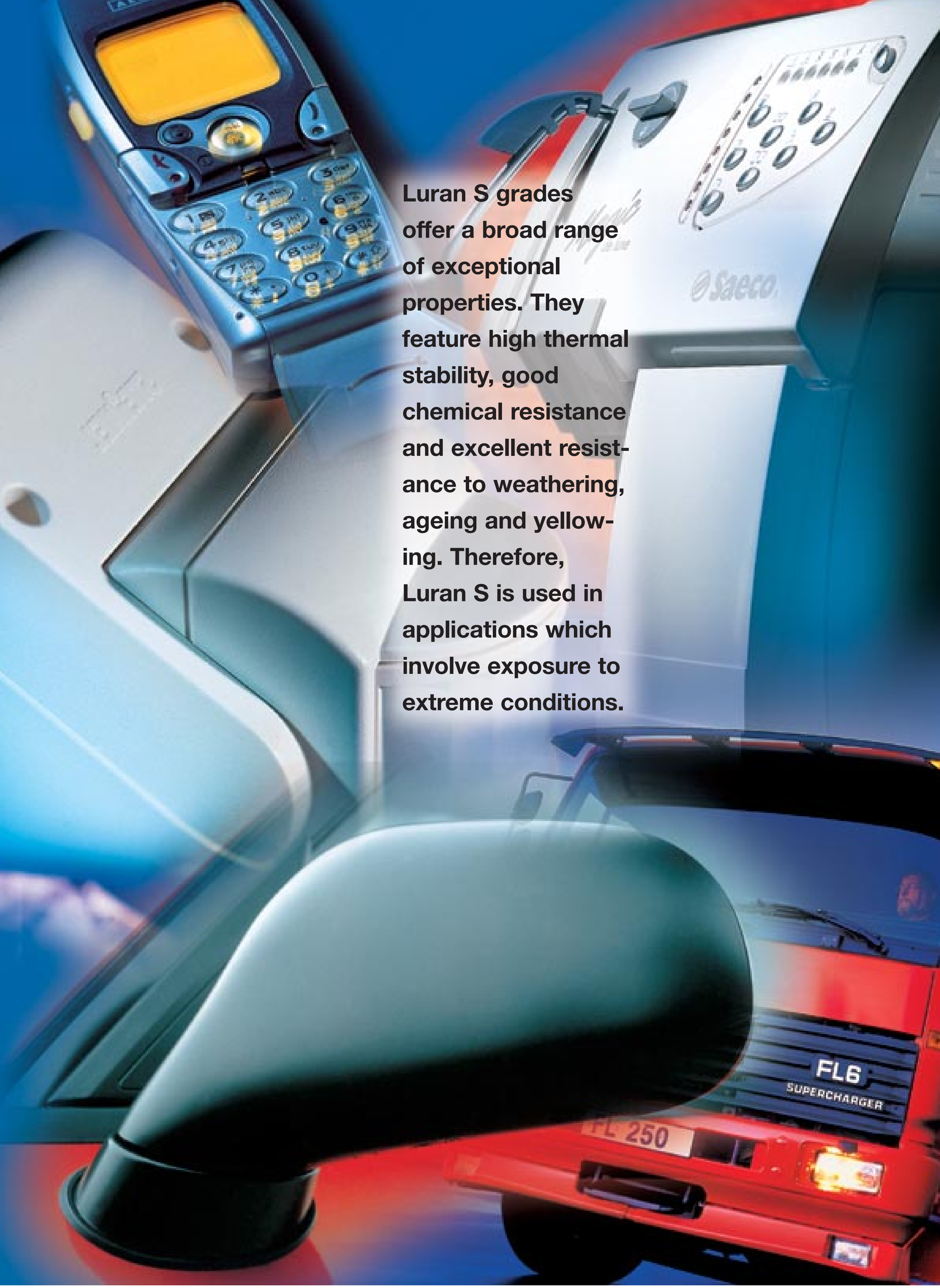
Luran® S

Acrylonitrile-styrene-acrylate copolymer (ASA and ASA + PC)

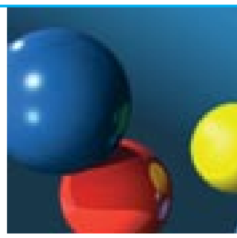
Applications
Range
Properties
Processing

BASF

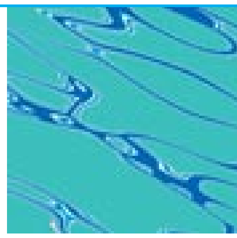


Luran S grades offer a broad range of exceptional properties. They feature high thermal stability, good chemical resistance and excellent resistance to weathering, ageing and yellowing. Therefore, Luran S is used in applications which involve exposure to extreme conditions.

Luran S has a broad range of applications...

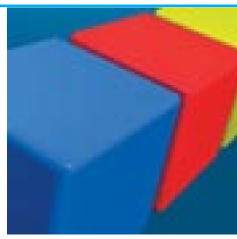


Luran S and its characteristic properties



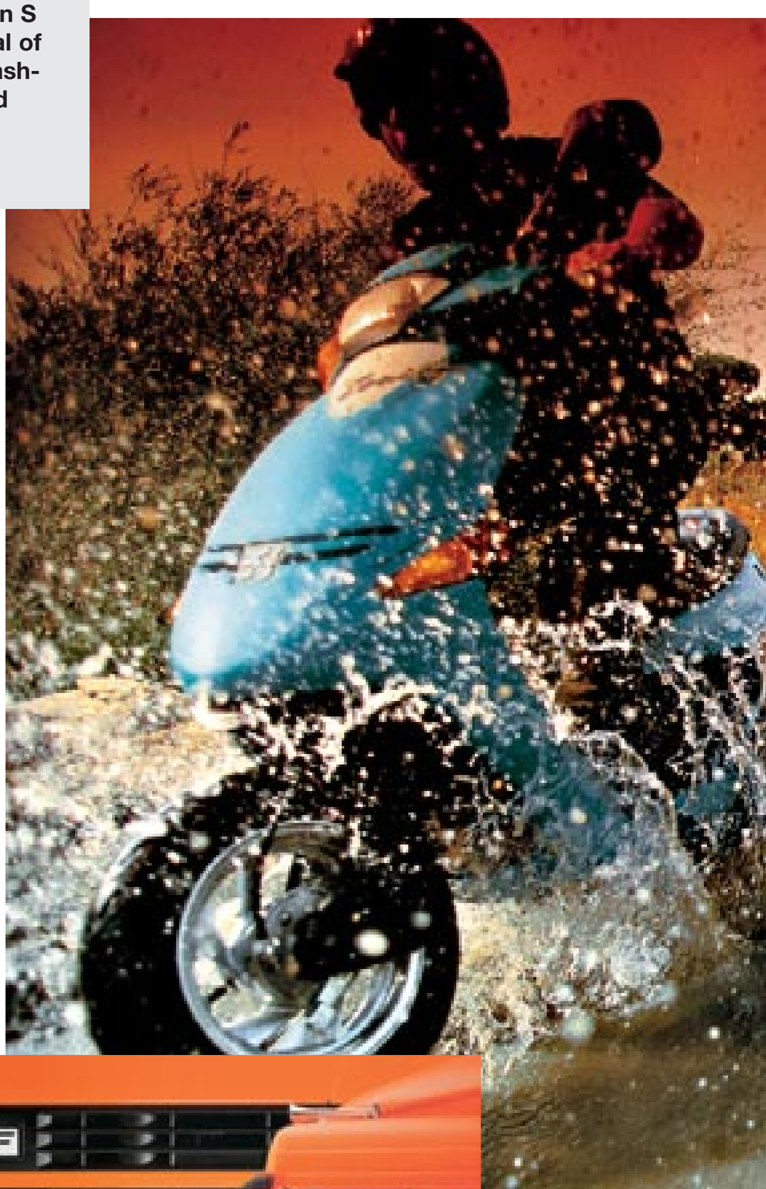
Processing of Luran S

Supply, literature references



Luran S has a broad range of applications ...
... in automotive construction

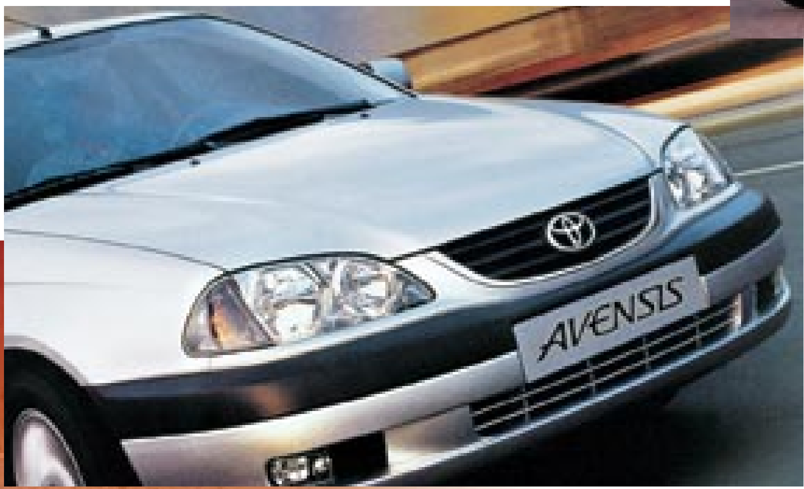
In the last 15 years, Luran S has captured a large share of the market for exterior automotive parts. More and more users choose Luran S because of its superior properties and its ability to resist UV radiation. Even after long-term weathering, Luran S does not show the greying typical of even UV-stabilized ABS. Also, Luran S withstands hot-water treatments such as the removal of the wax layer from new vehicles and frequent car washes. The cost saving compared with coated or painted ABS provides a further incentive for the change to Luran S.



