



WE THINK THE WORLD OF PLASTICS

PRIMO 

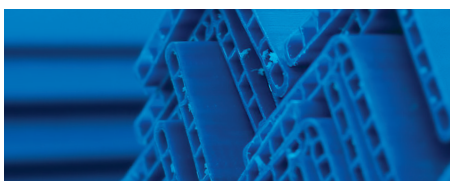
DESIGN & TOOLING

Comprehensive guide to extrusion
design and tooling





PASSIONATE ABOUT EXTRUSION



We are Primo, and we are passionate about what we do: Extrusion of plastic profiles for a broad array of applications. Our purpose is to design and extrude the profiles of tomorrow that will optimise performance and save resources. We will do our outmost to become your preferred partner in the development, production, and supply of extruded profiles – Primo is the place for you to go for any profile project, large or small.

The Primo organisation consists of several dedicated business areas, each with its area of expertise – medico, building, energy, transport and so forth. However, all business areas draw upon a shared base of experience, passion, and development common to the entire Primo organisation. Enthusiastic experts will always meet you with suggestions for new profiles – experts with know-how covering everything from materials science, extrusion, logistics and broad market knowledge. And quite uniquely, we have all development functions inhouse, including a dedicated test center.

It all starts with your ideas and we are inviting you to innovate together with us. Together we consider the requirements for development of profiles such as ease of use, agility in the production process, costs, sustainability, durability and many other important factors, including compliance with standards and legal requirements.

An extruded plastic profile can be made in almost any design you can imagine. In the design phase, the design options must be aligned with the properties you are aiming for. To ensure an efficient process, we will use our project management platform including check-points and tests, together with CAD computing, detailed drawings, and 3D prints.

This is how we best can assist you and contribute with the latest in materials science, production technology, market knowledge and engineering expertise. We are here to create solutions that are commercially sound, technologically brilliant, and exceptionally suited to your needs. Whether we produce specialised profiles or standardised ones, one thing remains at the very heart of what we do: To create value for you, all the way from initial ideas to delivery.

Welcome to Primo.

Søren Zylauv
Group Director, Primo Tools



GET A HEAD START WITH YOUR NEXT PROFILE PROJECT

GET A HEAD START IN YOUR NEXT PRODUCT DEVELOPMENT PROJECT BY INVOLVING YOUR PROFILE SUPPLIER AT THE EARLIEST STAGES. HERE WE WILL SHOW YOU HOW EXCEPTIONAL KNOWLEDGE ABOUT TOOLING, PROFILE DESIGN, MATERIAL AND – NOT THE LEAST – PRODUCT DEVELOPMENT PROCESS CAN IMPROVE YOUR PRODUCTS AND TIME TO MARKET.

All disciplines in the plastic profile development process are held within Primo. The process from idea to production has never been shorter, and at Primo, you will engage in a different journey where our experienced and dedicated teams will secure the physical, mechanical, thermal, electrical and optical properties of your new profile.

At Primo, we have a unique setup, unseen in the industry, which speeds up time-to-market and secures better, greener, and smarter profiles for you as a customer. Instead of relying on external specialist and workshops, we have all functions in-house.

Our inhouse R&D-center, our plastic profile design centre and the in-house tool shop, plus a dedicated test center, gives you an entirely new approach to profile design and improvement. To this comes our material lab, continually working to improve existing materials and develop new, stronger, and more sustainable materials for future products.

As a new customer, these incorporated and specialised teams are at your service.

