ZMERLY & CO
HEATING TECHNOLOGY

بسم الله الرحمن الرحيم
﴿ و على الله قصد السبيل ﴾

PLUMBING

HOT WATER

Eng. Wael Zmerly

2015

- HEAT EXCHANGER
- HOT WATER RETURN
- SAFETY
- THERMOSTATIC MIXING
- LEGIONELLA
- CONTROL
- SOLAR
- HP

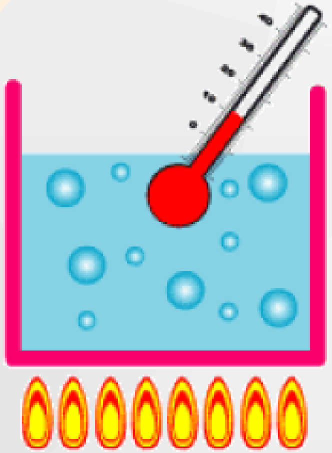
- STIEBLE ELTRON
- ACV
- BUDERUS

BASIC PRINCIPLE

Necessary heat quantity for:

Raising 1 liter of water

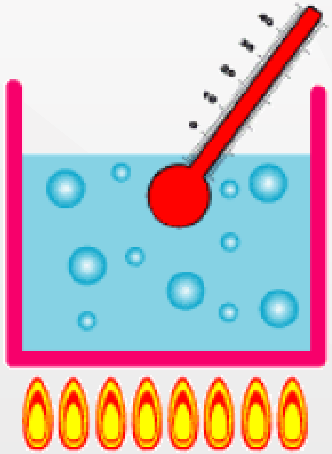
1°C



1.16 Wh

Raising 1 liter of water

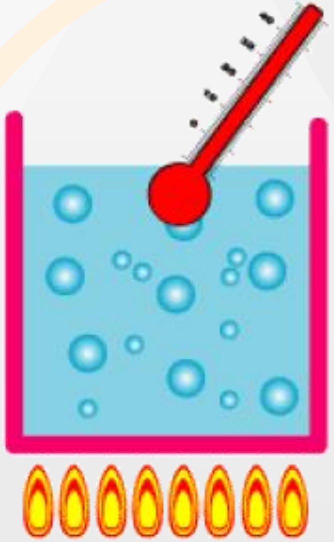
50°C



58 Wh

Raising 100 liter of water

50°C



5800 Wh

TYPE OF WATER HEATERS

- **Instantaneous:**
  - No hot water storage.
  - Heating capacity equal to peak flow capacity.
  - Very low heat losses.

- **Semi Instantaneous:**
  - Less heating capacity.
  - Very low capacity ready for use.
  - Stability of hot water production.

- **Semi Accumulation**
  - Heating capacity reduced to peak time need.
  - Storage equal to 10 min flow.

- **Accumulation:**
  - Minimum Heating capacity.
  - Storage for one day.

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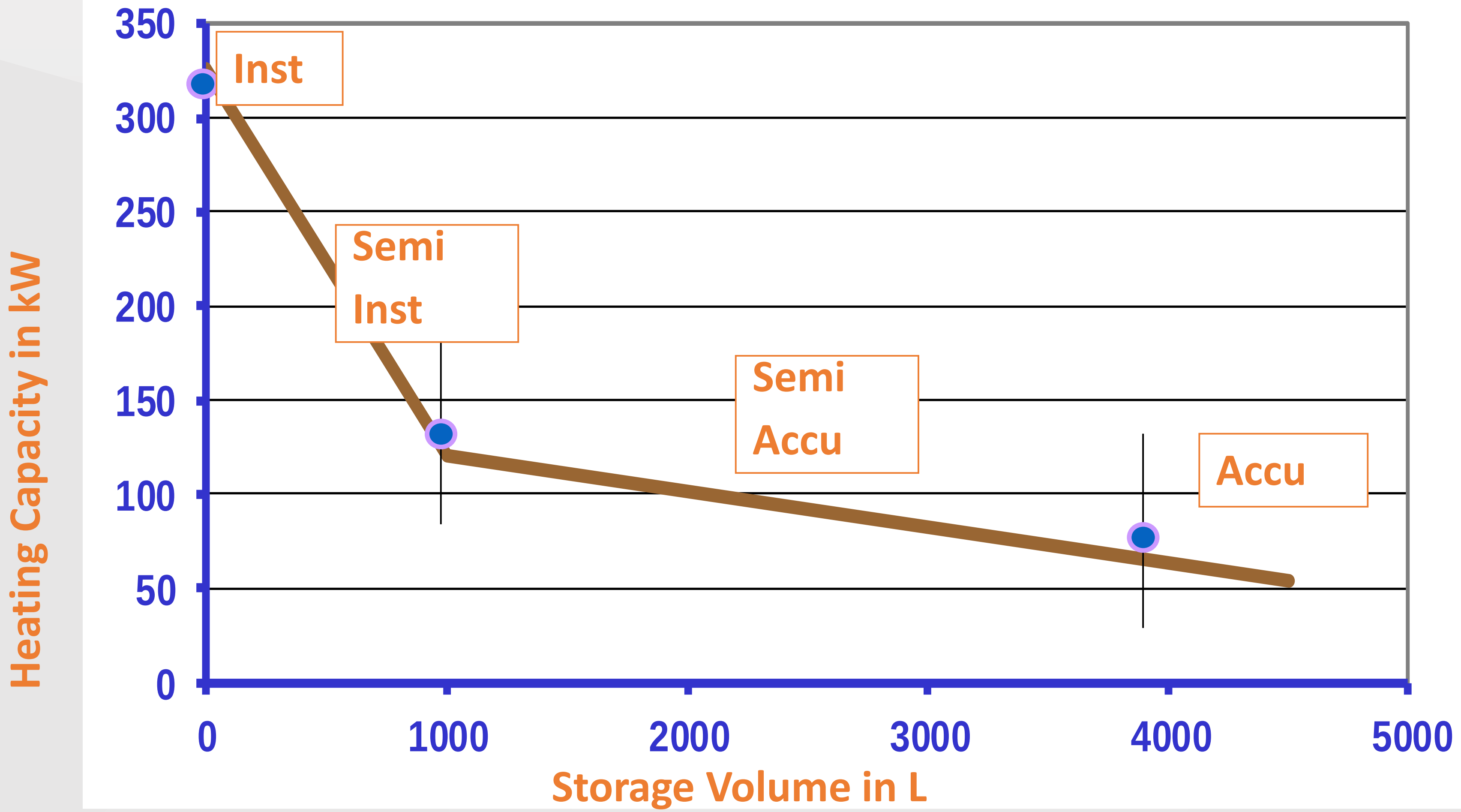
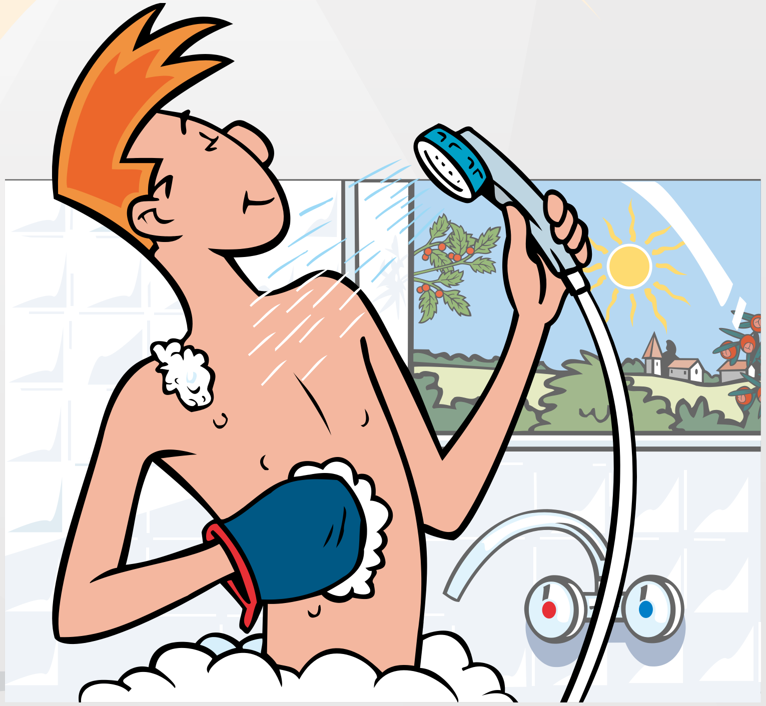
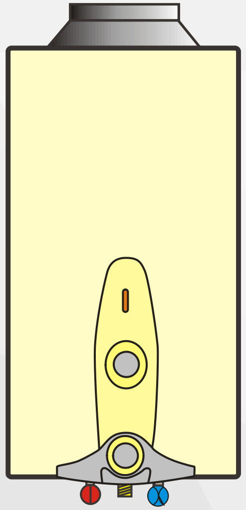
- Heating capacity for 50 apartments

- Instantaneous 294 kW
- Semi Inst. 158 kW (750 L)
- Semi-accu. 113 kW (1000 L)
- Accumulation 54 kW (4500 L)