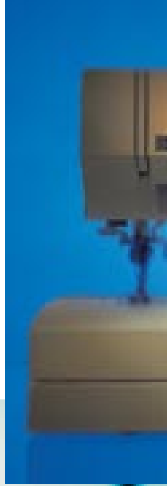
Typical Luran S applications in the automotive sector are exterior mirror housings, radiator grills, centre pillar trims, window frames, cowl vent grills, fairings and lamp housings. Even relatively large covering panels are often made from Luran S.

Coloured Luran S is increasingly used instead of metal, coated or painted ABS, or SMC materials for moped, motor scooters and motorcycle fairings. Luran S has also been successfully used for many years in exterior parts of recreational vehicles and trailers.

The commercial vehicle sector is of increasing importance. Draft deflectors, steps, radiator grills and exterior mirror housings from Luran S have so far been developed in joint projects. Dashboards and trim panels made from Luran S have long been in use in agricultural vehicles.



Luran® S
Fit for the future

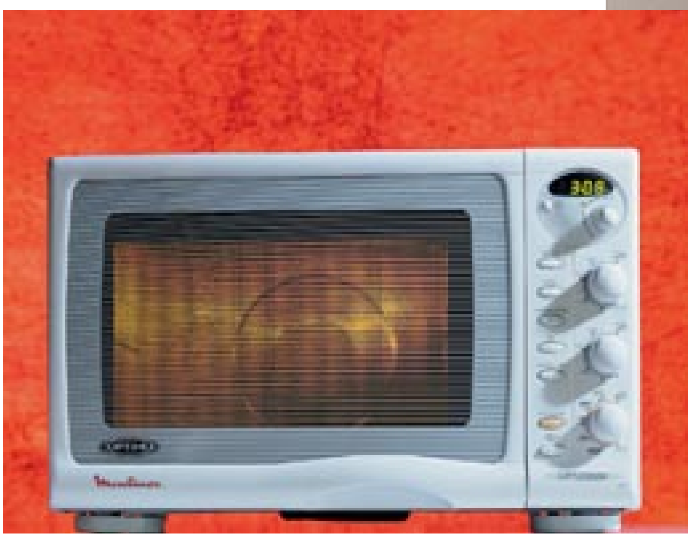


A typical application for Luran S, with its resistance to weathering, is antenna construction. Wind and weather subject the external elements of antennas to severe attack. Unsuitable materials corrode or become brittle. Luran S is not just an all-weather plastic; it is also the ideal material for heavily used household appliances and long-lived consumer goods, for example "white goods".

Because of its exceptional UV stability, well-known antenna manufacturers use Luran S for items such as parabolic reflector coverings, mobile antennas, TV antenna parts, cable connection housings, weatherproof protective housings for satellite electronics, diplexer housings and amplifier parts.

Luran S is distinguished by high heat resistance and colour stability combined with excellent resistance to oils, fats and other chemicals – properties which meet the stringent requirements of manufacturers of washing machine panels, refrigerator handles, mouthwash housings, sewing machines, kitchen appliances, grills and microwaves.

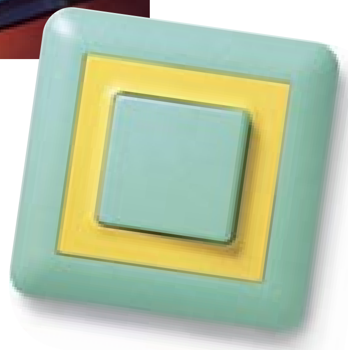
For equipment which can experience severe mechanical stresses, for example mobile telephones, the ASA + PC blends are especially suitable.





ALCATEL





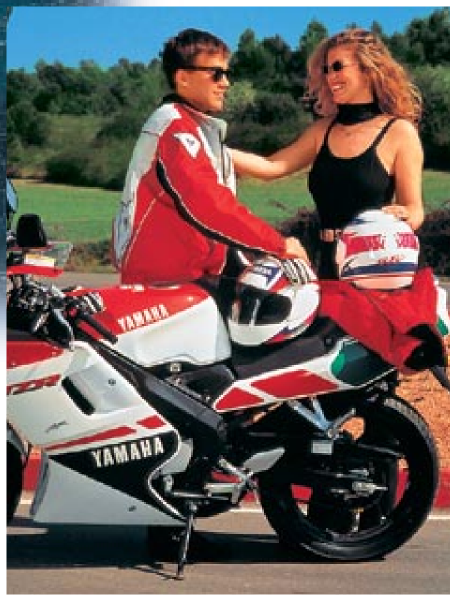
NOKIA

NOKIA
NOKIA

... in sport and leisu

Surfboard or sailboat, golf trolley or skibox - Luran S makes sure that you can enjoy your leisure time. The superior properties of Luran S are seen in improved long-term serviceability. Injection-moulded or extruded, Luran S performs in any weather.

The applications are extensive. They range from surfboards and snowboards to moped and motorcycle fairings.


YAMAHA
YAMAHA

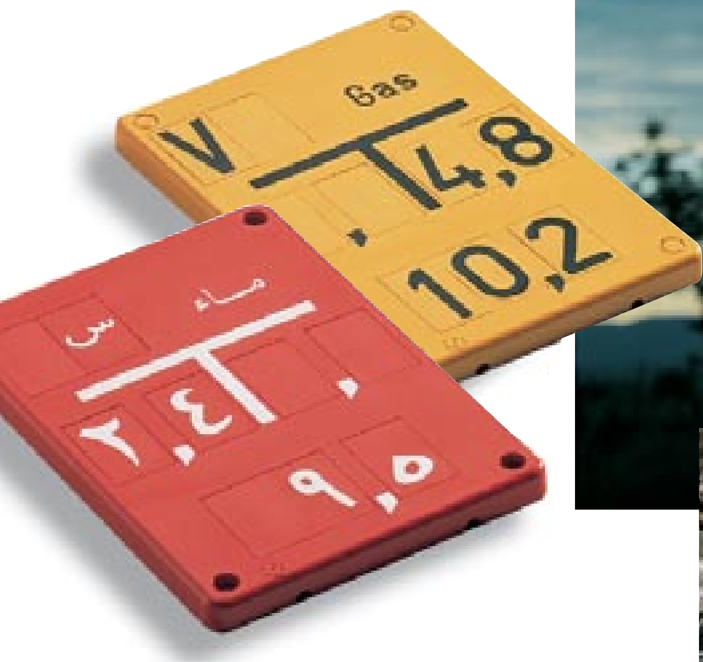

THULE

... in a wide variety of indoor and outdoor uses

The combination of properties which gives Luran S its success, namely excellent resistance to weathering, ageing and yellowing, have been tried and tested for many years in innumerable applications, both indoors and outdoors.

For example, petrol-powered lawnmowers require good mechanical properties, resistance to petrol and colour fastness. This is a clear case for Luran S.

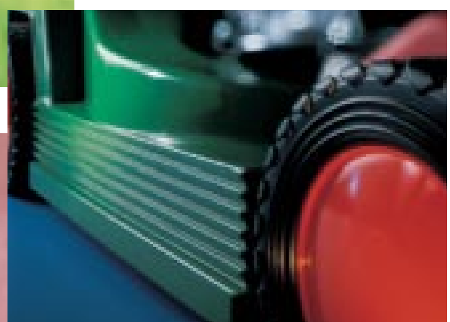
When an outdoor table or a serving trolley has to be scratch-resistant, Luran S not only gives you a surface which is harder than polypropylene, but also greater rigidity with comparable toughness.












Luran S and its characteristic properties

The Luran S range at a glance

Globally available grades

Luran S 757 G:
ASA injection moulding grade with high stiffness and flowability

Luran S 776 S:
ASA injection moulding grade with enhanced toughness and lower flowability

Luran S 776 SE:
ASA extrusion grade with enhanced toughness; especially suited for sheet and profiles with reduced gloss

Luran S 777 K:
Easy-flowing, ASA injection moulding grade with good impact resistance

Luran S 778 T:
ASA injection moulding grade with increased heat deflection temperature; especially for automotive parts

Luran S 778 TE:
ASA extrusion grade with increased heat deflection temperature and high gloss

Luran S 797 S:
ASA injection moulding grade with very high impact strength

Luran S 797 SE:
ASA extrusion grade with very high impact strength; especially suited for sheet and profiles with high gloss

Regional products*

Luran S 757 R:
ASA with high stiffness and medium flowability

Luran S 796 M:
ASA injection moulding grade with high toughness and enhanced flowability

Luran S KR 2858 G3:
ASA with 15 % glass fibres; high stiffness

Luran S KR 2861/1C:
ASA/PC standard grade for injection moulding and extrusion

Luran S KR 2863 C:
ASA/PC with very high heat deflection temperature

Luran S KR 2864 C:
ASA/PC injection moulding grade with high flowability

Luran S KR 2866 C:
ASA/PC grade with lower PC content; lower heat deflection temperature and impact strength

Luran S KR 2867 C WU:
Flame retardant ASA/PC with high flowability; free of chlorine, bromine and antimony

*not available in all geographic regions

Luran S is the trade name for BASF's styrene-acrylonitrile copolymers which are impact-modified with acrylate rubber. The range includes grades for injection moulding and for extrusion.

