

# Shimadzu Simulated Distillation Gas Chromatograph System



# Meets All Simulated Distillation Gas Chromatograph Standards

- Provides Highly Accurate Analysis Results with Excellent Reproducibility-

The Shimadzu simulated distillation system, consisting of a GC-2030 high-performance capillary gas chromatograph and LabSolutions simulated distillation GC analysis software, meets all applicable ASTM, ISO, EN, and JIS standards. Permitting accurate and highly reproducible analysis of high-boiling components in crude oil samples, it is the optimal system for product quality control and process management in oil refinery plants.



## Table of Simulated Distillation Gas Chromatograph Standards

The LabSolutions simulated distillation GC analysis software supports measurements that comply with the following simulated distillation gas chromatograph standards.

	Carbon Number	Sample
ASTM D 3710, D 7096	n-C <sub>3</sub> ~ n-C <sub>15</sub>	Gasoline, naptha
JIS K 2254	—	Kerosene, diesel oil
ASTM D 2887 (ISO3924, IP406)	n-C <sub>5</sub> ~ n-C <sub>44</sub>	Jet fuel, diesel oil
ASTM D 6417	n-C <sub>8</sub> ~ n-C <sub>60</sub>	Lubricating oil, base stock oil
ASTM D 7213 (Extended D2887)	n-C <sub>7</sub> ~ n-C <sub>60</sub>	Lubricating oil, base stock oil
ASTM D 6352	n-C <sub>10</sub> ~ n-C <sub>90</sub>	Lubricating oil, base stock oil
ASTM D 7500	n-C <sub>7</sub> ~ n-C <sub>100</sub>	Lubricating oil, base stock oil
EN 15199-1 (IP480, DIN 51435)	n-C <sub>7</sub> ~ n-C <sub>120</sub>	Lubricating oil, base stock oil
ASTM D 5307	n-C <sub>44</sub> Max	Crude oil (internal standard method)
ASTM D 7169, EN 15199-2 (IP 507)	n-C <sub>7</sub> ~ n-C <sub>100</sub>	Crude oil (external standard method, n-C <sub>120</sub> max. for EN)



# Support for High-Temperature Simulated Distillation GC Analysis

The Shimadzu simulated distillation gas chromatograph analysis system supports analysis of high-boiling-point samples (up to 120 carbon number). Examples of analyses conforming to ASTM standards are introduced below.

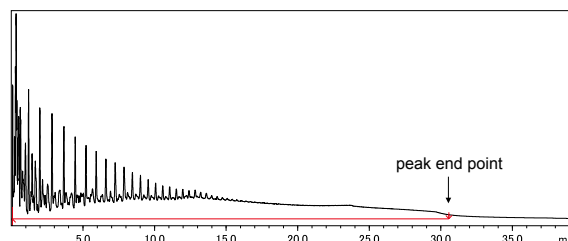
ASTM D7169, D5307, and D7500 High-Temperature GC Analysis Standards

## Support for Crude Oil Analysis

### ASTM D7169

The ASTM D7169 standard applies to crude oil samples with a final boiling point (FBP) exceeding 720 °C. Reference Oil 5010 was analyzed by the external standard method using a short capillary column with a thin film thickness.

- Using CS<sub>2</sub> quenching factors
- Comparison check against reference oil distillation characteristics standard values



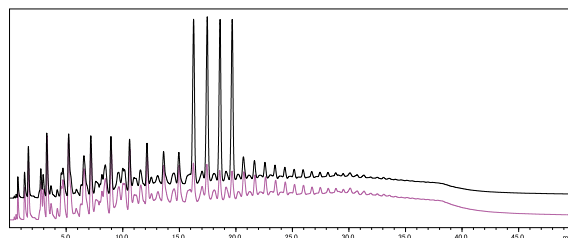
Sample Analysis of ASTM D7169 Crude Oil

The chromatogram display screen for unknown samples shows chromatograms for the reference oil and background correction together with other information such as the automatic peak recognition start and end points, and initial and final boiling points.

### ASTM D5307

The ASTM D5307 standard applies to crude oil with a FBP exceeding 538 °C. A packed column was used for analysis by the internal standard method of samples, including those spiked with (n-C<sub>14</sub> to n-C<sub>17</sub>) internal standards.

