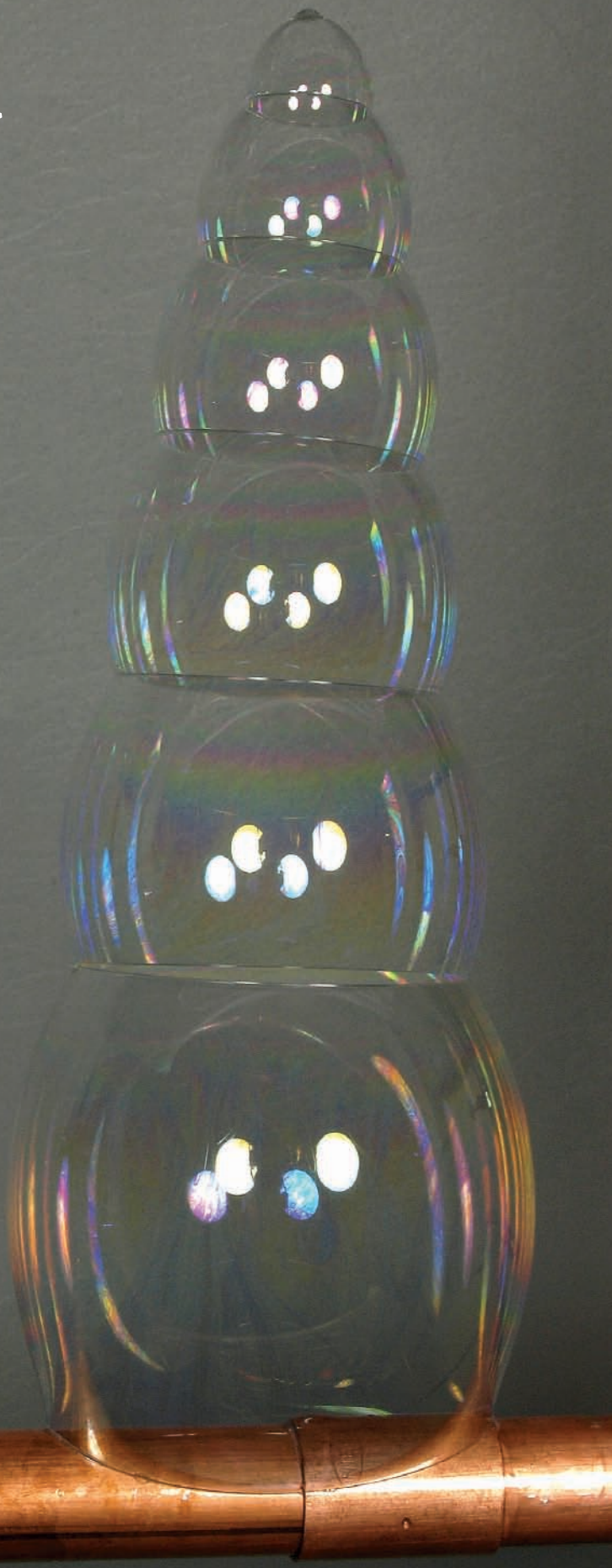


WE'RE TAKING LEAK DETECTION TO A HIGHER LEVEL



FOOD GRADE

Non Toxic - Biodegradable - Oxygen Safe



REFRIGERATION TECHNOLOGIES

Guide to Basic and Advanced Refrigerant Gas LEAK DETECTION

By reading, understanding and practicing the techniques outlined in this manual, the Refrigeration Service Mechanic will finally master the art of Leak Detection.
(The most under-taught skill in our trade)

