

Fitness-For-Service

API 579-1/ASME FFS-1, June, 2016



**The American Society of
Mechanical Engineers**



AMERICAN PETROLEUM INSTITUTE

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Foreword

In contrast to the straightforward and conservative calculations that are typically found in design codes, more sophisticated assessment of metallurgical conditions and analyses of local stresses and strains can more precisely indicate whether operating equipment is fit for its intended service or whether particular fabrication defects or in-service deterioration threaten its integrity. Such analyses offer a sound basis for decisions to continue to run as is or to alter, repair, monitor, retire or replace the equipment.

The publication of the American Petroleum Institute's Recommended Practice 579, Fitness-For-Service, in January 2000 provided the refining and petrochemical industry with a compendium of consensus methods for reliable assessment of the structural integrity of equipment containing identified flaws or damage. API RP 579 was written to be used in conjunction with the refining and petrochemical industry's existing codes for pressure vessels, piping and aboveground storage tanks (API 510, API 570 and API 653). The standardized Fitness-For-Service assessment procedures presented in API RP 579 provide technically sound consensus approaches that ensure the safety of plant personnel and the public while aging equipment continues to operate, and can be used to optimize maintenance and operation practices, maintain availability and enhance the long-term economic performance of plant equipment.

Recommended Practice 579 was prepared by a committee of the American Petroleum Institute with representatives of the Chemical Manufacturers Association, as well as some individuals associated with related industries. It grew out of a resource document developed by a Joint Industry Program on Fitness-For-Service administered by The Materials Properties Council. Although it incorporated the best practices known to the committee members, it was written as a Recommended Practice rather than as a mandatory standard or code.

While API was developing Fitness-For-Service methodology for the refining and petrochemical industry, the American Society of Mechanical Engineers (ASME) also began to address post-construction integrity issues. Realizing the possibility of overlap, duplication and conflict in parallel standards, ASME and API formed the Fitness-For-Service Joint Committee in 2001 to develop and maintain a Fitness-For-Service standard for equipment operated in a wide range of process manufacturing and power generation industries. It was intended that this collaboration would promote the widespread adoption of these practices by regulatory bodies. The Joint Committee included the original members of the API Committee that wrote Recommended Practice 579, complemented by a similar number of ASME members representing similar areas of expertise in other industries such as chemicals, power generation and pulp and paper. In addition to owner representatives, it included substantial international participation and subject matter experts from universities and consulting firms.

In June 2007, the Fitness-For-Service Joint Committee published the first edition of API 579-1/ASME FFS-1 Fitness-For-Service.

The 2016 publication of API 579-1/ASME FFS-1 includes a number of modifications and technical improvements. Some of the more significant changes are the following:

- Reorganized the standard to facilitate use and updates.
- Expanded equipment design code coverage.
- Added Annex for establishing an allowable Remaining Strength Factor (*RSF*).
- Simplified Level 1 criterion for the circumferential extent of a Local Thin Area (*LTA*) through the modification of the Type A Component definition and subdivision of Type B Components into Class 1 or Class 2.
- Updated crack-like flaw interaction rules.
- Re-wrote weld residual stress solution Annex for use in the assessment of crack-like flaws.

API 579-1/ASME FFS-1 2016 Fitness-For-Service

- Updated guidance on material toughness predictions for use in the assessment of crack-like flaws.
- Updated evaluation procedures for the assessment of creep damage.
- Added Annex covering metallurgical investigation and evaluation of mechanical properties in a fire damage assessment.
- Developed new Part 14 covering the assessment of fatigue damage.

This publication is written as a standard. Its words shall and must indicate explicit requirements that are essential for an assessment procedure to be correct. The word should indicates recommendations that are good practice but not essential. The word may indicate recommendations that are optional.

Most of the technology that underlies this standard was developed by the Joint Industry Program on Fitness-For-Service, administered by The Materials Properties Council. The sponsorship of the member companies of this research consortium and the voluntary efforts of their company representatives are acknowledged with gratitude.

The committee encourages the broad use of the state-of-the-art methods presented here for evaluating all types of pressure vessels, boiler components, piping and tanks. The committee intends to continuously improve this standard as improved methodology is developed and as user feedback is received. All users are encouraged to inform the committee if they discover areas in which these procedures should be corrected, revised or expanded. Suggestions should be submitted to the Secretary, API/ASME Fitness-For-Service Joint Committee, The American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016, or SecretaryFFS@asme.org.

There is an option available to receive an e-mail notification when errata are posted to a particular code or standard. This option can be found on the Committee Website at <http://go.asme.org/ffscommittee> after selecting "errata" in the "Publication Information" section.

This standard is under the jurisdiction of the ASME Board on Pressure Technology Codes and Standards and the API CRE Committee and is the direct responsibility of the API/ASME Fitness-For-Service Joint Committee. The American National Standards Institute approved API 579-1/ASME FFS-1 2016 in June, 2016.

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Contents

PART 1 – INTRODUCTION	1-1
1.1 INTRODUCTION	1-1
1.1.1 <i>Construction Codes and Fitness-For-Service</i>	1-1
1.1.2 <i>Fitness-For-Service Definition</i>	1-1
1.2 SCOPE	1-2
1.2.1 <i>Supplement to In-Service Inspection Codes</i>	1-2
1.2.2 <i>Application Construction Codes</i>	1-2
1.2.3 <i>Other Recognized Codes and Standards</i>	1-2
1.2.4 <i>Remaining Life</i>	1-3
1.2.5 <i>Assessment Methods for Flaw Types and Damage Conditions</i>	1-3
1.2.6 <i>Special Cases</i>	1-4
1.3 ORGANIZATION AND USE.....	1-4
1.4 RESPONSIBILITIES	1-4
1.4.1 <i>Owner-User</i>	1-4
1.4.2 <i>Inspector</i>	1-4
1.4.3 <i>Engineer</i>	1-4
1.4.4 <i>Plant Engineer</i>	1-5
1.5 QUALIFICATIONS.....	1-5
1.5.1 <i>Education and Experience</i>	1-5
1.5.2 <i>Owner-User</i>	1-5
1.5.3 <i>Inspector</i>	1-5
1.5.4 <i>Engineer</i>	1-6
1.6 DEFINITION OF TERMS.....	1-6
1.7 REFERENCES.....	1-6
1.7.1 <i>Types</i>	1-6
1.7.2 <i>Code, Standards and Recommended Practices</i>	1-6
1.7.3 <i>Technical reports and Other Publications</i>	1-6
1.8 TABLES	1-7
ANNEX 1A – GLOSSARY OF TERMS AND DEFINITIONS	1A-1
PART 2 – FITNESS-FOR-SERVICE ENGINEERING ASSESSMENT PROCEDURE	2-1
2.1 GENERAL	2-1
2.1.1 <i>Fitness-For-Service and Continued Operation</i>	2-1
2.1.2 <i>Organization by Flaw Type and Damage Mechanism</i>	2-2
2.1.3 <i>FFS Assessment Procedure</i>	2-2
2.2 APPLICABILITY AND LIMITATIONS OF THE FFS ASSESSMENT PROCEDURES.....	2-3
2.2.1 <i>FFS Procedures for Pressurized or Unpressurized Components</i>	2-3
2.2.2 <i>Component Definition</i>	2-3
2.2.3 <i>Construction Codes</i>	2-3
2.2.4 <i>Specific Applicability and Limitations</i>	2-3
2.3 DATA REQUIREMENTS.....	2-4
2.3.1 <i>Original Equipment Design Data</i>	2-4
2.3.2 <i>Maintenance and Operational History</i>	2-5
2.3.3 <i>Required Data/Measurements for a FFS Assessment</i>	2-6
2.3.4 <i>Recommendations for Inspection Technique and Sizing Requirements</i>	2-6
2.4 ASSESSMENT TECHNIQUES AND ACCEPTANCE CRITERIA.....	2-6
2.4.1 <i>Assessment Levels</i>	2-6
2.4.2 <i>FFS Acceptance Criteria</i>	2-7

API 579-1/ASME FFS-1 2016 Fitness-For-Service

2.4.3	<i>Data Uncertainties</i>	2-9
2.5	REMAINING LIFE ASSESSMENT	2-10
2.5.1	<i>Remaining Life</i>	2-10
2.5.2	<i>Guidance on Remaining Life Determination</i>	2-10
2.6	REMEDATION	2-10
2.6.1	<i>Requirements for Remediation</i>	2-10
2.6.2	<i>Guidelines for Remediation</i>	2-10
2.7	IN-SERVICE MONITORING.....	2-11
2.8	DOCUMENTATION	2-11
2.8.1	<i>General</i>	2-11
2.8.2	<i>Applicability and Limitations</i>	2-11
2.8.3	<i>Data Requirements</i>	2-11
2.8.4	<i>Assessment Techniques and Acceptance Criteria</i>	2-11
2.8.5	<i>Remaining Life Assessment</i>	2-12
2.8.6	<i>Remediation Methods</i>	2-12
2.8.7	<i>In-Service Monitoring</i>	2-12
2.8.8	<i>Retention</i>	2-12
2.9	NOMENCLATURE.....	2-12
2.10	REFERENCES.....	2-13
2.11	TABLES	2-14
2.12	FIGURES	2-16

