Schweißnahtbewertung nach den Regeln des ASME Codes

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Kurzfassung

Der ASME Code (600 Regelwerke und Normen) wird in mehr als 113 Ländern weltweit als technisches Regelwerk akzeptiert und angewendet. Damit hat sich dieser „internationale Code“ zu einem führenden technischen Regelwerk entwickelt und ist ein entscheidender Schlüssel für den Export druckführender Komponenten. Auch kann der ASME Code zur Erfüllung der europäischen Druckgeräterichtline (PED) herangezogen werden. Der ASME-Code unterteilt sich in einen Construction-, Reference- und Inservice-Code. Für die Herstellung normaler Druckbehälter kommt der Construction-Code Section VIII, Division 1 gemeinsam mit den Reference-Codes für Material (Section II), zerstörungsfreie Prüfung (ZfP) (Section V) und Schweißtechnik (Section IX) zur Anwendung.

Wer als Hersteller, Druckbehälter nach dem ASME-Code fertigen möchte, braucht eine entsprechende Zertifizierung durch ASME. Voraussetzung dafür ist, dass der Hersteller einen Vertrag mit einer Authorized Inspection Agency (AIA, z.B. TÜV Nord) abschließt. Die AIA stellt auch einen zugelassenen Authorized Inspector (AI). Der AI unterstützt den Hersteller bei der Einführung und Umsetzung eines ASME konformen Quality Control Manuals (QCM), welches als Grundlage für eine ASME Zertifizierung zwingend erforderlich ist. Gemeinsam mit einem ASME-Repräsentanten und dem AI wird dann ein Zertifizierungsaudit (Joint Review) beim Hersteller durchgeführt. Dieses Joint Review wird alle drei Jahre wiederholt. Die Abnahmen der Druckbehälter führt dann der Authorized Inspector beim Hersteller durch.

Der Construction-Code regelt Umfang und Art der zerstörungsfreien Prüfungen. Auch werden im Construction-Code Vorgaben zu Akzeptanzkriterien gemacht. Für die zum Einsatz kommenden ZfP-Methoden erstellt der Hersteller entsprechende Prüfanweisungen (Procedure). Dabei sind die Vorgaben z.B. aus der Section VIII, Division 1 und Section V zu beachten. Diese Procedure wird durch den Authorized Inspector überprüft und gegebenenfalls wird sich der AI das beschriebene ZfP-Verfahren demonstrieren lassen.

Die Qualifikation von ZfP-Personal (Level I, II, III) gemäß dem ASME Code ist reine Herstellerverantwortung. Ein Test durch unabhängige Dritte ist nicht erforderlich.

Der Arbeitgeber erstellt eine sogenannte Written Practice. Grundlage dieser Written Practice ist die Richtlinie SNT-TC-1A. Danach wird das entsprechende ZfP-Personal ausgebildet, geprüft und vom Arbeitgeber zertifiziert. Diese Qualifikation ist an den Hersteller gebunden und kann nicht auf andere Unternehmen übertragen werden. Die Written Practice wird auch, wie die Procedure, durch den Authorized Inspector hinsichtlich der Übereistimmung mit dem ASME Code überprüft.

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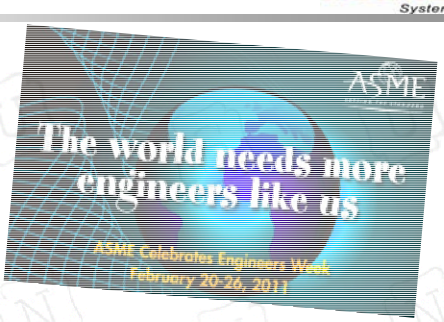

Herzlich Willkommen!

Schweißnahtbewertung nach dem ASME Code

Referent:
Dipl.-Ing. Peter Kaiser
Authorized Inspector Supervisor

TÜV NORD Systems

TÜV NORD Systems

- Authorized Inspection Agency (AIA-49)

TÜV NORD Systems

- Competence Center ASME

- Unser Hauptsitz befindet sich in Essen.
- Wir betreuen über 200 ASME - Stampholder weltweit.
- Wir haben ein Netzwerk von über 60 Inspektoren (AI) in Europa, Türkei, Saudi Arabien, Abu Dhabi, Indien, Thailand, Malaysia, Singapore und Brasilien.
- Wir profitieren von der engen Kooperation mit weiteren Fachbereichen der TÜV NORD Systems wie z.B. Entwurfsprüfung, Werkstofftechnik etc.
- Wir sind ist sowohl im konventionellen Bereich, als auch in der Kerntechnik tätig.

ASME

- American Society of Mechanical Engineers

- Gegründet 1880 als Ausbildungs- und technische Gesellschaft für Maschinen- und Anlagen-Ingenieure.
- Das Boiler and Pressure Vessel Committee wurde als Boiler Committee 1911 gegründet
- ASME vergleichbar als Kombination DIN und VDI
- ASME = eingetragenes Warenzeichen
- Entwicklung von Regelwerken und Vorschriften
- Herausgabe und Pflege von ca. 600 Regelwerke und Normen
- daran arbeiten (weltweit in 90 Ländern) ca. 3700 Personen ehrenamtlich
- 125000 Mitglieder
- Durchführung von Konferenzen, Messen und Ausstellungen
- Herausgabe von technischen Magazinen, Büchern, etc.
- Durchführung von Lehrgängen und Kursen
- Beratung von Behörden und offiziellen Stellen in technischen Fragen
- Zulassung der Inspektionsgesellschaften (AIA)
- Zulassung von Herstellern

Internationale Anwendung und Akzeptanz

Oder

ASME Code
Schlüssel für den Export druckführender Komponenten

Warum ASME Code?

- Kundenanforderung

- Akzeptanz des Regelwerkes am Standort der Anlage

- Einheitlicher Code für den gesamten Begriff „*Construction*“

- Politikrichtung der großen Konzerne:
  Weltweit verkaufen – Weltweit einkaufen

- Ersparnis beim Design
  (keine Vorprüfung, keine Spannungsanalyse etc.)

- Hoher Bekanntheitsgrad

Countries accepting ASME Code

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Countries accepting ASME Code Construction and Requirement
Boilers and Pressure Vessels

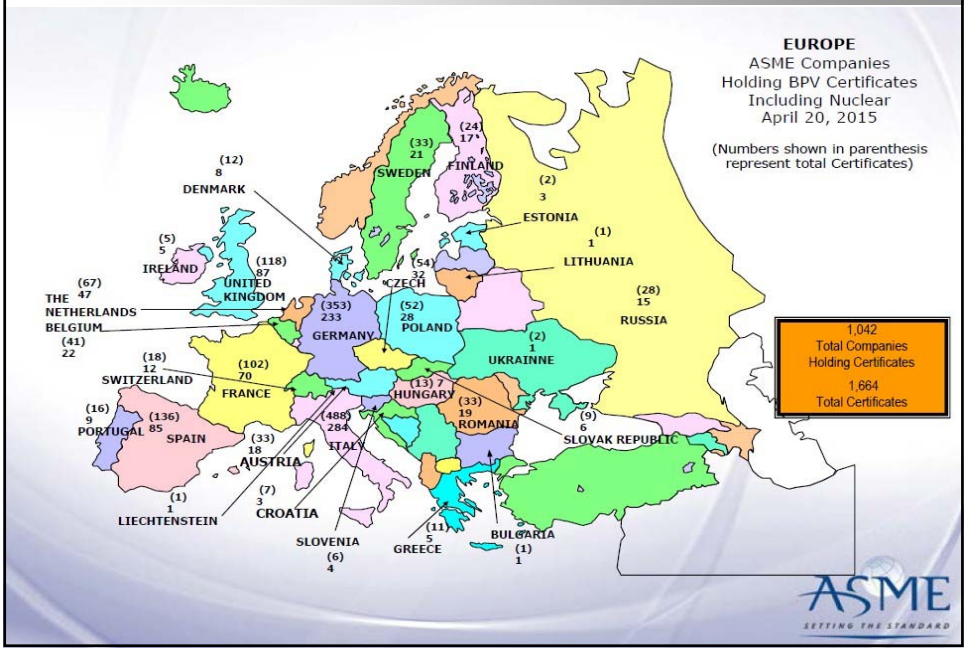
Albania *
Algeria
Argentina
Australia
Austria *
Bahamas
Bahrain
Bangladesh
Barbados
Belarus *
Belgium *
Bermuda
Bolivia
Bosnia and Herzegovina *
Brazil
Burma (Myanmar) *
Canada
Chile
China *
Colombia
Costa Rica
Croatia *
Cuba
Cyprus
Denmark *
Djibouti
Dominican Republic
Ecuador
* Egypt
* Estonia
Ethiopia
* Finland
Fiji
* France
Gambia
* Georgia
* Germany
Ghana
* Greece
* Hong Kong
* Hungary
* Iceland
* India
Indonesia
* Iraq
* Ireland
Israel
* Italy
Ivory Coast
Jamaica
* Japan
Jordan
Kazakhstan
* Kenya
Korea
Kuwait
Latvia
Lebanon
Libya
Lithuania *
Luxembourg *
Malawi
Malaysia
Malta *
Mauritius *
Mexico
Moldowa *
Morocco
Mozambique
Netherlands *
New Zealand
Nicaragua *
Nigeria *
Norway
Oman *
Pakistan
Paraguay *
Peru
Philippines
Poland *
Portugal
Puerto Rico *
Quatar *
Romania
Saint Lucia *
Saudi Arabia
* Serbia
Singapore
South Africa
* Spain
Sri Lanka
Sudan
Swaziland
* Sweden
* Switzerland
Syria
Taiwan
Tanzania
Thailand
The Russian Federation
Trinidad and Tobago
* Tunisia
* Turkey
* United Arab Emirates
United Kingdom
* Uganda
Uruguay
USA
Venezuela
Yemen
Yugoslavia
Zambia
Zimbabwe

* Subject to approval of local authority

Source: Technical help to Exporters, British Standard Inst. (June 2004)

ASME Certificate Holders

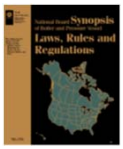
TÜV NORD Systems



Hierachie der Standards

- Verordnungen am Standort der Anlage (NB-370)

  (z.B. Minnesota, New York City, Quebec, Timbuktu,...)

