



INSTALLATION GUIDE

3D Milling (FROGMill CNC Polystyrene Carving)

A made-to-order CNC service: Technopol's FROGMill 4th-axis router carves full three-dimensional forms out of expanded-polystyrene blocks to your CAD file, for decorative, scenic and non-structural work.

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TP-IG-3D-MILLING

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3d-milling

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Issued for use

BEFORE YOU START

A carving is a delivered object, not a layer, so there is no substrate in the building sense. What must be true before you start: the mounting structure exists and has been designed by the project engineer for WIND on the projected area of the carving, not for its weight; the internal armature, baseplate or backing board (if any) was specified BEFORE milling and is already in the part, because it cannot be retrofitted; the coating system has been chosen and proven EPS-compatible on an offcut of the actual grade; the assembly area is clean, dry, out of the wind, above 10 C (PU6 must not be used below 5 C and cures very slowly below 10 C) and clear of all hot works, grinding sparks, welding and open flame. Confirm the EPS grade actually supplied against the order before you touch the piece - the grade drives everything, and there is no default.

TOOLS

- Fine-tooth handsaw, sharp craft knives, surform/rasp and progressively finer abrasive papers (80 to 220 grit) for trimming and fairing
- Technopol PU6 two-part solvent-free polyurethane adhesive: mix 6:1 by weight (4.5:1 by volume), spread 300-400 g/m² on ONE side only. No contact adhesive, no solvent-based adhesive, no polyester resin
- Accurate scale for the 6:1 mix, clean mixing vessels and a slow-speed paddle; mix only what can be clamped within 20 minutes (pot life 20-30 min at 20 C / 50% RH)
- EPS-safe lightweight filler for joint lines and blemishes
- Soft brushes, rollers or a spray rig suited to the supplied PU coating, and the coating supplier's own application data (coverage, dry-film thickness, primer, recoat, cure)
- Clean straightedge, spirit level, laser or string line, tape
- Soft slings, foam-faced clamps, cradles or weighted sandbags able to hold a joint under light pressure for a full 4 hours - never bare metal clamps on the foam
- Nitrile gloves, eye protection and respiratory protection: PU6 Part B is MDI, GHS signal word DANGER (H334 respiratory sensitiser, H317 skin sensitiser, H332 harmful if inhaled, Carcinogenicity Cat. 2). Mix and apply in ventilated conditions
- Offcuts of the SAME grade, kept aside, for compatibility-testing every adhesive, filler, primer and topcoat before it touches the piece

SEQUENCE

1. Receive, unwrap and inspect

Unwrap the segments in a clean, sheltered space. Check every piece against the CAD file and the delivery note: count of segments, orientation marks, the EPS grade supplied, and whether an internal armature or backing board is present. Photograph any transit damage immediately - dents, crushed corners and torn bead faces are what a badly travelled piece arrives with, and EPS damage is not repairable to a close-up standard once a thin coating is on it. Lay the segments out and dry-fit the puzzle joints on the floor before anything is glued.

CHECK BEFORE MOVING ON

- Grade supplied matches the grade ordered
- All segments present, and their orientation and sequence marks legible
- Puzzle joints dry-fit closed, with no gap wider than a filler can bridge
- Any internal armature, spine or baseplate is present and in the right place - if it is missing, stop: it cannot be retrofitted

2. Test every product on an offcut

Before anything wet goes on the carving, test each adhesive, filler, primer and topcoat on an offcut of the same grade. Apply it, leave it thirty minutes, then look and press. If the surface has pitted, softened, crazed, gone glossy or dished, the product contains a solvent that attacks EPS and it is out - no exceptions, no 'just a light coat'. The test takes half an hour and it has saved more carvings than any other step in this guide.

