

Special Process: Heat Treat System Assessment			
Facility Name:		ALLIED HEAT TREAT LTD.	
Address:		7521 TRANMERE DRIVE, MISSISSAUGA, ON	
Phone Number:	905-677-8000	Type(s) of Thermal Processing at this Facility:	
Fax Number:	905-677-4173	Process Table A - Ferrous	
Number of Heat Treat Employees at this Facility:		Carburizing	X
Captive Heat Treater (Y/N):		Carbonitriding	X
Commercial Heat Treater (Y/N):		Carbon Correction	X
Date of Assessment:		Neutral Hardening	X
Date of Previous Assessment:		Quench & Temper	X
NO		Austempering / Martempering	X
YES		Tempering	X
Aug. 22, 2012		Precipitation Hardening / Aging	
		Process Table B - Ferrous	
		Nitriding (Gas)	X
		Ferritic-Nitrocarburizing (Gas or Salt)	
		Process Table C - Aluminum	
		Aluminum Heat Treatment	X
		Process Table D - Ferrous	
		Induction Heat Treating	
		Process Table E	
		Annealing	X
		Normalizing	X
		Stress-Relieving	X

Current Quality Certification(s):	ISO 9001 : 2008
Date of Re-assessment (if necessary):	Aug. 22, 2013

Personnel Contacted:			
Name:	Title:	Phone:	Email:
M. PRICE	DIRECTOR OF OPERATIONS	905-677-2120	INFO@ALLIEDHEATTREAT.COM

Auditors/Assessors:			
Name:	Company:	Phone:	Email:
M. RAHMATI	ALLIEDHEATTREAT LTD.	905-677-8000	mark@alliedheattreat.com

Number of "Not Satisfactory" Findings:
0

Number of "Needs Immediate Action" Findings:
0

Number of "Fail" Findings in the Job Audit(s):
0

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Question Number	Question	Requirements and Guidance	Objective Evidence	Assessment		
				N/A	Satisfactory	Not Satisfactory
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.	Allied Heat Treat Ltd. has been in business since 1959.Moe Price (Director of Operations) has been in heat treating industries for more than 40 years.His job description is indicated under Appendix 2 of Allied's Quality Manual; The Director of Operations is responsible for directing production operations to finished parts and providing services, which meet customer needs and expectations. Additionally the Director of Operations contributes to the development and execution of corporate strategy.	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.	Quality Planning procedure is outlined under Document # AWI 2.2. Feasibility study starts when a an order being requested by the customer. A complete APQP will be assigned and PPAP shall be provided upon customer request.Any changes after PPAP provision shall be communicated with the customer for approval.	X		

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1.3	Are heat treat FMEA's 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 FMEA's 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.	<p>PFMEA # RPI-A-1 for Part No. 80.1692.9665 was observed. A team consisting of Q.A Manager, Maintenance Manager and Director of Operations work on preparing PPAP documentation including FMEA.</p>	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.	<p>Quality Plans are developed under Document # AWI 2.2 (Quality Plan) and are being updated when required. Quality plans cover the whole production process from start to end. Quality Plans address all parameters and sample size needed. A team consisting of Q.A Manager, Maintenance Manager and Director of Operations work on preparing PPAP documentation including FMEA.</p>	X		

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1.5	<p>Are all heat treat related and referenced specifications current and available? For example: SAE, AIAG, ASTM, General Motors, Ford, and DaimlerChrysler.</p>	<p>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.</p>	<p>Documents published by SAE, AIAG, ASTM, and other relevant standards are identified and checked for their validity by Quality Assurance Manager. Quality Assurance manager will ensure that appropriate documents are available at all locations or in a suitably identified location for review by all personnel involved in operations. The pertinent issues of these documents and data are available at all locations or workstations. They are controlled under "External Origin Documents Form Binder" form# AWI5.2-F2 which identifies the document name, and the latest issue date to prevent inadvertent use of invalid or obsolete documents. Obsolete documents will be maintained in the Quality Assurance office. The Quality Assurance Manager is responsible for any Updating or changes. Quality Assurance Manager will maintain a log to identify the current update Status (Form : AWI 5.2-F2 Identification of Obsolete Documents).</p>	X	
1.6	<p>Is there a written process specification for all active processes?</p>	<p>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.</p>	<p>Processes are specified under Section AWI9.1 (Control of Manufacturing Processes). All active processes have written procedures, work instructions and forms covering process specification.</p>	X	

