Special Process: Heat Treat System Assessment

Facility Name: American Metal Processing Company			
Address: 22720 Nagel Street, Warren, MI, 48089			
Phone Number: 586-757-7337		Fax Number: 586-757-8232	
Date of Assessment:	4/10/2024	Date of Previous Assessment:	4/10/2023
Internal (Captive) Heat Treater (Y/N):	N	Commercial Heat Treater (Y/N):	Y

Type(s) of Thermal Processing at this Facility:

Process Table A		**Process Table D**	
Carburizing	Yes	Induction Heat Treating	No
Carbonitriding	Yes	**Process Table E**	
Carbon Restoration	No	Annealing	No
Neutral Hardening (Quench and Temper)	Yes	Normalizing	No
Austempering / Martempering	No	Stress-Relieving	No
Tempering	Yes	**Process Table F**	
Precipitation Hardening / Aging	No	Low Pressure Processing (Carburizing / Carbonitriding / Neutral Hardening)	No
Process Table B		**Process Table G**	
Nitriding (Gas)	No	Sinter Hardening	No
Ferritic-Nitrocarburizing (Gas or Salt)	No	**Process Table H**	
Process Table C		Ion Nitriding	No
Aluminum Heat Treatment	No	**Process Table I**	
		Hot Stamping	No

Current Quality Certification(s): IATF 16949:2016, IATF Certificate Number 0494075, Certificate Number 5465; ISO 9001:2015, Certificate Number 5466

Date of Re-assessment (if necessary):

Personnel Contacted:

Name:	**Title:**	**Phone:**	**Email:**
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Auditors/Assessors:

Name:	**Company:**	**Phone:**	**Email:**
Ryan Currier	Plant Manager	586-757-7337, x-111	ryan@ampht.com
Devyn Jesiel	Quality Manager	586-757-7337, x-106	devyn@ampht.com

Number of "Not Satisfactory" Findings: 0

Number of "Needs Immediate Action" Findings: 0

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

Section 1 - Management Responsibility and Quality Planning

Please describe Objective Evidence for each Requirement

1.1	Is there a dedicated and qualified heat treat person on-site?

To ensure readily available expertise the following requirements shall be met.

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
There shall be a dedicated and qualified full-time heat treat person on site.	Quality Manager, Plant Manager, Sales Manager, President have 10+ yrs experience in heat treat operations. AMP has experienced operators and lab technicians, with a minimum of 5 years experience in heat treat operations, on each shift.		X		
The position shall be reflected in the organization chart.	Organizational Chart is part of the Quality Management System (QMS), and is available for viewing on AMP's Intranet.		X		
A job description shall exist identifying the qualifications for the positions including appropriate metallurgical and heat treat knowledge for the individuals.	Job Descriptions are part of the Quality Management System (QMS), and are available for viewing on AMP's Intranet.		X		
Evidence shall be available regarding the qualifications with a minimum of 5 years experience in heat treat operations or as a combination of a minimum of 5 years of formal metallurgical education and heat treat experience.	Quality Manager, Plant Manager, Sales Manager, President have 10+ yrs experience in heat treat operations.		X		
Comments:					

1.2	Does the heat treater perform advanced quality planning?

The organization shall incorporate a documented advance quality planning process. A structured system for such process with the APQP elements is recommended, samples are available in the AIAG APQP manual or other equivalent national automotive industry standards. Similar parts can be grouped into part families for this effort as defined by the organization.

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
There shall be documented advance quality planning procedure available.	AIAG APQP and Control Plan manual, 2nd Ed, Appendix D TEAM FEASIBILITY COMMITMENT is incorporated in AMP database for each PN.		X		
Feasibility studies shall be performed and internally approved for each part or group of similar parts.	APQP Planning and Team Feasibility Studies are done by a cross-functional team. In the case of a new part which is part of a family of parts, the Team Feasibility Study can be completed by only one of the Team Members.		X		
There shall be a documented system for process changes with approval by the customer.	Process changes are electronically documented (recorded) in computer part file change logs.		X		
Comments:					

1.3	Are heat treat FMEAs up to date and reflecting current processing?

Failure Mode and Effects Analysis (FMEA) for processes (PFMEA) is mandatory for the prevention of product/process failure modes and final product concerns. Examples of appropriate methods and standards include SAE J1739, AIAG & VDA FMEA Handbook.

	Assessment

Requirements	Objective Evidence	N/A	Satisfactory	Not Satisfactory	Needs Immediate Action
There shall be a documented Failure Mode and Effects Analysis (FMEA) procedure with the present FMEAs updated and reflecting the current part quality status.	Process Failure Mode and Effects Analyses (PFMEAs) are process-specific (Carburizing, Carbonitriding, and Neutral Hardening).		X		
FMEAs shall address all process steps from part receipt to part shipment and all the key heat treat process parameters as defined by the organization.	PFMEAs address each process step and heat treat process parameters.		X		
All special characteristics, as defined by the organization and its customers, shall be identified, defined, and addressed in the FMEA.	All special characteristics, as defined by AMP and/or its customers, are identified, defined, and addressed in the PFMEA and in the specific part recipes.		X		
A cross-functional team shall be used in the development of the FMEA and shall be consistent with all associated documentation such as Control Plans, work instructions and shop travelers.	A cross-functional team, is used in the development of the PFMEAs, which are maintained and controlled by the Quality Department.		X		
Comments:					

1.4	**Are heat treat process control plans up to date and reflecting current processing?**

Reference automotive industry Control Plan guidelines. The Control Plan may be specific for each part or part family or it can be process specific and written for each process. In any case it describes required controls and actions for each process step as well as periodic requirements to assure process is in control.

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
The organization shall incorporate the use of a documented Control Plan reflecting the current process.	Control Plans are process-specific (Generic Carburizing, Carbonitriding, and Neutral Hardening Control Plans are available). The Control Plans are maintained and controlled by the Quality Department.		X		
Control Plans 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.	Control Plans address each process step and key heat treat process parameters as defined by AMP and/or its Customers.		X		
A cross-functional team shall be used in the development of the Control Plan and shall be consistent with all associated documentation such as FMEAs, work instructions and shop travelers.	A cross-functional team, 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).		X		
All special characteristics as defined by the organization or its customers shall be identified, defined, and addressed in the applicable control plan.	All special characteristics, as defined by AMP and/or its customers, including Safety Items (Inverted Delta) are identified, defined, and addressed in the Control Plans and part-specific recipes.		X		
Sample sizes and frequencies for evaluation of process and product characteristics shall be addressed and shall be consistent with the minimum requirements listed in the applicable Process Table.	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		X		
Comments:					

1.5	**Are all heat treat related and referenced specifications current and available? For example: Material standards, SAE, AIAG, ASTM, General Motors, Ford, and FCA.**

A document control system is pertinent for the handling and internal distribution of received customer specifications and to keep up to date with national or global standards related or close to heat treat processes.

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
The organization shall have a procedure and process to ensure the timely review, distribution and implementation of all customer and industry engineering standards/specifications and changes based on customer-required schedule.	All related heat treat and customer-referenced standards and specifications are available for use and viewing via AMP's own Intranet. These standards and specifications are requested from the customers at the time of quotation of the parts, are saved into the electronic database within one week, and are available for viewing or printing on the AMP Intranet.		X		
The organization shall have all related heat treat and customer referenced standards and specifications available for use, like but not limited to SAE, AIAG, ASTM, ISO, EN, JIS, General Motors, Ford, and FCA.	As applicable		X		
The procedure shall include a 2-week distribution limit for cascading newly received and reviewed documents.	Updates to referenced standards and specifications are usually obtained from customers, reviewed at AMP Staff/Quality Meetings for possible impact on processes and implementation timetables, and then saved into the electronic database within one week of receipt, for viewing availability on the AMP Intranet.		X		
Comments:					

1.6	**Is there a documented system to create process specifications for all active processes?**

A documented system for creating process specifications is necessary for operating the heat treat process within the desired, requested process parameters to reach the final product specifications. Examples of process parameters include process temperatures, cycle times, load rates, atmosphere or gas flow settings, belt speeds, quench agitation speeds, etc.

