InertMask

GL Sciences Inc.

Presented by Tommy Yoshinaka

Problem 1

Rust

Sewage gas leaking from a drain pipe

Problem 1

Rust

Replacement work

- **Product cannot be manufactured during the replacement work**
- **Cost increase**

Corrosive gases

- Hydrogen Sulfide
- Sulfite
- Sulfuric acid
- Chlorine
- Nitric Acid
- Sulfur compounds
- Ammonia

Problem 2

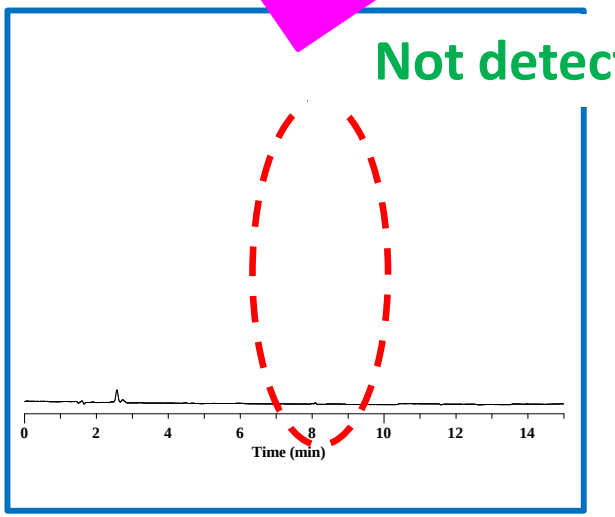
Adsorption

Compounds of Acidic, or Basic

If adsorbed…..

Internal Surface of Stainless Tube

Not detected



- **Loss of analysis accuracy**

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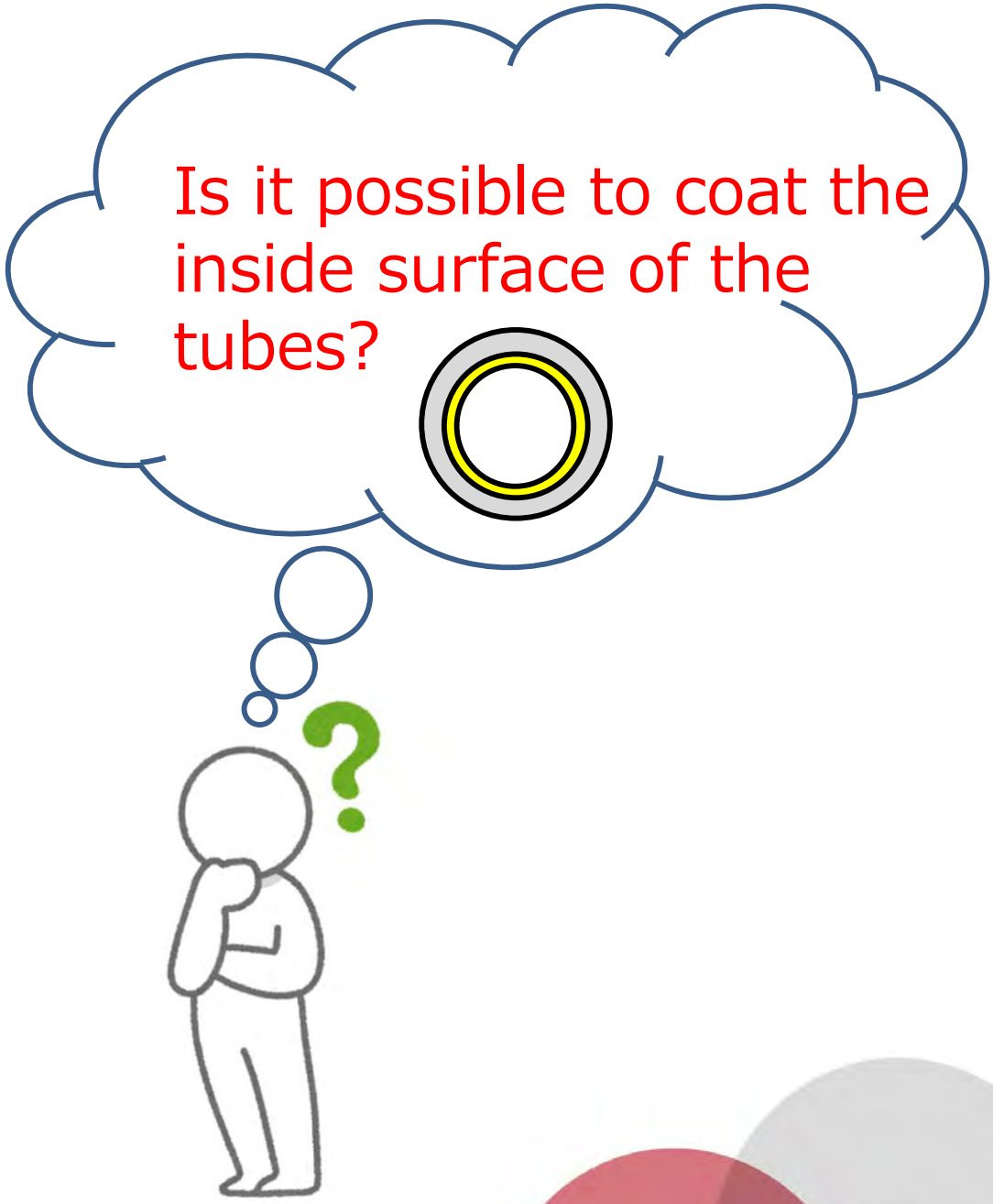
Type of surface treatment

- **Polishing**
- **Etching**
- **Painting**
- **Chemical conversion**
- **Plating** (Dry・**Wet**)
- **Ion implantation**

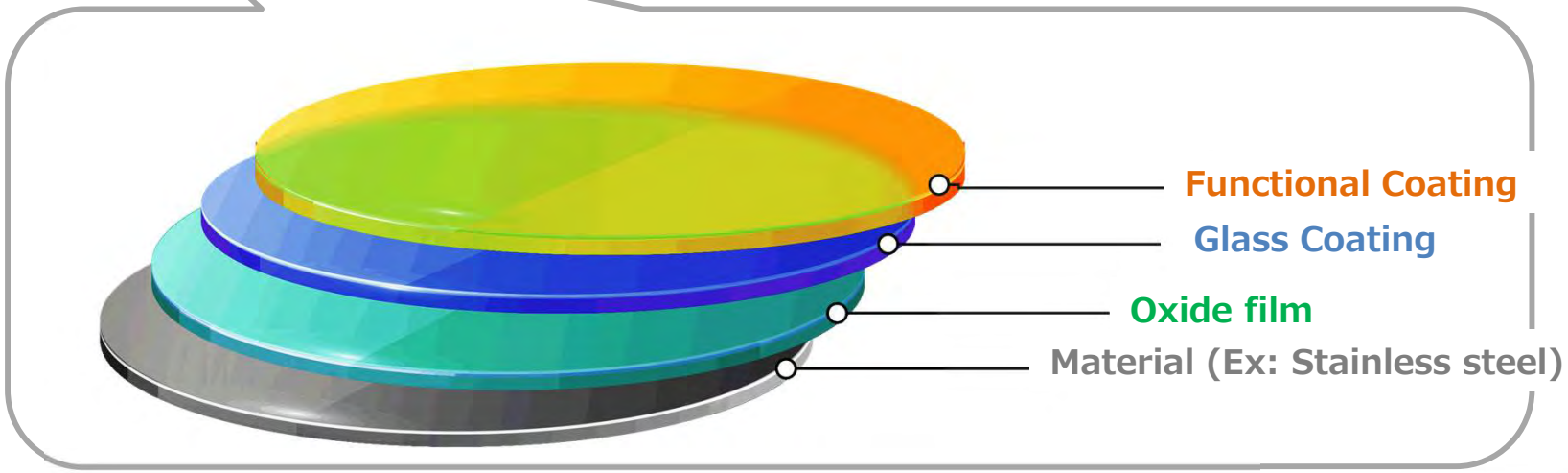


What is InertMask?

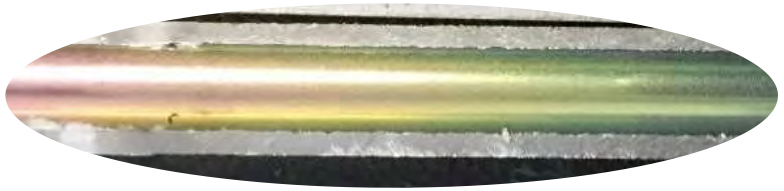
Coating Technology - InertMask

What is InertMask?

