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Other titles currently available. Please tick those you would like to receive.

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5

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Also on the CD

Some don’t like it hot

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2

6

I would like to request a copy of the Tem Performance CD (Temperature Rise Estimation software including test tool & PV calculation) Please complete the following form and fax to NHP on (03) 9429 1075 marked to the attention of the Marketing Services Department.

Name: __________________________ Title: __________________________
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**Heat Loss**

For electrical purposes the lower the resistance the better the material is for carrying current. Taking copper as 100, the relative conductivity of copper compared to other materials is shown in Table 1.

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</tr>
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</tr>
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</tr>
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Relative conductivity (typical)

Conductivity is only part of the story as the current flow through a conductor is not even. The excess is caused by the magnetic forces produced by the current flow. These forces act to push the current flow into the side walls of the conductor (skin effect) reducing the heat produced by the current increasing.

**What do I do**

Nominal current ratings are determined under basically ideal conditions. The item is tested by itself and may not be tested with conductors of large proportions connected. In the typical application there will be other equipment close by, adding to the heat generated.

In a switchboard, careful design is required to ensure that the temperature resulting from this heat is not excessive and that the permissible temperatures for the device in question.

The accepted approach is to take the temperature rise of the enclosure then subtract this from the permissible rise of the electrical device to calculate a derating. The aim is to control the maximum temperature so that the ambient is hotter, the temperature rise of the device must be lower. (See Graph 2).

For many electrical products the current rating at different operating temperatures is published. The nominal ratings are usually the rating applicable at 40 °C with a derating applied as the temperature increases.

The difficulty is in trying to determine what the temperature in the enclosure will be and in ascertaining in calculating this can be found in AS4348 (IEC609). The calculations require the watts loss or heat input from all current carrying parts to be known as well as the size of the enclosure and degree of ventilation. The NHP Tem Performance programme is based on the calculation method in the standard and it provides a calculated temperature rise of the enclosure. To assist in the equipment selection it also considers the effect on the rating of installed components at the circuit amps entered into the program. As the circuit amps is lowered the thermal margin or additional temperature that the device will work in becomes higher. A warning is given if the selected device is likely to overheat.

As with the devices in the switchboard the temperature must rise to a level that allows heat lost from the switchboard to equal the heat input. Heat is lost by radiation and convection from the external surfaces and if vents are provided, by the air flow of air through the board.

By allowing this natural cooling the temperature inside the switchboard becomes hotter at the top so it can be found that a device may be too hot if installed in the top but perform satisfactorily if fitted near the bottom. (See Graph 3).

**Enclosure Design**

For cooling, the top and sides of the enclosure are the most effective. The top surface is best as it is the hottest. The bottom is considered to have no effect. If the enclosure is placed against a wall the cooling possible from that surface is approximately halved.

**Ventilation**

Vents in the enclosure allow convection air currents to flow and assist cooling. The vents are best placed near the top and the bottom of the enclosure.

Fans

Fans can be an effective way of removing heat from an enclosure. If it is assumed that all the heat produced in the enclosure is removed by the flow of air from outside the enclosure then the temperature rise of the air flowing in and out of the enclosure can be calculated using Graph 1. If the produced heat in the enclosure is 600 watts and the fan used has a capacity of 200 cu m/hr giving 3 Witsac m/cu then from the graph the rise in cooling air temperature will be 9°C.

The installed equipment needs to be able to cope with this increase.

**Select the devices**

A library of devices allows the switchgear to be selected. If a device is not in the library it can be added to the device list for the particular calculation or an estimated power loss for a group of devices added at the bottom of the list.

As each device is added, the program indicates how the thermal performance is going. This allows reselection of devices as you go, to achieve satisfactory thermal performance. The next step is to select the conductors and this too will interact with the device selection / performance.

**Installed Current Rating**

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For electrical purposes the lower the resistance the better the material is for carrying current. Taking copper as 100, the relative conductivity of copper compared to other materials is shown in Table 1.

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Relative conductivity (typical)

Conductivity is only part of the story as the current flowing in the conductor is increased. This effect produces what is called the AC resistance. This may be more than double the resistance expected from the material. The maximum temperature a conductor reaches is determined by the point at which the heat in, is matched by the heat lost. To lose heat the conductor has to be hotter than the surrounds. The hotter it is the more heat it loses, so a point is reached where heat out equals heat in. The emissivity is a measure of the ability of a surface to radiate heat compared to the ideal black body. Bright copper is not very good but improves as a tarnish is formed. Coatings such as electrical insulating materials can improve the emissivity of copper conductors and improve current rating by increasing the heat lost at a given temperature.

