

Metal/Porcelain Compatibility

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The general method of predicting whether a particular porcelain/metal alloy system is compatible is by comparing the thermal expansion coefficient of the porcelain with that of metal. If the coefficients fall within a certain pre-determined range, the system is considered to be compatible. If the coefficients are outside this range, the system is considered not to be compatible.

In actual practice, this prediction method does not always work. Thus, some porcelain-metal systems predicted to be compatible, are not compatible in actual trials, and vice-versa.

The reason is that coefficient of thermal expansion is only one of several properties of porcelains and metals that determine their mutual compatibility. Other properties are thermal conductivity and heat capacity of both materials, tensile strength of the porcelain, and modulus of elasticity of the metal.

The modulus of elasticity of the metal is particularly important. The lower the modulus of the metal, the greater is the range of thermal expansion coefficients of porcelain that can be accommodated. Most alloy manufacturers do not report the modulus of elasticity for their products. But even if they were reported, they would be of limited value in making any prediction since they would be ambient temperature values. Modulus of elasticity changes with temperature and the change is at different rates for different alloys. The effective values would be those between room temperature and about 600°C (the temperature range at which porcelain has no elasticity). It is not unusual for certain high gold content alloys having low moduli of elasticity to exhibit compatibility with porcelains with thermal expansion coefficients well outside the range of expected compatibility. This behavior can be explained by slight yielding of the metal that relieves the tensile stress on the porcelain caused by the thermal expansion mismatch.