

COSASCO® HYDROGEN PROBES

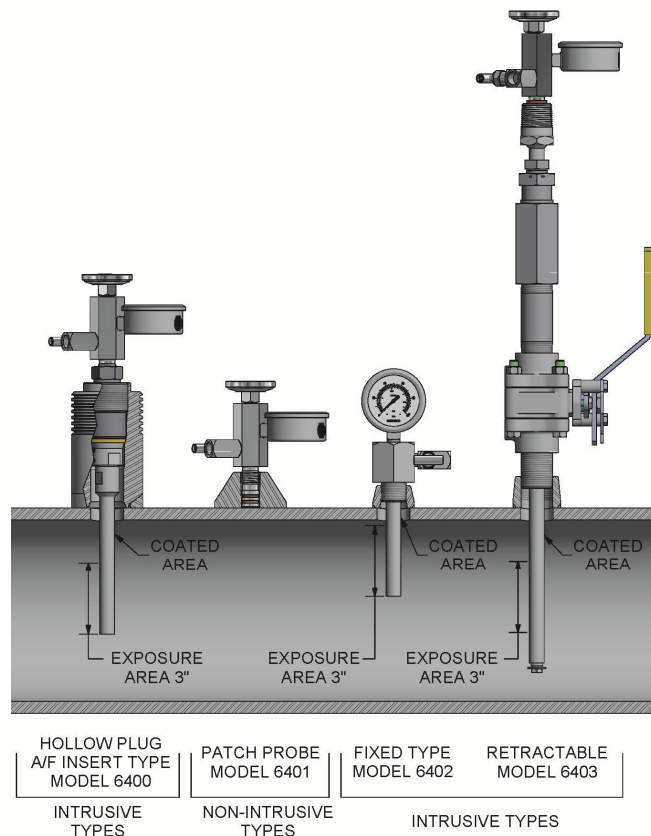
Model 6400

Features

- Simple Reliable Method
- Meets NACE MR0175 and MR0103
- Intrusive and Non-Intrusive Models
- No Chemicals or Shelf Life Problems

Introduction

Atomic hydrogen (H^+), generated by the cathodic corrosion reaction can lead to two types of failures in steels; **Hydrogen Blistering** and **Hydrogen Induced Cracking** (HIC). Part of the hydrogen produced by the cathodic corrosion reaction may permeate the steel by diffusion, and the balance is dissolved in the process electrolyte or released as bubbles of gas. Poisoning agents in the process, such as hydrogen sulfide, cyanide, and arsenic, inhibit the formation of molecular hydrogen on the metal surface and therefore increase the proportion of atomic hydrogen which diffuses into steel.



HYDROGEN BLISTERING

Atomic (or nascent) hydrogen (H^+), is small enough to permeate steel. At any cracks or inclusions in the pipes or vessels, the permeating atomic hydrogen combines to form hydrogen gas (H_2) which is then too large to diffuse any further through the steel. The accumulation of hydrogen gas in these interstitial spaces results in an ever growing gas pressure causing a deformation known as blistering. The effects of blistering can be sufficient to rupture steel several inches thick. This phenomena occurs irrespective of the hardness of the steel.

HYDROGEN INDUCED CRACKING (HIC)

Hydrogen embrittlement, which can lead to hydrogen induced cracking, occurs in hard carbon steel (above HRC22) at areas of high stress. Atomic hydrogen permeating the steel collects at inclusions, lattice defects, and grain boundaries, causing the embrittlement and susceptibility to stress induced cracking and fatigue. Although the exact mechanism of hydrogen embrittlement is unknown, it has shown experimentally that it is correlated to the flux of atomic hydrogen into the steel.

HYDROGEN MONITORING

Hydrogen monitoring instruments indicate the susceptibility of steel to HIC and hydrogen blistering by measuring the rate of atomic hydrogen permeation. Generally, the utility of this application is in qualitatively detecting process upsets which tend to markedly increase the flux of nascent hydrogen. Because the hardness and stressing of the steel affects the

susceptibility to hydrogen damage, quantitative assessment is often difficult. However, relative hydrogen flow rates and the estimated associated damage they create are available (See Cosasco Application Note AN111 for further guidance). Hydrogen monitoring is also used on occasions to monitor the rate of corrosion, but the relationship between corrosion rate and hydrogen permeation varies with fluid dynamics, the method of hydrogen monitoring, and relative content of poisoning agents in the process.

Cosasco hydrogen probes detect hydrogen gas by the simple hydrogen pressure increase produced in an artificial cavity in the steel, i.e. the same mechanism as hydrogen blistering. The pressure build-up is directly proportional to the flux of atomic hydrogen, which can be determined by implementation of the ideal gas law. If the volume of the hydrogen probe cavity and the cross-sectional area across which diffusion is occurring is known, determination of the flux is a simple calculation.

Models 6400, 6401 and 6403 utilize the same bleed cross assembly (P/N 127130). The assembly consists of a bleed cross/block, pressure gauge (dual scale metric and english), thermometer (dual scale Celsius and fahrenheit), and bleed valve. The thermometer provides a means for correcting the change in pressure readings due to fluctuations in either ambient or process stream temperatures. The bleed valve is used to relieve built up pressures at intervals in order not to exceed the pressure gauge rating.

