

Temperature Stability of Alloy 25, ToughMet® 3 Tensile Properties up to 650°F/340°C and Performet™, Alloy 3, and Alloy 10X Tensile Properties up to 932°F/500°C

Many copper-based alloys depend solely on cold work or simple alloy additions to obtain their strength. What makes Materion’s high performance alloys unique is the extra strength obtained through either precipitation or spinodal hardening. These hardening effects produce alloys that have the conductive, thermal, corrosion and magnetic properties of common copper-based alloys with the strength of many popular steels. However, continued exposure to elevated temperatures may alter the tensile properties of these materials. These effects are documented herein.

PROCESS HISTORY AND AGING

Each alloy temper combination has its own unique process history of hot work, cold work and heat treatment to obtain its property set. The final heat treatment, referred to as aging, is usually responsible for most of the material’s strength. Exposure to elevated temperatures will continue this aging process. Below, Figures 1 thru 3 show the general behavior during aging of Materion’s most popular alloys. The specific response to elevated temperature exposure after receipt from the supplier is dependent on the material’s process history and is shown on the next page.

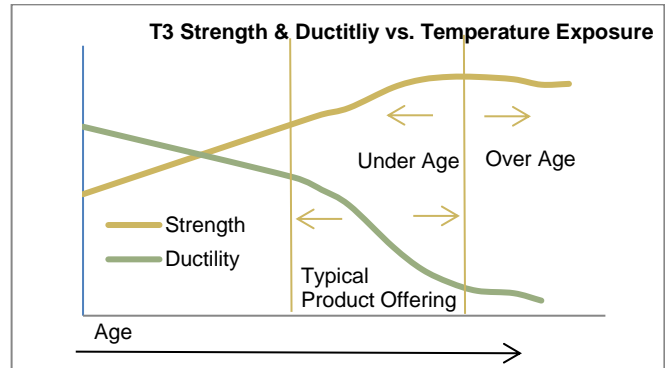


Figure 2: ToughMet 3 gains strength as it loses ductility. After reaching peak strength, the ductility plateaus at a low value.

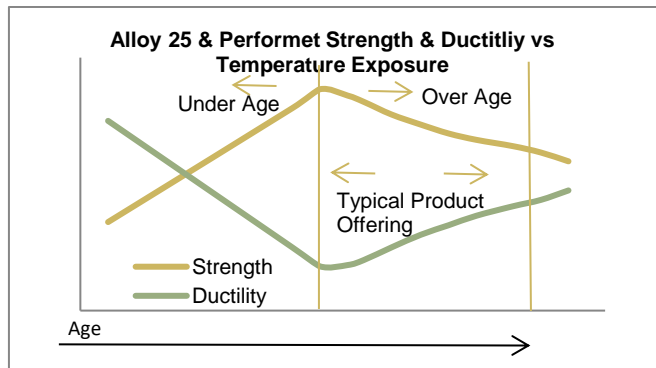


Figure 1: Alloy 25 initially gains strength and loses ductility as it ages. After reaching peak strength, it begins to lose strength and become more ductile.

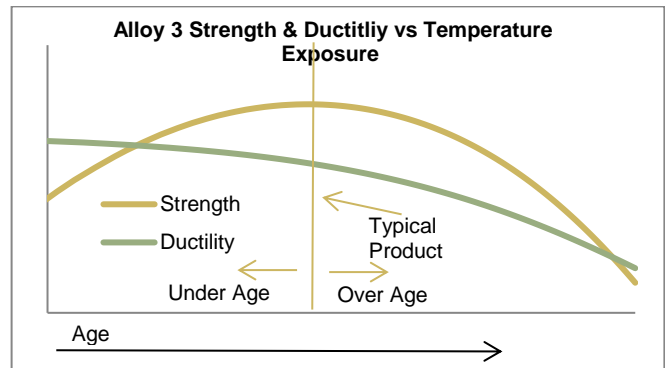


Figure 3: Alloy 3 reaches peak strength then loses both strength and ductility.

