DEVELOPMENT OF QUICK CONNECTING TYPE RESONATOR

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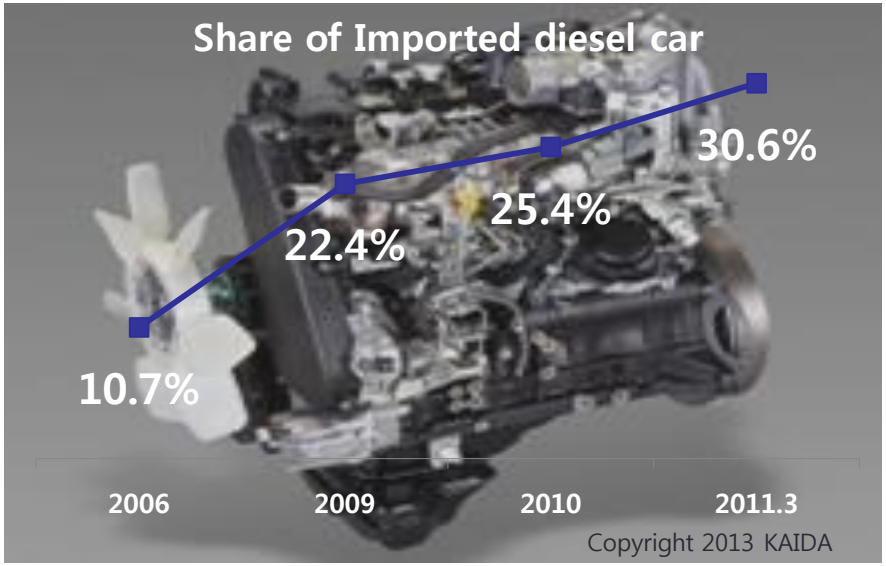
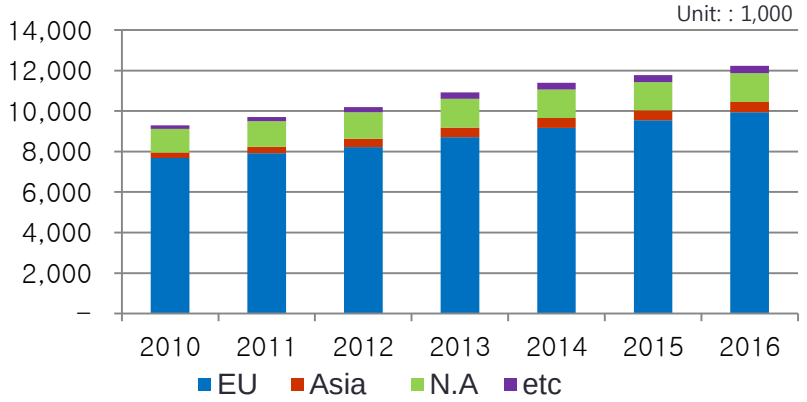
1. Introduction

- Motivation
  - Increase Turbo vehicle

  ('10 9,301,000 ⇒ '16 12,238000, 31.5% increase)
  - Increase low-noise design of turbocharger.
  - Increase in number of parts, Quick connecting technique is required to reduce assembly process



Expected sales volume of diesel car at the world

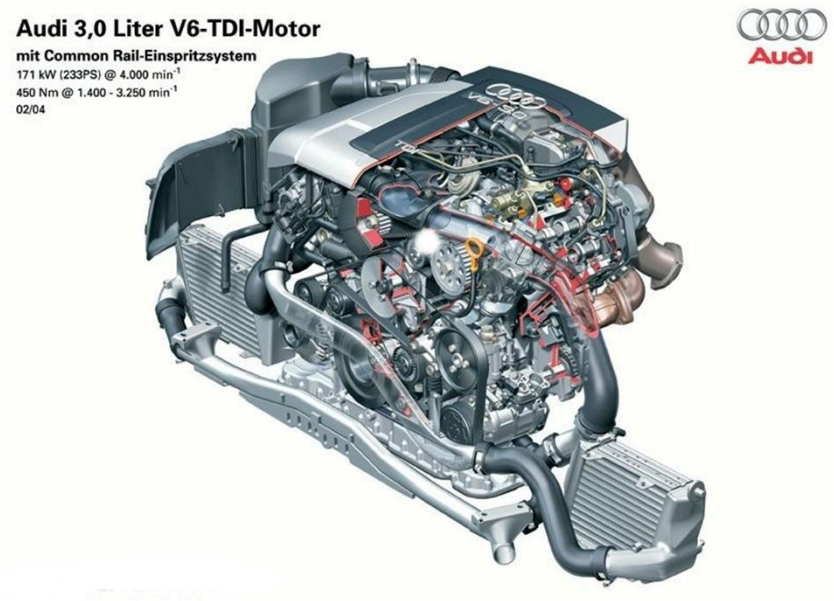


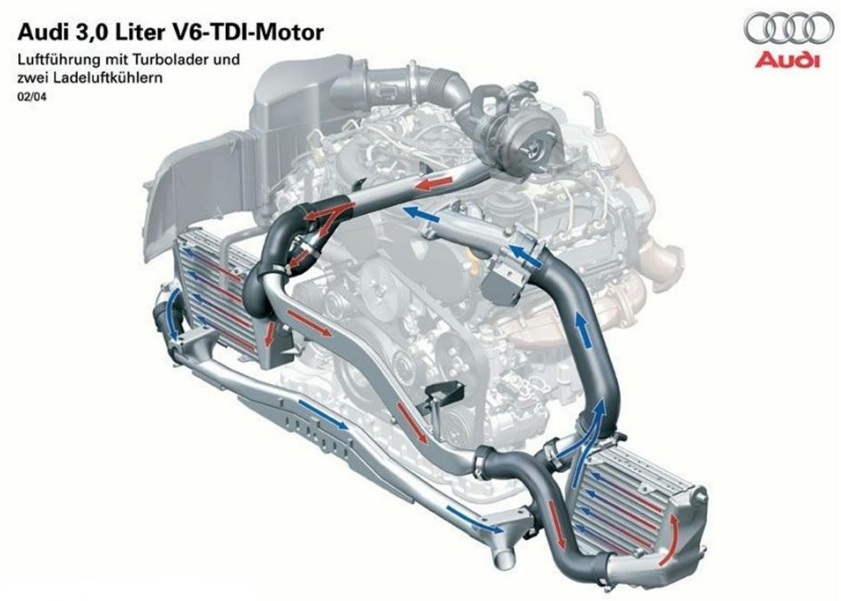
	2010	2011	2012	2013	2014	2015	2016
EU	7,677	7,913	8,214	8,704	9,162	9,542	9,941
Asia	279	328	423	483	492	501	512
N.A	1,167	1,265	1,307	1,421	1,404	1,386	1,411
etc	178	203	250	312	338	345	373
Total	**9,301**	**9,709**	**10,194**	**10,920**	**11,397**	**11,773**	**12,238**

