

IEEE 802.3cz Task Force - 26th Jan 2021 Interim Meeting

# **Optical connector requirements consideration – dust tolerance**

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January 26, 2021

# Optical connector requirements

## Optical connector requirements for automotive

- **Performance**

- Optical insertion loss
- Optical return loss

- **Robustness**

- Temperature & Humidity
- **Dust tolerance @assembly process environment**
- Water resistance
- Mechanical robustness

- **Safety**

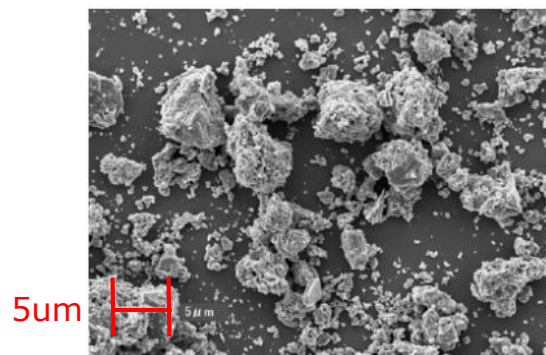
- Laser safety (IEC 60825-2 class 1)

# Environmental (Dust) condition

Amount of dusts	Number of dust-particles	note
$126 \times 10^5 \text{ug} / \text{m}^3$	8 billion	Sumitomo original Dust test
$50 \text{ug} / \text{m}^3$	31,000	PM10@WHO_std

$250 \times 10^3$

Test powder (JIS Z 8901) Class 8  
= KANTO(Japanese) loam =

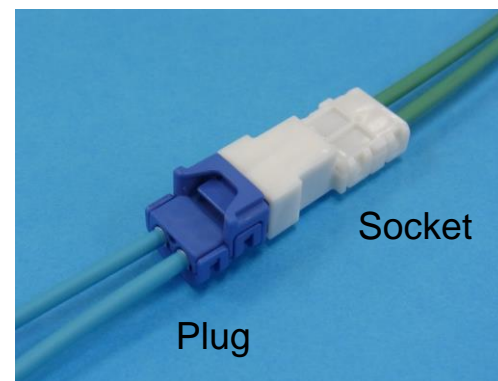
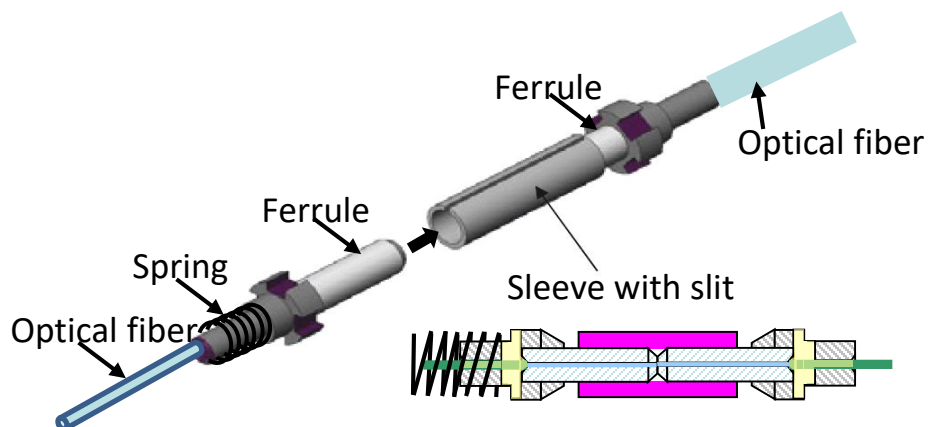


Particle size (um)	Oversize % (on mass basis)
5	56-66
10	40-46
20	24-30
30	12-18
40	6-12
75	< 3