EFFECTS OF TEMPERATURE EXPOSURE

Understanding and taking advantage of these aging effects allows the engineers at Materion to optimize material properties for many different applications. However, it is also important to understand these effects when considering these materials for applications at elevated temperatures. Depending on the combination of the alloy and temper, exposure to elevated temperatures could result in environmental aging. If the material was ordered at its optimal property combination for its function, this may lead to an undesirable characteristic such as reduced ductility or strength. Table 1 lists the exposure

temperature at three durations at which this environmental aging will cause a 10% loss of room temperature strength or elongation (i. e. ductility).

EFFECTS OF TEMPERATURE EXPOSURE

The graphs below Table 1 display the change in **room temperature** tensile properties of the material after exposure to elevated temperatures up to 500C for a period up to 2000 hours. The properties are presented as a factor of the mill certified properties measured before the elevated temperature exposure.

Table1: Upper Operating Temperature Limits

Exposure temperature at which room temperature strength or ductility falls 10%

Alloy	Temper	Work	Age Level	10% loss in Yield or Elongation 2hrs	10% loss in Yield or Elongation 20hrs	10% loss in Yield or Elongation 200hrs	Hardening Mechanism
3	AT	Hot Work	Peak-aged	>500C/932F	500C/932F	500C/932F	Precipitation
3	HT	Cold Work	Peak-aged	>500C/932F	500C/932F	500C/932F	Precipitation
10X	AT	Cold Work	Peak-aged	>500C/932F	500C/932F	500C/932F	Precipitation
10X	AT	Cold Work	Peak-aged	>500C/932F	500C/932F	500C/932F	Precipitation
Performet	AT	Hot Work	Peak-aged	500C/932F	370C/698F	370C/698F	Precipitation
25	AT	Hot Work	Peak-aged	>345C/653F	345C/653F	300C/572F	Precipitation
25	HT	Cold Work	Peak-aged	>345C/653F	345C/653F	300C/572F	Precipitation
25	DST	Both	Over-aged	>345C/653F	>345C/653F	345C/653F	Precipitation
T3	CX105	AS-Cast	Under-aged	300C/572F	300C/572F	260C/500F	Spinodal
T3	AT110	Hot Work	Under-aged	300C/572F	300C/572F	260C/500F	Spinodal
T3	TS 95	Cold Work	Under-aged	345C/653F	300C/572F	260C/500F	Spinodal
T3	TS120U	Cold Work	Under-aged	345C/653F	300C/572F	260C/500F	Spinodal
T3	TS160U	Cold Work	Peak-aged	>345C/653F	345C/653F	260C/500F	Spinodal