2. Define

- Objective
  - Quick connecting:
    - Easy to connect
    - Low installation/disassemble effort
    - Strong destructive disassemble effort
    - Tight air sealing
  - Noise reduction
    - Broad band noise reduction (2000 ~ 4000 Hz)

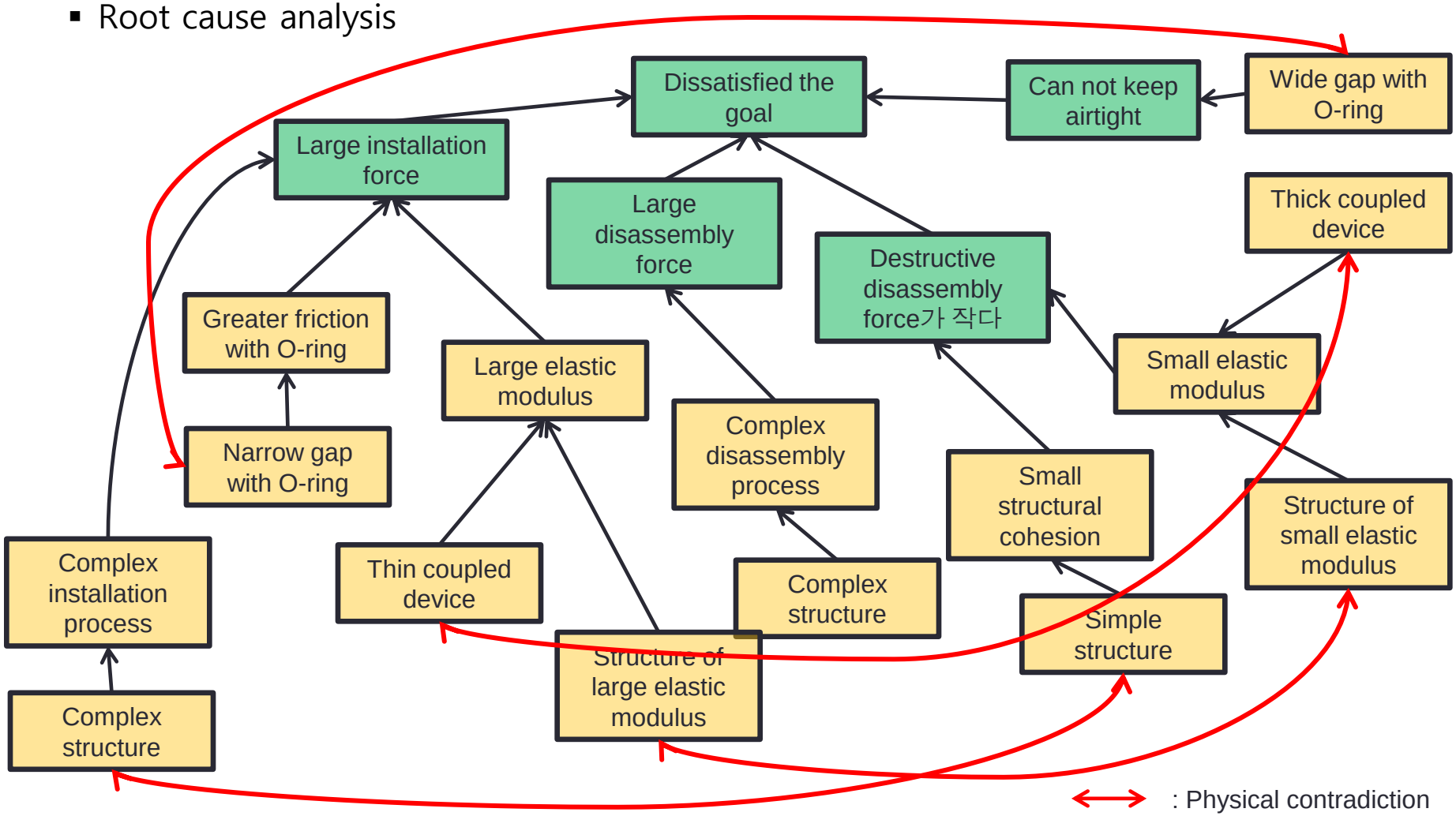
- Main problem
  - Narrow engine room space.
    - Difficult to assemble the hose between the engine manifold and intercooler, turbocharger.
    - Difficult to secure a space for noise reduction.