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
Authorization shall be defined to a responsible person (see 1.1) for establishing process specification for the heat treatment of the products with the available equipment.	Only key personnel can access, create, or modify computer-based part recipes. These are password protected.		X		
The heat treater shall have written process specifications for all active processes and identify all steps of the process including relevant process parameters.	Computer-based recipes for each part number include all process parameters, including process steps, tolerances, specifications, cycle times, gas flows, and process temperatures.		X		
Parameters shall have operating tolerances as defined by the organization in order to maintain process control.	All process parameters have operating tolerances.		X		
Process specifications shall be available in the form of work instructions, job card, computer-based recipes, or other similar documents.	Computer-based recipes for each part number, also printed shop travelers/WO		X		
All process specification changes shall be reviewed to the extent necessary to ensure continued conformity with customer requirements for process changes.	If process changes are deemed necessary, they are reviewed by key personnel and/or customer. Incoming steel quality is a major factor in demanding some recipe changes.		X		
All process specification changes shall be documented to include the date the process specification change was implemented and the person(s) approving the change.	Recipe history log is available.		X		
Comments:					

1.7	**Has the heat treat process been validated initially and after process equipment has been relocated, or had a major rebuild or modification?**

To demonstrate each heat treat process is capable of yielding acceptable product, the organization shall perform process validation as part of the initial validation of each process, after relocation of any process equipment or heat treat location change, and after a major rebuild of any equipment. Each process line may include a combination of equipment that is integrated in the performance of a heat treat process, e.g. hardening, quenching and tempering.
(Heat treat process validation consists of robust heat treat equipment, rigorous process controlling and monitoring requirements and calibrations, appropriate test equipment calibrations, and strategic product sampling techniques.)

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
The organization shall define what constitutes a major rebuild or modification that may impact product characteristics.	Decrease/increase in min/max operating temperatures, change in burner's position or size, furnace location, increase/decrease work zones.		X		
Process validation shall be performed on full production load, or production run, with production intended fixturing and load configuration.	If a major rebuild is performed, process validation will be performed on full loads. Capability Studies for Surface Hardness (if discrete Surface Hardness data is required) are automatically generated for each and every Work Order processed and can be readily accessed for each Work Order.		X		
An action plan shall exist if process control parameters or any of the product characteristics fall outside of the control tolerance limits or the heat treater does not conform to the respective Process Table.	QMS 8.7.1.7 Non-Conforming Material Process process map		X		
The heat treater shall demonstrate that all parts in the heat treat process (heat treat batch or production run) will meet customer specifications. Samples for these tests shall be selected that best represent the entire production load population. • An acceptable guideline for test sample locations is to use those loading locations prescribed for temperature uniformity surveys. • An acceptable guideline for induction hardening is to show a representative number of parts produced at the extremes of process parameter's tolerances meet customer specifications. Standard process capability indices may also be used to show compliance.	A heat treat certification is released upon completing each work order. Test results are electronically retained as documented information. The sampling plan is defined and followed for each part number, per part recipe. Capability Studies for Surface Hardness (if discrete Surface Hardness data is required) are automatically generated for each and every Work Order processed and can be readily accessed for each Work Order.		X		
Comments:					

1.8	**Does the heat treater collect and analyze data over time, and react to this data?**

The analysis of product characteristics (e.g. tensile strength) and processes parameters (e.g. temperature) over time can yield vital information for defect prevention efforts. Examples include but are not limited to product property trend charts, scrap trends, and variation in process parameter recordings.

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
The organization shall have a system to collect, analyze, and react to product or process data over time.	Product and process data is collected and analyzed for every work order and electronically stored. An analysis is done with each new created work order. See below.		X		

Methods of analysis shall include ongoing trend or historical data analysis of product characteristics or process parameters.	Historical Surface/Core Hardness, Case Depth data for each part (last 5 Work Orders processed) is displayed on each Work Order, including steel chemistry information (assumed or as supplied by Customer), Surface/Core Hardness (Min & Max) out of Quench, Tempering Temperature, and Surface/Core Hardness (Min & Max) out of Temper, Case Depth (Min & Max). Surface Hardness and Tempering Temperature historical data helps our associates to determine the best tempering temperature for current Work Order.		X		
The organization shall determine which parameters are included in such analysis.	Parameters are noted in the part recipe.		X		
Comments:					

1.9	**Is the heat treat monitoring system reviewed by Qualified Personnel?**				
This review is intended to be a second level review in addition to those performed by the heat treat operators. This review would be performed by qualified personnel as defined per question 1.17. 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.					
		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
Qualified Personnel shall review the furnace monitoring systems at intervals not to exceed 24 hours.	AMP has installed and implemented a real-time heat treat monitoring system/data acquisition system on all hardener furnaces, temper furnaces, and generators. This is currently available for viewing at a dedicated computer & monitor in the Laboratory, at the Supervisor's Station out in the plant, Office area and by management on their home PCs or smart phones. All of the selected process parameters (zone temperatures, etc) are viewable, in real time, at any computer monitor tied into the monitoring network at AMP, and by management at their home PCs or smart phones. Plant manager/maintenance review the furnace monitoring systems daily.		X		
The process of reviewing the furnace data shall be documented. This requirement also applies to computerized data.	Alarms log.		X		
This second level review shall include detection and reaction to out of control conditions or alarms. This reaction shall be documented.	Alarms log.		X		
Comments:					

1.10	**Are internal assessments being completed on an annual basis, at a minimum, using AIAG HTSA?**				
The internal assessment includes a completed job audit and process table for each applicable process.					
		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
The organization shall conduct internal assessments on an annual basis, at a minimum, using the current revision of the AIAG HTSA.	Internal heat-treat assessments are being performed on an annual basis, at a minimum, using the AIAG HTSA. Assesments are available for review.		X		

Comments:

1.11	**Does the heat treater have a documented procedure for the rework/reprocessing of parts?**

Rework/Reprocessing of heat treated components can have a significant impact on the performance of the component. Reworking/Reprocessing in some cases is an acceptable practice. A rework/reprocessing procedure is key to identifying the rework/reprocessing practice. To be approved for rework/reprocessing, either on a case by case basis or pre-approved in the PPAP, the heat treater shall meet the following requirements.

