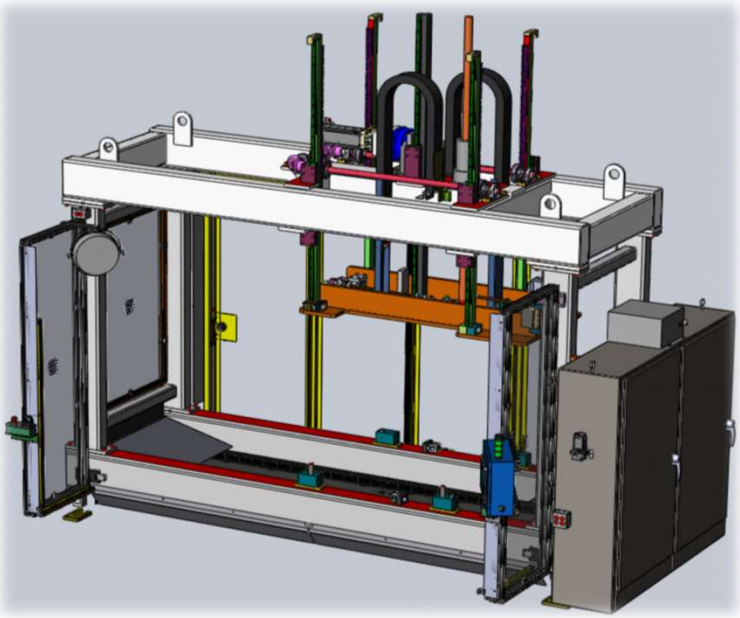
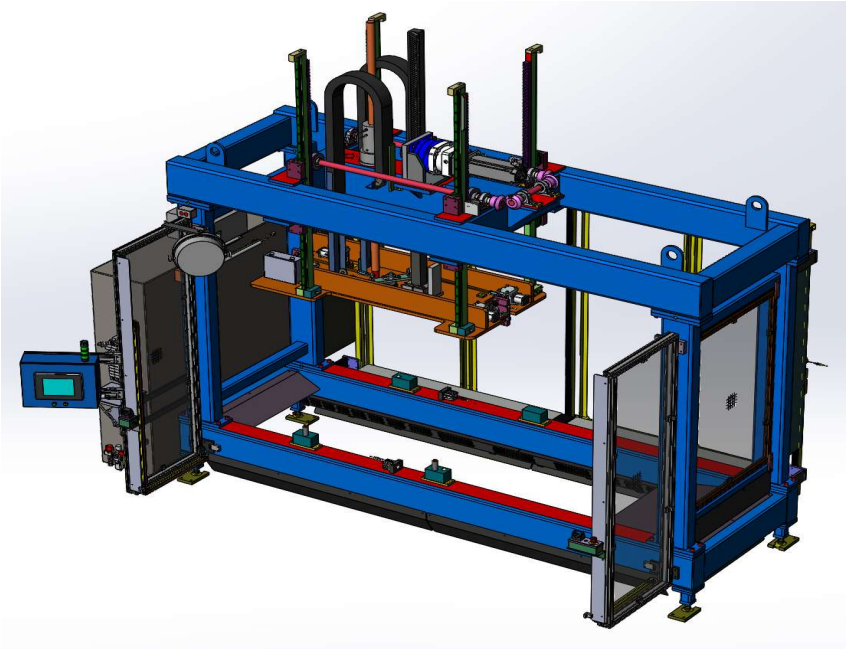
Edgefinishing Technologies (Non-Robotic)

- Localized re-thermoforming of a wide variety of substrates
- Tool pack changes allow for multiple variants
- Tight control over process parameters
- Options to integrate component assembly

