TRANE®

Service
Guide

Using The Trane Chemical Laboratory Services

ECTV-SVG01A-EN

Introduction

Trane Chemical Laboratory analytical services are a key part of a servicer's total HVAC solution. The purpose of this guide is to help servicers understand how to use these services in conjunction with their service business.

Contents

What Services Does The Trane Chemical Lab Offer?

The Trane Chemical Laboratory provides three services: Compressor Oil analysis, Absorption Solution analysis, and Refrigerant analysis. After a sample of a solution is received, the lab analyzes the solution and provides a report on the results.

Compressor oil analysis
Recommended for compressors over 10 tons, compressor oil analysis can be performed on any type (scroll, reciprocating, centrifugal, and screw) and manufacturer. (The **complete oil analysis** report provides wear metals, moisture content, acidity, and maintenance recommendations.) By trending a compressor's wear metals over time, problems can be detected before they become catastrophic.

For those compressors that would not benefit from a wear metals report, an **acid and moisture analysis** is available. This report provides acid and moisture levels, with no comments/ recommendations.

Absorption solution analysis
Recommended for all absorption chillers, an absorption solution analysis ensures that the chiller's chemicals are properly balanced. The Trane Chemical Laboratory analyzes all absorption chiller types and makes. There are several options to choose from when specifying an absorption solution analysis. These options allow the user to select the appropriate level of testing for each machine. Those analyses types and tests are:

Routine lithium bromide analysis – general appearance test, suspended solids test, specific gravity, lithium bromide level, inhibitor level, ammonia level,* amounts of chemicals needed to rebalance the chiller, and a maintenance recommendations section.

Complete lithium bromide analysis – all tests in a routine lithium bromide analysis, plus an additive level test, foaming test and foreign contaminants test.

Contaminated lithium bromide analysis - all tests in a complete lithium bromide analysis, plus a sulfate and permanganate test.

Molybdate analysis - general appearance test, suspended solids test, specific gravity, molybdate level, inhibitor level, amounts of chemicals needed to rebalance the chiller, and maintenance recommendations.

Refrigerant water only analysis – lithium bromide level, inhibitor level, and ammonia level.*

*For nitrate inhibited chillers only.

Refrigerant analysis
As refrigerants become more expensive due to CFC issues, the importance of performing routine refrigerant analyses increase. The Trane Chemical Laboratory provides two types of refrigerant analyses:

Suitability for continued use
A "Suitability for continued use" analysis determines contamination levels. If contaminant levels fall outside acceptable ranges, corrective actions are recommended by the report. The analysis provides percent high boiling residue, boiling point residue acid #, moisture and maintenance recommendations. A description of each test can be found on page 19.

Reclaimed refrigerant to ARI Standards 700-93
To be able to sell reclaimed refrigerant, a sample of the refrigerant must pass ARI Standard 700-93. The Trane Chemical Laboratory's report will provide a pass/ fail grade. The analysis provides testing for other refrigerants, non-condensables, high boiling residue, acidity, moisture, and comments. A description of each test can be found on page 20.

Why Use These Services?

Today, many servicers are taking a proactive approach to servicing equipment. For best results, servicers should institute a routine sampling program. By routine sampling, a baseline condition of the equipment is established, and allows subtle changes to be identified and addressed. A chemical laboratory analysis is a key part of any preventive/predictive maintenance program. The other important part is a knowledgeable service engineer. Such maintenance programs help:

- *Reduce maintenance costs* – Routine sampling takes less time and is less expensive than repairing or replacing equipment.
- *Detect problems before they become catastrophic* – A Trane Chemical Laboratory report can help find potential problems before it's too late; thus, it saves money in repair and replacement costs.
- *Schedule repairs to reduce downtime* – By finding potential problems before they become critical, you will be able to schedule repairs to reduce or eliminate downtime to business operations.
- *Maintain efficiency and reliability* – The machine's solutions are its life blood. Ensuring its purity allows for an efficient and reliable machine.
- *Extend the operating life of the solutions* – With today's environmental regulations, it is becoming more difficult and costly to purchase the solutions HVAC equipment depend on. By checking its purity on a consistent basis, steps can be taken to ensure the solutions will have a long useful life.
- *Reduce problems associated with disposal* – In many areas, there is a disposal fee for these solutions. By using the solutions longer, there is less need for disposal.
- *Add value to service contracts* – Show customers their equipment is being cared for. A preventive/predictive maintenance program shows customers that you are innovative.

Possible Savings With Routine Oil Analyses	**Range**
RETURN ON INVESTMENT	4-30X
REDUCTION IN MAINT. COST	7-60%
PROUCTION GAINS	2-40%
BREAKDOWNS ELIMINATED	50-98%
REDUCTION IN UNSCHEDULED DOWNTIME	33-45%
REDUCED INVENTORY COSTS AND POWER CONSUMPTION NOT INCLUDED	(difficult to estimate)

The Trane Chemical Laboratory

Reasons for servicers to use the Trane Chemical Laboratory are:

- An HVAC specific lab
- Trane's industry expertise
- Decades of experience
- ISO 9002 certified
- Confidential results

Labs are industry specialized. For example, a lab might specialize in motor oil analysis for mining industries. The Trane Chemical Laboratory has been analyzing only HVAC solutions since the 1950's. Therefore, the lab has developed extensive knowledge on analyzing the results of a test and applying it for an accurate maintenance recommendation.

Because the information contained on the report is important business data, all information provided to the Trane Chemical Laboratory is confidential.

Kit Availability

Kits are available from local Trane parts centers. These kits are free of charge. PRIDE order numbers for the kits are as follows:

Single Oil Analysis Kit – KIT06497

Eight-Pack Oil Analysis Kit – KIT06579

Single Absorption Analysis Kit – KIT06498

Single Refrigerant Analysis Kit – KIT06499

For those servicers that perform many oil analyses, the eight-pack oil analysis kit is available. This kit is specially designed to easily fit in any service truck. Once all eight samples are taken, the box only needs to be sealed and shipped.

In conjunction with the refrigerant analysis kit, a sample refrigerant cylinder is sold separately through Trane parts centers. Order number is KIT06500. The cylinders are DOT certified and made of aluminum. Therefore, they are less expensive than their stainless steel counterparts and less expensive to ship because of the decreased cylinder weight. After every refrigerant sample, the Trane Chemical Laboratory cleans and sends the cylinder back to the sample provider.

Kit Contents

Sample History Form

It is important to fill out the history form as completely as possible. The information on the sheet helps the lab technicians interpret the data from the sample.

TRANE
Analytical Services for Cooling Equipment

The Trane Chemical Laboratory
4500 Morris Field Drive, Rm 100
Charlotte, NC 28208
Phone: 704-398-4643, 877-632-9192 (toll free)
Fax: 704-398-2000

Compressor Oil Analysis

1. **Send report to:** (please print clearly)

Company: _____ Attention: _____

Address: _____ City/State/Zip: _____

Phone: _____ Fax: _____

Report will be sent by mail to sample provider only.

What Trane Parts Center did you receive your kit from? _____

2. **Analysis type:** (must check at least one box) ***Prices in US Dollars***

☐ Complete oil analysis - $30 (includes: wear metals, acid and moisture tests and comments)

☐ Express Analysis - $30 additional (results faxed in 24 hours)

Contact The Trane Chemical Laboratory for any other testing needs

3. **Sample Identification:**

Accuracy of the analysis and report depend on completion of this entire section.

