LOCTITE

HYDROGEN READY BONDING AND SEALING SOLUTIONS

H_2ERE TO PERFORM UNDER PRESSURE

BEYOND *THE BOND*

Henkel

Henkel Adhesive Technologies

LOCTITE
H2
HYDROGEN

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POWERING THE FUTURE *WITH HYDROGEN*

Hydrogen is emerging as a key pillar in the global transition toward clean, sustainable energy. As a versatile, zero-emission fuel, it plays a crucial role in decarbonizing hard-to-abate sectors such as heavy industry, transportation, and power generation.

The hydrogen ecosystem encompasses the entire value chain – from production using renewable or low-carbon sources, to storage, distribution, and end use across various applications. By enabling energy resilience, reducing carbon footprints, and supporting circular energy systems, hydrogen is not just an alternative fuel – it's a cornerstone of the future energy landscape.

22% OF GLOBAL ENERGY DEMAND[1]

Up to 22% of global energy demand can be met by H_2 by 2050.

UP TO 85 GIGATONS OF CO_2 SAVED[2]

Hydrogen plays a key role in the clean energy transition. Up to 85 gigatons of CO_2 can be saved cumulatively by 2050.

UP TO 1.4 TRILLION US DOLLARS[3]

The growth potential of hydrogen by 2050 is gigantic and will create up to two million new jobs worldwide.

1 https://hydrogencouncil.com/wp-content/uploads/2021/11/Hydrogen-for-Net-Zero.pdf
2 https://www.logistik-express.com/deloitte-studie-einsatz-von-gruenem-wasserstoff-kann-bis-2050-einsparungen-von-rund-85-gigatonnen-co2-bringen/
3 https://www.deloitte.com/at/de/issues/climate/hydrogen-outlook-2023.html

H2

HYDROGEN VALUE CHAIN

Grey hydrogen is produced from fossil fuels like natural gas through steam methane reforming, emitting significant levels of CO_2. Blue hydrogen follows the same process but incorporates carbon capture and storage (CCS) to reduce emissions. Green hydrogen, the cleanest variant, is generated by electrolyzing water using renewable energy sources, resulting in zero carbon emissions.

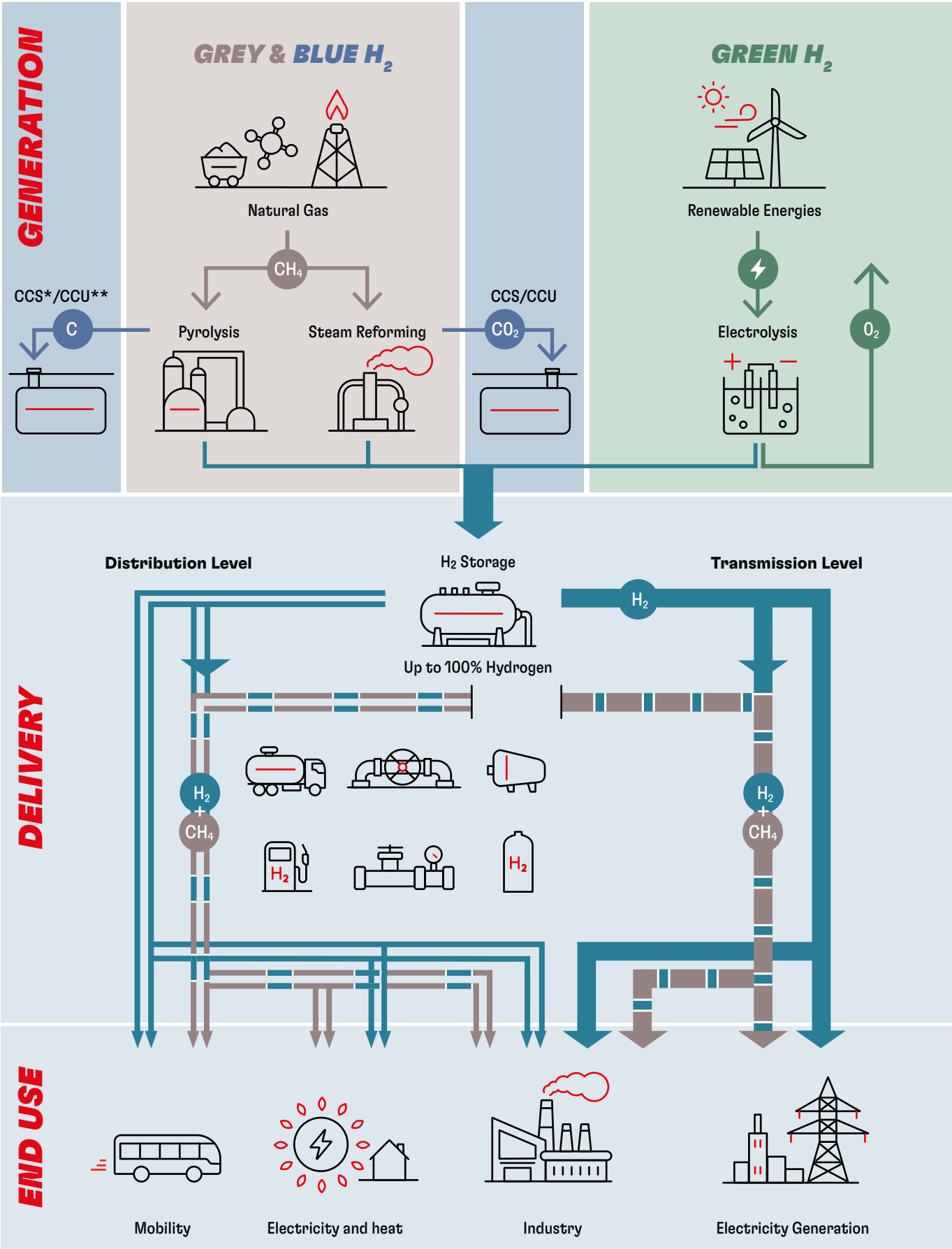
THE HYDROGEN VALUE CHAIN ENCOMPASSES SEVERAL KEY STAGES:

