

WHITE PAPER

Quality Assurance:

Flexible sprinkler hose with fittings

In compliance with KFI standard



INTRODUCTION

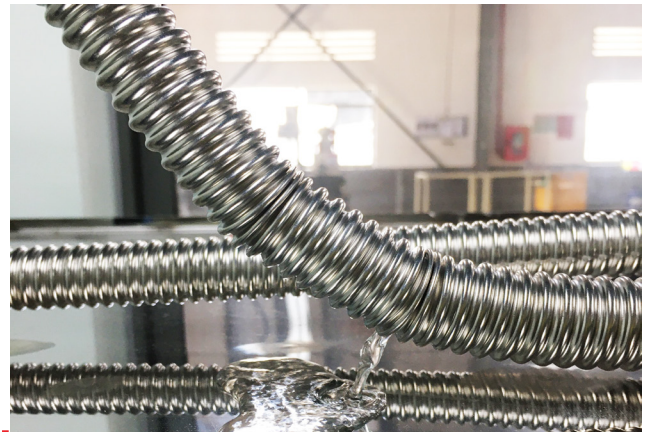
Why people use Flexible Sprinkler Hose?

Flexible sprinkler hose has been quite prevalent in water-based sprinkler system all over the world. With the main mission to convey fluid from water supply pipes to the sprinklers, the hose is endorsed for its flexibility, user-friendliness and seismic resistance.

Risks To Aware?

There are several potential undesirable risks with these hoses when the sprinkler system in operation, which should be taken into consideration:

- **Leakage:** More often than not, building owners always find it annoying to have some leakages they cannot find out and some leakages are only found when the damage became too big to be neglected.



- **Cracking or Rupture:** Usually after installation, if there are no inherent leakage being found, the hoses are deemed working properly. However, repetitive pressure changes or sudden sprinkler discharge can create a pressure surge that can affect the flexible sprinkler hose significantly.

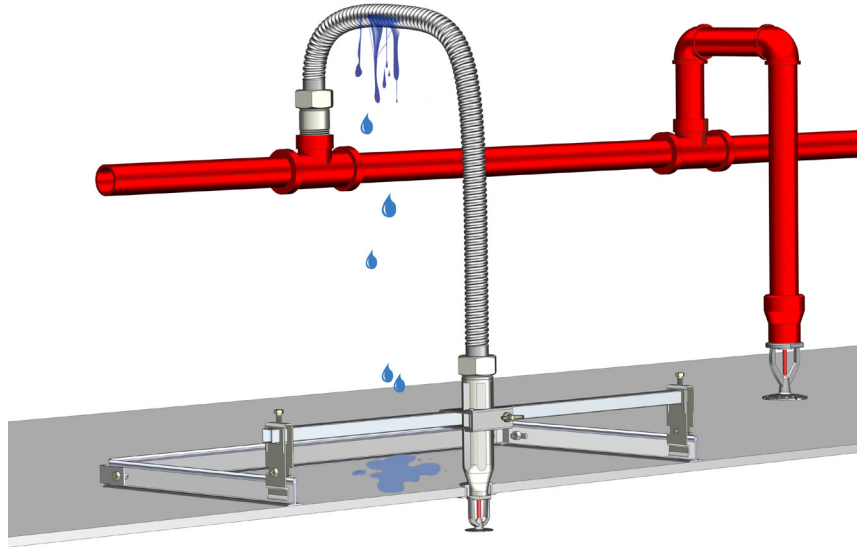
- **Corrosion:** Even though the corrugated hose is mainly made of stainless steel, the fittings are mainly made of Zinc-plated Carbon steel, which is more likely to be susceptible to corrosion.



Potential Consequences

Therefore the building's owners may face several consequences in return when using low-quality flexible sprinkler hoses:

- **Water damage to the facility:** Water damage varies from small damages to huge amount of monetary loss in property value like furnitures, electronics, machines,ect.

