WE THINK THE WORLD OF PLASTICS

PRIMO

# DESIGN GUIDE FOR INNOVATIVE PLASTIC PROFILES IN LINEAR LIGHTING

# LET'S INNOVATE TOGETHER

IN PARTNERSHIP WITH OUR CUSTOMERS IN THE LIGHTING INDUSTRY, WE CREATE LIGHTING FIXTURE SOLUTIONS DESIGNED TO MAXIMIZE PERFORMANCE AND SAVE RESOURCES.

At Primo, we support the development and manufacturing of new innovative linear lighting products. In close cooperation with our customers, we always aim to find the optimum solution; together, we are often able to improve the result. This is only possible because we know our business – extrusion of plastic profiles – and yours as well, with 60 years' experience in the lighting industry.

**It all starts with an idea**
Everything is based on our customers' ideas or on the need to introduce a new linear lighting solution to the market, and in this phase we truly innovate together. This is where we put the idea or concept to the test regarding requirements, ease of use, agility in the production process, costs, sustainability, durability and many other important factors, including compliance with standards and legal requirements. Together with a team of specialists you will end up with an idea that will make a difference.

**The right material**
With the right choice of material, you can optimise product features such as product lifetime, optical and thermal properties, stability, temperature as well as UV resistance. Plastics are non-corrosive and resistant to weather conditions, acids, lye, solvents and oil. Furthermore, product properties can be improved by mixing different types of materials or adjusted with colours and additives according to your needs. And always with respect to flexibility, sustainability and recyclability.

Our team of specialists continuously follows the development of plastics closely and will guide you to the best possible choice of material. Primo is also taking a leading role in improving and developing sustainable materials and manufacturing processes.

**Endless design options**
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 checkpoints and tests, together with CAD computing, detailed drawings and 3D prints.

**Fast time to market**
Primo's project management and in-house tooling facilities are your guarantee for a smooth time-to-market process. This include high flexibility and fast response times whenever refining or alteration work is required.

**International partner and supplier**
Primo was founded in Denmark in 1959; today, the Primo Group operates in nine countries in Northern and Eastern Europe and in China. You'll get an international partner with local support and business insight.

We hope that this guide will support and guide you in designing linear lenses, diffusers and lighting covers.

Let's innovate together!

**-Kristoffer Buhl Larsen**
Group Sales Development Director

# SIX REASONS FOR CUSTOMER-TAILORED PLASTIC PROFILES IN LINEAR LUMINAIRES

THE STANDARD PROFILE ISN'T ALWAYS THE MOST SUITABLE, CHEAPEST OR TECHNICALLY BEST SOLUTION. HERE'S WHY A CUSTOM-BUILD PROFILE IS THE RIGHT CHOICE.

**1. A perfect match for the job**
Luminaire consists of many components: the light source, electronics, body, diffuser, protective cover and nowadays increasingly an optical lens. Combining many different components can be challenging because every single part may impose restrictions on the rest of the luminaire's design.

The most significant advantage of a customer-tailored profile is that it fits your product perfectly. The profiles are designed and manufactured according to the DFA process to ensure that installing at the assembly stage is as smooth and straightforward as possible.

**2. Cost-effectiveness**
The total cost of a luminaire may depend on the number of assembled components. A general principle applies: fewer components equals lower cost of production.

The plastic profiles used in linear lighting fixtures are manufactured by the extrusion method. With extrusion it is possible to manufacture a profile that has one or more functions. For example, as a part of a single manufacturing process, it is possible to extrude a sealing and a surface pattern that changes the light's optical properties. This way, two separate and cost-increasing working stages or components can be combined.

**3. A wider range of colours**
The profiles can be in opaque, satin or transparent finish and any possible colour.

When designing with Primo, the plastic profiles for a luminaire, can be adjusted so the light reach just the right luminosity, colour, tone and refraction qualities. Our customer-focused development approach guarantees the best possible performance for the lighting fixture.

**4. Tailored product characteristics**
The luminaire has to fulfil the technical and quality requirements of the intended operating environment - cost-effectively. These include, for example, sufficient fire and impact resistance or good chemical resistance.

