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Standard

Quality Standard for Instrument Air

ANSI/ISA-S7.0.01 — Quality Standard for Instrument Air

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Preface

This preface, as well as all material contained in the footnotes and annexes, is included for information purposes and is not part of the ISA-S7.0.01.

This Standard has been prepared as a part of the service of ISA, the international society for measurement and control, toward a goal of uniformity in the field of instrumentation. To be of real value, this document should not be static but should be subject to periodic review. Toward this end, the Society welcomes all comments and criticisms and asks that they be addressed to the Secretary, Standards and Practices Board; ISA; 67 Alexander Drive; P.O. Box 12277; Research Triangle Park, NC 27709; Telephone (919) 549-8411; Fax (919) 549-8288; E-mail: standards@isa.org.

The ISA Standards and Practices Department is aware of the growing need for attention to the metric system of units in general, and the International System of Units (SI) in particular, in the preparation of instrumentation standards, recommended practices, and technical reports. The Department is further aware of the benefits to USA users of ISA Standards of incorporating suitable references to the SI (and the metric system) in their business and professional dealings with other countries. Toward this end, this Department will endeavor to introduce SI and acceptable metric units as optional alternatives to English units in all new and revised standards, recommended practices, and technical reports to the greatest extent possible. *The Metric Practice Guide*, which has been published by the Institute of Electrical and Electronics Engineers as ANSI/IEEE Standard 268-1982, and future revisions, will be the reference guide for definitions, symbols, abbreviations, and conversion factors. SI (metric) conversions in this Standard are given only to the precision intended in selecting the original numerical value. When working in SI units, the given SI value should be used; when working in customary U.S. units, the given U.S. value should be used.

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This Standard, complete with all updates, incorporates the following previous SP7 Subcommittees and documents:

SP7.1	Pneumatic Control Circuit Pressure Test
SP7.3	Air Quality Standards for Pneumatic Instruments
SP7.3S	Application and Tests for Quality Standards for Instrument Air
SP7.4	Air Pressures for Pneumatic Controllers and Transmission Systems
SP7.6	Pneumatic Control Circuit Transmission Distances
ISA-RP7.1-1956	Pneumatic Control Circuit Pressure Test
ISA-S7.3-1975 (R1981)	Quality Standard for Instrument Air
ISA-S7.4-1981	Air Pressures for Pneumatic Controllers, Transmitters and Transmission Systems
ISA-RP7.7-1984	Producing Quality Instrument Air

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Contents

1 Scope

The scope of this Standard is

a) to provide limits for moisture content in instrument quality air;

b) to provide limits for entrained particle size and oil content in instrument quality air;

c) to establish an awareness of possible sources of corrosive or toxic contamination entering the air system through the compressor suction, plant air system cross connection, or instrument air connections directly connected to processes;

d) to establish standard air supply pressures (with limit values) and operating ranges for pneumatic devices;

e) to specify ranges of pneumatic transmission signals used in measurement and control systems between elements of systems. It includes, but is not limited to, the following:

   1) Pneumatic controllers

   2) Pneumatic transmitters and information transmission systems

   3) Current-to-Pressure transducers

   4) Pneumatic control loops; and

f) to establish criteria for testing compliance with instrument-quality air standards.

2 Purpose

The purpose of this Standard is to establish a standard for instrument quality air.

3 Definitions

3.1 ambient temperature: The temperature of the medium surrounding a device.

3.2 dew point temperature: The temperature, referred to at a specific pressure, at which water vapor condenses.

3.3 elements of measurement and control systems: Functional units or integrated combinations thereof that ensure the transducing, transmitting, or processing of measured values, control quantities or variables, and reference variables. A valve actuator in combination with a current to pressure transducer, valve positioner, or a booster relay is considered an element that receives the standard pneumatic transmission signal or standard electric current transmission signal.

3.4 instrument quality air: Air, which is the working media for various devices, that has been treated to minimize liquid and particulate matter.

> **NOTE —** Some individual devices may require further conditioning of the air (filtration, dehumidification) to ensure reliable operation.

3.5 lower limit: The lowest value of the measured variable that a device can be adjusted to measure.

3.6 measured value: The numerical quantity resulting, at the instant under consideration, from the information obtained by a measuring device.

3.7 micrometer (m): A metric measure with a value of 10^{-6} meters or 0.000001 meter (previously referred to as "micron").

3.8 parts per million (ppm): Represents parts per million and should be given on a weight basis. The abbreviation shall be ppm (w/w). If inconvenient to present data on a weight basis (w/w), it may be given in a volume basis; (v/v) must be stated after the term ppm; e.g., 5 ppm (v/v) or 7 ppm (w/w).

3.9 pneumatic controller: A device that compares the value of a variable quantity or condition to a selected reference and operates by pneumatic means to correct or limit the deviation.

3.10 pneumatic transmission system: A system that develops an output directly corresponding to the input information for conveying information—comprising a transmitting mechanism that converts input information into a corresponding air pressure, interconnecting tubing, and a receiving element responsive to air pressure.

3.11 pressure dew point: The dew point value at line pressure of the compressed air system (usually measured at the outlet of the dryer system or at any instrument air supply source prior to pressure reduction). When presenting or referencing dew point, the value shall be given in terms of the line pressure; e.g., -40°C (-40°F) dew point at 690 kPa (approximate) (100 psig).

3.12 range of a pneumatic transmission signal: The range determined by the lower and upper limit of the signal pressure.

3.13 relative humidity: The ratio (expressed as a percentage) of the partial pressure of water vapor contained in the air at a given temperature and pressure to the maximum partial pressure of water vapor that could be present at the same temperature under saturated conditions.

3.14 span: The algebraic difference between the upper and lower range values.

3.15 supply pressure: The pneumatic supply pressure that enables the system element to generate the pneumatic transmission signals specified to provide the final device with required operational force.

