

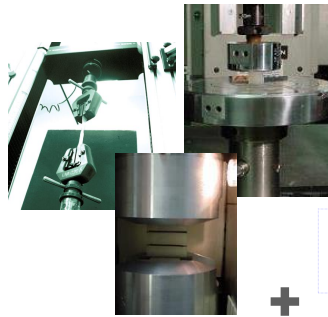
Material Testing and Calibration for Non-Linear ANSYS Simulations

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DatapointLabs
Ithaca NY, USA

expert material testing



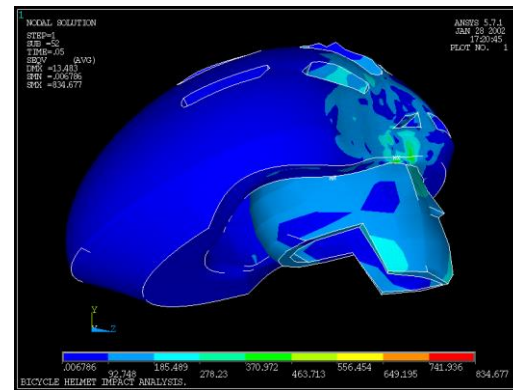
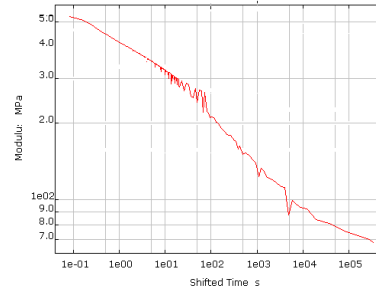
materials



testing

+

data conversion



Your CAE

- Materials testing + CAE material parameter conversion
 - metal, plastic, foam, rubber, composites...
 - ANSYS, LS-DYNA, Polyflow, Autodyn...



DatapointLabs

- Research quality material data since 1995
- ISO 17025 production environment
- Results in 5 days (48 hour RUSH service)
- On-line quotation & data delivery
- Domain expertise in CAE material calibration
 - All Major CAE supported
 - *TestPaks*: easy to order, complete data

Material Testing Expertise

- Non-linear FEA material data
 - Rubber
 - Plastic
 - Fiber filled plastics
 - Foam
 - Metal plasticity
- Crash/drop test simulation properties
- Injection-molding simulation material data
- Extrusion/Blowmolding/Forming properties

Objective

- ANSYS has grown significantly
 - Non-linear CAE
 - Crash (Explicit/Autodyn)
 - CFD (Fluent/CFX)
 - Process Simulation (Polyflow)
- Multi-physics is commonplace
- Material modeling is now important

Risk Analysis

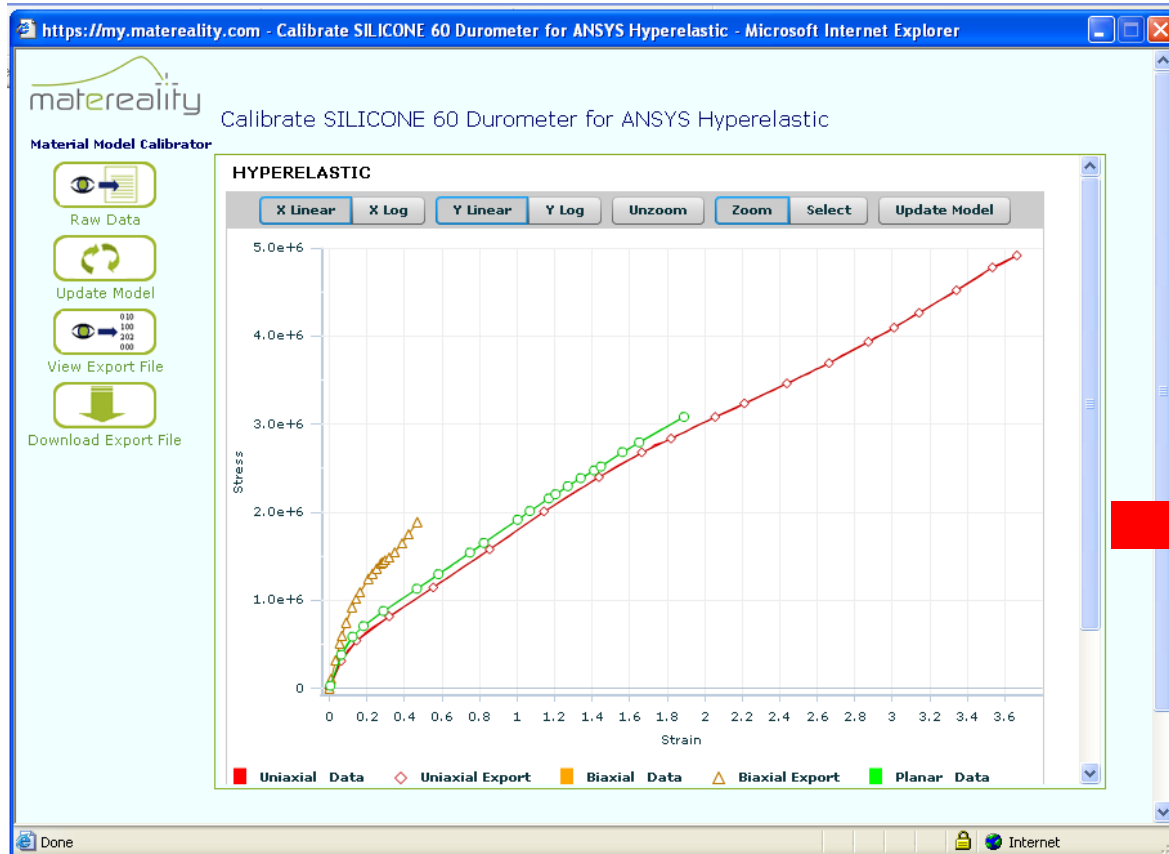
- Poor material representation brings risk to CAE and product development
 - Material data from illegitimate sources
 - Testing procedure in error or unsuitable for CAE
 - Improper conversion of material data to model calibration
 - Material model not suitable for material

