

# How We Reduced: Cost of Maintenance and Repair

## CHALLENGE

It is important to maintain equipment to ensure the best performance and longest life span. When a component fails, you want to replace it as soon as possible as to not disrupt normal operations.

With any equipment, it is virtually certain that maintenance and repairs will eventually be required, but what is uncertain and heavily product-dependent is the lifelong cost of these services. The factors that primarily dictate the cost of regular maintenance and repair are their severity, frequency, duration and the required resources.

Therefore, if we can reduce one of those factors without adversely affecting the system as a whole, we can lower the cost of ownership of our product. Our goal was to reduce them all.

## SOLUTIONS

### Standard Electronic Expansion Valves Reduce Maintenance and Repair Time and Provide Compressor Protection

Electronic expansion valves (EEVs) come standard in our DX Outdoor Air Conditioning System for a variety of reasons.

In relation to maintenance and repair costs, EEVs are more hands-off than the more commonly used thermal expansion valves (TXVs).

EEVs and TXVs both regulate refrigerant flow to the evaporator by measuring the temperature of the superheated refrigerant exiting the evaporator. However, there are many differences between the two. The superior capabilities of EEVs reduce maintenance and repair costs compared to TXVs, while also providing added protection to the systems compressors.

### FEATURE COMPARISON

Price Standard Electronic Expansion Valve (EEV)	Industry Standard Thermal Expansion Valve (TXV)
Digitally controlled through logic controllers and can be monitored remotely	Completely controlled through analog methods, requires a technician to physically monitor performance
Maintenance free design	Requires calibration
Durable components are less likely to be accidentally damaged, fewer tubing connections	Temperature bulb and increased tubing connections are delicate and easily susceptible to damage
Designed to provide equally precise control over a broad operating range	Designed for precise control over a narrow operating range
Stator and superheat sensor can be replaced in minutes without disturbing refrigerant circuit	Entire TXV must be replaced if any component is damaged, disturbing the refrigerant circuit
Protects against compressor flooding and slugging*	No inherent compressor protection to flooding and slugging

*\*Compressor flooding is when liquid refrigerant makes its way into the compressor. Once inside, it mixes with the compressor oil. The liquid may vaporize and pull oil up with it out of the compressor. If enough oil is pulled from the compressor, the lubrication will be lost and the compressor will be damaged. Slugging is when larger amounts of liquid enter the compressor and pass through the scroll in the liquid form. Unlike vapourized refrigerant, the liquid is incompressible and can severely damage the compressor.*



Standard EEV

**Remote Operability, Diagnostics and Detect + Protect™ Warning System Reduce Unexpected Repairs**

All units are equipped with our Detect + Protect™ anticipatory warning system. This anticipatory warning system monitors refrigerant charge, electronic expansion valves, VFD motors and discharge air temperature and checks those key metrics to verify that they are operating within expected ranges. An automatic warning is issued if something is operating outside of its expected range, indicating that the component may require repair or replacement.

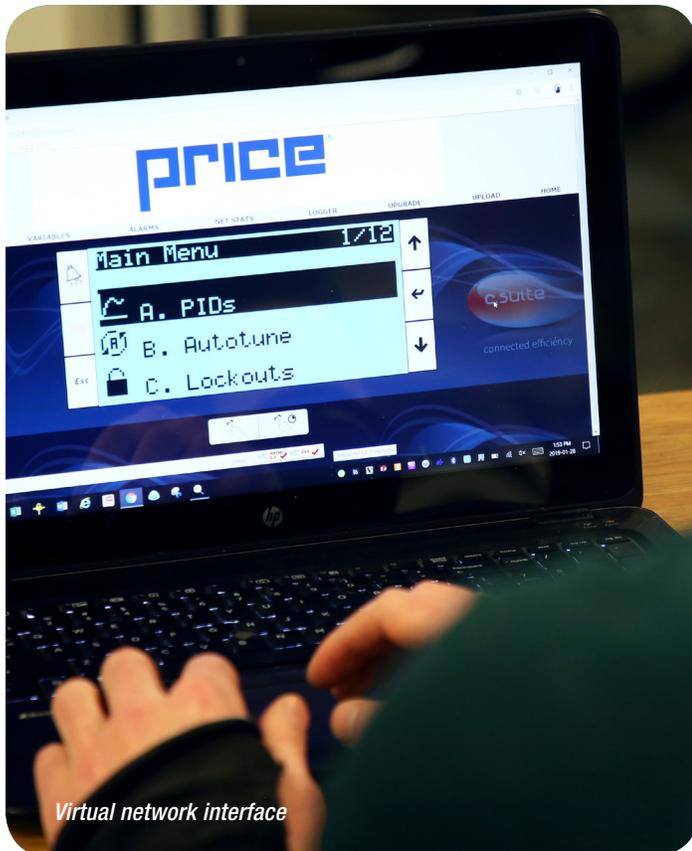
There are many reasons why repairing a component before failure is a good idea, including:

