

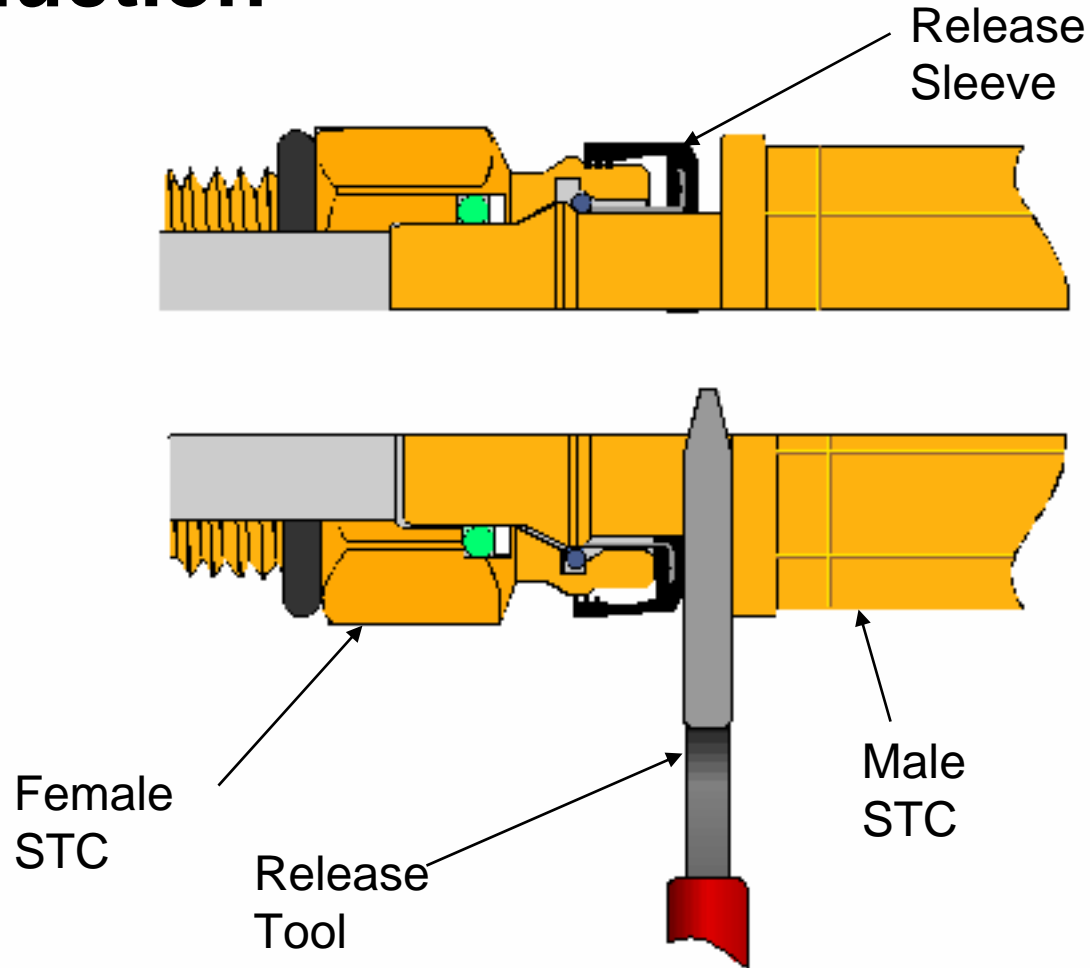


Designing and evaluating tooling used to form a hydraulic end connection on tubing using MSC.Marc

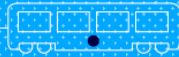
Philip C Van Riper
Senior Analysis Engineer
Eaton Corporation



