Explosion Overpressure by TNT Equivalence

TNT-equivalent mass of a vapour cloud or explosive, scaled distance and peak side-on overpressure at a distance from the Kinney–Graham curve fit.

Method: Crowl and Louvar; Chemical Process Safety: Fundamentals with Applications; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Mass of flammable material in the cloud	1,000.0	kg
Heat of combustion (energy of explosion)	46,000	kJ/kg
Explosion efficiency (1–10 % for vapour clouds)	5.0000	%
Distance from the explosion centre	100.00	m
Ambient pressure	101.33	kPa

Calculated results

Parameter	Value	Unit
Equivalent mass of TNT	490.82	kg
Scaled distance r/m_TNT^(1/3)	12.677	
Peak side-on overpressure	14.804	kPa
Scaled overpressure	0.14611	

Notes for this case

- TNT equivalence over-predicts near a vapour cloud explosion and under-predicts far away, because vapour clouds deflagrate; congested-area methods (TNO multi-energy, Baker–Strehlow) are better for plant layout.
- A screening estimate for training and early design, not a hazard or risk study.
- About 14–70 kPa: severe structural damage; lung haemorrhage becomes possible near the top of this range.

Formula and method

$$m_{TNT} = \frac{\eta m \Delta H_c}{E_{TNT}}, \quad E_{TNT} = 4686 \text{ kJ/kg}, \quad z_e = \frac{r}{m_{TNT}^{1/3}}$$

$$\frac{p^o}{p_a} = \frac{1616\left[1+\left(\frac{z_e}{4.5}\right)^2\right]}{\sqrt{\left[1+\left(\frac{z_e}{0.048}\right)^2\right]\left[1+\left(\frac{z_e}{0.32}\right)^2\right]\left[1+\left(\frac{z_e}{1.35}\right)^2\right]}}$$

Variables

m	Mass of flammable material in the cloud	kg
ΔH_c	Heat of combustion (energy of explosion)	J/kg
η	Explosion efficiency (1–10 % for vapour clouds)	-
r	Distance from the explosion centre	m
p_a	Ambient pressure	Pa
m_{TNT}	Equivalent mass of TNT	kg
z_e	Scaled distance r/m_TNT^(1/3)	-
p^o	Peak side-on overpressure	Pa
p^o/p_a	Scaled overpressure	-

Method and standards

TNT equivalence with the Kinney–Graham fit of the TNT overpressure curve (z_e in m/kg^(1/3)).

Assumptions and limits

- Hemispherical free-field blast; ideal TNT curve.

References

- Crowl and Louvar
- Chemical Process Safety: Fundamentals with Applications
- 2nd ed. (Prentice Hall, 2002)
- ch. 6
- eqs. 6-25
- 6-27 and 6-28 (Kinney and Graham)

Report details

Report reference	FCC-6KA3-JNDR (the same inputs always give the same reference)
Generated	17 November 2026, 19:48 UTC
Calculator	Explosion Overpressure by TNT Equivalence
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 17 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/chemical/process-safety/tnt-equivalent-overpressure

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.