DIVERSIFIED TOOLING
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Die Development for AHSS Case Study

Joe Meyecic
Diversified Tooling Group

Diversified Tooling Group

Superior Cam

Superior Cam has established itself as a technical leader in the Prototype Sheet Metal Industry during the past 30 years. We have built a reputation as an innovative, experienced and reliable full service operation which emphasizes production intent quality at every step of the tooling process.

Bespro Pattern

During the past 45 years Bespro Pattern has developed an excellent reputation for quality, timing and competitive prices. We are a respected leader in the CNC machining of poly patterns off solid CAD die design.

4 companies
1 goal:
Full Service

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Midland Design

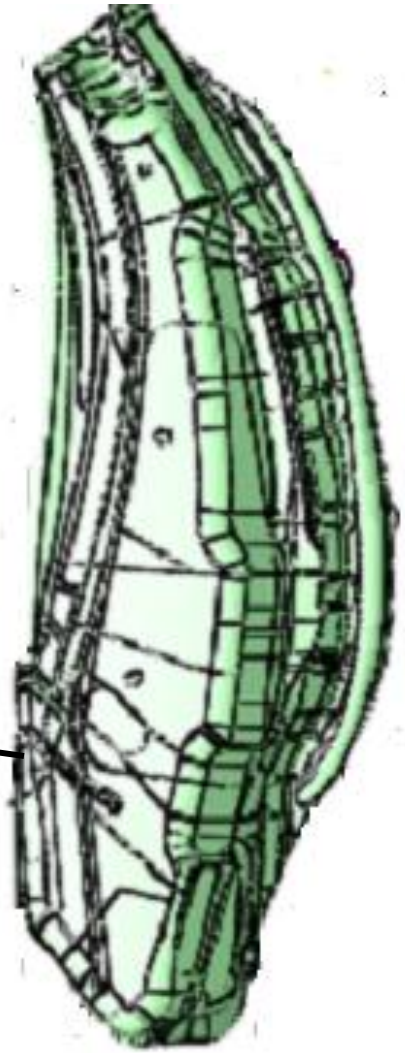
Midland Design has 40 years of experience designing all types of vehicle sheet metal stamping dies. Midland Design is regarded as a leader in the field of “Solid CAD Die Design.”

American Tooling Center

American Tooling Center is a modern state-of-the-art Tool and Die facility. Our full service operation was designed and constructed in 1989 as a world class production die facility which emphasizes a CAD/CAM/CNC utilization.

Defining the Part

- Fiat 500 Cabrio C-Pillar
- Material Specs:
  - 1.2mm gage
  - Dual Phase 590 steel



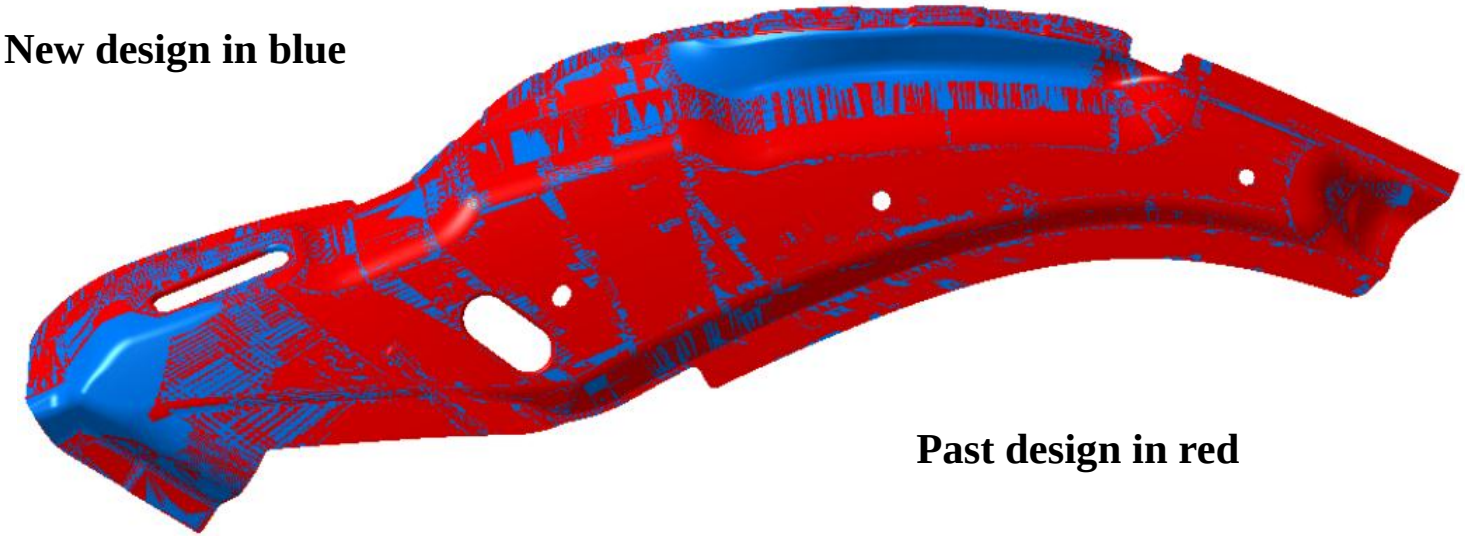
C-Pillar Concerns

- Dimensional Tolerance
- Edge Fractures
- Splits
- Zinc Pick-up
- Excessive Die Wear
- Excessive Tonnage Requirements

Product Design Modifications

Changes driven by FEA results

New design in blue



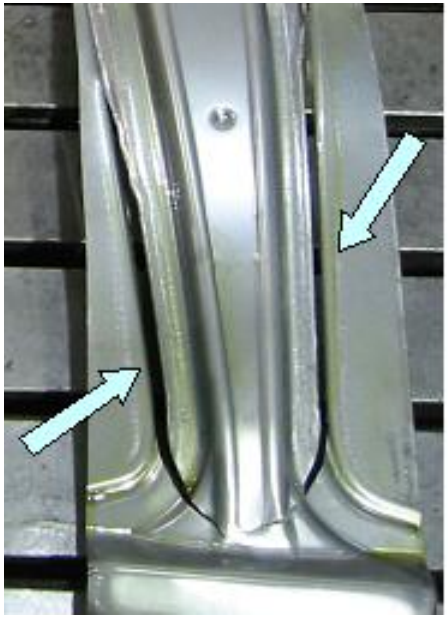
Past design in red

New product design also affected assembly features resulting in modified weld sequence

