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## Program Document HTBOK

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### BODY OF KNOWLEDGE:

**ROLE DESCRIPTION:** STAINLESS AND PRECIPITATION HARDENING STEELS SERVICE  
**SPECIAL PROCESS:** Heat Treatment  
**SCOPE/METHOD:** Performance of Stainless and PH Steel Alloys Requirements  
**LEVEL:** OWNER

All eQualified examinations are created using the applicable eQualified Body of Knowledge (BoK), which defines the baseline knowledge and experience required to be considered competent to perform the specified job role in aerospace special process manufacturing.

All eQualified BoKs are created by subject matter experts through an exhaustive job analysis process as detailed in the eQualified Program Document 6100: Industry Managed Special Process Bodies of Knowledge. All eQualified BoKs are updated periodically according to the requirements of the current eQualified PD6100 document to ensure they are consistent with current industry practice.

## 1. INTRODUCTION

This document has been created by the eQualified Heat Treat Body of Knowledge Review Board (HT BoKRB) according to the requirements of eQualified Program Document PD6100 Industry Managed Special Process Bodies of Knowledge.

This document constitutes the eQualified BoK for Stainless and PH Steels, Owner. It defines the baseline knowledge and experience required to be considered competent to perform this role.

Unless otherwise stated, the HT BoKRB has followed guidelines as detailed in the current version of International Aerospace Quality Group (IAQG) Guidance PCAP 001 (Competence Management Guideline) to develop this BoK.

The information in this BoK will provide guidance for the following:

- Training providers who wish to develop training courses intended to support eQualified examination candidate preparation
- Heat Treat Examination Review Board (HT-ERB) for the development of eQualified examinations
- Candidates taking eQualified examinations who wish to prepare in advance

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## 2. REFERENCES

eQuaLified documents:

PD6000	Governance & Administration of eQuaLified Program
PD6100	Industry Managed Special Process Bodies of Knowledge
PD6200	Industry Managed Special Process Examinations System
IAQG documents:	IAQG Guidance PCAP 001 Competence Management Guideline

## 3. DEFINITIONS

**Definitions described within are specific to the Special Process BoK. For program-specific definitions, please refer to either the PD 6000 or the eQuaLified Dictionary.**

**BODY OF KNOWLEDGE (BoK):** Baseline knowledge and experience required to be considered competent for a target position.

**GENERAL EXAMINATION:** The General Examination is designed to ascertain the candidate's general knowledge required for a particular job, role or activity. All of the questions will be derived from the corresponding BoK.

**EXPERIENCE:** The accumulation of knowledge or skill that results from direct participation in events or activities over a period of time.

**IN-HOUSE (or IN-SOURCING):** Keeping responsibility and control of key or critical processes inside an organization by using available internal resources In house control (Insourcing) is often preferred to ensure compliance of critical with specific customer or statutory requirements – The opposite of Outsourcing

**KNOWLEDGE:** Information / understanding acquired over a period of time. Information acquired through study and retained over that period of time (education, training, experience etc.) The combination of data and information, to which is added expert opinion, skills and experience, to result in a valuable asset which can be used to aid decision making and problem solving.

**LEVEL:** A class or division of a group based on education, training and experience. There are 3 levels: Operator, Planner and Owner. Please refer to the current version of PD 6000 for definitions

**METHOD:** A well-defined division of a SPECIAL PROCESS widely recognised by industry. A specific area of a special process for example anodizing within Chemical Processing

**NON-SPECIAL PROCESS RELATED REQUIREMENTS:** Miscellaneous requirements such as Health and Safety, Environmental, etc.

**OUT-SOURCED:** is the contracting out of a business process to a third-party (external) supplier. It relates to both product and services

**PERSONAL ATTRIBUTES:** A quality or characteristic expected and required for a particular job, role or activity.

**PRACTICAL EXAMINATION:** The Practical Examination shall consist of a demonstration of proficiency in performing tasks that are typical of those to be accomplished in the performance of the candidate's duties. The examination content is derived from the corresponding BoK.

**SERVICE PROVIDER:** A company or individual that provides a service or product. Service provider is generally used to refer to external or outsourced (third party) suppliers of services and product although large organizations may have Internal Service Providers for example IT. Examples may include Instrument calibration, Periodic Tests (TUS, SAT), analysis or testing which is outside the capability of internal resources. Service providers may also be suppliers of goods for example thermocouples pure gases etc

**SKILL:** Ability to perform a particular task. The quality of being able to do something that is acquired or developed through training or experience.

**SPECIFIC EXAMINATION:** The Specific Examination shall cover requirements and use of the specifications, codes, equipment, operating procedures and test techniques the candidate may use in the performance of his/her duties with the employer. Examination content will be derived from the corresponding BoK where applicable.

**WEIGHTING:** The “weighting” of each line item, using a scale of 1, 3, 7, 10, (1 being least important; 10 being most important) indicates the relative importance of that aspect of the BoK and will determine the likelihood and frequency of a question on that topic appearing in the examination

#### **4. GUIDANCE TO EXAMINATION CANDIDATES**

All eQualified examination candidates are recommended to read all documents referenced in section 2 of this document.

As stated in eQualified PD6200, every eQualified exam question shall relate directly to and be derived from the information as detailed in the current version of the BoK.

Re-assessment to this BoK is required every 5 years, unless otherwise specified.

Candidates are therefore advised to ensure familiarity with all aspects of the BoK as detailed in Table 1. This can be done through:

- Self-study
- Completion of internal training
- Completion of external training (a list of eQualified approved providers can be found at [www.eQualified.com](http://www.eQualified.com))

Records of all qualified personnel shall be maintained and include:

- Date of Qualification
- Results of Written
- Results of Practical (if applicable)
- Results of Experience

5. LEVELS

Descriptors	Level		
	Operator	Planner	Owner
	<i>Understand and perform the hands-on operations of the special process for which qualification is sought.</i>	<i>Capable of selecting manufacturing processes and interpreting process procedures to conform to customer specification and requirements.  Capable of problem solving and resolving day to day issues.</i>	<i>Capable of writing, reviewing and approving processes, procedures and qualifications of Operators and Planners. Capable of designing new processes and resolving issues among other levels.</i>
<b>Stainless and Precipitation Hardening Steels - Specific Criteria</b>	Basic Understanding of the specific requirements for HT of Stainless and Precipitation Hardening steel s –including cleaning , loading ,start and end of soak, atmospheres quenching tempering and Refrigeration	In addition to knowing what the Operator does, the Planner must: be able to interpret Customer requirements and convert them into clear Work Instructions at the appropriate level of Operator understanding  Manage HT shop that contracts the service provider and reviews reports. Technician must have higher understanding and be able to conduct and analyze output from TUS/SAT testing.	In addition to knowing what the Operator and Planner do, the Owner must:  Manage people that perform the work and evaluate and reviews reports; must have knowledge of “how” to run the testing.
<b>Technical Knowledge</b>	Basic knowledge of the special process, its main processes, methods and tools.	Good level of knowledge in all aspects of the special process, all its processes, methods and tools.  Ability to coach others on contents and methods in the context of their workplace.	High or extensive knowledge in all aspects of the special process, all its processes, methods and tools to assess and validate improvements.  Able to contribute to set externally recognized standards.  Ability to define contents and methods for using knowledge effectively in influencing and developing international processes. Ability to influence the process with one’s knowledge.
<b>Experience</b>	Sufficient experience to deal with recurrent activity.	Has enough experience to deal with unforeseen issues.	Wide proven experience of the subject. Is recognized specialist within the special process?
<b>Personal Attributes</b>	Takes into consideration behavioral characteristics such as but not limited to: team working, communication, direction and purpose, innovation and problem solving, mutual trust and respect, confidentiality and trustworthiness.		
<b>Skills</b>	Describes the activities necessary to perform each level of job function to comply with the Body of Knowledge		
<b>Non-Special Process Related Requirements</b>	Health & Safety, Environmental, Quality System Requirements.		

