EXCESSIVE QUANTITY OF COMPRESSOR OIL IN REFRIGERATION SYSTEM COMPONENTS

1 - INTRODUCTION

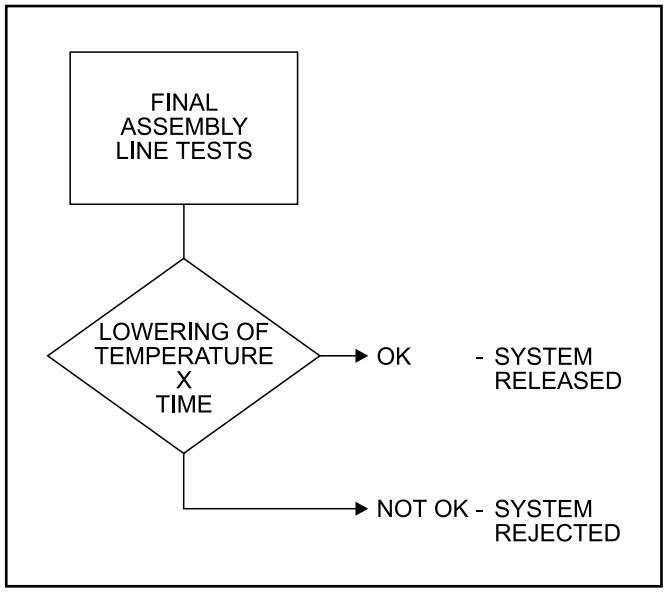
The main objective of this technical information is to clarify aspects related to oil circulation in refrigeration systems, with emphasis on the following:

- The excessive presence of compressor oil in refrigeration system components.
- Excessive oil pumping in hermetic compressors.

In domestic refrigeration systems by mechanical vapor compression, which use compressors whose lubricating oil is miscible with the refrigerant (gas), oil distribution is both acceptable and common by the components of which it consists. On the other hand an excessive oil presence in these components can be wrongly associated with a certain compressor defect, being on most occasions the result of incorrect diagnoses.

2 - IDENTIFYING THE DEFECT

Regardless of the type and degree of the modernization of the end of assembly line tests applied to refrigeration systems, the system's internal temperature, together with the cooling time of the same, are still the criteria most used for approval in system performance tests. Thermocouples or thermometers are placed inside the cabinet and/or freezer compartment. After a certain system functioning period, the temperature is then checked. Depending on the result, the system will be approved or rejected according to the following flowchart:



For a system to be rejected, it is necessary that the established parameter temperature is not reached within the determined time. Normally this system makes the compressor "suspect", as it is responsible for the product refrigeration and a premature judgment can result in it being condemned for "low capacity".

The system is then opened and the compressor is removed. During this operation it is common to notice the presence of a certain quantity of oil in the piping, generated from the evaporator and condenser. At this time, the association of lack of capacity and excessive oil circulation can also unduly condemn the compressor once there are other factors that equally contribute to the lack of refrigeration capacity, as well as by the presence of oil in the components.

3 - IDENTIFYING INFLUENCING CAUSES

The most influencing factors that can cause a system to present "low capacity" or "oil presence in its components" are:

INCORRECT REFRIGERANT (GAS) LOADING PROCESS

- inadequate equipment
- defective equipment
- incorrect procedure

INADEQUATE REFRIGERANT (GAS) LOAD

- leakage in system - welding problems
- leakage from components

BADLY PROJECTED SYSTEM

- inadequate evaporator circuit
- piping diameter
- deviation to cold plate
- number of parallel pipes
- internal volume

OTHER CAUSES

- energy cut during end of assembly line test
- thermostat with problem
- partial piping obstruction
- problem with compressor starting system
- leakage of refrigerant gas from capillary tube
- defective compressor
- incorrect diagnosis

4 - IDENTIFICATION OF POSSIBLE CAUSES X PROCEDURES

INCORRECT REFRIGERANT (GAS) LOADING PROCESS

Procedures:

- Check that the equipment used is compatible with the process to be carried out.
- Check any abnormal equipment functioning. Consult the manufacturer's Instruction Manual.
- Check that the specific procedures are being correctly followed.

INADEQUATE REFRIGERANT (GAS) LOAD

Procedures:

- Periodically check that the refrigerant (gas) loading equipment is injecting the specific quantity of refrigerant for each type of refrigeration system.
- Check for the existence of any type of leakage due to welding failure or defective components with specific equipment.

POORLY DESIGNED SYSTEM

Procedures:

- Tests carried out by Embraco did not prove that irregularities in refrigeration system projects were related to this defect. However, we requested that special attention be paid to the evaporator circuit, particularly concerning piping diameters, number of parallel pipes, internal volumes, and deviations to the cold plate, when this was planned in the project.

OTHER CAUSES

POWER OUTAGE DURING ASSEMBLY LINE FINAL TEST

Procedures:

- Check whether there is an energy cut during the carrying out of the final test of assembly line. Should this prove affirmative, repeat the test.

THERMOSTAT WITH PROBLEM

Procedures:

- Check that the thermostat is operating within the on and off range according to the manufacturer's technical specification. There are cases where the thermostat is unbalanced, thus causing a compressor disconnection before the internal system temperature reaches the specified value.

