

# **66th International Cable and Connectivity Symposium (IWCS 2017)**

Industry Leadership, Innovation and  
Professional Development

Orlando, Florida, USA  
8 - 11 October 2017

ISBN: 978-1-5108-5301-0

**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© (2017) by International Wire and Cable Symposium (IWCS)  
All rights reserved.

Printed by Curran Associates, Inc. (2018)

For permission requests, please contact International Wire and Cable Symposium (IWCS)  
at the address below.

International Wire and Cable Symposium (IWCS)  
644 Shrewsbury Commons Ave.  
PMB #250  
Shrewsbury, PA 17361  
USA

Phone: +1 717 993 9500

[www.iwcs.org](http://www.iwcs.org)

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

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2633  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

# TABLE OF CONTENTS

## SESSION 1: EXECUTIVE TRACK

<b>A Tale of Two Cable Markets: Metal and Fiber</b> .....	1
<i>R. Mack</i>	
<b>Global Supply Trends for Plastics and Potential Policy Impacts of the New Trump Administration in the U.S.</b> .....	2
<i>P. Pineda</i>	
<b>Economic Outlook</b> .....	3
<i>R. Fry</i>	

## EXECUTIVE PANEL SESSION: CTO'S CRYSTAL BALL – TELECOMMUNICATIONS IN 2025

<b>Panelist 1: Morgan Kurk, Chief Technology Officer, CommScope, North Carolina, USA</b> .....	4
<i>M. Kurk</i>	
<b>Panelist 2: Claudio Mazzali, Sr. VP Technology &amp; CTO, Corning Optical Communications, New York, USA</b> .....	5
<i>C. Mazzali</i>	
<b>Panelist 3: Fang Wei, Chief Cable and Connector Expert, 2012 LABs, Huawei Technologies Co., Ltd., Shenzhen, China</b> .....	6
<i>F. Wei</i>	
<b>Panelist 4: Marcello Andrade, Senior Vice President, R&amp;D, Prysmian Group, Milano, Italy</b> .....	7
<i>M. Andrade</i>	
<b>Panelist 5: Toby Redshaw, Senior Vice President, Digital Ecosystems, Verizon, New Jersey, USA</b> .....	8
<i>T. Redshaw</i>	

## SESSION 2: FIBER OPTIC SPECIAL APPLICATIONS

<b>G.654 Optical Fiber Laying in Complex Environment for Terrestrial Communication</b> .....	9
<i>J. Yuan, W. Chen, G. Zhang, Q. Huang, L. Wang, L. Zhang, P. Lu</i>	
<b>Successful Mass Production of Extremely Low Attenuation Submarine Cables</b> .....	13
<i>M. Kobiki, D. Masuda, H. Hayashi</i>	
<b>Large Reel Length High Strength Submarine Optical Fiber and its Application</b> .....	18
<i>G. Zhang, L. Wang, Q. Huang, H. Song, P. Lu, J. Yuan, W. Chen</i>	
<b>Low Smoke, Zero Halogen Tight-Buffer Breakout Cables Containing Radiation Tolerant, Full-Fluorine Doped, Graded Index Multimode Optical Fibers</b> .....	21
<i>B. Risch, J. Rosko, R. Lovie</i>	
<b>Evolution of Fluoropolymer Clad Fibers</b> .....	29
<i>D. Simoff, A. Stolov, H. Wu, N. Reingold, X. Sun</i>	
<b>Carburization Behavior of the 316L Stainless Steel in an Environment of Double Interface Layers-Graphite Product of Super High Temperature and Pure Water of Low Temperature</b> .....	39
<i>J. Huang, Q. Li, M. Chen, L. Jiang, T. Wang, B. Zhang</i>	
<b>Intelligent Cable Jetting (Blowing) Machine: Records Installation Parameters and Safeguards Cable</b> .....	44
<i>W. Griffioen, L. Saint-Raymond, D. Plumettaz, C. Pache</i>	

