AQUACURE® WATER TREATMENT

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Endoscopy: To RO, or not to RO?

This will *save you* money.

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Contents

Endoscope Reprocessing: Clearing muddy waters

Endoscope reprocessing uses water. But what *type* of water is required? What water *quality*, exactly? What water treatment *processes* are appropriate for this application?

Just as endoscope reprocessing methods and requirements are different from many other Reusable Medical Device (RMD) reprocessing requirements, the *feed water requirements* for endoscope reprocessing are *different* from those for RMD reprocessing in the Central Sterile Services Department (CSSD) of a Health Service Organisation (HSO).

There are differences in temperature and usage patterns. Under the current Australian Standard (AS/NZS 4187:2014 Amd2:2019), there are differences in the water quality requirements, too.

This means that the feed water supply to the Endoscopy Department Cleaning Room, and to an 'Automated Endoscope Reprocessor' (AER), should be considered separately from the water used in the CSSD.

Some are using a water treatment technology called **Reverse Osmosis (RO)**, even at times when it may not be required. There are capital and maintenance **cost** implications for the HSO, as well as performance implications in the Endoscopy Department.

Cutting straight to the chase, in many cases, contrary to common misconception, RO may *not* be required for Endoscopy.

In some cases even, *RO might be better avoided*.

How to know? The story starts with consideration of some different types of water.

Waters ain't Waters

Just like "Oils ain't oils," water from different sources can differ significantly in quality.

Water, a liquid at standard temperature and pressure, is at its simplest a couple of Hydrogen atoms covalently bonded to an Oxygen atom (H_2O). Pure water is an effective solvent, corroding and dissolving much of what it touches (various minerals, salts, metals, organic molecules, and gases) into solution. Some waters can support microbiological activity. Because of this, in the real-world water is seldom 'pure'; it is usually a mix of H_2O and various dissolved and suspended solids and gases and/or microorganisms that have been picked up along the way, and the mix can be highly variable depending on the water source. These 'extra' constituent parts, if present, may be undesirable and may need to be reduced or removed to make that water fit for a particular purpose.

There are different water standards and different water requirements for different uses. For example, agricultural use is different from industrial water use. Drinking water is different again.

The Australian Drinking Water Guidelines (ADWG)[1] inform requirements for safe drinking water. Drinking Water is usually the feed water source in an HSO. However, Drinking Water Standards are not the same as the Standards for some medical applications, and there is significant variability in drinking water quality around Australia, even within the limits of the ADWG.

Different HSOs can have different feed water, and different water quality requirements for different purposes within each HSO. Although the feed water quality at a particular site may be satisfactory for some uses, rarely would it be suitable at any site for all uses within the HSO without further treatment.

Some of the areas in an HSO with different water quality requirements can include:

- 'hospital drinking water' including water for an immunocompromised patient population (control of 'Legionella' other water quality hazards)
- water for haemodialysis
- feed water to boilers for 'plant steam'
- water for cooling towers
- water for laboratory use
- other process water (e.g. plant/equipment cooling)
- water for maintenance (e.g. garden) use
- and, of course, water for reprocessing RMDs

RMD reprocessing requires special consideration. Within that area, there are two distinct sub-categories for water quality requirements: CSSD and Endoscopy. The Australian/New Zealand Standard AS/NZS 4187:2014 specifies the different water quality requirements for RMD reprocessing in each department.

AS/NZS 4187:2014

"Water of the required quality shall be specified for use in the reprocessing facility"[2]

Use of water is a fundamental part of RMD reprocessing. As noted in the Standard, "The **quality of water** used at all stages in the cleaning process is **critical to the successful outcome** of the process"[3] (my emphasis).

The latest version of the Standard (AS/NZS 4187: 2014 Amd2:2019) identifies three water types required for RMD reprocessing:

1. 'Cleaning Process' water[4]
2. 'Final Rinse' water

[1] National Health and Medical Research Council (NHMRC) Australian Drinking Water Guidelines 6, 2011, Version 3.6 Updated March 2021
[2] Australian/New Zealand Standard AS/NZS 4187:2014, "Reprocessing of reusable medical devices in health service organizations", Clause 5.6.6 "Water"
[3] AS/NZS 4187:2014, Clause 5.6.6
[4] AS/NZS 4187:2014 (Amd2:2019), Clause 7.2.3.1

    a. for CSSD (Table 7.2[5])
    b. for Endoscope Reprocessing (Table 7.3[6])
3. Water for 'Clean Steam'[7] (not required in endoscope reprocessing)

Endoscope reprocessing is a **different process** from other RMD reprocessing, and the **water requirements differ** accordingly.

