

## Working directions for SMART-X®

**SMART-X® is a lightweight, yet very rigid all-plastic foam board with a core of expanded Polystyrene and hard surfaces of solid Polystyrene.**

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### Utilization of this publication

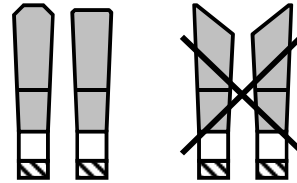
- The information contained in this publication is based on our current level of knowledge and is, in our opinion, reliable. However, we cannot guarantee the correctness of this information for every application and for the results arising from their use.
- The user or converter is always responsible for ensuring that the materials and processes are appropriate, cost-effective and suitable for the intended purpose and location, and that they comply with the local laws and regulations.
- Technical knowledge and skills as customary in trade and industry, a normally developed capacity to make judgements as well as knowledge and observance of the applicable regulations appertaining to work safety are assumed.
- Be aware of the manufacturing direction (anisotropy): SMART-X sheets have different characteristics (mechanical behaviour and optical appearance) depending on the manufacturing direction (parallel or across the direction of the sheets initial production).
- To ensure up-to-date relevance and impartiality of this publication, 3A Composites has decided to neither recommend any particular ancillary product and material nor their manufacturers, but always provide generic terms instead. This way, the purchasers remain free to obtain these products from suppliers of their choice.

### Cutting to size – Sawing

- SMART-X sheets can be cut to size on normal horizontal or vertical panel saws. Recommended are machines with chip and dust extraction, as commonly used in the woodworking and plastics industries.
- In view of the high rotating speed of cutting tools, it is very important for all protective devices on the machinery to be in good working order and also that they are being used. It is mandatory that the prescribed personal safety equipment - at the very least a pair of safety goggles - be worn at all times during chip generating cutting operations.
- Any existing hold-down devices and sheet feeder brackets must be set to minimum pressure so that they don't leave marks and indentations on the surfaces of the sheets.
- By the way: Sturdy vertical sheet material cutters provide a viable alternative means for trimming SMART-X sheets up to 10 mm thickness. The absence of dust particles is an important advantage of this technology!

### Circular saw blades

- **Attention:** The circular saw blade must be very keen (very sharp)! Worn or blunt circular saw blades would result in poor quality cuts (crumbling of the foam core on the edges, excessive burring and chipping on the lower surface).
- Best suited for SMART-X sheets are circular saw blades with a carbide-tipped (often marked HM) alternate flat tooth / trapezoid tooth design. A hollow (concave) face grind of the teeth would be ideal.
- Circular saw blades made of high-speed steel (often marked HSS) are entirely unsuitable because they would dull quickly.
- Equally unsuitable are circular saw blades with alternate top bevel teeth because those cause chipping on the lower surface.



### Sawing technique

- Very important for good quality cuts is the position of the circular saw blade. For cutting SMART-X sheets, the circular saw blade should project about 20 mm over the sheets.
  - > The higher the circular saw blade projects over the surface of the SMART-X sheet, the better the quality of the top face of the sheet.
  - > The lower the circular saw blade projects over the surface of the SMART-X sheet, the better the quality of the bottom face of the sheet.
- Other conditions which may improve the quality of the cut are slow feed, cutting in production direction and as little as possible vibrations.
- Since it is unlikely that ALL optimal conditions can be met in any given situation, the best possible combination needs to be determined locally by a series of practical tests. This is especially true for the tooth design: The difference between flat face grind and hollow face grind for example isn't decisive for a successful sawing job but would be noticeable if someone is looking for the best possible quality of the cut.
- Consider the manufacturing direction (anisotropy) when cutting sheets to smaller formats.

### Milling / Routing

- SMART-X sheets are best machined on modern CNC portal milling machines. These should allow for high tool speeds up to 50'000 rev / min. and rapid feed rates up to 500 mm / sec. in order to achieve a top quality edge finish.
- Single edge end mills (dia. 4 to 6 mm) are recommended, because these permit the removal of large quantities of chips without overheating.
- An alternative machining option would be routers which can be equipped with copy milling cutters with a ball bearing guiding roller. In this case, FOREXclassic would be the ideal material for the guide plates.

### Laser cutting

- As opposed to expanded rigid PVC sheet material, SMART-X sheets can be laser cut without damaging the laser machine. However, a very good knowledge of the laser technology is essential in order to achieve high grade machining results.
- Cutting can indeed be faster with higher laser power. However, the increase of the laser power in relation to the feed rate can easily lead to black discoloration on the cut edges. The following settings and advise have proven good starting points:
  - > Laser power: at least 70 W for 5 mm sheet / at least 250 W for 10 mm sheets
  - > Slow feed (start with 300 cm/min. for 10 mm sheets)
  - > High compressed air pressure (4 bar)
  - > High fume extraction volume above and beneath
  - > Nozzle with truncated cone shape (recommendation)

### Adhesive bonding

- Pieces of SMART-X can be bonded to each other using commercially available hot-melt glue. The heat of the adhesive won't damage the cell structure of the SMART-X sheets.
- Small parts can be glued with UHU Plast special glue for Polystyrene.
- High performance double-sided adhesive tapes (VHB<sup>™</sup>-products) are well suited for securely bonding SMART-X sheets to entirely different materials. These tapes are also available as self-adhesive picture hangers for mounting prints.

