

# **Development of Indoor / Outdoor cables with Robust Structure**

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# Outline

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- **The Demand for Data Center Cables**
- **Design of RIO WTC**
- **Cable Characteristics**
- **Conclusion**

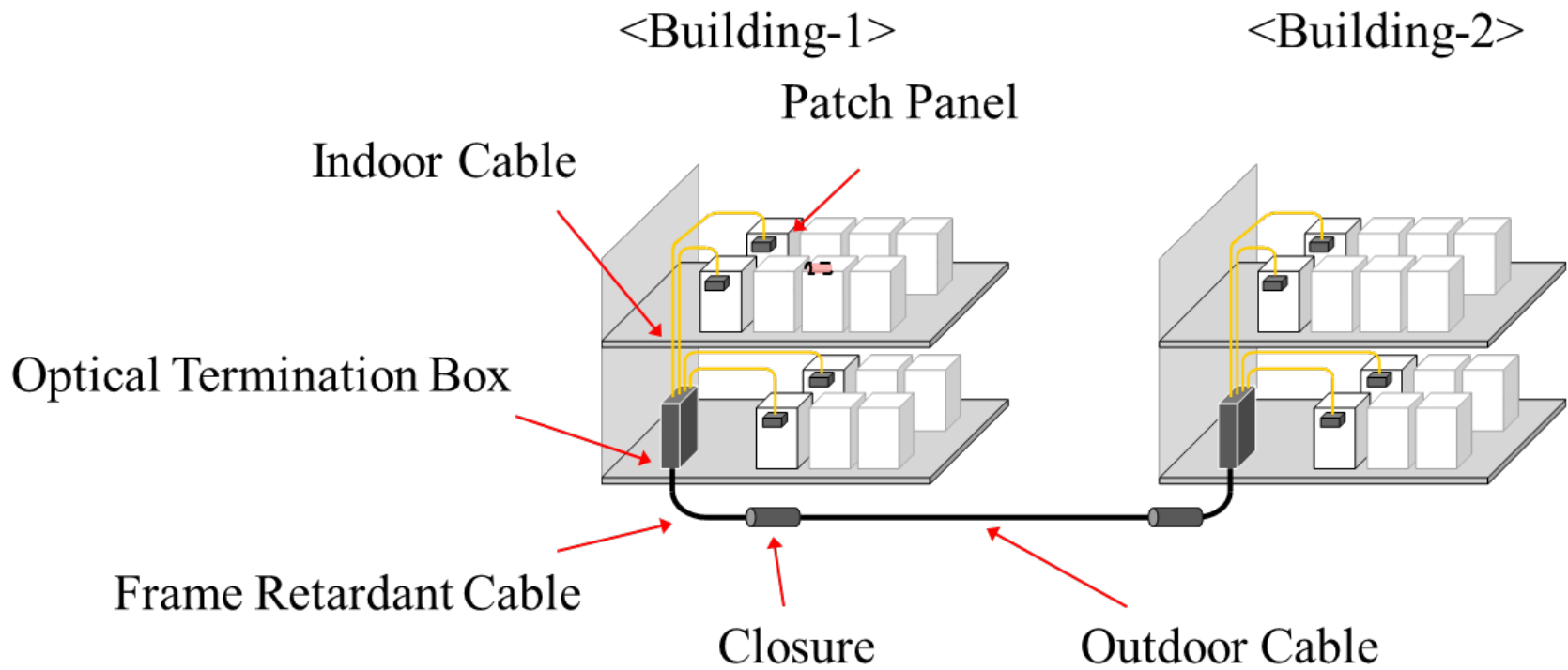


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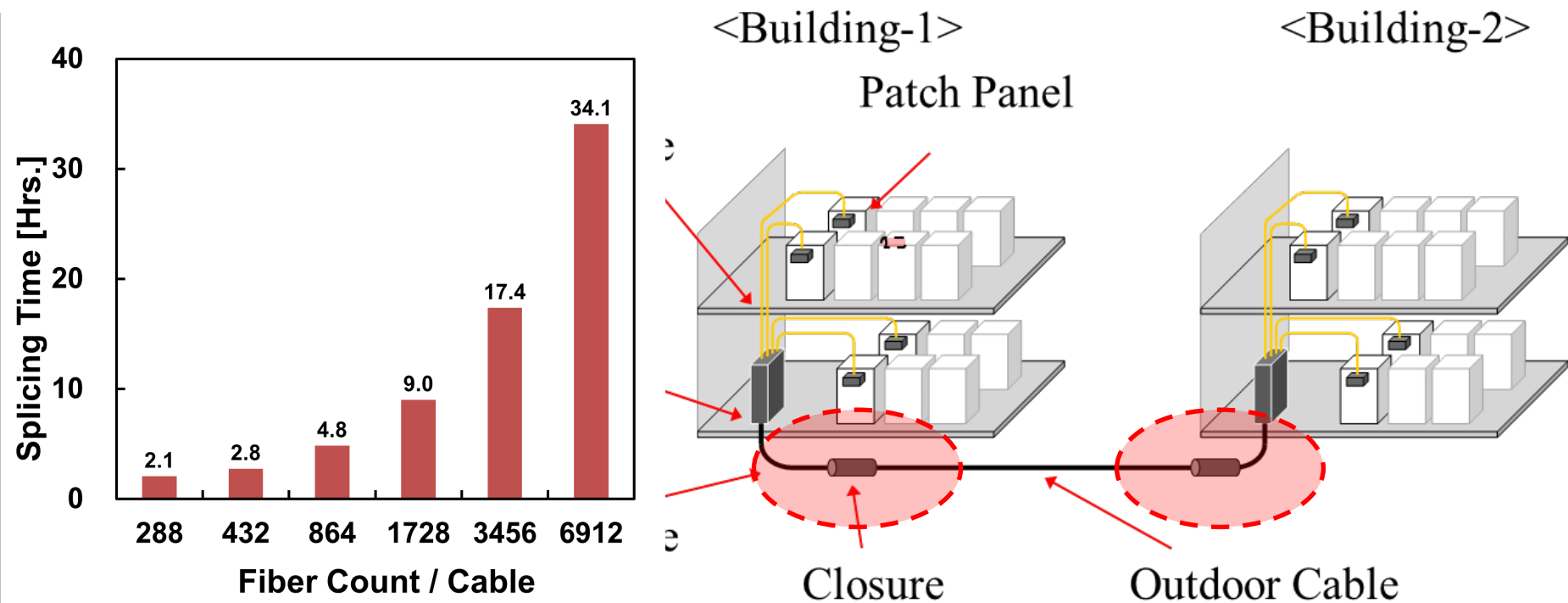
# The Demand for Data Center Cables



- ✓ Ultra-high Density Wiring in Limited Space
- ✓ Economical Wiring in Limited Space

