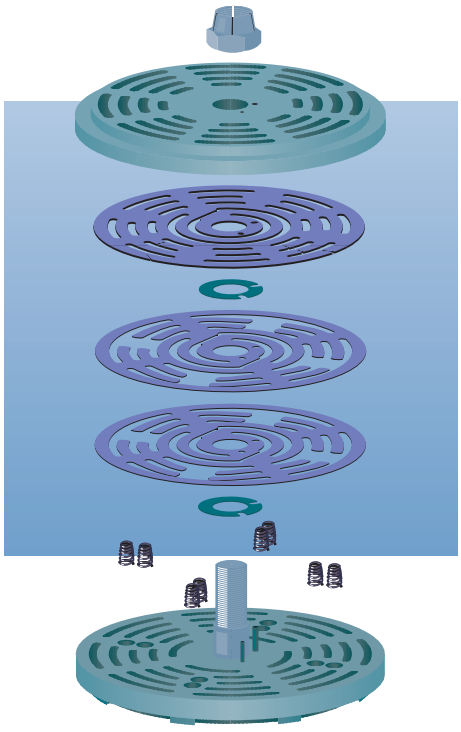
COMPRESSION
TECHNOLOGY
GROUP

Service Guide

SERVICE GUIDE FOR MAINTENANCE OF HOERBIGER VALVES



HOERBIGER

General

SERVICE GUIDE FOR MAINTENANCE OF HOERBIGER-VALVES

Modern compressors equipped with HOERBIGER-Valves require a minimum of maintenance. The performance and the reliability of such compressors depend, however, to a large degree on the care applied to these few maintenance operations.

AT WHAT INTERVALS HAS MAINTENANCE OF VALVES TO BE CARRIED OUT?

We cannot give any general guide lines as valve life is influenced by many parameters. Maintenance frequency will depend for example on the type of compressor (e.g. Process machine or garage compressor), whether the compressor is running on continuous duty or intermittent duty, on the compressor speed and pressures, the compression ratio, also the type of gas (corrosive or non-corrosive gas, clean gas with or without carry-over of foreign material, moisture content). The compressor manufacturer will have established guide lines both for the running in period and subsequent operation, which will have to be followed. Experience proves that after the initial running - in period the maintenance intervals can be extended considerably.

THEY COVER THE FOLLOWING PROCEDURES

1 Remove valve from compressor

2 Dismantle the valve

3 Clean all parts

4 Check the condition of all components
especially for wear, damage to the seat face, the plates, and for setting of the springs.

5 Repair or replace worn parts
Repair all parts which can be remachined without impairing the strength. Replace all parts which are worn or show any cracks.

6 Reassemble the valve
following the instructions on our drawing or assembly sheet.

RECOMMENDATIONS AND WARNINGS

1 Recommendations and warnings are to be followed according to the compressor manufacturer.

In case our recommendations and warnings deviate from those of the compressor manufacturer, the ones of the compressor manufacturer take precedence.

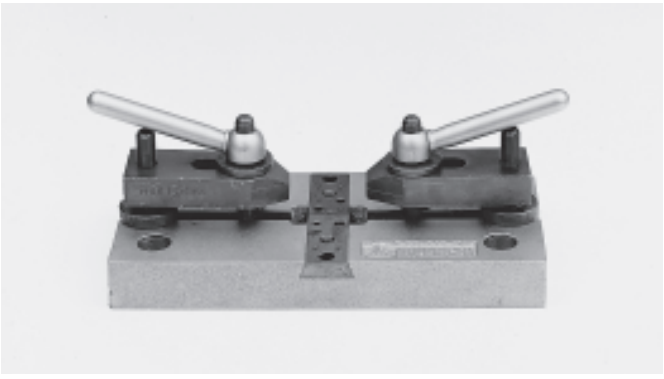
ASSEMBLY DEVICE

The HOERBIGER Assembly Device allows the valve to be held correctly without danger of damage. Adjustable location pins secure the valve against rotation. These pins locate in the slots of the seat or guard respectively without causing damage. The best way to tighten the nut is with a torque wrench. HOERBIGER Assembly Devices can be used for all valve types. The standard clamps will hold heights "H" (fig. 12) up to 78 mm. The base plate can be screwed on to any work bench or held in a suitable holding device.

