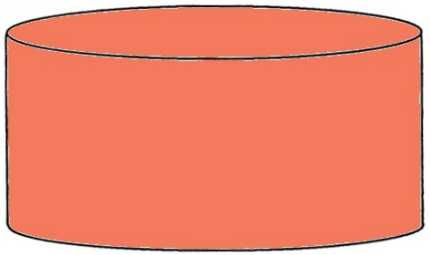
THE EFFECT OF CYCLIC LOADING ON THE RESIDUAL STRESSES OF A SHOT PEENED POWDER-FORGED COPPER STEEL

by

Russell A. Chernenkoff

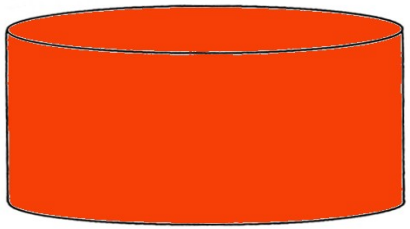
Wayne State University
Detroit, Michigan
1993

Pre-Sinter



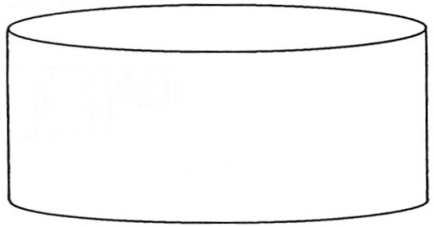
870 C

Vacuum Sinter

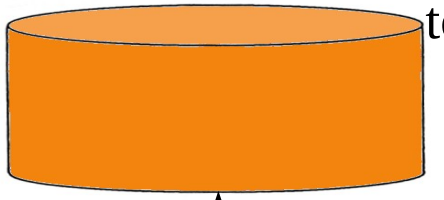


30min @ 1150 C

Shot blast

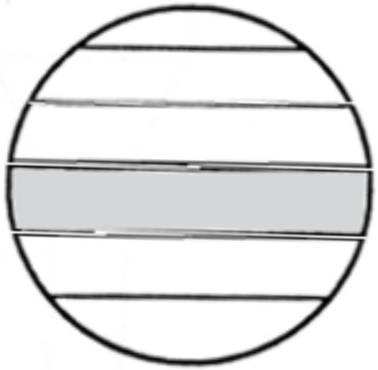


Induction heat
to 980 C

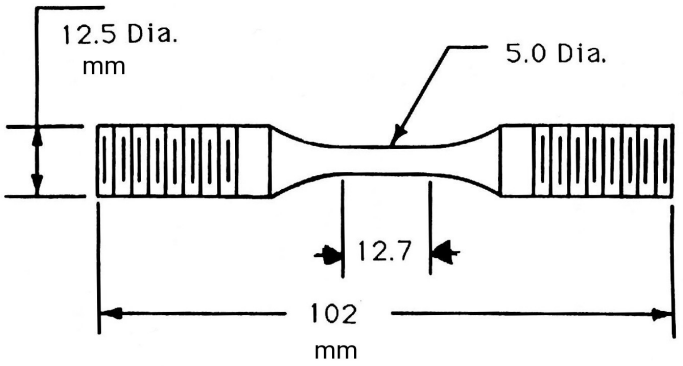


Forge at 13,800 mpa

Section puck



Normalize
1093 C



Powder Forged Copper Steel with 7.92g/cm density.

Base powder was ATOMET 1001PF (Quebec Metal Powder) blended with 2wt%Cu, 0.35% Mangnese Sulfide, 0.75% Acrawax-C and South Western 1651 Graphite to produce a carbon content of 0.5% after forging.

Final Chem.:
0.50 C wt%
0.018_Oxygen
0.081 S
2.06 Cu
0.33 Mn

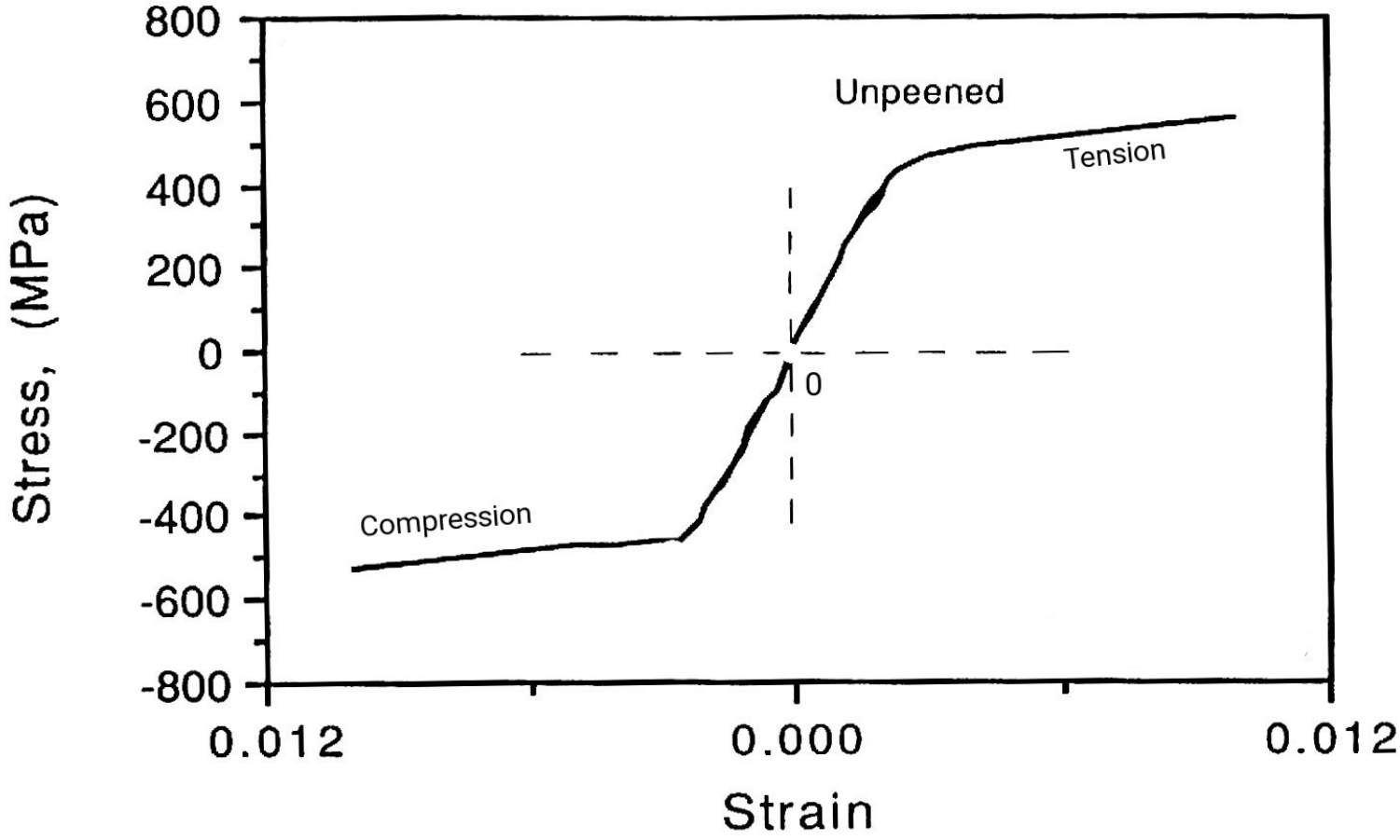
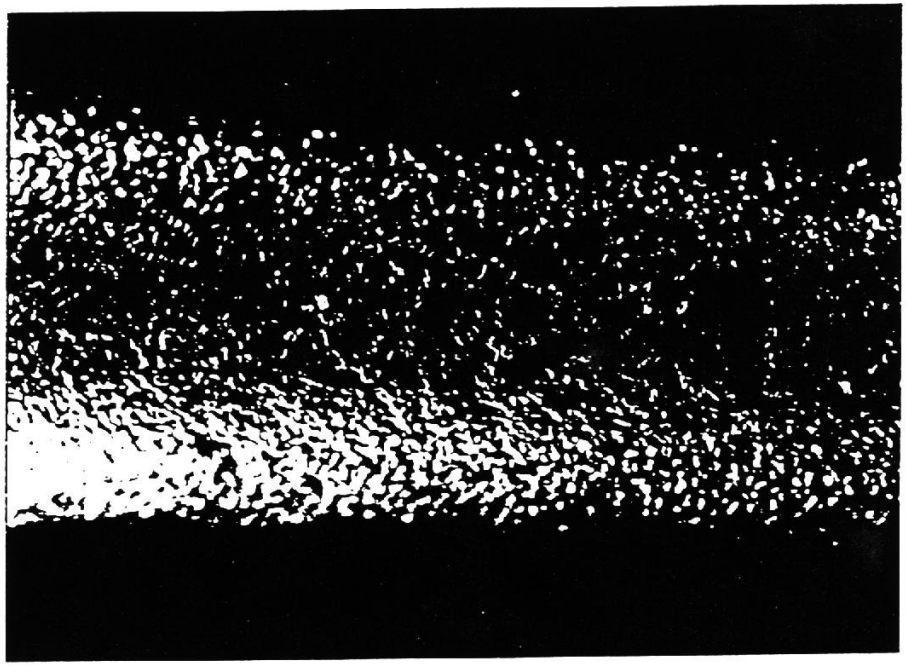