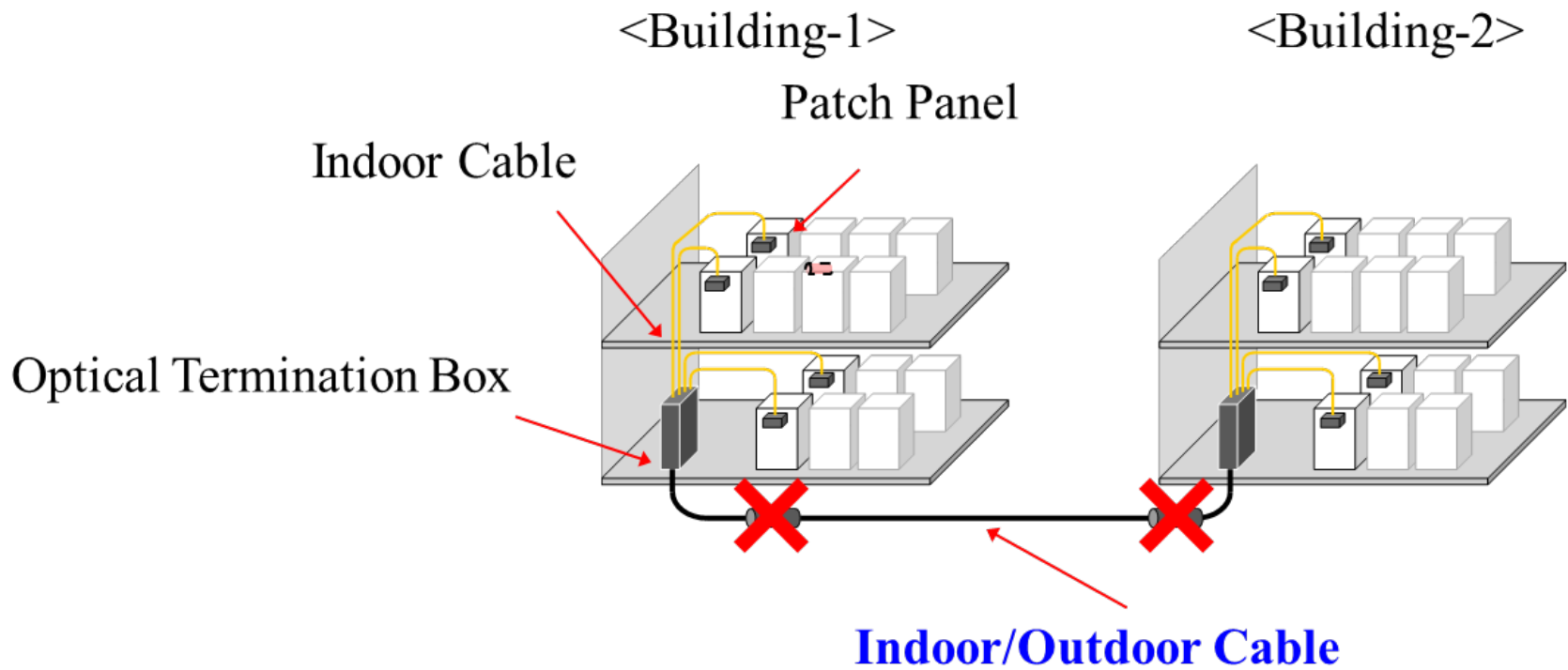
**➡ High demand for High-Fiber Count Cables in DC**

# The Demand for Data Center Cables



**Huge Cost & Time are Required  
to increase the fiber count.**

# The Demand for Data Center Cables

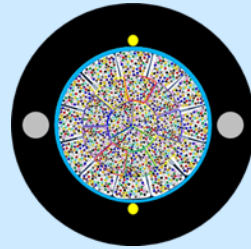


## Indoor / Outdoor Cable

- ✓ ISP (High FR Property, Flexibility)
- ✓ OSP (High Strength, Environmental Property, UV Resistance)

**➡ Aimed to Provide Solution by High Fiber Count I/O Cable**

# Report from Fujikura at IWCS 2021



~ 6,912F I/O WTC

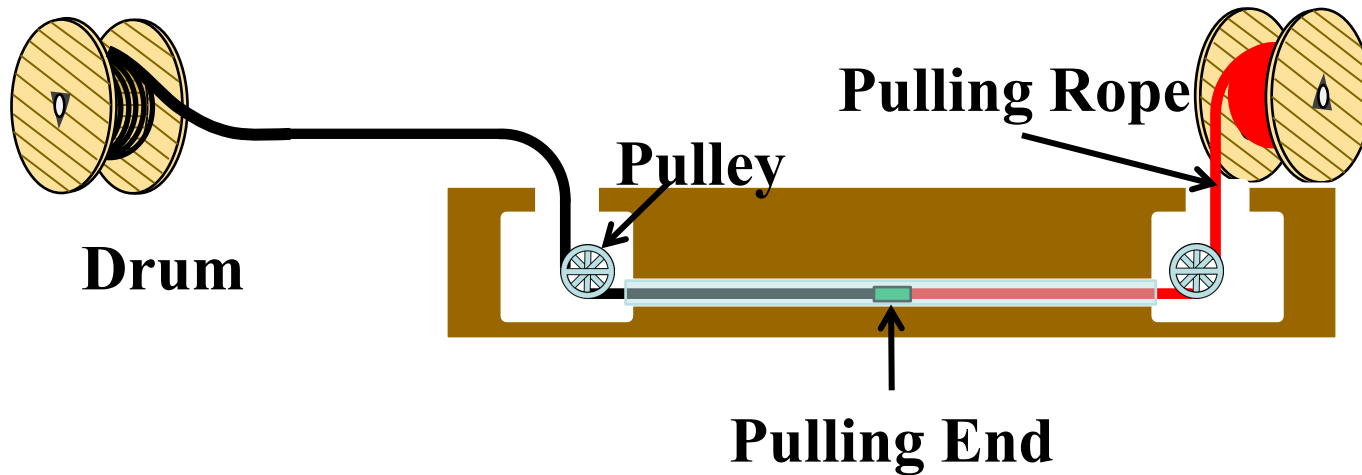
- ✓ Small O.D. & Light Weight
- ✓ High Fiber Packing Density
- ✓ High Flame Retardancy



