

KES

Method for Determining
the Transformation
Temperatures for Shape
Memory Alloys

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1. Scope of Application

This standard shall specify a measuring method of transformation temperature of shape memory alloy by differential scanning calorimetry.

Note ⁽¹⁾ The shape memory alloy mentioned here are a Ti-Ni type shape memory alloy and a Cu-Zn-Al type shape memory, which have a transformation temperature in the room temperature.

⁽²⁾ A transformation temperature is a martensite transformation temperature and a reverse transformation temperature.

Remark 1. For a measuring method of the transformation temperature, although there is an electric resistance measurement except the differential scanning calorimetry, the value obtained by this may not always be identical to the value obtained by the differential scanning calorimetry.

2. A transformation temperature measured by this standard is the transformation temperature after quenching treatment. It is appropriate to measure the transformation temperature of material or component that is shape memory treated by this standard.

2. Definition of Terminology

(1) Shape memory effect

The phenomenon that a certain shape of alloy goes back to a shape before transformation due to reverse transformation if heated by a temperature, which stabilizes at a high temperature (Object) state, although it is transformed to other shape at low temperature (Martensite).

(2) Shape memory alloy

There are a Ti-Ni alloy, Cu-Zn-Al alloy, etc. in the alloys that have the shape memory effect.

(3) Shape memory treatment

A treatment conducted to memorize a prescribed shape. In the shape memory treatment, there are a one-directional shape treatment and a two-directional shape treatment such as training, restraint heating, steel deformation, restraint prescription treatment, etc.

(4) Transformation temperature

A temperature that one shape changes to another shape when increasing or decreasing

temperature of alloy

Remark There is a temperature range generally for shape transformation of shape memory alloy.

(5) Martensite transformation

As a kind of solid shape transformation, it is a transformation that changes to a low temperature shape (Martensite) at a certain temperature by an arbitrary transformation device when cooling down from a temperature range, which shape is stabilized at a high temperature.

(6) Reverse transformation

A shape transformation that is occurred when heat and load is removed.

(7) Ma point

A temperature that the martensite transformation starts from the object when cooling
(Refer to Figure 1)

(8) Mr point

A temperature that the martensite transformation stops from the object when cooling
(Refer to Figure 1)

(9) As point

A temperature that the martensite transformation starts from the object when heating
(Refer to Figure 1)

(10) Ar point

A temperature that the martensite transformation stops from the object when heating
(Refer to Figure 1)

(11) Differential scanning calorimetry

It is a measuring method of a temperature function of a difference of energy input per unit period on both the specimen and the standard material under an environment that the both are heated or cooled at an adjusted speed so that the temperature of the standard material is maintained identical under same condition. This method is generally called as an input compensation differential scanning calorimetry. In case of the shape memory alloy, the transformation temperature is obtained from a curve by the measurement.

Remark 1. The differential scanning calorimetry is generally called short as DSC
(Differential scanning calorimetry).

2. In the DSC, there are an input compensation DSC as before and a heat velocity DSC.