CHECK BEFORE MOVING ON

- Adhesive: no softening or dishing on the offcut after 30 minutes, and a test joint on the offcut breaks in the foam rather than at the glue line
- Filler and primer: no pitting, no crazing, no shrink cracking as they dry
- Topcoat: no cratering. Aerosol cans and solvent-based lacquers crater the surface within minutes - they are out

3. Assemble the segments

Work in the sequence the joints were designed for, usually bottom-up. Mix PU6 6:1 by weight (4.5:1 by volume), and mix only what you can clamp inside the 20-minute window; pot life is 20-30 minutes at 20 C / 50% RH. Apply 300-400 g/m² to ONE mating face of the puzzle joint - a continuous bed, not spots. Push the joint fully home. The interlock is there to locate the parts, so it should close positively without force; if a joint needs hammering, check the sequence and the dry-fit rather than driving it.

Apply clamping pressure within 20 minutes of mixing and maintain it for at least 4 hours. Use soft slings, foam-faced clamps, cradles or weighted sandbags. Never clamp bare metal against the foam, and never over-tighten - at 12-30 kg/m³ the foam crushes long before the clamp feels tight. If the seam is curved and sculpted so that four hours of even pressure is not achievable, that joint is not the load path: the load goes through the internal armature or spine, and the adhesive only fills and locates.

Do not work below 5 C, and expect greatly extended cure below 10 C. The adhesive solidifies in about 4 hours at 25 C in a thin layer and reaches full cure after 7 days at 25 C. Do not move or load the assembly until it has cured.

CHECK BEFORE MOVING ON

- Mix ratio measured on a scale (6:1 by weight), not eyeballed
- Adhesive laid as a continuous bed on one face at 300-400 g/m², not in dabs
- Clamping pressure applied within 20 minutes of mixing and held for a full 4 hours
- Joint fully closed, faces flush, form correct against the CAD file before the adhesive skins
- Clamping pressure enough to hold, not enough to crush - inspect for dishing under every clamp and sling point
- Ambient above 10 C; adhesive cured before the assembly is moved or loaded
- Respiratory protection and gloves worn while mixing and spreading (Part B is MDI)

4. Fair the joints and the surface

Fill the joint lines and any transit dents with an EPS-safe lightweight filler. Fair back with a rasp, then progressively finer paper, working the filler flush to the milled surface and feathering well beyond the seam. Take a raking light along the piece: a joint line that is invisible under flat workshop light will telegraph straight through a thin coating under a spotlight, and the client will see it from across the room.

Do not fair down through the milled detail. On a fine carving the cutter path itself is the finish, and over-sanding a face flattens the crispness the higher-density grade was chosen to deliver.

CHECK BEFORE MOVING ON

- Joint lines invisible under raking light from at least two directions
- No filler ridges, and no sanding through into the bead structure
- Surface dust fully removed before coating - EPS dust clings and it will show under the first coat

5. Coat the piece

Coating is the client's scope: Technopol supplies the polyurethane protective coating but does not apply it. Get the coverage rate, dry-film thickness, primer requirement, recoat window and cure schedule from the coating supplier, and follow them. Do not improvise.

On method: build the film in several thin coats rather than one heavy one - a heavy first coat on porous EPS runs, sags off the detail and pulls open at the joint lines as it cures. Coat the entire form, including the underside and any face that will end up hidden; an uncoated back face is where moisture and UV get into an outdoor piece. Let each coat cure properly before the next.

An outdoor carving needs a complete, continuous hard coat. Treat the brochure's 'durable up to about 10 years' as a supplier statement, not a warranty, and build coating inspection and repair into the maintenance handover.

CHECK BEFORE MOVING ON

- Coating confirmed EPS-compatible on the offcut (step 2) before it goes on the piece
- Coating supplier's dry-film thickness, coverage and recoat data in hand and being followed
- Film built in thin coats: no runs, no sags, no pinholes at the joint lines
- Full coverage including the underside, the back face and every re-entrant corner
- Coating fully cured before handling, and certainly before the piece goes outdoors

6. Mount and anchor

This is where carvings fail. Understand the load case before you lift anything: the governing action on a mounted carving is wind on its projected area, not its 10-25 kg weight. A large sign letter or facade feature will see wind loads many times its own weight, and it must be anchored for that - SANS 10160-3 wind actions, designed by the project engineer.