**Special Process Bodies of Knowledge Review Boards must complete Table 1 to form the BoK**

**TABLE 1**

The guidelines for table 1 boxes are as noted:

**Box 1 – Knowledge – Are knowledge based questions.**

**Box 2 – Skills – Defined within these rolls describes the range of skills.**

**Box 3 – Personal Attributes – Are statements that will enable judgment of the person’s personal attributes.**

**Box 4 – Experience – Are the minimum experience requirement expected to demonstrate their competence.**

**Box 5 – Non-Special Process Related Requirements – Defined within these rolls are other general or pre-requisite needed.**

Row #	COMPETENCE	Level (e.g. OP, PL, OW, T1)	Weight (1.3.7.10)	Exam Type Gen/Specific/Practical	Reference Guidelines (See description above)	Checklist Reference
	<p><b>SPECIAL PROCESS: HEAT TREATMENT OF STAINLESS AND PRECIPITATION HARDENING STEELS</b></p> <p><b>SCOPE / METHOD:</b> Performance of Heat Treatment processes on Stainless and Precipitation Hardening alloy steels to comply with customer specific / international standard requirements.</p> <p><b>CONTROLLING SPECIFICATIONS – AMS 2759/3 :</b> Precipitation-Hardening Corrosion-Resistant and Maraging Steel parts <b>AMS 2759/4 :</b> Heat Treatment of Austenitic Corrosion-Resistant Steel Parts : <b>AMS2759/5</b> Heat Treatment Martensitic Corrosion-Resistant Steel Parts <b>AMS 6875 parts B,C,D for Heat Treatment of Raw Material</b>  <b>AMS2759</b> Heat Treatment of steel parts – General Requirements <b>AMS2769;</b> Heat Treatment of Parts in Vacuum</p> <p><b>REFERENCE GUIDELINES:</b> This document is written to cover both general and specific BoK requirements which are controlled by the specifications above.</p>					
	<b>Understands:</b>					
<b>1</b>	<b>The basic knowledge of the special processes, methods and tools</b>					
<b>2</b>	<b>GENERAL QUALITY SYSTEMS KNOWLEDGE:</b>					
<b>3</b>		OW	7	GEN	AS9100	
<b>4</b>	Knowledge and understanding of Aerospace Quality system and compliance.	OW	7	GEN	AS9100	
<b>5</b>	Full and complete understanding of internal work instructions as well as industry standards. (see Addendum -1 of this document)	OW	7	GEN	AS9100	
<b>6</b>	Knowledge and understanding of how non-conformance is controlled using tools such as Root Cause Corrective Action and 5 why's.	OW	7	GEN	AS9100	
<b>7</b>	Knowledge and understanding of the need to meet safety compliance requirements as applicable.	OW	10	GEN	AS9100	
<b>8</b>	Knowledge and understanding of the requirements for traceability of calibration to NIST or equivalent agencies for Pyrometry equipment. (In sourced or Out sourced)	OW	7	GEN	AS9100	
<b>9</b>	<b>PYROMETRY</b>	OW				
<b>10</b>	Knowledge and understanding of the importance of compliance with all Pyrometry requirements including temperature sensors, instrumentation, thermal equipment, system accuracy tests, and temperature uniformity surveys and including reporting of non-conformance.	OW	7	PRAC	AMS2750/E	
<b>11</b>	Knowledge and understanding of the importance of producing Work Instructions that are in compliance with Customer requirements and AMS 2750 related to pyrometry and furnace class (uniformity) including, Sensors (thermocouples) Calibration, Instrumentation Class and Type, TUS and SAT.	OW	10	PRAC	AMS2750/E	
<b>12</b>	<b>WARNING NOTE – Heat Treatment of Stainless and PH steels shall not be implemented without a prerequisite understanding of the pyrometry requirements which affect these materials types.</b>	OW				
<b>13</b>	<b>GENERAL METALLURGICAL KNOWLEDGE RELATED TO HEAT TREATING STAINLESS AND PH STEELS (Applicable to all specifications including AMS 2759 and AMS2769)</b>	OW	7	GEN		
<b>14</b>	Knowledge and Understanding of the metallurgy of different types of Stainless steels – Austenitic; Martensitic and Precipitation Hardening / Maraging. – and the effect this might have on meeting Customer/Prime requirements	OW	7	GEN		
<b>15</b>	<b>The ability to clearly define and execute Heat Treatment instructions applied to</b>	OW	7	GEN	AMS2759/3	

	<b>Stainless and Precipitation Hardening Steels including the following</b>					
16	<ul style="list-style-type: none"> <li>• Annealing</li> <li>• Stress relieving</li> <li>• Stabilization(Dimensional)</li> <li>• Solution Heat Treating</li> <li>• Austenite Conditioning</li> <li>• Aging/Precipitation Heat Treating</li> <li>• Carbide Solution Treatment (For AM-355)</li> <li>• Preheating</li> <li>• Hardening (Austenitizing and Quenching)</li> <li>• Tempering</li> <li>• Low Temperature /Cryogenic treatments</li> </ul>	OW	7	GEN	AMS2759, AMS2769 & AMS2759/3	
17	<b>Knowledge and understanding of the definitions and importance of terms applicable to Heat Treatment of Stainless and PH Steels</b>	OW	10	GEN	AMS 2759 & AMS 2769	
18	<ul style="list-style-type: none"> <li>• Set temperature (Set Point)</li> <li>• Recovery time</li> <li>• Heating</li> <li>• Start of soak</li> <li>• Soak time</li> <li>• End of soak</li> <li>• Interruptions</li> <li>• Quench delay</li> <li>• Temper / Cryogenic delay</li> <li>• Protective Coatings</li> <li>• Cleaning</li> <li>• Homogenization (effects on Heat treatment response)</li> </ul>	OW	7	GEN	AMS 2759 & AMS 2769	
19	Knowledge and understanding of the need to effectively meeting Customer/Prime requirements and control the use and application of protective compounds to minimize possible contamination from furnace atmospheres. Coatings must be applied according to Customer / Prime requirements, which must be reflected on Work Instructions	OW	7	GEN	AMS275/3 3.3.2 AMS2759/4 3.3.2 AMS 2759/5 3.3.4	
20	Knowledge and understanding that meeting Customer/Prime requirements must reflect the use of equipment and instruments for the Heat Treatment of Stainless and PH Steels must be in accordance with AMS2750 all the customers' requirements.	OW	7	GEN	AMS2759 3.1 AMS2769 3.1	
21	Knowledge and understanding that in meeting Customer/Prime requirements they must ensure that for heat treating Stainless and PH Steels only equipment that is in accordance with all the customers' requirements may be used	OW	7	GEN	AMS2759/3/4 /5 3.2	
22	<b>Furnace Atmospheres (including Vacuum)</b>	OW				
23	Knowledge and understanding that Works Instructions must stipulate the requirements for equipment and process such that furnace' atmospheres must be controlled so that the parts/raw material in process does not get contaminate by the atmosphere or by the residual atmosphere from a previous load.	OW	7	GEN	AMS2759/3 3.3.1 AMS 2759/4 3.3.1 AMS 2759/5 3.3	
24	Knowledge and understanding that in meeting Customer/Prime requirements account must be taken of the fact that furnaces may be required to be purged with inert gas before they can be used for treating Stainless or PH Steels. This is the case when the atmosphere used previously was Endothermic or Exothermic gas or any other Nitrogen/hydrocarbon /Hydrogen blend - this is particularly important in Batch type furnaces including Integral (Sealed) Quench and Retort type furnaces.	OW	7	GEN	AMS 2759 3.3.5 AMS2759/3 3.3.1 AMS 2759/4 3.3.1 AMS 2759/5 3.3	
25	Knowledge and understanding that meeting Customer/Prime requirements account must be taken of the fact that it is necessary to ensure that composition and maintenance of salt baths shall be such as to prevent contamination of the parts. Salt baths shall be tested in accordance with AMS2759.	OW	7	GEN	AMS2759 3.3.8 AC7102/H 9.6.2	AC7102/H 9.6.2
26	Knowledge and understanding that in meeting Customer/Prime requirements, account must be taken of and must allow for the fact that salt residues must be removed immediately after quenching and before any following process.	OW	7	GEN	AMS2759 3.3.8	
27	<b>Loading Check</b> Knowledge and Understanding that in developing Work Instructions they must reflect the need to verify the internal condition of the furnace prior to loading to check cleanliness and freedom from mechanical damage (may be a visual only check). Check should be recorded	OW	7	GEN		
28	<b>Heat Treatment in Vacuum Furnaces</b>	OW				
29	Knowledge and understanding that in meeting Customer/Prime requirements account must be taken of the need to ensure that Vacuum furnaces used meet the, requirements of AMS 2769 and Customer / Prime specifications and be capable of achieving the Vacuum levels specified and also leak rates.	OW	7	GEN	AMS2769 3.1 / 3.1.1.3	
30	Knowledge and understanding that in meeting Customer/Prime requirements account must be taken of the requirement to carry out regular contamination checks, in a timely manner, for which representative test coupons must be available and analyzed with results being documented. Knowledge and Understanding of QMS requirements should results fail to meet requirements	OW	7	GEN	AMS2769 3.1.1.4	