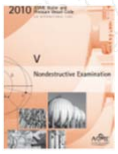


- ASME - Boiler & Pressure Vessel Code

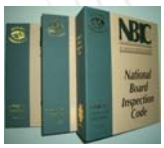
Construction-Code

Section I Dampfkessel	Section III Nuclear Power	Section IV Heizkessel	Section VIII Druckbehälter	Section X Fiber Plastics	Section XII Transport Tanks	ASME B31.1 Kraftw. Rohrleit.	ASME B31.3 Rohrleitungen

Reference Code	ASME B31.1 Power Piping	Section II Material	Section V ZfP	Section IX Schweißen
"Inservice"-Code		Section VI Heizkessel	Section VII Dampfkessel	Section XI Nuclear Power
Normen, Empfehlungen	ANSI	ASTM	AWS	ASNT



- National Board Inspection Code NBIC



ASME Code & ZfP von Bauteilen

- ZfP-Methoden nach ASME Section V

  RT *(Radiography Testing)*
  UT *(Ultrasonic Testing)*
  PT *(Liquid Penetrant Testing)*
  MT *(Magnetic Particle Testing)*
  VT *(Visual Testing)*

- ZfP Personalqualifizierung nach

  ASME / SNT-TC-1A

ASME Code & ZfP von Bauteilen

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Vorgaben der ASME Construction Codes

Was ist zerstörungsfrei zu prüfen nach:

ASME Code Section I *(Dampfkessel)*
ASME Code Section III *(Kerntechnische Bauteile)*
ASME Code Section IV *(Heißwasserkessel)*
ASME Code Section VIII-1 & VIII-2 *(Druckbehälter)*
ASME Code Section B31.1 & B31.3 *(Rohrleitungen)*

Vorgaben des ASME Construction Code zu Akzeptanzkriterien

Welche Ungänzen sind erlaubt?

Construction Codes

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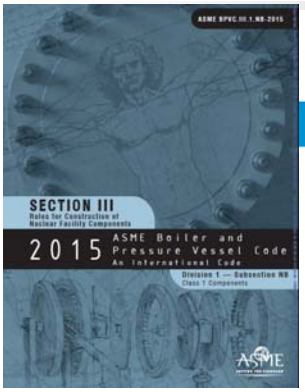
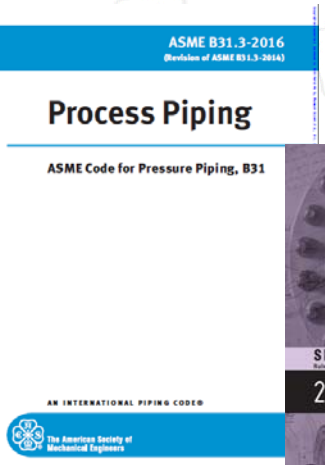
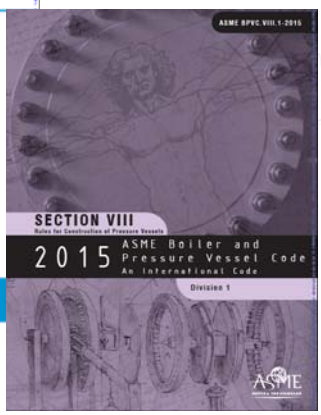






Reference Codes

ASME Code Key Words

… also worauf muss ich beim Lesen besonders achten:

shall	Gebot, absolut verbindlich
may not	Verbot
may **can**	Empfehlung oder Ausnahme bei Verboten
should	Gebot mit Ausweichmöglichkeiten

ASME and National Board Certification Marks

#

Section I - Dampfkessel

S	Dampfkessel
A	Dampfkesselmontage
E	elektrisch beheizte Kessel
M	Miniaturkessel
PP	Rohrleitungen (B31.1)
V*	Sicherheitsventile

Section IV - Heizkessel

H *	gußeiserne Heizkessel
H	Stahlheizkessel
HLW	Trinkwassererhitzer
HV*	Sicherheitsventile

National Board Inspection Code

R	Reparaturen und Änderungen
VR*	Reparatur von Sicherheitsventilen

Section VIII Div. 1 - Druckbehälter

U	Druckbehälter
UM*	Miniaturdruckbehälter
UV*	Sicherheitsventile
UD*	Berstscheiben

Section VIII Div. 2 - Druckbehälter

U2	Alternative Regeln für Druckbehälter

Section VIII Div. 3 - Druckbehälter

U3	Hochdruckbehälter
UV3*	Sicherheitsventile

Section X - Faserverbundbehälter

RP	Druckbehälter aus faserverstärktem Kunstharz

Section XII – Transportbehälter

T	Transportable Druckbehälter
TV*	Sicherheitsventile
TD*	Berstscheiben

**** Komponenten nicht durch AI abnahmepflichtig, Auditierung duch ASME/NB***

ASME Zulassungen

Keine ASME Zulassungen gibt es für:

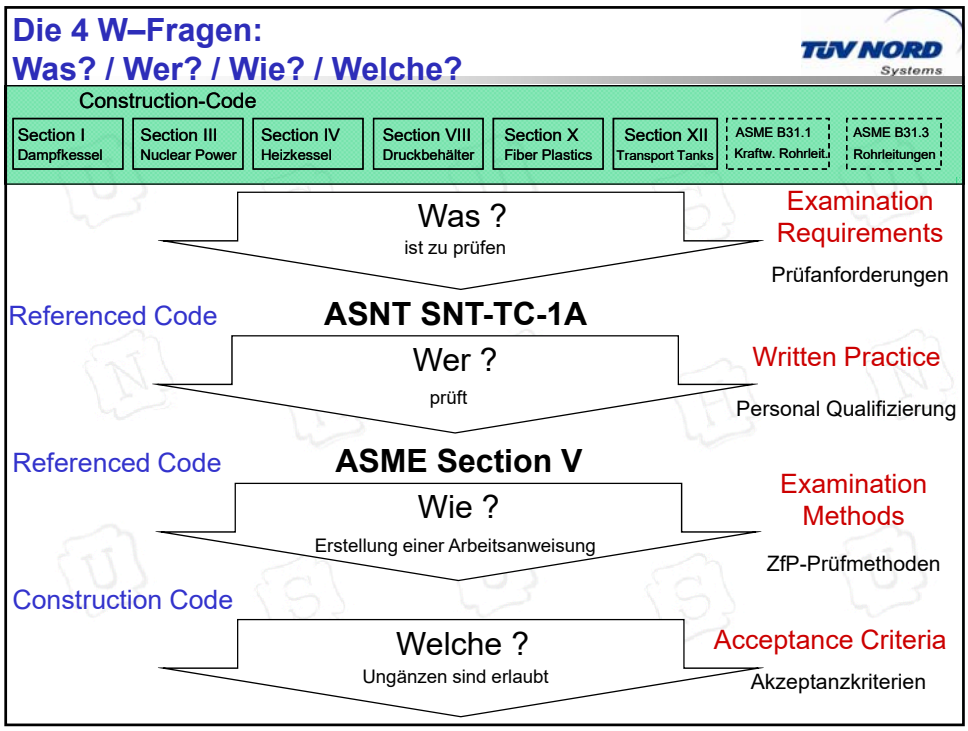
Materialhersteller (ausser Section III, Kerntechnik)

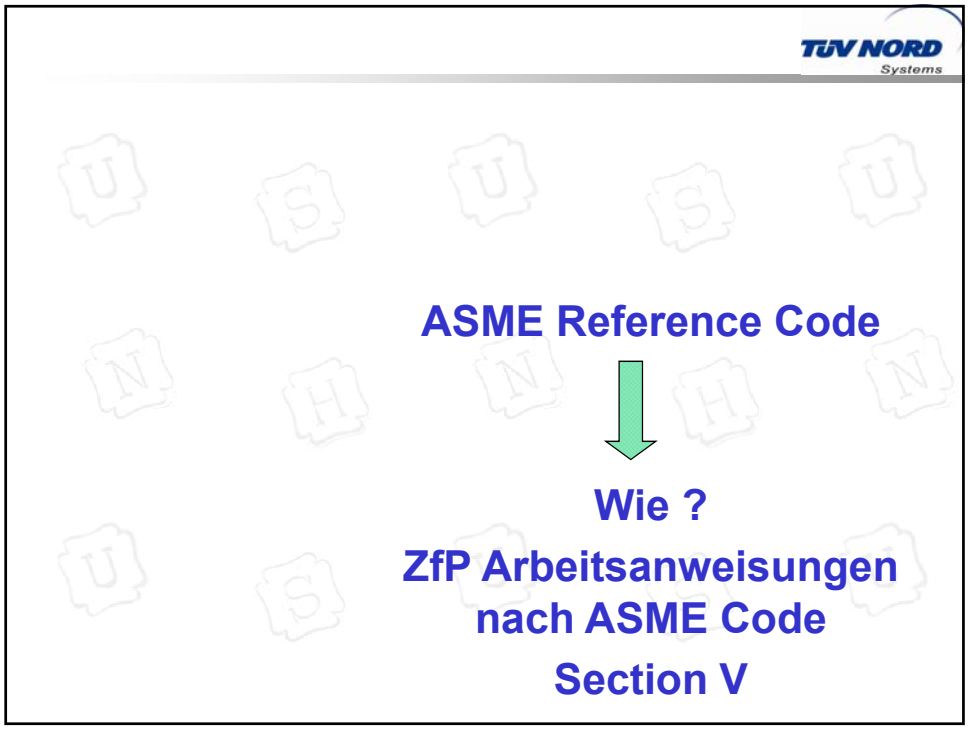
Schweisszusatzhersteller (ausser Section III, Kerntechnik)

Armaturenhersteller (ausser Section III, Kerntechnik und Sicherheitsventilen)

Dienstleister (Berechnung, Wärmebehandlung, mech. Bearbeitung, **ZfP(!)**)

Rohrleitungshersteller (ausser Section III und Section I, BEP)


Die 4 W–Fragen:
Was? / Wer? / Wie? / Welche?
TÜV NORD Systems
Construction-Code
Section I Dampfkessel
Section III Nuclear Power
Section IV Heizkessel
Section VIII Druckbehälter
Section X Fiber Plastics
Section XII Transport Tanks
ASME B31.1 Kraftw. Rohrleit.
ASME B31.3 Rohrleitungen
Was ?
ist zu prüfen
Examination Requirements
Prüfanforderungen
Referenced Code
ASNT SNT-TC-1A
Wer ?
prüft
Written Practice
Personal Qualifizierung
Referenced Code
ASME Section V
Wie ?
Erstellung einer Arbeitsanweisung
Examination Methods
ZfP-Prüfmethoden
Construction Code
Welche ?
Ungänzen sind erlaubt
Acceptance Criteria
Akzeptanzkriterien

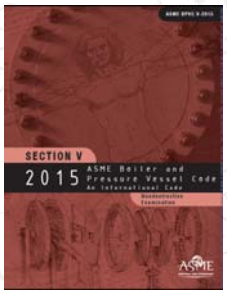

TÜV NORD Systems
ASME Reference Code
Wie ?
ZfP Arbeitsanweisungen nach ASME Code
Section V

Contents of ASME Section V

- Foreword - Statement of Policy - Personnel - Summary of Changes

Subsection A = Nondestructive Methods of Examination

- Article 1 = T-1XX : General Requirements
- Article 2 = T-2XX : RT
- Article 4 = T-4XX : UT for welds
- Article 5 = T-5XX : UT for materials
- Article 6 = T-6XX : PT
- Article 7 = T-7XX : MT
- Article 9 = T-9XX : VT



each time with mandatory & nonmandatory appendices

Subsection B = Documents Adopted by Section V (from ASTM)

- Article 22 = RT-standards (SE-94, SE-747, SE-999, etc.)
- Article 23 = UT-standards (SA-388, SA-435, SA-577, SA-578, etc.)
- Article 24 = PT-standards (SE-165)
- Article 25 = MT-standards (SE-709)

Article 1 – GENERAL REQUIREMENTS

T-110 Scope
Prüfmethoden und Anforderungen and die zfP

T-120 General
Aufbau; Prüfpersonal; Einheitensystem

T-130 Equipment
Prüf- und Messmittel

T-150 Procedure
Anforderungen an Prüfanweisungen (z.B. Demonstration)

T-160 Calibration
Die Kalibrierung ist Verantwortung des Herstellers

T-170 Examinations and Inspections
Definitionen Inspector, Examiner, Tester etc.

