REFRILINK TECHNICAL WHITE PAPER SERIES

# Refrigerant Quality & Purity Management

Contamination control, analytical verification and batch traceability from source to customer

| DOCUMENT | REVISION | ISSUE | AUDIENCE |
|---|---|---|---|
| WP-03 | 1.0 | September 2026 | Global B2B / Technical |



**TECHNICAL PURPOSE**

Practical engineering guidance for refrigerant selection, quality control, handling, logistics and application support.

EXECUTIVE SUMMARY

# Executive Summary

Refrigerant quality is not defined by the product name alone. Water, non-condensable gases, acids, oils, particulates and mixed refrigerants can cause performance loss, corrosion, control instability, compressor damage and service complications. A reliable quality program therefore combines supplier qualification, controlled transfer and filling, laboratory analysis, batch traceability and disciplined handling throughout the supply chain.

## Key Takeaways

**01**
**Specify purity and contamination limits explicitly - do not rely on product naming alone.**

**02**
**Use test methods appropriate to the contaminant: moisture, acidity, residues and composition require different analyses.**

**03**
**Traceability links every cylinder or shipment back to a controlled batch and inspection record.**

# 1. Critical Contaminant Categories

| Contaminant | Potential effect | Typical verification approach |
|---|---|---|
| Moisture | Ice formation, corrosion, acid formation, expansion-device instability | Karl Fischer or approved moisture method |
| Non-condensable gases | High head pressure, reduced heat transfer, unstable performance | Gas-phase analysis / non-condensable determination |
| Acidity | Corrosion and degradation of oils/materials | Acidity test per applicable specification |
| High-boiling residue / oil | Heat-transfer degradation, metering issues, compressor/lubricant contamination | Residue / oil-content analysis |
| Mixed refrigerants | Incorrect pressure-temperature behavior, glide and capacity | Gas chromatography or equivalent composition analysis |
| Particulates | Valve restriction, abrasion, cleanliness concerns | Filtration / visual or particulate method as applicable |

# 2. Quality System Layers

1. Supplier qualification: evaluate production controls, specifications, change management and complaint history.
2. Incoming control: verify identity, documentation, seal condition and batch information before unloading or transfer.
3. Storage control: segregate products, protect from cross-connection and maintain clean transfer equipment.
4. Process control: use dedicated or validated filling paths, evacuation/purge steps and contamination-prevention procedures.
5. Final verification: confirm fill quantity, leak tightness, labeling and required analytical results.
6. Release and traceability: release only after required checks are complete and link shipment identifiers to the batch record.

ANALYTICAL CONTROL

# 3. Sampling: The Often-Overlooked Variable

A laboratory result is only as reliable as the sample. Sampling hardware, sample-point location, vessel condition, purge method and sample handling can all bias results. The quality plan should define where samples are taken, how the line is conditioned, the required sample phase, the container type and how long samples may be held before analysis.

- Avoid dead legs or shared hoses that can retain another refrigerant.
- Use clean, compatible sample cylinders and fittings.
- Purge or condition the sampling path according to the approved method.
- Record batch number, source vessel, date/time, sampler and sample-point identification.
- Protect samples from mix-ups with tamper-evident labeling and chain-of-custody records when needed.

# 4. Batch Release Logic

| Control | Release expectation |
|---|---|
| Identity | Product is confirmed as the intended refrigerant or blend. |
| Composition | Blend components are within the applicable specification where composition limits apply. |
| Moisture | Result meets the product specification. |
| Acidity | Result meets the product specification. |
| Residue / oil | Result meets the product specification where required. |
| Non-condensables | Result meets the product specification. |
| Packaging | Cylinder/valve condition, net fill, label, seal and traceability are acceptable. |

**DO NOT INVENT UNIVERSAL LIMITS**

Acceptance limits depend on the refrigerant, specification and market. A quality plan should reference the exact approved standard or customer specification rather than applying one limit to every refrigerant.

# 5. Cross-Contamination Prevention

- Dedicated hoses, manifolds or validated cleaning procedures for incompatible product groups.
- Positive line identification and keyed/controlled connection points where practical.
- Physical and electronic segregation of product batches.
- Changeover procedures with documented evacuation, purge and verification steps.
- Separate recovery/rework inventory from virgin or released inventory.
- Clear status labeling: quarantine, under test, released, rejected and rework.

TRACEABILITY & IMPROVEMENT

# 6. Traceability Model

| Traceability layer | Minimum record |
|---|---|
| Source | Supplier / production lot / source vessel |
| Receipt | Date, quantity, receiving inspection and documentation status |
| Storage | Tank or location and any transfers |
| Filling | Line, date/time, operator or batch record, cylinder range |
| Testing | Sample ID, method, result and disposition |
| Shipment | Customer order, pallet/carton/cylinder identifiers and dispatch date |

# 7. Responding to a Quality Complaint

7. Secure the affected product and identify all linked batches and shipments.
8. Collect the customer evidence: cylinder ID, application, operating symptoms, service history and any field test results.
9. Review retained samples, batch records, filling-line data and analytical results.
10. Test a representative sample using appropriate methods and compare against the release specification.
11. Determine containment, disposition and corrective action; update process controls if a systemic cause is identified.

# Conclusion

Refrigerant purity is a controlled outcome created by supplier discipline, clean handling, validated analysis and traceable release. The strongest quality system prevents contamination rather than relying only on final testing to detect it.

## Reference Frameworks

- Applicable refrigerant purity specification used in the target market or customer contract.
- Current product safety data sheet and supplier certificate-of-analysis requirements.
- Laboratory method procedures for moisture, acidity, composition, residue and non-condensables.
- ISO 9001-style quality management principles for document control, traceability and corrective action (where adopted).

## Important Notice

**TECHNICAL GUIDANCE ONLY**

This white paper is general engineering guidance. Refrigerant selection, charging, storage, transport and servicing must follow the equipment manufacturer instructions, the applicable safety data sheet, cylinder/pressure-vessel requirements and all local laws, codes and dangerous-goods rules. Product suitability must be verified for the specific system and jurisdiction.