



# AVT Reliability Training Program 2019



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AVT Reliability® offer training covering all aspects of machinery reliability and condition based maintenance, to address technical and managerial needs from shop floor to boardroom.

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# Introduction to Condition Monitoring

A one day training seminar is an introduction to condition monitoring which can be delivered on site or at our training facilities.

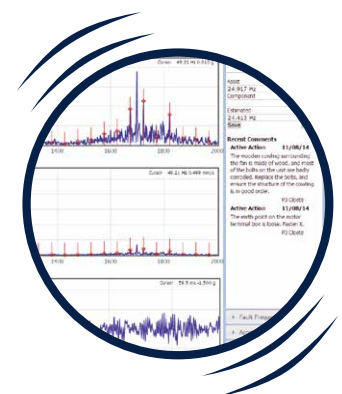
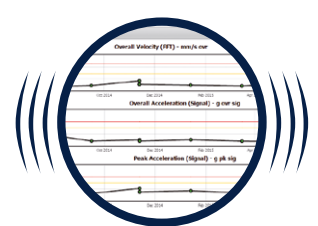
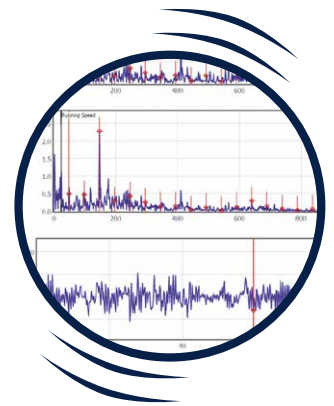
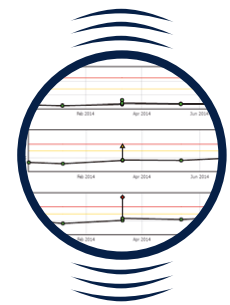
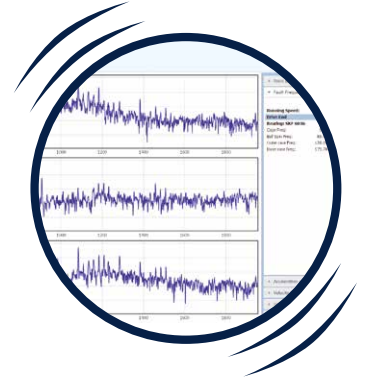
This introduction to condition monitoring gives an understanding of the effectiveness of Condition Monitoring and the various technologies it encompasses. It follows the methods and procedures defined in ISO 17359 and includes an introduction into vibration analysis, lubrication analysis, thermography and ultrasound.

## Recommended for:

- Managers, engineers, supervisors, technicians and operators who wish to learn about condition monitoring practices
- Understanding the effectiveness of condition monitoring and how it fits into a maintenance programme
- The course has been designed using AVT Reliability's extensive experience and knowledge so that the material is applicable to all industries where rotating and reciprocating machinery are in operation

## Topics include:

- Maintenance strategies and techniques
- Key steps to implementing condition monitoring
- Introduction to vibration monitoring
- Lubrication theory, practice and sampling
- Introduction to thermography
- Introduction to ultrasound



# Vibration Analysis Category 1

4 day course (09:00 – 16:00 ) including optional BINDT PCN Certification exam on the final day.

The ISO Category 1 Vibration Analysis “Practitioner” course is intended for personnel who are new to vibration monitoring and analysis or those who wish to get an introduction to vibration analysis, condition monitoring and maintenance practices. The course focuses on periodic, single channel data collection and analysis for condition based maintenance programs. The BINDT Category 1 vibration analysis examination is optional and can be taken at the end of the course, certification is achieved once you have had six months experience in the field.

## Course Objectives:

This course is based on the ISO 18436-2 certification program vibration analysis category 1 syllabus and is designed to prepare staff for the BINDT PCN VA Cat 1 Certification Exam. VA Cat 1 personnel are qualified to perform a range of simple single-channel machinery vibration condition monitoring and diagnostics of machine activities in accordance with ISO 17359 and ISO 13373-1.

### On completion you will be qualified to:

- Operate portable instrumentation on pre-assigned or pre-programmed routes
- Acquire readings from permanently installed instrumentation
- Input results into a database and download routes from a computer
- Conduct testing under steady-state operating conditions following pre-defined procedures
- Recognise that no signal is present
- Compare overall or single value vibration measurements against pre-established alert settings

## Recommended for:

- Managers, engineers, analysts, supervisors, technicians and operators who wish to learn about basic vibration monitoring and analysis in the areas of operations, maintenance, engineering, reliability and condition monitoring.
- If you have been collecting vibration readings and leaving the analysis to another person, then this course is for you.
- Personnel wishing to achieve PCN certification in vibration analysis level 1, an enabling qualification to perform single channel machinery vibration measurements according to established procedures.

## Key Learning Outcomes:

- Evidence of training to VA1 in accordance with ISO 18436-2 and BINDT PCN CM Gen App D
- Gaining skills in measuring vibration
- Awareness of typical vibration levels for a range of machines
- Understanding a basic range of VA techniques and single channel instrumentation
- Gaining practical approaches to practical vibration analysis and monitoring
- Awareness of key International Standards covering vibration condition monitoring

## Difficulty Level - Basic:

No prior experience in VA is required to attend this course

## References

The course is accredited by BINDT PCN to CM GEN App D. All our trainers are certified vibration analysts to VA Cat 3 and above.

## Vibration Analysis Category 2

5 day course (09:00 – 16:00 ) including optional BINDT PCN Certification exam on the final day.

The ISO Category 2 Vibration Analysis “Intermediate” course is intended for personnel who have at least 18 months vibration analysis experience and a basic understanding of vibration theory and terminology. The course provides an in-depth study of machinery faults and their associated spectrum, time waveform and phase characteristics. Category 2 certification requires that you have demonstrated 18 months experience in vibration analysis, completed the Category 2 course and successfully passed the Category 2 vibration analysis examination, however Category 1 is not a prerequisite to become certified as a Category 2 vibration analysis.

### Course Objectives:

This course is based on the ISO 18436-2 certification program vibration analysis category 2 syllabus and is designed to prepare staff for the BINDT PCN VA Cat 2 Certification Exam. The course is accredited by BINDT PCN to CM GEN App D. VA Cat 2 personnel are qualified to perform machinery vibration measurements and analysis using mainly single-channel measurements, with or without phase trigger signals, according to established and recognized procedures.

