# OVERMOLDING WITH THERMOPLASTIC ELASTOMERS

## AN ESSENTIAL GUIDE



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# INTRODUCTION

## TODAY'S PRESENTER

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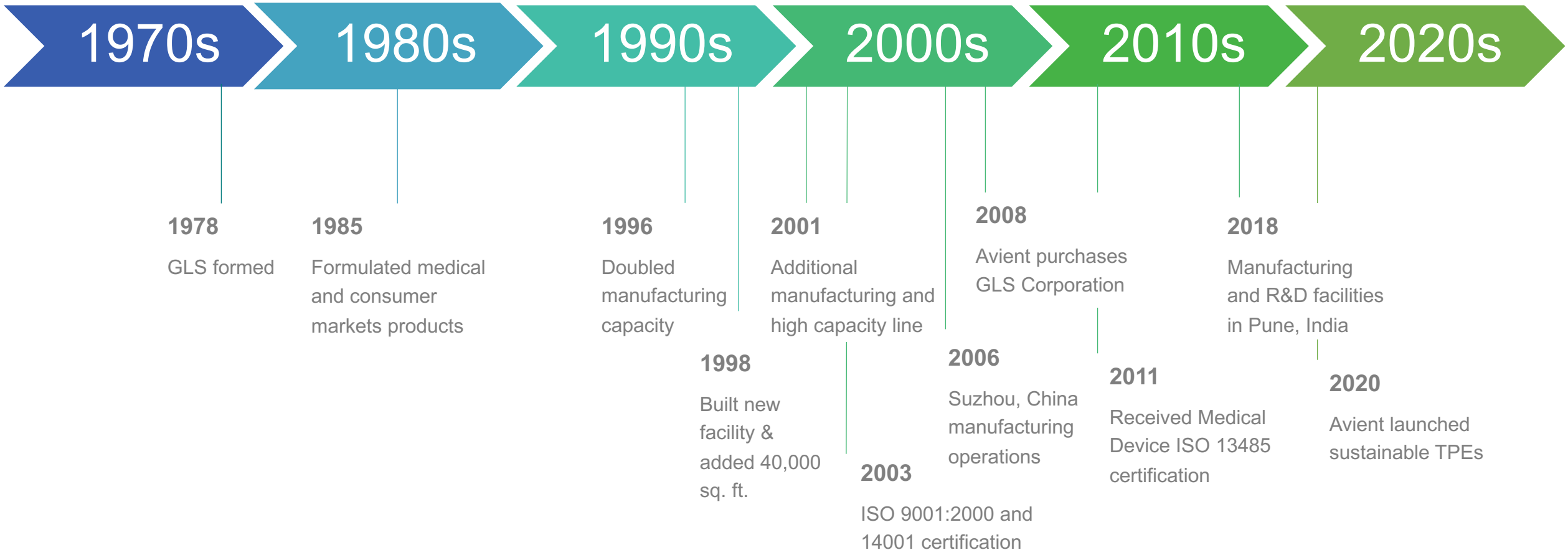
Specialty Engineered Materials

Avient Corporation

# THERMOPLASTIC ELASTOMERS AT AVIENT

## HISTORY AND MILESTONES



# DISCUSSION TOPICS

- Overmolding overview
  - What is overmolding?
  - Types of overmolding
- Material selection
- Design considerations
- Avient solutions

# WHAT IS OVERMOLDING?

- A manufacturing process that bonds one thermoplastic material to another using injection molding equipment

- Overmolding a TPE provides specific benefits
  - Haptics/aesthetics
  - Functional performance
  - Reduced manufacturing costs



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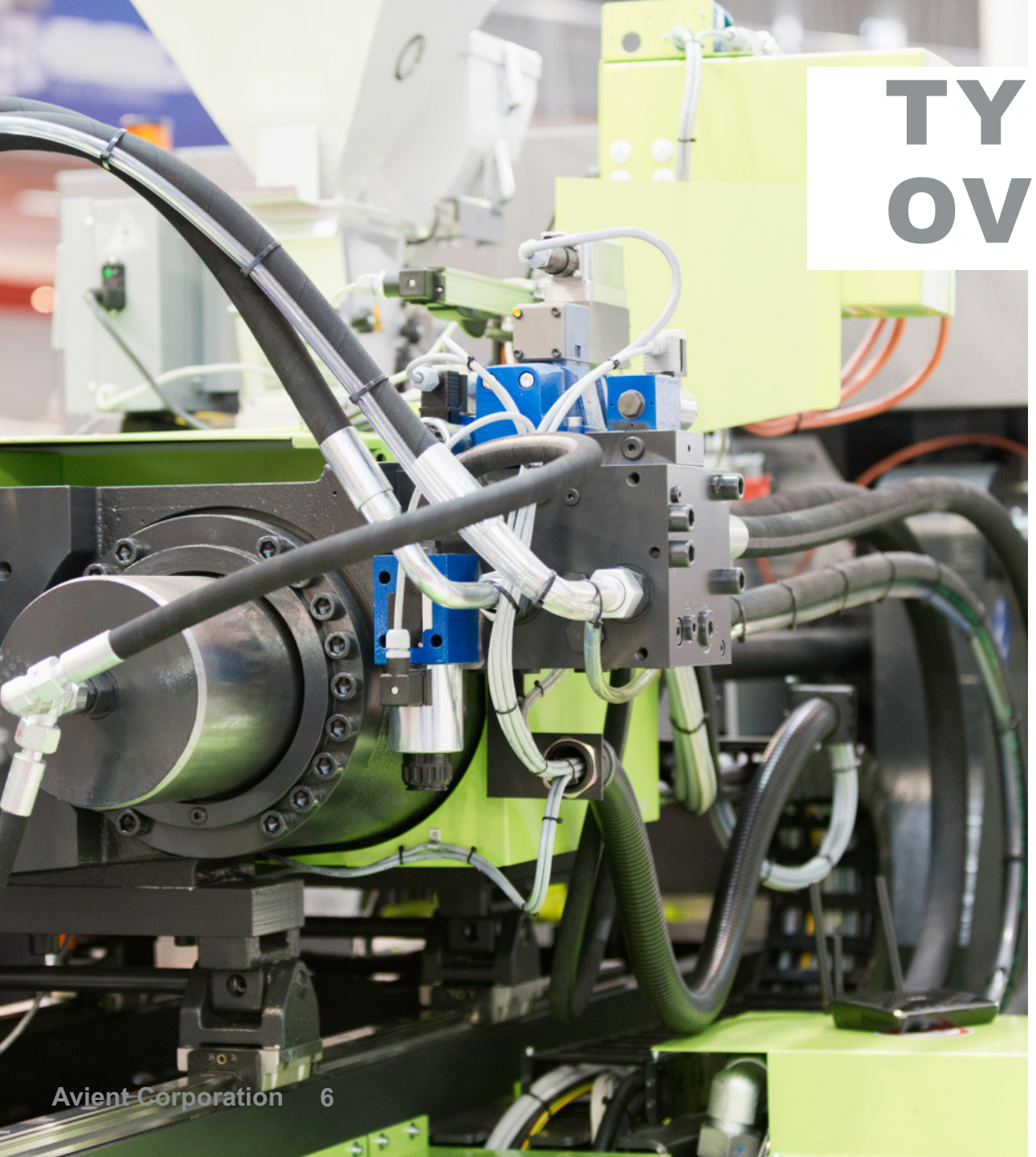

