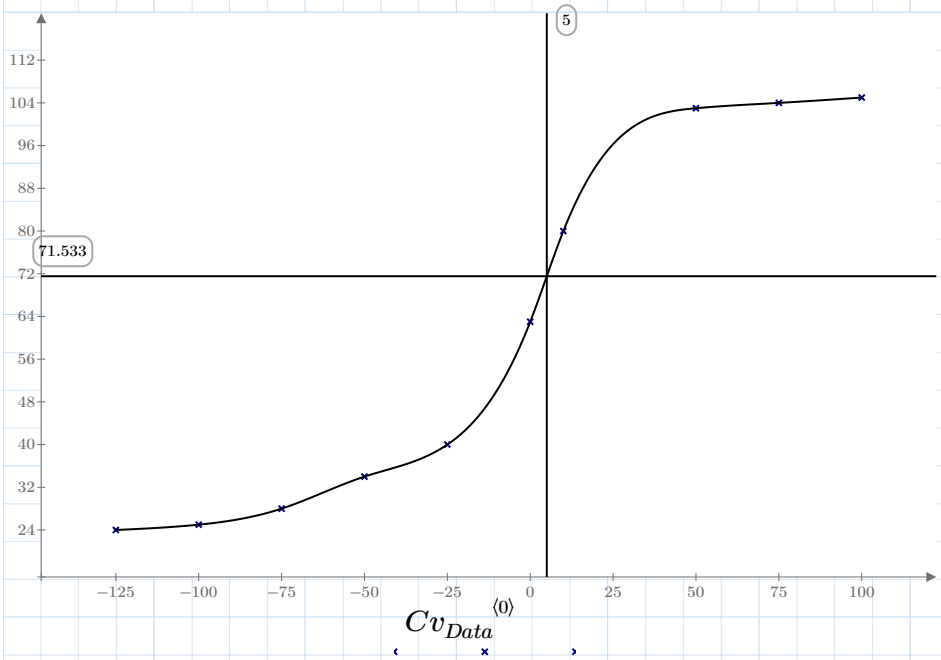
$$Cv_{Data} := \begin{bmatrix} -125 & 24 \\ -100 & 25 \\ -75 & 28 \\ -50 & 34 \\ -25 & 40 \\ 0 & 63 \\ 10 & 80 \\ 50 & 103 \\ 75 & 104 \\ 100 & 105 \end{bmatrix}$$

$$Plot_{cv} := \text{lspline}\left(Cv_{Data}^{\langle 0 \rangle}, Cv_{Data}^{\langle 1 \rangle}\right)$$

$$Plot(x) := \text{interp}\left(Plot_{cv}, Cv_{Data}^{\langle 0 \rangle}, Cv_{Data}^{\langle 1 \rangle}, x\right)$$

$$x := -125, -124 .. 100$$



$Cv_{Data}^{\langle 1 \rangle}$

$Plot(x)$

$Cv_{Data}^{\langle 0 \rangle}$

x

$$Plot(5) = 71.533$$

$$C_v := 71.533 \qquad B := 19.1$$

$$K_1 := \left(\left(12 \cdot \sqrt{C_v} - 20\right)\left(\frac{25}{B}\right)^{0.25}\right) + 20$$

$$K_1 = 107.166 \qquad K_2 := 0.54 \cdot C_v + 55 \qquad K_2 = 93.628$$

$$T_{40J} := -25$$

$$T := 5 \qquad T_0 := T_{40J} - 24 \qquad T_K := 25 \qquad P_f := 0.05$$

$$K_3 := 20 + \left(11 + 77 \cdot e^{\left(0.019 \cdot \langle T - T_0 - T_K \rangle\right)}\right)\left(\frac{25}{B}\right)^{\frac{1}{4}} \cdot \left(\ln\left(\frac{1}{1 - P_f}\right)\right)^{\frac{1}{4}}$$

$$K_3 = 93.602$$

$$K_{mat} := \min\left(K_1, K_2, K_3\right) = 93.602$$

$K_{PI} := 50.2$ $K_{SI} := 0$ $V := 1$ $\rho := 0$

As required in standard, KSI and Rho set to 0 as KSI is specified as a negative value. Further, V is set to unity as required in annex R.

$$K_{r1} := \frac{K_{PI} + V \cdot K_{SI}}{K_{mat}} \qquad K_{r2} := \frac{K_{PI} + K_{SI}}{K_{mat}} + \rho$$

$K_{r1} = 0.536$ $K_{r2} = 0.536$

$K_r := K_{r1}$

Taken from the web: http://www.bebonchina.com/Industry-news/AH36-Chemical-Composition-AH36-Mechanical-Property.html
IS sigma U UTS???

$$L_r := \frac{\sigma_{ref}}{\sigma_Y} \qquad \sigma_{ref} := 267.3\ \textit{MPa} \qquad \sigma_Y := 355\ \textit{MPa} \qquad \sigma_U := \frac{490 + 620}{2}\ \textit{MPa}$$

$$L_{rmax} := \frac{\sigma_Y + \sigma_U}{2\ \sigma_Y} \qquad E := 209\ \textit{GPa}$$

$$\mu := min\left(0.001\ \frac{E}{\sigma_Y}, 0.6\right) \qquad N := 0.3 \cdot \left(1 - \frac{\sigma_Y}{\sigma_U}\right)$$

Below is an exert from the standard itself.

