



सत्यमेव जयते

भारत सरकार
GOVERNMENT OF
INDIA
रेलवे विभाग
MINISTRY OF
RAILWAYS

एसी ईएमयू एवं एमईएमयू
के कम्प्रेसर के
अनुरक्षण की लघुपुस्तिका

**MAINTENANCE HANDBOOK
ON COMPRESSORS OF
AC EMU & MEMU**

**TARGET GROUP - AC EMU/MEMU CARSHED ARTISANS/
SUPERVISORS**

CAMTECH/E/2003/EMU-CP/1.0

कैमटेक/ई/2003/ईएमयू-सीपी /1.0

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**Centre
for
Advanced
Maintenance
TECHnology**



Excellence in Maintenance

रेलवे विभाग, नई दिल्ली - 474

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FOREWORD

With increasing passenger traffic in Metropolitans & their connected cities, reliability of AC EMU/MEMU has become very important. Proper maintenance of compressor is vital to ensure good reliability and availability of EMU/MEMU.

CAMTECH has prepared this handbook to cover all essential aspects of maintenance of air compressor of AC EMU/MEMU.

This handbook describes various maintenance schedules, trouble shooting & overhauling procedure.

I am sure the book will prove to be very useful to our maintenance staff in ensuring reliability of this equipment and thus bring about overall benefit to the Indian Railways.

CAMTECH, Gwalior
Date :21.11.2003

C.B.Middha
Executive Director

PREFACE

The air compressor fitted on AC EMU/MEMU is an important equipment which supplies compressed air for operation of electro-pneumatic brakes, horns, wipers and other pneumatically controlled equipment. Its proper upkeep and maintenance is necessary to ensure good reliability and availability of AC EMU/MEMU.

This handbook on maintenance of air compressor has been prepared by CAMTECH with the objective of making our maintenance personnel aware of correct maintenance and overhaul techniques to be adopted in field.

It is clarified that this handbook does not supersede any existing provisions laid down by RDSO or Railway Board and it is not a statutory document.

I am sincerely thankful to Director (PS & EMU) RDSO/LKO for his valuable comments. I am also thankful to all field personnel who helped us in preparing this handbook.

Technological upgradation and learning is a continuous process. Hence feel free to write us for any addition/modification in this handbook. We shall highly appreciate your contribution in this direction.

CAMTECH, Gwalior
Date : 21.11.20003

Randhawa Suhag
Director (Electrical)

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CHAPTER 1

GENERAL DESCRIPTION

1.1 INTRODUCTION

The compressor fitted below under frame on AC EMU/MEMU supplies compressed air for operation of electropneumatic brakes, horns, wipers and other pneumatically controlled equipments. It is fed with 110V DC by auxiliary rectifier which is connected to 141-volt auxiliary winding.

It is horizontal, three cylinder, two stage and air-cooled compressor. It is directly driven through an extended crankshaft by an integral electric motor and forms a monoblock. The cylinders and cylinder heads are covered by an aluminium shroud and cooled by air drawn in by the common fan to cool the motor and the compressor.

At present in BG AC EMU/MEMU KPC's 3HC-55 and ELGI's TRC-1000 DCM are in use.

The general parts/components of above type of compressors are given below. Slight differences which are there between the KPC and ELGI compressor are indicated.

1.2 CRANKCASE

The crankcase is made of high-grade cast iron in ELGI make and of cast aluminium in KPC make compressor into a single casting. This houses the crankshaft assembly and acts as the sump for the lubricating oil and has access to the

interior for inspection, maintenance and repairs. The low-pressure (LP) cylinder block and the high-pressure (HP) cylinder are fitted horizontally. The shroud, oil pump oil filter and the motor mounting bracket are also fitted to the crankcase. The crankcase is provided with a vent assembly, oil filter and two magnetic drain plugs to purify the oil by attracting magnetic impurities.

1.3 CYLINDERS

The two L.P. cylinders are made into single aluminium casting, which is fitted with centrifugally casted, close-grained graded cast iron liners for each cylinder. The inlet and discharge valves are individual disc valves and are assembled into the cylinder head using, clamping bushes, cages and valve caps. The inlet and outlet ports of the cylinder heads are threaded and fitted with pipe connections. These connections are then sealed in the shroud by sealing ring gaskets.

1.4 SHROUD

A cast aluminium shroud is provided to completely enclose the cylinders and cylinder heads. The cooling air for the cylinders and cylinder heads passes through the shroud. A cover is provided on the shroud for servicing the valves on the cylinder head, without removing the shroud or cylinder head.

1.5 CRANKSHAFT

The crankshaft is an integral forged shaft common for the compressor and the motor rotor. The journals and throws are induction hardened, ground to close tolerance and are dynamically balanced. Holes are provided in it for conveying the lubricating oil to the bearings.

1.6 CONNECTING ROD

There are three connecting rods, which are forged and identical. The big end is split type for easy assembling and dismantling and is provided with bimetal bearing. The small end is provided with phosphor bronze bush bearing. A hole is provided in the connecting rod to convey the lubricating oil from the big end to the small end. The connecting rod is precision machined, with the cap in position. Therefore the cap should not be interchanged or reversed and is suitably marked to identify it with the respective connecting rod.

1.7 PISTONS

The LP and HP pistons are of automotive type. The LP pistons are die cast from low expansion aluminium alloy. The HP piston is made of cast iron. All the pistons are provided with five piston rings comprising of one no. plain compression ring, two nos. stepped compression rings and two nos. slotted oil control rings. The gudgeon pins are of chrome steel, case hardened and precision ground which is assembled into the piston with hand push fit at room temperature and locked by two internal circlips.

1.8 BEARINGS

1.8.1 Main Bearings

The main bearings are bimetal bush bearings, lubricated by the force feed lubrication system of the compressor. The bearing bush of the non-driving end is seated in the crankcase and that of the driving end is seated in the motor mounting bracket.

1.8.2A Connecting Rod Big End

The big end of the connecting rod is provided with split type steel backed bimetal bearing. It is lubricated by the force feed lubrication system of the compressor.

1.8.2B Connecting Rod Small End

The small end of the connecting rod is provided with phosphor bronze bush bearing which is also lubricated by the force feed lubrication system of the compressor.

1.9 OIL FILTER, STRAINER AND DIPSTICK

The oil filter is an integral part of the crankcase. It is provided with a strainer to prevent entry of solid particles into the crankcase along with the oil. This strainer can be removed for cleaning. The cap of the oil filter is screwed into the crankcase and is fixed by a chain. The cap is provided with an integral dipstick with maximum and minimum oil level marks to check the oil level in the crankcase.

1.10 CRANKCASE VENT

An air vent along with aluminium elbow is fixed to the side of the crankcase.

1.11 AIR FILTER

The compressor is fitted with an oil bath air filter (not supplied by KPC or ELGI) of suitable capacity. Some of Railways are using dry type air filters also. It is connected to the suction side of the LP cylinder head.

1.12 INTER-COOLER

The compressor is fitted with an inter cooler. The inlet of the inter-cooler is connected to the outlet of the LP cylinder head and the outlet of the intercooler is connected to the inlet of the HP cylinder head using suitable piping. It is provided with a safety valve and set to the rated pressure. A drain cock is also provided at the lowest point to drain out the condensate.

1.13 AFTER-COOLER

An after cooler of adequate capacity is fitted in between the discharge of the HP cylinder head and the non-return valve on the air receiver. It is fitted with a safety valve set to the rated pressure. A drain cock is also fixed on it to drain out the condensate.