A fixing driven into bare EPS at 12-30 kg/m³ tears out of the foam. Every fixing must land on one of: (a) an internal armature or spine milled or bonded into the part at fabrication, (b) a bonded backing board or baseplate spreading the load over a large glued area, or (c) a through-bolt with large load-spreading plates on both faces.

Handle the piece in still air. A 20 kg carving with a large face is unmanageable in a gust and will be torn out of your hands. Use enough people, keep the piece low, and if it is windy, stop.

CHECK BEFORE MOVING ON

- Anchorage designed by the project engineer for wind on the projected area - not sized by eye, and not sized off the weight
- Every fixing lands on an armature, a bonded board or a spreader plate - never into bare foam
- No fixing over-tightened: it crushes the foam and then goes slack
- Piece plumb, level and true to the setting-out before the anchors are finally set
- Handled and lifted in still conditions

7. Protect and hand over

Keep the piece away from open flame, welding, grinding, hot cutting and stray sparks for the rest of the build. EPS is combustible whatever the grade, and a flame-retardant grade is treated, not non-combustible. Keep it clear of any surface that runs hot: EPS softens and creeps above roughly 70-80 C, and a PU6-bonded assembly is limited to +50 C by the adhesive, so a carving next to a hot light fitting, a flue or dark metal in full summer sun will slump.

At handover, tell the client plainly what they have: a coated decorative EPS form, non-structural, with no fire classification as supplied. Hand over the coating supplier's data and a maintenance instruction - inspect the coating film for chips and cracks, and repair any breach promptly. Once water and UV get behind the coat, the foam goes.

CHECK BEFORE MOVING ON

- No hot works scheduled near the piece for the remainder of the programme
- Piece clear of flues, lamp housings and hot metal surfaces
- Coating supplier's data and a coating-repair instruction handed to the client
- Client informed in writing that the carving is decorative and non-structural, and carries no fire classification as supplied

FIXINGS AND FASTENERS

Fixing specification	No fixing, anchor or pull-out capacity is specified for milled EPS. The anchorage is designed by the project engineer, using one of the three routes below.
Screws or anchors driven directly into bare EPS	Do not use. At 12-30 kg/m3 the foam has no usable pull-out capacity - the fixing tears out.
Route A - internal armature (preferred)	A steel or timber spine designed by the project engineer and milled or bonded into the form during fabrication, so every fixing lands on the armature. It must be specified before milling; it cannot be retrofitted. It is also the route that carries a segmented, puzzle-jointed assembly, because a curved seam cannot be clamped for the 4 hours PU6 requires.
Route B - bonded backing board or baseplate	A rigid board bonded to the back of the carving over a large area with EPS-compatible adhesive; the fixings go through the board. Bond area, not fixing count, carries the load.
Route C - through-bolts with spreader plates	Bolts passing right through the carving with large load-spreading plates on both faces. Visible, but effective. Do not over-tighten: the foam crushes and the bolt goes slack.
Adhesive for segment joints and bonded fixings	Technopol PU6 two-part solvent-free MDI polyurethane. Mix 6:1 by weight (4.5:1 by volume); spread 300-400 g/m2 on one side only; pot life 20-30 min at 20 C / 50% RH; clamp within 20 min of mixing and hold for at least 4 hours; full cure 7 days at 25 C; do not apply below 5 C (cure greatly extended below 10 C); service range -40 to +50 C. Bonds EPS, timber, galvanised steel and Chromadek. Any solvent-based or contact adhesive dissolves EPS.
PU6 handling and PPE	Part B is MDI (Cosmonate M-200): GHS signal word DANGER - H334 respiratory sensitiser, H317 skin sensitiser, H332 harmful if inhaled, Carcinogenicity Cat. 2. Respiratory protection, gloves, eye protection and ventilation are mandatory. Part A (castor oil with limestone filler) is non-hazardous.

