

# GENERAL DYNAMICS

Electric Boat

SQ/09-07  
January 30, 2009

Dear Valued Supplier,

1. The purpose of this letter is to notify Electric Boat suppliers that discoloration (e.g., bluish tint) of heat treated titanium product is not acceptable and secondly, suppliers must comply with all purchase order requirements. If contractual requirements or specifications are unclear or otherwise difficult to follow, those requirements must be clarified prior to performance of the scope of work.

2. During performance of a welding operation at the shipyard, a question was raised concerning titanium tubing that exhibited a bluish discoloration on the surface. It was determined that the discoloration was a tightly adherent oxide film that apparently occurred during heat treating. MIL-H-81200, Heat Treatment of Titanium and Titanium Alloys, as modified by EB Specification 3690, were the designated heat treat specifications for heat treatment of this titanium tubing.

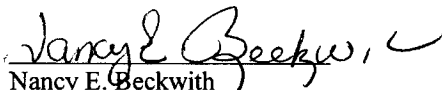
3. Investigation to determine the cause for the bluish discoloration of this titanium tubing revealed a number of problems and issues that required resolution:

- A partial anneal by the tube manufacturer and later completion of the annealing process by an independent heat treat supplier violated the specified total time duration at temperature.
- The modifying EB Specification 3690 required "...low temperature anneal in accordance with MIL-H-81200." Two revisions (A and B) of the MIL-H specification were in circulation each applicable for different purchase orders and each specifying a different low temperature for annealing resulting in confusion and misunderstanding.
- For product heated above 1000 degrees F (low temperature Revision B), MIL-H required metallographic examination to verify that the heat treated surface did not exhibit the effects of absorbed oxygen and nitrogen contamination (alpha case) that exceeded the level specified in the acquisition documents:
  - no contamination limits were specified in the acquisition documents (EB purchase orders or specifications)
  - heat treat suppliers incorrectly interpreted that product heat treated in an inert atmosphere did not require the metallographic examination
  - no evidence was available from the supplier that the metallographic examination was performed
  - no evidence was available from the supplier that maintenance-related contamination examination was performed to detect possible furnace leakage, as required in the MIL-H specification

4. As a result of the investigation, Electric Boat found it necessary to upgrade its titanium material specifications (EB3687, EB3688, EB3689, EB3690) and part number descriptions to better and more clearly define pertinent requirements for titanium product. Accordingly, the Electric Boat purchase order requirements are more descriptive and should minimize the need for interpretation during inspections and verifications. Supplier work instructions and deliverables must be updated to include the upgraded Electric Boat purchase order requirements.

5. Suppliers must remain mindful that any discoloration is not acceptable for titanium product. Additionally, suppliers must request clarification of any unclear purchase order requirements.

6. Please share this lesson learned letter with appropriate subtier suppliers and personnel within your organization. Should further discussion of this topic be required, contact Joseph Tycz of Electric Boat Supplier Quality at 860.433.5505 or e-mail [jtycz@gdeb.com](mailto:jtycz@gdeb.com)



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