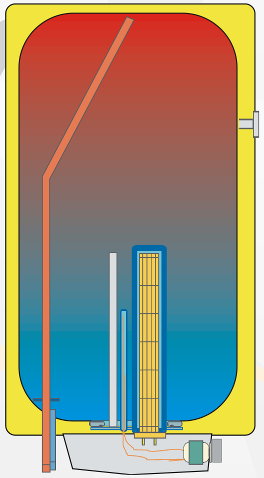




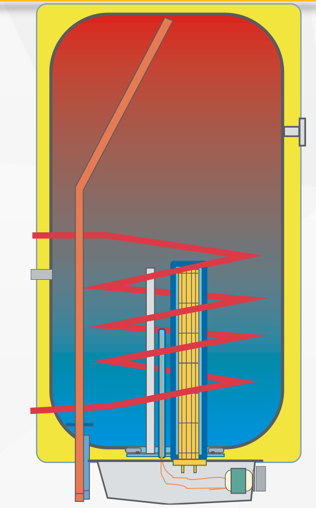
THE DIFFERENCE SYSTEMS



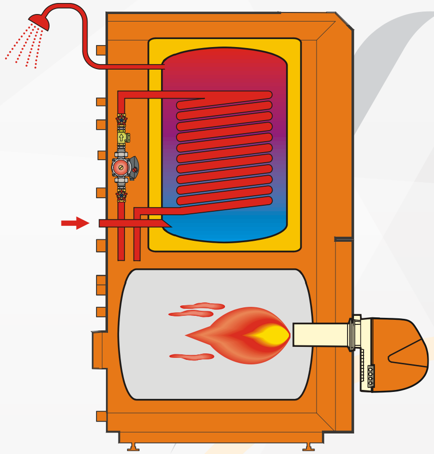
Gas water heater



Electric water heater



Hot water calorifier



Integrated water heater

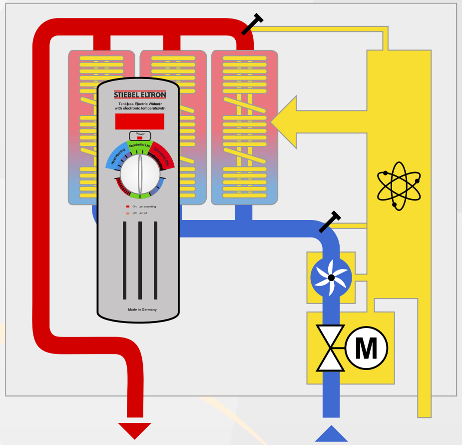
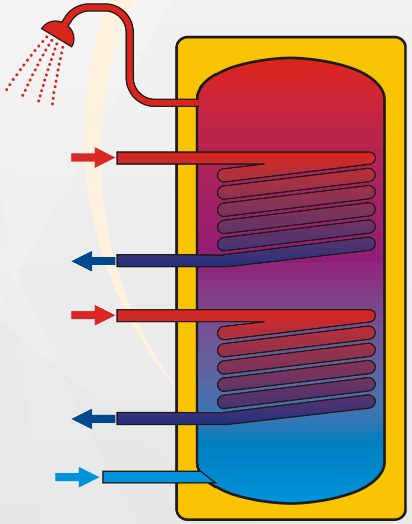


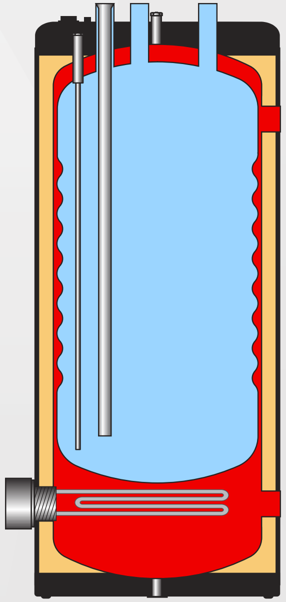
Plate heat exchanger

Independent heater

Direct fired heater



Polyvalent boiler



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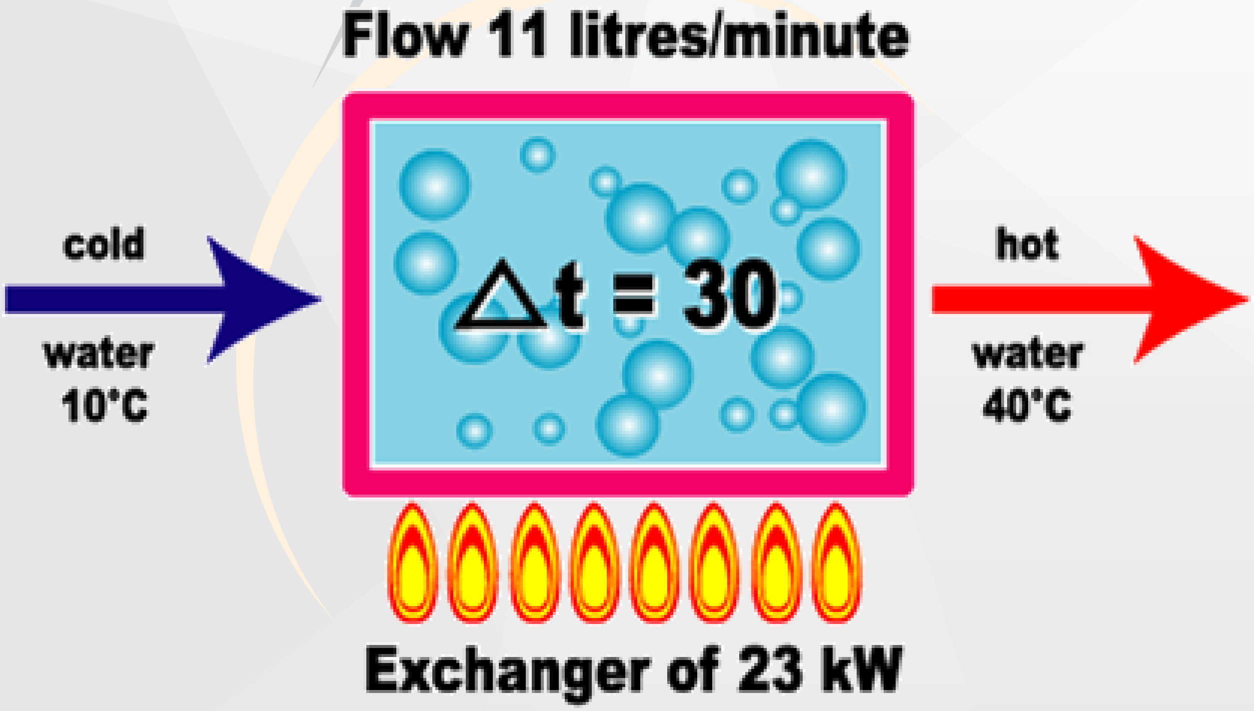
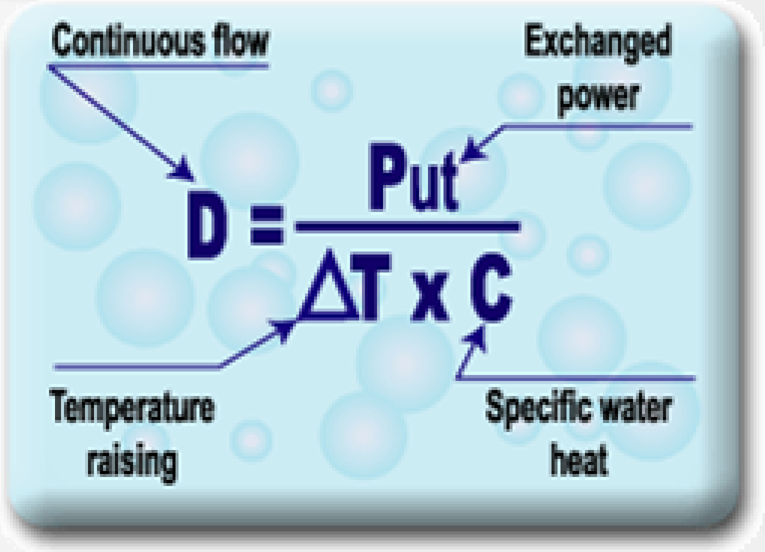
Calculation of the available continuous flow at 40°C :



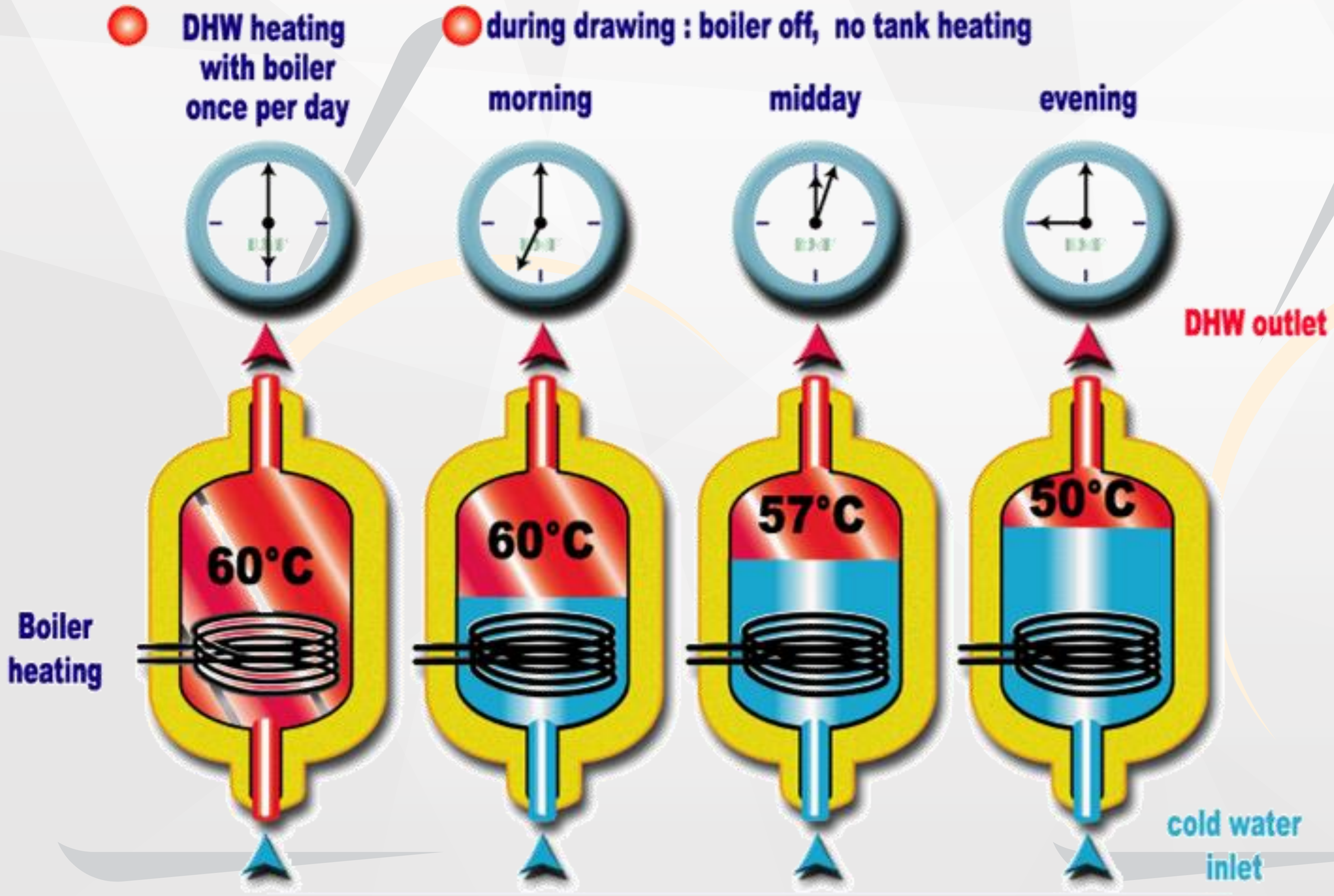


example :

