



Lubrizol

LUBRIZOL  
ENGINEERED  
POLYMERS

**ADVANCING MATERIALS.  
ELEVATING PERFORMANCE.**



**Estane<sup>®</sup> SKN TPU**  
High Transparency Solution for  
Mobile Device Protective Cases

# Agenda

**Introduction to Lubrizol**

**Estane<sup>®</sup> SKN TPU Introduction**

**Advantages of Estane<sup>®</sup> SKN TPU for Protective Cases**

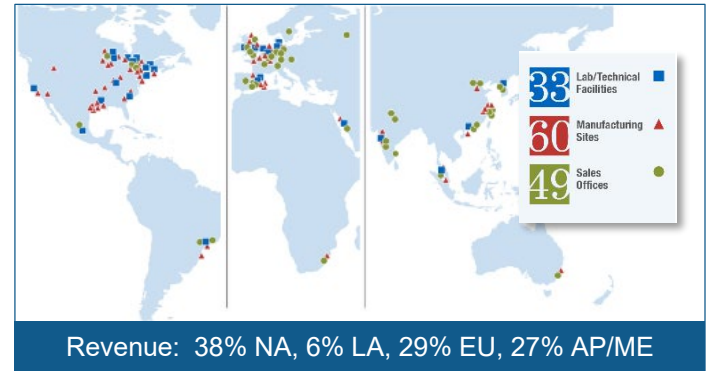
**Advantages of Anti-Blooming Estane<sup>®</sup> SKN TPU Technology**

**Molding Ability of Estane<sup>®</sup> SKN TPU**

© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.

# The Lubrizol Corporation

- **A Berkshire Hathaway company**
  - Chairman & CEO Warren E. Buffett
  - Portfolio of more than 60 businesses
  - 2016: \$222B revenue, \$24B net income
  - #1 on Forbes America's Top Public Companies, #3 on Forbes Global 2000
- **The Lubrizol Corporation, established 1928**
  - 2017: \$6.3B revenue, over 8,000 employees
  - Global business; headquartered in Cleveland, OH
  - Serves customers in > 100 countries from a well-networked global structure



© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.

# About Lubrizol

## Our Mission

We improve lives as an **essential partner in our customers' success**, delivering **efficiency, reliability** or **wellness** to their end users.

## Our Vision

We combine **market insights** with **chemistry** and **application capabilities** to deliver valuable solutions to customers and their end-users in the **global transportation, industrial** and **consumer markets**.

**Lubrizol is a global specialty chemical company.**

© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.

# Lubrizol Additives

- **Develop** products that play an essential part in the proven performance of the finished lubricant
- **Extensively test** additives in the lab and in the field under real-world conditions
- **Help customers** differentiate and succeed through trusted expertise, testing confidence, global supply and independent strength

## Product Lines

- Engine Additives
- Industrial Additives
- Driveline Additives
- Fuel Additives

**Our products keep the world moving...**



© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.

# Lubrizol Advanced Materials

- **Create** proprietary, high-performance materials for customers in a wide range of industries
- **Apply** core polymer and surface active chemistries and formulations know-how
- **Accelerate** development cycles and customer success through collaboration, strategic partnerships and a well-networked global team

## Global Business Units

- Engineered Materials
  - Engineered Polymers
  - Performance Coatings
  - CPVC Piping Systems
- Personal, Home & Health Care
  - Personal and Home Care
  - Skin Essentials
  - Life Sciences

**At work...at home...anywhere you are!**



© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.

# Engineered Polymers

- Inventor of TPU in 1959 – Acquired by Lubrizol in 2004
- Estane® brand TPU globally recognized as the benchmark for performance and quality
- Extensive portfolio of specialty polymers that bridge the gap between flexible rubber and rigid plastics, with a variety of physical and functional property combinations
- Collaborative applications development partner
- Locally present, globally networked for full support



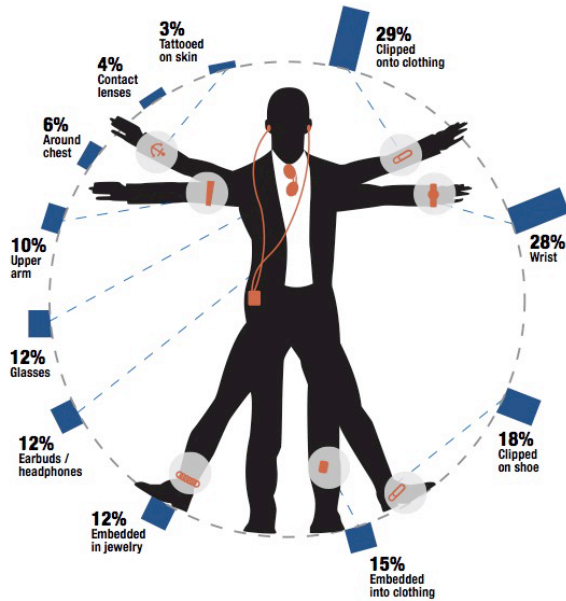
© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.