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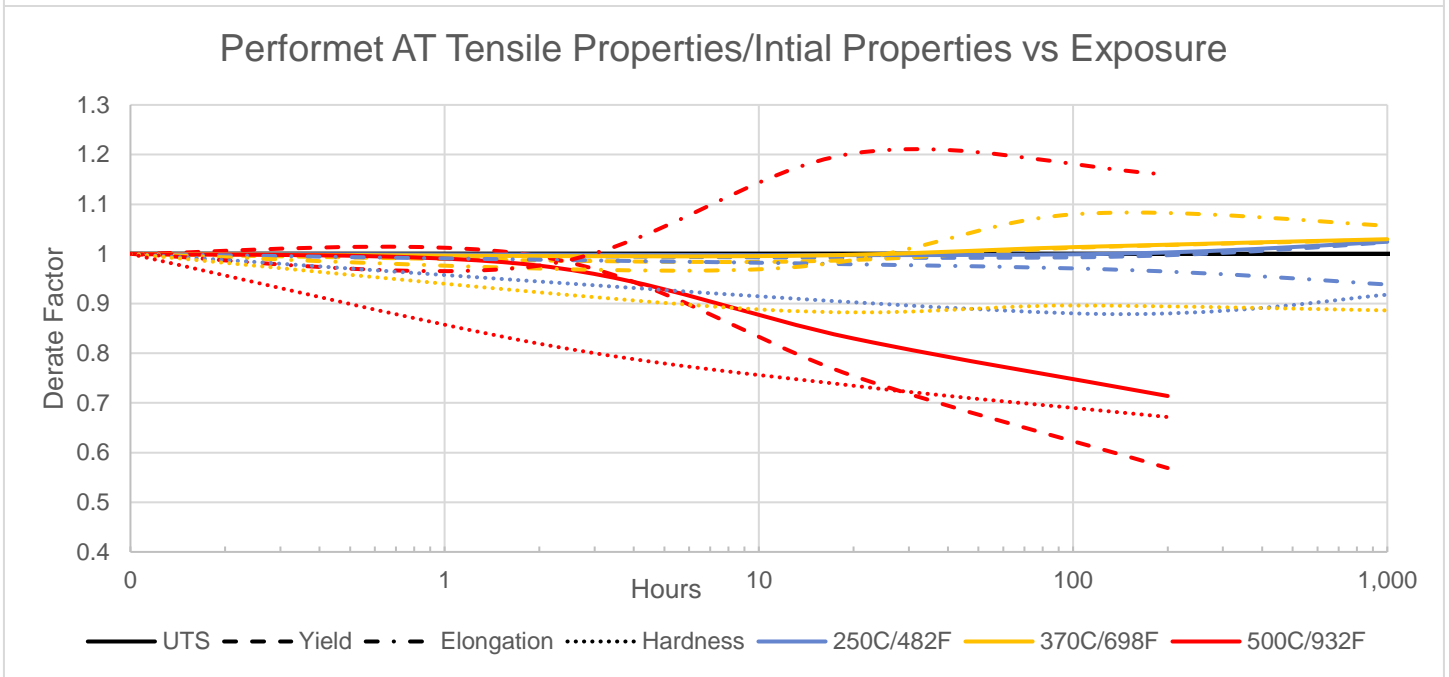
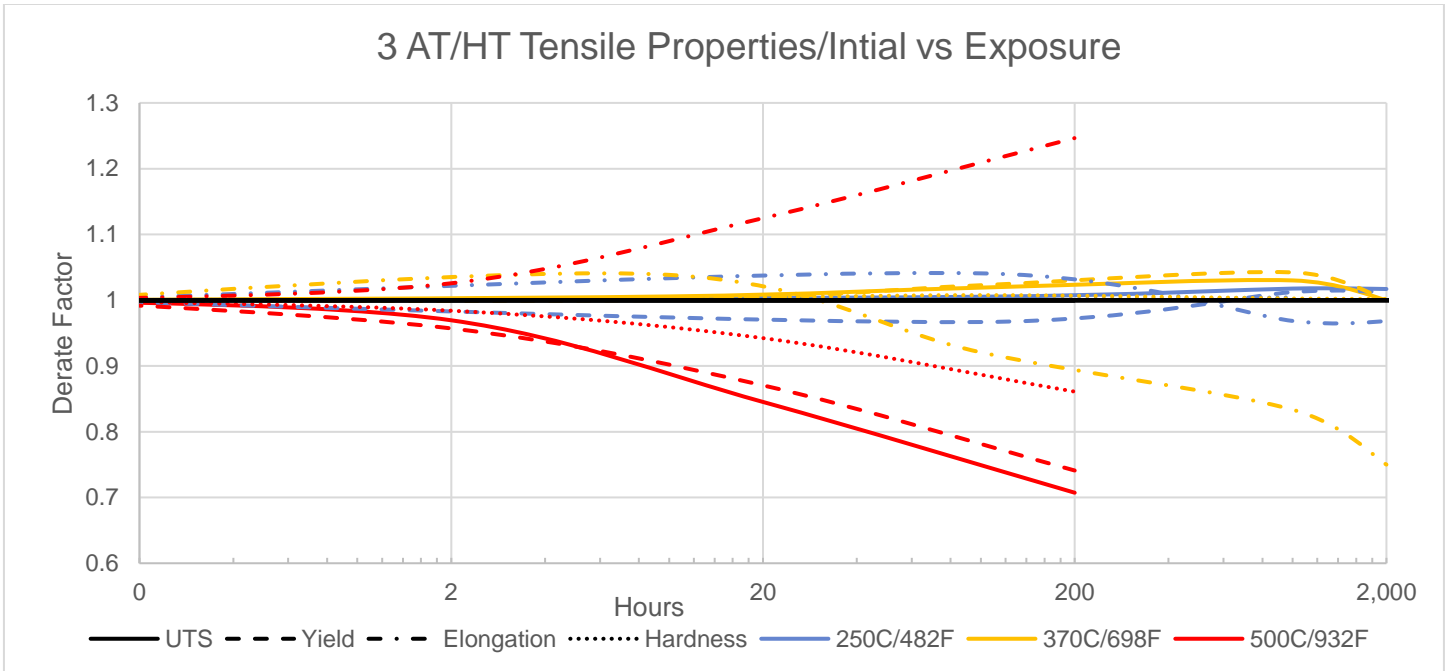
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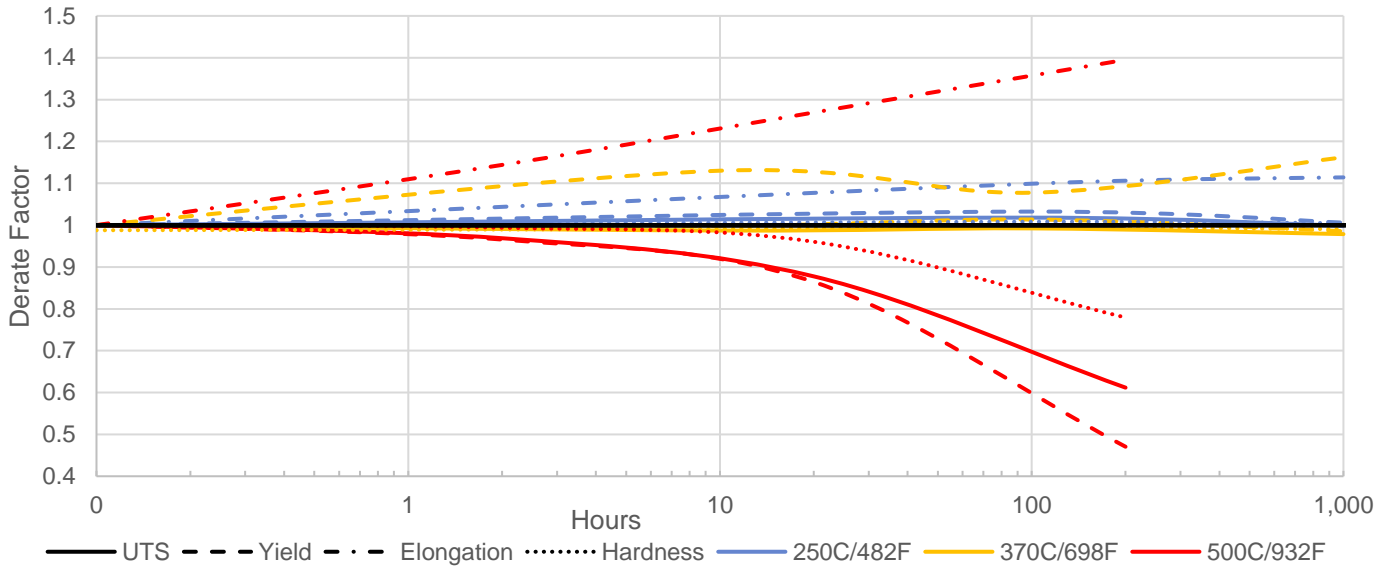
