APPENDIX C
RTL Program Sample Preparation Procedures

Purpose:

The purpose of this document is to outline the procedure for preparing samples for Participants in the AHRI Refrigerant Testing Laboratory (RTL) Certification Program.

Scope:

This document is used for the AHRI RTL certification program with analysis per the Standard.

Quarterly Preparation:

Cylinder Preparation:

1) Two 500 cc stainless steel liquid cylinders and one 1000 cc carbon steel vapor cylinder per Participant as well as two refillable refrigerant cylinders of appropriate size are cleaned by flushing the cylinders with an appropriate cleaning solvent such as R-22, then baking in an oven set at a temperature between 110 °C and 120 °C for a minimum of one hour. Cylinders are then removed from the oven and a hot vacuum is pulled on each cylinder to less than 400 microns.
2) All cylinders are allowed to cool to room temperature then weighed on a balance, traceable to SI through NIST or other appropriate accreditation body, to the nearest 0.5 g.
   Note: Vapor cylinders used for NCG evaluation are re-evacuated immediately prior to filling.

Liquid Cylinder Preparation:

1) The liquid refrigerant cylinder is filled between 80% to 85% liquid capacity with the Refrigerant Starting Material as selected by AHRI. The mass of the 80% to 85% full refrigerant cylinder, selected to avoid liquid full at 50° C, is recorded and the mass of the Refrigerant Starting Material is calculated and recorded to the nearest 0.5 g
2) The Refrigerant Starting Material is then analyzed per the latest edition of the Standard Appendix C & D for High Boiling Residue (HBR), Moisture and Other Refrigerants.
3) Following the analysis of the Refrigerant Starting Material, the cylinder is reweighed and the mass of the Refrigerant Starting Material is recorded to the nearest 0.5 g.
4) The starting quantity of all contaminants is calculated in micrograms or grams, as appropriate, from the determined individual impurity concentration and the mass of the Refrigerant Starting Material.
5) Additions of contaminants to achieve the desired contaminant level are then calculated based on the desired final concentrations, mass of the Refrigerant Starting Material and the calculated mass of Refrigerant Starting Material impurities.
6) The 90% full refrigerant cylinder and contents are chilled with liquid nitrogen until negligible vapor pressure exists.
7) ASTM II De-Ionized (DI) water is gravimetrically added using an analytical balance and gas tight syringe.
8) The next appropriate lubricant is added to the chilled cylinder using an analytical balance and gas tight syringe.
9) Finally, other refrigerant impurities are individually added either gravimetrically by injection of the specific refrigerant contaminant using a prefilled and weighed refrigerant cylinder or volumetrically with a gas tight syringe utilizing the Ideal Gas Law as appropriate.
10) Once all contaminants are added, the refrigerant cylinder is mechanically rolled periodically for the next four (4) hours then thermally cycled several times between Ambient Temperature and 49 °C +/-2°C at with a minimum of four (4) hours at each temperature
11) Following this thermal cycling equilibrium period, the refrigerant cylinder now becomes the RTL program liquid sample which is then analyzed for HBR, Moisture and Other Refrigerant Content via the Standard Appendix C & D Procedures.

Vapor Cylinder Preparation:

1) The vapor refrigerant cylinder is filled to 90% of saturation pressure as determined by REFPROP$_{TM}$ with the selected Refrigerant Starting Material. The weight of the 90% saturation pressure cylinder is recorded and the mass of the Refrigerant Starting Material is calculated and recorded.
2) The Refrigerant Starting Material is then analyzed per the current version of the Standard Appendix C & D for Non-Condensable Gases (NCG).
3) Following the analysis of the Refrigerant Starting Material, the refrigerant cylinder is purged down to 90% of saturation pressure and the mass of the Refrigerant Starting Material is recorded to the nearest 0.5 g.
4) This mass is then converted into volume using the Ideal Gas Law.
5) The NCG staring contaminants are calculated in mL from the determined individual impurity concentration and the calculated volume of the Refrigerant Starting Material.
6) Additions of air contaminant are then calculated based on the desired final concentrations, volume of the starting material and the calculated volume of Refrigerant Starting Material NCG.
7) The 90% saturated pressure vapor refrigerant cylinder and contents are chilled with liquid nitrogen until negligible vapor pressure exists.
8) The calculated volume of air is added to the chilled cylinder either volumetrically by gas tight syringe or calculated volume of the air is added gravimetrically using the Ideal Gas Law and a prefilled doping refrigerant cylinder as appropriate for the quantity of air desired.
9) Once the air contaminant has been added, the vapor refrigerant cylinder is allowed to equilibrate for a minimum of 24 hours at ambient temperature.
10) Following this equilibrium period, the vapor refrigerant cylinder is analyzed for NCG per the Standard Appendix C procedures. This refrigerant cylinder now becomes the RTL program vapor sample.

Participant Sample Preparation – Liquid Sample

1) Participant cylinders are numbered in sequential order 1, 2, 3, 4…n.
2) Liquid cylinders are filled to between 75% to 80% liquid fill in sequential order for the first of the two samples then in reverse order for the second. Therefore, the first, middle and last samples are reserved for Laboratory's evaluation to insure that the refrigerant has not changed composition from the first to last sample taken. Note: the size of the initial batch must be sufficiently large so that following all sampling, a minimum of 60% of the maximum fill must remain.
3) All samples including those taken for Laboratory use are thermally cycled several times between Ambient Temperature and 49 °C +/-2°C with a minimum of four (4) hours at each temperature.
4) Within one (1) week following this thermal cycling equilibrium period, the Laboratory reserved samples are analyzed for HBR, Moisture and Other Refrigerant Content via the Standard Appendix C & D Procedures.

Participant Sample Preparation – Vapor Sample

1) Participant cylinders are numbered in sequential order 1, 2, 3, 4…n.
2) Next, the Participant's one (1) liter steel cylinders are re-evacuated to less than 400 microns.
3) They are then attached to the vapor cylinder via a manifold.
4) The lines of the manifold are purged with the vapor; the valves of each Participant's cylinder(s) are then opened simultaneously and left open for a minimum of five (5) minutes to allow each cylinder to reach pressure equilibrium.
5) Finally, all of the Participant's vapor cylinders are analyzed for NCG per the Standard Appendix C to ensure that excess air has not leaked into any one (1) of the Participant's cylinders during the evacuation, transport and filling procedure.

Participant Sample Preparation – Certification of Results

1) Finally, a report is prepared including the average results obtained from the analysis of Laboratory's reserved samples.
2) This report is sent to AHRI.