What does Endoscopy need?

Endoscope reprocessing has its own 'Final Rinse' table in the Standard. There are also specific requirements for water **temperature**: Endoscope reprocessing uses **warm** water.

This is significant.

Water temperature influences other water quality characteristics and options for water treatment and water delivery to the AER.

Cleaning Process Water

The Standard[8] specifies maximum limits for Total Hardness (150mg/L) and Chloride (120mg/L) in the Cleaning Process feed water.

Total Hardness is a concern for build-up of scale. Chloride is a concern for corrosion. The effects of both can be amplified by other water chemistry characteristics including pH and temperature.

Both Hardness and Chloride at some level are common in drinking water supplies, though, fortunately, often below the specified maximums. In many parts of Australia, including the three largest capital cities—Sydney, Melbourne and Brisbane (most days)—the levels of Hardness and Chloride are usually low enough that no additional water treatment would be required to comply with this part of the Standard. Some other areas of Australia, on the other hand, are not so fortunate, with Hardness and/or Chloride levels routinely above the maximum limits of the Standard.

Total Hardness

Total Hardness (TH as $CaCO_3$) is often easily controlled with a Water Softener[9] treating the incoming drinking water supply. A Water Softener can provide a very good Return-On-Investment (ROI) even in areas where Hardness is below 150mg/L through efficiencies related to preventing scale. Water Softening is well proven technology that is simple and relatively low cost.

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[5] AS/NZS 4187:2014 (Amd2:2019), Table 7.2 "Final Rinse Water—Manual Cleaning Manual Disinfection and Washer-Disinfectors"
[6] AS/NZS 4187:2014 (Amd2:2019), Table 7.3 "Final Rinse Water—Washer-Disinfectors in Accordance with ISO 15883-4 for Thermolabile Endoscopes"
[7] AS/NZS 4187:2014 (Amd2:2019), Table 7.4 "Feed Water to a Dedicated Steam Generator—For Steam Sterilizers"
[8] AS/NZS 4187:2014 (Amd2:2019), Clause 7.2.3.1
[9] A fully automatic, brine regenerated cation exchange 'Water Softener'. These are widely available. Contact any reputable water treatment specialist such as Aquacure for more information.

From discussion with some AER manufacturers and CSSD/Endoscopy consultants, there appears to be broad consensus that Water Softening is often beneficial in endoscope reprocessing. For more information about the pros and cons of Water Softening for a specific site and water source, please contact a water treatment specialist such as Aquacure to discuss further.

Chloride

Chloride[10] (Cl^-) is another matter.

Chloride corrosion of stainless steel is a relevant concern in RMD reprocessing. It is affected by the chloride concentration, other water chemistry (temperature, pH), and the type of stainless steel. If the Chloride concentration levels are regularly above the Standard's maximum (120mg/L) then it's likely that at least partial desalination of the feed water will be required. This would require a more complex water treatment system, likely including Reverse Osmosis. There are flow-on effects with downstream plumbing and processes.

Fortunately, many Australian drinking water supplies have only very low levels of Chloride—well below the specified maximum of 120mg/L. However, the ADWG allow for Chloride levels of up to 250mg/L, and some drinking water supplies—e.g. Perth, some regional areas—can regularly have Chloride levels above the AS4187 Cleaning Process water requirements. If an Endoscopy Department's water falls into this category, then they will likely require a water treatment specialist like Aquacure to provide a suitable customised solution to suit site-specific feed water characteristics.

Final Rinse Water: Table 7.3

There was uncertainty in some quarters about the water quality requirements, including 'Final Rinse' requirements for endoscope reprocessing when AS/NZS 4187:2014 was first released. The first version of the 2014 Standard included one table only for all Final Rinse water: Table 7.2 (2014).