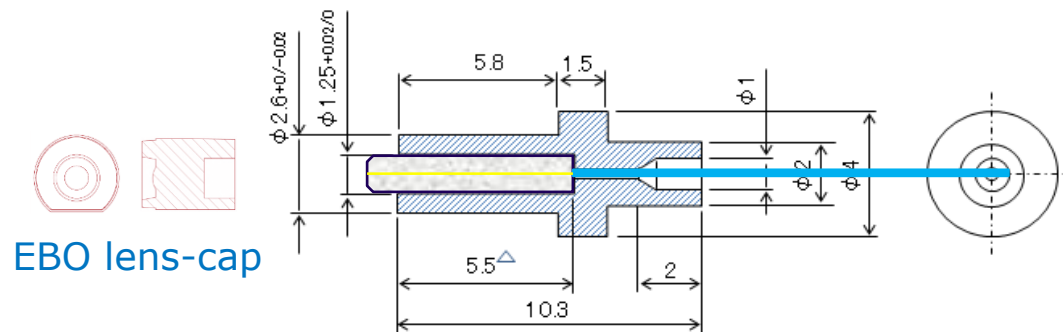
**The condition depends on each factory environment.  
Therefore, we made a condition far beyond the worst dust level.**

# Dust tolerance: test samples

## ■ Butt-coupling connector sample



## ■ EBO connector sample

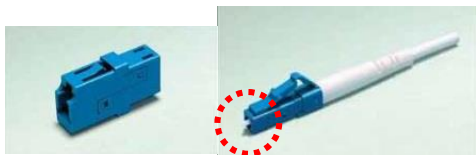


**Note: EBO connector sample has no connector housing**

# Dust tolerance: test samples

## ① LC-connector

Small core-diameter: 50um  
Exposed ferrule



## ② EBO-connector

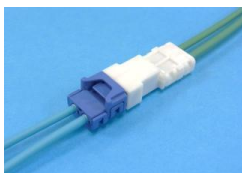
Large beam-diameter: 500um  
Exposed ferrule