# Introduction to Estane<sup>®</sup> SKN TPU for Consumer Electronics



# Estane<sup>®</sup> SKN TPU for Consumer Electronics



Base: 4,657 U.S. online adults (18+)  
(multiple responses accepted)

## Mobile Cases

- Transparent Cases
- Bumper Cases
- Phones/Pad Covers

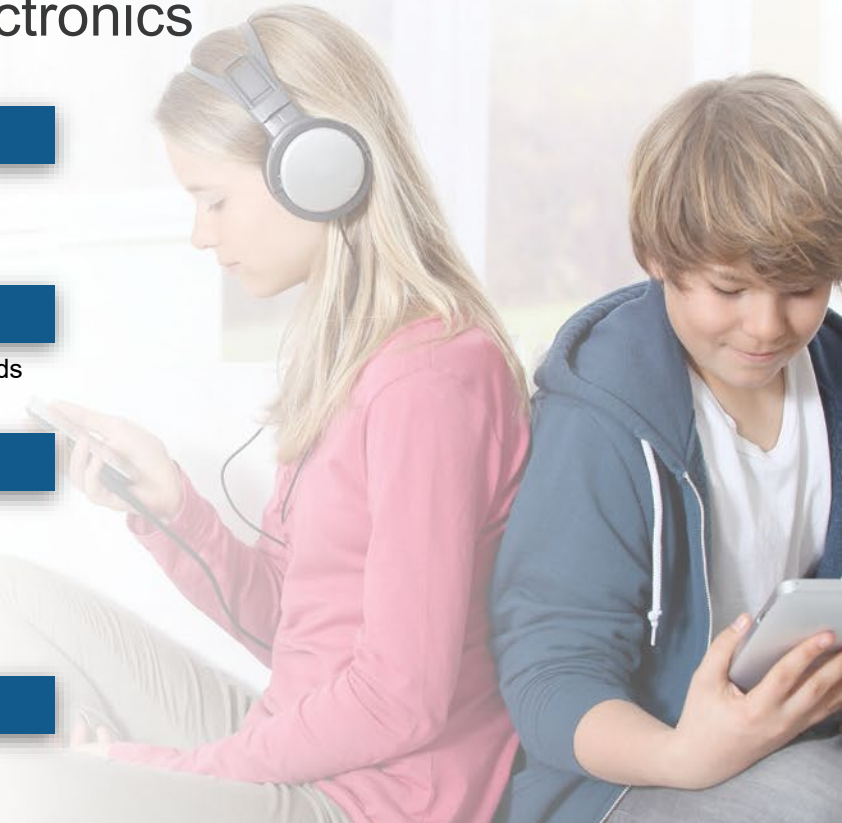
## Wearables

- Smart Watch Belts & Bands
- AR/VR

## Accessories

- Earphones/Headphones
- USB Cables/Headset Cables
- Speaker Components
- Component Packaging

## Flexible Electronics



© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.

**LUBRIZOL**  
ENGINEERED  
POLYMERS

**ADVANCING MATERIALS.  
ELEVATING PERFORMANCE.**

**Lubrizol**

# Estane<sup>®</sup> SKN TPU Benefits for Consumer Electronics

- High Performance
  - Stain Resistance
  - Chemical Resistance
  - Impact Resistance
  - Advanced Protection
- Sustainable
  - Bio-based\* TPU
  - Plasticizer Free
  - Recyclable
- More Appealing
  - Design Flexibility
  - Clarity, UV Resistance
  - Haptics
  - Self-healing

---

**We improve lives by  
providing innovative  
polymer solutions that  
make products**

---

\*Bio-based content as certified in accordance with ASTM D-6866

© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.





