

# **6th International Conference on Creep, Fatigue and Creep-Fatigue Interaction 2012**

**Procedia Engineering Volume 55**

**Kalpakkam, India  
22-25 January 2012**

**Editors:**

**S. C. Chetal  
R. Sandhya  
M. D. Mathew**

**T. Jayakumar  
K. Laha**

**ISBN: 978-1-62748-636-1  
ISSN: 1877-7058**

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© by Elsevier B.V.  
All rights reserved.

Printed by Curran Associates, Inc. (2013)

For permission requests, please contact Elsevier B.V.  
at the address below.

Elsevier B.V.  
Radarweg 29  
Amsterdam 1043 NX  
The Netherlands

Phone: +31 20 485 3911  
Fax: +31 20 485 2457

<http://www.elsevierpublishingsolutions.com/contact.asp>

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2634  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

# TABLE OF CONTENTS

<b>Preface</b> .....	1
<b>Influence of Chemical Composition and Heat Treatment on Long-term Creep Strength of Grade 91 Steel</b> .....	2
<i>K. Kimura, K. Sawada, H. Kushima, Y. Toda</i>	
<b>Advances in Low-Temperature (&lt;math&gt;\leq 0.25T_m&lt;/math&gt;) Creep Behavior of Single and Two-Phase Titanium Alloys</b> .....	10
<i>Sreeramamurthy Ankem, Zane W. Wyatt, William Joost</i>	
<b>Creep and Low Cycle Fatigue Behaviour of Fast Reactor Structural Materials</b> .....	17
<i>M. D. Mathew, K. Laha, R. Sandhya</i>	
<b>Long Term Microstructural Evolution of 9-12%Cr Steel Grades for Steam Power Generation Plants</b> .....	27
<i>A. Di Gianfrancesco, S. Tiberi Vipraio, D. Venditti</i>	
<b>Effect of Nitrogen on Evolution of Dislocation Substructure in 316LN SS During Creep</b> .....	36
<i>V. Ganesan, M. D. Mathew, P. Parameswaran, K. Laha</i>	
<b>Creep-Induced Microstructural Changes in Large Welded Joints of High Cr Heat Resistant Steel</b> .....	41
<i>Yuta Tanaka, Keiji Kubushiro, Satoshi Takahashi, Noriko Saito, Hirokatsu Nakagawa</i>	
<b>Comparison of Creep Properties of Four Copper Alloys and Creep Based Stress Analysis of a Rocket Engine Combustion Chamber</b> .....	45
<i>A. K. Asraff, R. Aparna, D. Kumaresan, R. Muthukumar</i>	
<b>Influence of Ru Addition on Microstructure, Creep and Rupture Properties of Nickel based DS Superalloy</b> .....	51
<i>D. Chatterjee, N. Hazari, N. Das</i>	
<b>Improvement in Creep Damage Tolerance of 14Cr-15Ni-Ti Modified Stainless Steel by Addition of Minor Elements</b> .....	58