Nose section

Fractures in Stamping

- Dual phase steel is susceptible to fracture prior to localized necking

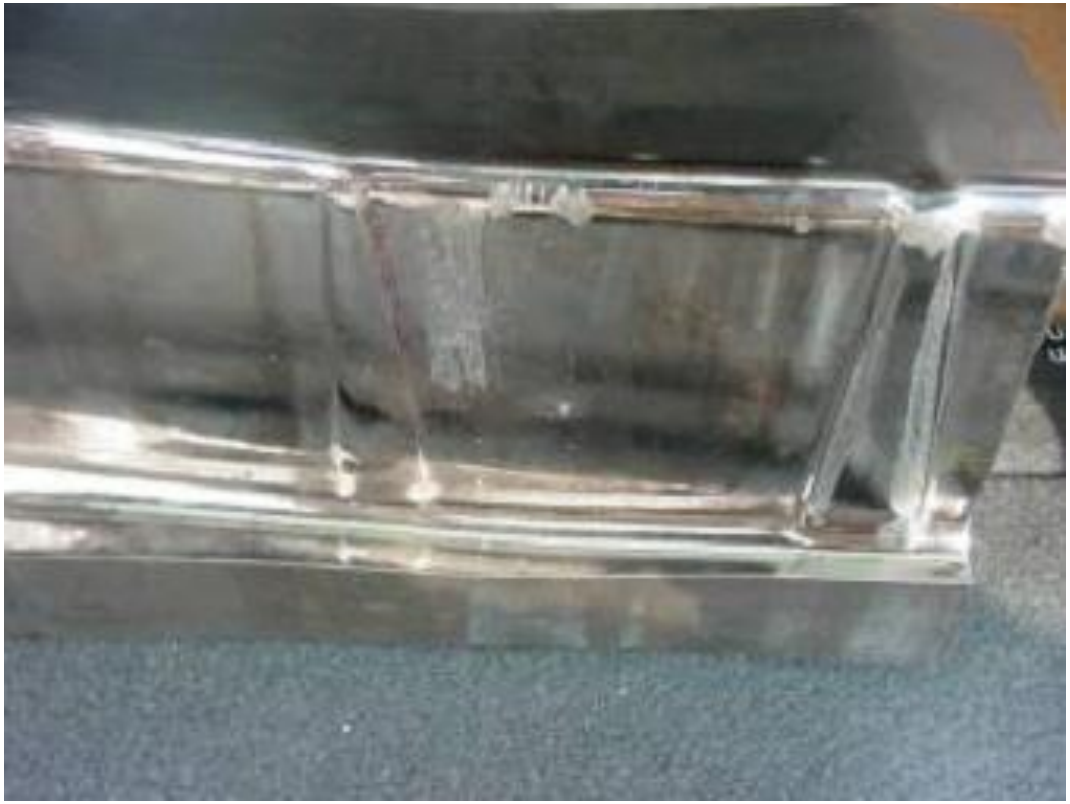


Zinc Pick-up on Die Steels

- Dies for dual phase material are prone to excessive zinc flaking from the material during the forming process.

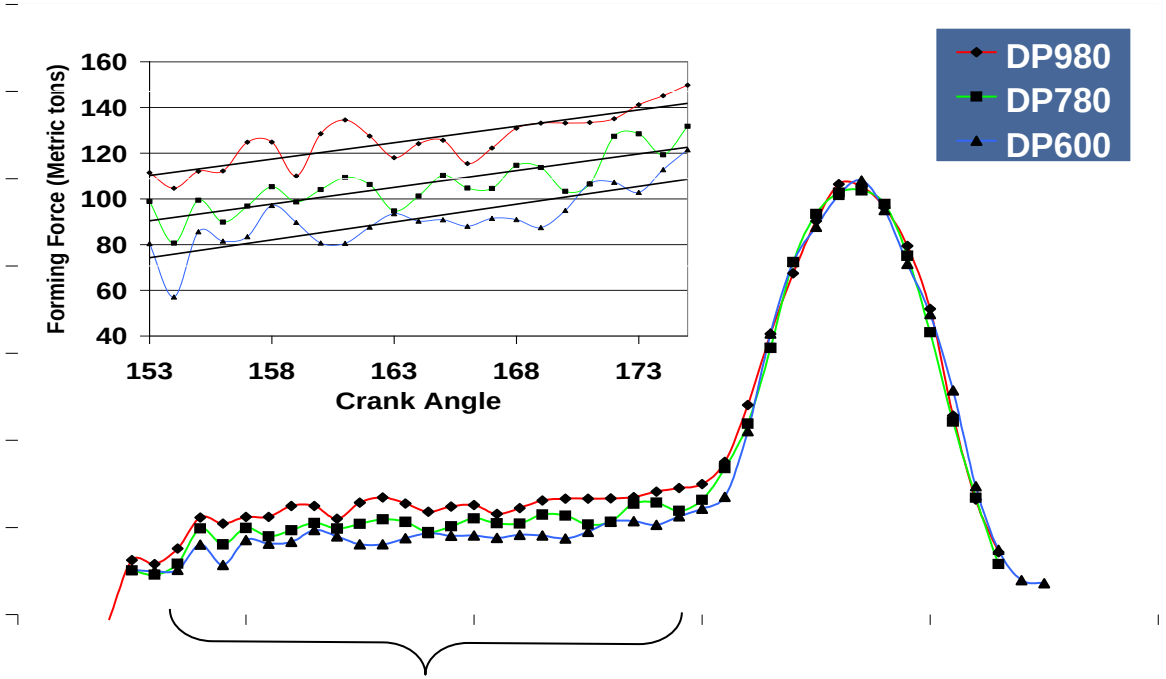
Excessive Die Wear

- Dual phase steel drives heavy wear on side walls in forming dies, requiring upgraded die materials and heat treatments / coatings.



