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Review Article

ISO STANDARDS FOR AIR SYSTEMS-REVIEW

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ABSTRACT

Air system is a system of mechanical refrigeration in which cold air is compressed, cooled, and permitted to expand and thus acts as the refrigerating agent.International Standards bring technological, economic and social benefits. This article provides an introduction to the ISO 8573 and ISO 12500series of International Standardswhich cover compressed air purity and test methods, as well as the purificationequipmentessential to achievethe standards. The amount of water present in a compressed air system is staggering. Combination of a small 2.8m^3/min (100 scfm) compressor and refrigeration dryer, operating for 4000 hours in typical Northern European climatic conditions can produce approximately 10,000 litres or 2,200 gallons of liquid condensate per year.If the compressor is oil lubricated with a typical 2 mg/m^3 (2ppm) oil carryover, then though the resulting condensate would visually resembleoil, oil would in factaccount for less than 0.1% of the overall volume and it is this resemblance to oil to which a false association is made.Testing standards are being revised to give the users anunblemished picture of how components will perform. These standards are being written to help users manage their total energy consumption. In order to help users evaluate their compressed air systems, additional standards are about to releaseand these newer standards can have significant impact on plant energy consumption if properly applied.

Keywords: Air System, ISO 8573, ISO 12500.

ISO (International Organization for Standardization) is the world's largest developer of voluntary International Standards. International Standards give state of the art specifications for products, services and good practice, helping to make industry more efficient and effective. Developed through global consensus, they help to break down barriers to international trade.[1]

Air System is a system of mechanical refrigeration in which cold air is compressed, cooled, and permitted to expand and thus acts as the refrigerating agent.

Compressors in today's market shall essentialmeet a variety of standards written by a wide range oforganizations throughout the world. Until recently most standards were written to deal with safety, mechanical, electrical, and performance of the individual components of a compressed air system. Recognition of the significant amount of power used by compressed air systems has led to a shift in standards writing over the past couple of decades. Testing standards are being revised to give the users an unblemished picture of how components will perform. These standards are being written to help users manage their total energy consumption.In order to help users evaluate their compressed air systems, additional standards are about to release. Among these new standards, the most significant is ASME (AmericanSociety of Mechanical Engineers) EA-4-2 008 and ISO 11011. EA-4-2 008 will be known an ANSI (American National Standards Institute) standard when its development is complete. [2]

One of the key features of ISO 11011 is the establishment of facts like capacity of compressed air to be used, its generation cost by a process indicating 'baseline' performance. The purpose of baselining is to establish the current performance levels and costs of a compressed air system, and to correlate the results with the plant's current production levels. As improvements are made to the system, it will be possible to estimate the success by comparing the new measurements with the original baseline.

Both of the standards deal with requirements for airsystem. The ASME standard, EA-4-2 008, is part of a suite of assessment standards that include compressed airsystem pumping stems, steam and process heat. ASME describes EA-4-2 008 as follows:

- To understand the international standards for compressed air quality, it isessentialto understandthe sources of contamination, the individual contaminants found within a compressed air system and the problems that contaminants can cause

Sources of contamination in a compressed air system:[3]

Contaminants in a compressed air system can generally be recognized to the following:

- **The quality of air being drawn into the compressor:**Air compressors draw in large volumes of air from the surrounding atmosphere containing large numbers of airbornecontaminants.
- **The type and operation of the air compressor:**The air compressor itself can also add contamination, for eg,Particlesin coolants and lubricants.
- **Compressed air storage devices and distribution systems:**The air receiver system andchannelling are designed to store and distribute the compressed air. As a consequence they will also store large amounts of contamination drawn into the system. Additionally, channelling and air receivers will also cool themoist compressed air forming condensate which causes damage and corrosion.