Job Name _____ Purchase Order No. _____

Unit Model No. _____ **Unit Serial No.** _____

Compressor Model No. _____ Compressor Serial No. _____

Compressor Manufacturer: (check one)

☐ Trane ☐ York ☐ Carrier ☐ Tecumseh ☐ Copeland ☐ Other: _____

Compressor Type: (check one)

☐ Centrifugal ☐ Scroll ☐ Screw ☐ Reciprocating ☐ Other: _____

4. **Sample History:**

Where was the oil sample taken? ☐ Compressor ☐ Gear Box ☐ Oil Sump ☐ Other: _____

Date of last oil change _____ **(mth/yr)**

Operating time since last oil change _____ **(hrs/months)** Number of starts _____

Brand of oil _____ Oil added since last oil change _____ (qts)

Has the Trane Chemical Laboratory previously analyzed any samples from this unit? ☐ Yes ☐ No

If Yes, Date _____ Lab No. _____

Refrigerant type: ☐ R-11 ☐ R-113 ☐ R-12 ☐ R-22 ☐ R-123 ☐ R-134 ☐ Other: _____

Purge time: _____ (min) Service technician taking sample: _____

5. **Service History:**

Please provide information on the service history of the machine:

☐ Motor burnout/replacement...Date _____ ☐ Replacement of worn or failed baring...Date _____

☐ Tube failure-water in the machine...Date _____ ☐ Excessive purging problems...Date _____

☐ Other...Date _____ Explain: _____

PART-IN-30B (July 2000)

Kit Contents

1.
First, fill out the **Send report to:** section. This is where and to whom the report on the sample will be sent. For the next question, indicate from which Trane parts center you received the kit. If you currently do not have an account set up with this Parts Center, please do so before sending the sample.

2.
The next section on the history form is the **Analysis type**. This is where you indicate the level of tests you want done on your sample. More than one box can be selected. Every analyses has an express analysis option. If selected, the sample is processed and a report is generated and sent to the sample provider within 24 hours. Remember to ship the sample overnight if an express analysis is required.

3.
The third section is the **Sample Identification**. The information here is used to search the Trane Chemical Laboratory's database for past analyses performed on the machine. This information also allows the servicer to match the report to the machine. The lab needs accurate model and serial numbers to ensure the machine is operating within its design range. If the servicer does not want to share this information with The Trane Chemical Laboratory, a word or set of numbers can be used to reference the machine for future analyses. *Note: It is important to make sure that the serial number is entered correctly.*

4.
The following section on the history form is **Sample History.** This information is used in interpreting the data that is extracted from the sample. If you have had a previous sample from the machine analyzed by the Trane Chemical Laboratory, place the lab number here. The lab number can be found at the top of the report.

5.
The final section is where the machine's **Service History** should be placed. In this section, indicate any major repairs that have been performed in the past. This information helps in final interpretation of the results.

Sampling Instructions

Basic sampling procedures are found on the back of the kit. ***The operating manual of the machine must be consulted before taking any sample.***

Compressor oil analyses kits and absorption analyses kits have sample bottles included. Fill out the labels on the sample bottles before taking a sample. This information is used to ensure that the samples and sample history forms are not separated. *Do not place tape around the edges of the caps after collecting a sample.* For collecting a refrigerant sample, an evacuated and clean DOT approved cylinder must be used. A proper sample refrigerant cylinder can be purchased through a Trane parts center (KIT06500).

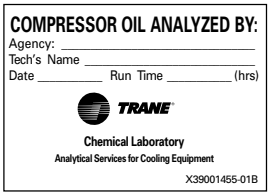
Shipping Instructions

After the sample history form is completed and the sample is collected, they are ready to be packaged together in the shipping box provided by the compressor oil and absorption solution kits. The refrigerant kit does not have a return box. If you purchased a refrigerant cylinder from a Trane Parts Center, the box can be reused for shipping. For shipping refrigerant, read the "Shipping Instructions for Refrigerant Samples" form which is included in the refrigerant kit. Each refrigerant is listed with shipping and labeling instructions. There are no environmental shipping requirements when sending samples of oils and absorption solutions.

Also contained in the kit is a return address label. Peel off the back and attach it to the package. The package can be shipped by any carrier, including US Mail. The Trane Chemical Laboratory recommends using UPS. Keep in mind a longer delivery time will delay the processing of your results.

"Analyzed By" Sticker

After the sample has been taken, fill out the "Analyzed By" sticker and attach it somewhere visible on the machine (near a user panel). This will show customers that their machines are being serviced proactively. The sticker will also have the run hours on it, so the number of run hours will be easy to calculate when taking the next sample. And since the service technician's name will be on the sticker, it identifies who last sampled the machine and when.



Report Interpretation

Compressor Oil Reports

There are two types of reports for compressor oil analysis: "complete" and "acid and moisture."

Compressor Oil Analysis (complete)
This report provides information on wear metals, moisture content, acidity, and maintenance recommendations. The graphs also indicate when an oil change or bearing change has taken place. This report usually contains three pages, but can contain more depending on the amount of past data. The first page of the report contains sample data, physical data, and wear metals data. The second page contains maintenance recommendations. The final page contains reference data, and chronological charts. ("Acid and moisture only" analysis is covered on page 12.)

Page 1

The first page of the report contains the current and historical data. There are three parts: Sample Data, Physical Data, and Wear Metals Data.

TRANE™

Oil Analysis

Trane - Charlotte

Lab #:	Serviced By:	Purchase Order #:	
010000011	[redacted]	IP14492	
Serial #:	**Equipment Owner:**	**Location:**	**Machine Type:**
[redacted]	[redacted]	PLT 53	CVHE-032F

1. **2.** **3.**

Sample Data				Physical Data		Wear Metal Data (in parts per million)						
Sample Number	Date analyzed	Service Period	Oil Type	Moisture PPM	Total Acid	Alum. (Al)	Chromium (Cr)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Tin (Sn)	Zinc (Zn)
129621366	01/02/1997		WHITEREX 425	11	0.029	0.38	0.57	0.16	0.73	0.00	2.05	0.00
089712277	08/14/1997		FREEZENE HEAVY	25	0.052	0.00	0.00	0.10	0.84	0.00	0.00	0.27
129720873	12/09/1997		WHITEREX	9	0.022	0.00	0.00	0.34	0.65	0.00	0.00	3.81
099816595	09/10/1998		WHITEREX 425	26	0.071	0.00	0.00	0.01	0.07	0.00	0.00	2.82
119822638	11/30/1998		WHITEREX 425	18	0.070	0.00	0.00	0.10	0.74	0.00	0.00	8.34
010000011	01/05/2000		WHITEREX 425	8	0.017	0.00	0.00	0.09	1.07	0.00	0.37	11.10

Report Interpretation

1.
The **Sample Data** section contains background information on all samples from this machine that have been submitted to the Trane Chemical Laboratory. Sample numbers, listed in the first column, identify the specific samples. Corresponding dates of each sample taken are in the second column. The service period indicates the amount of hours the machine has been running. High-run-hour machines show different characteristics in their oil than low-run machines. The type of oil used in the machine is also included because of the different properties.

