



The old BMW 7 weighs 2,021kg and consists of 15,6% plastics. (sources: A2Mac1)



The new BMW 7 weighs with 1,860kg less than the old one and consists of only 10,9% plastics.

# BMW 730i versus BMW 740i

## Analysis of thermoplastic materials employed in BMW 7 series

Lightweight construction is, currently, the central theme in automotive design. Lighter components can contribute towards lower overall vehicle weight, resulting in reduced fuel consumption and lower CO<sub>2</sub> emissions. This naturally also refers to the luxury car segment, including the BMW 7 series. In this edition we are surveying the BMW 730i (2006 year model) and its successor, the BMW 740i (2009 model). We will put our focus on the employed thermoplastic materials and the consequent shift in part weights, and the possible rise or fall of certain materials.

The A2mac1 database shows comparable data for both vehicles in respect to their overall body dimensions (length, width, height). In terms of body mass, the BMW 730i quotes a weight of 2,021kg. Despite the fact that the BMW 740i comes with dual turbos and many extras (e.g. powered rear glass, powered mirrors, cruise control, run flat technology), the overall weight is about 8% lower (1,860kg). A weight reduction of approximately 80kg was achieved by the actual saving of material and a further 80kg was saved because some

extra

equipment isn't built in to the new BMW. The new BMW features 315kg (15,6%) of plastics, a decrease to 202kg (10,9%).

### Body mainly unchanged – progress on the interior side

There are basically no major changes of plastic materials when it comes to the vehicle body. The bumper and bumper frame are still made of PP-EPDM 20%TV but the lower and upper shock absorbers (of the front bumper), two rather small parts, are now made of EPP, rather than PP, which cuts their weight by half. The two upper

central grills, the impressive and distinctive mark of any BMW, remain in ASA-PC.

When it comes to interior and dashboards, in particular, car drivers value an attractive appearance with a clear instrument layout. The dashboard of the 730i was made of PUR with a weight of 7.436 kg. The new PP-LGF20 dashboard of the 740i is slightly smaller in size but, at just 4.616kg, is much lighter. The reinforced PP material fulfils the overall requirement of dashboards of high stiffness, strength and safe fracture in case of an accident. In addition the material shows good flow characteristics and injection moulding of thin walls is possible.

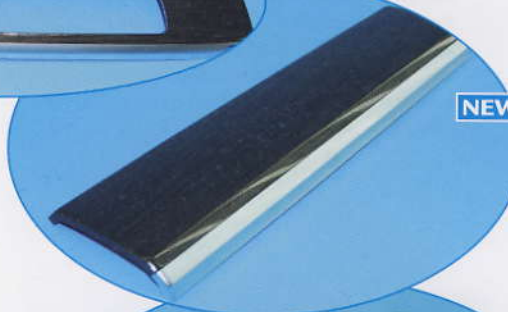
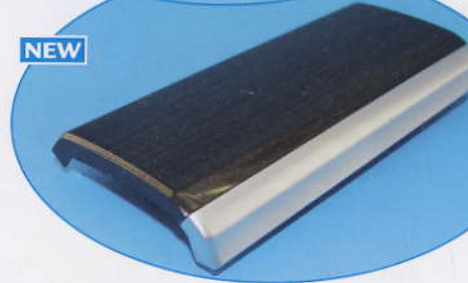
The bezel (PA6-GF30) of the new instrument panel consists of three parts and weighs 0.718kg compared to the previous 2.062kg (Al 231). The dashboard carrier in the former BMW 7 series model was constructed using PUR-LFI. The key objective of the redesign was to create a single material solution for the carrier module that would lower system costs and simplify the manufacturing process. It was also essential that the mate-

**NEW****OLD**

As regards the shock absorber under the bumper, changing from PP to EPP saves 2/3rds of the weight.

**NEW**

Changing from PUR LFI to PPLGF20 on the dashboard meant a saving of just under 3kg.

**OLD****OLD****NEW****NEW****NEW**

material was compatible with BMW's integral foam injection technology, known as SGI. This process enables BMW to produce a lightweight part that exhibits the same performance profile as compact material. The new module is made of a 20% long glass fibre reinforced polypropylene material from Borealis (see page 16). The new dashboard carrier weighs only 0.376kg, compared to the previous 0.876kg – a reduction of 57%.

BMW has been able to reduce the weight of the dashboard and its carrier while, at the same time, making them stronger, by using special glass fibre reinforced polypropylene. Due to the properties of long and now also short fibre reinforced polypropylene grades the material is able to replace other engineering plastics or metal alloys in a broad range of applications. Moreover, it is particularly well suited for processing in combination with special foaming technologies.