Edgefold Versions

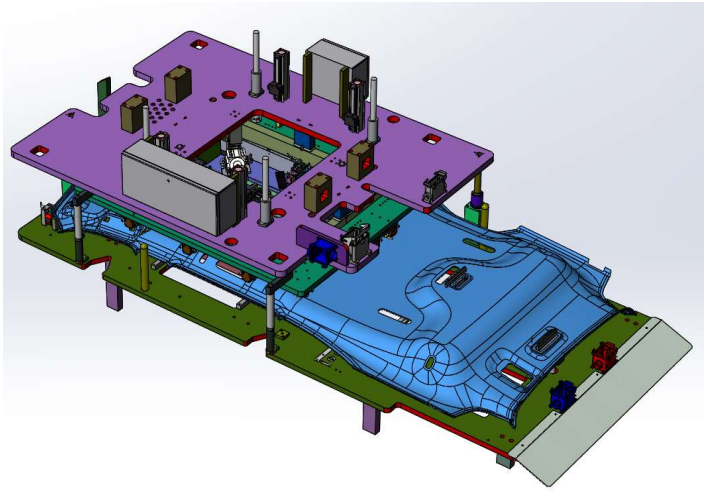
- Edgefold Koops Universal Press

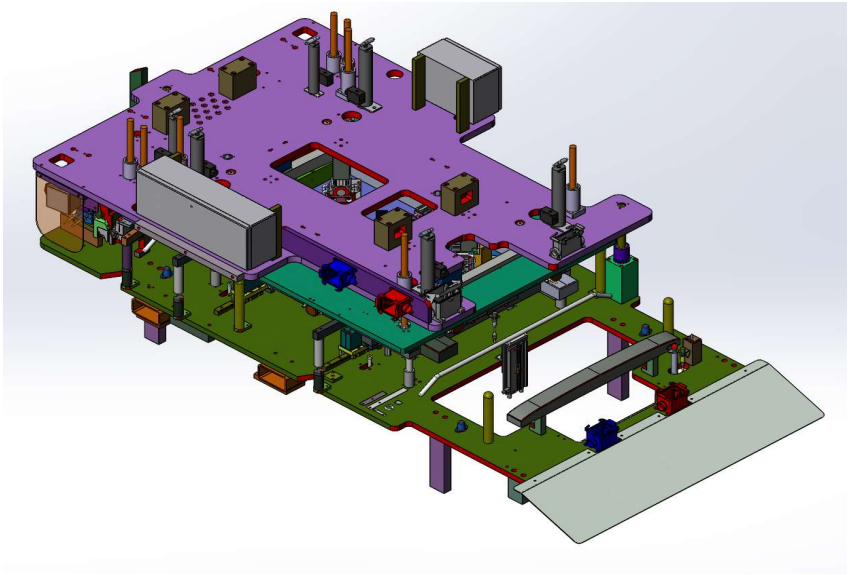




Edgefold Versions Cont.

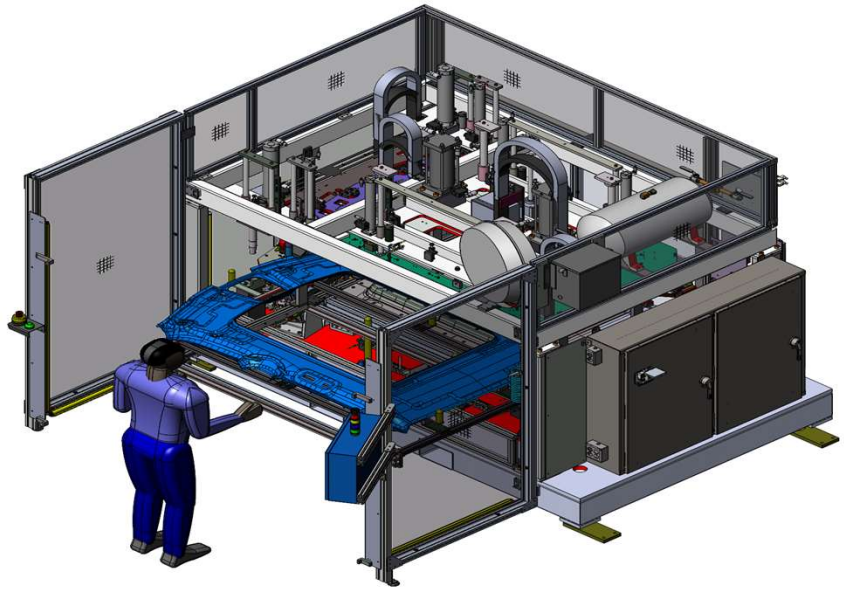
- Edgefold toolpacks





Edgefold Versions Cont

- Dedicated Small Edgefold



Design Guidelines

1. The edge folding process will compress the headliner substrate and cover stock thickness from nominal only in the folded area (see Figure 1 below). If a new customer provides CAD without this, this must be reviewed with the customer. The 2D edge fold drawing spec should also be provided to new customers.

