Recovery of refrigerants and vacuum procedures

Practical methods, test evidence and field-ready decisions

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Recovery and evacuation solve different problems

RECOVERY

Remove and contain refrigerant

Protect people and the environment
- Use a suitable recovery machine and cylinder
- Weigh, identify and label the refrigerant

EVACUATION

Remove air and water vapour

Only after recovery, repair and pressure testing
- Use a vacuum pump and micron gauge
- Prove dryness and tightness with a standing test.

Recover refrigerant through a controlled six-step workflow

1
Identify
Refrigerant, oil and hazards

2
Prepare
PPE, ventilation, power isolation

3
Select
Rated machine, hoses and cylinder

4
Connect
Vapour/liquid method to suit system

5
Recover
Monitor pressures and cylinder mass

6
Close out
Isolate, label and document

Never mix refrigerants in one recovery cylinder.
Never exceed the cylinder's permitted fill.

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The recovery cylinder is part of the safety system

Before recovery

- Verify cylinder condition and rating
- Confirm refrigerant compatibility
- Record tare mass
- Place cylinder on a calibrated scale

Control the mass — not just the pressure.

Cylinder pressure changes with temperature. Mass is the reliable control for preventing overfill.

For flammable refrigerants: eliminate ignition sources and use equipment approved for the refrigerant classification.

Recovery Cylinder Capacity Calculation

- To ensure that the recovery cylinder is not over filled, capacity calculation needs to be done.
- Information required:
- Gross Mass – GM
- Tare Mass – TM
- WC – Water capacity
- SG – Specific Gravity of the Refrigerant
- Safety Factor 70%
- Formula:
- **GM = TM+(0.7 x WC x SG)**

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Example

- **R22**
- TM – 12.3 kg
- WC - 21.6 lt.
- SG - R22 -1.197
- Safety Factor 70%
- **GM = TM+(0.7 x WC x SG)**
- = 12.3+(0.7 x 21.6 x 1.197)
- = 30.4 kg
- Cylinder Capacity=GM-TM
- =30.4-12.3
- = **18.1kg**

R290

TM – 12.3kg

WC – 21.6 lt.

SG – R290 -0.51

Safety Factor 70%

GM = TM+(0.7 x WC x SG)

= 12.3+(0.7 x 21.6 x 0.51)

