Specification for Gaseous Fuels

The SGT-600 is capable of burning all common natural gases and a variety of other gases, (LPG, refinery gases etc.). Some of these gases may require modifications of the fuel system due to differences in heating value, density, dew point etc. In order to clarify such points please read the notes or contact Siemens for clarification. The specification below relates primarily to gaseous hydrocarbon fuels such as natural gas. The specification is valid at gas fuel system terminal point, with last chance coalescer filter included in Siemens scope of supply. Further gas treatment options are available if required.

Property	Unit	Limit	Note [1]	Test method
Lower heating value, range	MJ/Nm³	30-100	a	ISO 6976
Wobbe index, range	MJ/Nm³		b	ISO 6976
2nd Gen. DLE burner		40-55		
Conventional burner		35-55		
Variation, max.		± 5 %		
Gas Supply Pressure	bar(a)	24.5 ± 0.5	c	
Gas Supply Temperature	°C		d	
Max. 2nd Gen. DLE burner		120		
Max. Conventional burner		140		
Min.		-15		
Above dew point, min.		20		
Hydrocarbon dew point	°C	Report [2]	e	
Water dew point	°C	Report [2]	e	
Density	kg/Nm³	Report [2]	f	ISO 6976
Composition		Report [2]	g	ISO 6975
Hydrocarbons				
Other combustibles (H_2, CO)				
Non combustibles (N_2, CO_2, H_2O, H_2S)				
Impurities, maximum			h	
Solids	ppm (w)	5		
Particle size	µm	5		
Na+K	ppm (w)	0.5		
Ca	ppm (w)	2		
Other metals	ppm (w)	2		
Gas impurities (HCl, NH_3, etc.)	ppm (v)	Report [2]		
Sulphur, total	ppm (w)	Report [2]		
H_2S	ppm (v)	Report [2]		ISO 6326
Lube oil content	ppm (w)			
2nd Gen. DLE burner		0.5		
Conventional burner		5.0		

Definition: Normal cubic meter, Nm^3 at 0°C, 1.0135 bar (a).

[1] See following pages [2] To be reported to Siemens for further evaluation, see attached Note

Notes:

a) Most types of gases with Lower heating values between 30-100 MJ/Nm³, such as natural gas, LNG, refinery gas, LPG and various process gases, are excellent gas turbine fuels. The heating value is only given as an indication for judging the suitability of the gas. The determining factor is however the Wobbe index.

b) To evaluate the suitability of multiple gases, the Wobbe index is introduced and defined as "Fuel gas lower heating value (volumetric) divided by the square root of the relative density (specific gravity)".

$$\text{Wobbe index} = \frac{LHV}{\sqrt{\rho_{rel}}} \qquad (\rho_{rel} = \frac{\rho_{gas}}{\rho_{air}})$$

Gases with Wobbe index above the maximum limit (but within 55-75 MJ/Nm³) can be used but will require modifications in the burners.

Maximum variation of the Wobbe index for all considered gases for the turbine shall be within ±5%. Maximum acceptable change of the Wobbe index is 0.5%/second. Combustion of gases with larger variation in Wobbe index can be tolerated but will require special control system arrangements.

c) The fuel gas control valves and governor are designed to suit a nominal fuel gas supply pressure defined as 24.5 bar(a) at the gas turbine terminal point (upstream gas fuel unit 1) at maximum fuel flow. The design pressure is 30 bar(g).

The gas pressure has to be kept within ±0.5 bar / ±7.3 psi during steady state operation, from synchronisation up to full load. Maximum allowed fluctuation during steady state operation is ±0.1 bar/sec / ±1.46 psi/sec, however no periodic cycling of gas pressure is permitted.
Transients, such as start-ups, sudden load steps or load rejections, must not result in a deviation higher than ±1.5 bar.

The gas turbine is able to operate at a set value lower or higher than 24.5 bar(a), but this is not considered as a normal mode of operation. Such conditions shall be evaluated case by case.
Further information regarding gas pressures and power output can be given upon request.

d) The maximum gas temperature for the standard fuel system must not exceed 120°C for applications with 2nd generation DLE burners or 140ºC for conventional burners. In cases with higher gas delivery temperature, modifications of the fuel system will be necessary (high temperature valves etc.).

The minimum supply temperature should not be less than -15°C. Depending on air humidity, cold gas can cause ice formation or condensation on piping, which can be considered harmless. For applications with water injection the supply temperature should not be less than +5°C in order to prevent water from freezing in the pipes.

The gas supply temperature shall also always be at least 20°C above the hydrocarbon dew point of the fuel. An alarm is normally given at 15°C above hydrocarbon dew point. The gas shall be preheated if any doubt exists as to whether the above criterion is satisfied.

e) At the fuel system inlet, the gas must not contain any hydrocarbons or water in either liquid or solid phase. Nor must there be any constituents that may condense at the prevailing pressure in the system.

f) Density should be quoted for dry gas. It should be stated under which conditions the unit volume is defined. For applications with gas densities above 1.1kg/Nm^3 special precautions have to be taken regarding safety equipment.

g) The gas composition and its variation shall be determined and reported. This is important information for determining:
   - emission performance
   - fuel system and control system designs

If the gas contains components which can form corrosive compounds with water, such as hydrogen sulphide (H_2S), sulphur dioxide (SO_2), sulphur trioxide (SO_3) or carbon dioxide (CO_2), the suitability of such a fuel must be further investigated.

In applications with 2^{nd} generation DLE burner, the hydrogen (H_2) content in the gas shall be less than 5% by volume. For conventional burner the H_2 content in the gas shall be less than 65% by volume. For applications with H_2-rich fuel, water or steam injection is required. Start up on H_2-rich fuel is not allowed.

For applications with wet gases or rich gases (i.e. gases containing water and heavy hydrocarbons), special treatment and heating of the gas is required. Siemens must be informed about the external fuel system design.

h) The information on impurities in the gas will advise if special precautions have to be taken.

Solids

A particle filter must normally be included by the customer or the gas supplier in the gas line upstream the turbine terminal point.
99.9 % by weight of the solids must have a particle size less than 5 µm. Gases with an excessive content of particles or contaminants will require installation of extra cleaning equipment.

Metals

The suitability to use gases containing heavy metals, such as vanadium (V) or lead (Pb), or alkali metals, such as sodium (Na) and potassium (K), that can form highly corrosive compounds during combustion, must be investigated by Siemens. Calcium (Ca) in the gas may form sulphates during combustion. The use of such gas must be investigated by Siemens.

Sulphur

A hydrogen sulphide (H_2S) content more than 0.013 % by volume (130 vppm) will require material in the fuel system according to NACE Standard MR0175-2002 or MR0103-2003.
The customer is responsible that local emission regulations are followed.
For predictions of acid dew point of the exhaust gases, in order to avoid exhaust channel corrosion in combined cycle or co-generation applications, the total sulphur content of the gas must be specified.