

# QUADAX<sup>®</sup> H<sub>2</sub> PREMIUM VALVES

## EXTREMELY SAFE AND RELIABLE

### BEST SOLUTION FOR

- PRODUCTION
- STORAGE
- DISTRIBUTION

H<sub>2</sub>



[www.quadax.de](http://www.quadax.de)

# MADE FOR THE EXTREME

## PRODUCTION OF HYDROGEN

### KEYFACTS

**Butterfly valve:**  
4-offset

**Pressure range:**  
PN 0 - 160  
ANSI cl. 150 - 900

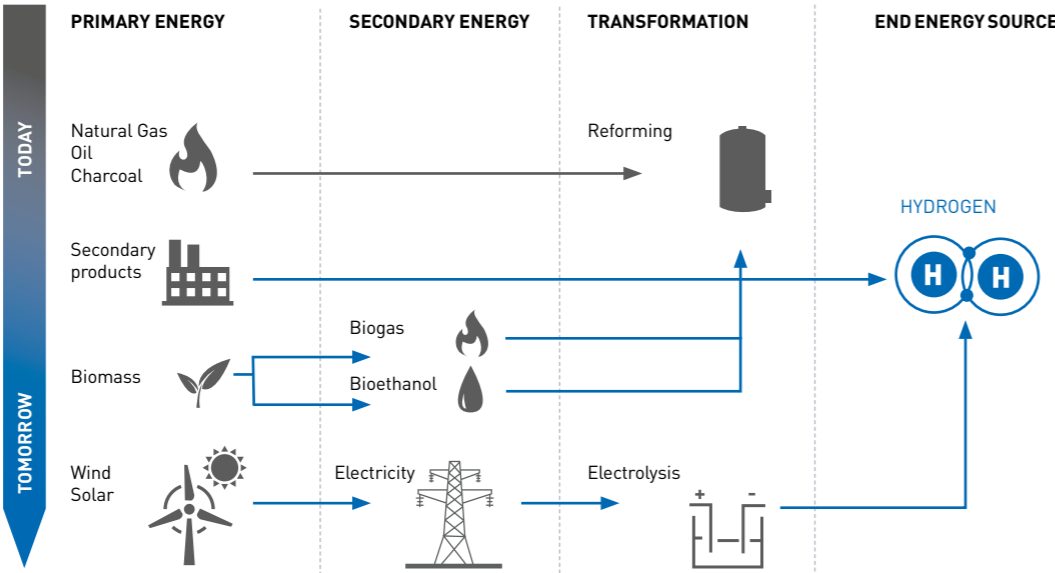
**Nominal size:**  
DN 50-1800 mm  
2 - 72 inch

Steam reforming is currently the most important large-scale industrial process for the production of hydrogen from carbon-containing energy sources and water. In this process natural gas is currently the most important raw material for steam production, where Quadax® valves are successfully applied in both natural gas and steam at temperatures from +250 - 300°C (482 - 572° F) and pressures from 0 - 100 bar (0 - 1450 psi).

In the future, hydrogen will be produced in a climate-neutral way using electricity from renewable energy for an electrolysis process. For adapting the increasing production capacity to the fluctuating demand, hydrogen storage facilities are necessary. For this purpose, the gaseous H<sub>2</sub> is cooled to minus 253° C (-423° F), compressed and then stored in liquefied gas storage tanks. **The Quadax® H<sub>2</sub> premium valve** is equipped with a sealing ring in a special material to ensure tightness even at these extreme temperatures.

-270° C up to  
+ 800 °C

- 450 °F up to  
+ 1472 °F



# EXTREME CHALLENGE

## EXPLOSIVE AND NOT PERCEPTIBLE

Hydrogen is **colorless, odorless and tasteless** and, depending on the concentration, it reacts **flammably or explosively** in combination with the gas mixture in the ambient air. The main reason why it is so tricky is that the leakage of gaseous hydrogen **cannot be perceived with the human senses**.

