

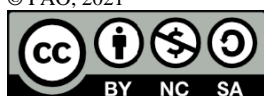
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- 5.4. Traceable standard buffer solutions of pH 4.0, pH 7.0, and pH 10.0 or standard buffer solutions of known pH prepared in deionized/distilled water (5.1). (see Appendix I).

Buffer solutions should be handled meticulously as Good Laboratory Practice demands for standards or reference materials. They should be stored preferably in polythene vials/containers. They should not be stored for more than 6 months. The pH 10 buffer solution is notably sensitive to carbon dioxide from the atmosphere and may quickly deteriorate and become unreliable. For the same reason it is good practice not to return buffer solutions to the mother container despite the basic fact that buffer solutions are solutions that can resist changes in hydrogen ion concentration to an extent.

6. Health and safety

Safety glasses, gloves and lab coats must be worn when performing this analysis. The unknown potential hazards from the soil chemical and biological hazards as well as toxicities from chemicals used in pH determination should be kept in mind throughout the procedure. (Refer to the specific Material Safety Data Sheet (MSDS) for the hazardous properties of any chemicals or reagents utilized in this analysis). While buffers are not generally considered to contain hazardous material, because of acidity or alkalinity, repeated contact with the skin can cause dryness or cracks. Similarly, accidental contact with the eyes can lead to redness and or swelling. The wearing of a mask particularly during sample preparation should also be encouraged and the same on sample disposal and on cleaning.

7. Sample preparation

Soil samples should be air dried (or dried in a ventilated drying oven at a temperature below 40 °C) and ground to pass a 2 mm sieve (N° 10).

Ensure that the milling equipment, sieves and all the materials used do not introduce contamination to the samples.

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<http://www.fao.org/3/w7295e/w7295e0a.htm#8> internal quality control of data

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12. Appendix I – Preparation of pH buffer solutions

Commercially available buffer solutions are adequate for use as calibration standards. Alternatively they may be prepared as follows (Rayment and Lyons, 2011; ASTM, 4972-19).

1. Buffer solution, pH 4.00 at 15 to 30 °C.

Dry potassium hydrogen phthalate ($\text{KHC}_8\text{H}_4\text{O}_4$) for 2 h at 110 °C, allow to cool in a desiccator. After drying, dissolve 10.12 g $\text{KHC}_8\text{H}_4\text{O}_4$ in water (5.1) and dilute to 1000 mL. As a preservative, add 1.0 mL of chloroform or a crystal (about 10 mm in diameter) of thymol per liter of buffer solution.

2. Buffer solution, pH 6.86 at 25 °C.

Dry the two phosphate salts, KH_2PO_4 and Na_2HPO_4 for 2 h. at 110-130 °C, allow to cool in a desiccator. After drying, dissolve 3.387 g. of KH_2PO_4 and 3.533 g. of Na_2HPO_4 in water (5.1) and dilute to 1000 mL. As a preservative add 1.0 mL of chloroform or a crystal (about 10 mm in diameter) of thymol per liter of the buffer solution. This solution has pH 6.90 at 15 °C, pH 6.88 at 20 °C, and 6.85 at 30 °C.

3. Buffer solution, pH 7.0 at 25 °C

Preference is to use a purchased solution. Alternatively dissolve 2.721 g KH_2PO_4 and 3.904 g of Na_2HPO_4 (previously dried at 130 °C for 2 h) in water (5.1) and dilute to 1000 mL. As a preservative add 1.0 mL of chloroform or a crystal (about 10 mm in diameter) of thymol per liter of the buffer solution. This solution has pH 7.05 at 15 °C, pH 7.02 at 20 °C, and 6.99 at 30 °C.

4. Buffer solution, pH 10.00 at 30 °C.

Dry the two salts, NaHCO_3 and Na_2CO_3 for 2 h at 130 °C, allow to cool in a desiccator. After drying, dissolve 2.10 g. of NaHCO_3 and 2.65 g. of Na_2CO_3 in water (5.1) and dilute to 1000 mL. This solution has pH 10.12 at 15 °C, pH 10.06 at 20 °C, and 9.96 at 30 °C

Buffer solutions can be stored with protection from CO_2 uptake, contamination and evaporation for up to one month.

