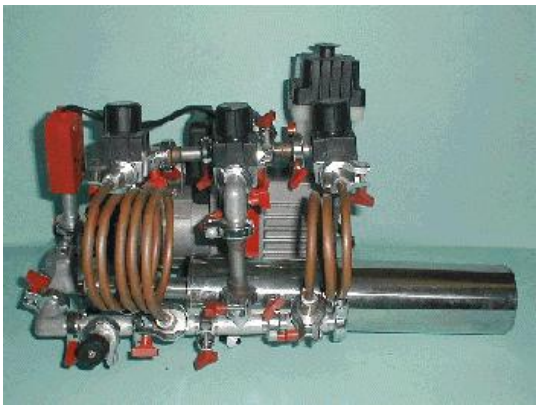
Revision 2013

Vacuum Technology 1-3 day

Good Vacuum Practice 1 Day Course Outline



Willett Technical Services

Vacuum Technology 1,2 or 3 Day Course

This training course outline is intended to cover the following:

- Introduction to vacuum
- Measurement
- Lubricated rotary pumps
- Dry pumps
- Turbo molecular pumps
- Diffusion pumps
- Leak checking
- Vacuum uses
- Cryogenic pumps
- Components/seals/valves and fittings

COURSE AIMS

This course is designed to provide, at a working level, knowledge of vacuum technology.

The course is divided into a number of sections as highlighted above, which cover relevant topics and objectives, as shown in the following course outline.

Successful completion is achieved by:

a Attending class to meet the required knowledge level.
b Completion of class based practical exercises
c Completion of a class question sheet.

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Vacuum Technology 1,2 or 3 Day Course

Overview of course

Objective

To introduce the concepts and offer a fundamental insight to vacuum technology, the principles involved, systems, pumps and gauges used.

The course is presented in a non-mathematical or calculating way, fully illustrated with overhead slide and significant equipment sectioned examples.

The course content is consolidated by the application of hands on vacuum experiments

The course is presented by highly experience vacuum engineer who can offer considerable real application/situation examples of vacuum technology.

Prerequisites

- Normal secondary education

The course is suitable for technicians and engineers with vacuum experience as the course delivery is adapted to suit the level of the candidate's expertise.

Course Facilities Layout

Classroom lecture style for the knowledge portions of the course. Followed by workshop hands-on practice session.

Location

Courses are usually held on campus on your own site

Enquiries

For vacuum course related technical enquiries please contact WTS Ltd direct on 07786 243763

1, 2 or 3 day vacuum technology course

Class Modules and practical experiments

Vacuum Introduction:
What is it, types of gas flow, how it relates to the real world

Pump down effects (Experiment)
To illustrate the effects of various lengths and diameters of pipeline and how this significantly effects pump down performance

Measurement of vacuum:
Why measure vacuum and how to measure the wide pressure ranges offer by vacuum.
A range of gauges principles and types will be covered.
Force, thermal and ionisation gauges will be covered and details of the construction are covered.

Reading gauges (Experiment)
Comparing various gauges types and understanding the readings

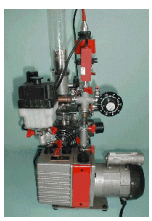
Gas Effects (Experiment)
The effects of different gases will be discussed including effects on thermal gauges will be illustrated

Contamination Effects (Experiment)
The effects of contamination will be discussed to illustrate practical effects of out gassing, water and dry gases.

Oil-sealed rotary pumps:
General principle of operation, construction is covered, the function of the lubrication fluid and the limitations of the design. Techniques are explained to obtain the best performance from the pumps. Various accessories are explained and when they should be used.

Oil free pumping:
Introduction to dry vacuum pumping, covering roots boosters, claw, and diaphragm and scroll designs

Vapour and diffusion pumps: Principles of operation and construction is covered. The types of fluid used and their advantages. How to operate diffusion pump systems and the various accessories available to improve performance



Diffusion Pump Operation (Experiment)
Demonstration of pump operations, and incorrect operation.

Turbo molecular pumps:
Construction, operation and characteristics, pump comparisons

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Turbo pump operation
How to operate a turbo molecular pump will be illustrated, showing initial chamber pump down and the sequential starting of the turbo pump.