Introduction



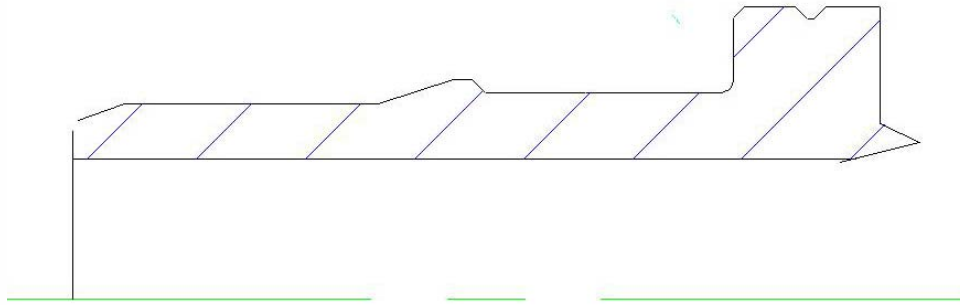
PRODUCT DEVELOPMENT CONFERENCE



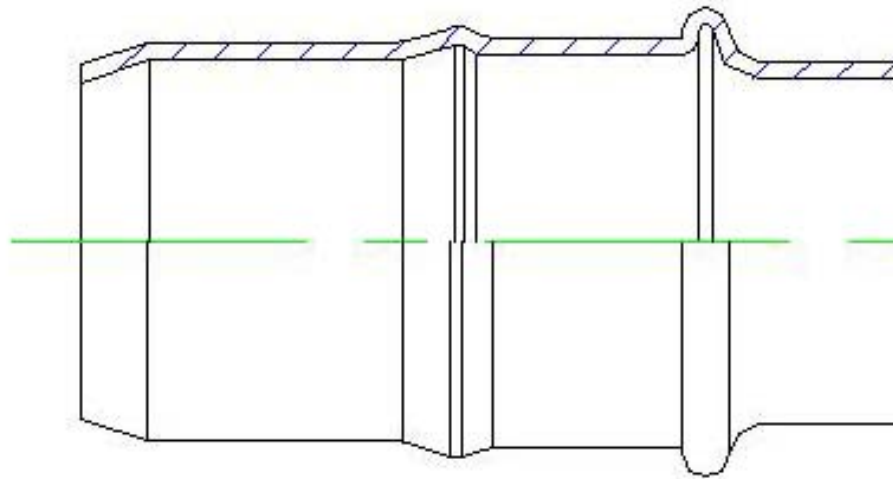
Problem Definition



Machined

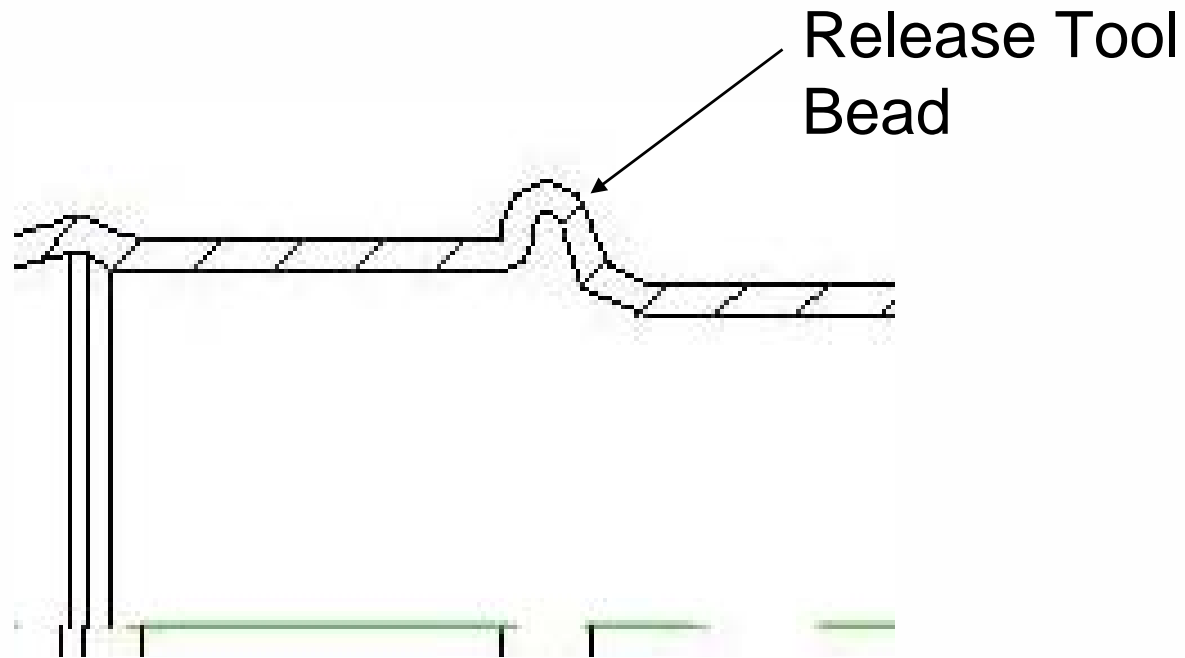


Formed





Problem Definition





Analysis

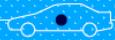


Material properties

