



**OKAZAKI**  
MANUFACTURING COMPANY

# Hydrogen & Fuel Cell Technology

Fuelling a  
Sustainable Future  
For a Better Tomorrow

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## We are Okazaki Manufacturing Company (OMC)

### *Temperature is our business*

**We design and manufacture market-leading temperature measurement products and heating systems.**

In choosing us as your temperature partner, you will have access to an unrivalled range of the most highly accurate and advanced temperature-related products, designed to operate in some of the harshest environments.

Our temperature measurement assemblies cover the full range of process applications and temperatures from 1.4K to +2,300°C.

### **Cutting Edge Technology**

Since 1954, we have been at the forefront of our field - pushing the boundaries and actively pursuing new technologies to take our product development and the industry to new levels. And in the current climate we are investing a number of resources into the development of products for the renewable energy sector that incorporates the Hydrogen and Fuel Cell Industries.

At Okazaki, we are proud of our state-of-the-art production facilities where all our VortexWell Thermowells are machined to give accurate finished helical strakes on every product. Despite being a very difficult material to work with we can machine using Alloy 625, and we are amongst the most efficient companies in the world at doing this. We can also issue WPS and PQR which covers various exotic materials. Thermowell designs offered include welded and from one-piece forgings.

### **Quality Assurance**

We are fully committed to quality management and the quality of our products and service is backed by numerous certifications and standards, including ISO 9001, ISO 14001 and JCSS 0079.

### **Bespoke Solutions**

We appreciate that one size does not fit all and despite a large range of products, we are happy to develop customised products and solutions to solve specific issues or market needs.

### **Global Footprint, Local Specialists**

With manufacturing sites in Japan, USA and Taiwan and offices around the globe, our world-wide footprint is coupled with local representatives who provide specialist instrumentation advice, guidance and technical support.



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## Hydrogen & Fuel Cell

The hydrogen industry is quickly growing in prominence as a viable alternative to conventional fossil fuels. Hydrogen can be used to power many types of vehicles, and it has the potential for use in numerous other industries.

It's cleaner, cheaper and more efficient than petroleum-based energy sources. Additionally, hydrogen production can occur on a local level at decentralized facilities instead of large centralized power plants like those used for coal or nuclear power generation. This has opened up new possibilities for reducing the reliance on traditional forms of energy production.

Hydrogen is a versatile element that can be used as an energy source, fuel, and industrial feedstock. It's also used in the manufacturing of consumer products such as plastics, textiles, and pharmaceuticals.

It is also seen as a potential solution to the global climate crisis due to its clean burning capabilities. As research into hydrogen technology progresses, the industry continues to grow and develop new opportunities in production and distribution.

Supplying Temperature Sensors & Cables through the complete hydrogen cycle from Electrolyzers Processing, Storage, Distribution and Usage.

## Hydrogen Production

Hydrogen is a powerful and versatile energy carrier that can facilitate the transition to a low-carbon economy.

In recent years, advances in technology have made it possible to produce hydrogen in an efficient, cost-effective, and environmentally friendly manner. This process of producing hydrogen is referred to as “green”, “blue” or “grey” hydrogen production depending on the source of energy used.

Green hydrogen is produced using renewable energy sources, such as solar or wind, to generate electricity for electrolysis processes to split water molecules into oxygen and hydrogen. This makes it one of the cleanest forms of energy generation available today. Blue hydrogen, meanwhile, uses natural gas as its primary source of energy but adds carbon capture and storage (CCS) technology to reduce emissions from production processes. Grey hydrogen is created through steam methane reforming processes that don't use CCS technology; as a result, it has higher emissions than both green and blue hydrogen solutions.