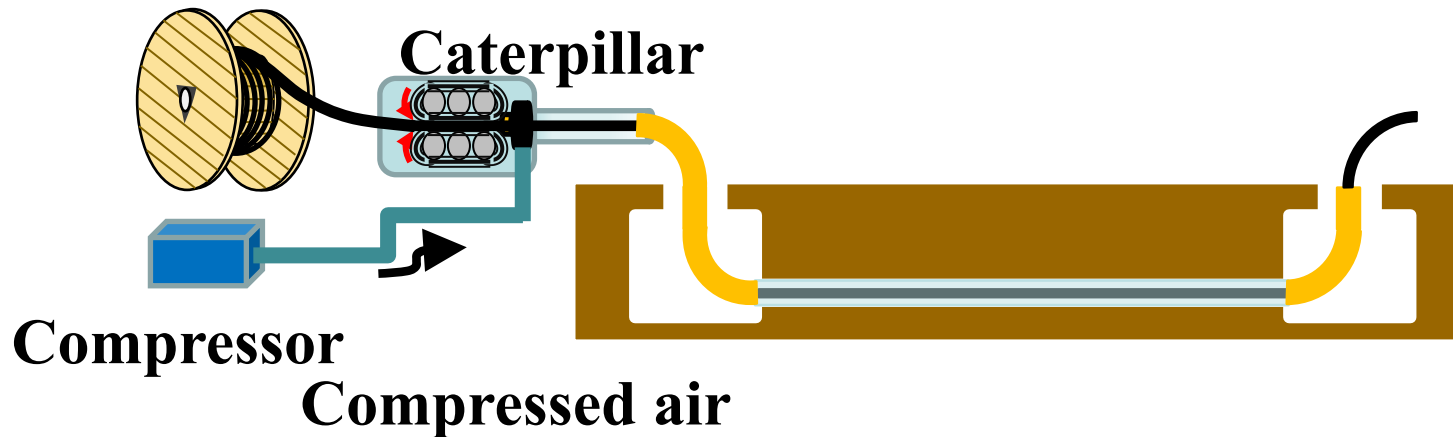
I/O WTC Deployment



# Installation Method of I/O WTC



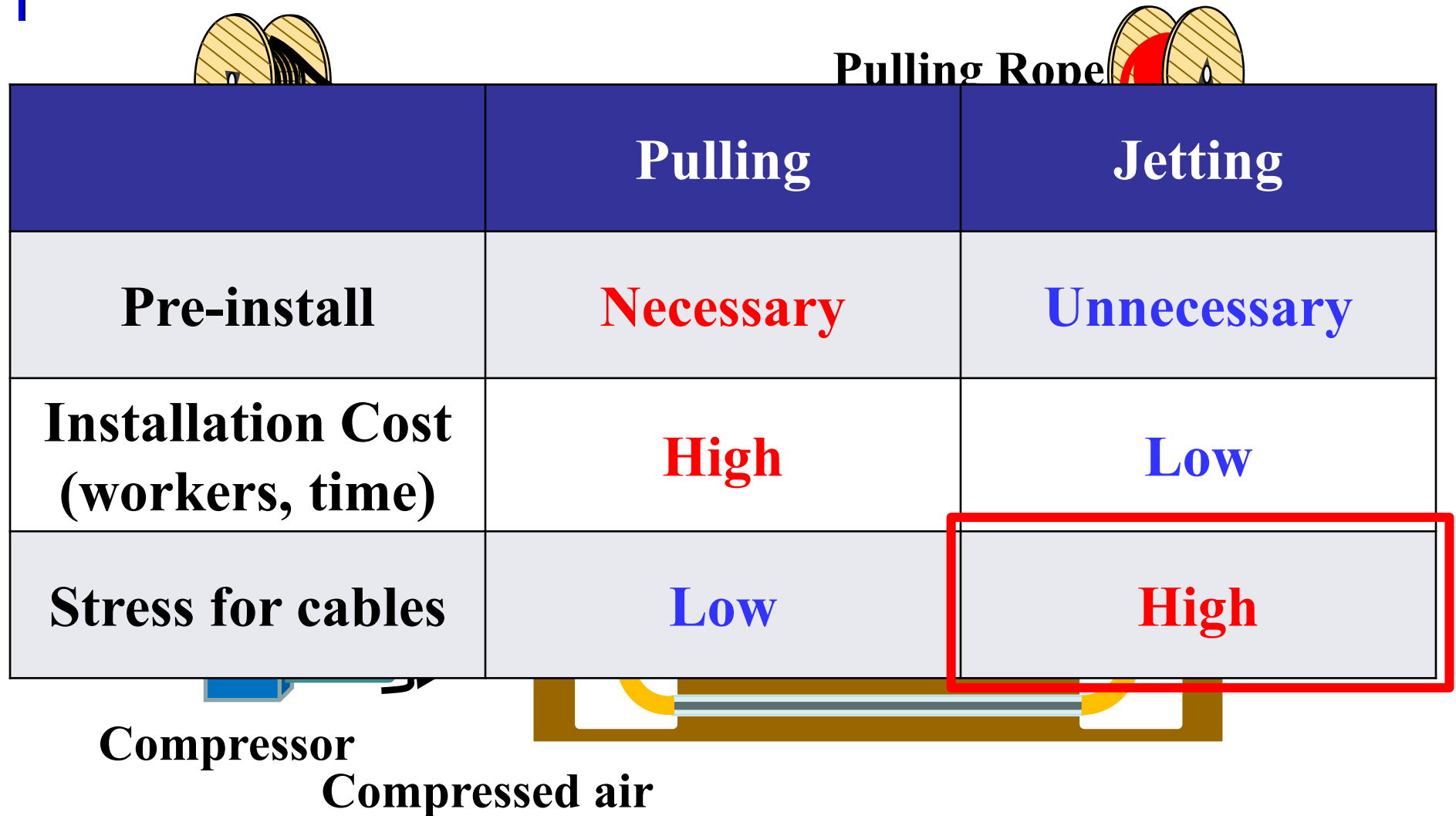
**Pulling Installation Method**



**Jetting Installation Method**



# Installation Method of I/O WTC



**Jetting Installation Method**

# Development of RIO WTC

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## **Robust I/O WTC called RIO WTC**

✓ **Flame Retardancy**

⇒ **Equivalent to Current I/O WTC**

✓ **Robustness**

⇒ **Equivalent to OSP WTC**

**Achieve RIO WTC allows for the same handling as OSP WTC.**

**Enhancement of installation workability**

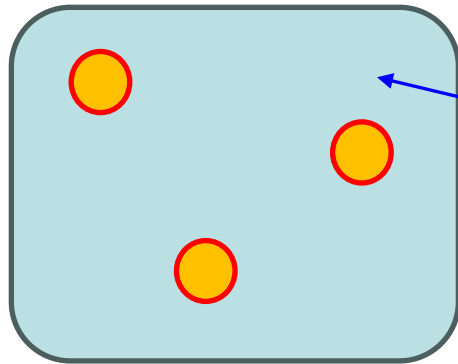


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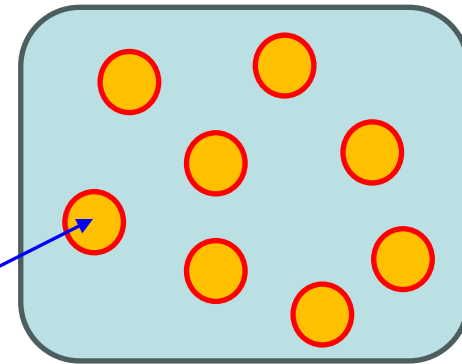
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# Flame Retardancy vs Robustness



Base Material

Flame-Retardant Additives



**Low Flame Retardancy**  
**High Robustness**

**High Flame Retardancy**  
**Low Robustness**

✓ **Flame Retardancy**

⇒ Low combustible, Low smoke emission, Environmental consideration, etc.