### In addition to understanding all areas included in Cat 1, Cat 2 personnel are also qualified to:

- Select the appropriate machinery vibration measurement technique
- Set up instruments for basic resolution of amplitude, frequency and time
- Perform basic vibration analysis of machinery and components such as shafts, bearings, gears, fans, pumps and motors using spectrum analysis
- Maintain a database of results and trends
- Perform basic (single channel) impact tests to determine natural frequencies
- Classify, interpret and evaluate the test results (including acceptance tests) in accordance with applicable specifications and standards
- Recommend minor corrective actions
- Understand basic single-plane field balancing concepts
- Be aware of some of the causes and effects of bad measurement data

### Recommended for:

- The course is aimed at those who have been trained to Vibration Analysis Category 1, or recognized equivalent, including those having appropriate vibration analysis experience together with a basic understanding of vibration theory and implementation of condition monitoring and condition based maintenance programs e.g. technicians, engineers, analysts, supervisors, managers and operators
- Personnel wishing to achieve PCN certification in Vibration Analysis Category 2, an enabling qualification to perform single channel machinery vibration measurements according to established procedures

### Key Learning Outcomes:

- Evidence of training to VA2 in accordance with ISO 18436-2 and BINDT PCN CM Gen App D
- Gaining skills in measuring vibration
- Awareness of typical vibration levels for a range of machines
- Understanding a basic range of VA techniques and single channel instrumentation
- Gaining practical approaches to practical vibration analysis and monitoring
- Awareness of key international standards covering vibration condition monitoring

### Difficulty Level - Intermediate:

Minimum of 12 months experience is recommended prior to attending this course

# Machine Sentry®

A 1 or 2 day training seminar on Machine Sentry® which can be delivered on customer site or at our training facilities.

AVT Reliability® offer training covering all aspects of the Machine Sentry® condition monitoring solution and is designed to address technical and managerial needs from shop floor to boardroom. Machine Sentry® is a unique condition based maintenance (CBM) solution which integrates all condition monitoring techniques and watchkeeping data, enabling effective maintenance planning and management reporting.

## Course Objectives:

This training course is designed to take the novice, or the experienced user through all elements of Machine Sentry® to ensure you have complete knowledge and confidence to utilize the system with ease and to benefit from its wide array of functionality.

## Recommended for:

- Any user of Machine Sentry® from basic users to advanced analysts
- Designed for maintenance technicians, supervisors and reliability engineers who would be at the front end of the utilization of this flexible and intuitive system
- This will give the end user the required knowledge and confidence to utilize the system with ease

### 1 Day Basic User:

This 1 day course is designed for the operator of Machine Sentry® and in particular the data collection process which would include the uploading and downloading of the Machine Sentry® database to the hand held device. The topics for this 1 day basic course will include:

- Logging on to the Machine Sentry® system
- Pairing Machine Sentry® Sensor to PDA and Android Tablet
- Navigation of the Machine Sentry® database
- Downloading routes into the hand held device and its navigation
- The data collection process in either single axis or triaxial
- Uploading the collected data to Machine Sentry® web
- Generating action notes and reliability service reports

### 2 Day Advanced User:

This 2 day course is designed for the full on system user from designer/operator to collection and analysis of Machine Sentry® data. It is aimed at those who will develop structured and detailed databases along with the inclusion of asset specific technical information. The topics for this 2 day advanced course will include:

- All of the topics from the 1 day basic user
- Navigation of the Machine Sentry® website
- Understanding the hierarchy structure.
- Understanding the KPIs and program metrics
- Database development. Via the Machine Sentry® web and hand held devices
- The analysis screens and the fault assistant
- The analysis process and associated tools
- The data collection and upload/download process
- The analysis screens and fault diagnosis assistant
- Raising, issuing, closing actions and navigation of the reporting functions

# Introduction to Reliability Centred Lubrication

This 1 day course will introduce the attendee to Reliability Centred Lubrication.

You will learn the fundamentals of lubrication and lubricants, which are the building blocks to kick-start your own world class reliability centred lubrication programme.

## Course Objectives:

This course provides a detailed introduction into the subject of lubricants and lubrication and raises the competence and confidence of existing staff. This enables them to be able to perform their own basic lubrication tasks and activities, giving them the confidence to challenge current procedures and activities ensuring best practices are being carried out.

## Recommended For:

- Plant Operator / maintainers, lubrication technicians, reliability engineers, plant engineers, production managers, condition monitoring specialists, engineering managers

### Topics include:

- Basic maintenance strategy
- Introduction to lubrication theory
- Introduction to lubricants
- Basic lubricant selection
- Specific lubricant application
- Introduction to oil analysis
- Lubricant condition control
- Lubricant storage and management
- Increase reliability
- Introduction to lubrication standards (ISO, HACCP, etc.)

## Difficulty Level - Basic:

No previous experience in lubricants and lubrication practices is required.

## References

The course is based on ISO and lubricant OEM standards including:

ISO 18436-4:2014, ISO 18436-3, MLTI



# Lubrication Update Training

This 1 day course will refresh the attendees knowledge of RCL, as well as providing an update on lubrication / lubricant advancement.

## Course Objective

This interactive course provides a detailed update on the subject of lubricants and lubrication, and reinforces the competence and confidence of existing staff, along with updating them on best practices and advances of lubrication technology. Allow attendees to develop their own lubrication programme to the next level. The course will allow the attendee to claim an essential 10 points towards the 15 points required to re-certify for their qualification.

## Recommended for:

- Plant operator / maintainers, lubrication technicians, reliability engineers, plant engineers, production managers, condition monitoring specialists and engineering managers

## Topics Include:

- Basic maintenance strategy update
- Introduction to lubrication theory refresher
- Introduction to lubricants refresher
- Basic lubricant selection refresher
- Specific lubricant application refresher
- Oil analysis update test techniques
- Lubrication condition control update, look at advancement in technologies
- Lubrication storage and management update, look at advancement in technologies
- Update / refresher on lubrication standards (ISO, HACCP, etc.)

## Difficulty Level:

Prior lubrication knowledge required.

## References

The course is based on ISO, and lubricant OEM standards including: ISO 18436-4:2014, ISO 18436-3



# Lubrication Analysis Category 1

This 3 day course\* not only covers the fundamentals, but provides best practice solutions to ensure your plant achieves world class levels in lubrication management.

The course is designed to be interactive and attendees will be encouraged to participate with questions and discussion. Worked examples and case studies will be a key part in this training.

The content covers the body of knowledge as laid out for ISO 18436/CM GEN Appendix C certification.

## Course Objectives:

A qualification will aid compliance with your company's ISO 9001:2000 Quality management systems - Requirements for training and qualification of personnel.

