the REFRIGERATION Line

Vol. 1 Issue 1

How To Minimize Refrigerated Case Operating Costs

A COMMON-SENSE APPROACH TO

- the lowest energy costs
- preventing breakdowns
- assuring perishable product protection
- keeping maintenance costs low
- extending equipment life

An information service of the Carlyle Compressor Division

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1. Introduction

More than Energy Savings: A Complete Approach To Lower Costs

Every food store manager knows the importance of controlling costs. Yet many stores make mistakes in installation or operation of refrigerated cases that dramatically increase overall cost. Because energy consumption is a major part of operating expense, it's easy to focus only on electric bills – while losing sight of service costs and equipment durability. In fact, in seeking to minimize energy consumption, technicians and sometimes engineers may make poor application decisions that increase life cycle costs. Such decisions can cause needless repairs while shortening equipment life!

If a refrigeration case installation seems to be using excess energy ... if it requires frequent service ... if it isn't performing the way it should ... if compressors are cycling on and off frequently ... be suspicious. There's probably a problem that's increasing your costs – one that can be easily corrected.

Understanding a few important facts can make it easy to assure low energy bills, minimize maintenance and repair expense, and prolong equipment life. How can you keep overall operating costs for refrigerated grocery cases as low as possible? Just read on!

2. How a Refrigeration System Works

What refrigeration systems actually do is move heat. In your store, refrigeration systems move heat from refrigerated cases to outdoor air. The "engines" that move that heat are the systems' compressors.

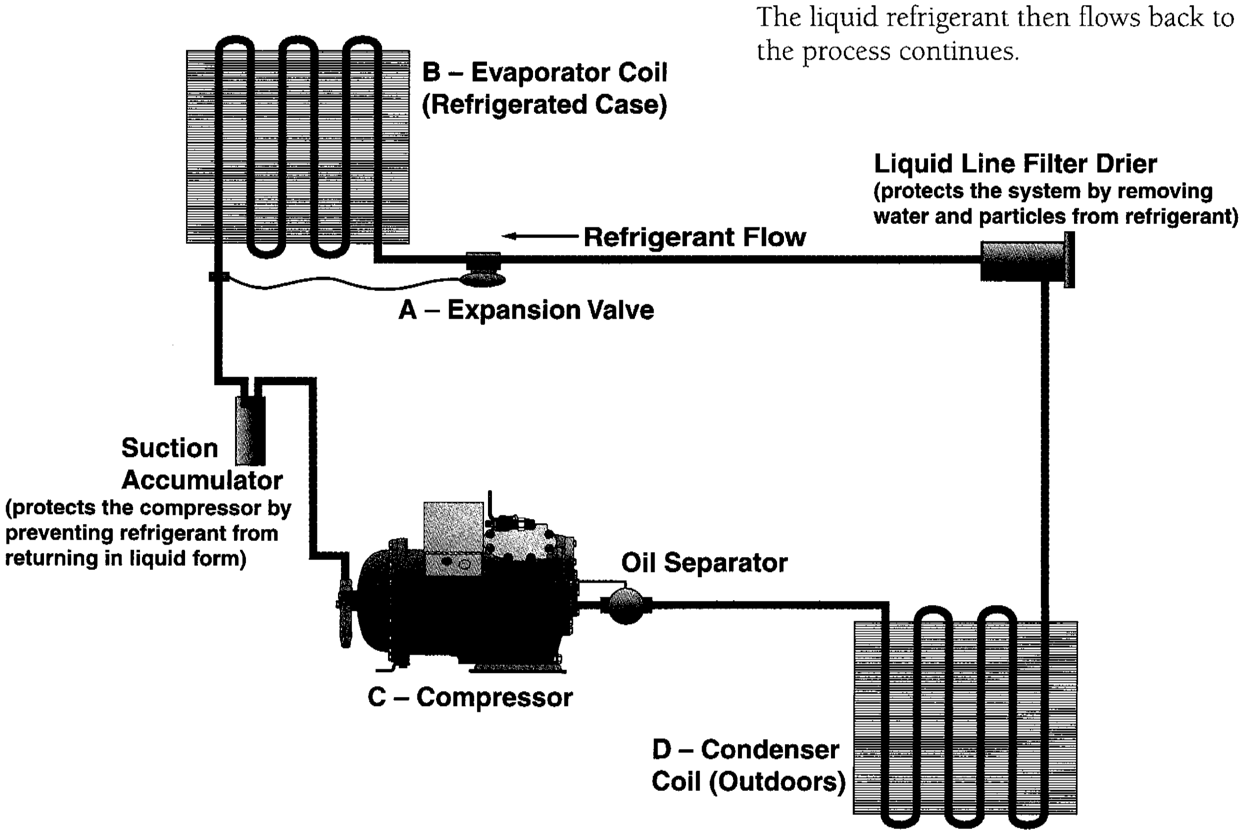
Refrigeration systems rely on basic principles of physics: when matter changes state, it releases or absorbs heat. When a liquid evaporates to become a gas, it absorbs heat. When a gas condenses to become a liquid, it releases heat. The points at which changes of state occur vary with pressure. For example, as pressure rises, the temperature at which a gas becomes a liquid increases.

