



**Hamworthy  
3S4-50  
Compressor**

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**HAMWORTHY WASTEWATER SYSTEMS LIMITED**

**Fleets Corner, Poole, Dorset, BH17 0JT, United Kingdom  
Telephone +44(0)1202 662600  
Email: [info@hamworthy.com](mailto:info@hamworthy.com)  
Website: [www.hamworthy.com](http://www.hamworthy.com)  
Facsimile: Spares and Sales +44(0)1202 668793; Service +44 (0)1202 662622**

**Offices, Associates Companies and Agents throughout the world**

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## W A R N I N G

Misuse of compressed air can be dangerous. It cannot be stressed too strongly the importance of taking every precaution in the use of compressed air and its associated equipment.

**NEVER** Commence any maintenance or servicing work on a compressor or compressed air system without ensuring entire system is fully depressurised. Failure to observe this precaution may result in serious injury.

**NEVER** Screw down a pipe union that is under pressure.

**NEVER** Screw down a safety valve beyond the manufacturer's setting. A safety valve is fitted to prevent over pressurising the air receiver and over-loading the air compressor. To interfere with its setting could result in serious damage or injury.

**NEVER** Carry out any work whatsoever unless the electric supply has been switched off at the mains - this applies to electrically driven plants.

**NEVER** Pass in front of an air receiver wheel valve when compressed air is being released. This is particularly dangerous as any particles of iron scale in the air stream could become imbedded in the skin and cause a serious wound.

**NEVER** Attempt to straighten badly bent pipes or re-use damaged union fittings.

**NEVER** Use worn or damaged components that particularly rely on threads for security - ie nuts, bolts, nipples and drain taps etc.

**NEVER** Tamper with a live electrical circuit. If in doubt call upon the services of a qualified electrician.

**REMEMBER** Before opening a manual drain or vent valve, always ensure that valve exhaust port is not blocked or plugged. Remove any red plastic plugs that may be present.

Determine in which direction air will exhaust through port to atmosphere and avoid positioning any part of the body in the direction of flow.

**ALWAYS** open a drain or vent valve **SLOWLY** and with caution. **NEVER** open a drain or vent valve rapidly.

**REMEMBER** To firmly secure all externally fitted installation pipe work. This will prevent undue vibration and possible fracture under pressure.

**REMEMBER** To have your compressors installed in accordance with your local Electrical Authority requirements. A piece of three core flex and a three pin plug does not constitute an installation.

**REMEMBER COMPRESSED AIR CAN KILL - TREAT IT WITH RESPECT**

## HEALTH AND SAFETY AT WORK ACT 1974

Where we supply a complete factory-built air compressor set, we ensure that measures are taken to comply with our responsibilities in respect of the Act.

In addition, it is essential that the operator is aware of the inherent hazards associated with the use of compressed air, particularly in such applications as breathing or food and drink processing where specialist filtration is essential.

Also, when we supply a bare air compressor unit, certain responsibilities under the Act will pass to the customer, and will include ensuring that:-

1. All drives and moving parts are adequately guarded.
2. Our recommendations on operating conditions, including maximum pressure and speed are not exceeded.
3. Any air receiver or pressure vessel, used in conjunction with the compressor is constructed to be suitable for the working pressure of the unit.
4. Interconnecting pipework is adequate in strength.
5. A suitable safety valve, correctly situated, and a pressure control device are included in the installation.

If in doubt, ask our advice.

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**SECTION 1 - LEADING PARTICULARS**

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## LEADING PARTICULARS

Compressor Type	3S 4-50	
Number of Stages	3	
Maximum Working Pressure	5000 lbf/in <sup>2</sup>	345 Bar
Speed	2400 rev/min	
Displacement	4.9 cfm	8.3 M <sup>3</sup> /Hr
Average Charging Rate <u>+5%</u>	2.32 cfm	3.9 M <sup>3</sup> /Hr
Cooling	Air	
Sump Capacity	0.68 pt	0.386 litre
Unit Weight (Dry)	28 lb	12.7 Kg
1st Stage Safety Valve Setting	150 lbf/in <sup>2</sup>	10.3 Bar
2nd Stage Safety Valve Setting.	750 lbf/in <sup>2</sup>	51.7 Bar
3rd Stage Safety Valve Setting.	Nominally 10% above working pressure - full blow.	

## FOREWORD

All necessary instructions for the efficient operation of the compressor are contained in this publication. In addition to this it is most essential that the operator should be aware of the hazard of producing, handling and storage of high pressure air before attempting to operate the compressor.

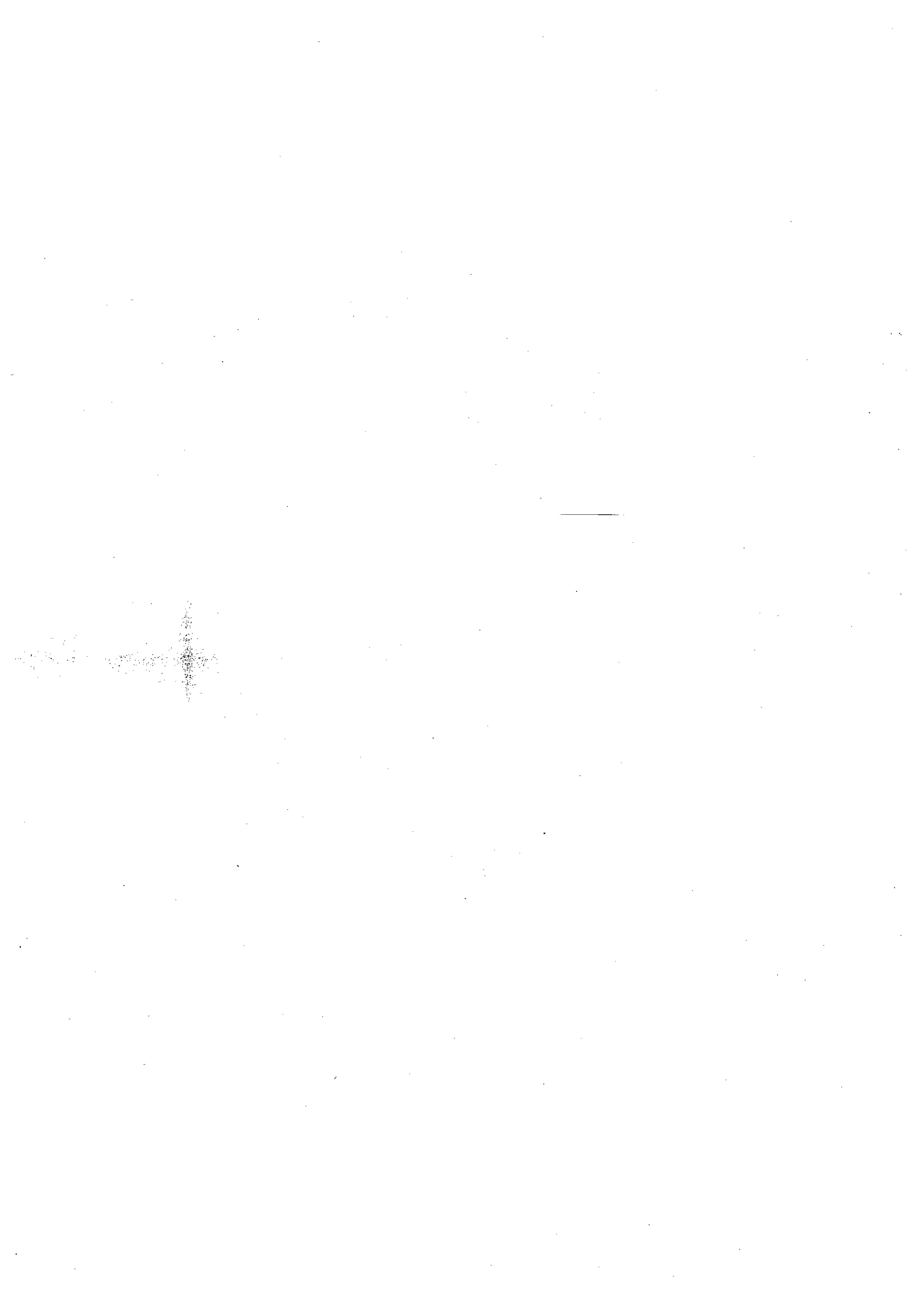
Before attempting to operate the compressor read the operating instructions carefully, they have been prepared to help you obtain the best possible service from your plant.

When ordering spare parts it is most important to quote the compressor serial number to avoid delays and incorrect parts being despatched. The serial number is stamped on a metal plate attached to the crankcase.

The efficiency of the compressor is dependent upon routine maintenance regularly carried out. Breakdowns and failures are usually due to neglect of routine maintenance.



**SECTION 2 - INSTALLATION**



## INSTALLATION

The compressor should be installed in a well ventilated position whether it is forced or natural. Allow at least thirty inches around the plant to enable all the normal maintenance and major repairs to be carried out with ease.

We strongly advocate that the necessary electrical installation be undertaken by a competent electrical engineer.

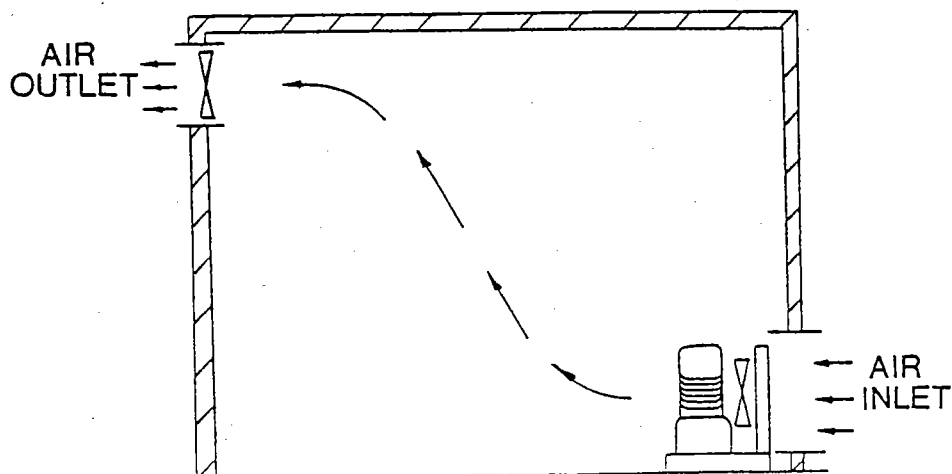
Motors and switchgear embodied in Hamworthy compressors are wound and set for specified voltages and any attempt to operate on a voltage other than that shown on the motor reference plate will inevitably result in damage or premature breakdown of these components. Therefore check the current conditions of the motor reference plate to ensure that they comply with those previously ascertained by direct enquiry to the Electricity Supply Authority.

A combined Isolator Switch Fusebox (wall mounted near the compressor) should be provided and wired to the starter switch. The wiring must be of sufficient capacity to carry the full starting load, and the voltage drop must not exceed 5% of the rated supply voltage if safe and efficient operation of the compressor is to be obtained. The fuses must not be less than THREE times the full load current of the motor up to 10 amps and TWICE the full load current OVER 10 amps.

The direction of rotation of the compressor is indicated on the crankcase cover or on the flywheel. When driven by a three phase motor, the direction may be reversed by interchanging any two mains supply leads.

As a general rule, air cooled compressors operating in a room or confined space should be installed to prevent cooling air recirculation and a build up of the ambient temperature within the room. Ideally, the cooling fan should be positioned close to an external intake duct and an extractor fan positioned in the ceiling or upper part of the confined space, as shown in the diagram. The extractor fan flow rate should be at least equal to the compressor cooling fan flow rate.

