

**Proceedings of
ASME 2022 Pressure Vessels
and Piping Conference**

(PVP2022)

Volume 4B

**July 17-22, 2022
Las Vegas, Nevada**

Conference Sponsor
Pressure Vessels and Piping Division

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Two Park Avenue * New York, N.Y. 10016

© 2022, The American Society of Mechanical Engineers, 2 Park Avenue, New York, NY 10016, USA
(www.asme.org)

All rights reserved. Printed in the United States of America. Except as permitted under the United States Copyright Act of 1976, no part of this publication may be reproduced or distributed in any form or by any means, or stored in a database or retrieval system, without the prior written permission of the publisher.

INFORMATION CONTAINED IN THIS WORK HAS BEEN OBTAINED BY THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS FROM SOURCES BELIEVED TO BE RELIABLE. HOWEVER, NEITHER ASME NOR ITS AUTHORS OR EDITORS GUARANTEE THE ACCURACY OR COMPLETENESS OF ANY INFORMATION PUBLISHED IN THIS WORK. NEITHER ASME NOR ITS AUTHORS AND EDITORS SHALL BE RESPONSIBLE FOR ANY ERRORS, OMISSIONS, OR DAMAGES ARISING OUT OF THE USE OF THIS INFORMATION. THE WORK IS PUBLISHED WITH THE UNDERSTANDING THAT ASME AND ITS AUTHORS AND EDITORS ARE SUPPLYING INFORMATION BUT ARE NOT ATTEMPTING TO RENDER ENGINEERING OR OTHER PROFESSIONAL SERVICES. IF SUCH ENGINEERING OR PROFESSIONAL SERVICES ARE REQUIRED, THE ASSISTANCE OF AN APPROPRIATE PROFESSIONAL SHOULD BE SOUGHT.

ASME shall not be responsible for statements or opinions advanced in papers or . . . printed in its publications (B7.1.3). Statement from the Bylaws.

For authorization to photocopy material for internal or personal use under those circumstances not falling within the fair use provisions of the Copyright Act, contact the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923, tel: 978-750-8400, www.copyright.com.

Requests for special permission or bulk reproduction should be addressed to the ASME Publishing Department, or submitted online at: <https://www.asme.org/publications-submissions/journals/information-for-authors/journalguidelines/rights-and-permissions>

ISBN: 978-0-7918-8618-2

CONTENTS

Proceedings of ASME 2022 Pressure Vessels and Piping Conference Volume 4B

MATERIALS AND FABRICATION

High Strength Steels for Pressure Vessels and Piping Applications

PVP2022-84672	V04BT06A001
Low-Alloy SA-533 Steels as Alternative to ASME SA-516 Carbon Steel for Fabrication of Lightweight FPSO Vessels <i>Valéry Ngomo, Evelyne Guyot, Ivan Lancini, and Dany Cornut</i>	

PVP2022-84987	V04BT06A002
High Strength Heavy Wall HY-80 Flux Cored Arc Welding <i>Dongmei Sun and Brent Johnstone</i>	

Leak Before Break

PVP2022-82129	V04BT06A003
Overview of Leak-Before-Break Best Practice Document Developed Under the ATLAS+ Project <i>John Sharples, Peter Gill, and Brian Daniels</i>	

PVP2022-84833	V04BT06A004
Evaluation of the Fracture Behavior of Cold-Worked Elbows With Prescribed Cracks <i>Sureshkumar Kalyanam, Sushma Pothana, Gery Wilkowski, Yunion Hioe, Fabian Orth, Frederick Brust, and Steven Gilbert</i>	

PVP2022-86180	V04BT06A005
Application of Leak-Before-Break to Small Diameter Piping Nozzles With Dissimilar Metal Butt Welds Susceptible to PWSCC Using xLPR <i>Nat Cofie, Dilip Dedhia, Gary Dominguez, Mo Uddin, Craig Harrington, Nate Glunt, and Do Jun Shim</i>	

Material Quality and Failure Analysis

PVP2022-80411	V04BT06A006
Unique Failures in Explosion Bond Cryogenic Transition Joints <i>Richard L. Colwell</i>	

PVP2022-84549	V04BT06A007
Effect of Normalizing Cooling Rate on Impact Toughness of ASME SA – 350 LF2 CL1 Forgings <i>R. Hernández Soto and J. M. Gómez de Salazar</i>	

PVP2022-84781	V04BT06A008
Hydrogen Induced Cracking Susceptibility in the Heat Affected Zone of SA-508 Pressure Vessel Steel <i>Joshua D. Velasquez, Boian T. Alexandrov, and Steven L. McCracken</i>	

PVP2022-84867	V04BT06A009
Flanges Impact Testing Exemption Assessment <i>Roberto Robles, Miguel Muñoz, and Antonio Santana</i>	

