

National Standard of the People's Republic of China

Reciprocating minitype air compressors

微型往复活塞空气压缩机

*(English Translation)*

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Foreword

SAC/TC 145 is in charge of this English translation.In case of any doubt about the contents of English translation, the Chinese original shall be considered authoritative.

This standard is drafted in accordance with the rules given in the GB/T 1.1-2009*.*

The standard replaces the GB/T 13928-2002 *Reciprocating minitype air compressors* in whole.In addition to a number of editorial changes, the following technical deviations have been made with respect to the GB/T 13928-2002(the previous edition).

—In the "scope", it is added that this standard also applies to the reciprocating air compressor with 18.5kw and 0.5MPa gear(see Clause 1);

—The table of optional nominal capacity parameters is added, together with the conditions under which theses parameters can be selected(see 4.3 and Table 2);

—Some of the specific power values at some pressure grades such as 0.7 (0.8) MPa, 1.0MPa and 1.25MPa are adjusted and the specific power values at 18.5kw and 0.5MPa are added (see 5.5 and Table 4, 5.3 and Table 3 in 2002 edition);

—The requirements of the energy-saving assessment index (the input specific power)(see 5.5);

—The requirements of the safety valve for the working pressure and the standards and regulations that the safety valve shall comply with are added.(see 5.14);

—The requirements of the air tank and its safety accessories are adjusted and it is specified that they shall be subjected to the supervision and inspection of TSG R0003 (see 5.21, 5.20 in 2002 edition);

—It is added that the input specific power shall be measured with the methods specified in GB 19153.(see 6.2);

—"Sampling inspection" in "Inspection rules" is deleted .(see 7.3 in 2002 edition);

—The inspection requirements for the input specific power are added in type inspection.[see 7.2.4.b)];

—The items of the delivery inspection are adjusted.It is specified that only the capacity and consumed power at rated discharge pressure shall be evaluated and verified, indirect methods are allowed.(see 7.3,7.2 in 2002 edition).

This standard was proposed by China Machinery Industry Federation.

This standard was prepared by SAC/TC 145(National Technical Committee on Compressor of Standardization Administration of China).

The previous editions of this standard are as follows:

—GB/T 13928-1992,GB/T 13928-2002.

Reciprocating minitype air compressors

1. Scope

This standard specifies the models, basic parameters, requirements, test methods, inspection rules, signs, packaging and storage requirements, etc. of air cooled, single acting, general-purpose oil lubricated reciprocating minitype air compressors.

This standard is applicable to the air compressors which are driven by the motor with the rated power of 0.18kW ~ 15kW or the internal combustion engine with equivalent power and whose rated discharge pressure is not greater than 1.4MPa

This standard is also applicable to the air compressors with rated power of 18.5kW and rated discharge pressure of 0.5MPa.

1. Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies.For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 1149 *Internal combustion engines (all parts)-Piston rings*

GB/T 3853 *Displacement compressors-Acceptance tests*

GB/T 4975 *Displacement compressors vocabulary-General*

GB/T 4980 *Determination of sound level for noise emitted by displacement compressors*

GB/T 5330-2003 *Industrial woven metal wire cloth(square opening series)*

GB/T 7777 *Measurement and evaluation of mechanical vibration of displacement compressors*

GB/T 9438 *Aluminum alloy castings*

GB/T 9440 *Malleable iron castings*

GB/T 13306 *Plates*

GB/T 15487 *Methods of flow measurement for displacement compressor*

GB 19153 *Minimum allowable values of energy efficiency and energy efficiency grades for displacement air compressors*

GB 22207 *Safety requirements of displacement air compressor*

JB/T 2231.4 *Reciprocating piston compressor part-subassembly-Part 4: Metal ring valve plate*

JB/T 2589 *Displacement compressors-Methods for model designation*

JB/T 6431 *Grey iron castings for displacement compressor-Specification*

JB/T 6441 *Safety valves for compressor*

JB/T 7663.1 *Packaging technical condition of displacement compressors*

JB/T 7663.2 *Coating specifications for displacement compressors*

JB/T 9104 *The technical specification for spheroidal graphite iron castings of displacement compressors*

JB/T 9107 *Reciprocating compressors-Vocabulary*

TSG R0003 *Simple pressure vessels safety and technical regulations*

1. Terms and definitions

For the purposes of this document, the terms and definitions given in GB/T 4975 and JB/T 9107 apply.