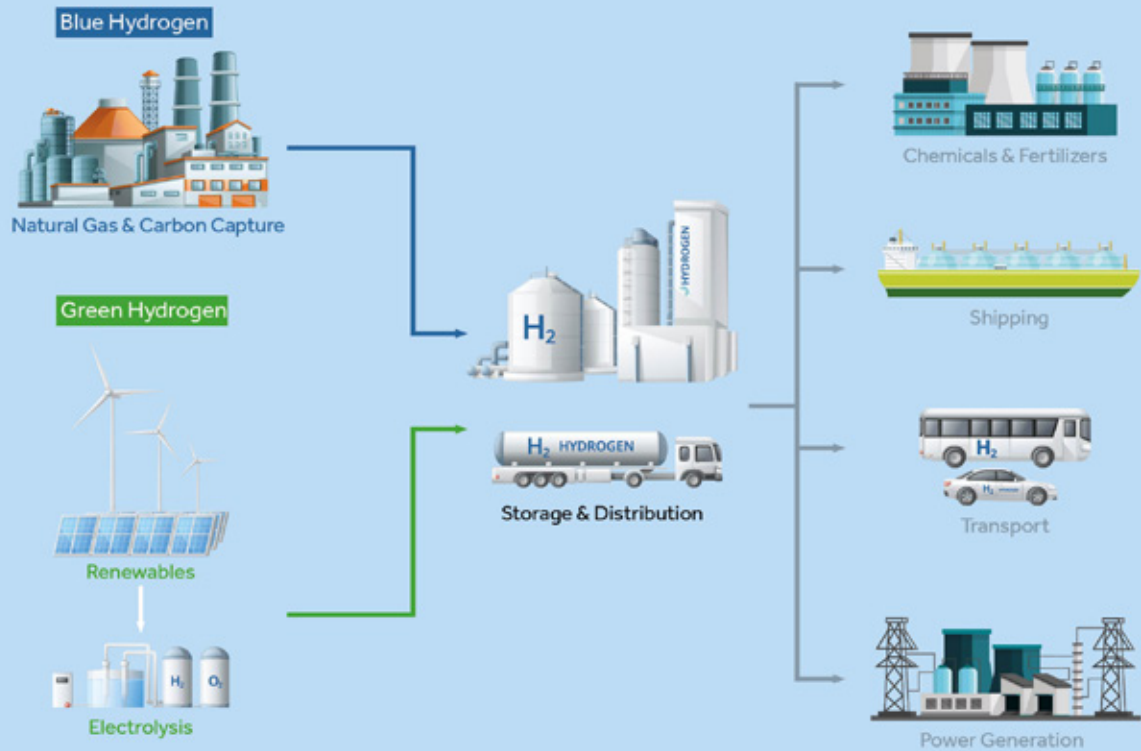
With decades of experience and expertise in designing temperature related products in the process industry, Okazaki is a leader in this area. Our team of engineers is experienced in developing and manufacturing temperature sensors, electric heaters and cables which enable hydrogen production systems to run at their optimal performance.





Hydrogen, the most abundant element in the universe, has become increasingly popular as a clean energy alternative. The need for sustainable and renewable sources of hydrogen is increasing rapidly as more countries strive to reduce their carbon footprint and reliance on fossil fuels. Hydrogen feed stocks are a key component in producing hydrogen from renewable resources like biomass, solar and wind power.

Feed stocks can be broadly defined as any material used as an input for a process or reaction that produces a desired product. In the case of hydrogen production, feed stocks are used to provide the raw materials needed to produce the necessary components for storing and using hydrogen fuel cells. Commonly used feedstocks include natural gas, coal, oil, biomass and waste streams which can be further converted into syngas or methanol that can then be processed into pure hydrogen gas.



# The Hydrogen Lifecycle

Encompassing the full range of processes involved in producing and using hydrogen, including the Processing, Storage, Distribution and Usage.

## Processing

Hydrogen processing is an industrial process that utilizes hydrogen to produce a variety of compounds and materials. This process involves the breaking down of molecular bonds between atoms to form single, atomic hydrogen molecules.

