



*Nadcap accreditation is crucial to maintaining quality systems and heat-treat operations. Suppliers can make compliance a little easier by learning from others' mistakes.*

## The 2021 PRI Top 10 NRCs in heat treating

**A**s the pandemic adjusted our lives and systems, we have still had to maintain Nadcap accreditation in heat treat and other commodities. While the pandemic may have changed our day-to-day operations, it has not changed the fact that Nadcap accreditation is crucial to our quality system and operations. As the aerospace industry ebbs and flows, as does the U.S. economy, the commitment to Nadcap accreditation does not, by any means. Suppliers are committed to maintaining the most robust quality system to ensure AS9100 and Nadcap requirements are accounted for and maintained throughout the process. It is beneficial to make connections all through the aerospace industry and understand what others may miss or, mistakenly, do not account for. This amounts to, “what do my colleagues receive findings for?”. While our colleagues may be competitors at times, they are our peers nonetheless, and we need to learn from each other, so we do not make the same mistakes.

With this in mind, I will use this article to examine the Top 10 findings from the Nadcap/PRI Heat Treat commodity from 2021. I will discuss each section in detail and talk about how to avoid becoming a part of the 2022 statistic.

### AC7102 CHECKLIST

PRI publishes the Top 10 findings on the eaudit.net site each year. This information is public and available to all who have log-in credentials. The list is separated into three categories: 1) AC7102 less the job audit portion, 2) AC7102 with job audits included, and 3) AC7102/8. They share the same findings within the lists, as we will see. Keep in mind, the revision of the Nadcap checklists in question is AC7102(J) and AC7102/8(NA). The numeric value identified below may not actually correspond with what is listed by PRI as I will be attempting to combine both the AC7102 with job audits and AC7102 without job audits. In other words, there will not be exactly 10 references on the list below as I have combined several.

#### #1

The top finding from 2021, from the list which does not include job audits, is from AC7102 para 1.1.4 which states, “Did the auditee provide a copy of their completed self-audit, including all 10 (ten) applicable job audits (exemption for ITAR and Export Control documents applies), to the Auditor at least 30 days prior to the audit utilizing the version of the checklist(s) applicable to this audit?”. This finding issued because the supplier either did not have a completed checklist or because the 10 required job audits were not completed. Suppliers are required to complete the entire checklist (as it applies) and this must include the 10 required job audits. The challenge for some suppliers may be when preparing for an initial Nadcap HT audit. Suppliers going through an initial audit typically need to use scrap material to simulate jobs. This would, of course, include simulated

flow down documentation including POs, routers, and even work instructions. Regardless whether the audit is an initial audit or a reaccreditation audit, all 10 job audits must be completed. It would be beneficial to ensure supplier’s internal audit procedure specifically requires that 10 job audits are included. Unfortunately, this and para 1.1.3 seem to make up 1-4 of the top ten findings.

#### #2

The next top finding is from AC7102, para 1.1.3. This somewhat relates to #1 above. Para 1.1.3 states, “Did the auditee provide the following documents to the Auditor 30 days prior to the audit?”. The list of documents needed is a list of equipment; list of purchased services (including name(s) of outside provider for calibration), processing, testing, etc.; list of prime customers and specifications for which heat treater is approved; list of heat treat specifications [military, government, industry (AMS, etc.), and customer] that auditee is working to; copy of internal general procedures for heat treat processing, pyrometry and testing/inspection of heat-treated product (exemption for ITAR and Export Control documents applies); and, finally, an organization chart. If a supplier receives a finding for this it could have been because they would have missed any one of the items listed. I recommend suppliers design a template document (controlled) which contains all of this information which can then be uploaded prior to every Nadcap HT audit. If the document is kept controlled, it will should always be accurate.

#### #3

Number three comes from para 3.2.1.1, which states, “The quality and technical requirements, including any unique customer requirements, are adequately defined and documented”. This statement tends to be very general and can have many different situations associated with it. For example, if a supplier forgets to flow down a require of “cool to below 250°F prior to exposing to air,” this will fall into this question. To ensure conformance, suppliers need to start with contract review. Capturing the requirements is the first step. After this, quality should be performing a review of all work instructions to ensure requirements are documented and flowed down the operators.

#### #4

This one is what we call a two-for-one deal — repeat findings. Para 3.4.1 states, “Are all corrective actions from the previous Nadcap audit still implemented (check the last full audit)?”. This is most likely one of the most difficult findings to respond to as suppliers, not only to receive a major finding for the specific issue, but also a major finding against their quality system for not properly implementing and/or maintaining the previous finding. Often, this finding is issued because suppliers are simply not giving the process the



attention that is required. Quality should be involved in the internal audit process to ensure previous findings have been properly closed and corrective actions maintained. It is worth mentioning that when suppliers receive this finding, it will affect any merit status, if the supplier has it at the time.

#### #5

Number five is against para 1.1.1.2 which states, “For each question in the checklist, has the auditee identified where the means of compliance or evidence\* of compliance may be found. (\*procedure, form, log, physical location of evidence, etc.)?”. When I perform internal audits for suppliers, I ensure each question, even if it is not applicable, has some type of verbiage beneath the question. Questions that use the phrase “do procedures ...” or “does documentation,” are a signal that that question must have the supplier’s internal procedure and applicable paragraph number where the requirement is accounted for. Other questions, such as 3.3.1, “Is the nonconforming material controlled, and the customer notified of each instance of nonconforming product in accordance with the contractual requirements?”, which does not specifically request a procedure or document, can still have a procedure referenced. With this example, the supplier can list the procedure and paragraph of their own procedure for nonconforming material which states this or is similar to this. The point is, each question should have a statement beneath it to show conformance. Below are examples of this from internal audits I have performed.