### THE CHALLENGE

#### LOWER VOLUME-RELATED ENERGY DENSITY:

To store the same amount of energy, you need either tanks that are three times as big or three times as high in storage pressure as for natural gas.

#### HIGH DIFFUSION RISK

Hydrogen has the highest diffusivity of all gases in relation to a gas atmosphere. As a result, hydrogen diffuses relatively well through a variety of materials. High temperatures and high operating pressures increase hydrogen embrittlement. Steels with a high carbon content are therefore not suitable for this medium, as the hydrogen atoms embrittle the material and the components lose their mechanical strength as a result.

#### LIQUEFACTION PROCESS

To liquefy hydrogen at atmospheric pressure requires a temperature of - 253 °C (-423° F) compared to LNG with „only“ -162 °C (-260° F). To clarify: Liquid natural gas (LNG) is 5.8 to 7 times denser than H<sub>2</sub>.

### CONCLUSION

The challenge for tank builders and valve manufacturers is, on the one hand, to use H<sub>2</sub>-compatible materials in a sustainable manner and on the other hand, **to adapt their sealing systems because of the high diffusion behavior of H<sub>2</sub>**. This is not an easy task, considering the difference between the liquid state during storage in cryogenic conditions from a temperature of -253 °C (-423° F) to a transport or gaseous distribution temperature of up to +50 °C (+122° F) **means a temperature variation of over 300 °C (572° F)**.

-253° C  
Storage

up to

+ 50 °C  
Transport



# THE SOLUTION

## 4-OFFSET BUTTERFLY VALVE

As one of the leading valve manufacturers in demanding applications, Quadax® is intensively involved with the subject of hydrogen and its many possibilities.

QUADAX® butterfly valves **have a round sealing seat with a uniform wall thickness all around.** Thus differs significantly from the common triple eccentric designs, which have an elliptical sealing seat.

**Material expansions due to high temperature fluctuations have a homogeneous effect on the entire sealing surface and thus ensure optimum leak tightness.** Performance tests and leak tests conducted by independent testing institutes prove the effectiveness of this design. The QUADAX® H<sub>2</sub> butterfly valve is equipped with a special sealing ring in order to function perfectly even at -253 °C (-472 °F). Because the disc moves smoothly into the seat, wear is significantly reduced. Our choice of alloy materials have a nickel content of 10 to 30 percent and therefore a very low embrittlement.