Figure 10 - Tension and compression monotonic stress-strain curves

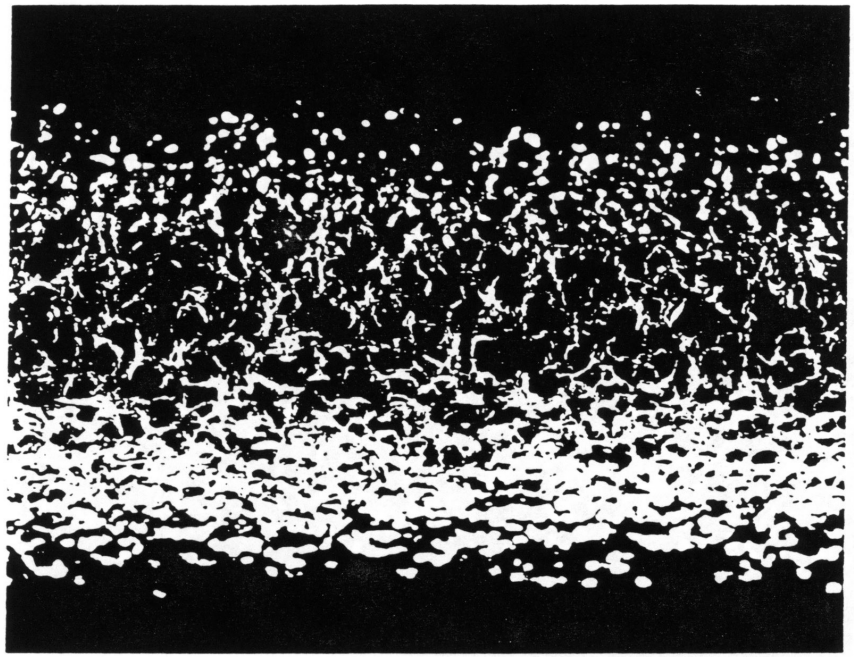
3 Specimen series:
Peened at
6 A
20 A
24 A (over peened)