Where two machines are installed in the same room, they should be positioned so that hot air from one machine is not induced into the other machine. Do not install machines back to back as this will effect the compressor fan flow rate. If in doubt, consult Hamworthy Compressor Systems Engineering Department.



## **SAFETY VALVES (RELIEF VALVES)**

### **INTRODUCTION**

Due consideration should be taken of climatic, process or other conditions which might adversely affect the performance of the safety valve. Installation must be undertaken by qualified technicians and to good engineering practice. In additions, user's attention is drawn to our joint responsibility to ensure that the Health and Safety at Work Act is not contravened by incorrect installation, commissioning or servicing. It is important that the valve to be installed is correct in every aspect, ie. set pressure, size, material and type etc. for the application.

### **STORAGE OF VALVE BEFORE INSTALLATION**

Valves should be stored preferably between 5°C and 25°C and a relative humidity of less than 75%. Very moist or very dry conditions should be avoided. If a safety valve is installed after six months, or more, of storage, it must be subjected to a functional test before commissioning.

Thread protectors should not be removed until immediately prior to testing or installation, as they also prevent the ingress of foreign matter which could harm the valve.

### **INSTALLATION - VALVE INLET**

Under no circumstances should it be possible to isolate the safety valve from the protected system. Safety valves should be mounted as close as possible to the protected system. The connecting pipe should be straight and as short as possible. The inlet line to the safety valve should have an effective area of flow at least equal to that of the safety valve inlet. The manufacturer should be consulted if the safety valve is to be mounted in any position other than vertically. The maximum pressure drop through the inlet line to the safety valve should not exceed 3% of the set pressure when the valve is discharging at its rated capacity.

### **VALVE OUTLET**

No isolating devices shall be fitted to the outlet pipe. Discharge pipes should be as short as possible and of such a size that the pressure developed therein will not reduce the relieving capacity. Ensure arrows indicating the direction of the flow are pointing in the correct direction. The cross-sectional area of the discharge pipe should not be less than the area of the safety valve outlet.

Where safety valves are discharged into a manifold, the manifold must be capable of accommodating simultaneous discharge of all valves connected to the manifold. Atmospheric discharge or discharge pipes should terminate at a location which will not cause a hazard to personnel, particular attention being given to hazardous fluids or particles.

### **GENERAL**

Inlet and outlet piping should be capable of supporting the safety valve so that no unacceptable mechanical load or vibration

is transmitted to the valve and be sufficiently strong to withstand the effects of the reaction forces when the valve is discharging.

All pipework or pressure vessels to which the safety valve is connected should be thoroughly cleaned before fitting the safety valve, to ensure that foreign matter does not pass through the valve. Particular care should be taken with the use of sealing compounds and P.T.F.E. tape to ensure that they do not enter the valve.

Atmospheric discharge valves should not be painted or coated with any substance which could possibly obstruct or restrict free and full discharge through the valve. Suitable protection should be provided to prevent environmental build up of ingress of foreign matter. Any condition that could lead to blockage of discharge piping or discharge ports on safety valves must be avoided. Where appropriate, discharge pipes should be provided to a non-hazardous location. Where there is a possibility of a liquid head forming in a discharge pipe, a drain should be provided which leads to a safe discharge location. To prevent unnecessary lifting of the safety valve it is recommended that there is a margin of at least 10% between the maximum operating pressure and the set pressure of the safety valve.

#### **FUNCTIONAL TESTING**

Once installed in service, valves should be tested at least once every six months to ensure free movement of parts. This should be carried out by operating the easing gear when the valve is under a pressure of not less than 75% of the set pressure. Where valves are supplied without easing gear, the test should be in accordance with the full functional test described below. Due regard must be paid to the safety of personnel. Testing should not create a hazard, particular attention being given to foreign matter located in discharge outlets.

When valves are installed in extreme operating environments, as listed below, the frequency of testing must be increased.

- a) Hot, dry, dusty or high humidity areas.
- b) Oil, tar or gumming deposits.
- c) Sand, grit, earth, cement (construction, quarry or similar sites).
- d) Pollution laden atmosphere (chemical works).
- e) Any area where the valve can become contaminated with foreign matter likely to obstruct free and full discharge through the valve.

**THE FREQUENCY OF TEST MUST BE ESTABLISHED BY THE USER TO SUIT EACH INSTALLATION OR PROCESS. IT IS IMPORTANT THAT DISCHARGE OUTLETS OF THE SAFETY VALVE BE KEPT IN A CLEAN CONDITION, FREE FROM DEPOSITS OR BUILD OF FOREIGN MATTER.**

#### **FULL FUNCTIONAL TEST**

Safety valves should be checked every 12 months for correct function and test of set pressure, full flow and reseal pressures. Ideally the valve should be removed from the system and tested on specific test equipment. Before dismantling any pressurised components, the system must be effectively isolated

from all sources of pressure and completely vented to atmosphere. When safety valves are taken out of service, care must be taken that the plant remains secure. Parallel or replacement safety devices of at least the same capacity must be provided. Where a safety valve does not meet the specification it must be refurbished, or replaced. If the valve is not functioning correctly, ie. noisy or 'hammering' refer to the manufacturer.

**IT IS RECOMMENDED THAT ADJUSTMENTS, MAINTENANCE AND REPAIR OF SAFETY VALVES, INCLUDING CHANGES IN SET PRESSURE, SHOULD ONLY BE PERFORMED BY THE MANUFACTURER OR AN AUTHORISED REPRESENTATIVE.**

**SECTION 3 - GENERAL DESCRIPTION AND LUBRICATION SYSTEM**

## ADDITIONAL INFORMATION - INITIAL STARTING PROCEDURE

On despatch, compressors are either inhibited for 6 months with oil drained or supplied with a full charge of oil in the sump, as indicated on label attached to compressor.

On receipt of compressor, examine label to determine which condition applies. If compressor is drained of oil, fill to the correct level with the correct grade of lubricant. If compressor is filled with oil, check oil level and replenish if necessary.

### IMPORTANT

Compressors supplied with oil in sump are filled with Anderol 555. This is a synthetic oil and must **NOT** be mixed with mineral oil under any circumstances. If synthetic and mineral oils are mixed, failure of the lubrication system will occur, resulting in seizure.

A compressor supplied with Anderol 555 in the sump must be operated using Anderol 555. However, if a change to mineral oil is required, drain synthetic oil, thoroughly clean all internal parts with flushing oil and refill sump with recommended mineral oil. Observe the same procedure if changing from mineral to synthetic oil.

## GENERAL

The 3S4-50 Air Compressor is a two cylinder 'vee' formation three stage reciprocating machine using a double acting differential diameter piston for the first and second stages, and a free floating plunger type piston for the third stage. A slipper piston and cylinder is mounted in the crankcase to which the third stage cylinder is bolted. The compressor has been designed to charge cylinders with air to a pressure of 5000 psi (345 Bar).

Compression is achieved in three stages. The first stage pressure is produced above the first/second stage differential piston. This air is passed through the intercooler and compressed to the second stage pressure in the annular compression space formed under the first/second stage piston. The air is again passed through an intercooler to the final stage cylinder where it is compressed to the final pressure by a ringless plunger piston driven by, but not attached to, a slipper piston. This plunger piston depends on the air pressure in the second stage to return it and maintain it in intimate contact with the slipper piston. During initial starting therefore a tapping noise will be heard until the second stage pressure has built up sufficiently to return the third stage piston. This will normally only take a few strokes and will disappear when the second stage pressure rises to approximately 100 psig (6.9 bar).

The final delivery of air is passed through an aftercooler to the delivery point, from where it should be connected to the final filter banks and take off manifolds of the installation. A safety valve must be included in the pipe line between the compressor and any subsequent equipment.

The compressor must be installed so that there is a good supply of cool ambient air available at the cooling fan. Ensure that the air flow is unobstructed.

The compressor intake filter must be located in a clean atmosphere. There must be no possibility that radiated heat from for example, a petrol engine can affect the unit or that engine exhaust gases or other pollutants can be drawn into the compressor intake. This is particularly important when the compressed air is to be used for breathing purposes.

There are no complicated procedures involved in using this air compressor. Before putting it into operation check that the sump is full with the correct grade of oil, to the top level mark on the dipstick and that the compressor has sustained no damage in transit. Rotation should be anti-clockwise looking at the flywheel.

After the initial 25 hours running, the third stage inlet sintered filter should be removed and cleaned and thereafter in accordance with the service procedures.

## CONSTRUCTION

The construction of the machine is simple and robust. The crankcase and slipper cylinder is of aluminium and machined in matched halves, dowelled and screwed together on assembly. The ball bearing mounted overhung crankshaft is of spheroidal graphite cast iron. The crankcase has a combined filler and dipstick and a drain extension tube.

The first and second stage piston is aluminium, the slipper piston is cast iron and the third stage floating piston is hard chrome plated steel which operates in a matched cast iron liner.

Both low pressure and high pressure cylinder heads are aluminium. The first stage valve is a combined suction and delivery reed valve consisting of a top and bottom plate with a centre plate to which is attached the reed valves.

The second stage valves are identical in make up and held together with spring pins (refer to valve reconditioning for details).

The third stage valve is a combined spring suction and delivery valve (refer to valve reconditioning for details).

#### **LUBRICATION**

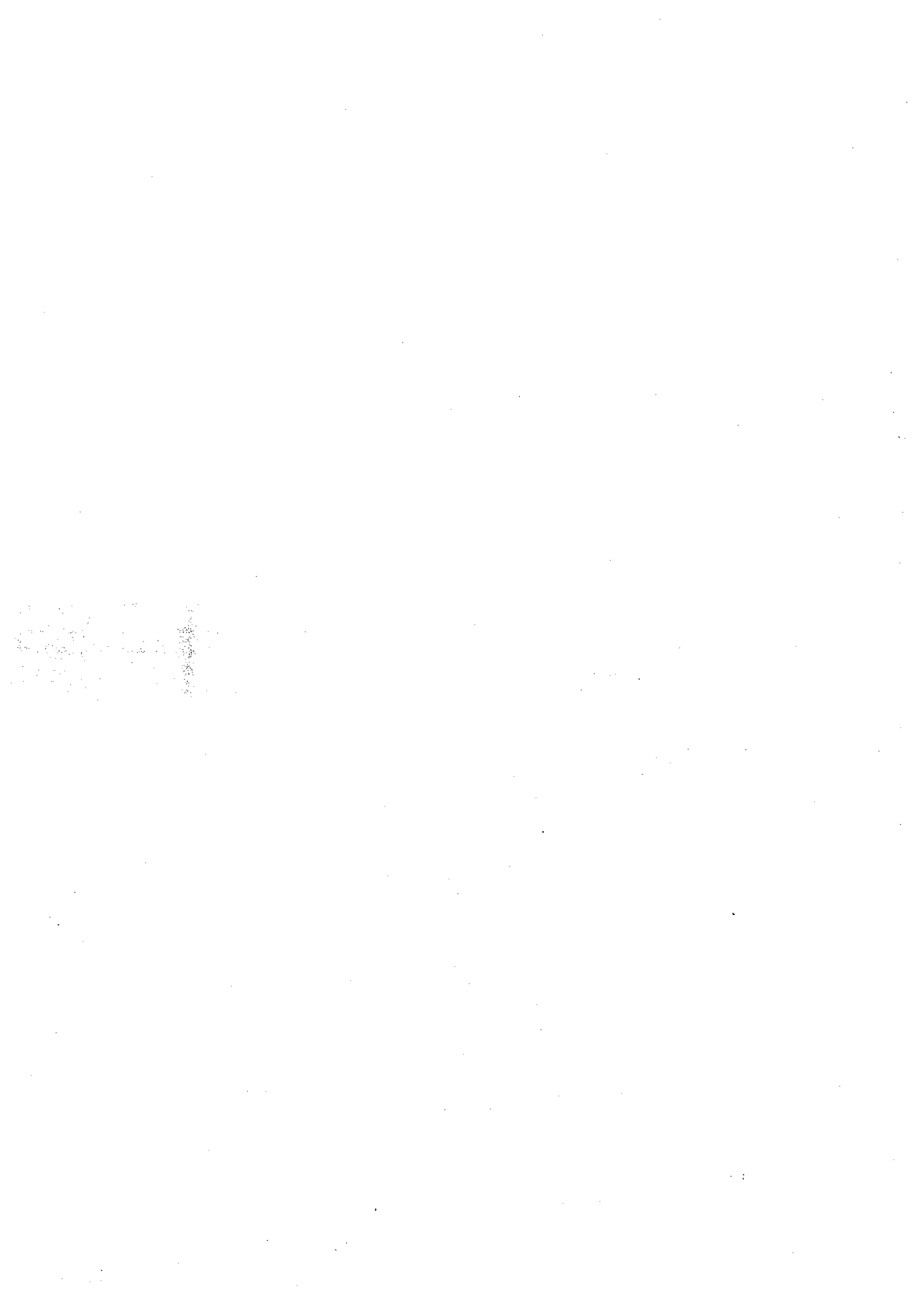
Lubrication is by a combination of controlled splash and crankcase to inlet differential pressure. Splash lubrication is created by a dipper on the high pressure connecting rod (LEADER) which passes through the oil in the crankcase control trough. All parts of the compressor except the upper portions of the first stage are lubricated by this means. The differential pressure which exists between the crankcase and the inlet depression causes oil vapour to travel up the external breather pipe into the inlet thus lubricating the first stage valves and cylinder.