Materials and Fabrication for Refining

- PVP2022-80246** V04BT06A010
Evaluation of Stainless Steels Welds Produced by Gas Tungsten Arc Welding With High Silicon Containing Solid Welding Filler Rod to Omit Back Shielding
Atsushi Takahashi
- PVP2022-84640** V04BT06A011
A Methodology for Calculating the Minimum Pressurization Temperature of New Built Hydroprocessing Reactors in 2¼Cr-1Mo-¼V Low Alloy Steel
Jan-Willem Rensman, Davide Frittitta, Fausto Fusari, and Nicola Ronchi
- PVP2022-84663** V04BT06A012
Mechanism of High Temperature Stability on Microstructures of 25Cr35NiNb Alloy Prepared by Laser Additive Manufacturing
Jizhan Li, Zhichao Fan, Tao Chen, and Yu Zhou
- PVP2022-84862** V04BT06A013
Mechanical Properties and the Effect of Hydrogen on Base Metal and Welds of 9Cr-1Mo-V Steel
Ian Zuazo Rodriguez, Stefano Alberini, Claude Bouillot, Dany Cornut, and Fausto Fusari
- PVP2022-84863** V04BT06A014
Case History of Hydrotreater Prefeed Heater Fire Recovery
Jorge Penso, Neil Park, Mitul Dalal, and Alexandra Hosack
- PVP2022-84889** V04BT06A015
Duplex Stainless Steel – Learning From Field Experience in Oil & Gas and Petrochemical Services
Mitul Dalal and Jorge Penso

Materials and Technologies for Nuclear Power Plants

- PVP2022-80557** V04BT06A016
Enhanced Mechanical Properties of Iron-Chromium-Aluminum Cladding for Light Water Reactor Fuels
Raul B. Rebak, Evan J. Dolley, Wanming Zhang, Rajnikant V. Umretiya, and Andrew K. Hoffman
- PVP2022-80559** V04BT06A017
Mitigating LWR IronClad Fuel Cladding Dissolution Using Zinc Water Chemistry
Raul B. Rebak, Liang Yin, Michael Larsen, Rajnikant V. Umretiya, and Andrew K. Hoffman
- PVP2022-84442** V04BT06A018
Fretting Corrosion Behavior of 316L Stainless Steel Heat Exchanger Tube in NaCl Solution
Xu Ma, Shengzan Zhang, Wei Tan, and Guorui Zhu
- PVP2022-84517** V04BT06A019
Post-Irradiation Fracture Toughness Characterization of Generation II FeCrAl Alloys
Xiang (Frank) Chen, Kevin G. Field, Richard Howard, Caleb P. Massey, and Andrew T. Nelson
- PVP2022-84606** V04BT06A020
Study on Ductile Crack Extension and Fracture Behavior in Plate Specimen With a Semi-Elliptical Surface Crack Using a BWR Reactor Pressure Vessel Material
Takahiro Hayashi, Takuya Ogawa, Shuichi Yoshida, Masao Itatani, and Toshiyuki Saito

PVP2022-85319 **V04BT06A021**
Metallurgical Characterization of a 114,000-Hour Service-Aged Forge 91-Pipe 91
Steel Header Weldment
*Yiyu Wang, Wei Zhang, Yanli Wang, Zhili Feng, John Siefert, Alex Bridges, and
Steven Kung*

Materials for Hydrogen Service (Joint With C&S)

PVP2022-80639 **V04BT06A022**
DetaClad™ Characterization for High-Temperature and High-Pressure Hydrogen
Service
Olivier Sarrat, Curtis Prothe, and Tim Delahanty

PVP2022-81492 **V04BT06A023**
Strain-Life Performance in Hydrogen of a Dot Pressure Vessel Steel
*May L. Martin, Peter E. Bradley, Damian Lauria, Robert L. Amaro, Matthew
Connolly, and Andrew J. Slifka*

PVP2022-81859 **V04BT06A024**
Testing for the Effects of Pressurized Hydrogen on Polymeric Elastomers
Jeff Ellis, Jessica Whitman, and Laura Zoller

PVP2022-83915 **V04BT06A025**
Investigating the Role of Ferritic Steel Microstructure and Strength in Fracture
Resistance in High-Pressure Hydrogen Gas
*Joseph A. Ronevich, Brian Kagay, Chris San Marchi, Yiyu (Jason) Wang, Zhili
Feng, Yanli Wang, and Kip Findley*

PVP2022-83958 **V04BT06A026**
Modelling the Effects of Hydrogen Pressure on Fatigue Crack Growth Behavior in
SA372 Pressure Vessel Steels
Ashok Saxena and Kip O. Findley