6 A (Almen)

Figure 7a - Shot peened surface at 6A intensity - 16X

20 A



20A Optimum
for fatigue

Figure 7b - Shot peened surface at 20A intensity - 16X

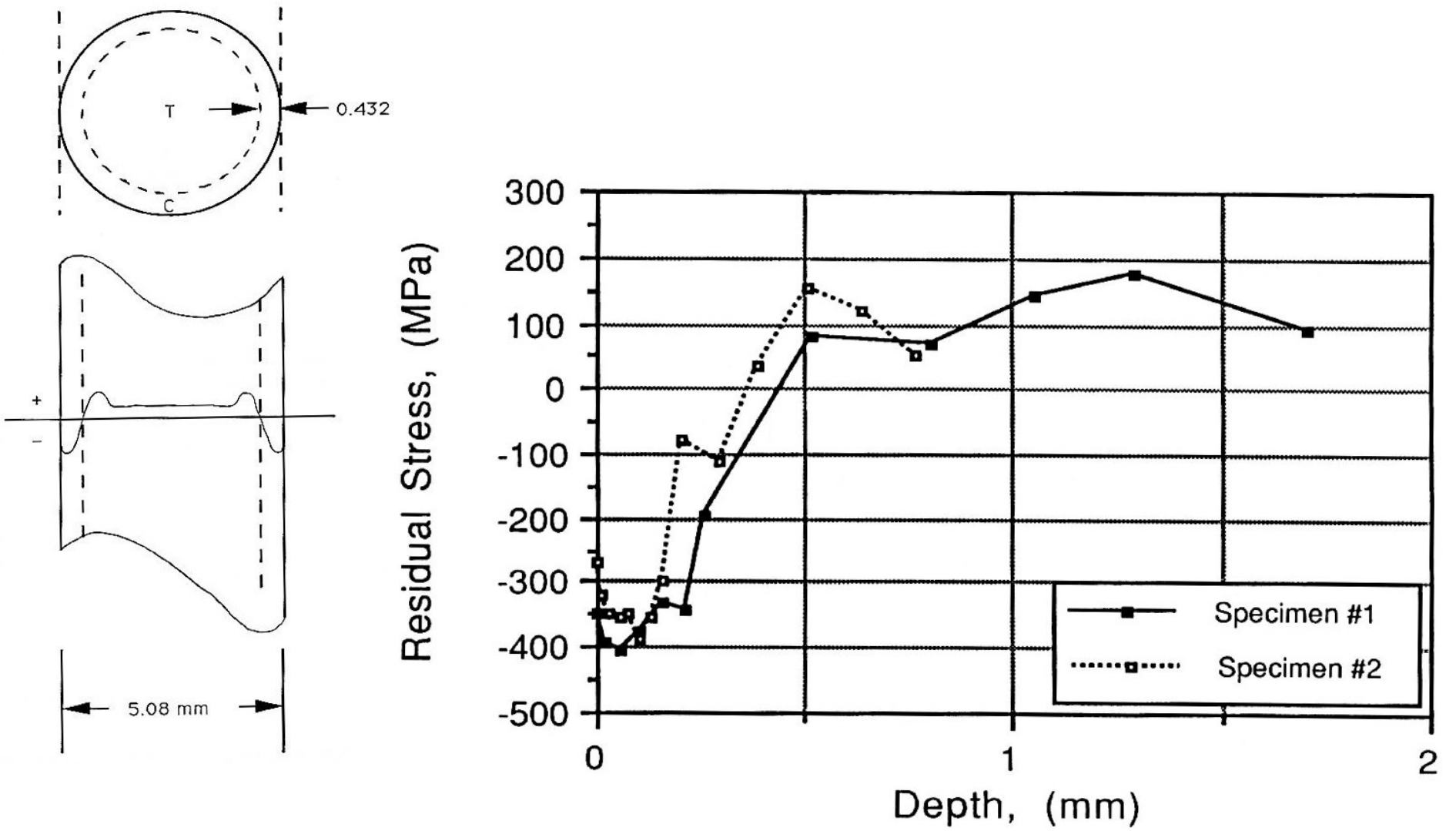
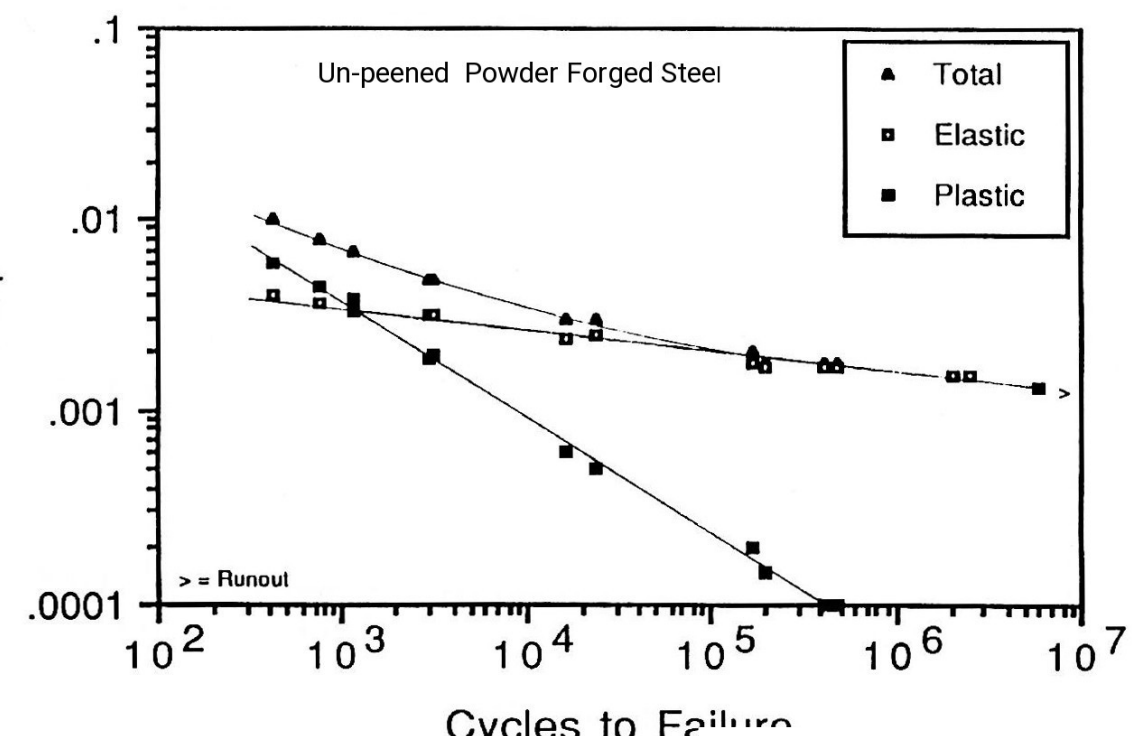
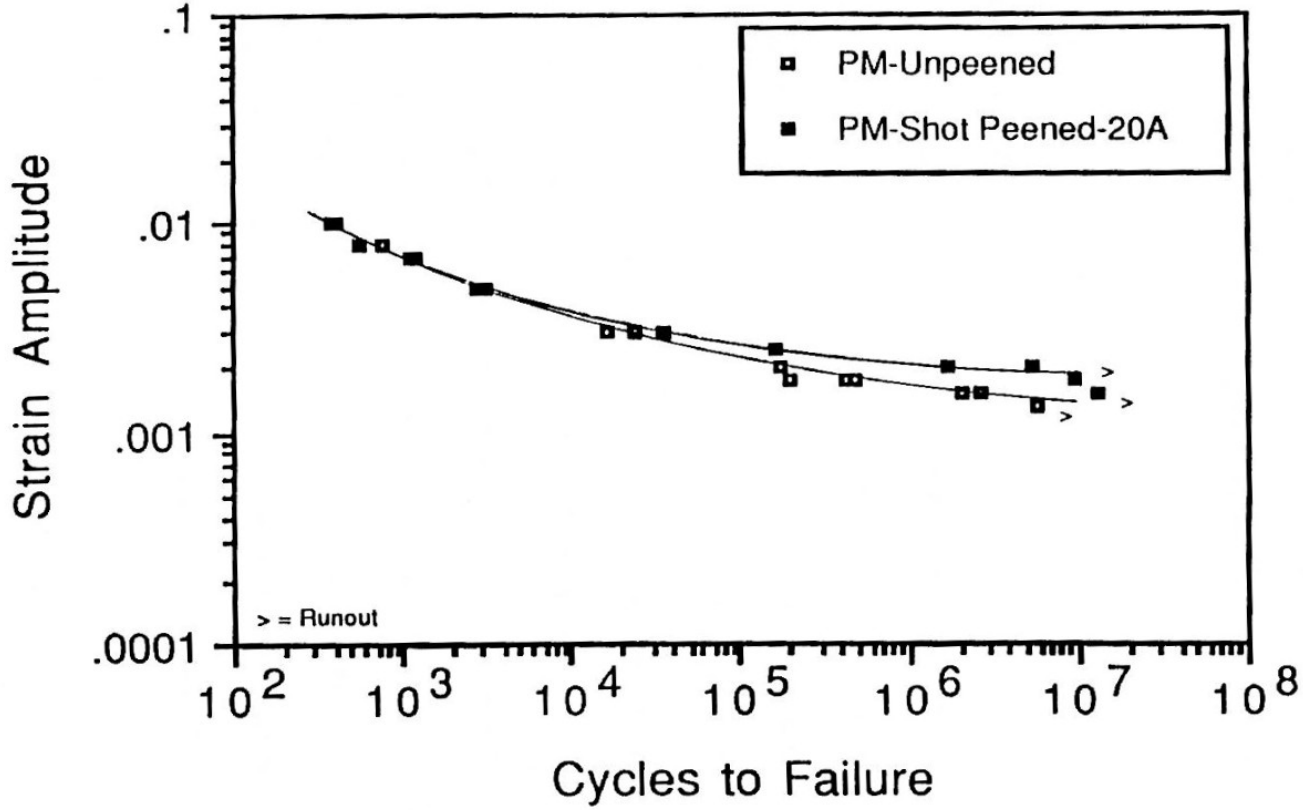
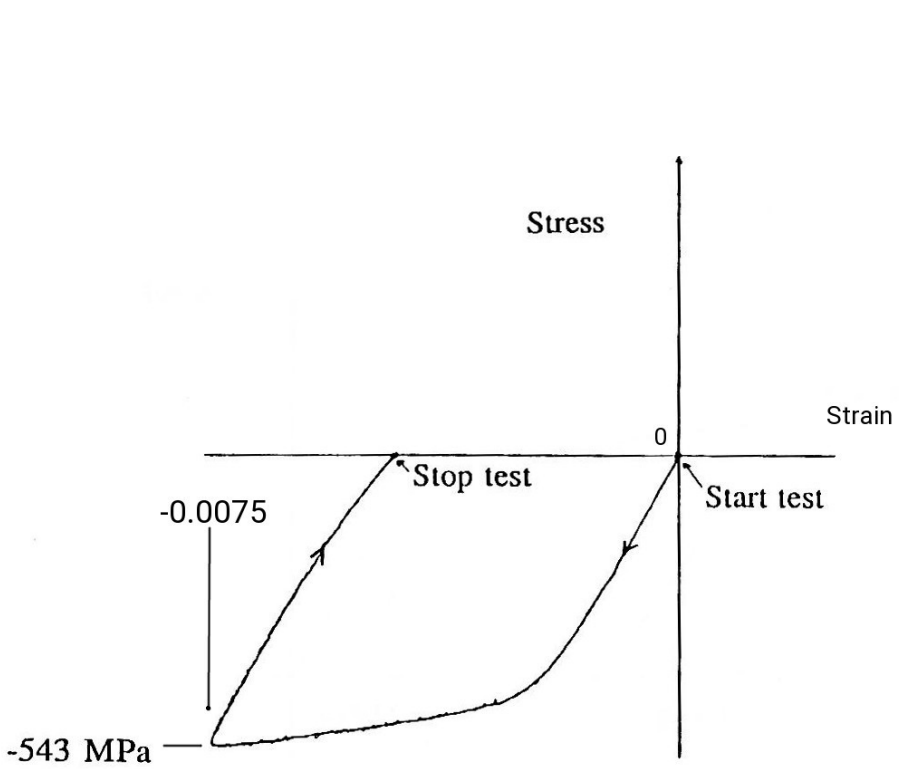
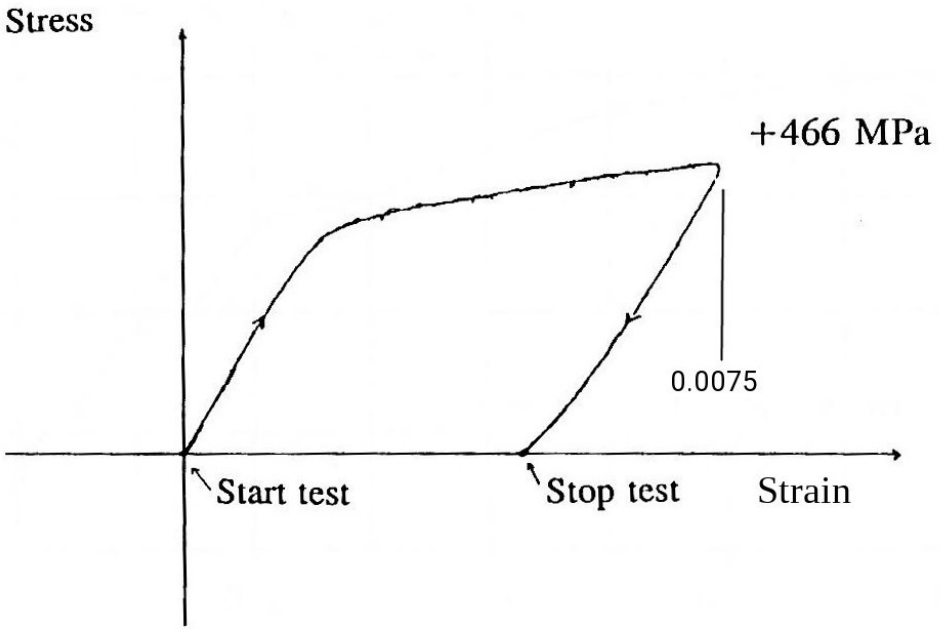