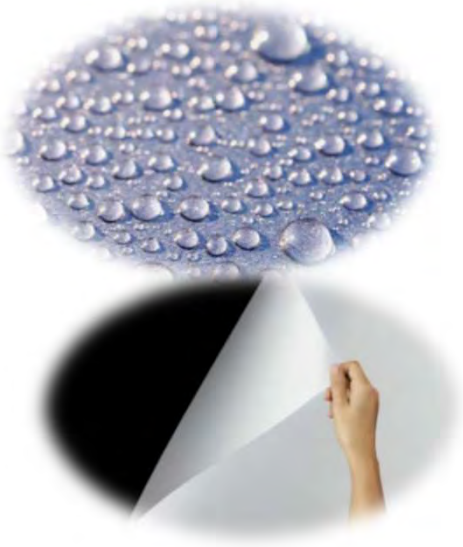
This is a coating technology that applies silica gel surface modification technology to metal surfaces.



InertMask Features



- Tube internal surface can be coated.
- Inertness (Non adsorptive)
- Corrosion Resistance
- Organic solvent resistance
- Corrosion Resistance
- Water repellency
- Antifouling
- Releasability



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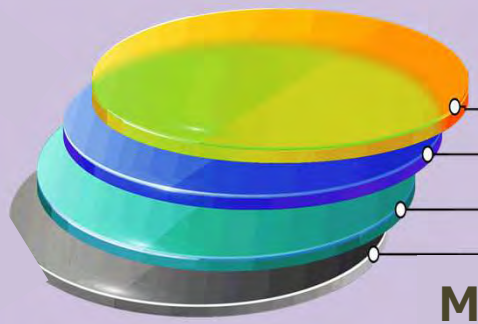
③What kind of markets are InertMask sold to ?

InertMask Markets

Semiconductors

Electric power



Functional Coating

Glass Coating

Oxide film

Material (Ex: Stainless steel)

Automobile

Petrochemical/Oil refinery

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The Target users

1) **Petrochemical/Oil Refinery Companies**

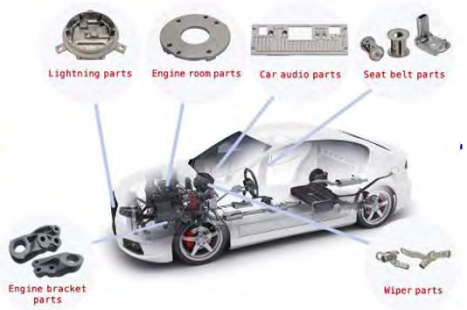
→**Adsorption of sulfur compounds in petroleum is serious problem.**

2) **Semiconductors**

→**Use of corrosive gas, corrosion and deterioration of flow path due to etching process**

3) **Automotive companies**

→**Rust, Adhesion of Chlorine cause poor cooling of aluminum die-cast**



4) **Electric power**

→Demand for improved analysis accuracy for ar compounds in combustion gas analys

5) **Other**

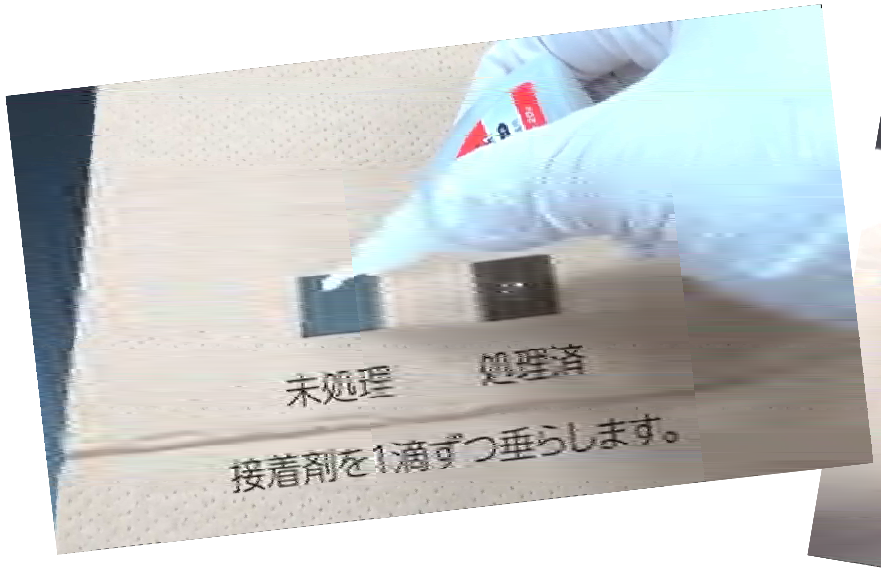
→ **Users using sulfuric acid**

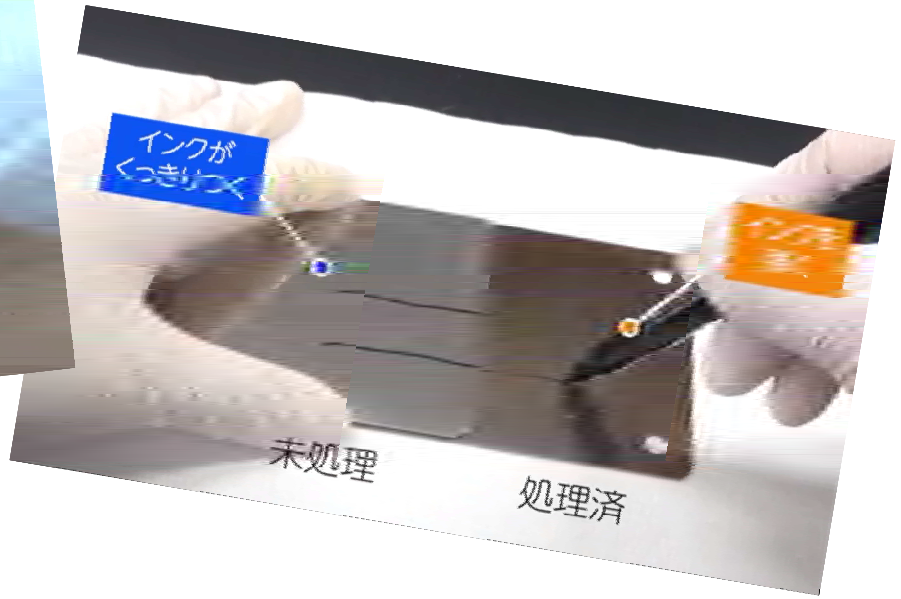
④ Test Data

Antifouling Test

- **Please take a look the related videos on our website.**

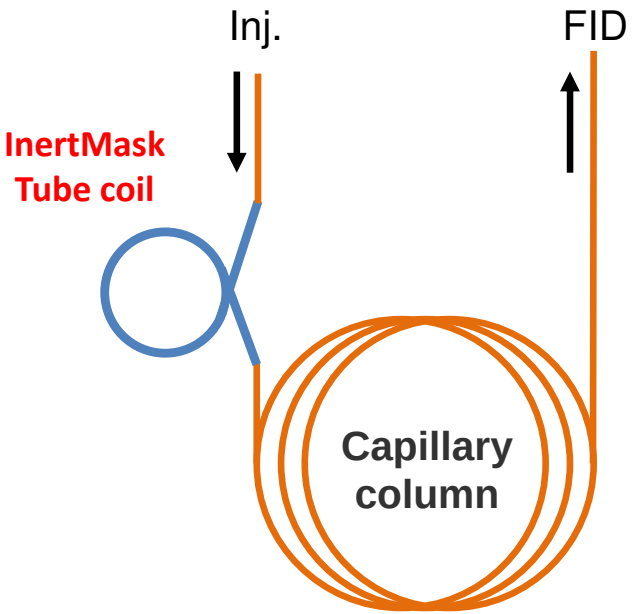
(https://www.gls.co.jp/product/other/surfacetreatment/02665.html -)





Adsorption Test (1)

- InertMask tube coil between the capillary columns, and connected and analyzed.

