



Appendix B

Meaning of Specification Tests

Chemical tests are specified because slag-forming substances present in oil ash can cause turbine corrosion and deposits, and the presence of sulfur can result in corrosion of heat recovery equipment in the turbine exhaust. Certain physical tests are specified because they influence the operation of the gas turbine fuel handling, fuel treatment and combustion systems.

Ash and Trace Metal Contaminants

Ash-forming materials may be present in a fuel as oil-soluble organometallic compounds, as water soluble salts in water dispersed in the fuel or as solid foreign contaminants. The most common ash-forming elements which can be present in fuels are aluminum, calcium, iron, magnesium, nickel, potassium, sodium, silicon and vanadium. Ash-forming materials are present to varying degrees in crude oils depending on their geographical source. They are concentrated in the residual fractions during the refining process, leaving the light distillates contaminant-free; however, ash-forming materials may be introduced later by contamination with salt-bearing water or with other petroleum products during transportation and storage.

Gas turbine operating experience has shown that some of the ash-forming substances that may be present in the fuel can lead to corrosion and deposit problems. These problems are most acute with residual and crude oils which contain larger quantities of the troublesome substances.

Corrosion can result from (1) vanadium, (2) sodium, (3) potassium or (4) lead. These elements as well as calcium (and others such as magnesium, manganese, iron, silicon and aluminum) can cause ash deposits which are difficult to remove. Calcium can act as an effective inhibitor for vanadium corrosion, but its deposition tendencies have precluded its use.

In light distillate fuels, the total ash content is usually very small, and trace metal contamination is essentially a sodium (salt) problem. There are also usually traces of lead and calcium and smaller traces of potassium and vanadium. It is advantageous to purchase fuel within the specified contaminant limits and to maintain this quality during transportation, handling and storage. On-site desalting by contaminated water removal or by fuel washing of distillate fuels with relatively high sodium levels is required to keep corrosion of the hot gas path and the fuel system components such as flow dividers and fuel pumps at a very minimum level.

Crudes and contaminated distillates almost without exception have high enough salt levels, or the risk of significant salt levels, that they require desalting. The vanadium levels may also be significant and require the addition of a magnesium-base inhibitor to establish a ratio of 3 parts of magnesium to 1 part of vanadium by weight.

Residual fuels have the highest ash and trace metal contaminant levels usually necessitating complete fuel pretreatment: desalting and vanadium inhibition by a magnesium-based additive (3Mg/1V). Due to the less favorable physical properties of residual fuels, it is not possible to