



TRANE®

It's Hard To Stop A Trane.®

Why Trane.



A History Of Innovation.

A Tradition Of Quality.

A Story Of Superior Reliability, Durability And Efficiency.

A Future Of Continued Leadership.

A Century Of Innovation.

Trane began as a family-owned business more than a century ago, when James Trane opened his plumbing company in La Crosse, Wisconsin in 1885. His engineer son Reuben joined him in 1913. Together, they put their mechanical inventiveness to work as they moved from plumbing into manufacturing heating products. Their first innovation was a type of low-pressure steam heating system called Trane Vapor Heating. In 1925 they conceived the idea of a lightweight, highly efficient convector radiator to replace the heavy cast-iron radiators of their day. Their first air conditioner, the Trane Unit Cooler was designed in 1931. It was a bold new idea from a company that was becoming well-known for its innovative thinking. Through the decades that followed, that innovative thinking became a hallmark of Trane. Another milestone was reached in 1982 when Trane acquired the central air conditioning department of General Electric. This marriage of technology forged an even stronger future in the manufacturing of residential comfort systems. James and Reuben may be gone, but their legacy lives on as Trane continues to develop and apply leading edge technology in the design and manufacturing of air conditioning and heating systems that deliver years of dependable comfort.

Trane: A Brief History.

Why Trane.



We admit it. We do things differently.

Trane is also a global leader in providing innovative products and systems for industry and commerce. For more information on commercial applications, please visit www.trane.com/commercial.

We're a different kind of manufacturer. And, we don't mind admitting it. We don't just assemble pieces into parts and parts into air conditioners.

Trane engineers spend years researching and developing products based on the analysis of consumer and dealer needs. We design our products and components using the most durable materials and the most innovative technologies available. We manufacture our products with the tightest specifications and the highest industry standards. And we test our products – over and over, and over again. At Trane, we control product quality from idea to installation. And, that makes us just a little different from the other guys.

Trane builds air conditioners, furnaces, heat pumps, air handlers, coils, air cleaners, and packaged units for the residential and light commercial markets – products that are efficient to operate, work when they're supposed to, and last for a long time. On the following pages, you'll discover the many factors that contribute to the Trane difference.

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Why Trane.

System Superiority.

When designed around a consumer's lifestyle and specific needs, a Trane system is the best long-term solution for providing a superior level of indoor comfort.

A Trane comfort system is just that – a system that is completely integrated into a home's indoor environment, enhancing its livability, room by room by room. In the following chapters, you will learn why Trane components are extremely reliable, durable and efficient. When these components are combined into a system, you can imagine the impact they can make in a home's comfort. At Trane, we believe that any comfort challenge can be overcome by the selection of the right heating and air conditioning system. By working closely with consumers, a Trane dealer can provide comfort solutions for a consumer's home and years of worry-free satisfaction.

Trane systems are highly flexible. They are engineered to offer options in terms of capacity, airflow, humidity control, air filtration, energy use and operating efficiency. There are also options in thermostats and zoning and system controls.

Only A Complete System Can Provide Complete Comfort.

The performance and efficiency of an outdoor unit is based on its being matched with a similarly engineered indoor unit of like size and capacity. In other words, it is not assigned an efficiency rating independently as a separate component. An air conditioner or heat pump is assigned an efficiency rating as part of a matched system. If a new, high efficient outdoor unit is installed without replacing the evaporator coil, it is immediately a mismatched system and will not achieve the SEER rating indicated on its EPA hang tag. In fact, its efficiency rating will be rendered indeterminable at best. Studies have shown that if an old coil is not replaced when a new outdoor unit is installed, the new unit could actually suffer more than a 20% decline in SEER.

compressor in the outdoor unit to work harder than it should, which could ultimately shorten its life. A mismatched system is not the best comfort choice for a consumer, particularly if the consumer is purchasing a high efficiency outdoor unit in order to reduce energy use.

constantly monitors, analyzes and regulates the operation of the gas burner, the induced draft motor and the indoor fan. The multi-port in-shot burner perfectly shapes the flame cone for the maximum heat possible, while using the least amount of fuel. Each burner is fired at 20,000 BTUH, which is significantly less than many other furnaces in the industry. This lower BTUH leads to long-life and reliability. Another efficiency feature is the adaptive hot surface silicon nitride igniter, which starts burners electrically, eliminating a wasteful pilot light.

Trane's variable speed air handlers are also highly efficient. Equipped with an ICM (Integrally Controlled Motor), these units achieve significant energy savings. A standard motor only has an "off" and "on" speed, which means it runs at maximum capacity

when it's on. An ICM motor automatically varies its speed between zero and maximum and has slow ramp-up capabilities, which allows it to use very little energy. It also offers continuous comfort and quiet operation. When matched with the appropriate outdoor unit, you can create a highly efficient system, which provides greater comfort and a lower cost of operation.

By the same token, the cooling or heating capacity can also be affected. Studies have shown, that if an old coil is not replaced, a system could realize as much as a 10% loss in capacity.

Reliability also becomes an issue with a mismatched system. An older coil is usually a dirty coil. And a dirty coil causes the

A High Efficiency Rating Makes Dollars And Sense For A Consumer.



Every Trane System Is Built With Efficiency In Mind.

Every Trane comfort system has been designed to attain the highest level of performance with the least amount of energy use. For example, Trane furnaces have key furnace control functions integrated into one microelectronic system, which

While all of Trane's heating and air conditioning systems are highly efficient, durable and reliable, there's one choice that stands head and shoulders above the rest. And, that's our two compressor XL19i systems. These state of the art comfort systems take comfort and efficiency to a new level, offering the consumer a one-of-a-kind comfort experience.

Drawing on Trane's heritage in heat transfer and compressor technology, and marrying it with our highly innovative and tightly integrated cabinet design, these systems offer the quietest and most efficient operation of any comfort system available today. Our XL19i two compressor air conditioning systems offer two-stage cooling, while our XL19i two compressor heat pump systems offer two-stage cooling and three-stage heating. Take a look and see how Trane is raising the bar in home comfort.



A Complete Line-Up Of Ultra Efficiency Matched Systems.

- XL19i air conditioner, variable speed furnace, Comfort™ coil, electronic air cleaner and programmable thermostat
- XL19i heat pump, variable speed air handler, electronic air cleaner and programmable thermostat
- XL19i air conditioner, variable speed air handler, electronic air cleaner and programmable thermostat
- XL19i heat pump, variable speed furnace, Comfort™ coil, electronic air cleaner and programmable thermostat

An Experience Unlike Any Other: The XL19i Comfort System.

The Highest Possible Efficiency.

Trane's two compressor systems offer some of the highest efficiency levels in the industry. In fact, the XL19i air conditioner, which is rated at 19.50 SEER, has the highest efficiency level of any air conditioner available today. Trane's two compressor XL19i heat pump system is rated at 17.90 SEER in the cooling mode and has an HSPF rating of 8.90 in the heating mode. These ultra high efficiency levels represent a significant annual savings in cooling costs for consumers.

Staged Heating And Cooling.

Instead of operating on a single, full-blast speed, a multiple stage system operates efficiently at a lower speed most of the time. On extremely hot or cold days, it switches to a higher stage to maintain comfort. Because of this, staged heating and cooling puts an end to temperature swings. And, since the system operates at a slower speed much of the time, conditioned air is continuously distributed throughout the home, enhancing comfort and indoor air quality.