### The course will help you to:

- Understand the fundamentals of lubrication and oil analysis
- Get more out of your lubrication strategy
- Improve your oil analysis success
- Increase reliability
- Increase profits and turnover
- Improve your quality goals
- Improve your health and safety success
- Reduce your environmental impact
- Ensure compliance with ISO9001/ISO55000
- Design your own 'Best Practice' lubrication programme

## Recommended for:

- Plant Managers, operations managers, plant engineers, reliability engineers, lubrication technicians, oil analysis practitioners, condition monitoring specialists, plant operators, maintenance technicians

### Topics Include:

- Maintenance strategies
- Lubrication theory/fundamentals
- Lubricant selection
- Lubricant application
- Lubrication storage and management
- Lubrication condition control
- Oil sampling
- Lubricant health monitoring
- Absolute (Dynamic) Viscosity (ASTM D2893)
- Wear debris monitoring and analysis

## References:

The examinations comply with the latest international standard ISO 18436-4:2008 Condition monitoring and diagnostics of machines - Requirements for qualification and assessment of personnel - Part 4: Field lubricant analysis.

\* 3 day course, exam on day 4

## Lubrication Analysis Category 2

This 3 day course is targeted at helping your company's reliability drive in the areas of lubrication, oil analysis and contamination control.

The course not only covers the fundamentals, but provides best practice solutions to ensure your plant achieves world class levels in lubrication management. The course is designed to be interactive and attendees will be encouraged to participate with questions and discussion. Worked examples and case studies will be a key part in this training.

### Course Objectives:

#### Certification course helps you to:

- Understand the fundamentals of lubrication and oil analysis
- Get more out of your lubrication strategy
- Improve your oil analysis success
- Increase reliability
- Increase profits and turnover
- Improve your quality goals
- Improve your health and safety success
- Reduce your environmental impact
- Ensure compliance with ISO9001/ISO55000

#### Topics Include:

- Lubricant roles and functions
- Oil analysis maintenance strategies
- Oil sampling
- Lubricant health monitoring
- Lubricant contamination measurement and control
- Wear debris monitoring and analysis

\* 3 day course, exam on day 4



## Lubrication Analysis Category 3

This 3 day course\*, Level III is directed toward advanced diagnostics and troubleshooting, integration with other technologies and program management.

This is targeted at the reliability engineer / engineering manager level of individual.

The course not only covers the fundamentals in depth, but provides best practice solutions to ensure your plant achieves world class levels in lubrication management. The course is designed to be interactive, and attendees will be encouraged to participate with questions and discussion. Worked examples and case studies will be a key part in this training.

The content covers the body of knowledge as laid out for ISO 18436/CM GEN Appendix C certification. Get your staff qualified and on the road to achieving best practice and world class standards.

### Course Objectives:

#### Certification course helps you to:

- Understand the advanced fundamentals of lubrication and oil analysis
- Get more out of your lubrication strategy
- Improve your oil analysis success through high level management
- Increase reliability
- Increase profits and turnover
- Improve quality goals
- Improve your health and safety success
- Reduce your environmental impact
- Ensure compliance with ISO9001/ISO55000
- Design and manage your own best practice lubrication programme
- Ensure compliance with ISO9001/ISO55000
- Design your own 'Best Practice' lubrication programme

#### Topics Include:

- Lubrication fundamentals recap
- Fundamentals of machine wear
- Wear debris analysis
- Analysing lubrication degradation
- Oil analysis programme development and programme management

# Certified Ultrasound courses Level 1

5 Day Course (09:00 – 16:00) in conjunction with our Partners UE Systems Inc.

The Level 1 course is for the “practitioner” seeking to advance their knowledge in airborne/structure borne ultrasound inspection, personnel who perform PdM, energy audits or leak detection for their clients or end users maintenance personnel who desire to demonstrate technical and inspection proficiency.

## Course Objectives:

On completion of the course you will be suitably trained to conduct ultrasound inspections on rotating, static and electrical equipment and proficient in being able to diagnose faults and/or unwanted conditions whilst recommending remedial actions to be taken.

On completion you will be qualified to:

- All aspects of airborne/structure borne ultrasound technology
- Effective mechanical analysis, leak detection, electrical inspections
- How to perform: compressed air leak surveys, condition-based lubrication, steam trap inspections, bearing analysis, electrical inspections
- How to improve asset availability and company profitability
- Improved techniques and methods for quality ultrasound inspection
- How to enhance recording and reporting skills through our data management software and special analysis software
- How to reduce and save on energy consumption

## Recommended for:

- Managers, engineers, analysts, supervisors, technicians and operators who wish to learn about ultrasound technology, monitoring and analysis in the areas of operations, maintenance, engineering, reliability and condition monitoring
- If you have ultrasound equipment but have never been trained
- You may wish to refresh your knowledge of the technology and its applicability

## Key Learning Outcomes:

- Practice the operation of the Ultraprobe
- Use software for analysis and trending
- Set up groups of points to test
- Upload points into the Ultraprobe
- Establish baseline readings on a “Pilot” group (Approx. 50 – 200 test points based on access and configuration)
- Download and organize the pilot group
- Record and store sound files in the pilot group
- Practice correct data acquisition techniques
- Use spectralyzer software
- View and import sound files
- Create a database, take baseline and subsequent readings, download information into DMS and generate a report

Difficulty Level - Basic

## Certified Ultrasound courses Level 2

This 5 Day Course is an advanced course. Students must meet Level 1 requirements before enrolling.

This 32-hour course is designed to meet the intent of SNT-TC-1A and is in accordance with ISO 18436-8. Students successfully completing this course are familiar with the scope and limitations of Airborne/Structure Borne Ultrasonic Inspection, are able to set up and calibrate equipment, interpret and evaluate results with respect to applicable codes, standards, and specifications, and organize and report inspection results.

### Course content:

- Advanced Theory of:
  - Airborne/Structure Borne Ultrasound
  - Compressed Gas Leaks
  - Electrical
  - Mechanical
    - Valves
    - Steam Traps
    - Bearings
    - Lubrication
- Advanced Inspection Logistics
- Condition Monitoring Principals
- Best Practices of Data Collection
- Data and Sound Analysis
- Writing and Establishing Procedures
- Program Implementation
- Generating Reports
- A General, Specific, and Practical 60 question exam is given at the end of the course.

### Requirements for Level II Certification

In order to achieve an official certification, one must attend certification training (32 hours of classroom training) and must pass the General, Specific and Practical examinations with a combined score of 80% or better. Documentation of education or experience must be maintained annually. Hearing acuity must meet the minimum requirement of one ear of less than 25 dBHL at 500 Hz to 4 kHz (with or without aid.) Hearing acuity examinations must be documented annually. Documented experience signed by a supervisor or superior for 6 months additionally of the Level I experience of 6 months, for a cumulative 12 months' experience to qualify for official certification of Level II.

