

11th IMEKO TC9 Conference on Flow Measurement

(FLOMEKO 2003)

**Groningen, The Netherlands
12-14 May 2003**

ISBN: 978-1-63439-896-1

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© (2003) by the International Measurement Confederation (IMEKO)
All rights reserved.

Printed by Curran Associates, Inc. (2015)

For permission requests, please contact the International Measurement Confederation (IMEKO)
at the address below.

IMEKO Secretariat
P.O. Box 457
H-1371 Budapest
Hungary

Phone/Fax: +36 1 353 1562

imeko@t-online.hu

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
Web: www.proceedings.com

TABLE OF CONTENTS

MODELLING WET-GAS ANNULAR-DISPERSED FLOW THROUGH A VENTURI	1
<i>M. van Werven, G. Ooms, B.J. Azzopardi, H. R. E. van Maanen</i>	
UNCERTAINTY ANALYSIS AND LONG-TERM STABILITY INVESTIGATION OF THE GERMAN PRIMARY HIGH-PRESSURE NATURAL GAS TEST FACILITY <i>pigsar</i>	31
<i>Wolfram Bremser, Werner Hässelbarth, Uwe Hirlehei, Hans-Jürgen Hotze, Bodo Mickan, Rainer Kramer, Dietrich Dopheide</i>	
DEMONSTRATION OF TELECALIBRATION CAPABILITIES AS A NEW TOOL FOR METROLOGY AT THE GERMAN PRIMARY HIGH PRESSURE NATURAL GAS TEST FACILITY “<i>pigsar</i>”	43
<i>Hans-Jürgen Hotze, Rainer Kramer, Bodo Mickan, Petra Kiesewetter, Dietrich Dopheide</i>	
UNIT OF VOLUME FOR NATURAL GAS AT OPERATIONAL CONDITIONS, PTB AND NMI VSL DISSEMINATE "HARMONIZED REFERENCE VALUES"	50
<i>M. P. van der Beek, I. J. Landheer, B. Mickan, R. Kramer, D. Dopheide</i>	
A CONTINUOUS CALORIFIC VALUE MEASURING SYSTEM BASED ON A CORRELATIVE METHOD	61
<i>Virginie van Ranterghem, Stéphane Loubat</i>	
A MOST EFFICIENT DIAGNOSTICS TOOL FOR GAS TURBINE METERS: THE ACCULERT G – II	76
<i>Bertrand Reeb</i>	
THE BIGGEST CALIBRATION FACILITY TO BE BUILT FOR ACTUAL NATURAL GAS IN CHINA	89
<i>Guo Liang, Zheng Qi, Guo Mingchang, Xiao Di, Guo Dianjie</i>	
NUMERICAL SIMULATION OF THE SMMI FLOW CONDITIONER	95
<i>Julien Cancade, Bertrand Reeb</i>	
EFFICIENCY OF THE SMMI INSERTION FLOW CONDITIONER	108
<i>Julien Cancade, Bertrand Reeb</i>	
CALIBRATION OF LARGE HIGH PRESSURE V-CONE FLOWMETERS AT HIGH REYNOLDS NUMBERS IN THE CEESI IOWA NATURAL GAS TEST FACILITY	117
<i>Steve Caldwell, Tom Kegel, R. J. W. Peters</i>	
DEVELOPMENT OF A NEW CALIBRATION WIND TUNNEL WITHIN LOW AIR VELOCITY RANGE : 0.05 UP TO 2 m.s⁻¹	138
<i>Isabelle Care</i>	
REALISATION OF A MASS FLOW MEASUREMENT DEVICE FOR A NEW REFERENCE GAS CALORIMETER	143
<i>P. Ulbig, A. Benito, P. L. Cremonesi, J.-R. Filtz, R. Forster, F. Haloua, B. Hay, M. Jaeschke, S. Loubat, S. Sarge, P. Wenz</i>	
QUALITY CONTROL PROGRAM OF THE CEESI VENTURA CALIBRATION FACILITY	161
<i>Thomas Kegel</i>	
DEVELOPMENT OF THE PVTi SYSTEM FOR VERY LOW GAS FLOW RATES	169
<i>Shin-ichi Nakao, Yoshiya Terao, Masaki Takamoto</i>	
Z/Z-METER, ON-LINE MEASUREMENT OF COMPRESSIBILITY-RATIOS FOR REFERENCE VALUES OF VOLUME AT OPERATIONAL CONDITIONS	184
<i>A. J. M. Herwijn, M. P. van der Beek, I. J. Landheer</i>	
NMi TraSys, THE ULTIMATE CARRIER & MULTIPLIER FOR THE UNIT OF VOLUME FOR HIGH-PRESSURE NATURAL GAS	198
<i>M. P. van der Beek, I. J. Landheer</i>	
QUADRATIC WEIGHING, APPLIED IN HARMONIZATION, A TOOL TO COMPARE THE PERFORMANCE OF TEST-FACILITIES	214
<i>R. van den Brink, M. P. van der Beek, I. J. Landheer</i>	
GAS-OIL PISTON-PROVER, A NEW CONCEPT TO REALIZE REFERENCE VALUES FOR HIGH-PRESSURE GAS-VOLUME IN THE NETHERLANDS	223
<i>M. P. van der Beek, R. van den Brink, I. J. Landheer</i>	
PERIODICAL CONTROL AND DYNAMIC TRACEABILITY TEST OF AN SNPS TO THE NATIONAL STANDARD OF GAS FLOWMETERS CALIBRATION	237
<i>Alex S. Kun, Balazs Rekasi</i>	
INFLUENCE OF FLOW CONDITIONS ON AN ULTRASONIC FLOW METER	243
<i>Olivier Broca, Joël Escande, Bruno Delenne, Gérard Mouton, Pierre Gajan, Alain Strzelecki</i>	

