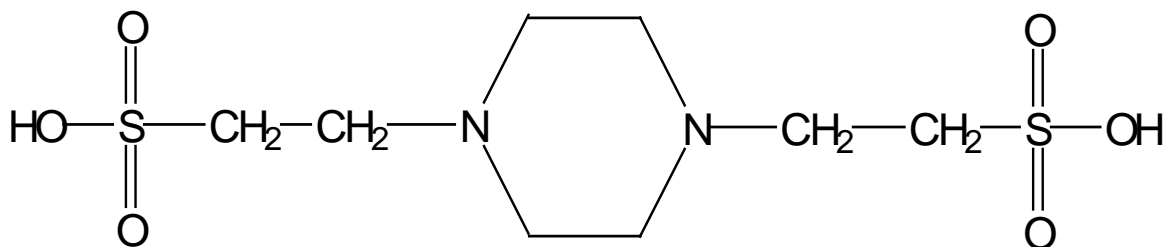


**PIPES BUFFER**  
Sigma Prod. No. P6757



**CAS NUMBER:** 5625-37-6

**SYNONYMS:** piperazine-N,N'-bis(ethanesulfonic acid); 1,4-piperazinediethanesulfonic acid

**PHYSICAL DESCRIPTION:**

Appearance: white powder

Molecular formula: C<sub>8</sub>H<sub>18</sub>N<sub>2</sub>O<sub>6</sub>S<sub>2</sub>

Molecular weight: 302.4

Melting point: decomposes >300°C<sup>1</sup>

(pK<sub>a1</sub> <3, but not usually reported)<sup>1</sup>; pK<sub>a2</sub> = 6.8 at 25°C<sup>1,2</sup>

Effective buffering range: 6.1 - 7.5 (at 25°C)

ΔpK/ΔT = - 0.0085<sup>3</sup>

No reported metal binding<sup>1</sup>

**STORAGE / STABILITY AS SUPPLIED:**

PIPES is expected to be stable for years at room temperature.

**SOLUBILITY / STABILITY OF SOLUTIONS:**

PIPES free acid is not very soluble in water (only 1 g per L at 100°C)<sup>1</sup>, but its salts are very soluble in water at the pH normally used as a buffer. PIPES does form a clear, colorless solution in 1 N NaOH, and is soluble at least to 20% (w/w) in 1 N NaOH. (The resulting solution has a pH ≈ 6.)<sup>2</sup> PIPES becomes soluble as the pH rises above pH 7 (it is converted to the salt form).

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**SOLUBILITY / STABILITY OF SOLUTIONS:**

If solutions are to be sterilized, filtration is generally recommended for ethanesulfonic acid buffers, but PIPES buffers have been successfully autoclaved.<sup>2</sup>

**GENERAL USAGE:**

PIPES is a member of the ethanesulfonic acid buffer series, first introduced by Good et al., developed to meet certain criteria: midrange pK<sub>a</sub>, maximum water solubility and minimum solubility in all other solvents, minimal salt effects, minimal change in pK<sub>a</sub> with temperature, chemically and enzymatically stable, minimal absorption in visible or UV spectral range and easily synthesized.<sup>1</sup> Since its pK<sub>a</sub> at 37°C is near physiological pH, it has applications in cell culture work. Sigma offers a cell culture-tested product (P8658) as well as several different salts for convenience in buffer preparation, and P8203, PIPES SigmaUltra which is tested for the presence of trace metals.

Buffers can be prepared by adding a solution of base to PIPES free acid, titrating to the appropriate pH, or by mixing equimolar solutions of the monosodium salt and the disodium salt, titrating to the appropriate pH.

Several application notes:

Glutaraldehyde fixation of plant and animal tissue samples can cause loss of lipid, leading to apparent morphological changes. Lipid loss and artifacts are minimized when PIPES was used to buffer the glutaraldehyde fixative.<sup>4,5</sup>

Alkaline phosphatase activity is lost selectively from certain rat hepatocyte organelles when fixed for ultracytochemistry with cacodylate-buffered glutaraldehyde. When PIPES was used as buffer, retention of activity was 60% greater.<sup>6</sup>

Fixation of fungal zoospores for fluorescence microscopy and electron microscopy was optimal with a combination of glutaraldehyde and formaldehyde in PIPES buffer.<sup>7</sup>

**REFERENCES:**

1. Good, N.E. et al., *Biochemistry*, 5, 456-477 (1966).
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4. Salema, R. and Brandao, I., *J. Submicr. Cytol.*, 9, 79 (1973).
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7. Hardham, A.R., *J. Histochem. Cytochem.*, 33, 110 (1985).

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