2.
The **Physical Data** section contains information on moisture and acid.

Moisture is measured in Parts Per Million (PPM) by weight. Moisture is tracked because it is an excellent indicator of the machine's condition. Water attacks the machine's internal components, which can lead to problems like premature bearing failure. A large water count may indicate an air leak in the system or a leak in the cooling tower or chilled water loop.

The total acid number is a good indicator of the oil's integrity. Acids are by-products of oil breakdown due to age, heat and outside contaminants.

3.
The **Wear Metals Data** section provides the amounts of metal (in Parts Per Million by weight) found in the oil sample. The Trane Chemical Laboratory tests for seven different trace metals that indicate wear in the machine. These metals are commonly found in chillers. Depending on the machine type and make, some examples of the metals are:
Aluminum: Impellers, rods, pistons
Chromium: motor shaft, roller bearings, wrist pins, crankshaft
Copper: tubes, thrust bearings
Iron: thrust bearings, gear drives, stator lamination, corrosion
Lead: babbit bearings
Tin: journel bearings, solders
Zinc: plated parts, eliminator screens

Note: Wear metal in oil is common. An increase in wear particles does not warrant a concern. The Trane Chemical Laboratory will state on the report's next section whether the increased wear metal is a concern.

Report Interpretation

Page 2

The second page of the report contains **comments** from the lab. This is the actual interpretation of the data from the previous page. Maintenance procedures and the next resampling time are also given. All past maintenance recommendations are provided from earliest to most recent.

TRANE™

Trane - Charlotte

Oil Analysis

Lab #:	Serviced By:	Purchase Order #:	
010000011	TRANE CHARLOTTE	IP14492	
Serial #:	Equipment Owner:	Location:	Machine Type:
L90H-02725	JOAN FABRICS	PLT 53	CVHE-032F

Comments:

129621366 01/02/1997

All wear metals, moisture, and oil acid number are in satisfactory ranges for this model unit and the running time reported.
Resample in 3-4 months or 2500 hours.
Note: Oil analysis will only evaluate the condition of sleeve bearings. Vibration analysis is the recommended predictive maintenance tool for ball bearings.

089712277 08/14/1997

All wear metals, moisture, and oil acid number are in satisfactory ranges for this model unit and the running time reported.
Resample in 3-4 months or 2500 hours.
Note: Oil analysis will only evaluate the condition of sleeve bearings. Vibration analysis is the recommended predictive maintenance tool for ball bearings.

129720873 12/09/1997

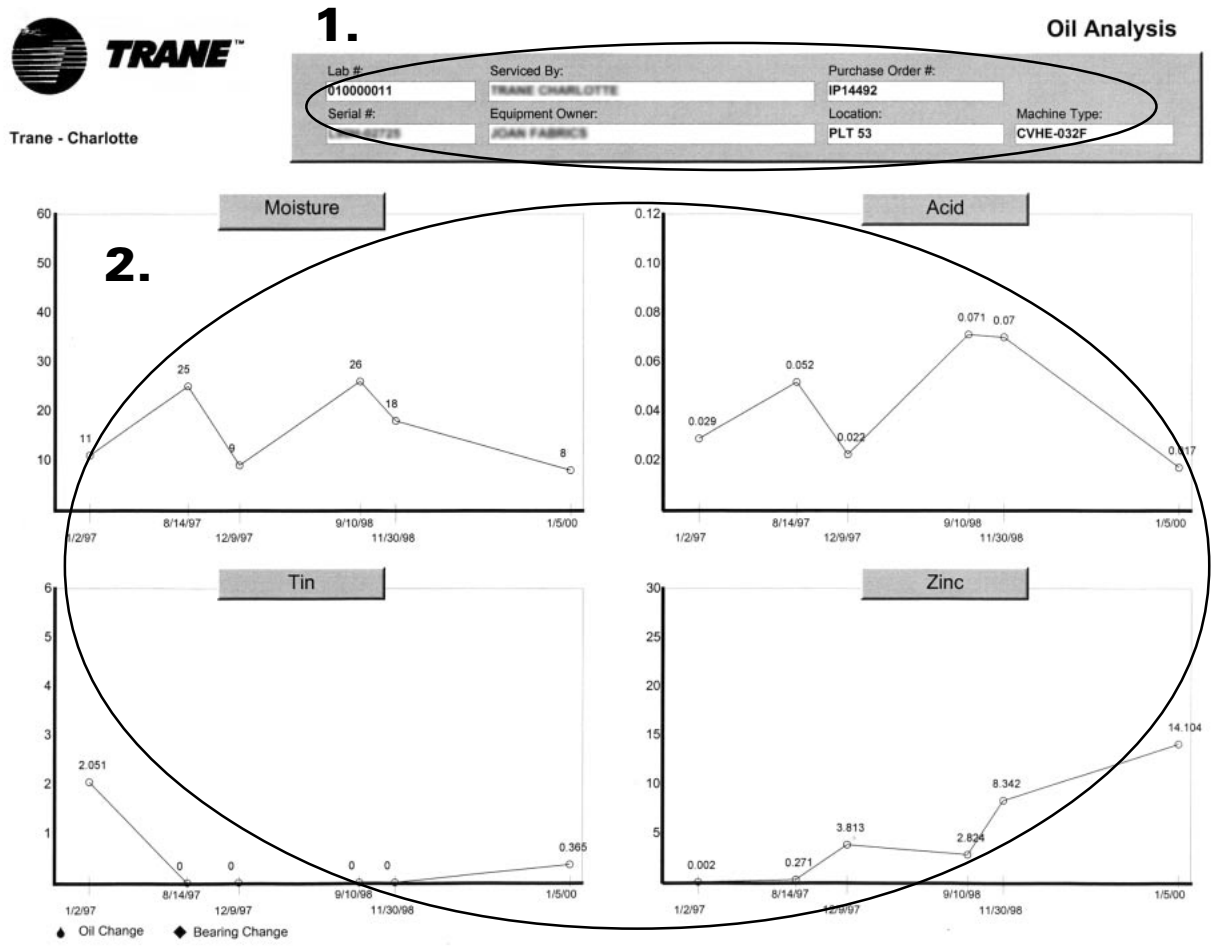
All wear metals, moisture, and oil acid number are in satisfactory ranges for this model unit and the running time reported.
Resample in 3-4 months or 2500 hours.
Note: Oil analysis will only evaluate the condition of sleeve bearings. Vibration analysis is the recommended predictive maintenance tool for ball bearings.

099816595 09/10/1998

All wear metals, moisture, and oil acid number are in satisfactory ranges for this model unit and the running time reported.
Resample in 3-4 months or 2500 hours.
Note: Oil analysis will only evaluate the condition of sleeve bearings. Vibration analysis is the recommended predictive maintenance tool for ball bearings.

Report Interpretation

Page 3



1.
Every page has an **identification box** at the top of the report. To help reference each sample, the lab assigns a number, which is found in the upper left. If there are any questions concerning the report, call the lab and reference the lab number. The box also contains information about the piece of equipment: location of the machine, servicer's name, equipment owner, machine type, and serial number. This is valuable information for billing and tracking purposes. An identification box appears at the top of every page in the report.

