

Fabrication Guidelines for SIMONA HDPE and Polypropylene Sheet

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SIMONA® HDPE and Polypropylene Sheet Products

SIMONA® HDPE (high density polyethylene) and PP (polypropylene) sheet products exhibit exceptionally consistent dimensional stability and flatness in fabrication. These benefits result from SIMONA's proprietary low stress extrusion technology, and characterize all grades and thicknesses:

SIMONA® HDPE Boat Board®

– Withstands weather extremes in marine components, outdoor cabinetry and furniture

SIMONA® HDPE Polytone® Multi-Color and Solid Color Sheet

– Durability for outdoor and indoor structures, signage

SIMONA® HDPE Industry Grades

– Natural, black and colors; NSF listed cutting board

SIMONA® PE-100 Pipe Grade

– Exceptional cold weather impact strength plus UV resistance

SIMONA® Polypropylene Homopolymer

– Chemical resistance, high rigidity and heat resistance

SIMONA® Polypropylene Copolymer

– Chemical resistance, exceptional cold temperature impact strength

SIMONA® FR-PP Flame-Retardant Polypropylene

– Meets UL 94 V-0 test criteria for electrical components and enclosures

General Fabrication Guidelines

Standard wood- and metal-working equipment typically works well with SIMONA HDPE and PP sheet products, and high speed tools are recommended.

Blades and bits for HDPE and PP designed by leading tool manufacturers for these materials are available from plastics distributors that offer SIMONA products.

Plastics are insulating materials, and not good heat conductors. Use sharp tools to help avoid overheating, and clear away machining swarf and dust frequently to prevent build-up, binding and scorching. Cool with compressed air or water to help minimize overheating and improve productivity.

Carbide-tipped tools yield a better surface and longer tool life. Standard tool steels also work well.

Factor in thermal expansion and contraction. Dimensional changes with temperature variations occur with all materials. This must be factored into fabricated sheet dimensions in the end-use environment. Use the worksheet on the back page for calculations to help ensure good fit and proper fastening.

Pre-production trials are recommended. Fabrication information and tables are guidelines only. SIMONA recommends making pre-production trials for each material, tool and condition for best results. Adjust conditions as needed to ensure a good finish without chipping, scorching or melting material.

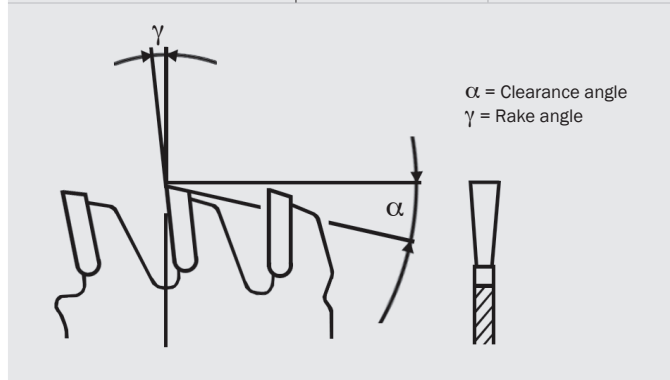
Cutting and Sawing

SIMONA HDPE and PP sheet products can be cut using the full range of saw types including circular radial arm, table, panel and hand-held power saws, band and scroll saws and jig saws.

Circular saws:

- Carbide tipped blades improve cutting performance, quality and blade life.
- The saw blade should extend slightly beyond the outer surface of the material being cut.
- Use relief-ground blades for materials over 0.2 inches thick.
- A feed of 12-16 feet per minute and the guidelines in the table are good starting points.

Circular saws – carbide tipped blades	HDPE	PP
α Clearance angle°	10-15	5-15
γ Rake angle°	0-10	0-10
Tooth pitch, inches	0.118-0.31	0.118-0.31
Cutting speed, feet/minute	3,300-10,000	2,000-10,000



Band saws:

- Band saws are best for cutting tubes, thick sheets and odd shapes.
- Use well-balanced sharp blades for friction-free cutting to avoid scorching and binding.
- Feeds up to 40 feet per minute and guidelines in the table are good starting points.

