RefriLink

REFRILINK TECHNICAL WHITE PAPER SERIES

Refrigerant Selection Fundamentals

A practical framework for choosing refrigerants across HVAC and refrigeration applications

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TECHNICAL PURPOSE

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

EXECUTIVE SUMMARY

Executive Summary

Refrigerant selection is an engineering decision that affects system architecture, energy performance, safety controls, service practices, regulatory exposure and long-term availability. The preferred refrigerant is therefore not simply the fluid with the lowest environmental metric or the lowest purchase price. It is the option that fits the equipment design and operating envelope while balancing safety, efficiency, reliability, compliance and lifecycle support.

Key Takeaways

01	02	03
Start with the equipment design envelope, not the refrigerant label.	**Evaluate safety classification together with charge size and installation conditions.**	**Use lifecycle thinking: efficiency, serviceability, supply continuity and end-of-life all matter.**

Scope

This paper provides a manufacturer-neutral decision framework for comfort air conditioning, commercial HVAC, transport cooling, industrial refrigeration, automotive air conditioning and retail cold-chain systems. It does not recommend retrofitting one refrigerant into equipment designed for another without explicit manufacturer approval.

1. The Six Selection Dimensions

Dimension	Engineering question	Typical evidence
Thermodynamic fit	Does the refrigerant operate within the compressor, heat-exchanger and pressure envelope?	OEM maps, pressure-temperature data, discharge temperature, capacity and efficiency testing
Safety	What controls are required for toxicity, flammability and pressure?	Safety classification, charge limits, ventilation, leak detection, ignition control
Materials & oil	Are elastomers, lubricants, seals and metals compatible?	OEM compatibility data, lubricant guidance, material qualification
Environmental profile	How does the choice support emissions and transition goals?	GWP class, energy use, leakage risk, recovery/reclamation plan
Serviceability	Can technicians install and service the system safely?	Training, tooling, recovery equipment, cylinder identification
Supply continuity	Is the refrigerant available in the required quality and packaging?	Approved suppliers, packaging formats, lead times, documentation

TECHNICAL FRAMEWORK

2. Refrigerant Families and Design Implications

Family / example	Common safety class*	Typical strengths	Design implications
HFC - R134a / R410A	A1	Established equipment base; well-understood service practices	Higher climate impact; transition pressure in many markets
HFC - R32	A2L	Good heat-transfer and efficiency potential; single-component fluid	Mild flammability requires A2L-compatible equipment and service procedures
HFO / HFO blends	Often A2L	Lower-GWP pathways for several applications	Compatibility, glide and service details depend on the specific blend
Hydrocarbon - R290	A3	Very low GWP; strong thermodynamic performance in suitable systems	High flammability; charge control and ignition-risk management are central
CO2 - R744	A1	Very low GWP; strong fit in selected commercial/cold-chain architectures	Very high operating pressures; architecture and components are specialized
Ammonia - R717	B2L	Excellent industrial efficiency; long-established industrial use	Toxicity and site safety requirements demand dedicated engineering and training

*** SAFETY CLASS NOTE**
Classifications are illustrative for the listed examples. Always verify the current classification and local code requirements for the exact refrigerant designation and jurisdiction.

3. Decision Sequence

1. Define cooling/heating duty, ambient range, evaporating/condensing conditions and required capacity.
2. Confirm the equipment platform and the refrigerants explicitly approved by the equipment or compressor manufacturer.
3. Check pressure level, discharge temperature, volumetric capacity and heat-exchanger implications.
4. Determine safety controls based on toxicity/flammability, charge quantity, occupancy and location.
5. Review lubricant, elastomer, seal and material compatibility.
6. Compare seasonal energy performance and likely leakage/recovery outcomes over the system life.
7. Confirm cylinder, service, recovery, transport and supply-chain availability before commercial release.

4. Common Selection Errors

- Selecting only on GWP without validating efficiency or system architecture.
- Assuming a lower-pressure or lower-GWP refrigerant can be used as a drop-in replacement.
- Ignoring refrigerant glide in zeotropic blends when setting superheat/subcooling or heat-exchanger controls.
- Using safety classification as the only risk criterion without considering charge quantity and installation environment.
- Evaluating first cost but not service tooling, training, recovery and future supply.

ENGINEERING CHECKLIST

5. Engineering Checklist for a New Project

Workstream	Minimum confirmation before selection
Load & climate	Design load, part-load profile, ambient extremes, defrost/heating mode if applicable
Equipment	Compressor approval, design pressure, heat-exchanger suitability, controls and expansion device
Safety	Classification, charge strategy, occupied-space limits, ventilation, detection and service plan
Performance	Capacity, COP/EER/seasonal efficiency, discharge temperature, pressure ratio
Materials	Lubricant, elastomers, seals, hoses and recovery equipment compatibility
Supply	Purity specification, cylinder format, traceability, lead time, transport documentation
End of life	Recovery, reclamation/recycling route and cylinder return/disposal plan

6. Procurement Specification - Recommended Structure

- Exact refrigerant designation and required standard / purity specification.
- Packaging type, nominal quantity and cylinder/valve requirements.
- Batch identification and certificate-of-analysis requirements.
- SDS, transport documentation and language requirements.
- Incoming-inspection plan and process for nonconforming material.
- Traceability and retained-sample expectations where applicable.

Conclusion

A robust refrigerant decision starts with the equipment and application, then integrates safety, performance, environmental objectives and supply-chain execution. The strongest specification is one that remains technically valid from design through installation, service and recovery.

Reference Frameworks

- ISO 817 - Refrigerants: designation and safety classification (use the current edition applicable to the project).
- ASHRAE Standard 34 - Designation and Safety Classification of Refrigerants (where applicable).
- Equipment and compressor manufacturer technical data and approved refrigerant lists.
- Applicable local building, fire, pressure-equipment and refrigerant-management requirements.

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.