NEW Metal Foams

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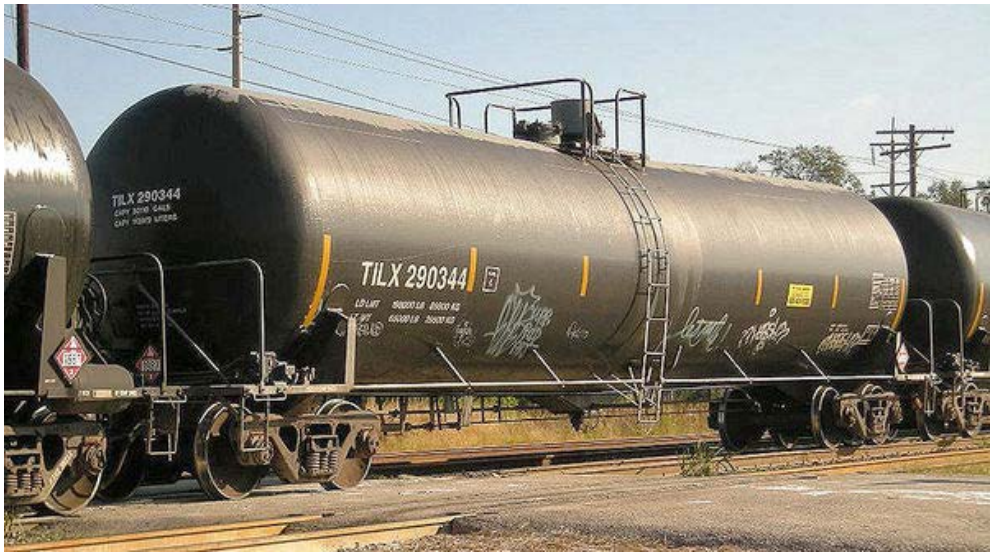
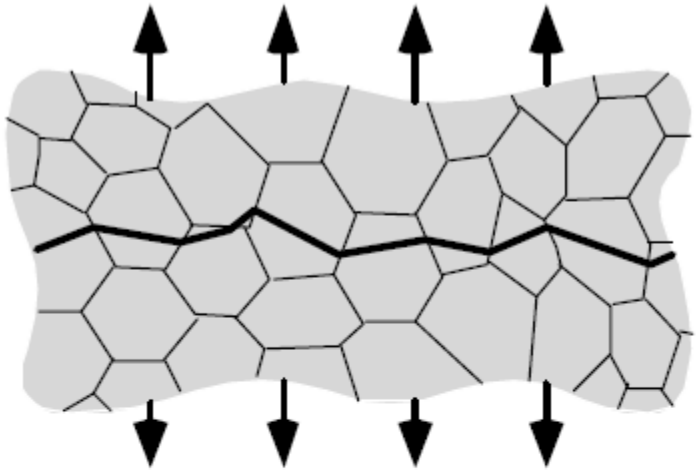
April 16, 2015

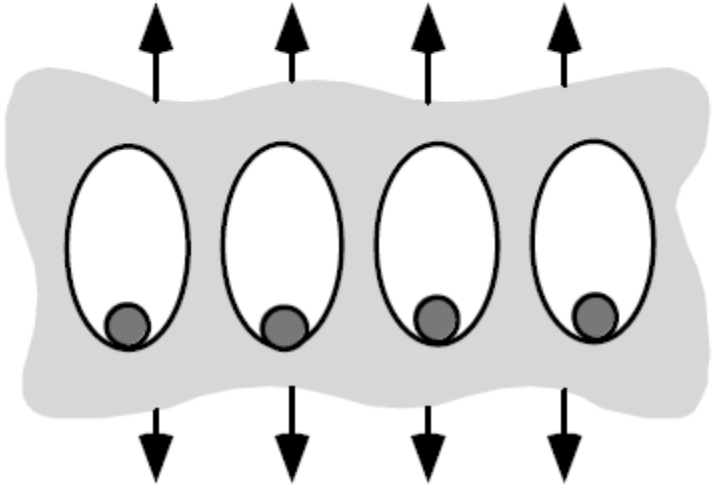
US/DOT, Washington DC

Background (Problem)



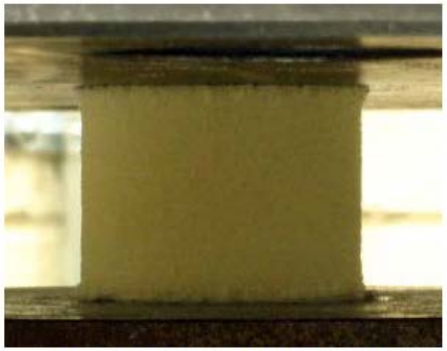


a) Brittle fracture (cleavage).