<i>S. Latha, M. D. Mathew, P. Parameswaran, K. Laha, S. Panneer Selvi, S. L. Mannan</i>	
<b>Creep Deformation and Rupture Behaviour of P92 Steel at 923 K</b> .....	64
<i>E. Isaac Samuel, B. K. Choudhary, D. P. Rao Palaparti, M. D. Mathew</i>	
<b>Creep Properties of Grade 91 Steel Steam Generator Tube at 923K</b> .....	70
<i>D. P. Rao Palaparti, E. Isaac Samuel, B. K. Choudhary, M. D. Mathew</i>	
<b>Effect of Prior Cold Work on Creep Rupture and Tensile Properties of 14Cr-15Ni-Ti Stainless Steel</b> .....	78
<i>V. D. Vijayanand, M. Nandagopal, P. Parameswaran, K. Laha, M. D. Mathew</i>	
<b>Hot-Tensile Data and Creep Properties Derived There-from for 316L(N) Stainless Steel with Various Nitrogen Contents</b> .....	82
<i>P. R. Sreenivasan</i>	
<b>Creep Behaviour of 9CrMoNbV (P91) Steel Having a Small Amount of Boron</b> .....	88
<i>J. Baral, J. Swaminathan, R. N. Ghosh</i>	
<b>Mechanism for Grain Refinement and Mechanical Properties of AZ91 Mg Alloy by Carbon Inoculation</b> .....	93
<i>M. Suresh, A. Srinivasan, U. T. S. Pillai, B. C. Pai</i>	
<b>Effect of Antimony and Yttrium Addition on the High Temperature Properties of AZ91 Magnesium Alloy</b> .....	98
<i>Arun Bobby, K. K. Ravikumar, U. T. S. Pillai, B. C. Pai</i>	
<b>Influence of Neodymium Addition on the Microstructure, Mechanical and Thermal Properties of Mg-Si Alloys</b> .....	103
<i>K. K. Ajith Kumar, Abhilash Viswanath, U. T. S. Pillai, B. C. Pai, M. Chakraborty</i>	
<b>Creep Behavior of AZ91 Magnesium Alloy</b> .....	109
<i>A. Srinivasan, K. K. Ajithkumar, J. Swaminathan, U. T. S. Pillai, B. C. Pai</i>	
<b>Mechanisms of High Temperature Damage in Elastoplastic Cyclic Loading of Nickel Superalloys and TiAl Intermetallics</b> .....	114
<i>Jaroslav Polák, Karel Obrtlík, Martin Petrevec, Jiri Man, Tomáš Kruml</i>	
<b>Secondary Hardening Behavior in Super Duplex Stainless Steels during LCF in Dynamic Strain Ageing Regime</b> .....	123
<i>Guocai Chai, Marcus Andersson</i>	
<b>Evaluation of Low Cycle Fatigue Damage in Grade 91 Steel Weld Joints for High Temperature Applications</b> .....	128
<i>Vani Shankar, K. Mariappan, R. Sandhya, M. D. Mathew</i>	
<b>Low Cycle Fatigue and Cyclic Plasticity Behavior of Indian PHWR/AHWR Primary Piping Material</b> .....	136
<i>Sumit Goyal, S. K. Gupta, S. Sivaprasad, S. Tarafder, V. Bhasin, K. K. Vaze, A. K. Ghosh</i>	