PARTIAL TUBING OBSTRUCTION

Procedures:

- Check that all welded joints were carried out in such a way so as not to permit any type of obstructions whether due to excessive welding material or folding or crushing of the tube. Special care must be taken in the cutting of the capillary tube to avoid burrs and crushing. Humidity in the system can cause blockage due to freezing at some point inside the capillary tube when $T \leq 0^{o}C$. This can be easily detected by switching the system off and then switching it on again after a certain time. If the system returns to normal functioning and shortly afterwards the problems repeats itself (loss of capacity) this is strong evidence of humidity freezing inside the capillary. In this case, check that the vacuum process is adequate and substitute the filter drier. Partial or total obstructions tend to increase system functioning pressures and temperatures, reducing its working life as well as its efficiency, without considering the possibility of total capacity loss in the case of compressor gasket rupture due to excessive pressure.

COMPRESSOR STARTING SYSTEM WITH PROBLEM

Procedures:

- Check that the compressor electrical components (relay and thermal protector) are those specified by the manufacturer or if there are any irregularities of the same. If this is affirmative, substitute the defective components.

LEAKAGE OF REFRIGERANT (GAS) FROM THE CAPILLARY TUBE

Procedures:

- Check that there is no refrigerant leakage at the joining of the capillary tube X suction line which can possibly occur in roll-bond evaporators with coaxial inlet/outlet.

DEFECTIVE COMPRESSOR

Procedures:

- If after having carried out the previously mentioned verifications a suspected defect persists, the compressor could have some problem. If this happens, contact Embraco who will provide complete instructions for the internal testing of this compressor at their laboratories.

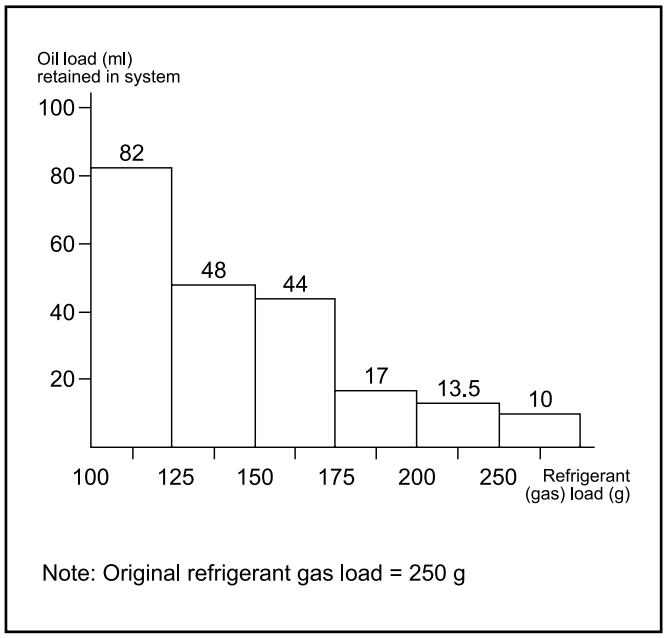
INCORRECT DIAGNOSIS

Procedures:

- The correct identification of any defect whatsoever and its causes is a predominant factor for solution of the same. Therefore, verify, step by step, all of the previous listed items before reaching a final diagnosis.

5 - GENERAL COMMENTS

- Any suspicion of a refrigeration system presenting an oil excess in components can only be proven with the removal of the compressor from the system. This problem cannot be solely diagnosed by associating it with “capacity loss” defect.
- The presence of oil in the system components does not affect performance of same. Systems whose components were inundated with oil did not present any capacity loss whatsoever nor an increase of evaporation temperature.
- Compressors tested outside the refrigeration system with suction and discharge open to the atmosphere can present spray or even small drops of oil through the discharge connector. There is no association with reality, i.e., with the compressor mounted in the system, because even together with the refrigerant (gas) the oil reduces its viscosity, thus increasing its free circulation through the refrigeration circuit.
- In tests carried out by Embraco on compressors with a high rate of oil circulation there were no irregularities in the functioning conditions of the systems in which they were mounted. Of the influencing causes stated in item 3, only those related to the refrigerant (gas) load actually contribute to the oil accumulation in system components. The following graph shows the quantity of oil retained in a system in relation to the refrigerant (gas) load present in same.
- The graphic below shows that the smaller the refrigerant load present inside a refrigeration system, the greater the quantity of retained oil in components of same. Therefore, the quantity of oil found in system components with an incorrect refrigerant load or reduced by any type of leakage, will be greater.



Note: Original refrigerant gas load = 250 g

- All previously listed causes can be directly or indirectly be related to the compressor low capacity symptom. Tests carried out by Embraco on compressors with a higher than normal oil circulation rate, did not reveal any impairment with the performance of the tested systems. Thus being, we suggest that all causes be investigated, step by step, emphasizing mainly those related to the refrigerant (gas) load.

Note: After replacement, the compressor and it’s accessories must have proper processing, and the components must be recycled according to the material group (ferrous, non-ferrous, polymers, oils, ...) directives. These recomendations are intended to minimize the adverse impacts that may be caused to the environment.

Embraco is participating in the United Nations Global Compact.