Obtained from tensile tests

Reduction of Area used to determine fracture strain

$$\varepsilon_f = \ln \frac{100}{100 - A_r}$$



Analysis



Plasticity

Von Mises Yield Surface

Large Strain-
Multiplicative

Isotropic Hardening

Elements

Axysymmetric Solid –10

Analysis Options

Updated Lagrangian

Constant Dilatation

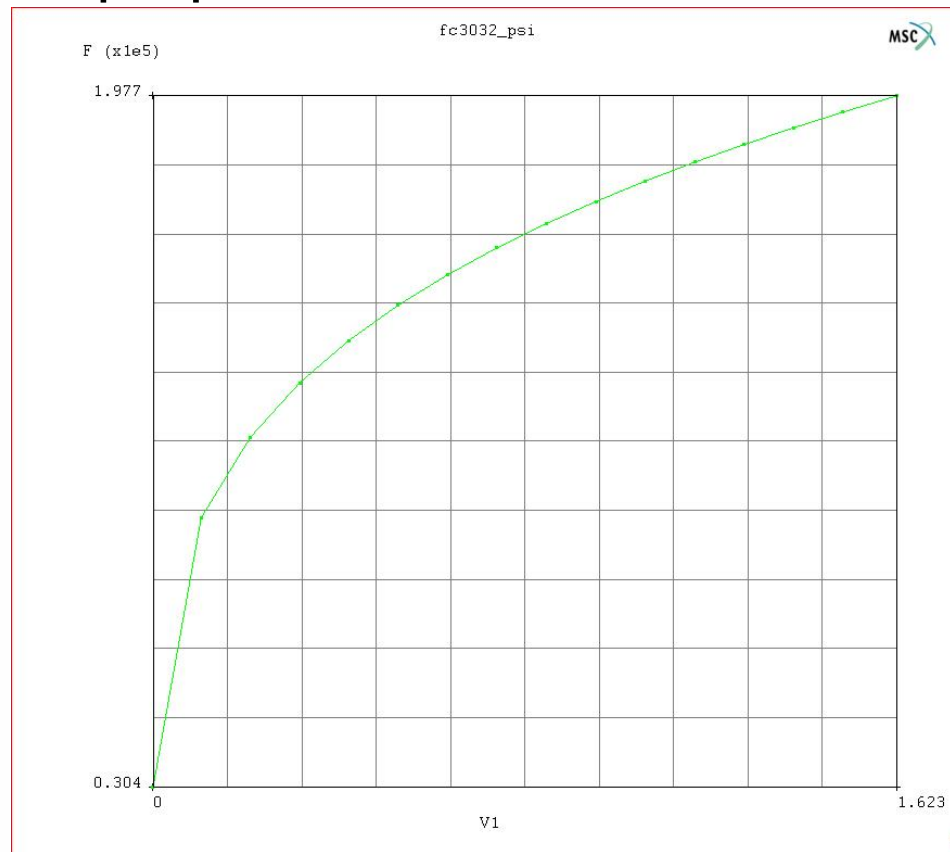
Large Strain



Analysis

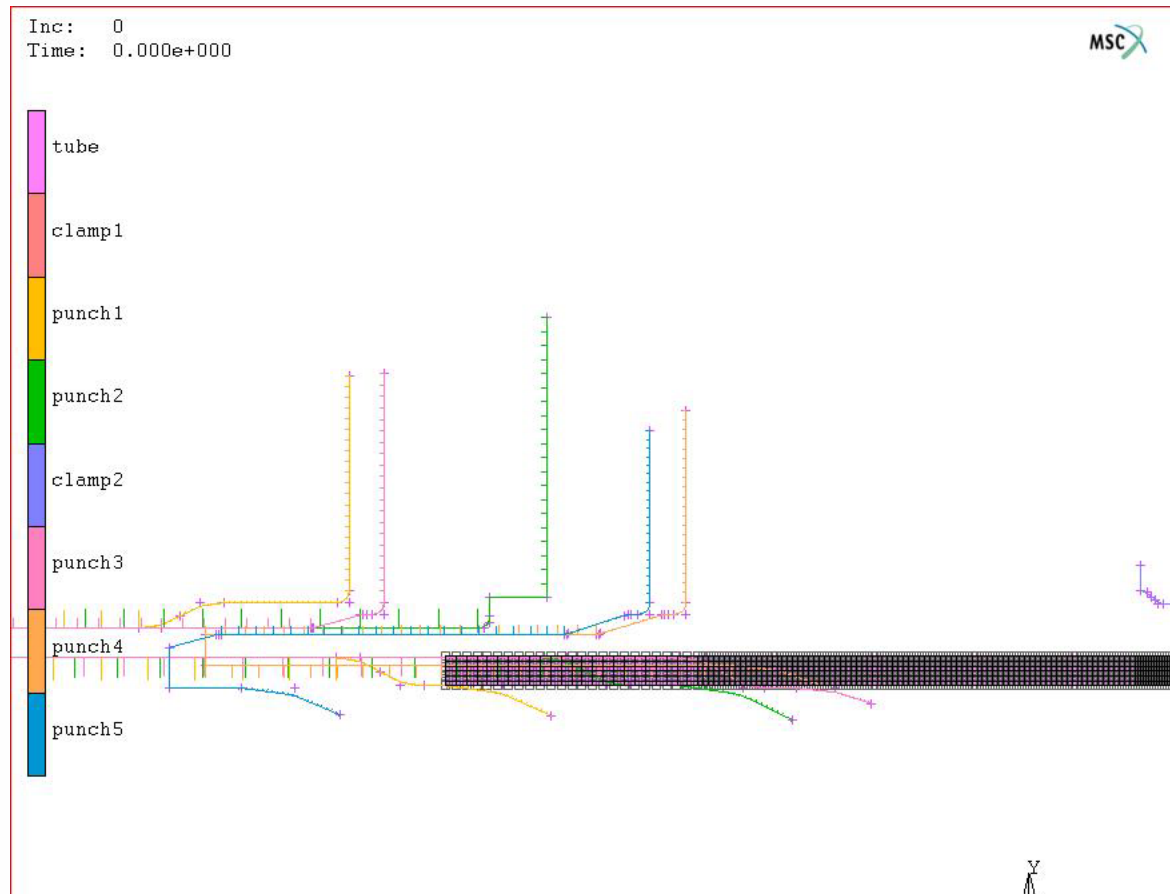


Material properties – obtained from tensile tests





Analysis



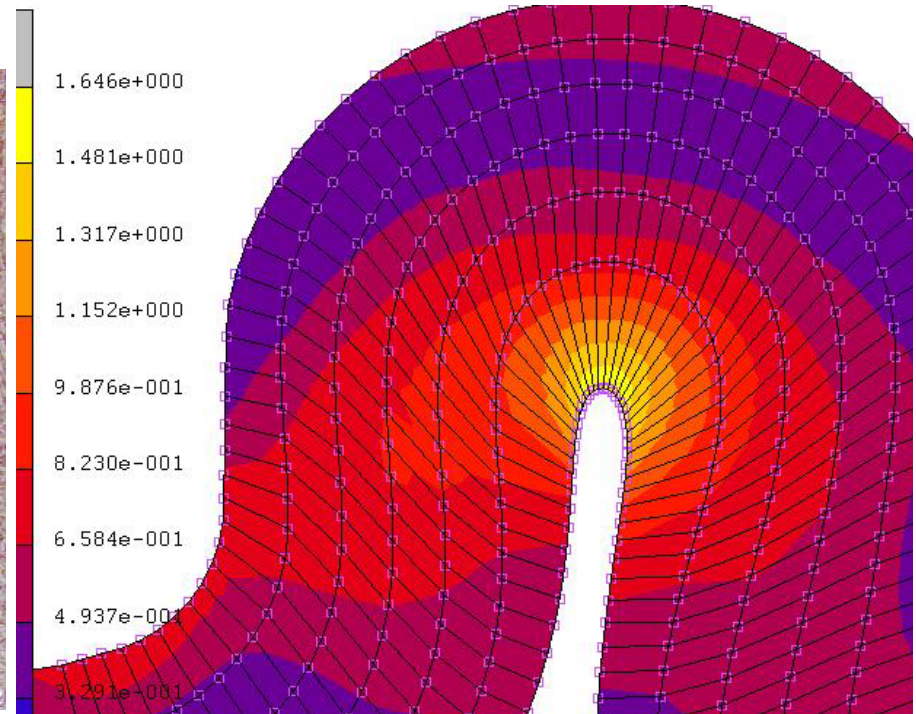
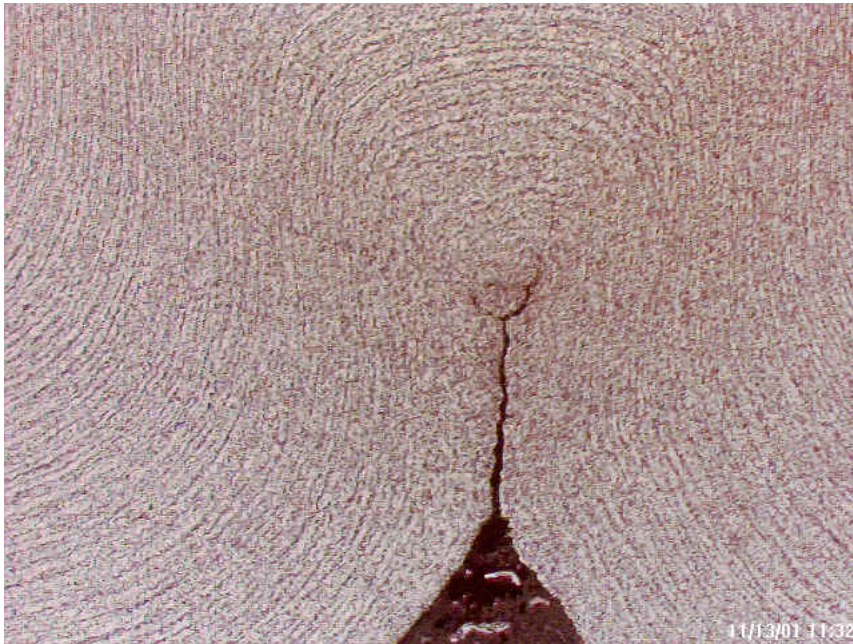
PRODUCT DEVELOPMENT CONFERENCE



