



*This is one of a series of technical bulletins from your friends at Progress Supply  
April, 2002*

## THE SINGLE PHASE MOTOR BURN

How many times have you heard the wholesaler counter person ask, **“How about starting components with this compressor?”** or **“How about a new contactor for this compressor?”** And how many times has the answer been, **“The ones on the job are OK.”**

For some reason, the service technician or the customer is trying to scrimp on the cost of replacing a defective compressor. And how many times have the start components or the contactor been the real cause of the compressor failure. Oh yes, if the replacement fails, the manufacturer will replace it under warranty.

There seems to be a misunderstanding in our industry that warranty is free. This notion is the furthest from the truth. **Warranty is not free to anyone — the manufacturer, the wholesaler, the service company and not the end user.** Each year warranty costs to manufacturers are big

dollars. It costs money to produce the product. When an item comes back in warranty, generally, the item has little to no value. This cost must be absorbed in the cost of doing business and it is reflected in the cost of all products. Yes, if warranties were reduced, the cost of goods would also be reduced.

The wholesaler buys product to put on their shelf so when the technician needs an item, even if it is for a warranty, it is available. The cost of the product may be reimbursed to the wholesaler, but the wholesaler must absorb the shipping cost both ways. The purchase of that item is a cost of doing business and that cost reflects itself in the selling price. Again, if warranty is reduced, the selling price could be reduced.

The service technician's time to replace a warranty item is not free. The time spent on that warranty could have produced income to the

service company. And last, but not least, the warranty failure costs the end user time and money through loss of product, time to move product and potentially lost production or business.

With this background, let's understand why it is very important that when a compressor is changed, new start components and/or contactors should also be changed. When one looks at the cost of these components compared to the cost of the compressor, this is low cost insurance. Are you that person who changes the oil in your car or truck and doesn't change the oil filter?

***In this article, we are only going to look at three-phase compressors, specifically the four, six and eight cylinder models.***

Just over a year ago, the Copeland Corporation instituted a change in the application of their warranty policy regarding four, six and eight cylinder compressors.

After they looked at the warranty failure rate of these compressors for single-phase motor burns, they said enough is enough. A single-phase motor burn is caused by a problem external to the compressor. The cause is generally a failure of the contactor(s). It can also be a problem with the electrical supply to the compressor.

***As of January 1, 2001, Copeland's position is that the contactor(s) must be changed when the compressor is changed and changed with a contactor that is ARI 780 approved and meets Copeland's specifications, as stated in their Application Engineering Bulletin 10-1244.*** If the compressor fails because of a single-phase motor burn, there will be no warranty.

***Effective January 1, 2002, this policy has been strengthened to the point that if the contactor being used with a replacement four, six or eight cylinder compressor is not a Copeland brand contactor and there is a single-phase motor burn, there will be no warranty.***

To the technician, the service contractor and to the end user, this policy may be frustrating. However, once you understand a single-phase motor burn was not caused by a defect in materials or

workmanship of the compressor manufacturer, this policy becomes more understandable.

As an aside, if one has a new automobile and in the warranty period you are involved in an accident, does the manufacturer honor warranty for the damaged parts? I don't think so. So, with this in mind, why should the compressor manufacturer warrant the compressor because of an external problem?

**Let's get down to technical reasons why the contactor(s) should be changed when a compressor is replaced.**

To better understand this, we need to understand what constitutes an acceptable contactor for use with a compressor. Copeland's Application Bulletin 10-1244, revised November 1, 2001, lists the proper size Copeland contactor(s) for use with four, six and eight cylinder compressors. In reading the bulletin carefully, one will note that not only is the size important, but also the approval. This application bulletin states that the contactors must meet **ARI Standard 780.**

**ARI, the Air Conditioning and Refrigeration Institute,** publishes a number of standards for our industry. This is done so you and I can feel comfortable that, when a

manufacturer makes a statement and the product meets an ARI Standard, we know it has been independently tested and meets that standard.

**ARI 780, specifically, is the standard for "Definite Purpose and Limited Duty Purpose Magnetic Contactors."** This is a very tortuous test that a manufacturer of Definite and Limited Purpose contactors must adhere to in order to get approval and state that their product meets the standard.

As an aside, all definite purpose contactors are not ARI 780 listed. There is one major manufacturer that has a line of contactors that are not ARI 780 listed. If you read their catalogue, they state this.