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1.7	<p>To demonstrate 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 requirements. 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 followed in case capability indices fall outside customer requirements or established ranges.</p> <p>Has a valid product capability study been performed initially and after process equipment has been relocated, or had a major rebuild?</p>	<p>Major Rebuild provision defined under Work Instruction AWI 10.2.Process Capability analysis are conducted for each individual part when submitting PPAP.SPC documents- 6/27/2005 was Observed.</p>	X			
1.8	<p>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.</p> <p>Does the heat treater collect and analyze data over time, and react to this data?</p>	<p>Part of regular management review meetings. Analysis and graphs were observed-(sample:Meeting of Oct 27,2006)</p>	X			

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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.	There are "Production Inspection Reports" recording heat treating parameters to be filled during shift (Form: 9.2.4-2) and shall be reviewed by Production Manager and Quality Assurance Manager.	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 Audit records (Form AWI 13.1-F2) and CQI-9 Ver. 2 observed.	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.	Rework instruction AWI 11.4 outlines reworking process. After detecting and identifying the nonconforming material the material will be moved to the HOLD AREA and clearly marked with the HOLD tags. The Q.A associate reviews the nonconformance and if required confers with the department manager/supervisor to confirm that the nonconformance is applicable. Once the condition is confirmed the Q.A associate will complete a Nonconformance Report and enters the NCR number into the NCR logbook, Form- AWI 11.1-F3. The Q.A manager, to inform the customer of the nonconforming condition to receive their approval on rework. The Quality Rep. and/or Director of Operations sign the Closeout.	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.	Customer Feedback Questionnaire : AWI 3.2.1-F1. Open doors policy for staff to put forward their concerns, log books, board,etc	X		

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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.	Part of regular management review meetings. Analysis and graphs were observed-(sample:Meeting of Oct 27,2006)	X		
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.	Yes, under "Control of Non-conforming Product-AWI 11.1"	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.	Procedures are established for ensuring that all heat treating processes are identified, planned, documented, and carried out under controlled conditions. Potential emergencies are identified under work instruction AWI 9.1	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.	Section 4 of Quality Manual & AWI 4.1-FCT1: Each new employee will be provided with a thorough orientation to their job, department, the Company, and its policies and practices, including health and safety. This policy is applicable to all associates of Allied Heat treat Limited (including contract or agency associates). The qualification requirements for each function is outlined by the management. Training effectiveness evaluation done after training and results discussed in management meetings.	X		

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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.	Quality Manual-Appendix 2 is developed and accessible by management team.	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.	Procedures & Work Instructions-Section 10-Forms AWI 10.2 series are developed To establish and maintain documented procedures to control, calibrate and maintain inspection, measuring and test equipment.	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.	Inventory of such spare parts is maintained by Maintenance department .Section 6 of Quality Manual & AWI 6.1	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.	AWI 10.1- CONTROL OF INSPECTION	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.	AWI 8.1 IDENTIFICATION, TRACEABILITY	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.	AWI 8.1 IDENTIFICATION, TRACEABILITY	X		

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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.	Nonconforming products are adequately identified and segregated to prevent inadvertent use or release to the customer. When nonconforming (or suspect) product is discovered, the employee who identified the material, put material in designated hold area and attach a nonconforming tag and documents the information. The associate forwards the NCR to Quality Assurance Manager for evaluation and disposition (AWI 11.1- CONTROL OF NON CONFORMING PRODUCT)	N/A	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.	YES, AWI 11.1- CONTROL OF NON CONFORMING PRODUCT		X	
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.	INSPECTION & TESTING: AWI 9.2		X	

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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.	YES, PRODUCTION CONTROL SHEET AWI 9.2.4-F3		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.	Section 4 of Quality Manual & AWI 4.1-FC1: Each new employee will be provided with a thorough orientation to their job, department, the Company, and its policies and practices, including health and safety. Orientation also includes material handling, containment action and product segregation in the event of an equipment emergency including power failure.		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.	Handling, storage, and packaging of customer supplied parts are done as requested by the customers. Items received verified stored and maintained to prevent deterioration or loss under same system as products purchased by company. Applicable packing, packaging and labeling processes are performed according to any documented customer / company instructions (i.e. skids, crates, shrink wrap and boxes) and are appropriate for transit and preservation. Product prior to use or shipment will be evaluated for deterioration.		X		