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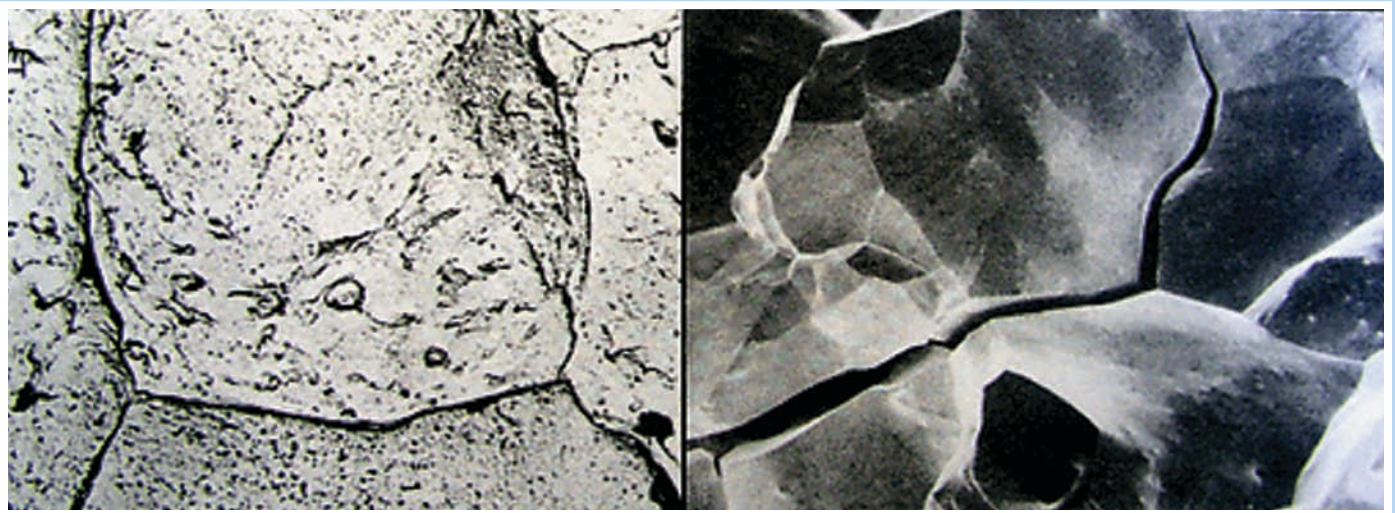
EVERYTHING LEAKS

All sealed systems leak. The leak could be at 1-lb. per second or as slow as 1-oz. every million years.

Every pressure system has leaks because “flaws” exist at every joint fitting, seam or weld. These “flaws” may be too small to detect even with the best of leak detection instruments. But given time, vibration, temperature and environmental stress, these “flaws” become larger, detectable leaks.

A LEAK IS NOT...Some arbitrary reading on a meter. Gas escapes at different times and at different rates. In fact, some leaks cannot be detected at the time of the test. Leaks may plug, then re-open under peculiar conditions.

A LEAK IS...A physical path or hole, usually of irregular dimensions. The leak may be the tail end of a weld fracture, a speck of dirt on a gasket or a microgroove between fittings.



An electron micrograph of a “clean” silver soldered joint. Note the crack lines and other impurities of the melted metal.

Further magnification shows actual metal separation. The leak rate was measured to be 0.00003 oz/yr, R-22 gas. After 1 year of system operation, the cracks opened to 0.00016 oz/yr.

It is incorrect to state that a unit has no “leaks.” All equipment has leakage to some degree. A sealed system which has operated for 20 years without ever needing a charge is called a “tight system.” The equipment still has leaks, but not enough leakage to read on a gauge or affect cooling performance. No pressurized machine is perfect.

THE IMPORTANCE OF SENSITIVITY

Sensitivity is the measure of performance in leak finding devices. High sensitivity means “fine” leak detection. Low sensitivity is considered “gross” detection.

Refrigeration Technologies has developed a fluid coating of remarkable leak reactant sensitivity.

Progressive compositions trademarked as “BIG BLU” are now capable of magnifying micro-gas leakage as small as 0.65 oz./yr. into visible foam “cocoon.”

Our research work has been verified and published in several distinguished scientific journals.¹

¹Reference: American Society for Non-Destructive Testing “The Study of Leak Detection Fluids.” *Materials Evaluation*. Vol 49 No. 8, Pages 1035-1037, August 1991.



The super sensitivity of the Big Blu fluid is demonstrated by micro-foam “cocooning” of R-11 vapor off a reference leak.

The advent of fine electronic sensing devices proves that microscopic leaks do in fact exist, and leaks larger than 0.5 oz./yr. can be detrimental to the operation of any refrigeration system.

