

Refrigerant Obsolescence & Transition Guide — R22, R404A, R507A, R410A !' R32, R448A, R449A, R454B, R1234yf (F-Gas Phasedown)

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Comprehensive refrigerant obsolescence and transition reference: R22 (banned in EU since 2015), R404A (GWP 3922, service-only 2020), R507A (GWP 3985, restricted), R410A (transitional) !' next-generation drop-in and system-redesign replacements R32 (GWP 675), R448A (Solstice N40, GWP 1387), R449A (Opteon XP40, GWP 1397), R454B (Opteon XL41, GWP 466), R1234yf (GWP 4), R1234ze(E) (GWP 7), R290 propane. Includes GWP values, glide, ODP, safety class (A1/A2L/A3), lubricant compatibility (POE/PAG/PVE/mineral), retrofit steps and replacement-charge factor. Covers marine and shipboard refrigeration compliance under IMO/EEDI and EU F-Gas.

Refrigerant obsolescence & transition — complete reference

Refrigeration and air-conditioning systems are undergoing the largest coordinated fluid transition in the industry's history, driven by the EU F-Gas Regulation (EU) 2024/573 (revised 2024) and the global Kigali Amendment to the Montreal Protocol. The compressed timeline is straightforward: legacy R22 has been phase-out complete in the EU since 2015; R404A and R507A (very high GWP HFCs) are service-restricted from 2020 and effectively market-withdrawn; R410A and R134a are on staged phase-down; and the new-generation refrigerants split into lower-GWP HFCs (R32, R448A, R449A), HFO blends (R454B, R454C), pure HFOs (R1234yf, R1234ze) and natural refrigerants (R290 propane, R744 CO₂, R717 ammonia). This reference covers every commonly encountered transition path.

Refrigerant properties & classification reference

Refrigerant | Type | GWP (100y) | ODP | Safety class | Glide (K) | Status |
R22 | HCFC | 1810 | 0.055 | A1 | 0 | Banned EU 2015; global phase-out |
R134a | HFC | 1430 | 0 | A1 | 0 | Phase-down in progress; retained for many chillers |
R404A | HFC blend | 3922 | 0 | A1 | 0.7 | Service-only 2020; effectively withdrawn |
R407C | HFC blend | 1774 | 0 | A1 | 4.5-7 | Legacy R22 retrofit; phase-down in progress |
R410A | HFC blend | 2088 | 0 | A1 | ~0 | Phase-down; being replaced by R32 or R454B |
R507A | HFC blend | 3985 | 0 | A1 | ~0 | Service-only 2020; effectively withdrawn |
R32 | HFC | 675 | 0 | A2L (mildly flammable) | 0 | Current standard for split AC and some heat pumps |
R448A (Solstice N40) | HFC/HFO blend | 1387 | 0 | A1 | 4-6 | R404A retrofit & new-install for commercial refrigeration |
R449A (Opteon XP40) | HFC/HFO blend | 1397 | 0 | A1 | 4-6 | R404A retrofit; competing with R448A |
R452A | HFC/HFO blend | 2140 | 0 | A1 | 4 | R404A drop-in for transport refrigeration |
R454B (Opteon XL41) | HFC/HFO blend | 466 | 0 | A2L (mildly flammable) | 1.5 | R410A replacement for chiller and split AC |
R454C | HFC/HFO blend | 148 | 0 | A2L | 7-8 | R404A low-GWP replacement |
R1234yf | HFO | 4 | 0 | A2L | 0 | MAC automotive; new lower-GWP HVAC |
R1234ze(E) | HFO | 7 | 0 | A2L | 0 | New chillers & commercial refrigeration |
R290 (propane) | Hydrocarbon | 3 | 0 | A3 (flammable) | 0 | Small-charge commercial & domestic; regulated by charge limit |
R744 (CO₂) | Natural | 1 | 0 | A1 | 0 | Supermarket refrigeration; heat pumps |
R717 (ammonia) | Natural | 0 | 0 | B2L (toxic + mildly flammable) | 0 | Industrial & food-process refrigeration |

R22 !' replacement decision matrix (existing systems)

Service-only R22 remaining stock & reclaim — effectively depleted; global market shortage.