1.14 COOLING SYSTEM

The motor as well as the compressor is cooled by radial flow of the air circulated by a fan provided in the motor mounting bracket and mounted on the extended crankshaft. The same air passes through the motor mounting bracket into the shroud. There it cools the cylinders and cylinder heads and passes out.

1.15 LUBRICATION SYSTEM

The lubrication system is piloted by a positive displacement of lube type oil pump. The drive of the pump is taken by the rotor shaft through a spigot at its end which seats into the slot at the end of the crankshaft. The rotor shaft is keyed into the inner rotor. The inner rotor rotates at the speed of the crankshaft. The outer rotor rotates in the oil pump housing and revolves eccentrically about the inner rotor, thus pumping the oil.

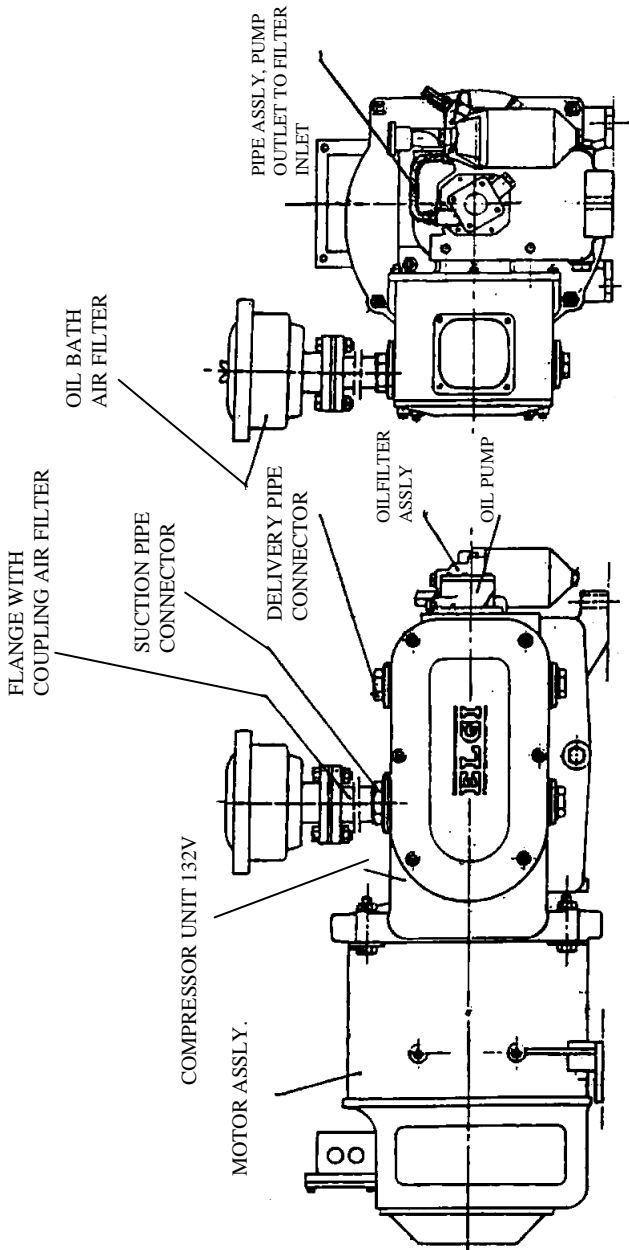


FIGURE 1.1 : ELGI AIR COMPRESSOR ASSEMBLY

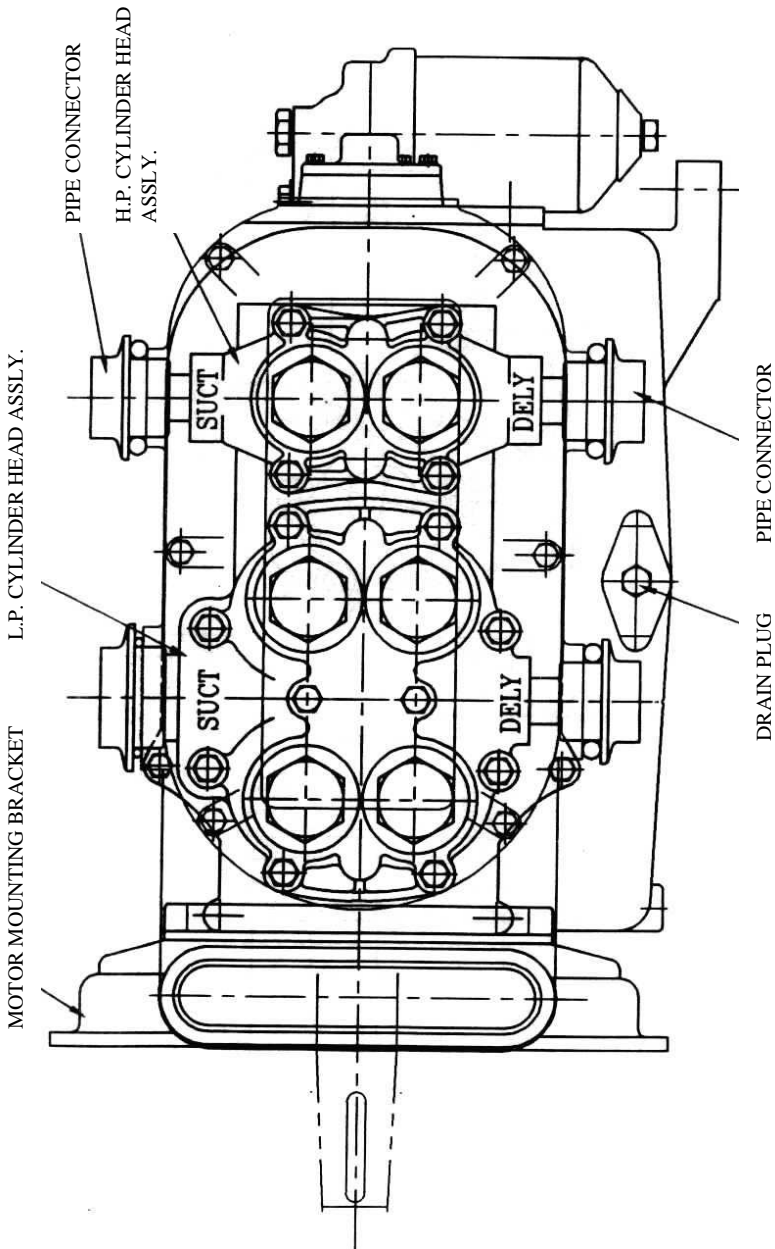


FIGURE 1.2 KIRLOSKAR AIR COMPRESSOR ASSEMBLY

1.16 TECHNICAL DATA OF COMPRESSOR

1.	<i>Make</i>	ELGI	KIRLOSKAR
2.	<i>Model</i>	TRC 1000 DCM	3 HC-55
3.	Type	Reciprocating, air cooled, force- feed lubricant, monoblock.	Reciprocating, air cooled, force feed lubricant, monoblock
4.	Free air delivery	1100 lpm	1150 lpm
5.	Working pressure	7.0 kg/sq. cm	7.0 kg/ sq. cm
6.	<i>No. of cylinders</i>	3 (LP-2 & HP-1)	3 (LP-2 & HP-1)
7.	No. of stages	2	2
8.	Cylinder bore and stroke length (mm)	LP – 106 x 76, HP – 84 x 76	LP-106.375 x 76.20, HP 84.138 x 76.20
9.	Speed – rpm	1160 rpm	980 rpm
10.	Type of valves (suction and delivery)	Individual concentric disc valves for suction & delivery	Individual concentric disc valves for suction & delivery
11.	Overall dimensions (L x W x H) 110V	1245 x 590 x 510 mm	1200 x 600 x 550 mm
12.	Crankcase oil capacity	Min. 3.25 litres Max. 6.25 litres	Min. 3.1 litres Max. 6.2 litres