3.16 upper limit: The highest value of the measured variable that a device can be adjusted to measure.

4 Instrument air system design

The specifications for instrument air systems vary in order to meet a range of application requirements. This makes the specification of any specific design requirements impractical, but in general, a properly designed instrument air system should

a) provide a sufficient quantity of air to supply the highest anticipated load plus margin for future growth including leakage;

b) provide the quality air required by the user; and

c) provide for maintenance and testing of the system.

5 Instrument air, quality standard

This Standard establishes four elements of instrument air quality for use in pneumatic instruments (see Annex B.2).

5.1 Pressure dew point

The pressure dew point as measured at the dryer outlet shall be at least 10°C (18°F) below the minimum temperature to which any part of the instrument air system is exposed. The pressure dew point shall not exceed 4°C (39°F) at line pressure. A monitored alarm is preferred; however, if a monitored alarm is unavailable, per shift monitoring is recommended. See Annex B.2.1. See Table B-1, Note 3 when using a refrigerant dryer.

5.2 Particle size

A maximum 40 micrometer particle size in the instrument air system is acceptable for the majority of pneumatic devices. Pneumatic devices that require instrument air with less than 40 micrometer particle sizes shall have additional filtration to meet the particulate size limit for the device.

Subsequent to any maintenance or modification of the air system, maximum particle size in the instrument air system should be verified to be less than 40 micrometers.

5.3 Lubricant content

The lubricant content should be as close to zero as possible, and under no circumstances shall it exceed one (1) ppm w/w or v/v. Any lubricant in the compressed air system shall be evaluated for compatibility with end-use pneumatic devices. For example, the use of automatic oilers is strongly discouraged.*

5.4 Contaminants

Instrument air should be free of corrosive contaminants and hazardous gases, which could be drawn into the instrument air supply. The air system intake should be monitored for contaminants. If contamination exists in the compressor intake area, the intake should be moved to a different elevation or location free from contamination. Some sources of contamination are

a) painting;

b) chemical cleaning; and

c) engine exhaust.

*For details on why the use of automatic oilers is strongly discouraged, read the United States Nuclear Regulatory Commission Inspection Report IN 95-53 (refer to Annex A). Some cylinder-type actuators recommend a lubricant. If an in-line automatic oiler is used in such a case, the location of the oiler must be selected to minimize the amount of the air system exposed to the lubricant. Also, the other control devices exposed to the lubricant must be of compatible material. The typical installation for an automatic oiler is at the point of use. Often the oiler is an integral part of an actuator assembly.

Annex A — References

NOTE — This annex is for information purposes only and is not part of ISA-S7.0.01.

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11 W. 42nd Street, 13th Floor
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P. O. Box 9101
One Batterymarch Park
Quincy, MA 02269-9101 Tel. (617) 770-3000

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UNITED STATES NUCLEAR REGULATORY COMMISSION (U. S. NRC)

NRC Information Notice 95-53	Failures of Main Steam Isolation Valves as a Result of Sticking Solenoid Pilot Valves, December 1, 1995
	This notice is available on the World Wide Web @URL: http:/www.nrc.gov/
NUREG 1275 Volume 2	Air Systems Problems in U.S. Light Water Reactors, 1987
Available from:	**U.S. NRC** 11555 Rockville Pike Rockville, MD 20852 Tel. (301) 492-7000

Annex B — Equipment and application guidelines for producing instrument air

NOTE — This annex is for information purposes only and is not part of ISA-S7.0.01.

B.1 Instrument air system design

An instrument air supply and conditioning system consists of components required to provide an adequate volume of instrument quality air at the desired pressure.

B.1.1 Instrument air supply system

Typical components of the air supply system (see Figures B-1, B-2, & B-3) include the following:

Filters	Aftercoolers and moisture separators
Compressors	Pressure regulators
Air treatment systems	Pressure-relief devices
Air receivers	Piping
Drain traps	

B.1.1.1 Intake filters

A dry cartridge intake filter should be provided for the compressor in accordance with the manufacturer's recommendations. Filters should be located so they are readily accessible for maintenance.

B.1.1.2 Compressor

Compressors should be sized to deliver air at the specified pressure under all conditions, plus a margin for future demand and leakage.

Various types of compressors are available including the following:

a) Reciprocating oiled piston

b) Reciprocating oil-less piston

c) Rotary vane

d) Rotary liquid ring

e) Diaphragm

f) Rotary screw

g) Centrifugal

Some compressors are lubricated internally by water, or by water with small amounts of soap or oil. Compressors identified as "unlubricated" do use lubrication for the bearings and working parts of the compressor, but the compressor chamber or cylinder is not lubricated because the plastic or other low friction seals used on the piston eliminate the need for lubricating the cylinder walls. The "diaphragm-type" compressor likewise is considered as being unlubricated because the compression chamber is separated from the lubricated portions of the compressor by a diaphragm.

Some compressors are identified as "oil-free" even though the compressor is internally oil lubricated because filters are used. Filter limitations can allow lubricant carryover; therefore, "unlubricated" compressors are recommended.

Although not recommended, if lubricated compressors are used, lubricant removal is required to avoid the damaging effects on air system components and end-use devices. Provisions should be made to recover lubricants for disposal in accordance with national and local environmental requirements.

If synthetic oil is used to lubricate compressors, compatibility should be evaluated for end-use devices. For example, effects of ester vapor released by synthetic oil can cause elastomeric damage to end-use devices.

B.1.1.3 Aftercooler and moisture separator

The aftercooler is a heat exchanger that cools the hot compressor discharge air below its dew point. The condensate is collected in a mechanical separator, which can remove 70 to 80 percent of the moisture and some particulate. Moisture is typically drained by an automatic drain valve with a manual bypass or drip leg. This moisture should be removed from the air system to prevent equipment damage downstream.

