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Optimization and compounding effect of element technology for Low-E packing

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(Engineer)
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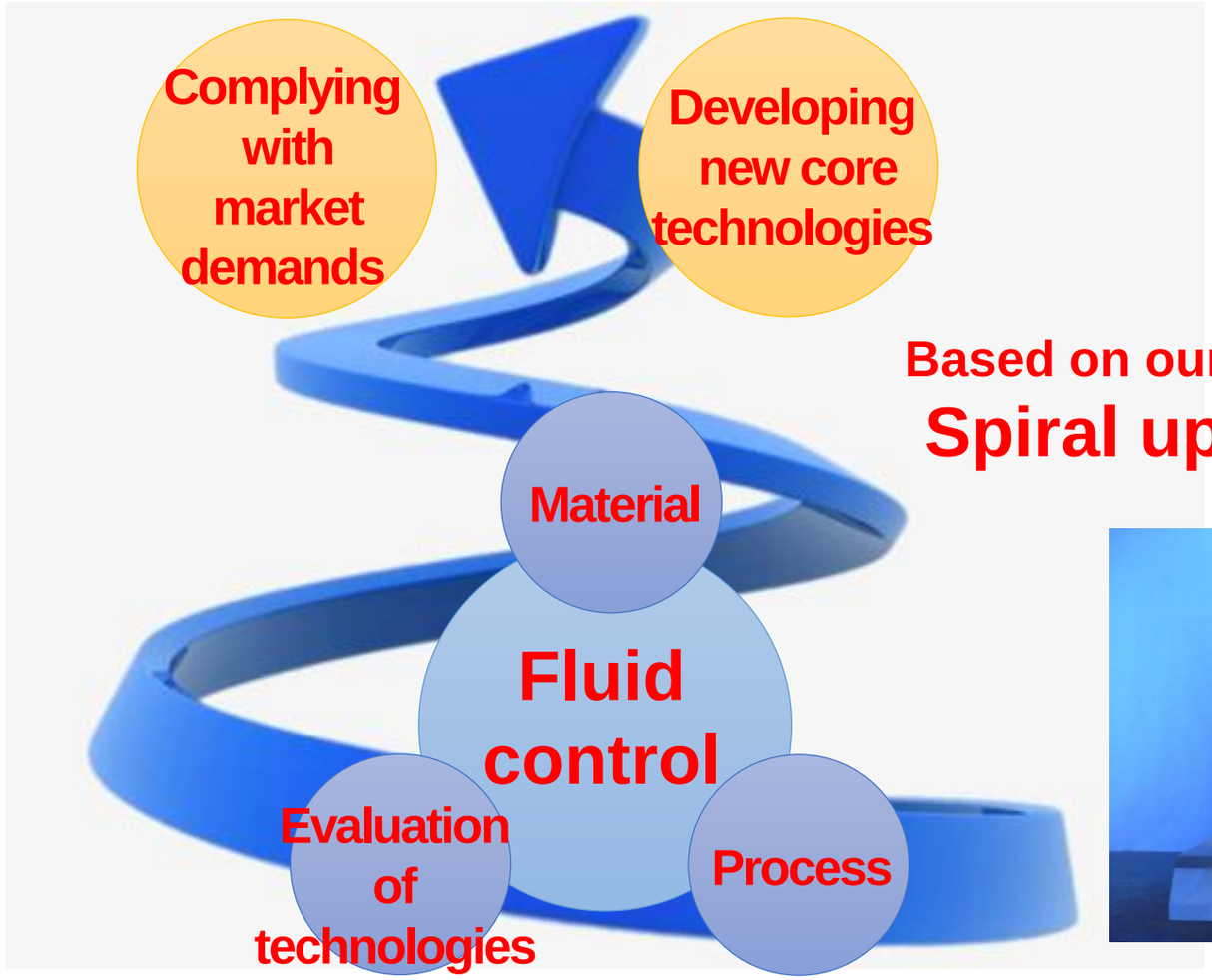
PILLAR Packing history

95 years ago, the founder decided to establish Nippon Pillar to save sailors' life. Since then, we have devoted all of our efforts to R&D in order to innovate our packing products.



Based on our fluid control technology,

Spiral up to Further Leap !

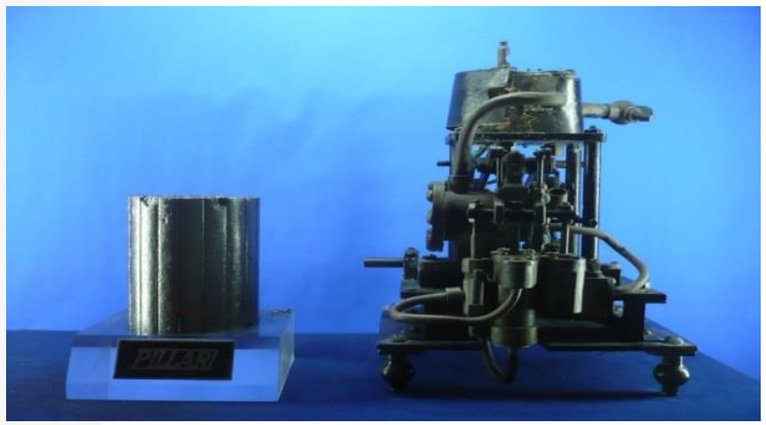


Table of contents

1. Market trends

1.1 Higher sealing performances are required by Environmental regulations

Upgrade of environmental controls	Required packing's performances		
CAAA	→ 500ppm	→ 100ppm	
API622 API624 API641	→ 500ppm	→ 100ppm	→ Less Leakage
ISO15848	→ Class BH : 1.78×10^{-7} Pa·m³/(sec·mm)	↓ Class AH : 1.78×10^{-8} Pa·m³/(sec·mm)	

1. Market trends

1.2 Expected packing performances

Market trends

- High temperature
- High pressure
- Long-term stability

Certified the Low-emission performance

Stable performance in different conditions at plant sites

✓ High seal performance

✓ Long-term stability

1.Sliding durability

2.Small stress relaxation

3.Less thermal weight loss

4.Small extrusions against valve clearance

2. Our new challenges

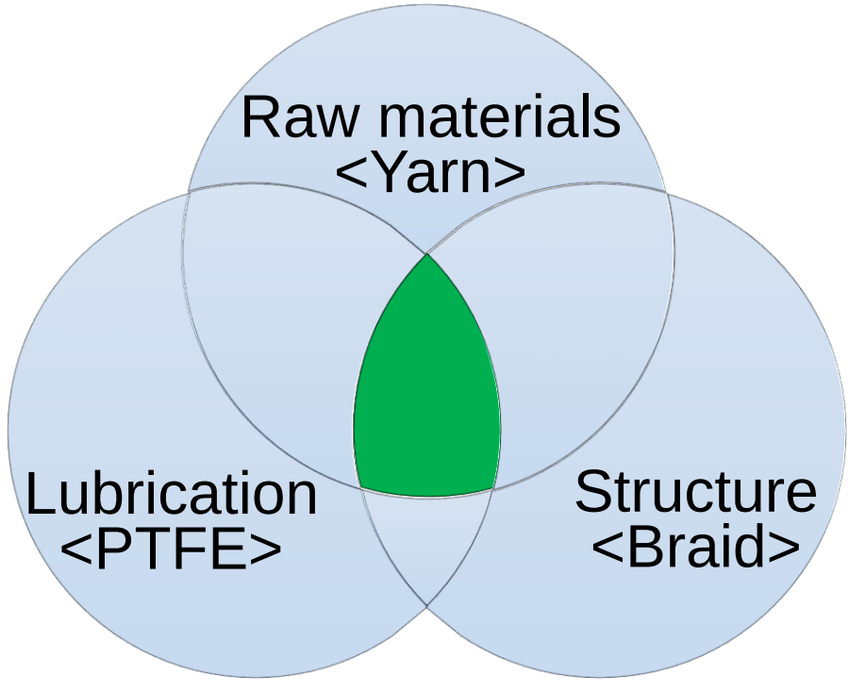
Optimization And Compounding

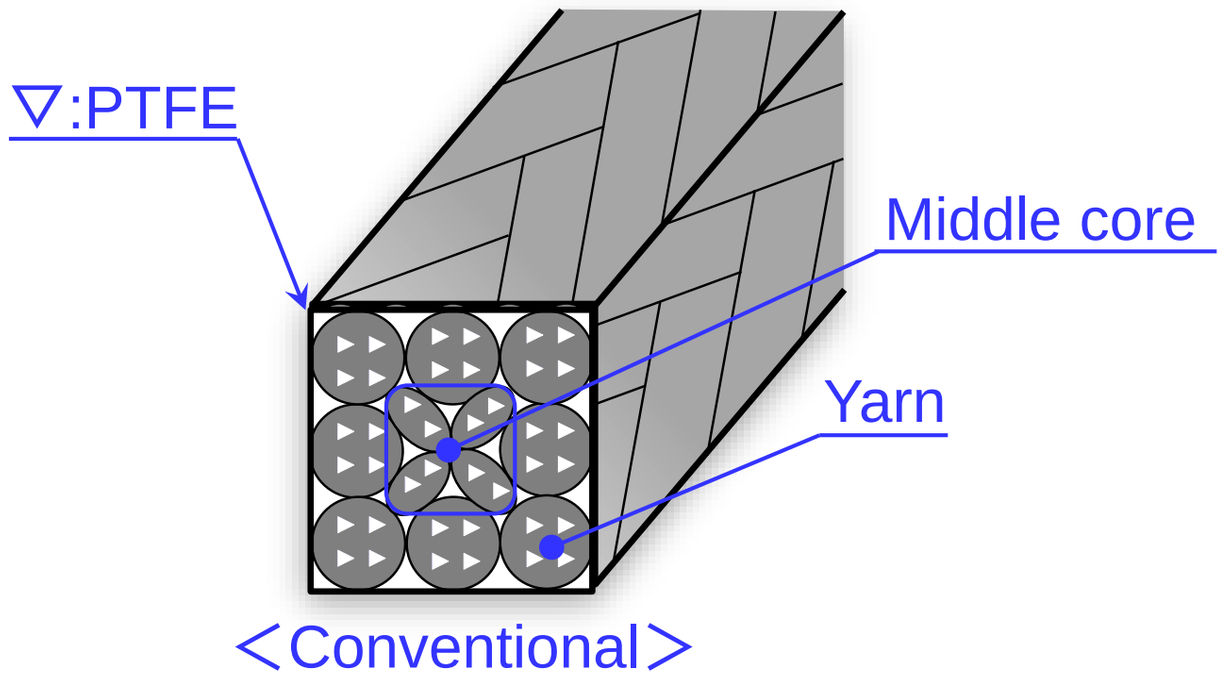
Respond to stricter environmental regulations

