
Trace elemental analyzer

# NSX-5000V SERIES

Vertical furnace system

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**Nittoseiko Analytech Co.,Ltd.**

# NSX-5000V

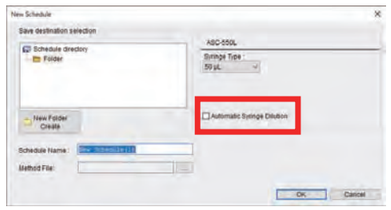
NSX-5000V series will contribute to the reduction of environmental impact through advanced technologies.

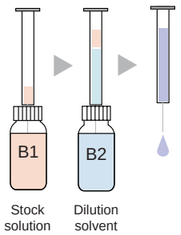
It enables automatic, safe and highly sensitive measurement of trace nitrogen, sulfur and chlorine in liquid or gas samples. Can be used in a wide range of applications such as quality control of petroleum/ chemical/ recycled products or automotive fuels and environmental analysis.

## Features

### Automatic syringe dilution (ASC-550L)

Automatic dilution can be performed accurately regardless of the proficiency of the operation by simply setting stock solution and solvent in the vials. Advance preparation for calibration curves is no need and waste solution can be reduced, resulting in reducing environmental load and low running costs.




### User-friendly software

Simple and Advanced modes are available for a wide range of users such as in lab and product quality control.

**Simple mode**

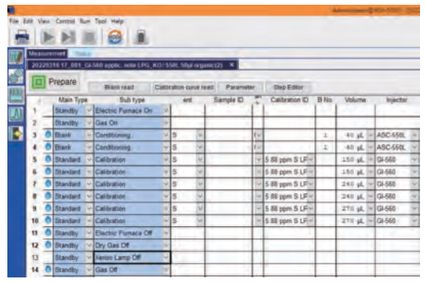
For steady sample measurement such as product inspections.
Easy and simple operation, no need to re-enter parameters.

**Advanced mode**

For unknown sample measurement or advanced operations.
Detailed setting for condition examination is possible.

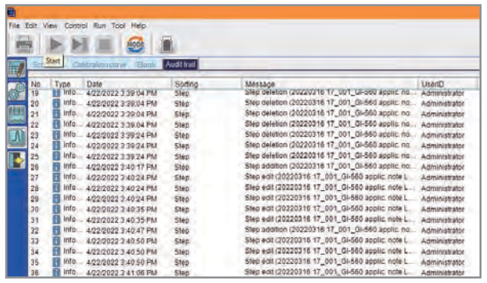
### Automatic operation

Automated operation is available from "Furnace ON" to "Gas OFF". Also continuous run with various temperature settings are able to conduct.



### Audit trail

All operations are recorded in preparation to an audit, and it can be viewed in Advanced mode.

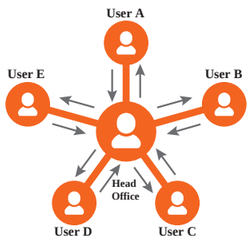


### Import/Export function

Various setting such as “schedule”, “methods” and “the others” can back up and restore.
This is useful function when using multiple systems need to be operated at the same condition.

#### Imported/Exported items

- **Schedule**
- **Calibration curve**
- **Blank**
- **Method**
- **Measurement results** (CSV)
- **Combustion program**
- **Audit trail**
- **Authority setting**




### User management

Three levels of login function enable to protect method and data from unintended change or deletion.




## Features

### Wide range, Easy of use

High/Low, simplified selection of sensitivity for each detector.

| | | High sensitivity | Low sensitivity |
|---|---|---|---|
| ND-500 | | 0.03～250 µg/mL | 1～10,000 µg/mL |
| SD-500 | | 0.02～100 µg/mL | 1～10,000 µg/mL |
| MCD-500 | chlorine | 0.05～200 µg/mL | 1～5,000 µg/mL |
| | Sulfur | 0.1～1,000 µg/mL | |

※ For TCL-5000V chlorination, a high-density electrolyte solution is used for quantitation of 10µL or more in a single measurement.