Note:  
No connector  
housing for EBO  
connector sample

## ③ Butt-connector

Small core-diameter: 50um  
Recessed ferrule housing



## ④ Butt-connector with shutter



## ⑤ POF connector

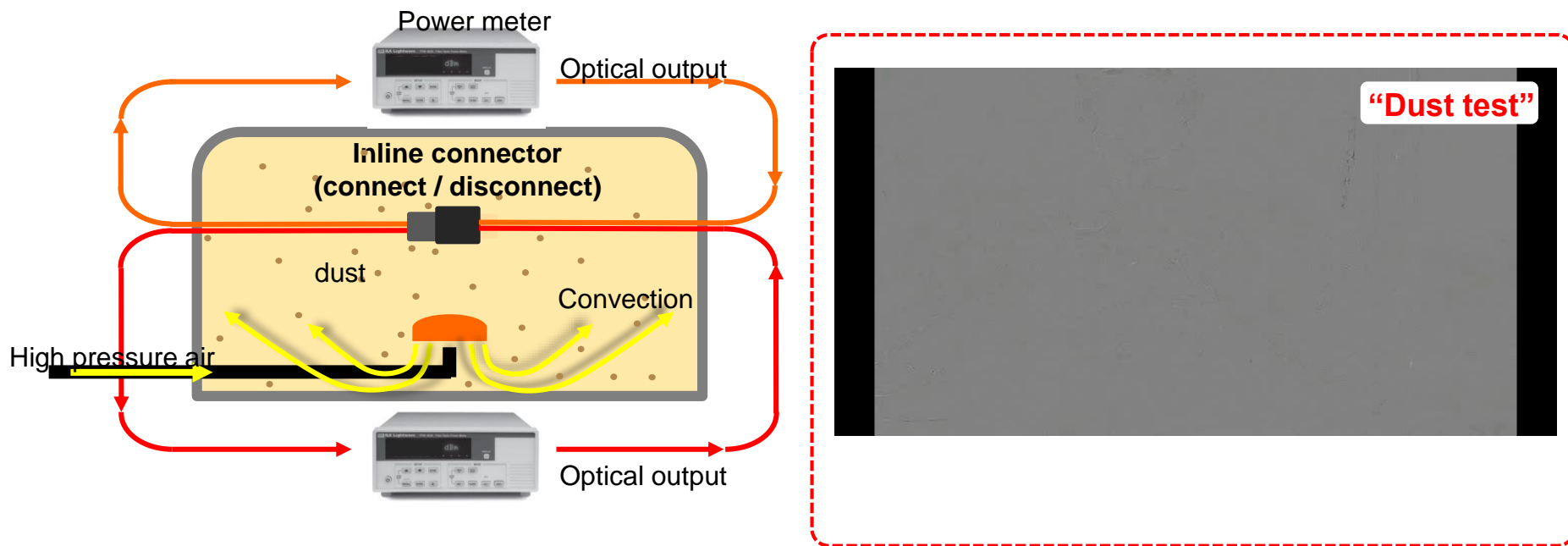
Large core-diameter : 980um  
MOST150



**Evaluated several optical connectors for relative comparison**

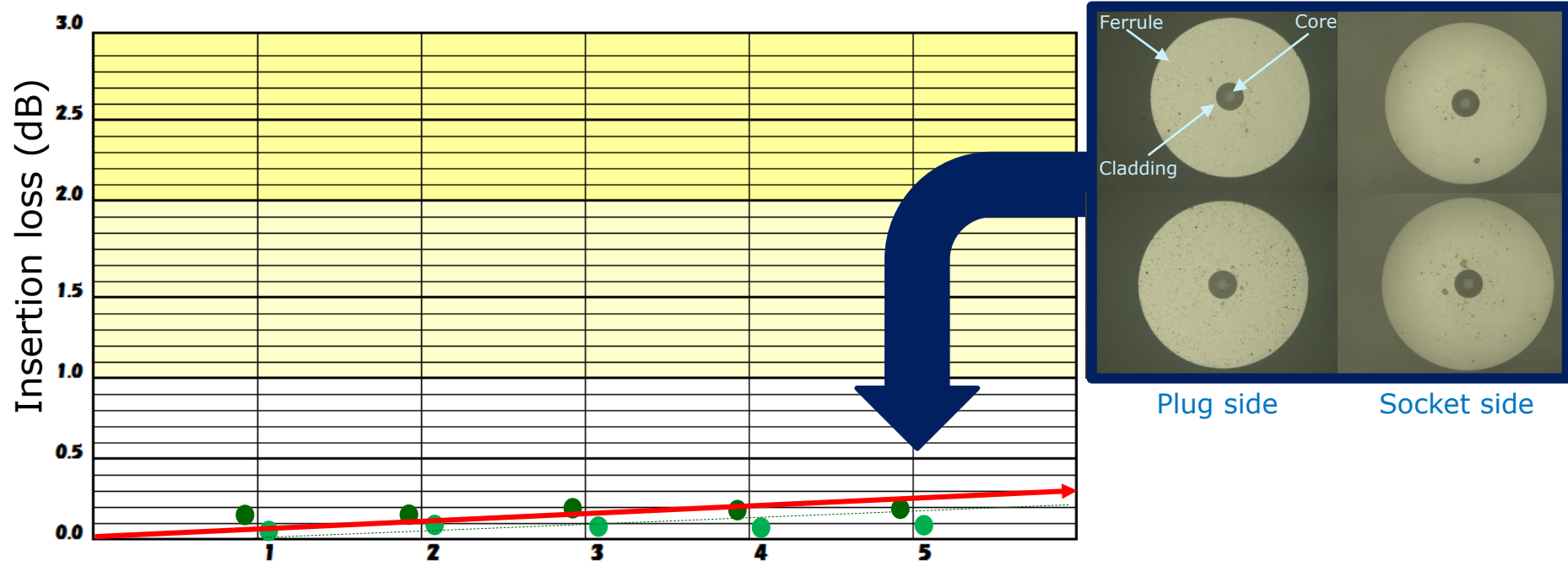
# Dust tolerance: Evaluation

Evaluated optical coupling loss increase by connector mating in the dusty environment