✔High sealing performance

✔Stable sliding performance

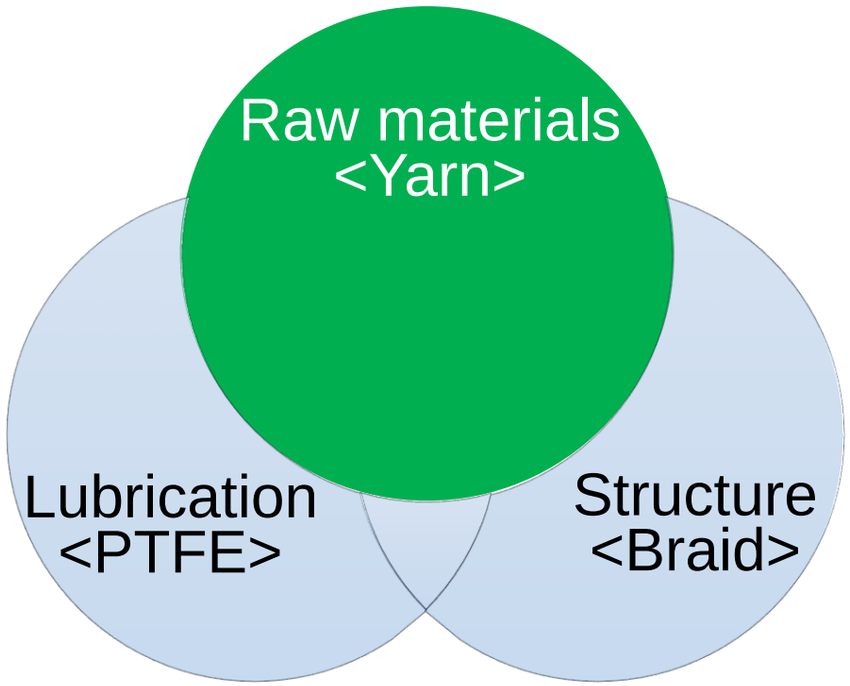
ISO15848 **Class AH CC1** @400℃

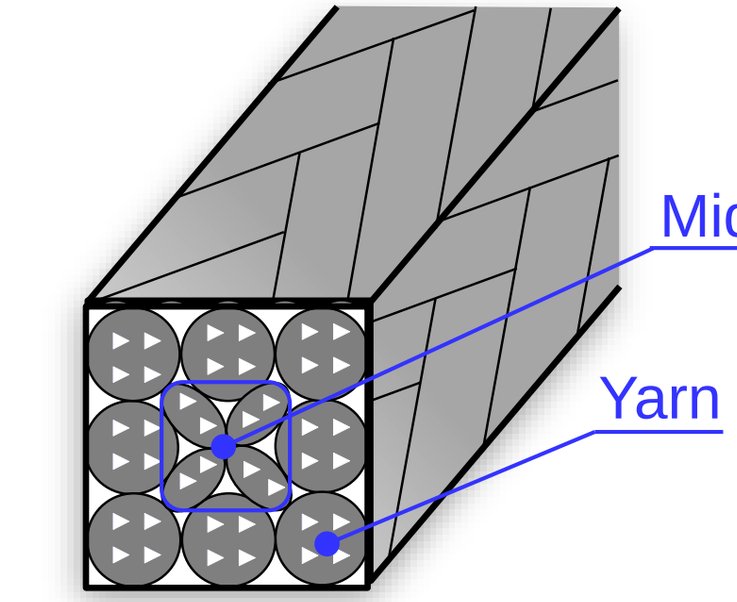




3. Optimization and compounding of element technology for Low-E packing

3.1 Raw materials <Yarn>

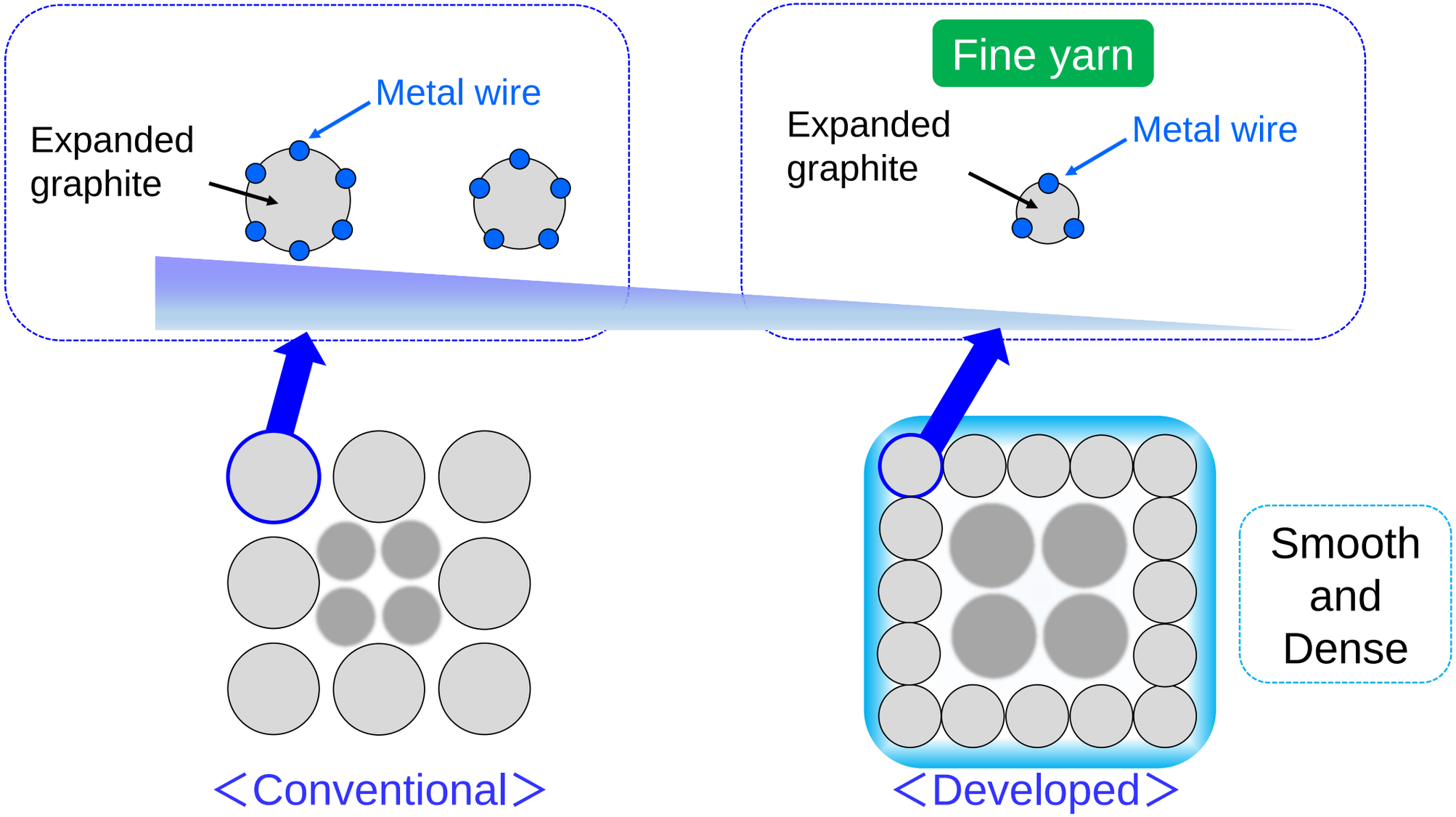




＜Conventional＞

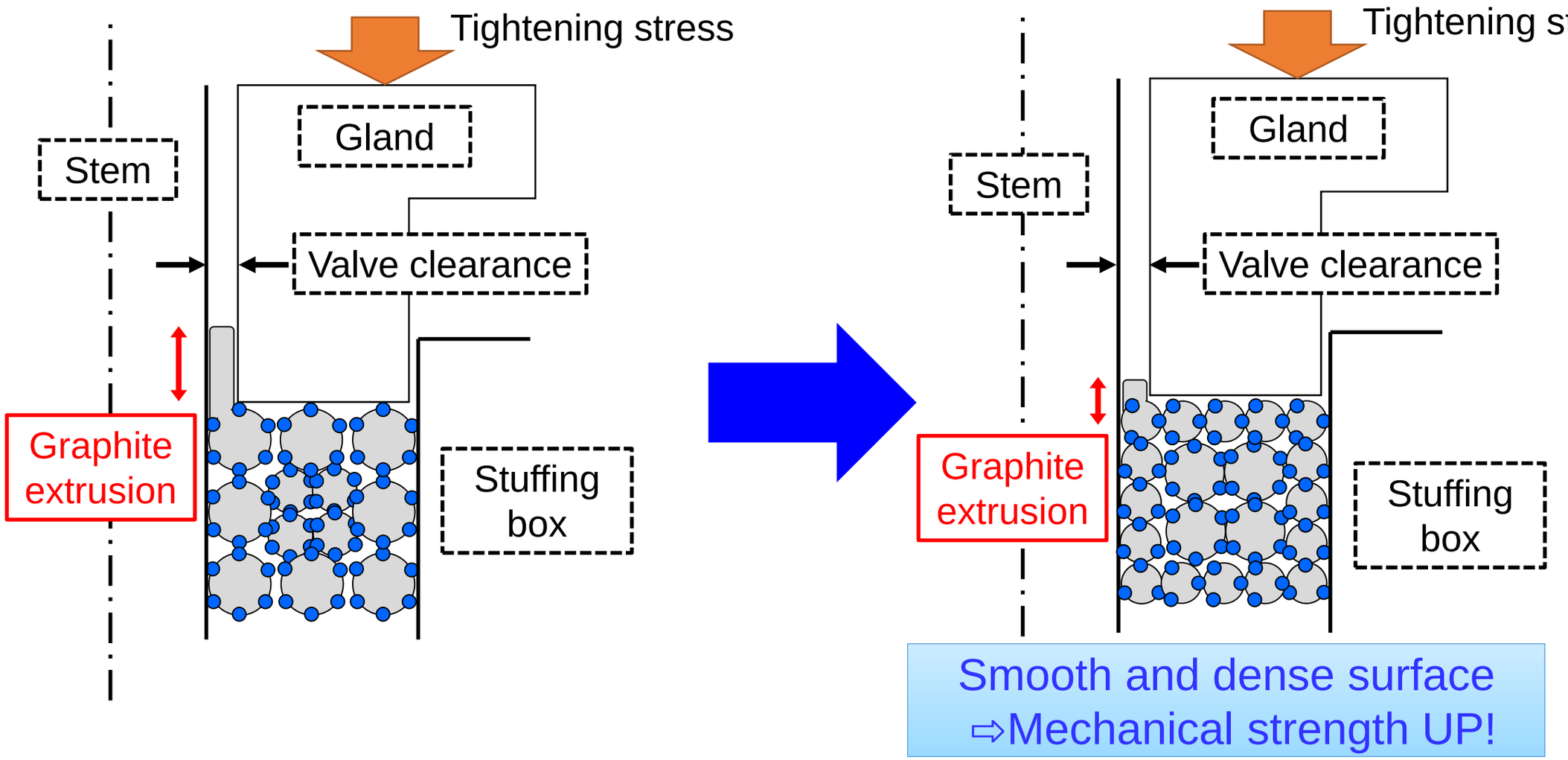
3. Optimization and compounding of element technology for Low-E packing