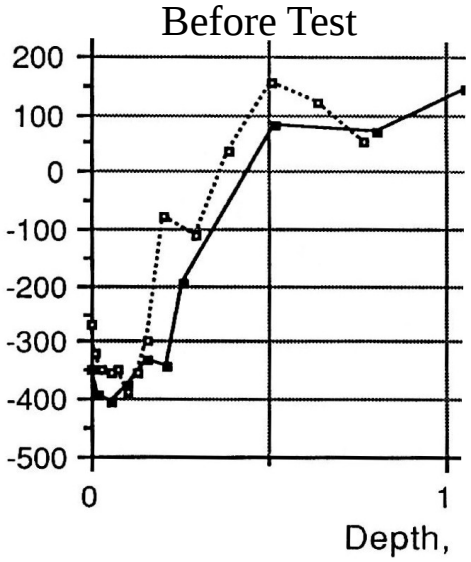
Figure 21 - Residual stress profiles for untested shot peened specimens - 20A


Un-peened Powder Forged Steel
Total
Elastic
Plastic
> = Runout
.1
.01
.001
.0001
10^2
10^3
10^4
10^5
10^6
10^7
Cycles to Failure


PM-Unpeened
PM-Shot Peened-20A
> = Runout
Strain Amplitude
.1
.01
.001
.0001
10^2
10^3
10^4
10^5
10^6
10^7
10^8
Cycles to Failure