TESTING THE PERFORMANCE OF ULTRASONIC SINGLE PATH HOT-TAP FLOW METERS	259
<i>G. J. van Essen, S. Bakker, H. J. Dane</i>	
CONFIDENCE LEVELS OF MEASUREMENT BASED DECISIONS	275
<i>Jos G. M. van der Grinten</i>	
THE COMPLIANCE TEST FOR FLOW CONDITIONERS AS APPLIED TO A ZANKER FLOW CONDITIONER PLATE WITH A VENTURI TUBE	285
<i>Michael Reader-Harris, Bill Brunton, Ian Nicholson, Ronnie Rushworth, David Hodges</i>	
THE USE OF ULTRASONIC GAS FLOW METERING TECHNOLOGY FOR THE DEVELOPMENT OF ACCURATE ENERGY METERS FOR NATURAL GAS	299
<i>Henk Jan Panneman, Cornelis W. Koreman, Sjoerd Toonstra, Floris Huijsmans</i>	
EFFECT OF GAS TYPE ON THE THERMAL PROPERTIES OF SMALL SONIC NOZZLES	320
<i>Noel Bignell</i>	
THE MIKES MEASURING SYSTEM FOR GAS MASS FLOW	326
<i>Sampo Sillanpää, Martti Heinonen</i>	
SPEED OF SOUND MEASUREMENTS IN GAS-MIXTURES AT VARYING COMPOSITION USING AN ULTRASONIC GAS FLOW METER WITH SILICON BASED TRANSDUCERS	331
<i>Torbjörn Löfqvist, Kestutis Sokas, Jerker Delsing</i>	
THE DESIGN AND APPLICATION OF CLAMP-ON ULTRASONIC FLOWMETERS FOR CUSTODY TRANSFER AND CHECK METERING GAS APPLICATIONS	336
<i>Douglas Baumel</i>	
INVESTIGATION OF FLOW CONDITIONING IN PIPES	351
<i>Gabriel Moniz Pereira, Bodo Mickan, Rainer Kramer, Dietrich Dopheide, Ernst von Lavante</i>	
FLOW BEHAVIOR IN SONIC MICRO-NOZZLES	380
<i>E. von Lavante, R. Kramer, B. Mickan</i>	
TIME DEPENDENT PERFORMANCE OF TURBINE GAS METERS	388
<i>A. Saglam, P. M. A. van der Kam, G. J. van Essen, D. H. Hebels</i>	
PRACTICAL EXPERIENCE ON INSPECTIONS OF ORIFICE PLATES MEASUREMENT SYSTEMS FOR NATURAL GAS	395
<i>Kazuto Kawakita</i>	
NUMERICAL SIMULATION OF UNSTEADY THREE-DIMENSIONAL FLOW FIELDS IN A TURBINE FLOW METER	408
<i>E. von Lavante, N. Lazaroski, U. Maatje, T. Kettner, V. Lötz-Dauer</i>	
PRINCIPLE OF CONVERTING THE MECHANICAL MOVEMENTS TO ELECTRICAL SIGNALS BY TURBINE METERS	417
<i>Hakan Kaykısızlı, Vahit Ciftçi, Ernur Karadogan, Basak Akselli</i>	
THE APPLICATION OF MEMS TECHNOLOGY TO ON-LINE ANALYZERS FOR NATURAL GAS	423
<i>Johan Bats</i>	
IMPROVING VORTEX FLOW METERING USING ULTRASOUND	439
<i>Volker Hans, Christian Filips</i>	
WHAT IS THE “BEST” TRANSFER STANDARD FOR GAS FLOW?	445
<i>John D. Wright</i>	
SPIN-OFFS FROM THE DEVELOPMENT OF ROTARY GAS METERS	472
<i>J. T. M. Bergervoet</i>	
REALISATION OF COMPACT METERING RUNS WITH ULTRASONIC GAS FLOW METERS AND REDUCING MEASUREMENT UNCERTAINTY	487
<i>Koen H. Commissaris, Geeuwke de Boer</i>	
WIB - WORKING-PARTY ON INSTRUMENT BEHAVIOUR	501
<i>Tom Kuperij</i>	
CORRECTION FOR K FACTOR OF GAS TURBINE FLOW METER	504
<i>Xue Chunling, Lv Deyue, Sun Yanzuo</i>	
PERFORMANCE OF ORIFICE METERS IN INSTALLATIONS WITH HEADERS	512
<i>Wojciech Studzinski</i>	
TWENTY -FIVE YEARS OF FLOW LAB COMPARISONS USING TANDEM'S METER TRANSFER STANDARDS: LESSONS LEARNED AND LESSONS NOT LEARNED	531
<i>G. E. Mattingly</i>	
THE MATEMATICA APPROACH	532
<i>Stephan Rudbäck</i>	
NUMERICAL SIMULATIONS OF THE FLUID FLOW IN THE MEASURING TUBE OF THE CORIOLIS FLOWMETER	549
<i>Gregor Bobovnik, Jože Kutin, Ivan Bajšić</i>	