HYDROGEN TEST

# THE TEST

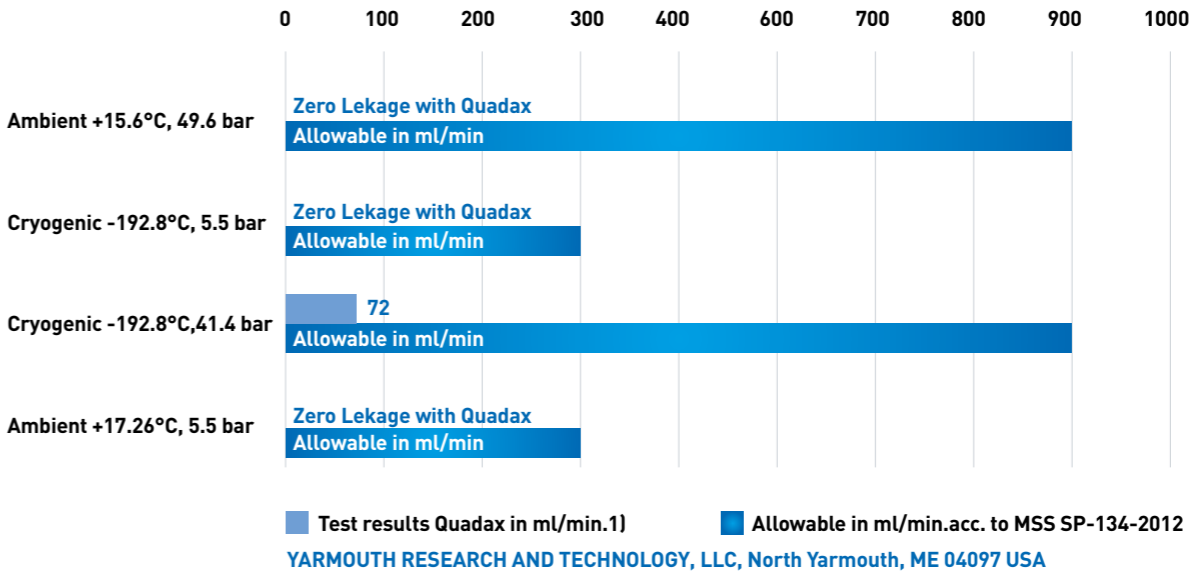
## SAFETY THROUGH HIGH TIGHTNESS

A comprehensive test for Valves for Cryogenic Service according to ANSI/MSS SP-134-2012 was conducted by YARMOUTH RESEARCH AND TECHNOLOGY, LLC in the USA. This standard covers the requirements for the material, design, dimensions, manufacturing, nondestructive testing and pressure testing of cryogenic valves made of stainless steel and other alloys.

Hydrogen has the highest diffusivity of all gases, relative to a gas atmosphere. Therefore, **gaseous hydrogen was used as the test medium instead of helium in accordance with the test standards.**

As the test results show, the Quadax premium valve impresses with **excellent leak tightness far beyond the permissible leakage, even with gaseous hydrogen.**

VALVE REQUIREMENTS FOR CYROGENIC SERVICE ACC. TO MSS SP-134-2012 VERSUS SEAT TEST WITH HYDROGEN OF QUADAX 4-OFFSET BUTTERFLY VALVE



TEST RESULTS WITH  
GASEOUS HYDROGEN

## APPLICATION EXAMPLE MADE FOR THE EXTREME

Reliability and safety are paramount in refueling systems. Major aerospace companies have switched to using QUADAX® in their most critical applications. QUADAX® supports the partners in the design and installation of piping systems to ensure that they are proven to operate reliably and extremely safely. Dealing with mixtures of LNG and hydrogen as rocket fuel requires the highest level of tightness and functionality of valves and other piping components. The aerospace industry demands individual tests that go far beyond the requirements of current standards. As demonstrated by the tests carried out by independent testing institutes in Europe and the USA, QUADAX® exceeds the requirements. According to reports, the aerospace industry agrees that QUADAX® butterfly valves have proven themselves in the field over many years delivering excellent results when used in refueling systems.

## QUADAX® H<sub>2</sub>-LUG TYPE



HIGHEST STANDARDS -  
ZERO EMISSIONS

FIRE SAFE API 607 / BS 6755

2014/68/EU

ISO15848-1: 2015 (BH, CO3)

API641

SIL 1-3

EN12266 Leakage rate

API598



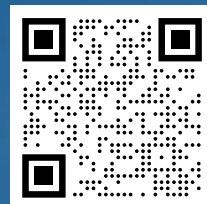
## YOUR CONTACT PARTNER

**müller quadax gmbh**  
Allmand 3  
74670 Forchtenberg  
Germany  
T.: +49 79 47 / 943 43-0  
F.: +49 79 47 / 943 43-29

info@quadax.de

[www.quadax.de](http://www.quadax.de)

QUADAX<sup>®</sup>  
H<sub>2</sub> LUG TYPE  
ONLINE



### BODY VERSIONS

- QUADAX<sup>®</sup> 01 Double flange
- QUADAX<sup>®</sup> 02 Lug type
- QUADAX<sup>®</sup> 03 Gate valve replacement
- QUADAX<sup>®</sup> 04 Buttweld
- QUADAX<sup>®</sup> 05 Top Entry