Band saws – high speed stainless steel	HDPE	PP
α Clearance angle°	30-40	30-40
γ Rake angle°	0-5	0-5
Tooth pitch, inches	0.08-0.236	0.08-0.236
Cutting speed, feet/minute	1,650-10,000	3,300-10,000

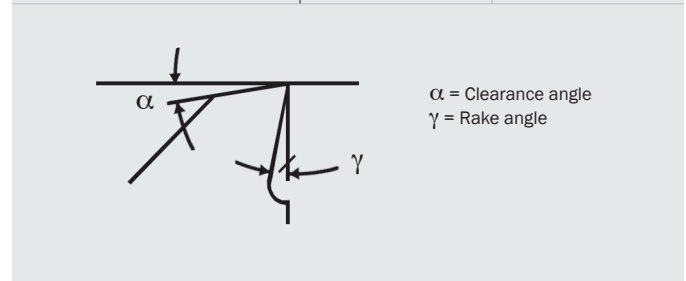
Milling and Routing

- High RPM equipment typically used for metals works well.
- Feed rates between 10 and 16 feet per minute are typical.
- Use high cutting speeds and tools with low rake depths.
- Up-cut double edge spiral bits work well to provide an upward chip flow and a smooth finish.
- Bits with high edge sharpness prevent fine strands or edge burrs.

Tested tools and conditions with excellent results:

- SIMONA copolymer polypropylene
 - Onsrud tool #52-634 (1/4 \varnothing double flute upcut spiral O)
 - 18,000 RPM; feed rate 120-180 inches/minute
- SIMONA HDPE
 - Onsrud tool #52-709 (3/8 \varnothing double flute upcut spiral O)
 - 18,000 RPM; feed rate 180-250 inches/minute

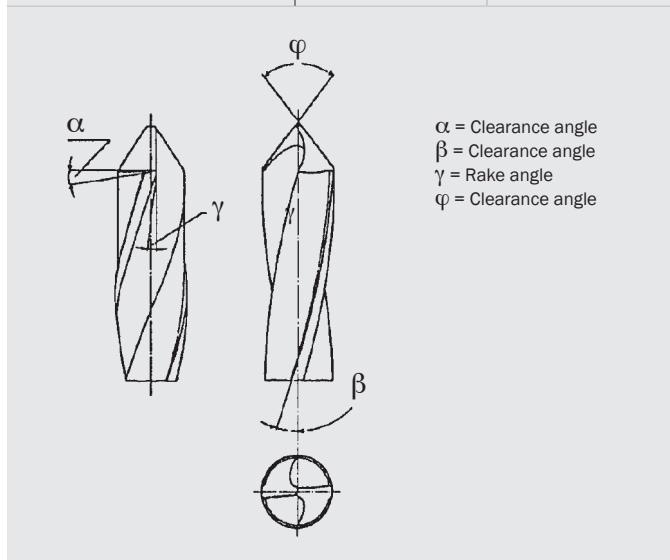
Tool design, conditions	HDPE	PP
α Clearance angle°	5-15	5-15
γ Rake angle°	5-15	10-15
Feed rate, feet/minute	180-250	120-180
Feed rate, in./revolution	0.004-0.02	0.004-0.02



Drilling

- Standard twist drills work well with HDPE and PP.
- A negatively ground rake angle helps prevent drill jamming and “tearing out” material.
- Avoid “plunge” cuts. Angle the drill into the material first, to provide an exit path for chips.
- “Pecking” or removing the drill repeatedly especially when drilling depths of 5 x the drill diameter allows easier swarf removal and helps minimize swarf build-up.
- Drill a pilot hole for final hole diameters of 0.40 inches or greater.
- Double-cut drills that have a pilot drill work well for hole diameters over 0.8 inches.

