Special Process: Heat Treat System Assessment - American Metal Processing Company

Facility Name:	**American Metal Processing Company**
Address:	**22720 Nagel Street**
	Warren, Michigan 48089
Phone Number:	**586-757-7337**
Fax Number:	**586-757-8232**
Number of Heat Treat Employees at this Facility:	**10**
Captive Heat Treater (Y/N):	**No**
Commercial Heat Treater (Y/N):	**Yes**
Date of Assessment:	**April 11, 2011**
Date of Previous Assessment:	**April 5, 2010**

Type(s) of Thermal Processing at this Facility:

Process Table A - Ferrous	
Carburizing	**Yes**
Carbonitriding	**Yes**
Carbon Correction	**No**
Neutral Hardening	**Yes**
Quench & Temper	**Yes**
Austempering / Martempering	**No**
Tempering	**Yes**
Precipitation Hardening / Aging	**No**

Process Table B - Ferrous	
Nitriding (Gas)	**No**
Ferritic-Nitrocarburizing (Gas or Salt)	**No**

Process Table C - Aluminum	
Aluminum Heat Treatment	**No**

Process Table D - Ferrous	
Induction Heat Treating	**No**

Process Table E	
Annealing	**No**
Normalizing	**No**
Stress-Relieving	**No**

Current Quality Certification(s):	**ISO/TS 16949:2009, IATF Certificate Number 0116963, Certificate Number 62941-TS4** **ISO 9001:2008, Certificate Number 62941-IS4**
Date of Re-assessment (if necessary):	

Personnel Contacted:

Name:	**Title:**	**Phone:**	**Email:**
Zenon Hotra	Director of Quality, Mgmt Rep	586-757-7337, x-109	**zhotra@gmail.com**

Auditors/Assessors: All trained as ISO/TS 16949 Auditors

Names:	**Company:**	**Phone:**	**Email:**
Jason Fettig	**AMP President**	**586-757-7337, x-101**	**jlfettig@gmail.com**
Zenon Hotra	**AMP Director of Quality**	**586-757-7337, x-109**	**zhotra@gmail.com**
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George Baloi	**AMP Metallurgist**	**586-757-7337, x-110**	

Number of "Not Satisfactory" Findings: 0

Number of "Needs Immediate Action" Findings: 0

Number of "Fail" Findings in the Job Audits: 0

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Question Number	Question	Requirements and Guidance	Objective Evidence	Assessment			
				N/A	Satisfactory	Not Satisfactory	Needs Immediate Action
Section 1 - Management Responsibility & Quality Planning							
1.1	Is there a dedicated and qualified heat treat person on-site?	To ensure readily available expertise, there shall be a dedicated and qualified heat treat person on site. This individual shall be a full-time employee and the position shall be reflected in the organization chart. A job description shall exist identifying the qualifications for the position including metallurgical and heat treat knowledge. The qualifications shall include a minimum of 5 years experience in heat treat operations or a combination of a minimum of 5 years of formal metallurgical education and heat treat experience.	Organizational Chart and Job Descriptions are part of the Quality Management System (QMS), and are available for viewing on AMP's Intranet. AMP has experienced operators and lab technicians, with a minimum of 5 years experience in heat treat operations, on each shift.		X		
1.2	Does the heat treater perform advanced quality planning?	The organization shall incorporate a documented advance quality planning procedure. A feasibility study shall be performed and internally approved for each part. Similar parts can be grouped into part families for this effort as defined by the organization. After the part approval process is approved by the customer, no process changes are allowed unless approved by the customer. The heat treater shall contact the customer when clarification of process changes is required. This clarification of process changes shall be documented.	APQP Planning and Team Feasibility Studies are done by a cross-functional team. PPAPs are done when specifically requested by customer and are also done when AMP determines that they are needed. Process changes are electronically documented (recorded) in computer part file change logs.		X		
1.3	Are heat treat FMEAs up to date and reflecting current processing?	The organization shall incorporate the use of a documented Failure Mode and Effects Analysis (FMEA) procedure and ensure the FMEAs are updated to reflect current part quality status. The FMEA shall be written for each part or part family or they may be process-specific and written for each process. In any case, they shall address all process steps from part receipt to part shipment and all key heat treat process parameters as defined by the organization. A cross-functional team shall be used in the development of the FMEA. All special characteristics, as defined by the organization and its customers, shall be identified, defined, and addressed in the FMEA.	Process Failure Mode and Effects Analyses (PFMEAs) are process-specific (Carburizing, CarboNitriding, and Neutral Hardening). PFMEAs address each process step and heat treat process parameters. A cross-functional team, which includes at least one production employee, is used in the development of the PFMEAs, which are maintained and controlled by the Quality Department. All special characteristics, as defined by AMP and its customers, are identified, defined, and addressed in the PFMEA and in the specific part recipes.		X		
1.4	Are heat treat process control plans up to date and reflecting current processing?	The organization shall incorporate the use of a documented Control Plan procedure and ensure the Control Plans are updated to reflect current controls. The Control Plans shall be written for each part or part family or they may be process-specific and written for each process. In any case, they shall address all process steps from part receipt to part shipment and identify all equipment used and all key heat treat process parameters as defined by the organization. A cross-functional team, including a production operator, shall be used in the development of Control Plans, which shall be consistent with all associated documentation such as work instructions, shop travelers, and FMEA's. All special characteristics, as defined by the organization and its customers, shall be identified, defined, and addressed in the Control Plans. Sample sizes and frequencies for evaluation of process and product characteristics shall also be addressed consistent with the minimum requirements listed in the Process Tables, Sections 3.0 and 4.0.	Control Plans are process-specific (Carburizing, CarboNitriding, and Neutral Hardening Control Plans are available). Control Plans address each process step and key heat treat process parameters as defined by AMP. A cross-functional team, which includes at least one production employee, is used in the development of the Control Plans, which are consistent with all associated documentation, such as work instructions, shop travelers, and PFMEAs (which are also process-specific). All special characteristics, as defined by AMP and its customers, are identified, defined, and addressed in the Control Plans and part-specific recipes. Sample sizes and frequencies for evaluation of process and product characteristics are addressed and are consistent with the minimum requirements listed in the Process Tables, Sections 3.0 and 4.0. The Control Plans are maintained and controlled by the Quality Department.		X		

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1.5	Are all heat treat related and referenced specifications current and available? For example: SAE, AIAG, ASTM, General Motors, Ford, and DaimlerChrysler.	To ensure all customer requirements are both understood and satisfied, the organization shall have all related heat treat and customer referenced standards and specifications available for use and a method to ensure that they are current. Such standards and specifications include, but are not limited to, those relevant documents published by SAE, AIAG, ASTM, General Motors, Ford, and DaimlerChrysler. The organization shall have a process to ensure the timely review, distribution, and implementation of all customer and industry engineering standards / specifications and changes based on customer-required schedule. Timely review should be as soon as possible and shall not exceed two working weeks. The organization shall document this process of review and implementation, and it shall address how customer and industry documents are obtained, how they are maintained within the organization, how the current status is established, and how the relevant information is cascaded to the shop floor within the two-week period. The organization shall identify who is responsible for performing these tasks.	All related heat treat and customer referenced standards and specifications are available for use via AMP's own Intranet. These standards and specifications are requested from the customers at the time of quotation of the parts, are scanned into the electronic database within one week, and are available for viewing on the AMP Intranet. Updates to referenced standards and specifications are usually obtained from customers, reviewed at AMP Staff and/or Quality Meetings for possible impact on processes and implementation timetables, and then scanned into the electronic database within one week of receipt, for viewing availability on the AMP Intranet.		X		
1.6	Is there a written process specification for all active processes?	The heat treater shall have written process specifications for all active processes and identify all steps of the process, including relevant operating parameters. Examples of operating parameters include process temperatures, cycle times, load rates, atmosphere or gas flow settings, belt speeds, quench agitation speeds, etc. Such parameters shall not only be defined, they shall have operating tolerances as defined by the organization in order to maintain process control. All active processes should have a written process specification. These process specifications may take the form of work instructions, job card, computer-based recipes, or other similar documents.	Computer-based recipes for each part number include all process parameters, including process steps, tolerances, specifications, cycle times, gas flows, and process temperatures.		X		
1.7	Has a valid product capability study been performed initially and after process equipment has been relocated, or had a major rebuild?	To demonstrate that each process is capable of yielding acceptable product, the organization shall perform product capability studies for the initial validation of each process, after relocation of any process equipment, & after a major rebuild of any equipment. The organization shall define what constitutes a major rebuild. Initial product capability studies shall be conducted for all heat treat processes per furnace line defined in scope of work & in accordance with customer reqts. A furnace line may include a combination of equipment that is integrated in the performance of a heat treatment process, e.g., hardening, quenching, and tempering. Capability study techniques shall be appropriate for the heat treat product characteristics, e.g., tensile strength, case depth, hardness. Any specific customer requirements shall be met; in the absence of customer requirements, the organization shall establish acceptable ranges for measures of capability. An action plan shall exist to address the steps to be followed in case capability indices fall outside customer requirements or established ranges.	Capability Studies for Surface Hardness are automatically generated for each and every Work Order processed and can be readily accessed for each Work Order. These Capability Studies are available for Work Orders going back to July of 2001.		X		

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1.8	Does the heat treater collect and analyze data over time, and react to this data?	The analysis of products and processes over time can yield vital information for defect prevention efforts. The organization shall have a system to collect, analyze, and react to product or process data over time. Methods of analysis shall include ongoing trend or historical data analysis of product or process parameters. The organization shall determine which parameters to include in such analysis.	Historical Surface Hardness data for each part (last 5 Work Orders processed) is displayed on each work order, including steel chemistry information (assumed or as supplied), surface hardness (Min & Max) out of quench, tempering temperature, and surface hardness (Min & Max) out of temper. Surface Hardness and Tempering Temperature historical data helps our associates to determine the best tempering temperature for current work order.		X		
1.9	Is management reviewing the heat treat monitoring system every 24 hours?	Management shall review the furnace monitoring systems at intervals not to exceed 24 hours. The heat treat monitoring system includes but is not limited to temperature strip charts, atmosphere strip charts, computer data logs, furnace and operator logs, etc. The management review shall include efforts to detect out-of-control conditions or alarm conditions. The process of reviewing the furnace data shall be documented and this requirement also applies to computerized data.	AMP has installed and implemented a real-time heat treat monitoring system on all hardener furnaces, temper furnaces, and generators. This is currently available for viewing at a dedicated computer & monitor in the Laboratory. Each of the selected process parameters (zone temperatures, etc) are viewable, in real time, at any computer monitor tied into the specific monitoring network at AMP.		X		
1.10	Are internal assessments being completed on an annual basis, at a minimum, using AIAG HTSA?	The organization shall conduct internal assessments on an annual basis, at a minimum, using the AIAG HTSA.	Internal heat-treat surveys (have been and) are performed annually, at a minimum, using the AIAG HTSA.		X		
1.11	Is there a system in place to authorize reprocessing and is it documented?	The quality management system shall include a documented process for reprocessing that shall include authorization from a designated individual. The reprocessing procedure shall describe product characteristics for which reprocessing is allowed, as well as those characteristics for which reprocessing is not permissible. Any reprocessing activity shall require a new processing control sheet issued by qualified technical personnel denoting the necessary heat treat modifications. Records shall clearly indicate when and how any material has been reprocessed. The Quality Manager or a designee shall authorize the release of reprocessed product.	Quality Procedure for Rework/ReProcessing is documented and in place, including special Yellow ReWork Form, issued, filled out, and signed by designated qualified technical personnel. Complete record documentation is kept of each ReWork and the ReWork Information is tracked and used as a Metric by AMP, to confirm the continuous reduction in number of ReWorks and the reduction in the percentage of ReWorks against the total work orders processed.		X		
1.12	Does the Quality Department review, address, and document customer and internal concerns?	The quality management system shall include a process for documenting, reviewing, and addressing customer concerns and any other concerns internal to the organization. A disciplined problem-solving approach shall be used.	Internal and Customer concerns are reviewed and addressed in documented Staff and Quality Meetings, using disciplined problem-solving. The documented concerns are tracked in the Quality Meeting Minutes until the concerns are resolved and closed. Depending on the nature of the concern, the concerns may be written up on a DMR (Defective Material Report) form, which uses an 8-D format, for additional visibility.		X		
1.13	Is there a continual improvement plan applicable to each process defined in the scope of the assessment?	The heat treater shall define a process for continual improvement for each heat treat process identified in the scope of the HTSA. The process shall be designed to bring about continual improvement in quality and productivity. Identified actions shall be prioritized and shall include timing (estimated completion dates). The organization shall show evidence of program effectiveness.	Continual improvement plans focus on the highest occurring problems, with monthly & quarterly reporting on the various metrics, including trend lines to gauge the effectiveness of the problem resolutions.		X		

