

1. SCOPE: This process standard outlines the method for full annealing of steel sheet/bar stock or steel parts/stock to form pearlite in hypoeutectoid steels and pearlite and/or spheroidal carbides in eutectoid and hypereutectoid steels.
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 (the A_{e3} for hypoeutectoid steels and the A_{cm} for hypereutectoid steels) with a protective atmosphere (or in a vacuum). For certain parts/configurations of relatively thick cross-section and with end uses that may permit some surface decarburization or scaling, an air atmosphere may be permitted provided concurrence is received from the affected Ford SQE or Quality/Engineering Activity and documented in the control plan.

NOTE: Control of the microstructure of the product/material prior to anneal is recommended in order to improve the consistency of the product resulting from the full anneal cycle.

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: Full annealing may be performed in a:

- batch-type muffle or radiant tube furnace.
- batch-anneal furnace with inner cover (includes box, carbottom, bell, and pit furnaces)
- continuous furnace with cooling zones sufficient to achieve appropriate cooling rates to produce desired hardness and microstructure.
- 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 730-925C (1350-1700F). (A higher temperature capability may be necessary if a low carbon material is to be annealed).

4.3 LOADING: Parts 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 for the necessary time.

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

Material from different steel mill heats, hot mill schedules, or melts which require different annealing 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: Atmospheres suitable for full annealing include exothermic, dissociated ammonia, or nitrogen base with hydrogen (less than 5% H₂). The neutral furnace atmosphere utilized shall be appropriate for the grade of steel involved. For parts/stock with adequate cross-sections and end uses for which limited decarburization and scaling are permitted, an air furnace atmosphere is acceptable if approved by the affected Ford SQE or Quality/Engineering activity and documented in the control plan.

Vacuum-type furnaces may be employed in lieu of the aforementioned atmospheres.