Production:
Hydrogen is produced via methods such as steam methane reforming for grey and blue hydrogen, and electrolysis powered by renewables for green hydrogen.

Distribution:
Once produced, hydrogen is transported through pipelines or compressed gas cylinders, or liquefied for shipping, ensuring it reaches various end-use locations.

Storage:
Hydrogen is stored in high-pressure tanks or underground caverns, or as metal hydrides, facilitating a steady supply and buffering demand fluctuations.

End use:
Hydrogen serves multiple sectors, including transportation (fuel cells), industry (as a feedstock), and energy (power generation), contributing to decarbonization efforts across the economy.



* CCS = Carbon Capture and Storage
** CCU = Carbon Capture and Utilisation

GREEN HYDROGEN *POWERING A SUSTAINABLE FUTURE*

Hydrogen is a clean, flexible energy carrier that plays a crucial role in the transition to a low-carbon economy. When produced using renewable energy sources – known as green hydrogen – the process creates zero emissions. This makes it especially ideal for decarbonizing hard-to-abate sectors such as heavy industry, long-haul transport, and energy storage.

By integrating green hydrogen into our energy systems, we can enhance sustainability by reducing reliance on fossil fuels and building a more resilient foundation for the global green transition.

HYDROGEN H2

OVERCOMING HYDROGEN **MARKET CHALLENGES**

ENSURING COMPATIBILITY, SAFETY, AND EFFICIENCY

The hydrogen market faces critical challenges, including material compatibility issues like embrittlement, safety concerns due to its flammability, leakage risks, and inefficiencies in storage and distribution systems. Our solutions are designed to tackle these obstacles by enhancing infrastructure compatibility, implementing advanced safety measures, and optimizing efficiency and reliability across the hydrogen value chain. By addressing these key issues, we aim to facilitate a safer and more efficient transition to a hydrogen-powered future.