Bubble testing is gross because only large leaks (above 4.2 oz./yr.) and leaks of proper position can be detected.

This can be demonstrated when a fitting is electronically sensed as leaking, but secondary application of a bubble solution to confirm the site yields no bubble or foam formation. The question immediately

confronting the technician is:

1. Did the electronic give a false reading? **OR**
2. Does the bubble solution lack the sensitivity to show the leak?

Refrigeration Technologies has conducted extensive studies investigating all the faults of bubble leak testing.

The failure of bubble solutions lies in their composition. Most are based on shampoo, bubble bath or dish washing soap, and usually contain artificial thickeners, fluorescent dyes, or glycerine that dramatically kill leak sensitivity.

THE SIX CLASSES OF LEAKS

Refrigeration Technologies has determined six (6) types of leaks you will at sometime during your servicing experience come to know.

Class 1. Standing Leaks (SL) are leaks that can be detected while the unit is at rest (off) and fully equalized. This shall include freezer evaporative coils warmed up by defrost. SL leaks, fortunately, are the most common of all.

Class 2. Pressure Dependent Leaks (PDL) are leaks that can only be detected as the pressure is built. Nitrogen is used to pressurize low sides to 150 psi and high sides to 450 psi. Never use CO2 or Oxygen. Helium or dry air is acceptable. PDL testing should be

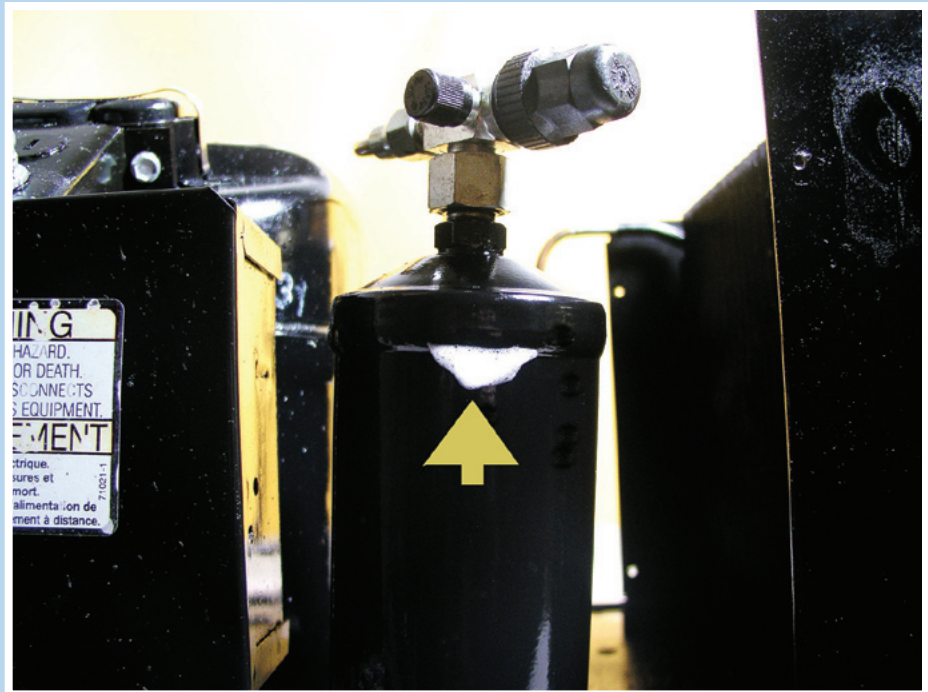
conducted if no leaks are discovered by the SL test.

Class 3. Temperature Dependent Leaks (TDL) are leaks associated with the heat of expansion. TDL usually occurs from high ambient air, condenser blockage or during defrost.

Class 4. Vibration Dependent Leaks (VDL) occur only during unit operation. The mechanical strain of motion, rotation, refrigerant flow, or valve actuation are all associated with VDL.

Class 5. Combination Dependent Leaks (CDL) are flaws that require two or more conditions in order to induce leakage. For example, temperature, vibration and pressure cause the discharge manifold on a semi-hermetic compressor to expand and seep gas.