Amendment 2 (2019)[11] provided further clarification, updating Table 7.2 for CSSD, and listing the different Final Rinse water quality requirements for endoscope reprocessing on **Table 7.3**.

Meeting the requirements of Table 7.3 (for Endoscopy) is *different* from meeting the requirements of Table 7.2 (for CSSD).

Whereas Table 7.2 (for CSSD) includes a list of limits for various chemical/physical parameters in the feed water and a couple of microbiological parameters (TVC and Endotoxin) only, Table 7.3 (for Endoscopy) focusses on stringent microbial control requirements in the feed water required for endoscope reprocessing, leaving the question of other aspects of water purity (chemical purity, including dissolved solids etc) to the recommendations of the AER manufacturer.

[10] Note: "Chloride" is different from "Chlorine". Chloride (Cl^-) in water is from dissolved salt. Sodium Chloride (NaCl) is the most common salt, though there are other chloride salts, too. Different water types can have different Chloride levels. Sea water contains a lot of dissolved salt, and has very high levels of Chloride (and Sodium). Bore water often contains some dissolved salts including Chloride, too. Use of a bore or other slightly salty primary water source can result in elevated Chloride levels in some drinking water supplies. "Chlorine" (Cl_2) on the other hand is a gas which is often used to disinfect drinking water (with acceptable 'chlorine residual' levels of up to 5mg/L per the ADWG).

[11] AS/NZS 4187:2014 (Amd2:2019), Section 7

Table 7.3 Microbial Water Quality

- *'Total Viable Count' (TVC):* ≤10cfu/100mL
- *Pseudomonas aeruginosa:* Not detected/100mL
- *(Atypical) Mycobacterium sp.:* Not detected/100mL
- *Endotoxin:* ≤30EU/mL

In Australia AERs are often supplied by the manufacturer complete with in-built systems for microbiological control. These often consist of a filter bank with staged microfiltration and regular after-hours disinfection of the filters and the machine (e.g. with a sanitising chemical). In some cases this can be enough to meet the requirements of the Standard without any further water treatment, though often additional low-cost cartridge filtration upstream can prolong the life of the (expensive) microfiltration cartridges in the AER. In many cases Water Softening can be beneficial, too.

Sometimes other strategies are required for microbiological control. RO is not necessarily the answer. Sometimes other water treatment processes, such as UV, chemical dosing, or hot water disinfection may be suitable, subject to the feed water quality and site-specific characteristics. One size does *not* fit all. There are many ways to mitigate microbial risks in water, and the best way for a specific site should be determined in partnership with an experienced water treatment specialist such as Aquacure.

Table 7.3 Chemical Water Quality

- *Chemical purity:* In accordance with WD manufacturer's recommendations.

A survey of the recommendations from three Washer-Disinfector (WD)—Automated Endoscope Reprocessor (AER)—manufacturers[12] indicate that 'potable water' is their minimum requirement, but that in many cases additional filtration and/or Water Softening may also be required.

There seems to be less clarity or consistency around the suitability of demineralised water and Reverse Osmosis (RO). This may be because the suitability of water treatment processes such as RO should be considered on a case-by-case basis, and a best-fit solution devised according to site-specific needs in partnership with an experienced water treatment specialist such as Aquacure.

Water Temperature

A specific, stable feed water temperature is usually a critical AER requirement, for both 'Cleaning Process' and 'Final Rinse' water. This is relevant for cycle times in the AER, the water and product chemistry used in AER cleaning and disinfection processes, and the temperature limitations of the endoscope itself.

The automated reprocessing of endoscopes occurs at *low* temperatures. This is a key difference from most RMD reprocessing in CSSD (which uses *high* temperatures). Commonly the AER requires feed water at or around human body temperatures. For example, one brand[13] of AER specifies feed water temperatures of 35°C ±2°C and/or 44°C ±2°C (depending on the cycle type, chemicals used, and the requirements of the department manager). Other AERs have similar requirements. This can be a challenge for microbial control in the feed water—many microorganisms thrive at these

[12] Cantel Australia (Medivator), In Vitro Technologies (Steelco), and Device Technologies (Reliance)
[13] Medivator Advantage

temperatures. However, this low temperature can be advantageous for management of some other water challenges: Temperature changes the scaling and corrosion potential of some waters. At higher temperatures e.g. 60°C - 100+°C (as found in CSSD cleaning, disinfection and sterilisation processes), the same levels of Hardness and Chloride may cause more problems with scale and/or corrosion than would occur at 35°C in Endoscopy.[14] Removal of these contaminants may be less critical for the Endoscopy Department (compared to CSSD) on some feed water sources.

