Chapter 2 — Specifications

Environmental Specifications

The 6900 subsystem will perform to specification when subjected to any combination of the environmental conditions listed below.

	Operating Range	Storage Range
Temperature	0 to 70°C (32 to 158°F) (reduced accuracy > 50°C)	–25 to 70°C (1) (–4 to 158°F)
Humidity	5 to 95% (non-condensing) (2)	
Altitude	–300 to 3,000 m (–1,000 to 9,750 ft)	–300 to 3,000 m (–1,000 to 10,000 ft)
Vibration	1.0 g sinusoidal, 5 to 1,000 Hz	0.01 g^2/Hz(3)
Shock	7.6 cm (3.0 inch) drop on any corner (in final system enclosure)	
EMI/EMC	CFR Title 47, Part 15, Subpart J, Class A and B. CFR Title 47, Part 68.	

1. Storage temperature range for Andros supplied NO_x sensor is –20 to 50°C; sensors may be stored outside this range for up to 10 days. The optimal storage temperature for the NO_x sensor is 5 to 20°C.
2. NO_x sensor humidity range is 15 to 90% RH.
3. Installed configuration or packaged for shipment.

Mechanical Specifications

	Model 6900 Shelf Subsystem (excluding water trap/filter assembly)		Model 6500/6510 NDIR Bench
	Basic	OIML	ALL
Width	27.0 cm (10.6 in)	27.0 cm (10.6 in)	19.7 cm (7.7 in)
Depth	20.06 cm (7.3 in)	18.5 cm (7.9 in)	7.3 cm (2.87 in)
Height	10.16 cm (4.0 in)	10.0 cm (4.0 in)	5.0 cm (2.0 in)
Weight	2.1 kg (4.63 lb.)	2.1 kg (4.63 lb.)	0.3 Kg (0.8lb)

Power Specifications

The following input power specifications define the worst-case conditions for acceptable operating performance of the 6900 shelf subsystem:

Input Voltage	+12 VDC nominal (+9 to +16 VDC)	
	Model 6900	Model 6500/6510
Average Power Consumption (1)	13.5 W	1.8 W
Maximum Power Consumption	18.5 W	2.4 W

(1) 12 VDC input power @ 25°C

Gas Measurement Accuracy, Repeatability, Noise, and Resolution

Gas	Measurement Range	Accuracy	Repeatability	Noise (rms.)	Resolution
HC n-Hexane	0 to 2,000 ppm 2,001 to 7,000 ppm 7,001 to 15,000 ppm 15,001 to 30,000 ppm	±4 ppm abs. or ±3% rel. ±5% rel. ± 15% rel unspecified.	±3 ppm abs. or ±2% rel. ±3% rel. ±5% rel. unspecified	2 ppm abs. or 0.8% rel.	1 ppm
HC Propane	0 to 4,000 ppm 4,001 to 30,000 ppm 30,001 to 60,000 ppm	±8 ppm abs. or ±3% rel. ±15% rel. unspecified	±6 ppm abs. or ±2% rel. ±5% rel. unspecified	4 ppm abs. or 0.8% rel.	1 ppm
CO	0.00% to 10.00% 10.01% to 15.00%	±0.02% abs. or ±3% rel. ±5% rel.	±0.02 abs. or ±2% rel. ±3% rel.	0.01% abs. or 0.8% rel.	0.001vol. %
CO_2	0.00 to 16.00% 16.01 to 20.00%	±0.3% abs. or ±3% rel. ±5% rel.	±0.1% abs. or ±2% rel. ±3% rel.	0.1% abs. or 0.8% rel.	0.01vol. %
NO_X	0 to 4,000 ppm 4,001 to 5,000 ppm	±25 ppm abs. or ±4% rel. ±5% rel.	±20 ppm abs. or ±3% rel. ±4% rel.	10 ppm abs. or 1% rel.	1 ppm
O_2	0.00 to 25.00%	±0.1% abs. or ±3% rel.	±0.1% abs. or ±3% rel.	0.1% abs. or 1.5% rel.	0.01 vol. %

Notes:

1) The Models 6900 / 6500 / 6510 can report outside of its specified measurement ranges.
2) The Models 6900 / 6500 / 6510 can report gas concentrations at reduced accuracy when operated outside of specified conditions defined by ISO3930/OIML R 99 and BAR i.e., temperature > 50°C or < 0°C.
3) Negative gas concentrations can indicate either of the following:
   a) Negative measurement drift, or
   b) Incorrect HC, CO, CO_2 zero calibration (e.g., zero calibration when IR absorbing gas or moisture is present in the sample cell).
4) When both absolute and relative measurement tolerances are specified, the greater measurement tolerance of the two is used.
5) The accuracy table is based on California BAR-97 requirements between the temperatures between 35 to 110°F (1.7 - 43°C)
6) ISO 3930/OIML R 99, Class 0 allows for ±5% relative error for temperatures between 32 to 122°F (0 - 50°C)
7) Drift is measured with Nitrogen flowing through the sample cell at one to two liters per minute. All zero requests are honored when indicated. Maximum stability occurs per BAR 97 ASM 30 minutes after POR.

Measurement Range: The range that is applicable to the accuracy and noise measurements.

Accuracy: The 6900 gas concentration measurement tolerance.

Repeatability: An individual 6900s measurement tolerance when repeating the same measurement.

Resolution: The smallest increment reported.

Noise: Measurement transients produced by the analyzer.

