



45<sup>TH</sup> **TURBOMACHINERY** & 32<sup>ND</sup> **PUMP SYMPOSIA**  
HOUSTON, TEXAS | SEPTEMBER 12 – 15, 2016  
GEORGE R. BROWN CONVENTION CENTER

# Centrifugal Compressors 101

## Part 1

**Mark J. Kuzdzal**  
**Director Business Development**  
**Supersonic Compression Program**  
**Dresser-Rand**

**Jay Koch**  
**Product Line Management**  
**Single Shaft Compressors**  
**Dresser-Rand**

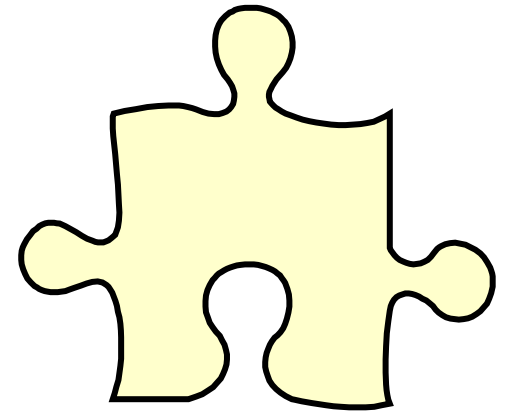
**DRESSER-RAND**  
A Siemens Business

 **TEXAS A&M**  
UNIVERSITY

  
**TURBOMACHINERY**  
**LABORATORY**  
TEXAS A&M ENGINEERING EXPERIMENT STATION

# Agenda

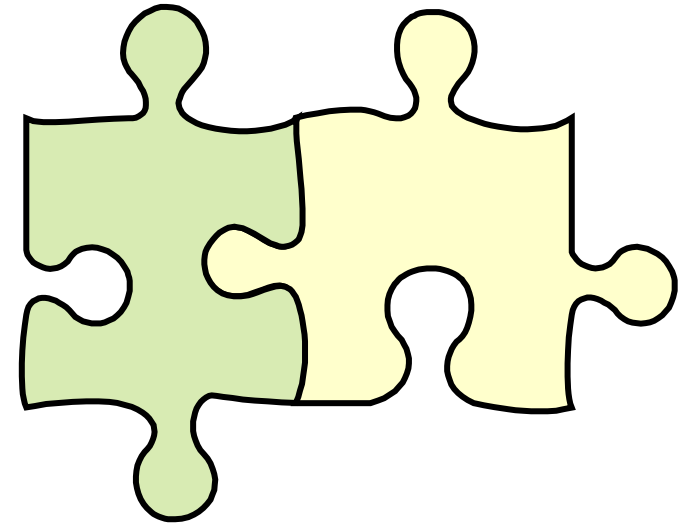
- Reciprocating and centrifugal compressor similarities/ differences
- How do they work? (Potential Energy, Kinetic Energy, PE, KE, ...)
- History of compressors
  - Timeline, major advances
  - Configurations, straight-through, back-to-back, compound, side streams, double-flow
- Markets served
- Pressure containment
  - Case
  - Nozzles and flanges



Mark

# Agenda Continued

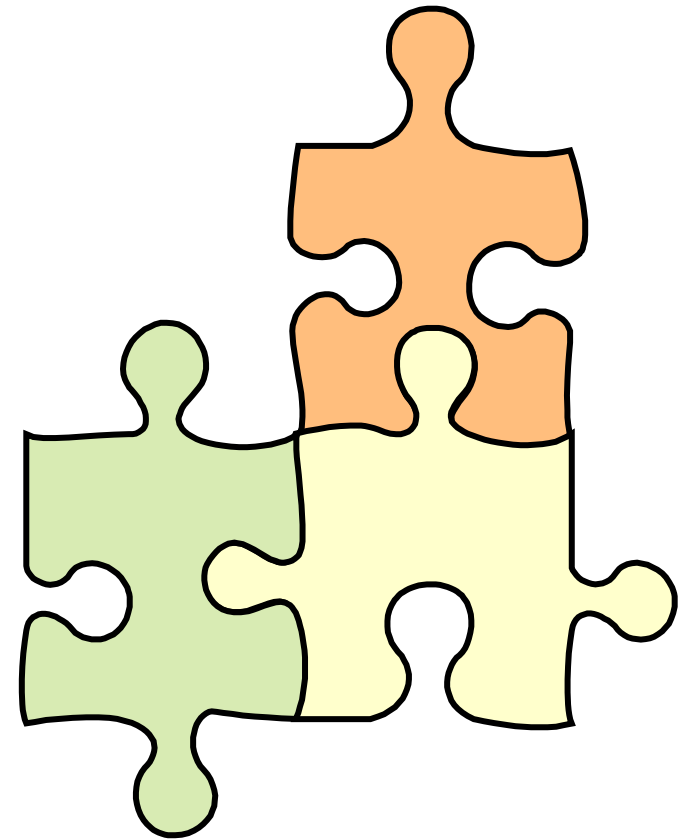
- Selection Process
  - Aerodynamic Selection
  - Mechanical Design
  - Rotordynamic Design
- Impellers
  - Design Basics
- Stationary Aero Components
  - Inlet, inlet guide
  - Diffuser, vaned and vaneless, LSD
  - Volute and collector
  - Return bend / Return channel
- Compressor Performance
  - Nomenclature
  - Impact of Operating Conditions
  - Internal Leakage
  - Surge Control