# TYPES OF OVERMOLDING

Manufacturing methods

- Insert/transfer overmolding
- 2k/2-shot overmolding

Overmolding materials

- Thermoplastic elastomers to rigid plastics
- Overmolding rigid plastics to other rigid plastics



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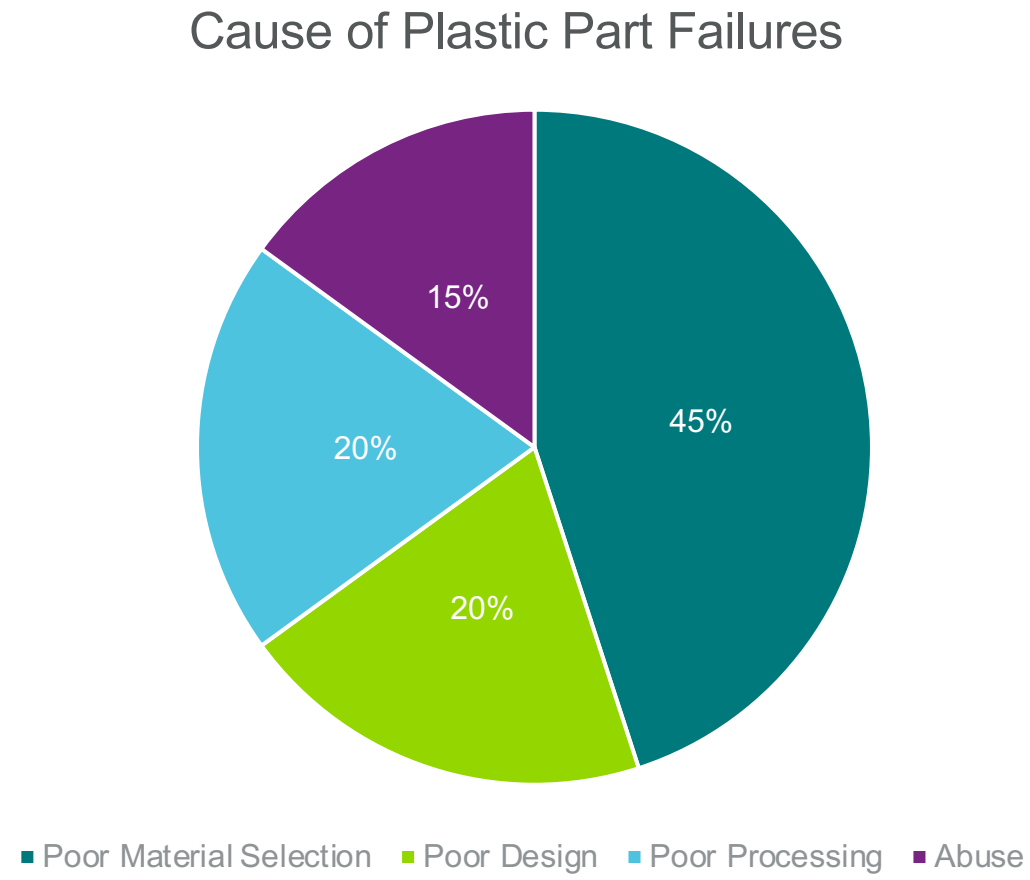
# MATERIAL SELECTION

## OVERMOLDING WITH TPES

# MATERIAL SELECTION

## CRUCIAL TO UNDERSTAND THE APPLICATION REQUIREMENTS TO SELECT THE RIGHT MATERIAL






**Application requirements**

- Functional purpose
- Environment
- Loading
- Wear
- Electrical
- Appearance
- Approvals / regulatory

# WHAT IS A THERMOPLASTIC ELASTOMER (TPE)?

- TPE materials are a type of synthetic rubber combining
  - the feel and performance of rubber
  - the processing efficiency of thermoplastics
- TPEs can be formulated to overmold and bond onto substrates such as engineering thermoplastics and commodity resins
- A wide range of product designs combine hard plastics and TPEs to improve aesthetics and functionality