The raw materials PC (Polycarbonate) and PMMA (acrylic) have many variances that can be adjusted to improve specific qualities. Due to our long experience in the business, we can recommend and select the best raw materials for your intended operating environment of the luminaire.

We bring our know-how of the overall design to our customers' use.

**5. Flexible delivery**
The profiles are delivered cut to a fixed size, and the consignments can be divided into different lengths according to the customer's needs. Besides, lot sizes and packaging methods are always agreed upon with the customer.

Primo's designated account manager reacts without delay to our customers' needs and situational changes. We are flexible due to our firm commitment to customer-focused service and localness. We have operating units in eight countries and fourteen different localities.

**6. Product protection**
Thanks to the customer-tailored product profile, the risk of having the product copied decreases because the components are specifically made for you. Tailored solutions make it possible to apply for a design patent.

# LIGHTING PROFILES
# - SPECIAL APPLICATIONS

## LINEAR LENSES

**The product:**
Lens profiles for linear LED lighting fixtures.

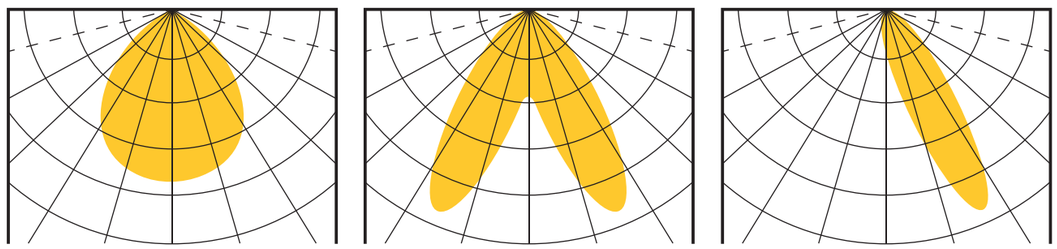
**Special characteristics:**
The geometric shape of the lens refracts light into the desired direction while simultaneously dispersing light without colour defects.

**Intended use:**
Indoor lighting of public and business premises, offices and industrial premises.

**Raw material:**
Transparent or diffusing PMMA that enables a high operating efficiency of the luminaire.

**Benefits:**
By using linear lenses it is possible to adjust the produced light pattern according to the intended use of the luminaire.

**Below are some examples of different light patterns projections.**



# LIGHTING PROFILES
# - SPECIAL APPLICATIONS

## 2-COMPONENT PROFILES

**The product:**
A 2-component profile with a soft lip seal extruded to the diffuser made out of PMMA in the manufacturing process.

**Special Characteristics:**
The sealing prevents the access of water and dust into the luminaire. Better sealing enables a higher IP rating for the end product.

**Intended use:**
The Maritime industry and wet spaces.

**Raw material:**
The diffuser is made out of PMMA and the soft lip seal of TPE. Both raw materials are halogen-free and thus comply with the maritime industry requirements.

**Benefits:**
The profile, together with the lip seal is immediately ready for installation. It saves the working stage required for sealing when assembling the luminaire.