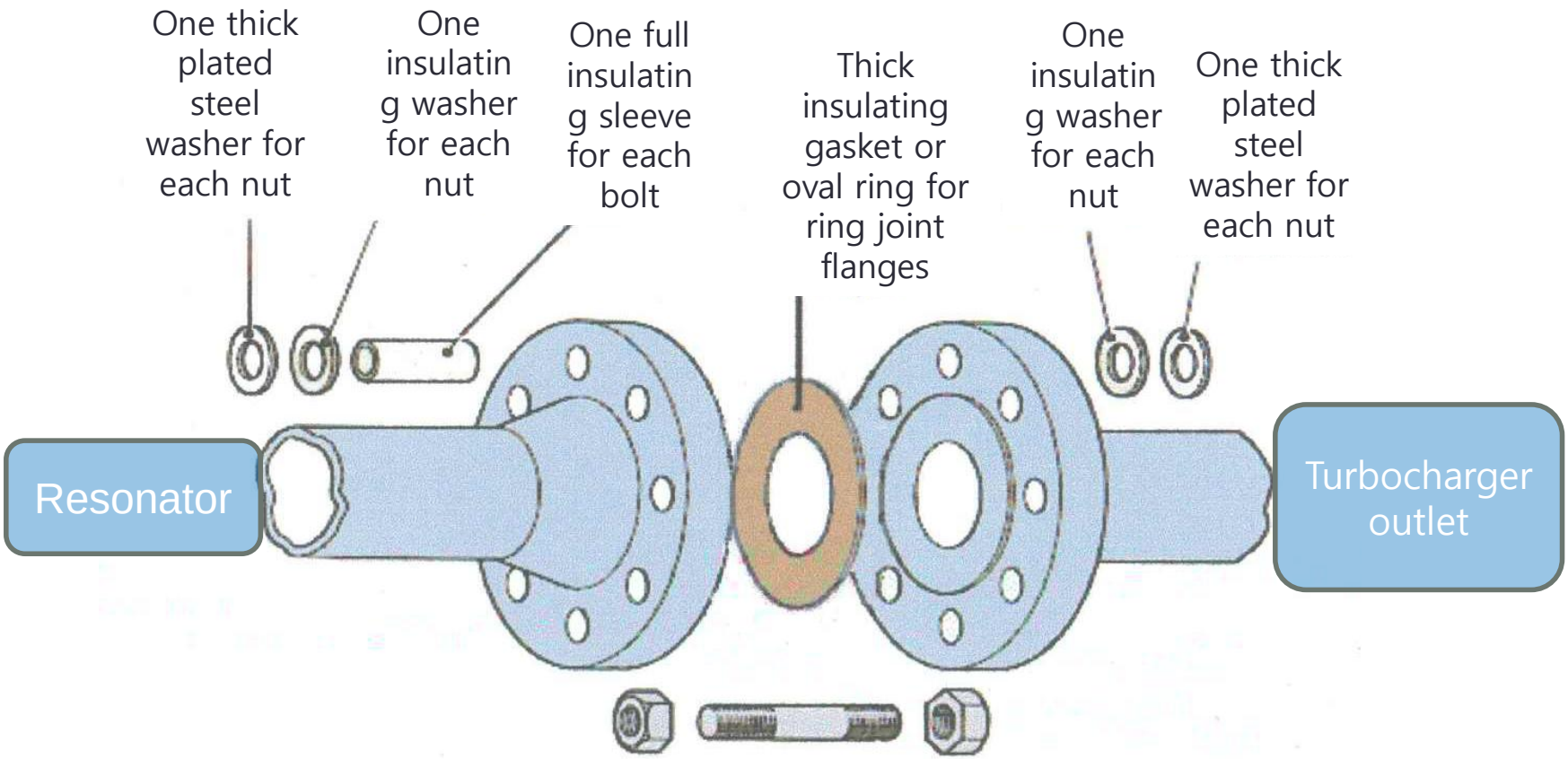
3. Problem Analysis

- Root cause analysis



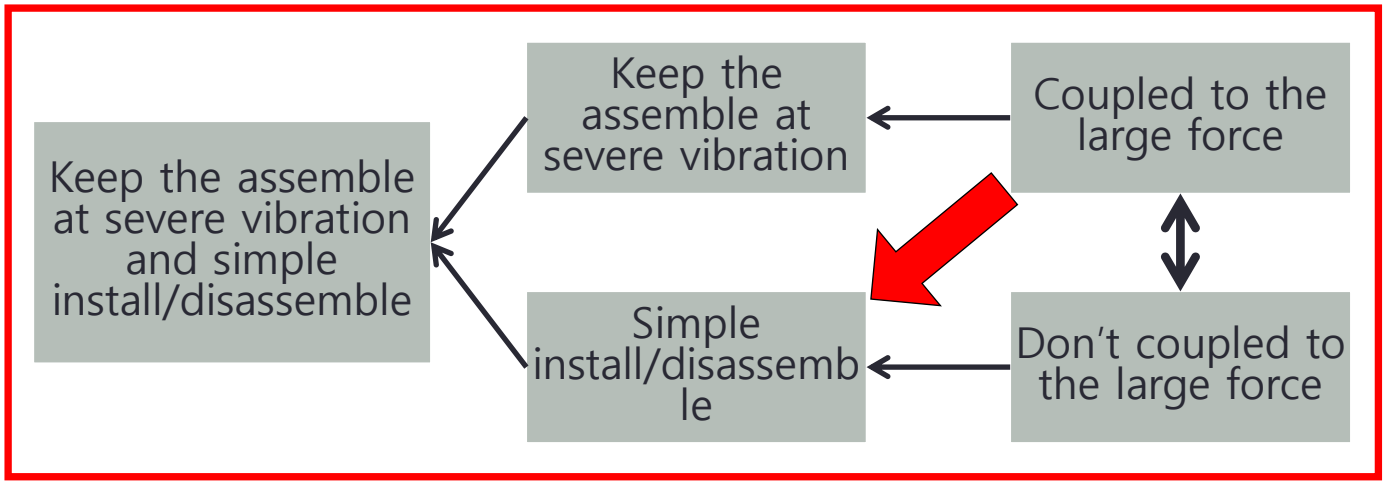
3. Problem Analysis

- Function Analysis
  - Flange type connection



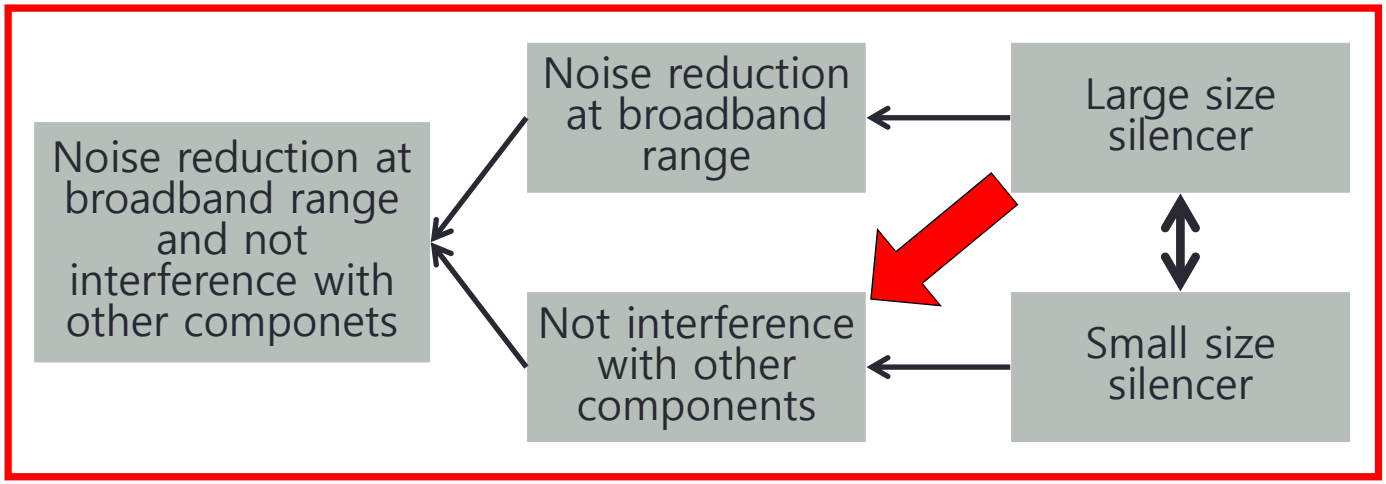
