Refrigeration Technologies

CHECK-MATE

Contamination Detector Kit

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Refrigeration Technologies
Advanced Materials & Applications for the HVACR Industry

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THE EASY OIL TEST

Color Chart for Determining the Level of Contaminants in Mineral, Alkylbenzene, PAG or POE Oils

Test Results

**PASS**

- RT752C
  - Yellow = Dry

- RT752C
  - Orange/Brown = Low Moisture

- RT752C
  - Pink/Lavender = Acceptable Moisture/Acid

**FAIL**

- RT752C
  - Magenta = Critical Moisture

- RT752C
  - Violet = Acid Hydrolysis

- RT752C
  - Blue = Severe Hydrolysis

*Indicator does not need to be fully stained. A 1mm spot is sufficient.*
PART ONE: OIL PHASE TESTING

1.1 DETERMINING CONTAMINANTS IN OIL

The bulk of all contaminants will be dissolved in the Compressor Oil of an operating System.

"The Easy Oil Test" (Detector Tube Method) offers a more definitive way to check the condition of any Compressor Oil or to pretest any stock Oil before it is to be added to a System.

The traditional pH test in a bottle cannot measure the full range of Oil contaminants. A pH test will only work after a System has been exposed to long term acid production. Therefore, when the acid content of the Oil is ruled by the pH method, it is already a foregone conclusion that extensive corrosion, metal wear, copper plating and damage to the Compressors' electrical windings has already occurred.

The Oil Detector Tube Method is not a pH test.

Our Oil phase Detector Tubes will accurately measure the Oils' **dielectric strength**. Dielectric strength is best defined as "the fluids ability to conduct an electrical current". Oil containing variable amounts of moisture and other dissolved impurities will increase the Oils' **conductance**.

The ideal Oil should be nonconductive however, even virgin Refrigeration Oil will register slight conductivity. Working Compressor Oil will manifest conductance due to chemical interaction, notwithstanding, the introduction of contaminants during an installation or repair.

The Color Chart opposite this page displays the color breakouts of this test. The soft colors indicate low Oil conductivity progressing stepwise to the stronger colors of highly conductive Oil.
1.2 THE OIL DETECTOR TUBE

The sections of the vial are the Transfer Agent and the Indicator. A Refrigerant Vapor/Oil stream is allowed to flow into the tube. The liquid Oil will be observed wetting through the Transfer Agent. As soon as the Oil reaches the Indicator segment, the flow must be manually stopped. *The Oil test is not affected by refrigerant gas type.*

The TRANSFER AGENT contains dye fractions bonded to an ion exchange resin. The ion exchange resin will release a specific dye in direct proportion to the conductance of the Oil. Ignore any color change that occurs within the Transfer Agent.

The INDICATOR segment of the Oil Detector Tube will capture and preserve the dye fraction liberated by the Transfer Agent for comparison against the Color Chart. The Indicator does not need to be fully stained. The Indicator can only hold about two (2) drops of Oil and this test only requires about one-tenth (1/10) of a drop.

Failure to stop Oil flow will completely wash the test results out of Tube.
1.3 MILeking THE SYSTEM FOR OIL

1. Connect blue extension hose and Checkmate Body to a clean and dry suction port of an operating system having positive pressure. Never connect to a liquid or discharge port.

2. Insert Oil Detector Tube RT752C - blue end first.

3. Attach metering cap and 1/4 flare cap to complete the assembly.

4. While the system is running, loosen the flare cap to commence a s-l-o-w bleed.

5. BE PATIENT. Watch for any Oil entering the Tube, Oil will appear as a liquid, wetting the crystals of the Transfer Agent.

6. Allow Oil to pass through the Transfer Agent and deposit a small stain on the Indicator.

7. As soon as the Oil hits the Indicator, stop flow immediately by tightening the flare cap. Close the suction port.

8. Remove entire Checkmate Assembly at extension hose relieving any remaining back pressure. Remove Detector Tube and compare stain on Indicator to the closest color on the chart.

