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INDEX

GENERAL

CONTRACT DATA SHEET

CUSTOMER	M/S. SKM ANIMAL FEEDS AND FOODS (INDIA) LIMITED					
LOCATION	MODAKURICHI, ERODE (DIST.), TAMIL NADU.					
BOILER TYPE	BI-DRUM WATER TUBE BOILER (FBC)					
CAPACITY	15 TPH (FROM & AT 100°C)					
PRESSURE	17.5 KSC (g)					
TEMPERATURE	SATURATED					
FUEL FIRING	DOB					
FEEDER TYPE	POCKET FEEDER					
FURNACE	TYPE OF FIRING		FLUIDISED BED COMBUSTION			
	BED SIZE		3900 X 1800 MM			
	EXPANDED BED HEIGHT		727 MM			
	HEAT INPUT (Kcal/hr)		10351438			
	HEATING SURFACE AREA (M²)					
HEATING SURFACE	BANK TUBE ASSY.				309.00	
	BED COIL ASSY.				62.00	
	WATER WALL ASSY.				151.20	
	TOTAL				522.20	
	LOCATION	QTY. (Nos)	SIZE (NB) / ORIFICE	SET PRESSURE (Kg/cm²)	RELIEVING CAPACITY OF VALVE (Kg/hr)	END CONN.
SAFETY VALVE	STEAM	2	50 / 80	i) 18.00	i) 9713	FLANGED
	DRUM		‘K’	ii) 18.25	ii) 9840	ANSI B16.5 300# / 150#

CONTENT

GENERAL DESCRIPTION OF BOILER

GENERAL DESCRIPTION OF BOILER

The "**CETHAR FLUIDIX**" is a fluidised bed boiler with the following features.

- a) Compartmentalised combustion chamber
- b) Under bed fuel feeding system
- c) Bi-drum water tube type.

The boiler is designed for **DEOILED BRAN (DOB)** as main fuel with capacity of **15 TPH** at MCR. The outlet steam parameters are **17.5 KSC(g)** pressure and **SATURATED** steam temperature.

AIR SYSTEM:

This system starts with FD fan to supply the required combustion air and impart energy for fluidisation. FD fan is a centrifugal type, direct coupled fan. Ambient air from fan outlet is heated in air heater and heated air is distributed evenly to combustion chamber through compartmentalised air box. A part of combustion air is tapped from air heater outlet and further pressurised by a PA fan for pneumatic fuel feeding. PA fan is also of centrifugal type, direct coupled fan. Air flow is measured using aerofoil meter.

COMBUSTION CHAMBER:

The distributor plate is the heart of FBC system. It is made up of carbon steel base plate with air nozzles to distribute the fluidising air from air box uniformly over the entire bed. Bed coils are immersed in the bed to maintain the bed temperature of 850-900°C by absorbing the heat through them. Sufficient free board volume is available above the bed to ensure complete combustion of fuel.

FUEL AND ASH HANDLING SYSTEM:

The fuel from bunker is fed pneumatically into the bed by pocket feeder and mixing nozzles located below the bunker. The speed of fuel flow can be adjusted from the control panel.

The ash generated is collected at bed, bank, air heater, feed water heater, spark arrestor for MDC and bag filter zones.

FLUE GAS SYSTEM:

The hot flue gas generated from the combustion chamber is cooled by, passing through waterwall, bank tubes, airheater, feed water heater, spark arrestor for MDC and Bag filter. Balance draft is maintained by FD and ID fans. Flue gas is passed through a high efficiency MDC and bag filter before lifting it to the atmosphere through the chimney. The bag filter shall have bypass ducting arrangement to pass flue gas during servicing of Bag filter.

WATER AND STEAM CIRCUIT:

The feed water at 30°C is fed to the boiler feed pump where it is pressurised to the required boiler pressure. The feed water from feed pump is fed to steam drum. From steam drum the water passes through the bank tubes to mud drum. While passing through the bank tubes the water is heated up by the flue gas passing over the tubes. The hot water enters into the bed coils, through downcomers and further heated up. The steam water mixture then rises through the water wall panel tubes and enters into the steam drum through riser tubes.

TECHNICAL WRITE-UP FOR THE BOILER COMPONENTS

TECHNICAL WRITE UP FOR THE BOILER COMPONENTS

FLUIDISED BED COMBUSTION .

In a typical fluidized bed combustor, solid, together with inert material - for example sand, silica, alumina or ash are kept suspended through the action of primary air distributed through the air nozzles.

Turbulence is promoted by fluidisation making the entire mass of solids behave much like a fluid. Improved mixing generates heat at a substantially lower and more uniformly distributed temperature.

While it is essential that temperature of bed should be at least equal to ignition temperature of fuel, it must never be allowed to approach adiabatic combustion temperature to avoid melting of ash.

This is achieved by extracting heat from the bed through heat transfer tubes immersed in the bed. Almost, all Atmospheric Bubbling Fluidised Bed Combustion Boilers (AFBC) use the bed evaporator (Bed coil) tubes as the mode of extracting heat from the bed to maintain the bed temperature.

The Boiler components are categorised as Pressure and Non – Pressure Parts as mentioned below.

1.0 BOILER PRESSURE PARTS

The complete system of boiler pressure parts covers

- Steam drum / Mud drum.
- Bank tubes
- Water wall system.
-
- Bed tube sections.
- Economiser

Together with all required headers, integral piping, interconnecting piping and supports.

The complete system of pressure parts tubing, piping and headers will be of ERW or seamless construction as applicable.

1.1 STEAM DRUM / MUD DRUM

The steam drum / mud drum shall be of fusion welded construction. Liberally sized with high efficiency of internals. The drums will be provided with 2 nos. manhole doors, to open inwards. Steam drum is provided with screen box separators with screen type dryers as drum internals.

Suitable nozzles with flanges of adequate thickness will be provided in the drum to mount the valves and fittings. Provision for blow down will be given in the mud drum. Liberally sized down comers and risers are provided.

The thickness on the drum is arrived based on the requirements as specified under IBR 1950 with latest amendments. The drums are provided with ellipsoidal dished ends.

1.2 BANK TUBES

The bank tubes are of ERW. Tubes connecting to the drums shall enter readily on both ends of the bank tubes are expanded into the steam and mud drums. The bank tubes are designed with multi pass arrangement and the average flue gas velocity is kept at optimum, considering the life of bank tubes.

1.3 FURNACE - WATER WALL SYSTEM

The furnace is of natural circulation, balanced draft design suitable for firing the fuels specified. The complete furnace section, including the fluid bed and water wall section are fabricated with welded wall type panel construction. Necessary supporting / suspension systems are provided for the complete system - for free expansion of components when unit is in operation.

1.4 BED COIL SECTION

The bed is provided with three nos. of compartments with individual air control system for reliable and continuous operation of Fluidised bed steam generator at continuous MCR load.

Water circulation in the bed tubes is kept optimum to ensure longer tube life. Access door are provided at suitable elevation on any sides of the bed on the walls, for easy access to the bed section, for any inspection and maintenance.

2.0 NON - PRESSURE PARTS.

2.1 BUNKER AND FUEL FEEDING SYSTEM

Boiler is equipped with fluid bed combustor consisting of complete system of fuel transportation from the bunker to the fluidized bed.

Bunker is sized with proper valley angle for the better flowability of the fuel. The bunker bottom portion is divided into required no. of hoppers corresponding to the number of compartment in the Air box. The outlet of each bunker is connected with pocket feeders. From Pocket feeder to the mixing nozzle the fuel will be taken by dividing chutes, and it will be sent into the furnace using high pressure air from Primary air fan. Feeder units will be so spaced and arranged that, individual units are well accessible for inspection, repair and maintenance as required.

2.2 FUEL DISTRIBUTING SYSTEM

The Primary fuels from the feeding points will be pneumatically transported through IS 1239 fuel feed pipes to the fluidised bed. Forced air flow to each of the bed compartments can independently controlled by suitable means. A manually operated damper is provided in the air ducting to each bed section. There are 8 nos. of feeding points and are located in the bed for uniform fuel distribution.

Fluidised Bed Proper: The Fluidised Bed system will be of the proven design capable of continuous reliable operation and firing the fuel specified with wide turndown range. The nozzle design will permit effective fluidisation at lower loads with shutting down of some compartments. Fluidising nozzles will have suitably sized stem portion extending from the bed plate to the furnace side. Besides the design and arrangement of fuel feeding, air supply to the bed, their controls, will ensure achieving complete combustion efficiency, avoiding problems of slagging and clinker formation.

The design and arrangement of the bed sections are such that it will be possible to isolate any bed section from fuel feed side, and primary air feed side, as and when required for operational requirements.

The bed air nozzles are of SS trip / MS body material and shall be fixed on to the bed plate by threading from the bottom side.

3.0 TUBULAR AIR HEATERS

Air heater of multitubular recuperative type is provided at the downstream of bank tubes with gas flow through the tubes and air flow over the tubes.

The air heater tubes are of mild steel construction. The air heater is complete with all casing, supporting structures, ducting systems etc.

4.0 FANS - DRAUGHT SYSTEM

The boiler is equipped with each one no. of 100% MCR FD fan, ID fan and PA fan.

The fans supplied are complete with coupling, base plates etc. All control vanes/dampers are provided with complete and connecting mechanism etc., All the Fan impellers are dynamically balanced. Forced draft fan are provided with grease lubrication.

5.0 DUCTING SYSTEM

All ducts are of Mild steel suitably stiffened and reinforced on the outside and designed to withstand the pressures encountered.

The ducting system is complete with all required expansion joints, mating flanges, dampers, supports, access doors, platforms, insulation etc. All ducts are of welded construction.

6.0 REFRACTORY, INSULATION, CLADDING

All other piping, air ducts, flue ducts, etc., are provided with insulating system of adequate thickness.

7.0 BOILER STRUCTURES

The boiler is provided with all required base frame, steel work of sufficient height, with required foundation bolts, etc. The steel supporting structure for boiler, bank tubes and airheater are from the firing floor, which is RCC.

The required structural columns, frame work for the ducting and piping, equipment, stair cases up to boiler drum level, are provided with stairs and walkways. The steam drum ends are provided with independent local platform.

In addition, pipe supports, duct supports, etc., are provided for the complete system.

8.0 AIR SYSTEM

The air from the Forced draught fan will pass through Airheater to Air box. The combustion air will assist the combustion as well as the fluidisation. In the proposed under bed feeding system a small quantity of air which is tapped from the combustion air, will be boosted by a primary air fan and will be used to transport the fuel pneumatically to the furnace.

FLUIDISED BED COMBUSTION

FLUIDISED BED COMBUSTION

FLUIDISED BED

When air or gas is passed through an inert bed of solid particles such as sand supported on a fine mesh or grid, the air initially will seek a path of least resistance and pass upward through the sand. With further increase in the velocity, the air bubbles through the bed and the particles attain a state of high turbulence. Under such conditions, the bed assumes the appearance of a fluid and exhibits the properties associated with a fluid and hence the name "Fluidised Bed".

MECHANISM OF FLUIDISED BED COMBUSTION

If the sand, in a fluidized state, is heated to the ignition temperature of the fuel and the fuel is injected continuously into the bed, the fuel will burn rapidly and the bed attains a uniform temperature due to effective mixing. This, in short is fluidized bed combustion.

While it is essential that temperature of bed should be atleast equal to ignition temperature of fuel and it should never be allowed to approach ash fusion temperature (1050°C TO 1150°C) to avoid melting of ash. This is achieved by extracting heat from the bed by conductive and convective heat transfer through tubes immersed in the bed.

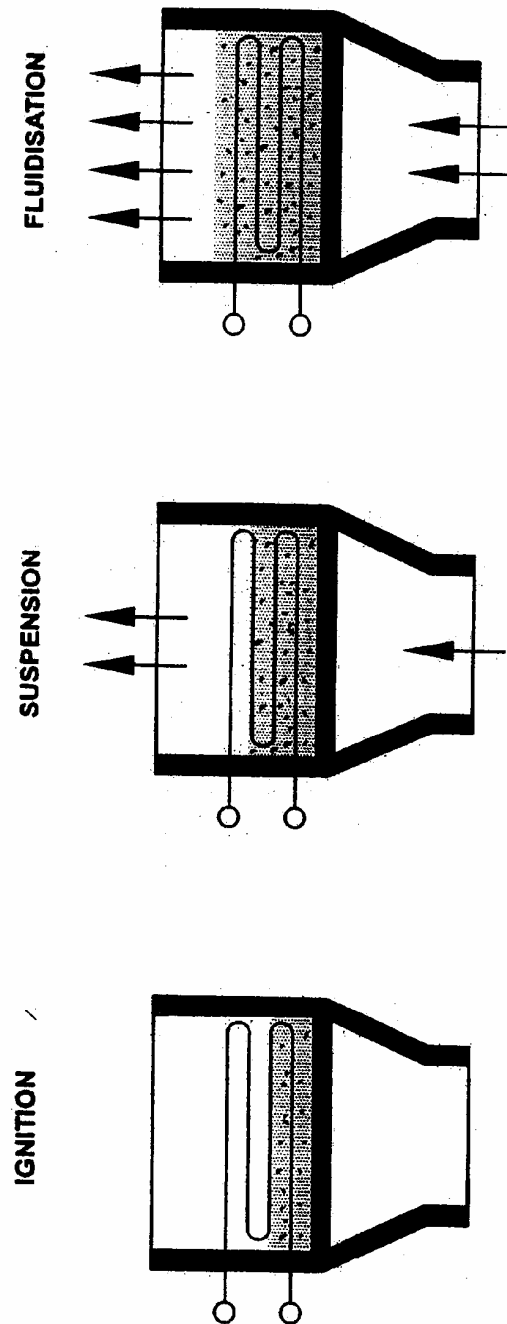
If velocity is too low, fluidization will not occur and if the gas velocity becomes too high, the particles will be entrained in the gas stream and lost. Hence to sustain stable operation of the bed, it must be ensured that gas velocity is maintained between minimum fluidization velocity and particle entrainment velocity.

ADVANTAGES OF FBC BOILERS

1. Considerable reduction in boiler size is possible due to high heat transfer rate over a small heat transfer area immersed in the bed.
2. Low combustion temperature of the order of 750°C - 900°C facilities burning of coal with low ash fusion temperature, prevents NO_x formation, reduces high temperature corrosion and erosion, and minimises accumulation of harmful deposits due to low volatilization of alkali components.

3. High sulphur coals can be burnt efficiently without much generation of Sox by feeding limestone continuously with the fuel.
4. The unit can be designed to burn a variety of fuels including low grade coals like floatation slimes and washery rejects without much sacrifice in operation efficiency, because only about 1% by wt. of carbon content in the bed can sustain the fluidized bed combustion.
5. High turbulence of the bed facilitates quick start-up and shut down.
6. Full automation of start-up and operation using simple reliable equipment is possible.
7. Inherent high thermal storage characteristics can easily absorb fluctuations in fuel feed rate.
8. There is reduced possibility of formation of local hot spots on heat transfer surfaces.
9. Though having comparatively low efficiency, fluidized bed coal fired boilers offer the following distinct advantages over pulverized coal fired boilers, especially when using low rank coals:-
 - i) High thermal inertia helps to overcome the problems of flame stability. It eliminates the necessity of supplementary oil firing to prevent extinction of flame when moisture and ash content of coal are high.
 - ii) The formation of sticky deposits on the fire side of the tubes because of lowering of ash fusion temperature by sodium components in ash is avoided due to low bed temperature.
 - iii) Lower coal crushing cost due to higher particle size.
10. Efficiency of 80% and above can be achieved.

PRINCIPLE OF FLUIDISATION



CONTENT

WATER QUALITY REQUIREMENT

WATER QUALITY REQUIREMENT FOR BI-DRUM BOILERS

FEED WATER:

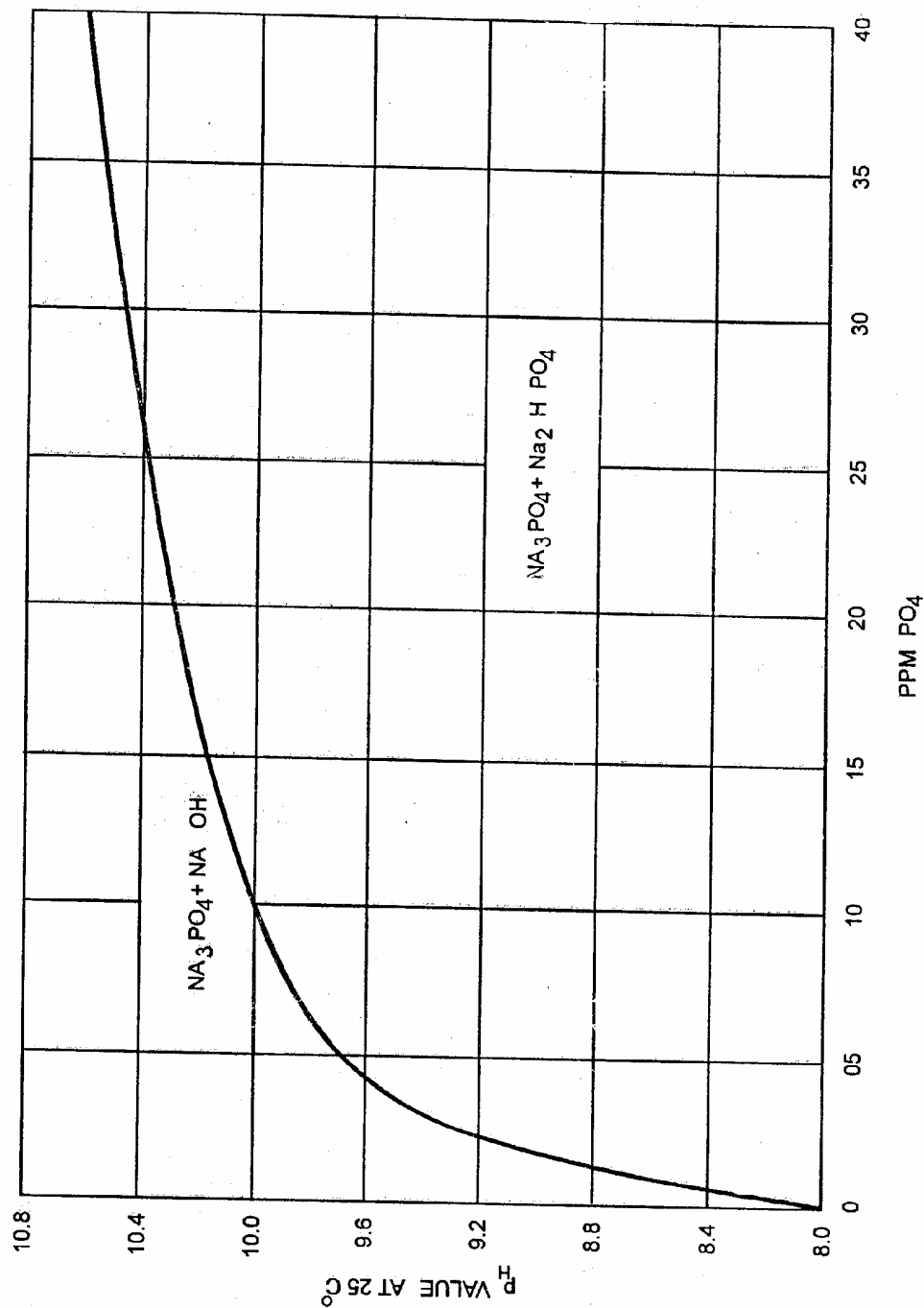
DRUM OPERATING PRESSURE (Kg/cm ² (g))	UPTO 20		
HARDNESS	ppm	max.	1.0
pH AT 25°C	---	---	8.8 - 9.2
OXYGEN	ppm	max.	0.02
TOTAL IRON	ppm	max.	0.05
TOTAL COPPER	ppm	max.	0.01
SiO ₂	ppm	max.	1.0
CONDUCTIVITY AT 25°C	µs/cm	max.	10.0
HYDRAZINE RESIDUAL	ppm	----	---

BOILER WATER

DRUM OPERATING PRESSURE (Kg/cm ² (g))	UPTO 20		
pH AT 25°C	---	---	10.0 – 10.5
PHOSPHATE RESIDUAL	ppm	---	10 – 40
TOTAL DISSOLVED SOLIDS	ppm	max.	2000
SPECIFIC ELECTRICAL CONDUCTIVITY AT 25°C	µs/cm	max.	4000
SILICA	ppm	max.	25.0
SODIUM SULPHATE AS Na ₂ SO ₃	ppm	--	20 – 40

PHOSPHATE CURVE

(NOTE : OPERATION ABOVE CURVE WHICH RESULTS IN FREE HYDROXIDE IS TO BE AVOIDED)



WATER TREATMENT

I. SOURCES OF WATER:

Water can be generally classified as:

- a. Surface water.
- b. Ground water

a. SURFACE WATER

Surface water comes from streams, ponds, lakes and reservoirs.

b. GROUND WATER

Ground water comes from wells, mines and springs.

II. IMPURITIES IN WATER:

Impurities in water can be classified into:

- a) Suspended solids.
- b) Dissolved solids.
- c) Dissolved gases.

a) SUSPENDED SOLIDS :

Clay, silt, Organic matter and micro organisms.

b) DISSOLVED SOLIDS.

Calcium Salts	Calcium carbonate, calcium bicarbonate, calcium sulphate, calcium chloride and calcium nitrate.
Magnesium salts	Magnesium carbonate, Magnesium bicarbonate, Magnesium sulphate, Magnesium chloride and Magnesium nitrate.
Sodium salts	Sodium carbonate, Sodium bicarbonate, Sodium sulphate, Sodium chloride and Sodium nitrate.

Miscellaneous :

Dissolved solids : Silica, Iron, Aluminium & Manganese.

Hardness forming salts:

Hardness is only due to calcium and magnesium salts.

Carbonate Hardness : (Temporary hardness)

- Calcium Bicarbonate
- magnesium Bicarbonate

Non-carbonate Hardness : (Permanent hardness)

- Calcium sulphate
- Calcium chloride
- Calcium Nitrate
- Magnesium sulphate
- Magnesium chloride
- Magnesium Nitrate

Silica : Presence of silica in water also gives rise to hard deposits which are as bed as scales.

Alkalinity :

Alkalinity is due to presence of

- Bicarbonates
- Carbonates
- Hydroxides

'M' Alkalinity represents Total Alkalinity.

'P' Alkalinity represents Partial Alkalinity.

Total Hardness : H

Total Alkalinity : M

- a) When $H > M$ Both carbonate and non-carbonate hardness are present
 $H - M$ Non carbonate hardness (NCH)
- b) When $H = M$ Only carbonate hardness is present.
- c) When $M > H$ Only carbonate hardness is present.
 $M - H$ Sodium bicarbonate.

c) DISSOLVED GASES :

Oxygen, Carbon-di-oxide and Hydrogen sulphide.

III. EFFECTS OF IMPURITIES:

A. DISSOLVED SOLIDS AND SUSPENDED SOLIDS:

They give rise to scaling and deposition in a given system. They also accelerate corrosion.

B. ORGANIC MATTER:

This has a greater effect on scale deposition than on corrosion. However, the effect of micro organisms on both deposition and corrosion can be major and must not be overlooked.

C. DISSOLVED GASES:

They invariably influence the corrosion rate.

IV. TREATMENT:

Water is purified by

- External treatment
- Internal treatment.

EXTERNAL TREATMENT:

- Clarifiers : For precipitating colloids and setting suspended matter.
- Filtration : To remove suspended matter.
- Remove of hardness : Cold Lime soda process.
Hot Lime soda process.
Ion Exchange process.
- Removal of dissolved Solids : Determinization by **Ion** Exchange process.
Desalination.
Electrodialysis.
Reverse Osmosis.

INTERNAL TREATMENT:

A. For Boiler Water Treatment:

Water is internally conditioned by the use of chemicals. Chemicals are added to water for the following purposes.

1. Internal softening.
2. Oxygen scavenging.
3. Alkalinity Building.
4. Sludge conditioning.
5. Anti foaming.

1. INTERNAL SOFTENING:

The residual hardness in the feed water should be treated to bring it down to zero. If allowed to concentrate, scales would begin to form. Hardness is taken care of by providing a phosphate treatment. The principle behind it is as follows:

Calcium is allowed to react with phosphate and is converted into calcium phosphate which is easily removed by blow down. Phosphate reserves of 30 ppm to 40 ppm is provided in the boiler water.

2. OXYGEN SCAVENGING

Corrosion would be rampant if oxygen in feed water is not removed. This can affect the pre-boiler, boiler and condensate line sections. The removal of oxygen therefore is a must.

The concentration of oxygen is dependent on temperatures. Oxygen content is lesser at higher temperatures. Oxygen in water is removed by addition of sodium sulphite. Sodium sulphite reacts with oxygen to form sodium sulphate. We should necessarily provide reserves of sulphite (around 30 ppm) for exigencies. Catalysed sulphite should be used.

Hydrazine hydrate can also be used for removal of oxygen. But the speed of reaction is much lesser with hydrazine. Further, it is toxic in nature. However, hydrazine is effective in reducing oxides of copper and iron and is more effective in preventing deposition of corrosion products in feed lines, etc. Hydrazine also helps in removing old corrosion products from boiler internals and helps to maintain a uniform Fe_3O_4 layer on internal boiler surfaces. Reserves of 0.1 to 0.2 ppm of hydrazine should be maintained.

3. ALKALINITY:

Alkalinity is necessary for the following reasons :

- a. To prevent Magnesium to Magnesium Hydroxide sludge which is easily removed by blow down. If Magnesium is allowed to react with phosphate Magnesium phosphate, a thick slimy sludge will be formed, which is as bad as a scale. Therefore OH alkalinity is provided whereby Magnesium preferably reacts with it to form Magnesium hydroxide.
- b. To minimize solubility of iron.
- c. It keeps silica in solution. i.e, it reacts with silica and forms a complex silicate compound which will remain in solution and will precipitate.

NOTE : Excess alkalinity should be avoided as it will give rise to caustic embrittlement.

4. SLUDGE CONDITIONING:

Sludge conditioning is a must and must be provided in boiler water. The sludge that is formed should be kept in suspension so that it is removed easily during blow down. If the sludge is not conditioned, it would deposit on the tubes and drums. This will serve as nuclear for scale formation. Sludge conditioning can be achieved by the use of chemical sludge conditioners.

5. ANTIFOAMING:

Foaming is said to occur when the steam space in the boiler is partially filled with unbroken steam bubbles. Foaming is caused by impurities in the water preventing the free escape of steam as it rises to the surface or by and oily scum on the surface on the water. This surface scum may be caused by oil, organic matter or any suspended matter in the water.

Remedy :

1. To provide an anti foaming agent.
2. Provide enough blow down to avoid excessive concentration of salts.
3. Treatment and filtration of the water to remove solid impurities.

Priming :

Priming is carrying over of water slugs with the steam. The causes are the same as that of foaming. But it may occur even with perfectly pure feed water itself.

- a. The steam space is too small.
- b. If the boiler is operated way above its normal capacity.
- c. If the water level is carried too high.

Remedy :

1. To avoid priming, all main stop valves on boilers and steam lines should be opened very slowly and water in the boiler should not be carried above its normal level.
2. Boiler design should be corrected to increase the steam space.

Summary :

01.	Internal Softening	Provide phosphate treatment to take care of residual hardness. (Provide 20-40 ppm of phosphate reserves) Avoid high PO_4
02.	Oxygen Scavenging	Introduce an oxygen scavenger like catalysed sodium sulphite to remove completely dissolved oxygen. Provide 20-30 ppm of sulphite reserves.
03.	Alkalinity	Provide 200 ppm of OH Alkalinity in boiler water.
04.	Sludge conditioning	Sludge should be conditioned with the help of a sludge conditioner.
05.	Antifoam	Antifoam should be incorporated in the chemical treatment to take care of foaming.
06.	Suspended Solids	Guard against mud, silt, oil, process contaminants, etc. Provide filtration for raw water if necessary.
07.	Blow down	Control blow down properly to keep sludge accumulation under control and to avoid excessive TDS concentration.

CONVERSION TABLE FOR SPECIFIC CONDUCTANCE TO TDS AT 25°C (11°F)

uS	TDS	uS	TDS	uS	TDS
5	3	300	188	2200	1485
10	6	350	218	2400	1647
15	8	400	251	2600	1795
20	11	450	284	2800	1950
25	14	500	320	3000	2085
30	17	550	347	3200	2200
35	20	600	376	3400	2395
40	23	650	402	3600	2530
50	26	700	428	3800	2685
60	35	750	462	4000	2855
70	40	800	495	4200	3010
80	47	850	530	4400	3180
90	53	900	564	4600	3335
100	59	960	623	4800	3505
110	64	1000	660	5000	3675
170	104	1300	858	8000	6115
180	110	1400	923	8500	6600
190	116	1500	975	9000	7045
200	121	1600	1000	9500	7525
220	136	1700	1145	10000	7857
240	148	1800	1195	12000	9850
260	160	1900	1205	14000	11805
280	173	2000	1315	16000	11900

BASED ON CONDUCTANCE OF SODIUM SULPHATE SOLUTIONS

OXYGEN CONTENT AT VARIOUS TEMPERATURES

Temperature °F	Temperature °C	Oxygen content ppm	Temperature °F	Temperature °C	Oxygen content ppm
135	57.2	4.9	185	85.0	2.4
145	62.8	4.4	190	87.8	2.0
155	68.3	3.9	-----	-----	-----
165	73.9	3.6	200	93.3	1.1
175	79.4	3.0	205	96.1	0.7
180	82.2	2.6	210	98.9	0.3

Deaerator pressure Psi	Temperature °F								
	212	205	197	188	178	164	148	133	118
0	218	212	204	195	186	175	162	149	134
2	227	221	215	208	200	191	180	169	159
5	237	227	221	215	208	200	190	181	170
7	239	235	230	224	218	211	204	196	185
10	239	235	230	224	218	211	204	196	185
Max. Oxygen content (ppm)	0	0.7	1.4	2.2	2.9	3.6	4.3	5.0	5.7

WATER TREATMENT SUPPLIER ADDRESS'S

**M/S. ANCO INDIA CHEMICALS (P) LTD,
PLOT NO. 1/1A, U.R. NAGAR EXTENSION,
JAWAHARLAL NEHRU ROAD,
ANNA NAGAR WEST EXTENSION,
CHENNAI – 600 101.**

**M/S. AQUA CONTROLS & SYSTEMS
2/33, D-TYPE SIDCO NAGAR,
VILLIVAKKAM,
CHENNAI – 600 049.**

**M/S. EFFIMAX ENGINEERS,
PLOT NO. : 5107, 1ST FLOOR,
12TH MAIN ROAD,
ANNA NAGAR,
CHENNAI – 600 040.**

**M/S. ION EXCHANGE (INDIA) LTD,
'ION HOUSE',
42, B.N. REDDY ROAD,
T. NAGAR,
CHENNAI – 600 017.**

**M/S. SURAJ CLEAR WATER SYSTEMS,
12, IIIRD STREET,
THIRUMURTHY NAGAR,
NUNGAMBAKKAM,
CHENNAI – 600 034.**

METHODS OF WATER ANALYSIS

METHODS OF WATER ANALYSIS

CONTENTS

- 1. SAMPLE COLLECTION - PRECAUTIONS**
- 2. USE OF INSTRUMENTS – GENERAL INSTRUCTIONS.**
- 3. DETERMINATION OF HARDNESS**
- 4. DETERMINATION OF P & M ALKALINITY**
- 5. DETERMINATION OF SULPHITE**
- 6. DETERMINATION OF DISSOLVED OXYGEN MORE THAN 0.1 PPM**
- 7. DETERMINATION OF TOTAL DISSOLVED SOLIDS.**
- 8. DETERMINATION OF OIL**
- 9. DETERMINATION OF pH**
- 10. DETERMINATION OF TOTAL SILICA**
- 11. DETERMINATION OF ORTHOPHOSPHATE**

METHODS OF WATER ANALYSIS

SAMPLE COLLECTION - PRECAUTIONS

Proper sampling procedure is equally important as the actual investigation to ensure reliable measurements.

As a matter of principle, water for testing should be sampled by the actual person responsible for the examination or atleast by someone familiar with the plant and suitably instructed.

Sampling lines are to be kept continuously flowing. Sampling and cooling water lines should be free from choking and sampling lines to be purged for about 30 minutes everyday as a routine and whenever choking is suspected. To avoid contamination of cooled samples, they are to be collected in dust-free atmosphere. Cooling water contamination of samples is to be prevented. The sampling rate should be of not less than 25 kg/hr and sample temperature shall not exceed about 40°C. The container used for collecting samples should be made of polythene or polyethylene. Before collecting samples, rinse the container atleast 3 times. After collecting the samples, rinse the stopper and tightly close the container.

USE OF INSTRUMENTS - GENERAL INSTRUCTIONS

SPECTROPHOTOMETER

The following instructions shall be followed to ensure the accuracy of spectrometric determinations.

1. The spectrophotometer used for colorimetric determinations is to be calibrated atleast once in six months.
2. The temperatures of both sample solution and calibration solution shall be nearly equal to each other. (Preferably within the range 20°C to 25°C). To obtain this temperature, the sample shall be externally cooled with ice.

3. Same optical cell is to be used for calibration and measurement.
4. For the determination of the various constituents, individual graphs are to be prepared with standard solutions.
5. The straight line portion of the curve which represents linearity only is to be used.
6. Solutions of higher concentrations are to be diluted suitably so that the concentrations can be measured within the linear portion of the graph.
7. Supplier's other operation instructions shall also be followed.

OTHER INSTRUMENTS

The general operating instructions supplied along with instruments shall be followed.

DETERMINATION OF HARDNESS

I. INTRODUCTION

1. TOTAL HARDNESS

Calcium and magnesium ions in water are sequestered by the addition of sodium ethylene diamine tetra acetate. The end point of the reaction is detected by means of an indicator, chrome-black Tat an optimum pH of 10.0 – 10.4 which has a wine red colour in the presence of calcium and magnesium and a blue colour when they are sequestered.

2. CALCIUM HARDNESS

Calcium ions in water are sequestered by addition of EDTA. The end point of the reaction is detected by means of an indicator, murexide which is dark purple in the absence of calcium but which with calcium forms a light salmon red complex. The optimum pH range is about 10.4.

II. PROCEDURE

1. TOTAL HARDNESS

- a. Pipette 50 ml of the sample into a white porcelain casserole. If necessary adjust to pH 7 – 10 using ammonium hydroxide or HCL.
- b. Add 0.5 ml of buffer solution and mix by stirring. (The pH of this solution should be between 10 – 10.2)
- c. Add approximately 0.2 gms of dry chrome black T indicator to produce the required depth of colour. The titration with EDTA should proceed immediately upon addition of the chrome black T.
- d. If hardness is present the solution will turn red. Standard EDTA solution is added slowly with continuous stirring until the end point is reached which is pure blue colour with no reddish tinge remaining. Further addition of EDTA will produce no further colour change.

2. CALCIUM HARDNESS

- a. Pipette 50 ml of the sample into a white porcelain casserole.
- b. Add 2 ml of 4% NaOH solution and stir. (The pH of this solution should be above 10.4)
- c. Add approximately 0.2 gms of calcium (Murexide indicator).
- d. Add standard EDTA solution slowly with continuous stirring until the colour changes from salmon pink to orchid purple.

CALCULATION

1. Total hardness (as ppm CaCO_3) = ml std EDTA soln x 20
2. Calcium hardness (as ppm CaCO_3) = ml std EDTA soln x 20
3. Magnesium hardness (as ppm CaCO_3) = Total hardness (as ppm CaCO_3)
minus calcium hardness (as ppm CaCO_3)

III. REAGENTS

1. Standard calcium chloride solution (1 ml equals 1 mg CaCO_3)

Dissolve 1.00000 gm of reagent grade calcium carbonate containing less than 0.04% MG (dry at 110°C for one hour) in 10 ml 1:1 Hydrochloric acid, without spattering, dilute exactly to one litre and transfer to a clean dry glass stoppered bottle for storage (or use a commercially prepared standard).

2. Buffer solution

350 ml ammonium hydroxide (conc.) + 54 gms ammonium chloride + 20 ml magnesium complex solutions are mixed and made up to one litre with distilled water. Magnesium complex solution is prepared as follows. 4.1 gm of MgO (analar) is mixed with 37.2 gms of EDTA and dissolved in 410 ml of warmed distilled water.

3. Calcium Indicator

Murexide : Grind 0.2 gm ammonium purpurate (murexide) with 100 gms of sodium chloride to 40 to 50 mesh size.

4. Chrome Black T Indicator

Grind 0.2 gms of chrome black T powder with 80 gms of powdered NaCl and store in a dark chloride bottle.

5. Standard EDTA solution

Weight 4.0 gms of di sodium di hydrogen EDTA di hydrate and dissolve it in 800 ml water. Adjust to pH 10.5 with 5% NaOH. To standardize, pipette 25 ml of standard CaCl_2 solution (prepared above) and add ammonium hydroxide (1 : 4) solution to obtain a pH of 10 to 10.4 add 0.2 gms of chrome-black T indicator. Titrate with EDTA solution according to the procedure above. This EDTA solution should be equivalent to more than 1 mg of CaCO_3 per ml. Let V = the volume of standard EDTA solution required to titrate 25 ml of standard CaCl_2 solution. Then $25 \text{ ml } \text{CaCl}_2 / V$ (times volume of EDTA to be diluted) = volume to which EDTA must be diluted.

Using volumetric pipettes and / or burettes make the required dilution, mix well and restandardize as a check. The use of a factor is also satisfactory. This solution should be stored in polyethylene bottles and restandardized monthly.

6. Sodium hydroxide solution (4%)

Dissolve 4.0 gms of NaOH in water and dilute to 100 ml.

IV. GLASS WARES

1. Titration apparatus outfit, consisting of automatic – zeroing 10 ml burette with reservoir bottle.
2. 50 ml measuring cylinder – 1 No.
3. White porcelain casserole with a glass stirrer.
4. Stop cock lubricant.

DETERMINATION OF P&M ALKALINITY

THEORY OF TEST

This test is based on the determination of the alkaline content of a sample by titration with a standard acid solution. In this measurement, the end points are taken of change in the colour of organic indicators phenolphthalein (approx. pH 8.3) and methyl orange (approx. pH 4.3) represent definite points to which the alkalinity of the sample has been reduced by the addition of the standard acid solution.

APPARATUS REQUIRED

- 1 Burette, automatic, 25 ml or ordinary
- 1 Casserole, porcelain 250 ml
- 1 Cylinder, graduated, 50 ml
- 1 Stirring rod, glass.

CHEMICALS REQUIRED

- Sulphuric acid, N/50
- Phenolphthalein indicator
- Methyl orange indicator
- Methyl purple indicator

PROCEDURE FOR TEST

Measure a clear 50 ml sample of water in the graduate and transfer to the casserole. Add 4 or 5 drops of phenolphthalein indicator. If the sample is an alkaline water, such as usually is the case with the boiler water, it will turn red. If the sample is a raw or natural water, it usually will remain colourless. Add the standard N/50 sulphuric acid from the burette drop by drop to the sample in the casserole, stirring constantly until the point is reached where one drop removes the last trace of red colour and the sample becomes colourless. Stop and record the total number of ml to this point as the P reading.

Add 4 drops of methyl orange indicator (if no red colour develops on the addition of the phenolphthalein indicator to the original sample, the titration may be started with the methyl orange indicator at this point). Continue adding the acid drop by drop until one drop changes the colour from a yellow to a salmon-pink. Record the final burette reading as the M reading. This is a more difficult end point and some practice may be required. The general tendency is to add too much acid. If too much acid is added, the sample will change from a salmon-pink to definite red. Record the titration to P point and the total titration to the M point as the P and M readings respectively. (Note that the M reading will always be greater than the P reading in as much as the P reading is included in the M reading.)

CALCULATION OF RESULTS

FORMULA

$$\text{ppm alkalinity as Ca CO}_3 = \text{ml N/50 sulphuric acid} \times \frac{1000}{\text{ml sample}}$$

Using a 50 ml sample, the phenolphthalein alkalinity in parts per million as CaCO_3 is equal to the ml of N/50 sulphuric acid required for the P reading multiplied by 20. The methyl orange alkalinity is equal to the ml of N/50 sulphuric acid required for the M reading multiplied by 20.

LIMITATION OF TEST

It is preferable to express the results of the alkalinity determination in terms of P and M alkalinity as above. However, results are sometimes calculated in terms of bicarbonate, carbonate and hydrate on the assumption that titration to the P and point is equivalent to all the hydrate and one half the carbonate alkalinity and that the titration to M is equivalent to the total alkalinity. Many factors such as the presence of phosphate silica, organic and other buffers affect this titration and the calculation of the form of alkalinity present may be in error. Under normal circumstances in plant control, expression of results as P and M alkalinity is entirely satisfactory and is to be preferred from the standpoint of simplicity.

DETERMINATION OF SULPHITE

This method is designed primarily for the routine control of boiler feed waters subject to sulphite treatment. Reductants like sulphite and certain heavy metal ions react similarly to sulphite. Copper catalyzes the oxidation of sulphite on exposure to air especially at warm temperatures.

REAGENTS

Standard Potassium Iodate Titrant

Dissolve 0.566 g KIO_3 dried at 120°C and 0.5 g NaHCO_3 in distilled water and dilute to 100 ml. The equivalent of this titrant is 1.0 mg Na_2SO_3 per 1.00 ml.

Potassium iodide solution 50 g per litre. Dissolve 50 mg of iodate free KI and 0.5 g of sodium bicarbonate (NaHCO_3) in freshly boiled and cooled water and dilute to one litre.

Starch indicator.

Hydrochloric Acid 1 + 1

PROCEDURE

Place 10 ml 1 + 1 HCL in a 250 ml flask. Rapidly add 100 ml sample submerging the pipette tip below the acid surface to minimize air exposure. After adding 1 ml starch indicator solution and 5 ml KI solution titrate with standard KIO_3 titrant to the first appearance of a persistent blue colour. Determine the blank titration by carrying 100 ml distilled water through the complete procedure.

SO_3 milligrams per litre = $(a-b) \times 6.35$

Na_2SO_3 milligrams per litre = $(a-b) \times 10$

Where A = milliliters of titration for sample

B = milliliters of titration for blank.

APPARATUS REQUIRED

1. 250 CC Erlenmeyer flask
2. 10 CC pipette (for 1 : 1 HCL)
3. 100 ml pipette (for the sample to be measured)
4. 1 ml pipette (for starch indicator)
5. 5 ml pipette (for KI solutin)
6. 50 ml burette (for KIO_3 titrant)

DETERMINATION OF DISSOLVED OXYGEN IN INDUSTRIAL WATERS CONTAINING MORE THAN 0.10 PPM

I. SAMPLING

It is important to use air tight connections in all apparatus used for sampling and testing. When sampling hot water a water cooled coil should be introduced into the sampling line. A convenient arrangement for sampling for feed water is shown in the figure. The sample itself should be taken in a 500 ml winkler flask containing a few glass beads, as shown in figure and water should flow through for atleast 10 minutes before taking the actual sample so as to displace all traces of air. Care must be taken to see that air bubbles do not form around the stopper of the winkler flask while sampling.

II. REAGENTS REQUIRED

1. Manganous chloride

Dissolve 400 gm of Manganous chloride (AR) in one litre.

2. Alkaline iodine

Dissolve 600 gm of Potassium Hydroxide and 140 gm of Potassium iodide in one litre of water.

3. N / 100 Sodium thiosulphate

Dissolve 2.482 gm of AR sodium thiosulphate ($\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$) in water and make up to one litre. Add about 1 gm of AR sodium carbonate to preserve the solution.

4. Sulphuric Acid 1 : 1

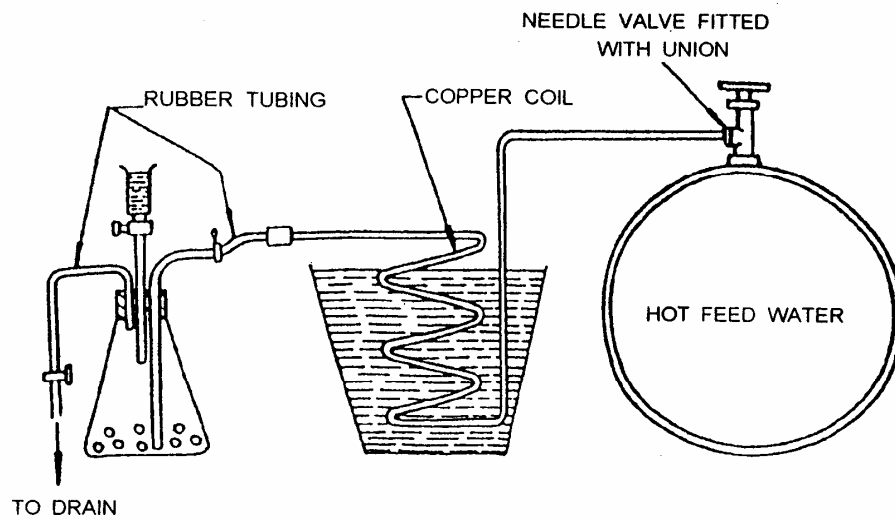
Add 250 ml of conc. Sulphuric acid to 250 ml of water. Cool and store.

III. PROCEDURE

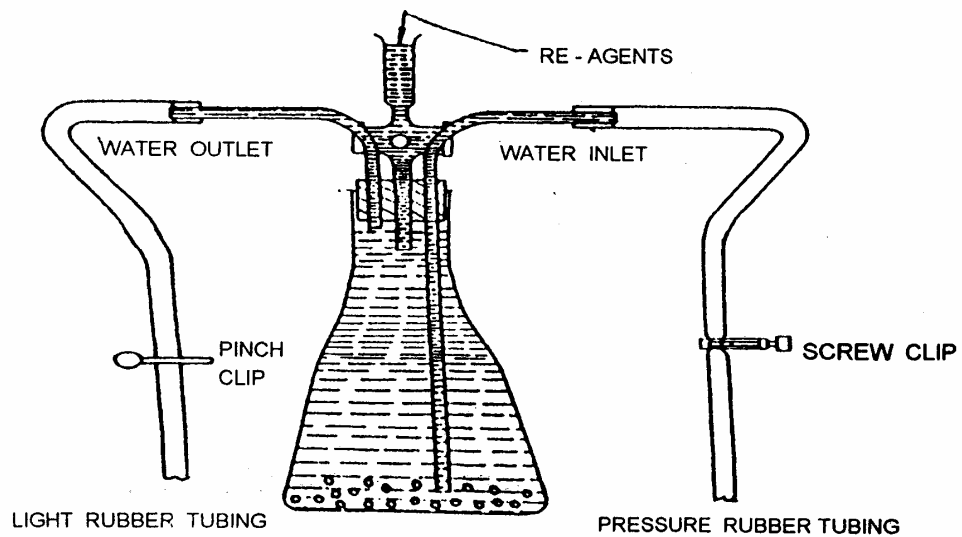
By means of the funnel fitted to the Winkler's flask add 2 ml of the manganous chloride solution and then add 2 ml of the alkaline iodide solution. Mix allow to stand for 10 minutes and then add 2 ml of 1 : 1 H_2SO_4 . Take 250 ml of the sample and titrate the liberated iodine with N/100 thiosulphate solution using starch as indicator. Millilitre of N/100 thiosulphate used for 250 ml sample $\times 0.224 = \text{ml of oxygen / litre}$ 1 ml of oxygen / litre = 1.430 mg / litre.

IV. GLASSWARES

1. Winkler' flask arrangement as shown in the figure.
2. 2 ml pipette.
3. Burette 50 ml – 1 No.



METHOD OF COLLECTING SAMPLE FOR OXYGEN
DETERMINATION ON HOT FEED WATER



WINKLER FLASK FOR DISSOLVED OXYGEN
DETERMINATION

DETERMINATION OF EVAPORATION (T.D.S.) IGNITION RESIDUES AND VOLATILE MATTER

a) Evaporation residues at 105°C apparatus required.

- 1, 200 CC. capacity platinum evaporation dish.
2. 100 CC. 200 CC. pipettes to measure water to be tested.
3. Water bath.
4. Drying oven.
5. Dessicator.
6. Ignition furnace.

PROCEDURE

100 CC or possible a greater quantity of the water to be tested (filter if suspended solids are present – estimate separately suspended solids content) is evaporated in a platinum dish on a water bath until it is dry after which it is dried down to constant weight in a drying oven at 105°C. It is weighed after cooling in the dessicator.

b) Determining the ignition residues

The evaporation residue determined at 105°C as described above is ignited in an ignition furnace at $600 \pm 25^\circ\text{C}$ until constant weight. Cool in the dessicator and weigh. Constant weight shall be considered as attained when the change in weight of the dish plus residue shall be not more than 0.5 mg between two successive operations involving heating, cooling in a dessicator and weighing.

c) Determining the volatile matter

Record the loss in weight in the previous determination as weight of volatile dissolved matter.

CALCULATIONS

Total dissolved solids ppm $A/W \times 1000$

Ignition residue ppm $B/W \times 1000$

Volatile matter ppm $\frac{(A - B)}{W} \times 1000$

Where,

A = mg of dissolved matter.
B = mg of ignition residue
(A-B) = mg of volatile matter
W = (CC) weight of sample used.

DETERMINATION OF OIL INDUSTRIAL WATERS CHLOROFORM – EXTRACTABLE MATTER

THEORY OF TEST

This test determines the substances which are extractable by chloroform and is not a test specific for oil. Heavy oils, fats and certain other organic compounds will be measured by the test. Following evaporation to dryness of the chloroform extract, the residue is weighed.

CHEMICALS REQUIRED

Hydrochloric acid (1 : 9)

Chloroform, redistilled

PROCEDURE FOR TEST

Procedure for collecting the sample – collect approximately 900 ml of sample in a glass container such as a wide-mouth, 1000 ml Erlenmeyer flask. The sample should be collected directly in the flask and not transferred from another container. Glass stoppers or caps covered with aluminum foil should be used. The flask should be weighed prior to collection of the sample.

Procedure for Determination – Weigh the flask and its contents to the nearest 1 gram and obtain the weight of the sample by difference. Withdraw a few drops of the sample, determine pH and adjust to between pH 3.0 and 4.0 by hydrochloric acid (1 : 9).

Add 100 ml of chloroform to the flask and agitate by means of shaking machine or mechanical stirrer for 15 minutes. After separation, transfer the chloroform layer by a glass siphon to a 500 ml separate funnel. No lubricant should be used on the funnel stopcock. Add 50 ml of chloroform to the flask and repeat agitation for 15 minutes. Then transfer this second portion of chloroform to the separate funnel.

Draw off the chloroform layer through a dry, fat-and-oil-free filter paper into a 250 ml breaker. If there is suspended matter at the interface, leave about 2 ml of the chloroform layer in the funnel. Add 20 ml portion of fresh chloroform directly to the funnel shake and then withdraw the chloroform, using it as a wash for the filter.

Evaporate the chloroform on a boiling water bath to about 20 ml then transfer quantitatively to a weighted platinum or silica evaporating dish. If the source of the water sample was at or above 212°F. Continue evaporation to dryness on the boiling water bath. If the sample was from a source below 212°F, again reduce the volume to about 20 ml on the boiling water and then continue evaporation at room temperature. Weigh until constant weight is obtained.

CALCULATION OF RESULTS

$$\text{Chloroform – extractable matter ppm} = \frac{\text{weight increase of evaporating dish, mg} \times 1000}{\text{ml sample}}$$

LIMITATIONS OF TEST

With proper technique, an accuracy of 1.0 ppm or 2% whichever is greater can be obtained. The method does not determine lighter hydrocarbons which volatilize under the test conditions. Substances other than oil are included as chloroform extractable matter. While this procedure is based on ASTM method D1178 -54T, that method should be consulted if it is desired to conduct the test in exact conformity to ASTM – standards.

APPARATUS REQUIRED

1. A well-equipped laboratory
2. Wide mouth 1000 ml Erlenmeyer flask.
3. Balance capable of weighing upto 1 kg with an accuracy of ± 1 gm.
4. pH meter.
5. 100 ml measuring cylinder.
6. Shaker or mechanical stirrer.
7. 500 ml separating funnel
8. Glass syphon
9. Oil free filter paper
10. 250 ml beaker.
11. Funnel with filter stand.
12. Water bath suitable for heating (thermostat)
13. Platinum or silica evaporation dish.

DETERMINATION OF pH VALVE

INTRODUCTION

As a yard stick for the concentration of hydrogen ions, the pH value gives an indication of the percentage reaction (alkalinity or acidity) of the water and hence its aggressivity. The pH value is the negative logarithm to the base 10 of the hydrogen ion concentration, expressed as gram ions per litre.

The pH value of a given solution depends on the temperature and as a rule it is quoted for 20°C. At this temperature the pH value ranges from 0 to about 14. Water with pH=7 has a neutral reaction, while there is an acid reaction at pH<7 and a basic reaction at pH>7.

APPARATUS REQUIRED

1. A pH meter with associated glass and reference electrodes.
2. Buffer table of known pH.

ELECTROMETRIC DETERMINATION OF pH VALUE

With the electrometric method, the pH value is determined from the potential difference between the measuring electrodes immersed in the liquid under test and a reference electrode of known potential for testing water electrode assemblies comprising a glass electrodes and a calomel reference electrode are suited.

pH meter is to be operated in accordance with the instruction supplied with it, by its manufacturer. To ensure accurate measurements, air must be prevented from getting to the sample, since pH value may be strongly influenced by atmospheric contaminants.

Where water is very pure and the pH value and electrical conductivity are being determined simultaneously, make sure that the pH electrodes are inserted AFTER the conductivity electrodes if the measuring points are connected in series.

ELECTRODE TREATMENT

New glass electrodes and those that have been stored dry shall be conditioned and maintained as recommended by the manufacturer. If the assembly is in intermittent use, keep the immersed ends of the electrodes in water between measurements. For prolonged storage, glass electrodes may be allowed to become dry, but the junction and filling openings of reference electrodes should be capped to reduce evaporation.

STANDARDISATION OF ASSEMBLY

Turn on the instruments, allow it to warm up and bring it to electrical balance in accordance with the manufacturer's instructions. Wash the glass and reference electrodes and the sample cap by means of a flowing stream of distilled water from a wash bottle. Note the temperature of the test solutions and adjust the temperature dial of the meter to correspond. Select the two reference buffer solutions, the pHs values of which are close to the anticipated pH of the test solution. (Buffer solutions can be prepared from the buffer tablets following manufacturer's instructions). Warm or cool these reference solutions as necessary to match within 2°C the temperature of the unknown. Fill the sample cup with the first reference buffer solution, and immerse the electrodes. Engage the operating button, turn the range switch if present to the proper position and rotate the asymmetry potential knob until the reading of the dial corresponds to the known pH of the reference buffer solution. Repeat the above procedure until two successive instrument readings are obtained, without changing the setting of the asymmetry potential knob. Care should be taken to see that the level of the KCl solution in the reference electrode must always be kept within that of the measured solution. To reduce the effects of thermal and electrical hysteresis, the temperature of electrodes, reference buffer solutions and wash water should be kept as close to that of the unknown sample as possible.

Wash the electrodes and sample cup three times with water. Place the second reference buffer solution in the sample cup and measure pH by simply reading the dial. Do not change the setting of asymmetry potential knob.

The assembly shall be judged to be operated satisfactorily if the pH reading obtained for the second reference buffer solution agrees with its assigned pH value within 0.05 unit. In long series of measurements, supplement initial and final standardisations by interim checks.

Wash the electrodes by means of a flowing stream from a wash bottle. Place the water sample in a clean glass beaker. Measure the temperature. Insert the electrode and measure pH as before.

INSTRUCTIONS

pH meter should be checked for its performance using buffer tablets at least once a shift.

DETERMINATIONS OF TOTAL SILICA IN HIGH PURITY WATER

INTRODUCTION

Some boiler stations using ion exchange columns of preboiler water purification have noticed silica concentrations building up in the units and at the same time a soluble silica analysis on water coming from the ion exchange column showed no silica. Analysis for colloidal silica on these same samples showed that the silica was present as a colloidal particle. This technique has been developed as an analytical procedure to accurately determine trace concentrations of silica where all or a part is present in colloidal form. Total silica is determined spectrophotometrically after solubilization by the pressurized bomb method. (Paar oxygen bomb).

PROCEDURE

1. Accurately measure 50 ml or a suitable aliquot of the sample into a platinum cup.
2. Add 1 ml of 0.2 N NaOH and close the cup with a platinum cover.
3. Place the closed cup in a paar oxygen bomb containing 100 ml of deionized water and completely assemble the bomb.
4. Nitrogen is added to obtain 30 pounds pressure and let out five times to completely, flush out oxygen in the bomb to prevent bomb corrosion.
5. Pressurize the bomb with nitrogen to 45 psig (maintained for specified period) and place in an oven at 190°C for 8 hours. The oven should be placed in a hood since all gaskets in the bomb are made of Teflon.
6. Remove the bomb from the oven, cool and remove the sample from the platinum cup. Silica is determined spectrophotometrically by using the applicable high or low range method.

CALCULATION

1. See silica curve for the spectrophotometer used.
2. $\text{Colloidal silica (ppm)} = \text{Total silica (ppm)} - \text{soluble silica (ppm)}$

APPARATUS REQUIRED

1. 25 ml – Pipette
 2. 50 ml – Pipette
 3. 10 ml – Pipette
- } for suitable aliquot sample.
4. Platinum cup with cover.
 5. Oxygen bomb.
 6. 1 ml Pipette (for 0.2 N NaOH solution)
 7. 10 ml – Pipette (for deionized water)
 8. Nitrogen cylinder with pressure regulator opener etc.
 9. AIR OVEN to be capable of giving a temp, of 190°C for 12 hours continuously.
 10. Spectrophotometer at 815 nm.

DETERMINATIONS OF ORTHOPHOSPHATE INDUSTRIAL WATER ASTM : D515-68

INTRODUCTION

This method is applicable to the routine determination of orthophosphate in the 2 – 25 ppm PO_4 range in industrial water and is based on the photometric measurement of the yellow colour of the molybdo vanadophosphoric acid produced. The colour intensity is proportional to the orthophosphate concentration in the sample. Highly coloured water such as tannin treated boiler water and high concentration of ferric iron interfere thus requiring preliminary treatment to remove these materials.

PROCEDURE

1. To a 125 ml Erlenmeyer flask, using a pipette or volumetric flask, add 50 ml. of the clear sample or a liquid there of diluted to 50 ml. with deionized water. The sample must be free of suspended matter to avoid erroneous high results. Filtration using what man no. 42 filter paper has been found to be satisfactory in most cases.
2. Add, using a graduate, 25 ml of ammonium vanadomolybdate solution and mix well by swirling.
3. Allow 10 minutes for colour development and read within 30 minutes on the spectrophotometer at 400 nm.
4. Reagent blank and atleast two phosphate standards should be run along with samples.

CALIBRATION AND STANDARDIZATION

1. Prepare a series of standards to cover the range 0-25 mg/litre (ppm) and prepare calibration curve.

REAGENTS

1. Ammonium vanadomolybdate solution – Dissolve 40 grams of ammonium molybdate – tetrahydrate ($(\text{NH}_4)_6\text{MO}_7\text{O}_{24}4\text{H}_2\text{O}$) in 400 ml. of water. Dissolve 1.0 gram of ammonium metavanadate in 300 ml of water and add 200 ml concentrated nitric acid (SP. GR. 1.42). Add the first solution to the second solution mix well, and dilute to 1 litre with water in a volumetric flask.
2. Phosphate standard solution (1 ml = 1 mg PO_4) – Dissolve 1.433 grams of oven dried (4 hours at 105°C) C.P. potassium dihydrogen phosphate (KH_2PO_4) in water and dilute volumetrically to one litre.

APPARATUS REQUIRED

1. 125 ml Erlenmeyer flask.
2.

50 ml – Pipette	} for suitable aliquot sample.
25 ml – Pipette	
10 ml – Pipette	
3. Filter stand with funnel, 42 what man filter paper etc.
4. 25 ml – Pipette (for ammonium vanadomolybdate solution)
5. Spectrophotometer at 40 nm.

BOILER OPERATING INSTRUCTIONS

BOILER OPERATING INSTRUCTIONS

- 01. STARTING OF ALL INDIVIDUAL EQUIPMENTS**
- 02. STARTING OF BOILER FEED PUMPS**
- 03. DP STUDY**
- 04. BED MATERIAL, CHARCOAL & KEROSENE REQUIREMENT**
- 05. BOILER LIGHT UP**
- 06. NORMAL OPERATION**
- 07. NORMAL SHUT DOWN TO COLD**
- 08. NORMAL SHUT DOWN TO HOT STAND BY**
- 09. HOT RESTART**

**STARTING OF ALL INDIVIDUAL
EQUIPMENTS**

STARTING OF ALL INDIVIDUAL EQUIPMENT

GENERAL

The boiler is provided with interlocks for safe and reliable operation and none of these should be bypassed.

The sequence of starting of the equipments is as follows:

* **Check water level gauge for water in Drum.**

01. Start the ID fan.
02. Start the PA fan.
03. Start the FD fan.
04. Start the Fuel feeders.

Similarly while switching off, reverse sequence must be followed.

The individual equipment can be started through DCS or from Local Push Button (LPB). Switch on the power supply to the motor control centre (MCC) panel. The fuses of individual motor controls shall be checked for continuity. Three phase supply of 415 V / 11000 V 50 Hz with allowable percentage of variation shall be ensured before switching on the equipment.

STARTING OF BOILER FEED PUMPS

GENERAL

Ensure that the suction valve is open and water is available in the deaerator storage tank. Also ensure that, the discharge valve or the feed control valve including the bypass valve is closed. Then start the feed pump. Do not close the suction valve, when the pump is running. The auto recirculation valve to be opened automatically at the time of starting the pump and the same will be after crossing the pump min. flow. After that outlet valve is to be opened immediately. Do not run the feed pumps without suction filter. During normal running of boiler the pump can be started / stopped with discharge valve open, since the feed line is under pressurised condition.

DP STUDY

DP STUDY

DP study must be carried out individually for all compartments. In simple terms, DP study is nothing but finding out the pressure drop across distributor plate at different air flows. Follow the steps given below.

DP study shall be done separately for each compartment. Hence close the FD, PA dampers of the compartments which are not being studied.

Switch on ID fan, PA fan and then FD fan. Open the suction damper of FD fan and set 10 mm air flow in Aerofoil meter. Measure the air box pressure and gas plenum pressure (ID fan damper is to be adjusted to maintain a gas plenum pressure of -5 mmwc at all conditions).

Suppose,

FD air flow	= 10 mmwc across Aerofoil meter
Air box pressure	= 75 mmwc
Gas plenum pressure	= -5 mmwc
The pressure drop across DP at 10 mm air flow	= 75 + 5 mmwc
	= 80 mmwc

Thus, the pressure drop across DP can be found out 20, 30, 40, 50, 75, 100 & 125 of air flow.