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2.10	Are plant cleanliness, housekeeping, environmental and working conditions conducive to control and improved quality?	Plant cleanliness, housekeeping, environmental, 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.	Monthly inspections are in place to ensure plant cleanliness, proper lighting and safety concerns (AWI 10.2) & WORKPLACE AUDIT FORM AHS-F-01	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.	Parts are pre-washed if found oily or contaminated. Rust inhibitor is also added to finished parts to prevent rust.	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 timing, delay, temperature, level and agitation is checked for every single job. The Quench system is being maintained and regularly checked using PM schedules.	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.	YES, PH and TITRATION are checked weekly and records are kept.	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 checked for every single job and per each shift. A daily inspection form (AWI 9.2.4) is developed and is used as control sheet.	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.	AWI 9.2.4 IN PROCESS/FINAL INSPECTION	X		

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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.	AWI 10-F1 -CALIBRATION EQUIPMENT LIST		X	

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Section 3 - Equipment							
3.1	Do furnaces, generators, and quench systems have proper 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.	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.	TEMPERATURE RECORDER HONEYWELL DR 4200		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.	AWI 10-F1 -CALIBRATION EQUIPMENT LIST		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.	JACK WADE COMBUSTION CALIBRATING COMPANY -SECTION QCI		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.	JACK WADE COMBUSTION CALIBRATING COMPANY -SECTION QCI		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.	OVERTEMPERATURE RECORDER HONEYWELL DCP 700		X		

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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.	AWI 10.2 MAINTAINANCE FORMS		X		
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.	All furnaces and generators are constantly checked by using appropriate Probes.AWI 10.2 MAINTAINANCE FORMS		X		
		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.			X		

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Question Number	Question	Requirements and Guidance	Objective Evidence	Assessment	
				N/A	Satisfactory
3.8	<p>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?</p>	<p>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:</p> <ul style="list-style-type: none"> • Carbon bar or slug • Shim stock • 3-gas analyzer • Dew point • Hot wire resistance 	<p>A Third party calibrating company "JACK WADE COMBUSTION CALIBRATING COMPANY" does all the calibration. Actual atmosphere carbon potential/dew point readings are done on a daily basis and records are kept.</p>	X	

Special Process: Heat Treat System Assessment						
Question Number	Question	Requirements and Guidance	Objective Evidence	Assessment		
				N/A	Satisfactory	Not Satisfactory
3.9	Are all ammonia lines equipped with quick disconnects or a three valve fail safe vent system?	<p>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.</p> <ul style="list-style-type: none"> 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. 	YES. All furnaces have Ammonia disconnect fail safety system.	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?	<p>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.</p>	YES	X		
3.11	Do all atmosphere furnaces and generators have flow scopes or flow meters for all gases?	<p>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.</p>	YES	X		

Special Process: Heat Treat System Assessment						
Question Number	Question	Requirements and Guidance	Objective Evidence	Assessment		
				N/A	Satisfactory	Not Satisfactory
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.		X		
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.	Salt level and chemistry is monitored regularly. Form AWI 10.2-CL 01/1 is developed to cover the whole maintenance requirements for Austenitizing furnace.		X	
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. <ul style="list-style-type: none"> 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. 	Quench Oil analyzed quarterly by APCO INDUSTRIES CO. for its Viscosity, water content, suspended solids, etc. and records kept.		X	

Special Process: Heat Treat System Assessment						
Question Number	Question	Requirements and Guidance	Objective Evidence	Assessment		
				N/A	Satisfactory	Not Satisfactory
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.		X		
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. <ul style="list-style-type: none"> • 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. 		X		
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. <ul style="list-style-type: none"> • 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. 		X		
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.		X		
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		X		

Section 4 - Job Audit

Job Identity: Customer: Theta Industries Limited
 Shop Order Number: 62139
 Part Number: 10WMG010-005H
 Part Description: LOCK INTERFACE UNF
 Material: As Supplied By Customer
 Heat Treat Requirements: FULL HEAT TREATING