1. Models and basic parameters
   1. The model of air compressors shall be designated as specified in JB/T 2589.
   2. The number of compression stages, the driving motor power, the rated discharge pressure and the nominal capacity of air compressors shall be as specified in Table 1.
   3. When the capacity of the air compressor under the specified conditions is constantly greater than that specified in Table 1, the value in Table 2 is permissible to be selected as the nominal capacity to be designated in the product model.

Table 1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Compression stage | Driving motor power/kW | Rated discharge pressure/MPa | | | | |
| 0.25 | 0.4(0.5) | 0.7（0.8） | 1.0 | 1.25(1.4) |
| Nominal capacity/(m3/min) | | | | |
| Single-stage | 0.18 | 0.026 | 0.022(0.020) | 0.017(0.016) | 0.014 | — |
| 0.25 | 0.036 | 0.030((0.028) | 0.022(0.020) | 0.020 |
| 0.37 | 0.056 | 0.045(0.042) | 0.036(0.032) | 0.030 |
| 0.55 | 0.09 | 0.071(0.063) | 0.056(0.053) | 0.048 |
| 0.75 | 0.12 | 0.10(0.09) | 0.080(0.075) | 0.067 |
| 1.1 | 0.18 | 0.15(0.14) | 0.12(0.11) | 0.10 |
| 1.5 | 0.25 | 0.21(0.19) | 0.18(0.17) | 0.14 |
| 2.2 | 0.38 | 0.32(0.28) | 0.26(0.25) | 0.21 |
| 3.0 | — | 0.45(0.40) | 0.36(0.32) | 0.30 |
| 4.0 | 0.60(0.53) | 0.50 (0.45) | 0.40 |
| 5.5 | 0.85(0.75) | 0.67(0.63) | 0.53 |
| 7.5 | 1.20(1.10) | 0.90(0.85) | \_\_ |
| 11 | 1.80(1.60) | 1.40（1.30） |
| 15 | 2.50(2.40) | 2.00(1.80) |
| 18.5 | (3.20) | — |
| Two-stage | 0.37 | — | — | — | 0.032 | 0.030(0.028) |
| 0.55 | 0.053 | 0.045(0.042) |
| 0.75 | 0.075 | 0.067(0.063) |
| 1.1 | 0.11 | 0.10(0.095) |
| 1.5 | 0.15 | 0.13(0.13) |
| 2.2 | 0.22 | 0.20(0.19) |
| 3.0 | 0.30 | 0.28(0.26) |
| 4.0 | 0.48(0.45) | 0.42 | 0.38(0.36) |
| 5.5 | 0.67(0.63) | 0.60 | 0.53(0.50) |
| 7.5 | 0.90(0.85) | 0.80 | 0.71(0.67) |
| 11 | 1.50(1.40) | 1.20 | 1.05(1.00) |
| 15 | 2.00(1.90) | 1.60 | 1.50(1.40) |

Table 2

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Nominal capacity/(m3/min) | | | | | | | | | |
| 0.014 | 0.015 | 0.016 | 0.017 | 0.018 | 0.019 | 0.020 | 0.021 | 0.022 | 0.024 |
| 0.025 | 0.026 | 0.028 | 0.030 | 0.032 | 0.034 | 0.036 | 0.038 | 0.040 | 0.042 |
| 0.045 | 0.048 | 0.050 | 0.053 | 0.056 | 0.060 | 0.063 | 0.067 | 0.071 | 0.075 |
| 0.080 | 0.085 | 0.090 | 0.095 | 0.10 | 0.105 | 0.11 | 0.12 | 0.125 | 0.13 |
| 0.14 | 0.15 | 0.16 | 0.17 | 0.18 | 0.19 | 0.20 | 0.21 | 0.22 | 0.24 |
| 0.25 | 0.26 | 0.28 | 0.30 | 0.32 | 0.34 | 0.36 | 0.38 | 0.40 | 0.42 |
| 0.45 | 0.48 | 0.50 | 0.53 | 0.56 | 0.60 | 0.63 | 0.67 | 0.71 | 0.75 |
| 0.80 | 0.85 | 0.90 | 0.95 | 1.0 | 1.05 | 1.10 | 1.2 | 1.25 | 1.3 |
| 1.4 | 1.5 | 1.6 | 1.7 | 1.8 | 1.9 | 2.0 | 2.1 | 2.2 | 2.4 |
| 2.5 | 2.6 | 2.8 | 3.0 | 3.2 | 3.4 | 3.6 | 3.8 | 4.0 |  |

* 1. The total volume of the air compressor air tank of shall not be smaller than that specified in Table 3.For the air compressor with an unloading valve for capacity regulation, the total volume of the air tank is permissible 10% smaller than that specified in Table 3.