Water-cooled aftercoolers are usually sized to cool outlet air to within 5°C (approximate) to 8°C (9°F to 15°F) of the inlet cooling water temperature.

Air-cooled aftercoolers are usually sized to cool outlet air to within 14°C to 17°C (25°F to 31°F) of the ambient air temperature.

B.1.1.4 Air receiver

Air receivers should be sized to provide an adequate volume of air surge and allow for future growth. The air receiver surge time can be calculated by using the methodology found in the *Compressed Air and Gas Handbook* (see Annex A). A pressure-relieving device should be installed as required by applicable local and national codes.

The receiver ambient temperature is typically lower than the dew point temperature of the air entering the receiver. This causes moisture to condense inside the receiver. To help prevent condensate and particulate intrusion, the outlet line should be located near the top of the receiver and above the inlet line.

An automatic drain with a manual bypass should be located near the bottom of an air receiver to dispose of the condensate. Drains on a receiver are susceptible to plugging; therefore an ability to clean the lines should be provided.

B.1.1.5 Drain traps

Automatic drain traps with manual bypasses should be located on receivers, air line driplegs, intercoolers, and aftercooler separator drains, as previously mentioned.

Trap failure indications such as level gauges, sight glasses, or alarms are recommended.

B.1.1.6 Air treatment systems

An instrument air treatment system consists of a prefilter, an air dryer, and an afterfilter.

B.1.1.6.1 Prefilter

Coalescing prefilters are required to limit liquids, oil, and water (in aerosol form) from entering the air dryers. An automatic drain with manual bypass is recommended.

B.1.1.6.2 Air dryer

The air drying equipment should meet the dew point requirements of this standard. Refer to 5.1.

Various types of dryers are available to remove moisture from compressed air. Selecting the proper type and size of dryer should be based on the actual inlet flow conditions under which the dryer is expected to perform and on the quality of air that is to be produced. Refer to Table B-1 for additional information.

Refrigerant dryers have limited applications due to dew point restrictions. If design application allows use of a refrigerant dryer, continuous monitoring is strongly recommended. (See Table B-1 and Figure C-1.)

The following factors should be considered when selecting dryers:

a) Maximum flow rate: m^3/s (m^3/h, SCFM)*

b) Maximum inlet temperature: °C (°F)

c) Maximum percentage moisture saturation of inlet (if unknown, assume inlet temperature at pressure dew point)

d) Minimum inlet pressure: kPa (psig)

e) Maximum inlet pressure: kPa (psig)

f) Maximum allowable outlet dew point temperature at dryer outlet pressure: °C (°F)

g) Required accessories (e.g., pressure gages, relief valves, thermometers, timers, safety switches.

h) Other pertinent information, such as: contaminants that may be present (oil, liquid, etc.)

i) Utilities available, such as: electricity, steam, water, and control power

j) Electrical area classification where equipment is to be installed.

See the *Compressed Air and Gas Handbook* Reference in Annex A for additional information.

B.1.1.6.3 Afterfilter

Afterfilters provide final cleaning of the airstream by removing particulate matter from the dryer discharge. Afterfilters should be specified by absolute particle size. Afterfilters are recommended on all instrument air systems and should be provided for desiccant dryers to prevent desiccant dust from passing downstream. Heat reactivated dryers require high temperature afterfilters. For refrigerated dryers, coalescing filters are recommended.

B.1.1.7 Pressure regulators

Pressure regulators are provided to control the pressure to downstream devices. Pressure regulator sizing and settings should be chosen such that each end-use device receives an adequate air supply.

Design review and installation of pressure-relieving devices should be considered, since pressure regulator failure will result in full system pressure on downstream system devices.

*SCFM = Standard Cubic Feet per Minute

Table B.1 — Typical compressed air dryer types(1)

1) Regenerative desiccant dryers

A. Regeneration with Heaters(5)

Flow Range:(2) 0 - 16,990 m^3/h @ 38°C at 690 kPa
(0 - 50,000 SCFM @ 100°F at 100 psig)

Outlet Dew Point Range at Line Pressure:(4) -40°C
(-40°F)

Utility Requirements: Electricity or Steam

B. Regeneration without Heaters

Flow Range:(2) 0 - 16,990 m^3/h @ 38°C & 690 kPa
(0 - 10,000 SCFM @ 100°F at 100 psig)

Outlet Dew Point Range at Line Pressure:(4) -40°C
(-40°F)

Utility Requirements: Dry Compressed Air

2) Heat of compression dryers(5)

A. **Flow Range:(2)** 0 - 17,000 m^3/h @ 84°C at 690 kPa
(0 - 10,000 SCFM @ 300°F at 100 psig)

Outlet Dew Point Range at Line Pressure:(3) -18°C to 4°C
(0°F to 40°F)

Utility Requirements: Hot Air and Electricity

3) Refrigerant

A. **Flow Range:(2)** 0 - 8,500 m^3/h @ 38°C & 690 kPa
(0 - 5,000 SCFM @ 100°F at 100 psig)

Outlet Dew Point Range at Line Pressure:(3) 2°C to 4°C
(35°F to 39°F)

Utility Requirements: Electricity

B. **Flow Range:(2)** 8,500 - 16,990 m^3/h @ 38°C & 690 kPa
(5,000 - 10,000 SCFM @ 100°F at 100 psig)

Outlet Dew Point Range at Line Pressure:(3) 10°C
(50°F)