$$D = \frac{23000}{30 \times 1{,}16} = 659 \text{ l/h}$$

$$= \frac{659}{60} = 11 \text{ l/mn}$$

PRDUCTION WITH ACCUMULATION OR SEMI ACCUMULATION



Safe Water Temperature

BATHS	43°C
WASH BASINS	40°C
ROWS OF BASINS	40°C
KITCHEN SINKS	48°C
SHOWERS	40°C
GROUP SHOWERS	40°C
BIDETS	37°C

calculation of the maximum available quantity of water of an electric heater

200 litres electric heater

drawed water : 45 ° C

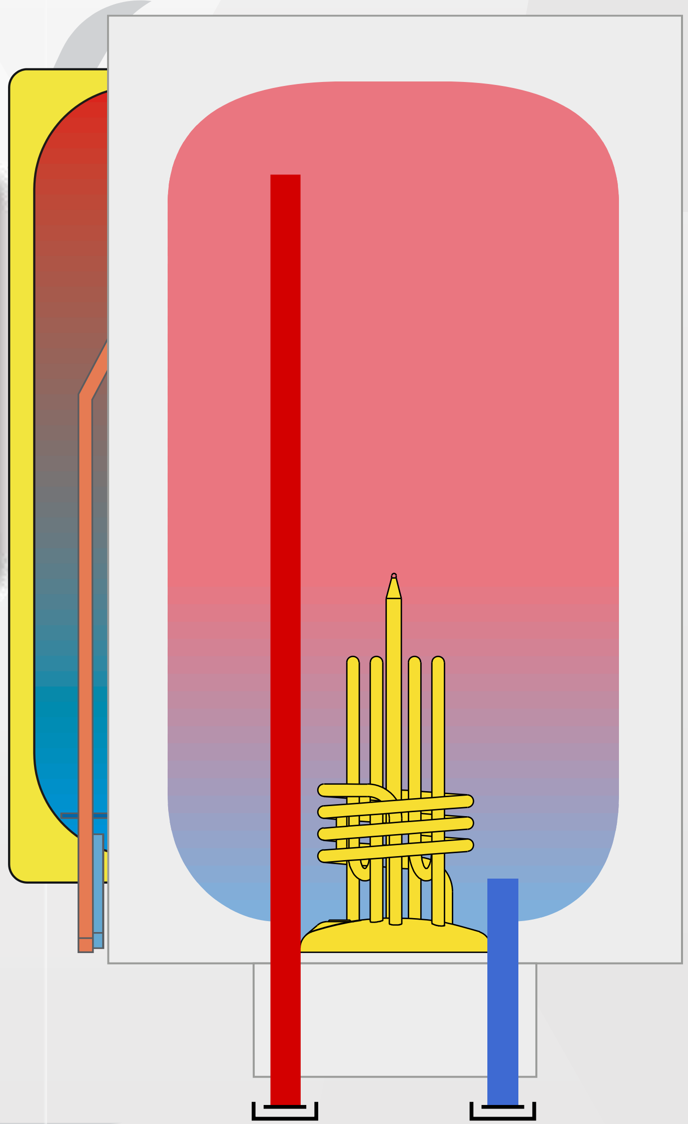
$$Q = Cp \times 0{,}95 \times \frac{T°\ water_{stored} - T°\ EF}{T°\ water_{drawed} - T°\ EF}$$

Tank capacity in litres

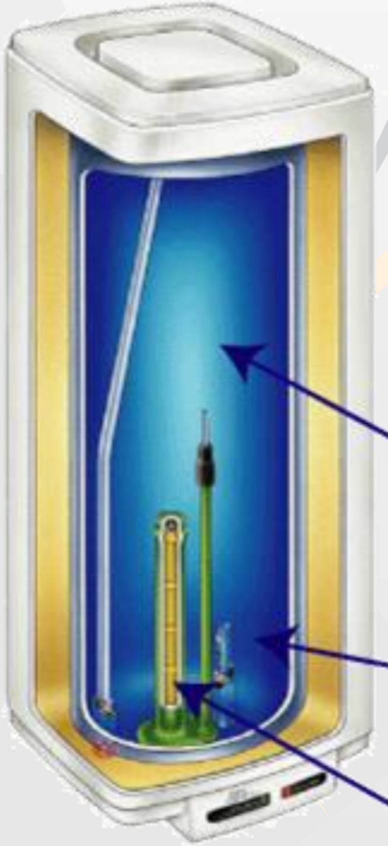
cold water temperature

example :

$$Q45 = 200 \times 0{,}95 \times = \frac{60 - 10}{45 - 10} = 271 \text{ litres}$$



- calculation of the heating time



electric heater
of 200 litres

Necessary heat quantity :

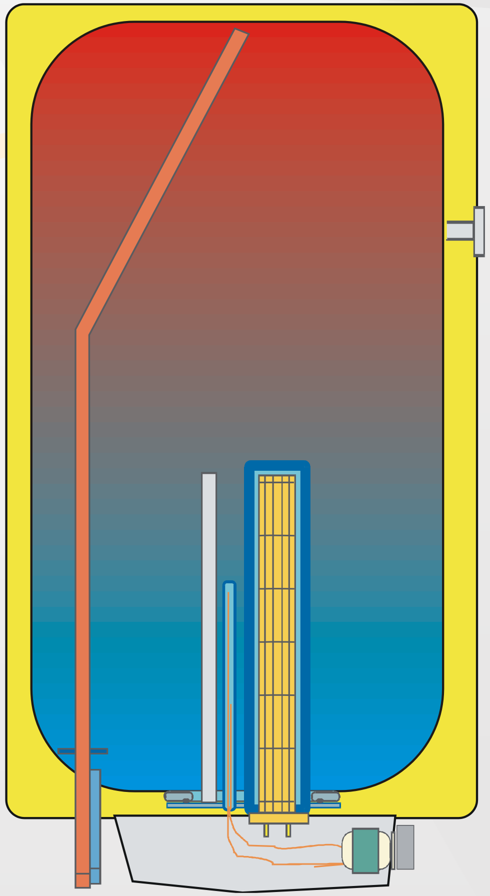
$$Q = Cp \times \Delta t \times C$$

- heat quantity: Q
- Tank capacity in litres: Cp
- Temperature difference between hot and cold water: Δt
- specific water heat: C

Calculation of heating time

$$T = \frac{Q \text{ (heat quantity)}}{P \text{ (power)}}$$

- Time in hours: T
- Heat element power: P



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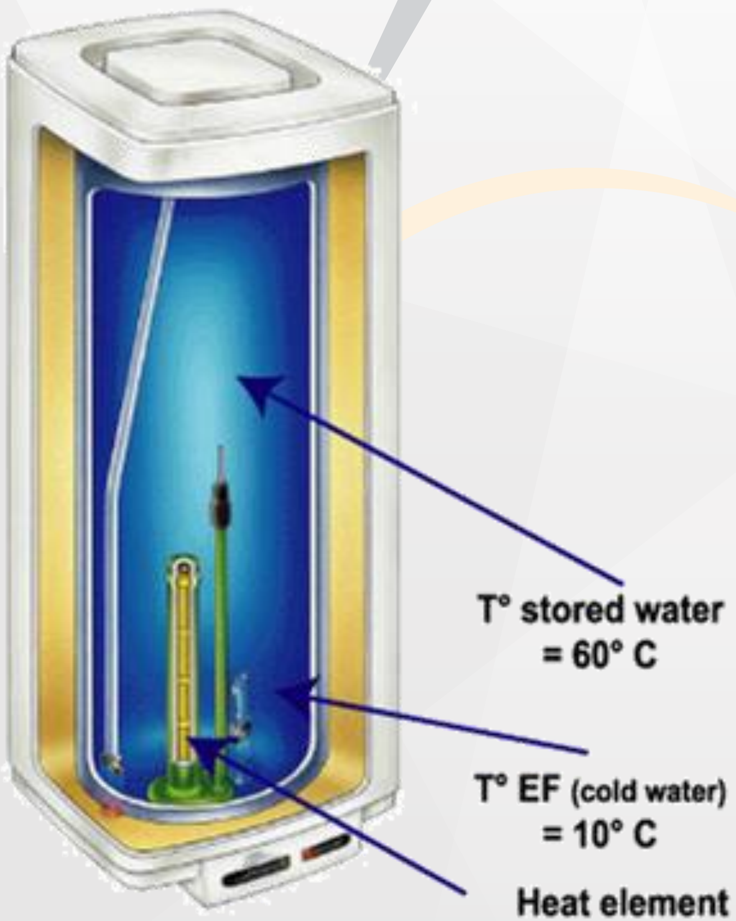
example of heating time calculation



electric heater
of 200 litres

Tank capacity : 200 l

Power of the heat element : 2 400 W

Necessary heat quantity :

heat quantity — specific water heat — tank capacity ballon in litres — temperature difference between hot and cold water

$$Q = Cp \times \Delta t \times C$$

$$= 200 \times 50 \times 1{,}16$$

$$= 11\,600 \text{ Wh}$$

Heating time

time in hours — power of heat element

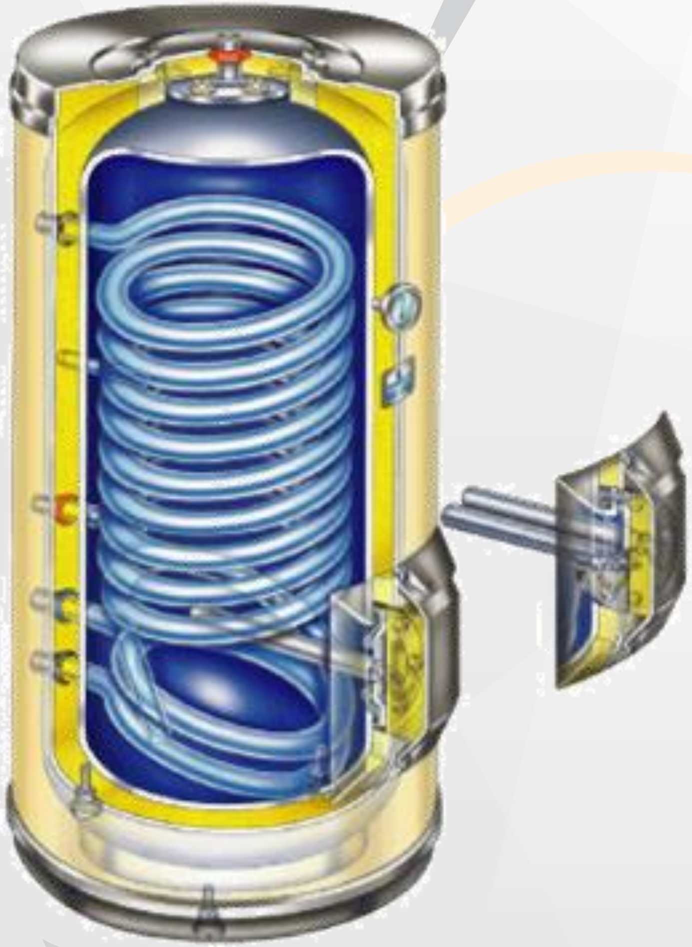
$$T = \frac{Q \text{ (heat quantity)}}{P \text{ (power)}}$$