Jay

# Agenda Continued

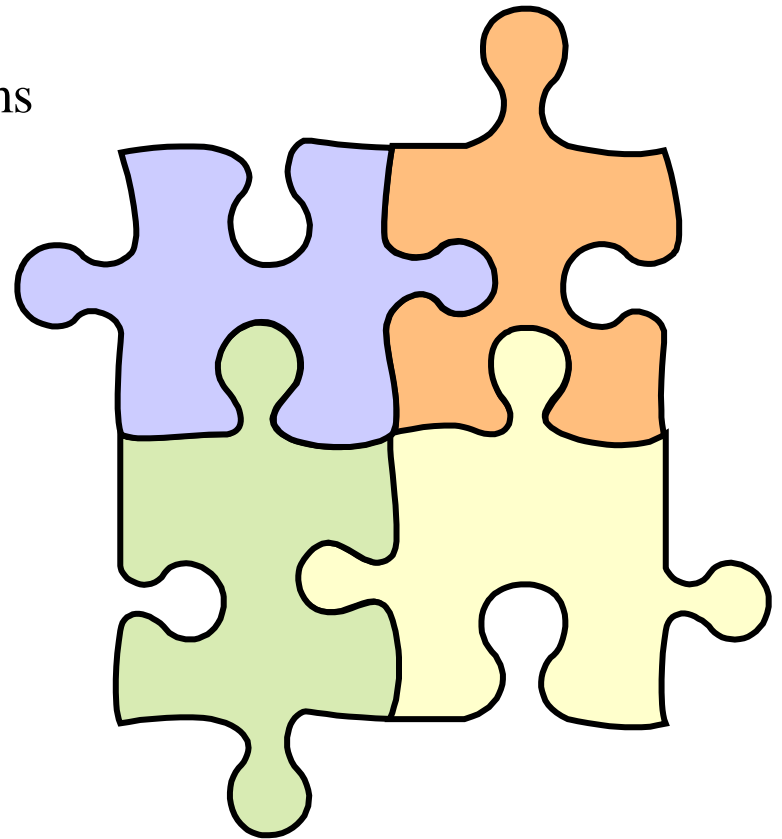
- Rotordynamics
  - Critical speed maps
  - Synchronous unbalance response
  - Stability, log decrement
  - Damper seals
  - Bearings, seals
  - TP, Sleeve, magnetic
  - Squeeze film damper
  - Steady state and transient torsional
- Stress analysis
  - Impeller dynamics
- Acoustics
- Seals
  - Gas seals
  - Oil film seals
  - Laby



Mark

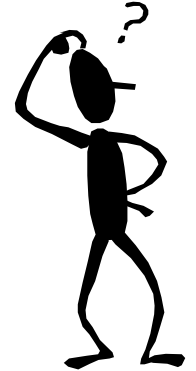
# Agenda Continued

- Testing
  - Type 2 and Type 1, Performance testing
  - Mechanical testing
- Vibration signatures of classic problems
  - Rotor Instability
  - Surge and stall - forced vibration
- Materials considerations
  - NACE
  - Typical compressor materials
  - Effects of blockage and fouling
- Adjourn



Jay

# Who Are We???



- **Mark J. Kuzdzal**
- **1988 Graduate of University of Buffalo (BSME)**
- **Joined Dresser-Rand in 1988**
- **Texas A&M Advisory Committee Member Since 2004**
- **Penn State Advisory Committee Member Since 2004**
- **RotorDynamics group, NPD team, Datum Development Team, Development Manager, Core Tech. Manager, Business Development Director.**
- **Current Responsibilities include:**
  - **Supersonic compressor product line definition and commercialization.**
  - **Favorite work-related topics: aero-mechanical excitation (SSV), & Acoustics**

# Who Are We???



- **Jay Koch**
- **Graduate of Iowa State University (BS Aerospace Eng.)**
- **Joined Dresser-Rand in 1991**
- **Worked for Allied Signal Aerospace before joining D-R**
- **Aero Dynamics group, NPD team, Datum Development Team, Manager Aero/Thermo Design Engineering, R & D Manager, Principal Engineering Lead , Product Line Management Single Shaft Compressors**
- **Responsibilities include:**
  - **Design, development, and analysis of all aero dynamic components of centrifugal compressors**
  - **Development of software used to select and predict compressor performance.**
  - **Improved aero dynamics efficiency and range.**
  - **New Product Development**

# Acknowledgements

This course would not have been possible without the contributions of numerous individuals. We'd like to specifically recognize:

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Ed Memmott

Mike Lyons

Dave Seib

John Stahley