Utility Requirements: Electricity

NOTES

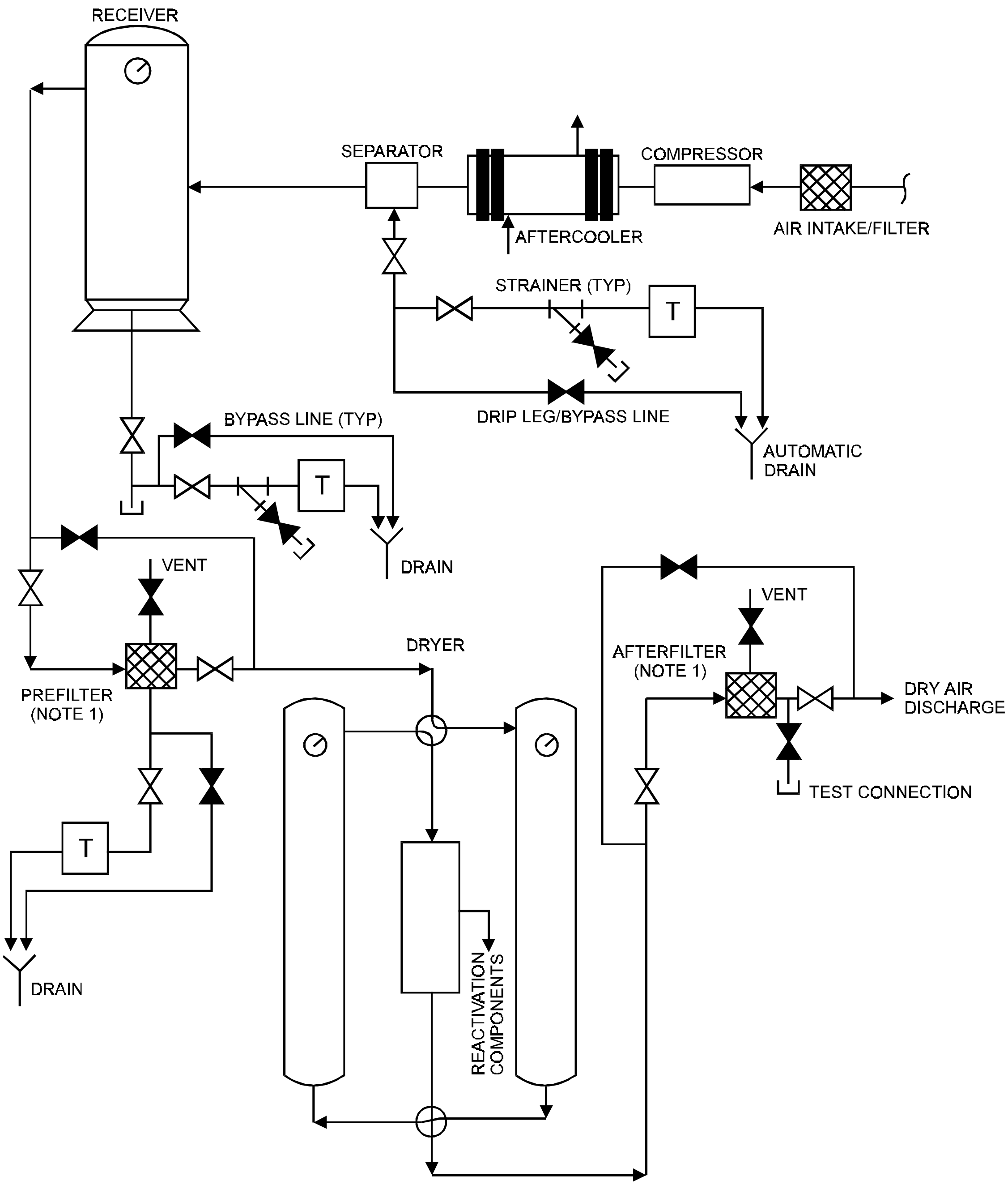
(1) The stated values are typical values only and may vary depending on manufacturer.

(2) Flow values are given at standard conditions; e.g., 16°C (60°F) and 101 kPa (14.7 psig).

(3) This dew point may be inadequate for many instrument air system applications. Refer to 5.1 for dew point requirements. (See ANSI/B93.45M 1982.)

(4) Traditionally, regenerative desiccant dryers for instrument air systems are sized to provide -40°C (-40°F) dew point air at pressure. However, in extremely cold climates, instrument air applications may require dew points as low as -73°C (-100°F) at operating pressure.

(5) Heat regenerated dryers are not recommended for use with lubricated compressors.



