

# International Rotating Equipment conference

Pumps and Compressors

Düsseldorf, 27<sup>th</sup>–28<sup>th</sup> September 2012



PROGRAMME

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## Ladies and Gentlemen,

As a result of continuous research and development, the worldwide pump, compressor, compressed air and vacuum technology sector now enjoys an excellent reputation for innovative pumps, compressors and vacuum technology design and provides excellent product quality. Our industry is anxious to further enhance this reputation by effective communication with its customers and suppliers. The International Rotating Equipment Conference offers a unique possibility to present new solutions to the sector, hold face-to-face discussions with users, plant manufacturers and equipment manufacturers and to accept proposals for the coming years.

As its promoter, we are happy to offer you the opportunity to attend the second "International Rotating Equipment Conference – Pumps and Compressors", incorporating three respected international forums: the 10<sup>th</sup> Pump Users International Forum, the 3<sup>rd</sup> Compressor Users International Forum and the 8<sup>th</sup> EFRC (European Forum for Reciprocating Compressors) Conference. Together with our European partner associations EUROPUMP and PNEUROPE and with additional support from several trade associations and professional bodies, we have been able to maximize the collaborative effect.

If you are a user, plant manufacturer, equipment manufacturer, component supplier, research & development organisation or pumps, compressors, compressed air and vacuum technology expert or you are new to the sector, we are certain that you will find the depth and quality of the specialist programme compiled with the international "Call for Papers" of interest and value. On behalf of the VDMA and EFRC, we welcome you to the Conference.



Sönke Brodersen  
Chairman of VDMA Pumps + Systems Association



Alexander Peters  
Chairman of VDMA Compressors, Compressed Air and Vacuum Technology Association



René Peters  
Chairman of EFRC European Forum for Reciprocating Compressors

# 10<sup>th</sup> Pump Users International Forum (PIF)

## Advisory Committee (AdvCom)

Sönke Brodersen, KSB

Frank Ennenbach, EUROPUMP, Sulzer  
Pump Solutions

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Christoph Singrün, VDMA

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*Chairman: Paul-Uwe Thamsen,  
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Thomas Herbers, KLAUS UNION

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Frank Holz, Leistritz Pumpen

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MUNSCH Chemie-Pumpen

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# 3<sup>rd</sup> Compressor Users International Forum (CIF)

## Advisory Committee (AdvCom)

Werner Brinkhoff, BEKO

Ralf Kannefass, SIEMENS

Monika Mattern-Klosson,  
Oerlikon Leybold

Alexander Peters, NEUMAN & ESSER

Jouko Peussa, PNEUROP,  
Ingersoll Rand

Christoph Singrün, VDMA

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Thomas Dreifert, Oerlikon Leybold

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Christoph Jakiel, MAN Diesel & Turbo

Friedrich Justen, Gardner Denver

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Michael Pehl, Thyssen Krupp

Jouko Peussa, Ingersoll Rand

Dieter Richter, BOGE

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Christoph Singrün, VDMA

Volker Thomassen, ALMIG

Kompressoren

Jürgen Wisse, Atlas Copco

Wolfgang Zacharias, SIEMENS

Matthias Zelinger, EUTurbines

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## **8<sup>th</sup> European Forum for Reciprocating Compressors (EFRC) Conference**

### **EFRC Industry Advisory Board (AdvCom)**

Siegmund Cierniak, RWE

Heinrich Ochs, BASF

Jeroen van Koperen, Shell

Tom Walisch, Lonza

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## **Programme Committee (ProgCom)**

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Eike Drewes, Prognost

Peter Duineveld,  
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Thomas Heumesser, LMF

Klaus Hoff, NEUMAN & ESSER

Ernst Huttar, LMF

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Rainer Weiss, Josef Mehrer

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## **EFRC Conference Organisation Committee (OrgCom)**

Martina Frenz, NEUMAN & ESSER

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Marco Scanderbeg,  
Burckhardt Compression

## Technical Exhibition

During the two days of the “International Rotating Equipment Conference – Pumps and Compressors” a Technical Exhibition will take place. Manufacturers and sub-suppliers will present a lot of product information in the CCD-Stadthalle within Düsseldorf Congress Center. Companies have the opportunity to present themselves at the exhibition. For interested companies standard booths are offered including a qualified and uniform booth design.

If you are interested in the Technical Exhibition, please visit the conference homepage [www.introequipcon.com](http://www.introequipcon.com) to download further information and participation conditions or contact directly:

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### Opening times of the Technical Exhibition

Thursday, 27<sup>th</sup> September 2012, 09.00 h until 18.00 h

Friday, 28<sup>th</sup> September 2012, 09.00 h until 16.00 h

Thursday, 27<sup>th</sup> September 2012

**9.00 h, Room 1**

## **Plenary Session**

### **Welcome and Opening**

by the Chairman  
of the VDMA Pumps + Systems Association  
and President of EUROPUMP  
Sönke Brodersen

by the Chairman  
of the VDMA Compressors, Compressed Air and  
Vacuum Technology Association  
Alexander Peters

by the Chairman  
of the European Forum for Reciprocating Compressors  
René Peters

and by the President of PNEUROP  
Paul Frigne

### **Plenary Speaker**

Michael Weinhold,  
Siemens, CTO Energy Sector

Title:  
Energy System – on the Way from a Linear Design to a Power Matrix

Moderator: Alex Puissant  
Journalist & independent conference moderator





**Pump Users**  
International Forum 2012

Sponsored by



Thursday, 27<sup>th</sup> September 2012

11.00 h, Room 14

Session 1

## Surface, materials and corrosive cavitation

**Chairman:** Michael Hirschberger

**1-1** Martin Swierczek / Frank Licht / Tony Young  
Results of a 5-year experience of using not metallic, abrasion resistant wear parts in vertical river water intake pumps

**1-2** Thomas Keil / Peter F. Pelz / Gerhard Ludwig  
Effect of different cavitation structures in a centrifugal pump

**1-3** Bryan Johnson / Franz Jansen / Hans-Michael Hoehle  
Thermal spray coatings for fluid machinery applications

Thursday, 27<sup>th</sup> September 2012

11.00 h, Room 1

Session 2

Pump Users International Forum 2012  
Compressor Users International Forum 2012

**Present:**

### Young professionals

“Selected Alumni present either their thesis or results of present research projects according to fluid dynamics”

**Moderator:** Friedrich Klütsch

No discussion after the presentation – opportunity for discussion is given extensively during the following break at the exhibition, booth B13.

