CQI-9
SPECIAL PROCESS:
HEAT TREAT SYSTEM ASSESSMENT

4TH EDITION | ROLLOUT PRESENTATION

MEDIUM BY: JAMES HAWTHORNE & KAREN KRUTSCH
THURSDAY, SEPTEMBER 17TH, 2020
CQI-9
PRESENTATION HOSTS/MODERATORS

JAMES HAWTHORNE
Chairperson, CQI-9 Technical Committee
ACUMENT GLOBAL TECHNOLOGIES, NORTH AMERICA
Corporate Heat Treat Specialist

KAREN KRUTSCH
CQI-9 Program Manager
AUTOMOTIVE INDUSTRY ACTION GROUP (AIAG)
Program Manager, Quality Initiatives

AIAG
Automotive Industry Action Group
JUNE 2020


TO PURCHASE, VISIT WWW.AIAG.ORG/STORE, SEARCH “CQI-9-4”.
CQI-9 LIVE VIRTUAL TRAINING: www.aiag.org/store/training/details?CourseCode=CQHSV
This presentation is intended to:

Showcase many of the notable updates within the 4th Edition.

Include ‘Q&A’ session with a panel of CQI-9 Technical Committee Members.
ACCESS TO PRESENTATION MATERIALS AND ASSOCIATED CONTENT AVAILABLE TO ALL PARTICIPANTS.

ACCESSED VIA https://www.aiag.org/store/events/past-events.
Feel free to submit your questions at anytime during the presentation.

Questions to be addressed during the ‘Q&A’ at the end of the presentation.

Reported technical issues will be addressed upon receipt.
OVERVIEW

DEVELOPMENT

OBJECTIVES

PRESENTED BY: JAMES HAWTHORNE, ACUMENT GLOBAL TECHNOLOGIES
THE WORK OF PREPARING THIS HEAT TREAT SYSTEM ASSESSMENT WAS CONDUCTED BY THE AIAG HEAT TREAT TECHNICAL COMMITTEE.

AIAG TECHNICAL COMMITTEES ARE COMPOSED OF VOLUNTEERS FROM AIAG MEMBER COMPANIES.
CURRENT CQI-9 CHAIRPERSON:
JAMES HAWTHORNE — Acument Global Technologies

DEAN HIGDON — Acument Global Technologies
DR. GERD BROCKMANN — Alsoswiss GmbH
JOHN VANDER WOUDE — Benteler Automobiltechnik GmbH
CURT HOLMES — Commercial Steel Treating Corp.
DARRELL RYDZEWSKI — Controls Service, Inc.
JUSTIN RYDZEWSKI — Controls Service, Inc.
ROBERT HURSH — Dana, Inc.
STEPHEN TOLTESI — Eaton Corporation
PETE BATCHE — Emerald Steel Processing
ED RAHE — FCA, North America
JAKE SLOAN — FCA, North America (formerly)
SURANJEETA DHAR — Ford Motor Company

MEDINA KAKNJO — Ford Motor Company
PETER SCHIEFER — Ford, Germany (retired)
ROBERT FERRY — FPM Heat Treating
RICK METCALF — General Motors Company
RANDALL LEWIS — GKN Driveline
VIRENDER CHOUDHRI — MAHLE International GmbH
PHILIP MIKULA — P.C. Mikula Consulting, LLC
WILLARD SCHULTZ — Peterson American Corp.
KEN STEELE — Peterson Spring
DANIEL ALDEA — ZF Friedrichshafen, AG
JEFF MARTIN — ZF Friedrichshafen, AG
JENS WUEPPENHORST — ZF Friedrichshafen, AG
DEVELOPMENT PROCESS BEGINS SHORTLY AFTER PUBLICATION OF THE CURRENT EDITION.

PROCESS RELIES HEAVILY ON INDUSTRY FEEDBACK.

FEEDBACK TYPICALLY COLLECTED VIA EMAIL AND/OR MAINTENANCE REQUEST FORM.
# MAINTENANCE REQUEST FORM

<table>
<thead>
<tr>
<th>Name of Submitter:</th>
<th>Date:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Company:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Company Address:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Phone:</th>
<th>Fax:</th>
<th>E-mail:</th>
</tr>
</thead>
</table>

## MAINTENANCE REQUEST

<table>
<thead>
<tr>
<th>Page Number of Change:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Document Currently Reads:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Recommended Changes/Should Read:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Reason for Change (Use additional sheets if necessary):</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Signature of Submitter:</th>
</tr>
</thead>
</table>

## DISPOSITION (AIAG USE ONLY)

<table>
<thead>
<tr>
<th>Manager's Recommendation:</th>
</tr>
</thead>
</table>
THE CQI-9 TECHNICAL COMMITTEE REVIEWS ALL FEEDBACK/MAINTENANCE REQUEST FORMS.

AN OFFICIAL CHARTER FOR THE SUBSEQUENT EDITION IS THEN ESTABLISHED BY THE COMMITTEE.

DEFINES THE PRIMARY FOCUS/OBJECTIVES OF DEVELOPMENT EFFORTS.
IN PART, OUR 4TH EDITION CHARTER INCLUDED:

• INCORPORATE ERRATA SHEET ITEMS.
• CONSIDER NEW TECHNOLOGIES WHICH MAY HAVE HAD IMPACT ON CURRENT REQUIREMENTS.
• ENHANCE DOCUMENT CLARITY, GUIDANCE, AND ILLUSTRATIONS.
• EMBRACE/ADOPT NEW QUALITY MANAGEMENT CONCEPTS.
  (E.G., ‘RISK MANAGEMENT’)
Once draft document is complete, it is then circulated to the Steering Committee for review, feedback, & consensus approval.

Prior to publication, all Steering Committee feedback, comments, concerns, and questions MUST be satisfactorily addressed by the Technical Committee.
COLLECTIVELY, THE CQI-9 TECHNICAL COMMITTEE DEDICATED THOUSANDS OF HOURS TO THE DEVELOPMENT PROCESS OF THE 4TH EDITION.
IN LINE WITH OUR CHARTER, TREMENDOUS AMOUNTS OF EFFORT WERE DEDICATED TO:

- Refining document formatting.
- Improving and increasing guidance.
- Enhancing clarity to the maximum extent possible.
- Updating reference illustrations, figures, and tables.
- Eliminating irrelevant/unnecessary content.
- Resolving ambiguous instructions/requirements.
THE 4TH EDITION IS GREATLY IMPROVED AND A MORE EFFECTIVE HEAT TREAT MANAGEMENT SYSTEM AND HEAT TREAT SYSTEM ASSESSMENT TOOL.
CRITICAL NOTE

THIS PRESENTATION IS NOT INTENDED TO IDENTIFY ALL THE UPDATES/CHANGES MADE.
CRITICAL NOTE

THIS PRESENTATION IS NOT INTENDED TO BE A COMPREHENSIVE TRAINING SEMINAR.
ULTIMATELY, IT IS THE RESPONSIBILITY OF THE “END-USER” TO REVIEW, UNDERSTAND, IMPLEMENT, AND COMPLY WITH ALL APPLICABLE REQUIREMENTS DENOTED IN THIS DOCUMENT.

IT IS ESSENTIAL TO READ THE DOCUMENT.
TO PROVIDE PARTICIPANTS:

  AGAIN, PLEASE NOTE, NOT ALL UPDATES/CHANGES WILL BE COVERED

- AN OPPORTUNITY TO ASK QUESTIONS DIRECTLY TO A PANEL OF CQI-9 TECHNICAL COMMITTEE MEMBERS REGARDING ANY 4TH EDITION RELATED MATTER.
MEDINA KAKNJO  
Member, CQI-9 Technical Committee  
**Ford Motor Company**  
STA Global Core Technical Expert  
Global Purchasing

JAMES HAWTHORNE  
Chairperson, CQI-9 Technical Committee  
**Acument Global Technologies, North America**  
Corporate Heat Treat Specialist

JOHN VANDER WOUDE  
Member, CQI-9 Technical Committee  
**Benteler Automotive Corporation, North America**  
Metallurgist, Automotive Division

RICK METCALF  
Member, CQI-9 Technical Committee  
**General Motors Company, North America**  
Materials Engineering – Valvetrain PMT

ROBERT FERRY  
Member, CQI-9 Technical Committee  
**FPM Heat Treating**  
Vice President, Engineering & Quality

JUSTIN RYDZEWSKI  
Member, CQI-9 Technical Committee  
**Controls Service, Inc.**  
Director, Sales and Market Development

DARRELL RYDZEW SKI  
Member, CQI-9 Technical Committee  
**Controls Service, Inc.**  
Director, Training and Standards Compliance  
Quality Manager
UPDATES

IMPROVEMENTS

CHANGES

NOTABLE IMPROVEMENTS

PRESENTED BY: JUSTIN RYDZEWSKI, CONTROL SERVICE, INC.
The 4th edition includes many great improvements which were focused on making the Heat Treat System Assessment more effective and easier to understand.
Some of the most notable improvements include...
ALL PYROMETRY SECTION NUMBERING
NOW INCLUDES THE PREFIX “P”.