- + It can be more economical to repair a component before it requires replacement.
- + If a component fails, it may create a domino effect, damaging or causing failure in other components.
- + A convenient time can be scheduled for servicing by knowing if a component needs repair. Emergency repair calls can be costly and operations can be disrupted until it is fixed.

Remote diagnostic capabilities come standard with the Detect and Protect™ anticipatory warning system. Without the connection of gauges or sensors, a virtual network interface provides a technician with the ability to:

- + View real time system and component performance data, including all refrigeration operating characteristics
- + Download unit history data
- + Connect to the unit via LAN or cellular connection
- + Connect with our factory service team, walk through any issues and review logged data

These features reduce the time it takes to diagnose a problem and increase the likelihood that the problem will be resolved efficiently.



*Virtual network interface*



*Direct drive motor*

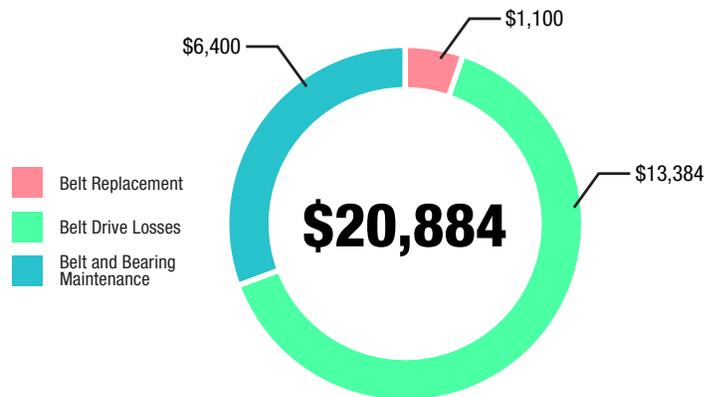
**Direct Drive Motors Reduce Maintenance and Repair Costs**

Direct drive motors are available for all DX Outdoor Air Conditioning Systems and are highly recommended. There are several advantages to choosing direct drive motors over belt drive motors.

- + Belt drives are more likely to fail – they require more moving components and place more strain on the bearings due to the tensioning in the belt
- + Belts will wear down and require regular replacement. They can also break or stretch, requiring unscheduled service.
- + Belt drive motors require more frequent inspections, translating to more servicing costs

Overall, the frequency of and cost of maintenance is greatly reduced when equipping direct drive motors. Additionally, eliminating belt drive losses will contribute to significant energy cost savings. The graph below demonstrates the significant savings a single fan and motor combination can accrue over its lifespan.