ANNEX 2A – TECHNICAL BASIS AND VALIDATION – FITNESS-FOR-SERVICE ENGINEERING ASSESSMENT PROCEDURE..... 2A-1

2A.1	TECHNICAL BASIS AND VALIDATION.....	2A-1
2A.2	REFERENCES.....	2A-1

ANNEX 2B – DAMAGE MECHANISMS..... 2B-1

2B.1	DETERIORATION AND FAILURE MODES.....	2B-1
2B.2	FFS ASSESSMENT AND THE IDENTIFICATION OF DAMAGE MECHANISMS.....	2B-1
2B.3	PRE-SERVICE DEFICIENCIES	2B-2
2B.3.1	<i>Types of Pre-service Deficiencies</i>	2B-2
2B.3.2	<i>In-Service Inspection</i>	2B-2
2B.4	IN-SERVICE DETERIORATION AND DAMAGE	2B-2
2B.4.1	<i>Overview</i>	2B-2
2B.4.2	<i>General Metal Loss Due to Corrosion and/or Erosion</i>	2B-3
2B.4.3	<i>Localized Metal Loss Due to Corrosion and/or Erosion</i>	2B-3
2B.4.4	<i>Surface Connected Cracking</i>	2B-4
2B.4.5	<i>Subsurface Cracking and Microfissuring/Microvoid Formation</i>	2B-5
2B.4.6	<i>Metallurgical Changes</i>	2B-6
2B.5	REFERENCES.....	2B-7
2B.6	TABLES	2B-8

ANNEX 2C – THICKNESS, MAWP AND STRESS EQUATIONS FOR A FFS ASSESSMENT 2C-1

2C.1	GENERAL	2C-2
2C.1.1	<i>Scope</i>	2C-2
2C.1.2	<i>MAWP and MFH</i>	2C-2
2C.1.3	<i>Construction Codes and Common Rules</i>	2C-2
2C.1.4	<i>Use of VIII-2 Design Equations</i>	2C-2
2C.2	CALCULATION OF T_{MIN} , MAWP (MFH), AND MEMBRANE STRESS	2C-3
2C.2.1	<i>Overview</i>	2C-3

API 579-1/ASME FFS-1 2016 Fitness-For-Service

2C.2.2	<i>Minimum Required Wall Thickness and MAWP (MFH)</i>	2C-3
2C.2.3	<i>Code Revisions</i>	2C-4
2C.2.4	<i>Determination of Allowable Stresses</i>	2C-4
2C.2.5	<i>Treatment of Weld and Riveted Joint Efficiency, and Ligament Efficiency</i>	2C-5
2C.2.6	<i>Treatment of Damage in Formed Heads</i>	2C-6
2C.2.7	<i>Thickness for Supplemental Loads</i>	2C-6
2C.2.8	<i>Determination of Metal Loss and Future Corrosion Allowance</i>	2C-8
2C.2.9	<i>Treatment of Metal Loss and Future Corrosion Allowance</i>	2C-8
2C.2.10	<i>Treatment of Shell Distortions</i>	2C-8
2C.3	PRESSURE VESSELS AND BOILER COMPONENTS – INTERNAL PRESSURE	2C-8
2C.3.1	<i>Overview</i>	2C-8
2C.3.2	<i>Shell Tolerances</i>	2C-9
2C.3.3	<i>Cylindrical Shells</i>	2C-9
2C.3.4	<i>Spherical Shell or Hemispherical Head</i>	2C-10
2C.3.5	<i>Elliptical Head</i>	2C-10
2C.3.6	<i>Torispherical Head</i>	2C-11
2C.3.7	<i>Conical Shell</i>	2C-12
2C.3.8	<i>Toriconical Head</i>	2C-13
2C.3.9	<i>Conical Transition</i>	2C-13
2C.3.10	<i>Nozzles Connections in Shells</i>	2C-16
2C.3.11	<i>Junction Reinforcement Requirements at Conical Transition</i>	2C-21
2C.3.12	<i>Other Components</i>	2C-21
2C.4	PRESSURE VESSELS AND BOILER COMPONENTS – EXTERNAL PRESSURE	2C-21
2C.5	PIPING COMPONENTS AND BOILER TUBES	2C-21
2C.5.1	<i>Overview</i>	2C-21
2C.5.2	<i>Metal Loss</i>	2C-21
2C.5.3	<i>Required Thickness and MAWP – Straight Pipes Subject To Internal Pressure</i>	2C-21
2C.5.4	<i>Required Thickness and MAWP – Boiler Tubes</i>	2C-22
2C.5.5	<i>Required Thickness and MAWP – Pipe Bends Subject To Internal Pressure</i>	2C-23
2C.5.6	<i>Required Thickness and MAWP for External Pressure</i>	2C-24
2C.5.7	<i>Branch Connections</i>	2C-24
2C.6	API 650 STORAGE TANKS	2C-25
2C.6.1	<i>Overview</i>	2C-25
2C.6.2	<i>Metal Loss</i>	2C-25
2C.6.3	<i>Required Thickness and MFH for Liquid Hydrostatic Loading</i>	2C-25
2C.7	NOMENCLATURE	2C-26
2C.8	REFERENCES	2C-33
2C.9	TABLES	2C-34
2C.10	FIGURES	2C-37

ANNEX 2D – STRESS ANALYSIS OVERVIEW FOR A FFS ASSESSMENT..... 2D-1

2D.1	GENERAL REQUIREMENTS	2D-1
2D.1.1	<i>Scope</i>	2D-1
2D.1.2	<i>ASME B&PV Code, Section VIII, Division 2 (VIII-2)</i>	2D-2
2D.1.3	<i>Applicability</i>	2D-2
2D.1.4	<i>Protection Against Failure Modes</i>	2D-2
2D.1.5	<i>Numerical Analysis</i>	2D-2
2D.1.6	<i>Material Properties</i>	2D-3
2D.1.7	<i>Applicable Loads and Load Case Combinations</i>	2D-3
2D.1.8	<i>Loading Histogram</i>	2D-3
2D.2	PROTECTION AGAINST PLASTIC COLLAPSE	2D-4
2D.2.1	<i>Overview</i>	2D-4
2D.2.2	<i>Elastic Stress Analysis Method</i>	2D-4

API 579-1/ASME FFS-1 2016 Fitness-For-Service

2D.2.3	<i>Limit-Load Analysis Method</i>	2D-4
2D.2.4	<i>Elastic-Plastic Stress Analysis Method</i>	2D-5
2D.2.5	<i>Treatment of the Weld Joint Efficiency</i>	2D-5
2D.3	PROTECTION AGAINST LOCAL FAILURE	2D-5
2D.3.1	<i>Overview</i>	2D-5
2D.3.2	<i>Elastic Analysis Method</i>	2D-6
2D.3.3	<i>Elastic-Plastic Analysis Method</i>	2D-6
2D.4	PROTECTION AGAINST COLLAPSE FROM BUCKLING	2D-6
2D.4.1	<i>Assessment Procedure</i>	2D-6
2D.4.2	<i>Supplemental Requirements for Components with Flaws</i>	2D-6
2D.5	SUPPLEMENTAL REQUIREMENTS FOR STRESS CLASSIFICATION IN NOZZLE NECKS	2D-7
2D.6	NOMENCLATURE	2D-7
2D.7	REFERENCES	2D-7
2D.8	TABLES	2D-8

ANNEX 2E – MATERIAL PROPERTIES FOR STRESS ANALYSIS2E-1

2E.1	GENERAL	2E-1
2E.1.1	<i>Material Properties Required</i>	2E-1
2E.1.2	<i>Material Properties and In-Service Degradation</i>	2E-1
2E.2	STRENGTH PARAMETERS	2E-2
2E.2.1	<i>Yield and Tensile Strength</i>	2E-2
2E.2.2	<i>Flow Stress</i>	2E-3
2E.3	MONOTONIC STRESS-STRAIN RELATIONSHIPS	2E-4
2E.3.1	<i>MPC Stress-Strain Curve Model</i>	2E-4
2E.3.2	<i>MPC Tangent Modulus Model</i>	2E-5
2E.3.3	<i>Ramberg-Osgood Model</i>	2E-5
2E.3.4	<i>Ramberg-Osgood Tangent Modulus Model</i>	2E-6
2E.4	CYCLIC STRESS-STRAIN RELATIONSHIPS	2E-6
2E.4.1	<i>Ramberg-Osgood</i>	2E-6
2E.4.2	<i>Uniform Material Law</i>	2E-7
2E.5	PHYSICAL PROPERTIES	2E-7
2E.5.1	<i>Elastic Modulus</i>	2E-7
2E.5.2	<i>Poisson's Ratio</i>	2E-7
2E.5.3	<i>Coefficient of Thermal Expansion</i>	2E-7
2E.5.4	<i>Thermal Conductivity</i>	2E-7
2E.5.5	<i>Thermal Diffusivity</i>	2E-7
2E.5.6	<i>Density</i>	2E-7
2E.6	NOMENCLATURE	2E-7
2E.7	REFERENCES	2E-9
2E.7.1	<i>Strength Parameters</i>	2E-9
2E.7.2	<i>Cyclic Stress-Strain Relationships</i>	2E-10
2E.7.3	<i>Physical Properties</i>	2E-10
2E.8	TABLES	2E-11

ANNEX 2F – ALTERNATIVE METHOD FOR ESTABLISHING THE REMAINING STRENGTH FACTOR...2F-1

2F.1	OVERVIEW	2F-1
2F.2	ESTABLISHING AN ALLOWABLE REMAINING STRENGTH FACTOR – RSF_A	2F-1
2F.3	NOMENCLATURE	2F-2
2F.4	REFERENCES	2F-2