#### **APPROVED LUBRICANTS**

- a) Machines rated up to a maximum pressure of 4000 lb/in<sup>2</sup> (275 bar) Shell Rotella X30 Oil to specification MIL-L-2104B may be used.
- b) Machines rated above a maximum working pressure of 4000 lb/in<sup>2</sup> (275 bar) Anderol 555 Oil must be used. This is a synthetic oil suitable for higher temperatures and is manufactured by Tenneco Chemicals Inc.
- c) The use of any other lubricant without prior approval of Hamworthy Compressor Systems will invalidate product warranty.

**WARNING:** These oils cannot be interchanged, ie. units supplied for use on Shell Rotella X30 oil must not subsequently be used on Anderol 555 oil.

**SECTION 4 - STORAGE**



## STORAGE

**Note:** The following is based on temperate climatic conditions and the periods specified may be superseded by alternatives as directed by the prevailing conditions.

The principal object when storing the compressor for either short or long terms is to remove all traces of moisture within the unit and to replace the normal lubrication oil with an inhibiting oil. The only inhibiting oil approved by Hamworthy Compressor Systems is Shell Ensis 158.

## SHUT DOWN

On manually operated compressors, the unit should be operated for 2 or 3 minutes with the condensate drains open, to purge the system of moisture before shut down. If the unit is likely to be shut down for more than 4 weeks it is advisable to carry out the short term inhibiting procedure.

## SHORT TERM INHIBITING (Up to six months - See Storage Note)

1. Drain off the lubricating oil while the compressor is still warm.
2. Fill compressor to maximum level with Shell Ensis 158 rust inhibiting oil.
3. Run the compressor 'off load' for 20 minutes.
4. Stop the compressor and remove air intake filter. Inject 3 to 4 cc of Shell Ensis 158 into the air intake port and refit the air intake filter.
5. Run the compressor for 1 minute.
6. Drain off the inhibiting oil from the crankcase.
7. Do not run the crankshaft after inhibiting. Attach label indicating the unit is in a rust inhibited condition for six months only.
8. Remove sintered bronze filter element, access to the filter is gained by unscrewing the brass cap and removing the spring from the filter.
9. Wash the filter in white spirit or carbon tetrachloride, dry thoroughly with a low pressure air jet and reassemble.

## LONG TERM INHIBITING

1. Carry out Shut Down Procedure, but run the compressor on a supply of dry air.
2. Carry out Short Term procedure.
3. Remove third stage piston. Coat with a suitable long term protective such as Shell Ensis 256 (Cold dip) or 352 (Hot dip) in accordance with suppliers recommendations, and store separately.
4. Clean and re-oil with Shell Ensis 158 all third stage valve parts and cylinder bore and replace together with head.

5. Place the complete compressor unit in a suitable long term storage container together with suitable desiccants (such as Silica-gel) and ensure that a Humidity Indicator is clearly visible for regular inspection.

#### **START UP - SHORT TERM INHIBITING**

Following Short Term inhibiting, remove all plugs from openings, re-connect the compressor into the installation and re-fill the crankcase with the correct grade of oil.

Run the compressor off-load for 10-15 minutes to fully circulate the oil. The compressor is then ready for duty.

**Note:** Initial running will purge the compressor of inhibiting oil. Care should be taken to see that this does not contaminate system equipment.

#### **START UP - LONG TERM INHIBITING**

1. Remove all plugs from openings.
2. Remove third stage head, remove protective covering from third stage piston.
3. Lubricate with correct oil and re-assemble together with valve gear and head. Tighten head bolts to recommended torque.
4. Refill crankcase with correct grade of oil.
5. Remove all valve covers and Air Cleaner and inject a small quantity of lubricating oil.
6. Turn the crankshaft over by hand for a few revolutions and subsequently run the compressor 'off load' for 10 to 15 minutes. The compressor is then ready for duty.

**SECTION 5 - ROUTINE MAINTENANCE AND OVERHAUL PROCEDURES**



## ROUTINE MAINTENANCE AND OVERHAUL PROCEDURES

### SERVICING

Strict observance of hours run and regular attendance to the maintenance and overhaul schedules are essential for the correct functioning of this compressor unit.

The following servicing information is based on intermittent operational duty and is sectionalised as follows:-

### MAINTENANCE

Routine     Daily  
              75 hours  
              150 hours

Overhaul    'A' Type 400 hours  
              'B' Type 1250 hours

**Note:** Reference Numbers quoted on this section may be identified in Section 8.

### ROUTINE DAILY

1. Check oil level before use. Maintain oil at the top notch on the dipstick for maximum level. The combined oil level dipstick and filler plug is removed from the top of the front of the crankcase by a sharp pull.
2. Refill the crankcase with the approved grade of oil and record the oil used in the log sheet provided in the back of this book.
3. Where a mains line filter separator is incorporated, this should be drained regularly. The frequency of draining will depend upon the duty cycle coupled with the air humidity at the time of operation. The filter separator is charged with activated charcoal compound and should be changed at 20/50 hours intervals. (See Filter Separator Servicing).

### ROUTINE - 75 HOURS

1. Drain off lubricating oil whilst compressor is warm. Refill with correct grade of oil.
2. Remove air filter element, wash in detergent (or as indicated in the supplier's instructions) dry thoroughly in a low pressure air jet and replace.
3. Check all valve holder screws for tightness to the correct torque figure as listed. This refers particularly to the second stage as the security of the valves in their ports depends upon the correct tightening of the suction and delivery valve holders.
4. Remove sintered bronze filter Ref No.98. See Para 2 of Routine - 150 Hours.
5. Clean filter as detailed in Para 3 of Routine - 150 Hours.

## ROUTINE - 150 HOURS

1. Carry out Paras 1 to 3 of 'Routine - 75 Hours'.
2. Remove second to third stage sintered filter Ref No.98. Access to the filter is gained by unscrewing plug Ref No.100. Pull out the retaining spring and remove the filter.
3. Wash the filter in white spirit or carbon tetrachloride, dry thoroughly with a low pressure air jet and reassemble. Ensure the open end of the filter is entered into housing first.
4. Clean all outside surfaces of the compressor to remove any traces of oil or dirt from the heat radiating surfaces of the cylinders and intercoolers.
5. Check all external fastenings and pipe fittings for tightness.
6. Check drive belts for wear and correct tension. Correctly tensioned belts should deflect approximately 3/8" by firm thumb pressure of 1 1/2 - 2 lbs at the centre point of span. Where applicable, always replace belts in matched sets.

## OVERHAUL 'A' TYPE - 400 HOURS

1. Carry out Para 1 and 2 of Routine - 75 Hours.
2. Carry out Paras 2 to 6 of Routine - 150 Hours.
3. Remove all valves and valve springs. Examine the valve seats and discs for signs of pitting, erosion or wear. Light scratch marks on the valve seats and discs may be removed by light lapping. Refer to valve reconditioning.

## VALVE REMOVAL

Isolate the compressor by switching off the main electrical supply and releasing all air pressure before commencing work.

## FIRST STAGE VALVE

This is a combined suction and delivery reed valve consisting of a top and bottom plate with a centre valve plate with reeds attached.

## TO REMOVE

1. Disconnect the air intake filter at the cylinder head.
2. Disconnect the first stage delivery pipe.
3. Pull off the plastic breather pipe.
4. Remove four cylinder head holding down nuts.
5. Lift off the head and valve plate from the studs.

The three sections making up the valve assembly are held together with spring dowels and may be prised apart for inspection.

Worn parts cannot be repaired and it is normally recommended that a complete new assembly is fitted.

## ASSEMBLY

The valve plates must be fitted together so that the 'nick' in the edge of each plate is aligned on assembly.

The cylinder stud retaining holes in the valve plate are on unequal spacings ensuring the valve plate cannot be fitted incorrectly.

**Note:** When replacing the first stage valve plate gasket, the gasket Ref No.19 is placed immediately on the cylinder top face and gasket Ref No.17 on the top face of the valve plate.

## SECOND STAGE

1. Disconnect the union nuts of the intercooler pipes to the cylinder.
2. Undo the capscrews holding the valve covers and remove.
3. Lift out the valve assemblies and seating washers.

## THIRD STAGE

1. Disconnect the union nut of the final delivery pipe at the cylinder head and unscrew the five cylinder head retaining capscrews.
2. Lift off the cylinder head to expose the final delivery valve disc and spring.
3. Remove the delivery valve seat to expose the suction valve disc and springs.

## VALVE RECONDITIONING

### FIRST STAGE VALVE

Because of the make-up of this valve, careful cleaning only can be carried out. Worn reed valves or worn seats cannot normally be replaced. A complete new valve plate assembly is recommended.

Where it is practical to service valve parts, scratches to valve seats and discs may be removed by careful hand lapping with two grades of valve grinding compound. To remove deep marks use Carborundum Grade 360 FINE followed by a lapping paste Carborundum H500-OP. Minor surface marks may be removed using Carborundum H500-OP only.

**Note:** It is vital for the satisfactory operation of the compressor to ensure that after the use of grinding or lapping compounds every trace of the compound is removed.

The most efficient method of doing this is the use of an Ultrasonic Cleaner. Alternatively washing thoroughly in white spirit is advised followed by drying with a low pressure air jet.

## **SECOND STAGE SUCTION AND DELIVERY VALVES**

Both valves are identical. Each valve consists of a seat and guard, held together by a spring dowel, enclosing a tapered coil valve spring and a valve sealing disc. Particular care should be taken when assembling as an incorrectly assembled valve could affect the performance of the compressor. Refer to **SECOND STAGE VALVES REASSEMBLY** for correct fitting.

