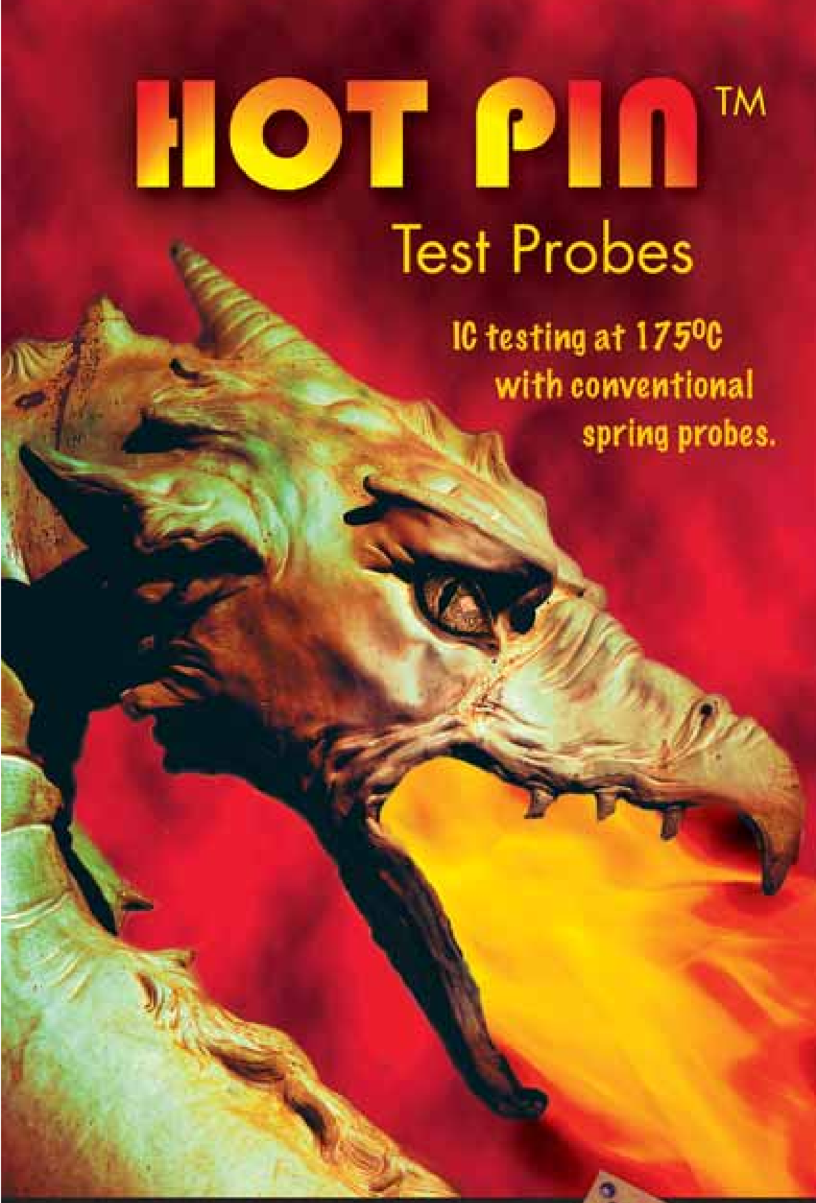
HOT PIN™

Test Probes

IC testing at 175°C with conventional spring probes.



Why Test ICs at Elevated Temperatures?

Some ICs are specified to work at elevated temperatures, and the final test has to duplicate the temperature conditions of the specifications. This is often the case for ICs used in automobiles.

Some ICs that are rated for room temperature use are temperature stressed during test to cull out marginal devices.

Historically, the upper temperature limit for testing ICs with spring probe sockets has been 150ºC, but there is an emerging need to test up to 175ºC.

Are There Other Reasons?

Even if the test chamber is at room temperature, sometimes the test probes get rather warm from having electrical current constantly passing through them. This is especially true when the spring probes are tightly contained in the insulating plastic jacket of a socket or a fixture.

A high temperature rating for the spring pins will result in less worries about the internal socket temperatures.

What Is the Temperature Rating of a Spring Probe?

When using a spring made from music wire, the maximum temperature rating is 120ºC. Above that temperature, a music wire spring looses some of its springiness and the spring probe's contact force will be lowered. Depending on the tip geometry and the test target material, the contact resistance might increase and the durability of the test probe will degrade.

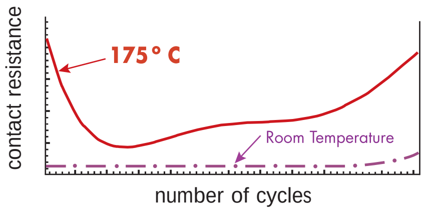
Stainless steel springs are rated up to 290ºC. But due to other metallurgical limits of standard spring probes, they cannot be used over 150ºC.

HOT PIN™ test probes can be used up to 175ºC.