SAFETY AND ENVIRONMENT
Leakage, pressure hazards, and hydrogen embrittlement

COMPATIBILITY
Testing, material compatibility, and approvals

EFFICIENCY
System efficiency, durability, and automation

		APPLICATIONS		
	HYDROGEN DEVICES	**THREAD SEALING**	**FLANGE SEALING**	**THREAD-LOCKING**
PRODUCTION	Electrolyzers	●	●	●
PRODUCTION	Electrolysis Systems	●	●	●
TRANSPORT / TRANSMISSION / STORAGE / DISTRIBUTION	Valves	●	●	●
TRANSPORT / TRANSMISSION / STORAGE / DISTRIBUTION	Compressors	●	●	●
TRANSPORT / TRANSMISSION / STORAGE / DISTRIBUTION	Pumps	●	●	●
TRANSPORT / TRANSMISSION / STORAGE / DISTRIBUTION	Pressure Sensors	●		
TRANSPORT / TRANSMISSION / STORAGE / DISTRIBUTION	New H_2 Pipelines		●	
TRANSPORT / TRANSMISSION / STORAGE / DISTRIBUTION	Current CH_4 Pipelines		●	
TRANSPORT / TRANSMISSION / STORAGE / DISTRIBUTION	Storage Systems	●	●	●
TRANSPORT / TRANSMISSION / STORAGE / DISTRIBUTION	Fuel Stations	●	●	●
END USE	Fuel Cells	●	●	●
END USE	Gas Boilers	●		●
END USE	Gas Appliances	●		●
END USE	Engines	●	●	●
END USE	Power Generators	●	●	●
END USE	Turbines	●	●	●
END USE	Ammonia Crackers	●	●	●
END USE	Steel Furnaces		●	●
END USE	Mobility drivetrains	●	●	●

