# Steam Main Warm-Up and Running Condensate Load

Condensate formed while warming a steam main from cold in a set time and during running from heat loss, with the drain trap load including a safety factor.

**Method:** Warm-up and running condensate loads

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Pipe mass per metre (with flanges) | 17.000 | kg/m |
| Length between drain points | 50.000 | m |
| Steam pressure (absolute) | 11.000 | bar |
| Initial pipe temperature | 10.000 | °C |
| Pipe specific heat | 0.49000 | kJ/(kg·K) |
| Warm-up time | 20.000 | min |
| Running heat loss per metre | 60.000 | W/m |
| Trap safety factor | 2.0000 | |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Steam saturation temperature | 184.07 | °C |
| Latent heat | 1,999.5 | kJ/kg |
| Warm-up condensate | 36.260 | kg |
| Warm-up condensate rate | 108.78 | kg/h |
| Running condensate rate | 5.4014 | kg/h |
| Trap capacity needed | 217.56 | kg/h |

### Notes for this case

• Warm-up: steel heated from $T_0$ to saturation by condensing steam, m = m'Lc(T_s − $T_0$)/h_fg (IAPWS-IF97), averaged over the warm-up time; insulation and heat loss during warm-up add a little. Running: heat loss/h_fg. Size drain traps for the larger with a safety factor, and at low start-up pressure.

## Formula and method

$$m_w = \frac{m' L c (T_s - T_0)}{h_{fg}}, \quad \dot{m}_r = \frac{q' L}{h_{fg}}, \quad \dot{m}_{trap} = k_s \max(\dot{m}_w / t_w, \dot{m}_r)$$

### Variables

| | | |
|---|---|---|
| $m'$ | Pipe mass per metre (with flanges) | kg/m |
| $L$ | Length between drain points | m |
| $p$ | Steam pressure (absolute) | Pa |
| $T_0$ | Initial pipe temperature | K |
| $c$ | Pipe specific heat | J/(kg·K) |
| $t_w$ | Warm-up time | s |
| $q'$ | Running heat loss per metre | W/m |
| $k_s$ | Trap safety factor | - |
| $T_s$ | Steam saturation temperature | K |

| | | |
|---|---|---|
| $h_{fg}$ | Latent heat | J/kg |
| $m_w$ | Warm-up condensate | kg |
| $\dot{m}_w$ | Warm-up condensate rate | kg/s |
| $\dot{m}_r$ | Running condensate rate | kg/s |
| $\dot{m}_{trap}$ | Trap capacity needed | kg/s |

### Method and standards

Warm-up load.

### Assumptions and limits

- Uniform pipe; steel heated to saturation.

### References

Warm-up and running condensate loads

## Report details

| | |
|---|---|
| Report reference | FCC-PN7R-M5S2 (the same inputs always give the same reference) |
| Generated | 23 November 2026, 17:51 UTC |
| Calculator | Steam Main Warm-Up and Running Condensate Load |
| Method last reviewed | 17 November 2026 |
| Software release | FireCAD Calc, release of 22 November 2026 |
| Release checks | 3 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/mechanical/piping/steam-line-warmup-condensate

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.