

Ultrahigh Pressure H₂ Gas Pipeline **HYDREXEL™** (HRX19®)

- Special Features of HYDREXEL™
- Chemical Composition of HYDREXEL™
- Lightweight/Compact Effect of HYDREXEL™ Welded Pipe
 - HYDREXEL™ Welding Characteristics
 - HYDREXEL™ Tensile Strength and Toughness
- HYDREXEL™ Hydrogen Embrittlement Resistance
 - HYDREXEL™ Fatigue Strength

koreabontech Company Profile



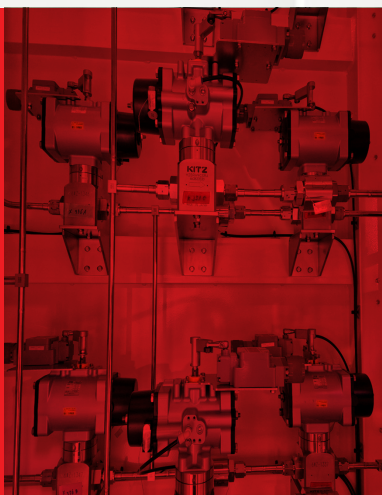
KB Tech Co., Ltd. was established to apply the welding technology of special stainless steel HYDREXEL™(HRX19®) tubes optimized for hydrogen gas piping to ultra-high pressure H₂ gas charging stations and H₂ gas piping for hydrogen vehicles in Korea and abroad. We acquired the know-how on HYDREXEL™ tube piping welding technology from Japan's "Bon High Pressure Industry Co., Ltd.(BonHP)" and secured the normal implementation right to exercise the related patents.

Japan's BonHP is specialized in advanced welding techniques, particularly for semiconductor manufacturing facilities and ultra-high pressure H₂ gas pipelines. It is always commissioned by Japanese semiconductor companies when they build new factories or perform maintenance and repairs. In addition, with its unrivaled welding technology, it is the only company in the world that has successfully commercialized ultra-high pressure H₂ gas piping for H₂ charging stations using HYDREXEL™ tube welding.

We, KB Tech, will make all our efforts to advance into the ultra-high pressure H₂ gas charging stations and H₂ gas piping for hydrogen vehicles using the HYDREXEL™ welding piping technology of BonHP, as well as in the vacuum and special gas piping business based on the CEO's extensive experience in piping construction in the domestic and international semiconductor and display industries.

Thank you.





Special Features of HYDREXEL™ (HRX19®)

- This material was developed by Sumitomo Metals, a subsidiary of Nippon Steel in Japan.
Compared to ASTM 316L which is currently used for H₂ gas piping, its tensile strength is greater than twice that of 316L. It is optimized for ultra-high pressure H₂ gas piping due to its superior hydrogen embrittlement resistance and fatigue strength. It is also superior to ASTM XM19 in all of these characteristics. (Tensile strength is 1.5 times that of XM19).
- Lightweight/Compact: Thickness and weight can be reduced by more than 40% compared to 316L pipe.
 - HYDREXEL™ is a global brand name, and HRX19® is a Japanese domestic brand name for the same material.
 - In Japan, more than 20 large and medium-sized companies have attempted to perfect the welding technology of HYDREXEL™ tubes for over 10 years, but only Japan's "BonHP" has succeeded, which shows the difficulty of the extremely demanding welding technology of this material.
- We have secured the normal implementation right to commercialize this technology from BonHP, the world's first company to complete and commercialize welding technology using HYDREXEL™ (HRX19®) tubes.

Chemical Composition of HYDREXEL™ (HRX19®)(%)

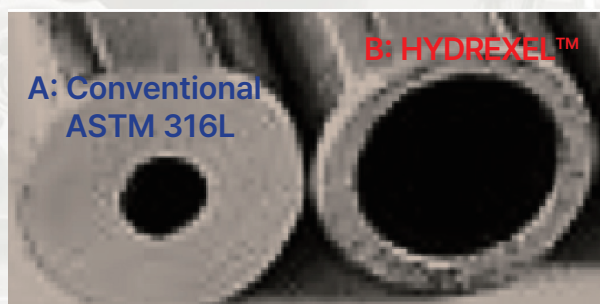
(Optimized for the composition range of Cr, Ni, Mo, Nb, and V of ASTM XM19)