3.1 Raw materials <Yarn>



3. Optimization and compounding of element technology for Low-E packing

3.1 Raw materials <Yarn>



＜Conventional＞

＜Developed＞

3. Optimization and compounding of element technology for Low-E packing

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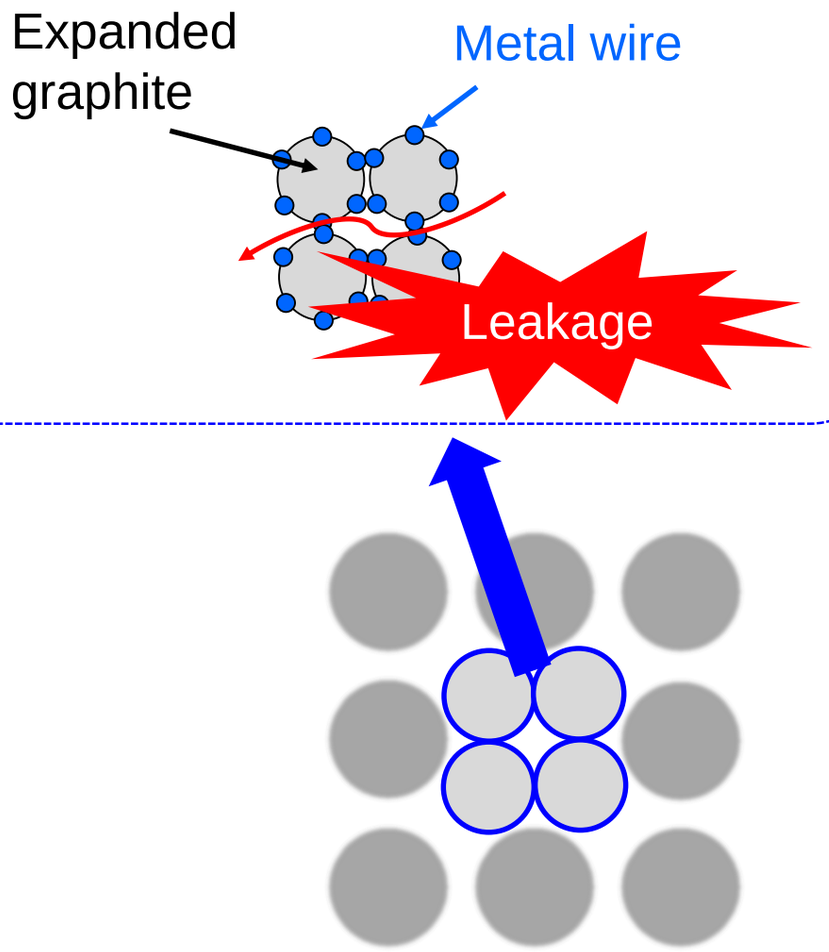
3.1 Raw materials <Yarn>



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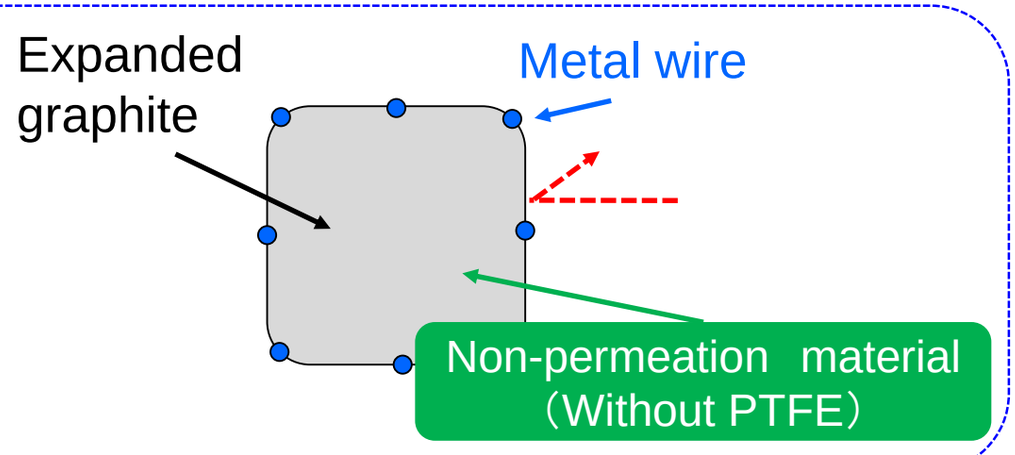
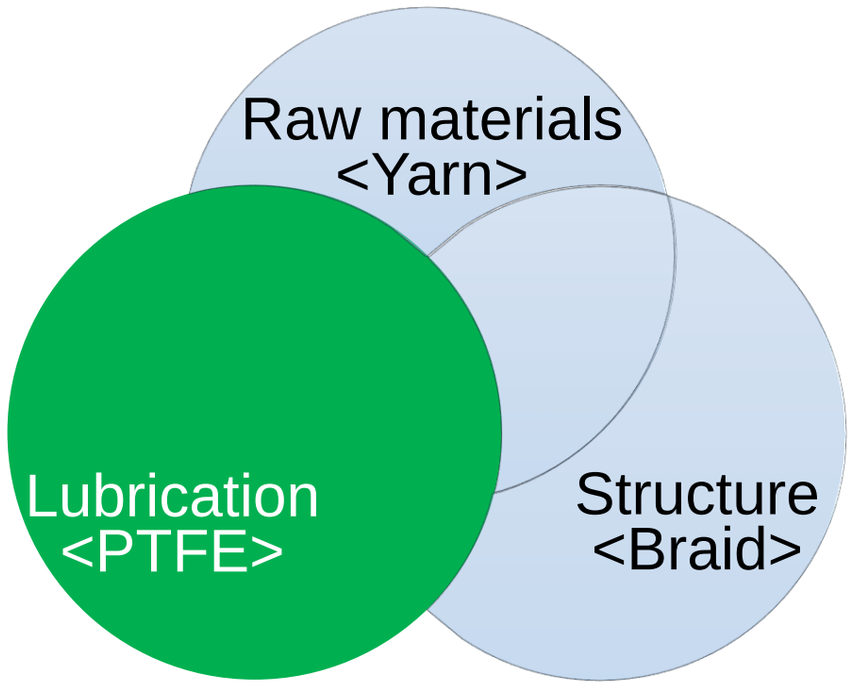
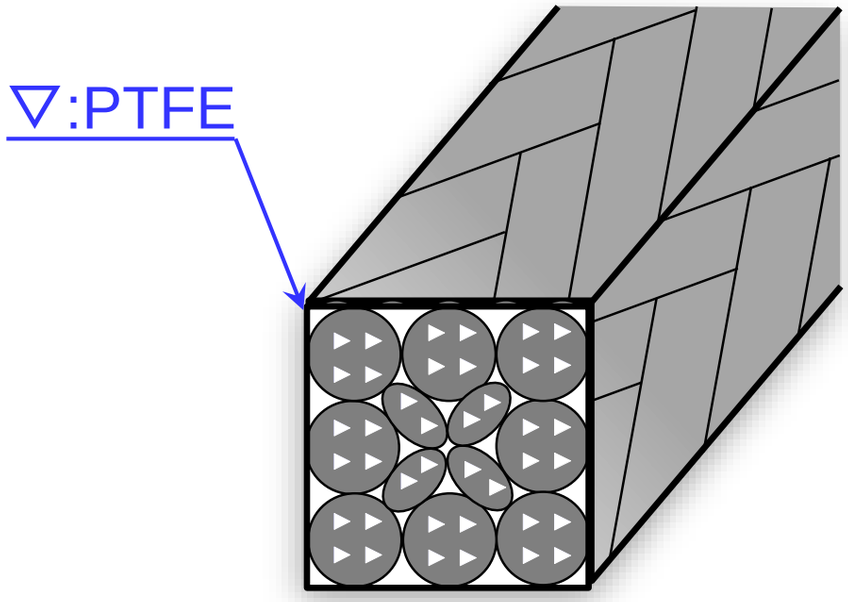


＜Developed＞

3. Optimization and compounding of element technology for Low-E packing

3.2 Lubrication <PTFE>

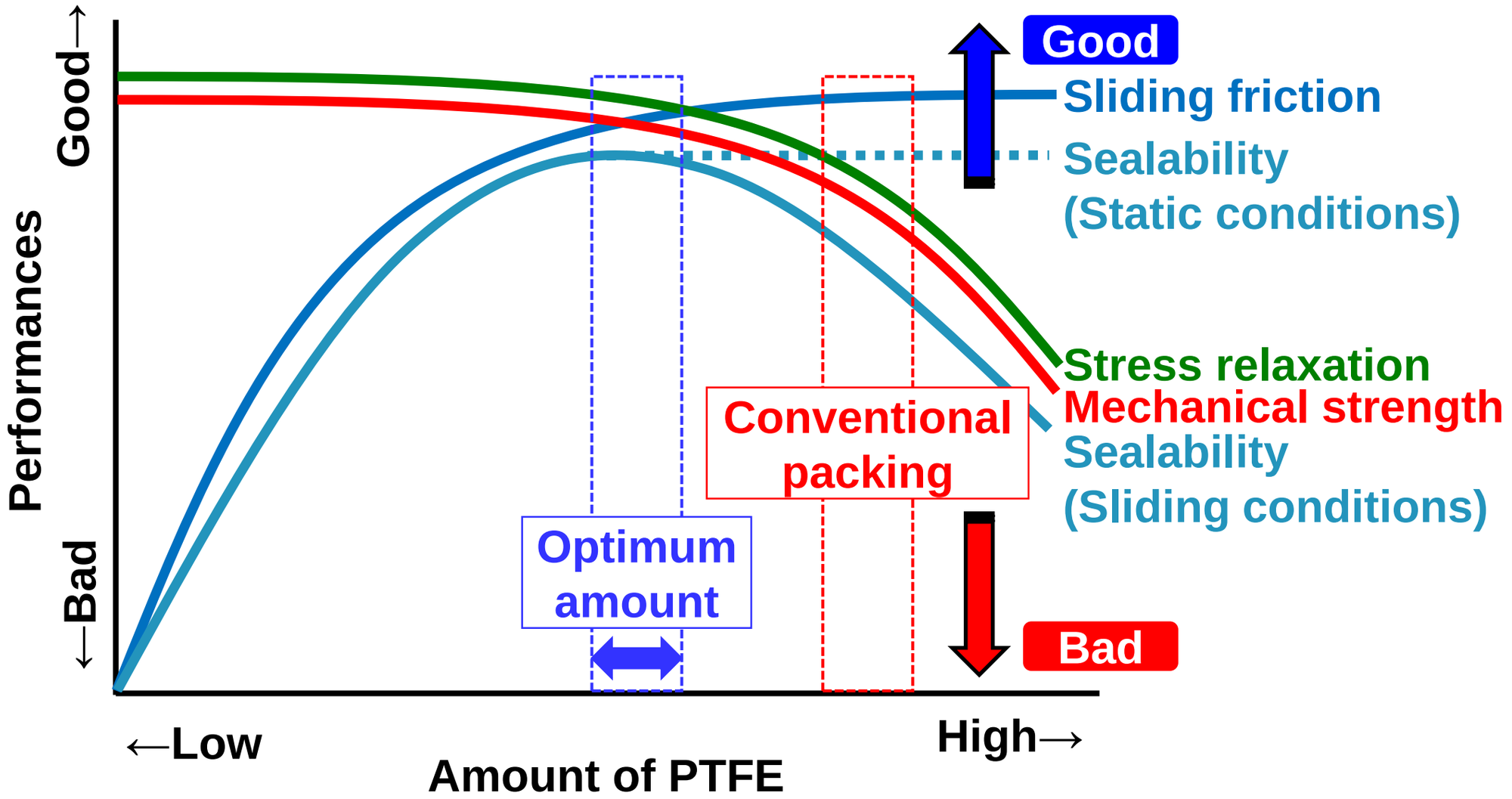




＜Conventional＞

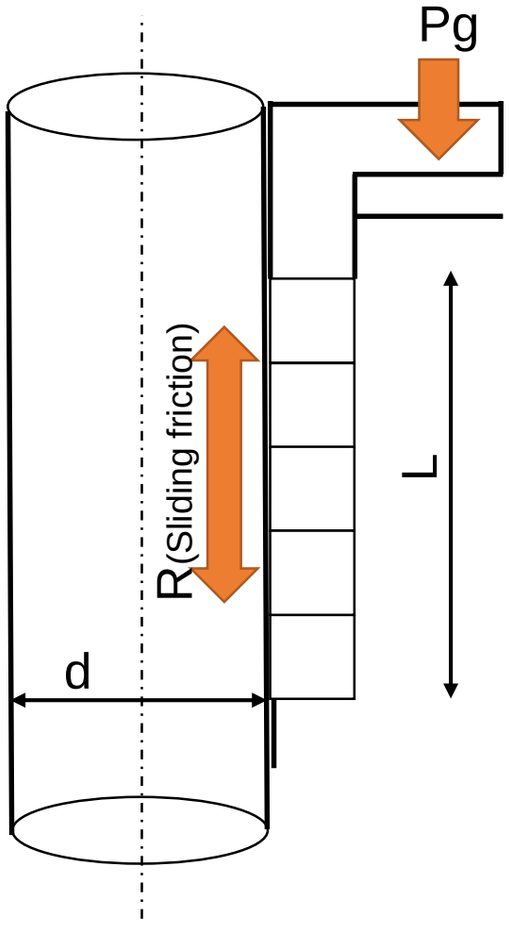
3. Optimization and compounding of element technology for Low-E packing

