Gas Pipeline Line Pack: Stored Gas Between Two Operating States

Gas held in a pipeline at a packed and a drawn-down state, from inlet and outlet pressures (average pressure), temperature and Z, and the usable line pack.

Method: Ideal-gas inventory with Z and the flowing-line average pressure $\bar{p} = \frac{2}{3}(p_1 + p_2 - p_1p_2/(p_1 + p_2))$ (pipeline engineering definitions)

Input parameters

Unit system: SI

Parameter	Value	Unit
Pipe inside diameter	300.00	mm
Pipeline length	20.000	km
Inlet pressure, packed state (absolute)	40.000	bar
Outlet pressure, packed state (absolute)	38.000	bar
Inlet pressure, drawn-down state (absolute)	30.000	bar
Outlet pressure, drawn-down state (absolute)	20.000	bar
Gas temperature	15.000	°C
Compressibility factor, packed	0.93000	
Compressibility factor, drawn down	0.95000	
Molar mass	17.400	kg/kmol

Calculated results

Parameter	Value	Unit
Average pressure, packed	39.009	bar
Average pressure, drawn down	25.333	bar
Gas held, packed	43,066	kg
Gas held, drawn down	27,380	kg
Usable line pack	15,686	kg
Usable line pack at 0 °C, 1 atm (Nm³)	20,207	m³

Notes for this case

- Average pressure of a flowing line, $\bar{p} = \frac{2}{3}(p_1 + p_2 - p_1p_2/(p_1 + p_2))$, is the usual pipeline-engineering figure.

Formula and method

$$\bar{p} = \frac{2}{3}\left(p_1 + p_2 - \frac{p_1 p_2}{p_1 + p_2}\right), \quad m = \frac{\bar{p}V}{ZRT}, \quad \Delta m = m_A - m_B$$

Variables

D	Pipe inside diameter	m
L	Pipeline length	m
$p_{1,A}$	Inlet pressure, packed state (absolute)	Pa
$p_{2,A}$	Outlet pressure, packed state (absolute)	Pa
$p_{1,B}$	Inlet pressure, drawn-down state (absolute)	Pa
$p_{2,B}$	Outlet pressure, drawn-down state (absolute)	Pa
T	Gas temperature	K

Z_A	Compressibility factor, packed	-
Z_B	Compressibility factor, drawn down	-
M	Molar mass	kg/kmol
$\bar{p}_A$	Average pressure, packed	Pa
$\bar{p}_B$	Average pressure, drawn down	Pa
m_A	Gas held, packed	kg
m_B	Gas held, drawn down	kg
Δm	Usable line pack	kg
ΔV_n	Usable line pack at 0 °C, 1 atm (Nm³)	m³

Method and standards

Gas inventory definitions.

Assumptions and limits

- Isothermal line; ideal gas with Z.
- Normal volume at 0 °C and 1 atm (not the 15 °C standard).
- A packed state not above the drawn-down state is flagged.

References

- Ideal-gas inventory with Z and the flowing-line average pressure $\bar{p} = \frac{2}{3}(p_1 + p_2 - p_1p_2/(p_1 + p_2))$ (pipeline engineering definitions)

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/mechanical/piping/gas-pipeline-line-pack

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Reopens the calculator with the inputs of this report.