T-180 Evaluation
Akzeptanzkriterien sind dem Construction Code zu entnehmen

T-190 Records/Documentation
Dokumentationsumfang

Article 1 – Imperfections

TÜV NORD Systems

Guide only!

Table A-110
Imperfection vs Type of NDE Method

	Surface [Note (1)]		Sub-surf. [Note (2)]		Volumetric [Note (3)]				
	VT	PT	MT	ET	RT	UTA	UTS	AE	UTT
Service-Induced Imperfections									
Abrasive Wear (Localized)	◉	⊙	⊙	...	◉	⊙	⊙	...	⊙
Baffle Wear (Heat Exchangers)	◉	...	...	⊙	...	...	...	...	...
Corrosion-Assisted Fatigue Cracks	◎	⊙	◉	...	◎	◉	...	◉	...
Corrosion									
-Crevice	◉	...	...	...	...	...	...	...	◎
-General / Uniform	...	...	...	◎	⊙	...	⊙	...	◉
-Pitting	◉	◉	◎	...	◉	◎	◎	⊙	◎
-Selective	◉	◉	◎	...	...	...	...	...	◎
Creep (Primary)[Note (4)]	...	...	...	...	...	...	...	...	...
Erosion	◉	...	...	...	◉	◎	⊙	...	⊙
Fatigue Cracks	◎	◉	◉	⊙	⊙	◉	...	◉	...
Fretting (Heat Exchanger Tubing)	⊙	...	...	⊙	...	...	...	...	⊙
Hot Cracking	...	⊙	⊙	...	⊙	◎	...	⊙	
Hydrogen-Induced Cracking	...	⊙	⊙	...	◎	⊙	...	⊙	...
Intergranular Stress-Corrosion Cracks	...	...	...	...	...	◎	...	...	...
Stress-Corrosion Cracks (Transgranular)	◎	⊙	◉	◎	⊙	⊙	...	⊙	...
Welding Imperfections									
Burn Through	◉	...	...	...	◉	⊙	...	...	◎
Cracks	◎	◉	◉	⊙	⊙	◉	◎	◉	...
Excessive/Inadequate Reinforcement	◉	...	...	...	◉	⊙	◎	...	◎
Inclusions (Slag/Tungsten)	...	...	⊙	⊙	◉	⊙	◎	◎	...
Incomplete Fusion	⊙	...	⊙	⊙	⊙	◉	⊙	⊙	...
Incomplete Penetration	⊙	◉	◉	⊙	◉	◉	⊙	⊙	...
Misalignment	◉	...	...	...	◉	⊙	...	...	...
Overlap	⊙	◉	◉	◎	...	◎	...	...	...
Porosity	◉	◉	◎	...	◉	⊙	◎	◎	...
Root Concavity	◉	...	...	...	◉	⊙	◎	◎	◎
Undercut	◉	⊙	⊙	◎	◉	⊙	◎	◎	...
Product Form Imperfections									
Bursts (Forgings)	◎	◉	◉	⊙	⊙	⊙	⊙	◉	...
Cold Shuts (Castings)	◎	◉	◉	◎	◉	⊙	⊙	◎	...
Cracks (All Product Forms)	◎	◉	◉	⊙	⊙	⊙	◎	◉	
Hot Tear (Castings)	◎	◉	◉	⊙	⊙	⊙	◎	◎	...
Inclusions (All Product Forms)	...	...	⊙	⊙	◉	⊙	◎	◎	...

Fabrication - weld reinforcement

TÜV NORD Systems

Section VIII-1 Druckbehälter

UW-35

Material Nominal Thickness, mm	Maximum Reinforcement, mm. Category B & C Butt Welds	Other Welds
Less than 2.4	2.5	0.8
2.4 to 4.8, incl.	3	1.5
Over 4.8 to 13, incl.	4	2.5
Over 13 to 25, incl.	5	2.5
Over 25 to 51, incl.	6	3
Over 51 to 76, incl.	6	4
Over 76 to 102, incl.	6	5.5
Over 102 to 127, incl.	6	6
Over 127	8	8

Edition 2015

Section VIII-2 Druckbehälter

Table 6.6
Maximum Reinforcement For Welded Joints

Section Thickness	Circumferential Joints in Pipe and Tubing	Other Welds
2.5 mm (3/32 in) < t	2.5 mm (3/32 in.)	0.8 mm (1/32 in.)
2.5 mm (3/32 in) ≤ t < 5 mm (3/16 in)	2.5 mm (3/32 in.)	1.5 mm (1/16 in.)
5 mm (3/16 in) ≤ t < 13 mm (1/2 in)	3 mm (1/8 in.)	2.5 mm (3/32 in.)
13 mm (1/2 in) ≤ t < 25 mm (1 in)	4.0 mm (5/32 in.)	2.5 mm (3/32 in.)
25 mm (1 in) ≤ t < 50 mm (2 in)	4.0 mm (5/32 in.)	3 mm (1/8 in.)
50 mm (2 in) ≤ t < 76 mm (3 in)	4.0 mm (5/32 in.)	4.0 mm (5/32 in.)
76 mm (3 in) ≤ t < 100 mm (4 in)	5.5 mm (7/32 in.)	5.5 mm (7/32 in.)
100 mm (4 in) ≤ t < 125 mm (5 in)	6 mm (1/4 in.)	6 mm (1/4 in.)
t ≥ 125 mm (5 in)	8 mm (5/16 in.)	8 mm (5/16 in.)

Section I Dampfkessel

PW-35

Nominal Thickness, in. (mm)	Maximum Reinforcement, in. (mm) Circumferential Joints in Pipe and Tubing	Other Welds
Up to 1/8 (3)	3/32 (2.5)	3/32 (2.5)
Over 1/8 (3) to 3/16 (5), incl.	1/8 (3.0)	3/32 (2.5)
Over 3/16 (5) to 1/2 (13), incl.	5/32 (4.0)	3/32 (2.5)
Over 1/2 (13) to 1 (25), incl.	3/16 (5.0)	3/32 (2.5)
Over 1 (25) to 2 (50), incl.	1/4 (6.0)	1/8 (3.0)
Over 2 (50) to 3 (75), incl.	[Note (1)]	5/32 (4.0)
Over 3 (75) to 4 (100), incl.	[Note (1)]	7/32 (5.5)
Over 4 (100) to 5 (125), incl.	[Note (1)]	1/4 (6.0)
Over 5 (125)	[Note (1)]	5/16 (8.0)

NOTE:
(1) The greater of 3/4 in. (6 mm) or 1/8 times the width of the weld in inches (mm).

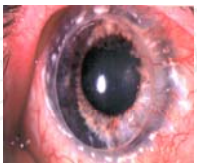
Table 127.4.2 Reinforcement of Girth and Longitudinal Butt Welds

ASME B31.1 Kraftw. Rohrleit.

Thickness of Base Metal, in. (mm)	Maximum Thickness of Reinforcement for Design Temperature > 750°F (400°C) in.	mm	350°F–750°F (175°C–400°C) in.	mm	< 350°F (175°C) in.	mm
Up to 1/8 (3.0), incl.	1/16	2.0	3/32	2.5	3/16	5.0
Over 1/8 to 3/16 (3.0 to 5.0), incl.	1/16	2.0	1/8	3.0	3/16	5.0
Over 3/16 to 1/2 (5.0 to 13.0), incl.	1/16	2.0	5/32	4.0	3/16	5.0
Over 1/2 to 1 (13.0 to 25.0), incl.	3/32	2.5	3/16	5.0	3/16	5.0
Over 1 to 2 (25.0 to 50.0), incl.	1/8	3.0	1/4	6.0	1/4	6.0
Over 2 (50.0)	5/32	4.0	The greater of 1/4 in. (6 mm) or 1/8 times the width of the weld in inches (millimeters).			

Section V – Article 9 – VT

TÜV NORD Systems



Visual Examination


Section V - Article 9 – VT Procedure

TÜV NORD Systems

T-920 GENERAL

T-921 WRITTEN PROCEDURE REQUIREMENTS

T-921.1 Requirements. Visual examinations shall be performed in accordance with a written procedure, which shall, as a minimum, contain the requirements listed in Table T-921. The written procedure shall establish a single value, or range of values, for each requirement.

T-921.2 Procedure Qualification. When procedure qualification is specified by the referencing Code Section, a change of a requirement in Table T-921 identified as an essential variable shall require requalification of the written procedure by demonstration. A change of a requirement identified as a nonessential variable does not require requalification of the written procedure. All changes of essential or nonessential variables from those specified within the written procedure shall require revision of, or an addendum to, the written procedure.

T-921.3 Demonstration. The procedure shall contain or reference a report of what was used to demonstrate that the examination procedure was adequate. In general, a fine line $^{1}/_{32}$ in. (0.8 mm) or less in width, an artificial imperfection or a simulated condition, located on the surface or a similar surface to that to be examined, may be considered as a method for procedure demonstration. The condition or artificial imperfection should be in the least discernable location on the area surface to be examined to validate the procedure.