Reverse Osmosis (RO)

We've observed that sometimes a water treatment system including RO is considered or installed for endoscope reprocessing when it may not necessarily be required to comply with the Standard. This can have significant cost implications for the HSO.

Knowledge is power: Understanding whether RO is the right solution starts with understanding what RO is.

What is RO?

Reverse Osmosis (RO) is a water treatment process used for removing most of the dissolved solids from water. It does not work in isolation; an RO machine is usually one part only of a complete Water Treatment Plant, which will typically also include filtration, Water Softening, de-chlorination, and other water treatment processes which can vary depending on the feed water characteristics and the treated water requirements.

RO is a *process*, <u>not</u> a water type. Some refer to the product of this process as 'RO water.' A better general description of the water type in this context is 'demineralised water'.

There are other processes. There are also different types of RO machine and different water treatment system designs, which can be relevant to outcomes in the clinic. Not all water treatment systems, and not all RO machines are created equal.

There are some general principals of how the RO process works. One of the basic principles is that an RO membrane "rejects" a high percentage (but not all) of the dissolved solids in the feed water: e.g. 90 - 99%, depending on RO type and system design. Because RO membranes work via '*percentage* rejection', the treated water quality is connected to the feed water quality. If the incoming water supply has a Total Dissolved Solids (TDS) content of 100mg/L (e.g. some Australian East Coast drinking water supplies), and if the RO rejects 98% of the TDS, then 2mg/L remains in the treated (demineralised) water. If the incoming TDS is 1,000mg/L (e.g. some regional water supplies), then the treated water at the same rate of rejection would have a TDS of 20mg/L.

There are other factors—as well as variability in the drinking water supply—which affect RO performance, including the design and quality of the water treatment system and operational settings. "RO" might produce different water quality at different locations and in different situations. This has broader implications in meeting the requirements of Tables 7.2 and 7.4 in CSSD, though can be relevant for Endoscopy (if RO is used), too. In general, though, if the feed water TDS is low (e.g.

[14] For further reading search for 'Langelier Saturation Index', and 'Chloride Corrosion of Stainless Steels' for multiple public domain sources on these general topics.

typical Sydney drinking water), the treated water output from a RO machine can be very low in dissolved solids i.e. 'demineralised water'.

'Demineralised' water, however, is not the same as 'sterile' water.

RO is primarily a desalination/demineralisation process. Controlling microorganisms is a *different function* from desalination/demineralisation, often *requiring different processes* (whether RO is used to demineralise the feed water, or not). Sometime RO can help, however, microbial control does not necessarily require RO.

In cases where *microbial control* is required, but *demineralised* water is <u>not</u>, is RO always the best solution?

Is RO Required for Endoscope Reprocessing?

This leaves open the question as to whether RO is required in endoscope reprocessing.

Many Endoscopy Departments around Australia are already meeting the Table 7.3 water quality requirements without RO. If the water quality is meeting the requirements of the Standard without RO, would the addition of RO bring any significant benefits equivalent to or greater than the associated additional costs?

On the other hand, is there any reason to *avoid* RO?

Why *not* RO?

Remember: "Waters ain't waters"? RO in this context produces a particular water type: *demineralised* water. Two characteristics of this water type can be:

- **Corrosivity**: Very low dissolved solids, no alkalinity → very low buffering potential → variable (often low-ish) pH → water that can corrode and dissolve some metals which are common in water contact systems, such as copper and brass.
- **No chlorine** residual. Chlorine is in our drinking water to control microbial activity. The water treatment process removes the chlorine (i.e. removes the chemical which was controlling microbial growth in the feed water).