Hyperelastic

- Tensile
- Compressive
- Planar
- Volumetric
- Range
 - pre-cycled or first pull
 - -50 to 200 C
 - rate dependency



Hyperelastic export to ANSYS



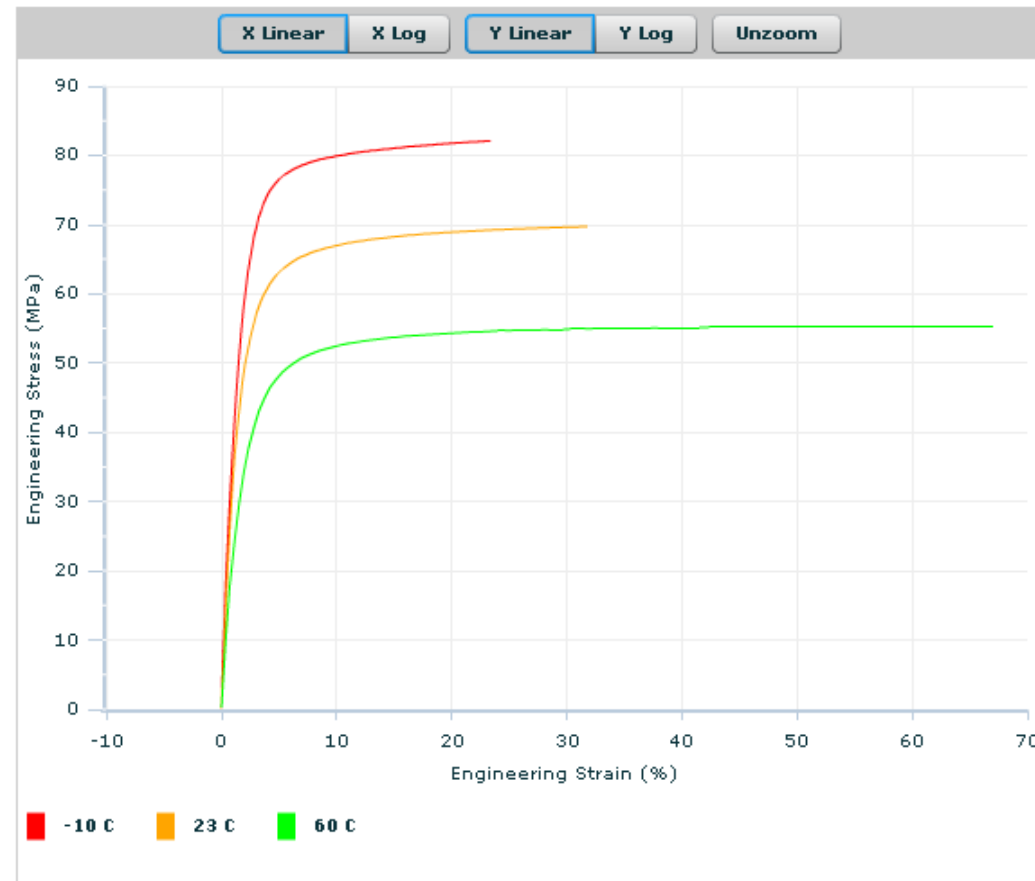
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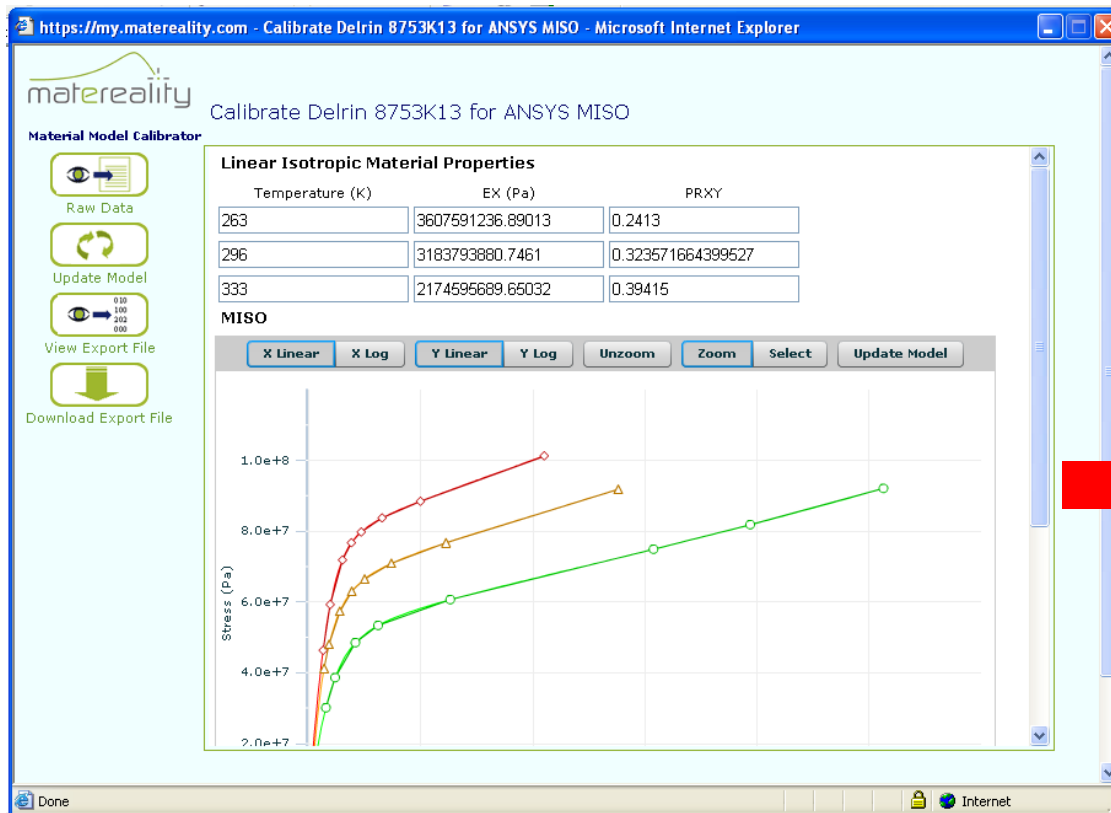
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Plastics non-linear stress-strain