T-922 PERSONNEL REQUIREMENTS (15)

The user of this Article shall be responsible for assigning qualified personnel to perform visual examinations to the requirements of this Article. At the option of the organization, he may maintain one certification for each product, or several separate signed records based on the area or type of work, or both combined. Where impractical to use specialized visual examination personnel, knowledgeable and trained personnel, having limited qualifications, may be used to perform specific examinations, and to sign the report forms. Personnel performing examinations shall be qualified in accordance with requirements of the referencing Code Section.

T-923 PHYSICAL REQUIREMENTS

Personnel shall have an annual vision test to assure natural or corrected near distance acuity such that they are capable of reading standard J-1 letters on standard Jaeger test type charts for near vision. Equivalent near vision tests are acceptable.

Section V - Article 9 – VT Procedure

TABLE T-921
REQUIREMENTS OF A VISUAL EXAMINATION PROCEDURE

Requirement (As Applicable)	Essential Variable	Non-Essential Variable
Change in technique used		
Direct to or from translucent	X	. . .
Direct to remote	X	. . .
Remote visual aids	X	. . .
Personnel performance requirements, when required	X	. . .
Lighting intensity (decrease only)	X	. . .
Configurations to be examined and base material product forms (pipe, plate, forgings, etc.)	. . .	X
Lighting equipment	. . .	X
Methods or tools used for surface preparation	. . .	X
Equipment or devices used for a direct technique	. . .	X
Sequence of examination	. . .	X
Personnel qualifications	. . .	X

Section V - Article 9 – VT Procedure

(15) **T-952 DIRECT VISUAL EXAMINATION**

Direct visual examination may usually be made when access is sufficient to place the eye within 24 in. (600 mm) of the surface to be examined and at an angle not less than 30 deg to the surface to be examined. Mirrors may be used to improve the angle of vision, and aids such as a magnifying lens may be used to assist examinations. Illumination (natural or supplemental white light) of the examination surface is required for the specific part, component, vessel, or section thereof being examined. The minimum light intensity shall be 100 fc (1 000 lx). The light intensity, natural or supplemental white light source, shall be measured with a white light meter prior to the examination or a verified light source shall be used. Verification of light sources is required to be demonstrated only one time, documented, and maintained on file.

T-953 REMOTE VISUAL EXAMINATION

In some cases, remote visual examination may have to be substituted for direct examination. Remote visual examination may use visual aids such as mirrors, telescopes, borescopes, fiber optics, cameras, or other suitable instruments. Such systems shall have a resolution capability at least equivalent to that obtainable by direct visual observation.

T-954 TRANSLUCENT VISUAL EXAMINATION

(...)

T-980 EVALUATION

T-980.1 All examinations shall be evaluated in terms of the acceptance standards of the referencing Code Section.

T-980.2 An examination checklist shall be used to plan visual examination and to verify that the required visual observations were performed. This checklist establishes minimum examination requirements and does not indicate the maximum examination which the Manufacturer may perform in process.

T-990 DOCUMENTATION

T-991 REPORT OF EXAMINATION

T-991.1 A written report of the examination shall contain the following information:

(a) the date of the examination

(b) procedure identification and revision used

(c) technique used

(d) results of the examination

(e) examination personnel identity, and, when required by the referencing Code Section, qualification level

(f) identification of the part or component examined

T-991.2 Even though dimensions, etc., were recorded in the process of visual examination to aid in the evaluation, there need not be documentation of each viewing or each dimensional check. Documentation shall include all observation and dimensional checks specified by the referencing Code Section.

Section V - Article 1

TÜV NORD Systems

I-121.6 VT – Visual Examination.

artificial flaw: an intentional imperfection placed on the surface of a material to depict a representative flaw condition.

auxiliary lighting: an artificial light source used as a visual aid to improve viewing conditions and visual perception.

candling: see *translucent visual examination*.

direct visual examination: a visual examination technique performed by eye and without any visual aids (excluding light source, mirrors, and/or corrective lenses), e.g., magnifying aids, borescopes, video probes, fiber optics, etc.

enhanced visual examination: a visual examination technique using visual aids to improve the viewing capability.

lux (lx): a unit of illumination equal to the direct illumination on a surface that is everywhere one meter from a uniform point source of one candle intensity or equal to one lumen per square meter.

remote visual examination: a visual examination technique used with visual aids for conditions where the area to be examined is inaccessible for direct visual examination.

surface glare: reflections of artificial light that interfere with visual examination.

translucent laminate: a series of glass reinforced layers, bonded together, and having capabilities of transmitting light.

translucent visual examination: a technique using artificial lighting intensity to permit viewing of translucent laminate thickness variations (also called *candling*).

visual examination: a nondestructive examination method used to evaluate an item by observation, such as, the correct assembly, surface conditions, or cleanliness of materials, parts, and components used in the fabrication and construction of ASME Code vessels and hardware.

Section V – Written Procedure

TÜV NORD tems

BUTTING | WORK PROCEDURE ASME ARBEITSANWEISUNG | PROCEDURE / ANWEISUNG AA.06 | PAGE/SEITE 1 of / von 25 | REVISION 1 | DATE / DATUM 27.01.2012

Durchstrahlungsprüfung von Schweißnähten

Radiographic Examination of welds

SGS Gottfeld NDT Services | PRÜFANWEISUNG INSPECTION PROCEDURE | PA-RT-10-05-01 | Rev.-Nr. 3 | Revision 4 | Ausgabe | Seite 1 von 19

Radiographic Examination of welds in accordance with ASME Section V, Article 2 ASME Section VIII, Div. 1, App. 8

This Procedure has been demonstrated by SGS Gottfeld NDT Services GmbH in accordance with Article T-150 of ASME Code Section V.; Edition 2010, 2011a Addenda

Client: Funke GmbH Client Code: 05

Revisions will be indicated on each page and marked with vertical lines in the margins of this document.

20.12.2011	T. Hellman – Level III	02.01.2012	B. Huber – Level III	
Date/Datum	Name / Unterschrift/Signature	Date/Datum	Name / Unterschrift/Signature	Date/Datum	Name / Unterschrift/Signature
Prepared		Approved and Released		AIP/Client Reviewed	

SGS Gottfeld NDT Services GmbH | Bahnhofstr. 88 D-44653 Herne T +49 (0)2323 9265-0 F +49 (0)2323 9265-111 www.de.sgs.com | Sitz der Gesellschaft: Herne, Amtsgericht HRB 10622

ASME Construction Code

Wer?

ZfP-Personal

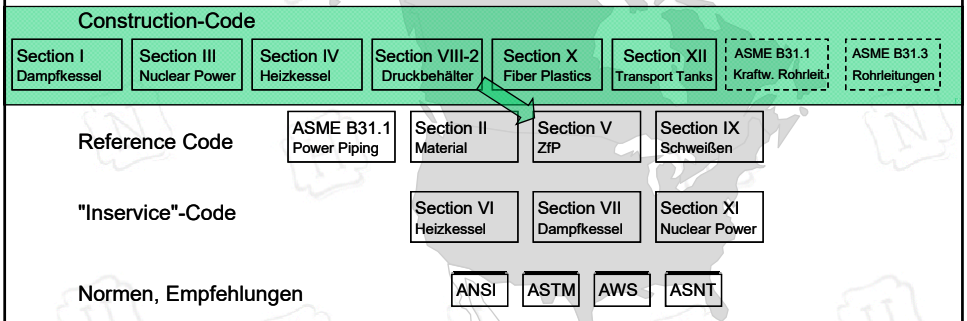
ASNT SNT-TC-1A

Hierachie der Standards

- Verordnungen am Standort der Anlage (NB-370)

  (z.B. Minnesota, New York City, Quebec, Timbuktu,...)

- ASME - Boiler & Pressure Vessel Code



- National Board Inspection Code NBIC

Section VIII-2 7.3.6 NDE Personnel

7.3.6 Qualification of Nondestructive Examination Personnel

a) The Manufacturer shall be responsible for assuring that nondestructive examination (NDE) personnel have been qualified and certified in accordance with their **employer's written practice** prior to performing or evaluating examinations required by this Division. SNT-TC-1A or CP-189 shall be used as a guideline for employers to establish their written practice. National or international Central Certification Programs, such as the ASNT Central Certification Program (ACCP), may be used to fulfill the examination and demonstration requirements of the employer's written practice. Provisions for training, experience, qualification, and certification of NDE personnel shall be described in the Manufacturer's Quality Control System.

b) NDE personnel shall be qualified by examination. Qualification of NDE Level III personnel certified prior to the 2004 Edition of this Division may be based on demonstrated ability, achievement, education, and experience. Such qualification shall be specifically addressed in the written practice. When NDE personnel have been certified in accordance with a written practice based on an edition of SNT-TC-1A or CP-189 referenced in Table 1.1 (Edition 2006), their certification shall be valid until their next scheduled recertification.

c) Recertification shall be in accordance with the employer's written practice based on the edition of SNT-TC-1A or CP-189 referenced in Table 1.1(Edition 2006). Recertification may be based on evidence of continued satisfactory performance or by reexamination(s) deemed necessary by the employer.

NDE Personnel; Written Practice

BUTTING	WORK PROCEDURE ASME ARBEITSANWEISUNG	PROCEDURE / ANWEISUNG AA.05 PAGE/SEITE 1 of / von 11 REVISION 03 DATE / DATUM 28.01.2015

Personnel Qualification in nondestructive Testing

- Radiographic Testing (RT) -

WRITTEN PRACTICE

5

PROCEDURE FOR TRAINING QUALIFICATION AND CERTIFICATION OF PERSONNEL FOR NON DESTRUCTIVE TESTING (NDE-INSPECTORS)	VERFAHREN ZUR ERLERNUNG, QUALIFIKATION UND ERNENNUNG DES PERSONALS FÜR DIE ZERSTÖRUNGSFREIE PRÜFUNG (ZfP-Prüfer)
5.1 **Scope**	**Geltungsbereich**
It is recognized that the effectiveness of nondestructive testing (NDE) applications depends upon the capabilities of the personnel who are responsible for and perform NDE. This procedure has been prepared to establish guidelines for the qualification and certification of NDE personnel whose specific jobs require appropriate knowledge of the technical principles underlying the nondestructive tests they perform, witness, monitor, or evaluate.	Es gilt als vereinbart, dass die Effizienz der zerstörungsfreien Prüfungen (ZfP) von den Fähigkeiten des Personals abhängt, dass für die ZfP verantwortlich ist und diese Prüfungen durchführt. Diese „Recommended Practice" wurde erstellt, um Leitlinien für die Qualifizierung und Zertifizierung von Personal der zerstörungsfreien Prüfung zu erstellen, dessen spezifische Aufgaben eine ausreichende Kenntnis der technischen Prinzipien verlangen, die den von ihm durchgeführten, bewerteten, überwachten und beurteilten zerstörungsfreien Prüfungen zugrunde liegen.
This document provides rules for the establishment of a qualification and certification program for	In diesem Dokument werden Leitlinien für die Erstellung eines Programms zur Qualifizierung und Zertifizierung für die
1) Radiographic Testing (RT)	1) Durchstrahlungsprüfung (RT)
in according with SNT-TC-1A – Edition 2006.	entsprechend SNT-TC-1A – Ausgabe 2006 festgelegt.

