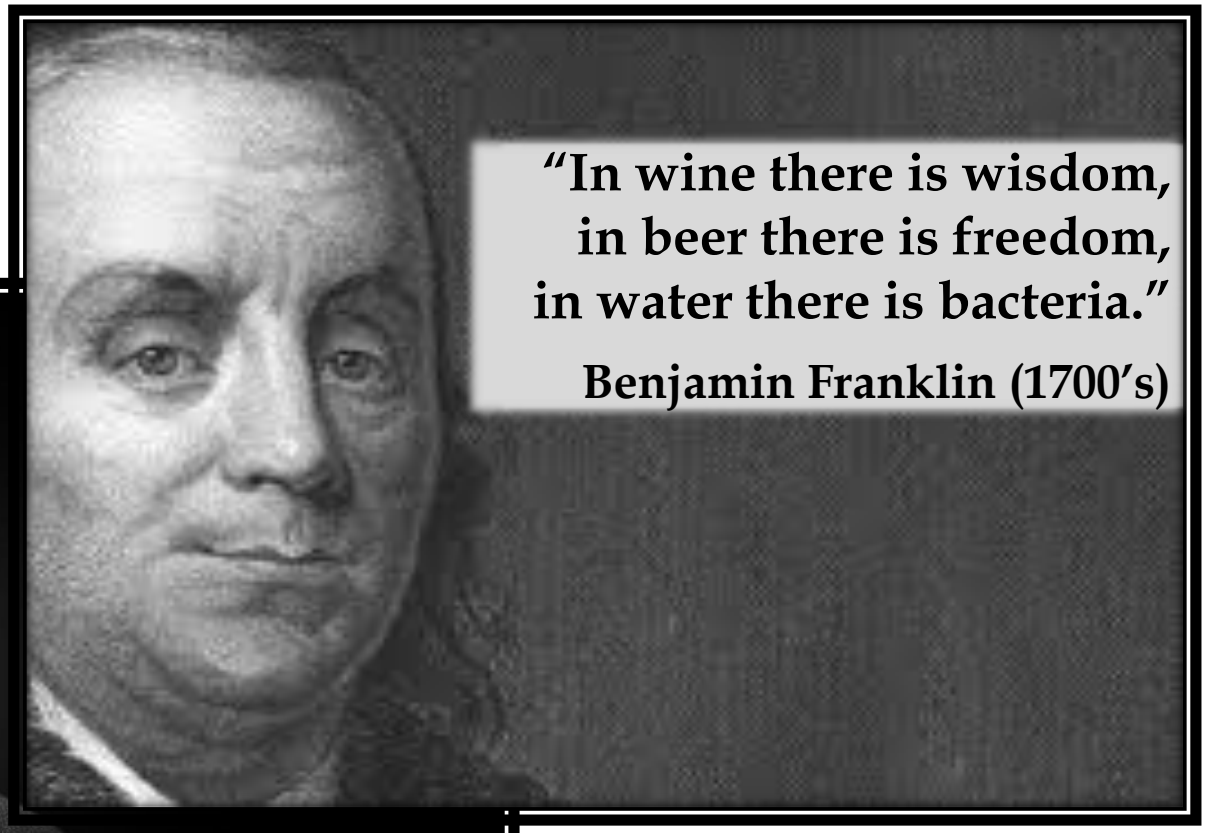
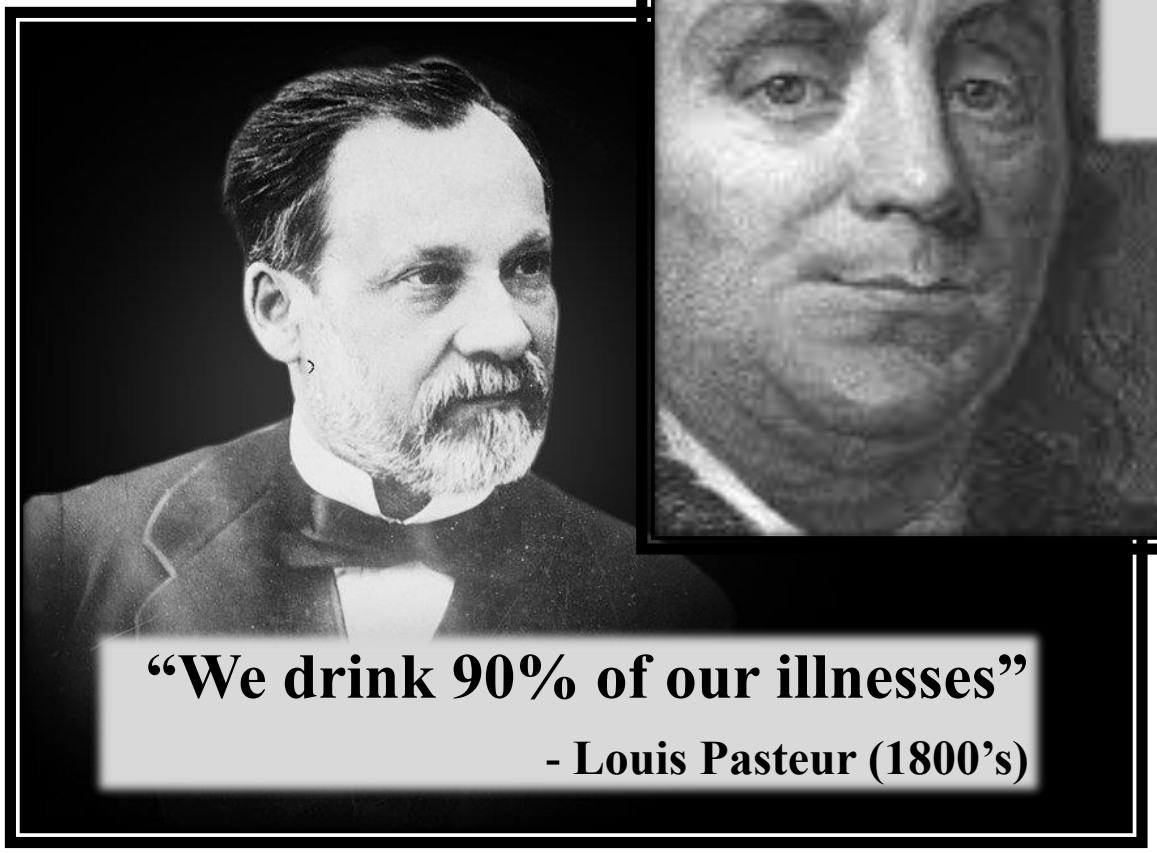
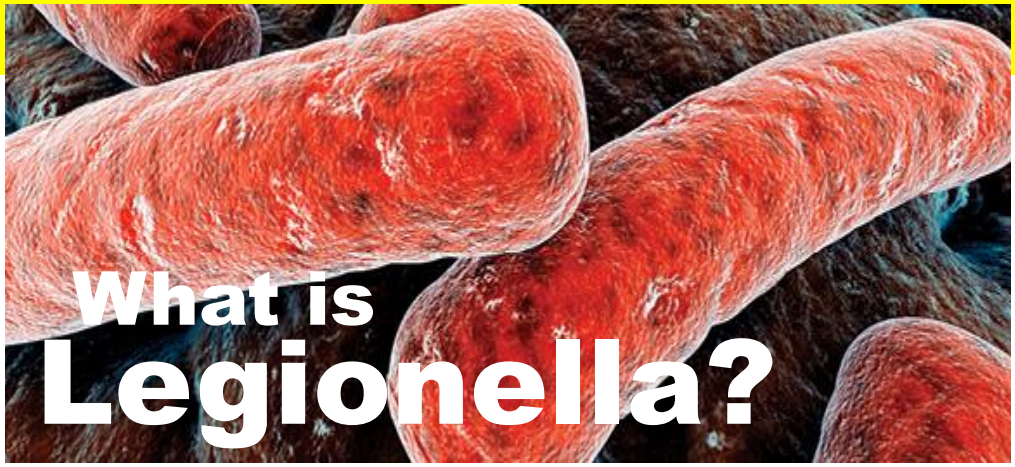

"In wine there is wisdom,
in beer there is freedom,
in water there is bacteria."
Benjamin Franklin (1700's)


"We drink 90% of our illnesses"
- Louis Pasteur (1800's)

Technical Presentation

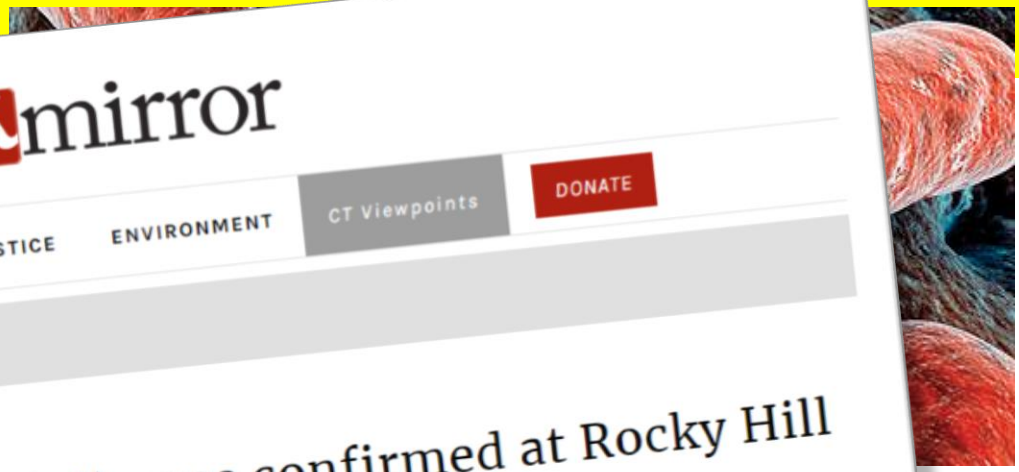
- Legionella Review
- Minimizing Risk with Engineered Devices
  - Eliminate Dead Legs
  - Temperature Control/Automated Balancing
  - Circulation of Cold & Hot Water

Legionella



- Legionella is a bacteria found naturally in the environment
  - Bacteria is breathed in due to atomization
- People at risk:
  - People over 50 years old (75-80% of cases)
  - Smokers or existing lung disease
  - People with weakened immune systems (HIV, etc.)
  - Fatality rate (up to 33%)
- It is the #1 cause of waterborne disease in the US
- Estimated 52,000 - 70,000 cases/year*(National Academy of Sciences, 2019)*
- Only 4% of LG cases are part of known outbreaks.

Legionella



the ct mirror

MONEY POLITICS EDUCATION HEALTH JUSTICE ENVIRONMENT CT Viewpoints DONATE

Two cases of Legionnaires' disease confirmed at Rocky Hill nursing home

DPH has launched an investigation after one resident died

HEALTH :: by JENNA CARLESSO | JULY 26, 2019 | VIEW AS "CLEAN READ"

The state Department of Public Health has opened an investigation into a Rocky Hill nursing home after two residents were diagnosed with Legionnaires' disease and one of them died.

DPH officials said they are coordinating a review with management at the facility, Apple Rehab. The department was notified on July 17 that a resident at the nursing home had contracted the disease.

Legionnaires' is a type of pneumonia caused by ingesting water that contains Legionella bacteria. The bacteria are normally found in freshwater lakes and streams but can grow in man-made water systems. It was detected in samples tested at Apple Rehab, DPH officials said.

The health department did not identify the residents who contracted the disease.

RELATED STORIES

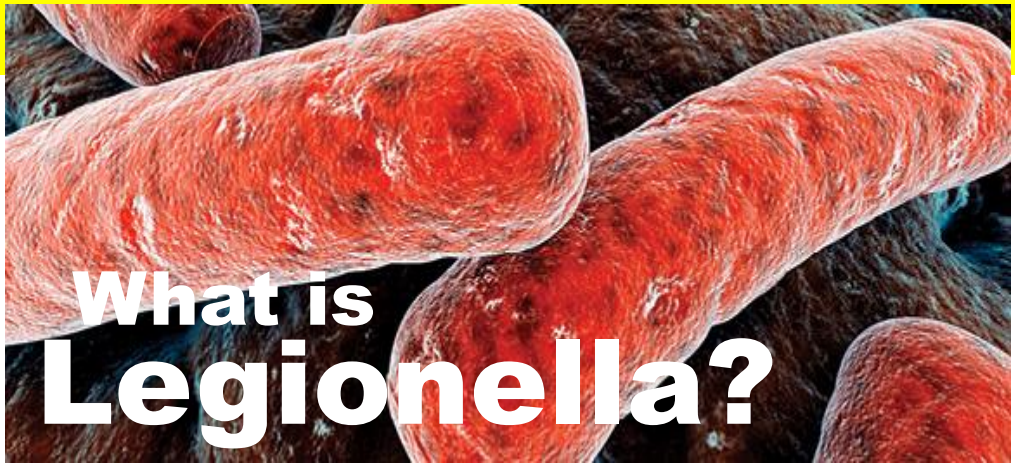
Five things to know about the rise in vaping illnesses

Longtime crusader against Oxycontin begins to see the fruits of her struggle

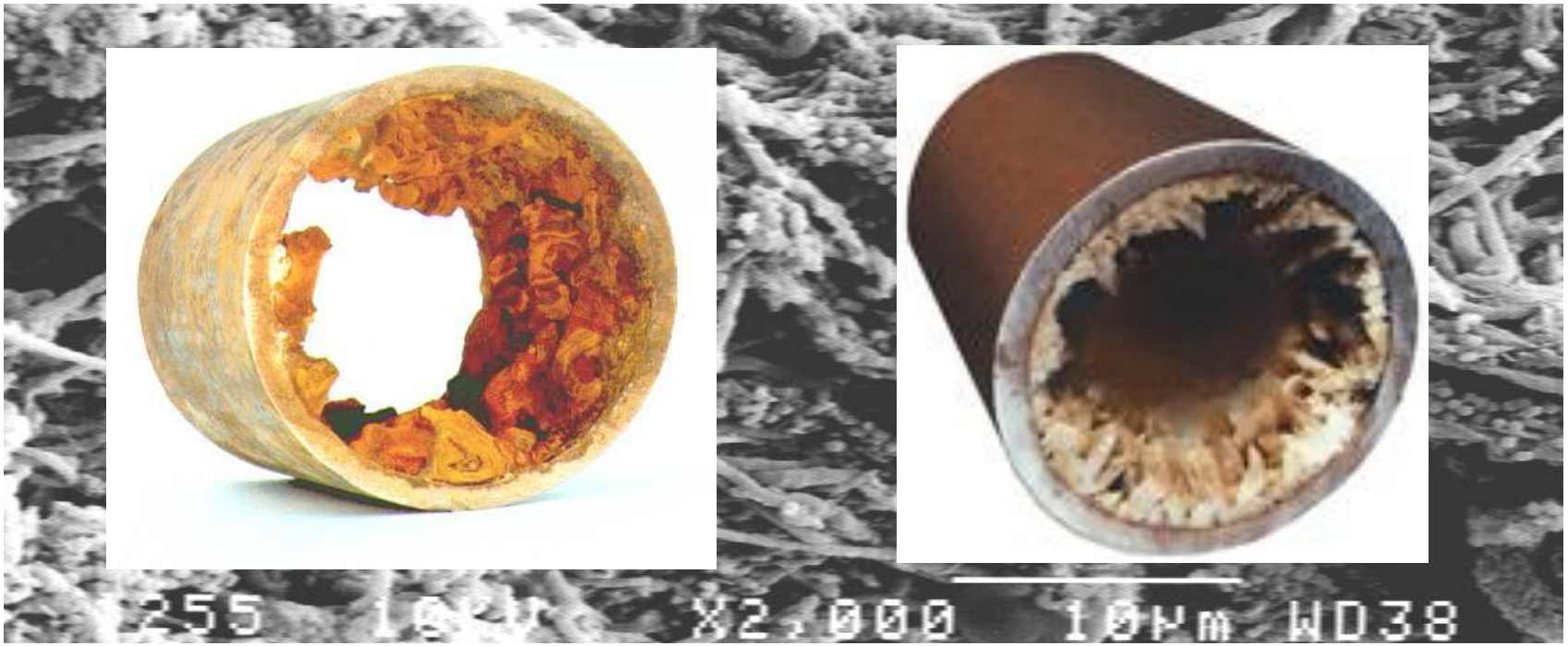
Lobbying war stalls Congress' attempt to end 'surprise medical bills'

- Only 4% of LG cases are part of known outbreaks.

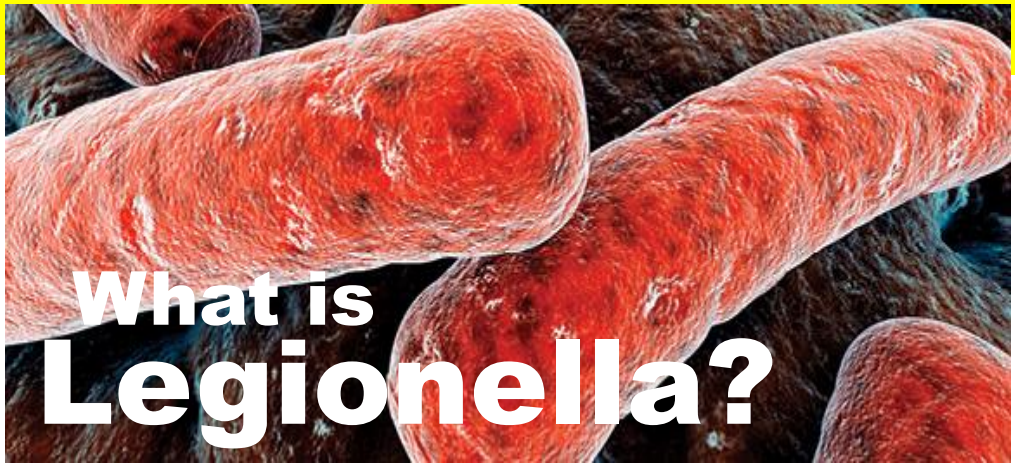
Legionella

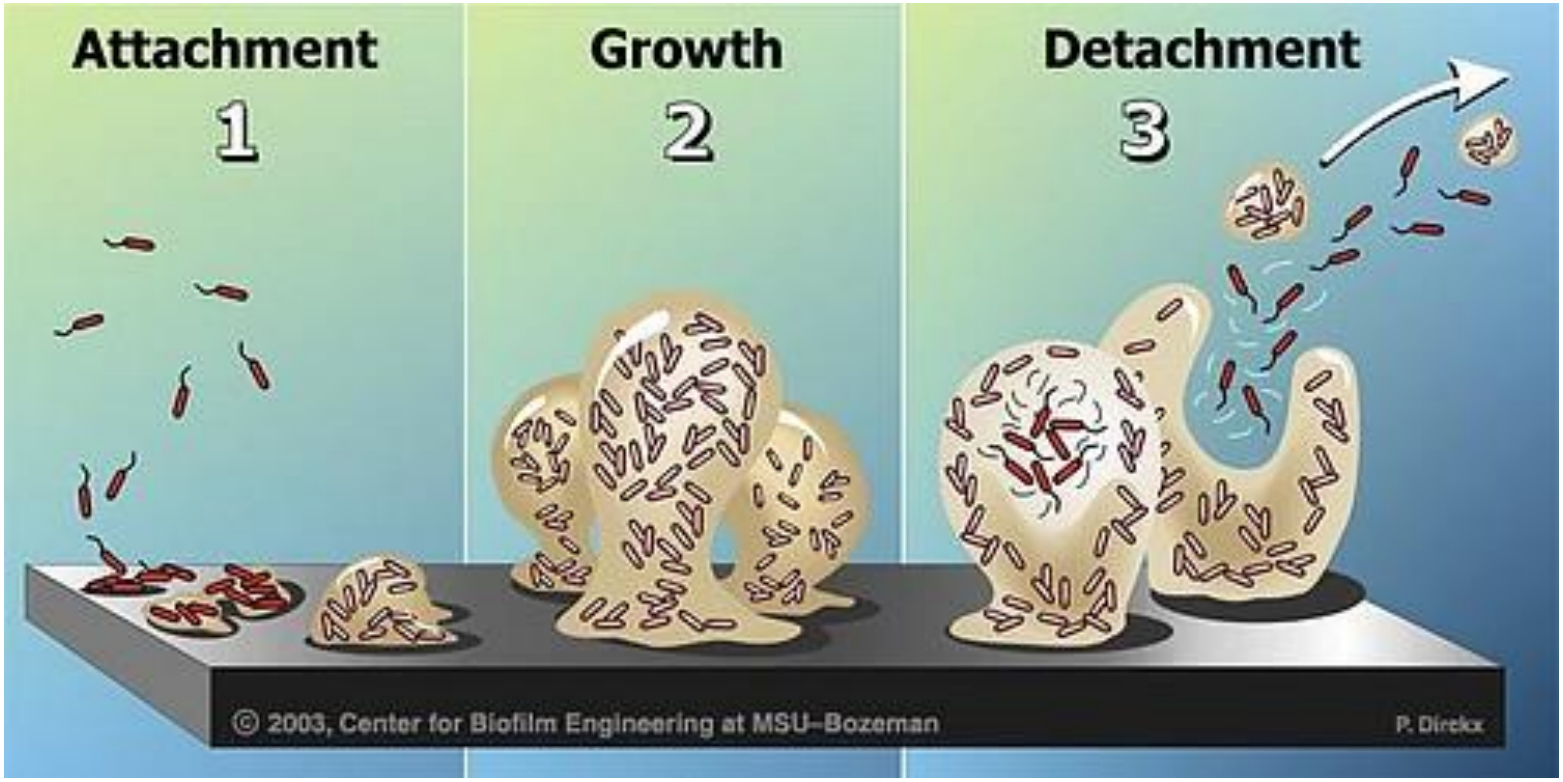


Pathogens thrive in the biofilm of building water systems



Legionella


What is
Legionella?


