July 24, 2006

Mr. Paul Lorek
XXX Corp
Hornell, NY 14843

Dear Paul:

Following your e-mail of June 27, 2006, AU-MTS Lab has conducted fatigue tests for steel of ID #22 and #34 parts of your company. One is a material which does not confirm its specification, the other is the reference steel. These steel materials were shipped to our lab on July 3 by IMR Test Labs with a shape shown in photo 1. Four kinds of samples with each of 5 pieces were fabricated by the machining shop at Alfred University. Two kinds are smooth specimens of #22 and #34 following the design in Attachment 1 with the specimen length of 128.5 mm. The other two are similar specimens of #22 and #34 but with notches as shown in Attachment 2. Under your permission, the notch radius shown in Attachment 2 was changed from R0.01 to 0.02 inch.

The fatigue tests were conducted in sophisticated servo hydraulic materials testing system of MTS 809.10 (photo 2) and Instron Model 1331 (photo 3) with stress control under tension-compression symmetric loading (R=-1). Testing frequency is 2 Hz for low and middle cycle fatigue and 5 Hz for high cycle fatigue. In all the cases, the frequencies are the same for both #22 and #34 samples under the same applied stress. The ID number, geometric parameters, applied stress magnitude and the obtained fatigue life for each specimen are listed in Table 1-4. The corresponding four S-N curves are shown, respectively, in Figures 3, 4, 6 and 7. The comparisons of S-N curves of smooth and notched specimens between #22 and #34 are shown, respectively, in Figure 5 and 8.

If you have any question please send me a e-mail at fanjing@Alfred.edu;

Thanks,

Jinghong Fan
Professor

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Photo 1: Overlook of XXX Corporation's steel parts of ID #22 and #34 and a fabricated fatigue testing specimen


Photo 2: AU-MTS Lab's 809.10 sophisticated servo hydraulic materials testing system


Photo 3: AU-MTS Lab's Instron-1331 sophisticated servo hydraulic materials testing system, its telescope measurement facility, and Nitrogen tank for fatigue testing with temperature below $0^0$C

**Table 1: #22 Steel Fatigue Data of Smooth Samples (R=-1)**

| SID | D (mm) | A (mm²) | σ (MPa) | $P_{max}$ (kN) | $P_{min}$ (kN) | $N_f$ |
|---|---|---|---|---|---|---|
| 22#-6 | 5.66 | 25.1479 | 280 | 7.0414 | -7.0414 | 1819809 |
| 22#-5 | 5.62 | 24.7938 | 300 | 7.4381 | -7.4381 | 869514 |
| 22#-3 | 5.686 | 25.3795 | 330 | 8.3752 | -8.3752 | 264283 |
| 22#-2 | 5.61 | 24.7056 | 360 | 8.894 | -8.894 | 109382 |
| 22#-4 | 5.68 | 25.326 | 385 | 9.7505 | -9.7505 | 30224 |

**Table 2: #34 Steel Fatigue Data of Smooth Samples (R=-1)**

| SID | D (mm) | A (mm²) | σ (MPa) | $P_{max}$ (kN) | $P_{min}$ (kN) | $N_f$ |
|---|---|---|---|---|---|---|
| 34#-6 | 5.7 | 25.5047 | 280 | 7.1413 | -7.1413 | 1748409 |
| 34#-2 | 5.613 | 24.732 | 300 | 7.419 | -7.419 | 499182 |
| 34#-4 | 5.68 | 25.326 | 330 | 8.3576 | -8.3576 | 124113 |
| 34#-3 | 5.686 | 25.3795 | 360 | 9.1366 | -9.1366 | 57012 |
| 34#-5 | 5.66 | 25.1479 | 385 | 9.6819 | -9.6819 | 28741 |

**Table 3: #22 Steel Fatigue Data of Notched Samples (R=-1)**

| SID | D (mm) | A (mm²) | σ (MPa) | $P_{max}$ (kN) | $P_{min}$ (kN) | $N_f$ |
|---|---|---|---|---|---|---|
| 22#-7 | 5.65 | 25.0592 | 330 | 8.2695 | -8.2695 | 3993 |
| 22#12 | 5.54 | 24.0929 | 260 | 6.2642 | -6.2642 | 14278 |
| 22#-8 | 5.63 | 24.8821 | 230 | 5.7229 | -5.7229 | 50631 |
| 22#-11 | 5.54 | 24.0929 | 210 | 5.0595 | -5.0595 | 57350 |
| 22#-9 | 5.6 | 24.6176 | 200 | 4.9235 | -4.9235 | 125056 |