INCLUDES ALL TABLE, ILLUSTRATION, AND FIGURE NUMBERING
P3.1 Thermocouples

P3.1.1 Application of Thermocouples: Thermocouples shall be selected as appropriate for their intended use. Where a process is to be controlled, consideration shall be given to variables that can have an impact upon thermocouple performance such as, but not limited to, atmosphere, temperature, electrical interference, etc.
ALL FORMATTING AND REQUIREMENTS NOW MORE THOROUGHLY HARMONIZED.

E.G., FREQUENCIES, PROCESS TABLE STRUCTURE, AND TERMS UTILIZED
CQI-9
4TH EDITION | NOTABLE IMPROVEMENTS

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 treator 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

<table>
<thead>
<tr>
<th>Item #</th>
<th>Related HTSA Question #</th>
<th>Category/Process Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1.1</td>
<td>3.1</td>
<td>Recording instruments are required for temperature controlling devices and protective atmosphere monitoring unit, e.g. dew point, oxygen probe, or other atmosphere controlling devices.</td>
</tr>
<tr>
<td>A1.2</td>
<td>1.18</td>
<td>A program for furnace, generator, and oxygen probe burnout is required. Not required for refractory handling.</td>
</tr>
</tbody>
</table>

REFERENCE: CQI-9 4TH EDITION, PROCESS TABLE A/B/E, ITEM #1.1
‘PROCESS AND TEST EQUIPMENT’, PAGE #69/74/84

AIAG
Automotive Industry Action Group
Errata Sheet content now included in the primary document.

Added Process Table I, corrected errors.
ASSESSOR QUALIFICATIONS WERE AMENDED.

NOW, MORE FOCUS PLACED ON THE IMPORTANCE OF HEAT TREAT EXPERIENCE.

REFERENCE: CQI-9 4TH EDITION, INTRODUCTION, ‘ASSESSOR QUALIFICATIONS’, PAGE #8
Assessor Qualifications

Assessor or assessing team shall collectively have the following specific experience to conduct the HEAT TREAT SYSTEM ASSESSMENT:

1. Assessor shall possess heat treating knowledge. Evidence shall include a minimum of 5 years’ experience in heat treating or a combination of formal metallurgical education and heat treating experience totaling a minimum of 5 years.

2. Assessor shall be able to demonstrate understanding of applicable quality management system (e.g. ISO 9001, VDA and IATF 16949) requirements related to the scope of the assessment.

3. Assessor shall possess knowledge of and be familiar with the application of automotive quality core tools including statistical process control, measurement systems analysis, part approval, failure mode and effects analysis, and advanced quality planning.

Note: If more than one assessor is required to meet the above qualifications, the lead assessor shall be the person meeting the requirements in item #1.
UPDATED & EXPANDED GLOSSARY OF TERMS.

NUMEROUS TERMS ADDED, REVISED, OR CLARIFIED;
MANY REFERENCE ILLUSTRATIONS UPDATED.
Control Thermocouple

Source (input)
Calibrated Signal to Control Instrument

Control Instrument

Multi-Point Calibration of Control Instrument

CALIBRATION IS DONE WITH EMPTY FURNACE

REFERENCE:
NEW & IMPROVED REFERENCE ILLUSTRATIONS.
ALL ILLUSTRATIONS, TABLES, AND FIGURES WITHIN THE PYROMETRY SECTION WERE UPDATED.

INCLUDES ALL SAT ILLUSTRATIONS AND TUS TABLES/FIGURES
REFERENCE: ERRATA SHEET FOR CQI-9 3RD EDITION (NOV-2013), ITEM #9, ‘EXAMPLE OF PROBE METHOD “A”, ILLUSTRATION 3.3.1
REFERENCE: CQI-9 4TH EDITION, P3.3 SYSTEM ACCURACY TEST (SAT), ‘EXAMPLE OF PROBE METHOD “A”’, ILLUSTRATION P3.3.1, PAGE #46
FOCUS
NOTABLE IMPROVEMENT

HEAT TREAT SYSTEM ASSESSMENT (HTSA)
QUESTION FORMATTING & LAYOUT

PRESENTED BY: JUSTIN RYDZEWSKI, CONTROLS SERVICE, INC.

THURSDAY, SEPTEMBER 17TH, 2020
In the 3rd Edition...

‘Requirements and Guidance’ for each HTSA question are cited together in a single cell.

Commonly, ‘Requirements and Guidance’ for a single question span multiple paragraphs and include several “shall” statements.

In this approach, it is much more difficult to capture all applicable requirements and to determine expectations of the HTSA question in terms of ‘Objective Evidence’.
### Special Process: Heat Treat System Assessment

<table>
<thead>
<tr>
<th>Question Number</th>
<th>Question</th>
<th>Requirements and Guidance</th>
<th>Objective Evidence</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>Are all heat treat related and referenced specifications current and available? For example: Industry and customer specific specifications such as SAE, AIAG, ASTM, ISO, EN, JIS, General Motors, Ford, and Chrysler.</td>
<td>To ensure all customer requirements are both understood and satisfied, the organization shall have all related heat treat and customer referenced standards and specifications available for use and a method to ensure that they are current. Such standards and specifications include, but are not limited to, those relevant documents published by SAE, AIAG, ASTM, ISO, EN, JIS, General Motors, Ford, and Chrysler. The organization shall have a process to ensure the timely review, distribution, and implementation of all customer and industry engineering standards / specifications and changes based on customer-required schedule. Timely review should be as soon as possible and shall not exceed two working weeks. The organization shall document this process of review and implementation, and it shall address how customer and industry documents are obtained, how they are maintained within the organization, how the current status is established, and how the relevant information is cascaded to the shop floor within the two-week period. The organization shall identify who is responsible for performing these tasks.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Section 1 - Management Responsibility & Quality Planning

**Question 1.5**

Are all heat treat related and referenced specifications current and available? For example: Industry and customer specific specifications such as SAE, AIAG, ASTM, ISO, EN, JIS, General Motors, Ford, and Chrysler.

To ensure all customer requirements are both understood and satisfied, the **organization shall** have all related heat treat and customer referenced standards and specifications available for use and a method to ensure that they are current. Such standards and specifications include, but are not limited to, those relevant documents published by SAE, AIAG, ASTM, ISO, EN, JIS, General Motors, Ford, and Chrysler. The **organization shall** have a process to ensure the timely review, distribution, and implementation of all customer and industry engineering standards / specifications and changes based on customer-required schedule. Timely review should be as soon as possible and shall not exceed two working weeks. The **organization shall** document this process of review and implementation, and it shall address how customer and industry documents are obtained, how they are maintained within the organization, how the current status is established, and how the relevant information is cascaded to the shop floor within the two-week period. The **organization shall** identify who is responsible for performing these tasks.
For the 4th Edition...

The HTSA Question Formatting and Approach was completely revamped.

Refined/Expanded Guidance; Simplified Navigation; Requirements Explicitly/Clearly Identified; Improved Approach to Requirement Organization.
### Section 1 - Management Responsibility and Quality Planning

Please describe Objective Evidence for each Requirement

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Objective Evidence</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td>N/A</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The procedure shall include a 2-week distribution limit for cascading newly received and reviewed documents.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Comments:**

**REFERENCE:** CQI-9 4TH EDITION, SECTION 1 – MANAGEMENT RESPONSIBILITY AND QUALITY PLANNING, HTSA QUESTION #1.5, PAGE #18
‘Requirements’ and ‘Guidance’ for each HTSA question are now cited separately.

More efficient navigation.
ALL “SHALL” STATEMENTS WITHIN THE HTSA QUESTIONS ARE NOW DENOTED INDIVIDUALLY.