7.3.3 Option 1

This option does not require detailed stress-strain data. The equations describing the assessment line are the following:

$$f(L_r)=\left(1+\frac{1}{2}L_r^2\right)^{-1/2}\left[0.3+0.7\exp\left(-\mu L_r^6\right)\right] \text{ for } L_r \le 1 \quad (26)$$

$$f(L_r)=f(1)L_r^{(N-1)/(2N)} \text{ for } 1 < L_r < L_{r,max} \quad (27)$$

and:

$$f(L_r)=0 \text{ for } L_r \ge L_{r,max} \quad (28)$$

where:

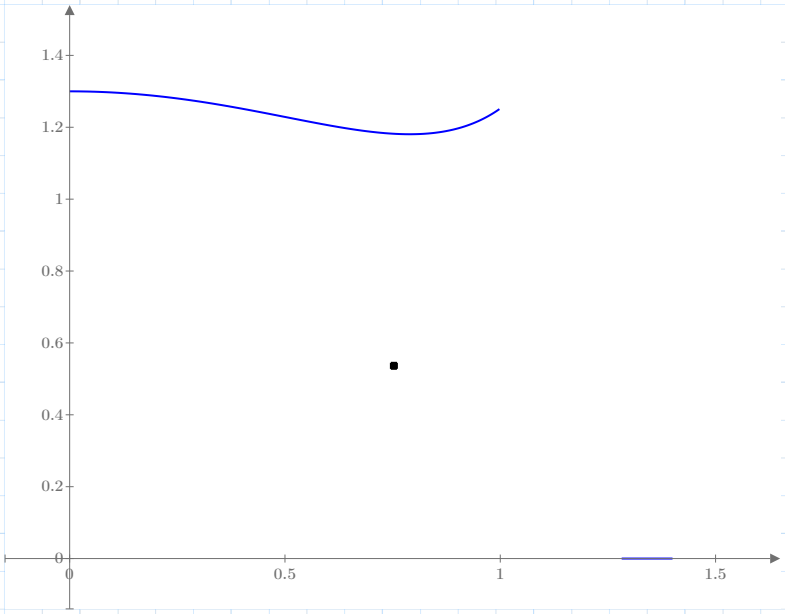
$$\mu = \min\left(0.001\frac{E}{\sigma_Y}, 0.6\right)$$

$$N = 0.3\left(1-\frac{\sigma_Y}{\sigma_u}\right)$$

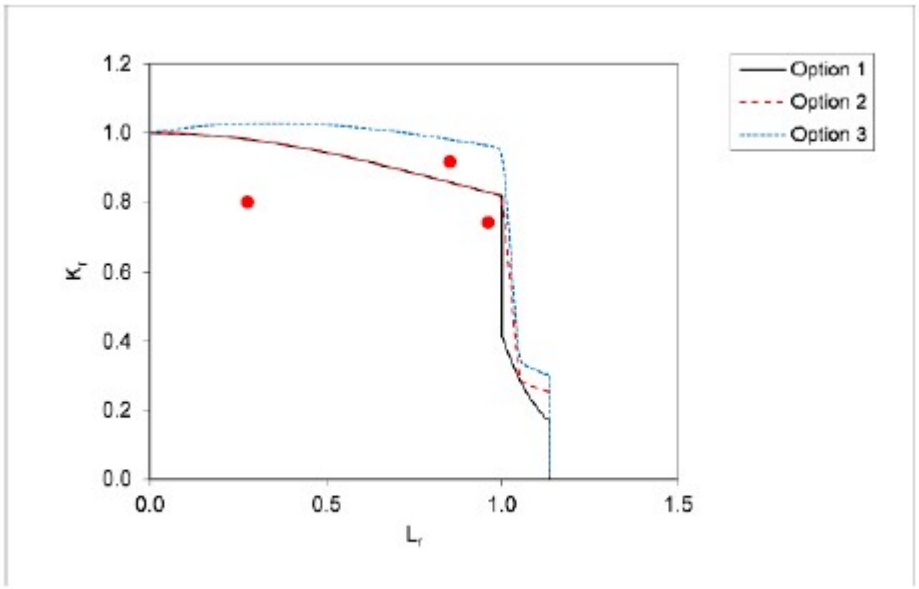
This is my programme for the above.

$$f(x) := \begin{cases} \text{if } x < 1 \\ \quad \left(1+\frac{1}{2}x^2\right)^{\frac{-1}{2}} \cdot \left(0.3+0.7^{\left(-\mu \cdot x^6\right)}\right) \\ \text{else if } 1 < x < L_{rmax} \\ \quad f(1) \cdot x^{\frac{(N-1)}{(2N)}} \\ \text{else if } x > L_{rmax} \\ \quad 0 \end{cases}$$

This is what I have ended up with which is obviously wrong



The below is what I would have expected where the option curves are the pass fail lines I am trying to plot (in this case option 1)



Source: Overview of BS 7910:2013, Isabel Hadley* and Henryk G Pisarski*, TWI Ltd
Paper presented at the ESIA12, 12th International Conference on Engineering Structural Integrity Assessment, 28 and 29 May 2013, Manchester, UK