✓ **Robustness**

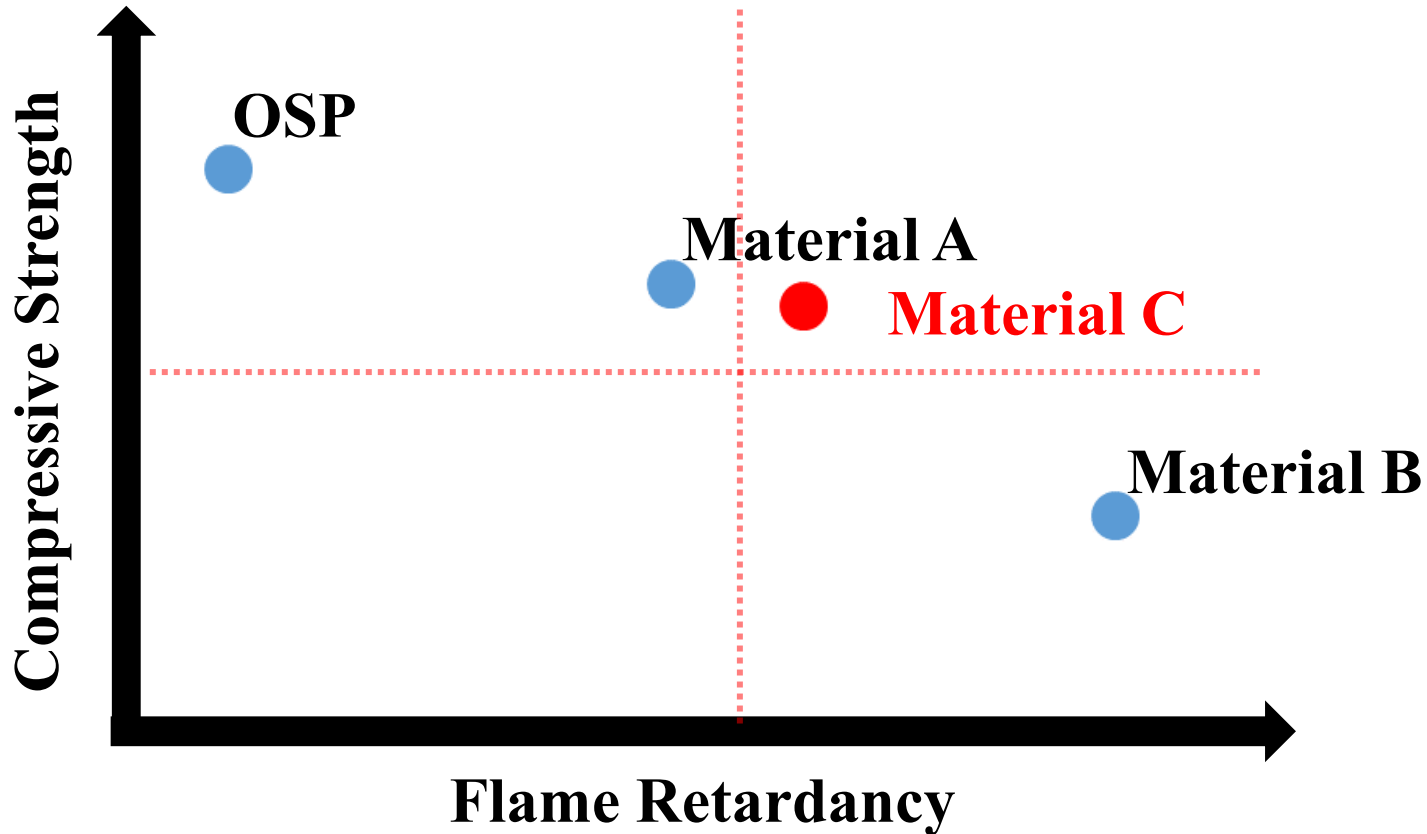
⇒ Compressive resistance, Minimum bending radius, Tensile strength, etc.

# Jacket Material Consideration for RIO WTC

	A	B
Flame Retardancy	Bad	Good
Robustness (Compressive Strength)	Good	Bad

- ✓ Compressive Strength means deformation rate during jetting installation.
- ✓ Both material A and B exhibit a trade-off relationship, they are not suitable for RIO WTC.

# Jacket Material Consideration for RIO WTC



✓ We have selected a new Material C based on the results of two types of tests.