API 579-1/ASME FFS-1 2016 Fitness-For-Service

PART 3 – ASSESSMENT OF EXISTING EQUIPMENT FOR BRITTLE FRACTURE..... 3-1

- 3.1 GENERAL 3-1
 - 3.1.1 *Evaluation of Resistance to Brittle Fracture*..... 3-1
 - 3.1.2 *Avoidance of Catastrophic Brittle Fracture*..... 3-2
 - 3.1.3 *Boilers and Boiler External Piping*..... 3-2
 - 3.1.4 *Supplemental Brittle Fracture Assessment to Other FFS Assessment Procedures*..... 3-2
 - 3.1.5 *Critical Exposure Temperature (CET)* 3-2
 - 3.1.6 *Minimum Allowable Temperature (MAT)*..... 3-3
- 3.2 APPLICABILITY AND LIMITATIONS OF THE PROCEDURE 3-3
 - 3.2.1 *Equipment Covered*..... 3-3
 - 3.2.2 *Components Subject to Metal Loss* 3-3
 - 3.2.3 *Requirements for In-Service Inspection and Maintenance Programs*..... 3-3
- 3.3 DATA REQUIREMENTS..... 3-4
 - 3.3.1 *Original Equipment Design Data* 3-4
 - 3.3.2 *Maintenance and Operational History* 3-4
 - 3.3.3 *Required Data/Measurements for a FFS Assessment*..... 3-4
 - 3.3.4 *Recommendations for Inspection Technique and Sizing Requirements*..... 3-5
- 3.4 ASSESSMENT TECHNIQUES AND ACCEPTANCE CRITERIA..... 3-5
 - 3.4.1 *Overview* 3-5
 - 3.4.2 *Level 1 Assessment* 3-6
 - 3.4.3 *Level 2 Assessment* 3-8
 - 3.4.4 *Level 3 Assessment* 3-13
- 3.5 REMAINING LIFE ASSESSMENT 3-14
 - 3.5.1 *Acceptability for Continued Service* 3-14
 - 3.5.2 *Pressure Vessels*..... 3-14
 - 3.5.3 *Piping Systems*..... 3-14
 - 3.5.4 *Atmospheric and Low Pressure Storage Tanks*..... 3-14
- 3.6 REMEDIATION 3-14
 - 3.6.1 *Potential Use of Remediation Methods* 3-14
 - 3.6.2 *Remediation Methods* 3-14
- 3.7 IN-SERVICE MONITORING..... 3-15
 - 3.7.1 *In-Service Monitoring and Control of Process Conditions* 3-15
 - 3.7.2 *Monitoring for Degradation of Low Alloy Steel Notch Toughness* 3-15
 - 3.7.3 *Monitoring for Criticality of Growing Flaws*..... 3-16
 - 3.7.4 *Assessment of Non-Growing Flaws Detected In-Service*..... 3-16
- 3.8 DOCUMENTATION 3-16
 - 3.8.1 *Documentation Requirements for Each Assessment Level* 3-16
 - 3.8.2 *Documentation Retention* 3-16
- 3.9 NOMENCLATURE..... 3-16
- 3.10 REFERENCES..... 3-18
- 3.11 TABLES 3-19
- 3.12 FIGURES 3-25

ANNEX 3A – TECHNICAL BASIS AND VALIDATION – ASSESSMENT OF EXISTING EQUIPMENT FOR BRITTLE FRACTURE3A-1

- 3A.1 TECHNICAL BASIS AND VALIDATION..... 3A-1
- 3A.2 REFERENCES..... 3A-1

PART 4 – ASSESSMENT OF GENERAL METAL LOSS 4-1

- 4.1 GENERAL 4-1
 - 4.1.1 *Assessment Procedures for General Metal Loss*..... 4-1
 - 4.1.2 *Thickness Averaging Approach Used For the Assessment* 4-1

API 579-1/ASME FFS-1 2016 Fitness-For-Service

4.2 APPLICABILITY AND LIMITATIONS OF THE PROCEDURE 4-2

4.2.1 *General Metal Loss Assessment*..... 4-2

4.2.2 *Limitations Based on Flaw Type*..... 4-2

4.2.3 *Calculation of the MAWP_r and MFH_r and Coincident Temperature* 4-2

4.2.4 *Limitations Based on Temperature* 4-2

4.2.5 *Definition of Component Types*..... 4-2

4.2.6 *Applicability of the Level 1 and Level 2 Assessment Procedures* 4-3

4.2.7 *Applicability of the Level 3 Assessment Procedures*..... 4-4

4.3 DATA REQUIREMENTS..... 4-4

4.3.1 *Original Equipment Design Data* 4-4

4.3.2 *Maintenance and Operational History* 4-4

4.3.3 *Required Data/Measurements for a FFS Assessment*..... 4-5

4.3.4 *Recommendations for Inspection Technique and Sizing Requirements*..... 4-7

4.4 ASSESSMENT TECHNIQUES AND ACCEPTANCE CRITERIA..... 4-8

4.4.1 *Overview* 4-8

4.4.2 *Level 1 Assessment* 4-9

4.4.3 *Level 2 Assessment* 4-10

4.4.4 *Level 3 Assessment* 4-12

4.5 REMAINING LIFE ASSESSMENT 4-13

4.5.1 *Thickness Approach*..... 4-13

4.5.2 *MAWP Approach*..... 4-13

4.6 REMEDIATION 4-14

4.6.1 *Objectives* 4-14

4.6.2 *Methods*..... 4-14

4.7 IN-SERVICE MONITORING..... 4-16

4.7.1 *Objectives* 4-16

4.7.2 *Monitoring Methods* 4-16

4.7.3 *Calibration* 4-16

4.8 DOCUMENTATION 4-16

4.8.1 *General*..... 4-16

4.8.2 *Inspection Data* 4-16

4.9 NOMENCLATURE..... 4-16

4.10 REFERENCES..... 4-19

4.11 TABLES 4-20

4.12 FIGURES 4-28

ANNEX 4A – TECHNICAL BASIS AND VALIDATION – ASSESSMENT OF GENERAL METAL LOSS 4A-1

4A.1 TECHNICAL BASIS AND VALIDATION..... 4A-1

4A.2 REFERENCES..... 4A-1

PART 5 – ASSESSMENT OF LOCAL METAL LOSS 5-1

5.1 GENERAL 5-1

5.1.1 *Assessment Procedures for Local Metal Loss* 5-1

5.1.2 *Choice of Part 4 or Part 5 Assessment Procedures* 5-1

5.1.3 *Pitting Damage*..... 5-2

5.2 APPLICABILITY AND LIMITATIONS OF THE PROCEDURE 5-2

5.2.1 *Local Metal Loss Assessment* 5-2

5.2.2 *Limitations Based on Flaw Type*..... 5-2

5.2.3 *Calculation of the MAWP_r and MFH_r and Coincident Temperature* 5-2

5.2.4 *Limitations Based on Temperature* 5-3

5.2.5 *Applicability of the Level 1 and Level 2 Assessment Procedures* 5-3

5.2.6 *Applicability of the Level 3 Assessment Procedures*..... 5-3

API 579-1/ASME FFS-1 2016 Fitness-For-Service

5.2.7	<i>Assessment of Blend Ground Areas for Crack-Like Flaw Removal</i>	5-4
5.3	DATA REQUIREMENTS.....	5-4
5.3.1	<i>Original Equipment Design Data</i>	5-4
5.3.2	<i>Maintenance and Operational History</i>	5-4
5.3.3	<i>Required Data/Measurements for a FFS Assessment</i>	5-4
5.3.4	<i>Recommendations for Inspection Technique and Sizing Requirements</i>	5-5
5.4	ASSESSMENT TECHNIQUES AND ACCEPTANCE CRITERIA.....	5-5
5.4.1	<i>Overview</i>	5-5
5.4.2	<i>Level 1 Assessment</i>	5-6
5.4.3	<i>Level 2 Assessment</i>	5-8
5.4.4	<i>Level 3 Assessment</i>	5-14
5.5	REMAINING LIFE ASSESSMENT	5-15
5.5.1	<i>Thickness Approach</i>	5-15
5.5.2	<i>MAWP Approach</i>	5-15
5.6	REMEDICATION	5-15
5.7	IN-SERVICE MONITORING.....	5-15
5.8	DOCUMENTATION	5-16
5.8.1	<i>General</i>	5-16
5.8.2	<i>Inspection Data</i>	5-16
5.9	NOMENCLATURE.....	5-16
5.10	REFERENCES.....	5-20
5.11	TABLES	5-21
5.12	FIGURES	5-27

ANNEX 5A – TECHNICAL BASIS AND VALIDATION – ASSESSMENT OF LOCAL METAL LOSS 5A-1

5A.1	TECHNICAL BASIS AND VALIDATION.....	5A-1
5A.2	REFERENCES.....	5A-1

PART 6 – ASSESSMENT OF PITTING CORROSION 6-1

6.1	GENERAL	6-1
6.1.1	<i>Assessment of Pitting Corrosion</i>	6-1
6.1.2	<i>Assessment of Blister Arrays</i>	6-1
6.2	APPLICABILITY AND LIMITATIONS OF THE PROCEDURE	6-1
6.2.1	<i>Assessment of Four Types of Pitting Corrosion</i>	6-2
6.2.2	<i>Calculation of the MAWP_r and MFH_r and Coincident Temperature</i>	6-2
6.2.3	<i>Limitations Based on Flaw Type</i>	6-2
6.2.4	<i>Limitations Based on Temperature</i>	6-2
6.2.5	<i>Applicability of the Level 1 and Level 2 Assessment Procedures</i>	6-2
6.2.6	<i>Applicability of the Level 3 Assessment Procedures</i>	6-3
6.2.7	<i>Assessment for Active Pitting Corrosion</i>	6-3
6.2.8	<i>Future Corrosion Allowance</i>	6-3
6.3	DATA REQUIREMENTS.....	6-3
6.3.1	<i>Original Equipment Design Data</i>	6-3
6.3.2	<i>Maintenance and Operational History</i>	6-4
6.3.3	<i>Required Data/Measurements for a FFS Assessment</i>	6-4
6.3.4	<i>Recommendation for Inspection Technique and Sizing Requirements</i>	6-5
6.4	ASSESSMENT TECHNIQUES AND ACCEPTANCE CRITERIA.....	6-5
6.4.1	<i>Overview</i>	6-5
6.4.2	<i>Level 1 Assessment</i>	6-6
6.4.3	<i>Level 2 Assessment</i>	6-8
6.4.4	<i>Level 3 Assessment</i>	6-14
6.5	REMAINING LIFE ASSESSMENT	6-14