### Liquid sample temperature control system
**STC-500L (Option)**

By cooling a “vial (containing a highly volatile liquid)” and a “microsyringe” to low temperature, it is possible to suction stably and inject the sample as a liquid state.

### Easy Daily maintenance

Unique open/close type furnace provides easy operation and easy visual check of the condition of pyrolysis tube.

### Reanalysis function
※Available only for TN-5000V, TS-5000V

After measurement, the “start time of measurement” and “end time” for chart date can be corrected if necessary to optimize.

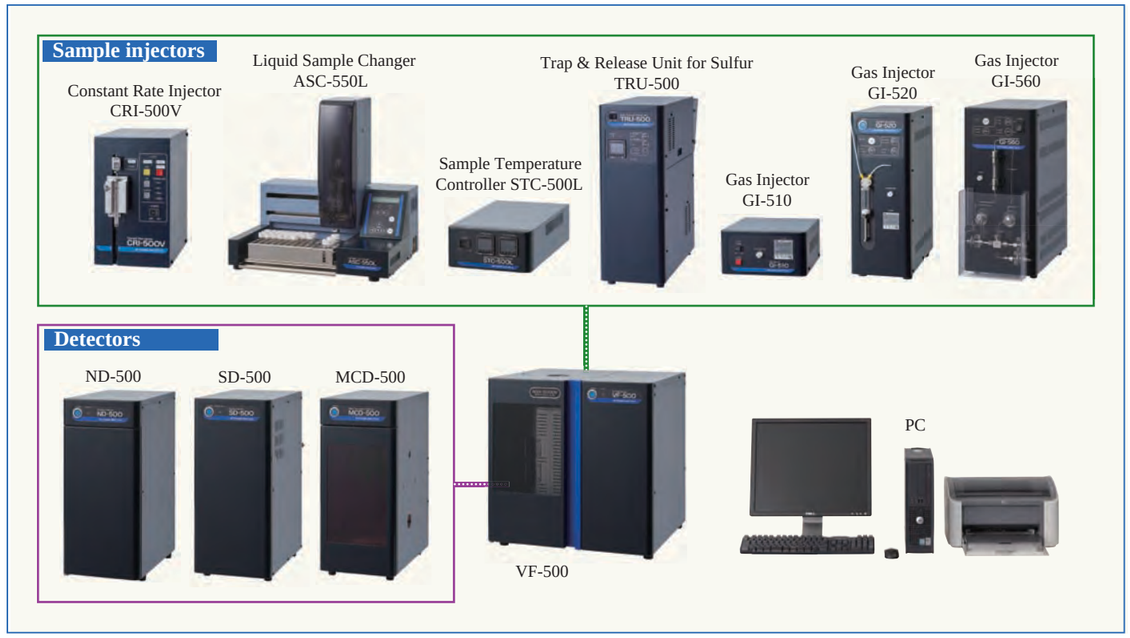
### Low running cost

Less gas consumption than before. It is also available to shut-off the gas at the end of measurement automatically.

### LINK to LIMS

Software makes data handling easier. It can output the result data to specified folder automatically.

### System configuration



# NSX-5000V MEASUREMENT PRINCIPLE

## UV fluorescence sulfur detector SD-500

### Sulfur Measurement

Sample is injected into a heated (800 to 1100 °C) pyrolysis tube by argon carrier gas. After sulfur compounds in the sample are pyrolyzed, they are oxidized by $O_2$ gas.