### Candidate Must Haves

Each Candidate for Level II certification of Airborne/Structure Borne Ultrasound should:

- Be Proficient with their ultrasonic device
- Be Proficient with collecting data in the field
- Should have basic computer skills (i.e. Word, Excel, Email)
- Basic Working Knowledge of Level I Material of Airborne/Structure Borne Ultrasound
- Each Candidate for Level II Certification of Airborne/Structure Borne Ultrasound must bring:
  - A Working Laptop with Admin rights for software install and input/export of data through usb/card reader slots
  - UE Systems' Latest Version of Ultratrend DMS software installed
  - UE Systems' Latest Version UE Spectralyzer Software installed

# Introduction to Thermography

This is a full 1-day course for beginners and anyone interested in infrared thermography and its applications.

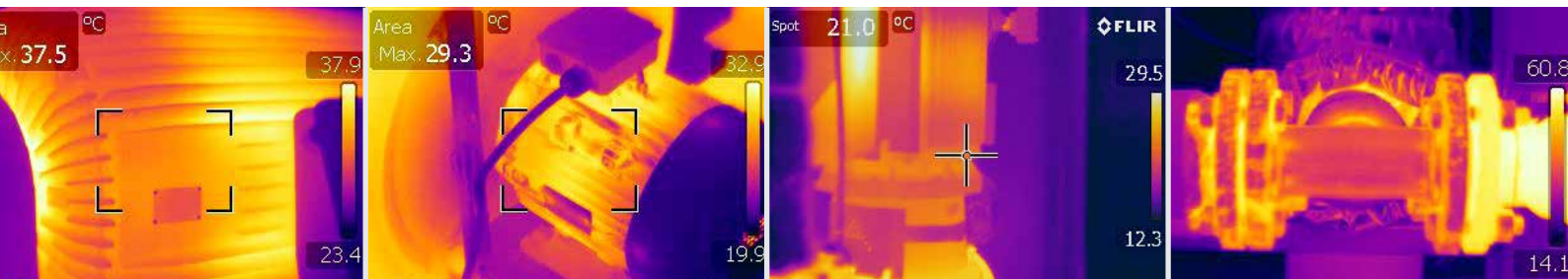
The course covers the basics of infrared theory and includes demonstrations, camera hands-on training and practical exercises using relevant laboratory sessions.

## Course content:

Basics of thermography, basics of emissivity and reflected apparent temperature, introduction to electrical and building inspections, infrared camera handling, data analysis and reports and laboratory sessions.

## Pre-requisites:

None



# Introduction to Electrical and Industrial Thermography

This is a one day course with a more focused introduction to electrical thermography.

This course provides a general introduction to infrared thermography and an overview of its specific use for inspections of electrical and industrial systems. It aims at giving you suggestions on what you can do with your infrared camera. During the first day, you learn the basics of thermography and how to use your camera the best way (the first day is identical to the course Introduction to Thermography). The second day you will start with a brief reminder about thermal transfers before you learn about electrical and industrial systems and components, material properties and typical problems and faults. Emphasis is put on case studies, selected from the field.

## Course content:

Basics of thermography, basics of emissivity and reflected apparent temperature, introduction to electrical and building inspections, infrared camera handling, basics of heat transfer, electrical and industrial systems, important properties of materials, common problems, case studies, common mistakes, application guidelines, data analysis and reports and laboratory sessions.

## Pre-requisites:

None

\* Certification courses may be presented on request.  
This course can also be delivered on customer sites.

# Category 1 Thermography ISO18436 PCN

Accredited Authorised Training Organisation (ATO) for the British Institute of Non-Destructive Testing (BINDT) as per the requirements of ISO 18436.

BINDT is an accredited certification body offering personnel certification against criteria set out in International and European standards.

The course teaches the basics of infrared, how to operate the camera under different conditions and for various purposes, how to do an appropriate judgement of the measurement situation in the field and identify potential error sources. You will be able to do IR inspections following written guidelines and to report the result of this inspection.

## Course Objectives:

- An understanding of thermography and the history of the camera technology development
- An explanation of the camera operation and how it works
- An understanding of infrared theory and the scientific laws relating to conduction, convection, radiation, blackbodies, transmission emissivity, reflectivity and calibration. Practical demonstration of these heat transfer modes with follow up theory
- An understanding of atmospheric and environmental considerations including distance, humidity, air temperature and reflected apparent temperature. How to measure them and setup the camera correctly
- An understanding of temperature definition and measurement, thermodynamics, heat and temperature, heat transfer, conduction, convection and radiation
- A look at cross hair measurement, area box /circle, colour alarms and specific dew point and insulation alarms
- The course includes hands-on camera experience throughout the course and camera operation practice using portable simulated labs; integration of images with reporting software; creation of reports
- On completion of the course you will be able to sit the Certification Test that which will be on the final day.

## Topics Include:

- Introduction to thermography
- Heat and temperature
- Infrared theory basics
- Measurement techniques
- Basic heat transfer theory
- Camera measurement tools
- Camera/software familiarisation

# Balancing Rotating Machinery

1 day training course (09:00 – 16:00).

The Balancing of Rotating Machinery course covers single and two plane balancing techniques for both rigid and flexible rotors. It includes topics such as pre-balance checks, influence coefficients, balance quality and tolerances and residual unbalance testing. The workshops and demonstrations, scheduled throughout the training course, are used to illustrate theory and applications.

## Recommended for:

- All condition monitoring specialists, engineers and supervisors responsible for improving machinery performance and reliability.

### Topics include:

- What is unbalance
- Collecting vibration and phase readings
- Understanding vectors
- Single plane balancing
- Estimating the size for the trial weight
- Adding weights
- Two-plane balancing
- The static-couple method
- Balancing overhung machines
- A quick review of balancing flexible rotors
- Balancing standards
- The four-run method – balancing without phase
- We will demonstrate the entire process, and you will also be able to take readings and balance a machine

## Difficulty Level - Intermediate:

Minimum of 12 months experience in vibration analysis is recommended prior to attending this course.



# Bearing Mounting & Dismounting

This 2 day training seminar can be delivered at our facilities or on-site.

This course provides an introduction to rolling element bearings, how to mount and dismount different types of bearings, maintenance of bearings and an introduction to analysis of defects.

## Course Objectives:

The objective of the course is to show how to improve the in-service life of rolling element bearings, which will improve the overall reliability of the rotating equipment. The course will use a combination of hands-on practical exercises, video, and classroom sessions which all provide opportunities to participate in discussions and raise questions.

## Recommended For:

Supervisors, technicians and craft persons who are involved with maintenance and repair of rotating equipment. It is also recommended for managers and engineers who wish to gain an understanding of these techniques.