Capture pumps:
Construction, operation and characteristics, pump comparisons. Including Cryo and Ion pumps

Leak Detection explanation of leakage rates, response times, location of leak detectors, real and virtual leaks, methods of detection, (including over pressure, Pirarni and helium mass spectrometer), use of calibrated leaks

Applications.
Discussion and illustrations of vacuum applications

Pipeline vacuum couplings and valves: The various types of seals and coupling are shown and discussed, together with a wide selection of typical valves. KF, NW, Con-flat and ISO to name some covered.

GOOD VACUUM PRACTICE 1 DAY COURSE

This short course has taken selected content from the full 3 day vacuum technology course to set a foundation knowledge, emphasis is then placed on good vacuum practice, cleanliness, handling, seals, assembly etc.

Vacuum:
What is it, types of gas flow, how it relates to the real world

Measurement of vacuum:
Why measure vacuum and how to measure the wide pressure ranges offer by vacuum.
A range of gauges principles and types will be covered.
Force, thermal and ionisation gauges will be covered and details of the construction is covered

Gas Effects
The effects of different gases will be discussed including effects on thermal gauges will be illustrated

Oil-sealed rotary pumps:
General principle of operation, construction is covered, the function of the lubrication fluid and the limitations of the design. Techniques are explained to obtain the best performance from the pumps. Various accessories are explained and when they should be used.

Contamination
The effects of contamination will be discussed including effects of out gassing, water and dry gases

Pipeline vacuum couplings and valves:
The various types of seals and coupling are shown and discussed, together with a wide selection of typical valves. KF, NW, Con-flat and ISO to name some covered.

Full List of Course Module Objectives

Objectives Module Introduction

State the definition of a vacuum
State 5 relevant constituents of atmospheric air
State where atmospheric pressure comes from
State how many gas molecules are in atmospheric air at normal pressure
State how many gas molecules are in a high vacuum
State how many gas molecules are in the lowest achieved vacuum
State how many gas molecules are in outer space
Indicate the basic components in a vacuum system
Describe the term viscous flow
Describe the term molecular flow
List 3 basic vacuum pump types and their approximate vacuum achievable
State the atmospheric pressure in Torr
Describe were the term Torr comes from
State the atmospheric pressure in millibar
State the atmospheric pressure in Pascals
State the pressure in millibars of outer space
Be able to read scientific notation powers of ten
State the 4 levels of vacuum commonly used
Indicate the approximate vacuum achievable for a range of pump types
State what transfer pumps mean
List 5 types of transfer pump
State what capture pumps mean
State basic units for pumping speed
State what is meant by throughput
State what is meant by conductance

Objectives Module Gauges

State the range commonly used vacuum gauges operate
State 4 types of vacuum gauge
Describe the term force gauge
List 4 types of force gauge
Describe the term thermal conductivity gauge
List 2 types of thermal conductivity gauge
Describe the effects of gases on thermal conductivity gauges
Describe the term electrical conductivity gauge
List 2 electrical conductivity gauges
Identify the gauge types above
List the vacuum ranges for given gauge types
Identify the correct placement of vacuum gauges
Identify how to protect vacuum gauges from processes
Identify the correct placement of gas injection into vacuum chambers
Demonstrate how to read an analogue gauge display
Demonstrate how to correctly read a digital display

Objectives Module Lubricated Rotary Pumps

Identify a rotary vane pump
Identify, the major internal components, rotor, stator, exhaust valves
Identify the operation cycle of the rotor assembly
State the purpose of an exhaust valve
State what the term duo seal means
State 2 factors that effect the ultimate pressure obtainable
State the purpose of using 2 stage pumps
Describe how oil pressure may be generated in a pump
Indicate the oil circuit on a pump
State the purpose of an inlet isolation valve
State how an inlet isolation valve may be operated
State one type of seal used on pump shafts
Describe how pumped vapours can be trapped inside a pump
Describe the effect of trapped vapours
Describe 2 methods to reduce the effects of trapped vapours
State the effect of vapour control has on the pumps vacuum performance
Illustrate the correct method to connect a pump exhaust
State 4 functions of the lubricant in a pump
State why you should not use regular car oil in rotary pumps
Describe the effect of oil back migration
Describe a method to reduce back migration
State an accessory used to reduce lubricant being lost from the pump exhaust
State the various lubricant types available
State 5 possible reasons for poor pump performance
Identify a rotary piston pump