### **STRIPPING**

1. The valves may be opened up by inserting a sharp blade of a knife between the seat and guard and gently easing it apart.
2. Inspect the valve seat and disc for signs of pitting and scratch marks and the springs for overheating and feathering at the edges.
3. Remove any carbon deposits very carefully, relap the seats and discs as detailed in first stage valve reconditioning and wash in white spirit. If any components are defective, the complete valve must be replaced. Individual valve parts are not available.

### **ASSEMBLY**

1. Place the smaller diameter of the spring over the retaining spigot in the valve guard.
2. Place the valve disc on top of the housing.
3. Take the valve seat, line the hole in the seat with the spring pin and press firmly together.

## **THIRD STAGE SUCTION VALVE AND DELIVERY VALVE**

The third stage seat is formed on the head of the cylinder liner and if in good condition need not be disturbed. Clean off all valve parts as previously described and check for any signs of excess wear or pitting. Relap seats and discs as necessary making sure that all traces of lapping compound is removed.

### **OVERHAUL 'B' TYPE - 1250 HOURS**

The following overhaul involves a complete dismantling of the compressor unit to check on the permissible amount of wear as given in the table of check dimensions. The sequence of a major overhaul has been tabulated as it is felt that this method is easier to follow.

### **STRIPPING PROCEDURE**

1. Drain off the lubricating oil whilst warm.
2. Remove the fan flywheel retaining bolt and washers Ref Nos. 83, 82 and 81 and pull off the flywheel.
3. Disconnect all intercooler pipes and plug all apertures.
4. Remove inline filter housing Ref No.97.

5. Remove the dipstick Ref No.84 and breather pipe Ref No.95.
6. Remove the first stage cylinder head retaining nuts Ref No.29 and washers Ref No.30. Lift off the cylinder head Ref No.16, valve plate Ref No.18 and both gaskets Ref No.17 and 28.
7. Remove cap nut Ref No.48, release locknut Ref No.47 and slacken off adjusting screw Ref No.46 on the third stage cylinder head.
8. Unscrew the five socket screws Ref No.45 and lift off the third stage cylinder head Ref No.44 and collect the third stage suction and delivery valve parts.
9. Remove the third stage cylinder Ref No.43 complete with its piston and liner.
10. Turn the compressor upside down, remove the eight capscrews and separate the crankcase halves. These are located by hollow dowels and will separate easily if tapped lightly with a soft mallet. Remove circlip and washer Ref 72 and 71 retaining the connecting rods to the crankpin. Free the crankshaft and bearings from the upper half of the crankcase and withdraw the crankshaft, leaving the pistons and connecting rods in situ.
11. Lift the first and second stage cylinder Ref No.20 off its retaining studs and push out the connecting rod and piston assembly.
12. Push out the third stage slipper piston and connecting rod assembly from its cylinder.

#### **FIRST AND SECOND STAGE PISTON & CON ROD ASSEMBLY - STRIPPING**

1. Remove all piston rings and label ensuring replacement in exact position.
2. Examine the ring grooves and rings for wear. Refer to Schedule of Limits and Fits for dimensions.
3. Check the connecting rod big end bearing for wear and surface finish.
4. Check for small end bearing wear by holding the piston in one hand and the connecting rod in the other then push and pull repeatedly. No perceivable movement should be detected although a slight rocking movement is acceptable.
5. **IMPORTANT NOTE:**

The first and second stage piston pin is retained in position by means of concave end plugs which are expanded and sealed during assembly. It is most important that these plugs are securely fitted to provide both a perfect seal and prevent displacement during operation. Due to the specialised nature of this procedure, it is strongly recommended that the first and second piston and connecting rod assembly is replaced with a factory fitted unit. Ref No.33. If any of the major components are defective, follow steps 6 to 18 only, if further maintenance to the existing piston/connecting rod assembly is to be carried

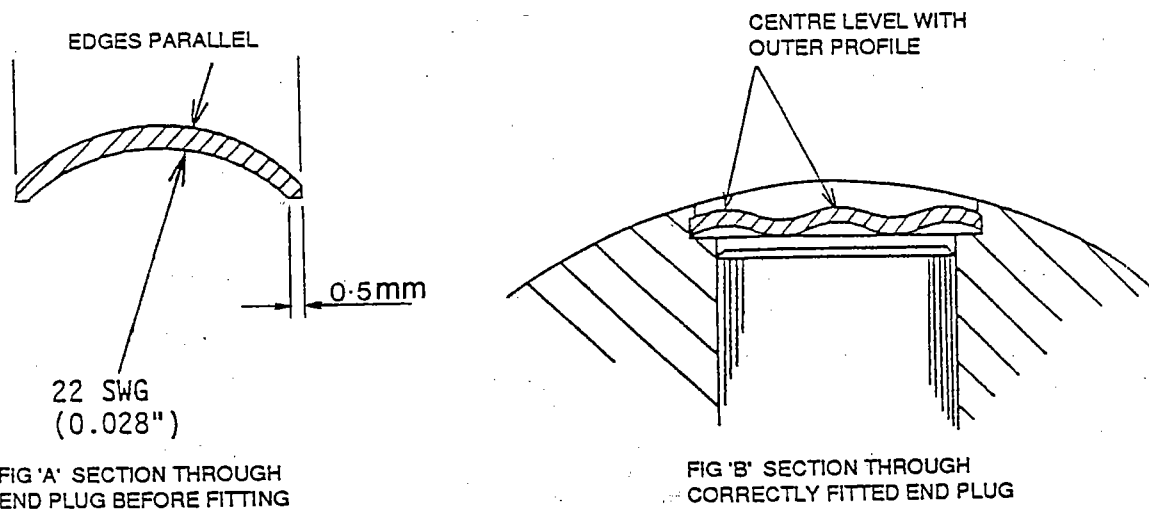
out.

6. Drill a 5mm diameter hole in one end plug and drive out the opposite plug using a 4mm diameter rod passed through the drilled hole.
7. Tap out the remaining end plug.
- 8) Place piston in hot water at a temperature of 80° to 85°C for two to three minutes. Immerse the piston until the water just covers the pin. The pin may then be pushed out with a wooden dowel. Under no circumstances should the pin be drifted out cold as this will damage the pin bores.
- 9) Check the piston pin and bosses for wear. Parts that indicate signs of wear in excess of the dimensions given in the schedule should be replaced by new items.
- 10) Check the connecting rod small end bearing for wear. Replace as necessary. It is recommended that connecting rods are renewed complete, although it is possible to replace the small end needle roller bearing as follows:

The needle roller small end bearing must be pressed into its housing with HCS Tool No.31310 under a hand press. Ensure that the stamped end of the bearing is fitted against the shoulder of the press tool and the lead in chamfer on the housing is uppermost before pressing the bearing centrally in the housing.

- 1 NOTE: The first and second stage connecting rod does not incorporate an oil dipper.
- 11) When fitting a new piston ensure any grooves or stepped diameters are free of sharp edges which may scuff the cylinder wall. These can be removed with a fine stone.
- 12) Place piston in hot water at 80° to 85°C for two to three minutes. Whilst hot, enter piston into first boss and line up the con rod small end pin.
- 13) Push in pin, ensuring that it is centrally located in the pin bosses.
- 14) Wash the piston thoroughly in solvent to remove all traces of dirt or oil deposits.
- 15) The piston pin is retained in position by means of concave end plugs which are expanded and sealed during assembly. Before fitting an end plug, first examine the edge for correct profile. The correct plug is made from 22 SWG (0.028") stainless steel with the edges sharp and parallel to the centreline. A 0.5mm wide flat land should be visible around the periphery of the concave face. See FIG 'A'
- 16) Coat each piston pin recess with Loctite 602. Use Loctite sparingly, ensuring that it does not run on to the piston pin. Fit plug with convex side outwards into one recess. The plug must now be expanded to lock and seal into the small undercut at the bottom of the recess. This can be done with a drift and light hammer but preferably under a press. It is essential that just sufficient load is applied to expand the plug, too much load will force the

centre of the disc inwards, reducing the outside diameter, and it will not be firmly held in place. Use a flat ended drift of 7/16" (11.1mm) diameter and tap smartly or press lightly until the plug resembles profile shown in FIG 'B'. Repeat procedure for opposite plug.



### IMPORTANT

The piston must be carefully supported when sealing the end plugs to prevent scoring or possible distortion, a too small diameter drift would deform the end plug until it became concave and therefore would not seal in the piston pin recess.

- 18) Prior to fitting new piston rings check the ring gaps by inserting them into their relative bores and ensuring they are square, measure the gaps with a feeler gauge. File the piston ring butt ends if necessary to give a closed gap of 0.05 to 0.10mm.
- 19) Fit piston rings in their respective grooves. The second stage rings have internal chamfers that should be fitted facing the piston pin.

### SLIPPER PISTON AND CON ROD ASSEMBLY - STRIPPING

The slipper piston pin is held in position by circlips only.

1. Remove the circlips and push out the piston pin.

Check piston pin bosses and connecting rod as described in first and second stage piston stripping procedure.

### THIRD STAGE PISTON AND LINER

The third stage piston and liner are supplied as a factory matched pair and are produced to very fine clearances. The practical indications that wear has taken place beyond the acceptable limits would be indicated by reduced compressor output and subsequent heavy oil consumption. General wear will also create this condition and must therefore be borne in mind when carrying out a major overhaul. A record kept in the log sheet of oil replenishment up will indicate any sudden increase in oil

consumption.

In the event of damage occurring to either the piston or the liner bore, under no circumstances must the components be individually polished. Any attempts to do so will affect the efficiency of the compressor and would result as already indicated in a loss of output and heavy oil usage.

#### SLIPPER PISTON AND CON ROD REASSEMBLY

**NOTE:** The slipper piston connecting rod incorporates an oil dipper.

1. Insert the piston pin and fit the circlips.

Ensure the circlips are securely fitted in their grooves. Failure to do so could result in damage to the cylinder bores.

#### FIRST AND SECOND STAGE CYLINDER AND PISTON ASSEMBLY

1. Lightly support the cylinder in a vice. Do not overtighten as this could distort the cylinder bores.
2. Lubricate the small end bearing and smear clean lubricating oil over the small end bearing and piston, stagger the ring gaps around the piston diameters and enter the con rod and piston into the cylinder.
3. With the finger tips, press each low pressure ring into its groove at the same time pushing the piston into the cylinder.
4. Should there be any indication of obstruction it will be due to the second stage rings sliding out of their grooves. To overcome this, take a length of 1/8" steel rod (such as welding rod) approximately 8" long, bend one end 3/8" long at right angles. Flatten this bent end with a hammer and file off all sharp edges. The other end of the tool may be bent over to form a convenient handle.
5. Take this tool and place the short end through the valve port in the cylinder and with firm pressure press the second stage rings into their grooves at the same time pushing the piston into the cylinder.
6. Pull the piston down to the bottom of the cylinder. There should be no evidence of a gap between the underside of the first stage piston and the step of the cylinder when viewed through the valve ports.

#### SLIPPER PISTON AND CYLINDER ASSEMBLY

No piston rings are fitted to the slipper piston as this is not a compression area.

1. Smear the piston with lubricating oil and simply slide the piston into the cylinder, which is part of the top half of the crankcase Ref No.61. Ensure the con rod oil dipper points downwards towards the sump.