Thursday, 27<sup>th</sup> September 2012

## Session 3

11.00 h, Room 27

### Benefit of certain components

**Chairman:** Frank Ennenbach

**3-1** Rok Pavlin / Franci Vehar / Aljaž Škerlavaj / Franc Kranjc  
Turning vanes in front of cooling water pump suction bell

**3-2** Jeff Lunsford / Bharat Makadia  
New way to control the piping loads imposed on load sensitive equipment

**3-3** Jordan Grose / Wally Bratek  
Integrity of pulsation dampeners in liquid systems

Thursday, 27<sup>th</sup> September 2012

## Session 4

14.00 h, Room 14

### Vibration

**Chairman:** Thomas Herbers

**4-1** Johannes Verhoeven / Daniel Irigo / Daniel Oller /  
Domingo Degennaro / Rene Ferreyra  
Case history of a full technical assessment on the Oldelval crude oil pipeline system to identify pump solutions to reduce energy costs, maintenance cost and operator cost

**4-2** Vitaliy Vasilyev / Anton Nitskiy / Matvey Kraposhin /  
Thomas Elsässer, Christof Schuler, Christian Schmidt  
Numerical and experimental study of fluid dynamic coefficients in smooth and grooved annular seals and investigation of flow induced self-excited rotor oscillations in high-capacity feed pumps

**4-3** Malcolm Robertson  
Measurement of pump performance on offshore oil and gas platforms by thermodynamic methods

Thursday, 27<sup>th</sup> September 2012

14.00 h, Room 1

Session 5

## New cognitions – research report

**Chairman:** Paul Uwe Thamsen

**5-1** Eugeniy Spiridonov / Nadezda Spiridonova  
Characteristics and calculation of nonsteady ejection in a jet pump

**5-2** Krzysztof Denus  
Optimisation of pumps operating at low specific speed

**5-3** Andreas Kögler / Nicolas Alt / Eberhard Schlücker  
Pressure pulsations of centrifugal pumps and their interaction with systems

Thursday, 27<sup>th</sup> September 2012

14.00 h, Room 27

Session 6

## Automation (drives; VSD/VFD; ...)

**Chairman:** Fred Donabauer

**6-1** Ulrich Hermann / Martin Graser  
Energy savings and energy recovery through the use of servo valve-controlled regulating pumps in modern press drives

**6-2** Juha Viholainen / Jukka Tolvanen / Fred Donabauer  
Flow metering and energy efficiency with variable speed drives

**6-3** Ramesh Ponnuswamy / Murugesan Chenniappan  
Irrigation of golf course by an efficient hydro pneumatic pumping system of 6+1 (working + standby) configuration

Thursday, 27<sup>th</sup> September 2012

## Session 7

16.00 h, Room 14

### Oil & Gas

**Chairman:** Jürgen Konrad

**7-1** Robert Kurz / Simon Williams

Progressing cavity pumps for pumping multiphase fluids in oil fields

**7-2** Deepak Chaware / Avinash Joshi

Practical approach towards centrifugal pump specifications for refinery: the user's view point

**7-3** Hesham Abdou

A new one-dimensional flow theory of the jet pump for pumping crude oil with different viscosities and densities using water powered flow

Thursday, 27<sup>th</sup> September 2012

## Session 8

16.00 h, Room 1

### The phenomenon of cavitation

**Chairman:** Bernd Stoffel

**8-1** Karsten Opitz / Sascha Engel / Alfred Leipertz /  
Eberhard Schlücker

Verification of a fluid dynamic cavitation model for reciprocating positive displacement pumps

**8-2** Vladimir Skara / Jens Friedrichs / Günter Kosyna

Vortex cavitation occurring in radial and mixed flow centrifugal pump impellers at part-load operation

**8-3** Stefan Berten / Mohamed Farhat / Philippe Dupont

Investigation of cavitating flow phenomena in a high energy pump diffuser at part-load operation

Thursday, 27<sup>th</sup> September 2012

16.00 h, Room 27

Session 9

## Invited papers\* (claim, option, solution)

**Chairman:** Peter Pelz

**9-1** Matthias Himstedt / Stefan Krämer

New concept for explosion protection for canned motor pumps of category 2 G

**9-2** Rafael Carmona / Peer Springer / Kilian Kirst / Jens Mielke  
Pump station “La Caldera” or how to avoid rain season flooding in Mexico City

**9-3** Philippe Dupont

A novel standardization approach for the development of a single stage double flow axially split pump range

Friday, 28<sup>th</sup> September 2012

09.00 h, Room 14

Session 10

## Energy efficiency & renewables

**Chairman:** Frank-Hendrik Wurm

**10-1** Paul Krampe / Per Reidar Orke

Four-Quadrant Operation of Rotary Lobe Pumps and Regenerative Throttling

**10-2** Charles de Marolles / Miguel Angel Rivas

HTF circulation pumps – pump solutions for parabolic trough concentrated solar power

**10-3** Falk Bahm / Rainer Landowski

New high-pressure pump for Green Power applications

\* Those papers do not enter the contest for the “Best Paper Award”.