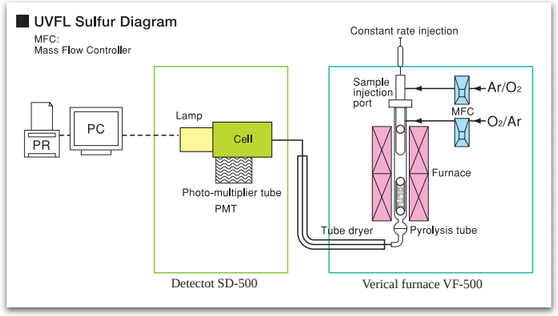
$$R\text{-}S + O_2 \rightarrow SO_2 + SO_3 + \text{combustion product}$$

The produced $SO_2$ gas is excited by irradiating the ultraviolet ray v1 (190 to 230 nm). Then, SO2* emits the energy (fluorescent ray) and returns to the ground state.

$$SO_2 + hv1 \rightarrow SO_2^* \rightarrow SO_2 + hv2$$

This fluorescent ultraviolet ray v2 (300 to 400 nm) is received by the photomultiplier tube and area value is obtained. The sulfur concentration is obtained by a calibration curve preliminarily drawn using standard solution.

■ UVFL Sulfur Diagram




### ■ UVFL Sulfur applications

| | Injection (µl) | Analysis (ppm) | RSD (%) |
|---|---|---|---|
| Diesel | 40 | 9.95 | 0.43 |
| Kerosene | 40 | 1.41 | 2.95 |
| Gasoline | 40 | 3.79 | 0.38 |
| BDF | 40 | 1.01 | 7.07 |
| BTX | 40 | 0.60 | 0.50 |
| Desulfured light naphtha | 40 | 0.61 | 6.77 |
| Propane | 10ml | 2.77 | 0.76 |
| Butane | 25ml | 0.18 | 2.97 |

### ■ Simultaneous applications for Nitrogen and Sulfur

| | N (ppm) | RSD (%) | S (ppm) | RSD (%) |
|---|---|---|---|---|
| Heavy oil | 0.32% | 0.84 | 0.48% | 1.47 |
| Lub oil | 2.11 | 2.61 | 7.72 | 1.42 |
| Diesel | 2.91 | 0.41 | 9.79 | 0.27 |
| Gasoline | 6.92 | 0.19 | 3.79 | 0.38 |
| Naphtha | 4.6 | 1.78 | 26.4 | 0.42 |

※ The above values are measured by the previous model NSX-2100V series. NSX-5000V series have as same level of capability as NSX-2100V series.

### ■ Liquid cooling option for auto sampler

By preventing sample vaporization during syringe handling, cooling option is very effective for high volatile sample.

| Low B.P. sample | Sample Temperature Control | |
|---|---|---|
| | OFF (22℃) | ON (15℃) |
| Result (n=5) ppm | 3.59 | 7.54 |
| RSD (%) | 21.1% | 1.0% |

### ■ SD-500 Detector

## Specification for Trace Sulfur Analyzer NSX-5000V/SD

| | Sulfur measurement | Nitrogen measurement (optional) |
|---|---|---|
| Sample | Liquid/Gas | |
| Analytical method | Oxidative combustion and UV fluorescence detection | Oxidative combustion and chemiluminescence detection |
| Furnace | Max. 1,100 °C, Openable electric furnace, 2-section type | |
| Measuring range | 2 to 20,000 ng (up to 10,000 µg/mL)<br>LOQ: 0.02 µg/mL* | Non-aq. 3 to 20,000 ng (up to 10,000 µg/mL)<br>Aq. 1 to 10,000 ng (up to 5,000 µg/mL)<br>LOQ: Non-aq. 0.03 µg/mL*, Aq. 0.01 µg/mL * |
| Sample volume | Liquid: Max 200 µL | |
| Measurement time | less than 5 min | |
| Vacuum pump | —— | Diaphragm type dry vacuum pump |
| Gas used | Argon: Purity 99.98 % or more, 0.3 ± 0.1 MPa , Oxygen: Purity 99.7 % or more, 0.3 ± 0.1 MPa | |
| Power supply | VF-500:AC100 / 115 V (50 / 60 Hz), 1100 VA, AC230 / 240 V (50 / 60 Hz), 1800 VA<br>SD/ND-500:AC100-240 V 300 VA | |
| Mass and weight | VF-500:500(W) ×430(D)×500(H) mm, approx. 35 kg<br>SD-500:220(W) ×375(D)×500(H) mm, approx. 21 kg ND-500: 220(W) x 375(D) x 500(H) mm, approx. 22 kg<br>Vacuum pump:160 (W) × 320 (D) × 220 (H) mm, approx. 7.5 kg | |

* It depends on the sample volume, the matrix, the purity of reagents and the condition of the unit.