31	Knowledge and understanding that in meeting Customer/Prime requirements account must be taken of any requirement to check and record the condition of door and other seals (e.g. Thermocouple entry bungs) which must be clean and free from damage or tears. Also understanding of the requirements for cleaning and greasing different types of sealing material which must be documented on Work Instructions the traveler / data card or in specific internal instructions.	OW	7	GEN		
32	Knowledge and understanding of the need for documenting repairs or changes of seals particularly on doors, thermocouple entry ports and gauges.	OW	7	GEN		
33	<b>Cleaning</b>	OW	7	GEN		
34	Knowledge and understanding that prior to Heat Treatment account must be taken of any Customer/Prime requirements that parts shall be clean and visually free of contaminants such as dirt, metal residues, lubricants and solvent residues. Knowledge and understanding of the need for cleaning parts the application of methods applicable. Particularly important in relation to Vacuum Heat Treatment and treatment of parts with less than 0.200 inch or 0.50mm machining after treatment. Where cleaning is required completion of this process must be documented	OW	7	GEN	AMS2759 3.3.2 AMS2769 3.3.4	AC 7102/H 5.2.1
35	Knowledge and Understanding of why all machined PH parts must be handled wearing gloves throughout processing .and how this is taken account of including Works Instructions	OW	7	GEN		AC7102/S 5.3.1
36	<b>Racking, Fixturing and Spacing</b>	OW				
37	Knowledge and understanding that in meeting Customer/Prime requirements action must be taken to positively identify specially designed racks and fixtures and monitor and document their condition. Work Instructions and procedures must reflect that specific jigs may be required for the specific parts for which t they are designed for.	OW	7	GEN	AMS2759 3.3.4	AC7102/S 5.3.1
38	Knowledge and understanding that racks, fixtures and/or baskets must be free from residues from salt baths and other contamination prior to use. When meeting these requirements it is necessary to ensure that there is sufficient time allowed for this process at the planning stage.	OW	7	GEN	AMS 2759 3.2.5/3.2.6	
39	Knowledge and understanding that in order to meet Customer/Prime requirements for specific parts, allowances must be made for these parts to be spaced far enough apart to ensure uniform heating and cooling and not impede circulation of the heating medium and quenchant.	OW	7	GEN	AMS2759 3.3.4	AC7102/S 5.3.1
40	<b>Soak</b>	OW				
41	Knowledge and understanding that in order to meet Customer/Prime requirements parts shall not be loaded into a furnace whose temperature is higher than the set temperature unless load sensors are used to check that temperature tolerance is not exceeded. Which should be included on the Works Instruction	OW	7	GEN	AMS2759 3.3.6	
42	Knowledge and Understanding of why it is necessary to ensure that adherence to set temperatures and furnace uniformity is critical, especially for solution treatment Set temperature shall be based on Work instructions unless a permissible Offset is applied. Offsets must meet AMS2750 and be documented.	OW	7	GEN	AMS2750 AMS2759 3.3.7	
43	Knowledge and understanding of how, in order to meet Customer/Prime requirements Works Instructions must accommodate the differences in the way start of soak is measured, through clear and accurate works Instructions either by a) the furnace control sensor (thermocouple) or b) a load (thermocouple). This is when the control sensor is within +/- 5F (+/- 3C) of set temperature and all other sensors are in tolerance. For Load sensors it is when the last load sensor reaches the lower tolerance on set temperature.	OW	10	GEN	AMS2759/3 3.4.2.1	
44	Knowledge and Understanding of how, through the use of concise and accurate Works Instructions, recognize and convey the importance of compliance with minimum and maximum treatment times, including how start and end of soak are defined and whether they are based on furnace (controller) readings or actual metal temperature (load thermocouples).	OW	7	GEN	AMS2759/3 3.4.2 AMS2759/4 3.4.2 AMS2759/D 3.4.3	
45	Knowledge and Understanding why it is necessary to convey requirements for End of soak through clear and concise Work Instructions. End of soak maybe when parts are removed from the furnace or when parts cool to the minimum temperature of the uniformity range.	OW	7	GEN	AMS2759 3.4.2.2.	
46	<b>Quench</b>	OW				
47	Knowledge and understanding that meeting Customer/Prime requirements must include that quench mechanisms (Manual or Automated) must be capable of meeting the maximum quench delay required by Customer /Prime specifications and results recorded and verified for each individual load.	OW	7	GEN		AC7102/H 9.9.1
48	Knowledge and understanding that in order to meet Customer/Prime requirements account must be taken of and convey, through concise Written Instructions, of the importance of meeting the maximum permitted process delays between Quench/Temper and Quench/Freeze/Temper. Also the effect exceeding the requirement might have on the mechanical properties of the product .Work Instructions must include that "In Process" delay times are recorded and subject to review if they are exceeded.	OW	7	GEN		AC7102H 9.9.1
49	<b>Quenchant Control</b>	OW				
50	Knowledge and understanding that in order to meet Customer/Prime requirements the temperature of quench media must be controlled and documented in accordance with Customer / Prime requirements.	OW	7	GEN	AMS2759 3.2	AC7102/H 9.10.1
51	Knowledge and understanding that in order to meet Customer/Prime requirements records	OW	7	GEN	AMS2759	AC7102



	must demonstrate that quench media has been at the specified temperature before, during and after the parts were quenched.				3.2.3	9.10
52	Knowledge and understanding that in order to meet Customer/Prime requirements Instructions must include a requirement to verify that agitation of quench media or the parts during quenching conforms to applicable specifications.	OW	7	GEN	AMS2759 3.2.	AC7102 9.10
53	Knowledge and understanding that in order to meet Customer/Prime requirements records must show that where parts are affected by high residual stress or cracking there is a system in place to measure and compare quenchant effectiveness.	OW	7	GEN	AMS2759 3.2	
54	<b>Gas Quenching in Vacuum furnaces</b>					
55	Knowledge and understanding that in order to meet Customer/Prime requirements concise instructions detailing the importance of working to traveler/data cards must be available and shall include the requirements for selection of quench gas type (e.g. Nitrogen/Argon/Helium) gas pressure during quench, and cooling direction.	OW	7	GEN		
56	Knowledge and Understanding of how to check cooling rates on gas quenching when there are customer specific requirement, and have the ability to demonstrate methods of calculation	OW	7	GEN		
57	<b>Low Temperature Treatment when Required by Specification</b>	OW				
58	Knowledge and understanding that in order to meet Customer/Prime requirements procedures addressing cooling requirements after quench are being met – and what action to take if they are not	OW	7	GEN		
59	Knowledge and understanding that records must show that cooling after quench is in compliance with customer requirements specified in procedures or any other shop papers.	OW	7	GEN		
60	Knowledge and understanding of the importance of recording the temperature in each refrigeration cycle to allow verification against Customer /Prime requirements.	OW	7	GEN		
61	<b>PERIODIC TESTING</b>	OW	7	GEN		
62	Knowledge and understanding of the need for procedures related to Periodic Testing which must take account of any instructions and requirements for reporting results when scheduling work.	OW	7	GEN	AMS2759 4.2.2 AMS2769 4.2.2	
63	Knowledge and understanding that in order to meet Customer/Prime requirements there must be a process to ensure that periodic testing is performed per procedures and the customers' requirements and in accordance with AMS 2759 and AMS 2769.	OW	7	GEN	AMS2759 4.2.2 AMS2769 4.2.2	
64	Knowledge and understanding of the importance of meeting cooling rates between between 875 and 1500 °F (468 and 816 °C) to minimize the formation of undesirable structures and grain boundary carbides in Austenitic Stainless Steels.	OW	7	GEN	AMS2759/4	
65	Knowledge and Understanding of how in order to meet Customer/Prime requirements account must be taken of the limitations of furnace atmosphere type related to part class and type. This is governed by the amount of material left to be removed by machining after Heat Treatment and the material type.	OW	7	GEN	AMS2759/5 3.3	
66	Knowledge and Understanding of recommendations for Pre-heating of parts Heat Treated above 1500F (816C) which have previously been hardened to greater than 35 HRC.	OW	7	GEN	AMS2759/5 3.4.2	
67	Knowledge and Understanding that in order to meet Customer/Prime requirements for post quench temper / snap tempering are met in accordance with material / customer specifications and how these will be applied through local procedures.	OW	7	GEN	AMS2759/5 3.4.7.1 /3.4.9	
70	Knowledge and Understanding that p in order to meet Customer/Prime requirements account must be taken of limitations on atmosphere control and surface contamination on parts with no post treatment machining.	OW	7	GEN	AMS2759/3 3.5.3	
1	<b>REQUIREMENTS SPECIFIC TO PRODUCT PROCESSED IN ACCORDANCE WITH SPECIFIC AMS STANDARDS DESCRIBED ABOVE (Competence)</b>	OW	7	SPEC		
2	<b>A) SPECIFIC REQUIREMENTS RELATED TO THE PROCESSING OF : Precipitation-Hardening Corrosion-Resistant and Maraging Steel parts AMS 2759/3</b>	OW	7	SPEC	AMS 2759/3	
3	Knowledge and understanding that in order to meet Customer/Prime requirements these must communicate through Works Instructions or Procedures that this specification establishes the heat treatment of PARTS manufactured to the specification above	OW	7	SPEC	1.0 Scope	
4	Knowledge and understanding that in order to meet Customer/Prime requirements these must apply this specification only to those materials listed in Table 1	OW	7	SPEC	1.1 Application	
5	<b>PYROMETRY</b>	OW	7	SPEC		
6	Knowledge and understanding that in order to meet Customer/Prime requirements these must be in accordance with the requirements of AMS2759 and AMS 2750 (Pyrometry)	OW	7	SPEC	3.2	
7	Knowledge and understanding that in order to meet Customer/Prime requirements processes must only use equipment that conforms to the TUS Class requirements listed below  a) Temperatures > 1400°F (760°C) and for stress relieving +/- 25°F (14°C) b) Temperatures > 1300°F (704°C) and <1375°F (746°C) +/- 15°F (+/-8°C) c) Temperatures < 1300°F (704°C) +/- 10°F (+/- 6°C)	OW	7	SPEC	3.2.1 3.2.2 3.2.3	
8	<b>Heating environment / Atmospheres</b>	OW	7	SPEC		
9	Knowledge and understanding that in order to meet Customer/Prime requirements atmospheres are controlled such that they do not contaminate parts being treated including	OW	7	SPEC	3.3	