2.
The final page of the report also contains **chronological charts** on moisture, acid, zinc, and tin. It is a general overview on the condition of the equipment. Only a dramatic increase in the numbers should give concern. The left side of each chart indicates the quantity increments and the bottom indicates analyses dates. The graphs also indicate when an oil change or bearing change has taken place. These are called out because of the dramatic changes in results from the previous analysis. For further information on what these readings mean, see page 10.

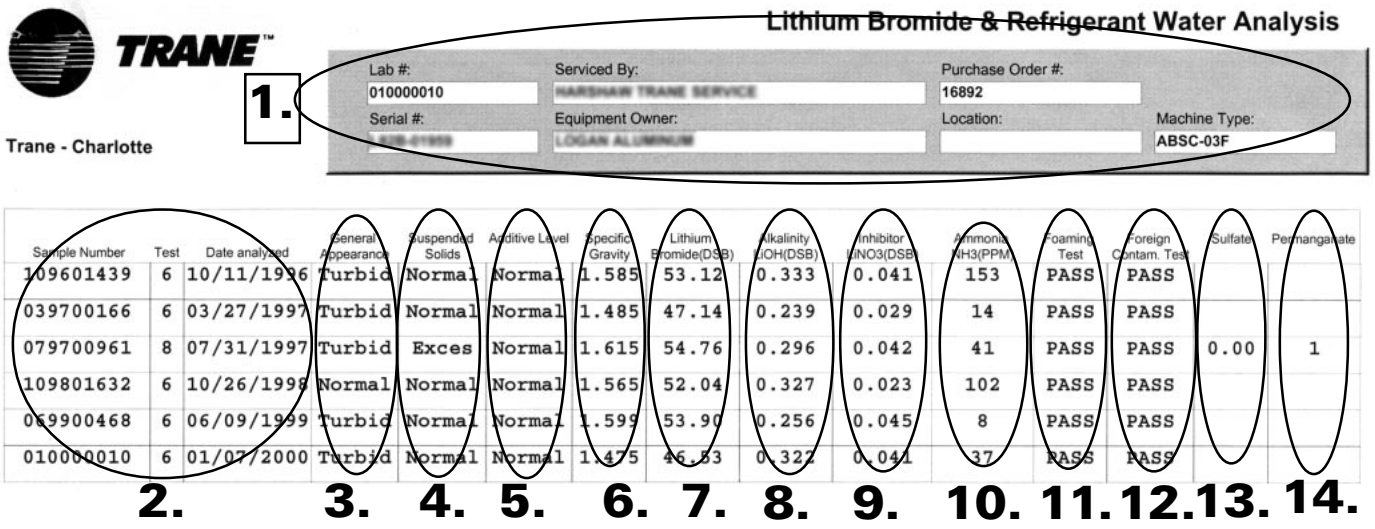
Compressor Oil Analysis (acid and moisture only)
For those machines that have compressors that do not contain trace metals, the acid and moisture only analysis can be used. The acidity and moisture of the oil is provided. This will give a good indication of the integrity of the oil charge. Therefore, it will indicate if an oil change is needed. See the physical data section (page 10, section 2) from the complete oil analysis report for the definitions of acidity and moisture.

Report Interpretation

Absorption Solution Reports

This report provides information on the condition of the solutions inside the absorption chiller as well as maintenance recommendations. The report typically contains two pages, but can have more depending on the amount of past data. For reports with a refrigerant water analysis, the second page contains the information. The first page of the report contains data extracted from the sample and the amounts of chemicals needed to rebalance the chiller. The final page contains maintenance recommendations.

Page 1



TRANE™

Trane - Charlotte

Lithium Bromide & Refrigerant Water Analysis

1.

Lab #:	Serviced By:	Purchase Order #:	
010000010	[redacted]	16892	
Serial #:	**Equipment Owner:**	**Location:**	**Machine Type:**
[redacted]	[redacted]		ABSC-03F

Sample Number	Test	Date analyzed	General Appearance	Suspended Solids	Additive Level	Specific Gravity	Lithium Bromide(DSB)	Alkalinity LiOH(DSB)	Inhibitor LiNO3(DSB)	Ammonia NH3(PPM)	Foaming Test	Foreign Contam. Test	Sulfate	Permanganate
109601439	6	10/11/1996	Turbid	Normal	Normal	1.585	53.12	0.333	0.041	153	PASS	PASS		
039700166	6	03/27/1997	Turbid	Normal	Normal	1.485	47.14	0.239	0.029	14	PASS	PASS		
079700961	8	07/31/1997	Turbid	Exces	Normal	1.615	54.76	0.296	0.042	41	PASS	PASS	0.00	1
109801632	6	10/26/1998	Normal	Normal	Normal	1.565	52.04	0.327	0.023	102	PASS	PASS		
069900468	6	06/09/1999	Turbid	Normal	Normal	1.599	53.90	0.256	0.045	8	PASS	PASS		
010000010	6	01/07/2000	Turbid	Normal	Normal	1.475	46.53	0.322	0.041	37	PASS	PASS		

2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14.

Chemical Additions: Single Stage

15.

Sample Number	Date analyzed	Lithium Hydroxide Monohydrate(lbs)	Lithium Nitrate(lbs)	Hydrobromic Acid (48% gal)	Octyl Alcohol(pints)	No Additions Required
109601439	10/11/1996	0.00	0.28	0.00	0	
039700166	03/27/1997	2.24	0.51	0.00	0	
079700961	07/31/1997	0.32	0.26	0.00	0	
109801632	10/26/1998	0.00	0.63	0.00	0	
069900468	06/09/1999	1.72	0.20	0.00	0	
010000010	01/07/2000	0.00	0.24	0.00	0	

NOTE: dsb - Weight percent dry salt basis
PPM - Part Per Million

16. 17. 18. 19.

Report Interpretation

1.
Every page has an identification box at the top of the report. To help reference each sample, the lab assigns a number, which is found in the upper left. If there are any questions concerning the report, call the lab and reference the lab number. The box also contains information about the piece of equipment: location of the machine, servicer's name, equipment owner, machine type, and serial number. This is valuable information for billing and tracking purposes.

2.
The first three columns in the report refer to sample identification. Sample number is given in the first column. The second column is used for internal referencing by the lab. The third column contains the date the sample was analyzed. They are listed earliest sample to most recent sample.

3. General Appearance (normal, turbid or opaque)
This test is very subjective. New or well-filtered Lithium Bromide solutions are clear in appearance. A Lithium Bromide solution that appears turbid or opaque may indicate other water-born contaminants are present from a current or previous air/tube leak. This test usually is an indication that a foaming or foreign contaminant test may be required if a tube leak is suspected.

4. Suspended Solids (normal or excessive)
The suspended solids in a Lithium Bromide solution will make the solution brown or black in color. Any solution that is thick with dark brown or black particles can be assumed to have too many suspended solids. The cure for suspended solids is filtration. If left unchecked for long periods of time, suspended solids can clog absorber and evaporator spray nozzles, plug heat exchangers and the abrasive action of the solids while circulating may cause pump bearing damage as well as tube erosion.

Suspended solids are comprised, for the most part, of iron oxides (magnetite or rust). Other substances that could be present in the solids are copper oxides and assembly dirt. Suspended solids are corrosion products from the result of corrosion occurring with iron materials (iron oxides) in the chiller. Under normal well-inhibited operational conditions, corrosion is very slow. Corrosion products become suspended in the Lithium Bromide solution usually due to high levels of corrosion. High levels of corrosion are caused by air leaks and poor maintenance procedures.