# Advantages of Estane<sup>®</sup> SKN TPU for Protective Cases

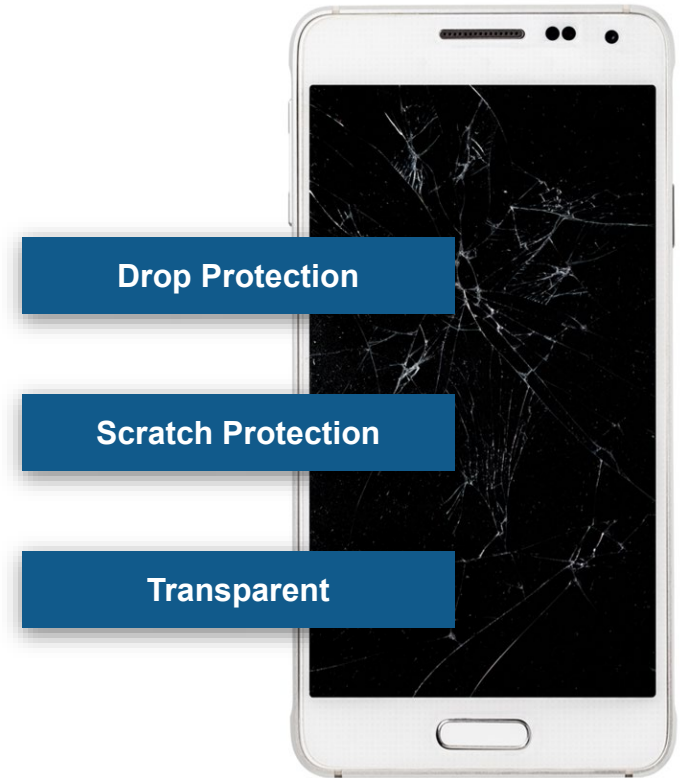
# Mobile Accessory and Protective Case Market Trends

- Spending on mobile phone accessories is expected to reach \$107.3 billion by 2022, up from about \$61 billion in 2014.
- Protective cases are the hottest sellers in the accessories category and represent 21% of market.
- The growth of protective cases is attributed to companies continuously focusing on designing lightweight protective cases for consumers.

© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.

# Advantages of Protective Cases

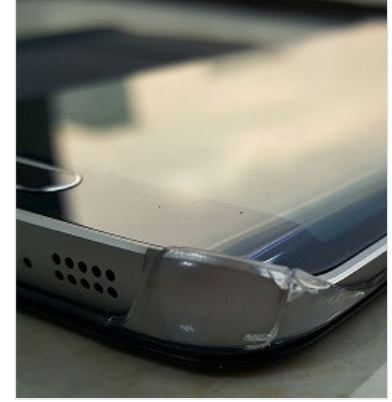
- **Question:** When you purchase a new smartphone, what's the first accessory you think of to go along with your device?
- **Answer:** The most common accessory is a protective case.



© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.

# Problems with Traditional Protective Cases

- x Blooming
- x Poor Clarity
- x Yellowing
- x Cracking



© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.

# Protective Case Customer Needs

- High Transparency
- Anti-Blooming
- UV Resistance
- Impact Absorbent
- Easy Processing



© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.

# Estane<sup>®</sup> SKN TPU is Ideal for Protective Cases

- Estane<sup>®</sup> SKN TPUs are **anti-blooming, high transparency**, polyester-type TPU that provide **super artistic, protective and design flexibility** for mobile phone and electronics devices.

Features	Benefits
Anti-Blooming	Longer Use Time, No Need to Change
High Transparency	Flexible and Soft, Promote Smart Phone Style
Good Bonding to PC/ABS	Can Meet Different Design Requirements (over molding, IMD)
Mechanical Strength	High Energy Absorption, Strong Device Protection
Easy Molding	High Production Efficiency
Flexible	Can Mold to Very Thin and Very Thick Cases