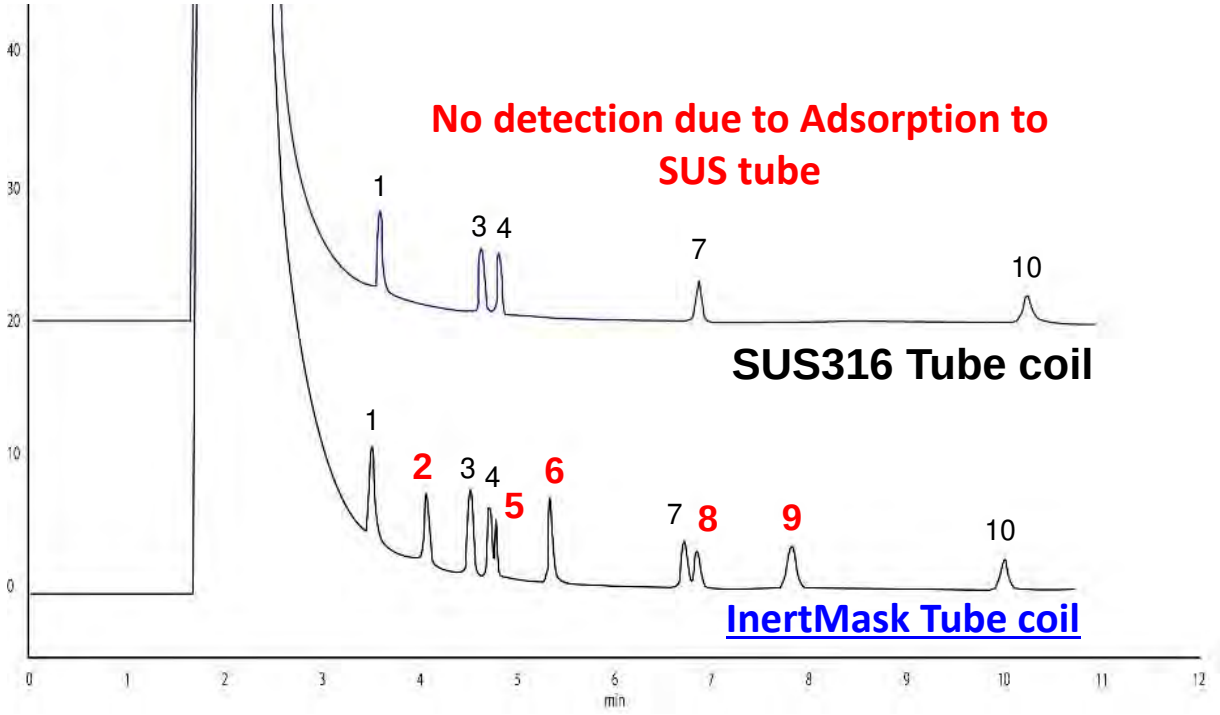


Test conditions

Column :InertCap 1	0.53 mm I.D.×30 m df = 1 μm
Col. Temp. :	140 ℃
Carrier Gas :	N_2 30 kPa
Split flow :	30 mL/min (1:10)
Injection Temp. :	250 ℃
Detection :	250 ℃
Sample :	Test Mixture D (10-50 ppm) 1 μL

Adsorption Test (2)

- All peaks have been detected because InertMask tube coil suppresses adsorption

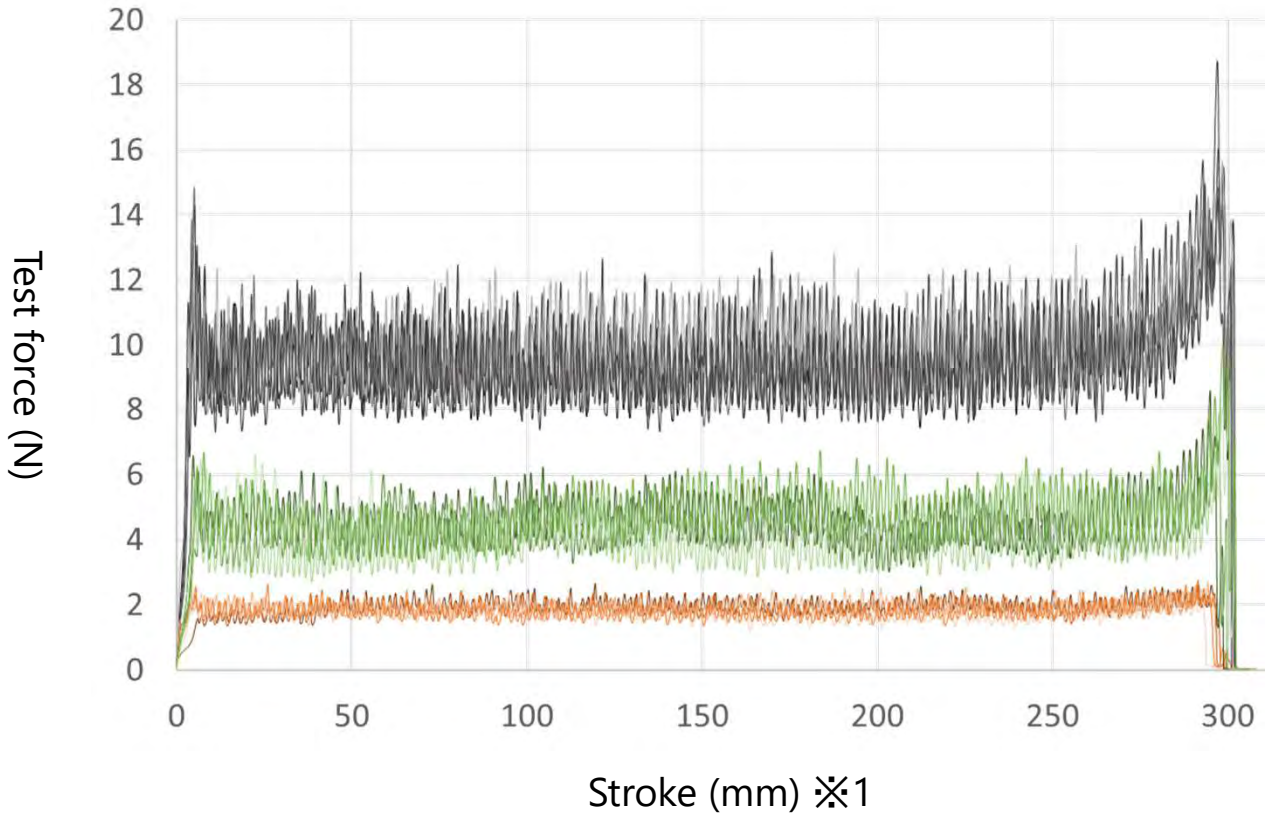


TEST Sample
1. *n*-Undecane
2. *n*-Nonanol（Acidic）
3. Naphthalene
4. *n*-Dodecane
5. 1,7-Heptanediol（Acidic）
6. *n*-Decylamine（Basic）
7. *n*-Tridecane
8. Methylcaprate（Acidic）
9. 2,4,5-Trichlorophenol（Acidic）
10. *n*-Tetradecane

The all peaks were detected with InertMask tubes.

Releasability Test (1)

☐ Test Results, n=5



※1 When peeling off, the peeled part will be folded back and then added to the part to be pulled, so the stroke will be twice the length of the sticking surface

→SUS304, 9.37N

→PTFE, 4.43N

→ **SUS304 w/InertMask, 1.83N**

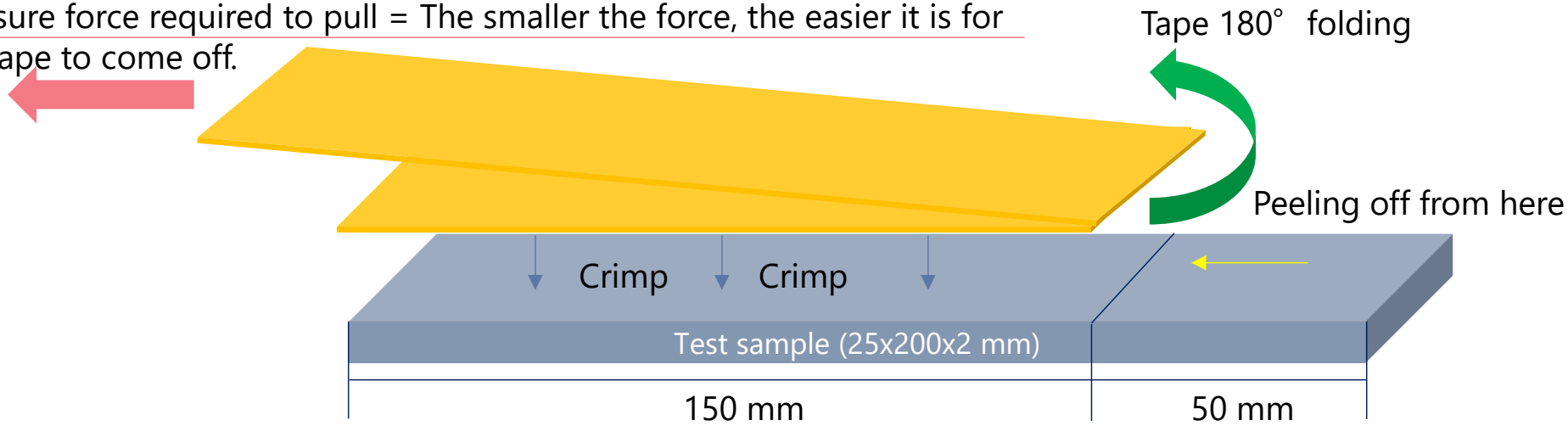
It can be peeled off with less than half the force of PTFE

Sample	Test force (N)	Stress (N/mm)
SUS304	9.37	0.37
PTFE	4.43	0.18
SUS304 w/InertMask	**1.83**	**0.07**

Releasability Test (2)

Test method (JIS Z 0237)

Measure force required to pull = The smaller the force, the easier it is for the tape to come off.