5. Additive Level (normal or low)
Octyl alcohol is found in single-stage chillers. The alcohol is a fluid needed to maintain an absorption chiller's peak performance. The alcohol is used to provide better heat transfer in the absorber section of the chiller. The alcohol is an organic fluid that can be seen floating on top of Lithium Bromide solutions because it is lighter and not very soluble in the Lithium Bromide solution.

The additive test is very subjective. Normal levels of alcohol in a Lithium Bromide solution occur when the additive can be either seen or smelled and there appears to be additive activity on the surface of the Lithium Bromide sample. Additive activity is when movement of the additive disturbs the surface of the Lithium Bromide solution.

6. Specific Gravity
The specific gravity of a Lithium Bromide solution is simply the ratio of the mass of Lithium Bromide solution to the mass of an equal amount of water at a specific temperature. Specific gravity of a Lithium Bromide solution is used to determine the concentration of the Lithium Bromide salt in the sample.

7. Lithium Bromide (LiBr)
Lithium bromide is a salt much like table salt (NaCl, sodium chloride). But unlike sodium chloride, Lithium Bromide has a strong need to absorb water. So much so that if solid Lithium Bromide is left out, it will absorb moisture from the air and turn from a solid to a liquid. This is the principle that absorption chillers operate on.

Like all salt solutions, a Lithium Bromide solution has the ability to corrode steel (iron). The Lithium Bromide salt itself does not corrode the steel. It is the reaction of steel with the water in the Lithium Bromide solution that creates the corrosion. However, the presence of the Lithium Bromide salt increases the conductivity of the water to such a great degree that the normal corrosion seen between steel and water happens at a very rapid pace. In addition, oxygen from an air leak can cause corrosion of steel parts at a faster rate than the water. Good inhibitor and pH solution maintenance, in conjunction with an air-leak-free chiller operation, will help to slow the process of corrosion.

The report gives concentration in weight percentage of Lithium Bromide in water. For example, if you have 2 pounds of a 50% solution of Lithium Bromide, one pound is Lithium Bromide and one pound is water. The percent of Lithium Bromide is determined by the specific gravity measurement.

Report Interpretation

8. Alkalinity

Alkalinity is the measure of the amount of Lithium Hydroxide (LiOH) in a Lithium Bromide solution. LiOH is a base and is used to keep the pH of the Lithium Bromide solution alkaline high. The pH level is a scale from 1 to 14 and used to indicate the acid or base nature of a fluid. For example, neutral solutions like drinking water have a pH around 7. Acidic solutions, like hydrochloric acid, have a very low pH (less than 4), and basic solutions, like LiOH, have a very high pH (greater than 9). *Note: The term "pH" is used here as a means of explaining alkalinity only. Measurement of pH is not done in salt solutions. Do not attempt to measure the pH of Lithium Bromide solutions with a pH meter. The Lithium Bromide will interfere with the meter and the results will not be valid.*

By raising the pH of a water solution's pH above 10, corrosion of steel is slowed considerably. High alkalinity in a solution protects the steel surfaces. This is the reason LiOH is added to a Lithium Bromide solution. The report gives concentration in weight percentage of LiOH based on the weight of Lithium Bromide on a dry salt basis (DSB). If the chiller uses molybdates or chromated brines, alkalinity is expressed in normality (equivalent weights/liter)

9. Inhibitors

Inhibitors (corrosion inhibitors) are added to absorption chillers in addition to Lithium Hydroxide to slow the corrosion of iron materials further. In addition to the corrosion process of iron or steel materials forming iron oxides, hydrogen gas is also produced in small levels. Hydrogen gas can act as a non-condensable and slow the absorption process inside the chiller, thus decreasing efficiency. Proper inhibitor maintenance will slow the formation of corrosion products of steel materials to acceptable levels.

10. Ammonia

Ammonia is found only in nitrate inhibited solutions. As a result of Lithium Nitrate's inhibiting action, small levels of ammonia are formed within the chiller. Ammonia, a by-product of nitrate, is one of two vital ingredients that causes corrosion cracking of copper materials within the chiller. The other is stress. Proper maintenance of the ammonia level is necessary to prevent this type of corrosion. The report gives the amount of ammonia present in Part Per Million per weight.

11. Foaming Test (Pass or Fail)

The foaming test is used to determine if the Lithium Bromide solution from a chiller has a tendency to foam while boiling. Excessive foaming of the Lithium Bromide solution can cause Lithium Bromide to contaminate the refrigerant in the chiller and cause severe operational problems. Lithium Bromide is manufactured very pure and should be kept as chemically clean as possible. The Lithium Bromide solution can foam if it is contaminated with other inorganic species, such as those contained in tower water. A pass is given if there is no significant foaming in the sample. Fail is recorded if there is a significant amount of foaming. Increased additions of alcohol have been shown to reduce the foaming of Lithium Bromide solutions.

12. Foreign Contaminant Test (Pass or Fail)

The foreign contaminant test is used to determine if the Lithium Bromide solution has been contaminated by other inorganic species like sulfate, sodium, carbonate, potassium and any other inorganic species contained in tower or chilled water. These species have a tendency to precipitate once the Lithium Bromide solution is concentrated in the chiller under normal operation. These species can cause plugging of components and/or accelerate corrosion. This test is used primarily to determine if the Lithium Bromide solution is contaminated with chilled loop water, cooling tower water or anything else. If the sample is relatively absent of foreign species, it is given a pass. If the sample contains a high amount of foreign species, a fail is recorded.

13. Sulfate

Sulfate has very limited solubility in highly concentrated Lithium Bromide solutions. Sulfate is typically analyzed after a cooling water or chilled water loop leak to see how badly contaminated the Lithium Bromide has become. High levels of sulfate have been know to precipitate in the Lithium Bromide and cause plugging of components.

14. Permanganate

The Permanganate test is conducted to see how contaminated the Lithium Bromide solution has become with oxidizable organic materials. This test is usually only conducted after a cooling water or chilled water leak. Excessive amounts of oxidizable organic materials can form sticky black or brown material. These materials can then stick to the heat exchanger.

15. Chemical Additions

This section contains the amount of chemicals that are needed to rebalance the chiller. The additions depend on the type of chiller. The type of chiller is indicated above this section. All past samples and the amounts added to rebalance the chiller are included in this section. Below are the different chemicals and their properties. The Trane Chemical Laboratory will provide most of the chemicals, premeasured and packaged, for a fee. This helps reduce storage and purity problems when buying large amounts of the compounds.

16. Lithium Hydroxide Monohydrate ($LiOH*H_2O$)

Over time, the Lithium Hydroxide (LiOH) can be depleted by air leaks in the chiller. When a solution analysis indicates that it is necessary to add LiOH to the chiller, Lithium Hydroxide Monohydrate ($LiOH*H_2O$) is added to raise the pH of the Lithium Bromide solution. Addition amount is given in pounds. When working with Lithium Hydroxide Monohydrate, follow safe chemical handling procedures on the Materials Safety Data Sheet.

Warning: Lithium Hydroxide Monohydrate is a very strong base. It will cause severe chemical burns if allowed to come in contact with skin or eyes.

