

The 11th NEDO-CDTI Joint Workshop

“Technologies for Hydrogen Valley in Spain and Japan – Regional H2 Value Chain”

Hydrogen



QUALIFICATION OF VALVES FOR LIQUID HYDROGEN APPLICATION

Adrián Jaime

Business Development & Product Manager

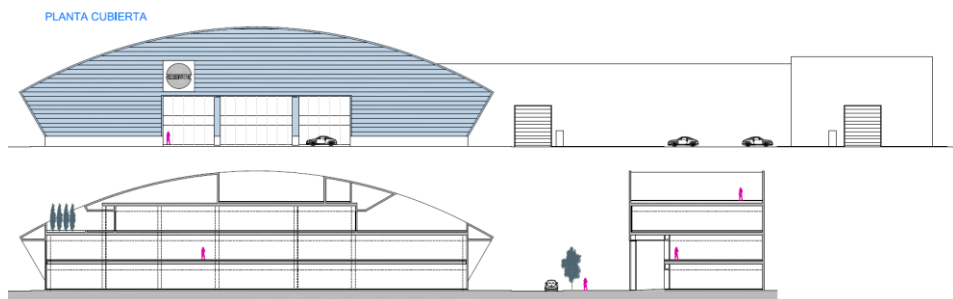
RINGO VALVULAS





RINGO VALVULAS AT GLANCE

- Company Name: **Ringo Valvulas S.L.**
- Founded in: 2000
- Factory Location: Zaragoza (Spain)
- Staff: 120 employees
- Sales: Around 50 MIO € - **Exporting more than 85%**
- Install Base: More than 90 countries around the world
- Subsidiary of **SAMSON GROUP**
 - Founded in: 1907
 - Sales: 700 MIO €
 - Staff: 4,000 worldwide, over 50 subsidiaries
 - Production Sites: 15 Factory Plants over the world
- Other Key Factors:
 - **Flexibility**
 - **Powerful R&D Department**
- Ringo Facility
 - Cryogenic Test Benches
 - High Pressure Gas Bunkerized Testing Facility
 - New Building Under Construction





RINGO FOCUS INDUSTRIES & APPLICATIONS

- ✓ Ringo Focus Industries and Applications
 - Oil and Gas, LNG, Marine Equipment
 - Power and Energy Distribution
 - Industrial Gases, Cryogenic Applications
 - Petrochemicals
- ✓ Additional Opportunities
 - Metallurgy and Mining
 - Water Technology
 - Other industries



RINGO FOCUS PRODUCTS

Smart Products & Components

Linear Control Products



Cage Globe Valve
Type 3595



Choke Valve
(Upstream)



Desuperheater

Rotary Control Products



Axial Control Valve
Type 3599



Ball Control Valve

ON/OFF Linear Products



Gate Valve



Check Valve



Axial Check
Valve



ON/OFF Cryo
Type 3588

ON/OFF Rotary Products



Top Entry
Ball Valve



Side Entry
Ball Valve



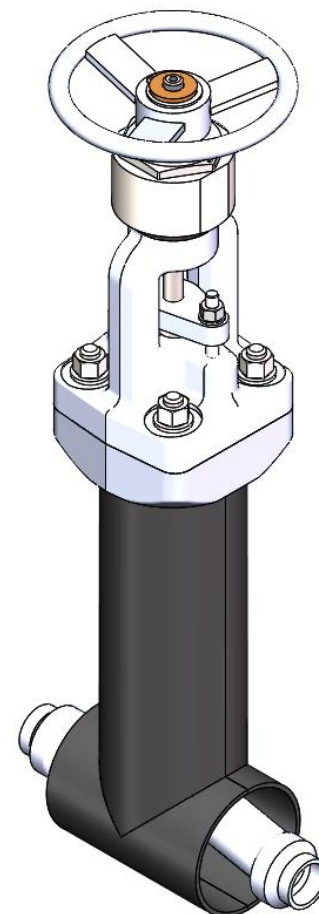
RSBV Valve
Type 3584



Development of Valves for Liquid Hydrogen

RINGO is actively working to develop special valve design for liquid hydrogen applications.