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1.14	Does the Quality Manager or designee authorize the disposition of material from quarantine status?	The Quality Manager is responsible for authorizing and documenting appropriate personnel to disposition quarantine material.	The Quality Manager is responsible for implementing the Quality Procedure for disposition of Quarantined Material, as addressed in the Quality Manual		X		
1.15	Are there procedures or work instructions available to the heat treat personnel that define the heat treating process?	There shall be procedures or work instructions available to heat treat personnel covering the heat treating process. These procedures or work instructions shall include methods of addressing potential emergencies (such as power failure), equipment start-up, equipment shut-down, product segregation (See 2.8), product inspection, and general operating procedures. These procedures or work instructions shall be accessible to shop floor personnel.	Operational Procedures and Forms are available for viewing or printing from any computer with access to the P-drive on the AMP Intranet.		X		
1.16	Is management providing employee training for heat treating?	The organization shall provide employee training for all heat treating operations. All employees, including backup and temporary employees, shall be trained. Documented evidence shall be maintained showing the employees trained and the evidence shall include an assessment of the effectiveness of the training. Management shall define the qualification requirements for each function, and ongoing or follow-up training shall also be addressed.	On-The-Job Material Handler and Heat-Treater training and qualification program is utilized. Training Matrix lists all personnel qualifications and training that was successfully completed, as well as any training still in process.		X		
1.17	Is there a responsibility matrix to ensure that all key management and supervisory functions are performed by qualified personnel?	The organization shall maintain a responsibility matrix identifying all key management and supervisory functions and the qualified personnel who may perform such functions. It shall identify both primary and secondary (backup) personnel for the key functions (as defined by the organization). This matrix shall be readily available to management at all times.	A Responsibility Matrix is part of the Quality Management System and is available for viewing and review on the AMP Intranet.		X		
1.18	Is there a preventive maintenance program? Is maintenance data being utilized to form a predictive maintenance program?	The organization shall have a documented preventive maintenance program for key process equipment (as identified by the organization). The program shall be a closed-loop process that tracks maintenance efforts from request to completion to assessment of effectiveness. Equipment operators shall have the opportunity to report problems, and problems shall also be handled in a closed-loop manner. Company data, e.g., downtime, quality rejects, first-time-through capability, recurring maintenance work orders, and operator-reported problems, shall be used to improve the preventive maintenance program. Furnaces and generators shall be scheduled for burn-out at frequencies determined by the organization (see Section 1 of the Process Tables). Maintenance data shall be collected and analyzed as part of a predictive maintenance program.	A documented Maintenance Program (including a document titled "Furnace Maintenance Instructions") is in place for key process equipment. Every employee has the opportunity to file an Incident Report, which is reviewed, analyzed, and documented in Quality & Staff Meetings. These Incident Reports are used to improve Maintenance Programs, training, process parameters, and APQP. Furnaces and generators are scheduled for burn-out at frequencies determined by the organization (see Section 1 of the Process Tables). Maintenance data is collected and analyzed as part of a predictive maintenance program.		X		
1.19	Has the Heat Treater developed a critical spare part list and are the parts available to minimize production disruptions?	The heat treater shall develop and maintain a critical spare parts list and shall ensure the availability of such parts to minimize production disruptions.	Computer list of critical spare parts has been developed and is maintained by the Operations Department.		X		

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Section 2 - Floor and Material Handling Responsibility							
2.1	Does the facility ensure that the data entered in the receiving system matches the information on the customer's shipping documents?	It is critical that all customer requirements and lot identification be adequately transferred to internal heat treat documents. The facility shall ensure that the data entered in the receiving system match the information on the customer's shipping documents. Documented processes and evidence of compliance shall exist, e.g., shop travelers, work orders, etc. Sometimes the material received does not precisely correspond to customer shipping documents. The facility shall have a detailed process in place to resolve receiving discrepancies. The requirements stated above also apply to captive heat treat departments. This process refers to receiving and shipping the parts in and out of the heat treat department.	All steel chemistry, heat, and lot information, if supplied by the customer, is entered into computer order entry system (WORP) for each work order. Material grades and heat treating instructions are compared against information in computer part file in database. Discrepancies are passed to Quality and Operations for review and resolution, before the work order is created and/or processed.		X		
2.2	Is product clearly identified and staged throughout the heat treat process?	Procedures for part and container identification help to avoid incorrect processing or mixing of lots. Appropriate location and staging within the facility also help to ensure that orders are not shipped until all required operations are performed. Customer product shall be clearly identified and staged throughout the heat treat process. Non-heat treated, in-process, and finished product shall be properly segregated and identified. All material shall be staged in a dedicated and clearly defined area.	Staging locations within the plant are clearly identified with large signs. Each customer container has an AMP router tag attached to it, identifying the heat-treating process, tub ID, Net Weight, Date order was created, Work Order number, photo of part, customer name, part number, lot number, and number of containers in order.		X		
2.3	Is lot traceability and integrity maintained throughout all processes?	Out-going lot(s) shall be traceable to the incoming lot(s). The discipline of precisely identifying lots and linking all pertinent information to them enhances the ability to do root cause analysis and continual improvement.	Lot identification is linked to the AMP Work Order number, which is unique for each order. All information is stored in AMP's WORP computer system.		X		
2.4	Are procedures adequate to prevent movement of non-conforming product into the production system?	The control of suspect or non-conforming product is necessary to prevent inadvertent shipment or contamination of other lots. Procedures shall be adequate to prevent movement of non-conforming product into the production system. Procedures shall exist addressing proper disposition, product identification, and tracking of material flow in and out of the hold area. A non-conforming hold area shall be clearly designated to maintain segregation of such material.	Suspect or Non-conforming product is quarantined with a red "Hold" tag. Non-Conforming Product Procedure is used for disposition of quarantined parts. Computer system will not print a Certification or a Shipper unless all process steps have been signed off.		X		
2.5	Is there a system to identify trap points in the entire heat treat process to reduce risk of mixed parts (inappropriate, non-heat treated, or improperly heat treated parts)?	Heat-treating furnaces and other processing equipment contain areas that have a risk of trapping or holding parts. Such trapping of parts can lead to damage, improperly processed parts or lot mixing/contamination. A system shall exist to identify trap points in the entire heat treat process to reduce risk of mixed parts (inappropriate, non-heat treated, or improperly heat treated parts). The heat treater shall have documented procedures to identify and monitor trap points for each process/equipment. Monitoring of potential trap points shall occur for every part changeover.	Alternating the processing of larger parts and smaller parts helps to minimize mixing and makes sorting easier if mixing does occur. Large gap times between orders reduce the risk of mixed parts. Chasers are placed at the end of orders to "bump" or "force" material out of the furnace and these chasers also serve to signify the end of the current order of material in the furnace. Trap points in the heat treat process have been identified and action plans were developed and implemented to monitor and minimize the potential impact of those trap points on product being processed.		X		

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2.6	Are containers free of inappropriate material?	Containers handling customer product shall be free of inappropriate material. After emptying and before re-using containers, containers shall be inspected to ensure that all parts and inappropriate material have been removed. The source of inappropriate material shall be identified and addressed. This is to ensure that no nonconforming heat treated parts or inappropriate material contaminate the finished lot.	Customer containers are rotated in several axes and flipped over to loosen and remove possible trapped parts. Each container is also visually inspected for foreign and trapped material. AMP's in-house proceessing containers (Roura hoppers) are free of seams that could trap inappropriate material. The relevant AMP documents are titled "Customer Containers" and "Dropped Parts Policy".		X		
2.7	Is furnace loading specified, documented, and controlled?	Furnace loading parameters shall be specified, documented, and controlled. Examples include feed rate, belt speed, number of parts per fixture, and load weight. Refer to Process Tables, Section 3.0, for frequency of checks.	Loading parameters are specified in the electronic recipes, controlled by electronic feeders, and printed out on the hard copies of the work orders.		X		
2.8	Are operators trained in material handling, containment action, and product segregation in the event of an equipment emergency including power failure?	Unplanned or emergency downtime greatly raises the risk of improper processing. Operators shall be trained in material handling, containment action, and product segregation in the event of an equipment emergency, including power failure. Training shall be documented. Work instructions specifically addressing potential types of equipment emergencies and failures shall be accessible to, and understood by, equipment operators. These instructions shall address containment actions related to all elements of the heat-treating process, e.g., loading, austenitizing, quenching, tempering.	Work Instructions for emergency procedures are documented and available to each operator on the shop floor and in the computer database; The relevant document is titled "Contingency Plans". Training is documented in the Training Matrix.		X		
2.9	Is the handling, storage and packaging adequate to preserve product quality?	Handling, storage, and packaging shall be adequate to preserve product quality. The heat treater's furnace loading system, in-process handling, and shipping process shall be assessed for risk of part damage or other quality concerns. Some equipment includes conveyors and other moving components that may not be able to handle all part configurations. Other practices such as stacking of overloaded containers can also increase the risk of part damage.	Equipment and material handling procedures are adequate to preserve product quality.		X		
2.10	Are plant cleanliness, housekeeping, environmental and working conditions conducive to control and improved quality?	Plant cleanliness, housekeeping, environmental conditions, and working conditions shall be conducive to controlling and improving quality. The heat treater should evaluate such conditions and their effect on quality. A housekeeping policy shall be clearly defined and executed. The facility shall be reviewed for conditions that are detrimental to quality processing such as loose parts on floor, oil around quench tanks, inadequate plant lighting, smoke, etc.	Plant cleanliness and housekeeping is the responsibility of each and every employee and, ultimately, each Shift Supervisor. The environmental and working conditions are evaluated regularly to ensure that they are conducive to maintaining employee health and welfare, as well as conducive to control of product and improving quality of product. A 7S Housekeeping Worksheet & Guideline (part of our Business Operating System) is available for double-checking conformance to expected plant conditions.		X		
2.11	Are parts free from contaminants that would be detrimental to the heat treatment of the product?	Many heat-treated parts are subjected to surface finish or appearance operations such as plating or coating after heat treatment. Parts shall be free from contaminants that are detrimental to subsequent processes or the product. Pre-wash (if applicable) and post-wash parameters shall be monitored and documented. Oils and other contaminants or residues can be difficult to remove once subjected to the heat treatment process. Review the chemical supplier's recommendation for cleaning the system. Parts shall be free of rust, burrs, chips, detrimental amounts of drawing compound, cutting fluids, rust preventing oils, lubricants, etc., prior to heat treat. Note: Refer to the appropriate heat treater's requirements and specifications to determine acceptability. Refer to Process Table, Section 5.0, for frequency of checking washer solutions.	Virtually all parts are pre-cleaned prior to heat treatment, since AMP installed pre-wash equipment, inline with the Hardening Furnaces, several years ago. All parts are washed between quench and temper.		X		