Luran S is obtained by copolymerizing styrene and acrylonitrile in combination with an elastomeric acrylate-based component. The elastomer component is distributed uniformly in the SAN structure in the form of very small particles.

The Luran S grades which have a "C" at the end of their product name are polymer blends of ASA and polycarbonate (eg. Luran S KR 2866 C).

Mechanical properties

Stress-strain performance
The mechanical performance of Luran S grades is depicted in Fig. 1 using the stress-strain curve from the tensile test.

Depending on their rubber content the individual grades show differences in their yield stresses. The shape of the stress-strain curves also depends on the test temperature and the strain rate. Fig. 2 uses Luran S 778 T to illustrate the temperature dependence of strength.

Increasing test temperatures give higher strain and lower strength values.

The modulus of elasticity also decreases with increasing test temperature. However, in the temperature range between –20 and 80°C, relevant in industrial applications, the Luran S grades have a high and essentially constant rigidity.

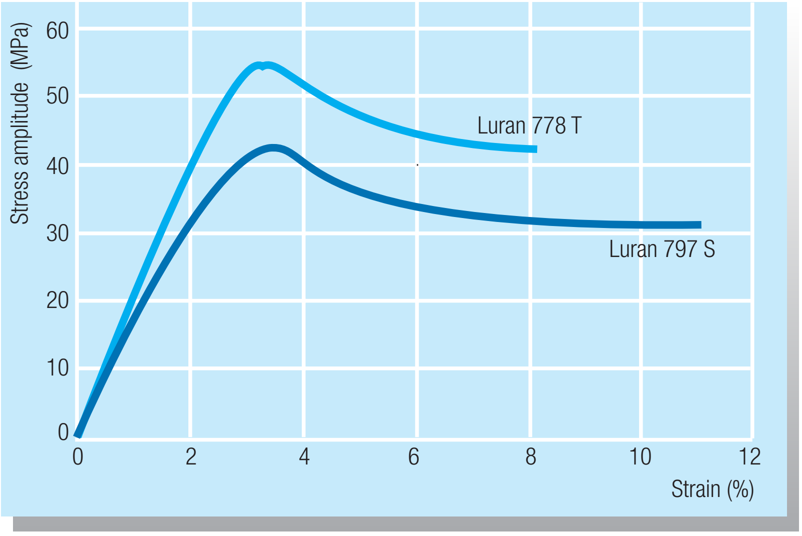


Fig. 1: Stress-strain curve for various Luran S grades (ISO 527 tensile test at 23 °C)

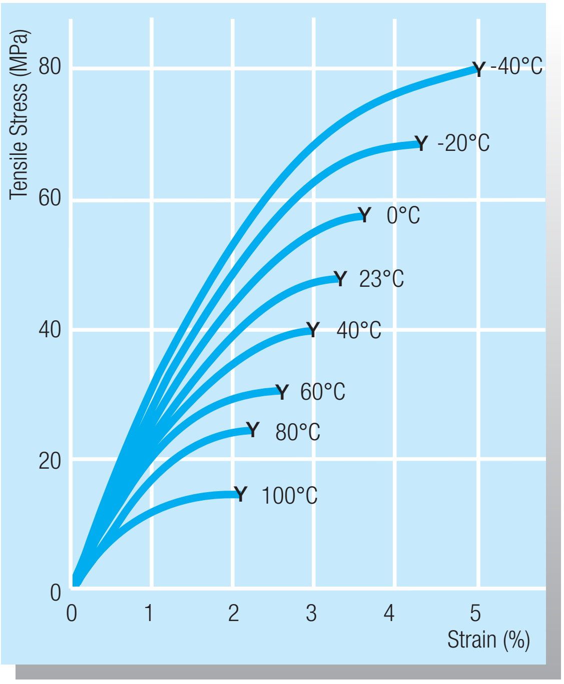


Fig. 2: Stress-strain curve of Luran S 778 T at differing temperatures (test was discontinued at 10 % strain)

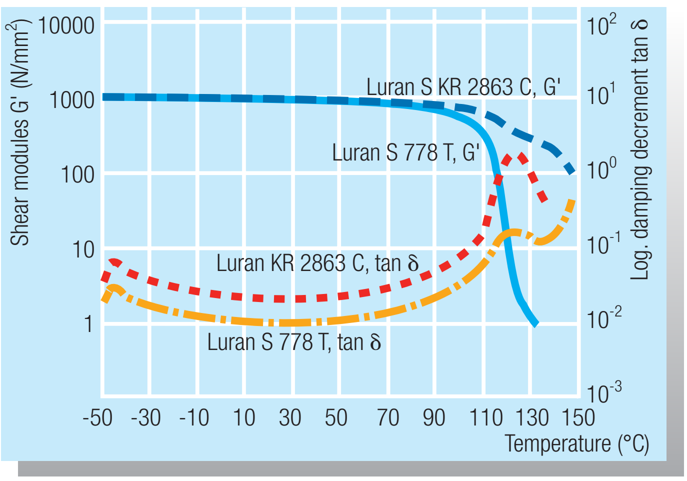


Fig. 3: Shear modulus and logarithmic decrement of mechanical damping of Luran S 778 T and Luran S KR 2863 C (ISO 537 torsion pendulum test)

Shear modulus

The curves for shear modulus and logarithmic decrement of mechanical damping shown in Fig. 3 give insight into the mechanical performance of the Luran S grades when undergoing small, periodically changing deformations, as a function of temperature.

The Luran S grades have a damping maximum at about –40°C which can be attributed to the glass transition temperature of the elastomer component. The elastomer component becomes effective above this point and gives Luran S a toughness which increases as the temperature rises.

The shear modulus is almost constant over the temperature range from about –40 °C to about 100 °C.

Thus, Luran S has high rigidity and excellent toughness over a wide temperature range.

Luran® S
Fit for the future

Impact strength

Luran S combines rigidity, strength and dimensional stability with high toughness. Typical values for the impact strength are given in the brochure “Luran S: Features, typical values, applications”.

An assessment of toughness which is very well correlated with the performance of plastics in practical applications can be obtained using the penetration test according to ISO 6603-2. A bolt impacts the test specimen (usually an injection-moulded disk) at a velocity of about 4.5 m/s, and the penetration energy serves as a measure of the toughness.

Fig. 4 shows the penetration energy measured on 2 mm thick disks (diameter 60 mm) as a function of the temperature. While the toughness of Luran S increases with increasing temperature the value for the blends of Luran S with polycarbonate (Luran S KR 2861/1 C), is almost independent of temperature.

Creep strength

The mechanical performance of Luran S under continuous static load is shown in the isochronous stress-strain curves (Fig. 5-8). The static load which can be withstood is strongly dependent on temperature. The graphs shown here are merely a selection from our extensive test results.

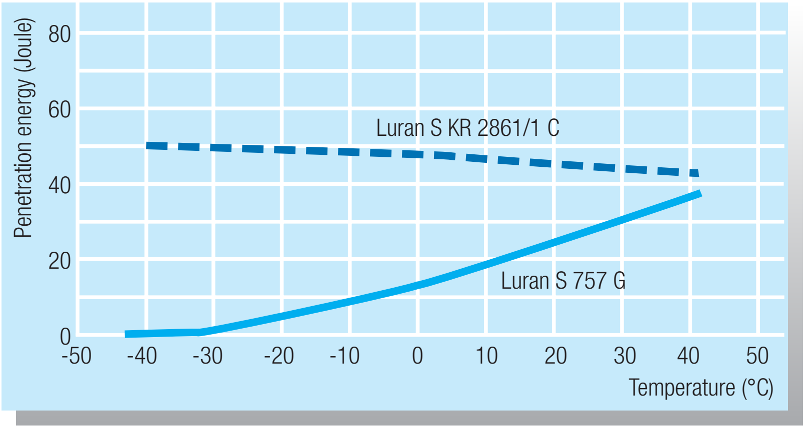


Fig. 4: Penetration energy for 2 mm thick disks (diameter 60 mm) of Luran S in the ISO 6603-2 penetration test