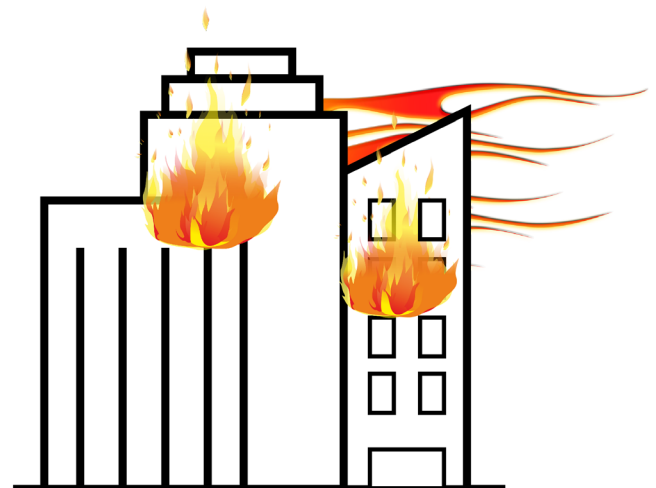


- **Longer operational downtime:** Building diagnostics and repetitive repair services will halt the normal operation of the facility. The cost of unscheduled operational downtime cannot be computed easily.



**Warning
Under maintenance**

- **Undermine the readiness of sprinkler system:** The faulty hose maybe inactive or damaged in an event of actual building fire. Hence, This creates underlying risks toward lives in the building and property's value.



How Korea tackle the issue

Korea has the highest number of flexible sprinkler hose manufacturers in the world along with the extremely developed corrugated metal hose industry. This is the result of industrial development and increasingly high demand on new technology in Fire Protection.



Even though there are many international standard for flexible sprinkler hose from third-party bodies like Underwriters Laboratory (UL), Factory Mutual (FM), VdS, etc, South Korea has its own standard for flexible sprinkler hose and different mechanism to inspect the quality of the fire protection products before they leave the manufacturers' facility.



The Korean Fire Institute (KFI) will send inspector to visit the factories, inspect and pick up samples to perform testings to every batch of fire protection products. Only when all tests are passed, the officials will allow the company to stick the inspection stamp to the products before they can be sold or installed in any building. The code number on the stamp also can help KFI to trace back to the manufacturers or importers if any incident happens. Therefore, the government can ensure every fire protection products are complied to a certain standard and the safety level remains consistent in every projects. The mechanism was established to hold manufacturer accountable for their products' quality and promises toward the society's well being.

THE KFI TEST PERFORMANCE TEST

The tests in the KFI standard for the performance of the flexible sprinkler hose can be divided into 2 main categories:

A Mechanical Performance Test:

1. Elongation Test
2. Vibration Test
3. Bending Test
4. Pressure Cycling Test
5. Flattening Test
6. Burst Pressure Test
7. Crushing Test

1. Elongation Test

• *Test requirement:*

The change of length per metre must be under 8.4mm/m and the total change of length must be under 32 mm.

• *Test Procedures and Result :*

The Flexible Sprinkler Hose shall be installed in its longitudinal direction, and measure the initial length. After that, the inlet pressure is gradually pressurised up to 1.5 times the rated working pressure and held for 1 minutes. The inside pressure of the hose is then to be decreased to 0 bar and be measured after 5 minutes.

Before
L₀ = 700 mm



After
L₁ = 702 mm



* Total change of length (ΔL) formula:

$$\Delta L = L_1 - L_0 = 2 \text{ mm}$$

* Change of length per metre ($\Delta L/m$) formula:

$$\Delta L/m = \frac{\Delta L}{L_0} = 2.86 \text{ mm/m} < 8.4 \text{ mm/m}$$

The G-Flex has successfully passed the Elongation Test.

• **Conclusion:**

As many people know, more corrugation and narrower pitch will enhance the flexibility but somehow they would be prone to be elongated to a certain extent. If the elongation of the hose is not kept in check, this can compromise with mechanical strength of the hose and expose the system with unforeseeable risk. The test is to ensure the best balance between flexibility and mechanical strength of the hose under pressure.