Objectives Module Dry Pumps

Identify 3 dry pump types
Indicate the major parts of a booster pump
Describe the functional operation of a roots stage
State the pressure range suited to booster pumps
State what is meant by the term back expansion
State 3 methods to prevent over pressurisation of a booster pump
Describe the effects booster may have on pump down performance
Review the speed curves of a number of pumps
Identify semiconductor type dry pumps
State 4 reasons why dry pumping is beneficial
State 6 advantages of dry pumping
Identify roots, screw and claw type mechanisms
State the function of gas ballast in dry pumps
Identify industrial type dry pumps
Indicate the operation of diaphragm pumps

Objectives Module Diffusion/Vapour Pumps

Identify a diffusion and vapour pump
State 1 application of vapour pumps
State 1 application of a diffusion pump
Indicate the major components of a pump system
Indicate the major components of a diffusion/vapour pump
State the operating range of a diff/vap pump
Describe the functional operation of the pump
Describe the term back streaming
State a method to reduce back streaming
Indicate typical pump speeds relative to pump physical size
Indicate the pump performance from a graph
State the pumps performance for various gases
State the effect of pumping fluids
State what is meant by critical backing pressure
Describe the function of a fractionating diff pump
State 4 pumping fluid types
Indicate a single backing pump system
Describe the advantage of a 2 backing pump system
Describe why a single shared pump system is often used
Describe how to operate a simple manual system
Describe a number of pump accessories used to improve ultimate vacuum
Describe the effect these accessories have of vacuum ultimate
Describe how some manufacturers have over come some of these issues

Objectives Module Turbo-molecular Pumps

Identify a turbo pump
Identify the major components of a turbo pump system
Identify the major components of a turbo pump
State the operating range of typical turbo pump
Describe the principle of operation
Describe the function of the blade design
State the tip speed of typical turbo pumps and why
State 3 types of bearing systems used
State what is meant by the term hybrid turbo
State what passive magnet bearing means
State what is meant by active magnet bearings
State 4 benefits of magnetic bearings
State the compression ration for a typical turbo pump for a range of gases
Review a mass spectrum above a turbo pump
State the typical run up times for a pump
State the ability to handle debris
Describe the need for pump cooling
Describe the need for pump venting
Describe the possible need for bearing purge
Identify a Gaede pump stage
Identify a Holwick pump stage
Compare the differences between a diff and a turbo pump

Objectives Module Capture Pumps

Identify a cryo pump
Describe the operation of a cryo pump
Review the temperature scale of Kelvin
Indicate the temperatures various gases condense
Describe the closed cycle loop for the refrigerant gas
Indicate the major pump components
Indicate the major system components
State the function of carbon of the cold arrays
Describe how to correctly operate a cryo system
Explain the term cross over capacity
Describe pump regeneration
State a typical start up time for a standard cryo pump
State the comparisons between turbo and diff and cryo pumps
State, what the term, water pump means
Describe what is the function of using a cold array in front of a turbo

Objectives Module Fittings and Seals

Review o ring groove
Review trapped o rings
Review co-seals
Review CF flange
Review NW/KF clamps and seals
Review metal seals
Review materials
Review o ring materials
Review use of vac grease
Review vacuum valves inc
- Diaphragm
- Bellow sealed
- O-ring sealed
- Soft start valves
- Swing valves
- Gate valves
- Needle valves

Objectives Module Leak Checking

Describe what is a leak
Describe the difference between a real and virtual leak
State 2 sources of virtual leaks
State 1 source of a real leak
Review the relative physical sizes of leaks
State 2 units of vacuum leak measurement
State what leak rates may be acceptable
Calculate how long for an example scenario to leak
Review problems that appear to be real leaks
Review manufacturing issues that effect leaks and leaks location
Describe 7 methods of leak checking including
- Over pressure
- Bubble
- Gas detector
- Vacuum
- Masking
- Gauges
- Mass spectrometers

Sample calculation of a simple leak rate
Describe how a mass spec operates including
- Ion source
- Analyser
- Collector

State the sensitivity of typical mass spectrometers

Describe the method to vac leak test using a mass spec
Describe reasons for delay in Response
Review of pumping speeds and leak checking
Describe the function of leak check probes
Describe why helium is used for mass specs
Describe the function of a reference leak and when they are used
Describe what effects
State what other parameters effect leak rate
State the difference between air and helium leak rates

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