WHITE PAPER

Applying thermostatic balancing valves and dynamic balancing valves to avoid the legionella bacteria issue in hot water distribution systems

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This paper will discuss the legionella bacteria issue and explain the Thermostatic Balancing Valve (TBV) and Dynamic Balancing Valve (DBV) solutions that Frese can offer in domestic hot water systems, aimed at maintaining circulating hot water above 45°C in order to avoid legionella growth. Whilst at the same time ensure best in class energy efficiency throughout the hot water distribution system

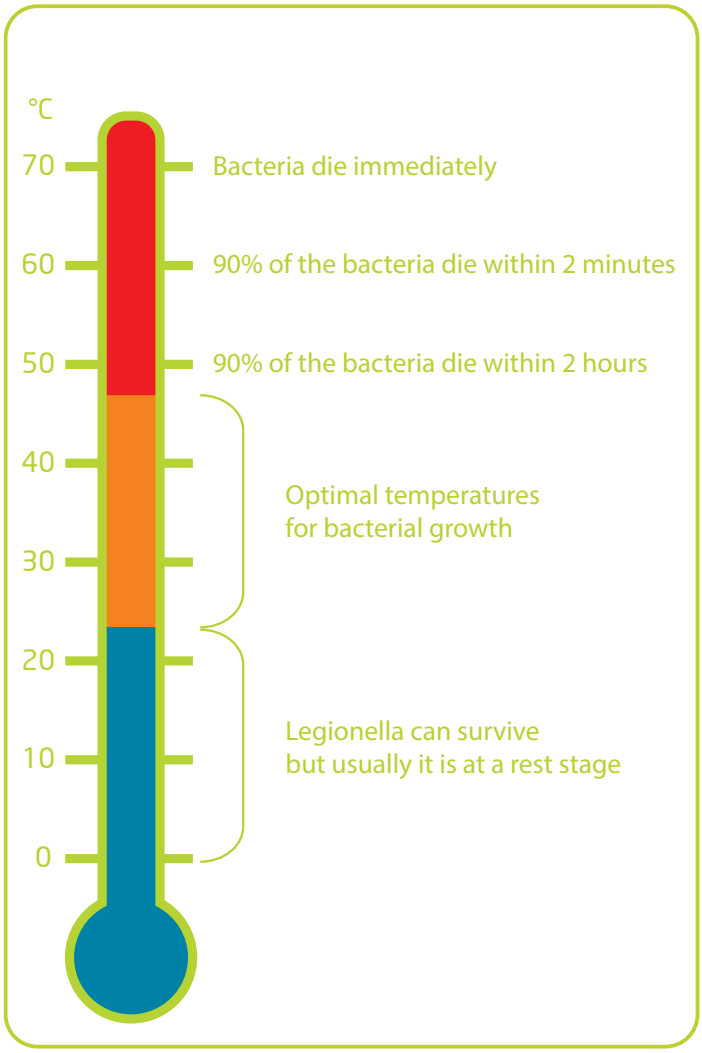
The legionella bacteria

- More than 90% of cases of Legionnaires' disease are caused by Legionella pneumophila.
- Most other types of Legionella bacteria behave similarly to Legionella pneumophila regarding thermal disinfection.
- Legionella bacteria grow readily at temperatures in the range 20°C to 50°C.
- Legionella bacteria in concentrations of 100,000 colony forming units per litre (cfu/l) and higher are not uncommon at the base of conventional hot water storage vessels where temperatures of 20°C to 50°C are maintained.
- Under optimum conditions, Legionella bacteria can multiply from background numbers to dangerous concentrations in less than five days.

Thermal disinfection facts

- The effectiveness of inactivating Legionella bacteria using raised temperatures (thermal disinfection) depends upon the temperature and how long the bacteria are exposed to that temperature.
- Thermal inactivation of Legionella bacteria starts around 45-50°C but is quicker at higher temperatures.
- Legionella pneumophila requires on average 2 minutes exposure to 60°C to inactivate 90% of the bacteria.
- Where the water contains 100,000 cfu/l Legionella, the bacteria need to be held at 60°C for approximately 10 minutes to reduce numbers to below the action level of 1000 cfu/l.
- Hot water storage cylinders that maintain a temperature of 60°C throughout the whole storage vessel for a period of one hour daily should achieve satisfactory control of Legionella bacteria, in line with health authority recommendations. Rules and threshold values vary between European countries.