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2.12	Is the quenching system monitored, documented, and controlled?	The quenching system shall be monitored, documented, and controlled. The temperature, agitation, level, concentration (if applicable), time in the quenchant, and additions shall be controlled to the heat treater's specifications. Refer to Process Tables, Sections 3.0 and 5.0, for frequency of checks. Computer-monitoring equipment, with alarms and alarm logs, satisfy the verification requirement. Quench delay tolerance and alarm is required for furnaces with integral quench tanks. Temper delay time shall be specified by the heat treater for parts that are quenched and tempered, e.g., carburizing, carbonitriding, neutral hardening, solution treating and aging.	Quench temperatures are monitored, controlled, and checked daily by each shift supervisor, as are quench levels and agitation. Oil is checked for quenchability quarterly for our rotary furnaces, since oil levels are continuously being replenished because of dragout. Furnace logs are used to record the daily monitoring & checking activities that are not actively monitored by our Process Control and Monitoring System.		X		
2.13	Is soluble oil or other rust preventive monitored and controlled if applicable?	Parts are often dipped in or sprayed with rust preventive solutions immediately after the heat treating process. Soluble oil solutions or other rust preventive solutions shall be monitored and controlled, if applicable. The heat treater shall have and maintain documented tolerances for the solutions. Refer to Process Tables, Section 5.0, for frequency of checks.	AMP has infrequent requirements for off-line rust Inhibitors/rust preventive solutions. When required, solutions are made up and the concentrations are checked weekly, per tolerances listed in MSDS sheets.		X		
2.14	Are process control parameters monitored per frequencies specified in Process Tables?	Process control parameters shall be monitored per frequencies specified in Process Tables. Refer to Process Tables, Section 3.0. Computer monitoring equipment with alarms and alarm logs satisfy the verification requirement. A designated floor person shall verify the process parameters, e.g., by initialing a strip chart or data log. Management review is required per Question 1.9.	Process control parameters are monitored in real time on several computers in the plant, as well as the Data Acquisition System. Individual furnace process parameters / steps are signed off on each work order by operators. Final inspection and signoff of all parameters for each work order is done by the Shift Supervisor or Designee. Furnace logs are also used to record additional parameters not recorded on the Data Acquisition System.		X		
2.15	Are In-Process / Final Test Frequencies performed as specified in Process Tables?	In-Process / Final Test Frequencies shall be performed as specified in Process Tables. Refer to Process Tables, Section 4.0.	Testing frequencies meet or exceed specifications. See individual work order instructions and Work Orders for actual Test Frequencies for each order.		X		
2.16	Is product test equipment verified?	Product test equipment shall be verified. Test equipment shall be verified/calibrated per applicable customer-specific standard or per an applicable consensus standard such as those published by ASTM, DIN, EN, ISO, JIS, NIST, SAE etc. Verification/calibration results shall be internally reviewed, approved, and documented. Refer to Process Tables, Section 1.0, for frequency of checks.	All hardness testers are calibrated at least semi-annually and are also verified at the beginning of each shift with certified test blocks, with the results reviewed, approved, and documented.		X		

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Section 3 - Equipment							
3.1	Do furnaces, generators, and quench systems have proper process control equipment?	The heat-treat furnaces, generators, and quench systems shall have proper process controls and related equipment. Examples include temperature, carbon potential/dew point, gas flows, quench monitoring system including agitation, temperature control, and quenching oil analysis, etc. as listed in the applicable Process Tables, Section 1.0.	All furnace lines, generators, and quench systems have proper Process Controls and are Monitored continuously via our Electronic Monitoring System.		X		
3.2	Are process equipment calibrations and/or verification certified, posted, and current?	The calibration and certification of the process equipment shall be checked at regular specified intervals. Refer to the applicable Process Tables, Sections 1.0 and 2.0, for equipment calibration or certification time tables.	Furnace instrument calibrations are performed monthly by an outside service. A calibrated portable 3-Gas Analyzer is available for verification testing by trained personnel.		X		
3.3	Are thermocouples & protection tubes checked or replaced per Process Tables?	The thermocouples and protection tubes shall be checked or replaced in compliance to a preventive maintenance schedule. Refer to the applicable Process Tables, Section 2.0.	Thermocouples are checked quarterly by an outside service, based on a maintenance schedule.		X		
3.4	Are temperature uniformity surveys performed per requirements in Process Tables?	Temperature uniformity surveys shall be conducted per the requirements in the applicable Process Tables, Section 2.0. The frequency reductions allowed in AMS 2750D are not allowed under this document. Certain furnace designs, e.g., rotary retorts, preclude direct temperature profiles. Alternate test methods per AMS 2750D 3.5.15 are acceptable for furnaces where temperature uniformity studies are not possible.	AMP's Rotary Furnaces: In lieu of temperature uniformity surveys or direct temperature profiles, Indirect Product studies are conducted to evaluate and correlate the CPK of the Surface Hardness versus the CPK of the Core Hardness, for additional information about the correlation of data and the effectiveness of the process.		X		
3.5	Is the variation of the furnace controlled thermocouple from set point within the requirements in the Process Table?	The variation between the furnace-control thermocouple and the set point temperature shall be within the limits defined in the applicable Process Tables, Section 2.0. This does not apply to the first zone of a multi-zone continuous furnace.	All control thermocouples in continuous furnaces are within specified tolerances, as is being verified by daily logging.		X		
3.6	Are the process & equipment alarm checks being tested quarterly or after any repair or rebuild?	The heat treater shall have a list of heat treat process and equipment alarms. These alarms shall be independently tested quarterly at a minimum, and after any repair or rebuild. These checks shall be documented.	System alarms are checked quarterly and documented in the Preventive Maintenance Book.		X		

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Question Number	Question	Requirements and Guidance	Objective Evidence	Assessment			
				N/A	Satisfactory	Not Satisfactory	Needs Immediate Action
3.7	Are generators and furnace atmospheres continuously monitored, automatically controlled, and documented?	Generator and furnace atmosphere carbon potential/dew point shall be continuously monitored, automatically controlled, and documented. This requirement is specific to Process Table 1, Sections 1.0 and 3.0, for carburizing, carbonitriding, and neutral hardening. Continuous monitoring and automatic control of the carbon potential/dew point is required for all generators and atmosphere furnaces except rotary retort and shaker furnaces that preclude in situ control and monitoring. For rotary retort and shaker furnaces, the method described in AMS 2750D 3.5.15..2 "Property Surveys" shall be used to ensure adequate control of the furnace atmosphere. If generators are not used, the flow rates of the supplied atmosphere gases shall be monitored and controlled. The assessor shall verify the effectiveness of the atmosphere control system per customer requirements, the heat treater's control plan, and internal procedures. . The atmosphere control system shall maintain the atmosphere dew point/carbon potential set point within the parameters specified in the control plan or internal procedures. The heat treater shall have a back-up method of checking the carbon potential/dew point. Examples are dew point, electrical wire resistance, gas analysis, shim stock, carbon bar, etc. The automatic and continuous atmosphere control system shall consist of sensors such as oxygen probes or on-line Infrared (IR) gas analysis. See Process Table A, Sect. 3.0 for verification frequencies.	Rotary Furnaces: Generators and furnace atmospheres are monitored via dew points and gas flow rates, which are recorded at the start of each and every work order. A portable 3-Gas Analyzer is available for verifying the dew point, while furnace-mounted carbon probes provide real-time, continuous monitoring of the atmosphere in the furnace shell to the Data Acquisition System.		X		
3.8	When the back-up verification check of the atmosphere does not agree or correlate within pre-established limits with the primary control method (carbon potential/dew point reading), is correlation of the carbon-bearing atmosphere to the primary control method re-established?	This issue is specific to Process Table 1, carburizing, carbonitriding, and neutral hardening. When the back-up verification check of the atmosphere does not agree or correlate within pre-established limits with the primary control method (carbon potential/dew point reading), the heat treater shall resolve the out-of-limit discrepancy. The back-up atmosphere monitoring system reading and the automatically controlled atmosphere dew point/carbon potential reading shall be maintained within the correlation limits specified in the control plan or internal procedures. These range tolerances vary with the specific heat treat process and the equipment used. The heat treater shall make appropriate technical adjustments and corrections and then re-establish/demonstrate the correlation of the actual atmosphere carbon potential/dew point reading to the primary control and back-up atmosphere reading. The range tolerances for correlation between the two readings shall be in the control plan or internal procedures. The back-up carbon potential/dew point reading shall be established using one or more of the following methods: • Carbon bar or slug • Shim stock • 3-gas analyzer • Dew point • Hot wire resistance	Shift Supervisors, Operations, and Lab Personnel resolve all atmosphere problems, using one or more of the primary control methods, including a portable 3-Gas Analyzer available for verification. Key associates are trained in the use of the 3-Gas Analyzer for use in checking atmosphere, allowing a backup/verification of the actual atmosphere dewpoint readings.		X		

Special Process: Heat Treat System Assessment - American Metal Processing Company