Tool design, conditions	HDPE	PP
α Clearance angle°	10-13	5-12
β Twist angle°	12-16	12-16
γ Rake angle°	3-5	3-5
φ Tip angle°	60-90	60-90
Cutting speed, feet/minute	165-330	165-330
Feed rate, in./revolution	0.008-0.02	0.008-0.02



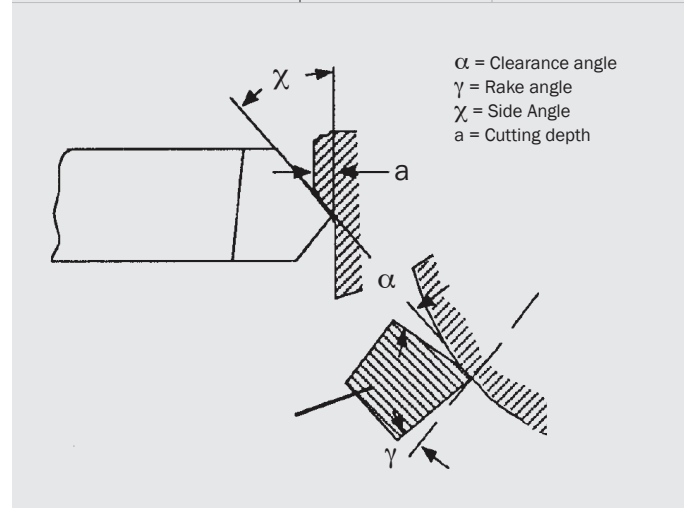
Planing

- Common woodworking planes and wood surfacing and sizing equipment work well.
- Planing equipment specifically developed for plastics is also available.

Turning

- Use as low a feed as possible.
- Use as large a cutting depth as possible.
- As with metals, use cutters with a small radius.
- Indexable inserts can help remove swarf, provide a smooth cut and improve efficiency.

Tool design, conditions	HDPE	PP
α Clearance angle°	5-15	5-15
χ Side angle°	45-90	45-60
γ Rake angle°	0-10	0-8
r Tip angle, inches	0.02	0.02
v Cutting speed, feet/minute	165-330	165-330
s Feed rate, in./revolution	0.008-0.02	0.008-0.02
a Cutting depth, inches	Up to 0.236	Up to 0.236



Fastening and Assembly

- Most types of fasteners and “tapping” screws work well.
- Screws designed specifically for plastics are readily available and are recommended.
- Drill oversize holes in the sheet to be fastened, to allow for expansion and contraction from temperature variations.
- Oversized washers or grommets used with fasteners will also facilitate the material's normal expansion and contraction.
- For applications that require repeated assembly and disassembly, press-in threaded inserts for fasteners provide good results.
- Threaded inserts are also recommended for applications that see repeated dynamic use, for example to secure hinges for bin lids, doors and hatches.

WORKSHEET

Calculating a Finished Part's Thermal Expansion and Contraction

All materials change dimensions to some extent with changes in temperature. This has to be taken into consideration when sizing and cutting panels in SIMONA HDPE and PP.

The following worksheet calculations will help fabricators and designers determine the correct cut sizes for each material, to allow for thermal contraction and expansion in finished products in their end-use temperature environments.

1. Determine temperature difference due to heat:

Expected <i>high</i> temperature in actual use	(Tu)	_____ °F
-(minus) Temperature at the time of fabrication	(Tf)	_____ °F
= Temperature difference	(Td)	_____ °F

2. Determine temperature difference due to cold:

Temperature at the time of fabrication	(Tf)	_____ °F
-(minus) Expected <i>low</i> temperature in actual use	(Tu)	_____ °F
= Temperature difference	(Td)	_____ °F

3. Determine the material's Coefficient of Linear Thermal Expansion from its physical properties data sheet. It may be reported as a number x 10⁻⁵. Convert it to its decimal value.