13.	Direction of rotation	Clockwise, when viewed from the non-driving end.	Clockwise, when viewed from pump end
14.	Safety valve setting on the inter cooler	3.2 kg/ sq. cm	3.2 kg/ sq. cm
15.	Safety valve setting on the after cooler	8 kg/ sq. cm	8.0 kg/ sq. cm
16.	Lubricating oil pressure range	2 –3.5 kg/ sq. cm	2.10–3.5 kg/ sq. cm
17.	Differential pressure to operate oil by-pass valve	1.05 to 1.4 kg/ sq. cm	1.05 to 1.40 kg/ sq. cm
18.	Net weight of compressor with motor	405 kg.	400 kg.
19.	Lubricating oil grade	SP-150 (IOC)	SS-68(IOC)

1.17 TECHNICAL DATA OF MOTOR

1.	<i>Make</i>	ELGI
2.	<i>Model</i>	160 EMC/1
3.	<i>Output power</i>	9.12 kw
4.	<i>Voltage</i>	110V
5.	<i>Current</i>	99A
6.	<i>Speed</i>	1160 RPM
7.	<i>Direction of rotation</i>	Anti-clock wise (as reviewing from comm.end)
8.	<i>Enclosure</i>	IP 55

9.	Type of cooling	Fan cooled
10.	Connection	Series
11.	Frame	160 EMC
12.	Insulation	Class F
13.	Rating	S1 continuous
14.	Grade of carbon brush	EG 236 S
15.	Specification	70 B.M. 41
16.	Ambient temp.	50°C
17.	Weight	265 kgs (Approx.)
18.	Resistance values at 200°C	
a.	Armature winding	0.0217375 ohms
b.	Series field winding	0.0324619 ohms
c.	Interpole winding	0.0164926 ohms.
19.	Lubrication	
a.	Lubrication	Servo gem 3 Veedol AP 3 Shell alvania 3 Multi purpose grade – H
b.	Frequency	18 months
20.	Brush gear	
a.	No. of brush studs	4
b.	No. of brushes/ studs	2 each
c.	Clearance between brush box & commutator	1.5 to 2.5mm
21.	Commutator	
a.	Diameter (New)	152mm
b.	Permissible minimum diameter	137 mm
c.	Depth of undercut	Max-1.5mm, min-0.8mm
d.	No. of segments	113

CHAPTER 2

MAINTENANCE

2.1 INSPECTION SCHEDULES FOR COMPRESSOR

The unit should be properly maintained as per the under mentioned schedules.

2.1.1 Daily Inspection

- Check oil level of air compressor, if required, top up with correct grade of oil.
- Drain the inter cooler, after cooler & air reservoir.

2.1.2 Trip Inspection (10 days)

- Clean the compressor thoroughly.
- Check oil level in crankcase, if required, top up with correct grade of oil up to the maximum level.
- Check compressor air filter and clean if necessary.
- Drain the inter cooler, after cooler & air reservoir.
- Check compressor crank case breather pipe.
- Check for any abnormal sound.
- Check the working of compressor.

2.1.3 IA Schedule (45 days)

In addition to all checks of trip inspection, carry out following checks.

- Clean the oil filter strainer.
- Check vibration.
- Check tightness of mounting bolts & fasteners.
- Check air leakage at pipe lines and safety valve.
- Check condition of crankcase oil and replace if necessary.

2.1.4 IB Schedule (90 days)

In addition to all checks of IA schedule, carry out following works.

- Check the safety valve setting.
- Dismantle the breather and clean it.

2.1.5 IC Schedule (180 days)

In addition to all checks of IB schedule, carry out following works.

- Open the crankcase side cover and check all the connecting rod nuts and the split pins.
- Renew oil in compressor crankcase.
- Change the oil filter element assembly.
- Clean the inter cooler and after cooler.
- Check oil pressure.
- Remove the valves from the cylinder head, dismantle and clean them thoroughly. Examine all the parts for excessive wear or damages and replace, if required. Reassemble the valves and assemble them to the cylinders with new packing.
- Check and service the safety valves, test & set them for correct operation.
- All the pipe joints to be checked for any leakage and packings may be renewed if necessary.
- Give attention to the following points while compressor is working.
 - i. Any abnormal sound or vibration.
 - ii. Discharge of air from the breather.
 - iii. Abnormal temperature.
 - iv. Setting of safety valves as given in technical data.
 - v. Check the leakage of lube oil.

NOTE:

1. On installing a new or reconditioned compressor of KPC make, the first oil change should be carried out after 50 hours of operation.
2. On installing a new compressor of ELGI make, the first oil change should be carried out after 150 hours of operation.

Before draining the oil the compressor should be run for a few minutes & drain the oil when it is warm.

CHAPTER 3

OVERHAULING

(Periodicity – 18 Months)

3.1 GENERAL

- The compressor should be completely dismantled by experienced staff.
- All the parts should be thoroughly cleaned, examined and repaired in a clean surrounding.
- Change all the items as per overhauling kit.

3.2 *REMOVAL OF COMPRESSOR FROM MOTOR COACH*

- Disconnect the lead connections from the junction box & earth lead connection.
- Before dismantling the unit from the carriage, make sure that the pipe lines are free from compressed air.
- Open the safety valves manually and open the drain cocks on the inter cooler and after cooler to release compressed air if any.
- Remove the pipe fittings and then the air filter without spilling the oil.
- Remove the compressor unit by opening the foundation bolts. Use hydraulic trolley to remove compressor unit.
- Clean the unit externally.
- Bring the unit to auxiliary repair shop.

3.3 DISMANTLING

- Remove the motor portion from the compressor.
- Remove the rotor and fan from the compressor shaft.
- Drain the oil from crankcase by opening drain plug.
- Disconnect the oil filter assembly and oil pump assembly.
- Remove the pipe connectors at the suction and delivery ports of the cylinder heads.
- Disconnect the oil filling cap and breather.
- Open the inspection cover by opening the nut.
- Remove split pin from big end bearing nut.
- Open the castle nut of big end bearing.
- Open the shroud cover by opening nut
- Take out the HP & LP head assembly.
- Take out the shroud by unscrewing nuts & bolts.

3.4 CYLINDER HEADS

- Remove the nuts fixing the cylinder head to the cylinder.
- Use a mallet and tap the sides of the cylinder head and take it out.
- Decarbonize and clean it thoroughly.
- Examine cylinder head for any damage.
- Use new gasket and spring washers below the nuts.

3.5 SUCTION AND DELIVERY VALVES

- Inspect all the parts for pitting, wear and distortion.
- Ensure that the locating pin is not worn out or bent or loose in vent seat.
- Renew the valve plates and spring plates in order to avoid fracture due to fatigue.
- Never use reconditioned valve plates.
- Valve seats should be reconditioned only by skilled personnel since air tightness and correct operation of the valve depends on the finish and flatness of the seating surface.
- If valve seat, seating face is damaged it should be replaced.
- The seat depth should be minimum 0.5mm.(Elgi)
- Reassemble the valve.
- Fit the spring plates properly on the locating pin.
- Tighten castle nuts with correct torque and provide split pins.