2. Vibration Test

• **Test requirement:**

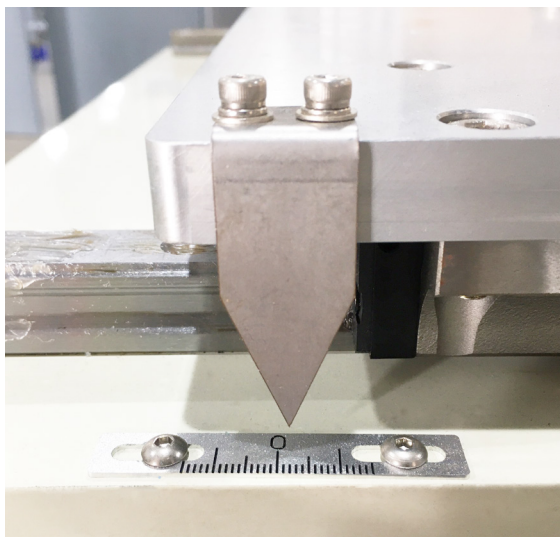
The flexible sprinkler hose shall show no evidence of leakage, rupture or loose nuts in the hose assembly.

• **Test Procedures and Result :**

The outlet fitting is to be installed in its intended position using the brackets referenced in the installation instructions and the bracket is then to be rigidly attached to the vibration table with the outlet fitting in a vertical plane. The Hose is to be bent 90° at minimum bending radius and the inlet fitting shall be fixed in a horizontal plane.



The flexible sprinkler hose shall be pressurized to 0.1 MPa and then subjected to 6-hour vibration with the amplitude of 5mm and frequency at 25Hz.



The G-Flex has successfully passed the Vibration test.

• **Conclusion:**

The Test was established for testing the seismic resistance of the hose assembly while being filled with water. Vibration in a structure can come from natural seismic activities or even the daily operation of the indoor infrastructures. The Flexible Hose assembly must always be ready for action during regular, or even irregular, tremblings in the installed space.

