Class Changes for Chrome Moly Filler Metals

The AWS Chrome-Moly Classification changed to allow for better grouping of alloys in the specifications, or to better define the properties according to the classification system. The alloy compositions remain unchanged. The changes are summarized as follows:

Old AWS Classification	New AWS Classification GMAW / GTAW / SMAW	New AWS Classification SAW
E502-15	E8015-B6	
E502-16	E8018-B6	
ER502	ER80S-B6	EB-6
E505-15	E8015-B8	
E505-16	E8018-B8	
ER505	ER80S-B8	EB8
ER515	ER80S-B2	EB-2
ER521	ER90S-B3	EB-3
	ER90S-B9	EB-9

CHROME-MOLY and the EMBRITTLEMENT FACTORS

A major application of Chrome-Moly steels is in the fabrication of pressure vessels to be used in oil refining operations where the materials are subjected to elevated temperatures for extended periods of time. Due to this long term exposure, a phenomenon known as temper embrittlement has a tendency to occur. Temper embrittlement is the migration of certain elements within the material to the grain boundaries over time, causing a loss in toughness. As a means to judge the relative temper embrittlement resistance of a material, the so called x- and J-factors were developed.

The J-factor was originally developed for the base materials and incorporates the elements Manganese, Silicon, Phosphorous and Tin in the following formula:

$$J = [(Mn + Si) \times (P + Sn)] \times 10^4$$

where the various elements are expressed in wt %. Most common specifications call for a J-factor of less than 150 but values as low as 120 have been seen. The control of these elements in the base material is critical since the Mn and Si tend to co-segregate with the P and Sn to cause the loss in toughness.

For the weld metal, the J-factor is not suitable since the rapid solidification and cooling rate of the weld beads do not allow time for the co-segregation of the Mn and Si. In fact, both Mn and Si are needed in the weld metal system; the Mn to develop the needed toughness and the Si for weldability.

Therefore, the x-factor was developed as a better means to judge the relative temper embrittlement resistance of the weld metal by incorporating the residual elements Phosphorus, Antimony, Tin and Arsenic as follows:

$$X = \frac{(10 P + 5 Sb + 4 Sn + As)}{100} \qquad \text{(elements in ppm)}$$

where the elements are expressed in ppm. Typical specifications currently call for a maximum x-factor of 15. This calculation has proven much more effective in gauging the temper embrittlement resistance of the weld metal by controlling those elements that tend to affect the toughness the most while not considering Mn and Si due to the inherent differences in the steel and weld metal.