NDE Personnel; Written Practice

TÜV NORD Systems

Table 1 Recommended Initial Training and Experiance Levels
Empfohlene Erstausbildungs- und Erfahrungszeiten

Initial Training (Hours) Erstausbildung (Stunden)					
Examination Method	Level	Technique	High School Graduate or Equivalent	Completition with a passing grade of at least 2 years of engineering or science study in a university, college or technical school	Experience Level** Month
Prüfmethode	Stufe	Technik	Hochschul-abschluss oder Gleichwertig	Abschluss mit einem mind. 2-jährigen Studium an einer FH, Universität oder einer Techniker Schule	Erfahrung** in Monaten
RT	I		40	30	3
	II		40	35	9

* RT Level I and II are the basic requirements / Stufe I+II sind die Grundvoraussetzung
** work time experience / Arbeitserfahrung

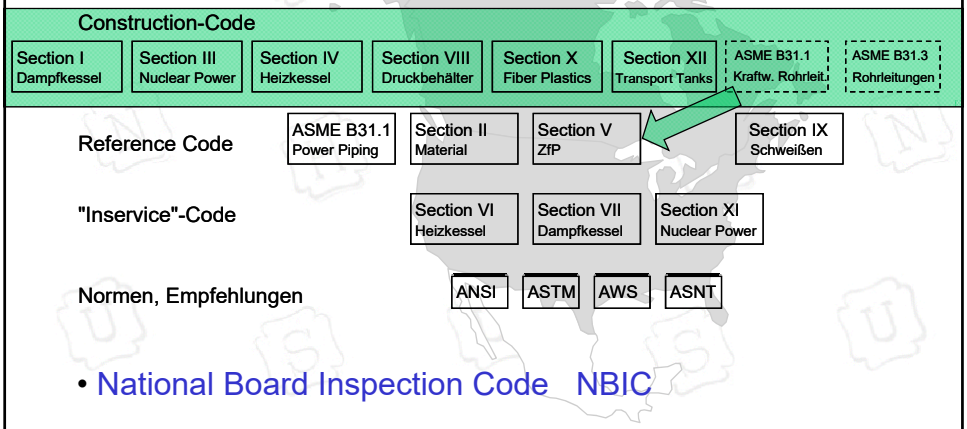
Distribution/Verteiler: - QCM/QCI;

	prepared / erstellt and approved / genehmigt	accepted / akzeptiert
Signed / Unterschrift		
title / Position	NDE-M RT	Authorized Inspector, AI
date / Datum	28.01.2015	28.01.2015

Hierachie der Standards

TÜV NORD Systems

- Verordnungen am Standort der Anlage (NB-370)
  (z.B. Minnesota, New York City, Quebec, Timbuktu,...)
- ASME - Boiler & Pressure Vessel Code



- National Board Inspection Code NBIC

Chapter VI: Examination, Inspection, Stamping

136 INSPECTION AND EXAMINATION

Verantwortung: zwischen Hersteller und Betreiber zu vereinbaren, wer Sicht- und Zf-Prüfung durchführt.

136.3.2 Qualification of NDE Personnel.

Personnel who perform nondestructive examination of welds shall be qualified and certified for each examination method in accordance with a program established by the employer of the personnel being certified, which shall be based on the following minimum requirements: ("written practice")

(A) instruction in the fundamentals of the nondestructive examination method.

(B) on-the-job training to familiarize the NDE personnel with the appearance and interpretation of indications of weld defects. The length of time for such training shall be sufficient to assure adequate assimilation of the knowledge required.

(C) an eye examination performed at least once each year to determine optical capability of NDE personnel to perform the required examinations.

Chapter VI: Examination, Inspection, Stamping

136.3.2 Qualification of NDE Personnel.

(D) upon completion of (A) and (B) above, the NDE personnel shall be given an oral or written examination and performance examination by the employer to determine if the NDE personnel are qualified to perform the required examinations and interpretation of results.

(E) certified NDE personnel whose work has not included performance of a specific examination method for a period of 1 year or more shall be recertified by successfully completing the examination of (D) above and also passing the visual examination of (C) above.

Substantial changes in procedures or equipment shall require recertification of the NDE personnel. As an alternative to the preceding program, the requirements of ASME Section V, Article 1 may be used for the qualification of NDE personnel. Personnel qualified to AWS QC1 may be used for the visual examination of welds.

136.4 Examination Methods of Welds

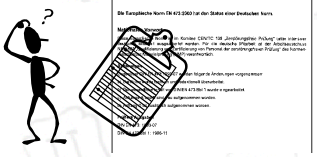
Types and Extent for pressure welds are specified in Table 136.4.

Acceptance Standards:

136.4.2 VT 136.4.3 MT 136.4.4 PT
136.4.5 RT 136.4.6 UT

TÜV NORD Systems

Mitgeltende Normen

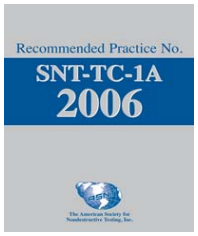


SNT-TC-1A

TÜV NORD Systems

ASME Code Edition 2013
References to SNT-TC-1A

Code Section	Source of Refenece	Edition Referenced	Page
Section I	Table A-360	2006	232
Section III, NCA	Table NCA-7100-2	2011	48
Section V	T-120(e)(1)	2006	1
Section VIII, Div.1	Table U-3	2006	6
Section VIII, Div.2	Table 1.1	2006	1-8
Section VIII, Div.3	Table KG-141	2006	4
Section XII	TG-130.1	2006	2
B31.1b-2010	Appendix F	SNT Specification deleted	
B31.3-2014	Appendix E	2006	246



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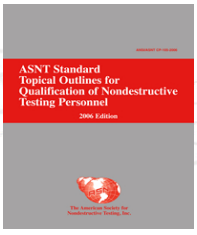


SNT-TC-1A – Written Practice – *Manufacturer*

►The employer (**manufacturer of the pressure vessel**) shall establish a written practice for the control and administration of NDT personnel **training**, **examination** and **certification**.

- ► **Training** in accordance to WP
- ► **Examination** in accordance to WP
- ► **Certification** in accordance to WP

►The employer's written practice should describe the responsibility of each level of certification for determining the acceptability of materials or components in accordance with the applicable codes, standards, specifications and procedures.

► The employer's written practice shall describe the training, experience and examination requirements for each level of certification.

► The employer's written practice shall be reviewed and approved by the employer's NDT Level III.

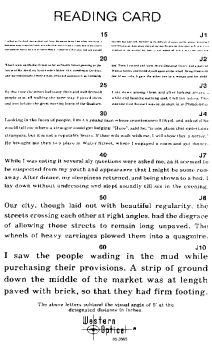
► The employer's written practice shall be maintained on file.

SNT-TC-1A – Written Practice – *Content*

►The content of the written practice shall include at least the following topics for the Personnel Qualification and Certification in Nondestructive Testing:

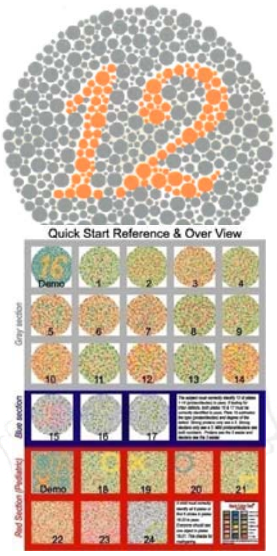
- ► Scope
- ► Definitions
- ► Nondestructive Testing Methods
- ► Levels of Qualification including Responsibilities
- ► Written Practice for NDE-Methods e.g. PT, MT, RT, UT
- ► Education, Training and Experience Requirements for Initial Qualification
- ► Training Programs
- ► Examinations including visual capability
- ► Certification
- ► Technical Performance Evaluation
- ► Interrupted Service
- ► Recertification
- ► Termination
- ► Reinstatement

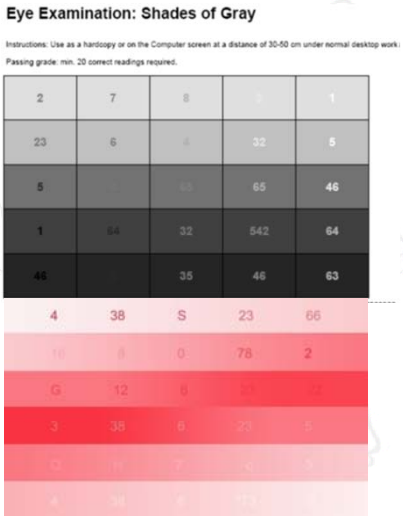
Eye Examination



Jaeger Standard Chart

Ishihara Test





ASME Reference Code

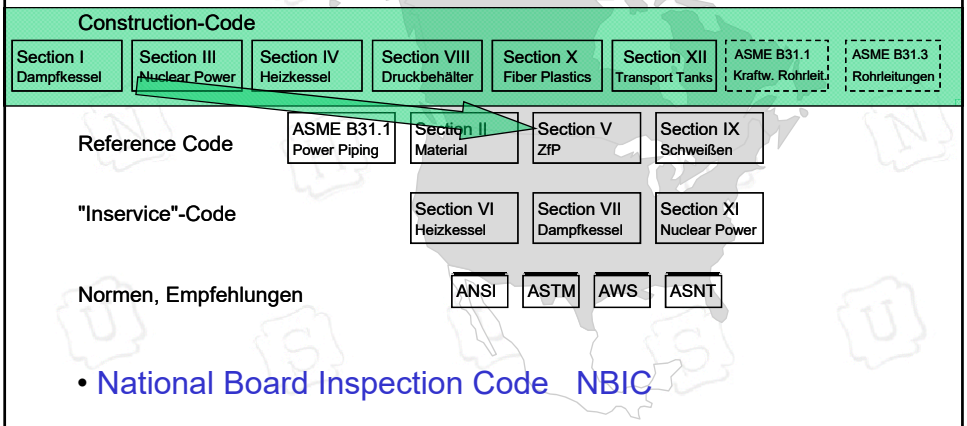
Was ist zu prüfen?

