making the test void. The material is not fit for the Ensat® bush series 309

The values shown are to be understood as an expression of an arithmetic mean obtained from a minimum of 4 tests. The results presented in this report are the result of laboratory tests carried out under non-repeating optimal conditions; therefore, the resulting data are intended as indicative and non-binding.



Results

Maximum TORQUE resistance peak per material type
Values in Nm

Ensat® SERIE 302



Legenda of results (E)

A	INSERT EXTRACTION
B	8.8 SCREW BREAK
C	MATERIAL BREAK

CODE	M	POLYPROPYLENE	E	POLYCARBONATE	E	ABS	E	NYLON PA6	E	CAST METHACRYLATE	E
302 0030.16	M 3	< 2,00	A	< 2,00	A	< 2,00	A	< 2,00	A	< 2,00	A
302 0040.16	M 4	2,80	A	9,70	A	4,00	A	5,50	A	6,70	B
302 0050.16	M 5	4,10	A	10,00	A	9,20	A	9,60	A	17,50	A
302 0060.16	M 6	12,00	A	26,10	B	23,30	A	21,10	A	36,00	B

Ensat® SERIE 305



CODE	M	POLYPROPYLENE	E	POLYCARBONATE	E	ABS	E	NYLON PA6	E	CAST METHACRYLATE	E
305 0030.80	M 3	< 2,00	A	< 2,00	A	< 2,00	A	< 2,00	A	< 2,00	A
305 0040.80	M 4	< 2,00	A	3,00	A	< 2,00	A	4,60	A	< 2,00	A
305 0050.80	M 5	< 2,00	A	6,30	A	6,00	A	5,30	A	7,00	A
305 0060.80	M 6	5,00	A	12,70	A	11,80	A	16,40	A	13,70	A

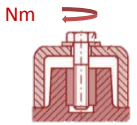
Ensat® SERIE 309



CODE	M	POLYPROPYLENE	E	POLYCARBONATE	E	ABS	E	NYLON PA6	E	CAST METHACRYLATE	E
309 0030.80	M 3	< 2,00	A	4,90	A	2,90	A	4,00	A	**	C
309 0040.80	M 4	4,00	A	8,30	A	8,20	A	8,90	A	**	C
309 0050.80	M 5	6,00	A	13,10	A	13,30	A	18,40	A	**	C
309 0060.80	M 6	14,70	A	28,70	B	33,00	A	28,20	A	**	C