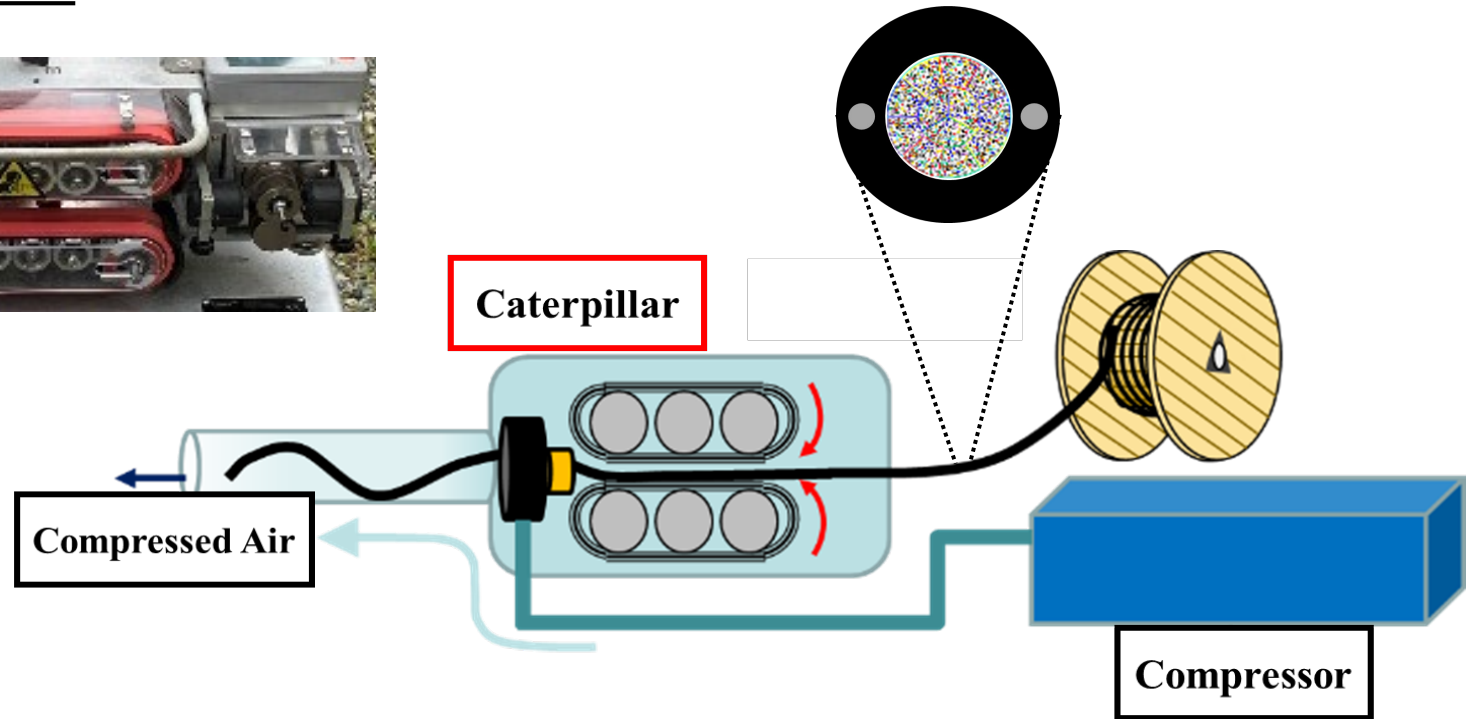
# Jacket Material Consideration for RIO WTC

	A	B	C
Flame Retardancy	Bad	Good	Good
Robustness (Compressive Strength)	Good	Bad	Good

- ✓ Material C has good Flame Retardancy & Compressive Strength.
- ✓ By determination of jacket material, we have decided to proceed with next evaluations.

# Jacket Material Consideration for RIO WTC

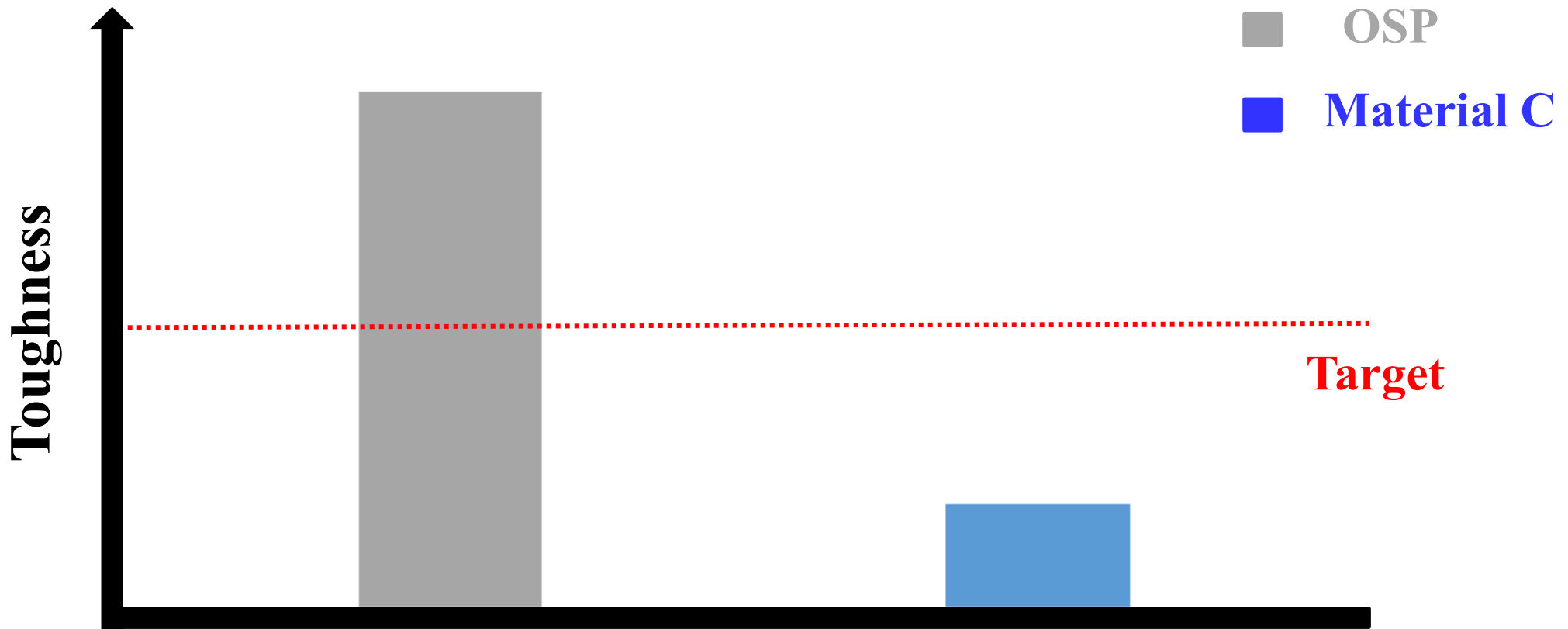
## Toughness Test



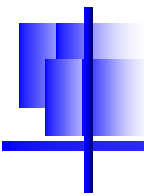
- ✓ Toughness means to the stress resistance of the jacket material.  
(Considering tensile strength and elongation etc.)
- ✓ We conducted evaluations by simulating Jetting Installation.



# Jacket Material Consideration for RIO WTC



✓ Under jetting installation environment, Toughness significantly decreases.

