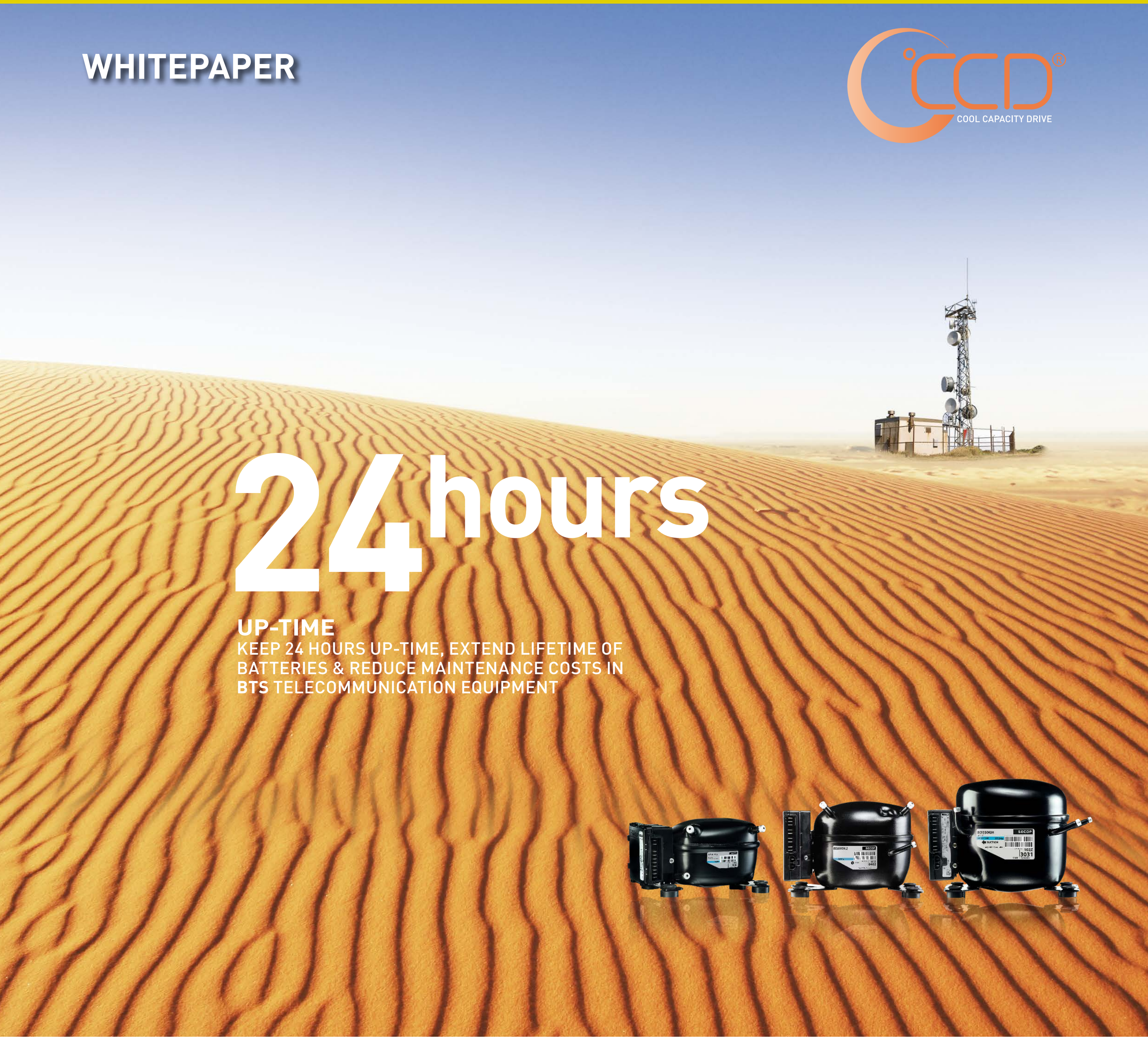
WE HAVE MORE THAN 40 YEARS OF EXPERIENCE DEVELOPING DIRECT CURRENT COMPRESSORS AND HELPING CUSTOMERS BENEFIT FROM THE OPPORTUNITIES OF MOBILE REFRIGERATION TECHNOLOGY.