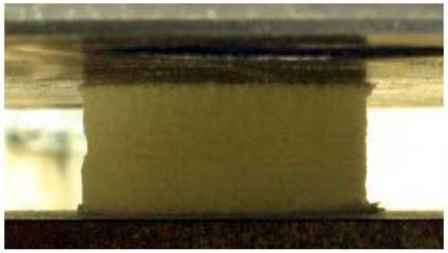


b) Ductile fracture (microvoid coalescence).

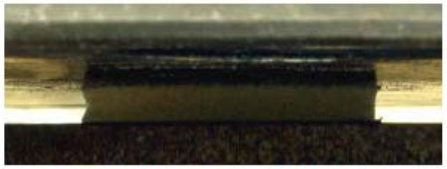
Previous Foam Studies



(a) 10 percent Compression

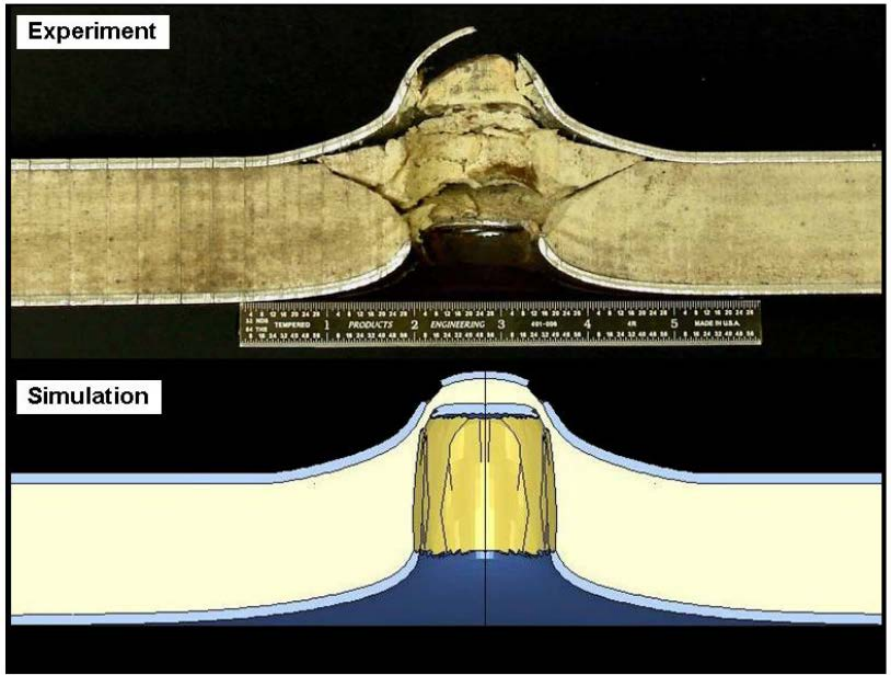


(b) 50 percent compression



(c) 90 percent compression

(d) Post-test configuration



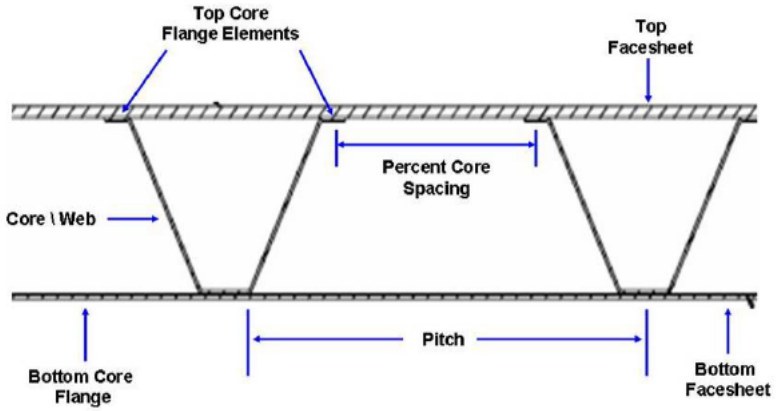
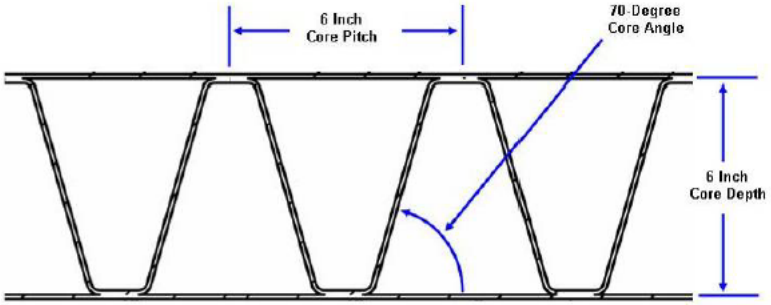
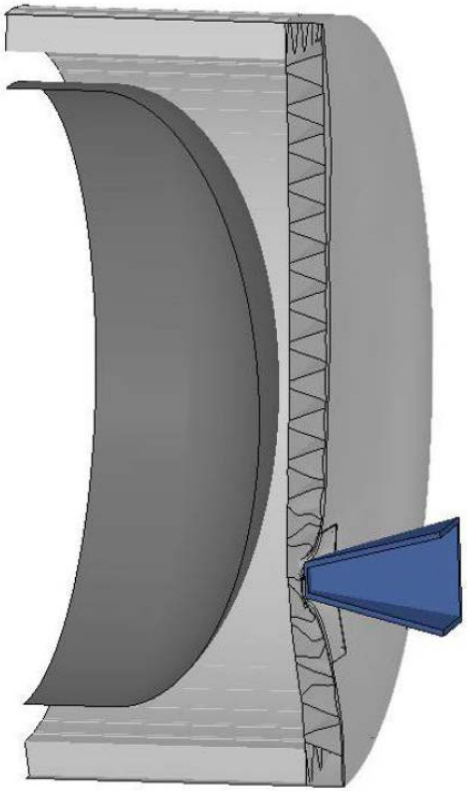
