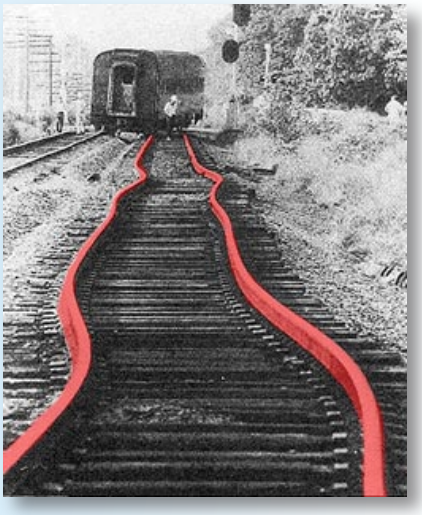
# The New NO-VAR Technology for the Aeroel Laser Micrometers

**The NO-VAR (NO-VARiation) technology developed for the Aeroel Laser Micrometers allows one to simply get perfect diameter measurements, even in non thermally controlled environments**, when the ambient temperature is significantly different from the reference temperature (20°C).

Thanks to this new technology **it is possible to get in the workshop or in line, the same results that one would get in a controlled temperature metrology room** when measuring any material and even when the ambient temperature is changing by some degree/hour.

You will no longer have to be concerned about frequent gauge remastering operations when the room temperature is changing, nor will you have to take into account part expansion.

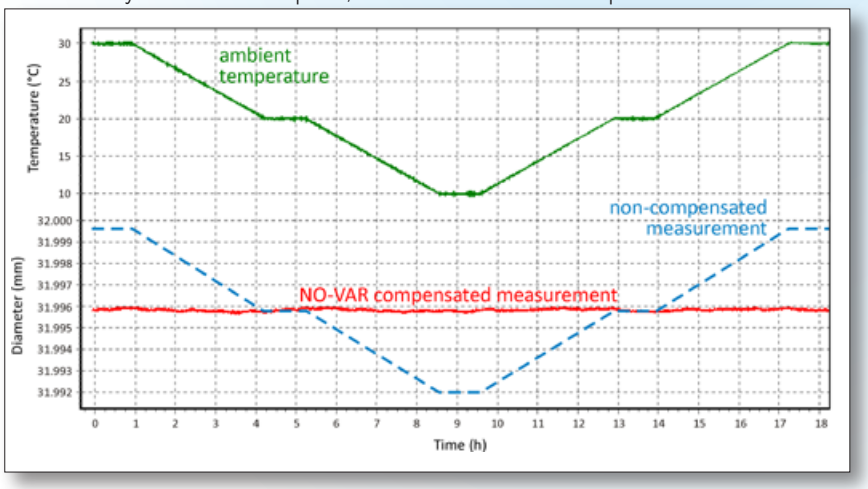
## The problem of thermal expansion



Any measurement process must take account the effect of the ambient temperature which affects both the measuring instrument and the part to be measured. Even if we would have a "perfect" instrument, not affected in any way by the room temperature, we would have to consider the effect of the room temperature on the part's dimension.
It is well known, for example, that a temperature difference of 10°C will result in a change of 3.6 µm on a 30 mm steel part, since the typical steel thermal expansion coefficient is about +0.012 µm/mm °C. In practice, with this deviation you have to add the gauge's thermal error, which is generally not known nor is perfectly reproducible. As a result, until now, no one was able to predict with reasonable accuracy the overall measuring error when the instrument is working at a temperature different from the reference temperature (20°C). The only way to by-pass the problem was to proceed to frequent re-mastering operations, using a master made with the same material of the parts being measured and stored near the gauge at the same temperature of the parts to be checked.

## How was the NO-VAR technology born ?

Since the very beginning the Aeroel laser micrometers have been designed and manufactured to have a negative thermal coefficient of expansion. This value was very close to the steel one but opposite in sign in order to self-compensate the thermal expansion of steel parts. This special feature has made it possible to use the Aeroel micrometers in the workshop or on-line, to accurately measure steel parts, without the need for frequent instrument re-mastering. Nevertheless before today the self compensation effect was not perfect, either because the thermal expansion coefficient of the steel varies from alloy to alloy, or because the gauge thermal coefficient was really not perfectly known and reproducible. In addition it would have been impossible to compensate materials different from steel (i.e. aluminum), as their thermal coefficients do not match.