3 sizes are available:

Size	max. O. D. of valve mm	L mm	B mm
1	20-100	260	120
2	20-250	420	200
3	20-430	590	350

fig. 1



1 Remove valve from compressor

2 Before valves are removed from the compressor, all pressure has to be released from the cylinders and piping. If combustible or poisonous gases are present, cylinder and piping have to be vented. Take necessary measures to prevent start up of the compressor. If the compressor valve is stuck in the cylinder, try to use valve puller device. If valve is to be jarred free by striking, use a wood block or soft metal bar to avoid damage. Never use a steel hammer to strike the valve directly.

2 Dismantle the valve

After sufficient cleaning of the center bolt and loosening of the locking device of the unit (either by removing of the cotter pin in case of a castle nut, or by pressing down the ends of the locking washer, if equipped with same), the valve should be held by means of a simple holding device shown in fig. 3 and 4. The holding pins keep the valve from rotating. It is better to use our Standard Assembly fixture shown in fig. 1 and 2 where the valve parts are clamped down effectively.

fig. 2

fig. 3

fig. 4

3 In order to prevent the locating pins in the valve from shearing off, it is advisable to hold the suction seat and delivery guard respectively, while loosening or tightening the nut especially in the case of valves with open guard (fig. 5).

fig. 5

4 How it should not be done!

Never should a valve be directly tightened in a vice, neither as shown in fig. 6 on the shoulder, nor as shown in fig. 7. Do not hammer on the wrench when loosening or tightening the nut (fig. 8 and 9).

fig. 6

fig. 7

fig. 8

fig. 9

3 Clean all parts

with a cleansing fluid using a soft brush, taking particular care to free the ports of the seat and the guard from all foreign matter to ensure full seat area in operation. Never use wire brushes or tools with sharp edges to clean the seats and plates.

5 All precautionary measures stipulated by the Occupational Safety and Health Act of 1970 (OSHA) or local safety instructions must be adhered to when handling solvents.

Caution: all excess solvent solutions used in the cleaning of compressor valves and/or pockets should be removed prior to start-up since their presence may cause an explosion hazard.

4 Check the condition of all components

6 Use only genuine HOERBIGER replacement parts.

5 Repair or replace worn parts

Valve plates
When a valve plate, or damper plate shows signs of wear, it is imperative to replace these parts, even if no breakage has occurred.

7 Valve plates and rings when worn should be replaced, not reground or inverted.

8 When a spring in a valve shows signs of deterioration, not only that particular spring but all springs must be replaced in this valve. In the case of conical springs care should be taken that they are inserted into the spring well with the large diameter resting at the bottom of the spring well (fig. 10).

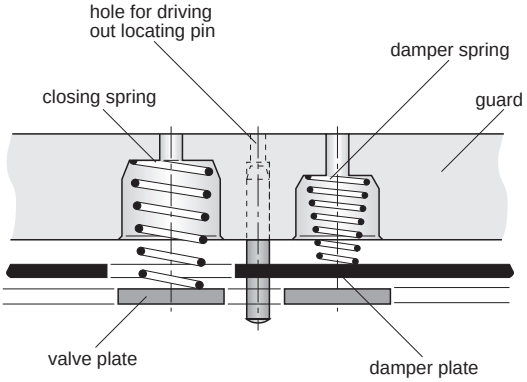
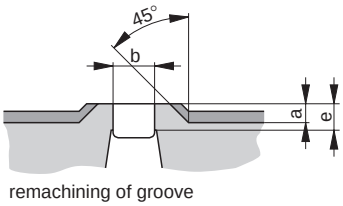


fig. 10

Seats
For highest efficiency of the valve it is important that the seat face is flat and free of any traces of wear, thus preventing valve leakage. If any damage of the seat face appears, it is necessary to remachine and lap the seating areas. Locating pins, if fitted, have to be removed first of all. Generally remachining is done by concentric grinding and lapping. If the seat face shows only slight defects, lapping alone may prove satisfactory. Also remachining on a center lathe with very low feed may be considered, particular attention being paid to the seat face being machined. Burrs are best removed with emery paper (fig. 11.1 and 11.2)

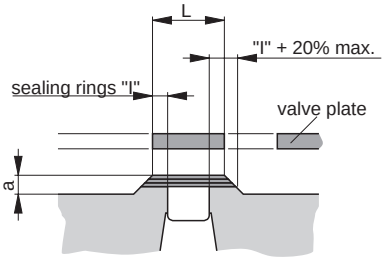
9 When a valve seat surface is remachined, new valve plates or rings must be used to assure proper seal.



remachining of groove

fig. 11.1

How often may a valve seat be remachined?
Under no circumstances must the bottom of the turned slots be machined to increase the depth, as this would impair the strength of the seat. The following may serve as a rough guide for remachining of seats. The material thickness „e“ (fig. 11.1) under the seating ledge should not be reduced to less than 60% of the slot width „b“ an



remachining of seat-face

fig. 11.2

exeption to the above are the steel seats of valve Types 52 R and 42 R, for which dimension „e“ should be limited to 1.2 mm minimum. Every grinding or lapping of the seat face increases the width of the ring surface marked „I“ in fig. 11.2. In order to keep the dimension constant the grooves have to be remachined. The maximum increase on width which can be tolerated is 20%.