To understand how your refrigeration system uses these principles, let's start at the evaporator coil in the refrigerated case. A thermostatic expansion valve, also called a TXV, (**A**) admits liquid refrigerant into a coil (**B**). Because gas pressure is lower in the coil, the liquid refrigerant expands, evaporating into a gas. In doing so, it absorbs heat. That chills the coil, which chills the air and products in the case.

Refrigerant gas then flows to the compressor (**C**). The compressor pressurizes the gas, and pumps it to the condenser (**D**), also called the outdoor coil. As it's compressed, the refrigerant's temperature increases. In effect, the heat the refrigerant absorbed in the evaporator coil is concentrated.

As the refrigerant flows through the outdoor coil (**D**), it releases excess heat into the outdoor air. The refrigerant changes back into a liquid.

The liquid refrigerant then flows back to the TXV and the process continues.



5. Start Me Up – But Not Too Often

For most any electrical or mechanical device, the most stressful, most wearing part of its life is starting. That's true for your car. It's true for light bulbs. And it's true for refrigeration compressors. If your compressors are cycling on and off more often than they should, they'll wear out faster. They'll be more likely to need repair. And, because electric motors use more energy when they start than they do when they're running, your energy consumption will be needlessly high.

To maximize compressor life, we recommend limiting Carlyle 06D and 06E reciprocating compressors to approximately 12 on/off cycles per hour and Carlyle 05T and 06T screw compressors to approximately 6 times per hour.

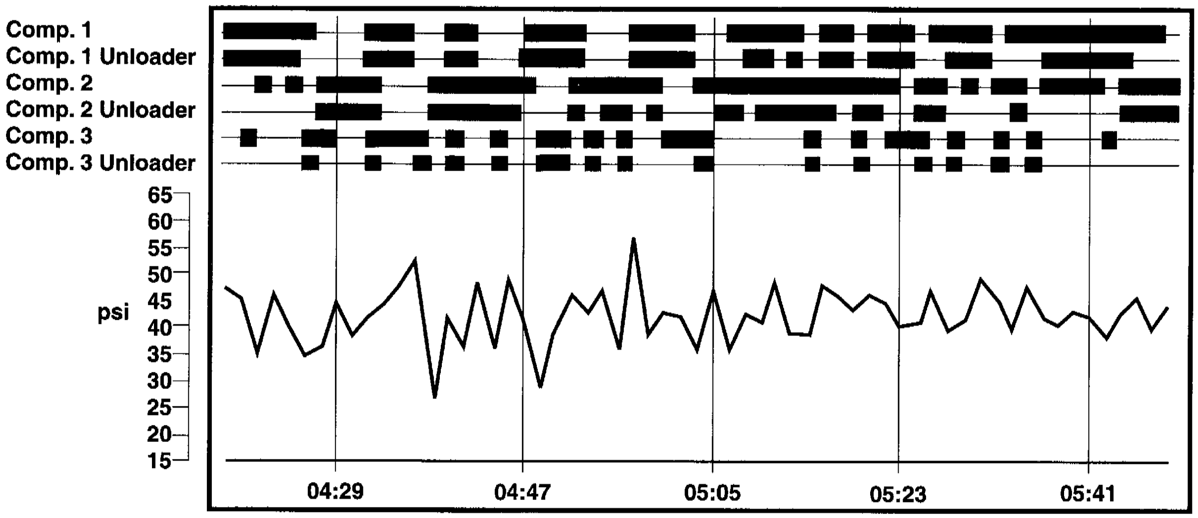
Reducing on/off cycles allows longer run times. That ensures sufficient time for proper oil return and internal component lubrication. With any compressor, the fewer cycles, the better!