Types of contamination found in a Compressed Air System[4]

1. **Atmospheric Dirt:** Atmospheric air in an industrial environment typicallycontains 140 million dirt particles for every cubic metre ofair. 80% of these particles are less than 2 microns in size and are too small to be captured by the compressor intakefilter, therefore passing directly into the compressed airsystem.
2. **Water Vapour, Condensed Water and Water Aerosols:** Atmospheric air contains water vapour (water in a gaseousform). The ability of compressed air to hold water vapour isdependent upon its temperature. The higher thetemperature, the more water vapour can be held by theair. During compression, the air temperature is increasedsignificantly, which allows it to easily retain the incomingmoisture.

3. After the compression stage, air is normallycooled to a usable
4. temperature. This reduces the air'sability to retain water vapour, resulting in a proportion ofthe water vapour being condensed into liquid water whichis removed by a condensate drain fitted to the compressorafter-cooler. The air leaving the after-cooler is now 100%saturated with water vapour and anyfurther cooling of the air will result in more water vapour condensing into liquidwater. Condensation occurs at various stages throughoutthe system as the air is cooled further by the air receiver,piping and the expansion of air in valves, cylinders, toolsand machinery. The condensed water and water aerosolscause corrosion to the storage and distribution system,damage production equipment and the end product. It increasesboth production efficiency and maintenancecosts. Water in any form must be removed to enable thesystem to run correctly and efficiently.
5. **Rust and Pipescale:** Rust and pipe scale can be found in air receivers and the piping of wet systems purification equipment being installed. Over time, this contamination breaks away to cause damage or blockage in production equipment which can also contaminate final product and processes.
6. **Micro-organisms:** Bacteria and viruses will also be drawn into the compressedair system through the compressor intake and warm, moist air provides an ideal environment for the growth ofmicroorganisms.Ambient air can typically contain up to 3,850micro-organisms per cubic metre. If only a few microorganisms were to enter a clean environment, a sterileprocess or a production system, enormous damage could because that not only diminishes product quality, but mayeven render a product entirely unfit for use and subject toa serious recall.
7. **Liquid Oil and Oil Aerosols:** Most air compressors use oil in the compression stage forsealing, lubrication and cooling. During operation,lubricating oil is carried over into the compressed air systemas liquid oil and aerosols. This oil mixes with water vapour inthe air and is often very acidic, causing damage to thecompressed air storage and distribution system, productionequipment and final product.
8. **Oil Vapour:** In addition to dirt and water vapour, atmospheric air alsocontains oil in the form of unburned hydrocarbons. Theunburned hydrocarbons drawn into the compressor intake as well as vaporisedoil from the compression stage of alubricated compressor will carry over into a compressed airsystem where it can cool and condense, causing the samecontamination issues as liquid oil. Typical oil vapourconcentrations can vary between 0.05 and 0.5mg per cubicmetre of ambient air.[5]

DISCUSSION[6, 7]

This Standard covers compressed air systems which are defined as a group of subsystems comprised of integrated sets of components including air compressors, treatment equipment, controls, piping, pneumatic tools, pneumatically powered machinery andprocess applications utilizing compressed air. The objective is consistent, reliable andefficient delivery of energy tomanufacturing equipment and processes.This standard sets the requirements for conducting and reporting the results of a compressed air system assessment that considers the entiresystem, from energy inputsto the work performed as the result of these inputs. An assessment complying with this standard need not address each individual system component or subsystem within an industrialfacility with equal weight.However, it must be sufficiently comprehensive to identify the major energy efficiency opportunities for improving the overall energy performance of the system. This standard is designed tobe applied primarily at industrial facilities, but many of the concepts can be used in other facilities such as those in the institutional and commercial sectors.

The Standard sets requirements for:

- Organizing and conducting an assessment
- Analyzing the data from an assessment
- Assessment reporting and documentation

Main intention of the standard is to provide industry with set of uniformrequirements that must be met during the assessment of particular factory energysystem. The U.S. Department of Energy (DOE) is working withthe Superior Energy Performance Partnership, the ASME and industry experts in the development of these standards as part of an initiative to improve overall energy efficiency of manufacturing plants in the United States companies, ANSI, U.S. Environmental Protection Agency, and the National Institute of Standards and Technology. The SEP is developing a program to certify industrial facilities for energy efficiency.