10 Do not remachine valve seats below the specified minimum dimension, otherwise there is danger of breakage.

11 Remachining has to be extended over the entire seat-face, including the center where lift washers or guide rings are located, in order to avoid any change of the valve lift.

Center bolts are secured into seats (or guards) with a dowel pin (Version A) or a bolt lock using a small ball (Version B). To remove the centre bolt, drill out the (soft) dowel pin or ball and unscrew the bolt. Upon re-assembly drill a new hole in the thread area of the

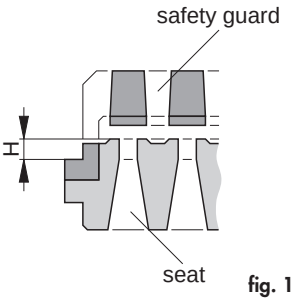


fig. 12

bolt and the seat or guard, respectively, and insert a new pin or ball to secure the bolt from coming loose.

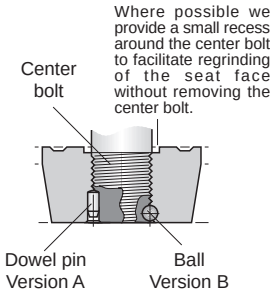


fig. 13

The dowel pin or ball, after it is inserted, has to be peened (slightly hammered in) to prevent it from falling out (fig. 13).

If so-called safety guards (Standard design fig.16) are centered on the seat, care must be taken to maintain dimension „H“ (fig. 16). This means any centering step on the seat, must be remachined to the same extent as the seat face.

After remachining of the seat the locating pins have to be refitted (fig. 15).

12 If the valve plate and guide plate are riveted together, the groove in the valve seat under the rivets has to be remachined after every grinding to prevent the rivet heads from hitting the seat. Remachine until the rivet has ample clearance (fig. 14).

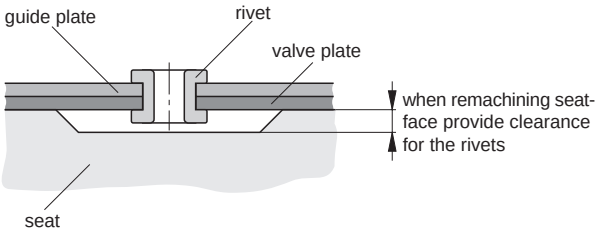


fig. 14

Locating Pins

Locating pins, which have been removed from the seat before the remachining, have to be refitted, taking care that the free length is the same as before (fig. 15). If necessary, the pin holes have to be drilled deeper in order to ensure that the maximum free length is not exceeded. If the pin in the seat or the hole is damaged redrill the locating pin holes displaced by 180°.

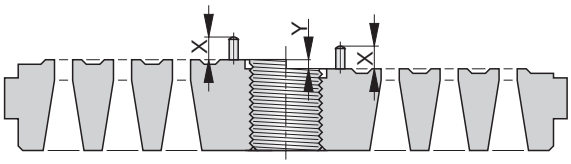


fig. 15
X... free length before and after remachining
Y... height reduction by remachining

The diameter of the new hole has to provide a press fit (dia. of drill. 0.1 mm less than dia. of locating pin). Make sure that the locating pins are at right angles to the seat face. When re-assembling the valve align the seat with the guard. In this position the nut can be tightened. Never tighten the nut without positioning the seat and guard properly. Any damage of the locating pins can impair the proper functioning of the valve.

Certain valves have no hole in their seat to accept the free end of the locating pin. Such valves are provided with marking holes on the periphery of seat and guard or visually by aligning the webs of the seat and guard, which must be lined up before the valve nut is tightened down (see fig. 16).

Valves using spirol pins instead of solid dowel pins must never have through holes in the seats to accommodate the pin. Drilling a through hole would result in leakage through the valve seat.