Tightening Torque

5/16” BSF/BSW	2.8-3.5 kg/sqcm.
3/18” BSF/BSW	4.2-4.8 kg/sqcm.

3.5.1 Checks After Valve Assembling

- **Valve lift** : The valve lift should not be less than 1.2mm(Elgi)
- **Leakage test** : Fill the hollow space in the valve seat with petrol on the valve plate. The time in which the petrol gets drained off should not be less than one minute.

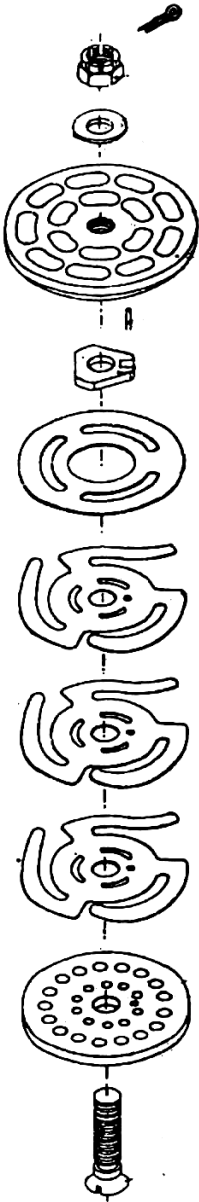


FIGURE 3.1 VALVE ASSLY. INLET



FIGURE 3.2 VALVE ASSLY. DISCHARGE

3.6 CYLINDERS

- Remove the nuts fixing the cylinder to the crankcase.
- Use a mallet and tap the sides of the cylinder to separate it from the crankcase.
- Slowly pull out the cylinder.
- Examine the cylinder bore visually for any damage.
- Measure the bore diameter at the top and bottom at two places 90° apart.

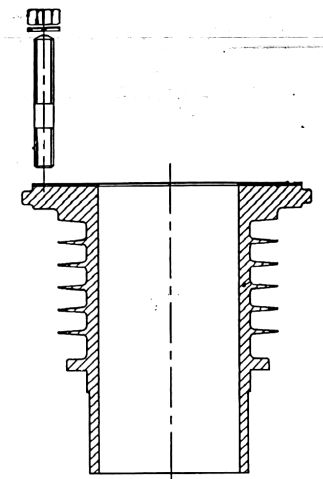


FIGURE 3.3 CYLINDER

- Change the cylinder or the piston if damaged.
- When changing the liners of the LP cylinder, take care to use a new 'O' ring below the liner step.
- Check clearance between the piston and liner bore at right angles at three places, viz. at the top of the liner, middle of the liner and at the bottom of the liner.
- Measure the dimension of the piston at the skirt at 90° to the gudgeon pin bore.
- Check the dimensions of the HP cylinder. Replace it with a new one if damaged or worn out beyond limits.

3.7 CONNECTING RODS

- Remove the nuts fixing the side cover to the crankcase and remove the split pins from the connecting rod bolts and unscrew the nuts.
- Take out the connecting rod bolts. Use a mallet and lightly knock out the connecting rod cap.
- Take out the connecting rods through the crankcase opening for the cylinder.
- Provide new big end bearings and small end bush.
- When changing the bearings, ensure that oil holes are properly located and fully opened.
- Check for correct fit on the crankshaft.

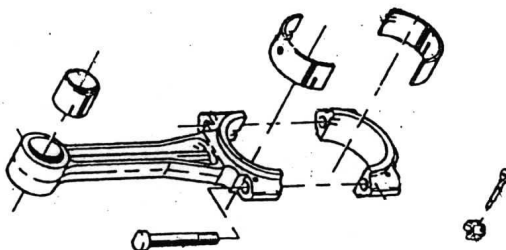


FIGURE 3.4 CONNECTING ROD AND CAP WITH BEARING

3.8 MOTOR MOUNTING BRACKET

- Unscrew the nuts fixing the motor mounting bracket to crankcase.
- Tilt & seat the oil pump fixing face of the crankcase on the floor.
- Unscrew the oil seal housing allen screws and remove the oil seal housing and oil seal.
- Using a circlip plier, remove the circlip on the crankshaft.
- Take out the motor mounting bracket and then the crankshaft from the crankcase.

3.9 PISTON & PISTON RINGS

- Replace small end bearing bush if piston is shaking on connecting rod.
- Use a circlip plier and remove the circlip from the piston.
- Knock out the gudgeon pin from the piston.
- Examine the gudgeon pin for damages.
- Take out the rings using a piston ring expander.
- Clean the piston and the ring grooves thoroughly, after de-carbonizing it.
- Assemble the rings in their respective grooves and measure the side clearance using a feeler gauge. If it exceeds the specified limit, replace with a new set for each piston.
- Insert the ring into the respective cylinder in such a way that it is in level with the top surface and then measure the butt clearance using a feeler gauge. If it exceeds the specified limits, provide new rings using proper tools.
- Never forget to lubricate the rings before assembling.
- The side marked “TOP” on the rings should face the top side of the piston.
- The piston should be assembled to the connecting rod and check for correct fit.
- The gudgeon pin should be push fit in the connecting rod bore.
- Before assembling the piston into cylinder, ensure that the gaps of adjacent rings are in opposite direction. It controls oil leak and prevents compressed air leak to increase the efficiency of the compressor.

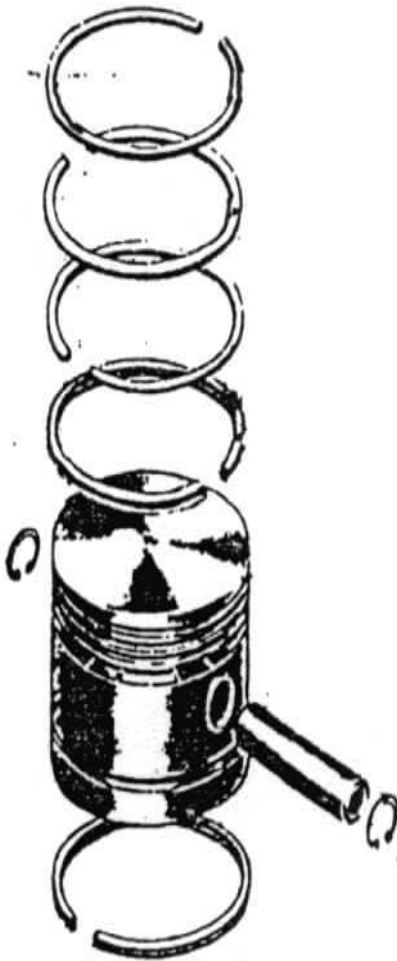


FIGURE 3.5 L.P.PISTON ASSLY.

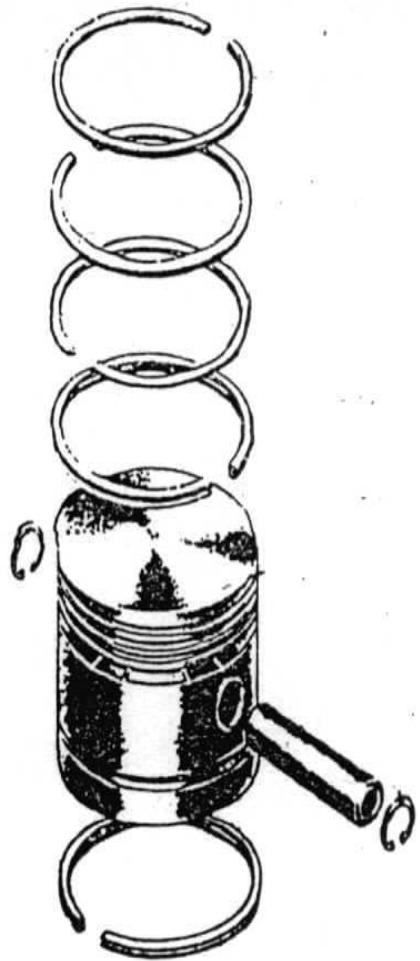


FIGURE 3.6 H.P. PISTON ASSLY.