#### #6

Number six replates to periodic testing. Para 7.2.2 states, “All qualification, periodic, and lot/batch acceptance testing as required by specifications?”. This can be a wide array of testing, depending on the material, customer requirements, and internal supplier requirements. It is important for suppliers to list all periodic testing, and the frequency and the specification it is derived from (see AC7102 para 7.0 and the Nadcap HT auditor handbook). Depending on the periodic testing required, some suppliers put the testing within a system similar to Gauge-Track which automatically reminds suppliers that a test (or calibration) is due.

#### #7

This finding comes from para 9.1.2.1 of AC7102 and states, “Does the internal procedure specify the method for determining heat-up rate, start of soaking time, end of soaking time, and cooling rate?”. In reading this question carefully, you will see there are a total of four requirements. First, how is heat-up rate determined; second, how is the start of soak determined; third, how is the end of soak determined; and fourth, what are the cooling requirements. I typically see suppliers account for these four requirements by writing default definitions within their internal general heat-treat procedure and, when more specific or modified requirements are needed, they are flowed down to the operator via work instruction/router. When answering this question, the internal procedure and applicable paragraph should be referenced.



## AC7102/8 CHECKLIST

Below I will examine the Top 10 findings in pyrometry, although it will relate to AMS2750E. Regardless of the revision, it is still worth recognizing and discussing the findings as it is still relevant.

### #1

The number one finding relates to the sticker for calibrations. It is against paragraph 4.2.4, which states “Do the instrument calibration records and stickers show conformance to the requirements of AMS 2750E, or more stringent customer requirements?”. AMS2750F is one additional requirement which is to identify the instrument or furnace number. The challenge I see, at times, is some suppliers have a metrology department with a template sticker for anything from calipers to gauge blocks to furnace instruments. The problem with this through process is simply that AMS2750F has different requirements than 17025:2017.

### #2

Number two will, most likely, pertain to field test instruments more than primary or secondary standard instruments. This one is related to paragraph 4.1.2 which reads, “Does the calibration of primary, secondary standard and field test instruments meet the requirements of AMS 2750E or more stringent customer requirements?”. The majority of suppliers do not have primary standards although some may have secondary standards. For practical purposes, let’s focus on field test

instrument requirements. Field test instruments must be calibrated at six points encompassing the range used in the field. Readability must be to the tenth of a degree (0.1°F) and the permitted error is  $\pm 1.0^\circ\text{F}$  or 0.1% of the reading, whichever is greater. It is permitted to use a field test instrument to calibrate another field test instrument in the field if that particular instrument meets secondary standard requirements. This is something quality should be reviewing on the field test instrument certification prior to signing off on it.

### #3

Normally, I would skip a finding like this one. Paragraph 2.1.1 states, “Does the supplier have an internal procedure, or procedures for pyrometry addressing all the aspects of AMS 2750E and other customer specifications applicable to their operations?”. I thought it would be a good idea to point something out about this question. If you are familiar with the AC7102/8 checklist, you’ll recognize this as the first question on the checklist. What this means is, if any question beneath this one on the checklist is marked “NO,” this one gets to be marked “NO” as well. In the end, you would need absolutely no findings in pyrometry to have this question marked as “YES.”

### #4

Finding number four is very common. It relates to para 5.4.1 which states, “Are the displayed temperature indication and recording of the sensor being tested, with appropriate offsets or correction fac-

tors, at any operating temperature, compared with the corrected temperature indication of the test sensor on a test instrument?”. This can encompass quite a few errors based on different scenarios. One of the most common scenarios I see is when a supplier incorporates control thermocouple and control instrument correction factors algebraically yet they do not use them in production. If the control system was corrected in production, then this can be done, although very few suppliers actually do this. The majority of the time, the only system that gets algebraic correction is the test instrument system.

#### #5

This finding is a bit like number 3 above. It relates to para 6.1.1 which states, “Does the internal TUS procedure conform to the requirements of AMS 2750E, or more stringent customer requirements for the specific method used by the supplier?”. This means if you get one finding associated with TUSs, this question gets marked as “NO.”

#### #6 and #7

These two are together because of how closely related they are. They are derived from paragraphs 6.7.1.d, “Does the documentation of the performed TUS include as a minimum: Time and temperature data from all recorded sensors required for furnace instrumentation type for all zones tested (Reference AMS 2750 Rev. E section 3.5.13.3.2)?” and paragraph 6.5.4 which states, “Are temperatures indicated by all furnace thermocouples recorded and included as part of the TUS record?”. This requirement is simple to conform to: Include the furnace chart from the TUS within the TUS package. The reason for this is the furnace chart needs to be reviewed for compliance along with the entire TUS report. Keeping them as one

package is the only way to ensure this and Nadcap auditors expect it to be presented to them in this way.

#### #8

This finding has to do with system accuracy testing. It is from AC7102/8, para 5.3.2 and states, “Are the SATs performed upon installation and periodically thereafter in accordance with the requirements of AMS 2750E, Tables 6 or 7, or more stringent customer requirements, including any applicable frequency reductions? (The SATs frequencies are based upon equipment class and instrumentation type).” The most common issue I see when consulting is with regards to the SAT extension requirements. It is important to understand what tasks need to be completed to enable suppliers to go to the extended frequency for SAT testing. There are two options, and they need to be well understood.

#### SUMMARY

This was a summary of the Top 10 findings in the Nadcap heat treat commodity. As I stated, the full list can be downloaded on eAudit.net by anyone who has access. Please feel free to contact me for any clarification of questions. ☞



#### ABOUT THE AUTHOR

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