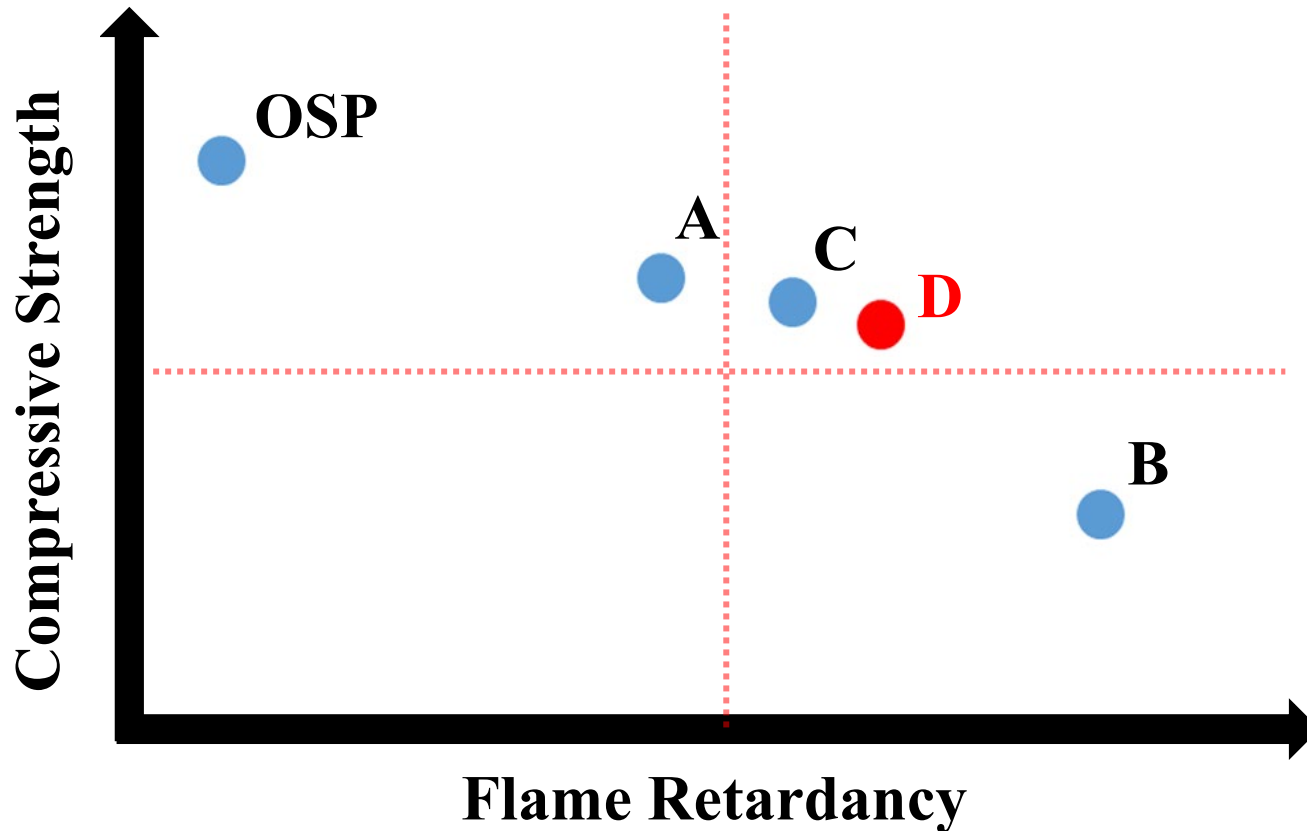


# Jacket Material Consideration for RIO WTC

		A	B	C	D
<b>Flame Retardancy</b>		Bad	Good	Good	Good
<b>Robustness</b>	<b>Compressive Strength</b>	Good	Bad	Good	Good
	<b>Toughness</b>	N/A	N/A	Bad	Good
<b>Judgement</b>		Bad	Bad	Bad	Good

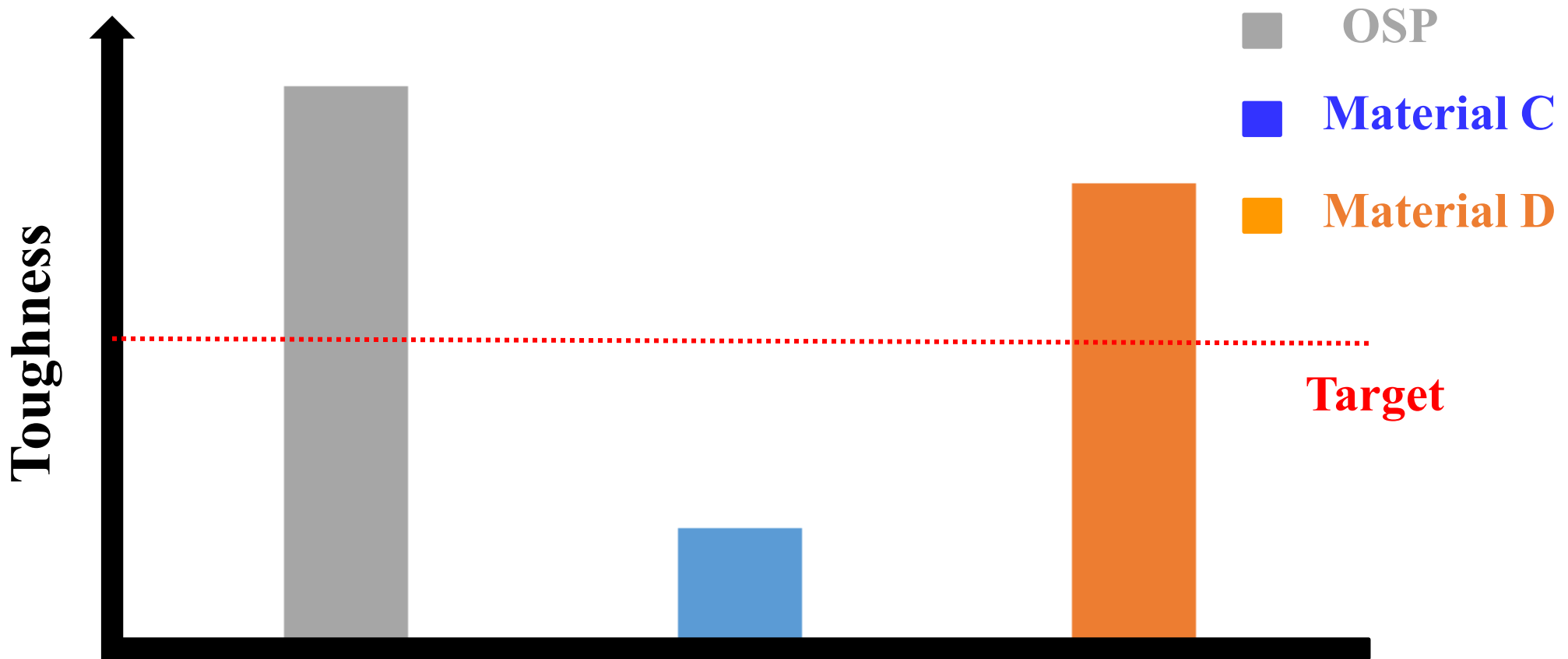
✓ Material D has excellent characteristics for jetting installation.

# Jacket Material Consideration for RIO WTC



✓ Material D has good Flame Retardancy & Compressive Strength just like Material C.