	Vacuum and Salt baths					
10	Knowledge and understanding that in order to meet Customer/Prime requirements it is necessary to take into account the need or requirement to carry out purges before treating materials in furnaces who's use is not limited solely to aerospace work	OW	7	SPEC	8.2	
11	Knowledge and understanding that in order to meet Customer/Prime requirements these must take account of the need for periodic tests to be carried out to monitor contamination. Test results must be recorded	OW	7	SPEC	3.5.3	
12	Knowledge and understanding that in order to meet Customer/Prime requirements these must take account of the type and suitability of an atmospheres used to protect parts from contamination in accordance with the limits set out in 3.3.1	OW	10	SPEC	3.3.1	
13	<b>Coatings</b>	OW		SPEC	3.3.2	
14	Knowledge and understanding that in order to meet Customer/Prime requirements Works Instructions and Procedures must prohibit the use of protective coatings unless approved by the cognizant engineering authority	OW	7	SPEC	3.3.2	
15	Knowledge and understanding that in order to meet Customer/Prime requirements Works Instructions or Procedures must accurately reflect the requirements for application and use of Special protective coatings where their use has been authorized by the Customer/Prime	OW	7	SPEC		
	<b>Acid Cleaning</b>	OW	7	SPEC	3.4.1	
	Knowledge and understanding that in order to meet Customer/Prime requirements it is necessary to ensure that parts formed with dies made from lead, kirksite or other low melting temperature materials, are cleaned in accordance with ASTM A 380 before heat treatment	OW	7	SPEC	3.4.1	
16	<b>Soaking</b>	OW	7	SPEC	3.4.2	
17	<b>Solution Heat Treatment , and Austenite conditioning</b>	OW	7	SPEC	3.4.2.1	
18	Knowledge and understanding that in order to meet Customer/Prime requirements it is necessary to ensure that soaking is continuous and not interrupted. Heating shall be controlled per AMS 2759 (AMS 2769 for Vacuum) such that the temperature of all thermocouples meets the requirements set out in Tables 2,3 and 4	OW	7	SPEC	3.4.2.1 Tables 2, 3 and 4	
19	Knowledge and understanding that in order to meet Customer/Prime requirements it must be communicated through Work Instructions or Procedures that soaking time commences in accordance with 3.4.2.1	OW	7	SPEC	3.4.2.1	
20	<b>Aging</b>	OW	7	SPEC	3.4.2.2	
21	Knowledge and understanding that in order to meet Customer/Prime requirements it is necessary to must ensure that soak time shall conform to Table 3 except as specified in Table 3	OW	7	SPEC	3.4.2.2 Table 3	
22	Knowledge and understanding that in order to meet Customer/Prime requirements it is necessary to ensure through Work Instructions and Procedures that start of soaking time shall be as defined in 3.4.2.2	OW	7	SPEC	3.4.2.2	
23	Knowledge and understanding that in order to meet Customer/Prime requirements then differences between load thermocouple and control thermocouple requirements for start of soak must be taken into account and agreed formerly with Customers/Primes per 3.4.2.2.1 and 3.4.2.2.2	OW	7	SPEC	3.4.2.2.1 and 3.4.2.2.2	
24	<b>Solution Heat Treating (Solution Annealing, Annealing), Austenite Conditioning and Aging (Precipitation Heat Treating)</b>	OW	7	SPEC	3.4.3	
25	Knowledge and understanding that through Work Instructions and Procedures the heat treatments above are accomplished by in accordance with the requirements set out in 3.4.3 and Tables 3,4 and 6	OW	7	SPEC	3.4.3 and Tables 3,4 and 6	
26	<b>Resolution heat treatment</b>	OW	7	SPEC		
27	Knowledge and understanding that Work Instructions and Procedures must flow down the specific requirement that resolutioning is restricted to 1 cycle only, for these particular alloys	OW	7	SPEC	3.4.3.1	
28	<b>Stress relieving</b>	OW	7	SPEC	3.4.4	
29	Knowledge and understanding that in order to meet Customer/Prime requirements it is necessary to ensure that Stress relieving is carried out in accordance with 3.4.4	OW	7	SPEC	3.4.4	
30	<b>Carbide solution treatment for AM-355</b>	OW	7	SPEC		
31	Knowledge and understanding that in order to meet Customer/Prime requirements it is necessary to ensure that Carbide solutioning treatments are carried out precisely as described in 3.4.5 of this specification and Table 2	OW	7	SPEC	3.4.5	
32	<b>Straightening</b>	OW	7	SPEC	3.4.6	
33	Knowledge and understanding that in order to meet Customer/Prime requirements it is necessary to ensure that process required for straightening at ambient temperature, during aging, or by heating to not more than 50°F (28°C) below the aging temperature are carried out in accordance with AMS 2759/3 section 3.4.6	OW	7	SPEC	3.4.6	
34	<b>Properties</b>	OW	7	SPEC	AMS 2759 and 3.4	
35	Knowledge and understanding that in order to meet Customer/Prime requirements it is necessary to take account of the requirements to process to specification requirements in order to obtain the required mechanical properties	OW	7	SPEC	3.5.1 3.5.2 3.5.3	
36	Knowledge and understanding of the importance of complying with set temperature, start and end of soak , meeting process delay times and aging processes in order to meet property requirements	OW	7	SPEC		