3. Problem Analysis

- Technical contradiction
  - Quick connecting



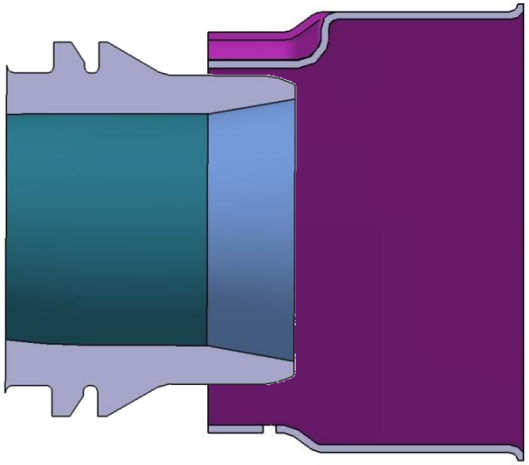
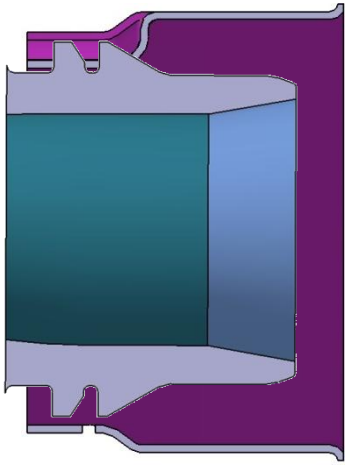
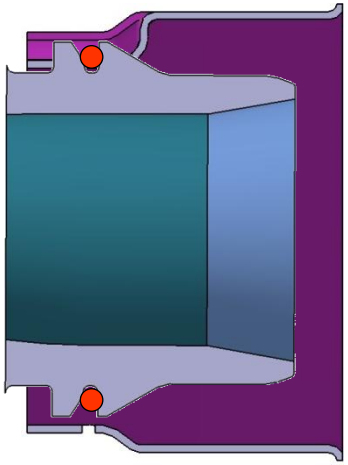
3. Problem Analysis