#### CRANKCASE AND CYLINDER REASSEMBLY

1. Screw in the four cylinder studs Ref No.28 and fit the two

- hollow dowels Ref No.68 into the top half of the crankcase.
2. Paint Wellseal Compound on the crankcase cylinder base and slide the cylinder Ref No.20 down onto the studs, together with the already fitted piston and connecting rod.
  3.
    - a) Take the crankshaft and press on bearing Ref No.70 to the inner journal.
    - b) Place the bearing spacer Ref No.73 onto the shaft.
    - c) Place one circlip Ref No.74 onto the shaft.
    - d) Press the bearing Ref No.75 onto the shaft followed by the final circlip Ref No.74.
  4. With the top half of the crankcase Ref No.61 turned upside down and with the pistons at or near the bottom of their stroke, fit the crankpin into the con rod big ends. To do this the balance weight of the crankshaft must be kept furthest away from the con rod big ends ie. facing out of the crankcase.

Without rotating the crankshaft push the pistons up the bores to allow the crankshaft Ref No.69 to take up its correct position, allowing the main bearings Ref Nos.70 and 75 to rest in their respective half housings and the circlips Ref No.74 in their grooves.

5. Replace the crankpin thrust washer Ref No.71 and secure with circlip Ref No.72.
6. Apply Wellseal Compound to the crankcase joint faces, place the bottom half of the crankcase Ref No.62 into position on the dowels ensuring that the circlips Ref No.74 enter their grooves. Fit the capscrews and tighten.
7. Press or tap the oil seal Ref No.76 into the crankcase so that the outer face is in line with the case.
8. Slide the pulley spacer onto the crankshaft. Ensure 'O' ring Ref No.77 is fitted in the internal groove of the spacer.
9. Using a slave distance piece approximately 1 3/8" thick to represent the hub of the pulley, fit end washer Ref No.81 and bolt Ref No.83 and tighten. This method of assembly will ensure that the roller bearing outer race is gripped in the crankcase without putting side load on the bearings.
10. Attach the inline filter housing Ref No.97 to the crankcase and replace the porosint filter with retaining spring and cap Ref Nos, 98, 99, 101 and 100 respectively.

### THIRD STAGE CYLINDER AND VALVES REASSEMBLY

1. Paint the top face of the slipper cylinder with Wellseal Compound. Use sparingly and ensure none of the compound runs into the cylinder bore.
2. Place the third stage cylinder Ref No.43 on a clean surface with the suction valve seat facing upwards. Paint the face with Wellseal Compound.

3. Place the sealing ring Ref No.51 in its recess on the suction valve seat.

**Note:** The suction valve seat is an integral part of the third stage cylinder liner.

4. Smear clean lubricating oil on the third stage piston and slide squarely into the cylinder.
5. Turn the cylinder head Ref No.44 upside down and place large diameter of valve spring Ref No.15 into the recess in the head. Place the delivery valve disc Ref No.14 onto the spring, recess side down. Place the head to one side ready to be finally assembled.
6. Place the two suction valve springs Ref No.10 one interlocked with the other by placing the convex sides facing each other into the recess of the delivery valve set Ref No.12 and place the suction valve disc Ref No.9 on top of the springs. Hold the valve disc and springs in place using either a .012"/.015" feeler gauge or a similar strip of plastic.
7. Place the assembly directly over the suction valve seat and whilst holding firmly, withdraw the feeler gauge.
8. Check that the delivery valve seat does not rock. This will indicate that the valve disc and springs are positioned correctly.
9. Whilst holding the delivery valve seat in position take the cylinder head with the delivery valve disc and spring in position, slide the head carefully over the delivery valve seat. Ensure the head is firmly in position and with the screw holes in line, fit the five retaining screws down through the head and cylinder. Ensuring that the piston is retained in the bore, place the complete assembly in position on the top of the slipper cylinder.
10. Screw down the socket screws to the torque figure quoted.
11. Replace the limit screw Ref No.46 into the centre hole in the cylinder head Ref No.44 and screw down finger tight. Slacken the screw off half a turn to provide a 0.5 mm working clearance for the third stage delivery valve. Hold the screw firmly in this position with a hexagon key and lock in position with locknut Ref No.47. Replace the capnut and washer Ref No.48 and 49. Refer to torque chart.

#### **FIRST STAGE CYLINDER HEAD AND VALVE PLATE REASSEMBLY**

With the first stage cylinder assembly fitted:-

1. Smear Wellseal Compound on the top face of the cylinder and place gasket Ref No.19 over the studs. Ensure the compound does not enter the cylinder bore.
2. Place the reed valve assembly Ref No.18 on the cylinder. The valve plate cannot be fitted incorrectly as the fixing holes are on unequal spacings.
3. Place gasket Ref No.17 on the plate valve.
4. Smear Wellseal Compound on the machined face of the

cylinder head and fit in position, securing with the nuts and washers Ref Nos.29 and 30 to the torque figure quoted.

## **SECOND STAGE VALVES REASSEMBLY**

Both suction and delivery valves are identical in their make-up so particular care must be exercised when fitting these valves into the cylinder.

The delivery valve Ref No.22 is always located in the valve port on the INSIDE of the vee of the cylinder formation and the SINGLE LARGE diameter hole must be entered first so that it is nearest the piston.

The suction valve Ref No.21 is always located in the valve port on the OUTSIDE of the vee and the SINGLE LARGE diameter hole must be visible with the valve in position.

1. Place the valve seat washers Ref No.23 into the valve port recesses.
2. Place the valves one at a time in the valve port in the correct position as described above.
3. Take the delivery valve holder Ref No.25 and with a new 'O' ring Ref No.26 fitted, replace the valve holder, tightening down the retaining cap screws to the torque figure quoted.
4. Carry out the same procedure for the suction valve using holder Ref No.24. Ensure that the six screws are tightened down evenly.

## **FINAL ASSEMBLY**

1. Replace the intercooler coils ensuring that all union nuts and olives are secure. Do not distort the coils and secure firmly with the support brackets.
2. Fit the fan/flywheel key and replace the flywheel. Lock with the retaining bolt lockwasher and retaining washer. The threads of the retaining bolt should be lightly smeared with Loctite No.241 to provide added security. Under no circumstances must any other Loctite adhesive be used.
3. Rotate the compressor by hand to ensure freedom of movement without fouling by intercooler coils, brackets, etc.
4. Replace the compressor into the system and check the drive belts for correct tension. Refer to Routine 150 Hours.
5. Fill the compressor with the correct grade of oil. Refer to recommended lubricant Section 3. Place compressor into service.

## **REPLACEMENT AND SERVICING PROCEDURE**

### **THIRD STAGE CYLINDER AND LINER**

The cylinder liner Ref No.53 and the suction valve seat are integral and sealed in the cylinder bore using special high temperature sealing rings. Unless there is evidence of wear to the liner bore or to the suction valve seat, the liner need not be removed.

## TO REMOVE LINER

1. With the cylinder head removed, place the top face of the cylinder on a wooden block.
2. Place a metal drift onto the bottom of the liner and press out the liner. Should it refuse to move, a sharp tap with a hide hammer should break the seal. Ensure the diameter of the drift tool does not damage the bore of the cylinder when pressing out the liner.

## REPLACING LINER

1. Clean out the cylinder bore and remove existing sealing rings.
2. Fit new sealing ring into the ring groove in the cylinder bore. Sealing ring Part No.Y20878, Ref No.50.
3. Place a new sealing ring Part No.Y20877, Ref No.51, into recess in the top of the cylinder.
4. Smear the outer face of liner with clean oil. Ensure liner is free of sharp edges that might damage the sealing rings and press the liner into the cylinder. It should enter into position in the cylinder using firm hand pressure.

## FILTER SEPARATOR SERVICING

1. Release all air pressure from the system.
2. Unscrew filter case from its base.
3. Lift off the inner element case from its bottom retaining spigot.
4. Remove the top retaining disc and spring and the felt pad.
5. Dispose of the charcoal element now exposed and clean out the element casing.
6. Recharge with 0.23 Kg of new charcoal element compound and new felt pads.
7. Replace the top retaining disc and spring and place the charged element case on the bottom spigot.
8. Replace the outer case and screw down firmly.

## OVERHAUL CHECK DIMENSIONS

### PISTON RINGS - SIDE CLEARANCE WHEN NEW

First Stage .089/.039 mm Maximum permissible side clearance not to exceed 0.1 mm providing the ring grooves are parallel throughout their depth to the piston rings to provide adequate sealing on the ring faces.

### CYLINDER BORES

First Stage Size + 0.13 mm  
Second Stage Size + 0.13 mm

### CRANKSHAFT

Maximum Permissible Ovality 0.05 mm

### CONNECTING RODS

Part No.Y23132 Trailer without dipper  
Part No.Y23133 Leader with dipper

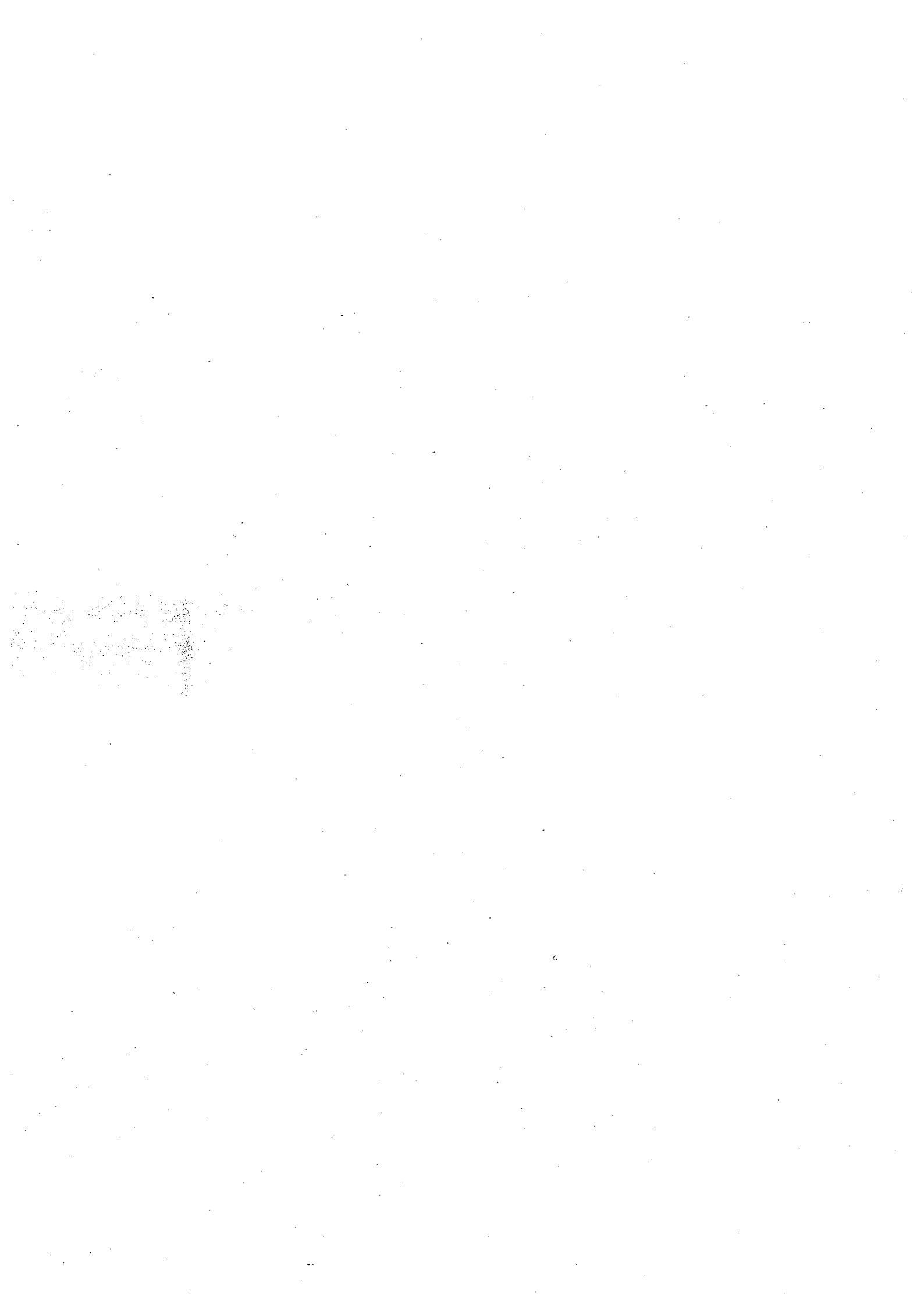
TORQUE LOADINGS	NM	LBS/FT	KG.M
First Stage Cylinder Nuts	7	5	0.69
Third Stage Cylinder Screws	14.0	10.3	1.42
Crankcase Screws	14.0	10.3	1.42
Second Stage Valve Holder Screws	6.0	4.4	0.61
Limit Screw Locknut	6.8 to 8.2	5.0 to 6.0	0.70 to 0.82
Limit Screw Capnut	6.8 to 8.2	5.0 to 6.0	0.70 to 0.82

The above torque figures are for specific applications and must be strictly adhered to.

