How to Properly Complete an IIAR 6 System Safety Inspection Checklist Form?

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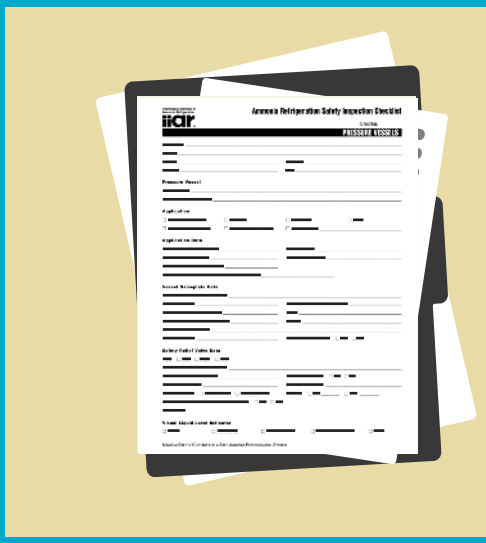


Earlier, this year, the "International Institute of Ammonia Refrigeration" (IIAR) released the "Standard for Inspection, Testing and Maintenance of Closed-Circuit Ammonia Refrigeration Systems", ANSI/IIAR 6-2019.

THIS STANDARD INCLUDES the following two requirements, among others: Under **"Section 5.1 *ITM Program Requirements":**

"5.1.1.3 Each inspection and test performed shall be documented and include the following information:

1. *Date of inspection or test;*
2. *Name of the individual or individuals who performed the inspection or test;*
3. *Serial number or other identifier of the equipment on which the inspection or test was performed;*
4. *Description of the inspection or test performed;*
5. *Recommended corrective action(s) for each deficiency identified;*
6. *Description of corrective action(s) for each deficiency identified;*
7. *Identification of each designated responsible person assigned and authorized to remedy each deficiency identified;*
8. *Results based on the conditions at commencement of the inspection or test, including instrumentation readings;*
9. *Expected activation set points (+/-) including functional description of the control logic;*
10. *Results based on the conditions after completion of the inspection or test, including instrumentation readings,*
11. *Expected completion date(s);*
12. *Actual completion date(s)."* [i]

Under **"Section 5.4 Inspection Requirements"** it states:

*"5.4.2 *Equipment inspections shall be performed by a qualified inspector(s). Every fifth (5th) year, at a minimum, the annual inspections shall be conducted by a qualified inspector who shall not be influenced by the facility's record keeping, operations, maintenance, or management. This person shall not present a conflict of interest and shall report instances of deficiencies."* [ii]

*The term "**qualified inspector**" is defined by the standard as "a person who is experienced with close-circuit ammonia refrigeration systems, has knowledge of the process, and has demonstrated proficiency and understanding to perform inspections"* [iii].

ANSI/IIAR 6-2019 Appendix B provides a series of forms known as *"Ammonia Refrigeration Safety Inspection Checklists"*. These checklists are considered an acceptable way of complying with ANSI/IIAR6-2019 5.1.1.3 and ANSI/IIAR 6-2019 5.4.2 of this standard. It must be understood that ANSI/IIAR 6-2019 does not require the use, specifically, of the forms provided in Appendix B. A facility may elect to meet requirements from IIAR 6-2019 5.1.1.3 and ANSI/IIAR 6-2019 5.4.2 by other means.

For the purpose of this paper, we will focus on understanding how to fill out the forms provided in ANSI/IIAR 6-2019 Appendix B and realizing the benefit the information in the forms provide the facility.

In general, each of the forms provided in ANSI/IIAR 6-2019 Appendix B can be broken down in to two sections. A first

section, typically page 1, which gathers the facility information, equipment data (application, manufacturer, serial number, model number, etc.), operating parameters (pressures, temperatures, etc.), related safeties (relief valve data, safety device set points, etc.), among others. A second section contains at the inspection items themselves. The first thing that needs to happen is knowing what equipment must actually be inspected. It is very common in the ammonia refrigeration industry to find equipment packages. Typically, such packages will be composed of several pieces of equipment which need to be individually inspected. Packages may have specific serial and model numbers tied to them; however, the pieces of equipment composing the package will most likely have their own model, serial number and may very well be manufactured by a different company than the package manufacturer.

Safety inspection checklists are supposed to be refrigeration equipment specific. This means that several checklists will need to be filled out for a single refrigeration equipment package. To better explain this, below are three examples of different packages commonly seen in

the industry, each of them requiring more than one equipment specific checklist to be filled out during an inspection.