## SESSION 3: COPPER CABLE MEASUREMENT MODELLING, HEATING & AGING

<b>Modeling of the Triaxial Setup to Measure the Screening Attenuation in the Case of Different Coupling Sections</b> .....	49
<i>T. Hahner, T. Schmid</i>	
<b>Method for Determining the Surface Resistivity of Prototype Conductors</b> .....	59
<i>W. Hopkinson</i>	
<b>Mixed-Mode S-Parameter Characterization of Network Cable with a Four Port Network Analyser</b> .....	65
<i>E. Arihilam, H. Sasse, A. Duffy, J. Withey</i>	
<b>An Improved Model for Balanced Cabling Channel Capacity</b> .....	72
<i>D. Hess</i>	
<b>The Effect of Nanoclays on Electrical Properties of Fluoropolymer Insulations</b> .....	82
<i>M. Beninca, M. Farmahini-Farahani, H. Noglik</i>	
<b>Four Pair Power over Ethernet (4PPoE) Deployment: Standards, Performance &amp; Challenge</b> .....	90
<i>T. Lanoe, C. McNutt, A. Sekhavat</i>	
<b>Temperature Rise Due to Power Delivery over Ethernet at Equipment Interface</b> .....	96
<i>B. Marchant</i>	
<b>Impact of the High End Device Performance on the Requirements of the PoE Suitability of the Network Cabling</b> .....	99
<i>B. Jung, S. Gruner, T. Klotsch, D. Wilhelm</i>	

#### **SESSION 4: WIRE AND CABLE MATERIALS**

<b>High Performance Polymers in Wire &amp; Cable</b> .....	106
<i>J. Henry, D. Kreh, J.-Y. Sun, P. Ran</i>	
<b>The Effects of Fluoropolymer Selection on Electrical Performance in Twisted Pair Cabling</b> .....	115
<i>R. Young, F. Johnston, J. Netta, K. Walck</i>	
<b>Long-Term Effect of Thermal Variation on the Performance of Ethernet Cabling Dielectrics</b> .....	123
<i>F. Akinnuoye, H. Sasse, P. Cave, S. Prescott, A. Duffy</i>	
<b>New Ethylene Vinyl Acetate Copolymers for Wire and Cable Compounds</b> .....	133
<i>J. Haley, N. Palyam, C. Schneider</i>	
<b>Enhanced Foaming Polyolefin Insulation for High Performance Telecommunication Cables</b> .....	137
<i>G. Sun, M. Esseghir, T. Geussens, C. Kmiec</i>	
<b>Cure Behavior of Optical Fiber Coatings with a UV-LED Curing System</b> .....	144
<i>T. Nakajima, H. Uchida, N. Shinohara</i>	

#### **SESSION 5: FTTX**

<b>Market Overview of Fiber Optic Cable - Its Place in North America Broadband</b> .....	149
<i>M. Render</i>	
<b>ADSS Micromodule Cable Family for FTTx Applications</b> .....	150
<i>M. Garcia, F. Rebanal, A. Lavenne, O. Tatat</i>	
<b>The Advantages of Using Reduced Coating Diameter Optical Fibers (200µm) in ADSS Cables for Deployment in a FTTx Networks</b> .....	157
<i>P. Zyl, I. Davis</i>	
<b>Study on Development and Properties of a New Drop Cable for FTTH</b> .....	163
<i>C. Zhou, L. Shi, S. Xie, X. Zhang, L. Mei, X. Yan</i>	
<b>The Technique of Effective Utilization for Existing Underground and Aerial Optical Facilities</b> .....	167
<i>K. Murase, A. Iwaoka, K. Yoshida, R. Tanaka, R. Tensaka, T. Ebine</i>	
<b>A Double-Core Invisible Optical Cable for FTTH</b> .....	171
<i>B. Zhang, Y. Zhang, Z. Liu, G. Suo, Y. Zhu, J. Song, Z. Wang, S. Liu</i>	