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13. Appendix II - Acknowledgments

GLOSOLAN thanks Ms. Nopmanee Suvannang, GLOSOLAN Chair for leading the harmonization of this SOP and the following members of the working group that served as leaders for their regions and contributed to the writing of this SOP: Mr. Sanjay Srivastava from India, Ms. Maria Cristina Suarez Marte from the Dominican Republic, Mr. Rob de Hayr from Australia, Mr. Lauris Leitans from Latvia, Ms. Elena Shamrikova from the Russian Federation, and Mr. Takesure Tendayi from Zimbabwe. GLOSOLAN also thanks the experts that served in the Review Panel and looked after the finalization of the SOP, all laboratories that provided inputs for the harmonization of this method, all experts that technically reviewed this SOP, and Mr. Christopher Lee from the Kellogg Soil Survey Laboratory, USDA-NRCS-NSSC, United States of America for proofreading it.

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15. Appendix IV - Contributing laboratories

GLOSOLAN thanks the following laboratories for completing the GLOSOLAN form on the method and providing information on their standard operating procedure for the soil pH determination method. This information was used as a baseline for the global harmonization.

From the Asian region:

- Bangladesh Soil Resource Development Institute, **Bangladesh**
- Soil & Plant Analytical Laboratory, **Bhutan**
- Royal University of Agriculture, **Cambodia**
- ICAR-Indian Institute of Soil Science, **India**
- International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), **India**
- Indonesian Soil Research Institute, **Indonesia**
- Institute for Agro-Environmental Sciences, NARO (NIAES), **Japan**
- Department of Agricultural Land Management, **Lao People's Democratic Republic**
- Mongolian University of Life Sciences, **Mongolia**
- Department of Agricultural Research, **Myanmar**
- Soil Science Division, NARC, **Nepal**
- Fauji Fertilizer Company Limited, **Pakistan**
- Regional Soils Laboratory, Integrated Laboratory Division, Department of Agriculture, Regional Field Office 3, **Philippines**
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- Sugar Research Institute of Fiji, **Fiji**
- Laboratoire des Moyens Analytiques Nouméa, **New Caledonia**
- University of the South Pacific, Aalfua Campus, **Samoa**

From the Near East and North African region:

- Directorate of Plant Wealth, Ministry of Works & Municipalities & Urban Planning, **Bahrain**
- KIMIA AB Environmental and Agricultural Consulting Laboratory, **Islamic Republic of Iran**
- Soil and Water Institute, **Islamic Republic of Iran**
- Ministry of Science and Technology, Directorate of Agricultural Researches, Soil and Water Resources Centre, **Iraq**
- National Agricultural Research Center, **Jordan**
- Kuwait Institute for Scientific Research, **Kuwait**
- Agricultural Research Institute, **Lebanon**
- Land and Water Research Center, **Sudan**
- General Commission for Scientific Agricultural Research, **Syrian Arab Republic**

From the African region:

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- Institute of Agricultural Research for Development, **Cameroon**
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- Laboratory Analytical Service-Accra Centre (CSIR-SRI), **Ghana**
- Soil Research Institute Analytical Services Laboratory, CSIR-Soil Research Institute, **Ghana**
- Environmental Analytical Laboratory, CSIR-SARI, **Ghana**
- Laboratoire National d'Analyse de Sols, des Engrais, des Végétaux et Eaux du Services National des Sols, **République de Guinée**
- Institut de Recherche Agronomique de Guinée (IRAG), **Guinea Bissau**
- Kenya Agricultural & Livestock Research Organization (KALRO), **Kenya**
- Laboratoire des Radiosotopes, **Madagascar**
- FES – Agrilab, **Malawi**
- Institut National de la Recherche Agronomique du Niger, **Niger**
- National Soil Testing Laboratory Complex, Kaduna, **Nigeria**
- Laboratoire des Sols, Eau, Végétaux et Engrais, Institut Togolais de Recherche Agronomique, **Togo**
- Zambia Agriculture Research Institute, **Zambia**
- University of Zambia, **Zambia**
- Zimbabwe Sugar Association Experiment Station, **Zimbabwe**
- Fertilizers, Seed and Grain, **Zimbabwe**

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- REQUASUD, **Belgium**
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- Kmetijski inštitut Slovenije/Agricultural Institute of Slovenia, **Slovenia**
- Rothamsted Research, **United Kingdom of Great Britain and Northern Ireland**

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