REFRILINK TECHNICAL WHITE PAPER SERIES

Cylinder Filling, Leak Testing & Final Inspection

A process-control framework for safe, consistent refrigerant packaging

DOCUMENT	REVISION	ISSUE	AUDIENCE
WP-04	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

Reliable refrigerant packaging requires more than placing a target mass into a cylinder. Cylinder condition, valve compatibility, cleanliness, evacuation, filling accuracy, leak tightness, overfill prevention, labeling and final release all affect safety and product quality. The filling process should therefore be treated as a controlled manufacturing operation with defined acceptance criteria and traceability.

Key Takeaways

01	02	03
Verify cylinder eligibility before filling and keep nonconforming cylinders out of production.	**Control fill quantity by calibrated weighing and approved fill limits for the specific refrigerant/cylinder combination.**	**Leak testing and final inspection are independent release gates, not optional visual checks.**

1. Recommended Process Flow

1. Receive and identify empty cylinders; confirm ownership/return status where applicable.
2. Inspect cylinder body, foot ring, guard, valve, threads, corrosion, damage and required inspection markings.
3. Confirm cylinder specification and valve are approved for the refrigerant and market.
4. Prepare the cylinder using the approved cleaning, evacuation or conditioning procedure.
5. Connect using controlled, product-identified filling equipment and verify tare weight.
6. Fill to the target net mass while respecting the applicable maximum fill limit.
7. Close valve and verify gross mass; apply leak test using the approved method.
8. Fit protective components, apply label/seal, complete final inspection and release traceability records.

2. Pre-Fill Cylinder Inspection

Check	Reject / quarantine when...
Identification	Cylinder type, ownership, pressure rating or refrigerant suitability cannot be confirmed.
Inspection status	Required periodic inspection/test is out of date or not legible.
Body condition	Severe corrosion, denting, gouging, heat damage or other disqualifying damage is present.
Valve & guard	Valve is damaged, incompatible, leaking, contaminated or protective guard is not fit for service.
Internal cleanliness	Previous contents are unknown or contamination is suspected and cannot be resolved by the approved process.

FILLING CONTROL

3. Filling by Mass

Refrigerant cylinders are commonly filled by mass using calibrated scales or automated filling stations. The permissible fill is not a universal percentage: it depends on cylinder water capacity, refrigerant liquid density, pressure-vessel rules and the applicable transport/filling standard. The production system should store approved recipes by refrigerant and cylinder type, with interlocks or independent verification to prevent overfill.

- Use calibrated weighing equipment with a defined verification frequency.
- Confirm tare weight before filling and control the net target in the filling recipe.
- Prevent wrong-product connection through line identification, procedural controls or physical keying.
- Use overfill alarms/interlocks where automated equipment is installed.
- Record actual net fill and maintain traceability to the filling batch.

4. Leak Testing

Method category	Strength	Control point
Pressure decay / hold	Useful for automated gross leak screening	Stabilization time, temperature and acceptance threshold must be validated
Electronic detection	Sensitive and fast for compatible refrigerants	Detector type, calibration/check and test geometry matter
Bubble solution	Simple localized confirmation	Surface cleanliness and dwell time affect sensitivity
Helium / tracer method	High sensitivity in controlled manufacturing environments	Requires dedicated equipment and validated correlation to field leakage

METHOD SELECTION

The approved leak-test method and acceptance criterion should be based on cylinder/valve design, production rate, sensitivity needs and applicable standards. No single method is optimal for every line.

5. Final Inspection

- Valve fully closed and dry; protective cap/guard installed as required.
- Cylinder exterior clean, dry and free from product residue.
- Net/gross fill result within the approved range.
- Correct refrigerant identification and hazard/transport labeling for the target market.
- Batch or lot number, filling date and traceability code legible.
- Tamper-evident seal applied when required.
- Packaging configuration suitable for handling and transport.

PROCESS CAPABILITY

6. Control Plan for a Filling Line

Process step	Key control	Evidence
Cylinder entry	Eligibility and inspection status	Inspection record / scan
Connection	Correct refrigerant line and valve connection	Line ID / recipe confirmation
Evacuation / conditioning	Target vacuum or approved preparation cycle	Cycle record
Filling	Target net mass and maximum fill limit	Scale record / recipe
Leak test	Validated test method and acceptance limit	Test result linked to cylinder or batch
Labeling	Correct product and compliance label	Barcode / visual verification
Release	All gates complete	Release status / quality approval

7. Measurement-System Discipline

- Calibrate scales and leak-test equipment on a defined schedule.
- Use check weights or verification standards between calibrations as appropriate.
- Control software recipes and prevent unauthorized changes.
- Investigate drift, repeated adjustments or unusually high rework as process signals.
- Maintain maintenance records for valves, hoses, couplings and filling heads that can introduce leakage or contamination.

Conclusion

A controlled cylinder-filling process protects both product quality and transport safety. Eligibility checks, mass control, leak testing and release documentation should work as independent layers so that one failure is not able to pass unnoticed.

Reference Frameworks

- Cylinder and pressure-vessel requirements applicable to the country of filling and destination market.
- Dangerous-goods packaging and filling provisions applicable to the transport mode.
- Current refrigerant safety data sheet and valve/cylinder manufacturer instructions.
- Internal calibration, leak-test validation and quality-control procedures.

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.