

가압기 노즐 Thermal Sleeve 관할 영역 경계 비교 및 검토



이 휘 승

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Thermal Sleeve 기능

- 온도 차이 큰 유체가 주입되는 배관 노즐 부위에 급격한 온도 변화로 인한 열 충격 및 열 변형 완화 목적
- 최초 Thermal Sleeve는 전차의 총신에 적용
총신의 일정한 온도를 유지시켜 열 변형으로 인한 정확도 감소를 방지



가압기 노즐 Thermal Sleeve

가압기 설계시방서

4.11.1.3

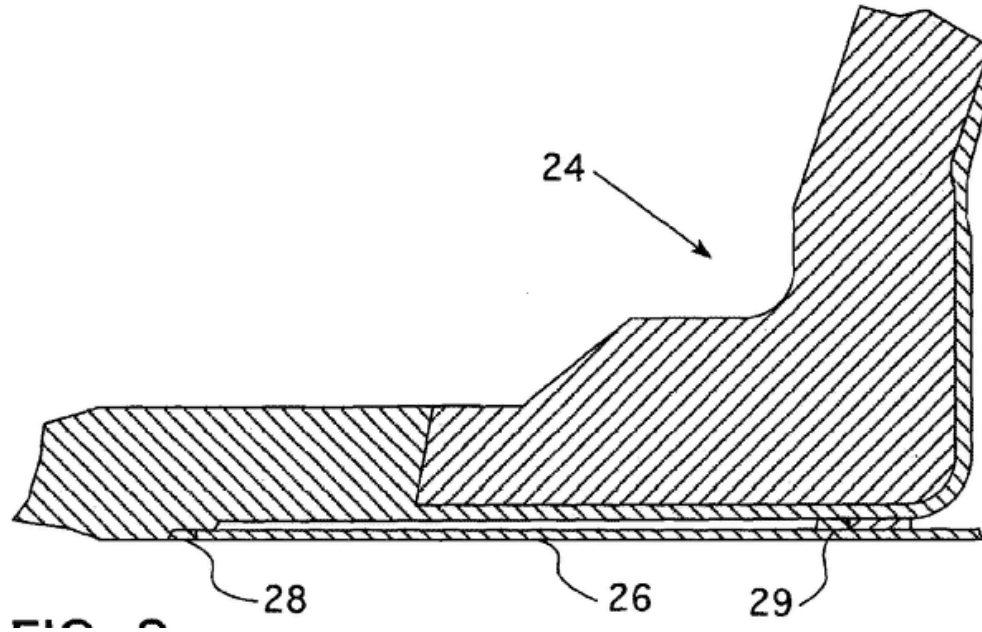
Thermal Sleeves shall be provided on the **surge and spray nozzles** and in any other locations as necessary.

살수온도: 564.5°F



- 2. SURGE NOZZLE
 - 3. SPRAY NOZZLE
 - 5. LEVEL-UPPER
 - 6. LEVEL-LOWER
 - 7. PRESSURE NOZZLE
 - 8. TEMPERATURE NOZZEL
 - 9. HEATER
 - 10. SHEAR LUG
 - 11. RCGVS NOZZLE
 - 12. ERDS NOZZLE
- Note : 1) Lugs, Nozzles & Manway are rotated into section.
2) Nozzle Number, Size and Schedule per Appendix L-2.