What Happens to a Conventional Probe at 175ºC ?

When a conventional spring pin is used at 175ºC, the CRES of the pin becomes very high and unstable.

Durability Test Result - Standard Probe

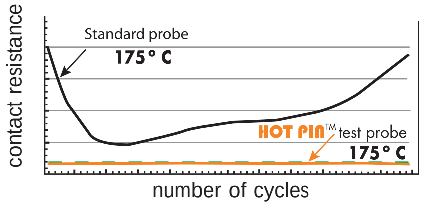


solid red line	Baking 20 hours at 175º C ⇨Life Test at 175º C	Average 320.6 mOhm Std.Dev. 699.4 mOhm
dash-dot purple line	Life Test at Room Temperature	Average 54.6 mOhm Std.Dev. 46.4 mOhm

How Does a HOT PIN™ Test Probe Perform at 175ºC ?

When a HOT PIN™ test probe is used at 175ºC, the CRES value is consistent and stable.

Durability Test Result - *e-barrel*™ & K3-Gold



solid orange line	Baking 20 hours at 175º C ⇨ Life Test at 175º C	Average 81.4 mOhm Std.Dev. 13.7 mOhm
dashed green line	Baking 20 hours at 200º C ⇨ Life Test at 175º C	Average 86.6 mOhm Std.Dev. 1.4 mOhm

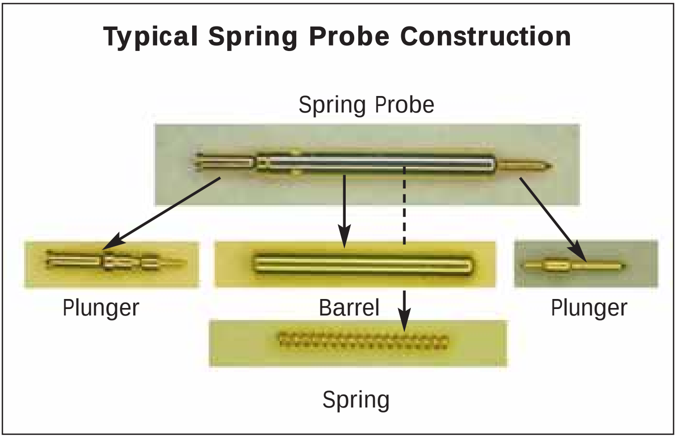
What Causes the Failures of a Conventional Spring Pin at 175ºC?

The root cause of the high CRES is the presence of oxides on the sliding surfaces of a spring probe. The oxides form when base metals in the spring probe diffuse up through the gold plating and become exposed to air. Diffusion is accelerated when the temperature of the spring probe is elevated.

Typical oxides on a spring pin are formed from nickel, copper, zinc and iron.

What Is a HOT PIN™ Test Probe?

HOT PIN™ test probes use the normal construction methods of most spring probes. But, the materials used in the components, and the plating or cladding techniques used on the surface of the components have to follow some special design rules.



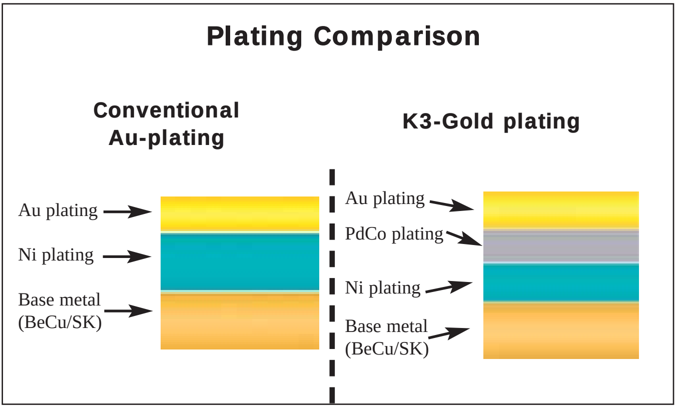
The compression spring has to be made of stainless steel.

The plungers need to be plated using the K3-Gold three-layer plating method.

The barrel of the spring pin can be 1) plated with the K3-Gold plating, 2) made from deep drawn clad metal, or 3) made using the new ***e-barrel***™ electroformed method.

What is K3-Gold Plating?

K3-Gold plating is a three layer plating of Au/PdCo/Nickel.



Why Does K3-Gold Plating Work So Well?

Conventional spring probe plating is Au/Nickel. The nickel acts as a diffusion barrier for the base metal atoms (copper, zinc and iron), and provides a hard foundation to the gold. But at elevated temperatures, the nickel will diffuse into the gold and cause surface oxides.