● = LOCTITE solution available

HYDROGEN READY SOLUTIONS

01

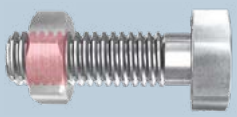
THREAD SEALING

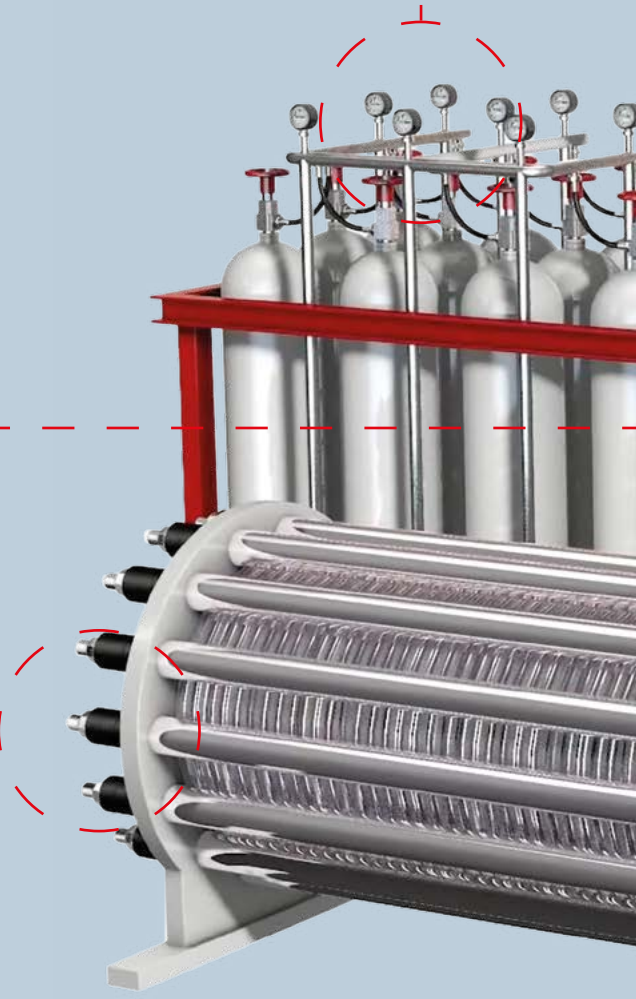
02

FLANGE SEALING

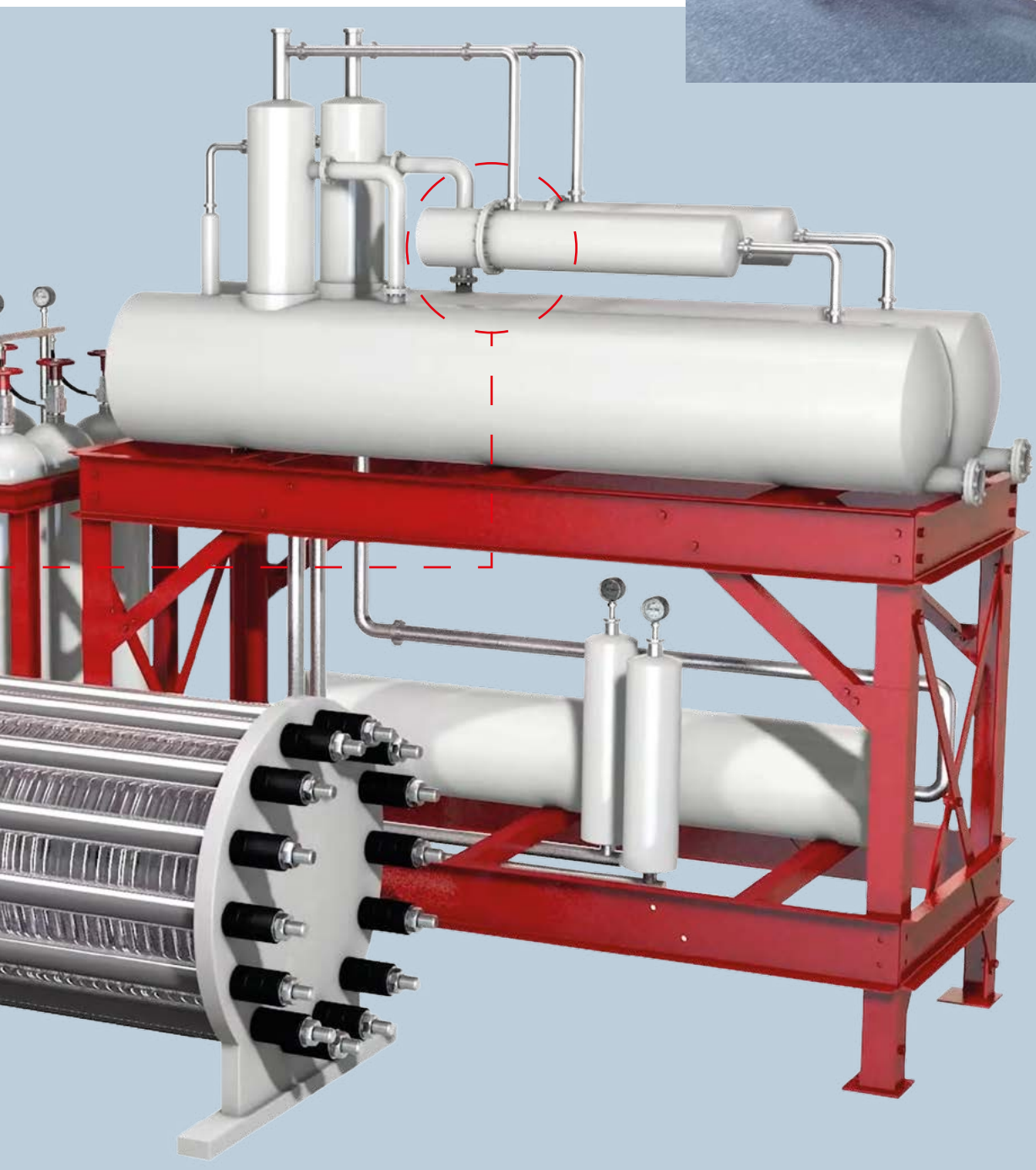
03

THREADLOCKING





LOCTITE® solutions are engineered to deliver safety, reliability, and high performance, providing secure sealing and locking even under extreme pressures and demanding conditions, thereby supporting our partners in advancing the hydrogen economy.



HYDROGEN READY **THREAD SEALING**

FOR THE SAFE AND RELIABLE PREVENTION OF HYDROGEN GAS LEAKS

Engineered to withstand the challenges of hydrogen environments, LOCTITE Hydrogen Ready Thread Sealing solutions withstand high pressures and meet the performance requirements of KIWA GASTEC QA AR 214 for admixtures up to and including 100% hydrogen gas. Certifications are available in select countries.

Rely on LOCTITE® Hydrogen Ready Thread Sealants to ensure a safe and reliable seal against hydrogen gas leaks while avoiding the complexity and costs associated with other sealing methods, such as seal welding and cone and thread fittings. Engineered to withstand the challenges of hydrogen environments, LOCTITE Hydrogen Ready Thread Sealing solutions meet the performance requirements of KIWA GASTEC QA AR 214 for admixtures up to and including 100% hydrogen gas – certifications are available in select countries.

LOCTITE Hydrogen Ready Thread Sealants are suitable for use on both NPT- and BSPT-style threaded components made of any type of metal, including tough-to-seal stainless steel. The easy-to-apply thread sealants allow for adjustment during assembly and do not shred or tear like tapes, nor shrink like pipe dopes.