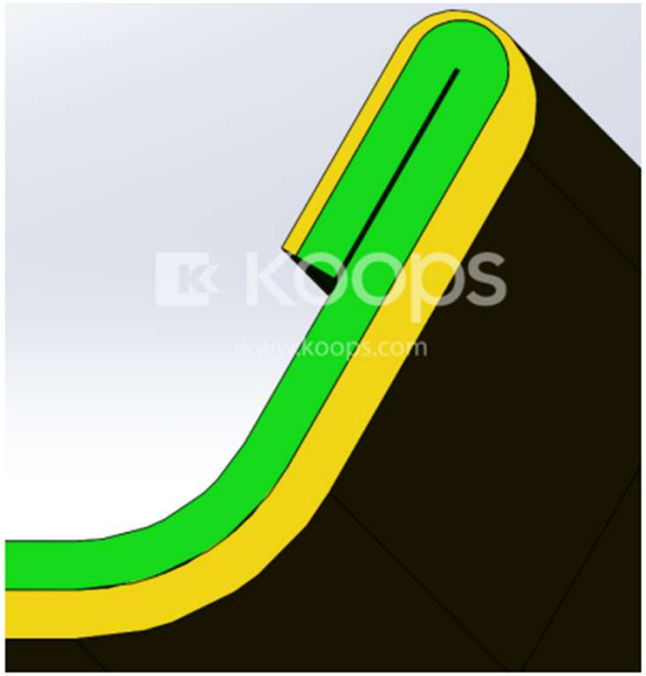


Figure 1 – Representation of headliner compression post edge fold.

Koops Slit Pattern Iterations

Figure 2 – Representation of Unfolded Headliner Corner Slits.

Figure 3 – Representation of Edge Folded Headliner Corner Slits.

Generally, Koops requests headliners with no slits for the initial tuning parts, and will develop the pattern with those parts

What can be adjusted on Edgefolds?

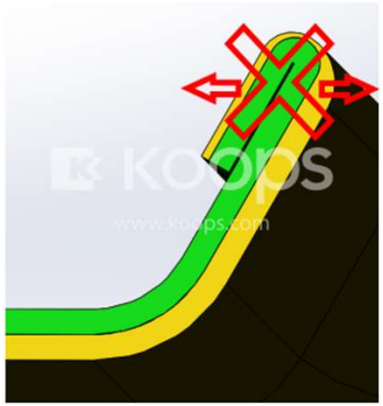


Figure 4 – Representation of Edge Folded Headliner Windage.

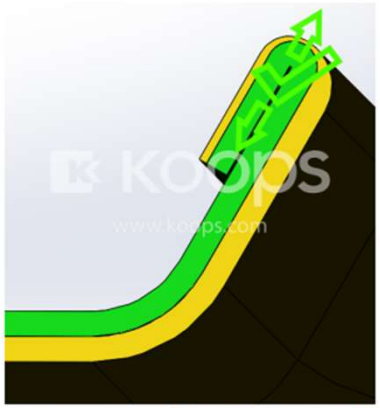


Figure 5 – Representation of Edge Folded Headliner Z Height.

- The edge folding process only affects the heated portion of the headliner, ‘windage’ is not something that can be controlled by edge folding. The ‘Z Height’ is the only dimension that can be adjusted by edge folding (See Figures 4 and 5 below).