Warm-Up

The bench/subsystem will transition from start-up to normal operating mode within 35 seconds after POR, after which it will request a zero. After the first zero, the analyzer is useable at reduced accuracy for the next three (3) minutes, after which it will request a second zero. The unit is at full accuracy after the second zero is performed. Zero drift as defined by the BAR 97 ASM specifications is measured after the unit has been allowed to stabilize for 30 minutes after POR.

Propane Equivalency Factor (PEF)

The 6900 subsystem Propane Equivalency Factor (PEF) value is nominally in the range of 0.470 to 0.560 for HC (n-Hexane) concentrations up to 2,000 ppm when the Models 6900 / 6500 / 6500 are operated at an ambient temperature environment of 25°C ±10°C. This applies to BAR-97 applications. For OIML and diagnostics applications the calculated variable PEF can be in the range of 0.470 to 0.585.

The 6900 variable PEF value (reported by $05--PEF1, PEF2) is calculated in real-time, and defines the n-hexane concentration as a fraction of the (optically) equivalent propane concentration that may be reported as the current HC concentration. The variable PEF range is 0.470 to 0.585.

Cross-Gas Interference

The presence of one gas can cause errors in the measurement of a second gas. Maximum 6900 cross-gas interference effects conform to ISO 3930/OIML R 99, Class 0/1 and BAR-97 specifications and are listed below:

Primary Gas	Maximum Cross-Gas Interference	Maximum Interfering Gas Concentrations
HC	±4 ppm	1) 16% carbon dioxide in nitrogen. 2) 1,600 ppm hexane in nitrogen. 3) 10% carbon monoxide in nitrogen. 4) 3,000 ppm nitric oxide in nitrogen. 5) 75 ppm hydrogen sulfide in nitrogen. 6) 75 ppm sulfur dioxide in nitrogen. 7) 18% carbon dioxide and 9% carbon monoxide in nitrogen. 8) h) Water-saturated hot air.
CO	±0.02%	
CO_2	±0.20%	
NOx	±20 ppm	

System Transport Time

System transport times are specified for a 6900 with 8m-hose/probe and particle filter/water trap as follows:

	System Transport Time
HC	≤ 5 seconds.
Propane	≤ 5 seconds.
CO	≤ 5 seconds.
CO_2	≤ 5 seconds.
NO	≤ 7 seconds.
O_2	≤ 7 seconds.

Method: Create a rapid step change in gas concentration at the probe tip. System transport time is the time required to report the first analyzer gas concentration change.

System Response Time

System response times are specified for a 6900 with 8m-hose/probe and particle filter/water trap as follows:

	Rise Time	Fall Time
HC	T90 ≤ 8.0 seconds.	T10 ≤ 8.0 seconds.
Propane	T90 ≤ 8.0 seconds.	T10 ≤ 8.0 seconds.
CO	T90 ≤ 8.0 seconds.	T10 ≤ 8.0 seconds.
CO_2	T90 ≤ 8.0 seconds.	T10 ≤ 8.0 seconds.
NO	T90 ≤ 12.0 seconds.	T10 ≤ 12.0 seconds.
O_2	Response time from 20.9% to 0.10% O_2 ≤ 40 seconds, and T90 response time ≤ 15.0 seconds.	

Method: Create a rapid step change in gas concentration at the probe tip. System response times (at a flow rate into the water trap at 6 liters/minute) are the times required to report the specified analyzer gas concentration changes.

Model 6500/6510 Analyzer/Sensor Response Time

Analyzer /sensor response time is measured as follows:

	Rise Time	Fall Time
HC	T90 ≤ 3.0 seconds.	T10 ≤ 3.0 seconds.
Propane	T90 ≤3.0 seconds.	T10 ≤ 3.0 seconds.
CO	T90 ≤ 3.0 seconds.	T10 ≤ 3.0 seconds.
CO_2	T90 ≤ 3.0 seconds.	T10 ≤ 3.0 seconds.
NO	T90 ≤ 5.0 seconds.	T10 ≤ 6.0 seconds.
O_2	Response time from 20.9% to 0.10% O_2 ≤ 40 seconds. Rise time for 1.10% O_2 to 20.9% O_2 ≤ 20 seconds.	

Method: With a minimum gas flow of 1 liters/minute, create a rapid step change in gas concentration at the inlet port of the Model 6500/6510 analyzer. Analyzer/Sensor response times are the times required to report the specified analyzer gas concentration changes.

Host Communications Interface

The Models 6900 / 6500 / 6500 commands, status, and data-transfer are provided by the host communications interface. Refer to the Hardware Interfaces chapter for connector pin assignments.

Interface Type: RS-232C asynchronous or USB 1.1.

Baud Rate: 19,200 bps (default) or 9,600 bps (optional via Model 6500/6510 parameter change).

RS-232 Format: 1 start bit; 8 data bits; no parity bit; 1 stop bit.

Signals: Transmit data; receive data; signal ground. CTS and RTS handshaking signals are not used by current Model 6900 / 6500 / 6500 configurations.

Auxiliary I/O Interfaces

Auxiliary interfaces are provided for attachment of external devices to the 6900 subsystem. Refer to the Hardware Interfaces chapter for additional specifications and connector pin assignments.

TTL Outputs: AUXOUT 6 and AUXOUT 7 are user-defined TTL outputs host system controlled via the $08 Device Control command.

Tachometer Input: TACHIN is a TTL compatible pulse counter input dedicated to a tachometer function.

Analog Input: Model 6900/6500 Mode: ADC1 and ADC2 are user-defined analog inputs. Input range is 0.01 to 4.0 VDC. A companion reference signal (V Ref) and the Model 6900 / 6500 / 6500 analog ground is also provided.