If the threads are lubricated, the nuts and bolts which have to be tightened to the above will be in danger of stripping their threads. Therefore, before reassembly, wipe the threads with a clean rag.

The following list is recommended for general use on unspecified bolts and nuts etc.

SIZE	LBS/FT	KG.M
2BA	4	0.55
1/4 BSF	5	0.70
5/8 BSF	8.25	1.14
3/8 BSF	13.25	1.83



**SECTION 6 - FAULT DIAGNOSIS**



## FAULT DIAGNOSIS

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FAULT	REASON & REMEDY
1. Light Tapping Noise.	a) H.P. Piston tapping on slipper piston. - Check second stage pressure, should be 100/120 psi (7 Bar), for correct working. - Check H.P. piston for smooth movement.
2. Light Knocking Noise.	a) Small end bearing worn - check and correct. b) Loose flywheel - check and correct. c) Loose valve gear - check and correct.
3. Rumbling Noise.	a) Main bearings worn - check and correct.
4. General Overheating	a) Lack of cooling air - improve ventilation. b) Intercoolers choked with dirt - clean all external surfaces. c) Heat from outside source - move compressor or erect a heat barrier.
5. Local Overheating	a) Recompression taking place - check delivery valve on overheating cylinder for leakage. b) High cylinder pressure - check delivery valve opens freely.
6. Safety Valves Blowing	a) This generally indicates pressure leaking back from following stage - check following suction valve for leakage. b) Cylinder pressure rising from the following stage - check following stage delivery valve for correct lift.
7. Loss of Output.	a) Intake filter blocked - remove and clean. b) First stage suction valve leaking - check valve and replace. c) Piston and ring wear (usually associated with high oil consumption). - Remove piston and check piston rings and pin end pads. Check final stage piston for wear and leakage.

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**SECTION 7 - SCHEDULE OF LIMITS AND FITS**



**SCHEDULE OF LIMITS AND FITS**

DESCRIPTION	DIMENSIONS		REMARKS
	Inches	MM	
<b>CRANKSHAFT</b>			
Crankshaft Main Journal	0.9837	24.987	Surface finish not to exceed 0.8 micrometres.
	0.9833	24.977	
Crankpin Diameter	0.9997	25.393	Surface finish not to exceed 0.4 micrometres.
	0.9993	25.383	

**BIG END BEARING AND PISTON PIN**

Big End Bearing Bore	1.0005	25.413
	1.0000	25.400
Piston Pin Diameter	0.4375	11.113
	0.4373	11.107
Piston Pin Clearance	0.0005	0.013
	0.0000	0.000

**CYLINDER 1st AND 2nd STAGE**

Cylinder Inside Diameter (Major)	2.0009	50.825	Cylinder must be replaced if bore dimensions are more than 0.13 micrometres in excess of the dimensions when new or if scored.
	2.0000	50.800	
Cylinder Inside Diameter (Minor)	1.7726	45.026	
	1.7716	45.000	

**PISTON 1st AND 2nd STAGE**

Piston Outside Diameter (Major)	1.9964	50.709
	1.9953	50.683
Piston Outside Diameter (Minor)	1.7683	44.917
	1.7674	44.892
Compression Ring Groove Width (Major)	0.065	1.651
	0.064	1.626
Compression Ring Width (Major)	0.0625	1.587
	0.0615	1.562
Compression Ring Groove Width (Minor)	0.065	1.651
	0.064	1.626

**SCHEDULE OF LIMITS AND FITS**

DESCRIPTION	DIMENSIONS		REMARKS
	Inches	MM	

**CYLINDER 1st AND 2nd STAGE (Con't)**

Inches    MM

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**CYLINDER 1st AND 2nd STAGE (Con't)**

Compression Ring Width (Minor)	0.062 0.061	1.588 1.562	
Compression Ring Groove Width (Minor Diameter) Bottom Groove	0.127 0.126	3.226 3.200	
Compression Ring End Gap (All Rings)	0.0032	0.08	Replace when gap exceeds 0.6mm.

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**GUIDE CYLINDER, SLIPPER PISTON AND PISTON PIN**

Cylinder Inside Diameter	2.001 2.000	50.825 50.800	
Slipper Piston	1.998 1.997	50.75 50.72	
Piston Pin Diameter	0.4375 0.4373	11.113 11.107	Piston pins are selectively assembled to give 'C' fit (0.0005") clearance.
Piston Pin Clearance	0.0005 0.0000	0.013 0.000	

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**CYLINDER AND LINER 3rd STAGE**

Cylinder Inside Diameter	0.5630 0.5627	14.300 14.292	
Cylinder Liner Outside Diameter	0.5626 0.5623	14.290 14.282	
Cylinder Liner Inside Diameter	0.3353 0.3351	8.515 8.510	

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**THIRD STAGE PISTON**

Bottom End Diameter After Grinding	0.3338 0.3331	8.48 8.46	Tapered length 30.5mm. (Nominal length).
Top End Diameter After Grinding	0.33492 0.33472	8.507 8.502	Parallel length 20.8mm. (Nominal length)

**Note:** The 3rd Stage Piston Part No.Y20118 is assembled in conjunction with the 3rd Stage Liner Part No.Y20115 to form a matched pair with a diametral clearance of 0.00050/0.00075mm.

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**SECTION 8 - EXPLODED DRAWINGS AND PARTS LISTS**



## INTRODUCTION

Spare parts for the Model 3S4-50 may be obtained from:

Hamworthy Compressor Systems  
Spares Parts Department  
Chequers Bridge  
Gloucester  
England  
GL1 4LL

Tel - 01452 528431

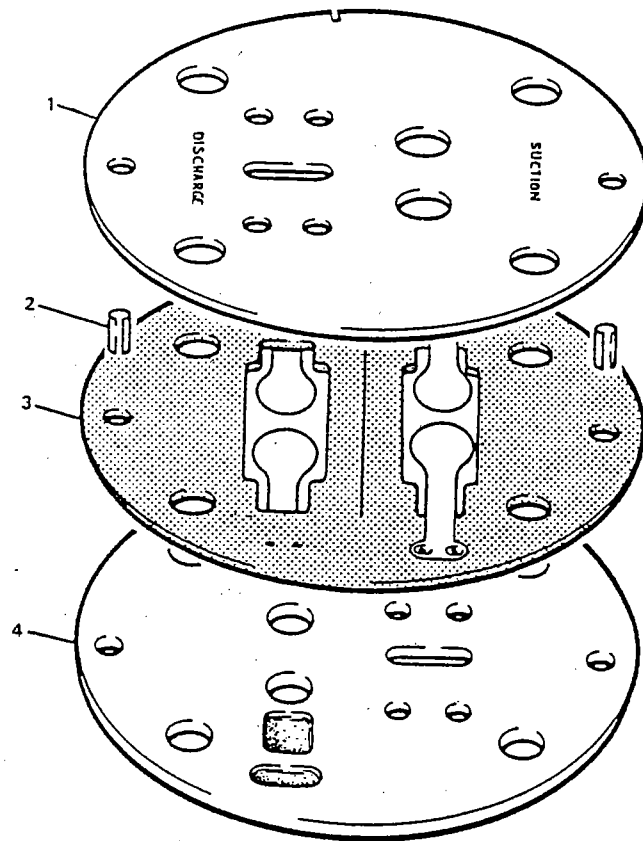
Telex - 43233 WILJAY G

Fax - 01452 507394

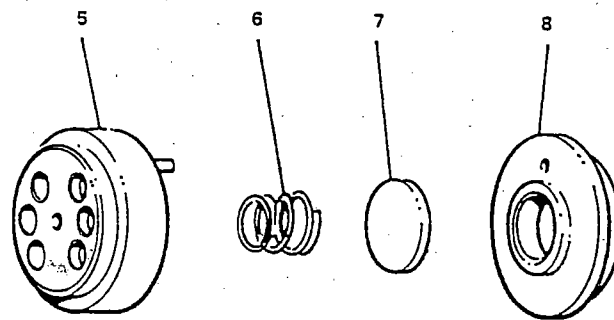
When ordering spare parts, please give the following information:

1. Name, model number and serial number of the compressor. Note that the serial number is stamped on the metal plate attached to the crankcase.
2. Description of part required.
3. Part number of part required.
4. Quantity of parts required.
5. Ordering department's name and full postal address.

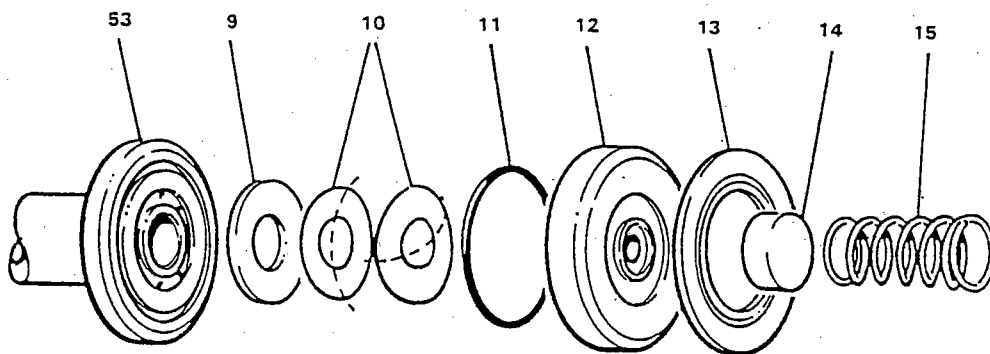
The following tables list the components parts of the compressor, which are also illustrated where possible on the associated exploded views.



