About Air Conditioning

EFFICIENT & COST EFFECTIVE

The NASI NTEC systems provide operators with more efficient cooling, employing electric vapor cycle system technologies delivering smaller, lighter and more powerful output than previously available to the aircraft industry.

New aircraft design and modernization of older fleets incorporating intelligent electronics, designed smaller and smarter, are proving to be more heat-sensitive than older technologies. The new technology available in the NTEC supplemental cooling systems takes the heat out for improved reliable aircraft dispatch and operation.

SYSTEM ASSEMBLIES

The NTEC Electric Vapor Cycle System design incorporates the following primary component systems; Compressor, Condenser, Condenser Fan, Expansion Valve, Evaporator, Evaporator Fan and Control System.

COMPRESSOR

The semi-hermetic scroll compressor is sealed and has no exposed moving parts. Enhanced reliability is achieved by cool refrigerant gas delivering lubricating oil and cooling to all parts of the compressor motor before entering the compressor chamber, with no external cooling required. The NTEC compressor is designed to reduce the equipment foot print permitting increased installation location options for the operator.

The compressor draws low-pressure gas refrigerant through the inlet on the motor end. This cool low-pressure gas, mixed with oil, is drawn across the motor and into the compressor where the oscillating scroll compresses the gas to high pressure through the reed valve and out the discharge port. The high-pressure superheated gas will travel to the condenser where all of the heat energy drawn out of the aircraft can be released through a condenser fan exhaust duct.

CONDENSER

Where size, weight and performance afford the highest consideration. The air cooled micro-channel all aluminum NTEC coil is the lightest, most efficient heat transfer system to be engineered into a NASI condenser.

The condenser converts high-pressure superheated gas into high-pressure liquid. High pressure, high temperature refrigerant gas enters the condenser from the discharge side of the compressor. Heat from the refrigerant gas is transferred from the condenser coils to the cooling fins, where cooling air from the condenser fan carries the transferred heat to the exhaust duct and overboard. As the heat is transferred out of the refrigerant gas it becomes a liquid. Throughout this transformation, the superheated refrigerant gas from the compressor remains essentially the same temperature until all of the refrigerant has been converted to a liquid, it will then begin to cool as it continues through the condenser. This process is called *sub cooling*. (Sub cooling is a process, which only takes place after the gas has turned completely to liquid.) The amount of sub cooling required has been determined by the hottest normal operating conditions for the aircraft, thus assuring only liquid refrigerant is leaving the condenser at all times.

With this design, sub cooling may be 30°F or greater during operation in less than hottest environments. Sub cooling can increase BTU output, therefore, in temperate environments, the vapor cycle system requires less power to perform the rated output.

CONDENSER FAN

Condenser Fans are selected for high volume efficiency. Ambient air pulled across the condenser coil absorbs the heat from superheated refrigerant and is exhausted outside by the Condenser Fan.

THERMAL EXPANSION VALVE

The Thermal Expansion Valve is an external equalized diaphragm operated pressure sensing type, located on the refrigerant inlet side of the evaporator. It divides equally among evaporator coils, metering the correct amount of liquid R134a refrigerant to the evaporator. The expansion valve incorporates an inlet, outlet and two (2) pressure sensing ports. A distributor connects the outlet port of the expansion valve to the evaporator, while the inlet port is connected to the high-pressure liquid line from the condenser. An internal pressure-sensing diaphragm and spring-loaded metering valve regulates the amount of liquid refrigerant flow into the evaporator. This controls the superheat, which is achieved by a temperature-sensing bulb attached to the suction header tube of the evaporator and a pressure sensing line connected immediately downstream of the temp-sensing bulb. These are the two sensor ports of the expansion valve. When the correct amount of liquid refrigerant is metered into the evaporator, all the liquid is evaporated into gas, the all-gas temperature will begin to rise and when the temperature of the gas in the suction header tube is above the gas/liquid combination upstream, in the coil, it is referred to as *superheat*. This superheat of refrigerant in the evaporator insures no liquid refrigerant enters the compressor. During operation the superheat may vary from 0°F to 15°F as the expansion valve modulates to adjust the amount of refrigerant entering the evaporator.