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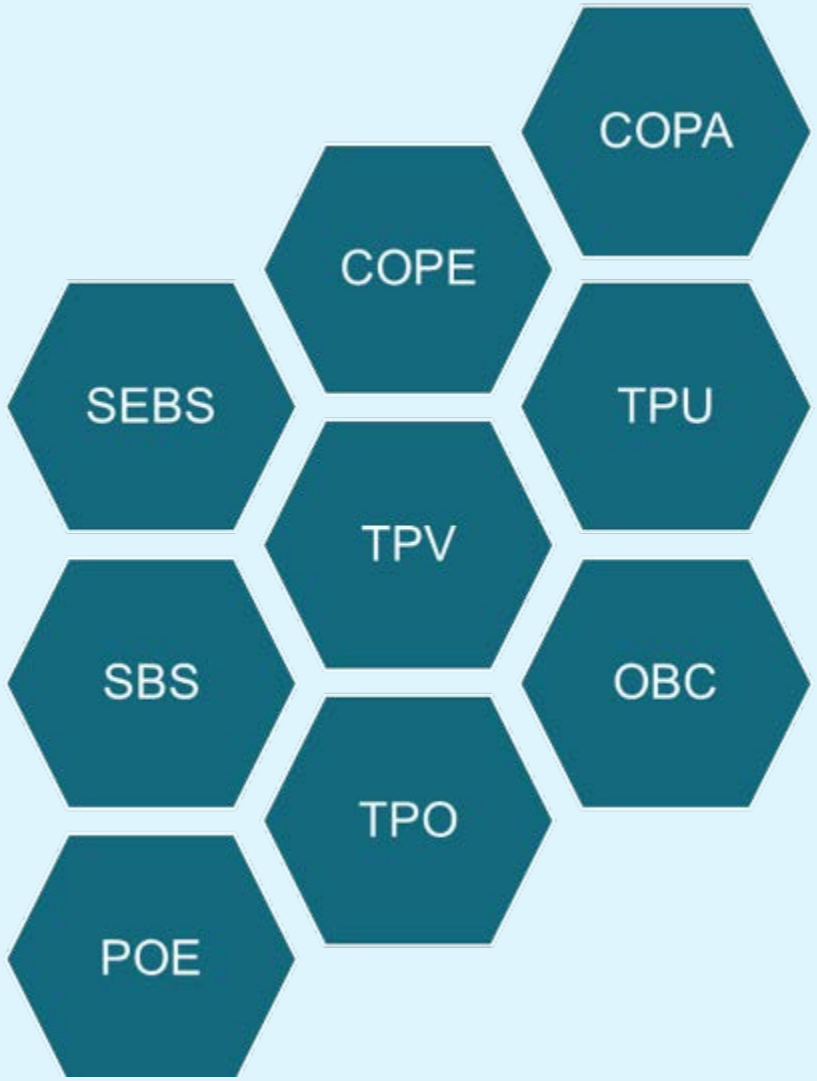
# DIFFERENT TYPES OF TPE




- Co-Polyamide Elastomer
- Co-Polyester Elastomer
- Thermoplastic Polyurethane
- Thermoplastic Vulcanizate
- Styrene-Ethylene-Butadiene-Styrene
- Olefin Block Copolymer
- Thermoplastic Polyolefin
- Styrene-Butadiene-Styrene
- Polyolefin Elastomer



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# BENEFITS OF OVERMOLDING TPES

- Improve ergonomics, aesthetics, haptics
- Achieve high performance benefits
- Reduce or eliminate assembly costs



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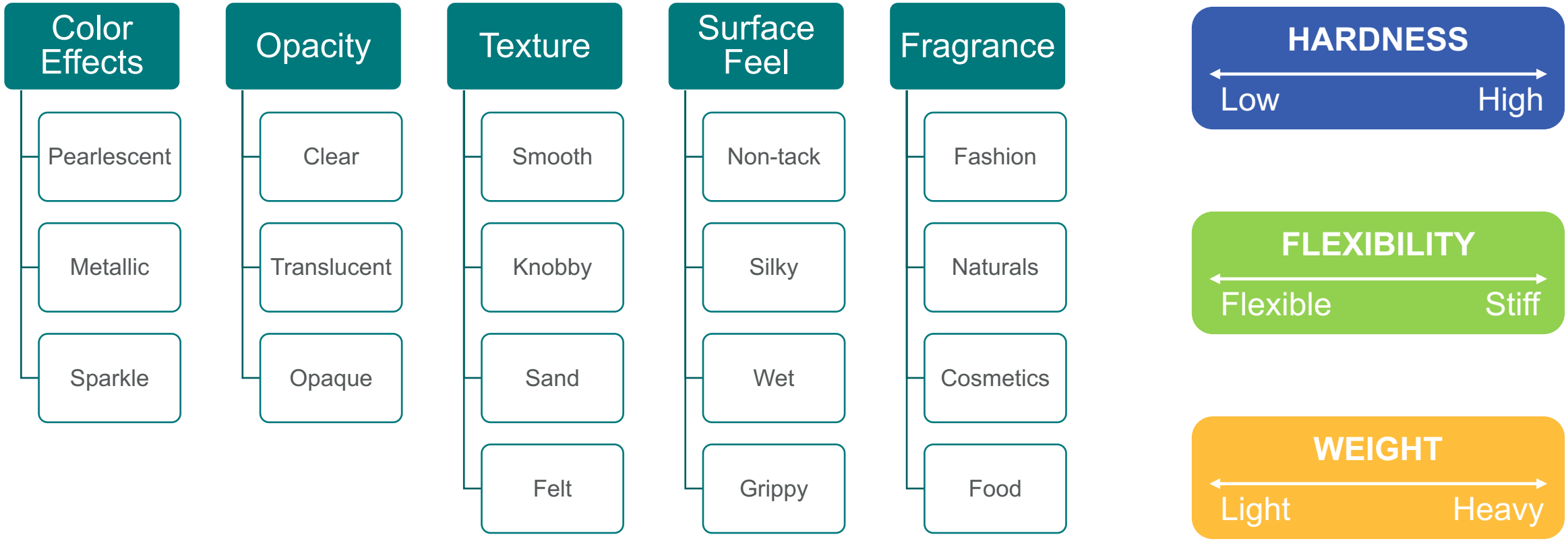
# BENEFITS OF OVERMOLDING TPES

## SENSORY CHARACTERISTICS OF TPES



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# MATERIAL SELECTION TO ACHIEVE HIGH PERFORMANCE BENEFITS

- Soft dry / wet grip
- Sealing properties
- Vibration damping
- Barrier packaging



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# OVERMOLDING SUBSTRATES

- ASA
- ABS
- PA
- PET
- PMMA
- POM
- PC, PC/ABS
- PE
- PK (polyketone)
- PP
- PS, HIPS
- PPO



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# OVERMOLDING POLYAMIDES

**Challenges to overcome**

- Chemistry – PA 6, 66
- Crystalline & amorphous regions
- Additives – chemistry & percentage content (e.g., glass, carbon fiber, flame retardants)