In addition to meeting the performance requirements of the KIWA GASTEC QA AR 214 specification, several of our thread sealants have also been tested by third-party labs and proven to seal hydrogen pressures up to 1,500 bar. See results below.

TABLE 1: Pressure testing results

	Kiwa Standard AR 214	Henkel testing: medium pressure*	Henkel testing: high pressure**
LOCTITE 55	✔	150 psi (10.3 bar)	
LOCTITE 567	✔	450 psi (31 bar)	7,252 psi (500 bar)
LOCTITE 577	✔	450 psi (31 bar)	7,252 psi (500 bar)
LOCTITE 638	✔		21,756 psi (1,500 bar)

*Test made with a 1/4" NPT and BSPT Pipe Nipple

**Test made with a 1/4" NPT Pipe Nipple

Thread Sealing solution	Description
LOCTITE 55	White, non-curing thread sealing cord provides immediate full-pressure sealing. Allows for reliable readjustments without leakage. Ideal for BSPT and NPT pipe threads.
LOCTITE 567	White, high-viscosity anaerobic-curing thread sealant paste. Provides instant low-pressure sealing. Seals and locks metal threaded pipes and fittings, but allows for easy disassembly. Ideal for NPT pipe threads.
LOCTITE 577	Yellow, high-viscosity anaerobic-curing thread sealant paste. Provides instant low-pressure sealing. Seals and locks metal threaded pipes and fittings, but allows for easy disassembly. Ideal for BSPT and NPT pipe threads.
LOCTITE 638	Green, medium-viscosity anaerobic-curing adhesive/sealant with high shear strength. Typically used to retain bearings on shafts, but also ideal for thread sealing and locking applications in high-pressure and/or extreme environments. Ideal for BSPT and NPT pipe threads.

SUCCESSFUL APPLICATION CASE

HIGH-PRESSURE HYDROGEN LEAKS ELIMINATED *WITH HIGH-PERFORMANCE, HIGH-STRENGTH SEALANT*

SITUATION

A leading manufacturer of high-pressure processing equipment was experiencing difficulties in finding a solution to seal the 1/4" and 1/2" AISI 316 stainless steel NPT fittings on a hydrogen compressor that needed to withstand pressures of up to 1,000 bar.
The previously evaluated sealants either failed their pressure requirements or required a long and complex curing process.

LOCTITE® SOLUTION

LOCTITE 638 high-strength adhesive is a single-component, fast, room-temperature curing adhesive that provides high shear strength.

Typically used to retain cylindrical components, such as bearings on shafts or in housings, LOCTITE 638 is also ideal for thread sealing and/or threadlocking applications that operate in high-pressure and other extreme environments. The anaerobic adhesive cures when confined in the absence of air between close-fitting metal surfaces and prevents loosening and leakage caused by shock and vibration. It cures on most metals without an activator or primer. The product offers high-temperature performance and good oil tolerance and tolerates minor surface contaminants. The product has been deemed hydrogen ready for use on metal fittings only, according to KIWA GASTEC QA AR 214 Class 8. Certifications are available in selected countries.

BENEFITS

Enhanced reliability
due to elimination of all leaks in the field

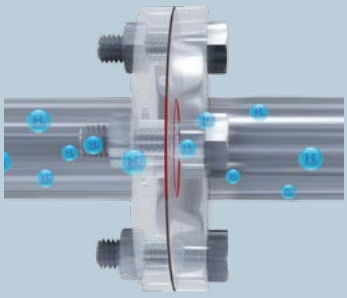
Increased productivity
and process time savings due to fast adhesive curing

Improved end-use equipment safety
by eliminating the risk of hydrogen leaks

HYDROGEN READY **FLANGE SEALING**

FOR THE SAFE AND RELIABLE PREVENTION OF HYDROGEN GAS LEAKS

Tested up to 41 bar of pressurized hydrogen with third-party labs, LOCTITE Hydrogen Ready Flange Sealing solutions have been engineered to withstand the challenges of hydrogen environments and provide reliable, leak-free sealing performance.