Attachment
1
Growth
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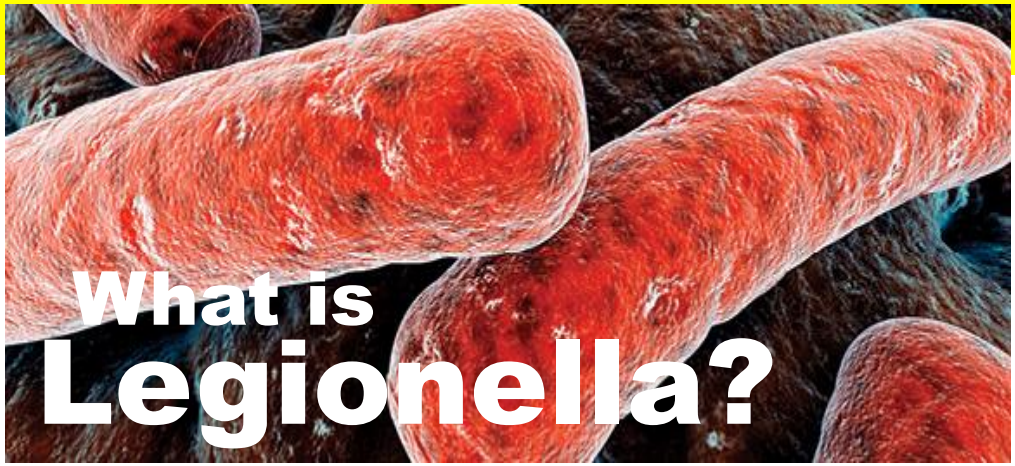
Detachment
3
© 2003, Center for Biofilm Engineering at MSU–Bozeman
P. Direkx

Legionella



- Cooling towers*
- Showers/taps/faucets*
- Spas/whirlpool tubs*
- Ornamental fountains*
- Ice making machines
- Misters (bars/grocery stores)
- Water sprinklers/irrigation systems
- Clinical nebulizers (health care premises)

**CDC states as most likely sources*

Legionella Growth Factors

Factors internal to buildings that can lead to Legionella growth

- **Water Stagnation:** *Encourages biofilm and has a negative impact on temperature and on disinfectants.*
- **Biofilm:** *Protects Legionella from disinfectant. Provides food and shelter for colonization.*
- **Water Temperature:** *Legionella grows between 68°F and 120 °F.*
  Control factors: Codes, low settings on water heaters, heat loss due to long pipe runs, recirculation pump settings, heat transfer between pipes and other heat sources, heat loss/gain due to stagnation.
- **Inadequate Disinfectant:** *Chemicals dissipate due to stagnation. Difficult to distribute effectively throughout entire plumbing system. Also from municipality.*

Legionella Litigation

"Legionnaires' disease in hospitals is widespread, deadly, and preventable…"

CDC Acting Director Anne Schuchat, M.D.
Vital Signs; June 6, 2017

"Designing, installing, operating, and maintaining plumbing systems to minimize Legionella bacteria is, therefore, key to reducing risk of disease. This gives plumbing engineers a greater role in Legionnaires' prevention than doctors, infection control professionals, HVAC engineers, water treatment specialists, microbiologists or epidemiologists…"

"Plumbing engineers must therefore understand and implement Legionella-preventive designs and specifications, not only for the moral obligation to protect health and life, but to reduce legal risk…"

Matt Freije; HC Info.
Plumbing & Mechanical; June 6, 2009

Legionella Litigation

Tim Keane
Legionella Risk Management, Inc.
2017 ASHRAE Annual Conference
Water and Other Indoor Aerosolizing Systems

"When Legionnaires' disease outbreaks occur no matter how long after construction or renovation, commonly those involved in design and construction are named parties should subsequent litigation occur".

"And when building water system Legionnaires' disease outbreaks occur within one year of construction or renovation almost always those involved in design and construction are primary named parties should subsequent litigation occur".

Legionella Litigation

Awards and Settlements

- $193 Million 2006 Settlement (Hot Tub Cruise Ship)
- $5.2 Million 2008 (Hospital)
- $4.5 Million Award 2010 (Alabama Hotel)
- $3.8 Million 2012 (Marriott Hotel)
- $2.4 Million Settlement 2010 (Hot Tub)
- $2 Million 2014 (Decorative Fountain)
- $307K Award 2011 (Hot Tub)
- $225K Award 2000 (Cruise Ship)

Dan Moretti, Esq.
Landman Corsi Ballaine & Ford P.C.
New York, NY
2018 Legionella Conference

"Reports of settlements are rare as most agreements include stipulations that payout amounts remain confidential."

Susan E. Smith, of counsel in Segal McCambridge Singer and Mahoney, Ltd.,

ASHRAE Standard 188 – 2018

ASHRAE Standard 188

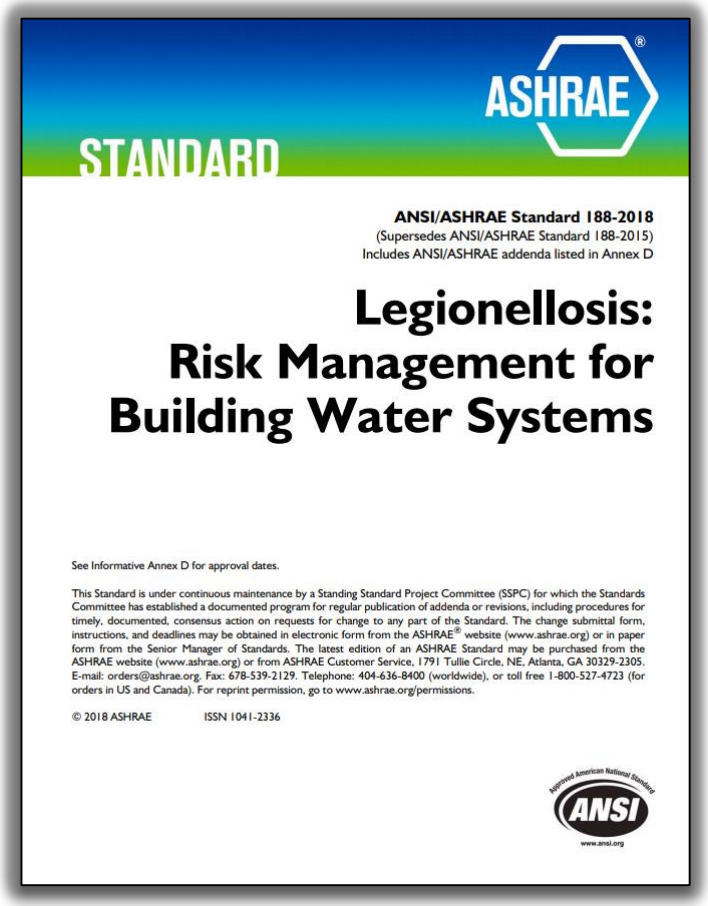
Legionellosis: Risk Management for Building Water Systems

- In development for over 15 years

- Approved by the ASHRAE Standards Committee and ANSI in July 2015

- Updated August 2018

  Includes clarification of compliance requirements, as well as a comprehensive update to enforceable, code-intended language.



ANSI
American National Standards Institute

ASHRAE Standard 188 – 2018

(8.0) Requirements for Designing Building Water Systems

(8.1) General. When designing for new construction, renovation, refurbishment, replacement or repurposing a facility the following shall be documented:

a. A system overview and intended mode of system operation.

b. Documentation and design compliance to address hazardous conditions for each of the following:

i. schematic diagrams of water systems,
ii. monitoring and control diagrams of water systems,
iii. local, regional and national code compliance,
iv. locations of access, fill, makeup, flush points, sampling points, temperature monitoring, and drain points,
v. locations of outside air intakes,
vi. building water equipment,
vii. commissioning,
viii. operating instructions and procedures,
ix. maintenance schedules, frequencies, and procedures,
x. dead legs and low flow portions of the piping and building water systems,
xi. impact of heat loss from hot water or heat gain by cold water in piping and water system components,
xii. possible cross connections between potable and non-potable water, and
xiii. inadequate access to water expansion tanks, water hammer arrestors, water storage tanks and water heaters and other equipment and components containing water.

Standard updates/developments

Many Guidelines/Recommendations

- OSHA; FDA; EPA, NAS; ASHRAE; CDC, AWWA, ASPE, AOS, WHO, ASHE…
  - *Storage at 140°F minimum*
  - *Minimize dead legs/stagnation*
  - *Maintain distribution temperatures at 120-124°F minimum*

Few Codes/Minimal Impact

- UPC (2018)
  - *32 oz. max in non circulating pipe (= 18' for ½" copper pipe)*
  - *Maximum fixture temperatures of 120°F. Recirculation pump restrictions*
- IPC (2015)
  - *Allows 25' non circulating pipe length*
  - *Maximum fixture temperatures of 120°F*
- FGI (2018)
  - *Allows 25' non circulating pipe length (IPC)*
  - *Maximum fixture temperatures of 120°F*
- VHA (2018) Directive 1061
  - *15 second availability of HW. Dead ends = 2 pipe diameters.*
  - *Maximum fixture temperatures of 110°F. 130°F out/124°F return. Mixing valves every fixture*
  - *Cold Water below 67 °F (chill or circulate). Sinks, lavs & showers (24 oz. max run out = 14')*
- IECC (2018) 404.5.1
  - *Allows @ 2' max non circulating pipe length*

ASHRAE Guideline 12-2000R

- Originally Published in 2000
- 4th Public Review (October 2019)

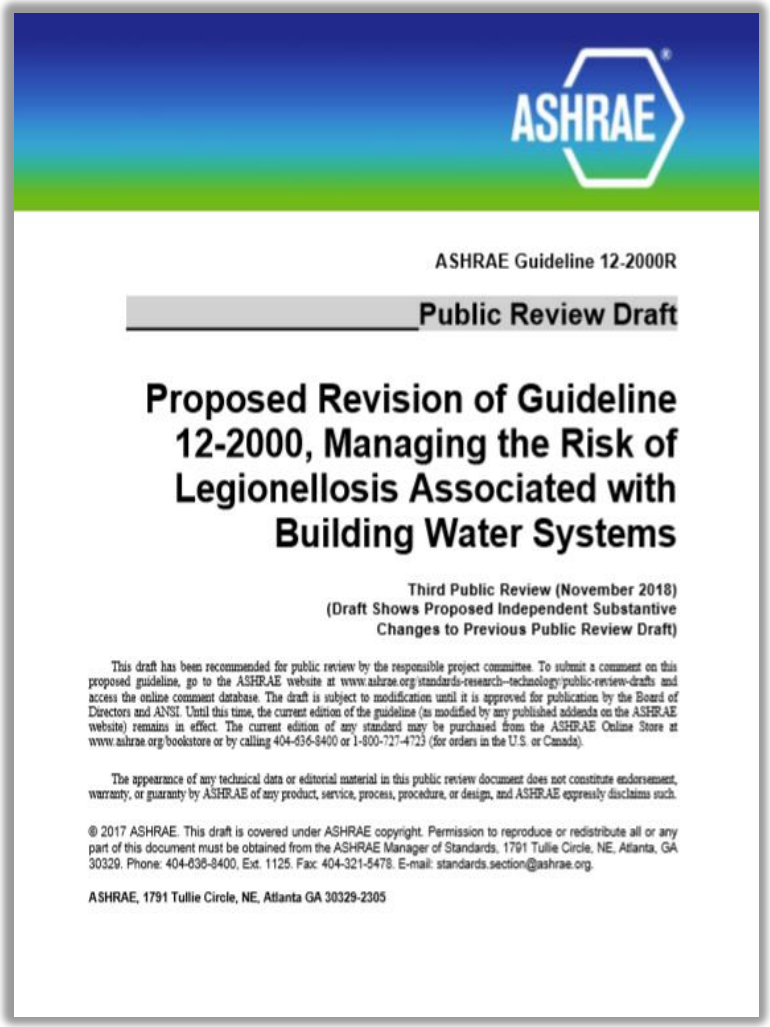
- **Section 4.2.2.2 Growth**

  Maintain HW above 120°F at all points throughout entire bldg.

- **Section 5.3.1 Temperature**

  …including water for delivery to the points of use and in the HWR.

  Water temperatures must be consistently maintained above 120°F between the water heater and the fixtures to assure a minimum of 120°F at the fixture and in the pipes returning to the water heater.



ASHRAE Guideline 12-2000R

Public Review Draft

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ASHRAE, 1791 Tullie Circle, NE, Atlanta GA 30329-2305

ASHRAE Guideline 12-2000R

- Originally Published in 2000
- 4th Public Review (October 2019)

- **Section**

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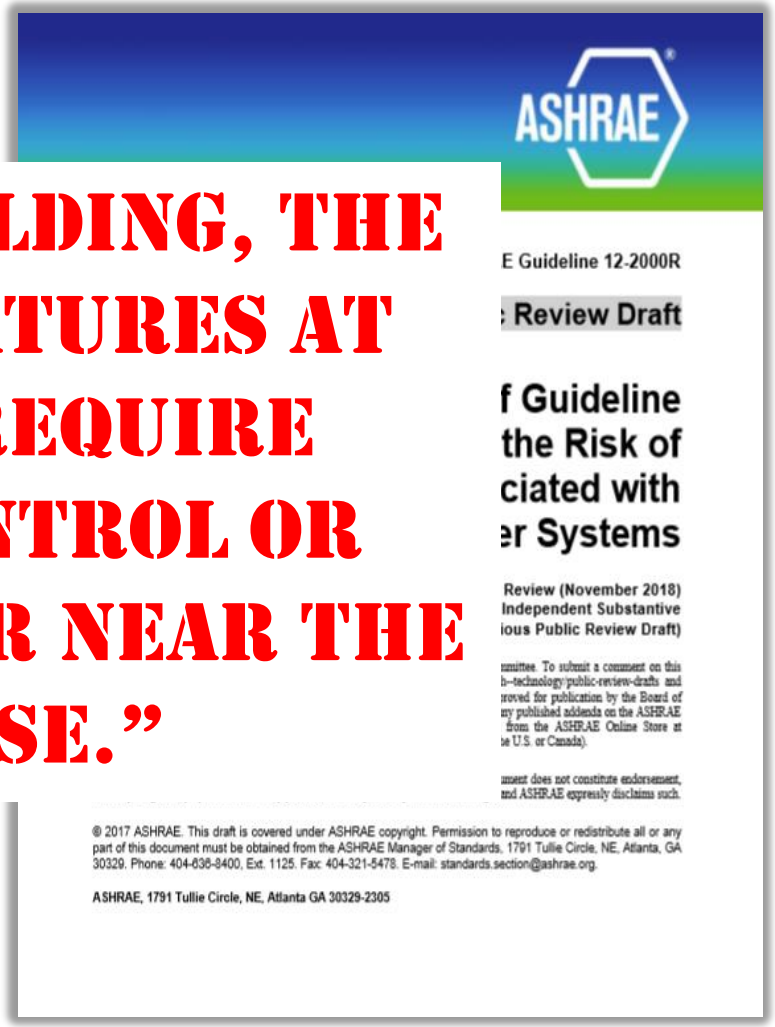
water heater and the fixtures to assure a minimum of 120°F at the fixture and in the pipes returning to the water heater.

"TO PREVENT SCALDING, THE WATER TEMPERATURES AT THE TAP MAY REQUIRE ADDITIONAL CONTROL OR ADJUSTMENT AT OR NEAR THE POINT OF USE."


