SIMONA PMC

Processing Guidelines

ONTEX® TPO

GLOBAL THERMOPLASTIC SOLUTIONS

TPO Technology Improvements with ONTEX®

TPO is a popular choice for a variety of thermoformed plastic parts due to its favorable properties including superior impact resistance, low coefficient of linear thermal expansion (CLTE) and excellent chemical resistance. However, one of the drawbacks of using TPO is its low surface energy that makes the material difficult to bond.

Significant surface preparation and specialty adhesion promoters are often required for painting of TPO parts and costly adhesive systems designed for low energy surfaces are required for bonding TPO with other components. ONTEX® addresses these drawbacks by creating a directly bondable and ready-to-paint surface without the need for surface treatments or specialty adhesives.

Thermoforming Guidelines

This guide provides information on processing ONTEX® TPO sheets as it does differ from typical TPO thermoforming. Generally, most grades of TPO should be heated to a core temperature of 340°F +/- 5°F for best results. However, the ONTEX® layer requires a higher temperature in order to properly soften and flow with the TPO substrate during thermoforming. This is counter to the standard thought process that adding a cap layer or laminate to a sheet means lowering the heat to that side of the product during processing.

If the ONTEX® layer is not hot enough during forming, narrow wrinkles will occur on the ONTEX® surfaces. While this does not affect bondability, it does create an aesthetic defect when painted. Most of the wrinkling tends to occur around the outer perimeter of the part, where there is typically a corner around the part boundary as well as some heat loss to the environment outside of the oven walls. Wrinkles can also occur in interior areas of the parts where there may be sharper corners or pockets as part of the design.

Examples of areas with wrinkling on ONTEX® TPO parts

When forming with ONTEX®, the following changes from a standard TPO heating profile are recommended:

- Increase width of the heat wall in the oven around the entire perimeter of the part on both top and bottom ovens.
    - Added heat wall should be around 10-20% on heater settings
    - Increase heat by another 20-30% near front of the oven not equipped with a door
- Increase oven settings in the center of the part area by around 5-10%.
- Increase perimeter heats around part boundary by 15-20% to avoid wrinkling on edges

- Keep the non-ONTEX® side of the ovens that same as normal TPO forming or reduce heats 10-20% in order to control sag depth and avoid webbing.

For reference, some example oven profiles for TPO and TPO with one side ONTEX® are included below. Please keep in mind that all ovens are different based on oven type, heating element setup, etc. so the below profiles are examples only from trials at SIMONA PMC and various other thermoforming sites. Quartz or ceramic elements with zone control are always preferred for TPO forming. The profiles below also assume a top-mounted tool with ONTEX® on the A surface (facing bottom oven) for painting and that the oven is open near the front.

Top Oven (non-ONTEX® side or B side)

Standard TPO Profile

	A	B	C	D	E	F	G
1	0	0	0	0	0	0	0
2	0	55	55	55	55	55	0
3	0	55	40	40	40	55	0
4	0	55	40	40	40	55	0
5	50	50	50	50	50	50	50

Profile with A Side ONTEX®

	A	B	C	D	E	F	G
1	20	20	20	20	20	20	20
2	20	55	55	55	55	55	20
3	20	55	40	40	40	55	20
4	20	55	40	40	40	55	20
5	50	50	50	50	50	50	50

Bottom Oven (ONTEX® side or A side)

Standard TPO Profile

	A	B	C	D	E	F	G
1	0	0	0	0	0	0	0
2	0	40	40	40	40	40	0
3	0	40	40	40	40	40	0
4	0	40	40	40	40	40	0
5	50	50	50	50	50	50	50

Profile with A Side ONTEX®

	A	B	C	D	E	F	G
1	20	20	20	20	20	20	20
2	20	60	60	60	60	60	20
3	20	60	50	50	50	60	20
4	20	60	50	50	50	60	20
5	70	70	70	70	70	70	70

Other recommendations for processing TPO or TPO with ONTEX®:

- Cycling on sag eye is best. Keep depth around same as the height of the tool.
- If you do get hot webs on the part with ONTEX®, try cooling those areas only.
- ONTEX® TPO can be overheated as well. When this happens, the surface gets an orange peel appearance.