Engineering Tensile Stress-Strain Curves



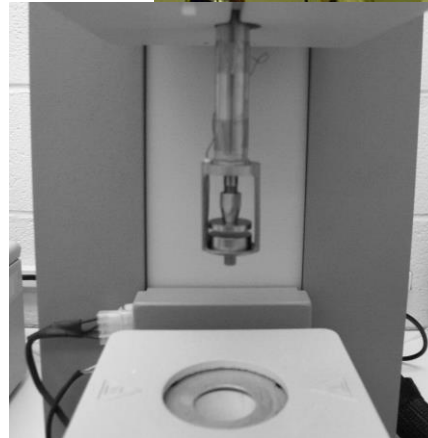
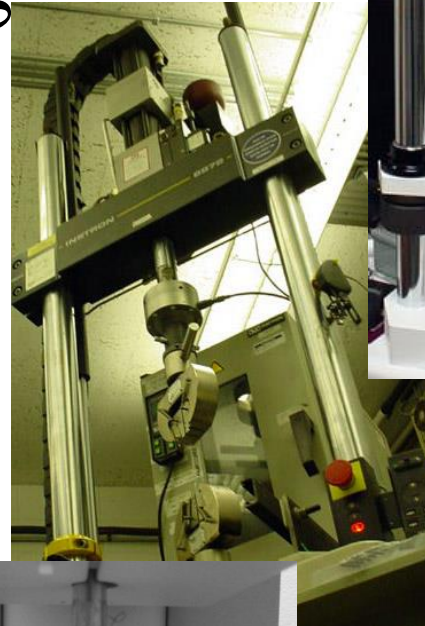
Post-processing and output