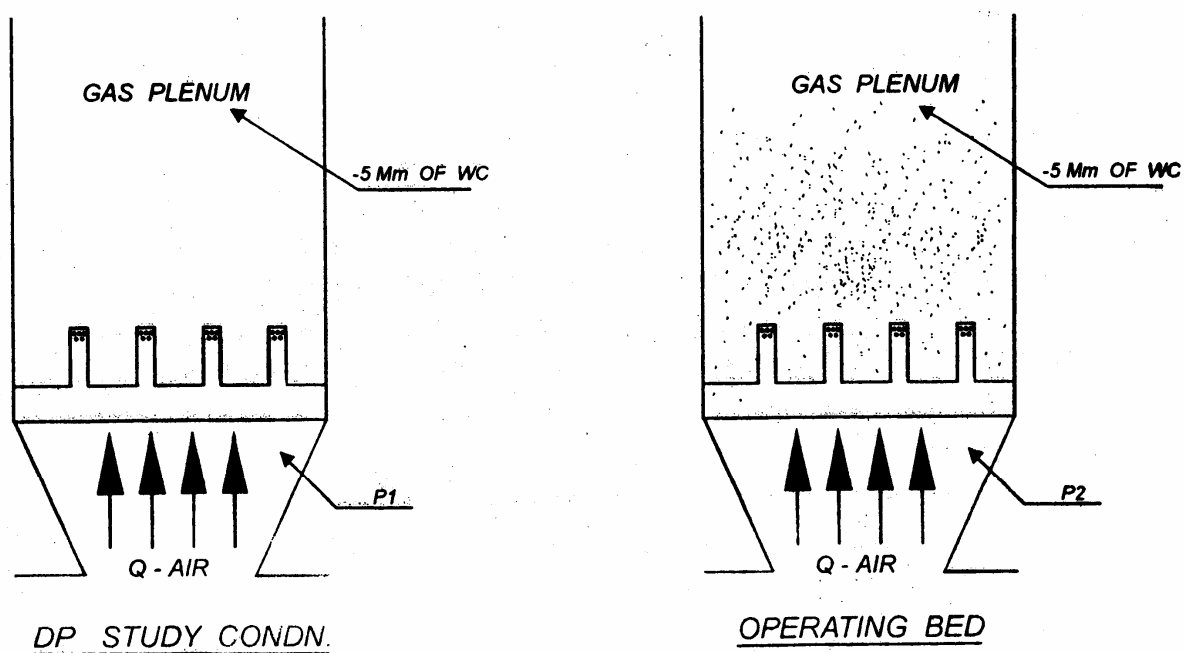
- * The pressure drop values should be found out for other compartment too.
- * The pressure drop values shall be compared. For the same air flow, if there is a deviation of more than 5 mm between compartments, then it becomes necessary to check the following.

- * The manometer readings may be incorrect. Check for leakage in the pressure tapping locations or Aero foil meter and air box.
- * Check for leakage in the impulse lines to manometer/ Draft indicator.
- * Check for leakage between fuel feed pipe and air box.
- * Check for broken air nozzles.
- * The pressure drop values found in DP study, shall be recorded for future use. The pressure drop values measured in DP study are used to find out the bed height when the boiler is in running condition i.e. at a particular air flow. Also it is used to establish the practical pressure drop across the aero foil meter at the MCR air flow. If the DP drop is subtracted from the total drop across the bed and DP, then bed height can be arrived at.

The pressure drop values taken shall be recorded on the following tables for future reference.



BED HEIGHT MEASUREMENT



$$P2 - P1 = \text{BED HEIGHT}$$

DP STUDY READINGS

COMPARTMENT – I

SL. NO.	FD AIR FLOW (MM)	GAS PLENUM PRESSURE (MM)	PRESSURE DROP ACROSS DISTRIBUTOR PLATE (AIR BOX PRESSURE – GAS PLENUM PRESSURE)
01			
02			
03			
04			
05			
06			
07			
08			

COMPARTMENT – II

SL. NO.	FD AIR FLOW (MM)	GAS PLENUM PRESSURE (MM)	PRESSURE DROP ACROSS DISTRIBUTOR PLATE (AIR BOX PRESSURE – GAS PLENUM PRESSURE)
01			
02			
03			
04			
05			
06			
07			
08			

DP STUDY READINGS

COMPARTMENT – III

SL. NO.	FD AIR FLOW (MM)	GAS PLENUM PRESSURE (MM)	PRESSURE DROP ACROSS DISTRIBUTOR PLATE (AIR BOX PRESSURE – GAS PLENUM PRESSURE)
01			
02			
03			
04			
05			
06			
07			
08			

COMPARTMENT – IV

SL. NO.	FD AIR FLOW (MM)	GAS PLENUM PRESSURE (MM)	PRESSURE DROP ACROSS DISTRIBUTOR PLATE (AIR BOX PRESSURE – GAS PLENUM PRESSURE)
01			
02			
03			
04			
05			
06			
07			
08			

**BED MATERIAL, CHARCOAL & KEROSENE
REQUIREMENT**

BED MATERIAL, CHARCOAL, KEROSENE REQUIREMENT

BED MATERIAL REQUIREMENT:

Quantity of bed material per startup	:	2350 Kgs.
Quantity of Bed material to be stocked	:	23500 Kgs. (For 10 Startups)

BED MATERIAL SPECIFICATION:

Maximum particle size	:	2.36 mm
Particles to pass through sieve No.	:	8
Minimum particle size	:	0.85 mm
Particles to stay on sieve No.	:	20
Particle density	:	2000 Kg/m ³
Bulk density	:	1000 to 1100 Kg/m ³
Chemical composition		
Alumina	:	45% to 35%
Silica	:	55% to 65%
Fusion temperature	:	1400°C (Min.)

(Bed material shall be from Crushed refractory bricks or from sieved ash).

CHARCOAL REQUIREMENT:

Quantity of charcoal per startup	:	150 Kgs.
Quantity of charcoal to be stocked	:	1500 Kgs. (For 10 Startups)

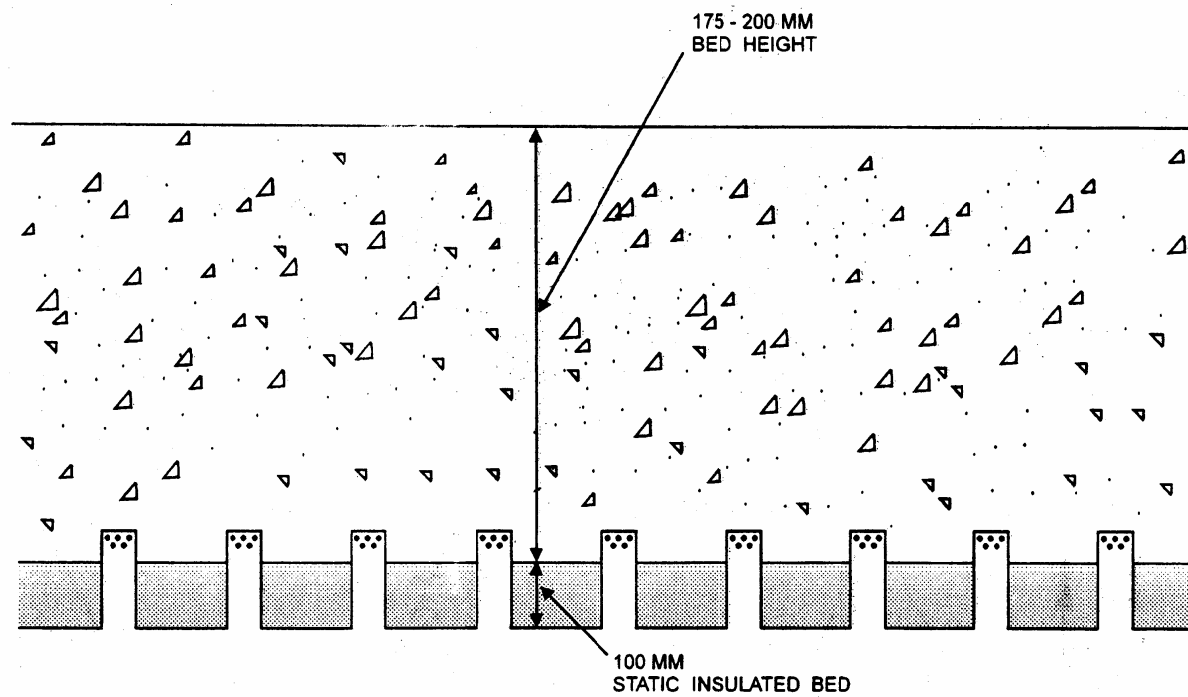
CHARCOAL SPECIFICATION:

Charcoal size	:	15 to 25 mm LUMPS
Calorific value (Charcoal should be sundried)	:	6600 Kcal/Kg.

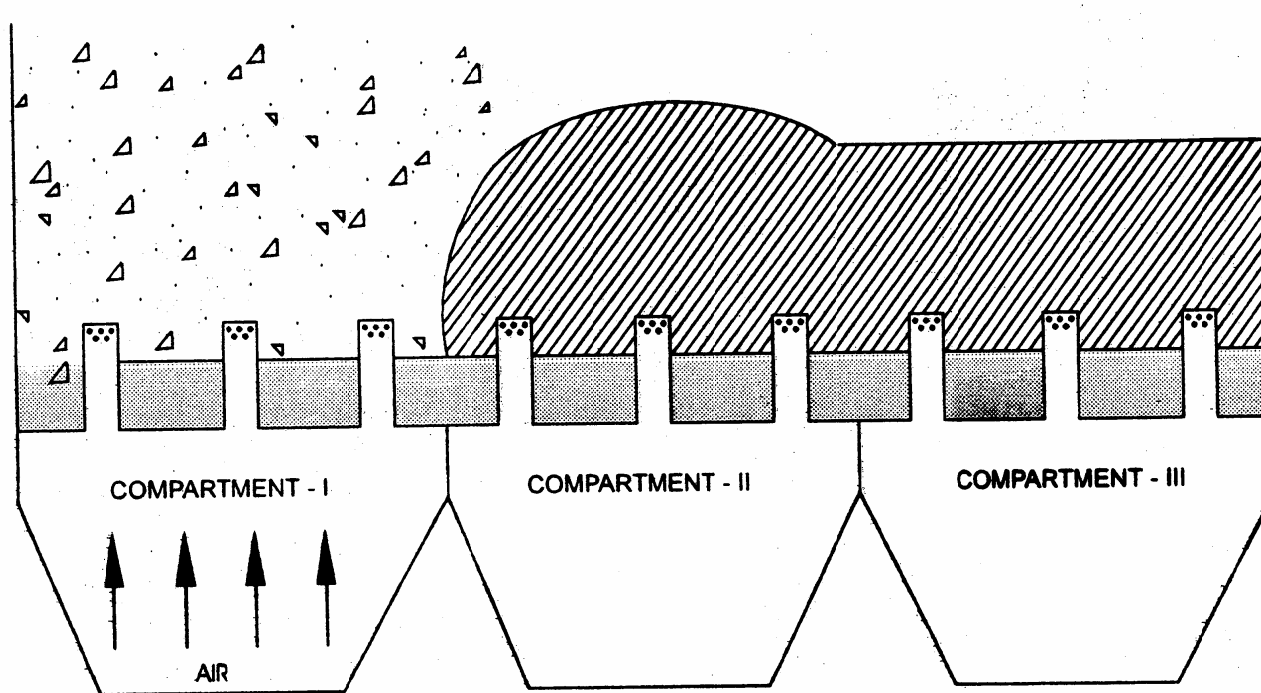
KEROSENE:

Quantity of kerosene per startup	:	10 Litres.
Quantity of kerosene to be stocked	:	100 Litres. (For 10 Startups)

STATIC BED HEIGHT AND OPERATING BED HEIGHT



COMPARTMENTAL FLUIDISATION



USE OF BED MATERIAL

The bed material plays a vital role in the fluidised bed combustion process. The bed material is inert and does not undergo any chemical change. The size of the bed material is so selected to meet the fluidisation requirements. The bed material once heated serves like an ignitor for the incoming fuel. The normal bed height when defluidised is maintained in the range of 300 mm to 400 mm. The bed material also acts as the carrier of heat between the burnt and the heat transfer surface.

PROCUREMENT OF BED MATERIAL

The bed material shall be procured from refractory supplier. Alternatively, the bed material can be purchased from the user of a coal fired fluidised bed boiler. The ash drained from the fluidised bed can be screened and used as bed material.

IMPORTANCE OF BED MATERIAL QUALITY AND QUANTITY

1. Before programming for a light up, it is necessary that the recommended quantity of bed material is procured according to the specifications. The bed material is to be stocked atleast for 10 start ups.
2. If the bed materials is procured from a refractory supplier, ensure only refractory bricks are crushed to make bed material. Mix up of insulation bricks is not allowed.
3. The fusion temperature of the bed material has to be above 1400°C. If the fusion temperature is lower, clinkering will occur in the bed.
4. It is important that the bed material is procured according to the size recommended. Oversize particles do not fluidise well and fine powder will fly away. Also the fine powder puts off charcoal fire while start up. (Because fine bed material quickly transfer heat to the bed coils).

5. In a coal fired boiler, the ash produced from coal partly accumulates in the bed and the same is drained to maintain a constant recommended bed height in the fluidised bed. This ash drained from the bed can also be screened and the screened ash can be used as bed material. In an agro fuel fired boiler, the bed material will not be generated and hence bed material has to be procured for daily consumption.
6. A coal fired fluidised bed in operation contain good amount of fines and coarse particles. Which are due to varying coal particle size on crushing. Hence for every light up (except hot restart) fresh bed material is to be used. This is essential for a smooth and quick start up.
7. When the bed material is procured from a refractory supplier, the size of the bed material is to be specified up mentioning the upper sieve no. 8 and lower sieve no. 20. The material has to pass through sieve no. 8 and to stay on sieve no. 20.

USE AND IMPORTANCE OF CHARCOAL:

1. Charcoal is required for lighting up of the boiler. A fixed quantity of charcoal is burnt in the fluidised bed to raise the bed temperature in the start up compartment. Once the bed temperature is raised further fuel is fed to establish combustion of fuel in the fluidised bed.
2. Charcoal is selected as the start up fuel, mainly, because of its high heat content, rapid burning characteristics and low ignition temperature.
3. Good quality charcoal is a must for easy light up. Ensure charcoal is dry and not already burnt. Heavier charcoal is an indication of good quality. Tamarind wood charcoal is the best because it burns for more time and the calorific value is about 6600 kcal/kg.
4. Charcoal should be dry for rapid burning. Wet charcoal should not be used in any case. Ensure the charcoal in stock is also dry.

5. The charcoal should not contain powder or bigger lumps. The charcoal shall be sized to 15 - 25 mm. Fine charcoal burns easily and does not contribute much for heating the bed. Bigger lumps would cause clinker formation as the lumps do not easily fluidise.

BED MATERIAL FILLING:

- * The bed material can be filled by entering the furnace. For start up purpose, the bed height shall be 200 - 225 mm above the air nozzle top level in the start up compartment.
- * The bed material below the nozzle level remains static all the time. This is not to be counted as the bed height.
- * Uniform spreading can be done by admitting fluidising air through the bed. The air should be sufficient enough to fluidise bed.
- * The bed height can be measured physically after putting off the air flow.
- * Alternatively the bed height can be found out by pressure drop across the fluidised bed.

Let us assume,

For 100 mm fluidising air flow the distributor plate pressure drop is found to be 150 mm.

Let gas plenum pressure = -10 mmwc

Let air box pressure drop across the fluidised bed = 484 mmwc

The pressure drop across the fluidized bed and the distributor plate = 491 mmwc

The pressure drop across the distributor plate is 121 mmwc as found in DP study.

The pressure drop across the bed $= 491 - 121.$

$= 270 \text{ mmwc}$

Since the bulk density of the bed material is 1000 kg/m^3 , the pressure drop across the bed in mm is the bed height in mm.

Though the normal operating bed height is 300 - 550 mm, initial bed material filling is done only upto 200-225 mm. This low bed height reduces the charcoal requirement for start up purpose. Also low bed height helps in raising the boiler pressure slowly.

In the case of compartmental start up the bed material shall be filled as explained below:

Fill the bed material to a height of 300 mm in all compartments. Fluidise all the compartments together provided the fan motor amperes are below the limits. If not possible, fluidise two compartments together for levelling. Then the next compartment can be fluidised separately. The start up compartment is to be fluidised separately. When this is done a portion of the bed material spills to the adjacent compartment and forms a mount along the edge of the compartment. Further bed material is to be added to the start up compartment so that the bed height of 200 - 225 mm is maintained.

BOILER LIGHT-UP

04. BOILER LIGHT-UP:

The lighting up of the boiler is to be done with the help of charcoal and kerosene. The light up is to be done only for a single compartment. After stabilising with a single compartment fire is transferred to other compartments as per the procedure explained separately.

PREPARATIONS:

01. Inspect the boiler prior to starting and check the following.
 - All access doors are closed.
 - All personnel cleared.
 - All foreign materials are removed from furnace and pressure parts.
 - Starting equipment and interlocks are in position.
 - Boiler is filled with DM water above the low level limit.
02. Check the following equipments for adequate lubrication and readiness for service.
 - Fans and drives.
 - Feed pumps and drives.
 - Fuel feeders and controllers.
03. Check dry fuel (0-6) mm is available in the bunker, the gates below the bunker are open and fuel is available at feeder inlet.
04. Check the instrument air is available at the required pressure (of 7 kg/cm²) for instrumentation and control.
05. Check the following valves in the Boiler drum are closed.
 - Feed control valve and its bypass valve.
 - Blow down valve.
 - Main steam stop valve.
 - Drain valves of water level gauge.
06. Check the following valves are kept open.

- Air vent on top of drum.
- Water level gauge, pressure gauge and level transmitter / isolation valves.
- Valves before and after the feed control valve in the feed line.
- Valves on the feed line connecting to the feed pumps in operation.

07. Check the bed material is filled in the furnace and fluidisation study is complete.

BOILER FILLING:

Before starting the filling up, keep the vent on the drum open and close the blow down and drain valves. The filling up is done by running the feed pumps but the rate of flow is controlled by means of feed control valve. During the filling up check the operation of blow down valve and drain valves and then close them. The boiler is filled up completely till water comes through the drum vent and is drained to bring the water level to low level alarm limit.

FLUIDISATION STUDY:

- * During the fluidisation studies, except for large compartments the fuel transport air need not be introduced as it would disturb the bed.
- * Observe the fluidisation of the start up compartment by varying the air flow gradually. Mark the position of dampers when the bed material begins to fluidise. In the case of pneumatically operated dampers, note the input signal "PSI" from the manual loaders.
- * The on set fluidisation may also be observed by plotting the bed pressure drop against the air flow.
- * Set the air flow at 5 mm P.
- * Measure the air box pressure, P1 mm wc
- * Add the gas plenum pressure P2 to P1 ($P1+(P2)$) is the pressure drop across the distributor plate and bed.
- * Subtract P3 mmwc, which is the pressure drop across DP alone which is measured in DP study. i.e., $(P1 + (P2)) - P3$ would be the pressure drop across the bed.

- * The pressure drop across the bed is thus obtained for various air flows. The readings may be plotted in a graph as shown.
- * The air flow at which fluidisation starts is noted. This value is to be maintained for the purpose of mixing at the time of startup.
- * Once the fluidisation study is completed, the fans shall be switched off and boiler shall be taken for light up.

The boiler light up is done using charcoal and kerosene as explained below.

- * A fixed quantity of dry charcoal is spread uniformly over the start up compartment.
- * A fixed quantity of Kerosene mixed charcoal is spread uniformly over the dry charcoal layer.
- * The fire is initiated using swab.
- * Further by proper air flow control, fire can be spread and the heat released by charcoal is utilised to heat the bed material to a temperature above the ignition temperature of the fuel.
- * In the process of preheating bed material the required fluidisation velocity is maintained in the bed by suitably opening the FD fan inlet damper.
- * Further the fuel feed rate is adjusted to maintain a bed temperature of 800°C to 850°C.
- * The charcoal of size below 15 mm shall not be accounted for the above quantity.
- * Keep the ID fan damper open at the time of lighting up. This would reduce the possibility of furnaces puff.
- * Initiate the fire bushing number of swabs. Throw the swabs in such a way that the fire spreads uniformly over the entire furnace. If the spreading of the fire is non uniform sprinkle some kerosene choked charcoal and throw it to the locations where fire is not there. Unless the fire is more or less present over the entire surface, it is advised not to proceed with the light up. Unless the top layer or charcoal gets ignited, further charcoal would not get ignited.

BED TEMPERATURE AND AIR FLOW CONTROL

The thermocouples are located in such a way that they are well utilised for start up.

The top level bed thermocouple is located at a height to read the temperature just at the burning charcoal layer. The bottom level thermocouple is located to read the bed material temperature at a height of 100 mm from nozzle level.

After the introduction of fire, top level thermocouple temperature will go up. It is very important to increase the air flow gradually in order to increase the top level temperature to 800°C. At first the ID fan damper opening alone allows some leakage air. Further opening of FD fan damper will add some more air to increase the bed temperature. Now close ID fan and FD fan inlet dampers. Start ID fan then FD fan. Open ID fan and FD fan inlet dampers step by step to increase the top level temperature to 800°C to 850°C. Till this period the bottom level thermocouple would not have shown increase in temperature. Once the top level temperature reaches 800 - 850°C, the burning top layer of charcoal shall be mixed with rest of the bed. The mixing is done by increasing the air flow so as to fluidise the bed. The mixing air flow should not be higher than that of the air flow established during the fluidisation study. For this purpose the markings made on damper positions shall be used. If the mixing is done at higher airflow, the burning charcoal will spill into the adjacent compartment. More than the loss of charcoal in the start up compartment, the bed height will reduce in start up compartment. This would lead to defluidisation as the air would tend to bypass at bed heights lower than 100 mm.

The duration of mixing shall be between 20 - 30 seconds. During the mixing process, the top level temperature would start reducing. At the same time, bottom level temperature would begin to rise.

Soon after the mixing is completed the air flow is brought to a minimum. Open the man hole door and visually ensure through mixing has been done. If top layer charcoal has not been disturbed at some places, mixing shall be carried out once again.

After ensuring thorough mixing, the air flow shall be brought down to minimum and then shall be increased in steps. The airflow shall be increased gradually so as to raise the bed temperature. The airflow shall be brought up at MCR airflow in process of raising bed temperature above 600°C.

Once the bed temperature shoots above 600°C, the fuel transport lines are to be dechoked and fuel flow shall be established.

- * Switch on the New PA fan.
- * Open the fuel transport air dampers of the start up compartment.
- * Check the suction at the mixing nozzle. If suction is not available, open the respective bottom drain gates of fuel pipes to dechoke, if any. After the choking of fuel feed pipe is cleared close the gates.
- * In the case of larger compartments it is advisable to initiate minimum airflow in fuel pipe lines just before mixing process to avoid choking of the fuel lines.
- * Adjust the PA fan suction damper, to maintain the header pressure in between 700 to 900 mm of wc.

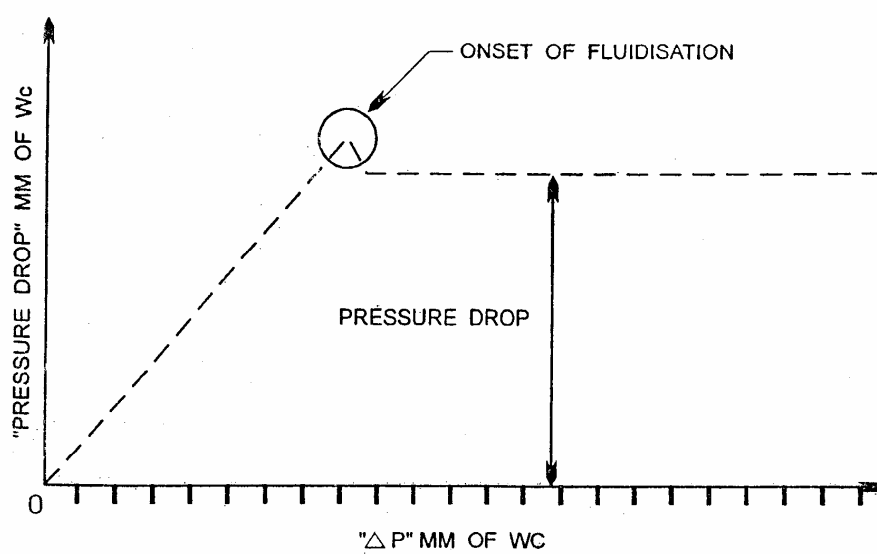
Initiate the fuel flow by switching on the fuel feeders. The fuel flow shall be kept minimum at the beginning. At the time of fuel feed initiation, the charcoal might not have burnt fully. Hence it is most important to initiate fuel feed gradually.

Excess fuel feed will increase the bed temperature uncontrollably. Though the bed temperature can be controlled by increasing the air flow, it is advisable to take care at the time of fuel feed initiation. Stabilise the start up compartment operation with a bed temperature of 850°C and with the MCR air flow.

- * On the waterside watch the drum level. If the level goes down switch on feed pump and regulate the feed control valve. ON/OFF operation of feed pump should be avoided to the extent possible. If the feed pump is auto operated, keep the selector switch in auto mode. Here again regulate the feed control valve to avoid frequent start/stop of the pump.
- * Close the drum vents at 2 kg/cm² pressure if the boiler is provided with superheater. This is done so that superheater coils are cooled better by more steam flow through them. Ensure the vents, start up vents, drains are open in superheater lines. The condensate in superheater coils and main steam pipe should have been removed earlier. In the case of non drainable sections of superheater coils it is possible that condensate leads to water hammer.
- * In cases of powercut during start up after the mixing it will not be possible to access how much charcoal is burnt out. It is advised to cool thoroughly and drain the bed material in start up compartment and do a fresh light up.
- * However, if the powercut had occurred before mixing one may attempt to light up as below:
- * Sprinkle Kerosene soaked charcoal through man hole evenly over the start up compartment. The charcoal quantity shall be the same as that for light up.
- * Throw swabs and light up.
- * Follow the same procedure as discussed in a regular light up.
- * If the powercut occurs after mixing and provided the duration is also short, it may be possible to light up.

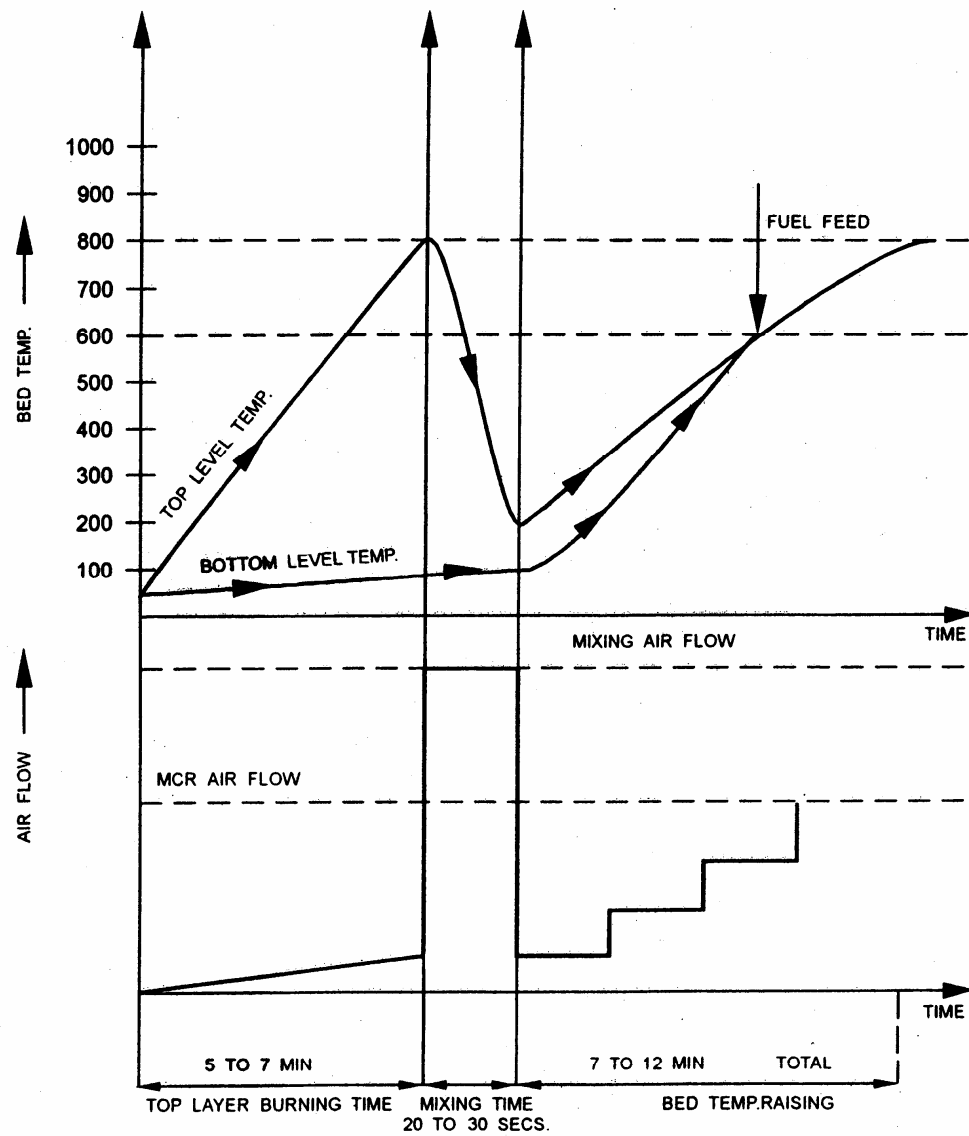


ONSET OF FLUIDISATION





THE START UP BEHAVIOUR IN GRAPHICAL FORM



- * Fluidise the bed minimally. Check the bed temperature. If the bed temperature is more than 400°C add dry charcoal to the bed. The charcoal should be thrown uniformly over the entire bed. Observe the rise in temperature. If there is no improvement in bed temperature it is better to cool the bed. Never allow the bed to be static in this method. If the bed is static, clinker formation will start.

START-UP PARAMETERS:

Before firing	Bed height	: 300 mm from Distributor plate
	Bed material size	: 0.85 - 2.38 mm.
	Charcoal (Dry)	: Kg.
	Charcoal kerosene mixed	: Kg.
Before mixing	PA header pressure	: mmwc
	Mixing temperature	: 850°C
	Mixing air flow	: mmwc
After mixing	Bed temp. before fuel feed	: Min. 600°C
	Fluidising airflow	: mmwc
	PA header pressure	: mmwc
	Feeder rpm	

COMPARTMENTAL TRANSFER:

The start up with one compartment is recommended for the following reasons.

01. Gradual loading of pressure parts.
02. Reduction of Charcoal for start up.
03. Load variation.

The compartment transfer means activating a static (cold) compartment of the furnace adjacent to the activated compartment. This is done just by admitting the fluidising air to the compartment to be activated and mixing the cold material with hot material of the operating compartment. Before activating a static compartment, the airflow in the fluidising compartment shall be increased to 120% of the MCR air flow, and the fuel feed rate shall be correspondingly increased to maintain the bed temperature at 900°C.

Now open the compartment air damper of the adjacent compartment which is to be activated. The cold bed material in this compartment would begin to mix up with that of hot bed material in the operating compartment. The bed temperature in new compartment would begin to rise.

The bed temperature in operating compartment will begin to drop. Once this temperature reaches 750°C slump the new compartment by closing the air damper.

The bed temperature of the operating compartment shall be once again brought up to 900°C before another attempt is made.

By following the process of mixing the bed material of the compartment to be activated with that of the operating compartment, on one or many attempts, the activation can be completed. The bed temperature of the new compartment shall be brought to atleast 600°C before fuel feeding is commenced.

The primary air lines in the new compartment shall be opened and the fuel feeding can be commenced and the bed temperature shall be brought to 800°C with MCR fluidising air flow condition. Care shall be taken not to drop the temperature of operating compartment below 600°C in the process of activating adjacent compartment.

If by mistake, the temperature of the operating compartment drops below 600°C, it becomes necessary to raise the temperature using charcoal. The charcoal should be sprayed over the entire compartment. Charcoal should be mixed with the bed keeping the bed minimally fluidised. The charcoal if burns under static condition, the chance of clinkering is high.

NORMAL OPERATION

05. NORMAL OPERATION

LOAD CONTROL:

The steam generation needs to be matched with that of demand to avoid venting of steam. If the steam drawn from the boiler is less compared to steam generated then the pressure would rise and thus resulting in lifting of safety valve. Frequent lifting of safety valve will damage the safety valve seat. Steam generation can be varied by slumping compartments or by varying the fluidisation air flow or by varying the bed temperature or by varying the bed height.

Load variation of 70% to 100% may be obtained by varying the bed temperature. The bed temperature can be reduced upto 700°C and can be increased to 900°C based on demand. For this purpose the fuel fed rate needs to be varied. Further turndown is also possible by reducing the fluidisation airflow but not to the extent of defluidisation of the bed. In such cases the air flow through primary air lines should never be reduced. Only the fluidising airflow should be reduced. Further load control is done by slumping the compartments. The compartments can be slumped only from either ends of the bed. In case of two compartments any compartment may be slumped. In case of three compartments only first or third compartment is to be slumped, before the middle compartment is slumped.

Slumping of the compartment is to be done as explained here. Bring down the fuel rate to minimum and switch off the feeder. Wait till the bottom bed temperature comes around 850°C, and then close the fluidising air damper of the compartment. Then close the fuel transport air line dampers. When the fluidising air through a compartment is cut off, the air through the other compartments would increase. This air flow shall be adjusted by throttling inlet damper of FD fan. Further draft in the furnace shall be adjusted by throttling of ID fan inlet damper.

Reactivation of a compartment shall be done in the following sequence. Open the fuel transport airline valves first and ensure the required air pressure is available in the PA fan header. If the line is choked, choke shall be removed by using the drain gates, of the fuel transport lines. Then open the fluidising air damper and set the FD fan inlet damper for the required MCR airflow. If the bed temperature is above 600°C fuel feed shall be initiated and the bed temperature shall be brought to the required operating temperature.

In case the temperature of the bed is less than 600°C immediately after fluidisation, the compartment shall be started in the manner explained in the compartment transfer method. The load control is graphically depicted in figure 2 for the furnace with three compartments.

During one compartment operation, the bed height can not be increased as the bed is not contained on one side. This is applicable to some extent to two compartments operation also maximum variation is possible in all compartments operation as the bed is totally contained in all four sides by the furnace water wall.

DYNAMICS IN FLUIDISED BED:

The height of the fluidised bed needs to be increased after the activation of all compartments in order to meet the steam demand. In the case of coal firing, the bed height automatically increases due to generation of ash from coal burning. The ash which is retained in the bed, if not drained, will accumulate to an extent that the air flow through the bed starts coming down below the MCR airflow. The height of bed is not to be allowed to increase beyond the recommended bed height which is about 300 mm to 400 mm. The bed height is indirectly measured by means of air box pressure as explained in the earlier sections. Other than the purpose of maintaining required bed height, the bed drain gates are to be operated for removing higher size particles. When there are deviations from the specified fuel feed size, ie., minus 6 mm, the higher size particles would begin to settle down at the air nozzle level. Similarly when agro fuel is used stones ingress with fuel would lead to setting of stones.

The bed drain is to be operated frequently to drain the higher size particles. If the drain is not operated frequently the fluidisation will be upset causing clinker formation. In the case of fuels (Agrowaste) which do not generate bed ash, bed material requires to be added frequently in order to compensate for loss of bed material by attrition and subsequent elutriation. Hence sufficient stock of bed material is to be maintained.

ASH REMOVAL:

The ash should be drained from all collection points. Failure to remove the ash will result in choking of flue gas path.

BOILER TRIPPING DUE TO POWER CUT:

In case of boiler tripping due to power cut or for any other reason, immediately close the inlet dampers of the FD fan and ID fan. In the event of power availability and if the boiler is required to be started immediately switch on the fans. Establish the MCR air flow and start fuel feeding. Otherwise if the boiler is to be boxed up, close the main steam stop valve. Close the compartment dampers also. The boiler can be restarted as explained in the further chapters. (Write up on hot restart).

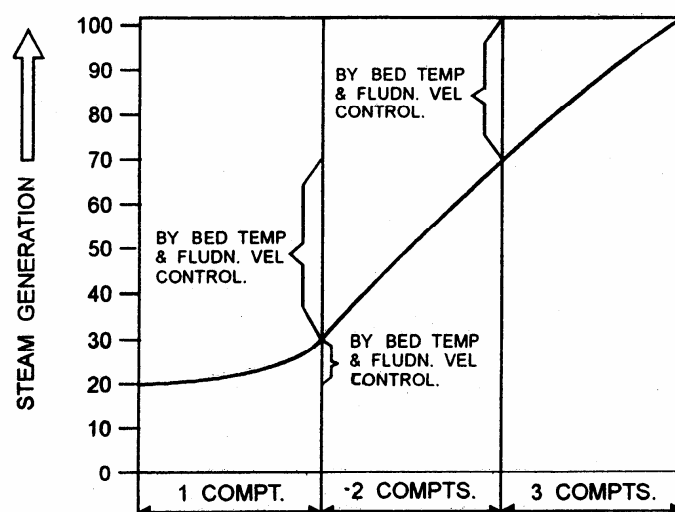
INGRESS OF FOREIGN MATTER IN FUEL:

Ingress of cotton waste, waste cloth, coconut shell, mango seed etc., will block the fuel flow from the chute into the feeder. This is indicated by the drop in bed temperature (provided the feed rate of the feeder is not increased).

The above mentioned problems can be eliminated if a screen is provided in the fuel handling system. Feeder tripping due to foreign material is a great nuisance and at times it may lead to boiler shut down. In case of coal, it becomes necessary to provide a magnetic separator to separate out the tramp iron from the coal. This not only protects the crusher, but also prevents to damage to the feeder. At times it may so happen that the foreign matter may block the fuel transport line. When there is no airflow in the fuel transport line, the bed material from the bed enters the fuel feed nozzle and leads to choking of the line. The choking should be removed by slumping the bed and by opening the drain gates. Also the foreign matter should be removed from the mixing nozzle opening the plug of the mixing nozzle.



LOAD CONTROL



NORMAL OPERATING PARAMETERS (STABILISED CONDITION)

Air box pressure :
(Drain the bed if the pressure is high) :
Fluidising air flow :
Primary air header pressure :
Bed temperature :
Feeder rpm / vibratory feeder setting :
Furnace gas plenum pressure :
Blowdown every : hrs.

NORMAL SHUT DOWN TO COLD

06. NORMAL SHUT DOWN TO COLD:

Reduce the fuel feed rate and slow the feeders to empty before stopping them. Maintain the same air flow to cool bed faster. If the steam is not drawn from the boiler, open the airvent to reduce pressure. If it is not necessary to enter the boiler for maintenance, slow rate of pressure and temperature decay is desirable switch off the fans after the bed has cooled down to 500°C. Switching off the fans should be in the order of FD and ID fans. If it is desirable to accelerate the cooling process in order to permit entry into the unit for maintenance, the fans could be continued to run at the same flow rate until temperature reaches 100°C. During the process maintain normal water level in the boiler. After the bed temperature reached 100°C open the blowdown valve and drain the boiler. (The boiler water temperature must be reduced atleast 90°C before draining). Drain the bed material. This can be done by opening the gates below the drain points collect this bed material, sieve and reuse for subsequent light ups.

NORMAL SHUT DOWN TO HOT STANDBY

07. NORMAL SHUT DOWN TO HOT STAND BY

If the boiler has to be shut for a relatively short period (minimum of 2 hours) follow the procedure given below.

01. Switch of the fuel feeder, FD, PA & ID fans instantaneously. The PA line dampers and fluidising air dampers need not be closed. But FD & ID fans dampers must be closed.
02. Do not reduce the boiler pressure in line with unit load reduction. When the desired pressure at which the boiler is to be held is reached after the boiler is off the line, the boiler may be up by closing the main steam valve.
03. Keep the water level in sight in the gauge glass and add make up rate as required.

HOT RESTART

08. HOT RESTART

After a shut down for a brief period, follow the steps given below to re-start the unit.

01. Open the air vent. Check fluidising air damper and PA damper are "OPEN".
02. Keeping the ID and FD fan dampers in the closed position.
03. Start ID, FD and PA fans in quick succession.
04. Start the fuel feeders with minimum speed.
05. Gradually open ID and FD fan dampers to maintain air flow D.P. of 30 mm and gas plenum pressure of 10 mm.
06. Increase the speed of fuel feeders and watch the bed temperature.
07. If the bed temperature is slowly increasing then increase fuel feed and air flow in line with load requirement.
08. If the bed temperature is not increasing, stop the fuel feeders.
09. If the bed temperature is below 600°C throw charcoal through access door, till temperature reaches 600°C. This has to be carefully done. This may be required if more than one hour has lapsed after shutting down.
10. If the bed temperature is less than 300°C, cool the bed and start the boiler following "normal startup from cold" procedure.

PROCEDURE FOR HYDROSTATIC TESTING

PROCEDURE FOR HYDROSTATIC TESTING

The system components have been hydrostatically tested to (1-1/2) times the design pressure in the factory. However, the complete system, along with all interconnecting piping should be hydrostatically tested before start-up to comply with code requirements and to check for leaks that might have resulted during shipping and handling. The boiler and process lines must be completely vented in order to fill them with water.

The following is a recommended procedure for hydrostatic testing:

1. Open the steam drum vent valve and close steam outlet valve.
2. The boiler safety valve stubs are plugged with end plates and sent as a dummied stub. Hence this end plate have to be cut and removed after hydrotest and the safety valves are to be buttwelded.
3. For subsequent hydro test if any and for every annual hydro testing gag the safety valves in accordance with safety valve manufacturer's recommendations. In lieu of gagging, the safety valves may be removed and replaced with test plugs or blind plates.
4. Isolate pressure switches, gauge glasses or control components which are not intended to be subjected to a hydrostatic test.
5. Fill the system with treated water in accordance with recommended CVPL's water quality. The temperature of water used shall not be less than 20°C and greater than 50°C.
6. Once the system is filled and the pressure is approximately 1 kg/cm², close all vents. The pressure may then be increased gradually to the test pressure requirement of the local steam boiler inspecting agency. Do not subject any pressure part to more than 1-1/2 times the design pressure rating of the component.

7. Examine the system for any leaks. If no leaks are visible, hold the system in a pressurised static condition for a period of 1/2 hour to satisfy the code requirements.
8. After that the pressure shall be reduced to maximum allowable working pressure and maintained for sufficient time to permit close visual inspection for leakage of pressure parts.
9. Upon completion of the test, release pressure slowly through a small drain valve. Then fully open the vents and drains when the pressure drops to 1 Kg/cm²(g). Particular care must be given to make sure that parts not normally containing water during operation are drained free of water. The system should be drained fully after hydrostatic testing to prevent freezing, if the unit is installed in a cold weather area, and to minimize corrosion of the metal surfaces.
10. If temporary handhole or manhole gaskets were used for the test, they should be replaced with regular service gaskets before reading the unit for operation. Gaskets should never be reused. Replace gauge glass if necessary and make sure that the gauge cocks are open. Remove all blanks or gags from safety valves and install safety valves, if removed.

PROCEDURE FOR SLOW FIRING

PROCEDURE FOR SLOW FIRING

REFRACTORY DRY OUT:

After the refractory works are finished, the refractory work must be subjected to proper curing and initial heating. These two procedures must be strictly carried out. Otherwise, cracks may occur on the refractory surface. These procedures are explained below.

CURING FOR CASTABLE REFRACTORY:

All the castable are hydraulic setting and need the presence of moisture for setting process, so it is necessary to ensure that the castable does not dry out to exposure or due to heat produced within the mass. It should not be allowed to dry during first 24 hours after it has been placed.

Moist condition has to be maintained by covering the castable with wet gunny sacks or by frequent sprinkling of fine mist of cold water on all exposed surfaces. Sprinkling should be started after the castable has set partially. It is generally advisable to spray water on dense castables every 45 minutes for hours.

INITIAL HEATING FOR CASTABLE REFRACTORY:

Proper attention should be given during initial heat up of castables, as they have considerably lower permeability when compared to brick. It is more difficult for the water to passthrough the castable and escape as the refractory is heated more rapidly. So due to this, high pressure steam is developed inside the brick and this ruptures the lining.

Rapid heating also causes the hot face to dry up and heat up while the rest of castables is still comparatively cool. This will lead to expansion of hot face and hence develops a crack on cold face.

SLOW FIRING PROCEDURE :

Following are to be done before slow firing is started:

- a) All the coal nozzles and air nozzles must be fully covered with bed materials.
- b) No fans should be operated for the heating purpose. Firing should be done only by natural draught. For this all dampers should be kept open.
- c) Sufficient sized fire wood required has to be stocked for the dry out.

The following heat and curing schedule is recommended:

- 01. Heat gradually up to 110°C and hold at this temperature for six hours.
- 02. Then raise the temperature at the rate of 10°C per hour up to 550°C and hold at this temperature for six hours.
- 03. After this, the furnace can be cooled naturally.

Slow firing can be done by burning sized waste wood in the furnace on the bed material. The fuel required shall be computed as if the boiler would be operated to generate 20% MCR load. The sized wood can be fed in the furnace through the manhole.

PROCEDURE FOR ALKALI BOILOUT

PROCEDURE FOR ALKALI BOILOUT

1. Check boiler erection work is completed with all assemblies, valves, fittings and necessary instrumentation.
2. Boiler auxiliaries such as fans, feed pumps should have been trial run and made ready for operation.
3. Check boiler instrumentation and control panel are ready for regular operation. But the following instruments are to be isolated for alkali boilout.
 - i) Flow, pressure and level transmitters.
 - ii) Pressure switches.
4. Ensure steam drum internals have been fixed in position.
5. Check all the refractory and insulation work are completed.
6. Check all scaffolding, temporary supports, debris are cleared.
7. Ensure slow firing is done as per the slow firing procedure.
8. Check suitable fire fighting equipments such as Co₂ or foam type fire extinguishers, sand buckets, etc, are available at suitable convenient places.
9. Check boiler chemical feeding system is ready for operation.
10. Check sufficient quantity of chemicals are available. Based on the water volume of the boiler the chemicals required can be estimated. If water volume of the boiler is $Q \text{ M}^3$ each chemicals required will be $4 \times Q$ kgs. The same quantity of chemicals will be required for each boil out.
11. For alkali boilout sodium carbonate and trisodium phosphate are used.

12. Prepare 20% concentrated solution of the chemicals separately in a drum and the solution is charged in to the boiler through the nozzles (either auxiliary steam top nozzle or Air vent nozzle) in to the shell/drum manually by means of funnel.
13. After the addition of chemicals in to the required quantity, the nozzles are covered with the cover flange and fill up water to the normal operating level.
14. Light up the boiler and raise the steam pressure is gradually to 5 ata as per standard operating procedure and maintain the pressure for minimum period of 12 hours.
15. Tighten all glands and flange joints.
16. Raise the firing rate to achieve a boiler loading of nearly of the normal loading rate of the boiler.
17. Samples to be taken every two hours and analysis is to be carried to determine the following:
 - a) Ph value
 - b) Alkalinity
 - c) Phosphate
 - d) Oil
 - e) Silica
18. Ensure the pre-commissioning activities are carried out as per the commissioning check list.
19. Ensure the alkali Boilout is carried out in 3 stages and fresh chemicals are changed before each stage.

20. Ensure the pressure is maintained in the boiler for each stage alkali boilout as follows:

DURATION

I stage - 5 kg/cm sq. - 12 hours.

II stage - 7 kg/cm sq. - 12 hours.

III stage - 10 kg/cm sq. - 12 hours.

(Ensure the pressure of the boiler is raised gradually for alkali boilout).

21. Each stage of boiling can be terminated when the content of oil in the boiler water maintains a steady value. However final reading of oil should be less than 5 ppm.
22. After termination of boilout procedure, shut down the boiler and allow the unit to cool down gradually.
23. Drain the boiler after the drum pressure reaches atmospheric pressure. Water jets shall be used to clean the headers.
24. After complete draining of boiler, clean the complete unit by filling the water and drain it for atleast one time.

The handhole pipes of all headers preferably at bottom most point to be cut and inspected for any foreign materials availability and to be cleaned.

25. After inspection and cleaning reweld the end caps and hydro test the boiler to working pressure.
26. Now the boiler is ready for steam blowing.

PROCEDURE FOR STEAM BLOWING

PROCEDURE FOR STEAM BLOWING

STEAM BLOWING

Steam blowing is an established practice for the purpose of physically removing any substance which remain deposited in the superheater and associated pipe lines. These substances are mainly scales and loose minerals that might have been entrapped during manufacture, storage and erection at site.

PRINCIPLE

The principle of steam blowing is to give thermal shock and dislodge the scales. These scales will be subsequently driven out by the dynamic velocity of the expanding steam. Before starting the boiler for steam blowing the following points are to be ensured:

1. Alkali boilout is completed.
2. All the instruments calibration are completed and safety interlocks are in line, except water level interlock which is to be isolated temporarily.
3. NRV and flow nozzle should not be fitted initially and thermowell in steam line is to be removed.
4. All the spring hangers in steam line are loaded properly.
5. Temporary steam line is erected and anchored properly for steam blowing.
6. Target plate fixing arrangement to be kept ready.
7. Required target plates are to be machined and kept ready to fix when required. Target plates shall be of aluminium material.

PROCEDURE :

The method of steam blowing is as below :

1. Operate with one compartment and raise the boiler pressure above 35 kg/cm². The bed temperature shall be maintained at about 800-950°C.
2. Quickly open the main steam stop valve (or the temporary blowing valves if provided). In order to maintain the flow to atmosphere the main steam stop valve is to be kept open till the steam pressure drops down close to 16 kg/cm².
3. Slowly reduce the firing rate and slump the boiler. The main steam stop valve shall be closed when the boiler pressure reaches 16 kg/cm².
4. After one hour, the boiler shall be restarted with one compartment and the bed temperature shall be maintained at about 800 - 950°C'.

The steam blowing shall be once again started when the pressure reaches 35 kg/cm². By the above procedure, the scale adhering to the contours get cracked due to temperature difference and get removed to subsequent blows.

*** SCHEME OF BLOWING**

Temporary discharge piping which lead the steam to the atmosphere shall be welded downstream of main steam line must be properly supported and anchored.

OPERATIONAL PRECAUTIONS

1. Normally the steam blowing operation is the first occasion to fire the unit at significant rate. The unit must be brought up much slower while all equipments are checked and expansion movements are monitored closely.

2. During blowing, water level in drum gauge glass may fluctuate very widely. Feed regulating station must be checked for proper remote operation. Sufficient quantity of D.M water availability must be ensured.
3. Flue gas temperature at the inlet of convection superheater must be restricted to 450°C.
4. Temporary discharge piping which should be at least equal to the diameter of piping to which it is connected must be well supported to withstand reaction forces during steam blowing.
5. Discharge piping should be so diverted that personnel and equipments are not endangered. The area should be cordoned off.
6. After three free blows, target plate can be fixed.
7. Based on target plate condition as recommended by the turbine supplier blow can be continued or terminated.
8. During blowing sufficient time duration should be given between blows to attain better thermal shock to discharge the scale and other deposits in pressure parts and steam line.
9. After clearing the steam blowing, boiler to be stopped and steam line to be cooled to complete the welding of NRV and flow nozzle and thermowell fixing in main steam line.
10. Temporary steam line to be removed and permanent line to be connected with TG.
11. After completion of the job, the boiler is ready for safety valve floating.

OPERATION ON LOW LOADS

OPERATION ON LOW LOADS

The boiler should not be operated at low loads continuously for long time. If the boiler is run continuously at low loads (<60% MCR load) then due to low quantity of steam flow through the super heater, the super heater tubes may fail. To protect the super heater tube from failure, the boiler should be run at higher loads (>60% load) only and the excess steam over the utilised steam shall be vented continuously through start-up vent.

TROUBLE SHOOTING CHART

TROUBLE SHOOTING CHART

DURING START UP

SI.NO.	TROUBLE	CAUSES	REMEDY
01.	Start up failures.	<p>Improper Bed material size.</p> <p>Improper charcoal size.</p> <p>Poor Quality of charcoal.</p> <p>Insufficient Qty. of charcoal.</p> <p>Insufficient bed height.</p> <p>Excess bed height.</p> <p>Improper spreading of charcoal.</p> <p>Improper spreading of fire over the top layer of kerosene soaked charcoal.</p> <p>Wrong bed temperature indication.</p> <p>Improper mixing.</p>	<p>Bed material size has to be between 0.85 mm and 2.36 mm.</p> <p>Charcoal size should be 15-25 mm.</p> <p>Charcoal shall be dry for good quality.</p> <p>Qty. of charcoal shall be 20 kg. per m² area of bed and kerosene soaked charcoal shall be 10 kg. per m² area of bed.</p> <p>Bed height should be 200 mm above the air nozzle.</p> <p>Bed height should be 200 mm above the air nozzle.</p> <p>Uniform spreading of charcoal shall be ensured.</p> <p>Swab fire initiated should be even. If not throw kerosene soaked charcoal at such locations where fire is not present.</p> <p>Thermocouples are to be checked using swab fire before starting</p> <p>Mixing should be done with the predetermined air flow level (Just above MFC level)</p>

SI.NO.	TROUBLE	CAUSES	REMEDY
02.	Clinker formation during start up over the entire bed.	<p>Improper fuel feeding.</p> <p>P.A. Line choking.</p> <p>High bed temperature over the entire bed. This is due to excess charcoal (or) due to excess fuel feed before charcoal combustion is complete. (or) incomplete mixing.</p> <p>Low fluidisation velocity after mixing.</p> <p>Wrong temperature indication.</p> <p>Excess fuel feeding.</p>	<p>Fuel is to be fed only after the bed temperature reaches 600°C.</p> <p>Minimum airflow in fuel transport line is to be maintained till the start of fuel feed. Before fuel feed, increase airflow to MCR air flow. Dechoking of the lines is possible by opening the line flap damper fully and by opening the corresponding drain gates in the airbox.</p> <p>Charcoal Quantity shall be as per recommendations.</p> <p>High bed temperature can be reduced by controlling fuel feed and by increasing the air flow.</p> <p>Give the required mixing air flow.</p> <p>Warning: Air flow should be slightly more than MCR level. Otherwise all hot material would go to the adjacent compartment.</p> <p>Air flow level can be increased. (MCR air flow level)</p> <p>Checking the thermocouple with swab fire before starting.</p> <p>Fuel feeding should be gradually increased after ensuring that the fuel is catching fire.</p>
03.	Localised Clinker Formation	Localised vigorous static burning of charcoal before and after mixing :	<p>Before mixing clinkers may form due to delay in mixing.</p> <p>After mixing, clinkers form due to inadequate mixing (i.e. less mixing air flow or less duration of mixing)</p> <p>After proper mixing, clinkers may form if the air flow is not brought to MCR level.</p>

SI.NO.	TROUBLE	CAUSES	REMEDY
DURING COMPARTMENTAL TRANSFER (FROM COLD CONDITION)			
01.	Fire extinguishing in operating compartments.	<p>Improper method of activation.</p> <p>Attempting for compartment transfer in one to two trials.</p>	<p>The bed temperature of operating compartment drops because of cold bed material in activated compartment mixing with hot bed material of operating compartment.</p> <p>Slump the activated compartment as soon as the bed temperature in operating compartment drops below 750°C. Further attempt should be made only after bringing the bed temperature of the operating compartment to 900°C with 120% MCR air flow.</p>
02.	Clinker formation in Operation compartment.	<p>Insufficient air flow.</p> <p>Excess fuel feed.</p>	<p>After compartmental transfer, the air flow should be once again brought to MCR condition in operating compartment.</p> <p>After tranfering, the fuel feed rate in operating compartment needs to be reduced.</p>
03.	Bed temperature not rising in activated compartment.	<p>a. Inadequate air flow for disturbing the cold bed material.</p>	<p>Increase the airflow momentarily if the fan capacity is available and provided the bed temperature in operating compartment is not low.</p> <p>Alternatively, momentarily close the FD damper of the operating compartment.</p> <p>Long operation with single compartment results in excess bed material ash accumulation in the compartment adjacent to the operating comparmnt. Drain the bed if necessary.</p>

SI.NO.	TROUBLE	CAUSES	REMEDY
04.	Clinker formation in activated compartment.	<p>Insufficient air flow static bed promotes vigorous burning of fuel at several locations and thus clinkers form.</p> <p>Excess fuel feed before the bed temperature rises to fuel ignition temperature. Otherwise, fuel accumulated leads to sudden bed temperature rise.</p>	<p>This can be avoided by maintaining the bed fluidising before fuel feed. To disturb the clinker formation momentary mixing may be adopted at times.</p> <p>Fuel should not be fed before bed temperature rises to fuel ignition temperature (600°C for coal; 300°C for husk) . Sudden bed temperature rise could be controlled by increasing the air flow or by activating the adjacent cold compartment.</p>
05.	Bed temperature dropping in activated compartment.	<p>Excess fuel feeding when the bed temperature around 600°C quenches the fire.</p> <p>Operating at less air flow condition leads to CO formation and less heat release and thus bed temperature remains low.</p>	<p>Fuel feeding should be gradually increased, when bed temperature is 500° - 600°C.</p> <p>Air flow should be sufficient. MCR air flow is required.</p>
06.	PA line choking	Failure to set fuel transport air flow before attempting activation.	Minimum air heater pressure of 700 mmwc is required to be set to prevent PA line choking. The header pressure should be increased to MCR condition before fuel feed.
DURING CONTINUOUS OPERATION			
01.	Bed temperature dropping.	<p>Insufficient fuel feed rate.</p> <p>Excess fuel</p> <p>Excess air flow.</p>	<p>Sufficient fuel feed rate is required.</p> <p>Sufficient fuel feed rate is required.</p> <p>Sufficient air flow is required (MCR air flow)</p>

SI.NO.	TROUBLE	CAUSES	REMEDY
02.	High bed temperature.	<p>Fuel line choking.</p> <ul style="list-style-type: none"> - Due to wetness of fuel. - Due to entry of foreign materials. <p>Fuel not being fed from feeder.</p> <ul style="list-style-type: none"> - Due to high moisture in the fuel, fuel would adhere in the pocket feeders blade, so no fuel would be fed. <p>Excess bed height causes less fluidisation.</p> <p>Thermocouple is in loose contact.</p> <p>Bed height is less than 175 mm.</p> <p>More fuel feed rate.</p> <p>Less air flow.</p> <p>Excess feeding of fuel from feeder.</p> <p>One of the causes may be, broken pocket feeder blades. Due to this more fuel would be fed.</p>	<p>Wet fuel should be avoided.</p> <p>To avoid the entry of foreign materials a vibratory screen (or) magnetic separator can be provided in the fuel handling system.</p> <p>To avoid this, high moisture fuel should not be used.</p> <p>Bed should be drained once in every shift. (Maintain air box pressure below 425 mm of wc).</p> <p>Thermocouple to be corrected.</p> <p>Bed height should be increased.</p> <p>Fuel feed rate has to be reduced.</p> <p>Air flow has to be increased slightly (upto MCR air flow level)</p> <p>Rotor requires replacement.</p>

SI.NO.	TROUBLE	CAUSES	REMEDY
03.	Clinker formation.	<p>High bed temperature due to excess fuel feeding.</p> <p>Low fluidisation velocity. - leads to static burning at places.</p> <p>Bigger size fuel.</p> <p>Bigger size fuel would burn partially. So partially burnt fuel would settle in the bed. Sometimes bed temperature would shootup suddenly. This may cause clinker formation.</p> <p>Bed draining not done - due to this bed height would increase. So, there would be defluidisation.</p> <p>Erratic disturbance in fuel feeding. - may be due to foreign particles, tripping the feeder or choking the mixing nozzle.</p>	<p>Decreasing the fuel feed rate (or) air flow may be slightly increased.</p> <p>Air flow can be slightly increased.</p> <p>Bigger size fuel could be avoided. So correct size fuel could be used (Below 6 mm).</p> <p>To avoid this bed should be drained once for every shift. (Maintain air box pressure below 425 mm of wc).</p> <p>Erentual disturbance fuel feed leads to reduction in bed temperature and thus velocity and the fuel feed is restored if be necessary to increase the air flow momentarily.</p>

SI.NO.	TROUBLE	CAUSES	REMEDY
04.	PA line choking.	Foreign material choking the mixing nozzle.	This can be avoided by providing vibratory screen or magnetic separator in fuel handling system.
05.	Backflow of air thro' bunker gate.	Fuel line choking due to one of the above causes.	Choking is to be removed..
06.	Back firing.	ID fan damper has been opened sufficiently.	ID fan damper has to be slightly opened. (maintain furnace pressure of minimum - 10 mm of wc).
		Insufficient air pressure to lift power cylinder.	Sufficient air pressure is to be supplied (pressure 3.5 to 5 kg/cm ² for power cylinder action).
		Ash accumulation in hoppers above various drain points. - This would reduce ID fan suction.	Ash should be removed periodically.
07.	Steam production is less.	Improper parameters.	Proper parameters should be followed.

DO'S AND DONT'S

DO'S AND DONT'S

SI.NO.		DO'S	DONT'S
01.	ECONOMISER	Run the boiler with continuous running of the feed pump.	Don't run the boiler with frequent switching ON & OFF of the feed pump.
02.	FEED PUMP	Keep the isolation valves at spare feed pump open.	----
03.	LEVEL TRANSMITTER	Blow down should be given once, daily for level transmitter lines.	Don't start the boiler, if the liquid level limiter is not functioning for high level, low level and trip level.
04.	WATER LEVEL GAUGE	Give frequent blow downs of water level gauge to free from blockages at both top and bottom points.	Don't run the boiler, if the water level gauges are not showing the same water level.
05.	FUEL OVER SIZE	Allow 10% of 8 - 10 mm size fuel.	Don't start the boiler if the fuel size is more than 6 mm (8 - 10 mm, over size upto 10% accepted).
06.	ASH DRAIN POINT (other than bed drain points)	During boiler operation check whether there is suction in all the ash drain points.	Don't open the ash drain gates frequently.
07.	FEED WATER & BOILER WATER	Analyse the feed water and boiler water daily.	Don't run the boiler if the water quality is not as per the specifications given in the manual.

SI.NO.		DO'S	DONT'S
08.	RELAY SETTING (MOTORS)	Set the relay in full load amps of the motor.	Don't start the fans before setting the relay amps.
09.	GAS PLENUM PRESSURE	Maintain the gas plenum pressure at minus 5 mmwc.	-----
10.	THREE PHASE SUPPLY	Check the continuity of fuses.	Don't bypass the fuses with direct wire connection.
11.	CONTINUOUS BACK FIRE	Ensure that ash chutes and ducts are clean from ash accumulation.	Don't run the boiler with continuous back fire.
12.	PART LOAD BOILER OPERATION	Change the compartments every shift.	Do not run a particular compartment alone continuousl.

INSPECTION AND MAINTENANCE SCHEDULE

INSPECTION AND MAINTENANCE SCHEDULE

EQUIPMENT	NO.	POINTS TO BE CHECKED	FREQUENCY	REMARKS
FD SYSTEM				
FD fans & Motors	1.	Check whether motor bearing temperature is normal.	Daily	One set of motor bearings is to be kept as spare.
	2.	Check whether the motor current is normal.	Daily	(For coupled fans, one set of fan bearings is to be kept as spare)
	3.	Check whether the vibration level and sound level is normal.	Daily	
Airfoil meter	1.	Ensure that the draught connections are not leaky.	Weekly.	
	2.	Ensure that the manometer water is clean.	Weekly.	
Air box draft / manometer / Draft gauge	1.	Ensure that the draft connections are not leaky.	Weekly.	
	2.	Ensure that the manometer water is clean if a manometer is provided.	Weekly.	
Air box	1.	Ensure that all the nozzles are in good condition.	At every shut down.	50 nozzles are to be maintained as spare.
	2.	Ensure that the nozzles are free from plugging by coal powder.	At every shut down.	Use compressed air for cleaning.
	3.	Ensure that the nozzles are free from plugging by refractory.	If furnace refractory work was done.	Use compressed air for cleaning.