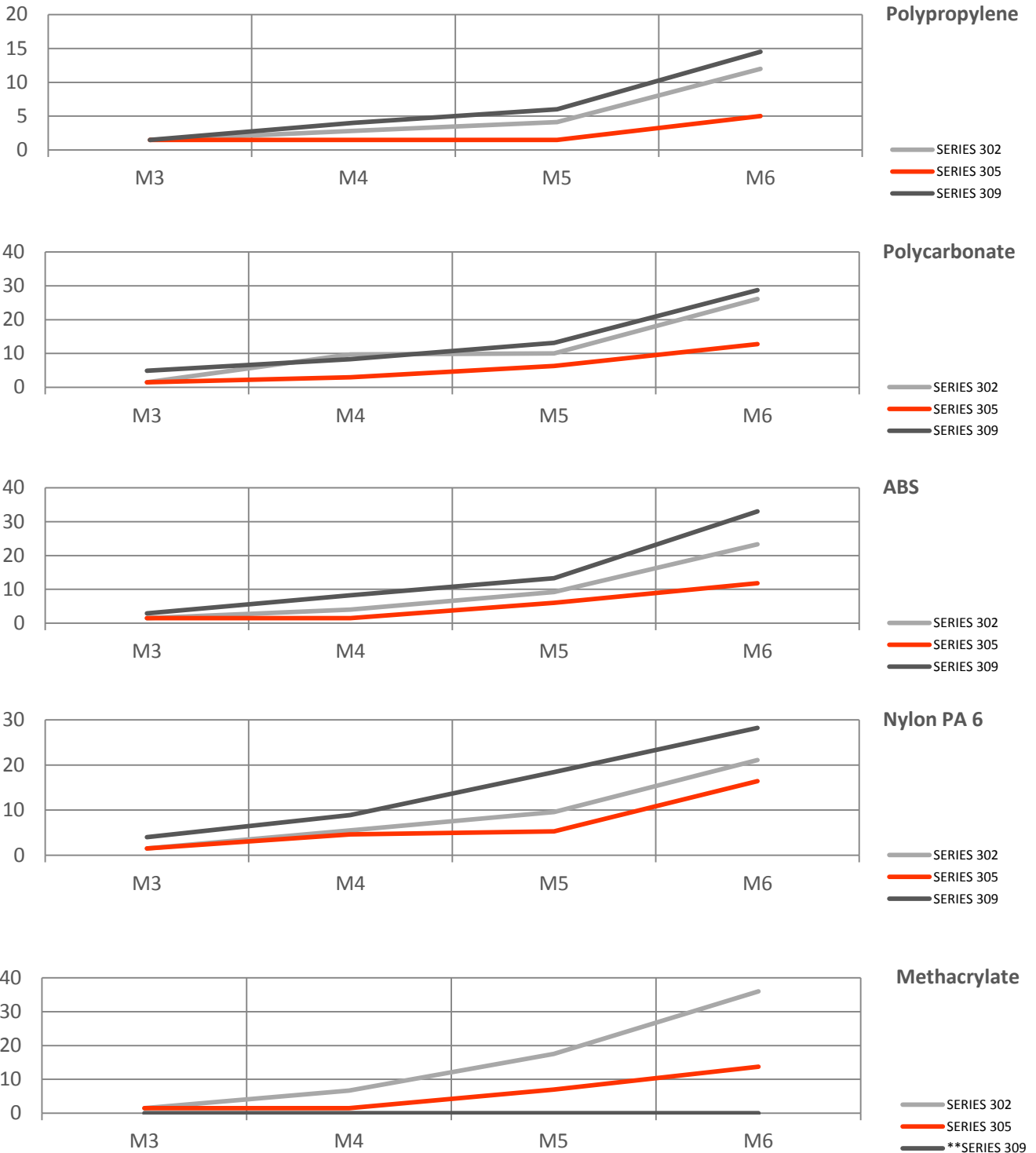
** in all the tests carried out, the material has reached the critical breaking point, therefore making the test void. The material is not fit for the Ensat® bush series 309

The values shown are to be understood as an expression of an arithmetic mean obtained from a minimum of 4 tests. The results presented in this report are the result of laboratory tests carried out under non-repeating optimal conditions; therefore, the resulting data are intended as indicative and non-binding.



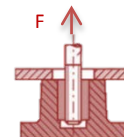
Results

Maximum TORQUE resistance peak per material type
Values in Nm



** in all the tests carried out, the material has reached the critical breaking point, therefore making the test void. The material is not fit for the Ensat® bush series 309

The values shown are to be understood as an expression of an arithmetic mean obtained from a minimum of 4 tests. The results presented in this report are the result of laboratory tests carried out under non-repeating optimal conditions; therefore, the resulting data are intended as indicative and non-binding.



Results

Maximum PULL OUT FORCE resistance peak per material type
Values in Kg

Ensat® SERIE 302



Legenda of results (E)

A	INSERT EXTRACTION
B	8.8 SCREW BREAK
C	MATERIAL BREAK

CODE	M	POLYPROPYLENE	E	POLYCARBONATE	E	ABS	E	NYLON PA6	E	CAST METHACRYLATE	E
302 0030.16	M 3	140	A	220	A	200	A	180	A	150	A
302 0040.16	M 4	170	A	245	A	290	A	300	A	250	A
302 0050.16	M 5	250	A	490	A	420	A	630	A	750	A
302 0060.16	M 6	460	A	950	A	585	A	920	A	850	A

Ensat® SERIE 305



CODE	M	POLYPROPYLENE	E	POLYCARBONATE	E	ABS	E	NYLON PA6	E	CAST METHACRYLATE	E
305 0030.80	M 3	75	A	90	A	140	A	155	A	170	A
305 0040.80	M 4	115	A	100	A	170	A	190	A	180	A
305 0050.80	M 5	160	A	320	A	370	A	390	A	300	C
305 0060.80	M 6	310	A	640	A	550	A	700	A	530	C