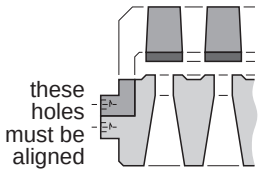


fig. 16

6 Reassemble the valve

Take special care in assembling the valve and follow procedures shown on our drawings. We are glad to give any further advice should problems arise. If valves are equipped with lock washers or locking plates, they have to be replaced after every dismantling. For more convenient assembly of the valve it is a good practice to grease the spring pockets, in order to hold the springs in place. This does not apply for valves of oxygen compressors. You will do a better job if you use a torque wrench for tightening the selflocking nut. (Follow the torque table given in this leaflet). When tightening the nut hold the suction seat, or the discharge guard, especially in case of valves with open guards (fig. 5) both parts should not move relative to each other. This could damage the locating pins in the valve and result in valve failure. Certain valves are provided with marking holes on the periphery of seat and guard which must be lined up before the valve nut is tightened down (fig. 16).

13 Never use oil or grease for valves used on oxygen-compressors!

14 Tightening torque of center bolt nut has to be maintained as specified. Bolt and nut threads must be clean, free of burrs and well lubricated. CAUTION: With Oxygen Compressors. Valves have to be completely free of oil and grease. Inspect valve again before installation. Failure to do so many result in an EXPLOSION! Never use self locking nuts on austenitic stainless steel material.

The torques listed in the table are for greased nuts and bolts. The data is only valid with a Genuine Centre Bolt. Self locking nuts should always be lubricated before tightening.

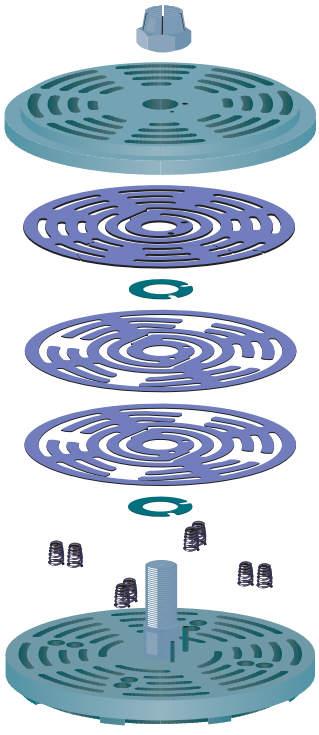


fig. 17

15 If suction valves are equipped with unloaders, the clearance between the valve plate and unloader finger as well as the clearance between unloader and actuator push rod has to be checked.

16 Valve plates have to be checked for free movement.

17 Before assembling the valve into the cylinder also clean the valve pocket and the cages.

18 When re-installing valves, do not interchange suction and discharge valves - DANGER OF EXPLOSION!

19 Do not install discharge valves upside down - DANGER OF EXPLOSION!

20 Valves must always be placed in the cylinder with the center bolt and nut AWAY from the cylinder bore.

fig. 18

21 Set screws or cover stud nuts holding the valve in place have to be tightened to the specified torque values, otherwise there is danger of valve seat breakage.

22 After all of the valves are installed, bar over the compressor at least one complete revolution to be certain there is no interference with moving parts.

Table of torque.
(valid for castle nuts, slotted nuts and self locking nuts).

PRACTICAL LEAKAGE TESTING OF COMPRESSOR VALVES

Compressor valves should be flowefficient and durable in service. Leakage is one criteria that impacts on both of the above. Excessive leakage causes back-flow of gas when the valve is closed, raises the temperature of the gas and reduces efficiency. Elevated temperatures also adversely affect valve life.

For this reason, HOERBIGER`s quality assurance program dictates that all valves are subjected to a leakage test. This policy covers newly made valves in our production plants and repaired valves in all our service centers. Different geometry valves and sealing elements made from steel or non-metallic material all undergo such rigorous testing.

Test methods may vary but preference is given to those procedures that simulate the conditions as they exist in a cylinder.

VALVE TESTING METHODS

There are 3 customary leakage test procedures, and HOERBIGER recommends 2 of the testing methods.