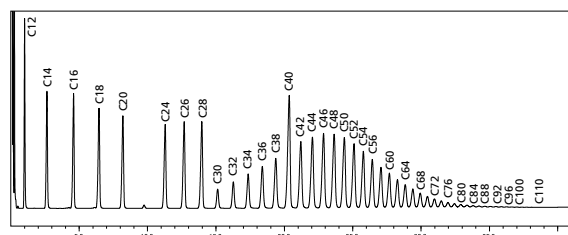
- Display of fractions (mass %) above 538 °C



Sample Analysis of ASTM D5307 Crude Oil and Crude Oil Spiked with Internal Standards

### ASTM D7500

The ASTM D7500 standard applies to samples with an initial boiling point (IBP) exceeding 100 °C and a FBP less than 735 °C. In this example, the sample was analyzed by the total area method using a short capillary column with a thin film thickness. Polywax® 655 and Polywax® 1000 are also used to create the retention time – boiling point curve.

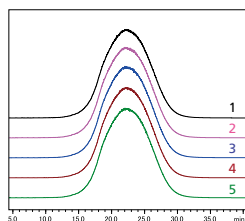


Sample Analysis of Calibration Mix Standard

Low Carryover and Excellent Reproducibility

## Dedicated Injection Unit Handles High-Boiling-Point Samples

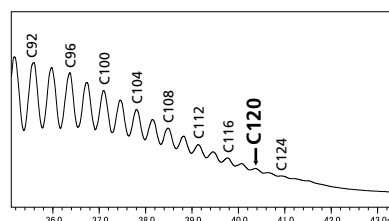
Using an OCI-2030NX on-column injection unit with the GC-2030 Capillary Gas Chromatograph achieves low carryover and provides analysis results with high reproducibility.



	FBP(°C)
1	643.4
2	644.4
3	642.8
4	643.1
5	643.1
Ave.	643.4
SD	0.619
RSD(%)	0.096

Reproducibility of ASTM D7500 Reference Oil Analysis (n=5)

The FBP of reference oil 5010 is equivalent to the boiling point of 73 carbon number n-paraffin.



Separation of High-Boiling-Point Components in ASTM D7500 Polywax® 1000 Analysis

Peak elution up to 120 carbon number n-paraffin (750 °C boiling point) indicates measurement of high-boiling-point samples is possible.

The simulated distillation GC analysis software offers comprehensive functions to support the calculation of the physical properties required for process management in oil refinery plants, multisample data comparison required for product quality control, and statistical calculations.

## Comprehensive Data Conversion and Customization

D86 Correlation Setting

D86 Correlation (Use Temp. Unit: F Current Temp. Unit: C)

Comment:

D86-BP	+46.566	-0.50209	* GC 10%	-0.34796	* GC BP				
D86-10	+33.300	-0.64562	* GC 10%	-0.28110	* GC 20%				
D86-10	+24.411	-0.40939	* GC 20%	-0.27520	* GC 20%				
D86-10	+14.431	-0.70036	* GC 30%	-0.24369	* GC 30%	+0.21713	* GC 10%		
D86-10	+1.876	-0.76937	* GC 50%			+0.22784	* GC 50%		
D86-10	-0.911	-0.51976	* GC 30%	-0.33260	* GC 10%	+0.10159	* GC 30%		
D86-10	-0.279	-0.75936	* GC 30%	-0.28333	* GC 95%	-0.09975	* GC FBP		
D86-10	-1.972	-0.61459	* GC 90%	-0.21909	* GC 95%				
D86-FBP	-34.179	-1.14626	* GC 95%	-0.59020	* GC 90%	-0.31842	* GC FBP		

Initialize

OK Cancel Help

[illegible]

Various reports can be created by overlaying a distillation characteristic curve over the chromatogram or an ASTM D86- or D1160-converted distillation characteristics curve over the distillation characteristic curve.