3.2 Lubrication <PTFE × performances>

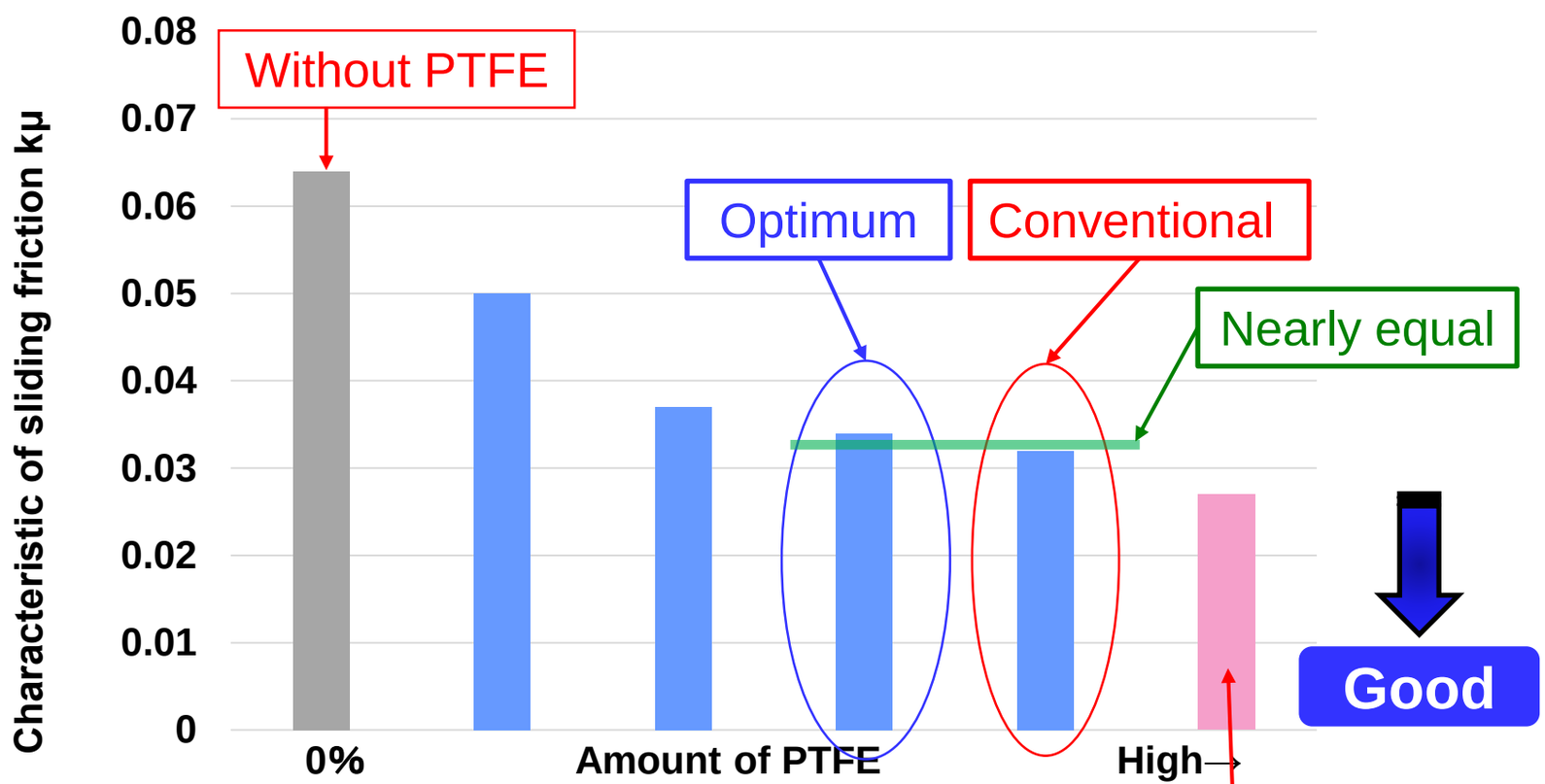


3. Optimization and compounding of element technology for Low-E packing

3.2 Lubrication—Sliding friction



$$k\mu = R/(\pi \times d \times L \times Pg)$$



kμ : Coefficient of sliding friction
R : Sliding frictional N
d : Stem diameter mm
L : Packing height mm
Pg : Tightening stress N/mm^2

3. Optimization and compounding of element technology for Low-E packing

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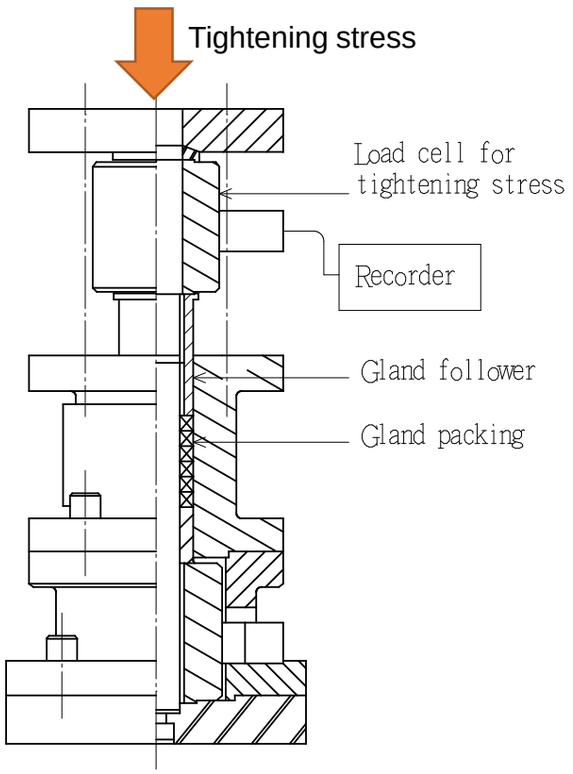
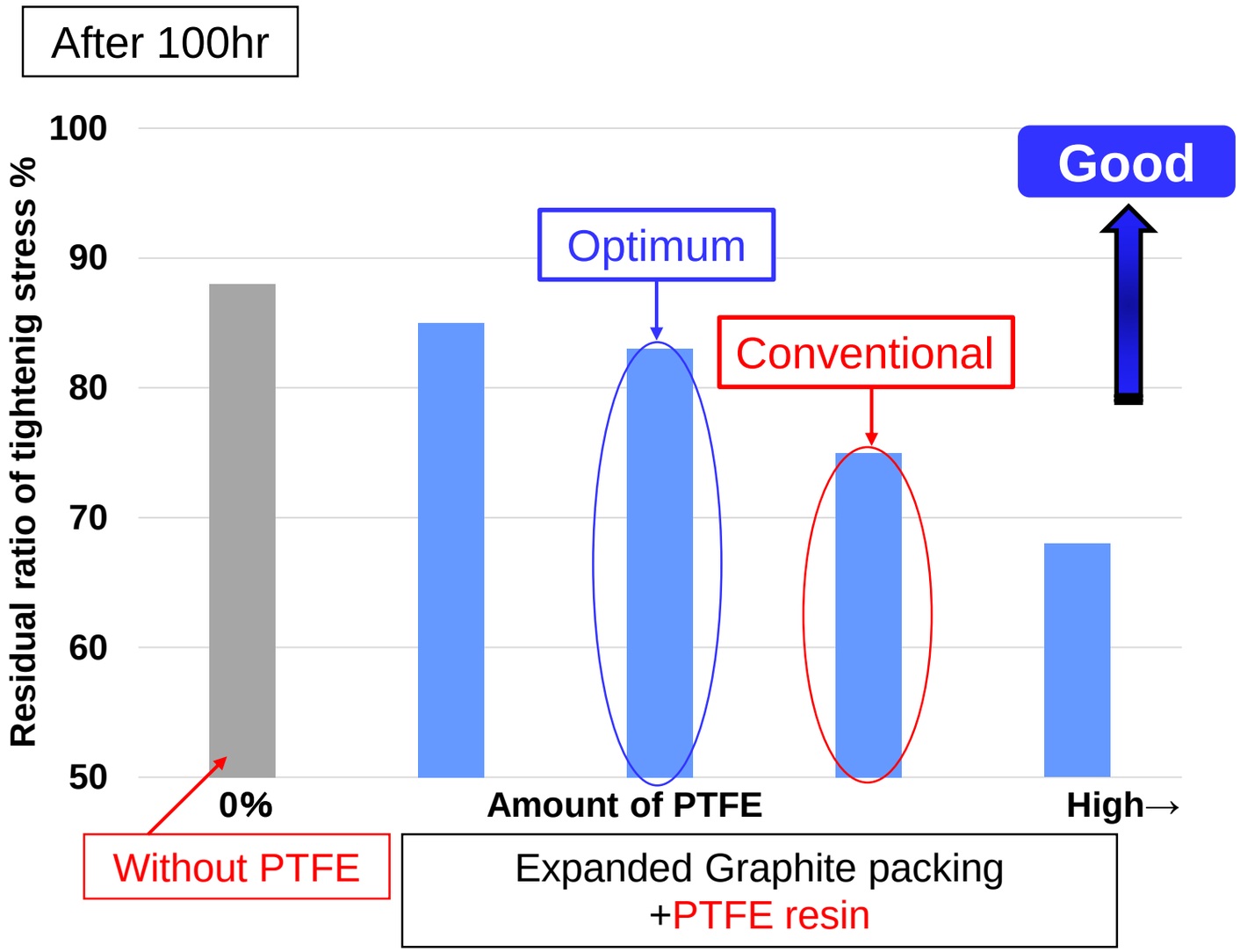
3.2 Lubrication－Stress relaxation