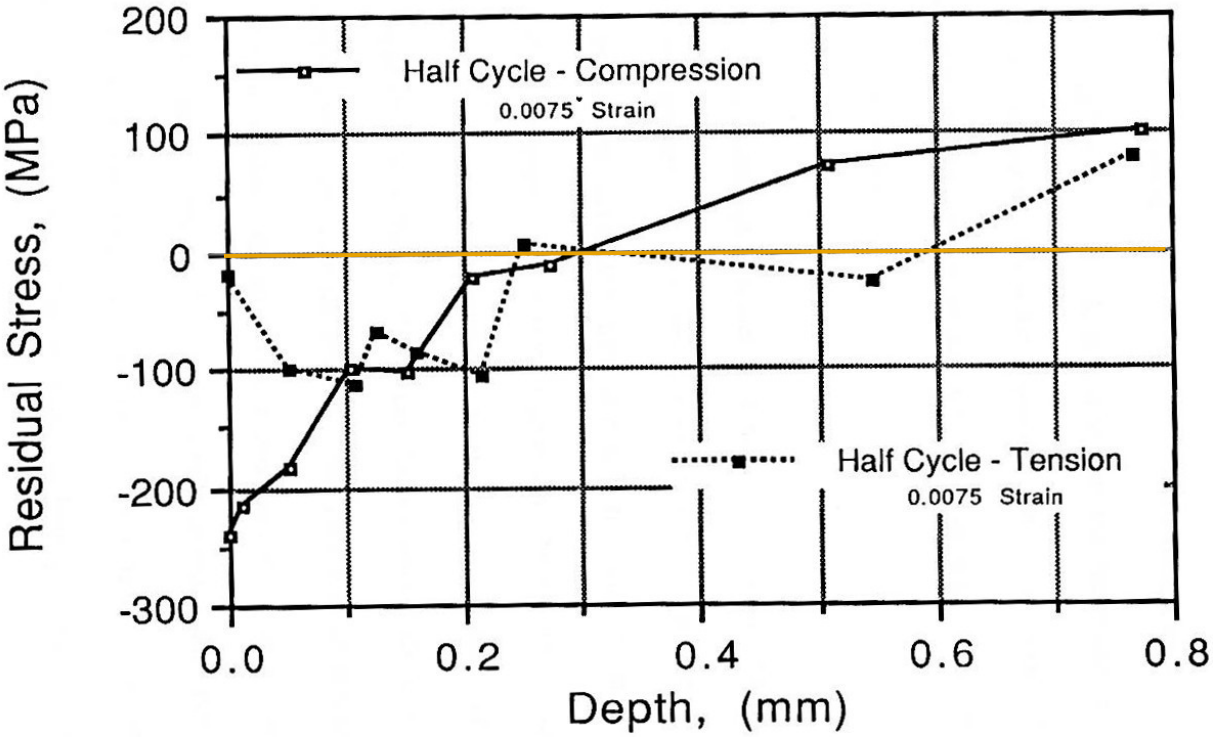


Figure 38 - Residual stress profiles for half cycle tests

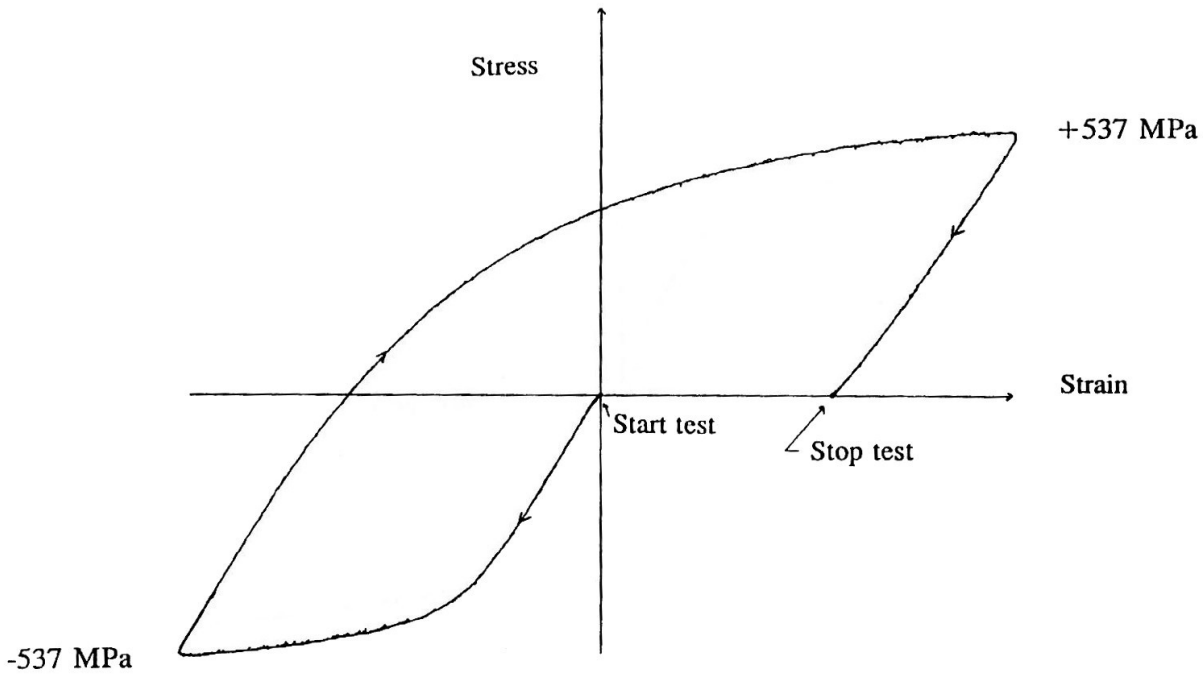


Figure 33 - Specimen A - Single cycle hysteresis loop - 0.0075 strain
initial load = compression - shot peened