#### **SESSION 6: FIBER CHARACTERIZATION & RELIABILITY**

<b>A Study of Nonlinear Coefficient Measurement Based on Continuous-Wave Dual-Frequency Method</b> .....	178
<i>Y. Liu, L. Zhang, J. Li, H. Zhou, X. Sun, S. Chen, L. Zhang</i>	
<b>DGD Measurement Of Few Mode Fibres Based On Mode Excitation</b> .....	182
<i>Y. Liu, L. Zhang, L. Shen, X. Sun, S. Chen, J. Li</i>	
<b>Study of Temperature and Strain Coefficients of Brillouin Frequency Shift for Ge-Free Single-Mode Optical Fibers</b> .....	186
<i>N. Korotkov, S. Akopov, C. Wang</i>	
<b>Static n Value and Lifetime Measurement of Bend-Insensitive Optical Fibres by Uniform Bending Method</b> .....	189
<i>L. Zhang, J. Li, C. Yan, L. Liu</i>	
<b>Environmental Effects on Static n Value of Silicon Optical Fibre</b> .....	194
<i>J. Duan, L. Zhang, J. Li, C. Yan</i>	
<b>Research on Splicing Reliability of G.654.B Submarine Optical Fiber</b> .....	198
<i>J. Yuan, W. Chen, G. Zhang, Q. Huang, L. Wang, H. Song, Z. He, L. Zhang</i>	
<b>The High Performance and Reliability Characteristics of 80-135 µm Polarization Maintaining Optical Fiber</b> .....	202
<i>W. Luo, W. Qi, C. Du, Y. Ke, L. Yan, T. Zhang, Z. Yu, Q. Lei</i>	

#### **SESSION 7: PERFORMANCE & DESIGN OF DATA AND POWER CABLES**

<b>Study on Correlation Between Types of Shielding and their Performance on Coupling Attenuation</b> .....	206
<i>J. Martins, M. Souza, T. Fukui, P. Ito, S. Joly, H. Durigan</i>	
<b>Performance Comparison of Reduced Diameter Category 6A Cables</b> .....	212
<i>E. Garza, K. Cornellson</i>	
<b>Attenuation of Screened Twisted Pairs</b> .....	219
<i>J. Poltz</i>	
<b>Numerical Approach to Derive Derating Factors for Buried Power Cables Loaded Unequally for Different Depths of Laying and No. of Circuits</b> .....	227
<i>S. Gaikwad, P. Vasani</i>	
<b>Clarification and Solution for the Service Life of Robot Cable - Taking the Machine Vision Cable as the Experimental Object</b> .....	232
<i>Y.-C. Lin, E. Wu, T. Chen, K. Wang, R. Lin</i>	
<b>Industrial Network Infrastructure, Your Future Business Foundation</b> .....	240
<i>R. Voss</i>	

## **SESSION 8: MANUFACTURING AND PROCESSING**

<b>Effect of Plastic Film on the Mechanical Properties of the Double-Surface Steel/PE Composite Strip</b> .....	249
<i>X. Fan, Z. Wang, S. Liu, Y. Zhang, B. Zhang, W. Zhang</i>	
<b>Applying Modern Weathering Testing Methods to the Development of Sustainable Cable Materials</b> .....	252
<i>B. Tobin, A. Francis</i>	
<b>Factorial Design Modeling &amp; Process Optimization to Develop High Performance Dry Polypropylene Loose Tubes</b> .....	257
<i>V. Albuquerque, J. Silva, D. Souza</i>	
<b>Research on Key Variables™ Effects on Polypropylene Gel Tube for High Speed Processing</b> .....	267
<i>J. Huang, X. Lu, Z. Xiong, B. Wan, M. Li</i>	
<b>Fiber Coating Quality Control Under High Draw Speed</b> .....	271
<i>W. Zhao, L. Deng, Q. Yuan, J. Cheng, R. Matai, Z. Jiang</i>	
<b>Collecting and Leveraging Actionable Data from Existing Equipment</b> .....	277
<i>W. Sundblad</i>	
<b>Analysis of Industry Manufacturing, Quality and Reliability Programs</b> .....	279
<i>H. Knehr, M. Ozgur</i>	