The total weight of the centre console could be reduced by almost 25%, from 12,208kg to 9,235kg. The main part of the centre console in the 730i was made

of ABS/PC; that in the 740i is constructed of ABS+leather, with trims and upper side covers made of ABS+PC.

The combination ABS+PC is widely used for trims, including those for the inner door panel, for covers and for the several storage boxes and compartments in both cars. However, there is a trend for trims and covers made of PA6-GF30 in the new model.

### Noise insulation with multi-layer sandwich structure

Another field that has the potential to achieve substantial weight savings is the noise insulation module. BMW changed from a RIM-PES-PUR fabrication to an innovative sandwich structure made of PP-GF30 REC100 PUR Vlies, which can save 14% in weight (from 31.226kg to 26.839kg). It is said that the lightweight system shows competitive or even better acoustics (see page 17). Some other parts of the insulation system are made of PP-E now, compared to PUR previously. The rear seat carpet insulation is made of EPDM+PUR in both models.

The single-section bezel in aluminium construction and weighing more than 2kg has blossomed into a triple-section component in PA. It has thus proved possible to save 2/3rds of the weight.

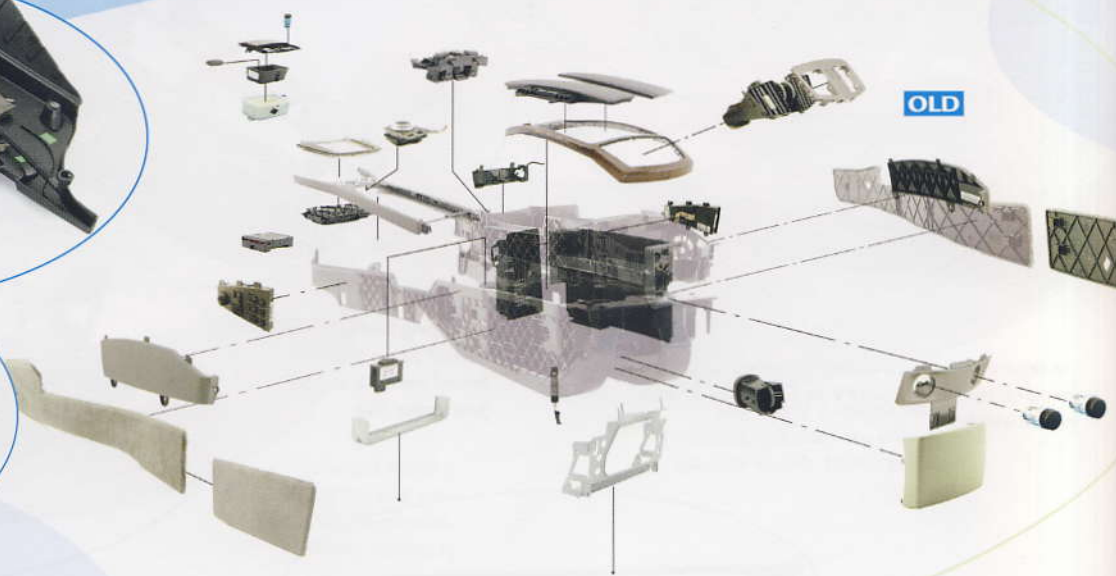
**NEW****OLD**

Whereas the engine style cover used to be nothing more than a painted plastic cap for the top section of the engine, in the new 7-series it has become a multi-function component. - along with an air filter and an impact absorber aimed at increasing pedestrian safety. At the same time the part has only become 200g heavier.

## Under the hood

The engine compartment is always a good candidate for the usage of new materials. If we open the hood and approach the motor, we encounter the engine compartment protection (also called access trap) which is still made of PP (TV20). The engine cover is located underneath in a high temperature environment where polyamides are predestined to be employed. Here, PA6-MX.GF30 is used for both models. The wind of change blows in the BMW 7 series (3.0 l 6-cylinder diesel engine), where a crash-active engine cover with an integrated air filter is employed. Its multi-stage energy absorption system for pedestrian protection is made primarily of PA (see page 15).

If we consider the engine itself, steel and alloy are predominant. Only a few parts, like sensors, filters and oil caps, covers and pulleys around the engine are made of PA or other high-temperature resistant materials. The surprise and real innovation is right inside: the pistons inside the 740i engine are made from phenolic compounds, which replace diecast aluminium. The material outperforms high-temperature engineering thermoplastics in chemical resistance, thermal stability and

**OLD**

creep resistance. Weight reductions can be achieved as the specific gravity is approximately 30% less than diecast aluminium. In the future such thermosetting plastics will be used increasingly in the transmission area and will substitute for metal parts used today.

