



# Centrifugal Pumps

## Troubleshooting Reliability & Efficiencies

Reduce your costs by improving the reliability of your pumps, by reducing energy consumption and optimizing the selection of pumps.

**02<sup>nd</sup>, 03<sup>rd</sup>, 04<sup>th</sup> May 2018**  
Ouagadougou, Burkina Faso

Engineering & Maintenance Series  
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# WHY

## ATTEND THIS COURSE?

Centrifugal pumps are one of the world's most widely used type of pump, having an extensive range of applications, from food processing to water or sewage transportation. Problems that arise within these machines decrease the flow of the fluid within the pipelines, thus interrupting the production and transport of the fluid to its destination within the process. This may lead to other parts of the process system slowing down or behaving undesirably.

As a result, it is imperative that these pumps be correctly selected, monitored, diagnosed, maintained or replaced prior to the pump failing catastrophically to reduce down-time, material cost, and labor costs.

There are 13 main problems that afflict centrifugal pumps when in use. Most of Original Equipment Manufacturer (OEM) pump training focuses solely on one brand and general maintenance but not component problems, while it is very critical for engineers to understand all these and learn to work with different pump brands in processing facility. This course shall address all these above issues.

# Centrifugal Pumps: Troubleshooting, Reliability & Efficiencies

## COURSE OVERVIEWS

This international 03 days training shall give the engineers a complete understanding of how to reduce costs and energy, improve the reliability of pumps.

Engineers learn a complete cycle of how to choose the right pumps, how to install, operate, troubleshoot and maintain properly.

## OUR TRAINING QUALITY

- **Limited Attendees**

The course has limited seats to ensure maximum learning and experience for all delegates.

- **Certificate of Attendance**

You will receive a Certificate of Attendance bearing the signatures of the Trainer upon successful completion of the course. This certificate is proof of your continuing professional development.

- **Interactive Training**

You will be attending training designed to share both the latest knowledge and practical experience through interactive sessions. This will provide you with a deeper and more long-term understanding of your current issues.

- **High Quality Course Materials**

Printed course manual will provide you with working materials throughout the course and will be an invaluable source of reference for you and your colleagues afterward. You can follow course progress on your laptop with soft copies provided.

## COURSE OBJECTIVES

- / Understand how the system controls the pump
- / Learn how to read a pump curve and how pumps really operate
- / Learn how the flow rate impacts on pump reliability – what is the reliable operating range
- / Design better systems and select better pumps, leading to improved reliability
- / Avoid operational problems that lead to pump failures
- / Understand what cavitation is, why it occurs and how to avoid it
- / Know how pumps should be installed and commissioned – avoid those common commissioning failures
- / Learn why pumps vibrate and why seals and bearings fail

## Who Should Attend?

This course is intended for all those involved in the operation and maintenance of pumps. These include, but are not limited to:

- |                              |                                    |
|------------------------------|------------------------------------|
| ▽ Maintenance Engineers      | ▽ Project & Construction Engineers |
| ▽ Operation Engineers        | ▽ Plant Engineers                  |
| ▽ Electrical Engineers       | ▽ Process Engineers & Designers    |
| ▽ Pump Application Engineers | ▽ Engineering Consultants          |
| ▽ Pump Sales Engineers       |                                    |

# Centrifugal Pumps: Troubleshooting, Reliability & Efficiencies

## COURSE DIRECTOR



**ADOU RAMDANE,**  
Canadian  
CMRP, CRE, PE  
Principal Consultant

Having over 40 years of international experience across Africa, Europe, USA, Asia and Australia

During the period with John Crane, an American company supplying mechanical seals, couplings, hydrodynamic bearings, seal support systems and pumps related products, Abdou and his team helped Shell save millions of Euros by reducing the energy and equipment outage via 235 Shell sites worldwide.

His expertise includes rotating and process control equipment: compressor seals and systems, centrifugal pumps, mixers, mechanical seals, gaskets and seals, bearings, couplings, filters and control valves, analysis of failure models for Mechanical seals, pump bearings and mode definition and failure mechanism, development of a pump improvement program, analysis of centrifugal pump and compressor failure models and definition of all failure mechanisms, pump management actor, analysis of the causes (operation, maintenance, design) of pump failures and definition of improvements.