<b>Effect of Shot Peening on Low Cycle Fatigue Life of Compressor Disc of a Typical Fighter Class Aero-Engine</b> .....	144
<i>Benudhar Sahoo, R. K. Satpathy, Kartik Prasad, Shah Nawaz Ahmed, Vikas Kumar</i>	
<b>Comparative Evaluation of the Low Cycle Fatigue Behaviours of P91 and P92 Steels</b> .....	149
<i>R. Kannan, Vani Sankar, R. Sandhya, M. D. Mathew</i>	
<b>Microstructural Characterization of Fatigue and Creep-Fatigue Damaged 316L(N) Stainless Steel Through Ultrasonic Measurements</b> .....	154
<i>P. Palanichamy, V. S. Srinivasan, T. Jayakumar, V. Rajendran</i>	
<b>Creep and Creep-fatigue Behaviour of 316 Stainless Steel</b> .....	160
<i>Stefan Holmström, Rami Pohja, Asta Nurmela, Pekka Moilanen, Pertti Auerkari</i>	
<b>Analysis of Hysteresis Loops of 316L(N) Stainless Steel under Low Cycle Fatigue Loading Conditions</b> .....	165
<i>Samir Chandra Roy, Sunil Goyal, R. Sandhya, S. K. Ray</i>	
<b>Low Cycle Fatigue Behaviour of a Cu-Cr-Zr-Ti Alloy</b> .....	171
<i>A. Biswas, A. Nagesha, G. Sukumaran, P. Parameswaran, A. K. Asraff, R. Sandhya, S. K. Ray</i>	
<b>Effect of Strain Rate on the Low Cycle Fatigue Behavior of 316L(N) Stainless Steel Weld Joints</b> .....	176
<i>Sayan Kalyan Chandra, Vani Shankar, K. Mariappan, R. Sandhya, P. C. Chakraborty</i>	
<b>Is Thermomechanical Fatigue Life Predictable?</b> .....	181
<i>H.-J. Christ</i>	
<b>Influence of Interface Roughness, Substrate and Oxide-Creep on Damage Evolution and Lifetime of Plasma Sprayed Zirconia-based Thermal Barrier Coatings</b> .....	191
<i>Tilman Beck, Mario Schweda, Lorenz Singheiser</i>	
<b>Thermomechanical Fatigue Behaviour of a Modified 9Cr-1Mo Ferritic-Martensitic Steel</b> .....	199
<i>A. Nagesha, R. Kannan, R. Sandhya, G. V. S. Sastry, M. D. Mathew, K. Bhanu Sankara Rao, Vakil Singh</i>	
<b>Microstructural Analysis of TMF Failure Mechanism of GTD-111 Applied to Gas Turbine Blades</b> .....	204
<i>Yongseok Kim, Dong-Keun Lee, In-Hwan Shin, Jae-Mean Koo, Chang-Sung Seok</i>	
<b>Assessment of the Characteristic of Thermal Barrier Coating Applied to Gas Turbine Blade by Thermo-Gradient Mechanical Fatigue Test</b> .....	210
<i>In Hwan Shin, Dong Keun Lee, Yong Seok Kim, Jae Mean Koo, Chang Sung Seok, Tack Woon Lee</i>	
<b>Qualification of Ni-Based Alloys for Advanced Ultra Supercritical Plants</b> .....	214
<i>K. Maile</i>	