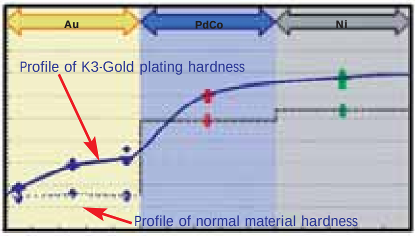
K3-Gold plating has a PdCo layer between the nickel and the gold. The PdCo layer acts as a diffusion barrier to the nickel and gives a hard-and-noble foundation to the gold. Since gold and palladium are both noble metals, they do not form oxides when exposed to air. (Palladium will form oxides at temperatures above 380°C.)

Because of these well known diffusion characteristics, the published industry standard limits for the two plating materials are:

gold < 150°C
PdCo < 390°C.

During the plating process, some palladium diffuses into the gold. This increases the hardness of the gold layer and improves the overall durability of the gold plating.

K3-Gold Measured Hardness

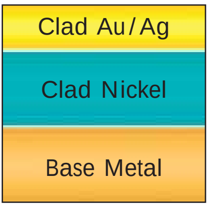


In the event that the gold/palladium layer is worn off the surface of the spring probe due to wear and tear (this is often the case on the sharp tips of the plungers), the hard PdCo layer of the K3-Gold plating will be exposed.

Conventionally plated spring pins that exhibit the same degree of wear and tear will expose the nickel layer. Both nickel and PdCo are very hard and durable, but the exposed PdCo will have a much better contact resistance than exposed nickel.

Why Does a Clad Barrel Work So Well?

The clad gold used in test probe barrels is a 14K or 18K alloy of gold and silver. Typically a nickel layer is placed between the Au/Ag layer and the base metal. The nickel layer stops the diffusion of the base metals, and the Au/Ag clad layer is an effective diffusion barrier to the nickel.



The clad layer is an effective nickel diffusion barrier because it is thick, dense, and hard. And the silver used in the alloy blocks the advancing nickel atoms as they try to diffuse into the Au/Ag layer.

The diffusion blocking characteristic of clad gold has been used by the jewelry industry to yield premium products (called "gold filled") that keep their color and surface shine forever.

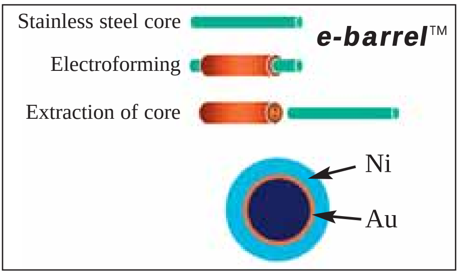
Why Does an *e-barrel*™ Electroformed Barrel Work So Well?

Typical spring probe barrels are manufactured from copper alloys. After making the barrels, they are usually gold plated.

e-barrel™ electroformed barrels are made by plating selected metals onto a stainless steel core. When the stainless steel wire is removed, the resulting cylindrical shape becomes the spring probe barrel.

Electroformed barrels are especially useful in fine-pitch spring probes where the basic cylindrical shapes are too small and fragile for conventional machining methods.

e-barrel™ electroformed barrels have very thick, uniform, and low-porosity gold plating on the ID of the barrel. When the spring probe is used at elevated temperatures, the nickel of the base metal will diffuse into the gold, but the thickness of the gold layer prevents the nickel from getting to the ID surface. Due to the uniformity of the gold plating thickness, there are no cracks or weak points that the nickel can use to diffuse to the surface and get converted into an oxide.



How Do I Order a HOT PIN™ Test Probe?

Almost any spring pin can be modified to become a **HOT PIN**™ test probe. Pick your favorite style and ask your local Rika Denshi sales office to advise you about what needs to be modified.

RIKA DENSHI

RIKA DENSHI Co., LTD.
1-16-17 Ohmori-minami, Ohta-ku, Tokyo, Japan
Phone:(81)3-3745-3811 Facsimile:(81)3-3745-3818

TAIWAN RIKA DENSHI Co., LTD.
2F-2, No25, Pu-Ding Road, Hsin-Chu 30072, Taiwan R.O.C.
Phone: (886)3-5781827 Facsimile:(886)3-5781805

RIKA DENSHI AMERICA INC.
112 Frank Mossberg Drive, Attleboro, MA 02703-4632, U.S.A.
Phone: (1)508-226-2080 Facsimile: (1)508-226-2980

RIKA DENSHI SINGAPORE PTE. LTD
8 Shenton Way #44-15 Temasek Tower, Singapore 068811
Phone:(65)6224-5043 Facsimile:(65)6224-7038

RIKA DENSHI MALAYSIA SDN. BHD
CT-9-10, Level 9 Corporate Tower Subang Square Jalan SS15/4G 47500 Subang, Jaya Selangor Malaysia.
Phone:(60)3-5787827 Facsimile:(60)3-5781805

SHANGHAI RIKA DENSHI TRADING Co., LTD.
Room 712, Tomson International Financial Building, 710 Dongfang Road, Pudong, Shanghai 200122, China
Phone:(86)21-6876-8218 Facsimile:(86)21-6876-9058

www.testprobe.com
www.rikadenshi.com