Friday, 28<sup>th</sup> September 2012  
09.00 h, Room 26

## Session 11

### CFD – numerical approach

**Chairman:** Markus Beukenberg

**11-1** Annika Fleder / Martin Böhle

Numerical and experimental investigations of the influence of the blade shape of industrial side channel pumps

**11-2** Andreas Schneider / Björn-Christian Will / Martin Böhle

Numerical analysis of stress and deformation in multi-stage pump impellers

**11-3** Günther Schneider / Bernd Drews / Michael Westib

Dependencies between journal bearings and internal flows and pressures in centrifugal pumps with permanent magnetic drives

**11-4\*** Helmut Benigni / Helmut Jaberg / Anthony Salisbury

Numerical simulation of deep part-load operation for stable head curves of API pumps

Friday, 28<sup>th</sup> September 2012  
09.00 h, Room 27

## Session 12

### Water & sewage

**Chairman:** Helmut Jaberg

**12-1** Werner Kröber

Experience with a fully automated cross-linked wastewater transportation system

**12-2** Peter Bonn

A hands-on approach to energy and operator cost saving refurbishment of municipal wastewater pumping stations

**12-3** Kristian Hoechel / Paul Uwe Thamsen / Helmut Rauwald

Problem analysis of sewage pumping stations

\* This Technical Paper will be published in the proceedings only. Due to time limits a presentation during the Forum is not foreseen.

Friday, 28<sup>th</sup> September 2012

11.00 h, Room 14

Session 13

## Energy efficient systems

**Chairman:** Kurt Bieniek

**13-1** Ludger Gottkehaskamp / Georg Cichon / Gabriel Muffler /  
Chris Denus

New submersible motor pump SU16-600 with highest efficiency

**13-2** Katharina Schächtele / Simon Schneider

Energy efficiency in complex systems of the chemical industry

**13-3** Daniel Gontermann

The systematic way to maximize the energy efficiency of pumping systems – application examples

Friday, 28<sup>th</sup> September 2012

11.00 h, Room 26

Session 14

## CFD – applied on PD pumps

**Chairman:** Heinz M. Nägel

**14-1** Klaus Rübiger / Frank Holz

Numerical flow analysis inside two- and three-spindle screw pumps

**14-2** Jürgen Schiffer

A comparison of CFD-calculations and measurements of the fluid flow in rotating displacement pumps

**14-3** Ralph van Rijswick / Arnold Talmon / Cees van Rhee

Fluid structure interaction in piston diaphragm pumps



Friday, 28<sup>th</sup> September 2012

## Session 15

11.00 h, Room 27

### Condition monitoring and root cause analysis

**Chairman:** Jean-Claude Bouricet

**15-1** Rüdiger Proff

New condition monitoring solutions for reducing TCO (total cost of ownership)

**15-2** Mahesh Subramaniam

Cost reduction by remote health monitoring

**15-3** Usman Sharif

Root cause failure analysis of submersible pump (P-110)

Friday, 28<sup>th</sup> September 2012

## Session 16

14.00 h, Room 14

### Performing pump systems

**Chairman:** Falk Bahm

**16-1** Swaminathan Gopalakrisham

Probabilistic approach to determine pump operating point

**16-2** Frank-Hendrik Wurm

Fields of innovation in pump systems for customer benefits

**16-3** Sebastian Wulff / Paul Uwe Thamsen

Reduction of energy consumption by using computer simulation of a complex fluid system

Friday, 28<sup>th</sup> September 2012

14.00 h, Room 26

Session 17

## Benefit of CFD in application

**Chairman:** Dirk-Harald Bestehorn

**17-1** Sten Sieber / Christian Schänzle / Saban Caglar /  
Martin Gabi

Evolutionary optimization of a pump inlet elbow

**17-2** Jitendra Kumar / Frank-Hendrik Wurm / Hendrik Sura

Effect of mixer blade geometry and deformation on jet flow shape  
and sedimentation in sewage applications

**17-3** Philipp Spenner / Jochen Fritz / Yujun Sha /  
ShuHong Liu / Yulin Wu

Survey for optimization of the spherical casing of a boiler  
recirculation pump with focus on hydraulic forces and pressure  
pulsations using CFD

Friday, 28<sup>th</sup> September 2012

14.00 h, Room 27

Session 18

## Positive displacement pumps

**Chairman:** Eberhard Schlücker

**18-1** Frank Holz / Armin Mosandl / Matthias Nolte

Applications of two spindle pumps in the chemical industry

**18-2** Stefan Willems

Energy and cost-efficient coal slurry pumps in the pressurised coal  
gasification process

**18-3** Joachim Thurner / Peter Pelz

Experimental and theoretical investigations concerning the  
prediction of the operation limit of three-spindle screw pump

## Session 29\*

Pump Users International Forum 2012  
Compressor Users International Forum 2012

**Present:**

### **EuP/ErP expert talk**

**Is the EUROPUMP Approach a general solution for industrial products under the Ecodesign directive and accommodates the concerns of the user?**

Introducing statements followed by an exchange of views by active members of EUROPUMP/PNEUROPEAN EuP/ErP Working groups

Moderator: Alex Puissant  
Journalist & independent conference moderator

### **Introducing Statements**

Frank Ennenbach: The EUROPUMP approach to answer the EuP/ErP challenge

Bernd Stoffel: How a harmonised standard fulfils the requirements of the EU regulation and the industry

### **Discussion**

#### **Visionary closing statement**

Ulf Lorenz / Peter Pelz: Optimization of pump systems by means of discrete mathematics – the chess playing or artificial fluid systems designer

\* session number according to CIF sequence.

## Contributors

### 10<sup>th</sup> Pump Users International Forum

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<b>Lunsford, Jeff</b> BelleFlex Technologies USA-PA 6229 Freeport	Ses. 3
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<b>Mielke, Jens</b> KSB AG D-06110 Halle	Ses. 9
<b>Mosandl, Armin</b> LEISTRITZ Pumpen GmbH D-90459 Nürnberg	Ses. 18