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# OVERMOLDING POLYKETONE

**Considerations**

- PK being used as an alternative to PA and PC alloys
  - Automotive
  - Healthcare
- PK is also being used to provide enhanced chemical resistance to cleaners vs PC alloys and PA
- Overmolding studies have shown some interesting results
  - Materials that bond to PA do not bond to PK
  - Not all existing OM TPEs bond to PK



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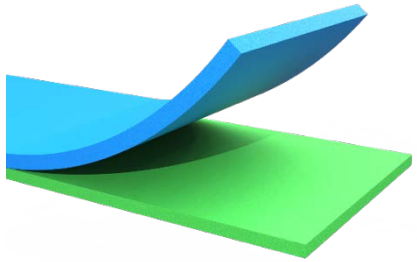
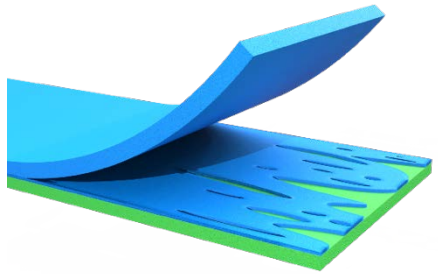
# FAILURE MODES & TESTING METHOD

## FAILURE MODE

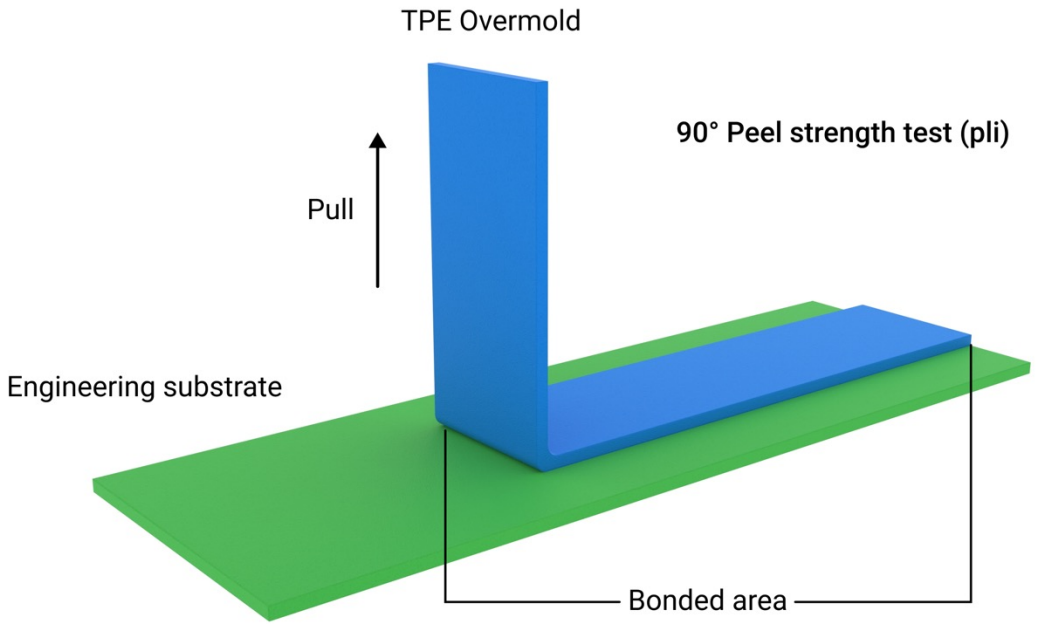


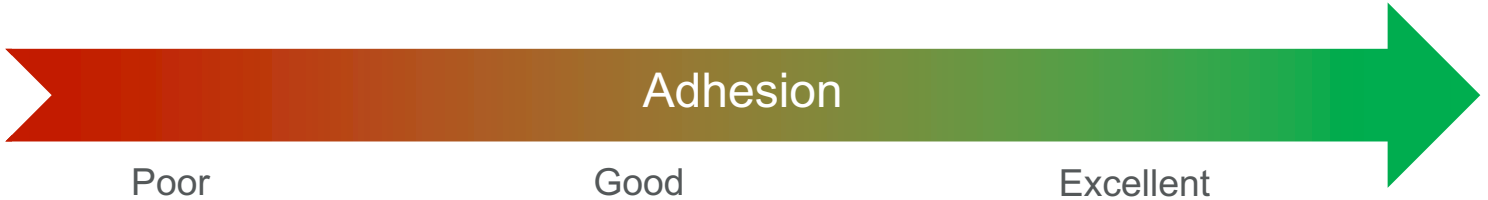
**Adhesive Bond**
TPE material residue not left behind when TPE is peeled off from the substrate