! Output generated by Matereality ! ANSYS MISO Model Model ! Setup and Clear existing temperatures /PREP7 !* MPTMP,,,,,,,, ! MATERIAL, name=Delrin8753K13 ! Elastic Data MPTMP,1,263 MPTMP,2,296 MPTMP,3,333 MPDATA,EX,1,,3607591236.89013 MPDATA,PRXY,1,,0.2413 MPDATA,EX,1,,3183793880.7461 MPDATA,PRXY,1,,0.323571664399527 MPDATA,EX,1,,2174595689.65032 MPDATA,PRXY,1,,0.39415 ! Stress v. Strain TB,MISO,1,3,,,, TBTEMP,263 TBPT,,0.0128566973348731,46381708.640637 TBPT,,0.0192916536341156,59318219.0072696 TBPT,,0.0300929508209243,71873640.0512504 TBPT,,0.0380678180558224,76715670.2762688 TBPT,,0.0467588262082868,79820424.4473178 TBPT,,0.0656156939036236,83752001.4704219 TBPT,,0.0996308323276602,88445801.20706 TBPT,,0.210287100181154,101286187.380666 TBTEMP,296 TBPT,,0.0137528741910411,41202747.4277636 TBPT,,0.0182053326922491,48013808.7197766 TBPT,,0.0278235499889977,57359137.021248 TBPT,,0.038397884337866,62987355.6601982 TBPT,,0.0497645179040533,66496779.3306663 TBPT,,0.0737103466826197,70900939.2980115 TBPT,,0.122493081510413,76725757.10626 TBPT,,0.276124313127409,91876816.291205 TBTEMP,333 TBPT,,0.0152815303653043,30117746.47629 TBPT,,0.0235235783164899,38668250.30697 TBPT,,0.512883924011926,92151413.540012

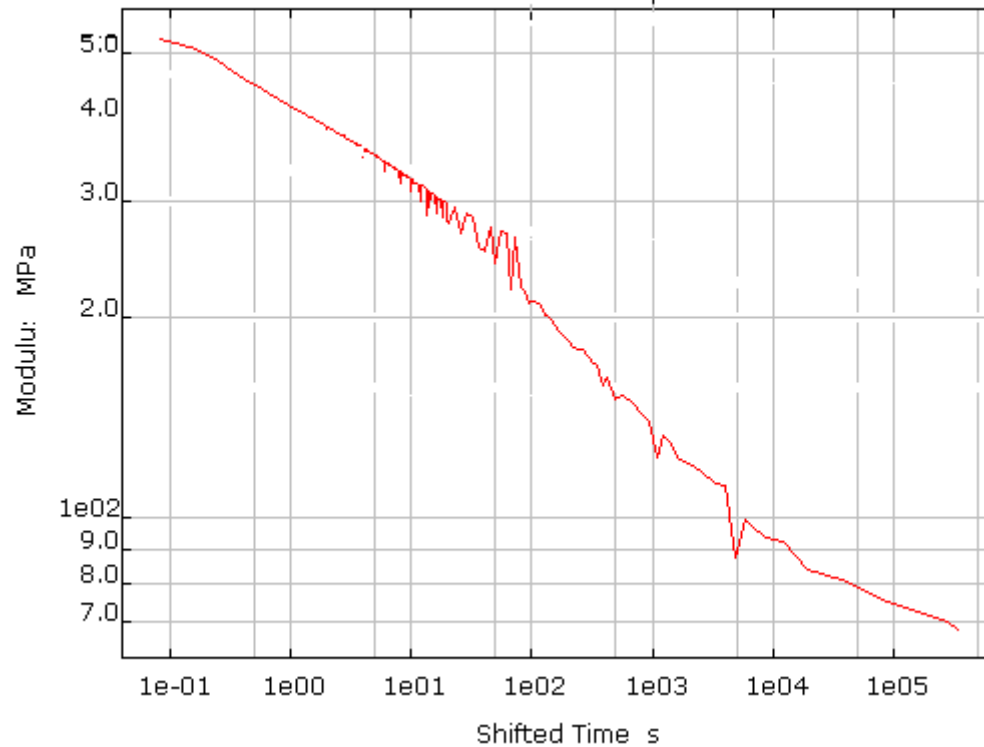
Visco-elastic testing

- Instruments
 - Rheometrics ARES
 - Bose Enduratec
 - Instron Servo
 - Perkin Elmer DMA 7e
- Test Modes
 - Stress relaxation
 - Creep
 - Frequency