Nowadays, thanks to the NO-VAR technology, all these problems are eliminated and the Aeroel Laser Micrometers are perfect for use in non-thermally-controlled environments and to measure any material very precisely.

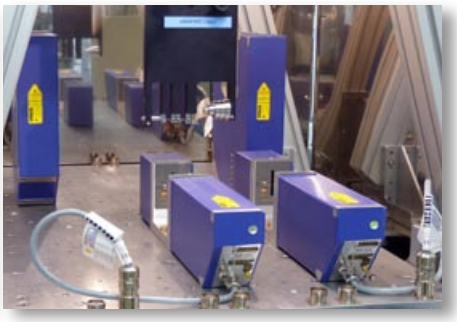
AEROEL
*PRECISION LASER SYSTEMS*

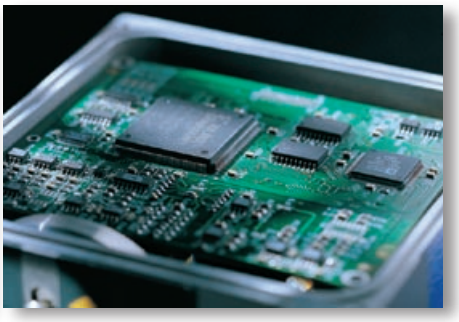
## How has it been possible to achieve this result ?


Four fundamental elements have enabled us to achieve this important result :

- The thermal coefficient of any instrument is perfectly known and reproducible over time and temperature. Using a **climatic chamber to perform the tests**, the coefficient is measured gauge by gauge and stored in the gauge memory.
- The instrument and the room temperature are measured in real time by **temperature sensors installed in the gauge**.
- The **thermal coefficient of the part** being measured is known and its value is **programmed in the gauge memory**.
- Smart software, installed inside the gauge, **compensates the part expansion** and the temperature effect on the gauge, **in real time and automatically**.

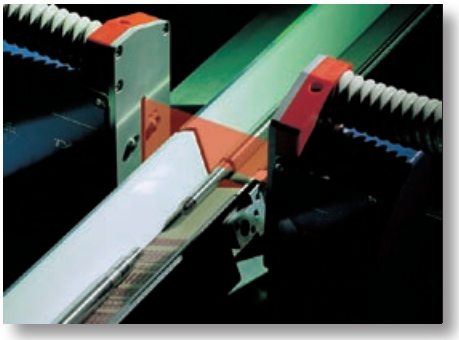
Of course, to get accurate results, the part being measured and the gauge itself must be in a quasi-equilibrium condition with the environment and the ambient temperature variation rate is within some degree/hour (typically lower than 3 °C/hr).

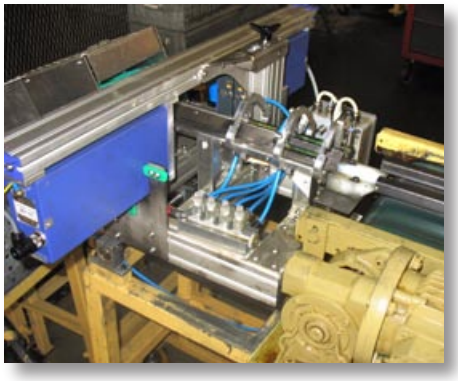





### The on-line measurements

In case of any temperature difference between the part and the environment, caused for example by the part heating due to the machining, that must be considered separately, i.e. by offsetting the measured value or by changing the programmed nominal value used for the process control. Indeed, even if it would be possible to measure the external temperature of the “warm” part, that would not help in any way: the part expansion is the overall result of the internal temperature distribution, which is impossible to know. However it is very reasonable to suppose that the process heating effect turns into an overall expansion which will be constant if the process parameters are constant as well (part mass and shape, machining speed, lubricant temperature, etc); so that the effect can be compensated by an experimental constant offset.





To find such an offset value is rather simple : just measure the “warm” part immediately after machining and then the same part when it has reached the equilibrium condition with the environment. The difference between these two measurements will be the offset value to be programmed. **You do not need a metrology room** to perform this operation: the Aeroel micrometers will be installed on-line or used in the workshop and the NO-VAR technology will take care of the ambient temperature changes, which is the temperature of the part before machining.

## For the Ultimate in Precision: choose Aeroel Laser Micrometers

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