Hierachie der Standards

- Verordnungen am Standort der Anlage (NB-370)

  (z.B. Minnesota, New York City, Quebec, Timbuktu,...)

- ASME - Boiler & Pressure Vessel Code



- National Board Inspection Code NBIC

Repair of Defects

► **PW-40**

PW-40.1

Weld imperfections, such as cracks, pinholes (nadelförmiger Lunker), and incomplete fusion, detected visually or by leakage tests or by the examinations described in PW-11 and found to be rejectable, shall be removed by mechanical means or by thermal grooving processes, after which the joint shall be rewelded and reexamined.

FIRETUBE BOILERS

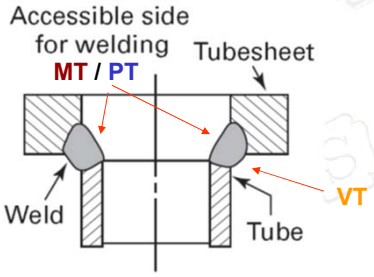
TÜV NORD Systems

- PFT

PFT-12.2.6 Welded tube attachments as shown by Fig. PFT-12.1, illustration (h), may be made with partial or no insertion of the tube into the flat tubesheet. The following requirements shall be met for these attachments:

.
.
.

(f) Each weld surface on the tube I.D. shall receive either a **MT** or **PT** examination in accordance with **A-260** or **A-270** of Appendix A, as applicable. In addition, a **VT** of the weld surface on the tube O.D. shall be performed. The maximum practicable number of these welds, but in no case fewer than 50%, shall be **VT**. **VT** shall show complete penetration of the joint root and freedom from cracks.



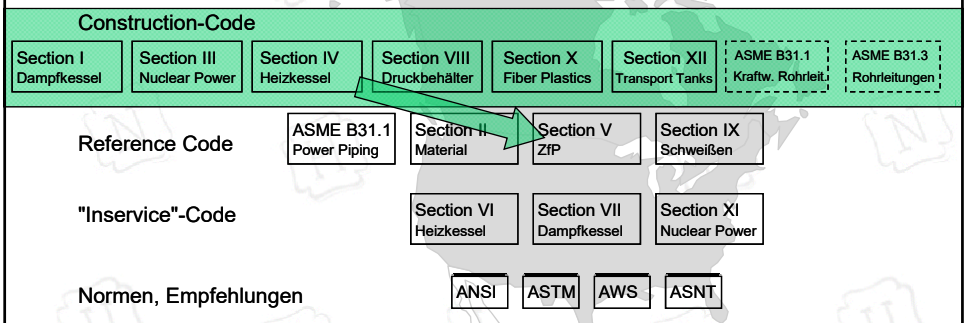
Hierachie der Standards

TÜV NORD Systems

- Verordnungen am Standort der Anlage (NB-370)

  (z.B. Minnesota, New York City, Quebec, Timbuktu,...)

- ASME - Boiler & Pressure Vessel Code



- National Board Inspection Code NBIC

Section IV - Heating Boiler and NDE

REQUIREMENTS FOR BOILERS FABRICATED BY WELDING

HW-820.7 The welded joint between two members joined by the inertia and continuous drive friction welding (Reibschweißen) processes shall be a full penetration weld. **Visual examination** of the as-welded flash roll of each weld shall be made as an in-process check.

REQUIREMENTS FOR BOILERS FABRICATED BY BRAZING

HB-1301 BRAZED JOINT EFFICIENCY FACTORS

(a) The joint efficiency factor to be used in design of boilers with brazed joints shall be 0.80 for joints in which **visual examination** assures that the brazing filler metal has penetrated the entire joint.

HB-1503 VISUAL EXAMINATION

(a) Where possible, both sides of each brazed joint shall be **visually examined** after flux residue removal. Where it joint), the Inspector shall check the design to determine that the proper joint factor has been employed, unless he can assure himself that the brazing filler metal has been preplaced in such a manner that it satisfied HB-1304.

(b) There shall be evidence that the brazing filler metal has penetrated the joint. In a butt braze there shall be no concavity. The braze may be repaired or rebrazed.

(c) The presence of a crack in the brazing filler metal shall be cause for rejection. Dye penetrant inspection maybe used if desired. The braze may be repaired or rebrazed.

(d) The presence of a crack in the base metal adjacent to a braze shall be cause for rejection even if the crack is filled with brazing alloy. Such cracking shall not be repaired.

(e) Visible pinholes or open defects in the braze shall be cause for rejection. The joint may be rebrazed.

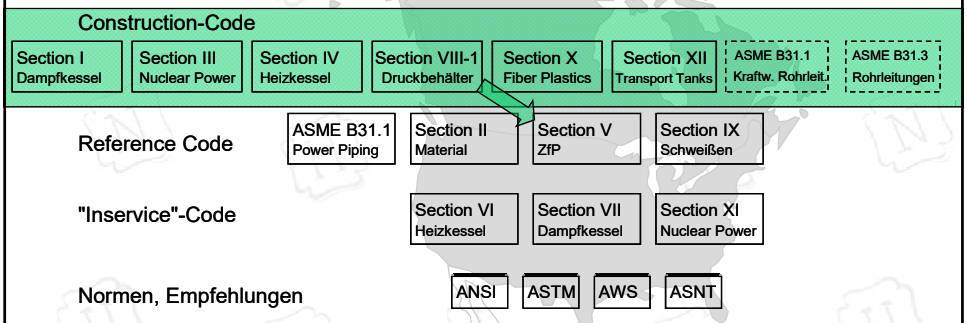
(f) Rough fillets, particularly those with a convex appearance, are cause for rejection. Such joints may be repaired or rebrazed.

Hierachie der Standards

- Verordnungen am Standort der Anlage (NB-370)

  (z.B. Minnesota, New York City, Quebec, Timbuktu,...)

- ASME - Boiler & Pressure Vessel Code

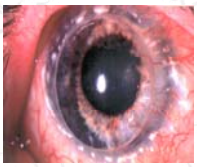


- National Board Inspection Code NBIC

VT Examination Requirements

Was ?
ist VT zu prüfen

Examination Requirements
Prüfanforderungen



Section VIII-1 NDE - VT

Visual Examination - VT

UG-93 Inspection of Materials

(d) All materials to be used in constructing a pressure vessel shall be examined before fabrication for the purpose of detecting, as far as possible, imperfections which would affect the safety of the vessel.

(1) Particular attention should be given to cut edges and other parts of rolled plate which would disclose the existence of serious laminations, shearing cracks, and other imperfections.

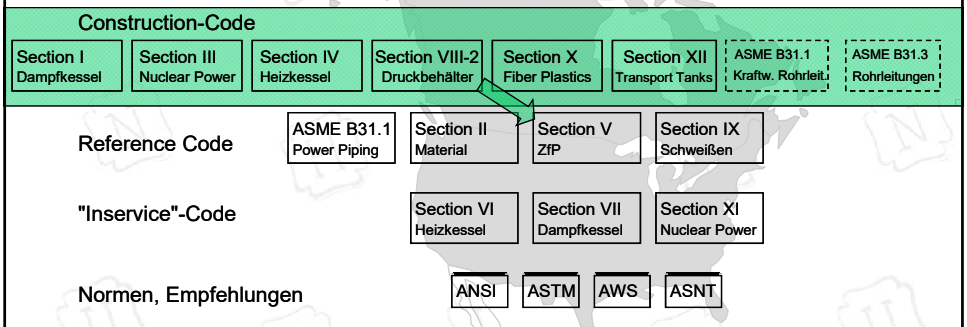
(2) All materials that are to be tested in accordance with the requirements of UG-84 (Impact Test) shall be inspected for surface cracks.

Hierachie der Standards

- Verordnungen am Standort der Anlage (NB-370)

  (z.B. Minnesota, New York City, Quebec, Timbuktu,...)

- ASME - Boiler & Pressure Vessel Code

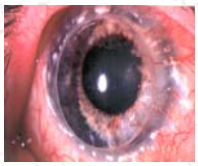


- National Board Inspection Code NBIC

VT Examination Requirements

Was ?
ist VT zu prüfen

Examination Requirements
Prüfanforderungen



Section VIII-2 7.4 Examination of Welded Joints

7.4.1 Nondestructive Examination Requirements

7.4.1.1 All finished welds shall be subject to VT visual examination in accordance with paragraph 7.5.2.

7.4.1.2 All finished welds shall be subject to nondestructive examination depending on Examination Group selected in paragraph 7.4.2 and the Joint Category and Weld Type as defined in paragraph 4.2.

7.4.1.3 All welding shall be subject to **in-process examination** by VT visual examination at the fit-up stage and during back gouging.

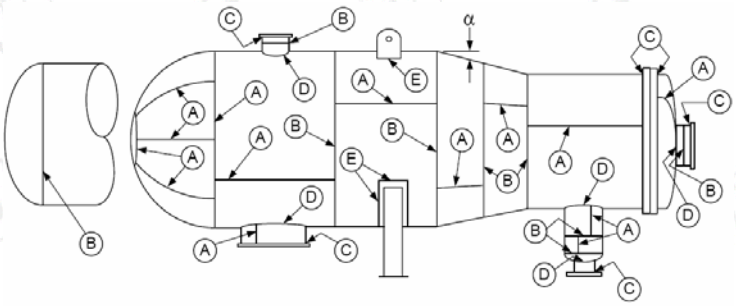


Figure 4.2.1 – Weld Joint Locations Typical Of categories A, B, C, D, and E

Section VIII-2 7.4 Examination of Welded Joints

7.5.2 VISUAL EXAMINATION

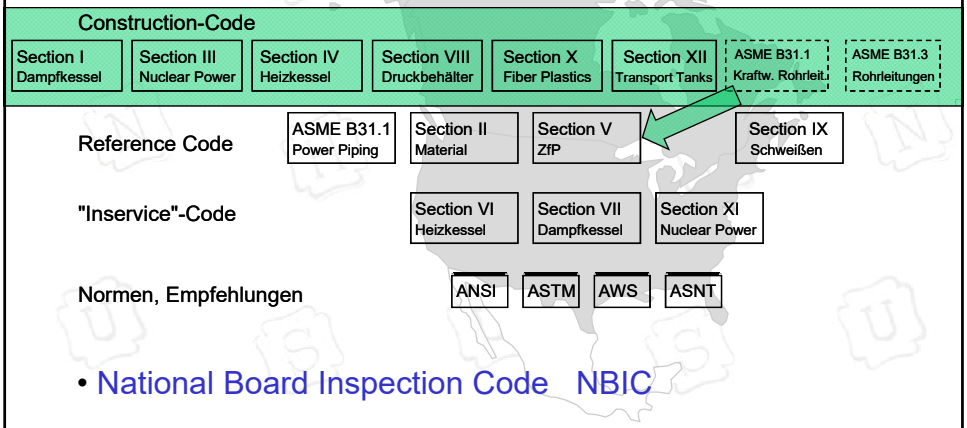
7.5.2.1 Examination Method. All welds for pressure retaining parts shall be visually examined. Personnel performing visual examinations shall have vision, with correction if necessary, to read a Jaeger Type No. 2 Standard Chart at a distance of not less than 300 mm (12 in.), and be capable of distinguishing and differentiating contrast between colors used. Compliance with this requirement shall be demonstrated annually.