**Cohesive Bond**
TPE material residue left behind when TPE is peeled off from the substrate

## PEEL STRENGTH TESTING

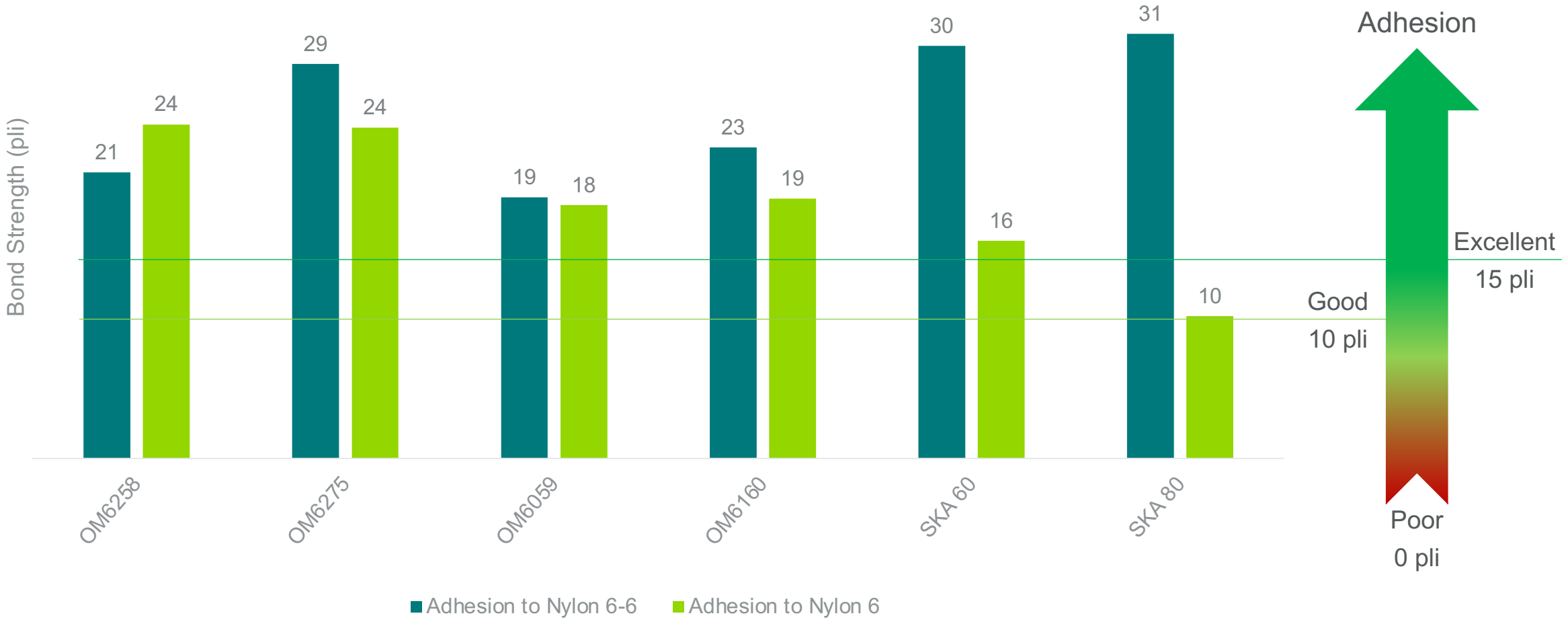



| Poor | Good | Excellent |
|---|---|---|
| 0 pli | 10 pli | 15 pli |

# ADHESION COMPARISON

## EXAMPLE OF ADHESION TO NYLON



# PROPERTY COMPARISON

## MATERIAL SELECTION IS DEPENDENT ON A NUMBER OF FACTORS

| Versaflex™, OnFlex™, and Dynaflex™ Grades | Substrate | Abrasion Resistance | Chemical Resistance | | Compression Set @ RT |
|---|---|---|---|---|---|
| | | | Acids/ Bases | Oils | |
| HC3810-50 | PP | ++ | ++++ | + | ++ |
| G7702-9 | | ++ | ++ | + | ++++ |
| OM6258 | PA 6 & 6,6 | ++ | ++ | + | ++ |
| OM1255 | PC, PET, ABS, & PK | ++++ | + | ++ | + |
| CE3620 | | +++ | ++ | ++ | ++ |
| OM9-802CL | | ++ | ++++ | + | ++ |



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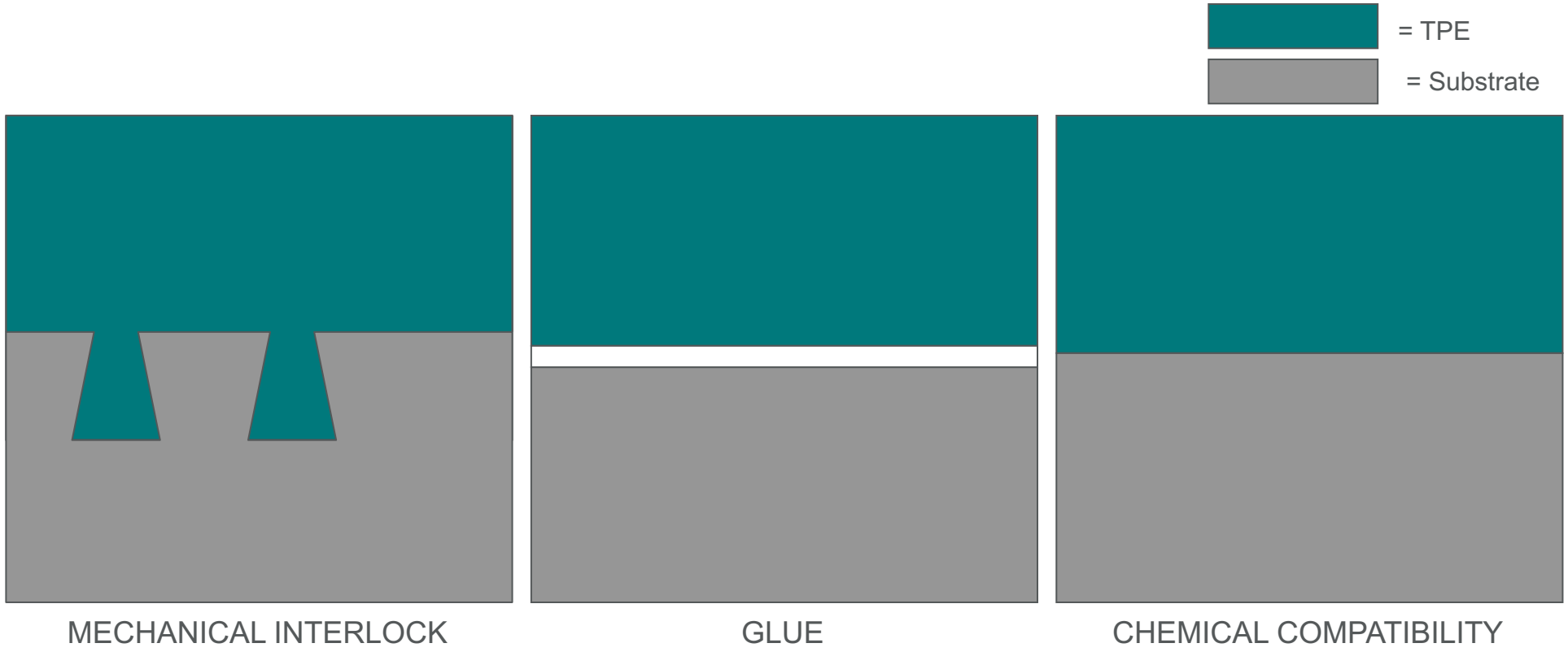
# DESIGN CONSIDERATIONS

