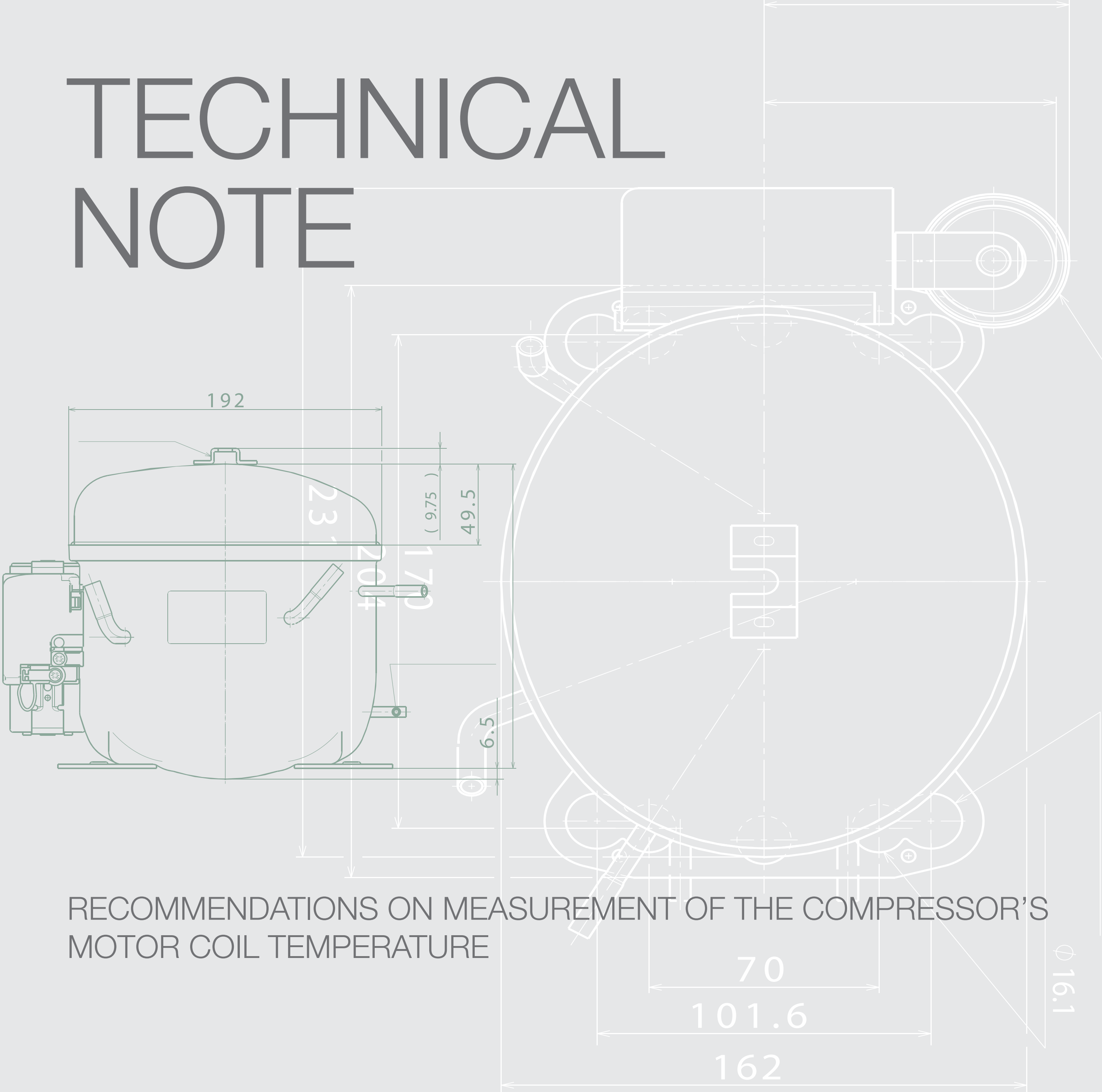
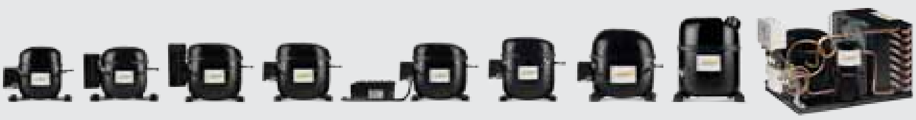
TECHNICAL NOTE



RECOMMENDATIONS ON MEASUREMENT OF THE COMPRESSOR'S MOTOR COIL TEMPERATURE



cubigel® compressors by HUAYI COMPRESSOR BARCELONA

Recommendations on Measurement of the compressor's motor coil temperature

For safe and long term use of the compressor, the motor winding temperature must be kept below certain limits, in all conditions in which the appliance can operate. Compressors from Huayi Compressor Barcelona, whose motors are approved according to temperature Class B, are considered safe when operating with the winding temperature at no more than 130ºC.