## **SESSION 9: ULTRA HIGH FIBER AND ROLL-ABLE RIBBON CABLE**

<b>Rm Dependent Optical Characteristics of High-Density Optical Fiber Cable with Rollable Multi-Core-Fiber Ribbons</b> .....	283
<i>M. Kikuchi, Y. Yamada, J. Kawatake, H. Izumita, T. Kurashima, K. Katayama</i>	
<b>Optical Loss Characteristics of Cables Containing 5-10 fibers/mm<sup>2</sup> and Measured Lateral Pressure on Fibers in Cable Core</b> .....	289
<i>Y. Yamada, M. Kikuchi, J. Kawatake, H. Izumita, K. Katayama</i>	
<b>Ultra Compact Indoor Optical Fiber Cables &amp; Applications</b> .....	294
<i>P. Vickle, D. Dancy, L. Rapp, J. Truckner</i>	
<b>High Density Fiber Optic Cables with Flame Retardant and Low Smoke Zero Halogen Properties</b> .....	299
<i>S. Shimizu, Y. Takahashi, T. Kobayashi, A. Namazue, K. Osato</i>	
<b>Characteristics of Ultra-High-Fiber-Count and High-Density Optical Cables with Pliable Ribbons</b> .....	304
<i>F. Sato, K. Ryan, Y. Nagao, T. Hirma, R. Oka, K. Takahashi</i>	
<b>Development of Ultra-High Density and Fiber-Count WTC with SWR</b> .....	312
<i>M. Ohno, S. Kaneko, T. Kaji, K. Tomikawa, K. Osato</i>	

## **SESSION 10: OPTICAL FIBER MANUFACTURING**

<b>Study on Fluorine Doping Technique of Optical Fiber Preform</b> .....	317
<i>N. Xiang, Y. Wang, K. Ma, C. Feng, S. Du, H. Xiao</i>	
<b>Production of Low-Cost Bending-Insensitive Fibers Using Large-Size Fiber Preforms</b> .....	320
<i>C. Wu, L. Zhang, R. Wang, H. Wang, L. Zhang, R. Matai</i>	
<b>Ultra Low Loss Series Fiber Made By PCVD Process</b> .....	324
<i>L. Zhang, R. Wang, J. Wu, J. Zhu, H. Wang, R. Matai</i>	
<b>Design of Filling Compound Compatibility of Optical Fiber Based on Oil Swelling in Coating</b> .....	327
<i>N. Iwaguchi, K. Sohma, T. Fujii</i>	
<b>Measurement of Broadband and LED UV Lamp Irradiance in Standard Draw Tower Configuration</b> .....	331
<i>B. Skinner, C. Harper, D. Leonhardt, P. Swain, R. Dreiskemper</i>	
<b>Cure Speed Measurements of UV-LED Curable Optical Fiber Coatings</b> .....	338
<i>X. Wu, K. Thomas, T. Ho</i>	

## **POSTER SESSION**

<b>A Novel Filling Technology for Low-Viscosity Grease Used in the Loose Tube</b> .....	343
<i>Q. Yu, L. Wang, G. Hu, Q. Qi, L. Chen, K. Fu</i>	
<b>Research on the Reliability of All Dry Optical Cable</b> .....	348
<i>J. Cai, X. Lu, J. He, Z. Xiong, B. Wan, M. Li</i>	
<b>Development Status and Application Research of Fiber Bundle in China</b> .....	352
<i>G. Hu, Q. Yu, K. Fu, L. Chen, Q. Qi</i>	
<b>Development of Indoor/Outdoor Cables with LSZH Sheath Used in Harsh Environment</b> .....	357
<i>J. He, X. Su, H. Hu, X. Lu, B. Wan, Z. Xiong</i>	
<b>Optimization of 12 Core MCF with Hexagonal Close-Packed Structure</b> .....	362
<i>R. Sugizaki, K. Maeda, K. Kawasaki, R. Jensen, B. Palsdottir</i>	
<b>Outlook for the Coaxial Cables in the Forthcoming 5G Mobile Networks</b> .....	367
<i>K. Dai</i>	
<b>Development of the Cable and Cable Fitting for Rural Informationization Construction</b> .....	378
<i>T. Li, D. Yang, G. Lei, Y. Wang, W. Chen, T. Ai, C. Zhou</i>	
<b>Optical Fiber Composite Young's Modulus: Theoretical Approach, Line Tracking Method, and Finite Element Analysis</b> .....	384
<i>S. Gaikwad, S. Girawale, S. Bhaumik, C. Saha</i>	

