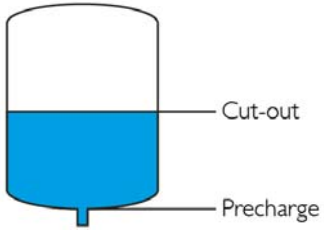
Pumping application tank sizing

Example

- Precharge = 1,8 bar
- Cut in pressure = 2 bar
- Cut out pressure = 4 bar
- Minimum required pump runtime: 1 minute
- Average flow rate = 3 m^3/h

1. **Calculate the Total Acceptance Factor (AF_{total})**
   The total acceptance factor may not exceed 0,4 (=40%) for US tanks and 0,5 (=50%) for tanks from Taiwan and Turkey.
   If the total acceptance factor exceeds the above mentioned limits, the pressure differential between precharge and cut-out pressure needs to be reduced by either increasing the precharge or lowering the cut-out pressure.



$$AF_{total} = \frac{Cutout\ pressure - precharge}{Cutout\ pressure + 1\ atm} = \frac{4\ bar - 1{,}8\ bar}{4\ bar + 1\ bar} = \frac{2{,}2\ bar}{5\ bar}$$
$$= 0{,}44 = 44\%\ of\ total\ tank\ volume$$

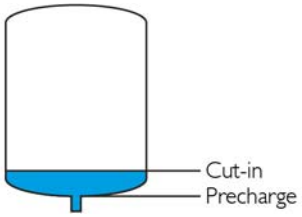
> ***Note:***
> 1 atm = standard atmosphere = 1,013 bar ≈ 1 bar

For tanks from Taiwan and Turkey this acceptance factor needs to be below the specification of 50% max. AF for US tanks below 40%. It might be considered to lower the cut-out pressure or increase the precharge to lower the acceptance factor and ensure the reliability of the tank.

2. **Calculate the percentage of Supplemental Supply (AF_{sup})**

$$AF_{sup} = \frac{Cutin\ pressure - precharge}{Cutin\ pressure + 1\ atm}$$

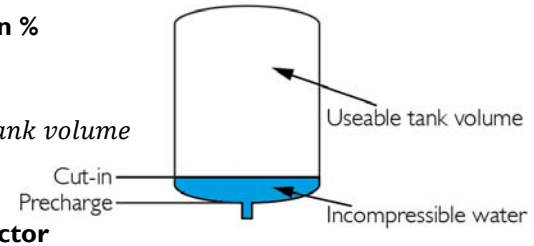
$$AF_{sup} = \frac{2\ bar - 1{,}8\ bar}{2\ bar + 1\ bar} = \frac{0{,}2\ bar}{3\ bar} = 0{,}067\ (6{,}7\%)$$



> ***Note:***
> AF_{sup}=0 if cut-in pressure ≥ precharge

3. **Calculate the useable tank volume in %**
   $1 - AF_{sup} = usuable\ tank\ volume\ \%$

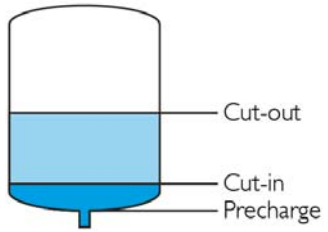
   $1 - 0{,}067 = 0{,}933 = 93{,}3\%\ useable\ tank\ volume$



4. **Calculate the usuable acceptance factor**

$$Useable\ acceptance\ factor = \frac{cutout\ pressure - P_{cs}{}^{*}}{cutout\ pressure + 1atm}$$

* P_{cs} = cycle start pressure → cut-in pressure or precharge, whichever is higher.



$$Useable\ acceptance\ factor = \frac{4\ bar - 2\ bar}{4\ bar + 1\ bar} = \frac{2}{5}$$
$$= 0{,}4\ (40\%)$$

5. **Calculate the percentage of useable water in the tank**

$$\%\ useable\ water\ in\ the\ tank$$
$$= \%\ useable\ tank\ volume * useable\ acceptance\ factor$$

$$\%\ useable\ water\ in\ the\ tank = 93{,}3\% * 40\% = 0{,}933 * 0{,}4 = 0{,}3732 = 37{,}3\%$$

$$Needed\ tank\ size = \frac{average\ supply\ during\ minimum\ runtime}{\%\ useable\ water}$$

Average flowrate:
$3\ {}^{m^3}/_{h} = 3000\ {}^{l}/_{h} = 50\ {}^{l}/_{min}$

Minimum runtime of 1 minute →
$50\ {}^{l}/_{min} * 1\ \text{min} = 50\ liter$ supplied by the pump during its minimum runtime.

$$Needed\ tanksize\ (TTV) = \frac{50\ liter}{0{,}3732} = 133{,}97\ liter$$

At least a 133,97 liter tank is needed.

Always choose a tank size at least equivalent or bigger than the calculated value. In this case we choose a PWB-150LX.