<b>Nickel-Base Alloy Solutions for Ultrasupercritical Steam Power Plants</b> .....	221
<i>D. L. Klarstrom, L. M. Pike, V. R. Ishwar</i>	
<b>Development of Nickel Alloys Based on Alloy 617 for Components in 700°C Power Plants</b> .....	226
<i>J. Klöwer, R. U. Husemann, M. Bader</i>	
<b>Creep and LCF Behaviors of Newly Developed Advanced Heat Resistant Austenitic Stainless Steel for A-USC</b> .....	232
<i>Guocai Chai, Magnus Boström, Magnus Olaison, Urban Forsberg</i>	
<b>Creep Behaviour of Thick-Wall Alloy 617 Seamless Pipes for 700°C Power Plant Technology</b> .....	240
<i>V. Knezevic, A. Schneider, C. Landier</i>	
<b>Nickel Base Superalloys for Next Generation Coal Fired AUSC Power Plants</b> .....	246
<i>Shailesh J. Patel, John J. Debarbadillo, Brian A. Baker, Ronald D. Gollihue</i>	
<b>High Temperature Alloy Development for Future Nuclear Systems in Korea</b> .....	253
<i>Yong Hwan Jeong, Sung Ho Kim, Weon Ju Kim, Ji Yeon Park, Junhyun Kwon, Jinsung Jang, Tae Kyu Kim</i>	
<b>High Temperature Materials for Nuclear Fast Fission and Fusion Reactors and Advanced Fossil Power Plants</b> .....	259
<i>T. Jayakumar, M. D. Mathew, K. Laha</i>	
<b>Effects of Tungsten and Tantalum on Creep Deformation and Rupture Properties of Reduced Activation Ferritic-Martensitic Steel</b> .....	271
<i>J. Vanaja, K. Laha, M. D. Mathew, T. Jayakumar, E. Rajendra Kumar</i>	
<b>Effect of Tungsten on Mechanical Properties of Reduced Activation Ferritic-Martensitic Steel Subjected to Intercritical Heat Treatment</b> .....	277
<i>C. S. Sasmal, K. S. Chandravathi, M. Nandagopal, S. Panneer Selvi, P. Parameswaran, K. Laha, M. D. Mathew, T. Jayakumar, E. Rajendra Kumar</i>	
<b>A Preliminary Development and Characterization of Ni-based ODS Alloys</b> .....	284
<i>Jinsung Jang, Tae Kyu Kim, Chang Hee Han, Hyung-Ki Min, Seog-Hwan Jeong, Do Hyang Kim</i>	
<b>Microstructural Damage Evaluation in Ni-based Superalloy Gas Turbine Blades by Fractal Analysis</b> .....	289
<i>Mita Tarafder, M. Sujata, V. R. Ranganath, S. Tarafder, S. K. Bhunik</i>	
<b>Microstructural Modifications Due to Tungsten and Tantalum in 9Cr Reduced Activation Ferritic Martensitic Steels on Creep Exposure</b> .....	295
<i>R. Mythili, Ravikiran, J. Vanaja, K. Laha, S. Saroja, T. Jayakumar, M. D. Mathew, E. Rajendrakumar</i>	
<b>Eurofer Steel, Development to Full Code Qualification</b> .....	300
<i>Farhad Tavassoli</i>	