$$= 11\,600 / 2\,400$$

$$= 4{,}8 \text{ h}$$

or 4h48

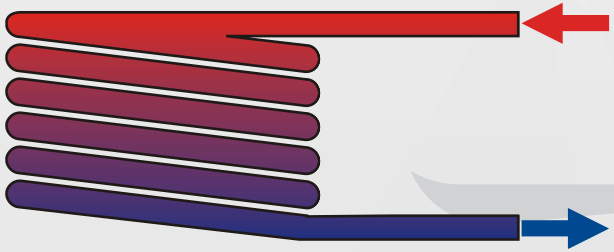
The independant calorifiers

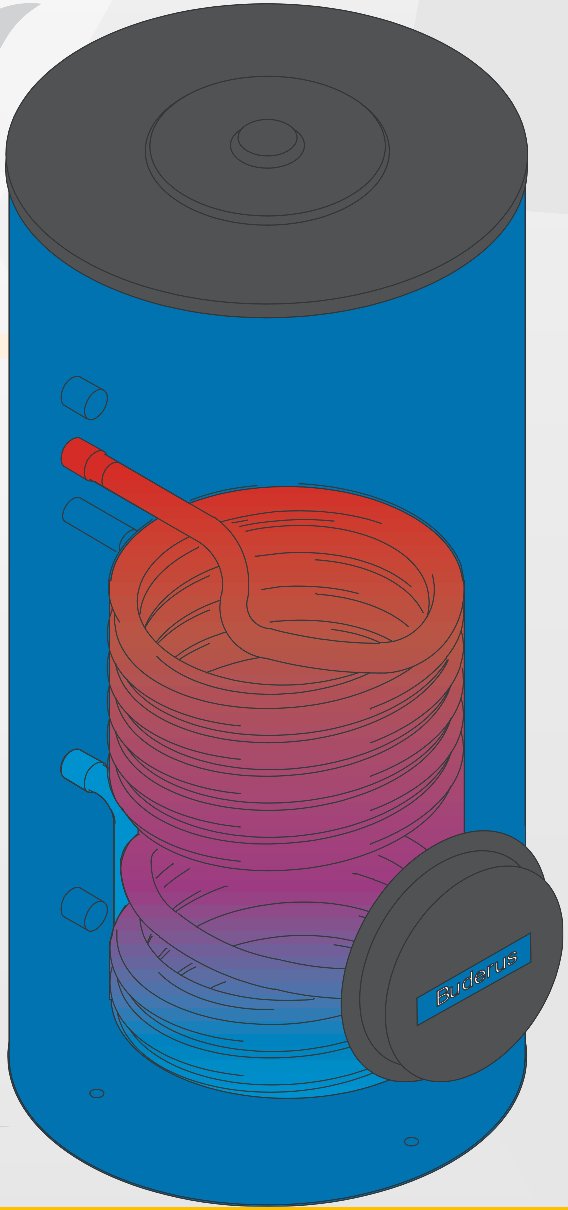


Calorifier

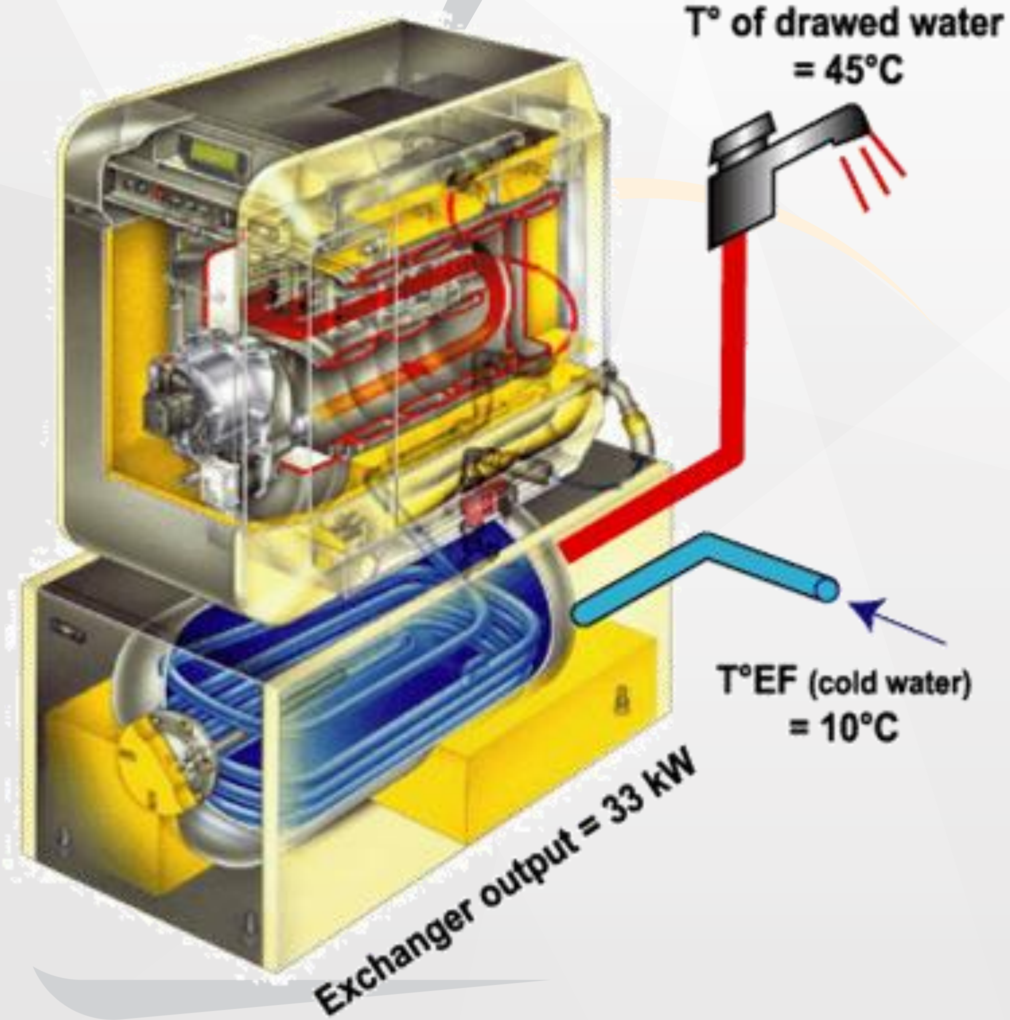
The performances are characterized by 2 figures :

- the continuous flow at 45°C
- The drawing capacity in 10 mn at 45 °C





The continuous flow : Qc



It is characterized by the power of the exchanger

$$Qc = \frac{Pe}{\Delta T \times C}$$

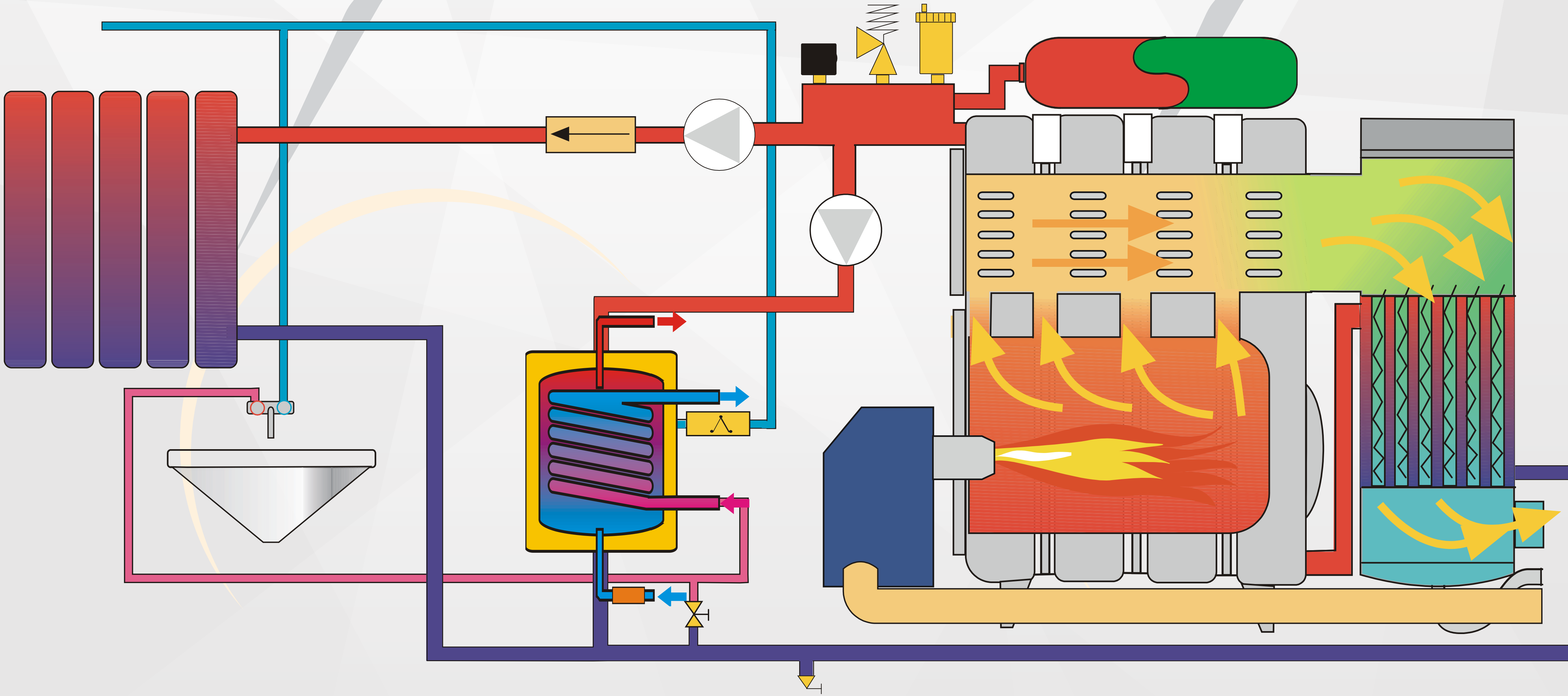
- Continuous flow: Qc
- Exchanger power: Pe
- Temperature raising: ΔT
- specific water heat: C