NOTE 1: PARALLEL FILTRATION IS RECOMMENDED

Figure B.1 — Compressed air-drying system: desiccant dryer

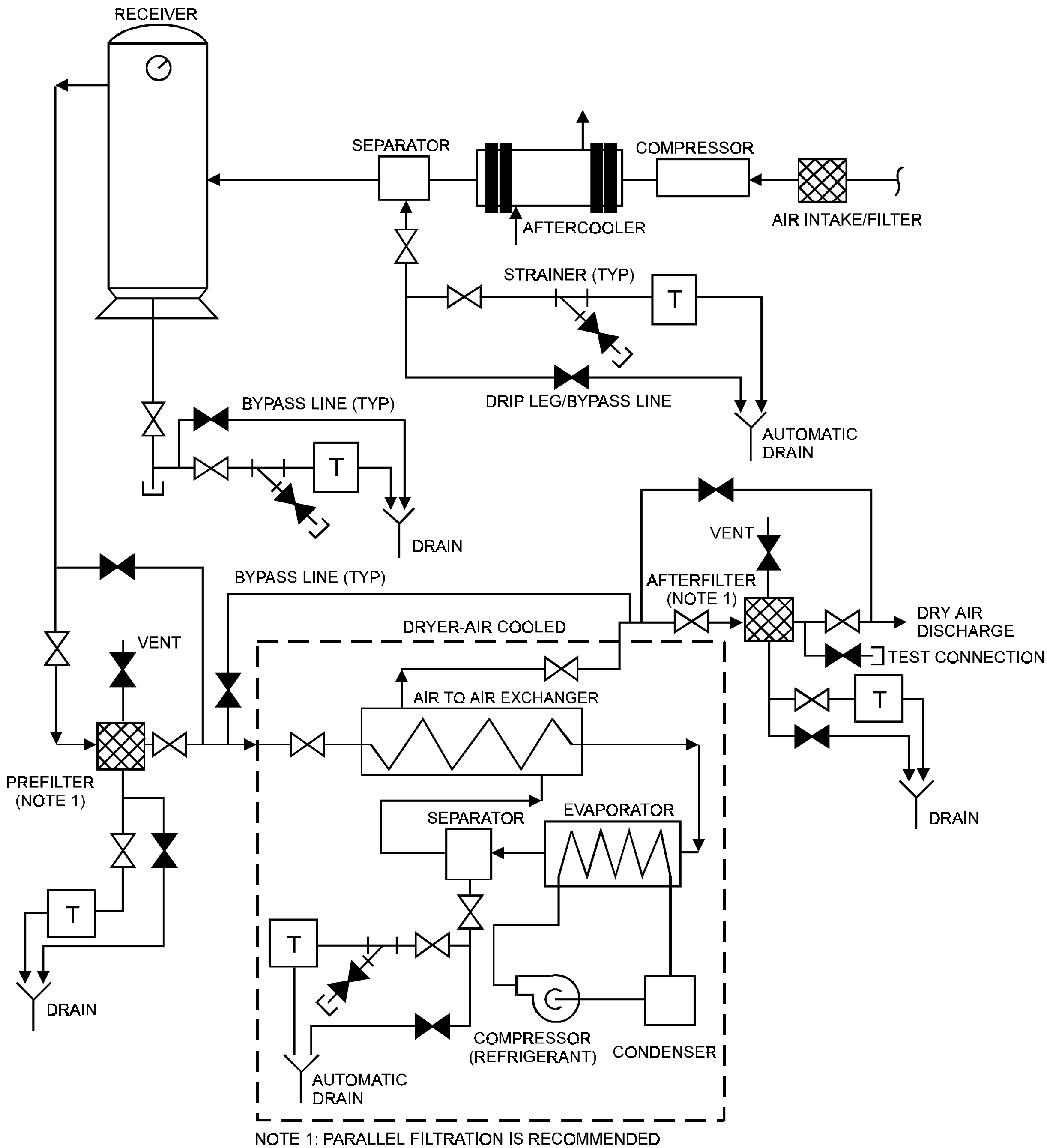
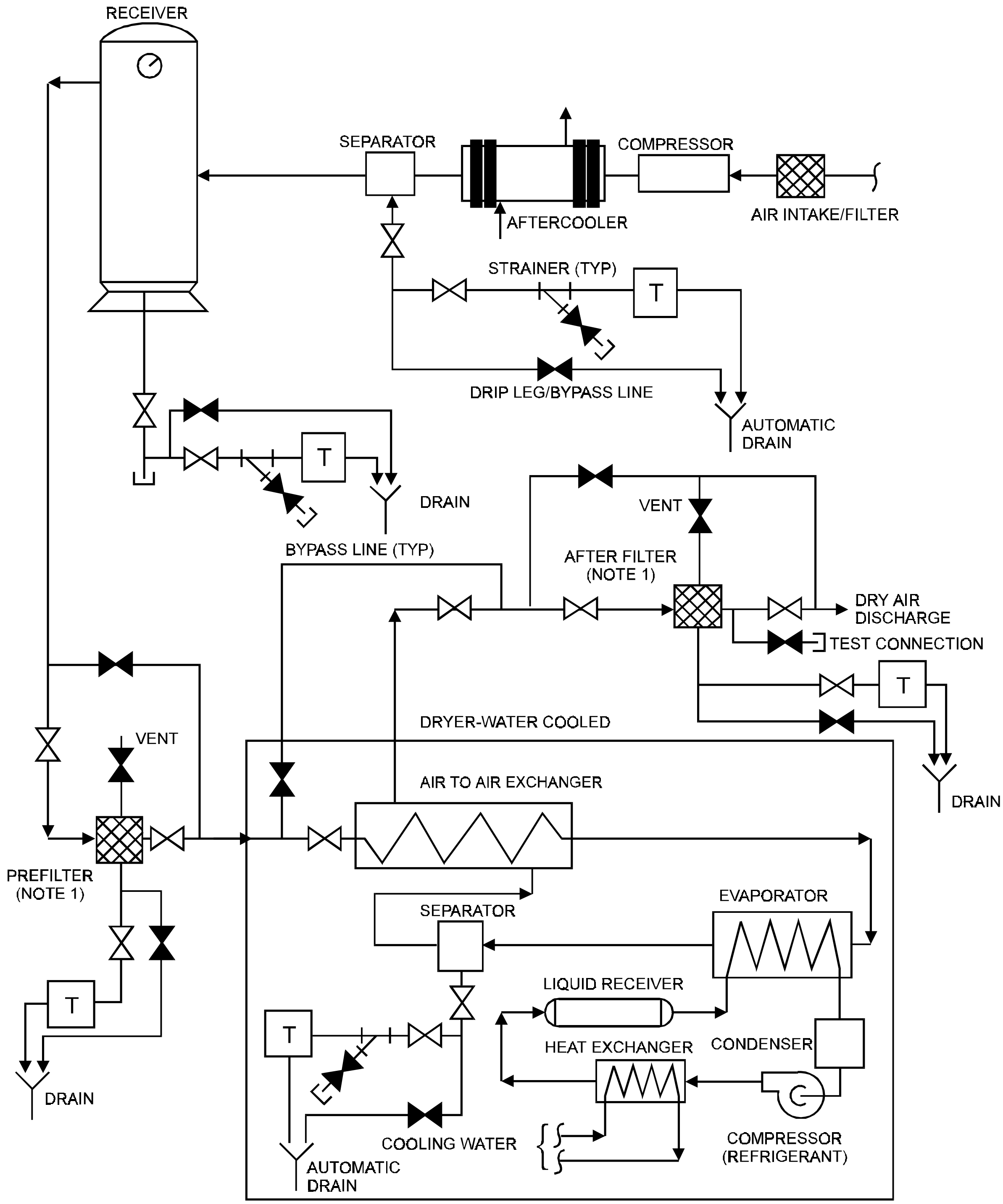


Figure B.2 — Compressed air-drying system: refrigerant dryer (air cooled)



NOTE 1: PARALLEL FILTRATION IS RECOMMENDED.