He has extensive field experience with onshore oilfields, offshore platforms, refineries, LNG plants, power plants, and extensive knowledge of Flowserve pump components, John Crane and Eagle Burgmann, and Sulzer, Burk, Haight, KSB, SKF, WEIR and more

The most recent project he has worked with is Flowserve / GASCO (UAE) Dry Gas Seal and System retrofits for Centrifugal Compressor valuing 125 millions Dollars.

## List of some of his clients

Bahrain Petroleum Company	Abu Dhabi National Oil Company
Chrysler	Petroleum Development Oman
Ford Motors	Kuwait Oil Company
General Motors	Kuwait National Petroleum Company
Middle East Battery Company	Qatar Petroleum
Murphy Oil Corporation	Qatar Gas
Foster Wheelers	TOTAL Cameroon
Bechtel	Société Ivoirienne de Raffinage SA
Technip	Exxon Mobil Equatorial Guinea
Snamprogetti	SONATRACH Algeria
Shell	SAMIR Morocco
TATA Power	British Gas Tunisia
Tetra Pak	et plus...
Yamama Cement	

## WHY YOU SHOULD ATTEND PRIME QUALITY TRAINING'S EVENTS

- To ensure that all objectives of the course match yours, all **Prime Quality Training** programs are developed after intensive and extensive research within the industry.
- **Prime Quality Training** programs focus on your immediate working issues to ensure that you are able to apply and deliver immediate results in real work situations.
- Application and implementation of industry knowledge and experience are the drivers for our course design, not theoretical academic lectures.
- **Prime Quality Training**'s training focuses on practical interactive learning tools and techniques including case studies, group discussions, scenarios, simulations, practical exercises and knowledge assessments during the course. Invest a small amount of your time to prepare before attending the course to ensure maximum learning.
- **Prime Quality Training** follows a rigorous selection process to ensure that all expert trainers have first-hand, up-to-date and practical knowledge and are leaders of their respective industrial discipline



# Centrifugal Pumps: Troubleshooting, Reliability & Efficiencies

## TESTIMONIALS

### **TATA Power India**

#### **Maintenance Manager**

*This event provided a valuable opportunity to learn from a group of highly experienced professionals based on firsthand experience.*

### **British Nuclear Group United Kingdom**

#### **Maintenance Manager**

*Very interesting and informative, I enjoyed attending."*

### **Oman Polypropylene, Oman**

#### **Operator**

*It was indeed a very good opportunity to get some clarifications on maintenance misunderstanding concepts.*

### **Nigerian National Petroleum Nigeria**

#### **Head of Maintenance**

*The event has provoked a new perspective of the inter-phase between operations, maintenance and engineering departments."*

### **Petronas, Malaysia**

#### **Maintenance Manager**

*Training conducted by a very capable person with a complex subject made easy to digest and understand. Able to communicate with trainer even after the course and get advice when working on actual plant problems.*

### **Murphy Oil**

#### **Reliability Manager**

*Practice without theory is blind and theory without practice is empty. The course proved integration of both and was very effective*

### **Reliability Leadership Institute, USA**

#### **Chief Asset Manager**

*Abdou is a true reliability leader and a business leader. He is very knowledgeable about the region and has spent years building relationships based on value. I would find it unthinkable to work in the region without requesting guidance from Abdou.*

### **Oman Polypropylene**

#### **Senior Facilities Engineer**

*Excellent course came in right time at the right place, during the time when everyone is looking forward to the best solutions.*

### **Tetra Pak, Saudi Arabia**

#### **Maintenance Engineer**

*The program was useful, practical & exciting! The resource persons were very knowledgeable and interactive. I'll recommend this program to my colleagues*

### **Saudi Aramco**

#### **Maintenance Engineer**

*Very organised. Speakers know their field and supplied very good case studies*

# Centrifugal Pumps: Troubleshooting, Reliability & Efficiencies

## Course Agenda

### DAY 1

#### INTRODUCTION UNDERSTANDING THE FUNCTION OF PUMPS

- ▽ Goals and Objectives-Reduce energy consumption, improve reliability
- ▽ Positive Displacement and Centrifugal Pumps
- ▽ Basic operating principles
- ▽ Different types of pumps
- ▽ The rotor of the pump - Flow and head
- ▽ Introduction to the pump performance curve

#### THE HYDRAULIC SELECTION PROCESS

- ▽ Flow determination
- ▽ Calculation of the system resistance

#### WORKSHOP

CALCULATION OF THE SYSTEM RESISTANCE CURVE

*Pumping a long pipe, pumping in a pressure vessel*

#### WORKSHOP

HOW TO CHOOSE RIGHT PUMPS

This workshop illustrates a procedure for evaluating survey data, proper selection of pumps, and tendering.