Report Interpretation

17. Inhibitors

Inhibitors are used in Lithium Bromide solutions to stop corrosion. It works by chemically slowing down the natural tendency of steel to oxidize or corrode. This results in the formation of smaller amounts of corrosion products like hydrogen gas. The absorption process slowly consumes inhibitors over time. And the presence of air will greatly accelerate the rate of depletion. The amount needed to rebalance the chiller is listed in pounds. The inhibitors used are dependent on the type and manufacturer of the chiller. Some inhibitors are:
Lithium Nitrate
Lithium Arsenite
Lithium Molybdate
Lithium Chromate

18. Hydrobromic Acid (HBr)

Over time, with the depletion of certain inhibitors, the alkalinity of the Lithium Bromide solution will rise. When the analysis indicates it is necessary to lower the Lithium Hydroxide (LiOH) level in the chiller, Hydrobromic Acid is added to lower the pH. The amount to be added to the chiller is in gallons of 48 percent solution.

Warning: Hydrobromic acid is a very strong acid. It will cause severe chemical burns if allowed to come in contact with skin or eyes. When working with Hydrobromic Acid, follow safe chemical handling procedures on the Materials Safety Data Sheet.

19. Octyl Alcohol

Octyl alcohol is a fluid needed to maintain an absorption chiller's peak performance. It is used only in single-stage units. The alcohol is used to provide better heat transfer in the absorber section of the chiller. Octyl alcohol has been shown to improve chiller capacity by as much as 15-20 percent. Octyl alcohol is an organic fluid that can be seen floating on top of Lithium Bromide (brine) solutions because it is lighter and not very soluble in the Lithium Bromide solution. Amount to be added is measured in pints.

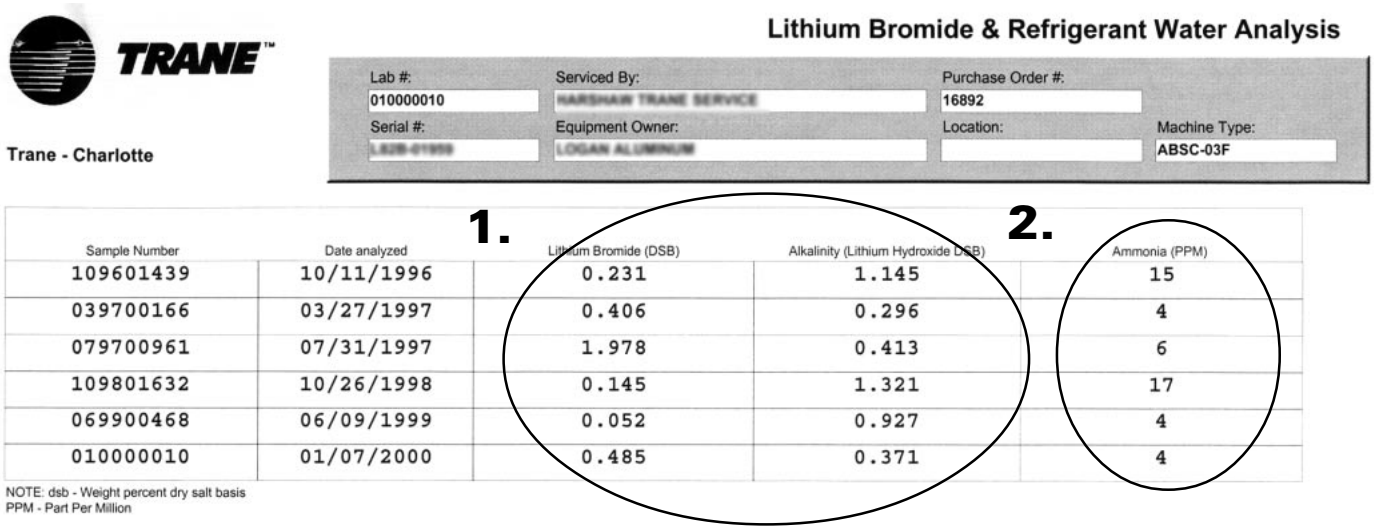
Note: Octyl Alcohol is not used in all absorption single-stage chillers.

Report Interpretation

Page 2 (only for analyses with refrigerant water)

Refrigerant water analysis

If a refrigerant water analysis is required, the second page of the report will contain the data extracted from the refrigerant water sample. The refrigerant water sample is separate from the Lithium Bromide sample. There are three columns of data, Lithium Bromide, Alkalinity and Ammonia.



TRANE

Trane - Charlotte

Lithium Bromide & Refrigerant Water Analysis

Lab #:	Serviced By:	Purchase Order #:	
010000010	[illegible]	16892	
Serial #:	Equipment Owner:	Location:	Machine Type:
[illegible]	[illegible]		ABSC-03F

1.

2.

Sample Number	Date analyzed	Lithium Bromide (DSB)	Alkalinity (Lithium Hydroxide DSB)	Ammonia (PPM)
109601439	10/11/1996	0.231	1.145	15
039700166	03/27/1997	0.406	0.296	4
079700961	07/31/1997	1.978	0.413	6
109801632	10/26/1998	0.145	1.321	17
069900468	06/09/1999	0.052	0.927	4
010000010	01/07/2000	0.485	0.371	4

NOTE: dsb - Weight percent dry salt basis
PPM - Part Per Million

1. Lithium Bromide and Alkalinity

High levels of lithium bromide and alkalinity in the refrigerant water sample can be a sign of operational problems. Carryover is one possible cause. This occurs when the lithium bromide solution (brine) boils over the eliminator screens and enters the refrigerant water, causing the chillers efficiency to drop. Another cause can be a seal leak in a pump. Amounts are listed in Dry Salt Basis.

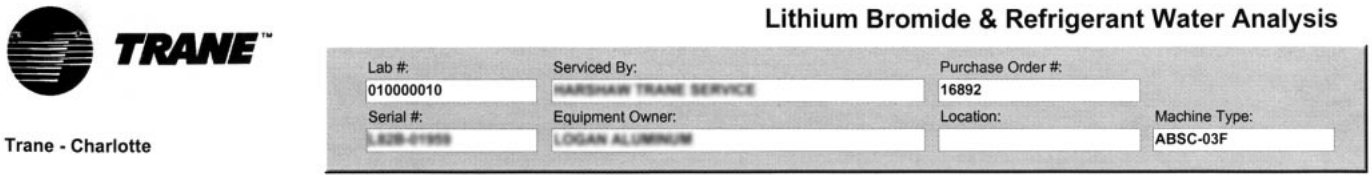
2. Ammonia

Present only in nitrated inhibited machines, ammonia and water have a high affinity for each other. Ammonia is tested for in refrigerant water because it is a leading corrosion indicator. Amounts are listed in Parts Per Million.

Report Interpretation

Page 2 or Page 3 (with refrigerant water analysis)

The final page of the report contains **comments** from the lab. This is the actual interpretation of the data from the previous page. Maintenance procedures and the next resampling time are also recommended. Past recommendations are provided from earliest to most recent.



TRANE™

Trane - Charlotte

Lithium Bromide & Refrigerant Water Analysis

Lab #:	Serviced By:	Purchase Order #:	
010000010	[illegible]	16892	
Serial #:	Equipment Owner:	Location:	Machine Type:
[illegible]	[illegible]		ABSC-03F

Comments:

109601439 10/11/1996

The additives under the "CHEMICAL ADDITIONS" section of the recommendations should be added to this unit in the precise amount shown to bring the inhibitor levels back to the original specifications.