REQUIREMENTS NOW MORE READILY IDENTIFIABLE.
### Special Process: Heat Treat System Assessment

<table>
<thead>
<tr>
<th>Question Number</th>
<th>Question</th>
<th>Requirements and Guidance</th>
<th>Objective Evidence</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.6</td>
<td>Is there a written process specification for all active processes?</td>
<td>The heat treater shall have written process specifications for all active processes and identify all steps of the process including relevant operating parameters. Examples of operating parameters include process temperatures, cycle times, load rates, atmosphere or gas flow settings, belt speeds, quench agitation speeds, etc. Such parameters shall not only be defined, they shall have operating tolerances as defined by the organization in order to maintain process control. All active processes should have a written process specification. These process specifications may take the form of work instructions, job card, computer-based recipes, or other similar documents.</td>
<td>N/A</td>
<td>Satisfactory</td>
</tr>
</tbody>
</table>

**Reference:** CQI-9 3rd Edition, Section 1 – Management Responsibility and Quality Planning, HTSA Question #1.6, Page #20
### Section 1 - Management Responsibility and Quality Planning

Please describe Objective Evidence for each Requirement

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Objective Evidence</th>
<th>N/A</th>
<th>Satisfactory</th>
<th>Not Satisfactory</th>
<th>Needs Immediate Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The heat treater shall have written process specifications for all active processes and identify all steps of the process including relevant process parameters.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameters shall have operating tolerances as defined by the organization in order to maintain process control.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process specifications shall be available in the form of work instructions, job card, computer-based recipes, or other similar documents.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All process specification changes shall be reviewed to the extent necessary to ensure continued conformity with customer requirements for process changes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All process specification changes shall be documented to include the date the process specification change was implemented and the person(s) approving the change.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments:
Several HTSA Question requirements were expanded to more clearly and adequately address the *Objective Evidence* sought.

Improved and expanded guidance.
## Special Process: Heat Treat System Assessment

<table>
<thead>
<tr>
<th>Question Number</th>
<th>Question</th>
<th>Requirements and Guidance</th>
<th>Objective Evidence</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td>Are thermocouples &amp; protection tubes checked or replaced per Process Tables?</td>
<td>The thermocouples and protection tubes shall be checked or replaced in compliance to a preventive maintenance schedule. Refer to the applicable Process Tables, Section 2.0.</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

**Reference:** CQI-9 3rd Edition, Section 3 – Equipment, HTSA Question #3.3, Page #31
### Section 3 - Equipment

Please describe Objective Evidence for each Requirement

#### 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.

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Objective Evidence</th>
<th>N/A</th>
<th>Satisfactory</th>
<th>Not Satisfactory</th>
<th>Needs Immediate Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control, monitoring and recording thermocouples shall be SAT checked as per the applicable Process Table(s) and Section P3.3.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>System Accuracy Test records shall meet the requirements established in Section P3.3.5.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protection tubes shall be checked or replaced in compliance to a documented preventive maintenance schedule.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Comments:**

**REFERENCE:** CQI-9 4th Edition, Section 3 – Equipment, HTSA Question #3.3, Page #27
RESULT OF UPDATE...

GREATLY IMPROVED ABILITY TO EASILY TRAVERSE THE HTSA QUESTIONS AND EFFECTIVELY CAPTURE ALL APPLICABLE REQUIREMENTS.
UPDATES

IMPROVEMENTS

CHANGES

GENERAL OVERVIEW

PRESENTED BY: ROBERT FERRY, FPM HEAT TREATING
The 4th Edition contains numerous new requirements, revised requirements, and additional clarifications that the supply organization **MUST** consider when completing its self-assessment.
Many of these changes are identified in the “Changes to CQI-9 4\textsuperscript{th} Edition” list which can be found on page #3 of CQI-9.

Available for download at [www.aiag.org](http://www.aiag.org)
HOWEVER...

THE LIST IS **NOT** COMPREHENSIVE.
ULTIMATELY, IT IS THE RESPONSIBILITY OF THE “END-USER” TO REVIEW, UNDERSTAND, IMPLEMENT, AND COMPLY WITH ALL APPLICABLE REQUIREMENTS DENOTED IN THIS DOCUMENT.

AGAIN, IT IS ESSENTIAL TO READ THE DOCUMENT.
UPDATES
CHANGES

HEAT TREAT SYSTEM ASSESSMENT (HTSA)
SECTION 1 – 3 QUESTIONS

PRESENTED BY: ROBERT FERRY, FPM HEAT TREATING
EVERY QUESTION WITHIN THE HTSA WAS REVIEWED IN DETAIL TO ENSURE RELEVANCY, IMPROVE CLARIFICATION, REDUCE AMBIGUITY, AND EASE TRANSLATION EFFORTS.
The most notable change within the Heat Treat System Assessment (HTSA) Questions is the improved formatting.
HOWEVER...

MINOR CHANGES WERE MADE TO MOST QUESTIONS.

AWARENESS OF ALL APPLICABLE CHANGES IS CRITICAL; IT IS ESSENTIAL TO READ THE DOCUMENT
ALL PROCESS SPECIFICATION CHANGES MUST NOW BE DOCUMENTED, REVIEWED, AND APPROVED.

DOCUMENTATION TO INCLUDE IMPLEMENTATION DATE OF CHANGE

REFERENCE: CQI-9 4TH EDITION, SECTION 1 – MANAGEMENT RESPONSIBILITY AND QUALITY PLANNING, HTSA QUESTION #1.6, PAGE #18
### Section 1 - Management Responsibility and Quality Planning

Please describe Objective Evidence for each Requirement

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Objective Evidence</th>
<th>N/A</th>
<th>Satisfactory</th>
<th>Not Satisfactory</th>
<th>Needs Immediate Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The heat treater shall have written process specifications for all active processes and identify all steps of the process including relevant process parameters.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameters shall have operating tolerances as defined by the organization in order to maintain process control.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process specifications shall be available in the form of work instructions, job card, computer-based recipes, or other similar documents.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All process specification changes shall be reviewed to the extent necessary to ensure continued conformity with customer requirements for process changes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All process specification changes shall be documented to include the date the process specification change was implemented and the person(s) approving the change.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Comments:**

**Reference:** CQI-9 4<sup>th</sup> Edition, Section 1 – Management Responsibility and Quality Planning, HTSA Question #1.6, Page #18
UPDATES

CHANGES

PYROMETRY

THERMOCOUPLES, INSTRUMENTATION, SYSTEM ACCURACY TEST (SAT), TEMPERATURE UNIFORMITY SURVEY (TUS)

PRESENTED BY: JUSTIN RYDZEWSKI, CONTROLS SERVICE, INC.
Majority of changes within the Pyrometry section intended to merely add clarification and guidance to existing requirements.
Because minor changes are often easy to miss, here are a few of note:

- Most *Reporting* requirements updated.
- *Grace Periods* now explicitly defined for all testing.
- *Offset* requirements revised; now more clearly defined.
- *Resident Thermocouple* requirements expanded.
- Multi-chamber furnace TUS requirements explicitly defined.
- *Test Thermocouple* requirements revised.
  *(E.g., Maximum usage intervals, # required for testing small/large furnaces)*
SOME OF THE MOST NOTABLE CHANGES WITHIN PYROMETRY SECTION INCLUDE…

AWARENESS OF ALL APPLICABLE CHANGES IS CRITICAL; IT IS ESSENTIAL TO READ THE DOCUMENT
ALL CONTROL, MONITORING, AND RECORDING INSTRUMENTATION MUST BE DIGITAL BY JUNE 2023.

REFERENCE: CQI-9 4TH EDITION, SECTION P3.2.1, ‘GENERAL INSTRUMENTATION REQUIREMENTS’, NOTE, PAGE #40
IN THE 3\textsuperscript{RD} EDITION...

AN EXTENDED CALIBRATION INTERVAL WAS ALLOWED, PROVIDED...

CALIBRATIONS PERFORMED WITH A TEST INSTRUMENT HAVING \textit{PRIMARY STANDARD ACCURACIES}

AND

MULTI-POINT CALIBRATION METHOD IS EMPLOYED

AND

SAT’S PERFORMED \textit{QUARTERLY} per Probe Method “A”

\textbf{REFERENCE:} \footnotesize{CQI-9 3\textsuperscript{RD} Edition, Section 3.2.4.3.2, ‘CALIBRATION FREQUENCY’, Option 2, page #46 \newline CQI-9 3\textsuperscript{RD} Edition, Section 3.2, Table 3.2.1, ‘INSTRUMENT CALIBRATION REQUIREMENTS’, Footnote #1, page #48}
NOW, EXTENDED INTERVAL CALIBRATIONS ARE ALLOWED PROVIDED...