API 579-1/ASME FFS-1 2016 Fitness-For-Service

6.5.1 MAWP Approach..... 6-14
6.5.2 MAWP Procedure for Remaining Life Determination 6-15
6.6 REMEDIATION 6-15
6.7 IN-SERVICE MONITORING..... 6-16
6.8 DOCUMENTATION 6-16
6.8.1 General..... 6-16
6.8.2 Inspection Data 6-16
6.9 NOMENCLATURE..... 6-16
6.10 REFERENCES..... 6-19
6.11 TABLES 6-20
6.12 FIGURES 6-22

ANNEX 6A – TECHNICAL BASIS AND VALIDATION – ASSESSMENT OF PITTING CORROSION..... 6A-1

6A.1 TECHNICAL BASIS AND VALIDATION..... 6A-1
6A.2 REFERENCES..... 6A-1

PART 7 – ASSESSMENT OF HYDROGEN BLISTERS AND HYDROGEN DAMAGE ASSOCIATED WITH HIC AND SOHIC 7-1

7.1 GENERAL 7-2
7.1.1 Assessment Procedures for Hydrogen Blisters, HIC and SOHIC 7-2
7.1.2 HIC Definition..... 7-2
7.1.3 SOHIC Definition..... 7-2
7.1.4 Hydrogen Blistering Definition..... 7-2
7.1.5 HIC, SOHIC and Blistering Distinct Damage Types 7-3
7.2 APPLICABILITY AND LIMITATIONS OF THE PROCEDURE 7-3
7.2.1 HIC, SOHIC and Blistering Distinct Damage Types 7-3
7.2.2 Calculation of the MAWP_r and MFH_r and Coincident Temperature 7-3
7.2.3 Limitations Based on Temperature 7-3
7.2.4 Applicability of the Level 1 and Level 2 Assessment Procedures 7-3
7.2.5 Applicability of the Level 3 Assessment Procedure 7-4
7.3 DATA REQUIREMENTS..... 7-4
7.3.1 Original Equipment Design Data 7-4
7.3.2 Maintenance and Operational History 7-4
7.3.3 Required Data/Measurements for a FFS Assessment..... 7-4
7.3.4 Recommendations for Detection, Characterization, and Sizing 7-7
7.4 ASSESSMENT TECHNIQUES AND ACCEPTANCE CRITERIA..... 7-7
7.4.1 Overview 7-7
7.4.2 Level 1 Assessment 7-8
7.4.3 Level 2 Assessment 7-10
7.4.4 Level 3 Assessment 7-14
7.5 REMAINING LIFE ASSESSMENT 7-16
7.5.1 HIC and SOHIC Growth Rates 7-16
7.5.2 Blister Growth 7-16
7.6 REMEDIATION 7-16
7.6.1 Elimination of Hydrogen Charging..... 7-16
7.6.2 Controlling Hydrogen Charging 7-16
7.6.3 Venting of Blisters 7-16
7.6.4 Blend Grinding..... 7-17
7.6.5 Repair and Replacement of Damaged Material 7-17
7.6.6 NACE Standard SP0296-10..... 7-17
7.7 IN-SERVICE MONITORING..... 7-17
7.7.1 Monitoring for Hydrogen Charging 7-17

API 579-1/ASME FFS-1 2016 Fitness-For-Service

7.7.2	<i>Inspection Methods for Monitoring</i>	7-17
7.7.3	<i>Detection of HIC, SOHIC, or Blister Damage Growth</i>	7-17
7.8	DOCUMENTATION	7-17
7.8.1	<i>General</i>	7-17
7.8.2	<i>Inspection Data</i>	7-18
7.8.3	<i>In-Service Monitoring</i>	7-18
7.9	NOMENCLATURE	7-18
7.10	REFERENCES	7-19
7.11	TABLES	7-20
7.12	FIGURES	7-22

ANNEX 7A – TECHNICAL BASIS AND VALIDATION – ASSESSMENT OF HYDROGEN BLISTERS AND HYDROGEN DAMAGE ASSOCIATED WITH HIC AND SOHIC..... 7A-1

7A.1	TECHNICAL BASIS AND VALIDATION	7A-1
7A.2	REFERENCES	7A-1

PART 8 – ASSESSMENT OF WELD MISALIGNMENT AND SHELL DISTORTIONS..... 8-1

8.1	GENERAL	8-1
8.1.1	<i>Evaluation of Weld Misalignment and Shell Distortions</i>	8-1
8.1.2	<i>ASME B&PV Code, Section VIII, Division 2</i>	8-1
8.2	APPLICABILITY AND LIMITATIONS OF THE PROCEDURE	8-2
8.2.1	<i>Types of Weld Misalignment and Shell Distortions</i>	8-2
8.2.2	<i>Limitations Based on Flaw Type</i>	8-2
8.2.3	<i>Calculation of the MAWP_r and MFH_r and Coincident Temperature</i>	8-2
8.2.4	<i>Limitations Based on Temperature</i>	8-2
8.2.5	<i>Applicability of the Level 1 and Level 2 Assessment Procedures</i>	8-3
8.2.6	<i>Applicability of the Level 3 Assessment</i>	8-3
8.3	DATA REQUIREMENTS	8-4
8.3.1	<i>Original Equipment Design Data</i>	8-4
8.3.2	<i>Maintenance and Operational History</i>	8-4
8.3.3	<i>Required Data/Measurements for a FFS Assessment</i>	8-4
8.3.4	<i>Recommendations for Inspection Technique and Sizing Requirements</i>	8-4
8.4	EVALUATION TECHNIQUES AND ACCEPTANCE CRITERIA	8-6
8.4.1	<i>Overview</i>	8-6
8.4.2	<i>Level 1 Assessment</i>	8-6
8.4.3	<i>Level 2 Assessment</i>	8-7
8.4.4	<i>Level 3 Assessment</i>	8-13
8.5	REMAINING LIFE ASSESSMENT	8-14
8.5.1	<i>Categories – Metal Loss, Cyclic Loading, High Temperature Operation</i>	8-14
8.5.2	<i>Requirements for a Level 3 Assessment</i>	8-14
8.6	REMEDICATION	8-14
8.6.1	<i>Addition of Reinforcement</i>	8-14
8.6.2	<i>Correction of Tolerances by Mechanical Means</i>	8-15
8.7	IN-SERVICE MONITORING	8-15
8.7.1	<i>Overview</i>	8-15
8.7.2	<i>Groove-Like and Crack-Like Flaws</i>	8-15
8.8	DOCUMENTATION	8-15
8.9	NOMENCLATURE	8-15
8.10	REFERENCES	8-20
8.11	TABLES	8-21
8.12	FIGURES	8-35

ANNEX 8A – TECHNICAL BASIS AND VALIDATION – ASSESSMENT OF WELD MISALIGNMENT AND SHELL DISTORTIONS..... 8A-1

8A.1 TECHNICAL BASIS AND VALIDATION..... 8A-1

8A.2 REFERENCES..... 8A-1

PART 9 – ASSESSMENT OF CRACK-LIKE FLAWS..... 9-1

9.1 GENERAL 9-1

9.1.1 *Assessment Procedures for Crack-Like Flaws*..... 9-1

9.1.2 *ASME B&PV Code, Section VIII, Division 2 (VIII-2)* 9-2

9.1.3 *Crack-Like Flaw Definition*..... 9-2

9.1.4 *Treatment of Volumetric Flaws as Crack-Like Flaws* 9-2

9.1.5 *Use of Assessment Procedures to Evaluate Brittle Fracture* 9-2

9.1.6 *Service Environment and Material Interactions with Crack-Like flaws* 9-2

9.2 APPLICABILITY AND LIMITATIONS OF THE PROCEDURE 9-3

9.2.1 *Overview* 9-3

9.2.2 *Applicability of the Level 1 and Level 2 Assessment Procedures* 9-3

9.2.3 *Applicability of the Level 3 Assessment Procedure*..... 9-4

9.2.4 *Assessment Procedures for Notches in Groove-Like Flaws* 9-4

9.3 DATA REQUIREMENTS..... 9-5

9.3.1 *General*..... 9-5

9.3.2 *Original Equipment Design Data* 9-5

9.3.3 *Maintenance and Operating History*..... 9-5

9.3.4 *Required Data/Measurements for a FFS Assessment – Loads and Stresses* 9-6

9.3.5 *Required Data/Measurements for a FFS Assessment – Material Properties*..... 9-7

9.3.6 *Required Data/Measurements for a FFS Assessment – Flaw Characterization*..... 9-8

9.3.7 *Recommendation for Inspection Technique and Sizing Requirements*..... 9-12