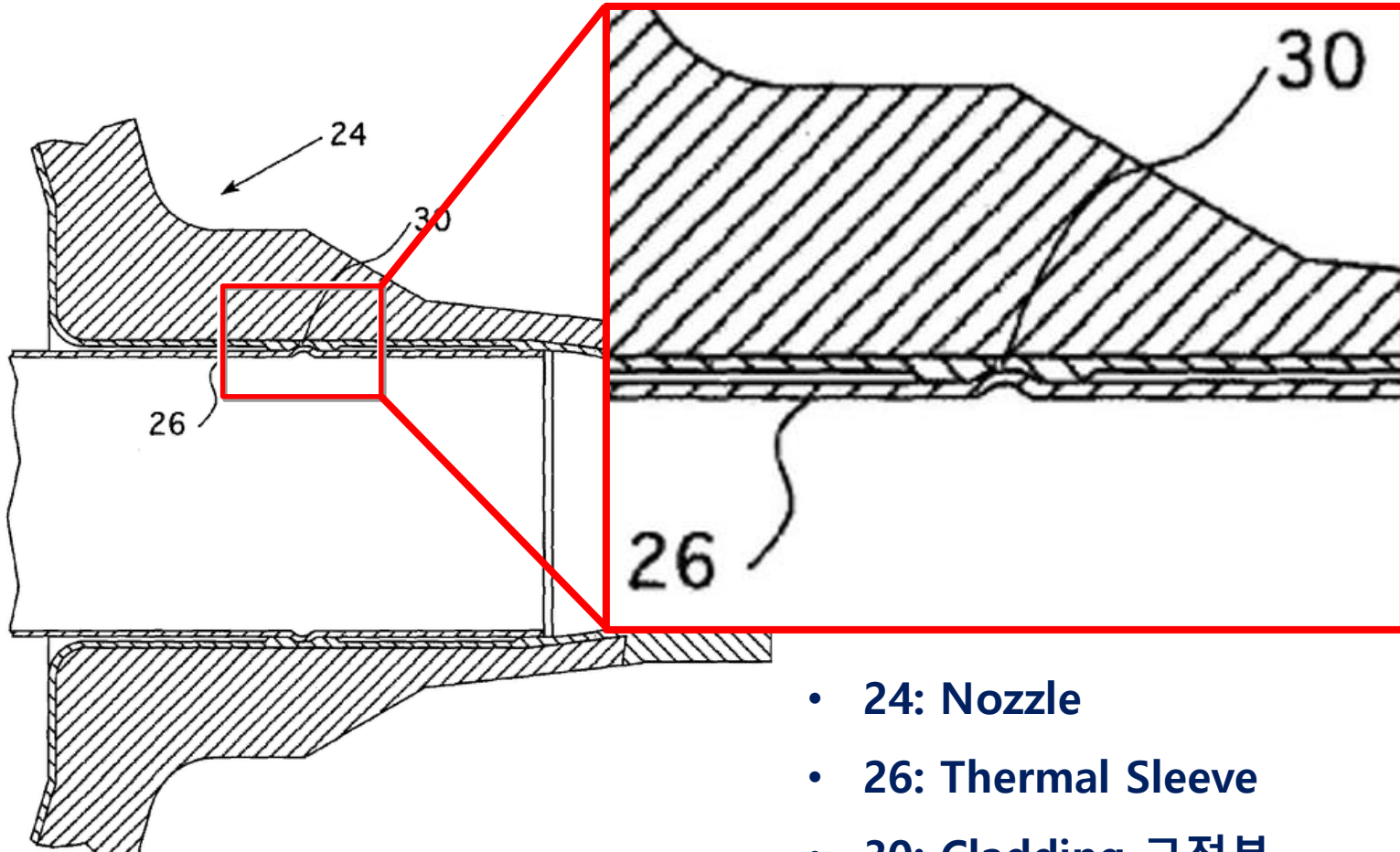
WEC형 가압기 노즐 Thermal Sleeve



US Patent, 20110170650

- 24: Nozzle
- 26: Thermal Sleeve
- 28: 원주 방향 45° 용접
