

## 구 매 규 격 서

### Commodity Description

품목번호 Item No.	관세분류번호 HSK No.	품 명 Description	단위 Unit	수량 Q'ty
1	9027.100000	실 도로 환경 배출 연비 평가 시험 시스템 (Real Road Driving Environmental Emission & Fuel Economy Testing System)	system	1

#### I. End-user's Use

1. The system should be designed to sample and measure the raw & bag exhaust emission from gasoline, diesel, LPG, and Plug-in Hybrid fueled light duty vehicle according to the latest US EPA, Europe ECE, UN GTR-15 and Korean Emission & Fuel economy testing Regulations.
2. The system should consist of Bag emission bench, CVS system with bags, Particulate sampling systems, and one emission host computer system, that should control and operate sub- systems to progress the emission testing. And this system should fully integrate to the already installed with 4WD chassis dynamometer, Climate chamber, Raw emission bench, Direct Exhaust Flow meter at Suwon University.
3. The system should be designed to be operate satisfactorily without performance degradation or malfunction in the following laboratory environmental & Utility Conditions.
  - 1) Equipment room Temperature : 5 ~ 35 °C
  - 2) Equipment Relative Humidity: less than 80% non-condensation
  - 3) Electric Power
    - 220 VAC/1ph, 60Hz (ups)
    - 380 VAC/3ph, 60Hz
  - 4) Compressed air
  - 5) Cooling water
  - 6) Span Gases

#### II. System Configuration

1. Bag Emission Bench - 1 Set
2. CVS (Constant Volume Sampler) - 1 Set
3. Tunnel & Particulate Sampler - 1 Set
4. Particulate Weighting Chamber - 1 Set
5. Hybrid Extension Package - 1 Set
6. Automation System - 1 Set
7. Calibration Tools - 1 Set

### III. Technical Description

#### 1. Bag Emission Bench

1-1. The system should be designed to sample and measure bag emission and continuous diluted emission (diluted modal mass emission) from gasoline, diesel, LPG, and Plug-in Hybrid fueled light duty vehicle.

1-2. The system should have the following general functions to fulfill the higher complexity of the test for the upcoming vehicle developments & certification tests.

##### 1) Following Alarm precaution functions to avoid failure

- Analyzer Sensitivity Monitor
- Sampling Flow rate Monitor
- THC Background Monitor
- Reactor Pressure Monitor
- Analyzer Sensitivity Monitor

##### 2) Hour meter functions to be countered for consumable parts working

##### 3) Quality check notifications for regulation compliance

- scheduling & historical management for the quality & verification check.
- All check & verification results should be saved in bench operating PC.

#### 1-3. Bench Basic Unit

1) It should contain the main control unit based on real-time operating system, sample handling and conditioning units, valve modules, power supply units and all internal tubing. The interfaces and communications between a PC based main control unit and individual modules in the bench should be completely digitalized communication based on CAN Bus.

- The analyzer data acquisition modules from the analog to the digital has 24 bits.
- The Analyzer Data Sampling rates should be over 50Hz.

##### 2) Software function

- Flexible and open control concept for easy further extension
- Plug & Play integration of standard analyzers
- Analyzer history tracking
- Display of real-time and averaged measuring value
- Data monitoring (temperatures, pressures, etc.)
- Zero and span gas functions
- Sample
- Back Flush or bypass flow
- Purge
- Automatic Calibration and Quality checks & Reporting
- Automatic and Manual liberalization and check
- US CFR1065 Specific functions should be included :

1065.305	Verification for accuracy, repeatability, and noise (ANR Check)
1065.307	Analyzer linearity verification
1065.307	Gas divider verification
1065.308	Continuous gas analyzer system-response and updating-recording verification
1065.342	Sample gas cooler verification (semi-automated or automated, depending on the

	additionally required hardware)
1065.345d	Leak verification by dilution of span gas (overflow valves required)
1065.345e	Leak verification by vacuum decay
1065.350	H <sub>2</sub> O interference verification for CO <sub>2</sub> NDIR analyzers
1065.355	H <sub>2</sub> O and CO <sub>2</sub> interference verification for CO NDIR analyzers
1065.360	FID optimization and verification (analyzer feature)
1065.362	Non-stoichiometric raw exhaust FID O <sub>2</sub> interference verification
1065.365	Non-methane cutter penetration fractions
1065.370	CLD CO <sub>2</sub> und H <sub>2</sub> O quench check
1065.378	NO <sub>2</sub> to NO converter conversion check
1065.520f	Hydrocarbon contamination verification (Hang-Up)

### 3) Gas Preparation Unit

- Separated filtering system for Gasoline & Diesel

#### 1-4. Span Gas Unit for 4th Span Gas

It provides all functionality necessary to operate the bag emission bench with 4 span gases for the analyzer channel under consideration.