## Chemiluminescence nitrogen detector ND-500

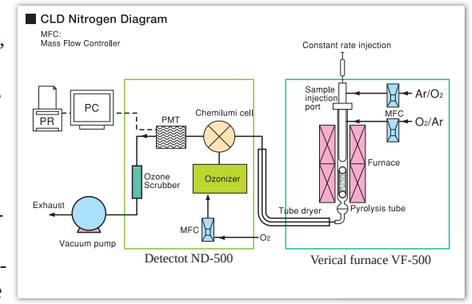
### Nitrogen measurement

Sample is injected into a high-temperature (900 to 1000 ℃) pyrolysis tube by argon carrier gas. After nitrogen compounds in the sample are pyrolyzed, it is combusted, oxidized, and converted to nitric oxide (NO). After removing moisture from the combustion gas by a dehumidifier (tube dryer), the following oxidation reaction occurs by the reaction of NO with ozone.

$$NO + O_3 \rightarrow NO_2 + O_2 + hv$$

By this reaction, 590 to 2,500 nm of emitting light is generated. The optical intensity of this light is proportional to the NO concentration at a wide wavelength range. After emitted light is detected by a photomultiplier tube and signal processing is performed, an area value is obtained. Using the calibration curve, the total nitrogen concentration in the sample is calculated. Some of samples generate interference substances such as SOx and $CO_2$ in the process of oxidative combustion. However, the interference can be decreased to an irrelevant level by the contribution of reduced pressure method.

■ CLD Nitrogen Diagram




### ■ Nitrogen, standard sample

| | Recovery (%) | RSD (%) |
|---|---|---|
| 10.0 ppm Quinoline | 98.5 | 0.9 |
| 0.32% Heavy oil | 99.1 | 0.7 |
| 0.11% Heavy oil | 104.0 | 0.1 |
| 0.0064% Heavy oil | 100.6 | 0.1 |

### ■ Nitrogen, application sample

| | Analysis (ppm) | RSD (%) |
|---|---|---|
| Naphtha | 0.8 | 4.2 |
| Kerosene | 3.2 | 2.2 |
| Diesel | 4.1 | 1.7 |
| Gasoline | 2.5 | 1.7 |

### ■ Nitrogen aqueous applications

| | Analysis (ppm) | RSD (%) |
|---|---|---|
| River Water | 3.1 | 1.70 |
| Factory Disposal | 2.6 | 2.10 |
| Seawater* | 0.2 | 4.80 |
| Sewage Plant (Treated Sewage) | 2.2 | 1.80 |

* Sea water option

※ The above values are measured by the previous model NSX-2100V series. NSX-5000V series have as same level of capability as NSX-2100V series.

### ■ ND-500 detector with vacuum pump

## Specification for Trace Nitrogen Analyzer NSX-5000V/ND

| | Nitrogen measurement (non-aqueous system) | Nitrogen measurement (aqueous system) |
|---|---|---|
| Sample | Liquid/Gas | |
| Analytical method | Oxidative combustion and chemiluminescence detection | |
| Furnace | Max. 1,100 °C, Openable electric furnace, 2-section type | |
| Measuring range | 3 to 20,000 ng (up to 10,000 µg/mL)<br>LOQ: 0.03 µg/mL*<br>Liquid: Max. 200 µL | 1 to 10,000 ng (up to 5,000 µg/mL)<br>LOQ: 0.01 µg/mL *<br>Liquid: Max. 100 µL |
| Sample volume | Liquid: Max 200 µL | Liquid: Max 100 µL |
| Measurement time | less than 4 min | |
| Vacuum pump | Diaphragm type dry vacuum pump | |
| Gas used | Argon: Purity 99.98% or higher, 0.3 ± 0.1MPa , Oxygen: Purity 99.7% or more, 0.3 ± 0.1MPa | |
| Power supply | VF-500: 100/115 VAC, 50/60 Hz: 1,100 VA, 230/240 VAC, 50/60 Hz: 1,800 VA<br>ND-500: 100/115/230/240 VAC, 50/60 Hz: 300 VA | |
| Mass and weight | VF-500:500(W) ×430(D)×500(H) mm, approx. 35 kg<br>ND-500:220(W) ×375(D)×500(H) mm, approx. 22 kg<br>Vacuum pump:160 (W) × 320 (D) × 220 (H) mm, approx. 7.5kg | |