Question Number	Question	Requirements and Guidance	Objective Evidence	Assessment			
				N/A	Satisfactory	Not Satisfactory	Needs Immediate Action
3.9	Are all ammonia lines equipped with quick disconnects or a three valve fail safe vent system?	All ammonia lines to furnaces shall be equipped with quick disconnects or a three-valve fail-safe vent system. Normal valves may allow ammonia to leak through even when they are closed. This can be undesirable and detrimental in heat treat processes not specifying/requiring ammonia. • A quick disconnect shall be present in any ammonia line going to a furnace. This line shall be disconnected after carbonitriding (or any other process using ammonia) before another heat treating operation not specifying/using ammonia begins. • An alternative three-valve ammonia "fail-safe" vent system is permitted. See the definition “Three Valve Fail-Safe Vent” and diagram in the glossary. • Documentation shall show when ammonia lines are disconnected for non-ammonia bearing atmosphere processes.	All ammonia lines going to furnaces are equipped with quick disconnects.		X		
3.10	For fasteners and small metal parts, is a minimum of 3 hours allocated for an oxidizing burn-out prior to processing product not requiring ammonia?	This is applicable to fasteners and small metal parts. The heat treater shall perform a minimum 3 hours oxidizing burn-out prior to processing product not requiring ammonia as an addition. Ammonia pick-up can be undesirable in parts and heat treat processes not specifying/requiring ammonia as an addition. Log book, data logger, or other records shall document the actual oxidizing burn-out time and that sufficient time has been allocated to remove ammonia from the furnace prior to processing parts in heat treat processes not specifying ammonia.	A minimum 3-hour oxiding burn-out is performed prior to processing product not requiring ammonia as an addition. End times for previous process (and part processed) are recorded, as well as the start time for the next process (and the specific part processed). The Furnace Log Book also records the start and end times for the burn-out.		X		
3.11	Do all atmosphere furnaces and generators have flow scopes or flow meters for all gases?	All atmosphere furnaces and generators (output trim/adjustment gas) shall have flow scopes or flow meters for all gases. Flow scopes and meters shall be periodically serviced per the heat treater's preventive maintenance program. Cleaning and proper re-assembly procedures shall be documented.	All generators and furnaces have flow scopes for each gas line that is connected, including endothermic gas, natural gas, air, nitrogen, and ammonia.		X		
3.12	For threaded fasteners, are all continuous belt furnaces equipped with sight glass inspection ports and infrared pyrometers at discharge end of the hardening furnace?	Infrared temperature pyrometers are required at the exit end of continuous belt furnaces running threaded fasteners to monitor for under temperature parts. The temperature alarm shall be within 28C (50F) of the furnace set point temperature. Results shall be strip charted or continuously data logged. Infrared (IR) units shall be calibrated annually at a minimum and certified. All sight glasses shall be cleaned per the preventive maintenance schedule.		N/A			
3.13	Is salt chemistry in the austenitizing salt bath monitored?	Applicable to ferritic-nitrocarburizing, austempering, and neutral hardening in salt. The heat treater shall check the salt chemistry in the austenitizing salt bath, or part decarburization, daily. Refer to the applicable Process Tables, Section 3.0, for frequency of checks.		N/A			
3.14	Is the quenching medium analyzed?	The heat treater shall periodically have the quenching medium analyzed for specific quenching characteristics, e.g., cooling curve, water content, salt concentration, as specified in the applicable Process Tables, Section 5.0. • The quench media characteristic tolerances shall be specified by the quench medium supplier or the heat treater. • Analysis shall be reviewed for conformance by the heat treater. This review shall be documented.	The quenching media (oil) is analyzed quarterly, while the water quench media is analyzed every six months.		X		

Special Process: Heat Treat System Assessment - American Metal Processing Company

Question Number	Question	Requirements and Guidance	Objective Evidence	Assessment			
				N/A	Satisfactory	Not Satisfactory	Needs Immediate Action
FOR INDUCTION HEAT TREATING							
3.15	Is the positioning of each part being controlled?	A method to detect proper part position, such as the use of proximity switches, optical sensors, mechanical probes, etc., is required for each part.		**N/A**			
3.16	Does the heat treater control the energy or power for each part?	The heat treater shall control the energy or power for each part. • A signature monitor for each machine is preferred. A signature monitor gives the energy unit (voltage, kilowatt, etc.) vs. time or distance (for scanning systems). • An energy monitor or equivalent is acceptable if approved by the authorized customer representative.		**N/A**			
3.17	Does the supplier have a coil management system? Coil refers to the heating coil and the quench plenum.	The heat treater shall have a coil management system. Coil refers to the heating coil and the quench plenum. • Spare coils for each part shall be available on-site. • Coils shall conform to the approved original design. • Engineering change approval from the customer is required whenever the coil design is changed.		**N/A**			
3.18	Is quench system automatic?	The quench system shall be an automatic operation. No manual quenching is allowed unless specifically approved by the authorized customer representative. Quenching shall be automatically initiated and controlled.		**N/A**			
3.19	Does each lot of parts have first piece set-up?	The heat treater shall perform first piece set-up for each lot of parts		**N/A**			

Section 4 - Job Audit

Job Identity:

Customer: ***Technical Stamping***
Shop Order Number: ***AMP WO 38642***
Part Number: ***3F0034***
Part Description: ***Washer***
Material: ***1038/1040-type steel***
Heat Treat Requirements: ***Neutral Hardening***

Question #	Job Audit Question	Related HTSA Question #	Customer or Internal Requirement	Job (Shop) Order or Reference Documentation Requirement	Actual Condition (Objective Evidence)	Pass / Fail / N/A
4.1	Are contract review, advance quality planning, FMEA, control plans, etc., performed by qualified individuals?	1.2 1.3 1.4 1.17	Internal and Customer	RFQ and Team Feasibility for each part. Generic PFMEA for each process. Control Plans for each part are integrated into electronic recipes. These are created and maintained by qualified individuals.	RFQ, Team Feasibility, APQP, PFMEA performed by designated and qualified individuals - electronic signoff of Team Feasibility evident for family of parts.	Pass
4.2	Does the heat treat facility have the customer specifications for the part?	1.5	Internal and Customer	Material specifications and customer specifications and requirements are listed on customer drawings and transferred to the specific part recipe.	No Customer Drawing available, but Customer specifications (from Shippers) are viewable & listed on Work Order/recipe. Customer Shippers are scanned into Worp.	Pass
4.3	Is a shop traveler created to meet customer requirements?	1.6 2.1	Internal	Work Order created electronically, as well as a hard copy.	Work order in WORP and on hard copy, AMP router tag.	Pass
4.4	Is material identification (part numbers, lot numbers, heat numbers, contract numbers, etc.) maintained throughout the heat treat process?	2.2 2.3 2.4	Internal and Customer	Lot no., Heat no., Material chemistry if available are on AMP WO. A part photo and customer PN are on AMP WO and Router Tags, also on the magnetic tag.	Neutral Hardening process, PN 3F0034, Tub #s, photo, PO/Shipper #4736, Lot #0311-284, & Heat #6162 are listed on WO; PN, Lot #, Tub #, and photo are also on the router tag.	Pass
4.5	Is there documented evidence of Receiving Inspection?	2.1	Internal requirement to check part ID, tub ID, tub weight and quantity at Receiving	AMP Receiving Inspection Procedure requires visual inspection of parts and customer container as received. AMP Quality Dept is notified if an apparent problem exists with parts or container, for disposition by the Quality Dept, but parts are placed on hold pending disposition.	Parts weighed in & part #, weight, container #, & general condition are recorded & compared to Customer paperwork before creation of work order.	Pass
4.6	Are the Loading / Racking requirements identified?	1.6 2.7 2.9	Internal	Work Order / Recipe defines/suggests a (maximum) Feedrate of up to 1000 lbs/hr.	Feedrate was lowered to 900#/hr, set on computerized feeder program; actual loading & timing documented on WO.	Pass
4.7	Is the proper recipe or process specification (cycle times, temperature, atmosphere, etc.) used? Refer to Process Tables, Section 3.0, for specific parameters. List parameters that were verified in this audit in the spaces provided below.	1.5 1.6 2.1 2.14 2.15	Internal	Proper recipe is integrated when part number is entered into electronic (Worp) work order creation software during creation of shop work order. Recipe does not have provision for adding additional steps to current WO. A hard copy of the WO is being used.	Hard copy WO (shop traveler) had been compared to the furnace setup and settings.	Pass
			Pre-Wash	Furnace #20	Furnace #20	Pass
			Quench-Oil Temperature	Setpoint: 160^{0}F	Actual: 159^{0}F	Pass
			Cycle Time	Setpoint: 43 minutes	Actual: 45 minutes	Pass
			Austenitizing Temperature	Setpoint: 1625^{0}F	Actual: 1624^{0}F	Pass
			Post-Wash	Furnace #203	Furnace #203	Pass
			Tempering Temperature	Setpoint: 800^{0}F	Actual: 801^{0}F	Pass
			Gas Generator Dewpoint	Setpoint: 42^{0}F	Actual: 42^{0}F	Pass
			Gas Generator CH4, flow	Setpoint: 0 CFH	Actual: 0 CFH	Pass
			Gas Generator Air, flow	Setpoint: 0 CFH	Actual: 0 CFH	Pass
			Endo Gas Retort, flow	Setpoint: 1000 CFH	Actual: 920 CFH	Pass
			CH4 Retort, flow	Setpoint: 0 CFH	Actual: 0 CFH	Pass
			NH3 Retort, flow	Setpoint: 0 CFH	Actual: 0 CFH	Pass
			Endo Gas Shell, flow	Setpoint: 1000 CFH	Actual: 920 CFH	Pass

Section 4 - Job Audit

Job Identity:

Customer: ***Technical Stamping***
Shop Order Number: ***AMP WO 38642***
Part Number: ***3F0034***
Part Description: ***Washer***
Material: ***1038/1040-type steel***
Heat Treat Requirements: ***Neutral Hardening***

Question #	Job Audit Question	Related HTSA Question #	Customer or Internal Requirement	Job (Shop) Order or Reference Documentation Requirement	Actual Condition (Objective Evidence)	Pass / Fail / N/A
4.8	What are the product inspection requirements?	2.15				
4.8.1	Requirement: (1)	**Surface Hardness As Quenched**				
	Test Method:	Surface Hardness testing	Internal	ASTM E18, AMP Inspection Photo defining sample preparation & locations for hardness testing, if necessary.	Test results recorded in WORP and on hard copy of Work Order	Pass
	Test frequency or quantity:		Internal	3 pcs/hr, min 10 pcs/order	42 pcs checked	Pass
	Selection of samples:		Internal	Random		Pass
	Specification:		Internal	No spec	Actual: 56.29-59.88 HRC	Pass
4.8.2	Requirement: (2)	**Surface Hardness As Tempered**				
	Test Method:	Surface Hardness testing	Internal and Customer	ASTM E18, AMP Inspection Photo defining sample preparation & locations for hardness testing	Test results recorded in WORP and on hard copy of Work Order	Pass
	Test frequency or quantity:		Internal	3 pcs/hr, min 10 pcs/order	33 pcs checked	Pass
	Selection of samples:		Internal	Random		Pass
	Specification:		Internal and Customer, Customer print	38-45 HRC Rockwell scale	Actual: 40.47-43.26 HRC	Pass
4.8.3	Requirement: (3)	**N/A**				
	Test Method:					
	Test frequency or quantity:					
	Selection of samples:					
	Specification:					
4.8.4	Requirement: (4)	**N/A**				
	Test Method:					
	Test frequency or quantity:					
	Selection of samples:					
	Specification:					

Section 4 - Job Audit

Job Identity:

Customer: ***Technical Stamping***
Shop Order Number: ***AMP WO 38642***
Part Number: ***3F0034***
Part Description: ***Washer***
Material: ***1038/1040-type steel***
Heat Treat Requirements: ***Neutral Hardening***