Reduced Operating Sound Levels.

Our systems are designed to be quiet, beginning with the heavy steel insulated cabinets and variable speed blower motors in our high efficiency indoor units. With our quiet Climatuff® compressors and sound insulators in our outdoor units, exterior operating sound is minimized as well. The cabinet design of our outdoor products also leads to reduced operating sound, with rattle-resistant panels and top, and a composite basepan which prevents metal on metal vibration.

Variable Speed Technology.

The variable speed motor used in XL19i systems is programmed to be a constant airflow blower motor. The drive module controls the motor speed and torque to ensure a constant volume of airflow. If the resistance to airflow in the duct system increases (due to dirty filters, closed registers or other reasons), the drive module immediately detects this and increases the rpm of the motor. When the drive module picks up the higher rpm, it will increase the speed and torque to move more air. When the desired airflow is again achieved, the motor settles into the proper speed. This unique feature of speed variability ensures compressor reliability, proper system capacity and airflow distribution throughout the duct system.

Comfort-R™ And Dehumidification.

When variable speed is combined with two compressor systems, airflow delivery can be programmed to deliver 50% airflow during first stage operation and 100% during second stage. This managed process is called Comfort-R™ and it's set by the installer. During cooling, the motor ramps up slowly – the slow movement of air allows the Comfort™ coil to cool quickly which means moisture is extracted from the air. This dehumidification feature removes six times the amount of moisture that a standard system can. It also provides more immediate comfort, allowing a home to get cooler or warmer faster.

Enhanced Indoor Air Quality.

With variable speed technology, a constant flow of conditioned air moves through a home, providing a cleaner indoor environment. But, there's another component of an XL19i system that provides cleaner indoor air – and, that's an electronic air cleaner. A Perfect Fit electronic air cleaner is up to 40 times more effective than a standard throwaway filter and is up to 99% effective at removing airborne particles. Because it removes particulate matter so effectively, it protects the operating efficiency of the system over time. It's also energy efficient, using less energy than a 40-watt bulb.

FACT: Trane's XL19i air conditioner has a SEER rating of 19.50. This makes it the most energy efficient air conditioner in the world.

Why Trane.

Reliability.

Trane and reliability go hand in hand. Every day we stake our reputation on the fact that our products work when they need to, year in and year out.

The heart of a reliable Trane system is the Climatuff® compressor. Since 1938 when the industry's first hermetic centrifugal refrigeration machine was introduced by Trane, we've lead the way in defining the standards in compressor technology. Our reciprocating compressor was the first successful heat pump compressor and is well known for its superior durability, its low noise levels, and its ability to provide high operating efficiencies. The Climatuff® scroll compressor uses a similar design and the same testing standards to continue the Trane tradition of excellence in compressor technology. Trane uses either a reciprocating or scroll compressor in all outdoor products, depending on the level of efficiency and reliability required for a specific application.

Reciprocating Technology

The Climatuff® Difference.

What makes a Trane Climatuff® compressor the talk of the industry? For starters, it was the world's first successful heat pump compressor. Over the years, its reputation has been built on the fact that it handles the extreme operating conditions of heat pump applications with ease. For example, a compressor's reliability is directly related to its ability to handle stress. The Climatuff's all-aluminum frame not only dissipates heat, but its light weight reduces stress on its mounting springs, as well. Valves are another critical factor because they experience more stress than any other component. For that reason, Trane manufactures compressor valves to extremely tight design specifications.



Our lightweight piston and connecting rods allow for easier starts and higher running efficiencies. A pearlitic cast iron cylinder increases durability.

The differences add up to the most durable compressor manufactured in the industry today. Read on.

Designed To Handle Thermal Stress.

The Climatuff® compressor's stress handling ability begins with its aluminum frame, and its aluminum pistons and connecting rods. An aluminum frame reduces thermal stress and allows the compressor to run cooler than compressors with cast-iron frames, which tend to retain heat, resulting in higher operating temperatures.

The frame is designed with a very large intake area to minimize the pressure drop of suction gas. Suction gas flow to the valve is virtually unrestricted.

The lightweight aluminum pistons and connecting rods provide for easy starts and relieve stress on the crankshaft. Trane uses an industry-unique pearlitic cast-iron cylinder liner for enhanced durability.

The Acousti-Cool Process.

The Acousti-Cool Process is engineered motor temperature management. Managed motor cooling allows the compressor to run cooler than other hermetic compressors, and leads to longer motor life and lower operating costs.

Acousti-Cool works like this. During the first phase of the process refrigerant is returned to the compressor through the high level suction inlet. Gas, which is approximately 100 degrees cooler than the motor windings, flows across the top of the motor cooling it down. Core motor cooling continues as the gas is routed downward through the windings and between the rotor and the stator. While it's being cooled, the motor performs the duty of a suction gas muffler. Since potential sound energy is being absorbed simultaneously with return gas motor cooling, the process is called Acousti-Cooling.

An all-aluminum frame, motor housing, piston and connecting rod help to reduce thermal stress and help the compressor run cooler by dissipating heat away from the bearing surfaces.





"Snowball" underwent a continuous flood back test in the Trane compressor life test facility for 27 years, before finally ceasing to operate in 2000. The test demonstrates the reliability of the compressor under conditions like low indoor airflow or system overcharge.



Climatuff® compressors are designed to handle the extreme conditions of heat pump applications, including higher operating temperatures, liquid refrigerant flooding, adverse electrical stresses, and the stress of long operating hours. To maintain this level of superior performance, Trane adheres to a strict compressor testing philosophy, which yields continuous application and design improvements.

All Climatuff® compressors feature highly reliable Rotolock mechanical fittings. These fittings make service and replacement much easier because there is no brazing or cutting required. Enhanced safety is another benefit.

The next phase takes place on the upstroke of the piston. The suction valve closes, holding back the incoming flow of gas until the next intake stroke. This abrupt stop creates a pressure pulse that travels backward along the inlet path at the speed of sound. The pulse of refrigerant vapor hits the bottom of the motor, muffling noise as it cools the bottom windings.



The rugged valve assembly is the most critical component of the Climatuff® compressor.

second, up to 800 million times a year. Because of this wear and tear, an indestructible valve material is required.

Trane manufactures discharge and suction valves using a special Swedish-type valve steel. The steel has a

unique microstructure that has a high carbon content and a very low amount of non-metallic inclusions, such as sulfides and silicates. This composition makes Climatuff® valves highly impact and distortion-resistant. They're also resistant to metal fatigue and are not affected by excessive heat.



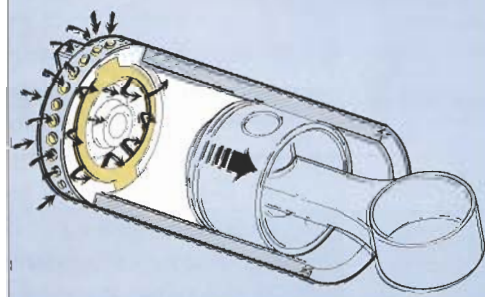
Valves are made of Swedish-type steel to handle extreme heat and the stress of opening and closing 57 times a second.

Why Valve Design Is Critical.