**Table 4: #34 Steel Fatigue Data of Notched Samples (R=-1)**

| SID | D (mm) | A (mm²) | σ (MPa) | $P_{max}$ (kN) | $P_{min}$ (kN) | $N_f$ |
|---|---|---|---|---|---|---|
| 34#-8 | 5.54 | 24.0929 | 330 | 7.9507 | -7.9507 | 5245 |
| 34#12 | 5.54 | 24.0929 | 260 | 6.2642 | -6.0642 | 18664 |
| 34#-9 | 5.54 | 24.0929 | 230 | 5.5414 | -5.5414 | 29479 |
| 34#-11 | 5.54 | 24.0929 | 210 | 5.0595 | -5.0595 | 59561 |
| 34#-10 | 5.62 | 24.7938 | 200 | 4.9588 | -4.9588 | 121118 |

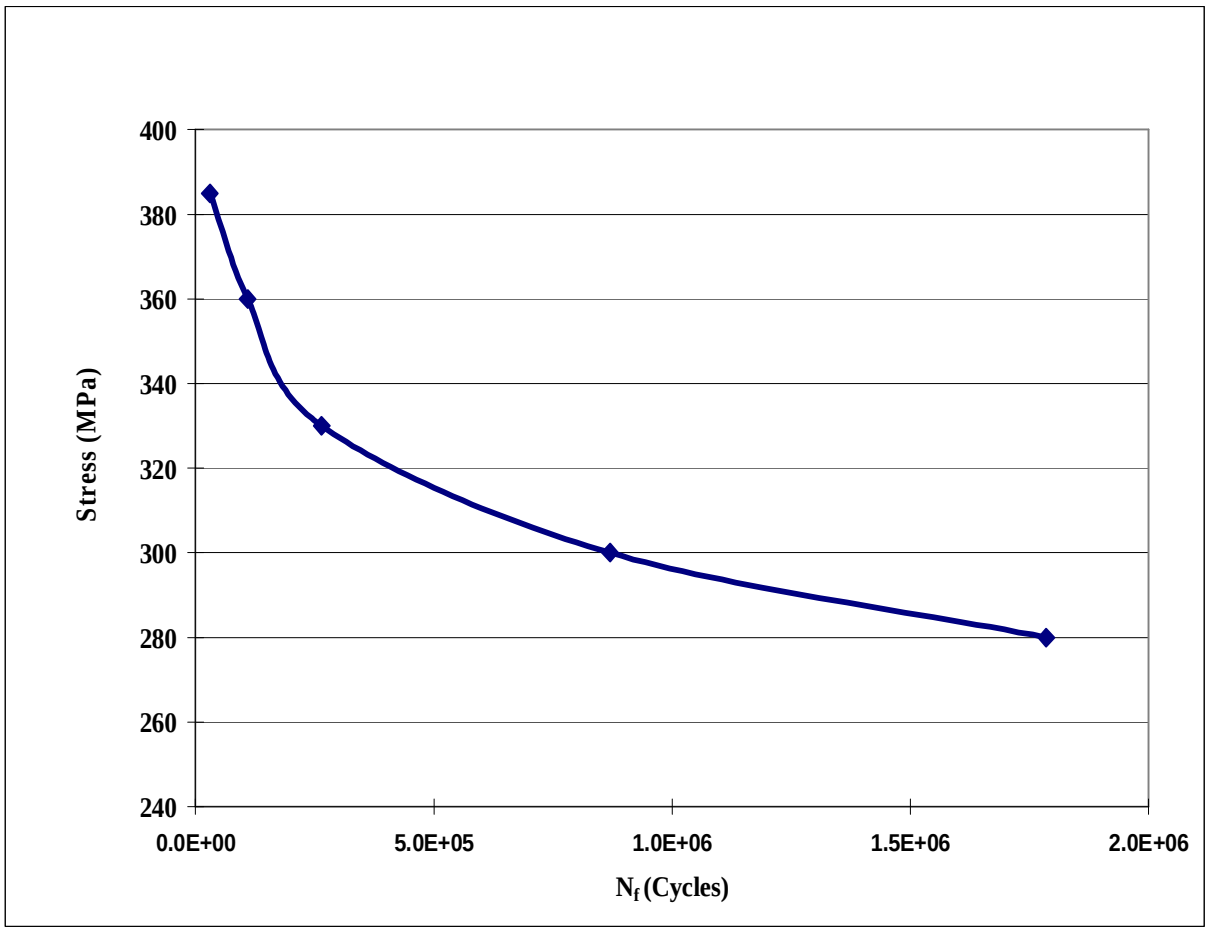