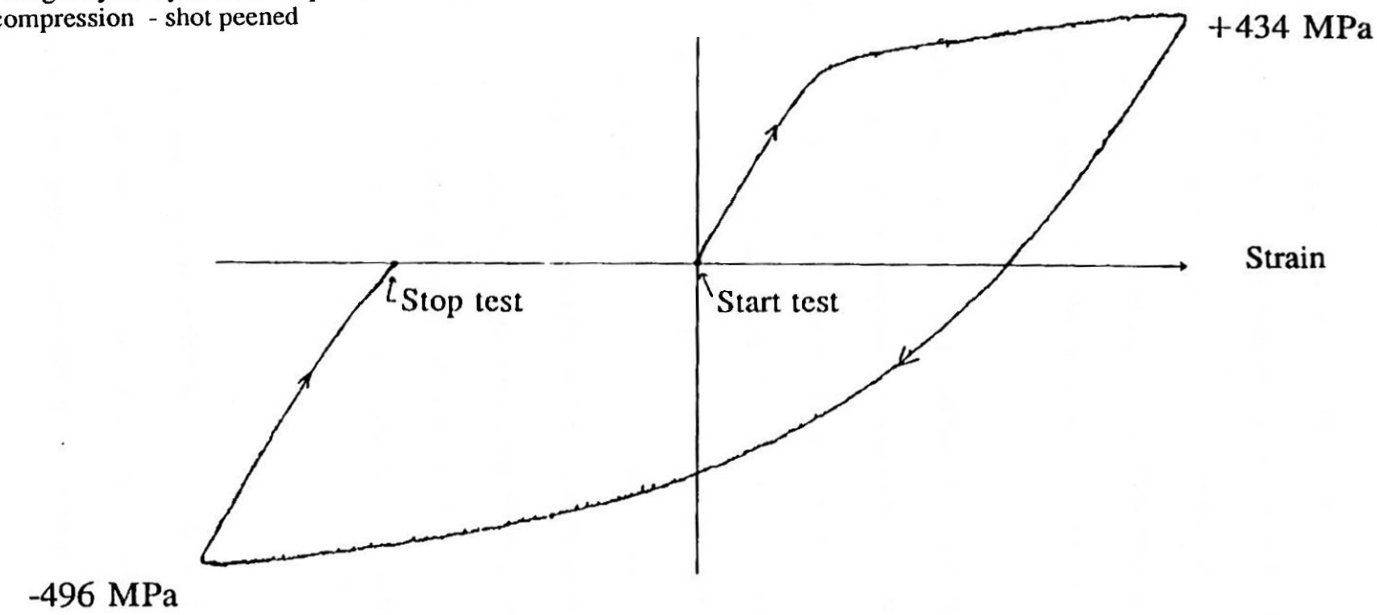


Figure 34 - Specimen B - Single cycle hysteresis loop - 0.0075 strain
initial load = tension - shot peened

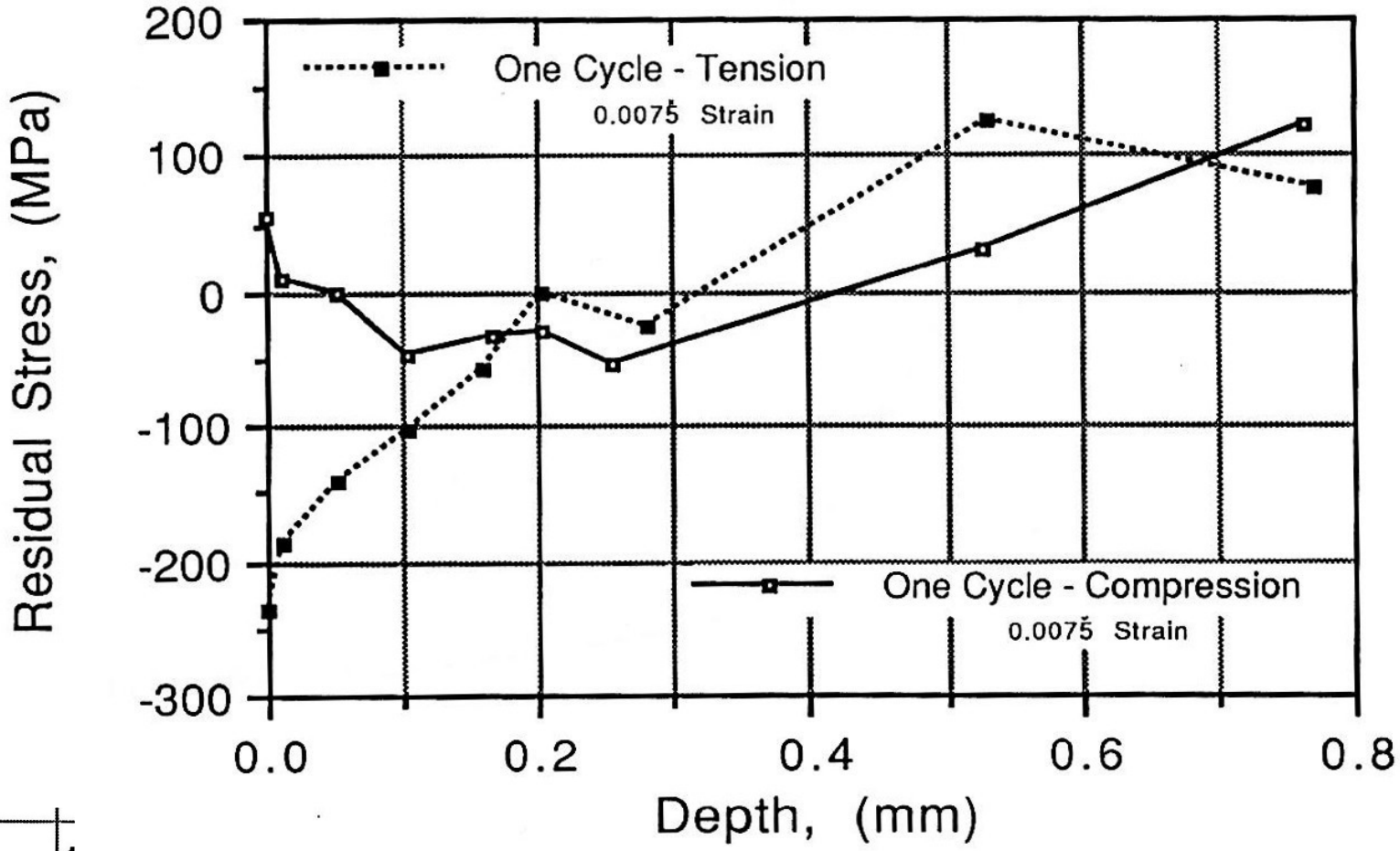
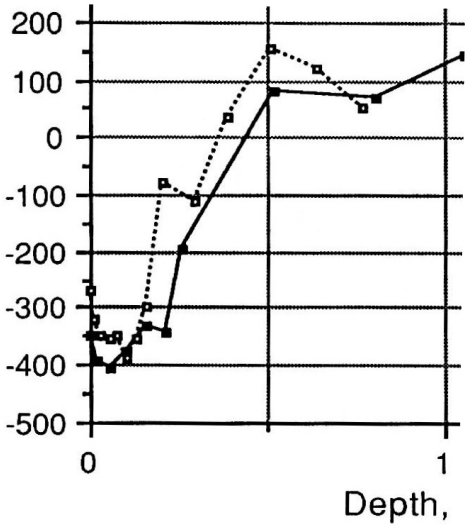
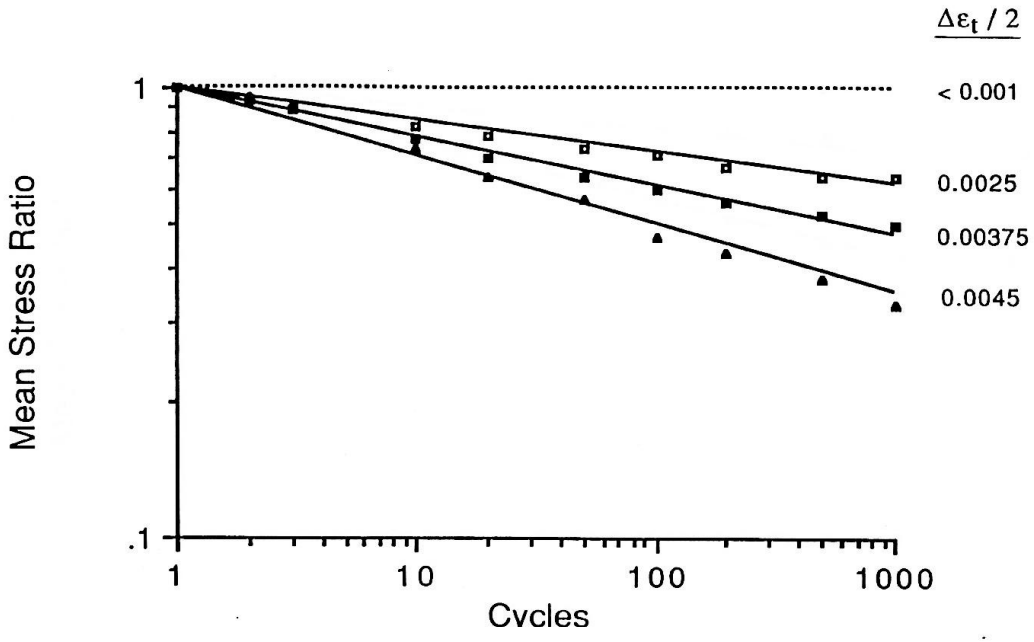
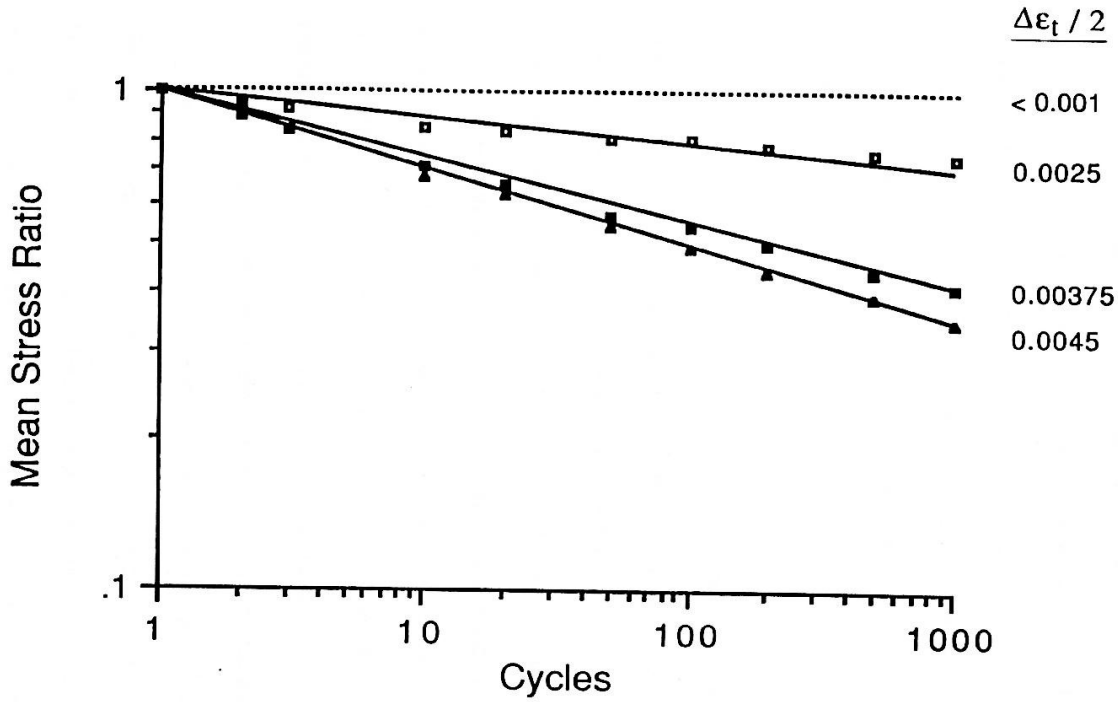