ASHRAE

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Review Draft

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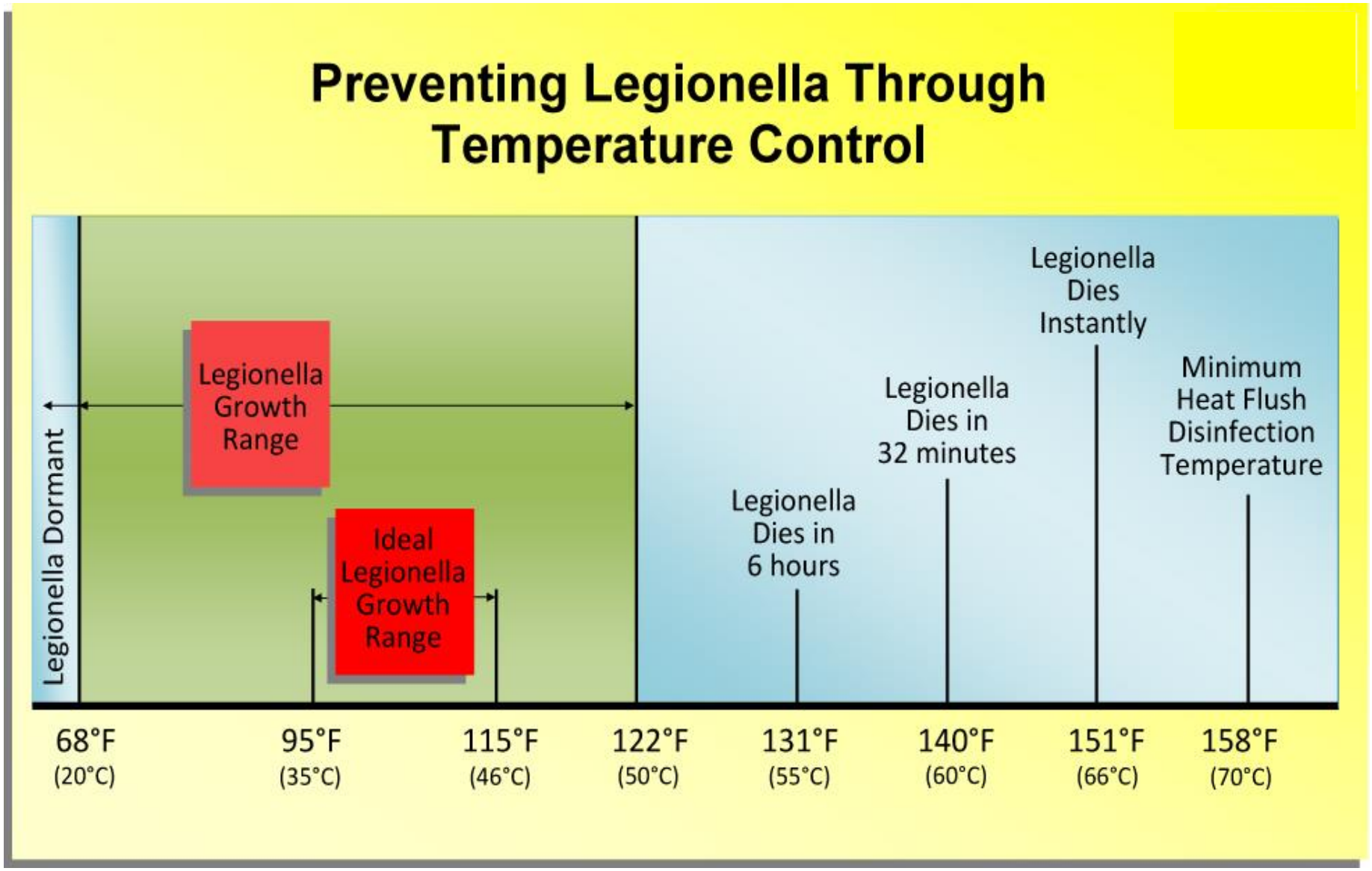
Standard updates/developments

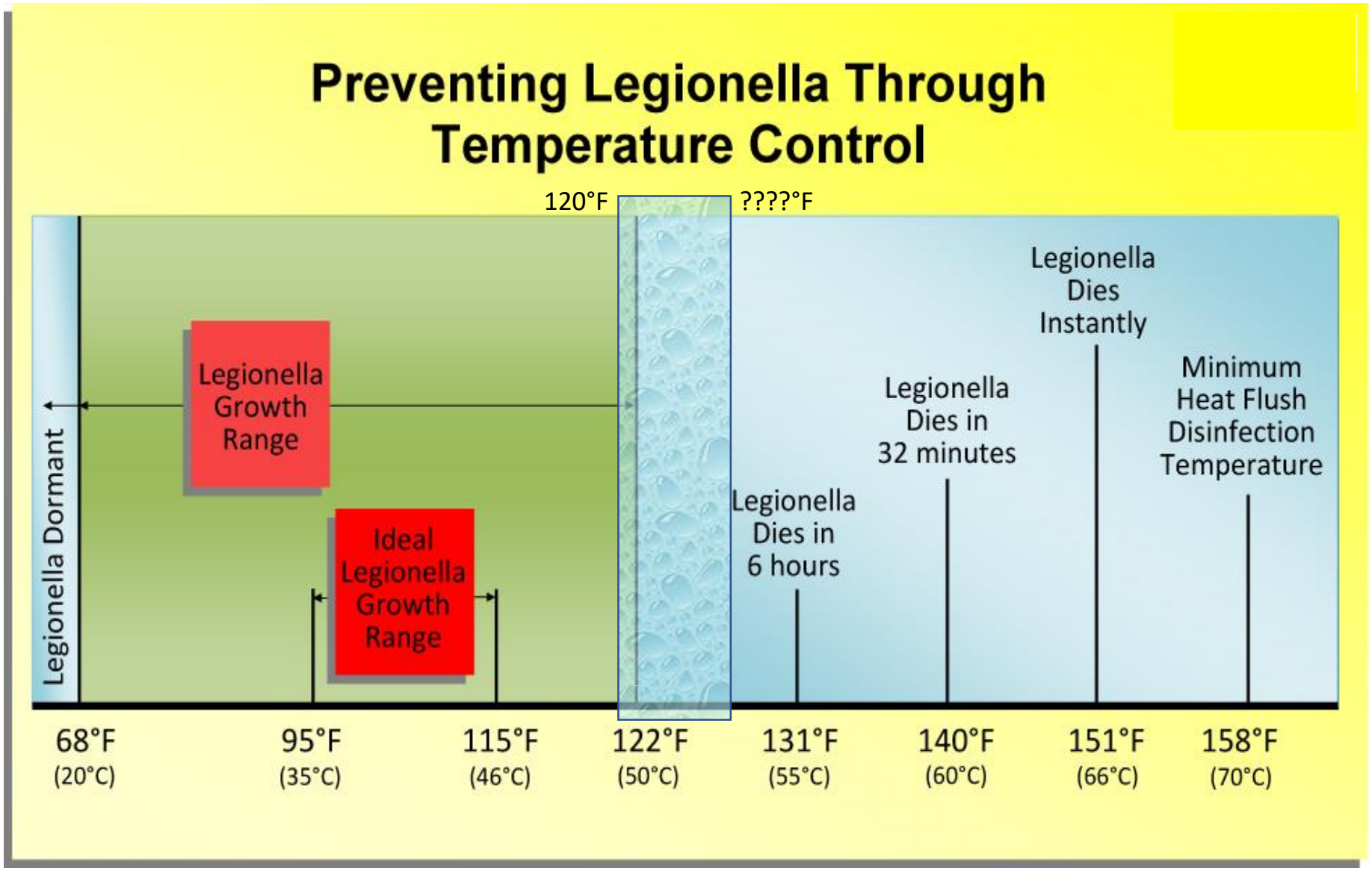
Standards Developments

- **Guideline 12-2000 update**
  - *Provide guidance for designing building water systems*
- **ASPE 15**
  - *New standard for hot water system temperature maintenance in order to reduce scalding/thermal shock*
  - *To address total system from point of entry to point of use*
- **ASHRAE 514 (NSF 444)**
  - *Prevention of injury and disease associated with building water systems.*
  - *All pathogens and all hazards.*
- **ASHRAE Legionella Task Group**
  - *Recommendations on the impact of temperature on Legionella and scald risks.*

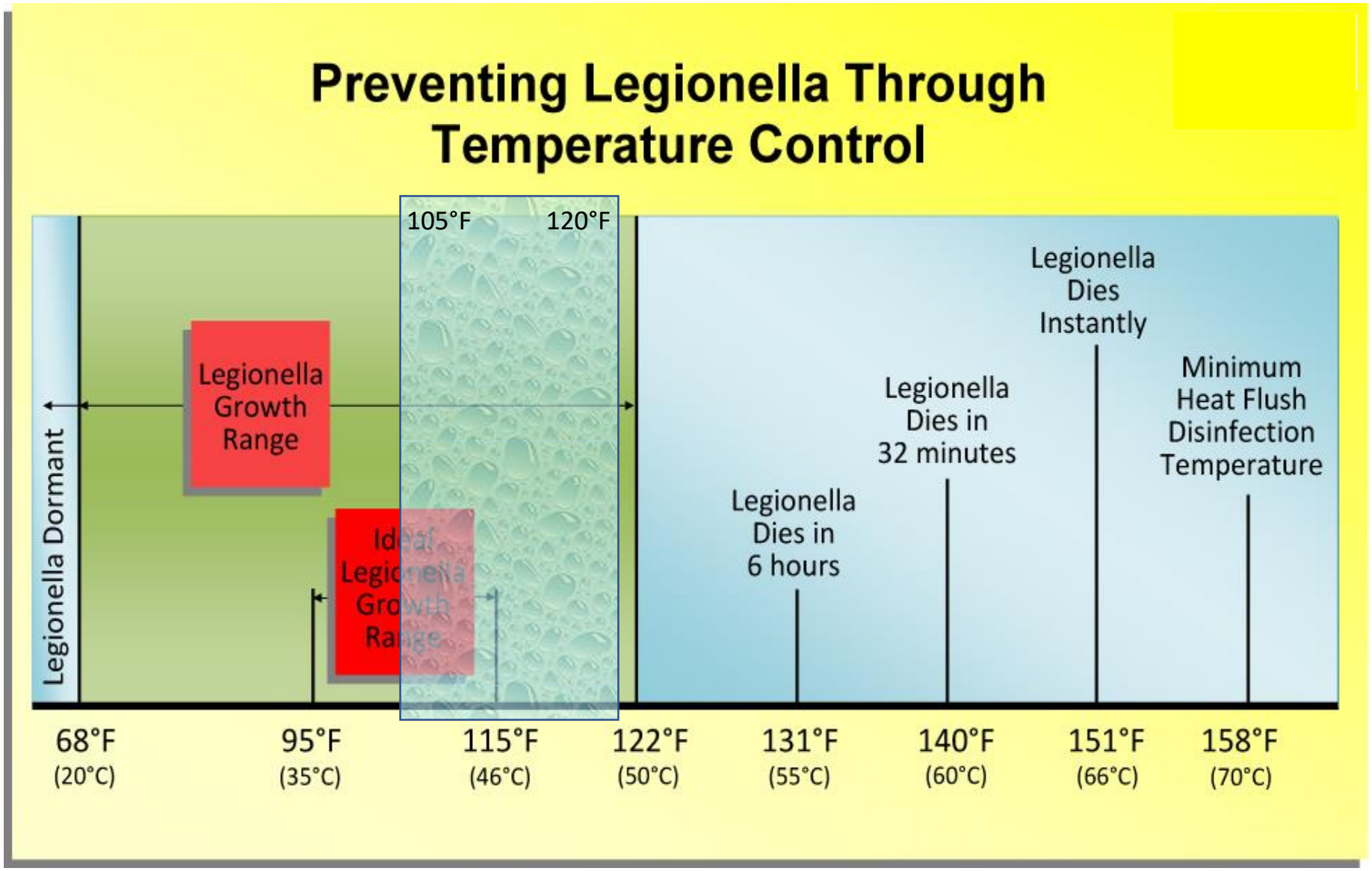
Legionella Growth



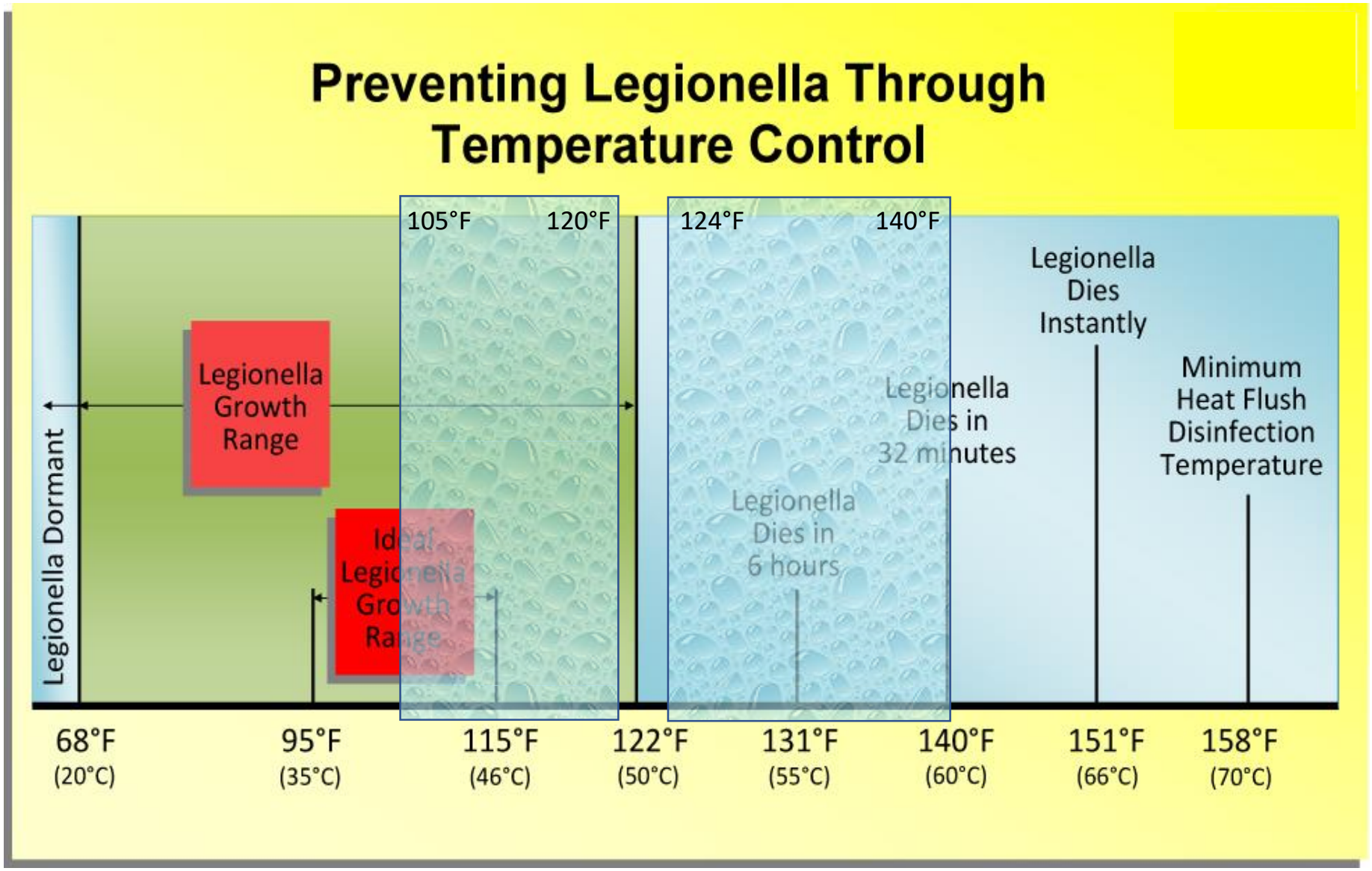
Legionella Growth



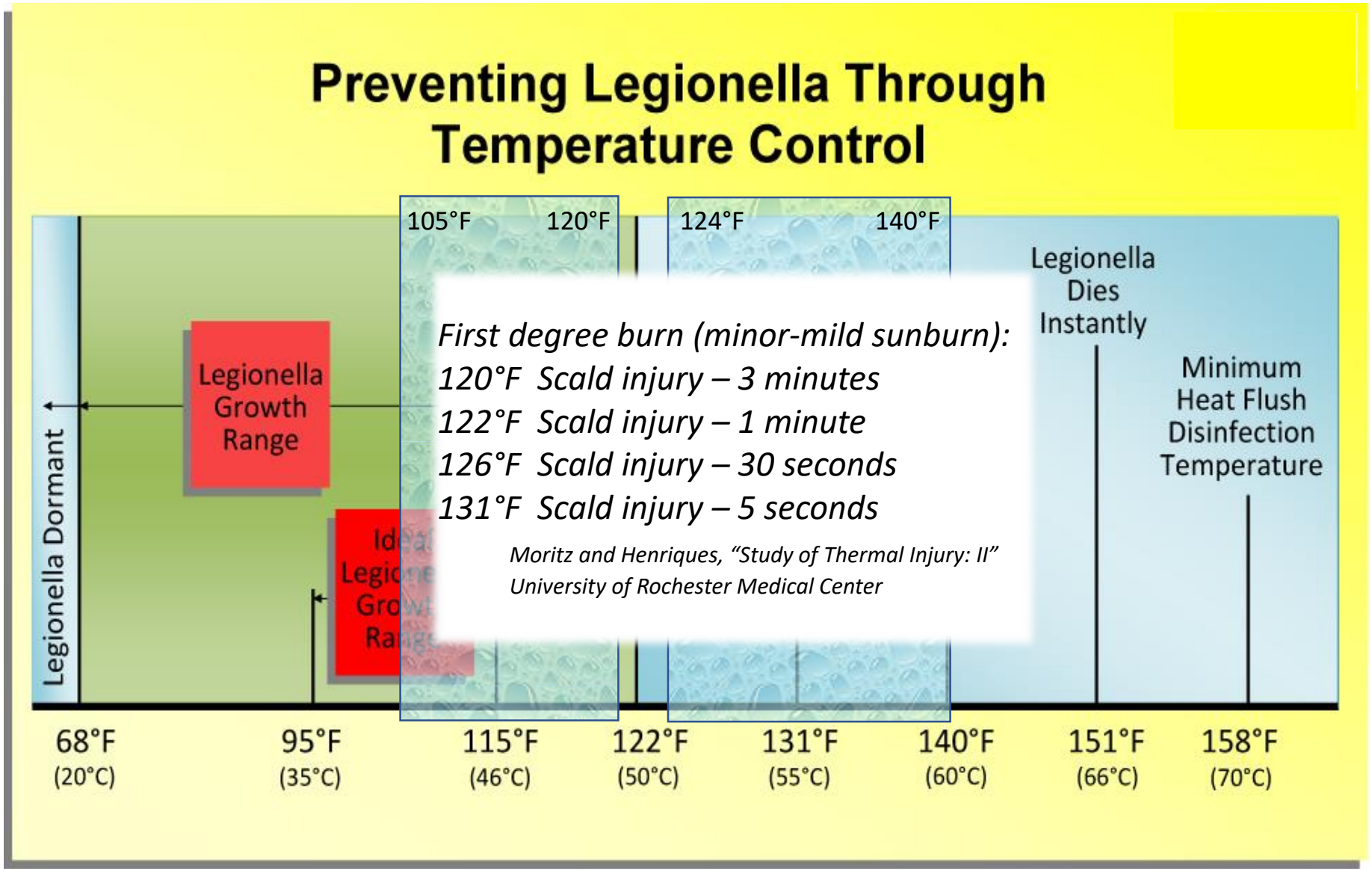
Legionella Growth



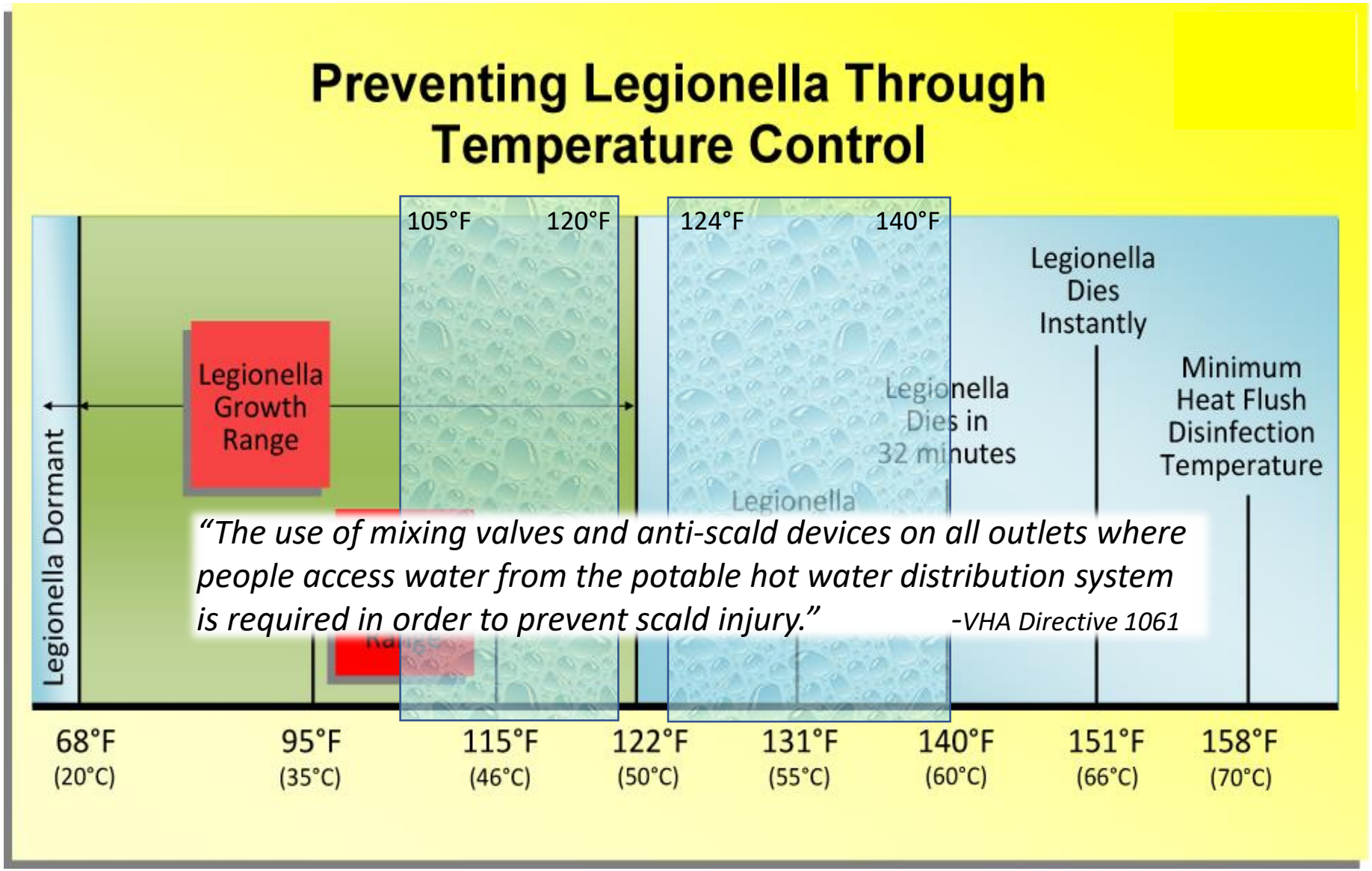
Legionella Growth



Legionella Growth



Legionella Growth



Legionella Growth

USA

There is no language in the model codes that addresses storage or distribution temperatures (ASHRAE Guideline 12-2000R suggests storage above 140°F a with a minimum return of 124°F).

