FLUKE ®

Monitoring temperature to keep server rooms within tolerance

Application Note

Testing Functions **Case Study**

Measuring tools:
- Fluke 54-2 Dual Input Thermometers
- 80PK-8 Pipe Clamp Probes
- 80PK-24 Air Probe
- FlukeView Forms™ Software

Operator: Specialized UPS and precision air-con system vendor

Tests conducted: Monitoring and logging temperature at key locations

Nowhere are reliability standards more stringent than for information communication technology (ICT) infrastructures. Many require 24/7 uptime and a reliability of nine 9's, because just a few minutes of downtime can have insurmountable impacts on their clients' market values.

Most ICTs implement multiple redundancies to protect against power supply variations / interruptions. Uninterruptible Power Supply (UPS) units usually form the back bone of such protection schemes. Given the tremendous heat generated by the high equipment density, ICTs also invest heavily in precision temperature and humidity controls.

Some ICT equipment protection providers have even integrated the UPS and thermal controls. They start by tailoring the power backup and cooling designs to individual site requirements and extend their services to installation and maintenance.

The service team in particular must ensure that room temperature variation does not exceed +/- 1 degree over the life of the installation. In keeping with predictive maintenance methods, they monitor server room temperature on a regular basis, watching for small fluctuations in system performance that could lead to bigger problems. Using the Fluke 54-II Dual Input thermometer, pipe clamp probes, air probes, and datalogging software, the team tracks temperatures in multiple locations over several days and builds an overall room profile.

Precision HVAC systems

Conventional heating, ventilation and air-conditioning HVAC systems cater to the comfort of personnel working in the building (thus, the term "Comfort air conditioners"). They are designed with low Sensible Heat Factor (SHF), making it difficult for these units to maintain temperature at +/- 1 degree Celsius. Another concern is that comfort air conditioners are designed to work during office hours (typically 8-hour days).

In contrast, precision air-con systems are designed with a high SHF of about 0.9 - 0.95. That means only 5 % to 10 % of the cooling is used for latent cooling (removal of moisture), and 90 % to 95 % of the cooling is for sensible cooling (reduction of temperature). They are designed for continuous 24/7 operation with low maintenance cost and high mean time between failure, ensuring the availability and maintainability of the entire operation.

The functional block diagram of a precision HVAC system is similar to the basic vapor compression refrigeration system shown in Fig. 1. The differences lies in the more sophisticated control circuits and algorithm, plus tuning towards high SHF.

The compressor sends hot gas to the condenser. Then the condensed liquid passes through an expansion valve into the evaporator where it evaporates and collects heat from the area to be cooled. The gaseous refrigerant then enters the compressor where the compression process raises the pressure and temperature. From the compressor, the refrigerant is routed back to the condenser and the cycle repeats.

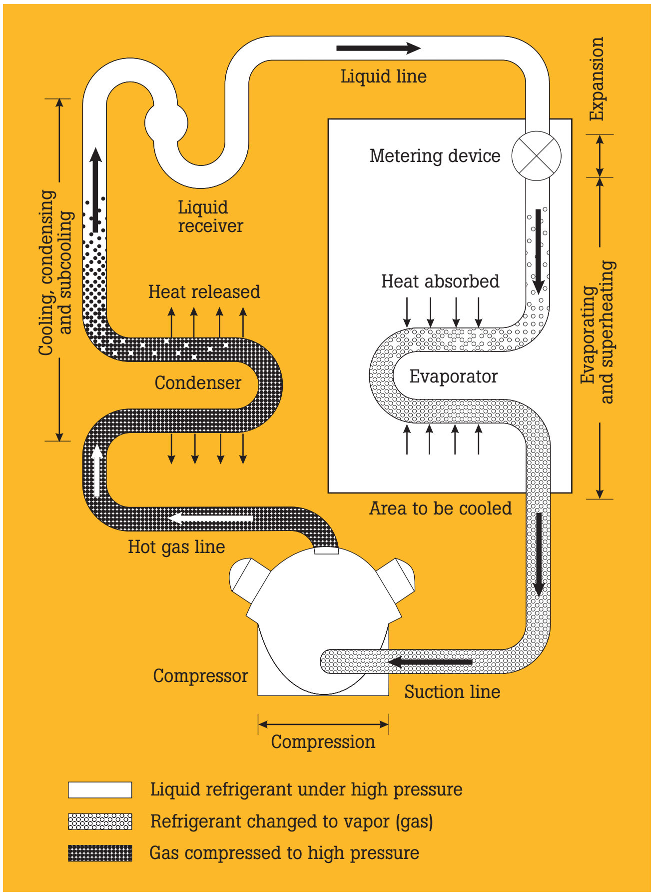

Figure 1. Block diagram of a precision air-con system.

Measurement points

The service team establishes key measurement locations with corresponding normal temperature ranges:

Location and description	Temperature range °C
Hot gas discharged from compressor	70 to 90
Suction air returned from evaporator	7 to 14
Server room ambient air temperature	20 to 22

Normally, the refrigerant entering the compressor should be sufficiently superheated above the evaporator boiling point to ensure that the compressor draws only vapor and no liquid refrigerant. Drawing liquid into the compressor can cause significant damage to the valves, pistons, and even shear cylinder rods (completely destroying the compressor). Additionally, liquid refrigerant in the compressor, when mixed with oil, reduces lubrication and increases wear, causing premature compressor failure. On the other hand, drawing refrigerant into the compressor which has excessive superheat will shorten the compressor life by insufficiently cooling the hermetic motor.

Tracking the suction air and hot gas temperature over time can provide real warning signs of various system problems, including a clogged filter drier, refrigerant undercharge / overcharge, a faulty metering device, or improper airflow across the evaporator.

Methodology

To cope with the heavy temperature logging schedule (quarterly for every precision air-con unit), the team invested in multiple Fluke thermometers and temperature probes. They measure hot gas and suction air temperatures by applying 80PK-8 pipe clamp probes over the metal pipes. Unlike a bead thermocouple, the 80PK-8 clamps directly to the pipe and has a fast-response thermocouple for instant readings. The dual input Fluke 54-II can monitor two temperatures simultaneously and its 500-point data memory can log data over four days at 15-minute intervals.

Setting up the Fluke-54-II for logging temperature:

1. Power up the unit.
2. Connect the temperature probes to the input(s). Verify that the readings are not far off which may indicate poor thermal contacts with the target media.
3. Press the [SET UP] button. Use the [UP] or [DOWN] buttons to select the desired pre-set logging interval (for 15-minute, choose "USEr" and then use [UP] or [DOWN] buttons to set the minute and second values).
4. Press the [SET UP] button to exit set up mode.
5. Press the [LOGGING] button to start recording. Press this button again to stop logging.

The server room ambient air temperature is measured separately using a 80PK-24 Air Probe.

For record keeping and presenting reports to clients, the team uses FlukeView Form™ software.

1. First they start the FlukeView Form™ software and choose a suitable form template to use. The "long log sample" form template is one of their favorites, because of the predefined elements such as instrument ID, purpose of test, event graph which shows the trend plot, event amplitude histogram which indicates the dispersions of the readings, and detailed reading table with individual time stamp.
2. Then they connect the Fluke 54-II to the computer's RS232 port using the interface cable. To initiate the data transfer, they press the yellow ("shift") button on the Fluke 54-II followed by the [RECALL] button. Within a minute or two, the form template is loaded with data and graphical results.

The software can also export the data in comma separated variable (.csv) format, integration with other predictive maintenance or reliability maintenance software.

Fluke. *Keeping your world up and running.*

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