Direct R22 drop-in (no oil change) — R427A (Forane Performax LT) is the mineral-oil-compatible R22 drop-in for existing systems without a full retrofit. GWP 2138; performance-equivalent.

R22 !' R407C (with POE oil change) — the historic 1998-2015 retrofit path. R407C GWP 1774; requires POE lubricant (compatibility with residual mineral oil poor).

R22 !' R32 (with system redesign) — R32 is A2L-flammable; requires charge-limit design and A2L-rated components. Not a direct drop-in.

New-install R22-replacement systems — specify R32, R290 (small charge), R744 CO₂, R454B or R1234yf per application. Do not install any new R22 or R404A system.

R404A / R507A !' replacement decision matrix

R404A and R507A are the two workhorse commercial-refrigeration HFCs, with GWP of ~4000. F-Gas restricts their service since 2020; new-install ban 2020. The dominant replacement paths:

Replacement | Approach | Pros | Cons / Considerations |

R448A (Solstice N40) | Retrofit with POE oil top-up | GWP 1387 (65 % reduction); A1 non-flammable; similar capacity to R404A | Has glide 4-6 K — slight superheat/subcool recalibration; check thermostatic expansion valve superheat setting |

R449A (Opteon XP40) | Retrofit with POE oil top-up | GWP 1397; A1; direct competitor to R448A | Similar glide; brand choice per operator preference |

R452A | Retrofit with POE oil | GWP 2140 (still significant reduction); A1 | Higher GWP than R448A/R449A; commonly used in transport refrigeration |

R454A | New-install or retrofit | GWP 239; A2L mildly flammable | Charge limits apply; A2L-rated components required |

R454C | Retrofit or new-install | GWP 148 (very low); A2L | Small commercial and low-charge applications; A2L compliance required |

R744 (CO₂) transcritical | Complete system redesign | GWP 1 (near-zero); natural refrigerant; A1; supermarket-standard in EU | High-pressure system (~120 bar); specialised design and componentry |

The standard R404A !' R448A / R449A retrofit: (1) recover R404A per F-Gas leak-check regulation; (2) change POE oil to new POE-oil-filled compressor (residual R404A oil is OK, but 2 oil-change cycles preferred); (3) reset thermostatic expansion valve superheat setting to compensate for 4-6 K glide; (4) recharge with R448A/R449A to 90-92 % of the R404A design charge (blends are lighter per kg); (5) log the retrofit in the F-Gas Portal or equivalent national register.

R410A !' replacement decision matrix

R32 (GWP 675, A2L) — dominant R410A replacement for split AC and small chillers. Requires A2L-compliant components; slightly higher operating pressure than R410A.

R454B (Opteon XL41) (GWP 466, A2L) — increasingly the preferred R410A replacement for new commercial chillers; lower GWP than R32.

R1234yf blends — various proprietary blends targeting sub-500 GWP for R410A replacement.

R32 and R454B are A2L (mildly flammable) — existing R410A systems cannot be directly retrofitted without component upgrade (relief valve rating, insulation, ignition-source separation). New-install systems ship as R32 or R454B by default from most European chiller and AC manufacturers.

R134a !' replacement decision matrix (chillers, mobile AC)

R1234ze(E) (GWP 7, A2L) — direct low-GWP replacement for R134a in chillers. Slightly lower capacity than R134a; new chillers redesigned around R1234ze.

R1234yf (GWP 4, A2L) — direct R134a replacement in Mobile Air Conditioning (MAC) per EU MAC Directive.

R513A (Opteon XP10) (GWP 631, A1) — drop-in for R134a where A2L is not acceptable; still lower than R134a.

R450A (Solstice N13) (GWP 605, A1) — direct competitor to R513A for R134a drop-in.

Lubricant compatibility & oil-change practice

Refrigerant | Standard lubricant | Notes |

R22 (HCFC) | Mineral oil (MO), alkylbenzene (AB) | Non-hygroscopic; unlimited moisture tolerance |

R134a / HFC / HFO blends | Polyol ester (POE) | Hygroscopic; strict moisture control; deep-vac to < 500 microns before charge |

R744 (CO₂) | Polyol ester (POE) or PAG | Wide temperature range; high-pressure formulation |

R717 (ammonia) | Mineral oil or PAO | Ammonia is not miscible; oil separator downstream of compressor |

R290 (propane) | Mineral oil, POE or synthetic | Compatible with most oils; hydrocarbon-rated components required |

POE (polyol ester) oil is highly hygroscopic and absorbs water from atmospheric humidity in seconds when exposed. Always store POE oil sealed and add to the system through a moisture-tight charging line. Water contamination of POE oil causes acid formation and copper plating on the compressor discharge port.