Question #	Job Audit Question	Related HTSA Question #	Customer or Internal Requirement	Job (Shop) Order or Reference Documentation Requirement	Actual Condition (Objective Evidence)	Pass / Fail / N/A
Operator or Inspector Responsibilities						
4.9	Were appropriate process steps signed off?	1.4 2.2 2.3 2.14	Internal	Work Order requirement	Electronic signoff of process steps in WORP, initialed on hard copy Work Order	Pass
4.10	Were all inspection steps, as documented in the control plan performed?	1.2 1.4	Internal	Control Plan, including inspection criteria, is integrated into electronic recipe in Worp software.	Electronic recipe requires electronic & manual signoff of each step, with final review & signoff by Shift Leader (or authorized representative) or work order cannot be closed for shipping.	Pass
4.11	Were steps/operations performed that were not documented in the control plan?	1.2 1.4 1.6	Internal	Additional washing step can be performed at Shift Leader's discretion, as allowed in AMP documentation.	No additional steps were performed.	Pass
4.12	If additional steps were performed, were they authorized?	1.2 1.4 1.6 1.11 1.17	Internal	Internal Requirement that certain (critical) additional steps can only be authorized by the Quality Department.	No additional steps were performed. If post-wash is performed, it is allowed per AMP documentation	Pass
4.13	Does the governing specification allow reprocessing or rework?	1.11	No specification	Rework of order requires Quality Department approval. Retempering is not considered rework.	Call customer for rework approval.	Pass
4.14	If the order was certified, did the certification accurately reflect the process performed?	2.14 2.15	Internal and Customer	Data on Certification and data on WO match, SH data is electronically recorded as generated.	Certification Data matched the data in the hard copy of the WO & the electronic copy of the WO.	Pass
4.15	Was the certification signed by an authorized individual?	1.17	Internal and Customer	Certification automatically acquires & applies Quality Manager's electronic signature.	Certification electronically signed by Quality Manager.	Pass
4.16	Are the parts and containers free of inappropriate objects or contamination?	2.6 2.11	Internal and Customer	AMP procedure requires visual inspection of parts & containers at Incoming and Outgoing.	Containers & parts were visually free of contaminants.	Pass
	Packaging Requirements					
4.17	Are packaging requirements identified?	2.9	Internal	AMP requires that, upon completion of Heat-treating & Sorting, parts are returned to Customer's original container(s) and then weighed.	Process Steps were signed off on electronic & paper copies of Work Order and each bin weighed out, with weights recorded.	Pass
4.18	Are parts packaged to minimize mixed parts (for example, parts packed over height of container)?	2.9	Internal	AMP attempts to package outgoing material as closely to incoming packaging as possible, by weight.	Parts were evenly distributed within the bins and were not packed over the heights of each bin.	Pass
	Shipping Requirements					
4.19	Were the parts properly identified?	2.3 2.9	Internal and Customer	WO creation requirement to identify parts & container with AMP Router Tags, linking container to parts to AMP Work Order to Customer PO.	Work Order Router Tags, identifying the parts within the bins, were attached to the Customer's bins.	Pass
4.20	Were the containers properly labeled?	2.3 2.9	Internal	WO creation requires to label Customer containers w/Router Tags.	AMP Router Tags were attached to customer bins.	Pass

Section 4 - Job Audit

Job Identity:

Customer: ***Franklin Fastener***
Shop Order Number: ***AMP WO 38435***
Part Number: ***23535699***
Part Description: ***Washer - Injector Clam,p***
Material: ***Low Carbon***
Heat Treat Requirements: ***Carburizing***

Question #	Job Audit Question	Related HTSA Question #	Customer or Internal Requirement	Job (Shop) Order or Reference Documentation Requirement	Actual Condition (Objective Evidence)	Pass / Fail / N/A
4.1	Are contract review, advance quality planning, FMEA, control plans, etc., performed by qualified individuals?	1.2 1.3 1.4 1.17	Internal and Customer	RFQ and Team Feasibility for each part. Generic PFMEA for each process. Control Plans for each part are integrated into electronic recipes. These are created and maintained by qualified individuals.	RFQ, Team Feasibility, APQP, PFMEA performed by designated and qualified individuals - electronic signoff of Team Feasibility evident.	Pass
4.2	Does the heat treat facility have the customer specifications for the part?	1.5	Internal and Customer	Material specifications and customer specifications and requirements are listed on customer drawings and transferred to the specific part recipe.	Customer specifications are viewable on AMP Intranet P-drive & listed on Work Order/recipe.	Pass
4.3	Is a shop traveler created to meet customer requirements?	1.6 2.1	Internal	Work Order is created electronically, along with a hard copy for the Shop Floor.	Work order in WORP, along with a hard copy and AMP router tag.	Pass
4.4	Is material identification (part numbers, lot numbers, heat numbers, contract numbers etc.) maintained throughout the heat treat process?	2.2 2.3 2.4	Internal and Customer	Lot #, Heat #, Material chemistry if available are on AMP WO. A part photo and customer PN are on AMP WO and Router Tags, also on the magnetic tag.	Heat treating process, PN 23535699, part photo, and Shipper #0117510 are listed on WO and PN 23535699 and photo are also on the router tag.	Pass
4.5	Is there documented evidence of Receiving Inspection?	2.1	Internal requirement to check part ID, tub ID, tub weight, and quantity at Receiving	AMP Receiving Inspection Procedure requires visual inspection of parts and customer container as received. AMP Quality Dept is notified if an apparent problem exists with parts or container, for disposition by the Quality Dept. If necessary, parts are placed on hold pending disposition.	Parts weighed in & part #, weight, container #, & general condition are recorded & compared to Customer paperwork before creation of work order	Pass
4.6	Are the Loading / Racking requirements identified?	1.6 2.7 2.9	Internal	Work Order / Recipe defines Feedrate Requirement of 200 lbs/hr.	Feeding rate set on computerized feeder and loading timing was documented on WO as 200#/hr.	Pass
4.7	Is the proper recipe or process specification (cycle times, temperature, atmosphere, etc.) used? Refer to Process Tables, Section 3.0, for specific parameters. List parameters that were verified in this audit in the spaces provided below.	1.5 1.6 2.1 2.14 2.15	Internal	Proper recipe is integrated when part number is entered into electronic (Worp) work order creation software during creation of shop work order. Recipe does not have provision for adding additional steps to current WO. A hard copy of the WO is being used.	Hard copy WO (shop traveler) was compared to the furnace setup and settings.	Pass
			Pre-Wash	Furnace #8	Furnace #8	Pass
			Quench - Water Temperature	Setpoint:160^{0}F	Actual:160^{0}F	Pass
			Cycle Time	Setpoint: 3:30 hours	Actual: 3:35 hours	Pass
			Austenitizing Temperature	Setpoint: 1750^{0}F	Actual: 1750^{0}F	Pass
	3		Post-Wash & Temper	Post-Wash & Temper	Furn #203	Pass
			500^{0}F Min Tempering Temperature	Setpoint: 560^{0}F	Actual: 560^{0}F	Pass
			Gas Generator Dewpoint	#305 Gas Generator Setpoint: 32^{0}F	Actual: 32^{0}F	Pass
			Gas Generator CH4, flow	#305 Setpoint ratio: 2.5-3 : 1	Actual: 420 CFH or 2.86:1	Pass
			Gas Generator Air, flow	#305 Setpoint ratio: 2.5-3 : 1	Actual: 1200 CFH or 2.86:1	Pass
			Endo Gas Retort, flow	Setpoint: 800 CFH	Actual: (8) 740/780 CFH	Pass
			CH4 Retort, flow	Setpoint: 200 CFH	Actual: (8) 195/200CFH	Pass
			NH3 Retort, flow	Setpoint: 0 CFH	Actual: 0 CFH	Pass
			Endo Gas Shell, flow	Setpoint: 800 CFH	Actual: 800 CFH	Pass

Section 4 - Job Audit

Job Identity:

Customer: ***Franklin Fastener***
Shop Order Number: ***AMP WO 38435***
Part Number: ***23535699***
Part Description: ***Washer - Injector Clam,p***
Material: ***Low Carbon***
Heat Treat Requirements: ***Carburizing***

Question #	Job Audit Question	Related HTSA Question #	Customer or Internal Requirement	Job (Shop) Order or Reference Documentation Requirement	Actual Condition (Objective Evidence)	Pass / Fail / N/A
4.8	What are the product inspection requirements?	2.15				
4.8.1	Requirement: (1)	**Surface Hardness as Quenched**				
	Test Method:	Surface Hardness Testing	Internal	ASTM E18 & AMP Inspection Photo defining sample preparation & location(s) for hardness testing, if applicable	Test results recorded in WORP and on hard copy. No Inspection Photo defining location(s) for Hardness Testing	Pass
	Test frequency or quantity:		Internal	5 pcs/hr, min 10 pcs/order	13 pcs checked	Pass
	Selection of samples:		Internal	Random		Pass
	Specification:		Internal	No spec	FH 50	Pass
4.8.2	Requirement: (2)	**Surface Hardness as Tempered**				
	Test Method:	Surface Hardness Testing	Internal and Customer	ASTM E18 & AMP Inspection Photo defining sample preparation & location(s) for hardness testing, if applicable	Test results recorded in WORP and on hard copy. No Inspection Photo defining location(s) for Hardness Testing	Pass
	Test frequency or quantity:		Internal	5 pcs/hr, min 10 pcs/order	10 pcs checked	Pass
	Selection of samples:		Internal	Random		Pass
	Specification:		Internal and Customer, Customer print	FH 50, per SAE J864	FH 50	Pass
4.8.3	Requirement: (3)	**Total Case Depth Testing**				
	Test Method:	Total Case Depth Testing Standard, as quenched	Internal	SAE J423	Test results recorded in WORP and on hard copy. No Inspection Photo defining locations for Hardness Testing	Pass
	Test frequency or quantity:		Internal	1 pc/hr, min 3 pcs/order	5 pcs checked	Pass
	Selection of samples:		Internal	Random		Pass
	Specification:		Internal	No spec	Actual: 0.036" - 0.044"	Pass
4.8.4	Requirement: (4)	**Effective Case Depth Testing**				
	Test Method:	Microhardness Testing, as tempered	Internal and Customer	ASTM E384	Test results recorded in WORP and on hard copy	Pass
	Test frequency or quantity:		Internal	1 pc/hr, min 3 pcs/order	3 pcs checked	Pass
	Selection of samples:		Internal	Random		Pass
	Specification:		Internal and Customer, Customer print	0.020"-0.028"	Actual: 0.023" - 0.024"	Pass

Section 4 - Job Audit

Job Identity:

Customer: ***Franklin Fastener***
Shop Order Number: ***AMP WO 38435***
Part Number: ***23535699***
Part Description: ***Washer - Injector Clam,p***
Material: ***Low Carbon***
Heat Treat Requirements: ***Carburizing***