3.10 MAIN JOURNAL BEARINGS

- Check the bore size of the bearings and provide new bearing if it is worn out or exceeds the condemning limit.

3.11 CRANKSHAFT

- Blow compressed air through the oil holes of the crankshaft and ensure that they are free from any dirt and blockage.
- The balance weights should not be removed from the shaft since reassembling may cause unbalance.

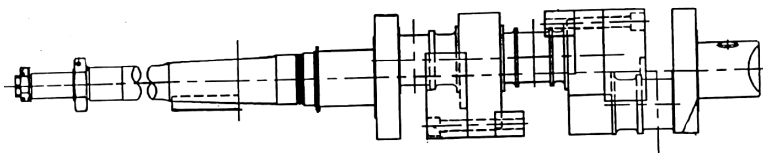


FIGURE 3.7 CRANKSHAFT ASSLY.

3.12 OIL PUMP

- Dismantle the oil pump, clean it thoroughly and inspect all the parts.
- Replace all worn out or damaged parts.
- There should not be any end play for the rotors.
- There should be sufficient clearance between the rotors and the cover plate so that the rotors do not stick to the end cover.
- If there is excess of end play it can be corrected by lapping the outer face of the pump body.

- Ensure free movement of the inner rotor in the outer rotor.
- Do not inter change parts of different pumps.
- Fit new sealing ring between the cover and body.

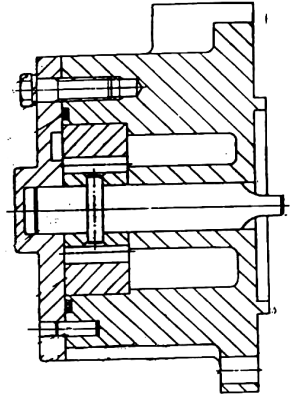


FIGURE 3.8 OIL PUMP ASSLY.

3.13 OIL FILTER

- Dismantle and replace all rubber seals and gaskets.
- Take out old filter element and fit new one.

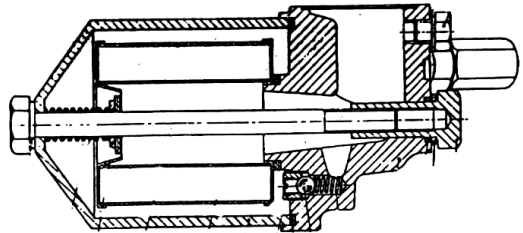
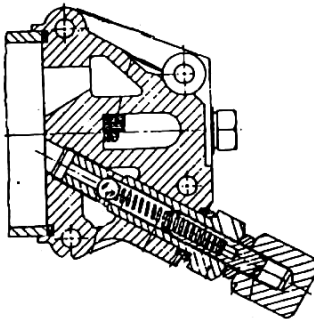


FIGURE 3.9 OIL FILTER

3.14 CLEARANCE CHART

Check all clearances and dimension as given below during overhauling & record. All dimensions are in mm.

SR NO	MAKE	ELGI	KIRLOSKAR
	MODEL	TRC 1000 DCM	3 HC-55
1.	<i>Crankshaft end float</i>	0.4 to 0.7	0.15 to 0.64
2.	Dia. clearance crankshaft to main bearing bush	0.11 to 0.16	0.075 to 0.110
3.	End float of connecting rod on crank pin	0.200 to 0.300	0.20 to 0.30
4.	Dia. Clearance connecting rod big end to crankshaft	0.036 to 0.128	0.013 to 0.076
5.	Dia. clearance of Gudgeon pin to connecting rod small end bush.	Push fit	0.013 to 0.031
6.	Dia. Clearance of Gudgeon pin to piston.	0.000 to 0.011	0.00 to 0.016
7.	Dia. Clearance H.P. piston to cylinder	0.071 to 0.107	0.05 to 0.10
8.	Dia. Clearance L.P. piston to cylinder	0.107 to 0.133	0.117 to 0.168
9.	Piston ring closed gap- (all rings side)	0.1 to 0.3	0.25 to 0.36

SR NO	MAKE	ELGI	KIRLOSKAR
	MODEL	TRC 1000 DCM	3 HC-55
10	Clearance of all rings in their grooves L.P. Piston rings H.P. Piston rings	0.03 to 0.07 0.04 to 0.09	0.013 to 0.064 ”
11	Piston top & cylinder top	0.2 to 0.4	LP 0.80 to 1.10 HP 1.5 to 1.9
12	<i>Oil pump assembly</i>		
	a) Side clearance housing and cover face	---	0.025 to 0.100
	b) Dia. Clearance rotor shaft O/D & bush I/D	---	0.030 to 0.060
	c) Dia, clearance outer rotor O/D & housing I/D	---	0.033 to 0.132

3.15 ASSEMBLY OF COMPRESSOR

- Assemble the compressor in the reverse sequence.
- Remove top plug of the oil filter and fit oil pressure gauge.
- Fill the crankcase with recommended fresh oil.
- Ensure that unit is free to run by rotating the shaft manually.

3.16 RUNNING IN AFTER OVERHAUL

3.16.1 Without Cylinder Head

- Run the unit for 2 hours and adjust the oil pressure to rated pressure.
- Ensure that there is no leakage in the cylinders.
- As the machine warms up, the current taken by the driving motor should fall and settle at a steady figure.
- An increasing current indicates the defective assembly. The cause should be investigated.
- Check the unit at frequent intervals for defects such as oil leakage, overheating, scored bores, excessive oil throw from the cylinder blocks etc.

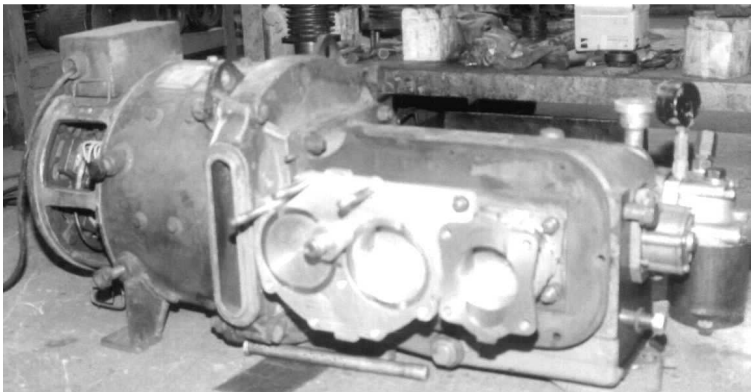


FIGURE 3.10 RUNNING WITHOUT CYLINDER HEAD

3.16.2 With Cylinder Head

- Assemble cylinder heads, shroud, shroud cover and connect manifolds.
- Connect safety valves to inter cooler as well as receiver.
- Safety valves should be set at 3.2 kg/sq. cm and 8.0 kg/sq. cm respectively.
- Initially run the unit without load for 15 minutes and then at rated pressure for 2 hours.
- Ensure that the oil pressure is steady and within recommended limits.
- Check for any air leakage in the pipe lines.
- Measure the current. It should be steady and within limits.
- Check for any sparking at commutator.
- Ensure that there is no overheating, abnormal noise or vibration.

