Quality Assurance in a Vacuum Environment

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Quality Assurance in a Vacuum Environment

We live in a world where Quality Assurance Systems are ubiquitous, particularly in the manufacturing and service worlds

- ISO 9001:2008 ***Quality management systems — Requirements***
- ***Investors in people***
- ***etc***

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When it comes to manufacturing vacuum vessels and components, normal engineering QA requirements are easily specified

- Materials
- Welding codes and standards

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ISO 15607	Specification for the qualification of welding procedures for metallic materials – general rules
ISO 15614 – 1, 2, 5 ,6, 8, 11:2004	Specification and qualification of welding procedures for metallic materials-welding procedure test
ISO 15609	Specification and qualification of welding procedures for metallic materials – Welding procedure specification
EN 970, ISO 17637	Non-destructive examination of fusion welds. Visual examination.
ISO 4063	Welding and allied processes – Nomenclature of processes and reference numbers.
EN 571 ,ISO 3452	Non destructive testing. Penetrant testing.
EN 1290, ISO 9934	Non-destructive examination of welds. Magnetic particle examination of welds
EN 1435, ISO 17636	Non-destructive examination of welds. Radiographic examination of welds.
EN 1714, ISO 17640	Non-destructive examination of welds. Ultrasonic Examination.
EN 287-1	Qualification test of welders – Fusion welding – Part 1: steels.
ISO 9606	Qualification test of welders – Fusion welding – Part 2: aluminium and aluminium alloys.
ISO 14344	Welding and allied processes – Flux and gas shielded electrical welding processes – Procurement guidelines for consumables.
ISO 5817	Fusion welded joints in steel, nickel, titanium and their alloys (beam welding excluded) – Quality levels for imperfections.
ISO 1418	Welding personnel. Approval testing of welding operators
EN 473 , ISO 9712	Non-destructive testing - Qualification and certification of NDT personnel - General principles
ISO 22825	Non-destructive testing of welds - Ultrasonic testing - Testing of welds in austenitic steels and nickel-based alloys
ISO 10380	Corrugated metal hoses and hose assemblies

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When it comes to manufacturing vacuum vessels and components, normal engineering QA requirements are easily specified

- Materials
- Welding codes and standards
- Tolerances
- etc.

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When we turn to vacuum aspects, things become less clear cut.

ISO has a number (22) of published standards relating to vacuum technology under the auspices of TC112

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ISO 1607-1:1993	Positive-displacement vacuum pumps -- Measurement of performance characteristics -- Part 1: Measurement of volume rate of flow (pumping speed)
ISO 1607-2:1989	Positive-displacement vacuum pumps -- Measurement of performance characteristics -- Part 2: Measurement of ultimate pressure
ISO 1608-1:1993	Vapour vacuum pumps -- Measurement of performance characteristics -- Part 1: Measurement of volume rate of flow (pumping speed)
ISO 1608-2:1989	Vapour vacuum pumps -- Measurement of performance characteristics -- Part 2: Measurement of critical backing pressure
ISO 1609:1986	Vacuum technology -- Flange dimensions
ISO 2861-1:1974	Vacuum technology -- Quick-release couplings -- Dimensions -- Part 1: Clamped type
ISO 2861-2:1980	Vacuum technology -- Quick release couplings -- Dimensions -- Part 2: Screwed type
ISO 3529-1:1981	Vacuum technology -- Vocabulary -- Part 1: General terms
ISO 3529-2:1981	Vacuum technology -- Vocabulary -- Part 2: Vacuum pumps and related terms
ISO 3529-3:1981	Vacuum technology -- Vocabulary -- Part 3: Vacuum gauges
ISO/TS 3567:2005	Vacuum gauges -- Calibration by direct comparison with a reference gauge