Question #	Job Audit Question	Related HTSA Question #	Customer or Internal Requirement	Job (Shop) Order or Reference Documentation Requirement	Actual Condition (Objective Evidence)	Pass / Fail / N/A
Operator or Inspector Responsibilities						
4.9	Were appropriate process steps signed off?	1.4 2.2 2.3 2.14	Internal	Work Order requirement	Electronic signoff of process steps in WORP, initialed on hard copy of Work Order	Pass
4.10	Were all inspection steps, as documented in the control plan, performed?	1.2 1.4	Internal	Control Plan, including inspection criteria, is integrated into electronic recipe in Worp software.	Electronic recipe requires electronic & manual signoff of each step, with final review & signoff by Shift Leader (or authorized representative) or work order cannot be closed for shipping.	Pass
4.11	Were steps/operations performed that were not documented in the control plan?	1.2 1.4 1.6	Internal	Additional washing step can be performed at Shift Leader's discretion, as allowed in AMP documentation.	No additional steps were performed.	Pass
4.12	If additional steps were performed, were they authorized?	1.2 1.4 1.6 1.11 1.17	Internal	Internal Requirement that certain (critical) additional steps can onl be authorized by the Quality Department.	No additional steps were performed. If post-wash is performed, it is allowed per AMP documentation	Pass
4.13	Does the governing specification allow reprocessing or rework?	1.11	No specification	Rework of order requires Quality Department approval. Retempering is not considered rework.	Call customer for rework approval.	Pass
4.14	If the order was certified, did the certification accurately reflect the process performed?	2.14 2.15	Internal and Customer	Data on Certification and data on WO match; data is electronically generated and recorded in Worp, manually recorded on hard copy of WO.	Certification Data matched the data in the hard copy of the WO & the electronic copy of the WO.	Pass
4.15	Was the certification signed by an authorized individual?	1.17	Internal and Customer	Certification automatically acquires & applies Quality Manager's electronic signature.	Certification electronically signed by Quality Manager.	Pass
4.16	Are the parts and containers free of inappropriate objects or contamination?	2.6 2.11	Internal and Customer	AMP procedure requires visual inspection of parts & containers at Incoming and Outgoing.	Containers & parts were visually free of contaminants.	Pass
	Packaging Requirements					
4.17	Are packaging requirements identified?	2.9	Internal	AMP requires that, upon completion of Heat-treating, Tempering, & Sorting, parts are returned to Customer's original container and then weighed.	Process Steps were signed off on electronic & paper copies of Work Order.	Pass
4.18	Are parts packaged to minimize mixed parts (for example, parts packed over height of container)?	2.9	Internal	AMP attempts to package outgoing material as closely to incoming packaging as possible, by weight.	Parts were evenly distributed in the container and were not packed over the height of the container.	Pass
	Shipping Requirements					
4.19	Were the parts properly identified?	2.3 2.9	Internal and Customer	WO creation requirement to identify parts & container with AMP Router Tags, linking container to parts to AMP Work Order to Customer PO/Shipper.	Work Order Router Tag, identifying the parts within the container, were attached to Customer container.	Pass
4.20	Were the containers properly labeled?	2.3 2.9	Internal	WO creation requires labeling of Customer containers w/Router Tags.	Properly labeled AMP Router Tags were attached to customer container.	Pass

Section 4 - Job Audit

Job Identity:

Customer: ***Metal Forming & Coining Corporation***
Shop Order Number: ***AMP WO 38229***
Part Number: ***10503***
Part Description: ***Retainer***
Material: ***1010***
Heat Treat Requirements: ***CarboNitriding***

Question #	Job Audit Question	Related HTSA Question #	Customer or Internal Requirement	Job (Shop) Order or Reference Documentation Requirement	Actual Condition (Objective Evidence)	Pass / Fail / N/A
4.1	Are Contract Review, Advance Quality Planning, FMEA, Control Plans, etc., performed by qualified individuals?	1.2 1.3 1.4 1.17	Internal and Customer	RFQ and Team Feasibility for each part. Generic PFMEA for each process. Control Plans for each part are integrated into unique electronic recipes, which are created and maintained by qualified individuals.	RFQ, Team Feasibility (TF), APQP, PFMEA & Control Plans (CP) are performed by designated and qualified individuals - electronic signoff of Team Feasibility evident in WORP.	Pass
4.2	Does the heat treat facility have the customer specifications for the part?	1.5	Internal and Customer	Material specifications and customer specifications and requirements are listed on customer drawings and transferred to the specific part recipe.	Copies of Customer Material Specifications (Heat #) are supplied by Customer; Customer product specifications are viewable on AMP Intranet (P-drive) & are listed on Work Order/recipe.	Pass
4.3	Is a shop traveler created to meet customer requirements?	1.6 2.1	Internal	Work Order created electronically and a hard copy generated for use on the Shop Floor.	Work order in WORP and hard copy of WO on Shop Floor, in addition to AMP router tag.	Pass
4.4	Is material identification (part numbers, lot numbers, heat numbers, contract numbers, etc.) maintained throughout the heat treat process?	2.2 2.3 2.4	Internal and Customer	Lot Number, Heat Number, & Material Chemistry, if available, are listed on AMP WO. A part photo and customer PN are on AMP WO and Router Tags, and also on the magnetic tags, if used.	CarboNitriding process, PN 10503, photo, all Tub IDs (Serial #s), PO #3134, Lot #SEV10202800, & Heat #SEV10202800 are listed on WO; PN 10503, Tub ID, and photo are also on the router tag.	Pass
4.5	Is there documented evidence of Receiving Inspection?	2.1	Internal requirement to check part ID, tub ID, tub weight, and part quantity at Receiving	AMP Receiving Inspection Procedure requires visual inspection of parts and customer container as received. AMP Quality Dept is notified if an apparent problem exists with parts or container, for disposition by the Quality Dept; parts are placed on hold pending disposition.	Parts weighed in & part #, weight, container #, & general condition are recorded & compared to information on Customer paperwork before creation of work order.	Pass
4.6	Are the Loading / Racking requirements identified?	1.6 2.7 2.9	Internal	Work Order / Recipe defines Feedrate Requirement of 450 lbs/hr.	Feedrate was set on computerized feeder and loading timing was documented on WO.	Pass
4.7	Is the proper recipe or process specification (cycle times, temperature, atmosphere, etc.) used? Refer to Process Tables, Section 3.0, for specific parameters. List parameters that were verified in this audit in the spaces provided below.	1.5 1.6 2.1 2.14 2.15	Internal	Proper recipe is integrated when part number is entered into electronic (Worp) work order creation software during creation of shop work order. Recipe does not have provision for adding additional steps to current WO. A hard copy of the WO is being used on the shop floor.	Hard copy WO (shop traveler) had been compared to the furnace setup and settings.	Pass
		Furnace #8	Pre-Wash	N/A	N/A	
			Feedrate	450#/Hr on Recipe	451#/Hr (Calculated)	
			Quench-Oil Temperature	Setpoint: 160^{0}F	Actual: 160^{0}F	Pass
			Cycle Time	Setpoint: 2:05 hours	Actual: 2:15 hours	Pass
			Austenitizing Temperature	Setpoint: 1580^{0}F	Actual: 1579^{0}F	Pass
			Post-Wash	Furnace #204	Furnace #204	Pass
			Tempering Temperature	Setpoint: 330^{0}F	Actual: 334^{0}F	Pass
			Tempering Time	VFD Setpoint: 75 Hz	Actual: 75 Hz	Pass
			Gas Generator Dewpoint	Setpoint: 32F	Actual: 31F	Pass
			Gas Generator CH4, flow	Setpoint ratio: 2.5-5.0 : 1	Actual: 250 CFH or 4.5:1	Pass
			Gas Generator Air, flow	Setpoint ratio: 2.5-5.0 : 1	Actual: 1125 CFH or 4.5:1	Pass
			Endo Gas Retort, flow	Setpoint: 800 CFH	Actual: 780 CFH	Pass
			CH4 Retort, flow	Setpoint: 150 CFH	Actual: 150 CFH	Pass
			NH3 Retort, flow	Setpoint: 50 CFH	Actual: 50 CFH	Pass
			Endo Gas Shell, flow	Setpoint: 800 CFH	Actual: 800 CFH	Pass

Section 4 - Job Audit

Job Identity:

Customer: ***Metal Forming & Coining Corporation***
Shop Order Number: ***AMP WO 38229***
Part Number: ***10503***
Part Description: ***Retainer***
Material: ***1010***
Heat Treat Requirements: ***CarboNitriding***

4.8	**What are the product inspection requirements?**	**2.15**				
4.8.1	Requirement: (1)	As Quenched				
	Test Method:	Surface Hardness testing	Internal	ASTM E18, AMP Inspection Photo defining sample preparation & locations for hardness testing	Test results recorded in WORP and on hard copy of Work Order	Pass
	Test frequency or quantity:		Internal	5 pcs/hr, min 10 pcs/order	75 pcs checked	Pass
	Selection of samples:		Internal	Random		Pass
	Specification:		Internal	No spec	Actual: 89.9-92.4 15N	Pass
4.8.2	Requirement: (2)	As Tempered				
	Test Method:	Surface Hardness testing	Internal and Customer	ASTM E18, AMP Inspection Photo defining sample preparation & locations for hardness testing	Test results recorded in WORP and hard copy	Pass
	Test frequency or quantity:		Internal	5 pcs/hr, min 10 pcs/order	70 pcs checked	Pass
	Selection of samples:		Internal	Random		Pass
	Specification:		Internal and Customer, Customer print	88-92 15N Rockwell scale	Actual: 88.7-91.5	Pass
4.8.3	Requirement: (3)	Total Case Depth (TCD) Testing				
	Test Method:	Total Case Depth Testing Standard	Internal	SAE J423	Test results recorded in WORP	Pass
	Test frequency or quantity:		Internal	1 pc/hr, min 2 pcs/order	15 pcs checked	Pass
	Selection of samples:		Internal	Random		Pass
	Specification:		Internal	No spec	Actual: 0.010"-0.014"	Pass
4.8.4	Requirement: (4)	Effective Case Depth (ECD) Testing				
	Test Method:	Microhardness Testing	Internal and Customer	ASTM E384	Test results recorded in WORP and hard copy	Pass
	Test frequency or quantity:		Internal	1 pc/hr, min 1 pc/order	1 pc checked	Pass
	Selection of samples:		Internal	Random		Pass
	Specification:	0.005"-0.015"	Internal and Customer, Customer print	HK 500 converted to HRC 50, below surface	Actual: 0.007"	Pass

Section 4 - Job Audit

Job Identity:

Customer: ***Metal Forming & Coining Corporation***
Shop Order Number: ***AMP WO 38229***
Part Number: ***10503***
Part Description: ***Retainer***
Material: ***1010***
Heat Treat Requirements: ***CarboNitriding***

Operator or Inspector Responsibilities						
4.9	Were appropriate process steps signed off?	1.4 2.2 2.3 2.14	Internal	Work Order requirement	Electronic signoff of process steps in WORP, initialed on hard copy Work Order	Pass
4.10	Were all inspection steps, as documented in the control plan, performed?	1.2 1.4	Internal	Control Plan, including inspection criteria, is integrated into electronic recipe in Worp software.	Electronic recipe requires electronic & manual signoff of each step, with final review & signoff by Shift Leader (or authorized representative) or work order cannot be closed for shipping.	Pass
4.11	Were steps/operations performed that were not documented in the control plan?	1.2 1.4 1.6	Internal	Additional washing step can be performed at Shift Leader's discretion, as allowed in AMP documentation.	No additional steps were performed.	Pass
4.12	If additional steps were performed, were they authorized?	1.2 1.4 1.6 1.11 1.17	Internal	Internal Requirement that certain (critical) additional steps can only be authorized by the Quality Department.	No additional steps were performed. If post-wash is performed, it is allowed per AMP documentation	Pass
4.13	Does the governing specification allow reprocessing or rework?	1.11	No specification	Rework of order requires Quality Department approval. Retempering is not considered rework.	Contact customer for rework approval.	Pass
4.14	If the order was certified, did the certification accurately reflect the process performed?	2.14 2.15	Internal and Customer	Data on Certification and data on WO match; data is electronically generated.	Certification Data matched the data on the hard copy of the WO & on the electronic copy of the WO.	Pass
4.15	Was the certification signed by an authorized individual?	1.17	Internal and Customer	Certification automatically acquires & applies Quality Manager's electronic signature.	Certification electronically signed by Quality Manager.	Pass
4.16	Are the parts and containers free of inappropriate objects or contamination?	2.6 2.11	Internal and Customer	AMP procedure requires visual inspection of parts & containers at Incoming and Outgoing.	Containers & parts were visually free of contaminants.	Pass
	Packaging Requirements					
4.17	Are packaging requirements identified?	2.9	Internal	AMP requires that, upon completion of Heat-treating & Sorting, parts are returned to Customer's original container and then weighed.	Process Steps were signed off on electronic & paper copies of Work Order.	Pass
4.18	Are parts packaged to minimize mixed parts (for example, parts packed over height of container)?	2.9	Internal	AMP attempts to package outgoing material as closely to incoming packaging as possible, by weight.	Parts were evenly distributed in the containers and were not packed over the heights of each container.	Pass
	Shipping Requirements					
4.19	Were the parts properly identified?	2.3 2.9	Internal and Customer	WO creation requirement to identify parts & container with AMP Router Tags, linking container to parts to AMP Work Order to Customer PO.	Work Order Router Tag, identifying the parts within the container, were attached to Customer container.	Pass
4.20	Were the containers properly labeled?	2.3 2.9	Internal	WO creation requirement to label Customer containers w/Router Tags.	AMP Router Tags were attached to customer containers.	Pass

PROCESS TABLE A - Carburizing / Carbonitriding / Carbon Correction / Neutral Hardening / Austempering / Martempering / Tempering / Precipitation Hardening - Aging

All requirements given below are subordinate to customer specific requirements.