## Simple Summary Reports of Complex Data

===== Shimadzu LabSolutions Summary Report =====							
	Sample001.cad	Sample001.cad	Sample001.cad	Area	Mean	Mean	Mean
10	242.413	243.051	233.097	432.000	443.983	439.414	438.414
15	481.476	480.954	479.966	481.466	483.476	479.966	479.966
10	494.004	495.919	494.000	504.000	505.919	504.000	504.000
15	506.693	504.144	504.176	505.071	506.693	504.144	504.144
10	516.185	511.388	517.101	513.555	516.185	511.388	511.388
15	533.116	531.633	539.000	539.017	533.116	531.633	531.633
10	539.709	533.093	531.642	536.468	539.709	533.093	533.093
15	536.311	530.588	533.130	533.679	536.311	530.588	530.588
40	543.167	536.113	538.000	533.561	543.167	536.113	536.113
15	543.167	543.136	543.136	543.136	543.136	543.136	543.136
10	553.374	547.069	549.177	549.883	553.374	547.069	547.069
15	553.374	553.374	553.374	553.374	553.374	553.374	553.374
60	562.147	558.681	560.581	562.147	562.147	558.681	558.681
60	570.480	563.869	566.240	566.520	570.480	563.869	563.869
10	586.311	586.311	586.311	586.311	586.311	586.311	586.311
25	588.031	575.166	577.728	578.133	588.031	575.166	575.166
10	594.000	594.000	594.000	594.000	594.000	594.000	594.000
15	597.838	588.546	591.138	591.526	597.838	588.546	588.546
20	604.147	597.014	600.237	600.541	604.147	597.014	597.014
15	604.147	604.147	604.147	604.147	604.147	604.147	604.147
10	613.831	613.831	613.831	613.831	613.831	613.831	613.831
10	613.831	613.831	613.831	613.831	613.831	613.831	613.831
Start eluting point	7.1101	8.8111	8.1240	7.0119	8.1101	7.1101	7.1101
End eluting point	7.1101	8.8111	8.1240	7.0119	8.1101	7.1101	7.1101
Elution Area	3.7174	4.97708	4.96708	5.07708	3.7174	4.97708	4.97708
1 Elution Recovery	100.000	100.000	100.000	100.000	100.000	100.000	100.000
1	248	0.000	1.137	1.061	1.348	0.000	0.000
2	57.006	0.000	0.1484	0.1424	0.0004	0.000	0.000
3	41.029	0.000	0.0740	0.0116	0.000	0.000	0.000
4	30.000	0.000	0.000	0.000	0.000	0.000	0.000
5	2.000	0.000	0.000	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14	0.000	0.000	0.0				

Multiple distillation characteristics results can be printed in a report. The boiling points for specific elution volumes and fractions, as well as data, maximums, minimums, averages, and relative standard deviations, can be extracted.

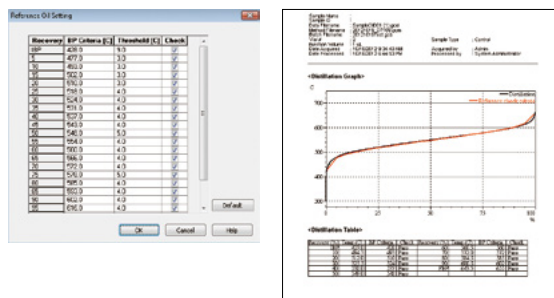
# High Data Reliability

The keys to obtaining reliable and reproducible data are daily system accuracy management and a robust system configuration. Optimized software and hardware are combined to deliver the highest data accuracy.

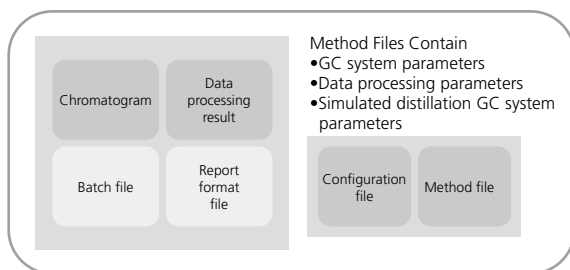
Support for Reference Oil Analysis

## Comprehensive System Check Functions

The system performance must be comprehensively checked in advance to ensure high-accuracy data when analyzing high-boiling-point samples. It is possible to check whether the system performance specifications prescribed in official methods, such as peak resolution, peak symmetry, and relative sensitivity calculations, are satisfied for standard sample analysis and to check for differences from standard values in reference oil analysis.

