

Table 1. Typical compositions of gases used as fuel for reciprocating engines

		Landfill gas <i>Notes (a/e)</i>	Sewage digester <i>Notes (b/e)</i>	Bio- gas <i>Notes (c/e)</i>	Coal bed/ mine methane <i>Note (d)</i>	Shale gas <i>Note (e)</i>	Associated petroleum gas <i>Note (e)</i>	Natural gas – well head <i>Notes (e/f)</i>	Natural gas – delivered <i>Note (g)</i>
		A	B	C	D	E	F	G	H
Higher Wobbe index	MJ/Nm ³	19	23	26	39	49	52	50	~50
Lower calorific value (LCV)	MJ/Nm ³	17	20.4	22	29	36	38	38.5	35
	kWh/Nm ³	4.7	5.7	6.1	8.1	10	10.6	10.7	9.7
Methane number		~130	~130	~130	92	70	67	60	82
Methane	Vol%	50	60	64	81	85	87	77	88
Long chain hydrocarbons	Vol%	<1	<1	<1	2	10	11.5	15.5	4.7
Carbon dioxide	Vol%	40	39	35	2 (and oxygen up to 10%)	2	1	1.6	<1
Nitrogen	Vol%	10	1	1	5	3	0.5	3	3
Hydrogen sulphide	Vol%	<1	<1	<1	0	0	0	2.9	<<1
Water	°C	Usually saturated but depends on processing			Can be saturated but depends on gas/oil well water production or coal source condition				Usually specified as dewpoint, typically minus 30

Notes:

It is important to note that methane number is derived from test data and as such can vary between engine manufacturers, the above values should therefore be taken as indicative. Note that even pipeline delivered gas (H) does not have a methane number of 100.

(a) Composition varies not only with feedstock but also over time. Air ingress over time increases nitrogen significantly; the associated oxygen is consumed through microbiological action.

(b) Properties here vary with feedstock since in many instances industrial waste is co-mingled with sewage.

(c) These properties are very dependent on feedstock.

(d) When exploited specifically for methane coal beds (untapped coal seams) produce a gas with about 90% methane, while methane content for gas from active coal mines is about 45%. The values in this table are therefore general rather than specific.

(e) All natural gases vary with geological formation. Two of the most problematic constituents, from a practical point of view, are nitrogen, which can reach 20%, particularly in shale gas, resulting in a reduction in LCV, and hydrogen sulphide, which is instrumental in many forms of corrosion as well as being extremely toxic to humans. Carbon dioxide at high values is also a problem for engines, particularly in terms of high exhaust path component temperatures. The high methane numbers for gases A, B, C are due to the high levels of inert gases.

(f) Natural gas at the well head, before in-field processing, is very dependent on whether the source is an oil or gas reservoir. Hydrogen sulphide is severely restricted by engine manufacturers and, hence, although this figure of 2.9% is not unusual, it would be normal to remove the hydrogen sulphide before use in the engine.

(g) Values for delivered natural gas vary considerably by country but Wobbe index is usually around 50