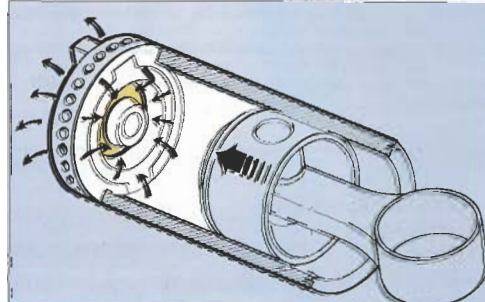
Valve design is critical to liquid refrigerant tolerance. On mild days, liquid refrigerant can accumulate in the suction line and flood the compressor on start-up. Because of this, valves must be able to tolerate some slugging. Climatuff's valve assembly has been designed to allow liquid refrigerant to be expelled from the cylinder without damaging the valves.

Valves experience more mechanical, thermal and pressure-related stresses than any other component of the compressor. In heat pumps for example, they spring open and shut 57 times a

How Reciprocating Compression Works.



On the downstroke of the piston, when pressure in the cylinder is less than suction pressure, the suction valve is pushed off its seat allowing refrigerant into the cylinder. The gas enters efficiently in a cylindrical pattern around the circumference of the valve.



On the upstroke, the suction valve closes preventing refrigerant from leaving the cylinder. When cylinder pressure exceeds discharge pressure, the large round discharge valve lifts completely off its seat allowing gas to efficiently exit the cylinder. If there is liquid present, flow dynamics resulting from tapered surfaces and valve proximity will allow the liquid to be purged from the cylinder without damaging the valves. Besides being gas flow efficient, Trane's valving is engineered to tolerate some liquid slugging.

FACT: As of 2003, Trane will have manufactured 100 million Climatuff® compressors.



Climatuff® Reciprocating Compressor

- 1 **Internal Pressure Relief Valve (IPR)** – High pressure protection for a longer life.
- 2 **Metal To Glass Hermetic Terminal** – Insulates terminal from steel shell, and prevents electrical and refrigerant/oil leakage.
- 3 **Pearlitic (Super Hard) Cast Iron Cylinder Liners** – Superior wear resistance for long life.
- 4 **Aluminum Pistons And Connecting Rods** – Lighter weight provides for quicker starts and lower stresses.
- 5 **Aluminum Pump Body** – Dissipates heat faster and runs cooler.
- 6 **Internal Overload** – Provides overheating temperature protection caused by (1) low refrigerant pressures or (2) excessive electrical currents resulting from extreme operating conditions. Resets itself, avoiding service calls.
- 7 **Motor Winding Insulation** – Super strong epoxy locks the windings in place and resists erosion of insulation by refrigerant and oil.
- 8 **Internal Muffler** – Reduces compressor sound and vibration levels for quieter operation.
- 9 **Special Valve Steel** – Made from one of the world's finest steels, so impact resistant that valve stress is not a problem for the Climatuff.®
- 10 **Rotolock Fittings** – Unique design makes compressor service quick and easy should it ever be required.
- 11 **Internal Spring Mounting** – Double spring mounting reduces motor vibration and noise. The design is so unique it's patented.
- 12 **Special Oil** – Specially refined and formulated to keep internal parts lubricated and running smooth.

The heavy steel shell of the Climatuff® reciprocating compressor can withstand many times normal operating pressure. It's designed to seal oil and refrigerants in – and keep contaminants out.

Large Shell Design Is A Distinct Advantage.

Climatuff® reciprocating compressors have 25 percent more volume inside the shell, which is a distinct advantage over other compressors. With a large shell design, the need for suction line accumulators on residential systems is eliminated. Because of this, the potential oil traps, system leaks and pressure drops associated with a separate accumulator are no longer a concern.

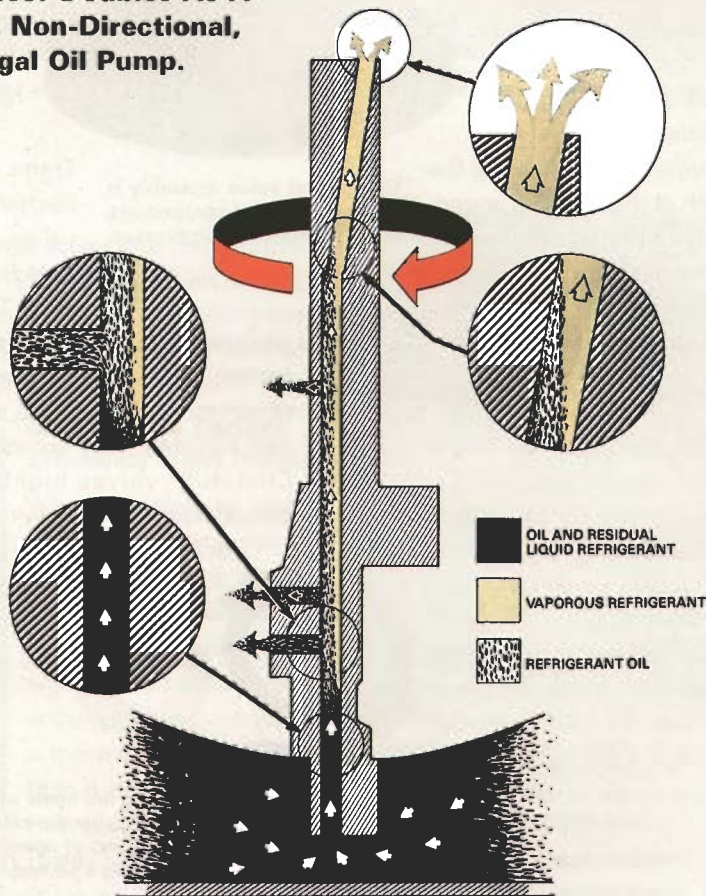
Large shell volume of a Climatuff® reciprocating compressor.

All Climatuff® compressors have the discharge line routed through the compressor sump.

With the compressor running, the hot discharge line will vaporize the liquid refrigerant in the sump separating it from the oil. In the off cycle, Trane uses crankcase heat on compressors where needed to vaporize liquid refrigerant and maintain desired oil temperature.

For increased reliability, magnets are installed in the large sump to catch metal particulate and keep it out of the bearings.

The Climatuff® Reciprocating Compressor Doubles As A Positive, Non-Directional, Centrifugal Oil Pump.

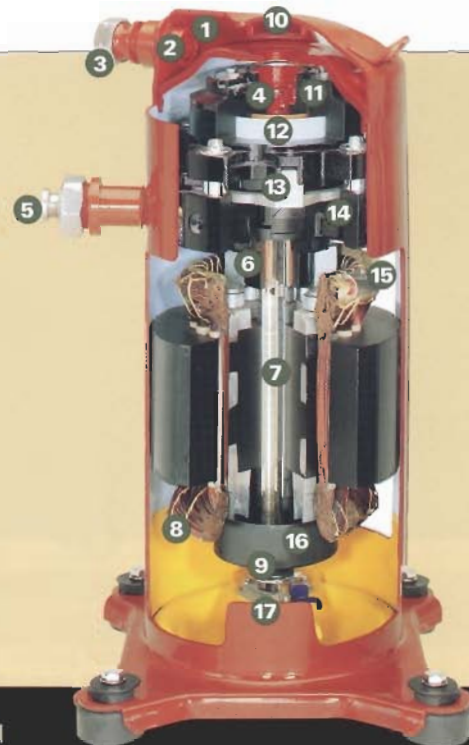


A Dual Purpose Crankshaft.