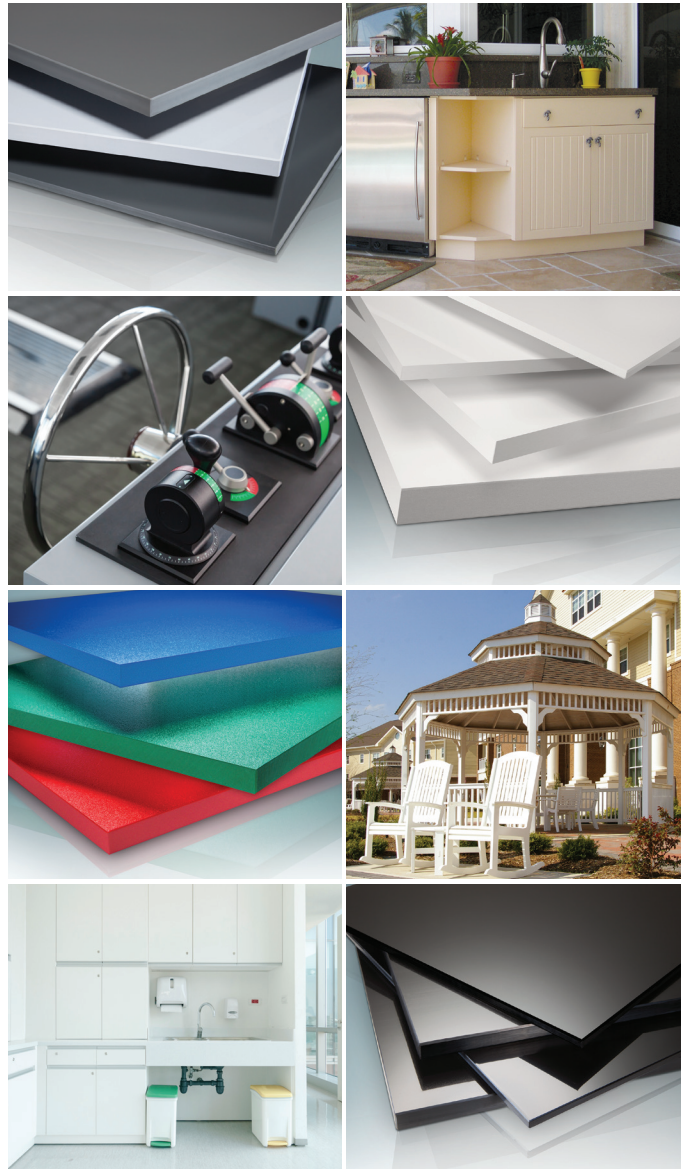
Material	CLTE x 10 ⁻⁵	CLTE decimal value
SIMONA HDPE	10 x 10 ⁻⁵	0.00010
SIMONA Polypropylene	8.9 x 10 ⁻⁵	0.000089

4. Calculation:

By using the length or width of the part (inches), the Coefficient of Linear Thermal Expansion (CLTE) for each material, and the temperature difference (Td), the dimensional changes at each in-use temperature extreme is now easy to calculate:

	Part L or W (inches)	x	°F Temperature difference (Td)	x	CLTE	=	Part expansion or contraction (inches)
HDPE		x		x	0.00010	=	
Polypropylene		x		x	0.000089	=	
<i>Example - HDPE</i>	58	x	27	x	.00010	=	0.157 inches

Note: Always check the physical properties data sheet for actual Coefficient of Linear Thermal Expansion (CLTE) as it will differ by material.



SIMONA manufactures HDPE and Polypropylene sheet products specifically for consistent flatness, ideal for machining and fabricating of large, flat panel structures intended for exterior and interior applications including cabinetry, furniture and boatbuilding components.

DISCLAIMER AND LIMITATION OF WARRANTY:

All information contained herein is believed by SIMONA AMERICA Industries to be reliable. Typical properties are based on laboratory tests conducted on material samples in accordance with standard test methodology. SIMONA AMERICA Industries makes no express or implied warranty that its products will perform in accordance with the data in all conditions and circumstances. To determine suitability for use, users must test applications under actual operating conditions. As a result, ALL EXPRESS OR IMPLIED WARRANTIES IN CONNECTION WITH SIMONA AMERICA INDUSTRIES and SIMONA BOLTARON PRODUCTS INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY DISCLAIMED.

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