TechNote HBM

Pressure Measurement Gage PMS40

The pressure measurement gage PMS40-3/120 is a flat and flexible sensor which is applicable to transient pressure measurements typically in the range between 100bar and a few kbar. The bonding is analogous to electrical strain gages.

PMS Output Signal in General

The electrical output signal of the PMS is given as:

(1) $\Delta R/R = a * \Delta p + k * \varepsilon + k * \varepsilon_S(T)$

- The main term for the pressure measurement reads $a * \Delta p$. It contains the pressure sensitivity of the PMS of a =2.5*10^{-6}/bar.
- The term $\varepsilon_S(T)$ displays the temperature response of the electric resistance of the PMS and needs to be implemented for both bonded and unbonded applications.

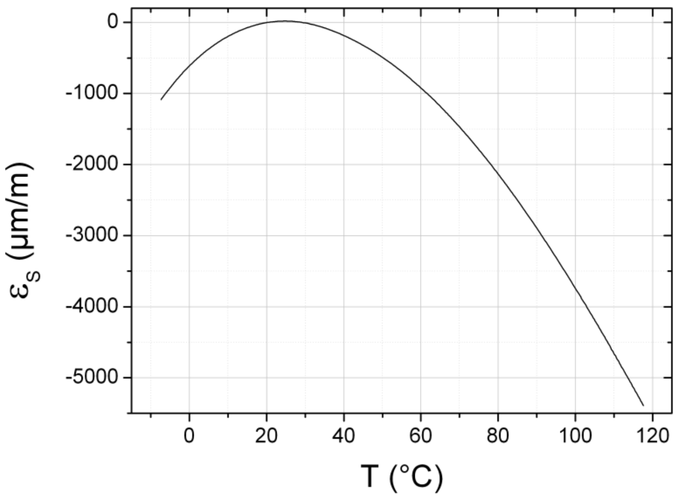

Fig. 1. *Temperature response of the PMS.*

- The strain value ε in formula (1) has to be implemented for bonded applications and is given as the sum of mechanical strain ε_m of the specimen due to external forces, of the strain $\varepsilon_p(\Delta p)$ of the specimen inferred by hydrostatic pressure, and of the thermal expansion $\alpha_S * \Delta T$ of the specimen, where α_S is the corresponding coefficient of thermal expansion:

  (2) $$\varepsilon = \varepsilon_m + \varepsilon_p(\Delta p) + \alpha_S * \Delta T$$

Contrary to the electrical strain gage, the PMS gage factor is k=0.57.

The active measurement grid of the PMS must be completely exposed to the ambient pressure. The electric feed lines need not to be in the pressure zone.

Bonded and Unbonded Application

Both cases of (a) unbonded and (b) bonded PMS applications are described for measurements under hydrostatic conditions below:

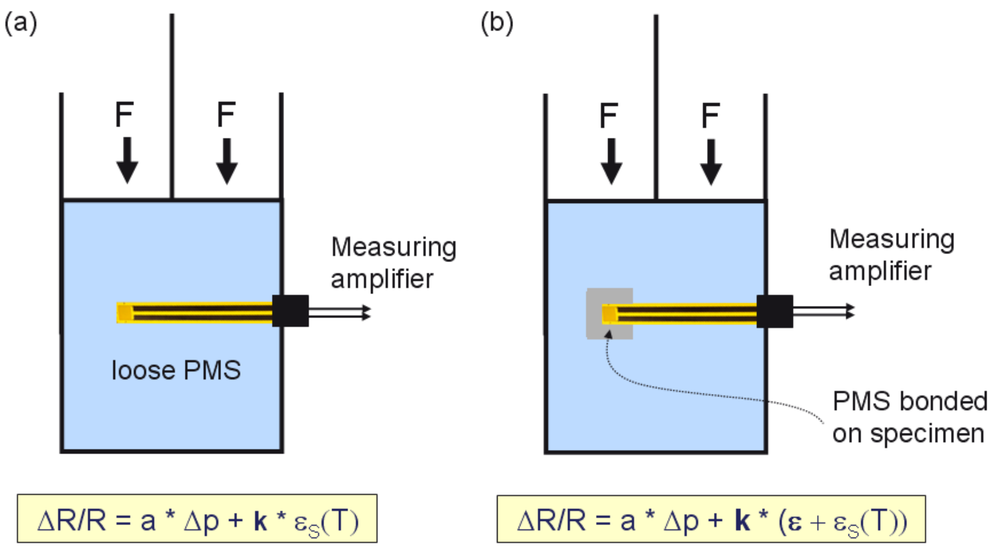

Fig. 2. *PMS pressure measurements under hydrostatic conditions. In (a) the PMS is loose in the compressed medium; in (b) the PMS is additionally bonded on a specimen.*

(a) If the PMS experiences no additional mechanical strain, the formula in Fig. 2(a) is valid.

(b) Here, the compressive strain of the specimen induced by hydrostatic forces must be implemented (see (2) and formula in Fig. 2(b)). For a specimen out of an isotropic material, the compressive strain includes the compressibility κ :

(3) $\varepsilon_p(\Delta p) = -1/3\,\kappa * \Delta p$.

Isothermal Application

In many transient processes, such as shock waves, pressure changes are much more rapid than temperature changes. The pressure changes are then (quasi) isothermal. In such cases, the temperature influence can be neglected.

For isothermal applications, the PMS output signal (1), (2) is reduced to:

(4) $\Delta R/R = a * \Delta p + k * \varepsilon$ with $\varepsilon = \varepsilon_m + \varepsilon_p(\Delta p)$