Good lubrication is essential to long compressor life and is one of the keys to its reliability. The Climatuff® compressor's crankshaft doubles as a positive, non-directional, centrifugal oil pump. It provides a constant oil supply to the bearing surfaces when the pump is running. In addition, it helps vaporize liquid refrigerant and cools the motor bearings.

Climatuff® Scroll Compressor

- 1 High Pressure Volume – Small top cap of shell serves as internal muffler.
- 2 Check Valve – Internally equalizes shell for easy start ups.
- 3 Discharge Rotolock – Allows for ease of installation and removal.
- 4 Bi-Metallic (TOD) Thermal Disc – Bypasses discharge gas.
- 5 Suction Rotolock – Allows for ease of installation and removal.
- 6 Rotor Counterweights – Allows for smooth operation.
- 7 Crankshaft – Feeds oil centrifugally through center bore to bearings.
- 8 Yellow Shows Oil Level
- 9 Lower Bearing – Supports crankshaft.
- 10 Discharge Deflector
- 11 Floating Seal For Axial Conformance – Seals high to low pressure and allows axial conformance.
- 12 Lower Orbiting Scroll Set – Rotating crankshaft converts to orbiting motion of lower scroll, which produces compressed gas.
- 13 Orbit Coupling
- 14 Positive Shutdown Device – Separates scrolls at shutdown to eliminate noise or reversal.
- 15 Internal Overload – Protects motor from overheating.
- 16 Oil Baffle – Separates oil in sump from churning counterweights.
- 17 Oil Pick-up (Underneath)
- 18 Terminal Plug (Not Shown) – Assures correct electrical connections.



Rather than a fixed chamber that uses a piston or roller to change volume, the scroll compressor uses a moving pocket, which is produced by the orbiting motion of two involutes.

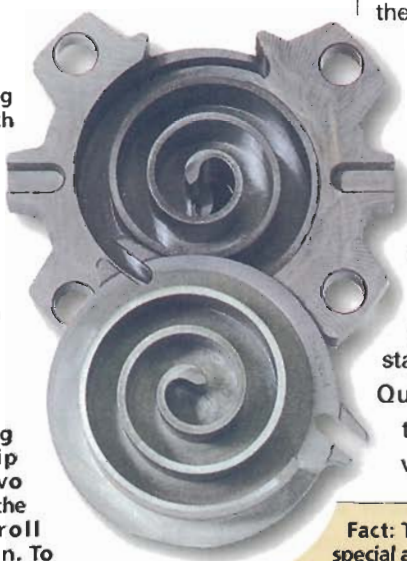
Scroll Technology

Conformance Is Key.

Trane's Climatuff® scroll compressor features an innovative method, referred to as "conformance" for assuring a tight compression pocket. The orbiting scroll is self-adjusting. It moves radially in and out to precisely follow the shape of the involute; the fixed scroll moves vertically to maintain optimum contact of the tips. This dual motion is the key to achieving the full benefits of the Climatuff® scroll.

The scroll compressor uses a moving pocket which is produced by the orbiting motion of the four spiral operations described in the box at right.

The orbiting relationship of these two involutes is the key to scroll compression. To perform properly, they have to stay in contact the entire length of the involute.



The Benefits Of Conformance.

The benefits of Climatuff® conformance are many, including maximized efficiency, durability, low voltage start-up and quiet operation. Compressor conformance increases efficiency by continuously compressing the refrigerant gas in each rotation with minimal leakage. Low leakage is achieved with minimal efficiency-robbing friction because of the tight manufacturing tolerances of Climatuff® compressors. Durability is improved because conformance allows the scroll to handle reasonable amounts of liquid flooding and system contamination. Flanks and tips will separate if liquid refrigerant or debris is present allowing the particulate to pass through without harm to the involutes. Conformance allows the flanks and tips to separate when the compressor cycles off and on and unloads the gas from its high-pressure state. This allows for low voltage start-ups. Hard start kits are not required. Quiet operation is achieved because the orbiting motion causes very little vibration.

Fact: Trane is the only manufacturer to patent a special anti-reverse control device for scroll compressors. When coupled with a 30-second delay on the defrost control board, this device ensures that power interruptions will never cause heat pumps to run backwards.

How A Scroll Compressor Works: Unrestricted Gas Flow Optimizes Efficiency



Cold, Low Pressure – Entering Gas. Compression in the scroll is created by the interaction of the orbiting spiral and a stationary spiral. Gas enters the outer opening as one of the spirals orbits.



Warmer, Medium Pressure – Interim Gas. The open passage is sealed off as gas is drawn into the spiral.



Hot, High Pressure – Discharge Gases. As the spiral continues to orbit, the gas is compressed into an increasingly smaller pocket. By the time the gas arrives at the center port, discharge pressure has been reached.



All Stages Working Together. During operation, all six gas passages are in various stages of compression at all times, resulting in nearly continuous suction and discharge.

Systems Extreme Environmental Test Laboratory (SEET)

Trane's Reliability Testing Facility

What it is:	A controlled testing environment that simulates extreme weather conditions. Built in 1982.
What it tests:	Heat pump systems – up to 72 at a time.
Length of test:	16 weeks of high stress, accelerated conditions simulating five years of wear and tear.
Why it exists:	SEET supports Trane's manufacturing philosophy of testing in the lab, not in a consumer's home. All of Trane's testing procedures are conducted at much higher extremes and in more stressful conditions than the rest of the industry.

In the SEET lab, Trane technicians will put a heat pump system through 2,688 hours of continuous testing, watching for signs of weakness or unusual wear. Why do we only test heat pumps? Because if a Climatuff[®] compressor can withstand SEET as a heat pump, it will easily handle any stress it may encounter as an air conditioner. During the 16-week testing period, heat pump systems undergo two-week cycles of torture, eight consecutive times allowing engineers to measure and manage a system's quality and performance. Only the strong survive.

Round 1: Heating defrost with snow

Outside temp: 23° with snow

Inside temp: 105°

Objective: The heat pump's challenge is to heat and maintain an inside room at 105° while operating in sub-freezing conditions. The coil must be free of ice build-up in order to perform under these conditions. This test will require the compressor to work very hard and run almost continuously.

Round 2: Cooling

Outside temp: 100° with fan shut off

Inside temp: 75°

Objective: To cause the unit to cycle on overload by simulating outdoor fan failure. This test will also determine if the unit will restart after it cools down.

Note: When pressure builds too high, the internal pressure relief valve will open and discharge hot gases over the internal motor overload device, which in turn will open and shut down the compressor. The internal overload device is designed to take the compressor off-line on any combination of temperature and current that exceeds motor winding tolerances.

Round 3: Minimum load heating

Outside temp: 0°

Inside temp: 90°

Objective: With minimum refrigerant flow, the motor often seizes because there's not enough oil to lube the bearings to keep them from burning. The Climatuff[®] compressor has the velocity necessary to pull oil back through the lines and into the compressor to lubricate all bearing surfaces.

After each test period, each unit is disassembled and its compressor is cut apart and analyzed to locate signs of stress.