Remark : the boiler power should be superior to that of the exchanger

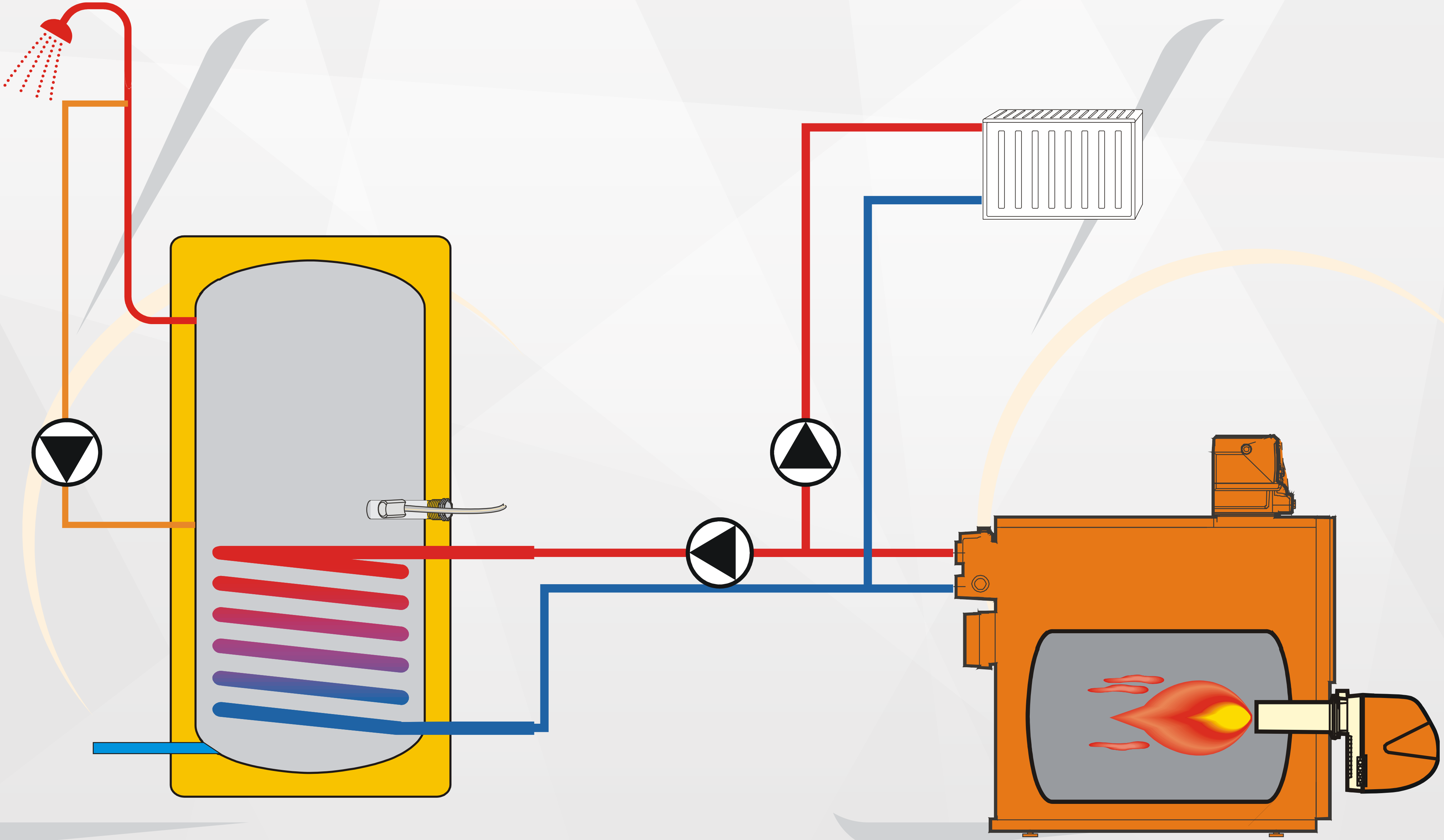
example of calorifier of 150 litres :

$$Qc = \frac{33\,000}{35 \times 1{,}16} = 810 \text{ l/h or } 13{,}5 \text{ l/mn}$$

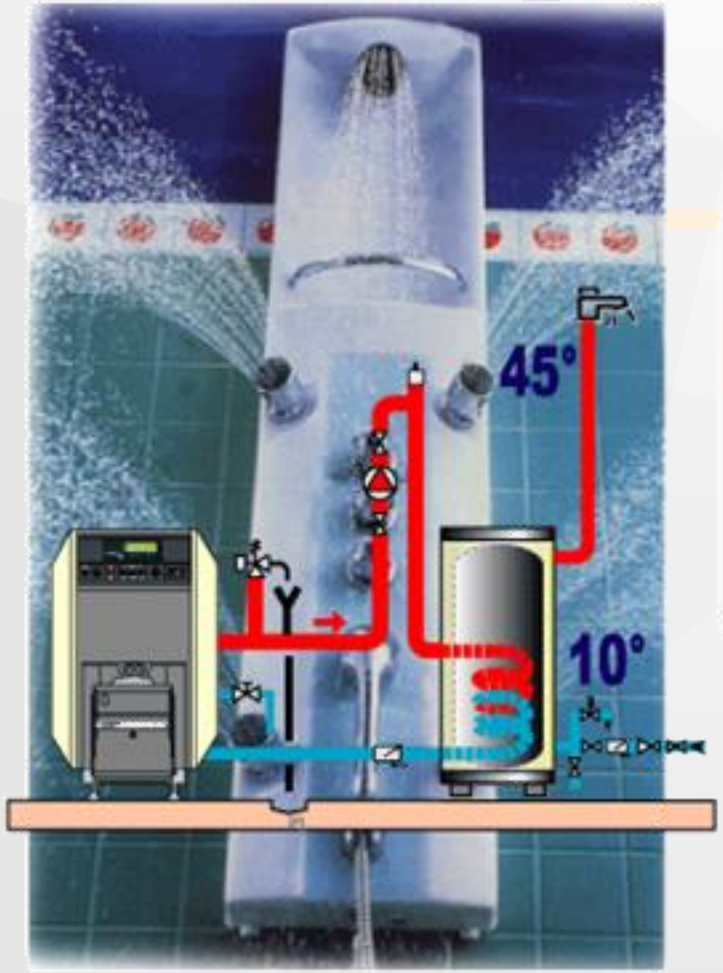
SEMI-ACCUMULATION SYSTEMS PERFORMANCE



SEMI-ACCUMULATION SYSTEMS PERFORMANCE

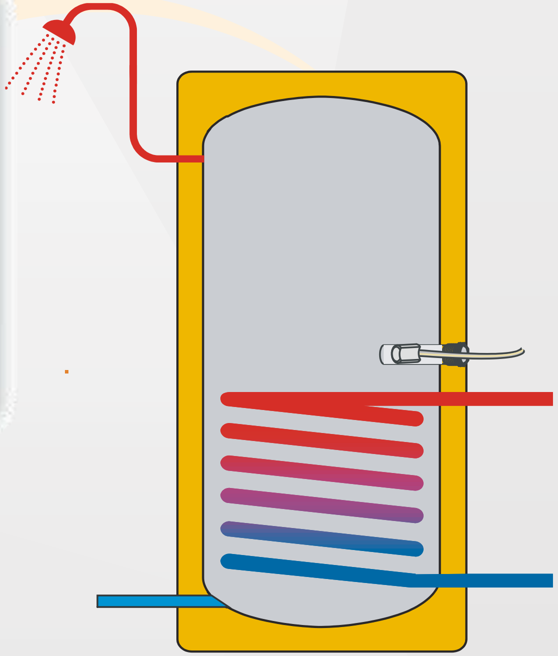


The flow in 10 mn (drawing capacity)



$$Q = Cp \times 0{,}9 \times \frac{T°water_{stored} - T°EF}{T°water_{drawed} - T°EF} + 0{,}5 \times flow$$

- Q: drawed water 45 °C in 10 mn
- Cp: Calorifier capacity in litres
- 0,9: not heated volum under the exchanger
- T°water drawed: mixed temperature
- 0,5: starting of the boiler during the water drawing
- flow: continuous in 10 mn



$$Vs = \frac{Vu}{\eta \left(1 + \frac{Dp-a}{Dr}\right)} \times \frac{Tp - Tf}{Tu - Tf}$$

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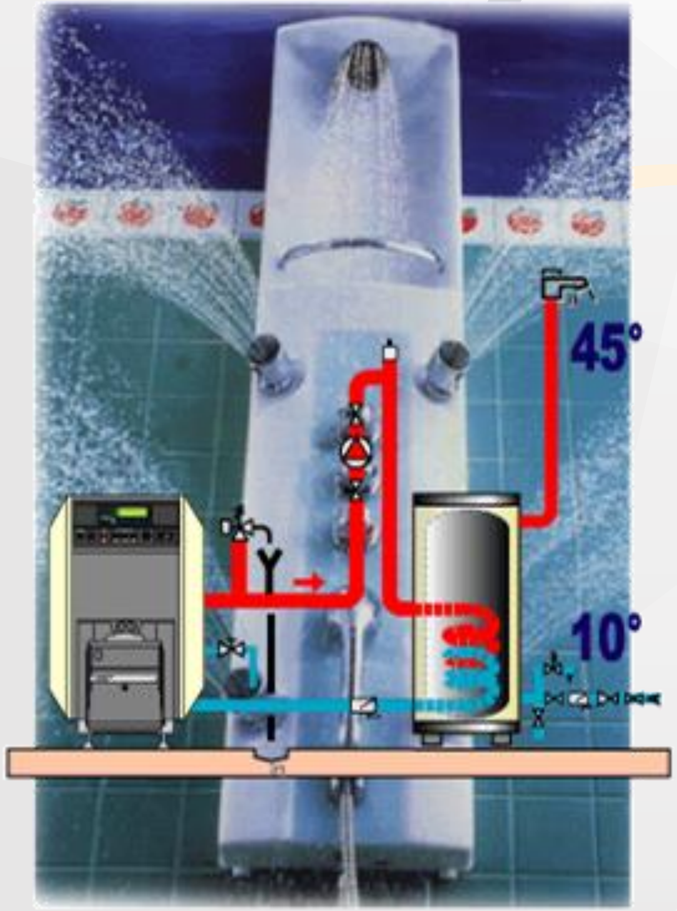
Example of flow in 10 minutes



