DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS
WASHINGTON, D.C.

(November 17, 1926)

THERMAL EXPANSION OF SOLIDS

The Expansion Laboratory devotes most of its time to original investigations, and therefore limits the number of commercial tests on thermal expansion. Only those tests that seem to the Bureau absolutely necessary for the public welfare, and which can not be carried out elsewhere, may be accepted.

1. Preparation of Specimens

Each specimen submitted should be in the form of a straight rod or bar of uniform cross-section. The length should be at least 320 mm (12 5/8 inches), and the diameter (or diagonal, if the rod has a rectangular or irregular cross-section) should be between 5 and 10 mm (between 3/16 and 3/8 inches). Sizes other than these may be tested, but applicants wishing tests on special sizes should communicate with the Bureau before preparing specimens. Each sample accepted for test, is cut to an exact length at the Bureau, and the ends of the sample are also shaped and highly polished. After the tests, specimens are usually retained at the Bureau.

2. Composition, Heat Treatment, etc.

The Bureau requires a complete record of the chemical

composition, previous heat treatment, and method of manu-
facture, - whether cast, drawn, rolled, etc. These data
should accompany the request for test. Specimens liable
to break in shipment or in cutting should be sent in
duplicate.

3. Report of Tests

Unless otherwise specified all reports on expansion
will be based on observations made at four temperatures,
including room temperature. Average coefficients of expan-
sion for several temperature ranges will usually be reported.
If necessary, expansion equations will also be derived by
the method of least squares, for materials that show regular
expansion. An extra fee will be charged for the derivation
of each expansion equation.

The expansion equation will be given as a second-degree
equation of the form

$$L_t = L_0 (1 + at + bt^2)$$

where L_t and L_0 are the lengths of the material at t° and
0°C, respectively. Since this equation is derived by the
method of least squares, it will be the best second-degree
equation obtainable from the observations taken. From this
equation it is possible to obtain an instantaneous coefficient
of expansion applicable at any given temperature within the
proper range, or an average coefficient of expansion for
a given range of temperature. Values of these types are
usually given in tables of expansion.

The equation, $L_t = L_0 (1 + at + bt^2)$, indicates the desired length L_t in terms of L_0 the length at 0°C. Since it is often more convenient to measure the initial length of materials at some other temperature t_1, say room temperature, the following formula is added and may be used in such cases:

$$L_t = \frac{L_{t_1}(1 + at + bt^2)}{1 + at_1 + bt_1^2}$$

where L_{t_1} represents the initial length of the material at the known temperature t_1.

Bureau of Standards,
Washington, D. C.
November 17, 1926

Test Fee Schedule 261. - THERMAL EXPANSION OF SOLIDS.

Effective October 1, 1926, superseding all previous schedules
for the items covered.

Item	Description	Fee
261a to i	Comprise the shaping of the ends of specimens and the determinations of the thermal expansion for the temperature ranges specified.	
261a	From 20°C (or higher) to 100°C (or lower)........	$15.00
261b	" 20°C " " " 300°C " "	20.00
261c	" 20°C " " " 500°C " "	25.00
261d	" 20°C " " " 700°C " "	35.00
261e	" 20°C " " " 900°C " "	40.00
261f	" 20°C " " " 1000°C " "	50.00
261g	" -20°C " " " 20°C " "	20.00
261h	" -20°C " " " 300°C " "	35.00
261i	" -140°C " " " 20°C " "	50.00
261j	Determination of thermal expansion at each additional temperature within the range tested........	2.00
261k	For the derivation of an expansion equation, an extra fee will be charged dependent upon the amount of work required (minimum charge $2.00)	
261x	Copies of certificates or reports previously issued or reissue of worn or damaged certificates or reports returned, each...........	.50
261z	For special tests not covered by the above schedule, fees will be charged dependent upon the nature of the test.	