<b>Influence of Freezing Condition on All-Dry Cable with Water-Blocking Yarn after Water Absorption</b> .....	389
<i>Y. Ruan, Y. Xu, X. Liu, Z. Xiong</i>	
<b>Invisible Cable for Installation at Room Temperature</b> .....	394
<i>B. Wan, Z. Xiong, X. Lu, H. Duan, H. Hu</i>	
<b>Solutions for Central Unit Structure ADSS Cable in Access Network Operation</b> .....	399
<i>W. Liu, W. Liao, C. Chen, J. Fu</i>	
<b>The Miniaturized all Dielectric Self-Supporting Optical Fiber Cable Used in Sapiential City</b> .....	403
<i>W. Lin, C. Shen, B. Lu, F. Gao, Y. Wang, P. Liu, Q. Meng, H. Shi</i>	
<b>Green Chemistry to Manage Pests in Cable Industry</b> .....	408
<i>C. Joshi, M. Palsamkar</i>	
<b>Study and Control of Welding Quality of Stainless Tube and its Influences on OPGW Cable Stranding Process</b> .....	413
<i>Q. Qi, K. Fu, L. Chen, G. Hu, M. He, H. Wang</i>	
<b>Effect of Resin Structure on the Oil Resistance Properties of Flame Retardant Polyolefin Compounds</b> .....	417
<i>Y. Sun, X. Cheng, C. Huang, C. Wang, C. Peng</i>	
<b>Application of G.657B3 Optical Fiber in Invisible Optical Cable</b> .....	422
<i>H. Xu, S. Cao, W. Miao, Z. Liu, Z. Wang</i>	
<b>Study on the Reliability Performance of the Polypropylene(PP) Loose Tube</b> .....	427
<i>L. Chen, Q. Qi, G. Hu, M. Yang, M. He, G. Hu, G. Liu</i>	
<b>Study of PE Sheathing Shrinkage in Optical Cable</b> .....	431
<i>L. Li, Y. He, G. Hu, G. Hu, M. He, C. Liu</i>	
<b>Long Term Response of Radiation Tolerant Multimode Optical Fiber Designs to Gamma Radiation Exposure</b> .....	435
<i>J. Kim, E. Quiroga, Y. Yang, A. Lakhia, G. Pickrell, B. Risch</i>	
<b>Design and Performance Study of PP all Dry ADSS Cable</b> .....	440
<i>H. Zhang, W. Liu, L. Li, H. Liu, Z. Xiong</i>	
<b>The Multicore Fiber Preform Processing Techniques and the Multicore Fiber Properties</b> .....	445
<i>Y. Zhang, H. Yu, Q. Mo</i>	
<b>Development and Application of Multifunctional Lightweight Lightning-Proof Optical Cables for Access Network</b> .....	449
<i>L. Zhan, P. Liu, P. Cao, Q. Meng, H. Shi, Q. Han, Y. Sun</i>	
<b>Influence Factors Analysis for Polyethylene Sheath Shrinkage of Access Network Optical Fiber Cable</b> .....	455
<i>C. Wang, H. Zhou, W. Miao</i>	
<b>Application of Ceramic Low Smoke Zero Halogen Polyolefin in Fire-Resistant Fiber Optic Cable</b> .....	458
<i>B. Shen, B. Miao, X. Li, X. Miao</i>	
<b>The Impact of Parameters Setting in Optical Fiber Design on Raman Gain Coefficient</b> .....	464
<i>X. Sun, S. Chen, R. Wang, H. Wang, L. Zhang, H. Zhou, Y. Liu, L. Zhang, J. Li</i>	
<b>Application Research of LCX in LTE-M System</b> .....	467
<i>R.-J. Zhao, B. Wang, L.-L. Lin, Y.-R. Lan, D.-B. Huang</i>	
<b>Design and Development of Low Friction Coaxial Cable</b> .....	472
<i>Z. Wen, B. Wang, Y. Lan, D. Huang</i>	
<b>Design of Low Loss Optical Fiber with Large Effective Area</b> .....	477
<i>Y. Fan, F. Zheng, X. Jiang, W. Li, Y. Shen, M. Tang, H. Zhou</i>	
<b>Discussion on the Factors Affecting Performance of the High Frequency</b> .....	482
<i>W. Shi, X. Li, S. Zhang, Y. Lan, D. Huang</i>	
<b>High-Voltage Cable for New Energy Vehicles</b> .....	485
<i>X. Xie, Q. Yao, B. Liang, Y. Ma, L. Ye</i>	
<b>Fiber Ribbon Dimensional Measurement and Color Sequence Verification</b> .....	492
<i>C. Girdwood, A. McCloskey</i>	

