Lever Safety Valve Weight and Position

Weight to hang on a lever safety valve, or where to hang it, for a blow-off pressure, by moments about the fulcrum including the lever and valve weights.

Method: Moments about a fulcrum (statics, textbook)

Input parameters

Unit system: SI

Parameter	Value	Unit
Blow-off pressure	9.8066	bar g
Valve diameter (area the steam acts on) The diameter at which the disc seals on the seat; exam questions give it as the valve diameter. The force goes with its square.	80.000	mm
Fulcrum to valve centre	100.00	mm
Fulcrum to the weight	0.80000	m
Mass of the lever	10.000	kg
Fulcrum to the lever's centre of gravity	0.45000	m
Mass of the valve and spindle	2.0000	kg
Weight available (to find its position)	50.000	kg

Calculated results

Parameter	Value	Unit
Steam force on the valve	4,929.4	N
Weight needed at distance L	56.957	kg
Distance for the weight available	0.91131	m

Notes for this case

- Moments about the fulcrum: F a = g (W L + m_l l_g + m_v a). Friction in the pins is ignored.
- The weight available would have to hang beyond the given lever length: use a heavier weight or a longer lever.

Formula and method

$$F = (p - p_{atm})\,\frac{\pi d^2}{4}$$

$$Fa = g\,(WL + m_l\,l_g + m_v\,a)$$

Variables

p	Blow-off pressure	Pa
d	Valve diameter where the disc seals on the seat (area the steam acts on)	m
a	Fulcrum to valve centre	m
L	Fulcrum to the weight	m
m_l	Mass of the lever	kg
l_g	Fulcrum to the lever's centre of gravity	m
m_v	Mass of the valve and spindle	kg
m_w	Weight available (to find its position)	kg
F	Steam force on the valve	N
W	Weight needed at distance L	kg
L_W	Distance for the weight available	m

Method and standards

Moments about the fulcrum at the instant the valve lifts: the steam force at distance a balances the weight, the lever's own weight and the valve's weight.

Assumptions and limits

- Static balance; spindle friction neglected.
- The steam acts on the area at the seat sealing diameter; the force goes with its square, so use that diameter, not the inlet pipe bore.
- Atmospheric pressure is taken as the standard 101.325 kPa. Enter the blow-off pressure as gauge; an absolute pressure measured at altitude would overstate the gauge pressure by the drop in atmospheric pressure.
- Modern boilers use spring-loaded valves to code; this is a principle calculation.

References

- Moments about a fulcrum (statics, textbook)

Report details

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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/boilers/lever-safety-valve

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Reopens the calculator with the inputs of this report.