- ▽ Pump selection approach
- ▽ Collection of information from the client
- ▽ Grouping of desired characteristics
- ▽ Elimination of inappropriate pump types
- ▽ Selection of the pump to meet hydraulic requirements

#### LIQUID CHANGES AND PERFORMANCE OF THE PUMP

- ▽ Density
- ▽ Viscosity
- ▽ Solids and Workshop exercises on

#### WORKSHOP

Viscosity Correction

#### CALCULATING PUMP PERFORMANCE FOR SPEED OR IMPELLER DIAMETER CHANGES

Pump Affinity Laws

- ▽ Change of the diameter of the wheel
- ▽ Changing the speed of the pump

#### WORKSHOP

Calculating pump performance with speed and impeller changes

#### SPECIAL PUMP INSTALLATIONS

- ▽ Pumps in parallel
- ▽ Pumps in series

#### WORKSHOP

Pumps in parallel, pumps in series

END of Day 1

#### PROGRAM SCHEDULE

08:00 – 08:30	Registration & Morning Coffee
08:30 – 10:00	First Session
10:00 – 10:15	Morning Coffee Break
10:15 – 12:15	Second Session
12:15 – 13:30	Networking Buffet Luncheon
13:00 – 15:00	Third Session
15:00 – 15:15	Afternoon Coffee Break
15:15 – 16:30	Fourth Session
17:30	Session End

# Centrifugal Pumps: Troubleshooting, Reliability & Efficiencies

## Course Agenda

### DAY 2

#### NETT POSITIVE SUCTION HEAD AND CAVITATION

- ▽ Cavitation definition: *The process, the noise, the damage*
- ▽ NPSH available
- ▽ NPSH required

#### WORKSHOP

Calculating NPSH Available

Troubleshooting: Why Is Your Pump Cavitation ?  
*The Consequences Of Designing A System With Low NPSH Available – Pump Type*

#### SEALING OPTIONS

- ▽ How they work
- ▽ Why they fail ?
- ▽ Gland Packing: *Proper packing installation, Correctly adjusting packing*
- ▽ Mechanical Seals: *Different Designs, Single Seals, Double and Tandem Seals, Flush and lubrication requirements*
- ▽ Dry Gas Seals
- ▽ Other Sealing Methods

#### PUMP MECHANICAL CONSTRUCTION OPTIONS

- ▽ Single stage vs Multi-stage
- ▽ Horizontal vs Vertical
- ▽ Casing options
- ▽ Impeller options
- ▽ API 610 vs ANSI B73.1M and ISO 5199

#### MECHANICAL CONSTRUCTION VS RELIABILITY

- ▽ Minimizing axial forces
- ▽ Minimizing radial forces
- ▽ Volute designs
- ▽ Shaft design
- ▽ Wearing rings and consumable components
- ▽ Seal chamber design
- ▽ Bearing arrangements
- ▽ Bearing housing seals
- ▽ API 610 vs ANSI B73.1M and ISO 5199

#### WORKSHOP

Pump Modifications for High Pressure Applications and High Temperature Applications

#### FLOWRATEVS RELIABILITY

- ▽ Low flow vs poor reliability
- ▽ High flow vs poor reliability
- ▽ Controlling the flowrate
- ▽ API 610 vs ANSI B73.1M and ISO 5199

#### PUMPS FOR LOW NPSH APPLICATIONS

- ▽ The consequences of designing a system with low NPSH
- ▽ Pump Types for low NPSH systems

#### THE PUMP INDUSTRY STANDARDS – API 610, ANSI B73.1M and ISO 5199

- ▽ Understanding using API 610
- ▽ Understanding using ANSI B73.1M
- ▽ Understanding using ISO 5199