- 29: 90° 간격 4곳 스팟 용접

OPR1000 가압기 노즐 Thermal Sleeve



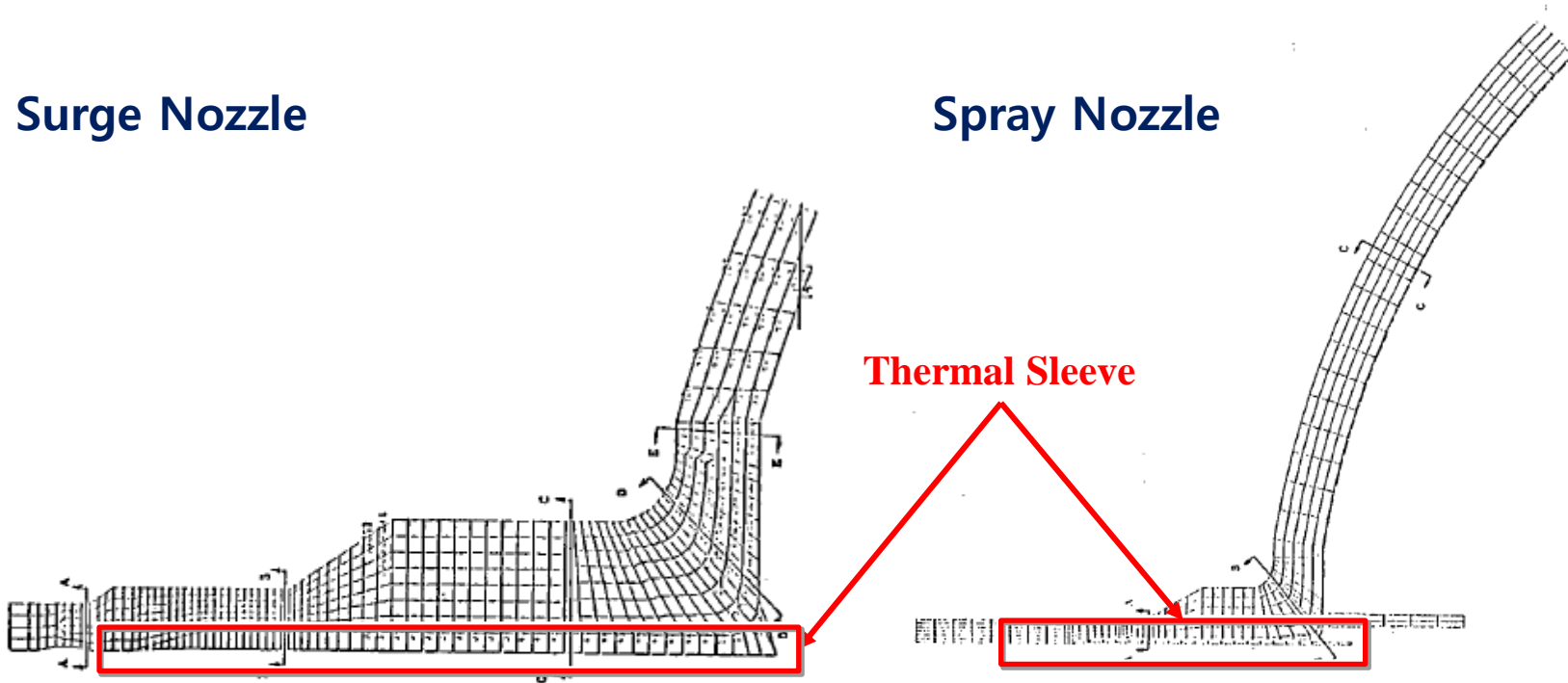
- 24: Nozzle
- 26: Thermal Sleeve
- 30: Cladding 고정부