The ammonia level in the brine is high.

This refrigerant water is suitable for continued use.

Recommend resampling at the normal frequency of 5,000 hours or one year, whichever occurs first. If this unit will routinely be sampled on a once a year basis, the sample should be taken at such a time to allow necessary chemical additions to be made prior to Fall shutdown. If this unit serves a critical operation, the frequency of sampling should be scheduled for mid season and at such a time to allow necessary chemical additions prior to Fall shutdown.

039700166 03/27/1997

The additives under the "CHEMICAL ADDITIONS" section of the recommendations should be added to this unit in the precise amount shown to bring the inhibitor levels back to the original specifications.

This refrigerant water is suitable for continued use.

Recommend resampling at the normal frequency of 5,000 hours or one year, whichever occurs first. If this unit will routinely be sampled on a once a year basis, the sample should be taken at such a time to allow necessary chemical additions to be made prior to Fall shutdown. If this unit serves a critical operation, the frequency of sampling should be scheduled for mid season and at such a time to allow necessary chemical additions prior to Fall shutdown.

079700961 07/31/1997

Sulfate and permanganate number are satisfactory. These are indicators of possible contamination. Therefore, this brine appears to be reusable.

This brine has excessive suspended solids. We suggest filtering the solution to remove these solids.

The additives under the "CHEMICAL ADDITIONS" section of the recommendations should be added to this unit in the precise amount shown to bring the inhibitor levels back to the original specifications.

Analysis of this refrigerant sample indicates the presence of excessive lithium bromide. Recommend refrigerant be reclaimed. Check machine operation and inspect as required to determine the reason. Failure to correct this condition may result in premature failure of critical internal parts.

Recommend resampling at the normal frequency of 5,000 hours or one year, whichever occurs first. If this unit will routinely be sampled on a once a year basis, the sample should be taken at such a time to allow necessary chemical additions to be made prior to Fall shutdown. If this unit serves a critical operation, the frequency of sampling should be scheduled for mid season and at such a time to allow necessary chemical additions prior to Fall shutdown.

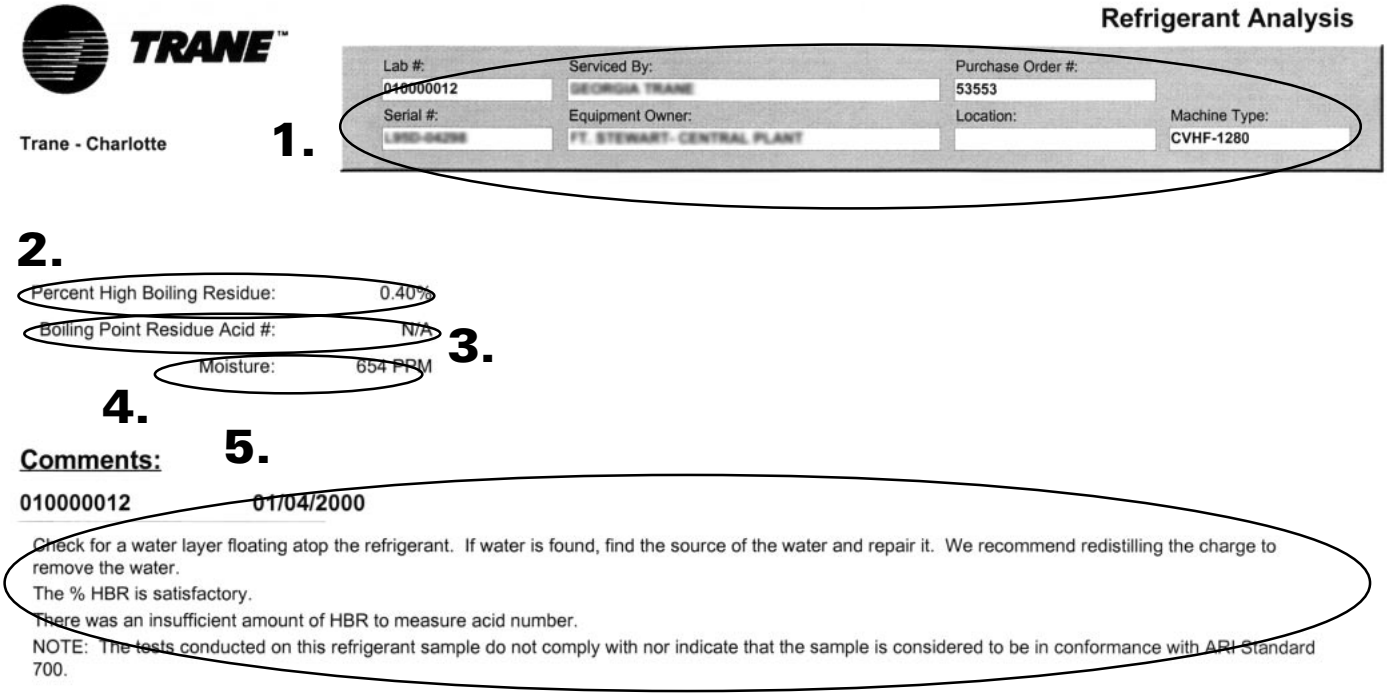
Report Interpretation

Refrigerant Analysis Reports

There are two types of refrigerant analysis reports: "Suitability for continued use" and ARI Standard 700-93.

Suitability for continued use

A "Suitability for continued use" analysis provides Percent High Boiling Residue, Boiling Point Residue Acid #, Moisture and Maintenance Recommendations. The report contains one page. (ARI Standard 700-93 analysis is covered on page 20.)



TRANE™

Trane - Charlotte

Refrigerant Analysis

1.

Lab #:	Serviced By:	Purchase Order #:	
010000012	GEORGIA TRANE	53553	
Serial #:	**Equipment Owner:**	**Location:**	**Machine Type:**
L95D-04298	FT. STEWART- CENTRAL PLANT		CVHF-1280

2.

Percent High Boiling Residue:	0.40%
Boiling Point Residue Acid #:	N/A
Moisture:	654 PPM

3.

4.

5.

Comments:

010000012 **01/04/2000**

Check for a water layer floating atop the refrigerant. If water is found, find the source of the water and repair it. We recommend redistilling the charge to remove the water.

The % HBR is satisfactory.

There was an insufficient amount of HBR to measure acid number.

NOTE: The tests conducted on this refrigerant sample do not comply with nor indicate that the sample is considered to be in conformance with ARI Standard 700.

1.

Every page has an **identification box** at the top of the report. To help in referencing each sample, the lab assigns a number, which is found in the upper left. If there are any questions concerning the report, call the lab and reference the lab number. The box also contains information about the piece of equipment: location of the machine, servicer's name, equipment owner, machine type, and serial number. This is valuable information for billing and tracking purposes.

2.

Percent High Boiling Residue is an indicator of impurities in the refrigerant. Some of the impurities are system oil and other organic material that entered the machine.

3.

Boiling Point Residue Acid # is a measurement of acid contained in the refrigerant. Checking the system for acid is a common maintenance recommendation since acidic conditions can be cleaned up before a compressor motor fails. Acids can be formed by chemical reactions with impurities entering the machine. The instability of refrigerant, and thus formation of acids, can also be accelerated by high temperatures, which could be the result of improper operation of the machine.