3.17 FITMENT IN MOTOR COACH

- Carry the MCP unit from section to motor coach on trolley.
- Fit the MCP unit in motor coach using hydraulic trolley and tighten the foundation bolts.
- Connect all pipe connections of compressor, filter, suction and both side air ducts.
- Do the electrical connections.

3.18 SERVICE LIMITS OF DIFFERENT COMPONENTS

For 3 HC 55 Compressor (KPC)

S. No.	PART NAME	SPECIFIED DIMENSIONS (mm)	CONDEMNING LIMITS (in mm) PROPOSED
1.	Crank shaft	Main O.D. 63.50/63.487	63.347
		Crank pin O.D. 57.137/57.122	56.972
2.	H.P.Piston	O.D. 84.04/83.96 O.D. 84.087/84.06	83.860
		G.P. bore 25.4/ 25.41	25.490
3.	Connecting rod	B.E. bore with Brg.	5.730
		S.E. bore with bush I.D. 2.54/ 2.541	2.560
4.	L.P.Piston	G.P. bore 25.4/ 25.41	25.496
		O.D. 106.15/106.07 O.D. 106.22/106.247	106.067
5.	L.P.Liner	Bore 106.383/106.388 Bore 106.363/106.247	106.570
6.	H.P.Block	84.137/84.163	84.353
7.	Dimetrical clearance between L.P. liner & Piston	0.117/0.166	0.300
8.	Dimetrical clearance between H.P. liner & Piston	0.0508/0.1016	0.250

S. No.	PART NAME	SPECIFIED DIMENSIONS (in mm)	CONDEMNING LIMITS (in mm) PROPOSED
9.	Side clearance piston ring L.P.	0.0127/0.0635	0.120
10	Side clearance piston ring H.P.	0.0127/0.0635	0.140
11.	Close gap L.P. piston ring	0.254/0.356	1.500
12.	Close gap H.P. piston ring	0.254/0.356	2.000
13.	Side clearance oil ring H.P.	0.0127/0.0635	0.120
14.	Side clearance oil ring H.P.	0.0127/0.0635	0.140
15.	Close gap L.P. oil ring	0.25/0.35	1.50
16.	Close gap H.P. oil ring	0.25/0.35	2.00
17.	Gudgeon pin L.P.	O.D. 25.40/25.394	25.320
18.	Gudgeon pin H.P.	O.D.25.40/ 25.394	25.320
19.	Crank shaft end float	0.052/ 0.635	1.000
20.	Side clearance con. Rod to crank shaft	0.203/ 0.305	0.600

3.19 OVERHAULING KIT

3.19.1 For KPC Compressor Type 3 HC-55-110V-DC

S. No	Description	Qty/ unit	Drawing. No.
1	Gasket HP Cyl. To crank case	1	091 00 302 00
2	Gasket oil pump to crank case	1	091 00 501 00
3	Oil pump assembly	1	091 00 500 00
4	Gasket oil filter to crank case	1	091 00 701 00
5	Gasket crank case to side cover	1	091 00 108 00
6	“O” ring	1	999 12 238 00
7	Oil seal	1	091 00 206 00
8	Oil seal housing	1	091 00 205 00
9	Gasket LP Cyl. To crank case	3	097 00 508 50
10	“O” ring	1	091 00 803 00
11	Gasket LP Cyl. To HP head	2	097 00 509 00
12	Gasket shroud to shroud cover	1	091 80 109 00
13	Gasket crank case to vent body	1	091 00 108 00
14	Gasket HP Cyl. To HP Cyl. Head	1	091 00 604 00
15	Gasket LP cylinder head	1	091 00 602 00
16	Gasket HP cylinder	2	091 00 302 00
17	Gasket shroud cover	1	091 00 804 00

S. No	Description	Qty/ unit	Drawing. No.
18	Gasket side cover	1	091 00 108 00
19	Gasket crank case to vent body	4	091 80 207 00
20	Gasket crank case vent	1	091 00 115 00
21	Oil filter assembly	1	091 00 700 00
22	LP cylinder liner	2	091 00 303 00
23	Thrust bearing bush	2	091 00 105 00
24	Big end bearing half	6	091 00 402 00
25	Small end bush	3	091 00 404 00
26	Piston rings LP	1	091 00 407 00
27	Internal “L” ring LP	4	091 00 408 00
28	Scraper ring LP	4	091 00 409 00
29	Gudgeon pin HP	1	091 00 411 00
30	Piston ring HP	1	091 00 412 00
31	Internal “L” ring HP	2	091 00 413 00
32	Scraper ring HP	2	091 00 414 00
33	Suction valve assembly	3	091 00 605 00
34	Delivery valve assembly	3	091 00 606 00
35	“O” ring	6	091 00 810 00

3.19.2 For ELGI Compressor - TRC 1000 DCM 110V-DC

3.19.2.1 1st POH Kit (18 Months) Code no: 072403609

S. No	Part name	Qty. /unit	Part Code no.
1	Packing (110V)	1	000 466 710
2	Gasket (suction)	1	000 463 180
3	Gasket (del. Pipe)	6	000 463 210
4	Packing ring (del. Pipe)	3	000 469 770
5	Gasket (oil filter assy.)	1	000 463 220
6	Gasket (C.case to oil pump assy)	1	000 463 450
7	Gasket (C.case to side cover)	1	000 464 070
8	Gasket (C.case to shroud)	1	000 464 010
9	Gasket 0.4mm (HP cyl. To C.Case)	1	000 463 75A
10	Gasket 0.75mm (HP cyl to C.Case)	1	000 463 75B
11	Gasket 0.75mm (HP cyl to Cyl. Head)	1	000 463 780
12	Gasket 0.4mm	1	000 463 78A
13	Gasket0.75mm (LP Cyl to C. Head)	1	000 463 760
14	Gasket 0.75mm (LP Cyl. To C. Case)	1	000 463 730
15	Gasket 0.4mm (LP Cyl to C. Case)	1	000 463 73A
16	Oil seal B60 x 80 x 12	1	000 463 650
17	“O” ring	1	000 463 640
18	Packing (oil seal HSG)	1	000 466 720
19	Valve Assy – inlet (000 463 870)	3	A 070018

S. No	Part name	Qty./ unit	Part Code no.
20	Valve assy.discharge (000 463 940)	3	A 070019
21	Valve gasket (inlet & discharge)	6	000 463 860
22	Gasket	1	000 464 150
23	Copper washer	1	000 469 860
24	Gasket (shroud to cover)	1	000 464 050
25	Copper washer (valve top)	6	000 463 830
26	Copper washer (inlet)	3	000 469 870
27	Copper washer (discharge)	3	000 464 350
28	Ring set dia 106	2	072 400 569
29	Internal circlip dia – B25	6	000 917 225
30	Ring set dia 84	1	072 400 559
31	Gudgeon pin (HP)	1	000 464 270
32	Bearing con.rod upper half	3	000 325 840
33	Bearing con.rod lower half	3	000 325 720
34	Split pin dia 2 x 22 (con.rod)	6	000 965 568
35	Valve seat breather	1	000 510 060
36	Rings sealing	1	000 463 520
37	Sealing ring	1	000 463 430
38	Sealing ring	1	000 463 290
39	Packing ring	1	000 463 330
40	Filter element	1	000 463 440
41	Washer for cap nut	2	000 464 340
42	Thrust bearing bush	2	000 463 630