Figure 1: S-N Curve of Smooth Samples for #22 Steel

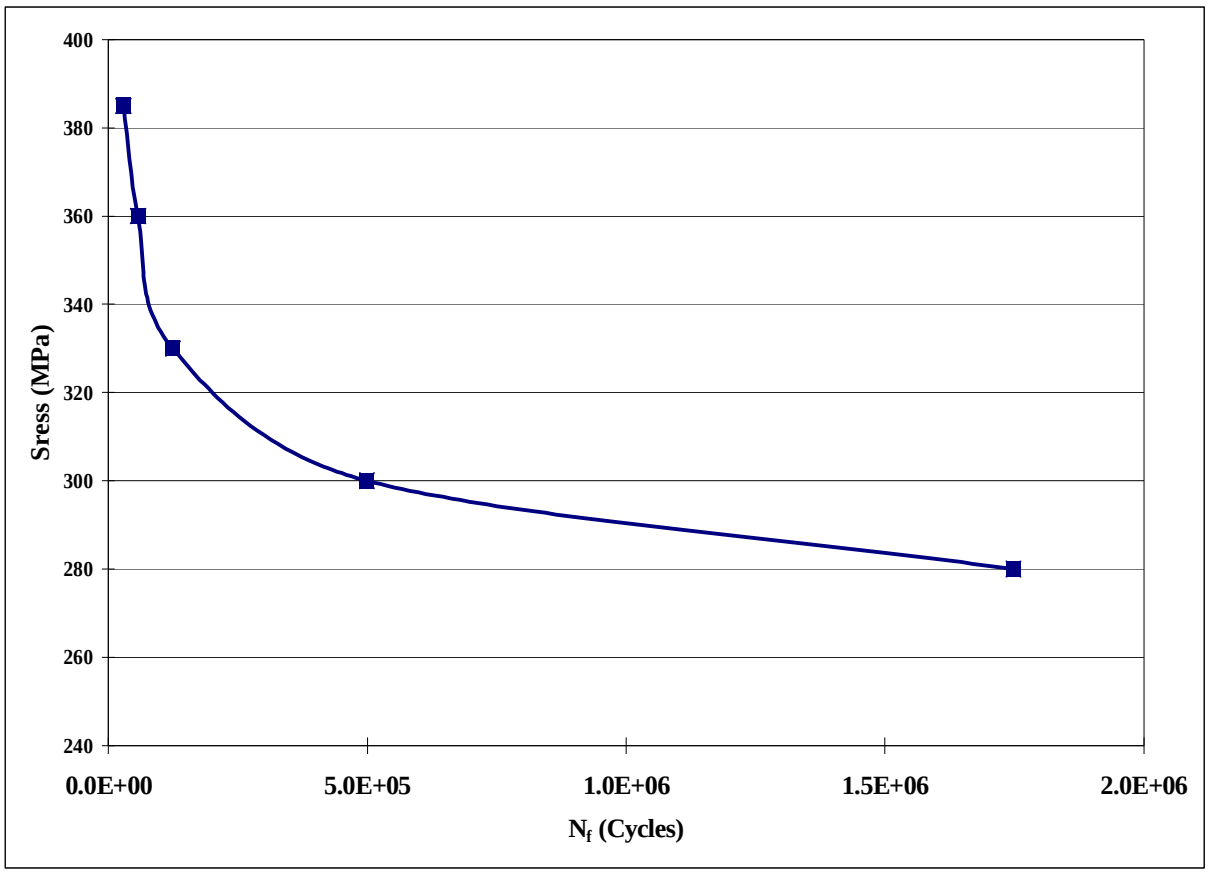



Figure 2: S-N Curve of Smooth Samples for #34 Steel

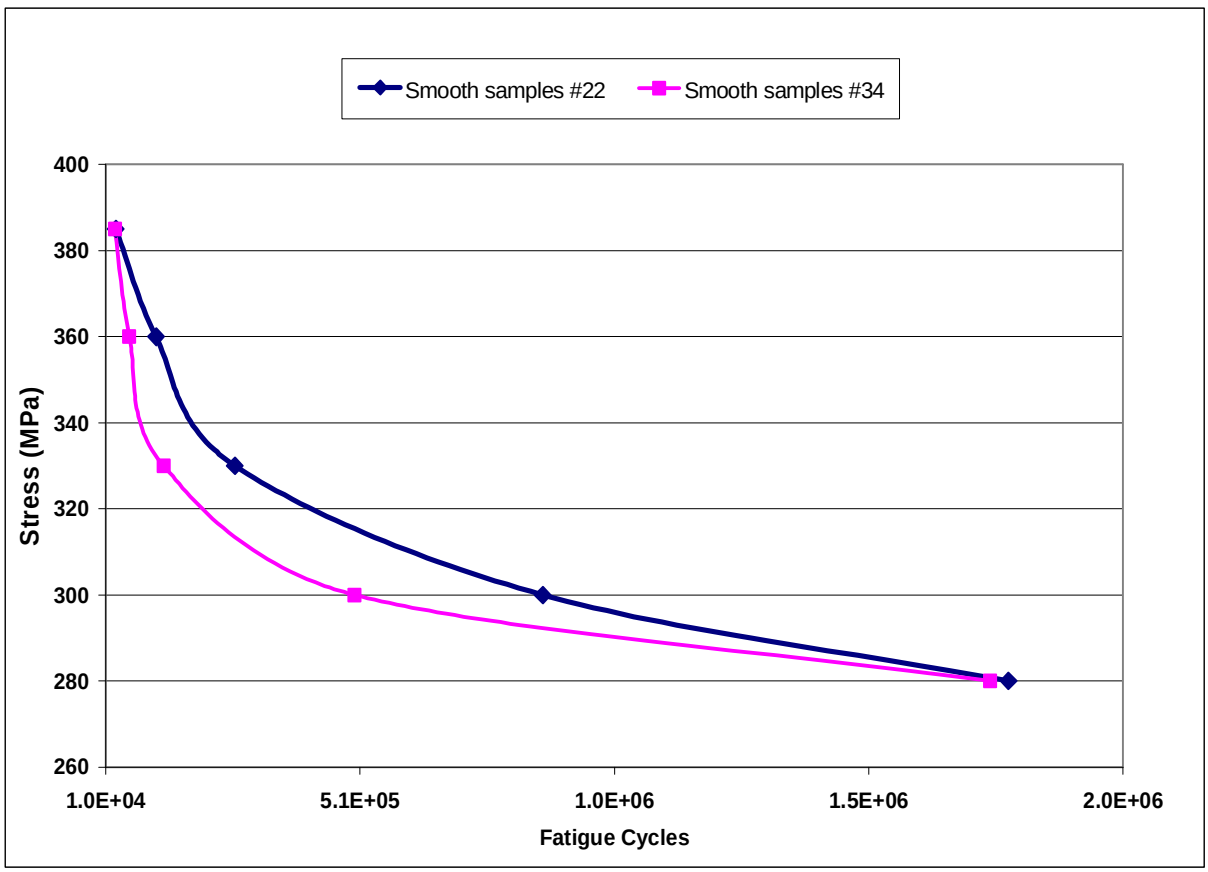



Figure 3: A Comparison of S-N Curves between #22 and #34 Steel Smooth Specimens

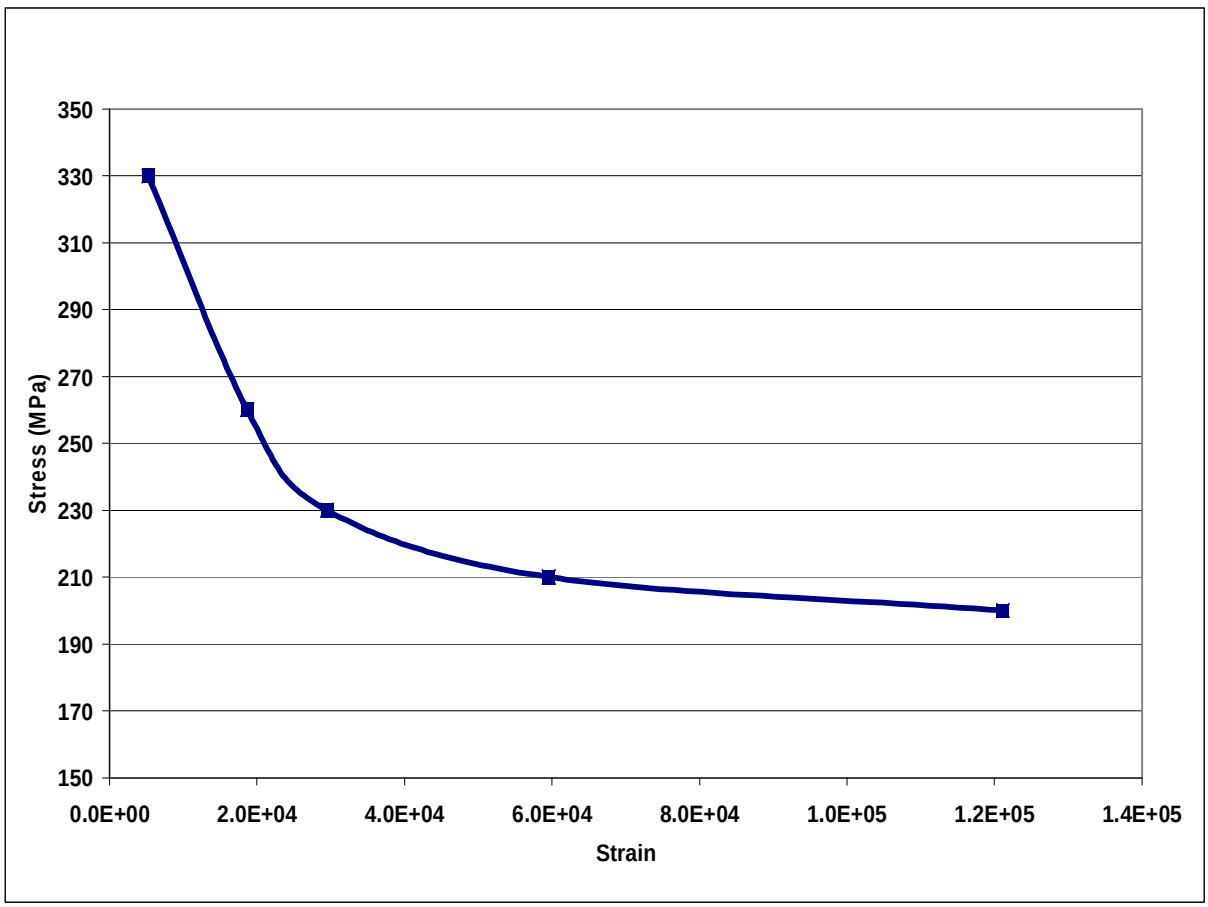



Figure 4: S-N Curve of Notched Samples for #34 Steel

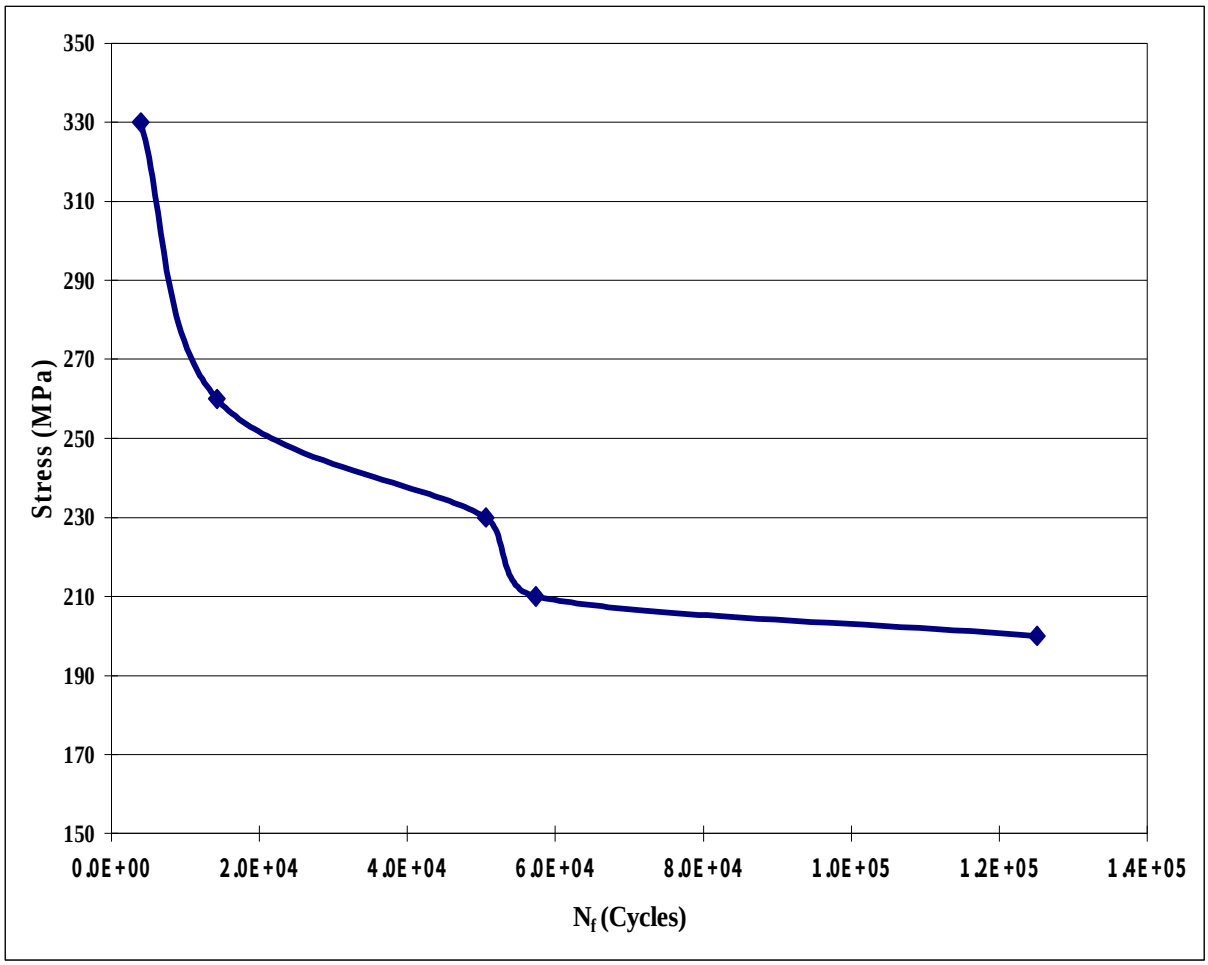



Figure 5: S-N Curve of Notched Samples for #34 Steel

