Specification for Liquid Fuels

General

Liquid fuels of widely different properties can be used in SGT-600, ranging through naphtha, jet fuel, kerosene and gas oils. The common property of these fuels is that they usually have little or no ash content and that the sticking point of the possible ash is normally above 950°C. The SGT-600 with 2nd generation DLE combustion system has a narrow viscosity acceptance in comparison to the SGT-600 with conventional combustion system due to its less pollutant combustion. Detailed requirements of the fuel are specified further in this fuel specification.

Fuel specification

Table 1, column 1, shows the requirements on the fuels, which can be used in SGT-600 standard scope of supply, specified at the gas turbine internal fuel system inlet.
Table 1, column 2, shows fuel properties stated for such fuels which can be used in SGT-600 provided that:

- The fuels are correctly stored in accordance with K-8436-1E and
- The fuels are correctly treated (with separators or filters) in order to reduce the levels of the contaminants (sediment, water, Na + K) to acceptable levels and/or
- The fuels are correctly treated with anti corrosion additives in order to minimise risk of corrosion in the gas turbine and/or
- The external and internal fuel systems are specially designed for the actual fuel.

Siemens will give advice on equipment, additive type and dosage in case the actual fuel deviates from the specification in column 1.

The physical and chemical properties of a fuel must be tested in accordance with the methods laid down in the specification or an equivalent ISO, EN or DIN test method. The ash sticking point temperature, which decreases with increasing content of vanadium, lead and/or sodium, is the most important characteristic from a corrosion point of view.

The following standard fuels can normally be used or be upgraded to meet SGT-600 fuel specification.

ASTM D 396 – 1998: No. 1 and No. 2
ASTM D 975 – 1998b: No. 1-D and No. 2-D
ASTM D 1655 – 2000a: Jet A and Jet B
ASTM D 2880 – 1998: No 0-GT, No 1-GT and No. 2-GT
ISO 4261 – 1993: DST0, DST1/DMT1 and DST.2/DMT.2
DIN 51603-Teil 1 – 1998: Heizöl EL-01
SS 155410 – 1998: Eo 1
BS 2869 – 1998: A2, D, C1 and C2

Fuel storage and handling

Fuel storage, handling and monitoring must in all applications be done in accordance with Siemens recommendations K-8436-1E and K-8436-2. The fuels must be correctly treated with coalescer filters or centrifugal separators in order to reduce the levels of the contaminants (water, sediment, sodium and potassium) to acceptable levels stated in Table 1, column 1.

The fuel may suffer contamination during transport and storage. Contamination by salt water during transportation is not uncommon and will usually result in unacceptably high levels of sodium in the fuel. Transportation, storage, pumping and piping facilities used for residual fuels can cause vanadium contamination of distillate fuels if these facilities are not adequately cleaned prior to use. Solids contamination can also increase during storage due to corrosion products from the tank and piping

All reasonable means must be used to avoid contamination. The fuel should only be transported and stored in clean containers.

Table 1. Liquid fuel specification for SGT-600, 2nd gen. DLE and conventional combustion system.

Column 1. Fuels for standard scope of supply at the gas turbine internal fuel system inlet
2. Fuels that require additional treatment and/or optional fuel system