WITH IN-DEPTH KNOWLEDGE OF USE ACROSS VARIOUS APPLICATIONS, WE HAVE EARNED A POSITION AS MARKET LEADER, WORKING WITH OEM CUSTOMERS.

SECOP

BATTERY COOLING WITH DC COMPRESSORS

WHITEPAPER



24 hours

UP-TIME

KEEP 24 HOURS UP-TIME, EXTEND LIFETIME OF BATTERIES & REDUCE MAINTENANCE COSTS IN BTS TELECOMMUNICATION EQUIPMENT

INTRODUCTION

Introduction

Telecommunications equipment is often housed inside shelters at remote sites far away from conventional power lines. Controlling the temperature inside the shelter is a high priority for improving the performance of the electronic equipment. The equipment dissipates heat during its operation in addition to the absorbed heat from surroundings with high ambient temperatures especially in desert (tropical) environments.

This whitepaper reviews various techniques for cooling the telecom equipment. The Whitepaper then describes the recent alternatives made possible by new technological developments such as Direct Current (DC) powered cooling systems.

The whitepaper will also focus on the importance of cooling the UPS (Utility Power Supply) battery pack in order to improve battery lifetime, reduce service cost, and last, but not least maintain 24/7 up-time of the BTS station.

Historically, telecommunications equipment has always been considered sensitive equipment and accordingly, housed in controlled enclosures or shelters. Cooling for this equipment is realised using traditional methods. However, in many new systems being developed and deployed today, such as 3G & 4G, heat dissipation densities have been increasing considerably, raising the possibility of heat-related failure.

The daily air temperatures exceeding 50 °C in Middle Eastern deserts, which, when combined with internal heat generation from the telecommunications equipment, make the inside telecom shelter prone to temperatures as high as 80 °C:
In these conditions, electronic equipment will not function reliably.

The whitepaper will also describe the importance of separating battery cooling from the rest of the BTS (Base Transceiver Station) equipment in urban areas.

BATTERY COOLING

Battery Cooling

Telecommunications development in regions with unstable grid and high ambient temperature environments are increasing.

Why are batteries needed?
The battery packs are typically used as back-up power in areas where the grid is very unstable and power outage is quite normal.
In order to secure operation of the base station, the battery will take over the power supply until the grid is up and running again.
In some geographical regions, the grid is down up to 10 hours a day.
The battery pack can also be used as power supply for the BTS station in rural areas with no grid. See diagram in Fig. 1.
The batteries are an expensive component of a telecommunications site.

Why battery cooling?
For every 9-degrees increase in temperature above 25 ºC, the lifetime of the battery is reduced by more than 50 %. In many areas, temperatures are up to 20-30 degrees above 25 ºC. This will reduce the lifetime of the battery to only 25 % or less, of nominal lifetime. See graph in Fig. 2.
Taking an example shows easily the advantage of cooling the batteries.
Cost of a 1200 Ah battery package approx. USD 2,000 on average.
Temperatures in the summer can be up to 50-60 °C.

No battery cooling
Lifetime 1 year
Replacement costs over an 8-year life span:
8 x USD 2,000 = USD 16,000
In addition to that, labor, etc. has to be added. Reduced up-time are other disturbances which are difficult to calculate in monetary terms.

Battery cooling
Invest USD 2,000
Savings approx. USD 14,000

BTS EQUIPMENT

BTS Equipment

As stated in the introduction, the critical temperature for electronic equipment is 80 ºC. In order not to exceed these temperatures, the complete base station needs to be cooled.
Experience has shown that a shelter temperature between 32 ºC and up to 38 ºC is acceptable in order to meet these requirements.

Bearing in mind that batteries need 25 ºC, there are two important statements to make.:

1) It is not necessary to maintain 25 ºC in the entire shelter in order to keep the batteries at 25 ºC. The batteries should be kept separately in a cabinet cooled independently at 25 ºC.
2) The remainder of the shelter should be maintained at 32 ºC.
The advantage of this is that the compressors for shelter cooling will have a much higher capacity and COP, as the operating envelope is approximately 10 degrees higher in evaporating temperature.
This means that a smaller capacity compressor can handle the job. In the end this leads to less investment and less operating costs.