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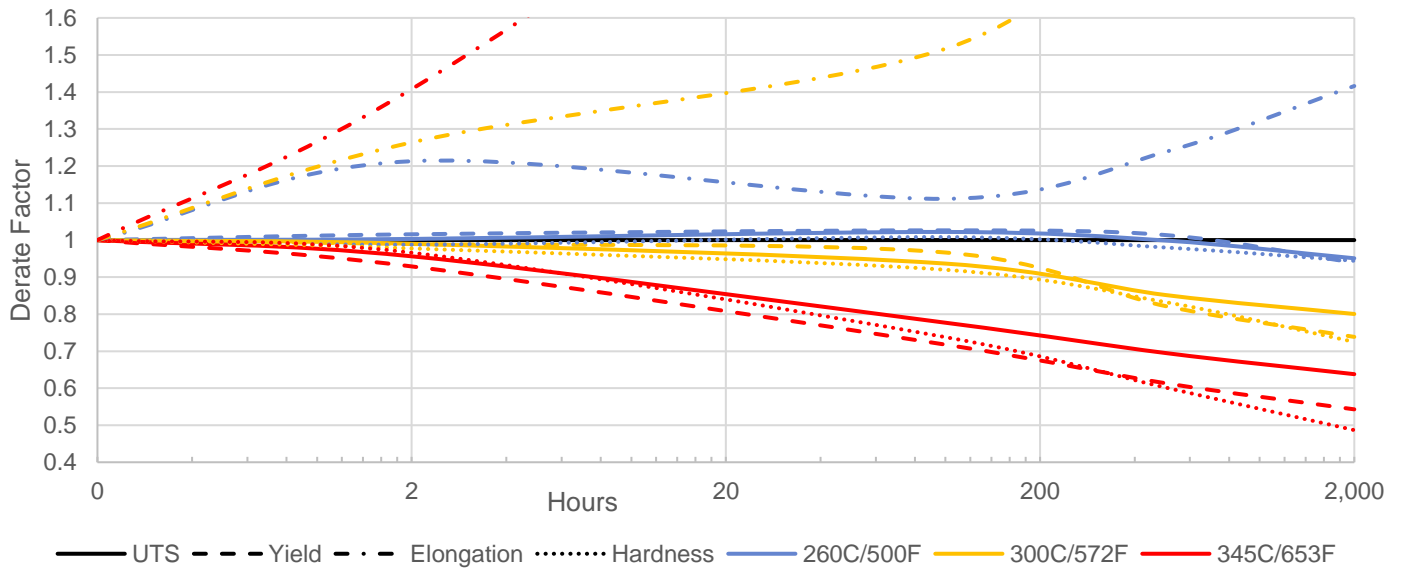
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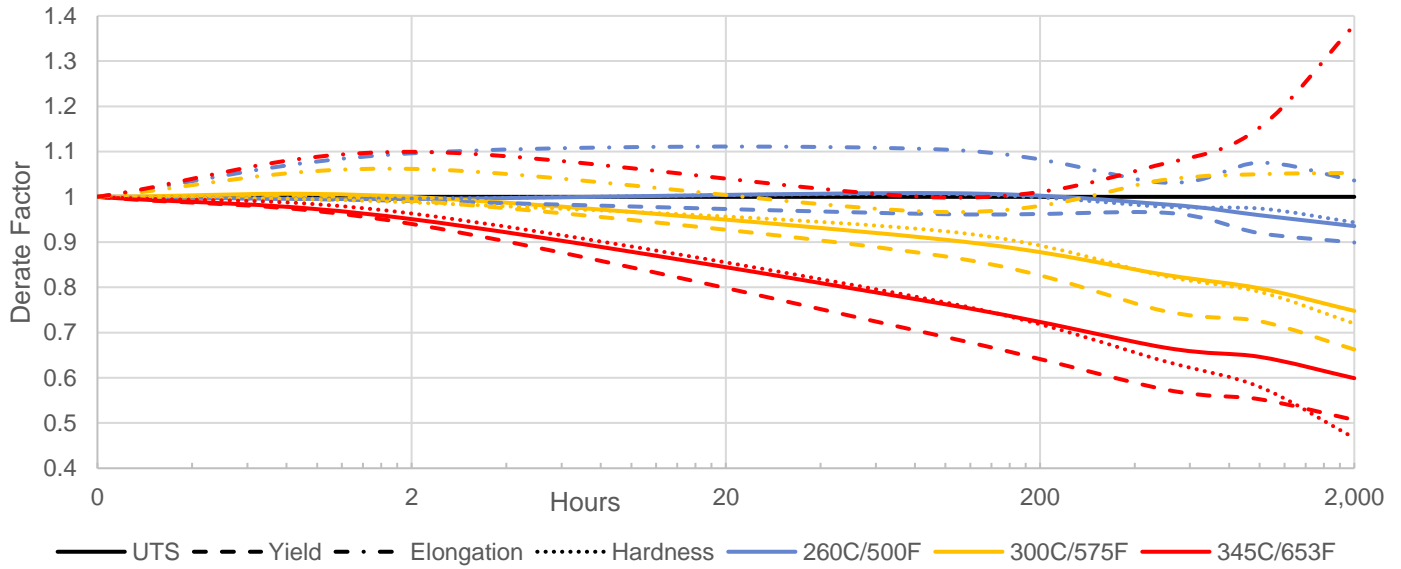
10X AT/HT Tensile Properties/Intial vs Exposure