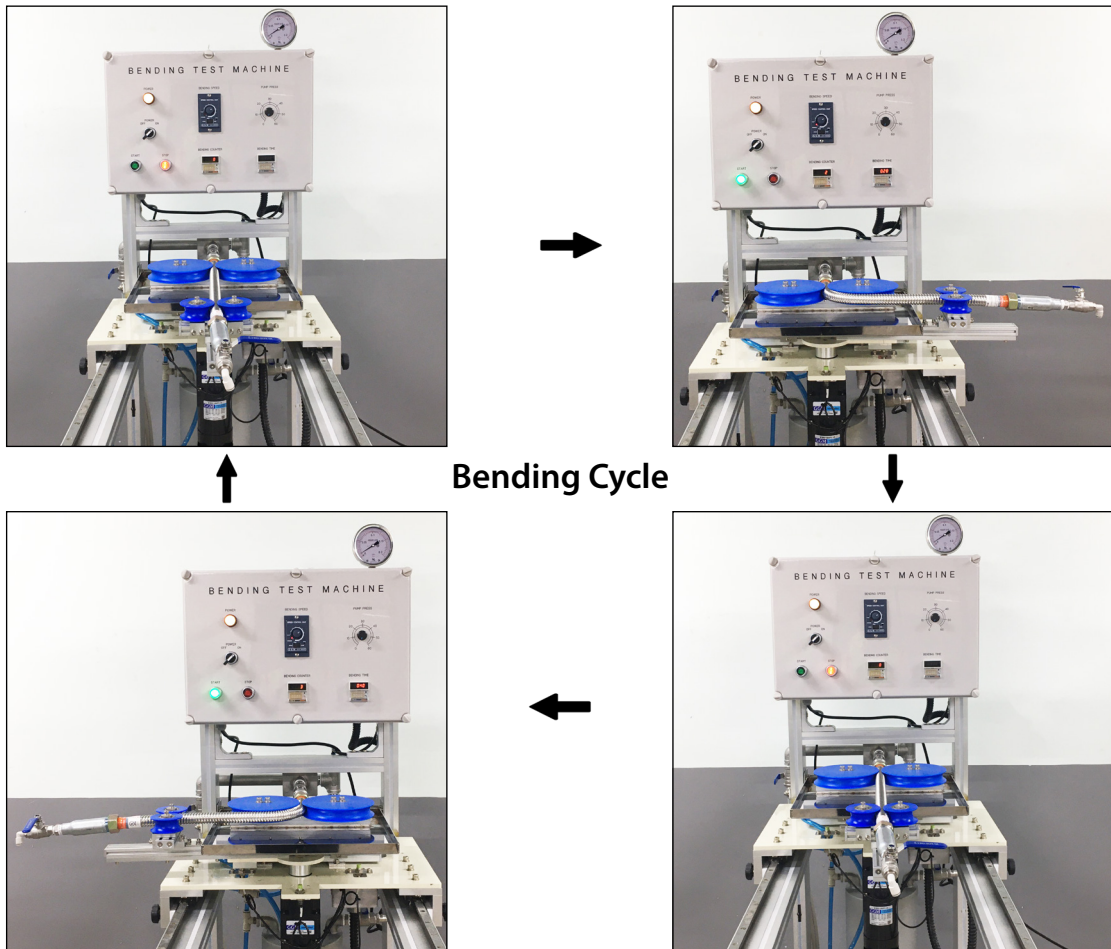
3. Bending Test

- *Test requirement:*

After the the test, the flexible sprinkler hose shall show no leakage or rupture.

- *Test Procedures and Result :*

With 0.02 MPa of water pressure applied to the flexible sprinkler hose, the radius of the bent part is three times the nominal diameter of the hose. The bending test is performed 15 times in the order of O --> A --> O --> B --> O , the bending intervals should be set between 10 to 12 seconds.



The G-Flex has successfully passed the Bending Test.

- **Conclusion:**

The hoses are always meant to be bent during installation process, sometimes in retrofits and maintenance. It is important to make sure there are no rupture or cracks happened when the hose being bent. With numerous tests performed during years, it takes the G-Flex nearly 30 times in the the same test condition before any leakage can be found.