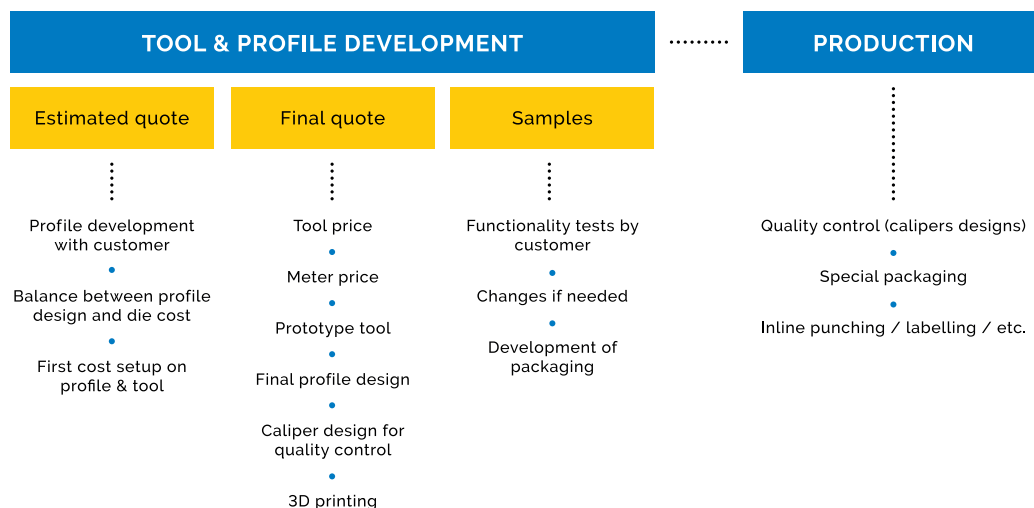
Initially, our committed staff will give you a general idea of what is possible to produce and at what cost. This is typically done in a brainstorm session where we address common challenges and often overlooked details. Often this is accompanied by visits to your production facilities by our experts and salespeople.

Brainstorming for a smarter product

For instance, what are the requirements for the visible sides of the profile? Could we lower the cost by extruding a lower quality material for nonvisible parts of the profile? What specifications are we aiming for in terms of chemical resistance, colour durability regarding UV-light, heat resistance and physical stress?

This is important issues to address to align your demands with the actual extrusion possibilities. And, equally important: How your product can be improved according to the newest procedures and materials.

Even if you have an exact 3D-drawing and complete specifications of your profile, we reserve the right to challenge your product. Simply to ensure the best possible solution for you.





THE RIGHT PROFILE AT THE RIGHT COST

IN OUR EXPERIENCE, NEARLY ALL CUSTOMER PROJECTS CAN BE IMPROVED ONE WAY OR ANOTHER. WE DO SO BY RIGOROUSLY GOING THROUGH CHECKLISTS REGARDING ESSENTIAL FACTORS SUCH AS TEMPERATURE TOLERANCES, MATERIAL SPECIFICATIONS, CHEMICAL RESISTANCE, PHYSICAL STRENGTH, COLOUR FASTNESS AND DURABILITY OVER TIME.

These first meetings result in estimated quotes. We understand that price is an important factor when designing new products, and we consider this from the very beginning, for instance, by balancing the profile design with the cost of producing the tool.

When your product is ready for production at a plant near you, the process is not over. To secure products that fit into your assembly lines, we study how your set-up works. On that basis, we suggest unique cuts, drilling of holes, special packaging or labelling and even ongoing documentation of narrow tolerances, if relevant.

This thorough process secures that we:

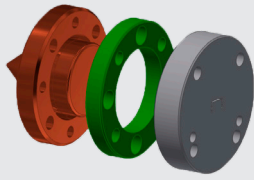
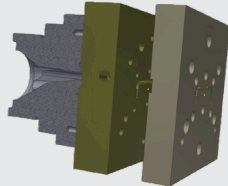
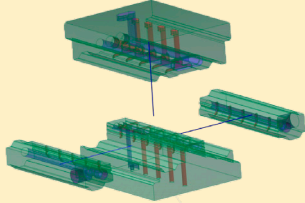
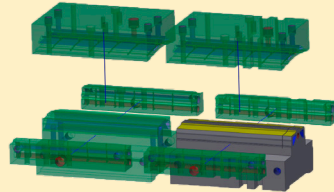
- Do things right the first time.
- Save costs for the customer by making the profile lighter by reducing material and achieve higher extrusion speeds.
- Achieve the optimal tolerances on the profile to reduce cost.
- Build a strong relationship with our existing customers and that we are attractive partners for new customers.
- Design profiles perfectly fit for further assembly when the customer takes the next step in processing the end-product.
- Consider the environment by reducing scrap and choose the most sustainable materials.



The value of brainstorming and our understanding of the end-product should not be underestimated.