Instead, there are specific temperature limits for plumbing fixtures due to scalding:

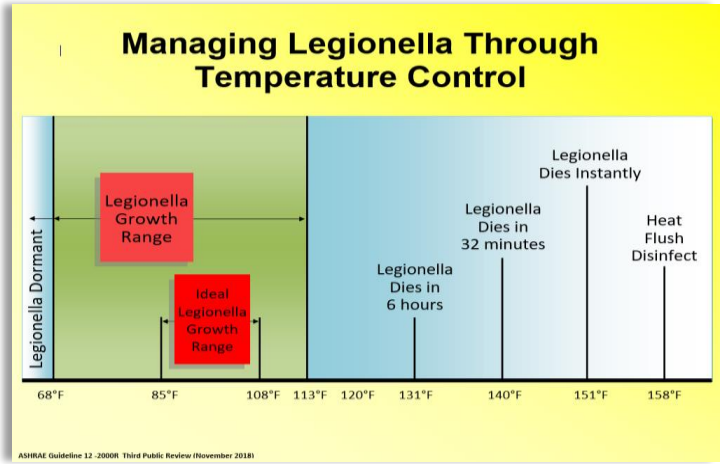
- *Bidets = 110°F max with mixing valve protection (ASSE 1070)*
- *Public hand washing = 120°F max with mixing valve protection (ASSE 1070)*
- *Showers = 120°F max with mixing valve protection/limit stop (ASSE 1016)*
- *Bathtub and whirlpools = 120°F max with mixing valve protection (ASSE 1070)*

Australia, Netherlands, Germany, UK and other European countries

Hot water circulation = 131°F minimum

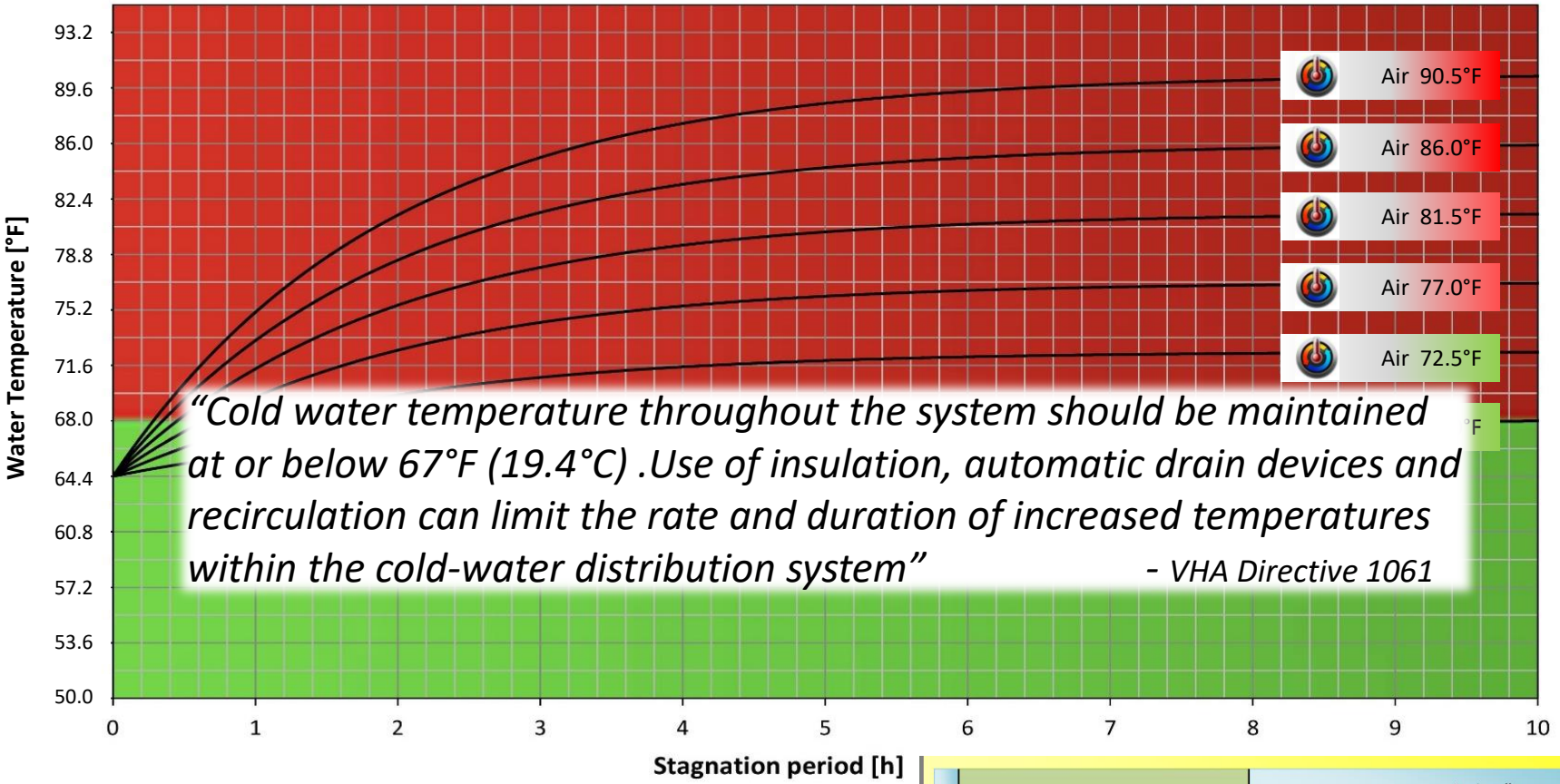
Hot water return = 124°F minimum

- *Mixing vales required at every device.*
- *Scalding threat averted*
- *Legionella threat minimized*



Legionella Growth

Temperature increase of a stagnant ¾” insulated cold water copper pipe.



Heat Sources:

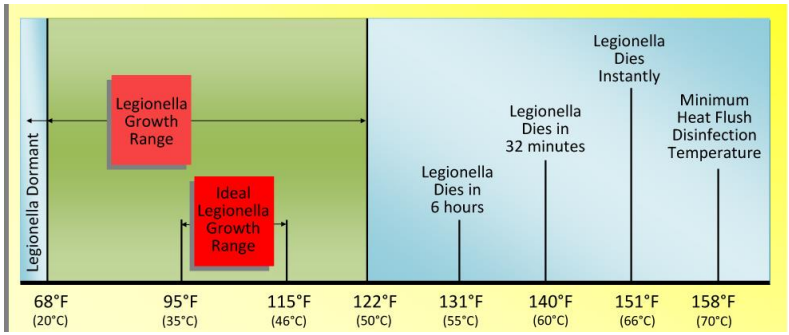
Heating Pipes, Hot Water and Hot Water Return Pipes

Electric Cables

Lighting, Transformers and all other Electrical Components

Sun Exposure

85 - 90˚F in ceiling voids for calculations



Legionella Growth

Why do you think they are called 'Dead Legs'?

According to the Center for Disease Control (CDC), dead legs are a leading factor in the growth of Legionella.

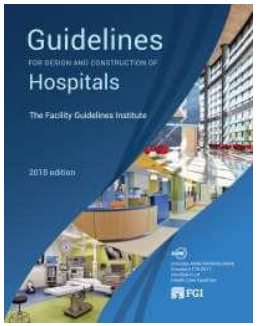
'Dead Legs'

"Dead legs are portions of the water system leading to an outlet that is either unused or rarely used".

'Dead Ends'

ASHE

"Dead ends are lengths of pipe that are closed at one end such that water cannot flow".



2018 FGI Guidelines for hospitals:

- *25 feet max non circulated piping*
- *Dead end installations not permitted*
- *Renovations require dead end removal*

2018 International Plumbing Code:

- *25 feet maximum non circulated piping*

Legionella Growth

2018 International Energy Conservation Code (IECC):

***C404.5.1** Maximum allowable pipe length*

"The maximum allowable pipe length from the nearest source of heated water to the termination of the fixture…"

TABLE C404.5.1
PIPING VOLUME AND MAXIMUM PIPING LENGTHS

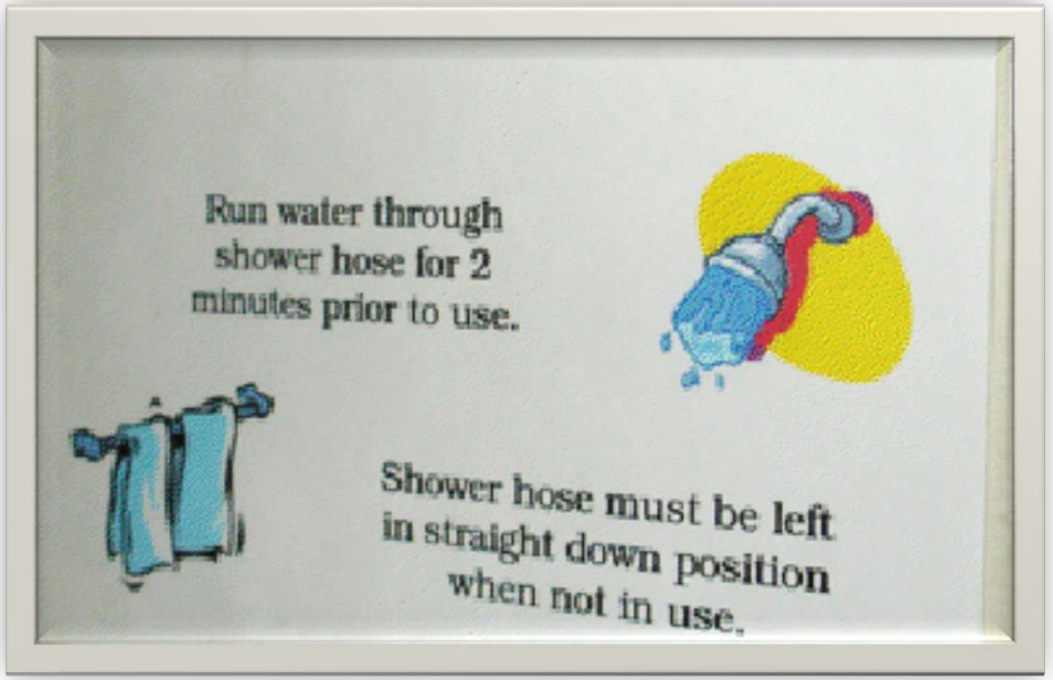
NOMINAL PIPE SIZE (inches)	MAXIMUM PIPING LENGTH (feet)	
	Public lavatory faucets	Other fixtures and appliances
1/4	6	50
5/16	4	50
3/8	3	50
1/2	2	43
5/8	1	32
3/4	0.5	21
7/8	0.5	16
1	0.5	13
1 1/4	0.5	8
1 1/2	0.5	6
2 or larger	0.5	4

Legionella Growth

Study - Bone Marrow Transplant Showers

	Number of Samples	Mean (CFUs/ml)	Median (CFUs/ml)	Range (CFUs/ml)
Before Flush	16	49,471	25,050	110-196,000
After 2 Minute Flush	16	146	35	3-970

University of Minnesota data: Andrew Streifel Hospital Environment Specialist

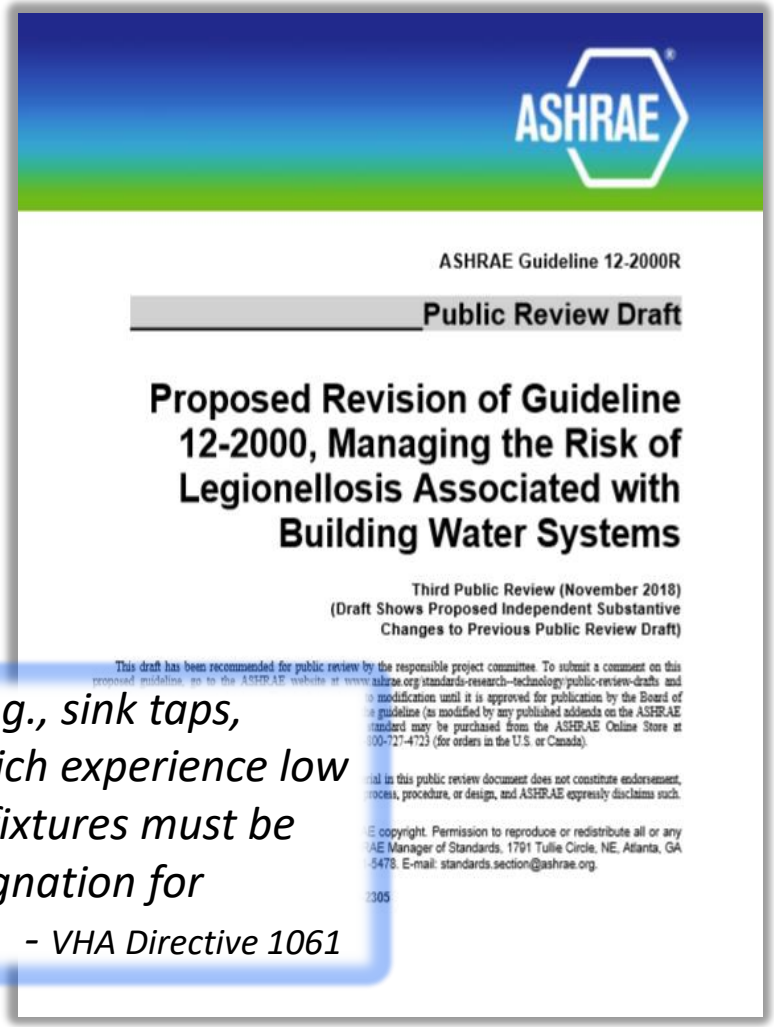


ASHRAE Guideline 12-2000R

- **Section 5.3.4 Routine Flushing**

  Routine flushing is the control measure most often used to reduce water age…

  When flushing, the practitioner should consider use of auxiliary drain valves to facilitate flow through areas of the building water system or components that are not necessarily flushed by opening taps at normal points of use.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2305

"Regular flushing of hot and cold water at outlets (e.g., sink taps, showers), particularly those not in routine use or which experience low water flow, is necessary... Irregular use or low flow fixtures must be flushed at least twice per week to prevent water stagnation for extended periods of time."

- VHA Directive 1061

Engineering vs. Legionella

Venturi Splitter Valves

Eliminates legs and stagnation

Automated Thermostatic Balancing Valves

Automates hot water temperature control

Automated Cold-Water Flush Valve

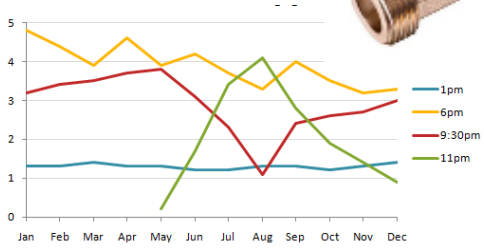
Avoids stagnation in cold water

Temperature & Flow Sensors

Provides cold water flushing and system monitoring

BMS Monitoring System

System monitoring



Sampling Port

Verifying and testing

Engineering vs. Legionella

Splitter Valves Eliminate Dead Legs

- Venturi Splitter Valves are a designer's new weapon against stagnation, dead legs and Legionella growth.
- They provide a constant circulating flow of hot and cold water throughout the building.

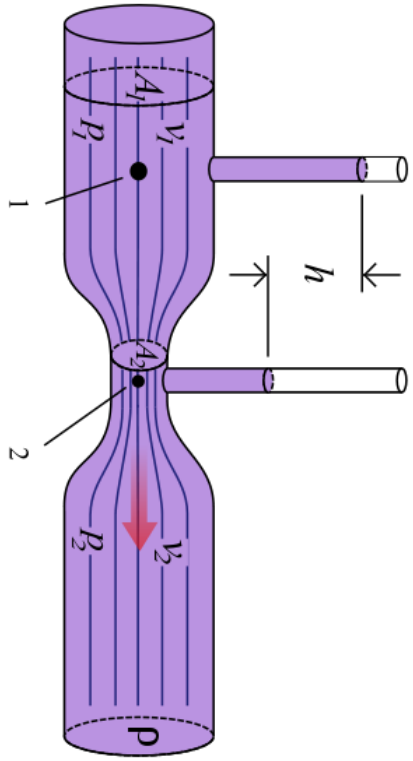
"…in many parts of the world people don't have any other solution than drinking "stagnant water"

1001 FontainesJean; François Rambicur
33 rue Pierre Brunier - 69300 CALUIRE & CUIRE - FRANCE

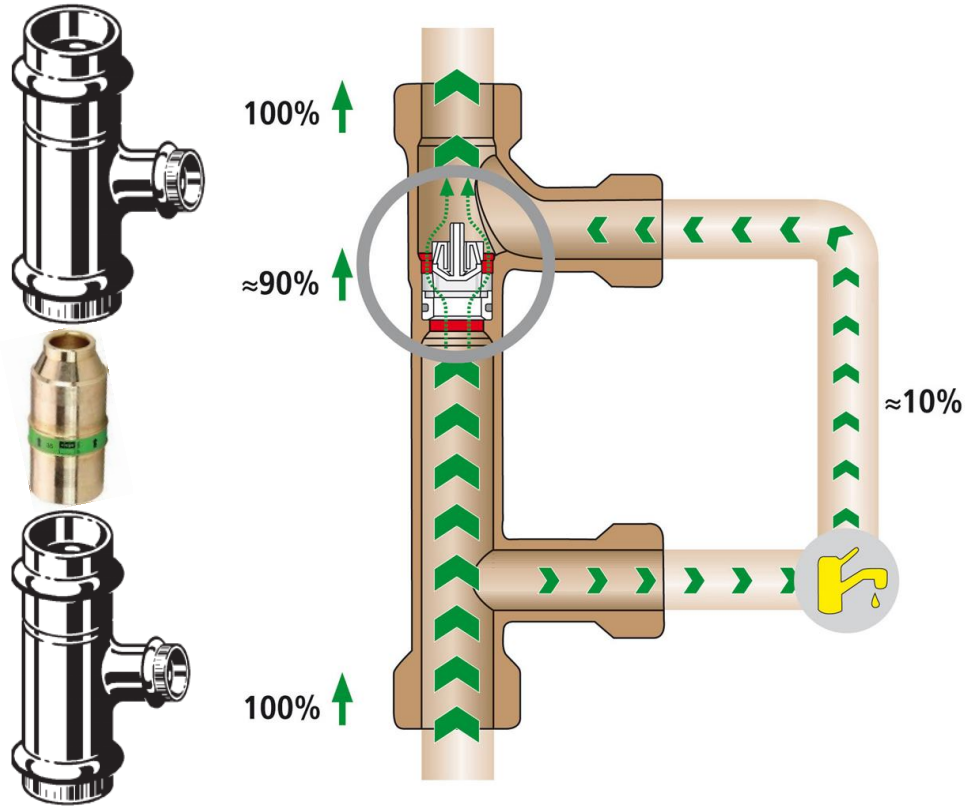
Kemper Engineering vs. Legionella

Giovanni Venturi (1746 - 1822) Italian Physicist introduced The Venturi Effect which is the change in pressure that results when a fluid flows through a constricted section (or choke) of a pipe.