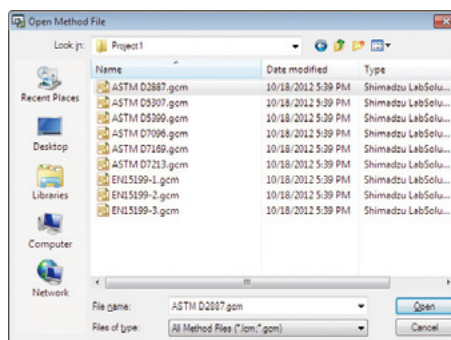


Sample Reference Oil Standard Value Setting Screen and Analysis Results Report



### Data File Structure

Data files have an "All-in-One" structure that contains not only chromatograms and data processing results, but also information related to analysis methods and batch files used for serial analysis. The files also contain parameters related to the simulated distillation gas chromatograph system that permit accurate tracing of the analysis parameters from the data.



### Templates Provided for Each Analysis Method

Using the analysis parameters contained in the method and report file templates supplied with the system allows analysis to be started immediately. These files are not fixed but can be freely created from new or expanded parameters.

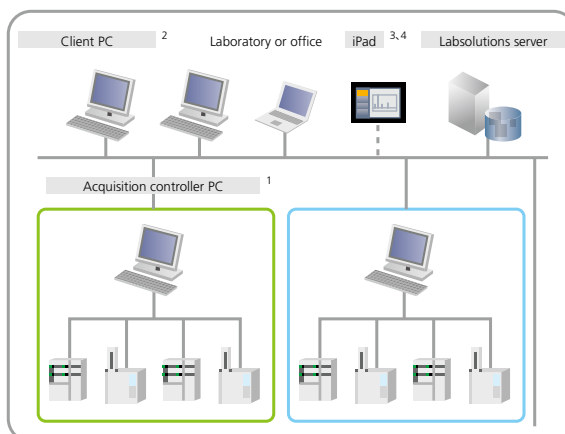
Network Compatibility

## Compatible with LabSolutions Network Functions

Data acquired using the Shimadzu simulated distillation gas chromatograph system can be registered to the LabSolutions database, together with data acquired using other instruments. The highly secure database system permits optimal analysis operations. Configuring a network system with LabSolutions CS permits analysis directions and instrument monitoring and control from a remote PC.

### Notes

1. The acquisition controller PC controls the analytical instruments. Analysis directions and re-analysis of data can be performed using a client PC.
2. It is not necessary to install LabSolutions software on the client PC for terminal service.
3. iPad is a registered trademark of Apple Inc.
4. When using an iPad, the installation of Citrix's XenApp is required.





# LabSolutions Simulated Distillation GC Analysis Software Specifications

Basic Specifications	Create retention time - boiling point curves (tables, retention time - boiling point curves, °C or °F temperature units) Create distillation curves (tables, distillation characteristics curves, °C or °F temperature units) Unknown sample - blank difference chromatogram Analysis methods: total area method, internal standard method (single, double), external standard method
Supported Simulated Distillation Gas Chromatograph Standards	ASTM D2887 (ISO3924,IP406), ASTM D3710, ASTM D5307, ASTM D5399, ASTM D6352, ASTM D6417, ASTM D7096, ASTM D7169, ASTM D7213 (Extended D2887), ASTM D7500, EN 15199-1 (IP480, DIN 51435), EN 15199-2 (IP 507), JIS K 2254
Requirements of Simulated Distillation Gas Chromatograph Standards	Automatic evaluation of distillate peak start and end points Distillation calculation (mass%, volume%) Quenching factor calculation MOV calculation (elution volume % to 371 °C, ASTM D6417) Specific component volume % calculation (ASTM D3710, D7096) Cut point and distillate fraction calculation
System Check Support	Peak resolution calculations, peak symmetry calculations, relative sensitivity calculations, reference oil distillation, characteristics checks
Conversions and Calculations from Distillation Characteristics (Factors can be customized.)	ASTM D86 and D1160 conversion Diesel oil and jet fuel conversions (ISO3924, ASTM D2887, IP 406) NOACK conversion (DIN 51.582-2) Flash point calculations (ASTM D7215) Reid Vapor Pressure calculations (ASTM STP577)
Chromatogram Output	Display of IBP, FBP, distillate peak start and end points, standard substance intervals, maximum distillation temperatures, quenching intervals Background chromatograms, distillation characteristics curves, ASTM D86 and D1160 conversion, diesel oil and jet fuel conversions, overlay of reference oil standard curves
Distillation Characteristics Curve Output	Display of cut points and fractions ASTM D86 and D1160 conversion, diesel oil and jet fuel conversions, overlay of reference oil standard curves
Comparison of Multiple Data	Distillation characteristics comparison, summary reports of conversion and calculation results



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