selecting a laboratory

water purification system

Water Purification Systems UK

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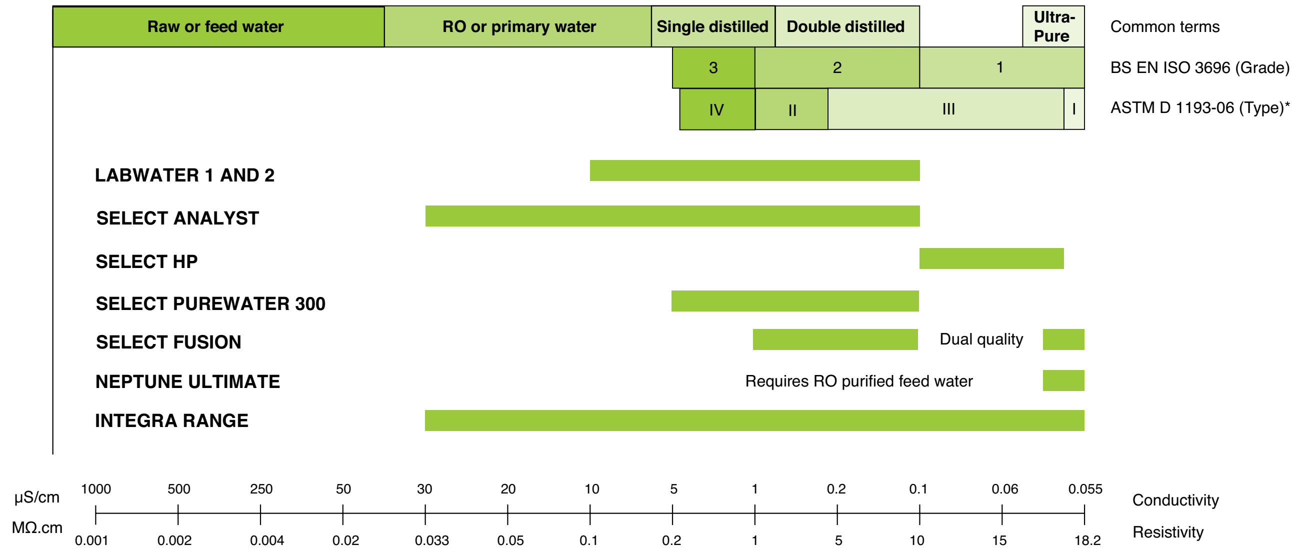
Clean water is a basic human requirement, purified water is a laboratory requirement. The chemical composition of potable or raw water drawn from boreholes or direct from mains supplies can vary considerably in terms of the quantity and the variety of dissolved minerals and particulate matter. As a result of its variability, utilising the correct water purification techniques is essential to ensure a consistent supply of high purity or ultra-pure water.

This guide explains the principal considerations for laboratories looking to specify, purchase and operate a suitable water purification system.

Matching systems to requirements



*Based on resistivity only

quality

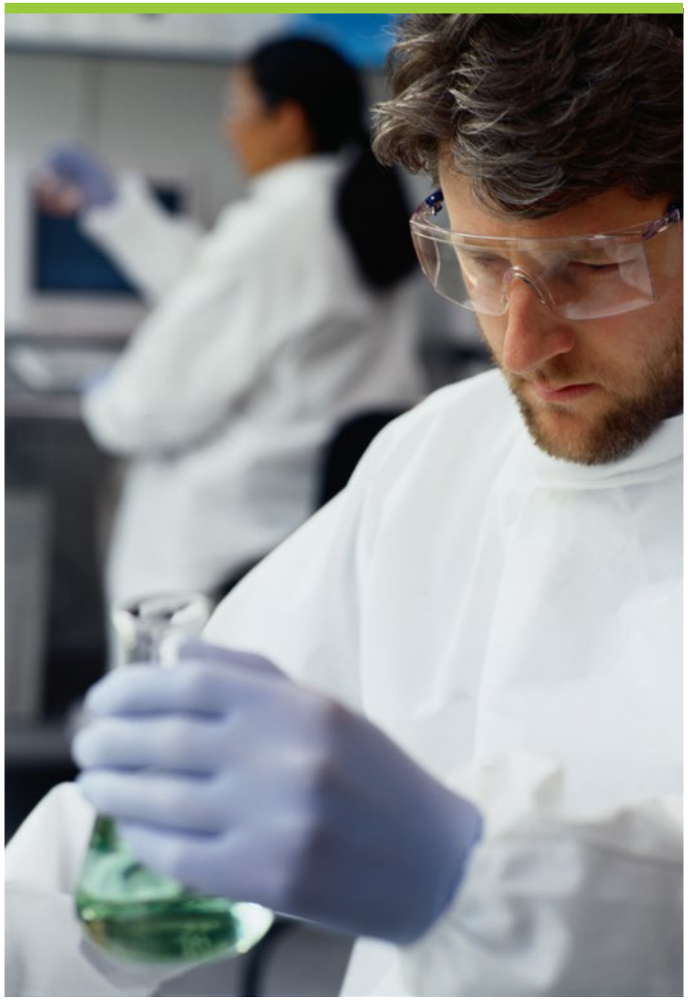
The impurities in water come from a number of different sources, and the importance of eliminating the different types of contaminant will vary depending on the specific equipment and processes in use in the laboratory. For most applications, contaminants can be divided into five main groups: ions; organic materials; bacteria; endotoxin by-products; and dissolved gases.