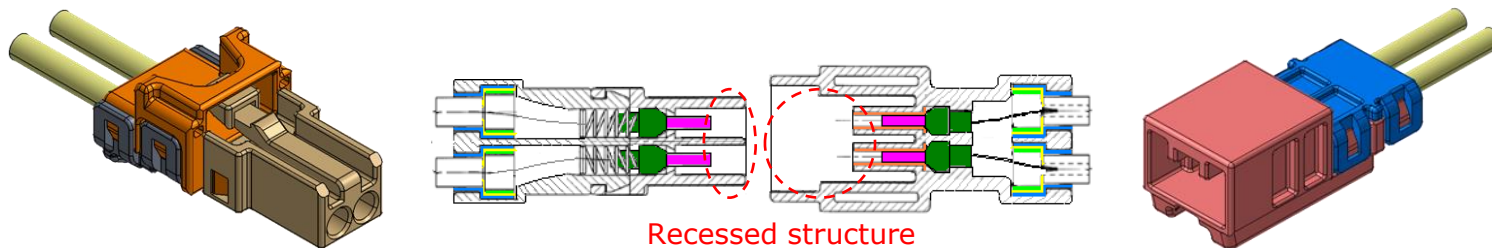


**Note: This is not a standard evaluation method**

# Dust tolerance: butt-connector

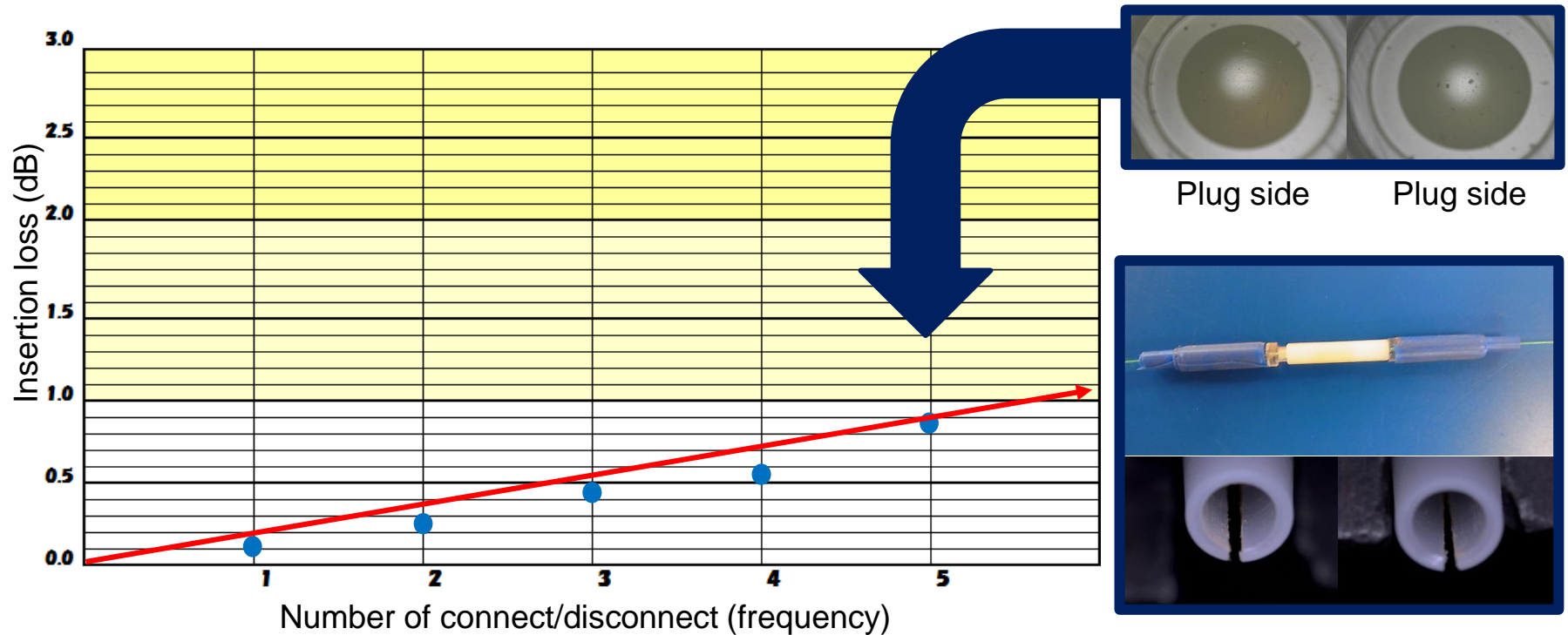


Number of connect/disconnect (frequency)