Discussion



Fracture Strain
1.623

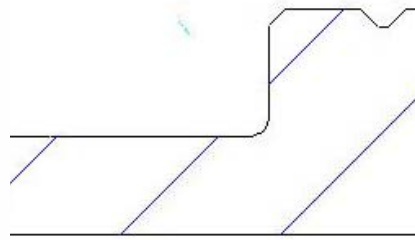




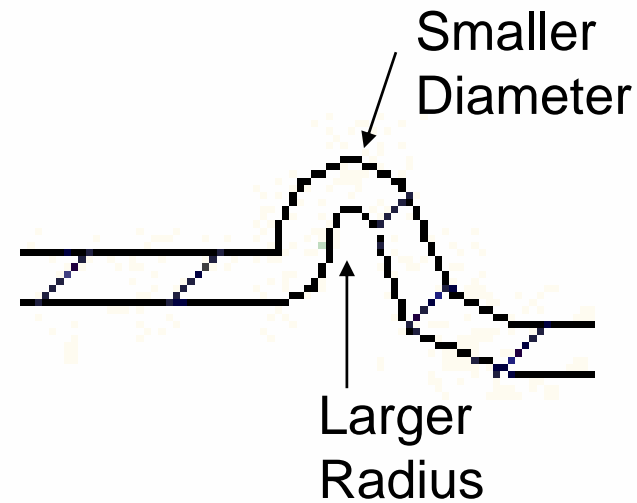
Discussion



Release Tool
Support Bead



Machined



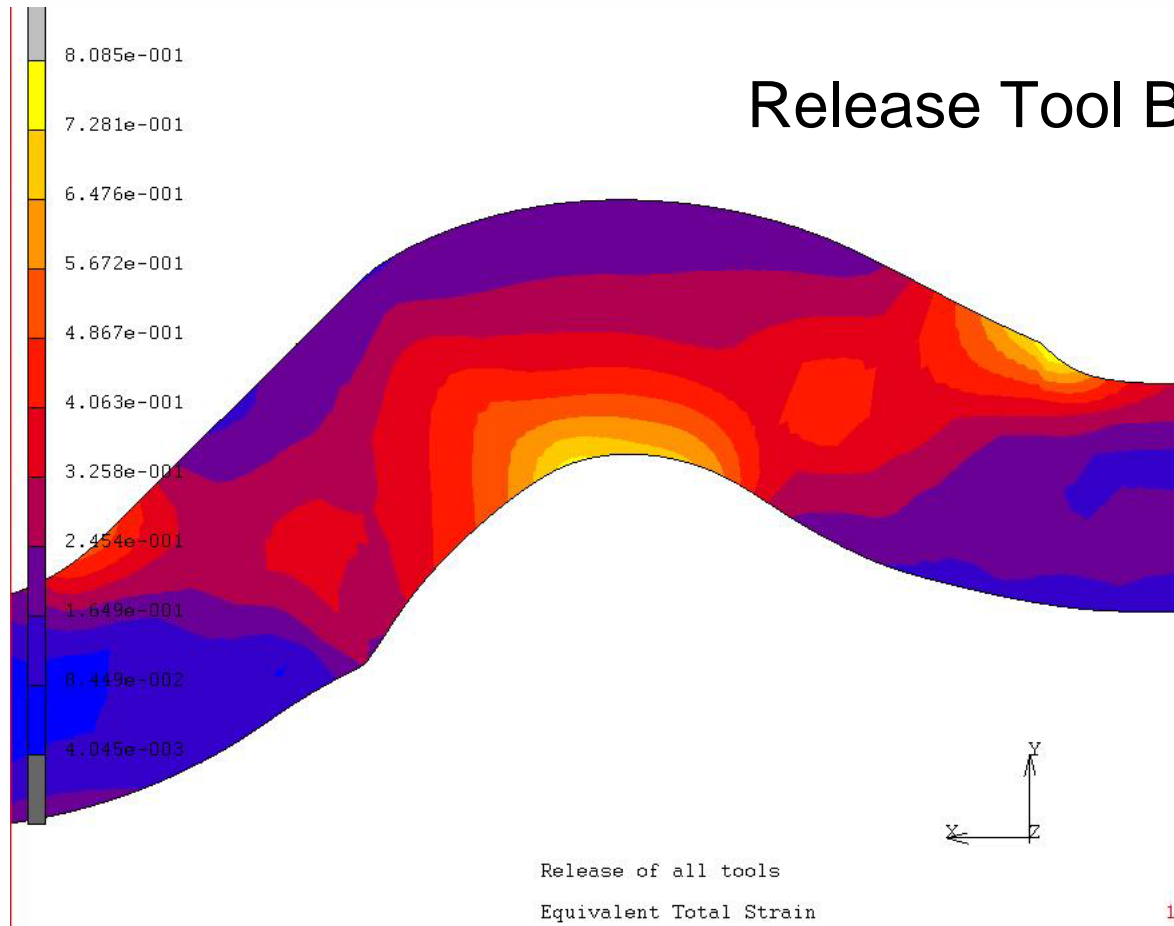
Formed