## Topics will include

- Basic theory of rolling element bearings.
- The fundamentals of rolling element bearing technology including types and nomenclature; components; common terminology; types of loads and lubrication regimes.
- Factors that affect the performance and life of rolling element bearings including quality of the bearing; operating environment and maintenance activities.
- Mounting and dismounting of bearings including proper mounting & dismounting techniques with a variety of different equipment; the effects of improper handling; incorrect maintenance procedures and lack of or incorrect lubrication procedures.
- Basics of lubrication including understanding the importance of proper lubrication selection for a specific application; increasing bearing life by understanding lubrication principles and the functions of a lubricant; understanding the principles of a proper lubrication regime (how much and how often).
- An introduction to bearing failure mechanisms, their causes and how to analyse them.
- An introduction to actual bearing failures and how to understand the failure mechanism

# Machine Alignment

The Machine Alignment training course will introduce the concepts of shaft alignment and how it affects equipment operation.

The proper alignment of rotating equipment and maintaining the optimum operating conditions is essential when looking to obtain improved machine reliability and reduced energy consumption.

## Course Objectives:

This course aims to provide attendees with an understanding of how they can apply shaft alignment techniques using different methods & equipment. The course will address the problems that can occur when carrying out machine alignment and help to develop a systematic approach to solving these problems. The effects that misalignment has on machines will be demonstrated using condition monitoring techniques.

## Recommended For:

This course is recommended for anyone who is involved with maintaining rotating equipment, including supervisors and managers who wish to understand the effects that misalignment can have on their equipment.

## Topics will include

- The principles of rotating objects such as loads, forces and resulting vibration; parallel, angular and combination alignment.
- Different methods of measurement including using clock gauges (rim & face; reverse double dial) and laser alignment systems.
- Necessary pre alignment checks such as rough alignment; identify and eliminate soft-foot conditions; identify and eliminate piping strain.
- How to move the machine using shims; different mechanical methods; the tools available and effects of grouting and fixings.
- Problems with repeatability and what causes them, how to troubleshoot and eliminate them.
- Simple applications including direct coupled and belt driven machines.
- Thermal expansion and its effects, how to measure, analyse and compensate for this.
- Alignment problems such as base- and bolt-bound conditions; movement when operating.

# Pump Practical Course

3 day training course provides an introduction into pumps and pumping systems. It will cover different types of pumps, their operation and strip down/rebuild.

Due to the practical nature of this course, it intended to be delivered at our facilities. On-site courses may be available depending on the facilities that are available.

## Course Objectives:

The objective of the course is to provide a clearer understanding of different types of pump and associated systems. It will also provide the opportunity to strip down, assess and repair, or replace, the component parts. The installation and commissioning will provide guidance on such items as alignment, connection with piping systems and the operation of the equipment.

## Recommended For:

Supervisors, technicians and craft persons who are involved with maintenance, repair and operation of pumps and pumping systems. It is also recommended for managers and engineers who wish to gain an understanding of, or refresh their knowledge of pumps and pumping systems.

## Topics will include

- Basic Theory of pumps and pumping
- The strip down and rebuild of a pump including all the component parts such as seals/packing; the bearings, wear of parts and whether to repair or replace and balancing on assembly.
- The installation and commissioning of pumps including the alignment of parts, connecting to the piping system; system commissioning; the lubrication of pumps and running performance checks

# Pump Testing Course

This 2 day training course provides an introduction into the different types of tests that need to be carried out for pumps and pumping systems.

It will cover different types of testing that are necessary for the correct operating of the equipment.

## Course Objectives:

The objective of the course is to provide a clearer understanding of the different tests that are required, such as FAT and SAT tests, system testing and testing for, identifying and correcting cavitation.

## Recommended For:

Supervisors, technicians and craft persons who are involved with installation and maintenance of pumps and pumping systems. It is also recommended for managers and engineers who wish to gain an understanding of, or refresh their knowledge of pumps and pumping systems.

## Topics will include

- Basic Theory of Factory Acceptance Testing (FAT) and Site Acceptance Testing (SAT)
- Installation into the system and system testing
- Testing for, identifying and correcting cavitation

# Advanced Pump Training

2 day training course for industries that seek increased Mean Time Between Failure...

... improved process availability and reduced unplanned outages whilst reducing maintenance and purchasing costs.

This training course gives an in-depth understanding of all aspects of rotating equipment and helps operators to effectively troubleshoot costly equipment reliability issues.

The course is designed to give delegates an understanding of all aspects of rotating equipment and help them effectively troubleshoot costly equipment reliability issues. It also gives an in-depth understanding of the links between mechanical seal, bearing and pump failures.

## Course Objectives:

- Learn the importance of correct equipment selection
- Understand on-site operating practices and their effect on mechanical seal and bearing reliability
- Understand cost effective techniques to improve process availability
- Learn the benefits of creating pump purchasing standards to improve mechanical seal life
- Learn the common objective between production, maintenance and purchasing
- Learn the reasons for selecting particular maintenance strategies
- Learn the value of a specialist troubleshooting team to implement focused improvements

## Recommended For:

- Plant supervisors, pump repairers and senior engineering staff involved in maintenance, design, reliability, production and operations, etc.

## Topics Include:

- Introduction to pumps
- Head, flow and electrical consumption, The "Affinity Laws"
- Creating pump standards
- Pump terminology, understanding head and cavitation
- Importance of correct installation
- Understanding oversized pumps

If you have any questions or want to know more information please contact AESSEAL:

**t:** 01709 369966

**e:** [training@aes seal.com](mailto:training@aes seal.com)



# Mechanical Seals – The Fuse in the System

2 day specialist training to develop your workforce.

AVT Reliability® sister company AESSEAL® provide specialist training courses that are positioned to help staff develop their knowledge and understanding of mechanical seals, centrifugal pumps and protection of bearings.

This course is designed to give delegates an introduction to correct mechanical seal operation and an insight into root-cause and pump failure modes, accompanied by easy to implement troubleshooting techniques.

## Course Objectives:

- Understand the principles behind good mechanical seal life and how to achieve it
- Learn how to improve your margin for operational error
- Understand the importance of correct rotating equipment operation
- Understand the relationship between equipment reliability and stop-start operation
- Understand the need for correct seal and seal support system selection and application
- Understand bearing life and the changes required for improvement
- Understand the importance of the mechanical seal materials selection process and the properties of materials
- Learn simple troubleshooting techniques to improve equipment availability
- Understand the operational importance of implementing mechanical seal standards

## Recommended For:

- Plant operators, maintenance personnel, purchasing personnel and engineers.
- Whether new to this field or a seasoned professional looking to refresh their knowledge, this course is designed to give a practical insight into improved plant reliability

## Topics Include:

- Seal failure analysis
- Dual seals and support system
- Environmental controls
- Seal installation / pump re-build procedures
- What is a mechanical seal?
- Centrifugal pumps - What is a pump?
- Bearing failure & protection

If you have any questions or want to know more information please contact AESSEAL:

**t:** 01709 369966

**e:** [training@aesseal.com](mailto:training@aesseal.com)



# Reliability Engineering for Rotating Equipment

A 3 day training seminar on machinery reliability which can be delivered on site or at our training facilities.