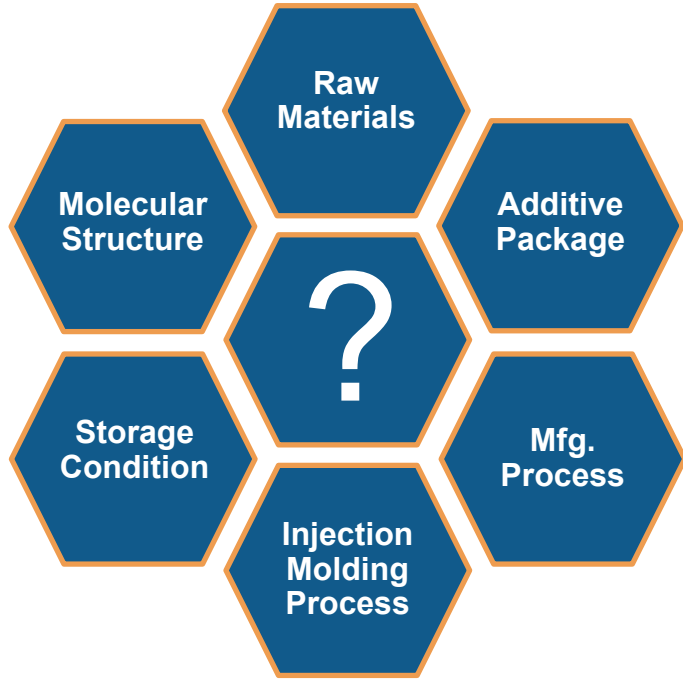
© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.





# Advantages of Anti-Blooming Estane<sup>®</sup> SKN TPU Technology

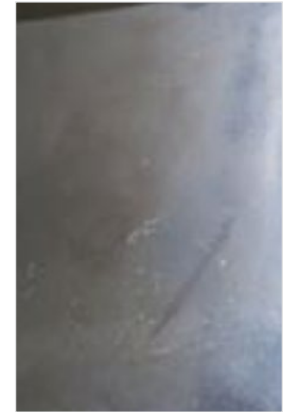
# What Causes Blooming?