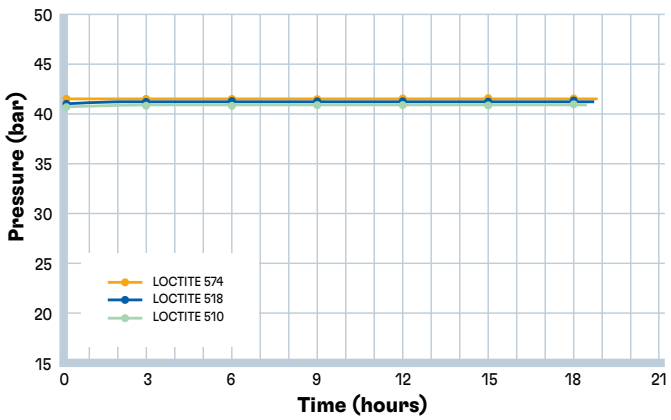
Count on LOCTITE® Hydrogen Ready Flange Sealing solutions to ensure a safe and reliable seal against hydrogen gas leaks on rigid metal flanges, while avoiding the compression-set risks, high costs, and inventory complexities associated with pre-formed gaskets.

LOCTITE Hydrogen Ready Flange Sealants are self-forming anaerobic-curing liquid gaskets that provide a perfect seal between close-fitting, rigid metal flanges. The easy-to-apply, single-component sealants fill all gaps and surface imperfections between the mating flanges, adding structural stiffness and eliminating micromovement and slipping. They do not shrink, crack, or relax over time.

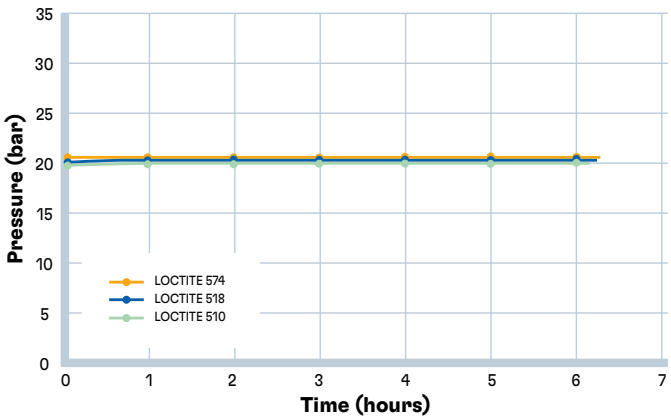
Based on tests conducted by a third-party laboratory, the following LOCTITE Hydrogen Ready Flange Sealants have been proven to provide reliable, leak-free performance against hydrogen. Evaluated on 304 stainless steel raised flanges, the sealed assemblies were pressurized with 100% hydrogen gas and then monitored for pressure drops while at two different pressure and temperature conditions, tested sequentially. No notable pressure drops were detected. Hydrogen pressure tests were conducted sequentially at 41 bar at ambient temperature for 18 hours, followed by 20 bar at 80°C for 6 hours.

TABLE 2: Pressure testing results

Flange sealants at 41 bar at ambient temp. for 18 hrs



Flange sealants at 20 bar at 80°C for 6 hrs

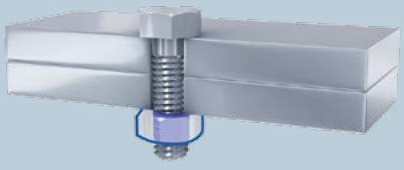


Flange Sealing Solution	Description
LOCTITE 510	Pink, high-viscosity anaerobic-curing flange sealant for close-fitting, rigid metal flanges. Ideal for steel, stainless steel, and cast iron surfaces. Fills gaps up to 0.25 mm. Provides instant low-pressure seal. Resists temperatures up to 204°C.
LOCTITE 518	Red gel, semi-flexible anaerobic-curing flange sealant for close-fitting, rigid metal flanges. Ideal for steel, stainless steel, and aluminum surfaces. Fills gaps up to 0.25 mm. Provides instant low-pressure seal. Resists temperatures up to 150°C.
LOCTITE 574	Orange, high-viscosity anaerobic-curing flange sealant for close-fitting, rigid metal flanges. Ideal for steel, stainless steel, and cast iron surfaces. Fills gaps up to 0.25 mm. Provides instant low-pressure seal. Resists temperatures up to 150°C.

THREADLOCKING

FOR THE SAFE AND RELIABLE PREVENTION OF HYDROGEN GAS LEAKS

Ideal for reliably securing threaded metal fasteners to prevent loosening caused by vibration, thermal cycling, shock loads, and other stresses. Suitable for use on pumps, valves, compressors, motors, and other industrial equipment.