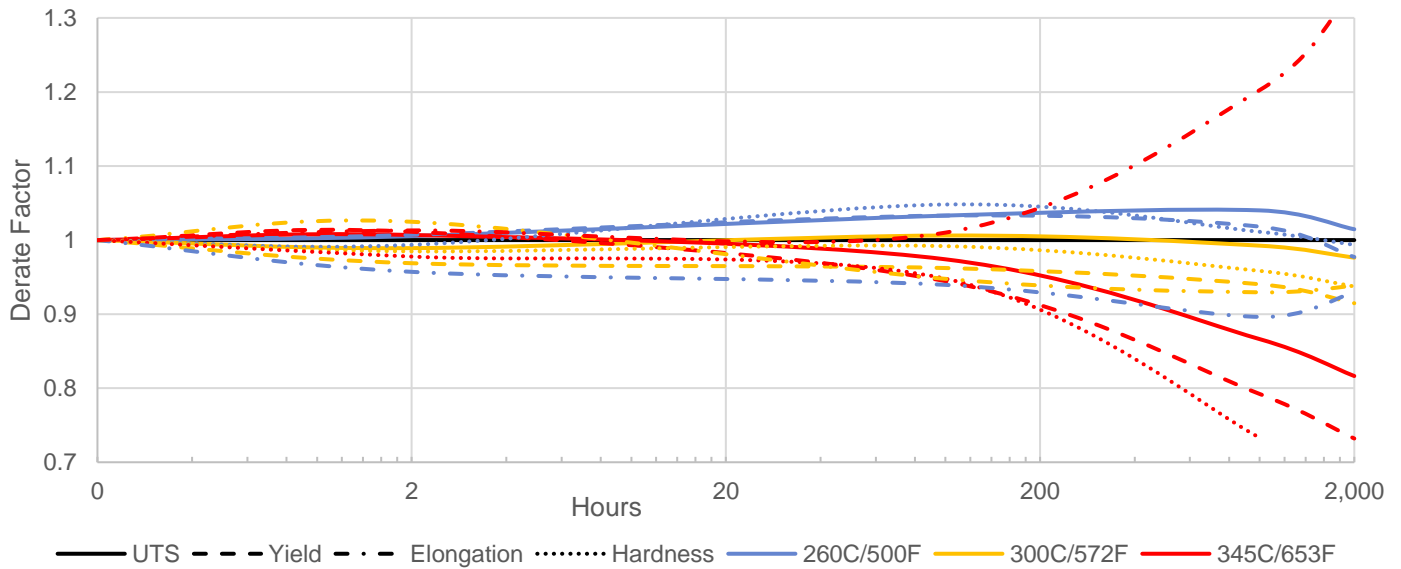
25 AT Tensile Properties/Intial vs Exposure



