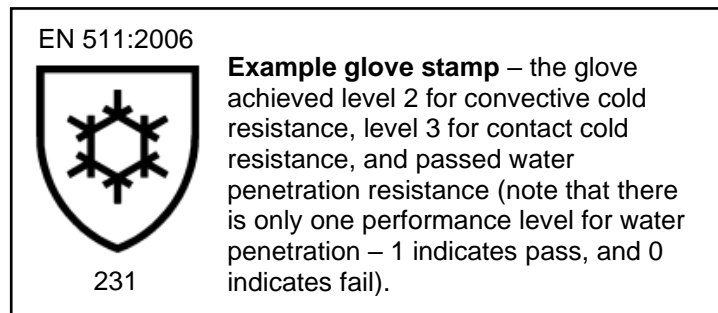


## Thermal risks (cold) – EN 511:2006

EN 511 is the standard for gloves designed to protect against convective and contact cold down to -50°C. The standard also covers resistance to water penetration. The below pictogram is used to claim protection from convective and/or contact cold – the letters A to C would indicate performance levels (tests are explained below) on an actual glove stamp. A '0' displayed under the pictogram indicates the glove did not meet the minimum requirements for the test, and an 'X' indicates a test was not carried out or is not applicable.



**A – Convective cold resistance:** this test assesses the ability of a glove to prevent heat loss from a heated hand model into the surrounding environment to determine the level of thermal insulation. This is determined by measuring for a 10-minute period the power required to maintain a constant surface temperature between 30 and 35°C while the hand model is placed in a climatic chamber with a specified air flow rate ( $4 \pm 0.5$  m/s) controlled to a temperature of at least 20°C lower than the hand surface temperature. The resultant thermal insulation is calculated from the difference in temperature between the hand surface and ambient conditions divided by the power delivered to the hand model. Performance levels are assigned according to the below table:

Performance level	Thermal insulation, $I_{TR}$ (m <sup>2</sup> K/W)
1	$0.10 \leq I_{TR} < 0.15$
2	$0.15 \leq I_{TR} < 0.22$
3	$0.22 \leq I_{TR} < 0.30$
4	$0.30 \leq I_{TR}$

Note: gloves must achieve at least performance level 1 in the EN 388 abrasion and tear resistance tests to claim any level of protection from convective cold. To claim a convective cold resistance performance level of 2 or more, the glove must achieve at least performance level 2 for EN 388 abrasion and tear resistance.

**B – Contact cold resistance:** this test (according to ISO 5085-1) involves placing glove material specimens taken from the palm side of the fingers between a hot (maintained at 31 – 35°C) and a cold metal plate, with thermocouples recording the temperature after a steady state of at least 30 minutes. Thermal resistance is then calculated from the difference in temperature between the inner and outer surfaces of the test material. Performance levels are assigned according to the below table:

Performance level	Thermal resistance, R (m <sup>2</sup> K/W)
1	$0.025 \leq R < 0.050$
2	$0.050 \leq R < 0.100$
3	$0.100 \leq R < 0.150$
4	$0.150 \leq R$

Note: gloves must achieve at least performance level 1 in the EN 388 abrasion and tear resistance tests to claim any level of protection from contact cold. To claim a contact cold resistance performance level of 2 or more, the glove must achieve at least performance level 2 for EN 388 abrasion and tear resistance.

**C – Water penetration resistance:** this test (according to ISO 15383) involves test subjects donning gloves over a water-markable inner glove and immersing their hands up to the wrist line of the glove in water which has been treated with a surfactant to lower its surface tension to less than  $34 \pm 5$  dyn/cm. The test subject then flexes their hands 12 times, and the inner glove is examined for water marks. The presence of water marks indicate a leak – if any leaks are present a fail result is recorded. A performance level of 1 is assigned for a pass result, and a performance level of 0 is assigned for a fail result.

If this test is failed or not carried out, a warning must be added to the user instructions that the glove may lose its insulative properties when wet.

**Flexibility behaviour:** this test (according to ISO 7584) is for coated gloves. Four test specimens taken from palm areas with no seams are repeatedly flexed by a machine for 10000 cycles in an environment maintained at  $-20^{\circ}\text{C}$ . The specimens are then examined and must show no cracks in the coating. Note that there are no associated performance levels, and this test is not indicated on the glove stamp.

**Extreme cold flexibility:** this test (according to ISO 4675) is required for coated gloves intended to be used in conditions of extreme cold, defined as temperatures of  $-30^{\circ}\text{C}$  and below. Three test specimens are placed in a cold chamber maintained at  $-50^{\circ}\text{C}$  for 4 hours. The test specimens are then bent in a bending jig and examined under 5x magnification. The specimens must show no cracks in the coating to pass the test. Note that there are no associated performance levels, and this test is not indicated on the glove stamp.