Property	Unit			Note[1)]	Test method[2)]
Column		**1**	**2**		
Density at 15°C	kg/m^3	Report[3)]			ASTM D 4052
Viscosity, **Conv burner**	mm^2/s				ASTM D 445
at 40°C, Dual fuel	(=cSt)	≤ 4.1			
at 40°C, Single oil		≤ 4.1	≤ 12	a	
at lowest fuel temp		≤ 7.0		b	
at highest fuel temp		≥ 2.0		c	
Viscosity, **2nd gen. DLE**					
at 40°C		≤ 3.6			
at lowest fuel temp		≤ 6.0		b	
at highest fuel temp		≥ 2.0		c	
Supply temperature	°C	≥ 5		d	
Flash point	°C	Report[3)]		e	ASTM D 93
Cloud point	°C	Report[3)]		f	ASTM D 2500
Reid vapour pressure	bar	Report[3)]			ASTM D 323
Aromatic content	%wt	≤ 30		g	ASTM D 5186
Di-aromatic content	%wt	≤ 5		g	ASTM D 5186
Polyaromatic content	%wt	≤ 1		g	ASTM D 5186
Olefin content	%vol	≤ 5			ASTM D 1319
Water	ppm(w)	≤ 100	Report[3)]	h	ASTM E 1064
Sediment	mg/l	≤ 2	Report[3)]	h	ASTM D 5452
Carbon Residue Conradsson (on 10% residue)	%wt	≤ 0.25			ASTM D 189
Sulphur content	%wt	Report[3)]		i	ASTM D 4294
Ash content	ppm(w)	≤ 50	≤ 300		ASTM D 482
Heavy metals (V+Pb+Ni+Zn)	ppm(w)	≤ 0.5	≤ 10	j	ASTM D 3605
Salts (Na+K)	ppm(w)	≤ 0.5	Report[3)]	k	ASTM D 3605
Calcium (Ca)	ppm(w)	≤ 2	Report[3)]	k	ASTM D 3605
Ash sticking point temp	°C	≥ 950	Report[3)]	l	SIS 15 51 37

[1)] See following pages [2)] Or equivalent ISO, EN or DIN method
[3)] To be reported to Siemens for further evaluation, see attached Note

Notes:

a) A separate starting fuel is required for applications with single oil conventional burner if the fuel viscosity is above 4.1 mm²/s at 40°C.

b) The viscosity of the fuel at the injectors must not exceed 6.0 mm²/s (2nd gen. DLE burner) or 7.0 mm²/s (conventional burner) for good atomisation. A fuel with a higher viscosity than 6.0 respectively 7.0 mm^2/s, at the lowest temperature the fuel system may experience, requires preheating and trace heating of fuel piping in order to achieve correct viscosity at the fuel injectors.

c) Fuels with viscosity less than 2.0 mm^2/s at highest fuel operating temperature, such as naphtha or kerosene, require dosage of anti-wear additives in order to prevent pump failures.

d) The supply temperature of minimum 5°C prevents eventual free water from freezing in pipes and valves. The supply temperature shall also always be higher than the cloud point.

e) Fuels that are handled at temperatures close to or above the flash point require explosion proof equipment and a separate starting fuel. Special safety regulations will apply which vary from country to country.

f) The fuel must be kept at least 10°C above the cloud point.

g) In the specification polyaromatic compounds are defined as tricyclic compounds and higher, i.e. no di-aromatics included.

h) Siemens recommends coalescer filters to be installed in all applications. For fuels with higher water and/or sediment content separators should be installed. Siemens can, as an option, supply equipment to reduce the water and sediment content of the fuel.

i) The sulphur content will limit the heat utilised from the gases when using a waste heat recovery unit. Furthermore, local legislation may limit the sulphur content.

j) Generally less than 0.5 ppm(w) heavy metals is required in order to conform to the condition for the ash sticking point. Somewhat higher contents can often be handled by employing corrosion inhibition additives. The quantity of the additive shall be enough to keep the ash sticking temperature above 950°C. However, a high content of additives requires additional cleaning of the turbine. Siemens will advise on equipment, additive type and dosage.

k) Generally less than 0.5 ppm(w) sodium + potassium is required in order to conform to the condition for the ash sticking point. Somewhat higher concentrations of sodium, potassium and calcium can be reduced to acceptable limits by fuel washing and/or separation. However, the washability of the fuel has to be checked. Siemens will advise on equipment.

l) The use of a fuel having an ash sticking point temperature below 950 °C introduces a great risk of high temperature corrosion for the gas turbine and must not be permitted even for a short period of time. The sticking point temperature can be raised by additive treatment of the fuel. Any such additive must be approved by Siemens