Element	C	Si	Mn	P	S	Ni	Cr	Mo	V	Nb	N
Ni Equivalent ≥32.09	0.005 ~0.060	0.20 ~1.00	4.30 ~6.00	0.030 max.	0.001 max.	12.0 ~13.5	21.5 ~23.5	1.50 ~3.00	0.15 ~3.00	0.15 ~0.30	0.25 ~0.40

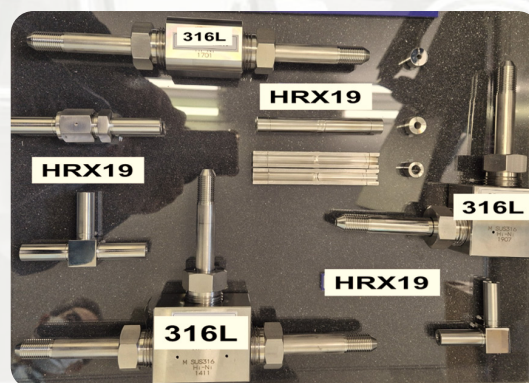
* Source: Nippon Steel Corp.

Comparison of Cone & Threaded and **Welded** Piping

Cone & Threaded (ASTM 316L)	Welded Pipe (HYDREXEL™)
<ul style="list-style-type: none"> Offers proper sealing and connections, and allows for easy disassembly for inspection and replacement of parts when necessary. Installation Cost: The initial installation cost is relatively low. However, after a two-year free maintenance and repair period following installation, ongoing maintenance and repair expenses arise due to operational downtime and subsequent repairs. Gas leaks: Not suitable for high pressure or extreme environments (including ultra-vacuum) 	<ul style="list-style-type: none"> Special Stainless steel material optimized for H₂ gas piping <ul style="list-style-type: none"> It offers excellent resistance to hydrogen embrittlement and has twice the tensile strength of conventional ASTM 316L, allowing for lighter and more compact designs. Stability and durability: Provides high strength and durability, no risk of gas leakage, and is stable even under high pressure or high temperature Compared to 316L in the same size tube, the inner diameter is much larger, which is advantageous for gas flow rate. While it is not easy to disassemble when needed, it is economical in the long run because it requires no maintenance. Low-cost production possible in mass production through standardization In Japan, it is currently in practical use at hydrogen charging stations.



Category	A	B	B/A
Outer Diameter	14.3mm	14.3mm	1
Wall Thickness	4.0mm	2.0mm	0.5
Inner Cross-sectional Area	31.2mm ²	83.3mm ²	2.7
Tensile Strength	480MPa	800MPa	1.7



※ Source : Bon High Pressure Industry Co.,Ltd.

Lightweight/Compact Effect of HYDREXEL™ Welded Pipe

½" Tube		Cone & Thread (ASTM 316L)	HYDREXEL™ Welded	Weight
Weight(g) (In case of Japan)	Elbow	1,224	95	< 8%
	Tee	1,606	116	

HYDREXEL™ Welding Characteristics

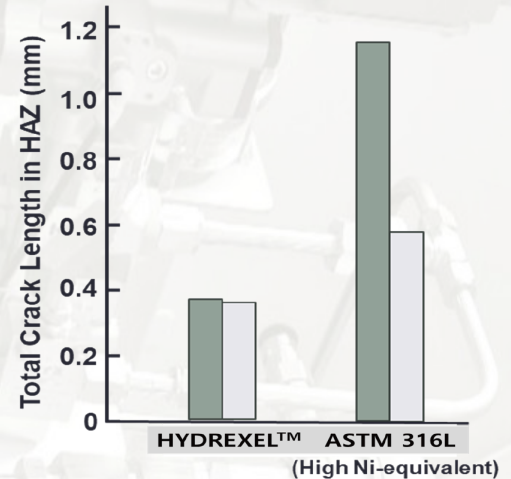
- Minimize screw connections
- No tube thickness required for screw formation ► Large inner diameter, lightweight, and miniaturization possible with the same outer diameter tube
- High cost-effectiveness and safety
- No gas leaks ► Reduced maintenance costs