4.

Moisture is an indicator of problems within the machine. The presence of moisture in refrigerant can be an indication of a leak within the system. Water is a harmful contaminant in refrigerants because it causes freeze-up, corrosion and chemical breakdowns.

5.

The **comments** will indicate if the refrigerant charge is appropriate to be further used. If the refrigerant is not suitable for use, there will be a recommendation for what should be done to cleanup the charge.

Report Interpretation

ARI Standard 700-93

An ARI Standard 700-93 analysis is used when a refrigerant is being sold to a second party. In order to do so, the refrigerant must be tested according to these standards. The tests include:

Other refrigerants
A level of every refrigerant type must be recorded from the sample refrigerant. Different types of refrigerants can be present due to cross contamination with refrigerant recharge tanks and because different types of refrigerant are breakdown products of the primary refrigerant.

Non-condensables
Non-condensables consist primarily of air. Air can be introduced into the system by refrigerant containment tanks or a leak in the chiller. The solubility of air in the refrigerant's liquid phase is extremely low and therefore effects efficiency.

High Boiling Residue
High boiling residue is an indicator of impurities in the refrigerant. Some of the impurities are system oil and other organic material that entered the machine.

Acidity
The development of acids can severely shorten the life of the compressor and the refrigerant. These acids can be formed by chemical reactions with materials of construction, lubricating oils, and/or impurities. The instability of the refrigerant, and thus the formation of acids, is accelerated by elevated temperatures, which could be the result of improper operation.

Moisture
Moisture indicates problems within the machine. The presence of moisture in refrigerant can be an indication of a leak within the system. Water is a harmful contaminant in refrigerants because it causes freeze-up, corrosion and chemical breakdowns.

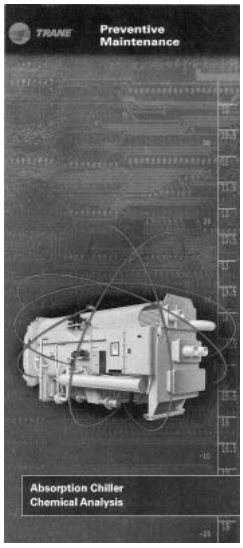
Comments
The report will give a pass/fail grade based on the provided sample and the data extracted. A grade of pass means the refrigerant charge can transfer ownership. A failing grade indicates the refrigerant must be cleaned and retested again.

Service Promotion

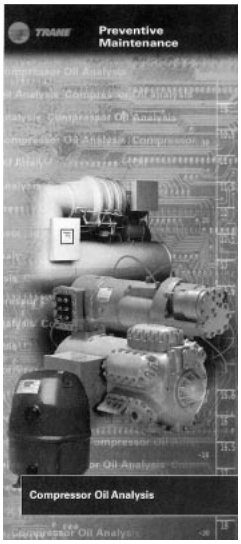
The report itself is a promotional tool. After reviewing the report, make a copy, attach a cover letter and send it to the customer. This lets the customer know their equipment is being serviced and advertises your service agency. Or better yet, sit down with your customer and go over the results.

Use the Trane Chemical Laboratory sales literature (Absorption Chiller Chemical Analysis: E/CTV-S-69, Compressor Oil Analysis: E/CTV-S-70, and Refrigerant Analysis: E/CTV-S-71) as billing stuffers, for a direct mail campaign, or as leave behind sales pieces. Or use them as attachments to your service contract proposals.

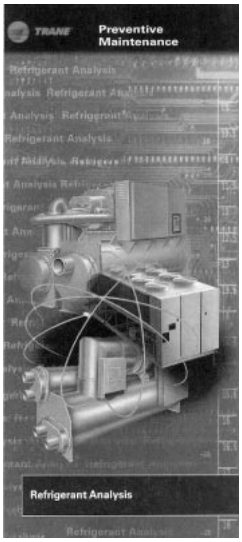
There is also a customization area where you can print a sales tag line, your agency's address, phone/fax numbers, and contact name. To make this process easier for you, included is a form (page 23) you can fill out and fax to Inland Printing. They will take care of the customization and printing.



E/CTV-S-69



E/CTV-S-70



E/CTV-S-71

Support Services

Call Trane Existing Building Services (EBS) Marketing at 608-787-3950 for questions concerning the promotion of the Trane Chemical Laboratory. For questions concerning results on reports, call the Trane Chemical Laboratory at 877-632-9192.

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877-632-9192 (toll free)
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e-mail: charlottechemlab@trane.com

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Let your maintenance needs to us.
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Get your HVAC repairs done right the first time - give us a call!
Your partner in meeting your HVAC service needs.

Your Tag line message: (print clearly and include spaces)

1.
2.

Office Information: six lines maximum
Example
XYZ Trane
1111 Chiller Ave.
Anywhere, USA 01234
Phone: (555) 555-5555
Fax: (555) 555-5555
Joe Smith - Service Engineer

Your Office Information: (print clearly and include spaces)

1.
2.
3.
4.
5.
6.

Order Quantities:
Absorption Solution Analysis literature (E/CTV-S-69):
☐ 100 pieces-$51 ☐ 250 pieces-$57 ☐ 500 pieces-$68
Compressor Oil Analysis literature (E/CTV-S-70):
☐ 100 pieces-$51 ☐ 250 pieces-$57 ☐ 500 pieces-$68
Refrigerant Analysis literature (E/CTV-S-71):
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Total amount: $_____

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- Unmatched applications knowledge
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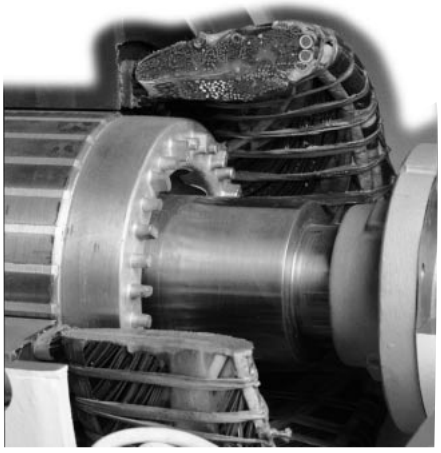

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- Removes air, moisture, and acidic non-condensables which can accumulate in the refrigerant charge of low-pressure chillers.
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- Reduces annual refrigerant losses to as little as 0.005% of a typical chiller's charge, saving as much as 50-100 pounds of refrigerant a year.

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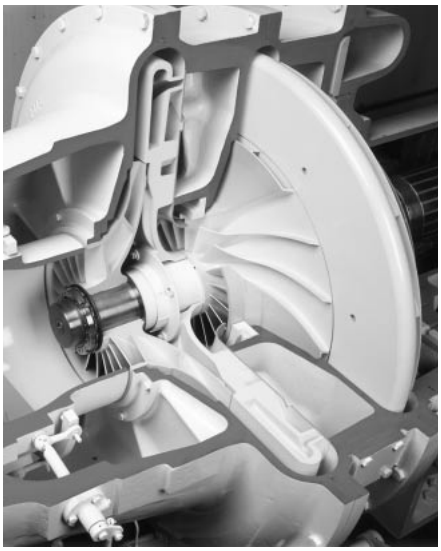

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