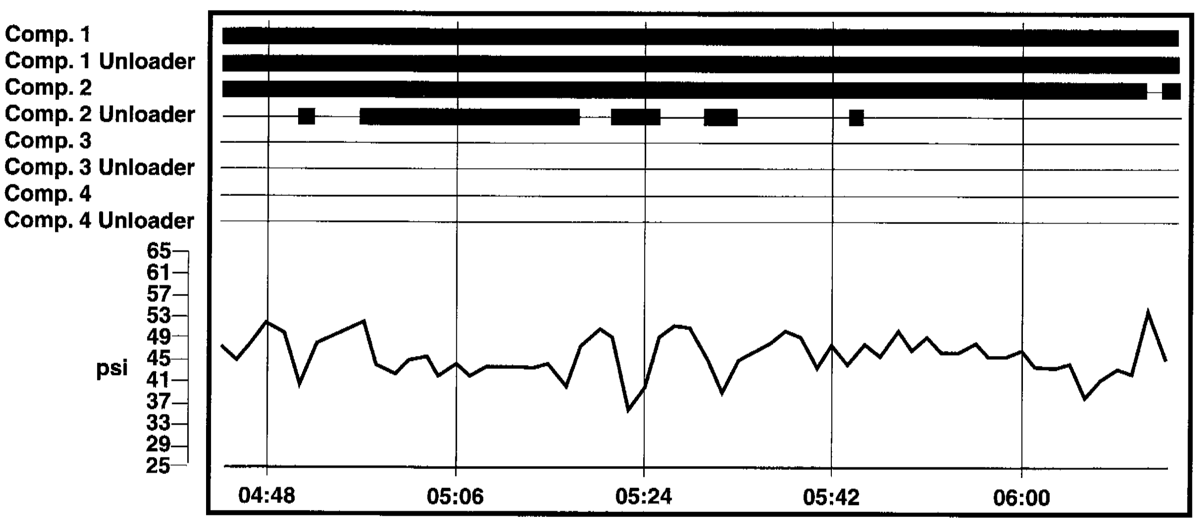
For Example: Cycle Madness

Brad, a hard-working store manager, spends five minutes inspecting the machine room to make sure the staff has done a good cleaning job. During that inspection, he notices that his three compressors have cycled on and off, three times in total. With all the tasks he's responsible for, Brad doesn't do the math. But his compressors are cycling on and off 800 times a day. At that rate, their expected operating life could be cut in half!

What's causing the problem? Brad is rightly concerned about the quality of the product his store sells. So he asked that the refrigerated case be set up to control temperature extremely tightly.

The service technician did what Brad thought he needed. Knowing that temperature control is achieved by setting the system's suction-pressure sensor, he adjusted it to





On these graphs of refrigeration system operation over time, black bars indicate compressor and unloader run time. The upper graph represents a three-compressor system that's improperly set up and cycling far too often. One result is erratic suction pressures, charted below the compressor operation bars.

The lower graph represents a four-compressor system that is set up properly. During the time monitored, there was only one compressor cycle and moderate cycling of one compressor's unloader. Suction pressure is much more even, with far narrower swings. Two of the system's compressors never cycled on during this period. If the too-rapid cycling shown in the upper graph isn't corrected, that system's compressors will need maintenance and repairs far more often than the properly-set up system. Compressor life expectancy will be dramatically reduced.

.2 lb. per square inch tolerance. That hair-trigger setting is working Brad's refrigeration system to death. In fact, a tolerance between 2 and 4 pounds per square inch would have given Brad all the temperature accuracy needed to protect his products – without excess cycling.

This problem is one of the sneakiest. After all, a case set to tolerances that are overly tight will seem to be operating well. Too few store managers know that rapid cycling is a serious threat to the bottom line. Fortunately, it's an easy problem to eliminate. Ideally, your compressors should be cycling fewer than 50 times in 24 hours. More than 100 is definitely too many. If your compressors are starting and stopping too often, an easy control adjustment will cut your costs and preserve reliability.

6. Cold Weather Can Cut Energy Costs, But ...

The colder the weather gets, the more easily outdoor coils can shed the heat your refrigeration system is removing from food cases. That means refrigerant will return to a liquid state at lower pressures. The compressors won't work as hard, so they'll use less energy. That's great – but only up to a point.

For Example: "Free" Refrigeration Becomes Costly

Linda, a store manager in Maine, has been told a bit about her store's case refrigeration system by a relative who works for a contractor. She knows that her refrigeration system has a two-section outdoor coil. When the outdoor temperature gets very cold, the system automatically shuts off part of the coil. Linda asked her chain's engineering staff to lower the temperature setting at which part of the coil is shut off. She reasoned that, with more coil surface, heat transfer will be greater and that she'll save energy. She expected to take advantage of "free" refrigeration, courtesy of her area's cold winters. But now, the temperature in her refrigerated case is inconsistent.

Linda is right to want to save energy. But she's gone beyond a reasonable limit in resetting controls. That dual-coil system is designed to maintain more uniform pressures in the refrigeration system. Linda has inadvertently reduced refrigerant pressures enough to affect the performance of the TXV. That's why her case temperature control has suffered.

In addition to risking her store's product quality, Linda is also likely to experience costly repairs. Those too-low pressures are affecting the circulation of oil in her refrigeration system and causing excess compressor wear.

Proper operation requires more consistent system pressures year round. We call that uniform system stability. It contributes to reliable operation and long life. Maintaining stability is as simple as proper control set up. It's especially important in areas where winter temperatures get below 0 degrees F.