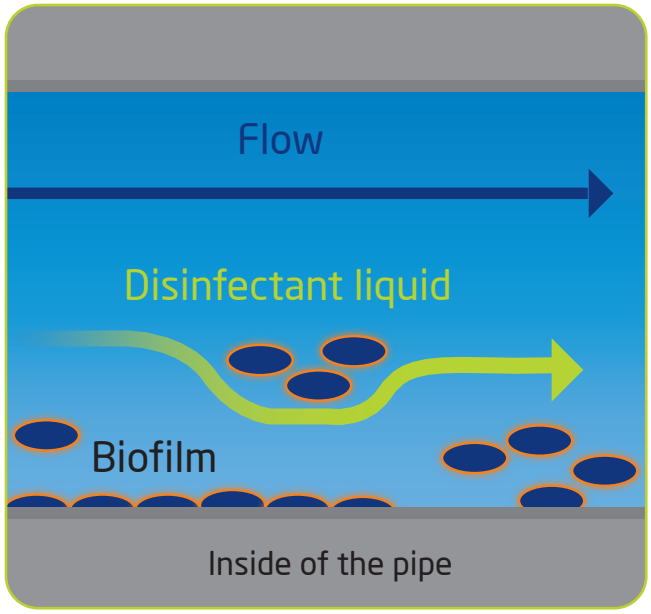
Relation between legionella growth and temperatures in hot domestic water