Normal



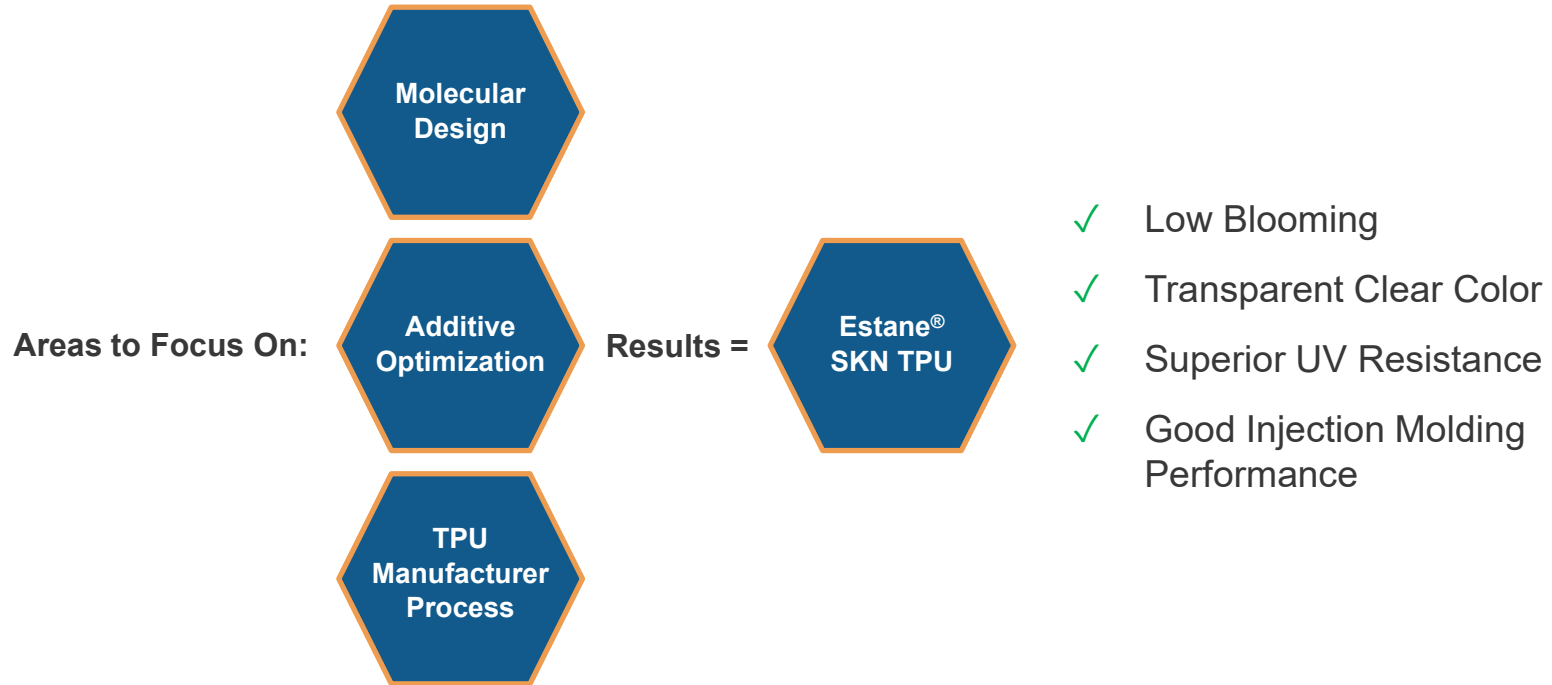
Blooming



Severe Blooming

© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.

# How Can You Control Blooming?



© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.

# Estane® SKN TPU Anti-Blooming: Storage Test Results

- Storage Testing (Kept in Storage for 12 months)



© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.

# Estane<sup>®</sup> SKN TPU Anti-Blooming: Temperature Results

- Samples kept 18 months at room temperature and 40°C and high humidity (85%)

at 40°C X 85RH% X 4 weeks



SKN95C2



SKN98C0



General polyester

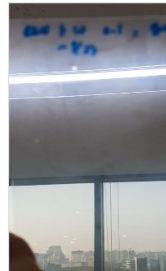


- Samples Kept 2 Months at High Temperature (65-80°C)

at 80°C X 2months



SKN95C2



General polyester  
(medium to high level of wax)



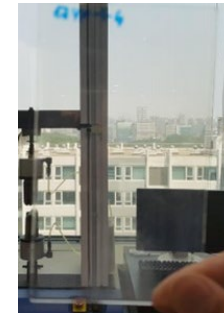
© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.

# Anti-Blooming Comparison: Estane<sup>®</sup> SKN TPU vs. Competitor

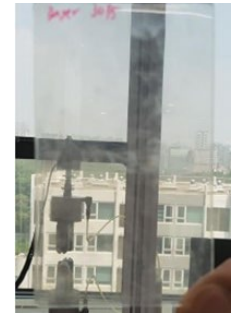
- Blooming Rating (0 = None – 5 = Serious)
- Estane<sup>®</sup> SKN95C2 Anti-Blooming 1 Year at Room Temperature
- Estane<sup>®</sup> SKN95C2 Anti-Blooming 2 Weeks at High Temperature

Test Condition	Test Period	Estane <sup>®</sup> SKN95C2	Competitor
Room Temperature	1 Year	0	-
@ 40°C Oven	3 Months	0	1
40°C / 80% Humidity Chamber	2 Weeks	0	2
80°C Oven	2 Weeks	1	5

NOTE: Blooming test result, tested by injection plaque (120mm\*90mm\*1mm). Only SKN95C2 was tested for Room temperature / 1 year test condition.



SKN95C2



Competitor

© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.

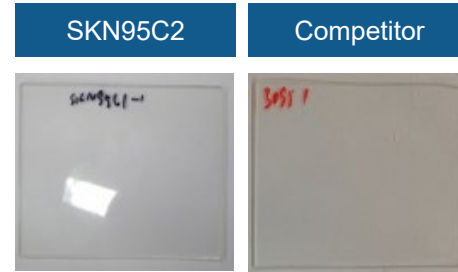
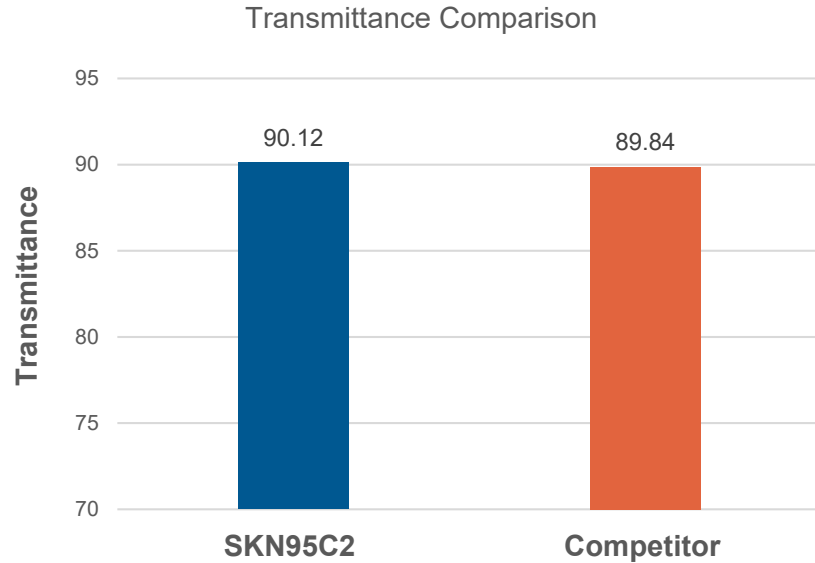
# Mechanical Properties: Estane® SKN TPU vs. Competitor