37	Knowledge and understanding of the importance of accurate in order to meet Customer/Prime requirements and timely recording of process parameters including reporting process faults and non-conformity	OW	7	SPEC		
38	Knowledge and understanding that WORK Instructions and Procedures must ensure that periodic and other process determining tests must be carried out in accordance with the appropriate specifications for Hardness (see Table 5) Tensile properties and surface contamination. Results must conform to specific values in the absence of any other information results shall conform to the appropriate material specification	OW	10	SPEC	3.5.1 3.5.2 3.5.3	
39	Knowledge and understanding that Procedures include a mandatory requirement to ensure review and reporting of any non-conformity (process or product) and the requirement to document and follow through the processes involved in their resolution	OW	7	SPEC		
40	<b>Surface contamination</b>	OW	7	SPEC	3.5.3	
41	Knowledge and understanding that where the surface of the part is not machined after heat treatment the protective atmosphere or backfill media shall be controlled not to produce carburization or nitriding in accordance with 3.5.3.1 and 3.5.3.2	OW	7	SPEC	3.5.3.1 3.5.3.2	
42	<b>Test Methods</b>	OW	7	SPEC	3.5.6	
43	Knowledge and understanding that testing shall be carried out in accordance with AMS 2759	OW	7	SPEC		
44	Knowledge and understanding of the differences in requirements as set out in 4.1 depending on the particular classification of the test being carried out including a) Acceptance Tests e.g.) Tensile and Hardness (4.1.1) b) Periodic Tests e.g.) Contamination ,SAT,TUS (4.1.2) c) Pre-production tests e.g. Surface contamination, process evaluation (4.1.3)	OW	7	SPEC	4.1.1 4.1.2 4.1.3	
45	Knowledge and understanding that sampling and testing must be carried out in accordance with AMS 2759	OW	7	SPEC	4.2	
46	Knowledge and understanding that tensile testing must be carried out in accordance with 4.2.1 and subsections 4.2.1.1 (AM350 and AM355) 4.2.1.2 (17-4PH and 15-5PH Steels) and 4.2.1.3 (17-7PH and 15-7Mo to the RH Condition	OW	7	SPEC	4.2.1	
47		OW	7	SPEC		
1	<b>B) SPECIFIC REQUIREMENTS RELATED TO THE PROCESSING OF : Heat Treatment of Austenitic Corrosion Resistant Steel Parts AMS 2759/4</b>	OW	7	SPEC	AMS 2759/4	
2	Knowledge and understanding that in order to meet Customer/Prime requirements it must be communicate, through Works Instructions or Procedures, that this specification establishes the heat treatment of PARTS manufactured to the specification above	OW	7	SPEC	1.0 Scope	
3	Knowledge and understanding that in order to meet Customer/Prime requirements the application of this specification relates only to those materials listed in Section 1.1	OW	7	SPEC	1.1 Application	
4	<b>PYROMETRY</b>	OW	7	SPEC		
5	Knowledge and understanding that in order to meet Customer/Prime requirements Pyrometry must be controlled in accordance with the requirements of AMS2759 and AMS 2750 (Pyrometry)	OW	7	SPEC		
6	Knowledge and understanding that in order to meet Customer/Prime requirements processing may only use equipment that conforms to the TUS Class requirements +/- 25°F (14°C) for annealing , stress relieving and stabilising	OW	7	SPEC	3.2	
7	<b>Heating Environment / Atmospheres</b>	OW	7	SPEC	3.3	
8	Knowledge and understanding that in order to meet Customer/Prime requirements furnace atmospheres must be controlled such that they do not contaminate parts being treated including Vacuum and Salt baths	OW	7	SPEC		
9	Knowledge and understanding that in order to meet Customer/Prime requirements account must be taken of the requirement to carry out purges before treating materials in furnaces who's use is not limited solely to aerospace work	OW	7	SPEC		
10	Knowledge and understanding that in order to meet Customer/Prime requirements these must take account of the need for periodic tests to be carried out to monitor contamination. Test results must be recorded	OW	7	SPEC		
11	Knowledge and understanding that in order to meet Customer/Prime requirements account must be taken of the type and suitability of atmospheres used to protect parts from contamination in accordance with the limits set out in 3.3.1	OW	7	SPEC	3.3.1	
12	Knowledge and understanding that the use of Nitrogen manufactured by the dissociation of Ammonia is prohibited	OW	10	SPEC	3.3.1	
13	<b>Protective coating</b>	OW	7	SPEC		
14	Knowledge and understanding that use of protective coatings is permitted only when approved by the cognizant engineering authority	OW	7	SPEC	3.3.2	
15	<b>Acid Cleaning</b>	OW	7	SPEC		
16	Knowledge and understanding that in order to meet Customer/Prime requirements it is necessary to ensure that parts formed with dies made from lead, kirksite or other low melting temperature materials, are cleaned in accordance with ASTM A 380 before heat treatment	OW	7	SPEC	3.4.1	
17	<b>SOAKING</b>	OW	7	SPEC		
18	<b>Solution Heat Treatment , and Austenite conditioning</b>	OW	7	SPEC		

19	Knowledge and understanding that in order to meet Customer/Prime requirements it is necessary to ensure that soaking is continuous and not interrupted. Heating shall be controlled per AMS 2759 (AMS 2769 for Vacuum) such that the set temperature for the particular material in Table 1 is maintained for the soak time given in Table 2	OW	7	SPEC	3.4.2	
20	Knowledge and understanding that in order to meet Customer/Prime requirements there must be communication, through Work Instructions or Procedures that soaking time commences in accordance with 3.4.2	OW	7	SPEC	3.4.2	
21	Knowledge and understanding that for Annealing, Stress relieving and dimensional stabilization shall be accomplished as shown in Table 1 and Table 2	OW	7	SPEC	3.4.3	
22	Knowledge and understanding that in order to meet Customer/Prime requirements there must be communication, through Work Instructions or Procedures that assure awareness at all levels that all unstabilized grades (with exceptions detailed in 3.4.3) are prohibited from being heated , stress relieved or slow cooled through the range 875 to 1500°F (468 to 816°C)	OW	7	SPEC	3.4.4	
23	<b>Straightening</b>	OW	7	SPEC	3.4.5	
24	Knowledge and understanding that in order to meet Customer/Prime requirements the process required for straightening at ambient temperature, with a post process stress relieve must be in accordance with Table 1	OW	7	SPEC		
25	<b>Properties</b>	OW	7	SPEC	3.5	
26	<b>Surface Contamination</b>	OW	7	SPEC	3.5.1	
27	Knowledge and understanding that where the surface of the part is not machined after heat treatment the protective atmosphere or backfill media shall be controlled not to produce carburization or nitriding in accordance with 3.5.1 and 3.5.1.1 and 3.5.1.2	OW	7	SPEC	3.5.1 3.5.1.1 3.5.1.2	
28	<b>Carbide precipitation</b>	OW	7	SPEC	3.5.2	
29	Knowledge and awareness that when using other means of cooling in accordance with Table 1 Note 2 carbide precipitation is not permitted	OW	7	SPEC	3.5.2	
30	<b>Test Methods</b>	OW	7	SPEC	3.6	
31	Knowledge and understanding that testing shall be carried out in accordance with AMS 2759	OW	7	SPEC	3.6	
32	<b>Surface Contamination</b>	OW	7	SPEC	3.6.1	
33	Knowledge and understanding of the requirements to prepare samples in accordance with ASTM E 3 (Metallography)and determination of contamination in accordance with ARP 1820 –The Chord Method	OW	7	SPEC	3.6.1	
34	Knowledge and understanding of the differences in requirements as set out in 4.1 depending on the particular classification of the test being carried out including a) Acceptance Tests e.g.) Tensile and Hardness (4.1.1) b) Periodic Tests e.g.) Contamination ,SAT,TUS (4.1.2) c) Pre-production tests e.g. Surface contamination, process evaluation (4.1.3)	OW	7	SPEC	4.1 4.1.1 4.1.2 4.1.3	
35	Knowledge and understanding that sampling and testing must be carried out in accordance with AMS 2759	OW	7	SPEC	4.2	
36	Knowledge and understanding that Surface contamination tests shall be carried out and results recorded in accordance with 4.1.1	OW	7	SPEC	4.2.1	
37						
1	<b>C ) SPECIFIC REQUIREMENTS RELATED TO THE PROCESSING OF Heat Treatment Martensitic Corrosion-Resistant Steel Parts to AMS2759/5</b>	OW	7	SPEC	AMS 2759/5	
2	Knowledge and understanding that in order to meet Customer/Prime requirements it must be communicate, through Works Instructions or Procedures, that this specification establishes the heat treatment of PARTS manufactured to the specification above	OW	7	SPEC	1.0 Scope	
3	Knowledge and understanding that in order to meet Customer/Prime requirements the application of this specification relates only to those materials listed in Section 1.1	OW	7	SPEC	1.1 Application	
4	<b>Pyrometry</b>	OW	7	SPEC		
5	Knowledge and understanding that in order to meet Customer/Prime requirements Pyrometry must be controlled in accordance with the requirements of AMS2759 and AMS 2750 (Pyrometry)	OW	7	SPEC	3.1	
6	Knowledge and understanding that in order to meet Customer/Prime requirements only equipment that conforms to the TUS Class requirements listed below may be used for processing to AMS 2759/5 a) Annealing ,subcritical annealing, hardening, straightening, stress relieving and baking shall be +/- 25°F (14°C) b) Tempering shall be +/- 15°F (+/-8°C)	OW	7	SPEC	3.2	
7	<b>Heating Environment / Atmospheres</b>	OW	7	SPEC		
8	Knowledge and understanding that in order to meet Customer/Prime requirements parts must be controlled by type (as required by section 3.3.1) and atmosphere class (required by section 3.3.2) permitted in Table 1 when heating above 1250°F (677°C)	OW	7	SPEC	3.3	
9	Knowledge and understanding that when treating below 1250°F (677°C) atmosphere types A, B or C may be used (See section .2)	OW	7	SPEC	3.3 8.2	
10	Knowledge and understanding that in order to meet Customer/Primes requirements parts	PL	7	SPEC	3.3.1	