- Technical contradiction
  - Noise reduction

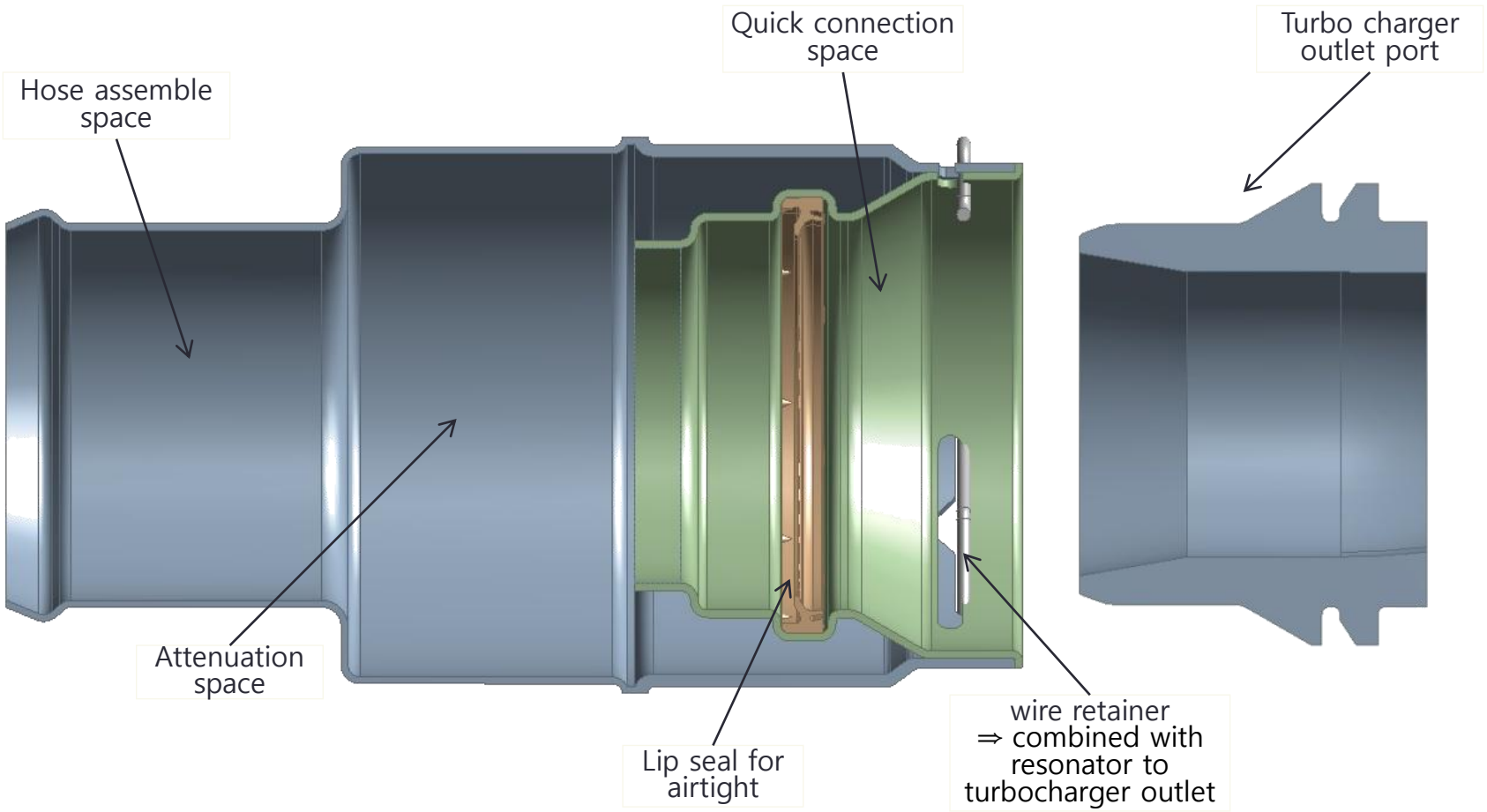


3. Problem Analysis

- Ideal final result
  - Quick connecting – Time separate

	Before install	Install	After install
Time	No Coupling device		Coupled device
Figure			

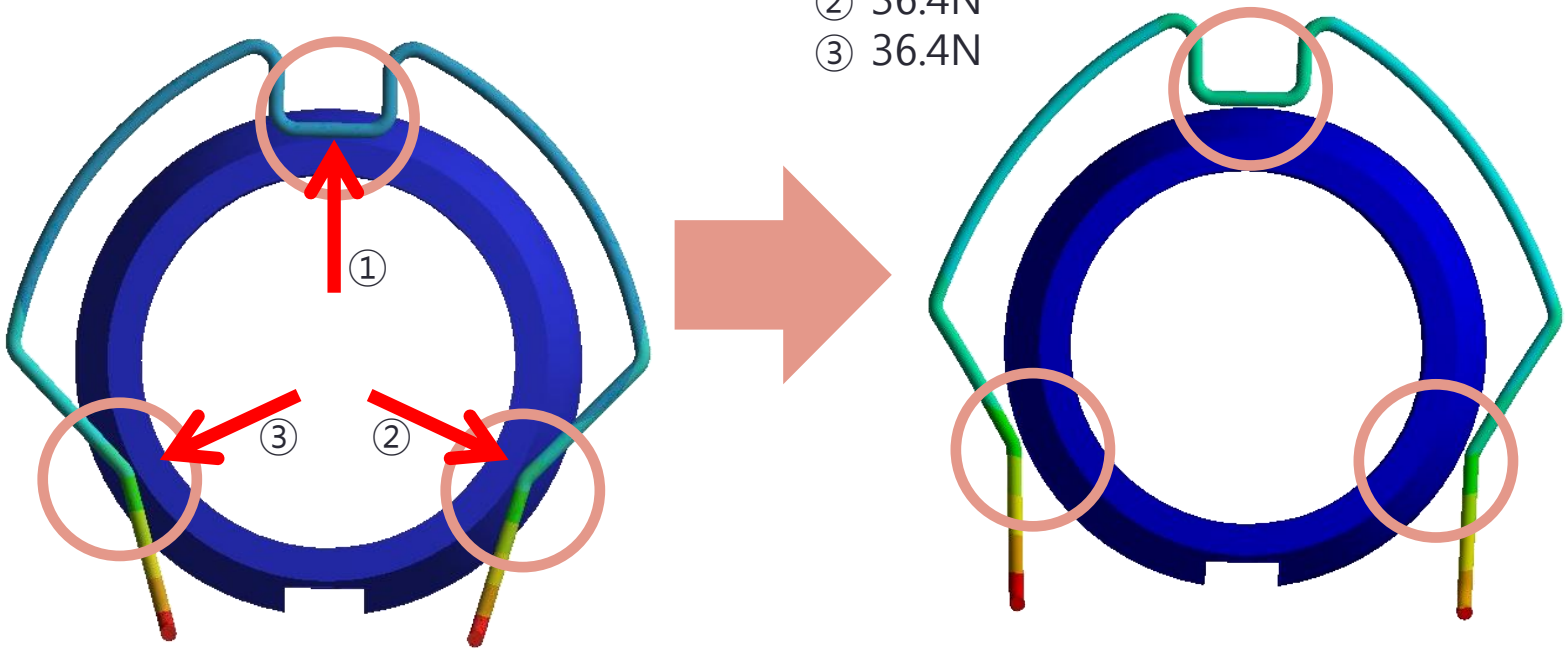
4. Solutions


Hose assemble space
Quick connection space
Turbo charger outlet port
Attenuation space
Lip seal for airtight
wire retainer ⇒ combined with resonator to turbocharger outlet