* It depends on the sample volume, the matrix, the purity of reagents and the condition of the unit.

# MEASUREMENT PRINCIPLE

## Micro coulometry detector MCD-500

### Chlorine analysis

Samples are combusted in an argon/oxygen atmosphere.
The resulting hydrogen chloride is led into a titration cell where it is automatically titrated by silver ions generated by electrolysis.
The amount of chlorine is calculated from the quantity of electricity required for the titration.

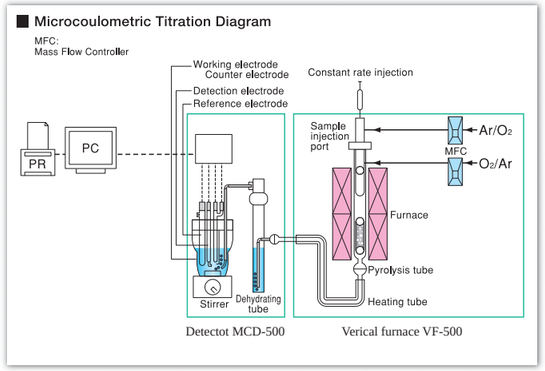
$$HCL + Ag^{+} \rightarrow H^{+} + AgCl \text{ (titration)}$$
$$Ag \rightarrow Ag^{+} + e^{-} \text{ (electrolysis)}$$

### Sulfur analysis

Samples are combusted in an argon/oxygen atmosphere.
The resulting sulfur dioxide is led into a titration cell where it is automatically titration by triiodide ions generated by electrolysis.
The amount of sulfur is calculated from the quantity of electricity required for the titration.

$$SO_2 + I_3^{-} + H_2O \rightarrow SO_3 + 3I^{-} + 2H^{+} \text{ (titration)}$$
$$3I^{-} \rightarrow I_3^{-} + 2e^{-} \text{ (electrolysis)}$$

■ Microcoulometric Titration Diagram




■ MCD-500 detector

● Sample applications

■ Chlorine

| | Injection (µl) | Analysis (ppm) | RSD (%) |
|---|---|---|---|
| Naphtha | 200 | 0.08 | 9.8 |
| Gasoline | 200 | 0.53 | 5.3 |
| Kerosene | 200 | 0.09 | 5.0 |
| Lub oil | 90 | 1.35 | 3.2 |
| Diesel 1 | 200 | 0.18 | 7.6 |
| Diesel 2 | 200 | 0.05 | 13.5 |
| Xylene | 90 | 2.47 | 3.1 |

■ Sulfur

| | Injection (µl) | Analysis (ppm) | RSD (%) |
|---|---|---|---|
| High Octane | 50 | 7.3 | 2.3 |
| Gasoline | 50 | 5.5 | 1.7 |
| Kerosene | 50 | 13.7 | 1.3 |
| Diesel | 50 | 1.3 | 3.9 |
| Lub oil 1 | 50 | 126 | 2.1 |
| Lub oil 2 | 50 | 37 | 1.2 |
| Lub oil 3 | 50 | 13 | 2.3 |

※ The above values are measured by the previous model NSX-2100V series.
NSX-5000V series have as same level of capability as NSX-2100V series.