EQUIPMENT	NO.	POINTS TO BE CHECKED	FREQUENCY	REMARKS
	4.	Clear the sieved bed material from each compartment in the air box.	Once in three months/in case of air nozzle breakage.	
ID SYSTEM				
ID fan & Motor	1.	Check the bearing temperature of the fan and motor	Daily	One set of motor and fan bearings is to be maintained as spare.
	2.	Check whether the motor current is normal.	Daily	
	3.	Check whether the vibration and sound level is normal.	Daily.	
ID fan impeller	1.	Check for erosion / damage.	Once in six months.	Keep a spare ID fan impeller expected life 1 year.
PA SYSTEM				
PA fan & Motor	1.	Check motor bearing temperature.	Daily	One set of motor and fan bearings are to be maintained as spare.
	2.	Check whether the motor current is normal.	Daily	
	3.	Check whether the vibration level and sound level is normal.	Daily.	
Fuel feed nozzle	1.	Inspect the fuel nozzle cap for any damage.	Everyshutdown	Keep 4 nos. of fuel nozzles as spare for replacement.
	2.	Inspect the supporting lugs of coal nozzle cap.	Everyshutdown	

EQUIPMENT	NO.	POINTS TO BE CHECKED	FREQUENCY	REMARKS
FUEL FEEDING SYSTEM				
Feeders & Drive	1.	Check the any damage in the feeder due to foreign material.	Weekly	
	2.	Chain lubrication.	Weekly	
	3.	Gear box Lubrication oil level.	Weekly	
	4.	Change gear box oil, on contamination.	Weekly	
FEED WATER SYSTEM				
Feed pumps	1.	Check the operation of spare pump.	Daily	Refer O & M Manual.
	2.	Replace the gland packing.	If leaking.	Keep spare gland packings.
	3.	Check for abnormal vibration and sound.	Daily	Keep spare gland packings.
	4.	Check for suction strainer choking.	Daily	
Feed water	1.	Check for Hardness, pH, O2, oil content and TDS in feed water.	Daily	Compare with recommendation given and take corrective measures.
FURNACE				
Bed thermocouple.	1.	Ensure that all the thermocouple compensating cables are in good condition and the end connections are not loose.	When thermocouple shows above 1200°C.	40 m length of compensating cable is to be kept as spare.
	2.	Replace the thermocouple if burnt.	During the immediate next shut down	Keep 4 nos. of spare bed thermocouples at stock.

EQUIPMENT	NO.	POINTS TO BE CHECKED	FREQUENCY	REMARKS
Refractory wall	1.	Repair the cracks in the refractory wall.	During the immediate next shut down.	Keep required castable refractory and binding mortar in stock.
Water level gauge	1.	Check the water level gauge function by giving a blowdown.	Every shift.	Keep spare glasses and washers for both water level gauges.
BOILER SYSTEM				
Boiler water	1.	Check Alkalinity, pH, Residual SO ₄ residual phosphate and TDS.	Every shift	Compare with recommendation given and take corrective actions.
	2.	Follow blowdown schedule to bring TDS to limits.	Every shift	
Safety valves	1.	Blow the steam through safety valve by hand popping with the lever to avoid seat seizure.	Every one month	
ASH REMOVAL SYSTEM				
Ash hoppers	1.	Ensure that ash is being removed and ash flows out freely.	Every shift.	
Bed coil headers.	1.	Inspect and remove sludge accumulation in the bed coil header.	Every year.	
		Blowdown the water through header drain valve after the fire is put off, but with the boiler under a pressure of min. 5 kg/cm ² .	At every shut down.	
Valves in feed water, boiler water systems, steam line	1.	Inspect for gland leakages and tighten the gland nuts.	Weekly.	
	2.	Replace the gland packings.	Every year / on major leakage	

PRESERVATION OF BOILERS

PRESERVATION OF BOILERS

INTRODUCTION

Atmospheric corrosion of ferric materials proceeds rapidly in the presence of oxygen and moisture. The oxides produced are objectionable and can be transported to critical heat transfer areas. Also, through the wall, pit type corrosion can occur. In today's boilers with their numerous complex circuits and bends, it is usually impossible to completely dry a boiler in preparation for storage. Draining all circuits (if drainable) while hot may temporarily dry the surfaces; however, unless dry air can be continuously circulated to eliminate all the water vapour from the unit, recondensation will again result in moist conditions. For this reason, wet lay-up normally offers the most positive method of protection for components in modern boilers.

LAY-UP METHOD

This method employs filling up the boiler with treated water and keeping the unit pressurized to 5 Kg /cm²(g) feed pump may be used for this purpose. Water conforming to recommended specification furnished in earlier section, is to be used for filling.

However, a better method of preserving of boiler would be to have nitrogen blanketing. In this method the boiler is filled with water treated for pH and O₂ and sealed with nitrogen at a pressure of 0.35 atg to avoid air ingress.

Figure shows the general arrangement of the rig up required for nitrogen blanketing. Nitrogen cylinders can be employed for this purpose. The nitrogen supply can be connected to the drum vent and superheater vent.

WET METHOD

If the boiler is likely to be out of service for more than a few days, but may be needed for steaming at short notice, all parts, including the economizer and superheater should be completely filled with correctly conditioned water. Non-drainable superheaters should be filled only with condensate quality water treated with volatile chemicals such as hydrazine

or ammonia. It is most important that pockets of air are not allowed to remain in the boiler and that there should be no leakage.

When completely filling the boiler with water, sufficient sodium sulphite or hydrazine should be added to combine with the dissolved oxygen and leave an excess of 100 mg/1 to 200 mg/1 of sodium sulphite as Na_2SO_3 or hydrazine as N_2H_4 . In addition, alkali should be added to ensure that a pH value of 10.0 to 11.5 is maintained. Distribution of these chemicals throughout the bulk of the water should be ensured by filling with a premixed solution, by use of a circulating pump or by heating the boiler when partially filled and then topping up with conditioned water.

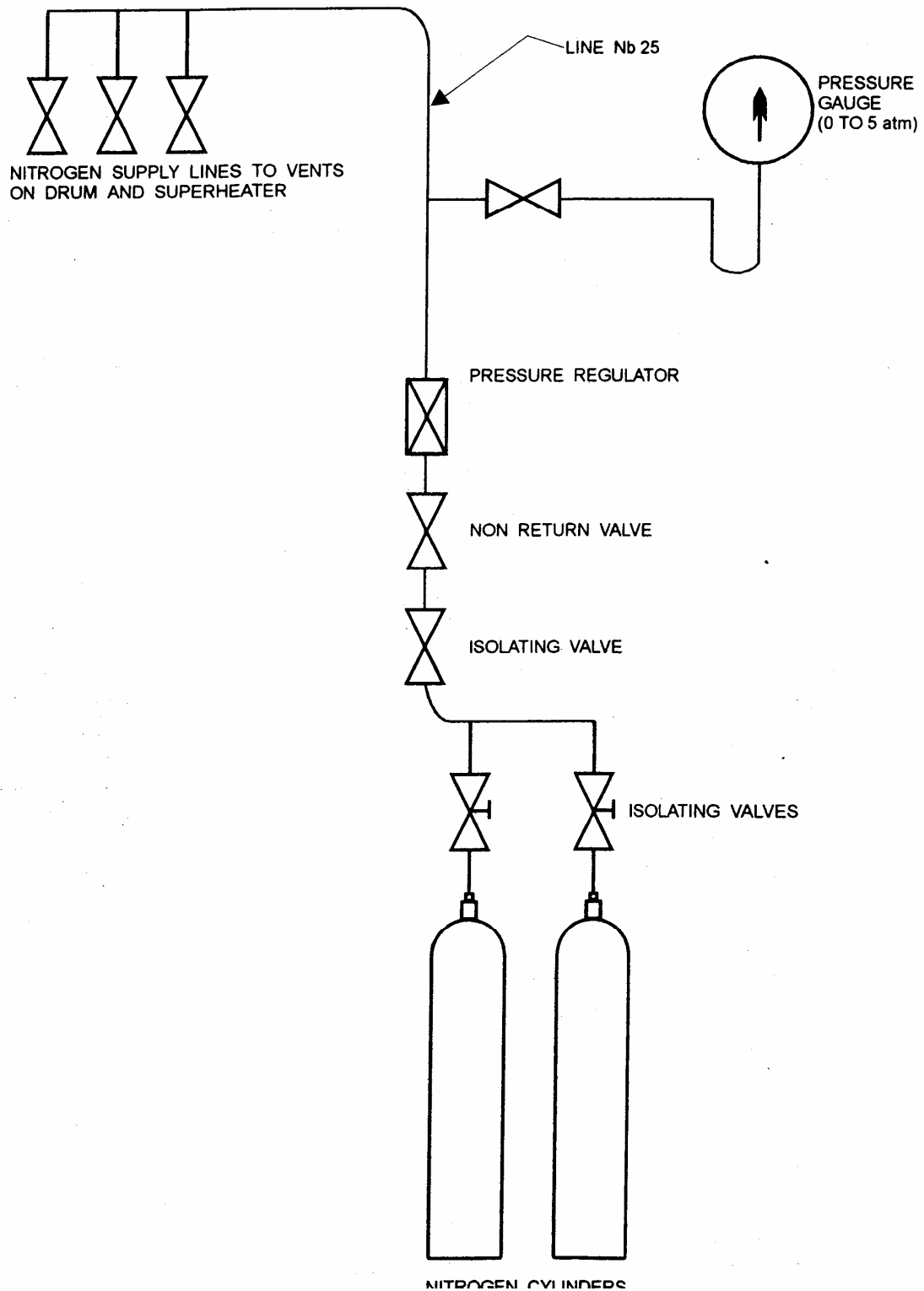
It is recommended that the aircock on the drum or shell should be connected to a surge tank located at a higher level. This compensates for any volumetric change and ensures a positive pressure thus preventing admission of oxygen to the unit. This tank should be covered and kept dosed with oxygen scavenger and alkali. Alternatively, pressure on the system should be maintained by using a small pump.

The oxygen scavenger reserve and the pH value or alkalinity should be checked regularly and additional treatment chemicals added, as necessary and distributed to maintain the treatment levels within the recommended range. Any additional water added to the boiler should contain the appropriate quantities of treatment chemicals.

When required for service the boiler should be drained down to normal working level before firing. Phosphate or other conditioning reserves should be re-established as soon as possible.

This method of storage is recommended only if there is no likelihood of frost damage occurring. Wet storage is not recommended for periods of longer than 2 or 3 months unless the treated water is circulated regularly in all parts of the boiler including the economizer and superheater. Wet storage tends to promote condensation of atmosphere moisture and hence corrosion in the flue gas side. Where this proves trouble some dry storage is to be preferred.

SCHEME FOR NITROGEN BLANKETTING



SCHEDULES

VALVES SCHEDULE

VALVES LIST (CVPL SCOPE)

BOILER SYSTEM

TAG.No.	LOCATION IN SYSTEM	TYPE	SIZE	END	RATING(#)	MATL.	QTY(Nos)	TEST	SCOPE
V201	ISO.VALVE FOR STEAM DRUM PR. GAUGE	GV	25	(SW)F	(800)300	SA105	1	IBR	CVL
V202	AIR VENT VALVE FOR STEAM DRUM	GV	25	(SW)F	(800)300	SA105	1	IBR	CVL
V203	AUXILIARY VALVE FOR STEAM DRUM	GV	40	(SW)F	(800)300	SA105	1	IBR	CVL
V204	MAIN STEAM STOP VALVE	GV	150	F	300	SA216WCB	1	IBR	CVL
V205	CONTINUOUS BLOWDOWN VALVE	GLV	25	(SW)F	(800)300	SA105	1	IBR	CVL
V206	ISO. VALVE FOR INERMITTENT BLOWDOWN	GV	40	(SW)F	(800)300	SA105	1	IBR	CVL
V207 & V208	ISO. VALVES FOR LIQUID LEVEL LIMITER	GV	25	(SW)F	(800)300	SA105	2	IBR	CVL
V209	DRAIN VALVE FOR LIQUID LEVEL LIMITER	GV	15	SW	800	SA105	1	IBR	CVL
V210	DRAIN VALVE FOR BED COIL HEADER	GV	25	(SW)F	(800)300	SA105	1	IBR	CVL
V211 TO 214	ISO VALVE FOR DRUM WATER LEVEL GAUGE	GV	25	(SW)F	(800)300	SA105	4	IBR	CVL
V215 & 216	DRAIN VALVE FOR DRUM WATER LEVEL GAUGE	GV	15	SW	800	SA105	2	IBR	CVL

SPECIAL VALVES

PSV201 & 202	SAFETY VALVES AT STEAM DRUM	SLSV	50X80	F	300/150	SA216WCB	2	IBR	CVL
BDV201	INTERMITTENT BLOWDOWN(RACK&PINION) OPERATED	BOV	40	F	300	SA216WCB	1	IBR	CVL

AIR SYSTEM & FLUE GAS SYSTEM

V301 TO V309	ISO. VALVES FOR DTP PR.GUAGES & MANOMETER	GV	15	SCR	-	GM	9	NON IBR	CVL
V310 TO V312	DRAIN VALVES FOR AIR BOX	GV	50	F	125 LBS	CI	3	NON IBR	CVL
V401 TO V404	ISO.VALVES FOR MANOMETER, PR.GAUGES & DTP	GV	15	SCR	-	GM	4	NON IBR	CVL

FEED LINE:

V001 & V002	DRAIN VALVES FOR STRAINER	GV	15	SCR	-	GM	2	NON IBR	CVL
V101 & V102	ISO. VALVES FOR FEED PUMP DELIVERY	GV	50	SW	800	SA105	2	IBR	CVL
V103 & V104	CHECK VALVES FOR FEED PUMPS	NRV	50	SW	800	SA105	2	IBR	CVL
V105	ISO. VALVE FOR FEED LINE PR. GAUGE	GV	15	SW	800	SA105	1	IBR	CVL
V106	ISO. VALVE FOR FEED LINE	GLV	50	SW	800	SA105	1	IBR	CVL
V107	CHECK VALVE FOR FEED LINE	NRV	50	SW	800	SA105	1	IBR	CVL


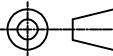
LIQUID LEVEL LIMITER

TAG.No.	DESCRIPTION.	Qty.	REMARKS
LLL 201	LIQUID LEVEL LIMITER	1	-

WATER LEVEL GAUGE

TAG.No.	DESCRIPTION.	Qty.	REMARKS
LG 201 & LG 202	WATER LEVEL GAUGE	2	-

DRAWING No. : BH112-00-12-4-001

TOTAL WT IN Kg.	-	ON PROCESS	FOR APPROVAL	<input checked="" type="checkbox"/>	FOR PLANNING	<input checked="" type="checkbox"/>	FOR PRODUCTION	FOR ERECTION
	SCALE	NTS	DATE	BOILER No. BH112	P & I PART LIST (SHEET 01 OF 03)			
	DRAWN	V.Raja	03/04/2008	PG-MAN No. 00-12				
	CHECKED		03/04/2008	NO.OFF				
	APPROVED		03/04/2008	-				
					ALL DIMENSIONS ARE IN MM, UNLESS OTHERWISE SPECIFIED.		DRAWING NUMBER BH112-00-12-4-001	
							REVISION	NIL

PRESSURE INDICATIONS:

TAG NO.	DESCRIPTION	RANGE	DIAL SIZE(mm)	LOCATION	SCOPE
APG301	PA HEADER PRESSURE	0 TO 1600 mm of wc	150	LOCAL	CVL
APG302	FD HEADER PRESSURE	0 TO 1000 mm of wc	150	LOCAL	CVL
APG303	AIR PRESSURE AT COMPARTMENT-I	0 TO 1000 mm of wc	150	LOCAL	CVL
APG304	AIR PRESSURE AT COMPARTMENT-II	0 TO 1000 mm of wc	150	LOCAL	CVL
APG305	AIR PRESSURE AT COMPARTMENT-III	0 TO 1000 mm of wc	150	LOCAL	CVL
PG401	BED PRESSURE	0 TO 600 mm of wc	150	LOCAL	CVL
PG101	FEED WATER PRESSURE AT FEED LINE	0 TO 40 kg/CM ²	150	LOCAL	CVL
PG201	STEAM PRESSURE AT STEAM DRUM	0 TO 40 kg/CM ²	250	LOCAL	CVL
U401	MONOMETER FOR FLUE GAS PRESSURE AT FURNACE	-100TO100mm of WC	-	NEAR PANEL	CVL
U301	MONOMETER FOR AIR FLOW MEASUREMENT AT AEROFOIL	0 TO 200mm of WC	-	NEAR PANEL	CVL

TEMPERATURE INDICATIONS:

TAG NO.	DESCRIPTION	RANGE C	DIAL SIZE IN(mm)	LOCATION	SCOPE
TG301	AIR TEMPERATURE AT AIR HEATER OUTLET	ZERO TO 300	150	LOCAL	CVL
TG401	FLUE GAS TEMPERATURE AT BANK OUTLET	ZERO TO 500	150	LOCAL	CVL
TG402	FLUE GAS TEMPERATURE AT AIR HEATER OUTLET	ZERO TO 300	150	LOCAL	CVL
TG403	FLUE GAS TEMPERATURE AT MDC OUTLET	ZERO TO 300	150	LOCAL	CVL

TAG NO.	DESCRIPTION	ELEMENT	INDICATION	RANGE IN °C	TYPE	LENGTH(mm)	SCOPE
TE401&TE402	BED TEMPERATURE AT COMPARTMENT-I	CR/AL	TM401	ZERO TO 1200	DUPLEX	1000	CVL
TE403&TE404	BED TEMPERATURE AT COMPARTMENT-II	CR/AL	TM402	ZERO TO 1200	DUPLEX	1000	CVL
TE405&TE406	BED TEMPERATURE AT COMPARTMENT-III	CR/AL	TM403	ZERO TO 1200	DUPLEX	1000	CVL
TE407	FURNACE TEMPERATURE	CR/AL	TM401	ZERO TO 1200	DUPLEX	750	CVL

VARIABLE FREQUENCY DRIVES

TAG.No.	DESCRIPTION.	Qty.	REMARKS
VFD801 TO VFD803	VARIABLE FREQUENCY DRIVES FOR FUEL FEEDER	3	-

POCKET FEEDER

TAG.No.	DESCRIPTION.	Qty.	REMARKS
PF801 TO PF803	POCKET FEEDER (5" WITH CS ROTOR)	3	-

MIXING NOZZLE

TAG.No.	DESCRIPTION.	Qty.	REMARKS
MN801 TO 806	MIXING NOZZLE AT PA LINE (5 INCH)	6	-

ASH FEEDER

TAG.No.	DESCRIPTION.	Qty.	REMARKS
AF 401	ASH FEEDER AT MDC	1	-
AF 402	ASH FEEDER AT BAG FILTER	1	SUPPLIER SCOPE

FEED PUMP

TAG.No.	DESCRIPTION.	Qty.	REMARKS
FP101 & FP102	FEED PUMP	2	-



MOTOR FOR FUEL FEEDER

TAG.No.	DESCRIPTION.	Qty.	REMARKS
M801 TO M803	FUEL FEEDER DRIVE MOTOR	3	-

COUPLING

TAG.No.	DESCRIPTION.	Qty.	REMARKS
COP801 TO COP803	COUPLING FOR POCKET FEEDER	3	-

DRAWING No. : BH112-00-12-4-001

TOTAL WT IN Kg.		-		ON PROCESS		FOR APPROVAL		✓		FOR PLANNING		✓		FOR PRODUCTION		FOR ERECTION	
		SCALE	NTS	DATE		SOLER No. BH112		P & I PART LIST (SHEET: 02 OF 03)									
		DRAWN	V.Raja	03/04/2008		PG-MA No. 00-12				ALL DIMENSIONS ARE IN MM, UNLESS OTHERWISE SPECIFIED.				DRAWING NUMBER BH112-00-12-4-001			
		CHECKED		03/04/2008		NO.OFF -											
		APPROVED		03/04/2008													
												REVISION		NIL			

GEARED MOTORS & MOTORS

TAG.No.	DESCRIPTION.	Qty.	REMARKS
GM 401	GEARED MOTOR FOR MDC ASH FEEDER	1	CVPL
GM 402	GEAR MOTOR FOR ASH FEEDER AT BAG FILTER	1	BAG FILTER SUPPLIER SCOPE
M301	FD FAN MOTOR	1	CVPL
M302	PA FAN MOTOR	1	CVPL
M401	ID FAN MOTOR	1	CVPL
M101 & M102	FEED PUMP MOTOR	2	CVPL

GEAR BOX

TAG.No.	DESCRIPTION.	Qty.	REMARKS
GB801 TO GB803	GEAR BOX	3	-

TEMPERATURE MONITOR

TAG.No.	DESCRIPTION.	Qty.	REMARKS
TM401 TO TM403	TEMPERATURE MONITOR	3	IN PANEL


ALARM ANNUNCIATION POINTS: (4R x 5C)

SL.NO.	DESCRIPTION.	SL.NO.	DESCRIPTION.
01	FD FAN MOTOR TRIPPED	11	BED TEMPERATURE AT COMPARTMENT-I LOW
02	PA FAN MOTOR TRIPPED	12	BED TEMPERATURE AT COMPARTMENT-II HIGH
03	ID FAN MOTOR TRIPPED	13	BED TEMPERATURE AT COMPARTMENT-II LOW
04	FEED PUMP-I & II MOTOR STOPPED.	14	BED TEMPERATURE AT COMPARTMENT-III HIGH
05	FUEL FEEDER-I STOPPED	15	BED TEMPERATURE AT COMPARTMENT-III LOW
06	FUEL FEEDER-II STOPPED	16	STEAM DRUM WATER LEVEL HIGH
07	FUEL FEEDER-III STOPPED	17	STEAM DRUM WATER LEVEL LOW
08	BAG FILTER ASH FEEDER MOTOR TRIPPED	18	SPARE
09	MDC ASH FEEDER MOTOR TRIPPED.	19	SPARE
10	BED TEMPERATURE AT COMPARTMENT-I HIGH	20	SPARE

INSTRUMENT AIR LINE

TAG.No.	DESCRIPTION.	TYPE	SIZE(NB)	END CONNS.	Qty.	MATL.	SCOPE
V900	ISO VALVE FOR INSTRUMENT AIR HEADER	BV	50	SCR	1	CS	SAFL
V901 & 902	ISO VALVE FOR INSTRUMENT AIR INLET	BV	15	-	2	-	SAFL

DRAWING No. : BH112-00-12-4-001

TOTAL WT IN Kg.	-	ON PROCESS	FOR APPROVAL	<input checked="" type="checkbox"/>	FOR PLANNING	<input checked="" type="checkbox"/>	FOR PRODUCTION	FOR ERECTION
	SCALE	NTS	DATE	SOLER No. BH112	P & I PART LIST (SHEET: 03 OF 03)			
	DRAWN	V.Raja	03/04/2008	PG-MA No. 00-12				
	CHECKED		03/04/2008	NO.OFF	ALL DIMENSIONS ARE IN MM, UNLESS OTHERWISE SPECIFIED.			
	APPROVED		03/04/2008	-				
					DRAWING NUMBER BH112-00-12-4-001			
					REVISION NIL			

LUBRICATION SCHEDULE

LUBRICATION SCHEDULE

SL. No.	ITEM DESCRIPTION	MAKE	ITEM QTY. (Nos)	PARTS TO BE LUBRICATED	PARTS QTY. (Nos)	TYPE OF LUBRICANT	BRAND NAME / SPECN. OF LUBRICANT		INITIAL FILLING QUANTITY (PER ITEM)	FIRST FILLING (RUNNING HOURS)	SUBSEQUENT FILLING (RUNNING HOURS)
							IOCL MAKE	HP MAKE			
01.	FD FAN	CVL	1	BEARING	2	GREASE	SERVOGEM EP-2	---	0.33 Kg.	1100	1100
02.	ID FAN	CVL	1	BEARING	2	GREASE	SERVOGEM EP-2	---	0.80 Kg.	2000	2000
03.	PA FAN	CVL	1	BEARING	2	GREASE	SERVOGEM EP-2	---	0.23 Kg.	1500	1500
04.	FEED PUMP	GRUNDFOS	2	BEARING	2	OIL	SERVOPRIME-46(OR) SERVOSYSTEM- 46	ENKLO 46	1.25 Kgs.	300	8000
05.	GEAR BOX	ELECON	3	GEAR UNIT	2	OIL	SERVOMESH-SP320	ENKLO-320	1.8 Ltrs.	250	3000
06.	GEARED MOTOR	POWER BUILD	1	GEAR UNIT	1	OIL	HP - 90	EP - 90	2.7 Ltr.	10,000	2 TO 3 YEARS
				BEARING	2	GREASE	SERVOGEM-2	LITHON 2	0.3 Kg.	150	ONCE IN A WEEK
07.	MOTORS	CROMPTON	6	BEARING	2	GREASE	SERVOGEM-2	LITHON 2	0.5 Kg	300	1200

IOCL -- INDIAN OIL CORPORATION LTD.

HP - HINDUSTAN PETROLEUM

CONTENT



CETHAR VESSELS LIMITED

**M/s. SKM ANIMAL FEEDS AND
FOODS (INDIA) LIMITED.
1 X 15 TPH FBC BOILER(BH112)**

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	WATER LEVEL GAUGE	003
	LIQUID LEVEL LIMITER	010
	SAFETY VALVE	017
	BLOW DOWN VALVES	025
IV.	BOILER AUXILIARIES:	
	FAN	031
	FEED PUMP	068

INDEX

BOILER MOUNTINGS

CONTENT

DATA SHEET	
WATER LEVEL GAUGE	
DESCRIPTION	SPECIFICATION
GENERAL DATA:	
MAKE	M/S. LEVCON INSTRUMENTS PVT. LTD.
QUANTITY	2 NOS.
APPLICATION	STEAM DRUM
TAG NO.	LG201 & LG202
TYPE	TRANSPARENT
CENTRE TO CENTRE DISTANCE	450 MM
MINIMUM VISIBILITY	320 MM
END CONNECTION	25 NB, FLANGED ANSI B16.5, 300# RF
GAUGE GLASS	BORO-SILICATE MOULDED
IBR T.C. IN FORM III-C	PROVIDED
OPERATING DATA:	
WORKING PRESSURE	18.25 Ksc (g)
HYDRO TEST PRESSURE	27.38 Ksc (g)
WORKING TEMPERATURE	SATURATED

SUPPLIER'S ADDRESS:

M/S. LEVCON INSTRUMENTS PVT. LTD,
6TH FLOOR, "RAJKAMAL",
13, CAMAC STREET,
KOLKATA - 700 017.

CONTENT

Installation, Operation and Maintenance Manual for LEVCON REFLEX & TRANSPARENT LEVEL GAUGE

A. General

'Levcon' Liquid Level Gauges are used for local indication of liquid levels in vessels under temperature and pressure conditions like Steam Boilers, condensate Accumulators and other pressure vessels.

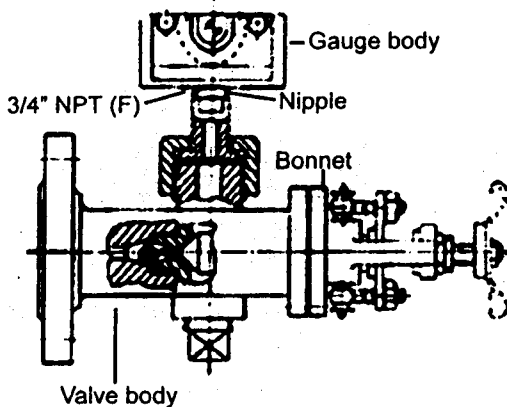


Fig.1. Offset Type Valve (Bottom)
Union Nut & Nipple

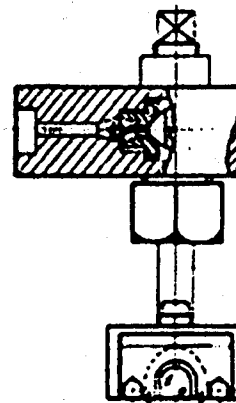


Fig.2 Vessel Connection
(Socket Weld)

The Gauge Body can be either Reflex type or Transparent type. Reflex type level gauges are normally used for clear non-viscous liquids and suitable for severe duty conditions. Forged construction and superior design make the level gauges immune to Mechanical and Thermal shocks. Moulded grooves of Reflex Glass provide clear indication of liquid level from a distance. Limited reaction with Glass expected when acid is present in liquid under **Temperature & Pressure**.

Transparent type Level Gauges are equally robust and reliable as Reflex type level gauges but are used for better indication in case of Dirty, Viscous and Aggressive Liquids. Moulded Transparent Plate type Toughened Glasses are provided at front and back so as to get through vision for liquid level indication. The indication is much more prominent when an Illuminator is provided at the back.

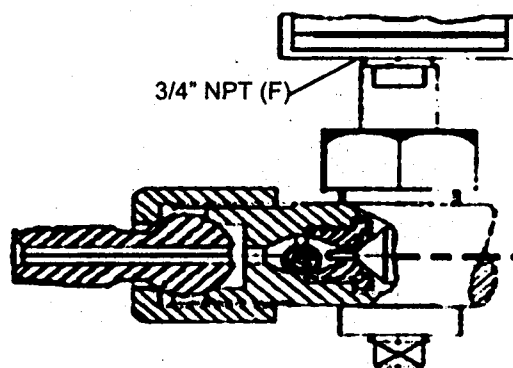
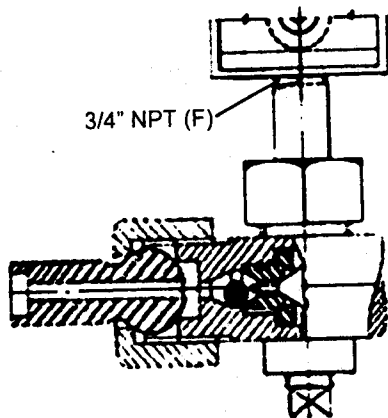
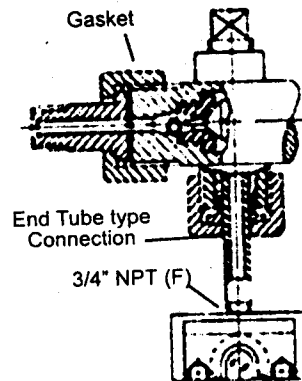


Fig.3. Spherical Union Connection
(Screwed)



**Fig. 4. Spherical Union Connection
(Socket weld)**



**Fig. 5. Vessel Connection
Screwed (M)**

Reflex Level Gauges are suitable for temperature upto 400° C (or above) in case of non-steam, non-corrosive applications and upto 243° C in case of steam and corrosive applications. In case of Transparent type Level Gauge only, temperature withstanding capacity of 243° C can be substantially increased by using Mica Backings for Glasses. Mica is normally 0.15 mm to 0.2 mm thick.

Large Chamber type Level Gauges are used for Boiling/Evaporating liquids. These are manufactured from thick walled seamless pipes (or solid rods).

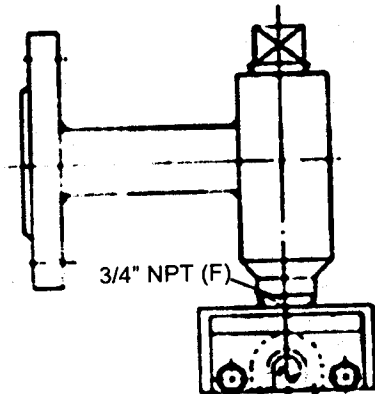
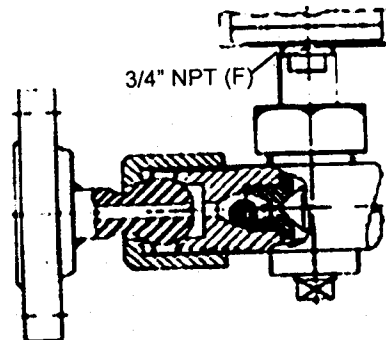


Fig. 6. Straight Type Connection



**Fig. 7. Spherical Union Connection
(Flanged)**

Normally 3/4" NPT (F) connections are provided at Top and Bottom (Gauge Body). Offset type valves (Fig. 1) or straight type connections without valves (Fig. 6) can be provided at top and/or bottom. The vessel connections can be Flanged as shown in Fig 1 or 6. Alternatively, Vessel connection can also be screwed as per Fig. 5, or Socket Weld type as per Fig. 2. Again instead of rigid connections, connections can be taken through Spherical Unions (Screwed, Socket Weld or Flanged type) as shown in Fig 3, 4 & 7 respectively.

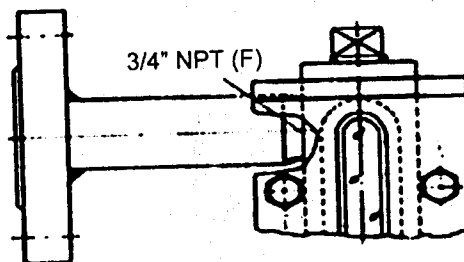


Fig. 8. Side Connection with out valve

When required, instead of top and bottom connections, back or side connection at top and/or bottom can be provided on the Gauge Body. The side/back connections can be without valves as shown in Fig. 8 or with valves as shown in Fig. 9 (offset type) and fig. 10 (Straight type).

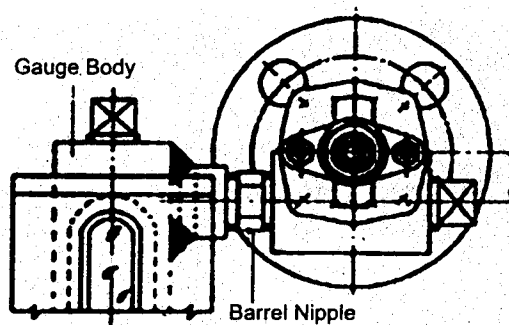


Fig:9 Offset Type valve (Top side)

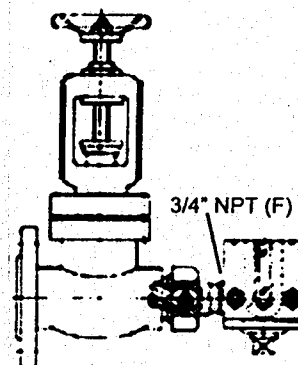


Fig:10 Side Connection with Valve

Again the Vessel connections can be Flanged or Screwed or Socket Weld type and may be taken through Spherical Union Connections

In case of connections from top and bottom, the connection between Gauge Body and bottom valve is normally Union Nut & Nipple type as shown in Fig. 1 and connection between Gauge Body and Top Valve can be either Union Nut and Nipple type or "End Tube" type as shown in Fig. 5. In case of both the types the Gauge Body may be easily rotated through 360°. The "End Tube" type connection is not positive but can take care of any effect of unequal expansion due to temperature.

Alternatively, Expansion Loops can be provided (between Gauge Body & Top & Bottom valves to take care of Expansion (refer to contract Drawing).

Following optional features can be provided :-

(a) Illuminators

Perspex Plate type Illuminator is used for Transparent type Level Gauges only and can be in weatherproof or flameproof type execution (IP : 66 & Gr IIA, IIB or IIC-CMRS approved). Illuminators are suitable for one/two Glass sections. When more than one Illuminator is provided, these are interconnected by non armoured cable taken through appropriate Cable Glands (Fig 11A & B). (Armoured Cable Gland is used in case of Flp. Illuminators).

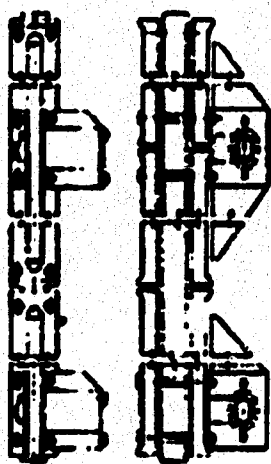


Fig:11A Illuminator (Flameproof)

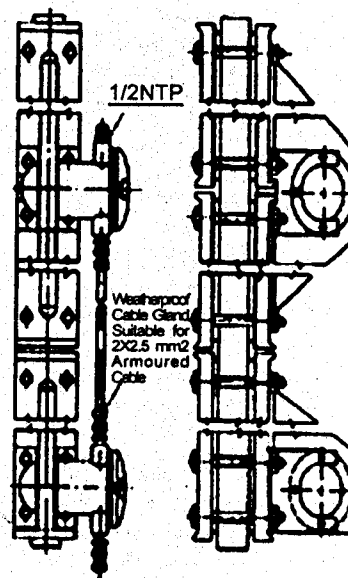


Fig:11B Illuminator (Weatherproof)

(b) Heating Jacket

External or Internal steam Heating arrangements (non – IBR) can be provided for media which tend to harden or solidify. Electrical external heating arrangement, if required, can be provided. Refer to Contract Drawing.

(c) Calibrated Scale

Aluminium or St. Steel Engraved Scale can be provided, mounted on suitable brackets, at the side of the Level Gauge.

(d) Antifrost Block

Perspex non-frost extension can be provided in case of sub-zero application to prevent visibility obstruction by Ice formation (Fig. 12).

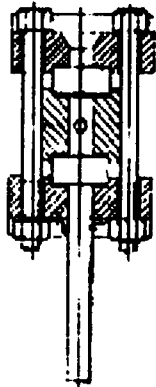


Fig.12
Non Frost Extension

B. Unpacking and Installation

Level Gauge is normally supplied in fully assembled condition. Unpack carefully and install the Level Gauge vertically on the side of the Vessel. Ensure that centre-to-centre distance between connections on the Vessel is same as centre-to-centre distance of the Level Gauge. In case of Flanged ends, fix directly, preferably thro' **additional isolating valves**, using suitable Gaskets, Bolts and Nuts. In case of screwed connection, first remove Screwed Adaptors from top and bottom connections of Level Gauge, Screw Adaptors in position (preferably thro' addl. Isolating valves) and then mount the Level Gauge and fix in position by tightening Gland Nuts. In case of Socket Weld type, weld directly on Nipples provided. Where Spherical Unions are provided, Gland Nuts of Spherical Unions to be tightened only after the Level Gauge is properly mounted. Close top and bottom Valves (when Integral Valves are not provided, close the separate isolating valves which should be provided between Level Gauge and Vessel). Close Drain and Vent Valves/Cocks (where provided). Where Level Gauge is fitted with Illuminator, remove cover of bottom most Illuminator (when more than one Illuminator Assemblies are fitted), take Cable through Cable Entry (either using appropriate Conduit or Cable gland of appropriate size) and connect 230V AC (or as required) supply. Fit back Cover. As the Illuminators are supplied interconnected (when more than one Illuminator is provided) giving supply to the bottom-most Illuminator is sufficient.

C. Commissioning:

The Level Gauge Glass can now be commissioned. Open top and bottom Valves partly. After the Level Gauge is fully pressurized, open (partly) and then close Vent Plug/Valve/Cock to remove any trapped air and then open and subsequently close the Drain Plug/Valve/Cock to properly flush the Level Gauge. Now open top and bottom Valves fully. In case of any leak through Valve Glands or End Tube Gland, tighten Gland Nuts to stop leakage. If necessary, close the Isolating/Integral Valves and repack Bonnets with fresh packings (Graphited Asbestos/Teflon). Switch on supply to Illuminator (where provided). Fit non-frost Extension Blocks (supplied separately) where provided.

Where built-in Ball Check Arrangements are provided with Valve Spindles having Pins at ends to push back Balls, Valves to be partially opened initially (not more than half turn) to prevent Balls from closing the ports due to sudden gush of flow. Valves to be fully opened after giving a time gap to allow equalization of pressures on both sides of Balls. If Valves are fully opened quickly and if the Balls close the ports (thereby making the Level Gauge inoperative) close the Valves again and reopen in the manner described above.

Glass Cover Bolts should be tightened at Specified torque using Torque Wrench. Torque data under "Cold" Condition are given in Tables below. However, under actual working conditions (involving high temperature as in case of Boilers etc) the Torque Value reduces due to expansion of bolts/studs. This is likely to cause leakage. Hence on attainment of temperature, the bolts/studs to be retightened at "Hot" Torque figures given below.

A. Reflex type Level Gauge

Type of Cover	Pressure Range - Kg/cm ²				
	Upto 30	30 - 50	50 - 75	75 - 100	100 - 120
	Cold Hot	Cold Hot	Cold Hot	Cold Hot	Cold Hot
Standard Cover -7/5 Bolts	29.8 (22) 27.1 (20)	32.5 (24) 28.5 (21)	— —	— —	— —
Standard Cover -8/6 Bolts	— —	— —	38 (28) 31.2 (23)	40.7(30) 32.5 (24)	— —
3-PC., Cover - 8/6 Bolts	— —	— —	— —	— —	58.3 (43) 46.1 (34)

N.B. 7 / 5 bolts mean 7 x 2 bolts/Studs in case of 340 mm Glass Section and 5 x 2 bolts/studs in case of 250 mm Glass Section. Similarly for 8/ 6 bolts.

2. Torque Values are in NM (Newton-Meters). Figures within brackets are in ft-lb.

B. Transparent type Level Gauge

Type of Cover	Pressure Range - Kg/cm ²					
	Upto 25	25 - 40	40 - 50	50 - 75	75 - 100	100 - 120
	Cold Hot	Cold Hot	Cold Hot	Cold Hot	Cold Hot	Cold Hot
Standard Cover -7/5 Bolts	57 (42) 52.9 (39)	— —	— —	— —	— —	— —
Standard Cover -8/6 Bolts	— —	51.5 (38) 46.1 (34)	69 (51) 59.7 (44)	73.2 (54) 61.7 (45.5)	— —	— —
3-PC., Cover - 8/6 Bolts	— —	— —	— —	— —	108.5 (80) 88.1 (65)	118 (87) 94.9 (70)

4. In case of leakage isolate the level Gauge immediately and re-commission only after rectification. Otherwise, cutting actions of steam etc. may damage Gauge Body, Glasses, Valves etc.

D. Maintenance

The Drain Valve/Cock/Plug should be opened periodically in order to remove any dirt or mud that is likely to collect inside the Level Gauge. Before draining, ensure that the top and bottom Valves are partially open only (so that the top and bottom Safety Balls cannot sit on the seats). The top and bottom Valve packings and also End Tube Packings (also Gasket of Union Nipple) can be replaced even when the Vessel is under pressure. Close top and bottom valves, open Drain Valve/Cock/Plug. Remove Gland Followers/ Gland Nuts and Glands. Where Screwed type Bonnets for Valves are provided, Handwheels also are to be removed. Remove old packings and Gaskets, fill the space with new Packings and Gaskets. Replace Glands and re-fit Gland Followers or screw in Gland Nuts. Tighten Nuts on Gland Follower Eye Bolts and Gland Nuts. Recommission the Level Gauge. To replace the Glasses of any particular section close top and bottom valves, open Drain Valve/Cock/Plug. When Illuminator is provided, Switch-off Illuminator supply and remove the particular Illuminator mounted on the cover to be removed for replacement of Glass. Remove Cover Fixing Bolts and Nuts and very carefully remove the Front (and Back) Cover, Glass (and Glasses), Gaskets and Mica Backings (in case of Transparent Level Gauge). After cleaning (ensure that there are no scratches on Glass seating surfaces) place new Gaskets (CAF or Graphited Asbestos) on the groove at front (and back), new Mica Backings on Gaskets (for Transparent Level Gauge only), new Reflex / Transparent Glass and new top CAF/Graphited Asbestos Gaskets on the Glass (Glasses). Put back Front Cover (and Back Cover) in position and fit back Bolts and Nuts and tight them. Mica Backings to be handled very carefully and Mica surfaces should not be touched.

Tighten Bolts and Nuts increasing load on the Cover Bolts stepwise upto the required Torque. **Start with the Centre Bolts**, then work at opposite sides alternately towards the ends. After the Gauge is first put in service and reaches its working temperature, the Bolts should be re-tightened. Use Torque Spanner to ensure that all Bolts are equally tightened. For final tightening use Torque as per chart by the Torque Spanner. Fit back Illuminator (where provided) after replacing Bulb, if necessary

To replace Bulb of Illuminator, remove Screws and Nuts holding Aluminium Bulb cover (in case of weatherproof Illuminator). Remove old Bulb and refit new Bulb (holding Illuminator case by one hand). Replace Cover (with Gaskets) and re-fit Cover Fixing Screws and Nuts.

In case of Flameproof Illuminator, **first isolate Electric Supply elsewhere**, take away Perspex Plate by removing 2 Nos. Screws and then unscrew front part (including Glass Dome) of the Lamp Housing. Change Bulb, fit back front part of Lamp Housing and Perspex Illuminator Plate.

Since improvements are made from time to time, the design/ specifications are liable to change without notice.

ADDRESS	
Kolkata (Office) "RAJKAMAL" 6 th Floor 13, Camac Street Kolkata - 700 017 INDIA Phones: 2283-2766, 30225767, 9831826885 Fax No.: 91 33 2280 9645/ 2283 2719 E-Mail- levconh@vsnl.net Website: www.levcongroup.com	Kolkata (Factory) 138-G. Picnic Garden Road, Kolkata-700 039 Phones:2343-8528/4325, 9831826884 Fax No: 23442680 Email: levconw@vsnl.net
Mumbai Branch 301,Protoprima Chambers.1, Suren Road. Andheri East.Mumbai-400 093. Phones : (022) 26832127/26833015 Cable: CONLEV. MUMBAIS Fax : (022) 26833015	

DATA SHEET	
LIQUID LEVEL LIMITER	
DESCRIPTION	SPECIFICATION
GENERAL DATA:	
MAKE	M/S. LEVCON INSTRUMENTS PVT. LTD.
QUANTITY	1 NO.
APPLICATION	FOR STEAM DRUM
TAG NO.	LLL201
MEDIUM	STEAM / WATER
CENTRE TO CENTRE DISTANCE	450 MM
SWITCHING RANGE	250 MM
END CONNECTION	25 NB, FLANGED, ANSI B16.5, 300#
NO. OF CONTACTS PER CARRIAGE	1 SPDT, 1 NO + 1 NC
CURRENT RATING	5 AMPS, 230 V AC
NO. OF SET POINTS	3
SET POINTS	HIGH LOW LOW LOW 77.77% 33.33% 22.22%
OPERATING DATA:	
WORKING PRESSURE	18.25 Ksc (g)
HYDRO TEST PRESSURE	27.38 Ksc (g)
MAX. WORKING TEMPERATURE	SATURATED

SUPPLIER'S ADDRESS:

**M/S. LEVCON INSTRUMENTS PVT. LTD,
6TH FLOOR, "RAJKAMAL",
13, CAMAC STREET,
KOLKATA - 700 017.**

CONTENT

INSTRUCTION MANUAL FOR LEVCON MAGNETIC LEVEL SWITCHES (LS SERIES)

LEVCON LS Series Level Switches are used for high and/or low level signalizations (Visual and/or audible) or automatic level control (by starting and stopping pumps or opening and closing valves) in pressurised or non-pressurised industrial vessels. Level Switch Enclosure can be, weatherproof type (IP 66) or Flameproof (as per IS 2148 : 1981 for Gr. I, IIA, IIB or IIC gases) and weatherproof type.

Installation Instructions:

1. Unpack the level switch carefully.
2. Mount the Level Switch horizontally on a flanged Nozzle (see figure in Pub.LS/I) having flange dimensions matching with the Level Switch Flange. The Nozzle is to be at appropriate height where Level Signalization is desired. Sometimes it is not desirable/possible to fit the level switch directly on the vessel. In such cases, the switch can be installed in chamber of suitable construction (cast iron/ steel/ stainless steel). The chamber is to be installed at appropriate height near the vessel (**to be supported properly, if required**). The top and bottom (or side) connections (flanged/ sw/ screwed) are to be piped up to suitable nozzles/ threaded bosses at top and bottom of the vessel, **through two isolating valves**. Pipings (should be minimum 25 NB) to be as short as possible with minimum bends and Isolating Valves should be full bore type. Level Switch is to be installed through the main opening/ nozzle provided. If required, by closing the isolating valves, the level switch can be easily repaired or replaced without disturbing the main vessel.

For details of different types of chambers that can be supplied, kindly refer to us.

When the magnetic level switch is supplied with special flange, the nozzle flange or chamber flange data will be to suit the level switch flange.

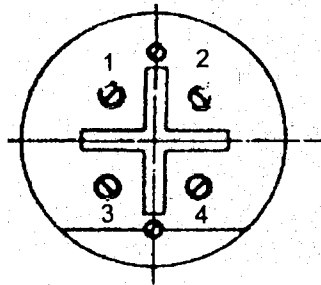


Fig.1

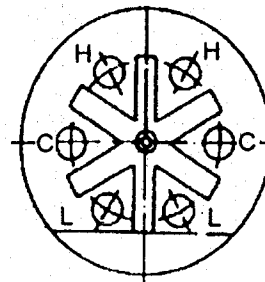


Fig.2

- 2.1 Level Switches having standard float assemblies (standard or miniature types 41, 61, 71, 91 or 46) : Insert horizontally (cable gland or cable entry point to face downwards) and fix with suitable Gaskets and nuts. Ensure that the float movement is absolutely free. The switch should not be installed at place **where there is too much turbulence** (near liquid inlet port etc.)
- 2.2 Level Switches having float Assemblies with Extension rods (Type 42/ 43/ 44 & 62/ 63/64): The switch, extension rod and float are separately supplied. Standard extension rod has M4 threads with nuts on each side for length upto 200 mm (length above 200 mm-2BA threads). In case of high Pressure type (16 swg 60 mm dia float) M6 threads (rod length upto 50 mm) and in case of Extra high Pressure type (70 mm dia float)-M8 threads (rod length upto 50 mm). Assemble the level switch before installation. First screw in the extension rod on boss fitted to the tail piece. Tighten locknut (in case of extension rod bent twice at right angles, see that after tightening the locknut, the direction of bent is as desired. Then, screw in float to the other end of extension rod. Tighten locknut.

Sometime in case of extension rod bent twice at right angles, it may be necessary to fit the extension rod assembly from inside the vessel (after fixing switch head on nozzle).

While fitting extension rod bent at right angle, ensure that after tightening, the bent portion of the rod is at right angle to the fulcrum pivot rod and float is on the other side of cable gland. **In this case the magnetic level switch has to be installed vertically.** While installing, take care that the float movement is free and float is not too near the vessel wall (say within 50 mm). Cable gland can face any direction, but while laying conduit piping ensure that there is no chance of accumulated moisture flowing into the level switch.

- 2.3 Magnetic level switches with adjustable float assemblies (Types 45 and 65). The switch head is supplied complete with tail piece and adjustable attachment. Adjustable rod and float are supplied separately. Assemble the level switch. The adjustable rod has M4 threading with locknut at one end. The other end has a hole at right angle to the rod on a cylindrical piece welded at the end. Screw in the adjustable rod on float boss, tighten locknut. Unscrew and partly withdraw fulcrum pivot rod. Introduce the hole end of the adjustable rod in-between the adjustable attachments and the end studs (provided on the attachments) so that the hole is in fulcrum axis. Screw back fulcrum pivot rod after passing through the hole of the adjustable rod. Float can now move up and down freely and studs in the adjustable attachment serve as end stops for the float rod assembly. Depending upon the differential required and the levels of higher and lower switch operating points (with respect to centre line through the level switch) the studs can be screwed in appropriate holes and the length of the adjustable rod can be reduced suitably. To reduce the length of the adjustable rod, cut it from threaded end, and provide the same length of threading as was present originally.
- 2.4 Intermediate Chamber type level switch: Installation procedures are same as in case of standard type. Where vent holes are provided, ensure that there is no chance of water getting in intermediate chamber from outside. In case of sealed type, **do not open the intermediate chamber**, but send the complete level switch to us in case it is not functioning properly.
- 2.5 Flameproof Level Switch: Installation procedures are same as in the case of standard type.
- 2.6 Level Switch having fulcrum guard with neoprene bellows: Use one ring gasket between level switch flange and metallic guard and another between metallic guard and the mounting bracket.

Electrical Connections:

3.1 In case of weatherproof models (Standard type) :

- (a) Open the cover at the back by unscrewing the two nos. screws. In case of Ebonite model, cover to be removed by unscrewing.
- (b) Connect to terminals 1,2,3 and 4 (in case of Air break type) or to terminals HCL (in case of Microswitch type) with the help of multi-core cable. See Fig. 1 & 2.
- (c) Cable is taken out through conduit pipe screwed directly to the level switch (standard cable entry is $\frac{1}{2}$ " / $\frac{3}{4}$ " NPTF). While laying the conduit ensure that there is no chance of accumulated condensate flowing inside the Level Switch. Use Condensate/Moisture Trap, if required. Alternatively armoured cable can be taken out through appropriate Double Compression type Cable gland.

Earth the switch at the terminal provided outside the body (in case of Ebonite level switch, the earthing terminal is provided inside the body).

- (d) After completing the connections, fit back the cover the position along with the gasket.
- 3.2 Miniature and submerged type level switches are normally supplied complete with 2 meters (5Meters in case of submerged type) of 4 Core PVC cable (longer cable can be supplied if required). 7 core cable in case of 2-SPDT.
- (a) The 4 – core cable has red, blue, yellow and green PVC covered wires. Red and blue make when level is low. Red and Yellow make when level is high. The green is connected to the earth. In case of 2-SPDT all cores are black and Ferrules H_1, C_1, L_1 (for 1 switch) and H_2, C_2, L_2 (for 2 Switch) are provided at cable ends (unferruled core is to be connected to Earth). H_1, C_1 and H_2, C_2 make when level is high and C_1, L_1 and C_2, L_2 make when level is low.
- (b) The cable should be terminated to a suitable 4 / 7 way terminal block.
- 3.3 In case of flameproof (I, IIA, IIB or IIC as per IS 2148:1981) level switch:-
- (a) Remove the back cover by unscrewing 4 Nos. 6mm bolts with the help of special tubular spanner supplied.
- (b) Mode of Electrical Connections is same as in case of Standard type.
- N.B.: Supply to be switched on only after cover is fitted back in position. Also, supply to be switched off before cover is opened.**
- 3.4 In case of intermediate chamber type level switch, due to the presence of the intermediate magnet, the switching action reverses: i.e. terminals 1 and 2 make and 3 and 4 break when the level is high and 1 and 2 break and 3 and 4 make when the level is low. However, in case of Microswitch type, switching actions remain unchanged as connections are reversed inside.

Mode of Electrical connections is same as in the case of Standard type.

Switch Details:

The switch is air break type (contacts are of pure silver) : single pole double throw (SPDT) switching action or one SPDT/ Two SPDT Microswitch type.

Rating :

Voltage	Air break type	Microswitch type
	Amperage	Amperage
250V A.C.	2.0	5.0
440V A.C.	1.5	-
220V D.C.	0.25	0.25

N.B: For current ratings of Special Microswitches (Hermetically Sealed, Gold Contacts,etc.)— see Contract Drawing or refer to us.

Maintenance:

LEVCON Level Switches hardly need any maintenance. The float assembly should be cleaned periodically (specially just after shut down and before switching on service after a long time) with soft cloth to wipe out any dirt etc.

FOLLOWING ARE SOME USEFUL INSTRUCTIONS FOR DISMANTLING OF LEVEL SWITCH-ES AND REPLACEMENT OF SEVERAL PARTS:

(a) Replacement of internal assembly of Standard Level Switch.

1. Unscrew two screws holding the cover. Remove cover, Remove external connections after switching off supply.
2. Unscrew two screws (at top and bottom), holding the internal assembly.
3. Lift the Internal assembly partially, rotate it by 45°; withdraw it completely from body (holding the internal assembly straight).
4. Fit back the new internal assembly following the reverse procedure. When fixed, terminals marked 1 and 2 (or H) should be at the top (away from gland).

N.B.:- It is advisable to return defective internal assembly to us for repair/replacement.

In case of Miniature/ Submerged Models (the type of switches that are supplied complete with return the complete defective level switch to us for repair/ replacement.

(b) Replacement of Internal Assembly for Ebonite Level Switch type LS 31171 – 71 etc.

1. Unscrew and remove cover.
2. Remove connections after switching off supply.
3. Remove ring screw after unscrewing the same with the help of special screw driver provided. Care should be taken not to damage the threads.
4. Remove Internal assy., in the same manner as in case of standard type.
5. While fitting back new/rectified internal assembly, ensure that the locating pins go inside the holes provided on bosses inside the body.

(c) Replacement of internal assembly for Flameproof Models.

1. **Isolate electric supply elsewhere** and then remove 4 Nos. 6mm bolts holding the cover with the help of special tubular spanner provided. Subsequent procedure is same as in case of standard type.
2. **Do not switch on Supply unless the cover is properly refitted.cable).**

(d) Replacement of magnet in tail piece – Standard type Level Switch.

1. Remove float assembly from level switch.
2. Take out the split pin. Remove float.
3. Unscrew and remove the gland with the help of screwdriver.
4. Take the magnet out, if necessary with a jerk. Remove old 'O' Ring and remains of Teflon tape. Use Graffoil tape in case of vessel temp. Higher than 250°C
5. Fit back new magnet after slipping on a new Teflon 'O' Ring making sure that the end of the tail piece **is repelling the internal magnet**. Use Graffoil tape in case of high temperature.
6. Wrap two rounds of Teflon tape on the gland. Make sure that the direction of wrapping is proper and tape does not have tendency to unwrap while screwing in. Screw in the gland and tighten it. Use Graffoil tape in case of high temperature.
7. Fit back float and split pin. Bend the ends of the split pin.
8. Fit back float assembly on switch body. Head of split pin should be at top and the end of tail piece must be in between the end stops.

9. In case of longer Tail-piece with Counterbalance Weight, ensure that the wt. Is properly and rigidly fixed (with no chance of fouling with end stops or legs).
- (e) Replacement of Fulcrum Guard Bellows:
1. Remove the level switch from tank and place it on a clean work table. Roll up Bellows.
 2. Unscrew pivot rod and remove float assembly.
 3. Roll up Bellows further, taking care not to damage it, and remove split pin. Bellows can now be removed. Do necessary cleaning and replace part/ parts including bellows (if necessary). Replace gaskets above and below stainless steel metallic guard if necessary.
 4. Fit back Bellows carefully. Re-insert split pin and bend the ends **completely**.
 5. Keeping the bellows rolled up put float assembly in position, in between the legs and end stops (with split pin loop at top). Insert and screw in pivot rod, tighten fully.
 6. Pull up Bellows on metallic guard uniformly. Ensure that Bellows is not pulled too much, because that will hamper the free movement of float assembly.

Since improvements are made from time to time, the design/ specifications are liable to change without notice.

ADDRESS	
Kolkata (Office) "RAJKAMAL" 6th Floor 13, Camac Street Kolkata - 700 017 INDIA Phones : 2283-2766 / 30225767 / 9831826885 Fax No. : 91 33 2280 9645/ 2283 2719 E-Mail - levconh@vsnl.net Website : www.levcongroup.com	Kolkata (Factory) 138-G. Picnic Garden Road, Kolkata - 700 039 Phones: 2343-8528/4325, 9831826884 Fax No: 23442680 Email: levconw@vsnl.net
Mumbai Branch 301, Protoprima Chambers.1, Suren Road. Andheri East. Mumbai-400 093. Phones : (022) 26832127/26833015 Cable: CONLEV. MUMBAIS Fax : (022) 26833015	

Ref No.: LI/ IM/ LS/ 17-12-2002

Annexure I To Instruction Manual for Levcon Magnetic Level Switches (LS Series)

Notes on Submerged Design

(Also Miniature type with 1 – SPDT/ 2 – SPDT Microswitches)

1. Submerged type Level Switch is suitable for mounting inside water (or at a place where Switch head may get immersed in water due to flooding, overflow etc). In this case the cover is screwed type and level switch is supplied complete with PVC cable (normally 5 m long), which is passed through Cable Entry using Single Compression type Gland. The Cover and Cable Entry points are further sealed by Araldite to ensure better leakproofness. The cable (after making a U – loop) is also Clamped on a bracket (Screwed on flange) to ensure that there is no chance of leakage at cable entry point due to twisting of Cable.

In Case of mounting inside liquid The Level Switch is fixed on a Vertical plate (welded / fitted inside the vessel/ sump) which has 63.5 mm dia. through bore and 4 nos. 14 dia. Bolt holes at 92 mm PCD at appropriate height. M12 bolts and nuts can be used for fixing.

2. Wiring and Terminal identifications already given in details in Main Instruction Manual

Dt: 17/12/2002

CONTENT





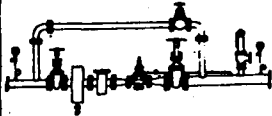
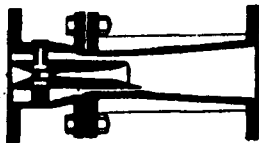
DATA SHEET			
SAFETY VALVE			
DESCRIPTION	UNIT	SPECIFICATION	
GENERAL:			
MAKE	--	M/S DARLING MUESCO (INDIA) PVT.LIMITED	
QUANTITY	--	2 NOS.	
TYPE	--	SPRING LOADED	
NOZZLE & DISC	--	SS 410 STELLITED	
BONNET TYPE	--	OPENED	
LIFTING LEVER	--	PLAIN	
BODY & BONNET MATERIAL	--	SA216 GR. WCB	
SPRING MATERIAL	--	C.S SPRING STEEL CD PLATED	
OPERATING DATA:		DRUM - I	DRUM - II
TAG NO.	--	PSV-201	PSV-202
MODEL NO.	--	SVC-500	SVC-500
MEDIUM	--	SATURATED STEAM	SATURATED STEAM
SET PRESSURE	Kscg	18.00	18.25
TEMPERATURE	°C	SATURATED	SATURATED
ACTUAL RELEAVING CAPACITY	Kg/hr	9713	9840
BLOW DOWN PERCENTAGE	%	5.0	5.0
SIZING CODE	--	IBR	IBR
VALVE INLET / OUTLET SIZE	MM	50 / 80	50 / 80
ORIFICE	--	K	K
END CONNECTION INLET	--	FLANGED, ANSI B16.5, 300# RF	
END CONNECTION OUTLET	--	FLANGED, ANSI B16.5, 150# RF	

SUPPLIER'S ADDRESS:

M/S DARLING MUESCO (INDIA) PVT.LIMITED
PLOT NO.97 A, PHASE-I, G.I.D.C.,
VATVA,
AHMEDABAD - 382445

CONTENT

PRODUCT RANGE

	PNEUMATIC CONTROL VALVES
	AUTOMATIC CONTROL VALVES
	SAFETY RELIEF VALVES
	PRESSURE REDUCING VALVES
	PRESSURE REDUCING STATIONS
	DE-SUPERHEATER AND DE-SUPERHEATING STATIONS

INSTALLATION, OPERATIONAL & MAINTENANCE MANUAL OF SAFETY RELIEF VALVES



Darling Muesco (India) Pvt. Ltd.

97/A, PHASE-1, G.I.D.C., VATVA,
AHMEDABAD-382 445.

PHONE : (0272) 832578, 834392

TLX. : 121-6836 PEC-IN FAX : (0272) 834392 & 830578



1. VALVE CONDITION :

- 1) "Darling Muesco" Safety Relief Valve are supplied properly assembled and duly tested at the Works for given conditions.
- 2) Valves are tested on Air or liquid depending upon the working media.
- 3) Correction for working Temp. and Back Pressure are taken care of.
- 4) Valves are packed with Rubber Covers on Inlet and Outlet. DO NOT REMOVE them unless Valve is ready to be installed.

2. INSTALLATION :

- 1) The Line or Vessel on which the valves is to be installed should be thoroughly cleaned before installing the Valve.
- 2) Ensure the Pipe Dia. on which Valve is installed is same as Valve Inlet Size.
- 3) Discharge Capacity of Valve is stamped on Name Plate. Ensure the required capacity does not exceeds the Valve Capacity.
- 4) Valve should be installed VERTICALLY.
- 5) On Discharge Line, there should not be any obstacle which would create Back Pressure or Block the smooth flow. THIS IS VERY IMPORTANT. If the outlet is connected to a close loop, which is likely to create CONSTANT BACK PRESSURE, Please make sure, the Valve supplied is already with Back Pressure correction.
- 6) REMOVE TEST GAG, if provided, after installation of the Valve. Test Gag is provided to block opening of the Valve, in case of Hydro Test Pressure of complete installations/Vessel. Make sure to remove it after Testing.



- 7) If provided with MANUAL LEVER, please ensure that the Lever is not pulled-up, keeping Valve open.

3. VALVE OPERATION :

- 1) Safety Relief Valve should open with a sharp popping noise at the Set Pressure mentioned on the Name Plate. The Valve should not have more than rated accumulation. Valve shall obtain Max. Discharge Capacity at the ACCUMULATED PRESSURE.
- 2) Valve RESETS at 5% or 10% below the POP PRESSURE (Set Pressure) depending on the Orifice Size. For any faulty operation, please refer TROUBLE SHOOTING.