US Patent, 20110170650

WEC형 가압기 노즐 Thermal Sleeve

Surge Nozzle

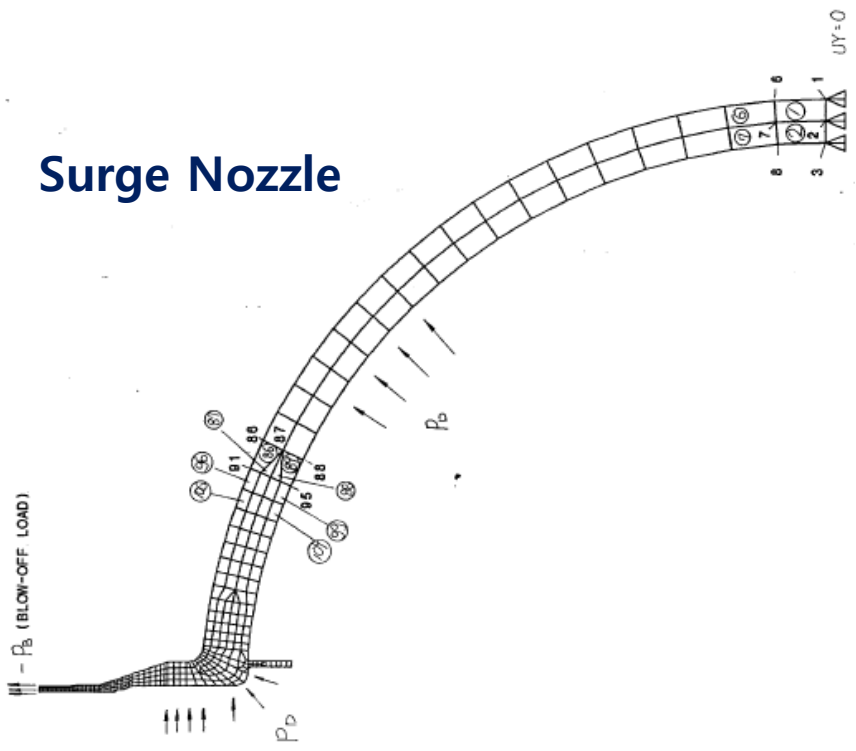
Spray Nozzle



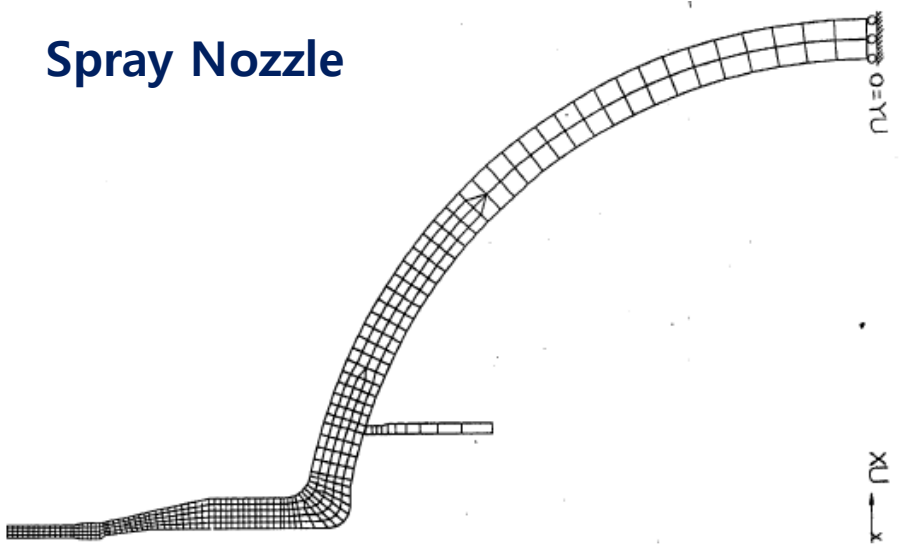
- WEC형 가압기 Surge and Spray Nozzles 구조건전성평가 시, Thermal Sleeve를 고려하여 구조건전성평가를 수행

OPR1000 가압기 노즐 Thermal Sleeve

Surge Nozzle



Spray Nozzle



- OPR1000 가압기 Surge and Spray Nozzles 구조건전성평가 시, Thermal Sleeve를 고려하지 않고 구조건전성평가를 수행

WEC형 및 OPR1000 Thermal Sleeve 비교

	WEC형	OPR1000
ASME Code 적용 년판	1974 Edition	1989 Edition
설치위치	Surge and Spray Nozzles	Surge and Spray Nozzles
설치방법	용접	폭발 확관
건전성 평가 T/S 포함 여부	O	X

ASME 코드 비교 및 검토

ASME B&PV Sec.III Division 1 – 1974 edition.

Subsection NB

ARTICLE NB-1000 INTRODUCTION

NB-1100 SCOPE

NB-1110 ASPECTS OF CONSTRUCTION COVERED BY THESE RULES

(a) Subsection NB contains rules for the materials, design, fabrication, examination, testing, overpressure relief, marking, stamping, and preparation of reports by the Manufacturer or Installer of items¹ which are intended to conform to the requirements for Class I construction.

(b) The rules of Subsection NB cover the requirements for strength and pressure integrity of items, the failure of which would violate the pressure retaining boundary. The rules cover initial construction requirements but do not cover deterioration

¹In this Subsection, the term *items* is defined as components, parts, and appurtenances.

which may occur in service as a result of corrosion, radiation effects, or instability of material. NA-1130 gives further limitations to the rules of this Section.