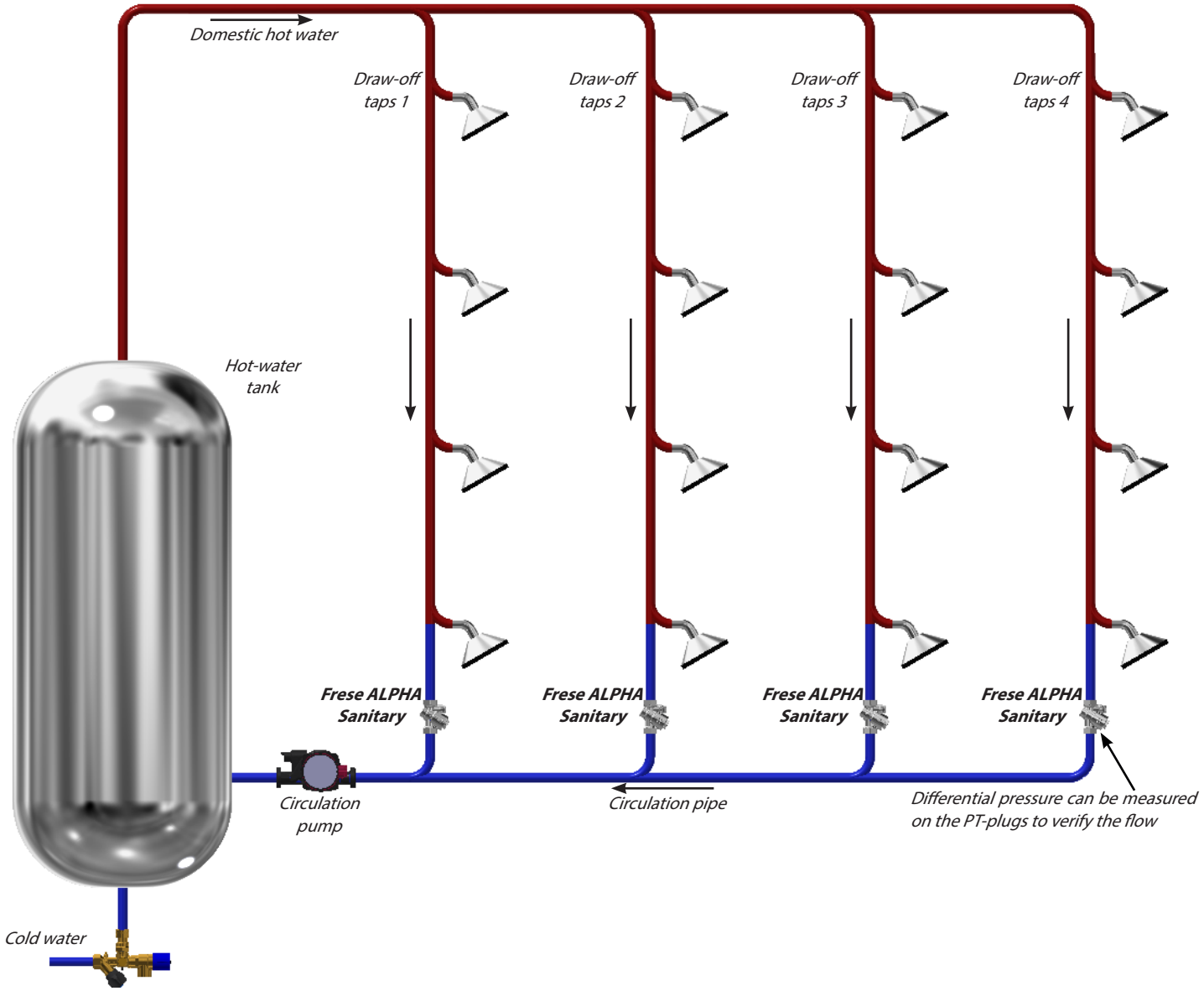
Legionella grow in hot water pipes

Biofilm consists of a layer of different micro-organisms and organic material. In addition, there will be inorganic material, for example from corrosion processes and other precipitates.

There may be different microorganisms in a biofilm, including legionella.



Domestic hot water system and circulation



Frese makes three different valves for domestic hot water circulation: Frese CirCon, Frese TemCon and Frese ALPHA Sanitary.

Frese TemCon and Frese ALPHA Sanitary have been developed specifically to address the legionella bacteria issue in domestic hot water, as they allow for flushing of the system at high temperatures.

Both valve types are placed on the risers for the domestic hot water circulation, just before the riser is connected to the main return line and compensate for the heat loss in the pipes. This will ensure that the waiting time for the hot tapping water is as short as possible.

Frese TemCon is a thermostatic balancing valve with a by-pass, which maintains the pre-set temperature in the circulation system. In order to inactivate legionella growth through thermal disinfection, the by-pass will open (this can be done manually or automatically) to ensure effective flushing.

Frese ALPHA Sanitary is a dynamic valve, which balances the circulation system automatically via flow control. During thermal disinfection, this dynamic balancing ensures effective flushing of the entire system.

Frese TemCon Features

- The valve uses a thermostatic element that controls the flow of the circulating water and a by-pass that allows thermal disinfection of the system with hot water above 60°C.
- When the water temperature is above the set point the valve closes, forcing the water to move further in the system thus decreasing the load of the circulating pump.
- By controlling the temperature of the water that circulates in the system, hot water is instantly available even at the most remote tap whilst substantial energy savings are obtained.
- Furthermore, the by-pass located outside the thermal part of the valve allows raising the temperature of the water to between 70°C and 80°C in order to thermally disinfect and decrease any bacterial concentration.
- The by-pass can either be balanced manually by setting a Kv-value or by an actuator automatically opening or closing when the legionella disinfection cycle is running.

Frese TemCon
with manual by-pass control

Frese TemCon with actuator
for automatic by-pass control

Frese TemCon benefits

- The thermostatic element is located out of contact with the circulating water, preventing scale problems.
- The setting temperature of the valves is stepless between 37°C and 65°C at an accuracy of ±2°C.
- The valve is factory pre-set at 57°C & 0.10Kv.
- The by-pass valve Kv can be adjusted between 0.0 and 0.3 m^3/h
- Each valve is calibrated separately.
- The valves are manufactured from stainless steel AISI 316 for higher corrosion resistance.

