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American National Standards Institute (ANSI) Safety Code B9

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American National Standards Institute (ANSI) Safety Code B9.1

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The ANSI B9.1 Safety Code for Mechanical Refrigeration is intended to assure the safe design, construction, installation, operation and inspection of every refrigerating system when employed in or adjacent to Institutional, Public Assembly, Residential, Commercial, Industrial or Mixed occupancies.

This code, co-sponsored by the American Society of Heating, Refrigeration and Air Conditioning Engineers and the Air Conditioning and Refrigeration Institute, has been endorsed by twenty-six other leading professional societies, trade associations, and government agencies. It has been accepted and is included by reference in local codes in more than 4,000 jurisdictions.

It is important that all persons involved with the design, construction, installation, operation and inspection of refrigeration systems be well versed with the B9.1 Safety Code, and since the compressor is a vital part of every refrigerating system, this applies to all persons involved in the design and application of refrigeration compressors.

The code is all inclusive as far as the refrigeration system is concerned. Since this is a Compressor Technology Conference we will direct our attention to those parts of the code affecting the compressor design.

Alltold there are forty-plus items in the code that relate to the compressor. Lets take a look at them.

1.1 is the Scope, which is covered in the first part of the introduction.

1.2 the Purpose of the code, follows the scope and answers the question "why". This code is intended to establish reasonable safeguards to life, limb and health, to define certain practices which are inconsistent with safety and to prescribe standards of safety which will properly influence future progress and developments in refrigerating systems.

1.3 Application - The code applies to refrigerating systems installed subsequent to its adoption and to parts replaced or added to systems installed both prior and subsequent to the adoption of the code. An important part of this section is the acceptance of listing by an approved nationally recognized testing laboratory, such as UL, as demonstration that the equipment meets the design, manufacture and factory test requirements of the code. Such listed refrigerating systems are also exempt from field testing.

The following ten paragraphs are definitions of terms used in the code that in some form include the compressor.

2.8 Compressor

2.9 Compressor Unit

2.36 Limited Charge System - This is important as it can effect the design pressure of the compressor.

2.37 Listed

2.4 Machinery

2.46 Non-Positive Displacement Compressors

2.48 Positive Displacement Compressor

2.50 Pressure Imposing Element

2.54 Pressure Vessel - This is important as it excludes the compressor under the definition of a pressure vessel, and therefore not subject to specific code requirements for pressure vessels

2.56 Refrigeration System

Section 5 classifies 24 refrigerants by toxicity and flammability, and divides them into three groups.

Section 6 then establishes requirements for Institutional Public Assembly, Residential and

Commercial occupancies, specifying where refrigerating systems may not be installed and establishing refrigerant charge limitations for certain locations with specific requirements for refrigerants of the three groupings. Indirectly the compressor is affected by these requirements.

Section 8 of the Code covers the Design and Construction of equipment, with 8.1 covering Materials, 8.2 Design Pressure, and 8.3 through 8.5 covering construction requirements for various components of the refrigeration system.

8.1.1 and 8.1.2 are important as they read on materials of construction. 8.1.1 states that no material shall be used that will deteriorate because of the refrigerant, or the oil, or the combination of both.

8.1.2 states that aluminum, zinc or magnesium shall not be used in contact with methyl chloride in a refrigerating system, and that magnesium shall not be used in contact with any halogenated refrigerant.

If you have ever seen a compressor with aluminum parts that has been in a system charged with methyl chloride you will quickly realize the importance of 8.1.2.

8.2.1 notes minimum design pressures for both the high side and low side of refrigerating systems and establishes separate minimum high side design pressures for air cooled systems and water or evaporative cooled condensing. Table 5 gives the minimum design pressures for 24 different refrigerants.

8.2.1 also notes that design pressures shall be selected high enough for all operating and standby conditions. This is very important as standby conditions can create much higher pressures than those occurring during operation. For example, consider an R-22 self contained unit utilizing a welded hermetic compressor. Normally these units do not incorporate service valves. The minimum low side design pressure per Table 5 could be 144 psig, yet sitting in a 100°F ambient the unit pressure would be 198 psig. Railroad car ambients have been measured as high as 150°F. In such a location the compressor shell pressure could approach 400 psig. One can argue that even with the lower design pressure the ultimate strength would be adequate from the safety point of view. However, shell deformation would most likely occur, and the designer must assure himself that any deformation that occurs will not affect the operation of the compressor.