Demineralised water cannot be safely used in most existing Endoscopy Departments, because:

Feed water to AERs:	***<u>Challenge</u>*** if using demineralised water/RO:
1. Requires ***warm*** water, i.e. ***heated*** water, usually blended (with TMV) from two feeds—***hot*** and cold—though sometimes only warmed from a cold feed, by an 'instant' heater, in line.	Many *<u>hot water units</u>* are *<u>not compatible</u>* with demineralised water (due to problems with corrosion and dissolved metals). This problem is common to many storage and 'instant' hot water units. In some cases, these will eventually fail, possibly suddenly and catastrophically, causing significant damage and disruption—potential ticking time-bombs!

2. Existing plumbing: usually ***copper*** pipes, with ***brass*** fittings.	Copper and brass are ***not compatible*** with demineralised water (due to problems with corrosion and dissolved metals). In extreme cases dissolved copper can stain (usually a green patina on exposed surfaces), and longer term, pipework and fittings can fail suddenly and catastrophically, potentially causing significant water damage in the surrounding area.
3. Usually uses a ***Thermostatic Mixing Valve (TMV)*** to blend hot and cold water, providing water at the required temperature to the AER. Some clinics have two TMVs per AER—one for each of ***two temperature set points***.	Materials in TMVs (brass and copper) are ***not compatible*** with demineralised water (due to problems with corrosion and dissolved metals). Two temperatures (when required) increases heating/control complexity, especially if using demineralised water.
4. At the inlet to the AER (e.g. after the TMV) the water is neither cold nor hot, it is ***warm*** (e.g. 35°C and/or 44°C)	Warm temperatures—especially if there is no remaining chlorine residual—encourage ***microbial growth*** (extra risk in endoscope reprocessing)
5. Inlet to AER often a ***brass*** solenoid valve.	Brass components are ***not compatible*** with demineralised water (due to problems with corrosion and dissolved metals).
6. Some AERs use ***conductivity*** to measure water levels	Conductivity-based level sensors are ***not compatible*** with demineralised water (because demineralised water has very low conductivity, which can 'trick' the sensors).

Using RO to demineralise water for endoscope reprocessing would mean changing all of the above, or designing and fitting out a new Endoscopy Department Cleaning Room to suit. This can be more involved—and more expensive—than it might first seem.

Already in Australia some others have tried and failed. You may have heard of some of the mistakes made by others, maybe even in your own hospital or clinic: Mistakes including (but not limited to) misunderstanding the complexity of heating demineralised water to 35°C ±2°C and/or 44°C ±2°C (for example), with different materials compatibility challenges and control requirements.

Poor outcomes in this area that we have heard of, resulting from poorly conceived solutions installed by some others, have included:

- Failures in heating and plumbing systems, leading to disruption and sometimes water damage in the surrounding area.
- Extended AER cycle times, e.g. AER stops or faults while waiting for the water treatment system to get the temperature right—slowing down reprocessing and creating additional operational costs in the clinic such as extra staff hours/employment costs.
- Explosions in microbial growth in the feed water supply due to poor hydraulic and/or system design exacerbated by the (warm) temperatures of the feed water.
- Cancelled surgeries/procedures due to problems with endoscope reprocessing as a result of the above failures.

These sorts of mistakes ultimately must be rectified, usually at additional cost to the HSO—sometimes a 'budget' or poorly conceived solution can end up being very expensive indeed.

It *is* possible to overcome the challenges of using demineralised water in endoscope reprocessing. However, to do so reliably does *not* require 'just' an RO and some stainless-steel pipe. The water temperature requirements and microbial control aspects add a significant degree of complexity to the required solution if using demineralised water. This all translates to increased capital expenditure.

Some feed water sources (e.g. with very high chloride levels) may need a complex water treatment plant including RO and new plumbing. However, in other cases, the existing arrangement in many Endoscopy Departments, with microfiltration, and sometimes other microbial control processes, may be sufficient to meet the requirements of the Australian Standard. If a demineralised water system is *not* required at your site to comply with the Standard, then perhaps the best solution is a simpler water treatment system, that does not require new plumbing and other major expenditure.