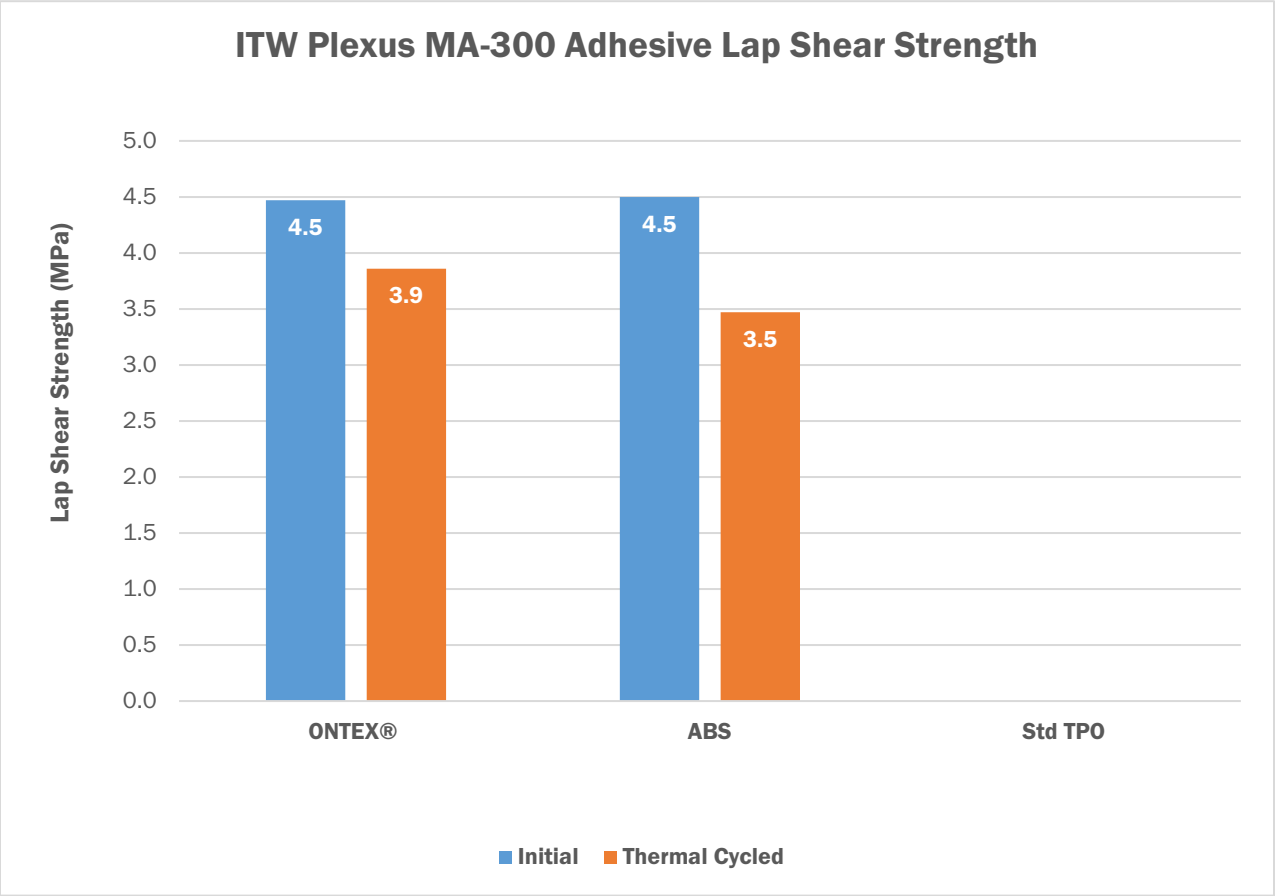
Orange peel in ONTEX® part due to Overheating

- Temperature-controlled aluminum tooling is best for TPO. However, other tooling types are used successfully with longer cooling times between parts.
- Epoxy tools are not recommended for contact with ONTEX®. ONTEX® creates an easy to bond surface which easily bonds to the surface of epoxy tooling.
- Controlled, even cooling is critical for TPO to prevent warp. Cooled tools and the use of cooling fans are recommended as well as cooling fixtures for after demolding.

Painting and Bonding with ONTEX®

Some general guidelines to consider when painting or bonding to ONTEX® TPO parts or sheet:

- No surface preparation is required. Avoid sanding, as this will damage or remove the directly bondable layer. If anything, simply wipe with a clean rag and isopropyl alcohol to remove dust.
- Standard adhesives like those used with ABS parts are acceptable to use with ONTEX® as well. Examples include Loctite plastic bonder or Plexus MA-300. Specialty adhesives such as those used with standard TPO parts are not recommended.
- ONTEX® results in excellent adhesive bond strength, similar to that seen in ABS parts. Failure mode in adhesive testing is mainly tensile failure of the plastic part itself.



Lap Shear test results for ONTEX® using a common ABS adhesive system

- ONTEX® can also be used to bond with other materials such as fiberglass resins, polyurethane foams, etc. as long as care is taken to avoid localized heating which can cause warp of the TPO substrate.

Example of ONTEX® use with foam reinforcement

- Most standard paint systems can be used with ONTEX® including PPH, DuPont, Akzo Nobel, BASF, Sherwin Williams, and others. ONTEX® provides excellent crosshatch adhesion results, even after thermal cycling.

Black part with ONTEX® partially painted white

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