Specifications of the tape used

Maker	Thickness (mm)	Width (mm)	Adhesive force (N, gf/W25 mm)	Tensile strength (N/W25 mm)	Growth (%)
Teraoka	0.32	25	8.83, 900	183.9	10

Test sample (n=5)

- SUS304
- PTFE
- SUS304 w/InertMask

CCT: Cyclic Corrosion test 1)

☐ Test Result (Flat board, 30 cycles

SUS304	SUS304 w/InertMask

Before

30 cycles

SUS304	SUS304 w/InertMask

After

Suppresses the occurrence of rust with InertMask

CCT: Cyclic Corrosion test 2)

- Test Result (Flat board, 60 cycles)

SUS316L

Exterior

Inner Surface

SUS316L w/InertMask

Exterior

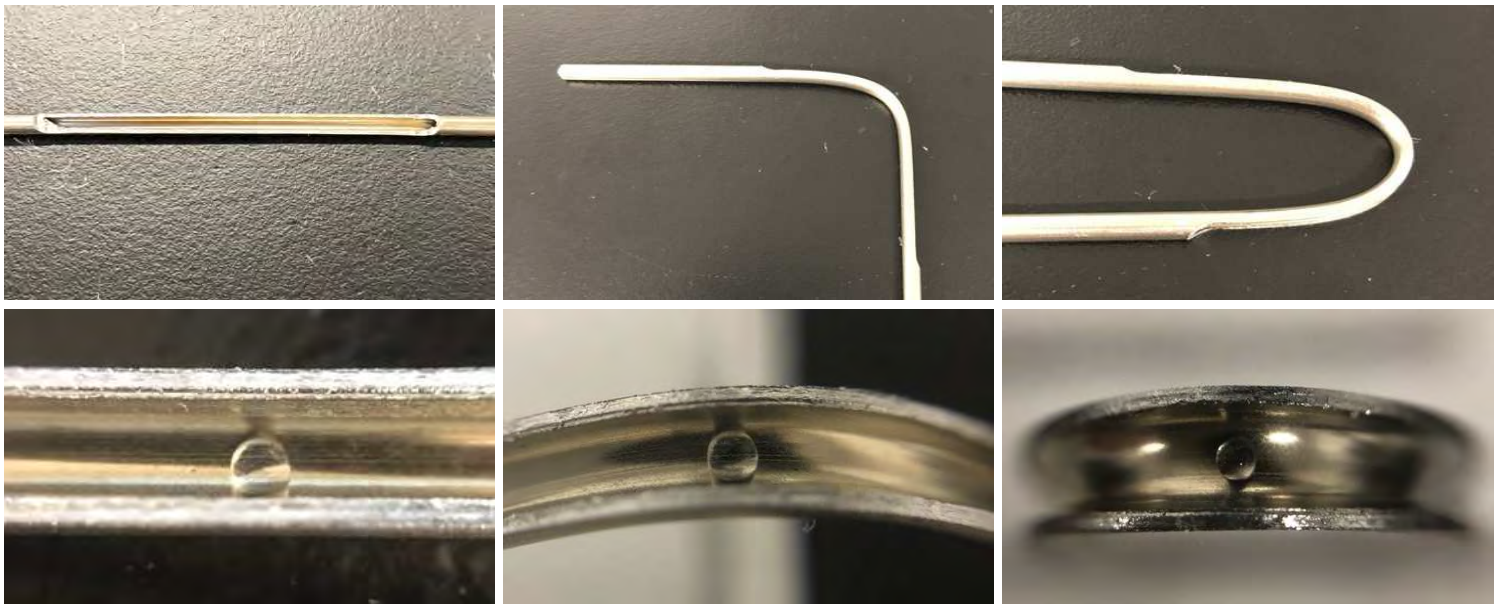
Inner Surface

Suppresses the occurrence of rust with InertMask

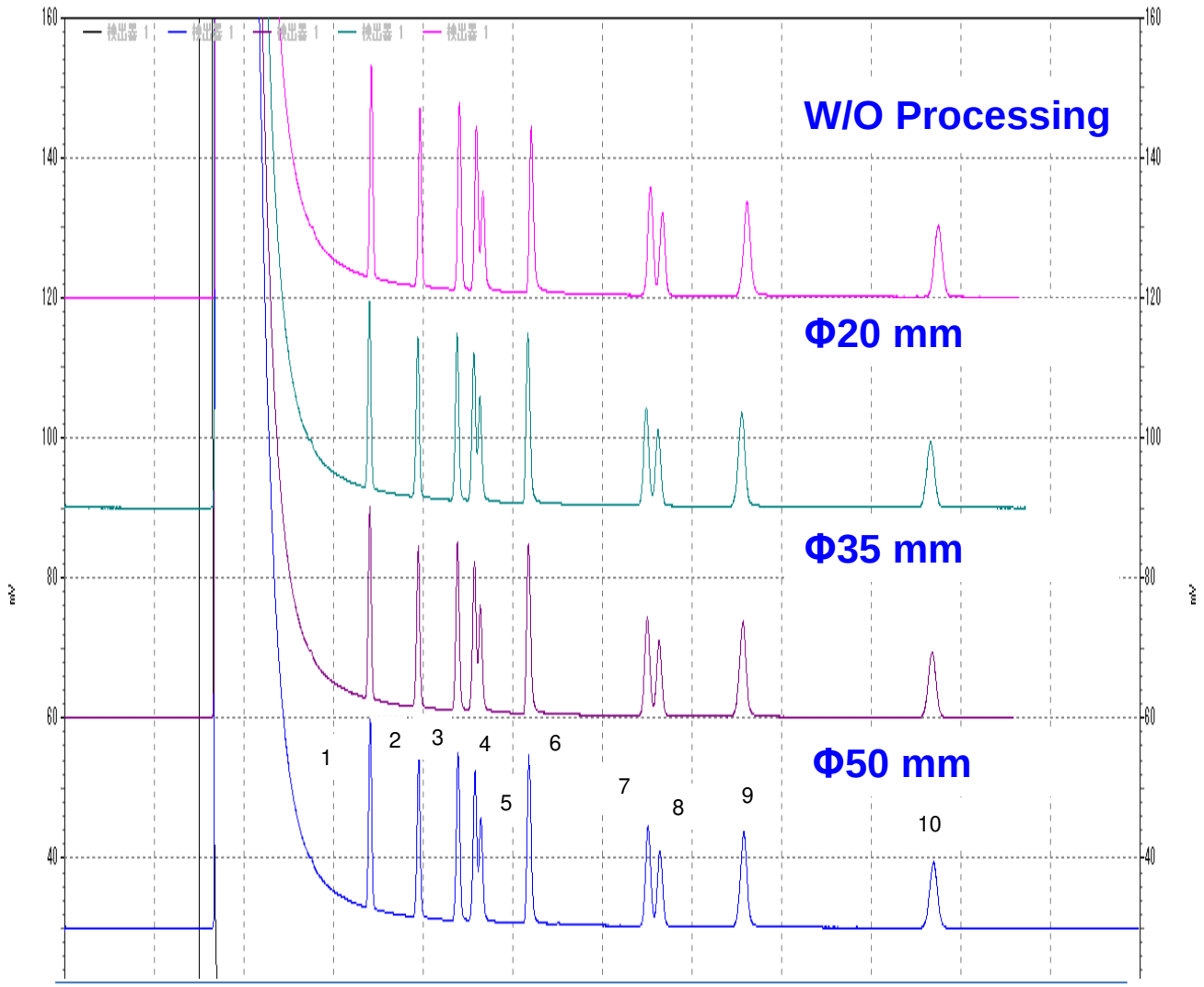
Flexibility Test (1)

- Maintains water repellency even after bending,
- No membrane damage was observed.

Before bending	Right angle	U shape



Flexibility Test (2)



SUS tube : 0.8 mm I.D.
1/16 mm O.D.

Test sample

1. n-Undecane
2. n-Nonanol
3. Naphthalene
4. n-Dodecane
5. 1.7-Heptanediol
6. n-Decylamine
7. n-Tridecane
8. Methylcaprate
9. 2.4.5-Trichlorophenol
10. n-Tetradecane

