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BLOCKED FAN TEST

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ABSTRACT:

An internal pressure relief valve or IPRV is used to limit the maximum system pressures by venting the discharge gas into the suction side of the compressor. The IPRV works with the overload protector to keep the system from unsafe operation. Air conditioning units with an IPRV were blocked fan tested. The blocked fan test indicates the maximum system pressures. The pressures and compressor current were recorded. The effects of voltage, system charge, and pressure relief valve setting on system pressures were investigated.

Systems that operate in high ambient conditions can open the IPRV and cause nuisance shutdowns. Recently designed systems with minimized coil size has required the reexamination of IPRV selection. A brief review of the conflicting requirements and resolution is proposed.
INTRODUCTION

What is an IPRV?
An internal pressure relief valve or IPRV is a fixed pressure differential valve. The IPRV vents the discharge gas into the suction side of the compressor when the preset pressure differential is exceeded, so none of the refrigerant is released into the environment and the maximum system pressures are limited.

Why do we need an IPRV?
The IPRV limits the maximum system pressure to allow the use of 2100 psi (14,480 kPa) rated tubing in the system and 1000 psi (6895 kPa) rated pressure vessels on the suction side of the system. Safety certification requires the maximum possible operating pressures be below one third of the rated pressures.

How does it work with the internal overload protector?
The IPRV does not vent the total flow of the compressor, it provides a major discharge to suction connection when opened. The suction and discharge pressures do not equalize once the IPRV vents. The internal overload protector works with the IPRV by being heated by the venting discharge gas to the trip point to stop the compressor operation.

BLOCKED FAN TEST

What is the blocked fan test?
The blocked fan test of an air conditioning system operates the unit at maximum rated voltage with condenser and evaporator fans stopped. The compressor current, pressures and temperatures are recorded. The blocked fan test is accepted as the test that determines the maximum system operating pressures. The maximum discharge pressure occurs before the overload protector trips and the maximum suction pressure occurs just after it trips when the compressor equalizes pressures.

What is the effect of compressor voltage?
The 230 Volt compressor is tested at 240 Volts to simulate an over voltage condition. The voltage must be maintained at 240 Volts for the whole test. If the voltage is allowed to lower due to line resistance at the higher operating currents the over load protector will have a higher current drawn through it by the motor. The higher current will trip the over load protector at a lower than maximum possible discharge pressure. The plots of the same compressor at 240 Volts and 215 Volts shows the 130 psi (900 kPa) difference:
What is the effect of system refrigerant charge?

The window air conditioning unit was tested at three refrigerant charge levels: 85% (38oz), 100% (46oz), and 115% (54oz) of nominal charge. The maximum discharge pressure increased from 530 psia (3654 kPa) at 85% to 590 psia (4068 kPa) at 100% to 630 psia (4344 kPa) at 115%. The maximum suction pressure also increased from 300 psia (2070 kPa) at 85% charge to 340 psia (2344 kPa) at 100% to 380 psia (2620 kPa) at 115% charge. The system charge level in relation to the system volume influences the maximum pressures.
What is the effect of IPRV differential pressure setting?

A compressor with a 515 psi (3550 kPa) differential IPRV had a maximum system pressure of 810 psia (5585 kPa). The maximum suction pressure was 340 psia (2344 kPa). The IPRV was replaced with a 415 psi (2860 kPa) differential IPRV. The maximum system pressure was reduced to 620 psia (4275 kPa). The maximum suction pressure increased to 375 psia (2585 kPa). The system pressure can be influenced by IPRV setting, but changes to the IPRV do not always produce the desired results.
Conflicts:

High ambient conditions can cause high pressure differentials which vent the IPRV and cause nuisance shut downs of the air conditioning system. These systems need a higher differential pressure setting. These systems typically do not require safety certification of the blocked fan test.

A high differential pressure setting of the IPRV allows excessive pressures to occur in the system during the blocked fan test, which requires a higher pressure rated system. A system rated at higher pressures increases coil and component cost and reduces coil efficiencies.

The compressor manufacturer desires to have a minimum number of IPRV’s to stock and install to reduce inventory cost.

Possible Solution:

If the IPRV is positioned to vent on to the internal overload protector the resultant discharge gas heating could be used to trip the protector without developing excessive discharge pressures. This is incorporated in some designs of compressors. The IPRV location with respect to the discharge plenum influences the way it reacts.

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