Progress Supply Inc.
The Progress Report
Helpful Information for HVAC & Controls Contractors from Progress Supply

# COPELAND DIGITAL SCROLL™ TECHNOLOGY

## The Next Generation in Modulated Compressor Technology

Global warming and ozone depletion are serious issues facing the environment and the HVAC industry has a challenging task to limit this damage. For the air-conditioning industry, the system efficiency is very important because it determines the amount of energy that is being consumed for cooling or heating. The increasing buying power of consumers globally is also generating a large demand for the development of air-conditioning systems that provide a higher level of comfort than that provided by the standard fixed capacity systems. These trends, economic and environment related, are placing a growing demand for the development of variable capacity systems. A variable capacity system offers unique benefits — it has higher seasonal energy efficiency and is able to control the room temperature to a much tighter band, thus ensuring higher customer comfort.

### AN INNOVATIVE TECHNOLOGY

Technologies that have been used to achieve modulation so far have been the variable speed compressor driven by the inverter, multiple compressors along with bypass circuits (hot gas and liquid), 2 speed compressors and also 2-step capacity control compressors. Copeland Corporation, after doing many years of research, has developed a new technology for achieving capacity modulation. This new technology, **Copeland Digital Scroll™,** is unique, simple, and extremely reliable and has the potential to make fundamental changes in the market.

The beauty of this technology is its inherent simplicity. The standard Copeland scroll has a unique feature called axial compliance. This allows the fixed scroll to move in the axial direction, by very small amounts, to ensure that the fixed and orbiting scrolls are always loaded together with the optimal force. This optimal force holding the 2 scrolls together at all operating conditions ensures the high efficiency of Copeland scrolls. The Digital Scroll operation builds on this principle.

The Digital Scroll operates in two stages — the "loaded state," when the solenoid valve is normally closed and "unloaded state," when the solenoid valve is open. During the loaded state the compressor operates like a standard scroll and delivers full capacity and mass flow. However, during the unloaded state, there is no capacity and no mass flow through the compressor.

### TECHNOLOGY COMPARISON

Copeland's Digital Scroll™ has simpler system architecture than Inverter technology, thereby increasing reliability and ease of application. In addition, the Digital Scroll modulates capacity output seamlessly over a wide range as compared to Inverter technology.

- √ Eliminate Electronic Components like Inverter and EMI Protection
- √ Reduce Complexity of Design
- √ Easier to Maintain and Better Reliability in Developing Countries
- √ Best Value Multi-Evap Modulation Solution

*(cont'd on p. 3)*

**Progress Supply wants you to be aware of the latest compressor technology from Copeland Corporation.**

**For more detailed information and diagrams, log on to:**
***http://www.digitalscroll.com/copeland_english/advantages.htm***

## *IN THIS ISSUE*

# Controls Tech Tips

By Dave Boyle

***Economizer Season will be here soon!***

An economizer, when functioning properly, will reduce the compressor runtime and save energy by using outdoor air, when suitable to provide a "free" first stage of cooling.

Fall will be here soon, and with it will come the cooler temperatures, which is when an economizer in good working order will save the building owner's operation cost.

Performing a building survey for the purpose of evaluating an existing economizer, or adding one to your customer's HVAC system is something that can save your customer operating cost, and at the same time, net you some profitable jobs.

The following are a few things that should be considered when performing your survey:

- Building HVAC requirements
- Type of HVAC equipment
- How is the cooling controlled
- Is there an existing economizer, if so, is it in good working order
- What types (if any, economizers exist

The most common economizer types are:

- Dry bulb
- Enthalpy
- Differential enthalpy
- Demand controlled ventilation (DVC)

A few things to keep in mind when reviewing HVAC equipment for an economizer addition, or upgrade, should include:

- Size and condition of dampers
- Type of existing damper motors
- Age and type of any existing economizer controls

When performing an upgrade it is a good time to replace old style mechanical controls with the new solid-state controls. They are more reliable and less expensive. Also, keep in mind that up grading an old dry bulb type economizer to an enthalpy, or an enthalpy plus DCV type, can provide additional savings, which could be substantial. With DCV additional savings can be realized, due to the ability to totally close off the outside air when there is no, or low occupancy.

Stop in today, or call us here at **Progress Supply,** for sales information or additional information on economizers.

# SHORT CYCLING DAMAGE TO COMPRESSORS

By Steve Schlewinsky

A compressor failure that is not always recognized is short cycling. If a compressor failure occurs from short cycling, it will be a motor burn or lubrication failure; in most cases this problem is not diagnosed.