CALIBRATIONS PERFORMED WITH A TEST INSTRUMENT HAVING *Field Test Instrument Accuracies*

AND

MULTI-POINT CALIBRATION METHOD IS EMPLOYED

AND

SAT’S PERFORMED *MONTHLY* per Probe Method “A”

FOCUS
NOTABLE CHANGE

PYROMETRY SECTION
ALTERNATIVE TUS TESTING METHODS

PRESENTED BY: JAMES HAWTHORNE, ACUMENT GLOBAL TECHNOLOGIES

THURSDAY, SEPTEMBER 17TH, 2020
In the 3rd Edition...

The alternative TUS testing methods section was the subject of much industry feedback.

Users cited confusion with when Alternative TUS test methods were appropriate and how to determine what was acceptable and unacceptable.

And, users found it difficult to determine which other section requirements were applicable. (E.g., reaction to failures, furnace parameters, process control requirements)

Per industry feedback, the alternative TUS test method section required additional guidance and clarity.

3.4.5. **Alternative TUS Testing Methods:** Design characteristics of certain furnaces may prevent the traversing or insertion of TUS test thermocouples through or into the furnace work zone(s).

In such instances it is incumbent upon the Heat Treater to develop acceptable alternative methods to provide objective evidence that temperature uniformity characteristics of the thermal processing equipment meet the requirements of the applicable Process Tables and satisfy the intent of this document. The alternative approach taken shall be reviewed and approved by the customer.

3.4.5.1 **Property Surveys:** In the event an acceptable alternative TUS testing method cannot be developed employing traversing or insertion of TUS test thermocouples through or into the furnace work zone(s), property surveys shall be accepted as objective evidence of thermal processing capabilities.

Initial property surveys of the selected product shall analyze those characteristics that are sensitive to variations in process temperatures and shall establish baseline data against which monthly product property trends shall be performed. If possible the selected product is processed frequently. The normal process size range shall be represented in the selected product. When a two-step process is under review, the second step can be run on the samples independent from the remainder of the lot.

If the furnace qualified operating temperature range is equal to or less than 170°C (305°F), the highest and lowest operating temperatures shall be represented by the product property survey. If the furnace qualified operating temperature range is greater than 170°C (305°F), the product property surveys shall include an intermediate temperature in addition to the highest and lowest operating temperatures.

At least five product property surveys shall be performed at each survey temperature. Samples for product property surveys shall be taken from the extremes and center of the load.

Monthly property survey trends shall include selected characteristics of heat-treated product analyzed by an appropriate statistical technique. Trends shall be examined monthly with defined control limits. Processing will be halted if any property trend exhibits a shift beyond assigned control limits until the cause of the shift is corrected.
For the 4th Edition...

The Alternative TUS Testing Method section was completely rewritten.

Most requirements were revised; new terms defined in Glossary; considerable guidance and clarity added.
CQI-9
Focus Session #2  |  Alt. TUS Methodologies

AIAG

Special Process: Heat Treat System Assessment
Fourth Edition, June 2020

P3.4.8.1.3 Property Survey Test Parameters: If property surveys be performed utilizing similar property survey temperature(s) and product location, surveys shall be performed every six months.

P3.4.8.1.3.1 All control thermocouples readings shall be within tolerance requirements shown in the applicable Process Table.

P3.4.8.1.4 Property Survey Procedure: When property survey procedure shall exist, which at a minimum, clearly contains:
- The temperature-critical part quality characteristic
- The acceptable tolerances of each characteristic
- The test methods used to check each characteristic
- The test equipment used
- The quantity of parts tested
- The defined part sampling locations
- The operating temperature range of the furnace
- The person qualified to evaluate and approve the response to part failures
- The reaction plan to failures or unfit parts

P3.4.8.1.5 Reaction to Failures: In the event that the cause of the failure shall be determined and document additional processing until the cause has been sufficient. A passing acceptable property data has been collected

P3.4.8.1.6 Reporting: The items listed below shall be included:
- Identification of property survey procedure
- Furnace identification
- Product identification
- Product lot identification
- Identification of part quality characteristic
- Initial baseline test data
- Identification of process type
- Operating temperature range / test temperature
- Time and temperature profile data for all TUS thermocouples and control thermocouples for all zones tested. Control thermocouple data shall be generated by the associated process recorder or process data acquisition system
- Indication of test pass or test fail status
- Summary of final pass and minus readings at each test temperature
- Sign-off by responsible person in the heat treat organization

P3.4.8.8 Alternative TUS Testing Methods: It is incumbent upon the Heat Treater to provide objective evidence that the temperature uniformity characteristics of thermal processing equipment meet the requirements of the applicable Process Table(s) and satisfy the intent of this document.

In instances where it is impossible or impractical to traverse or insert TUS test thermocouples through or into the furnace work zone(s) due to the design characteristics of the furnace system, the Heat Treater shall be required to perform Property Surveys or develop an acceptable alternative TUS testing method.

P3.4.8.1.11 Initial Property Survey: Initial property surveys shall establish baseline data against which subsequent product property trends shall be performed. If possible, the selected product is processed frequently and the typical process lot size range shall be representative in the selected product. When a two-step process is under review, the second step can be read on the samples independent from the remainder of the lot.

P3.4.8.1.1.1 For initial property surveys, a minimum of one product property survey shall be performed at each required survey temperature.

P3.4.8.1.1.2 For batch/chamber furnaces and semi-continuous furnaces or other furnace systems where parts are indexed or sequenced from the charge end to the discharge (e.g. pushers), at a minimum, product shall be sampled from the corners and the center of the load.

P3.4.8.1.1.3 For continuous furnaces where the product is continuously moving through the furnace (e.g. belt furnaces), at a minimum, efforts shall be made to sample product across the work zone at the beginning, middle, and end of the lot.

P3.4.8.1.1.4 Any furnace relocation, modification or repair that could alter the temperature uniformity characteristics of the furnace shall result in an initial property survey being performed.

P3.4.8.1.1.5 All furnace modifications or repairs shall be documented and include the determination made by the responsible authority within the organization as to whether these modifications or repairs could alter the temperature uniformity characteristics of the furnace.

P3.4.8.1.2 Property Survey Test Temperatures: If the operating temperature range of the furnace is equal to or less than 170°C (305°F), then only one temperature within the operating temperature range shall be represented by the product property survey. If the operating temperature range is greater than 170°C (305°F), then a minimum of three temperatures within the operating temperature range shall be represented by the property survey.
‘ALTERNATIVE TUS TESTING METHODS’ NOW DEFINES A CATEGORY OF NON-TRADITIONAL TUS TEST METHODS.

INCLUDES PROPERTY SURVEYS AND SITE-DEVELOPED TUS TESTING METHODS.

REFERENCE: CQI-9 4TH EDITION, GLOSSARY OF TERMS, ‘ALTERNATIVE TUS TESTING METHODS’, PAGE #102
GLOSSARY OF TERMS

In the context of this document, the following definitions shall apply:

**Accuracy:** The closeness of agreement between a measured quantity value and a true quantity value.

**Adjustment:** Set of operations carried out on a measuring system so that it provides prescribed indications corresponding to given values of a quantity to be measured.

**AIAG:** Automotive Industry Action Group.

**Alternative TUS Testing Methods** – Testing processes which are intended to provide adequate objective evidence to verify the temperature uniformity, qualified work zone(s), and qualified operating temperature range(s) of thermal processing equipment in the specific instances where it is not possible or practical to traverse or insert TUS test thermocouples through or into the work zone. Alternative TUS Testing Methods include ‘Property Surveys’ and ‘Site-Developed Alternative TUS Testing Methods’.
TEST REQUIREMENTS AND PARAMETERS ARE NOW MORE THOROUGHLY DEFINED.

GREATER LIKELIHOOD OF SUCCESSFUL TEST REPEATABILITY

REFERENCE: CQI-9 4TH EDITION, SECTION P3.4.8, ‘ALTERNATIVE TUS TESTING METHODS’, PAGE #60
SECTION AND REQUIREMENT STRUCTURE NOW HARMONIZED WITH THAT OF TRADITIONAL TUS’S.