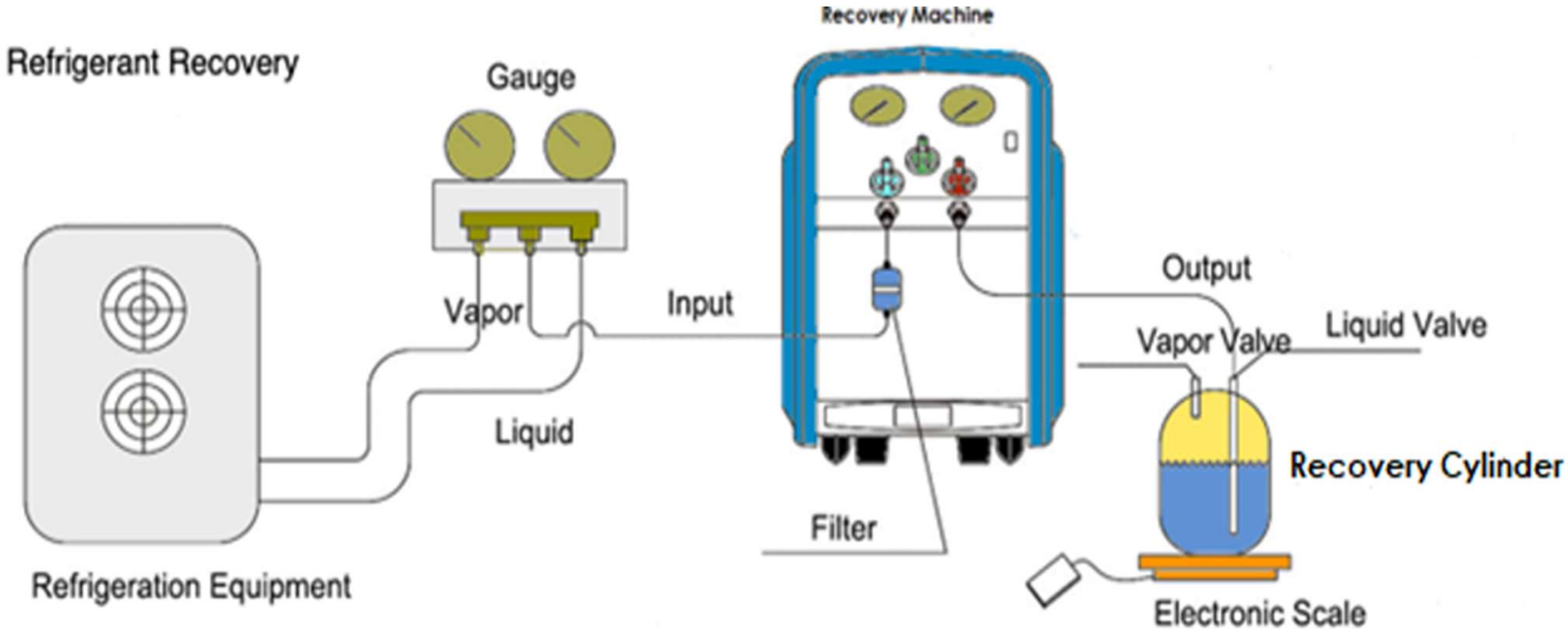
= 20.01 kg

Cylinder Capacity=GM-TM

=20.01-12.3

= **7.71kg**

Set up of recovery equipment



Vacuum

500

microns

The target is not the whole test.
The system must also hold.

A vacuum is only meaningful after the system is tight

01	**Recover**	No refrigerant remains
02	**Repair**	Complete the mechanical work
03	**Pressure-test**	Use dry nitrogen correctly
04	**Release nitrogen**	Return to atmospheric pressure
05	**Evacuate**	Connect clean vacuum equipment

Moisture and non-condensable shorten system life

H_2O

Water vapour can remain trapped in oil and surfaces

AIR

Non-condensable raise condensing pressure and temperature.

ACID

Moisture, heat, oil and refrigerant can drive harmful reactions

Poor evacuation can reduce efficiency, damage oil and insulation, and contribute to premature compressor failure.

A fast evacuation removes restrictions before adding pump capacity

1

Fresh oil

Clean, dry pump oil seals better

2

Core tools

Remove valve-core restrictions.

3

Large hoses

Short, vacuum-rated and direct

4

Gauge at system

Measure far from the pump

The setup is a flow path. The narrowest restriction controls how quickly gas and vapour leave the system.

Pull, isolate and prove the vacuum

1

PULL DOWN

Run the pump until the required vacuum is achieved

2

ISOLATE

Close the system-side valve without exposing the system

3

OBSERVE

Allow pressure to equalize during the standing test

500 microns ≈ 66.7 Pa ≈ 0.667 mbar — use the equipment manufacturer's specified target and decay limit.

The standing test tells you what the pump-down cannot.