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
Any change or addition to the rework/reprocessing procedure shall require notification and approval in accordance with the AIAG PPAP process. Any rework/reprocessing not previously approved and identified in the rework/reprocessing procedure is not allowed.	The customer is notified when parts are reprocessed in the heat treat operation, on a case-by-case basis. However, Retempering is normally not considered as reprocessing or rework, so customer notification for Retempering is a rare occurrence.		X		
The OEM shall be notified by the Tier 1 supplier prior to rework/reprocessing product utilizing an unapproved process. If not Tier 1, the customer shall be notified.	The customer is notified when parts are reprocessed in the heat treat operation, on a case-by-case basis.		X		
The rework/reprocessing procedure shall be referenced in the heat treater's PPAP approved PFMEA and process control plan.	A Quality Procedure for Reworking / 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 translated into several different Metrics by AMP, primarily to confirm the continuous reduction in number of Reworks and the reduction in the percentage of Reworks against the total Work Orders processed.		X		
The rework/reprocessing procedure shall include the following: • A description of product characteristics for which rework/reprocessing is allowed and those characteristics for which rework/reprocessing is not permissible. • A requirement that all rework/reprocessing activity have a new process control sheet issued by qualified personnel; this new process control sheet shall include the heat treat parameter modifications. • A requirement that there is a record or log of all rework/reprocessing work. • A description of the sampling plan. • A requirement that the Quality Manager or a designee shall authorize the release of rework/reprocessed product.	Special Yellow Rework Form, issued, filled out, and signed by designated qualified technical personnel. Sampling plan is included. Complete record documentation is kept of each Rework and the Rework Information is tracked. HT certification signed by QM or designee.		X		
Comments:					

1.12	**Does the Quality Department review, address, and document customer and internal concerns?**

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**

The quality management system shall include a process for documenting, reviewing, and addressing customer concerns and any other concerns internal to the organization.	Internal and Customer concerns are reviewed and addressed in documented Staff/Quality Meetings, using disciplined problem-solving. The documented concerns are tracked in the Staff/Quality Meeting Minutes until the concerns are resolved and closed.		X		
A disciplined problem-solving approach shall be used.	Depending on the nature of the concern, the concerns may be written up formally on a DMR (Defective Material Report) form, which uses an 8-D format, for additional visibility.		X		
Comments:					

1.13	**Does the organization have a Continual Improvement Plan (CIP)?**				
Continual improvement is an ongoing effort in the organization to improve processes, services, or products. These efforts may seek incremental improvement over time or breakthrough improvement all at once. A CIP identifies specific continual improvement items, responsibilities and estimated completion dates. Downtime reports, scrap reports, preventive maintenance reports, energy consumption, use of medias, etc., may be used to develop a CIP.					
		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
The organization shall have continual improvement plan(s).	Continual improvement plans focus on the highest occurring problems in Quality and Productivity, with quarterly reporting on the various metrics, including trend lines to gauge the effectiveness of the problem resolutions.		X		
The CIP shall have specific action items, identify responsibilities and target completion dates for each action item.	Part of Staff Meetings agenda		X		
The organization shall show evidence of program execution.	Part of Staff Meetings agenda		X		
Comments:					

1.14	**Does the organization have a documented procedure for the control of nonconforming material?**				
This practice is the responsibility of the manufacturers' quality management organization and their included personnel. The procedure should best describe the complete process with the handling of nonconforming or suspect products, beginning with detection and the authorization/obligation to quarantine those products up to the final decision and disposition in quarantine status.					
		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
The documented procedure shall specify the responsibilities for handling segregation and disposition of suspect or non-conforming products.	QMS 8.7.1.7 Non-Conforming Material Process process map. The Quality Manager is responsible for implementing the Quality Procedure for disposition of Quarantined Material, as addressed in the QMS.		X		
The organization shall keep records showing evidence of process being followed.	Rework log and Staff Meetings.		X		
Comments:					

1.15	**Are there procedures or work instructions available to the heat treat personnel that define the heat treating process?**
	Assessment

Requirements	Objective Evidence	N/A	Satisfactory	Not Satisfactory	Needs Immediate Action
There shall be procedures or work instructions available to all employees involved in heat treating and inspection of heat treated product.	Operational Procedures and/or Work Instructions and Forms are available for viewing and/or printing from any computer with access to the G-drive on the AMP Intranet.		X		
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.	Power failure, equipment start-up/shut-down, emergency power failure, product inspection/segregation, general operating procedures are comprehended and available to floor personnel via procedures or work instructions.		X		
Comments:					

1.16	**Is management providing employee training for heat treating?**

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
The organization shall provide employee training (including follow up and ongoing training) for all heat treating and inspection operations, including backup and temporary employees.	On-The-Job material handler, heat-treater, laboratory technician, maintenance training and qualification program is utilized.		X		
Management shall define the qualification requirements for each function.	Training Matrix and job descriptions.		X		
Documented evidence of training and training effectiveness shall be maintained.	The Training Matrix lists all personnel qualifications and training that was successfully completed, as well as any training still in process.		X		
Operators shall be trained in material handling, containment action, and product segregation in the event of an equipment emergency including power failure.	Operators are trained in all these categories.		X		
Comments:					

1.17	**Are all key management and supervisory functions (in regards to Heat Treatment) performed by qualified personnel?**

Key management and supervisory functions, in regards to heat treatment, are critical to ensure both process stability and product quality. This can be accomplished in several different ways. Some examples to consider are a responsibility matrix, the organizational chart, job descriptions, or incorporation into other similar system documentation.

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
The organization shall define and document, key management and supervisory functions in regards to heat treatment.	A Responsibility Matrix is part of the Quality Management System and is available for viewing and review on the AMP Intranet.		X		
This documentation shall clearly identify both primary and secondary (backup) personnel.	Responsibility Matrix. Cross training is indicated in the Training Matrix.		X		
This information shall be readily available to appropriate personnel.	Available for viewing and review on the AMP Intranet.		X		
Comments:					

1.18	**Is there a preventive maintenance program? Is maintenance data being utilized to form a predictive maintenance program?**

Preventive maintenance is essential to ensure equipment, machines and tools are kept in appropriate condition for the manufacturing of products at desired quality and capacity levels. The organization shall comply with the following requirements.

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
The organization shall have a documented preventive maintenance program for all heat treat process equipment.	A documented Maintenance Program (including forms and records) is in place for key process equipment.		X		
The program shall be a closed-loop process that tracks maintenance efforts from request to completion to assessment of effectiveness.	Program is a closed-loop process. Forms are retained as documented information.		X		
Equipment operators shall have the opportunity to report problems, and the problems shall be handled in a closed-loop manner.	Employee has the opportunity to file an Incident Report, which is reviewed, analyzed, and documented in Quality & Staff Meetings.		X		
The 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.	Incident Reports are used to improve Maintenance Programs, training, process parameters, and APQP.		X		
Maintenance data shall be collected and analyzed as part of the defined predictive maintenance program.	Maintenance data is collected and analyzed as part of a predictive maintenance program. Based on collected data, key components are tracked and consequently scheduled for replacement.		X		

Comments:

1.19	**Has the Heat Treater developed a critical spare part list and are the parts available to minimize production disruptions?**

The critical spare parts list and available inventory is typically comprised of long lead time components such as (but not limited to) burners, fans, rolls, belts and other alloy parts. Availability of spare parts may be maintained on-site or off-site (for example, consignment) as identified by the heat treater.

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
The heat treater shall develop and maintain a critical spare parts list.	Computer list of critical spare parts has been developed and is maintained by the Operations Department.		X		
The heat treater shall ensure the availability of critical spare parts to minimize production disruptions.	Critical parts are ordered in advance and stored.		X		

Comments:

1.20	**Is material from different heat lots which may preclude achieving the specified metallurgical properties prevented from being processed together?**

Batch to batch variation may have an adverse effect on metallurgical properties. This variation may require that batches be processed separately.