Round 4: Power shut off

Objective: After 12 hours of power outage, oil has drained or has been washed off bearing surfaces by refrigerant migration. The oil reservoir at the bottom of the sump has been floated above the oil pump opening by the heavier liquid refrigerant. On start-up, Trane's unique bearing plating will serve as a boundary lubricant until oil flow is established. This test simulates the effects of a power outage, giving engineers the opportunity to see if the compressor can withstand starting conditions with little or no oil pressure.

Round 5: Cooling maximum load #2

Outside temp: 135°

Inside temp: 100°

Objective: To remove excessive indoor heat, getting rid of it outdoors. The compressor is required to stay on-line in order to pass this grueling test.

Round 6: Cooling flood

Outside temp: 85°

Inside temp: 80° with indoor blower off

Objective: To subject the compressor to the mechanical stresses of liquid refrigerant flood back. Gross system overcharge or blocked indoor airflow could cause this condition.

Round 7: Cooling maximum load #1

Outside temp: 125°

Inside temp: 80°

Objective: To attempt to force the compressor to shut down under the stress of high load conditions.

Round 8: Power shut off

Objective: To produce a start-up situation that could seize most compressors due to low oil pressure across the bearings.



XL19i
Heat Pump



XV90 Variable
Speed Gas
Furnace

Outdoor Unit Testing Procedures:

Psychrometric Lab Tests:

Run tests according to ARI Standard 210/240. Indoor rooms capable of simulating temps of 40 F to 100 F. Outdoor rooms simulate -20 F to 120 F.

Compressor Motor Tests:

Compressor motors are tested at five to six times the rated current and at twice normal temperatures. Compressor is turned on and off at cycling rates ten times faster than normal for weeks at a time.

Compressor Calorimeter Testing:

Capacity and development tests are conducted in a thermally controlled environment, unmanned and collecting data continuously.

Compressor Life Test Room:

50 test stands for testing mechanical loadings, high-pressure refrigerant charge, bearing stresses, fatigue stress, chips contamination in the refrigerant and more.

Rain Room Tests:

Underwriters Laboratory (UL) rain tests conducted at 6-inches per hour to detect any risk of shock from electrical components.

Materials And Processes Lab Tests:

Ongoing testing on alternate refrigerants, metallurgy, oils, powder paint processes and more.

Rain/Fog/Low Temperature Room Tests:

Tests demand defrost controls, ice build-up, oil migration and cold start-ups for motors and compressors.

Why We Test:

Performance.

Prescribed by ARI and carried out with tests in accordance with ASHRAE standards.

Reliability.

Trane's reliability tests exceed industry standards. For example, a 2,000-hour salt spray test is run on fin-type coil samples to check corrosion levels. Industry standards require 1,000 hours of testing. Trane also field-tests units in real-world environments to monitor the harmful effects of salt spray on painted surfaces, Spine Fin coils and electrical components.

Safety.

Required by UL, safety tests consist of electrical component temperature and pressure testing. Trane's safety tests are conducted at extremes higher than required by industry standards.

Simulation Of Data.

Airflow and sound tests are conducted in order to simulate product performance.

Gas Furnace Testing Procedures:

Heat Exchanger Thermal Stress Test:

ANSI.Z21.47 residential gas furnace design standards require all furnace heat exchangers to pass a 10,000-cycle stress test without failure. Trane's patented heat exchanger design successfully passed this test five times.

Heat Exchanger Corrosion Test:

Trane's heat exchangers are tested with "chlorine-spiked fuel" to simulate operation with contaminated combustion air. The corrosion test is operated for a minimum of 100 days and 12,000 cycles and provides the assurance of long-term reliability.

Heat Exchanger Pressure Decay Test:

Each individual heat exchanger is pressure tested to comply with the ANSI.Z21.47 test standards. Trane goes one step further and stamps the test station number into the corner of each heat exchanger that passes the test. This stamp of approval provides a visual confirmation of a gas-tight heat exchanger and approval for use in a Trane furnace.

Combustion Testing.

There is an extensive set of combustion and emission tests required for design certification. Trane not only meets these industry standards, but also routinely conducts more stringent tests in order to produce a more robust design.

Electronic Verification Of Parts:

Key furnace components are electronically verified for each individual furnace model by scanning the bar code label. The end of line run test requires all critical parts to be verified before the test can begin.

End Of Line Run Test:

Trane fires each furnace and cycles all of the components. The computer controlled run test automatically sequences the furnace through a series of tests and will only print a shipping label for furnaces that pass. The test data for each furnace is permanently stored for use by Trane's field support personnel.

Daily Audits.

Compliance audits are required in order to maintain agency approval. Trane exceeds these requirements by performing a daily audit of furnaces built on each assembly line.

Trane reliability is the result of a long history of comprehensive component and system testing – testing that not only meets industry standards, but exceeds them. That's because at Trane, we set industry-leading standards.

Why Trane.

Durability.

Trane manufactures products using durable materials and time-proven technologies. The end result? Products that withstand the daily demands of living and the constant requirements of comfort. Products that are built to last a long time.

At Trane, we build in durability from the inside out. First we design our indoor and outdoor products with exacting specifications and innovative features that will wear well over time. Then, we make sure they're easy to access and service for better long-term performance and a longer life. Plus, we use only the most durable materials in the manufacturing process – materials that have passed the test for strength and resistance to stress. And, finally, we finish with protective coatings so our products can stand up to any climate, from coast to coast, for years to come.

O u t d o o r P r o d u c t s

From the durable DuraTuff™ basepan, to the galvanized steel louvers, on up to the polycarbonate Weatherguard™ II top, a Trane outdoor unit is built to last. Even the cabinet fasteners are specially treated to resist rust and outlive normal zinc coated screws.

Durability By Design.



Weatherguard™ II Top

- Withstands 1,440 hours of 194° desert heat
- Withstands 100 ft/lbs of impact in -35° Arctic cold
- Withstands a 300-pound load
- Withstands the impact of a 90 mph fastball

Weatherguard™ Fasteners

- Rust resistant
- Meet 1,500-hour salt spray test
- Double the thread engagement area
- 50% improvement over ceramic coated screws



Seacoast Shield



- Protects transition joints from salt spray and pollution
- Eliminates need for corrosion prevention materials
- An added durability feature for ocean-front environments

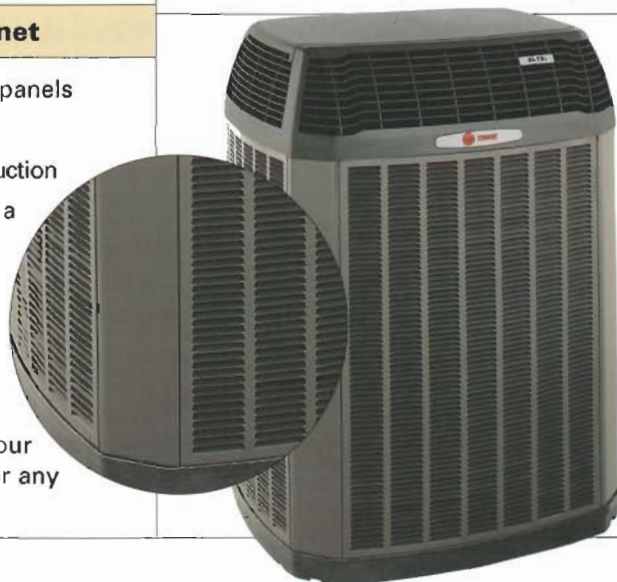
Integrated Steel Cabinet

- Powder painted louvered panels
- Full coil protection
- G90 galvanized steel construction
- Interlocking seams create a tight fit and finish
- X-brace construction enhances cabinet stability
- Recessed screws, rounded edges and integrated panels make our outdoor products safe for any backyard