Class 6. Cumulative Micro-Leaks (CML) are all the individual leaks that are too small to detect with standard tools. The total loss over many years of operation slightly reduces the initial gas charge. In practice, a system having many fittings, welds, seams or gasket flanges; the greater the amount of CML.



OEM's and field installers should always conduct a PDL test before charging a system with refrigerant. Nitrogen pressurization to 450 psi reveals a cracked receiver seam indicated by white micro foam.

REQUIRED TOOLS

We are all intuitively equipped with basic leak detection tools. With our ears we can hear large leaks. With our nose, we can smell certain gases. With our fingers,

we can feel for oil residue which surrounds many leaks sites. But the best leak confirmation comes by sight. The verification of a leak by watching bubbles or foam actively brew at the point of leakage.

This manual describes a systematic method of search using common leak detection tools.

1. An electronic halogen instrument having a sensitivity of at least 0.50 oz./yr.
2. Our BIG BLU Bubble/Foam Promoter.
3. An inspection mirror.
4. A light source.

The electronic sensor shall be used as a screening tool to “sniff” which component is emitting gas. BIG BLU will be used to spray coat ALL surfaces of the target component.

We shall then observe for any bubble/foam emissions, using when necessary, an inspection mirror to view blind sides and a light source for illuminating dark areas.



BASIC LEAK DETECTION

Field Testing for the Standing Leak (SL)

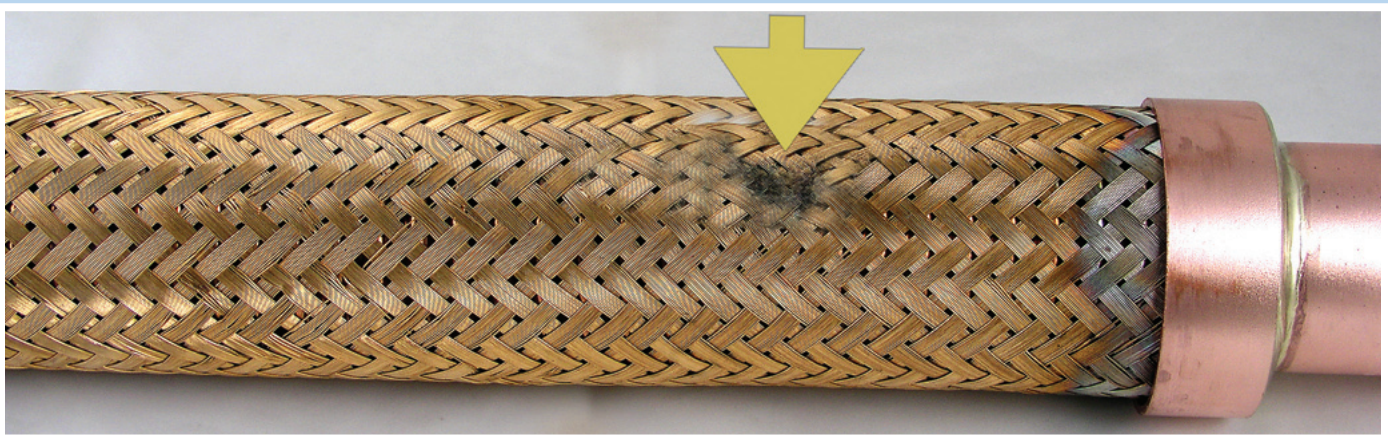
Successful leak detection is solely dependent on the careful observations made by the testing technician.

SPOTTING REFRIGERATION OIL RESIDUE

Fortunately, all refrigeration systems circulate compressor oil internally. Oil will blow-off with refrigerant gas and mark the general areas of leakage.

Oil spots appear wet and have a fine coating of

dust. Determine that the wetness is oil and not condensate by rubbing the area with your fingers to feel for oil slickness.



The faint dark area on this vibration eliminator is evidence of oil-refrigerant seepage.

1. With the unit fully pressurized to equalization, spray coat all oily areas with “BIG BLU”.
2. Observe for bubble/foam emission.
3. Continue to observe the area for at least 10 minutes to allow time for micro-leaks to build a cocoon of foam.

