ADVANCED PRESSURE TECHNOLOGY

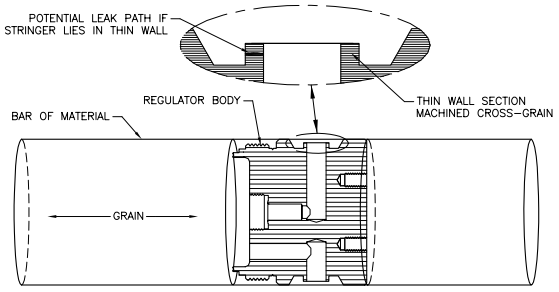
Product Note, PN 414
Cautions Concerning Use of Single Melt 316L Stainless Steel

October 31, 2008

The purpose and intent of this product note is to insure awareness of concerns regarding the use of single melt 316L stainless steel (SS). It is not intended to be a technical paper that details all the differences between melt processes. There are many excellent papers already published which address all facets of the material, its weld ability and use.

Single melt 316L SS material, such as the AZ series employs, commonly has concentrations of randomly distributed sulfide and other non-metallic inclusions. The inclusions can be found in clusters which are called 'stringers'. During hot rolling of the bar, sulfide inclusions are elongated. As the stringer is formed and elongated during hot rolling of the bar, the length of the stringers is aligned in the direction of the axis of the bar stock. If machining of a component results in a thin wall section perpendicular to the bar axis, it is possible that a stringer could extend mostly or completely through this thin wall. If a component with such an inclusion stringer crossing through a thin wall section is used in corrosive gas service, it is possible that the corrosive gas will attack the non-metallic inclusion and cause a leak to atmosphere. In secondary remelt material, such as 316L SS VAR, the inclusion content is lower and the material is more homogeneous, meaning the inclusions are fewer, smaller in size, and evenly dispersed. The sulfur content of secondary remelt 316L SS material is controlled to a low level (typically less than 0.008 percent by weight) while the sulfur content of single melt 316L SS is typically near the maximum (0.030 weight percent) to improve machinability. Additionally, electropolishing of single melt material results in more surface defects, due to the higher concentration of inclusions, compared to VAR material. The single melt material surface does not have the uniform luster and mirror finish of VAR material. Single melt material tends to have hazing or mottling which is not uniform in appearance. Increased localized pitting is more likely to occur on single melt material as electropolishing removes inclusions located on the surface.

Thin wall sections which are perpendicular to the bar axis are typically created in regulators and valves when machining the fitting butt weld preparation in the body. Mini weld elbow fittings, such as the Micro-Fit®, are another example of a component that can have a thin wall section with stringers aligned through the wall, as one leg of the elbow is machined perpendicular to the axis of the bar.



Single melt 316L SS was the semiconductor industry standard for material until the early 90's. Two primary factors were the driving forces behind the quantum shift to secondary remelt (VAR) material. One factor was the desire for finer and finer surface finishes with enhanced surface chemistry. VAR material is more homogeneous than single melt, which enables mirror like surface finishes unattainable with single melt. Lower impurities coupled with finer

Micro-Fit ® Swagelok

control of key elements, also produces better surface chemistries. The second factor was to eliminate the potential for leaks to atmosphere in corrosive gas service resulting from corrosive attack on sulfide stringers located in thin wall sections. There were several instances of corrosive gas leaks due to stringers in mini weld elbows which caused extensive damage. VAR material virtually eliminated this problem.

Single melt material affords a cost savings two ways. The material itself costs less and the machinability is better due to the higher sulfur content. Sulfur acts as a cutting tool lubricant which enables faster machining and better tool life.

Is single melt appropriate for a given application? This is a question best left to the consumer to decide. Our task is to make sure it is an informed decision.