Duratuff™ Basepan

- Molded-in-color will not fade
- Withstands 135-degree 20-year accelerated heat test
- Won't crack, warp, corrode or rust
- Withstands a 800-pound load



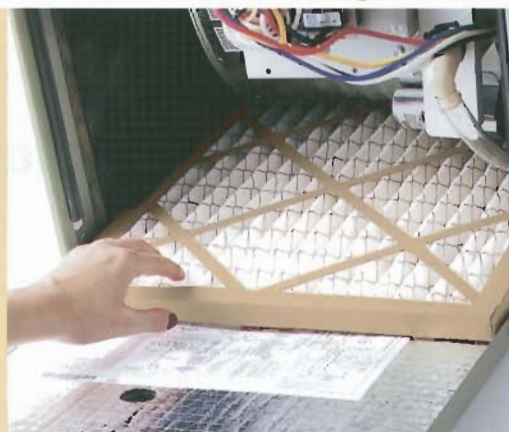
Trane Products Are Easy To Service And Easy To Maintain Which Leads To Longer Life.



Every Trane air conditioner and heat pump model is quick to install and service. All electrical and refrigerant controls are always in the same place under one easy to remove corner panel.



The front panel of our Comfort™ coils is removable for easy cleaning access. A clean coil is more efficient and supports a long system life.



The dual door latch design of our upflow furnaces makes the filter door easy to open so filter changing is a breeze for homeowners. This helps maintain system performance over the long haul.

Accessibility is an important design feature of all Trane products. That's because a product that is easy to access for service or regular maintenance is a product that will age well over time.

Premium Products Require A Premium Finish.

One of the most recognizable attributes of a Trane outdoor product is its powder paint finish. Not only is this high gloss finish a consistent winner with consumers, but it is also a tried and true durability feature. Ultraviolet light from the sun breaks down the chemical bonds in most paints and results in chalking and fading. Powder paint resists the effects of ultraviolet light, so a unit that is installed today will still look good ten years from now.

The electrostatic application of powder paint also provides an excellent coating for sharp metal edges. Unlike liquid paint processes where the paint recedes from the edges, powder paint builds at the edges and forms a protective shield against corrosion and rust.

The combination of corrosion resistance, chalking resistance, and a quality appearance continue to make powder paint far superior to other paint processes.

A Perfected Process.

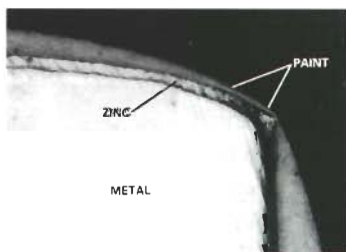
An excellent paint finish is only as good as the material underlying it and the pretreatment process. At Trane, we begin with quality untreated galvanized steel.

Then we put it through a six-stage pretreatment process, which cleans and etches the steel, applies a corrosion-fighting zinc phosphate layer, and then seals the surface.

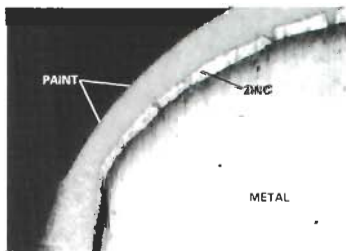
The zinc phosphate is present as microscopic crystals that completely cover the untreated steel. This provides additional corrosion resistance and a jagged surface for better paint adhesion.

After the powder paint is applied to the steel, the metal is then baked in a series of ovens where the 390° heat produces a powerful chemical bond.

The final result is an incredibly durable finish that protects the louvers of our outdoor products during the harshest winters and the hottest summers.



A louvered panel has been painted with liquid paint, cut in half, and magnified to show paint coverage. Because of surface tension, liquid paint recedes from the sheared edge.



With our powder paint process, an electrostatic charge builds at the edges of the metal drawing the powder to the sheared edge.

Indoor Products Durability Features

Air Handlers

- 1 Heavy steel insulated cabinet
- 2 No-rust polycarbonate drain pan
- 3 Corrosion resistant finish



Variable Speed Air Handler

Furnaces

- 1 Heavy steel insulated cabinet
- 2 Heavy duty aluminized steel primary heat exchanger
- 3 Durable stainless steel secondary heat exchanger
- 4 Internal vent pipe of long-lasting CPVC material



XV90 Variable Speed Gas Furnace

Durability: Indoors

Why Trane

11

Why Trane.

Efficiency.

Heat transfer is one of the most important factors in achieving heating and cooling efficiencies. Trane's proprietary coil design, Spine Fin[®], has proven to be superior to any other technology.

Extensive research and development have led to the innovative heat transfer characteristics of radiating finned, all-aluminum Spine Fin[®] coil heat exchangers. And, more than 40 years of real-world application experience have confirmed Spine Fin's long-lasting effectiveness and work-horse durability. Trane continues its tradition of excellence in heat transfer by focusing on the basics of success: always using modern and innovative technologies; only using similar metals and proven materials; and, maintaining our notably high standards in the manufacturing process.

All - Aluminum Spine Fin[®] Coil

In a typical year, Trane will produce more than 26,000 miles of Spine Fin[®] coil – that's enough Spine Fin[®] to go around the world.

We Continue To Push The Envelope.

Trane began full-scale production of Spine Fin[®] coils for use in outdoor products in 1968. After years of success, Spine Fin[®] has reached a legendary status in the industry. In fact, today it ranks as the most efficient heat exchanger currently being manufactured.

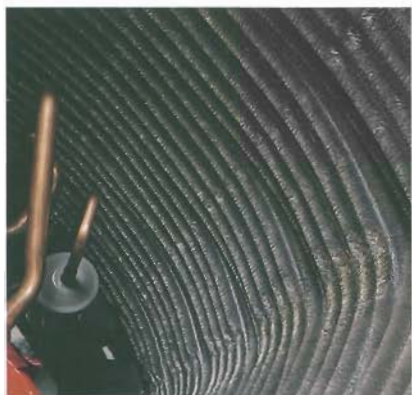
But at Trane, we're not known for resting on our laurels. Our engineers and product specialists continue to push the envelope in heat transfer technology, constantly looking for greater efficiencies and more durable processes. For example, our new woven coil technology has proven to provide ultra levels of efficiency in our high-end air conditioners and heat pumps, clearly paving the way for even

greater consumer acceptance and a further reduction in the use of fossil fuels. In fact, Trane again made history, by rolling out an air conditioner with a SEER level of 19.50 in the first quarter of 2003.

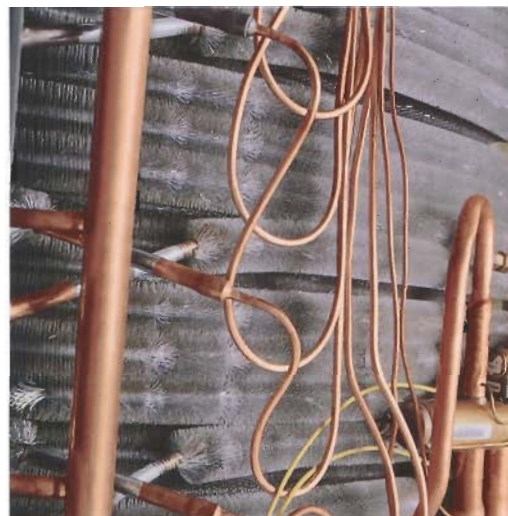
Consumers Expect Efficiency From Trane.