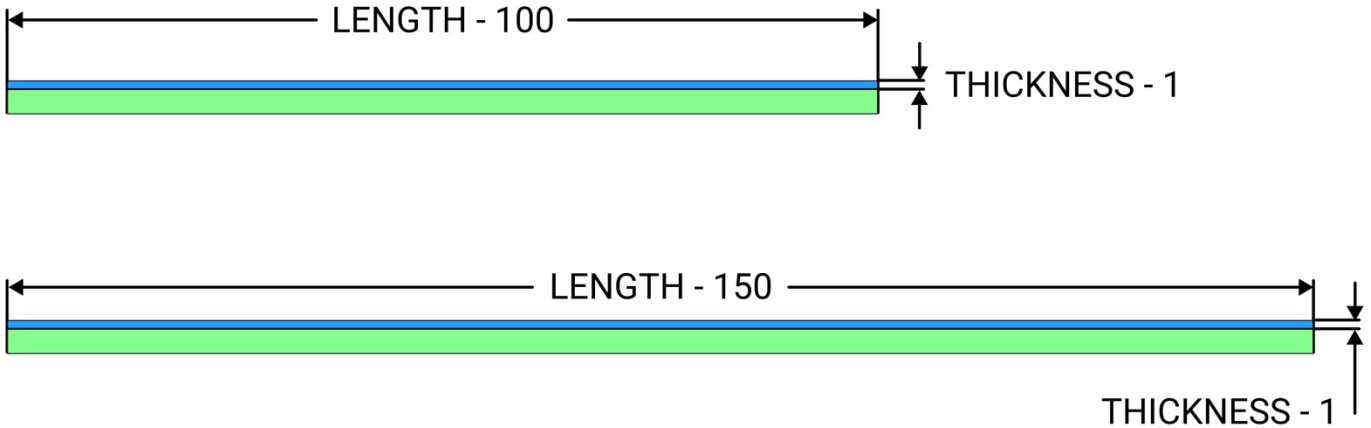
## OVERMOLDING WITH TPES

# BONDING THERMOPLASTIC ELASTOMERS

## TPES CAN BOND WITH SUBSTRATES MECHANICALLY, WITH GLUE, OR THROUGH CHEMICAL COMPATIBILITY

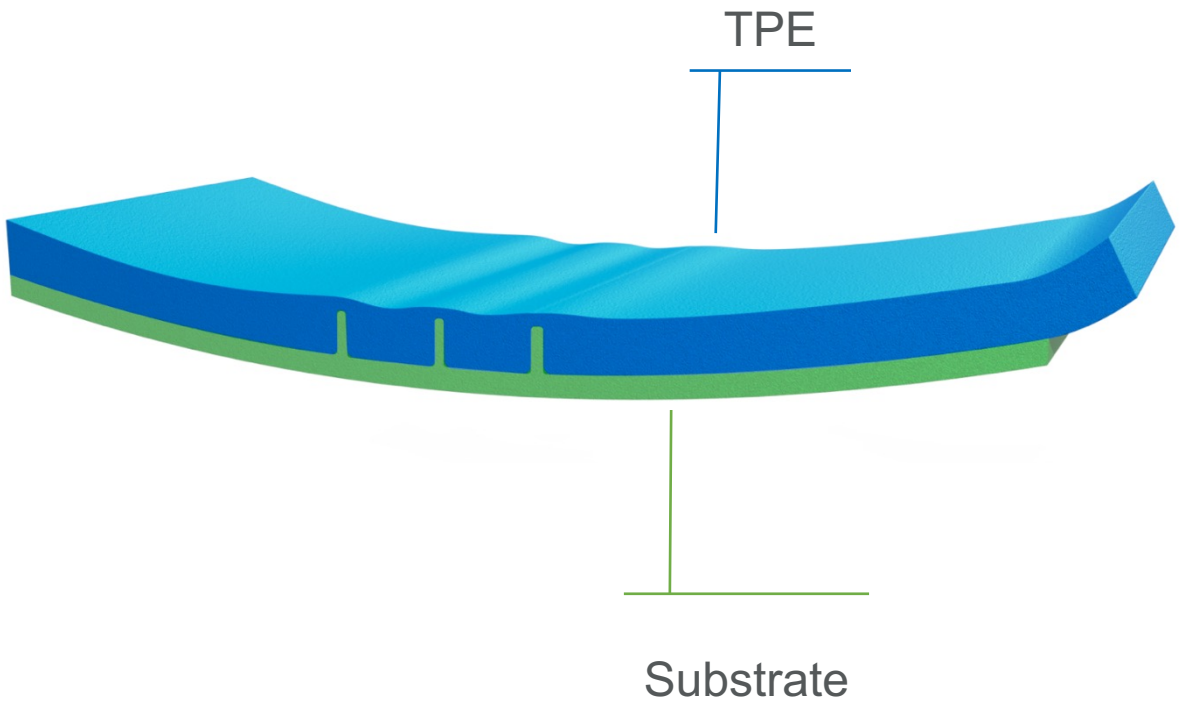


# EFFECT OF FLOW LENGTH / THICKNESS RATIO (L/T) ON TPE OVERMOLDING




- Bond strength of the overmold depends on melt temperature
- L/T recommended to be between 80 – 120 to maintain good bonding
- If L/T higher than 150, utilize multiple gates
- Avoid using thicknesses less than 0.040” as a guideline for minimum wall thickness to maintain good bonding
- For lower thicknesses, use mechanical interlocks

# EFFECTS OF TPE SHRINKAGE ON OVERMOLDED COMPONENTS




- TPE shrinkage varies from 0.010” – 0.025”. Thermoplastic shrinkage varies from 0.002” – 0.014”
- Thickness of substrate is recommended to be twice that of the thickness of the TPE
- Adding ribbing on the substrate area, underneath the TPE overmold, can cause heat sinks
- When the TPE sticks out beyond the edge of the substrate, it could try to curl towards the warmer side