	must be classified according to the rules in section 3.3.1 related to parts machined ,part machined or in the 'as supplied' condition					
11	Knowledge and understanding that in order to meet Customer/Prime requirements parts must be controlled such that if the part type cannot be determined in accordance with 3.3.2 it shall be processed as Type 3 – parts with finished machined or less than 0.020 inches (0.51mm) of stock removal or parts protectively coated on all surfaces	PL	7	SPEC	3.3.1.1	
12	Knowledge and understanding that in order to meet Customer/Prime requirements the heat treatment of parts must be controlled through Work Instructions or procedures such that atmospheres shall be limited to those classified in section 3.3.2	OW	7	SPEC	3.3.2	
13	Knowledge and understanding that in order to meet Customer/Prime requirements parts must only be treated in atmosphere furnaces equipped and controlled to meet the Surface contamination limits of section 3.5.1 of this specification	OW	7	SPEC	3.3.3 3.5.1	
14	Knowledge and understanding that in order to meet Customer/Prime requirements the use Hydrogen or Hydrogen containing blends is limited to furnaces where the Dew point at the exit end of is lower than -40°F (-40°C)	OW	7	SPEC	3.3.3.1	
15	<b>Protective coating</b>	OW	7	SPEC		
16	Knowledge and understanding that use of protective coatings is permitted only when approved by the cognizant engineering authority	OW	7	SPEC	3.3.4	
17	<b>Acid Cleaning</b>	OW	7	SPEC		
18	Knowledge and understanding that in order to meet Customer/Prime requirements that parts formed with dies made from lead, kirksite or other low melting temperature materials, are cleaned in accordance with ASTM A 380 before heat treatment	OW	7	SPEC	3.4.1	
19	<b>Preheating</b>	OW	7	SPEC		
20	Knowledge and understanding that preheating shall be carried out in accordance with section 3.4.2 of the specification	OW	7	SPEC	3.4.2	
21	<b>Soaking</b>		7	SPEC		
22	Knowledge and understanding that in order to meet Customer/Prime requirement it is necessary to ensure that soaking is continuous and not interrupted. Heating shall be controlled per AMS 2759 (AMS 2769 for Vacuum) such that the set temperature for the particular material in Table 2 or 3 is maintained for the soak time specified herein	OW	7	SPEC	3.4.3	
23	Knowledge and understanding that Work Instructions or Procedures must flow down the requirement that soaking time commences in accordance with 3.4.3 and AMS2759	OW	7	SPEC	3.4.3	
24	Knowledge and understanding that Work Instructions and procedures must flow down that parts protected by Copper plating shall have their soaking time increased by 50% unless load thermocouples are used	OW	7	SPEC	3.4.3.1	
25	Knowledge and understanding that Annealing shall be accomplished by heating to the temperature shown in Table 2 for the time shown in Table 4 and cooled to the below the temperature shown in Table 2 at the rate shown in Table 2 followed by air cooling to ambient temperature in accordance with 3.4.4	OW	7	SPEC	3.4.4 Table 2 and Table 4	
26	Knowledge and understanding that Subcritical annealing shall be carried out in accordance with section 3.4.5 to soaking times shown in Table 2	OW	7	SPEC	3.4.5 and Table 2	
27	Knowledge and understanding that Hardening (Austenitizing and Quenching) shall be carried out in accordance with section 3.4.6 at the Temperature shown in Table 2 for soaking times shown in Table 4	OW	7	SPEC	3.4.6 Table 2 and Table 4	
28	Knowledge and understanding that Tempering shall accomplished by heating quenched parts to the temperature required to develop the required properties in accordance with section 3.4.7 of this specification	OW	7	SPEC	3.4.7	
29	Knowledge and understanding that Suggested temperatures for specific tensile strengths and specific alloys are shown in Table 3	OW	7	SPEC	3.4.7 and Table 3	
30	Knowledge and understanding that in accordance with Section 3.4.7 of this specification Soaking time for tempering shall be for a minimum of 2 hours with additional time determined from section thickness as set out in section 3.4.7 and AMS 2759	OW	7	SPEC	3.4.7 and AMS 2759	
31	Knowledge and understanding that according to section 3.4.7 multiple tempering is permitted	OW	7	SPEC	3.4.7	
32	Knowledge and understanding that 'Snap Tempering' is permitted in accordance with section 3.4.7.1 for either 2 hours at 300°F (149°C) or 25°F(14°C) below the tempering temperature if this is >325°F(163°C)	OW	7	SPEC	3.4.7.1	
33	<b>Straightening</b>		7	SPEC		
34	Knowledge and understanding that where straightening is authorized by the cognizant engineering authority and there are no specific instructions the process shall be performed per section 3.4.8.1 and 3.4.8.2 of this specification	OW	7	SPEC	3.4.8.1 3.4.8.2	
35	Knowledge and understanding that post straightening or other post treatment processes stress relieving shall be carried out in accordance with section 3.4.9 of this specification for a minimum of one hour except for exclusions described in 3.4.9	OW	7	SPEC	3.4.9	
36	<b>Properties</b>	OW	7	SPEC		
37	Knowledge and understanding that testing shall be carried out in accordance with AMS 2759	OW	7	SPEC		
38	Knowledge and understanding that parts shall conform to the hardness specified by the cognizant engineering authority	OW	7	SPEC	3.5	