#### 1-5. Analyzers

##### 1) Analyzer General Specification

- Linearity  $\leq 2\%$  of measured value (10 - 100 % of range full scale)  
 $\leq 1\%$  range full scale whichever is smaller
- Permissible Ambient Temperature 5 - 40 °C
- Permissible Ambient Pressure 700-1,100 hPa abs. / 10.15-15.95 psi abs.
- Signal Processing Raw signal, requires bench control SW

##### 2) THC Analyzer

- Measured Compounds: THC
- Measurement Principle Flame Ionization Detector
- Possible Meas. Range: 0 ... 10 ~ 50,000 ppmC or more
- T90 for THC  $\leq 1.5$  sec
- Drift:  $\leq 1\%$  full scale / 8 h
- Reproducibility:  $\leq 0.5\%$  full scale

##### 3) CH4 Analyzer

- Measured Compounds: CH<sub>4</sub>
- Measurement Principle; Cutter Flame Ionization Detector
- Possible Meas. Range: 0 ... 10 ~ 20,000 ppmC or more
- T90 for CH<sub>4</sub>  $\leq 1.5$  sec
- Drift:  $\leq 1\%$  full scale / 8 h
- Reproducibility:  $\leq 0.5\%$  full scale

##### 4) NO<sub>x</sub> / NO Analyzer

- Measured Compounds: NO<sub>x</sub> / NO
- Measurement Principle Heated Chemiluminescence Detector
- Possible Meas. Range: 0 ... 10 ~ 1,000 ppm or more

- T90 for NO/NOx                    ≤ 1.6 sec
- Drift:                                    ≤ 1 % full scale / 8 h
- Reproducibility:                    ≤ 0.5 % full scale
- Quenching NO/NOX                ≤ 0.20 % / 0.30 % / % H2O  
                                              ≤ 0.04 % / 0.06 % / % CO2

#### 5) CO2 Analyzer

- Measured Compounds:    CO2
- Measurement Principle    Infrared Detector
- Possible Meas. Range:    0 ... 0.5 ~ 6.0 % or more
- T90 Time for CO2:        ≤ 1.8 sec
- Drift:                                    ≤ 1 % full scale / 8 h
- Reproducibility:            ≤ 0.5 % full scale

#### 6) COL Analyzer

- Measured Compounds:    CO
- Measurement Principle    Infrared Detector
- Possible Meas. Range:    0 ...50 ~ 2,500 ppm or more
- T90 Time for CO:        ≤ 3.0 sec
- Drift:                                    ≤ 1 % full scale / 8 h
- Reproducibility:            ≤ 0.5 % full scale

## 2. CVS (Constant Volume Sampler)

### 2-1. CVS Basic Unit

1) It should contain the bag manifold and sample pumps for collecting the exhaust and ambient sample into the bags.

The CVS is specially characterized by significantly simplified pneumatically gas manifold with new compact and modular valve matrix. The actual system operation status like valves and pumps are displayed through the flow schematic on the CVS user interface.

- Assembly design for easy integration into the test bed
- Extension of application range at the test bed due to the flexible design of exhaust-guiding measurement lines
- Fast and easy switching of flow using pressured-air controlled shut-off flaps
- Automated flushing and routine analysis
- Automated leak check via pressure decline method
- Easy extension of assemblies according to the application
- Automated bag purge and line purge functionality
- Automated leak check via vacuum switch

### 2) Software function

- 1065.345 Vacuum side leak verification
- 1065.545 Validation of proportional flow control
- 1065.170 MFC Batch sampling for gaseous
- 1065.350 Hang-up Test

The following CFR 1065 functions will be carried out without additional hardware but depending on one time system setting:

- 1065.20 unit display and transfer in mol, mol/sec
- 1065.640 CVS volume calculation in mol, mol/sec

### 3) CFV(Critical Flow Venturi) with Heat Exchanger & Silencer

The flow rate of each venturi can be selected by supplier, but the maximum flow rate of venturi combination should be 30M<sup>3</sup>/MIN with 4 venturis.

- Sensors for temperature, absolute- and differential pressure at venturi nozzles
- Humidity sensors after the heat exchanger
- Bag sample point through venturis
- Sampling point for dilute modal analysis
- Heat exchanger with temperature control unit and miscellaneous tubing's and connections for water transport.