Figure B.3 — Compressed air-drying system: refrigerant dryer (water cooled)

B.1.1.8 Pressure relief devices

Pressure relief devices should be installed in accordance with applicable codes and to protect devices from potential over-pressurization. Pressure relief devices may include self-relieving pressure regulators, rupture discs, and relief valves. Check valves should be located and oriented, so they do not defeat the intended operation of the relief valves.

Relief valve settings should be high enough to avoid continuous lifting. The relief device setting should not exceed the design pressure rating of any device it protects.

B.1.1.9 Piping

Air distribution systems should be designed in accordance with local, national, and international codes and standards. Air distribution systems should be designed to ensure that all end-use devices receive adequate air supply to ensure their satisfactory operation.

B.1.1.9.1 Discharge piping

Piping between the compressor and the aftercooler, and the aftercooler separator and the air receiver, is considered to be discharge piping. This portion of the air system up to the air dryer will experience high moisture and high temperature variations. Corrosion-resistant pipe is recommended in systems using oil-free compressors. Unlike a lubricated compressor system, the piping lacks the oil film that protects the piping.

The corrosive effects are accelerated by the warm, moist air; vibration; pulsation; and temperature variations as compressors load and unload. The corrosion by-products lead to plugged lines, filters, and traps, and an increased corrosion rate can lead to premature wall failure. When using carbon steel, an increased corrosion allowance should be used in calculating wall thickness for piping, valves, and vessels.

B.1.1.9.2 Branch connections

The minimum pipe size for horizontal piping should not be less than 25 mm (1 inch) NPS*, except when six-foot centered, horizontal piping supports are maintained, the minimum pipe size may be reduced to 15 mm (½ inch) NPS. All branch takeoffs should be from the top of any horizontal piping header. A typical instrument air supply and branch piping arrangement is shown in API 550 (see Annex A).

B.1.1.10 Manual valves

The effects of moisture, lubricants, and particle contaminants on a valve's internals should be considered. Flow rate and pressure drop should be considered when selecting the proper type of valve to use in each application. Valves should be installed per manufacturer's recommendations and should be accessible for operation and maintenance.

Three basic types of valves are used commonly in instrument air distribution systems: globe, gate, and ball. Some advantages and disadvantages of each valve type are listed in B.1.1.10.1 through B.1.1.10.3.

B.1.1.10.1 Globe valves

Advantages of globe valves are that they provide the capabilities to regulate system flow rates and to provide tight shut-off. Globe valves with a dial pointer or stem scales can be used to provide repeatable settings in a manual control mode.

*National Piping Size

Disadvantages of globe valves are that they reduce flow rate, increase pressure loss, and allow places for particulates to collect (which can cause valve leakage).

B.1.1.10.2 Gate valves

Advantages of gate valves are that they provide a full, line-size port for air flow with minimal pressure drop and are conducive to internal cleaning. Gate valves typically are used for on/off isolation.

Disadvantages of gate valves are that they provide places for particulates to collect in their disc guides, and the valve discs have been known to separate from their stems. Gate valves should not be used for throttling.

B.1.1.10.3 Ball valves

Advantages of ball valves are that they provide a full, line-size port for air flow, with minimal pressure drop, and are conducive to internal cleaning. Ball valves typically are used for on/off isolation. Another advantage of ball valves is that they provide better shutoff than gate valves due to their elastomeric ball seal design.

Disadvantages of ball valves are that they are more expensive than comparably-sized globe or gate valves, and their sealing surfaces are susceptible to leakage from particulate scoring.

B.1.1.11 Valve location and installation

The following should be considered to determine valve location and orientation:

a) Valves should be accessible from grade level or from personnel platforms.

b) Valves required to isolate or bypass a component should be located as close to the component as practical.

c) When globe or gate valves are used, rising-stem construction provides visual valve position.

d) Valve orientation should be per the manufacturer's recommendations.

B.2 Air quality considerations

B.2.1 Dew point

ISA-S7.0.01 establishes a maximum pressure dew point to protect instrument air systems from the presence of moisture.

Compression and cooling stages in an instrument air system cause condensation. Compression increases the partial pressure of the water vapor present. If the water vapor partial pressure is increased to the saturation water vapor pressure, condensation occurs. Cooling reduces the saturation water vapor pressure, a temperature-dependent variable. If the saturation water vapor pressure is reduced to the partial pressure of the water vapor present, water or ice will result. Therefore, moisture removal is a major consideration of instrument air treatment systems.

The most common methods of moisture removal are compression cooling, absorption, chemical methods, mechanical separation, and combinations of these methods. See Figures B-1, B-2, and B-3.

B.2.2 Oil contamination

ISA-S7.0.01 establishes an upper limit for oil contamination in instrument air systems.

If the upper limit is exceeded, special adsorption or collection equipment is required to remove oil in the liquid or vapor state to minimize pneumatic end-user problems ranging from inaccuracies to failure. Oil in the system can affect system dew point and desiccant life and can create a potential fire hazard with use of heat reactivated desiccant dryers. Oil contamination of instrument air systems can result in end-use device failures. For example, the oil can form a varnish-like substance on hot surfaces, preventing proper component operation. (See NUREG 1275, Volume 2.)

