AHRI A2L Task Force Training Webinar

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The following questions are regarding the first presentation on ASHRAE RP-1808. These responses have been developed by the RP-1808 Project Monitoring Subcommittee. This is not an official position statement from ASHRAE.

1. Why were braze fittings used as a baseline for a flameless fitting test?

   Braze joints were chosen as a baseline or point of reference due to widespread and long usage history in the HVACR industry as a permanent joint type for refrigerating systems. The braze joints also served to demonstrate the measurement capability of the test facility, to show the sensitivity of the method of test to detect very small leak rate for joints under pressure and under vacuum, on the order of 3 grams per year or less.

2. ASME Brazing Code requires Brazers to be qualified for the performance of the process. Why were non-qualified Brazers used for the test?

   The project studied the influence of operator experience level and skill as one of many variables, so the project intentionally selected two levels of skill, “low” and “high”, but without any further delineation or documentation of qualifications such as certifications. The test results demonstrated a correlation between skill level, assembly quality and assembly time, and to a lesser extent with leak rates. ASME BPVC Section IX “Welding, Brazing, and Fusing Qualifications” is applicable to pressure vessels, but not all joints in a refrigerating system are required to meet pressure vessel code. ASME B31.5-2019 “Refrigeration Piping and Heat Transfer Components” (§528.2.4) requires brazing qualifications per ASME BPVC, Section IX, Part QB. However, ASHRAE Standard 15-2019 does not impose specific qualification requirements for brazing; nor does ICC IMC 2021 Chapter 11 Refrigeration (which only references ASME B31.5 for the piping design in §1109.1, but not for the fabrication); nor does IAPMO UMC 2021 Chapter 11 Refrigeration (which only references ASME B31.5 for the piping material in §1109.1, but not for the fabrication); nor does ICC IRC 2021 Chapter 14 Heating and Cooling Equipment and Appliances.

3. Why were 1⅛ inch fittings used for test instead of ¾ inch fittings as were used for the flare and compression fittings?

   Due to time and budget limitations of the project, the scope of the test matrix was limited. The basic concept was to test “small” and “large” fittings that are commercially available for each fitting type, and to obtain some information about whether or not there is a size effect for each type of fitting. The choice of 1⅛ inch braze joint corresponded to the largest of the fitting sizes (press connect).

4. Why were compression fittings included in the test as compression fittings not usually applied for use on refrigeration systems?

   Compression fittings are routinely used in some types of refrigerating systems, especially field-erected systems.

5. ASME Brazing code allows for a leaking braze joint to be repaired once. During harshness testing, leaking fittings were allowed to be tightened, but repairs were not allowed for the braze fittings even though the brazing code allows for repair. Why was this not considered during the tests?

   The project did not consider ASME BPVC Section IX as a mandatory requirement for all braze joints used in refrigerating systems.

6. Who drafted the test specification requirements? ASHRAE, testing entity, or others like a fitting manufacturer?

   Following ASHRAE research procedures, the test matrix was jointly developed by the research contractor and a project monitoring subcommittee (PMS) composed of industry experts. The PMS had representation from a national laboratory and several equipment manufacturers. The research contractor directly contacted several fitting manufacturers during the project to confirm recommended installation practices. Technicians were provided the fitting manufacturer written assembly instructions.

7. Who funded the testing from start to finish? Everyone involved either donating materials or other financial support, either directly or indirectly provided.

   ASHRAE Research entirely funded the project. Components were donated by fitting manufacturers. A project monitoring subcommittee (PMS) composed of industry experts had oversight of the research contractor. The PMS had representation from a national laboratory and several equipment manufacturers. No fitting manufacturers were represented on the PMS.

8. Was the annual leak rate for press-connect higher than that of brazing?

   Press-connect fittings and brazed joints had an average leak rate well below 3 grams per year. RP-1808 measured leak rate at a single point in time (a short test duration of a few days) on a relatively small number of samples. Extrapolation to cumulative leaked refrigerant during service life was outside the scope of the project. As points of reference, product safety standards IEC/UL/CSA 60335-2-40 and 60335-2-89 require that leak tightness at the factory be demonstrated by detecting "no leak" when using an instrument with a sensitivity of 3 grams per year or less, and in some cases 5 grams per year or less for field made joints. ASHRAE 147 establishes leak rate thresholds that range from 3 to 85 grams per year depending on the equipment type.