# LIGHTING PROFILES - SPECIAL APPLICATIONS

## MICROPRISMATIC PROFILES

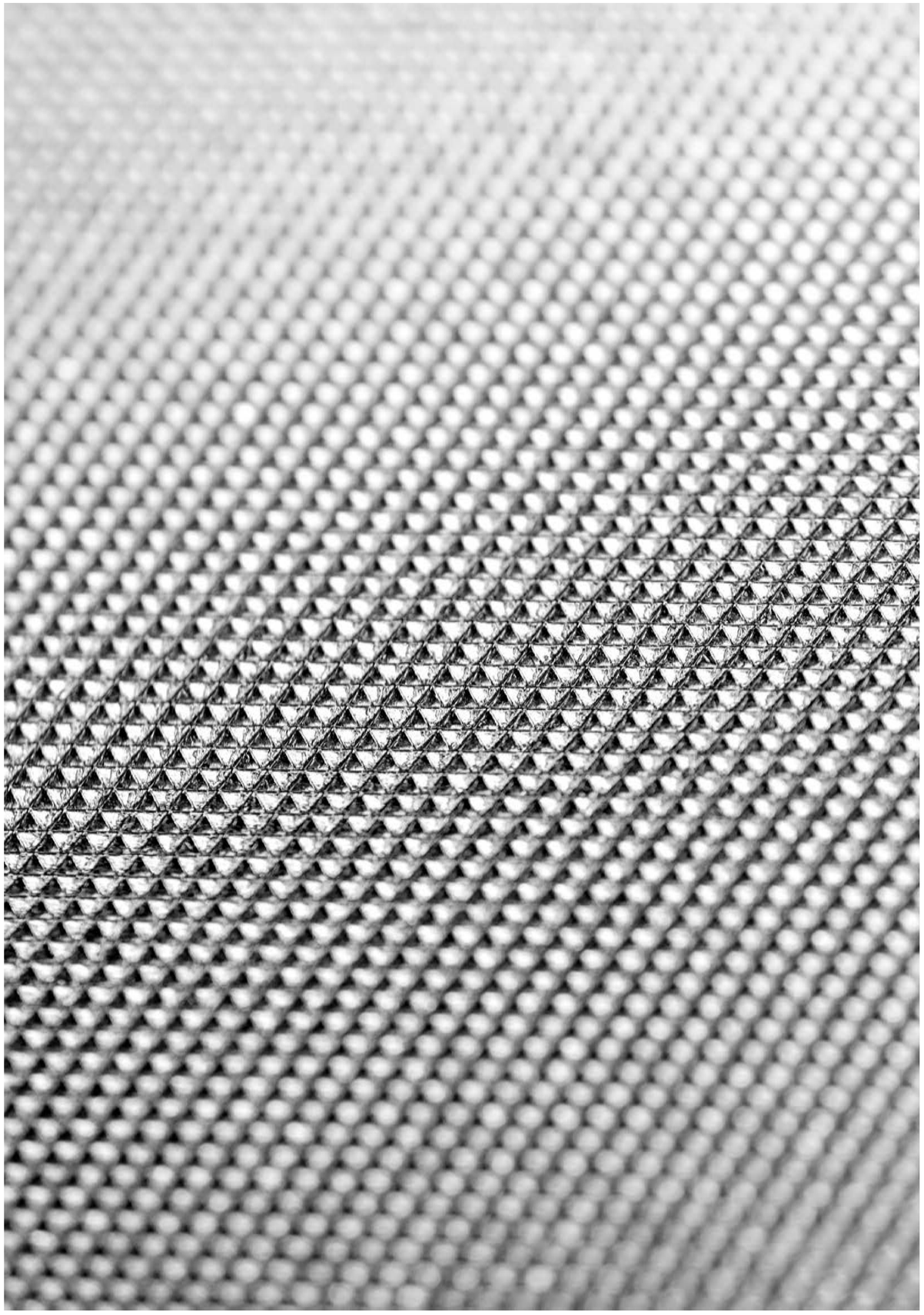
**The product:**
Microprism patterned profile. Pyramid or diamond-shaped patterns of typically the size of a few millimetres are embossed on the profile.

**Special characteristics:**
The microprism method disperses and spreads the light rays and makes the light comfortable on the eye. The light does not glare the eyes but still maintains high performance.

**Intended use:**
For premises requiring efficient lighting and good working conditions. For example, indoor lighting of public premises, offices and industrial premises.