〔Test conditions〕

Temperature	Ambient
Number of packing	6 rings
Time	100 hr





3. Optimization and compounding of element technology for Low-E packing

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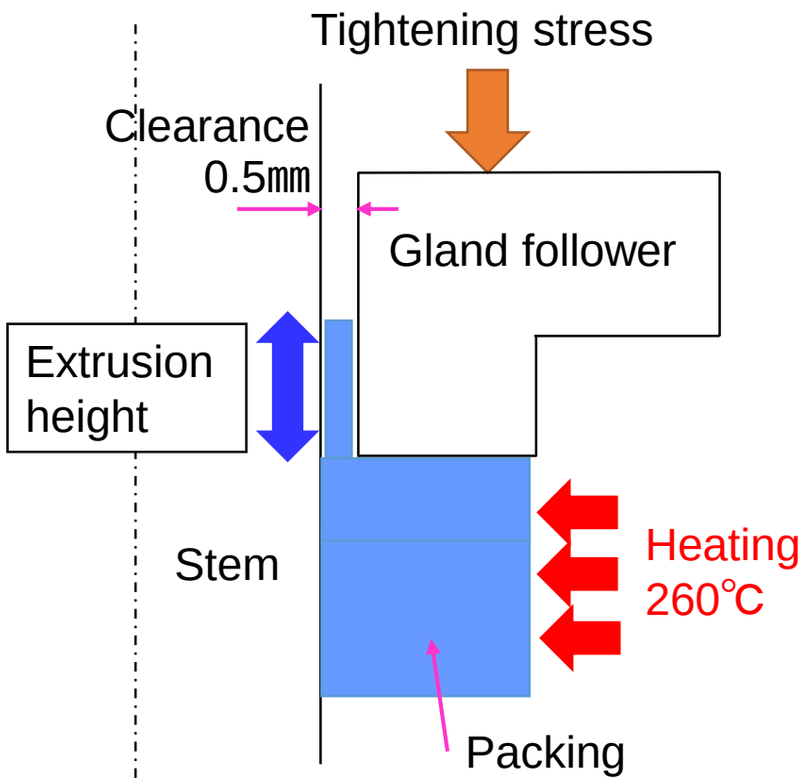
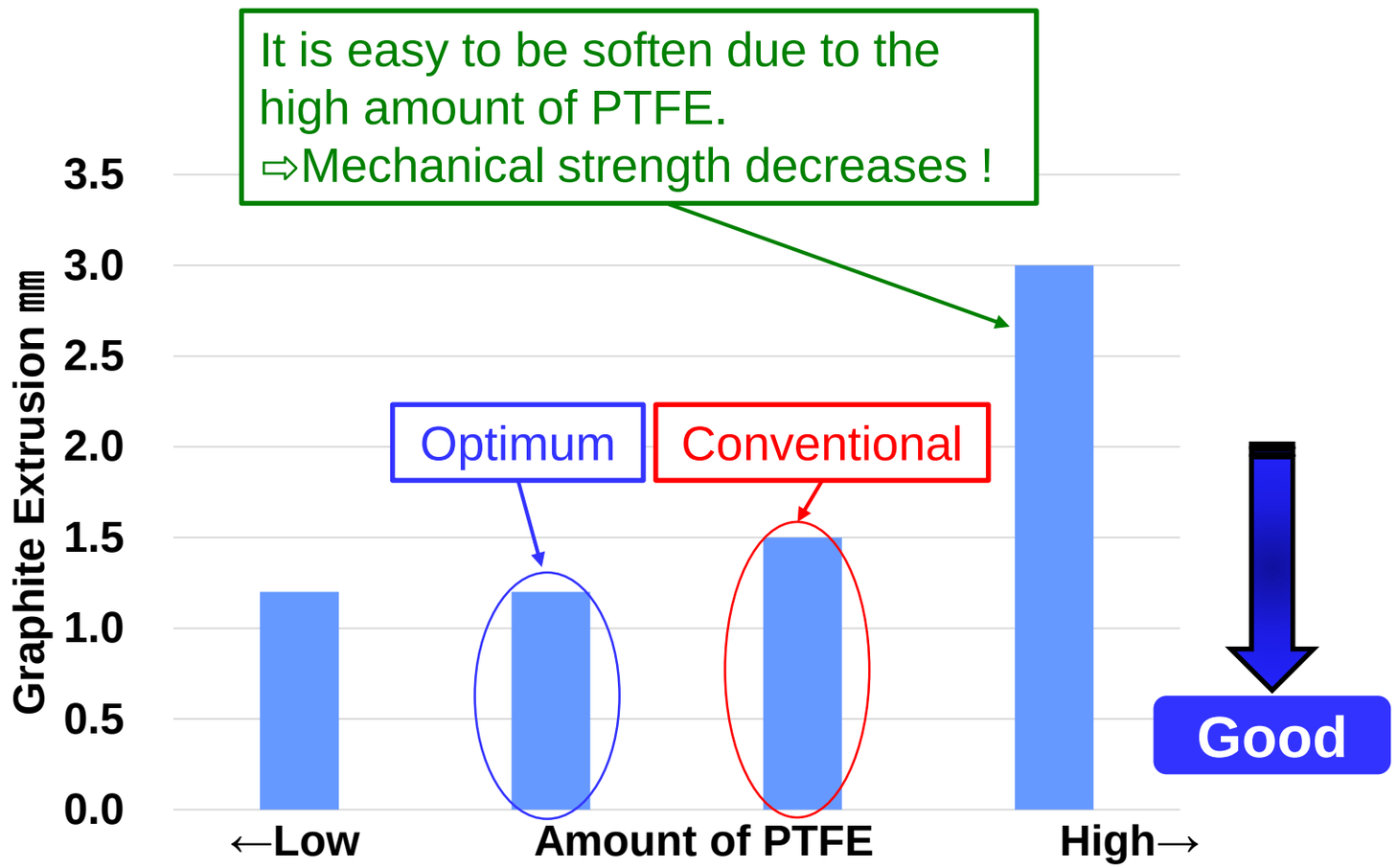
3.2 Lubrication－Graphite extrusion

〔Test conditions〕

Temperature	260℃
Tightening stress	100N/mm²





3. Optimization and compounding of element technology for Low-E packing

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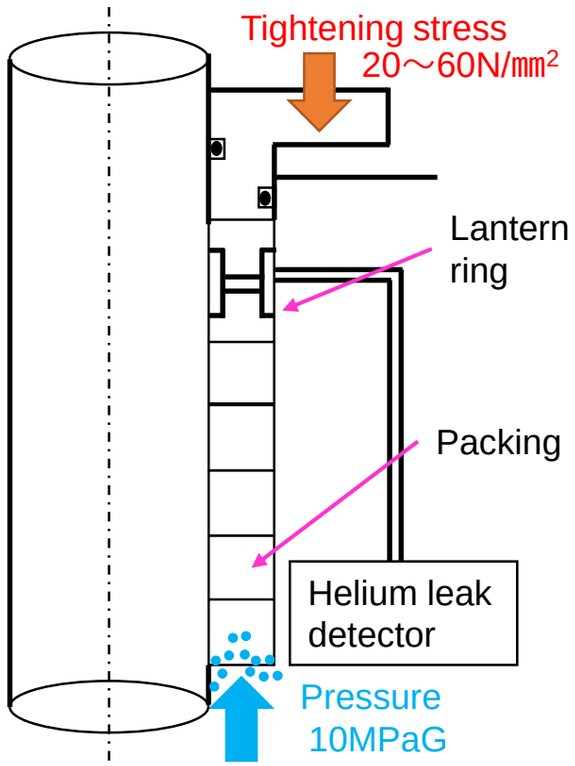
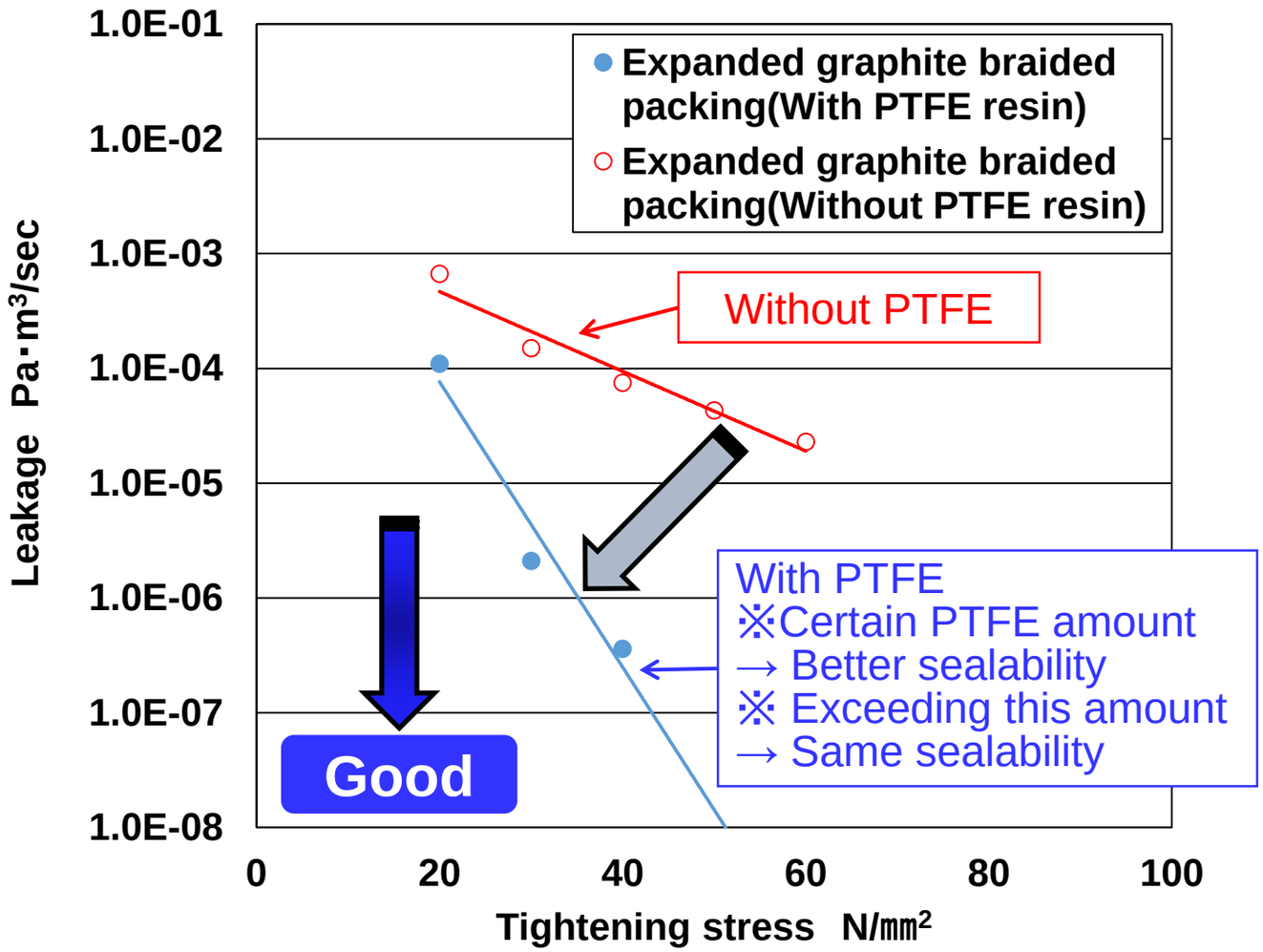
3.2 Lubrication－Seal (static)