9.4 ASSESSMENT TECHNIQUES AND ACCEPTANCE CRITERIA..... 9-13

9.4.1 *Overview* 9-13

9.4.2 *Level 1 Assessment* 9-14

9.4.3 *Level 2 Assessment* 9-15

9.4.4 *Level 3 Assessment* 9-19

9.5 REMAINING LIFE ASSESSMENT 9-21

9.5.1 *Subcritical Crack Growth* 9-21

9.5.2 *Leak-Before-Break Analysis*..... 9-23

9.6 REMEDIATION 9-25

9.6.1 *Objectives of Remediation*..... 9-25

9.6.2 *Remediation Methods* 9-25

9.7 IN-SERVICE MONITORING..... 9-26

9.7.1 *Monitoring of Subcritical Crack Growth* 9-26

9.7.2 *Validation of Monitoring Method* 9-26

9.8 DOCUMENTATION 9-27

9.8.1 *General*..... 9-27

9.8.2 *Assessment Procedure*..... 9-27

9.8.3 *Remediation Methods* 9-28

9.8.4 *In-Service Monitoring*..... 9-28

9.9 NOMENCLATURE..... 9-28

9.10 REFERENCES..... 9-30

9.11 TABLES 9-31

9.12 FIGURES 9-35

ANNEX 9A – TECHNICAL BASIS AND VALIDATION – ASSESSMENT OF CRACK-LIKE FLAWS	9A-1
9A.1 TECHNICAL BASIS AND VALIDATION.....	9A-1
9A.2 REFERENCES.....	9A-2
ANNEX 9B – COMPENDIUM OF STRESS INTENSITY FACTOR SOLUTIONS	9B-1
9B.1 GENERAL	9B-1
9B.2 STRESS ANALYSIS.....	9B-2
9B.3 STRESS INTENSITY FACTOR SOLUTIONS FOR PLATES.....	9B-4
9B.4 STRESS INTENSITY FACTOR SOLUTIONS FOR PLATES WITH HOLES	9B-16
9B.5 STRESS INTENSITY FACTOR SOLUTIONS FOR CYLINDERS.....	9B-22
9B.6 STRESS INTENSITY FACTOR SOLUTIONS FOR SPHERES.....	9B-31
9B.7 STRESS INTENSITY FACTOR SOLUTIONS FOR ELBOWS AND PIPE BENDS.....	9B-35
9B.8 STRESS INTENSITY FACTOR SOLUTIONS FOR NOZZLES AND PIPING TEES.....	9B-35
9B.9 STRESS INTENSITY FACTOR SOLUTIONS FOR RING-STIFFENED CYLINDERS	9B-37
9B.10 STRESS INTENSITY FACTOR SOLUTIONS FOR SLEEVE REINFORCED CYLINDERS	9B-37
9B.11 STRESS INTENSITY FACTOR SOLUTIONS FOR ROUND BARS AND BOLTS.....	9B-38
9B.12 STRESS INTENSITY FACTOR SOLUTIONS FOR CRACKS AT FILLET WELDS	9B-40
9B.13 STRESS INTENSITY FACTOR SOLUTIONS CRACKS IN CLAD PLATES AND SHELLS	9B-43
9B.14 THE WEIGHT FUNCTION METHOD FOR SURFACE CRACKS	9B-43
9B.15 NOMENCLATURE.....	9B-47
9B.16 TABLES	9B-56
9B.17 FIGURES	9B-197
ANNEX 9C – COMPENDIUM OF REFERENCE STRESS SOLUTIONS FOR CRACK-LIKE FLAWS	9C-1
9C.1 GENERAL	9C-1
9C.2 STRESS ANALYSIS.....	9C-2
9C.3 REFERENCE STRESS SOLUTIONS FOR PLATES.....	9C-9
9C.4 REFERENCE STRESS SOLUTIONS FOR PLATES WITH HOLES	9C-12
9C.5 REFERENCE STRESS SOLUTIONS FOR CYLINDERS	9C-13
9C.6 REFERENCE STRESS SOLUTIONS FOR SPHERES.....	9C-21
9C.7 REFERENCE STRESS SOLUTIONS FOR ELBOWS AND PIPE BENDS	9C-23
9C.8 REFERENCE STRESS SOLUTIONS FOR NOZZLES AND PIPING TEES.....	9C-23
9C.9 REFERENCE STRESS SOLUTIONS FOR RING-STIFFENED CYLINDERS.....	9C-24
9C.10 REFERENCE STRESS SOLUTIONS FOR SLEEVE REINFORCED CYLINDERS.....	9C-24
9C.11 REFERENCE STRESS SOLUTIONS FOR ROUND BARS AND BOLTS.....	9C-25
9C.12 REFERENCE STRESS SOLUTIONS FOR CRACKS AT FILLET WELDS	9C-26
9C.13 REFERENCE STRESS SOLUTIONS FOR CRACKS IN CLAD PLATES AND SHELLS.....	9C-27
9C.14 NOMENCLATURE.....	9C-27
9C.15 REFERENCES.....	9C-29
9C.16 FIGURES	9C-32
ANNEX 9D – RESIDUAL STRESSES IN A FITNESS-FOR-SERVICE EVALUATION	9D-1
9D.1 GENERAL	9D-2
9D.1.1 <i>Scope</i>	9D-2
9D.1.2 <i>Crack Driving Force Associated with Residual Stress</i>	9D-2
9D.2 APPLICABILITY AND LIMITATIONS	9D-2
9D.2.1 <i>Residual Stress Solutions for In-Service and New Welded Joints</i>	9D-2
9D.2.2 <i>Technical Basis</i>	9D-2
9D.2.3 <i>Applicable Materials</i>	9D-3
9D.2.4 <i>Weld Joint Geometry</i>	9D-3

API 579-1/ASME FFS-1 2016 Fitness-For-Service

9D.2.5 Residual Stress Distributions 9D-3
9D.2.6 Residual Stress Distribution Reference Point..... 9D-3
9D.2.7 Use of Alternative Residual Stress Solutions 9D-3
9D.2.8 Residual Stress Distributions from Welding Simulation 9D-3
9D.3 DATA REQUIREMENTS AND DEFINITION OF VARIABLES 9D-3
9D.3.1 Required Data 9D-3
9D.3.2 Optional Data..... 9D-4
9D.3.3 Yield Strength in Residual Stress Calculations 9D-4
9D.4 RESIDUAL STRESS DISTRIBUTION MODIFYING FACTORS 9D-4
9D.4.1 Post Weld Heat Treatment 9D-4
9D.4.2 Pressure Tests 9D-5
9D.5 FULL PENETRATION CIRCUMFERENTIAL WELDS IN PIPING & PRESSURE VESSEL CYLINDRICAL SHELLS..... 9D-5
9D.5.1 Residual Stress Perpendicular to the Weld Seam (Circumferential Flaw) 9D-5
9D.5.2 Residual Stress Parallel to the Weld Seam (Longitudinal Flaw)..... 9D-6
9D.5.3 Technical Basis 9D-7
9D.6 FULL PENETRATION LONGITUDINAL WELDS IN PIPING & PRESSURE VESSEL CYLINDRICAL SHELLS..... 9D-7
9D.6.1 Residual Stress Perpendicular to the Weld Seam (Longitudinal Flaw) 9D-7
9D.6.2 Residual Stress Parallel to the Weld Seam (Circumferential Flaw) 9D-7
9D.6.3 Technical basis..... 9D-8
9D.7 FULL PENETRATION CIRCUMFERENTIAL WELDS IN SPHERES AND PRESSURE VESSEL HEADS 9D-8
9D.7.1 Residual Stress Perpendicular to the Weld Seam (Circumferential Flaw) 9D-8
9D.7.2 Residual Stress Parallel to the Weld Seam (Meridional Flaw)..... 9D-8
9D.7.3 Technical Basis 9D-8
9D.8 FULL PENETRATION MERIDIONAL (SEAM) WELDS IN SPHERES AND PRESSURE VESSEL HEADS 9D-9
9D.8.1 Residual Stress Perpendicular to the Weld Seam (Meridional Flaw) 9D-9
9D.8.2 Residual Stress Parallel to the Weld Seam (Circumferential Flaw) 9D-9
9D.8.3 Technical Basis 9D-9
9D.9 FULL PENETRATION WELDS IN STORAGE TANKS..... 9D-9
9D.10 FULL PENETRATION WELDS AT CORNER JOINTS (NOZZLES OR PIPING BRANCH CONNECTIONS)..... 9D-9
9D.10.1 Corner Joint, Set-In Nozzle Weld (See Figure 9D.7 and Figure 9D.8, Weld Joint A)..... 9D-9
9D.10.2 Corner Joint, Set-On Nozzle Weld (See Figure 9D.7 and Figure 9D.8, Weld Joint B)..... 9D-10
9D.10.3 Reinforcing Pad Shell Fillet Weld (See Figure 9D.7 and Figure 9D.8, Weld Joint C) 9D-11
9D.10.4 Piping Branch Connection (See Figure 9D.11) 9D-11
9D.10.5 Technical Basis 9D-12
9D.11 FULL PENETRATION AND FILLET WELDS AT A TEE JOINT..... 9D-13
9D.11.1 Main Plate (See Figure 9D.12, Figure 9D.13 and Figure 9D.15)..... 9D-13
9D.11.2 Stay Plate (See Figure 9D.12, Figure 9D.14 and Figure 9D.15) 9D-14
9D.11.3 Technical Basis 9D-14
9D.12 REPAIR WELDS..... 9D-15
9D.12.1 Residual Stress Perpendicular to the Weld 9D-15
9D.12.2 Residual Stress Parallel to the Weld Seam 9D-15
9D.12.3 Technical Basis 9D-15
9D.13 WELDING SIMULATION-BASED STRESS DISTRIBUTIONS 9D-16
9D.13.1 General 9D-16
9D.13.2 Description of Simplified Method 9D-16
9D.13.3 Simulation References 9D-18
9D.14 NOMENCLATURE..... 9D-18
9D.15 REFERENCES..... 9D-19
9D.16 TABLES 9D-22
9D.17 FIGURES 9D-24

ANNEX 9E – CRACK OPENING AREAS 9E-1

9E.1 INTRODUCTION 9E-1

API 579-1/ASME FFS-1 2016 Fitness-For-Service

9E.1.1	Scope.....	9E-1
9E.1.2	Overview of Crack Opening Area Calculations.....	9E-1
9E.2	CRACK OPENING AREAS (COA) FOR CYLINDERS AND SPHERES	9E-2
9E.2.1	Longitudinal Cracks in Cylinders.....	9E-2
9E.2.2	Circumferential Cracks in Cylinders.....	9E-3
9E.2.3	Meridional Cracks in Spheres.....	9E-4
9E.2.4	Plasticity Correction for the COA.....	9E-5
9E.2.5	Nomenclature	9E-5
9E.2.6	References.....	9E-6
9E.2.7	Tables.....	9E-7

