

WATER CHILLER REFRIGERANT ANALYSIS

This offer has been designed to allow Districts to capitalize on a traditional, but effective chiller diagnostic tool. Refrigerant Analysis provides a relatively inexpensive opportunity to gain access into customers' machines with an initial S & R approach to later develop Maintenance Agreements or generate additional S & R.

55 % of YORK's Refrigerant Analysis business is included within Maintenance Agreements, while the remaining 45 % is incremental revenue. The offer allows growth of each through a professional marketing of YORK's depth of analytical service and expertise.

The purpose of this offer is to optimize flexibility in such a way so as to allow each District to select their own analytical methods, establish their own pricing schedule, and grow additional S & R or Maintenance Agreements in accordance with their greatest business advantage.

OBJECTIVES:

- * Gain a foot-in-the-door to additional S & R or Maintenance Agreements with a low-cost, diagnostic entree.
- * Provide flexibility for District customizing.
- * Demonstrate YORK depth of Service and Expertise to both existing and potential customers.

PROFILE:

Periodic Refrigerant Analysis is a good "preventive maintenance" technique to assess the mechanical condition of a water chiller, when interpreted by refrigeration system experts. Most manufacturers of water chiller equipment recommend an annual check unless conditions warrant greater frequency.

YORK will be responsible for collecting the refrigerant sample, submitting for appropriate analysis to a laboratory of the District's choice, interpreting and reporting those results along with equipment recommendations to the customer. Various analytical sources exist for refrigerant testing. A list appears at the end of the OVERVIEW. There is no formal YORK report format provided within this offer. Some customers prefer "Independent" analysis, while others prefer "Factory Service" analysis. Districts can choose their most effective method. Develop your cover letter most appropriate to the analytical service you use. Suggested examples can be found in CUSTOMER REPORT.

REFRIGERANT ANALYSIS:

Refrigerant Analysis can reveal the presence of moisture, acidity, and rust. If excessive, these conditions can accelerate the corrosion of chiller components and reduce efficiency.

Rust particles suspended in the circulating refrigerant can settle out in the evaporator whenever the unit is shut down. This build-up of sludge can cover heat exchanger tubes and reduce operating efficiency. Rust can also work its way into the lubricating circuit and accumulate in the oil filter. The build-up can restrict oil flow causing the machine to shut down for low oil pressure.

In hermetic chillers, rust can clog nozzles designed to spray cool refrigerant onto the motor windings. Moisture can chemically combine with the refrigerant to form corrosive hydrochloric acid that will attack metal surfaces in the chiller.

TESTING ANALYSIS:

Laboratories typically analyze refrigerants for Water, Acidity, and Oil Content.

MOISTURE:

Moisture in the refrigerant may indicate leaks in the system.. Refrigerant moisture analysis can be determined using Karl-Fischer Analysis, or an Electrolytic Analyzer. These tests determine the existence of free water present in the sample, but can not quantitatively determine how much water is present in the system.

Its important to log the evaporator temperature and other critical conditions at the time of sampling. This permits the analytical laboratory to correlate the parts per million by weight of water with the specific conditions and sampling techniques to provide a basis for reliable recommendations.

Sampling differences exist for refrigerant analysis, depending on the particular refrigerant being sampled. Refer to the Methods section, following in the OVERVIEW.

OIL CONTENT:

Oil Content is reported by the laboratory as a percentage by weight. It can be determined using Infrared Spectroscopy or with Weight-Loss methods. Comprehensive sample data should be recorded to enable a laboratory to make reliable recommendations.

ACIDITY:

Acidity is recorded as the parts per million of Hydrochloric Acid present in the sample. Oil Acidity analysis can help to determine the degree of Oil-Refrigerant reaction in a chiller. It can also help to determine the effect of the free water in the system, having reacted with the refrigerant to become an acid. The analysis is most often performed with an Acid-Base Titration.

OTHER TESTS:

The YORK International Chem Lab includes Appearance and Sediment Analysis, if necessary, in the testing of refrigerants. Refrigerant samples should appear clear to slightly yellow in color.

There should be no appreciable sediment, nor layering within the sample. Sediment analysis can be accomplished by filtering the refrigerant sample to establish weight difference percentages for the sample. If necessary, the sediment itself can be evaluated.

SAMPLING PROCEDURES

The next section of the OVERVIEW details sampling procedures. These sampling procedures are specific to the testing and interpretation techniques of the YORK Chem Lab. With refrigerant analysis, knowledge of the exact sampling methods and conditions at the time of sampling are required for reliable interpretation of the analysis results.

If you choose to use an independent lab for your analysis, you MUST use the sampling methods that particular lab specifies to obtain reliable results. Use of the YORK Chem Lab sampling procedures presented in this OVERVIEW with a non-YORK lab can provide an inaccurate basis for analysis. Coordinate sampling procedures with the Independent lab you elect to use.

These sampling procedures update Circular Letters S-42-82 and @-37-85.

Note that Moisture Analysis requires logging whether the system was running or shut down, whether the sample was taken as liquid or condensed vapor, the evaporator temperature at the time of sampling, and the type of refrigerant. The Methods section details all data required with each sample submittal.

Differences in proper sampling technique exist for low pressure and high pressure refrigerants.

