SAE Aerospace
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AEROSPACE RECOMMENDED PRACTICE

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TRAINING AND APPROVAL OF HEAT-TREATING PERSONNEL

RATIONALE

This document has been reaffirmed to comply with the SAE 5-year Review policy.

1. SCOPE:

1.1 Scope:

This document requires that the company (facility) employing the personnel ensure a verifiable program of on-the-job training, experience, education, classroom instruction, and evaluation of personnel using either company-created programs or programs described herein.

1.2 Purpose:

It describes the requirements for training and approval of personnel performing certain heat-treating and associated operations. It also establishes that only approved personnel may perform or monitor the functions listed in Table 1 for the processes and materials listed in Table 2.

1.3 Responsibility:

The company (facility) employing the heat-treating and associated personnel is the responsible agency for determination of its training and evaluation program and approval of the individual heat treaters and associated personnel.

1.4 Summary of Requirements:

Approved personnel must meet certain requirements of on-the-job training, education, classroom instruction, and evaluation. Some suggested on-the-job training may be substituted by experience and education. Some suggested classroom instruction may be substituted by equivalent experience. The company (facility) employing the personnel is responsible for determining these substitutions and equivalencies.

This document does not mandate any specific on-the-job training program or specific education or classroom instruction program. It does not require any specific testing or evaluation nor any specific question(s) on the test or evaluation. The ASM MEI and the MTI training and testing documents described herein are not required by this document; they are provided as sources which the heat-treating facility can obtain and use as needed.

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TABLE 1 - Suggested Minimum Classroom Instruction

Function	Classroom Instruction Hours (4)(6)(8)	or CEUs (4)(5)(8)	or Heat Cap Lessons (7)(8)
Heat Treat Processes	80	8	20
Verify part cleanliness before and after heat treatment			
Load work into and out of furnace (1)			
Set temperature controls			
Set atmosphere and vacuum controls			
Monitor nonapproved personnel			
Rack parts			
Determine specific equipment to be used			
Determine or verify temperatures and soak times			
Determine or verify load size			
Verify temperature control settings			
Verify atmosphere and vacuum settings			
Determine and adjust heating and cooling rates			
Verify conformance of indicated and recorded temperatures and times to specified requirements			
Insert, position, and adjust load thermocouples			
Insert, position, and adjust control, indicating and recording thermocouples (3)			
Approve racking procedure or verify racking if no procedure is established			
Determine or verify when soaking commences (heat up time, stabilization, etc.)			
Verify quenching medium			
Determine or verify retemper or reage temperature and time			
Monitor accuracy of heat treat log			
Shop Paperwork	40	4	10
Monitor nonapproved personnel			
Prepare shop travelers/job cards			
Determine specific equipment to use			
Determine number and type of test samples (2)			
Prepare cleaning procedures (2)			
Prepare heat treating procedures (2)			
Determine temperatures and soak times			
Set up new job in plant			
Preapprove shop travelers/job cards, heat treat procedures, or any other document providing heat treating instructions			
Determine quenching medium			
Determine retemper or reage temperature and time			
Prepare reheat treat instructions			
Interpret customer specifications and drawings (2)			
Determine and document testing and inspection requirements (2)			
Prepare personnel approval tests for use by the employing facility (2)			
Testing and Inspection	40	4	10
Prepare parts for hardness testing (3)			
Conduct hardness tests (3)			
Monitor nonapproved personnel			
Perform visual inspection for cleanliness, scale (3) discoloration, blistering, protective coating effectiveness, or any other evidence of improper heat treating			
Analyze SPC or any other statistical data (2)			
Prepare samples for and conduct metallographic tests (3)			

TABLE 1 (Continued)

Function	Classroom Instruction Hours (4)(6)(8)	or CEUs (4)(5)(8)	or Heat Cap Lessons (7)(8)
Conduct mechanical property tests (3)			
Monitor accuracy of heat treat log			
Maintenance, Etc.			
Insert, position, and adjust control, indicating and recording thermocouples (3)			

NOTES:

(1) At standard part producers, where continuous runs of the same product are processed, only the first run needs to be monitored on each shift for each specific material or part, each piece of equipment, and each unapproved operator.
(2) See 3.2.2-5
(3) See 3.2.2-6
(4) Classroom instruction for various functions may run concurrently; however, all functions must be thoroughly covered. CEUs are in lieu of the classroom instruction hours, not in addition to them. Classroom instruction should include each of the material and process categories in Table 2 for which the individual is to be approved.
(5) Continuing Education Unit (CEU) is 10 h of participation in an organized continuing education experience under responsible sponsorship, capable direction, and qualified instruction. It is recognized by business and industry throughout the United States and Canada.
(6) See 3.3.1.3.1
(7) Heat cap lessons are in lieu of classroom hours, not in addition to them.
(8) The suggested minimums are intended for companies and personnel performing a wide variety of heat treatments and testing and inspections on numerous materials. For companies or personnel performing limited processes or limited tests and inspections, the suggested minimums could be much less.