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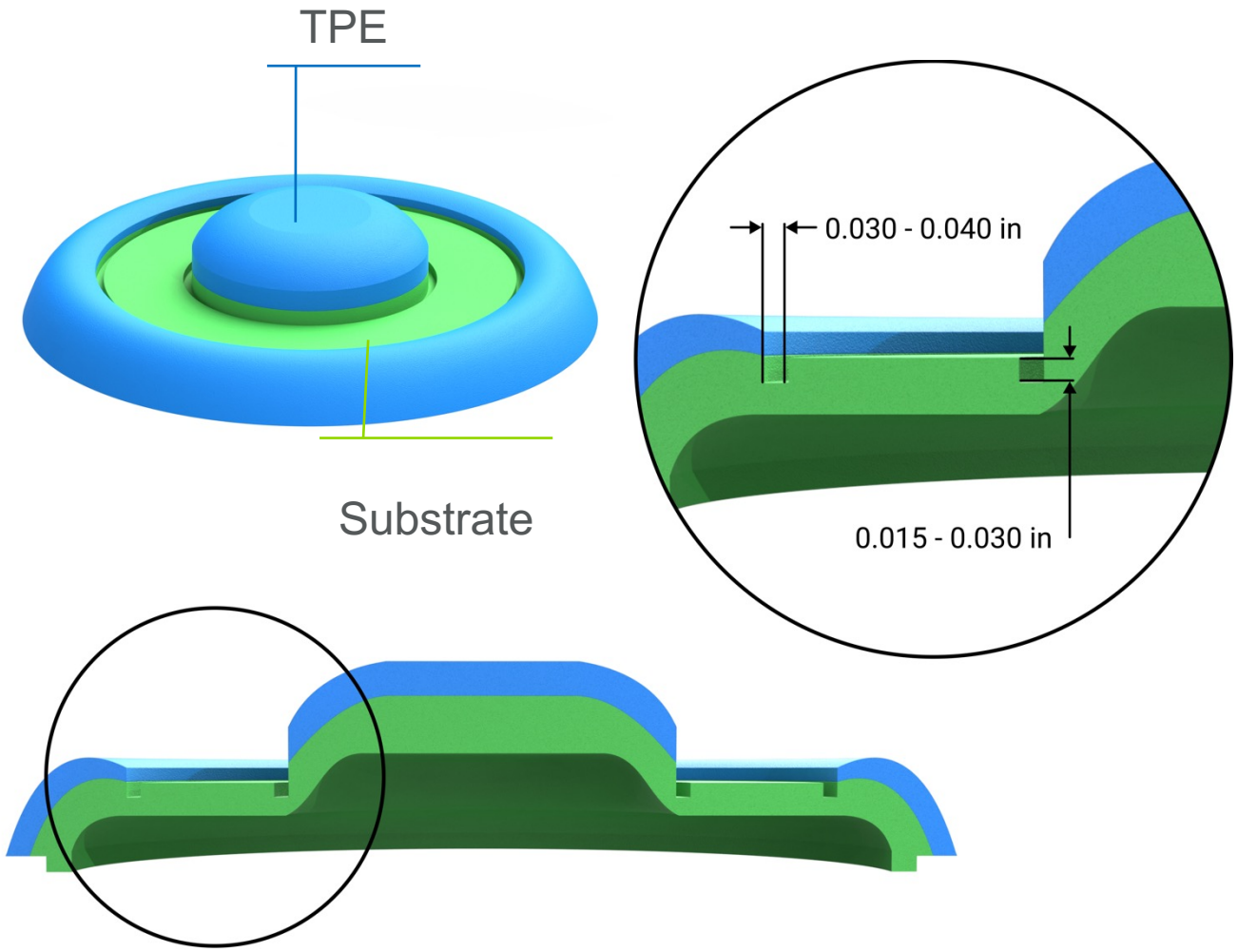
# SHUT-OFF DESIGN TO PREVENT FLASH




- Shut-off design is critical to stop TPE flash
- Shut-off grooves are designed on substrate into which tool steel enters
- Tool steel should crush into substrate by 0.003” – 0.004”
- The shut-off grooves can be used to vent the TPE overmold section



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# EFFECT OF SURFACE TEXTURE ON PART EJECTION

- TPEs stick to polished tool steel surfaces
- Surface texture helps in preventing the part from sticking to the tool
  - A minimum of a sand blast or a light EDM texture about 0.001” deep is recommended
- It is recommended to add a heavy texture to the runners, sprue, and the gate
  - A minimum texture pattern depth between 0.003” to 0.004” is recommended
- In some cases, it is recommended to use a release coating such as nickel-PTFE on a textured surface