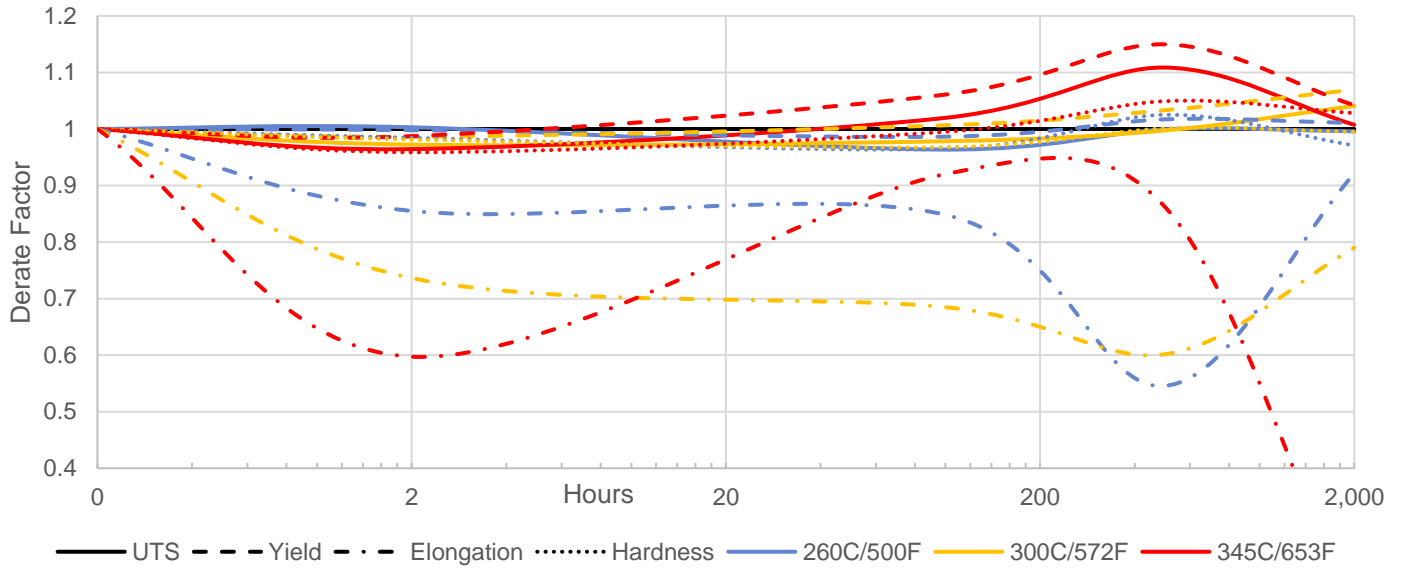
25 HT Tensile Properties/Initial Properties vs Exposure