ANNEX 9F – MATERIAL PROPERTIES FOR CRACK-LIKE FLAWS..... 9F-1

9F.1	GENERAL.....	9F-1
9F.2	CHARPY V-NOTCH IMPACT ENERGY.....	9F-2
9F.2.1	Definition.....	9F-2
9F.2.2	Charpy V-Notch (CVN) Test.....	9F-2
9F.2.3	Charpy V-Notch Transition Curve.....	9F-4
9F.2.4	Charpy Transition Curves and ASME Division 1 and 2 Toughness Exemption Curves	9F-5
9F.3	FRACTURE TOUGHNESS.....	9F-6
9F.3.1	Definition.....	9F-6
9F.3.2	Fracture Toughness Parameters.....	9F-6
9F.3.3	Fracture Toughness Testing.....	9F-7
9F.3.4	Fracture Toughness Estimation from Charpy V-Notch Data.....	9F-8
9F.3.5	ASME B&PV Code, Section VIII Division 1 and 2 Fracture Toughness.....	9F-8
9F.4	FRACTURE TOUGHNESS ESTIMATION FOR AN FFS ASSESSMENT.....	9F-9
9F.4.1	Introduction.....	9F-9
9F.4.2	ASME Section XI Fracture Toughness – Lower Bound.....	9F-9
9F.4.3	Assessing Fracture Toughness Carbon and Low Alloys Steels – Transition Region.....	9F-10
9F.4.4	Assessing Fracture Toughness Carbon and Low Alloys Steels – Upper Shelf.....	9F-14
9F.4.5	Dynamic Fracture or Arrest Toughness.....	9F-15
9F.4.6	Fracture Toughness for Materials Subject to In-Service Degradation.....	9F-17
9F.4.7	Aging Effects on the Fracture Toughness of Cr-Mo Steels.....	9F-19
9F.4.8	Fracture Toughness of Austenitic Stainless Steel.....	9F-20
9F.4.9	Fracture Toughness Estimation for Brittle Fracture Assessments.....	9F-20
9F.5	MATERIAL DATA FOR CRACK GROWTH CALCULATIONS.....	9F-21
9F.5.1	Categories of Crack Growth.....	9F-21
9F.5.2	Fatigue Crack Growth Equations.....	9F-22
9F.5.3	Fatigue Crack Growth Data.....	9F-26
9F.5.4	Stress Corrosion Crack Growth Equations.....	9F-29
9F.5.5	Stress Corrosion Crack Growth Data.....	9F-30
9F.6	NOMENCLATURE.....	9F-31
9F.7	REFERENCES.....	9F-36
9F.8	TABLES.....	9F-38
9F.9	FIGURES.....	9F-41

ANNEX 9G – STRESS ANALYSIS FOR CRACK-LIKE FLAWS..... 9G-1

9G.1	GENERAL REQUIREMENTS.....	9G-1
9G.1.1	Scope.....	9G-1
9G.1.2	ASME B&PV Code, Section VIII, Division 2 (VIII-2).....	9G-2
9G.1.3	FAD-Based Assessment Procedure.....	9G-2
9G.1.4	Assessment Using Stress Analysis Results – Uncracked Configuration.....	9G-2
9G.1.5	Assessment Using Stress Analysis Results – Crack Incorporated into the Model.....	9G-2

API 579-1/ASME FFS-1 2016 Fitness-For-Service

9G.1.6	<i>Assessment of Growing Cracks</i>	9G-2
9G.1.7	<i>Numerical Analysis</i>	9G-2
9G.1.8	<i>Applicable Loads and Load Case Combinations</i>	9G-2
9G.2	STRESS ANALYSIS OF THE UN-CRACKED CONFIGURATION.....	9G-3
9G.2.1	<i>Overview</i>	9G-3
9G.2.2	<i>Categorization and Linearization of Stress Results</i>	9G-3
9G.2.3	<i>Fitting Stress Results to a Polynomial</i>	9G-3
9G.2.4	<i>The Weight Function Method</i>	9G-3
9G.3	FINITE ELEMENT ANALYSIS OF COMPONENTS WITH CRACKS.....	9G-4
9G.3.1	<i>Overview</i>	9G-4
9G.3.2	<i>Output Quantity</i>	9G-4
9G.3.3	<i>Mesh Design</i>	9G-4
9G.3.4	<i>Crack Tip Modeling Approaches</i>	9G-4
9G.3.5	<i>Focused Mesh Approach</i>	9G-4
9G.3.6	<i>Finite Radius Approach</i>	9G-5
9G.3.7	<i>Small Strain vs. Large Strain Analysis</i>	9G-6
9G.3.8	<i>Convergence</i>	9G-6
9G.3.9	<i>Initial and Thermal Strains</i>	9G-6
9G.3.10	<i>Modeling Procedure</i>	9G-7
9G.4	FAD-BASED METHOD FOR NON-GROWING CRACKS.....	9G-7
9G.4.1	<i>Overview</i>	9G-7
9G.4.2	<i>Assessment Procedure</i>	9G-8
9G.5	DRIVING FORCE METHOD FOR NON-GROWING CRACKS.....	9G-10
9G.5.1	<i>Overview</i>	9G-10
9G.5.2	<i>Assessment Procedure</i>	9G-10
9G.6	ASSESSMENT OF GROWING CRACKS	9G-11
9G.6.1	<i>Crack Growth Models</i>	9G-11
9G.6.2	<i>Crack Parameter Solutions</i>	9G-11
9G.6.3	<i>Determination of a Remaining Life</i>	9G-11
9G.6.4	<i>Crack Growth Using Numerical Methods</i>	9G-12
9G.7	NOMENCLATURE.....	9G-12
9G.8	REFERENCES.....	9G-13
9G.9	FIGURES	9G-14

PART 10 – ASSESSMENT OF COMPONENTS OPERATING IN THE CREEP RANGE..... 10-1

10.1	GENERAL	10-1
10.1.1	<i>FFS Procedures and Temperature Limits</i>	10-1
10.1.2	<i>Remaining Life of Components with and without Crack-Like Flaws</i>	10-2
10.2	APPLICABILITY AND LIMITATIONS OF THE PROCEDURE	10-2
10.2.1	<i>Suitability for Service and Remaining Life</i>	10-2
10.2.2	<i>Applicability and Limitations</i>	10-2
10.3	DATA REQUIREMENTS.....	10-4
10.3.1	<i>General</i>	10-4
10.3.2	<i>Original Equipment Design Data</i>	10-4
10.3.3	<i>Maintenance and Operational History</i>	10-4
10.3.4	<i>Required Data for a FFS Assessment – Loads and Stresses</i>	10-4
10.3.5	<i>Required Data for a FFS Assessment – Material Properties</i>	10-5
10.3.6	<i>Required Data for a FFS Assessment – Damage Characterization</i>	10-6
10.3.7	<i>Recommendation for Inspection Technique and Sizing Requirements</i>	10-7
10.4	ASSESSMENT TECHNIQUES AND ACCEPTANCE CRITERIA.....	10-9
10.4.1	<i>Overview</i>	10-9
10.4.2	<i>Level 1 Assessment</i>	10-10
10.4.3	<i>Level 2 Assessment</i>	10-11