Thomas Werkhoven
Tool design manager at Primo

The extrusion tool consists of a die and a calibrator. In the process, the plastic is melted and extruded through a die into a profile of the desired shape. Then, the shaped plastic is drawn through a calibrator where it reaches its final form assisted by vacuum and cooling.

TYPE OF TOOL	PROTO TOOL	VOLUME TOOL
DIE		
CALIBRATION Actual sizes: Proto: 10 x 5 cm Volume: 2x15 cm x 10 cm		
Tool parts and their functions	Profile specific flat head die . Plastic is pressed through the die. A spike torpedo is usually a standard component that improves the flow.	The die has between one and five conically machined die blades. They direct the melted mass into each cavity of the die.
Calibration	Calibration of proto tool consist of 1-2 calibration blocks located after the die where the profile is cooled and calibrated to the correct dimensional accuracy.	Calibration of the volume tool consists of 2-4 parts performing the cooling by using vacuum and water. Complex profiles require additional water and vacuum tank.
Suitable profiles	Simple, open profiles.	Complex profiles with cavities or varying wall thicknesses.
Cost of the tool*	2,000 - 10,000 €	> 10,000 €
Manufacturing batch	Short production runs and proto testing.	Volume production and long runs.
Quality	Adequate for simple end products.	Small tolerances, good surface quality and consistence of quality.
Performance	Higher consumption of the raw material and low production speed of the profile.	Quick start up of production, little waste and high production speed of the profile.

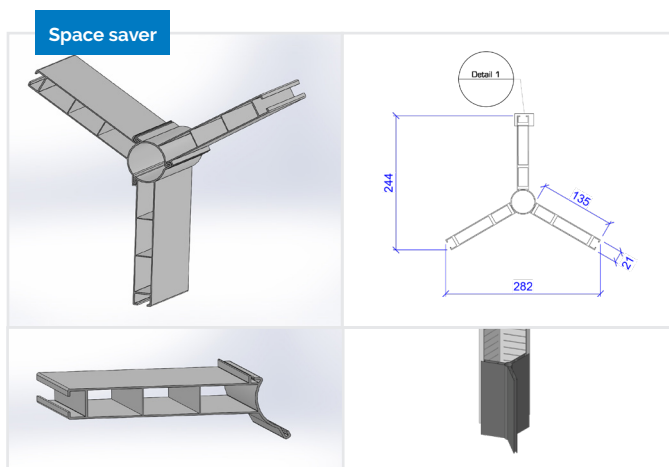
*The total cost of the tool is based on the design, materials used for the tool, wire cutting, milling and electrical discharge machining of the tool parts and test runs. The cost of the tool is always fixed on a case-by-case basis.