UHMWPE mastercurve

Modulus v. Time Mastercurve

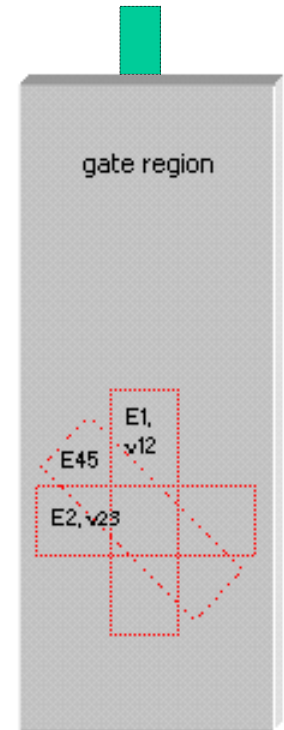


Fiber Filled Plastics

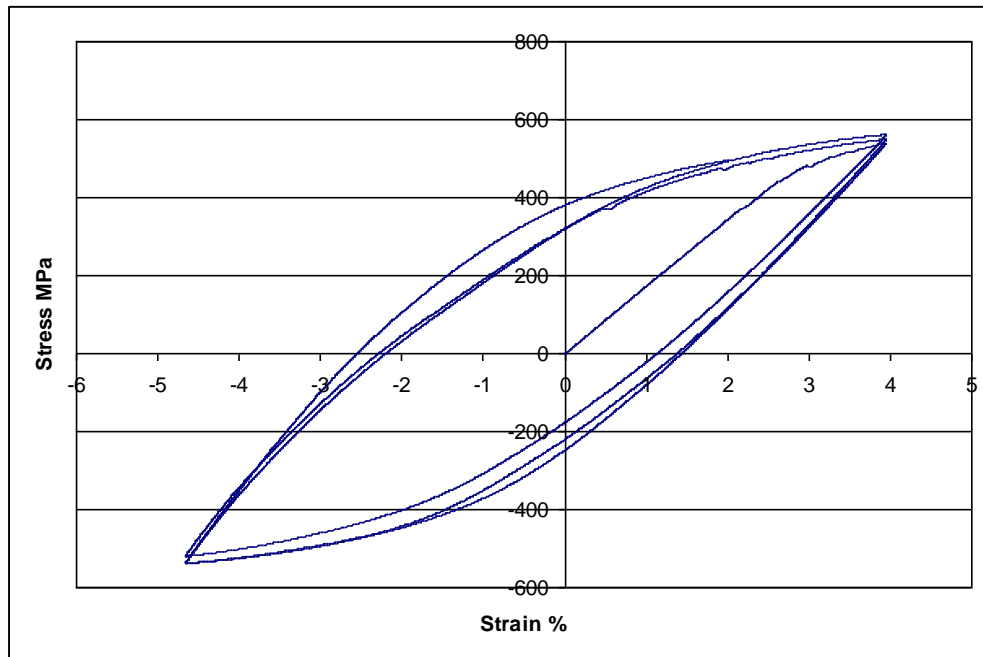
- *TestPaks* for Digimat MX
 - Reverse Engineering process
 - Inputs created for spatially varying material models
 - Stiffness
 - Failure
 - Crash simulation
 - Creep and visco-elasticity

Basic Digimat *TestPak* Protocol

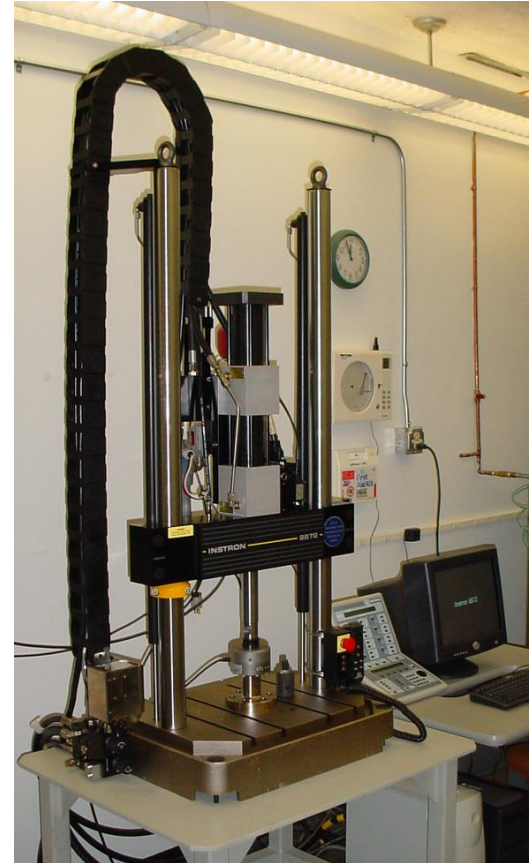
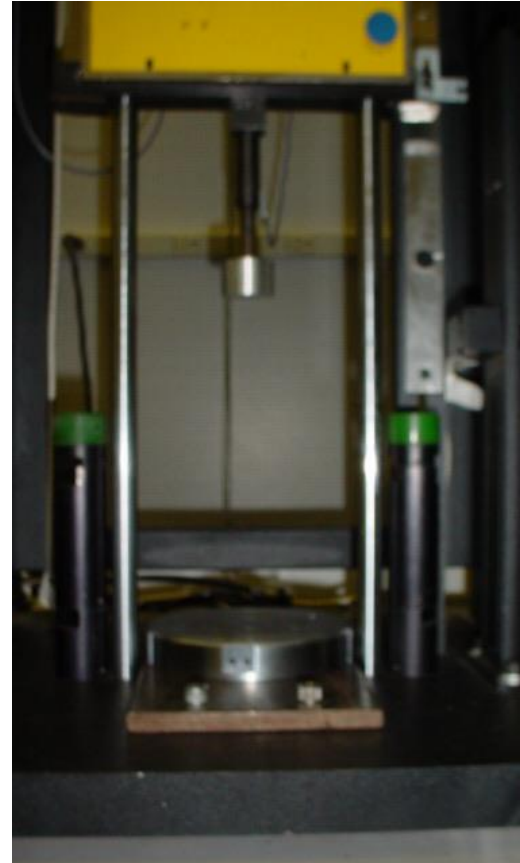
- Mold 100X200X3.16mm plaques
 - Edge gated on 100 mm end
 - Long flow length
 - Fully developed flow
 - Highly fiber orientation
- Cut test specimens by CNC
- 5 specimens each (0° , 45° , 90°)
- Obtain true stress-strain data