Maintains performance even when processed to φ20

Organic solvent resistance

➢It is also resistant to various organic solvents

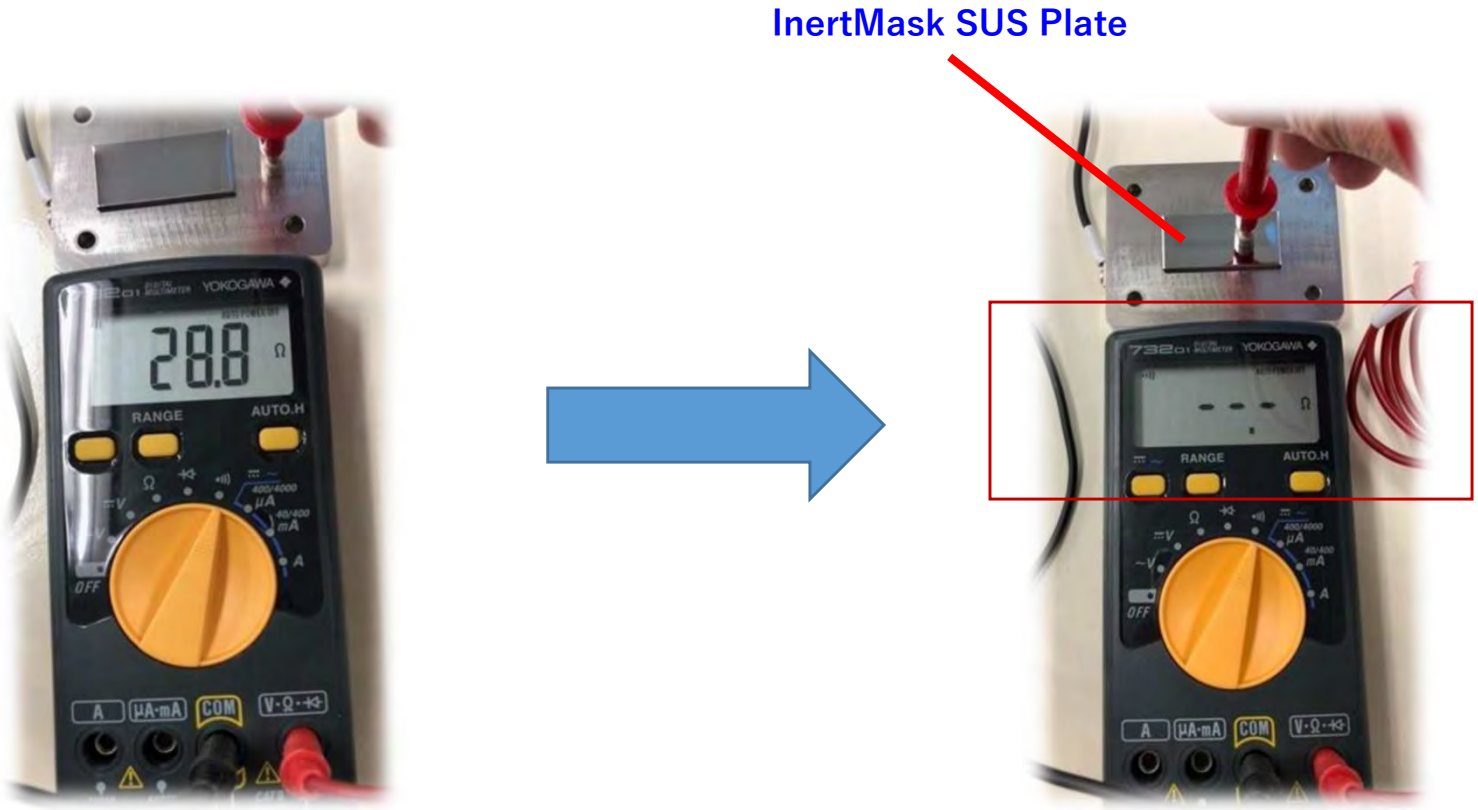
	Methanol	Acetone	Hexane	Toluene	THF	Chloroform	Diethyl ether	Cyclohexane
Resistance	○	○	○	○	○	○	○	○

※ This test data does not guarantee resistance.
Before using the product, test is under each operating conditions.

Test conditions
Immersion time : 360hours
Temperature : Room Temperature
Evaluation method : Presence or absence of changes in appearance and water repellency

Electrical Continuity Test

- The test was performed using a tester on a stainless steel plate with InertMask



Electrical Continuity is not confirmed

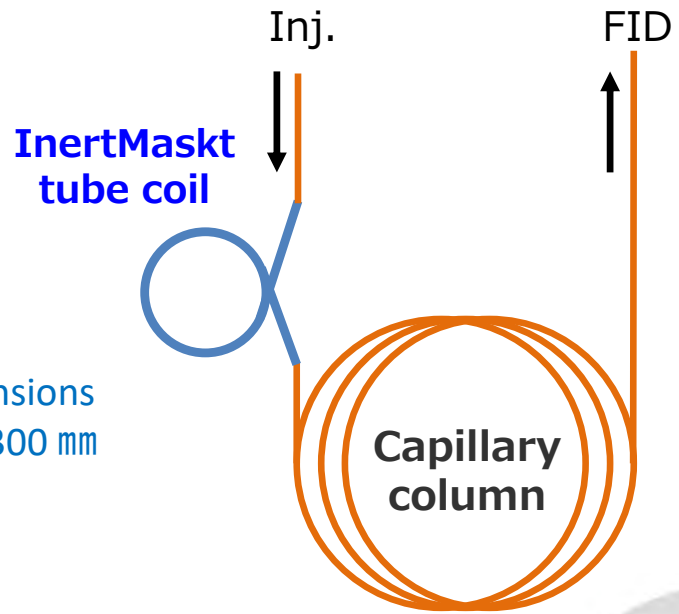
GC Adsorption test

Adsorption (inertness) of the sample to the InertMask-treated SUS tube was evaluated by GC.

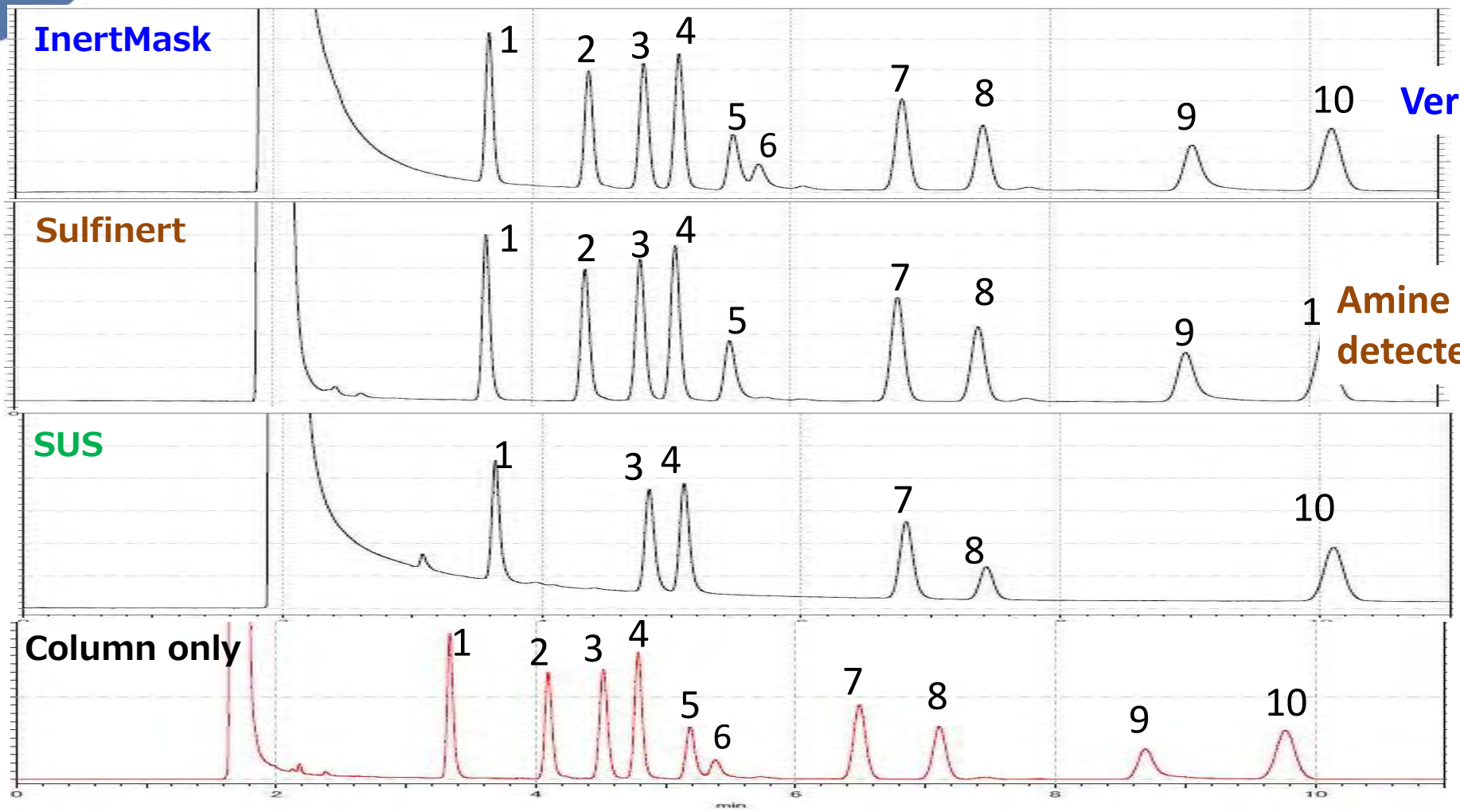
GC conditions :

Column : InertCap 5 0.53 mm i.d.×30 m df = 1 μm
Col. Temp. : 140 ℃
Carrier Gas : N2 25 kPa
Inject. Temp. : 250 ℃
Detection : 300 ℃
Sample : Test Mixture D

(1) *n*-Undecane
(2) *n*-Nonanol
(3) Naphthalene
(4) *n*-Dodecane
(5) 1,7-Heptanediol
(6) *n*-Decylamine
(7) *n*-Tridecane
(8) Methyl-n-Decanoate
(9) 2,4,5-Trichlorophenol
(10) *n*-Tetradecane



Adsorption test (Inertness)



Tube dimensions
2.1 ㎜I.D.-1/8” O.D.-300 ㎜

1. *n*-Undecane
2. *n*-Nonanol
3. Naphthalene
4. *n*-Dodecane
5. 1,7-Heptanediol
6. *n*-Decylamine
7. *n*-Tridecane
8. Methyl-n-Decanoate
9. 2,4,5-Trichlorophenol
10. *n*-Tetradecane

Heat resistant Test

The InertMask tube and the Sulfinert tube were heated at 250-400℃ and evaluated in the same conditions as the GC adsorption test to observe changes in peak shape.