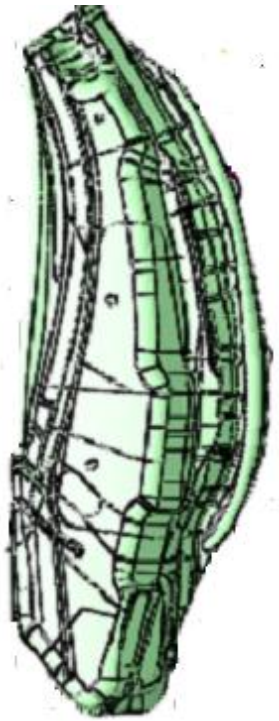
Forming Force Requirements

- Effect of Material Strength
  - Increases in material strength result in increases of forming force requirements for typical automotive parts



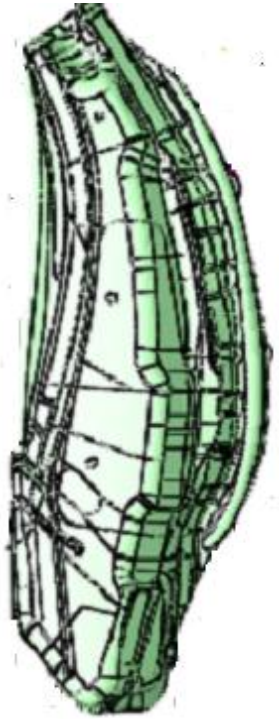
C-Pillar "Givens"

- Have to meet dimensional requirements (nominal)
- Lead time is short (22 weeks including design)
- Little time for physical rework loops
- Restrike operations have minimal effect
- Parts have to run double
  - Die investment
  - Piece cost



Goals

- Plan for Advanced High Strength Steel Success
- Reduce / Eliminate Iterations in the press
- Increase Capability of Math-based system and process
- Drive the iterations into Math
- Meet the short lead time requirements
- Meet the dimensional requirements



C-Pillar Concerns - Addressed

- Dimensional Tolerance
- Edge Fractures
- Splits

Full Cycle Simulation With Part Compensation & Minor Product Chgs.

- Zinc Pick-up
- Excessive Die Wear

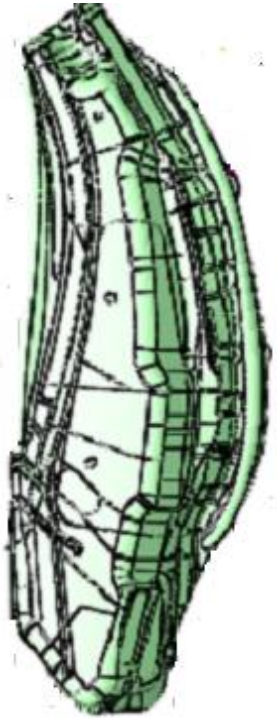
D2 Inserts with Coated Steels for Heat Treat

- Excessive Tonnage Requirements

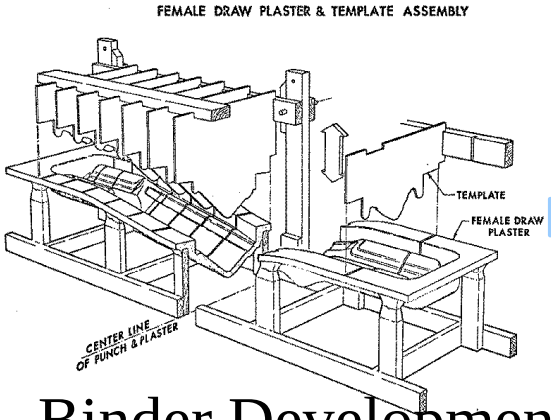
High Pressure calculated For Binder System

C-Pillar Overall Approach

- Examine the historic process
- Implement every technological advantage
- Intense focus on FEA / Full cycle process
- Implement upgraded machining process
- Implement upgraded tryout process
- Intense focus on Project Management
- Meet the requirements