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	Customer/Internal requirement	Contract Review AWI 3.1.1, FMEA, Control Plan as part of PPAP are performed and provided to customers upon their request.	P.O: SP02588	Pass
4.2	Does the heat treat facility have the customer specifications for the part?	1.5	Customer/Internal requirement	Customer Order Processing AWI 3.1	P.O: SP02588	Pass
4.3	Is a shop traveler created to meet customer requirements?	1.6 2.1	Internal	Production Control Sheet AWI 9.2.4-F3	Process Control Plan	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	Identification & Tracability AWI 8.1	Process Control Plan	Pass
4.5	Is there documented evidence of Receiving Inspection?	2.1	Internal	Receiving Instruction AWI 9.2.2	Process Control Plan	Pass
4.6	Are the Loading / Racking requirements identified?	1.6 2.7 2.9	Internal	Control of Manufacturing Process AWI AWI 9.1	Atmosphere Furnace T9 AWI 9.1.1-22	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	Production Control Sheet AWI 9.2.4-F3 Heat Treating Operating Parameters AWI 9.1.2	Production Control Sheet AWI 9.2.4-F3	Pass

Section 4 - Job Audit

Job Identity: Customer: Theta Industries Limited
 Shop Order Number: 62139
 Part Number: 10WMG010-005H
 Part Description: LOCK INTERFACE UNF
 Material: As Supplied By Customer
 Heat Treat Requirements: FULL HEAT TREATING

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	Correct hardness and specific heat treating properties required.			
4.8.1	Requirement: (1) HARDNESS					
	Test Method:	2.15	Internal	ASTM E18-92	Process Control Plan	Pass
	Test frequency or quantity:	2.15	Internal	Sampling AWI 9.2.1-F1	Process Control Plan	Pass
	Selection of samples:	2.15	Internal	RANDOM	Process Control Plan	Pass
	Specification:	2.15	Internal	TABLE : MIL-STD-105E	Process Control Plan	Pass
4.8.2	Requirement: (2)					
	Test Method:					
	Test frequency or quantity:					
	Selection of samples:					
	Specification:					
4.8.3	Requirement: (3)					
	Test Method:					
	Test frequency or quantity:					
	Selection of samples:					
	Specification:					
4.8.4	Requirement: (4)					
	Test Method:					
	Test frequency or quantity:					
	Selection of samples:					
	Specification:					

Section 4 - Job Audit

Job Identity: Customer: Theta Industries Limited
 Shop Order Number: 62139
 Part Number: 10WMG010-005H
 Part Description: LOCK INTERFACE UNF
 Material: As Supplied By Customer
 Heat Treat Requirements: FULL HEAT TREATING

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	Production Control Sheet AWI 9.2.4-F3	Process Control Plan	Pass
4.10	Were all inspection steps, as documented in the control plan performed?	1.2 1.4	Internal	Production Control Sheet AWI 9.2.4-F3	Process Control Plan	Pass
4.11	Were steps/operations performed that were not documented in the control plan?	1.2 1.4 1.6	N/A			
4.12	If additional steps were performed, were they authorized?	1.2 1.4 1.6 1.11 1.17	N/A			
4.13	Does the governing specification allow reprocessing or rework?	1.11	N/A			
4.14	If the order was certified, did the certification accurately reflect the process performed?	2.14 2.15	Internal	Production Control Sheet AWI 9.2.4-F3	Process Control Plan	Pass
4.15	Was the certification signed by an authorized individual?	1.17	Internal	Production Control Sheet AWI 9.2.4-F3	Process Control Plan	Pass
4.16	Are the parts and containers free of inappropriate objects or contamination?	2.6 2.11	Internal	Control of Manufacturing Process AWI AWI 9.1	Atmosphere Furnace T9 AWI 9.1.1-22	Pass

Section 4 - Job Audit

Job Identity: Customer: Theta Industries Limited
 Shop Order Number: 62139
 Part Number: 10WVG010-005H
 Part Description: LOCK INTERFACE UNF
 Material: As Supplied By Customer
 Heat Treat Requirements: FULL HEAT TREATING

