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Reactor Vessel Head Drop

NEI Initiative

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The Figure below shows an actual stress-strain curve for a typical carbon steel at 75 degrees F. The accumulated area under the curve [E_T] is directly proportional to the total energy (area under the curve) and is shown in the same Figure (red curve, with the red empty squares). The calculated factors of safety, based on accumulated energy (for energy based component Design), are as follows:

- *for acceptable maximum strain at ultimate stress Su: SF = 1.52.*

- *for acceptable membrane strain at 2/3 of strain at ultimate stress Su: SF = 2.42.*

The safety factor given in appendix F for load controlled analysis is ≈ 1.5 for membrane stress. The energy based analysis membrane safety factor shown below is greater than 2.0. Also, for the maximum stress, the energy based safety factor of ≈ 1.5 exceeds by far the Appendix F margin on maximum stress, which is 1 / 0.9 = 1.1. Therefore the energy based analysis safety factors exceed the Appendix F load controlled safety factors.

The reactor vessel head drop is beyond Design basis yet the energy based safety factors are >> than those in Appendix F.

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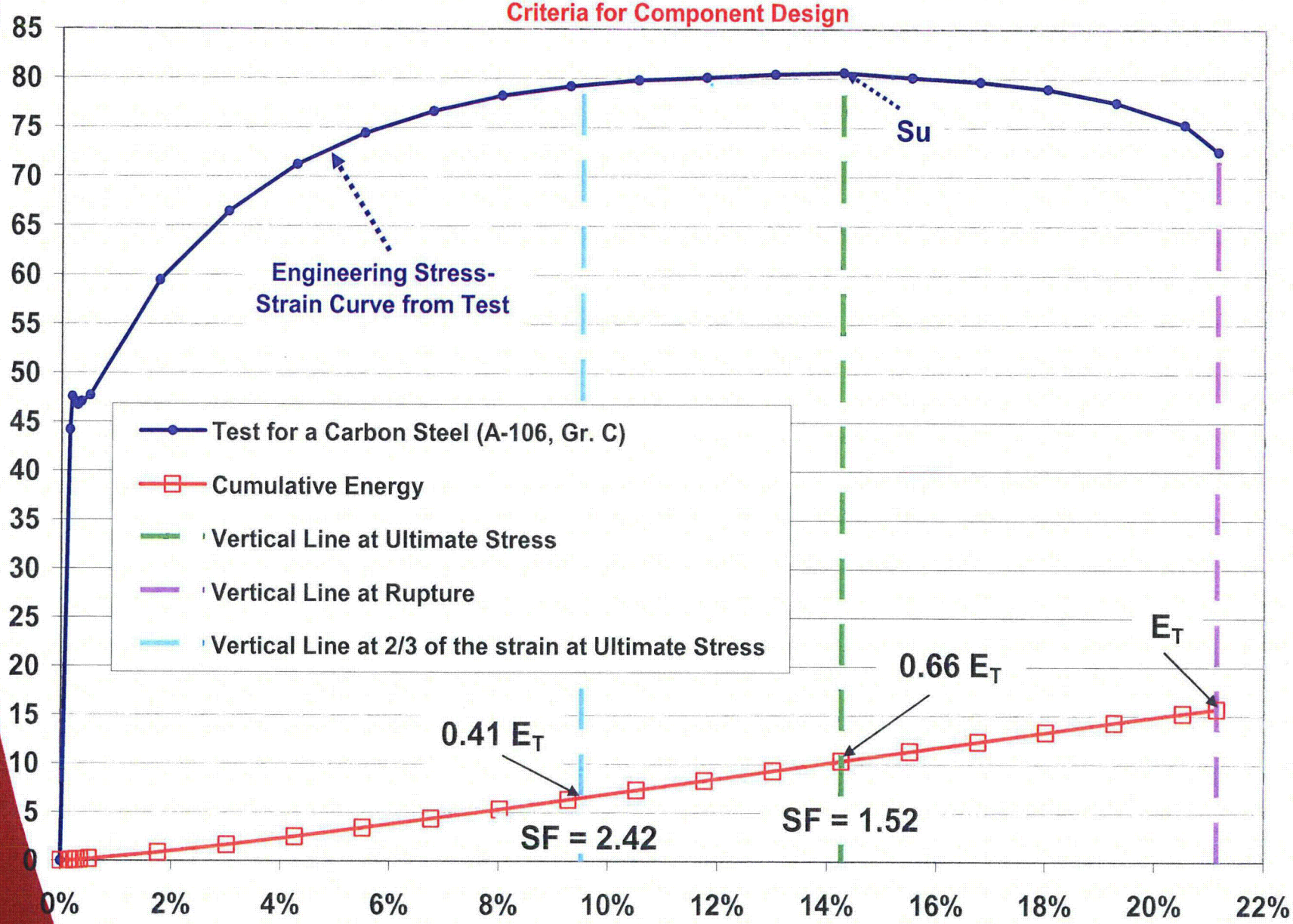
Criteria for Component Design