The main argument against 'RO' then, if it is not required, is **cost**—both capital costs and the ongoing operational costs of a more complex system, or the additional costs which can be associated with installing a 'budget' RO system that creates further problems down the track, such as potential system and equipment failures, increased microbial challenge, additional (otherwise unnecessary) maintenance costs, and/or extended AER cycle times leading to other hospital costs in additional staff hours or cancelled surgeries.

Other Options

There are cases where RO may not be required, but other water treatment processes may be beneficial: Water Softening, additional filtration, UV disinfection, chemical dosing, or automated hot water disinfection, are examples of some different options which may be suitable. The best fit will depend on the local feed water quality and other site-specific requirements. There can be many variables from site to site. At the end of the day, the goal is to reliably meet the AS4187 Standard, and the solution should be tailored to site-specific challenges and requirements: including incoming water quality, spatial limitations, number of AERs, types of cycle required, and usage/duty hours. The suitability of various options should be considered on a case-by-case basis, and a best-fit solution devised according to site-specific needs in partnership with an experienced water treatment specialist such as Aquacure.

"Can we use our CSSD RO?"

In most parts of Australia, a sophisticated water treatment plant including RO producing demineralised water is *absolutely* required for **CSSD** to meet the requirements of the Standard in that department.

However, CSSD is different from Endoscopy. The requirements are different.

It *might* be possible to take a feed to Endoscopy from the CSSD demineralised water loop, however, it also may *not* be possible or advisable, too. There can be additional unanticipated challenges in taking water from a water treatment plant intended for one purpose (CSSD) and attempting to use it for a different purpose (endoscope reprocessing).

For example: Remember the different water temperature requirements in each of the two different departments? CSSD uses water at a different temperature from the Endoscopy Department.

Modifying the CSSD's treated water supply temperature to suit the Endoscopy Department still brings the challenges described above and would add further cost and complexity to make the system suitable for the two different purposes, compared to having a separate water system for each department. It could require additional heating or cooling of the CSSD's treated water, and/or management of "dead-legs" and microbial control, and/or extending the AER cycle times to allow for changes in temperature whenever water is used in CSSD—all challenges possibly leading to unnecessary extra costs.

The *amount* of water used in endoscope reprocessing is different too. Adding a medium-sized Endoscopy Department to the CSSD's demineralised water loop could double the size—and cost—of the required 'combined' water treatment plant.

If it's not necessary, are the additional costs and complexity of trying to use one water treatment system for two different purposes a good return on investment? Or would the challenges, risks and costs be better managed with different water treatment systems for the different needs in each different department?

Standards Abroad

Australia and New Zealand have their own Standards for RMD reprocessing, which are different from the Standards in other parts of the world. Our water supplies and climate conditions are different from many other parts of the world, too. At the end of the day, what applies in some other parts of the world may not necessarily apply to the requirements in this region, and different approaches to water treatment may be required within Australia and New Zealand to suit site specific needs.

A Reverse Osmosis or other water treatment system which was built in another country for that country's Standards, requirements, and conditions, may not necessarily be suitable for the Standards, requirements, and conditions in Australia and New Zealand.

To RO, or not to RO? That is the question.

Our company, Aquacure Water Treatment Pty Ltd, is an Australian family-owned business. We have been installing water treatment systems including RO machines since 1988 (over 33 years). We live and breathe RO at Aquacure and are passionate about building the best possible versions of this technology right here in Brisbane, Australia: If you need an RO for CSSD or Endoscopy, we are the people to design, build, and install a world-class RO for you.

And yet, our advice very often is that RO may not be required for endoscope reprocessing, and there are times when RO should perhaps be avoided: especially when the choice may be between a simpler system (without RO) which is meeting the requirements of the Standard, and a poorly conceived or 'budget' generic RO system which may not be appropriate for a particular site or situation and could create ongoing maintenance complications and costs rather than the improvements desired.

To RO, or not to RO? That is the question. RO might be required at your HSO, or it might not. If it is required, then the overall best solution may be completely different from at another site. If it isn't required, there may be something else which could be better—and more cost effective—for you.

At the end of the day, for the answer to this and other water treatment related questions, the individual requirements of each site must be considered.