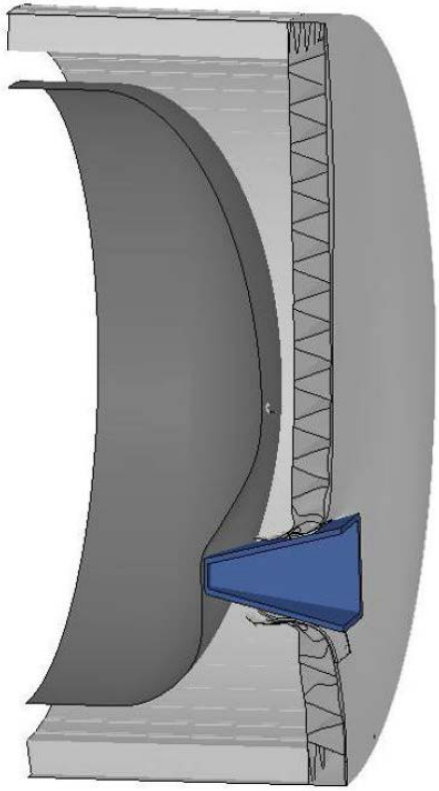


Figure 257. Nomenclature for corrugated EMS structures.







29,000 GALLON TANK CAR

DIMENSIONS (APPROX.)

LENGTH, OVER PULLING FACES:	59' – 3 ½"
LENGTH, BETWEEN TRUCK CENTERS:	45' – 9"
HEIGHT, EXTREME:	15' – 6"
SLOPE, TANK:	¼" PER FOOT
WIDTH, EXTREME:	10' – 7"
TANK, OUTSIDE DIAMETER:	9' – 10 ¾"
TANK, LENGTH:	53' - 4"
CLEARANCE:	AAR PLATE C

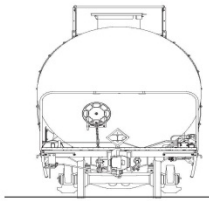
WEIGHT/CAPACITY (EST.)