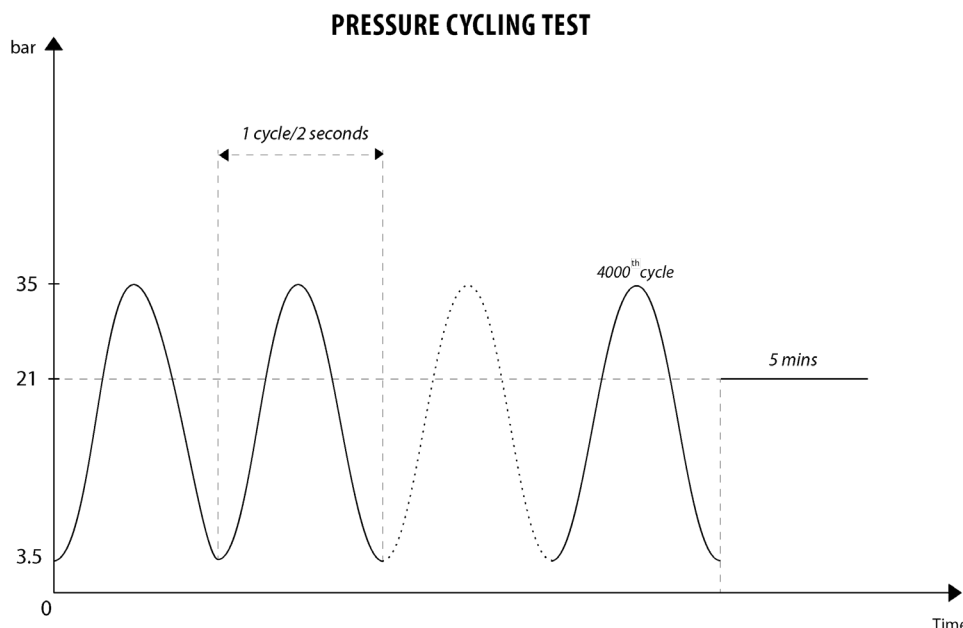
4. Pressure Cycling Test

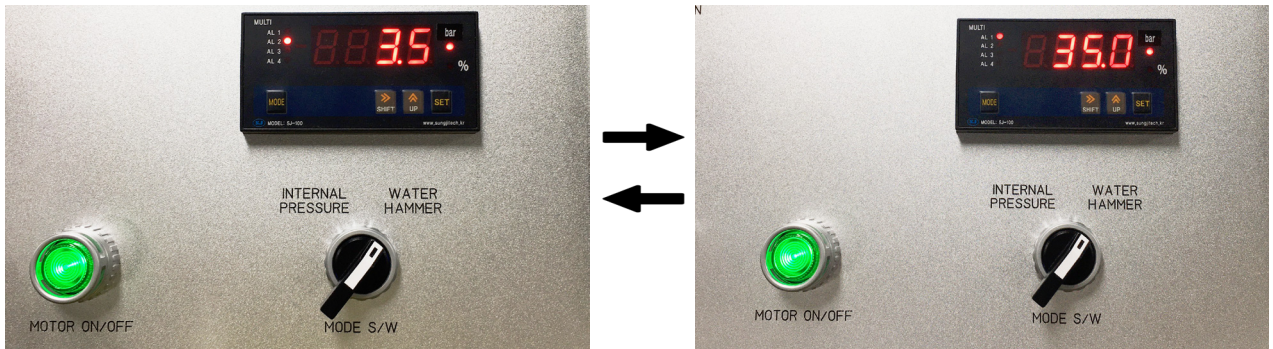
- **Test requirement:**

The flexible sprinkler hose shall show no leakages or irreversible deformation.

- **Test Procedures and Results**

The flexible sprinkler hose shall withstand being continuously applied pressure fluctuations from 0.35 MPa to 3.5 MPa per second for 4,000 cycles and then being pressurised with water at 1.5 times the rated working pressure for 5 minutes.





The G-Flex has successfully passed the Pressure Cycling Test.

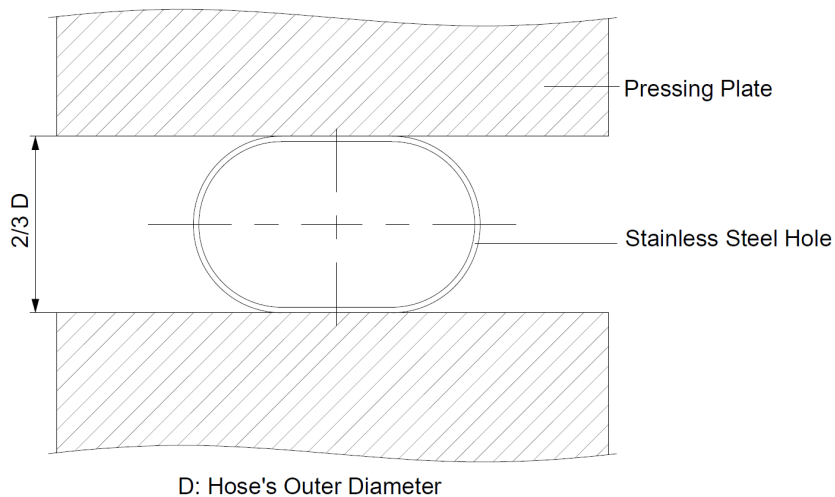
• **Conclusion:**

Pressure surges can happen in the sprinkler system as a result of sudden change in fluid velocity and opening or closing of valves. The test is to make sure that the flexible hose can cope with any water hammer issue while still able to convey enough water to the sprinkler head. The second phrase of applying 1.5 times the rated working pressure is meant to check the integrity of the hose after a long time affected by water hammer.

6. Flattening Test:

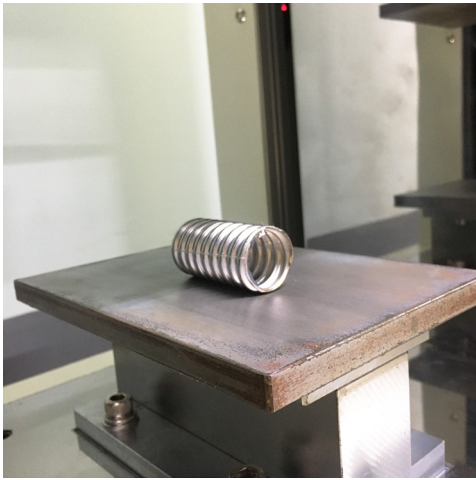
• **Test requirement:**

The pipe shall retain its loop and shall not be cracked.



• **Test Procedures and Results**

A piece of flexible sprinkler hose with a length of 50 mm or more is placed sandwiched between two flat plates of universal testing machine at room temperature, and then the spicemen will be compressed until the distance between the flat plates is 2/3 D of the outside diameter of the pipe.