〔Test conditions〕

Fluid	99% Helium
Temperature	Ambient
Pressure	10MPaG
Stem diameter	30mm





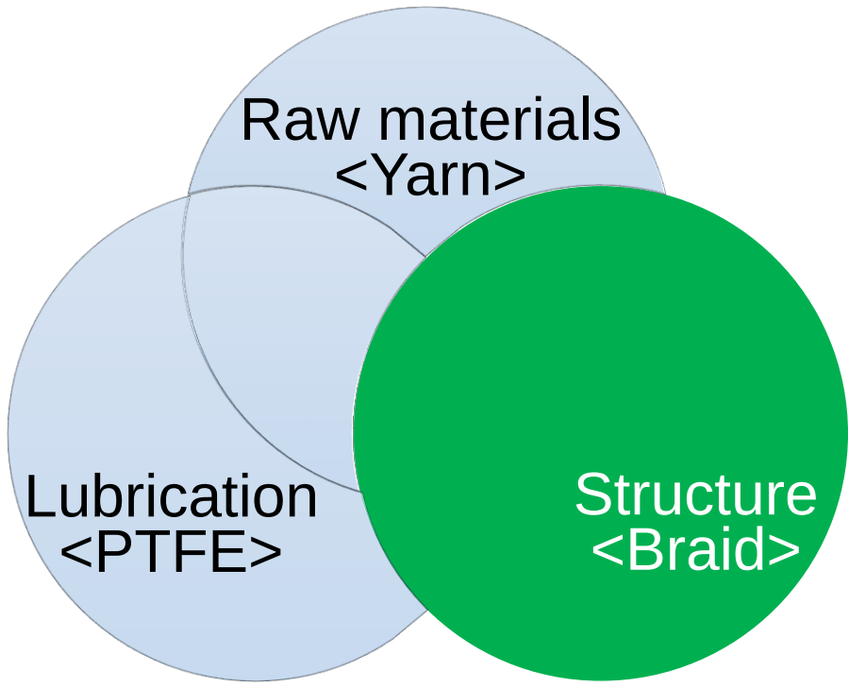
3. Optimization and compounding of element technology for Low-E packing

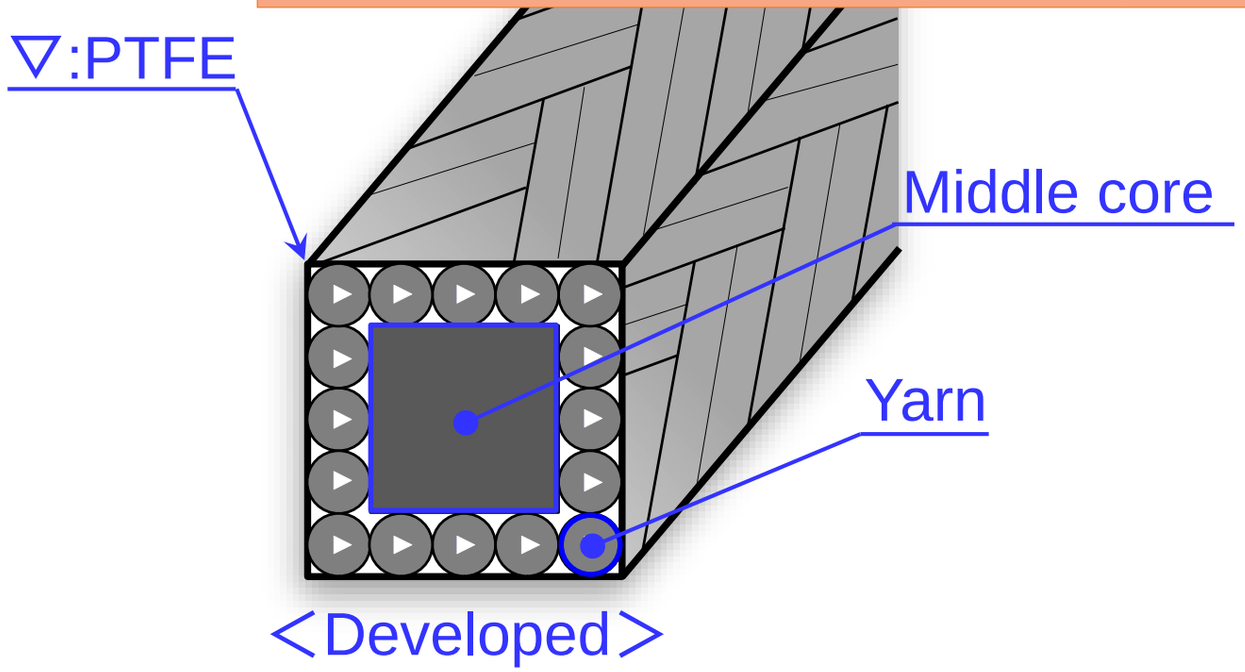
3.3 Structure <Braid> Compounding of element

<Point 1>
Decrease the amount of PTFE

<Point 2>
Dense and smooth surface

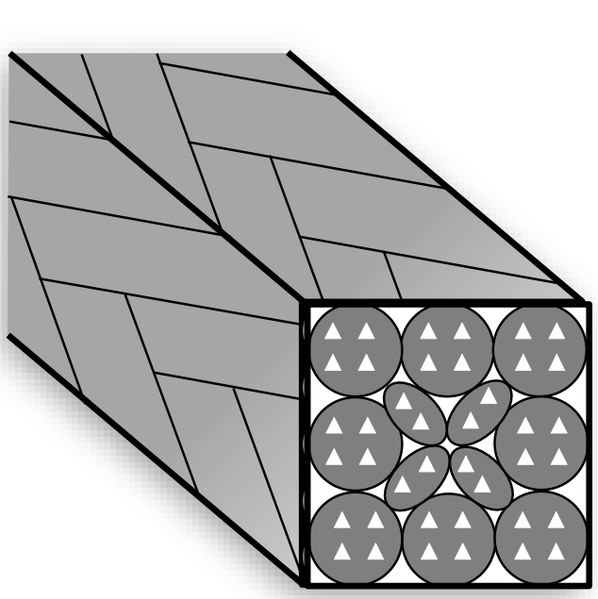
<Point 3>
Partial addition of PTFE (Only surface)



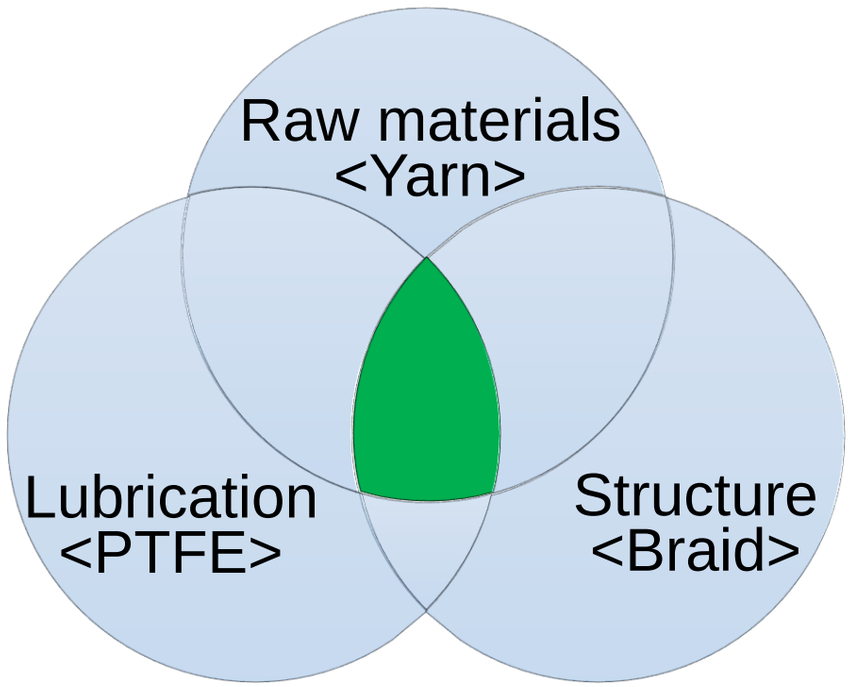


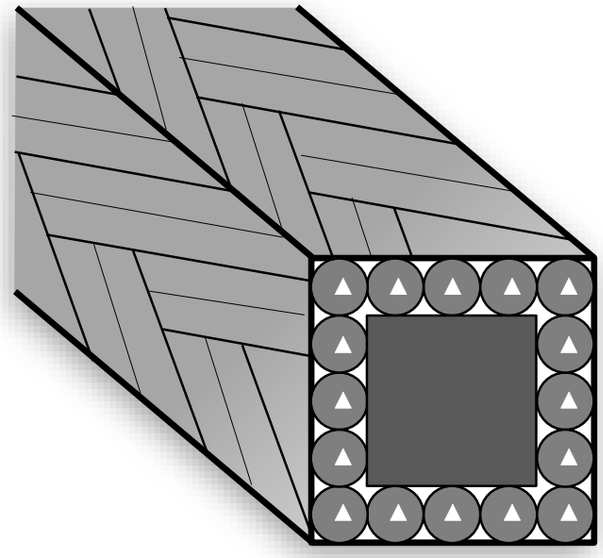
3. Optimization and compounding of element technology for Low-E packing