Cyclic Plasticity

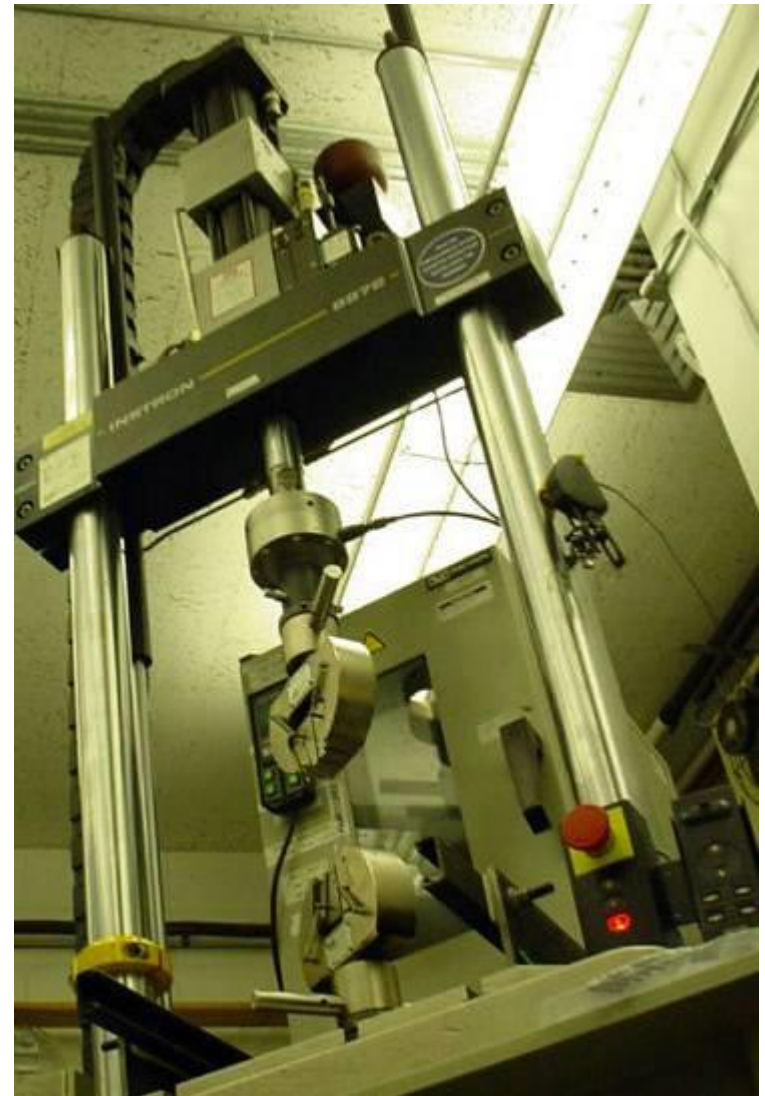


Testing of foams



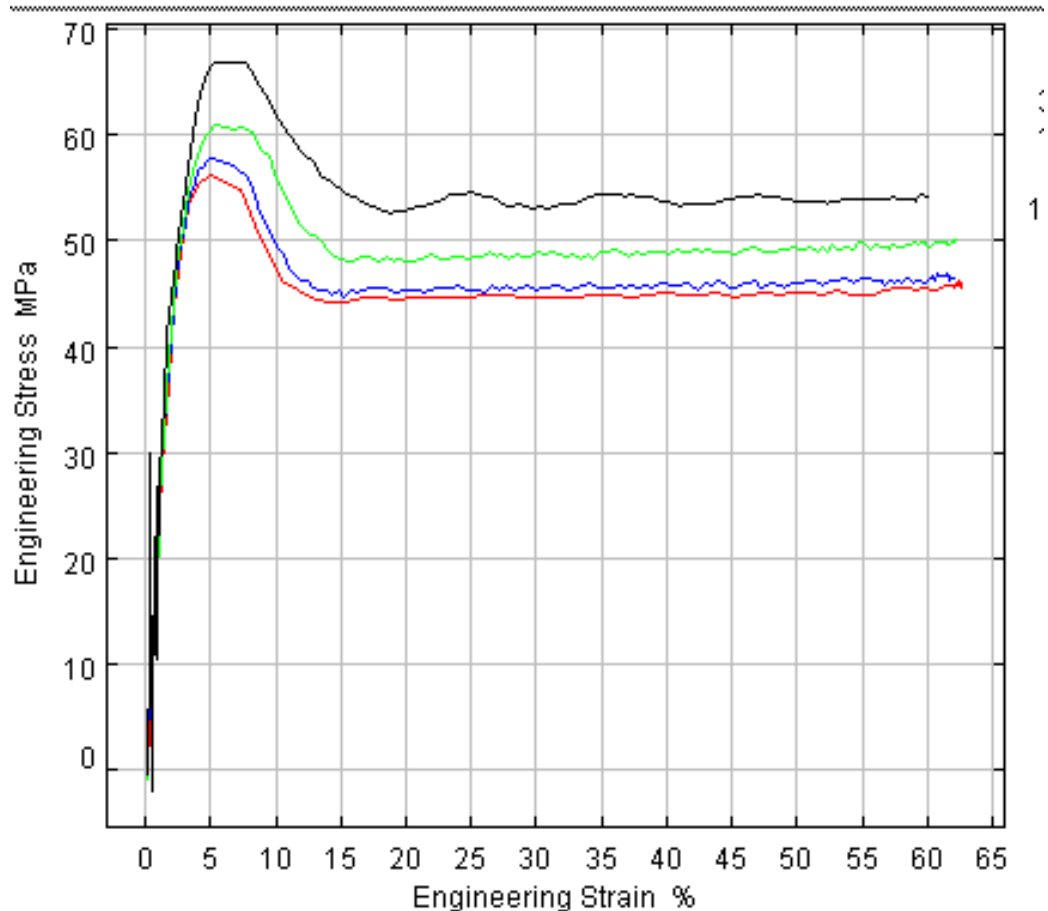
High speed testing

- Instron servo-hydraulic
 - Dynamic load cell