At times you may experience difficulty coaxing Oil out of the System. Try the following:

(1) Shut down System and commence bleed while suction pressure is rising. Still no Oil?

(2) Restart Compressor after a 5 minute rest. Bleed at startup. Be prepared to stop flow immediately. This technique may cause an enormous surge of Oil into the Detector Tube.

Oil is always attainable with a de minimis Refrigerant bleed. If required, outlet of Checkmate devise can be adapted to a tank or vessel to capture the Refrigerant bleed.
1.4 TESTING OIL "OUTSIDE" A SYSTEM

To pretest stock Oil before addition to a System, or to test Oil that can be directly drained from a Compressor. Use the following procedure:

1. Add about two (2) drops of Oil to the Blue inlet of a fully assembled unit with Detector Tube in place.

2. Connect the Oil primed assembly to any gas source having a pressure displacement less than 150 psig.

3. Open gas valve to pressurize the assembly.

4. Loosen flare cap for a mild bleed.

5. Gas pressure will quickly drive the Oil through the Transfer Agent and deposit a stain on the Indicator.

6. Stop flow by tightening the flare cap and close the gas valve.

7. Disconnect entire assembly at extension hose relieving any remaining back pressure.

8. Remove Detector Tube and match the Indicator to the Color Chart.
1.5 INTERPRETING THE RESULTS

Primary Color
Bright to pale YELLOW

Equivalent Colors
Yellow with possible tints of green or tan

Indication: Compressor Oil
Exceptionally pure system fluid

Indication: Stock Oil
The preferred condition for virgin Mineral and Alkylbenzene
Oils to be added to equipment

Special Notes: None

Primary Color
ORANGE

Equivalent Colors
Orange with light brown or tan

Indication: Compressor Oil
A very clean Mineral or Alkylbenzene system.
An exceptionally clean POE or PAG system.

Indication: Stock Oil
Mineral or Alkylbenzene Oils containing high amounts of
special additives will test at this level. It is otherwise preferred that
MO and AB oils test Yellow before addition to a system.
Virgin POE or PAG oils will test at this level unless these Oils
contain a high additive package.

Special Notes: None

Primary Color
PINK or LAVENDER

Equivalent colors
Pink with Lavender - combined or separating on the Indicator.
Soft Purple - a Lavender observed under a low lighting condition

Indication: Compressor Oil
An acceptable condition for all system lubricants.

Indication: Stock Oil
Do not add Mineral or Alkylbenzene Oils that test at this level.
POE and PAG Oils containing high additive packages are
acceptable for use at this level. All others should not be added.

Special Notes
The gap between the Pink/Lavender state to a Magenta or Violet condition
is broad. Therefore, a Pink/Lavender status should not be considered
a borderline condition since many systems tend to equilibrate normally
at this level.
The Pink/Lavender state may revert to Orange when the same system is
measured at a lower ambient, or under other operating conditions that
stabilize and improve dryer performance.
### 1.5 INTERPRETING THE RESULTS cont.