EASIER TO NAVIGATE/CAPTURE TEST REQUIREMENTS

REFERENCE: CQI-9 4TH EDITION, SECTION P3.4.8, ‘ALTERNATIVE TUS TESTING METHODS’, PAGE #60
P3.4.8 Alternative TUS Testing Methods: It is incumbent upon the Heat Treater to provide objective evidence that the temperature uniformity characteristics of thermal processing equipment meet the requirements of the applicable Process Table(s) and satisfy the intent of this document.

In instances where it is impossible or impractical to traverse or insert TUS test thermocouples through or into the furnace work zone(s) due to the design characteristics of the furnace system, the Heat Treater shall be required to perform Property Surveys or develop an acceptable alternative TUS testing method.

P3.4.8.1 Property Surveys: The purpose of a property survey shall be to establish and routinely evaluate those characteristics that are sensitive to variations in process temperatures to ensure and objectively demonstrate that each furnace process is capable of consistently yielding an acceptable product.

P3.4.8.1.1 Initial Property Survey: Initial property surveys shall establish baseline data against which subsequent product property trends shall be performed. If possible, the selected product is processed frequently and the typical process lot size range shall be representative in the selected product. When a two-step process is under review, the second step can be run on the samples independent from the remainder of the lot.

P3.4.8.1.1.1 For initial property surveys, a minimum of one product property survey shall be performed at each required survey temperature.

P3.4.8.1.1.2 For batch/chamber furnaces and semi-continuous furnaces or other furnace systems where parts are indexed or sequenced from the charge end to the discharge (e.g. pushers), at a minimum, product shall be sampled from the corners and the center of the load.

P3.4.8.1.1.3 For continuous furnaces where the product is continuously moving through the furnace (e.g. belt furnaces), at a minimum, efforts shall be made to sample product across the work zone at the beginning, middle, and end of the lot.

P3.4.8.1.1.4 Any furnace relocation, modification or repair that could alter the temperature uniformity characteristics of the furnace shall result in an initial property survey being performed.

P3.4.8.1.1.5 All furnace modifications or repairs shall be documented and include the determination made by the responsible authority within the organization as to whether these modifications or repairs could alter the temperature uniformity characteristics of the furnace.
P3.4.8.1.4 Property Survey Procedure: When property surveys are used, a documented procedure shall exist, which at a minimum, clearly describes each of the following:

- The temperature-critical part quality characteristics
- The acceptable tolerances of each characteristic
- The test methods used to check each characteristic
- The test equipment used
- The quantity of parts tested
- The defined part sampling locations
- The operating temperature range of the furnace system
- The person qualified to evaluate and approve data/reporting
- The response process to part failures/unsatisfactory data (e.g. Action Plan)

P3.4.8.1.5 Reaction to Failures: In the event that property data exceeds assigned tolerances, the cause of the failure shall be determined and documented. The equipment shall not be used for additional processing until the cause has been sufficiently mitigated and/or corrected and passing/acceptable property data has been collected.

P3.4.8.1.6 Reporting: The items listed below shall be included in the property survey report:

- Identification of property survey procedure used
- Furnace identification
- Product identification
- Product lot identification
- Identification of part quality characteristic being tested
- Initial baseline test data
- Identification of process type
- Operating temperature range / test temperature(s)
- Identification load rate or load condition
- Identification of product sampling locations
RESULT OF CHANGE...

**EASIER** TO COMPREHEND EXPECTATIONS OF TESTING PROCESS.

**GREATER LIKELIHOOD OF** REPEATABLE TESTING AND **MEANINGFUL** TEST RESULTS.
UPDATES
CHANGES

PROCESS TABLES
GENERAL OVERVIEW

PRESENTED BY: JAMES HAWTHORNE, ACUMENT GLOBAL TECHNOLOGIES
Every Process Table was meticulously reviewed to ensure the adequacy of each requirement, improve clarification, reduce inconsistencies, and ease translation efforts.
Like the Pyrometry Section, many changes within the Process Tables intended to merely add clarification and guidance to existing requirements.
HOWEVER...

MINOR CHANGES WERE MADE TO ALL PROCESS TABLES.

AWARENESS OF ALL APPLICABLE CHANGES IS CRITICAL; IT IS ESSENTIAL TO READ THE DOCUMENT
In the 4th Edition:

Formatting & grading system of OK/NOK/NA was maintained.

Requirement to calibrate hardness test equipment was expanded to all lab and test equipment used for product and process testing.

Calibration requirement for refractometers was removed.

Significant effort focused on harmonizing requirements and using consistent terminology across all Process Tables.
One of the most notable changes within the Process Tables is...
THE PRIMARY TEMPERATURE CONTROL INSTRUMENT OF EACH GENERATOR NOW MUST BE CONTINUOUSLY MONITORED AND RECORDED.

REFERENCE: CQI-9 4TH EDITION, PROCESS TABLES A/B/E/G/I, ITEM #3.1 - ‘PROCESS MONITORING’, PAGE #70/75/85/92/99
UPDATES

CHANGES

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

Presented by: Medina Kaknio, Ford Motor Company
SOME OF THE MOST NOTABLE CHANGES TO *PROCESS TABLE A* INCLUDE...

AWARENESS OF ALL APPLICABLE CHANGES IS **CRITICAL**; IT IS ESSENTIAL TO **READ THE DOCUMENT**
Verification frequency of gas analyzers now dependent upon dedicated purpose.

When used for back-up verification, verify **weekly**;
For primary control of atmospheres, verify **daily**.

Requirements now defined for “Gas Quench” Systems.

Includes Pressure, Fan Speed or Power, & Cooling Water Temperature and Flow Rate.

All must be monitored; an alarm system is required.

UPDATES

CHANGES

PROCESS TABLE B
Nitriding (gas) and Ferritic-Nitrocarburizing (gas or salt)

PRESENTED BY: MEDINA KAKNJO, FORD MOTOR COMPANY
SOME OF THE MOST NOTABLE CHANGES TO PROCESS TABLE B INCLUDE...

AWARENESS OF ALL APPLICABLE CHANGES IS CRITICAL; IT IS ESSENTIAL TO READ THE DOCUMENT
GAS RATIOS FOR FNC NOW REQUIRED TO BE DOCUMENTED WITH SIGN-OFF EACH FURNACE LOAD OR EVERY 4 HOURS AT A MINIMUM.

IN PREVIOUS EDITION, GAS RATIOS HAD TO BE CHECKED EACH BATCH [Batch], OR EVERY 2 HOURS AT A MINIMUM [Continuous].

REFERENCE: CQI-9 4TH EDITION, PROCESS TABLE B, ITEM #B3.5 – ‘PROCESS MONITORING’, PAGE #76
CQI-9 3RD EDITION, PROCESS TABLE B, ITEM #B3.5 – ‘PROCESS MONITORING’, PAGE #74
Nitriding salt aeration now required to be checked daily.

In previous edition, no requirement defined.

INSPECTION REQUIREMENTS FOR “WHITE LAYER/COMPOUND ZONE” ARE NOW DEFINED.

WHEN SPECIFIED, MUST BE CHECKED EACH BATCH OR LOT.

REFERENCE: CQI-9 4TH EDITION, PROCESS TABLE B, ITEM #B4.5 - ‘IN-PROCESS/FINAL TEST’, PAGE #77
UPDATES
CHANGES

PROCESS TABLE C
Aluminum Heat Treat

Presented by: Robert Ferry, FPM Heat Treating
SOME OF THE MOST NOTABLE CHANGES TO *PROCESS TABLE C* INCLUDE...

AWARENESS OF ALL APPLICABLE CHANGES IS **CRITICAL**; IT IS ESSENTIAL TO **READ THE DOCUMENT**
Requirements for “Spray Quench”
Systems now defined.

Flow rate and pressure must be monitored with alarms set per
limits or sign-offs are required.

Nozzle pattern (#, direction) must be defined, verified, & logged.

Requirements for “Forced Air Quench” systems now defined.

Flow rate must be monitored with alarm set per limits or sign-offs are required.

Distribution pattern must be defined, verified, & logged.

Quench delay time now defined by the type of quench system.

I.e., immersion, forced air, or spray.

UPDATES

CHANGES

PROCESS TABLE D

INDUCTION HEAT TREATING

PRESENTED BY: RICK METCALF, GENERAL MOTORS COMPANY
SOME OF THE MOST NOTABLE CHANGES TO PROCESS TABLE D INCLUDE...