MOISTURE ANALYSIS

LOW PRESSURE REFRIGERANT SAMPLING (R-11 AND R-114)

****CONDENSED REFRIGERANT VAPOR IS REQUIRED****

1. The system must be shut down for a minimum of 14 hours prior to taking the vapor sample. Run water through the tubes in the condenser and evaporator using pump heat to raise the temperature of the system to at least 80 F. during the shutdown period. This process permits maximum solubility of moisture in the refrigerant vapor and facilitates sampling (condensation) of the vapor.
2. A sample of the refrigerant vapor is then condensed into an evacuated (2) pound steel refrigerant container. The sample bottle must be cooled in a dry ice/R-11 liquid cold bath to condense the sample. As an alternate, a liquid R-12 cold bath can be used. Place a two inch length of plastic hose in the line leading to the sample bottle to permit observation of flow efficiency of the condensed vapor. Flow of condensed vapor can be increased by holding several ice cubes on the valve body from which the sample is obtained.
3. Sampling containers are to be used on a "throw-away" basis. Cylinders are available through the Service Warehouse under YORK Part Number 366-94098-000. Each two-pound cylinder contains 55 cubic inches and has a 3/8-inch Female Pipe thread opening.
4. The cylinder should be filled between one and three quarters capacity to supply sufficient amount of refrigerant sample for analysis. All air must be removed from the sampling lines by purging prior to opening the valve to the evacuated sample cylinder.

MOISTURE ANALYSIS

HIGH PRESSURE REFRIGERANT SAMPLING (R-22 OR 502, R-12, OR R-500)

1. The sample may be taken with the system either operating or shutdown.
2. The sample is taken as a liquid from the bottom of the evaporator into an evacuated, cooled, two-pound steel sampling cylinder.
3. The cylinder should be cooled in an ice bath. All air must be removed from the sampling lines by purging prior to opening the valve on the evacuated sampling cylinder.
4. The refrigerant sampling cylinder detailed in Number 3 (YORK P/N 366-94098-000) of the Low Pressure sampling methods above is to be used.

The following machine characteristics, conditions at the time of sampling, and relevant data must be recorded for submittal to the laboratory along with the sample cylinder(s) to enable reliable Moisture testing and analysis.

- * DATE SAMPLE TAKEN
- * JOB NAME
- * JOB LOCATION
- * INDICATE WHETHER SYSTEM WAS RUNNING OR SHUTDOWN
- * WAS THE SAMPLE TAKEN AS A LIQUID OR CONDENSED VAPOR
- * EVAPORATOR PRESSURE AT THE TIME OF SAMPLING
- * EVAPORATOR TEMPERATURE AT THE TIME OF SAMPLING
- * TYPE OF REFRIGERANT
- * UNIT MODEL NUMBER
- * UNIT SERIAL NUMBER
- * BRIEF SERVICE HISTORY
- * LOCATION (DISTRICT) LABORATORY REPORT IS TO BE SENT TO

ACID AND SEDIMENT CONTENT
FOR ALL REFRIGERANTS

The sample MUST be taken with the COMPRESSOR OPERATING.

Connect an evacuated, cooled, two-pound steel test cylinder to the Oil Eductor line. Fill from one to three quarters capacity. The sample can also be drawn from the float chamber for ACID CONTENT samples.

Include the following data with the submittal of the sample.

- | | |
|---------------------|-------------------------|
| * DATE SAMPLE TAKEN | * UNIT SERIAL NUMBER |
| * JOB NAME | * TYPE OF REFRIGERANT |
| * JOB LOCATION | * BRIEF SERVICE HISTORY |
| * UNIT MODEL NUMBER | * WHERE TO SEND REPORT |

REFRIGERANT ANALYSIS LABORATORIES

The following laboratories conduct analysis of chiller system refrigerants. This is only a partial list of the available labs who offer this service. Each was chosen for their ability to handle Nation-wide District Service Office demands.

As emphasized in the OVERVIEW, it is very important to use the specific sampling technique recommended by the manufacturer under the direction of the lab you elect to use.

T.A.I., INC.	(404) - 448-5235
P.O. BOX 1182	1-800 - 241-6315
ATLANTA, GEORGIA	
30301	

Moisture Analysis	COST: \$ 100.00 per sample
Acidity	
Oil Content	

YORK INTERNATIONAL CHEM LAB	(717) - 771-7890
P.O. BOX 1592-231 D	
YORK, PENNA. 17405-1592	

Appearance / Color	COST: \$ 50.00 per sample
Moisture Analysis	
Acidity	
Oil Content	
Sediment analysis and ANY other tests as required for comprehensive sample evaluation	

Sample reports from these analytical laboratories follow.

YORK INTERNATIONAL CHEMICAL AND METALLURGICAL LABORATORY
REFRIGERANT ANALYSIS SAMPLE SUBMITTAL DATA SHEET

CUSTOMER NAME _____
CUSTOMER ADDRESS _____
CITY _____
STATE, ZIP _____
PHONE _____
PERSONS TO NOTIFY 1) . _____
2) . _____

JOB NAME _____

JOB LOCATION _____

DATE OF LAST REFRIGERANT ANALYSIS _____

CHILLER MANUFACTURER _____

CHILLER MODEL NUMBER _____

UNIT SERIAL NUMBER _____

UNIT (SHUT DOWN) (OPERATING) AT TIME OF SAMPLING _____

SAMPLE TAKEN AS (LIQUID) (CONDENSED VAPOR) _____

EVAPORATOR PRESSURE AT THE TIME OF SAMPLING _____

EVAPORATOR TEMPERATURE AT TIME OF SAMPLING _____

TYPE OF REFRIGERANT _____

BRIEF SERVICE HISTORY _____

SEND LAB ANALYSIS TO: YORK INTERNATIONAL CORPORATION
APPLIED SYSTEMS DIVISION

ADDRESS: _____ DISTRICT SERVICE OFFICE

PHONE: _____
ATTENTION: _____