**Raw material:**
PMMA.

**Benefits:**
Higher operating efficiency of the lighting fixture.



# LIGHTING PROFILES
# - SPECIAL APPLICATIONS

## PROFILES FOR DEMANDING OPERATING CONDITIONS

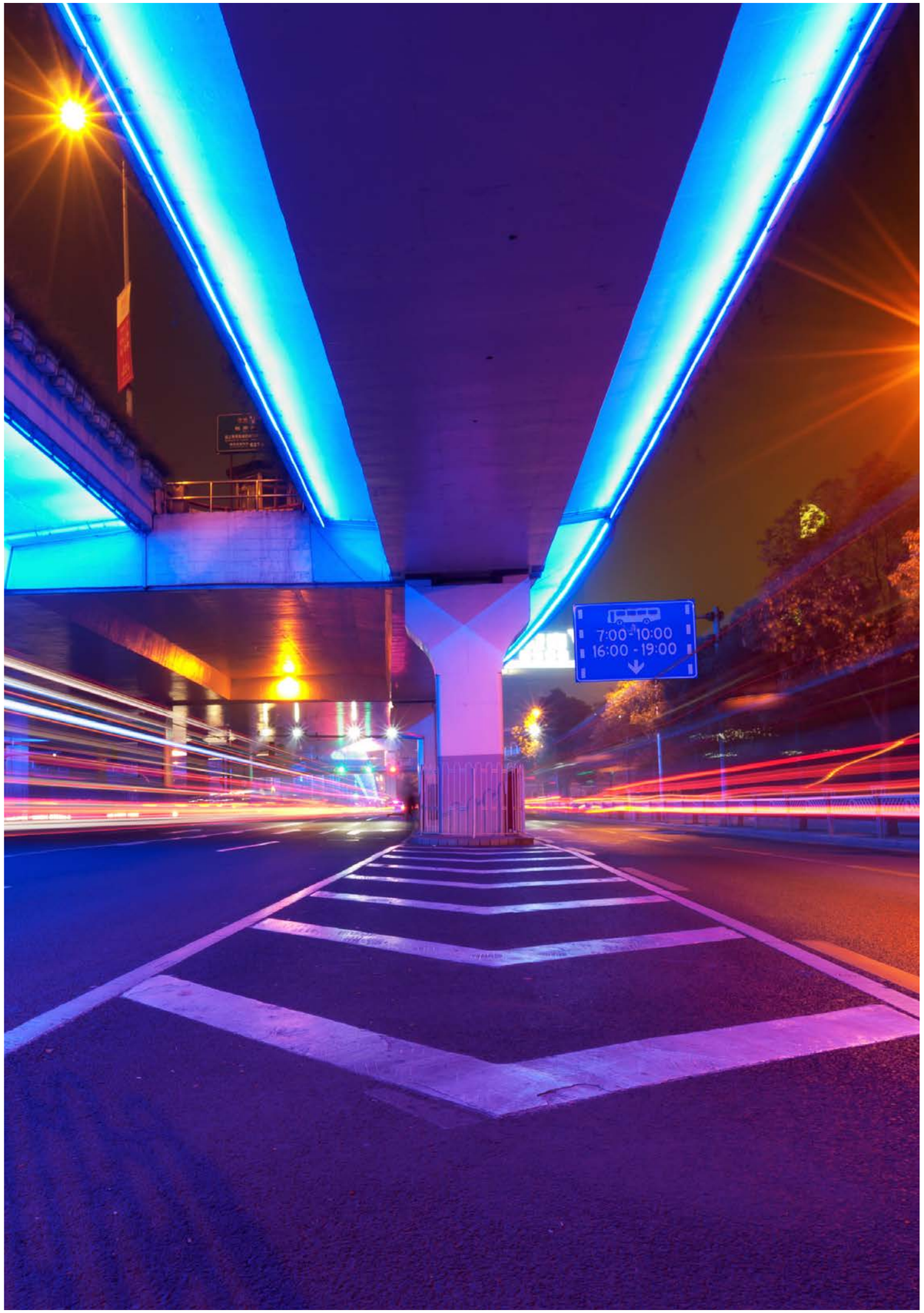
**The product:**
Diffusers and lighting covers meant for outdoor use and demanding operating conditions.

**Special characteristics:**
The profiles endure ultra-violet radiation, different temperatures and mechanical stress caused by the environment.

**Intended use:**
Building fronts and architectural lightings such as bridge hand railings, tunnels and advertisement illumination.