Table 3

|  |  |
| --- | --- |
| Driving motor power/kW | Total volume of air compressor air tank/L |
| 0.18 | 15 |
| 0.25 |
| 0.37 |
| 0.55 | 24 |
| 0.75 |
| 1.1 |
| 1.5 | 40 |
| 2.2 |
| 3.0 | 80 |
| 4.0 |
| 5.5 | 120 |
| 7.5 |
| 11 | 150 |
| 15 |
| 18.5 | 250 |

1. Requirements
   1. The air compressors shall be as specified in this standard and be manufactured in accordance with the drawings and technical documents approved by the specified procedures.
   2. The specified conditions of air compressors are as follows:
2. Inlet pressure:0.1MPa(a);
3. Inlet temperature:20℃;
4. Inlet relative humidity:0;
5. Discharge pressure: as specified in Table.1, unit: MPa;
6. Rated speed：as specified in the technical documents of the product. unit: r/min.
   1. Under the specified conditions, the actual capacity of the air compressor shall not be smaller than 95% of its nominal capacity.
   2. When the transmission efficiency is taken into account, the actual power consumed by the air compressor at the rated discharge pressure (including the power consumed by the cooling fan)shall not exceed the rated power of the driving motor.
   3. Under the specified conditions, the specific power of the compressor air end shall not be greater than that as specified in Table 4 and the input specific power shall not be greater than that for the 3rd-grade indexes as specified in GB 19153.

Table 4

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Compression stage | Driving motor power/kW | Rated discharge pressure/MPa | | | | |
| 0.25 | 0.4(0.5) | 0.7（0.8） | 1.0 | 1.25(1.4) |
| Specific power/[kW/(m3﹒min-1)] | | | | |
| Single -stage | 0.18 | 6.2 | 7.4(8.1) | 9.4(10) | 11.0 | — |
| 0.25 |
| 0.37 | 6.0 | 7.1(7.8) | 9.0(9.5) | 10.6 |
| 0.55 | 5.8 | 6.9(7.6) | 8.6 (9.2) | 10.2 |
| 0.75 | 5.6 | 6.7(7.3) | 8.3 (8.9) | 9.9 |
| 1.1 | 5.5 | 6.5(7.1) | 8.0(8.6) | 9.7 |
| 1.5 | 5.3 | 6.4(7.0) | 7.8(8.3) | 9.4 |
| 2.2 | 5.2 | 6.2(6.8) | 7.6(8.1) | 9.2 |
| 3.0 | — | 6.0(6.6) | 7.5(7.9) | 8.9 |
| 4.0 |
| 5.5 | 5.9(6.5) | 7.4(7.8) | 8.7 |
| 7.5 | 5.8(6.4) | 7.3(7.7) | — |
| 11 | 5.7(6.3) | 7.3(7.6) |
| 15 | 5.6(6.2) | 7.2(7.5) |
| 18.5 | (5.9) | — |
| Two-stage | 0.37 | — | — | — | 9.4 | 10.4(10.9) |
| 0.55 | 9.3 | 10.3(10.8) |
| 0.75 | 9.2 | 10.2(10.7) |
| 1.1 | 9.1 | 10.1(10.6) |
| 1.5 | 9.0 | 10.0(10.5) |
| 2.2 | 8.9 | 9.9(10.4) |
| 3.0 | 8.8 | 9.7(10.3) |
| 4.0 | 7.4（7.8） | 8.7 | 9.5(10.2) |
| 5.5 | 7.3（7.7） | 8.6 | 9.4(10.0) |
| 7.5 | 7.2（7.6） | 8.5 | 9.3(9.9) |
| 11 | 7.2(7.5) | 8.4 | 9.2(9.8) |
| 15 | 7.1(7.4) | 8.3 | 9.1(9.7) |

* 1. The vibration severity of the motor-driven air compressor shall not be greater than 45 mm/s, and the sound power level shall not be greater than the specifications in Table 5.
  2. The total amount of lubricant consumption and the cleanliness of the air compressor shall not be greater than the specifications in Table 5.