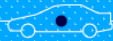


Discussion

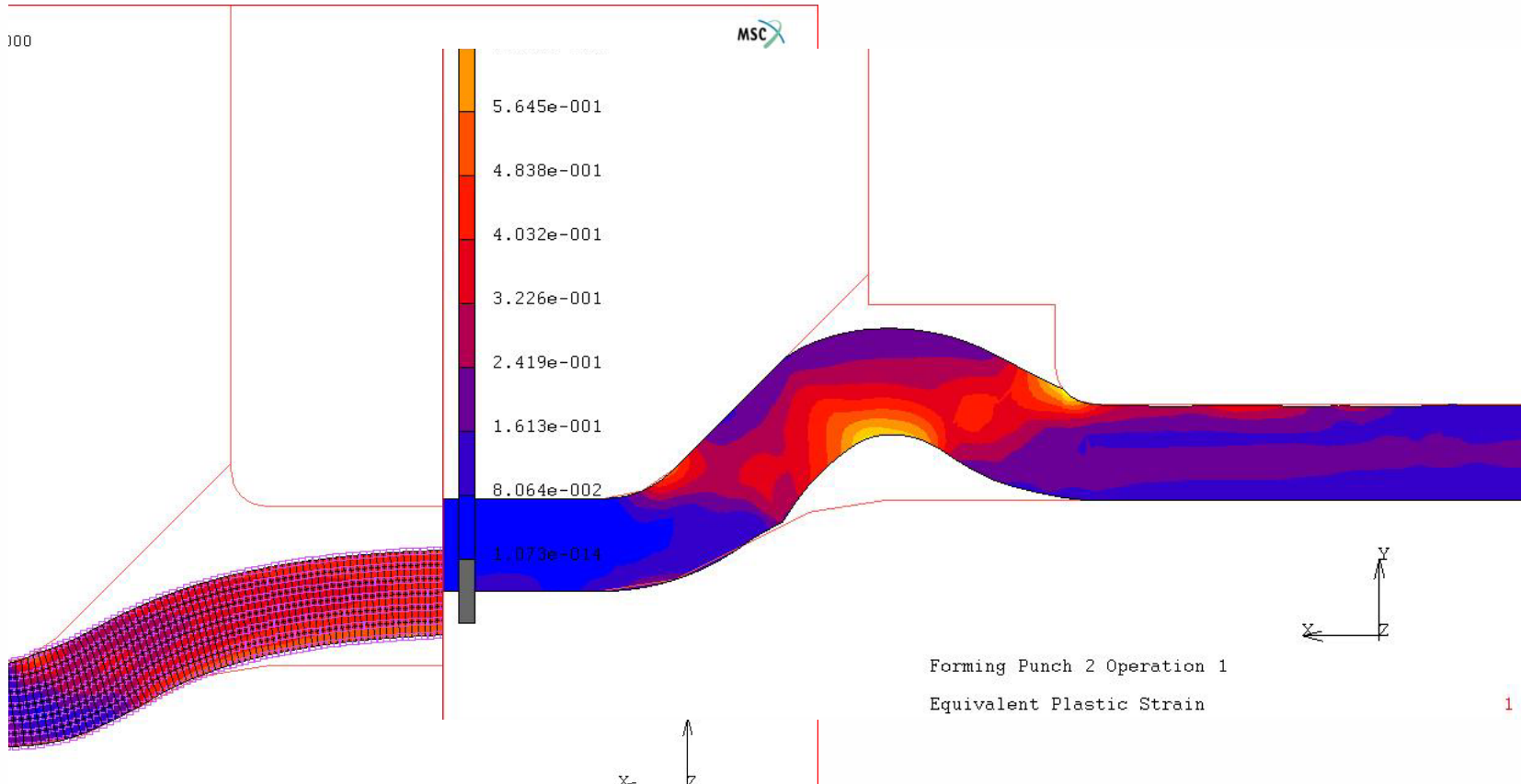


Release Tool Bead



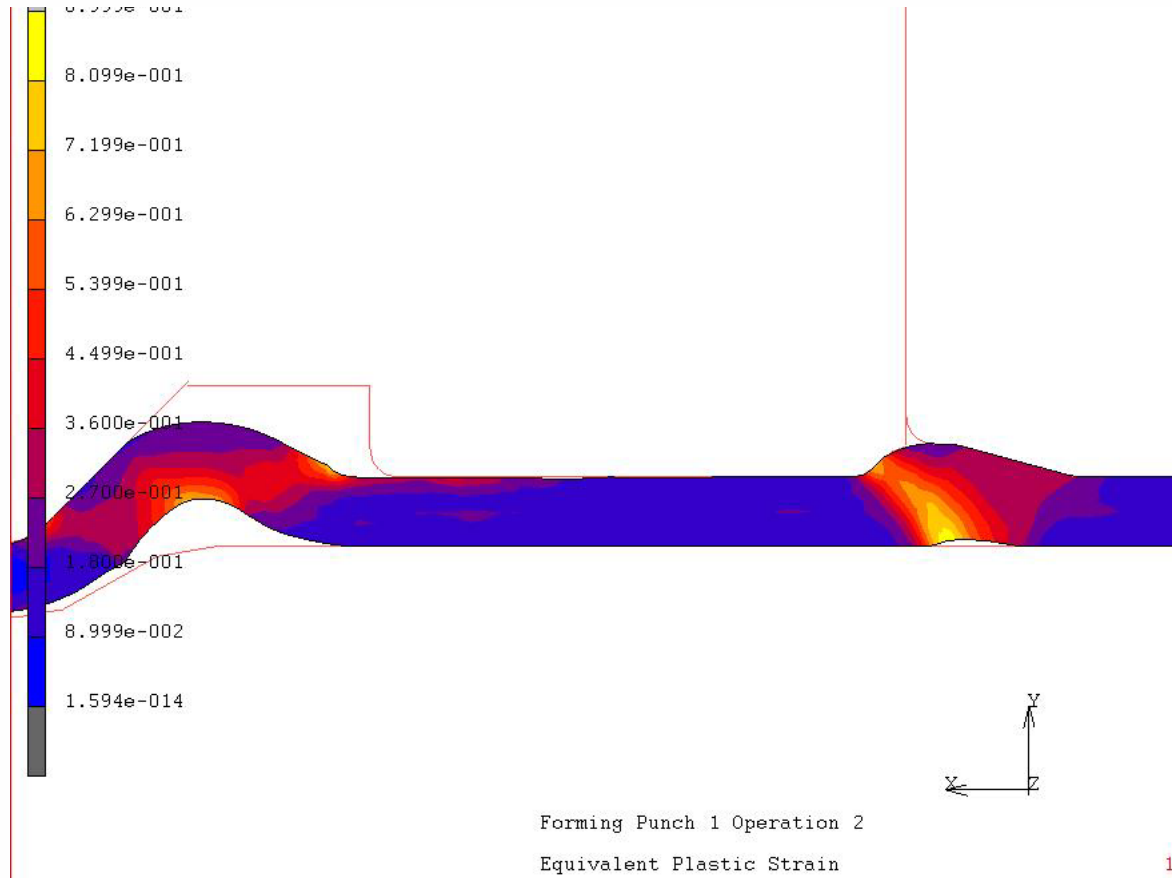


Discussion



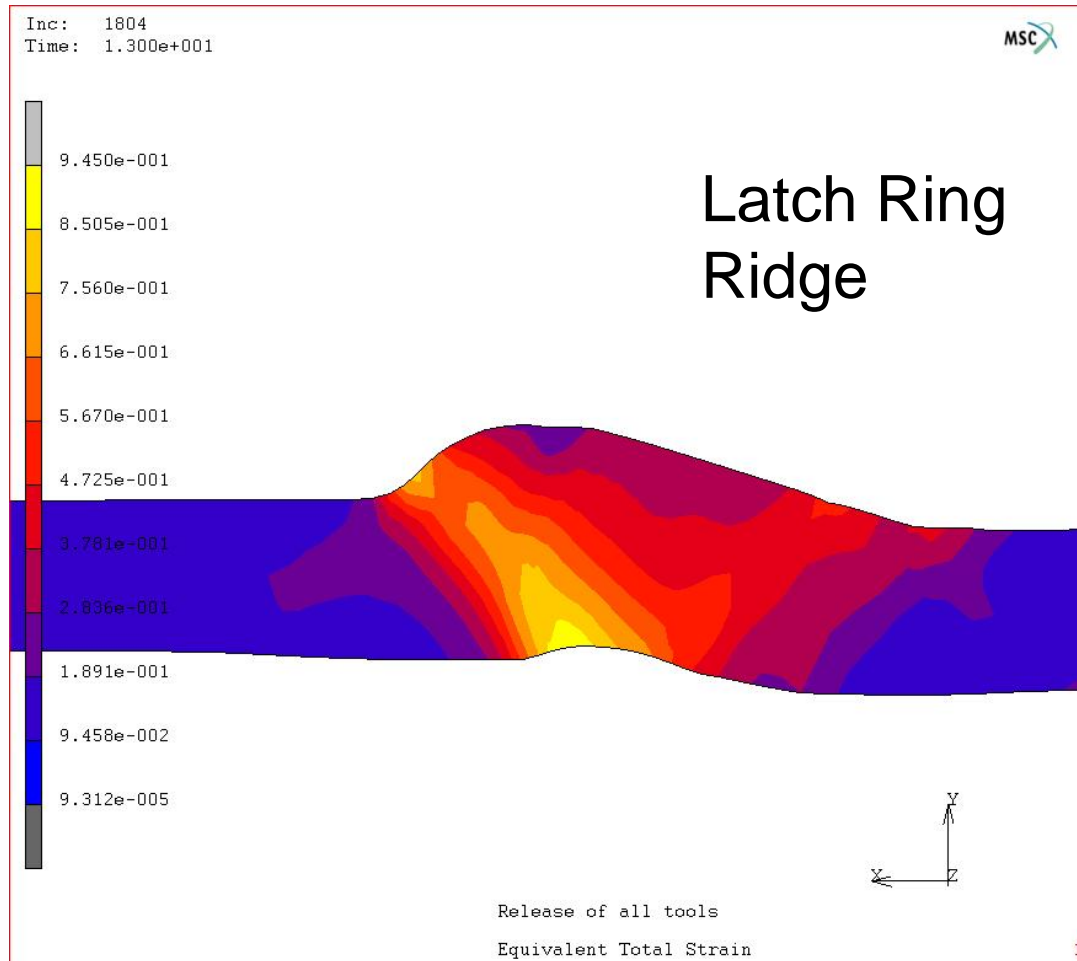