Before

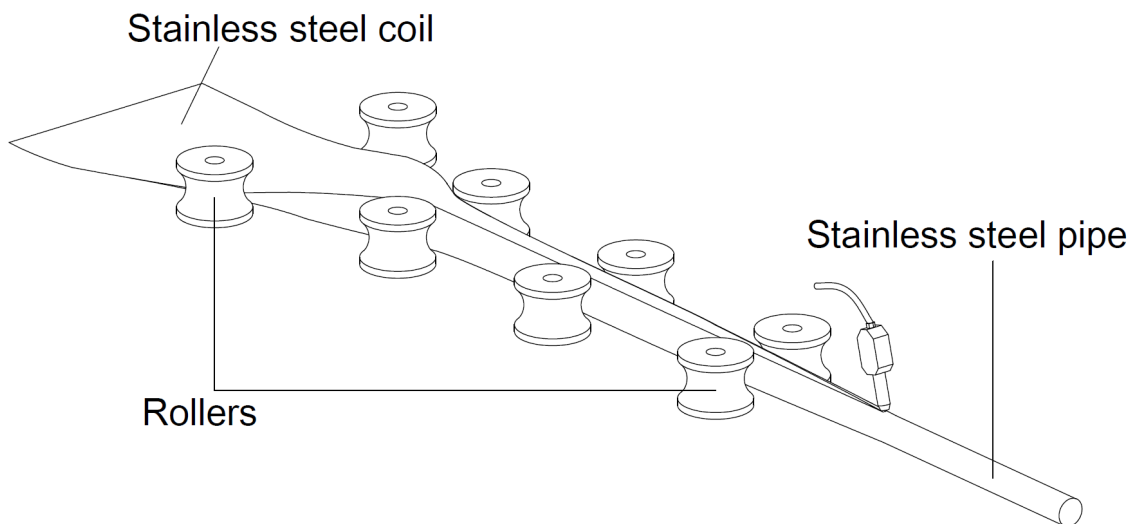


After

The G-Flex has successfully passed the Flattening Test.

• **Conclusion:**

Many Flexible Sprinkler Hoses today are made by turning stainless steel coil into welded pipe, just like other welded pipe we can find in the market. However, the stainless steel pipe is then to be corrugated to create flexibility, if the whole process is not controlled properly, the welding line may be damaged during production and therefore contains an intrinsic risk of rupture during operation. We perform flattening testing for every batch of G-Flex before shipment so our customers don't have to experience water damages or system failure in an incident of building fire.



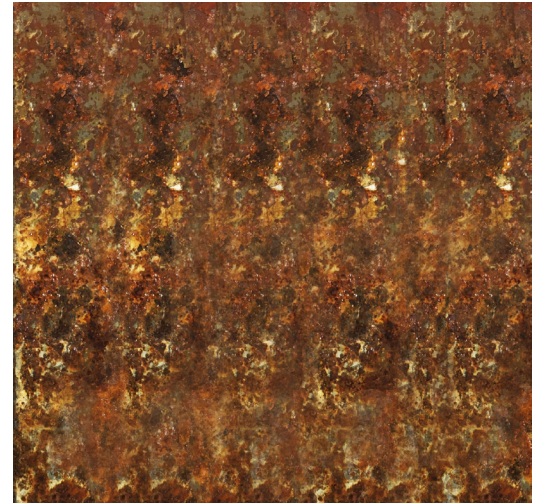
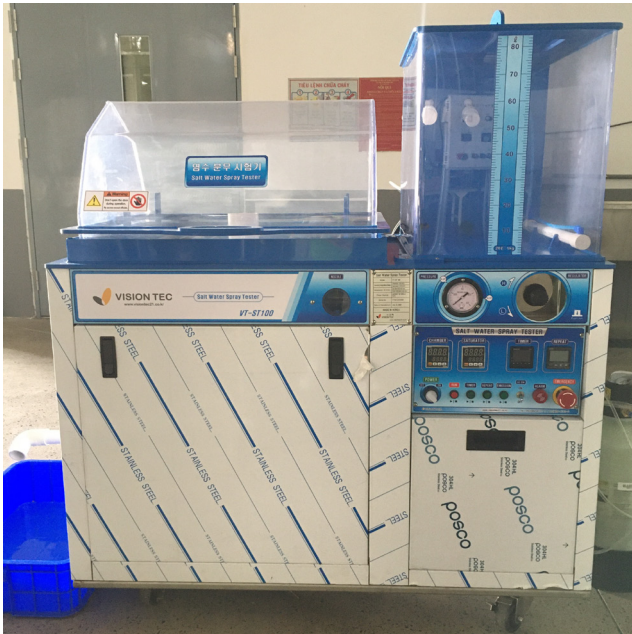
5. Salt Spray Test:

• **Test requirement:**



After the Salt Spray Test, the flexible sprinkler hose shall have no visible sign of incipient corrosion.