Table 5

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Driving motor power/kW | Sound power level  /dB(A) | The total amount of lubricant consumption  /(g/h) | Cleanliness/mg | |
| Single-stage | Two-stage |
| 0.18 | 84 | 1 | 200 | 300 |
| 0.25 |
| 0.37 |
| 0.55 | 88 | 2 |
| 0.75 |
| 1.1 | 91 | 3 |
| 1.5 |
| 2.2 | 93 | 4 | 300 | 400 |
| 3.0 | 95 | 5 |
| 4.0 | 96 | 6 |
| 5.5 | 98 | 8 |
| 7.5 | 100 | 12 |
| 11 | 102 | 16 | 400 | 500 |
| 15 | 103 | 24 |
| 18.5 | 104 | 40 | 500 | — |

* 1. The safety requirements of the air compressors shall be as specified in GB 22207.
  2. The storage capacity of the lubricating oil in the air compressor crankcase shall at least be large enough to ensure that the air compressor can continuously operate without lubricating oil being replenished for 48h when the motor power is not greater than 5.5kW or for 36h when the motor power is greater than 5.5kW.
  3. For the air compressor driven by the internal combustion engine, the capacity and specific power of the compressor air end shall be assessed in accordance with the standards for the motor-driven air compressor of the same power level and the noise and vibration of the unit shall be assessed in accordance with the standards for the internal combustion engine.
  4. The discharge temperature for all stages of compression shall not exceed 180 ℃.If synthetic lubricating oil is used, the discharge temperature shall not exceed 200 ℃.The lubricating oil temperature in the crankcase shall not exceed 70 ℃.
  5. When pressure lubrication is used for the air compressor, the oil filter shall be able to remove mechanical contaminants, and the oil pump pressure shall not be less than 0.1MPa, and can be adjusted appropriately.
  6. The automatic regulation system of the air compressor shall be able to automatically adjust the capacity in accordance with the change of the air pressure in the air tank and ensure that the air compressor can be started safely and reliably without the compressed air in the air tank being discharged.
  7. The air compressor shall be have the safety valve for all stages of compression.The valve shall be sensitive, safe and reliable and shall not be used as the venting valve. The functioning of the safety valve shall ensure that the pressure on the pressure-bearing parts in the system does not exceed 1.1 times their maximum working pressure or 0.1MPa plus their maximum working pressure (depending on whichever is larger).The safety valve shall be as specified in JB/T 6441 and TSG R0003.
  8. The piping for air, oil and water in the air compressor shall be reliably connected and well sealed, without inter-leakage or exter-leakage.All piping and cables shall be laid out properly.
  9. The cylinder, cylinder head and the air passage of the intercooler, etc of the air compressor shall be subjected to the hydrostatic test at the pressure of 1.5 times the maximum working pressure for 5min, causing no leakage.
  10. After the components of the suction or discharge valves of the air compressor are assembled, the leakproofness test shall be performed. When kerosene is injected into the valve, only the single drop leakage is allowed at most (the reed type suction valve may not be subject to this test).
  11. The iron castings of the air compressor shall be as specified in JB/T 6431, GB/T 9440 or JB/T 9104 and the aluminum alloy castings shall be as specified in GB/T 9438.
  12. The piston ring of the air compressor shall be as specified in GB/T 1149.
  13. The metal ring valve plate of the air compressor shall be as specified in JB/T 2231.4.
  14. The air tank of the air compressor and its safety accessories shall be subjected to the supervision and inspection as specified in TSG R0003.
  15. The weights of the piston and connecting rod of the air compressor shall conform to the specifications in the drawing, with the deviation of less than ±5% allowed.The belt pulley (flywheel) shall be subjected to the static balance test as specified in the drawing and meet the requirements in the design.
  16. The overhaul periods of the wearing parts of the air compressor shall not be shorter than those specified in Table 6.

Table 6

|  |  |
| --- | --- |
| Name of wearing parts | Overhaul period/h |
| Piston ring | 4000 |
| Valve plate, valve spring |
| Connecting rod bearing shell, connecting rod small end bush |
| Reed valve, leaf | 3000 |

* 1. The air compressors shall be coated as specified in the drawings and relevant technical documents. Coating shall be as specified in JB/T 7663.2.
  2. The complete set of the air compressor supplied to the user shall include:

1. Compressor air end, driving devices, transmission parts, electrical starting device, automatic capacity, regulating system, air tank, safety valve, pressure gauge and other necessary auxiliary equipments;
2. Accessories;
3. Special tools;
4. Documents(including product certificate, product instructions, packing list and relevant documents of pressure vessel).
   1. The manufacturers shall offer a warranty of one year, but for no more than 18 months from the date of delivery, if the air compressor is operated in accordance with the product instructions.During the period, the manufacturer shall be responsible for repair or replacement for free if the product fails due to poor design or manufacturing.
5. Test methods
   1. The performance test of the air compressor shall be as specified in GB/T 3853 and the measurement of capacity shall be as specified in GB/T 15487.
   2. The input specific power shall be measured as specified in GB 19153.
   3. The sound power level of the air compressor shall be measured as specified in GB/T 4980.
   4. The vibration severity of the air compressor shall be measured as specified in GB/T 7777.
   5. The cleanliness of the air compressor shall be measured as specified below：
6. Disassemble the air compressor and clean the cylinder head, cylinder, air valve, piston, connecting rod, crankshaft, crankcase and other parts and components (excluding exposed surfaces) with a brush in the cleaning agent;
7. Filter the cleaning agent with the copper wire mesh as specified in GB/T 5330-2003 and with the basic mesh size being 0.08mm.Heat the filtered contaminants to 80℃ before drying them for 1h;
8. Weigh the dried residue with an ordinary balance with an accuracy of no less than grade 7 and the obtained is the cleanliness value of the air compressor.
9. Inspection rules
   1. Inspection types
10. Type inspection;
11. Delivery inspection.
    1. Type inspection

7.2.1 Trial-manufactured air compressor (including the new product or old product produced by relocated factories) shall be subjected to type inspection. For this purpose, the product shall operate continuously at full load for at least 500h, including 4h during which the pressure is 1.1 times of the rated discharge pressure and 1h during which the inlet temperature is 40°C.

7.2.2 For the air compressor in normal production, if there are major changes in its structure, material or process which may affect the performance, or if the production has resumed after long-term shutdown, type inspection shall be performed. For this purpose, the product shall operate continuously at full load for at least 200h, including 2h during which, the pressure is 1.1 times that rated discharge pressure and 1h during which, the inlet temperature is 40 ℃.

7.2.3 For the air compressor in normal production, type inspection shall be performed on a regular basis or when a specific quantity of production has been reached. For this purpose, the compressor shall operate continuously at full load for at least 24h, including 2h during which, the pressure is 1.1 times the rated discharge pressure.

7.2.4 The contents and requirements of type inspection shall be as specified below:

1. The assembly quality, working condition and the interaction correctness of various parts and components shall be checked;
2. At both the beginning and the end of the inspection, the performance test shall be carried out to measure the capacity, the specific power, the input specific power, the rotating speed, the inlet and discharge pressure as well as the temperature of each stage, the temperature of lubricating oil, the total consumption of lubrication oil, the sound power level and the vibration severity under the specified conditions, and the results shall conform to the specifications in this standard;
3. During the overpressure test and high-temperature test, the oil temperature and discharge temperature shall be checked. They shall not exceed the specifications in 5.11 and the air compressor shall operate properly;
4. For the automatic capacity-regulating system and safety valves, the sensitivity test shall be carried out. They shall perform their actions three times and shall operate properly;
5. After the inspection, the cleanliness shall be measured and conform to the specification in Table 5 and the wear amount of the wearing parts and friction surfaces shall also be measured and recorded.The wear shall be normal(except 7.2.3).
   1. Delivery inspection

Each air compressor shall be subjected to delivery inspection. During the inspection, the assembly quality, working condition and interactional correctness of various parts and components shall be checked. In addition, the capacity and power shall also be assessed at the rated discharge pressure. It is allowed to use indirect methods to carry out the assessment and the verification, the results shall conform to the specifications in this standard and relevant technical documents.

1. Sign,packaging and storage
   1. Each air compressor shall have its product nameplate fixed in a flat and visible place, the size of which shall be as specified in GB/T 13306.The nameplate shall provide at least the following information:
2. Product model;
3. Product name;
4. Nominal capacity,unit: m3/min;
5. Rated discharge pressure, unit: MPa;
6. Shaft power or driving motor power, unit: kW;
7. Input specific power,unit: kW／（m3·min-1）
8. Rotating speed,unit: r/min;
9. Overall dimensions(length×width×height), unit: mm;
10. Net weight,unit: kg;
11. Serial number;
12. Date of delivery;
13. Name and address of the manufacturer.
    1. The power input end of the air compressor shall be equipped with a rotation direction sign.
    2. The packaging of the air compressor shall be as specified in JB/T 7663.1.
    3. The air compressor shall be stored in a dry and ventilated warehouse or a covered place not subject to the dampness.
    4. The manufacturer shall guarantee that under proper storage and transportation conditions the product will not be rusted and mildewed due to poor packaging within a year from the date of delivery.Special requirements shall be implemented in accordance with the agreement between the supplier and the buyer.

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