The required level of purity is based on the measurement approach used to determine the level of these different types of contaminants. Ions increase the ability of the water to conduct electricity, so are measured by determining the conductivity of the water. In purer water, due to the lack of ions, resistivity is used. Organic compounds are measured in terms of total oxidisable carbon (TOC). Particulates are measured by size, and quantity per millilitre (ml).

Manufacturers of laboratory water purification equipment typically design their systems to meet one of the established international standards for water quality, such as ISO 3696 (1987) or ASTM D1193 (1991).

The most commonly used standards define three basic categories of water: Type 3 for general use, such as washing glassware, Type 2 for most standard applications, making reagents / media etc., and Type 1 for critical applications, such as PCR work, where a high level of purity is required.

consider quantity



Some processes may be particularly sensitive to specific forms of contamination, requiring even higher levels of impurity removal than those defined by the general standards. In these cases, laboratories may need to install additional technologies to produce water at an appropriate level of purity.

volume

The quantity of water required will determine the size of the purification system, or systems, specified and may influence a user's choice of technology and equipment configuration. As well as overall volume demand, its variability throughout the day will have implications for system selection and the sizing of on-board or local storage tanks to manage peaks. Some modern systems include built in recirculation to maintain the quality of water stored in these tanks.

The number of technologies employed, and hence the cost to produce water, increases with its purity, so labs should consider their requirements for all grades when planning their water purification strategy. Many commercially available systems use several process stages to produce Type 1 water, for example, with the output from a Type 3 or Type 2 process used as the feedwater for a final 'polishing' stage.

Sizing decisions should consider both current and expected future water needs, to ensure the selected system is able to fulfil the laboratory's foreseeable water requirements.

At the same time, care should be taken not to significantly oversize the water purification system, since this will lead to higher capital and operating costs and may result in purified water being stored for longer periods, increasing the risk of contamination after purification.

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choosing the right technology

technology choices

Laboratory water purification systems make use of a number of different technologies, or combinations of technologies, in their operation.

- **Reverse Osmosis (RO)** – uses a semipermeable membrane to remove particles. The best RO systems can remove more than 98 percent of mineral particulates and more than 99 percent of bacteria from the feed water supply.

- **UV radiation** – typically applied at wavelengths of 254 or 185nm to destroy microorganisms and reduce Total Organic Carbon (TOC) levels.

- **CEDI** – Continuous Electro Deionisation - special resins are used to capture charged particles from the water and these are regenerated using electricity.

- **Filtration** – sub-micron filters can be used to remove very small contaminants, including bacteria, endotoxins and RNases/DNases.

- **Ion-exchange** – special resins are used to capture charged particles from the water. Ion-exchange resins can be provided as disposable cartridges, or in systems that are periodically regenerated, usually as an off-site service.