Properties	Test Method	Unit	Estane® SKN95C2	Competitor
Hardness	ISO 868	Shore A	95	95
Specific Gravity	ISO 2781	g/cm3	1.23	1.22
Tensile Strength	ISO 527	MPa	40	40-45
Tensile Stress @100% elongation	S1 dumbbell Speed=500mm/min	MPa	12	18
Tensile Stress @200% elongation	S1 dumbbell Speed=500mm/min	MPa	21	30
Elongation		%	630	540
Tear Resistance	ISO 34	KN/m	180	240

NOTE: Prior to testing samples were conditioned at 23°C for 48 hours. The mechanical test is based on injection plaque (120mm\*90mm\*2mm). Density and hardness are based on injection plaque. Listed values are “typical (average) values” and should/cannot be applied for specification purposes

© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.

# Strength of Estane<sup>®</sup> SKN TPU: High Transparency

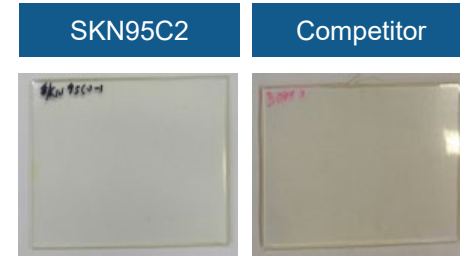
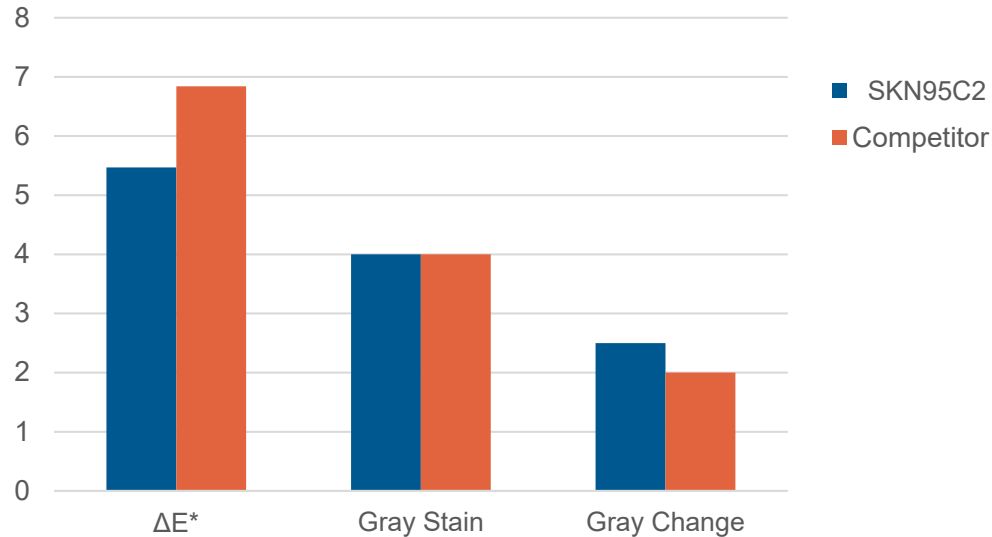


Referenced by ASTM D1925 Standard Test Method Luminous Transmittance of Transparent Plastics; 2mm Plaque for test

© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.



# Strength of Estane<sup>®</sup> SKN TPU: High UV Resistance



Notes:  
QUV lamp A 340nm; 0.68 W/m<sup>2</sup>\*nm; 4 hours  
UV at 600C, 4 hours no UV at 500C; 8h as  
one cycle. 96hrs means 12 cycles.

**Less color change (lower  $\Delta E$ ) and similar grey change**

© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.