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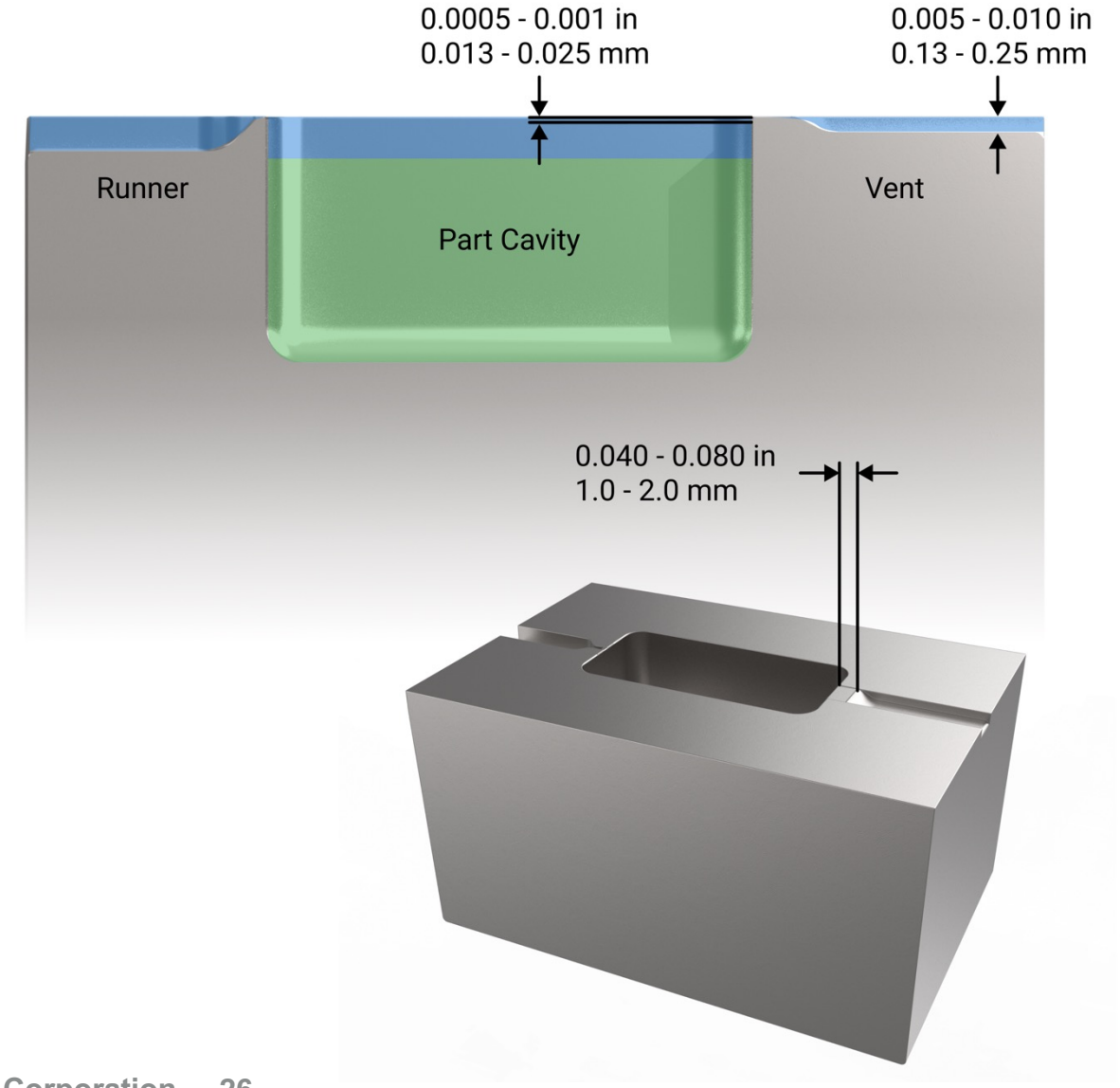
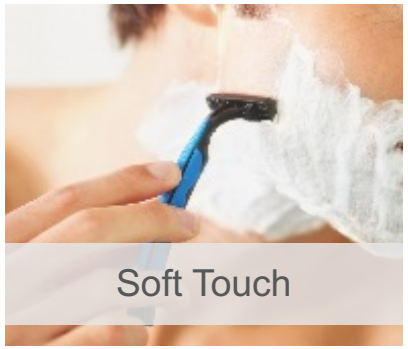
# VENTING FOR OVERMOLDED TPE PARTS




- The purpose of venting is to evacuate all entrapped air from the part cavity
- Venting should be provided at end of fill or at the perimeter edge
- Vent depth recommendations for GLS™ TPEs - 0.0005” – 0.001”
- In overmolding, no bonding is seen at locations of air traps and gas traps
- In overmolding, venting may also be provided by drilling a hole in the substrate

# AVIENT SOLUTIONS

# TPE OVERMOLDING SOLUTIONS


Soft Touch


Rugged Overmolding


Integrated Gasket Elastomers


Durable Look & Feel

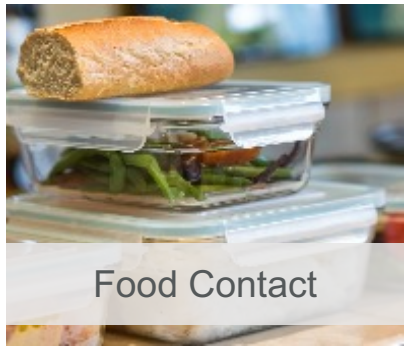

Low VOC/FOG


Chemically Resistant


Stain Resistant


Vibration Damping

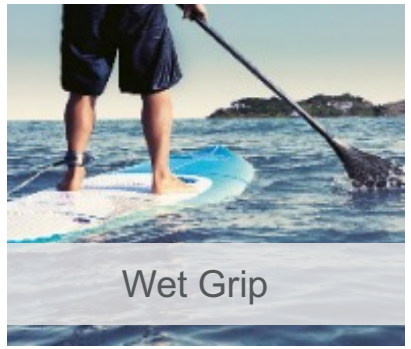

Antimicrobial Additives


Food Contact


Gels


Barrier


Shape Memory


Wet Grip


Pre-Colored Solutions



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# OVERMOLDING WITH SUSTAINABLE CONTENT

## BIO-DERIVED THERMOPLASTICS

RESOUND™ OM THERMOPLASTIC ELASTOMERS

Bio-based thermoplastic elastomers suitable for overmolding onto PP and ABS

## RECYCLED CONTENT TPE

RESOUND™ R RECYCLED CONTENT TPES

Post-consumer recycled and post-industrial recycled thermoplastic elastomers formulated with 9-83% recycled content suitable for overmolding onto PP, PC, ABS, PC/ABS



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# TOP TEN RULES

## TOOL DESIGN FOR NEW OVERMOLDED COMPONENTS

1. **Match chemistry** of TPE to substrate
2. For new component designs, **flow ratios (L/T) have to be between 80:1 – 120:1**
3. Incorporate **air vents between 0.0005” and 0.001”** along perimeter and / or at end of fill
4. Incorporate **good flow shut-offs** to prevent flashing
5. **Add surface texture** to prevent sticking and mask aesthetic defects
6. Use **rigid substrate surface for ejection**
7. Ensure **TPE is thick enough to ensure good bonding**; typically 0.040” at a minimum and use mechanical interlocks if thinner
8. The thickness of **substrate section should be twice that of the TPE** section to minimize warp
9. Use **appropriate gate size** depending on type of TPE and thickness of TPE. Start with a small gate
10. Use of a **balanced runner system or hot runner in large cavitation parts** is critical to have balance flow and ensure good bonding



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# THANK YOU

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