<b>Creep-Fatigue Evaluation Methodologies and Related Issues for Japan Sodium Cooled Fast Reactor (JSFR)</b> .....	309
<i>Tai Asayama, Shigeru Takaya, Yuji Nagae, Masanori Ando, Kazuyuki Tsukimori</i>	
<b>Recent Status of ASME Code on Creep Strength Enhanced Ferritic Steels</b> .....	314
<i>Fujimitsu Masuyama, John P. Shingledecker</i>	
<b>Evaluation of Creep-fatigue Damage for Heat Exchangers in the Stella Sodium Test Loop</b> .....	326
<i>Hyeong-Yeon Lee, Yong-Bum Lee, Jong-Bum Kim</i>	
<b>Analysis of Interaction of Calandria Tubes with the End Shields in Advanced Heavy Water Reactor (AHWR)</b> .....	333
<i>A. K. Dureja, S. K. Sinha, R. K. Sinha</i>	
<b>Evaluation of Creep Deformation and Mechanical Properties of Nickel-based Superalloys through FE Analysis Based on Crystal Plasticity Models</b> .....	342
<i>M. K. Samal, S. Ghosh</i>	
<b>Creep Transition of a Thin Rotating Annular Disk of Exponentially Variable Thickness with Inclusion and Edge Load</b> .....	348
<i>Sanjeev Sharma, Ila Sahai, Ravindra Kuma</i>	
<b>Assessment of Design Safety Limits for Fuel Cladding Based on Benchmark Tests</b> .....	355
<i>Rosy Sarkar, R. Suresh Kumar, N. Raghu, P. Chellapandi, S. C. Chetal</i>	
<b>Stress Indices for Non-Radial Branch Connections for Piping</b> .....	361
<i>S. D. Sajish, Bhuwan Chandra Sati, S. Jalaldeen, P. Selvaraj, P. Chellapandi</i>	
<b>A Generalized Geometric Shape Function for Evaluation of SIF Values of Thin-Walled Axially-Cracked Fuel Pin Specimens</b> .....	367
<i>M. K. Samal, G. Sanyal</i>	
<b>Robust Mesh Insensitive Structural Stress Method for Fatigue Analysis of Welded Structures</b> .....	374
<i>P. Selvakumar, J. K. Hong</i>	
<b>Creep/Fatigue Crack Growth Testing, Modelling and Component Life Assessment of Welds</b> .....	380
<i>Kamran Nikbin</i>	
<b>Microstructural Degradation in Power Plant Steels and Life Assessment of Power Plant Components</b> .....	394
<i>Kulvir Singh, M. Kamaraj</i>	
<b>Effect of Boron on Creep Behaviour of Inter-Critically Annealed Modified 9Cr-1Mo Steel</b> .....	402
<i>C. R. Das, S. K. Albert, J. Swaminathan, A. K. Bhaduri, B. S. Murty</i>	
<b>Effect of Joining Process on the Accumulation of Creep Deformation and Cavitation Across the Weld Joint of 316L(N) Stainless Steel</b> .....	408
<i>T. Sakthivel, M. Vasudevan, K. Laha, P. Parameswaran, K. S. Chandravathi, M. D. Mathew, A. K. Bhaduri</i>	
<b>Weld Behavior of Martensitic Steels and Ni-based Alloys for High Temperature Components</b> .....	414
<i>Andreas Klenk, Magdalena Speicher, Karl Maile</i>	
<b>Real-Time Monitoring of High Temperature Components</b> .....	421
<i>Rajesh Daga, Mahendra Kumar Samal</i>	
<b>Remaining Life Related Issues Being Pursued at DRDO for Indian Air Force</b> .....	428
<i>Vikas Kumar</i>	
<b>Effects of Boron and Cerium on Creep Rupture Properties of Modified 9Cr-1Mo Steel and its Weld Joint</b> .....	433
<i>K. S. Chandravathi, K. Laha, Norio Shinya, M. D. Mathew</i>	
<b>Role of Microstructure on Creep Rupture Behaviour of Similar and Dissimilar Joints of Modified 9Cr-1Mo Steel</b> .....	438
<i>P. Parameswaran, K. Laha</i>	
<b>Burst and Biaxial Creep of Thin-Walled Tubing of Low c/a-Ratio HCP Metals</b> .....	443
<i>K. Linga Murty, C. S. Seok, B. Kombaiah</i>	
<b>Evaluation of Speed Lowering of Primary Sodium Pump into Sodium Pool for 500 MWe PFBR Based on Creep Damage</b> .....	451
<i>P. Chellapandi, R. Suresh Kumar, S. Jalaldeen, P. Selvaraj, S. C. Chetal</i>	
<b>Low Cycle Fatigue Damage of Mod.9Cr-1Mo Steel under Non-Proportional Multiaxial Loading</b> .....	457
<i>Takamoto Itoh, Kenichi Fukumoto, Hideki Hagi, Akira Itoh, Daichi Saitoh</i>	
<b>Monitoring of Axial and Radial Creep of Coolant Channels in Operating PHWRs</b> .....	463
<i>R. J. Patel, R. Ranjon, S. Battacharyya, G. Sharma</i>	
<b>Experience with the Operation of a Test-RIG for 700°C Power Plant Materials</b> .....	470
<i>K. Metzger, K.-H. Czychon, S. Zickler, K. Maile</i>	
<b>Effect of Multiaxiality on the Creep Rupture Properties of 316L(N) SS</b> .....	474
<i>S. R. Charde, M. L. Prasad, A. R. Ballal, D. R. Peshwe, M. D. Mathew, R. K. Paretkar</i>	
<b>Fretting Fatigue in Aircraft Components Made of Ti-Al-V Alloys</b> .....	481
<i>M. Sujata, M. Madan, K. Raghavendra, S. K. Bhaumik</i>	