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**

Where appropriate, the heat treater shall have a material product flow management system to prevent the processing of mixed batches.	When different steel mill heats or metals are indicated on the incoming orders, and they are not separated, but indicate that they should be processed separately, the order is placed on hold and the Customer is contacted for the Customer's final disposition. The final disposition is noted/written on the incoming order, with the date and name of the authorizing Customer who provided the final disposition.		X		
Comments:					

Section 2 - Floor and Material Handling Responsibility

Please describe Objective Evidence for each Requirement

2.1	**Does the heat treat responsible organization ensure that customer data entered in the process tracking system matches the customer order?**				
It is critical that all customer requirements and lot identification be adequately transferred to internal heat treat documents. This also applies to captive heat treaters and their internal material flow.					
		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
The heat treater shall establish a documented product tracking system (e.g. shop travelers, work orders, etc.) which supports the heat treatment with relevant product and process information.	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.		X		
The heat treat organization shall establish a system to detect and resolve discrepancies on received products and corresponding customer information.	Discrepancies are passed to Quality and Operations for review and resolution, before the Work Order is created and/or processed.		X		
Comments:					

2.2	**Is product clearly identified and staged throughout the heat treat process?**				
Product identification, process status and location of products with their process status are important to prevent incorrect processing or mixing of lots.					
		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
There shall be a procedure for part and container identification to avoid incorrect processing or mixing of lots.	Each customer container has an AMP router tag attached to it, identifying the heat-treating process, tub ID, Work Order number, photo of part, customer name, part number, lot number, and number of containers in order. Cannot close WO/ship product until all steps are electronically signed off by the shift supervisor.		X		
Non-heat treated, in-process, and finished product shall be properly segregated in clearly identified locations.	Staging locations within the plant are clearly identified with large signs.		X		
Comments:					

2.3	**Is lot traceability and integrity maintained throughout all processes?**

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
Lot traceability shall be maintained throughout the entire process.	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 database.		X		
Comments:					

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.					
		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
Procedures shall exist addressing proper disposition, product identification, and tracking of material flow in and out of the hold area.	Suspect or Non-Conforming Product is quarantined with a red "Hold" tag. A Non-Conforming Product Procedure is used for disposition of quarantined parts. Parts are put on hold in the AMP Computer system and can only be released by a manager, will not print a Certification or a Shipper unless all process steps have been signed off.		X		
A non-conforming hold area shall be clearly designated to maintain segregation of such material.	A non-conforming hold area is clearly designated to maintain segregation of suspect material.		X		
Comments:					

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 (including but not limited to baskets, conveyors, chutes, etc.) 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.					
		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
The heat treater shall have procedures to identify and monitor trap points for each process/equipment.	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 also 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 developed and implemented to monitor and minimize the potential impact of those trap points on product being processed.		X		
Monitoring of potential trap points shall occur for every lot changeover.	Large gap times between orders also reduce the risk of mixed parts.		X		
Comments:					

2.6	Are containers free of inappropriate material or free of heat treated parts mixed with non-heat treated parts?

The purpose of the requirement is to reduce the risk of contaminating the finished lot with nonconforming parts or inappropriate material. Containers used for the transport of parts to be heat treated are often used for the same material after completion of the heat treat process. It is critical that the finished lot is not contaminated with non-heat treated parts or other inappropriate material remaining in the container.

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
There shall be a procedure that addresses the inspection of containers used for transporting non-heat treated and heat treated parts.	The relevant AMP documents are titled "Container Handling Process" and "Dropped Parts Policy".		X		
The procedure shall include the inspection of containers after emptying and immediately before re-using to ensure that all parts and inappropriate material have been removed.	Customer containers are rotated and flipped over to loosen and remove possible trapped parts, in the dumping station. Each container is also visually inspected for foreign and trapped material. AMP's in-house processing containers (Roura hoppers) are free of seams that could trap inappropriate material.		X		
The source of inappropriate material shall be identified and addressed.	The customer is contacted when inappropriate material is found.		X		

Comments:

2.7	Is furnace loading specified, documented and controlled?

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
Furnace loading parameters shall be specified, documented, and controlled (including but not limited to the following examples: feed rate, belt speed, number of parts per fixture, load weight, etc.).	Furnace loading parameters are specified in the electronic recipes, controlled by electronic feeders, and printed out on the hard copies of the Work Orders.		X		

Comments:

2.8	Is there a procedure for material handling, containment action, and product segregation in the event of an equipment emergency including power failure?

Unplanned or emergency downtime greatly increases the risk of improper processing.

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
There shall be a procedure for material handling, containment action, and product segregation in the event of an equipment emergency including power failure.	The relevant document is titled "Contingency Plans".		X		
The procedure 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. Training is documented in the Training Matrix.		X		
The procedure shall define when this emergency plan is to be implemented.	Defined in document.		X		

Comments:

2.9	Is the handling, storage and packaging adequate to preserve product quality?

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.

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
Handling, storage, and packaging shall be adequate to preserve product quality.	Equipment and material handling procedures are adequate to preserve product quality.		X		
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.	Loaders and in process bins have been designed to avoid part damage.		X		
Comments:					

2.10	**Are plant cleanliness, housekeeping, environmental, and working conditions conducive to control and improve quality?**

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
Plant cleanliness, housekeeping, environmental, and working conditions shall be conducive to controlling and improving quality.	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.		X		
A housekeeping policy shall be clearly defined and executed.	A Housekeeping Worksheet Guidelines (part of our Business Operating System) is available for double-checking conformance to expected plant conditions.		X		
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.	Items are included in Housekeeping Worksheet Guidelines. Dropped Parts Policy and signage around the plant. Oil and smoke are constantly monitored.		X		
Comments:					

2.11	**Are parts free from contaminants that would be detrimental to the heat treatment process?**

Oils, coatings and other contaminants or residues may adversely affect the heat treatment process or subsequent processes. Pre/Post wash or other methods of contamination removal may be required by customer or mandatory for process function.

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
If applicable, cleaning parameters shall be monitored and documented.	Every shift. Recorded in productive maintenance checklist.		X		
The frequency for checking the cleaning parameters shall conform to applicable Process Table, Section 5.0	Yes		X		
Comments:					

2.12	Is the quenching system monitored, documented, and controlled?					
Refer to Process Tables, Sections 3.0 and 5.0, for details and frequency of checks.						
		Assessment				
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**	
The quenching system shall be monitored, documented, and controlled. (Computer-monitoring equipment, with alarms and alarm logs, satisfy the verification requirement.)	Quench temperatures are monitored, controlled, and checked daily in each shift, as are quench levels and agitation. Digital alarms are in place for temperature. Oil is checked for quenchability quarterly. Furnace logs are used to record the daily monitoring & checking activities that are not actively monitored by our Process Control and Electronic Monitoring/Data Acquisition System.		X			
Quench delay time with alarm is required. Not applicable for belt, shaker, or pusher furnaces where parts free-fall into the quench.		X				
Temper delay time shall be specified by the heat treater for parts that are quenched and tempered (e.g. carburizing, carbonitriding, neutral hardening, induction hardening).	Temper delay is specified on the work order and CP.		X			
Comments:						

2.13	Are soluble oil or other rust preventive solutions monitored and controlled if applicable?					
Parts are often dipped in or sprayed with rust preventive solutions immediately after the heat treating process. Refer to Process Tables, Section 5.0, for frequency of checks.						
		Assessment				
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**	
Soluble oil solutions or other rust preventive solutions shall be monitored and controlled, if applicable.		X				
The heat treater shall have and maintain documented tolerances for the solutions.		X				
Comments: AMP has very infrequent requirements for off-line rust Inhibitors/rust preventive solutions. When required, solutions either from customer or to their requirements, are freshly made up with the required concentrations per manufacturer, then discarded after use.						