3.4 Comparison of conventional packing and developed packing



＜Conventional＞





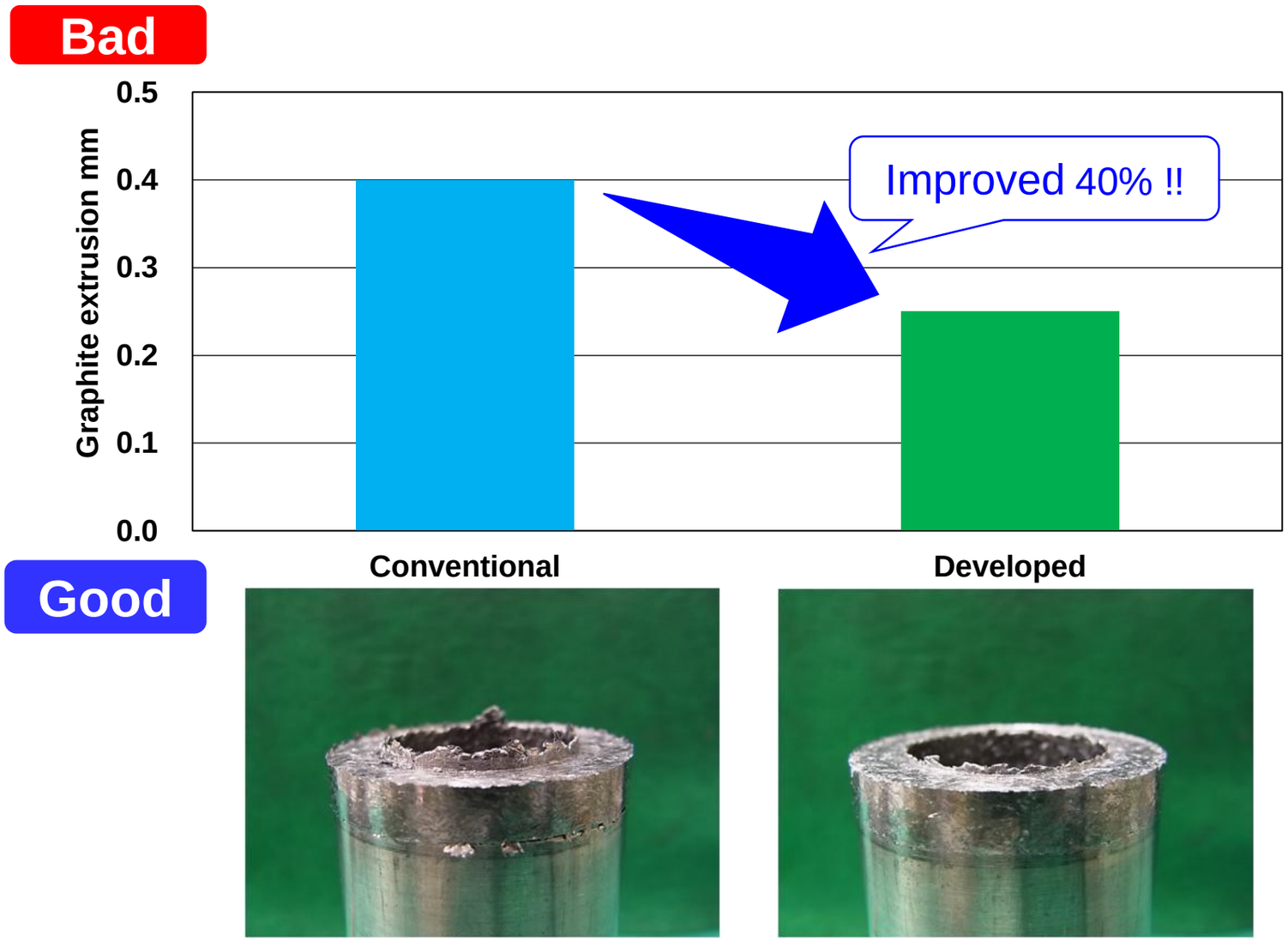
＜Developed＞

3. Optimization and compounding of element technology for Low-E packing

3.4.1 Graphite extrusion

〔Test conditions〕

Temperature	Ambient
Tightening stress	100N/㎟
Clearance diameter	0.7mm

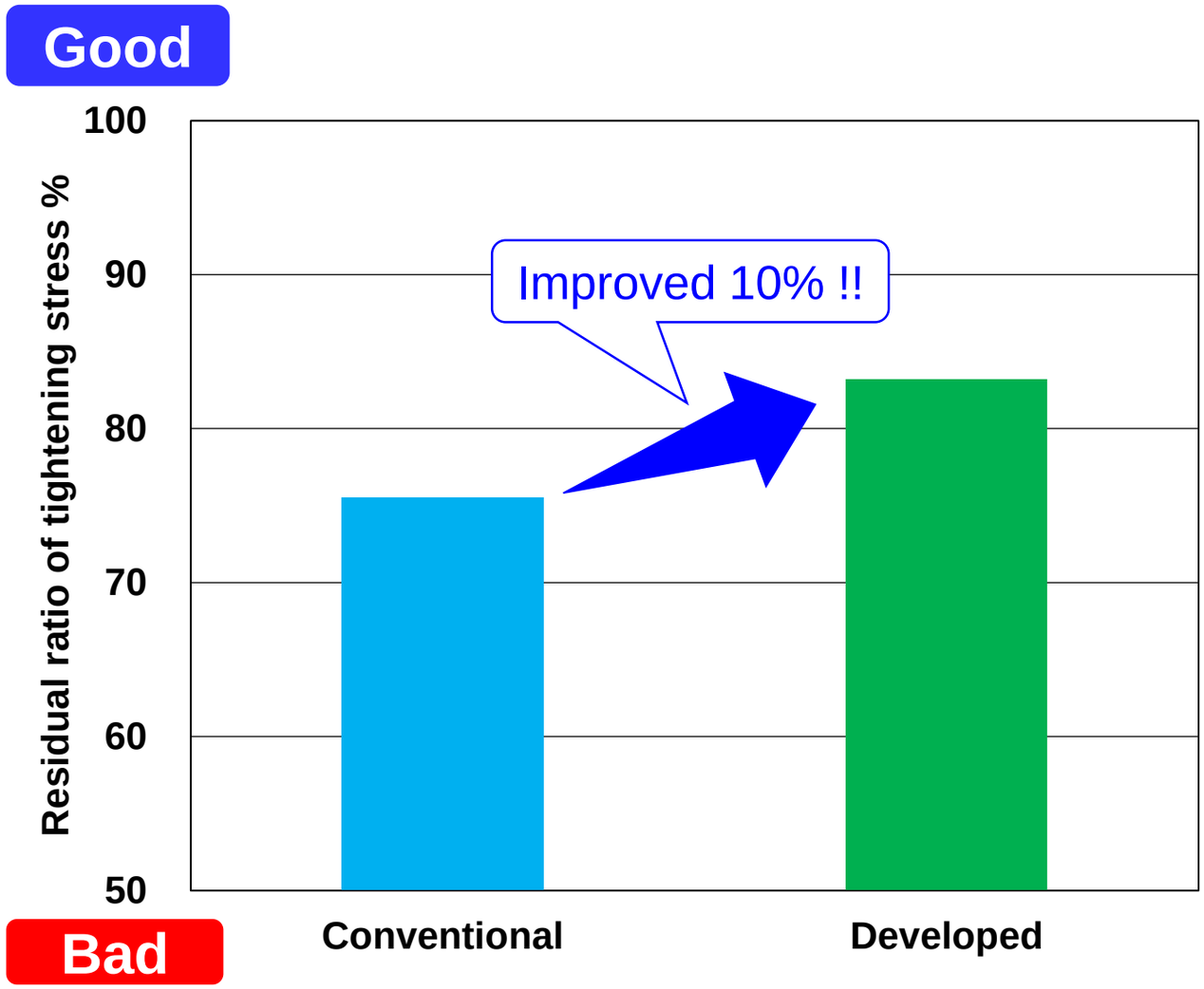


3. Optimization and compounding of element technology for Low-E packing

3.4.2 Stress relaxation

〔Test conditions〕

Temperature	Ambient
Number of packing	5 rings
Packing size	φ32×φ48mm
Time	100 hr

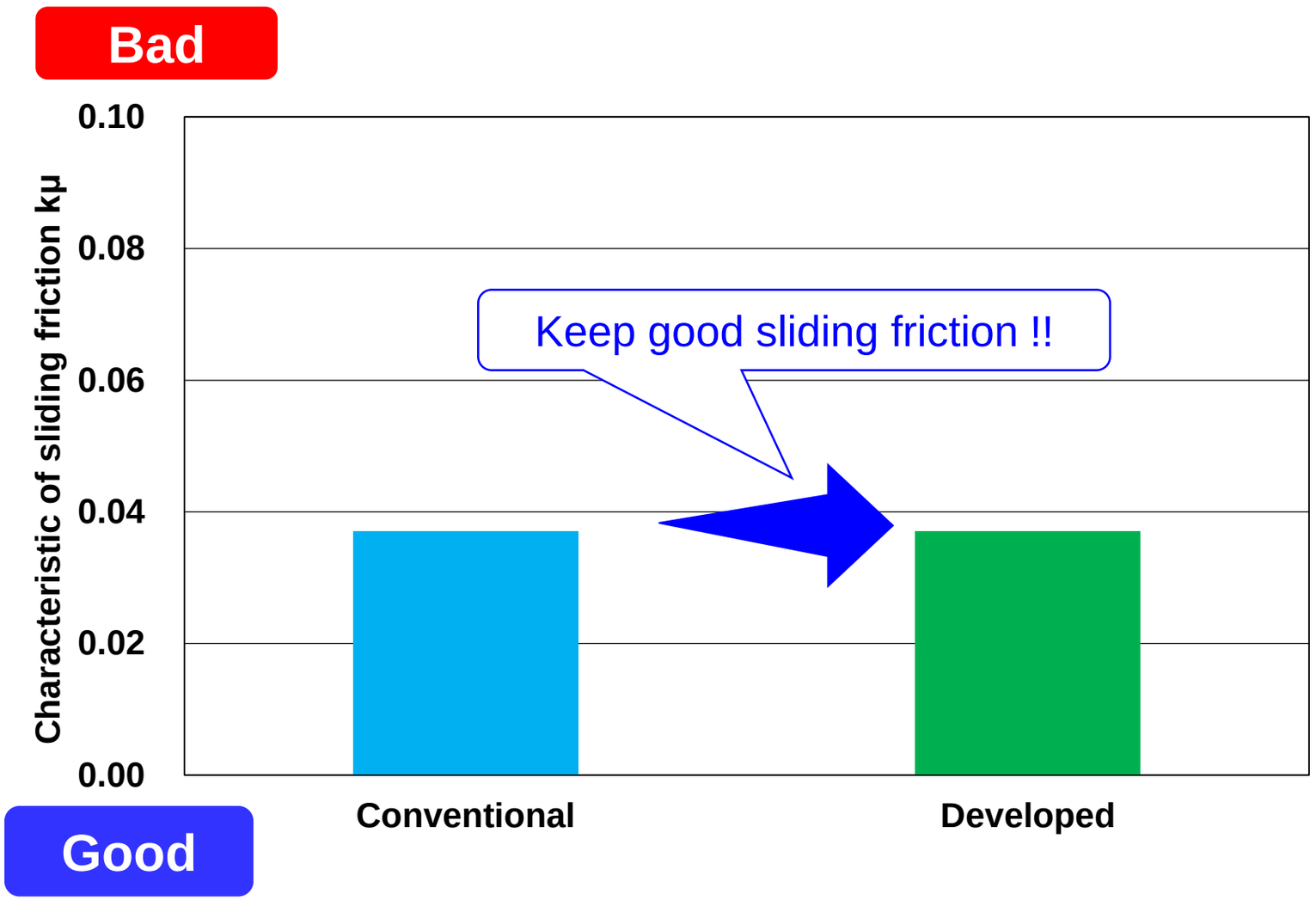


3. Optimization and compounding of element technology for Low-E packing

3.4.3 Sliding friction

〔Test conditions〕

Temperature	Ambient



3. Optimization and compounding of element technology for Low-E packing

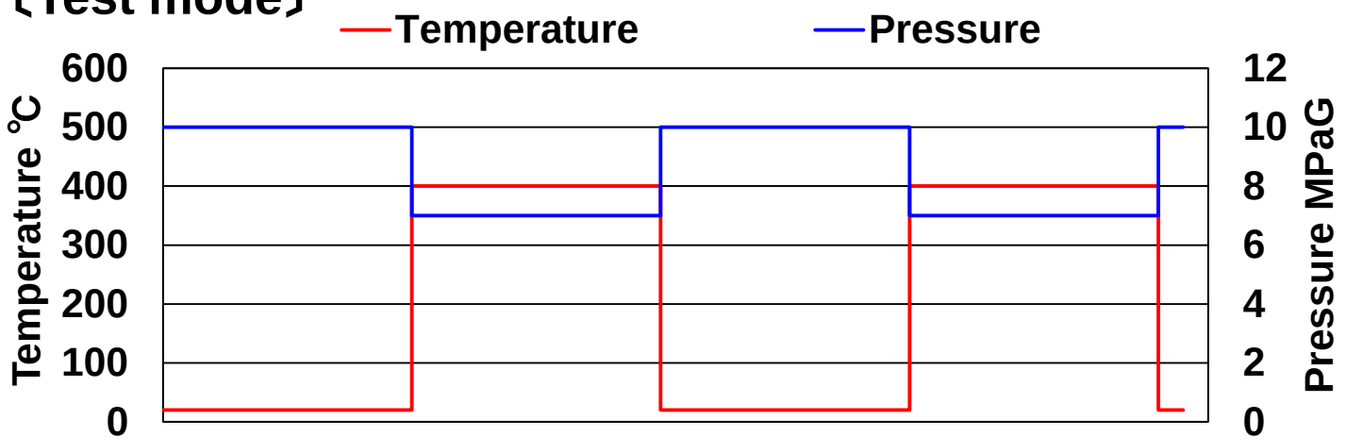
3.4.4 ISO15848-1 2nd CO1

〔Test conditions〕

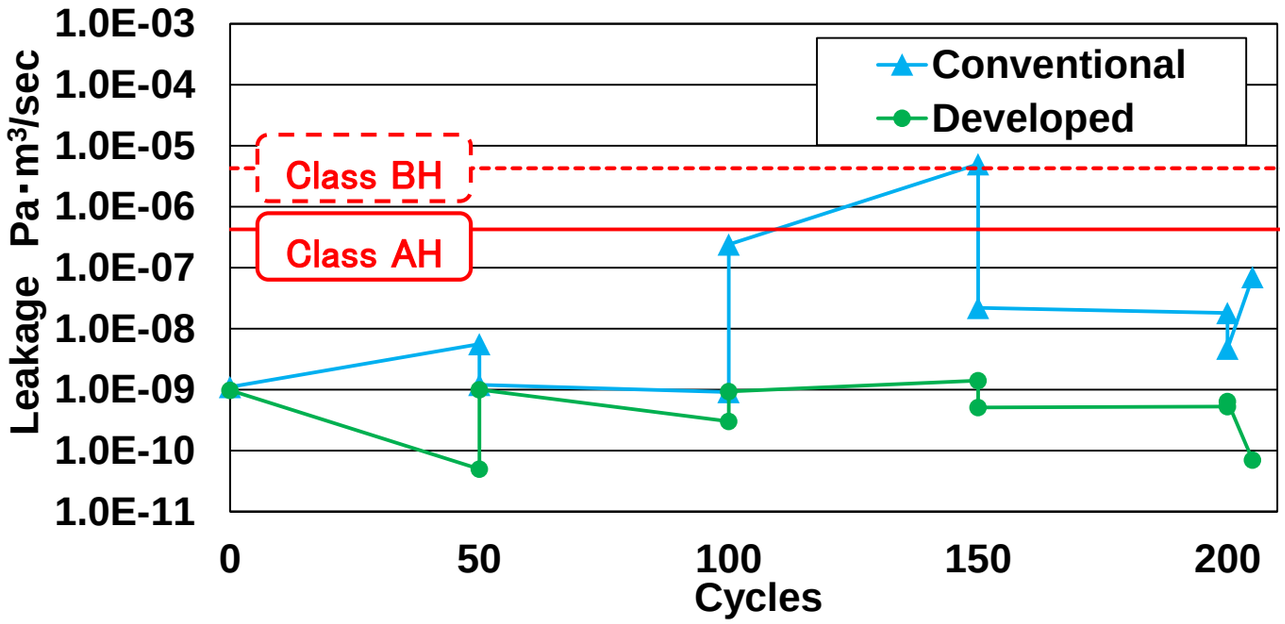
Fluid	99% Helium
Temperature	Ambient / 400℃
Pressure	10MPaG
Number of packing	5 rings
Packing size	φ24×φ37mm
Fugitive emission standard	ISO15848-1 2nd CO1
