

# Total Sulfur Analysis in base oil samples using TS 7000 according to ASTM D7183

This note describes the backgrounds, principle of operation and performance data of the Trace Level Total Sulfur analysis in base oil samples carried out by the new TSHR Total Sulfur analyzer, model TS 7000, according to ASTM D7183.

## Introduction

Base oils having applications to manufacture products including lubricating greases, motor oil and metal processing fluids and is produced by means of refining crude oil. During the refining process, light and heavy hydrocarbons are separated – the light ones can be refined to make petrol and other fuels, while the heavier ones are suitable for bitumen and base oils.

By using hydrogenation technology in this process, in which sulfur and aromatics are removed using hydrogen under high pressure, extremely pure base oils can be obtained, which are suitable when quality requirements are particularly stringent. The sulfur content in these high-quality base oils will be very low ppm or ppb level. This application note describes the principle of operation and performance of the TSHR 7000 Total Sulfur Analyzer for the determination of Trace Level Total Sulfur analysis in these type of base oil samples according to ASTM D7183 methodology.

## Experimental

Calibration of the TS 7000 model Total Sulfur analyzer was done using sulfur standards that were produced by dissolving dibenzothiophene in xylene. Several standards covering the range 0 to 2,5 mg/kg were prepared to provide calibration of the sulfur UV-Fluorescence detector. A set of 6 base oil samples were analyzed and three CRM standards of 0.2, 0.4 and 0.8 ppm were used to check the accuracy of the determined total sulfur content in the base oil samples.

The TSHR HR 7000 autosampler was used in conjunction with the TS 7000 analyzer to directly inject the samples into the injection port and furnace. Data acquisition and peak analysis was fully automated by the TSHR Athena software. System parameters were set by Athena software in accordance with ASTM D7183 method and presented in Table 1.



Figure 1: TS 7000 with HR 7000 autosampler

Parameter	System Value
Argon carrier flow	75 mL/min
Oxygen primary flow	300 mL/min
Oxygen secondary flow	100 mL/min
Temperature inlet	500 °C
Temperature furnace I	850 °C
Temperature furnace II	1000 °C
Injection speed	1.0 uL/s
Sample volume	80 uL

Table 1: TS 7000 system parameters used in this analysis

All samples were injected directly into the TS 7000 analyzer without dilution and measurements were made in six (6) replicates.

## Results

Figure 1 presents the sulfur calibration line (0 – 2,5 ppm) for the TS 7000 analyzer. The calibration fit shows excellent linearity, with  $R^2 = 0,9998$ .

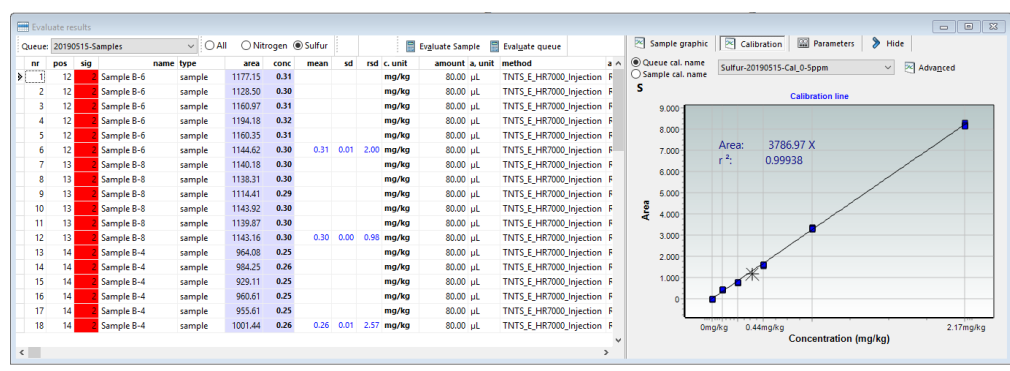
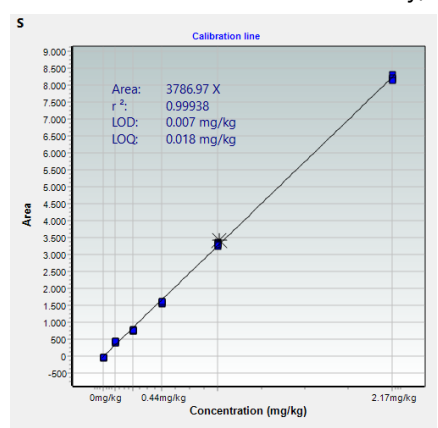
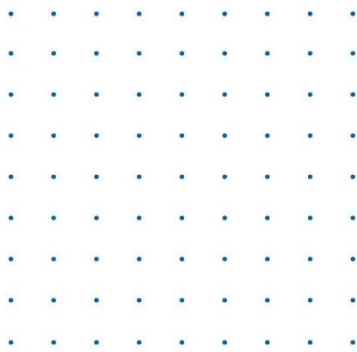


Figure 2: Linear calibration line for the TSHR TS7000 Total Sulfur Analyzer

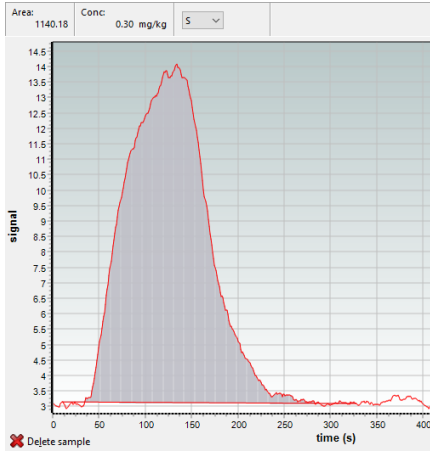
Sample	Average (mg S/kg)	RSD (%)
Base Oil 1	0.31	2.0
Base Oil 2	0.30	1.0
Base Oil 3	0.26	2.6
Base Oil 4	0.30	1.7
Base Oil 5	0.30	2.2
Base Oil 6	0.25	2.1

Table 2: Sulfur performance data of the base oil samples with TS 7000 analyzer (n=6)

Name	Mean (mg/kg)	RSD (%)
CRM 0.22 mg/kg	0.23	3.2
CRM 0.43 mg/kg	0.44	1.0
SCMR 0.86 mg/kg	0.87	0.6



**Table 3: Results of analyzed CRM's with TS 7000**



**Figure 3: Sample peak of Total Sulfur in base oil sample**

## Conclusion

Analysis of base oil sample with the TSHR TS 7000 model, Total Sulfur analyzer, shows performance data which are accurate based on CRM standards control check.

The RSD's for all samples is less than 3% at a sub-ppm level, which shows a very good repeatability among them and no carry over effects caused by the analyzer.

### References

[1] ASTM D7183 – 18 Standard Test Method for Determination of Total Sulfur in Aromatic Hydrocarbons and Related Chemicals by Ultraviolet Fluorescence

## Contact info

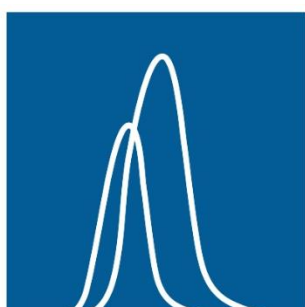
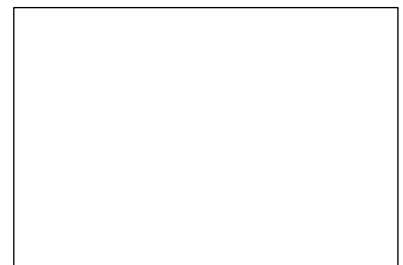
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