## Course Objectives:

- Gain a good knowledge of maintenance strategies and techniques to improve reliability and availability including conducting an effective FMEA (Failure Mode Effect Analysis) and RCFA (Root Cause Failure Analysis).
- Become familiar with various proactive maintenance methods
- Gain a basic understanding of a system's life-cycle and understand the financial implications involved with assessing life cycle costs.
- Learn how to implement best practices

## Recommended for:

- The course will benefit engineers, technicians, supervisors and managers who are or plan to be involved in reliability engineering and condition monitoring of industrial assets.

## Topics Include:

- RCM methods
- Maintenance strategies and techniques
- Functions and functional failures
- Failure modes and effects analysis
- Maintenance engineering: Maintenance regimes, reactive vs. proactive maintenance; Reliability Centered Maintenance (RCM), Risk-based maintenance (RBM)
- System's life-cycle: Life-cycle cost (LCC) analysis, whole-life costing, how to identify key cost drivers
- Implementing an effective condition monitoring program
- Key factors that influence selection of CBM techniques
- Key steps in implementing a CBM program in line with best practice
- CBM techniques
- Workshops and case studies: Work in groups to analyse the reliability, availability and maintainability of various systems and components





# Introduction to Rotor Dynamics

A 2 day training seminar (09:00 – 16:30 ) which can be delivered on customer site or at our training facilities.

A two day practical introduction and understanding into turbomachinery rotor dynamics, this introduction will allow clients rotating equipment engineers and technicians to fully understand rotor dynamic reports and key behaviour activity in turbomachinery to aid in longer term understanding of critical equipment reliability on the plant.

The class will learn about normal and troubleshooting rotor behaviour and which information is key to understand common failure modes, the class will focus on real time hands on application using our rotor dynamics kit which will be used throughout.

## Course Objectives:

- Introduction to machinery management and diagnostics
- Organise data plots for preparation to aid in identification of failure modes
- Phase measurements and understanding
- Steady state data
- Transient data
- Fundamental rotor responses
- Introduction to single and multiplane balancing
- Preloads and radial measurements
- Vibration responses
- Radial rubs
- Fluid whip and whirl
- Shaft cracks

## Recommended For:

- Managers, engineers, supervisors, technicians and operators involved in: Plant Maintenance, reliability, asset integrity, plant improvement, health and safety, COMAH compliance

### Topics include:

- Basic vibration
- Main causes & consequences of vibration
- Fatigue basics
- Basic assessment methodology
- Qualitative assessment
- Visual inspection
- Practical exercise
- Basic vibration measurements and analysis
- Basic vibration measurements practical exercise
- Basic vibration analysis practical exercise
- Specialist techniques
- Corrective actions
- Good design practice summary

## Difficulty Level - Basic:

No prior knowledge of vibration testing is required.

Mathematics will be kept to the minimum necessary for an understanding of the subject.



# Pipework Vibration Compliance

A two day training seminar (09:00 – 16:30) which can be delivered on customer site or at our training facilities.

This course provides a detailed introduction into the subject of pipework vibration and raises the competence and confidence of existing staff to be able to perform their own basic visual inspection and basic pipework vibration surveys and assessments and have a good knowledge of common remedial solutions and other specialist techniques available to them. The course also covers methods for the theoretical assessment of likelihood of failure (LOF). Emphasis is placed on the practical aspects of the subject and only the essential theory is covered. The course covers essential data assessment methods.

## Course Objectives:

- Gain an understanding of pipework vibration, including the main causes and consequences of pipework vibration
- Learn about theoretical methods for calculating 'Likelihood of Failure' (LOF)
- Gain the necessary skills and confidence to be able to perform an initial visual assessment of pipework to be able to identify and prioritize potential areas of concern
- Gain familiarity with portable vibration measurement instrumentation
- Learn how to perform basic vibration measurements and gain practical experience
- Learn how to perform basic vibration data assessments against Energy Institute limits
- Gain an understanding of other 'specialist techniques' and when these should be used
- Gain an understanding of how to deal with common vibration problems
- Learn what constitutes 'good practice' for avoidance of vibration induced fatigue problems

## Recommended For:

- Managers, engineers, supervisors, technicians and operators involved in: plant maintenance, reliability, asset integrity, plant improvement, health and safety, COMAH compliance

### Topics include:

- Basic vibration
- Main causes & consequences of vibration
- Fatigue basics
- Basic assessment methodology
- Qualitative assessment
- Visual inspection
- Practical exercise
- Basic vibration measurements and analysis
- Basic vibration measurements practical exercise
- Basic vibration analysis practical exercise
- Specialist techniques
- Corrective actions
- Good design practice summary

## Difficulty Level - Basic:

No prior knowledge of vibration testing is required.

Mathematics will be kept to the minimum necessary for an understanding of the subject.

# Root Cause Analysis Facilitator Course

A 2 day course which can be delivered at a customer site or at one of our training facilities.

The RCA facilitator course has been designed with an industrial focus for those who wish to eliminate recurring defects, problems and failures. These may be one-off, large failures that have had a safety or financial impact, or those small failures that re-occur often and have a large cumulative financial impact on the customer's bottom line. The cause and effect charting technique is designed to broaden the problem perspective by way of lateral thinking and move away from simple, linear thinking that can miss key opportunities for solutions.

## Course Objectives:

This course provides a detailed understanding of a structured problem-solving process using cause and effect charting to get to the root causes of recurring or one-off problems that present asset and business risks to customers. The objective is to take the participant through the 5 step problem-solving process and give them the confidence and knowledge to facilitate group RCAs by using industrial case studies and scenarios. Participants can also bring their own industrial problems to use in the final case study on day 2. The 5 step process is designed to result in targeted and lasting solutions that will prevent recurrence and be within the customer's control.

## Recommended For:

This course is recommended for operators, technicians, engineers, supervisors, managers and anyone involved in root cause analysis, defect elimination, reliability improvement, and continuous improvement on industrial plant, processes, and systems.

## Topics will include:

- The why and when of RCAs
- Structured problem solving
- Threshold criteria
- Collect and organise data
- A problem statement
- Cause and effect analysis
- Finding solutions
- RCA reporting and follow up
- Practical case studies

## Difficulty Level - Basic:

\*AVT Reliability are also available to facilitate one-off RCAs at your site or plant. Please contact us for more information.