## Storage

Storage of hydrogen is a critical element of the modern energy landscape, as it provides an efficient means of storing energy. Hydrogen can be stored in various forms such as compressed gas, cryogenic liquid and metal hydride. Compressed gas storage systems involve compressing hydrogen to pressures up to 700 bar, while cryogenic liquid storage involves liquefying hydrogen at temperatures below -253°C.

## Distribution

Hydrogen distribution is the process of making hydrogen available for use as a fuel source or for other applications. This typically involves distributing and storing the gas in order to meet consumer demand. Hydrogen must be stored and safely distributed, either through transport, pipelines or on-site tanks.

## Usage

As a non-polluting energy source, hydrogen is an attractive alternative fuel that can be employed in various ways, such as for power generation via fuel cells or combustion engines. Hydrogen can also be used in industrial processes and as a chemical feedstock in the production of ammonia and methanol.

## Other Factors

There are other factors to consider within the Hydrogen Lifecycle including Cryogenics, Temperature, Pressure and Hydrogen Embrittlement.

### Cryogenics

Cryogenics is the process of using cryogenic technologies to liquefy hydrogen gas for storage and transport. It typically involves cooling the hydrogen to extremely low temperatures, and compressing it to a liquid form. This process enables a higher energy density compared to traditional gaseous storage, which can lead to more efficient transportation of hydrogen. The use of cryogenic technology also allows for the safe containment of hydrogen in tanks or vessels at low pressures.

### Temperature

The temperature range for the safe use of Hydrogen is a critical consideration. Hydrogen is highly flammable, and its ignition temperature can vary depending on the circumstances of its use. As such, it is important to ensure that the temperature of any hydrogen-based application remains within an acceptable range in order to minimize risk.

### Pressure

It is essential to monitor the pressure of hydrogen in order to ensure a safe and efficient production process. Failure to properly monitor the pressure can result in a variety of hazardous scenarios, ranging from catastrophic explosions due to overpressure to inefficient operation due to inadequate operating conditions. The accurate measurement and regulation of hydrogen pressure is paramount for the optimization of its industrial applications, such as fuel cells and hydrogen storage tanks.

### Hydrogen Embrittlement

Hydrogen Embrittlement is a phenomenon in which the presence of hydrogen atoms causes increased brittleness and decreased ductility of steel-based materials. This occurs when hydrogen atoms are absorbed into metals, resulting in the formation of hydride precipitates. The resulting decrease in material strength can be severe, causing fractures or other mechanical failures.





## Our Solutions

### **Mineral Insulated Thermocouple for High Pressure Hydrogen**

Meeting the needs of hydrogen stations for fuel cell vehicle and the coming hydrogen economy.

Conforms to explosion protection standards of Japan, other countries and regions, and IECEx.

Used in many hydrogen applications with a design pressure of 100 to 150 MPa!  
(Thermocouple measuring junction: Ungrounded)

Used in many real liquid hydrogen applications!

### **Explosion/Flame Proof Sheathed Thermocouple for High-pressure Hydrogen Temperature Sensing**

Excellent pressure resistance for temperature sensing under high-pressures of 400 MPa!

Explosion-proof design allows for use in the presence of hydrogen!  
ExdIICT6.

The ungrounded thermocouple measuring junction allows for use at 100 MPa!



Hydrogen

### **Bespoke Solutions**

At Okazaki, we pride ourselves on meeting our clients needs no matter how exacting. Which is why our engineers and designers work tirelessly to provide Bespoke Solutions to our clients Temperature Sensing requirements.

That is true across all of the sectors we work and none more so than the Hydrogen and Fuel Cell Industry. Whatever stage of the Hydrogen Lifecycle our sensors can provide reliable and consistent temperature readings across a wide temperature range of 1.4K to 2300°C.

### **Hydrogen Embrittlement Bespoke Solutions**

Our sensors have been designed to possess a robust structural integrity, enabling them to resist the deleterious effects of hydrogen embrittlement.

The protective measures we incorporate into our products such as high-strength corrosion-resistant alloys and surface treatments has allowed our sensors to remain resilient in the face of such an oxidative environment.



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