- Technical requirements to be met:
 - Design temperature of **-254°C**
 - **Top-entry design** (internals removable without disassembling the valve from the line)
 - Leakage class V
 - Cryogenic testing of production and components (cryogenic treatment).
 - Options with vacuum or cold-box jackets.
 - Special certifications from local or regional authorities (e.g. TSG)
 - **Minimum heat leak coefficient**
 - **Qualified welding procedures** for components at -254°C and acceptable for liquid hydrogen.
 - Bellows-tightness to the outside, with molecular structure valid for liquid hydrogen.
 - On-off design and actuated design for valves with safety function.





Development of Valves for Liquid Hydrogen

The project proposes the following blocks:

- Technical development:

It includes the applicable R&D resources and calculations of Ringo to generate and study the solutions to the previously mentioned problems and requirements.

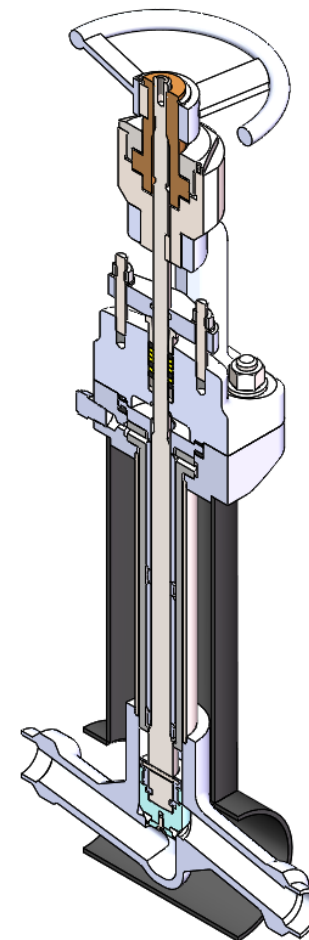
It is intended to develop the **line of manual valves and actuated valves**.

- Development of the production system:

Includes the generation of a series of **manufacturing procedures and processes** to produce these valves according to the testing requirements.

- Internal and external design validation:

Includes the necessary **tests to validate the designs**, internal to production as well as through an external laboratory.

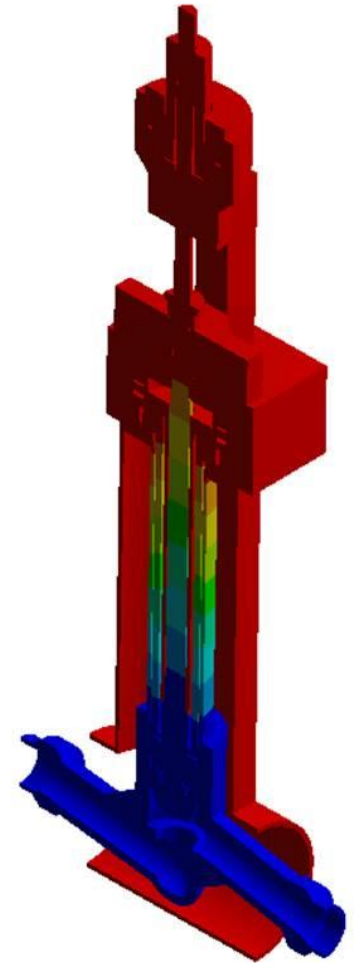




Development of Valves for Liquid Hydrogen

Technical development:

- Generation of designs and parameterization of designs (eg, being able to scale to various sizes and pressure classes).
- Selection of materials for the different components.
- **Calculation and simulation** of thermal transmittance coefficient.
- Structural calculation
- **Capacity calculation**
- Liner design
- **Actuator sizing** for actuated valves
- Generation of a specific welding procedure for -254°C
- Design of prototypes for qualification and testing based on the above

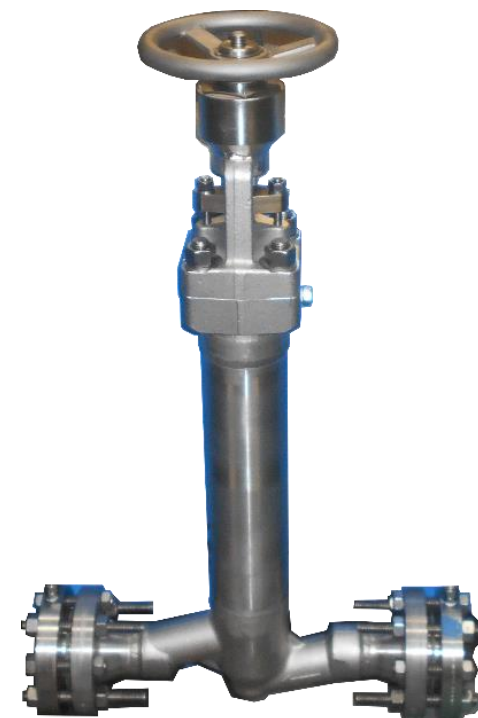




Development of Valves for Liquid Hydrogen

Development of the production system:

- Generation of internal processes related to design:
 - Management of raw material suppliers and **creation of a purchasing specification** based on requirements.
 - Welding procedure for -254°C and for LH₂.
 - Internal **production test procedure** (including specific tests that are subsequently required in customer specifications, such as cryogenic treatment of components or leak testing).
- Generation of a global production process:
 - Studying the **feasibility of mass production** of the designs. For this purpose, the Samson AG factory in Germany will be used to study the costs associated with the procedures generated in order to, if positive, be implemented in the new factory that Ringo plans to build in 2023.





Development of Valves for Liquid Hydrogen

Internal and external validation of the design:

- Ringo internal validation
 - Functional and pressure tests
 - Material specific tests (charpy, intergranular corrosion, etc).
 - Cryogenic tests at -196°C
- Ringo external validation
 - Tests related to technical requirements for design validation.
 - This protocol includes **tests at -254°C with liquid hydrogen, helium tests, cycle tests, body rupture tests** (at 4 times the nominal pressure) and many other tests based on a protocol.
 - For these tests, prototypes will be used in redundancy due to the harshness of the tests.





Validation of Prototypes Program

The following prototypes are generated:

- ✓ 1", 2" and 3" class 150# prototypes.
 - These prototypes will be manufactured in order to:
 - Ensure the technical feasibility of the designs (construction problems, assembly, etc).
 - Ensure serial production feasibility of the designs (testing costs, component handling, production testing, etc).
- ✓ Prototypes of 2" 600# and 3" 300#, quantity 2 of each.
 - These prototypes will be manufactured in order to:
 - Perform tests required for product validation, including actual tests at -254°C with liquid hydrogen among others. Redundancy in prototypes is used to ensure a spare in case any of the required tests damage any component.
- ✓ Additional 2" 600# and 3" 300# bodies, quantity 2 of each.
 - These prototypes will be manufactured for the purpose of:
 - Perform the 4xPN test required for this type of valves. This is a destructive test.
- ✓ 2 2" Conveying Valves (actuated)
 - These prototypes will be manufactured in order to:
 - Generate an alternative design of the actuated liquid hydrogen valve to generate an emergency function.





Analysis of Results

After the fabrication of the prototypes and tests carried out on them, the following conclusions have been obtained:

- ✓ The **designs are sustainable** both from a technical and manufacturing point of view as well as from an economic point of view.
- ✓ They have **passed all the tests carried out** on these prototypes including cycle tests at working temperature -254°C and subsequent seat leakage test.
- ✓ **Heat leakage coefficients** have been verified for the different designs, which are critical for some applications such as transport and/or storage of liquid hydrogen.
- ✓ Some of the prototypes have been subjected to a destructive **shell test at 4 times rating pressure**. No leakage nor deformations were detected. These tests, besides validating the structural calculation, confirm the resistance of the designs in case of overpressure in the system.
- ✓ The required **thrust/torque values are measured under real conditions**, therefore, sizing of actuators could be much more efficient to ensure required leakage rate on each case.





Ideas for a Japan – Spain collaboration



- ✓ As leaders in hydrogen technology, Spain and Japan should work together to **cooperate** in the **research and development** of efficient technologies to increase sustainable and affordable uses of green hydrogen.
- ✓ Based on international cooperation, they will encourage the **creation of transparent international standards** that regulate the necessary quality criteria.
- ✓ **Project development** in the context of multilateral cooperation initiatives, not only in Japan or Spain but also on third countries.
- ✓ Both countries are committed to achieve **climate neutrality by 2050**, for which hydrogen must contribute on an active and protagonist way.
- ✓ **SAMSON GROUP** and **RINGO VALVULAS** in particular are **ready to collaborate** in projects related to **Hydrogen** as it is our major commitment as a company.

Hydrogen

水素が
次世代エネルギー
社会を切り拓く！



CONTACT US

RINGO VÁLVULAS S.L.

✓ Telephone:

+34 976 45 49 40

✓ e-mail:

sales-ringo-es@samsongroup.com

✓ Web page:

www.ringospain.com

www.samsongroup.com