AWARENESS OF ALL APPLICABLE CHANGES IS CRITICAL; IT IS ESSENTIAL TO READ THE DOCUMENT
THERMOCOUPLE AND INSTRUMENT CALIBRATION REQUIREMENTS NOW DEFINED.

ALL THERMOCOUPLES/TEMPERATURE SENSORS MUST COMPLY WITH SECTION P3.1; ALL INSTRUMENTS MUST COMPLY WITH SECTION P3.2.

REFERENCE: CQI-9 4TH EDITION, PROCESS TABLE D, ITEM #D2.1/#D2.2 - ‘PYROMETRY’, PAGE #81
REQUIRED FREQUENCY OF POLYMER COOLING CURVE ANALYSIS REDUCED.

Analysis now required every 6-months (previously every 4-months); complete replacement of quench media still satisfies requirement.

UPDATES

CHANGES

PROCESS TABLE E
Annealing / Normalizing / Stress-Relieving

Presented by: Rick Metcalf, General Motors Company
SOME OF THE MOST NOTABLE CHANGES TO PROCESS TABLE E INCLUDE...

AWARENESS OF ALL APPLICABLE CHANGES IS CRITICAL; IT IS ESSENTIAL TO READ THE DOCUMENT
TUS & PROCESS TEMPERATURE CONTROL TOLERANCES NOW DEFINED IN TERMS OF OPERATING TEMPERATURES.

Requirements group furnaces into two (2) temperature ranges:
- Furnaces operating at or above 680°C (1250°F)
- Those operating below 680°C (1250°F).

Reference: CQI-9 4th Edition, Process Table E, Item #E2.4/#E2.5/#E2.6 - ‘Pyrometry’, Page #85
PROCESS TEMPERATURE CONTROL TOLERANCES NOW DEFINED FOR FURNACES OPERATING BELOW 680°C (1250°F).

PROCESS TEMPERATURES MUST BE CONTROLLED WITHIN ±5°C (±10°F) OF THE SET POINT.

REFERENCE: CQI-9 4TH EDITION, PROCESS TABLE E, ITEM #E2.6 - ‘PYROMETRY’, PAGE #85
Cooling rates now must be monitored.
Includes start/end temperatures and °F/min, as applicable; each batch/load [batch], or once per shift [continuous].
UPDATES

CHANGES

PROCESS TABLE F

LOW PRESSURE PROCESSING
(CARBURIZING / CARBONITRIDING / NEUTRAL HARDENING)

PRESENTED BY: RICK METCALF, GENERAL MOTORS COMPANY
Some of the most notable changes to Process Table F include...

Awareness of all applicable changes is **critical**; it is essential to **read the document**.
Flow controllers for atmosphere delivery now must be verified against a calibrated master or calibrated annually.

Master used for verification must be calibrated annually.

REFERENCE: CQI-9 4TH EDITION, PROCESS TABLE F, ITEM #F1.3- ‘PROCESS AND TEST EQUIPMENT REQUIREMENTS’, PAGE #88
CQI-9 4TH EDITION, GLOSSARY OF TERMS, ‘CALIBRATED MASTER’, PAGE #102
**Vacuum Monitoring Devices** now must be **verified against a calibrated master** or calibrated annually.

Master used for verification must be calibrated annually.

**Reference:**
- CQI-9 4th Edition, Process Table F, Item #F1.5- ‘Process and Test Equipment Requirements’, page #88
PROCESS TEMPERATURE CONTROL TOLERANCE FOR AUSTENITIZING PROCESSES NOW ±10°C (±15°F).

PREVIOUS TOLERANCE REQUIREMENT WAS ±5°C (±10°F).

REFERENCE: CQI-9 4TH EDITION, PROCESS TABLE F, ITEM #F2.5- ‘PYROMETRY’, PAGE #89
Rotation of cells for all applicable In-Process/Final Testing now required.

Previously cited as an option, “May rotate cells”; now cited as a requirement, “MUST rotate cells”; frequency requirement remained the same.

UPDATES
CHANGES

PROCESS TABLE G
SINTER HARDENING

PRESENTED BY: Ed Rahe, FCA
SOME OF THE MOST NOTABLE CHANGES TO PROCESS TABLE G INCLUDE...

AWARENESS OF ALL APPLICABLE CHANGES IS CRITICAL; IT IS ESSENTIAL TO READ THE DOCUMENT
“SINTERING” & “SINTER HARDENING” NOW INCLUDED IN THE GLOSSARY OF TERMS.

UNLESS REQUIRED BY CUSTOMER SPECIFIC REQUIREMENTS, CQI-9 DOES NOT APPLY TO “SINTERING” WHERE HARDENING IS NOT PERFORMED.

REFERENCE: CQI-9 4TH EDITION, GLOSSARY OF TERMS, ‘SINTER HARDENING’ / ‘SINTERING’, PAGE #112
Generator temperature control instrument & atmosphere values now must be continuously monitored and recorded.

Previous option allowed data to be recorded twice per shift.

CONTINUOUS FURNACE ATMOSPHERE VALUES NOW MUST BE CONTINUOUSLY RECORDED.

PREVIOUS OPTION ALLOWED DATA TO BE RECORDED TWICE PER SHIFT.

REFERENCE: CQI-9 4TH EDITION, PROCESS TABLE G, ITEM #G3.3- 'PROCESS MONITORING', PAGE #92
UNLESS GREATER FREQUENCY SPECIFIED BY CUSTOMER, MICROSTRUCTURE NOW MUST BE CHECKED DAILY.

PREVIOUS REQUIREMENT WAS EITHER:
“EACH BATCH” OR “1ST AND LAST PIECE, EACH LOT”.

REFERENCE: CQI-9 4TH EDITION, PROCESS TABLE G, ITEM #G4.1- ‘IN-PROCESS/Final Test’, PAGE #94
UPDATES CHANGES

PROCESS TABLE H
ION NITRIDING

PRESENTED BY: Ed Rahe, FCA
Some of the most notable changes to *Process Table H* include...

Awareness of all applicable changes is **critical**; it is essential to **read the document**.
VACUUM MONITORING DEVICES NOW MUST BE VERIFIED AGAINST A CALIBRATED MASTER OR CALIBRATED ANNUALLY.
MASTER USED FOR VERIFICATION MUST BE CALIBRATED ANNUALLY.

REFERENCE: CQI-9 4TH EDITION, PROCESS TABLE H, ITEM #H1.3- ‘PROCESS AND TEST EQUIPMENT REQUIREMENTS’, PAGE #95
CQI-9 4TH EDITION, GLOSSARY OF TERMS, ‘CALIBRATED MASTER’, PAGE #102
GAS RATIO CONTROLLERS FOR ATMOSPHERE DELIVERY

NOW MUST BE VERIFIED AGAINST A CALIBRATED MASTER OR CALIBRATED ANNUALLY.

USING PRE-MIXED GAS OF CERTIFIED COMPOSITION SATISFIES THIS REQUIREMENT.

ALL PRE-MIXED GASES MUST HAVE A CERTIFICATE OF RATIO OF GAS MIXTURE AND GAS PURITY.

REFERENCE: CQI-9 4TH EDITION, PROCESS TABLE H, ITEM #H1.4/#H1.5- ‘PROCESS AND TEST EQUIPMENT REQUIREMENTS’, PAGE #95
PROCESS GAS MIXTURE SETTINGS NOW MUST BE VERIFIED.

NOW REQUIRED “EACH BATCH”.

REFERENCE: CQI-9 4TH EDITION, PROCESS TABLE H, ITEM #H3.4- ‘PROCESS MONITORING’, PAGE #96
UPDATES

CHANGES

PROCESS TABLE I
HOT STAMPING

PRESENTED BY: JOHN VANDER WOUDE, BENTELER AUTOMOBILTECHNIK GMBH
PROCESS TABLE I was initially established as a 3RD EDITION ERRATA ITEM IN MAY OF 2014.
originally titled ‘Dry Contact Press Hardening’. 
While not, technically, a “new process table”, Process Table I - Hot Stamping is now part of the primary document.
SOME OF THE MOST NOTABLE CHANGES TO Process Table I include...

AWARENESS OF ALL APPLICABLE CHANGES IS CRITICAL; IT IS ESSENTIAL TO READ THE DOCUMENT
TEMPERATURE OF SUPPLEMENTAL COOLING WATER NOW MUST BE CONTINUOUSLY RECORDED.

ALARM FOR TEMPERATURE CONTROL SYSTEM NOW ALSO REQUIRED.