Original Venturi Tube (1797)

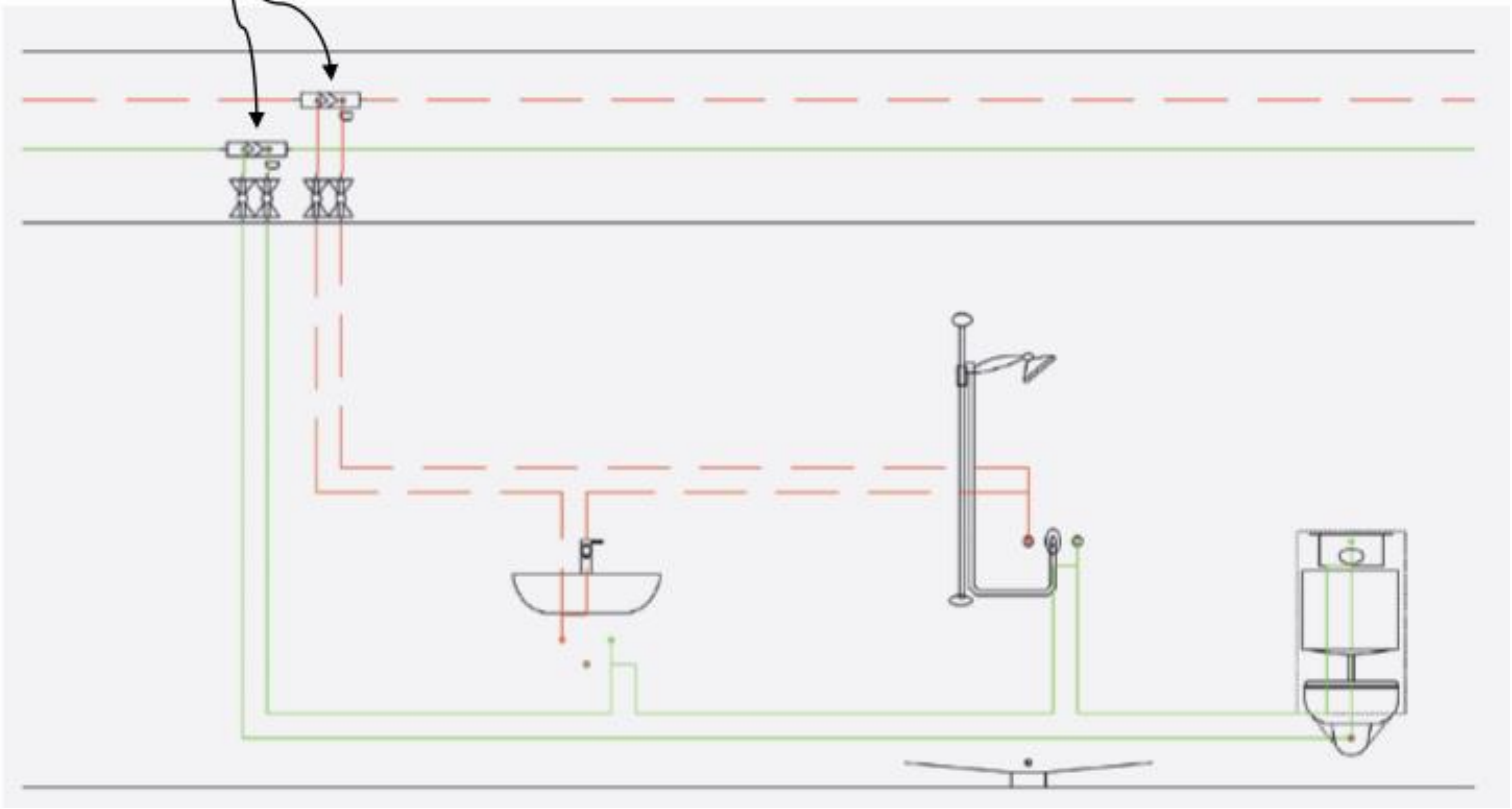


Modern Day Venturi Valves (2007)



Engineering vs. Legionella

Water moving through the main portion of the valve causes an exchange of water in the loop piping.

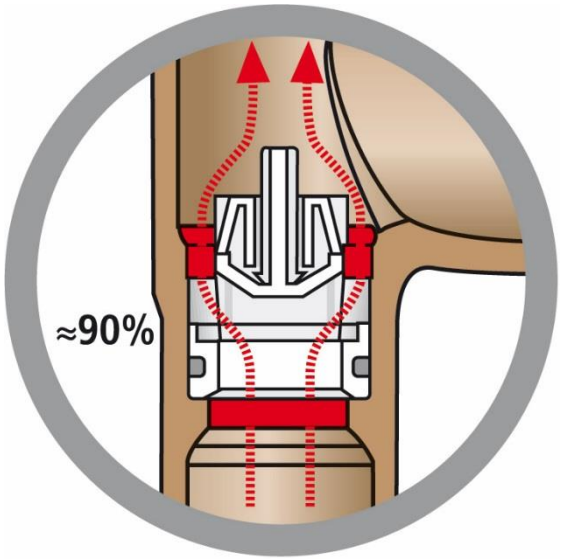


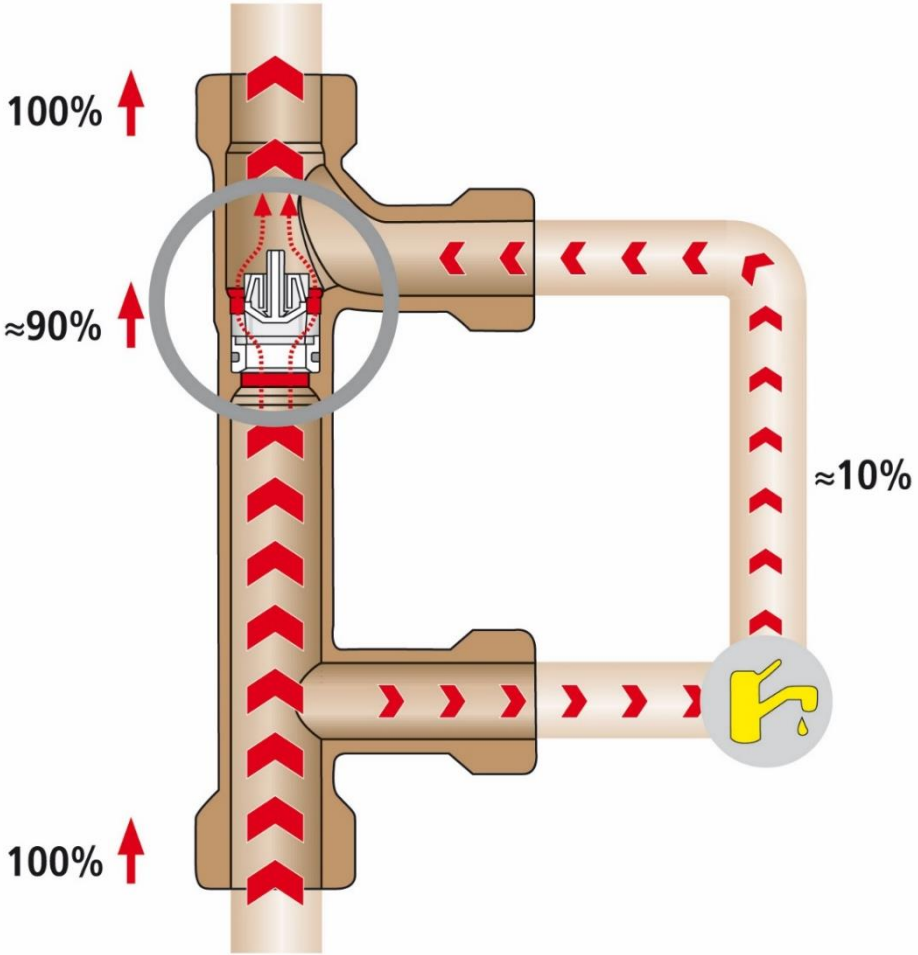
Engineering vs. Legionella

Venturi Splitter Valve

Engineering vs. Legionella

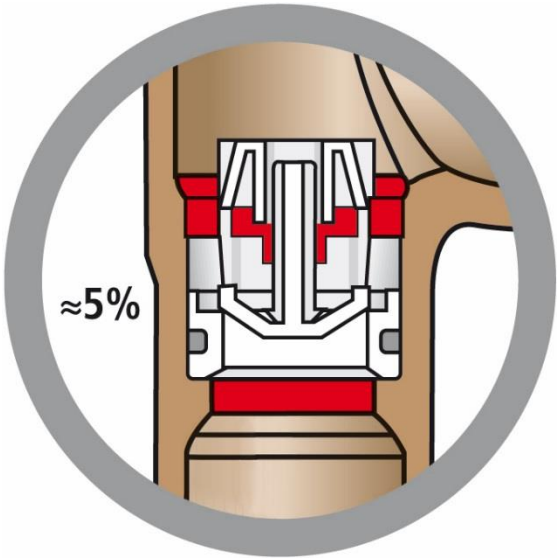
Flow effect with high downstream consumption:

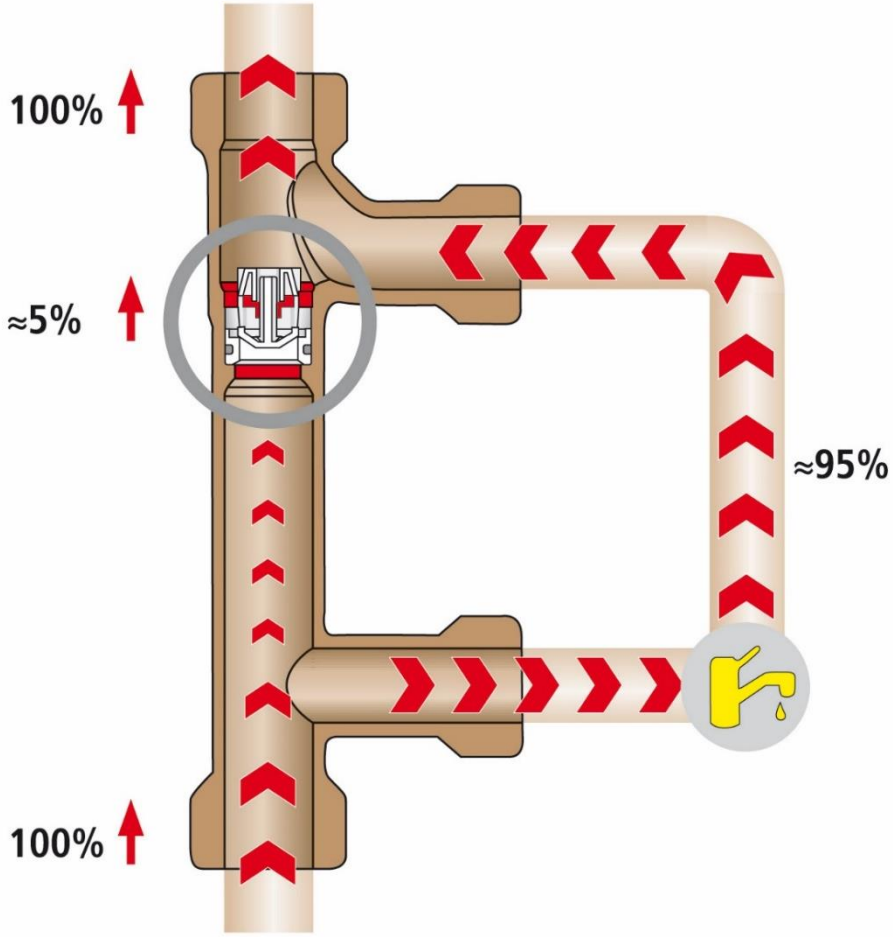




Engineering vs. Legionella

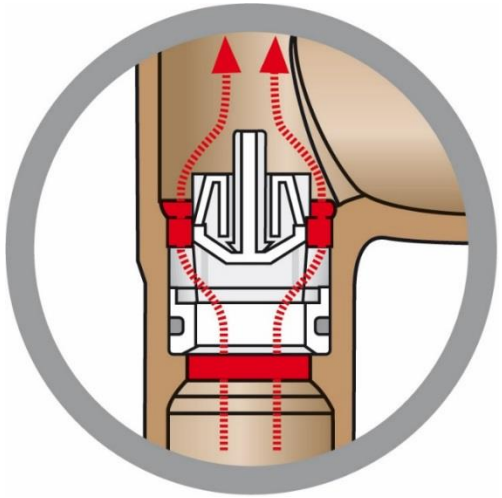
Flow effect with low downstream consumption:

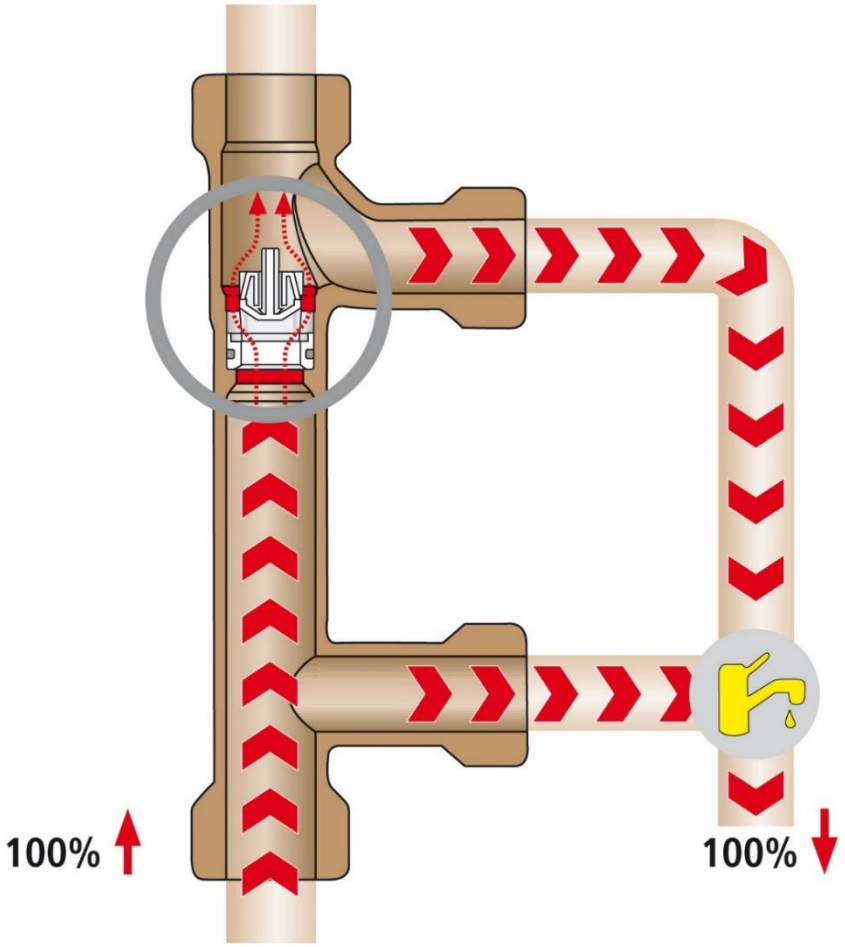




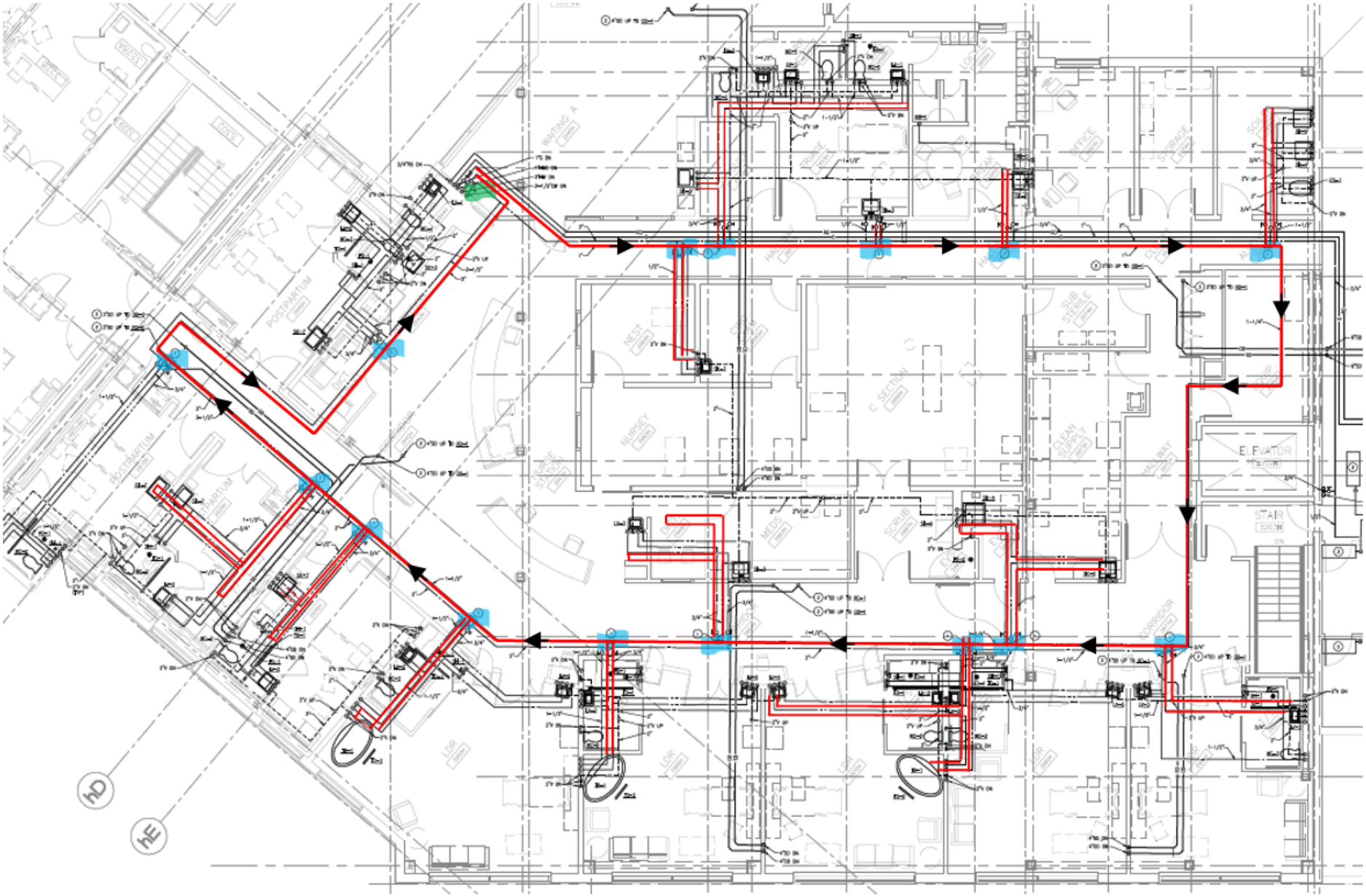
Engineering vs. Legionella

Flow effect with high loop consumption:

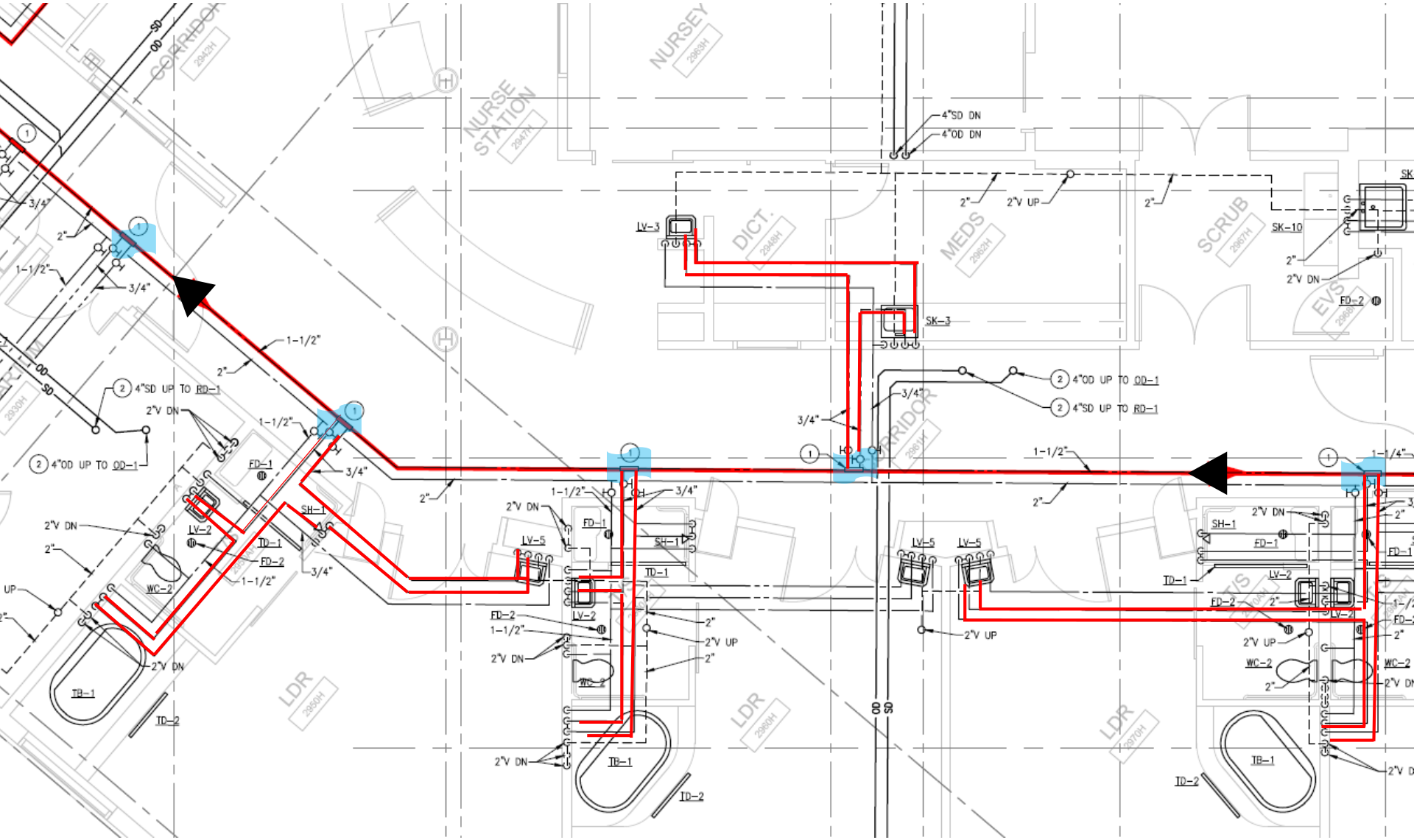




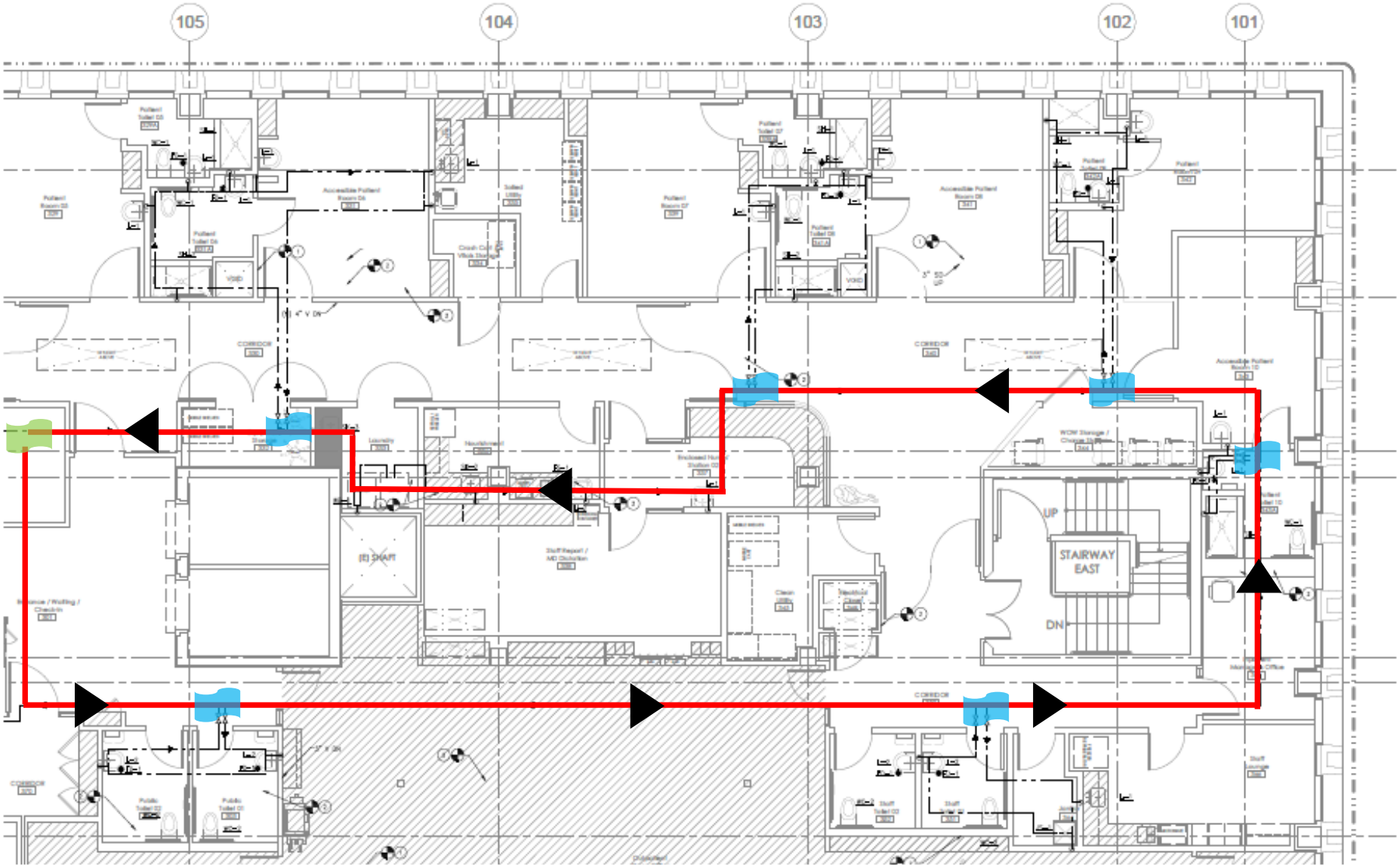
Engineering vs. Legionella



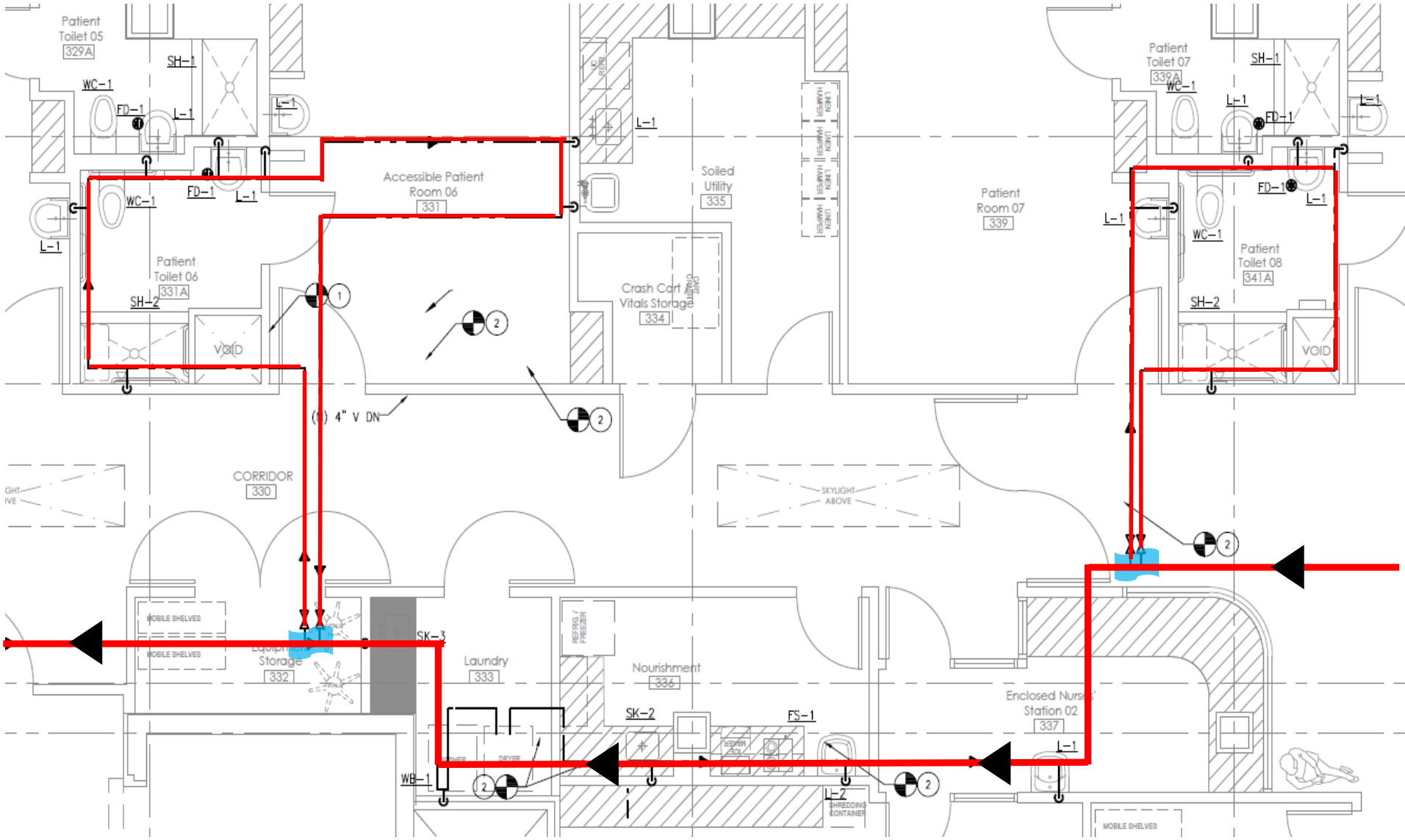
Engineering vs. Legionella



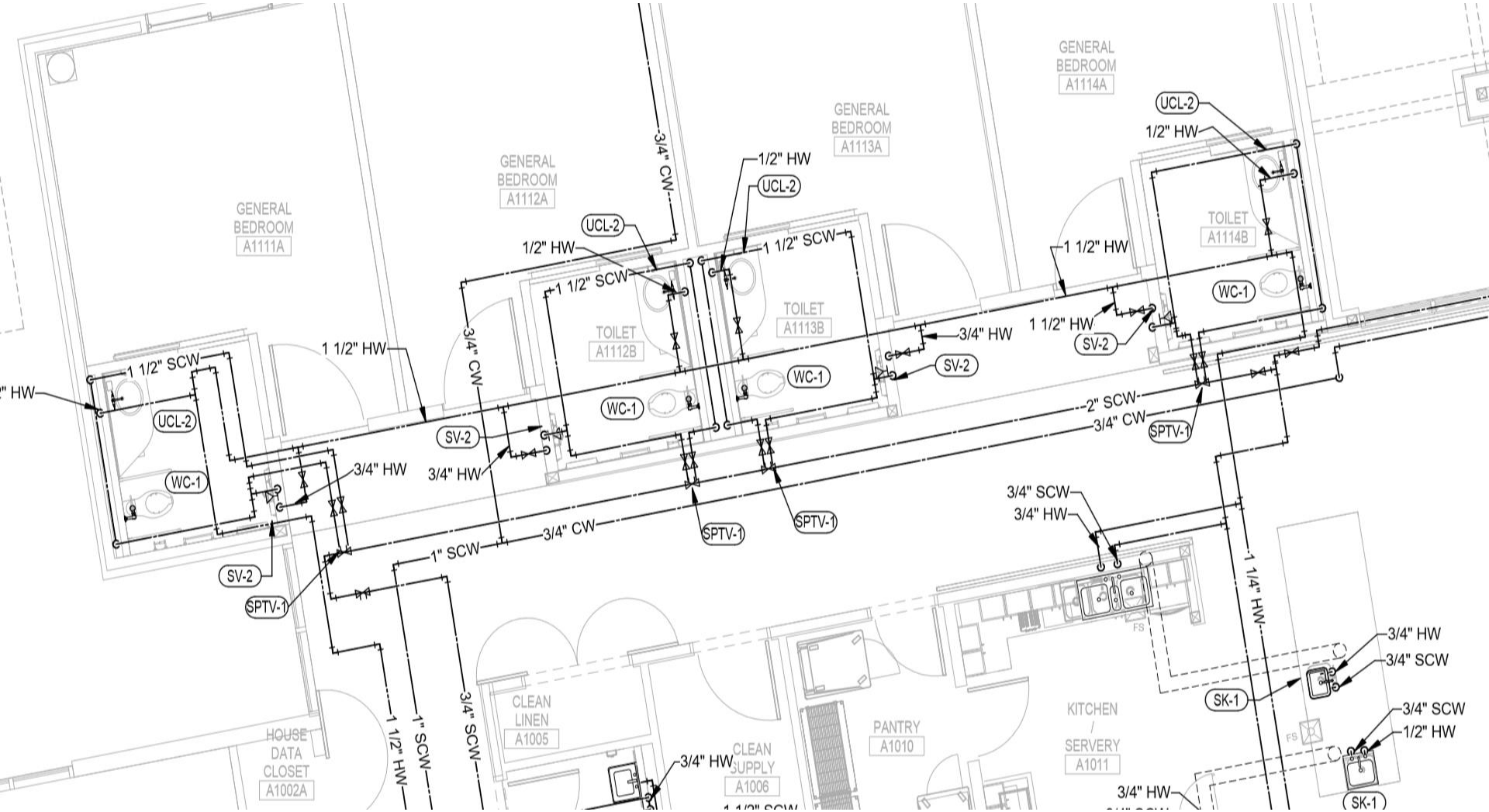
Engineering vs. Legionella



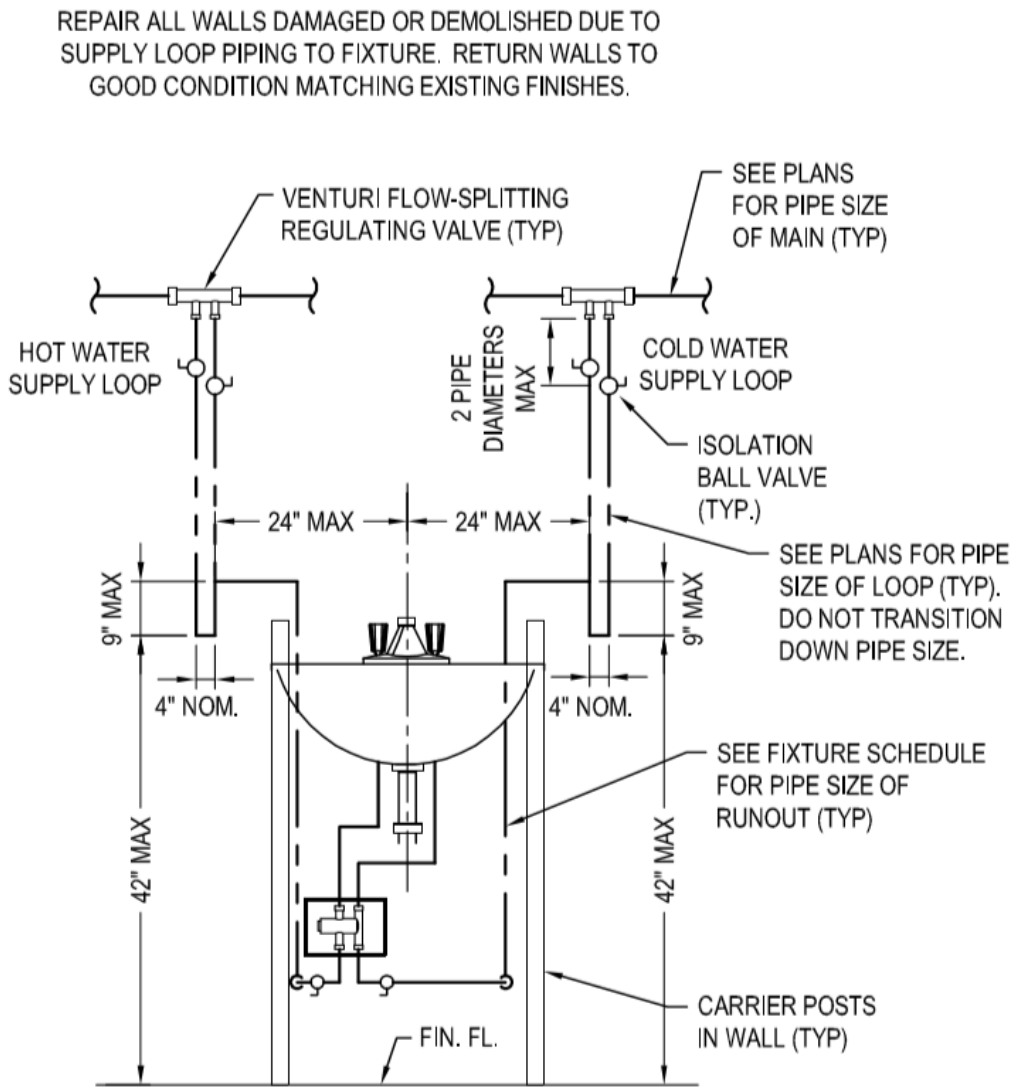
Engineering vs. Legionella



Engineering vs. Legionella



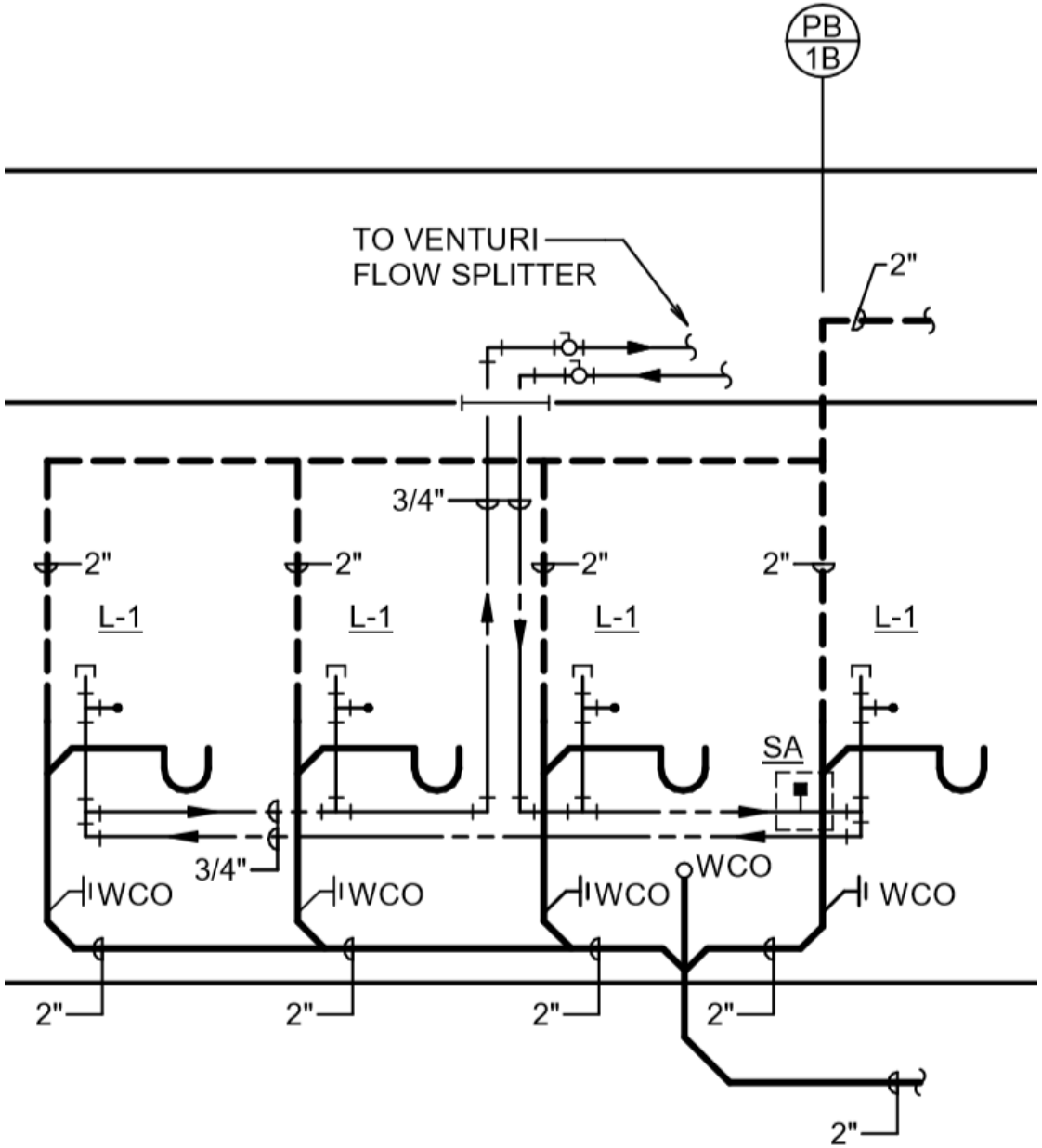
Engineering vs. Legionella



2 TYPICAL LAVATORY/SINK CONNECTION DIAGRAM

NOT TO SCALE

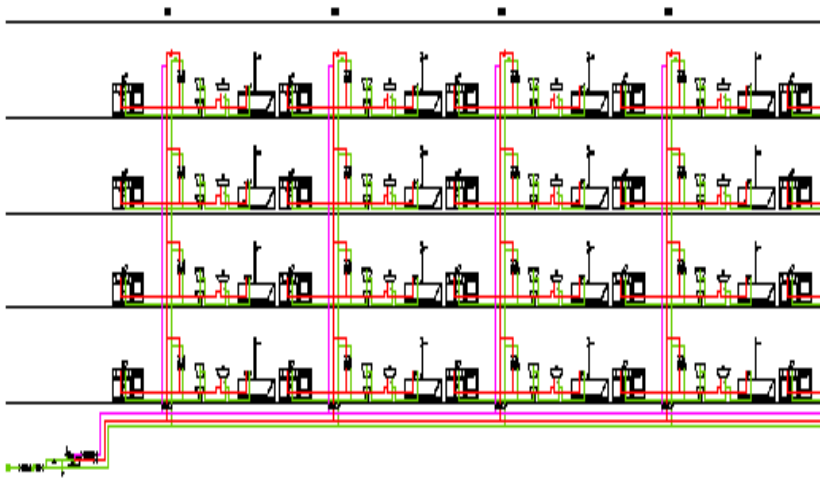
Engineering vs. Legionella

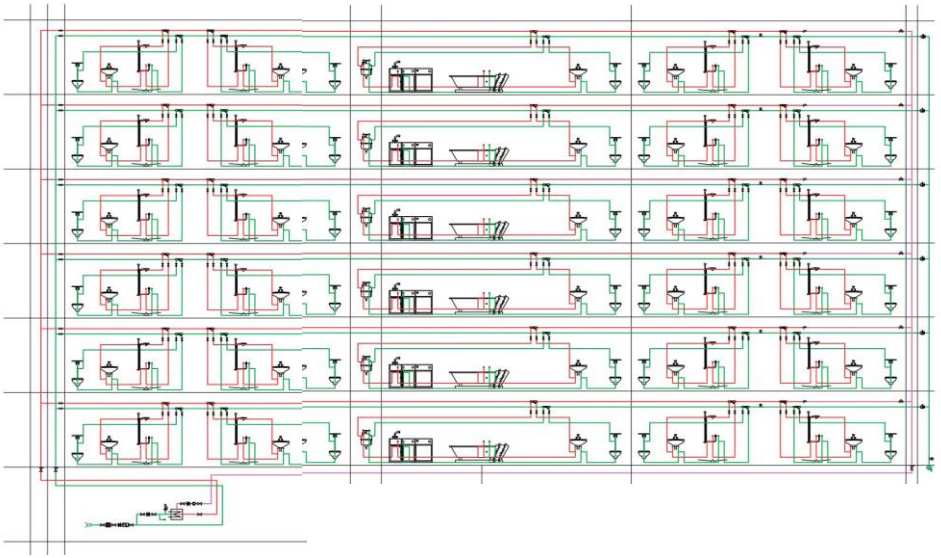


Engineering vs. Legionella

Benefits of using Venturi Flow Splitters in hot water:

- Eliminates deadlegs
- Hot water immediately
- Water savings/energy savings
- Less pipework (fewer risers/returns)
- Less piping in the room/fewer and smaller connections