### Mechanical fastening

- SMART-X sheets can be quickly assembled into free-standing information posts and totems using universal sheet connectors or clamping bases.
- Plasterboard plugs inserted (screwed) into the edges of 19 mm SMART-X sheets can in turn accommodate standard eye bolts. A plasterboard plug can hold a tensile load of up to 10 kg.
- SMART-X sheets can be mounted to rigid support structures with screws and large diameter washers or to a chain link fence with cable ties. Due to thermal expansion, unforced assembly with unrestricted movement of the SMART-X component is essential. Clearance holes should be drilled at least 30 mm from the edge!
- The **linear thermal expansion** of SMART-X sheets is **0.08 mm/mK**

### Edge finishing

- The edges of SMART-X sheets can be lined or made look nice with commercially available 10 mm plastic extrusions, usually made of PVC. The double-U extrusions (called W-profile) which are available from 3A Composites are especially useful for corner joints. Attention: PVC extrusions must be bonded to the SMART-X sheets with any PVC glue.
- The white edge liners made of Melamine resin intended for furniture industry have proved an interesting alternative to PVC extrusions. They are available in hardware stores as well as at the carpenter around the corner in small quantities and have a coat of hot melt glue on their backside. This adhesive, molten with an ordinary pressing iron or a special machine will bond the liners to the edges of SMART-X sheets without melting them. A bit of experimenting will be necessary to set the correct bonding speed.

### Painting

- SMART-X sheets can be painted in a choice of colours using acrylic paint from spray cans. The edges won't be etched.
- On the other hand, aggressive solvent based paints (e.g. screen printing inks!) may attack the surfaces of SMART-X sheets rather seriously.

### Direct digital printing

- SMART-X sheets can be printed with excellent results using UV-curing inks on flatbed printers. A low lamp power setting (half the UV lamps) is sufficient to cure the UV inks and obtain good ink adhesion (cross hatch test Gt 0 according to EN ISO 2409).
- Rule of thumb: The higher the power setting of the lamps, the lower the dot gain and the better any surface imperfection becomes visible.
- Attention: High lamp power generates a lot of heat and may also cause warping of small formats due to the high thermal insulation power of SMART-X.
- Wear cotton gloves when handling unprinted sheets. Never spray liquid cleaning agents directly onto the sheets, only on a rag. Use ionized air to blow loose debris off SMART-X sheets prior to printing them.
- **45% relative humidity of air** has proven very successful in fighting static charges not only on SMART-X sheets. To this end, the climate in the print shop must be checked regularly, especially in cool weather.
- Remove the protection film slowly but steadily to prevent the generation of additional static charges in SMART-X sheets and blow ionised air over them one last time just before starting to print.
- NOT due to 'defective' sheets are the following problems:
  - > Bowing/warping of SMART-X sheets during or after printing
  - > Arched streaks and 'banding'
  - > Static charge and the resulting poor print quality
  - > Unsatisfactory ink adhesion

### Working with adhesive films

- Compared to traditional sheet materials, the surfaces of SMART-X sheets are slightly rougher. A laminating test with the intended graphics film prior to undertaking a commercial operation with SMART-X for the first time is highly recommended in order to verify that the adhesive strength of the film is really adequate for the application.
- It is good practice to ensure that there is no humidity, no large temperature differences between the SMART-X substrate and the film and no over-drawing of the film during its application. And that the ink of a printed film is completely dry, of course!
- If the face which is covered with the light blue protection film is used for lamination, cleaning of the surface underneath won't be necessary. Heavy stains on SMART-X can be removed with IPA.
- Thin gauge adhesive films and cast types adapt easier to the surface structure of SMART-X than thick decorative films and especially much better than multi-layer film composites whose high inherent stiffness limits the contact area of the adhesive layer to the higher points of the surface roughness of the SMART-X sheets. It is therefore recommended to apply first the adhesive film separately to the SMART-X sheet in order to achieve a good adhesive base for the multi-layer composite right from the beginning.
- If contrary to all expectations, an adhesive film has delaminated from a SMART-X sheet, it is worth the trouble to inspect the back face of the film, i.e. its adhesive side: The more brilliant (untouched) the layer of adhesive, the less it was in contact with the surface of SMART-X and the lower in turn must have been the adhesive strength of the film.
- It is good practice to fight the dreaded 'label effect' by rolling over the edges of a laminated film once more firmly with a hand roller in order to press the adhesive as deeply as possible down into the surface structure of the SMART-X sheet.
- Large format laminates should be moved as little as possible during the first 24 hours after lamination and on no account must they be bent during the transport.

### Transport – Storage – Handling

- Unprocessed sheets must be stored dry, flat and away from heat and dust. Surplus sheets are best kept in their original wrapping which should be carefully resealed for storage. Never store SMART-X outdoors!
- Polystyrene is rather brittle compared to other plastics. Particularly the corners of already printed SMART-X sheets should be well padded for transport to prevent them from chipping and to avoid injuries from sharp corners.
- The structure of SMART-X sheets is oriented in the direction of production (arrow on the protective film, long side of an original sheet). SMART-X panels are therefore much more brittle along the manufacturing direction than across. For this reason, large sized 5 mm SMART-X sheets must not be bent along the manufacturing direction and should be lifted around and handled by two persons during unpacking and processing.