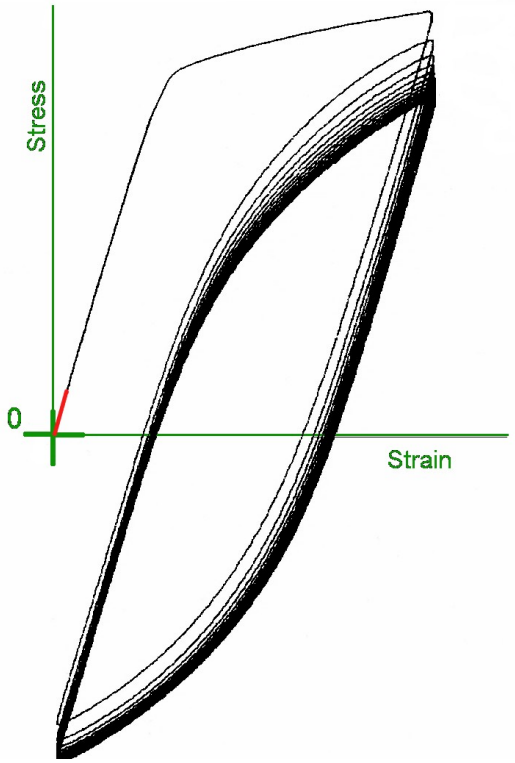
Figure 35 - Residual stress profiles for single cycle tests