- Delivers secondary chemicals throughout building
- Helps to meet energy code (2‘ non circulating max from device)



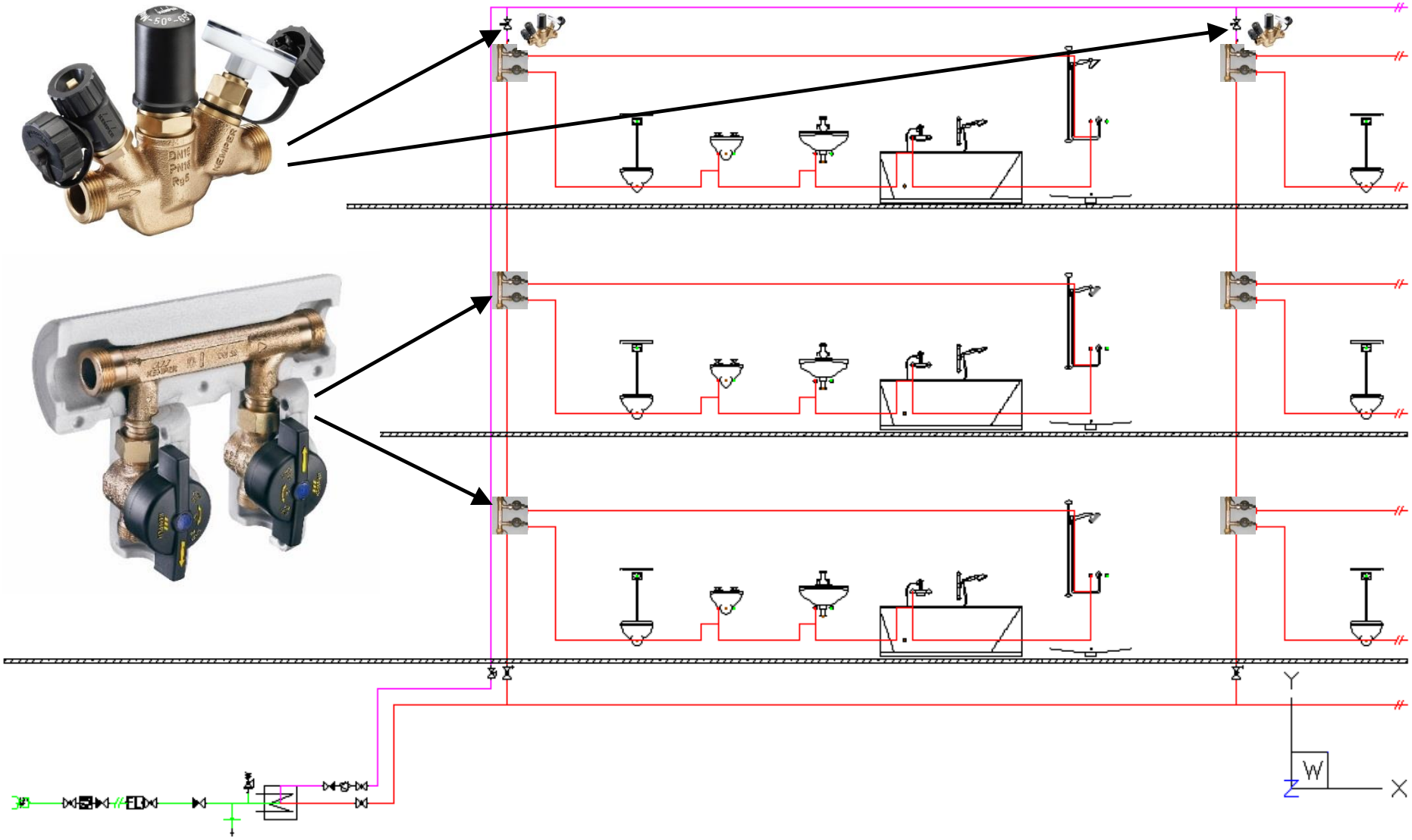


Engineering vs. Legionella

Automated thermostatic balancing valve

- Automated thermal balancing of hot water circulation
- Set it/forget it
- Automatically adjusts to changes in plumbing system
- Includes thermal disinfection mode
- Field adjustablable
- Stop valve and/or sample port
- Optional temperature gage or sensor

Engineering vs. Legionella

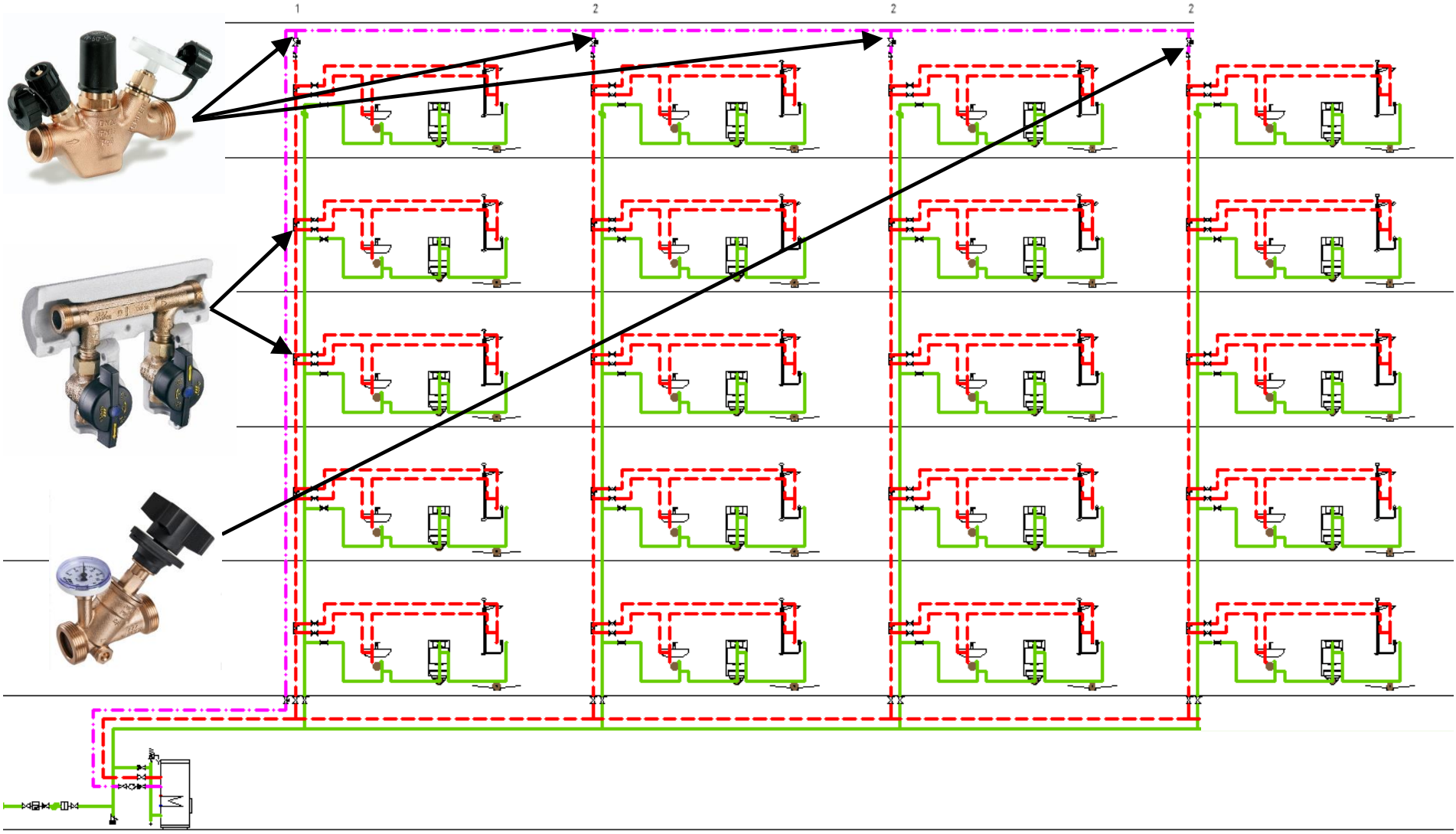


Engineering vs. Legionella

Manual/static regulating valves

- Static presetting for hydraulic balancing of HWR systems
- To be placed on longest index run for proper flow setting
- Stop valve function without changing the adjusted pre-setting
- Optionally available with a temperature sensor for use in building management services