**SAVINGS ANALYSIS OF A DIRECT DRIVE MOTOR COMPARED TO A BELT DRIVE MOTOR**



*Theoretical maintenance savings when switching a 10 horsepower motor from a belt drive system to a direct drive system, over a 20 year life span. An \$80 hourly rate was assumed for service technicians, with belt inspections and bearing inspections occurring quarterly. Belts are assumed to be replaced yearly. Electrical costs assumed to be 12.95¢/kWh, with a 2.2% rate increase per year. Belt drive losses are assumed to be 6% (AMCA 203-90).*



*Low fin per inch evaporator coil*

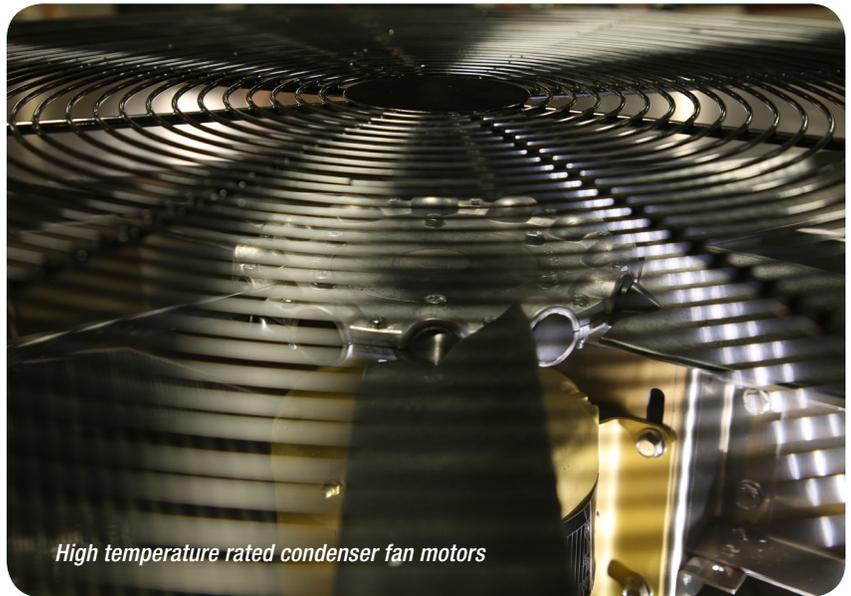
### **High Temperature Rated Condenser Fan Motors Increase Reliability**

Electric motors deteriorate with heat. This deterioration can be reduced by having motors rated to higher temperatures. Our direct drive condenser fan motors are rated for operation at temperatures of 158 °F (70 °C), which is higher than the industry's more typical motors that are rated for 125-130 °F (52-55 °C) operation.

Having higher temperature rated fan motors reduces the chance of failure when temperatures reach or exceed typical conditions, saving the owner time and money servicing or replacing a damaged motor.

### **Low Fin per Inch Coils Increase Ease of Maintenance and Lifespan**

Condenser and evaporator coils are selected to have a low number of fins per inch (FPI). Low FPI coils don't clog as easily or quickly, and are easier to clean. Water can penetrate deeper within the coil to remove dust and debris that can decrease both longevity and performance.



*High temperature rated condenser fan motors*



*Marine grade aluminum construction*

### **Available Marine Grade Aluminum Cabinet, Fasteners and Coils Extend Life Cycle**

All units come standard with aluminum evaporator and condenser coil frames, improving the frames' corrosion resistance. The available marine grade aluminum Thermoshield cabinet further improves the corrosion resistance of the entire system by leveraging the inherent properties of aluminum in order to minimize oxidization and galvanic corrosion. This allows the Thermoshield cabinet to maintain its strength and premium appearance for its 20 year lifespan and protects copper refrigerant tubing in the coils from galvanic corrosion.

Aluminum is naturally resistant to oxidization (rusting) and will not be compromised as it ages. With the Thermoshield cabinet, galvanic corrosion is reduced by using the same material in the fasteners as in the cabinet.

Galvanic corrosion occurs when two or more dissimilar metals are in contact with each other and an electrolyte (i.e. rain water or condensate), otherwise known as electrical contact. Electrical contact can come from direct contact between two materials or through indirect contact, such as through a bolt or screw. If such contact occurs, one material may corrode at an increased rate, while the other may see a reduced corrosion rate. This is a by-product of one material transferring electrons to the other material.

In the case of copper refrigerant tubing contacting aluminum coil frames, the copper will see a reduction in corrosion rates, protecting the vital refrigerant tubing.