REFERENCE: CQI-9 4TH EDITION, PROCESS TABLE I, ITEM #I3.9- ‘PROCESS MONITORING’, PAGE #99
FLOW RATE OF SUPPLEMENTAL COOLING WATER NOW MUST BE CONTINUOUSLY MONITORED.
ALARM FOR FLOW CONTROL SYSTEM NOW ALSO REQUIRED.

REFERENCE:  CQI-9 4TH EDITION, PROCESS TABLE I, ITEM #I3.10- ’PROCESS MONITORING’, PAGE #99
SOME NOTABLE CHANGES

NOT YET MENTIONED INCLUDE...

AWARENESS OF ALL APPLICABLE CHANGES IS CRITICAL; IT IS ESSENTIAL TO READ THE DOCUMENT
**Only minor changes were made to the Cover Sheet.**

**Job Audit Instructions & Form were refined and are now much more concise.**

Reference:
FOCUS
NOTABLE CHANGE

OTHER/GENERAL
COVER SHEET / JOB AUDIT FORM

PRESENTED BY: JOHN VANDER WOUDE, BENTELER AUTOMOBILTECHNIK GMBH

THURSDAY, SEPTEMBER 17TH, 2020
IN THE 3RD EDITION...

FORMATTING OF THE COVER SHEET AND JOB AUDIT FORMS WAS A LITTLE CUMBERSOME.

FORM FLOW WAS NOT EFFECTIVE.

SOME REQUIRED INFORMATION WAS RATHER IRRELEVANT.

THE FORMS REQUIRED UNNECESSARY ADDITIONAL EFFORT TO COMPLETE WHICH, IN SOME INSTANCES, LEAD TO CONFUSION.

REFERENCE: CQI-9 3RD EDITION, SECTION P3.4.5, ‘ALTERNATIVE TUS TESTING METHODS’, PAGE #59
For the 4th Edition...

The Cover Sheet and Job Audit Forms were updated and refined.

Changes mostly minor; several questions were removed from Job Audit; focus largely on improving guidance/clarity.
# Special Process: Heat Treat System Assessment

<table>
<thead>
<tr>
<th>Facility Name:</th>
<th>Type(s) of Thermal Processing at this Facility:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Process Table A - Ferrous Carburizing</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Box Number:</td>
<td>Number of Heat Treat Employees at this Facility:</td>
</tr>
<tr>
<td></td>
<td>Carbonizing</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Internal (Captive) Heat Treater (Y/N):</td>
</tr>
<tr>
<td></td>
<td>Carbon Recarburization</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Commercial Heat Treater (Y/N):</td>
</tr>
<tr>
<td></td>
<td>Quench and Tempers</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Date of Assessment:</td>
</tr>
<tr>
<td></td>
<td>Precipitation Hardening / Aging</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Date of Previous Assessment:</td>
<td></td>
</tr>
</tbody>
</table>

| Process Table B - Ferrous Nitriding (Gas) |
|                                          |
| Ferrocarburizing (Gas or Salt)           |
|                                          |
| Process Table C - Aluminum              |
| Aluminum Heat Treatment                  |
|                                          |
| Process Table D - Ferrous                |
| Induction Heat Treating                  |
|                                          |
| Process Table E                          |
| Annealing                                |
| Normalizing                              |
| Stress Relieving                         |
| Process Table F                          |
| Low Pressure Carburizing                  |
| Process Table G                          |
| Sinter Hardening                          |
| Process Table H                          |
| Ion Implanting                            |

Current Quality Certification(s):

Date of Re-assessment (if necessary):

Personnel Contacted:

<table>
<thead>
<tr>
<th>Name:</th>
<th>Title:</th>
<th>Phone:</th>
<th>Email:</th>
</tr>
</thead>
</table>

Auditors/Assessors:

<table>
<thead>
<tr>
<th>Name:</th>
<th>Company:</th>
<th>Phone:</th>
<th>Email:</th>
</tr>
</thead>
</table>

Number of "Not Satisfactory" Findings:

Number of "Needs Immediate Action" Findings:

Number of "Fail" Findings in the Job Audit(s):
## Special Process: Heat Treat System Assessment

<table>
<thead>
<tr>
<th>Facility Name:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Address:</td>
<td></td>
</tr>
<tr>
<td>Phone Number:</td>
<td>Fax Number:</td>
</tr>
<tr>
<td>Date of Assessment:</td>
<td>Date of Previous Assessment:</td>
</tr>
<tr>
<td>Internal (Captive) Heat Treater (Y/N):</td>
<td>Commercial Heat Treater (Y/N):</td>
</tr>
</tbody>
</table>

**Type(s) of Thermal Processing at this Facility:**

<table>
<thead>
<tr>
<th>Process Table A</th>
<th>Process Table B</th>
<th>Process Table C</th>
<th>Process Table D</th>
<th>Process Table E</th>
<th>Process Table F</th>
<th>Process Table G</th>
<th>Process Table H</th>
<th>Process Table I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carburizing</td>
<td>Nitriding (Gas)</td>
<td>Aluminium Heat Treatment</td>
<td>Induction Heat Treating</td>
<td>Process Table E</td>
<td>Process Table F</td>
<td>Nitriding</td>
<td>Process Table H</td>
<td>Hot Stamping</td>
</tr>
<tr>
<td>Carbo-nitriding</td>
<td>Ferit-Nitrocarburizing (Gas or Salt)</td>
<td>Process Table I</td>
<td></td>
<td>Ion Nitriding</td>
<td></td>
<td>Process Table G</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Current Quality Certification(s):**

**Date of Re-assessment (if necessary):**

**Personnel Contacted:**

<table>
<thead>
<tr>
<th>Name:</th>
<th>Title:</th>
<th>Phone:</th>
<th>Email:</th>
<th></th>
</tr>
</thead>
</table>

**Auditors/Assessors:**

<table>
<thead>
<tr>
<th>Name:</th>
<th>Company:</th>
<th>Phone:</th>
<th>Email:</th>
<th></th>
</tr>
</thead>
</table>

**Number of “Not Satisfactory” Findings:**

**Number of “Needs Immediate Action” Findings:**

**Number of “Fail” Findings in the Job Audit(s):**
Instructions for completing the Job Audit

The organization is to complete a minimum of one heat treat part job audit during each assessment. This should be done preferably on a part identified for one of the customers requiring compliance to this document. More part job audits may be done if time permits. Preferably, safety or critical parts should be audited. This may not be easily determined with fasteners, especially if the fastener manufacturer does not identify the end customer (auto manufacturer, tier one, etc.). It is recommended that the job audit be performed at the end of the heat treat system assessment.

The job audit is not the only or main focus of the HTSA. The other three sections on Management Responsibility and Quality Planning, Floor and Material Handling Responsibility, and Equipment are equally if not even more important. The job audit of one part, one heat process, and one furnace is not sufficient to use as a basis to complete the other sections of the complete HTSA.

The job audit is a compliance type audit/review of a specific part and its related paperwork and processing, including heat treat equipment and processing records for that job from the beginning receipt of a part through processing in the heat treat operation and inspection to packaging. Parts shall be taken from the shipping area at the dock or the end of the heat treat operation. If an automotive manufacturer’s part is not available or identifiable, then parts from other customers requiring compliance with this document shall be used for the assessment.

The part or lot checked shall represent a major heat treat operation such as quench and tempering, carburizing and tempering, induction hardening for steel, solution treating and aging of aluminum, etc. In subsequent heat treat system assessments, different parts and heat treat processes shall be checked.

The specific heat treat processing parameters (applies to 4.7 in the Job Audit) that are required in the job audit shall be added to the job audit form. This can be done by reviewing the customer specification(s), the Control Plan, the FMEA, and the floor work/job order. Each processing step shall be reviewed for proper production records/compliance/inspection. These steps can be compared to those in the Heat Treat System Assessment for the actual job/heat treat process being reviewed for compliance. The heat treat and furnace records for the actual time frame/shift etc. that the job was processed shall also be checked. The actual furnace equipment and instrumentation certification shall be verified as being in compliance to the appropriate equipment requirements in the equipment section.

For specific heat treat parameters that are proprietary (applies to 4.7 in the Job Audit), the heat treat supplier may enter the controlling document number, e.g., control plan or process sheet, on the Job Audit. The parameters shall be available to the auditor for review but proprietary information is not required to be documented in the Job Audit.
Instructions for Completing the Job Audit

The organization shall complete a job audit during the annual HTSA. The scope of the job audit is intended to verify the overall effectiveness of the heat treat system.