Lighter and stronger plastic profiles

REDESIGN FOR SAVING SPACE AND TOOL COST

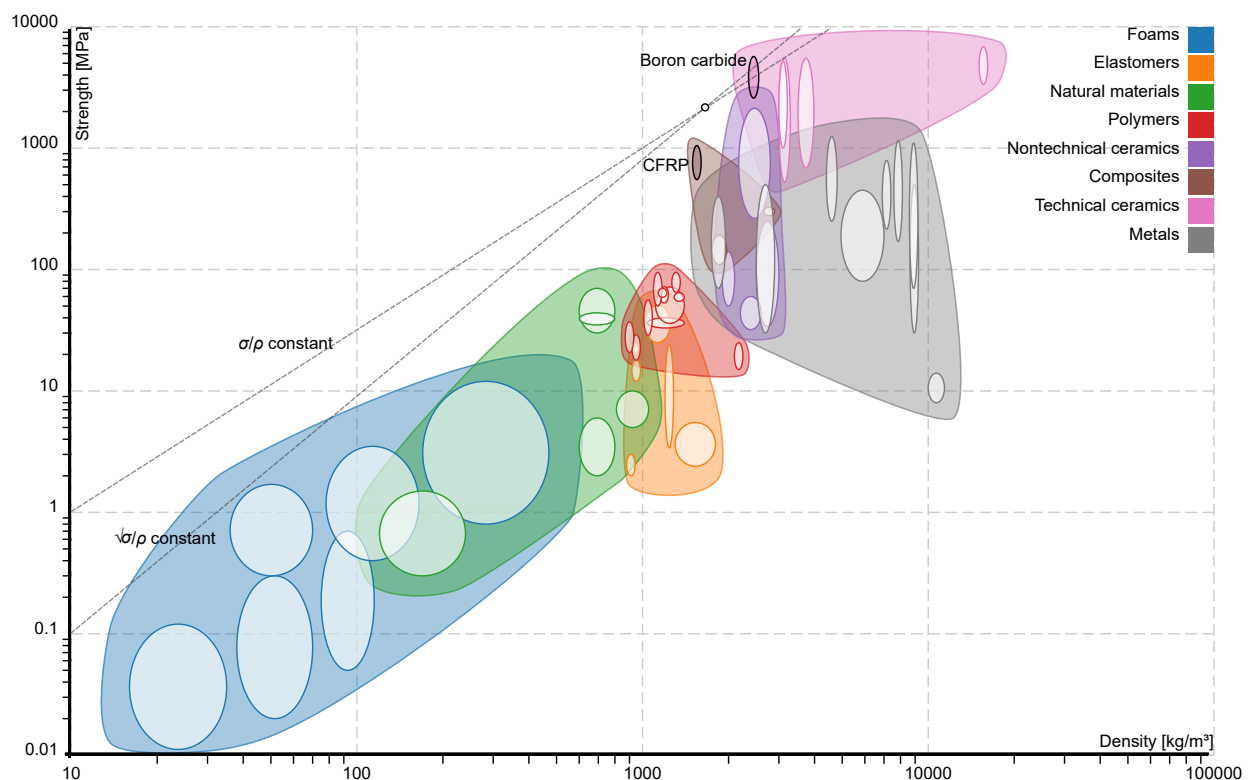
Profile cost is directly connected to the initial expenses on building the tool and the amount of raw material used for production. Furthermore, lighter profiles reduce the CO₂-footprint during transportation and ease manual assembly. Within the tolerances of strength, we always aim at reducing the weight and thereby the

volume of material used for production. There are several ways to achieve lighter profiles while maintaining structural strength. For instance, we always consider ways to design hollow profiles or multiple profiles connected in a space-saving way a single extruded profile would not be able to.



STRENGTH-TO-WEIGHT RATIO

Developments in polymer science have made thermoplastic and polymer composites more usable alternatives to metal. Now plastic in many cases even outperforms metal in ratios such as strength-to-weight and strength-to-stiffness.





Co-extrusions and clickable profiles

BUILDING COMPLEX PROFILES WITH MOUNTING CAPABILITIES

At Primo, we are experts in co- and even triple extrusion. This comes in handy when more material features are desirable in the same profile. For instance, a profile for window sealing might need a soft layer on one side, accompanied by a stiffer part for assembly to another surface. But co-extrusion has its limits, and that is why mounting is such an important technique. With clickable features, two or more profiles can be combined easily. This is used when co-extrusion is too slow, complicated or physical impossible. The procedure is also handy when dealing with large plastic profiles that would otherwise require a large and expensive extrusion tool. With the mounting-technology, we break the complex profiles into more manageable parts.

Other benefits from this can be that more complicated work can be performed on the profile after extrusion,