RELIABILITY OF OIL SPOTTING

Oil spotting is the technician’s first quick-check, but not reliable for the following reasons:

1. Oil is always present at schraeder valves and access ports due to the discharging of refrigerant hose gauges. Often these ports are falsely blamed as the main point of leakage.
2. Oil blotches can originate from motors, pumps, or other sources.
3. Oil residue may be the result of a previous leak.
4. Oil is not always present at every leak site. It may take many months, even years of unit operation to cause enough oil blow-off to accumulate on the outer side.
5. Oil may not be present with micro leaks.
6. Oil may not reach certain leak positions.
7. Oil will not be present on new start ups.



TESTING FOR EVAPORATOR SECTION LEAKS

Many leaks that go undetected are in the Evaporator Coil. This is because evaporator sections are cabinet contained, buttoned-up or framed into areas that do not allow easy access. In order to avoid time consuming labor to strip off covers, ducting, blower cages, or the unloading of product, an easy electronic screen-

ing method is outlined:

1. Turn off all system power including evaporator fan motors.
2. Pressurize system to equalization including defrosting of freezer coils.
3. Warm-up and calibrate an electronic sniffer to its highest sensitivity.
4. Locate the evaporator drain outlet or downstream trap.
5. Position the detector probe at the drain opening. (Be careful that the probe does not come in contact with any water).
6. Sniff a minimum of 10 minutes or until a leak is sensed. Recalibrate the device and test again. Two consecutive POSITIVE tests confirms an evaporator leak. Two consecutive NEGATIVE tests rule out a detectable evaporator section leak.

Refrigerant gas is heavier than air, and gravity will cause the gas to flow to the lowest point. If the evaporator section tests positive, we must expose the coil and spray coat ALL surfaces with BIG BLU.



Sniff the outlet of the condensate drain pipe to confirm or rule out an evaporator leak.

TESTING FOR CONDENSING SECTION LEAKS

Just as the electronic sensor was used to screen for evaporator leaks, we have devised a quick method for determining condensing section leakage.

1. Calibrate an electronic sniffer to its highest sensitivity and place the probe at the base of the unit (usually under the compressor). Unit should be fully pressurized to equalization.
2. Cover the condensing unit with a cloth tarp or bed sheet to serve as a barrier against any outside air movement and also trap refrigerant gas. Do not use a plastic material.
3. Monitor for leakage for ten (10) minutes or until a leak is sensed. Re-calibrate and test again. Two consecutive positive tests confirm condensing section leakage: Two consecutive negative tests rule out a detectable leak.
4. Use the electronic sniffer to test for leaking bellows on pressure controls. Remove the control box cover and place the probe within the housing. Cover the control tightly with a cloth barrier and monitor for ten min-

utes as above.

5. If the results are positive, uncover the equipment and begin spray coating with BIG BLU. If the results are negative, continue to the Suction/Liquid line leak test.



Cover the condensing unit (or section on a package unit) to pick up any refrigerant drift. The cloth barrier prevents air dilution.

SUCTION/LIQUID LINE LEAK TEST

The longer the tubing runs between the evaporator and condensing unit, the greater the odds for defects. Count on all possibilities whether it be a typical sight glass drier connection leak to a poor solder joint hidden under pipe insulation.

1. The suction line can be screened by calibrating an electronic to it's highest sensitivity.
2. Tuck the probe underneath the pipe insulation. Monitor at ten minute intervals while the system is at rest and fully pressurized to equalization. It may be necessary to insert the probe at several downstream points.



An insulated pipe being scanned for leakage. It is important that the insulating material is not glued to the metal pipe and does not have any open gaps or tears.

3. If a leak is sensed, strip off insulation and apply BIG BLU to all pipe surfaces. If no leak was positively screened, test liquid line.
4. The liquid line almost always has oil residue as the result of leakage. Coat all suspected liquid line connections with BIG BLU allowing sufficient time (10-15 minutes) for micro-foam expansion.

ADVANCED LEAK DETECTION

Leakage that avoids detection by the basic field test (SL) must be determined by Nitrogen pressurization (PDL), run-vibration (VDL), or by adding heat (TDL).

For advanced leak detection the electronic halogen detector cannot be used. We shall rely on the super sensitive microfoamers unique to the BIG BLU fluid coating.