Calorifier capacity : 150 l
Exchanger output : 38 kW

Calculation of continuous flow

$$D = \frac{Put}{\Delta T \times C}$$

Continuous flow (D); Exchanger output (Put); Temperature raising (ΔT); specific water heat (C)

$$D = \frac{38000}{45 \times 1,16} = 933 \text{ l/h}$$

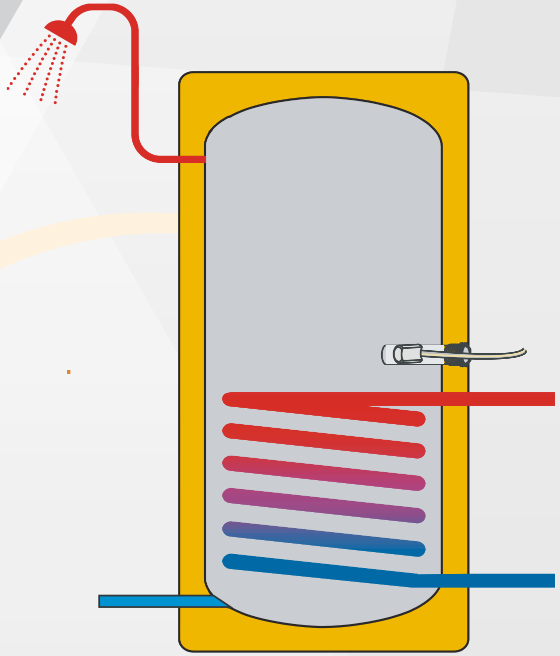
35

$$= \frac{659}{60} = 15,5 \text{ l/mn}$$

Calculation of the flow in 10 mn

$$Q = Cp \times 0,9 \times \frac{T°\ eau_{stored} - T°\ EF}{T°\ eau_{drawed} - T°\ EF} + 0,5 \times Flow$$

Drawed water at 45 °C in 10 mn (Q); not heatedwater under the exchanger (0,9); starting of the boiler during the water drawing (0,5); Capacity of calorifier in litres (Cp); mixed temperature; continuous flow in 10 mn (Flow)



$$Q_{10mn} = 150 \times 0,9 \times \frac{60 - 10}{45 - 10} + 0,5 \times (15,5 \times 10) = 193 + 77 = 270 \text{ litres}$$

Example of heating time calculation

CALORIFIERS

B 150-200-300-400-500

Tank capacity : 150 l
Storage temperature : 60° C
Exchanger output : 38 kW

Necessary heat quantity

$$Q = Cp \times \Delta t \times C$$

- heat quantity: Q
- Tank capacity in litres: Cp
- Temperature between hot water and cold water: Δt
- specific water heat: C

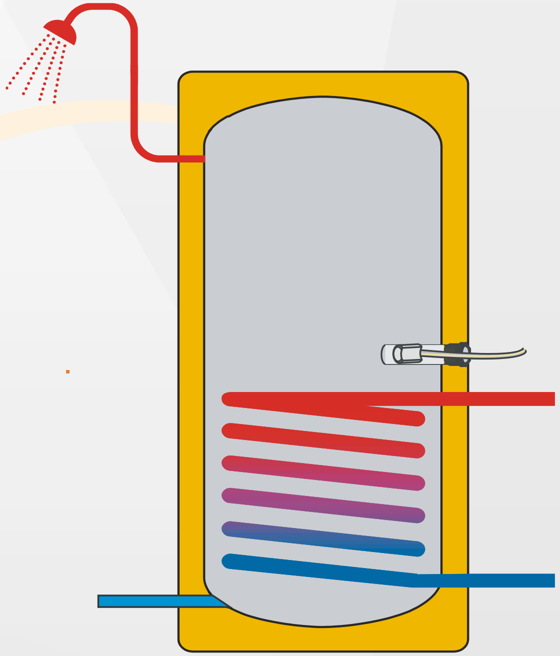
= 150 x 50 x 1,16
= 8 700 Wh

Heating time :

$$T = \frac{Q \text{ of heat}}{P \text{ (power)}}$$

- time in hours: T
- Power of heat-exchanger: P

= 8700 / 38000
= 0,22 h
= about 14 mn

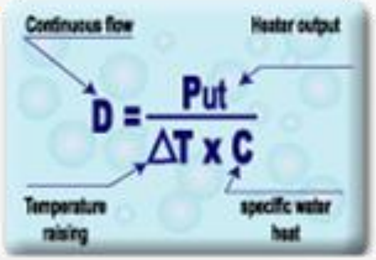


example of calculation

DHW 45° C

Tank capacity : 142 l
Storage temperature : 60° C
Heater output : 8,12 kW

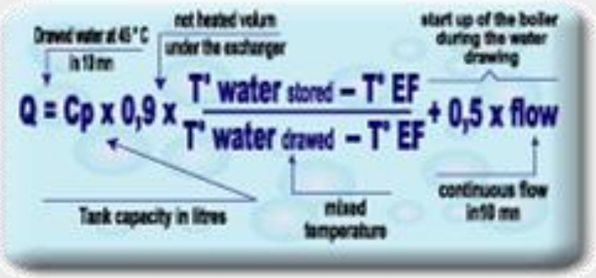
Calculation of continuous flow



$$D = \frac{8120}{35 \times 1{,}16} = 199 \text{ l/h}$$

$$= \frac{199}{60} = 3{,}3 \text{ l/mn}$$

Calculation of flow in 10 minutes



$$Q_{10mn} = 145 \times 0{,}9 \times \frac{60 - 10}{45 - 10} + 0{,}5 \times (3{,}3 \times 10) = 182 + 16{,}5 = 199 \text{ litres}$$

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example of heating time calculation

Tank capacity : 142 l
Storage temperature : 60¡ C
Heater output : 8,12 kW

Necessary heat quantity

$$Q = Cp \times \Delta t \times C$$

Heat quantity; Tank capacity in litres; temperature difference between hot and cold water; specific water heat

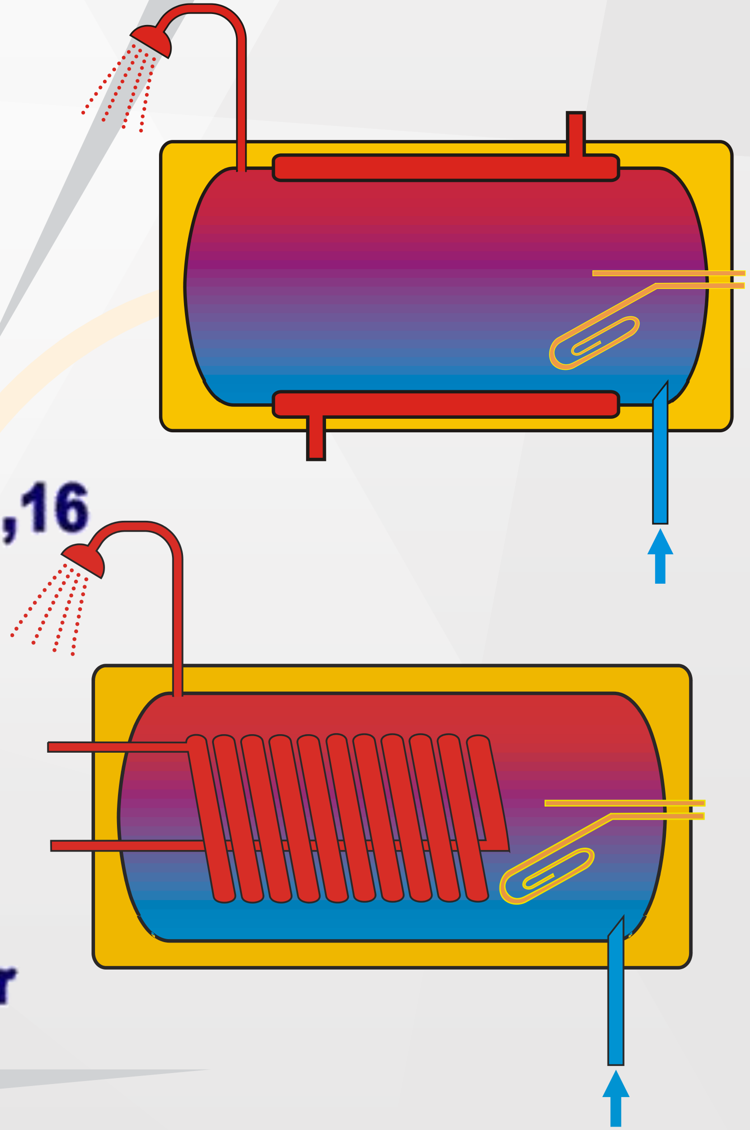
= 142 x 50 x 1,16
= 8 236 Wh

Heating time :

$$T = \frac{Q\ heat}{Pe}$$

Time in hours; Output of heat element

= 8236 / 8120
= about 1 hour



DHW heating costs

- example : DHW needs per day : 200 l at 60° C

Necessary heat for DHW per day :

Q chj = 200 x 50 x 1,16 = 11600 Wh

Necessary heat for DHW per year

11600 x 365 = 4234 kWh

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Domestic hot water

DHW heating costs

Cost with oil

4 234 x 0,04 = 169 €

Cost with natural gas

4 234 x 0,04 = 169 €

Cost with propane

4 234 x 0,079 = 334 €

cost with electricity

4 234 x 0,108= 457 €

Price of energies in France per kWh :

Oil	: 0,04 €
Natural Gas	: 0,04 €
LPG	: 0,079 €
Electricity	: 0,108 €

source Enerstat

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Domestic hot water

Comparaison consumption/investment

Example : DHW needs 200 l at 60°C per day

Investment :

1st solution

GTU 1204 D/V 130 = 3606 €

2nd solution

GTU 124 D + 200 L wall-mounted heater

= 3016 €

Investment economy with the 2nd solution

3606 - 3016 = 590 €

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Comparaison consumption/investment

Example : DHW needs of 200 l at 60°C per day

Consumption during one year

Needs on DHW heat : Q chal = 200 x 50 x 1,16) x 365 = 4 234 kWh

- 1st solution (oil : 0,04 €/ Kwh)

  4 234 x 0,04 = 169 €

  2nd solution (electricity : 0,108 €/Kwh)

  4 234 x 0,108 = 457 €

- Economy between the 2 nd and the 1st solution :