Heating conditions

Temperature : 250～400℃
Time : 10hours
Atmosphere : Atmosphere
Tube : InertMask, Sulfinert
2.1 ㎜I.D.-1/8” O.D.-300 ㎜

⑤ Who are our competitors?

Restek & Silcotek

InertMask

vs

Sulfinert (Restek), Silconert 2000 (Silcotek)

These are the same products and Restek just name Sulfinert as OEM.

Sulfinert
https://www.restek.com/ja/technical-literature-library/articles/sulfinert-treated-sample-cylinders/
Silconert 2000 combined with Swagelok
https://www.silcotek.com/silcod-technologies/silconert-inert-coating

⑥Comparison Data

Specifications

- Coating Method： CVD (Chemical Vapor Deposition)
- Coated by : Functionalized amorphous silica
- Max. Temp. : Up to 400 ℃
- Thickness: 50-500 nm
- Hydrophobicity: 100-110°
- Substrate compatibility: Stainless Steel(SUS304,SUS316 etc.), Titanium, Aluminum, Glass and others

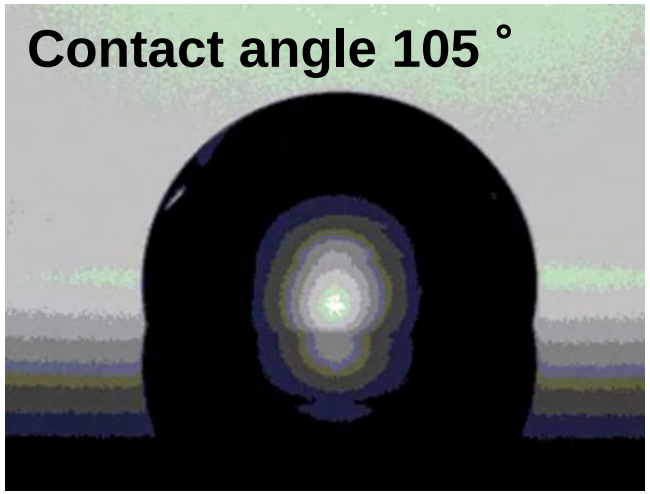
- Resin is not available due to the forms a film by applying heat.

Basic specifications

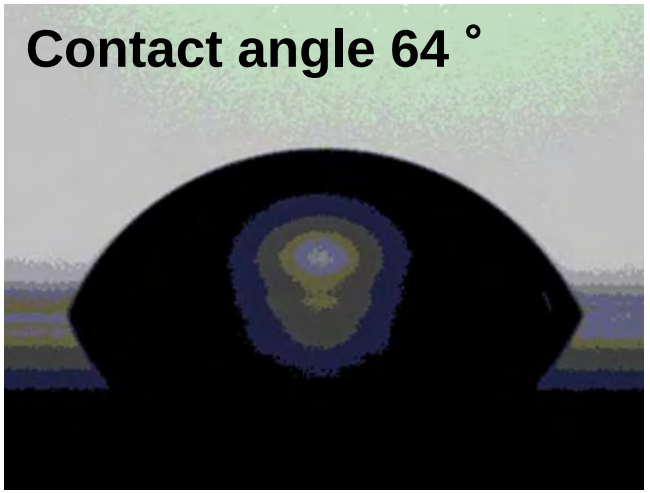
	InertMask	Sulfinert
Film thickness	50-500 nm	100-500 nm
Contract angle	105° （Actual value）	64° （Actual value）
Main gradient	SiO2	Si