1st STAGE SUCTION AND DELIVERY VALVE  
 ASSEMBLY No. 20043 Ref. No. 18



2nd STAGE SUCTION AND DELIVERY VALVE  
 ASSEMBLY No. 13129 Ref. Nos. 21 & 22

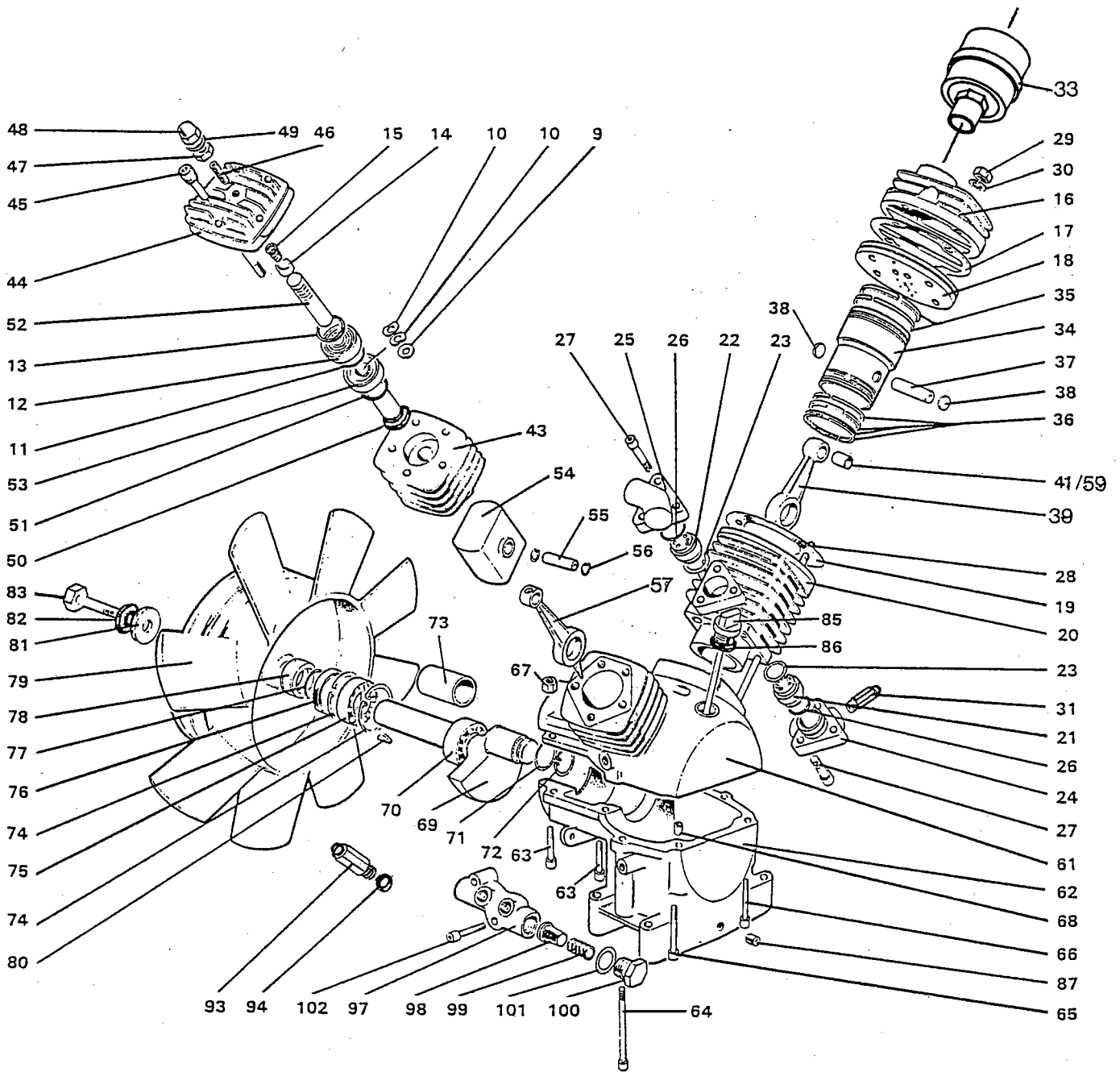


3rd STAGE SUCTION AND DELIVERY VALVE

3S4 VALVE ASSEMBLIES

**VALVE ASSEMBLIES**

ITEM	PART NUMBER	DESCRIPTION	QTY
<b>FIRST STAGE SUCTION AND DELIVERY VALVE ASSEMBLY No.Y20043</b>			
1		Top Plate	1
2		Retaining Pin	2
3		Reed Plate	1
4		Bottom Plate	1
<b>Note: The Reed Valve Assembly Y20043 is available only as a complete assembly.</b>			
<b>SECOND STAGE SUCTION AND DELIVERY VALVE ASSEMBLY No.Y23129</b>			
5		Valve Guard	1
6		Valve Spring	1
7		Valve Plate	1
8		Valve Seat	1
<b>Note: The Second Stage Valve Assembly Y23129 is available only as a complete assembly.</b>			
<b>THIRD STAGE SUCTION AND DELIVERY VALVE PARTS</b>			
9	Y08433	Suction Valve Plate	1
10	Y12197	Suction Valve Spring	2
11	Y20877	Valve Seat 'O' Ring	1
12	Y23137	Delivery Valve Seat	1
13	Y23136	Delivery Valve Seat Seal	1
14	Y16413	Delivery Valve Plate	1
15	Y16411	Delivery Valve Spring	1



3S4-50 COMPRESSOR EXPLODED VIEW

## 3S4-50 COMPRESSOR

ITEM	PART NUMBER	DESCRIPTION	QTY
<b>FIRST AND SECOND STAGE CYLINDER AND HEAD PARTS</b>			
16	Y20862	First and Second Stage Cylinder Head	1
17	Y20179	Cylinder Head Gasket	1
18	Y20043	1st and 2nd Stage Reed Valve Plate Assy	1
19	Y20156	Valve Plate Gasket	1
20	Y20872	First and Second Stage Cylinder	1
21	Y23129	Second Stage Suction Valve Assy	1
22	Y23129	Second Stage Delivery Valve Assy	1
<b>Note: These Valves are identical in their make-up. Refer to Second Stage Valves Re-Assembly.</b>			
23	Y20157	Valve Seating Washer	2
24	Y20858	Suction Valve Holder	1
25	Y20861	Delivery Valve Holder	1
26	Y20796	'O' Ring - Valve Holder	2
27	Y20500/16	Socket Head Capscrew M5 x 16 mm	6
28	Y20905/130	Stud M6 x 130mm - Cylinder Head Fixing	4
29	MCN6Z	Nut M6mm Dia - Cylinder Head Fixing	4
30	MPW6Z	Washer 6mm - Cylinder Head Fixing	2
31	Y38236	First Stage Safety Valve	1
32	*10001/9	Bonded Washer 1/4" BSP	1
33	Y39282	Intake Filter Silencer c/w item 33A	1
33A	Y39282E	Filter Element	1
	Y39296	L.P. Piston/Connecting Rod Assy Comprising Items 34-41	1
	Y20853	<b>FIRST AND SECOND STAGE PISTON ASSEMBLY</b> Comprising Items 34-38	
34	Y20892	Piston	1
35	Y22094	Piston Ring - Major Diameter	2
36	Y20784	Piston Ring - Minor Diameter	4
37	Y20393	Piston Pin	1
38	Y20383	Piston Pin End Pad	2
39	Y23132	<b>LOW PRESSURE CONNECTING ROD ASSEMBLY</b> Comprising Items 40-41	1
40	-	Connecting Rod	1
41	Y39337	Needle Roller Bearing	1
<b>THIRD STAGE CYLINDER AND HEAD PARTS</b>			
43	Y20112	Third Stage Cylinder	1
44	Y20384	Third Stage Cylinder Head	1
45	Y20501/75	Socket Head Capscrew M6 x 75mm	5
46	Y36363	Delivery Valve Limit Screw	1
47	Y27253	Delivery Valve Limit Nut M6	1
48	Y20501/08	Capscrew M6 x 8mm	1
49	Y27254	Capnut Bonded Washer 1/4"	1
50	Y20878	Cylinder Liner 'O' Ring	1
51	Y20877	Valve Seat 'O' Ring	1
<b>THIRD STAGE PISTON AND LINER ASSEMBLY Y38874</b>			
52	Y38873	Piston	1
53	Y20115	Liner	1