<table>
<thead>
<tr>
<th>Primary Color</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAGENTA</td>
<td>Change dryers and recheck after 80-100 operating hours. Correct the problem that has caused abnormal liquid line temperature.</td>
</tr>
<tr>
<td>Equiv. Colors</td>
<td>Special Notes</td>
</tr>
<tr>
<td>Bright Reds having Lavender to Violet separations on the Indicator segment.</td>
<td></td>
</tr>
<tr>
<td>Indication</td>
<td>A “False Positive” is possible from connection of Checkmate unit to a wet service port. Dry service port and Checkmate assembly - Retest the equipment. Liquid line moisture indicators will not confirm or forewarn of this condition because the Oil passing by the sight glass indicator is diluted with liquid Refrigerant.</td>
</tr>
<tr>
<td>Cause</td>
<td>gressed due to inadequate dehydration. Numerous other known and unknown sources can lead to this condition.</td>
</tr>
<tr>
<td>Inadequate dehydration or: Moisture has been driven out of dryer due to elevated liquid line temperature.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Primary Color</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIOLET</td>
<td>Most systems can recover by installing new dryers. However, an Oil change may be necessary. Retest after 80-100 operating hours.</td>
</tr>
<tr>
<td>Equiv. Colors</td>
<td>Special Notes</td>
</tr>
<tr>
<td>Dominant Violet with Strong Red separating on the Indicator.</td>
<td></td>
</tr>
<tr>
<td>Indication</td>
<td>Cross-Contamination can give a “False Positive” Violet. This is most often, but not necessarily, the level at which a pH test kit may indicate acidity. Retest the system.</td>
</tr>
<tr>
<td>Products of acid activity dissolved in the Oil phase.</td>
<td></td>
</tr>
<tr>
<td>Cause</td>
<td></td>
</tr>
<tr>
<td>System operating at higher than normal operating temperatures. A system condition that has pro-</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Primary Color</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLUE</td>
<td>Change Oil and add new dryers to salvage remaining Compressor life.</td>
</tr>
<tr>
<td>Equiv. Colors</td>
<td>Special Notes</td>
</tr>
<tr>
<td>Blue with a Violet separation, Navy Blue, Blue-Gray with small carbon deposits.</td>
<td></td>
</tr>
<tr>
<td>Indication</td>
<td>Compressor Oil viscosity and lubricity has diminished. A Blue level may also occur from Oil super saturated with liquid water.</td>
</tr>
<tr>
<td>A reservoir of acid/acidic products dissolved in the Oil Phase.</td>
<td></td>
</tr>
<tr>
<td>Cause</td>
<td></td>
</tr>
<tr>
<td>Prolonged exposure to high contaminant levels. Extreme heat. Numerous other circumstances.</td>
<td></td>
</tr>
</tbody>
</table>
Use your Checkmate Contamination Detector Kit to correctly determine the ACID/MOISTURE content of any CFC, HCFC or HFC Refrigerant.

- Determine the reusability of Recovered or Reclaimed Gas
- In System Diagnostics, correlate the level of contaminants found in the Refrigerant Phase (vs) the Oil Phase. (Section 2.3)

Technical Notes:
This test is conducted by sampling a specific volume of Refrigerant in the vapor phase. Any Oil vapor or mist entering the tube will not affect the results. When the correct volume of vapor is allowed to pass through the Detector Tube, the results will be consistent with Laboratory Analysis.
2.2 CHECKMATE ASSEMBLY FOR GAS TESTING

Configure hose gauge manifold for 8 - 10 ft. of Gas volume

Example:
Three 36” x 1/4” ID hoses

or Two 48” or Two 60”
or One 48” + One 60”

ALTERNATE

2.3 TAKING THE TEST

1. Arrange hose gauge manifold (as pictured above) with 8-10 ft of 1/4 inch ID hose. Optimum is 9 feet.
2. Connect Blue extension hose and Checkmate Body to gas source.
3. Purge extension hose and body with the test gas.
4. Stop purge. Slide and press Detector Tube into body Blue end first.
5. Screw down metering cap.
6. Connect to hose gauge arrangement.
7. Start Refrigerant flow. **Stop gas flow when low side gauge reaches the correct Termination Pressure for the Refrigerant being tested. Refer to Chart on back cover.**
8. Remove Detector Tube and note the length of color change. Refer to chart on inside back cover.
2.3 INTERPRETING THE RESULTS

TESTING FOR ACIDIC
"Refrigerant Gas"

Reaction: BLUE → YELLOW/WHITE
Positive test will yield yellow and/or white crystals.

Sensitivity: 0.10 ppm (0.00001%).

Accuracy: ±10% from cylinder gas, ±15% from a pressure
equalized system. Invalid results can occur from
“running” systems.

Standard: ARI recommends that the total acid content be less
than 1.0 ppm for refrigerant gas. (Midpoint of detector
tube scale).

False Reactions: NONE.
Correlations: The acid present in the oil is not directly indicated. If
the test is negative, the system oil may be neutral to
slightly acidic. If the tube registers ‘any’ acid read-
ing, the oil is usually “highly acidic”.