A suitably experienced water treatment specialist such as AQUACURE should be engaged to provide the best, site-specific solution, based on achieving the best long-term performance in the clinic and reliable compliance with the Standard. Compared to the wrong solution, an unnecessary solution, or a poor-quality solution that ultimately creates further problems and costs, the right solution will also be the best value solution in the long run.

If the right solution is not RO, then it shouldn't be RO. Getting it right the first time, RO or not RO, will save a lot of future heartache, and a lot of money.

Contact Christopher Hall at Aquacure Water Treatment
(07 3277 6696 or water@aquacure.com.au)
to discuss whether RO is the right solution for you.

Glossary of Acronyms

ADWG	**Australian Drinking Water Guidelines**. Reference for the requirements of drinking water quality. *Full Title:* National Health and Medical Research Council (NHMRC) Australian Drinking Water Guidelines 6, 2011, Version 3.6 Updated March 2021.
AER	**Automated Endoscope Reprocessor**. Washer-Disinfector (WD) machine to used to clean and disinfect thermolabile endoscopes. Many different brands and models from many different manufacturers including (but not limited to), 'Medivator', 'Soluscope', 'Steelco', 'Steris' and more.
AS/NZS 4187	**Standard for RMD reprocessing**. *Full Title:* Australian/New Zealand Standard AS/NZS 4187:2014, Reprocessing of reusable medical devices in health service organizations. Current Version: Amendment 2 (2019).
CFU	**Colony-Forming Unit**. Measurement unit for quantity of viable microorganisms (e.g. bacteria) in sample. Used in 'Total Viable Count' (TVC) testing.
CSSD	**Central Sterile Services Department**. The section of the hospital that is responsible for reprocessing (cleaning/disinfection/sterilisation and maintenance) most RMDs. Different from the Endoscopy Department, which usually has its own Cleaning Room for reprocessing its RMDs (endoscopes).
EC	**Electrical Conductivity**. A measure of chemical water purity. EC is widely used as a proxy for TDS due to its low cost and simple testing methodology. The correlation with TDS is non-linear but is predictable for some known water types. When a base-line correlation is established for a particular water source, EC can be useful for tracking change. High conductivity relates to 'salty' water with high levels of TDS, low conductivity relates to 'fresh' or demineralised water with low levels of TDS. Unit of measure: µS/cm (micro-Siemens per centimetre).
HSO	**Health Service Organisation**. Hospital, day hospital, clinic etc.
mg/L	**Milligrams per Litre**. Unit of measurement for quantity of dissolved solids in water. Equivalent to 'ppm' (parts per million). For very salty waters g/L (grams per Litre) or 'ppt' (parts per thousand) are also used.
RMD	**Reusable Medical Device**. E.g. surgical instruments, endoscopes etc.
RO	**Reverse Osmosis**. A process utilised in water treatment to remove dissolved solids from water; can produce demineralised water.
TDS	**Total Dissolved Solids**. The amount of dissolved solids in a water supply, usually consisting of a variable mix of mostly ionic content (salts, metals etc), used as an indicator of chemical water purity. Often calculated from conductivity (EC), though more accurately measured through other (more expensive) laboratory methods. Unit of measure: mg/L (ppm) or g/L (ppt). Example TDS of some water types (approximate values only): Drinking Water 50mg/L – 500mg/L; Brackish

	Bore Water 1,000 – 10,000mg/L; Sea Water 35,000mg/L; Saturated Brine Solution 360,000mg/L.
TMV	**Thermostatic Mixing Valve**. A valve that blends hot and cold water sources to produce warm water at a set temperature. When correctly specified, installed and maintained, TMVs can maintain blended water temperature reliably, independent of variability in the incoming temperatures and flow rates. TMVs are generally suitable for use with 'typical' drinking water but not with demineralised water. Their materials of construction usually include soft metals like copper and brass, which can be corroded by demineralised water.
TVC	**Total Viable Count**. A measure of microbial activity in water, represented by a number of 'Colony-Forming Units' (CFU) in a specified sample size. Table 7.2 (CSSD): 100cfu/100mL. Table 7.3 (Endoscopy): 10cfu/100mL.
WD	**Washer-Disinfector**. Machine used for cleaning and disinfecting RMDs. For endoscope reprocessing see also 'Automated Endoscope Reprocessor' (AER).