Hierachie der Standards

- Verordnungen am Standort der Anlage (NB-370)

  (z.B. Minnesota, New York City, Quebec, Timbuktu,...)

- ASME - Boiler & Pressure Vessel Code



- National Board Inspection Code NBIC

ASME B31 Rohrleitungs-Codes

B 31.1 Power Piping – 2016
Kraftwerksrohrleitungen

B 31.3 Process Piping - 2014
Raffinerie und Chemie

B 31.4 Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids – 2012

B 31.5 Refrigeration Piping and Heat Transfer Components - 2013

B 31.8 Gas Transmission and Distribution Piping Systems - 2014

Keine Herstellerzulassung
Keine Abnahmen durch Authorized Inspector
Ausnahmen: Boiler External Piping nach Section I , Kerntechnik oder CSA-B51

B31.1 – 2016

Power Piping
Kraftwerksrohrleitungen

RT, UT, PT, MT and VT Examination Requirements

Was ?

ist RT, UT, PT, MT und VT zu prüfen

Examination Requirements

Prüfanforderungen

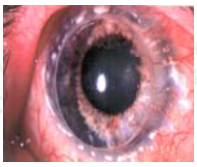


Table 136.4 Examination Requirements

Table 136.4 Mandatory Minimum NonDestructive Examinations for Pressure Welds or Welds to Pressure-Retaining Components

Type Weld	Piping Design Conditions and Nondestructive Examination: Temperatures Over 750°F (400°C) and at All Pressures	Temperatures Between 350°F (175°C) and 750°F (400°C) Inclusive With All Pressures Over 1025 psig [7100 kPa (gage)]	All Others
Butt welds (girth and longitudinal) [Note (1)]	RT or UT for over NPS 2. MT or PT for NPS 2 and less [Note (2)]	RT or UT for over NPS 2 with thickness over 3/4 in. (19.0 mm). VT for all sizes with thickness 3/4 in. (19.0 mm) or less.	Visual for all sizes and thicknesses
Welded branch connections (size indicated is branch size) [Notes (3) and (4)]	RT or UT for over NPS 4. MT or PT for NPS 4 and less [Note (2)]	RT or UT for branch over NPS 4 and thickness of branch over 3/4 in. (19.0 mm) MT or PT for branch NPS 4 and less with thickness of branch over 3/4 in. (19 mm) VT for all sizes with branch thickness 3/4 in. (19.0 mm) or less	VT for all sizes and thicknesses
Fillet, socket, attachment, and seal welds	PT or MT for all sizes and thicknesses [Note (5)]	VT for all sizes and thicknesses	VT for all sizes and thicknesses

GENERAL NOTES:

(a) All welds shall be given a visual examination in addition to the type of specific nondestructive examination specified.
(b) NPS — nominal pipe size.
(c) RT — radiographic examination; UT — ultrasonic examination; MT — magnetic particle examination; PT — liquid penetrant examination; VT — visual examination.
(d) For nondestructive examinations of the pressure retaining component, refer to the standards listed in Table 126.1 or manufacturing specifications.
(e) Acceptance standards for nondestructive examinations performed are as follows: MT — see para. 136.4.3; PT — see para. 136.4.4; VT — see para. 136.4.2; RT — see para. 136.4.5; UT — see para. 136.4.6.

NOTES:

(1) The thickness of butt welds is defined as the thicker of the two abutting ends after end preparation.
(2) RT may be used as an alternative to PT or MT when it is performed in accordance with para. 136.4.5.
(3) RT or UT of branch welds shall be performed before any nonintegral reinforcing material is applied.
(4) In lieu of volumetric examination (RT, UT) of welded branch connections when required above, surface examination (PT, MT) is acceptable and, when used, shall be performed at the lesser of one-half of the weld thickness or each 1/2 in. (12.5 mm) of weld thickness and all accessible final weld surfaces.
(5) Fillet welds not exceeding 1/4 in. (6 mm) throat thickness which are used for the permanent attachment of nonpressure retaining parts are exempt from the PT or MT requirements of the above Table.

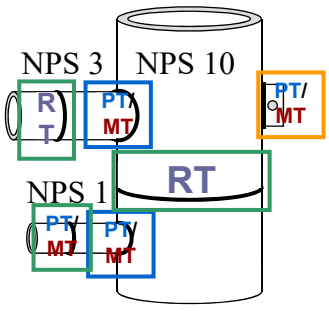
B31.1: Table 136.4 Examples

Table 136.4 Mandatory Minimum NonDestructive Examinations for Pressure Welds or Welds to Pressure-Retaining C

Piping D

Main Steam 450°C, 200 bar

Type Weld	Temperatures Over 750°F (400°C) and at All Pressures		
Butt welds (girth and longitudinal) [Note (1)]	RT or UT for over NPS 2. MT or PT for NPS 2 and less [Note (2)]		
Welded branch connections (size indicated is branch size) [Notes (3) and (4)]	RT or UT for over NPS 4. MT or PT for NPS 4 and less [Note (2)]		
Fillet, socket, attachment, and seal welds	PT or MT for all sizes and thicknesses [Note (5)]	thicknesses	thicknesses



GENERAL NOTES:

(a) All welds shall be given a visual examination in addition to the type of specific nondestructive examination specified.
(b) NPS — nominal pipe size.
(c) RT — radiographic examination; UT — ultrasonic examination; MT — magnetic particle examination; PT — liquid penetrant examination; VT — visual examination.
(d) For nondestructive examinations of the pressure retaining component, refer to the standards listed in Table 126.1 or manufacturing specifications.
(e) Acceptance standards for nondestructive examinations performed are as follows: MT — see para. 136.4.3; PT — see para. 136.4.4; VT — see para. 136.4.2; RT — see para. 136.4.5; UT — see para. 136.4.6.

NOTES:

(1) The thickness of butt welds is defined as the thicker of the two abutting ends after end preparation.
(2) RT may be used as an alternative to PT or MT when it is performed in accordance with para. 136.4.5.
(3) RT or UT of branch welds shall be performed before any nonintegral reinforcing material is applied.
(4) In lieu of volumetric examination (RT, UT) of welded branch connections when required above, surface examination (PT, MT) is acceptable and, when used, shall be performed at the lesser of one-half of the weld thickness or each 1/2 in. (12.5 mm) of weld thickness and all accessible final weld surfaces.
(5) Fillet welds not exceeding 1/4 in. (6 mm) throat thickness which are used for the permanent attachment of nonpressure retaining parts are exempt from the PT or MT requirements of the above Table.

B31.1: Table 136.4 Examples

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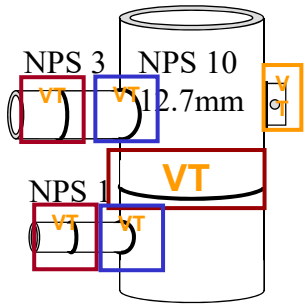
Table 136.4 Mandatory Minimum NonDestructive Examinations for Pressure Welds or Welds to Pressure-Retaining Components

Steam 360°C, 100 bar



Piping Design Conditions and Nondestructive Examination		
	Temperatures Between 350°F (175°C) and 750°F (400°C) Inclusive With All Pressures Over 1025 psig [7100 kPa (gage)]	All Others
Butt welds (nal) [Note	RT or UT for over NPS 2 with thickness over 3/4 in. (19.0 mm). VT for all sizes with thickness 3/4 in. (19.0 mm) or less.	Visual for all sizes and thicknesses
Welded brar indicated (3) and (4	RT or UT for branch over NPS 4 and thickness of branch over 3/4 in. (19.0 mm) MT or PT for branch NPS 4 and less with thickness of branch over 3/4 in. (19 mm) VT for all sizes with branch thickness 3/4 in. (19.0 mm) or less	VT for all sizes and thicknesses
Fillet, soc and se	VT for all sizes and thicknesses	VT for all sizes and thicknesses

GENERAL NOTES:

(a) All welds shall be given a visual examination in addition to the type of specific nondestructive examination specified.
(b) NPS — nominal pipe size.
(c) RT — radiographic examination; UT — ultrasonic examination; MT — magnetic particle examination; PT — liquid penetrant examination; VT — visual examination.
(d) For nondestructive examinations of the pressure retaining component, refer to the standards listed in Table 126.1 or manufacturing specifications.
(e) Acceptance standards for nondestructive examinations performed are as follows: MT — see para. 136.4.3; PT — see para. 136.4.4; VT — see para. 136.4.2; RT — see para. 136.4.5; UT — see para. 136.4.6.

NOTES:

(1) The thickness of butt welds is defined as the thicker of the two abutting ends after end preparation.
(2) RT may be used as an alternative to PT or MT when it is performed in accordance with para. 136.4.5.
(3) RT or UT of branch welds shall be performed before any nonintegral reinforcing material is applied.
(4) In lieu of volumetric examination (RT, UT) of welded branch connections when required above, surface examination (PT, MT) is acceptable and, when used, shall be performed at the lesser of one-half of the weld thickness or each 1/2 in. (12.5 mm) of weld thickness and all accessible final weld surfaces.
(5) Fillet welds not exceeding 1/4 in. (6 mm) throat thickness which are used for the permanent attachment of nonpressure retaining parts are exempt from the PT or MT requirements of the above Table.