Threadlocking Solution	Description
LOCTITE 243	Blue, medium-strength threadlocker for securing nuts, bolts, and other threaded metal fasteners. Prevents vibrational loosening yet can be removed using a standard hand tool without heat for easier servicing. Performs reliably on a variety of metals, including stainless steel, aluminum, and plated surfaces. Resists temperatures up to 182°C.
LOCTITE 270	Green, high-strength threadlocker for securing nuts, bolts, studs, and other threaded metal fasteners. For use on parts that are not expected to be disassembled regularly – requires heat to disassemble. Performs reliably on a variety of metals, including stainless steel, aluminum, and plated surfaces. Resists temperatures up to 182°C.
LOCTITE 2400	Blue, medium-strength threadlocker that carries no hazard symbols or risk or safety phrases. Prevents vibrational loosening yet can be removed using a standard hand tool without heat for easier servicing. Performs reliably on a variety of metals, including stainless steel, aluminum, and plated surfaces. Resists temperatures up to 150°C.
LOCTITE 2700	Green, high-strength threadlocker that carries no hazard symbols or risk or safety phrases. For use on parts that are not expected to be serviced regularly – requires heat to disassemble. Performs reliably on a variety of metals, including stainless steel, aluminum, and plated surfaces. Resists temperatures up to 150°C.

SURFACE PREPARATION

ESSENTIAL FIRST STEP FOR RELIABLE SEALING

CLEANERS

For best results, it is recommended to thoroughly clean surfaces with an appropriate cleaner before applying sealants or threadlockers, especially when surfaces are heavily oiled or contaminated.

ACTIVATORS

Activators are surface-activating agents used to accelerate the curing speed of anaerobic adhesives such as threadlockers, thread sealants, and flange sealants. Ideal for use with inactive or passive metal surfaces or in cold conditions that can slow the curing process.

Surface Preparation Solution	Description
LOCTITE SF 7063 Cleaner	Solvent-based general purpose cleaner that dries quickly and leaves no residue on the parts. Ideal for cleaning and preparing surfaces prior to adhesive bonding and sealing applications. Removes most greases, oils, lubrication fluids, metal cuttings, and fines from all surfaces.
LOCTITE SF 7649 Activator	Designed to promote the curing speed of LOCTITE anaerobic adhesives and sealants without any significant loss of joint strength. Especially recommended for applications with passive metals, inert surfaces, or large gaps, or for assembly in cold conditions.

ASSEMBLY AUTOMATION

COMPREHENSIVE EQUIPMENT OFFERING AND GLOBAL SUPPORT

DISPENSING

LIGHT-CURING

ROBOTICS

TECHNICAL EXPERTISE

WORLD-CLASS TRAINING

FULL RANGE OF SERVICES

ENGINEERED TO WORK TOGETHER: ADHESIVES & EQUIPMENT

COST SAVINGS
Reduce scrap and minimize rework

SUSTAINABILITY
Minimize waste and decrease energy consumed

TOTAL SOLUTIONS
Ensure compatibility between adhesives and equipment

PRODUCTIVITY
Increase throughput and quality

TECHNICAL SUPPORT
Wide ranging support that includes process set-up, training, troubleshooting

HEALTH & SAFETY
Minimize handling through automated dispensing solutions

PERFORMANCE AND BEYOND – *TOGETHER*

H_2ERE TO PERFORM *UNDER PRESSURE*

ENGINEERED FOR SUSTAINABILITY
Our hydrogen-ready solutions are designed to reduce leaks, extend equipment life, and minimize environmental impact—supporting long-term sustainability in critical hydrogen applications.

IN PARTNERSHIP WITH YOU
We work closely with customers across the hydrogen value chain to understand their challenges and deliver tailored sealing and bonding solutions that enhance safety and reliability.

INNOVATION AT THE HEART
Backed by decades of research and cutting-edge technology, LOCTITE continuously innovates to meet the demanding requirements of the evolving hydrogen industry.

EXPERTISE AROUND THE WORLD
With a global network of experts, technical support, and training, we ensure consistent performance and localized service wherever our customers operate.

VISIT OUR WEBSITES TO LEARN MORE

HYDROGEN READY FLANGE SEALING SOLUTIONS

HYDROGEN READY THREAD SEALING SOLUTIONS

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