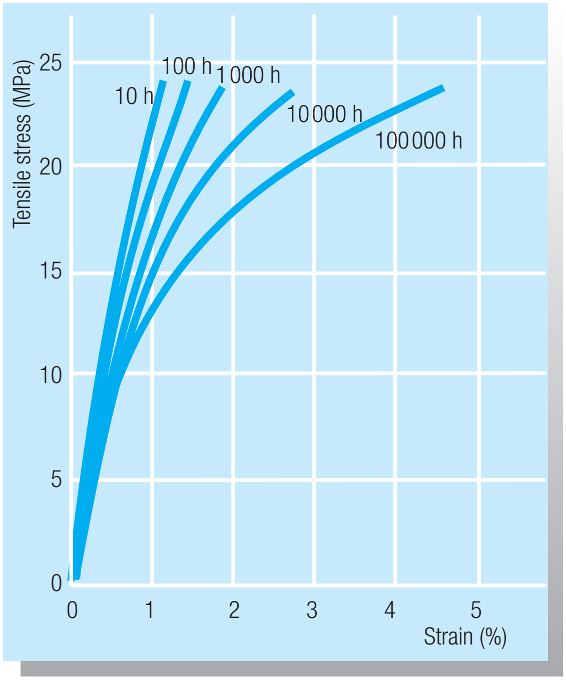


Fig. 5: Isochronous stress-strain curves for Luran S 778 T at 23 °C (ISO 899)

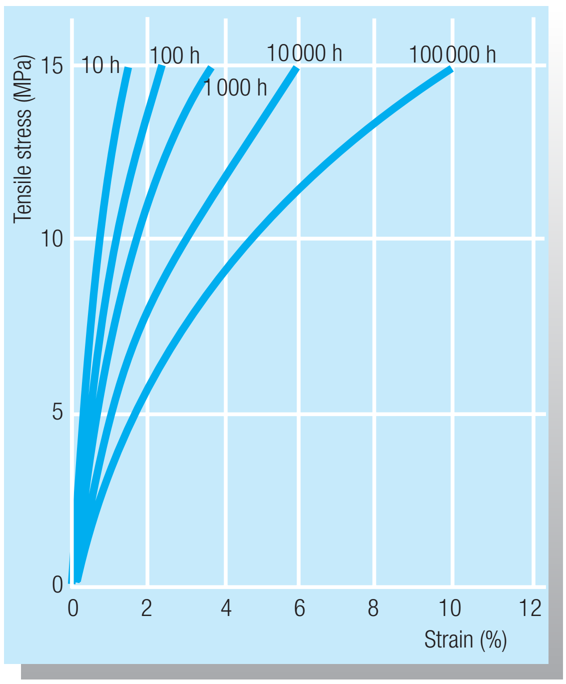


Fig. 6: Isochronous stress-strain curves for Luran S 778 T at 60 °C (ISO 899)

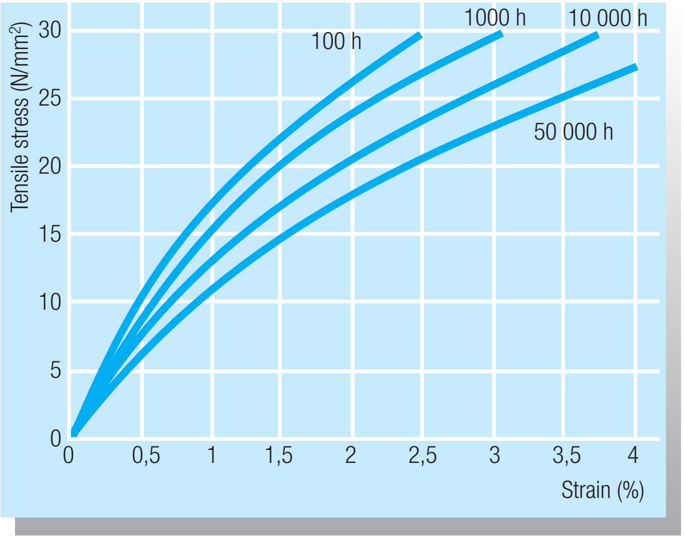


Fig. 7: Isochronous stress-strain curves for Luran S KR 2861/1 C at 23 °C (ISO 899)

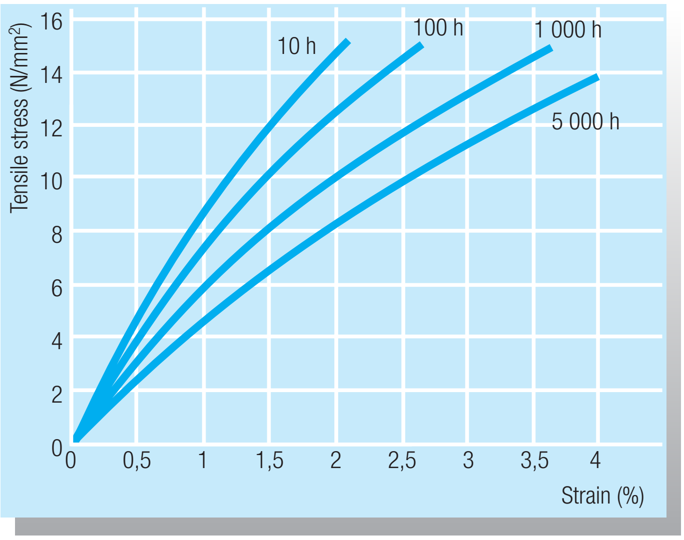


Fig. 8: Isochronous stress-strain curves for Luran S KR 2861/1 C at 80 °C (ISO 899)

Resistance to weathering

Luran S has high resistance to weathering because the elastomer component consists of an acrylate having a significantly higher resistance to UV radiation and attack by atmospheric oxygen than the butadiene rubber which is used, for example, in impact-modified polystyrene and ABS.

A very sensitive method of quantifying the change in the mechanical properties of polymers brought about by the effects of weathering is to determine the penetration energy on weathered specimens. If the (unirradiated) reverse side of the specimens is impacted, the irradiated front side experiences a sudden tensile stress, so that even the slightest deterioration gives a clear reduction in the measured values. This test is therefore an excellent indicator of weathering resistance. In contrast, if the impact is on the irradiated side, as most frequently happens in practice, a reduction in toughness is only observed after much longer exposure times. Measurable reductions in the values of properties such as breaking stress and modulus of elasticity are also seen only at a much later stage.

Figure 9 shows the penetration energy curve for 2 mm thick disks of ABS and Luran S. While the toughness of ABS falls away very rapidly, Luran S remains at a high level for a significantly longer period. The (ASA+PC)-Blends and UV-stabilized Luran S show particularly favourable performance.

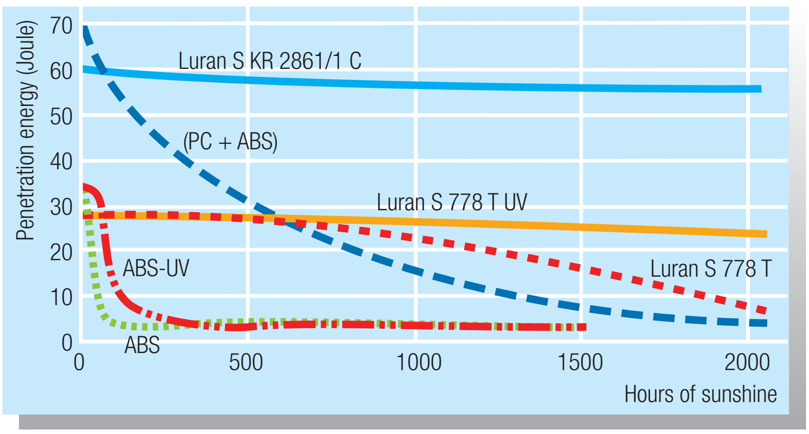


Fig. 9: Toughness in the ISO 6603-2 penetration test after outdoor weathering in Limburgerhof, Germany; penetration energy on 2 mm thick disks

The outdoor weathering of plastics may not only change their mechanical properties. The combination of UV radiation, atmospheric oxygen and heat frequently causes a clearly visible yellowing. Also in this respect, the chemical structure of Luran S makes it exceptionally stable.

Figure 10 shows the yellowing of different white-coloured plastics on outdoor weathering. All products change colour very slightly in the early stages. Whereas ABS and PC + ABS show rapid yellowing afterwards, Luran S yellows only at a much later stage and to a much lesser extent. Luran S containing an additional UV stabilizer shows particularly excellent performance. Even after 4000 hours of sunshine, corresponding to more than two years of outdoor weathering, this product still shows virtually no yellowing.

The very low level of yellowing of Luran S in outdoor weathering is comparable with that of PVC, a material whose ideal suitability for outdoor applications has been proven in many years of use.

For applications of Luran S in automotive exteriors it is particularly important that, in contrast to UV-stabilized ABS and PC + PBT blends, dark-colored formulations have only a very slight tendency to graying after weathering followed by contact with hot water or soap solution. This represents the typical conditions both for the removal of wax from new vehicles after outdoor storage and also for vehicles which are cleaned after being subjected to solar radiation.