#### PURCHASING RELIABLE PUMPS

- ▽ The mechanical specification
- ▽ The hydraulic specification
- ▽ Reviewing Bids and purchasing reliable pumps (not just cheap ones)

#### WORKSHOP

Purchasing Reliable Pumps

END of Day 2

# Centrifugal Pumps: Troubleshooting, Reliability & Efficiencies

## Course Agenda

### DAY 3

#### INSTALLATION AND COMMISSIONING

- ▽ Piping Layout and Set-up
- ▽ Providing Smooth Flow to the Pump
- ▽ Pipe Supports
- ▽ Avoiding Vapour Traps in Piping Valves
- ▽ Pump Installation
- ▽ Shaft Alignment
- ▽ Priming
- ▽ Start-up
- ▽ Monitoring

#### WORKSHOP

Developing a Pre-start Check List

#### PUMP MAINTENANCE

- ▽ Internal Alignment
- ▽ Concentricity
- ▽ Run-out
- ▽ Preventive and Predictive Maintenance

#### MONITORING AND INSTRUMENTATION

- ▽ The importance of Instrumentation
- ▽ Condition Monitoring

#### WORKSHOP

Reducing Power Consumption  
Efficient Pump Selection  
Efficient System Design  
Efficient Control Method

#### TROUBLESHOOTING: ROOT CAUSE FAILURE ANALYSIS

The Troubleshooting Process - Root Cause Failure Analysis  
Common problems and their solutions  
Mechanical failures

- ▽ Mechanical Seal Failures
- ▽ Bearing failure
- ▽ Seal failure
- ▽ Lubrication
- ▽ Excessive vibrations
- ▽ Fatigue

Hydraulic failures

- ▽ Mechanical Seal Failures
- ▽ Cavitation
- ▽ Pressure pulsations
- ▽ Radial thrust
- ▽ Axial thrust
- ▽ Suction
- ▽ Discharge recirculation

Other types of failure

- ▽ Erosion
- ▽ Corrosion
- ▽ Excessive power consumption

#### WORKSHOP

Case Studies and Troubleshooting Exercises

#### INTERNAL WEAR AND LOSS OF PERFORMANCE

- ▽ Wear vs Flow
- ▽ Determining When Your Pump Needs and Overhaul
- ▽ Monitoring Performance
- ▽ System Changes

#### WORKSHOP

Pourquoi les performances de votre pompe ont-elles chuté?

#### CONCLUSION

Summary of the Master-Class purpose, objectives, and organization  
Review of participants' objectives  
Questions and answers  
Workshop evaluation

END of Master-Class

## IN-HOUSE SOLUTIONS

- **SAVE COST**
- **IMPROVE PERFORMANCE**
- **REDUCE RISK**

Prime Quality Training understands that in current economic climate, getting an excellent return on your training investment is critical for all our clients. This excellent training can be conducted exclusively for your organization. The training can be tailored to meet your specific needs at your preferred location and time. We will meet you anywhere around the globe. If you like to know more about this excellent program, please contact on **+65 3159 1297** or email **[tommy@pri-qua.com](mailto:tommy@pri-qua.com)**





# Centrifugal Pumps: Troubleshooting, Reliability & Efficiencies

Ouagadougou, Burkina Faso

## TERMS & CONDITIONS

### DISCLAIMER

Please note that trainers and topics were confirmed at the time of publishing; however, Prime Quality Training may necessitate substitutions, alterations or cancellations of the trainers or topics. As such, Prime Quality Training reserves the right to change or cancel any part of its published programme due to unforeseen circumstances without penalty and in such situations no refunds, part refunds or alternative offers shall be made. Any substitutions or alterations will be updated on our web page as soon as possible.

### DATA PROTECTION

The information you provide will be safeguarded by Prime Quality Training that may be used to keep you informed of relevant products and services. As an international group we may transfer your data on a global basis for the purpose indicated above. If you do not want us to share

your information with other reputable companies, please tick this box ☐.