THE CHARACTERISTICS OF THE STRAIGHT-TUBE CORIOLIS FLOWMETER FOR DIFFERENT LATERAL VIBRATION MODES.....	561
<i>Jože Kutin, Ivan Bajšić</i>	
PHASE MODULATION OF THE ULTRASONIC WAVE IN VON KARMAN STREET	570
<i>Mustafa Music</i>	
THEORY OF A CORIOLIS MASS FLOWMETER INSERTION PROBE	576
<i>Lynn A Hendry, John Hemp</i>	
NEW TEST FACILITY FOR LARGE WATER FLOWRATES UP TO 1000 m³ / h IN A TEMPERATURE RANGE BETWEEN 3 °C AND 90 °C AT PTB - BERLIN.....	588
<i>Thomas Lederer, Nicolaus Mathies, Jürgen Rose, Dieter Stuck</i>	
A NEW SLIGHTLY BENT SINGLE TUBE CORIOLIS MASS FLOWMETER FOR CORROSIVE FLUIDS	594
<i>Martin Anklin, Alfred Wenger</i>	
CORIOLIS MASS FLOW METER WITH DIRECT VISCOSITY MEASUREMENT	598
<i>Michael Fuchs, Wolfgang Drahm, Christian Matt, Alfred Wenger</i>	
NEW PRIMARY STANDARD FOR HYDROCARBON FLOWMETERS AT NMIJ - INTERNATIONAL COMPARISON BETWEEN NMIJ AND SP	603
<i>Takashi Shimada, Ryouji Doihara, Yoshiya Terao, Masaki Takamoto, Krister Stolt, Anders Andersson</i>	
COMPARATIVE PERFORMANCE EVALUATION BY WTB OF TWO-WIRE AND FOUR-WIRE EMF METERS OF THREE DIFFERENT MAKES.....	619
<i>Frans van Laak</i>	
STUDY OF WATER FLOW CALIBRATION FACILITIES WITH MULTI-FUNCTION AND HIGH ACCURACY	640
<i>Hongjun Sun, Chao Wang</i>	
A CURRENT-TYPE ELECTROMAGNETIC FLOWMETER FOR TWO-PHASE FLOW	646
<i>Yeh-Chan Ahn, Byung Do Oh, Moo Hwan Kim</i>	
NOVEL TECHNIQUE FOR CALIBRATION PIPE PROVER MEASURING VOLUME	698
<i>Helmut Többen</i>	
DEVELOPMENT OF A NEW TYPE OF CORIOLIS FLOWMETER WITH INDEPENDENT VIBRATION FRAMES FOR DRIVE AND TORSION.....	705
<i>Ryouji Doihara, Yoshiya Terao, Masaki Takamoto</i>	
EXPERIENCES OF PULP FLOW MEASUREMENTS WITH ELECTRO- MAGNETIC FLOWMETERS	714
<i>Esa Luntta, Harri Nystedt, Jouko Halttunen, Juha Kortelainen</i>	
NEW-DESIGN DUAL-BALANCE GRAVIMETRIC REFERENCE SYSTEM WITH PTB'S NEW "HYDRODYNAMIC TEST FIELD"	721
<i>Rainer Engel, Hans-Joachim Baade</i>	
VELOCITY MEASUREMENT IN BOILER TUBES USING A NOVEL ULTRASONIC FLOW MEASUREMENT TECHNIQUE	731
<i>M. L. Sanderson, R. H. Al-Rabeh</i>	
NUMERICAL MODELLING OF VORTICES DEVELOPMENT IN TAPERED DUCT.....	740
<i>Grzegorz L. Panknin, Jerzy Berlinski, Ryszard Chmielewski</i>	
FLOW SENSORS OF HEAT METERS FOR THERMAL SOLAR SYSTEMS.....	746
<i>J.-F. March</i>	
CLOSURE MODEL FOR TWO-PHASE LIQUID-GAS MEASUREMENT UNDER SLUG FLOW CONDITIONS	752
<i>S. Al-lababidi, M. L. Sanderson</i>	
TWO-PHASE FLOW MEASUREMENT BASED ON THE ANALYSIS OF THE SENSOR SIGNAL FROM A CONVENTIONAL VORTEX FLOWMETER.....	765
<i>M. Pusayatanont, P. J. Unsworth, E. H. Higham</i>	
ANALYSIS OF THE SENSOR SIGNAL FROM A TURBINE FLOWMETER TO RECOVER INFORMATION REGARDING THE FLOW REGIMES.....	773
<i>M. Pusayatanont, E. H. Higham, P. J. Unsworth</i>	
ANALYSIS OF THE SENSOR SIGNAL FROM A VORTEX FLOWMETER TO RECOVER INFORMATION REGARDING THE FLOW REGIMES.....	786
<i>M. Pusayatanont, E. H. Higham, P. J. Unsworth</i>	
MODAL ANALYSIS OF CORIOLIS MASS FLOWMETER.....	794
<i>Tong Meng, Ren Ping, Chen Ming</i>	
PERFORMANCE IMPROVEMENT OF LIQUID FLOW CALIBRATORS BY APPLYING SPECIAL MEASUREMENT AND CONTROL STRATEGIES	801
<i>Rainer Engel, Hans-Joachim Baade, Andreas Rubel</i>	