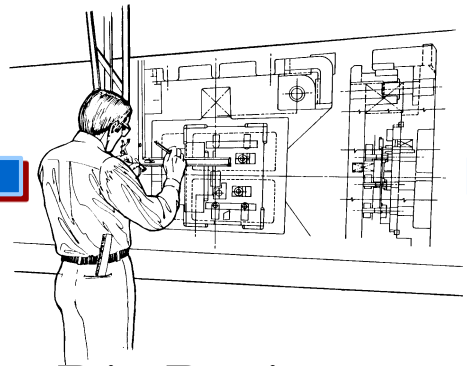


Historical Die Development Process



Binder Development

+



Die Design

+

Duplicating Mill

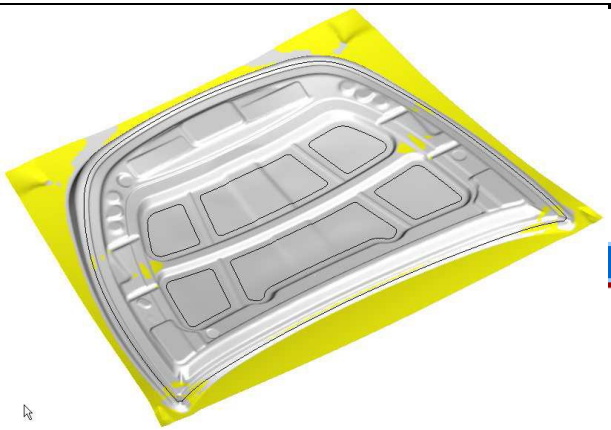
+

Tryout Iterations

= $

Quality

Latest Die Development Process



Full Cycle Simulation

3D Solid Model

High Speed NC

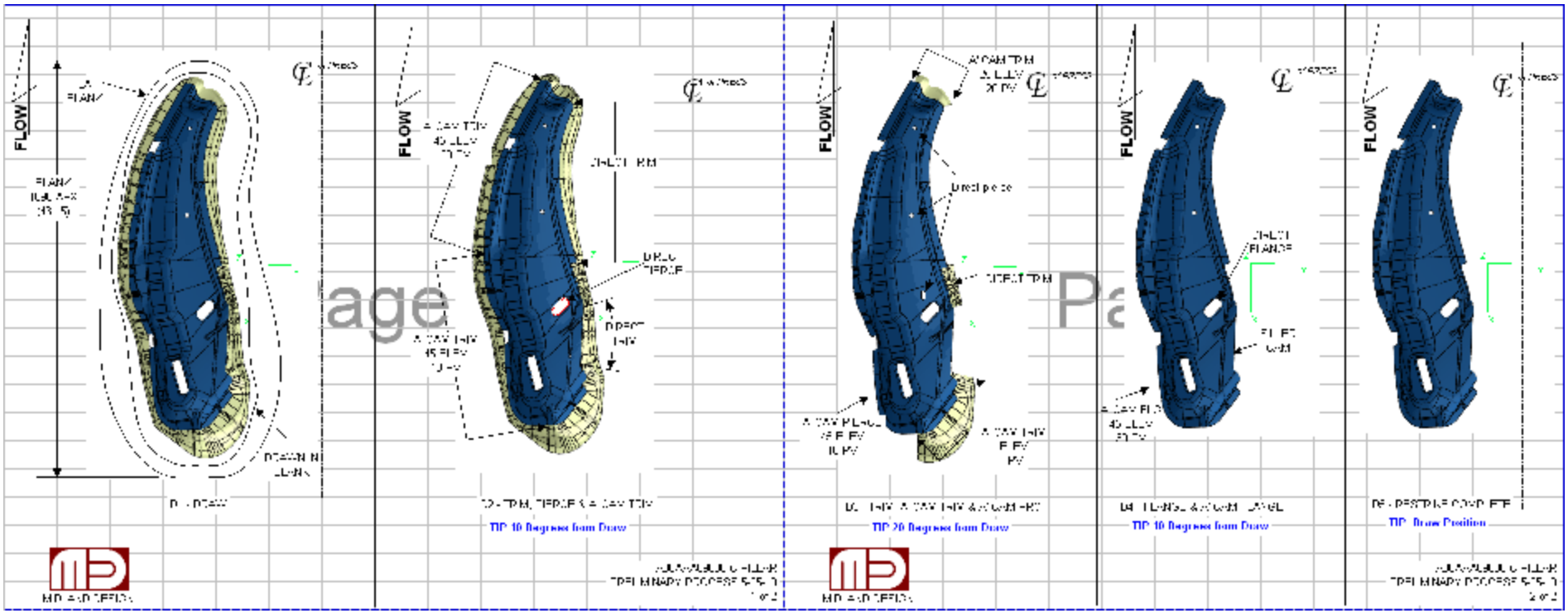
ATOS SCANNER

Accurate!

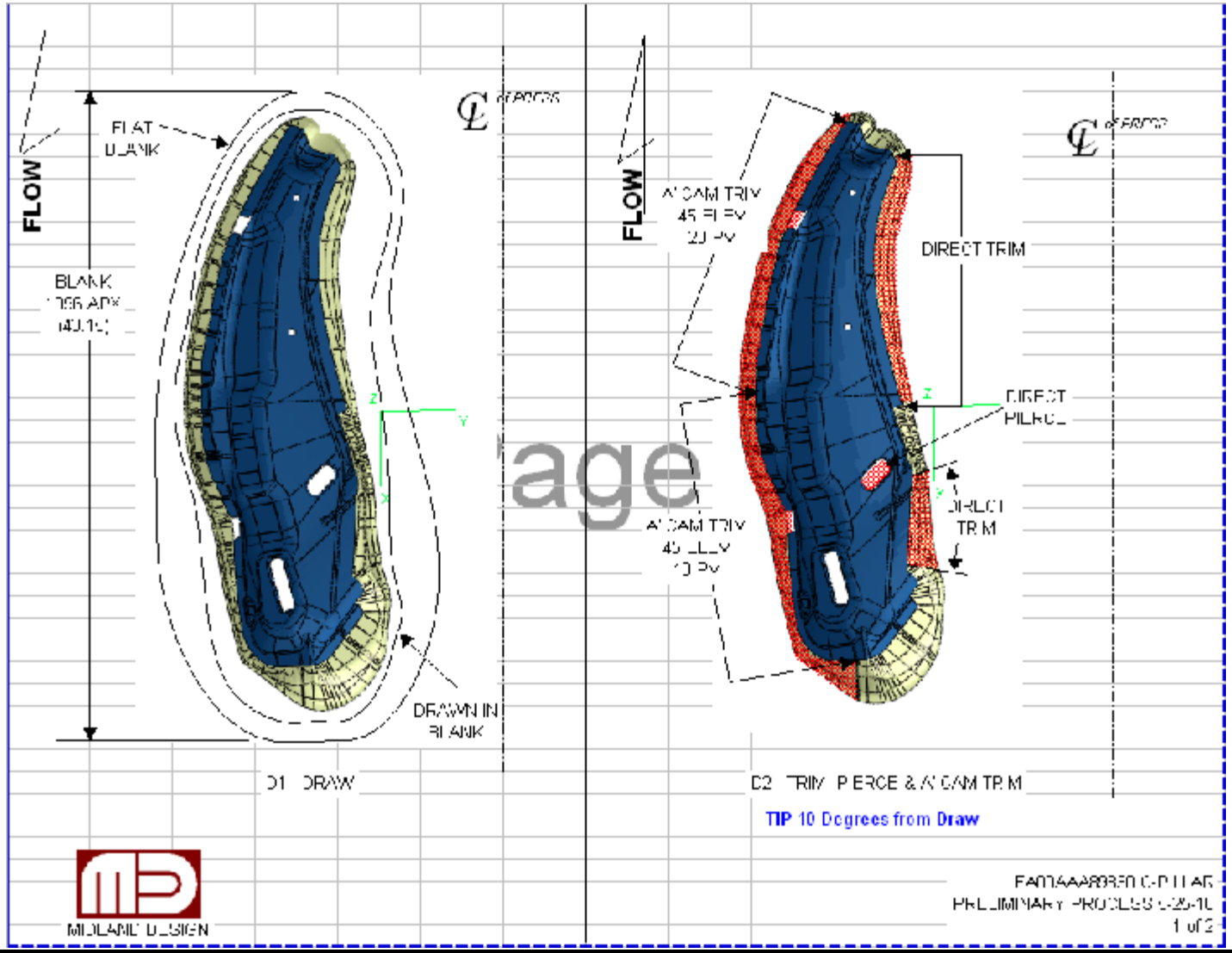
ATOS SCANNER

Press Validation (include scanning + CMM)