Using auto oilers in nuclear facilities is strongly discouraged since operating experience has shown auto oilers to introduce oil contamination, which has resulted in component failures. Other industries should evaluate specific applications to determine if using auto oilers is acceptable.*

B.2.3 Particulate (particle size)

Filters should be used to remove particulate from the instrument air system. The afterfilters should meet the desiccant dryer's manufacturer's recommended micrometer ratings to prevent desiccant carryover. Particulate can cause equipment malfunction by clogging and eroding small orifices and working parts in pneumatic instruments and controls.

Each point-of-use filter shall be sized in accordance with the pressure and flow rate requirements for the end-use device.

Particulate matter can be introduced into an instrument air system from a variety of sources; such as ambient air through the intake filter and the formation of rust particles, oxide, scale, and desiccant dust, which can be carried over from the air drying equipment.

B.2.4 Other contaminants

The compressor intake shall be located in an area free from potential air contamination. The area shall be free from toxic and corrosive vapors, flammable gases and vapors, combustible dust, and ignitible fibers. The air intake shall not be located in a hazardous (classified) location as defined by National Fire Protection Association (NFPA) 70, the National Electrical Code, Chapter 5, Article 500 — Hazardous (Classified) Locations. See reference to NFPA in Annex A.

Unless the air intake can be located in an area that is free of contaminants, an appropriate scrubber or absorber may be required for the protection of the pneumatic devices. The range of possible contaminants is so wide that each installation must be considered individually. The kind and concentration of contaminant, the air dryness, and the amount of compression are all factors for consideration.

Any cross connections or process connections to the instrument air piping should be isolated and/or filtered to prevent contamination of the instrument air system.

Contaminants can originate from the system components, such as corrosive vapors generated from the phosphate esters used in fireproofing synthetic lubricants for compressors. Materials used for seals and diaphragms in pneumatic devices should be compatible with any synthetic lubricant used, or an appropriate scrubber should be used in the air system to remove contaminants.

*For details on why the use of automatic oilers is strongly discouraged, read the United States Nuclear Regulatory Commission Inspection Report IN 95-53 (refer to Annex A). Some cylinder-type actuators recommend a lubricant. If an in-line automatic oiler is used in such a case, the location of the oiler must be selected to minimize the amount of the air system exposed to the lubricant. Also, the other control devices exposed to the lubricant must be of compatible material. The typical installation for an automatic oiler is at the point of use. Often the oiler is an integral part of an actuator assembly.

B.3 Instrument air supply pressure and pneumatic pressure transmission signal

See Table B-2 for Instrument air supply pressures, spans, and ranges.

B.3.1 Line pressure

Nominal instrument air line pressure for the utility industry should be 690 kPa (approximate) (100 psi). For other industries, nominal instrument line pressure will vary based on specific applications.

B.3.2 Supply pressure

Nominal supply pressure may vary between 0 kPa and 690 kPa (approximate) (100 psi) to meet the requirements of the end-use device.

B.3.3 Pneumatic transmission signals

Pneumatic transmission signals are used in process measurement and control systems to transmit information between components. Pneumatic transmission signals are used for

a) pneumatic controllers;

b) pneumatic transmitters and information transmission systems;

c) current-to-pressure (I/P) transducers;

d) valve positioners; and

e) pneumatic control loops.

Refer to Table B-2 for spans, ranges, and supply pressures.

Table B.2 — Typical spans, ranges, and supply pressures

SI Units (kPa)				English Units (psi)			
Span	Range	Supply Pressure		Span	Range	Supply Pressure	
		Min.	Max.			Min.	Max.
80	20-100	130	150	12	3-15	19	22
140	35-175	230	260	20	5-25	33	38
160	40-200	260	300	24	6-30	38	44
170	20-190	205	240	24	3-27	30	35

Annex C — Guideline for testing pneumatic systems

NOTE — This annex is for information purposes only and is not part of ISA-S7.0.01.

The permissible leakage tolerance in a pneumatic system cannot be critically defined. These pneumatic systems vary in characteristics; some are more tolerant of leaks than others.

Current methods of testing vary widely in

a) test pressures;

b) static or cycling pressure; and

c) time duration of holding test pressures.

Pneumatic system design should minimize the number of probable leakage sources.

C.1 Application

A pneumatic system pressure test may be used for the following:

a) To establish initial system integrity

b) To guide trouble-shooting activities

c) To re-establish system integrity after modification

d) To confirm system integrity after maintenance

C.2 Inspections and testing

C.2.1 Initial inspection

Confirm that the name plate data is consistent with the system design criteria; e.g., pressure, capacity, and temperature.

C.2.2 Verification of air path

Verify the air path from the air supply valve to the air-operated device by performing the following steps:

a) Isolate the air supply to the air-operated device

b) Disconnect the air line at the air-operated device

c) Set the instrument to deliver air to the air-operated device

d) Observe air flows from the disconnected line at the air-operated device

C.2.3 Pressure tests

Pressure testing should be performed after initial system or component installation, maintenance, and/or modification to verify the following:

a) Component and/or system operability and integrity at design pressure, for initial testing

b) Component and/or system operability at operating pressure, for in-service testing

c) System integrity

   Technicians can use a bubble fluid, ultrasonic probe, or tracer gas-measuring device (electronic or infrared) to observe indication of leakage.

C.3 Tests

It is necessary to test for dew point, lubricants, particles, and other contaminates. Tests or analysis must be conducted on initial start-up and periodically thereafter. However, continuous monitoring for dew point is strongly recommended.

It is necessary to monitor performance of individual system devices because improper use or malfunction can adversely affect system performance. For example, high dew point can result in component malfunction and system degradation. Therefore, when high dew point problems occur, action should be taken to lower dew point within limits. Continuous dew point monitoring provides early detection and/or warning to help prevent high moisture content (see Figure C-1).