Why is maintaining long-term efficiency important? When replacing an air conditioning or heat pump system, consumers can significantly save on their cooling bills by purchasing a more efficient system than they currently have. However, the unfortunate reality is the efficiency of their new system will decline over time, as will their savings. That's why

Spine Fin's ability to retain a system's efficiency over the course of its lifetime is so significant. Not only is a Trane



Spine Fin[®] coils are fabricated in continuous lengths. Because of the number of leading edges, one row has the ability to transfer the same amount of heat as three rows of plate fin.



A typical 2 1/2 ton air conditioner or heat pump requires 30 or more brazed joint connections in the coil. A modern Trane unit of the same size requires only 10 with Spine Fin[®].

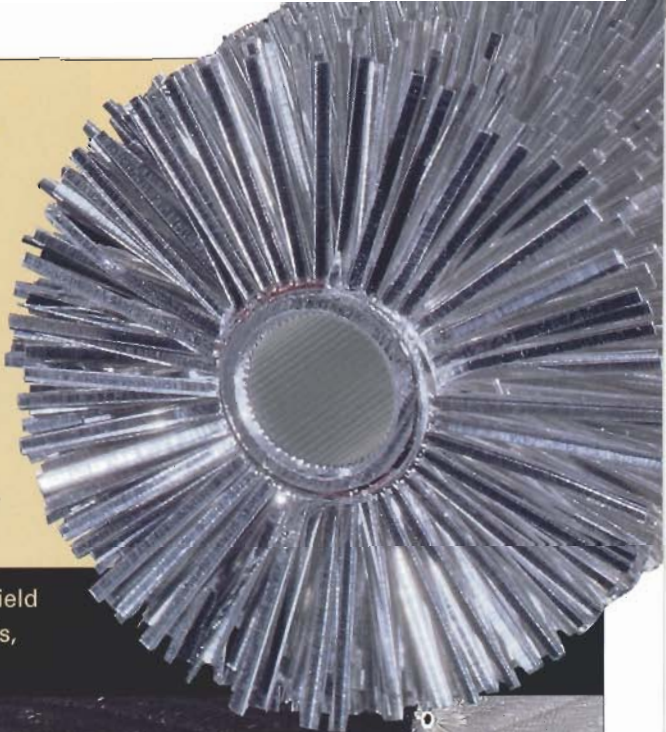
system efficient to operate today – but it maintains that efficiency during its years of service to the homeowner. And, that's the Spine Fin[®] difference. Consumers have come to expect a higher standard of efficiency and durability from Trane products. Spine Fin[®] helps us fulfill this expectation.

What Causes Efficiency Loss?

1. A leak in a coil joint.
2. Loss of thermal contact between the fin and tube caused by corrosion.
3. A dirty or damaged coil.
4. Different manufacturing processes. For example, the use of dissimilar metals (copper and aluminum) leads to loss of thermal contact because they expand at different rates.

How Does Spine Fin® Prevent Efficiency Loss?

1. It's designed for leak resistance.
2. It's made with corrosion resistant materials and innovative construction techniques.
3. It's housed in an enclosed, protective cabinet. And, it's cleanable.
4. On-going research and development keep Spine Fin® on the leading edge.



A five-year survey by Trane's Product Service Department showed that the field leak rate in two million coils of various sizes, which contained 15 million joints, was only .05% over a five-year period.

The Spine Fin® Difference: A Leak Resistant Design

One-Third The Number Of Brazed Joints.

Spine Fin® has an extremely low leak potential. Coils are more prone to leaking at joints, and Spine Fin® has far fewer joints than plate fin. That's because Spine Fin® tubing is manufactured in continuous lengths. Brazed connections are required only at the coil (or circuit) inlet and outlet.

Elimination of end-turns used in copper tube plate fin designs permits a dramatic reduction in brazed joints and potential leaks in this design. Of course fewer leaks increases system reliability and durability. This also means a longer compressor life, because the introduction of moisture and contaminants into the sealed system is prevented.

In contrast, plate fin coils are made by stacking flat fins on parallel tubes. Each tube pair requires an end-turn to complete

the refrigerant circuit. A typical 2 1/2 ton air conditioner or heat pump requires 30 or more brazed joint connections. A modern Trane unit of the same size requires about 10. Plate fin coils have three times the leak potential.

Trane's Unique Transition Joint.

Like other manufacturers, Trane uses copper tubing in piping the refrigerant circuit. What is unique is Trane's copper aluminum transition joint. This component is ultrasonically pre-tinned with a zinc rich, aluminum solder. As it is assembled into the heated aluminum tubing, it forms a solder fillet at the joint. This solder fillet is sacrificial and protects both of the base metals from corrosion.

A five-year survey by Trane's Product Service Department showed that the field leak rate in two million coils of various sizes, which contained 15 million such joints, was only .05% over a five-year period.



Woven coil technology is the newest generation of Spine Fin®. The woven coil design weaves a continuous roll of Spine Fin® in a layered configuration, creating an even greater surface area. This greater surface area results in increased efficiency and a reduced cabinet size.



This patented, plated copper tube enables Trane to make a remarkably sound copper/aluminum transition joint.



The integrity of the copper to aluminum connection in the coil is legendary.



The rounded corners of Trane's four-sided coil design eliminates return bends and provides maximum efficiency.

The Environment Outdoors Is A Powerful Corrosive Force.

The outdoor environment is harsh, with dramatic swings in temperature, precipitation, wind and humidity. Near the ocean, the air contains salt-laden moisture. In and around cities, the atmosphere contains oxides of sulfur and nitrogen, acid and alkaline dusts and gases. Most competitors' coils can't stand up to these powerful corrosive forces. However, the carefully selected aluminum alloys in Spine Fin® provide protection from even the harshest outdoor environments.

At right: Competitive units in Florida show the wear and tear of beachfront living.



A defense against corrosion prolongs system life while maintaining system efficiency. The positive attributes of any heat exchanger – high heat transfer efficiency, freedom from leaks, debris tolerance, and compressor protection – are meaningful only if a coil can survive the aggressive environment outdoors.

The Spine Fin® Difference: Resistance To Outdoor Corrosion.

A Defense Against Galvanic Corrosion.

Corrosion can prove deadly to a coil. It can cause a loss of thermal contact between the tube and fin and in turn can lead to a significant reduction in efficiency. The resistance of Spine Fin® to outdoor corrosion and subsequent deterioration is a substantial benefit. Spine Fin® has the lowest corrosion potential of any outdoor heat transfer technology, particularly in seacoast environments and acid rain exposure. In these kind of damaging exposures, an air conditioning coil experiences two kinds of corrosive actions: galvanic, or two-metal corrosion and crevice corrosion.

Galvanic corrosion occurs when two dissimilar metals in close proximity to each other are exposed to a conducting fluid, such as salt spray, acid rain or chemically tainted rainwater. From there, the two metals act as a battery in which one metal sacrifices itself to the other. The more dissimilar the metals (for example,

copper and aluminum), the greater the potential for corrosion. This is why a copper tube/aluminum plate fin coil has five times the corrosion potential of an all-aluminum coil such as Trane's.