## **SESSION 11: ADVANCES IN FIBER CONNECTIVITY**

<b>Low-Loss MM MPO Connectors Under EF Launched Power Condition. Theoretical Simulation and Experimental Results</b> .....	495
<i>T. Satake, S. Lutz, S. Chuang, K. Wang, M. Hughes</i>	
<b>Work Support System Using AR Technology for Optical Network Element Operation in Central Offices</b> .....	510
<i>Y. Koshikiya, Y. Enomoto, T. Manabe</i>	
<b>New Single-Fiber Cleaving Technique with Simple Mechanism for Mechanical Splice Type Field Mountable Single-Mode Optical Fiber Connector</b> .....	516
<i>R. Koyama, C. Fukai, M. Kihara, K. Katayama</i>	
<b>Short Size and Low-Loss MPO Connector for High-Density Optical Interconnection Applications</b> .....	520
<i>S. Kanno, T. Otomitsu, K. Fujiwara, K. Takizawa</i>	
<b>Statistical Methods for Modeling Optical Network Loss Budget</b> .....	525
<i>S. Zimmel</i>	
<b>Multi-Function Joint Closure</b> .....	529
<i>I. Griffiths, L. Cavenaghi</i>	
<b>New Ribbon Fiber Stripper and Fiber Holder</b> .....	532
<i>S. Tanaka, S. Sogae, S. Sakanishi, N. Maewawa, Y. Kanda</i>	
<b>Fiber Optic Cable Assembly Manufacturing Process Improvements: The Often-Overlooked Benefits of Industry Standards</b> .....	537
<i>D. Rocheleau</i>	

## **SESSION 12: CODES AND STANDARDS**

<b>UL Standard Proposals, Recent Revisions and North American Harmonization Activites</b> .....	543
<i>S. Stene</i>	
<b>Cable and Connectivity Standards Where Will They Meet?</b> .....	547
<i>W. Kachmar</i>	
<b>Cabling for HDBaseT and Power over HDBaseT (PoH)</b> .....	552
<i>A. Tassone</i>	
<b>Communications Cable Fire Performance Hierarchy</b> .....	555
<i>F. Dawson, G. Dorna, S. Kaufman</i>	
<b>Investigation of Reliability of the Test for Assessing Reaction to Fire of Cables According to CPR</b> .....	562
<i>K. Langfeld, T. Meyer</i>	
<b>Research on EU CPR Standards and Optical Cable Certification</b> .....	569
<i>P. Cao, M. Feng, P. Liu, Q. Meng, H. Shi, Q. Sun, Y. Yixing</i>	
<b>Simulation of Cable Flammability Testing with Computational Fluid Dynamics</b> .....	575
<i>A. Freeland, F. Xia, P. Rajeshirke</i>	