<b>Muffler, Gabriel</b> ANDRITZ Ritz GmbH D-73529 Schwäbisch Gmünd	Ses. 13
<b>Nägel, Heinz M.</b> FELUWA Pumpen GmbH D-54570 Mürlenbach	ProgCom
<b>Nitskiy, Anton</b> Chelyabinsk State University RUS-454000 Chelyabinsk	Ses. 4
<b>Nolte, Matthias</b> Bayer Material Science AG D-51373 Leverkusen	Ses. 18
<b>Oller, Daniel</b> Flowserve – Flow Solutions Group RA-Mendoza	Ses. 4
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<b>Orke, Per Reidar</b> Zeropex AS N-4325 Sandnes	Ses. 10
<b>Pavlin, Rok</b> Turboinstitut d. d. SLO-1210 Ljubljana	Ses. 3
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<b>Puissant, Alex</b> Journalist & independent conference moderator	Plenary Ses. 24 Ses. 29
<b>Räbiger, Klaus, Dr.</b> LEISTRITZ AG D-90459 Nürnberg	Ses. 14
<b>Rauwald, Helmut</b> Technische Universität Berlin D-10623 Berlin	Ses. 12
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<b>Sharif, Usman</b> Fauji Fertilizer Ltd. PK-Sadiqabad	Ses. 15
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<b>Thurner, Joachim</b> Technische Universität Darmstadt D-64289 Darmstadt	Ses. 18
<b>Tolvanen, Jukka</b> ABB Drives FIN-00380 Helsinki	Ses. 6
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<b>Viholainen, Juha</b> Lappeenranta University of Technology FIN-Lappeenranta	Ses. 6
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<b>Westib, Michael</b> Ruhrpumpen GmbH D-58453 Witten	Ses. 11
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<b>Williams, Simon</b> NETZSCH Mohnopumpen GmbH D-84478 Waldkraiburg	Ses. 7
<b>Wu, Yulin, Prof.</b> Tsinghua University CN-100084 Peking	Ses. 17
<b>Wulff, Sebastian</b> Technische Universität Berlin D-10623 Berlin	Ses. 16
<b>Wurm, Frank-Hendrik, Prof.</b> Universität Rostock D-18059 Rostock	ProgCom Ses. 16 Ses. 17
<b>Young, Tony</b> Greene, Tweed & Co. Ltd GB-Nottingham	Ses. 1



**Compressor Users**  
International Forum 2012

Sponsored by



Thursday, 27<sup>th</sup> September 2012  
**11.00 h, Room 1**

**Session 2\***

Pump Users International Forum 2012  
Compressor Users International Forum 2012

**Present:**

## **Young professionals**

“Selected Alumni present either their thesis or results of present research projects according to fluid dynamics”

**Moderator:** Friedrich Klütsch

No discussion after the presentation – opportunity for discussion is given extensively during the following break at the exhibition, booth B13.

\* session number according to PIF sequence.

Thursday, 27<sup>th</sup> September 2012

**11.00 h, Room 18/19**

**Session 19**

## **Systems control and condition monitoring**

**Chairmen:** Jens Friedrichs  
Heiner Kösters

**19-1** Christian Licht / Martin Böhle

Development of an early fault detection system for gas pressure regulators by monitoring of the breakdown critical elements spindle, valve seat and membrane

**19-2** Salim Ramachandran

Failure prediction of screw air compressors

**19-3** Joerg Kortstock

Report of wide range field experience with condition monitoring system for pumps

Thursday, 27<sup>th</sup> September 2012

**11.00 h, Room 28**

**Session 20**

## **Energy efficiency in compressed air systems**

**Chairmen:** Volker Thomassen  
Werner Brinkhoff

**20-1** Conrad Latham / Andre Balliauw

Evolution of compressor performance and performance of compressed air systems

**20-2** Robert Lamprecht

Smart motor systems and advanced variable speed drives

**20-3** Andreas Schlegel / Dieter Richter / Nico Schikade

Energy-conscious planning of car body manufacturing – from production engineering to compressed air infrastructure

Thursday, 27<sup>th</sup> September 2012  
14.00 h, Room 18/19

## Session 21

### Simulation of machines and processes

**Chairmen:** Martin Böhle  
Hans.-U. Fleige

**21-1** Dominik Surek / Silke Stempin  
Simulation and evaluation of the flow in side channel compressors

**21-2** Jan Hütker / Andreas Brümmer  
Experimental and theoretical investigation of dry running high-speed screw motors

**21-3** Martin Kamann / Martin Häfele  
Dynamic machine simulations for the investigation of machine protection systems

Thursday, 27<sup>th</sup> September 2012  
14.00 h, Room 28

## Session 22

### Monitoring and optimization of compressed air systems

**Chairmen:** Dieter Richter  
Jürgen Wisse

**22-1** Tugdual de Fontbrune  
Scoreboard energy for compressed air system

**22-2** Jan Hoetzel / Norman Kloss  
Compressed air master control and monitoring including vibration control

**22-3** Horst Bäuml  
Cost reduction in replacement of two oilfree reciprocating booster compressors because of a compressed-air-check through owner's engineer

Thursday, 27<sup>th</sup> September 2012  
16.00 h, Room 18/19

**Session 23**

## Retrofits, service and maintenance

**Chairmen:** Thomas Scholbrock  
Wolfgang Henser

**23-1** William Paul Hancock / Petter Berg  
Lessons learnt from modifying offshore compressors

**23-2** Wilfried Blotenberg  
Dynamic simulation of an intercooled axial-flow compressor  
emergency shutdown sequence

**23-3** Michael Schiller  
Compressor train retrofits

**23-4\*** Edi Hamdi / Zainal Abidin / Nunang Hidayat  
Vibration measurement and dynamics analysis of KLB P/F deck  
structure due to installation of new mini compressor

Thursday, 27<sup>th</sup> September 2012  
16.00 h, Room 28

**Session 24**

## Panel discussion compressed air systems

**Theme: Compressed Air in industrial processes –  
Future challenges for design and operation**

This panel discussion shall focus on specific challenges and solutions for users of compressed air systems. The variety of different expositions according to customer demand, energy issues (including assessments of compressed air systems) and operation (including maintenance) offers the floor to a controversial discussion about the expectancies of the users versus the solutions of the manufacturers.

The debaters will be

- two manufacturers with different approaches,
- two to three users of compressed air systems (who have recent experiences with adapting compressed air systems)
- one energy consultant

**Moderator:** Alex Puissant  
Journalist & independent conference moderator

\* This Technical Paper will be published in the proceedings only. Due to time limits a presentation during the Forum is not foreseen.