TESTING FOR PRESSURE DEPENDENT LEAKAGE (PDL)

On newly connected field installations, always proceed to the PDL Test. The old habit of pressure checking with Refrigerant Gas, besides being taboo, is more expensive, more time consuming and less reliable.

On existing systems, the technician must properly remove and store any refrigerant charge.

1. Pressurize the low side to 150 psi and the high side to 450 psi using dry Nitrogen, Helium or dry air. If the high and low sides cannot be split by way of isolation valves, pressurize the entire system to about 350 psi.
 2. Always conduct proper bubble testing by thoroughly saturating all surfaces with BIG BLU. Allow up to 15 minutes reaction time for the microfoamers to expand into visible white “cocoon” structures. Use an inspection mirror to view undersides and a light source for dark areas.
 3. Starting at the compressor, coat all suspected surfaces. Continue to coat all suction line connections back to the evaporator section.
 4. Spray coat all fittings starting with the discharge line at the compressor to the condenser coil. Spray coat all the soldered condenser coil U-joints.
 5. From the condenser, continue to spray coat all liquid line connections including the receiver (valves, seams, pressure taps and any mounting hardware). Continue the liquid line search back to the evaporator section.
 6. Any control line taps to the sealed system must be spray coated the entire length of their run all the way back to the bellow device.
 7. Expose the evaporator section and coat all connections, valves and U-joints.
- Our first sequence of search started with the compressor and suction line due to their large surface areas. The next sequence begins with the discharge line, across the condenser to the liquid line connection at the evaporator section. The evaporator section is the last and least desirable component to pressure test in the field.
- This completes the PDL Test.

TESTING FOR VIBRATION DEPENDENT LEAKAGE (VDL)

Leaks that only occur while the unit is in operation are some of the rarest leaks of all. These are cracks that open and close from physical shaking.

Studies have shown that certain components and piping on refrigeration units will develop vibration leaks.

1. The high pressure gas used during PDL should be dumped and the unit recharged with the proper refrigerant.

2. Place the unit in operation and spray coat the following areas while viewing for Bubble/Foam formation:

- All compressor bolts and gasket edges
- Suction line connection at compressor

- Suction line connection at evaporator
- Discharge line connection at compressor
- Discharge line connection at condenser
- Vibration eliminators
- Any joint or fitting on unsupported pipe runs
- Expansion and solenoid valves
- Cap tube connections
- Sight glass

This completes VDL Testing.

TESTING FOR PRESSURE DEPENDENT LEAKAGE (PDL)

All mechanical connections expand when heated. The connections on a refrigeration system are usually of soft metals such as copper, brass or aluminum. These metals actually warp when heated, then contract and seal when heat is removed.

1. Place the unit in operation and raise the operating temperature by partially blocking the condenser air intake.

2. Spray coat all metal connections, one at a time, and observe for leakage. Re-wet any

extremely hot surface with water to keep the fluid from evaporating too quickly.

3. When testing Evaporator components, you may induce heat by placing the unit into defrost.

TESTING FOR COMBINATION DEPENDENT LEAKAGE (CDL)

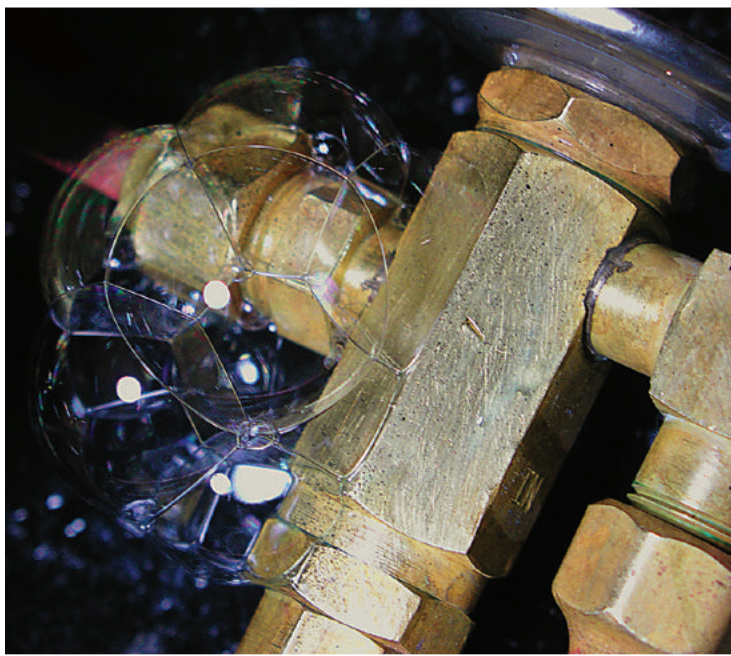
CDL testing is overlapped by the PDL, VDL and TDL procedures. CDL can only be determined by merging at least two, possibly all three procedures into one. The CDL test requires the highest order of skills and observation techniques. Each suspected component must be isolated and tested in the following manner:

1. A valve or fitting is subjected to high pressure.
 2. Spray coat the valve or fitting.
 3. Tap the component repeatedly with a rubber mallet to induce vibration. If no leakage...
 4. Gently add heat to the component. If no leakage, continue on to another component.
- This completes a labor intensive CDL test.

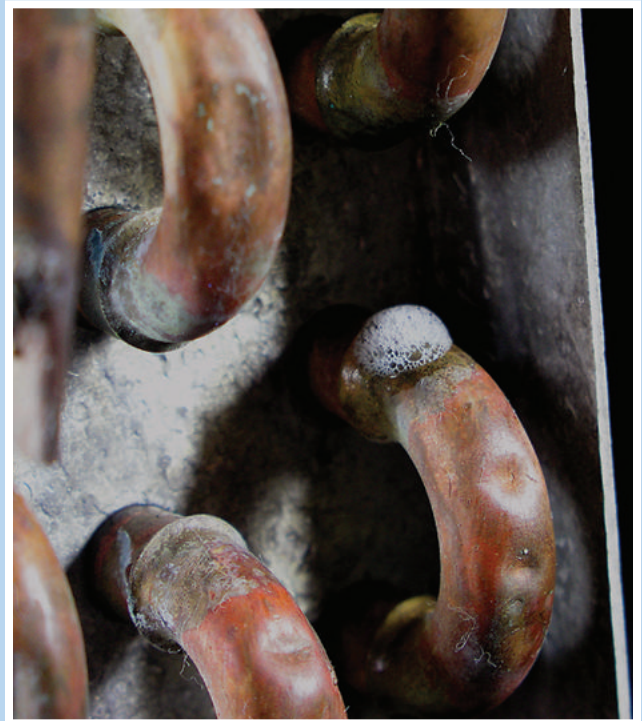
TESTING FOR CUMULATIVE MICRO-LEAKS (CML)

CML are measured using a Helium Mass Spectrometer. Such super fine leak testing is beyond the normal operations of the Refrigeration Service Mechanic.

CML is considered an acceptable amount of leakage in our industry at this point in time.



BIG BLU is an exclusive composition of micro-foaming compounds, wet adhesives and coagulants. The presence of dirt, oil or water does not affect bubble production.



Foam Cocoons: BIG BLU is the only gas leak detector that can reveal gas leakage down to 0.5 oz./yr.

THE IMPORTANCE OF SENSITIVITY...

BIG BLU is the only fluid that can reveal gas leaks far below 4.2 oz./yr.

BIG BLU is an exclusive composition of esoteric micro - foamers coupled into a base of coagulants and wet adhesives.

BIG BLU...the only bubble detector capable of identifying gas leakage approaching the sensitivity of electronic sniffers.



“The Professional Technician is very particular about his Leak Detector”

Our solutions perform more effectively with the higher pressure HFC refrigerants and blends.

SUPER BLU is the most durable product of its kind. Our temperature rating of -30 to 200°F is a true figure, remaining fluid on the coldest of days while resisting evaporation on hot discharge lines. This is our former Low Temp solution *“kicked up a few notches”* to earn the title... *Super Blu*



BRUSH ON BLU:

We redesigned the old dauber, adding a handle with a telescopic stem. The new dauber transfers a flatter liquid, free of counter-indicating bubbles or foam. Freeze resistant to about 0°F with a smooth and silky viscosity for excellent hold.