LIGHT WEIGHT:	84,300 LBS
GROSS RAIL LOAD:	286,000 LBS
LOAD LIMIT:	201,700 LBS
NORMAL CAPACITY:	29,080 U.S. GALLONS

CRUDE OIL AND OTHER FLAMMABLE LIQUIDS TRANSPORTATION

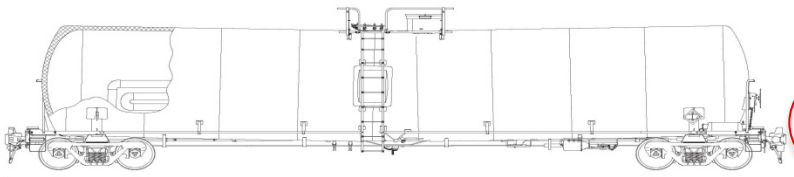
This 29,000 gallon (US) coiled and insulated tank car has been designed with a 286,000 lb gross rail load for the transportation of crude oil and other like commodities. The car is equipped with a 20-inch, eight (8) bolt manway, a 75 psi pressure relief valve, and a protected top fitting arrangement. Top fittings consisting of 2- and 3-inch valves and options for a thermowell, sample line, MGD, and a vacuum relief valve to accommodate closed system loading and unloading. The bottom outlet is a 4-inch steam jacketed ball valve. This car is fitted with 12-line exterior heating coil system and 4" thermal insulation.

Various options for loading/unloading valve configurations are available depending on the service requirements.



CURVE NEGOTIABILITY RADIUS

UNCOUPLED:	150'
COUPLED TO LIKE CAR:	217'
COUPLED TO BASE CAR:	215'

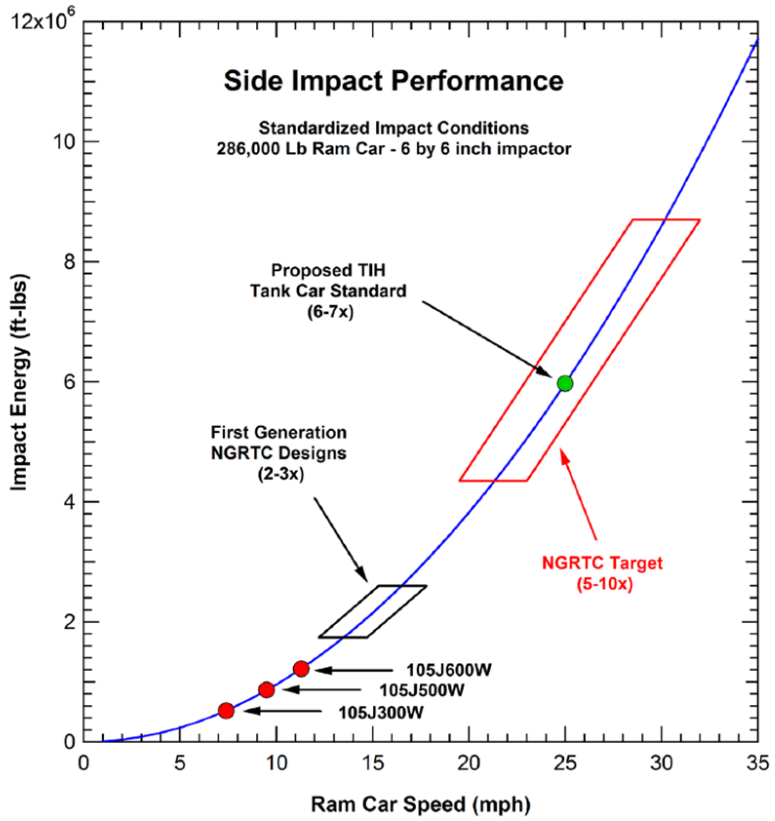


DESIGNED AND BUILT [illegible] AAR SPECIFICATION FOR M-1002; DOT SPECIFICA[illegible] DOT 111A100W1

THESE GENERAL DIMENS[illegible] ARE REPRESENTATIVE AND SUBJECT TO CHANGE WIT[illegible]T NOTICE AS REQUIRED BY CUSTOMER SPECIFICATIO[illegible]R DESIGN IMPROVEMENTS BY THE GREENBRIER CO[illegible]