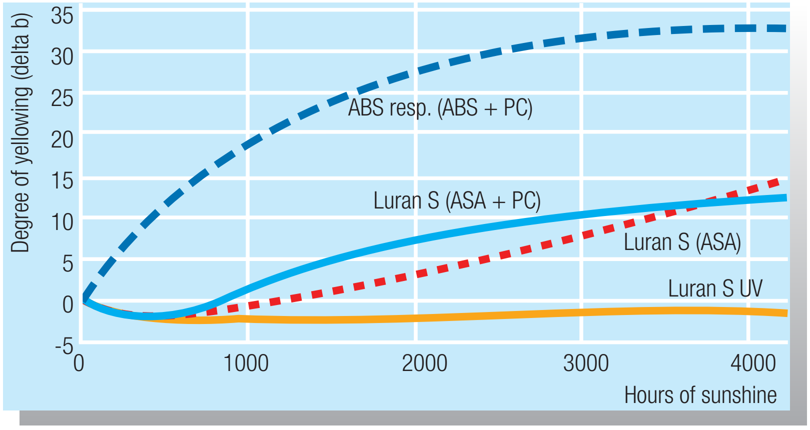


Fig. 10: Yellowing of ABS, Luran S and blends on outdoor weathering (white pigmentation)

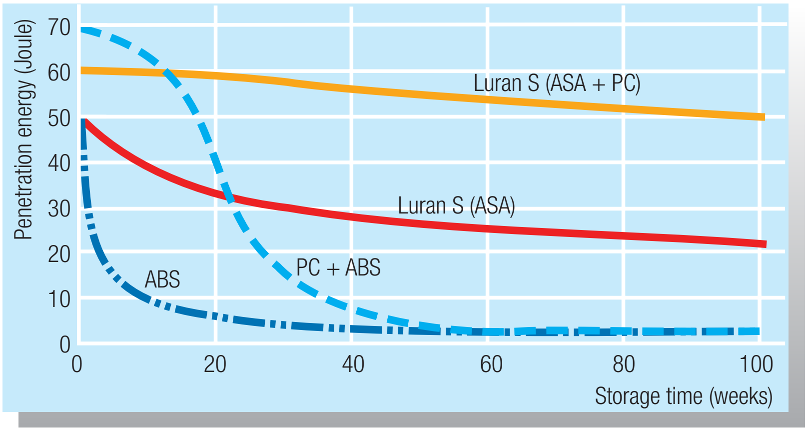


Fig. 11: Toughness of ABS, Luran S and blends after heat ageing at 90 °C Penetration energy on 2 mm thick disks

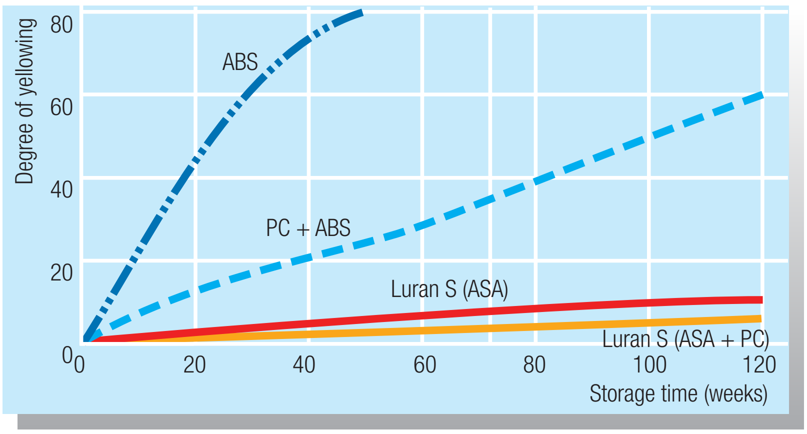


Fig. 12: Yellowing of ABS, Luran S and blends (white pigmentation) on heat ageing at 90 °C

Long-term heat resistance

The stability of Luran S grades to long-term heat exposure can be proven by storage at, for example, 90 °C. Whereas the mechanical strength of comparable ABS products decreases rapidly in this test, Luran S shows only a small change in toughness over the same period (Fig. 11).

Likewise, the resistance to yellowing of Luran S on exposure to heat is very much higher than that of ABS and PC + ABS (see Fig. 12).

Fire performance

Fire performance according to UL 94 and DIN IEC 707/VDE 0304 Part 3, "Test methods for determining the flammability under the action of igniting sources" is given in the brochure "Luran S: Features, typical values, applications".

Building products made from Luran S are tested according to "Supplement to DIN 4102–Fire performance of building materials and building components". Flat samples of Luran S of thickness of 1.0 mm and above are generally rated B2 ("building materials of normal flammability") according to this standard. Further, they are normally rated as "not forming burning droplets".

For applications in automotive construction, the requirements of MVSS 302 and/or DIN 75200 must be met. Flat specimens of Luran S in thicknesses of 1mm and above fulfill these requirements.

Gaseous combustion products of Luran S

In principle, every combustion process gives rise to toxic substances; carbon monoxide is the most important of these and generally has a decisive role.

The combustion products of Luran S contain carbon dioxide, carbon monoxide and water as main components, and also unburnt carbon (soot), acrylonitrile and hydrogen cyanide as the most important secondary products.

Toxicological investigations show that the decomposition products formed at up to 400 °C are no more toxic than the combustion gases formed from wood under the same conditions. When decomposition takes place at above 500 °C, the level of risk is comparable with that presented by the combustion of nitrogen-containing natural products such as wool and leather.

The combustion gases from Luran S are not particularly corrosive. The formation of soot means that smoke is produced in considerable amounts.

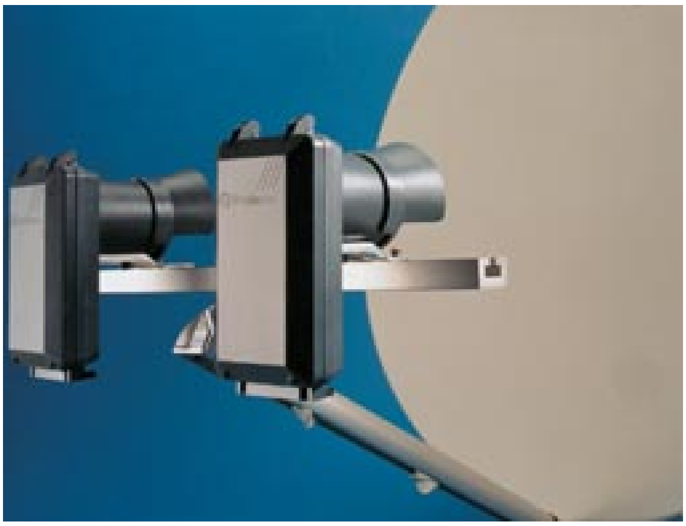
Flame-retardant Luran S

The flame-retardant product Luran S KR 2867 C WU has been developed for parts subject to higher fire protection requirements. This grade, which contains no chlorine, bromine or antimony, has good pigmentability, even in pale colours, and excellent resistance to yellowing. The product achieves the UL 94 V-0 classification at a thickness of 1.5 mm and passes the glowing wire test (IEC 695-2-1) at 960 °C and a thickness of 2 mm.

Electrical properties

Luran S has good electrical insulation performance. The important parameters are the volume resistivity and surface resistivity, the dielectric strength, the comparative cracking performance, and the dielectric constant and dissipation factor (see the brochure "Luran S: Features, typical values, applications").

In the electrical supply industry, Luran S is used particularly for protective insulation-housings and covers. In electrical communications engineering, Luran S is used both as a material for housings and covers and as an actual insulator.



Antistatic performance

At normal atmospheric humidity levels, finished parts made from Luran S have the advantage that dust marks do not form on them during manufacture or storage or in use. High electrical charges applied to the surface of Luran S, for example by corona discharge, dissipate rapidly.

Resistance to chemicals

At room temperature, Luran S is stable to saturated hydrocarbons, low-aromatic fuels and mineral oils, vegetable and animal fats and oils, water, aqueous salt solutions and dilute acids. Although most Luran S grades are also stable to alkalis, the polycarbonate content of the Luran S (ASA+PC) grades makes them susceptible to damage by alkalis, ammonia and amines.

Concentrated acids, aromatic hydrocarbons and chlorinated hydrocarbons, esters, ethers and ketones attack Luran S.

The effect of any medium on a plastic article depends to a great extent on the time of exposure and the temperature. The effect is generally amplified if the Luran S part is subject to internal or external stresses.

It should also be noted that engineering materials usually contain varying amounts of ancillary ingredients, which can have different effects on stability.

In pigmented Luran S, the possible effect of the pigments used must also be taken into account. For example, certain pigments can undergo changes in heavily chlorinated water, and this can cause a colour shift of the parts.

Because such effects vary widely, laboratory experiments can only give guidelines; it is essential to carry out tests on the actual finished part.

Detailed information can be found in the data sheet "Chemical Resistance of Styrene Copolymers".

Luran S has good resistance to stress cracking; the acrylate rubber in Luran S gives it a better performance than ABS (Fig. 13).

Because of their polycarbonate content, the (ASA + PC) blends are more susceptible than other Luran S grades to environmental stress cracking.

Finished parts made from Luran S do not require special care. Scratches can be treated with the majority of commercially available creams and polishes for paint, leather or wood. Dirt can be removed with water and soap or detergents.

Permeability to water vapour and gases

Luran S is impermeable to water. Depending on the pressure drop between the inside and outside, water vapour and gases can diffuse through a sheet of Luran S. Further details are given in Table 1.

The gas permeability also depends on the conditions of manufacture of the films or other finished parts.