4. Solutions

- Quick connecting
  - Vertical direction

Vertical direction force : ① 70N
② 36.4N
③ 36.4N

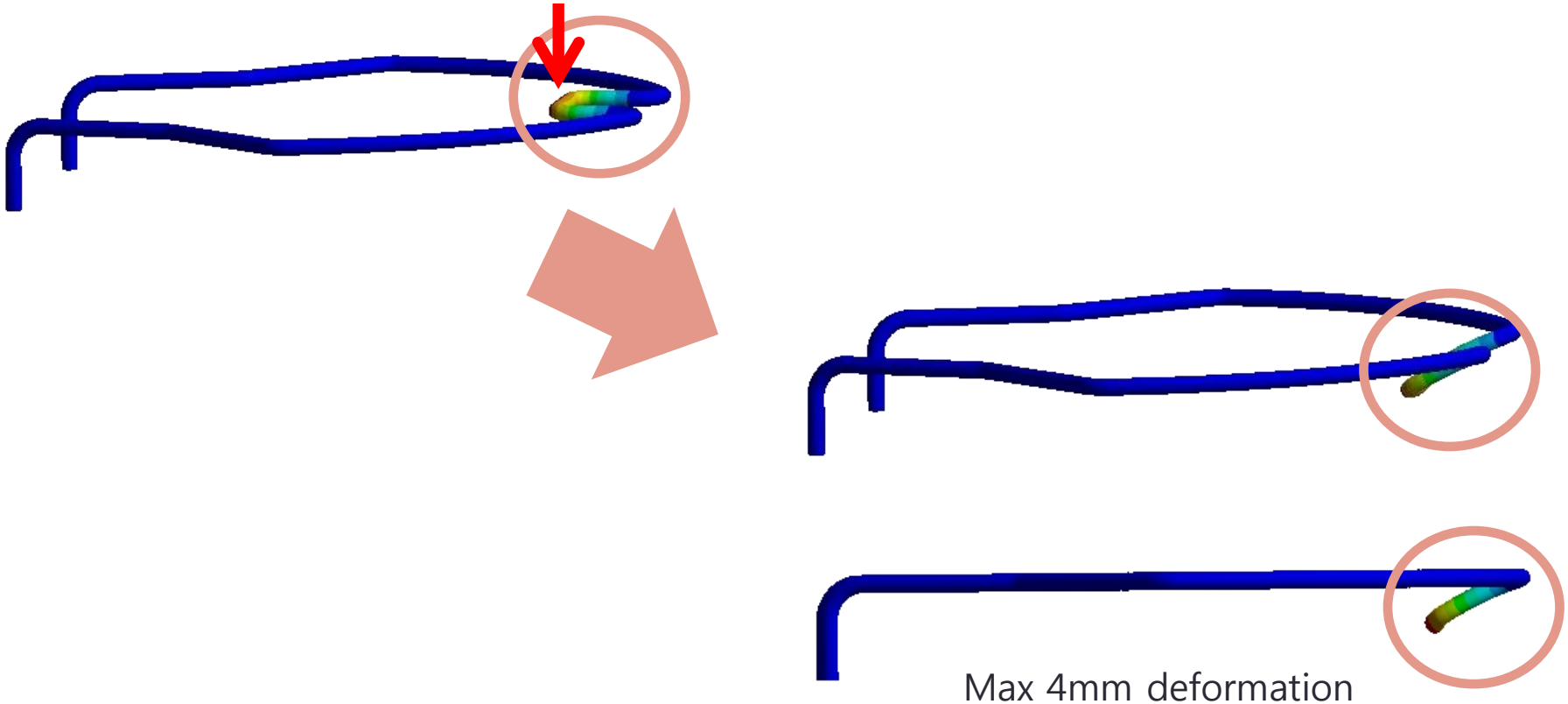


Max 8mm deformation

4. Solutions

- Quick connecting
  - Normal direction

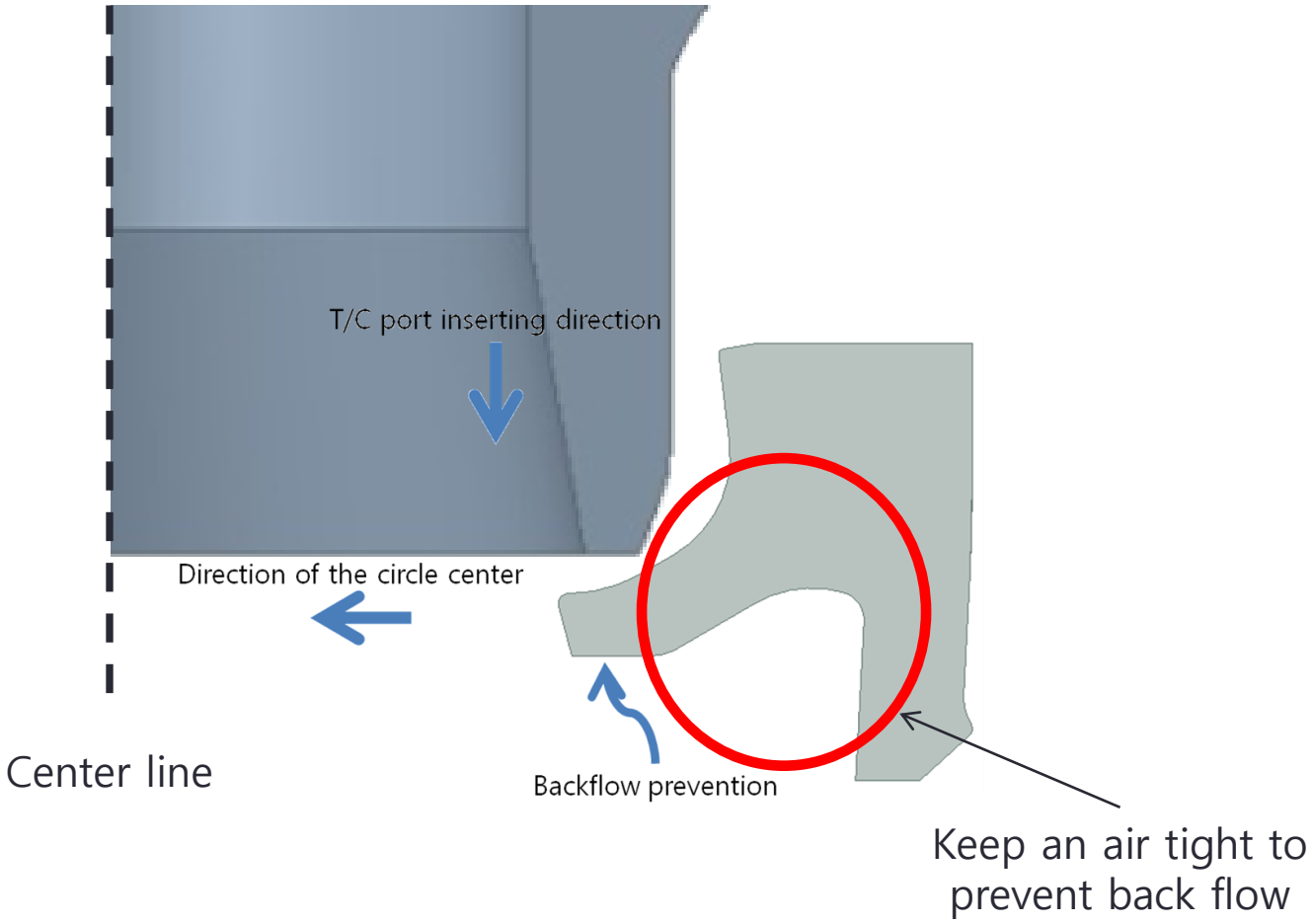
Normal direction force : 1000N



Max 4mm deformation

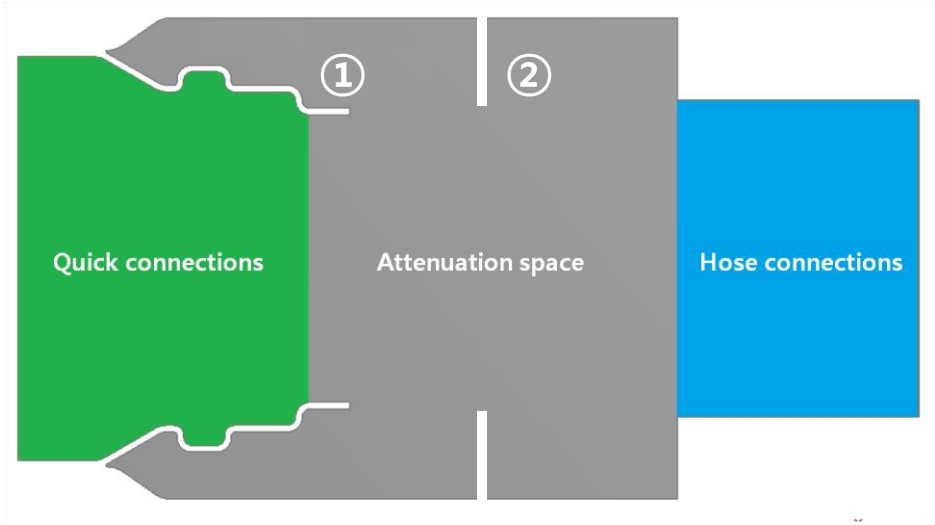