consider configuration

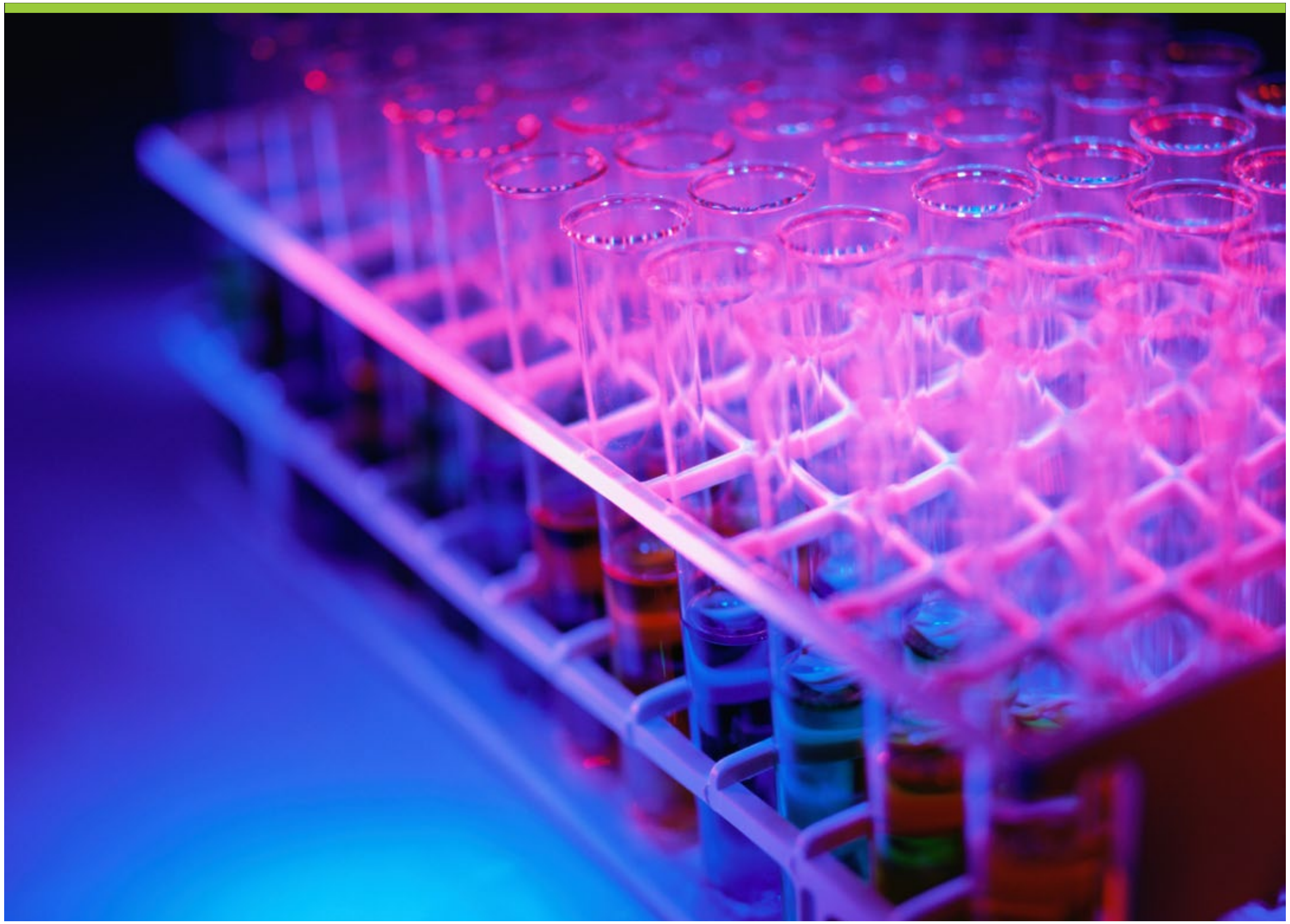
system configuration

Water purification systems can be arranged in a number of different configurations, depending on the overall size of the facility and the volumes and water grades required.

- **Central systems** – use a single, large purification plant, with water distributed through pipework to the entire building. Useful when high volumes of a consistent grade of water is required.

- **Floor-by-floor systems** – use a number of separate purification systems, with water distributed locally via pipework. Useful where different activities within the same building have different water quality requirements. Floor-by-floor systems also reduce the impact of a system outage, allowing supplies to other parts of the building to be maintained.

- **Point of use (POU) systems** – use smaller floor, wall or bench mounted systems to supply the specific water requirements of each lab. Useful for lower volume applications, or where some activities have highly specific water purity requirements.



total cost of ownership

Some applications may make use of hybrids of these approaches; for example, installing a central system to generate Type 3 or Type 2 water for general use, then using this as the feedwater for point-of-use polishing treatment to generate higher purity water for specific applications.

operating costs

Besides the initial capital cost of the equipment, the choice of technology, system configuration and supplier will have important implications for the operating cost of a laboratory water supply.

Energy use can vary significantly between different types of equipment, for example, the better systems are able to save energy by putting pumps into standby mode when there is sufficient water in storage tanks to meet current demand, as well as having variable speed distribution pumps which increase speed with demand.

All water purification systems require regular monitoring and maintenance to ensure proper operation. Filters and ion-exchange cartridges will need to be periodically replaced, for example, and RO membranes need regular sanitisation, typically on a half yearly basis.

are your systems user-friendly?

Well-designed equipment simplifies maintenance requirements, by ensuring that replaceable parts are easy to change, but laboratories will need to decide if they want to handle routine maintenance themselves or enter a service agreement with their chosen provider. Whichever option is selected, they will need to ensure they have service arrangements in place to suit their needs; for example, ensuring that support is available overnight or at weekends if needed to ensure continuity of supply.

Point-of-use purification systems must also compete with other equipment for valuable lab space.

other considerations

Ease of use is a key consideration for laboratory applications, especially for equipment that will be operated and maintained by laboratory staff themselves. Modern systems have made significant strides in this area, for example through the use of colour indicators in ion exchange systems that provide a clear visual indication that it is time to change the resin cartridge. Larger systems often come with user-friendly digital displays to indicate flow rates, overall water quality, specific contaminant levels and the condition of consumables.

On-board data logging capabilities, and more recently internet cloud communication are also built into many higher-end systems, allowing operations and maintenance staff to monitor their performance over time.

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