PVP2022-84051 **V04BT06A027**
Hydrogen Permeability of Self-Healing Copolymers for Use in Hydrogen Delivery
Applications
*Dale Hitchcock, Timothy Krentz, Anastasia Mullins, Charles James, Qianhui Liu,
Siyang Wang, Samruddhi Gaikwad, and Marek W. Urban*

PVP2022-84184 **V04BT06A028**
Gaseous Hydrogen Charging and Fatigue Testing on IN718
Fabien Ebling and Ken Wackermann

PVP2022-84452 **V04BT06A029**
Development of Material Mechanical Properties Testing Platform for Liquid Hydrogen
Temperature Zone
*Yufeng Feng, Yingzhe Wu, Jiyong Kuang, Chaohua Gu, Jinyang Zheng, Zhengli
Hua, and Ruizhe Gao*

PVP2022-84462 **V04BT06A030**
Difference of Hydrogen Diffusion Regularity Between Interstice-Doped and
Substitution-Doped Formed by Steel Carburizing
*Baihui Xing, Jing Wang, Haotian Wei, Juan Shang, Zhengli Hua, Chaohua Gu, and
Jinyang Zheng*

PVP2022-84647 **V04BT06A031**
Development of Screening Technology for Hydrogen Embrittlement Compatibility of
Pipeline Steels and Welds Using Simple In-Situ Tests in High-Pressure Environments
Hyung-Seop Shin, Eunsu Min, Sungbeom Kang, and Un-Bong Baek

PVP2022-84717	V04BT06A032
The Influence of Hydrogen on the Elastic Modulus of 316L and XM-19 Austenitic Stainless Steels	
<i>Kevin Scott, Patricio Mendez, and Sridhar Seetharaman</i>	
PVP2022-84745	V04BT06A033
Evaluation of Hydrogen Embrittlement Sensitivity of 4130X Material Based on the Disc Method	
<i>Jian-Ming Zhai</i>	
PVP2022-84757	V04BT06A034
Fatigue and Fracture of Pipeline Steels in High-Pressure Hydrogen Gas	
<i>Chris San Marchi and Joseph A. Ronevich</i>	
PVP2022-84797	V04BT06A035
Influence of High-Pressure Hydrogen Gas and Pre-Charged Hydrogen on Fatigue Crack Initiation and Fatigue Life of 255 Super Duplex Stainless Steel	
<i>Brian Kagay, Joseph Ronevich, and Chris San Marchi</i>	
PVP2022-84879	V04BT06A036
Effect of Trace Water Vapor on Measurement of Fatigue Crack Growth Rates in Hydrogen Gas at Low ΔK	
<i>Kevin Nibur and Brian Somerday</i>	
Mechanistic Modelling of Deformation and Fracture	
PVP2022-85773	V04BT06A037
Modeling Electric-Potential for a Crack Subjected to Corrosion Under Static and Cyclic Loading	
<i>Raghu V. Prakash, C. Anish, and Dhinakaran Sampath</i>	
Pipeline Integrity	
PVP2022-80320	V04BT06A038
Fatigue Crack Growth Assessment of Pipeline Steels and Girth Welds	
<i>Dong-Yeob Park, Jie Liang, and Jean-Philippe Gravel</i>	
PVP2022-84341	V04BT06A039
Calibration and Verification of XFEM Model to Predict Ductile Fracture	
<i>Israel Cubas Pereira and Diego F. B. Sarzosa</i>	
PVP2022-84788	V04BT06A040
Numerical Investigation of Ductile Crack Propagation of Circumferentially Cracked Pipes Subjected to Multiaxial Loading at Room and Low Temperatures	
<i>Yuhao Li and Marcelo Paredes</i>	
PVP2022-84791	V04BT06A041
Compatibility of Medium Density Polyethylene (MDPE) for Distribution of Gaseous Hydrogen	
<i>Rakish Shrestha, Joseph A. Ronevich, Lisa Fring, Kevin Simmons, Noah D. Meeks, Zachary E. Lowe, Timothy J. Harris, Jr., and Chris San Marchi</i>	
PVP2022-84902	V04BT06A042
New Strength Theory and Its Application to Determine Burst Pressure of Thick-Wall Pressure Vessels	
<i>Xian-Kui Zhu, Bruce Wiersma, Robert Sindelar, and William R. Johnson</i>	
PVP2022-84908	V04BT06A043
Machine Learning Models of Burst Strength for Defect-Free Pipelines	
<i>Xian-Kui Zhu, William R. Johnson, Robert Sindelar, and Bruce Wiersma</i>	

Small-Scale and Miniature Mechanical Testing (Joint With C&S)

