

Compressed Air for General Use—Part 1: Contaminants and Quality Classes

This document is technically equivalent to ISO 8573-1.

Foreword—This Document has not changed other than to put it into the new SAE Technical Standards Board Format. The Definition section has been changed to Section 3.

SAE J1649-1/ISO 8573-1 Part 1 was prepared by SAE Compressed Air Quality Subcommittee, Manufacturing Technology Division, and ISO/TC 118, Compressors, pneumatic tools and pneumatic machines, Subcommittee SC4, Quality of compressed air. SAE J1649-1/ISO 8573-1 consists of the following parts, under the general title: Compressed air for general use:

Part 1: Contaminants and quality classes

SAE J1649-1 Part 1 is technically equivalent to ISO 8573-1. Designations made to either standard will interchange to designations made to the other standard.

It is not possible using most test methods to measure the full flow area of a compressed air stream and therefore it is necessary to take samples of the air. This method of testing has a major drawback in that oil, for example, is not evenly distributed over the flow area.

Measurements should preferably be carried out at the actual operating pressure and temperature of a compressor as otherwise the balance between contaminants in liquid, aerosol, or gaseous form will be altered. Liquid oil and free water in particular tend to cling to pipe and tube walls where they form a film or thin rivulets.

The content of water, oil, and particles in compressed air varies owing to sudden changes in the intake air, to the wear of components as well as to changes in flow, pressure, temperature, and ambient conditions. Therefore the quality classes of a compressed air system have to be based on the mean value of a number of measurements carried out over a specified period of time.

Recommended methods for measuring the oil content of compressed air will be given in SAE J1649-2/ISO 8573-2.

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- 1. Scope**—This part of SAE J1649-1 specifies quality classes of industrial compressed air for general use (e.g., for workshops, the construction industry, pneumatic transport, etc.) without consideration of the quality of the air when it is discharged from the compressor. The quality class of compressed air for a particular application has to be based on the mean value of several measurements carried out over a specific period of time and under defined operating conditions.

This part of SAE J1649-1 is not applicable to compressed air for direct breathing and for medical use.

2. References

- 2.1 Applicable Publications**—The following publications form a part of this specification to the extent specified herein.

2.1.1 ISO PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO 7000:1989—Graphical symbols for use on equipment—Index and synopsis

ISO 7183:1986—Compressed air dryers—Specifications and testing

- 2.2 Related Publications**—The following publications are provided for information purposes only and are not a required part of this document.

2.2.1 ISO PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO 1219-1:1991—Fluid power systems and components - Graphic symbols and circuit diagrams - Part 1:
Graphic symbols

ISO 3649:1980—Cleaning equipment for air or other gases—Vocabulary

- 3. Definitions**—For the purposes of this part of SAE J1649-1, the following definitions apply:

3.1 Abrasion—Surface wearing of material by mechanical action between solids.

3.2 Absorption—Process of attraction of one substance into another, so that the absorbed substance disappears physically.

3.3 Adsorption—Attraction and adhesion of gaseous and liquid molecules to the surface of the solid.

3.4 Aerosol—Suspension in a gaseous medium of solid particles, liquid particles, or solid and liquid particles having a negligible fall velocity (generally less than 0.25 m/s).

3.5 Agglomerate—Group of two or more particles combined, joined, or formed into a cluster by any means.

3.6 Brownian Movement—Random movement of small particles suspended in a fluid.

3.7 Coalescence—Action by which liquid particles in suspension unite to form larger particles.

3.8 Compression Drying—Drying of air by compressing it to a higher pressure, cooling it, and extracting the water condensed, and finally expanding it to the required pressure.

3.9 Contaminant—Any material or combination of materials (solid, liquid, or gaseous) which adversely affects the system or the operator.

3.10 Dewpoint—Temperature at which vapor begins to condense.

3.10.1 ATMOSPHERIC DEWPOINT—Dewpoint measured at atmospheric pressure.

NOTE—The term atmospheric dewpoint should not be used in connection with compressed-air drying.