NB-1120 TEMPERATURE LIMITS

The rules of Subsection NB shall not be used for items which are to be subjected to metal temperatures other than those for which design stress intensity values are given in Tables I.1.0. Above those temperatures the creep and stress rupture characteristics of the materials permitted to be used become significant factors which are not presently covered by the rules of this Subsection. Fatigue design curves and specified methods for fatigue analysis are not applicable above 700 F for materials covered by Fig. I-9.1, above 800 F for materials covered by Fig. I-9.2, and above 500 F for materials covered by Fig. I-9.3.

NB-3135 Attachments

Lugs, brackets, stiffeners, and other attachments(NB-4430) may be welded, bolted, or studded to the outside or inside of a component. The effects of attachments in producing thermal stresses, stress concentrations, and restraints on pressure resisting member shall be taken into account in checking for compliance with design criteria.

- 관할 영역 설정 기준을 제시하지 않음
- 기기 외면 및 내면에 용접, 볼트, 스테드로 연결되는 부착물에 대한 요건 제시
- 부착물로 인한 영향을 고려하도록 요구

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ASME B&PV Sec.III Division 1 – 1989 edition.

Subsection NB

NB-1132 Boundary Between Components and Attachments

NB-1132.1 Attachments

(a) An *attachment* is an element in **contact** with or **connected** to the inside or outside of the pressure retaining portion of a component which may have either a pressure retaining or nonpressure-retaining function and either a structural or nonstructural function.

(b) Attachments with a pressure retaining function include items such as stiffeners and branch or vessel opening reinforcement.

(c) Attachments with a nonpressure-retaining function include items such as valve guides, **thermal sleeves**, turning vanes, and component support load path items such as vessel saddles, support and shear lugs, brackets, pipe clamps, trunnions, and skirts.

(d) Attachments with a structural function (structural attachments) perform a pressure retaining function or are in the component support load path.

(e) Attachments with a nonstructural function (nonstructural attachments) do not perform a pressure retaining function nor are they in the component support load path. Nonstructural attachments include items such as nameplates, insulation supports, and locating and lifting lugs.

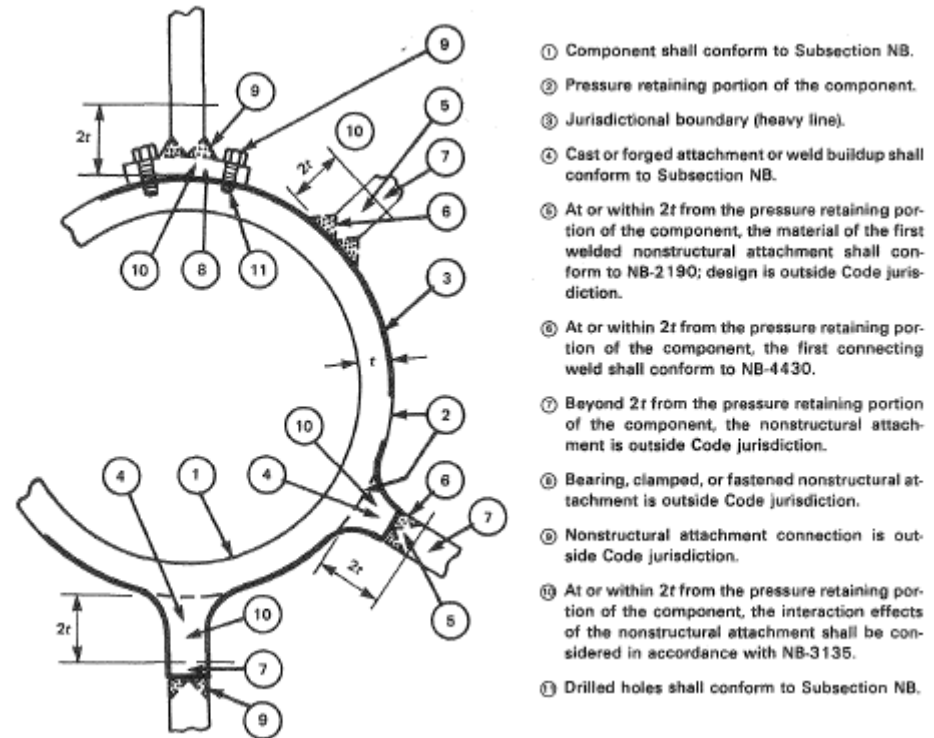


FIG. NB-1132.2-2 ATTACHMENTS WHICH DO NOT PERFORM A PRESSURE RETAINING FUNCTION AND ARE NOT IN THE COMPONENT SUPPORT LOAD PATH (NONSTRUCTURAL ATTACHMENTS)