4. Solutions

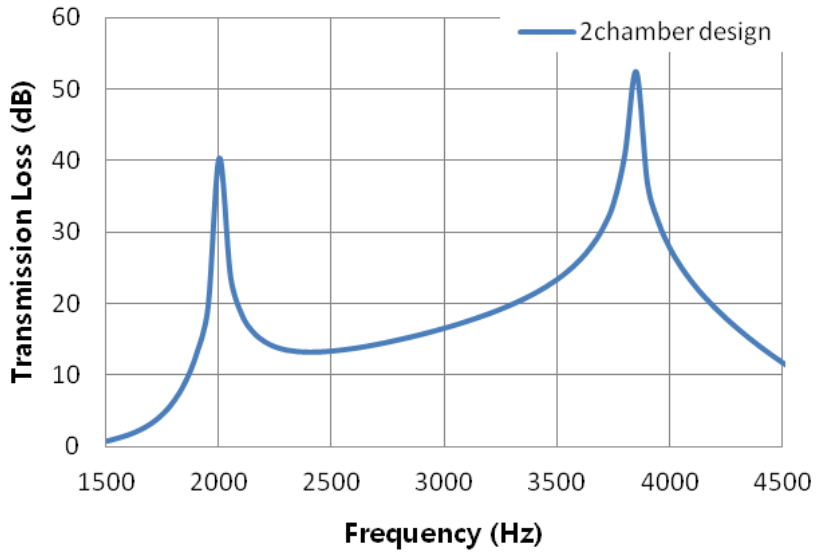
- Quick connecting
  - Air tight



4. Solutions

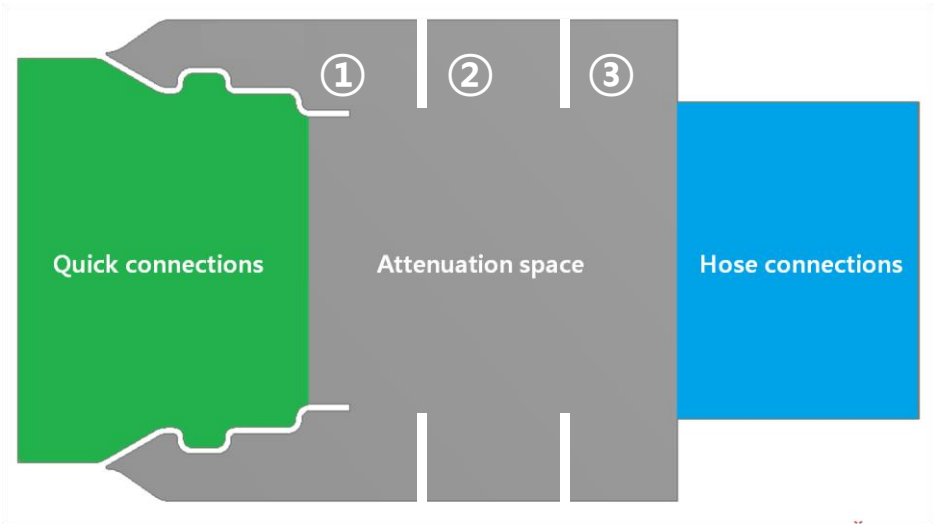
- Noise reduction
  - 2 chamber design
    - Attenuation space is divided into two area
    - ① area is responsible for the relatively low frequency
    - ② area is responsible for the relatively high frequency