4) DISMANTLING & ASSEMBLING :

For dependable performance, it may be necessary to Dismantle & Assemble Valve depending on the Maintenance schedule. Kindly follow below mentioned procedures.

- 1) Remove Packing Box (30) of packed lever and Lever (27)
- 2) Remove Cap (3) and Spindle Nut (28)
- 3) Measure or "Mark", the position of Adjusting Screw, to enable to record the Approximate position, which would help while Assembling the Valve.
- 4) Remove Adjusting Screw (11) and Nut (12).
- 5) Lift Bonnet (2), Spring, (14), Washers and Spindle (9).
- 6) Remove Guide (8)
- 7) Remove Disc. & Disc. Holder Assembly (6/7)/Disc, Disc Holder & Reaction Hood assembly (upto size 2"x3")
- 8) Unscrew the set Screw (13).



- 9) Remove Nozzle Ring by Unscrewing off the nozzle from top of the Valve body.
- 10) Remove Nozzle (4) by holding body (1) into bench vice and with Lug key. The key fits into the holes provided on the Nozzle outer Diameter.

For Valve Size upto 2"x3" (Model SVC-500 & SVE-520)

- 11) Unscrew Cheese head Set Screw (52) from the Reaction Hood (41) with the help of screw driver. Remove Reaction Hood (41) from Disc Holder. If any difficulty, soak the assembly into degreasing / Anti Rust solution and "Tap" while unscrewing.

- 12) Disc (6) and St. Steel Ball (10) will come out with it.

The Valve is fully Dismantled now.

5. INSPECTION OF VALVE PARTS :

- 1) Nozzle and Disc are most vital components of Safety/Relief Valve. They are always in contact with fluid and are subjected to high impact in case of Valve opening & closing. Check their seating surfaces carefully. If severely damaged, machine the surfaces, Lap it individually and reassemble. If not severely damaged, just lap it with suitable lapping powder.
- 2) Ensure Guide is Snug-tight in the Body and is freely moving in its tap. Clean this area thoroughly.
- 3) All threads should be cleaned, and Rust Free.
- 4) Spring (14) is also vital part. Ensure spring has not buckled or de-shaped. Change spring if required. Spring No. given on Name Plate should be referred to for re-ordering.
- 5) Stainless Steel Ball (10) should be checked for proper roundness. The ball permits Disc (6) the FLOATING movement



which is QUITE NECESSARY for proper performance. (for Valve size upto 2"x3", SVC-500 & SVE-520)

6. ASSEMBLY OF VALVE :

After inspection and reconditioning or replacing the components, as described above, assemble valve as under :

- 1) Place body (1) in a bench vice and replace Nozzle. Tighten Nozzle with Lug Key or spanner.
- 2) Fit nozzle Ring screw in the body.
- 3) Screw the Nozzle Ring on the Nozzle from the top side of body and keep it approx. 1 mm below Nozzle seat.
- 4) (A) For Valve Size upto 2"x3" (Model SVC-500 & SVE-520)
 - 4.1 Place Disc (6) into Reaction Hood. Put the St. Steel Ball (10) above the Disc.
 - 4.2 Screw on Disc Holder (7) into the Reaction Hood upto the last thread. Back-up slightly to match the hole for cheese head screw.
 - 4.3 Tighten the Cheese head screw to secure Disc Holder with Reaction Hood.
 - 4.4 Turn over and see that Disc (6) is still having FLOATING MOVEMENT and seating surface is projecting out.
- 4) (B) For Valve Size 3"x4" and above.
 - 4.1 These sizes do not have Antifrictional Ball (10) and Cheese head Screw in the design. Instead the Disc has been rounded from the top giving FLOATING movement.
- 5) Assemble Disc & Disc Holder Assembly, Gasket & Guide.



Assemble Spindle (9), Spring Washer (15), Spring (14), Bonnet and Gasket (22).

- 6) Tighten Adjusting Screw until the initially "Marked" place.

7. TESTING & ADJUSTMENT OF VALVE :

1) TESTING :

Testing of Safety Relief Valve should be carried out on a proper Test Bench with accurate and calibrated Pressure Gauge.

2) SETTING :

- 1) Safety Relief Valve Set Pressure setting is INCREASED by turning Adjusting Screw clockwise and DECREASED by turning anti-clockwise.
- 2) The Spring supplied is designed for Spring Range mentioned in the Test Report and this manual. It is normally + or - 10% of set pressure.
- 3) Temperature correction and Back Pressure correction should be done at the time of setting of Valve.

3) ADJUSTMENT :

- 1) Move Nozzle Ring anti-clockwise from the outlet side of the Valve until it touches Disc. Bring it down by 5 to 6 teeth and lock.
- 2) If clear popping action is not obtained, the Nozzle Ring is too low. Isolate, Safety Relief Valve, loosen Nozzle Ring Screw, bring Nozzle Ring up by one or two notches at a time, until the CLEAR POPPING is obtained.

- 3) If the Valve opens sharply but closes slowly allowing high percentage of blow down, Nozzle Ring is high. Lower it by one or two notches at a time until CLEAR POPPING is obtained and also closes within limit.
- 4) Once Valve is set, repeat it 4 to 5 times. The opening pressure should be within 1.5% all the times.
- 5) Assemble Cap, Lever and other Top Assemblies supplied.
- 6) Test the Valve for seat Leakage Test as per API-527 guidelines, if required.

8. TROUBLE SHOOTING :

1) CONSTANT LEAKAGE

- A) Hard particle trapped between Nozzle & Disc. causes leakage. Open the Valve by means of Hand Lever, if provided and blow off.
- B) If it still leaks, Nozzle & Disc should be reconditioned as per 5.1. Follow Dismantling and Assembly procedure.

2) VALVE RESETS BELOW REQUIRED PRESSURE. BLOW DOWN PERCENTAGE IS HIGH.

- A) Follow 'ADJUSTMENT' procedures under 7.3

3) OVER PRESSURE IS HIGH

- A) Valve size is undersized. Check the discharge capacity of Valve against required capacity.
- B) Outlet Connections are not proper which is obstructing the flow. Please check and modify if required.



C) Valve Lift is being restricted by Cap Assembly. Ensure that the available Valve Lift is 1/4th of the Orifice Diameter.

4) VALVE OPENS EARLIER THAN SET PRESSURE

A) Outlet connection is not proper causing Back Pressure. Please correct.

B) Valve is not corrected for Temp. correction. Tighten Adjusting Screw (11) Clockwise to achieve desired set pressure.

9. RECOMMENDED SPARES :

Disc (6)
Nozzle (4)
Spring (14)
Gasket Set
Antifriction Ball (10)

SERIES SLW - 300

The Set Pressure for this design of Valve is increased by moving Weight nearer to the Valve Body and is decreased by moving it away from the Valve Body.

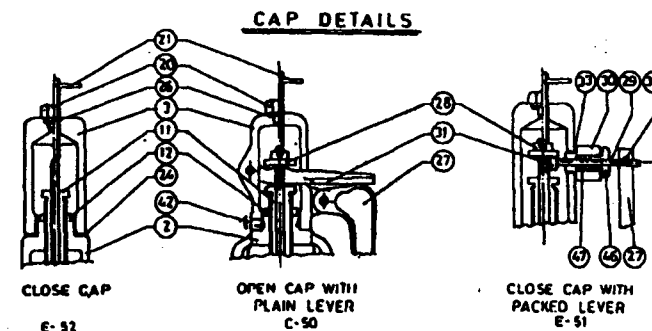
SERIES - T- 100/T - 110

The internal design of this type of Valve is slightly different. However, the setting procedures and other maintenance procedures remains the same as explained above.

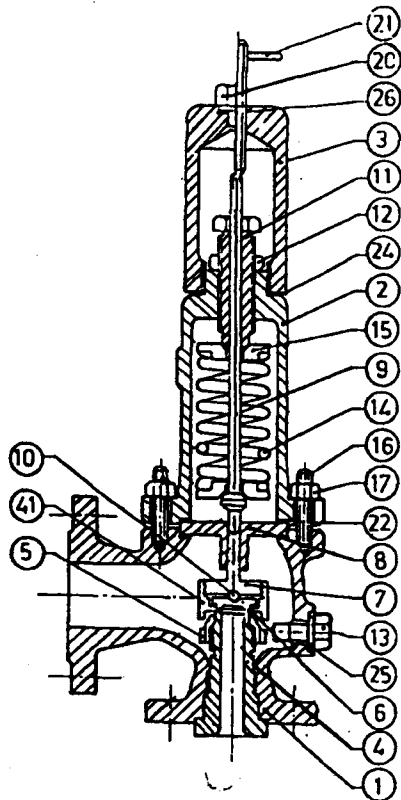


VALVE PART LIST

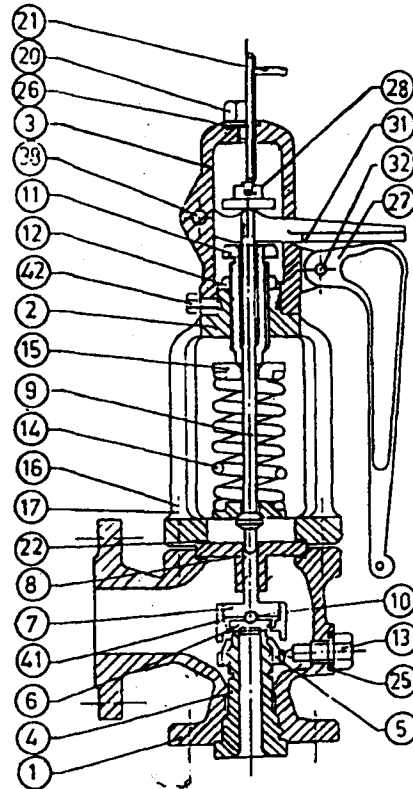
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| 1. BODY | 26. CAP PLUG GASKET |
| 2. BONNET | 27. LEVER |
| 3. CAP | 28. STEM NUT |
| 4. NOZZLE | 29. LEVER SHAFT |
| 5. NOZZLE RING | 30. PACKING BOX |
| 6. DISC | 31. FORK |
| 7. DISC HOLDER | 32. LEVER PIN |
| 8. GUIDE | 33. PACKING BOX GASKET |
| 9. STEM | 34. LOCK PIN |
| 10. ANTIFRICTION BALL | 35. COVER |
| 11. ADJUSTING SCREW | 36. SUPPORT |
| 12. ADJUSTING SCREW NUT | 37. CAP BOLTS |
| 13. NOZZLE RING LOCK SCREW | 38. FORK SHAFT |
| 14. SPRING | 39. GRUB SCREW |
| 15. SPRING WASHER | 40. COTTER PIN |
| 16. BODY / BONNET, STUDS | 41. REACTION HOOD/RING |
| 17. BODY / BONNET, NUTS | 42. CAP LOCKING SCREW |
| 18. GLAND | 43. BODY NOZZLE GASKET |
| 19. WEIGHT | 44. FLANGE |
| 20. PLUG | 45. COLLAR |
| 21. TEST GAG | 46. PACKING FOLLOWER |
| 22. GUIDE GASKET | 47. PACKING |
| 23. STEM POINTER | 48. BLOW DOWN RING, UPPER |
| 24. CAP GASKET | 49. UPPER RING, SCREW |
| 25. NOZZLE RING SCREW GASKET | 50. GUIDE SLEEVE |



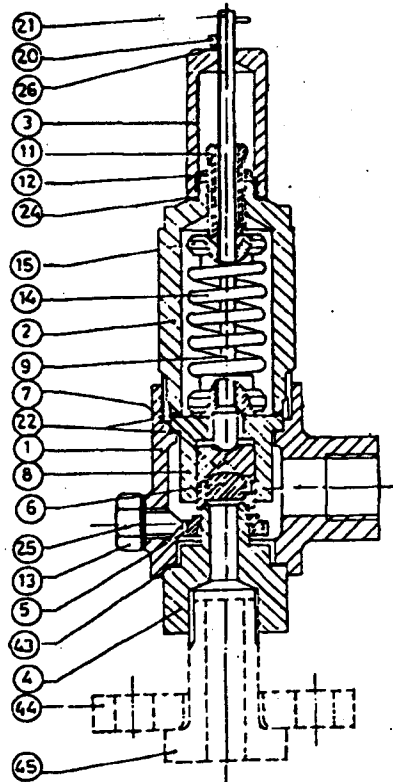
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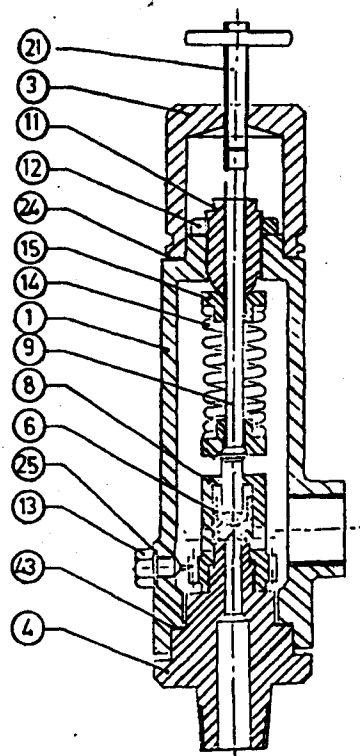
SERIES SVC - 500



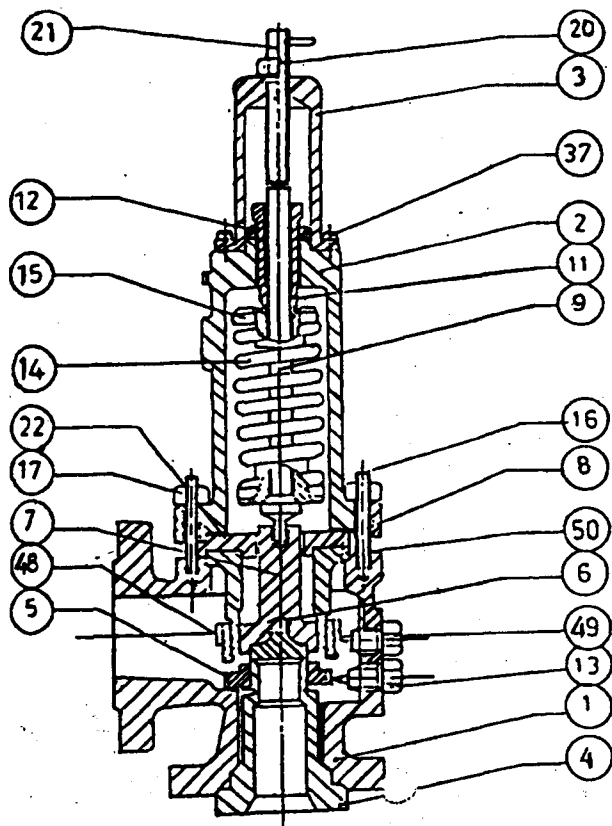
SERIES T-100



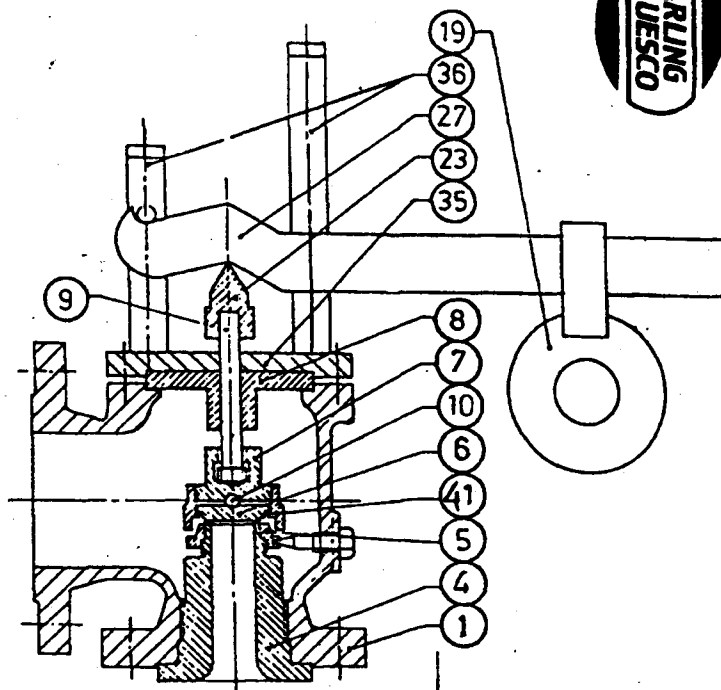
SERIES T-110



SERIES SVC-510



SERIES SLW-300



DATA SHEET	
BLOW DOWN VALVE	
DESCRIPTION	SPECIFICATION
GENERAL DATA:	
MAKE	M/S. LEVCON INSTRUMENTS PVT. LTD.
QUANTITY	1 NO.
APPLICATION	INTERMITTENT BLOWDOWN LINE
TAG NO.	BDV201
TYPE	RACK & PINION OPERATED
SIZE	40 NB
END CONNECTION	FLANGED, ANSI B16.5
RATING	300#
OPERATING DATA:	
MEDIUM	BOILER SATURATED WATER
WORKING PRESSURE	18.25 Ksc (g)
HYDRO TEST PRESSURE	27.38 Ksc (g)
WORKING TEMPERATURE	SATURATED

SUPPLIER'S ADDRESS:

M/S. LEVCON INSTRUMENTS PVT. LTD,
 6TH FLOOR, "RAJKAMAL",
 13, CAMAC STREET,
 KOLKATA - 700 017.

CONTENT

MANUAL FOR INSTALLATION, OPERATION & MAINTENANCE OF PARALLEL SLIDE BLOW DOWN VALVE

GENERAL

All Industries use different types of valves for controlling flow of fluids through the pipeline. Different types of valves are available for different applications and end-use. Selection of valves should be done depending on the actual service condition, i.e., type of medium, operating pressure and temperature, etc. Valves, although considered hardware items, are extremely important because mal-functioning of valves may cause serious disruption of production and may even result in costly shut-down. Hence it is very important to properly install, operate and maintain valves to ensure long trouble-free service.

CARE BEFORE INSTALLATION

Valves are generally protected from damage during despatch from Factory. This protection should be left in place until the valve is to be installed. If the valves are left exposed, sand and other gravity materials may get into the working parts. Unless all such foreign material is thoroughly cleaned out, it may cause trouble when the valve has been placed in service.

Valves should be stored where they are protected from corrosive fumes, and in such a manner that they will not fall or where other heavy material will not fall on to the valves.

Prior to installation it is advisable to have all valves either blown out with cleaned compressed air or flushed out with water to remove all dirt and grit. Piping should be cleaned out in the same manner, or swabbed out to remove dirt or metal chips left from threading operations or welding on the pipe. All joint bolts are to be tightened before installation.

INSTALLATION

When installing valves, make sure that all pipe strains are kept off the valves. The valves should not carry the weight of the line. Distortion from this cause results in inefficient operation, jamming, and necessity of early maintenance. It will be difficult to tighten the end flanges of the valves. Piping should be supported by hangers placed on either side of the valves to take up the weight. Large heavy valves should be supported independently of the piping system so as not to induce stress into the piping system. Flange bolts of the end flanges are to be tightened by pulling down the nuts diametrically opposite to each other. All bolts should be pulled down gradually to uniform tightness. Make all bolts finger tight first, then take 3 or 4 turns with a wrench. Apply the same number of turns, on each bolt, following the order. Repeat the procedure as many times as required until the joint is tight. Uniform stress across the entire cross section of the flange eliminates a leaky gasket.

OPERATION

Valves should only be used in services where they can always be either fully opened or fully closed. The bottom of the Parallel Discs and Seat will erode very rapidly if Discs are left in intermediate position. In addition, the Discs will tend to chatter and cause noise in the line.

Valves should be opened slowly to prevent shock in the line. Closing the valve slowly will help to flush trapped sediment and dirt, if any. When the valve has been fully opened, rotate the spindle by operating wrench (or key) one turn towards the closed position so as not to leave the spindle jammed in the open position.

MAINTENANCE

Periodical examination should be made for possible leakage from the Cover Joint and Gland; after the valve has been in service for a short time follow up gland nuts if necessary. **DO NOT ALLOW GLANDS TO LEAK.** Packing leaks should be corrected immediately by tightening the Gland which compress the packing. If left unattended long enough, corrosive fluids will ruin the stem. In addition, a leaking spindle can lead the valve to chatter in which the vibration will damage the working parts of the valve. If it is apparent that Gland has been compressed the packing to its limit, replacement with new packing is necessary.

Before replacing gland, make sure that there is no steam pressure in the system. The repacking is done as follows :

- a) Release gland nuts and lift gland clear of stuffing box. Remove old packing, especially from the sides of the stuffing box and spindle.
- b) Repack with fresh gland packing. See that each coil of packing is packed down before inserting the next coil.
- c) Replace gland and gland nuts make certain that the gland is correctly positioned with lettering on the lock guard.
- d) Tighten the gland nut alternatively and evenly and follow up periodically as occasion demands.

Lubrication of the valves is especially important and should be done on an established schedule. Valves which are opened and closed frequently should be lubricated at least once a month. Threads of spindle rack and pinion are lubricated by opening the Cover. The threads left dry and unprotected will become worn by grit and other abrasives, threatening stem failure.

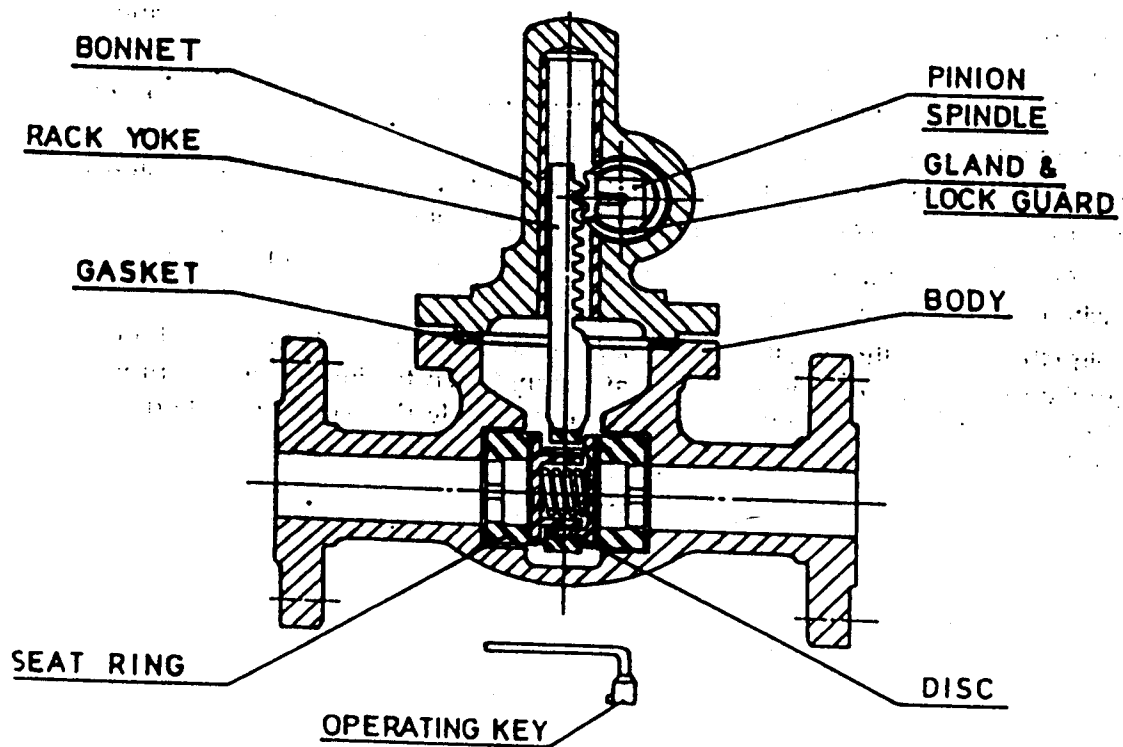
For inspection and repair for maintenance, dismantling of valve is done as follows :-

- a) Release cover bolts and left off cover complete with top gear. Clean Disc and Seat faces by rubbing the surfaces with fine carborandum paper (grade 400C). Slightly pitted or scored surfaces may be reconditioned by lapping, badly damaged surfaces should be replaced by grinding or very fine machining followed by lapping or by replacing the parts.
- b) When it is required to remove the spindle rack and pinion, release the gland and back cover nuts and remove the gland and back cover. The Pinion Spindle can now be withdrawn through the back cover port and pinion rack through the bass of the cover.
- c) When reseating the valve, be sure to mark the discs so that the disc is inserted in the valve body the same way it was removed. Otherwise light closure may not be obtained.

The refacing of seats can be done by lapping the seats in the body with the help of Lapping Tool. Thoroughly clean the seats and lap faces with coarse compound, e.g., Powder Aloxite (grit 60) by applying a thin layer of the same and rubbing the seat faces gently with the Lapping Tool. The Tool is to be operated slowly with reciprocating motion through a small angle exerting only light pressure on the handle, occasionally changing the position of the Tool. Continue lapping until a good joint face is obtained. If the faces cannot be restored by lapping, mount complete body in a lathe and check with a dial indicator to see that the seat is running perfectly true. Grind off just sufficient metal to obtain smooth clean face. Finally lap as stated above.

If Disc faces are slightly pitted or scored, take out the discs and renew by lapping on a flat lapping block in the following manner, after making sure that the joint face and surface of the lapping block are perfectly clean :-

- a) Firstly, lap with coarse compound, e.g., Powder Aloxite (grit 60) by applying a very thin layer of the same to the joint face and rubbing the Disc gently over the lapping block.



CAST STEEL PARALLEL SLIDE
BLOW DOWN VALVE

b) Finish lapping with a find compound having a grain of about 280 e.g. Powder Carborundum (grit F) or Paste Carborandum (Fine).

c) Finally, polish with a mixture of paraffin and oil to remove surplus compound.

If joint face of Disc is badly cut or scored, mount the Disc in a lathe using copper or any other shaft material between chuck jaws and Disc. Check with a Dial Indicator to see the face is running true and grit off or fine machine just sufficient metal to obtain smooth clean face. Finally lap as described above.

Re-assembly of the Valve component parts are to be done as follows :

- a) Clean all parts thoroughly before replacing in the Body, especially joint faces, screw threads and working surfaces.
- b) The Discs should be moved freely together and small port hole in each Disc should be clear of obstruction.
- c) Now cover joint gaskets should be fitted of a similar material and quality of the old one unless alternative material is given.
- d) Make certain that pinion and rack spindles engage correctly, pinion should be replaced so that stop position is reached when rack is in the fully closed condition.
- e) Tighten cover bolts evenly, i.e. after lightening first bolts follow up with bolt diametrically opposite. Repeat with each pair of bolt.

Before replacing the valve in the line, it is advisable to test disc and seat faces for tightness by hydraulic testing by gravity method or with the help of test pump. When testing by gravity press the Top Disc downwards to allow water to pass in the remainder of the body. By hydraulic testing, leakage through Disc and Seat faces is checked.



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Fax : (08455) 41396, Gram : LEVCON

BOILER AUXILIARIES

CONTENT

DATA SHEET			
FANS			
DESCRIPTION	SPECIFICATION		
GENERAL DATA:			
MAKE	M/S. CETHAR VESSELS LIMITED.		
APPLICATION	FD FAN	ID FAN	PA FAN
QUANTITY	1 NO.	1 NO.	1 NO.
TYPE	CENTRIFUGAL	CENTRIFUGAL	CENTRIFUGAL
MEDIUM	AMBIENT AIR	FLUE GAS	HOT AIR
FLOW	5.05 M ³ /SEC.	8.30 M ³ /SEC.	1.8 M ³ /SEC.
PRESSURE	700 MMWC	450 MMWC	700 MMWC
TEMPERATURE	40°C	170°C	199°C
TYPE OF DRIVE	DIRECT COUPLED	DIRECT COUPLED	DIRECT COUPLED
SPEED	1500-1480 RPM (RATED)	1480 RPM	2900 RPM (RATED)
CASING ORIENTATION	ACW-10	CW-2	CW-3
MOTOR RATING	55 KW	75 KW	22 KW
MOTOR FRAME SIZE	ND 250M	ND 280S	ND 180M
MOTOR MAKE	CROMPTON	CROMPTON	CROMPTON
BEARING	22217 EK/C3	22219 EK/C3	22215 EK/C3
BEARING MAKE	SKF	SKF	SKF
COUPLING	109Z – BIBBY RESILENT	110Z– BIBBY RESILENT	104Z– BIBBY RESILENT
PLUMMER BLOCK	SNH 517 TG	SNH 519 TG	SNH 515 TG
LOCATING RING	----	FRB 15/170	FRB 13/130
ADAPTER SLEEVE	H317	H319	H315
DOUBLE LIP SEAL	TSNA 517G	TSNA 519G	TSNA 515G
LUBRICATION	GREASE SERVOGEM EP-2	GREASE SERVOGEM EP-2	GREASE SERVOGEM EP-2

SUPPLIER'S ADDRESS:

M/s. CETHAR VESSELS LIMITED,
No. 4, DINDIGUL ROAD,
TRICHY - 620 001.

CONTENT



OPERATION AND **MAINTENANCE MANUAL**

FOR INDUSTRIAL FANS



CETHAR VESSELS LIMITED

4, DINDIGUL ROAD, TIRUCHIRAPALLI - 620 001. INDIA.

TEL : 91 - 431 – 2484000

FAX : 91 - 431 – 2481079

e-mail : engineering@cethar.com



FAN OPERATION AND MAINTENANCE MANUAL

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2.2	IMPELLER
2.3	SHAFT
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2.5	COUPLINGS
2.6	PULLEY & BELT ARRANGEMENT
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2.10	COOLING DISC
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1.0 DETAILS OF FAN

Centrifugal fans are being used to handle cold air / hot air / hot flue gas without abrasive dust. These fans are used as Forced Draught, Induced Draught, Primary Air as booster fan, seal air fan, ash / fuel conveying line fans and other various applications.

The air / gas enters the impeller auxiliary from the IGV / multi flap damper in the guided controlled way and passing through the blade passage leaves the impeller through the spiral casing. In the casing, the area increases gradually, so the part of the kinetic energy of fluid is converted into static pressure. The fan is controlled by IGV / multi flap dampers or by speed drive. The fan is driven by a motor / Turbine.



2.0 DESCRIPTION OF COMPONENTS

The fan consists of the following major parts.

2.1 CASING

The spiral casing assembly is a fabricated component. It is having opening in the front side of the casing (or split along the shaft axis) for installation / removal of the impeller. The casing consists of two stiffened side walls with a spiral scroll and it is supported at bottom or at side according to the construction. The single / double suction boxes are also fitted to side walls of the casing. The suction box helps in accelerating the flow to the impeller.

2.2 IMPELLER

Impeller is a welded structure, consists of back center plate, shroud plate and blades. The impeller is fitted to hub having the machined bore or it is bolted to flange which is welded to the shaft depending on its construction. The impeller assembly is dynamically balanced in the works and balancing weights are welded to counter unbalance, created during manufacturing. The handling of the impeller is very important since it is a critical part of the fan.

2.3 SHAFT

The shaft is turned from solid or fabricated from hollow and solid combination and it is supported between two bearings. The positions where hub and bearings are to be fitted are machined to close tolerances.

2.4 BEARINGS

Grease lubricated spherical roller bearings take charge of supporting the fan shaft.

These are bearings with cylindrical bore.



The bearing housing is split horizontally. The upper members are screwed to the lower members. Two asymmetrically arranged tensioning pins each will prevent incorrect assembly of the housing elements. Feet on the lower members of the housing serve for screw connection to the supporting structure.

The shaft passage ways on the bearing housings are provided with talcum soaked felt seals, which prevent penetration of dirt in to the inside of the housing.

Grease cups are arranged on the upper housing members for normal relubrication.

One floating bearing and one fixed bearing are located on each side of the fan shaft.

The spherical roller bearing on the floating bearing side will be installed into the bearing housing so as to under go axial displacements in the housing bore wherever a change is occurring in the length of the shaft.

On fixed bearing side, where axial forces have to be accommodated, the spherical roller bearing will be fixed in the housing by appropriate rings.

2.5 COUPLING

The fan shaft is connected to the motor through a coupling viz., spring grid or tyre - type coupling, which are generally used. In case where the rotor is very heavy the fan moment of inertia becomes huge, a hydraulic coupling, whose output speed can be varied steplessly by means of a scoop tube is used.



2.6 PULLEY & BELT ARRANGEMENT

The fan shaft is connected to motor shaft through pulley and belt arrangement to have lower / higher speed than motor.

2.7 PLUMMER BLOCK / MOTOR SUPPORT PEDESTAL

A shallow fabricated base of M.S. construction carries the bearing / shaft assembly and the driving motor. In case of impeller supported in between bearings, the non-located bearing is supported by a separate frame. The fan casing is supported independently and have provision for thermal expansion while handling hot air / gas.

2.8 IGV AND MULTIFLAP DAMPER

The damper assembly consists of a outer shell, damper flaps with individual shaft and bearings. The damper will be radial vane type or single flap butterfly type. The shafts are connected by levers and links to the actuator. In case of double inlet fans both the dampers are connected to a common shaft and operated using a single actuator.

2.9 SEALING

a. SHAFT SEALING

To avoid air leak at the shaft passageway, it is sealed using soft material viz., brass, gasket.

b. IMPELLER SUCTION SEALING

It is provided between impeller suction nozzle and casing suction cone.

2.10 COOLING DISC

To reduce the temperature rise in the bearing cooling disc is provided nearer to it.



3.0 STORAGE & INSTALLATION

3.1 STORAGE OF FAN

GENERAL

As soon as received, the different parts of the equipment should be placed in clean and dry covered premises.

LONG TERM STORAGE

Storage for a period of three years must be ensured in the best possible condition, basically protected from dampness so as to avoid oxidization of the different parts of the fan unit.

The mechanical parts with machined surfaces are coated with anti-corrosion varnish. In the case of prolonged storage, before putting into service, the equipment shall be inspected periodically and the machined parts shall be protected from time to time using a protective coating in case of need.

They will be stored in sufficiently large premises, thus providing space for inspection and easy maintenance of the equipment stored. Moreover, the storage premises will protect the equipment from sudden change in temperature, dust, foreign matter, etc.

The impeller and bearing assembly should be rotated at a very low r. p. m. (rotation by hand) for about thirty minutes, once a week.

STORAGE OF BEARINGS

As a general rule, the bearings are given a rust prevention treatment in the works before being packed. The can be preserved for several years, in their original packing, on a condition that the relative humidity in the storage premises is not over 60%. A higher degree of relative humidity, upto 75% is however permissible for short term storage.



TRANSPORT

The fans are despatched in dismantled condition with proper packing.

Handle all fan parts carefully during transport. Avoid damaging damper control unit and rotor by careless installation or by chains of lifting devices.

Pay particular attention to impeller, bearing housings and bearings. They should not be dropped on the floor or should not be mishandled.

INSPECTION

When packages are received at site, check all parts with the help of the packing list and drawing. If necessary, make a list of the missing parts (in case of shortage) and initiate action for replacement, insurance etc.

Check for any damage occurred to the parts during transit. In consultation with the manufacturer, take steps to repair the damages, if any.

3.2 ERECTION OF STATIC CASING PARTS

INSTALLATION PROCEDURE

PRELIMINARY ACTION

- a. Ensure that civil work is correct to drawing and that holding down bolt pockets are clean and positioned to accommodate fan casing assembly.
- b. Using an optional level or water level, transfer a 'bench mark' on to the plinth which will be used for setting the casing to the correct height above Ordnance Datum.



- c. Using a steel measure, mark into the plinth top surface, the longitudinal center line of the fan shaft and the transverse center line of the casing.
- d. Identify the correct casing and ensure that the inlet and outlet flanges have correct orientation.
- e. Clean the casing to expose the original, works, shaft and bearing centre line markings. These should be reinforced for clarity.
- f. The fan casing will be arranged such that a minimum number of pieces will need to be omitted to facilitate the installation or removal of the shaft / impeller / assembly for maintenance purposes.
- g. The items required to form the remainder or lower casing must be identified and moved to the work area. The inlet box(es) should be installed first, and where these are in close proximity to the plinths and access is limited, lagging should be applied prior to installation (where applicable).

INSTALLATION

The casing sections must be assembled in accordance with the general arrangement drawing and should be mounted on steel packers placed at each side of the holding down bolts. The correct flange jointing material must be used ensuring that gaps do not occur at junctions. The casing flange joint bolts should remain untightened to allow flexibility during leveling and further assembly.

Initial alignment of the casing must be carried out ensuring correct radial and axial location, with respect to fan-shaft and located bearing centre lines.

The casing assembly must not proceed further until the shaft / Impeller / Assembly and if applicable Inlet Guide Vane installation has been completed.



Secure the holding down bolts into the plinth in accordance with the set procedure. Where the procedure required bolts to be held in square pockets cast into a plinth by filling the pockets with a grouting mixture, the grout must completely fill the pocket and be trowelled level to facilitate the positioning of steel packers.

INSTALLATION (TOP HALF)

The final casing sections can now be installed and positional checks made. When final alignment is complete the casing joint securing bolts can be tightened.

Secure the suction cone to the inlet ducts and centralize to the rotor seal in accordance with the arrangement drawings, taking care to ensure that the expansion clearance has been set correctly.

Fit the casing-to-shaft seal in accordance with the appropriate drawing.

The holding down bolts can now be tightened down to required torque, making sure that adequate packing material has been placed at each side of the bolts.

INSPECTION

Final examination must be made to ensure that all flange bolts are securely tightened and that joint sealing is effective. The clearance between the suction cone and impeller seal must be checked and recorded.

The suction and discharge flanges must be inspected for correct orientation and position.

3.3 INSTALLATION OF BEARING

PRE-ASSEMBLY CHECKING

As the bearings are finished to high precision, thorough inspection and checking on the following points are essential prior to assembly.



- a. On opening the packing of bearings, the same shall be thoroughly checked for dirt or other foreign matter and if found, same shall be carefully washed off with petrol. The new bearings should not be washed unless and until it is necessary.
- b. The shaft shall be checked for damage due to transport and handling. Particularly the surfaces where the bearings are to be mounted should be checked for rusting, scoring etc. Rust, if found, should be removed by rust remover. Heavy pittings on bearing surfaces of shaft is not acceptable.

Localized scorings could be removed using oil stone.

If the shaft is found to have a bend, the same should not be used for assembly.

- c. Plummer blocks although made by precision matching to the given specifications, a thorough checking is essential to make sure against any defects in the bearing seating surfaces or dirt inclusion which can possibly result from handling, transportation etc. The flaw, if any, is to be carefully removed with the use of an oil stone or fine emery paper and the dirt to be thoroughly washed off and cleaned.
- d. Bearing to be mounted shall be taken out of the original protective packing only immediately before mounting.
- e. The mounting and dismounting tools and necessary jigs must be of proper dimension and simple design so that they do not cause any mechanical damage to the bearings.

Keep the rotor assembly on the floor by proper support.

GENERAL INSTRUCTIONS

- a. Never apply direct blows to the bearing. Always use a length of tubing or similar tool-otherwise the ring may crack, the cage may become damaged, or metal fragments may break off and cause damage when the bearing is put into operation.



- b. Small bearing may be mounted with the aid of a mounting dolly or a length of tubing. The tube should be clean and have no burrs.

Place the tool against the inner ring and apply blows, evenly distributed around its end face, with an ordinary hammer (hammers with head or other soft metal heads are unsuitable as fragments can easily break off and enter the bearing). Ensure that the bearing does not skew on the shaft.

- c. Never apply force to the outer ring when mounting a bearing on a shaft. The raceways and rolling elements can easily be damaged and the bearing life reduced considerably as a consequence.
- d. If the shaft has external or internal threads, they may be utilized when mounting the bearing.
- e. If a mechanical or hydraulic press is available, this can be used for mounting small and medium sized bearings. Use a mounting dolly or a clean piece of tubing between the press and the inner ring.
- f. Large bearings are easier to mount if they are first heated to a temperature of 80°C to 90°C above ambient temperature. However, the bearing should never be allowed to reach a temperature above +120°C. One method is to use an oil bath. The oil should be clean and have a flash point above +250°C. Clean a suitable receptacle and pour in sufficient oil to completely cover the bearing. The bearing should not be in direct contact with the base of the receptacle but should be placed on a suitable platform to avoid local heating. Heat the bath on an electric hot plate, gas flame, or similar equipment.

A bearing should never be heated using a naked flame.

- g. Put on clean protective gloves or use clean rags to hold the hot bearing drain off any oil which may be left in the outer ring and wipe the bearing bore push the bearing quickly into position.
- h. Press the bearing hard against the abutment face until it has cooled sufficiently so that the inner ring fits well to the shoulder.



MOUNTING OF BEARING

I. BEARING

- a) The inner ring of bearings is always mounted with an interference fit usually on shaft. The original radial internal clearance of the bearing is gradually reduced as the bearing is driven up. Thus reduction in clearance is a measure of the degree of interference.
- b) Before mounting, remove the rust inhibiting compound from the bearing bore only. Press the bearing on the shaft and screw on the lock nut. Drive the bearing up the sleeve by tightening the lock nut.
- c) Before spherical roller bearings are mounted on shaft, the radial internal clearance should be measured using a feeler gauge. Stand the bearing on the work bench and rotate the inner ring a few times to allow the rollers to assume their correct positions, before inserting the blade of the feeler gauge between the upper most roller and the outer ring raceway. Use a thin blade to start with and increase the thickness gradually until the blade can be just inserted. The measured clearance should be the same for both rows of rollers.
- d) Check the reduction in clearance frequently during the driving-up process. Measure between the lowest roller and the outer ring raceway. The adjacent table contains guideline values for the reduction in radial internal clearance and axial drive-up for spherical roller bearings. Heavy loads, high speeds, or large differences in temperature between inner and outer rings (inner ring hotter than outer) mean that a relatively large residual radial internal clearance is required. In such cases a bearing having larger initial radial internal clearance than normal, i.e, C3 or C4 is generally used and mounted using the maximum reduction clearance. If the outer ring is hotter than the inner, a bearing having less initial radial internal clearance than normal is generally used.
- e) Remove the lock nut after the drive-up has been completed and place the locking washer in position. Screw on the lock nut again and tighten it. Bend down a suitable tab of the locking washer so that it engages in one of the slots in the lock nut. Measure the residual clearance again to see that it is unchanged.



II. INTERFERENCE FIT IN THE HOUSING

- a) Lightly smear the bearing seating with oil use a mounting dolly or a clean piece of tubing, but place it against the outer ring race. Ensure that the bearing does not skew in the housing. A mechanical or hydraulic press may also be used as advantage. Otherwise the rules for mounting bearings with an interference fit on shafts are valid when the bearings is to have an interference fit in the housing.
- b) It may sometimes be necessary to heat the housing in order to mount the bearing. Normally, a small rise in temperature will be sufficient because the interference is rarely tight. An electric lamp, a heating tool, hot oil or a naked flame may be used to heat the housing. If a naked flame is used, great care must be exercised otherwise the housing may crack or disort.

Check the dimension of bearing seating after heating and do not forget to wipe the seating clean before mounting the bearing. Press the bearing hard against the abutment face until the housing has cooled sufficiently for the bearing to have an interference fit.

III. TEST RUNNING AND REPORT

It is during the very first period of operation after starting up that any mounting errors can be corrected. Keep a check on bearing behavior immediately after starting up.

If there is the slightest doubt as to bearing performance, the machine should be stopped and the bearing arrangement checked.

Mounting data, such as the date, the full designation of the bearing, results of dimensional checks, bearing radial internal clearance before and after mounting, the lubricant used, etc., should be noted in report form. A maintenance schedule should be attached to the report giving details of relubrication, inspection routines, operating temperature etc., if this is done, a good record of the bearing will be obtained and any future replacement can be planned well in advance.



3.4 ERECTION OF SHAFT AND IMPELLER ASSEMBLY

PRELIMINARY ACTION

- a) Check the centre line of casing, shaft axis and impeller axis.
- b) Position bearing pedestals and bolt with base frame.
- c) Check the levels, height and centre to centre of bearing pedestal.
- d) Identify the shaft and impeller ensuring that both bear the same works order number and that the impeller is of the correct handling.

NOTE: TOP SURFACE LEVEL OF BEARING PEDESTAL SHOULD BE CHECKED BY MASTER LEVEL. PERMISSIBLE DEVIATION IS 1 DIVISION OF MASTER LEVEL HAVING ACCURACY 0.02 MM / METER. THIS LEVEL SHOULD BE OBTAINED BY ADDING OR REMOVING STEEL PACKERS IN BETWEEN BASE FRAME AND FOUNDATION.

INSTALLATION

Ensure that sound access roads and hard standing are prepared, adequate to support the assembly, transporter and the mobile crane.

Assemble the bearings in shaft as per the “assembly procedure of plummer block and bearing”.

Before lifting into position it may be necessary to fit the suction cone into the impeller seal (on larger fans the suction cone should be fitted at works). This is achieved by placing the cone over the shaft end and moving it towards the impeller as far as the transport cradle will permit.

ALIGNMENT

To facilitate rotor alignment, the face of the shaft half coupling should be vertical. This is achieved by raising the outboard bearing until the shaft is level at the inboard bearing journal when measured with an engineer's spirit level.

Drop a plumb line set through the centre of the drive coupling to ensure that the shaft lies over the centre line of the base frame.



With a straight edge and steel measure, check the distance / square ness off the coupling face to the motor holding down bolt holes on both sides of the centre line. If correction of square ness is required this can be achieved by moving the outboard bearing.

When the foregoing checks have been completed and recorded, the outboard bearing must be positioned to obtain the correct axial expansion clearances.

INSPECTION

Complete the shaft location inspection record sheet.

3.5 ERECTION OF MOTOR / BEARING PEDESTAL ON FOUNDATION

PRELIMINARY ACTION

Ensure conformity with the civil arrangement drawing.

NOTE : Make sure that non-shrinkage type grout materials are used. Allow to dry long enough.

Check the holding down bolt pockets are in the correct position, of adequate depth and size to allow bolts to hang vertical and that no debris remains in the pockets.

The surface area where steel packers are placed must be sound and flat ensuring good contact between the matting surfaces.

INSTALLATION PROCEDURE

- a) Using a optical level or water level, transfer a 'bench-mark' on to the plinth which will be used for setting the pedestal to the correct height above ordnance Datum.
- b) Using a steel measure, mark into the plinth top surface, the longitudinal centre line of the fan shaft and the transverse centre line of the located bearing.



- c) Clean the pedestal to expose the original, works, shaft and bearing centre line markings. These should be reinforced for clarity,
- d) Insert the pedestal / holding down bolts into the respective pockets and lower the pedestal into position on adequate number of temporary packers placed beneath the pedestal for leveling.
- e) Fit the holding down bolts and nuts along with lock-nuts ensuring that sufficient thread protrudes to facilitate further adjustment (approx. 15 mm).
- f) Using a straight edge and steel measure adjust the pedestal to the correct height, and level to within ± 1.5 mm.
- g) Align the pedestal centre lines with the plinth centre lines using piano wire as a datum reference. When the inboard and outboard pedestal are separate components, further measurements must be made to ensure precise relative alignment and location.
- h) Secure the holding down bolts in accordance with the set procedure. Where the procedure required bolts to be held in square pockets cast into a plinth by filling the pocket with a grouting mixture, the grout must completely fill the pocket and be trowelled level to facilitate the positioning of steel packers.

FINAL LEVELING

Steel packers must be placed between the pedestal underside and the plinth surface to give adequate support. This is best achieved by placing on either side of the holding down bolts and also at any other point where load is being supported.

Tighten bolts to specified torque.

Using suitable optical or water level, check the height of each machined pad on the pedestal top surface. One pad, local to the located bearing, should be taken as the reference pad and the height of the remaining pads should be corrected by adjusting the thickness of the steel packer units satisfactory level state has been achieved.



BEARING PEDESTALS

The bearing support pedestals should be positioned on the pedestal, after final alignment inspection, in accordance with the appropriate drawing. All machined foot pads should be cleaned and lightly oiled and the grillage support pads wiped clean before positioning the pedestals.

INSPECTION

Final inspection must be recorded on the correct inspection sheet and witnessed by all the concerned personnel.

3.6 INSTALLATION OF MOTOR

PRELIMINARY ACTION

- a) Identify the correct motor ensuring that the bearings and cooling fan are arranged for the appropriate rotation.
- b) Remove protective coating from the motor feet and the drive coupling faces and lightly oil the machined surfaces.

ERECTION

- a) Lift the motor on to the base and position approximately.
- b) Where bearings of the sleeve or friction type are used, remove the bearing top halves, examine the bearings and remove any temporary restraints which have been fitted for transit.
- c) Where the bearings are of the non-located type, move the rotor axially to coincide with the marked magnetic running centre. Where no mark exists the manufacturer must be consulted.

ALIGNMENT

Alignment must be carried out in accordance with drive coupling assembly and alignment.



4.0 FAN OPERATION

4.1 GENERAL

The ready-to-operate condition of the fans is established only when the work and tests described under “MAINTENANCE” are completed and have been entered into protocols.

Fan operation comprises of the following phases :

- a) Check points prior to starting the fan.
- b) Starting the fan.
- c) Continuous operation of the fan.

The work to be performed under point 4.2 until start-up of the machines has to be done in a chronological order which is not interrupted. When interruption is absolutely necessary, the checks and tests have to be repeated.

The “CHECKS” under points 4.2, 4.3, 4.4, 4.5 & 4.6 have to be made and entered into protocols upon each and every start-up. Conformations to this effects have to be entered into the check list.

4.2 CHECK POINTS BEFORE TRIAL RUN

- 01. Check up the fixation of the bearing housings and electric motor.
- 02. Check up the coupling is correctly tightened.
- 03. Check up the fixation of the whole fan assembly on the base frame.
- 04. Check that the connecting flanges between the fan and ducting are good, and proper packing is provided.
- 05. Check that the different components of the control system are correctly connected.
- 06. Check that the inlet damper is fully closed.
- 07. Check that linkage between actuator and damper.
- 08. Check that no foreign object has been left anywhere inside the fan.
- 09. Check that no water stays in the bottom of the casing and inlet box.
- 10. Check the inspection door on the casing and inlet box are correctly shut.



11. Check that the rotor can turn freely without rubbing with any as it is noted in the individual document.
12. Check that the bearings have been correctly filled with oil as it is noted in the individual document.
13. If some time has elapsed between the erection and the start up of the fan, it is advisable to recheck the alignment to ensure that no settling of foundations has occurred sufficient to cause fouling. This may be checked by turning the impeller by hand or momentary operation of the fan motor starter.
14. If an auxiliary lubrication system is incorporated check that oil is being returned via the drains before starting the fan.
15. When the fan is being started up (after a shut down for inspection or maintenance) the casing and duct (if fitted) should be checked for the presence of loose tools, nuts or bolts which might cause damage to the fan.
16. Check proper clearances in the expansion joints at the entry and exit if the same is provided.
17. Ensure proper functioning of "Emergency off" switch.
18. Ensure the provision of all protections / interlocks for fan and motor.
19. Check proper earthing of motor body.

4.3 LUBRICATION

- | | | |
|----|---------------------------|----------------|
| a) | Check type of lubrication | Grease |
| b) | Check type of lubricant | Servogem – EP2 |

GREASE LUBRICATION

Fill the space between the balls or rollers with a grease which is suitable for the operating conditions. The free space around the bearing should normally be between a third and half – filled with grease if the bearing is to operate at very high speeds, the quantity of grease in the free space should be just less than one third or, where the bearing is to operate at very slow speeds, the free space may be completely filled with grease.

LUBRICATION INTERVAL

Normally six months, to be changed as and when required.



4.4 STARTING THE FAN

The fan shall be started with closed control unit in order to avoid over loading of the driving motor.

For safety reasons no persons should stay in the coupling and rotor zone during the start-up procedure.

The control unit shall be opened after operating speed has been reached. Operation with closed control unit should not be continued for too long a time, because the fan would then be heated to an excessive extent.

People responsible for the starting must always stay nearest as possible to the emergency stop switch.

During the acceleration phase, that there is no abnormal noise.

4.5 CHECK POINTS DURING TRIAL RUN

- a) Check bearing vibration level. The vibration levels indicated in below are in full accordance with the standard VDI 2056.

Velocity in mm/sec. (RMS)

Good	:	≤ 1.8
Satisfactory	:	≤ 4.5
Unsatisfactory	:	≤ 11.2
Alarm level	:	7.1
Trip level	:	11.2

- b) Check that the bearings temperature is good.

Normally, this temperature first raises and then decreases and stabilizes at particular temperature.

SET THE ALARM POINT AT 90°C.

SET THE TRIPPING POINT AT 100°C.

- c) Check up the noise of the bearing housings. This can be heard by applying an ear against the handle of a screw driver, the tip of which is applied against the bearing.



- d) If everything seems to be good, let the fan be running for five to six hours.
- e) After this trial, check that all nuts are correctly tightened.

4.6 CONTINUOUS OPERATION

- a) Fan running shall be steady and free from trouble. Steady running and noise produced by running shall carefully be observed during the initial operating hours.
- b) The bearing temperatures shall be supervised until constant temperature has been established after some hours.
- c) When unsteady running is observed or the bearing temperatures are rising permanently and exceed 90°C, the fan shall be shut down for finding and eliminating the cause.

4.7 SERVICE CHECK LIST

During continuous operation of the fan, the various operating data may be recorded at regular intervals of time. A typical format is suggested in this manual. Apart from these, the following shall be recorded at convenient timers.

- a) Vibration levels.
- b) Water flow.

4.8 STOPPING SEQUENCE

- a) Gradually decrease the load on the fan to minimum.
- b) Close the discharge damper and switch off the motor.
- c) Where a fan is handling hot gases it should not be allowed to come to rest with the shaft and impeller subjected to high gas temperature. When shutting down, the fan should be kept running until the gas temperature is below 120°C, or in the case where the hot gases have been isolated the impeller should be kept running until it has dissipated its heat and has a surface temperature not exceeding 120°C.



4.9. OPERATIONAL TROUBLES, REMEDIES

	TROUBLE	CAUSE	REPAIRS
4.9.1	High bearing temperature	Bearing damages (fatigue)	Replace bearing.
		Bearing clearance too small.	Install with correct clearance.
		Lubrication failure.	Add lubricant and check for leakage.
4.9.2	Unquiet running	Bearing clearance too large.	Check bearings. If required replace them (Check also motor bearing if required). Possibly measure sound conducted through solids.
		Mechanical rubbing	Check all gaps between stationary rotating parts.
		Unbalance due to deposits at rotor.	Remove deposits.
		Unbalance due to wear on blades.	Replace or repair the impeller and dynamically balance.
		Misalignment.	Check alignment realign.
4.9.3	Vibration	Deposit on Impeller	In most cases deposit will be heaviest on backs of blades. This must be removed and the impeller thoroughly cleaned with a wire brush.
		Misalignment of fan and driving unit.	Correct the alignment.
		Abrasion of Impeller.	Impeller wear may cause out of balance, even though wear is not sufficiently severe to justify replacement or repairs. Re-balance impeller in position.



	TROUBLE	CAUSE	REPAIRS
		Impeller damaged in transit or erection.	Rectify any obvious damage and re-balance impeller in position. If badly damaged return impeller to our works.
		Bent shaft.	Shaft should be replaced.
		Slack H.D. Bolts in bearings, base plates or pedestals.	Tighten all H.D. bolts and check alignment.
		Inferior concrete foundations or grouting.	Renew concrete or grouting with a stronger mixture of good quality material. Make sure plinth is feathered into concrete floor or supporting steel work.
		Weak structural	Reinforce supporting structure with additional members, suitably tied to existing members. Experience has proved that bolted structures are less satisfactory than riveted. If structure is bolted, holes should be reamed and fitted bolts with locking washer used.

NOTE : The recommended maximum “out of balance” running, measured as an R.M.S. velocity at the fan shaft bearings, is 5.5 mm/sec. It is recommended that the fan is tripped and steps taken to improve the condition if the “out of balance” reaches 10 mm/sec.



4.10 MAINTENANCE OF THE FANS

BETWEEN PLANNED SHUT DOWNS

Every 8 operating hours Routine recording in accordance with check sheets.

See also point "Check during operation".

Every 2000 operating hours or at least once in every six months :

Check the impeller erosion.

Check and dampers condition.

Retighten all fixing bolts.

Check the balancing weights condition in impeller and shaft.

Every 4000 operating hours or at least once in a year.

Check the lube oil system, service it and change the oil as recommended.

Check the wear in the impeller, if excessive wear is noticed change the impeller in consultation with manufacturer.

Check for freeness of expansion joints at suction and delivery.

DURING PLANNED SHUT DOWNS

It is recommended to effect overhauls every 8000 to 10000 operating hours (at least once in two years). It is also suggested to get the assistance of the manufacturer to carry out such overhauls.

Check the impeller for soot deposition and wear. Clean the impeller.

If erosion is found excessive, change the impeller in consultation with manufacturer.

Check wear on fan casing, stiffening pipes, rods etc.

Check the condition of damper flaps. Repair in case of small dampers and replace, if required.



MAINTENANCE AND LUBRICATION OF BEARING

Rolling bearings must be lubricated to prevent inter-metallic contact between in rolling elements, raceways and cage and also to protect the bearing against corrosion and wear.

Rolling bearings may be lubricated with grease or oil lubricant properties deteriorate with time as a result of mechanical working and edging. Additionally, all lubricants become contaminated in service and must therefore be replenished or changed from time to time.

RELUBRICATION INTERVAL

The period during which a grease lubricated bearing will function satisfactorily without relubrication is dependent on the bearing type, size, speed, operating temperature and the grease used. The relubrication intervals (hours of operation) is based on the use of an age-resistant average quality grease and is valid for bearing temperatures of +70°C measured on the outer ring. The intervals should be halved for every 15°C increase above +70°C, but the maximum permissible operating temperature for the grease should obviously not be exceeded.

The amount of grease needed for relubrication can be obtained from $G = 0.005 DB$

Where,

G = Grease quantity, g

D = Bearing outside diameter, mm

B = Total bearing width, mm

CHECKING NOISE LEVEL

a) Grinding Noise :

Inadequate lubrication (surface rubbing directly against one another).

b) Whistling:

Improper lubrication (grade or quantity).



c) Clear noise at regular intervals :

Imprints in race of outer ring because of abnormal vibration.

d) Intermittent noise :

Rolling part deteriorated or damaged.

e) Cracking Noise :

Presence of foreign particles.

f) Whinning or high pitch Noise :

Axial thrust from motor.

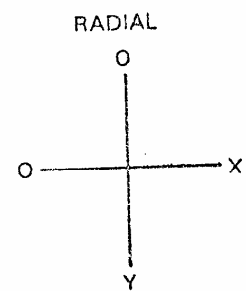
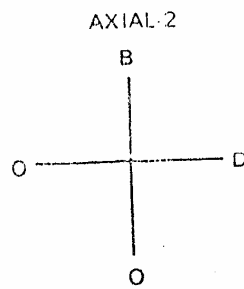
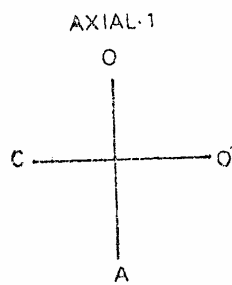
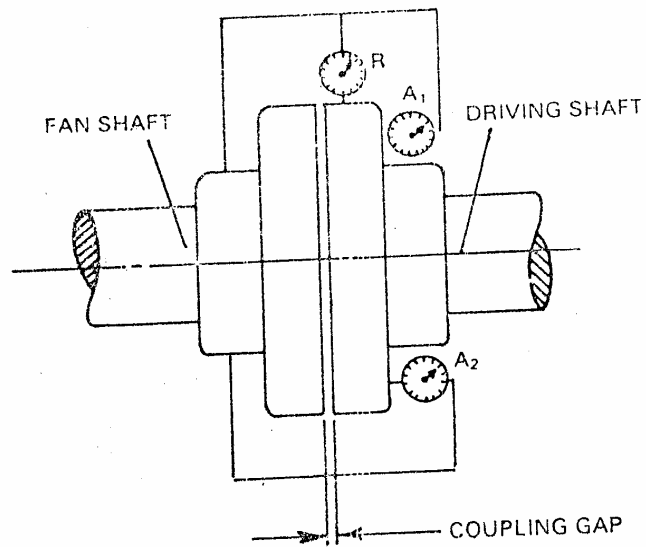


5.1 BEARING CLEARANCE RADIAL & EXPANSION

Bearing bore diameter d		Reduction in radial internal clearance		Axial drive - up				Min. permissible residual clearance other mounting bearings with initial clearance		
				Taper 1 : 12 on diameter		Taper 1 : 30 on diameter				
Over	incl.	Min.	Max.	Min.	Max.	Min.	Max.	Normal	C3	C4
MM		MM		MM		MM		MM		
30	40	0.020	0.025	0.35	0.40	----	----	0.015	0.025	0.040
40	50	0.025	0.030	0.40	0.45	----	----	0.020	0.030	0.050
50	65	0.030	0.040	0.45	0.60	----	----	0.025	0.035	0.055
65	80	0.040	0.050	0.60	0.75	----	----	0.025	0.040	0.070
80	100	0.045	0.060	0.70	0.90	1.75	2.25	0.035	0.050	0.080
100	120	0.050	0.070	0.75	1.10	1.90	2.75	0.050	0.065	0.100
120	140	0.065	0.090	1.10	1.40	2.75	3.50	0.555	0.080	0.110
140	160	0.075	0.100	1.20	1.60	3.00	4.00	0.055	0.090	0.130
160	180	0.080	0.110	1.30	1.70	3.25	4.25	0.060	0.100	0.150
180	200	0.090	0.130	1.40	2.00	3.50	5.00	0.070	0.100	0.160
200	225	0.100	0.140	1.60	2.20	4.00	5.50	0.080	0.120	0.180
225	250	0.110	0.150	1.70	2.40	4.25	6.00	0.090	0.130	0.200
250	280	0.120	0.170	1.90	2.70	4.75	6.75	0.100	0.140	0.220
280	315	0.130	0.190	2.00	3.00	5.00	7.50	0.110	0.150	0.240
315	355	0.150	0.210	2.40	3.30	6.00	8.25	0.120	0.170	0.260
355	400	0.170	0.230	2.60	3.60	6.50	9.00	0.130	0.190	0.290
400	450	0.200	0.260	3.10	4.00	7.75	10.00	0.130	0.200	0.310
450	500	0.210	0.280	3.30	4.40	8.25	11.00	0.160	0.230	0.350
500	560	0.240	0.320	3.70	5.00	9.25	12.50	0.170	0.250	0.360
560	630	0.260	0.350	4.00	5.40	10.00	13.50	0.200	0.290	0.410
630	710	0.300	0.400	4.60	6.20	11.50	15.50	0.210	0.310	0.450
710	800	0.340	0.450	5.30	7.00	13.30	17.50	0.230	0.350	0.510
800	900	0.370	0.500	5.70	7.80	14.30	19.50	0.270	0.390	0.570
800	1000	0.410	0.550	6.30	8.50	15.80	21.00	0.300	0.430	0.640
1000	1120	0.450	0.600	6.80	9.00	17.00	23.00	0.320	0.480	0.700
1120	1250	0.490	0.650	7.40	9.80	18.50	25.00	0.340	0.540	0.770



COUPLING ALIGNMENT



AXIAL

$$\frac{A - B}{2} \leq 0.05 \text{ mm}$$

$$\frac{C - D}{2} \leq 0.05 \text{ mm}$$

RADIAL

$$X \text{ AND } Y \leq 0.05 \text{ mm}$$



COUPLING ALIGNMENT RECORD

DATE

CLIENT

SITE

FAN DETAIL

W/O No.

Ser No.