When a compressor starts, there is a reduction in the crankcase pressure. That pressure drop causes a reduction in the saturation temperature, resulting in oil-refrigerant mixture flashing into foam and vapor. The result is crankcase oil carried out of the compressor. If the system operates for sufficient time to stabilize, the oil will return to the crankcase. If the run time is short, oil may be trapped out in the system at shutdown.

If the cycle is repeated, more oil will be pumped out each time, eventually leaving the compressor crankcase low or out of oil. If the running cycle is short, an oil safety control may not be tripped, since it requires two minutes run time to trip the heat actuated safety element (Note: Copeland's *Sentronic* control does address this problem.) Under such conditions, the compressor can operate without lubrication to bearings, with potential for mechanical damage.

A second source of damage from short cycling is liquid refrigerant flooding and loss of refrigerant control. Most thermostatic expansion valves (txv's) tend to react slowly to any sudden change in system operative conditions. When short cycling, (txv's) may not be able to reach stable control and liquid refrigerant flooding can occur — again with the potential for mechanical damage.

Every time the compressor cycles on or off, the starter windings try to flex or move. Under prolonged cycling, this flexing may eventually create sufficient movement in the windings to scrub the insulation and cause a short.

The larger the motor, the more vulnerable it is to winding flexing. With the improvements to motor insulation and varnishes, this failure is rare but the potential is present in a system with excessive cycling.

Short cycling can have many causes and most of these can be prevented, if understood.

**Discharge Air Thermostat**

On larger roof top package units, short cycling may be the most common cause of maintenance and compressor problems. A large part of these problems stems from the lack of a time delay.

If the controlling thermostat is in the return air, it won't see rapid changes in the air temperature and short cycling is seldom a problem. Unfortunately, the thermostat is often placed in the discharge air stream.

Particularly with large compressors, the abrupt change in cooling capacity as the compressor cycles can create wide swings in discharge air temperature. Compressors equipped with unloaders can minimize this temperature swing. There still may be short cycling, however.

Most manufacturers and engineers recognize this problem but, because of competitive pricing, an operational time delay is often priced as an option. In an effort to have low bid, this option is left out.

In too many cases, after costly service expense, the time delay is then added. Obviously, the need for better communication between sales and service personnel exists.

**Close Differential Control**

On any air-conditioning or commercial refrigeration system, where the compressor is controlled by a close differential control, short

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## COPELAND DIGITAL SCROLL™ TECHNOLOGY

*(cont'd from p. 1)*

### ADVANTAGES

***Drop-In-Solution***

No more complex bypass circuits and unreliable electronics that come with variable speed systems! Copeland's Digital Scroll™ package does not have any bypasses, and has simple electronics to control and increase the reliability of the modulation system. Copeland's digital package is truly a "Plug-and-Play" compressor system as it comes with a full set of electronic controls — outdoor, indoor, and remote controls that are required for an air-conditioning system.

***Better Humidity Control***

The Digital Scroll possesses excellent dehumidification capability across the entire range of operation, as it operates at lower evaporating temperatures as compared to existing modulation technology. Even at very low capacity operation, Copeland's Digital Scroll™ is able to deliver a comfortable relative humidity.

***No Electromagnetic Interference***

The Digital Scroll runs at a constant speed throughout the operating range, unlike the variable speed compressor technology. Due to this design, there is negligible electromagnetic interference. This unique feature eliminates the need for expensive electromagnetic suppression electronics required to ensure electromagnetic compatibility.

***Energy Saving***

For modulated systems, seasonal energy efficiency ratio (SEER) is the standard measure of energy saving from running the system year-round. Copeland's Digital Scroll™ has been evaluated as per the JIS & ARI standard and shows excellent SEER, as it can reduce annual energy consumption by as much as 40%.

***Widest Capacity Range***

Copeland's Digital Scroll™ operating capacity range of 10% to 100% is the widest in the industry. The broad capacity range ensures fewer compressor start-stops and increases the efficiency of the system. Moreover, it can achieve a continuous spectrum of capacity output, ensuring a very tight control on room temperature. This is an improvement over the inverter technology, which can only adjust capacity outputs in steps.

***Reliable and Simple***

Copeland's Digital Scroll™ has excellent oil return capability even at low capacities, and with long pipe lengths. This makes it more reliable than ordinary modulation systems where oil return is a major issue. The beauty of Copeland Digital Scroll™ technology is in its inherent simplicity: fewer system parts, no complicated inverter controls, and no issues of EMI/EMC. This simple product design leads to easier application, and increases system reliability and serviceability. A Digital Scroll system, because of its simplicity, can be designed to be more compact and the savings in space can be up to 30% over existing technology options.