8.2.4 covers the compressor design pressure requirement when a compressor is used as a booster compressor and discharges into the low side of another system. In this case the compressor can be considered to be part of the low side of the system, provided that it is protected by a pressure relief device.

8.2.5 and 8.5.1 are very important as these are the parts of the code that spell out the design pressure and strength requirements of the compressor.

8.2.5 reads "All components connected to pressure vessels shall have a design pressure equal to or greater than the design pressure of the pressure vessels. The compressor comes under the classification of a component, and as such is subject to this requirement.

8.5.1 establishes the ultimate strength requirement by noting that every pressure-containing component shall either be listed by an approved nationally recognized testing laboratory or shall be designed, constructed and assembled to have an ultimate strength at least three times the design pressure for which it is rated. Again the compressor comes under the classification of a component.

8.6 covers Service Provisions and 8.6.2 notes that stop valves shall be installed at the inlet and discharge of each compressor, compressor unit, or condensing unit used in a system containing more than six lbs. of a Group 2 or 3 refrigerant; that is, any refrigerant except the halogenated and CO_2.

8.7 covers Factory Test requirements.

8.7.1 notes that every refrigerant containing part shall be tested and proved tight by the manufacturer at not less than the design pressure for which it is rated. Many unit or system manufacturers find it costly and difficult to segregate and test the compressor high and low sides at different pressures, and accordingly require the entire compressor to be capable of being tested at the high side design pressure. Strength is not usually a problem but in the case of welded hermetic compressors, shell deformation has to be considered.

8.7.3.1 covers systems with non-positive displacement compressors, considering the entire system for test purposes as the low side pressure.

8.8 requires each separate compressor, compressor unit, or condensing unit sold for field assembly in a refrigerating system to have a nameplate marked with the manufacturer's name, nationally registered trademark or trade name, identification number, design pressures and refrigerant for which it is designed.

Section 9 covers pressure limiting devices, which per 9.1 are required on all systems containing more than 20 lbs. of refrigerant and all water-cooled condensing systems where the compressor is capable of producing a pressure in excess of the high side design pressure; except for unit systems containing 3 lbs or less of a Group 1 refrigerant and which meet specific strength requirements.

9.2 specifies the maximum setting to which the pressure-limiting device may be readily set by the adjusting means and a requirement that the device must stop the compressor without exceeding this maximum.

9.3 connects the pressure limiting device pretty much to the compressor by noting that it must be connected between the pressure-imposing element and any stop valve on the discharge side.

Section 10 covers pressure-relief protection. Two items pertaining to compressors are included in this section.

10.1 specifies that every refrigerating system shall be protected by a pressure-relief device or some other means to safely relieve pressure due to fire or other abnormal means.

10.4.9 requires that all positive displacement compressors operating above 15 psig and having a displacement exceeding 50 cfm shall be equipped with an adequately sized relief valve properly set to prevent rupture of the compressor and located between the compressor and the stop valve on the discharge side. The manufacturer has the option of discharging into the low pressure side of the system or to atmosphere.

Section 11 covers Installation Requirements.

11.1 states that foundations and supports for condensing or compressor units when more than 6" high shall be made of substantial non-combustible material.

11.3 notes that space will be provided for inspection and servicing of condensing or compressor units. In cases where the compressor would not normally be removed for overhaul, space must be provided for removing heads, piston and rod assemblies, and the crankshaft.

11.4 is similar to 11.3 but includes compressor units or condensing units with enclosures.

11.6 is often overlooked, but specifies that illumination shall be provided that is adequate for inspection and servicing of condensing units or compressor units.

Section 12 covers field testing. Of interest is 12.1 which notes that compressors as well as other components that are factory tested are exempted from the field test.

The last item in the Code of interest to compressors is 13.11 which notes that there will be a card conspicuously located near the compressor of a refrigerating system containing more than 50 lbs. of refrigerant with instructions for shutting down the system in case of emergency, and with names, addresses and telephone numbers for day and night service, and the municipal inspection department having jurisdiction.

The establishment of this safety code, voluntarily established by the refrigeration industry and in existance for over three decades, is a demonstration that the industry recognizes the responsibility to establish safety standards for mechanization that has the potential to injure people. This code is revised and updated every five years to keep it abreast of developments in the industry and safety practices. In addition, a standing committee is maintained for interpretations.

References

1. American National Standards Institute (ANSI) Safety Code B9.1 - 1971
2. ARI Brochure - Public Safety and Health - Everybody's Business