The table gives a summary of normal boiling temperatures of natural-composition hydrogen, determined after the phenomenon of the conversion ortho-vapor became known.

LITERATURE CITED


CERTAIN PROBLEMS IN MEASURING THE TEMPERATURE OF ROTATING OBJECTS

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The methods of measuring the temperature of rotating objects have not been sufficiently developed and they have been insufficiently treated in literature. This is mainly due to difficulties in developing nondistorting slip-ring devices, which secure the electrical connection between rotating sensitive elements and the measuring equipment.

One of the variants of nondistorting slip rings which are used in circuits of rotating electrical thermoconverters is described in [1]. The same paper gives a short survey of various practical measurement methods designed for laboratory use or for stationary (for instance, electrical) machines. Measurements in other machines, for instance, in high-speed gas turbines of different types, where it is sometimes necessary to determine by experiment the temperature of vanes and rotor disks, have a number of specific characteristics which render the problem even more difficult.

*See English translation.
A variant of the method of measuring the temperature of rotating objects, which we have developed in investigating the thermal state of structural elements of gas turbines under actual operating conditions, is described below. K. K. Kosterov, V. V. Dolinskii, and N. G. Bodrov collaborated in developing this method.

Basic Measurement Characteristics. In measuring the temperatures of rotor vanes in high-speed gas turbines, the sensitive elements must operate under conditions of high rotational linear velocities, where the gas in vane channels moves at high velocities and is at high temperatures.

In investigating the thermal state of a turbine vane, the temperature field is usually studied along its length as well as over the vane cross section. In this, the sensitive elements must not distort either the temperature field in the vane or its profile and the conditions of gas flow around the vane.

Nonstationary turbines operate in a wide range of quickly changing operating conditions. In investigating such turbines, the measurement method must secure a reliable oscillographic recording of thermal processes when the machine operates under all conditions without using compensation devices. The recording of thermal processes must be automatic and continuous, and it must not require any additional operations on the experimenter’s part besides switching on and switching off the oscillographic equipment. The requirement for a reliable operation of all measuring devices and especially, slip ring devices and sensitive elements, is of paramount importance in such measurements. Considering

<table>
<thead>
<tr>
<th>Angular velocity, 1/sec</th>
<th>Temperature of slip ring parts in °C, measured by thermocouples</th>
<th>Cooling air temperature, °C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.1</td>
<td>No. 2</td>
</tr>
<tr>
<td>1080</td>
<td>120</td>
<td>118</td>
</tr>
<tr>
<td>1120</td>
<td>131</td>
<td>129</td>
</tr>
</tbody>
</table>

that the space available for the mounting of these devices is extremely limited in machines and that their installation must be performed without demounting any units or parts necessary for the normal machine operation, the fulfillment of these requirements represents one of the difficult problems.

The measuring instruments must provide the possibility of the simultaneous recording of thermal processes from as great a number of sensitive elements as possible. Since, in a number of cases, the space available for mounting the oscillographic equipment is also strictly limited, the measurement method must secure a recording of a large number of parameters with a minimum number of standard oscillographs.

For matching the thermal state of the structural element under investigation with the machine operating conditions, the simultaneous recording of the basic parameters characterizing the operation of the machine as a whole must be secured.

Measurement errors must be as small as possible, and they must not exceed 2%, at the most.

Sensitive Elements. As was shown by analysis, the sensitive element most suitable for these measurement conditions is a thermocouple with thermoelectrodes of a small diameter (0.2-0.3 mm). For such small dimensions, the temperature at various points of the thermocouple junction can be considered as practically constant.

For a well-insulated and heat-resistant thermocouple, the following method of insulating the thermoelectrodes is recommended: the thermoelectrode, which is first coated with a layer of heat-resistant lacquer, is wrapped in asbestos threads, and the insulation is soaked in distilled water; the asbestos layer is rolled by means of a special flat polisher on a flat polished plank and is then impregnated with a mass consisting of kaolin, quartz powder, and liquid glass, after which the electrode is again rolled and dried in air; the dried electrode is again coated with a thin uniform layer of heat-resistant lacquer and then dried.