Spine Fin® Is Not Prone To Crevice Corrosion.

Crevice corrosion is the second major corrosive force that can undermine the integrity of an outdoor heat exchanger. Crevice corrosion is caused when stagnant solutions are trapped in very small spaces. A few thousandths of an inch is a sufficient enough space to qualify as a crevice and is typical of the space between the tubing and fin stock of plate fin coils.

In the construction of plate fin coils, aluminum fin sheets are stacked on parallel rows of copper tubes. The copper tubes are then mechanically expanded to make contact with the fin sheets. After a few months or years of use, a tiny gap develops between the tube and fin sheet because the two metals expand and contract at different rates. Moisture enters this tiny crevice and the coil becomes susceptible to corrosion.

Acid Rain.

The corrosion resistant construction of all aluminum Spine Fin® is augmented by the stabilizing characteristics of the aluminum metal itself. Industrial and urban atmospheres are corrosive environments primarily because they are ripe with sulfur gases generated by the burning of fuels. These gases mix with water vapor to form sulfurous and sulfuric acids, which form "acid rain." Aluminum is an active metal, but its behavior is stable because of the protective, tightly adherent invisible oxide film on its surface. In general, aluminum alloys have a high resistance to dilute sulfuric acid and hydrogen sulfide, which are present in outdoor environments.



At left: The patented Spine Fin® machine wraps aluminum spined ribbon tightly onto adhesive coated tubing. At right: The red color indicates adhesive, which has extruded out from under the fins, locking them together and sealing out moisture.

Fact: The more dissimilar the metals in a coil, the greater the potential for corrosion. Trane uses aluminum for both the fin stock and the tube in the construction of Spine Fin®.

Corrosion Resistance Begins With The Manufacturing Process.

Trane manufactures Spine Fin[®] on patented high-speed machines that cut, form and wrap aluminum fin stock around aluminum tubing. The tubing rises through a colored adhesive bath in the center of the machine, which coats the tube. Tension rollers wrap the ribbons tightly to the tube using the bonded adhesive. A seam of the adhesive extrudes between the fin wraps, which not only locks the fin stock on the tube, but also forms a protective barrier against moisture and contaminants, minimizing corrosion.

The Spine Fin[®] Difference: A Protective Cabinet And A Cleanable Design.

A Protective Cabinet Prevents Damage.

The outdoor coil in an air conditioner or heat pump can easily get damaged in a backyard environment. Lawn equipment, damaging hail, even baseballs, sticks and tree limbs can all add years of wear and tear to a heat exchanger. Trane's protective cabinet design prevents coil damage by encasing the heat exchanger in heavy gauge steel louvered panels. These panels allow air to pass through the cabinet, but seal out dangerous external elements.

Ease Of Cleaning A Definite Plus.

One of Spine Fin's strengths is that because of its design, any potential surface loading and clogging – when and if it occurs – is insignificant to its performance. First of all, its large surface area permits more airflow volume at a lower velocity. This lower velocity means that fewer solids, such as dirt, grass clippings or leaves are picked up in the airstream, which reduces the possibility of normal dirt build-up.

If dirt build-up does occur, the thousands of leading edges of Spine Fin[®] distribute the dirt and debris throughout the depth of the coil. Airflow and heat transfer are maintained. When required, Spine Fin[®] coils can be easily cleaned with a reverse flow of low velocity water.

The Spine Fin[®] Difference: Continuous Research And Development.

Perfecting The Process.

Spine Fin[®] is the product of extensive research – research that has been conducted over the course of 75 years, dating back to 1927, when the first compilation of the laws and data on heat transfer began. Over the years, third-party testing continues to show that all-aluminum heat exchangers are not only more thermally efficient than all-copper or copper/aluminum heat exchangers, but they're also much more resistant to corrosion.

Most recently, a study conducted at the Ray Herrick Laboratories of Purdue University in 2001, showed that a typical system's efficiency degrades twice as much with enhanced plate fin versus Spine Fin[®] when a three to four-year buildup of graded dust is present. Even in the event that Spine Fin[®] is loaded with more particulate than enhanced plate fin, more system efficiency is retained with Spine Fin[®]. This study proves the fact that surface loading and clogging are not typical to Spine Fin[®].

U.S. Navy Research Testimony

In a corrosive environment (coastal or urban), heat exchanger performance can degrade quite rapidly. According to an unbiased study performed by the United States Navy Civil Engineering Laboratory, Naval Construction Battalion Center in Port Hueneme, California, evidence of the fact, and support of all-aluminum coils in such environments is presented. Technical Report #N-1560 observes that after 24 months, aluminum tube/aluminum fin, heat exchangers are performing 32% better than copper tube/aluminum fin units.

One conclusion of this research was that "uncoated aluminum tube/aluminum fin heat exchangers are more thermally efficient than either the uncoated copper tube/aluminum fin heat exchangers after two-years of operation in a temperate marine environment."

The recent development of Trane's woven coil technology takes the success of Spine Fin[®] one step further. Its increased surface area offers an even greater prevention of dirt build-up, providing superior long-term efficiency and effectiveness against the environment outdoors.

The Purdue Study: Spine Fin To Plate Fin Performance Comparison.

Fact: All coils lose efficiency over time
Fact: Plate Fin coils lose more efficiency than Spine Fin and cost more to operate.

Energy Use Penalty Due To Contaminated Condenser Surfaces In 3Ton 10 SEER Systems (1500 hrs/year operation)



Operating Cost Penalty For Contaminated Condenser Surfaces In 3Ton 10 SEER Systems



Why Trane. Since the earliest days of James and Reuben Trane, we've built our reputation on manufacturing reliable, durable and efficient home comfort products for consumers from coast to coast. Over the years we've developed precise processes and stringent quality control measures to support and maintain our on-going standards of excellence. Our component testing procedures and performance tests are unmatched in the industry. While our competitors may find our unerring attention to detail a bit old-fashioned, the payoff is in our products.

We design and manufacture our products to be as reliable and durable as possible. In fact, with our top-of-the-line XLI products we ensure further peace of mind with the best residential manufacturer's limited warranties in the industry: 10-years on the compressor, 10-years on the outdoor coil, and 10-years on internal functional parts. At Trane, our commitment to excellence continues long after a product leaves the factory.



It's The End Result That Counts.

While we may stake our reputation on our state of the art manufacturing processes and our durable products, it's our people who deliver the goods. Trane's NATE-certified Comfort Specialist™ Dealers bridge the gap between technology and comfort, providing consumers with the service and satisfaction they need and the peace of mind they've come to expect from the leader in residential heating and air conditioning. Our Comfort Specialist™ Dealers are an extension of the Trane philosophy of providing long term, practical indoor comfort solutions for the way people live today. We know that in our industry, technology is meaningless unless it can be applied to the lives of real people, making them more comfortable today and for years to come.

Trane Comfort Specialist™ Dealers can be found through the Dealer Locator on www.trane.com or in your local Yellow Pages.

**You've heard the expression,
"It's Hard To Stop A Trane."
Now, you know why.**

**Innovation.
Quality.
Reliability. Durability. Efficiency.
Leadership.**



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