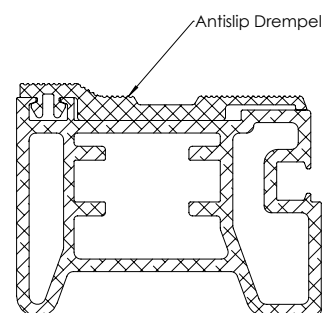
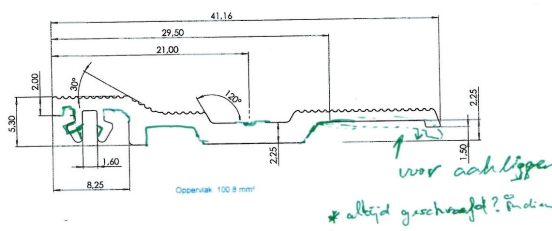
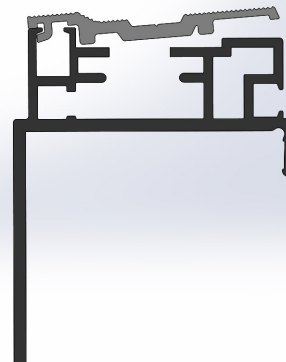
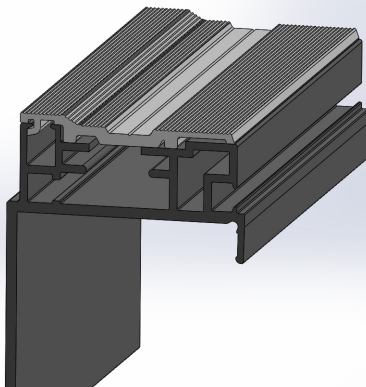
but before the parts are mounted together. Examples of these could be quality checks, drilling holes, surface work or even assembly of one part of the profile at the place of use before the other part is mounted.

This is what profile extrusion can do – produce customized profiles in any size and any dimension, customised for a specific end product in a specialised area.

Advantages of mountable profiles:

- Reduces the cost of complex tools in the extrusion process
- Easy assembly at any location
- Expands the possibilities of after-extrusion processing

Assembly mounting solution



Opening the toolbox

REDESIGN TO MAXIMISE FUNCTIONALITY

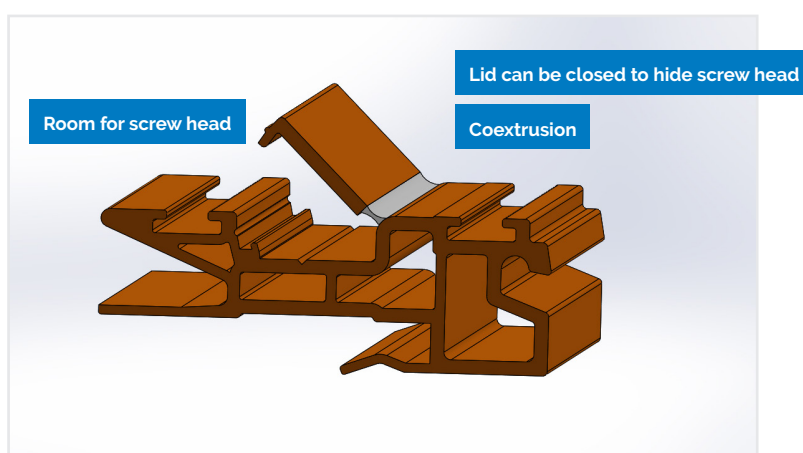
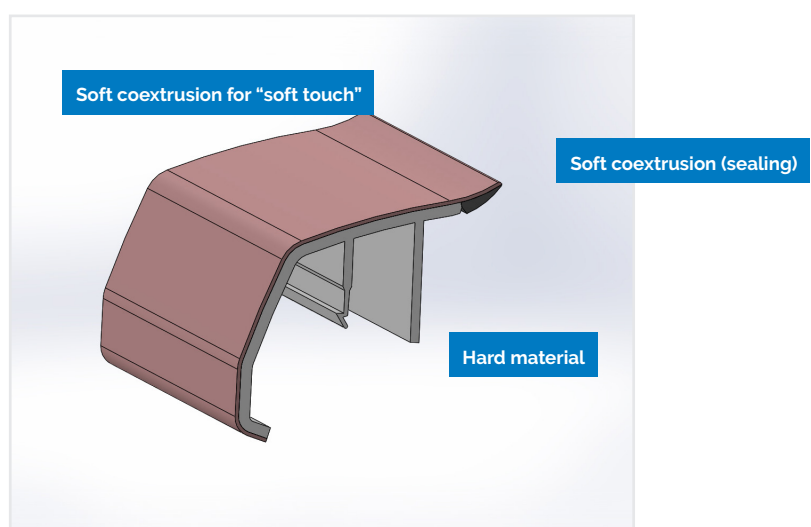
Usually, the profiles shipped from Primos' plants are integrated into more complex products. This can be buildings, machinery, technical appliances, boats, medical devices and much more.