- PVP2022-81773** V04BT06A044
Evaluation of Validity Criteria for Subsize Compact Tension Specimens Using a Bending Modified J-A₂ Solution
Kenneth Bagnoli, Greg Thorwald, Ryan Holloman, and Y. Hioe
- PVP2022-83663** V04BT06A045
Investigation on Mechanical Properties of X80 Pipeline Girth Weld Welded by Semi-Automatic and Automatic Welding
Wei Ren and Jian Shuai
- PVP2022-83811** V04BT06A046
Round Robin Analysis of Small Punch Testing on 15Kh2NMFA Reference Material
Romy Welschen, Ferenc Gillemot, Igor Simonovski, Oliver Martin, Marek Adamech, Jana Petzova, Rebeca Hernandez, Radim Kopriva, Frederiki Naziris, Boy Molenaar, and Murthy Kolluri
- PVP2022-83875** V04BT06A047
Application of Small Punch Testing Methods for Thermal Ageing Assessment at Steam-Generators Materials From Decommissioned V1 NPP to LTO Support on VVER Type Units in Slovakia
Jana Petzova, Marek Adamech, and David Sinek
- PVP2022-84744** V04BT06A048
Overview of Suitable Methodologies for Threshold Stress Determination by Small Punch in Aggressive Environments
Laura Andrea Calvo, Borja Arroyo Martinez, José Alberto Álvarez Laso, Federico Gutiérrez-Solana, Sergio Cicero González, and Roberto Lacalle Calderón
- PVP2022-84936** V04BT06A049
Determination of Irradiated Stainless Steel Properties and Its Effects on Reactor Vessel Internals
Dong-Hyeon Kwak, Jae Min Sim, Yoon-Suk Chang, Byeong Seo Kong, and Changheui Jang

Structural Integrity for Spent Fuel Canisters

- PVP2022-83765** V04BT06A050
Effects of Strain Rate on Strain-Based Failure Assessment of Cask 1m-Puncture Drop for 304 Stainless Steel
Hune-Tae Kim, Jun-Min Seo, Ji-Hye Kim, and Yun-Jae Kim
- PVP2022-83766** V04BT06A051
Effect Of The Mean Temperature of Storage Site on Chloride-Induced Stress Corrosion Cracking Rate in ASME Code Case N-860: Case Study
Jae-Yoon Jeong, Yun-Jae Kim, Poh-Sang Lam, Seunghyun Kim, and Gi-Dong Kim
- PVP2022-83772** V04BT06A052
Determination of Johnson-Cook Fracture Strain Model for Austenitic Stainless Steel 304
Jun-Min Seo, Hune-Tae Kim, Yun-Jae Kim, Hiroyuki Yamada, Tomohisa Kumagai, Hayato Tokunaga, and Naoki Miura

Welding Residual Stress and Distortion Simulation and Measurement

- PVP2022-84662** V04BT06A053
Effect of Welding Direction and Bead Pattern in Alloy 52 / SA508 Repair Weld
Heikki Keinänen, Juha Kuutti, Noora Hytönen, Pekka Nevasmaa, Caitlin Huotilainen, Iikka Virkkunen, Suprit Bhusare, Alishious Lambai, and Gaurav Mohanty

PVP2022-84741	V04BT06A054
Combining Weld Residual Stress Predictions and Measurement for Use in Probabilistic Structural Integrity Assessments	
<i>Harry Coules, Christopher Simpson, and Mahmoud Mostafavi</i>	
PVP2022-84779	V04BT06A055
Electron Beam Welds in 316L Part 1: Weld Production, Residual Stress Measurements and Predictions	
<i>Graeme Horne and Andrew Moffat</i>	
PVP2022-84798	V04BT06A056
Electron Beam Welds in 316L Part 2: A Methodology and Example for Parameterised Residual Stress Profiles	
<i>Graeme Horne, Ben Elliott, and Andrew Moffat</i>	
PVP2022-85023	V04BT06A057
Development of a Phased Array Ultrasonic System for Residual Stress Measurement in Welding and Additive Manufacturing	
<i>Yashar Javadi, Alistair Hutchison, Rastislav Zimmermann, David Lines, Nina E. Sweeney, Momchil Vasilev, Ehsan Mohseni, Randika K. W. Vithanage, Charles N. MacLeod, Gareth Pierce, Jorn Mehnen, and Anthony Gachagan</i>	
PVP2022-85083	V04BT06A058
NeT Project Task Group 8 – An International Benchmark on Residual Stress Assessment for Welding Repair	
<i>Vincent Robin, Jefri Draup, Sofiane Hendili, Josselin Delmas, Qingrong Xiong, Mike Smith, and Alexandre Paget</i>	
PVP2022-85958	V04BT06A059
Weld Residual Stress Modeling of and Fracture Assessment of Layered Pressure Vessels	
<i>F. W. Brust</i>	