HOTSEAT

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Heat treating has come a long way, but the heat treater, component manufacturer, and furnace supplier must still choose the most cost effective and application-appropriate process.

LOOK AROUND YOU SOMETIME. Whether you're in a car driving to work or shopping in a mall, metal is everywhere. Dental tools are made from martensitic stainless steel, hardened, quenched, and tempered, as are the latches that hold bombs on carrier-based aircraft. Legs of chairs are extruded and annealed, and automobiles have thousands of pounds of steel, of course. About the only time you'll hear a news reference regarding metal, however, is when a failure occurs, like an airplane crash. The broadcast may tell you that sections will be sent to a lab for metallurgical analysis to help determine the cause.

Keeping that reference, the production of metal for an airplane involves detective work including refining the metal, forming the shape, heat treating, final machining, assembly, and lubrication. Everywhere at each step of the production process records must be kept to verify conformation to specifications.

Commercial heat treaters are especially aware of the documentation required for every batch of material heat treated because they process countless loads of differing processes such as carburizing, annealing, nitriding, etc. And for each load of any number of parts, records must be kept for many years. So when an automobile has a problem such as last year's Toyota acceleration problem, engineers and metallurgists may be called upon to render an opinion of possible contributing factors. Remember years back when a Boeing 737 had a rudder jamb in one direction and a steel ball screw was targeted as a potential source? Airframes see service for decades; the Boeing 737 for example has a lengthy history, in operation since 1968, expressed at [www.b737.org.uk/history.htm]:

- About 1,250 737s are in the air at any time;
- A 737 takes off somewhere in the world every 5 seconds;
- The 737 fleet has flown about 296 million hours in revenue service, travelling 75 billion nautical miles in 232 million flights, and;
- 737s have carried about 12 billion passengers.

Every one of the hundreds of thousands of heat-treated parts on all of the 737s ever manufactured has a documented process history held by the thousands of heat treaters all over the world. If an airplane crashes and a component is suspected as a contributing factor the search starts by tracing its entire manufacturing history, many times going back decades to one heat treater in one load of parts carburized in a particular furnace on a specific day. The process report must be provided whether on microfilm, paper strip-chart record, or electronic media to find what happened during the eight-hour heat treat process. Investigators will be looking for evidence of carburizing potential control problems, temperature survey results, or quenching issues. Maybe a power outage during a summer storm upset the process, affecting the strength of the component.

Remember the time at the airport when the load speaker blared "the flight is delayed due to a mechanical problem with the aircraft" while you waited at the boarding gate? This happened to me earlier in the year on a trip to Jamshedpur, India. I flew from Detroit to Amsterdam and waited to board the flight to Delhi, and then to Ranchi. The stomach-turning announcement came and, long story short, I ended up flying from Amsterdam to Dubai, and then to Delhi and on to Ranchi. I finally reached Jamshedpur by car in 103°F heat. Business travel is so enjoyable!

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There is a related point here. My trip to Jamshedpur was for troubleshooting a heat treat problem involving a very complex multi-chamber pusher furnace. This pusher is carburizing and free quenching pinions and press quenching ring gears destined for large commercial trucks at TATA Motors. Although atmosphere furnace construction has changed little over the years—they're still made from brick, mortar, and steel—computerized process control has moved process data documentation into the 21st century. Now furnace process trending is electronic, so no more writing on paper charts. Alarms, temperature, carbon control, and gas flow, among other trends, are archived on to dual hard drives for live backup if one fails.

Heat treating has come a long way, but the heat treater, component manufacturer, and furnace supplier must still choose the most cost effective and most application-appropriate process to ensure everyone's well-being.

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