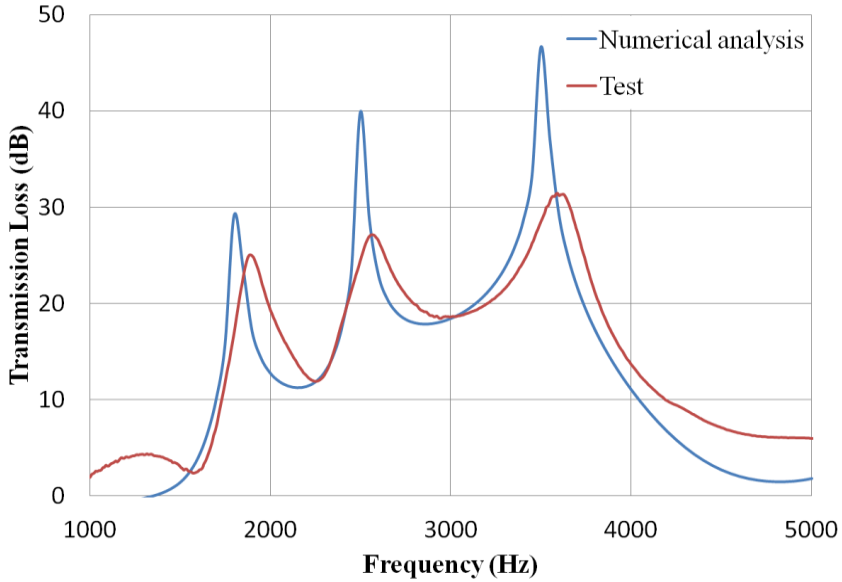




4. Solutions

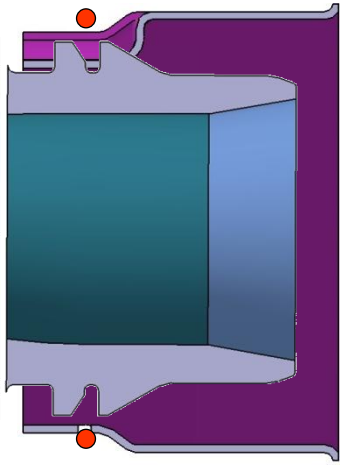
- Noise reduction
  - 3 chamber design
    - Attenuation space is divided into three area
    - ① area is responsible for the relatively low frequency
    - ③ area is responsible for the relatively high frequency
    - ② area is responsible for the middle frequency
    - ② area keep high performance at 2500 ~ 3000 Hz

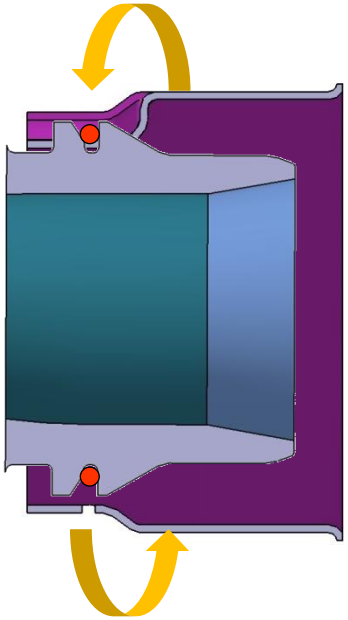




Appendix. Review of retaining device

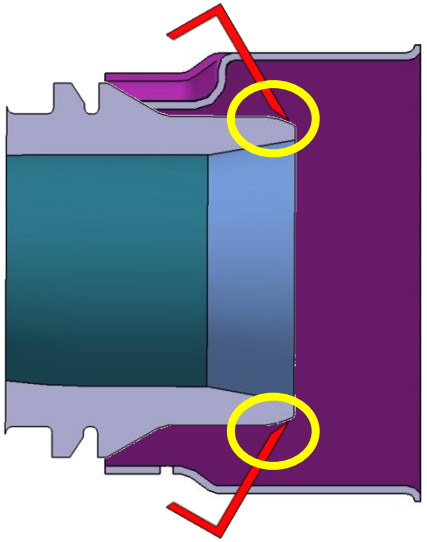
- Rotational method





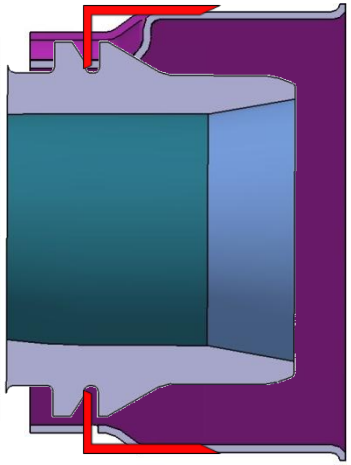
After inserting T/C out port, T/C out port and resonator combine by rotating resonator housing or retainer

- Rotational method



T/C out port push the clips when it is inserted

After completely inserting T/C out port, clips and T/C out port combine



Appendix. Review of retaining device

- Assessment

Selection Criteria	Weight Value (1 ~ 3)	Concept 1 (rotation)	Concept 2 (clip)	Concept 3 (wire spring)
1. Ease assembly	3	2	3	3
2. Keep assembly	3	3	2	2
3. Quick connector structural simplicity	2	2	1	3
4. Ease of production	2	2	2	3
5. Manufacturing cost	3	2	1	3
Sum	-	29	24	36
Priority of Concept	-	2	3	1