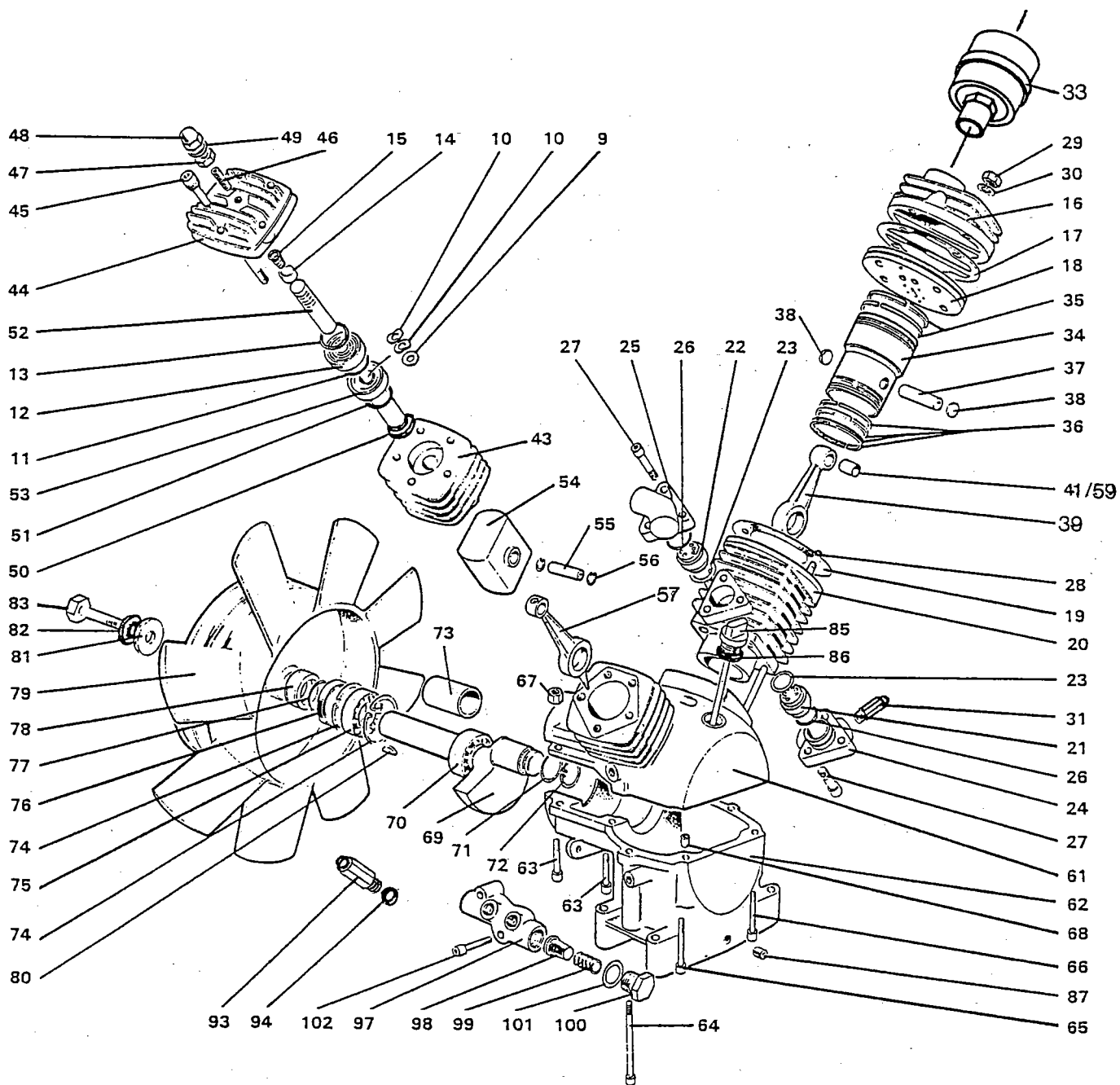
\*NOT ILLUSTRATED



3S4-50 COMPRESSOR

ITEM	PART NUMBER	DESCRIPTION	QTY
<b>THIRD STAGE SLIPPER PISTON</b>			
54	Y20605	Slipper Piston	1
55	Y20393	Piston Pin	1
56	Y24146	Circlip	2
<b>THIRD STAGE CONNECTING ROD ASSEMBLY</b>			
57	Y23133	Comprising Items 58-59	1
58	-	Connecting Rod	1
59	Y39337	Needle Roller Bearing	1
<b>CRANKCASE AND UNIT PARTS</b>			
61	Y20850	Crankcase Top	1
62	Y20851	Crankcase Bottom	1
63	Y20501/50	Capscrew M6 x 50mm	4
64	Y20501/75	Capscrew M6 x 75mm	2
65	Y20501/45	Capscrew M6 x 45mm	1
66	Y20501/40	Capscrew M6 x 40mm	1
67	Y20896	Nut 6mm	4
68	Y20871	Dowel	2
<b>Note: Items 61-68 inclusive are supplied as a complete assembly only No.Y21553.</b>			
<b>CRANKCASE AND UNIT PARTS</b>			
69	Y20857	Crankshaft	1
70	Y20901	Roller Bearing	1
71	Y20124	Big End Thrust Washer	1
72	Y20894	Big End Circlip	1
73	Y20865	Bearing Spacing Sleeve	1
74	Y20902	Circlip	2
75	Y20900	Ball Bearing	1
76	Y20903	Oil Seal	1
77	Y20897	'O' Ring	1
78	Y20868	Pulley Spacer	1
79	Y20860	Pulley and Fan	1
80	Y20793	Pulley key	1
81	Y20870	Pulley Retaining Washer	1
82	Y20642	Shakeproof Washer 8mm	1
83	Y20466/20	Setscrew M8 x 20mm	1
84	*Y13253	Rotation Plate	1
85	Y20912	Dipstick	1
86	Y21912	Dipstick 'O' Ring	1
87	Y17329	Drain Plug	1
88	Y09539	Male Adaptor	2
89	*Y20790	Oil Hole Plug	1
90	*Y21941	Reference Plate	1
91	*Y09926	Drive Screw Size 'O'	4
92	*Y11389	Pressure Plug 1/8" BSP	1
93	Y39162	Second Stage Safety Valve	1
94	10001/9	Bonded Washer 1/4" BSP	1
95	Y26658L	Breather Pipe	1
96	Y14294	Tubing Nut 1/4"	2
96A	Y14295	Tubing Sleeve	2

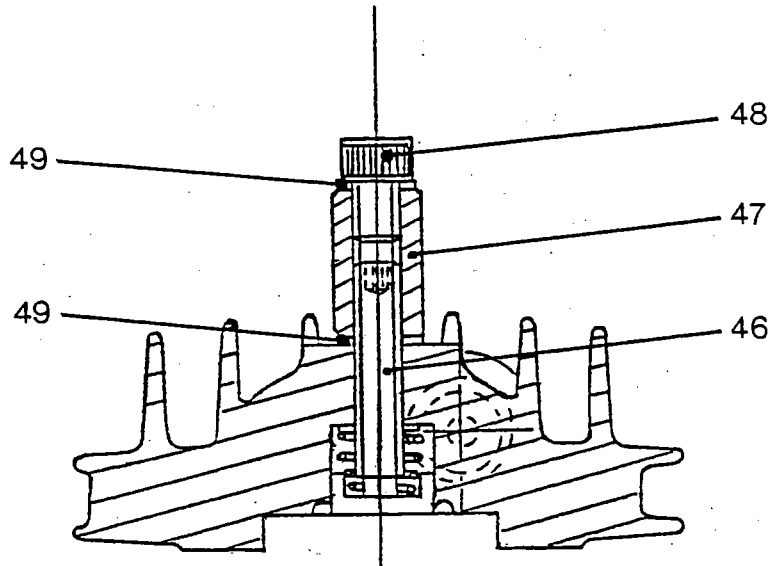
\*NOT ILLUSTRATED



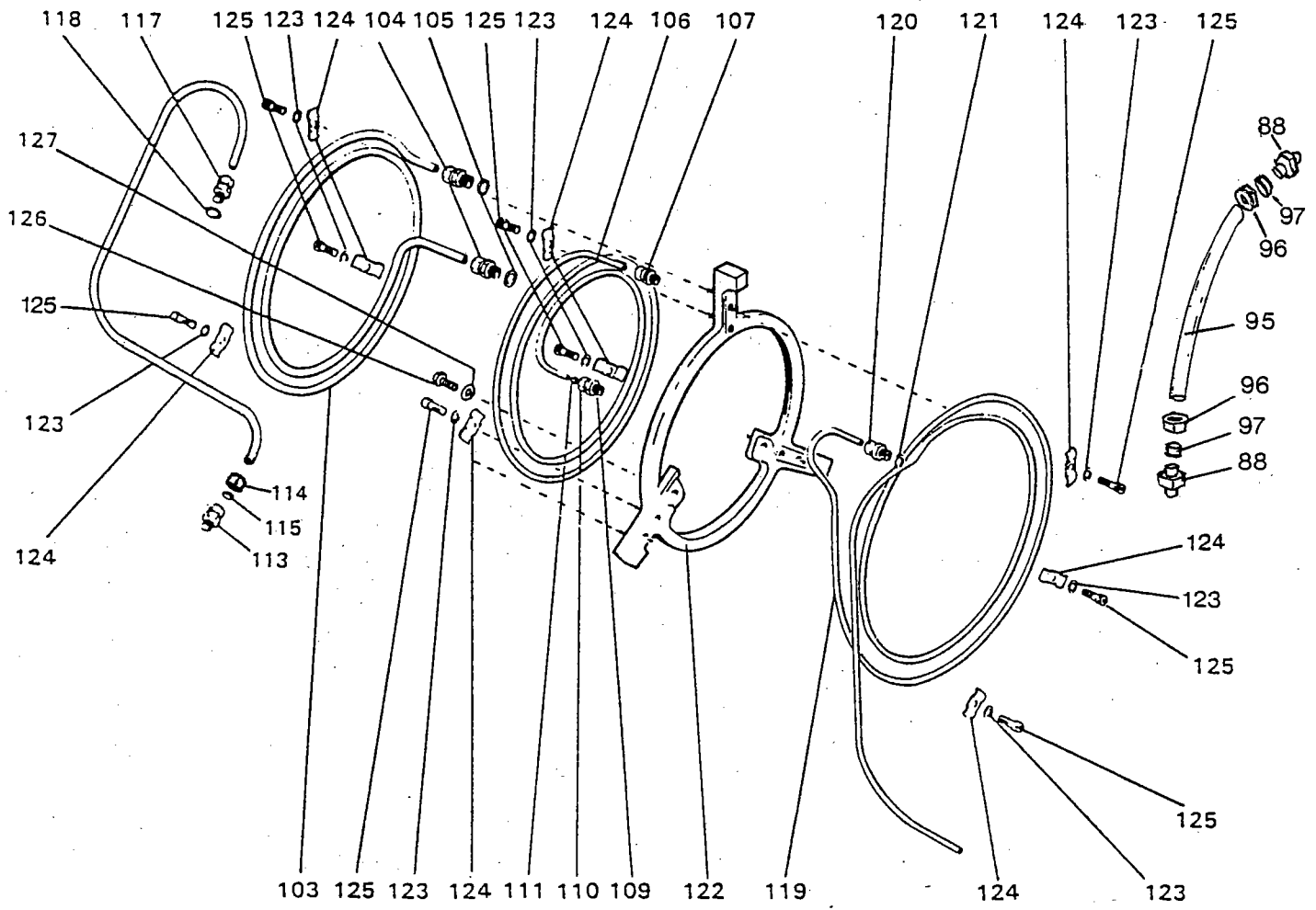
3S4-50 COMPRESSOR EXPLODED VIEW

3S4-50 COMPRESSOR

ITEM	PART NUMBER	DESCRIPTION	QTY
<b>INTERSTAGE FILTER ASSEMBLY No.Y21570</b>			
97	Y20856	Filter Housing	1
98	Y17817	Porosint 37.5 Micron Filter	1
99	Y20588	Retaining Spring	1
100	Y09786	Retaining Cap	1
101	10001/1	Bonded Washer 1/2" BSP	1
102	MCC6/30	Capscrew M6 x 30mm	2



SECTIONAL VIEW OF THIRD STAGE VALVE LIMIT SCREW ARRANGEMENT



**3S4-50 COOLING PIPEWORK ASSEMBLY**

3S4-50 COMPRESSOR

ITEM	PART NUMBER	DESCRIPTION	QTY
<b>FIRST STAGE INTERCOOLER PIPE ASSEMBLY No.Y38872</b>			
103	Y38757	First Stage Intercooler Pipe 3/8" O/D x 63" x 18 SWG	1
104	Y29688	Male Stud Coupling 1/4" BSP x 3/8" Pipe	2
105	Y17969	Bonded Washer 1/4" BSP	2
<b>SECOND STAGE INTERCOOLER PIPE ASSEMBLY No.Y21555</b>			
106	Y20888	Second Stage Intercooler Pipe 1/4" O/D	1
107	Y09540	Tube Adaptor	1
108			
109	Y09539	Male Tube Adaptor 1/8" BSP x 1/4" Pipe	1
110	Y14294	Tubing Nut 1/4" Pipe	2
111	Y14295	Tubing Sleeve 1/4" Pipe	2
<b>FILTER OUTLET PIPE ASSEMBLY No.Y21556</b>			
112	Y20891	Pipe 1/4" O/D	1
113	Y09539	Male Tube Adaptor 1/8" BSP x 1/4" Pipe	1
114	Y14294	Tubing Nut 1/4" Pipe	1
115	Y14295	Tubing Sleeve 1/4" Pipe	1
116			
117	Y20798	Male Stud Coupling 1/4" BSP x 1/4" Pipe	1
118	10001/9	Bonded Washer 1/4" BSP	1
<b>AFTERCOOLER PIPE ASSEMBLY No.Y21557</b>			
119	Y23431	Aftercooler Pipe 1/4" O/D	1
120	Y20798	Male Stud Coupling 1/4" BSP x 1/4" Pipe	1
121	Y23113	Sealing Washer 1/4" BSP Aluminium	1
<b>INTERCOOLER FIXING BRACKET ASSEMBLY No.Y22873</b>			
122	Y22595	Intercooler Bracket	1
123	Y09515	Shakeproof Washer	9
124	Y23438	Bracket Pipe Clip	9
125	Y20500/16	Socket Head Capscrew M5 x 16mm	9
126	MCS6/16Z	Hexagon Head Setscrew M6 x 16mm	2
127	Y20641	Shakeproof Washer	2

## 3S4-50 AIR COMPRESSOR VALVE SERVICING KIT FOR 'A' TYPE OVERHAUL

PART NUMBER	DESCRIPTION	QTY
Y08433	Valve Disc	1
Y12197	Suction Valve Spring	2
Y16411	Delivery Valve Spring	2
Y16413	Delivery Valve Plate	1
Y17380	Bonded Seal	4
Y17969	Bonded Seal	6
Y18071	Seal	2
Y20043	Reed Valve Assembly	1
Y23137	Delivery Valve Seat	1
Y20156	Cylinder Valve Gasket	4
Y20157	Sealing Washer	4
Y20179	Cylinder Head Gasket	2
Y20796	'O' Ring	4
Y20877	'O' Ring Valve Seat	6
Y20878	'O' Ring Cylinder Liner	2
Y22241	Bonded Seal	2
Y22280	Valve Disc	2
Y23136	Valve Seat Seal	1
Y23130	Valve Spring	2