### 2-2. CVS Bag Cabinet & Sampling Lines from Bags to Bag emission bench

#### 1) Bags & Cabinet

- Gasoline Sample Bags : 4ea
- Diesel Sample Bags : 4ea
- Ambient Bags : 4ea
- The bag cabinet should be tempered up to max. 35°C ±5°C. The temperature control is done via four fan heaters, mounted nearby the cabinet basement. For effective and reasonable temperature measurement the temperature sensors are mounted at the cabinet.

#### 2) Sampling Lines from to Bags to Bag emission bench

- The sampling lines from to bags to bag emission bench should be heated up to 35°C to avoid water contamination.

### 2-3. Tailpipe Adopters

- The adopters should be provided to connect from exhaust tailpipe of vehicle to emission system.

### 2-4. Dilution Air Mixing device.

#### 1) Dilution Air Filter

This filter should be composed of 3 stages which are pre filter, absolute filter, and activated carbon filter to have 99.97% efficiency removing particulates in dilution air.

#### 2) Dilution Air Heater

The system should have the heater to avoid the risk of condensation by the undiluted exhaust gas in a cooling chamber is reduced. The temperature of the heated dilution air is measured by a temperature sensor and controlled to a temperature of e.g. 25 °C ± 5 °C.

### 3. Tunnel & Particulate Sampler

#### 3-1. Dimensions of the Mixing Path of Tunnel

- The Material : Electro polishing inside of Stainless steel
- Exterior diameter: 273 mm
- Interior diameter: 270 mm
- Length: 2700 mm

#### 3-2. Probe Holes in Tunnel

- 1 hole for THC measurement probe
- 2 holes for Particulate Number Counter probe

### 3-3. Particulate filter

- 4 sets of PM filter holder for EU/US

### 3-4. Heated Particulate filter Box

- The box should provide a temperature stabilized enclosure for the particle filter installation and particulate sampling. The temperature of the housing is regulated up to 47°C +/-5°C. To exchange the particle filter the box provides a front door with quick release.

### 3-5. Particulate Sampling Controller

- This should have following check functions according to the listed 1065 paragraphs:

1065.20	Conversion units and calculations
1065.170	Sample flow calculation and control
1065.345/.644	Leak verification by vacuum decay
1065.545	Validation of proportional flow control
1065.640	Calculation of the volume flow rate and flow meter check
1065.667	PM background calculation

### 3-6. Diesel THC Analyzer

- Measured Compounds: THC
- Measurement Principle Heated Flame Ionization Detector
- Possible Meas. Range: 0 ... 10 ~ 50,000 ppmC or more
- T90 for THC ≤ 0.5 sec
- Drift: ≤ 1 % full scale / 8 h
- Reproducibility: ≤ 0.5 % full scale

## 4. Particulate Weighting Chamber

### 4-1. Weighing Chamber

This chamber should be a weighing chamber with a laminar flow, which monitors the temperature, pressure and dew point in the weighing area according to EPA 40 CFR part 1065 and therefore, fulfills the following legislations:

- 1065.190 PM weighing
- 1065.205 Performance spec for measurement instruments
- 1065.215 Pressure transducers, temperature and dew point sensors.
- 1065.305 Verifications for accuracy, repeatability, and noise
- 1065.315 Pressure, temperature, and dew point calibration
- 1065.390 PM balance verifications and weighing process verification
- 1065.790 Mass standards

### 4-2. Micro Balance

- Weighting capacity : 2.1g
- Readability : 0.0001mg

## 5. Hybrid Extension Package

5-1. Engine On-Off detector

This device should be used for detecting engine on-off, and send the signal to main host computer.

5-2. Tailpipe Pressure sensor & Controller

This sensor should measure the static pressure compared to the atmosphere at the raw exhaust inlet of the mixing device. And an error message should be sent from sensor to the host computer when the limit of ± 12.0 hPa is exceeded in order to comply the US CFR1065.140, (C), (2) .

This controller should control back pressure at the exhaust outlet (vehicle tailpipe) to keep almost no pressure difference to the ambient pressure at the tailpipe ending.

5-3. Bag filling with MFC(Mass Flow Controller)

This device should be designed for sampling from the diluted CVS volume flow and the subsequent exhaust bag filling via MFC as an alternative to sample venturis. The flow rate can be controlled step lessly by the CVS from 0 to 15 l/min.