THE GREENBRIER COMPANIES • ONE CENTERPOINTE DR., SUITE 200 • LAKE OSWEGO, OREGON 97035 • 800.343.7188

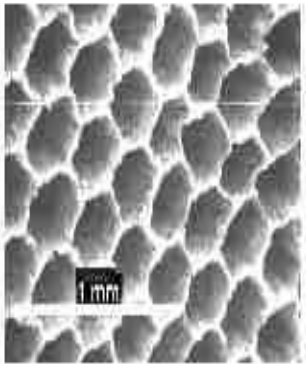
Last Revised: 11/2013

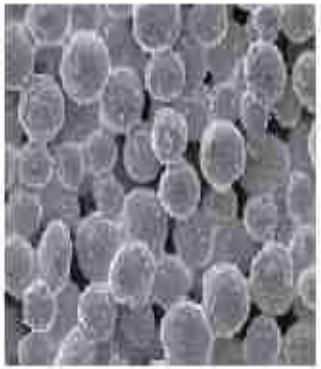


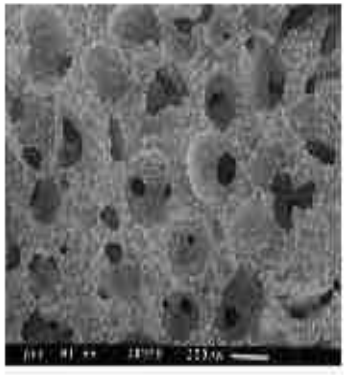
1,223,775 ft-lbs @ 8 mph

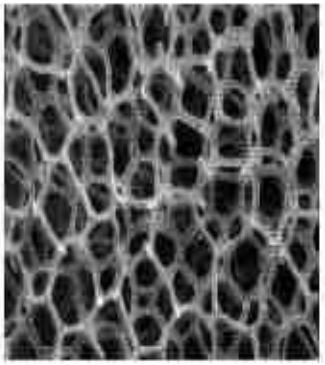
Proposal (Solution)

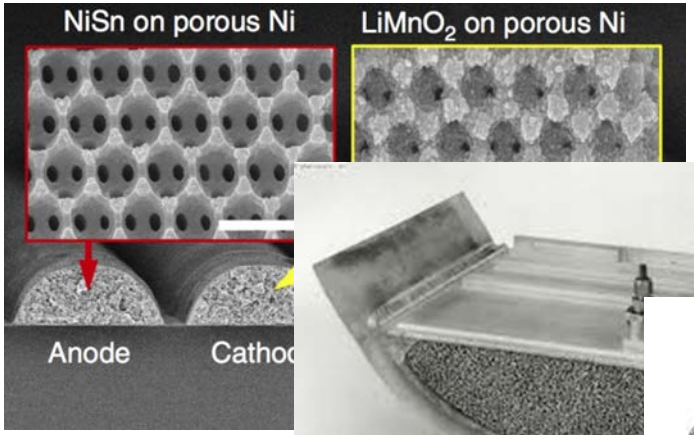
Metal Foams











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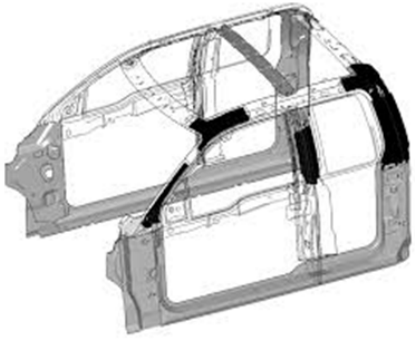
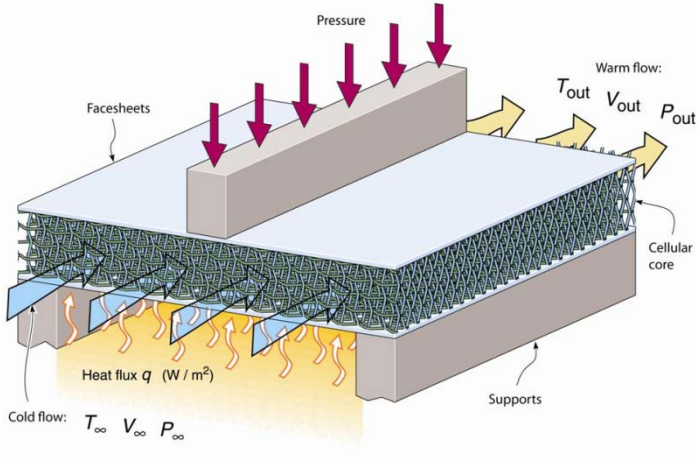
Mechanical & Aerospace Eng., NCSU