C.3.1 Dew point tests

A maximum allowable dew point should be established. A continuous monitoring alarm system is recommended; however, periodic checks should be scheduled to help ensure delivery of instrument quality air to end-use devices.

Various methods are available for determining moisture content. These methods include, but are not limited to, dew point instruments: dewcup, chilled mirror, cloud chamber, hygroscopic salts, electrical hygrometers, psychrometers, capacitance, spectroscopy, and thermal conductivity.

The dew point temperature value should be expressed at line pressure. If the determination is made at other than the line pressure, the measured value and the pressure of measurement also should be noted.

C.3.2 Lubricant content tests

The maximum lubricant content should be as close to zero as possible, and under no circumstances shall it exceed one (1) ppm w/w or v/v. Any lubricant in the compressed air system should be evaluated for compatibility with the end-use device. When using a lubricated compressor, oil contamination is likely.

Periodic checks and routine filter maintenance are required to ensure air quality.

Various methods are available for determining the lubricant content. These methods include, but are not limited to, microscopic techniques, infrared spectrometry, and ultraviolet molecular emission for liquids. Gas chromatography can be used for vapors.

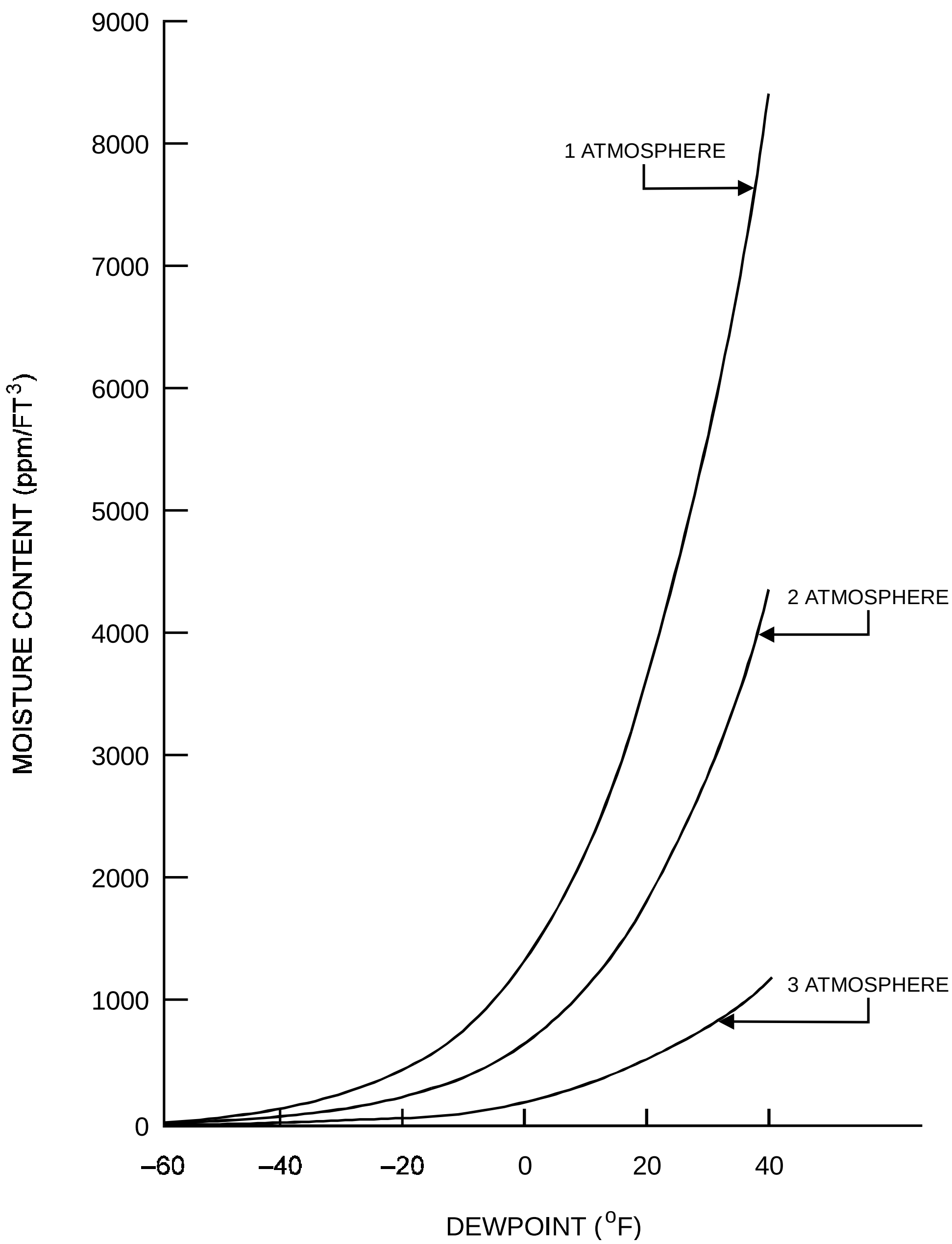


Figure C.1 — Moisture content of air vs. dewpoint

C.3.3 Particle size tests

A maximum 40 micrometer particle size in the instrument air stream is acceptable for the majority of pneumatic devices. Pneumatic devices that require instrument air with less than 40 micrometer particle sizes shall be provided with additional filtration to meet the particulate size limit for the device.

Periodic checks for particulate matter are strongly recommended, especially if operating problems are prevalent. Microscopic techniques normally are required for determining particle size. Various methods are available for determining particle content. These methods include, but are not limited to, laser analyzers.

C.3.4 Other contamination tests

The instrument air should be free of corrosive contaminants and hazardous gases, which may be drawn into the instrument air system. The air system intake should be monitored as applicable for contaminants. If contamination exists in the compressor intake area, the air should be taken from a different elevation or a remote location free from contamination (see B.2.4 for details). Examples of contamination sources are as follows:

a) Painting

b) Chemical cleaning

c) Engine exhaust

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