## The air system

All-new is the air filter system supplied by Mann+Hummel Filter. The air filter housing has a completely novel design with a total weight of 1.753kg (1.244kg previously). The filter housing is made of PA6-GF30 and has replaced the previous PP-GF30. The air intake and air filter duct were also re-designed but remain in PP-T20.

The air temperatures inside the air ducting parts determine whether reinforced PP or the higher-temperature resistant PA is employed. If we look at the manifolds around the turbocharger (note: only the BMW 740i has a turbocharger), reinforced grades of PA are predominant: ducts, intercooler intake and repartition pipe (post-intercooler) are made from 15-30% reinforced PA; hotter parts like the duct connector (out of turbo) and the second turbocharger duct are made from TPC.

	BMW 730i	BMW 740i
Total weight (kg)	2.021	1.860
Maximum power (hp) / (kW)	258/190	326/240
Fuel consumption (l/100km)	10.1	9.9-10.0

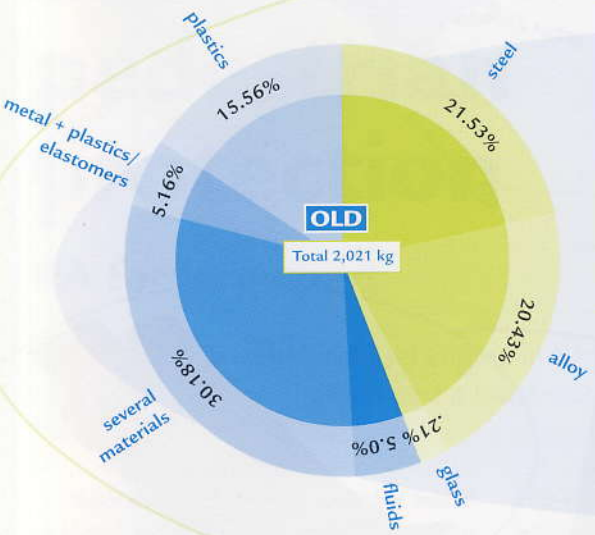
Comparison between BMW 730i and 740i

As regards the centre consoles, the weight has been successfully reduced from 12kg to just over 9kg without any impairment of functionality.



**NEW**

Plastics being used in the new BMW 7 Series are lighter, more advanced and deployed in some areas that are completely new. The usage of PUR, PA, ABS/PC and PBT has been reduced; PP, EPDM and ABS are still extensively employed in the vehicle.



**OLD**

Total 2,021 kg



**NEW**

Total 1,860kg



**NEW**



**OLD**

Matters are becoming weightier too: whereas the old filter housing in PP GF30 weighed 1.244kg, the new housing - now made from PA GF 30 - weighs 1.750 kg.

All in all the new BMW 7 weighs less than the old BMW 7. Both materials - steel and plastics - are being used less in the new BMW 7, with the proportion of light metal on the other hand increased.

## There are several other changes worth mentioning:

### Turning signal

A combination of PBT+ASA+20GF+ABS has replaced the previously-used PC+ABS+PMMA.

### License plate support

The part with one of the comparative highest weight reductions (more than half) hardly contributes to the overall weight savings. The license plate support is now made from PP EPDM 20TV and weighs only 0.175kg.

### Headlamp support

The headlamp support, previously made of PC, is now a compound of metal + PP-GF30.

### Pedals

BMW was always a forerunner when it came to pedals made of plastics. The old accelerator pedals weighed 0.518kg and the new ones weigh 0.330kg made of PP-GF50. The brake pedal remained a little bit above 0.5kg made by PA6.6-GF35.

The accelerator pedal has gone ahead and lost some weight. Formerly around 0.518kg, it is now down to 0.330kg



### Conclusion

The shares of PP (from 3.2-3.4%) and the well-established PA (from 2-1.7%) remain basically unchanged. Remarkable is the sharp drop of PUR from 2.3% to a low of 1.2%, due to dashboard and noise insulation, among others. The 25% more motorized BMW 740i could keep the same fuel consumption as its predecessor. BMW has, over a period of just three years, been engaged in exploring new ways to make its 7 series lighter and more fuel-efficient. At the same time, the company presents itself, once again, as a forerunner when it comes to the development and employment of new thermoplastic materials in its cars.