## Specification for Trace Chlorine/Nitrogen Analyzer NSX-5000V/MCD

| | Chlorine measurement | Sulfur measurement |
|---|---|---|
| Sample | Liquid/Gas | |
| Analytical method | Oxidative combustion and chemiluminescence detection | |
| Furnace | Max. 1,100 °C, Openable electric furnace, 2-section type | |
| Sensing electrode | Silver electrode | Platinum electrode |
| Measuring range | 10 to 500,000 ng (up to 5,000 µg/mL)<br>LOQ: 0.05 µg/mL* | 20 to 50,000 ng (up to 1,000 µg/mL)<br>LOQ: 0.1 µg/mL* |
| Sample volume | Liquid: Max 200 µL | |
| Measurement time | less than 10 min | |
| Gas used | Argon: Purity 99.98 % or more, 0.3 ± 0.1 MPa , Oxygen: Purity 99.7 % or more, 0.3 ± 0.1 MPa | |
| Power supply | VF-500: 100/115 VAC, 50/60 Hz: 1,100 VA, 230/240 VAC, 50/60 Hz: 1,800 VA<br>MCD-500: 100/115/230/240 VAC, 50/60 Hz: 300 VA | |
| Mass and weight | VF-500:500(W) ×430(D)×500(H) mm, approx. 35 kg<br>MCD-500:220(W) ×375(D)×500(H) mm, approx. 14 kg | |

* It depends on the sample volume, the matrix, the purity of reagents and the condition of the unit.



# Option

## Liquid Sample Changer ASC-550L

| | |
|---|---|
| Sample | Liquid (non-aqueous, aqueous) |
| Injection | Gastight microsyringes: 25, 50, 100, 250 µL |
| Rinse vial | 28 mL vials with septum |
| Number of samples | 50 or 105 bottles |
| Vial size / Sample tray | 6 mL / 50 bottles<br>4 mL / 50 bottles<br>2 mL / 50 bottles<br>2 mL / 105 bottles |
| Power | 100/115/230/240 VAC (50/60 Hz) 180 VA |
| Dimensions | 460(W) ×320(D)×470(H) mm Approx. |
| mass | 16 kg |

## Sample Temperature Controller STC-500L

| | |
|---|---|
| Sample | Liquid |
| STC vial rack | 2 mL vial / 24 bottles<br>4 mL vial / 24 bottles<br>6 mL vial / 24 bottles |
| Rinse vials | 2 pcs. 28 mL |
| Cooling temperature | STC vial rack:<br>15 °C to room temperature<br>STC syringe holder:<br>10 °C to room temperature |
| Power | 100/115/230/240 VAC (50/60 Hz)<br>400 VA |
| Dimensions and mass | Temperature controller:<br>220 (W) × 375 (D) × 100 (H) mm,<br>4 kg |
| | STC vial tray: 2.7 kg |
| | STC syringe holder: 0.45 kg |

## Constant Rate Injector for Vertical Furnace CRI-500V

| | |
|---|---|
| Sample | Liquid(non-aqueous) |
| Syringe | Gastight microsyringe<br>25, 50, 100 and 250 µL |
| Injection | Minimum injection volume 10 µL<br>Maximum injection volume 200 µL<br>(with 250 µL gas-tight microsyringe) |
| Injection rate | 0.4~1.6 µL/sec |
| Power | 100/115/230/240 VAC (50/60 Hz)<br>30 VA |
| Dimensions and mass | 150 (W) × 248 (D) × 240 (H) mm<br>5.6 kg |

## Gas Injector GI-510

| | |
|---|---|
| Sample | Non-pressurized gas, Volatile liquid |
| Injection | Gas: 10 mL with gastight syringe<br>Liquid: 10 µL with gastight microsyringe |
| Carrier gas | Argon<br>(Purity 99.98 % or more, 300±100 kPa) |
| Heater | 80 °C for vaporization of liquid |
| Power | AC100-240 V(50/60 Hz) 45 VA |
| Dimensions | 220(W) ×250(D)×110(H) mm |
| Mass | 4 kg |