This reliable physical measurement principle is a simpler and easier method than other electrochemical methods. These alternative methods require the handling of hazardous chemicals, or have sealed cells with limited shelf life. The life of the intrusive probe type measurement elements are normally substantial but they may be replaced, when required. Several Cosasco hydrogen probe configurations are available, each having their own benefits and limitations.

Model 6400

MODEL 6400 HYDROGEN INSERT PROBE

Intrusive monitoring element which uses Cosasco Two Inch System Access Fitting.

Benefits

- Thin wall sensing element allows for quicker response times.
- Rated for pressures up to 6000 PSI
- Removable under system pressure.
- Internal temperature gauge allows compensation for temperature variations.

Limitations

- Requires service valve and retriever if not already available

Spares	P/N
Bleed Cross Assembly	127130
Pressure Gauge 0 -100 psi	201924
Temperature Gauge	200746
Vent Valve	202008
O-Ring Seals	124603

MODEL 6401 HYDROGEN PATCH PROBE

Non-intrusive carbon steel patch welded to the exterior of the pipe or vessel to be monitored.

Benefits

- Directly monitors the flux of H+ through the walls of the pipe or vessel.
- Can be used at all system pressures and temperatures.
- Internal temperature gauge allows compensation for temperature variations.

Limitations

- Slower response time (dependent upon pipe or vessel wall thickness).
- Stress relieving after welding is necessary (possible problem for large vessels which are already installed).

Ordering Information

Note: For high velocity process conditions it is recommended that Wake Frequency Calculations be performed – please contact a Cosasco Representative for further details.

Model	High Pressure Hydrogen Probe Assembly	
6400	Hydrogen Insert Probe	
	Code	Length – Indicate Length Required
	XX.XX	Available in 1/4" increments from 5.75 inches to 9.75 inches and 1" increments from 10.00 inches to 30.00 inches
	Code	Bleed Cross Assembly
	0	Not Required
	1	Supply - Assembled

6400	—	06.00	—	1	←	Example
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UNIT

WEIGHT: Model 6400
 Probe length 5.75" - 9.75", 3 lbs./1.36 kg.
 Probe length 10.00" - 20.00", 4.5 lbs./2.04 kg.
 Probe length 21.00" - 30.00", 6 lbs./2.72 kg.
 Bleed Cross Assembly 2 lbs./ .9 kg.

Ordering Information

Model	Hydrogen Probe Assembly	
6401	Hydrogen Patch Probe	
	Code	Pipeline Size
	02	2 Inches
	03	3 Inches
	04	4 Inches
	06	6 Inches
	08	8 Inches
	10	10 Inches
	12	12 Inches
	14	14 Inches
	16	16 Inches
	18	18 Inches
	20	20 Inches
	24	24 Inches
	30	30 Inches
	36	36 Inches
	FL	Flat
	Code	Material
	G10220	AISI 1022 C.S.
	K03011	ASTM A350 LF 2 C.S.
	CODE	Bleed Cross Assembly
	0	Not Required
	1	Supply – Not Installed

6401	—	02	—	G10220	—	1	←	Example
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UNIT WEIGHT: Model 6401 5 lbs./2.27 kg.
 Bleed Cross Assembly 2 lbs./ .9 kg

Model 6400

MODEL 6402 FIXED HYDROGEN PROBE

Intrusive monitoring element requiring 3/4" or 1" NPT fixed access.

Benefits

- Low cost.
- Thin wall sensing element allows for quicker response times.

Limitations

- No compensation for temperature variations.
- Cannot be removed under system pressure.

Spares	P/N
Pressure Gauge (0-100 PSI)	201924
Vent Valve	202008

MODEL 6403 RETRACTABLE HYDROGEN INSERT PROBE

Intrusive monitoring element which requires a minimum of 1" full port valve and NPT mounting nipple for access.

Benefits

- Thin wall sensing element allows for quicker response times.
- Retrievable under system pressure.
- Internal temperature gauge allows compensation for temperature variations.

Limitations

- Maximum pressure rating 1500 psi.

Spares	P/N
Bleed Cross Assembly	As Model 6400
Probe Insert P/N - Length	640011-LL
Stuffing Box	745002-8003

Note: For high velocity process conditions it is recommended to Wake Frequency Calculations be performed – please contact a Cosasco representative for further details.

Ordering Information

Note: For high velocity process conditions it is recommended that Drag Force Calculations be performed – please contact a Cosasco representative for further details.

Model	Retractable Hydrogen Probe	
6403	Model 60 Hydrogen Probe Assy. C/W Safety Clamps	
	Code	Order Length in Inches
	18	18 Inches
	24	24 Inches
	29	29 Inches
	Code	
	0	Without Safety Clamp
	1	With Safety Clamp
6403	18	1

Example

UNIT WEIGHT: Model 6403
 Probe Length 18" 7 lbs./3.17 kg.
 Probe Length 24" 8 lbs./3.60 kg.
 Probe Length 29" 9 lbs./4.08 kg.
 Bleed Cross Assembly 2 lbs./0.9 kg.

Cosasco
 11841 Smith Avenue
 Santa Fe Springs, CA 90670, USA
 Tel: 1-562-949-0123
 Email: sales@cosasco.com
 Web Site: www.cosasco.com

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Rohrbach Cosasco Systems Corrosion Monitoring Equipment is manufactured and sold under one or more of the following US Patents: 4138878, 4238298, 4338563, 4514681, 4537071, 4587479, 4605626, 4625557, 4755744, 4839580, 4841787, 4882537 5243297



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