Huayi Compressor Barcelona R&D department have developed the motors according to this temperature norm and, as a result, in the calorimeter tests for motor overheating or overload protector tripping, the limit of 130ºC is never exceeded. These tests are carried out under standard test conditions whilst the actual compressor is designed within the limits these conditions represent, so the compressor will run safely.

Sometimes the actual operation cannot be positioned within the standard test limits. However, this does not mean the compressor will run in an unsafe manner. Normally, not all the operating conditions will simultaneously exceed those values, i.e. actual applied voltage may decrease below the standard limits if suction and discharge pressures are kept far enough from the standard overload parameters, or, actual ambient temperature can rise above the established one if voltage and pressures are within a narrow range of values. In these circumstances, the winding temperature still acts as the optimum measurement to ensure the necessary conditions for safe operation are maintained.

As the winding temperature measurement is not a directly read value, some appliance manufacturers consider the shell temperature as a sufficient indication of the internal temperature, which can lead to meaningless errors.

The heat exchange between the motor windings and the shell depends mainly on the compressor design - i.e. better heat transfer from the windings to the oil (windings immersed in oil) and from the oil to the shell (oil pump efficiency) - which result in possible temperature differences of more than 10 K between the shell and windings. Where a good heat exchange is achieved, this can indicate that the warmer shell is helping to maintain cooler windings.

The winding temperature is read by measuring the motor winding resistance. For RSIR and CSIR motors, only the main winding temperature needs to be considered. But for CSR and RSCR motors, both start and main windings need to be checked.

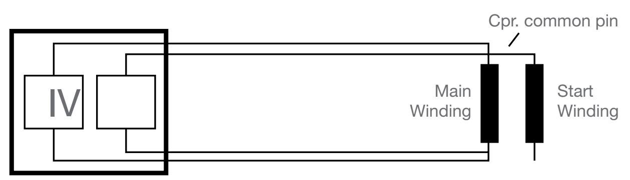
The winding resistance increases with the winding temperature, because the copper resistivity increases with the temperature. The law of resistance variation is well established and allows the winding temperature to be established when the resistance at a given temperature is known. The formula is:

$$T = \frac{R^*(T_0+234.5) - 234.5^*R_0}{R_0}$$

T = temp. to evaluate (ºC)
T0 = reference temp. (ºC)
R0 = winding resistance at temp. T0

To determine R0 , let the reference temperature T0 be 32ºC, by way of example. Put the appliance concerned in the test room at room temperature, 32ºC, and leave it there for 24 hours without operating. After that time, measure the winding resistance. The reading is R0.

The accuracy of the measuring instrument needs to be around 0.01 ohm. An error of 0.1 ohm in a compressor for a domestic refrigerator with a resistance of 25 ohm at 25ºC, represents a miscalculation of 1.04ºC in the winding temperature. If the same error is made in an air conditioning compressor of 1.5 ohm resistance, the temperature miscalculation will be 17ºC. To avoid the measuring instrument's connecting leads' resistance affecting the calculations, a four wire bridge is preferred to the traditional Whetstone Bridge. Basically, a four wire bridge consists of a constant current supply and a voltmeter, as shown below.



I = Constant current supply // V = Voltmeter

The voltage drop in a motor winding depends only on its resistance and is not affected by the connecting leads. This voltage is read at the compressor pins and, as the current is known, the winding resistance is calculated from the ratio between voltmeter reading and current supplied. The calculation is automatically made and the instrument displays the resistance value. The market is currently offering different types of four wire resistance bridges and multimeters which incorporate the above mentioned principle for the resistance measurement function.

Immediately the motor heating test is finished, the winding resistance must be read within a few seconds of switching off the compressor, to avoid alterations in the winding temperature. If this cannot be done so quickly, it is common practice to make a number of resistance readings after various time intervals and plot these values back to zero on logarithmic paper.

Sometimes it is necessary to measure the winding temperature (winding resistance) under running conditions. In such cases it is not possible to use the afore-mentioned apparatus. Nevertheless, the market is offering devices which allow a Wheatstone bridge to be connected to a running motor albeit with some loss of accuracy. Special care needs to be taken when testing a motor with a disc type overload protector (generally used in domestic and commercial refrigeration or air conditioning). If the motor reaches a temperature near to the overload protector trip out temperature, the disc begins to move, causing high contact resistance. Where there is a reason to believe that such a motor will run extremely hot, the overload protector should be shorted out to prevent errors in the resistance reading.

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