**Raw material:**
PMMA or UV-stabilised Polycarbonate according to the intended operating environment.

**Benefits:**
The luminaire's long operating life in demanding operating conditions.



# THE EXTRUSION PROCESS

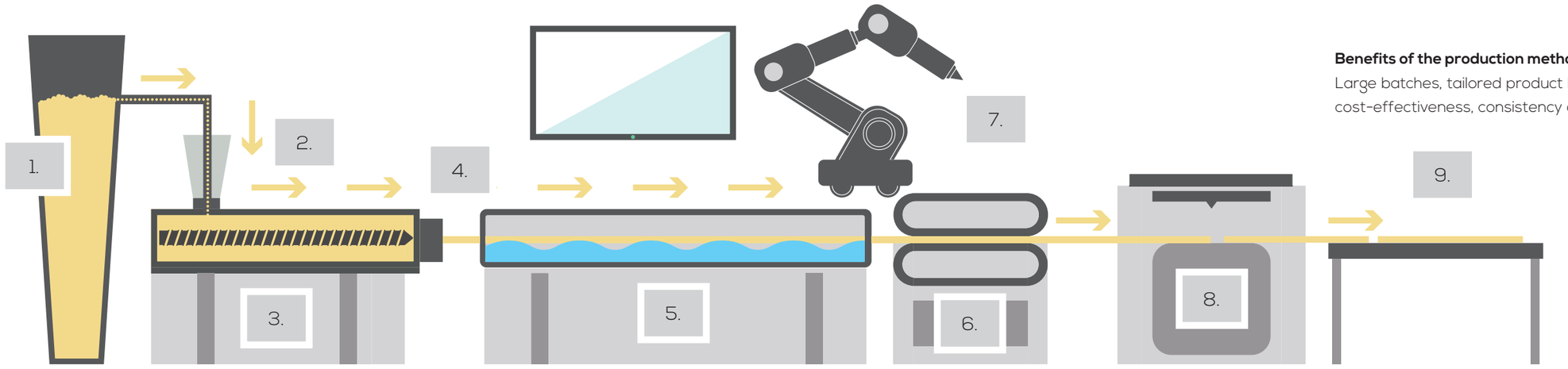
IN EXTRUSION, THE PLASTIC IS MELTED AND EXTRUDED THROUGH THE DIE INTO A PROFILE OF THE DESIRED FORM. PROFILES CAN BE DELIVERED TO THE CUSTOMER READY-MACHINED IF NECESSARY.

## 1. STORAGE AND DRYING

*The raw materials are stored in silos and flexible intermediate bulk containers (1t). Before the process, the raw material is dried according to the raw material manufacturer's instructions.*

## 2. DOSING

*The raw material is dosed into the extruder using a gravimetric scale. Masterbatches (colouring agents or other additives) can be added to the raw material to improve different qualities.*




**Benefits of the production method:**
Large batches, tailored product lengths, cost-effectiveness, consistency of quality.

## 3. EXTRUDER

*The cylinder's zone-based electric heaters and screw melts the plastic raw material into a 110-260-degree homogenous mass. A specially designed screw pushes the solid mass towards the die with steady pressure.*

## 4. DIE

*The pressure pushes the hot mass through the die that gives it its form. The width of the profile can be up to 25 cm and height up to 15 cm.*

## 5. CALIBRATION AND COOLING

*The calibrator cools the profile and shapes the final form by using vacuum and water or air. High-quality calibration and cooling ensure surface appearance, dimensional accuracy and the desired form.*

## 6. HAUL-OFF UNIT

*Two opposite belts that rotate in uniform speed keep the process going.*

## 7. INLINE MACHINING (OPTION)

*The profile can be milled, drilled, punched and stamped and seals or adhesive tapes can be added if necessary. This makes the customer's work easier at the assembly stage.*

## 8. CUTTING

*The profile is cut in the desired length already inline (min 0.02 m, max 16 m). The cutting method is selected according to the profile's shape and raw material. The methods include rotary saw, guillotine, and hot knife.*

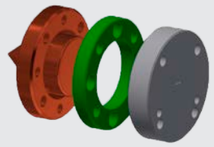
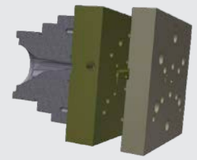
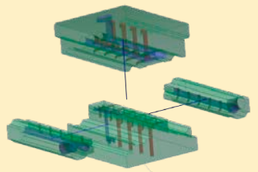
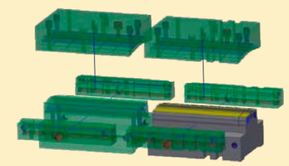
## 9. PACKAGING

*The packaging method is individually designed for each profile type. The profiles are typically packed in cardboard boxes or wooden crates to ensure sufficient protection and easy unloading.*

# CHOOSING THE RIGHT TOOL TYPE

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

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**<br>**Actual sizes:**<br>Proto: 10 x 5 cm<br>Volume:<br>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 variating 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.