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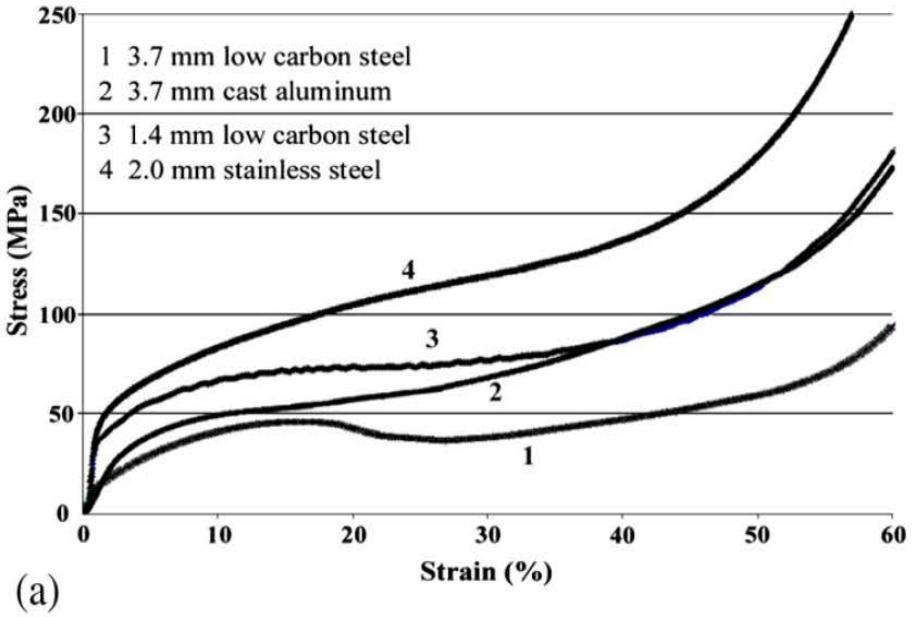
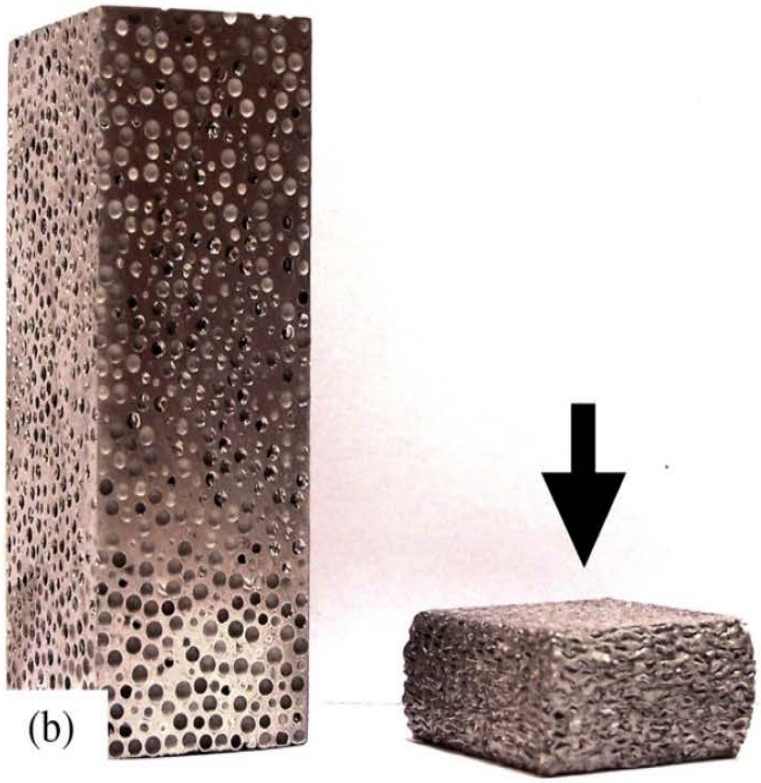
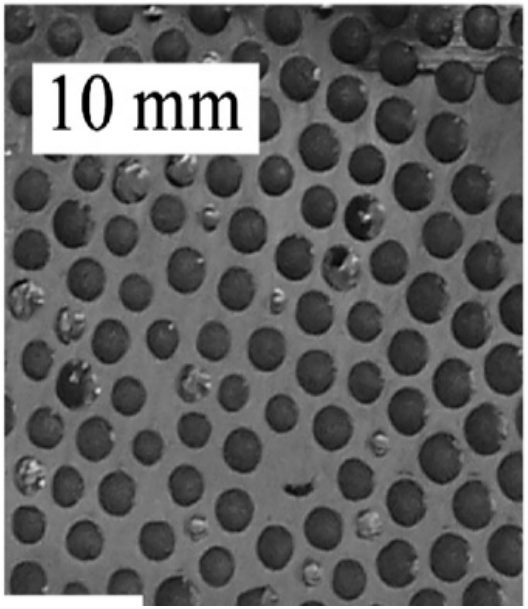
North Carolina State University