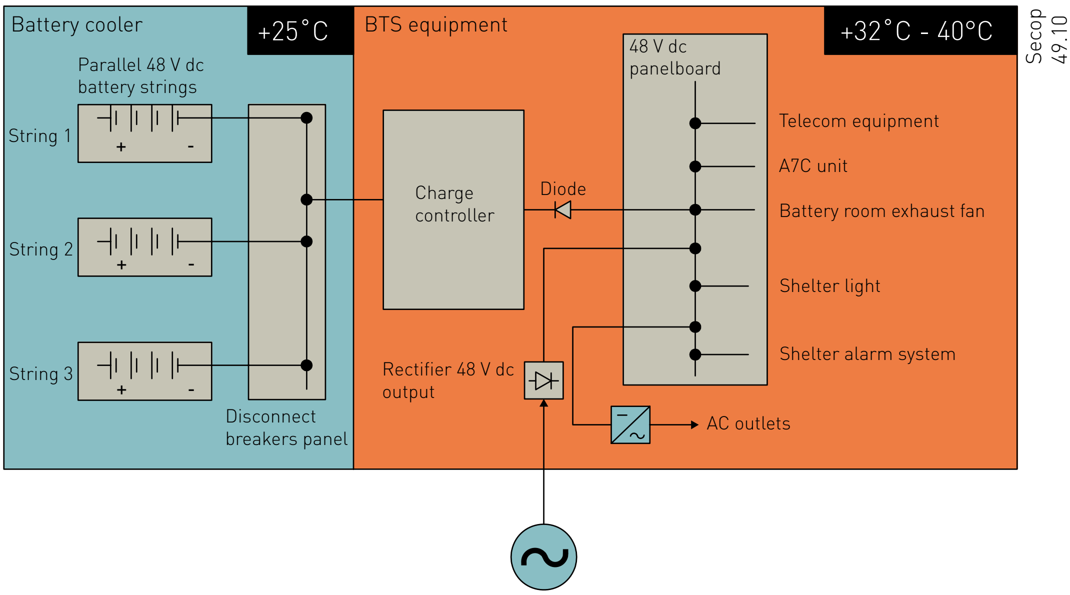


Fig. 1. Schematic of 48 V DC power supply in area without grid.

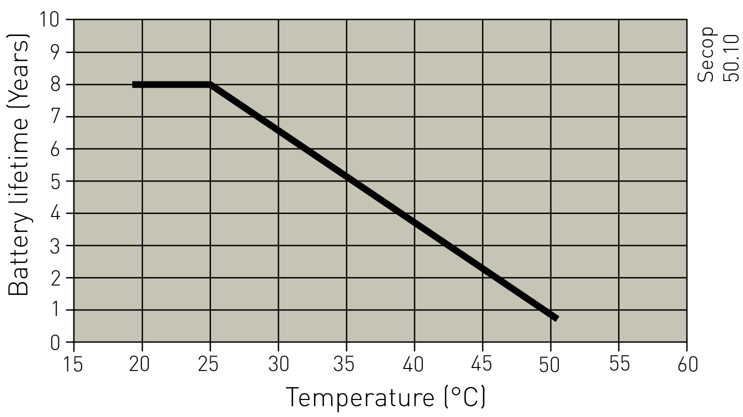


Fig. 2. Battery lifetime vs. temperature (May differ between battery brands).

SPOT COOLING OF ELECTRONICS

Spot Cooling of Electronics

Spot cooling has started to become a necessity in electronic racks due to the increased density in heat dissipation as mentioned in the introduction.

One method for creating spot cooling for electronics is to use so-called thermoelectric coolers (TEC).
Peltier coolers use the Peltier effect to create a heat flux between the junctions of two different types of materials.
This is basically a solid-state active heat pump which transfers heat from one side of the device to the other side, against the temperature gradient (from cold to hot), with consumption of electrical energy. Such an instrument is also called a Peltier element or thermoelectric cooler.
Simply connecting it to a DC voltage will cause one side to freeze while the other side heats up. The effectiveness of TEC moving the heat away from the cold side is totally dependent upon how well the heat from the hot side can be removed. Due to the relatively low efficiency, thermoelectric cooling is generally only used in environments where the solid state nature outweighs the poor efficiency. Thermoelectric junctions are generally only around 5-10 % as efficient as the ideal refrigerator, compared with 40-60 % achieved by conventional compression cycle systems.
Peltier coolers are therefore candidates for spot cooling.
A good TEC cooler is able to lower the ambient temperature by approx. 20 K, meaning in an environment of 50–55 °C, a temperature of 30–35 °C can be obtained.