The customer may have additional requirements, e.g., inspection testing, greater frequencies, etc. When performing the job audit, the auditor shall verify heat treater is conforming to the customer's requirements.

*** Continuous furnace frequencies are per lot (work order) or as specified, whichever is more frequent.**
**** Does not apply to furnaces operating below 760C (1400F).**
----- indicate "not applicable".

Item #	Related HTSA Question #	Category/Process Steps	Batch Furnace	Continuous Furnace *	Generators
1.0		**PROCESS AND TEST EQUIPMENT REQUIREMENTS**			
A1.1	3.1 3.7	All furnaces, generators and quench systems shall have temperature indicating instruments.	N/A	Yes	Yes
A1.2	3.1 3.7	Continuous strip charts and/or data loggers are required for temperature and carbon monitoring unit, e.g., dew point, oxygen probe, IR gas analyzer, etc.	N/A	Yes	Yes
A1.3	1.18	A program for furnace and generator burnout is required (applies to carbon bearing atmospheres).	N/A	Yes - "Furnace Maintenance Instructions" is the relevant document.	Yes - "Generator Maintenance Instructions" is the relevant document.
A1.4	3.2	Furnace weigh scales shall be verified quarterly and calibrated annually at a minimum.	N/A	Yes	N/A
A1.5	3.2	Dew pointers, 3-gas analyzers, spectrometers, and carbon IR combustion analyzers (shim stock analysis), used to verify carbon potential in furnaces, shall be calibrated annually at a minimum.	N/A	Yes	-----
A1.6	3.2	Verification of calibration of spectrometers, and carbon IR combustion analyzers, shall be checked daily or prior to use.	N/A	N/A	-----
A1.7	3.2	Verification of calibration of 3-gas analyzers with zero gas and span gas shall be performed weekly at a minimum.	N/A	N/A	-----
A1.8	3.2	Oxygen probe controllers shall be calibrated quarterly at a minimum.	N/A	Yes	Yes
A1.9	2.16	All hardness test equipment (for each scale used) shall be calibrated semi-annually minimum, and verified daily minimum per the applicable ASTM standard.	N/A	Yes	N/A
A1.10	2.16	Files shall be verified daily (or prior to use) with provers per SAE J864.	N/A	Yes	N/A
A1.11	3.2	Refractometers (typically used to check polymer quenchants and washer solutions) shall be verified daily (with distilled water) and calibrated annually (per manufacturer's requirements) at a minimum.	N/A	N/A	N/A

PROCESS TABLE A - Carburizing / Carbonitriding / Carbon Correction / Neutral Hardening / Austempering / Martempering / Tempering / Precipitation Hardening - Aging

All requirements given below are subordinate to customer specific requirements.

The customer may have additional requirements, e.g., inspection testing, greater frequencies, etc. When performing the job audit, the auditor shall verify heat treater is conforming to the customer's requirements.

*** Continuous furnace frequencies are per lot (work order) or as specified, whichever is more frequent.**
**** Does not apply to furnaces operating below 760C (1400F).**
----- indicate "not applicable".

Item #	Related HTSA Question #	Category/Process Steps	Batch Furnace	Continuous Furnace *	Generators
2.0		**PYROMETRY**			
A2.1	3.2 3.3	Thermocouples and calibration of thermocouples shall conform to AMS 2750D.	N/A	Yes - checked by outside contractors quarterly	Yes
A2.2	3.2 3.3	Instrument Calibration per AMS 2750D shall be quarterly at a minimum. Frequency reductions per AMS 2750D are not allowed.	N/A	Yes	Yes
A2.3	3.2 3.3	CQI-9 requires a comparative check of the control temperature sensor (CTS) in the Qualified Work Zone to a (1) calibrated test temperature sensor (CTTS) or, (2) resident thermocouple (R-T/C). (1) The CTS shall be within an operating temperature range of +/- 5C (or +/-10F) of the CTTS. This check shall be performed monthly. (2) Within the operating temperature range the difference between the CTS and R-T/C readings shall be no more than +/- 1C (or +/-2F) as determined at the time of the most recent temperature uniformity survey. This check shall be performed weekly. Any actions to correct a failing reading or validate a test result shall be documented. Additionally, Type K and N thermocouples shall be checked monthly for equipment operating at or above 760C (1400F) and changed annually at a minimum. Type K and N thermocouples shall be checked quarterly for equipment operating below 760C (1400F) and changed every two years at a minimum. Type R and S thermocouples shall be checked monthly for equipment operating at or above 760C (1400F) and changed every two years at a minimum. Protection Tubes shall be visually checked at the same frequency as thermocouples.	N/A	Yes - Resident ThermoCouple (R-T/C)	Yes
A2.4	3.4	Temperature Uniformity Survey (TUS): refer to AMS 2750D for procedures. TUS frequency shall be annual and after major rebuild. Temperature uniformity tolerance for hardening furnaces shall be +/- 14 C (or +/- 25 F). Temperature uniformity tolerance for tempering furnaces shall be +/- 11 C (or +/- 20 F). Minimum and maximum temperature ranges shall be tested per AMS 2750D. Exception: If the operating range of the Qualified Work Zone is equal to or less than 85 C (153 F) then only one temperature is required to be tested. The temperature shall be within the operating range of the Qualified Work Zone. Frequency reductions per AMS 2750D are not allowed.	N/A	Yes - In Qualified Work Zone	-----
A2.5	3.5	Recorded temperatures for austenitizing processes shall be controlled within +/- 9C (or +/- 15F) of the set point as evidenced by continuous recording pyrometers. Furnace temperature shall be controlled with soak times starting at the lower tolerance limit (as defined above).	N/A	N/A	-----
A2.6	3.5	Recorded temperatures for tempering and precipitation hardening processes shall be controlled within +/- 6C (or +/- 10F) of the set point as evidenced by continuous recording pyrometers. Furnace temperature shall be controlled with soak times starting at the lower tolerance limit (as defined above).	N/A	Yes - In Qualified Work Zone	N/A
A2.7	3.2	Infrared pyrometers shall be calibrated to a black body furnace annually.		N/A	-----

PROCESS TABLE A - Carburizing / Carbonitriding / Carbon Correction / Neutral Hardening / Austempering / Martempering / Tempering / Precipitation Hardening - Aging

All requirements given below are subordinate to customer specific requirements.

The customer may have additional requirements, e.g., inspection testing, greater frequencies, etc. When performing the job audit, the auditor shall verify heat treater is conforming to the customer's requirements.

*** Continuous furnace frequencies are per lot (work order) or as specified, whichever is more frequent.**
**** Does not apply to furnaces operating below 760C (1400F).**
----- indicate "not applicable".

Item #	Related HTSA Question #	Category/Process Steps	Batch Furnace	Continuous Furnace *	Generators
3.0		**PROCESS MONITOR FREQUENCIES**			
A3.1	1.4 2.14	Monitor primary temperature control instruments).	N/A	Each lot or continuous recording with sign-off every 2 hours. Alarm systems satisfy the sign-off requirement	Each Shift
A3.2	1.4 2.14 3.7	Monitor generator atmospheres.	-----	-----	Continuous with each Work Order & Daily Inspection Log
A3.3	1.4 2.14 3.7	Monitor primary furnace atmosphere controls)**.	N/A	N/A	-----
A3.4	1.4 2.14 3.7	Verify primary atmosphere control method by back-up method**.	N/A	3-Gas Analyzer & Daily Inspection Log	Daily
A3.5	1.4 2.14 3.13	For austenitizing salt baths: Salt chemistry (soluble oxides) or decarburization on the parts shall be checked daily.	N/A	N/A	-----
A3.6	1.4 2.12	**Quench Media Process Parameters**			
		- Temperature	N/A	Each lot or continuous recording with sign-off every 2 hours. Alarm systems satisfy the sign-off requirement.	-----
		- Quench Level	N/A	Daily	-----
		- Agitation	N/A	- Daily visual check. - Monitor every 2 hours in the absence of an alarm system.	-----
A3.7	1.4 2.14	Monitor time in furnace, cycle time, or belt speed.	N/A	Twice/shift & after any change in the belt speed.	-----
A3.8	1.4 2.7	Monitor load size or fixturing or loading rate as applicable.	N/A	Twice/shift & after any change in loading rate.	-----
A3.9	1.4 2.12	Quench Delay Time - Alarm system shall be based on the time that the load exits the furnace to the time the load is at the bottom of the quench tank.	N/A	N/A	-----

PROCESS TABLE A - Carburizing / Carbonitriding / Carbon Correction / Neutral Hardening / Austempering / Martempering / Tempering / Precipitation Hardening - Aging

All requirements given below are subordinate to customer specific requirements.

The customer may have additional requirements, e.g., inspection testing, greater frequencies, etc. When performing the job audit, the auditor shall verify heat treater is conforming to the customer's requirements.

*** Continuous furnace frequencies are per lot (work order) or as specified, whichever is more frequent.**
**** Does not apply to furnaces operating below 760C (1400F).**
----- indicate "not applicable".