Table 1: **Typical values[1] for permeability to water vapour and gases**

Luran S-grade	Water vapour[2] $g \cdot m^{-2} \cdot d^{-1}$	Oxygen[3]	Nitrogen[3] $cm^2 \cdot m^{-2} \cdot d^{-1} \cdot bar^{-1}$	Carbon-dioxide[3]
797 S	35	550	100	2300

[1] The values are highly dependent on the conditions of manufacture of the film, and may vary by more than 50% in either direction as a result.
[2] Measured according to DIN 53122, relative humidity drop from 85% to 0%, pressure drop 23.87 mbar.
[3] Measured by a method similar to that of DIN 53380, Part 2 (M).

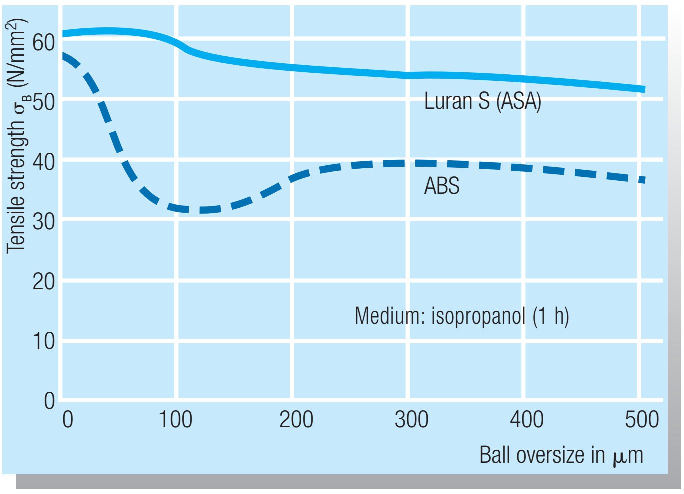


Fig. 13: Stress cracking performance of Luran S and ABS with respect to isopropanol, measured by the ISO 4600 ball indentation test

Processing of Luran S

Luran S can be processed by any of the processes suitable for thermoplastics. The most important processes are injection moulding and extrusion. Because of its chemical structure, Luran S is relatively stable to the temperatures encountered in processing. Even so, unnecessarily long residence times in the machine should be avoided, especially if melt temperature is high.

General information

Predrying

Luran S granules can absorb small amounts of moisture from the air during storage. Although this does not change the properties of the product, streaks or bubbles can appear during processing, depending on the moisture content. We therefore recommend predrying of Luran S before processing.

The Luran S grades which have a “C” in their designation (eg. Luran S KR 2861/1 C) are blends of ASA and polycarbonate. Since these products are generally processed at melt temperatures which are higher than those for other products in the Luran S range, we always recommend that they be predried. The drying temperature should be about 10–20 °C lower than the Vicat softening point (VST/B/50, see “Luran S: Features, typical values, applications”). The drying conditions are given in Table 2.

Self-colouring of Luran S

Special know-how is required for colouring Luran S. Compared to other plastics, e.g. ABS, Luran S requires much higher pigment concentrations. Many colourants and masterbatches are unsuitable due to their insufficient heat or weathering resistance. In addition, unsuitable colourants or masterbatch ingredients may, over time, migrate to the surface of the finished parts or be extracted by the influence of chemicals (e.g. cleaning agents or solvents).

Because of this we do not recommend self-colouring of Luran S. Instead we suggest using Luran S coloured by BASF.

Over several decades BASF has developed considerable expertise in the colouration of Luran S. The colourants used meet high requirements and have passed stringent tests in order to be approved for Luran S. Therefore Luran S coloured by BASF has excellent weatherability and heat ageing resistance, and the colourants are embedded permanently in the plastic material.

Mechanical Recycling

Because of its high thermal stability, up to 30 % of clean Luran S of a single grade and whose previous processing has not involved contamination may be added to the starting material in the manufacture of moldings where this is appropriate. The usual crushers or granulators can be used for size reduction. Regrind should be well dried.

Table 2:	Drying temperature (°C)	Drying time (h)	Acceptable moisture content
Luran S (ASA)	80	2–4	< 0.1
Luran S (ASA + PC)	90–115*	2–4	< 0.1

* = 10–20 °C below Vicat softening point VST/B/50

Table 3: **Typical values for screw configuration**

Zone length			Flight depth in mm		
Overall length	L	16-20 D	D*	h_E	h_A
Feed zone	L_E	0.5 L	30	5	2.5
Compression zone	L_K	0.3 L	50	6	3
Metering zone	L_A	0.2 L	70	8	4

D*= Screw diameter
h_E= Flight depth in the feed zone
h_A= Flight depth in theMetering zone

Nozzles

Open nozzles can be used for processing Luran S moulding compounds because Luran S melts are relatively viscous. Open nozzles have a very simple design and therefore give particularly good flow.

Shut-off nozzles have advantages when high back pressure is being used or undesirable stringing has to be avoided and thick-walled parts are to be manufactured.

Mechanically or hydraulically operated needle valve nozzles have proven the most successful.

Injection mould

Gate and mould design

Any known type of gate may be used, including hot runner systems.

The guidelines for the design of gates and moulds for the manufacture of injection-moulded parts from thermoplastics (VDI 2006) are also applicable to Luran S. Gates and feed channels should not be too small, otherwise excessively high melt temperature and injection pressure are required. This can result in streaks, charring caused by shear, voids or sink marks.

Use of inserts

Metal parts can be moulded in without difficulty, but they should be preheated to 80–120 °C before being placed in the mould so that no internal stresses are created. The metal parts must be free of grease, and to improve anchoring should have milled, grooved or similar surfaces. Metal edges should be well rounded.

Mould temperature control

A carefully designed temperature control system for the mould is particularly important, since the effective mould surface temperature has a decisive effect on surface quality (gloss, flow lines) and on the weld line strength, distortion, shrinkage and tolerances of mouldings. The recommended mould surface temperatures for Luran S grades are given in Table 4.

An eventual warpage of the moldings can be counteracted by separate and differentiated temperature control of the two halves of the mold.

The injection moulding process

Processing temperature

Luran S moulding compounds are generally processed at melt temperatures of from 240 to 280 °C, but the polycarbonate-containing Luran S grades (eg. Luran S KR 2861/1 C) should be processed at 260 to 300 °C except the flame-retardant grade Luran S KR 2867 CWU, for which a temperature range of 260 to 280 °C is recommended (Table 4).

For processing at the upper end of the temperature range short residence times should be used, since otherwise the material can undergo thermal degradation. This can be recognized in coloured compounds by the change in colour; it normally becomes somewhat paler.

Table 4

	Processing temperature (°C)	Mold temperature (°C)	Typical shrinkage (%)
Luran S (ASA)	240-280 °C	40-80 °C	0.4-0.7
Luran S (ASA+PC)	260-300 °C	60-90 °C	0.3-0.7
Luran S KR 2867 C WU	260-280 °C	40-60 °C	0.3-0.7

Feed characteristics
Even at high screw rotation rates plastification of Luran S moulding compounds proceeds smoothly and without thermal degradation. Plastification performance rises with increasing processing temperature.

It is frequently possible to set the individual heating zones of the cylinder to the same temperature. For high processing temperatures and/or for long cycle times the temperature of the first heater band (close to the feed hopper) should be set somewhat lower in order to prevent premature melting of the granules in the feed zone (bridging).

Mould filling
A relatively high injection speed is useful since little cooling occurs during mould filling; this gives a glossy surface, a low visibility of the weld lines and a high weld line strength. Too low a rate of mould filling gives parts with unsatisfactory surfaces.

When the melt is injected, care should be taken that the air in the mould cavity can escape at a suitable point, to avoid charring by compressed air (Diesel effect).

To obtain perfect injection-moulded parts and to prevent the formation of voids, the hold pressure and the hold pressure time must be sufficient to compensate the volume reduction which occurs when the melt is cooled. On the other hand overfeeding of the mould cavity must also be avoided, since this causes stresses in the moulding. The risk of overfeeding exists mainly in the vicinity of the gate, at high injection rates and high hold pressure.

Flow characteristics
The spiral flow test in Figs. 14 and 15 shows the flow characteristics of Luran S. Although this test is not covered by a standard, it gives an assessment which is close to practical experience.

The flowability or the flow distance of a product depends not only on the processing parameters, such as injection pressure, injection rate, melt temperature and mould temperature, but also on the design of the mould.