THE IMPACT OF FLOW DYNAMICS IN THE DESIGN OF FLOW METERS AND METERING STATIONS	814
<i>E. van Bokhorst, M. C. A. M. Peters, F. M. Braal</i>	
CALIBRATION OF 24 TON WEIGHING SCALE BY CORIOLIS MASS MASTER METER UNCERTAINTY CALCULATION IN LOAD AND IN LOAD DIFFERENCE	830
<i>Aart Pruijsen</i>	
ISO 17025 ACCREDITATION FOR A STANDING START FINISH (SSF) PRIMARY FLOW STAND AND THE APPLICATION TO USING CORIOLIS FLOWMETERS AS REFERENCE STANDARDS.....	863
<i>Mark Lee, Aart Pruijsen</i>	
FIELD PROVING BY MICRO MOTION CORIOLIS PROVER MASS MASTER METER METHOD	877
<i>Bert Roos, Milovan Antonijevic</i>	
THEORETICAL SELF-ERROR-CANCELLING DIVERTERS FOR LIQUID FLOW CALIBRATION FACALITIES	894
<i>Tsyh-Tyan Yeh, Nhlanhla P. Yende, Pedro I. Espina</i>	
THE NEW NIST WATER FLOW CALIBRATION FACILITY	904
<i>Vikram. Gowda, Tsyh-Tyan Yeh, Pedro I. Espina, Nhlanhla P. Yende</i>	
A NEW GENERATION OF INLINE LIQUID ULTRASONIC FLOW METERS.....	914
<i>Jankees Hogendoorn, Herman Hofstede, André Boer, Helen Danen</i>	
CALIBRATION OF THE SLUICE GATES IN THE AFSLUITDIJK	920
<i>Ivo Pothof, Christof Lubbers</i>	
DETECTION OF IMPROPER MOUNTING FROM THE SENSOR SIGNAL OF VORTEX FLOWMETERS.....	935
<i>A. G. Rossberg, P. Riegler, F. Buhl, J. Herwig, J. Timmer</i>	
INFLUENCE OF SHAPE DEVIATIONS ON THE MEASUREMENT PRECISION OF VORTEX FLOW METERS	948
<i>Ernst von Lavante, Burger Nath</i>	
Author Index	