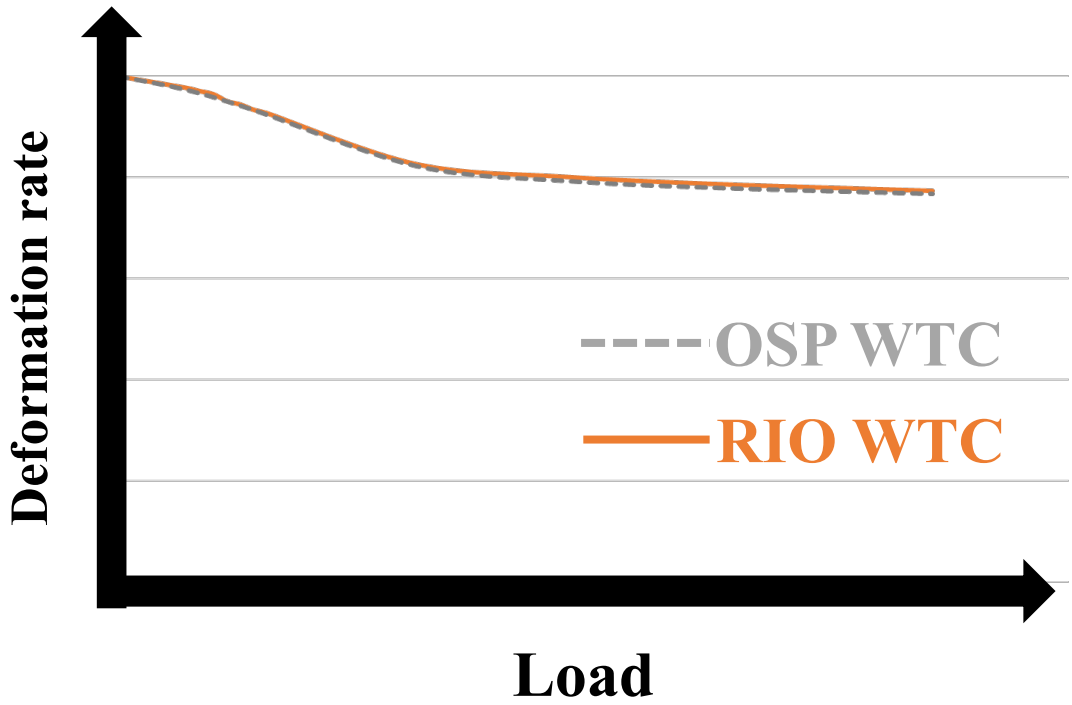
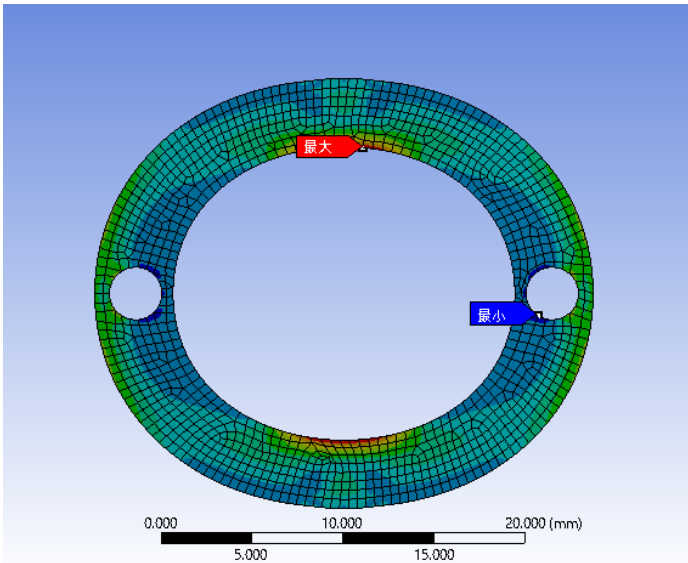
# Jacket Material Consideration for RIO WTC



✓ Material D has good Toughness just like OSP.

# Design of RIO WTC

## Simulation Result



✓ As a result of optimizing the materials and structure, we achieved to the same deformation rate as OSP WTC.



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# Flame Retardant Test Result

	Flame Retardant Test	
	OFNR(UL)	CPR(EN)
<b>144F-WTC</b>	<b>Pass</b>	<b>B2ca-s1a, d0</b>
<b>288F-WTC</b>	<b>Pass</b>	<b>Cca-s1a, d0</b>
<b>432F-WTC</b>	<b>Pass</b>	<b>B2ca-s1a, d0</b>
<b>864F-WTC</b>	<b>Pass</b>	<b>B2ca-s1b, d0</b>
<b>1728F-WTC</b>	<b>Pass</b>	<b>Cca-s1b, d1</b>
<b>3456F-WTC</b>	<b>Pass</b>	<b>Cca-s1, d0</b>
<b>6912F-WTC</b>	<b>Pass</b>	<b>Cca-s1, d0</b>

✓ All lineups of RIO WTC satisfies objective of the Flame Retardant Test.

# Mechanical Test of RIO WTC

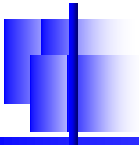
Item	Condition	Result
Low-high Temperature Bend (*1)	Bending radius: 10D (D:Cable Diameter) Temperature: -10, +60 degree C Turns: 4, Cycle: 3	Pass
Cable Cyclic Flexing	Bending radius: 20D (D:Cable Diameter) Cycle: 25	Pass
Impact	Striking surface: 12.5 mm Impact energy: 4.4 N·m Striking count: twice at the same place	Pass
Tensile Strength	Load: 2700 N 1 h (Short Term)	Pass
	Load: 810 N (Long Term)	Pass
Compressive Strength	110 N/cm 10 minutes after 220 N/cm 1minute	Pass
Cable Twist (*1)	Sample length: 1 m Test angle: ±180 degrees, Cycle: 10	Pass

\*1 : Tested by ICEA S-83-596-2016 for indoor because it is a stricter test condition.