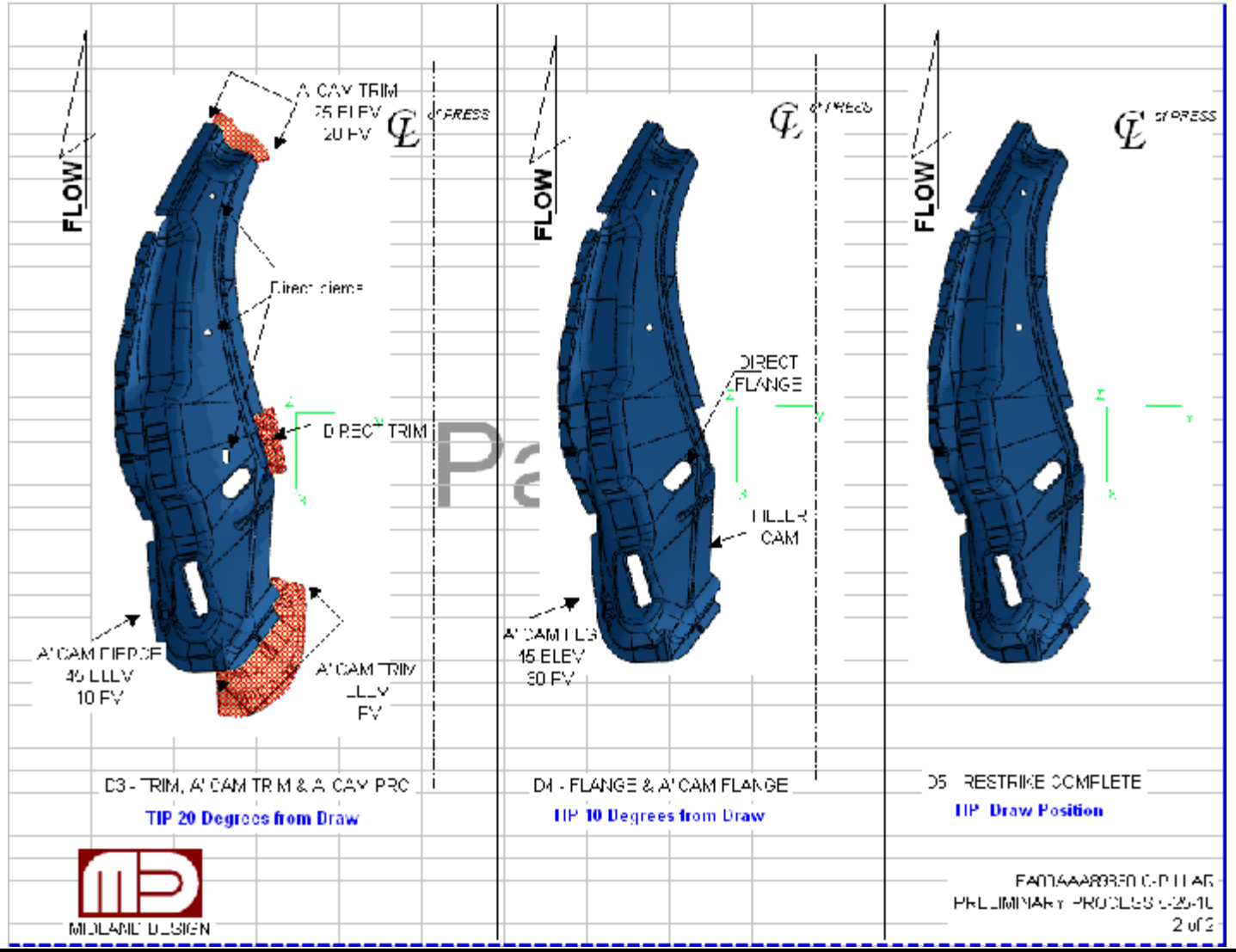
C-Pillar Process



C-Pillar Process



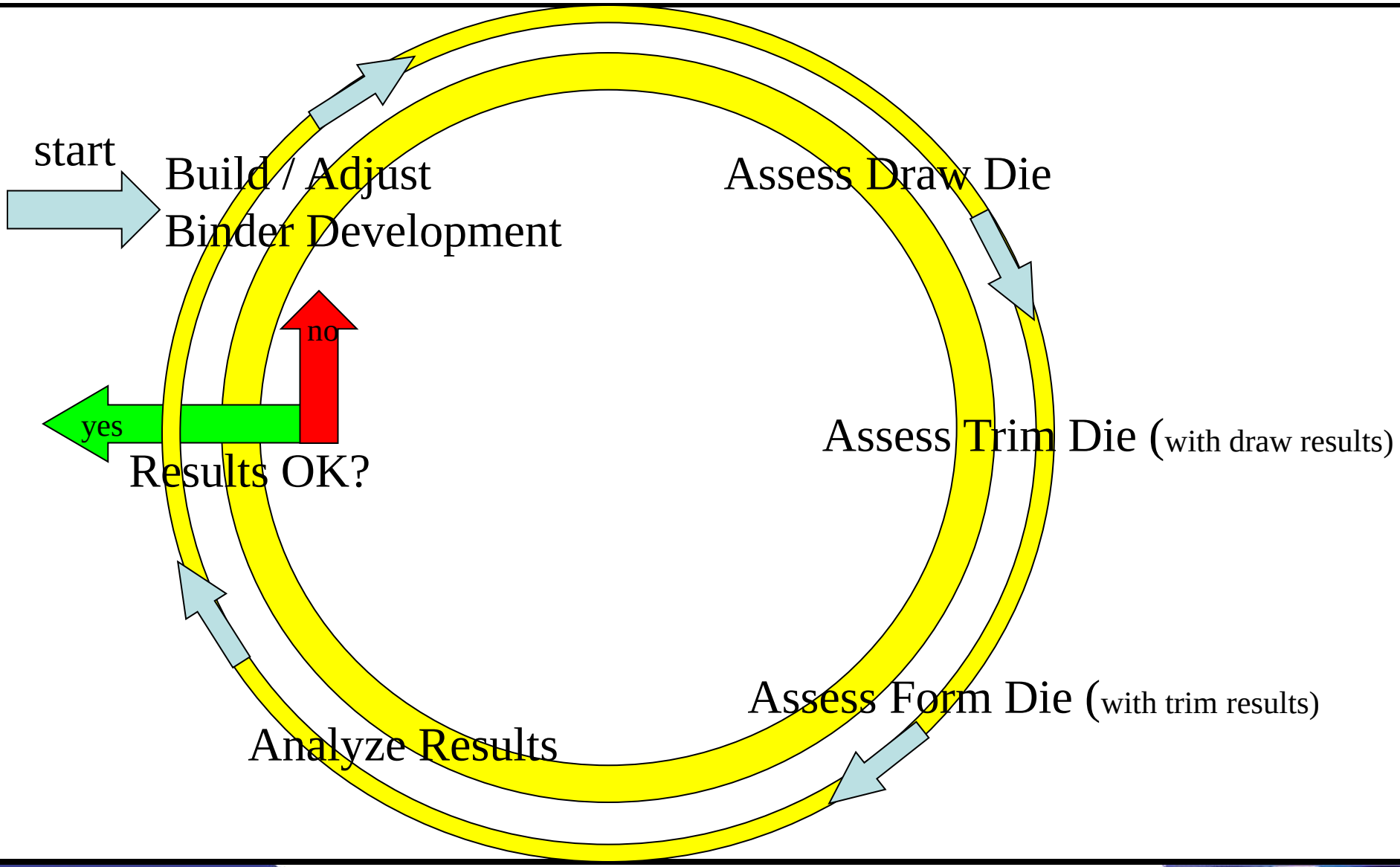
C-Pillar Process



Forming Simulation

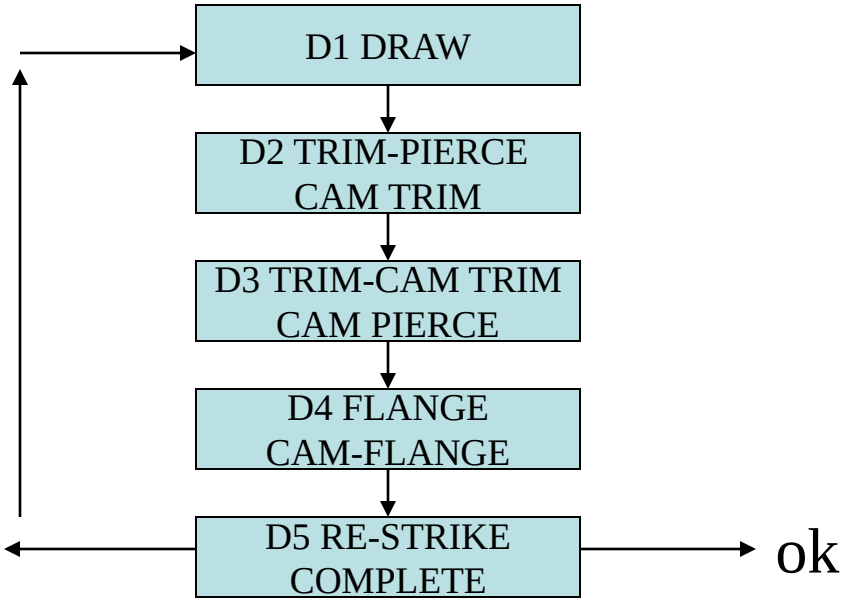
- Full Cycle Simulation per 3D Die Process
  - Analyze every operation in the line
  - Morph required die faces to accommodate results
  - Iterate in math to get to nominal
- Commercial Codes
- Proprietary Process and Methods
- Resolve forming issues in math (Virtual)
- Cut dies to morphed shape
- Inspect and compare to nominal

Full cycle explained



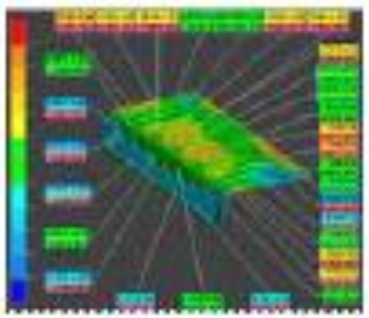
Full cycle

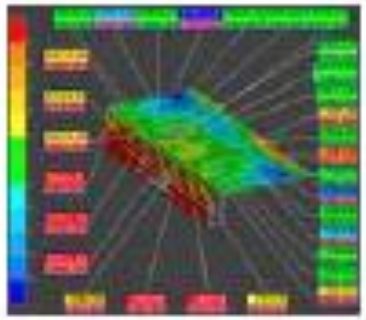
- Iteration



Keep iterating & adjusting binder development and Morphing until final results produce a nominal product.