Friday, 28<sup>th</sup> September 2012  
09.00 h, Room 18/19

## Session 25

### Compressor design 1

**Chairmen:** Michael Pehl  
Markus Sauerborn

**25-1** Hans-U. Fleige  
Pulse-charging of Twin-shafted Rotary Positive Displacement Compressors

**25-2** Kai-Henning Brune  
Introduction of an optimization chain for the aerodynamic optimization of a return-channel for a low flow coefficient centrifugal compressor stage

**25-3** Peter Mahlberg / Lars Schlüter  
High efficient pre-designed main air compressors for air separation plants

**25-4\*** Robert Mc Ginn / Niles Hlavacek  
Analytical case study demonstrating the leakage reduction available in centrifugal compressors by utilizing thermoplastic labyrinth seals

Friday, 28<sup>th</sup> September 2012  
09.00 h, Room 28

## Session 26

### Vacuum pumps and applications 1

**Chairmen:** Andreas Brümmer  
Thomas Dreifert

**26-1** Clive Tunna  
Introduction to vacuum technology, development trends and future challenges

**26-2** Stephan Becker / Ian Stones / Owain Charles  
Technical design features of the 3<sup>rd</sup> and 4<sup>th</sup> generation of screw technology and the resulting economic benefits in vacuum pumping solutions

**26-3** Christopher Huck / Kai Nadler / Andreas Brümmer  
Influence of the geometric parameters on the performance of screw vacuum blowers

\* This Technical Paper will be published in the proceedings only. Due to time limits a presentation during the Forum is not foreseen.

Friday, 28<sup>th</sup> September 2012

11.00 h, Room 18/19

Session 27

## Compressor design 2

**Chairmen:** Stefan Günther  
Christoph Jakiel

**27-1** Ronald Sachs / Ingo Nowitzky  
Burner air supply unit for an active regeneration of diesel particulate filter (dpf) – systems

**27-2** Frank von Oppenkowski  
Aspects of turbocompression in high pressure (690 bar) – an innovative concept

**27-3** Carolina Rodriguez  
New elastomer developed to meet severe rapid gas decompression specifications

Friday, 28<sup>th</sup> September 2012

11.00 h, Room 28

Session 28

## Vacuum pumps and applications 2

**Chairmen:** Martin Böhle  
Friedrich Justen

**28-1** Stefan Kluck / Martin Böhle / Magnus Janicki  
Numerical examination of flow phenomena in roots blowers

**28-2** Alois Greven  
Current and future trends in the control of vacuum pumps, their control environment and user interfaces

**28-3** Matthias Tamm  
Development and operation of modern liquid ring vacuum pumps

## Session 29

Pump Users International Forum 2012  
Compressor Users International Forum 2012

**Present:**

### **EuP/ErP expert talk**

**Is the EUROPUMP Approach a general solution for industrial products under the Ecodesign directive and accommodates the concerns of the user?**

Introducing statements followed by an exchange of views by active members of EUROPUMP/PNEUROPEAN EuP/ErP Working groups

Moderator: Alex Puissant  
Journalist & independent conference moderator

#### **Introducing Statements**

Frank Ennenbach: The EUROPUMP approach to answer the EuP/ErP challenge

Bernd Stoffel: How a harmonised standard fulfils the requirements of the EU regulation and the industry

#### **Discussion**

#### **Visionary closing statement**

Ulf Lorenz / Peter Pelz: Optimization of pump systems by means of discrete mathematics – the chess playing or artificial fluid systems designer

## Dry gas seal systems

**Chairmen:** Wolfgang Zacharias  
Markus Sauerborn

**30-1** Michael Müller / Andreas Schrüfer / Markus Höfer /  
Lothar Schäfer

Crystalline diamond coated seal faces for Dry Gas Seals in slow  
roll operation

**30-2** Norbert Gentz

Boosting efficiency of clean gas supply for Dry Gas Seals

## Contributors

### 3<sup>rd</sup> Compressor Users International Forum

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<b>Schlegel, Andreas, Dr.</b> Fraunhofer-Institut D-09126 Chemnitz	Ses. 20
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# EFRC

8<sup>th</sup> EFRC

Conference 2012

Sponsored by



Wednesday, 26<sup>th</sup> September 2012

## Training Seminar EFRC (TraiSem)

Time schedule: from 13.00 h to 17.00 h

Location: Room 28

### “Condition Monitoring and Diagnostics”

Time	Topic
13.00–13.15	Introduction to the programme
13.15–13.45	General design elements of protection, condition monitoring and diagnostic systems
13.45–14.15	Standard instrumentation used on reciprocating compressors
14.15–14.45	Rider ring wear measurement methodologies
14.45–15.15	Coffee break
15.15–15.45	Condition monitoring and diagnostics of compressor valves
15.45–16.15	Allowable vibration and pulsation levels in compressor installations
16.15–16.45	On site vibration diagnosis – Practical approach guidelines
16.45–17.00	Summary and conclusions

For participation fee see page 56.

responsible:

Course director: René Peters, TNO Energy

Tobias Ahlert, PROGNOST

André Eijk, TNO Energy

Christoph Kastelitz, Hoerbiger Kompressortechnik

Albert Koenig, PROGNOST

Lau Koop, Howden Thomassen Compression

Harry Lankenau, NEAC Compressor Service

Gaia Rossi, GE Oil & Gas

Klaus Stachel, Hoerbiger Kompressortechnik

Thursday, 27<sup>th</sup> September 2012  
11.00 h, Room 26

## Session 31

### Fundamentals

**Chairman:** Peter Steinrück

**31-1** Riccardo Traversari

Nonlinear multi-axial fatigue analysis of a threaded crosshead to piston rod connection of a reciprocating compressor using the Brown Miller algorithm

**31-2** Peter Duineveld

Development of advanced multilevel solution for journal paths including bearing deformation

**31-3** Guido Pratelli

CFD evaluation of pressure losses in reciprocating compressors

Thursday, 27<sup>th</sup> September 2012  
11.00 h, Room 16/17

## Session 32

### Operation & maintenance

**Chairman:** Jeroen van Koperen

**32-1** Gerard Zima

Steel casting defects – an issue for both, compressor user and manufacturers

**32-2** Markus Weber / Stefan Damberg

3D-laser form and position verification after cylinder repair welding

**32-3** Brian Howes / Tom Stephens

Field assessment of overall RMS vibration guidelines for reciprocating compressors