A thermosiphon oil cooled rotary screw compressor package:

- ☐ Checklist 1. Compressor unit
- ☐ Checklist 2. Oil cooler heat exchanger
- ☐ Checklist 3. Oil separator vessel

A dual pump recirculator package:

- ☐ Checklist 1. Recirculator vessel
- ☐ Checklist 2. Pump 1
- ☐ Checklist 3. Pump 2
- ☐ Checklist 4. Oil Pot vessel

A flooded heat exchanger package:

- ☐ Checklist 1. Surge drum vessel
- ☐ Checklist 2. Heat exchanger
- ☐ Checklist 3. Oil pot vessel

Some of the information required on the first section of the safety inspection checklists may be readily available; Often, it may be obtained from the equipment's nameplate. At a minimum, a typical nameplate will have the equipment's manufacturer, serial number and model number. Most, if not all, of the operating parameters can be obtained from observations throughout the inspection, discussion with operators, etc. When dealing with equipment packages, it is important to understand that the serial number or other identifier of the specific pieces of equipment being inspected is required. Checklists in ANSI/IIAR 6-2019 Appendix B also ask for model number. For example, when filling out an ANSI/IIAR 6-2019 safety inspection checklist for a compressor from a compressor package, the serial number or other identifier and model number of the compressor unit is requested by the form. There is added value of including the package model and serial number, but the model and serial number of the specific piece of equipment, not the package, is the requirement. An obvious question that will present itself is:

If a refrigeration equipment nameplate is not present or not legible, should a recommendation be made?

The answer is yes. Per current ANSI/IIAR 2-2014 Standard for Safe Design of Closed- Circuit Ammonia Refrigeration Systems section 5.14.4.1 which states: *"Equipment shall have a nameplate with minimum data that describes or defines the manufacturer's information and design limits and purpose as specified in Chapter 8 through Chapter 16."* [iv] Furthermore, previous Standard ANSI/IIAR 2-2008, also had nameplate requirements on refrigeration equipment. ANSI/IIAR 6-2019 safety inspection checklist do not specify compliance for any specific year of IIAR 2. An inspector should consider the age of the equipment when making nameplate related recommendations. At a minimum, legible nameplates is considered RAGAGEP. Hence, the owner or designated representative should be aware.

The above question is in fact the question a) *"Equipment labeled and name plate legible per ANSI/IIAR 2?"* [v] of most current

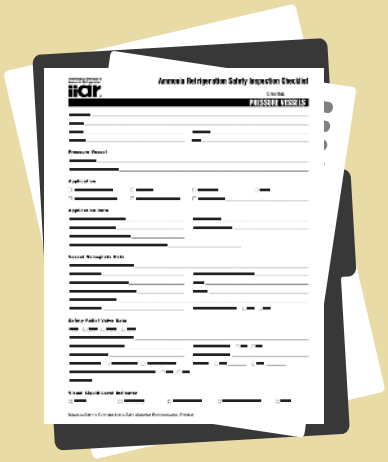
ANSI/IIAR 6-2019 equipment Safety Inspection Checklists.

However, the information needed to complete some of the equipment information, may go in to much more detail for each piece of equipment. For example, when motors are part of the refrigeration equipment, the motor information (manufacturer, hp, rpm, FLA, Hz, voltage, phase, service factor, frame size, belt quantity, belt size and motor quantity) will typically be required in the checklist forms. Another example is that air cooling evaporator, heat exchanger and condenser safety inspection checklists all ask that the material for the heat exchanger surface(s) (galv. steel, stainless steel, aluminum, or other) be checked or indicated. This type of information may not be readily available; it is not uncommon that equipment motors cannot be freely accessed or their nameplate is no longer legible; the material of the heat exchanger surface is often not marked on the equipment itself. An inspector should not freely guess this information but rather the equipment manufacturer specifications will be needed to properly verify it.

Ideally, a facility owner or designated representative will be able to provide the information that is not readily available to an inspector before an inspection. When the information is not available, the owner or designated representative may choose to have the inspector research missing information. Depending on what information is needed, the amount of research may be extensive and will consequently have a cost associated with it. The good thing is that once the manufacturer's data sheets, drawings, cut sheets, or manuals are obtained, the research will not have to be conducted again.

When the data gathered, on the first section of an equipment specific safety inspection checklist is correct and up to date, it may be used as a quick reference tool for simple tasks, such as ordering replacement parts, such as ordering an air cooling evaporator fan motor. Or it may be used to aid more complex tasks, such as replacement of the air cooling evaporator itself. Gathering all this information for the first time may require an original investment of time and effort, but once is completed it can save maintenance and operations staff time when the information is needed. Rather than having to look for this data repeatedly on the equipment, or in the equipment documentation, every time it is needed, it will be readily available by simply referencing the checklists. This can represent significant savings in time and money over the life span of an ammonia refrigeration system.

When filling out equipment specific checklists it is very important to read in detail what is actually required.