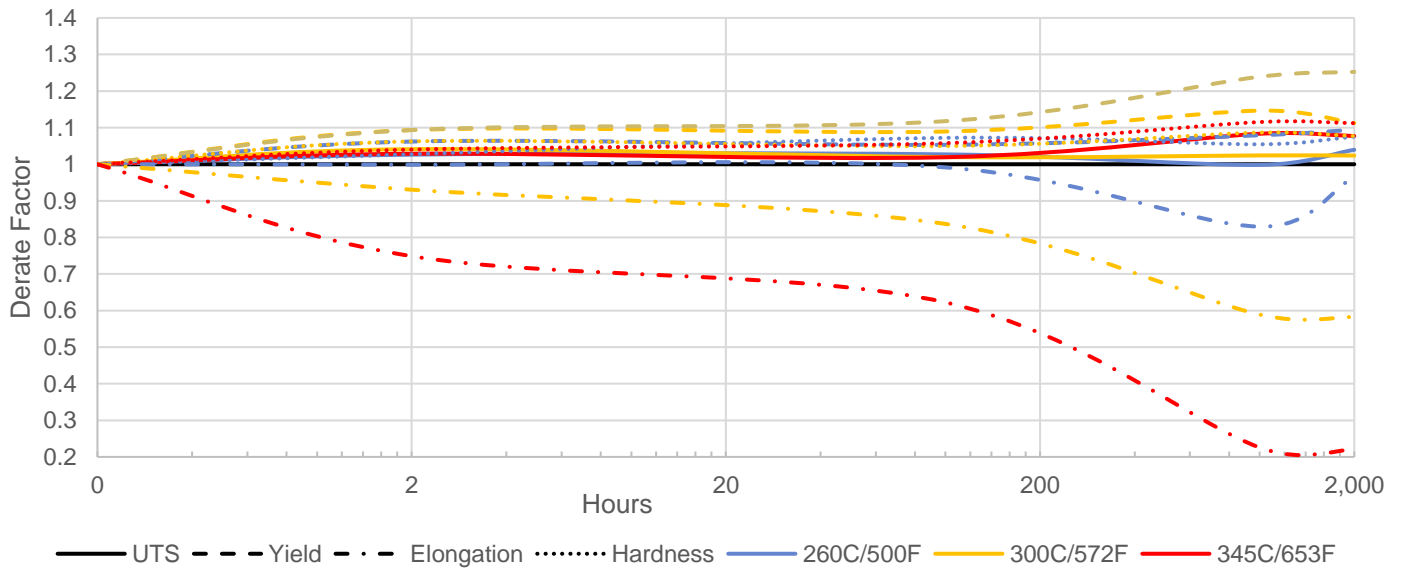
25 DSTO Tensile Properties/Intial vs Exposure