SLOW RISE, THEN STABLE

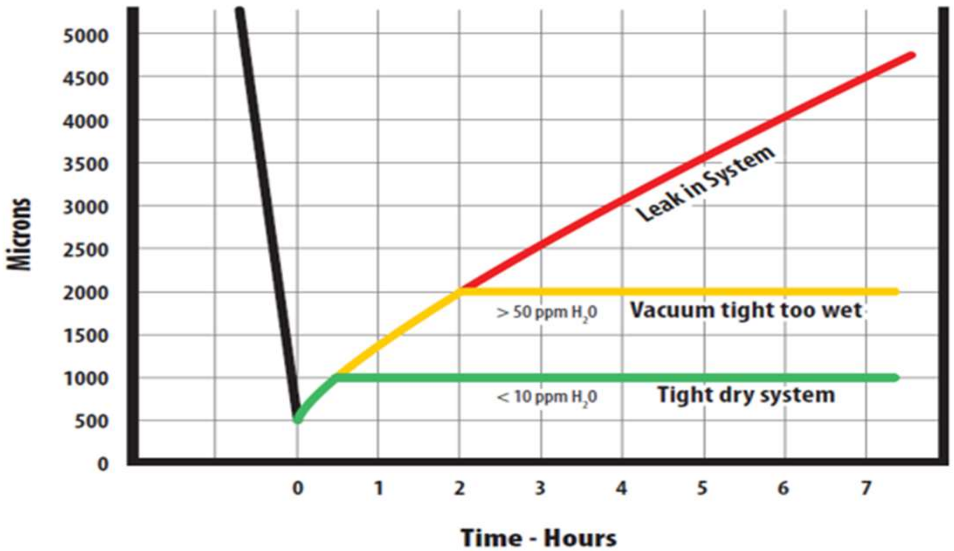
Likely moisture or outgassing

- Continue evacuation
- Change contaminated pump oil
- Use dry-nitrogen breaks if appropriate

FAST, CONTINUING RISE

Likely leak or open path

- Check hoses, seals and valves
- Confirm isolation method
- Repair before continuing



The 18-pump test isolated the variables that matter.

18

New vacuum pumps tested on the same day.

26 L

Simulated system volume

1.25–8 CFM

CFM range: 35–227 L/min

A successful evacuation depends on more than the vacuum pump's CFM rating. The test results demonstrate that clean oil, unrestricted connections, large-diameter evacuation hoses, valve-core removal tools and an accurate micron gauge can have a greater influence on evacuation time and quality than simply using a larger, heavier pump.

Same fresh mineral oil
- Same target: 500 microns
- Small and large pump groups
- Hose setup changed as a test variable

Credit
Sheb Powell
REFCO Manufacturing

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Bigger hoses changed evacuation time more than bigger pumps.

59%

Faster average evacuation — small-pump group with 3/8-inch hose

68%

Faster average evacuation — large-pump group with 3/8-inch hose

3 Minutes

Each pump had a 3 minute runtime to achieve its ultimate vacuum with each different vacuum gauge.

Test basis: a single dedicated 3/8-inch evacuation hose on a 26-litre simulated system, pulled to 500 microns.

CFM matters most early; conductance dominates deep vacuum

FREE-AIR FLOW	DEEP-VACUUM PERFORMANCE
CFM / L·min^{-1}	**Ultimate vacuum + setup**
Describes pumping speed near atmospheric pressure. Useful for initial air removal and larger system volumes.	At low absolute pressure, hose diameter, length, valve cores, oil condition and system tightness increasingly control the result.

Select the whole evacuation system — not the pump specification in isolation.

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A 14 kW split system can still have substantial internal volume.

ILLUSTRATIVE EXAMPLE

≈19.6 L

Assumed combined internal volume for a 48,000 BTU/h (≈14 kW) split system with an 18 m line set.

What the example means

- System volume is not defined by capacity alone
- Coil and compressor designs vary by manufacturer
- Longer and larger piping increases evacuation load
- Use measured performance, not assumptions, to accept the vacuum

Treat 19.6 L as an illustrative assumption—not a universal system volume.

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Choose the pump for the work—and the technician carrying it

Deep-vacuum rating	Can it achieve the required ultimate vacuum?	**Flow capacity**	Is the CFM suitable for expected system volume?
Ports	At least practical 1/4-inch and 3/8-inch connections	**Oil service**	Easy inspection, draining and replacement
Weight	Safe to carry up stairs and ladders	**Refrigerant class**	Approved for the refrigerants and work environment

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The field checklist: recover safely, evacuate intelligently.

- Identify the refrigerant and hazards
- Recover into the correct weighed cylinder
- Repair and pressure-test with dry nitrogen
- Use clean oil, core tools and short large-bore hoses
- Place the micron gauge at the system
- Pull to the specified target, isolate and observe
- Document recovery mass and evacuation result

THE PRACTICAL TAKEAWAY

Carry the right hose—not unnecessary weight.

A trustworthy vacuum is measured at the system and proven after isolation.

Thank you for your attention

- Any Questions ?