Resistance to weld cracking

Gas arc welding

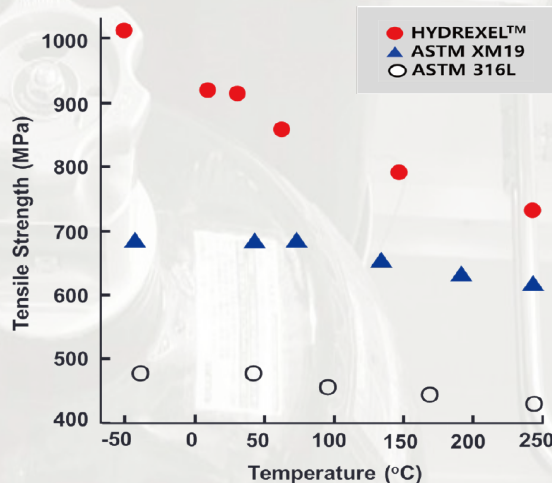
Applied strain : 2%

Specimen : 12T x 50W x 300L

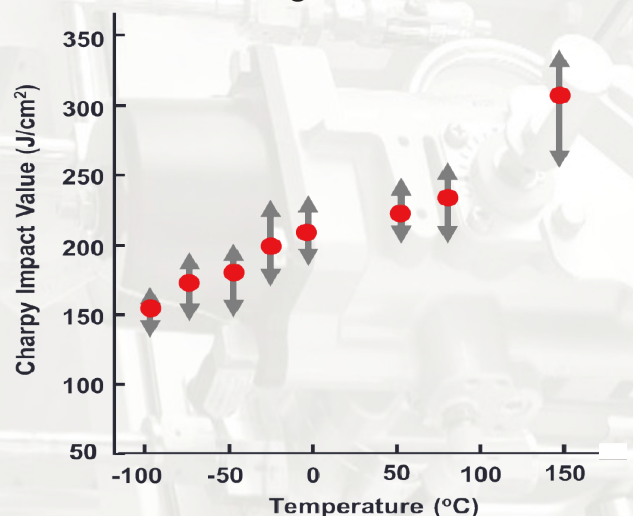


HYDREXEL™ Tensile Strength and Toughness

Tensile Strength



Toughness



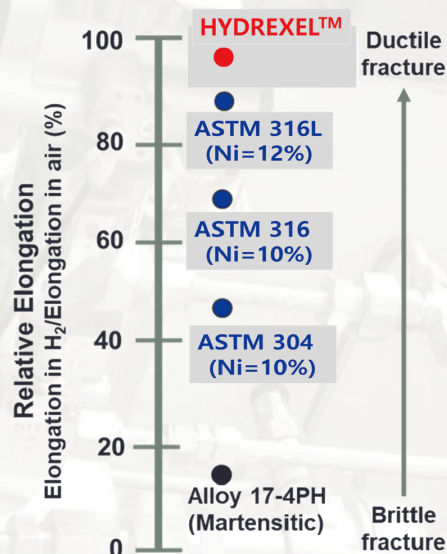
HYDREXEL™ : Tensile Strength (Twice that of 316L)

- Safe operation and ultra-high pressure/rapid charging possible
- Rapid charging of ultra-high pressure H₂ gas required by SAE J2601 (Charging 5 kg of H₂ gas in 200 seconds)
- Thin wall tube: compact/lightweight

* Source: Nippon Steel Corp.

HYDREXEL™ Hydrogen Embrittlement Resistance

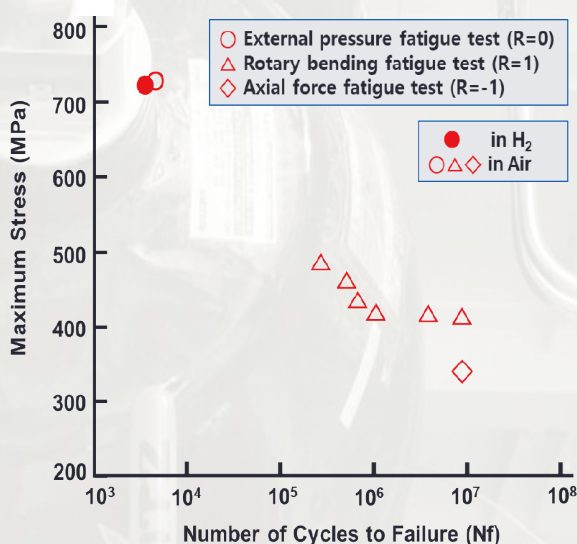
- High elongation (>35%)
- Elongation ratio : $\frac{\text{in-H}_2}{\text{in-Air}} > 95\%$
- Excellent hydrogen embrittlement resistance even at ultra-high pressure (100MPa) and low temperature (-50°C)
- Long-term operation possible
 - ▶ Reduced maintenance costs