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Design the enclosure

The Ten Performance programme requires the enclosure size, the exposure of the outside surfaces, the partitioning and the size of any vents to be entered. This allows the enclosure ability to transfer internal heat to be calculated.

Enclosure Design

For cooling, the top and sides of the enclosure are the most effective. The top surface is best as it is the hottest. The bottom is considered to have no effect. If the enclosure is placed against a wall the cooling possible from that surface is approximately halved. For cooling, the top and sides of the enclosure are the most effective. The top surface is best as it is the hottest. The bottom is considered to have no effect. If the enclosure is placed against a wall the cooling possible from that surface is approximately halved.

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Table of values for different ambient temperatures:

Available temperature rise

Max. allowable temperature (typical)

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If the existing or expected load conditions of an installation are known this calculator will provide the required capacitor bank size to correct the power factor.

Other tables currently available. Please tick those you would like to receive.

- Controlling high short circuit currents with current limiting circuit breakers (short circuit coordination KT)?
- EMC – what’s all the noise about (understanding EMC)?
- How does electrical equipment (electrical equipment) result in ultrasound
- The quality Switchboard (Switchboard and protection devices for Switchboards)
- RCDs are saving lives (RCDs)
- IP ratings what do they mean? (IP Ratings, use and meaning)
- Motors and torque (Motors and torque)
- Terminals, good or bad? (Terminals)
- Electrical surges can be expensive
- Power factor and correction
- Electrical life of contactors
- The development of the motor protection
- ‘Electrical life of contactors’ (understanding EMC)
- What do I do?
- Nominal Ratings
- Connecting Conductors
- Power Factor Correction
- Fault Calculations
- Technical News
- Electrical Technology
In calculating the expected temperature rise the answer is approximate as there are many factors to be considered in different situations and Tem Performance provides selection tables to accommodate this.

Other titles currently available. Please tick those you would like to receive.

- Controlling high short circuit currents with current limiting circuit breakers (short circuit co-ordination KT)?
- EMC - what's all the noise about (understanding EMC)?
- How does electrical equipment rain (Undergrounding of electrical equipment)?
- The quality Switchboard (Switchgear and protection devices for Switchboards)
- RCDs are saving lives (Application of earth leakage protection devices)
- Termination, good, bad or both? (Terminals)
- Power factor, what is it? (Power factor and correction equipment)
- Set the protection (MCB breakers and application)
- IP ratings what do they mean? (IP Ratings, use and meaning)
- Utilisation categories (Electrical life of contactors)
- Don't forget the motor protection (Motor protection devices and application)
- Electrical life of contactors (Wiring and how you connect is avoided)
- Taking the 'hit' out of DC switching (DC switching principles)
- Start in the correct gear (Application of different motor starters)
- Applicability guidelines for lamp selection (Industrial pushbuttons controls)
- Electrical surge can be expensive (Electrical surge)
- The thinking contactor (The development of the motor contactor)
- Some don't like it (Temperature rise to electrical enclosure)
- Pollution of the airways (Unwanted signals and their effects on motor protection devices)
- What's the difference between safety (Safety devices and their application)
- Talk about torque (Motors and torque)
- Keep your cables cool (Installation of cables)
- A link to earth can be electrical (Application of earth leakage protection devices)

Keeping cool - derate

In calculating the expected temperature rise it is approximate as there are many factors which are considered. The answer is however a useful guide to determine nominal ratings in a particular application.

Power Factor Correction

If the existing or expected load conditions of an installation are known this calculator can provide the required capacitor bank size to correct the power factor.

Nominal Ratings

The performance standards define type tests to determine a Nominal current rating for the various items of electrical equipment. If the device is run at its Nominal rating in a situation that will cause extra temperature rise, damage may result. To compensate for higher temperatures the maximum current the device is running at may need to be reduced. The Nominal rating is intended to provide a guide to as size comparisons between similar pieces of equipment. It will be found however that some devices have capacity in reserve and will not require derating in some situations.

Connecting Conductors

Standard tests for Nominal current ratings are with defined conductor sizes. In the case of busbar connections the sizes used have a comparatively low temperature rise at the test current. They can act as a heat sink to the device under test. To allow for this, conductors connecting directly to devices need to be larger than those in say the general busbar system. The standard provides guidance as to sizes for the two different situations and Tem Performance provides selection tables to accommodate this.