**3.19.2.2 IInd POH Kit (36 Months)
Code No. 072420079**

S. No	Part name	Qty./unit	Part Code no.
1	Packing (110V)	1	000 466 710
2	Gasket (suction)	1	000 463 180
3	Gasket (del. Pipe)	6	000 463 210
4	Packing ring (del. Pipe)	3	000 469 770
5	Gasket (oil filter assy.)	1	000 463 220
6	Gasket (C.Case to oil pump assy)	1	000 463 450
7	Gasket (C.Case to side cover)	1	000 464 070
8	Gasket (C.case to shroud)	1	000 464 010
9	Gasket 0.4mm (HP Cyl. To C.Case)	1	000 463 75A
10	Gasket 0.75mm (HP Cyl to C.Case)	1	000 463 75B
11	Gasket 0.75mm (HP Cyl to Cyl. head)	1	000 463 780
12	Gasket 0.4mm	1	000 463 78A
13	Gasket 0.75mm (LP Cyl to Cyl. Head)	1	000 463 760
14	Gasket 0.75mm (LP Cyl. To C.Case)	1	000 463 730
15	Gasket 0.4mm (LP Cyl to C. Case)	1	000 463 73A
16	Oil seal B60 x 80 x 12	1	000 463 650
17	“O” ring	1	000 463 640
18	Packing (oil seal HSG)	1	000 466 720
19	Valve Assy – Inlet (000 463 870)	3	A 070018

S. No	Part name	Qty./ unit	Part Code no.
20	Valve assy-Discharge (000 463 940)	3	A 070019
21	Valve gasket (Inlet & Discharge)	6	000 463 860
22	Gasket	1	000 464 150
23	Copper washer	1	000 469 860
24	Gasket (Shroud to Cover)	1	000 464 050
25	Copper washer (valve top)	6	000 463 830
26	Copper washer (Inlet)	3	000 469 870
27	Copper washer (Discharge)	3	000 464 350
28	Ring set dia 106 mm	2	072 400 569
29	Internal circlip dia – B25	6	000 917 225
30	Ring set dia 84 mm	1	072 400 559
31	Bearing Con.rod upper half	3	000 325 840
32	Bearing Con.rod lower half	3	000 325 720
33	Split pin dia 2 x 22 (Con.rod)	6	000 965 568
34	Rings sealing	1	000 463 520
35	Sealing ring	1	000 463 430
36	Sealing ring	1	000 463 290
37	Packing ring	1	000 463 330
38	Washer for cap nut	2	000 464 340

S. No	Part name	Qty./unit	Part Code no.
39	Thrust bearing bush	2	000 463 630
40	Piston with G.pin dia 106 mm	2	000 477 710
41	Piston with G.pin dia 84 mm	1	000 477 760
42	Breather Assy.	1	A020030
43	H.P. Cylinder	1	000 218 840
44	L.P. Cyl with liner	1	070301440
45	Crank shaft with balance Wt. Assy.	1	000 329 670
46	Cage (inlet valve)	3	000 463 800
47	Cage (delivery valve)	3	000 463 810

3.20 OVERHAULING OF INTER COOLER/AFTER COOLER

3.20.1 Removal from Motor Coach

- Disconnect the air pipe line from the inter cooler/after cooler.
- Remove, inter cooler/ after cooler by opening the foundation bolts.
- Carry, both inter cooler/ after cooler from coach by trolley.

3.20.2 Overhauling

- Dismantle inter cooler/ after cooler.
- Heat the tube of the cooler by gas and scrap the rust.
- Blow the tube with compressed air.
- Clean with kerosene oil and wipe with dry cloth.
- Replace the gasket with new.

- Assemble, inter cooler/ after cooler.

3.20.3 Testing

- Connect the air supply to inter cooler/after cooler at inlet and dummy at outlet.
- Check for air leakage from joints.

3.20.4 Fitment in the Coach

- Fit inter cooler/ after cooler in the motor coach.
- Connect all pipelines.

3.21 FINAL TESTING OF MCP IN MOTOR COACH

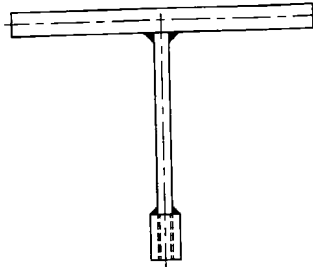
- Check the oil level in crankcase with dipstick.
- Check the proper securing of all air pipelines and start the compressor.
- Check air leakage by applying soap water.
- Check the pressure of pressure relief valve by using pressure gauge.
- Check the cut in & cut out pressure with pressure switch and MR gauge.
- Ensure that safety valve blows at pressure of 8kg/sq. cm.
- Observe the working of compressor for any vibration, abnormal sound and heating.

3.22 TOOLS REQUIRED FOR MAINTENANCE

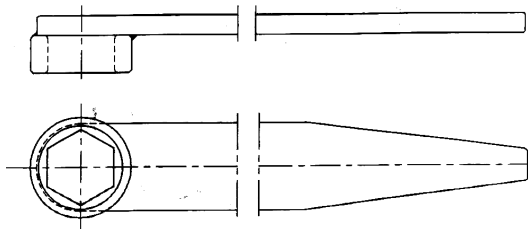
SR. NO.	DESCRIPTI ON	SIZE
1.	'D' Spanner	10 x 11, 12 x 13, 14 x 15, 16 x 17, 21 x 23, 24 x 26, 30 x 32, 32 x 36, 18 x 19.
2.	Tubelar spanner	10 x 11, 12 x 13, 16 x 17, 24 x 26
3.	Pipe wrench	14", 18", 16"
4.	Ring spanner	24 x 26, 30 x 32
5.	Allen key	5mm, 10mm
6.	Goti with erection handle	14, 15, & 16

3.23 SPECIAL TOOLS FOR KPC COMPRESSOR

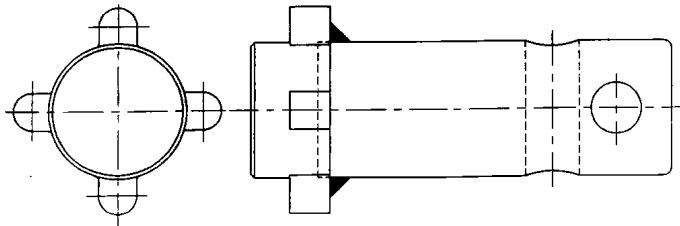
1. Tool for Lapping Valve Seat on Cylinder Head



2. Spanner for Suction and Delivery Valve Cap



3. Extractor for Suction & Delivery Valve Cage



CHAPTER 4

TROUBLE SHOOTING

FAULT	LIKELY CAUSES	REMEDIES
Compressor over heat.	<ul style="list-style-type: none"> i. <i>Dirty oil</i>. ii. Oil level low. iii. Incorrect grade of oil. iv. Cylinder, cylinder head, inter cooler and after cooler fins are dirty. v. Failure of cooling fan. vi. Obstruction in cooling air passage. vii. Valves broken/ loose/ leaking. viii. Inadequate lubrication. ix. Excessive air discharge pressure. 	<p>Change oil.</p> <p>Fill up to correct level.</p> <p>Fill correct grade of oil.</p> <p>Blow with compressed air.</p> <p>Change the fan.</p> <p>Remove obstructions.</p> <p>Change the damaged valves.</p> <p>Check oil level and oil pressure in the lubricating system and rectify, if required.</p> <p>Adjust the pressure to the recommended limit.</p>
Oil carry over in compressed air.	<ul style="list-style-type: none"> i. Air filter choked. ii. High oil level in crankcase & air filter. iii. Low oil viscosity. iv. Crankcase breather choked. 	<p>Clean the air filter and change the oil.</p> <p>Maintain correct oil level.</p> <p>Change to recommended grade.</p> <p>Clean & reassemble.</p>