2.14	Are process control parameters monitored per frequencies specified in Process Tables?					
Refer to Process Tables, Section 3.0.						
		Assessment				
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**	
Process control parameters shall be monitored per frequencies specified in Process Tables.	Yes. Table A, Section 3.0		X			

A designated floor person shall verify the process parameters, e.g. by initialing a strip chart or data log. (Computer monitoring equipment with alarms and alarm logs satisfy the verification requirement.)	Process control parameters are monitored in real time on several computers in the plant, as well as being recorded in 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 Electronic Monitoring/Data Acquisition System.		X		
Comments:					

2.15	**Are In-Process/Final Test Frequencies performed as specified in Process Tables?**				
		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
In-Process/Final Test Frequencies shall be performed as specified in Process Tables.	Yes. Table A, 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		
Any exceptions to test frequencies specified in the process tables shall be approved by the Customer in writing.	As instructed/agreed by customers.		X		
Comments:					

2.16	**Is product test equipment calibrated and verified?**				
Refer to Process Tables, Section 1.0, for frequency of checks.					
		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
Test equipment shall be calibrated and verified per applicable customer-specific standards or per an applicable consensus standard such as those published by ASTM, DIN, EN, ISO, JIS, NIST, SAE etc.	Yes. Table A, Section 1.0		X		
Calibration and verification results shall be internally reviewed, approved, and documented.	All hardness testers are calibrated at least annually and are also verified at the beginning of each shift, using certified test blocks and certified diamonds, with the results reviewed, approved, and documented.		X		
Comments:					

Section 3 - Equipment

Please describe Objective Evidence for each Requirement

3.1	**Do furnaces, generators, and quench systems have proper process control equipment?**
Examples include temperature, carbon potential, dew point, gas flows, quench monitoring system including agitation, temperature control, etc., as listed in the applicable Process Tables, Section 1.0	
	Assessment

Requirements	Objective Evidence	N/A	Satisfactory	Not Satisfactory	Needs Immediate Action
The heat-treat equipment including furnaces, generators, and quench systems shall have proper process controls.	All furnace lines, generators, and quench systems have proper Process Controls and are Monitored continuously via our Electronic Monitoring / Data Acquisition System. Agitation is not electronically monitored, but is monitored via Furnace Logs.		X		
Comments:					

3.2	Are process equipment calibrations, verifications and certifications current?

Refer to the applicable Process Tables, Sections 1.0 and 2.0, for equipment calibration, verification and certification frequencies.

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
The calibrations, verifications and certifications of the process equipment shall be performed at regular intervals as specified in the applicable Process Table(s).	Yes, per Table A, section 1.0 and 2.0 specified frequencies.		X		
Non-contact thermometry devices shall be calibrated as specified in the applicable Process Tables.		X			
A documented offset procedure as defined in Section P3.2.3 shall exist.	Offsets are not being used		X		
The documented offset procedure shall indicate who has the authority to approve the use of offsets and how this approval is documented.	Offsets are not being used		X		
Offset or bias applied for the instrumentation calibration adjustment shall comply with P3.2.3.	Offsets are not being used		X		
Calibration labels shall meet the requirements established in Section P3.2.5.1.	Date of calibration, next due date, technician and serial numbers are on labels.		X		
Calibration reports shall meet the requirements established in Section P3.2.5.2.	Reports meet the requirements of Section P3.2.5.2		X		
Comments:					

3.3	Are thermocouples and protection tubes checked or replaced per Process Tables?

The accuracy of thermocouples is essential for good temperature control, the collection of accurate process data and the protection of furnace equipment.

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
Thermocouples shall be calibrated before first use, within the temperature range in which they will be used and meet the accuracy requirements of the Section P3.1 Tables.	Manufacturer cert of calibration conforming with section P3.1 requirements.		X		
Control, monitoring and recording thermocouples shall be SAT checked as per the applicable Process Table(s) and Section P3.3.	Yes, per Table A, section 2.0 and section 3.3 SAT test. Thermocouples are checked quarterly by an outside service, based on a preventive maintenance schedule.		X		
The insertion depth of Type K and Type E test thermocouples shall be documented when the thermocouple is reused as per Section P3.1.3.3.	Type K, the depth of insertion is equal to the depth of insertion of previous use if it is SAT reused, but normally not reused. N/A for TUS, TC wire is new.		X		
System Accuracy Test records shall meet the requirements established in Section P3.3.5.	Records meet the requirements of Section P3.3.5		X		

Protection tubes shall be checked or replaced in compliance to a documented preventive maintenance schedule.	Furnace Yearly PM Checklist		X		
Comments:					

3.4	**Are temperature uniformity surveys performed per requirements in Process Tables?**				
		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
Temperature uniformity surveys shall be conducted per the requirements in the applicable Process Tables, Section 2.0.	Temperature Uniformity Surveys (TUS) are conducted per the requirements in the applicable Process Table A, Section 2.0.		X		
Actions that alter the temperature uniformity characteristics of a furnace shall be documented per section P3.4.1.2.	If furnace modifications or major rebuild take place, they will be documented in mgmt. meetings. If necessary, a TUS will follow.		X		
If used, alternate temperature uniformity test methods shall meet the requirements of Section P3.4.8.	Rotary furnaces, TUS are not possible. Test results are collected, monitored, and stored, to conduct Property Surveys on each furnace line and to evaluate and analyze the performance and the effectiveness of the performance of each furnace. Year-long Property Studies using high-volume / frequently-processed parts were also conducted. TUS is performed for tempering furnaces.		X		
The upper temperature tolerance shall not be exceeded at any time. Exceptions may exist in systems where multiple process temperatures exist in a single process cycle per section P 3.4.5.1.	If the upper temperature tolerance is exceeded, requirements of P3.4.5.2 Reaction to TUS Failure will apply.		X		
The organization's internal process specification shall define suitable soak time at temperature requirements for pass/fail determination as per Section P3.4.5.1.	Yes, per equipment, 30-60 minutes.		**X**		
Temperature uniformity survey reporting shall meet the requirements established in Section P3.4.7.	Yes		X		
Comments:					

3.5	**Is the variation of the furnace control thermocouple from set point within the requirements in the Process Table?**				
		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
The variation between the furnace control thermocouple value and the set point temperature shall be within the limits defined in the applicable Process Tables, Section 2.0.	All control thermocouples are within specified tolerances, and are being verified continuously and alarmed via our Electronic Monitoring System.		X		
Comments:					

3.6	**Are the process and equipment alarm checks being tested quarterly or after any repair or rebuild?**
	Assessment

Requirements	Objective Evidence	N/A	Satisfactory	Not Satisfactory	Needs Immediate Action
The heat treater shall have a list of alarms that, if not properly working, may have a high probability of producing non-conforming product.	Yes		X		
The listed alarms shall be checked quarterly at a minimum or after any repair or rebuild.	System alarms are checked for proper function monthly (and after any repair or rebuild)		X		
Other alarms, including but not limited to safety-related, shall be checked per the heat treater's requirement.	Yes		X		
These alarm checks shall be documented.	Documented in the Preventive Maintenance log.		X		
Comments:					

3.7	**Are generators and furnace atmospheres continuously monitored, automatically controlled, and documented?**

For furnaces that preclude in-situ control and monitoring, use the method described in Section 3.4.5 "Property Surveys".

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
Generator and furnace atmosphere carbon potential/dew point shall be continuously monitored, automatically controlled, and documented.	Rotary Furnaces: Generators and furnace atmospheres are monitored via dewpoints and gas flow rates. DP are continuously monitored, automatically controlled, and documented. Gas flow rates are recorded at the start of each and every Work Order.		X		
The recorded furnace carbon potential shall be controlled within ±0.05 of the set point.	CP is controlled within +/- 0.05 of the set point, via DP control.		X		
The recorded dew point shall be controlled within acceptable limits as specified in the control plan or internal procedures.	DP is controlled and alarmed to satisfy CP within +/- 0.05 of the set point.		X		
If generators are not used, the flow rates of the supplied atmosphere gases shall be monitored and controlled.		X			
The automatic and continuous atmosphere control system shall consist of sensors such as oxygen probes or on-line infrared (IR) gas analysis.	Oxygen probes		X		
The heat treater shall also have a back-up method of checking carbon potential/dew point.	A portable 3-Gas Analyzer is available for verifying the endo gas composition and a portable DP analyzer verifies the dewpoint		X		
Back up method verification frequencies shall be conducted according to the applicable process tables.	Yes, per Table A, section 3.0 specified frequencies.		X		
Comments:					

3.8	**When the back-up verification check of the atmosphere does not 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?**