## Molding Ability of Estane<sup>®</sup> SKN TPU

# Molding Ability of Estane<sup>®</sup> SKN TPU

- **Injection Temperature:** 220~235°C (melting zone) is the proper injection temperature. **Result:** Slightly higher than competitive
- **Injection Speed:** Moderate to slightly fast
- **Mold Temperature:** 40~70°C which is proper for thin wall mold
- Recommendation slightly higher injection and mold temperature is better to avoid flow mark, shrinkage and warpage for thin wall molding

© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.

LUBRIZOL  
ENGINEERED  
POLYMERS

ADVANCING MATERIALS.  
ELEVATING PERFORMANCE.

*Lubrizol*

# Estane<sup>®</sup> SKN TPU Injection Guide Appendix

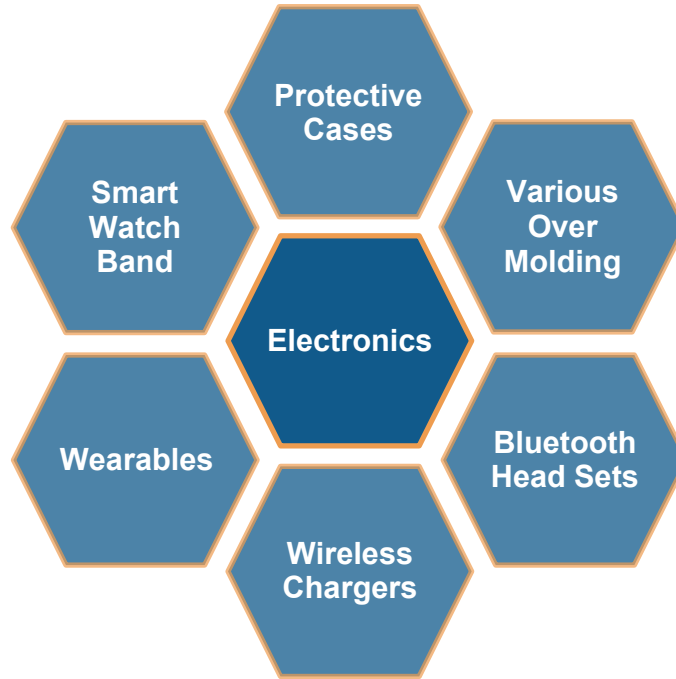
Conditions	Estane <sup>®</sup> SKN95C2
Feed Zone Temperature (°C)	200
Metering Zone Temperature (°C)	225
Compression Zone Temperature (°C)	232
Nozzle Temperature (°C)	235
Injection Speed (mm/s)	65-65-60
Injection Pressure(MPa)	65-60-60
Holding Pressure (MPa)	30
Cooling Time(s)	16
Mold Temperature (°C)	70
Holding Time(s)	3



- 0.78 mm thickness
- Pin gate
- Three plate mold

© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.

# Consumer Electronic Applications that Can Benefit from Anti-Blooming Estane<sup>®</sup> SKN TPU Technology



© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.

# Why Lubrizol?

- Broadest and deepest specialty portfolio
  - Decades of experience with TPU
- Understand what's needed for success, with decades of proven experience
  - From polymer design to application
  - From test scale to full production scale support
  - Polymer, rheology and surface expertise
- Related downstream applications know-how
- Collaborative and responsive, local & global

© 2018 The Lubrizol Corporation. All rights reserved. All marks are the property of The Lubrizol Corporation.

Offering the highest quality TPU, we are preferred by end users across the globe. **Tapping into ever-evolving trends**, we turn exciting visions into high-performing products that leave a global impact. Working in **close collaboration with our customers**, we empower our employees to use their unique talents to **solve the toughest challenges** with the most innovative solutions.

The information contained herein is believed to be reliable, but no representations, guarantees or warranties of any kind are made as to its accuracy, suitability for particular applications, how the product(s) will perform in combination with other substances or in the user's process or the results obtained. Because of the variations in methods, conditions and equipment used commercially in processing these materials, no warranties or guarantees are made as to the suitability of the products for the applications disclosed. Full-scale testing and end product performance are the responsibility of the user. Lubrizol Advanced Materials, Inc. shall not be liable for and the customer assumes all risk and liability of any use or handling of any material beyond Lubrizol Advanced Materials, Inc.'s direct control. The SELLER MAKES NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Nothing contained herein is to be considered as permission, recommendation, nor as an inducement to practice any patented invention without permission of the patent owner.

All ® and ™ products listed in this presentation are owned by The Lubrizol Corporation.

© 2018 The Lubrizol Corporation. All rights reserved.