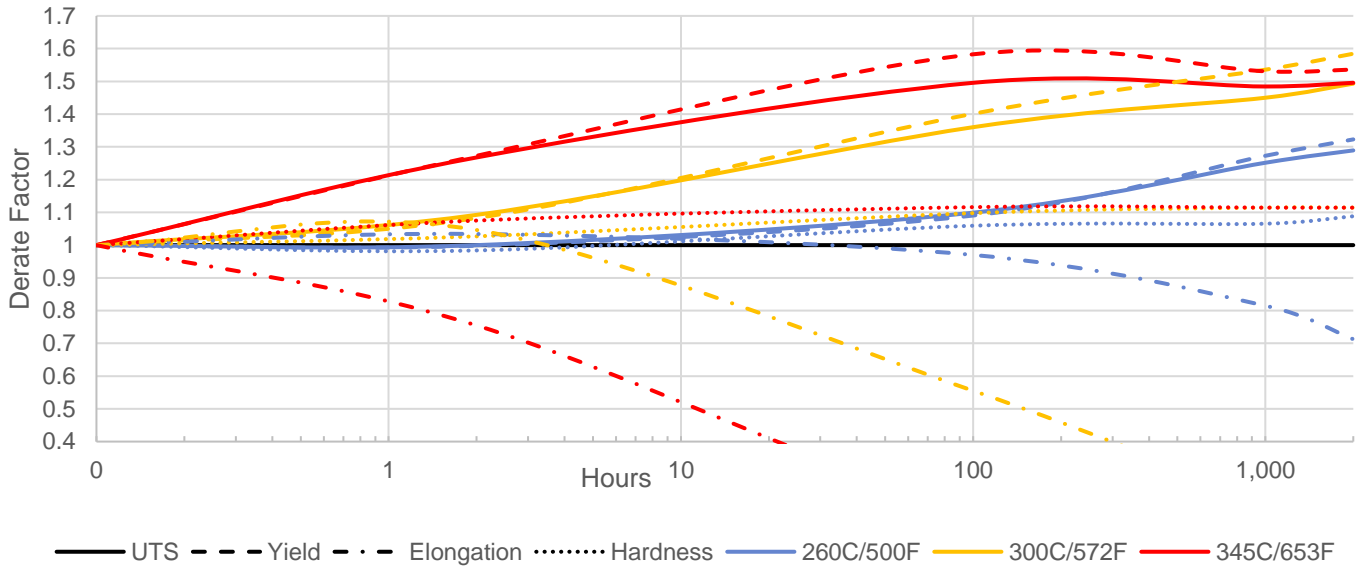
T3 CX105 Tensile Properties/Initial vs Exposure



T3 AT110 Tensile Properties/Initial vs Exposure



T3 TS95 Tensile Properties/Intial vs Exposure



T3 TS120U Tensile Properties/Intial vs Exposure