 - Strain rate range
 - 0.01 to 100/s
 - Test modes
 - tensile
 - compressive
 - flex



High strain rate tensile properties

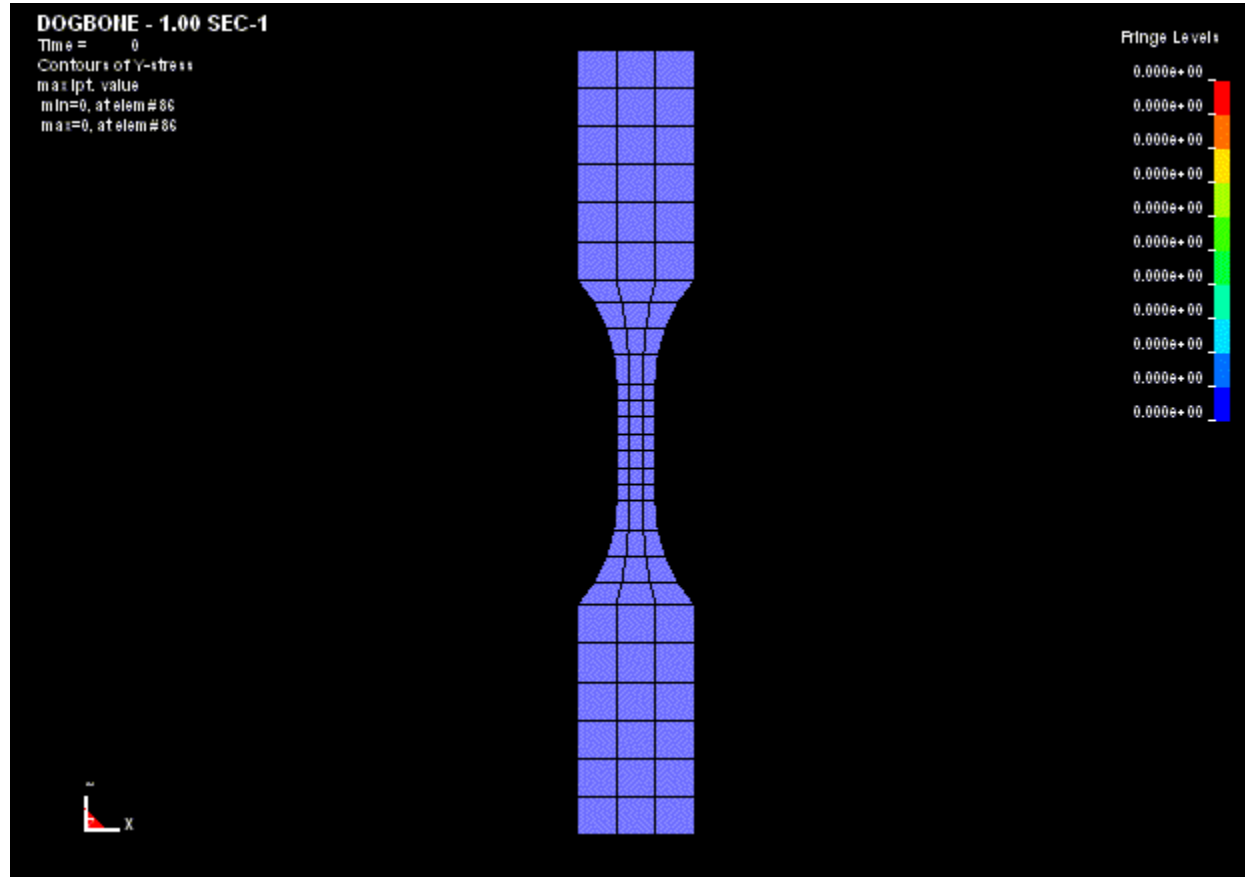
Engineering Tensile Stress-Strain Curves