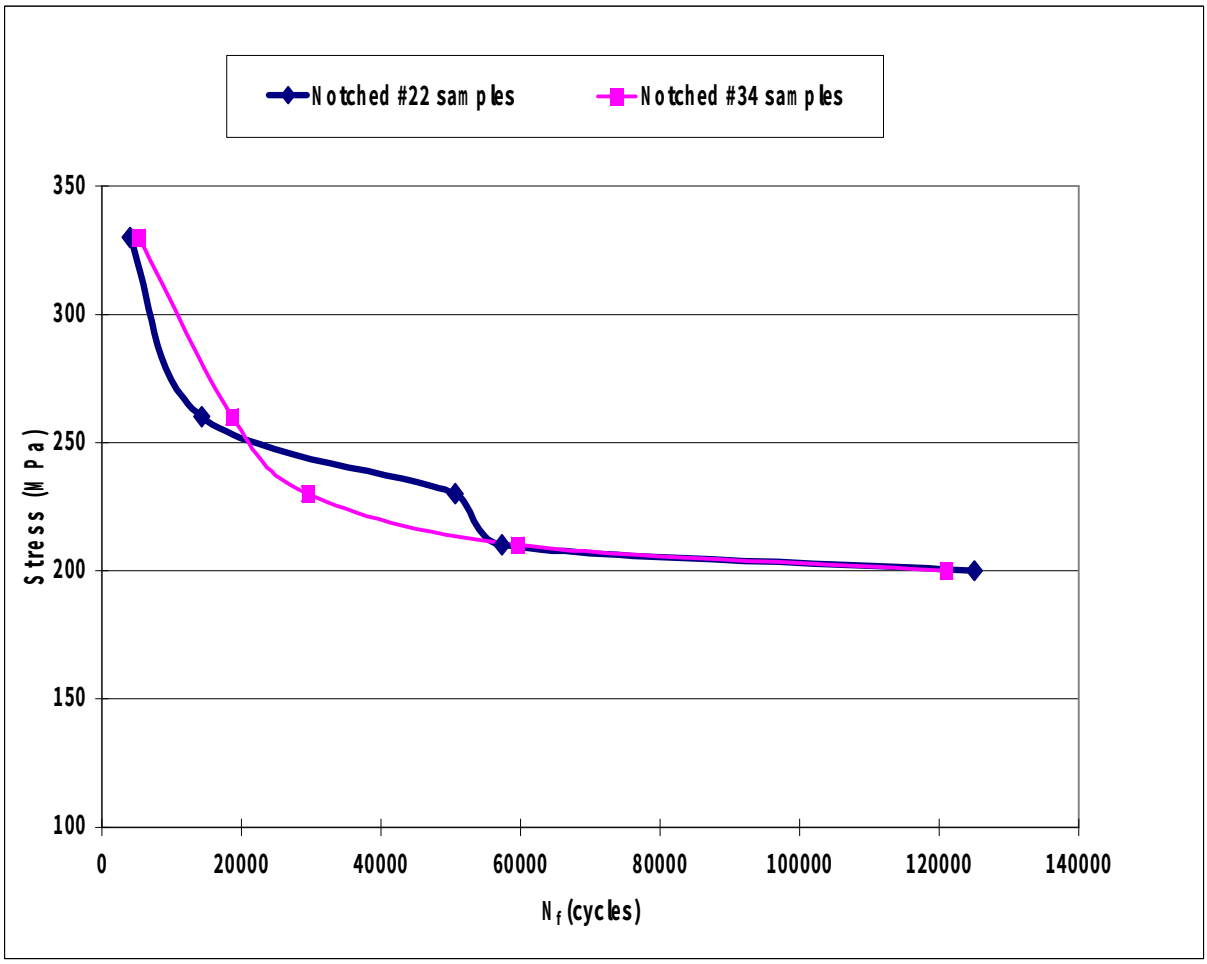
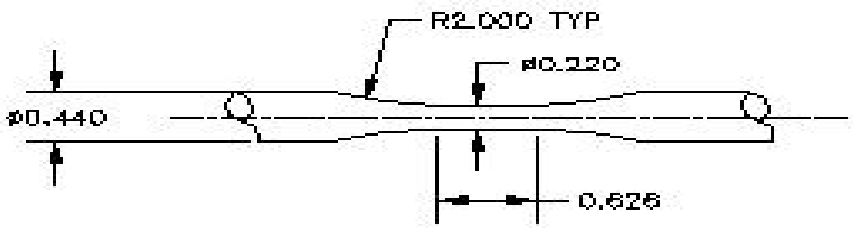

Notched #22 samples
Notched #34 samples
350
300
250
200
150
100
Stress (MPa)
0
20000
40000
60000
80000
100000
120000
140000
Nf (cycles)

Figure 6: A Comparison of S-N Curve of Notched Steel Sample #22 & #34

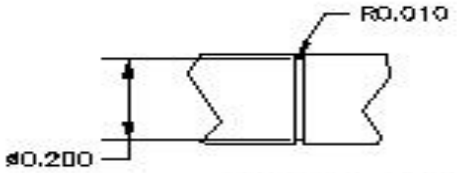
Attachment

(1) Drawing of smooth specimen

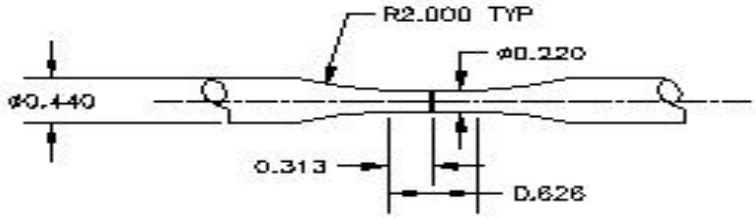



UNNOTCHED TEST SPECIMEN

(2) Drawing of notched specimen




NOTCH DETAIL




NOTCHED TEST SPECIMEN