This is one reason Copeland has taken their stand that only Copeland name plated contactors should be used in front of a Copeland compressor if one wants warranty in case of a single-phase motor burn. This assures that the contactor(s) meet the ARI standard 780.

**Let's define a single-phase motor burn.** No, this is not a single-phase motor that has burned. It is a three-phase motor that has been single-phased. I hope you understand that, electrically, single-phase power comes to the product with two wires and

a three-phase motor has three wires coming to it. When only two of the three wires carry power to the motor, it is said that it has been single-phased.

***When do contactors typically fail and cause compressor motors to fail?***

This happens when they are being shut off. It is at this time that a defective contactor hangs up, causing a burn out, typically a single-phase motor burn.

***Then why doesn't the motor overload take the compressor off of the line?***

Dual voltage compressors use negative coefficient thermistors installed one in each phase, winding when the motor is wound. These thermistors measure motor temperature very accurately and very fast. The thermistors are connected to a solid-state relay. Should the motor temperature rise to an unsafe hot level, the solid-state relay contacts will open. The solid-state relay contacts are wired in series with the compressor contactor(s) coil. When the solid-state relay contacts open, the contactor(s) coil is de-energized and the contactor should drop out, stopping the compressor. If the contactor cannot drop out, there is no protection. Yes, the contactor(s) is an integral part of the compressor's safety circuit.

***What can cause a contactor to hang up?*** If a poor quality contactor is used, one or more of the contacts may weld. Welding typically happens at the time of start. It is at that moment that the contactor has locked rotor current flowing through it. After a number of starts, especially a number of quick starts, the contactor contact(s) surface material may, for an instant, melt due to the high heat caused by the high current. During the run period, the contact or contacts will be welded together. When the contactor tries to drop out, only one contact may open and the compressor motor is single-phased.

***What else can cause the contactor to hang up?*** A contactor consists of two sets of contacts — one stationary and one that moves. The moving set is attached to an armature that goes through the center of an electromagnetic coil. When the coil is electrically energized, a magnetic field is established, causing the armature to move to close the contacts. During the compressor's run period, the contactor(s) coil remains energized and it will heat up. The heat causes the coil to swell slightly. This is a natural occurrence. If the contactor is poorly manufactured, the space between the center of the coil and the armature may

be closed. When this occurs, the armature cannot drop out when the coil is de-energized. Again, the armature hangs up, not allowing all of the contacts to open up.

If two of the contacts remain closed, the compressor will experience a single-phase motor burn. Once the motor burns, the circuit breaker or fuses will open, stopping the flow of electricity to the contactor and motor. The contactor will now cool off and may then drop out. It may look OK to you, but it is a problem waiting to happen again.

***What is important about ARI Standard 780 as it applies to you?*** Application Engineering Bulletin 10-1244 has a synopsis of this standard. When you read the standard that an approved contactor must meet, I am sure you will only want contactors that meet this standard.

Yes, single-phasing of the four, six and eight cylinders is real. It is also a failure mode that can be almost eliminated if each and every time a compressor is replaced, the contactor(s) is replaced.

***Remember  
ARI Standard 780.***

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Dayton, Ohio. . .Progress Supply Inc., located at 1345 Stanley Avenue, has been named a **Copeland PrimeSource Wholesaler** location for the Dayton market.

Copeland Corporation, with headquarters in Sidney, Ohio, is a world leader in the manufacture of refrigeration and air conditioning compressors, and markets its products through the PrimeSource Authorized Wholesaler Network with over 850 locations nationwide.

Progress Supply, with main offices in Cincinnati, is a totally independent company staffed with

trained personnel to serve the refrigeration and air conditioning industry in the area. The company also maintains another wholesale operation in Columbus.

Mark Faessler, President of Progress Supply, said, "With all three of our locations being authorized PrimeSource wholesalers it enables us to provide total coverage for Copeland in our 60-county marketing area covering Ohio, Indiana and Kentucky. We will carry an in-depth stock of Copeland Compressors, condensing units and electrical service parts in addition to our many other product lines at all our locations."



To earn the "PrimeSource" designation, Progress Supply must be a sales leader in its area and provide product availability, technical assistance, application support, comprehensive training programs and new product solutions.

Progress Supply currently carries HVAC products and controls from 32 different manufacturers, and has been in business for over 40 years.