# WHY IS PLASTIC A SUPERIOR MATERIAL FOR LUMINAIRE?

PLASTIC IS A VERSATILE RAW MATERIAL, AND THE PLASTICITY ENSURES ENDLESS POSSIBILITIES IN PRODUCT DESIGN.

**Plastics used in lighting profiles**

- The two most commonly used plastic types in lighting profiles are Polycarbonate (PC) and Polymethylmethacrylate, also known as acrylic (PMMA).
- Polycarbonate is a sturdy type of plastic that endures demanding mechanical stress. It also endures higher temperatures than PMMA.
- The optical qualities of PMMA are the best of any plastic types. PMMA transmits light better than glass, even up to 92%. PMMA is a surface-hard plastic type naturally resistant to ultra-violet radiation.

**Benefits**

- Easy to mold and customize
- It is possible to combine two or more types of raw materials in the same product
- For demanding operating conditions, it is possible to improve the plastics' mechanical material properties with additives
- Plastic is a lightweight raw material
- Plastic is easy to process and processing can be automated as part of the manufacturing process

**Mechanical material properties**

- Transparency or correspondingly throughout colored
- Chemical resistance
- Rigid and strong in proportion to its weight
- Electrical and thermal insulating

**Durable and environmentally friendly**

- Manufacturing plastic profiles is energy efficient because plastic profiles consume up to 2-3 times less energy compared to extruding aluminium profiles
- Plastic is a lightweight material, which enables lower weight for the end product
- Thermoplastics can be recycled and reused

Primo is committed to operating according to the principles of sustainable development. We aim to minimise the use of raw materials and resources that are environmentally damaging by means of product design, optimising the production processes and reusing waste materials.

# PRIMO GROUP

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

The Primo Group is a leading, international plastic extrusion technology expert. We develop and produce tailored and competitive solutions, know-how, products and services for the industrial sectors of construction, offshore, medical and many more. Quality, customer satisfaction, environmental matters and safety are of paramount importance to our operations. All of Primo's operating units are certified and comply with the following management system standards, among others: **OHSAS 18001:2007 | ISO 14001:2015 | ISO 9001:2015**


Subsidiaries:

**CHINA**
PROFILEX Plastic Technology
(Zhuhai FTZ) Co. Ltd.
No. 41, Hongwan Free Trade Zone
Zhuhai, Guangdong, CHN 519030
sales@profilex.cn
www.profilex.cn

**DENMARK**
PRIMO DANMARK A/S
Jernbanegade 11
DK-6862 Tistrup
primo@primo.dk

**FINLAND**
OY PRIMO FINLAND AB
PB 283
FI-65370 Vaasa
primo.finland@primo.fi
*Heinola/Vaasa*

**GERMANY**
PRIMO PROFILE GmbH
Otto-Porath-Platz 1
D-15831 Groß Kienitz
info@primo-profile.de
*Berlin/Hamburg/Papenburg*

**NETHERLANDS**
Essentra Extrusion B.V.
Beatrixstraat 7
NL-9285 TV Buitenpost
info@essentraextrusion.com

**NORWAY**
PRIMO NORGE AS
P.O.Box 2096
N-3255 Larvik
post@primo.no

**POLAND**
PRIMO PROFILE sp.z.o.o.
Ul. Chemiczna 2
PL 44-240 Żory
primoprofile@primo.com

**RUSSIA**
LLC PRIMO
Leningrad area
Vsevolozhsky pr. 113
RU-188640 Russia
info@primo.ru

**SWEDEN**
PRIMO SVERIGE AB
Box 4073
SE-514 12 Limmared
info@primo.se
*Dalstorp/Limmared*

Joint venture:

**POLAND**
SPYRA PRIMO Poland
Sp. z o.o. Ul. Darwina 8
PL 43-190 Mikołów
biuro@spyraprimo.pl
www.spyraprimo.pl

Mother company:

**INTER PRIMO A/S**
Højbro Plads 6
DK-1200 København K
Denmark

**www.primo.com**