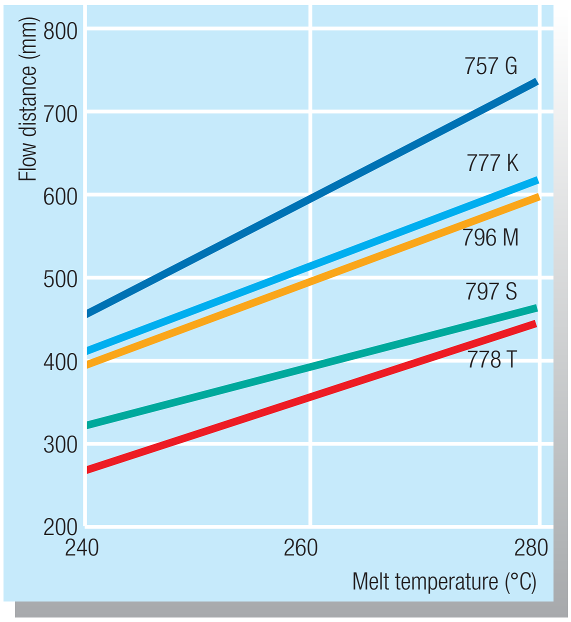


Fig. 14: Flowability of Luran S (ASA) as a function of melt temperature (spiral flow test). Mould: Test spiral 2 mm x 10 mm; Injection pressure: 1100 bar; Mould surface temperature: 60 °C

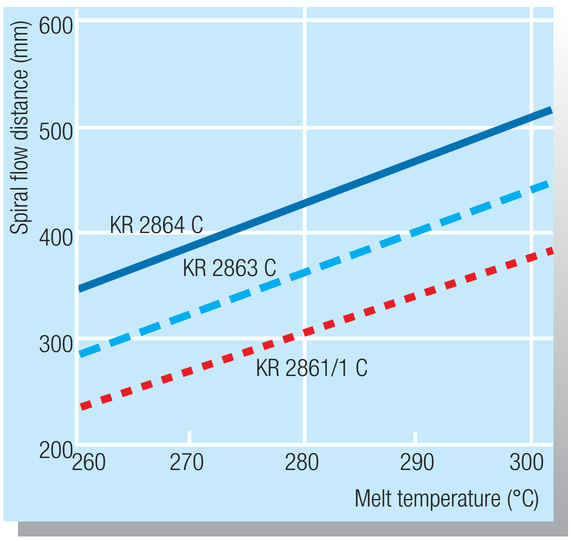
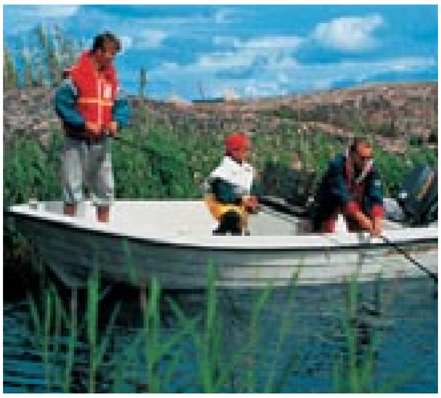


Fig. 15: Flowability of Luran S (ASA + PC) as a function of melt temperature (spiral flow test). Mould: Test spiral 2 mm x 10 mm; Injection pressure: 1100 bar; Mould surface temperature: 80 °C

Mould release
Luran S can be readily demoulded, so that even mouldings of complicated design are possible. Drafts of from 0.5 to 0.9° are generally sufficient.

Textured surfaces require larger drafts: 1° makes it possible to demould a part with 0.02 mm depth of texture from the mould cavity and a part with 0.01 mm from the mould core.



Shrinkage and post-shrinkage
Shrinkage is significantly lower with Luran S moulding compounds than with semi-crystalline plastics.

The processing shrinkage is usually from 0.4 to 0.7 %, and in exceptional cases well below 0.4 %. In regions of a moulding which experience high hold pressure (near to the gate) it may even be close to 0 %.

Post-shrinkage is negligible in most applications, making up about 1/10 of the overall shrinkage.

Extrusion

Luran S is highly suitable for the extrusion of sheets, solid and hollow profiles and pipes. Specific extrusion grades are available for this and are identified with an “E” (eg. Luran S 797 SE).

Sheet manufacture
Suitable extruders for the manufacture of extruded sheets comprise those generally used for processing impact-modified polystyrene and ABS, having a sheet extrusion die. Vented extruders with a screw length of from 25 to 30 D and a compression ratio of from 1:2 to 1:4 are preferable.

In most cases the optimum throughput of sheets with superior mechanical properties and good appearance is achieved at about 230 °C for the Luran S (ASA) grades or at about 260 °C for the Luran S (ASA + PC) grades.

Pipe and profile manufacture
The same conditions apply for the manufacture of pipes and profiles as for the extrusion of sheets. The melt temperature, however, is generally set lower in order to achieve sufficient melt strength between die and calibrator. The recommended lower limit here is 200 °C. Preferably, the cooling conditions should be set to give an external temperature of about 70 to 80 °C for the semifinished products after passing through the waterbath.

Blow moulding

The Luran S grades most suitable for blow moulding are those with low flowability.

The parison should be extruded at a melt temperature of from 220 to 230 °C. In individual cases, the melt temperature can be lowered to about 210 °C in order to reduce stretching of the extruded tube.

In order to avoid a high material temperature resulting from frictional heat, the screw of extruders with a grooved, cooled and thermally insulated feed zone should have somewhat deeper flights than those, for example, for high-molecular-weight PE-HD.

Short ejection cycles, as achieved when melt accumulators are used, are advantageous.

Undercuts in blowing moulds, eg. at the thread runout or as a result of the curvature of bottle bases, should be avoided. The pinch-off areas can be designed in the same way as for PE-HD processing. The pinch-off edges should be as sharp as possible to ease flash removal. In the case of engineering parts, the flash areas should be sectioned off by well-defined pinch-offs.

Thermoforming

Sheets and films made from Luran S can be thermoformed to give mouldings with good wall thickness distribution. Thermoforming of Luran S can be carried out with standard machinery for the vacuum forming and compressed-air forming of sheets and films. Recommended forming temperatures are from 140 to 170 °C.

Storage and packing of thermoforming sheet

Like ABS, Luran S tends to absorb moisture under poor conditions of storage. On thermoforming, sheets which have become moist can generate bubbles which make the moulding unusable.

Storage in dry areas (about 20 °C, 30 % relative humidity) prevents the absorption of moisture which impairs thermoforming. However, if storage takes place under standard conditions of temperature and pressure (DIN 50014-23/50-2), the moisture content may reach levels which could adversely affect processing after some days or weeks.

Under standard conditions of temperature and pressure, the final moisture absorption value is about 0.4 %, and it is achieved after about 20 days in the case of 1.5 mm thick sheets. Even a moisture content of from 0.05 to 0.1 % can, however, impair the surface of mouldings. Wrapping in welded polyethylene film of adequate thickness, ie. at least 100 µm, provides effective protection against the absorption of moisture. This special packing greatly delays the absorption of moisture, but does not prevent it entirely. Even specially packed Luran S sheets should therefore be stored under dry conditions.

Machining and post-processing

Machining

Semifinished products made from Luran S are easy to machine, ie. die-punch, saw, drill, mill, turn etc., using conventional metal- and woodworking machinery.

Tools used for machining brass and bronze are suitable. Because heat dissipation is slow, water cooling is frequently necessary even at low cutting speeds. Luran S parts can be stamped and flanged without difficulty and can be fastened using self-tapping screws.

Assembly

Welding

Hot-plate and spin welding are suitable for welding semifinished products and mouldings made from Luran S, and in specific cases high-frequency and ultrasonic welding can also be used.

Ultrasonic welding can also be used to connect Luran S to a number of other thermoplastics, such as SAN, ABS, PVC and PMMA.

Adhesive bonding

Examples of solvents suitable for adhesive bonding are methyl ethyl ketone, dichloroethylene and cyclohexanone. Parts made from different grades of Luran S may be bonded to one another, and furthermore parts made from Luran S may be bonded to parts made from ABS or SAN.

For more information we recommend contacting the adhesives industry, which offers a wide variety of suitable special adhesives.

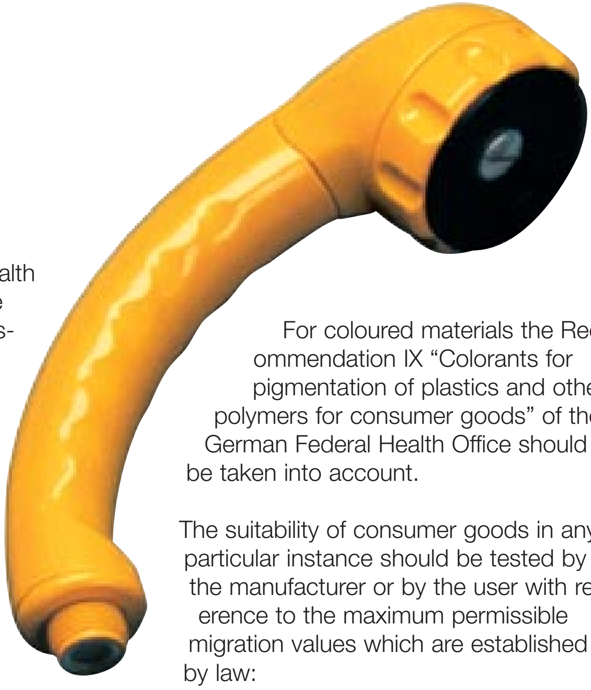
Surface treatment

Parts made from Luran S may be easily and permanently printed, coated or painted without any special pretreatment. They can also be metallized by the metallizing processes commonly used in industry.