Discussion





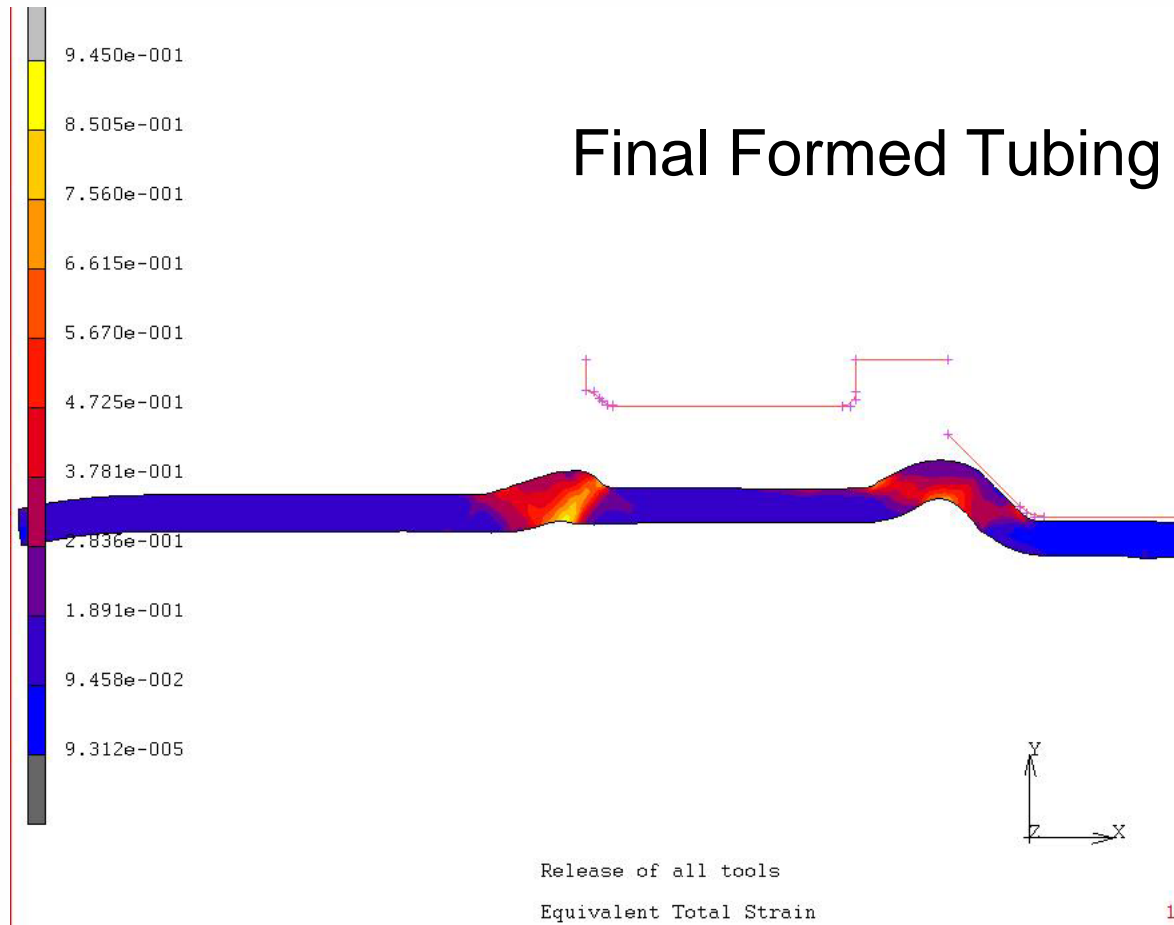
Discussion

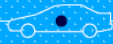


PRODUCT DEVELOPMENT CONFERENCE



Discussion





Conclusion



- ① Saves time and money on tooling development
- ② Allows greater understanding of finished product and intermediate forming steps.
- ③ Allows experimentation of many different options without much cost.
- ④ Augments, does not replace tooling designer / manufacturing engineering.