Before testing







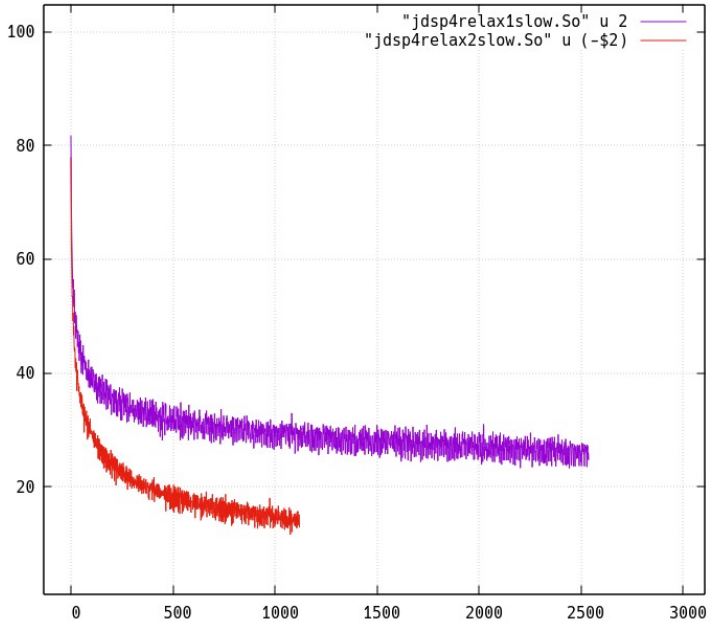
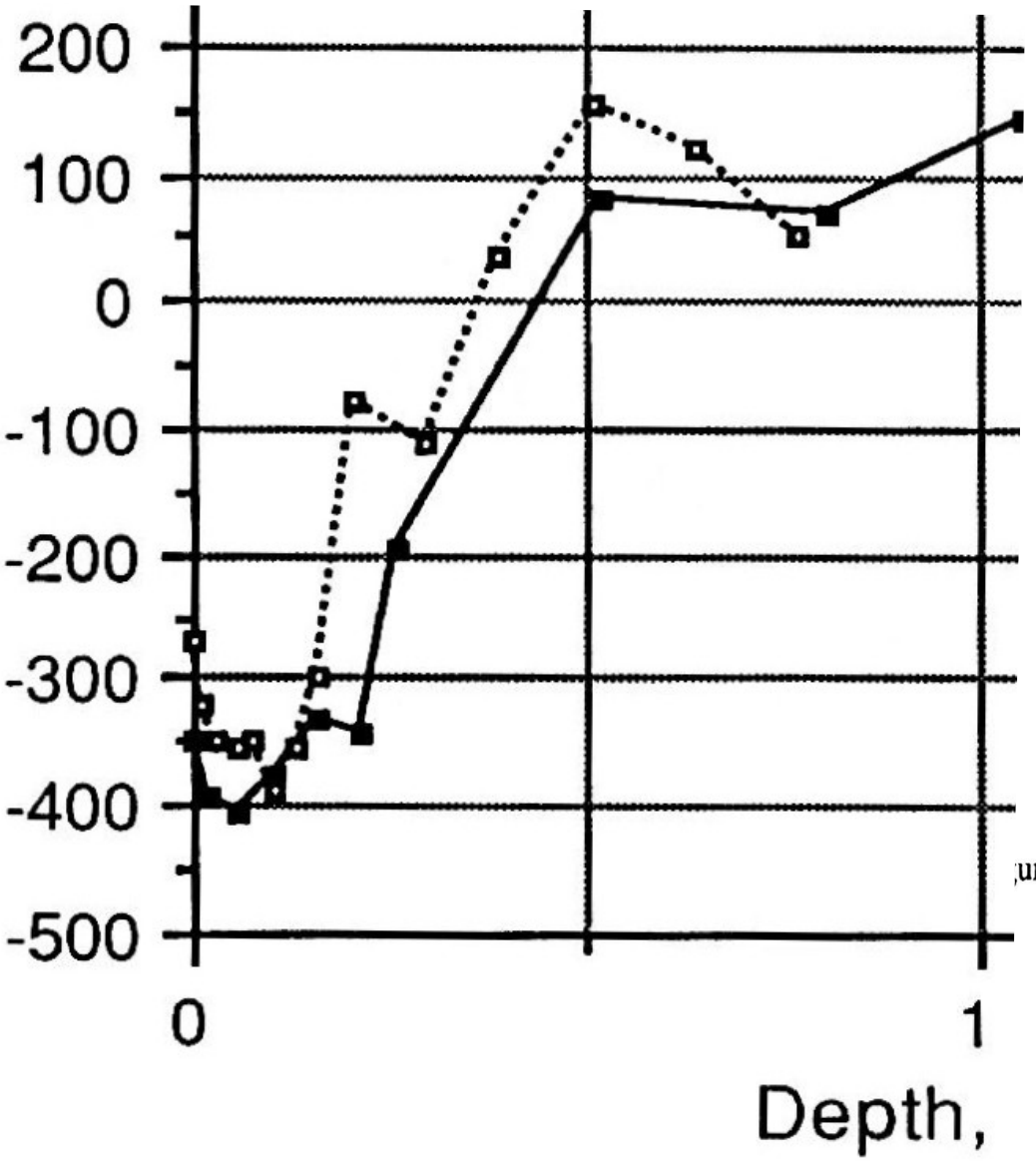
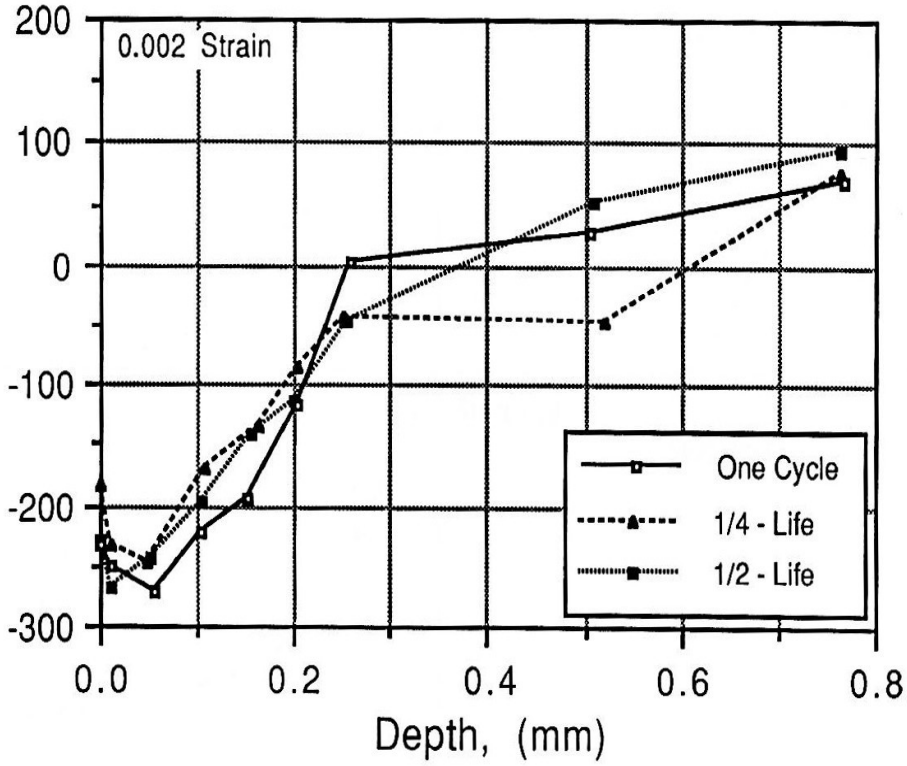


Figure 31 - Relaxation model for powder-forged steel - shot peened

Before testing

After some cycling





ure 32 - Residual stress profiles for shot peened specimens tested at 0.002 strain