Thursday, 27<sup>th</sup> September 2012  
14.00 h, Room 26

Session 33

## Condition monitoring 1

**Chairman:** Heinrich Ochs

**33-1** Yousef Al-Shammari

Efficient maintenance of the worlds largest LDPE compressor train

**33-2** Luc Bertheloot / Wolfgang Grillhofer

Maintenance practices and experienced failure modes in  
Air Liquide plants – Protection & monitoring systems

**33-3** Uwe Ladwig

Automatic shutdown caused by dynamic piston rod position  
analysis saved compressor

Thursday, 27<sup>th</sup> September 2012  
14.00 h, Room 16/17

Session 34

## Design & engineering 1

**Chairman:** Ernst Huttar

**34-1** Dirk Sattur

Biogas injection into transport gas grids – an interesting new  
application for reciprocating compressors

**34-2** Anders Siggberg / Frans Launonen

Efficient compressor drivers for the smart power grid

**34-3** Ben Williams

Non-lubricated, moderate speed reciprocating compressors in a  
Hydrogen plant

Thursday, 27<sup>th</sup> September 2012  
16.00 h, Room 26

## Session 35

### Condition monitoring 2

**Chairman:** Klaus Hoff

**35-1** Eike Drewes

Bridging the gap between safety protection and condition monitoring

**35-2** Klaus Stachel

Digital communication technologies have arrived at condition monitoring systems for reciprocating compressors

**35-3** Gaia Rossi

Localization of reciprocating compressor component faults using on-line dynamic correlation of impulsive vibration signatures with calculated forces and displacements at individual running gear components

Thursday, 27<sup>th</sup> September 2012  
16.00 h, Room 16/17

## Session 36

### Design & engineering 2

**Chairman:** Leonhard Keller

**36-1** Mike Hüllenkremer

Variable stroke flow control for reciprocating compressors

**36-2** Gunther Machu

How the golden age of gas is challenging the reciprocating compressor business

**36-3** Andrea Raggi

Analysis of the movements of the valve sealing elements

Friday, 28<sup>th</sup> September 2012

09.00 h, Room 1

Session 37

## Retrofit

**Chairman:** Siegmund Cierniak

**37-1** Hisung Lee / Manfred Strässler  
Capacity increase of a LDPE plant

**37-2** Peter Duineveld / Lau G.M. Koop  
Design and manufacturing of a new large bore compressor cylinder

**37-3** Ralf Krich  
Increasing the reliability (and reducing vibration) of a 35 year old compressor by replacing the frame housing by an optimised design using the FEA method

Friday, 28<sup>th</sup> September 2012

09.00 h, Room 16/17

Session 38

## Flow controls

**Chairman:** René Peters

**38-1** Roland Aigner  
Experience with electromagnetic stepless flow control systems

**38-2** Bernhard Spiegl  
New concept for electric step less compressor capacity control

**38-3** Klaus Hoff / Georg Flade  
Step less mass flow control using fix clearance pockets – a new solution using an old idea



Friday, 28<sup>th</sup> September 2012

11.00 h, Room 1

## Session 39

### Pulsation & vibrations

**Chairman:** Marc Langela

**39-1** Joachim Golliard

High-frequency radiated noise in a reciprocating compressor installation: analysis and mitigation

**39-2** Jan Steinhausen

Vibrations at natural gas storage facilities during combined operation of reciprocating and turbo compressors

**39-3** Leonard van Lier / Rob Crena de longh

Impact of pulsations on flow metering accuracy: identification and remedies

Friday, 28<sup>th</sup> September 2012

11.00 h, Room 16/17

## Session 40

### Rings and packings

**Chairman:** Georg Samland

**40-1** Craig Martin

Uncut ring technology for rod packing

**40-2** Norbert Feistel

Friction surface coating in dry-running piston compressors – benefits and risk

**40-3** Marc Langela

Reciprocating sealing elements – importance of material and layout

Friday, 28<sup>th</sup> September 2012

14.00 h, Room 1

Session 41

## EFRC

**Chairman:** Peter Duineveld

**41-1** Siegmund Cierniak

Educating reciprocating compressor engineers at the EFRC

**41-2** Christiane Hammer

Temperature reduction of the piston rod in non-lubricated piston compressors by internal cooling

**41-3** André Eijk

Compressor foundation analysis tool (COFANTO)

Friday, 28<sup>th</sup> September 2012

14.00 h, Room 16/17

Session 42

## Torsional vibrations

**Chairman:** Eike Drewes

**42-1** Gerhard Knop

The importance of motor dynamics in reciprocating compressor drives

**42-2** Johann Lenz / Fikre Boru

Practical experience from torsional vibration measurement and analysis of reciprocating compressors – case studies

**42-3** Javã Atayde Pedreira

Flywheel and induction motor sizing

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<b>Williams, Ben</b> Ariel Corp. USA-Mount Vernon, Ohio 43050	Ses. 34
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## **Final Plenary Session**

Moderator: Alex Puissant  
Journalist & independent conference moderator

### **Best Paper Award**

Prior to the epilogue the Best Paper Awards will be handed over to the selected authors and others. The submitted papers will be assessed by each forum's programme committee. The awards are assigned for the following categories:

Pump Users International Forum

- Best scientific paper
- Best industry paper

Compressor Users International Forum

- Best paper

EFRC Conference

- Best papers
- Students' Award
- Audience Award

### **Closing remarks**

by the Chairman  
of the VDMA Pumps + Systems Association  
Sönke Brodersen

by the Chairman  
of the VDMA Compressors, Compressed Air and Vacuum  
Technology Association  
Alexander Peters

by the Chairman  
of the European Forum for Reciprocating Compressors  
René Peters

# General Information

## Proceedings

Proceedings include the technical papers from all sessions of either the Pump Users International Forum, Compressor Users International Forum or EFRC Conference. The proceedings are written in the English language. One copy of the conference proceedings (Pump Users International Forum, Compressor Users International Forum or EFRC Conference) is included with each participant's ticket for the International Rotating Equipment Conference. Additional proceedings copies must be ordered on the registration form. The fees for additional proceedings are listed below.