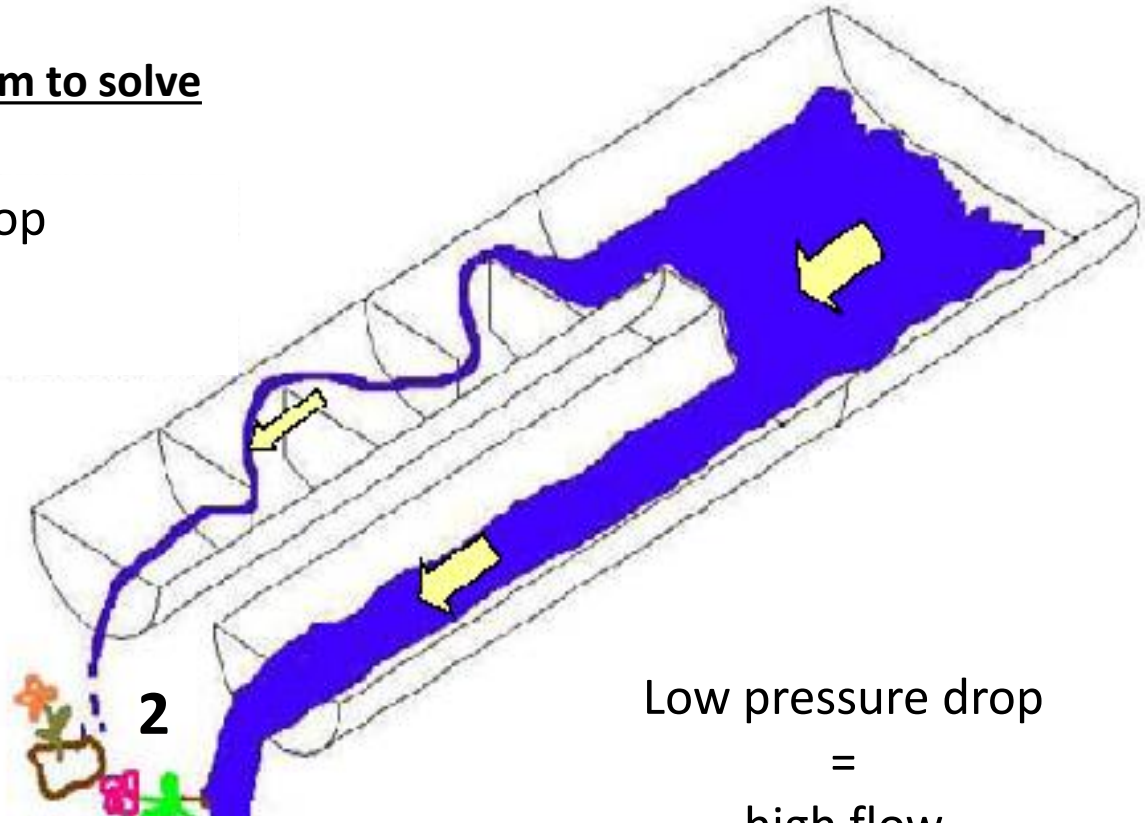
Engineering vs. Legionella



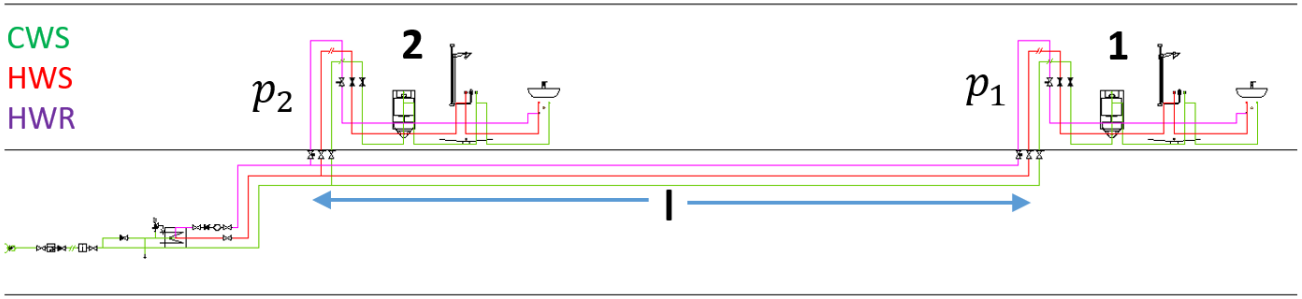
Engineering vs. Legionella

Hydraulic balancing – the problem to solve

High pressure drop
=
low flow

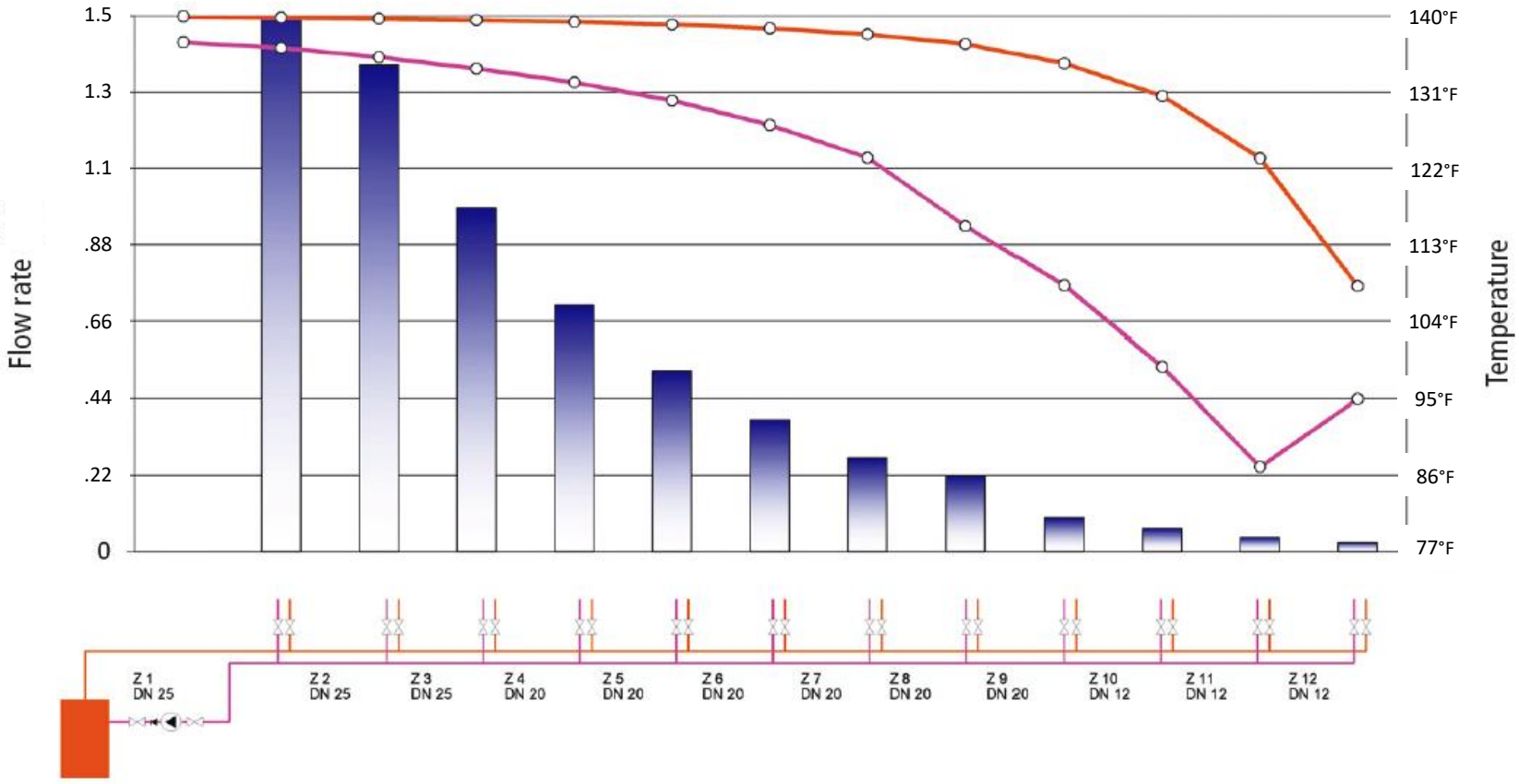


Low pressure drop
=
high flow



Engineering vs. Legionella

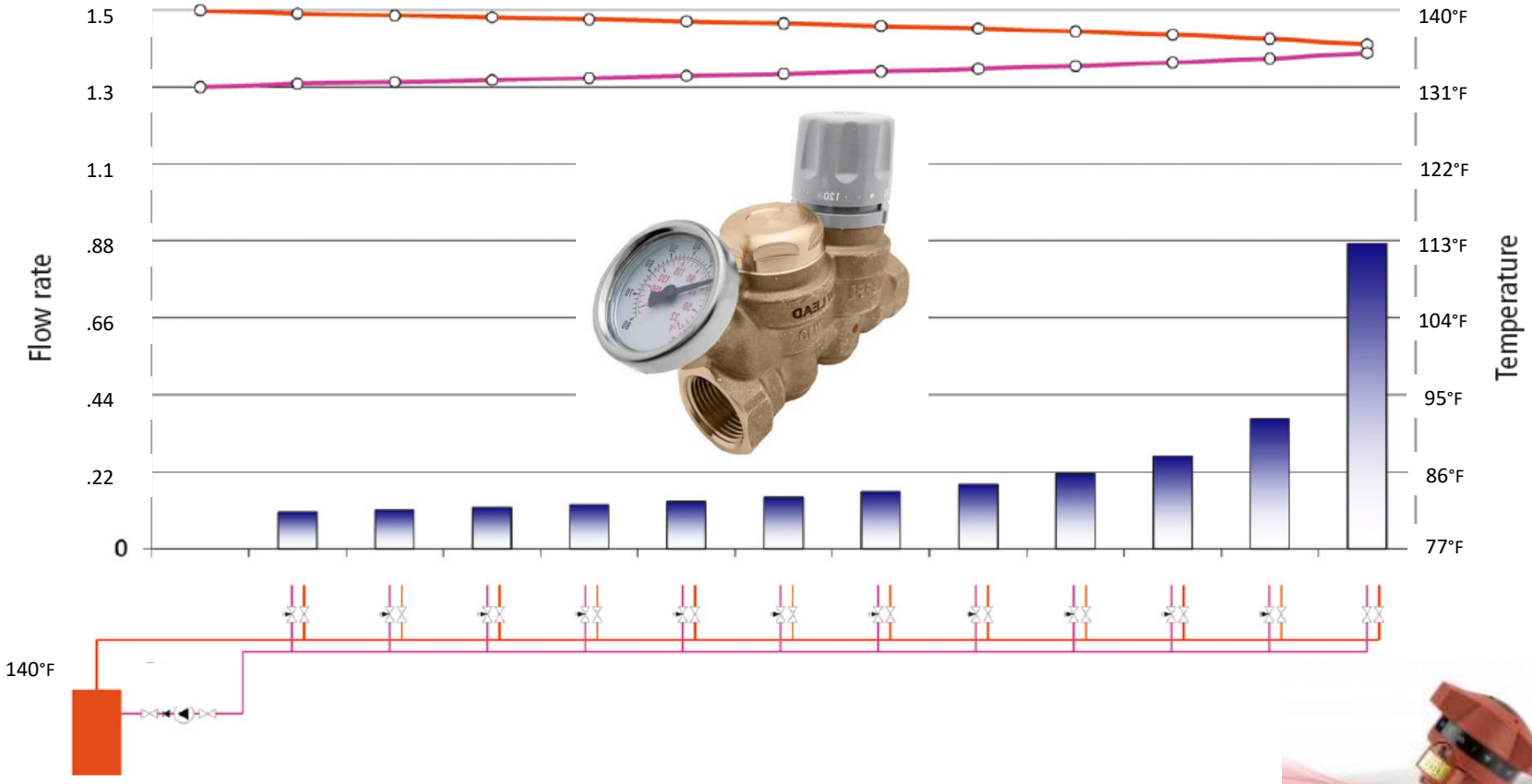
Legionella hazard increased due to unbalanced hot water system and hot water not available when needed



Distribution of the hot water return flow rate in a system with 12 unbalanced risers.

Engineering vs. Legionella

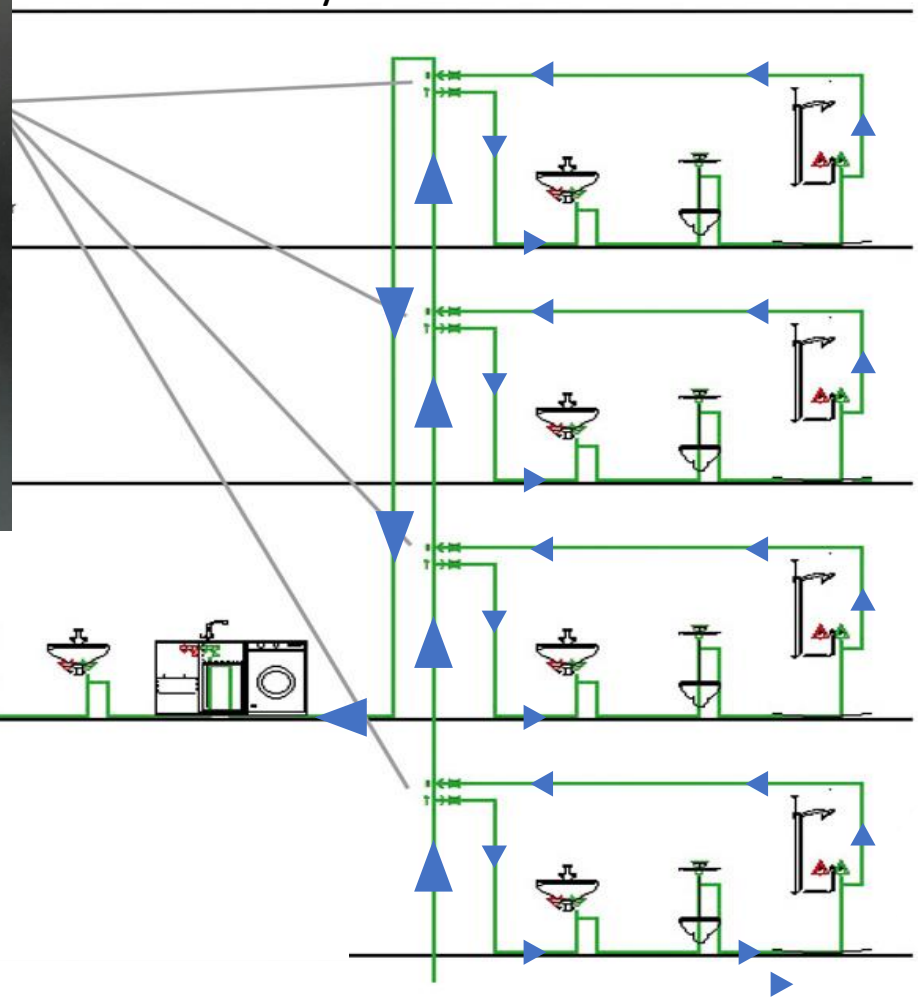
Legionella Hazard Minimized Due to Balanced Hot Water Systems and Hot Water readily available



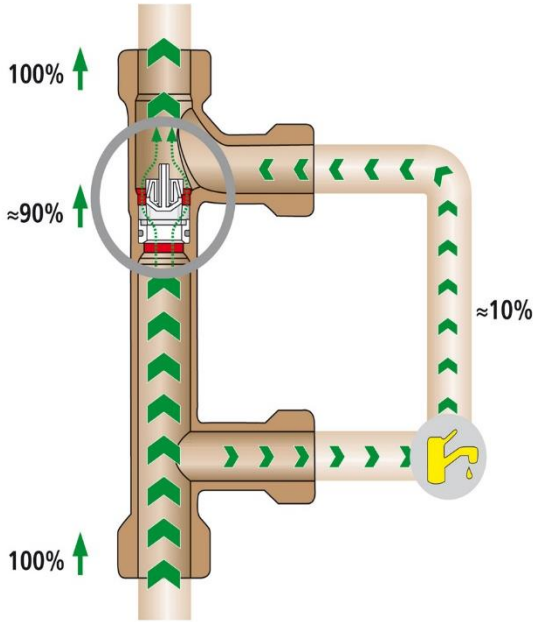
Distribution of the hot water return flow rate in a system with 12 balanced risers.

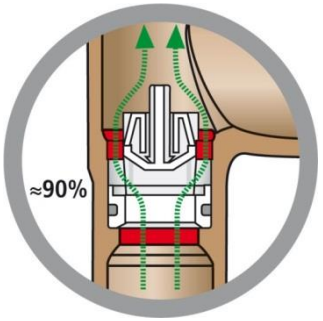
Engineering vs. Legionella

Cold Water Layout



or…





Engineering vs. Legionella

Automated flushing valve

- Automatically activates to flush a predetermined volume of water
- Activated by water temperature, time or flow
- Helps eliminate stagnation
- Helps control cold water temperature to avoid heat gain
- Great for periods of non-use (schools, etc.)
- BMS integration
- Flush to pool systems, irrigation, water features, etc.

Engineering vs. Legionella

Master 'EB Ventil 15l ' V2.09 21.08.2014

No.	Date	Time	ID	Device	Type	Event / Parameters before event	Duration	Volume[l]	Tstart[°C]	Tstop[°C]
4	11/26/2014	7:05	4	4 KS Ventil 20l	1	Time flushing	0:02:00	41.7	37.7	57.2
5	11/26/2014	7:00	8	8 EB Ventil 4l	1	Time flushing	0:02:00	10.7	31.3	51.3
6	11/26/2014	6:55	3	3 KS Ventil 20l	1	Time flushing	0:02:00	40.8	35	57.3
943	8/19/2014	16:52	3	3 KS Ventil 20l	3	Temperature flushing	0:00:00	4.7	29.7	50.4
947	8/19/2014	16:51	5	5 EB Ventil 20l	3	Temperature flushing	0:00:00	3.8	28.8	53.3
951	8/19/2014	14:21	3	3 KS Ventil 20l	72	Routine-Duration flushing	0:01:00	17.7	29.3	43.7
952	8/19/2014	14:21	2	2 KS Ventil 15l	72	Routine-Duration flushing	0:01:00	15.3	29.2	43.5
953	8/19/2014	11:30	6	6 EB Ventil 20l	72	Routine-Duration flushing	0:01:00	20.8	30.2	56.9
983	8/15/2014	11:22	6	6 EB Ventil 20l	72	Routine-Duration flushing	0:01:00	28.2	28.6	47
984	8/15/2014	11:14	8	8 EB Ventil 4l	72	Routine-Duration flushing	0:01:00	6.7	28.7	51.5
985	8/15/2014	0:27	0	EB Ventil 15l	72	Routine-Duration flushing	0:01:00	19	30.3	56.5
986	8/15/2014	0:23	5	5 EB Ventil 20l	72	Routine-Duration flushing	0:01:00	24.6	29.5	59.3
1040	8/14/2014	11:21	6	6 EB Ventil 20l	3	Temperature flushing	0:00:00	0.9	39.9	49.2
1041	8/14/2014	11:13	8	8 EB Ventil 4l	3	Temperature flushing	0:00:26	4.2	19.8	46.7
1042	8/14/2014	11:13	6	6 EB Ventil 20l	3	Temperature flushing	0:00:00	3.7	20.3	43.7
1045	8/14/2014	11:11	2	2 KS Ventil 15l	3	Temperature flushing	0:00:00	5.8	39.9	47.4
1046	8/14/2014	11:01	8	8 EB Ventil 4l	3	Temperature flushing	0:10:01	46.1	18.5	19.7
1049	8/14/2014	11:01	6	6 EB Ventil 20l	3	Temperature flushing	0:10:01	202.5	17	20.5
1054	8/14/2014	11:01	4	4 KS Ventil 20l	3	Temperature flushing	0:00:50	20.2	37	45.7
1061	8/14/2014	11:01	1	1 KS Ventil 4l	3	Temperature flushing	0:00:00	1.5	54.2	40.9
1076	8/14/2014	10:32	6	6 EB Ventil 20l	3	Temperature flushing	0:00:00	1.3	39.9	49.4
1077	8/14/2014	10:32	8	8 EB Ventil 4l	3	Temperature flushing	0:00:03	2.1	39.9	47.2

Engineering vs. Legionella

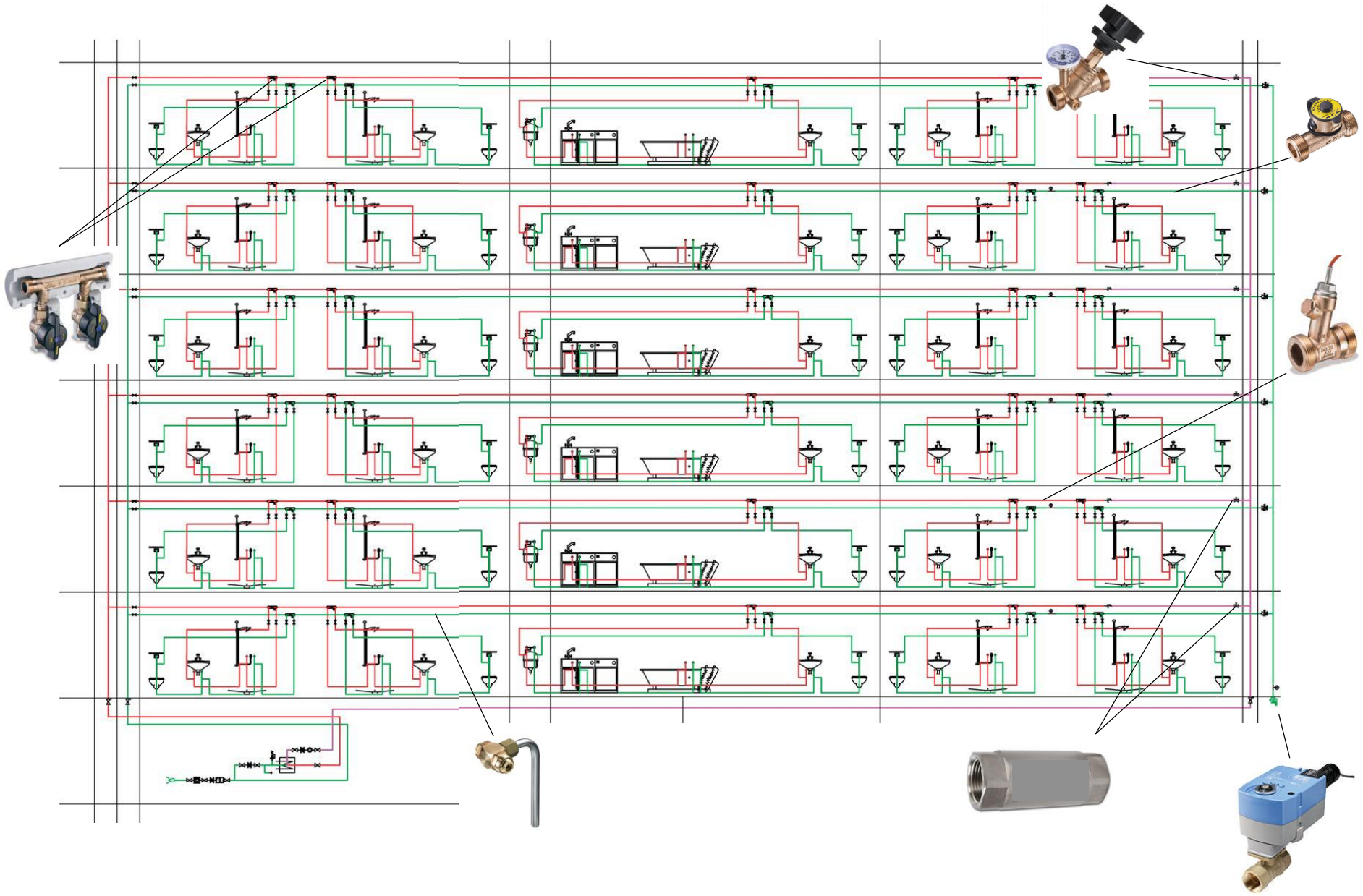
Temperature & Flow Sensors

- Provide temperature and flow data throughout the building
- Actuates automatic flushing valve
- Ties in to BMS for total system monitoring

Sampling Port

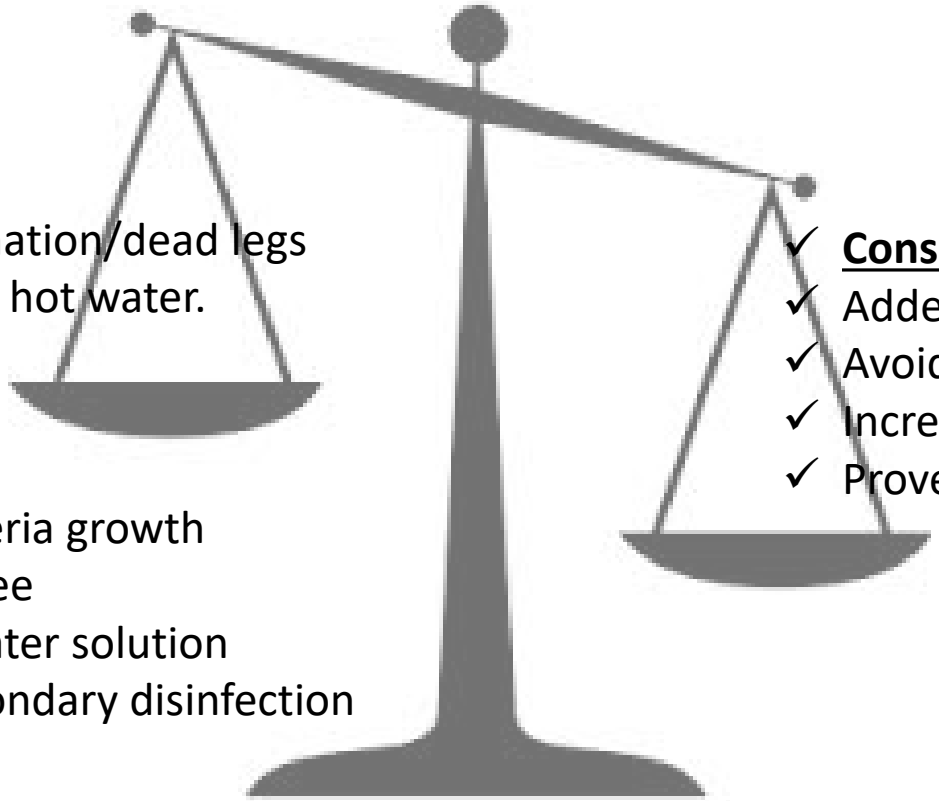
- Provides ability to sample throughout the building
- Acts as stop valve

Engineering vs. Legionella



Engineering vs. Legionella

There is a cost Associated with
Minimizing the Risk of Legionella



- ✓ **Best Practices**
- ✓ Eliminates stagnation/dead legs
- ✓ Provides instant hot water.
- ✓ Saves energy
- ✓ Saves piping
- ✓ Reduces biofilm
- ✓ Minimizes bacteria growth
- ✓ Maintenance free
- ✓ Cold and hot water solution
- ✓ Works with secondary disinfection

- ✓ **Considerations**
- ✓ Added investment
- ✓ Avoid millions $$$ in liability
- ✓ Increases value of building
- ✓ Proven technology

Thank you…

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