SERIES AP

AP1 Probe

In-Situ Carbon Probe For Carbon Control Systems

- High temperature carburizing heat treating
- Carbonitriding
- Endothermic gas generators
- High accuracy and repeatability
- High efficiency, low maintenance
- Energy cost savings
- Rapid response
- Compatible with all carbon controllers
- Reference air supply and burnoff enclosures

Introduction

The AP1 In-Situ Carbon probe, one of the Series AP probes, is a direct and continuous carbon potential probe. Its unique patented design features a cylinder of special zirconium oxide formulation, welded into the end of an alumina tube by means of an eutectic welding process. The resultant homogenous structure provides the most rugged element design. The superstructure is a high temperature special alloy with a flow through tip design to minimize soot collection. Internal connections are protected by a high quality connecting head. External connections are made with a quick disconnect plug. The probe can measure very low oxygen partial pressures with extreme accuracy and repeatability. It will control furnace atmospheres and generator gas supplies over the full range of carburizing hardening applications.

Energy Cost Savings

Using the AP1 Carbon probe, operating conditions can be achieved more rapidly and better atmosphere control can be maintained. The carburizing gas supply is used more efficiently, resulting in energy savings and reduction in furnace burnouts. Leakage of furnace seals or firing tubes are detected, notably improving furnace efficiency.

Maintenance

This Series AP carbon probe does not require frequent maintenance and cleaning. No calibration is required. The only part subject to wear is the outer electrode, which can be renewed at the factory. A special purge fitting just below the head of the probe allows filtered air to enter the sheath of the probe for burnoff. Probe burnoff is initiated manually or by the carbon controller. The protection tube has excellent resistance to corrosion and carburization at high temperature, good mechanical strength, and is not affected by hydrogen embrittlement.

Operation

The AP1 Probe is suitable for high temperature carburizing heat treating, carbonitriding and endothermic gas generators. It should not be used for nitriding applications.

Zirconia is a solid state electrolyte, which conducts oxygen ions at temperatures above 1400°F. The ion conduction results in a voltage between the two electrodes. Two connections to the zirconia cell conduct the voltage to the four pin connector.

$$\text{probe Vdc} = 0.0215 \times T \times \ln(O_1/O_2)$$

probe Vdc = sensor output in mV;
T = sensor temperature in degrees Kelvin (°K);
O_1 = oxygen concentration on inside surface of the sensor – ambient air which is 20.9% oxygen;
O_2 = sample oxygen concentration on outside surface of the sensor – furnace atmosphere.
ln = natural logarithm

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Reference Air Supply and Burnoff Enclosures

Burnoff Enclosure shown

The reference air and burnoff enclosures are self-contained CE compatible units that provide reference air and/or burnoff purge to the AP1 carbon probe. Reference air of approximately 20% oxygen must be supplied for the carbon probe to perform properly. The reference air enclosure is equipped with a single flow-meter and output. The burnoff enclosure is equipped with reference air and burnoff air flowmeters and outputs. An atmosphere controller with an event output can trigger the probe burnoff.

Probe burnoff is recommended to keep the carbon probe free of carbon deposits and its performance at an optimum level. Carbon accumulation in the probe can create intermittent connections and erroneous localized oxygen reading. Using atmosphere controllers with probe cleaning, burn-off and recovery features will increase the longevity of the probe and keep control upsets to a minimum.

AP1 CARBON PROBE TECHNICAL SPECIFICATIONs

Output	1.00 to 1.20 Vdc over carburizing range.
Readout	% carbon probe should be used with controlling, recording, and indicating instruments that have input impedance of 8 MegOhms or higher.
Immersion Depth	Two to four inches (recommended).
Thermal Shock	The special alloy protection tube acts as a heat sink that allows the alumina tube inside to change temperature at a slow rate.
Mechanical Shock	The protection tube is not subject to mechanical shock. The alumina tube inside has fair resistance to mechanical shock.
Weight/Length	Weight–3lb 5oz. Length–21" (other lengths available). Shipping wt–5lb 8oz.
Accuracy	±0.05 weight % carbon in normal operating range.
Response Time	Less than 1.0 second.
Reference Air	Uncontaminated air at recommended rate of 236cc per minute (0.5 cubic feet per hour).
Protection Tube	Special alloy is resistant to corrosion and oxidation up to 2012°F (1100°C).Very good mechanical strength.
Operating Temperature	Approx. 1400°F (760°C) to 2012°F (1100°C) vertical mount; Approx. 1400°F (760°C) to 1760°F (960°C) horizontal mount
Thermocouple	Types K, R and S.
Air Purge Fitting	Allows connection of low flow (approximately 2 CFH) air supply to burn off accumulated carbon in probe.
Endothermic Atmospheres	Millivolt readings for endothermic atmospheres generated from methane (natural gas) and containing approximately 20% CO + CO_2:

AP1 ACCESSORIES

Cable Assemblies

A-	10727-200-0-06	Type K/flexible armor
A-	10727-300-0-06	Type R/S/flexible armor
A-	12237-200-0-06	Type K/no flexible armor
A-	12237-300-0-06	Type R/S/no flexible armor

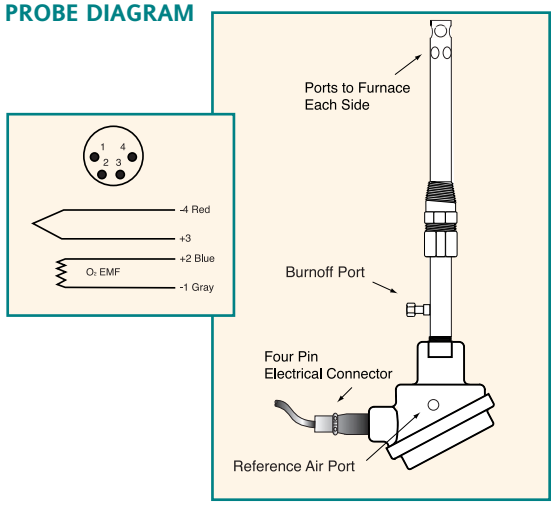
Reference Air Supplies, Single Output

A-	13893-000-0-00	120 Vac, 50/60 Hz., panelmount
A-	13893-000-1-00	120 Vac, 50/60 Hz., with housing
A-	13893-000-0-01	240 Vac, 50/60 Hz., panelmount
A-	13893-000-1-01	240 Vac, 50/60 Hz., with housing

Reference Air Supplies, Reference and Purge Output

A-	13893-200-0-00	120 Vac, 50/60 Hz., panelmount
A-	13893-200-1-00	120 Vac, 50/60 Hz., with housing
A-	13893-200-0-01	240 Vac, 50/60 Hz., panelmount
A-	13893-200-1-01	240 Vac, 50/60 Hz., with housing

AP1 CARBON PROBE DIAGRAM



ORDERING CODE

Base Model	T-couple Type	Reserved	Length (Dim "L")	Reserved	Cable	Reserved	Reserved	Label/ Manual	Reserved
AP1		001		4		1	1		0

Base Model	
AP1	Carbon probe

Thermocouple	
1	Type K
2	Type R
3	Type S

Length (Dimension L)	
21	21" probe, Type K, Type R or Type S
LL	Length in whole inches (22" min. to 41" max.)

Cable	
0	Six feet, no armor
1	Six feet, with armor
9	Other than 6 feet (specify length when ordering)

Label/Manual	
0	Barber-Colman
E	Eurotherm

EUROTHERM CONTROLS INC
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