White Light / Cloud Scanning





- Part Inspection
- Die Inspection
- Die Duplication
- Matching Events – Launch Support
- Reverse engineering with point cloud verification

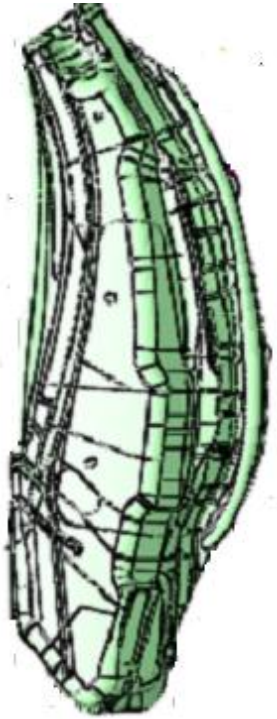
DTG Expertise to Highlight

New Process in the Die Shop

- Review / validate 3D Die Process
- Full cycle simulation (virtual tryout loop)
- Kick-off meeting
- NC cutter path generation
- High Speed NC machining
- Specific Bench Criteria prior to Tryout
- Die Tryout
- Inspection / Validation

Kick-off Meeting

- Use full cycle simulation results
- Changes to cutter path programming
- Bearing maps
- Clearance for side walls
- Variation in metal clearance
- Different tryout process