Properties of Metal Foams



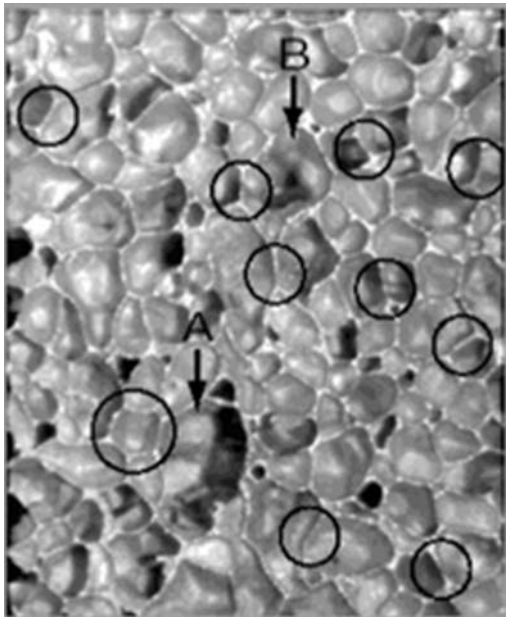


These Metal Foams

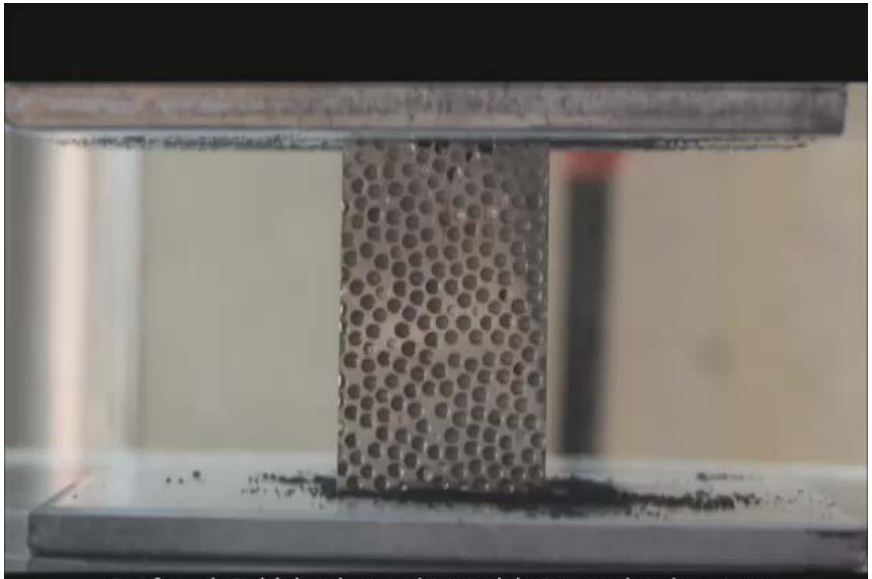


A. Rabiei, L.J. Vendra / Materials Letters 63 (2009) 533–536

Other Metal Foams



Sugimura, Rabiei et al Mater Sci Eng A 269 (1999)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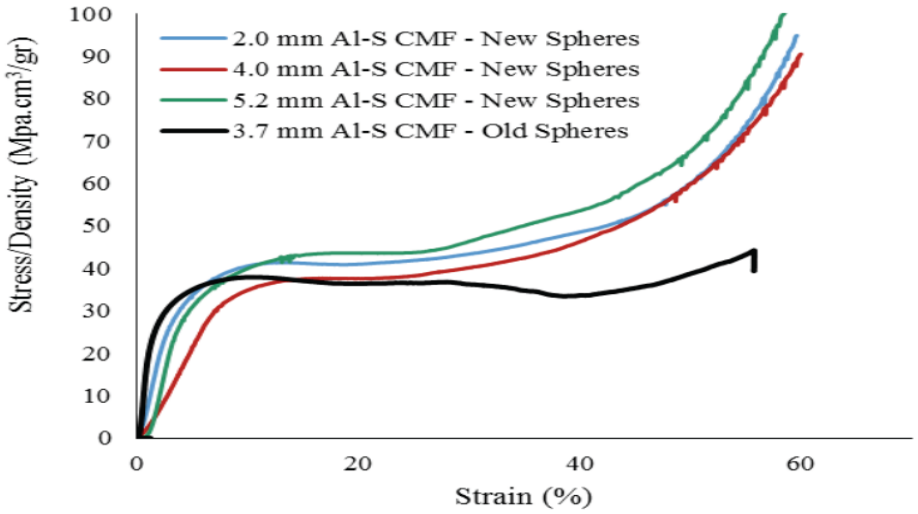
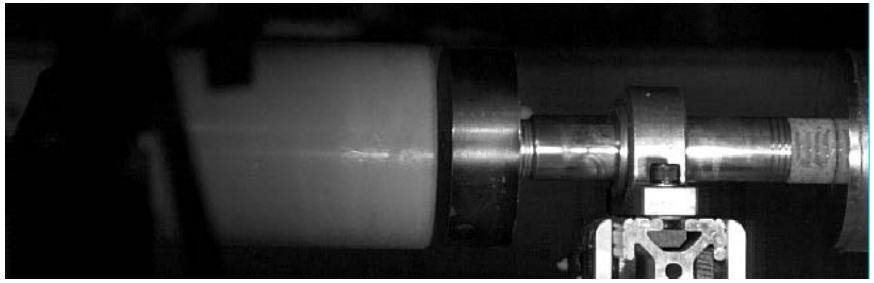