  457 -169 = 288 €

Amortization of the additional investment :

$$\frac{590}{288} = 2 \text{ years}$$

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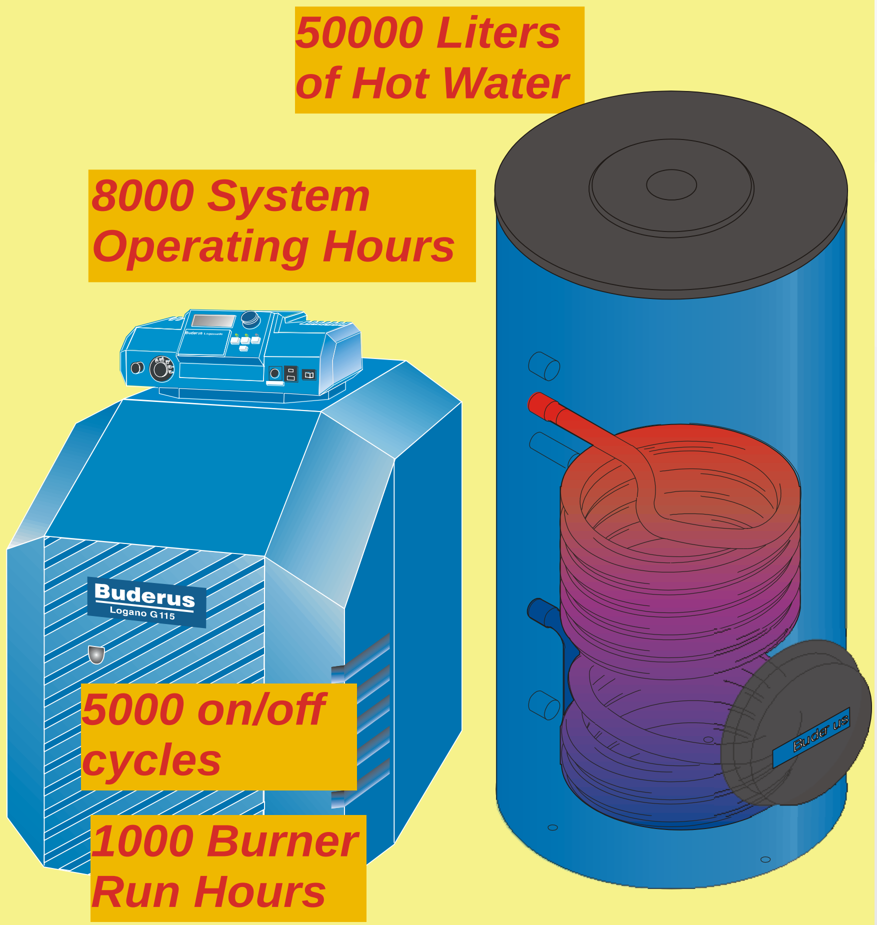
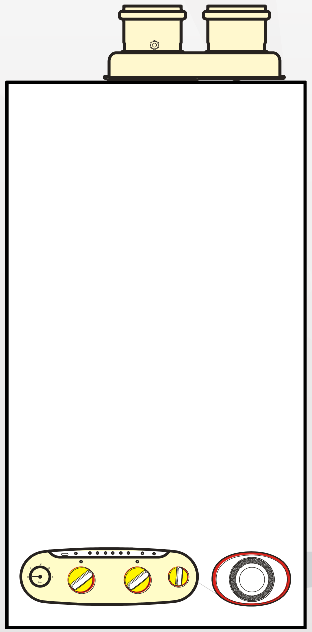
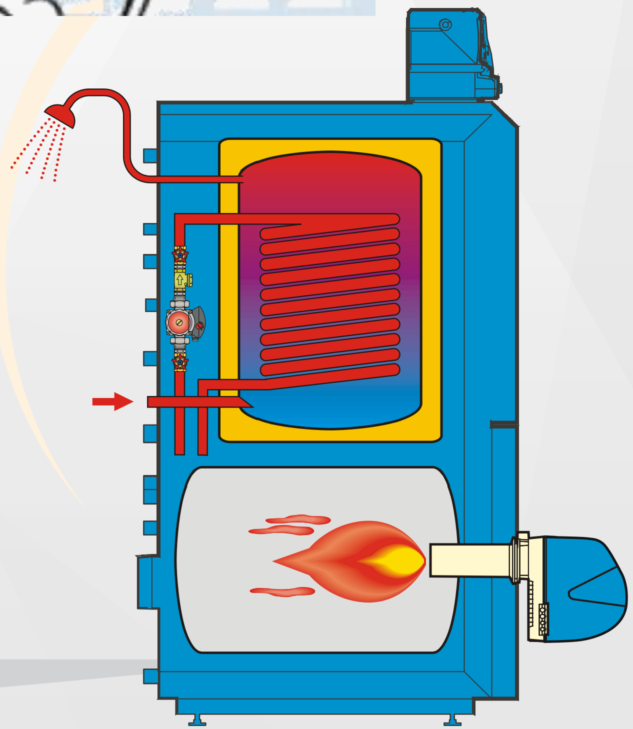
Yearly Heating Operation for a typical family house (4 persons)