Flow Meter Testing

The leakage is determined by subjecting the closed valve to a "set" air pressure of e.g. 5 bar (70 PSI) and measuring the leakage through the valve by means of a flow meter (fig. 19).
Since small contaminants at times can be caught between the valve plate and seat lands,

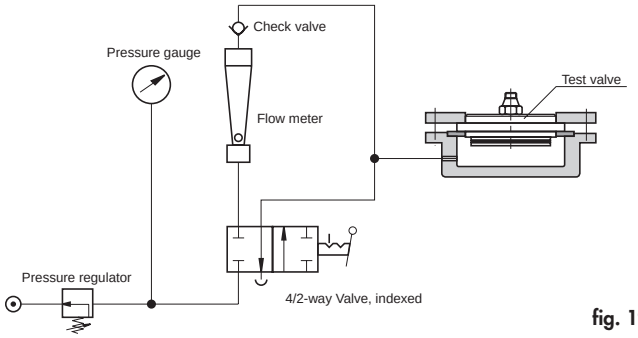


fig. 19

it is common practice to "tap" the valve plate in several areas repeatedly. This will briefly lift the plate off the seat lands and the escaping air will blow out any small particles that might be trapped between the sealing surfaces and cause excessive leakage.
This should be done with an appropriate tool (flat or soft-tipped) so no damage is done to the valve plate or sealing element. Particular care is called for when non-metallic plates are used so no damage is done to these components.

Measuring Pressure Drop

In this test method, leakage is measured in pressure drop over time, using a fixed volume "V" (air supply is shut off) and measuring the time it takes for the pressure to drop from p1 to p2 (fig. 20).

The time for the pressure drop to occur and parameter for acceptable leakage are dependent on the valve size, volume of the vessel and the selected pressures of p1 and p2.

The prior "tapping" of the valve to blow out any impurities should be standard practice in this test procedure as well.

Liquid Testing

Test procedures as discussed under 2.1 and 2.2 are compatible and represent conditions as they prevail in the compressor cylinder. The sealing element is "pressure loaded" much like it is in its operating environment when installed in a cylinder (the suction valve is kept closed by the cylinder pressure while the discharge valve is under the influence of the line pressure).

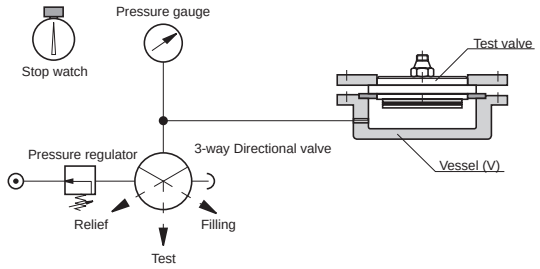


fig. 20

Thread size	Carbon Steel Min. tensile strength 800 N/mm²			
METRIC mm	Martensitic Stainless Steel*)(En56) Min. tensile strength 750 N/mm²		Austenitic Stainless**) (En 58) Min. tensile strength 550 N/mm²	
	Torque in Nm		Torque in Nm	
	Minimal	Maximal	Minimal	Maximal
4	1,2	1,5	1,0	1,2
5	2,4	2,9	1,8	1,2
6	4,1	5,0	3,2	3,8
8	10,0	12,0	7,5	9,0
10	20,0	24,5	15,5	18,5
12	36,0	44,0	28,0	33,0
14	57,0	69,0	43,0	52,0
16	90,0	110,0	70,0	85,0
20	178,0	215,0	135,0	160,0
22	245,0	295,0	185,0	220,0
24	305,0	370,0	230,0	280,0
27	330,0	400,0	330,0	400,0
30	450,0	540,0	450,0	540,0

*) Martensitic stainless steel (magnetic) is used with slightly corrosive gases
**) Austenitic stainless steel (non magnetic) is used with highly corrosive gases

Frequently, field people do not have access to leakage testers and resort to a simple "liquid testing" of the valve.

Filling the seat ports of a valve with a fluid and observing the leakage rate of the fluid through the valve is a common practice. Kerosene, Varsol and other light viscosity fluids (even water) are employed in such crude leakage tests.

Although the procedure is widely used, it is not without controversy as to the viability of its results. Contrary to the previously described methods of air pressure testing, the liquid test does not simulate conditions as found in the cylinder. The fluid pre-loads the sealing element towards its opening lift, and test results can be distorted, especially if valves use non-metallic sealing elements and if the pre-load of the springs used in the valve is very light.

Certain valves, due to thier design, cannot be tested at all with the fluid method, and others will create the appearance of "leakers" when their sealing characteristic under air pressure is perfectly acceptable. This test method, therefore, is controversial and should be avoided whenever possible. The cleaning process described in air testing cannot be applied in liquid tests, and any impurities in the sealing area will show as excessive leakage.

Frequently, such liquid tests lead to unnecessary labor and repair of the valve which would possibly be termed fine under air tests.

It is recognized that proper testing of valves with air pressure is not always possible, but it remains the superior prodedure and should be adopted wherever possible.

Our experts are available at any time - worldwide

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