Common questions

Q: Is R452A compatible with R404A? R452A is a drop-in R404A replacement for transport refrigeration. Compatible with the R404A POE oil (no oil change required); GWP 2140 (compared to R404A's 3922). Slight glide (~4 K); expansion valve superheat may need a small adjustment. Acceptable retrofit for reefer container and truck-refrigeration operators looking for a low-effort GWP reduction.

Q: Should we move on from R507A to R448A? Yes — for most commercial refrigeration systems, R448A is the preferred R507A replacement. GWP reduction ~65 %, POE-oil compatible, A1 non-flammable, capacity within a few percent of R507A. Retrofit is straightforward: recover R507A, top up POE oil, recalibrate the expansion valve for the ~5 K glide, recharge with R448A. Ships built after ~2020 that carry R507A on the refrigeration plant should plan the retrofit as part of the next scheduled overhaul.

Q: What drawbacks does a vessel experience when converting from R404A to R407F, R448A or R449A? Main considerations: (1) capacity ~5-8 % lower than R404A, which may need a compressor speed or condenser fan upgrade on marginal systems; (2) discharge temperature ~5-10 K higher, which may require thermal-protection review on hermetic compressors; (3) glide 4-6 K on the blends, which means the evaporator superheat setpoint must be recalibrated for the correct dry-out point; (4) F-Gas leak-check regulation applies proportionally to the new-refrigerant CO₂-equivalent charge, which may reduce the required leak-check frequency (a GWP-1400 charge is checked less often than a GWP-4000 equivalent charge).

Q: Is Loctite Locquic Activator 707 the correct primer for refrigerant-service brazed copper joints? No — Loctite 707 is an anaerobic accelerator for threadlocked joints, not for brazing. For brazed refrigeration joints, use a phosphorus-copper brazing rod (BCuP-2, -3 or -5 depending on filler) — no flux required on copper-to-copper joints. On copper-to-brass or copper-to-steel, use a silver brazing filler with the appropriate flux.

Q: What is the standard leak-check interval under EU F-Gas? Under (EU) 2024/573, leak-check frequency is based on the CO₂-equivalent charge: (a) 5-50 tCO₂e = 12 months; (b) 50-500 tCO₂e = 6 months; (c) > 500 tCO₂e = 3 months. Fitted leak-detection system halves the required interval. For a R404A system with 20 kg charge (~78 tCO₂e), the interval is 6 months. After retrofit to R448A (~28 tCO₂e), it drops to 12 months.

Related references & cBallast products

Refrigerant transition HFC !' HFO (R404A, R448A, R449A) — adjacent doc

Danfoss refrigeration cross-reference to IMPA OEM codes

Danfoss product code decoder (this cycle)

Refrigerant cylinders and refill sizes on cBallast

Danfoss refrigeration valves and controls

Refrigeration compressors & components

HVAC & refrigeration category

How to request an RFQ from cBallast

For refrigerant transition RFQs, include: (1) current refrigerant and estimated charge (kg); (2) target replacement refrigerant; (3) compressor make, model, capacity; (4) expansion valve type (electronic vs thermostatic); (5) oil type currently in system; (6) vessel or plant location; (7) planned retrofit window. cBallast quotes on refrigerant supply, POE oil top-up, compatible Danfoss controls (see Danfoss decoder doc), leak-detection equipment and F-Gas Portal registration support.

GWP values, safety classifications and phase-down schedules above are the current EU F-Gas Regulation (EU) 2024/573 and IPCC AR5 100-year GWP values. National regulations may vary; consult the specific jurisdiction's F-Gas or ODS regulator before scheduling a retrofit. Refrigerant brand names (Solstice, Opteon, Forane, Freon) are trademarks of Honeywell, Chemours (formerly DuPont), Arkema and other manufacturers.

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