# Chilled or Hot Water Closed Loop: Pump Head and Power

Pump head of a closed chilled or hot water loop from pipe friction (Colebrook), fittings and the pressure drops of chiller, coil and valve, with pump power.

**Method:** Darcy–Weisbach with Colebrook friction; water properties IAPWS-IF97 and IAPWS 2008 viscosity

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Water flow | 120.00 | m³/h |
| Pipe inside diameter | 154.10 | mm |
| Pipe length, supply and return | 400.00 | m |
| Pipe roughness | 0.045000 | mm |
| Sum of fitting loss coefficients | 40.000 | |
| Equipment drops (chiller, coil, valve, strainer) | 150.00 | kPa |
| Water temperature | 10.000 | °C |
| Pump and motor efficiency | 65.000 | % |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Velocity | 1.7872 | m/s |
| Reynolds number | 210,935 | |
| Darcy friction factor | 0.017563 | |
| Pipe and fittings | 136.68 | kPa |
| Pump head | 29.236 | m |
| Electrical power | 14.702 | kW |

**Notes for this case**

- A closed loop has no static lift: the pump overcomes friction only. Water properties at 5 bar(a) from IAPWS.

## Formula and method

$$H = \frac{(fL/D + \Sigma K)\rho v^2/2 + \Delta p_e}{\rho g}, \quad P = \frac{\rho g \dot{V} H}{\eta}$$

### Variables

| | | |
|---|---|---|
| $\dot{V}$ | Water flow | m³/s |
| $D$ | Pipe inside diameter | m |
| $L$ | Pipe length, supply and return | m |
| $\varepsilon$ | Pipe roughness | m |
| $\Sigma K$ | Sum of fitting loss coefficients | - |
| $\Delta p_e$ | Equipment drops (chiller, coil, valve, strainer) | Pa |
| $T$ | Water temperature | K |
| $\eta$ | Pump and motor efficiency | - |
| $v$ | Velocity | m/s |
| $Re$ | Reynolds number | - |
| $f$ | Darcy friction factor | - |

| | | |
|---|---|---|
| $\Delta p_p$ | Pipe and fittings | Pa |
| $H$ | Pump head | m |
| $P$ | Electrical power | W |

### Method and standards

Darcy–Weisbach.

### Assumptions and limits

- Single index circuit, steady flow.

### References

- Darcy–Weisbach with Colebrook friction; water properties IAPWS-IF97 and IAPWS 2008 viscosity

## Report details

| | |
|---|---|
| Report reference | FCC-2Z86-E905 (the same inputs always give the same reference) |
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| Calculator | Chilled or Hot Water Closed Loop: Pump Head and Power |
| Method last reviewed | 12 November 2026 |
| Software release | FireCAD Calc, release of 17 November 2026 |
| Release checks | 2 reference cases of this calculator, computed independently, are checked on every release |

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

### This calculator online

https://calc.firecad.com/hvac/chillers/closed-loop-pump-head

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.