| | TIW CORPORATION | Section: | MS-302288 |
|---|---|---|---|
| | ENGINEERING SPECIFICATIONS<br>MATERIAL SPECIFICATION | Revision Date: | 06-26-13 |
| | | Revision: | 1 |
| | AISI 4140 - Tubing in the Heat Treated Condition<br>(80,000 min Yield- NACE) | Date: | 05-29-01 |
| | | Page: | 1 of 2 |
| Approved By: HEH | | Prepared By: | R. Arnold |

## SCOPE:

This specification shall be utilized in the procurement of 4140 quench and tempered to meet 80,000 min yield strength (22 max Rc) in compliance to NACE MR-01-75.

## MELTING PRACTICE:

Material shall be produced by the Electric Furnace or Basic Oxygen method, followed by Vacuum Degassing, Argon Stirring or ladle refining.

A fine grain melting practice shall be used, with an Austenitic grain size of 5 or finer, as determined in accordance with ASTM E-112.

## CHEMICAL LIMITATIONS:

(Performed in accordance with the practices established in ASTM A-751)

| | Min. | Max. |
|---|---|---|
| C | .38 | .43 |
| Mn | .75 | 1.00 |
| P | | .025 |
| S | | .025 |
| Si | .15 | .35 |
| Cu | | .35 |
| Ni | | .25 |
| Cr | .80 | 1.10 |
| Mo | .15 | .25 |

☞ **OTHER ELEMENTS MAY BE REPORTED BUT ARE NOT CONSIDERED FOR THIS SPECIFICATION.**

## HEAT TREATMENT:

All products shall be Austenitized, liquid quenched, and tempered to meet the mechanical properties of this specification. Minimum tempering temperature shall be 1150 F. Surface hardness shall be 235 max BHN, or 22 max Rc. In the case of dispute, rockwell shall be used for the final analysis.

Tubes are expected to be free of stress related to straightening. Hot straightening, or stress relieving may be utilized to meet this expectation. Stress relieving temperature shall be 50 F below the final temper.

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The mill certification shall show the actual times, temperatures, and quench media employed during this heat treatment cycle.

**TEST REQUIREMENTS:** In accordance with ASTM A-370 latest revision.

Test Frequency- Material shall be tested per heat, per size, and per heat treat load.

Tensile Location- At the mid-wall location on tubes.

**MECHANICAL PROPERTIES:**

| | Min. | Max. |
|---|---|---|
| **Yield at .2% offset (psi)** | 80,000 | 95,000 |
| **Tensile (psi)** | 95,000 | |
| **Elongation in 2.0" gage** | 18.0% | |
| **Reduction of Area** | 40.0% | |
| **Surface Hardness BHN** | 207 | 235 |

**TOLERANCES:**

Diameter and wall tolerances as established in ASTM A-519
Straightness shall be 1/8" in any 5 ft.

**CONDITION:**

Cold Rotary straightening or cold working in excess of 5% plastic deformation shall be followed by a stress relief treatment.

Raw material shall be free of any welding.

**CERTIFICATION REQUIREMENTS:**

Mill test report with the shipment.

A) Report The Melting practice used
B) Heat number and chemistry from the ladle analysis
C) Heat treatment Cycle-Times, Temperatures and Quench Media
D) Mechanical Properties-
(report yield at .2% offset and elongation in 2.0" gage)