Design action for anchorage	Wind on the projected area (SANS 10160-3), designed by the project engineer - not self-weight. Self-weight is only 12-30 kg per m3 of carved volume and is never the governing case.
Puzzle joints	A positioning aid with no specified capacity. Never rely on the foam joint alone to transfer load between segments.
Service-temperature limit of a bonded assembly	+50 C, set by the PU6 adhesive - lower than the 70-80 C softening point of the EPS itself. The adhesive governs.

WHAT ACTUALLY GOES WRONG ON SITE

- Using an aerosol spray can, a solvent-based primer, a lacquer or a contact adhesive on the carving. Aromatic solvents crater EPS within minutes, and the damage cannot be sanded out to a close-up standard. Test every product on an offcut of the same grade first - every time, including a brand you have used before.
- Mixing PU6 by eye instead of 6:1 by weight, or mixing more than can be clamped inside the 20-minute pot life. Off-ratio or skinned adhesive gives a joint that looks closed and has no strength.
- Releasing the clamps early. PU6 needs pressure held for a minimum of 4 hours. If the seam is too sculpted to clamp for 4 hours, the joint was never the load path - the armature is.
- Gluing below 5 C, or in an unheated shed on a winter morning. Cure is greatly extended below 10 C, and the adhesive must not be used below 5 C at all.
- Mixing or spreading PU6 without respiratory protection. Part B is MDI, a respiratory and skin sensitiser, GHS DANGER. One careless exposure can sensitise a person for life.
- Screwing or bolting the carving straight into the foam. It holds for the site inspection and lets go in the first gust. Every fixing must land on an armature, a bonded board or a through-bolted spreader plate.
- Sizing the mounting from the weight of the piece. A carving weighs nothing and catches everything - the governing load is wind on the projected area, and it can exceed the self-weight by an order of magnitude.
- Discovering after delivery that the piece needed an internal armature. The armature is milled into the part at fabrication; retrofitting one means cutting the carving open, and it will show.
- Over-tightening clamps, slings or fixings. The foam crushes long before the fitting feels tight, and the dish it leaves is permanent.
- Putting on one heavy first coat to save a pass. It runs on the porous surface, sags off the detail and pulls open at the joint lines as it cures. Build the film in thin coats.
- Leaving the back face, the underside or a hidden corner uncoated on an outdoor piece. Water and UV find the gap and go straight for the foam.
- Not fairing the puzzle joints under a raking light. A seam that is invisible in flat workshop light telegraphs straight through a thin coating under a spotlight - which is exactly the lighting a sculpture, sign or set piece ends up in.
- Hot works anywhere near the carving. Grinding sparks, welding spatter and a cutting torch will all set EPS running, whatever the grade. Flame-retardant means treated, not non-combustible.
- Mounting the piece against something that runs hot - a flue, a lamp housing, a dark metal panel in full sun. EPS softens above roughly 70-80 C, and a PU6-bonded assembly is limited to +50 C.
- Handling a large piece outdoors in wind. It is light enough to feel easy and large enough to be torn out of your hands. Two people, still air, or wait.
- Assuming the carving is fire-rated because Technopol EPS can be classified B-s1,d0. That class applies only where FRCel grade was named on the order and confirmed, it was determined on a bare 60 mm FRCel 20DV board rather than on a carving, and it is a reaction-to-fire class - never a fire-resistance rating.

How to read this document. Every technical value carries a label saying where it came from — whether an accredited laboratory measured it, whether Technopol measured it, or whether it is simply the figure the standard tabulates for that class of material. Values we have not tested are marked as such rather than presented as test results.

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