## Gas Injector GI-520

| | |
|---|---|
| Sample | Non-pressurized gas, Volatile liquid |
| Injection | 1-10 µL liquid<br>2-25 mL gas (max. 999 mL) |
| Carrier gas | Argon<br>(purity 99.9 8 % or more, 300±100 kPa) |
| Heat | 80 °C for vaporization of liquid |
| Power | AC100-240 V(50/60Hz) 70 VA |
| Dimensions | 180(W) ×360(D)×500(H) mm |
| Mass | 13 kg |

## Gas Injector GI-560

| | |
|---|---|
| Sample | (1) Gas (Use a gastight syringe.)<br>Nitrogen, sulfur, and chlorine in gas<br>(2) Volatile liquid (Use a gastight microsyringe.)<br>Nitrogen, sulfur, and chlorine in volatile liquid<br>(3) Liquefied petroleum gas (Use an LPG cylinder.)<br>Nitrogen, sulfur, and chlorine in liquefied petroleum gas (LPG)<br>* Liquefied natural gas (LNG) is not acceptable. |
| Injection | Gas: Syringe port (max. 10 mL/ min)<br>Volatile liquid: Syringe port (max. 10 µL)<br>LPG: 30 µL sampling loop |
| Carrier gas | Argon |
| Heater temperature | From room temperature to 105 °C<br>(Recommended value: 85 °C) |
| Sample gas pressure | 6.5 MPa or less |
| Power | 100/115/230/240 VAC (50/60 Hz) 108 VA |
| Dimensions | 220 mm (W) × 370 mm (D) × 490 mm |
| Mass | 18 kg |

## Trap & Release Unit for Sulfur TRU-500(SD-500)

| | |
|---|---|
| Sample | Liquid, Gas |
| System | SO2 Gas Adsorption and Desorption |
| Measuring range | 5 ppb to 1 ppm |
| Temperature | 100～1,050 °C |
| Power | 100/115/230/240 VAC (50/60 Hz)<br>1500 VA |
| Dimensions | 180 (W) × 540 (D) × 500 (H) mm |
| Mass | 16 kg |

# NSX-5000V: List of relevant standard testing method

| Element | Method | Number | Scope |
|---|---|---|---|
| Sulfur by UVFL | ASTM | D5453 | Light hydrocarbons, Fuels, Oils |
| | ASTM | D6667 | LPG, Gaseous hydrocarbons |
| | ASTM | D7183 | Aromatic hydrocarbons |
| | ASTM | D7551 | Gaseous hydrocarbons, LPG & NG |
| | DIN/EN/ISO | 20846 | Petroleum products |
| | JIS | K2541-6 | Crude oil and petroleum products |
| | UOP | 987 Part-A | Very volatile liquid hydrocarbons |
| Nitrogen by CLD | ASTM | D4629 | Trace contents, Liquid petroleum hydrocarbons |
| | ASTM | D6069 | Aromatic hydrocarbons |
| | ASTM | D7184 | Ultra-traces, Aromatic hydrocarbons |
| | JIS | K2609 | Crude oil and petroleum products |
| | UOP | 936 | LPG |
| | UOP | 971 | Light aromatic hydrocarbons |
| | UOP | 981 | Very volatile liquid hydrocarbons |
| Chlorine by coulometry | ASTM | D5808 | Aromatic hydrocarbons |
| | ASTM | D4929 | Crude oil |
| | ASTM | D7457 | Aromatic hydrocarbons |
| | IP/EPA | 9076 | New and used petroleum products |
| | UOP | 779 | Petroleum products |
| | UOP | 910 | LPG and gases |
| Sulfur by coulometry | ASTM | D3120 | Light petroleum hydrocarbons |
| | ASTM | D3246 | LPG |
| | DIN/EN/ISO | 16591 | Petroleum products |
| | JIS | K2541-2 | Crude oil and petroleum products |
| | JIS | K2240 | LPG |



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