By understanding the exact context which our profiles are part of we can begin to suggest new features that will:

- Maximise functionality
- Reduce the need for other parts
- Ease assembly time and manufacturing complexity at your end
- Lower the total cost of product fabrication

In general, we pay attention to details. Our high-end extruders can handle tiny tolerances, which allows for details that will stand out from the competition.

For instance, flexible profiles are popular for a range of purposes; at Primo, we have the experience and tools to describe and document exactly how much a profile can bend – and how often – and still maintain its function over time.



Reducing common risks

EXTRUDING FOR DURABILITY

Durability is a central concern at all parts of profile product design. Plastic is a diverse group of materials with abilities ranging from short-lived biodegradable compounds to fortified structural elements, competing with construction metal. Therefore, we have a range of options when optimising durability. In our terminology, durability is not only about strength. We are also considering factors such as colour resilience, surface, and resistance to heat and even fire.

Durability-issues are often handled by following best practices in the extrusion industry. For instance, plastic profiles should always be extruded with regular wall thickness to avoid shrinking that might deform the entire profile. The issue arises when uneven parts of the profile are cooled down. The cooling will happen at different rates, and the result might be structural damage or visible inconveniences.

This is a typical error seen in low quality extruded profiles. The problem may not be visible right away but will follow the profile during its lifetime and expose the end-product to structural instability.

Similarly, we do our utmost to limit the details in hollow profiles. Since thermoplastic extrusion is a continuous

process, the hollow section's internal definition is difficult to achieve as there is no way to access the hollow area and secure the inner sections' right tolerances.

Therefore, other general rules are also to avoid hollows in hollows and secure adequate access to internal details.

When we understand where and how the profiles are used, we can reduce the number of common risks. For instance, some plastic types do not go well together. Rigid polymers such as polycarbonate, ABS, polystyrene, and acrylic, which is in contact with soft or flexible PVC, will risk degradation due to stress cracking because the plasticiser can migrate from PVC to rigid polymers.

Make sure your extrusion partner follows best practices, such as:

- Avoid hollows in hollows
- Secure access to the interior of profiles
- Use the optimal raw material for the profile
- Use similar wall thickness on non-hollow profiles
- Reduce inner walls in hollow chambers.
- Consults the material properties databases



Designing surfaces

APPLYING SKINS AND COATINGS

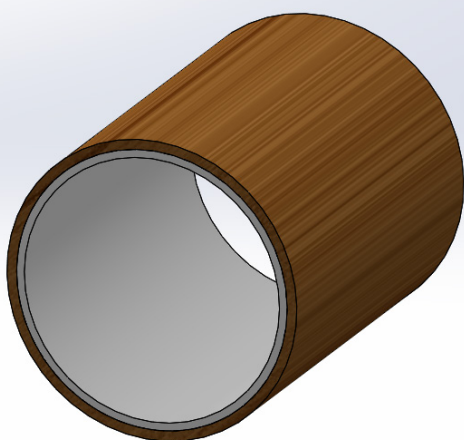
Apart from achieving dual hardness properties by co-extrusion, the same process can be used for applying a suitable finish layer on the profiles. "Wood layers" are among the popular choices. The layer does not just look like wood but can be made with actual wood fibres for an authentic look and feel.

Skins and coatings are used to:

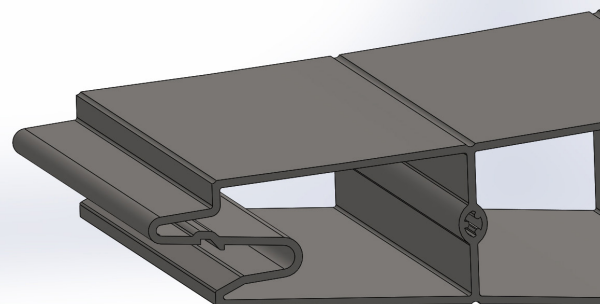
- Reduce overall cost
- Add colour
- Add effects such as wood grain or a glossier finish
- Increase UV resistance

A range of options is at your disposal for skins and layers. A primary benefit is that the surface material can be different from the rest of the profile. For instance, the inner, not visible parts can be extruded from cheap regrinded material with optimal strength, while the more expensive coating material is applied only where visible or exposed to UV-light.