## Sessions – Technical Papers

After a short introduction by the chairman, each author will present his/her respective paper. His speaking time will be 20 minutes. Directly after the presentation, the audience is provided the opportunity to pose the author questions for 10 minutes.

Please note that the titles of the technical papers and presentations may vary because of later changes made by the authors.

## Training Seminar

The Training Seminar gives an in-depth overview about a specific technical theme. It offers a good opportunity especially for young engineers from operators, engineering companies and suppliers but also manufacturers or universities to get acquainted with new technical fields. You are kindly asked to mark your request to participate on the registration form (additional fee required!).

## Final Report

The final report includes the opening and plenary presentations in unabridged text as well as the full text of technical papers in English. The final report will be available early 2013 as a CD-ROM/DVD.

## Languages

The official conference language will be English.

## Internet

You will find further information about the conference at [www.introequipcon.com](http://www.introequipcon.com).



## Confirmation and Participation tickets

After payment of your invoice, the Forum office in Düsseldorf will provide you with your ticket/s.

## Participant lists

Participant lists as well as an exhibition leaflet and documentation which has not yet been mailed yet will be made available by the Forum office.

## Food and Beverages during Breaks

Food and beverages will be offered in the CCD-Stadthalle. They include a lunch snack on 27<sup>th</sup>/28<sup>th</sup> September 2012. Beverages during breaks will be available free of charge for conference participants in the foyer.

## Dinner Cruise

27<sup>th</sup> September 2012  
from 18.30–22.30 h

Location: MS RheinFantasie  
(name of boat)

Admission: 18.30 h



Departure: 19.00 h (Schnellenburg quay, within walking distance of the CCD)

Return: 21.30 h

## Best Paper Award

As recognition of excellence, Best Paper Awards will be bestowed to selected authors. These awards will honour the authors for their outstanding practice experience or well founded scientific papers. The Best Papers Awards of the Pump Users International Forum, the Compressor Users International Forum and the EFRC Conference will be bestowed over during the final plenary session.

## Registration Fees

Early bird registration

**By 31st July 2012** EUR 850.– (plus 19 % VAT)

Regular registration EUR 950.– (plus 19 % VAT)

Participation fee for the

EFRC Training Seminar EUR 250.– (plus 19 % VAT )

The participation ticket is not transferable!

Any bank charges incurred are paid by the participant.

One issue of the Conference Proceedings is included.

Additional copies with

technical papers EUR 95.– (plus 19 % VAT)

Adverts in proceedings:

Half page 4c EUR 1,050.– (plus 19 % VAT)

Full page 4c EUR 1,930.– (plus 19 % VAT )

CD-ROM of technical papers and final report

(participants only) EUR 55.– (plus 19 % VAT)

The amounts are payable upon receipt of the invoice from the VDMA-Maschinenbau-Institut GmbH.

The participation fee includes participation in all events indicated in the Forum Programme with the visit of the Technical Exhibition, food and beverages and the dinner cruise.

Only cancellations made in writing shall be valid.

The Organizer charges EUR 100.– (plus 19 % VAT) as a processing fee with respect to cancellations received up to 31<sup>st</sup> July 2012. Substitute attendees can be designated at any time free of charge.

Cancellations received between 1<sup>st</sup> August 2012 and 31<sup>st</sup> August 2012 shall be subject to a cancellation fee at 70 % of the regular participation fee (EUR 950.–), i. e. EUR 665.– (plus 19 % VAT).

For cancellations received on or after 1<sup>st</sup> September 2012 the participation fee or parts thereof is/are non-refundable. The participation fee of EUR 950.– (plus 19 % VAT) shall then be payable in full.

The Contracting Party is entitled to prove that the damage incurred by the Organizer is less.

The participation conditions of the International Rotating Equipment Conference 2012 shall apply. They can be found on the web at [www.introequipcon.com](http://www.introequipcon.com). Deviating from these conditions, the cancellation provisions referred to above shall apply.

## **The paid participation ticket for the conference allows free entrance to all three forums!**

Programme alterations are possible. Please contact the Forum office for information.

### **Online Registration**

**[www.introequipcon.com](http://www.introequipcon.com)**

Closing date for registration: 14<sup>th</sup> September 2012

You can only register later at the Congress Center Düsseldorf registration desk in the Stadthalle on

27<sup>th</sup> September 2012 and pay by credit card.

### **Room reservation**

We have put together some highly attractive hotel and travel offers for you. These can be conveniently booked on the conference website **[www.introequipcon.com](http://www.introequipcon.com)** or you can contact us for personal advice and an individually tailored offer to suit your requirements. We look forward to seeing you in Düsseldorf.

### **Düsseldorf Marketing & Tourismus GmbH (DMT)**

– Business Travel Service –

Phone +49 211 17202-839

Fax +49 211 17202-3221

E-Mail [business@duesseldorf-tourismus.de](mailto:business@duesseldorf-tourismus.de)

### **How to get to the conference**

A map and a route description to the Congress Center Düsseldorf can be found under [www.ccd.de/en/sub/7\\_0\\_0/8/anreise/8](http://www.ccd.de/en/sub/7_0_0/8/anreise/8).

For further information, visit the website [www.ccd.de/en/](http://www.ccd.de/en/) of the Congress Center Düsseldorf.

### **Sightseeing**

For sightseeing arrangements please contact the Düsseldorf Marketing & Tourismus GmbH ([www.duesseldorf-tourismus.de/en](http://www.duesseldorf-tourismus.de/en))

## Forum office prior to the Forum

For further information please ask the Forum Manager:

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## Forum office during the Forum

The Forum office with organisation staff indicated above will be located in the Congress Center Düsseldorf foyer and will be open on 27<sup>th</sup> and 28<sup>th</sup> September 2012 from 8.00 to 18.00 h.