TABLE 2 - Suggested Minimum On-The-Job Training Requirements

Material or Process Category (1)	Minimum Months of Total On-The-Job Training (2)(3)
Air atmosphere	9
Salt bath	9
Visual inspection (4)	12
Lab testing (4)	12
Controlled atmosphere	12
Inert gas atmosphere	12
Vacuum	12
Aluminum alloys (aging and stress relief only)	12
Carbon, alloy, and CRES steel hardening	12
Nickel and cobalt alloys	12
Titanium alloys	18
Magnesium alloys	18
Aluminum alloys (all other processes)	24
Carburizing/carbonitriding	24
Nitriding	24
Ion nitriding	24
Furnace brazing	24
Hydrogen atmosphere	24
Dip brazing	24
Induction heat-treating or brazing	24
Flame hardening	24
High-strength steel (220 ksi (1515 MPa) and higher)	24

NOTES:

(1) If two or more categories apply to the same job, the more stringent category applies.
(2) Training in multiple alloys and processes may be covered concurrently providing substantial time is devoted to each category and function.
(3) On-the-job training for various categories may run concurrently; however, all categories must be thoroughly covered.
(4) If the approved person is doing only testing or visual inspection, that person needs to be trained for only those categories.

1.5 Application:

This document is applicable to heat treatment of parts and castings, forgings, and fasteners. It is invoked only when cited by another specification, either the material or product specification or the heat-treating specification specified by the material or product specification or the engineering drawing. This procedure is not applicable for raw materials that are heat-treated at the producing mill, excluding forgings and castings as described above. It is applicable for raw materials heat-treated by an outside vendor, but only when invoked by specification. It is applicable to both heat treat vendors and to captive heat treat departments. It is not applicable to airline maintenance facilities, unless specifically specified.

2. REFERENCES:

2.1 Applicable Documents:

The following publications form a part of this specification to the extent specified herein.

2.1.1 Heat Treater Certification Manual; available from Metal Treating Institute (MTI) Publications, Metal Treating Institute, 302 3rd Street, Suite 1, Neptune Beach, FL 32266, (904) 249-0448.

2.1.2 Heat Treat Training Directory of North America; available from Materials Engineering Institute (MEI) Publications, ASM International, Materials Engineering Institute, Materials Park, OH 44073, (216) 338-5151.

2.1.3 Heat Treating Certificate of Educational Achievement Program™ (Heat Cap); available from ASM International Education Department, Materials Park, OH 44073, (216) 338-5151.

2.2 Definitions:

2.2.1 HEAT-TREAT PLANNERS: Planners who are providing detailed heat-treat instructions to the shop.

2.2.2 MANUFACTURING SEQUENCE PLANNERS: Planners who are only listing step-by-step operations for which the heat-treat details are covered in a more detailed document.

2.2.3 FACILITY: A facility is a different plant of the same company.

3. TECHNICAL REQUIREMENTS:

3.1 Training Program:

The company shall have a formal written program that defines the progression for education, experience, on-the-job training, classroom instruction, and evaluation for each individual to become approved. In addition, the company should have a documented system for assessing the heat treater's ability to produce acceptable hardware; such a system would use inspection and test data and failure data that is traceable to the individual heat-treater. Evidence of problems should trigger consideration of retraining, reevaluation, withdrawing of approval, or not granting reapproval.

3.2 The functions in Table 1 shall be performed or monitored by approved personnel who have been specifically documented as approved for each function they perform. Determination of which personnel are approved for which functions is solely the responsibility of the heat-treat company or facility. Personnel may be approved for any or all of these functions.

3.2.1 The functions in Table 1 may be performed by nonapproved personnel who can follow instructions when they are designated by and monitored by an approved person (for the function(s) being monitored). The approved person is responsible for the proper performance of the function. Monitoring shall entail either frequent periodic witnessing or verification checking of the function, verification of the accuracy of shop paper, test results, and inspection records, and stamping, initialing, or signing off the shop paper, test results, and inspection records by approved personnel. The frequency of witnessing shall be determined by heat-treating company approved personnel based on their confidence in the experience and capability of the nonapproved personnel. Monitoring does not imply constant visual contact.

3.2.2 Personnel requiring approval are heat-treaters, including leads, supervisors, foremen, inspectors, laboratory technicians, heat-treat planners (2.2.1), engineers or metallurgists, and all other personnel performing or monitoring the functions listed in Table 1 with the exceptions listed below:

1. Foremen and supervisors in captive heat-treat shops who are responsible for other activities and whose function in the heat-treat department is only administrative.

2. Manufacturing sequence planners (2.2.2) in captive heat-treat facilities unless they are preparing detailed heat-treat instructions or procedures.

3. Personnel from outside subtier vendors, such as laboratory technicians, who perform associated functions.

4. Metallurgists and other graduate engineers who have documented records of on-the-job shop training and who have passed the evaluation specified herein. On-the-job shop training for metallurgists and other graduate engineers may be waived with 6 months of related heat-treat experience.

5. Metallurgists and other graduate engineers who are proficient or have been trained in these functions and who are performing only functions listed in footnote 2 to Table 1.

6. Personnel performing functions listed in footnote 3 to Table 1, who do not work in the heat treat department; however, documentation of training in the functions being performed is required.

3.3 Approval Guidelines:

The following describes the guidelines for a heat-treater to be approved and perform the specific functions listed in Table 1 for the specific processes and materials listed in Table 2.

3.3.1 Required for approval are a minimum on-the-job training time (suggested times are shown in Table 2) with waivers for experience as defined in 3.3.1.1; completion of a minimum amount of classroom instruction (suggested times are shown in Table 1) with waivers for experience as defined in 3.3.1.1; and passing of an evaluation management may use judgment to modify by decreasing the suggested minimum training and/or classroom instruction times while providing competence. This shall be defined in the formal written program requirements in 3.1.