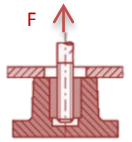
Ensat® SERIE 309



CODE	M	POLYPROPYLENE	E	POLYCARBONATE	E	ABS	E	NYLON PA6	E	CAST METHACRYLATE	E
309 0030.80	M 3	150	A	250	A	220	A	320	A	**	C
309 0040.80	M 4	280	A	370	A	430	A	590	A	**	C
309 0050.80	M 5	390	A	615	A	550	A	800	A	**	C
309 0060.80	M 6	525	A	870	B	850	A	900	A	**	C

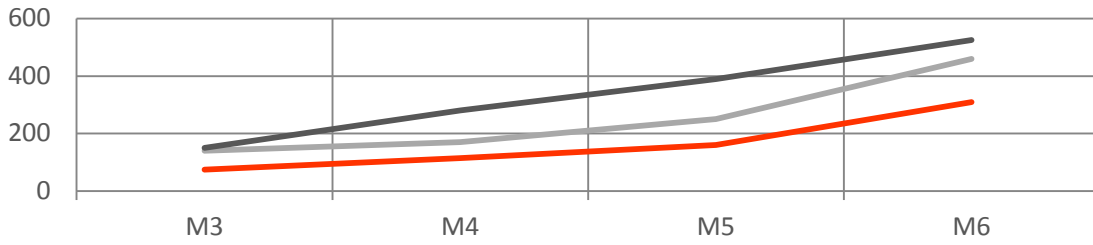
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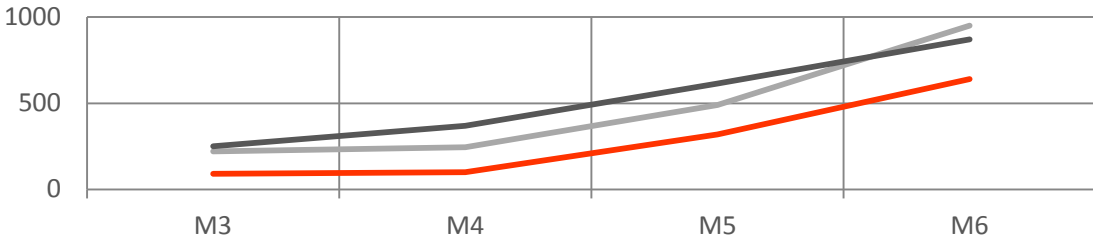
Results