<b>Fatigue Failure of a Distortion Screen during Testing</b> .....	487
<i>Swati Biswas, Jivan Kumar, M. D. Ganeshachar, S. N. Narendra Babu, S. Ramachandra</i>	
<b>A Comparative Assessment of Local and Nonlocal Damage Models for Prediction of Fracture Behavior during Mixed-Mode Loading</b> .....	493
<i>M. K. Samal, M. Seidenfuss, E. Roos</i>	
<b>Current Practices in Structural Analysis and Testing of Aero-Engine Main Shafts</b> .....	499
<i>Sanju Kumar, Rashmi Rao, B. A. Rajeevalochanam</i>	
<b>Effect of Multiaxial State of Stress on Creep Rupture Behaviour of 2.25Cr-1Mo Steel</b> .....	510
<i>Sunil Goyal, K. Laha, V. D. Vijayanand, S. Panneer Selvi, M. D. Mathew</i>	
<b>Effect of Notch on Creep Behavior of 316L(N) SS</b> .....	517
<i>S. R. Charde, A. R. Ballal, D. R. Peshwe, M. D. Mathew, R. K. Paretkar</i>	
<b>Effect of Notch on Creep Behavior of 316L(N) SS Weld Joint</b> .....	526
<i>S. R. Charde, A. R. Ballal, D. R. Peshwe, M. D. Mathew, R. K. Paretkar</i>	
<b>Creep Behaviour of 316L(N) SS in the Presence of Notch</b> .....	534
<i>J. Ganesh Kumar, V. Ganesan, V. D. Vijayanand, K. Laha, M. D. Mathew</i>	
<b>Effect of Thermal Gradient on Steady State Creep in a Rotating Disc of Variable Thickness</b> .....	542
<i>Manish Garg, B. S. Salaria, V. K. Gupta</i>	
<b>Stress Rupture Properties of 316L(N) Stainless Steel under the Influence of Multiaxiality at Various Stress Levels</b> .....	548
<i>M. Lakshmi Prasad, A. R. Ballal, R. K. Paretkar, D. R. Peshwe</i>	
<b>Finite Element Simulation of Cyclic Ball Indentation on Zr 2.5 wt.% Nb Alloy and Assessment of the Residual Stress Produced</b> .....	553
<i>S. Chatterjee, K. Madhusoodanan, J. N. Kayal</i>	
<b>Impression Creep Behaviour of U?6%Zr Alloy: Role of Microstructure</b> .....	561
<i>T. R. G. Kutty, Santu Kaity, Arun Kumar</i>	
<b>Dynamic Strain Ageing in AISI 316L Type Stainless Steel as Revealed by Indentation Creep Studies</b> .....	566
<i>H. Udaya Prasanna, K. Rajendra Udupa</i>	
<b>Multifunctional High Precision Pneumatic Loading System (HIPS) for Creep-Fatigue Testing</b> .....	573
<i>Rami Pohja, Asta Nurmela, Pekka Moilanen, Stefan Holmström</i>	
<b>Investigation of Fracture Behavior of Steam Generator Tubes of Indian PHWR using PLT Specimens</b> .....	578
<i>G. Sanyal, M. K. Samal</i>	
<b>Application of Impression Creep Technique for Development of Creep Resistant Austenitic Stainless Steel</b> .....	585
<i>Naveena, V. D. Vijayanand, V. Ganesan, K. Laha, M. D. Mathew</i>	
<b>Advances in Creep Damage/Life Assessment Technology for Creep Strength Enhanced Ferritic Steels</b> .....	591
<i>Fujimitsu Masuyama</i>	
<b>Creep Life Predictions of Engineering Components: Problems &amp; Prospects</b> .....	599
<i>R. N. Ghosh</i>	
<b>Creep-Fatigue Lifetime Assessment with Phenomenological and Constitutive Material Laws</b> .....	607
<i>Stefan Linn, Alfred Scholz</i>	
<b>Predicting Remaining Creep Life using Damage Mechanics Principles</b> .....	612
<i>Iain Le May</i>	
<b>Design Life Prediction of Structural Components Subjected to Various Fatigue Loadings</b> .....	616
<i>Imran Firdous, G. A. Harmain, Junaid H. Masoodi</i>	
<b>Experimental and Numerical Study to Predict Residual Growth in an Aeroengine Compressor Disc After Overspeed</b> .....	625
<i>C. Ayyappan, Rajesh Kumar, P. Ramesh, Rajeev Jain</i>	
<b>A Study on Fatigue Life Prediction of Ni-base Superalloy</b> .....	631
<i>Dongkeun Lee, Inhwan Shin, Yongseok Kim, Jae-Mean Koo, Chang-Sung Seok</i>	
<b>Damage Mechanisms and Fatigue Lives: From the Low to the Very High Cycle Regime</b> .....	636
<i>Hael Mughrabi</i>	
<b>High Temperature Fatigue of Nickel-based Superalloys during High Frequency Testing</b> .....	645
<i>M. Zimmermann, C. Stoecker, H.-J. Christ</i>	
<b>Effect of Temperature on Ratcheting Behaviour of 316LN SS</b> .....	650
<i>Aritra Sarkar, A. Nagesha, R. Sandhya, M. D. Mathew</i>	
<b>Extension of Ruiz Criterion for Evaluation of 3-D Fretting Fatigue Damage Parameter</b> .....	655
<i>K. Anandavel, Raghu V. Prakash</i>	
<b>Fretting Fatigue and Wear Behaviour of Timetal 834</b> .....	661
<i>Rahul Garg, G. Sudhakar Rao, Vikash Bhartia, Vakil Singh</i>	
<b>Ratcheting Strain Assessment in Pressurised Stainless Steel Elbows Subjected to In-plane Bending</b> .....	666
<i>S. Vishnuvardhan, G. Raghava, P. Gandhi, Sumit Goyal, Suneel K. Gupta, Vivek Bhasin</i>	