The job audit shall be conducted on a specific lot that is in process or has been recently processed but not yet shipped. In subsequent heat treat system assessments, different parts and heat treat processes shall be audited.

An automotive manufacturer’s part shall be used in performing the job audit. If an automotive manufacturer’s part is not available, the selected part shall be another part processed in compliance with CQI-9. The job audit shall be performed when applicable parts are available.

Each processing step shall be reviewed for proper production records/compliance/inspection. These steps can be compared to those in the HTSA for the actual job/heat treat process being reviewed for compliance. The heat treat and furnace records for the actual time frame/shift etc. that the job was processed shall also be audited.

Address each “Fail” item immediately. Any fail item shall result in the update of the corresponding HTSA element (see Heat Treat System Assessment Procedure).
## Section 4 - Job Audit

<table>
<thead>
<tr>
<th>Question #</th>
<th>Job Audit Question</th>
<th>Related HTSA Question</th>
<th>Customer or Internal Requirement</th>
<th>Job (Shop) Order or Reference Documentation Requirement</th>
<th>Actual Question (Objective Evidence)</th>
<th>Pass / Fail / N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Are contract review, advance quality planning, FMEA, control plans, etc., performed by qualified individuals?</td>
<td>1.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.2</td>
<td>Does the heat treat facility have the customer specifications for the part?</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.3</td>
<td>Is a shop traveler created to meet customer requirements?</td>
<td>1.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.4</td>
<td>Is material identification (part numbers, lot numbers, heat numbers, contract numbers, etc.) maintained throughout the heat treat process?</td>
<td>2.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.5</td>
<td>Is there documented evidence of processing inspections?</td>
<td>2.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.6</td>
<td>Are the Loading &amp; Racking requirements identified?</td>
<td>2.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Operator or Inspector Responsibilities

<table>
<thead>
<tr>
<th>Question #</th>
<th>Job Audit Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.9</td>
<td>Were appropriate process steps signed off?</td>
</tr>
<tr>
<td>4.10</td>
<td>Were all inspection steps, as documented in the control plan performed?</td>
</tr>
<tr>
<td>4.11</td>
<td>Were steps/operations performed that were not documented in the control plan?</td>
</tr>
<tr>
<td>4.12</td>
<td>Were additional steps performed, were they authorized?</td>
</tr>
</tbody>
</table>

### Packaging Requirements

<table>
<thead>
<tr>
<th>Question #</th>
<th>Job Audit Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.14</td>
<td>Did the governing specification allow reprocessing or rework?</td>
</tr>
<tr>
<td>4.15</td>
<td>Was the certification signed by an authorized individual?</td>
</tr>
<tr>
<td>4.16</td>
<td>Are the parts and containers free of inappropriate objects or contamination?</td>
</tr>
<tr>
<td>4.17</td>
<td>Were the parts properly identified?</td>
</tr>
<tr>
<td>4.18</td>
<td>Were the containers properly labeled?</td>
</tr>
</tbody>
</table>
## Section 4 - Job Audit

<table>
<thead>
<tr>
<th>Question</th>
<th>Job Audit Question</th>
<th>Related HTSA Question</th>
<th>Customer or Internal Requirement</th>
<th>Job (Shop) Order or Reference Document</th>
<th>Actual Condition (Objective Evidence)</th>
<th>Pass / Fail / NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Does the heat treat facility have the customer specifications for the part?</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.2</td>
<td>Is material identification (part numbers, lot numbers, heat numbers, contract numbers, etc.) maintained throughout the heat treat process?</td>
<td>2.2</td>
<td>2.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.3</td>
<td>Are the Loading/Unloading requirements identified?</td>
<td>1.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.4</td>
<td>Is the proper recipe or process specification (cycle times, temperature, atmosphere, etc.) used? Refer to Process Tables, Section 3.0, for specific parameters.</td>
<td>1.5</td>
<td>1.6</td>
<td>2.1</td>
<td>2.14</td>
<td>2.15</td>
</tr>
<tr>
<td>4.5</td>
<td>What are the product inspection requirements per the Control Plan?</td>
<td>2.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Requirement: (1)
- **Test Method:**
- **Test frequency or quantity:**
- **Selection of samples:**
- **Specification:**

### Requirement: (2)
- **Test Method:**
- **Test frequency or quantity:**
- **Selection of samples:**
- **Specification:**

### Requirement: (3)
- **Test Method:**
- **Test frequency or quantity:**
- **Selection of samples:**
- **Specification:**

### Requirement: (4)
- **Test Method:**
- **Test frequency or quantity:**
- **Selection of samples:**
- **Specification:**

### Packaging Requirements
<table>
<thead>
<tr>
<th>Question</th>
<th>Packaging Requirement</th>
<th>Related HTSA Question</th>
<th>Customer or Internal Requirement</th>
<th>Job (Shop) Order or Reference Document</th>
<th>Actual Condition (Objective Evidence)</th>
<th>Pass / Fail / NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.14</td>
<td>Are packaging requirements identified?</td>
<td>2.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.15</td>
<td>Are parts packaged to minimize mixed parts (for example, parts packed over height of container)</td>
<td>2.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Shipping Requirements
<table>
<thead>
<tr>
<th>Question</th>
<th>Shipping Requirement</th>
<th>Related HTSA Question</th>
<th>Customer or Internal Requirement</th>
<th>Job (Shop) Order or Reference Document</th>
<th>Actual Condition (Objective Evidence)</th>
<th>Pass / Fail / NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.16</td>
<td>Were the parts properly identified?</td>
<td>2.3</td>
<td>2.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.17</td>
<td>Were the containers properly labeled?</td>
<td>2.3</td>
<td>2.9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
RESULT OF CHANGE...

LESS REDUNDANCY.

FORM/AUDIT EXPECTATIONS MORE EVIDENT.

MORE EFFECTIVE.
Q&A WITH THE CQI-9 TECHNICAL COMMITTEE

DISCUSSION

**MODERATOR:** JAMES HAWTHORNE, ACUMENT GLOBAL TECHNOLOGIES

**THURSDAY, SEPTEMBER 17TH, 2020**
If you’ve not yet submitted your question(s), please feel free to do so now.

We will answer as many questions as time permits; if we don’t get to your question today, we do apologize.
Dependent upon feedback & the total number of unanswered questions today, we may decide that a follow-up Q&A/webinar is necessary.

For up-to-date information, please visit: www.aiag.org/store/quality/events.
CURRENTLY, WE’RE ALSO WORKING WITH SEVERAL HEAT TREAT INDUSTRY MEDIA OUTLETS TO DEVELOP ADDITIONAL CQI-9 RELATED CONTENT.

INDUSTRY MEDIA OUTLETS MAY INCLUDE: AIAG, Heat Treat Today, Industrial Heating, MTI

Questions/Feedback can always be submitted to the CQI-9 Technical Committee for review.

Email all questions/feedback & Maintenance Request Forms to QUALITY@AIAG.ORG.
AND, LASTLY...

IF YOU’VE NOT YET PURCHASED YOUR COPY, THE 4TH EDITION OF CQI-9 IS NOW AVAILABLE FOR PURCHASE AT AIAG.ORG.

VISIT WWW.AIAG.ORG; SEARCH “CQI-9-4”
CQI-9
4th Edition | Q&A Panel

MEDINA KAKNJO
Member, CQI-9 Technical Committee
Ford Motor Company
STA Global Core Technical Expert
Global Purchasing

JAMES HAWTHORNE
Chairperson, CQI-9 Technical Committee
Acument Global Technologies, North America
Corporate Heat Treat Specialist

JOHN VANDER WOUDE
Member, CQI-9 Technical Committee
Benteler Automotive Corporation, North America
Metallurgist, Automotive Division

RICK METCALF
Member, CQI-9 Technical Committee
General Motors Company, North America
Materials Engineering – Valvetrain PMT

JUSTIN RYDZEWSKI
Member, CQI-9 Technical Committee
Controls Service, Inc.
Director, Sales and Market Development

ROBERT FERRY
Member, CQI-9 Technical Committee
FPM Heat Treating
Vice President, Engineering & Quality

ED RAHE
Member, CQI-9 Technical Committee
FCA, North America
Heat Treatment Engineer, Metals Group

DARRELL RYDZEWSKI
Member, CQI-9 Technical Committee
Controls Service, Inc.
Director, Training and Standards Compliance
Quality Manager