Contact Angle Test

InertMask



Sulfinert



Conditions

System : Contact Angle Meter DMo602

Solvent : H_2O

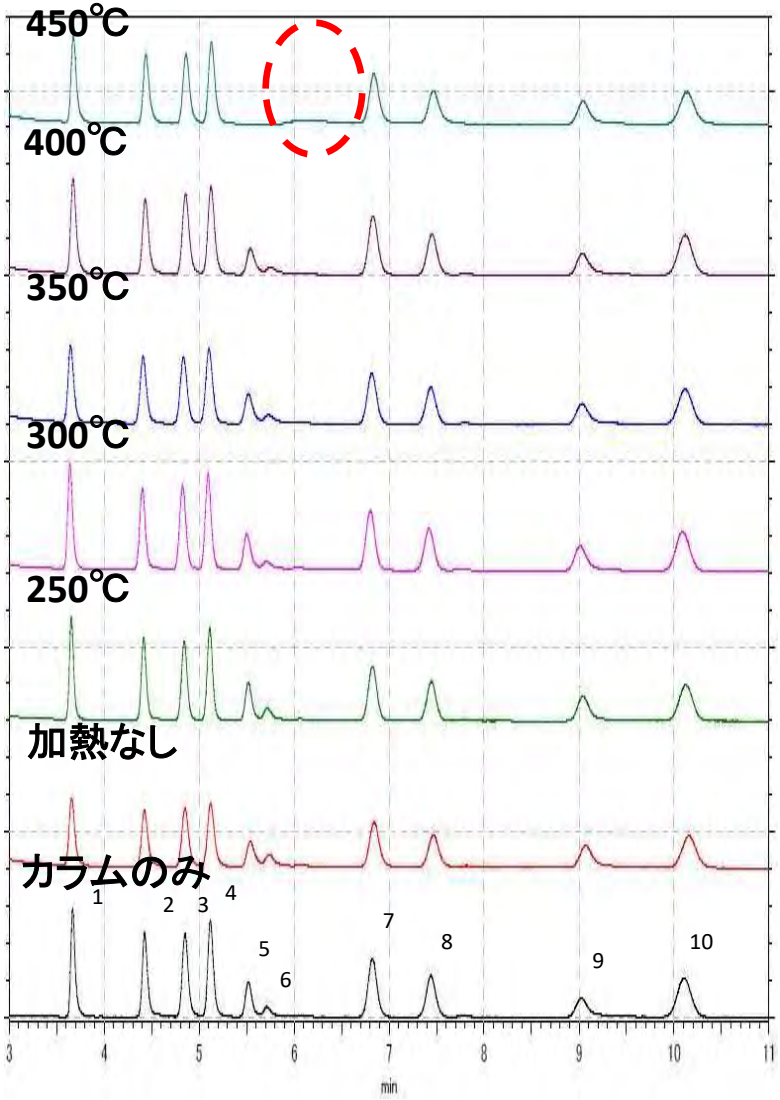
Drop volume : 2 µm

Method : θ/2

Temp. : RT

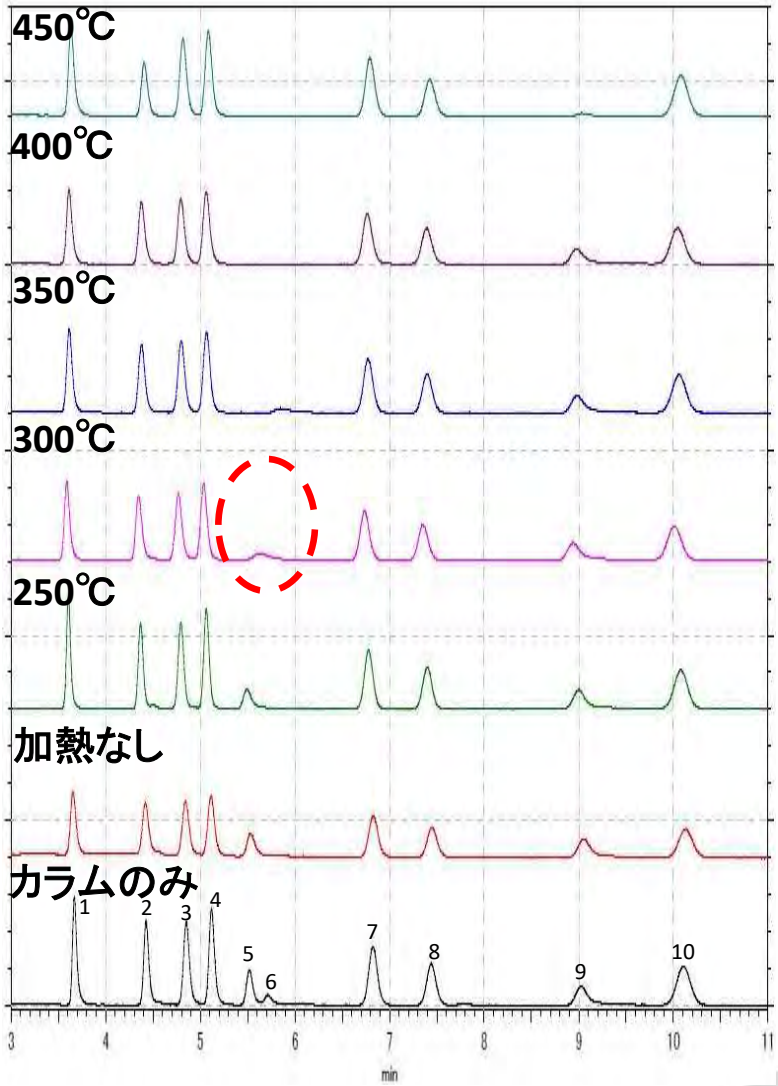
Heat Resistant Test

InertMask



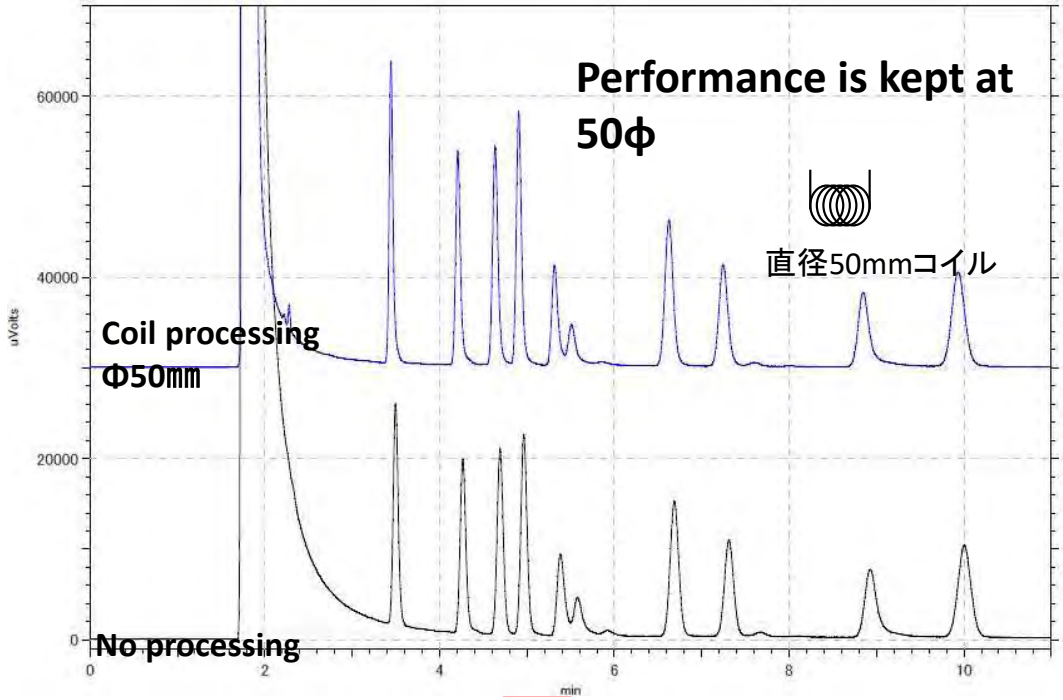
Max.400℃

Sulfinert

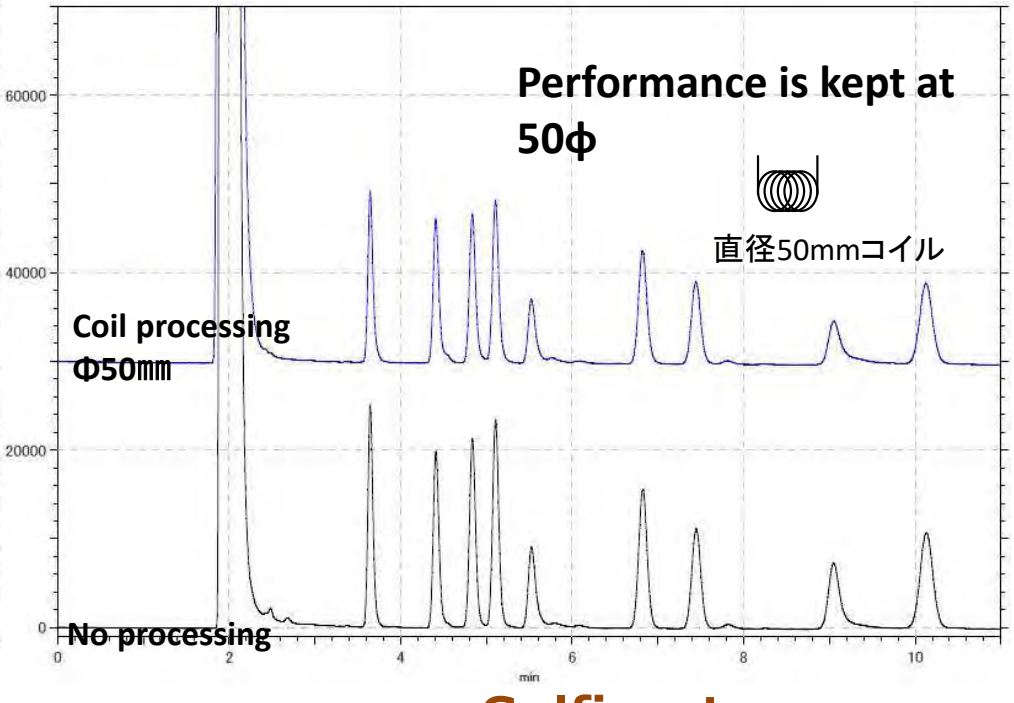


Less than 300℃

Flexibility Test



InertMask



Sulfinert

Tube Dimensions
2.1 ㎜I.D.-1/8” O.D.-300 ㎜

Test Result : Both were good

Sulfuric Acid Resistance Test

Immersed in 25% sulfuric acid at room temperature for 3 days, observed appearance and weight change before and after

InertMask

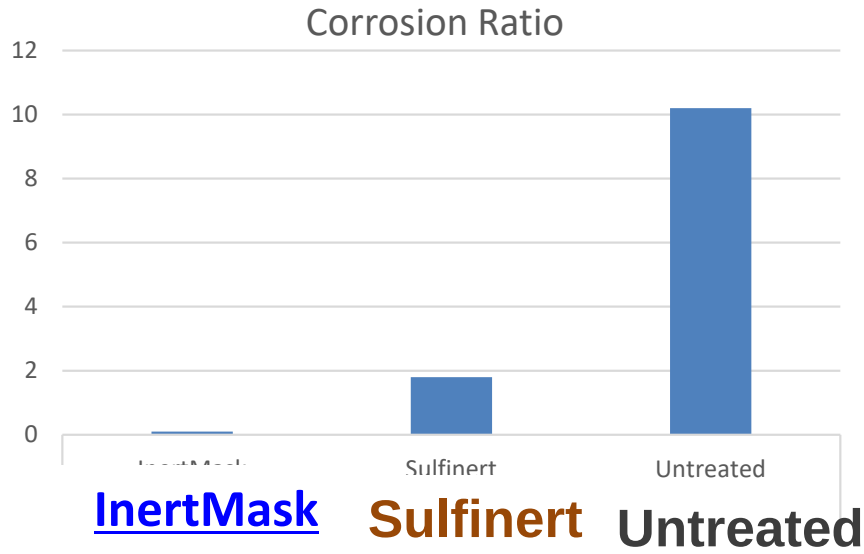
No change

Sulfinert

Air bubbles (Corroded)

Untreated

Discolored Black (Corroded)



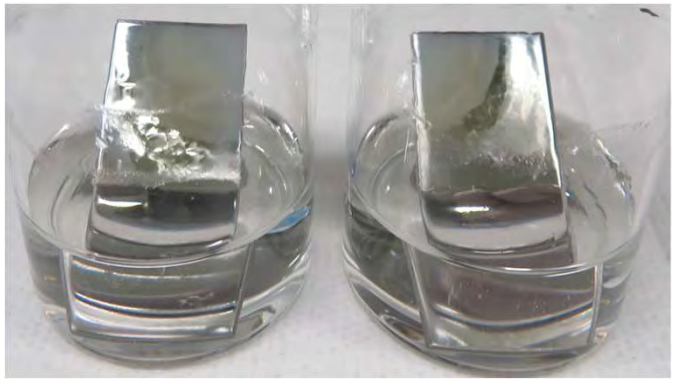
Inhibit corrosion

Test Conditions

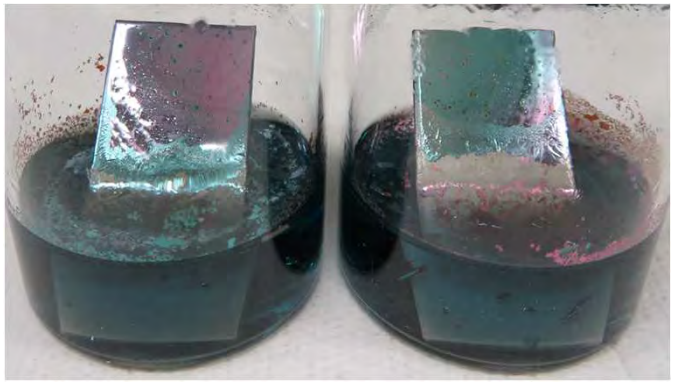
Solvent : Dilute Sulfuric acid (6 N, 25 %)
Immersion time : 72 hours
Temperature : Room temp.