39	Knowledge and understanding that in the absence of a specification of maximum hardness for certain alloy types then the requirements of section 3.5 of this specification shall apply	OW	7	SPEC	3.5	
40	<b>Surface Contamination</b>	OW	7	SPEC		
41	Knowledge and understanding of the requirements for determining the presence or absence of surface contamination according to section 3.5.1 of this specification	OW	7	SPEC	3.5.1 3.5.1.1	
32	Knowledge and understanding that parts which are machined after heat treatment may be reclassified depending on the level of material to be removed in accordance with Section 3.5.1.2 of this specification	OW	7	SPEC	3.5.1.2	
43	<b>Test methods</b>	OW	7	SPEC		
44	Knowledge and understanding that testing shall be carried out in accordance with AMS 2759	OW	7	SPEC	3.6	
45	Knowledge and understanding of the test methods used for determination of Surface contamination and in particular the Chord method described in ARP 1820	OW	7	SPEC	3.6.1	
46	Knowledge and understanding that testing for reclassification per section 3.5.1.2 of this specification may be by any microhardness method	OW	7	SPEC	3.6.1.1	
47	<b>Classification of tests</b>	OW	7	SPEC		
48	Knowledge and understanding of the differences in requirements as set out in 4.1 depending on the particular classification of the test being carried out including	OW	7	SPEC	4.1	
49	Knowledge and understanding that sampling and testing must be carried out in accordance with AMS 2759	OW	7	SPEC	4.1	
50	Knowledge and understanding that Surface contamination tests shall be carried out and results recorded in accordance with 4.1.1; 4.1.2 and 4.1.3	OW	7	SPEC	4.1.1 4.1.2 4.1.3	
51			7	SPEC		
1	<b>D) SPECIFIC REQUIREMENTS RELATED TO THE PROCESSING OF : Heat Treatment of Raw Material to AMS 6875 parts B,C and D</b>	OW	7	SPEC	AMS H6875	
2	Knowledge and understanding that Works Instructions or Procedures communicate or flow down that this specification establishes the heat treatment of Raw Material .It does not include requirements for the treatment of parts	OW	7	SPEC	Scope 1.1	
3	Knowledge and understanding that the apply this specification applies only to those materials listed in Section 1.1and Tables 1A / 1B / 1C and 1D	OW	7	SPEC	1.2	
4	Knowledge and understanding that in terms of Stainless and PH Steels this specification only applies to types B , C and D	OW	7	SPEC	1.2	
5	<b>Furnace media and protective coatings</b>	OW	7	SPEC		
6	<b>Atmospheres</b>	OW	7	SPEC		
7	Knowledge and understanding that gases used as furnace atmospheres must only be used for the appropriate class of 'parts' determined from Table 1. Supplementary protective coatings may be used in accordance with section 3.3.1.3 of this specification	OW	7	SPEC	3.1.1.1 and 3.3.1.3	
8	Knowledge and understanding that furnaces for Mill Products shall be supplied with a consistent atmosphere gas that meets the requirements of the material specification	OW	7	SPEC	3.1.1.2	
9	Knowledge and understanding that that atmospheres must be controlled such that they do not contaminate parts being treated including Vacuum and Salt baths	OW	7	SPEC	3.1.1.2	
10	Knowledge and understanding that the need or requirement to carry out purges before treating materials in furnaces who's use is not limited solely to aerospace work	OW	7	SPEC	3.1.1.2	
11	Knowledge and understanding that Salt baths may only be used for Class B steels (Martensitic Corrosion Resistant Steels) and must be tested initially and at least weekly to prevent carburization , decarburization, IGA, IGO,	OW	7	SPEC	3.1.1.3	
12	<b>Temperature Uniformity</b>	OW	7	SPEC		
13	Knowledge and understanding that TUS must be performed and determined in accordance with the requirements of AMS 2750 (Pyrometry) and Customer /Prime requirements where these are more stringent	OW	7	SPEC	3.1.1.4	
14	Knowledge and understanding that furnaces must have instrumentation to a minimum of Type D	OW	7	SPEC	3.1.2.1	
15	Knowledge and understanding that Furnace Class requirements are per AMS2750 as set out in Figure 1 which relates AMS H 6875 Processes to AMS 2750 Furnace Class 2 +/-10°F (+/- 6°C) Furnace Class 3 +/- 15°F (+/-8°C) and Class 5 +/-25°F (+/-14°C)	OW	7	SPEC	3.1.2.1	
16	<b>Quench tanks</b>	OW	7	SPEC		
17	Knowledge and understanding that Quench tanks must permit total immersion and provide adequate circulation to produce the required properties in the largest material processed	OW	7	SPEC	3.1.3.1	
18	Knowledge and understanding that for Oil Quenching medium must be between 60°F and 160°F (15°/71°C) at the beginning of the quench and shall not exceed 200°F (93°C) at any time	OW	7	SPEC	3.1.3.1.1	
19	Knowledge and understanding that Aqueous Polymer Quenchants may be used as permitted in Tables 1A through 1D .Baths must have adequate circulation	OW	7	SPEC	3.1.3.1.3	
20	<b>Thermal Treatment</b>	OW	7	SPEC		
21	Knowledge and understanding that heating rates must be controlled to prevent damage to material per section 3.2.1	OW	7	SPEC	3.2.1	



22	Knowledge and understanding that Material in Class B shall be hardened by Austenitizing , Quenching and Tempering	OW	7	SPEC	3.2.2	
23	Knowledge and understanding that Austenitizing temperature shall conform to Table 1B whilst times shall conform to Table 2A	OW	7	SPEC	3.2.2.2	
24	Knowledge and understanding that Quenching shall be carried out in the quenchant specified in Table 1B as applicable	OW	7	SPEC	3.2.2.3	
25	Knowledge and understanding that a process is in place for when hardened material cannot be tempered within 2 hours after quenching. Material may be Snap Tempered at 400°F +/- 25°F (204°C +/- 14°C) for 1 hour or as appropriate to prevent cracking	OW	10	SPEC	3.2.2.3	
26	Knowledge and understanding that Tempering shall be carried out in compliance with Table 3 tempering temperatures in Table 1B are recommended unless indicated as mandatory.	OW	7	SPEC	3.2.2.4	
27	Knowledge and understanding that Class D steel parts shall be hardened by precipitation heat treatment of material which has been either Solution heat treated or Solution Treated and cold worked. Thermal treatment for Type D material shall conform to Table 1D. The temperature in Table 1D may be adjusted higher to meet specific tensile strengths	OW	7	SPEC	3.2.3	
28	<b>Cleaning</b>	OW	7	SPEC		
29	Knowledge and understanding that material shall be cleaned prior to heat treatment to remove contaminants and leave no substance that could have a deleterious effect.. Cleaning prior to heat treatment is not required for Mill products	OW	7	SPEC	3.3.1.1	
30	<b>Spacing</b>	OW	7	SPEC		
31	Knowledge and understanding that material should be racked or supported to allow circulation of heating and quenching media exposure to heating or quenching media and to minimize warpage	OW	7	SPEC	3.3.1.2	
32	Knowledge and understanding that except for Copper or Nickel plating approval from the cognizant engineering organization must be obtained prior to the use of coatings or plating for protection of surfaces during heat treatment	OW	7	SPEC	3.3.1.3	
33	<b>Mechanical Properties</b>	OW	7	SPEC		
34	Knowledge and understanding that Work Instructions and Procedures take account of the specific requirements of sections 3.3.2.and 3.3.3. for the relevant Class of material in determining the heat treatment parameters required to achieve the desired mechanical properties.	OW	10	SPEC	3.3.2 3.3.2.1	
35	<b>Surface Contamination</b>	OW	7	SPEC		
36	Knowledge and understanding that and account for the requirements of 3.3.3 when material is hardened, normalized, or re-hardened the requirements of sections 3.3.3.1, 3.3.3.2 and 3.3.3.3 shall apply unless it is definitely known that sufficient material will be subsequently removed to eliminate deleterious surface conditions.	OW	7	SPEC	3.3.3.1	
37	<b>Decarburization, Carburization and Nitriding and inter-granular attack (IGA)</b>	OW	7	SPEC		
38	Knowledge and understanding that process Work Instructions and procedures must take into consideration the need to control decarburization of Class B material. For furnaces required to treat material to >HRC46 (220ksi/1517Mpa) the requirements for partial decarburization in section 3.3.3.1 are met	OW	7	SPEC	3.3.3.1	
39	Knowledge and understanding that total decarburization is not acceptable	OW	10	SPEC	3.3.3.1	
40	Knowledge and understanding that furnaces used for Heat Treatment above 1250°F(676°C) must be controlled to preclude carburizing or nitriding. The extent of Carburizing and nitriding shall be determined in accordance with Section 4.2.3.1 of this specification	OW	7	SPEC	3.3.3.2 4.2.3.1	
41	Knowledge and awareness that furnaces used for Heat Treatment above 1250°F(676°C) shall be controlled to preclude IGA exceeding 0.0007 inches(0.018mm) on material heat treated to <220 ksi (1517Mpa) and 0.0005 inches (0.013mm) on other materials. Test method shall be as specified in section 4.2.3.2	OW	7	SPEC	3.3.3.3 4.2.3.2	
42	<b>Quenchant effectiveness</b>	OW	7	SPEC		
43	Knowledge and understanding that the consistency of quenchant effectiveness must be determined in each quench tank initially then at least quarterly by one of the methods detailed in Section 4.3. Results shall be recorded for ongoing comparison. When results deviate outside of required limits then the Test shall be repeated after appropriate Corrective action has been taken	OW	7	SPEC	3.3.4	
44	<b>Heat Treatment of Parts</b>	OW	7	SPEC		
45	Knowledge and understanding that under this specification PARTS must be treated in accordance with AMS 2759 and that any reference in this specification (AMS H 6875) to Parts is superseded by the requirements of AMS 2759	OW	7	SPEC		
		OW				
1	<b>GENERAL/QMS REQUIREMENTS AFFECTING ALL PROCESSING/SPECIFICATIONS</b>	OW	7	GEN		
2	Knowledge and awareness that the responsibility for Inspection lies with the special process provider and includes the verification and control of activities carried out by authorized third party contractors or approved suppliers	OW	7	GEN		
3	Knowledge and understanding that the responsibility for compliance lies with the special process provider	OW	7	GEN		
4	Knowledge and understanding that records of SAT, TUS, Calibration, Initial , Periodic, Acceptance Tests, Test results on product and records of all related process parameters and controls must be maintained and available for inspection for a period specified by regulating bodies or customers whichever is the greatest	OW	7	GEN		