AXIAL ALIGNMENT

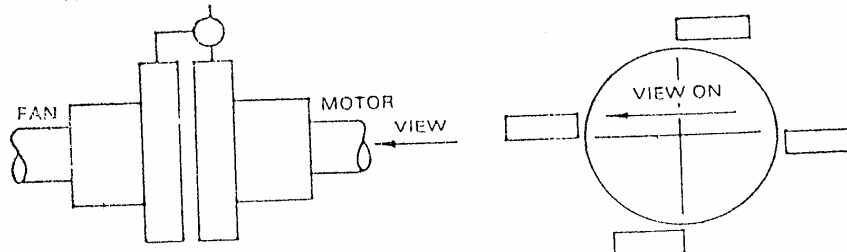
0°	
90°	
180°	
270°	
AVE	

0°	
90°	
180°	
270°	
AVE	

0°	
90°	
180°	
270°	
AVE	

Coupling Halves Rotated Together Readings Taken At 90° Intervals
Average Reading Taken As Final Result

RADIAL ALIGNMENT



Coupling Halves Rotated Together. Reading By Dial Indicator

NOTE :
ALL H/D BOLTS TO BE
FLOTTED TIGHT PRIOR
TO INSPECTION

Checked By

Witnessed By



5.3 SHAFT AND BEARING ALIGNMENT

The arrangement is as follows :

- a) Located or thrust bearing showing equal clearance on each side of bearing bush.
- b) Motor shaft on true running centre.
- c) Coupling.
- d) Expansion clearance on non-located bearing.
- e) Clock gauge fixed to fan half coupling.

Procedure for checking coupling alignment :

- a) Take face and peripheral readings on motor half coupling by rotating both an and motor shaft.
- b) The alignment is correct when the readings taken fall within the following figures.
- c) Coupling faces parallel to 0.001.
- d) When the two shafts are rotated, the deflection to the clock gauge should not be greater than 0.002.



5.4

VIBRATION AMPLITUDE

(PEAK – PEAK IN MICRONS)

I.

	H	V	A	
FIXED BEARING				LOAD :
FREE BEARING				
MOTOR COUPLING END BEARING				
MOTOR FREE END BEARING				

II.

	H	V	A	
FIXED BEARING				LOAD :
FREE BEARING				
MOTOR COUPLING END BEARING				
MOTOR FREE END BEARING				

III.

	H	V	A	
FIXED BEARING				LOAD :
FREE BEARING				
MOTOR COUPLING END BEARING				
MOTOR FREE END BEARING				

CHECKED BY :



5.5 TRIAL RUNNING DETAILS

TRIAL RUNNING DATA

OPERATION		REMARKS & MEASURED VALUES
-----------	--	------------------------------

a) ASSEMBLY CHECK LIST

- Tightening of grouting bolts :

b) STATIC PARTS

- Positioning of the shaped inlet :

- Tightening of fixing bolts on the ducts :

- Tightening of the fixing bolts on static parts :

- Closing of the inspection door :

ROTOR

- Shaft alignment :

- Tightening of fixing bolts Impeller / shaft :

- Expansion clearance on the free bearing :

- Alignment of the coupling :

CHECK UP BEFORE STARTING UP LUBRICATION

- Bearings lubrication :



UTILITIES

- Connection to the electric circuit :
- Connection to the control system :

DRIVES

- Rotation of the motor :

CHECK UP DURING RUNNING

- Abnormal noise :
- Vibration level during the acceleration phase :
- Free bearing :
- Fixed bearing :
- After 2 – 3 hours :
- Free bearing :
- Fixed bearing :
- Vibration level after stabilization of the bearing temperature :
- Free bearing :
- Fixed bearing :



CHECK SHEET

OPERATIONAL PARAMETER

Ambient Temp : _____ °C Starting time : _____ Sec. Started at : _____ hrs

Medium Temp : _____ °C Deceleration time : _____ min. Stopped at : _____ hrs

No-Load current : _____ Amp.

Sl. No.	Time	Ambient Temp.	Fan bearing temperature °C		Motor bearing temperature °C		Motor		% Load
	Hour	°C	Free brg.	Fixed brg.	Driving End	Non-Driving End	Current Amps	Voltage Volts	
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
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21									
22									
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24									
25									
26									
27									
28									
29									
30									

Checked by :

Date :

Fan :

Site :

DATA SHEET		
FEED PUMP		
DESCRIPTION	SPECIFICATION	
GENERAL DATA:		
MAKE	M/S. GRUNDFOS PUMPS INDIA PVT. LTD.	
QUANTITY	2 NOS	
MODEL NO	CR 20-17	
	RATED	RESULTED
FLOW	21 m ³ /hr	19 m ³ /hr
HEAD	203 Mwc	215 Mwc
TEMPERATURE	105°C	
SPEED OF THE PUMP	2934 RPM	
TYPE OF SHAFT SEAL	HQQE	
SHUT OFF HEAD	255 MWC	
METHOD OF STARTING	DOL / STAR DELTA	
MATERIAL OF CONSTRUCTION		
PUMP HOUSING	CAST IRON EN-JL1030 DIN W-Nr A48-30-B ASTM	
IMPELLER	STAINLESS STEEL 1.4301 DIN W-Nr 304 AISI	
INSTALLATION		
MAX. AMBIENT TEMPERATURE	50 DEG C	
MAX. PRESSURE AT STATED TEMP.	25 / 120 BAR / DEG C	
STANDARD PIPE CONNECTION	DIN	
SIZE, PIPE CONNECTION	DN50	
MATERIAL CLASS	F	
PRESSURE STAGE, PIPE CONN.	PN 25	
FLANGE SIZE OF MOTOR	FF300	
LIQUID TEMPERATURE RANGE	-20 TO 120 DEG C	

DATA SHEET	
FEED PUMP	
DESCRIPTION	SPECIFICATION
ELECTRIC MOTOR	
MOTOR TYPE	160L
EFFICIENCY CLASS	1
NUMBER OF POLES	2
MOTOR CAPACITY	18.5 KW
MAINS FREQUENCY	50 HZ
RATED VOLTAGE	3 X 380 - 415 D / 660 - 690 Y V
RATED CURRENT	31.5 / 18.4 AMPS
STARTING CURRENT	700%
COS PHI-POWER FACTOR	0, 92
RATED SPEED	2940 RPM
ENCLOURE CLASS (IEC 34-5)	IP 55
INSULATION CLASS (IEC 85)	F

SUPPLIER'S ADDRESS:

**M/s. GRUNDFOS PUMPS INDIA PVT. LTD,
NO. 118, OLD MAHABALIPURAM ROAD,
OKKIAM THORAIPAKKAM,
CHENNAI - 600 096.**

CONTENT

CR, CRI, CRN

Installation and Operating Instructions



Declaration of Conformity

We **Grundfos** declare under our sole responsibility that the products **CR**, **CRI** and **CRN**, to which this declaration relates, are in conformity with the Council Directives on the approximation of the laws of the EC Member States relating to :

- **Machiner (98/37/EC).**
Standard used : EN ISO 12100
- **Electromagnetic compatibility (89/336/EEC).**
Standards used : EN 61 000-6-2 and EN 61 000-6-3.
- **Electrical equipment designed for use within certain voltage limits (73/23/EEC) [95].**
Standards used : EN 60 335-1 and EN 60 335-2-51

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Before beginning installation procedures, these installation and operating instructions should be studied carefully. The installation and operation should also be in accordance with local regulations and accepted codes of good practice.

1. Handling



The motors of the CR, CRI, CRN 1s, 3, 5, 10, 15 and 20 pumps are supplied with lifting eyes which must not be used for lifting the entire pump.

When the entire pump is to be lifted, observe the following :

- CR, CRI, CRN 1s, 1, 3, 5, 10, 15 and 20 pumps fitted with Grundfos MG motors should be lifted in the pump head by means of straps or the like.
- CR, CRN 32, 45, 64 and 90 fitted with Grundfos MG motors up to and including 11 kW should be lifted by means of the eye nut fitted to the pump head.
- CR, CRN 32, 45, 64 and 90 fitted with Siemens motors of 15 kW and up should be lifted by means of the eye bolts fitted to the motor flange.
- For other motor makes than those mentioned above, it is recommended to lift the pump in the pump head by means of straps.

2. Type of designation

2.1 Pump key for CR, CRI, CRN 1s, 1, 3, 5, 10, 15 and 20

Example	CR 3- 10 X - X - X - X - XXXX
Pump range: CR, CRI, CRN	
Nominal flow rate in m ³ /h	
Number of impellers	
Code for pump version	
Code for pipework connection	
Code for materials	
Code for rubber pump parts	
Code for shaft seal	

2.2 Pump key for CR, CRN 32, 45, 64 and 90

Example	CR 32 - 2-1 - X - X - X - X - XXXX
Pump range: CR, CRN	
Nominal flow rate in m ³ /h	
Number of stages	
Number of impellers with reduced diameter	
Code for pump version	
Code for pipework connection	
Code for materials	
Code for rubber pump parts	
Code for shaft seal	

3. Applications

Grundfos multistage in-line centrifugal pumps, types CR, CRI and CRN, are designed for a wide range of applications.

Pumped liquids

Thin, non-explosive liquids, not containing solid particles or fibres. The liquid must not attack the pump materials chemically.

When pumping liquids with a density and/or viscosity higher than that of water, motors with correspondingly higher outputs must be used, if required.

CR, CRI, CRN

For liquid transfer, circulation and pressure boosting of cold or hot clean liquids.

CRN

In systems where all parts in contact with the liquid must be made of high-grade stainless steel, CRN pumps must be used.

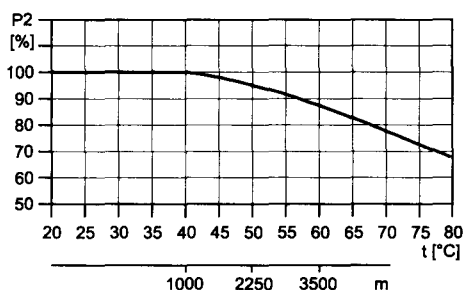
4. Technical data

4.1 Ambient temperature

Maximum +40°C.

If the ambient temperature exceeds +40°C. or if the motor is located 1000 metres above sea level, the motor output (P2) must be reduced due to the low density and consequently low cooling effect of the air. In such cases, it may be necessary to use a motor with a higher rated output.

Fig. 1



Example:

Figure 1 shows that P2 must be reduced to 88% when the pump is installed 3500 metres above sea level. At an ambient temperature of 70°C, P2 must be reduced to 78% of the rated output.

4.2 Liquid temperature

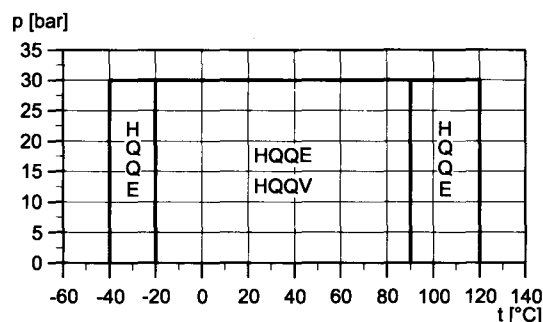
See page 6 which indicates the relationship between liquid temperature and maximum permissible operating pressure.

Note: The maximum permissible operating pressure and liquid temperature ranges apply to the pump only.

4.3 Maximum permissible operating pressure and liquid temperature for the shaft seal

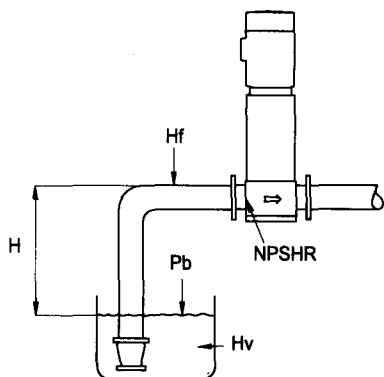
Fig. 2

CR, CRI, CRN 1s to 20 and CR, CRN 32 to 90



4.4 Minimum inlet pressure

Fig. 3



The maximum suction lift "H" in metres head can be calculated as follows:

$$H = pb \times 10.2 - NPSHR - H_f - H_v - H_s$$

pb = Barometric pressure in bar.
(Barometric pressure can be set to 1 bar.)
In closed systems, pb indicates the system pressure in bar.

NPSHR = Net Positive Suction Head in metres head (to be read from the NPSHR curve on page 7 at the highest flow the pump will be delivering).

Hf = Friction loss in suction pipe in metres head at the highest flow the pump will be delivering.

Hv = Vapour pressure in metres head, see fig. E on page 152. tm = Liquid temperature.

Hs = Safety margin = minimum 0.5 metres head.

If the calculated "H" is positive, the pump can operate at a suction lift of maximum "H" metres head.

If the calculated "H" is negative, an inlet pressure of minimum "H" metres head is required. There must be a pressure equal to the calculated "H" during operation.

Example:

pb = 1 bar.

Pump type: CR 15, 50 Hz.

Flow rate: 15 m³/h.

NPSHR (from page 7 & 8) : 1.1 metres head.

Hf = 3.0 metres head.

Liquid temperature: +60°C.

Hv (page 11): 2.1 metres head.

H = pb x 10.2 - NPSHR - Hf - Hv - Hs [metres head].

H = 1 x 10.2 - 1.1 - 3.0 - 2.1 - 0.5 = **2.7 metres head**

This means that the pump can operate at a suction lift of maximum 2.7 metres head.

Pressure calculated in bar: 2.7 x 0.0981 = 0.265 bar.

Pressure calculated in kPa: 2.7 x 9.81 = 26.5 kPa.

4.5 Maximum inlet pressure

See page 9, shows the maximum permissible inlet pressure.

However, the actual inlet pressure + pressure when the pump is running against a closed valve must always be lower than the "maximum permissible operating pressure"

The pumps are pressure-tested at a pressure of 1.5 times the value stated in page 9.

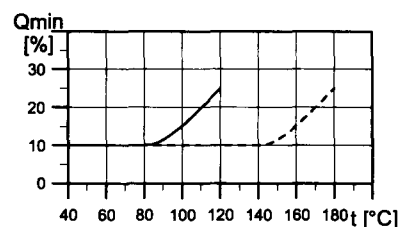
4.6 Minimum flow rate

Due to the risk of overheating, the pump should **not** be used at flows below the minimum flow rate.

The curve below shows the minimum flow rate as a percentage of the nominal flow rate in relation to the liquid temperature.

----- = air-cooled top.

Fig. 4



Note:

The pump must never operate against a closed discharge valve.

4.7 Electrical data

See motor nameplate.

4.8 Frequency of starts and stops

Motors up to and including 4 kW: Maximum 200 times per hour.

Motors of 5.5 kW and up: Maximum 100 times per hour.

4.9 Dimensions

See page 10 for Dimensions

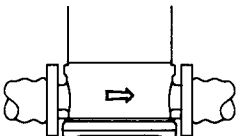
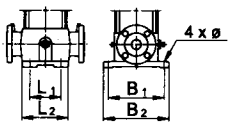
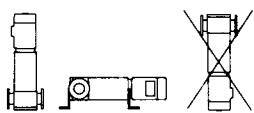
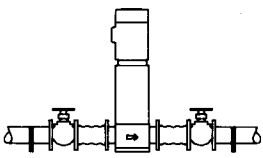
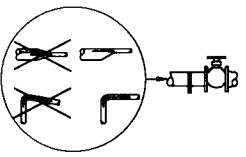
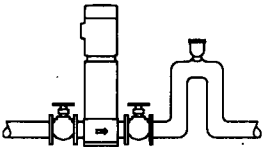
4.10 Sound level

See page 11

5. Installation

The pump must be secured to a solid foundation by bolts through the holes in the flange or base plate.

When installing the pump, follow the procedure below in order to avoid damaging the pump.

Step	Action
1	 <p>Arrows on the pump base show the direction of flow of liquid through the pump.</p>
2	 <p>Page 10 shows:</p> <ul style="list-style-type: none">• port-to-port lengths,• dimensions of the base,• pipework connections and• diameter and position of foundation bolts.
3	 <p>The pump can be installed vertically or horizontally. Ensure that an adequate supply of cool air reaches the motor cooling fan. However, the motor must never fall below the horizontal plane.</p>
4	 <p>To minimize possible noise from the pump, it is advisable to fit expansion joints either side of the pump and anti-vibration mountings between foundation and pump. Isolating valves should be fitted either side of the pump to avoid draining the system if the pump needs to be cleaned, repaired or replaced.</p> <p>The pump must always be protected against backflow by means of a non-return valve (foot valve).</p>
5	 <p>Install the pipes so that air locks are avoided, especially on the suction side of the pump.</p>
6	 <p>In the case of installations in which:</p> <ul style="list-style-type: none">• the discharge pipe slopes downwards away from the pump,• there is a risk of siphon effect,• protection against backflow of unclean liquids is necessary, <p>a vacuum valve must be fitted close to the pump.</p>

6. Electrical connection

The electrical connection should be carried out by an authorized electrician in accordance with local regulations.



Before removing the terminal box cover and before any removal/dismantling of the pump, make sure that the electricity supply has been switched off.

The pump must be connected to an external mains switch with a minimum contact gap of 3 mm in all poles.

The operating voltage and frequency are marked on the motor nameplate. Make sure that the motor is suitable for the electricity supply on which it will be used.

Single-phase Grundfos motors incorporate a thermal switch and require no additional motor protection.

Three-phase motors must be connected to a motor starter.

The terminal box can be turned to four positions, in 90° steps:

1. If necessary, remove the coupling guards. Do not remove the coupling.
2. Remove the bolts securing the motor to the pump.
3. Turn the motor to the required position.
4. Replace and tighten the bolts.
5. Replace the coupling guards.

The electrical connection should be carried out as shown in the diagram inside the terminal box cover.

6.1 Frequency converter operation

Motors supplied by Grundfos:

All three-phase motors supplied by Grundfos can be connected to a frequency converter.

Dependent on the frequency converter type, this may cause increased acoustic noise from the motor. Furthermore, it may cause the motor to be exposed to detrimental voltage peaks.

Note: Grundfos motors types MG 71 and MG 80 as well as MG90 (1.5 kW, 2-pole), all for supply voltages up to and including 440 V (see motor nameplate), must be protected against voltage peaks higher than 650 V (peak value) between the supply terminals.

It is recommended to protect all other motors against voltage peaks higher than 850 V.

The above disturbances, i.e. both increased acoustic noise and detrimental voltage peaks, can be eliminated by fitting an LC filter between the frequency converter and the motor.

For further information, please contact the frequency converter or motor supplier.

Other motor makes than those supplied by Grundfos:

Please contact Grundfos or the motor manufacturer.

7. Start-up Note:



Do not start the pump until it has been filled with liquid and vented. If the pump runs dry, the pump bearings and the shaft seal may be damaged.

Pay attention to the direction of the vent hole and take care to ensure that the escaping water does not cause injury to persons or damage to the motor or other components.

In hot-water installations, special attention should be paid to the risk of injury caused by scalding hot water.

Follow the instructions on page 12

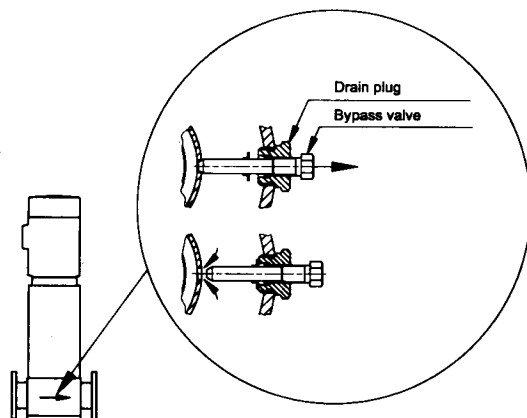
CR, CRI, CRN 1s to 5:

For these pumps, it is advisable to open the bypass valve during start-up. The bypass valve connects the suction and discharge sides of the pump, thus making the filling procedure easier. When the operation is stable, the bypass valve can be closed.

When pumping liquids containing air, it is advisable to leave the bypass valve open if the operating pressure is lower than 6 bar.

If the operating pressure constantly exceeds 6 bar, the bypass valve must be closed. Otherwise the material at the opening will be worn because of the high liquid velocity.

Fig. 5



8. Maintenance



Before starting work on the pump, make sure that all power supplies to the pump have been switched off and that they cannot be accidentally switched on.

Pump bearings and shaft seal are maintenance-free.

Motor bearings:

Motors which are not fitted with grease nipples are maintenance-free.

Motors fitted with grease nipples should be lubricated with a high-temperature lithium-based grease, see the instructions on the fan cover.

In the case of seasonal operation (motor is idle for more than 6 months of the year), it is recommended to grease the motor when the pump is taken out of operation.

9. Frost protection

Pumps which are not being used during periods of frost should be drained to avoid damage.

Drain the pump by loosening the vent screw in the pump head and by removing the drain plug from the base.



Care must be taken to ensure that the escaping water does not cause injury to persons or damage to the motor or other components.

In hot-water installations, special attention should be paid to the risk of injury caused by scalding hot water.

Do not tighten the vent screw and replace the drain plug until the pump is to be used again.

CR, CRI, CRN 1s to 5:

Before replacing the drain plug in the base, screw the bypass valve out against the stop, see fig. 5.

Fit the drain plug by tightening the large union nut followed by the bypass valve.

10. Service

Note: If a pump has been used for a liquid which is injurious to health or toxic, the pump will be classified as contaminated.

If Grundfos is requested to service the pump, Grundfos must be contacted with details about the pumped liquid, etc. before the pump is returned for service. Otherwise Grundfos can refuse to accept the pump for service.

Possible costs of returning the pump are paid by the customer.

However, any application for service (no matter to whom it may be made) must include details about the pumped liquid if the pump has been used for liquids which are injurious to health or toxic.

10.1 Service kits

Service kits for CR, CRI and CRN, see www.grundfos.com (WebCAPS), WinCAPS or Service Kit Catalogue.

11. Fault finding chart



Before removing the terminal box cover and before any removal/dismantling of the pump, make sure that the electricity supply has been switched off and that it cannot be accidentally switched on.

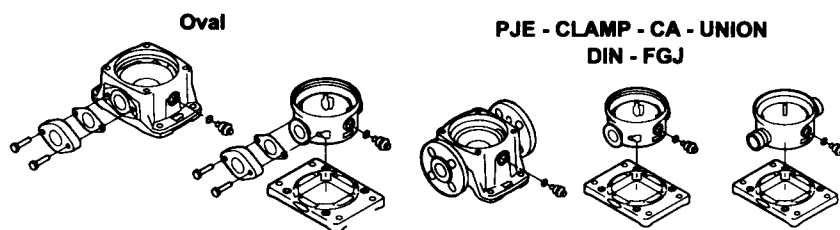
Fault	Cause	Remedy
1. Motor does not run when started.	a) Supply failure	Connect the electricity supply.
	b) Fuses are blown.	Replace fuses.
	c) Motor starter overload has tripped out.	Reactivate the motor protection.
	d) Thermal protection has tripped out.	Reactivate the thermal protection.
	e) Main contacts in motor starter are not making contact or the coil is faulty.	Replace contacts or magnetic coil.
	f) Control circuit is defective.	Repair the control circuit.
	g) Motor is defective.	Replace the motor.
2. Motor starter overload trips out immediately when supply is switched on.	a) One fuse/automatic circuit breaker is blown.	Cut in the fuse.
	b) Contacts in motor starter overload are faulty.	Replace motor starter contacts.
	c) Cable connection is loose or faulty.	Fasten or replace the cable connection
	d) Motor winding is defective.	Replace the motor.
	e) Pump mechanically blocked.	Remove the mechanical blocking of the pump.
	f) Overload setting is too low.	Set the motor starter correctly.
3. Motor starter overload trips out occasionally.	a) Overload setting is too low.	Set the motor starter correctly.
	b) Low voltage at peak times.	Check the electricity supply.
4. Motor starter has not tripped out but the pump does not run.	a) Check 1 a), b), d), e) and f).	
5. Pump capacity not constant.	a) Pump inlet pressure is too low (cavitation).	Check the suction conditions.
	b) Suction pipe/pump partly blocked by impurities.	Clean the pump or suction pipe.
	c) Pump draws in air.	Check the suction conditions.
6. Pump runs but gives no water.	a) Suction pipe/pump blocked by impurities.	Clean the pump or suction pipe.
	b) Foot or non-return valve blocked in closed position.	Repair the foot or non-return valve.
	c) Leakage in suction pipe.	Repair the suction pipe.
	d) Air in suction pipe or pump.	Check the suction conditions.
	e) Motor rotates in the wrong direction.	Change the direction of rotation of the motor.
7. Pump runs backwards when switched off.	a) Leakage in suction pipe.	Repair the suction pipe.
	b) Foot or non-return valve is defective.	Repair the foot or non-return valve.
8. Leakage in shaft seal.	a) Shaft seal is defective.	Replace the shaft seal.
9. Noise.	a) Cavitation occurs in the pump.	Check the suction conditions.
	b) Pump does not rotate freely (frictional resistance) because of incorrect pump shaft position.	Adjust the pump shaft.
	c) Frequency converter operation.	See section 6.1 Frequency converter operation.

12. Disposal

Disposal of this product or parts of it must be carried out according to the following guidelines:

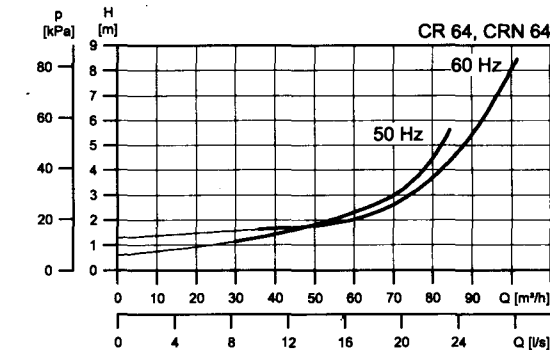
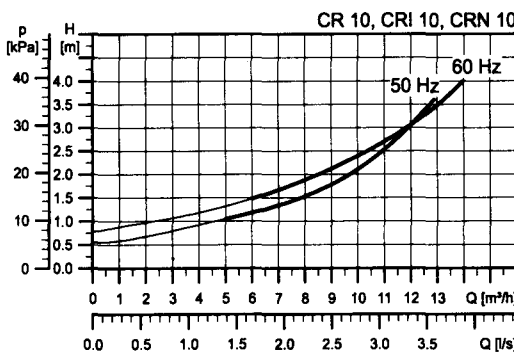
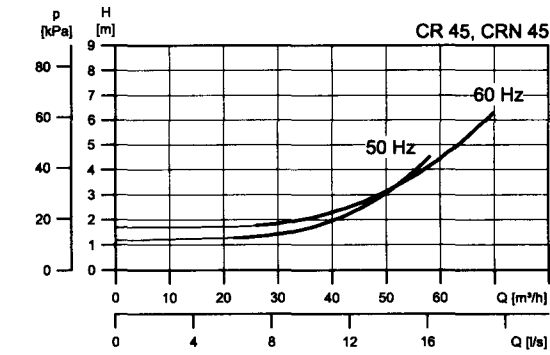
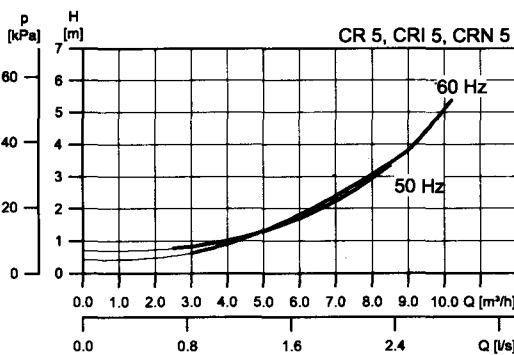
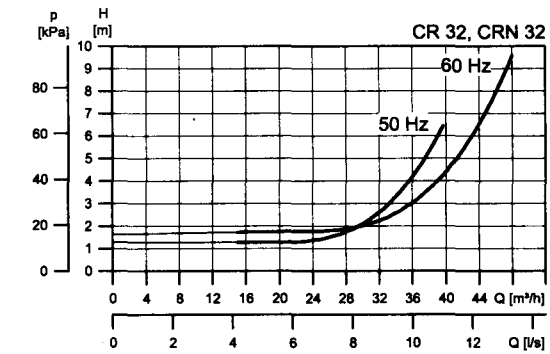
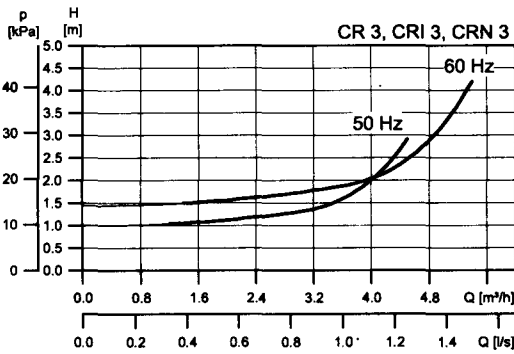
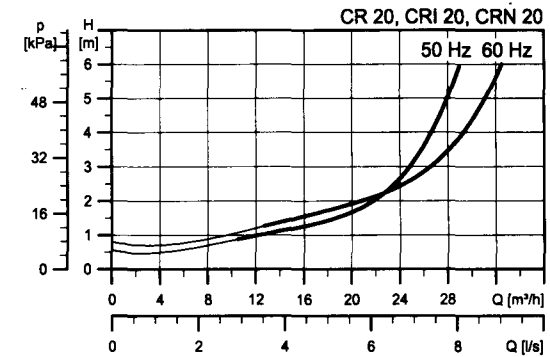
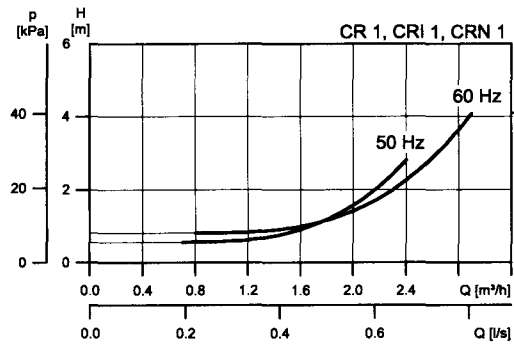
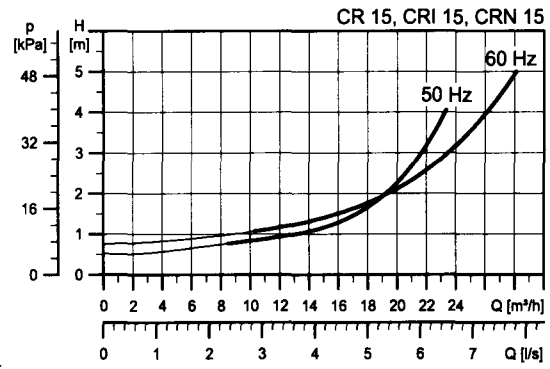
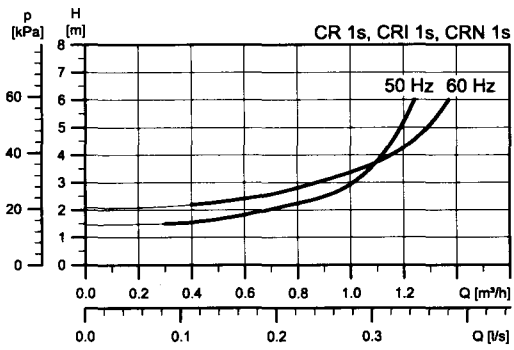
1. Use the local public or private waste collection service.
2. In case such waste collection service does not exist or cannot handle the materials used in the product, please deliver the product or any hazardous materials from it to your nearest Grundfos company or service workshop.

Liquid temperature range and maximum permissible operating pressure :

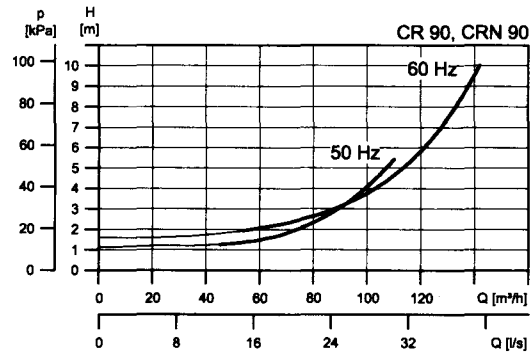


		Operating pressure	Liquid temperature range	Operating pressure	Liquid temperature range
50 Hz	CR, CRI, CRN 1S	16 bar	−20°C to +120°C	25 bar	−20°C to +120°C
	CR, CRI, CRN 1	16 bar	−20°C to +120°C	25 bar	−20°C to +120°C
	CR, CRI, CRN 3	16 bar	−20°C to +120°C	25 bar	−20°C to +120°C
	CR, CRI, CRN 5	16 bar	−20°C to +120°C	25 bar	−20°C to +120°C
	CR, CRI, CRN 10-1 → CR, CRI, CRN 10-16	16 bar	−20°C to +120°C		
	CR, CRI, CRN 10-1 → CR, CRI, CRN 10-22			25 bar	−20°C to +120°C
	CR 15 -1 → CR 15-7	10 bar	−20°C to +120°C		
	CRI, CRN 15 -1 → CRI, CRN 15-10	16 bar	−20°C to +120°C		
	CR 15 -1 → CR 15-17			25 bar	−20°C to +120°C
	CR, CRN 20 -1 → CRI, CRN 20-7	10 bar	−20°C to +120°C		
	CR, CRI, CRN 20 -1 → CR, CRI, CRN 20-10	16 bar	−20°C to +120°C		
	CR, CRI, CRN 20 -1 → CR, CRI, CRN 20-17			25 bar	−20°C to +120°C
	CR, CRN 32 -1-1 → CR, CRN 32-7			16 bar	−30°C to +120°C
	CR, CRN 32-8-2 → CR, CRN 32-12			25 bar	−30°C to +120°C
	CR, CRN 32-13-2 → CR, CRN 32-14			30 bar	−30°C to +120°C
	CR, CRN 45 -1-1 → CR, CRN 45-5			16 bar	−30°C to +120°C
	CR, CRN 45-6-2 → CR, CRN 45-9			25 bar	−30°C to +120°C
	CR, CRN 45 -10-2 → CR, CRN 45-10			33 bar	−30°C to +120°C
	CR, CRN 64-1-1 → CR, CRN 64-5			16 bar	−30°C to +120°C
	CR, CRN 64-6-2 → CR, CRN 64-7-1			25 bar	−30°C to +120°C
	CR, CRN 90 -1-1 → CR, CRN 90-4			16 bar	−30°C to +120°C
	CR, CRN 90 -5-2 → CR, CRN 90-6			25 bar	−30°C to +120°C
60 Hz	CR, CRI, CRN 1s	16 bar	−20°C to +120°C	25 bar	−20°C to +120°C
	CR, CRI, CRN 1	16 bar	−20°C to +120°C	25 bar	−20°C to +120°C
	CR, CRI, CRN 3	16 bar	−20°C to +120°C	25 bar	−20°C to +120°C
	CR, CRI, CRN 5	16 bar	−20°C to +120°C	25 bar	−20°C to +120°C
	CR, CRI, CRN 10-1 → CR, CRI, CRN 10-10	16 bar	−20°C to +120°C		
	CR, CRI, CRN 10-1 → CR, CRI, CRN 10-17			25 bar	−20°C to +120°C
	CR 15-1 → CR 15-5	10 bar	−20°C to +120°C		
	CRI, CRN 15-1 → CRI, CRN 15-8	16 bar	−20°C to +120°C		
	CR, CRI, CRN 15-1 → CR, CRI, CRN 15-12			25 bar	−20°C to +120°C
	CR 20 → CR 20	10 bar	−20°C to +120°C		
	CRI, CRN 20-1 → CRI, CRN 20-7	16 bar	−20°C to +120°C		
	CR, CRI, CRN 20-8 → CR, CRI, CRN 20-10			25 bar	−20°C to +120°C
	CR, CRN 32-1-1 → CR, CRN 32-5			16 bar	−30°C to +120°C
	CR, CRN 32-6-2 → CR, CRN 32-8			25 bar	−30°C to +120°C
	CR, CRN 32-9-2 → CR, CRN 32-10-2			40 bar	−30°C to +120°C
	CR, CRN 45-1-1 → CR, CRN 45-4			16 bar	−30°C to +120°C
	CR, CRN 45-5-2 → CR, CRN 45-6			25 bar	−30°C to +120°C
	CR, CRN 64-1-1 → CR, CRN 64-3			16 bar	−30°C to +120°C
	CR, CRN 64-4-2 → CR, CRN 64-4-1			25 bar	−30°C to +120°C
	CR, CRN 90-1-1 → CR, CRN 90-3			16 bar	−30°C to +120°C
	CR, CRN 90-4-2			25 bar	−30°C to +120°C

NPSHR



NPSHR



Maximum, inlet pressure for CR, CRI and CRN.

50 Hz		60Hz	
CR, CRI, CRN 1s			
CR, CRI, CRN 1s-2 → CR, CRI, CRN 1s-36	10 bar	CR, CRI, CRN 1s-2 → CR, CRI, CRN 1s-27	10 bar
CR, CRI, CRN 1			
CR, CRI, CRN 1-2 → CR, CRI, CRN 1-36	10 bar	CR, CRI, CRN 1-2 → CR, CRI, CRN 1-25 CR, CRI, CRN 1-27	10 bar 15 bar
CR, CRI, CRN 3			
CR, CRI, CRN 3-2 → CR, CRI, CRN 3-29	10 bar	CR, CRI, CRN 3-2 → CR, CRI, CRN 3-15	10 bar
CR, CRI, CRN 3-31 → CR, CRI, CRN 3-36	15 bar	CR, CRI, CRN 3-17 → CR, CRI, CRN 3-25	15 bar
CR, CRI, CRN 5			
CR, CRI, CRN 5-2 → CR, CRI, CRN 5-16	10 bar	CR, CRI, CRN 5-2 → CR, CRI, CRN 5-9	10 bar
CR, CRI, CRN 5-18 → CR, CRI, CRN 5-36	15 bar	CR, CRI, CRN 5.10 → CR, CRI, CRN 5-24	15 bar
CR, CRI, CRN 10			
CR, CRI, CRN 10-1 → CR, CRI, CRN 10-6	8 bar	CR, CRI, CRN 10-1 → CR, CRI, CRN 10-5	8 bar
CR, CRI, CRN 10-7 → CR, CRI, CRN 10-22	10 bar	CR, CRI, CRN 10-6 → CR, CRI, CRN 10-17	10 bar
CR, CRI, CRN 15			
CR, CRI, CRN 15-1 → CR, CRI, CRN 15-3	8 bar	CR, CRI, CRN 15-1 → CR, CRI, CRN 15-2	8 bar
CR, CRI, CRN 15-4 → CR, CRI, CRN 15-17	10 bar	CR, CRI, CRN 15-3 → CR, CRI, CRN 15-12	10 bar
CR, CRI, CRN 20			
CR, CRI, CRN 20-1 → CR, CRI, CRN 20-3	8 bar	CR, CRI, CRN 20-1	8 bar
CR, CRI, CRN 20-4 → CR, CRI, CRN 20-17	10 bar	CR, CRI, CRN 20-2 → CR, CRI, CRN 20-10	10 bar
CR, CRN 32			
CR, CRN 32-1-1 → CR, CRN 32-4	4 bar	CR, CRN 32-1-1 → CR, CRN 32-2	4 bar
CR, CRN 32-5-2 → CR, CRN 32-10	10 bar	CR, CRN 32-3-2 → CR, CRN 32-6	10 bar
CR, CRN 32-11-2 → CR, CRN 32-14	15 bar	CR, CRN 32-7-2 → CR, CRN 32-10-2	15 bar
CR, CRN 45			
CR, CRN 45-1-1 → CR, CRN 45-2	4 bar	CR, CRN 45-1-1 → CR, CRN 45-1	4 bar
CR, CRN 45-3-2 → CR, CRN 45-5	10 bar	CR, CRN 45-2-2 → CR, CRN 45-3	10 bar
CR, CRN 45-6-2 → CR, CRN 45-13-2	15 bar	CR, CRN 45-4-2 → CR, CRN 45-7	15 bar
CR, CRN 64			
CR, CRN 64-1-1 → CR, CRN 64-2-2	4 bar	CR, CRN 64-1-1	4 bar
CR, CRN 64-2-1 → CR, CRN 64-4-2	10 bar	CR, CRN 64-1 → CR, CRN 64-2-1	10 bar
CR, CRN 64-4-1 → CR, CRN 64-8-1	15 bar	CR, CRN 64-2 → CR, CRN 64-5-2	15 bar
CR, CRN 90			
CR, CRN 90-1-1 → CR, CRN 90-1	4 bar	CR, CRN 90-1-1 → CR, CRN 90-2-2	10 bar
CR, CRN 90-2-2 → CR, CRN 90-3-2	10 bar	CR, CRN 90-2-1 → CR, CRN 90-4-2	15 bar
CR, CRN 90-3 → CR, CRN 90-6	15 bar		

DIMENSIONS

Pump Type	Oval			PJE			CLAMP - FlexiClamp			UNION			DIN - FGJ							
	L [mm]	H [mm]	D [Rp]	L [mm]	H [mm]	D [mm]	L [mm]	H [mm]	D [mm]	L [mm]	H [mm]	D [G]	L [mm]	H [mm]	DN	L ₁ [mm]	L ₂ [mm]	B ₁ [mm]	B ₂ [mm]	ø [mm]
CR 1s	160	50	1										250	75	25/32	100	145	180	220	13
CRI, CRN 1s				210	50	42.2	162	50	30	228	50	2	250	75	25/32	100	150	180	220	13
CR 1	160	50	1										250	75	25/32	100	145	180	220	13
CRI, CRN 1				210	50	42.2	162	50	30	228	50	2	250	75	25/32	100	150	180	220	13
CR 3	160	50	1										250	75	25/32	100	145	180	220	13
CRI, CRN 3				210	50	42.2	162	50	30	228	50	2	250	75	25/32	100	150	180	220	13
CR 5	160	50	1½										250	75	25/32	100	145	180	220	13
CRI, CRN 5				210	50	42.2	162	50	30	228	50	2	250	75	25/32	100	150	180	220	13
CR 10	200	80	1½										280	80	40	130	178	215	256	13.5
CRI, CRN 10				261	80	60.1	202	80	50				280	80	40	130	200	215	248	13
CR 15	200	80	2										300	90	50	130	176	215	256	13.5
CRI, CRN 15				261	90	60.1	202	90	50				300	90	50	130	200	215	248	13
CR 20	200	80	2										300	90	50	130	176	215	256	13.5
CRI, CRN 20				261	90	60.1	202	90	50				300	90	50	130	200	215	248	13
CR 32													320	105	65	170	223	240	298	14
CRN 32													320	105	65	170	226	240	298	14
CR 45													365	140	80	190	248	266	331	14
CRN 45													365	140	80	190	251	266	331	14
CR 64													365	140	100	190	248	266	331	14
CRN 64													365	140	100	190	251	266	331	14
CR 90													380	140	100	199	261	280	348	14
CRN 90													380	140	100	199	261	280	348	14

CONTENT



CETHAR VESSELS LIMITED

**M/s. SKM ANIMAL FEEDS AND
FOODS (INDIA) LIMITED.
1 X 15 TPH FBC BOILER(BH112)**

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FUEL FEEDING SYSTEM

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DATA SHEET**VARIABLE FREQUENCY DRIVE**

DESCRIPTION	SPECIFICATION
GENERAL DATA:	
MAKE	M/S. ABB LIMITED.
QUANTITY	3 NOS
APPLICATION	TO CONTROL THE SPEED OF POCKET FEEDER MOTORS
MOTOR CAPACITY	1.5 KW / 1440 RPM
SPEED VARIATION RANGE	10 TO 100%
MODEL NO.	ACS550-01-06A9-4
INPUT VOLTAGE	415 V $\pm 10\%$
INPUT FREQUENCY	50 Hz $\pm 5\%$
AMBIENT TEMPERATURE	50°C
MOTOR CONNECTION	
OUTPUT VOLTAGE	0 TO U _{in}
LOAD CHARACTERISTIC	CONSTANT TORQUE VARIABLE POWER
CONTROL CHARACTERISTIC	
CONTROL METHOD	OPEN LOOP SENSORLESS CURRENT VECTOR METHOD.
INPUT PROTECTION	MCCB
RADIO (V/Hz)	PROGRAMMABLE (THROUGH FRONT PANEL KEY PAD)
PROTECTION FUNCTION	
OVER CURRENT PROTECTION	TRIP LIMIT 4 * ICT (SELECTABLE)
OVER VOLTAGE	Un=415 V, TRIP LIMIT = 1.35 * Un
UNDER VOLTAGE	1.65 * Un
EARTH FAULT	PROTECTS THE CONVERTOR IN CASE OF EARTH FAULT IN MOTOR OR MOTOR CABLE
INPUT PHASE SUPERVISION	TRIPS IF ANY OF THE INPUT PHASE MISSING
OUTPUT PHASE SUPERVISION	TRIPS IF ANY OF THE OUTPUT PHASE MISSING
MOTOR OVERLOAD PROTECTION	PROVIDED
MOTOR STALL PROTECTION	PROVIDED
UNIT OVER TEMPERATURE	PROVIDED
SHORT CIRCUIT PROTECTION	PROVIDED

VARIABLE FREQUENCY DRIVE

DESCRIPTION	SPECIFICATION
CONTROLS CONNECTIONS AVAILABLE INSIDE THE DRIVE:	
ANALOG VOLTAGE INPUT	0 TO +10 V
ANALOG CURRENT INPUT	4 TO 20 MA DC
DIGITAL INPUTS	POSITIVE OR NEGATIVE CONTROL LOGIC
RELAY OUTPUT	MAX. CLOSING VOLTAGE 300 V DC, 250 V AC. MAX. CONTINUOUS CURRENT : 2 AMPS
ANALOG CURRENT OUTPUT	4 TO 20 mA DC (SPEED FEED BACK TO PANEL)
ENVIRONMENTAL CONDITION	
AMBIENT OPERATING	-10°C TO 50°C
AMBIENT STORING	-40°C TO 60°C
RELATIVE HUMIDITY	LESS THAN 95% NO CONDENSATION ALLOWED
VIBRATION	OPERATION Mx AMPLITUDE 3 MM IN FREQUENCY RANGE 2 TO 9 HZ, MAX.
ACCELERATION	AMPL 0.5 g IN FREQUENCY RANGE AT 9 TO 200 HZ
SHOCK	OPERATING MAX., 8G 11 MS STORING TRANSPORT MAX. ,15G 11 MS
DRIVE ENCLOSURE CLASS	IP 20
PANEL ENCLOSURE	IP 41
DRIVE ENCLOSURE	PLASTIC COATED HOT DIP GALVANISED (1500/MM) STEEL SHEET

SUPPLIER'S ADDRESS:

M/s. ABB LIMITED,
"CENTURY PLAZA", 3RD FLOOR, 3C, 3D & 3F,
561 - 562, MOUNT ROAD, TEYNAMPET,
CHENNAI - 600 018

[CLICK HERE TO OPEN THE MANUAL](#)

[CONTENT](#)

DATA SHEET	
GEAR BOX	
DESCRIPTION	SPECIFICATION
GENERAL DATA:	
MAKE	M/S. ELECON ENGINEERING COMPANY LTD.
QUANTITY	3 NOS.
APPLICATION	FOR FUEL FEEDING SYSTEM
MODEL	3 NU
TYPE	WORM AND WORM WHEEL
INPUT CAPACITY	1.5 KW
INPUT SPEED	1440 RPM
GEAR RATIO	50 : 1
MOUNTING	FOOT MOUNTED
PRIME MOVER	MOTOR (FOR VFD)
DUTY CYCLE	CONTINUOUS
ROTATION	REVERSING
ORIENTATION	RIGHT (VIEWED FROM MOTOR END)

SUPPLIER'S ADDRESS:

**M/S ELECON ENGINEERING COMPANY LTD,
553, MOUNT ROAD, III FLOOR,
TEYNAMPET,
CHENNAI - 600 018.**

CONTENT

INSTALLATION, OPERATION AND MAINTANANCE MANUAL



Always a step ahead in technology



FVM/SFV



FSM/SFU



SMM/SSM



NU/SNU



NU/SNU DOUBLE
REDUCTION



FIM/SFO



COOLING
TOWER
GEAR UNIT

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1) INTRODUCTION

Thank you for choosing ELECON gear box, the value leader among reputed gear manufacturers in India. We sincerely request you to go through this operation and maintenance manual, before you start using this product. This manual is designed carefully covering all important aspects and features of the gear box.

To obtain warranty service or paid after sales services for our product, contact EMTICI Engineering Limited office nearest to you. An address/telephone/fax/e-mail list of EMTICI offices is provided on the back cover of the manual.

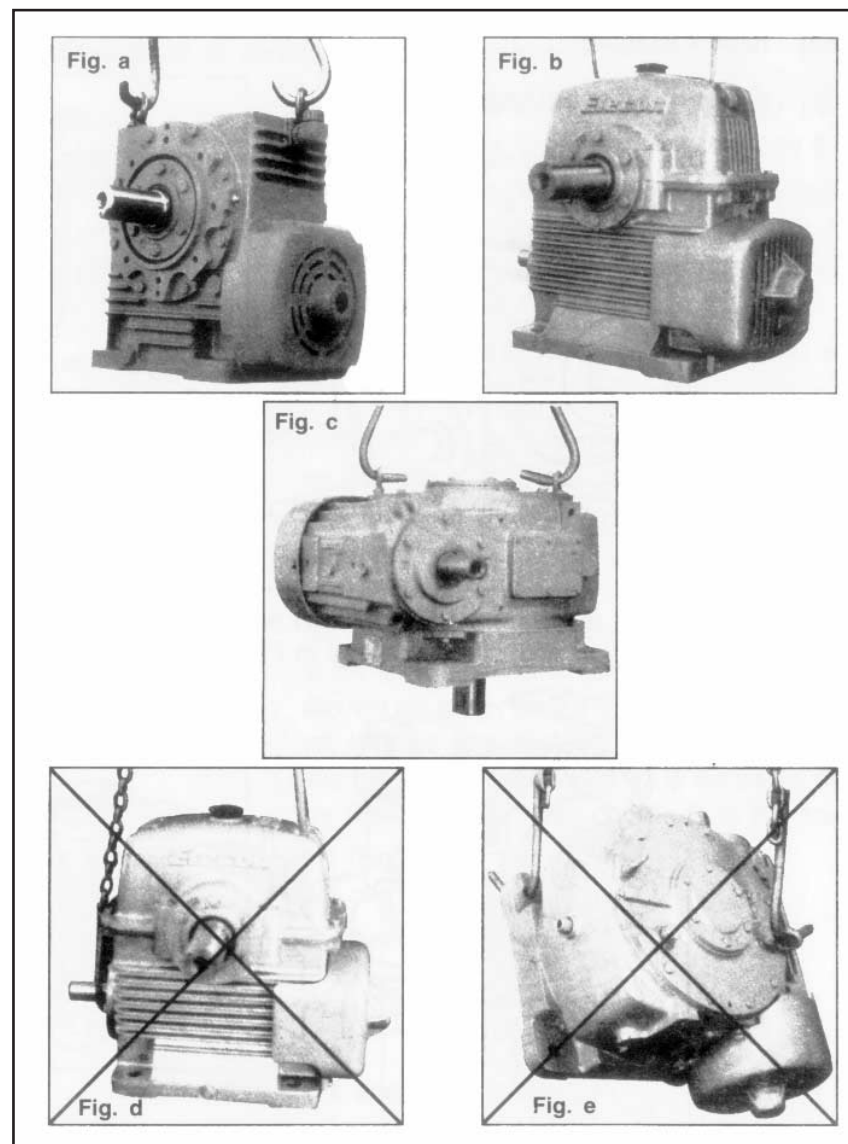
The proper working of a gear unit depends on careful installation, correct grade of lubricant and good working conditions. Hence, it is most important to see that the installation of the gear unit is done according to the instructions given in this manual to ensure proper working of the gear unit, and to ensure a long and trouble free service.

2) INSTALLATION

ELECON worm reduction gear units are supplied in completely assembled condition without oil. The shaft ends are coated with anti-corrosive agents which are to be removed only by suitable solvents. In no case, shafts should be scraped on field.

2.1) TRANSPORTATION

The gear units should be lifted by making the use of the eyebolts or integrally cast lugs. These are designed for the weight of the gear units only and no accessories should be lifted along with the gear units. In no case shaft ends should be used for handling the units. NU/SNU models, vertical gear units should be lifted by using eye bolts fitted on the gear units. The complete method of lifting is shown in the figures a, b and c. Not to lift the gear unit as shown in fig. d & e.



2.2) Hand Changing.

(a) $1 \frac{5}{8}$ " to 3" NU/SNU

This is achieved easily and quickly by just replacing the cap from one end to the other end of the worm shaft as shown in Fig. 1 & Fig. 2.

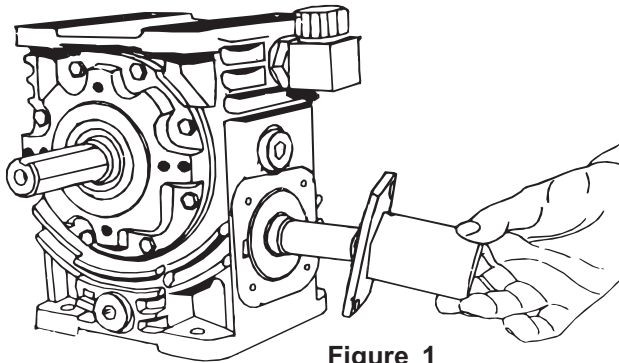


Figure 1

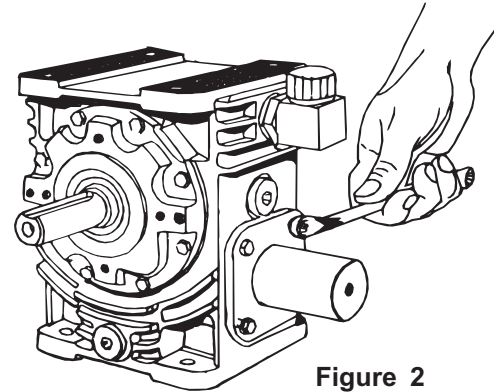


Figure 2

(b) NU/SNU models 3.54" to 10.5" and in all other types of gear units just replace the fan and fan cowl from one end and fix on other end. This is shown in Fig. 3 & Fig. 4. **It is not necessary to dismantle the gear unit in any way.**

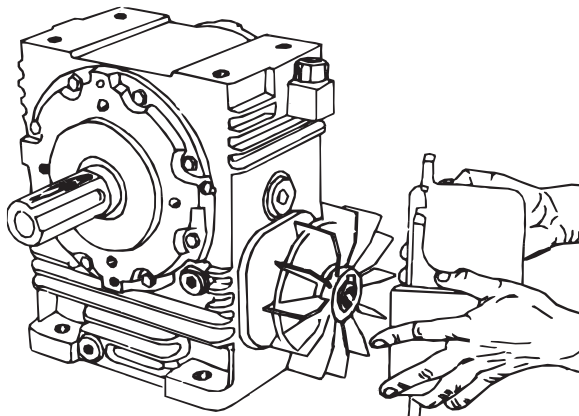


Figure 3

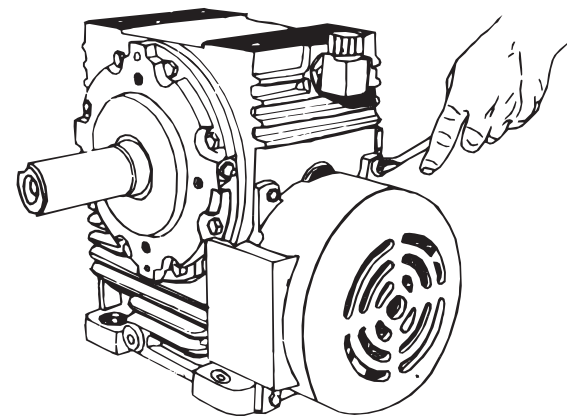


Figure 4

2.3. INSTRUCTION FOR CONVERSION of NU/SNU type gear units in to various mounting positions.

The gear unit is supplied in NU-U / SNU-U assembled condition (i.e. underdriven mounting position) as shown in figures 5a & 5b.

The gear unit can be quickly converted from underdriven mounting position to other mounting positions by re-arranging the interchangeable Breather plug, Oil level indicator, Drain plug and by fixing additional base for vertical mounting.

2.3.1 NU-U → NU-O / SNU-U → SNU-O

1. For gear units $1\frac{3}{4}$, $2\frac{1}{4}$, & 3" NU/SNU tilt

the unit upside down as shown in figure 6a.

Each gear unit from 4" NU/SNU onward is supplied with a kit containing two detachable feet and screws. Fix these feet on top of the gear unit with screws, as shown in figure 6b and the unit can be turned upside down.

2. Replace breather plug (B) and drain plug (D), keeping oil level indicator (L) in the same position.
3. Fill oil inside the gear unit upto the mid point of oil level indicator (L).
4. The gear unit is ready for NU-O/SNU-O position as shown in (figure 6a & 6c)

Figure 6b

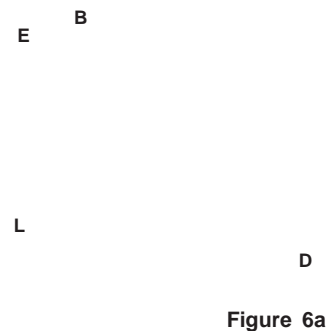
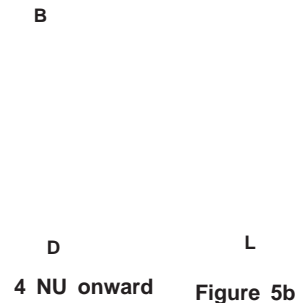
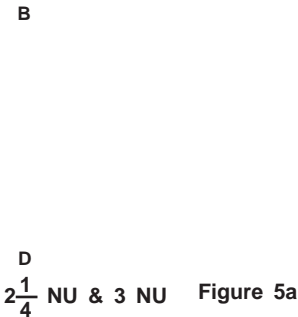
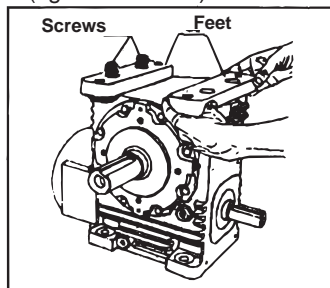


Fig. 5a और Figure 5b के अनुसार NU-U / SNU-U (नीचे से संचालित स्थिति) प्रकार से जुड़ा हुआ प्रेषित किया जाता है।

नीचे की दिशा से संचालित स्थिति का गियर अलग-अलग स्थिति में ब्रीदर प्लग, ऑइल लेवल इन्डिकेटर, और ड्रेन प्लग के स्थलांतर से बदला जा सकता है। वर्टिकल प्रस्थान की स्थिति के लिये अतिरिक्त बेस का प्रयोग किया जाता है।

प्रस्थापन स्थिति को बदलने के लिये नीचे दी हुई विधि का अनुसरण करें।

१. गियर एकम के उपर के भाग को नीचे उलटिये। यह विधि केवल $1\frac{3}{4}$, $2\frac{1}{4}$ और 3" NU/SNU गियर एकम के लिये दी है। (Fig. 6a)
- प्रत्येक 4" NU/SNU और उपर वाले गियर एकम के साथ एक किट दी जाती है। जिसमें दो पाँव और स्कू होते हैं। इन पाँव को Fig. 6b में दिखाये हुई तरीके से लगाइये और स्कू से कस दीजिये। अब गियर के उपरी भाग को नीचे उलटिये।
२. ब्रीदर प्लग (B) और ड्रेन प्लग (D) के स्थल का वैकल्पिक उपयोग करें, और ऑइल लेवल इन्डिकेटर (L) को यथावत रखें।
३. गियर एकम में ऑइल लेवल इन्डिकेटर (L) के मध्य तक तेल भरें
४. अब गियर एकम NU-O/SNU-O परिस्थिति के लिए तैयार है। (Fig. 6a और 6c)

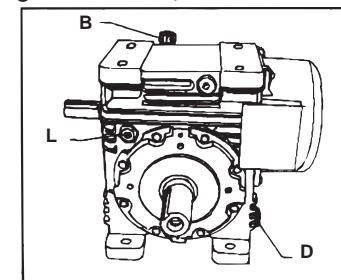


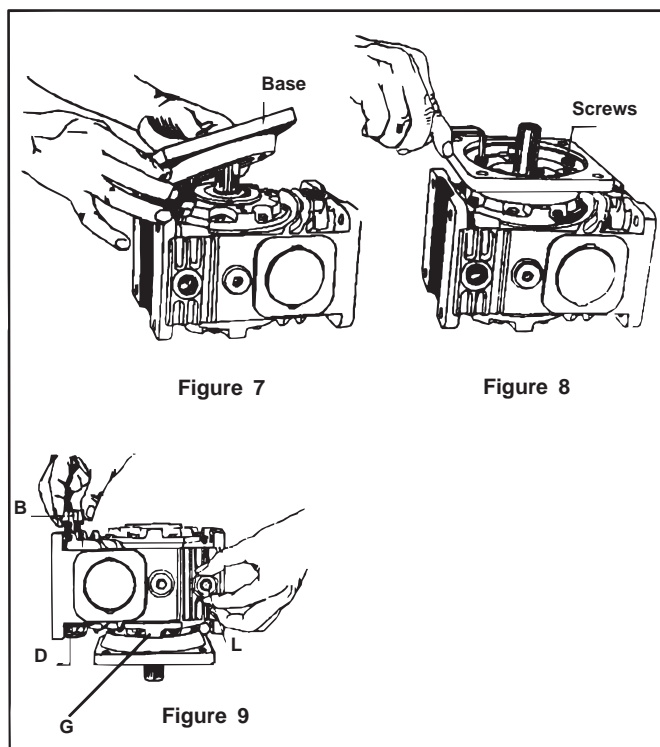
Figure 6c

2.3.2 . **NU-U** **SNU-U** **NU-V (X)** **SNU-V** **NU-V (Y)** **SNU-V**

X – FOR OUTPUT SHAFT VERTICAL **UPWARD**

Y – FOR OUTPUT SHAFT VERTICAL **DOWNWARD**

1. Tilt the gear unit so that the output shaft is vertically upward (X) or downward (Y) as per your requirement.
2. A kit contains a base, screws and plug supplied with gear unit. Fix this base to the gear unit as shown in figure 7 and tighten the screws as shown in figure 8. The gear unit is now ready with base for NU-V/SNU-V mounting.
3. Replace the oil level indicator (L), drain plug (D) and the breather plug (B). Remove elbow (E) while replacing the breather plug, as shown in figure 9.
4. Fill oil inside the gear unit upto the mid point of oil level indicator.
5. The gear unit is ready for NU-V (X)/NU-V (Y) position. Figure 9 shows the gear unit in NU-V (Y) position. Similarly in SNU model.
6. Replace grease nipple by plug on base side as shown in figure 9 to avoid oil leakage from grease nipple (G).