## **SESSION 13: NEXT GENERATION FIBER CABLE DESIGN**

<b>Solving Difficult Problems while Customizing Cables to Reduce Installation Cost</b> .....	581
<i>W. McCollough, D. Seddon, M. Gimblet</i>	
<b>Development of Low Friction, Dual Rated, Pushable Cable</b> .....	585
<i>N. Pausan, A. Abbas, D. Walker, M. Livesey</i>	
<b>Research on Several Types of Aerial Drop Fiber Optic Cable with Rated Tensile Strength</b> .....	594
<i>W. Lin, B. Jiang, H. Wang, B. Lu, F. Gao, Y. Wang, P. Liu, Q. Meng, H. Shi</i>	
<b>Next Generation Compact Interconnect and Backbone Cables for Multifiber Connectivity</b> .....	598
<i>H. Toland, A. Scarpaci, D. Benjamin, P. Weimann, G. Sandels</i>	
<b>The Development and Application Discuss of the Prefabricated End Double Core Parallel Branch Butterfly Fiber Optic Cable</b> .....	608
<i>Z. Li, L. Shi, S. Xie, C. Zhou, W. Xin, X. Yan</i>	
<b>Intelligent Cable for Resources Management System</b> .....	612
<i>B. Wan, Z. Xiong, X. Lu, H. Duan, H. Hu</i>	
<b>Exploration on Solution of Flexible and Anti-Bending Optical Cables</b> .....	616
<i>H. Fei, R. Wang, P. Liu, D. Wu, Q. Meng, H. Shi, Y. Sun</i>	

## **SESSION 14: SINGLE-MODE AND FEW-MODE FIBERS**

<b>A Novel Ultra Low Loss Few Mode Fibre</b> .....	622
<i>H. Zhou, R. Wang, L. Zhang, J. Wu, L. Zhang, L. Shen, S. Chen, H. Wang</i>	
<b>Design and Fabrication of 9-LP-Mode Fiber with Low DGD and Low Loss</b> .....	625
<i>L. Shen, S. Chen, X. Sun, L. Yaping, L. Zhang, H. Zhou</i>	
<b>Dispersion Measurements in Few Mode Fibers</b> .....	629
<i>B. Kose, J. Castro, R. Pimpinella, P. Huang, B. Lane, A. Novick, J. Antonio-Lopez, J. Zacarias, R. Correa, M. Bigot-Astruc, D. Molin, A. Amezcua-Correa, P. Sillard</i>	
<b>Multimode Fibers for Mode Division Multiplexing</b> .....	634
<i>P. Sillard, D. Molin, M. Bigot-Astruc, K. Jongh, F. Achten</i>	
<b>Low Attenuation and Large <math>A_{eff}</math> Fiber with a Matched-Cladding Profile</b> .....	638
<i>D. Sega, K. Okada, R. Maruyama, K. Nagasu, H. Nakagome, T. Onodera, A. Murata, S. Matsuo</i>	
<b>A Novel Single Mode Fiber with Ultra-Low Loss and Large Effective Area</b> .....	644
<i>P. Li, R. Wang, H. Wang, L. Zhang, J. Zhu</i>	
<b>Issues Concerning Dissimilar Single Mode Fiber Splicing</b> .....	648
<i>D. Duke, D. Mansperger</i>	
<b>A Ultra Low Loss Single Mode Fibre</b> .....	657
<i>J. Wu, R. Wang, L. Zhang, L. Zhang, H. Zhou, J. Zhu, H. Wang, R. Matai</i>	

## **SESSION 15: COMMERCIAL APPLICATIONS**

<b>Making OSP Loose Tube Armored Cable Safer, Easier, and Faster to Use</b> .....	661
<i>J. Dempsey, J. Baucom, J. Greenwood</i>	
<b>Development of High Performance Low Smoke Zero Halogen Moisture Curable Cross Linked Jacket Compounds with Attractive Processability Features</b> .....	667
<i>M. Slevin, J. Freestone, T. Getzie</i>	
<b>Easy-e-Beam® V3 Self-Shielded Dynamitron® Electron Beam Accelerator</b> .....	672
<i>S. Goldfarb</i>	
<b>New High Performance Materials for Communication Cable 4.0</b> .....	680
<i>F. Zelder</i>	

<b>CIQ Software Solutions Leading to Improved Quality and Productivity Levels Can Generate Serious Gains in Profitability</b> .....	691
<i>M. Felder, W. Klein</i>	
<b>The Effect of Thickness on Dielectric Strength in Low Voltage Compounds</b> .....	699
<i>P. Lorigan</i>	