5	<b>Definitions Raw Material and Parts</b>	OW	7	GEN		
6	Knowledge and understanding that Raw Material includes but is not limited to items such as Sheet, Plate, Wire, Rod, Bar, Forgings or Extrusions. It is usually identified by a Heat, Charge, Batch, or Lot number. It may or may not have been heat treated by the producer	OW	7	GEN		
7	Knowledge and understanding that Parts are usually identified by a Part Number and are produced from Raw Material to the requirements of a drawing. They are heat treated to meet the requirements of a drawing, contract, purchase order, or heat treatment specification. At the time of heat treatment they may resemble Raw Material	OW	7	GEN		
1	<b>SKILLS:</b>	OW	7	GEN		
2	<b>The skills required to perform a particular special process task Within these Rows enter text that describes the range of skills specified in the Body of Knowledge.</b>	OW	7	GEN		
3	Has knowledge and understanding to be able to recognize and report in real time deviations from process parameters or other events which may have a negative impact on product quality.	OW	7	GEN		
4	Capable of understanding, interpreting and complying with various customer requirements for precedence in documents	OW	7	GEN		
5	Capable of understanding interpreting and complying with various requirements for identification , review and revision of documents (Document Control)	OW	7	GEN		
6	Ability to understand and interpret specification requirements and customer flow-down requirements.	OW	7	GEN		
7	Has knowledge understanding and experience to be able to recognize conflicts within customer requirements and deviations from specifications and to ensure that they are resolved prior to final preparation for processing	OW	7	GEN		
8	Capable of generating clear and concise Work Instructions consistent with company practices and 'higher level' QMS requirements for general and specific procedures, operator training and approvals. Must be able to flow down information in a concise manner such that it can be readily understood at all levels from shop floor to CEO	OW	7	GEN		
9	Capable of reviewing and approving records required to demonstrate compliance with customer requirements including: <ul style="list-style-type: none"> <li>Set temperature</li> <li>Soak Time</li> <li>Quench delay time</li> <li>Quench concentration</li> <li>Quench temperature before and after quench</li> <li>Cooling after quench including refrigeration temperature</li> <li>Periodic and lot acceptance test requirements and results</li> <li>Temper delay</li> <li>Heating and Cooling rates (where applicable)</li> </ul>	OW	7	GEN		
10	Capable of evaluating potential product impact of deviations from process parameters or other events which may have a negative impact on product quality, and the experience and knowledge to handle these situations with both Customer and OEM/Prime	OW	7	GEN		
11	Knowledge and understanding of the proper operation, maintenance, and calibration requirements for equipment used for testing evaluation and acceptance (e.g. Hardness)	OW	7	GEN		
12	Knowledge and understanding of Pyrometry testing requirements including Furnace Class and Type , Calibration , Sensors (thermocouples) , SAT and TUS	OW	7	GEN		
13	Capable of reviewing Calibration, SAT and TUS reports when required	OW	7	GEN	General Industry	
14	Capable of developing and documenting an on-going schedule for Pyrometry compliance to AMS 2750 to be effective at shop and site level.	OW	7	GEN		
15	Capable of developing a schedule, monitoring performance and making timely reminders/notifications of Pyrometry requirements and test frequencies	OW	7	GEN		
16	Capable of carrying out 'Self Audits' and Internal Audits against specific Systems and Customer requirements	OW	7	GEN		
17	Capable of writing developing and delivering internal training and personal qualification exams to comply with HT BoK /ERB requirements	OW	7	GEN		
18	Understanding the safety concerns involved with heat treatment including the need to include in Works Instructions and Procedures the need for the safe use of handling tools, personal protective equipment and customer product	OW	7	GEN		
19	Knowledge and understanding of the Preventive Maintenance Program including developing mutually beneficial relationships with other internal Department Heads , External Systems organizations and Customers/Primes.	OW	7	GEN	General Industry	
	<b>Sequencing</b>					
	<b>Has an appropriate understanding of where this process falls in the sequence of events and why it should not deviate without customer/end user permission.</b>	OW	10	GEN		
	<b>PERSONAL ATTRIBUTES:</b>	OW				
	<b>Are statements that will enable judgment of the person's personal attributes</b>					
	Define within the following rows statements from the Body of Knowledge or statements from Company sources that will enable judgment of the person's personal attributes.	OW	7	GEN		

	Willingness and ability to train and mentor co-workers.					
	Good communicator at all levels.	OW	7	GEN		
	Takes responsibility to challenge work instructions that do not appear to conform to specification or customer requirements.	OW	10	GEN		
	Personal integrity	OW	7	GEN		
	Attentive to details	OW	7	GEN		
	<b>EXPERIENCE:</b> <i>Are the minimum experience requirement expected to demonstrate their competence.</i>					
	NOTE: ARP 1962 (Aerospace Recommended Practice -Training and Approval of Heat-Treating Personnel) requires that suppliers have a documented personnel training program including documented training to an established outline and initial and periodic evaluation of the competency. Evaluation to the requirements of this program should be used in completing this section. The following are recommendations and would be superseded by the supplier's specific documented program. The supplier program may define alternative criteria, waivers and equivalences.	OW				
	Recommended Minimum Classroom Training					
	Heat Treatment – 80 hours Paperwork – 40 hours Test, Inspection, Maintenance – 40 hours	OW	10	GEN	ARP 1962 Table 1	
	Recommended Minimum On-the-Job-Training					
	Furnace atmospheres and atmosphere control –12 months	OW				
	Stainless and PH Steels – annealing , stress relief and dimensional stabilization– 12 months All other treatments except those above - 24 months		10	GEN	ARP 1962 Table 2	
	Testing and Evaluation	OW				
	Initial and periodic evaluation of personnel is required. The type of frequency of the evaluation shall be determined by the company employing the individual, except that each individual shall be evaluated at least every 5 years. This shall be defined in the formal written program. Evaluation may consist of any combination of written or oral examination or testing, structured checklist review, employee performance appraisal, company employee specific audit program or other appropriate methodology defined in the formal written program.	OW	10	GEN	ARP 1962 3.3.1.4, 3.3.1.4.1, 3.3.1.4.2	
	<b>NON-SPECIAL PROCESS RELATED REQUIREMENTS:</b> Defined within these rolls are other general or pre-requisite needed					
	Must have a thorough understanding of general Quality Systems (AS9100) or equivalent.	OW	7	GEN	General Industry	
	Must have a thorough understanding of customer specific requirements.	OW	7	GEN	General Industry	
	Must have a thorough understanding of Control of Non Conformance for equipment and product including containment, customer notification and disposition.	OW	7	GEN	General Industry	

ADDENDUM 1

LIST OF INDUSTRY STANDARDS FOR HEAT TREATMENT OF STAINLESS AND PH STEELS

SPECIAL PROCESS	DOCUMENT TITLE	DOCUMENT NUMBER
Heat Treating	Nadcap Audit Criteria for Heat Treatment	AC7102
Heat Treating	Nadcap Audit Criteria for Hardness and Conductivity Testing	AC7102/5
Heat Treating	Nadcap Audit Criteria For Heat Treating Pyrometry	AC7102/8
Heat Treating	SAE Aerospace Materials Specification – Pyrometry	AMS2750
Heat Treating	SAE Aerospace Materials Specification –Heat Treatment of Steel Parts General Requirements	AMS2759
Heat Treating	SAE Aerospace Materials Specification – Heat Treatment of Parts in Vacuum	AMS2769
Heat Treating	SAE Aerospace Materials Specification – Precipitation-Hardening Corrosion-Resistant and Maraging Steel parts	AMS2759/3
Heat Treating	SAE Aerospace Materials Specification – Heat Treatment of Austenitic Corrosion-Resistant Steel Parts	AMS 2759/4
Heat Treating	SAE Aerospace Materials Specification – Heat Treatment Martensitic Corrosion-Resistant Steel Parts	AMS 2759/5

Heat Treating	SAE Aerospace Recommended Practice - Training and Approval of Heat-Treating Personnel	ARP 1962
Quality	AS9100 Quality Management Systems - Requirements for Aviation, Space and Defense Organizations	AS9100
Quality	Quality Standards	ISO9001