MOISTURE ANALYSIS
"Refrigerant Gas"

Reaction: LT. BROWN OR PINK → GRAPE/BLUEBERRY
Screen Refrigerant Gas for Acid first. Moisture test
is only valid if acid content is below 1.0 ppm.
Quickly remove tube from test holder and allow 2-3
minutes for color to fully develop, then read tube
against dark background.

Sensitivity: 1.0 ppm (0.0001%).

Accuracy: ±5% from cylinder gas, ±10% from a pressure equal-
ized system, ±25% from a “running” system. Invalid
results can occur from “running” system.

Standard: ARI has established a 10 ppm limit for reusable
refrigerant.

False Reactions: From atmospheric moisture. Be sure to purge exten-
sion hose and the metering body inlet fitting with the
refrigerant gas being tested.
Highly acidic refrigerant gas voids the test.

Correlations: The amount of moisture present in the oil can be 5 to
10 times greater.
PART THREE: THE CHECKMATE METHOD

3.1 THE DETECTION TUBES

At the heart of the CHECKMATE system is the detection tube. Each tube is septum sealed and made of heavy wall Pyrex with fire embossed graduations. All materials are sterile analytic grade compounds packed under dry nitrogen gas.

Septum ends will automatically be pierced when fully assembled; then self seal upon disassembly. Exposure to counter indicating atmospheric moisture is nil by this process.

Indicating layer will react with a graphic color change. The reacted layer is read against a scale calibrated to ARI standards, or compared against a color chart.

A detector tube can only be used once even if the test is negative.

3.2 THE METERING DEVICE

The CHECKMATE BODY is a precision engineered in-line gas sampling device built to endure a lifetime of usage.

- A short extension hose provides adequate clearance for connection to system or cylinder.
- Blue inlet fitting containing a regulating Needle-Nozzle.
- Recessed track providing view of Detector Tube.
3.3 CLEANING THE TEST DEVICE

Residual Oil or Moisture in the test devise will cause False Positives.

Or, use a fast drying-solvent such as ECC.

Connect the assembly to any high pressure gas source and blow clear.

Never use a detergent/degreaser, soap or slow drying solvent.

3.4 PARTS DIAGRAM
### 3.5 TROUBLESHOOTING

<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Checkmate Devise</strong>&lt;br&gt;Gas will not flow through unit</td>
<td>1. Detector Tube not fully engaged&lt;br&gt;2. Clogged needle nozzle (inlet/outlet)&lt;br&gt;3. Defective detector tube&lt;br&gt;4. Rubber Septum dislodged blocking needle-nozzle</td>
<td>Make sure metering Cap is screwed down tight.&lt;br&gt;Blow clear with high pressure gas. Use solvent cleaner.&lt;br&gt;Hone out with small diameter wire.&lt;br&gt;Try different tube</td>
</tr>
<tr>
<td>Gas flows through tube but can’t reach desired Termination Pressure</td>
<td>1. Low ambient temperature&lt;br&gt;2. Partially clogged needle&lt;br&gt;3. Defective detector tube&lt;br&gt;4. Loose hose&lt;br&gt;5. Insufficient gas charge</td>
<td>Warm up gas or conduct two passes at 1/2 the recommended Termination Pressure&lt;br&gt;Clean unit&lt;br&gt;Replace detector tube&lt;br&gt;Tighten all connections&lt;br&gt;No Refrigerant in liquid phase</td>
</tr>
<tr>
<td>Gas leakage</td>
<td>1. Broken needle&lt;br&gt;2. Cracked detector tube&lt;br&gt;3. Loose hose</td>
<td>Replace unit&lt;br&gt;Replace detector tube&lt;br&gt;Tighten all connections</td>
</tr>
<tr>
<td><strong>Oil Test</strong>&lt;br&gt;Refrigerant bleeds but no Oil</td>
<td>1. Low system charge&lt;br&gt;2. Fractional Hp Compressor&lt;br&gt;3. Insufficient bleed</td>
<td>Top off sight glass&lt;br&gt;Try supplemental method (pg 3)&lt;br&gt;Be persistent and patient&lt;br&gt;Milk system at start up (pg 3)</td>
</tr>
<tr>
<td>Oil Flows too fast and Indicator races past</td>
<td>1. Bleed pressure too high&lt;br&gt;2. Caught off guard</td>
<td>Reduce volume of gas flow and insert new tube&lt;br&gt;Be attentive to the test and always be ready to stop flow</td>
</tr>
<tr>
<td><strong>Vapor Test</strong>&lt;br&gt;Acid tube did not change white or yellow</td>
<td>Negative for Acid</td>
<td>Conduct an Oil Phase test if testing a system</td>
</tr>
<tr>
<td>Moisture tube did not change to Purple or Blue</td>
<td>1. Acidic Refrigerant Gas&lt;br&gt;2. Moisture less than 1 ppm</td>
<td>Conduct acid test&lt;br&gt;Very rare condition</td>
</tr>
<tr>
<td>Indicator layer of Moisture Tube is Purple/Blue when removed from pkg.</td>
<td>Expired Moisture tube</td>
<td>Shelf life is 6 mo. to 1 yr. Longer if stored under refrigeration</td>
</tr>
</tbody>
</table>
REFRIGERANT GAS