### **SESSION 16: MATERIALS: FLAME RETARDANCY & ADDITIVES**

<b>Low-Smoke Halogen-Free Compounds Replacing Halogenated Materials in Cables (Industrial, Construction and Specialty in the Next Generation)</b> .....	704
<i>E. Lee</i>	
<b>Halogen Free Compound Solutions to Address Thermal Stress Cracking in Extreme Conditions</b> .....	712
<i>M. Jozokos, T. Artingstall</i>	
<b>Improved Halogen-Free Flame Retardant Wire and Cable Jacket Compound</b> .....	715
<i>Y. Zhang, B. Chaudhary, M. Alves, C. Heah, A. Ghosh-Dastidar, R. Tapper, B.-D. Nguyen</i>	
<b>The Missing Link for 125°C Automotive Wires - Halogen Free Flame Retardant Polypropylene Solution</b> .....	722
<i>C. Beisert, A. Watson, J. Ruder, L. Karlsson, B.-A. Sultan</i>	
<b>A Case Study of Processing HMH (Hydromagnesite/Huntite) on a Production Scale Compact Processor</b> .....	729
<i>P. Ye, S. Viering</i>	

### **SESSION 17: NETWORK MANAGEMENT & RELIABILITY**

<b>Optical Cable Re-Routing Operation Support System Without Service Interruption</b> .....	733
<i>T. Manabe, K. Noto, M. Inoue, H. Watanabe, Y. Koshikiya</i>	
<b>End-To-End Testing of Optical Distribution Network in Access Networks without Entering Customer's Premises</b> .....	739
<i>K. Toge, H. Takahashi, C. Kito, T. Manabe</i>	
<b>Revisiting Link Losses: Cable cuts, Link Reliability and Emerging Markets</b> .....	745
<i>S. Bhaumik, P. Agarwal, P. Pardeshi, B. Gomatam</i>	
<b>Optical Fiber Line Testing System Technologies for Various Optical Cable Networks</b> .....	749
<i>T. Iwadou, Y. Enomoto, Y. Kajihara, J. Onishi</i>	
<b>Operation Technology for Efficient Maintenance of Underground Optical Cable</b> .....	754
<i>M. Akamatsu, C. Kito, K. Mine, T. Ebine</i>	
<b>Novel Outside-Facility Management Technology for Maintenance and Inspection Work Using MMS</b> .....	758
<i>M. Waki, T. Goto, K. Katayama</i>	

### **SESSION 18: SHORT REACH, HIGH CAPACITY OPTICAL INTERCONNECTS**

<b>A Perspective on the Future of MMF</b> .....	765
<i>G. Choudhury, R. Lingle, J. Kamino, R. Shubochkin, D. Vaidya, D. Braganza</i>	
<b>Wideband Multimode Fiber for High Speed SWDM Systems</b> .....	773
<i>R. Huang, R. Wang, W. Xiao, L. Zhang, Y. Liu, J. Li, J. Zhu, H. Wang, R. Wang</i>	
<b>Characterizing Differential Mode Delay Tilt and its Relationship to the Effective Modal Bandwidth of Multimode Fibers as a Function of Wavelength</b> .....	776
<i>A. Novick, B. Kose, J. Castro, R. Pimpinella, P. Huang, A. Berian, B. Lane</i>	
<b>Method to Improve the Accuracy of Bandwidth Measurements for OM5 Fiber</b> .....	781
<i>E. Parsons, R. Patterson, P. Kidd, G. Irwin</i>	
<b>Performance Analysis of VCSEL Based Wavelength Division Multiplexing over OM3, OM4 and OM5 Fiber Infrastructure</b> .....	787
<i>M. Dodds, R. Sambaraju</i>	
<b>High Speed Short Reach Optical Interconnect over OM4 and OM5 Multimode Optical Fiber</b> .....	791
<i>Y. Sun, J. Kamino, R. Shubochkin, A. Swartz, R. Lingle, D. Braganza</i>	
<b>Author Index</b>	