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Subsection NB

NB-3135 Attachments

(a) Except as in (d) and (e) below, attachments and connecting welds within the jurisdictional boundary of the component as defined in NB-1130 shall meet the stress limits of the component or NB-3200.

(b) The design of the component shall include consideration of the interaction effects and loads transmitted through the attachment to and from the pressure retaining portion of the component. Thermal stresses, stress concentrations, and restraint of the pressure retaining portion of the component shall be considered.

(c) The first welded structural attachment within $2t$ of the pressure retaining portion of the component, where t is the nominal thickness of the pressure retaining material, shall be evaluated for cyclic loading. Evaluation shall be in accordance with the appropriate Subarticle of NB-3000 and shall be made at the juncture of the attachment to the component.

(d) Beyond $2t$ the appropriate design rules of NF-3000 may be used as a substitute for the design rules of NB-3000 for portions of attachments which are in the component support load path.

(e) Nonstructural attachments shall meet the requirements of NB-4435.

- Thermal Sleeve는 NB-1132.1에 따라 압력 경계 유지 기능을 하지않는 비구조적 부착물로 분류
- 비구조적 부착물의 경우, NB-3200 만족을 요구 받지 않음
- 비구조적 부착물은 용접에 대한 요건만 NB-4435 만족하도록 요구

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ASME B&PV Sec.III Division 1 – 1989 edition.

Subsection NB

NB-4435 Nonstructural Attachments

Nonstructural attachments (NB-1132.1) welded to the pressure retaining portion of the component need not comply with NB-2000 and may be welded with continuous or intermittent fillet or partial penetration welds, provided the requirements of (a) through (d) below are met.

(a) The welding procedure and the welders have been qualified in accordance with NB-4321.

(b) The material is identified and is compatible with the material to which it is attached.

(c) The welding material is identified and compatible with the materials joined.

(d) The welds are postweld heat treated when required by NB-4620.

- 비구조적 부착물은 NB-2000 준수를 요구 받지 않음
- 용접 절차와 열처리의 경우 NB-4321 및 NB-4620을 준수

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ASME B&PV Sec.III Division 1 – 1992 edition.

Subsection NB

NB-3135 Attachments

(a) Except as permitted in (d), (e), or (f) below, attachments and connecting welds within the jurisdictional boundary of the component as defined in NB-1130 shall meet the stress limits of the component or NB-3200.

(b) The design of the component shall include consideration of the localized interaction effects and loads transmitted through the attachment to and from the pressure retaining portion of the component. Localized interaction effects include thermal stresses, stress concentrations, and restraint of the pressure retaining portion of the component.

(c) The first welded structural attachment within $2t$ of the pressure retaining portion of the component, where t is the nominal thickness of the pressure retaining material, shall be evaluated for cyclic loading. Evaluation shall be in accordance with the appropriate Subarticle of NB-3000 and shall be made at the juncture of the attachment to the component.

(d) Beyond $2t$ the appropriate design rules of NF-3000 may be used as a substitute for the design rules of NB-3000 for cast and forged portions of attachments which are in the component support load path.

(e) Nonstructural attachments shall meet the requirements of NB-4435.

(f) Beyond $2t$ the appropriate design rules of NG-3000 may be used as a substitute for the design rules of NB-3000 for portions of cast or forged attachments which are core support structures.

결론

- ASME 1989 Edition이전 부착물의 효과를 건전성평가에 고려하도록 요건 설정, 관할 경계 영역 설정에 대해 정의하지 않음
- ASME 1989 Edition부터 부착물에 대한 요건을 구체화하여 관할 경계 영역 설정
- 관할 경계 영역 설정 시, 부착물의 기능 고려
- 부착물의 기능 분류에 따라 설계 요건 차이 발생

감사합니다!