• *Test Procedures and Results*

Flexible sprinkler hose is to be undergone 5 cycles of salt spray sessions according to KS D 9502 (1 cycle means 8 hours of operation time of the testing machine and 16 hours of no-spraying time).



Red rust

Time	Other Brand Sample and G-Flex Sample
Start	 <p>All samples in good condition</p>
2 days (48 h)	 <p>White rust appears on blue</p>

Time	Other Brand Sample and G-Flex Sample
4 days (96 h)	 <p>Partial corrosion appears on</p>
5 days (120 h)	 <p>Total corrosion on blue</p>

The G-Flex has successfully passed the Salt Spray Test.

We create standard

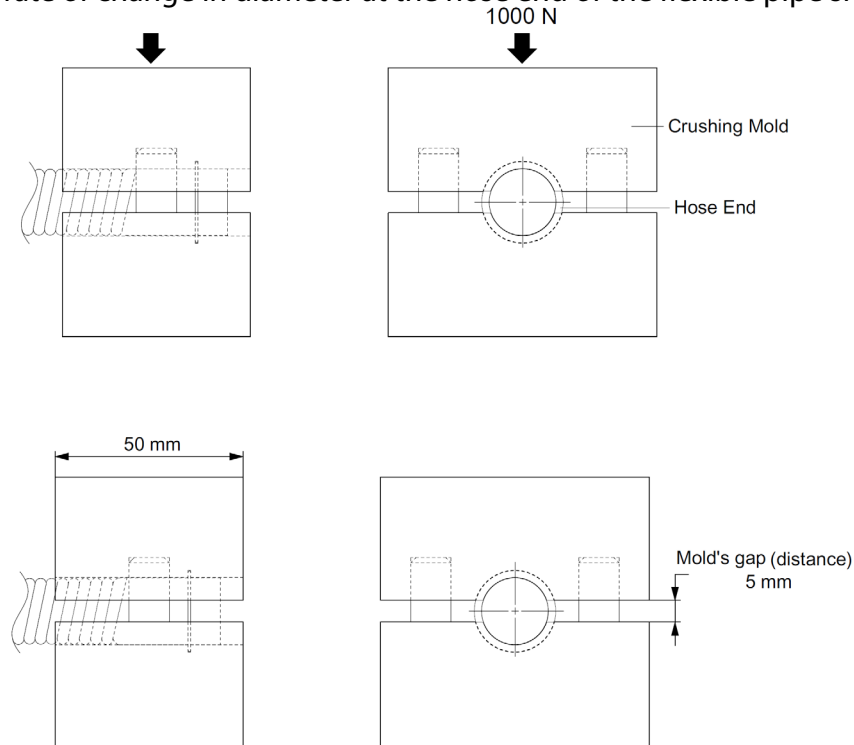
- *Conclusion:*

Most of the fittings being used in Flexible Sprinkler Hose are zinc-plated to prevent corrosion. The zinc layer acts as a sacrificial coating because it sacrifice itself to protect the underlying steel from corrosion factors. The test create an extremely corrosive enviroment to hasten the corrosion process and let us know whether the zinc coating can withstand to a certain extent and protect the steel inside. G-Flex is tested on regular basis to make sure our end-users have one less thing to worry.