API 579-1/ASME FFS-1 2016 Fitness-For-Service

10.4.4 Level 3 Assessment 10-12

10.5 REMAINING LIFE ASSESSMENT 10-12

10.5.1 Overview 10-12

10.5.2 Creep Rupture Life 10-13

10.5.3 Creep-Fatigue Interaction 10-20

10.5.4 Creep Crack Growth 10-21

10.5.5 Creep Buckling 10-26

10.5.6 Creep-Fatigue Assessment of Dissimilar Weld Joints 10-28

10.5.7 Microstructural Approach 10-31

10.6 REMEDIATION 10-33

10.6.1 Components with and without a Crack-Like Flaw 10-33

10.6.2 Components with a Crack-Like Flaw 10-33

10.7 IN-SERVICE MONITORING 10-33

10.8 DOCUMENTATION 10-33

10.8.1 General 10-33

10.8.2 Assumptions Used in the Assumptions 10-33

10.8.3 Documentation for Life Assessment 10-34

10.8.4 Supplemental Documentation for Creep Crack Growth 10-34

10.8.5 Supplemental Documentation for Microstructural Approaches 10-35

10.9 NOMENCLATURE 10-35

10.10 REFERENCES 10-42

10.11 TABLES 10-43

10.12 FIGURES 10-49

ANNEX 10A – TECHNICAL BASIS AND VALIDATION – ASSESSMENT OF COMPONENTS OPERATING IN THE CREEP RANGE 10A-1

10A.1 TECHNICAL BASIS AND VALIDATION 10A-1

10A.2 TECHNICAL BASIS AND VALIDATION REFERENCES 10A-1

10A.3 ADDITIONAL REFERENCES 10A-3

ANNEX 10B – MATERIAL DATA FOR CREEP ANALYSIS 10B-1

10B.1 GENERAL 10B-1

10B.2 CREEP RUPTURE DATA 10B-1

10B.2.1 MPC Project Omega 10B-1

10B.2.2 API Std 530, 6th Edition, September 2008 10B-3

10B.2.3 WRC Bulletin 541 10B-3

10B.3 TANGENT AND SECANT MODULUS 10B-4

10B.4 CREEP STRAIN-RATE DATA 10B-5

10B.5 ISOCHRONOUS STRESS-STRAIN CURVES 10B-5

10B.6 CREEP REGIME FATIGUE CURVES (CRACK INITIATION) 10B-5

10B.7 CREEP CRACK GROWTH DATA 10B-6

10B.8 NOMENCLATURE 10B-6

10B.9 REFERENCES 10B-8

10B.9.1 Technical References – High Temperature Assessment 10B-8

10B.9.2 Creep Rupture Strength and Creep Strain Rate Data 10B-9

10B.9.3 Creep Crack Growth Data 10B-10

10B.10 TABLES 10B-12

10B.11 FIGURES 10B-53

PART 11 – ASSESSMENT OF FIRE DAMAGE 11-1

11.1 GENERAL 11-1

API 579-1/ASME FFS-1 2016 Fitness-For-Service

11.1.1 Assessment of Fire Damage 11-1
11.1.2 Assessment of Process Upsets 11-1
11.1.3 Guidelines and Assessment Flowchart 11-2
11.1.4 Forms of Fire Damage 11-2
11.1.5 Alternative Methods for Equipment Not Suitable for Operation 11-2
11.2 APPLICABILITY AND LIMITATIONS OF THE PROCEDURE 11-2
11.2.1 Equipment and Components Covered by the Assessment Procedure..... 11-2
11.2.2 Equipment and Components Not Covered by the Assessment Procedure 11-2
11.3 DATA REQUIREMENTS..... 11-3
11.3.1 Original Equipment Design Data 11-3
11.3.2 Maintenance and Operational History 11-3
11.3.3 Required Data/Measurements for a FFS Assessment..... 11-3
11.3.4 Recommendations for Inspection Techniques and Sizing Requirements..... 11-7
11.4 ASSESSMENT TECHNIQUES AND ACCEPTANCE CRITERIA..... 11-8
11.4.1 Overview 11-8
11.4.2 Level 1 Assessment 11-8
11.4.3 Level 2 Assessment 11-9
11.4.4 Level 3 Assessment 11-11
11.5 REMAINING LIFE ASSESSMENT 11-11
11.5.1 Thinning and Crack-Like Flaw Damage 11-11
11.5.2 Creep Damage 11-12
11.6 REMEDIATION 11-12
11.6.1 Techniques 11-12
11.6.2 Need for Repair or Replacement..... 11-12
11.7 IN-SERVICE MONITORING..... 11-12
11.8 DOCUMENTATION 11-12
11.8.1 General..... 11-12
11.8.2 Heat Exposure Zones..... 11-12
11.8.3 Record Retention 11-12
11.9 NOMENCLATURE..... 11-12
11.10 REFERENCES..... 11-13
11.11 TABLES 11-14
11.12 FIGURES 11-41

ANNEX 11A – TECHNICAL BASIS AND VALIDATION – ASSESSMENT OF FIRE DAMAGE 11A-1

11A.1 TECHNICAL BASIS AND VALIDATION..... 11A-1
11A.2 REFERENCES..... 11A-1

ANNEX 11B – METALLURGICAL INVESTIGATION AND EVALUATION OF MECHANICAL PROPERTIES IN FIRE DAMAGE ASSESSMENT 11B-1

11B.1 GENERAL 11B-1
11B.1.1 Metallurgical Investigations 11B-1
11B.1.2 Materials Covered..... 11B-1
11B.1.3 Change in material properties from Fire Damage 11B-2
11B.2 APPLICABILITY AND LIMITATIONS OF THE PROCEDURE 11B-2
11B.3 SPECIFIC RESPONSIBILITIES AND QUALIFICATIONS..... 11B-2
11B.3.1 Overview..... 11B-2
11B.3.2 Field Assessment Team 11B-2
11B.3.3 Laboratory Assessment Team 11B-3
11B.4 EVALUATION TECHNIQUES 11B-3
11B.5 FIELD ASSESSMENT TECHNIQUES 11B-3
11B.5.1 Field Hardness Testing 11B-3

API 579-1/ASME FFS-1 2016 Fitness-For-Service

11B.5.2 *In-situ Metallography or Replication*..... 11B-4
11B.5.3 *Positive Material Identification*..... 11B-4
11B.6 LABORATORY ASSESSMENT TECHNIQUES..... 11B-5
11B.6.1 *Coupon or Sample Removal*..... 11B-5
11B.6.2 *Metallurgical Mounts and Mechanical Testing Specimens*..... 11B-5
11B.7 WORK PROCEDURE..... 11B-5
11B.7.1 *STEP 1 – Select Equipment and Component Subject to Analysis*..... 11B-5
11B.7.2 *STEP 2 – Select Sampling Technique(s)*..... 11B-6
11B.7.3 *STEP 3 – Perform In-situ Metallography or Replica Evaluation* 11B-6
11B.7.4 *STEP 4: Take Field Hardness Readings*..... 11B-6
11B.7.5 *STEP 5: Remove Samples for Laboratory Analysis and Mechanical Testing (Optional)*..... 11B-7
11B.8 GUIDANCE FOR METALLOGRAPHIC ANALYSIS AND MECHANICAL TESTING INTERPRETATION 11B-7
11B.8.1 *Overview*..... 11B-7
11B.8.2 *Reduction in Tensile Strength*..... 11B-7
11B.8.3 *Reduction in Toughness* 11B-7
11B.8.4 *Decrease of Corrosion Resistance*..... 11B-8
11B.8.5 *Consideration for Reuse* 11B-8
11B.8.6 *Heat Treatment* 11B-8
11B.9 EXAMPLE OF METALLOGRAPHY ANALYSIS AND HARDNESS TESTING RESULTS..... 11B-8
11B.9.1 *Overview*..... 11B-8
11B.9.2 *Samples*..... 11B-9
11B.9.3 *Test Sequence* 11B-9
11B.9.4 *Test Results – Metallography*..... 11B-9
11B.9.5 *Test Results – Hardness*..... 11B-10
11B.10 FIGURES 11B-11

PART 12 – ASSESSMENT OF DENTS, GOUGES, AND DENT-GOUGE COMBINATIONS 12-1

12.1 GENERAL 12-1
12.1.1 *Assessment Procedures for Dents, Gouges and Dent-Gouge Combinations*..... 12-1
12.1.2 *Assessment Procedures for LTAs, Grooves and Other Shell Distortions* 12-1
12.2 APPLICABILITY AND LIMITATIONS OF THE PROCEDURE 12-2
12.2.1 *Overview* 12-2
12.2.2 *Calculation of the MAWP and Coincident Temperature* 12-2
12.2.3 *Limitations Based on Flaw Type*..... 12-2
12.2.4 *Limitations Based on Temperature* 12-2
12.2.5 *Applicability of the Level 1 and Level 2 Assessment Procedures* 12-2
12.2.6 *Applicability of the Level 3 Assessment Procedure* 12-3
12.3 DATA REQUIREMENTS..... 12-4
12.3.1 *Original Equipment Design Data* 12-4
12.3.2 *Maintenance and Operational History* 12-4
12.3.3 *Required Data/Measurements for a FFS Assessment*..... 12-4
12.3.4 *Recommendations for Inspection Technique and Sizing Requirements*..... 12-6
12.4 ASSESSMENT TECHNIQUES AND ACCEPTANCE CRITERIA..... 12-6
12.4.1 *Overview* 12-6
12.4.2 *Level 1 Assessment* 12-7
12.4.3 *Level 2 Assessment* 12-9
12.4.4 *Level 3 Assessment* 12-12
12.5 REMAINING LIFE ASSESSMENT 12-13
12.5.1 *Categories of Remaining Life Assessment*..... 12-13
12.5.2 *Requirements for a Level 3 Assessment*..... 12-14
12.6 REMEDIATION 12-14
12.6.1 *Flaw Severity and Evaluation of Material Condition* 12-14
12.6.2 *Reinforcement of Dents, Gouges and Dent-Gouge Combinations* 12-14