Safety information

Safety precautions during processing

No adverse effects on the health of processing personnel have been observed when processing of the products is carried out correctly and there is suitable ventilation of the production areas. The maximum allowable concentrations (MAC) of 20 ml/m³ for styrene, 100 ml/m³ for α-methylstyrene, 10 ml/m³ for butyl acrylate and the technical reference concentration of 3 ml/m³ for acrylonitrile must be observed (German Hazardous Materials Regulations 900; MAC list 1999). Acrylonitrile is a Group III, A2 substance for which carcinogenic activity is assumed as a result of toxicity testing. Experience has shown that when Luran S is processed correctly with appropriate ventilation, the levels are far below the limits mentioned above. Inhalation of the vapours of degradation products which can arise on severe overheating of the materials or during pumping out should be avoided. Our safety data sheets give further information.



Food regulations

Most Luran S formulations fulfill the requirements of the German Consumer Goods Regulations of 23.12.97 and of Recommendation VI “Styrene polymers, copolymers and graft polymers” and Recommendation XI “Polycarbonates” of the German Federal Health Office as at 01.06.98.

For coloured materials the Recommendation IX “Colorants for pigmentation of plastics and other polymers for consumer goods” of the German Federal Health Office should be taken into account.

The suitability of consumer goods in any particular instance should be tested by the manufacturer or by the user with reference to the maximum permissible migration values which are established by law:

Acrylonitrile: SML	= not detectable
(detection limit	= 0.02 mg/kg)
Bisphenol A: SML	= 3 mg/kg
Phosgene: QM	= 1 mg/kg

(SML = specific migration limit in foods or food simulants; QM = maximum allowable residual content of the substance in the consumer good)

In cases where Luran S is to be used in contact with foodstuffs, we will be happy to provide more detailed information and confirmation regarding compliance with regulatory requirements.

No substances which can damage the ozone layer (ODC) of Class I (CFC/Halons) or Class II (HCFC) are used as starting materials or additives in the manufacture of Luran S.

Luran S in the medical sector

BASF does not carry out product developments for applications in medical products (including packaging) as defined by the German Medical Product Act. We therefore have no in-house experience of the suitability of Luran S in applications of this type and, as a result, BASF is unable to make any product recommendations for this section.

Luran S and the environment

Waste disposal

In Germany, Luran S waste is classified under Waste Code No. 57 108 (polystyrene wastes), except for the Luran S (ASA + PC) grades, which contain polycarbonate and are classified under Waste Code 57 117.

Under German waste monitoring regulations, solidified plastic waste of this type does not require any special disposal measures. Luran S waste can therefore usually be disposed of to landfill (cf. Safety Data Sheet). According to our knowledge, Luran S waste is inert in landfill. Luran S is classified as presenting no threat to ground water.

Subject to official regulations Luran S may also be incinerated in a suitable incinerator, eg. a household waste incinerator. The fuel value of Luran S is about 10 kWh/kg, about 70 % higher than that of dry wood. Complete combustion gives carbon dioxide, water and nitrogen, the nitrogen being oxidized to a limited extent to give nitrogen oxides.

Recovery

Waste consisting solely of Luran S can be recycled. Waste arising during injection moulding or thermoforming, for example, can be fed back to the process as regrind (cf. mechanical Recycling, page 19). Used parts consisting solely of Luran S can also be recycled, after cleaning and size reduction, to give new mouldings. Depending on the age and application of the used parts to be mechanically recycled, certain properties, such as mechanical properties, colour etc., may have undergone change; it is therefore necessary to check the suitability of the recycled material for the intended application in each individual case.

The good compatibility of Luran S with ABS also makes it possible to include a limited quantity of Luran S in the processing of ABS (up to about 25 % of Luran S, based on ABS).

It should be noted that, under Underwriters Laboratories (UL) regulations, the flame-retardant grade Luran S KR 2867 C WU does not retain its UL material classification when more than 25 % of regrind or recycled material is added.

Supply and literature references

Supply

Product quality alone is no longer any guarantee of success in the market. We offer our customers tailored supply arrangements so that they can achieve success in the marketing of their products. Our professional advice and customer care ensure that service and costs are kept in balance, from recognizing customer requirements at order placement, production, storage and distribution through the receipt and use of our products. We can help in finding the right methods for reducing raw materials inventory or achieving service level targets. Special measures can often be found to make shipments quicker and more flexible. We will help you optimize cost-value ratios.

When the customer examines the whole of the supply chain, certain questions always arise: In which situations does fast and flexible delivery really make

sense? What are the consequences for costs in the overall supply chain? What is an acceptable level for raw material inventory costs? What degree of delivery reliability is necessary to allow a continuing reduction in inventories?

Besides advising on measures to increase the security of supply over the entire supply chain, our specialists can also help with packing, transport and storage problems. We can collaborate as partners to offer help and solutions on any question which may arise.

Cooperation from order booking to delivery brings the supplier and customer advantages which are well worth having.

Luran® S
Fit for the future

Literature references

BASF publications
“Chemical Resistance of Styrene Copolymers”
(TI-KTC/A 01 d 82 442 July 1995)

“BASF Plastics: Automotive construction”
B 569

“BASF Plastics: Electrical engineering”
B 570

Other literature
“Design of thermoplastic injection moldings” VDI 2006

G. Lindenschmidt, R. Theysohn: “Styrene copolymers (SAN, ABS, ASA)”
Kunststoffe, 77 (1987), p. 982

K. Ruppmich: “ASA/PC - An interesting alternative to ABS/PC”
Kunststoffe, 75 (1985), p. 740

B. Rosenau: “ASA plastics: Properties and applications”
Kunststoffe, 85 (1995), p. 804

A. Zahn: “ASA and ABS compared”
Kunststoffe, 87 (1997), p. 314

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Internet: http://www.basf.de

Plastics from BASF

The product range at a glance

Products from BASF Aktiengesellschaft

Terluran®	Acrylonitrile/butadiene/styrene polymer	ABS
Ronfalin®	Acrylonitrile/butadiene/styrene polymer	ABS
Luran® S	Acrylonitrile/styrene/acrylate polymer	ASA, (ASA + PC)
Luran®	Styrene/acrylonitrile copolymer	SAN
Terlux®	Methyl methacrylate/acrylonitrile/butadiene/ styrene polymer	MABS
Terblend® N	Acrylonitrile/butadiene/styrene polymer and polyamide	ABS + PA
Luranyl®	Blend of polyphenylene ether and PS-I	(PPE + PS-I)
Polystyrol, impact-modified	Styrene/butadiene polymer	PS-I
Polystyrol, impact modified	Polystyrene	PS
Styrolux®	Styrene/butadiene block copolymer	SBS
Styroblend®	Blend based on styrene/butadiene polymer	PS-I blend
Styroflex®	Styrene/butadiene block copolymer	SBS
Ecoflex®	Biodegradable plastic/polyester	
Ultradur®	Polybutylene terephthalate	PBT, (PBT + ASA)
Ultraform®	Polyoxymethylene	POM
Ultramid®	Polyamides	PA 6, 66, 6/66, 6/6T
Ultrason® E	Polyethersulfone	PES
Ultrason® S	Polysulfone	PSU
Styropor®	Expandable polystyrene	EPS
Neopor®	Expandable polystyrene	EPS
Styrodur® C	Extruded rigid polystyrene foam	XPS
Neopolen® P	Polypropylene foam	EPP
Neopolen® E	Polyethylene foam	EPE
Basotect®	Foam from melamine resin	MF
Palusol®	Silicate foam	

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Polyurethanes

Lupranat®	Diisocyanates	PU
Lupraphen®	Polyester polyols	PU
Lupranol®	Polyether polyols	PU
Pluracol®*	Polyether polyols	PU
Elastan®	Systems for sportsfield coverings	PU
Elastocoat®	C systems as coating and casting compounds	PU
Elastoflex®	Soft polyurethane foam systems	PU
Elastofoam®	Soft integral polyurethane foam systems	PU
Elastolit®	Rigid integral polyurethane foam systems and RIM systems	PU
Elastonat®	Flexible integral polyurethane systems	PU
Elastopan®	Polyurethane shoe foam systems	PU
Elastopor®	Rigid polyurethane foam systems	PU
Elasturan®	Systems as cold curing cast elastomers	PU
SPS®	Steel-polyurethane systems	PU
Elastospray	PU system	PU
Autofroth®	PU system	PU
Elastoskin™*	Flexible integral polyurethane systems	PU
Cellasto®	Components made from microcellular PUR elastomers	PU
Elastocell®	Components made from microcellular PUR elastomers	PU
CeoDS®	Multifunctional composits made from Cellasto® components	PU
Emdicell®	Components made from microcellular PUR elastomers	PU
Elastollan®	Thermoplastic polyurethane elastomers	TPU

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Further Information:
www.basf.com
www.basf.de

Additional information

on polyurethanes can be found at:
www.elastogran.de

on polyolefines can be found at:
www.basell.com

on PVC and PVDC can be found at:
www.solvay.com and www.solvay.de

Note
The information submitted in this publication is based on our current knowledge and experience. In view of the many factors that may affect processing and application, this data does not relieve processors of the responsibility of carrying out their own tests and experiments; neither do they imply any legally binding assurance of certain properties or of suitability for a specific purpose. It is the responsibility of those to whom we supply our products to ensure that any proprietary rights and existing laws and legislation are observed.

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