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
Packaging Requirements						
4.17	Are packaging requirements identified?	2.9		Production Control Sheet AWI 9.2.4-F3	Process Control Plan	Pass
4.18	Are parts packaged to minimize mixed parts (for example, parts packed over height of container)?	2.9		Production Control Sheet AWI 9.2.4-F3	Process Control Plan	Pass
Shipping Requirements						
4.19	Were the parts properly identified?	2.3 2.9		Identification & Tracability AWI 8.1	Process Control Plan	Pass
4.20	Were the containers properly labeled?	2.3 2.9		Identification & Tracability AWI 8.1	Process Control Plan	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.	Yes	N/A	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.	Yes	N/A	Yes
A1.3	1.18	A program for furnace and generator burnout is required (applies to carbon bearing atmospheres).	Yes	N/A	Yes
A1.4	3.2	Furnace weigh scales shall be verified quarterly and calibrated annually at a minimum.	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.	-----	-----	-----
A1.6	3.2	Verification of calibration of spectrometers, and carbon IR combustion analyzers, shall be checked daily or prior to use.	-----	-----	-----
A1.7	3.2	Verification of calibration of 3-gas analyzers with zero gas and span gas shall be performed weekly at a minimum.	-----	-----	-----
A1.8	3.2	Oxygen probe controllers shall be calibrated quarterly at a minimum.	Yes	N/A	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.	-----	-----	-----
A1.10	2.16	Files shall be verified daily (or prior to use) with provers per SAE J864.	-----	-----	-----
A1.11	3.2	Refractometers (typically used to check polymer quenchant and washer solutions) shall be verified daily (with distilled water) and calibrated annually (per manufacturer's requirements) at a minimum.	-----	-----	-----

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.	Yes	N/A	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.	Yes	N/A	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.	Yes	N/A	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.	Yes	N/A	-----
A2.5	3.5	Recorded temperature(s) for austenizing 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).	Yes	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
A2.6	3.5	Recorded temperature(s) 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).	Yes	N/A	-----
A2.7	3.2	Infrared pyrometers shall be calibrated to a black body furnace annually.			-----

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 instrument(s).	Each batch or continuous recording with sign-off every 2 hours. Alarm systems satisfy the sign-off requirement.	N/A	Each Shift
A3.2	1.4 2.14 3.7	Monitor generator atmospheres.	-----	-----	Continuous
A3.3	1.4 2.14 3.7	Monitor primary furnace atmosphere control(s)**.	Continuous recording with sign-off every 2 hours. Alarm systems satisfy the sign-off requirement.	N/A	-----
A3.4	1.4 2.14 3.7	Verify primary atmosphere control method by back-up method**.	Daily	N/A	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.	Daily	N/A	-----
A3.6	1.4 2.12	Quench Media Process Parameters			
		- Temperature	Each batch or continuous recording with sign-off every 2 hours. Alarm systems satisfy the sign-off requirement.	N/A	-----
		- Quench Level	Daily	N/A	-----
		- Agitation	- Daily visual check is required. - Monitor each load in the absence of an alarm system.	N/A	-----
A3.7	1.4 2.14	Monitor time in furnace, cycle time or belt speed.	Each batch	N/A	-----
A3.8	1.4 2.7	Monitor load size or fixturing or loading rate as applicable.	Each batch	N/A	-----
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.	Each batch	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	Daily per furnace	N/A	-----
A4.2	1.4 2.15	Surface hardness	Each batch	N/A	-----
A4.3	1.4 2.15	Core hardness (when specified)	Each batch	N/A	-----
A4.4	1.4 2.15	Case depth (when specified)	Each batch	N/A	-----
5.0		QUENCHANT AND SOLUTION TEST FREQUENCIES			
A5.1	2.12 3.14	Polymer Quench Media - Concentration - Quenchability Check; e.g., cooling curve, viscosity, or titration	Daily Every six months	N/A N/A	----- -----
A5.2	2.12 3.14	Water Quench Media - Suspended solids	Every six months	N/A	-----
A5.3	2.12 3.14	Salt Quench Media - Analysis & Contaminants	Every six months	N/A	-----
A5.4	2.12 3.14	Brine or Caustic Quench Media - Concentration and/or Specific Gravity. - Suspended solids	Daily Every six months	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.	Quarterly	N/A	-----
A5.6	2.13	Rust Preventive - Soluble Oil - Concentration	2x / week	N/A	-----
A5.7	2.11	Washers - Concentration of cleaner - Temperature of solution (required if temperature is specified to be above ambient temperature).	Daily Each shift	N/A N/A	----- -----