Filtrationis required to remove the large volumeof water aerosols, particulate, rust, Pipescaleandmicrobiological contamination entering the system.Failure to remove this contamination from the compressedair system can cause numerous problems.Compressed air is a safe and reliable power source that iswidely used throughout industry. Approximately 90% of allcompanies use compressed air in some aspect of theiroperations.However unlike gas, water and electricity,compressed air is generated on-site, giving the userresponsibility for air quality and operational costs.Compressed air is not without its problems, and mostsystems suffer from some performance and reliabilityissues. Almost all of these can be directly attributed tocontamination. The main sources of contamination in a compressed air system are the ambient air being draw into the compressor, the type of air compressor, thecompressed air storage vessels and the distributionpipework.

Meeting the Newest Challenge - ISO 12500[8]

ISO 8573, Air Quality Standard is serving the industry well by raising 'enduser' awareness of how to measure and define the quality of compressed air. Using this, the end-user can make educated decision as to the filtration performance required to generate a certain quality level. However, this standard does not address how manufacturers are to test and rate the filters. The playing field is not level and consumers become confused.

ISO 12500 filter standard addresses this issue and establishes how manufacturers test and rate compressed air filters. The standard defines critical performance parameters (namely,inlet oil challenge, inlet compressed air temperature and pressure measurement techniques) that will deliver certifiable filter performance information suitable for comparative purposes.

ISO 12500 is a multi-part standard, with subparts ISO 12500-1, ISO 12500-2, ISO 12500-3

1. **ISO 12500-1:**Encompassingthe testing of coalescing filters for oil aerosol removal performance.
2. **ISO 12500-2:**Quantifies vapour removal capacity of adsorption filters.
3. **ISO 12500-3:**Outlines requirements to test particulate 3000scfm filters for solid contaminant removal. The SPX Dehydration and Filtration Research and Developmentcentre, located in Canonsburg, Pennsylvania, maintains advanced testing resources to conduct ISO 12500-1,2 and 3 filter testing. Three separate test laboratories were constructed, each equipped with stainless steel piping, state of the art instrumentation and contaminant measurement equipment. SPX D & F maintains capabilities to Generate dehydrate and filter compressed pass through 3000 scfm.

Table 1: Operational Qualification & Performance Qualification of Air Systems

OPERATIONAL QUALIFICATION (OQ)	
Tests	**Acceptance Criteria**
Identification test	Oil-free compressed air must show a chromatogram with no additional peaks other than those obtained with the air standard
System supply reliability test	The data generated should be compared with the specifications of the system.
PERFORMANCE QUALIFICATION (PQ)	
Tests	**Acceptance Criteria**
Moisture Content	The dew point of compressed air less than or equal to -10°C, or less than the lowest temperature to which the system is exposed
Oil content	Oil content of oil free compressed air should be NMT 0.01ppm
Non viable particle count	Nonviable particulate counts must be ≤ 100/ft^3 of0.5µ or larger at all critical use points
Viable Monitoring	less than 0.03 CFU/ft^3 or less than 1 CFU/m3
Hydrocarbon Monitoring	Should show less than 0.2 mg/m3 (25 mg/125liters) detected. (the lower limit of a Dragger tube)
Identity and Purity (Nitrogen)	Not less than 99.0% nitrogen by volume. Not more than 0.001% Carbon Monoxide. No appreciable odour
Identity Purity (Oxygen)	Not less than 99.0% Oxygen by volume. No appreciable odour

CONCLUSION

ISO Standards for Air Systems help to harmonize technical specifications of products and services making industry more efficient and breaking down barriers to international trade. Conformity to International Standards helps reassure consumers that products are safe, efficient and good for the environment.These newer standards can have significant impact on plant energy consumption if properly applied.[9]

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