TESTING REQUIREMENTS OF API 5CRA

For Groups 2, 3, & 4

API 5CRA provides detailed testing requirements for satisfaction of the specification. The testing requirements vary by group, or alloy family. This article summarizes the testing requirements for Groups 2, 3 and 4 (duplex, super duplex, austenitic & nickel base alloys). API 5CRA Checklists have also been provided as a reference.

CHEMISTRY

For each heat, the chemical analysis representing the melt must be reported in addition to the analysis of the product. Alloys that are not ESR or VAR re-melted are required to have two product analysis reported. The chemistry is reported as the percentage of each element by mass. The required percentages are listed in the attached API 5CRA checklists. For Group 2 alloys, the PREN must also be reported. This is easily calculated from the analysis using the PREN calculator on our website.

TENSILE PROPERTIES

A minimum of one room temperature longitudinal tensile test must be performed on each heat. The test report needs to include the yield strength at .2% offset, ultimate tensile strength, percentage elongation, diameter of the specimen and gage length. The gage length should be 4X the specimen diameter. For example, a .250" diameter specimen will have a 1" gage length. The requirements depend upon the minimum specified yield strength, and these can be found in the API 5CRA checklists provided. Tensile properties are commonly reported in thousands of pounds per square inch (KSI), rounded to the nearest whole number. API 5CRA also requires the tensile strength be at least 10ksi greater than the specified minimum yield, or a minimum of 5ksi greater than the yield strength.

CHARPY V NOTCH (CVN) OR FLATTENING TESTING

Charpy V-Notch impact tests or flattening tests are required to be performed on each end of two pieces per heat of pipe and each end of each piece of coupling stock. The preferred test is a transverse Charpy V-Notch (TCVN). However flattening tests are performed when TCVN specimens can't be obtained due to the size of the pipe. The TCVN requirements, provided in the API 5CRA checklists, depend upon the minimum specified yield strength and maximum critical wall thickness. The testing is performed at 14°F, unless otherwise specified. Reduction factors are also provided for when a full size TCVN specimen cannot be obtained. The formula for calculating the flattening test requirements can be found in section 7.7 of API 5CRA. For flattening tests, a load versus deflection record should be made for each test, and the test record should report the required load and deflection accuracy. Charpy V-Notch test results are commonly reported in units of foot-pounds (ft-lbs) rounded to the nearest whole number. Flattening tests are simply reported as pass or fail.

HARDNESS

A hardness survey must be performed on one pipe per heat. If the wall thickness is greater than 0.450”, the survey consists of three rows of measurements; near the OD, Mid-Wall, and ID. Each row consists of three indentations. For thinner wall pipe, the survey may be limited to one or two rows, as described in API 5CRA figure B.4. The average hardness at each location needs to be reported along with the individual readings. The maximum allowable hardness and variation are provided in the attached API 5CRA checklists. Hardness values are commonly reported in Rockwell C (HRC) rounded to the nearest whole number.

MICROSTRUCTURE

One microstructural evaluation is required to be performed on each heat. For all alloys, the microstructure needs to be free of continuous grain boundary precipitates. Inter-metallic phases, nitrides and carbides cannot exceed 1.0% in total and sigma phase cannot exceed 0.5%. For Group 2 alloys, ferrite content must be measured and reported per ASTM E562. Duplex alloys should have ferrite in the range of 40-60%, while super duplex alloys should have a ferrite content 35-55%.

ULTRASONIC TESTING (UT)

Each manufactured piece of material certified to API 5CRA must be ultrasonically inspected for the detection of longitudinal and transverse imperfections on the outside and inside surfaces to acceptance level L2 in accordance with ISO 9303 or ASTM E213 (longitudinal) and ISO 9305 or ASTM E213 (transverse), and laminar imperfections with an area greater than 260 mm^2 (0.4 in^2) when outlined on the surface by ultrasonic testing in accordance with ISO 10124. The Mill Test Report should report the notch depth, notch length, width and radial hole.

**API 5CRA Checklists for Group 2 and Groups 3 and 4 follow below.*