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**

The back-up atmosphere monitoring system reading and the primary control method atmosphere dew point/carbon potential reading shall be maintained within the correlation limits specified in the control plan or internal procedures.	The back-up atmosphere monitoring system reading and the primary controlled method atmosphere dew point are maintained within the correlation limits. The secondary DP verifies the +/- of the primary DP.		X		
The back-up carbon potential/dew point reading shall be established using one or more of the following methods: • Direct measurement of surface carbon of sample • Shim Stock • Gas Analyzer • Dew Point • Wire Resistance • Redundant Oxygen Probe	Dew point and 3 Gas Analyzer		X		
When a discrepancy has been detected, the correlation shall be re-established between the back-up and primary method and documented.	If a discrepancy has been detected, the secondary DP unit is verified against a known dew point for accuracy. If inaccurate, the gas composition measured by the 3 Gas Analyzer will provide the theoretical DP for comparison. The secondary DP unit will be repaired/recalibrated. If accurate, the primary DP unit will be diagnosed. The correlation is re-established.		X		
The range tolerances for correlation between the two readings shall be in the control plan or internal procedures.	Both, primary control and back-up units have the same tolerance.		X		
Comments:					

3.9	**Are all ammonia lines equipped with a fail-safe method to prevent the inadvertent introduction of ammonia into the furnace?**				
		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
One of the following fail-safe methods shall be used to prevent inadvertent introduction of ammonia into the furnace. • A quick disconnect or physical separation of the lines • Three-valve ammonia "fail-safe" vent system is permitted. See the definition “Three Valve Fail-Safe Vent” and diagram in the glossary. • 1 manual and 2 electrical magnetic valves in series	All ammonia lines going to furnaces are equipped with quick disconnects.		X		
The disconnecting of ammonia atmosphere from non-ammonia bearing atmosphere shall be documented.	Recipe process step signoff for non-ammonia bearing processes.		X		
Comments:					

3.10	**Is there a minimum of 3 hour purge of the furnace atmosphere when switching from an ammonia bearing atmosphere to a non-ammonia bearing?**				
Ammonia pick-up can be undesirable in parts and heat treat processes not specifying/requiring ammonia as an addition.					
		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
The heat treater shall perform a minimum 3 hours purge prior to processing product not requiring ammonia as an addition.	A minimum 3-hour purge is performed prior to processing product not requiring ammonia as an addition.		X		

Any reduction of the 3 hour purge shall require conclusive test data of the atmosphere to show no significant amount of residual ammonia is present in the furnace atmosphere.		X			
Log book, data logger, or other records shall document the actual purge 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.	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 WORP Furnace Log also records the start and end times for the purging.		X		
Comments:					

3.11	**Do all atmosphere furnaces and generators have flow scopes or flow meters for all gases?**				
		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
All atmosphere furnaces and generators (output trim/adjustment gas) shall have flow scopes or flow meters for all gases.	All generators and furnaces have flow scopes for each gas line that is connected, including endothermic gas, natural gas, air and ammonia.		X		
Flow scopes and meters shall be periodically serviced per the heat treater's preventive maintenance program.	Yes. Per PM program.		X		
Cleaning and proper re-assembly procedures shall be documented.	Cleaning is documented in the Furnace PM Log.		X		
Comments:					

3.12	**Is there a fail-safe system at the front of continuous belt furnaces for austenitizing to prevent non-uniform loading of parts?**				
		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
Sight glass inspection ports shall exist for the visual evaluation of load distribution.		X			
Sight glass inspection ports shall be cleaned per the preventive maintenance schedule.		X			
There shall be a fail-safe system implemented on continuous belt furnaces to prevent non uniform loading of the parts.	AMP has computer-controlled feeder systems to ensure that parts are uniformly loaded into the furnaces.		X		
In the absence of a fail-safe system, a non-contact thermometry device shall be employed with the following requirements met: • A non-contact thermometry device shall be aimed at the center of product mass from the discharge end of the furnace (i.e. bulk head portal) in order to acquire part temperature immediately prior to quenching. • A non-contact thermometry device temperature alarm shall be -28°C (-50°F) maximum of the final zone set point temperature. • Non-contact thermometry device temperature data shall be continuously recorded.		X			
Comments:					

3.13	**Is salt chemistry in the austenitizing salt bath monitored?**
This is applicable to salt bath heat treating processes listed in Process Tables A and B.	

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
The heat treater shall check the salt chemistry in the austenitizing salt bath, or part decarburization.		X			
The heat treater shall conform to the frequency of checks defined in the applicable Process Table Sections 3.		X			
Comments:					

3.14	**Is the quenching medium analyzed?**

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
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 quenching media (oil) is analyzed quarterly, while the water quench media is analyzed every six months.		X		
The quench medium characteristic tolerances shall be specified by the quench medium supplier or the heat treater.	Quench supplier.		X		
Test results shall be reviewed for conformance and documented by the heat treater.	Results are reviewed for conformance and documented in QMS		X		
Comments:					

FOR INDUCTION HEAT TREATING

3.15	**Is the positioning of each part being controlled?**

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
There shall be a method to ensure proper part position such as the use of proximity switches, optical sensors or mechanical Poka-Yoke system.		X			
Comments:					

3.16	**Does the heat treater control the energy or power for each part?**

		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
The heat treater shall control the energy or power for each part.		X			
Signature monitor or energy monitor shall be used to monitor energy or power to the part and record all out of control events.		X			

Any alternative method shall be approved by the Customer.		X			
Comments:					

3.17	**Does the supplier have a coil management system?**				
Coil refers to the heating coil and the quench plenum.					
		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
The heat treater shall have a coil management system.		X			
Spare coils for each part shall be available on-site.		X			
Coils shall conform to the customer approved design.		X			
Comments:					

3.18	**Is quench system automatic?**				
		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
The quench system shall be automatically initiated and controlled.		X			
Comments:					

3.19	**Is there a procedure that addresses maintenance of the inductor and quench spray nozzle(s) (e.g. quench ring, quench shower)?**				
		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
There shall be a procedure that includes regular inspection and cleaning of the inductor and quench spray nozzle(s).		X			
Comments:					

3.20	**Is there a procedure to purge the air pockets from the quench lines?**				
After downtime of the induction heating system, air pockets may form in the quench lines. These air pockets will cause interrupted quenching at start-up. Factors such as quench line diameter, length, geometry, etc., should be considered when establishing the time limit of the downtime.					
		Assessment			
Requirements	**Objective Evidence**	**N/A**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
There shall be a procedure to purge the quench lines after downtime.		X			
The Heat treater shall establish the time limit (of the downtime) when this procedure is to be followed.		X			
Comments:					

Section 4 - Job Audit

Job Identity: Carburizing (C)

Customer: Non-Disclosure

Shop Order Number: WO 95363, 04/03/2024

Part Number: Non-Disclosure

Part Description: Non-Disclosure

Material: Per Customer print or specification

Heat Treat Requirements: Carburize & Temper

Question #	Job Audit Question	Related HTSA Question #	Customer or Internal Requirement	Job (Shop) Order or Reference Documentation Requirement	Actual Condition (Objective Evidence)	Pass / Fail / NA
4.1	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 or specifications and transferred to the specific part recipe.	Copies of Customer Material Steel Certs are not supplied by Customer; Customer product specifications and Material is on Customer print, which is viewable on AMP WORP software & is listed on Work Order/recipe.	Pass
4.2	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; WO Number and number of tubs are on the magnetic tags.	Carburizing, Quench Media, PN XXXX, part photo, PO/Shipper provided, Lot# not provided, Material Chemistry not provided, & # of tubs is listed on WO. Carburizing, no Tubs ID provided, WO#, PN, Customer, part photo, and # of tubs are on the router tag. WO # & # of tubs are on the magnetic tag.	Pass