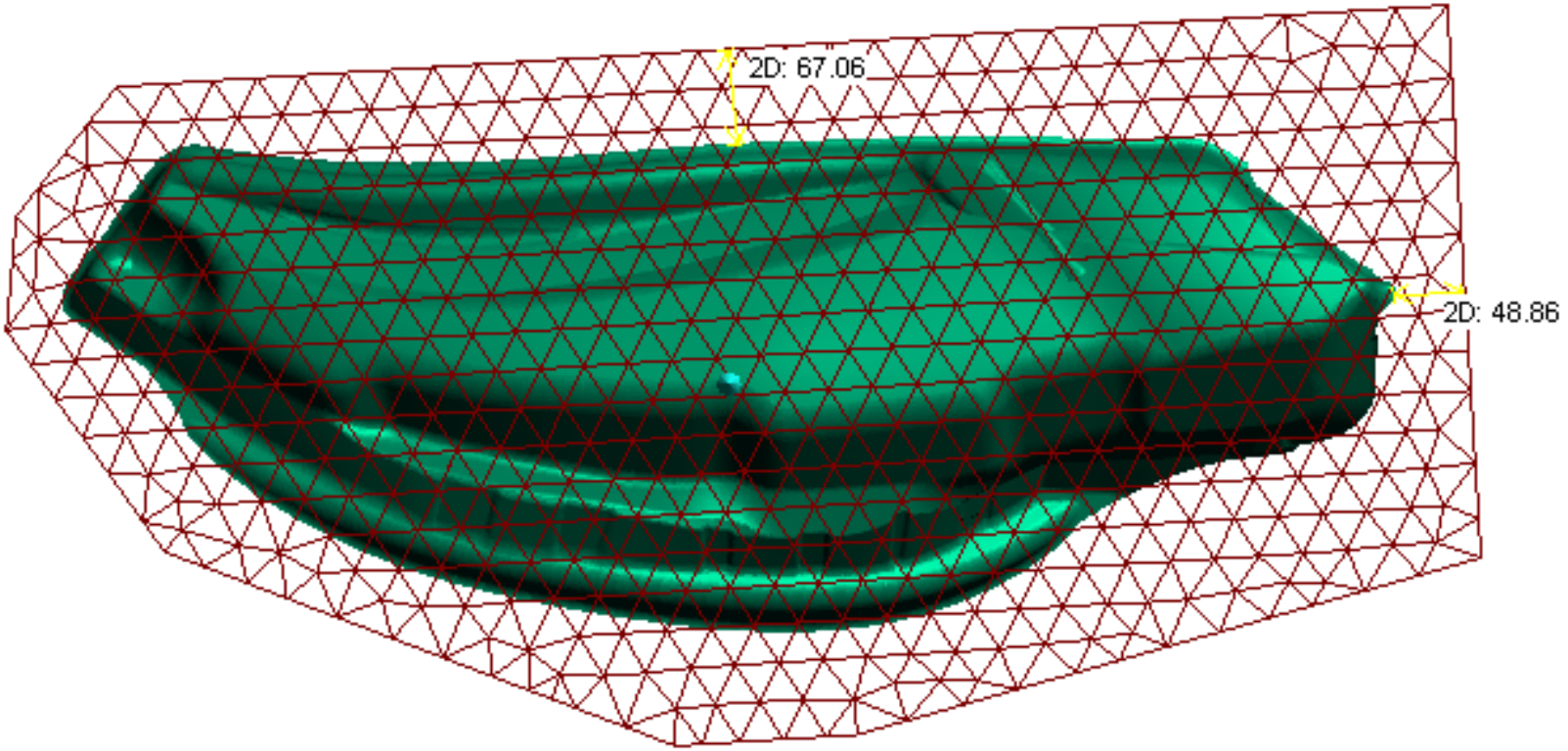
Tryout process changes

- Blank outline
- Blank location
- Binder tonnage / Ram tonnage
- Binder travel
- Lube
- Metal draw-in map
- Engineered beads per FEA force factor