<b>Low and High Cycle Fatigue Behavior of Nickel-base Alloy at High Temperatures</b> .....	671
<i>Guocai Chai, Ping Liu, Nian Zhou, Johan Frodigh</i>	
<b>Subcritical Crack Growth on Crystallographic Planes in a Ni-base Superalloy: Relevance to Orientations</b> .....	677
<i>M. Okazaki, M. Sakaguchi, S. Yamagishi</i>	
<b>Assessment of Deformation Behavior of Zr-2.5Nb Alloy during Thermo-Mechanical Processing and under Service Condition</b> .....	685
<i>J. K. Chakravarty, R. N. Singh, A. Sarkar</i>	
<b>Cyclic Fracture, FCG and Ratcheting Studies on Type 304LN Stainless Steel Straight Pipes and Elbows</b> .....	693
<i>G. Raghava, P. Gandhi, K. K. Vaze</i>	
<b>Fatigue Crack Growth Studies on SA403 TP 304LN SS Elbows</b> .....	699
<i>D. M. Pukazhendhi, G. Raghava, G. M. Samuel Knight</i>	
<b>Fatigue Crack Growth Behavior in Pipes and Elbows of Carbon Steel and Stainless Steel Materials</b> .....	703
<i>Punit Arora, P. K. Singh, V. Bhasin, K. K. Vaze, D. M. Pukazhendhi, P. Gandhi, G. Raghava</i>	
<b>On the Application of Rousselier's Damage Model to Predict Fracture Resistance Behavior of Zircaloy Fuel Pin Specimens</b> .....	710
<i>M. K. Samal, P. K. Shah</i>	
<b>Fatigue Crack Growth Behavior of 316LN Stainless Steel with Different Nitrogen Contents</b> .....	716
<i>M. Nani Babu, B. Shashank Dutt, S. Venugopal, G. Sasikala, Shaju K. Albert, A. K. Bhaduri, T. Jayakumar</i>	
<b>Fatigue Crack Growth Characterisation of RAFM Steel using Acoustic Emission Technique</b> .....	722
<i>M. Nani Babu, C. K. Mukhopadhyay, G. Sasikala, B. Shashank Dutt, S. Venugopal, Shaju K. Albert, A. K. Bhaduri, T. Jayakumar</i>	
<b>A Comprehensive Creep Model for Advanced 9-10% Cr Ferritic Steels</b> .....	727
<i>Ramkumar Oruganti, Mallikarjun Karadge, Srinivasan Swaminathan</i>	
<b>Modeling Creep Behaviour of Boiler Grade Steels - Application to Grade 92 Steel</b> .....	735
<i>E. Cini, E. Desdoit, A. Villani, J. Besson</i>	
<b>Effect of Temperature and Strain Amplitude on Fatigue Behaviour of BCC Iron Single Crystal using Molecular Dynamics Simulation</b> .....	742
<i>V. S. Srinivasan, G. Sainath, B. K. Choudhary, M. D. Mathew, T. Jayakumar</i>	
<b>Modeling the Effect of Grain Boundary Sliding on Creep Lifetime: Application to Two Austenitic Stainless Steels</b> .....	747
<i>Sivasambu Mahesh, M. D. Mathew</i>	
<b>Creep Modelling of P91 Steel for High Temperature Power Plant Applications</b> .....	751
<i>Somnath Nandi, Ksn. Vikrant, Pavan Ahv, Kulvir Singh, R. N. Ghosh</i>	
<b>Prediction of Creep Curves of High Temperature Alloys using <math>\theta</math>-Projection Concept</b> .....	756
<i>C. M. Omprakash, A. Kumar, B. Srivathsa, D. V. V. Satyanarayana</i>	
<b>Modeling Steady State Creep Behavior of Functionally Graded Thick Cylinder in the Presence of Residual Stress</b> .....	760
<i>Tejeet Singh, V. K. Gupta</i>	
<b>Modeling of the Effect of a Defect on HCF Life of a Magnesium AZ91 Specimen Subjected to Transverse Load</b> .....	768
<i>G. Murugan, K. Raghukandan, U. T. S. Pillai, B. C. Pai</i>	
<b>Modeling and Finite Element Simulation of Low Cycle Fatigue Behaviour of 316 SS</b> .....	774
<i>J. Shit, S. Dhar, S. Acharyya</i>	
<b>Prediction of Temperature Dependence and Scatter in Fracture Toughness of Pressure Vessel Steel using Nonlocal Damage Models</b> .....	780
<i>M. K. Samal, M. Seidenfuss, E. Roos</i>	
<b>Analysis of Damage Accumulations in High Strength Low Alloy Steels under Monotonic Deformation</b> .....	786
<i>Arpan Das, S. K. Das, S. Sivaprasad, M. Tarafder, S. Tarafder</i>	
<b>Creep-fatigue Damage Analysis of Lower Stay Plate in Control Plug</b> .....	793
<i>S. K. Pandey, S. Jalaldeen, P. Selvaraj, P. Chellapandi</i>	
<b>Continuum Damage Mechanics Approach to Predict Creep Behaviour of Modified 9Cr-1Mo Ferritic Steel at 873 K</b> .....	798
<i>J. Christopher, G. Sainath, V. S. Srinivasan, E. Isaac Samuel, B. K. Choudhary, M. D. Mathew, T. Jayakumar</i>	
<b>Stochastic Creep Damage Growth Due to Random Thermal Fluctuations Using Continuum Damage Mechanics</b> .....	805
<i>Y. Appalanaidu, Yash Vyas, Sayan Gupta</i>	
<b>Fatigue Behaviour of a Martensitic and an Austenitic Steel in Heavy Liquid Metals</b> .....	812
<i>Jean-Bernard Vogt, Ingrid Proriol-Serre</i>	
<b>Creep and Oxidation Behaviors of Alloy 617 in Air and Helium Environments at 1173 K</b> .....	819
<i>Woo-Gon Kim, Gyeong-Geun Lee, Ji-Yeon Park, Sung-Deok Hong, Yong-Wan Kim</i>	