Item #	Related HTSA Question #	Category/Process Steps	Batch Furnace	Continuous Furnace *	Generators
4.0		**IN-PROCESS/FINAL TEST FREQUENCIES**			
A4.1	1.4 2.15	Microstructure	N/A	Daily per furnace and/or job requirement.	-----
A4.2	1.4 2.15	Surface hardness	N/A	Every 2 hours / per job requirement	-----
A4.3	1.4 2.15	Core hardness (when specified)	N/A	Every 4 hours / per job requirement	-----
A4.4	1.4 2.15	Case depth (when specified)	N/A	Every 4 hours / per job requirement	-----
5.0		**QUENCHANT AND SOLUTION TEST FREQUENCIES**			
A5.1	2.12 3.14	**Polymer Quench Media**			
		- Concentration	N/A	N/A	-----
		- Quenchability Check; e.g., cooling curve, viscosity, or titration	N/A	N/A	-----
A5.2	2.12 3.14	**Water Quench Media**			
		- Suspended solids	N/A	Every six months	-----
A5.3	2.12 3.14	**Salt Quench Media**			
		- Analysis & Contaminants	N/A	N/A	-----
A5.4	2.12 3.14	**Brine or Caustic Quench Media**			
		- Concentration and/or Specific Gravity.	N/A	N/A	-----
		- Suspended solids	N/A	N/A	-----
A5.5	2.12 3.14	**Oil Quench Media**			
		- Water content, suspended solids, viscosity, cooling curve, total acid, and flash point.	N/A	Quarterly	-----
A5.6	2.13	**Rust Preventive - Soluble Oil**			
		- Concentration	N/A	1x / week	-----
A5.7	2.11	**Washers**			
		- Concentration of cleaner	N/A	Non-commercial washer; checked as frequently as needed.	-----
		- Temperature of solution (required if temperature is specified to be above ambient temperature).	N/A	Daily, per "Washer Temper Maintenance Instructions"	-----

Ford Specific CQI-9 requirements

Requirements and Guidance				Assessment			
W-HTX Element/Pg #	**W-HTX Requirements and Guidance not included in CQI-9**	**CQI-9 section**	**Objective Evidence**	**NA**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
Scope (pg 7)	CQI-9 assessment and Ford Specific CQI-9 assessment are also to be completed for brazing and sintering.		***No Brazing or Sintering processes being done at American Metal Processing.***	***N/A***	***YES***		
Carburizing/ Carbonitriding/ Carbon Correction (pg 24)	- Alarms, if used for process monitoring, must be set at acceptable control limits. - Quench media Soluble oil: Concentration must be checked daily. - Quench media Soluble oil: Suspended solids must be checked semi-annually. - Microstructure for batch heat treat must be checked per batch and when any of the process parameters are out of spec.	Process Table A	***Alarms not used for process monitoring.*** ***Process parameters are monitored & viewable in real time & recorded on Data Acquisition System.*** ***No Soluble oil used for quench media.*** ***No Soluble oil used for quench media.*** ***No batch heat treat***	***N/A*** ***N/A*** ***N/A*** ***N/A***	***YES***		
Neutral Hardening (pg 26)	- Alarms, if used for process monitoring, must be set at acceptable control limits. - Quench media Soluble oil: Concentration must be checked daily. - Quench media Soluble oil: Suspended solids must be checked semi-annually.	Process Table A	***Alarms not used for process monitoring.*** ***Process parameters are monitored & viewable in real time & recorded on Data Acquisition System.*** ***No Soluble oil used for quench media.*** ***No Soluble oil used for quench media.***	***N/A*** ***N/A*** ***N/A***	***YES***		
Tempering/ Stress Relieving/ Annealing/ Normalizing/ Solution Heat Treat/ Age Hardening (pgs 27, 29, 30)	- Alarms, if used for process monitoring, must be set at acceptable control limits.	Process Tables A and E	***Tempering: Alarms not used for process monitoring. Process parameters are monitored & viewable in real time & recorded on Data Acquisition System.***	***N/A***	***YES***		
Nitriding/ Nitrocarburizing (pg 28)	- Alarms, if used for process monitoring, must be set at acceptable control limits. - Disassociation of ammonia must be checked in gas nitriding twice a shift and after any change (or per batch). - Gas ratios for ferritic nitrocarburizing must be checked twice a shift and after any change (or per batch).	Process Table B	***Alarms not used for process monitoring*** ***No gas nitriding process.*** ***No ferritic nitrocarburizing process.***	***N/A***	***YES***		
Brazing/Sintering (pg 31)	Assess Brazing/Sintering heat treat processes per Attachment 1 for WHTX - Brazing & Sintering Process Table	Scope 1.2	***No Brazing/Sintering processes.***	***N/A***	***YES***		
Vacuum Carburizing (pg 25)	Assess Vacuum Carburizing heat treat processes per Attachment 2 for WHTX - Vacuum Carburizing Table	Scope 1.2	***No Vacuum Carburizing processes.***	***N/A***	***YES***		

Ford Specific CQI-9 requirements							
Requirements and Guidance				**Assessment**			
W-HTX Element/Pg #	**W-HTX Requirements and Guidance not included in CQI-9**	**CQI-9 section**	**Objective Evidence**	**NA**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
Salt Bath (pg 32)	- Alarms, if used for process monitoring, must be set at acceptable control limits. - Bath activity and exhaust smoke analysis must be done every batch and after any change. - Visual condition of quench media must be checked each shift. - Quench media Soluble oil: Concentration must be checked daily. - Quench media Soluble oil: Suspended solids must be checked semi-annually.	Process Tables A and B	***No Salt Bath processes.***	***N/A***	***YES***		
Induction (pg 33)	- Cycle time must be visually checked and logged twice a shift and after any change. - In the absence of an alarm system for high and low control limits, quench media temperature must be checked and logged each shift and after any change. Quench level must must be checked and logged each shift and after any change. - Quench media Soluble oil: Concentration must be checked daily. - Quench media Soluble oil: Suspended solids must be checked semi-annually. - Quench media Oil: Water content, Suspended solids, Viscosity, Quenchability, Flash, and fire point must be checked on semi-annual basis - Flame process: Oxygen to fuel ratio shall be monitored and recorded.	Process Table D	***No Induction Hardening processes.***	***N/A***	***YES***		
Loading rate and cycle parameters (pg 15)	Control plan must have maximum delay between quench and temper specified and it must be monitored and logged.	2.7; A3.8; B3.9; C3.4; E3.7	***Computerized Recipe, with integrated Control Plan, monitors and records all start and stop times for loading and cycle parameters.***		***YES***		
Processing temperature (pg 11)	Overtemp/Undertemp (when applicable) must be set at 50^0 F over the process set temperature to protect material and furnace from overheating	N/A	***Overtemp is set for 50^0 F above the process set temperature; Undertemp is not applicable.***		***YES***		

Ford Specific CQI-9 requirements

Requirements and Guidance				Assessment			
W-HTX Element/Pg #	**W-HTX Requirements and Guidance not included in CQI-9**	**CQI-9 section**	**Objective Evidence**	**NA**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
Monitor of carbon atmosphere (pg 11)	Dew point test is not acceptable for inverted delta parts.	3.7; 3.8; A3.3; A3.4; B3.2; B3.3; E3.3; E3.4	***Carbon atmosphere being monitored, but No inverted delta parts are being processed.***		***YES***		
Furnace atmosphere (pgs 12, 13)	If applicable, refrigerator temperature must be monitored. Check furnace conditions for positive internal furnace pressure. Check furnace conditions for presence of air and gas leaks.	3.7	***Refrigerator temperature N/A. Furn condition is set for positive internal furn pressure; air/gas leaks are monitored & detected via oxygen probes installed in furnaces, with outputs fed to computer monitors for recording & viewing in real time.***		***YES***		
Condition of quench (pg 15)	Additions to quench systems must be recorded in logging record.	3.14	***Because of dragout, quench systems are replenished frequently, according to required depth in tank, as marked.***		***YES***		
Rules for checking service T/C (SAT test) and temperature instrumentation (pg 34)	The calibrated test thermocouple must be placed adjacent to the service thermocouple with the two junctions within 2 inches of each other. The test results of the instrument, thermocouple, and protection tube checks must be appropriately logged. The date that a given thermocouple or protection tube is replaced must be recorded. Service Thermocouples should be checked in place at their normal operating temperatures (not by removing the thermocouples from the normal operating temperature and checking them at a lower temperature.	Item # 2.0 of the applicable Process Table	***Calibration of T/Cs performed correctly.*** ***The test results of the instrument, thermocouple, and protection tube checks are appropriately logged.*** ***Thermocouples are checked in place at their normal operating temperatures whenever possible (furnace operational); thermocouple and/or protection tube replacement dates are recorded.***		***YES*** ***YES*** ***YES***		
Microstructure (pgs 17, 22)	At the minimum, microstructure must be checked @ 100X and 500X. Visual standards are required. Results must be recorded.	Item # 4.0 of the applicable Process Table	***At a minimum, microstructures are checked @ 100X & 500X against visual standards & the results are recorded.***		***YES***		

Ford Specific CQI-9 requirements

Requirements and Guidance				Assessment			
W-HTX Element/Pg #	**W-HTX Requirements and Guidance not included in CQI-9**	**CQI-9 section**	**Objective Evidence**	**NA**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
Hardness (pgs 18, 23)	- When tempering is done immediately after the quenching, the testing may be done after tempering rather than after both quenching and tempering. The heat treater shall maintain average and range or other statistical charts as appropriate for hardness to detect trends in the process and to serve as a quality record. File, Rockwell, or Brinell scale shall be used as indicated on the Engineering Drawing unless the affected Product Engineering Office permits the use of an alternative hardness scale and the change is noted in the control plan. Surface hardness testing with files (refer to SAE J864), where an indentation hardness test is not specified and/or for purposes of correlation, shall only be used if authorized by the affected Ford Supplier Technical Assistance (STA) engineer. When checking the hardness tester with certified blocks, the distance between the centers of two adjacent indentations shall be at least three times the diameter of the indentation and the distance to the edge of the test piece shall be at least two and a half times the diameter of the indentation.	Item # 4 of the applicable Process Table	***For maximum effectiveness, AMP chooses to do hardness testing after quenching and after tempering.*** ***AMP maintains Mean, Low, & High values and Standard Deviation records (out of Quench & out of Temper) for each work order and supplies the (out of Temper) Mean & SD information to the customer via the Certification provided with each work order.*** ***FH is used for Surface Hardness Testing, per SAE J864, when specified by the customer.*** ***The distance between indentations, on certfied test blocks and from the edges of the test blocks, is kept at least 3 times the diameter of the indentations.***		***YES*** ***YES*** ***YES*** ***YES***		
Case Depth (pgs 18, 23)	Case depth checks may be made on production parts or test bars, provided correlation to production parts has been established. However, case depth for induction and flame processes must be checked on production parts. Case depth records shall be maintained on average-range or other statistical charts as appropriate to detect trends in the process and to serve as a quality record.	Item # 4 of the applicable Process Table	***Case depth checks are made on production parts, not test bars, unless specifically requested by the customer.*** ***Case depth records are maintained for each work order and the average and standard deviation are supplied to the customer with each work order, via the Certification.***		***YES*** ***YES***		
Induction/Flame Pattern (pg 23)	The surface and cross-sectional pattern shall be checked as required by the Engineering Drawing or in-process specification.	Item # 4 of the Process Table D		***N/A***	***YES***		

The objective of CQI-9 and WHTX is to define the requirements and to encourage Best Practices which will assure a quality part, as well as promoting continuous improvement relative to quality and productivity. Exceptions to the CQI-9 and WHTX requirements or reductions of sampling strategies for control of heat treating processes may be used, provided they afford adequate protection of a process currently proven to be stable and capable, and have the concurrence of the affected Ford Supplier Technical Assistant (STA) engineer and/or Quality Planning team and are documented in a control plan.