

INCONEL® ALLOY 625 LCF | BELLOWS APPLICATIONS

(SAE AMS 5879) in High Stress, High Cycle Life Aerospace Bellows Applications

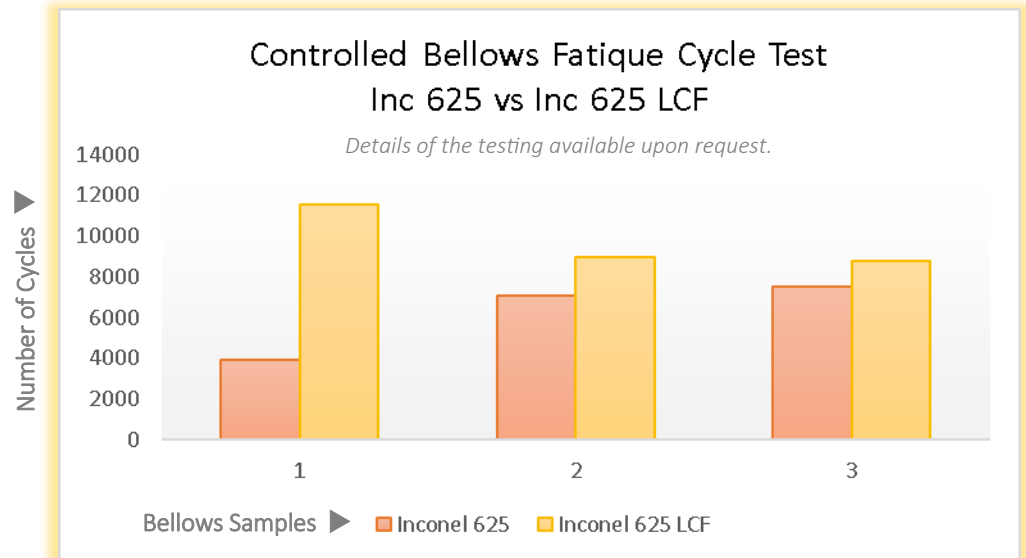
INCONEL® 625 LCF (Low Cycle Fatigue) is a modified form of INCONEL® 625 (ASTM B 443 & SAE AMS 5599). It is important to note that although INCONEL® 625 LCF will meet all [INCONEL® 625](#) industrial & aerospace specifications, INCONEL® 625 will not meet the specifications of INCONEL® 625 LCF. Thus, because chemical composition & other mechanical properties of LCF fall within the specification range of standard INCONEL® 625 there is typically no need to get approval or recertification if standard INCONEL® 625 is already specified & approved.

The most significant differences between standard & LCF variants result from the restricted minimum grain size requirement, the controlled melt technique, the limitations on chemical composition and balance which together enhances cycle fatigue properties and promotes thermal fatigue resistance. The improvements are especially documented in high stress bellows applications associated with extremely high pressure & high motion product performance requirements and/or severe installations. The material is used at **Duraflex, Inc.** in our hydroformed bellows, hydroformed expansion joints, hydroformed flexible hose & our precision edge-welded bellows.

Attachment: <https://www.specialmetals.com/assets/smc/documents/alloys/inconel/inconel-alloy-625.pdf>
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Another paper showing benefits of refined grain size (ASTM # 5 or finer), optimizing chemistry (Restricted Carbon, Nitrogen & Silicon) & improved melt techniques (VIM & ESR vs. AOD & ESR - for standard Inconel 625) leading to better fatigue properties with Inconel 625 LCF. The importance of metal carbide formation at the grain boundaries was only possible with the advances in SEM in the late 80's & 90's. https://www.tms.org/superalloys/10.7449/1997/Superalloys_1997_447_458.pdf

Duraflex, Inc.'s recent bellows data is shown to the right on a direct comparison between standard 625 & 625 LCF:



All other factors such as heats, product processing, fabrication personnel, tooling, testing set-ups & procedures were documented & kept under statistical control to allow for a validation of the effects of LCF – ONLY under completely controlled conditions. Obvious are the bellows fatigue improvements with LCF.

Dean DellaCecca, Duraflex, Inc.'s company president & author of this paper had the honor to be both a data & science contributor to the development of INCONEL® 625 LCF alongside the esteemed Ralph H. Scharck (Flexonics) & Gaylord D. Smith (INCO). This was a profound experience given the magnitude of both scientific minds, as well as their vast contributions to metallurgical significance.