Loft Angle effect on folding

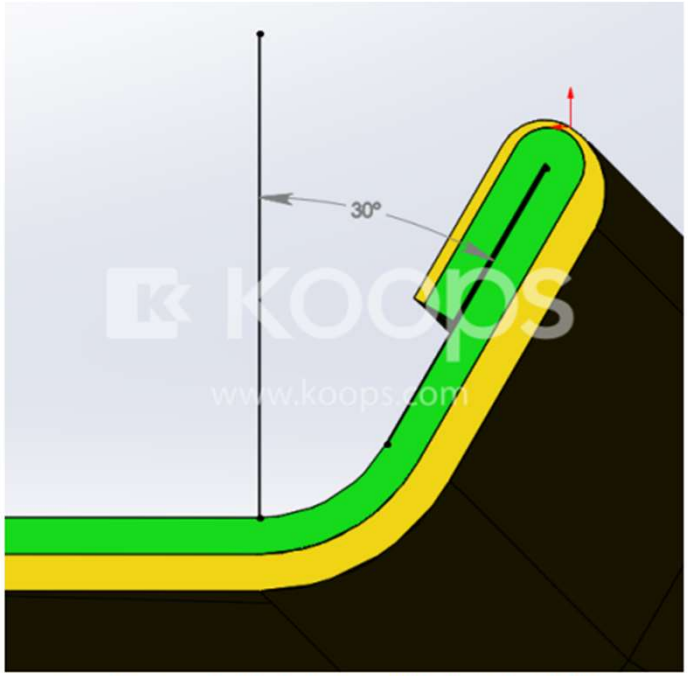


Figure 6 – Representation of Edge Folded Headliner Loft Angle.

- The loft angle of the edge folded flange angle affects feasibility and design decisions. Loft angles of less than 15 degrees from vertical require different tooling and headliner runout, and increase cost (See Figure 6 below)

270 degree vs 180 degree folds

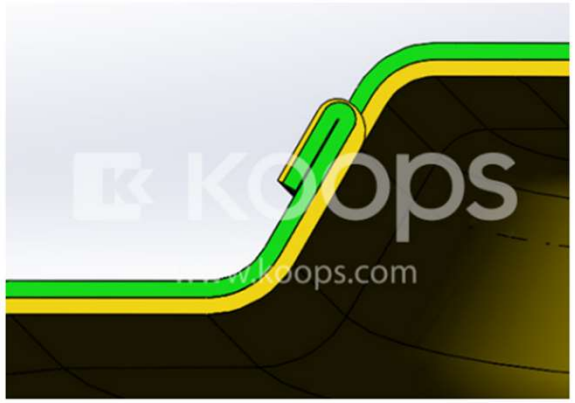


Figure 7 – Representation of 270-degree Edge Fold Unfolded and Folded Data.

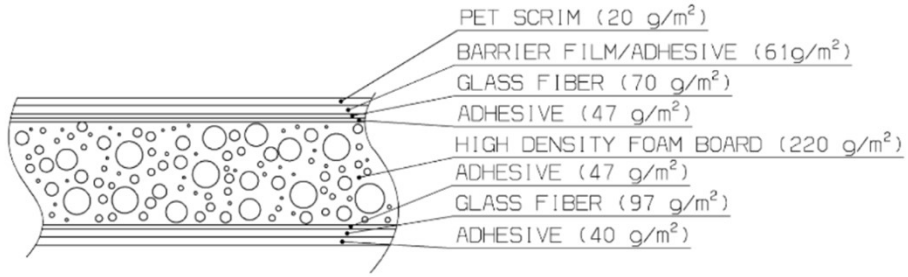
Figure 8 – Representation of 180-degree Edge Fold Unfolded and Folded Data.

- Depending on the angle of fold, Koops will need different types of tooling.

Information to Quote

- Platform & Name Plate
- Plant Location
- Substrate information
  - Manufacturer (Azdel, Quadrant, etc.)
  - Brand Name (SuperLite, SuperLite XLT, etc.)
  - Substrate GSM (1000, 1200, etc.)
  - Substrate thickness (millimeters)
  - Cross section breakdown (see *Figure 1*)
  - Type (Dry PU, Wet PU, PP/Glass, etc)

Figure 1



Information to Quote (continued)

- Fabric information
  - # of Fabrics
  - Manufacturer(s) (Lyric, Miko, etc.)
  - Brand Name (Arctic, Dinamica, etc.)
  - Type (Knit, Suede, etc.)
  - Fabric/Foam Thickness (millimeters)
  - Fabric Elongation (4% cross car, 10% fore-aft, etc.)
- # of versions running on equipment
- Folded areas
- Gage Information
  - Type (EF Substrate, Trim Ring & Substrate, After Assembly, etc.)

CAD Data Requirements

- Production level 3D CAD required at project kickoff (timing does not start until data is received)
- Native CAD such as CATIA, UG-NX preferred
  - Unfolded part data after forming and waterjet, but prior to edge finishing
  - Finished part data after edge finishing with A-B-C surfaces included
  - All parts placed on headliner should be included such as the trim ring on a headliner
- GD&T drawings with position of 4-way and 2-way locators