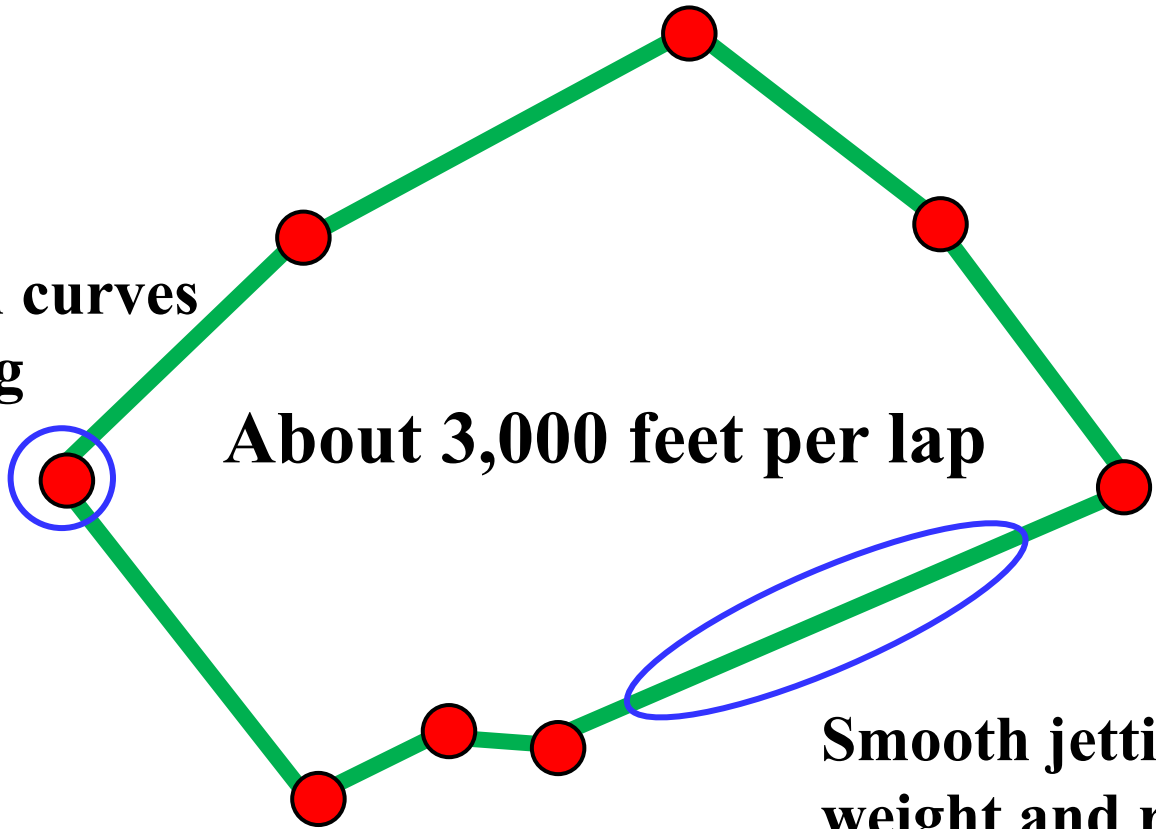
# Environmental Test for RIO WTC

<b>Item</b>	<b>Condition</b>	<b>Result</b>
<b>Temperature Cycling</b>	<b>-40 to +70 degree C Cycle : 2</b>	<b>Pass</b>
<b>Water Penetration</b>	<b>Height of water : 1 m Sample length : 40 m</b>	<b>Pass</b>
<b>Weathering Test</b>	<b>Exposure Time : 720h</b>	<b>Pass</b>
<b>Cable Aging Test</b>	<b>Temperature : 85 degree C Aging Time : 720h</b>	<b>Pass</b>



# Jetting Installation Test for RIO WTC

Passing through curves without stopping



About 3,000 feet per lap

Smooth jetting for light weight and robust structure

Item	Property	Result
864F-WTC	Duct size : 1.25 inch	3,322 feet
1728F-WTC	Duct size : 1.50 inch	3,700 feet

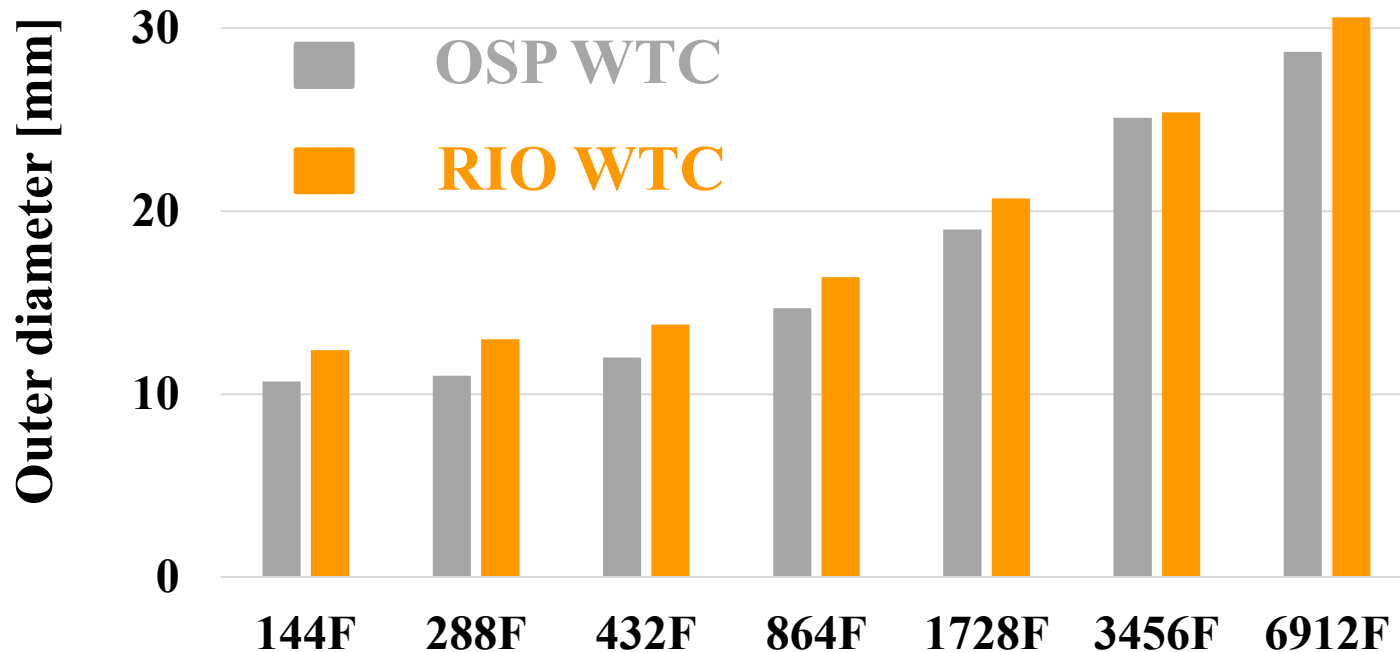


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# Conclusion



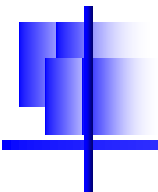
- ✓ **RIO WTC has the same outer diameter as OSP WTC, while still maintaining high flame retardancy**
- ✓ **RIO WTC enables the introduction of Jetting Installation, which achieves both workability and low installation costs..**



# Conclusion

	OSP	Current I/O	RIO
Fiber Count	~ 6912F	~ 6912F	~ 6912F
Mechanical Characteristics	Good	Good	Good
Environmental Characteristics	Good	Good	Good
Flame Retardancy	N / A	Good	Good
Jetting Installation	Good	N / A	Good

✓ RIO WTC has achieved a balance between Flame Retardancy and workability installation with maintaining the current specifications.



**END**

**Thank You for Your Kind Attention !!**