

1. SCOPE: This process standard outlines the method for normalizing steel sheet/bar stock or steel parts/stock to refine and homogenize the grain structure. Tempering may be employed on certain grades to reduce hardness.
2. REFERENCES:
 - Q101, Ford Quality Standard (or successor document as defined in the applicable purchase order)
 - W-HTX-1, Ford Manufacturing Standard
 - W-HTX-12, Ford Manufacturing Standard
3. APPLICATION: This Standard applies to ferrous parts and materials which are heated in a furnace above the "upper critical" temperature and subsequently air cooled.
4. REQUIREMENTS:

- 4.1 PROCESS CONTROL: Suppliers utilizing this process standard must be able, by means of their existing process practices and records, to show evidence of control of the process as per Ford Quality System Standard Q-101. Appropriate statistical tools shall be used to analyze significant process parameters and product characteristics and appropriate reaction plans implemented in order to assure continuous reduction of variation in the final product. Users of this process are referred to Ford Manufacturing Standard W-HTX-1 (for parts with heat-treat characteristics denoted as Control Item () or for parts with Engineering prints denoted as "Must conform to Q-101, Appendix E" or "Must conform to Q-101, Appendix F") or to W-HTX-12 (for heat-treated parts not covered by W-HTX-1) in which control practices are outlined.

The process, equipment, heat treatment parameters, loading, charging sequence, and test procedure must form part of the component part control plan and take into account any Engineering requirements shown on the final part drawing which override specific items in this Standard.

- 4.2 PROCESS: Normalizing may be performed in a:
 - Continuous furnace with cooling zones that permit the steel to cool uniformly in still or slightly agitated air.
 - Other thermal processing unit approved by the affected Ford SQE or Quality/Engineering activity and documented in the control plan.

The equipment must be capable of heating parts uniformly up to and within the range of 840-925C (1550-1700F). If tempering equipment is to be utilized, it shall be capable of heating in the range of 150-745C(300-1375F).

- 4.3 **LOADING:** Parts/material shall be suitably loaded in such a manner to assure that all parts/material are able to be properly heated to the required temperature and time and can be uniformly air cooled.

Components/material must be thoroughly clean, dry and free of dirt, oil, soap residue, chips, etc. prior to introduction to the furnace.

With any continuous process, there shall be ADEQUATE SPACING between lots which require different normalizing times and/or temperatures to ensure that a given lot is processed as necessary to attain the specified metallurgical properties; e.g., in multi-zoned furnaces, it is recommended that the MINIMUM gap spacing be equivalent to one zone-length. It should be noted that a greater gap may be necessary.

Material from different steel mill heats, hot mill schedules, or melts which require different normalizing times and/or temperatures to ensure that a given lot is processed as necessary to attain the specified metallurgical properties SHALL NOT BE MIXED OR PROCESSED TOGETHER.

- 4.4 **FURNACE ENVIRONMENT:** An air atmosphere shall be employed in both the furnace and the cooling zones.
- 4.5 **TEMPERATURE:** The temperature shall be controlled within +/-5C (+/- 10F) of the set point, as evidenced by continuous recording pyrometers. Also, the mean isothermal temperature shall not differ by more than 15C (27F) from one part of the load and another as measured by use of thermocouples within the load. (Note: while the use of thermocouples within the load is recommended, it is not required in all production lots except for periodic verification of temperature consistency as documented in the control plan).
- 4.6 **CYCLE:** A normalize cycle involves heating the components/material to approximately 55C (100F) above the upper critical temperature (Ac3 for hypoeutectoid steels) (Acm for hypereutectoid steels) for sufficient time to assure complete austenitization of the microstructure. The components/material are then air cooled in such a fashion that cooling in any portion of the component/material is not restricted or accelerated relative to other sections.