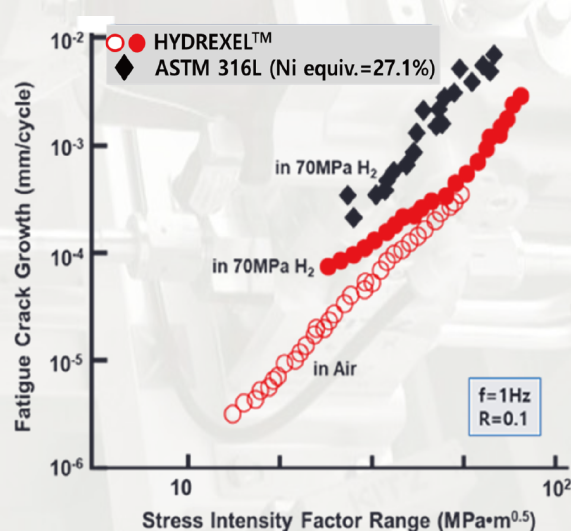
HYDREXEL™ Fatigue Strength

- High durability ▶ Long-term operation ▶ Reduced maintenance costs

Fatigue Strength



Fatigue Crack Growth Rate



* Source: Nippon Steel Corp.

Introduction of CEO

- He spent 11 years working at "Bon High Pressure Industry, Co. Ltd.(BonHP) in Japan, where he was recognized for his expertise in semiconductor equipment and high-pressure facility construction. During this time, he earned a reputation as a skilled welding technician and craftsman while building on-site facilities for semiconductor companies. such as SONY, HITACHI, FUJITSU, CANON, SEIKO, TEXAS INSTRUMENTS and EPSON in Japan.
- Upon returning to Korea, he established Hanbon Co., Ltd. and expanded his work in the special gas line and vacuum equipment and parts sector, both domestically and internationally (including China and Singapore). He currently founded KB Tech Co., Ltd. to enter the hydrogen industry, focusing on HYDREXEL™ tube welding technology.

[Hanbon's main customers: TEL, Juseong Engineering, LG Display, Mirae Industry, DMS, ULVAC Korea, SEMES, Daesung Oxygen, etc. in semiconductor and display-related industries]

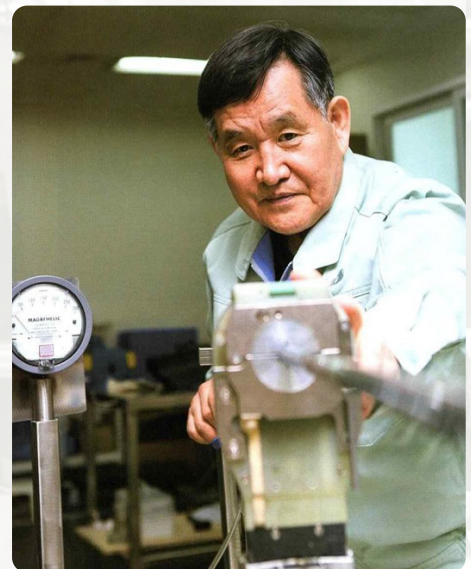
- The motivation behind founding KB Tech was to become the first and only Korean company to commercialize ultra-high-pressure H₂ gas piping with HYDREXEL™ tube welding technology. After receiving an exclusive offer from BonHP to enter the worldwide markets (excluding Japan), he completed specialized training and obtained certification in the HYDREXEL™ welding technology. Also, KB Tech acquired a normal implementation license for the HYDREXEL™ tube welding patents, establishing a solid foundation for business operations in Korea and abroad.
- He holds a gas safety management license (gas facility construction management and tubing construction), and can handle not only HYDREXEL™ H₂ gas piping but also special gas/vacuum piping demands:

Semiconductor equipment (Gas cabinet, Gas scrubber)

Construction of semiconductor manufacturing line equipment (Toxic gas line)

Manufacturing of vacuum double-layer pipes for transporting liquefied hydrogen

Manufacturing of vacuum pipes and bellows





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Technical Capabilites & Business Domain

- Ultrahigh pressure H₂ gas piping(HYDREXEL™)
 - Hydrogen gas charging station
 - Hydrogen vehicles
 - Hydrogen energy propulsion ships
- Specialty gas piping for semiconductor industry
- Gas cabinets
- Gas scrubbers
- Vaccum insulated pipes, vacuum insulated bellows
- Formed bellows and welded belows
- Nuclear power plant piping

KB Tech

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