DETECTOR TUBES

Color Reactions

VIRGIN ACID TUBE

<table>
<thead>
<tr>
<th>RT750A</th>
<th>ACID PPM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NEGATIVE = No color change
Reference Diffuser

<table>
<thead>
<tr>
<th>RT750A</th>
<th>ACID PPM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

POSITIVE = Yellow
Reference Diffuser

<table>
<thead>
<tr>
<th>RT750A</th>
<th>ACID PPM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

or POSITIVE = White
Length of color change is 1.0 ppm

A Positive test may be a blend of yellow and white crystals.

VIRGIN MOISTURE TUBE

<table>
<thead>
<tr>
<th>RT751M</th>
<th>MOISTURE PPM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RT751M</th>
<th>MOISTURE PPM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Length of Color change is 15 ppm

Moisture Tubes have a limited shelf life (6-12 mos). Check manufacture date stamped on each tube pack. Tube has expired if Indicating Layer is Purple or Blue. Storing Tubes under refrigeration (45 F) prolongs life.
REFRIGERANT PHASE TESTING
TERMINATION PRESSURE

The point at which to stop Refrigerant Gas flow through a Checkmate Detector Tube Assembly which is pressurizing a gauge manifold having approximately 9 feet of hose volume. Refer to instructions (pg. 8).

<table>
<thead>
<tr>
<th>Type</th>
<th>± 2 PSIG Vapor Phase</th>
<th>Type</th>
<th>± PSIG Vapor Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-22</td>
<td>100</td>
<td>R-114</td>
<td>5</td>
</tr>
<tr>
<td>R-12</td>
<td>60</td>
<td>R-123</td>
<td>2</td>
</tr>
<tr>
<td>R-134a</td>
<td>30 acid</td>
<td>R-124</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>55 moisture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R-500</td>
<td>65</td>
<td>R-125</td>
<td>160</td>
</tr>
<tr>
<td>R-502</td>
<td>120</td>
<td>R-401a</td>
<td>80</td>
</tr>
<tr>
<td>R-507 (AZ-50)</td>
<td>100 acid</td>
<td>R-401b</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>135 moisture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R410a (AZ-20)</td>
<td>145 acid</td>
<td>R-402a</td>
<td>85 acid</td>
</tr>
<tr>
<td></td>
<td>180 moisture</td>
<td></td>
<td>130 moisture</td>
</tr>
<tr>
<td>R-11</td>
<td>2</td>
<td>R-404a</td>
<td>110</td>
</tr>
<tr>
<td>R-13</td>
<td>80</td>
<td>R-406a</td>
<td>60</td>
</tr>
<tr>
<td>R13B1</td>
<td>95</td>
<td>R-408a</td>
<td>120</td>
</tr>
<tr>
<td>R-113</td>
<td>1</td>
<td>R-409a</td>
<td>85</td>
</tr>
</tbody>
</table>

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