PENFLEX

ENGINEERING BULLETIN #109

Calculating Pitting Resistance Equivalent Number (PREN)

When a metal hose is considered in an application for transferring an aggressive media, like high chlorides, or when it fails while in service due to pitting corrosion or chloride stress corrosion cracking, it is essential to use a hose or replacement hose manufactured from the proper alloy to prevent future failure. Many times, a failed hose is replaced with the same alloy and most likely will fail within the same time frame.

Stress corrosion cracking usually starts with pitting corrosion. The most common cause of pitting in stainless steel is acid chlorides. Chlorides react with chromium to form the very soluble chromium chloride ($CrCl_3$), removing chromium from the passive layer, and leaving only the active iron. As the chromium dissolves, chlorides bore into the surface of stainless steel creating spherical, smooth wall pits which become stress concentrators.

To improve the pitting corrosion resistance of stainless steel such alloying elements like molybdenum (Mo) and/or nitrogen (N) are added. To help in the selection of an appropriate alloy for an application an equation called the pitting resistance equivalent number, or PREN, has been developed. PREN is a theoretical way of comparing the pitting corrosion resistance of various types of stainless steels based on the chemical compositions of an alloy. The most commonly used formula is as follow.

PREN = %Cr + 3.3 (%Mo) + 16 (%N)

The table below shows a comparison range of calculated PREN values for common alloys. The higher PREN for an alloy the better its resistance to pitting corrosion.

Alloy	PREN
304, 304L, 309, 310, 321	18.0 – 20.0
316, 316L	22.6 – 27.9
317, 317L	27.9 – 33.2
AL-6XN	39.8 – 45.1
Inconel® alloy 625	46.4 – 56.0
Hastelloy® alloy C-276	64.0 – 73.8

Note: A PREN of 32 is considered the minimum for seawater pitting resistance.

If you have any questions or comments, please contact us.