## Reliability Leadership

Reliability Mindset 3 days course (with optional coaching days as follow up).

**Course Objectives:** Reliability outcomes are strongly influenced by mindsets and capabilities of any individuals or teams within an organisation. A mindset refers to the underlying patterns of thought, feelings, assumptions, values, priorities and opinions which shape a person's perception and motivation. The objective of this programme is to recognise the need for management commitment and active leadership throughout the reliability journey and to ensure common values are shared across the organisation. The programme starts with a 3 day event followed by optional coaching support back in the workplace.

**Recommended For:**

This course is recommended for senior leadership team, senior managers, asset managers, reliability managers.

## Reliability in Design

1 days Reliability in Design Workshop.

**Course Objectives:**

Reliability in design workshop will look at what reliability techniques need to be focussed on during project phases from initiation to close-out. We cover the nine deliverables of a Reliability in Design (RiD) process.

Reliability in Design (RiD) is a concept for ensuring all elements of lifecycle cost are considered during the design phase of the Project Gate Process. The decision to address reliability and life cycle cost is best made during the design phase of a project. When these decisions regarding reliability are made later during the life cycle, the return on investment decreases as plant problems start to occur. This in turn reduces plant availability and capacity.

The concept is to ensure there is no waste during start up and that a smooth transition from Project to Production occurs. The RiD process will ensure increased asset performance with reduced operating and maintenance costs.

**Recommended For:**

Project managers, project designers, reliability managers, reliability engineers.

## Work Management

3 days maintenance planning and scheduling for reliability course.

**Course Objectives:**

In conjunction with our associate Lifetime Reliability of Australia, we are delivering this course which will identify the best practices and methods, the specific requirements and the systems that need to be in place (and in use) to get the most from planning and scheduling.

Too much time, production and money can be lost if the preparation is not done well. Maintenance planning done correctly maximises tool time, by ensuring jobs are ready (with all resources and information at-hand) so tradesmen walk from job to job uninterrupted, doing their work with 100% right-first-time quality. High quality planning leads to top quality performance.

**Recommended For:**

Reliability managers, reliability engineers, maintenance managers, maintenance supervisors, maintenance technicians, production managers.

# Failure Modes Effect and Criticality Analysis(FMECA)

2 days failure modes effect and criticality analysis course.

## Course Objectives:

The objective of the course is to interactively teach participants how to conduct and facilitate their own asset/equipment FMECA's. The participants will explore the key elements Failure Modes Effects & Criticality Analysis and practice conducting their own analysis using the core facilitation skills. Many of the exercises will be performed in groups of 4-5 minimum and facilitator skills and ground rules will be established.

- Introduction to FMEA/FMECA
- Setting Up For FMECA
- The FMECA Process
- Functions
- Functional Failures
- Failure Modes and Causes
- Failure Severity and Effects
- Criticality Ranking
- Mitigating tasks
- Summary

## Recommended For:

Reliability managers, reliability engineers, design engineers, maintenance managers, production managers, production operators, maintenance technicians.

# Asset Strategy Optimisation with RCM (Reliability Centred Maintenance)

2 days Asset Strategy Optimisation with RCM (Reliability Centred Maintenance).

## Course Objectives:

This two day course works through the elements of Asset Strategy optimisation, zero based maintenance budgets, resource optimisation, spares optimisation and is for anyone looking to improve the effectiveness of their existing maintenance strategies. It will consider the impact of both predictive and preventive maintenance plans on the overall business and show the comparison between your current and optimum strategy.

## Recommended For:

Reliability managers, reliability engineers, design engineers, maintenance managers, production managers, production operators, maintenance technicians.

# Introduction to Reliability Basics

2 days Asset Strategy Optimisation with RCM (Reliability Centred maintenance).

## Course Objectives:

This two day course works through the basics of Reliability and covers several topics including, Failure data analysis, Reliability Centred Maintenance, Root Cause Analysis, Planning and Scheduling, Condition Monitoring, Lubrication Excellence.

## Recommended For:

Reliability managers, reliability engineers, maintenance managers, maintenance supervisors, maintenance technicians, production managers.

## About the trainers

### Specialist training to develop your team's skills.

For over 30 years AVT Reliability's highly qualified trainers have been helping generations of maintenance professionals worldwide to improve and consolidate their skills in maintenance management and Condition Based Maintenance. With courses ranging from maintenance strategy and reliability engineering to practical maintenance engineering techniques and applications, AVT Reliability has the capability to deliver the course that you need when you need it.

#### Alec McCann

##### **External Training Manager for at AVT Reliability®**

After completing a mechanical engineering apprenticeship with the MOD, Alec spent over 5 years working in South Africa on mining, construction and maintenance contracts. After returning to the UK, he went on to complete an MSc at Glasgow Caledonian University and since 1998, he has been involved in condition monitoring training and consultancy services in a variety of industries including power generation, chemical and oil & gas. He is currently certified to Vibration Analyst Cat IV; Infrared Thermography Cat I and Airborne Ultrasound Cat 1. Alec leads our external training services and sits on the BINDT working groups for vibration analysis and lubrication management. Alec's experience includes:

- Remote analysis and reporting to offshore assets
- Site surveys, implementation and commissioning of new condition monitoring programmes, both in the UK and abroad
- Review and update of existing condition monitoring systems including Rockwell Automation, SKF, Pruftechnik & SPM, both UK and abroad
- Creation of a City & Guilds Condition Monitoring award scheme (RA)

#### David Stevens IEng, MIET, FIDiagE, FISCM

##### **Remote Data Centre and Internal Training Manager at AVT Reliability®**

Machine Sentry® — As an experienced engineer David Stevens has worked in a variety of industrial sectors in both technical and managerial levels having specialized in reliability engineering and condition monitoring for the last 30 years. David is a qualified Category 3 Vibration Analyst through BINDT, he is also part of the BINDT VA working group. David has delivered many training courses throughout the UK and now specializes in delivering training for our own Machine Sentry® solution. David is also an ICML level 2 Lubrication Analyst. David's experience includes:

- Implementing condition monitoring programs from the plant audit to full blown CBM solutions.
- With over 30 years in the industry, David has been involved with many manufacturing industries such as mining, food and beverage, pulp and paper, speciality chemicals, onshore and off-shore oil and gas.
- Responsible for technical support and development of our internal engineering teams and also training of our external customers.

#### Andy Fyfe BEng (Hons) Oil & Gas Technical Authority

##### **Oil and Gas Technical Authority at AVT Reliability®**

Andy Fyfe worked for the Defence Evaluation and Research Agency (DERA; later QinetiQ) for 12 years, carrying out vibration assessments and far field radiated noise trials for the Royal Navy. Andy joined AVT Reliability in 2010 working predominantly in the oil and gas sector. He led the AVT reliability team in the central belt of Scotland supporting oil refineries and petrochemical industries, and led the overhauls of several compressor trains during scheduled shutdowns for some of these clients.