<b>A Comparison of Creep Deformation and Rupture Behaviour of 316L(N) Austenitic Stainless Steel in Flowing Sodium and in Air</b> .....	823
<i>S. Ravi, K. Laha, M. D. Mathew, S. Vijayaraghavan, M. Shanmugavel, K. K. Rajan, T. Jayakumar</i>	
<b>Effect of Salt Coatings on Low Cycle Fatigue Behavior of Nickel -base Superalloy GTM-SU-718</b> .....	830
<i>G. S. Mahobia, R. G. Sudhakar, Ajesh Antony, K. Chattopadhyay, N. C. Santhi Srinivas, Vakil Singh</i>	
<b>Effect of Prior Cyclic Oxidation on the Creep Behavior of Bare and Pt-Aluminide Coated Directionally Solidified CM-247LC Alloy</b> .....	835
<i>Md Zafir Alam, D. V. V. Satyanarayana, D. Chatterjee, R. Sarkar, D. K. Das</i>	
<b>Experience in Long Term Operation of Sodium Loop for Creep Experiments in Dynamic Sodium at High Temperature</b> .....	842
<i>P. Rajasundaram, S. Vijayaraghavan, T. Chandran, M. Shanmugavel, M. Shanmugasundaram, S. Ravi, K. Laha, B. Babu, M. D. Mathew, K. K. Rajan</i>	
<b>Author Index</b>	