5-4. Automated Test Cycles for EU Hybrid

EU Hybrid NOVC/OVC Vehicles					
Test Type	Test Cycle	Procedure	HEV	PHEV	EV
Preconditioning	Discharge Test	ECE R-101Amendment 4 Rev 2		X	X
	NEDC + NEDC		X		
	NEDC + EUDC			X	
	3 x EUDC			X	
Emissions Test	NEDC 2 phases		X		X
	NEDC 1 phase			X	
	n x NEDC (electric range)			X	X
	n x NEDC (gaseous bag emissions)			X	

5-5. Automated Test Cycles for US Hybrid

US Hybrid					
Test Type	Test Cycle	Procedure	HEV	PHEV	EV
Preconditioning	2 x UDSS	SAE J-1711 from June 2010	X	X	
Emissions Test	2 x UDSS		X	X	
	FTP75		X	X	
	HWFET		X	X	

	n x UDDS (1 or 2 bags)			X	X
	n x HWFET			X	X
	n x US06 Range Test			X	
	US06		X	X	
	SC03		X	X	

## 6. Automation System

### 6-1. Automation Hardware

- 1 Test bed workstation advanced in 19" rack
- 1 Ethernet interface (2 channel)
- 1 IEEE 1394 F-FEM adapter
- 1 8xRS232 adapter / USB
- 1 F-FEM-CON ADVANCED
- 1 F-FEM-DIO
- 1 F-FEM-AIN
- 1 F-FEM-DAC
- 2 21,5" TFT-display
- 1 Double conversion on-line UPS with 1500 VA / 1350 W

### 6-2. Weather Station

- Temperature of test cell air
- Relative humidity of test cell air
- Ambient barometric pressure of test cell air

### 6-3. Diver's Aids PC & Monitor

- This should be installed inside of test cell to lead a driver to follow the test cycles.

### 6-4. Automation Software

1) This Emission Automation system should control, manage, and operate for each all sub- devices following.

- Bag Emission Bench
- CVS (Constant Volume Sampler)
- Particulate Sampler
- Calibration Tools
- (Existed) AMA i60 R1 for Raw measurement
- (Existed) Flow sick direct exhaust flow meter

#### 2) Functions

- Test Mode operation
- Raw Modal Analysis
- Diluted Modal Analysis
- Bag Analysis
- Test calculation, reporting, saving test results

#### 3) Test Cycles

- FTP 75
- FTP 72 (city cycle)- UDDS (Urban Dynamometer Driving Schedule)



- US 505
- ECE and EURO3
- NEDC
- MVEG (ECE R-15/05)
- JC08
- SC03
- US06
- HFET (Highway Fuel Economy Test)
- NYCC (New York City Cycle)
- WLTC
- Korea Environmental Regulation

## 7. Calibration Tools

### 7-1. Gas Divider & NOx Converter checker

- 15 Steps gas dividing with 4 sonic nozzles

### 7-2. CFO Checker

- Precision of flow rate : +/- 0.5% of selected flow rate

## IV. Remarks

1. Supplier has to propose and provide the latest model of Emission Test System for th Light Duty Vehicle Emission system of supplier.
2. Warranty period of all supplied equipment has to be two years after issuing of the final acceptance certificate by the end user.
3. Technical proposals should include as follows ;
  - Drawings & Materials for layout and utilities
  - Catalogues or materials that user can check the performance of all supplying equipment.
  - After Service Organization in Korea and A/S plan has to be proposed
4. Supplier/contractor should provide a certificate of type approval that issued by Ministry of Environmental of Korea within three month after final acceptance test and provide some engineers and preparation documents for the accuracy tests that issued by Ministry of Environmental of Korea
6. After warranty period, the supplier/contractor should have system checks and report for the total system according to the accuracy test method.
7. Training program:
  - On-site training Supplier should provide the on-site training for two weeks after installation at its expense.
8. Each three copies of instruction, operation, trouble shooting and maintenance manuals of all equipment

should be provided (English Version)

9. The daily / weekly / monthly and annual maintenance check list should be provided in the manual.
10. Contractor/Supplier should submit the daily work-sheet during installation.
11. In the event of any damage of system during installation the contractor/ supplier should restore it to the original condition with his expenses.
12. User is designated as custom tax reduction institute by Korea government, so supplier should provide all documents (catalogue, drawings, material part book and soon) about the tax reduction by airmail before shipping.
13. Installation  
The supplier should provide all necessary electrical and mechanical materials as well as man powers for the installation of the system and supplier has to provide the detail schedule at least one month before starting of installation.
14. Commissioning
  - Verification of installation
  - Check of electrical and pneumatic operation
  - Verification of calibration and general operation, Specially the supplier should provide gases, vehicle, driver, etc for this work.
  - Stand alone execution of test cycles to verify proper operation.