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ISO 3669:1986	Vacuum technology -- Bakable flanges – Dimensions
ISO/TS 3669-2:2007	Vacuum technology -- Bakable flanges -- Part 2: Dimensions of knife-edge flanges
ISO 5302:2003	Vacuum technology -- Turbomolecular pumps -- Measurement of performance characteristics
ISO 9803-1:2007	Vacuum technology -- Mounting dimensions of pipeline fittings -- Part 1: Non knife-edge flange type
ISO 9803-2:2007	Vacuum technology -- Mounting dimensions of pipeline fittings -- Part 2: Knife-edge flange type
ISO 21358:2007	Vacuum technology -- Right-angle valve -- Dimensions and interfaces for pneumatic actuator
ISO 21360:2007	Vacuum technology -- Standard methods for measuring vacuum-pump performance -- General description
ISO 27892:2010	Vacuum technology -- Turbomolecular pumps -- Measurement of rapid shutdown torque
ISO/TS 27893:2009	Vacuum technology -- Vacuum gauges -- Evaluation of the uncertainties of results of calibrations by direct comparison with a reference gauge
ISO 27894:2009	Vacuum technology -- Vacuum gauges -- Specifications for hot cathode ionization gauges
ISO 27895:2009	Vacuum technology -- Valves -- Leak test

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and 2 in work

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ISO/NP 14291	Vacuum technology -- Vacuum gauges -- Definitions and specifications for quadrupole mass spectrometers
ISO/DIS 21360-2	Vacuum technology -- Standard methods for measuring vacuum-pump performance -- Part 2: Positive displacement vacuum pumps

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But as we have seen, none of these really refer to “quality” of vacuum, but to dimensions of things, equipment and calibration and measurement techniques

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There is also a set of standards relating to leak testing and leak detectors issued by CEN/CENELEC WG6

- EN 1779 – Guide to method selection
- EN 13185 – Tracer gas method
- EN 1593 – Bubble emission method
- EN 13184 – Pressure change method
- EN 1518 – Characterization of mass spectrometer leak detector
- EN 13192 – Calibration of gaseous reference leaks
- EN 13625 – Selection of instrumentation
- EN 1330-8 – Terminology

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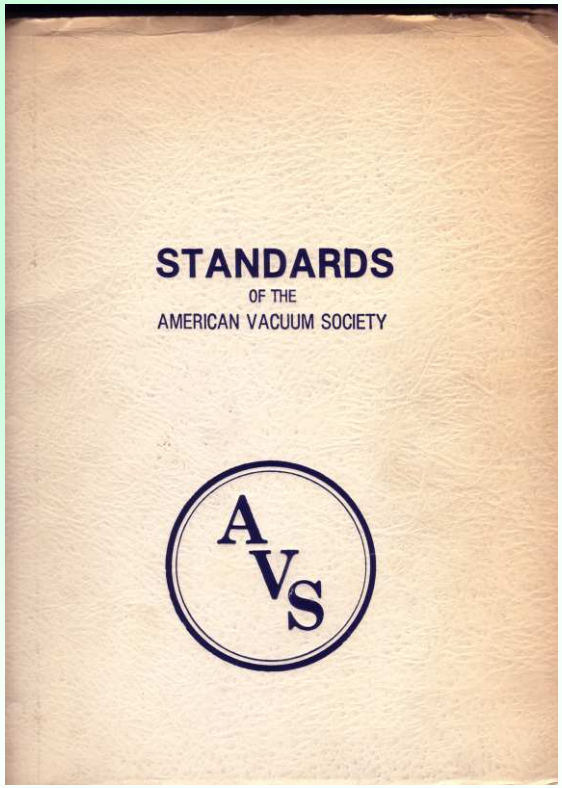
In addition, individual bodies have recommended practices – chief of which is AVS where they are published in the Journal of Vacuum Science and Technology from time to time



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Perhaps it is not surprising that vacuum standards are dominated by things that are important to the vacuum industry, since the committees tend to comprise mainly representatives of large vacuum companies who are prepared to finance the process.

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But when it comes to specifying the quality assurance requirements for the vacuum performance of the system or component you are about to order

Then you are on your own! Why?

You have to decide what are the make or break properties for your particular case, evaluate how they can be measured and write the appropriate test and measurement procedures.

Perhaps there is a case for some body to commission a generic set of procedures which could be generally applicable.

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Complications can arise when other standards which have been drawn up without explicitly considering vacuum need to be applied to a particular job.

Examples might be EN 13445 : Unfired Pressure Vessels which might require double welds for integrity.

Another example would be where nuclear reactor vessels have to comply to RCC-MR design and construction codes, which mandate the use of dye-penetrant on all welds.

Compromise (based on understanding) may be necessary!

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The next talk will describe how QA was applied to one specific project

Thank you for your attention