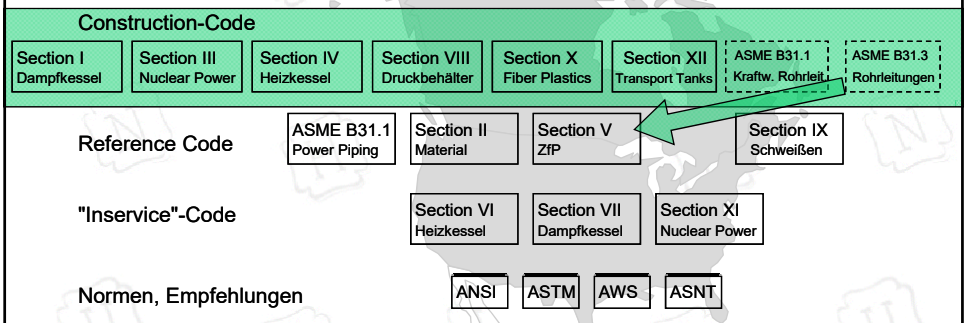
Hierachie der Standards

TÜV NORD Systems

- Verordnungen am Standort der Anlage (NB-370)

  (z.B. Minnesota, New York City, Quebec, Timbuktu,...)

- ASME - Boiler & Pressure Vessel Code



- National Board Inspection Code NBIC

B 31.3 – 2016

TÜV NORD Systems

B31.3: Chapter VI: Prüfumfang

TÜV NORD Systems

Fluid Service	*Long. Joint*	*Girth Joint*	*Branch conn.*
Category D - 341.4.2 ungiftig, unbrennbar, ungefährlich, vom Betreiber zu spezifizieren design pressure ≤1035 kPa	VT 344.2	VT 344.2	VT 344.2
Normal - 341.4.1	100% VT RT depd on Eff	5% VT 5% RT	5% VT
Category M - M341 Giftige Medien, selbst der einmalige Kontakt mit kleinen Mengen schädigt ungeschützte Personen vom Betreiber zu spezifizieren	100% VT RT depd on Eff 	100% VT 20% RT	100% VT RT for butt welds
Severe Cyclic Service-341.4.3 Mehr als 7000 Lastspiele und erhebliche Spannungen (SE>0,8SA)	100% VT RT depd on Eff	100% RT	100% MT/PT, RT for butt welds
In addition all examination specified in the Engineering Design shall be required. For Details please refer to B31.3 Chapter VI			

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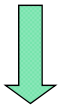
ASME Construction Code



Welche?
Akzeptanzkriterien

Acceptance Standards of VT

TÜV NORD Systems

Welche ?

Ungänzen sind erlaubt bei VT

Acceptance Criteria

Akzeptanzkriterien

Construction-Code

Section I Dampfkessel	Section III Nuclear Power	Section VIII-1 Druckbehälter	Section VIII-2 Druckbehälter	ASME B31.1 Kraftw. Rohrleit.
several	—	—	—	—

PW-40 REPAIR OF DEFECTS

PW-40.1 Weld imperfections, such as cracks, pinholes, and incomplete fusion, detected visually or by . . .

PFT-12.2.3 (f) FIRETUBE BOILERS

Visual examination shall show complete penetration of the joint root and freedom from cracks.

Acceptance Standards of VT

Welche ?

Ungänzen sind erlaubt bei VT

Acceptance Criteria

Akzeptanzkriterien

Construction-Code

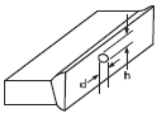
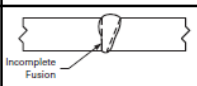
Section I Dampfkessel	Section III Nuclear Power	Section VIII-1 Druckbehälter	Section VIII-2 Druckbehälter	ASME B31.1 Kraftw. Rohrleit.
—	—	—	**7.5.2.2** Table 7.6	—

VT examination does not require a written VT procedure

Welds that are observed to have indications exceeding the criteria given in Table 7.6 are unacceptable. Unacceptable indications shall be removed or reduced to an indication of acceptable size. . . .

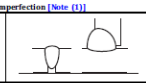
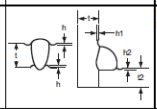
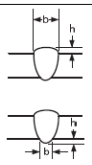
Acceptance Standards of VT

Table 7.6
Visual Examination Acceptance Criteria

No.	Type of Imperfection [Note (1)]		Acceptance Criteria
1	Cracks (all)	...	Not permitted.
2	Gas cavity (all) Shrinkage cavity (all)		Not permitted.
3	Slag inclusions (all) Flux inclusions (all) Oxide inclusions (all) Metallic inclusions (all)	...	Not permitted when occurring at the surface 2.
4	Incomplete fusion (all)		Not permitted.

Acceptance

Table 7.6
Visual Examination Acceptance Criteria (Cont'd)

No.	Type of Imperfection [Note (1)]		Acceptance Criteria
5	Lack of penetration		Not permitted if a complete penetration weld is required.
6	Undercut		Refer to 6.2.4.1(b)(2) for acceptable undercut. Requirements in 7.5.3.2 to permit proper interpretation of radiography shall also be satisfied.
7	Weld reinforcement		Acceptable weld reinforcement in butt welding joints shall be in accordance with 6.2.4.1(d). A smooth transition is required.
8	Joint offset	...	Refer to 6.1.6 for acceptable offset in butt welded joints.
9	Peaking	...	Refer to 6.1.6 for acceptable peaking in butt welding joints.
10	Stray flash or arc strike	...	Not permitted [Note (2)].
11	Spatter	...	Spatter shall be minimized [Note (2)].
12	Torn surface Grinding mark Chipping mark	...	Not permitted [Note (2)].
13	Concavity		Refer to 6.2.4.1(d) for acceptable concavity.

NOTES:
(1) The following symbols are used in this Table:

a = nominal fillet weld throat thickness
b = width of weld reinforcement
d = diameter of pore
h = height of imperfections
t = wall or plate thickness

(2) These imperfections may be removed by blend grinding.

Acceptance Standards of VT

Welche ?

Ungänzen sind erlaubt bei VT

Acceptance Criteria

Akzeptanzkriterien

Construction-Code

Section I Dampfkessel	Section III Nuclear Power	Section VIII-1 Druckbehälter	Section VIII-2 Druckbehälter	ASME B31.1 Kraftw. Rohrleit.
▬	▬	▬	▬	136.4.2 (A)

A written VT procedure is required !

The following indications are **unacceptable**:

(A.1) cracks — external surface.

(A.2) undercut on surface which is greater than 1⁄32 in. (1.0 mm) deep.

(A.3) weld reinforcement greater than specified in Table 127.4.2.

(A.4) lack of fusion on surface.

(A.5) incomplete penetration (applies only when inside surface is readily accessible).

(A.6) any other linear indications greater than 3⁄16 in. (5.0 mm) long.

(A.7) surface porosity with rounded indications having dimensions greater than 3⁄16 in. (5.0 mm) or four or more rounded indications separated by 1⁄16 in. (2.0 mm) or less edge to edge in any direction. Rounded indications are indications which are circular or elliptical with their length less than three times their width.

B 31.3 – 2016

TÜV NORD Systems

Process Piping
Prozessrohrleitungen

Acceptance Criteria

TÜV NORD Systems

Construction Code

Welche ?

Ungänzen sind erlaubt

Acceptance Criteria

Akzeptanzkriterien

FIG. 341.3.2 TYPICAL WELD IMPERFECTIONS

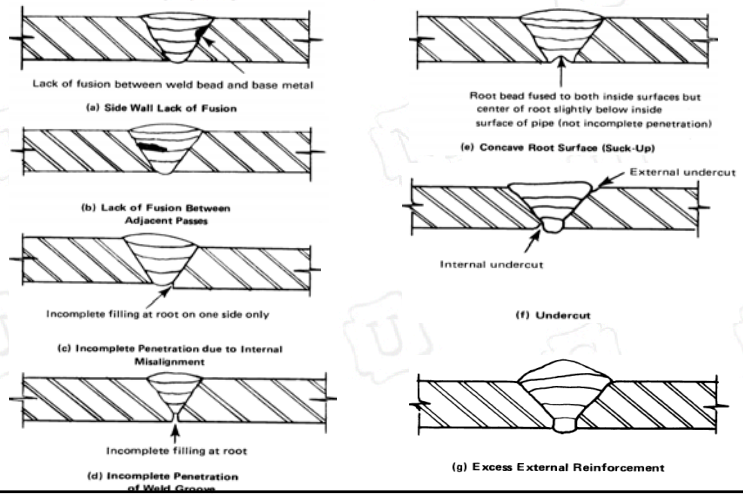


TABLE 341.3.2 ACCEPTANCE CRITERIA FOR WELDS

Criteria (A to M) for Types of Welds and for Service Conditions [Note (1)]										Weld Imperfection	Examination Methods			
Normal and Category M Fluid Service			Severe Cyclic Conditions			Category D Fluid Service								
Type of Weld			Type of Weld			Type of Weld								
Girth, Miter Groove & Branch Connection [Note (2)]	Longitudinal Groove [Note (3)]	Fillet [Note (4)]	Girth, Miter Groove & Branch Connection [Note (2)]	Longitudinal Groove [Note (3)]	Fillet [Note (4)]	Girth and Miter Groove	Longitudinal Groove [Note (3)]	Fillet [Note (4)]	Branch Connection [Note (2)]		Visual	Radiography	Magnetic Particle	Liquid Penetrant
A	A	A	A	A	A	A	A	A	A	Crack	✓	✓	✓	✓
A	A	A	A	A	A	C	A	N/A	A	Lack of fusion	✓	✓	...	...
B	A	N/A	A	A	N/A	C	A	N/A	B	Incomplete penetration	✓	✓	...	...
E	E	N/A	D	D	N/A	N/A	N/A	N/A	N/A	Internal porosity	...	✓	...	...
G	G	N/A	F	F	N/A	N/A	N/A	N/A	N/A	Internal slag inclusion, tungsten inclusion, or elongated indication	...	✓	...	...
H	A	H	A	A	A	I	A	H	H	Undercutting	✓	✓	...	...
A	A	A	A	A	A	A	A	A	A	Surface porosity or exposed slag inclusion [Note (5)]	✓	...	...	...
N/A	N/A	N/A	J	J	J	N/A	N/A	N/A	N/A	Surface finish	✓	...	...	...
K	K	N/A	K	K	N/A	K	K	N/A	K	Concave root surface (suck up)	✓	✓	...	...
L	L	L	L	L	L	M	M	M	M	Weld reinforcement or internal protrusion	✓	...	...	...

GENERAL NOTES:
(a) Weld imperfections are evaluated by one or more of the types of examination methods given, as specified in paras. 341.4.1, 341.4.2, 341.4.3, and M341.4, or by the engineering design.
(b) "N/A" indicates the Code does not establish acceptance criteria or does not require evaluation of this kind of imperfection for this type of weld.
(c) Check (✓) indicates examination method generally used for evaluating this kind of weld imperfection.
(d) Ellipsis (. . .) indicates examination method not generally used for evaluating this kind of weld imperfection.

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VIELEN DANK FÜR IHRE AUFMERKSAMKEIT!

FRAGEN?