PROCESS TABLE E - Annealing / Normalizing / Stress-Relieving

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			
E1.1	3.1 3.7	All furnaces, generators and quench systems (where applicable) shall have temperature indicating instruments.	Yes	N/A	Yes
E1.2	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.	Yes	N/A	Yes
E1.3	3.2	Furnace weigh scales shall be verified quarterly and calibrated annually at a minimum.	Yes	N/A	-----
E1.4	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. This is applicable when used in controlling carbon-bearing atmospheres.	-----	-----	-----
E1.5	3.2	Verification of calibration of spectrometers, and carbon IR combustion analyzers, shall be checked daily or prior to use. This is applicable when used in controlling carbon-bearing atmospheres.	-----	-----	-----
E1.6	3.2	Verification of calibration of 3-gas analyzers with zero gas and span gas shall be performed weekly at a minimum. This is applicable when used in controlling carbon-bearing atmospheres.	-----	-----	-----
E1.7	3.2	Oxygen probe controllers shall be calibrated quarterly at a minimum. This is applicable when used in controlling carbon-bearing atmospheres.	Yes	N/A	Yes
E1.8	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.	-----	-----	-----

PROCESS TABLE E - Annealing / Normalizing / Stress-Relieving

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			
E2.1	3.2 3.3	Thermocouples and calibration of thermocouples shall conform to AMS 2750D.	Yes	N/A	Yes
E2.2	3.2 3.3	Instrument Calibration per AMS 2750D shall be quarterly at a minimum. Frequency reductions per AMS 2750D are not allowed.	Yes	N/A	Yes
E2.3	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 +/- 5C (or +/- 10F) of a CTTS at the operating temperature range; this checked shall be performed monthly. (2) The relationship between the CTS and R-T/C at the operating temperature range shall be within +/- 1C (or +/- 2F) of their relationship determined at the time of the most recent temperature uniformity survey; this checked 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 bi-annually every two years at a minimum. Protection Tubes shall be visually checked at same frequency as thermocouples.	Yes	N/A	Yes

PROCESS TABLE E - Annealing / Normalizing / Stress-Relieving

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
E2.4	3.4	<p>Temperature Uniformity Survey (TUS): refer to AMS 2750D for procedures. TUS frequency shall be annual and after major rebuild.</p> <p>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).</p> <p>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.</p> <p>Frequency reductions per AMS 2750D are not allowed.</p>	Yes	N/A	-----
E2.5	3.5	<p>Recorded temperature(s) 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).</p>	Yes	N/A	-----

PROCESS TABLE E - Annealing / Normalizing / Stress-Relieving

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			
E3.1	1.4 2.14	Monitor primary temperature control instrument(s).	Each batch or continuous recording with sign-off every 2 hours. Alarm systems satisfy the sign-off requirement.	N/A	Each Shift
E3.2	1.4 2.14 3.7	Monitor generator atmospheres	-----	-----	Continuous
E3.3	1.4 2.14 3.7	Monitor primary furnace atmosphere control(s)**.	Continuous recording with sign-off every 2 hours. Alarm systems satisfy the sign-off requirement.	N/A	-----
E3.4	1.4 2.14 3.7	Verify primary atmosphere control method by back-up method**.	Daily	N/A	Daily
E3.5	1.4 2.14 3.13	For salt baths: check salt chemistry (soluble oxides) in salt baths or decarburization on the parts.	Daily	N/A	-----
E3.6	1.4 2.14	Monitor time in furnace, cycle time or belt speed.	Each batch	N/A	-----
E3.7	1.4 2.7	Monitor load size or fixturing or loading rate as applicable.	Each batch	N/A	-----
4.0		IN-PROCESS/FINAL TEST FREQUENCIES			
E4.1	1.4 2.15	Microstructure (when specified)	Daily per furnace	N/A	-----
E4.2	1.4 2.15	Surface hardness (when specified)	Each batch	N/A	-----
E4.3	1.4 2.15	Core hardness (when specified)	Each batch	N/A	-----
5.0		SOLUTION TEST FREQUENCIES			
E5.1	2.13	Rust Preventive - Soluble Oil			
		- Concentration	2x / week	N/A	-----
E5.2	2.11	Washers			
		- Concentration of cleaner	Daily	N/A	-----
		- Temperature of solution (required if temperature is specified to be above ambient temperature).	Each shift	N/A	-----