### PAYMENT TERMS

Full payment (in the currency that is reflected in invoice) is required within three (3) working days on receipt of invoice or before the event date, whichever is earlier. Prime Quality Training reserves the right to refuse admission if payment is not received as stated. Should client request payment to be made in another currency (other than the one reflected on the invoice), an additional 5% exchange rate administrative fee will be added to the invoiced amount.

### CANCELLATION

Registration carries a 50% cancellation liability immediately after signed sales registration contract has been received by Prime Quality Training. Prime Quality Training has to be notified of the cancellation in writing and respond with a written acknowledgment for the cancellation to be valid. Cancellation confirmed less than four (4) weeks prior to the event is non-refundable and the full fee is payable. By signing this contract, the client agrees that in case of dispute or cancellation of this contract that Prime Quality Training will not be able to mitigate its losses for any less than 50% of the total contract value.

If, for any reason, Prime Quality Training decides to cancel or postpone this event; Prime Quality Training is not responsible for covering airfare, hotel, or other travel costs incurred by clients. The fee will not be refunded, but can be credited to a future event.

### TRANSFER

Transfer to future event or to another person is allowed upon written notification from authorized personnel of Client Company. For transfer to future event(s), client shall receive a credit voucher of 90% for the amount that the client has been invoiced for (including GST, if any), which is valid for one year to be used for any future Prime Quality Training event. Transfer to future event confirmed less than two (2) weeks prior to the event will be subjected to an additional 5% administrative fee (credit voucher will bear only 85% for the amount client has been invoiced for including GST, if any). Should the value of the future event exceed the amount reflected on the credit voucher, client is responsible for the additional amount. No refunds will be made for any unutilized credit voucher amount(s). Each Credit Voucher can only be used once.

### NO SHOW

No show does not constitute transfer or cancellation and the full fee is payable.

### GOVERNING LAW

This Agreement shall be governed and construed in accordance with the law of Singapore and the parties submit to the exclusive jurisdiction of the Singaporean Courts in Singapore. However Prime Quality Training only is entitled to waive this right and submit to the jurisdiction of the courts in which the client is located.

## REGISTRATION FORM

I hereby agree to Prime Quality Training's terms & conditions, payment terms and cancellation policy.

**AUTHORISATION** (REGISTRATION NOT VALID WITHOUT AUTHORIZATION)

**AUTHORISER**.....  
**DESIGNATION**.....  
**TEL**.....  
**MAIL**.....

**SIGN**  
**DATE**

## PAYMENT METHOD

### By Direct Bank Transfer

Account Name : Prime Quality Training Pte Ltd.  
Bank : Overseas-Chinese Banking Corporation Singapore  
Account Number : USD 503-180325-301  
Bank Code : 7339  
Swift Code : OCBGSGSG

## REGISTRATION MANAGER

TOMMY NGUYEN

**Tel** : + 65 3159 1297  
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**Fax** : + 65 6809 3050  
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**COMPANY**.....  
**ADDRESS**.....  
**TEL**.....  
**FAX**.....  
**HR EMAIL**.....  
**FINANCE EMAIL**.....  
**PROCUREMENT EMAIL**.....

**DELEGATE 1**.....  
**DESIGNATION**.....  
**TEL**.....  
**MAIL**.....

**DELEGATE 2**.....  
**DESIGNATION**.....  
**TEL**.....  
**MAIL**.....

**DELEGATE 3**.....  
**DESIGNATION**.....  
**TEL**.....  
**MAIL**.....

**DELEGATE 4**.....  
**DESIGNATION**.....  
**TEL**.....  
**MAIL**.....

**DELEGATE 5**.....  
**DESIGNATION**.....  
**TEL**.....  
**MAIL**.....

## REGISTRATION FEE

Please checklist the package you are attending

	Standard Price
<input type="checkbox"/> <b>3 Days</b>	<b>USD 2,999</b>
<input type="checkbox"/> <b>3 Days with 4 or more delegates</b>	10% discount on top of total invoice

- \* Registration fee is per head.
- \* Registration fee is excluding any local taxes.
- \* To enjoy the offer, full payment must be made before the deadline.
- \* Price includes luncheons, refreshments and complete set of documentation. It does not include the cost of accommodation and travel.
- \* Administrative Fee as of USD 100 will be added to total invoice amount regardless of total invoice amount.