9. अपेक्षित परिस्थिति में गियर एकम को इस तरह पलटिये कि उसका आउटपुट शाफ्ट उपर या नीचे की ओर हो जाय ।
2. गियर एकम के साथ एक किट दिया गया है जिसमें एक बेस, स्कू और प्लग है । बेस को Fig. 7 के अनुसार लगाइये और स्कू से कस दीजिये जैसा कि Fig. 8 में दिखाया गया है । अब आपका गियर एकम NU-V/SNU-V स्थिति में प्रस्थापित करने के लिये तैयार है ।
3. ऑइल लेवल इन्डिकेटर और ड्रेन प्लग का स्थलांतर करें । Fig. 9 के अनुसार, ब्रीदर प्लग को बदलते समय एल्बो (E) निकाल दें ।
8. गियर एकम में ऑइल लेवल इन्डिकेटर के मध्य तक तेल भर दें ।
4. गियर एकम NU-V(X)/NU-V(Y) की परिस्थिति में तैयार है । Fig. 9 में दर्शित, गियर एकम NU-V(Y) की परिस्थिति में है । SNU मोडल में भी इस तरह से प्रयोग करें ।
6. बेस साइड की ग्रीसनिपल से ऑइल बाहर न निकले इसलिए बेस साइड की ग्रीसनिपल को निकाल कर प्लग लगाइये । यह Fig. 9 में दिखाया गया है ।

2.3.3 This mounting is possible only for 1 $\frac{3}{4}$ ", 2", 2 $\frac{1}{4}$ " and 3" NU/SNU

1. Tilt the gear unit so that the input shaft is vertically upward or downward as per your requirement.
2. Remove all the screws of the output cover and rotate the cover in such a way that the oil level indicator position comes to 45° above the horizontal axis as shown in fig. 10
3. Replace the drain plug (D) and breather plug (B) and fix it to the appropriate position as shown in fig. 10
4. The gear unit can be mounted horizontally by using additional support which is supplied on request.
5. The gear unit is ready for NU-H (X)/NU-H(Y) position

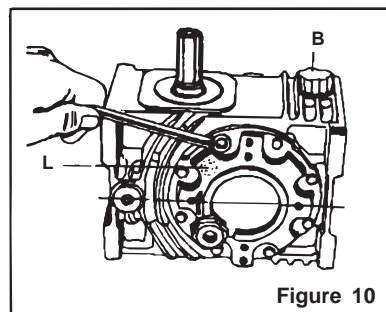


Figure 10

9. अपेक्षित परिस्थिति में गियर एकम को इस तरह पलटिये कि इसका इनपुट शाफ्ट बिलकुल उपर की तरफ या नीचे की तरफ हो जाय ।
2. आउटपुट कवर के सभी स्कू निकाल दें और कवर को इस तरह घुमाइये कि वह Fig. 10 के अनुसार ऑइल लेवल इन्डिकेटर की समछितिज दुरी उपर 45° पर आ जाये।
3. ड्रेन प्लग (D) और ब्रीदर प्लग (B) का स्थलांतर करें। जैसा कि Fig.10 में दर्शाया गया है, ब्रीदर प्लग को बदलते समय एल्बो (E) निकाल दें और यथाचित स्थिति में लगाए ।
4. गियर एकम को समछितिज परिस्थिति में अतिरिक्त पॉव के उपर लगाया जा सकता है। ये अतिरिक्त पॉव मांगे जाने पर उपलब्ध हैं ।
5. अब गियर एकम NU-H(X)/NU-V(Y) परिस्थिति के लिये तैयार है ।

2.4 FOUNDATION

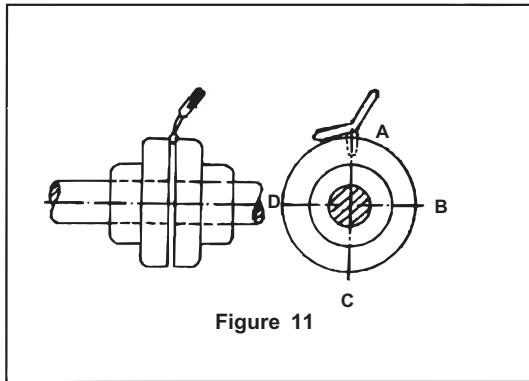
Correct installation of the gear system is essential to achieve good performance. The gear unit must be rigidly connected to the foundation which must also be rigid and have a flat mounting surface. If the foundation on base plate structure is incorrectly designed or constructed, shaft misalignment, vibration, bearing damage and even shaft or housing breakage can result.

The best practice is to install the gear box on rigid concrete foundations, however, in some applications the gear boxes are required to be mounted on machining structure especially in cement and chemical plants.

While the gear unit is installed on structural foundation, care should be taken that gear unit is mounted on a combined base plate with driving motor and sufficient areas should be there to properly align the input and output couplings. Packing should be placed so that support is given in the plane of coupling face.

2.5 COUPLING AND SYSTEM ALIGNMENT

In order to minimize wear, vibration and coupling problem, it is must that the accurate alignment between coupling hubs on connected shafts is essentially achieved.



2.5.1. Ensure correct gap between two coupling halves.

2.5.2. Angularity error should be corrected by using feeler gauge shown in figure 11 and arriving at a constant gap measures every 90 deg. of rotation of the coupling halves simultaneously.

Difference between clearances measured at opposite positions should be less than 0.25mm/100 mm outside diameter of coupling.

2.5.3. Eccentricity error can be corrected by using straight edge, as shown in figure 12 when both coupling halves have the same outside diameters.

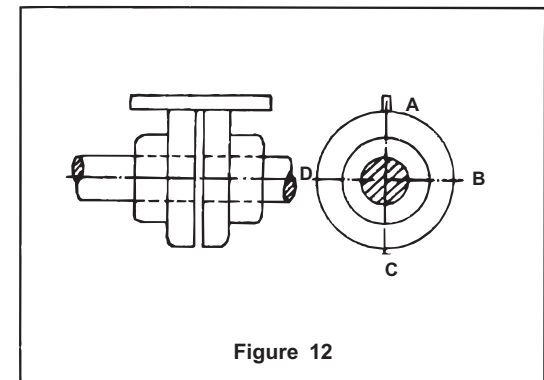
If not a straight edge, should be used in conjunction with feeler gauge to half the difference in diameter. Here also checking should be done every 90 deg. while mounting both coupling halves simultaneously.

2.5.4 SAFETY PRECAUTION.

The client should protect the coupling, rotating shaft extensions etc. with safety guards.

3. LUBRICATION

Gear units are supplied in completely assembled condition **without oil** and must be filled with the correct grade of lubricant to the correct level. Reliability, efficiency and wear free operation mainly depend on lubricant use. Over-filling of lubricant results in over heating and leakage.



RECOMMENDED LUBRICANT - ISO VG 320**MINERAL OIL**

BRAND	GRADE
International Brands	
British Petroleum	CS 320 or GR-XP320
Castrol	Alpha Zn 320 or Alpha Sp 320 or Tribol 110/320 IGQA
Caltex	Meropa 320
Esso	Teresso 320 or Spartan 320
Fuchs	Renolin CKC 320
Mobil Oil Co.	Mobil DTE Oil AA or Mobilgear 632
Shell Co	Vitera Oil 320 or Omela 320
Kluber	Kluber oil GEM 1E320
Indian Brands	
Bharat Petroleum	Cabol 320
Fuchs	Renolin CKC 320
Castrol	Alpha Zn 320 or Alpha Sp-320 or Tribol
Gulf	Gulf harmony 320 or Gulf EP 320
Hindustan Petroleum	ENklo 320 or Parthan EP 320
Indian Oil	Servomesh SP 320 or Servosystem 320 or Servomesh EE320
Veedol	Avalon 320
Kluber	Kluber oil GEM 1E320

Recommended Grease : For low speed of operations. Below 50 RPM, splash lubrication is not sufficient and bearings are required to be grease packed.

Brand	Grade
Castrol Indian Oil Hindustan Petroleum	EPL 2 Servogem EP 2 HP LITHON EP 2

POLYGLYCOL BASED SYNTHETIC LUBRICANT

USE OF POLYGLYCOL BASED SYNTHETIC LUBRICANT IS ALSO ADVISABLE TO IMPROVE THE TRANSMITTING CAPACITY (RATING) OF GEAR UNITS MIN 20% AS COMPARED WITH USE OF MINERAL OIL AT SAME WORKING TEMPERATURE. THIS GEAR OIL SHOWS EXCELLENT NON AGEING STABILITY WITH FAVOURABLE INFLUENCE ON EFFICIENCY.

Approved Synthetic Lubricants

Brand	Grade
Castrol Fuchs Klüber	Tribol 800-220 Renolin PG 220 Klubersynth GH 68220

Special Note : Synthetic Lubricants must not be mixed with any other type of oil. The gear unit must be flushed while changing to or from this lubricant.

¥ **First change of oil should be made after 500 hours of operation.**

¥ **Subsequent oil change must be made after every 3000 hours of operation. The interval should not exceed 12 months.**

Cleanliness of oil is of prime importance and it is imperative to flush the gear unit with flushing oil before refilling. Fluid is to be drained off completely before filling the fresh oil.

Oil of two different manufacturers should not be mixed in any case even though they may be of equivalent grade.

The unit is ready to be put into operation So it's not needed to make any adjustment in the assembly.

¥ **Maximum rise in oil temperature 93°C under full load with ambient temperature 35°C**

3.1. OIL LEVEL MONITORING

All units are supplied with a filler plug (which also acts as a breather) at the top of the unit. In most cases, there is an oil level indicator (Knob type) screwed to the gear unit and also oil level indicator (glass tube inserted in the pipe) provided at the side of the gear unit.

- 1) The oil is to be filled up during stationary position to the center in case of the knob type oil level indicator / on to the mark given on the glass tube.
- 2) The oil level should be examined periodically and should not fall below the level.
- 3) The gear unit is to be stopped before you check the oil level position. If required, the required amount of oil should be filled again.
- 4) It is essential to ensure that the breather plug hole is kept clear at all times. This may lead to oil leakage and the inhalation of foreign matter through the oil seal, which could cause the inability of the gear unit to ventilate freely.

Especially in lower ratios 5:1 to 10:1, the filler cum breather plug is to be mounted opposite to the direction of rotation to prevent oil leakage from breather.

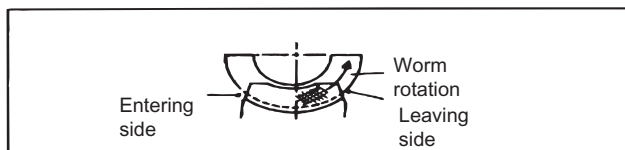
4. WORM/WORM WHEEL REPLACEMENT INSTRUCTIONS

In order to obtain the best performance from a pair of worm gears, it is essential, when mounting them in the gear unit, they should be adjusted correctly.

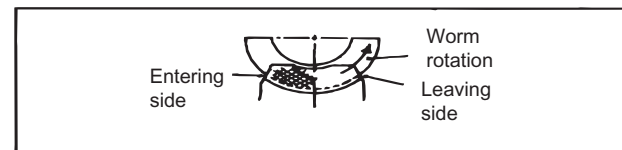
Given below are some notes on assembly for all worm gear mounting that will be of particular use to users of ELECON worm gear units.

4.1. METHOD OF ADJUSTMENT.

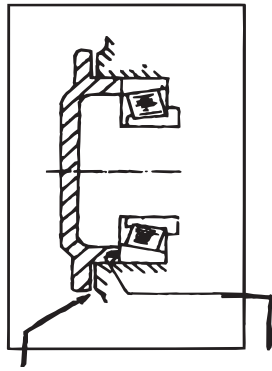
The Worm wheel should be mounted approximately to the center with the worm and after coating the worm threads with a Prussian blue or similar compound, the gear should be turned by hand to produce a tooth marking on the wheel. If the marking is not as desired, the wheel should be adjusted sideways until a correct marking is obtained as shown in fig. 13.



**figure 13
(CORRECT)**

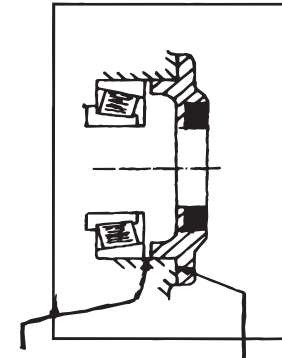


**figure 14
(INCORRECT)**



Gap taken up by shims here on removal of metal from spigot face.

This sketch represents a typical shaft assembly after the hand of assembly has been changed, i.e. a gap between flange and case on one side and a gap between gap spigot and bearing on the other side.



Gap taken up by shims here on removal of metal from spigot face.

Figure 15

The gap observed between cover and gear case face is to be covered by using required set of aluminum shims and accordingly the adjustment to be made for correct positioning of the wheel as shown in fig.15, Moreover rotate the wheel in both direction of rotation and to consider both of the driving faces of the teeth and to get a contact as shown in figure 16.

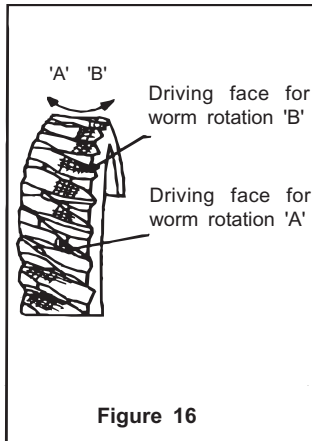


Figure 16

This figure shows that correct leaving side contact on both faces of a worm wheel, which is desirable when the gears are required to run in both direction of rotation.

4.2. ALLOWANCES FOR DEFLECTION AND OIL ENTRY GAP

Elecon worm gears are manufactured in such a manner so as to allow for deflection and to give an entry gap for the lubricants on the entering side on the wheel teeth. This is done by producing the gears with a "leaving side" contact as shown in figure 13. This contact obviously leaves an entry gap for the oil and moreover when the wheel deflects under load, the contact tends to become more central which still leaving some entry gap.

A driving face contact as shown in figure 14 is the worst possible condition under which a pair of worm gears can be run, since there is no entry gap for the oil and moreover, any deflection will aggravate the trouble further.

A gear mounted in this manner may cause a temperature rise in the oil as much as 20 percent higher than the correctly mounted gear as shown in figure 13. The remedy is to make the wheel (by means of adjustment provided in the design) to the left until contact similar to that in figure 13 is obtained. This is to be done by trial and error and by movement of wheel to the left will cause the contact to move to the right.

4.3. BEARING ASSEMBLY

All worm gear units where the worm shaft and wheel shaft are supported on taper roller bearings. The covers are provided for location and fitting purpose. This is shown in Fig. 15 and proper adjustment is to be carried out by using shims.

4.4 OIL SEAL MOUNTING

When a gear unit has been dismantled, it is advisable to replace the old oil seal to a new oil seal and this should be done carefully to avoid the damage of the sealing lip of seal. If a special fitting accessory is not available it is advisable to use a piece of thin card or a plastic sheet round the shaft to cover keyways and sharp edges, then apply a grease on the lip and slide the seal over it.

5. SHIPPING SPECIFICATIONS AND OIL CAPACITIES

The approximate oil quantities and weight of the various worm gear unit types and sizes are given in the following tables. However, these are only indicative and actual oil filling should be up to the center where plug type oil level indicator used and upto maximum marking level for oil level indicator.

			3	4	5	6	7	8	9	10.5	12	14	17
FSM/FSS	Net Weight		35	70	90	130	175	210	295	450	640	900	1300
	Gross Weight		50	90	110	165	220	275	365	595	900	1150	1750
	Oil Capacity		2.5	3.5	4.5	6.5	9	11	15	20	25	36	60
	Net Weight		32	65	95	135	185	223	320	480	660	940	1380
FIM	Gross Weight		50	86	120	170	228	300	390	610	920	1180	1800
	Oil Capacity		3.3	4	5	7	8.5	12	17	22	27	38	95
	Net Weight		40	55	70	125	170	240	295	440	630	870	1575
FVM/FSV	Gross Weight		50	75	90	160	210	265	350	560	845	1120	2000
	Oil Capacity		1.5	2.25	3	4.5	5	8	11	20	29	43	105
	Net Weight						145	210	290	430	780	1280	
	Gross Weight						195	259	354	500	940	1540	
SMM/SMWR	Approx. Oil	A					7	10	14	21	24	28	
	Capacity in ltrs	B					7	10	13	18	22	25	
	For Diff.Mounting	C					5	8	11	20	26	28	
	Positions	D/ E					8	12	15	21	23	30	

* Weight in Kg.

¥Capacity in ltrs.

5.2 SHIPPING SPECIFICATIONS AND OIL CAPACITIES FOR SNU/SFU/SFO/SFV/SSM

AVERAGE WEIGHT IN KILOGRAMS

GEAR SIZE	1 5/8		1 1/4		2		2 1/4		3		3.54		4		5		6		7		8		9		10.5	
GEAR TYPE	NET	GR	NET	GR	NET	GR	NET	GR	NET	GR	NET	GR	NET	GR	NET	GR	NET	GR	NET	GR	NET	GR	NET	GR	NET	GR
SNU-U	7	8.5	8	10.5	12	23	14	25	32	60	40	65	65	95	95	125	152	190	180	230	220	270	319	385	460	585
SNU-O	7	8.5	8	10.5	12	23	14	25	32	60	40	65	72	102	105	135	165	204	195	265	237	305	336	400	480	600
SNU-V	7.3	9	8.5	11.5	14	24	15	25	37	67	43	68	73	103	105	135	166	205	200	270	250	315	348	430	481	610
SNU-SM	...	...	...	...	15	28	16	28	35	65	41	66	64	80	110	140	157	170	200	270	252	316	330	415	465	590

APPROXIMATE OIL CAPACITY FOR **SNU** GEAR UNIT IN LITRES

SNU-U	0.3	0.4	0.6	0.7	2.2	2.1	2.5	4	5	9.5	11	16	21
SNU-O	1.4	0.5	0.7	0.8	2	3.8	5.1	8	13.5	18	19	41	45
SNU-V	0.3	0.4	0.6	0.7	2	3.5	4.0	5.7	8.5	18	20	25	26

APPROXIMATE OIL CAPACITY FOR **SNU-SM** GEAR UNIT DIFFERENT MOUNTING POSITION IN LITRES

A	....	....	0.6	0.7	1.3	4	5	7	10	18	19	41	45
B	....	....	0.6	0.7	2.1	2.5	2.5	4	6	9.5	11	16	21
C	....	....	0.6	0.7	1.7	2.5	2.5	4.7	8.8	18	20	25	26
DE	....	....	0.7	0.8	2.6	3	3	8	11.6	19	20	25	26

			10	12	14	17
SFU	Net Weight		450	580	885	1260
	Gross Weight		595	900	1140	1700
	Oil capacity		20	25	36	60
SFO	Net weight		480	660	940	1380
	Gross Weight		610	920	1180	1800
	Oil capacity		22	27	38	95
SFV	Net weight		440	660	870	1575
	Gross Weight		560	845	1120	2000
	Oil capacity		20	29	43	106
SSM	Net Weight		...	780	1280	
	Gross Weight		...	940	1540	
	Approx. Oil Capacity For Diff.Mounting Positions	A	...	24	28	
		B	...	22	25	
		C	...	26	28	
		D/E	...	23	30	

First change of oil should be made after 500 hrs. of operation.

Subsequent oil changed must be made after every 3000 hours of operation. The interval should not exceed 12 months.

* Weight in kg.

* Capacity in ltrs.

5.3 SHIPPING SPECIFICATIONS AND OIL CAPACITIES FOR DOUBLE REDUCTION WORM GEARS.

SIZE		2 $\frac{1}{4}$ /40	2 $\frac{1}{4}$ /50	3/60	3/70	4/80	4/90	5/105	5/120	6/140
NU-UD/FSMD										
Net Weight	kg.	79	109	184	200	270	350	530	720	1100
Gross Weight	kg.	110	130	220	240	320	410	615	950	1190
Approx. Oil Capacity Ltrs.	1st Stage	0.7	0.7	2.2	2.5	3.5	3.5	4.5	4.5	6.5
	2nd Stage	2.5	4	5	9	11	15	20	25	36
NU-OD/FIMD										
Net Weight	kg.	86	119	195	210	290	385	550	745	1070
Gross Weight	kg.	125	150	250	250	340	440	630	958	1220
Approx. Oil Capacity Ltrs.	1st Stage	0.8	0.8	2	2	3.5	3.5	4.5	4.5	6.5
	2nd Stage	4.1	8	13.5	14.5	15.5	17	22	27	38
NU-VD/FVMD										
Net Weight	kg.	87	119	195	205	300	350	520	720	1000
Gross Weight	kg.	110	150	250	260	360	410	615	950	1090
Approx. Oil Capacity Ltrs.	1st Stage	0.7	0.7	2.2	2.2	3.5	3.5	4.5	4.5	6.5
	2nd Stage	3.10	5.7	8.5	9.9	10	11	20	29	43

ELECON SPEED REDUCERS TROUBLE-SHOOTING GUIDE

Our worm gear units are designed to run satisfactorily for the service life of more than 26,000 hours depending upon their proper installation, operation and maintenance. When malfunction does occur, the source of trouble can be easily traced. Special skills or abilities are not required in case of corrections or repairs is needed. As a guide to continuous good performance the following information will prove useful :

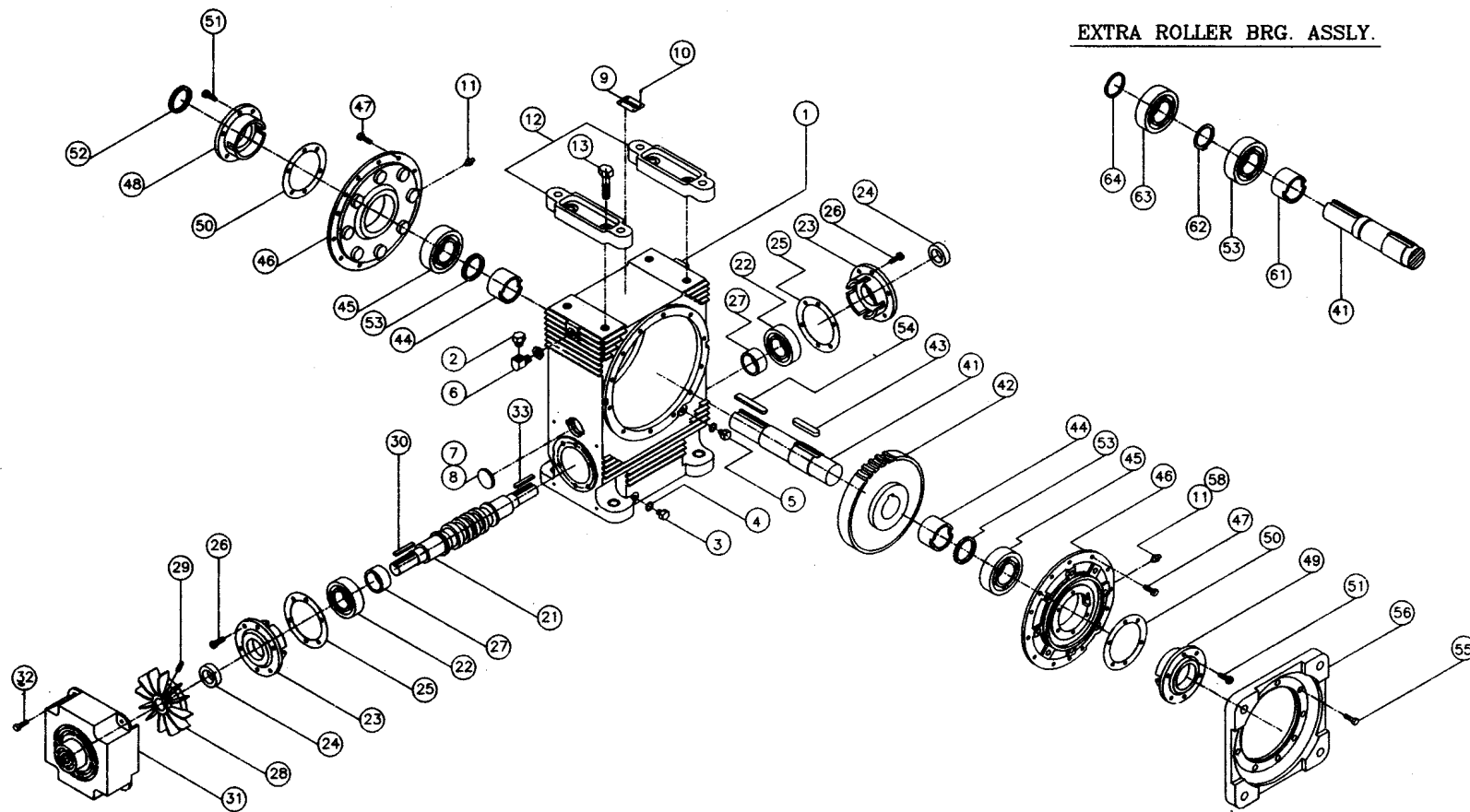
Problem	Cause	Remedy
Reducer is over heated	<ul style="list-style-type: none"> * Over load * Lubricant is more or less than required * Incorrect grade of lubricant * Oil seal damaged 	<ul style="list-style-type: none"> * Check the actual loading * Fill oil to specified level * Use oil of correct grade * Replace the oil seal
Reducer buzzes	<ul style="list-style-type: none"> * Gear damaged * Bearing damaged * Inadequate lubricant * Foreign matter enters the reducer 	<ul style="list-style-type: none"> * Correct gears * Replace the bearing * Supply with more oil * Remove it and change the oil
Unusual vibration	<ul style="list-style-type: none"> * Foreign matter * Bearings damaged / worn out * Bolts loosened 	<ul style="list-style-type: none"> * Remove it and change the oil * Replace the bearing * Tighten the bolts
Leakage of oil	<ul style="list-style-type: none"> * Oil seal damaged * Packing damaged * Drain plug loosened 	<ul style="list-style-type: none"> * Replace * Replace * Tighten the drain plug
Input/output shafts do not work	<ul style="list-style-type: none"> * Bearing damaged * A solid foreign matter in gearing 	<ul style="list-style-type: none"> * Replace * Remove it and clean the inside & fill fresh lubricant

Note : The information given here is for users guidance. It will enable them to obtain satisfactory performance of the gear box. However, in case of doubt, the users are advised not to do any guess-work or take chance but to consult Elecon.

Materials used for construction of Worm gears

No.	DESCRIPTION	MATERIAL USED	No.	DESCRIPTION	MATERIAL USED
1	WORM SHAFT	Up to 100mm O/D 20MnCr 5 Above 100mm O/D En 8 353	4	OUTPUT SHAFT	Ck60N
2	WORM WHEEL	PHOSPHOR BRONZE (Pb ₂ BC)	5	BEARINGS	ANTIFRICTION (Taper Roller Bearings)
3	GEAR CASE	CAST IRON	6	OIL SEALS	RADIAL

The material specified above is only for standard Worm gear units. For special application depending on criticality of load conditions, Elecon Design office suggests special material and can be offered with additional price.



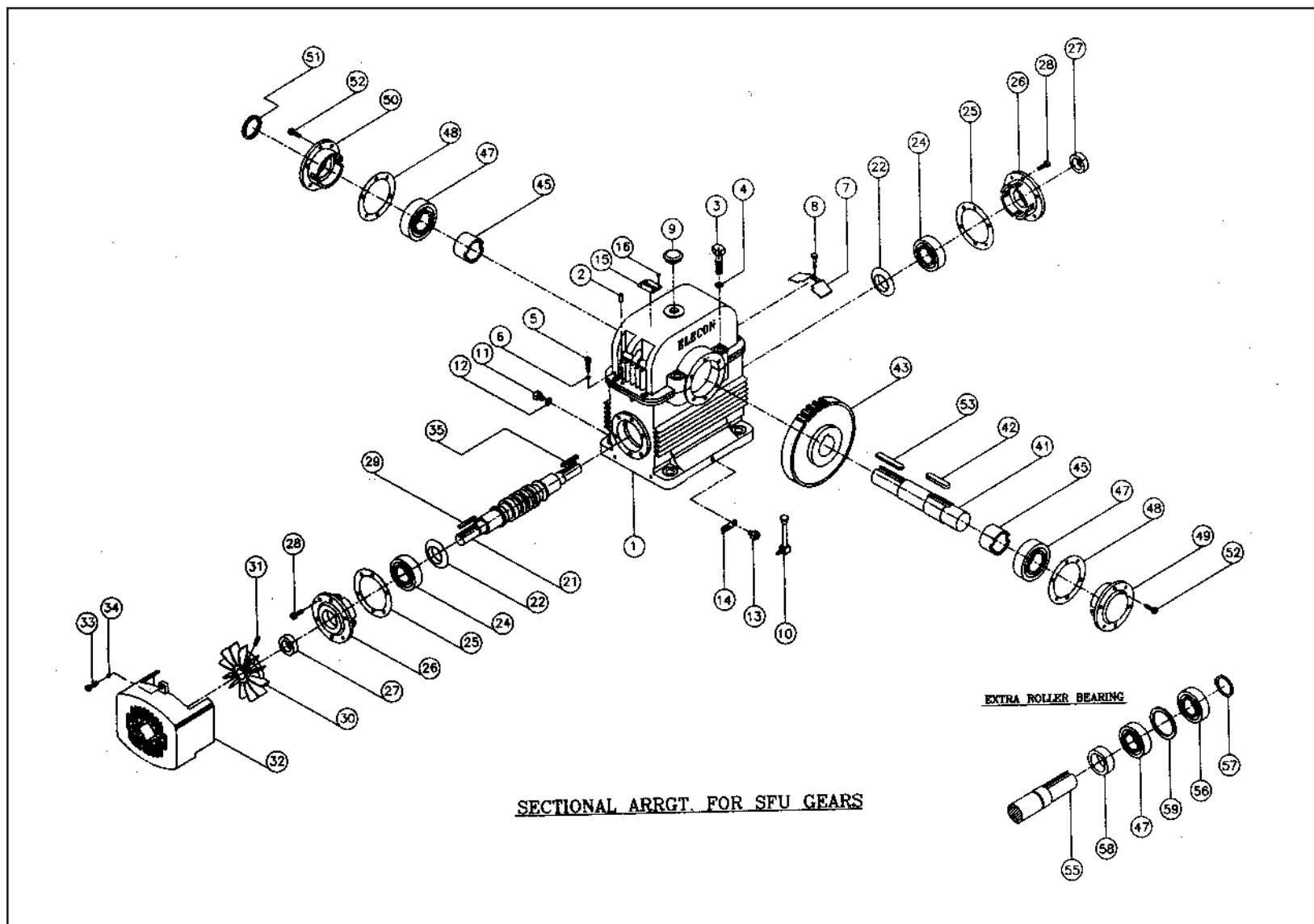
EXTRA ROLLER BRG. ASSLY.

SECTIONAL ARRGT. FOR SNU GEARS

PART NOS. FOR SNU - U, O, V, GEAR UNITS

PART NO.	DESCRIPTION	QTY/GB	CODE NO.
1	GEAR CASE	1	
2	BREATHER PLUG	1	
3	DRAIN PLUG	4	
4	NYLON WASHER	1	
5	OIL LEVEL INDICATOR	1	
6	M/F ELBOW WITH CHECK NUT	1	
7	SEALING CAP	1	
9	NAME PLATE	1	
10	RIVET	4	
11	STRAIGHT GREASE NIPPLE	2	
12	FEET	2	
13	HEX. HEAD SCREW	4	
21	WORM SHFT	1	
22	TAPER ROLLER BRG.	2	
23	WORM SHFT OPEN COVER	2	
24	OIL SEAL	2	
25	SHIMS	1SET	
26	HEX. HEAD SCREW	12	
28	FAN	1	
29	HEX. SCOKET GRUB SCREW	1	
30	KEY FOR FAN	1	
31	FAN COWL	1	
32	HEX. HEAD SCREW	4	
33	KEY ON EXTENSION LENGTH	1	
41	SLOW SPEED SHAFT	1	
42	WORM WHEEL	1	
43	KEY FOR WORM WHEEL	1	
44	DISTANCE PIECE	2	
45	TAPER ROLLER BEARING	2	
46	BEARING HOUSING	2	
47	HEX. HEAD SCREW	24	
48	BLANK COVER	1	
49	OPEN COVER	1	
50	SHIMS	1SET	
51	HEX. HEAD SCREW	12	
52	OIL SEAL	1	
53	BAFFLE PLATE	2	

PART NO.	DESCRIPTION	QTY/GB	CODE NO.
54	KEY ON EXTENSION LENGTH	1	
55	HEX. SOCKET SCREW	8	
56	BASE	1	
58	PLUG		
	(IN PLACE OF GREASE NIPPLE)] FOR "V" MOUNTING	1	
EXTRA ROLLER BRG. ASSLY			
41	SLOW SPEED SHAFT	1	
61	DISTANCE PIECE	1	
62	DISTANCE RING	1	
63	CYLINDRICAL ROLLER BEARING	1	
64	EXTERNAL CIRCLIP	1	



PART NOS. FOR SFU GEAR UNITS
G/B SIZES : 10", 12", 14" & 17"

PART NO.	DESCRIPTION	QTY/GB	CODE NO.	PART NO.	DESCRIPTION	QTY/GB	CODE NO.
1	GEAR CASE	1		52	HEXAGON HEAD SCREW	12	
2	SPRING DOWEL SLEEVE	2		53	KEY ON EXTN. SIDE	1	
3	HEXAGON HEAD BOLT	4					
4	SPRING WASHER	4			EXTRA ROLLER BEARING		
5	HEXAGON HEAD SCREW	4					
6	SPRING WASHER	4		55	SLOW SPEED SHAFT	1	
7	OIL SCRAPER	2		56	CYLIDRICAL ROLLER BEARING	1	
8	HEXOGON HEAD SCREW	4		57	EXTERNAL CIRCLIP	1	
9	FILTER PUG	1		58	DISTANCE RIECE	1	
10	'L' TYPE OIL LEVEL INDICATOR	1		59	DISTANCE RING	1	
11	DRAIN PLUG	1					
12	NYLON WASHER	1					
13	PLUG	1					
14	LABEL	1					
15	NAME PLATE	1					
16	HAMMER DRIVE RIVETS	4					
21	WORM SHAFT	1					
22	OIL THROWER	2					
24	TAPER ROLLER BEARING	2					
25	SHIMS	1SET					
26	WORM SHAFT OPEN COVER	2					
27	OIL SEAL	2					
28	HEXAGON HEAD SCREW	12					
29	KEY	1					
30	FAN	1					
31	HEXAGON SOCKET GRUB SCREW	1					
32	FAN COWL	1					
33	HEXAGON HEAD SCREW	3					
34	SPRING WASHER	3					
35	KEY ON EXTN. SIDE	1					
41	SLOW SPEED SHAFT	1					
42	KEY	1					
43	WORM WHELL	1					
45	DISTANCE PIECE	2					
47	TAPER ROLLER BEARING	2					
48	SHIMS	1SET					
49	S. S. SHAFT BLANK COVER	1					
50	S. S. SHAFT OPEN COVER	1					
51	OIL SEAL	1					

PRODUCT SAFETY INFORMATION

General ELECON gear units will operate safely provided that they are selected, installed, used and maintained properly. As with any equipment that consists of rotating shafts and transmitting power, adequate guarding is necessary to eliminate the possibility of physical contact with rotating shafts or coupling.

Potential Hazards The following points should be noted and brought to attention to the persons involved in the installation, use and maintenance of equipment.

1. For lifting of gear unit, eye-bolts or lifting points (on larger units) should be used.
2. Check the grade and quantity of lubrication before commissioning. Read and carry out all instructions on lubricant plate and in the installation and maintenance manual literature.
3. Installation must be performed in accordance with the manufacturer's instructions and be undertaken by suitably qualified personnel.
4. Ensure the proper maintenance of gear boxes in operation. USE ONLY ELECON Spares for gear boxes.
5. The oil level should be examined periodically, if required the oil should be filled again.
6. The operating speeds, transmitting powers, generated torques or the external loads must exceed the design values.
7. The driving and the driven equipment must be selected to ensure that the complete installation of the machinery will perform satisfactorily e.g. avoiding system critical speeds, system torsion vibration etc.

NOTES FROM CLIENT :

NOTES FROM CLIENT :

CUSTOMER'S FEEDBACK

ELECON CONTACT

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Always a step ahead in technology

CONTENT

DATA SHEET	
BAG FILTER	
DESCRIPTION	SPECIFICATION
GENERAL DATA:	
MAKE	M/S. BATLIBOI ENVIRONMENTAL ENGINEERING LIMITED
QUANTITY	1 NO
APPLICATION	FLY ASH COLLECTION
FUEL	DOB
MEDIUM	FLUE GAS
TYPE	REVERSE PULSE JET (ONLINE CLEANING)
NUMBER OF FIELD	1
GAS VOLUME (M ³ /SEC.)	6.95 (25020 AM ³ /hr)
GAS TEMPERATURE	
NORMAL / MAXIMUM / MINIMUM (°C)	170 / 180 / 160
INLET DUST CONCENTRATION (gms/NM ³)	13.73
OUTLET DUST CONCENTRATION (mg/NM ³)	LESS THAN 150
GUARANTEE PRESSURE DROP ACROSS THE BAGS	
DURING INITIAL START UP	125 MMWC
MAX. PRESSURE DROP DURING OPERATION	150 MMWC
GROUND CLEARANCE BELOW HOPPER (mts)	1200 MM
COMPRESSED AIR QTY REQUIRED	40 Nm ³ /hr
PRESSURE RANGE	5 - 6 Ksc(g)
QUALITY	CLEAN AND DRY AIR.
AIR TO CLOTH RATIO	1.3 M ³ /min/m ²
FILTERING AREA	319 M ²
BAG DETAILS	
SIZE (DIA X LENGTH)	152 X 3965 MM
MATERIAL	RYTON
QUANTITY (NOS)	169 NOS.

DATA SHEET	
BAG FILTER	
DESCRIPTION	SPECIFICATION
FLUE GAS COMPOSITION (APPROX)	
- CO2 (%)	15.54
- H2O (%)	13.34
- O2 (%)	3.61
- N2 (%)	67.41
- SO2 (%)	0
PARTICLE SIZE DISTRIBUTION	69% - ABOVE 14.5 MICRONS 31% - LESS THAN 14.5 MICRONS 22% - LESS THAN 8.5 MICRONS 18% - LESS THAN 5.2 MICRONS
CONSTRUCTIONAL DETAILS	
TOP PLENUM	
MATERIAL	MILD STEEL
THICKNESS (MM)	3.15
MID CASING	
MATERIAL	MILD STEEL
THICKNESS (MM)	3.15
HOPPER	
MATERIAL	MILD STEEL
THICKNESS (MM)	3.15
TUBE SHEET	
MATERIAL	MILD STEEL
THICKNESS (MM)	5
PULSING VALVES	
QUANTITY	13 NOS
SIZE	40 NB
POWER SUPPLY	220 V AC SINGLE PHASE

DATA SHEET	
BAG FILTER	
DESCRIPTION	SPECIFICATION
TIMER	
QUANTITY	1 NO.
TYPE	SOLID STATE SEQUENTIAL
PULSE DURATION (MILLI SECONDS)	20 TO 200
INTERVAL	1.5 TO 60 SECONDS
POWER SUPPLY	220 VAC SINGLE PHASE
DIFFERENTIAL PRESSURE SWITCH	
TYPE	DIAPHRAM SEALED PISTON ACTUATED
PRESSURE RANGE	25 TO 250 MMWC
POWER SUPPLY	220 VAC SINGLE PHASE

SUPPLIER'S ADDRESS:

**M/S. BATLIBOI ENVIRONMENTAL ENGINEERING LIMITED,
BATLIBOI HOUSE,
GOVNDI (W) ,
MUMBAI – 400 043.**

CONTENT

M/s CETHAR VESSELS LTD.

**4, Dindigul Road, Tiruchirapalli
TamilNadu - 620 001**

**Operation and Maintenance Manual
For
Bag Filter**

**Design & Supplied By
Batliboi Environmental Engineering Ltd.,**

BATLIBOI HOUSE

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NOTE

These instructions do not purport to cover all details or variations in the equipment or to provide for every possible contingency to be met in connection with installation, operation or maintenance. The information contained herein is not to be used for design purposes. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to Batliboi Environmental Engineering Ltd. Mumbai.

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- 1. BAG FILTER**
- 2. ROTARY AIR LOCK VALVE**
- 3. INSTRUMENTS**
- 4. DRAWINGS**

BAG FILTER

Operation and Maintenance Manual

For Bag Filter

SR. NO.	DESCRIPTION	MODEL NO.	DRG NO. BEEL/	REV.	QTY.
1	BAG FILTER	1715 RA 156	3595-01/2	0	1





BATLIBOI ENVIRONMENTAL ENGG. LTD.

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BATLIBOI ENVIRONMENTAL ENGG. LTD.

(I) INTRODUCTION

This document contains information and drawings for the installation, operation, and servicing of the Batliboi JET - III air pollution control equipment and some vendor supplied items.

(II) SYSTEM DESCRIPTION

The air pollution control equipment ordered under this contract is one of the most efficient dust collectors in existence, the Batliboi JET - III. This system uses controlled blasts of compressed air to run the bag-cleaning system.

In normal operation, the Jet III Bags operate in the suction mode, with the unclean air passing from the outside of the bag through the fabric to the inside and then out through the upper end. At intervals set by a timer, bursts of compressed air are released in the reverse direction into the bags, thus expanding them successively to their maximum size and dislodging the deposits of dust. As soon as the expansion energy is spent, the bags return to normal filtering position and the dust that has just been pulsed off falls into the collection hopper assisted by downward air patterns.

The specific items of equipment ordered under this contract are related as per the technical specifications attached separately

THEORY OF OPERATION JET III DUST COLLECTOR

The Jet III Pulse-Jet Dust Collector is a continuous automatic suction or pressure type dust collector capable of filtering dust laden air through a felted filter media.

The dirty or contaminated gas enters the dust collector through the module inlet. A baffle plate distributes the gas uniformly throughout the housing and drops out heavy particulate into the hopper. The dust laden air then passes through a number of filter tubes which retain the dust particles on the exterior surface while allowing the clean gas to pass through to the module outlet.

As the collector operates, the collected dust begins to form a dust cake which eventually diminishes the porosity of the filter tubes. This reduction in porosity is measured by a U-tube manometer. As the pressure drop increases, the ventilation volume of the collector decreases.

To maintain a moderate pressure drop, the cleaning cycle is employed to provide continuous cleaning of the filter bags. The cleaning system consists of a solid state program timer which actuates electric solenoids governing the air valves. These air valves deliver a momentary burst or pulse of high compressed air through the manifold pipe into the filter tube. This pulse of air creates a reverse air flow which expands the filter tube to remove the collected dust.

This cleaning procedure occurs on a row by rows basis, therefore, only a fraction of the total filter air is interrupted for cleaning allowing continuous ventilation.

The dust cake when pulsed from the filter bags falls directly into the hopper where it is removed by the dust conveying system.



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STANDARD PROCEDURE FOR ERECTING A JET III DUST COLLECTOR

These instructions concern erection procedures for a typical Jet III Unit. For the specific arrangement of the equipment purchased, please see the General Arrangement drawing.

1. FOUNDATION

- 1.1. The foundation should be prepared according to the anchor bolt location layout, which is usually found on the General Arrangement Drawing. Piers, or slabs, are to be designed by the customer to suit loadings of the unit as indicated on the above drawings and by soil conditions.

2. ERECTION

- 2.1. After verifying that foundation dimensions are accurate to within 3mm, bolt the support columns to the anchor bolts. Erect the rest of the support steel, tightening the bolts only enough to hold the columns in an upright position until the hopper is installed. Level and square the framework with shims under the base plates if necessary; then tighten all bolts and grout under the base plates.

NOTE -1: It is essential that all pieces of support steel (i.e. columns, beams, bracing, etc.) be erected before setting any piece of the collector.)

NOTE-2: All high strength bolts shall be installed in accordance with the specifications for structural joints. The tightening mechanism used shall be either a torque wrench, a properly calibrated impact wrench, or the turn-of-the-nut method.

- 2.2. Set hopper into place on the support steel, and bolt in loosely. Make sure entire structure is level and square; then tighten bolts to the proper pretension values. Warning: Do not set hopper without installing cross bracing.

NOTE: Some small units arrive on site with support steel attached.

- 2.3. Lift the module housing by the lugs provided on the top corners and set the housing assembly on the hopper support channels. Insert aligning bolts in flanges and weld air tight at seam on the inside of the module.

NOTE-1: Welding shall be done while housing is not subjected to any live loads.

NOTE-2: Some units arrive on site in one piece, therefore. This procedure may not be necessary.

- 2.4. Assemble the walkway and handrail on the ground near the unit, Cut, bend and weld handrail to suit. Place ladder(s) in desired position and cut cage to suit. Weld to the support framework.

- 2.5. Bolt inlet and outlet ductwork to module inlet and outlet making sure to use a gasketing material between flanges on modules where an inlet or outlet damper valve is required. Bolt all mating flanges as above with gasket material. Be sure that damper blade and damper actuator have proper clearance and do not have interferences.

NOTE: Inlet and outlet ducts are not to be supported from collector flanges. All ductwork must be self-supporting.



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- 2.6. Assemble screw conveyor and/or rotary valve to hopper discharge flange, making sure to use a Gasketing material between all flanges. Assemble drive components and wire motors taking note of rotation.

NOTE: Ensure all joints in filter house and at flanges are air tight by providing proper gasket.

2.7. BAG INSTALLATION

Roof & Top Access Style:

NOTE: To insure proper operation and the longest possible bag life, it is imperative that bags be handled with care at all times. Any small cut or puncture can result in total bag failure in the future.

Before bagging the collector, inspect all cages for broken or bent wires. Do not install damaged cages into bags. Bag rows nearest side walls first then proceed to work towards access door. Remove any dust, debris or excess paint from the tube-sheet before installing bags.

Install bags by first inserting closed end portion of bag into tube-sheet hole. It is helpful to fold bag in half lengthwise while lowering into tube-sheet.

Compress snap ring by grasping with both hands and pushing in with thumbs. Once the top ringed portion of the bag is inserted in cup. Be certain it is properly seated. Top edge of bag cuff should be slightly below top of the tube-sheet or just even. We suggest bagging three rows front to back before proceeding to next step.

Snap cage to (open end) onto venturi lugs, making sure venturi is locked into place.

NOTE: Be certain that the venturi lugs do not line up with the splits in the cage ring.

Insert closed end of cage into bag and allow cage to slide until venturi flange rests flatly on the tube-sheet.

NOTE: There is no fastening hardware required as the interference between the bag and cage is sufficient to hold down the assembly.

2.8. MANIFOLD PIPE INSTALLATION

Remove compression nut and spacer from coupling and slide on manifold pipe, followed by gasket. Place manifolds with holes facings down and adjust pipe such that holes are directly over the venturi throats. Bolt tail to support angle firmly and slip compression nut. Spacer and gasket on and into coupling. Secure nut firmly on coupling and at tail. Proceed through all rows working side wall ends first and working to door until complete.

2.9. COMPRESSED AIR

To insure trouble free operation and adequate supply of clean, dry compressed air is essential. Check the detail of order to see Batliboi recommendations for the compressed air required. The pressure at the air header (air valves) should be 6 kg/cm², 8.5 kg/cm² maximum. Recommends that a line filter, dryer and regulator be installed ahead of the air header to insure trouble free service. All air piping should be of 32dia, minimum with a remote shutoff valve with pressure gauge located at each header section. The air header inlet is located on the bottom side of the air header.



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ELECTRICAL

For trouble-free service, a solid state pulse timer is provided in a IP-55 weather-tight enclosure (explosion-proof optional). The timer is to be remotely mounted in an area that is free of the danger of being bumped or damaged, yet is accessible. To wire solenoids to timer, follow the wiring schematic as shown per Elect. Drawing recommended wire from the timer to solenoids is No. 12 gauge and should be encased in a 25 mm dia. minimum conduit.

Power input and output to and from the timer is 200/220 volt AG. It is recommended that a toggle-type on/off switch be located ahead of the timer for isolation purposes during maintenance.

NOTE: That the timer is equipped with "on time" and "off time" control knobs. Do not adjust the "on time" setting as it has been factory set to give a 50 millie-second pulse. The "off time" can be adjusted as required to maintain a satisfactory differential pressure across the filter. Decreasing the off time increases the pulse rate causing the unit to clean at a faster rate.

Wire all motors-fan, air locks. Screw conveyor, Compressor, etc., - in accordance with nameplate data and note rotation of each to insure proper operation of driven equipment.

If light fixture (optional) is furnished, locate in a convenient location free from the danger of being bumped. Be sure to install a toggle-type on/off switch.

PRECOMMISSIONING FOR JET III DUST COLLECTORS

The following should be checked and corrected before introducing dust laden air into the filter.

1. Check filter bags for proper fit into the cup so that the top edge of bag cuff is slightly below the top of the tube sheet or just even.
2. Make sure the cage is properly snapped into the venturi lugs and that venturi flange is flush with the tube sheet floor. NOTE: No additional hold down device is required, as the interference fit between the cage and bag is adequate.
3. Make certain the manifold pipes are parallel; the holes are facing down and are centered over the venturi throats. Manifolds should be secure by connection of the open end of pipe to coupling and bolts to the manifold support angle at rear of module.
4. Insure the access door is properly secured and sealed.
5. Inspect hopper area to insure that the screw conveyor and/or rotary valves are free of debris. Firmly secure hopper access door or bolted panels.



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6. Check the screw conveyor for correct rotation. The rotary valve direction should also be checked.
7. Open the compressed air header drain plugs and slowly feed compressed air to header system via shut off valve. When header discharge is free of visible moisture, close the drain cocks or plugs.
8. Energize the electronic timer(s) on the timer board and adjust for a rapid firing sequence. Observe signal lights until all terminals have been fired. (See timer schematic wiring diagram if trouble occurs).
9. With timer operating as described and air header charged, check 'audibly' for the energizing of all pilot. (Solenoid) valves. These are positioned on the collector just above the air header.
10. Reduce compressed air pressure by adjusting the regulating valve for approximately 6 kg/cm² at the air header. Check the operation of each diaphragm valve in turn. The 'normally closed' diaphragm (air valves) will open only on being signaled by the timer via the pilot (solenoid) valves. The sudden release to atmosphere of compressed air from the 'bleed- hole' of each pilot valve will prove the air valves are being opened as required. NOTE: At no time should two adjoining valves fire simultaneously. Check timer wiring diagram if this occurs.
11. Reset timer adjustment back to an "off time" setting of about 60 seconds and isolate power with disconnect switch.
12. Check to insure that each collector is fitted with a manometer, or magnehelic differential pressure gauge (zero liquid level in manometer for correct setting prior to starting fan). A manometer is shipped for each collector module. Be sure tubing lines are clean and tight.
13. Close the exhaust fan damper valve. On initial start-up, the fan must be under dampened condition. Failure to do so could seriously damage the filter media and cause premature "blinding" of the filter cloth. Excessively high differential pressure across the filter could also result in leakage of the finer dust particles to atmosphere.
14. Test start (bump) the exhaust fan to insure proper rotation.
Note: The above instructions are general in nature and are not intended to detail all aspects of all units. If any questions arise or if any areas are not covered and require explanation, contact Batliboi.

SYSTEM START UP & SHUT DOWN

SYSTEM START UP

1. Start mechanical dust handling system. Screw conveyor(s) and/or rotary air lock valves.



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2. Insure compressed air is open to header system at a pressure of 4 kg/cm² minimum and increase as required.
3. Start exhaust fan in dampened condition as previously described. NOTE: On process systems where water vapor or other condensable are present, it is necessary to preheat the system so that the module skin temperature of the complete dust control system is above the dew point temperatures. The gas temperature should be maintained above the dew point of the condensable and below the maximum limit of the filter media.
4. Slowly and in 10% increments, open the fan damper with enough time between increments. Observe and record differential pressure at each increment. Upon reaching 100% damper opening or full fan motor current, continue recording pressure drop until reaching 100-125 mm W.G. check for stable operation and temperature.
Note: Over cleaning of cloth must be avoided. Operate at prescribed pressure drop, Differential pressure switch available as optional equipment.
5. At this point, start the pulse cleaning system. The timer off-time setting should be adjusted for a one (1) minute pulse frequency initially. Increase or decrease the off-time setting to pulse as required to maintain a manometer reading between 100-125 mm.
6. If timer off-time is at minimum, and differential pressure continues to rise, increase air pressure in 1 kg/cm² increments until pressure drop stabilizes at 100- 125 mm across bag house.
7. With the collector operating at design volume, the pulse frequency should ideally be

set for the fewest pulses/minute while holding the pressure differential across the filter bag at a stable condition above 75mm.
Note: During periods of gas flow stoppage when the system is not required, it is recommended that the timer be shut down to prevent over cleaning of the filter media.

System Shut Down

- a) Fan off, (Purge on acid gas applications)
- b) Timer on for one (1) cleaning cycle or manually pulse unit(s).
- c) Timer off.
- d) Leave dust handling system on for 30 minutes after timer is shut off.

If you have questions as to the correct procedures, do not hesitate to contact Batliboi.

TROUBLE SHOOTING

1. VISIBLE STACK EMISSIONS

- 1.1 Improperly installed bags: Check bag snap bands to insure full expansion into tube-sheet.



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- 1.2 Torn or Punctured bags: Bag should be flush or slightly below the top of tube-sheet. Inspect filter bags for tears or punctures caused by mechanical damage during installation. Abrasion, thermal or chemical attack and broken cages can also cause failures.
- NOTE: If cage wires are broken or split, replace cages immediately. Do not put new bags on broken cages.
- NOTE: Always clean tube-sheet after replacing bags.

2.0 HIGH DIFFERENTIAL PRESSURE

- 2.1 Over Volume: Check fan and motor to insure proper RPM.
Adjust fan damper to design volume. Some fans are sized over volume.
- 2.2 Lack of Compressed Air: System resistance is too low.
Check the pulsing system for compressed air leakage repair as required.
Check the compressor output to assure it meets pulse cleaning system usage.
Compressed air pressure too low-increase line pressure from regulator- compressor.
Check the piping for any malfunctions.
Check lubricator, regulator and clean line filter.
- 2.3 Malfunctioning Timer: Check the timer outputs to insure all terminals are firing. If timer is faulty, replace.
Check the program wire to insure that the last terminal will have included all the solenoids.
- 2.4 Dust Re-entrainment : Check the dust removal system for worn or faulty seals - repair or replace as required.
Check the mating flanges - apply Gasketing and/or re-tighten fasteners as required.
Check the dust disposal system for proper operation, including hopper obstructions.
- 2.5 Bag Blinding: Insure that the gas temperature is at designed operating temperature.
Over cleaning of the cloth must be avoided, operate at prescribed pressure drop.

3.0 INADEQUATE SYSTEM VOLUME

- 3.1 Fan rotating backwards: Check and correct if necessary.
- 3.2 High Differential Pressure: See Section 2.0 Above.
- 3.3 Fan RPM low: Check drive ratio between fan and motor. Check Drive for slippage - retighten or replace as required.
Fan damper improperly adjusted.



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- 3.4 Leakages in System: Check all ducting and flanges to and from collector for leaks, Re-gasket and re-tighten fasteners as required. Check hopper dust disposal equipment for leaking seals. Adjust or replace as required.
- 3.5 System Resistance too high: Check ductwork for material buildup or blockages. Clear to lower system resistance.
- 3.6 Blinded bags result in high pressure drop: Clean bags with fan off, restart fan and check differential pressure, If differential pressure is still high, install new bags. See 5.0 - Filter Bag Problems.
- 4.0 LOW COMPRESSED AIR**
- 4.1 Sticking Solenoid Valves: Check solenoid plungers for dirt. Clean or replace as required. Short circuit in wiring may cause one or more solenoids to remain open - check wiring and repair or replace as required. Short circuits in timer relays - check and repair if possible. Replace timer, if required.
- 4.2 "On-time" too long. Adjust "on-time": (Factory setting- 500 Millie Sec.)
- 4.3 Sticking diaphragm valves: Check for torn or damaged diaphragms. Replace as required.
- 4.4 Debris in diaphragm valves: Check for dirt or frost on diaphragm wafer. Clean or replace as required. If frost, install dryer on compressed air system to eliminate moisture.
- 4.5 Leaks in compressed air system: Inspect compressed air system and repair of required.
- 4.6 Insufficient supply of compressed air: Check capacity of air compressor to insure proper sizing. See Detail of Order to determine demand of unit. Also check for under designed branch-offs in compressed air system. Add extra capacity or independent source if required.
- 5.0 FILTER BAG PROBLEMS (Poor Life, Blinding, Etc.)**
- 5.1 Check system operating temperature against filter media rating.
- 5.2 Check the chemical characteristics of the gas for compatibility with the filter media.
- 5.3 Check for abrasion patterns on bag, collector walls, etc. Evaluate duct design or install larger baffle plate.



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- 5.4 Check for material build-up in hopper.
Inspect dust disposal equipment for proper operation. Repair as required.
- 5.5 Check for hopper bridging. Install vibrators, rappers, etc. or enlarge discharge opening.
- 5.6 Incorrectly installed bags. Check for proper seating of bag into tube-sheet also, be certain bags are not touching walls.
- 5.7 Inspect cages for broken or bent wires which can puncture or tear bags. Replace cage(s).
- 5.8 Inspect tube-sheet floor for dust accumulations, Dust on tube-sheet floor can enter the inside of the bag by the cleaning system. This can cause blinding or abrasion by impregnating bags from the reverse direction.
- 5.9 Rough handling of bags at time of installation can lead to bag failures.

INSPECTION AND MAINTENANCE

1. AIR CYLINDER OPERATORS AND SOLENOID VALVES

- 1.1. **DAMPER VALVE OPERATORS:** All /some damper valves on this unit are operated by air cylinders. An adequate supply of clean, compressed air is required for satisfactory operation of the air cylinder. A filter, drip-well and oiler should be installed in the line with a manually operated pressure regulator between filters and air cylinders Service to the air cylinders is kept to a minimum if the above suggestions are followed. It would be wise to check air cylinders for air leaks at monthly or bimonthly periods. An air leak can usually be detected by the noise. The filter and drip-well should be drained on the weekly inspection of the collector and filter material replaced when necessary. The pressure regulator requires no attention, except the cleaning of the exhaust vent as long as satisfactory operation continues. As a semi-annual maintenance, check air lines for moisture, oil or dirt. The normal position of the air cylinder shafts should be retracted in order to minimize corrosion.
- 1.2. **SOLENOID VALVE:** Refer to the solenoid valve instructions as listed in the Table of Contents, Part I.
- 1.3. **NOISE:** Two types of noises are present in the solenoid valves one is due to opening and closing, which produces a clicking noise, the other is a straight magnetic hum such as a small transformer. When operated on alternating current, it is not noticeable unless amplified by the pipe lines or other attachments.
- 1.4. **CLEANING:** A periodic cleaning approximately once every six months of all solenoid valves is recommended. In general, if current supply is correct, sluggish action indicates that cleaning is required.



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(III) INSTALLATION AND MAINTENANCE OF SOLENOID VALVES

1. OPERATION :

Each valve opens when voltage is applied to the coil and the resultant magnetic field attracts the SS plunger with integral disc off the seat. In the de-energized position the plunger is held on the seat by a spring and the system pressure assists in seating. The solenoid valve is of the popper type construction with the disc automatically adjusting for wear. The only moving parts are the plunger and spring. To manually override the valve simply insert a rod, diameter of a paper clip, into the outlet and push.

2. INSTALLATION:

The assembly is complete with mounting lugs to secure it against a bulkhead. The ideal mounting arrangement is to have the coils in the vertical and upright position. This position shields the outlet, preventing rain or other foreign substances from settling therein, Screw terminals in the coil provide for one step electrical connections.

3. SERVICE

The valve requires no periodic service. Should a valve malfunction the cause is usually dirt from the system.

4. TROUBLE SHOOTING

4.1. VALVE DOES NOT OPEN:

Step 1. Confirm adequate electrical service.

Step 2. Remove cover.

Step 3. Coil- check continuity, or if metallic click is heard when coil is energized, the coil is not the source of the problem.

Step 4. Depressurize the system.

Step 5. Remove body for access to plunger, spring and orifice. Check orifice to be sure it is not blocked or for other foreign objects that may prohibit Operation.

Step 6. If dirt was 'problem clean and reassemble.

Step 7. If plunger is excessively worn, to where it lodged in the ferrule assembly, rebuild valve with the repair kit.

4.2. VALVE DOES NOT CLOSE:

Step 1. Disconnect the electrical signal to be sure coil is not continuously energized.

Step 2. Depressurize the system.

Step 3. Remove body for access to plunger, spring and orifice, check for dirt in valve preventing disc from sealing on seat.

Step 4. If dirt was the problem clean and reassemble.

Step 5. if disc is excessively worn to where it will not seal on the seat or plunger is jammed in enclosing tune because of excessive wear, rebuild valve with the repair kit.



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PRESSURE SENSING MANOMETERS

The effectiveness of the dust collector is monitored by manometers. The manometer compares the air pressure on the dirty air section of the dust collector with the pressure on the clean air side. There is one manometer for each compartment filter.

CLEANING

The tubing can be cleaned by disconnecting the fittings at the manometers head assembly, and using compressed air to blowout the dirt. Small valves should be installed to permit easy connection of a compressor directly to the line.

Manometers also detect malfunctioning because of improperly operated valves and leaks in tubing connections. The integrity of the entire unit should be checked thoroughly when a leak is suspected.

SAFETY

Manometers should not be cleaned or fluid changed unless the compartment or unit is shutdown or valued off.

INSTRUCTIONS FOR REMOVAL AND REPLACEMENT OF JET III BAGS

1. BAG REMOVAL

- 1.1. Loosen the manifold compression coupling nut in the front of the module and slide nut and gasket down the manifold pipe. Remove the bolt holding the crimped end of the manifold pipe from the support angle in the rear of the module. Slide the manifold pipe out of the coupling and set aside.
- 1.2. Pull the Venturi and bag cage out of the tube sheet as a complete assembly. Inspect the cage for broken or bent wires. Do not re-install a damaged cage
- 1.3. Reach inside the bag and collapse the bag snap-ring using the finger loop attached to-the top inside portion of the bag cuff. The bag may then be pulled up through the tube sheet and discarded or dropped into the hopper below for removal. Do not forget to remove the bag from the hopper.
- 1.4. Remove any dust, debris or excess paint from the tube-sheet before installing bags.

2. BAG REPLACEMENT

- 2.1. Replacement bags should be carried to the module in the original containers. Unpack only one bag at a time. Bags should not be dragged along walkways, through a doorway, or across the manifold pipes.