Andy became more involved with offshore assignments, carrying out transient vibration analysis of large machinery trains and rotor dynamic assessments. As a qualified Category IV Master Vibration Analyst through BINDT, he is AVT Reliability's oil and gas technical authority. Andy has also completed GE Introductory and Advanced Machinery Diagnostics Training, motion amplification training, as well as being an ICML level 1 Lubrication Analyst.

## Mark Needham

### **Technical Manager for Lubrication at AVT Reliability®**

Lubrication — As an experienced engineer Mark has worked in a variety of industrial sectors at both technician and supervisory levels having specialized in lubrication, condition monitoring and reliability engineering for the last sixteen years. Before joining AVT Reliability® Mark spent 13 years in the Royal Air Force as a propulsion engineer, part of his role within the RAF was running the EFDC (early failure detection centre) to look at wear debris analysis for gas turbines, gearboxes, auxiliary power units etc. Mark is an ICML MLAll level lubricant analyst with experience:

- Providing technical support to all customers for lubricants and lubrication.
- Implementing lubrication and condition monitoring programs from the plant audit to measuring its effectiveness throughout the world.
- Developed the AVT Maintenance Assessment Programme from conception to implementation for all industry types.
- Designing and delivering customer reliability driven lubrication training programmes.

## PJ Cloete

### **Electrical and Thermal Technical Authority at AVT Reliability®**

Thermography — PJ is a Level 3 ITC Certified Thermographer and has been involved in industrial engineering since 1997, and specifically in condition monitoring and reliability specialist disciplines since 2003. PJ is certified in a number of CM techniques, including vibration analysis, thermal imaging and airborne ultrasound.

PJ's early years were spent within the mining sector and specifically with a major international mining organisation in South Africa, where he worked in both surface processing plants and underground areas. After five years at the forefront of operational roles, PJ was promoted to a corporate position as a senior machinery inspector. In this role, he provided leading support of reliability focused services to gold, platinum, diamond, iron ore and zinc mines in Southern and Central Africa, leading machinery reliability program improvements.

## Neil Parkinson BSc CEng FIMechE

### **Technical Director at AVT Reliability®**

Pipework Vibration — Neil joined AVT Reliability® in 1985 and has helped establish AVT Reliability's pipework vibration services, including the development of a range of remedial repair options, including braces, visco-elastic dampers and dynamic vibration absorbers. Neil has been Technical Director since 1993 and has over 30 years' experience in structural integrity monitoring.

## Jamie Borley MSc CMRP IEng

### **Reliability Engineer at AVT Reliability®**

On completion of a multi-skilled apprenticeship with Ford Motor Company, Jamie gained a wide range of electrical and mechanical experience in the automotive sector – focussing on gearbox manufacture, assembly, and quality. After taking a year out to travel the world, he later gained a BEng (Hons) in Manufacturing Systems Engineering whilst working in technical roles in building services and papermaking. Since 2012, Jamie has been involved in asset management, condition monitoring and reliability in the steelmaking, food & beverage, pharmaceutical, oil & gas and chemicals industries as a consultant engineer with AVT Reliability. With accreditations ranging from VA Category II, Airborne Ultrasound Level 2, IR Thermography Level 1 and RCA Facilitator Level 1, Jamie also successfully achieved an MSc in Maintenance Engineering & Asset Management from University of Manchester. Jamie's experience includes:

- Condition monitoring program implementations.
- Significant condition monitoring experience in terms of vibration analysis, thermal imaging, lubrication and ultrasound.
  - Reliability improvement projects.
    - RCA facilitation & training.
      - Creator AVT Reliability's 'Reliability Performance Model' and assessment tools.

## Chris Dean

### **Group Technical Training Officer for AESSEAL®**

Chris has been involved in mechanical engineering for over 35 years and has developed a vast array of skills and experience regarding pump and seal installation and maintenance.

Having worked in a variety of industries from Pulp and Paper to Chemical and Nuclear Reprocessing to Power, there isn't much Chris hasn't seen in relation to pump and seal maintenance. Having this experience over an extended period of time has enabled Chris to develop relationships with distributors, end users and pump repair houses throughout the world.

Chris regularly conducts rotating equipment reliability training both at AESSEAL and at customer premises throughout the world. The primary objective of this training is to increase mean time between failure to reduce operational costs and increase profitability. Chris's relaxed, but professional approach to the training sessions ensures all attendees leave with the knowledge and skills that can be instantly applied in the workplace.

## Clive Wilde

### **Engineering Service Manager at AESSEAL®**

Clive graduated in 1991 with a BEng(Hons) in Mechanical Engineering Design and immediately started his career with Sulzer Pumps in the UK where he stayed for the next 23 years. He trained at Sulzer R&D HQ in Winterthur, Switzerland, as a Hydraulics Engineer and became interested in pump testing after having development test responsibility for high specific speed cooling water pumps.

He returned to Leeds with Sulzer HQ's automated pump testing software and implemented automated pump testing and data acquisition in the Leeds Factory. Clive's enjoyment of the test environment led him to spend 10 years as Sulzer UK's Testbed Manager where he expanded the test facility to include an additional 30MVA of electrical power, an 18MW VFD for soft starting and string testing customer drive motors and a 30MW Gas Turbine Test Facility where engines, injection pumps and compressors were string tested at full load.

Clive also enjoyed roles as Sulzer's Multiphase Pump (MPP) Product Manager being part of the team that launched the Sulzer Subsea MPP project and was also Sulzer's Retrofit specialist covering the North Sea and latterly Africa.

Clive left Sulzer in 2014 to join Total Aberdeen as a Rotating Equipment Engineer where as well as heading and implementing many mechanical reliability improvement projects he assumed responsibility for the continuous improvement of the Dunbar MPPs, the largest offshore MPPs in the world.

Since 2017 Clive has worked for AESSEAL PLC as their resident pump specialist, his skill set also enjoying a natural synergy with AESSEAL's sister company AVT Reliability.

# AVT RELIABILITY



AVT Reliability now has more than 100 fully employed professional CBM engineers at locations in the UK and mainland Europe.

The comprehensive AVT Reliability program covers Asset Integrity, Performance Monitoring, Training, Maintenance Consultancy and Total Pump Management / Products to Manufacturers.

AVT Reliability are certified to ISO 17359 and ISO 9001. Accredited by UKAS as a Machine Directive Notified body, and are ICML and BINDT members.

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Proud members of the AES  
Engineering Ltd group of companies  
“passionate about reliability”