3.10.2 PRESSURE DEWPOINT—Dewpoint at the actual pressure of the compressed air (this pressure should be stated).

3.11 Diffusion—Movement of gas molecules or small particles caused by a concentration gradient.

3.12 Direct Interception—Filtration effect in which a droplet or a solid particle collides with an element of a filter medium (e.g., fiber or granule) which is in its direct path or is captured by pores of diameter smaller than the diameter of the droplet or particle.

3.13 Effective Particle Diameter—Diameter of a circle having an area equivalent to the smallest projected area of the particle.

3.14 Equivalent Particle Diameter—Diameter of a spherical particle having an equivalent “behavior” to that of the considered particle with regard to a given characteristic (e.g., projected area or diameter).

3.15 Erosion—Wearing of material caused by the mechanical action of a fluid system with or without solid particles in suspension.

3.16 Filter—Apparatus for separation of contaminants from a fluid stream in which they are present.

3.17 Filter Rating—Parameter expressing a particular characteristic of a filter. This parameter may be the filtration efficiency, the filtration ratio, or the penetration.

3.17.1 FILTRATION EFFICIENCY E—The change in concentration across the filter divided by the upstream concentration. It may also be expressed as:

$$E = 1 - P \quad (\text{Eq. 1})$$

where:

P is defined in 3.17.3

The filtration efficiency is usually expressed in percent.

3.17.2 FILTRATION RATIO β —For each particle size class, the ratio of the number of particles upstream of the filter to the number of particles downstream. It may also be expressed as:

$$\beta = 1/P \quad (\text{Eq. 2})$$

where:

P is defined in 3.17.3

The particle class size is used as an index. For example, $\beta_{10} = 75$ means that the number of particles of 10 μm and greater is 75 times higher upstream of the filter than downstream.

3.17.3 PENETRATION P—Ratio of the downstream particle concentration to the upstream particle concentration.

3.18 Inertial Interception—Process in which a particle impinges on a part of the filter owing to the momentum of the particle.

3.19 Particle—A small discrete mass of solid or liquid matter.

3.20 Relative Vapor Pressure p —Ratio of the partial pressure of water vapor to its saturation pressure at the same temperature.

3.21 Van der Waals' Forces—Attractive or repulsive forces between any pair of molecules, caused by the electric fields of the electrons (negative) and nuclei (positive) of which molecules are built up.

3.22 Vapor—Gas which is at a temperature below its critical temperature and which therefore can be liquefied by isothermal compression.

4. Units—The SI units of pressure and of volume are the pascal and the cubic meter, respectively. However, for compliance with current practice in the pneumatic field, non-SI units bar^1 for pressure and liter^2 for volume are used in this part of SAE J1649-1. In addition, the non-SI unit parts per million (ppm) is employed for concentration. A summary of the units used in the pneumatic field is given in Table 1.

TABLE 1—UNITS FOR VARIOUS CONTAMINANTS

Contaminant	Pressure dewpoint °C	Particle or droplet size μm	Vapor pressure mbar	Content ⁽¹⁾ mg/m^3	Relative vapor pressure	Concentration ppm (by mass)	Concentration ppm (by volume)
Solids: size content		x		x			
Water: liquid vapor	x		x	x	x		
Oil: liquid vapor		x	x	x		x	x

1. At 1 bar absolute pressure, +20 °C and a relative vapor pressure of 0.6. It should be noted that at pressures above atmospheric, the contaminant concentration is correspondingly higher.

5. The Compressed Air System

5.1 A typical compressed-air generating system is shown in Figure 1.

5.2 The maintenance and operation of compressors and their auxiliaries and prime movers shall be in accordance with the manufacturer's instructions and specifications.

5.3 The lubricant shall meet the specifications for the compressor.

5.4 The compressor or the remote intake pipe should be located in an uncontaminated area, i.e., in an area with the lowest possible contamination from engine exhaust, process discharge, etc. The intake air should preferably be as cool and dry as possible.

1. 1 bar = 10^5 Pa

2. 1 liter = 10^{-3} m³