Benefits with actuator

- Provides full control over the disinfection process in each individual riser.
- Optimisation of total disinfection time.
- Optional choice of temperature for the disinfection.
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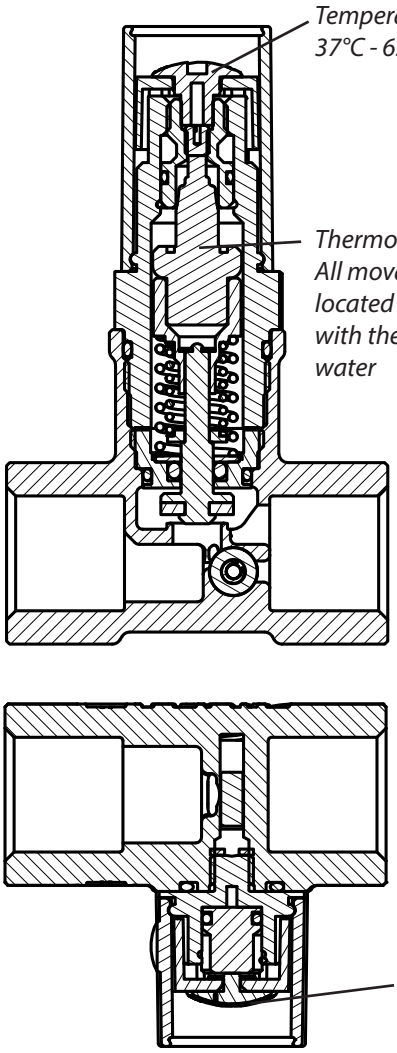
- On-line measurement and monitoring of the water temperature in each individual riser.
- Enabling the possibility of connecting to the controller in the heat substation or boiler room.



Frese TemCon specifications

Valve body	AISI 316 stainless steel
O-rings	EPDM
Springs	Stainless steel
Thermostatic Element	Wax
Plastic components	POM, ABS, PC
Temperature range	37°C to 65°C (57°C)
Accuracy	+/-2°C <100 kPa Dp
P-band	10°C (Xp=10k)
Max. Kv-value	1.10 (m^3/h) (closed by-pass)
Recommended differential pressure	3-10 kPa (0.03-0.1 bar)
Max. differential pressure	100 kPa (1 bar)
Maximum temperature	100°C
Pressure rating	PN10
Kv-value, open by-pass	0.3 (m^3/h)
Running time actuator	180 sec. from closed to fully open
Power consumption actuator	1W
Supply voltage actuator	24V DC/AC or 230V AC

Frese ALPHA Sanitary features

Frese ALPHA Sanitary is the next generation of optimised system balance and legionella control in one compact valve solution.

This dynamic balancing valve is manufactured in stainless steel in order to ensure the highest possible resistance against corrosion in domestic hot water, but it is based on familiar and extremely well proven technology.

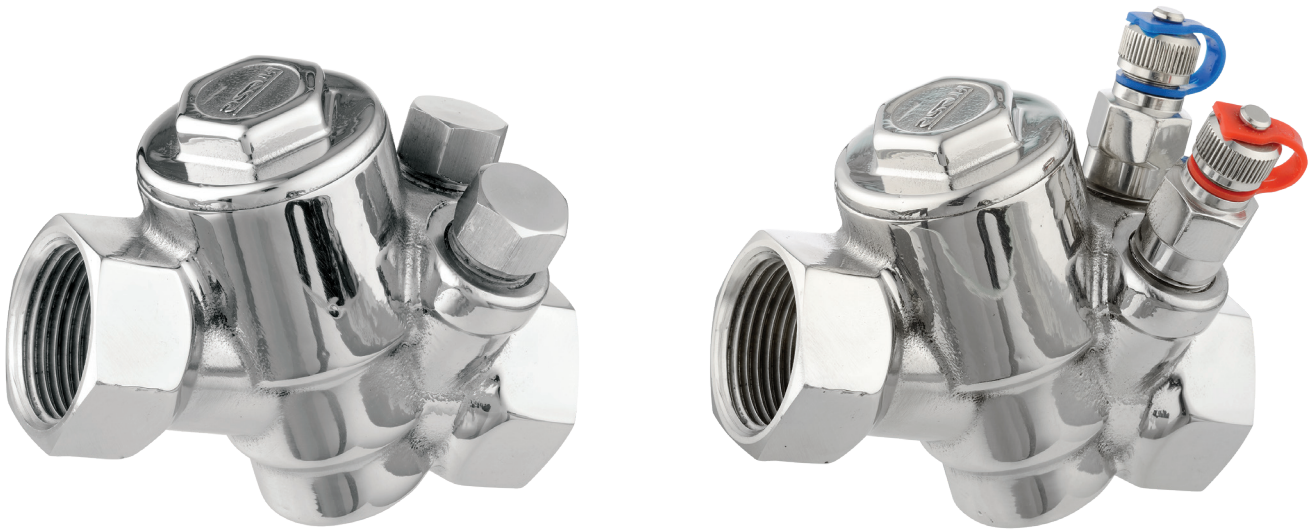
It is, in fact, identical to one of Frese's classic valves - The Frese ALPHA - which has been used in heating and cooling systems all over the world for several years. Only the material is different - the core features and benefits remain exactly the same.