	Corrosion weight loss (mg)	Degree of corrosion (g/m^2/day)
Untreated	28.7	10.32
Sulfinert	4.6	1.65
InertMask	0.2	0.07

Sulfuric acid exposure Test



InertMask



Sulfinert

⑦ Sales performance

InertMask Sales Records (1)

- Chemical companies : Sample line of CO production facilities
  （Pipings, Fittings）

- Construction Companies : Piping for analyzer in wood combustion gas
  (Pipings) Repeat order has been occurred.

- Semiconductors : Line from cleanroom to an analyzer.
  （Pipings, fittings, cylinders and etc.）

- Petrochemical companies : Fittings, adaptors, pipings for system GC
(Oil refineries)

InertMask Sales Records (2)

Public office : Container for air sampling
(Internal treatment of stainless steel flask)　Repeat orders have been occurred

・**Reagents and chemical company:** Sample containers for thermal analytical system
(SUS, aluminum pan)　Repeat orders have been occurred.

・ **University:** Hydrogen isotope research Gas sample line
(Piping, calibration tube) Repeat orders have been occurred.

・**Parts company:** Lines for exhaust gas analyzers
(Piping, fittings, valves, etc.)

・**Sensor development company:** Gas chromatograph related parts (concentrator, manifold, tube, sensor cell)

InertMask Sales Records (3)

- Valve, Fitting makers : Fitting treatment

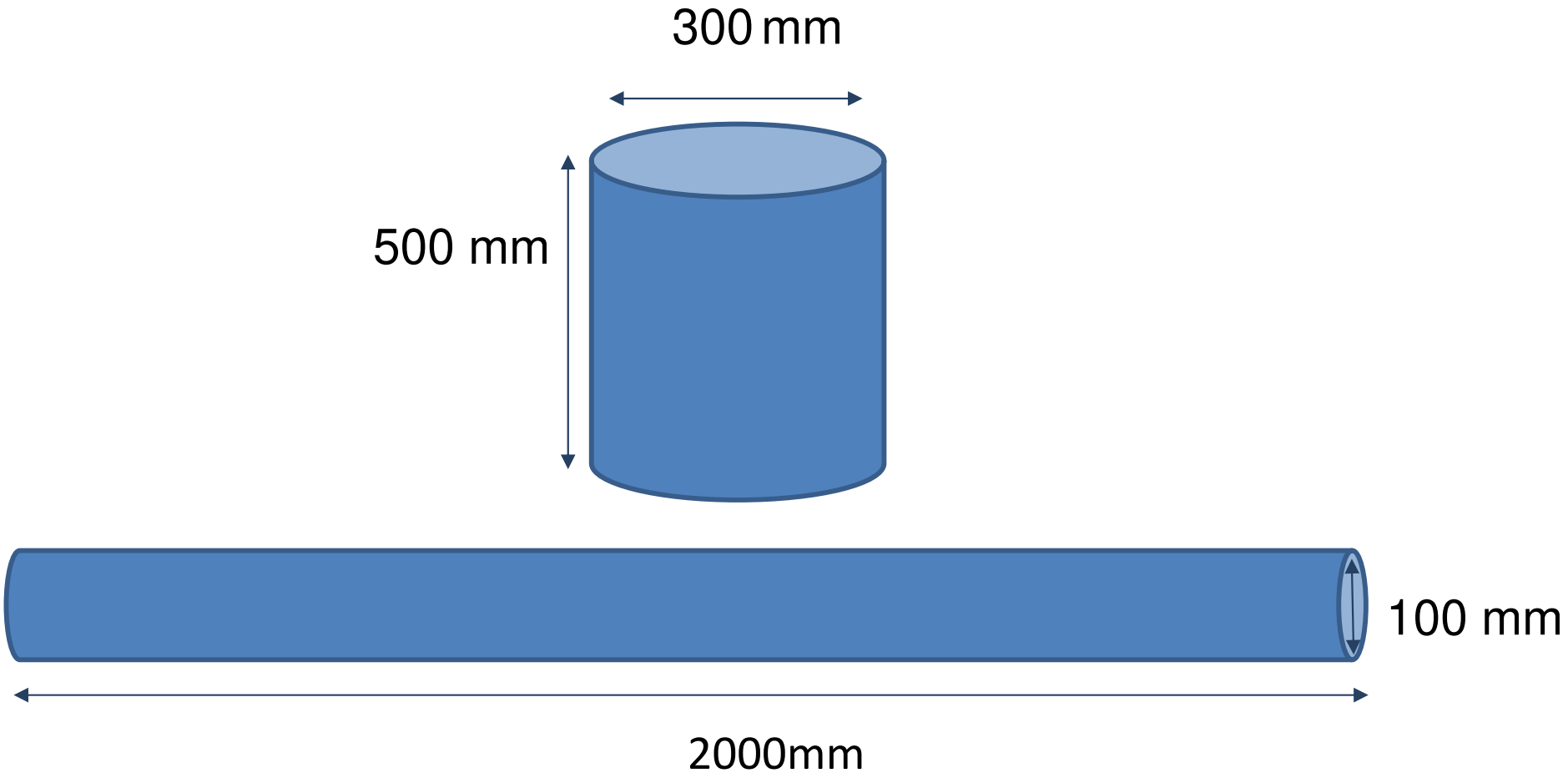
- Construction companies : Parts of the abatement system(cooler), piping, etc.

For Free demo:

Please let us know if you have any request for non-adsorption, durability, sulfuric acid resistance, etc.

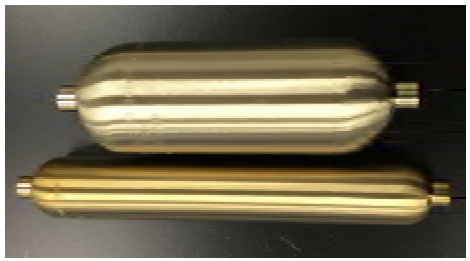
⑧ Product information

InertMask *Lineup – Dimensions*



Note : Products for coating must be provided smaller than the above dimensions

Lineup



Cylinders

Capacity	Cat.No.	Q'ty
300mL	7510-	1
500mL	7510-	1

Coil Tubes

OD	ID	L	Qty	Cat.No.
1/16”	1.0	5 m	1	7510-21501
1/16”	1.0	10 m	1	7510-21500
1/16”	0.8	5 m	1	7510-21601
1/16”	0.8	10 m	1	7510-21600
1/8”	2.0	5 m	1	7510-21701
1/8”	2.0	10 m	1	7510-21700

Lineup

Plugs

Tube OD	Qty	Cat.No.
1/8”	1	7510-20650
1/4”	1	7510-20651

Elbows

Tube OD	Qty	Cat.No.
1/8”	1	7510-20700
1/4”	1	7510-20701

Reducing Unions

Tube OD	Qty	Cat.No.
1/8”-1/16”	1	7510-20100
1/4”-1/16”	1	7510-20101
1/4”-1/8”	1	7510-20102

Female Connectors

Tube	Qty	Cat.No.
1/8”-1/8”NPT	1	7510-20400
1/8”-1/4”NPT	1	7510-20401
1/4”-1/8”NPT	1	7510-20402
1/4”-1/4”NPT	1	7510-20403

Unions

Tube OD	Qty	Cat.No.
1/16”	1	7510-20000
1/8”	1	7510-20001
1/4”	1	7510-20002

Male Connectors

Tube OD	Qty	Cat.No.
1/16”-1/8”NPT	1	7510-20300
1/8”-1/8”NPT	1	7510-20301
1/8”-1/4”NPT	1	7510-20302
1/4”-1/8”NPT	1	7510-20303
1/4”-1/4”NPT	1	7510-20304

Reducers

Tube OD	Qty	Cat.No.
T1/16”-Tx1/8”	1	7510-20500
T1/16”-Tx1/4”	1	7510-20501
T1/4”-Tx1/8”	1	7510-20502
T1/8”-Tx1/4”	1	7510-20503

Port Connectors

Tube OD	Qty	Cat.No.
1/16”	1	7510-20600
1/8”	1	7510-20601
1/4”	1	7510-20602

Tee Unions

Tube OD	Qty	Cat.No.
1/16”	1	7510-20800
1/8”	1	7510-20801
1/4”	1	7510-20802

Cross Unions

Tube OD	Qty	Cat.No.
1/8”	1	7510-20900
1/4”	1	7510-20901

Bulk Head Unions

Tube OD	Qty	Cat.No.
1/16”	1	7510-20200
1/8”	1	7510-20201
1/4”	1	7510-20202

Coil Tubes

OD	ID	L	Qty	Cat.No.
1/16”	1.0	5 m	1	7510-21501
1/16”	1.0	10 m	1	7510-21500
1/16”	0.8	5 m	1	7510-21601
1/16”	0.8	10 m	1	7510-21600
1/8”	2.0	5 m	1	7510-21701
1/8”	2.0	10 m	1	7510-21700

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