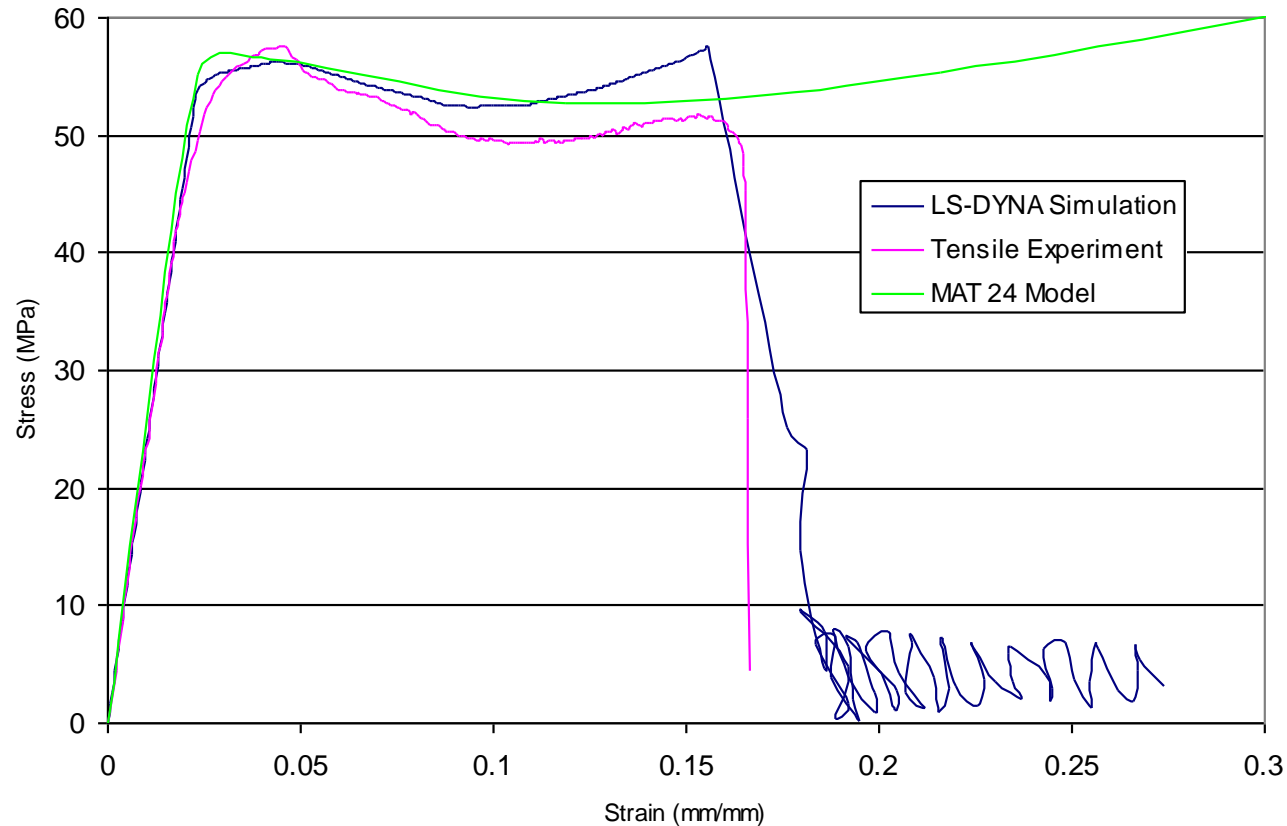
LS-DYNA model calibration



Simulation of the tensile test



Model validation*



*validation not available for all material models

TestPaks[®] for CAE

- Material testing
- Material model selection
- Material parameter evaluation
- Material model validation*

* only available for some models

- CAE input file

www.datapointlabs.com