   IEC 60335-2-40 edition 6: https://webstore.iec.ch/publication/31169
   IEC 60335-2-89 edition 3: https://webstore.iec.ch/publication/62243
   UL 60335-2-40 edition 3: https://standardscatalog.ul.com/ProductDetail.aspx?productId=UL60335-2-40
   UL 60335-2-89 edition 2: https://standardscatalog.ul.com/ProductDetail.aspx?productId=UL60335-2-89_2_S_20211027
   CSA C22.2 No. 60335-2-40:19 edition 3 https://www.csagroup.org/store/product/CSA%20C22.2%20NO.%2060335-2-40%3A19/
   CSA C22.2 No. 60335-2-89:21 edition 2 https://www.csagroup.org/store/product/2704221/
   ASHRAE 147-2019: https://www.techstreet.com/standards/ashrae-147-2019?product_id=2095231

9. What is the annual leak rate of brazing?

   The only true answer is "it depends". The answer depends on many assumptions, such as the specific brazing procedures followed, the qualifications, skill, and experience level of the brazer; the type of braze joints as well as the age of the joint and history of exposure to various stressors; and also the test pressure. Keep in mind that some brazing is automated for factory production processes, so the relevant operator is not a brazer. For the specific braze joints used in RP-1808, the leaks under pressure were not detectable within the sensitivity of the method of test; the leaks under vacuum were measurable but it was not clear what proportion of the measured leak rate was for the joints under test and what proportion was due to the test fixtures and additional connections required to conduct the test. RP-1808 only tested a relatively small number of braze joints, so extrapolation to the leak rate distribution of a large number of joints is not possible. As points of reference, product safety standards IEC/UL/CSA 60335-2-40 and 60335-2-89 require that leak tightness at the factory be demonstrated by detecting "no leak" when using an instrument with a sensitivity of 3 grams per year or less, and in some cases 5 grams per year or less for field made joints. ASHRAE 147 establishes leak rate thresholds that range from 3 to 85 grams per year depending on the equipment type.

10. As the Executive Summary of the published ASHRAE RP-1808 indicates the report describes the results of investigating the durability and leak rate of field-made mechanical joints used in refrigeration and air-conditioning systems that utilize flammable refrigerants, why were the variables of time, difficulty, and skill included when evaluating the durability of field-made mechanical joints?

    These commonly observed real-world factors are relevant to quality and durability of field-made mechanical joints.

11. The Introduction of the report says brazing was included as a reference baseline. What purpose did brazing serve as a baseline for durability testing of field-made mechanical joints other than to prove it takes skill and time to make a proper sound braze joint? Please explain in detail.

    See answer to Question 1 above.

12. Was annealed or hard temper tubing used for the testing? Which and why?

    For copper tubing the temper varied by diameter size: ⅜ inch was soft annealed while ¾ inch and 1⅛ inch were hard temper. For aluminum tubing all sizes were hard temper 6061 alloy. Due to time and budget constraints, material hardness was not a factor that was studied in this project.

The following questions are on the second presentation:

1. What happens to a product listed to an earlier standard when the standard used for testing is updated?

   The certification body sets an effective date for when products need to be listed by the latest version of the standard. That is well communicated by the certification body. The updated version of the standard only effects products that are certified commencing with the effective date set by the certification body.

2. Which version of the UL 207 is being referred to for the testing data in this presentation?

   UL 207: 2020 (8th edition).

3. Which Group of Refrigerants were used for the testing data being provided? Group A1 or A2L?

   The information presented by Intertek was general in nature and not specific to any refrigerant type. Please check if you meant the work done by ASHARE.

4. Was annealed or hard temper tube used during the testing by Intertek for the testing data being provided?

   No data was provided by Intertek.

5. What manufacturer(s) fittings were used during the testing by Intertek for the testing data being provided?

   No data was provided by Intertek.

The following questions are on the third presentation:

1. What type of tube was used for the information you are providing in the presentation? Annealed, hard temper, ASTM B280?

   Press has been tested on both annealed and drawn tempered tubing. Both Type-L and Type-K, as well as R410A tubing primarily sold in ASEAN regions (thicker walls on 1⅜ inch than Type-K). The tubing is primarily manufactured to ASTM B88 for the drawn temper straight lengths, with the annealed coil being manufactured to ASTM B280.

2. What was the diameter of the tube used during testing?

   The tube OD would be either nominal or actual depending on the standard used for the tubing production.

3. What was the Internal Diameter (ID) of the tube prior to and after the crimp was made?

   The tube type would dictate the requisite wall thickness, and thus determine what the starting ID is. Regarding ID post-press the system utilizing the circular press illustrated, typically reduces the OD anywhere from 8%~10% depending on size, though that deformation wouldn't be 100% transferred to the ID.

Additional questions for any of the three Presenters:

1. ASHRAE RP-1808 references the use of UL 109 for testing parameters. The UL 109 requires fittings to be pull tested. Why was a pull test not performed as part of the ASHRAE RP-1808 testrequirements?

   RP-1808 created a test matrix based on a combination of relevant tests adapted from UL 109 as well as ISO 14903. Per §6.2 of UL 109, one end of the fitting must be threaded and the scope of this project excluded threaded fitting types.

2. If a pull test was performed, where is the data for the test results?

   The pull test of UL 109 (§7) was not performed as part of RP-1808. The pull test is not applicable to the purposes of the project; also see answer to the question above.