Endurance limit (stress below which failure does not happen)

* Steels have a definite endurance limits
* Other metals a value around 10 cycles is considered to be infinite life

Finding endurance limit of the actual Part $S_e$ from special test results $S_e$ (rotating bending test - Moore test)

Moore test

![Diagram of Moore test](image)

- Polished Surface
- Loading
- Tensile
- Compressive
- Fully Revered Stress
Can we estimate $S_e$ from $S'_e$?

$$S_e = K_a K_b K_c K_d K_e K_f S'_e$$

Estimate $S'_e$ from $S_{ut}$ (steels)

- $S'_e = 0.5 \ S_{ut}$ when $S_{ut} < 200 \ \text{ksi}$
- $S'_e = 100 \ \text{ksi}$ when $S_{ut} > 200 \ \text{ksi}$

Also

$$S_{ut} \approx 0.5 \ H_B \ \text{ksi} \quad (\text{EQ}\ 2-21)$$

$H_B =$ Brinell hardness number

if $H_B = 400 \ \Rightarrow \ S_{ut} = 200 \ \text{ksi}$

$$S'_e = 100 \ \text{ksi}$$

**Correction factors**

*Moore test*
\( K_a = \) Surface roughness factor
\( K_b = \) Size factor
\( K_c = \) Loading factor (special case only)
  Apply only if there is purely axial loading
\( K_d = \) Temperature (use \( K_d = 1 \) for room temp)
\( K_e = \) Reliability factor

\( K_f = \) Miscellaneous factor
  Corrosion / Plating /

Example

Find \( S_e \) for a power transmission shaft under rotating bending load while carrying a torsional load. Both bending and torsion are completely reversed kind.

\[ A151 \ 4130 \]
- No data on $S_e$ directly

- Surface finish is ground

- Size is $1$ in

- Room temp.

- No plating / Corrosion / Shot Peening

- Reliability of 99.9% for $S_e$ values

Find $S_e$ for 99.9% reliability

\[ S_{ut} = 217 \quad \text{ksi} \quad \Rightarrow \quad S_e = 100 \quad \text{ksi} \]

\[
K_a = a \frac{S_{ut}}{b} \\
\text{ground} \quad a = 1.34 \\
b = -0.085 \\
K_a = 1.34 \ 217 \approx 0.85 \\
\]

Size factor \text{ inch} \\
\text{for } d \leq 2 \quad -0.107 \quad -0.107
\[ K_b = 0.879 \ d = 0.879 \ (1) \approx 0.88 \]

Loading factor \( K_c = 1 \)

Temp \( K_d = 1 \)

Reliability (Table 6-5) \( K_e = 0.753 \)

for 99.9%.

Therefore

\[ S_e = (0.85)(0.88)(1)(1)(0.753) \ S_e' \]
\[ S_e = 0.563 \ S_e' \]

\[ S_e = 56.3 \ \text{kSi} \quad \frac{S_y}{200} \ \text{kSi} \]