Maximum PULL OUT FORCE resistance peak per material type
Values in Kg



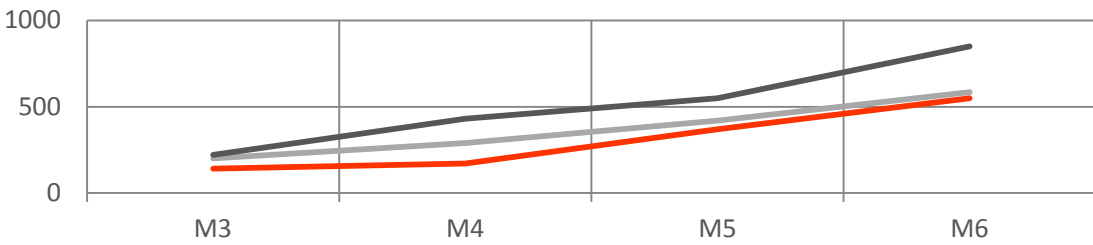
Polypropylene

— SERIES 302
— SERIES 305
— SERIES 309



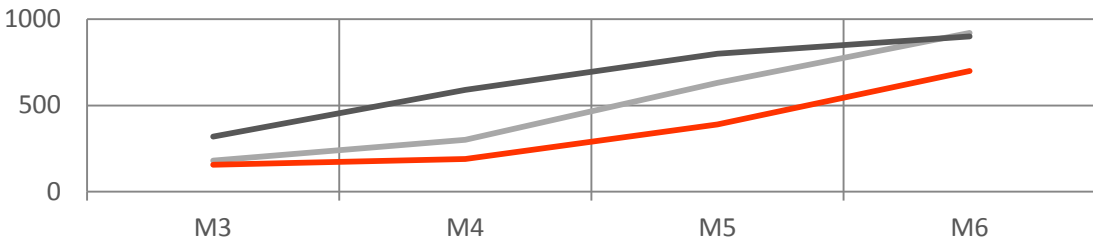
Polycarbonate

— SERIES 302
— SERIES 305
— SERIES 309



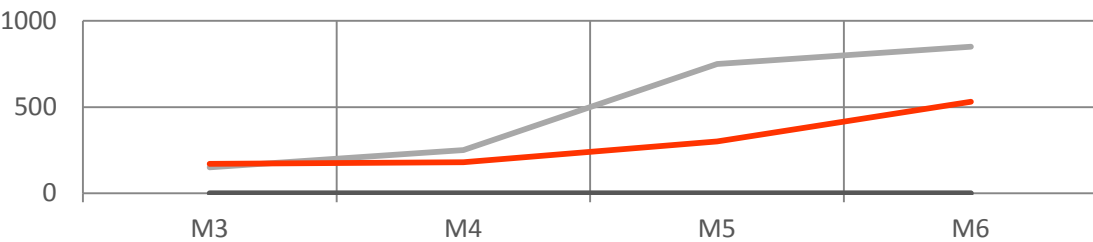
ABS

— SERIES 302
— SERIES 305
— SERIES 309



Nylon PA 6

— SERIES 302
— SERIES 305
— SERIES 309



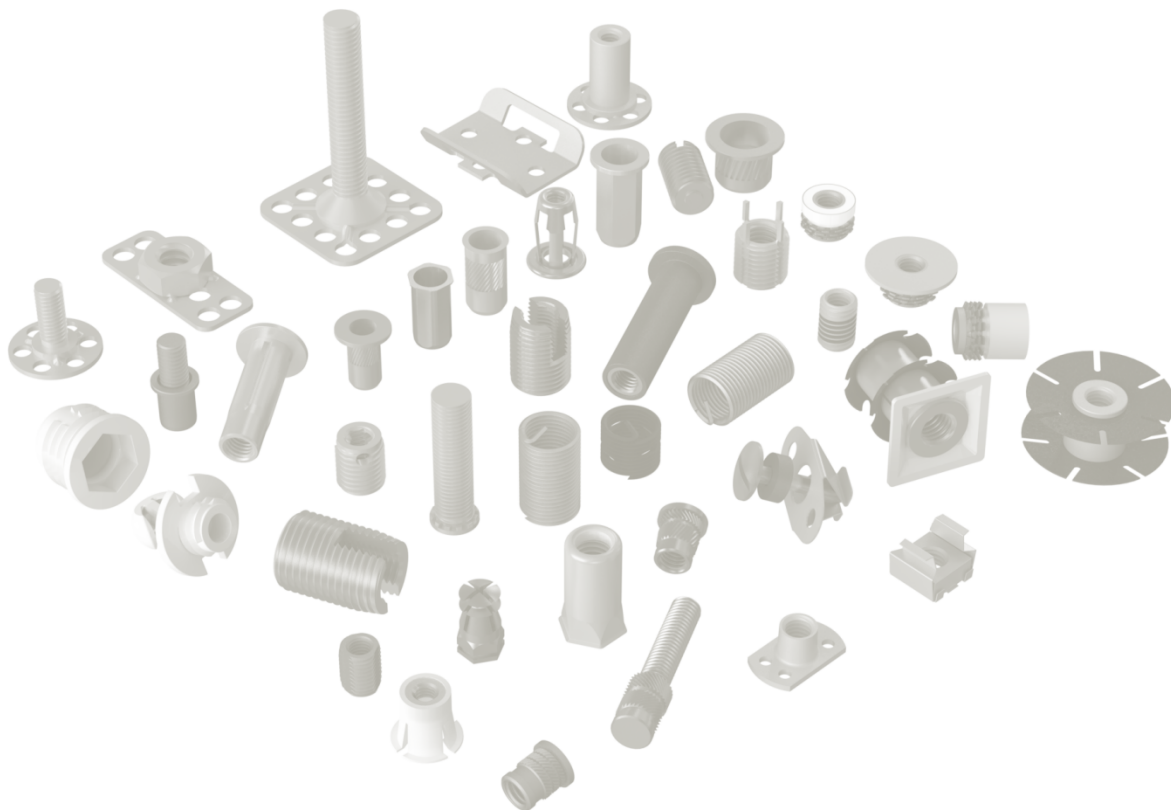
Methacrylate

— SERIES 302
— SERIES 305
— **SERIES 309

** in all the tests carried out, the material has reached the critical breaking point, therefore making the test void. The material is not fit for the Ensaf® bush series 309

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