**Butt-coupling connector with recessed structured housing**

# Dust tolerance: EBO connector

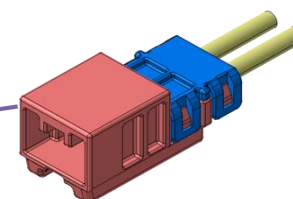
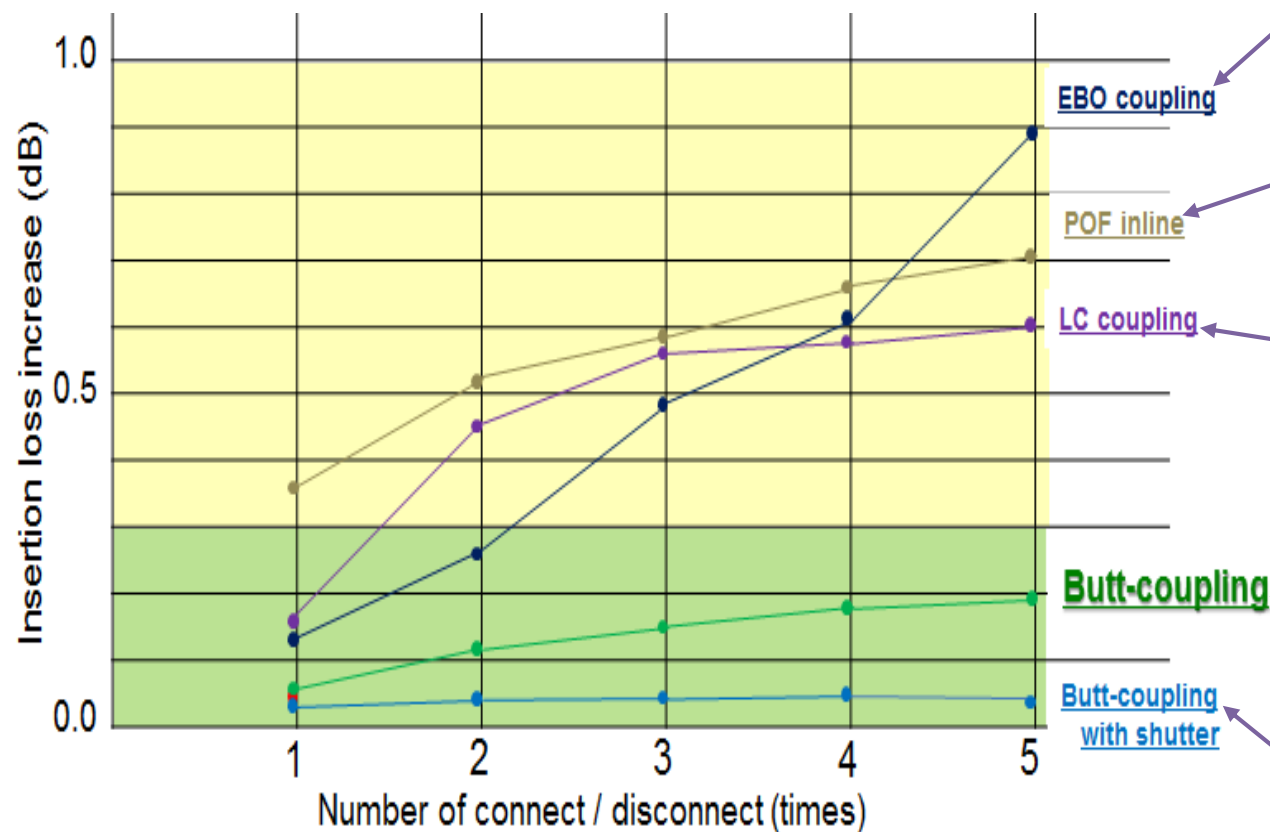


**Note: No connector housing**

(Dusts might have invaded easily between lenses, because the connector housing had not been prepared.)



# Dust tolerance: test results



**Dust tolerance @mating is varied by connector (housing) design**

# Summary

## Optical connector requirements for automotive:

Dust tolerance at harness assembly is depend on ...

- Connector housing design  
(Recessed ferrule structure etc.)
- Environmental condition and handling at the plant  
(Dust size distribution vs. core diameter)

Probability of optical loss increase due to dust can not be “zero” for any kind of optical connectors.

**Implementation of a received optical power monitoring function would be a countermeasure to check abnormal optical loss increase.**



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