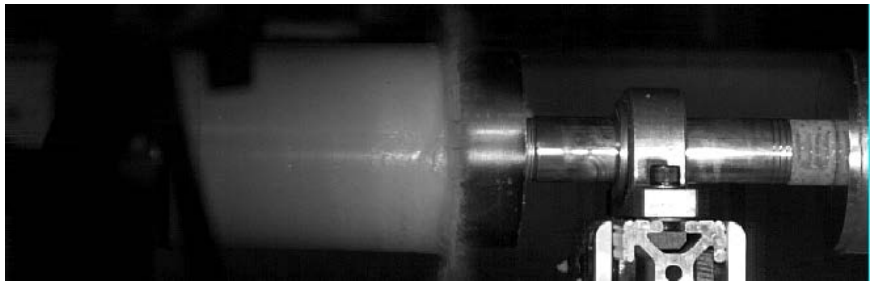
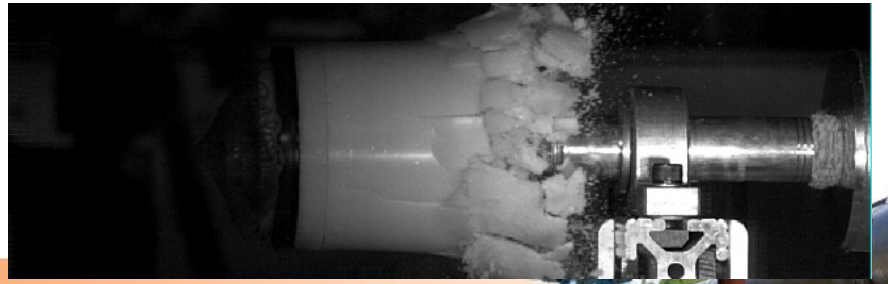
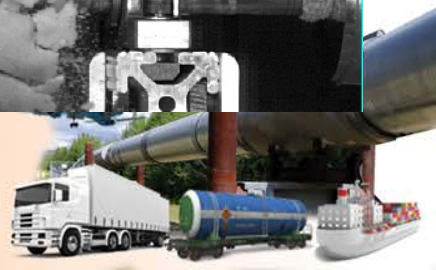

Stress/Density (Mpa.cm3/gr)
Strain (%)
2.0 mm Al-S CMF - New Spheres
4.0 mm Al-S CMF - New Spheres
5.2 mm Al-S CMF - New Spheres
3.7 mm Al-S CMF - Old Spheres
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60









Schedule (Output)

Estimated Budget
1 year; $150,000; stipend(s) and supplies