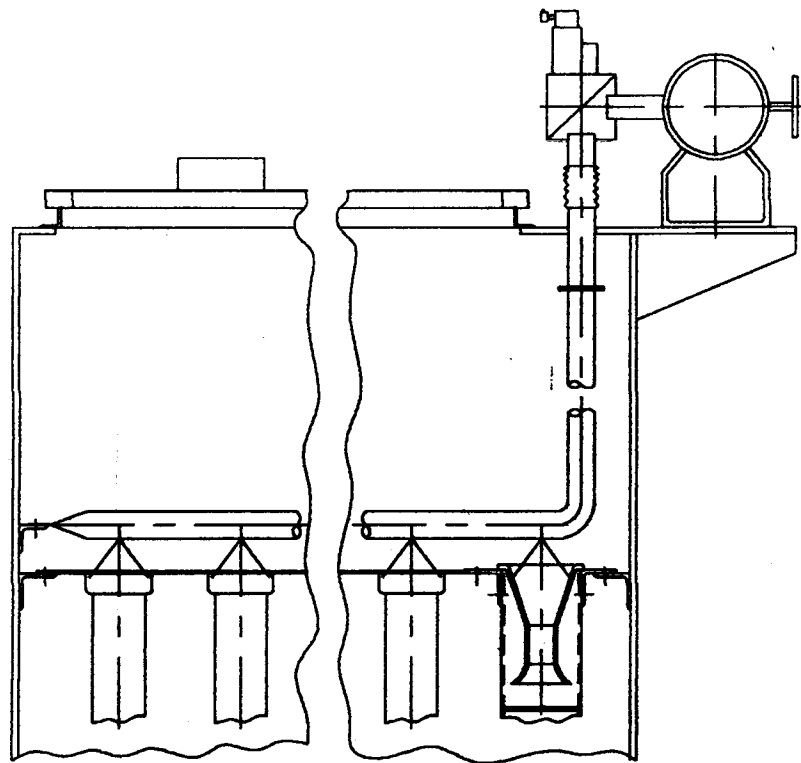


FIGURE 1

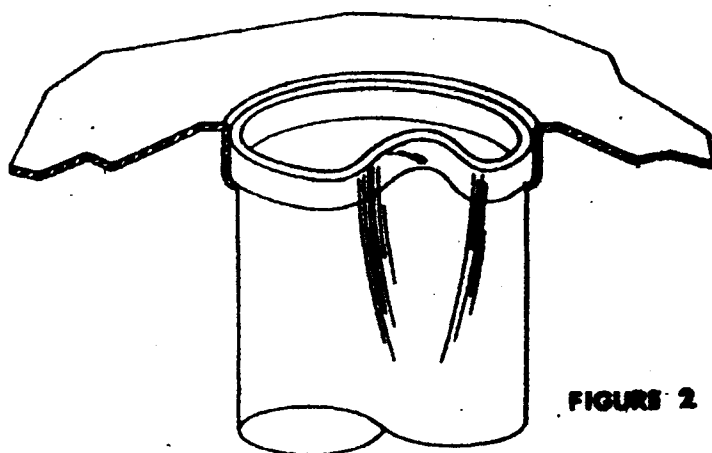


FIGURE 2

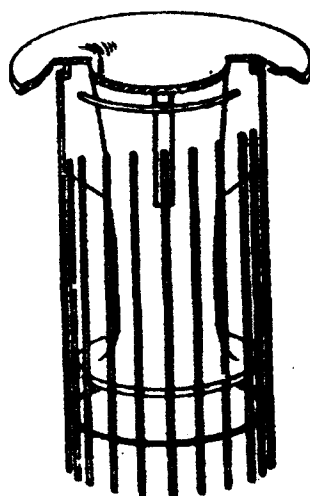


FIGURE 3



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- 2.2. The people installing the bags should remove all sharp objects from their person. It is imperative that the bags be handled with care at all times. Any small cut or puncture caused by a screw driver or belt buckle can result in total bag, failure in the future.
- 2.3. Before installing the new bag, inspect the cage for broken or bent wires. Do not install a damaged cage into a bag.
- 2.4. To install the bag, first insert the closed end portion of the bag into the tube-sheet hole. It is help full to fold bag in half length wise while lowering into tube-sheet.
- 2.5. Collapse the snap-ring at the top of the bag by grasping with both hands and pushing in with thumbs (See Figure 2). Once the top portion of the bag is inserted in the tube-sheet, (See Figure 1) be certain it is properly sealed. (Top edge of the bag cuff should be slightly below the top of the tube-sheet or just even.)
- 2.6. If a new cage is to be installed, snap cage top (open end) onto venture lugs. Verify that the Venturi is locked into place (See figure 3).
- 2.7. Insert closed end of the cage into bag, allow cage to slide until the Venturi flange rests flatly on the tube-sheet.
- 2.8. Replace the manifold by, first inserting the manifold pipe into the coupling. Adjust the manifold so that the holes are facing down and are directly over the Venturi throats. Bolt the crimped end of the manifold to the support angle ill the rear of the module. Slide the coupling gasket and nut down the manifold and tighten.



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REPAIR PARTS INFORMATION SHEET

1. This section contains a list of repair parts that we recommend you maintain as spares to guarantee operation of your Batliboi pollution control equipment. If possible, repair parts should be stocked before initial start-up.
2. It would be your advantage to amend your original Purchase Order to include spare parts. They can be capitalized and written off as depreciation, rather than being counted as a budget expenses.
3. Batliboi will handle and supply all replacement parts. Orders and inquiries for replacement parts should be sent to this address

Batliboi Environmental Engineering limited
'Batliboi House'
Govandi West
Mumbai 400 043
Ph: 022-25587421 / 25583031
Fax: 022-25566677 / 25566949

4. The recommended spare list includes items Batliboi manufacturer, plus vendor supplied items.
5. Specific details and other information relating to equipment or parts can be best understood by referring to the drawings and instructions included in this manual.

STORAGE OF FILTER TUBES

Proper storage of Filter Tubes is essential in maintaining maximum collecting efficiency of your air pollution control unit.

Store Filter Tubes in the crate(s) in which they were shipped in a cool, dry place, (preferably on pallets covered with plastic, in a warehouse), where mold and physical damage to crates will not occur.



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(IV) TECHNICAL SPECIFICATION

TECHNICAL SPECIFICATION

	<u>COAL</u>	<u>GROUNDNUT SHEEL</u>
Type	: De-Dusting System	
Model	: 1715 RA 156	
Material Handle	: Fly Ash	: Fly Ash
Capacity (m ³ /Hr)	: 33228	: 37224
Operating Temp (°C)	: 170	: 170
Inlet Dust Load (gms/Nm ³)	: 56.8	: 2.18
Outlet Dust Load (mgm/Nm ³)	: 150	: 150
Pressure Drop (mm WC)	: 150 (Max)	: 150 (Max)
Air to Cloth Ratio (m ³ /min/m ²)	: 1.15	: 1.29
Filtration Area (m ²)	: 480	: 480
Comp. Air Requirement (m ³ /Hr)	: 50	: 50
Filter Media	: Ryton	
No of Filter Bag (Nos.)	: 255	
Size of Filter Bag (ø x Lg.)	: 152 x 3960	
No. of Pulse Valve (Nos.)	: 17	
Size of Pulse Valve	: 1 1/2", 24 V (1 Phase DC)	
Qty.	: 1 No.	

ROTARY AIR LOCK VALVE



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INTRODUCTION

Rotary Airlock Valves are positive displacement Valves used for discharging of powers, chips or any type of granules. They are capable of discharging material without disturbing the system pressure. They can be made in various types of materials of construction. For example: Stainless steel, Mild steel, Cast Iron, Cast Alloy Steel etc. depending upon the application.

INSTALLATION

Rotary Airlock Valves are installed below hoppers or on the pipelines having similar matching flanges with gaskets properly fitted. The top and bottom flanges should be bolted firmly after putting proper gasket in between. Generally, the final drive between the gear output and the Rotary Airlock Valve shaft is through chain and sprocket.

However, the drive can also be directly coupled to the equipment shaft. In such cases the drive output shaft speed should be equal to the rotor speed.

In drive system-using chain/sprocket, the geared motor is mounted on a base plate and the same is bolted to the valve body with in built out board lugs. The drive base plate will be provided with slotted holes for adjusting the chain tension if necessary.

If the drive motor is directly coupled to the equipment shaft, generally a separate base frame is provided for mounting the drive. However to make the arrangement compact and to avoid driving support for drive at site at difficult locations, the drive mounting frame is usually designed in such a way that the same can be bolted in between the valve outlet flange and the outlet duct flange.



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The following points should be checked up before starting the unit:

1. In case the final drive between Geared Motor and Rotary Airlock Valve is through chain and sprocket, the alignment of driving and driven sprocket to be checked up before starting. Also ensure that sufficient chain tension has been given. If the drive is directly coupled to the equipment shaft, coupling alignment has to be done. See that sufficient gap is provided between the two coupling halves as required for alignment of drive and coupling. Shims may be used wherever required.
2. Ensure that all the flange bolts are tightened properly with spring washers to avoid vibration. Also please ensure that the drive has been firmly bolted to its base.
3. Ensure that proper earthing has been given for the drive motor.
4. The Geared Motor is to be filled with proper quality/quantity of lubricating oil. The oil should be filled up in the Gear Box up to the level mark indicated.

MAINTENANCE

1. The rotor is provided with adjustable tips. The tips are having slotted holes. The clearance between the body inside and the rotor is in the range of 0.2 to 0.5 mm. after a period of operation, the clearance may increase resulting in the leakage of air. This clearance can be restored by adjusting the tips again to the desired clearance.
2. Grease nipple is provided on the bearing housing for lubricating the bearing.
3. The bearings are provided with felt seals for preventing the dust from entering the bearing. The felt seals are likely to wear out and should be replaced after 6 months of operation. The gland packing asbestos is provided at the shaft opening in the Rotary valve body. The gland packing also needs replacement after 6 months of operation. The gland packing to be replaced without dismantling the complete end cover.



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LUBRICATION

Refer Lubrication chart.

LUBRICATION CHART FOR ROTARY AIRLOCK VALVE

Sr. No.	Part to be Lubricated	Method of Lubrication	Recommended Lubricant	Frequency	Qty. charge
01.	Bearings	Through Grease Nipples provided on housing	Lithium Base Grease LITHOPLEX 2, 3 (high Temp. Application)	Once in 15 days (Refill after 3 months)	20 gms. (60 gms/ refill)
02.	Gland packing	Loose Gland & put oil	General purpose Lubricating oil/machine oil	Once in 15 days	10-15 drops
03.	Geared Motor/ Gear Box	Fill through Filling plug	REFER MANUFACTURER'S RECOMMENDATIONS		

INSTRUMENTS

- **D.P. SWITCH**
- **LEVEL SWITCH**
- **SOLENOID VALVE**
- **PRESSURE SWITCH**
- **SEQUENTIAL TIMER**
- **FILTER REGULATOR**
- **ZERO SPEED SWITCH**

D.P. SWITCH



OPERATION AND MAINTENANCE INSTRUCTIONS
FOR CLASSIC SERIES
PRESSURE / DIFFERENTIAL PRESSURE SWITCHES

SWITZER INSTRUMENT LIMITED
CHENNAI – 600 098
INDIA

SWITZER Pressure or Differential Pressure Switch is a simple electro mechanical device operating on basic principles of Levers and opposing forces. Three essential elements, various combinations of which form the basics for presenting hundreds of variants to suit a variety of industrial applications. They are :

1. sensing element either of bellows or diaphragm (metallic or elastomeric)
2. a stable spring to determine the range set point and
3. a snap-acting microswitch available in a wide variety.

Mounting / Connections / Precautions

1. Position gaskets correctly while covers are fixed. Cover mounting screws must be tight.
2. Properly seal the electrical entries and cables with correct cable gland, weatherproof or flameproof as required. If in doubt, consult factory.
3. Process pressure should not exceed stated maximum working pressure.
4. Connected electrical load should not exceed declared maximum electrical capacity BOTH in amperes and volts.
5. **Do not establish pressure connections by rotating the housing. Hold hexagon of the sensor pressure connector with suitable spanner and tighten.**
6. Mount the instrument firmly and rigidly either directly on the pressure piping or on a vibration free wall, panel or pipe stanchion.
7. If outdoor installation is envisaged provide sufficient protection against aggressiveness of air, dust, very low or very high temperature, solar radiation, water penetration etc. This is essential even for weatherproof instruments.
8. If process temperature is higher than the permissible maximum temperature, it can be brought down at the instrument end by employing a longer pressure piping. Ask factory for piping nomogram.
9. A condensate coil or Pig tail should be used invariably for steam service.
10. Ensure that suitable dampener / snubber is used in rapidly fluctuating pressure lines.

OPERATION

Pressure Switch : Models 201, 203, 281, 204, 208, 209 and 021 & 023

Process pressure when applied to the sensing element creates a force which overcomes that of a pre-tensioned spring, and in turn moves a balancing arm to effect a minimal movement required to actuate a microswitch (es).

Refer table below for sensing element type and material.

Instrument Model	Sensor & Material	On-off Differential
201	Bellows Phosphor Bronze / 316LSS / Monel	Fixed
203	Bellows Phosphor Bronze / 316LSS / Monel	Adjustable
281 (Dual Setpoint)	Bellows Phosphor Bronze / 316LSS / Monel	Fixed
204 (High Static Pressure)	Metallic Diaphragm 316SS / Monel/Hast'l C	Fixed
208	Metallic Diaphragm 316SS / Monel/Hast'l C	Fixed
209 (Food Grade / Hygenic Service)	Metallic Diaphragm 316LSS	Fixed
021 (Draft & Compound Ranges)	Elastomer Diaphragm Nitrile/ EPDM / Viton / Silicone	Fixed
023 (Draft & Compound Ranges)	Elastomer Diaphragm Nitrile/ EPDM / Viton / Silicone	Adjustable

Differential Pressure switch : Models 301,303, 381, 304, 384, 306, 386, 310, 313, GN 310

When pressures from two different sources in a process are connected across the sensing diaphragm, metallic or elastomeric, the pressure difference creates a force which when overcomes that of a pre-tensioned spring, moves a balancing arm to effect the minimal movement required to actuate a microswitch(es).

High and low pressures are applied on either side of the specially contoured diaphragm and this design feature straight away eliminates the errors due to the difference in area, a common problem present in twin element pressure differential switches.

In models 301/ 4, 303, 381/ 4, 306, 386 and GN 310, a unique motion transfer assembly is used, which is sensitive to minute movements of the diaphragm but immune to the application of very high static pressure except in 310, 313 & GN 310.

In models 310 & 313, the task of transferring the resultant movement of the diaphragm is achieved by employing an additional sealing diaphragm above the low pressure chamber.

Refer table below for sensing element type and material.

Instrument Model	Sensor & Material	On-off Differential
301	Metallic Diaphragm 316L SS	Fixed
303	Metallic Diaphragm 316L SS	Adjustable
304 (High Static Pressure)	Diaphragm 316L SS	Fixed
381 (Dual Setpoint)	Diaphragm 316L SS	Fixed
384 (Dual Setpoint, High Static Pressure)	Diaphragm 316L SS	Fixed
306 (Economy Version)	Diaphragm Nitrile	Fixed
386 (Dual Setpoint, Economy Version)	Diaphragm Nitrile	Fixed
310, GN 310 (Low Ranges)	Diaphragm Neoprene / EPDM / Silicone	Fixed
313	Diaphragm Neoprene / EPDM / Silicone	Adjustable

Setting of Switching points :

1) Set-up :

A pressure source and a master gauge of accuracy better than 0.5% is required to set the actuating point. In the case of Differential Pressure switches connect the pressure source to the high pressure port and leave the low pressure port vented to atmosphere.

Switching point should preferably lie in the mid 50% of the adjustable range span.

Markings provided on the range scale are for guidance only. **To set switching points precisely use a master Pressure Gauge.**

The switching point can be set, either for fall in pressure or rise in pressure by rotating the Range Adjusting screw.

Remove the instrument cover. Unscrew and remove the lock plate, which prevents the movement of the Range screw.

Now proceed with the setting of the switching points as below:

2) Fixed ON-OFF Differential Models :

- Rotate the range adjustment screw clockwise to increase the switching point. Rotating anti-clockwise will decrease the switching point.
- After setting, re-fix the locking device back in position to prevent unauthorised adjustment of the set point.
- The center screw and the striker screw are precisely adjusted and factory-set using Loctite. **Alteration** of centre screw height will disturb the contact established between the sensor and the balance beam. **Disturbance** of striker screw will result in microswitch not acting or set-point shift. Ref. Fig 1.

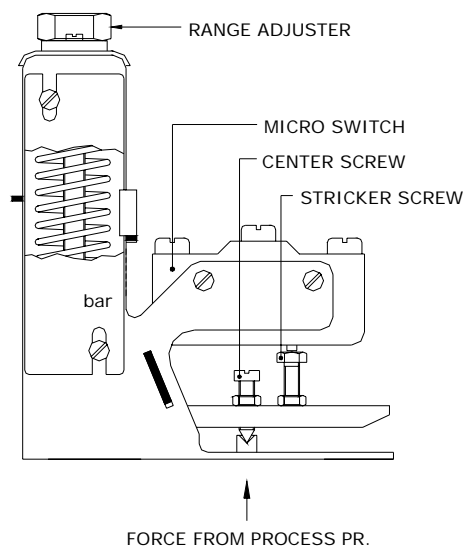


FIG.1 Fixed ON-OFF Differential Model

Models 281 & 381/4 provide an independently adjustable high and low set point facility. A single sensing element actuates two different balance arms through a floating arm. See Fig.2. Two sets of range springs, range scales, balance arms and micro switches are independently operated.

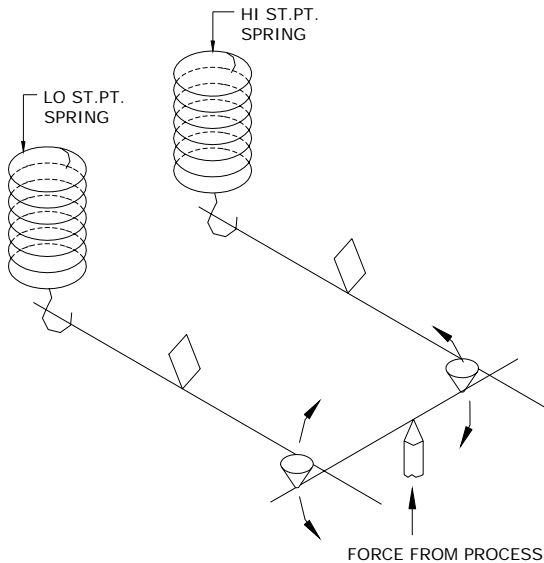


FIG. 2 Operating principle of dual set pt. version

Both the range springs are clearly marked for high and low functions. First set the low range spring and adjust the desired value for the actuation of the microswitch. The high range spring should then be adjusted similarly to the desired high set point. Ensure that the correct micro switch is monitored while settings are done. Refer Fig.3.

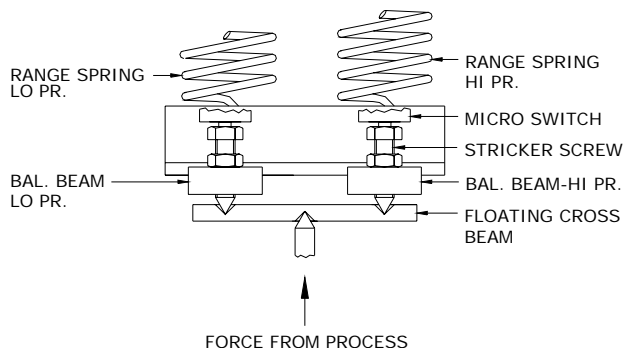


FIG.3 Side-view of Mechanical Frame S.A. of Dual set-point version

3) Adjustable ON-OFF Differential Models :

On-Off differential value can be adjusted for a wider value from about 10 to 15% of the span to a maximum of 60% as specified against each range. The minimum value will vary with different switch combinations. This facility is achieved by an auxiliary spring brought into action when the switch actuating plate moves up before it operates the micro switch. Adjustment of the tension of the spring decides the pressure difference between the on point and off point. Refer Fig. 4.

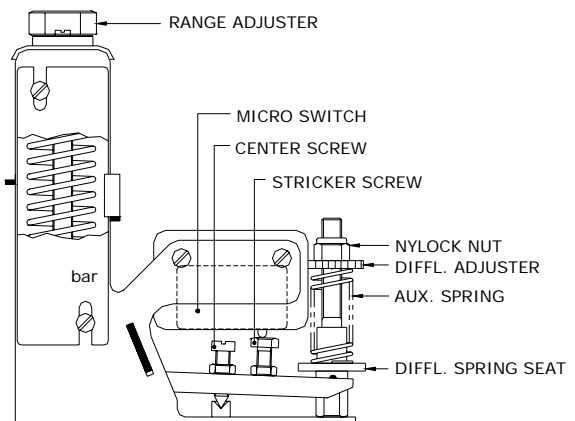
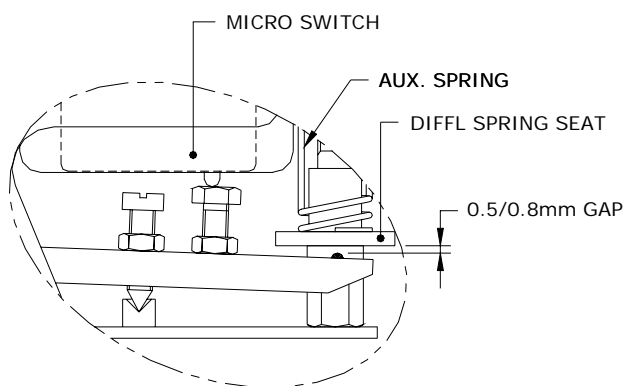


FIG.4 Wide Band Adj. Differential Mechanism

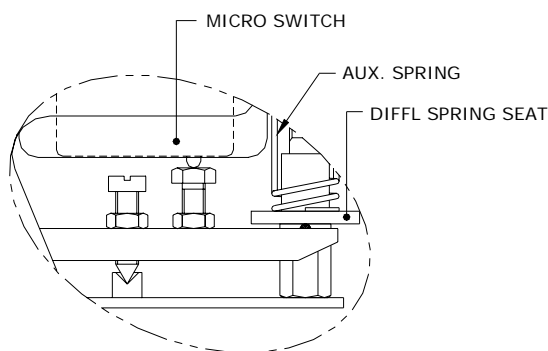
- In adjustable differential model set the lower switching point first. Release the aux. spring to be free by lifting up the nyloc nut and the diff. Adjuster. Using the range adjuster set the lower switching point. Then load the aux. spring by turning in the Diff. Adjuster to set the upper switching point.
- Adjusting the differential adjuster will shift only the upper switching point i.e. the switching pressure difference (on-off differential) alone changes. A clockwise rotation will increase upper switching point and anti-clockwise rotation will decrease it.
- The upper switching point should not exceed the maximum range value.
- After setting the differential, tighten the Nyloc nut to lock the differential adjuster to prevent loosening during operation.

Precaution :

The switch actuating screw on the balancing arm is critically adjusted. **Disturbance** of this would result in not achieving the desired result while ON-OFF differential adjustments are made. If accidentally disturbed, to reset the micro switch for correct operation adjust the height of the striker screw such that the balancing arm is not in contact with the auxiliary spring seat at the time of switch de-actuation. Refer Fig.5. This alone will ensure unloaded condition of the auxiliary spring during de-actuation. For actuation of the microswitch, the balance beam has to lift the aux. spring seat which is pre-loaded with the desired value of wide band On-Point. Refer Fig.6.



**FIG.5 Switch at off position –
Aux Spring load not acting**



**FIG.6 Switch at on position –
Aux Spring load acting**

Notes :

- 1) In the instruments with 2 SPDT switches for DPDT action, the synchronization of actuation is achieved within practical limits. The switches are synchronized as per customer preference either on falling or on rising pressure. If no preference is indicated, synchronization is done on fall in pressure at factory.
- 2) Do not exceed the rated maximum working pressure. Over pressure beyond the specified value will permanently damage the sensing element leading to replacement.

MAINTENANCE

Instruments are so designed with rugged components that they seldom require maintenance. Occasional cleaning of the moving parts, checking of the microswitch(s) and ensuring firm electrical contacts at the terminals will provide a long trouble-free performance.

In the case of diaphragm operated instruments, **do not attempt** dismantling the sensing diaphragm as it would permanently disturb the factory settings. Special jigs are needed for reassembly and hence replacement is not recommended at the user end. However, cleaning of the diaphragm chamber can be performed by flushing with a cleaning fluid, which is compatible with the diaphragm and its housing material.

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LEVEL SWITCH

INSTALLATION OPERATION AND MAINTENANCE MANUAL

**RF
LEVEL SWITCH
MODEL-550**

**EIP ENVIRO LEVEL CONTROLS PVT LTD
NOIDA - INDIA**

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LEVEL SWITCH

FOR GRANULAR MATERIALS & LIQUIDS

I. INTRODUCTION

A APPLICATION

The instruction in this manual pertain to the Model -550 Level Control based on radio frequency principle capable of monitoring the level of material present in a vessel at a preset point. The relay contacts may then be used to operate other devices.

The Model - 550 point level control utilises an electronics to provide Precision Reliability Independent of Moisture, material temperature, Coating Transit material Suspended dust etc., meaning thereby it can be used with wide variety of materials which may be conductives, non conductive solids, liquids, corrosive or even tend to coat on the sensing probe can be accurately measured and controlled.

B CONFIGURATION

RF Level Switch comprises of an Electronic Controller, a Sensing Probe & Co-axial Cable for the connection of the Electronic Controller to the probe. Controller provides RF signals to the probe and measures the changes in parameters provided by the sensing probe mounted in the material (to be measured) container. The Sensing Probe do not contain any electronics.

RF signal provided to the probe varies with the change of media (the application material having interparticle cohesive contact) upto the vessel body as reference ground. The material in transit or the suspended particles which do not have cohesive intraparticle contact upto the vessel shell are ignored. The vessel part selected for the probe mounting does not act as reference ground, as long as shield section is placed physically between active section of the probe and vessel body part where the probe is mounted. The variation in RF signal is utilised to activate a relay and its contacts are available as output for further use. To protect the equipment from electrostatic charge developed in the vessel/hopper an Electrostatic Charge Protector is provided in the Probe Head.

Drawings of electronic unit, sensing probe and electrostatic protector with connection details are included in this manual in Section V.

C. EQUIPMENT SPECIFICATION

1. ELECTRONIC CONTROLLER – MODEL - 550

- ◆ Line Voltage 220 /110/24 VAC OR DC OR as specified
- Line Voltage Sensitivity $\pm 10\%$
- ◆ Frequency Hz 50 / 60 $\pm 5\%$ for AC Supply
- ◆ Power Consumption 3 VA Approx.
- ◆ Ambient Temperature Limits (-) 10 to (+)60°C. or as specified
- ◆ Output Relay 2 sets of Change over potential free contacts (SPDT) or as specified.
- ◆ Contact Rating 5 AMPS 220 VAC non-inductive or as specified
- ◆ Local LED Indications
 - Green Normal Level
 - Red Alarm Level
 - Yellow Probe Healthy : LED glows off in the case of Probe or probe cable short circuited to ground or supply off. It is not effected by loose open probe cable connection i.e. yellow LED continues to glow viz.
- ◆ Cable length, Electronic unit to probe, Special cable supplied by EIP only. 25 Mtrs (max.) unless confirmed by EIP.

2. SENSING PROBE

Model	PR-550 RT ST / ESP / BE/ FLX	PR-550 HT	PR-550 FLSH
◆ Ambient Temp.	250°C (Max.)	600 °C	260°C
◆ Vessel Pressure	_____ Customer Specification _____		
◆ Probe Type	_____ Rigid or Flexible _____ Flush / DISC		
◆ Material Construction			
Exposed Metal	SS 304	SS 316	SS-304
Insulation	PTFE	Ceramic	PTFE
Insertion Length mm	50 to 10000	50 to 7000	Zero
◆ Mounting	-40 NB BSP threaded or flanged-		Flanged

Note : For other special requirements contact EIP ENVIRO.

3. PROBE HEAD

For use with SWITCH Model Probes

- ◆ Construction Cast Aluminum
- ◆ Conduit / Cable Gland connection : ½" BSP
- ◆ Size : Ref drawing in section V

4. ELECTROSTATIC PROTECTOR

- ◆ Mounting

Provided inside the Probe Head

5. CABLE-Model SWITCH -226

For connection of Probe and Electronic Controller

- ◆ Cable

Special coaxial cable, connection
Centerwire for Probe connection, Middle
shield for Signal connection,
Top layer wire for Ground Connection

- ◆ Conductor

Copper

- ◆ Insulation

PVC/PTFE

II. INSTALLATION

A. RECEIVING & INSPECTION

To ensure proper receipt of material, it is important to immediately check the content of shipping containers. Contents should be compared against packing list to ensure proper equipments have received and that it has not been damaged during transit. If any discrepancies arise, consult EIP factory.

B. ELECTRONIC CONTROLLER

1. UNIT LOCATION

The following should be considered while mounting the electronic controller :

- ◆ Location

Mount on convenient structure (near to probe location) free from obstruction, at man height for easy operation.

- ◆ Temperature

Be sure ambient temperature at installation point does not exceed unit temperature limitation, (-) 10 to (+) 60°C.

◆ Environment

Install unit at a location so that no exposure to direct sunlight, rain or snow

◆ Vibration

If excess vibration in the area is anticipated, consider alternate mounting area or place vibration absorbing material under enclosure base.

◆ Distance

Be certain cable distance from probe to electronic controller is minimum possible and does not exceed 25 mtrs. maximum.

(For longer cable length confirm with EIP)

2. CABLE CONNECTION

Make cable connection as per drawing enclosed (as part of this manual) in section V. etc. and ensure that there is no chance of damage / disconnection/shorting of cable/cable connection in future.

C. PROBE

1. LOCATION & INSTALLATION

The following should be considered while mounting sensing probes.

- i. Verify that material will cover the active section of the probe at the proposed mounting location consider the probe length.
- ii. Be certain that shield section of the probe must project freely inside the vessel (at least 2 inch or 50 mm) for Rod type/flexible probes.
- iii. Be certain there is a sufficient clearance outside the hopper for inserting and wiring. For thermal insulated vessel use lagging extension (of length equal to thickness of insulation) for easy access to terminals.
- iv. Disc type (flush mounted) probe must be either flushed with inner surface of hopper wall or may project inside (up to 5mm) but not remain behind the inner surface of the vessel.
- v. Probe must be almost perpendicular ($90 \pm 15^\circ$) to the vessel wall on which probe is mounted, unless confirmed by EIP.
- vi. Active section must not be too close to any other grounded metal part/of the hopper/ Vessel maximum possible gap must be maintained. Preferable location along centre line of the wall/plate of the vessel.
- vii. Termination must be done with proper lugs & gland and each conductor must be totally isolated from each other.
- viii. Flexible/Probe length is selected considering angle of repose (for solids), roof thickness, mounting nozzle height etc. as a rule of thumb for solid materials, Horizontal distance from fill point/points must be less than the insertion length of the probe.

- ix. Select location for flexible top mounted sensing probe nearest (possible) to the vertical centre axis of the filling point/points & maximum possible distance from side walls.
- x. Probe grounding of hopper / vessel body with electronic controller must be ensured
- xi. Do not provide additional metallic protection like pipe/channel/plate inside the vessel covering the sensing probe, if provided must be removed, as this can result malfunctioning. For large size particles (side mounting), use disc type flush mounted model SWITCH-FP probes.
- xii. Coaxial cable supplied/specified by EIP only to be used for the connection of sensing probe to electronic unit.

For additional queries contact EIP application engineering staff, if required.

D. ELECTROSTATIC CHARGE PROTECTOR

Electro-static charge protector is provided on all applications where the possibility of electrostatic charge build up on the probe exists. This protector, a small board is mounted inside the Probe Head. It fastens directly to the active section of the probe via screw connections. The probe cables from the electronic unit are fastened to terminal connections on this board.

E. WIRING

1. PROBE CABLES

- ◆ Cable EIP provides coaxial cable for connection of electronic unit to probe.
- ◆ Termination Hook-up of the probe cable requires connections of the three cable conductors centre wire (CW) to "PR", Middle layer (MW) to "SH" and Top Layer Drain wire (DW) to "G" at both electronic controller and probe. Refer the Drawing in Section V.

2. POWER CONNECTIONS

Power connections (as specified) as made directly to the terminal blocks located in electronic controller. Due to the low power consumption of the unit, (3VA) light gauge wiring of size 1.0mm sq. may be sufficient. However, consult the local Electrical Regulations for exact wire gauge selection.

3. OUTPUT CONNECTIONS

Output relay connections are made directly to the terminal blocks located inside the electronic controller. These relay contacts (two numbers change over potential free contacts) are rated for 5Amp at 220 VAC non-inductive or as specified. Output wiring should be compatible with the intend output load (less than relay contact rating)

III. OPERATION

A. START-UP

Before start-up ensure that all the following must comply.

1. ELECTRONIC UNIT

1. Ambient condition suitable (-10 to +60 Deg. C. Max.).
2. Electronic unit installed at convenient man height.
3. Electronic Unit not exposed to direct sunlight, rain or snow.
4. Fasteners tightened properly.
5. Earthing grid connected at both the earthing terminals of electronic unit.
6. Supply voltage is as specified on the terminals.
7. Cable used from electronic unit to probe is EIP supplied/EIP specified Cable length from Electronic Unit to probe is less than 25 Mtrs. Centre wire connected to "PR", middle layer to "SH" & top layer/drain wire to "G" at both ends.
8. Glands used for cables are proper.
9. Proper Lugs are provided at both ends of the cable.
10. Proper Dressing of cable done with cable tray/conduit for all the cables to ensure no disconnection / damage in future.

2. PROBE

1. Probe Mounted 90 (+/-) 15 Deg to vessel wall / plate
2. No Pipe cover/Hood/Canopy inside vessel over/near probe.
3. Maximum gap from other walls / any other metal parts.
4. Shield section projection inside the vessel more than 50mm (2 inch)
5. If flexible probe mounted from top only and distance from fill point less than length of the probe.
6. If flushed probe : either flush with inner surface of the vessel or projects inside upto 5mm (all around the probe).
7. Verify probe ground terminal shows firm continuity with vessel / vessel structure earthing grid.
Switch on the appreciated supply voltage and yellow & either green or red local indications glow.

B. CALIBRATION

The instrument has been factory calibrated for use in the majority of applications, However, due to variations in installations, it is advisable to field verify this setting. This may be accomplished using the following procedure. For maximum accuracy, all calibration adjustments should be made with the vessel/hopper at operating conditions.

1. Ensure the level of application material well below the probe.
2. If time delay opted, select "Cal/Opn" switch to "Cal"

Check local indications LED (Green or Red) Green LED should glow, if not turn adjustment clockwise (CW) so that green LED glow and Red LED glows off.

Turn the turning adjustments counter-clockwise (ccw) counting the number of revolutions until the local indication LED just glows Red.

Turn the adjustment clockwise (cw) slowly until the local indication LED just glows Green.

3. Turn further cw turns to preload the setting.
4. Increase the material level above the desired level of operation and check the unit operation, the local indication LED glows "RED".
5. If unit does not respond, the preload setting must be reduced.
6. Verify once again with material level for satisfaction of calibration.
7. If time delay opted select "Cal/Opn: switch to "Opn".

CALIBRATION IS NOW COMPLETE

IV. MAINTENANCE

A. NORMAL

The EIP SWITCH models are designed for years of maintenance-free service. This is ensured by use of no moving parts in the unit except the output relay and there is no electronics or any sensitive part in the sensing probe.

B. TROUBLE SHOOTING

1. ELECTRONIC CONTROLLER

Verify supply voltage at supply terminals, if it is as it should be Yellow LED and one of Red or Green LED glows, if not, check Fuse (rating 100 mA)

- a. Disconnect the probe cable connections (centre wire, shield wire, ground wire,) at the electronic unit. Leave (specified) power connected.
- b. Hold two Screw Drivers in your hands from non conductive portion.
- c. Touch the Screwdriver G and PR terminals (Probe Connection) at the Electronic Controller.
- d. Touch the metallic portion of the screw drivers by fingers. Proceed to B1e (below).
- e. If the relay actuates and de-actuates on disconnecting the screw driver from the terminal PR and again actuates by replacing the screw drivers at terminal PR. The Electronic Controller is working properly proceed to section IV B-2 Checking the Probe.

- f. With probe cable connection disconnected at electronic unit, a Volt-ohm meter (VOM) which is set on low DC Voltage range (20 VDC) Proceed to g.
- g. With specified input power applied to the electronic unit, measure the following voltage on the unit terminals.
 - i) Probe to ground VDC
 - ii) Shield to groundVDC

The above values should read with in 2 to 5 VDC Value (I) should read 5 to 10% less than value (ii)

- h. If you were unable to get required results "e" and "g" above then there is fault in the electronic unit. It is recommended that the electronic controller be returned to EIP for repair see Section VC.

2. PROBE

- a. Reconnect coaxial cable (Probe Cable) to electronic unit.
- b. Repeat IV B1 f & g corresponding with material level below probe.
 - i) Probe to ground VDC
 - ii) Shield to ground VDC

Both should read with in 20% of the values obtained in IV 1g

- c. If possible, repeat IV B1 f&g corresponding with material level above Probe.
 - i) Probe to ground VDC
 - ii) Shield to ground VDC

Both should read within 10% of the values attained in b.

- d. If measurements obtained in 2b & 2c are as they should be ie within 10% of the values obtained in 1 B1g verify calibration as per Section III C.
- e. If measurement are not as they should be, proceed to f & B3.
- f. Disconnect cable at probe also remove the electrostatic protector (with probe still in its position, mounted on the hopper). With the VOM in the resistance scale, measure the following probe values.

Probe uncovered with material

Probe to shield OHMS

Shield to ground.....OHMS

Probe to groundOHMS

All above values should read above 1M Ohms, if not, remove the probe from its position and repeat 4B2f if values are above 1 Mohms check installation as per 3b2, if not, proceed to IV C.

3. PROBE CABLE

- a. Disconnect Probe cable at both probe and electronic unit.'
- b. Using VOM on the resistance scale measure the resistance between centre wire (CW) and middle layer (MW) of the cable end at the electronic unit. This reading should be infinite "open circuit".
- c. If infinite in b, short CW and MW at probe end of the cable using a short jumper measure resistance between CW and MW at electronic unit end of cable. This reading should be zero, (Short-Circuit)
- d. Repeat step b and c measuring between MW and ground wire (DW) Reading should be as above.
- e. If reading are correct, confirming continuity and no shorting of the cable the probe cable is in proper condition.
- f. If reading are incorrect, check cable for loose or broken terminations or shorting. If none can be found, the cable should be replaced.

4. OUTPUT CIRCUITRY

The output circuit of the instrument consists of two sets change over contacts brought out to terminal blocks. These contacts open and close in response to material level change. Relay operation may generally be heard as an audible "click" Relay operation can also be checked placing a VOM, set on resistance scale between terminal block points on NC and COM. The VOM reading should change from OHMS to infinity when material contacts the probe or when the probe terminal "PR" is touched with finger, and change of local indication LED from Green to Red.

C. ASSISTANCE

If problems exist other than those mentioned above or if the attempts to locate the problems fail, call the EIP factory and ask for the service department at the following address with details of the problem faced in the complaint format issued included in this manual Appendix B by EIP further guidance/deputation of representative for attending the problems.

EIP ENVIRO LEVEL CONTROLS PVT LTD
B-130, SECTOR-X,
NOIDA – 201 301 (U.P.) INDIA.
TEL. : 0120-2442527 & 2442528
FAX : 0120-2555767
Email : rgoyal@vsnl.com

“INSTALLATION CHECK POINTS”

RF LEVEL SWITCH MODEL-SWITCH-550

EIP ENVIRO LEVEL CONTROLS PVT. LTD.

NOIDA

FAX NO: 0120-2555767

Fax one copy to EIP record and reference

Date

PROJECT _____ APPLICATION (MATERIAL) _____ VESSEL _____

INSTRUMENT SL. NO _____ FROM _____ TO _____ QTY _____

MOUNTING ☐ TOP ☐ SIDE ☐ APPLICATION ☐ HL ☐ LL ☐ IL

PROBE: ☐ RIGID ☐ FLEXIBLE ☐ FLUSHED,

PROBE LENGTH _____ TEMP. _____ PRESSURE _____

SUPPLY VOLTAGE _____ AC/DC FILING POINTS ☐ ONE ☐ MORE _____

FILLING CONVEYOR ☐ PENUMATIC ☐ GRAVITY ☐ OTHER _____

MUST COMPLY ALL THE FOLLOWING BEFORE COMMISSIONING FOR EACH LEVEL SWITCH

SR. No./APPLICATION

A. ELECTRONIC UNIT

- | | |
|--|-----|
| 1. Ambient Condition suitable (-10 to +60 Deg C) | Y/N |
| 2. Electronic UNit Installed at convenient man height | Y/N |
| 3. Electronic Unit not exposed to direct sunlight, air or snow | Y/N |
| 4. Fasteners tightened properly | Y/N |
| 5. Earthing grid connected at both the earthing terminals of electronic Unit | Y/N |
| 6. Supply Voltage is as specified on terminals | Y/N |

B. PROBE

- | | |
|--|-----|
| 1. Probe Mounted 90(+/-) 15 Deg to wall/Plate | Y/N |
| 2. No Pipe Cover/Hood/Canopy inside vessel over Probe | |
| 3. Gap from other wall/any metal part more than 450 MM | Y/N |
| 4. Shield section projects freely inside the vessel more than 50 MM/ | Y/N |
| 5. If flexible probe mounted from top distance from fill point less than the length of the Probe. | Y/N |
| 6. If flushed Probe : either flush with inner surface or projects inside upto 5MM (all around the Probe) | Y/N |

C. CABLE

- | | |
|---|-----|
| 1. Cable used for the Connection of Electronic Unit and Probe is EIP supplied/EIP Specification only | Y/N |
| 2. Cable Length from Electronic Unit to Probe is less than 25 Mtrs and connected Center wire connected to "PR" middle layer to "SH" & top layer/drain wire to "G" at both ends. | Y/N |
| 3. Glands used for coaxial cables are proper | Y/N |
| 4. Proper Lugs are provided at both ends of the cables | Y/N |
| 5. Proper Dressing of cable done, (using cabletray/conduit) i.e. no chance of loose connection/damage in future | Y/N |

REMARKS

Checked By

Signature

Name

Designation

Company

FOR ANY DEVIATION/DISCREPANCY CONTACT EIP

COMPLAINT FORMAT SEC, VI. APPENDIX. B

From, _____ Ref. No. _____ Dt. _____

Company : _____ Project : _____

Address : _____ Contact Persons : _____
 _____ Designation : _____

Tel. No.: _____ Fax _____

To,
 EIP ENVIRO LEVEL CONTROLS PVT. LTD.
 NOIDA-201301 (U.P.) INDIA

FAX : 0120-2555767

We are using your make RF LEVEL SWITCHES Model : SWITCH-550 bearing Sl. Nos to
 Total Qty supplied to us directly/ through
 during the month Year for the (applica-
 tion) mounted on (name of the vessel) Installed/Commissioned during the month
 Year We are facing the problem
 on
 serial Nos.

We have checked the Instruments at our end. Detail are given below for your reference.

ELECTRONIC UNIT (EU)

- | | |
|---|---|
| 1. Supply Voltage connected is as specified on the terminals | ... V AC/DC |
| 2. Earthing Grid is connected at the earthing terminals of the EU | YES/NO |
| 3. EU is not exposed to direct sun/snow/rain | YES/NO |
| 4. Ambient temperature at location of electronic unit is within -10 to + 60 deg.C | YES/NO |
| 5. Coaxial Cable used for the connection to the Sensing Probe
supplied by EIP other (details) and connected at both
EU&Probe | |
| Centre wire at "PR" | YES/NO |
| Middle Layer at "SH" | YES/NO |
| Top layer/drain wire at "G" | YES/NO |
| 6. With probe Connection disconnected at "PR" hold Metallic Portion of
a Screw-driver by hand firmly and touch screwdriver to the terminal
"PR", Sound of relay actuation heard every time touching the "PR" by
Screwdriver and Local Indication (LED) glowing changes Green to
Red or to Green | YES/NO |
| 7. With all proper connections and supply-ON, measure the following : | |
| a) Terminal "PR" & nearby structure/Earthing grid | Probe conctd. discountd.
..... Vdc Vdc |
| b) Terminal "SH" & nearby structure/Earthing grid | Vdc Vdc |
| c) Yellow LED Glowing during all above conditions | YES/NO |

SENSING PROBE

... S.No.

1. TYPE: Rigid/Flexible/Flushed, length mm, Insulation : Teflon/Ceramic Mounting, Connection Size..... Threaded/Flange, Active Section length mm,
2. Temperature rating of Probe..... C/F Max application Material Temperature deg. C/F
3. Probe mounted Top/Side/Other
4. Probe mounted at angle of Degree approx (with respect to Horizontal Axis)
5. Inclination of vessel body part where probe is mounted wrt. Horizontal.
6. If side mounted, distance from other side walls mm, mm
7. If Top mounted, distance from the filling point mm
8. Inside the vessel?
9. Any hood/Pipe/Canopy or any other structure provide over/near probe YES/NO
10. With Coaxial Cable connected at both ends and supply voltage 'ON' at EU
Voltage (DC) at Probe terminals.
Terminal "PR" to nearby structure/Earthing Grid Vdc
Terminal "SH" to nearby structure/Earthing Grid Vdc
11. With Coaxial cable disconnected at Probe but connected at EU, DC voltage at coaxial cable.
a) Centre Wire to near by structure/Earthing Grid Vdc
b) Middle Layer to nearby structure/Earthing Grid Vdc
12. With Coaxial Cable disconnected at both ends continuity measurements are
A. AT PROBE (Protective unit Connected) Protective Unit Removed
"PR" to "SH" Ohms Ohms
"SH" to "G" Ohms Ohms
"PR" to G Ohms Ohms
B. AT COAXIAL CABLE (Disconnected at both ends)
Centre Wire (CW) to Middle layer (MW) Ohms
Middle Layer to Top Layer/Drain Wire (DW) Ohms
Center Wire to Top layer/Drain Wire (DW) Ohms
Short CW & MW at one end Resistance Ohms
Between CW & MW at other end
Repeat above for MW & DW Ohms
Repeat above for CW & DW Ohms

You are required to (Tick () one of following)

Advice presentive action per Tix no at no charge basis. Depute your Engineer for a period of day from to We shall pay service charges as per EIP's present prevailing rates Please send your bill along with him.

Thanking your,

Signature

Name

Designation

**LEVEL
CONTROL**

EIP ENVIRO LEVEL CONTROLS PVT. LTD.

NOIDA

FAX NO.: 0120-2555767

APPLICATION DATA SHEET

FOR FUTURE/ADDITIONAL REQUIREMENTS OR NEW APPLICATION

LEVEL INSTRUMENT

Sec. VI, Appendix D

REF.....

Date.....

PLEASE PROVIDE FOLLOWING DETAILS, IT HELPS US SELECT & SUGGEST BEST LEVEL INSTRUMENT & LOCATION

CUSTOMER _____ ADDRESS _____

COUNTRY _____ FAX _____ CONTACT PERSON _____ PROJECT _____

USE SEPARATE DATA-SHEET FOR EACH TYPE OF APPLICATION

NAME OF VESSEL _____ HOPPER/SILO/BUNKER _____ QTY _____

APPLICATION MATERIAL (NAME OF MATERIAL): _____

☐ SOLID ☐ LIQUID ☐ CORROSIVE ☐ ERROSIVE ☐ ELECTRICITY CONDUCTIVE

IF SOLID: PARTICLE SIZE MAX _____ MIN _____ AVG _____ mm/INCH ANGLE OF REPOSE _____

IF LIQUID: ☐ STICKY ☐ NONSTICKY ☐ SLURRY (COMPOSITION) _____

POWER AVAILABLE: ☐ 110 VAC ☐ 220 VAC ☐ 240 VAC ☐ 48 VDC ☐ OTHER _____

LEVEL INSTRUMENT REQUIREMENT: ☐ DIGITAL (SWITCH) ☐ ANALOGOUS (CONTINUOUS)

IF ANALOGOUS: OUTPUT REQD/ ☐ 4-20 mA ☐ OTHER _____ RANGE _____ M/Ft

☐ LOCAL DISPLAY ☐ SET POINTS (ADJUSTABLE) Y/N _____

IF DIGITAL (SWITCH): ☐ HIGH LEVEL ☐ LOW LEVEL ☐ INTERMEDIATE LEVEL

CONTACT: ☐ SPDT ☐ DPDT CONTACT RATING _____ AMPS

ANY OTHER SPECIAL REQUIREMENT: _____

TYPE OF FILL: ☐ CONVEYOR ☐ PNEUMATIC ☐ GRAVITY ☐ OTHER _____

FILLING POINTS: ☐ ONE ☐ MORE OUT-LETS ☐ ONE ☐ MORE _____

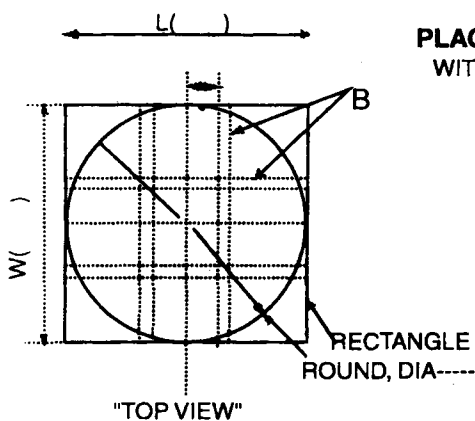
PRESSURE: (a) IN VESSEL - MAX _____ MIN _____ (BAR) (b) OUT-SIDE _____ (BAR)

TEMPERATURE: (a) IN VESSEL - MAX _____ MIN _____ (b) OUT-SIDE MAX _____ MIN _____ C/F

VESSEL CONSTRUCTION: ☐ CONCRETE ☐ STEEL ☐ OTHER _____ ☐ LINING _____

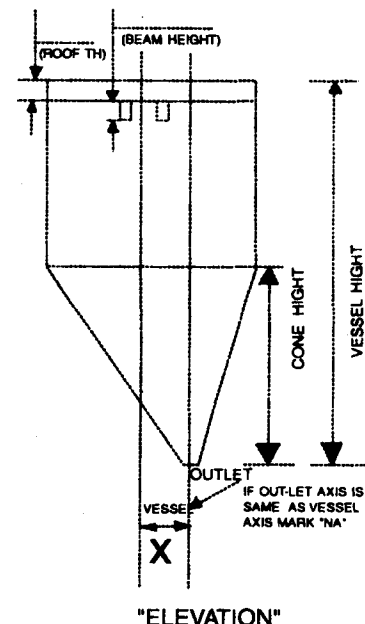
VESSEL DIMENSIONS:

PROVIDE DETAILS IN THE FOLLOWING SKETCH:



**PLACE ITEMS ON SKETCH
WITH APPROX DIMENSION**

- Ⓕ FILL POINT
- Ⓖ LEVEL SENSOR PROPOSED
- Ⓒ OTHER ITEMS
- Ⓐ ROOF SUPPORTING BEAMS NEAR CENTRE



ANY OTHER SPECIAL INFORMATION:

IF REQUIRED USE BACK OF THIS SHEET OR EXTRA SHEETS

SIGNATURE & DATE

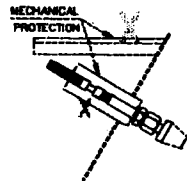
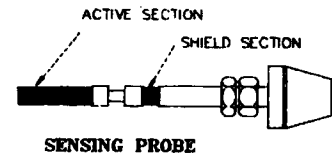
NAME _____

DESIGNATION _____

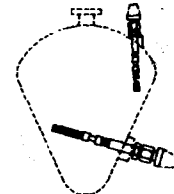
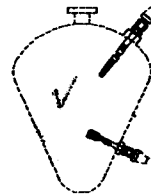
INSTALLATION TIPS

FOR EIP'S RF LEVEL SWITCHES

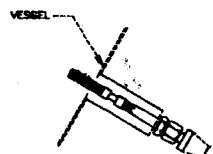
MODEL: SWITCH-550



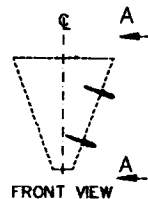
SHIELD SECTION OF THE PROBE MUST PROJECT INSIDE THE VESSEL "FREELY" AT LEAST 50 MM (2")
NO MECHANICAL PROTECTION IS REQUIRED
BECAUSE LONG INSERTIONS ARE NOT REQUIRED FOR EIP PROBES
FOR LARGE SIZE PARTICALS & TALL BINS USE FLUSH PROBES



ACTIVE SECTION OF PROBE MUST "NOT" BE TOO CLOSE TO THE VESSEL SHELL OR ANY OTHER METALLIC-GROUNDED PARTS
ASK "EIP" FOR A SUITABLE PROBE

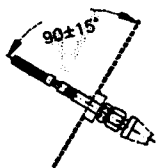


IF LONG LEGGING EXTENSION IS REQUIRED OUTSIDE VESSEL
ASK "EIP" FOR A SUITABLE PROBE



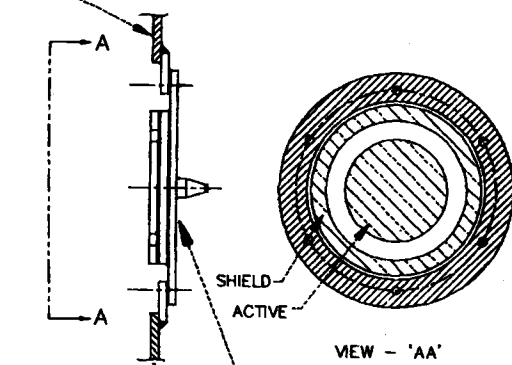
VIEW "AA"

DO NOT INSTALL THE PROBE VERY CLOSE TO THE OTHER SIDE WALL/PLATE
PREFERRED LOCATION: NEAR "C" OF THE WALL/PLATE OF MOUNTING FOR PROBE



MOUNT THE PROBE ALMOST PERPENDICULAR ($90 \pm 15^\circ$) TO THE VESSEL SHELL
FOR SPECIAL REQUIREMENTS ASK "EIP"

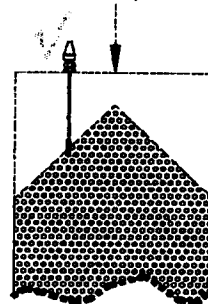
CONTAINER INNER SURFACE
PROBE INSERTION 0.00 TOL. ± 0.05



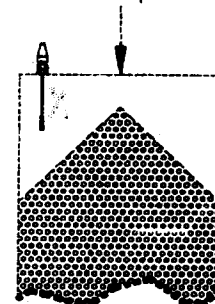
FLUSH PROBE (DISC TYPE)

THE PROBE MUST FLUSH WITH THE INNER SURFACE OF THE VESSEL WALL/PLATE OR MA PROJECT INSIDE THE VESSEL UPTO 5 mm BUT MUST **NOT** REMAIN BEHIND THE INNER SURFACE OR ANY METALLIC LINERS etc. IF ANY

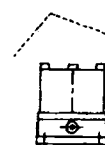
fill point



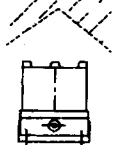
fill point



FLEXIBLE TOP MOUNTED PROBE
AWAY FROM SIDE WALLS AND NEAREST TO THE FILL POINT
PROBE INSERTION LENGTH TO BE SELECTED CONSIDERING:
ANGLE OF REPOSE OF MAERIAL, DISTANCE FROM FILL POINT,
MTG NOZLE HIGHT, SAFETY LEVEL ETC. +150 MM FOR SENSING
RULE OF THUMB: HORIZONTAL DISTANCE FROM FILL POINT TO PROBE MOUNTING "LESS" THAN INSERTION LENGTH OF PROBE



ELECTRONIC CONTROLLER



PROTECT ELECTRONICS FROM DIRECT SUN, RAIN & SNOW AND DO NOT SELECT VERY HOT OR HEAVY VIBRATION AREA FOR LOCATION

SOLENOID VALVE

Diaphragm Valves for dust bag shaker

SERVICING AND OPERATING INSTRUCTION

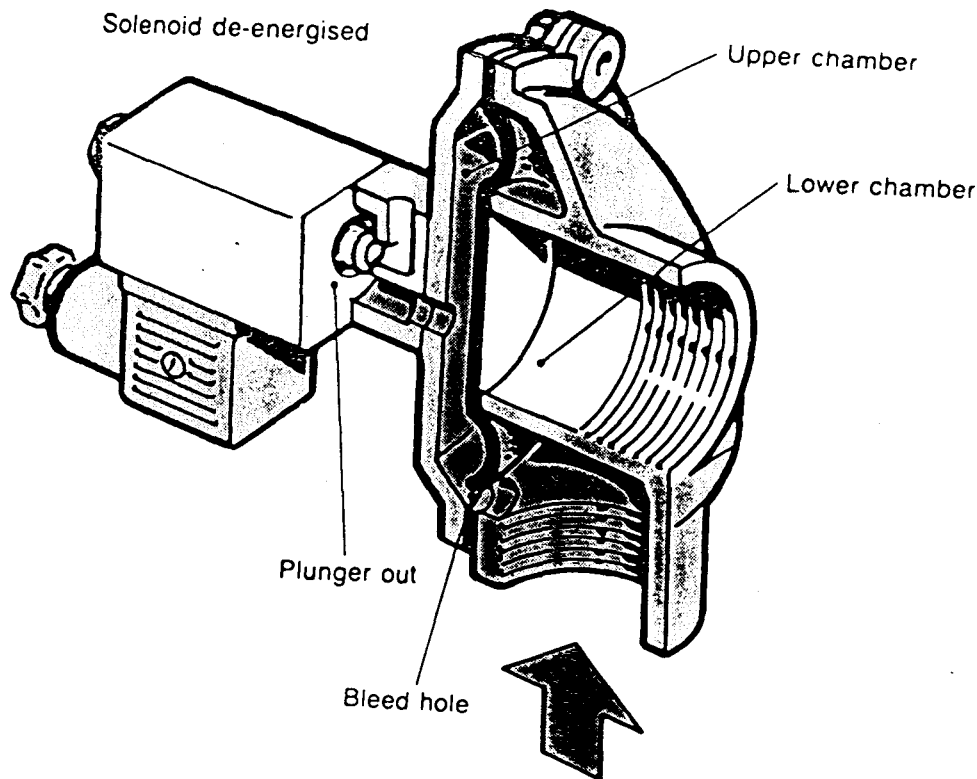
1) DESCRIPTION :

The valves are 2 - way normally closed diaphragm valves operated by a pilot solenoid valve. These valves are designed for extremely fast opening /closing and high flow rates. The body and cover are of die cast aluminum alloy with spacial anti corrosive coating .The Solenoid valve is integrally mounted on the diaphragm valve and has encapsulated coil - (class F insulation) with a water proof (IP-65) plug -on connector.

2) OPERATION :

The diaphragm divides the valve in to an chamber and a lower chamber. The air inlet leads in to the lower chamber from where it passes into the outlet when the diaphragm lifts.

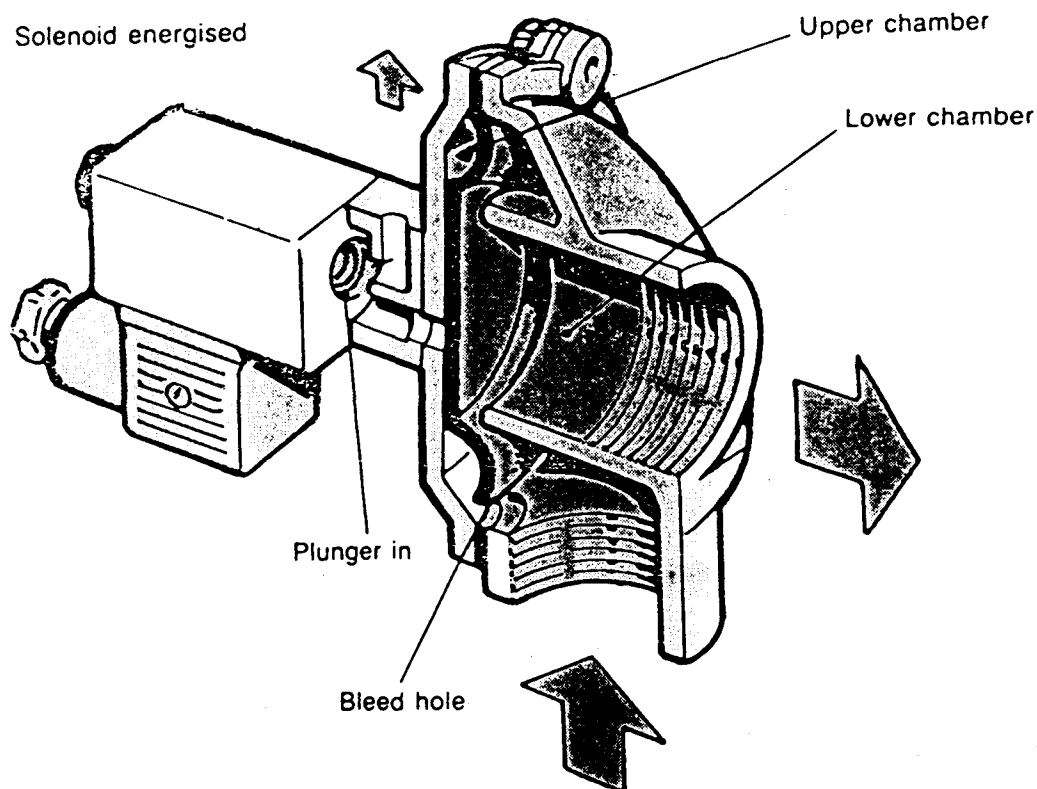
The diaphragm has a bleed hole through which the high pressure inlet air bleeds into and fills up the upper chamber ,creating the same pressure on both sides of the diaphragm. The pressure in the upper chamber acts on the full surface of the diaphragm- whereas the pressure in the lower chamber acts on a lesser(less outlet area)area of the diaphragm. This keeps the diaphragm pressed down on the outlet port ,closing it.



The upper chamber is connected to the atmosphere through the air passage in the pilot base. The plunger in "normal" conditions keep the air passage closed, maintains the pressure in the upper chamber and hence the diaphragm valve closed.

When electric supply is given to the solenoid coil, the plunger lifts within the core tube and the compressed air in the upper chamber exhausts quickly to the atmosphere. Because the exhaust air passage has a higher flow rate than the bleed hole on diaphragm, the pressure in the upper chamber falls suddenly. The pressure in the lower chamber then lifts the diaphragm, causing the compressed air to flow from inlet through outlet.

When the solenoid is de-energised, the plunger closed the air passage resulting in the diaphragm closing the valve outlet.



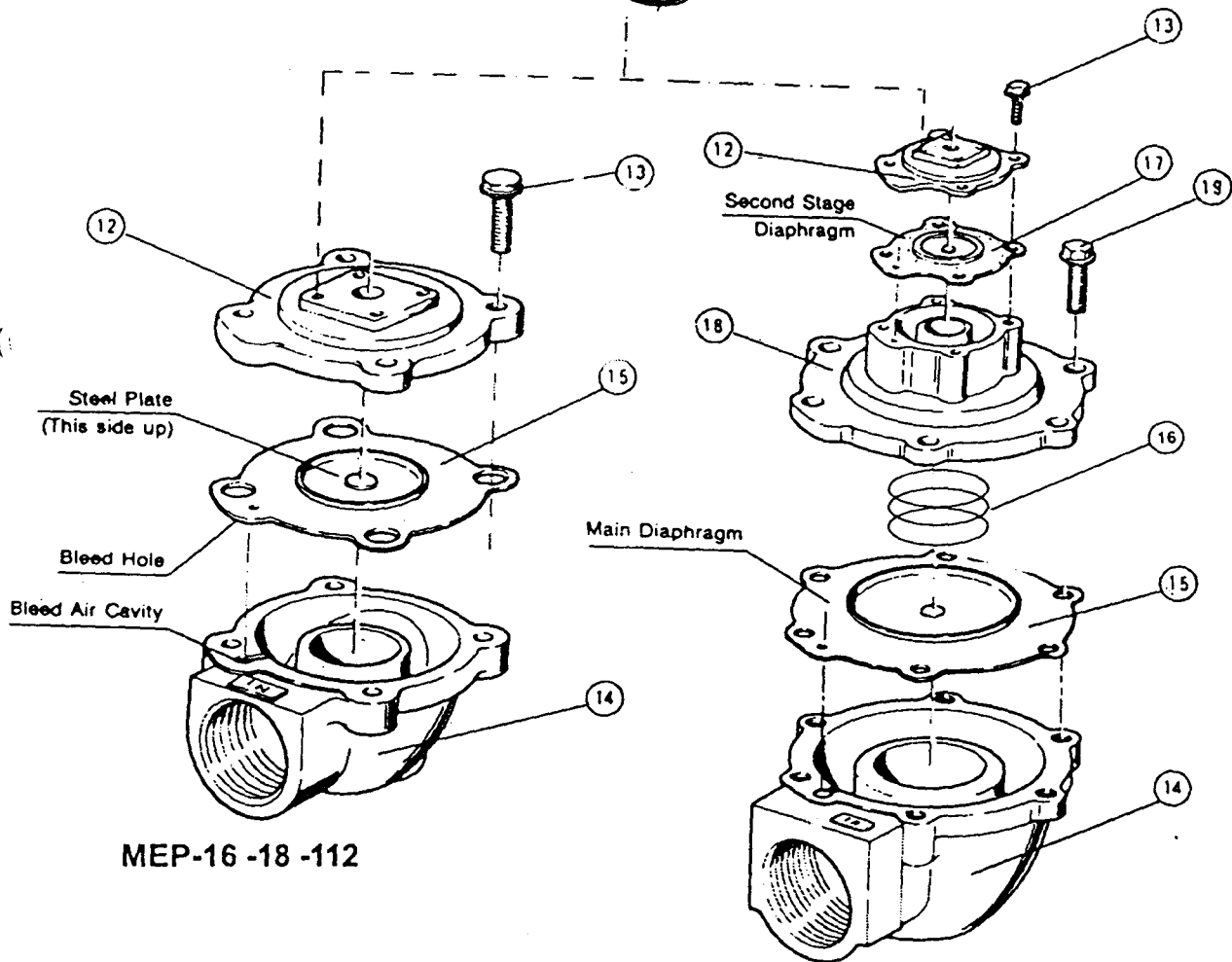
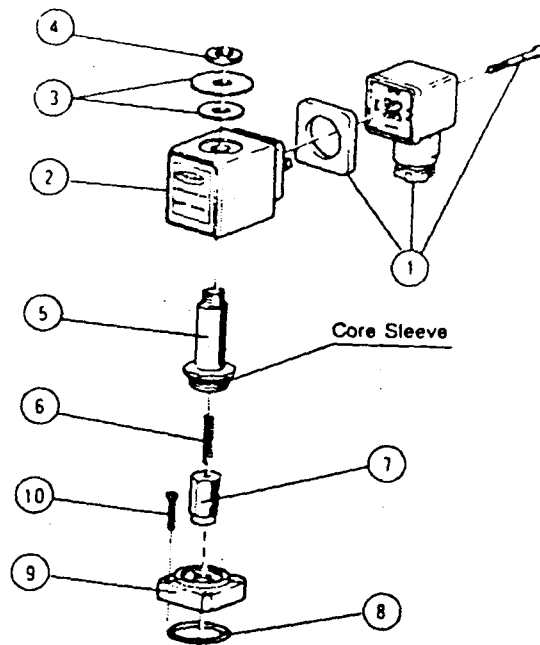
3) VALVE DISASSEMBLY & REASSEMBLY :

Depressurize valve, turn off electric supply and proceed as per steps below :

- ☐ Loosen plug screw and remove PLUG CONNECTOR (1) from COIL (2).
- ☐ Remove coil retaining Nut(4) and slip COIL(2) off CORE TUBE(5)
- ☐ Loosen core sleeve and remove CORE TUBE(5) from PILOT BASE(10). The PLUNGER(7) AND SPRING(6) come loose.
- ☐ Loosen screw holding PILOT BASE(9) to VALVE COVER(12) and remove PILOT BASE(9). The 2nd rubber O-RING (8) comes loose.
- ☐ Loosen COVER SCREWS (13) and remove COVER(12) AND DIAPHRAGM(15) from VALVE BODY(14). [The VALVES model 114-116-120-124 with large capacity have two stages (two diaphragms (15-17) to allow a standard small pilot solenoid valve to control them)].
- ☐ Loosen and remove screws (13-19) both from the PILOT CAP(12) of the smaller SECOND STAGE DIAPHRAGM(17) and from the COVER(18) of the MAIN DIAPHRAGM(15)

ELECTRONIC PILOT EL 8

Item NO	Part Description	Qty.
1	Plug	1.
2	Coil	1.
3	Washer Name Plate	2.
4	Nut	1.
5	Core Tube	1.
6	Spring	1.
7	Plunger	1.
8	Pilot Base O Ring	1.
9	Pilot Base	1.
10	Pilot Base Screw	4.