The dynamic properties of Frese ALPHA Sanitary ensure balance throughout the circulation system, regardless of fluctuating pressure conditions and water temperature. Once the valve has been installed with the correct cartridge for the system in question, you will at all times achieve the exact flow required to compensate for heat loss in the pipes.

This way there will always be quick access to hot water even at outlying tapping points, so consumers will not be left waiting.

Flow control is particularly relevant since many district heating providers are attempting to run their distribution systems at lower temperatures. This may pose a challenge for thermostatic circulation control, while Frese ALPHA Sanitary is in no way affected by this development.

Because Frese ALPHA Sanitary performs its balancing tasks with no regard for water temperature, this valve is ideal for thermal disinfection in domestic hot water systems, since this process can be accomplished with no disruption of normal operation.



Frese ALPHA Sanitary

Frese ALPHA Sanitary benefits

Design

- Less time to define the necessary equipment for a hydraulically balanced system
- No impact if the calculated pressure in the installation is inaccurate
- Security that the specified circulated flow is also the real one
- Well-proven technology
- Robust and corrosion resistant design

Installation

- Minimized commissioning time due to automatic balancing of the system
- No need for oversized pumps
- No requirements for straight pipes upstream and down-stream of the valve
- Can be easily installed where space is limited

Operation

- Balancing of the system takes place automatically even under fluctuating pressure conditions
- Performance optimization
- Distribution/balancing optimization
- System balance regardless of water temperature
- Quick access to hot water at every tapping point

Frese ALPHA Sanitary specifications

Frese ALPHA Sanitary valve housing	
Valve body	Stainless Steel AISI 316 (EN 1.4408)
P/T Plugs	Stainless Steel AISI 316 (EN 1.4408)
Plug	Stainless Steel AISI 316 (EN 1.4408)
Pressure class	PN25
Temperature	-20°C to +120°C
Flow range	40 l/h to 410 l/h
Thread	ISO 228

Frese ALPHA Sanitary cartridge	
Cartridge Material	Stainless Steel AISI 316 (EN 1.4408)
O-rings	EPDM 281
Springs	Stainless Steel
Diaphragm	HNBR
Medium temperature	-20°C to +120°C
DP range	9-350 kPa
Valve housing	DN15-DN20

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www.frese.eu/hvac

Denmark - Main Office
Frese A/S
Tel: +45 58 56 00 00

Germany
Frese Armaturen GmbH
Tel: +49 (0)241 475 82 333

United Kingdom
Frese Ltd
Tel: +44 (0) 1704 896 012

Turkey
Frese Eurasia DIS TIC. LTD. STI.
Tel: +90 216 580 93 60

China
Frese Valves (Ningbo) Co., Ltd.
Tel: +86 (21) 5110 3212

Saudi Arabia
Frese Saudi Arabia
Tel: +966 5410 25 405

Australia & New Zealand
Frese Asia Pacific
Tel: +61431 794 414

South Africa
Frese Asia Pacific
Tel: +61431 794 414