Even though this seems simple and obvious, an otherwise qualified inspector who is unfamiliar with the checklists may record the wrong information simply because they failed to fully read and understand a question. For example:

- Question n) of the current ANSI/IIAR 6-2019 Compressor Safety Inspection Checklist reads; *"Free of modifications, alterations, damage or repairs such that casing integrity is or has been affected?"* [vi]
- Question e) of the previous IIAR Bulletin 109 Compressor Safety Inspection Checklist reads; *"Has compressor been modified, altered, damaged or repaired such that casing integrity is affected? If yes, has casing been recertified and documented?"* [vii]

These questions are very similar, however answering yes or no on each of them have opposite meaning. ANSI/IIAR 6-2019 checklist is asking if it is "**Free of**" while previous IIAR B109 checklist was asking if it "**Has been**". Furthermore, the second part of IIAR Bulletin 109 Compressor Safety Inspection Checklist question, *"If yes, has casing been recertified and documented?"* [v] has been separated into a question by itself in the current ANSI/IIAR 6-2019 Compressor Safety Inspection Checklist, Question o), which reads; *"If, No has it been pressure tested and documentation filed?"* [iv]. Again, the questions are very similar in nature but the same yes or no answer to each of them will have opposite meaning. This scenario is not specific to the compressor safety inspection checklist; similar questions are contained within the safety inspection checklists for pressure vessels and heat exchangers.

An experienced inspector who is used to filling out a B109 checklist may assume that these questions are the same, when in reality they are similar but opposites.

Another important detail, which should not be overlooked, is the possibility of selecting the Not Applicable (N/A) box on ANSI/IIAR 6-2019 Safety Inspection Checklists. There are questions on the forms that are linked together. Looking at the same ANSI/IIAR 6- 2019 Compressor Safety Inspection Checklist questions n) and o):

- *"n) Free of modifications, alterations, damage or repairs such that casing integrity is or has been affected?"* [iv]
- *"o) If, No has it been pressure tested and documentation filed?"* [iv]

When checking the "Yes" box to question n), consequently, the "N/A" box should be checked on question o). The same does not apply if the "No" box is checked on question n). In this case, answering question o) may require further review of related information and a recommendation may be required.

In summary, when filling out the ANSI/IIAR 6-2019 Ammonia Refrigeration Safety Inspection Checklists, located in appendix B, some of the information required may not be readily accessible. When answering the checklist questions, a "Yes" answer does not generally require a recommendation and a "No" answer usually requires a recommendation [viii]. The qualified inspector should be familiar with current applicable standards (ANSI/ IIAR 2, and ANSI/IIAR6 as a minimum), industry recognized and generally accepted good engineering practices (RAGAGEP), ammonia refrigeration industry applicable regulations (GDC, PSM, RMP, CalARP, NDEP CAPP, among others) and they must meet the "***qualified inspector***" definition per ANSI/IIAR 6-2019. When information required to complete a checklist information field, or to answer a question, is missing or not accessible , the inspector should consider applicable standards, RAGAGEP, regulations, and experience to determine what recommendation is appropriate and when.

REFERENCES:

[i] IIAR 2019. "Chapter 5. General, Section 5.1 ITM Program Requirements". ANSI/IIAR 6 Standard for Inspection, Testing and Maintenance of Closed-Circuit Ammonia Refrigeration Systems. Revision 2019 pp 9.

[ii] IIAR 2019. "Chapter 5. General, Section 5.4 Inspection Requirements". ANSI/IIAR 6 Standard for Inspection, Testing and Maintenance of Closed-Circuit Ammonia Refrigeration Systems. Revision 2019 pp 13.

[iii] IIAR 2019. "Chapter 2. Definitions, qualified inspector". ANSI/IIAR 6 Standard for Inspection, Testing and Maintenance of Closed-Circuit Ammonia Refrigeration Systems. Revision 2019 pp 4.

[iv] IIAR 2014. Chapter 5. General System Design Requirements. ANSI/IIAR 2-2014 Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems. Revision 2014 pp 15

[v] IIAR 2019. "Appendix B. Ammonia Refrigeration Safety Inspection Checklist. Air Cooling Evaporators". ANSI/IIAR 6 Standard for Inspection, Testing and Maintenance of Closed-Circuit Ammonia Refrigeration Systems. Revision 2019 pp 85

[vi] IIAR 2019. "Appendix B. Ammonia Refrigeration Safety Inspection Checklist. Compressors". ANSI/IIAR 6 Standard for Inspection, Testing and Maintenance of Closed-Circuit Ammonia Refrigeration Systems. Revision 2019 pp 89

[vii] IIAR 1997. "Section 7. Inspection Checklist". IIAR Bulletin No. 109. Guidelines for: IIAR Minimum Safety Criteria for a Safe Ammonia Refrigeration System. Revision 10/97

[viii] [viii] IIAR 2019. "Appendix B. Ammonia Refrigeration Safety Inspection Checklists.3.". ANSI/IIAR 6 Standard for Inspection, Testing and Maintenance of Closed-Circuit Ammonia Refrigeration Systems. Revision 2019 pp 83