Number of cycle	205 cycles
Shaft motion	Linear motion

Passed to CO1 class AH

〔Test mode〕



〔Test result〕



3. Optimization and compounding of element technology for Low-E packing

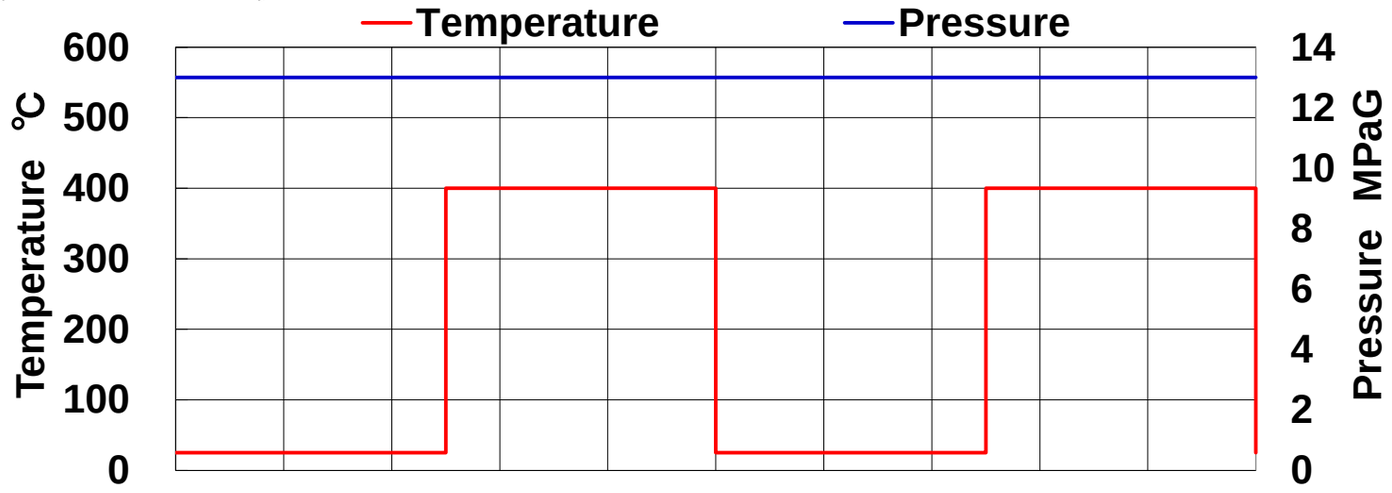
3.4.4 ISO15848-1 2nd CC1

〔Test conditions〕

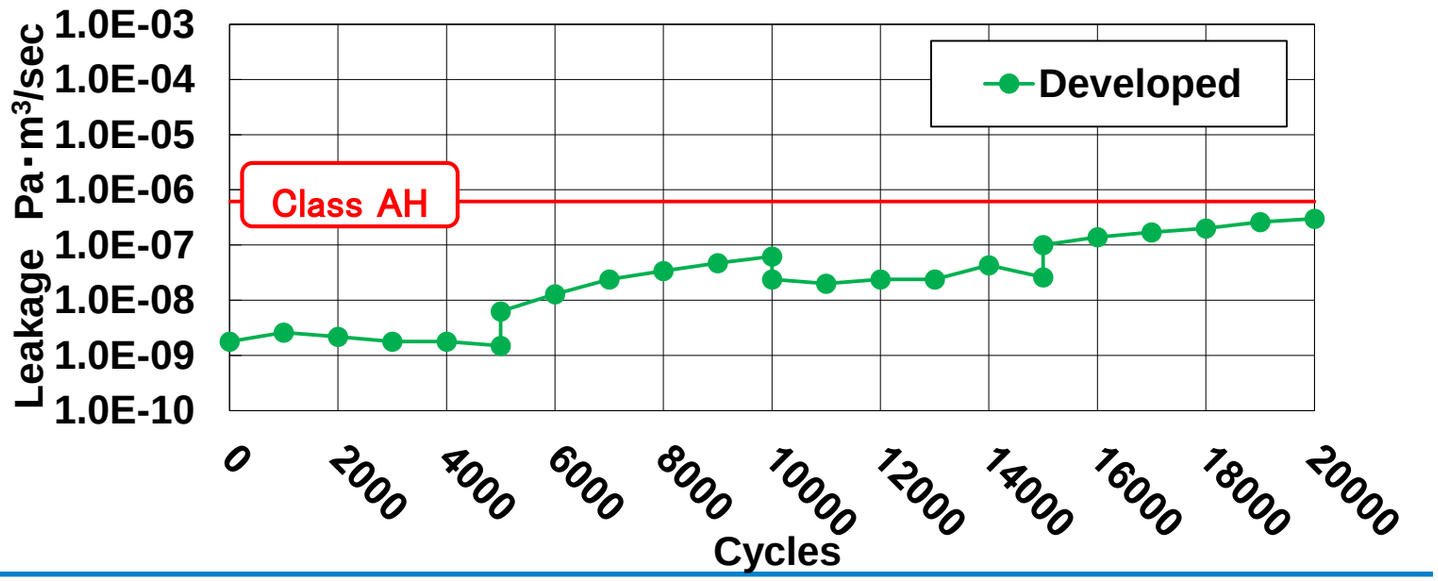
Fluid	99% Helium
Temperature	Ambient / 400℃
Pressure	13MPaG
Number of packing	4 rings
Packing size	φ32×φ48mm
Fugitive emission standard	ISO15848-1 2nd CC1
Number of cycle	20000 cycles
Shaft motion	Rotary motion

Passed to CC1 class AH

〔Test mode〕

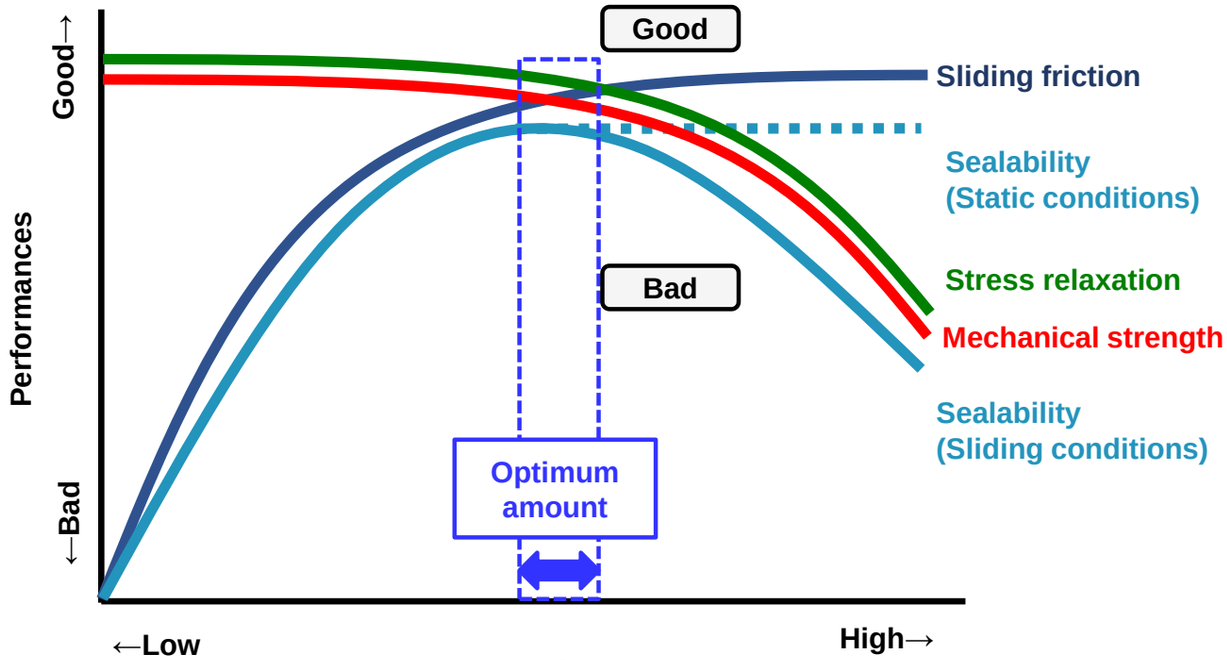


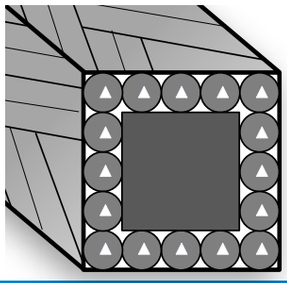
〔Test result〕



4. Conclusion

Raw materials ⇒ Fine yarn & Non-permeation material
Lubrication ⇒ Optimum amount of PTFE
Structure ⇒ New Braid & Partial addition of PTFE





- ✔ Sliding durability
- ✔ Small stress relaxation
- ✔ Less thermal weight loss
- ✔ Small extrusions against valve clearance

✓ High seal performance

✓ Long-term stability

Thank you for your attention.

Do you have questions?

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