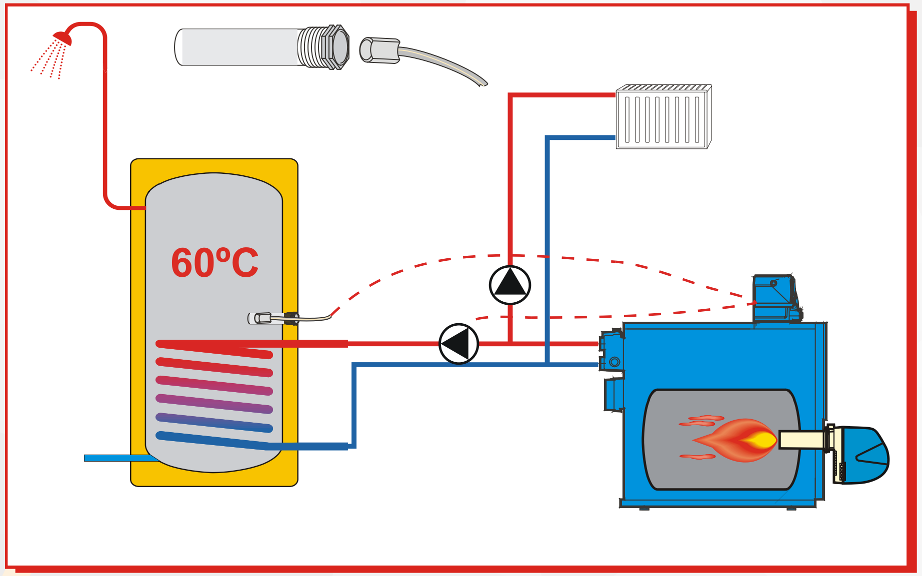




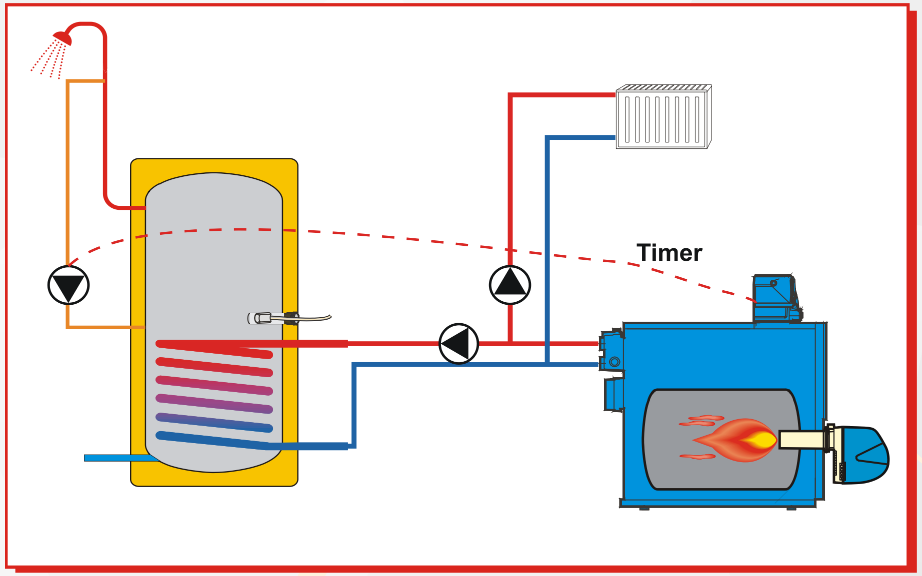


DOMESTIC HOT WATER CONTROL

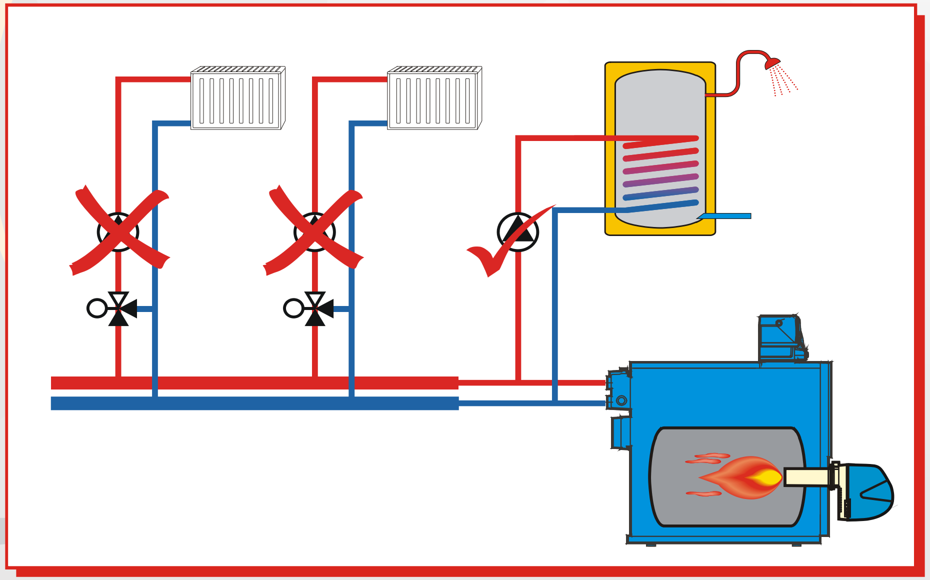
DHW Control



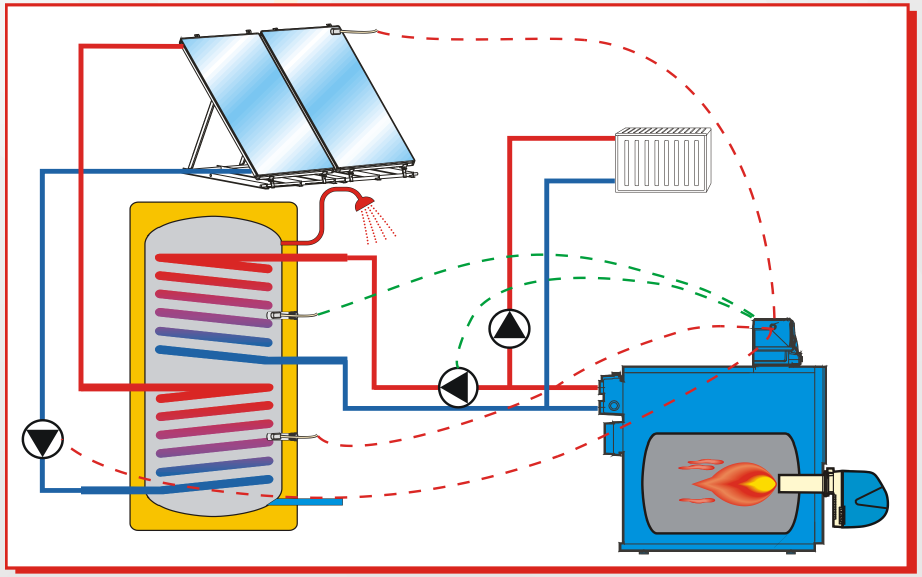
DHW Circulation



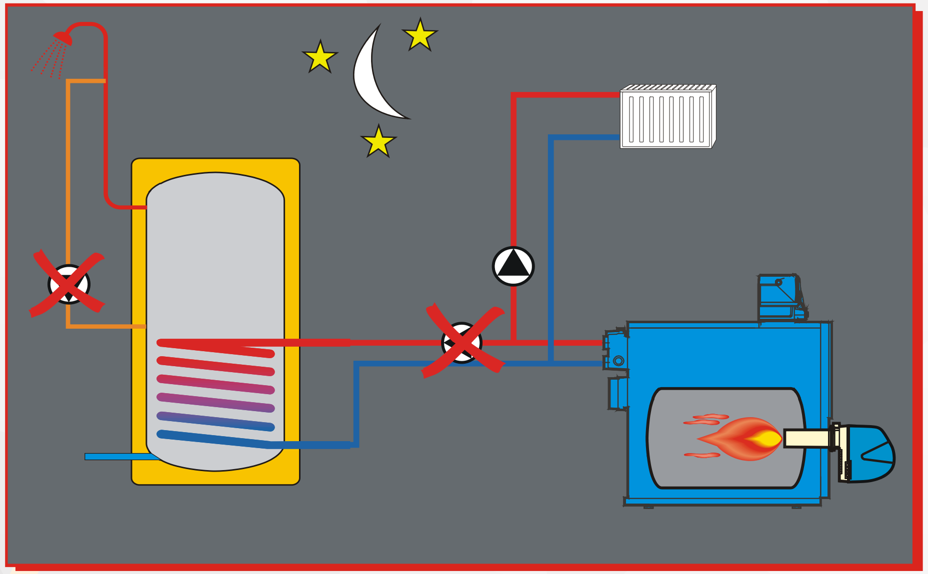
DHW Priority



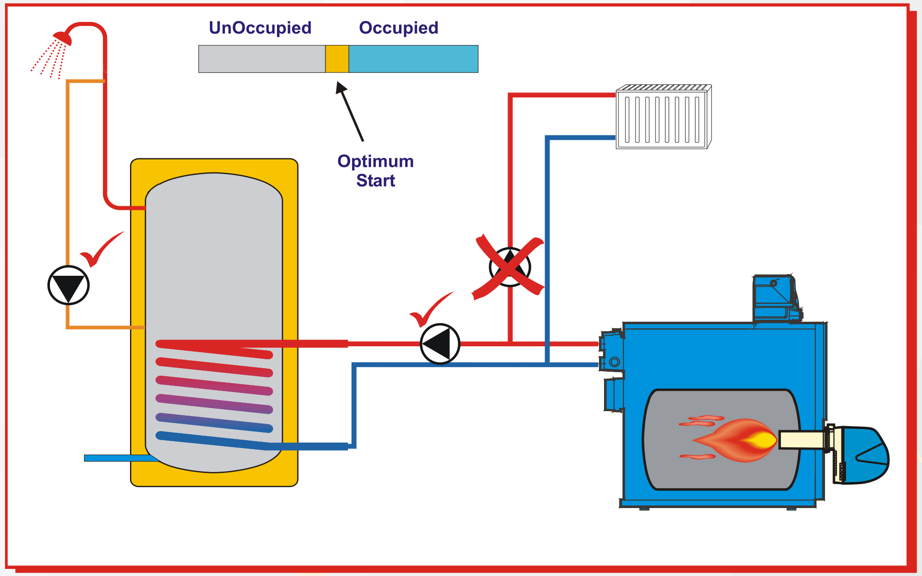
Solar Water Heating



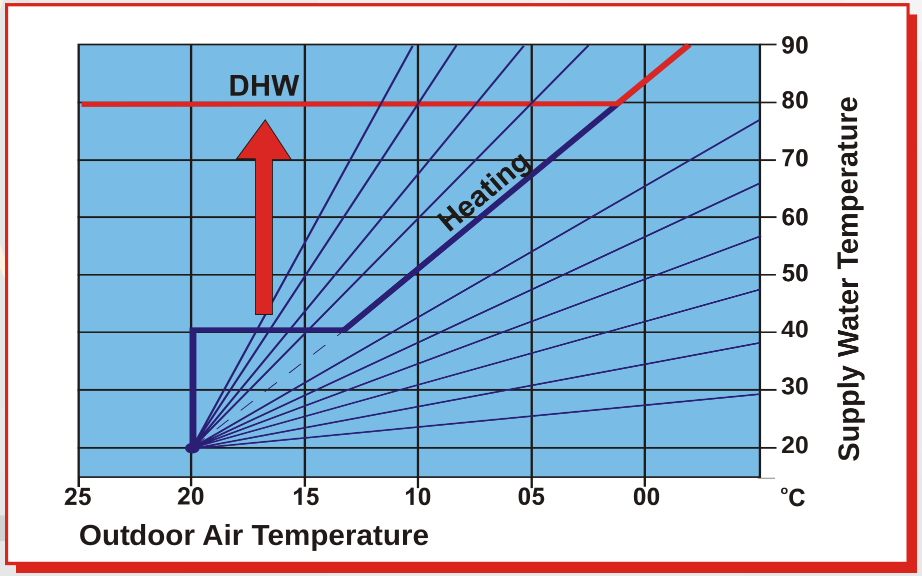
DHW Setback



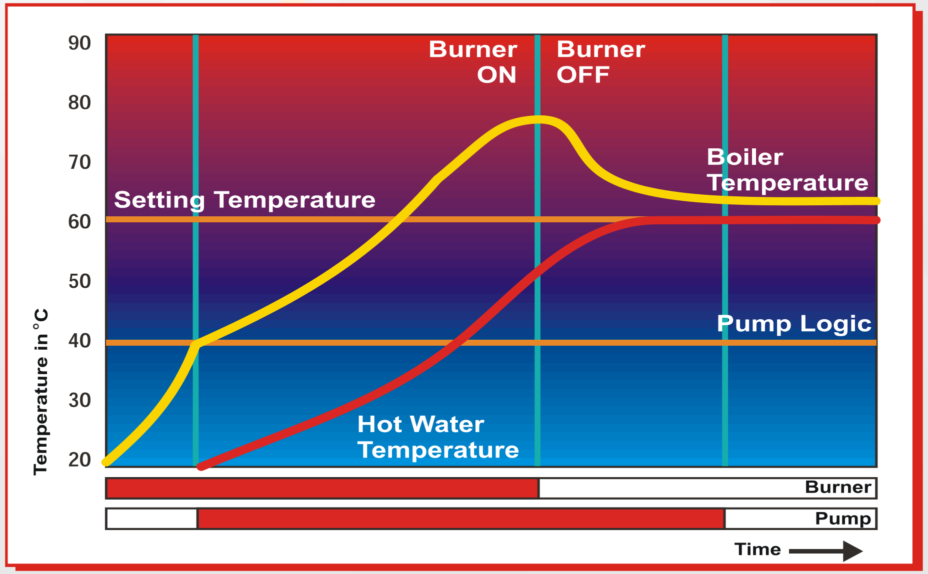
Optimum Start



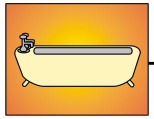
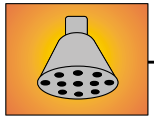
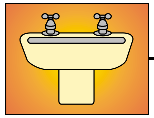
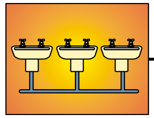
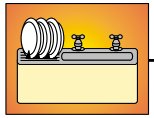
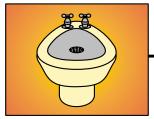
DHW Boiler Reset Override



DHW Optimization



DHW Safe Temperature

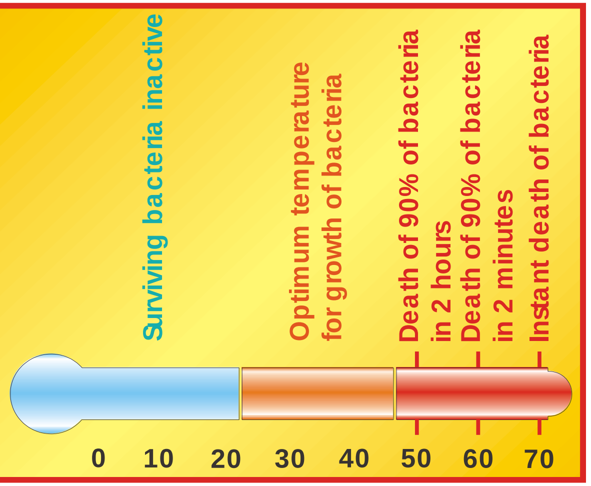
BATHS	43°C
SHOWERS	40°C
WASH BASINS	40°C
ROWS OF BASINS	40°C
KITCHEN SINKS	48°C
BIDETS	37°C

Scalding

Time to produce a 2nd & 3rd degree burn to adult Skin:

70°C	About 1/2 seconds
65°C	About 1-1/2 seconds
60°C	Less than 5 seconds
55°C	About 30 seconds
52°C	About 2 minutes
50°C	More than 5 minutes
40°C	No hazard

Legionella



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Thank you

ملاحظة: حقوق النشر لدينا غير محفوظة، بإمكانكم النسخ و التوزيع بهدف تعميم الفائدة.

ZMERLY & CO
HEATING TECHNOLOGY

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GENERAL MANAGER

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