4.3	Are the Loading/Racking requirements identified?	1.6 2.7 2.9	Internal	Work Order / Recipe defines Feed-Rate Requirement of 210 lbs/hr.	Feeding rate set at 210 lbs/hr on computerized feeder and loading times (start/finish) were documented on WO.	Pass
4.4	Is the proper recipe or process specification (cycle times, temperature, atmosphere, etc.) used? Refer to Process Tables, Section 3.0, for specific parameters.	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
4.5	What are the product inspection requirements per the Control Plan?	2.15				
4.5.1	Requirement: (1)	Surface Hardness Testing as Quenched				
	Test Method:	Surface Hardness Testing Standard	Internal	ASTM E18. If specified, inspection photo defining sample preparation & location(s) for Surface Hardness testing.	Test results recorded in WORP and on hard copy of Work Order	Pass
	Test frequency or quantity:		Internal	3 pcs every 2 hrs / minimum of 10 pcs per order	6 pcs checked at audit, 78 pcs total	Pass
	Selection of samples:		Internal	Random	Random	Pass
	Specification:		Internal	No Specification	Actual: HRC 64.1 – 66.9	Pass
4.5.2	Requirement: (2)	Surface Hardness Testing as Tempered				

	Test Method:	Surface Hardness Testing Standard	Internal	ASTM E18. If specified, inspection photo defining sample preparation & location(s) for Surface Hardness testing.	Test results recorded in WORP and on hard copy of Work Order	Pass
	Test frequency or quantity:		Internal	3 pcs every 2 hrs / minimum of 10 pcs per order	6 pcs checked at audit, 75 pcs total	Pass
	Selection of samples:		Internal	Random	Random	Pass
	Specification:		Internal and Customer	HRC 59-64	Actual: HRC 60.0 – 64.0	Pass
4.5.3	Requirement: (3)	Core Hardness Testing				
	Test Method:	Core Hardness Testing Standard	Internal	ASTM E18 (and converted, ASTM E140). If specified, inspection photo defining sample preparation & location(s) for Surface Hardness testing.	Test results recorded in WORP and on hard copy of Work Order	Pass
	Test frequency or quantity:		Internal	1 pc every 4 hrs / minimum of 5 pcs per order	2 pc checked at audit, 25 pcs total	Pass
	Selection of samples:		Internal	Random	Random	Pass
	Specification:		Internal and Customer	15N 83 Maximum	Actual: 15N 75.9 – 81.1	Pass
4.5.4	Requirement: (4)	Effective Case Depth Testing				
	Test Method:	Effective Case Depth Testing Standard	Internal	Mount Preparation per ASTM E3-11 and ASTM E407 and Micro-hardness Testing in accordance with ASTM E384 and SAE J423	Test results recorded in WORP and on hard copy of Work Order	Pass

	Test frequency or quantity:		Internal	1 pc every 8 hrs / minimum of 2 pcs per order	2 pc checked at audit, 6 pcs total	Pass
	Selection of samples:		Internal	Random	Random	Pass
	Specification:		Internal and Customer	0.026” - 0.034”	Actual: 0.029” - 0.034”	Pass
	Operator or Inspector Responsibilities					
4.6	Were appropriate process steps signed off?	1.4 2.2 2.3 2.14	Internal	Work Order requirement for redundant sign-offs.	Electronic sign-off of process steps in WORP, as well as initialed on hard copy of the WO. C and Temper in WORP and paper shop traveler at audit time.	Pass
4.7	Were all inspection steps, as documented in the control plan performed?	1.2 1.4	Internal	Most of the Control Plan (CP), including inspection criteria, is integrated into electronic recipe in WORP software; a Generic Control Plan has also been created to address other aspects of Control Plans.	Electronic recipe requires electronic & manual sign-off of each step, with final review & sign-off by Shift Leader (or authorized representative) or WO cannot be closed for shipping. All steps signed off at the end of the job.	Pass
4.8	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
4.9	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.	Pass
4.10	Does the governing specification allow reprocessing or rework?	1.11	No Specification	Rework of order requires Quality Department approval. Re-tempering is not considered rework.	Call customer for rework approval.	Pass
4.11	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 in the hard copy of the WO & the electronic copy of the WO.	Pass

4.12	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
4.13	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. Outgoing customer containers inspected during audit.	Pass
	Packaging Requirements					
4.14	Are packaging requirements identified?	2.9	Internal	AMP requires that, upon completion of Heat-Treating & Sorting, parts are returned to Customer's original containers and weighed, weights recorded on Work Order.	Process Steps were signed off on electronic & paper copies of Work Order and each bin weighed out, with weights recorded. Shipping records and signed shipper in WORP.	Pass
4.15	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 1 container.	Pass
	Shipping Requirements					
4.16	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 containers.	Pass
4.17	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

PROCESS TABLE A – Carburizing / Carbonitriding / Carbon Restoration / 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. When performing the job audit, the auditor shall verify heat treater is conforming to the Customer's requirements.

Continuous furnace frequencies for item numbers A4.2, A4.3, and A4.4 are per lot (work order) or as specified, whichever is more frequent.

OK - Complies to requirement
NOK - Does not comply to requirement (Explain noncompliance in 'Related HTSA Question #')
NA - Requirement not applicable

Item #	Related HTSA Question #	Category/Process Steps	
1.0		**PROCESS AND TEST EQUIPMENT REQUIREMENTS**	**OK / NOK / NA**
A1.1	3.1 3.7	Recording instruments are required for temperature controlling devices and protective atmosphere monitoring unit, e.g. dew point, oxygen probe, or other atmosphere controlling devices.	OK
A1.2	1.18	A program for furnace, generator, and oxygen probe burnout is required (applies to carbon bearing atmospheres).	OK
A1.3	3.2	Furnace loading weigh scales shall be verified quarterly and calibrated annually at a minimum.	OK
A1.4	3.2	Dew pointers, gas analyzers, spectrometers, and carbon IR combustion analyzers (shim stock/foil analysis), used to verify carbon potential in furnaces, shall be calibrated annually at a minimum.	OK
A1.5	3.2	Verification of spectrometers and carbon IR combustion analyzers (shim stock/foil analysis) shall be performed daily or prior to use.	NA
A1.6	3.2	Verification of gas analyzers with zero gas and span gas when used as the back-up verification shall be performed weekly at a minimum. When used for primary control of the carbon-bearing atmospheres, verification shall be daily.	OK
A1.7	3.2	Atmosphere controllers shall be calibrated quarterly (single-point or multi-point calibration). A six month calibration interval is allowed if multi-point calibration is utilized.	OK
A1.8	2.16 3.2	Laboratory and Test equipment used for product and process testing shall be calibrated annually at a minimum, per the applicable national standard (e.g. ASTM, EN, JIS) or approved equivalent standard, and verified per internal procedure if not specified in the applicable standard.	OK
A1.9	2.16	Files for testing hardness shall be verified per the Customer requirement.	OK
A1.10	3.2	Refractometers typically used to check polymer quenchants and washer solutions shall be verified prior to use with distilled water.	NA
2.0		**PYROMETRY**	**OK / NOK / NA**
A2.1	3.2 3.3	Thermocouples and calibration of thermocouples shall conform to Section P3.1.	OK
A2.2	3.2 3.3	Calibration of instrumentation shall conform to Section P3.2.	OK
A2.3	3.2 3.3	System Accuracy Test (SAT) for all control, monitoring, and recording thermocouples shall conform to Section P3.3.	OK
A2.4	3.4	Temperature Uniformity Survey (TUS) shall be performed annually and after major rebuild per Section P3.4. Temperature uniformity tolerance for austentizing furnaces shall be +/- 15°C (or +/- 25°F). Temperature uniformity tolerance for tempering and precipitation hardening furnaces shall be +/- 10°C (or +/- 20°F).	OK
A2.5	3.5	Temperature(s) for austentizing processes shall be controlled within +/- 10°C (or +/- 15°F) of the set point as evidenced by recording instruments. Furnace temperature shall be controlled with soak times starting at the lower tolerance limit (as defined above). **For Continuous Furnaces, this requirement applies to the Qualified Work Zone.**	OK