API 579-1/ASME FFS-1 2016 Fitness-For-Service

12.6.3 Use of General Corrosion Remediation Methods 12-14

12.7 IN-SERVICE MONITORING 12-14

12.7.1 Requirements for In-Service Monitoring 12-14

12.7.2 Visual Inspection and Field Measurements of Distortion 12-14

12.8 DOCUMENTATION 12-14

12.8.1 Requirements 12-14

12.8.2 Inspection and Field Measurements 12-15

12.9 NOMENCLATURE 12-15

12.10 REFERENCES 12-16

12.11 TABLES 12-17

12.12 FIGURES 12-20

ANNEX 12A – TECHNICAL BASIS AND VALIDATION – ASSESSMENT OF DENTS, GOUGES, AND DENT-GOUGE COMBINATIONS..... 12A-1

12A.1 TECHNICAL BASIS AND VALIDATION 12A-1

12A.2 REFERENCES 12A-1

PART 13 – ASSESSMENT OF LAMINATIONS 13-1

13.1 GENERAL 13-1

13.1.1 Assessment Procedures for Laminations 13-1

13.1.2 Definition of Laminations 13-1

13.1.3 Laminations in Hydrogen Charging Service 13-1

13.1.4 Detection of Laminations 13-2

13.1.5 Acceptance of Laminations 13-2

13.2 APPLICABILITY AND LIMITATIONS OF THE PROCEDURE 13-2

13.2.1 Applicability and Limitations of the Assessments Procedures for Laminations 13-2

13.2.2 Calculation of MAWP and Coincident Temperature 13-2

13.2.3 Limitations Based on Temperature 13-2

13.2.4 Limitations Based on Flaw Type 13-2

13.2.5 Applicability of the Level 1 and Level 2 Assessment Procedures 13-3

13.2.6 Applicability of the Level 3 Assessment 13-3

13.3 DATA REQUIREMENTS 13-3

13.3.1 Original Equipment Design Data 13-3

13.3.2 Maintenance and Operational History 13-3

13.3.3 Required Data/Measurements for a FFS Assessment 13-3

13.3.4 Recommendations for Inspection Technique and Sizing Requirements 13-4

13.4 ASSESSMENT TECHNIQUES AND ACCEPTANCE CRITERIA 13-4

13.4.1 Overview 13-4

13.4.2 Level 1 Assessment 13-5

13.4.3 Level 2 Assessment 13-6

13.4.4 Level 3 Assessment 13-7

13.5 REMAINING LIFE ASSESSMENT 13-7

13.6 REMEDIATION 13-7

13.7 IN-SERVICE MONITORING 13-7

13.8 DOCUMENTATION 13-7

13.8.1 General 13-7

13.8.2 Documentation of Flaw Size and Conditions 13-7

13.8.3 Documentation of Flaw Growth 13-7

13.9 NOMENCLATURE 13-7

13.10 REFERENCES 13-8

13.11 TABLES 13-9

13.12 FIGURES 13-10

ANNEX 13A – TECHNICAL BASIS AND VALIDATION – ASSESSMENT OF LAMINATIONS.....	13A-1
13A.1 TECHNICAL BASIS AND VALIDATION.....	13A-1
13A.2 REFERENCES.....	13A-1
PART 14 – ASSESSMENT OF FATIGUE DAMAGE	14-1
14.1 GENERAL	14-2
14.1.1 <i>Assessment Procedures for Fatigue Damage</i>	14-2
14.1.2 <i>Damage Tolerance</i>	14-2
14.1.3 <i>Fatigue Evaluation in the Creep Range</i>	14-2
14.1.4 <i>Fatigue Evaluation and Crack-Like Flaws</i>	14-2
14.1.5 <i>ASME B&PV Code, Section VIII, Division 2 (VIII-2)</i>	14-2
14.1.6 <i>Use of Fatigue Curves in Performing Assessments</i>	14-2
14.1.7 <i>Adjustment for Mean Stress</i>	14-2
14.1.8 <i>Ratcheting</i>	14-3
14.2 APPLICABILITY AND LIMITATIONS OF THE PROCEDURE	14-3
14.2.1 <i>Applicability and Limitations of the Assessment Procedures</i>	14-3
14.2.2 <i>Calculation of MAWP and Coincident Temperature</i>	14-3
14.2.3 <i>Limitations Based on Temperature</i>	14-3
14.2.4 <i>Limitations Based on Flaw Type</i>	14-3
14.2.5 <i>Applicability of the Level 1 and Level 2 Assessment Procedures</i>	14-3
14.2.6 <i>Applicability of the Level 3 Assessment</i>	14-4
14.3 DATA REQUIREMENTS.....	14-4
14.3.1 <i>Original Equipment Design Data</i>	14-4
14.3.2 <i>Maintenance and Operational History</i>	14-4
14.3.3 <i>Required Data/Measurements for an FFS Assessment</i>	14-4
14.3.4 <i>Recommendations for Inspection Technique and Sizing Requirements</i>	14-5
14.4 ASSESSMENT TECHNIQUES AND ACCEPTANCE CRITERIA.....	14-5
14.4.1 <i>Overview</i>	14-5
14.4.2 <i>Level 1 Assessment</i>	14-6
14.4.3 <i>Level 2 Assessment</i>	14-10
14.4.4 <i>Level 3 Assessment</i>	14-24
14.5 REMAINING LIFE ASSESSMENT	14-27
14.5.1 <i>Included in Level 2 and Level 3 Assessments</i>	14-27
14.5.2 <i>Loading Time History</i>	14-27
14.6 REMEDIATION	14-27
14.6.1 <i>Overview</i>	14-27
14.6.2 <i>Removal or Reduction of the Driving Energy Source or Forces</i>	14-27
14.6.3 <i>Alteration of Component Constraint, Mechanical Design, or Weld Quality</i>	14-28
14.6.4 <i>Reduction of Temperature Differentials or Gradients</i>	14-28
14.7 IN-SERVICE MONITORING.....	14-28
14.8 DOCUMENTATION	14-29
14.8.1 <i>General</i>	14-29
14.8.2 <i>Assessment Level</i>	14-29
14.8.3 <i>Loading Time History</i>	14-29
14.8.4 <i>Material Properties</i>	14-29
14.8.5 <i>Stress Analysis Results</i>	14-29
14.8.6 <i>Assessment Results</i>	14-29
14.8.7 <i>Remaining Life Assessment</i>	14-29
14.8.8 <i>Remediation Methods</i>	14-29
14.8.9 <i>In-Service Monitoring</i>	14-30
14.9 NOMENCLATURE.....	14-30
14.10 REFERENCES.....	14-37
14.11 TABLES	14-38

API 579-1/ASME FFS-1 2016 Fitness-For-Service

14.12 FIGURES 14-56

ANNEX 14A – TECHNICAL BASIS AND VALIDATION – ASSESSMENT OF FATIGUE DAMAGE 14A-1

14A.1 TECHNICAL BASIS AND VALIDATION..... 14A-1

14A.2 REFERENCES..... 14A-1

ANNEX 14B – MATERIAL PROPERTIES FOR FATIGUE ANALYSIS..... 14B-1

14B.1 SMOOTH BAR FATIGUE CURVES..... 14B-1

 14B.1.1 *Fatigue Curves* 14B-1

 14B.1.2 *Fatigue Curve Models* 14B-1

 14B.1.3 *Computation of Allowable Cycles* 14B-4

14B.2 UNIFORM MATERIAL LAW 14B-4

14B.3 WELDED JOINT FATIGUE CURVES 14B-4

 14B.3.1 *Fatigue Curve Models* 14B-4

 14B.3.2 *Computation of Allowable Cycles* 14B-4

14B.4 NOMENCLATURE..... 14B-5

14B.5 REFERENCES..... 14B-6

14B.6 TABLES 14B-7

14B.7 FIGURES 14B-10

ANNEX 14C – PLASTICITY CORRECTION AND CYCLE COUNTING FOR FATIGUE ANALYSIS..... 14C-1

14C.1 INTRODUCTION 14C-1

 14C.1.1 *Cycle Counting* 14C-1

 14C.1.2 *Plasticity Correction* 14C-1

 14C.1.3 *Definitions*..... 14C-2

 14C.1.4 *Histogram Development* 14C-3

14C.2 PLASTICITY CORRECTION 14C-3

 14C.2.1 *Uniaxial Plasticity Correction*..... 14C-3

 14C.2.2 *Multiaxial Plasticity Correction* 14C-3

14C.3 UNIAXIAL CYCLE COUNTING 14C-8

 14C.3.1 *Rainflow Cycle Counting – With Reordering*..... 14C-8

 14C.3.2 *Additional Rainflow Cycle Counting – Without Reordering*..... 14C-9

14C.4 MULTIAXIAL CYCLE COUNTING 14C-10

 14C.4.1 *Wang-Brown Cycle Counting*..... 14C-10

 14C.4.2 *Critical Plane Cycle Counting*..... 14C-15

14C.5 NOMENCLATURE..... 14C-18

14C.6 REFERENCES..... 14C-22

14C.7 FIGURES 14C-24

PART 1 – INTRODUCTION

CONTENTS

PART 1 – INTRODUCTION	1-1
1.1 INTRODUCTION	1-1
1.1.1 <i>Construction Codes and Fitness-For-Service</i>	1-1
1.1.2 <i>Fitness-For-Service Definition</i>	1-1
1.2 SCOPE	1-2
1.2.1 <i>Supplement to In-Service Inspection Codes</i>	1-2
1.2.2 <i>Application Construction Codes</i>	1-2
1.2.3 <i>Other Recognized Codes and Standards</i>	1-2
1.2.4 <i>Remaining Life</i>	1-3
1.2.5 <i>Assessment Methods for Flaw Types and Damage Conditions</i>	1-3
1.2.6 <i>Special Cases</i>	1-4
1.3 ORGANIZATION AND USE	1-4
1.4 RESPONSIBILITIES.....	1-4
1.4.1 <i>Owner-User</i>	1-4
1.4.2 <i>Inspector</i>	1-4
1.4.3 <i>Engineer</i>	1-4
1.4.4 <i>Plant Engineer</i>	1-5
1.5 QUALIFICATIONS.....	1-5
1.5.1 <i>Education and Experience</i>	1-5
1.5.2 <i>Owner-User</i>	1-5
1.5.3 <i>Inspector</i>	1-5
1.5.4 <i>Engineer</i>	1-6
1.6 DEFINITION OF TERMS	1-6
1.7 REFERENCES	1-6
1.7.1 <i>Types</i>	1-6
1.7.2 <i>Code, Standards and Recommended Practices</i>	1-6
1.7.3 <i>Technical reports and Other Publications</i>	1-6
1.8 TABLES	1-7

1.1 Introduction

1.1.1 Construction Codes and Fitness-For-Service

The ASME and API new construction codes and standards for pressurized equipment provide rules for the design, fabrication, inspection and testing of new pressure vessels, piping systems, and storage tanks. These codes typically do not provide rules to evaluate equipment that degrades while in-service and deficiencies caused by degradation or from original fabrication that may be found during subsequent inspections. API 510, API 570, API 653, and NB-23 Codes/Standards for the inspection, repair, alteration, and rerating of in-service pressure vessels, piping systems, and storage tanks do address the fact that equipment degrades while in service.

1.1.2 Fitness-For-Service Definition

Fitness-For-Service (*FFS*) assessments are quantitative engineering evaluations that are performed to demonstrate the structural integrity of an in-service component that may contain a flaw or damage, or that may be operating under a specific condition that might cause a failure. This Standard provides guidance for conducting *FFS* assessments using methodologies specifically prepared for pressurized equipment. The