**Inverter Technology vs. Digital Scroll**

| | Typical Inverter System | Digital Scroll System | |
|---|---|---|---|
| **Microprocessors** | Multiple | Single | ✓ |
| **Electronic Expansion Valve** | Multiple | Single | ✓ |
| **Hot Gas Bypass System** | Required | Not Required | ✓ |
| **Liquid Bypass System** | Required | Not Required | ✓ |
| **Oil Separator** | Required | Not Required | ✓ |
| **Electromagnetic Suppression** | Required | Not Required | ✓ |

# Compressor Tech Tips

By George Kaebel

**Single Phase Burns**

Extensive Copeland testing and field experience has proven that single phase motor burns are caused by the malfunction or misapplication of the system contactor(s).

Contactors play a role in any compressor overload protection scheme, but are particularly important when they are part of a pilot-operated protection system.

Contactors have a limited life and should be inspected during routine maintenance and replaced every time a compressor is installed.

The Copeland warranty does not extend to external electrical components furnished by others, and the failure of such components resulting in compressor failure will be taken into consideration by Copeland in determining the warranty status of returned compressors.

**Compressor Overheat**

Overheat is a major cause of compressor failures. Temperatures in the compressor head and cylinder become so hot that the oil thins and loses its ability to lubricate. This may cause rings, pistons, and cylinders to wear, resulting in blow by, leaking valves and metal debris in the oil. It can also cause the stator to ground due to a spot burn.

Cylinder temperatures exceeding 300° F will begin the breakdown of oil and at 350° F oil will be vaporized. To measure cylinder temperature, place your temperate gauge no more than six inches out on the discharge line from the compressor. For most applications, the temperature should be below 225° F. This factors in a 50-75 degree temperature drop from the cylinder to the measured point.

To correct for overheat:

1. Correct abnormally low load conditions
2. Correct high discharge and low suction pressure conditions
3. Insulate suction lines, clean dirty condensers
4. Provide proper compressor cooling
5. Check low pressure control settings

Pressure controls can help to identify or remedy system problems.

**Progress Supply Inc.**
2864 Spring Grove Avenue
Cincinnati, OH 45225-0067

## SHORT CYCLING DAMAGE TO COMPRESSORS *(cont'd from p. 2)*

cycling can be a problem. There is no clear-cut answer as to an acceptable cycling rate. An adequate runtime to stabilize the operating conditions and insure oil return is more important than a long off cycle. The probability is that cycles at three minute intervals will not cause a temperature problem in the compressor or the contactor.

But the tremendous number of cycles over a period of time that accumulate from short cycling must shorten the life expectancy of both the contactor and the motor. The benefits of close differential control versus short compressor life must be evaluated on a judgment basis.

The design of the compressor affects its cycle life expectancy. Copeland air-conditioning and heat pump compressors are spring-mounted with relatively soft mounts for noise suppression. 200,000 cycles would be adequate for a 10-year life. Commercial applications will see more frequent cycling and 300,000 cycles is the design of this application. In semi-hermetic compressors, the cycle life is related to the motor used so it varies from 500,000 to 1,000,000 cycles.

**Compressor Motor Reversal Test**

In order to substantiate a 3-phase motor's ability of surviving under short cycling conditions, Copeland Corporation performs extensive reversal tests. The rotation is reversed every 3 seconds on a test stand, putting tremendous stress on the motor windings. This has proven to be a reliable standard to establish a motor's capability of withstanding short cycling.

**Summary**

Regardless of motor design, extensive short cycling can shorten compressor design life and the service engineer must be alert to malfunctions in systems that can create short cycling conditions.

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***For More Information Contact Jay Kathman at:***
**Phone: 513-681-3881**
**Fax: 513-681-1151**
**Email: JKath7239@aol.com**

**CINCINNATI**
2864 Spring Grove Avenue
Cincinnati, OH 45225-0067
***Phone: 513-681-3881***
***Fax: 513-681-1151***

**COLUMBUS**
1434 Fields Avenue
Columbus, OH 43211-2676
***Phone: 614-299-6220***
***Fax: 614-299-6225***

**DAYTON**
1345 Stanley Avenue
Dayton, OH 45404-1015
***Phone: 937-222-8689***
***Fax: 937-222-3730***