EVAPORATOR

The R134a evaporator is an air-cooled direct expansion type, all aluminum micro channel coil with high efficiency heat transfer. Refrigerant is converted from high-pressure liquid to low-pressure liquid through the expansion valve and delivered into the coil through an integral distributor, which feeds all the channels. The instant lowering of the pressure turns some of the liquid into gas (referred to as *flash gas*) which absorbs heat and cools the remaining liquid to a low temperature.

Just the right amount of flash gas is allowed as only the liquid flowing through the evaporator absorbs heat from the ventilating air passing over the coils. The correct amount of refrigerant is regulated through the coil, for any given cockpit or compartment air temperature, allowing all the liquid to absorb heat and turn to gas before leaving the evaporator.

As long as the refrigerant is partly liquid it will remain a constant temperature, however once it becomes gas, with no liquid remaining, the refrigerant quickly increases in temperature, this is called *superheat.* While superheat is necessary to prevent liquid from entering the compressor, only the smallest amount of evaporator coil is dedicated to superheat, resulting in the greatest evaporator efficiency for the given system.

Any excess superheat reduces BTU output.

EVAPORATOR FAN

The evaporator fan is designed to pull ventilating air across the evaporator coils for maximum effective heat transfer without entraining water condensate into the cooling air stream. This fan is designed for the most efficient, lightweight, high-output evaporators.

CONTROL SYSTEM

The 28VDC control circuit has a single 2-amp breaker.

Protecting each compressor and fan motor from over load is a resettable circuit breaker.

Each motor operated compressor and fan has its own relay located in a relay control box which also houses the power safety logic.

Compressors are equipped with a condenser airflow safety switch preventing start up or running of the compressor until adequate airflow across the condenser coil is achieved. This prevents excessive amperage spike from simultaneous starting of the fan and compressor motors also eliminating possible compressor operation without condenser cooling air.

Compressors are also equipped with a thermal safety switch preventing the compressor from overheating during extreme high load conditions. The compressor safety system is equipped with high and low (ternary) pressure switches, preventing compressor start with excessively low refrigerant, also preventing excessively high pressure operation.

Along with the high-pressure safety switch is a total system high pressure pop off valve, located in a contained unoccupied area designed as a fail-safe high-pressure safety.

SUPPLEMENTAL HEAT OPTION

Optional supplemental heat is supplied by thermal heater rods inserted with the evaporators. When selecting supplemental heat, power is supplied through circuit breakers to separate heater relays.

Supplemental heat control is equipped with thermal safety switches, preventing heating operations when the evaporator coil is too hot or when ambient air temperature is above a pre-determined setting.

Supplemental heating systems are also equipped with evaporator/heater fan airflow safety switches preventing the heater relay from energizing without adequate system airflow.

The optional temperature indicating system consists of a single indicator with a multi-position rotary switch. The gauge-monitored positions include *#1 Compressor Discharge, #2 Compressor Discharge, #1 Evaporator Outlet* and *#2 Evaporator Outlet.*

NASI – NTEC ELECTRIC SUPPLEMENTAL AIR CONDINTIONING SYSTEM

ON BOARD SYSTEMS

In flight or ground operations, on board NTEC Systems are cooling aircraft equipment, personnel, and VIP compartments. NTEC is cost effective cooling operating as standalone or running concurrently with existing ACM Systems.

GROUND BASED SYSTEMS

Aircraft with limited or no access to passenger gate cooling systems use NTEC Electric Vapor Cycle Air Conditioning units operating on any available power, aircraft 400Hz GPU (Ground Power Units) or 50Hz/ 60Hz standard utility power. Optional power tees allow NTEC units to power up with the GPU supplying power to the aircraft.

NTEC Systems are also available in 12 or 28 VDC for helicopters, private and corporate aircraft.