Drum Pressure Rate After a Load or Feedwater Change

Rate of drum pressure change and steam generation when steam demand, feedwater or heat input changes, from the stored energy of metal and water.

Method: Ganapathy; Industrial Boilers and Heat Recovery Steam Generators (Marcel Dekker, 2003); ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Drum pressure (absolute)	42.403	bar
Heat to the evaporator	13,452	kW
Feedwater flow	20,412	kg/h
Feedwater temperature	105.15	°C
Steam withdrawn	22,680	kg/h
Mass of metal in the evaporator and drums	34.019	t
Metal specific heat	0.50240	kJ/(kg·K)
Water inventory	8.1647	t
Steam space volume	3.2564	m³

Calculated results

Parameter	Value	Unit
Steam generated	22,611	kg/h
Rate of pressure change	-1,161.5	Pa/s
Rate of pressure change (per minute)	-0.69693	bar/min
Stored-energy factor (kJ per bar, fixed unit)	80,968	

Notes for this case

- Instantaneous rates at the moment of the change; controls normally restore the balance. Steam space treated as a perfect gas (Ganapathy's Eq. 86b).

Formula and method

$$Q = W_s h_{fg} + (h_l - h_{fw}) W_f + \left(W_m c_m \frac{dT_s}{dp} + W_w \frac{dh_l}{dp} \right) \frac{dp}{dt}, \quad \frac{dp}{dt} = \frac{p}{m_s}(W_s - W_l), \; m_s = \frac{V_s}{v_g}$$

Variables

p	Drum pressure (absolute)	Pa
Q	Heat to the evaporator	W
W_f	Feedwater flow	kg/s
T_{fw}	Feedwater temperature	K
W_l	Steam withdrawn	kg/s
W_m	Mass of metal in the evaporator and drums	kg
c_m	Metal specific heat	J/(kg·K)
W_w	Water inventory	kg
V_s	Steam space volume	m³
W_s	Steam generated	kg/s
dp/dt	Rate of pressure change, shown in Pa/s and in bar/min	Pa/s
S	Stored-energy factor, $W_m c_m \, dT_s/dp + W_w \, dh_l/dp$, shown in kJ per bar	J/Pa

Method and standards

Ganapathy's lumped energy balance with IF97 derivatives. The slopes dT_s/dp and dh_l/dp are central differences over ±1 % of the drum pressure. Ganapathy's rounded steam-table slopes give somewhat smaller rates than IF97 (see the FAQ).

Assumptions and limits

- Instantaneous; uniform saturation.
- The feedwater must be liquid at the drum pressure (below the saturation temperature).

References

• Ganapathy
• Industrial Boilers and Heat Recovery Steam Generators (Marcel Dekker, 2003)
• Q8.44c–d (boiler response to load changes: stored energy of metal, water and steam space); IAPWS-IF97 properties

Report details

Report reference	FCC-TDTX-EXAX (the same inputs always give the same reference)
Generated	17 November 2026, 19:50 UTC
Calculator	Drum Pressure Rate After a Load or Feedwater Change
Method last reviewed	13 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/boilers-power-plant/plant-performance/boiler-pressure-rate-load-swing

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.