Item #	Related HTSA Question #	Category/Process Steps				
A2.6	3.5	Temperature(s) for tempering and precipitation hardening processes shall be controlled within +/- 5°C (or +/- 10°F) of the set point as evidenced by recording instruments. Furnace temperature shall be controlled with soak times starting at the lower tolerance limit (as defined above). **For Continuous Furnaces, this requirement applies to the Qualified Work Zone.**				OK
A2.7	3.2	Non-contact thermometry devices used for temperature monitoring (e.g. infrared pyrometer, thermal imaging camera) shall be calibrated annually at a minimum in the temperature range to be used utilizing a blackbody device or per the manufacturer's recommended procedure.				NA
3.0		**PROCESS MONITORING PARAMETERS**	**REQUIREMENTS / FREQUENCY**			**OK / NOK / NA**
			Batch (Chamber) Furnace	**Continuous Furnace**	**Atmosphere Generation**	
A3.1	1.4 1.6 2.14	Monitor primary temperature control instrument(s).	Continuous recording with alarm system set per limits in A2.5 and A2.6. In absence of alarm system, sign-off every 2 hours and at the end of the cycle, or each cycle for processes under 2 hours satisfies this requirement.	Continuous recording with alarm system set per limits in A2.5 and A2.6. In absence of alarm system, sign-off every 2 hours and at the end of the cycle, or each cycle for processes under 2 hours satisfies this requirement.	Generators shall be continuously monitored and recorded. Sign-off required for each shift for generators. An alarm system will satisfy the sign-off requirement.	OK
A3.2	1.4 2.14 3.7 3.11	Monitor atmosphere generation as applicable.			Generators shall be continuously monitored and recorded. Other systems, such as nitrogen-methanol systems, may either be continuously monitored and alarmed, or sign-off every 2 hours.	OK
A3.3	1.4 1.6 2.14 3.7	Monitor primary furnace atmosphere control(s).	Continuous recording with alarm system. In absence of alarm system, sign-off every 2 hours and at the end of the cycle, or each cycle for processes under 2 hours satisfies this requirement.	Continuous recording with alarm system. In absence of alarm system, sign-off every 2 hours and at the end of the cycle, or each cycle for processes under 2 hours satisfies this requirement.		OK
A3.4	1.4 2.14 3.7 3.8	Verify primary atmosphere control method by back-up method.	Daily	Daily	Daily	OK
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		NA
A3.6	1.4 2.14	Monitor time in furnace, cycle time, or belt speed.	Each batch or furnace load.	Sign-off twice/shift and after any change in the belt speed. Alarm systems (if set per acceptable limits) or continuous recording satisfy this requirement.		OK

Item #	Related HTSA Question #	Category/Process Steps				
A3.7	1.4 2.7	Monitor load size, fixturing, or loading rate as applicable.	Each batch or furnace load.	Sign-off twice/shift and after any change in loading rate. Alarm systems (if set per acceptable limits) or continuous recording satisfy this requirement.		OK
A3.8	1.4 2.12	**Quench Media Process Parameters - Liquid**				
		Temperature	Continuous recording with sign-off every 2 hours and at the end of the cycle, or each cycle for processes under 2 hours. Alarm systems (if set per acceptable limits) satisfy the sign-off requirement.	Continuous recording with sign-off every 2 hours and at the end of the cycle, or each cycle for processes under 2 hours. Alarm systems (if set per acceptable limits) satisfy the sign-off requirement.		OK
		Quench Level	Continuous monitor with alarm or daily verification.			OK
		Agitation	Daily visual check, or monitor the agitation during the quenching operation with alarm systems set at acceptable limits.			OK
A3.9	1.4 2.12	**Quench Media Process Parameters - Gas**				
		Pressure in the quench cell.	Monitor each load. Alarm system is required.			NA
		Fan speed or power.	Monitor each load. Alarm system is required.			NA
		Cooling water temperature and flow rate.	Monitor each load. Alarm system is required.			NA
A3.10	1.4 2.12	Quench Delay Time	Each batch or furnace load.	Each basket for pusher-type continuous furnaces where the loaded basket is quenched. Not applicable for belt, shaker, or pusher furnaces where parts free-fall into the quench.		NA
A3.11	1.4 2.12	Temper Delay Time - The maximum delay time between quenching and tempering shall be specified on the control plan and monitored.	Each batch or furnace load.	Each load.		OK
4.0		**IN-PROCESS/FINAL TEST PARAMETERS**	**REQUIREMENTS / FREQUENCY**			**OK / NOK / NA**
			Batch (Chamber) Furnace	**Continuous Furnace**	**Atmosphere Generation**	

Item #	Related HTSA Question #	Category/Process Steps				
A4.1	1.4 2.15	Microstructure shall be checked at a low magnification of 100X and a high magnification of 400X or above. Microstructure visual references shall be available.	Daily per furnace unless specified by Customer to be checked with greater frequency, e.g. each batch.	Daily per furnace unless specified by Customer to be checked with greater frequency, e.g. each load.		OK
A4.2	1.4 2.15	Surface hardness (when specified).	Each batch or furnace load.	Each lot or every 2 hours.		OK
A4.3	1.4 2.15	Core hardness (when specified).	Each batch or furnace load.	Each lot or every 4 hours.		OK
A4.4	1.4 2.15	Case Depth (when specified).	Each batch or furnace load.	Each lot or every 4 hours.		OK
5.0		**QUENCHANT AND SOLUTION TEST PARAMETERS**	**REQUIREMENTS / FREQUENCY**			**OK / NOK / NA**
			Batch (Chamber) Furnace	**Continuous Furnace**	**Atmosphere Generation**	
A5.1	2.12 3.14	**Polymer Quench Media**				NA
		Concentration	Daily	Daily		
		Cooling Curve Analysis	Every six months (complete replacement of the quench media and cleaning of the quench tank within six months satisfies this requirement).	Every six months (complete replacement of the quench media and cleaning of the quench tank within six months satisfies this requirement).		
A5.2	2.12 3.14	**Water Quench Media**				
		Suspended solids	Every six months (complete replacement of the quench media and cleaning of the quench tank within six months satisfies this requirement).	Every six months (complete replacement of the quench media and cleaning of the quench tank within six months satisfies this requirement).		OK
A5.3	2.12 3.14	**Salt Quench Media**				NA
		Analysis and Contaminants	Every six months.	Every six months.		
A5.4	2.12 3.14	**Brine or Caustic Quench Media**				NA
		Concentration and/or Specific Gravity	Daily	Daily		
		Suspended solids	Every six months (complete replacement of the quench media and cleaning of the quench tank within six months satisfies this requirement).	Every six months (complete replacement of the quench media and cleaning of the quench tank within six months satisfies this requirement).		
		Oil Quench Media				

Item #	Related HTSA Question #	Category/Process Steps				
A5.5	2.12 3.14	Water content, suspended solids, viscosity, cooling curve, maximum cooling rate, total acid, and flash point.	Every six months.	Every six months.		OK
A5.6	2.13	**Rust Preventive - Soluble Oil**				
		Concentration	2x/week	2x/week		NA
A5.7	2.11	**Cleaning Solution**				
		Concentration of cleaner	Daily	Daily		OK
		Temperature of solution (required if temperature is specified to be above ambient temperature).	Each shift.	Each shift.		OK