Temperature Compensation Users Guide

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Introduction

The Temperature Compensation utility was written to allow users to see the effect of temperature on measurement length when using a coordinate measuring machine. The length correction is based on the temperature of the CMM axis, the temperature of the part, and the expansion coefficients of the axis and part.

Using a coordinate measuring machine in a thermally poor environment can result in a significant measurement error. This utility will show the compensation amount based on the input conditions in order for a given measurement length to be correct at the standard reference temperature. CMM's that have active temperature compensation will have this correction done in the background without the operator even aware of it.

This utility is cross platform compatible and can be run on all supported operating systems.

Overview

The Temperature Compensation Utility is a single dialog with inputs for temperature, expansion coefficients, and measurement length.

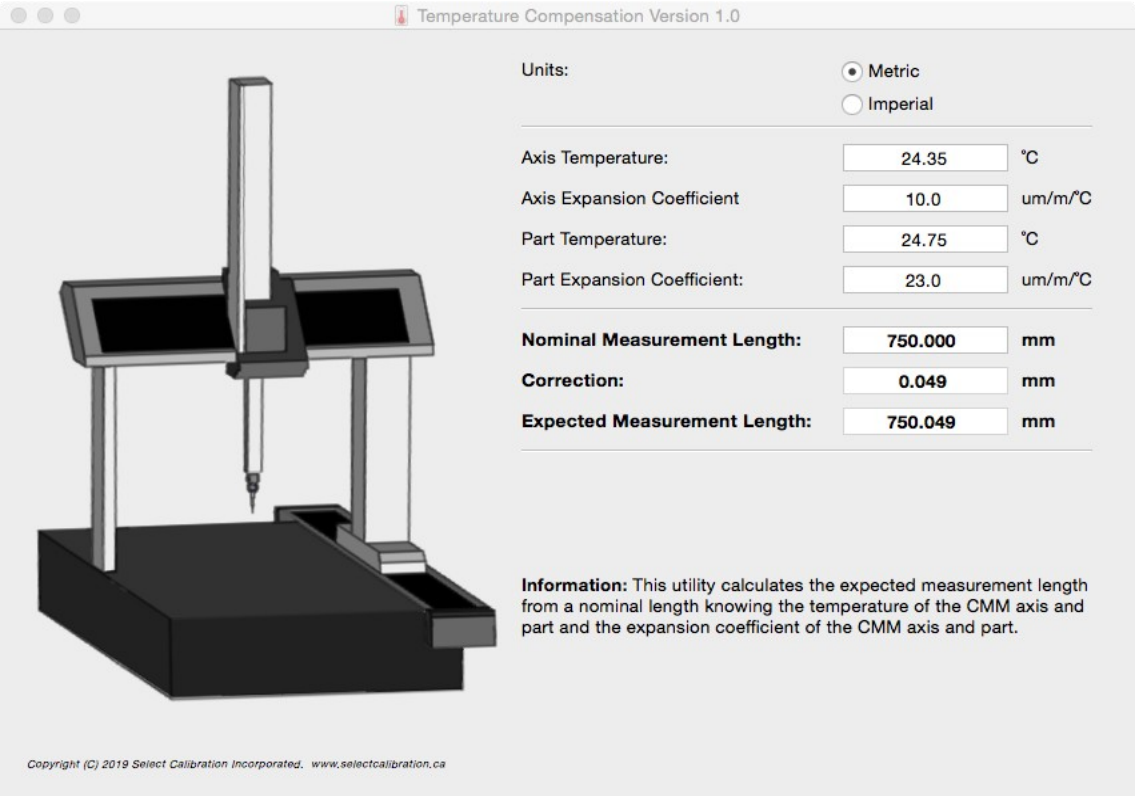

Illustration 1: Temperature Compensation utility main window.

Options

Item	*Description*
Units	Working units of the Temperature Compensation utility. Metric units use millimeter for length and celsius for temperature. Imperial units use inch for length and fahrenheit for temperature.
Axis Temperature	Temperature of the CMM axis relevant to the measurement. If the measurement is in 3D then this would be the average of all three axis.
Axis Expansion Coefficient	Expansion coefficient of the CMM axis. Normally (ideally) all axis of a CMM are the same but there are cases where this is not always true.
Part Temperature	Temperature of the measured part.
Part Expansion Coefficient	Expansion coefficient of the part material. This information is available from various websites.
Nominal Measurement Length	The measurement length without compensation applied. This could be a nominal length or an actual measurement length from a CMM.
Correction	The amount of correction based on the input conditions and length.
Expected Measurement Length	The expected measurement length (sum of the *Nominal Measurement Length* and *Correction*). This is the expected measurement length in the measurement environment.

Calculation of Correction

The general formula to calculate the correction value for compensation is shown below:

$$Part_{expansion} = Length * K_p (T_p - 20)$$

$$CMM_{expansion} = Length * K_a (T_a - 20)$$

$$Correction = Part_{expansion} - CMM_{expansion}$$

Where:

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Part[expansion] = Expected change in length of part.
CMM[expansion] = Expected change in length of CMM.
Kp = Expansion coefficient of the part.
Tp = Temperature of the part in celsius.
Ka = Expansion coefficient of the CMM axis.
Ta = Temperature of the CMM axis in celsius.
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The correction is zero when the expansion coefficient of the part matches the CMM axis and both are at the same temperature.

Revision History

Date	*Version*	*Changes*
Sep 28, 2019	1.0	New Program