Day 1: Thursday, September 27 <sup>th</sup>			
Pump Users International Forum (PIF)			
Time	Room 14	Room 1	Room 27
09.00–10.30	Room 1		
	Plenary session: Welcome and Opening; Welcome Address; Plenary Speaker		
10.30–11.00	Coffee break		
11.00–12.30	<b>Session 1:</b> Surface, materials and corrosive cavitation	<b>Session 2:</b> Young professionals	<b>Session 3:</b> Benefit of certain components
	see page 8	see pages 8 + 27	see page 9
12.30–14.00	Lunch break		
14.00–15.30	<b>Session 4:</b> Vibration	<b>Session 5:</b> New cognitions – research report	<b>Session 6:</b> Automation (drives; VSD/VFD; ...)
	see page 9	see page 10	see page 10
15.30–16.00	Coffee break		
16.00–17.30	<b>Session 7:</b> Oil & Gas	<b>Session 8:</b> The phenomenon of cavitation	<b>Session 9:</b> Invited papers (claim, option, solution)
	see page 11	see page 11	see page 12
17.30	Break		
18.30	Dinner Cruise		
22.30	End of day 1		

Technical Exhibition

Day 2: Friday, September 28 <sup>th</sup>			
Pump Users International Forum (PIF)			
Time	Room 14	Room 26	Room 27
09.00–10.30	<b>Session 10:</b> Energy efficiency & renewables	<b>Session 11:</b> CFD – numerical approach	<b>Session 12:</b> Water & sewage
	see page 12	see page 13	see page 13
10.30–11.00	Coffee break		
11.00–12.30	<b>Session 13:</b> Energy efficient systems	<b>Session 14:</b> CFD – applied on PD pumps	<b>Session 15:</b> Condition monitoring and root cause analysis
	see page 14	see page 14	see page 15
12.30–14.00	Lunch break		
14.00–15.30	<b>Session 16:</b> Performing pump systems	<b>Session 17:</b> Benefit of CFD in application	<b>Session 18:</b> Positive displacement pumps
	see page 15	see page 16	see page 16
15.30–15.45	Room 1		
	Final Plenary Session: Best Paper Award; Closing remarks		
15.45	End of 2012 conference		

Technical Exhibition

Day 1: Thursday, September 27 <sup>th</sup>		
Compressor Users International Forum (CIF)		
Time	Room 18/19	Room 28
09.00–10.30	Room 1	
	Plenary session: Welcome and Opening; Welcome Address; Plenary Speaker	
10.30–11.00	Coffee break	
11.00–12.30	<b>Session 19:</b> Systems control and condition monitoring	<b>Session 20:</b> Energy efficiency in compressed air systems
	see page 28	see page 28
12.30–14.00	Lunch break	
14.00–15.30	<b>Session 21:</b> Simulation of machines and processes	<b>Session 22:</b> Monitoring and optimization of compressed air systems
	see page 29	see page 29
15.30–16.00	Coffee break	
16.00–17.30	<b>Session 23:</b> Retrofits, service and maintenance	<b>Session 24:</b> Panel discussion compressed air systems
	see page 30	see page 30
17.30	Break	
18.30	Dinner Cruise	
22.30	End of day 1	

Technical Exhibition

Day 2: Friday, September 28 <sup>th</sup>		
Compressor Users International Forum (CIF)		
Time	Room 18/19	Room 28
09.00–10.30	<b>Session 25:</b> Compressor design 1	<b>Session 26:</b> Vacuum pumps and applications 1
	see page 31	see page 31
10.30–11.00	Coffee break	
11.00–12.30	<b>Session 27:</b> Compressor design 2	<b>Session 28:</b> Vacuum pumps and applications 2
	see page 32	see page 32
12.30–14.00	Lunch break	
14.00–15.30	<b>Session 29:</b> EuP/ErP expert talk	<b>Session 30:</b> Dry gas seal systems
	see pages 17 + 33	see page 34
15.30–15.45	Room 1	
	Final Plenary Session: Best Paper Award; Closing remarks	
15.45	End of 2012 conference	

Technical Exhibition

Day 1: Thursday, September 27 <sup>th</sup>		
8 <sup>th</sup> EFRC Conference		
Time	Room 26	Room 16/17
09.00–10.30	Room 1	
	Plenary session: Welcome and Opening; Welcome Address; Plenary Speaker	
10.30–11.00	Coffee break	
11.00–12.30	<b>Session 31:</b> Fundamentals	<b>Session 32:</b> Operation & maintenance
	see page 43	see page 43
12.30–14.00	Lunch break	
14.00–15.30	<b>Session 33:</b> Condition monitoring 1	<b>Session 34:</b> Design & engineering 1
	see page 44	see page 44
15.30–16.00	Coffee break	
16.00–17.30	<b>Session 35:</b> Condition monitoring 2	<b>Session 36:</b> Design & engineering 2
	see page 45	see page 45
17.30	Break	
18.30	Dinner Cruise	
22.30	End of day 1	

Technical Exhibition

Day 2: Friday, September 28 <sup>th</sup>		
8 <sup>th</sup> EFRC Conference		
Time	Room 1	Room 16/17
09.00–10.30	<b>Session 37:</b> Retrofit	<b>Session 38:</b> Flow controls
	see page 46	see page 46
10.30–11.00	Coffee break	
11.00–12.30	<b>Session 39:</b> Pulsation & vibrations	<b>Session 40:</b> Rings and packings
	see page 47	see page 47
12.30–14.00	Lunch break	
14.00–15.30	<b>Session 41:</b> EFRC	<b>Session 42:</b> Torsional vibrations
	see page 48	see page 48
15.30–15.45	Room 1	
	Final Plenary Session: Best Paper Award; Closing remarks	
15.45	End of 2012 conference	

Technical Exhibition



## Organizer

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Maschinenbau-Institut GmbH  
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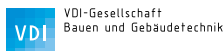
## In collaboration with

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## As well as

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**Promoter**



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Pumps + Systems Association,  
Compressors, Compressed Air and  
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Sönke Brodersen (VDMA Pumps + Systems)  
Alexander Peters (VDMA Compressors,  
Compressed Air and Vacuum Technology)

**Managing Director:**

Christoph Singrün

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for RECIPROCATING  
COMPRESSORS

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