FAULT	LIKELY CAUSES	REMEDIES
Unusual wear of cylinder, piston and rings.	i. Inadequate air filter maintenance. ii. Oil contamination. iii. Incorrect grade of oil.	Ensure proper cleaning. Monitor the condition of oil. Change to correct grade.
While working compressor knocks.	i. Worn out piston, cylinder, crankshaft or connecting rod bearings. ii. Loose gudgeon pin and piston. iii. Less clearance between cylinder head and piston. iv. Valve broken or loose . v. Scored piston and/ or cylinder. vi. Rotor of the motor fitted on the crank shaft loose. vii. Excessive carbon deposit on valves. viii. Foreign material in cylinder.	Overhaul the compressor & replace the defective items. Change the piston along with gudgeon pin and rings and change the small end bush. Adjust to recommended values using suitable gaskets. Change the valve. Change the corresponding parts. Fit the rotor correctly. Overhaul the valves. Remove and check the cylinder.
Compressor vibrates while working.	i. Foundation/ fixing bolts loose. ii. Improper piping support.	Tight the fixing bolts. Clamp the piping properly.

FAULT	LIKELY CAUSES	REMEDIES
	iii. Incorrect speed. iv. Misalignment of motor compressor. v. Motor rotor unbalanced.	Maintain correct speed. Alignment to be done properly. Motor rotor balancing to be done.
Pressure build up time excessive	i. Leaky joints in pressure pipe lines. ii. Defective valves. iii. Worn out piston rings. iv. Piston to cylinder head clearance more. v. Clogged suction filter. vi. Defective pressure gauge. vii. Relief valve setting incorrect. viii. Relief valve spring defective or broken. ix. Low oil level in the crankcase. x. Oil pump defective. xi. Choked oil pump inlet port. xii. Excessive carbon deposit on valves.	Rectify the leakage from joints. Change or service the valves. Replace rings as a set after checking the related components. Adjust suitably using gaskets. Clean the filter and change oil . Rectify Adjust to recommended pressure. Change the spring. Top up the oil with fresh oil upto the maximum mark on the dipstick. Service the oil pump. Clear the inlet port. Overhaul the valves.

FAULT	LIKELY CAUSES	REMEDIES
Inter cooler pressure high.	i. Defective pressure gauge. ii. Blocked inter cooler. iii. HP suction valve defective.	Change or calibrate the pressure gauge. Service the inter cooler. Overhaul the valve.
Inter cooler pressure low.	i. Defective pressure gauge. ii. Defective L.P. valves. iii. Clogged suction filter. iv. Leakage in pressure line, cylinder head etc. v. Worn out piston rings and cylinder.	Change or calibrate the pressure gauge. Overhaul concerned the valve. Clean it. Arrest the leakage. Change defective part..
Oil pressure high.	i. Heavy grade of lube oil. ii. Defective pressure gauge. iii. Relief valve not working. iv. Oil passage blocked.	Change to recommended grade. Change or calibrate the pressure gauge. Check and service the relief valve. Service the compressor and clear all oil passages.
Oil pressure low.	i. Defective pressure gauge. ii. Excessive bearing clearance. iii. Leakage in the lubrication system. iv. Light grade of lube oil.	Change or calibrate the pressure gauge. Change the bearings. Locate the leakage and arrest it. Change to recommended grade.

FAULT	LIKELY CAUSES	REMEDIES
	<ul style="list-style-type: none"> v. Relief valve setting in correct or relief valve spring broken. vi. Low oil level in crankcase. vii. Choked oil pump inlet port. viii. Worn out oil pump rotors. 	<p>Correct the setting or replace the spring.</p> <p>Top up with correct grade oil up to maximum mark level.</p> <p>Clean inlet port of oil pump.</p> <p>Change defective rotor.</p>
Air delivery temperature high.	<ul style="list-style-type: none"> i. Excessive discharge pressure. ii. Valves broken/ loose or leaking. iii. Inadequate inter cooling and/or after cooling. iv. Piston top clearance less. v. Heavy carbon deposits on valves. 	<p>Adjust the pressure to the recommended limit.</p> <p>Change the damaged valves.</p> <p>Clean the inter cooler/ after cooler fins.</p> <p>Adjust within the recommended limit.</p> <p>Overhaul the valves.</p>

CHAPTER 5

DO'S AND DON'TS

5.1 DO'S

1. Clean the air compressor unit regularly.
2. Use only genuine spares.
3. Maintain correct oil level in the crankcase.
4. Use only fresh recommended grade oil.
5. Use the proper tools.
6. Drain the condensate daily by opening the drain cocks of inter cooler, after cooler & air reservoir.
7. Maintain logbook to monitor operation of compressor.
8. Clean the inlet air filter regularly.
9. Start up the unit and drain inter cooler, after cooler for a few minutes.
10. Ensure that inter cooler and after cooler safety valves functioning properly.
11. Always maintain cleanliness during inspection and checks.
12. Maintain correct oil pressure.
13. Keep cooling air ducts obstruction free & clean.
14. Clean oil filter element regularly.

15. Change all the packings & rubber items during overhauling.
16. Ensure that side marked 'TOP' on the piston rings face the topside of the piston.
17. Ensure that the gap of adjacent rings is in opposite direction.
18. Ensure that oil holes of the crankshaft are free from any dirt & blockage.
19. After complete overhauling of the machine, check all nuts/ bolts for tightness.
20. Ensure that oil holes are properly located and fully opened while changing the bearings of connecting rods.

5.2 DON'TS

1. Neglect the routine attention.
2. Allow any leakage in the system.
3. Keep any tools or loose items on the compressor.
4. Run the compressor without lube oil in the crankcase.
5. Use cleaning agents, while changing oil.
6. Overload the compressor for a long period even though it is of continuous rating.
7. Start the compressor unless it is safe to do so.
8. Attempt to operate the air compressor with known unsafe condition.
9. Modify compressor without approval of competent authority.
10. Inter change parts from different units.
11. Forget to lubricate the piston rings before assembling.
12. Remove the balance weights from the crankshaft since reassembling may cause unbalance.
13. Inter change or reverse the connecting rod caps since these are machined with the connecting rods.
14. Distort the connecting rod when pressing it in the small end bush during overhauling.
15. Forget to measure the clearance for the mating parts which should be within limits as per clearance chart.
16. Interfere with any adjustments or settings.
17. Use reconditioned valve plates.

REFERENCE

1. AC Traction maintenance & operation (ACTM) manual Vol.III-1994.
2. Operation & maintenance manual of 3 HC – 55 compressor, of M/s Kirloskar.
3. Operation & maintenance manual of TRC 1000 DCM compressor of M/s ELGI.
4. BHEL maintenance manual for 25 kV BG, AC EMU MEMU, electrical equipment, book no. mm/AC-M/EMU/003.
5. Papers presented during the seminar on date 01.08.2003 at CAMTECH on “maintenance of air compressor of AC EMU/MEMU.

OUR OBJECTIVE

To upgrade maintenance technologies and methodologies and achieve improvement in productivity, performance of all Railway assets and manpower which inter-alia would cover reliability, availability, utilisation and efficiency.

If you have any suggestions and any specific Comments please write to us.

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