7. Keep it Dry

It's easy to guess that moisture in a refrigeration system can be a problem. But what many store managers don't realize is that it's a bigger problem than it used to be. That's because more and more stores are switching to Refrigerant 507 or Refrigerant 404a. These refrigerants are chlorine-free, which means that even if they escape, they have no chlorine to deplete the Earth's ozone layer.

While those new refrigerants are good for the environment, they require a different type of oil than older refrigerants, polyolester oil. Unfortunately, polyolester oil attracts and holds moisture far more readily than older lubricants.

Moisture can react with oil and compressor components in ways that form acid. That causes corrosion. In high amounts, moisture in the system can form ice, which will shut down the refrigeration system or break components. Many compressors have required costly reengineering to increase moisture resistance. Carlyle compressors have proven to be highly resistant to refrigerant moisture without reengineering – but no compressor is immune to moisture damage.

To avoid moisture problems, it's important that service technicians minimize the amount of time a system is open during routine service and evacuate systems to the specified vacuum settings. Chlorine-free refrigerants may require more frequent filter changes in a system's filter-drier – a simple procedure that easily removes excess moisture.

8. You Want a Clean Machine

Dirty coils make refrigeration systems work harder, increasing wear and energy consumption. Keep an especially close eye on the system's condenser coils. They're far more likely to collect dust and dirt than evaporator coils.

9. Your Route to the Lowest Operating Costs for Your Refrigerated Cases

With proper installation, control settings, and maintenance, Carlyle compressors can typically operate from 10 to 15 years without major repairs or rebuilding. Their advanced design brings you what you need to minimize energy costs. By avoiding common refrigeration mistakes, you'll help assure not only the best energy efficiency, but also the lowest maintenance costs and the longest equipment life. All are essential to the best bottom line for your facility. And all help you achieve perishable product-protecting performance and minimized management time.

3. The Line on Refrigeration System Performance

Refrigeration lines connect your refrigerated cases to compressors and outdoor coils. It's easy to think of those lines as being similar to water piping. But what flows through refrigeration lines, refrigerant gas or liquid and system lubricating oil, doesn't behave like water. The rules for running refrigeration lines are different. Line size, slope, and distance (both vertically and horizontally) are all very important. If they're wrong, the system may work – but it won't work the way it should.

For Example: The Case of the Excess Oil

The new refrigerated case is installed, and it seems to be running perfectly. But the next morning, it's stopped working. The service person tells you, "The system needed more oil. I've added it, and it should be fine now."

Sure enough, the system starts and keeps running.

Beware!

It may be that the service man didn't fix the problem, instead camouflaging it. The real problem in this example could be a refrigerant line that's too big or improperly sloped. If so, refrigerant could be flowing too slowly through the line to carry sufficient oil back to the compressor. In this example, the compressor shut down automatically to prevent costly damage from lack of lubrication. The oil the compressor needed was in the system, but "hiding," trapped in the case's evaporator coil.

If the correct amount of oil is specified and added at installation, but the system needs more to keep running, the lines that return refrigerant gas to the compressor require changes. Masking the problem with extra oil will cause excess electrical consumption. And there's a serious risk that too much oil will return to the compressor all at once. If that happens to you, you're likely to need compressor repairs.

Repairs mean downtime. Because such damage is caused by faulty installation, repairs won't be covered by the compressor warranty. That means needless repair costs.

Less serious errors in running refrigerant lines may not be this obvious. But they'll still increase operating costs and the risk of preventable repairs. Mistakes in refrigerant line design or installation are the most common problems in refrigerated case installation.

How to Prevent Refrigerant Line Problems

Your specifying engineer needs to be sure refrigerant line design meets all operating specifications and requirements. That means assuring that the design is correct from the start – and that installers follow it accurately. If a service technician adds oil or refrigerant beyond the specified amount, your engineer should evaluate the system. If the real problem isn't corrected promptly, your costs will be much higher than they should be.

Remember, if your engineer has any questions about correct compressor application, he or she can ask Carlyle Compressor for assistance.

4. What State is Your Refrigerant In?

There's a very important little component installed with the evaporator coil in your refrigerated case. It's the thermostatic expansion valve (TXV). It acts like a traffic cop, controlling how much liquid refrigerant is admitted into the coil. Too little, and you won't have enough cooling. Too much, and refrigerant could get back to the compressor in the wrong state – before it's completely turned into a gas.

Either way, the system will be operating inefficiently, so your energy costs will be higher than they should be. And if liquid refrigerant gets back to the compressor, it will cause damage. Though excess oil is more likely to break components quickly, liquid refrigerant will always wash away compressor lubricant. As a result, your compressor will wear far faster than it should.

That TXV has to be the right size. And it has to be adjusted properly. Once again, your specifying engineer can easily determine if this important component is correctly installed and set up. And once again, Carlyle will be happy to answer any questions that arise.

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