7. Crushing Test:

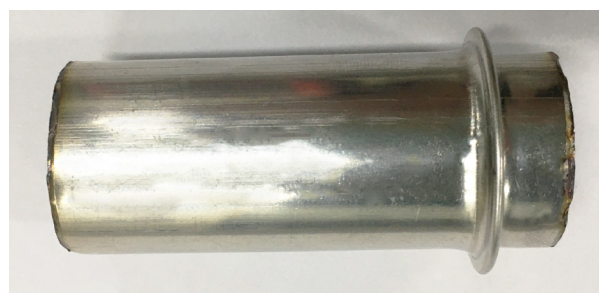
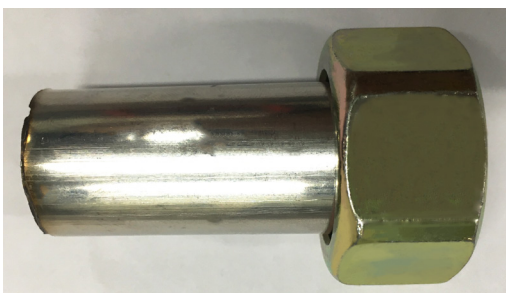
- *Test requirement:*

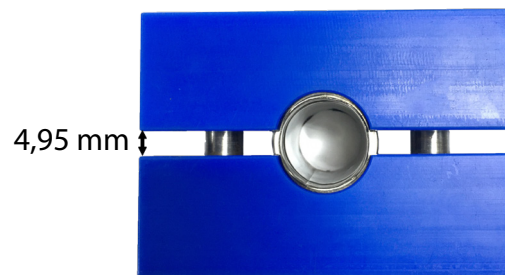
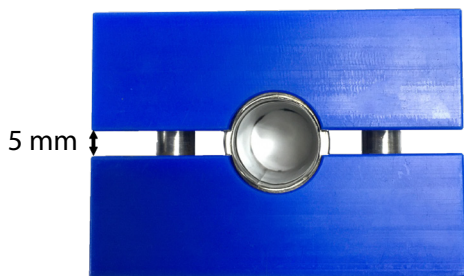
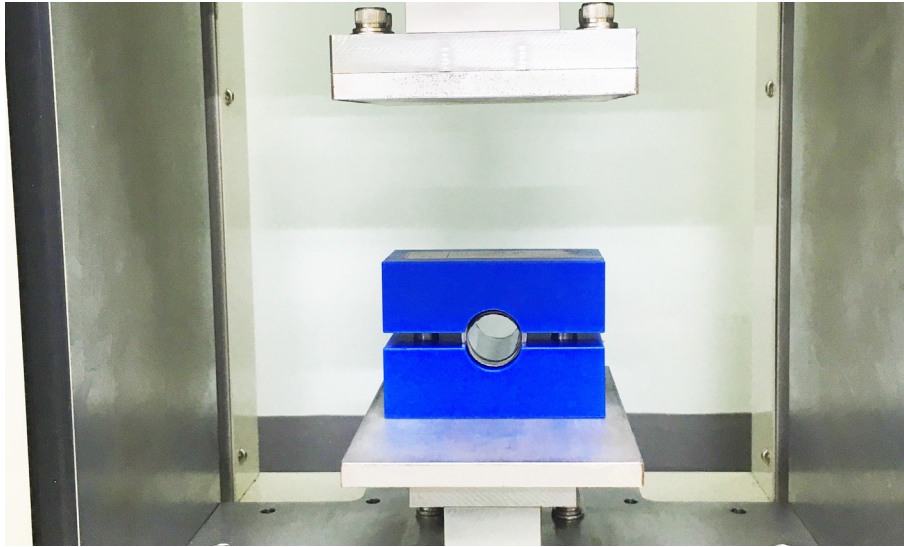
The rate of change in diameter at the hose end of the flexible pipe should be 5% or less.



- *Test Procedures and Results*

One end of flexible sprinkler hose with the nut ring removed shall withstand a load of 1,000 N uniformly applied to a length of 50 mm for 30 seconds.





The G-Flex has successfully passed the Crushing Test.

• ***Conclusion:***

To be economical and easy for fitters adjustments, many brands of Flexible Sprinkler Hose now offering a threaded nut ring to easily connect and disconnect to fittings for inlets and outlets. Even though convenient, the threaded nut ring can cause dents on the corrugated hose due to unintended human error during installation. Thus, the hose ends need to be tested to minimize any chances of distortion in the integrity of the hose assembly.



Other International Standards for Flexible Sprinkler Hose

Every countries will have different regulations for the Flexible Sprinkler Hose, many countries accept the certification, or listings from third-party certifying bodies. With more than 30 year experience in developing the product, our G-Flex has successfully passed all the current international standards for Flexible Sprinkler Hose.