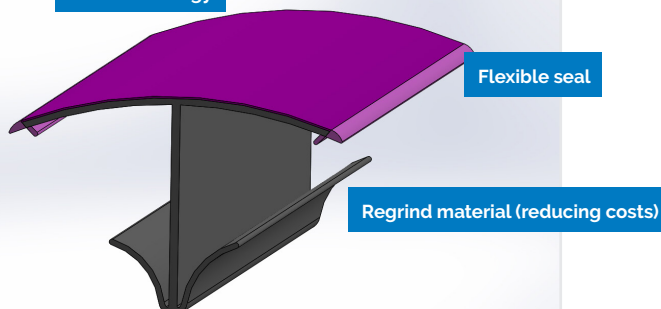
Coextrusion "wood" layer



Avoid witness lines or add contra effect



Skin technology



Consider the environment

DESIGNING SUSTAINABLE PROFILES

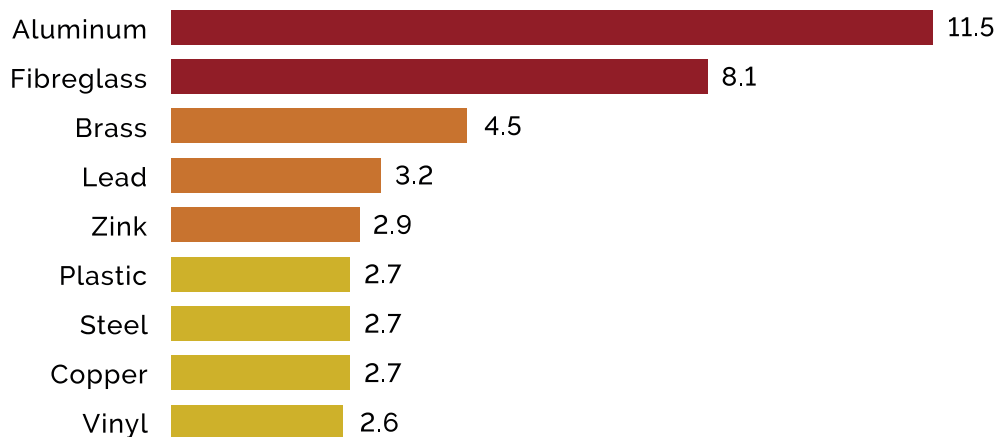
Thanks to developments in sustainable materials, we have never before had so many options for designing sustainable plastic profiles. We have years of experience in sustainable production and manufacturing of profiles based on biodegradable and toxic-free raw materials. For instance, we have in-depth knowledge about TPE and PLA as alternatives to plasticisers that might be problematic in specific industries and appliances.

At Primo, sustainability is taken into consideration at all stages of the process:

- Low weight profiles for reduced CO₂-emissions at transport
- Regrinding of scrap – all scrap at Primo is re-used
- Circular models available for scrap produced at our customers
- Environmentally friendly raw materials
- Biodegradable materials for disposable products with a short lifespan

Shifting from aluminum to plastic can significantly reduce total CO₂ emissions

The amount of CO₂ emission per kilogram material produced



Source: Inventory of Carbon & Energy (ICE) database,
Download: <http://www.circularecology.com/ice-databse.html>

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PRIMO GROUP

PRIMO DESIGNS AND MANUFACTURES TOMORROW'S PROFILES TO OPTIMISE PERFORMANCE AND SAVE RESOURCES.

Primo is an international extrusion specialist, supplying a multitude of industries with tailored polymer profile solutions, such as: Building, HVAC, Energy, Lighting, Offshore, Medico, Electronics, Transport and many more. Quality, customer satisfaction, environmental matters and safety are of paramount importance to our operations.

Driven by our care for a better tomorrow and based on our extensive experience, know-how and proven process, we continuously seek to design and extrude the profiles of tomorrow that will optimise performance and save resources. Thanks to the private ownership of Primo, we have the agility, ability, and willingness to invest in the future. We treat our customers as long-term partners and steadily work to improve our footprint.

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