Engineering = Design = Physical Reality

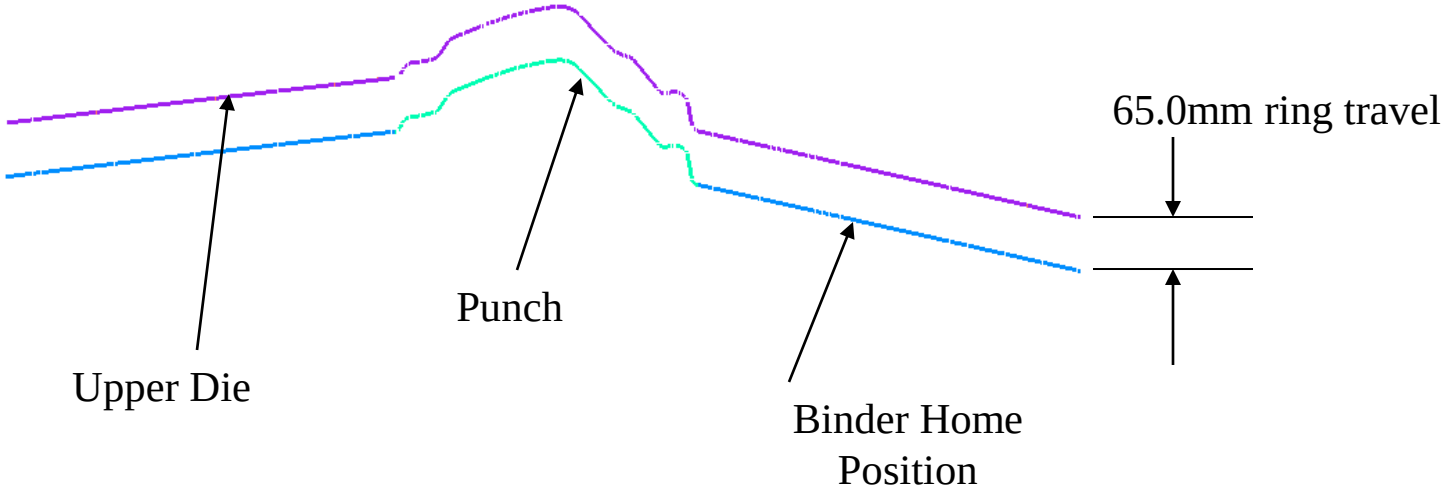
Blank Outline & Location

Blank location to punch



Binder Travel / Tonnage

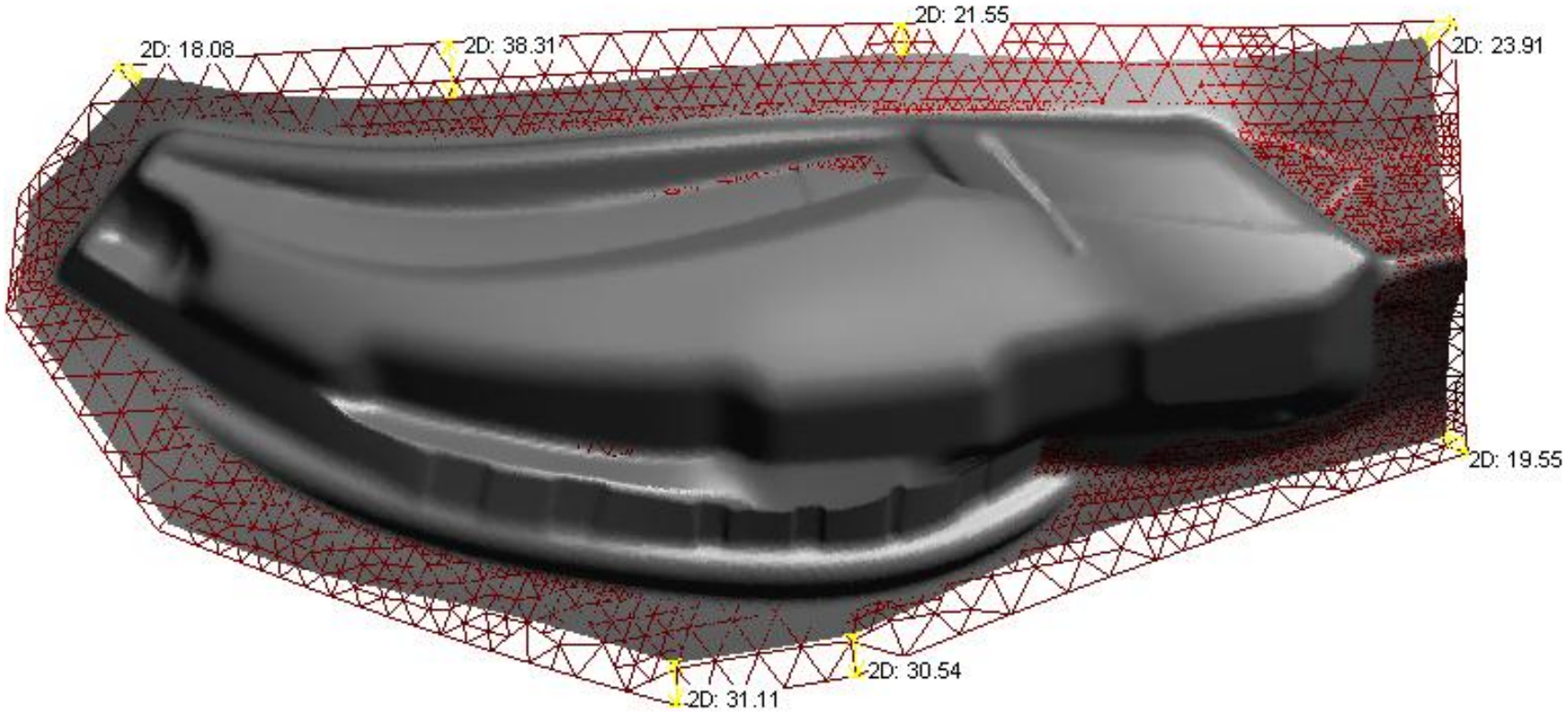
Die set-up / binder travel



Technical Data	
Material Spec:	590 Dual Phase
Material Code:	1182 Chrysler Code
Thickness:	1.2 mm
Blank holder force:	80 approximate tons
Total force: tons	450 approximate
Ring Travel	65 mm ring

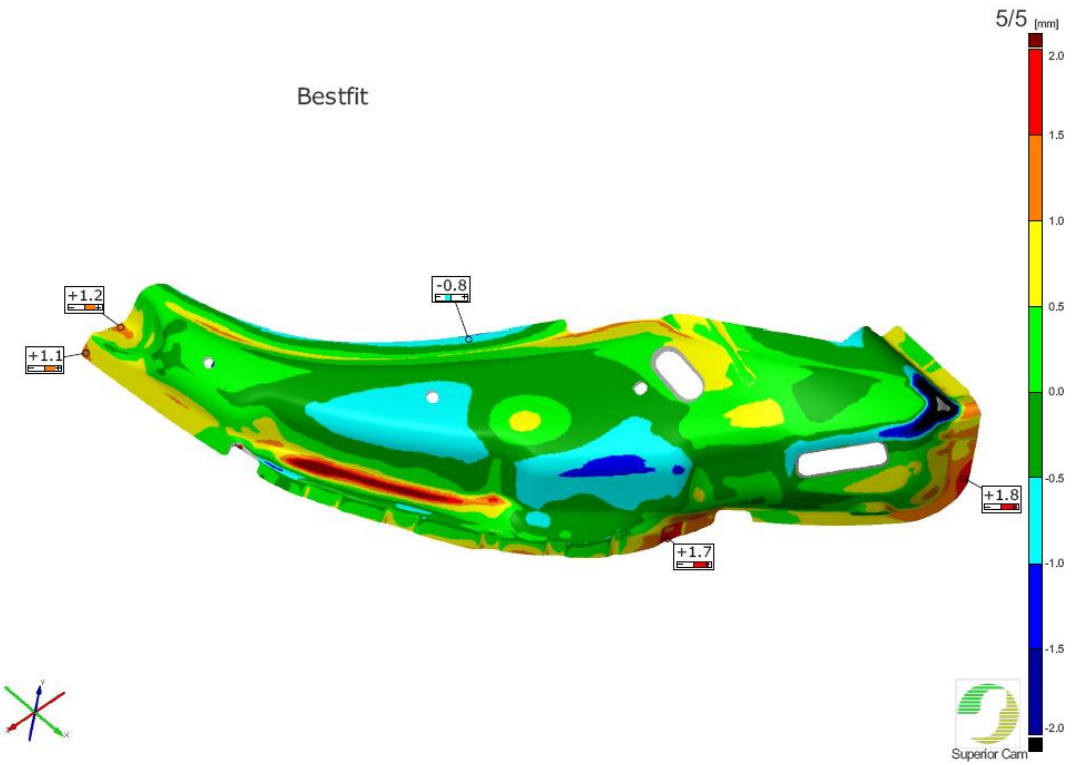
Metal Draw-in Maps

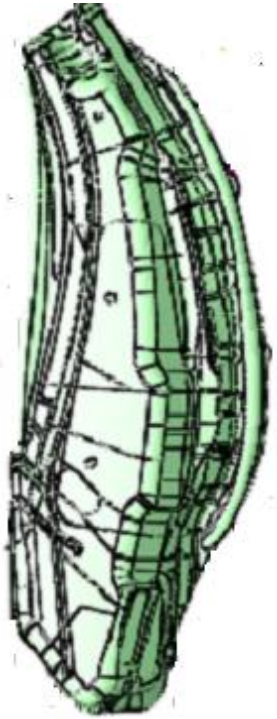
Blank run-in measured from binder set



First Panel Results

- First panel through the line within 1.8mm of nominal on the checking fixture
- Still had one iteration to morph (3 days)





Process used for Iteration

- White Light Scan
- Color map inspection reports
- Morph 120% correction factor
- Re-cut
- Re-scan
- Results after morph = OK

Total lead time = 22 weeks, including die design

Part met nominal criteria

Recommendations

- Use formability analysis through the line
- Die design & analysis must agree 100%
- Blank outline and location match
- Tryout drives the process from the beginning
- Match the metal draw-in
- Use the same material throughout (eliminate potential variables)

dtg

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Thank you