Quality Inspection Standards

TDLS8000
Tunable Diode Laser Spectrometer

1. Scope

This inspection standard applies to the Customized content specially designed TDLS8000 Tunable Diode Laser Spectrometer.

2. Inspection Items

2.1 Insulation Resistance Test
*** 2.2 Withstand Voltage Test**
*** 2.3 Repeatability, Linearity Test**
*** 2.4 Communication Test**
*** 2.5 I/O Test**

Note: Items marked with an asterisk (*) are reviewed only for the test certificate.

3. Inspection Methods, Standards, and Conditions

- ○ All inspections have to be done by dedicated inspection equipment.
- ○ Power supply: ±10% of 24V DC
- ○ Repeatability test and Linearity test are done by measuring Zero Gas, Span gas, and Mid-level gas, which are introduced into Calibration Cell.
  The gas conditions in the calibration cell are as follows. These tests can be done in completed analyzer style, and can be done in Laser module separately as well.
  Measurement gas temperature: 25~1500 °C
  Measurement gas pressure: 0~1 MPa
  Optical path length: 0.5~30m
- ○ The calibration standard gas (zero gas, middle gas, span gas) have to be ±2% accuracy.
- ○ Communication test and I/O test may be done by automatic inspection equipment.

3.1 Insulation Resistance Test

Apply 500 V DC to below part and confirm if insulation resistance is 100 MΩ or greater. When this inspection is done, jumper for Over voltage protection devices have to be removed.

- Sensor Control Unit (SCU)
  Between POWER, AO, AI, DI, DO, FAULT, VO, VO(HMI), SV and earth terminal (⏚)
  Between (POWER, VO, VO(HMI) , SV) and (AO, AI, DI, DO, FAULT), and earth terminal (⏚)
- Laser Unit (LU)
  Between VO and earth terminal (⏚)

3.2 Withstand Voltage Test

Apply 500 V AC which is close to sine wave, 50 Hz or 60 Hz frequency. The insulation must withstand this voltage for one minute at least. The sensed current should be 20 mA or less. When this inspection is done, jumper for Over voltage protection devices have to be removed.

- Sensor Control Unit (SCU)
  Between POWER, AO, AI, DI, DO, FAULT, VO, VO(HMI), SV and earth terminal (⏚)
  Between (POWER, VO, VO(HMI) , SV) and (AO, AI, DI, DO, FAULT), and earth terminal (⏚)
- Laser Unit (LU)
  Between VO and earth terminal (⏚)

3.3 Repeatability, Linearity Test

Repeatability is calculated by 2σ. σ is the Standard Deviation of the measurement data set on Zero Gas, Span gas, and Mid-level gas concentration. The criterion is shown in Table 1.

Linearity is calculated by δ/(Range). δ is the deviation between the reading and the known concentration of Mid-Level gas, after calibrating by Zero Gas and Span Gas. The criterion is shown in Table 1.

Table 1

Measured gas		Tolerance of Repeatability	Tolerance of Linearity
O_2		±1% FS or ±0.01% O_2 whichever is greater	±1% FS
CO (ppm)		±1% FS or ±1 ppm CO whichever is greater	±1% FS
CO + CH_4	CO	±1% FS or ±1 ppm CO whichever is greater	±1% FS
	CH_4	±2% FS or ±0.02% CH_4 whichever is greater	±2% FS
NH_3		±1% FS or ±1 ppm NH_3 whichever is greater	±1% FS
H2O (ppm) in non HC		±2% FS or ±0.1 ppm H_2O whichever is greater	±2% FS
H2O (ppm) in HC		±2% FS or ±0.1 ppm H_2O whichever is greater	±1% FS
CO (%)		±0.5% FS or ±0.01% CO whichever is greater	±0.5% FS
CO(%) + CO_2(%)	CO	±1% FS or ±0.1% CO whichever is greater	±1% FS
	CO_2	±1% FS or ±0.1% CO whichever is greater	±1% FS
H_2S		±1% FS or ±0.005% H_2S whichever is greater	±1% FS
CO_2 (%) High Range		±1% FS or ±0.005% H_2S whichever is greater	±1% FS
CO_2 (%) Extend. Range		±1% FS or ±0.02% CO_2 whichever is greater	±1% FS
H_2O (%)		±1% FS or ±0.02% H_2O whichever is greater	±2% FS
HCl		±1% FS or ±2.5ppm HCl whichever is greater	±2% FS

3.4 Communication Test

Confirm the following items;

. Connect TDLS8000 and PC (or YH8000) with an Ethernet cable, and confirm if connection works

. Connect HART communicator and 250 Ω resistors with AO-1 terminal in parallel. Confirm HART communication can be established.

3.5 I/O Test

Connect YH8000 and confirm the signal.

- **Analog Input**

Apply electric current shown in table 2 connecting a current generator to AI-1 terminal.

Choose I/O from setting Configuration display button (①) displayed on YH8000, and confirm it the current value at AI-1 terminal of Analog Input is within the values shown in table 2.

Similarly, confirm the current value at AI-2 terminal as well.

Table 2

Setting value	Reference value	Tolerance
4 mA	4 mA	±0.032 mA
12 mA	12 mA	±0.032 mA
20 mA	20 mA	±0.032 mA

- **Analog Output**

Apply electric current shown in table 2 connecting a multi meter to AO-1 terminal.

Choose Analog Output from Configuration button () displayed on YH8000, turn “Loop check mode” on, and confirm it the current value of “Check output” of AO-1 is within the values shown in table 2.

Similarly, confirm the current value at AO-2 terminal is within table 2 as well.

- **Digital Input**

Connect a switch to DI-1 terminal and switch on and off.

Choose I/O from setting Configuration display button (①) displayed on YH8000, and confirm it the value at DI-1 terminal of Digital Input is same as the values shown in table 3.

Similarly, confirm if the value at DI-2 terminal as well.

Table 3

Switch	DI value of YH8000
Short	Closed
Open	Open

- **Digital Output (DO/FAULT)**

Connect a multi meter to DO terminal (NC-COM).

Choose Digital Output from Configuration button () displayed on YH8000, and turn on “Loop check mode” of DO. Confirm it the resistance value on the multi meter (except the wiring resistance) is within the values shown in table 4 when Check status is changed.

Similarly, confirm the resistance value at DO terminal (NO-COM) and FAULT terminal (NC-COM) as well.

Table 4

Check status	Resistance value	
	NC-COM	NO-COM
On	100 MΩ or more	1 Ω or less
Off	1 Ω or less	100 MΩ or more

- **Solenoid Valve**

  Connect a multi meter to SV-1 terminal.

  Choose “Valve” from Configuration button () displayed on YH8000, and turn “Loop check mode” of SV-1 on, and turn “Check status” of. Confirm if the voltage value of the multi meter is within the values shown in table 5.

  Similarly, confirm it the voltage value at SV-2 is within the values shown in table 5 as well.

  Table 5

Check status	Voltage value
On	24 ±2.4 V DC
Off	1 V DC or less