Another more effective and energy efficient method is to use a small 48 V DC powered compressor. The advantage is that a compressor is able to create a much bigger delta T (30–40 K without problems) than a TEC cooler.
Additionally, the energy consumption is 2 to 4 times less than a TEC cooler.

The company Secop (formerly Danfoss Compressors) has introduced such a small compressor with a weight of only 2.3 kg. In terms of size, it is not bigger than a TEC cooler including fans and control electronics.

DC COMPRESSOR COOLING SYSTEMS

DC Compressor Cooling Systems

A DC compressor outperforms a conventional AC compressor in many areas.

- A DC motor uses a brushless DC motor. The efficiency is much higher than an AC motor since there is no loss due to slippage.
- COP (Coefficient of Performance) is several points higher, meaning less energy consumption.
- Improved system efficiency thanks to higher evaporating temperatures and lower condensing. temperatures, offering up to 40 % energy savings.
- Dynamic speed range from 1:4.Adjustable cooling capacity for actual system demand.
- Smaller compressor in terms of displacement and size.
- Lower noise emission due to low speed – up to 5 dB(A).
- Released for rough applications, unstable power supply and tropical regions.

CONCLUSION

Conclusion

This whitepaper illustrates all the advantages of using DC compressors to cool batteries in base stations and using spot cooling in the electronic racks.

In the future, we will see DC compressors replace all TEC systems and AC compressors to cool batteries, electronics, and full shelter cooling.

Secop DC compressors offer fully integrated control of a battery rack such as:

- Temperature control, evaporator and condenser fan speed control, battery monitoring, alarm system, and bus communication local or via Ethernet.
- The compressor range offer cooling capacities from 250 W up to 1.7 kW.

SECOP VARIABLE-SPEED DC-POWERED BD COMPRESSORS (BATTERY DRIVEN)

COOL CAPACITY DRIVE

MAXIMIZE UPTIME & REDUCE RUNNING COSTS IN TELECOM COOLING APPLICATIONS

When the power fails, battery cooling systems must draw on the batteries' power. As the compressor is the main power consumer, much can be gained with a solution that is extremely efficient without being overly power hungry.

By using a battery-powered direct current (DC) compressor, it is possible to build a cooling system that can run on batteries, solar cells, and wind turbines without needing to convert to alternating current (AC).

The BD250GH.2 and BD350GH compressors are unique as they are constructed with integrated fan control and electronic thermostat. In this way, it is possible to simplify the design of the overall system and still ensure maximum performance.

With battery drain being a big issue, it is important to use an energy-efficient compressor with the highest COP possible.

Compared to other solutions that rely on AC and 230 V AC conversion, the BD250GH.2 and BD350GH compressors save up to 250 W per hour.

In areas that rely on battery power for up to 16 hours a day, you can be certain that Secop BD compressors will ensure that batteries will last as long as possible.

The optimal temperature for batteries is 25°C. Anything above this will shorten their life expectancy and provide their owners with an inconvenient replacement cost.

OUR JOURNEY SO FAR

1956 Production facility and headquarters in Flensburg, Germany founded.

1958 Start of production for PW compressors.

1970 Introduction of SC compressors. The birth of a standard-setting platform in the light commercial market.

1972 Introduction of FR compressors.

1977 Introduction TL and BD compressors.

1990 Introduction of NL compressors.

1992 Introduction of PL compressors.

1993 Start of production with natural refrigerant R600a (isobutane). Production facility in Crnomelj, Slovenia founded.

1999 Start of production with natural refrigerant R290 (propane).

2002 Production facility in Zlate Moravce, Slovakia founded.

2005 Introduction of GS compressors.

2008 Production facility in Wuqing, China founded.

2010 Introduction SLV-CNK.2 and SLV-CLK.2 variable speed compressors. Introduction BD1.4F Micro DC compressor. Introduction of DLX and NLU compressors.

2013 Introduction of the XV compressor - opening a new chapter in refrigeration history. Secop acquires ACC Fürstenfeld, Austria.

2015 New generation of energy-efficient propane compressors. New variable speed platforms for household and light commercial applications.

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