MEP-16 -18 -112

VALVE SINGLE STAGE DIAPHRAGM MEP 16 - 18 - 112		
Item No .	Part Description	Qty.
12	Cover	1.
13	Cover Screw	4.
14	Body	1.
15	Diaphragm	1.

MEP -114 - 116 - 120 - 124

VALVE DOUBLE STAGE DIAPHRAGM MEP 114 - 116 - 120 - 124		
Item No .	Part Description	Qty.
12	Pilot Cap	1.
13	Pilot Cap Screw	4.
14	Body	1.
15	Main Diaphragm	1.
16	Spring	1.
17	Second Stage Diaphragm	1.
18	Cover	1.
19	Cover Screw	6.

- ☐ All parts are now accessible for cleaning or replacement. Clean the air passage in PILOT BASE (9). Replace worn or damaged parts.
- ☐ Reassemble in reverse order paying careful attention to exploded view.
- ☐ Clean the bleed hole and replace diaphragm (15) with the steel plate up facing the cover ((12). The bleed hole on Diaphragm should match with the cavity on valve body and cover.
- ☐ Tighten the COVER SCREWS (13) to 10 ± 1 Nm. and the COVER SCREWS (19) of the MAIN DIAPHRAGM (15) to $18 \pm$ Nm. Tighten the PILOT BASE SCREWS criss-cross. Tighten the plug connector screw.
- ☐ After reassembly, operate the valve a few times to be sure of proper opening and closing.

4) INSTALLATION :

The valve body has threaded inlet / outlet ports for installing the valve in the bag filter .The inlet port (marked 'IN') is connected to the compressed air header and , the outlet port to the compressed air distribution pipes .The valve can be mounted in any position. Apply pipe compound sparingly to male pipe threads only; if applied to valve threads ,It may enter valves and cause operational difficulty.

Pipes strain should be avoided by proper support and alignment of piping .When tightening pipe ,do not use valve as a lever. Wrenches applied to valve body or piping should be located as close as possible to connecting point .

Do not over tighten pipe connection to avoid damage to the valve body.

The voltage to be given to the coils is marked on the valves.

Nominal voltage tolerance {DC- 5 % + 20 %	Power consumption {20 W DC Current
{AC - 10 % + 20 %	{14VA AC Current

The valve is fitted with standard components and hence suitable for compressed air temperature of -20 + 65 C .For higher temperatures, spacial components are available. Electrical connection is given to the plug connector. Remove the connector screw and pullout the plug. The connector can be remove from its cover.

While fitting the plug connector back to coil, ensure that the rubber gasket is put in place properly.

5) MAINTENANCE :

Warning: Turn off electrical supply depressurize valve before making any repairs. It is not-necessary to remove the valve from pipeline during maintenance.

Cleaning: A periodic cleaning of valve is desirable. The time between cleaning will depend on the compressed air and duty conditions. In general, if the voltage to the coil is correct ,sluggish valve operation excessive leakage or noise will indicate that cleaning is required.

- Preventible maintenance :**
- ☐ Keep the compressed air clean, dry and free from oil.
 - ☐ Check the valves at least once a month to ensure proper opening and closing.
 - ☐ Periodically inspect valve internals for damage, wear or clogging of the bleed.hole on the diaphragm and on the pilot base. thoroughly clean and replace worn/damaged parts.

While replacing the Diaphragm tighten the screws in criss - cross manner.

6) IMPROPER OPERATION :

- ☐ Check for and ensure supply to solenoid coil.
- ☐ Check for "BURN OUT " of coil and replace if faulty.
- ☐ Check and ensure voltage to coil is at least 90 % of rated.
Coil is designed to accept + 20 % or more over the voltage marked on the valve. A higher voltage to coil is possible and desirable .On the contrary a voltage to coil less than 90 % of rated could cause malfunction.
- ☐ Check and ensure pressure of compressed air, 2 Kg to 7 Kg/cm²
- ☐ If fault not corrected with above, disassemble valve , clean and replace worn/damaged parts.

7) RECOMMENDED SPARE PARTS :

The spare parts required and available are .

- ☐ Coil (specify voltage)
- ☐ Diaphragm (specify valve size)
- ☐ Pilot group (includes O-rings,plunger,plunger spring).

MANIKS reserves the right to make changes in the design and/or construction at any time without incurring any obligations on units previously sold.

MANIKS

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PRESSURE SWITCH



OPERATION AND MAINTENANCE INSTRUCTIONS
FOR CLASSIC SERIES
PRESSURE / DIFFERENTIAL PRESSURE SWITCHES

SWITZER INSTRUMENT LIMITED
CHENNAI – 600 098
INDIA

SWITZER Pressure or Differential Pressure Switch is a simple electro mechanical device operating on basic principles of Levers and opposing forces. Three essential elements, various combinations of which form the basics for presenting hundreds of variants to suit a variety of industrial applications. They are :

1. sensing element either of bellows or diaphragm (metallic or elastomeric)
2. a stable spring to determine the range set point and
3. a snap-acting microswitch available in a wide variety.

Mounting / Connections / Precautions

1. Position gaskets correctly while covers are fixed. Cover mounting screws must be tight.
2. Properly seal the electrical entries and cables with correct cable gland, weatherproof or flameproof as required. If in doubt, consult factory.
3. Process pressure should not exceed stated maximum working pressure.
4. Connected electrical load should not exceed declared maximum electrical capacity BOTH in amperes and volts.
5. **Do not establish pressure connections by rotating the housing. Hold hexagon of the sensor pressure connector with suitable spanner and tighten.**
6. Mount the instrument firmly and rigidly either directly on the pressure piping or on a vibration free wall, panel or pipe stanchion.
7. If outdoor installation is envisaged provide sufficient protection against aggressiveness of air, dust, very low or very high temperature, solar radiation, water penetration etc. This is essential even for weatherproof instruments.
8. If process temperature is higher than the permissible maximum temperature, it can be brought down at the instrument end by employing a longer pressure piping. Ask factory for piping nomogram.
9. A condensate coil or Pig tail should be used invariably for steam service.
10. Ensure that suitable dampener / snubber is used in rapidly fluctuating pressure lines.

OPERATION

Pressure Switch : Models 201, 203, 281, 204, 208, 209 and 021 & 023

Process pressure when applied to the sensing element creates a force which overcomes that of a pre-tensioned spring, and in turn moves a balancing arm to effect a minimal movement required to actuate a microswitch (es).

Refer table below for sensing element type and material.

Instrument Model	Sensor & Material	On-off Differential
201	Bellows Phosphor Bronze / 316LSS / Monel	Fixed
203	Bellows Phosphor Bronze / 316LSS / Monel	Adjustable
281 (Dual Setpoint)	Bellows Phosphor Bronze / 316LSS / Monel	Fixed
204 (High Static Pressure)	Metallic Diaphragm 316SS / Monel/Hast'l C	Fixed
208	Metallic Diaphragm 316SS / Monel/Hast'l C	Fixed
209 (Food Grade / Hygienic Service)	Metallic Diaphragm 316LSS	Fixed
021 (Draft & Compound Ranges)	Elastomer Diaphragm Nitrile/ EPDM / Viton / Silicone	Fixed
023 (Draft & Compound Ranges)	Elastomer Diaphragm Nitrile/ EPDM / Viton / Silicone	Adjustable

Differential Pressure switch : Models 301,303, 381, 304, 384, 306, 386, 310, 313, GN 310

When pressures from two different sources in a process are connected across the sensing diaphragm, metallic or elastomeric, the pressure difference creates a force which when overcomes that of a pre-tensioned spring, moves a balancing arm to effect the minimal movement required to actuate a microswitch(es).

High and low pressures are applied on either side of the specially contoured diaphragm and this design feature straight away eliminates the errors due to the difference in area, a common problem present in twin element pressure differential switches.

In models 301/ 4, 303, 381/ 4, 306, 386 and GN 310, a unique motion transfer assembly is used, which is sensitive to minute movements of the diaphragm but immune to the application of very high static pressure except in 310, 313 & GN 310.

In models 310 & 313, the task of transferring the resultant movement of the diaphragm is achieved by employing an additional sealing diaphragm above the low pressure chamber.

Refer table below for sensing element type and material.

Instrument Model	Sensor & Material	On-off Differential
301	Metallic Diaphragm 316L SS	Fixed
303	Metallic Diaphragm 316L SS	Adjustable
304 (High Static Pressure)	Diaphragm 316L SS	Fixed
381 (Dual Setpoint)	Diaphragm 316L SS	Fixed
384 (Dual Setpoint, High Static Pressure)	Diaphragm 316L SS	Fixed
306 (Economy Version)	Diaphragm Nitrile	Fixed
386 (Dual Setpoint, Economy Version)	Diaphragm Nitrile	Fixed
310, GN 310 (Low Ranges)	Diaphragm Neoprene / EPDM / Silicone	Fixed
313	Diaphragm Neoprene / EPDM / Silicone	Adjustable

Setting of Switching points :

1) Set-up :

A pressure source and a master gauge of accuracy better than 0.5% is required to set the actuating point. In the case of Differential Pressure switches connect the pressure source to the high pressure port and leave the low pressure port vented to atmosphere.

Switching point should preferably lie in the mid 50% of the adjustable range span.

Markings provided on the range scale are for guidance only. **To set switching points precisely use a master Pressure Gauge.**

The switching point can be set, either for fall in pressure or rise in pressure by rotating the Range Adjusting screw.

Remove the instrument cover. Unscrew and remove the lock plate, which prevents the movement of the Range screw.

Now proceed with the setting of the switching points as below:

2) Fixed ON-OFF Differential Models :

- Rotate the range adjustment screw clockwise to increase the switching point. Rotating anti-clockwise will decrease the switching point.
- After setting, re-fix the locking device back in position to prevent unauthorised adjustment of the set point.
- The center screw and the striker screw are precisely adjusted and factory-set using Loctite. **Alteration** of centre screw height will disturb the contact established between the sensor and the balance beam. **Disturbance** of striker screw will result in microswitch not acting or set-point shift. Ref. Fig 1.

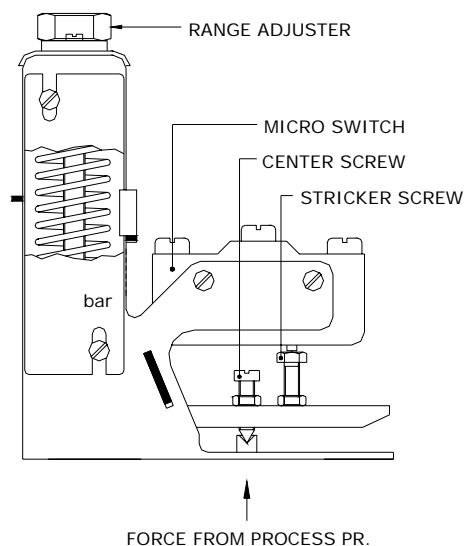


FIG.1 Fixed ON-OFF Differential Model

Models 281 & 381/4 provide an independently adjustable high and low set point facility. A single sensing element actuates two different balance arms through a floating arm. See Fig.2. Two sets of range springs, range scales, balance arms and micro switches are independently operated.

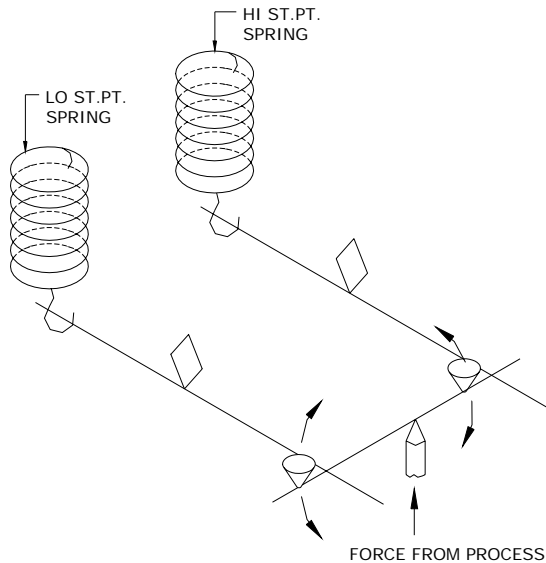


FIG. 2 Operating principle of dual set pt. version

Both the range springs are clearly marked for high and low functions. First set the low range spring and adjust the desired value for the actuation of the microswitch. The high range spring should then be adjusted similarly to the desired high set point. Ensure that the correct micro switch is monitored while settings are done. Refer Fig.3.

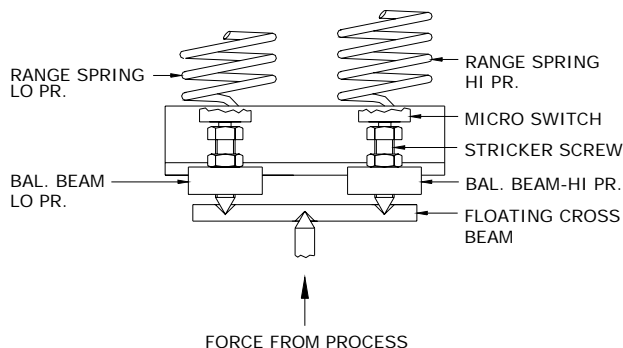


FIG.3 Side-view of Mechanical Frame S.A. of Dual set-point version

3) Adjustable ON-OFF Differential Models :

On-Off differential value can be adjusted for a wider value from about 10 to 15% of the span to a maximum of 60% as specified against each range. The minimum value will vary with different switch combinations. This facility is achieved by an auxiliary spring brought into action when the switch actuating plate moves up before it operates the micro switch. Adjustment of the tension of the spring decides the pressure difference between the on point and off point. Refer Fig. 4.

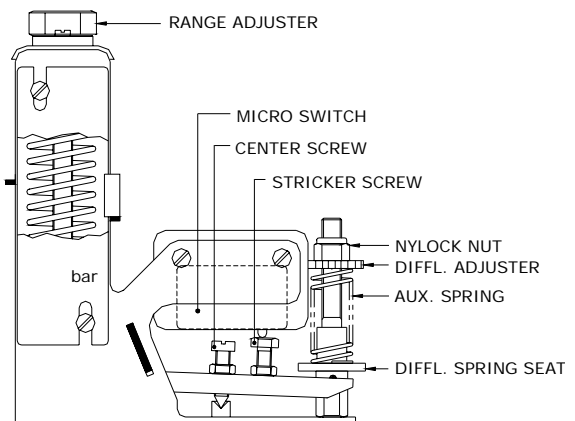
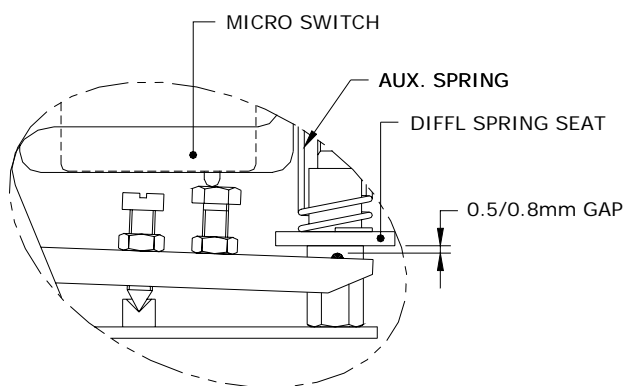


FIG.4 Wide Band Adj. Differential Mechanism

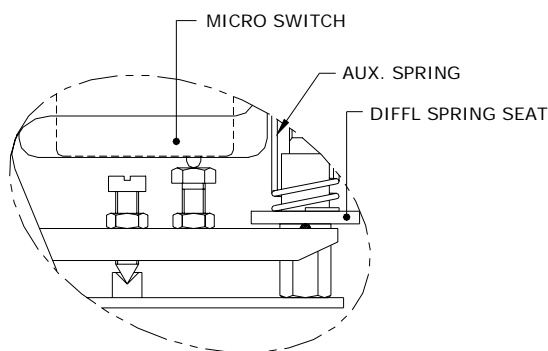
- In adjustable differential model set the lower switching point first. Release the aux. spring to be free by lifting up the nyloc nut and the diff. Adjuster. Using the range adjuster set the lower switching point. Then load the aux. spring by turning in the Diff. Adjuster to set the upper switching point.
- Adjusting the differential adjuster will shift only the upper switching point i.e. the switching pressure difference (on-off differential) alone changes. A clockwise rotation will increase upper switching point and anti-clockwise rotation will decrease it.
- The upper switching point should not exceed the maximum range value.
- After setting the differential, tighten the Nyloc nut to lock the differential adjuster to prevent loosening during operation.

Precaution :

The switch actuating screw on the balancing arm is critically adjusted. **Disturbance** of this would result in not achieving the desired result while ON-OFF differential adjustments are made. If accidentally disturbed, to reset the micro switch for correct operation adjust the height of the striker screw such that the balancing arm is not in contact with the auxiliary spring seat at the time of switch de-actuation. Refer Fig.5. This alone will ensure unloaded condition of the auxiliary spring during de-actuation. For actuation of the microswitch, the balance beam has to lift the aux. spring seat which is pre-loaded with the desired value of wide band On-Point. Refer Fig.6.



**FIG.5 Switch at off position –
Aux Spring load not acting**



**FIG.6 Switch at on position –
Aux Spring load acting**

Notes :

- 1) In the instruments with 2 SPDT switches for DPDT action, the synchronization of actuation is achieved within practical limits. The switches are synchronized as per customer preference either on falling or on rising pressure. If no preference is indicated, synchronization is done on fall in pressure at factory.
- 2) Do not exceed the rated maximum working pressure. Over pressure beyond the specified value will permanently damage the sensing element leading to replacement.

MAINTENANCE

Instruments are so designed with rugged components that they seldom require maintenance. Occasional cleaning of the moving parts, checking of the microswitch(s) and ensuring firm electrical contacts at the terminals will provide a long trouble-free performance.

In the case of diaphragm operated instruments, **do not attempt** dismantling the sensing diaphragm as it would permanently disturb the factory settings. Special jigs are needed for reassembly and hence replacement is not recommended at the user end. However, cleaning of the diaphragm chamber can be performed by flushing with a cleaning fluid, which is compatible with the diaphragm and its housing material.

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SEQUENTIAL TIMER

CUSTOMER : BEEL
SR.NO(S) : 12702-03

INSTRUCTIONS MANUAL OF BAG FILTER CONTROLLER.

TYPE : BFC 101-22R-24VDC. (22 – Refers to no. of channels)

PCB NO. : BFC 10RLY-SNBR (Main PCB) &

BFC 6R-SL-SNBR (Slave PCB or Add-on PCB of 6 channel each)

INTRODUCTION :

The Bag Filter Controller is a specially developed electronic unit, which controls the cleaning cycle of a Pulse Jet Bag Filter. It is suitable to drive up-to 22 channels Relay output. The ON and OFF time of the control solenoid valve can be controlled over a wide range, to suit individual requirements. The Timer finds extensive use in Cement, Fertilizer, Chemical, Power, and in general, most of the Process Industries.

SPECIFICATIONS :

CONTROL SUPPLY	: 24Vdc (Timer circuit requires 150mA Current for its operation)
OUTPUT CHANNELS	: TYPE : BFC 101-22R-24VDC. (22 – refers to no. of channels)
OUTPUT DEVICE	: RELAY.
OUTPUT CONTACTS	: 'NO' Type.: 1 'NO' CONTACT per channel, suitable for driving standard Solenoid.
SOLENOID VOLTAGE	: 24VDC. For the solenoid of 20VA, the 24 VDC supply rating should be atleast 50 VA.
ON TIME	: 20 to 200 mSecs. continuously adjustable.
OFF TIME	: 02 to 120 Secs. continuously adjustable.
CHANNEL INDICATION	: 3mm red LEDs. (Standard).
ON TIME	: This is the time for which solenoid remains energized. This can be set between the specified limit by means of ON TIME potentiometer on the unit.
OFF TIME	: This is the time between the two consecutive solenoid becomes energized. This can be set between the specified limit by means of OFF TIME potentiometer on the unit.

AUTO / MAN

AUTO/MAN switch is provided on the PCB for the selection of Timer circuit to work on Auto mode OR in Manual mode, respectively. In Auto mode the output channels are fired sequentially as per selected On time and Off timing.

In Manual mode the output channels can be fired manually one by one in series by pressing Manual Pulsing Switch. For normal operation keep the S/W in Auto mode.

DIFFERENTIAL PRESSURE S/W CONTACTS

A provision is made to accept NO Contact of Differential Pressure Switch (across terminals A & B) as a input. In Healthy condition this contact remains in closed condition. In case of pressure drop this contact opens up & the Timer stops functioning after operation of currently operating channel & further output channels will not be fired even if PLC/DCS ON Command is in healthy condition. Once the D/P comes in healthy condition, the selection is

provided for restart of timer sequence by using 'JP1' LINK. The Timer starts function from the Next channel where sequence is terminated when link is open OR starts function from first channel when link is shorted. The LINK JP1 is common for both command (D/P S/W contact & PLC/DCS command). If D/P Switch is not provided then keep the above terminals shorted.

'TIMER ON COMMAND' FROM PLC / DCS :

Timer sequential operation is governed by 'Timer ON' command from PLC/DCS, also known as 'PLC ON' Command. A provision is made to accept a potential free 'NO' contact from PLC/DCS as a 'ON Command'. (across terminals C & D) as shown in Electrical connections. In Healthy condition this contact remains in closed condition. If command is not present, this contact opens up & the Timer stops functioning after operation of currently operating channel & further output channels will not be fired even if Differential Pressure Switch contact is in Healthy condition. Once 'ON Command' from PLC/DCS becomes healthy, the sequence restart as per LINK JP1 selection. If 'ON Command' is not provided then keep the above terminals shorted.

Please note that 'PLC/DCS ON Command' and Differential Pressure Switch contact, both individually affects Timer operation as specified above.

TERMINATION

Number of Channels to be fired is depend on DIP s/w position (for details of DIP S/W selection facility Please refer enclosed diagram). Normally all the Switches are kept in OFF position except last, in this condition all the Channels will be fired automatically. For Channel termination selection, say, if the Switch at position 3 is kept ON, the Channels from 1 to 3 will fire Sequentially and the cycle will terminate after 3rd channel and the channels next to 3rd will be skipped. Keep only one DIP S/W ON at a time. Otherwise, termination priority goes to the lower channel. Then the timing cycle will resume automatically from the 1st channel after Pause Time gap (if provided). Please note once the particular channel is selected, the channels prior to that channel can not be skipped by the timer.

PULSING ON FEEDBACK CONTACT

One 'NO' contact is provided for feedback from timer unit to PLC or any controller. Relay contact becomes NC only during Timer pulsing operation.

FUSE PROTECTION :

The unit carries two fuse sockets, each having a differently rated glass cartridge fuse. The Mains Fuse is rated for 100mA and is meant for protection against wrong supply connection only. The other fuse is Load Fuse and its fuse link is rated for 1 Amp. so that it can safely withstand the solenoid coil current. If multiple solenoid coils are connected in parallel across the output, then the total solenoid coil current may exceed its rating and it may give way. In such a case, a higher rated fuse link may be substituted.

However, it may be noted that, the connection between the output Relays and the output terminals, is through P.C.B. tracks which have a limited current carrying capacity and hence too much increase in Fuse Rating may cause burning of tracks.

TESTING AND MAINTENANCE MANUAL FOR BAG FILTER CONTROLLERS TIMERS**PCB NO. : BFC 10RLY-SNBR**

1. Connect the circuit as shown in electrical connections diagram. Mains ON/OFF switch is provided near the terminal strip. Also 100mA Mains fuse is kept in series with the Transformer primary to protect the circuit from accidental increase in control supply. Surge suppressors are provided for protection of circuit from any surge on the Supply.

2. AUTO/MAN Switch is provided on PCB for the selection of Timer circuit to work in Auto mode or Manual mode, respectively. In Auto mode, the output channels are fired sequentially as per selected pulse duration (ON time) and pulse frequency (OFF time) timings. In manual mode, the output channels can be operated manually one by one in sequence by pressing 'manual Pulsing Switch'. For Normal operation, keep the 'AUTO/MANU' switch in Auto mode.
3. Timer sequential operation is governed by 'Timer ON' command from PLC/DCS, also known as 'PLC ON' Command. A provision is made to accept a potential free 'NO' contact from PLC/DCS as a 'ON Command'. (across terminals C & D) as shown in Electrical connections. In Healthy condition this contact remains in closed condition. If 'ON Command' is not provided then keep the above terminals shorted.
4. A provision is made to accept 'NO' contact of Differential Pressure Switch (as a input. In Healthy condition, this contact remains in closed condition. If D/P switch is not provided then, keep the above terminals shorted.
5. Connect specified control supply voltage 24Vdc (refer electrical connection diagram) between terminals After supply is made ON if the 'D/P' and 'PLC/DCS Command' contacts are healthy and AUTO/MANU switch is in Auto mode, the Pulse LED will start blinking as well as the channel ON LEDs will start glowing one by one sequentially. Timer ON contact / feedback becomes 'NC' (provided on the terminal strip : Terminal.No.26 & 27). This indicates that Timer is operating properly. As soon as Timer stops its sequential operation due to D/P low condition or Absence of PLC/DCS Command, Timer ON contact becomes 'NO', indicating Timer is not healthy.
6. The DIP switch (just below the channel LEDs) is provided for channel termination i.e. to decide channel NOs. to be fired in one cycle. Normally all the switches are kept in 'OFF' position and in this condition all the channels will get fired automatically.
7. Please note that once the particular channel is selected, channels prior to that channel can not be skipped by the Timer. If two or three switches are selected at a time, the sequence will terminate after first selected channel.
8. Load should be connected between terminal pairs on main Terminal strip (marked as ch. No. & com starting from terminal no. 6 upto 24 for master pcb). Output relays are suitable to drive standard solenoid coil. 1 Amp. Fuse (Load Fuse) is connected in series with Load to protect the circuit from accidental short-circuiting of the Load. If two or three switches are selected at a time, the sequence will terminate after first selected channel.
9. Pulse duration (Channel ON Time) & Pulse frequency (OFF Time between two successive channels) timing adjustment potentiometers are provided on the PCB.

SR. NO	NATURE OF FAULT	CAUSE	REMEDY
1.	Power supply LED is not glowing.	a. Blown Fuse Link. b. Faulty LED.	a. Check Fuse Link & replace fuse if required. b. Check all components related to 12VDC Rectifier. c. Change the LED.
2.	Timer remains OFF after switching ON the supply. Timer ON relay is not functioning.	a. D/P Switch contacts are open or PLC/DCS contact is open. b. No O/P pulses at Pins 1 to 11 of IC4017 (U6&U7). c. Relay driving transistor.	a. Check the D/P switch contact & PLC contact b. Check IC 4017. c. Check associated circuitry.
3.	Pulse LED is not blinking.	No input clock pulses to IC 4017 and IC 555.	a. Check pulses at pin 3 of IC 555. A/M Switch should be in Auto mode.

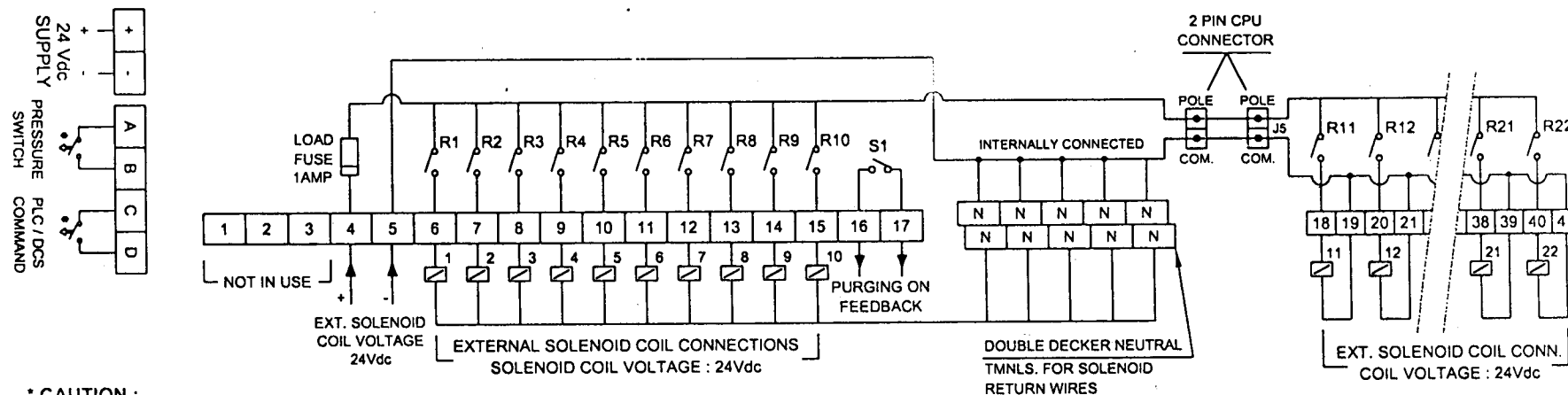
SR. NO	NATURE OF FAULT	CAUSE	REMEDY
4.	Sequence is terminating in between.	DIP S/W selection	a. Make proper selection of channel position & B. check associated diodes.
5.	Timer is not working in Manual Mode.	a. A/M switch. b. Manual pulsing switch.	a. Check A/M Switch connections. b. Check push button.
6.	Timing sequence is working but output is not operating.	a. Load Fuse blown-up. b. Fault in Relay.	a. Check Load Fuse (1A) b. Check Relay, its driving transistors.
7.	Pulse Duration Timing (ON Time) is not proper	Timer circuit.	Check IC 555. Related resistors and capacitors.
8.	Pulse Frequency Timing (OFF Time) is not proper.	Timer circuit.	Check IC 358 and related resistors and capacitors.

If any other problem occurs or if any additional information is needed, please feel free to contact our works/office at

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ELECTRICAL CONNECTIONS FOR BAG FILTER CONTROLLER. TYPE : BFC 101-22R-24Vdc

SR.NO. :12702-03

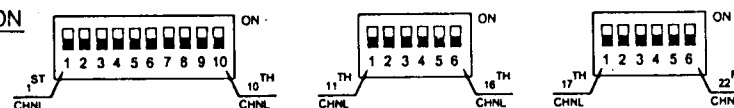


* CAUTION :

ALWAYS USE POTENTIAL FREE 'NO' CONTACT OF 'DIFFERENTIAL PRESSURE SWITCH' AND 'PLC/DCS ON COMMAND'.

IF 'DIFFERENTIAL PRESSURE SWITCH' OR 'PLC/DCS ON COMMAND' IS NOT USED, THEN KEEP RESPECTIVE TERMINALS SHORTED.

DIP SWITCH SELECTION



NOTE : THE SEQUENCE TERMINATES AFTER THE OPERATION OF SELECTED CH. NO. KEEP AT A TIME ONE SWITCH AT 'ON' POSITION.

FILTER REGULATOR

INSTRUCTIONS

MODEL F17

AIR FILTER

LARGE FLOW SERIES

SPECIFICATIONS :

Port Sizes : G 1, G 1½ Standard

Filtration Ranges : 50 Micron (Standard)
5 Micron (Optional)

Filter Element Material : Sintered Bronze / Plastic

Bowl : Metal - Standard

Max. Primary : 17.5 Kg/cm² (250 psig)
(Inlet) Pressure

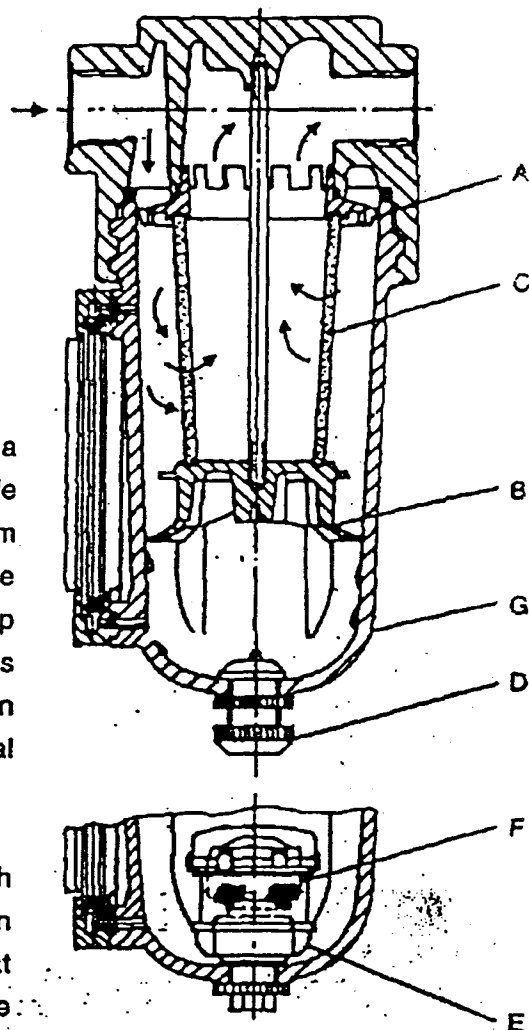
Temperature range : 0° - 80°C (32° - 175°F)
(ambient)

Drain : Manual or Automatic

OPERATION :

Air flows through the directional louvres (A) which force it into a swirling flow pattern. Liquid particles are thrown against the inside wall of the bowl (G) by centrifugal force and settle to the bottom of the bowl. The baffle (B) maintains a 'QUIET ZONE' in the lower part of the bowl to prevent air turbulence from picking up the liquid and returning it to the air stream. The air then passes through the filter element (C) to remove solid contaminants. On manual drain models the liquid is removed by opening the manual drain cock (D).

The automatic drain assembly (E), easily interchangeable with manual drain (D), automatically dumps liquid as it collects. When the liquid in the bowl reaches a pre-determined level, the float (F) opens a pilot valve. This admits air above a piston in the mechanism causing the drain valve to open and expel the liquid whereupon the float closes the pilot valve and so the drain valve. The mechanism - a sealed unit - is also designed to remain open when no air pressure is in the permitting overnight draining.



MAINTENANCE :

The filter can be disassembled for servicing without removal from the pipe line. Shut-off the air supply and bleed down the pressure. Then proceed as follows :

To remove the filter element, unscrew the metal bowl (13) anti-clockwise. Unscrew the baffle (6) from the staked rod and withdraw the element (4) and louvre deflector (2) complete with 'O' ring (1) together with upper and lower gaskets (3&5). Clean the filter element in kerosene or soap water and reverse blow with compressed air. Keep filter clean for best performance and minimum pressure drop.

The automatic drain and screen assembly can be removed from the metal bowl by unscrewing the retaining ring (14) and withdrawing the components from the bowl. Unclip the plastic drain mechanism (10). These are non repairable items. Clean the strainer with compressed air and wash the bowl in kerosene.

After cleaning, inspect 'O' rings and gaskets for nicks and cuts. On reassembly, ensure they are not twisted and lightly smear with silicone grease. Do not crush the filter element by over-tightening baffle. Ensure that the gasket (12) is in position on the bottom on the automatic drain or manual drain if these assemblies have been disturbed. Engage bowl and rotate so that when bowl is tightened the indicator mark on bowl is against mark on the body.

PARTS :

Repair kit

CONTAINS

- 1 'O' ring - louvre
- 3 Upper gasket - element
- 5 Lower gasket - element
- 7 'O' ring - bowl

1Ltr. Metal Bowl Repair kit

CONTAINS

- 7 'O' ring - bowl
- 15 Seal-sight glass (2 Nos.)
- 16 Sight glass
- 17 'O' ring (2 Nos.)
- 18 Guard - sight glass
- 19 Screws (4 Nos.)

OTHER REPLACEMENT PARTS :

- 2 Louvre
- 4 Filter element - 5 micron (Sint. Br.)
- 4 Filter element - 50 micron (Sint. Br.)
- 4 Filter element - 50 micron - Plastic
- 6 Baffle
- 13 Metal Bowl
- 20 Bracket (2 Nos.)
- Plastic Manual Drain cock Assly

SN -1376

2306 - 36

5314 - 01

5317 - 01

2316 - 52

2273 - 22

2316 - 52

5843 - 83

5872 - 11

706 - 01

1218 - 89

3391 - 05

5313 - 89

5311 - 01

5311 - 03

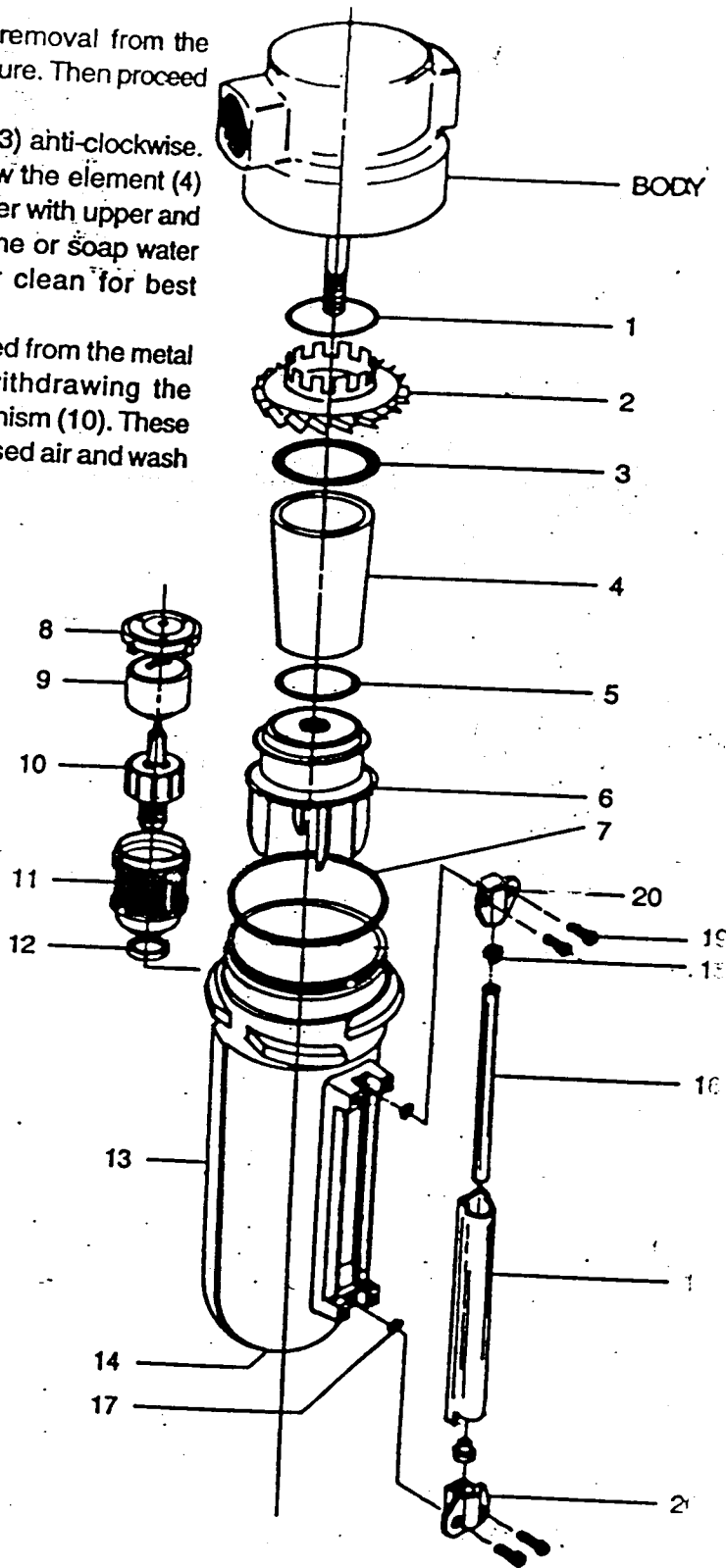
5311 - 13

5316 - 88

5390 - 15

3378 - 89

684 - 84



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ZERO SPEED SWITCH

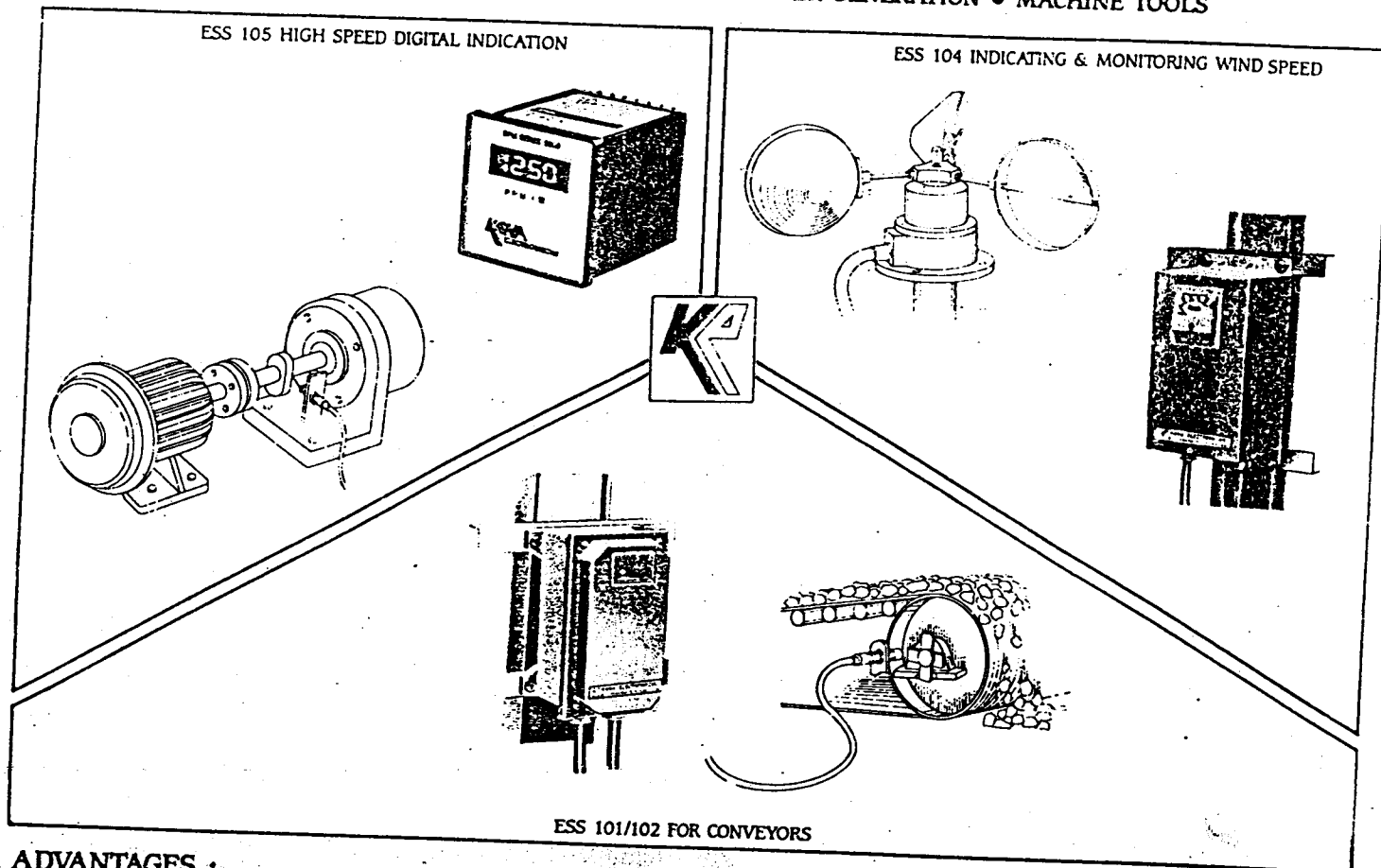
THE FINEST QUALITY ENGINEERED • PROVEN TECHNOLOGY



TECHNICAL BULLETIN : ESS 101-02
ELECTRONIC SPEED SWITCH
 (ZERO/UNDER/OVER SPEED MONITOR)

Another reliable product from **KANA ELECTROMECHS** for critical industrial application.

• CEMENT • FERTILIZERS • CHEMICALS • POWER GENERATION • MACHINE TOOLS



ADVANTAGES :

- ★ Non Contact Sensing
- ★ Extreme Low Speed Detection Possible.
- ★ Built-in Initial By-Pass Facility
- ★ Probe Dust & Water tight to IP-67.
- ★ Monitor Dust & Water tight to IP-55/65.
- ★ Matching Speed Indicators Available.

EXCLUSIVE FEATURES :

- ★ Linear Dial Markings for setting.
- ★ Special Probes for 120°C operation.
- ★ Variety of Accessories available.
- ★ 'Intrinsically Safe' Model available.
- ★ Multi-range, Programmable Model for reducing inventory.

APPLICATIONS :

- The Electronic Speed Switch is ideally suited to monitor any repetitive motion, whether rotational or translational. In fact, it is best suited for the speed monitoring of critical elements of any material handling system, such as belt/screw conveyors, elevators, crushers, drag chains, rotary feeders etc. It senses the under speed/over speed conditions in the system by non contact method and provides output contacts for protection, control and interlock purposes. Applications include, detection of jamming in feeders, sequential interlocking of conveyors, detection of blade breakage in reclaimer chain, motion detection, fan speed monitoring etc.
- Models having indication facility or having 4-20mA output, find extensive use in central control room instrumentation. Models with multiple setting facility find use in speed dependent switching of control gear.

CONSTRUCTION :

The Speed Switch comprises of a sensor probe and a monitor unit. The sensor probe is Non-Contact type Inductive Proximity Switch, which picks up speed information from the system. The monitor unit accepts this information, evaluates it and provides necessary output. The epoxy potted probe is dust and water tight to IP-67 and the monitor, in Sheet Steel or cast aluminium, epoxy painted housing, is dust tight to IP-55. The LEDs, 'Supply ON', and 'Pulses' are clearly visible through the transparent window on the cover. The terminal strip, which can accept conductors upto 2.5 square mm, the speed setting knob, the range switch and the bypass trip setting knob, all are accessible only after opening the cover. Proper markings are provided for test points and external connections. Different housings are available to suit individual requirements. The sensor probe is available in threaded housing, either thermoplastic or metallic, with two clamping nuts, having sizes as per selection table.

SELECTION RANGE : Add the following code Nos. in sequence, after the name of the series, as ESS XXX XX X XX XX

CODE : FUNCTION	CODE : ENCLOSURE	CODE : CONTACTS	CODE : SUPPLY	CODE : DELAY
101 : Single Range, Min : Max 1 : 10. 102 : Multi Range Programmable.* 103 : Linear, 4-20mA Transmitter 104 : Analog Indication, Auto Ranging 105 : Digital Indication 106 : Multiple Setting Facility 107 : Freq. Monitor for D.G. Set 108 : Adjustable Trip & Bypass Delay 109 : Wind Speed Switch 110 : Special Executions * 5 : 5000	01 : Cast Aluminium 02 : Sheet Steel 03 : Thermoplastic 04 : Special	1 : 1NO + 1NC 2 : 2NO + 2NC 3 : Special Contacts rated for 5A, AC, Res at 240V, 50Hz	01 : 110V, 50Hz 02 : 240V, 50Hz 03 : 24Vdc 04 : Special	01 : 3-30 Secs. Bypass Delay 02 : 3-30 Secs. Trip Delay 12 : Both, Trip and Bypass Delays. S : Special
SAMPLE ORDERING CODE : ESS 102 01 1 01 01 : (Type ESS with Multirange Programming facility, in Cast Aluminium enclosure, 1 NO + 1 NC contacts, 110V, 50Hz, supply, with Bypass delay 3-30 secs.				

PROBE SELECTION TABLE : Following sizes of Probes, with different options, are available :

SIZE	SENSING DISTANCE	WIRE LENGTH	HOUSING	SPECIAL FUNCTION	SAMPLE ORDERING CODE
M 8 M 12 M 18 M 30 M 50	1.5 mm 3.0 mm 5.0 mm 12.0 mm 22.0 mm	01 meter 02 meters 03 meters	1 : Metallic Threaded 2 : Thermoplastic Threaded 3 : Square Type 4 : Special	HT : High Temp. 2W : 2 Wire Add : this code for special probes only.	Probe : M30-12-03-1 (M 30 size probe, Sensing distance 12mm, wire length 1 mtr., in threaded metallic housing.)

OPERATION :

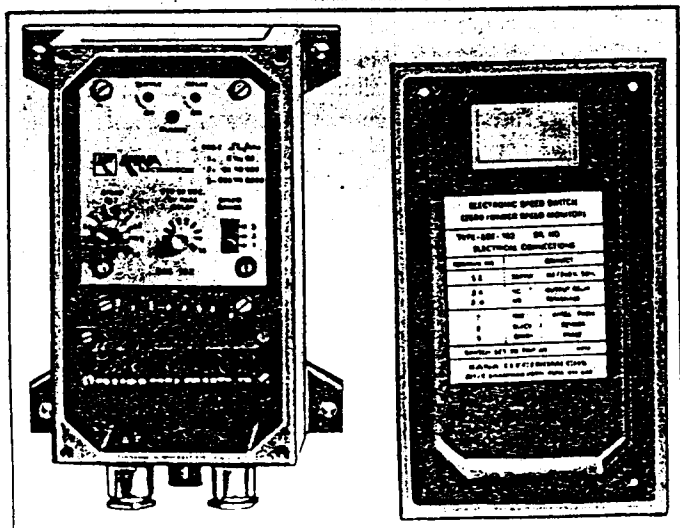
With the unit connected as shown, the 'Supply ON' and 'Relay ON' LEDs light up as soon as the supply is switched on. During the Initial By-pass time, which is initiated by supply on, the output relay remains picked up, independent of speed. It is further held, only if the speed reaches set value, before the expiry of by-pass. The relay then drops, whenever the speed falls below the set value. It can again pick-up, if the system speed picks-up to healthy running condition. The 'Pulses' LED lights ON & OFF in response to the actuation and deactuation of the probe.

SELECTION OF PULSE RATE :

The monitor unit evaluates the duration between successive pulses from the probe and compares it with the set value, to give the desired output. Consequently, the tripping time is dependent upon available pulse rate. For example, at a pulse rate of 12 pulses/min, the duration between successive pulses is 5 secs and hence the tripping time is slightly more than it. Therefore, it is preferable to choose number of flags such that, at a given speed, the pulse rate falls approximately between 60 pulses/min to 180 pulses/min, giving a tripping time of 1 sec & 1/3 sec respectively. Generally, the number of flags chosen are 1, 2, or 4 because of practical convenience.

ACCESSORIES AVAILABLE :

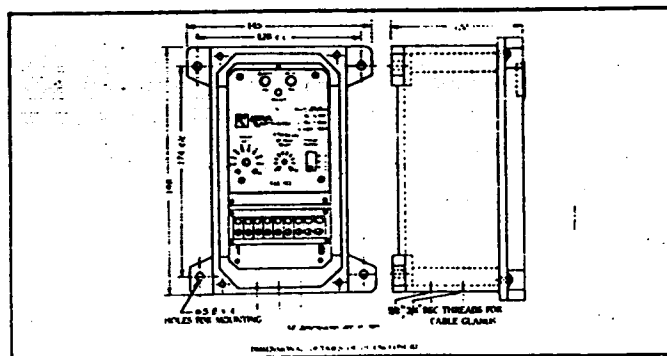
1. Mounting Bracket For Monitor Unit.
2. Mounting Bracket For Sensor Probe.
3. Dust Tight Junction Box For Probe Connections.



COMMISSIONING AT SITE :

The commissioning of switch involves proper mounting of the sensor probe and the selection of Range, Speed and By-pass time on the monitor. The sensor probes are available in a variety of sizes, starting from M8 to M80, but for field applications, generally M30 and M50 size probes, having sensing distances of 12 mm and 22mm respectively, are preferred. The probe is mounted near the rotating part in such a way that, the distance between the faces of probe and the M.S. Flag, is @ 0.7 of the nominal sensing distance of the probe. This ensures that, there is no missing pulse at higher speeds or due to nominal mechanical tolerances. The LED at the rear end of the probe, helps in proper alignment of the probe with flags.

At the healthy running speed of the rotating part, with a chosen number of flags, a definite pulse rate is available at the probe output. The Speed setting is to be done just below this rate, to ensure that the relay picks up at this speed definitely. The relay, once it picks-up, will drop out only when the speed falls down by 8 to 10% from the pick-up speed. In case of multi-range switch, first the range should be selected by means of range switch, such that the available pulse rate comes within it. For under speed monitoring, to avoid tripping during start up, the Initial Bypass Time is to be set such that, it is slightly more than the maximum acceleration time of the rotating part under consideration. For model with Trip Delay facility, adjust the delay to overcome tripping due to momentary speed fluctuations.



Specifications subject to change without prior notice in view of continuous efforts towards further improvement.

KANA ELECTROMECHS

17/18, Kothrud Industrial Estate, Pune-38.
Phone : 020-25430630, 25437905, 25450393
Fax : 25461772. e-mail : kana@vsnl.com

KANA ELECTROMECHS

TESTING & MAINTENANCE MANUAL FOR ELECTRONIC SPEED SWITCH

(P.C.B. : NO. : ESS-U1/ECO-R1)

1. Connect the circuit as shown in connections diagram affixed inside the cover. Connect specified control supply 110/230 VAC between terminals 1 & 2, connect the Sensor Probe between terminals 9(+) Red, 10 (-) Black, 11 (O/P) Green.
2. Sensor probe selection facility is available for Input Sensor Probe for Electronic Speed Switch unit. Options are : a) 2Wire probe, b) PNP probe or c) NPN probe. Usually ESS Unit is provided with NPN type of Sensor Probe. Therefore keep the link (SW2) at 'NPN' position.
3. Logic selection facility is available for Output Relay operation. Options are : a) 'NO' logic & b) 'NC' logic. The Status of the output Relay & LED for NO Logic shall be as follows :

When the supply is switched ON : Relay Energized - Green LED ON

During By Pass Delay condition : Relay Energized - Green LED ON

During Healthy Speed condition : Relay Energized - Green LED ON

During Under Speed condition : Relay De-energized - Green LED OFF

For selecting the NC logic at site a link changing arrangement is provided on the PCB. for link selection pl. refer enclosed diagram. Relay energization logic get reversed when 'NC' Logic is selected. Generally Logic Link is factory set at 'NO' position.

4. Keep the proper link shorted at the link selection for the Sensor Probe and for output Relay logic. Open link may cause false tripping.
5. Start-up Bypass Delay facility (IBPD) is provided to avoid fault indication during 'motor Start-up' since, initially motor will take some time to cover speed from 'Start-up Condition' to 'Healthy condition'. This start up under speed condition may be treated as fault by the speed switch. To bypass this condition and to allow safe time to take up the healthy speed, Initial Bypass Delay is provided. IBPD timer gets actuated upon Switching ON the supply to the Speed Switch. During that time the relay shall remain energized till the completion of Initial By-pass delay (IBPD, 1-30 Sec. adjustable). After completion of by-pass delay the relay shall de-energize if the speed does not reach to its healthy condition. For testing in laboratory, actuate the sensor probe by bringing in and out metal piece in its sensing zone at regular intervals of time. When the pulse rate reaches the healthy speed condition defined by the SPEED SET knob, relay will get energized. Select the proper speed range so that the conditions can be easily simulated.
6. Three ranges are provided for Trip speed setting viz. 5-50, 50-500 & 500-5000 PPM (Pulses per Minute). The range in PPM can be computed as No. of actuations of Sensor per revolution X RPM of the pulley. For selecting the range 4 way DIP Switch is provided on the PCB. The required range can be selected by making the particular switch ON. The Trip speed is adjustable in 1:10 ratio e.g. from 50-500 PPM or 500-5000 PPM etc by means of Trip Set knob. Around Speed Set Knob, 10 segment dial marking is provided. If 2nd Range is selected and Speed Set Knob is on 3rd Marking it means that currently Set Trip Speed is 150 PPM. If the input pulses are stopped or pulse rate is decreased approximately 10% of Set Trip Speed, relay will get de-energized. This action is possible in case of 'NO' logic and after completion of IBPD only. The output contacts are available across terminals 3 to 8. When Speed input exceeds Set Trip Speed, Relay get energized indicating 'Healthy Speed' condition. In case of 'NC' logic, the relay logic shall work in reverse way.
7. It is to be noted that the tripping time of the relay is dependent on the selected Trip Speed. At lower most Trip Speed Setting i.e. at 5 P.P.M., the Tripping will take place after 14 Sec. From the last input pulse. As the Trip speed increases the tripping time decreases. Typically at 100 PPM Trip Setting the tripping time is quite less than 1 Sec.
8. When Trip Delay is provided, the relay tripping will take action after the set Trip Delay (adjustable from 1 to 30 Sec). If proper results are not obtained, please check at the following test points shown in the circuits diagram.

If proper results are not obtained, please check at the following test points shown in the circuits diagram.

S.R. NO.	MEASURE BETWEEN	READING APPROX.	IF NOT SHOWING PROPER THEN CHECK
1.	TP2 (GND) & TP1	19 VDC	unregulated voltage
2.	TP2(GND) & TP3	8 VDC	Regulator IC 7808, C2(1 μ F)
3.	TP2 & Mid of Speed pot(Module PinNo.4)	From 4.4 VDC (min) to 5.5 VDC	Speed Set Knob, R6(5K1), R3 (100E)
4.	TP2 & TP6 (Module pin NO. 2)	Sawtooth waveform when input pulses are given.	Use Oscilloscope to see this waveform, Check DIP SW (Range Selector C3(10 μ F), C4(10 μ F), R11, R12, R13.
5.	TP2 & TP4	5.6 VDC (150E, 1/2W)	Zener Z1 & R2
6.	TP2 & TP5	Charging of Capacitor during Supply ON condition.	C6(cal.), D7, IBPD set knob.

The Sensor probe is of size M , DC, NPN, NO type. 3 core, mtrs long cable is provided with the probe. The LED indication on the probe as well as in the unit is provided to observe the alignment & actuation of the Probe. (PNP type or 2-Wire DC type probes can also be used on this Speed Switch. For input probe selection pl. refer enclosed diagram.)

Component layout is printed on the PCB and hence all components are easily identifiable. Cast.Al., IP 65 grade housing is used for the monitor unit and Sensor Probe body is chrome plated threaded Brass housing.

The control transformer for this unit is following specifications.

Primary - 0-110-230V
Secondary 0-14V, 100mA.

For making the Unit suitable to accept required supply voltage, connect proper transformer primary tap at the base of the fuse. The unwanted primary tapping is to be insulated properly and may be wound on the plastic stud used for PCB mounting.

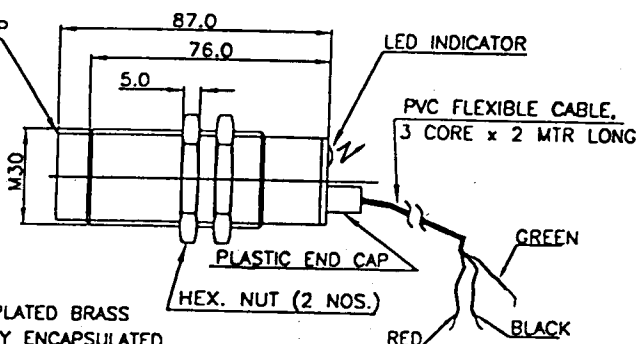
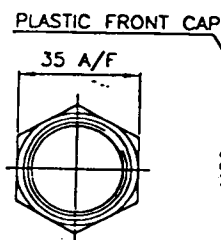
If any additional help is needed, Please contact :

KANA ELECTROMECHS,

17/1B-1A/2-3, KOTHRUD INDL. ESTATE, PUNE-411038.

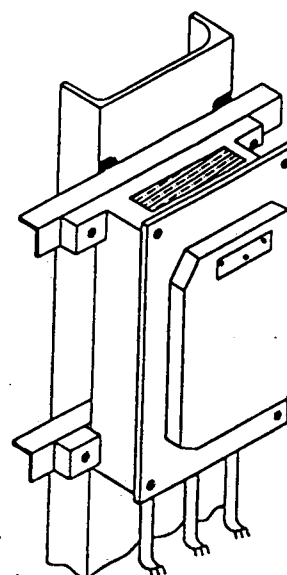
PHONES : (020)25437905, 25439630.

FAX : (020)25461772. Email : kana@vsnl.com

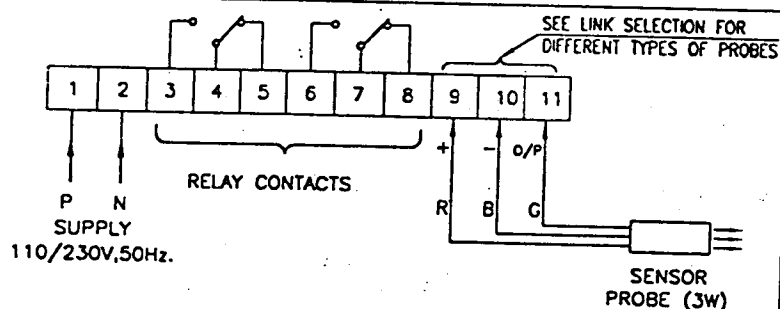


MATERIAL : Cr. PLATED BRASS
CONSTRUCTION : EPOXY ENCAPSULATED
PROTECTION : IP 67

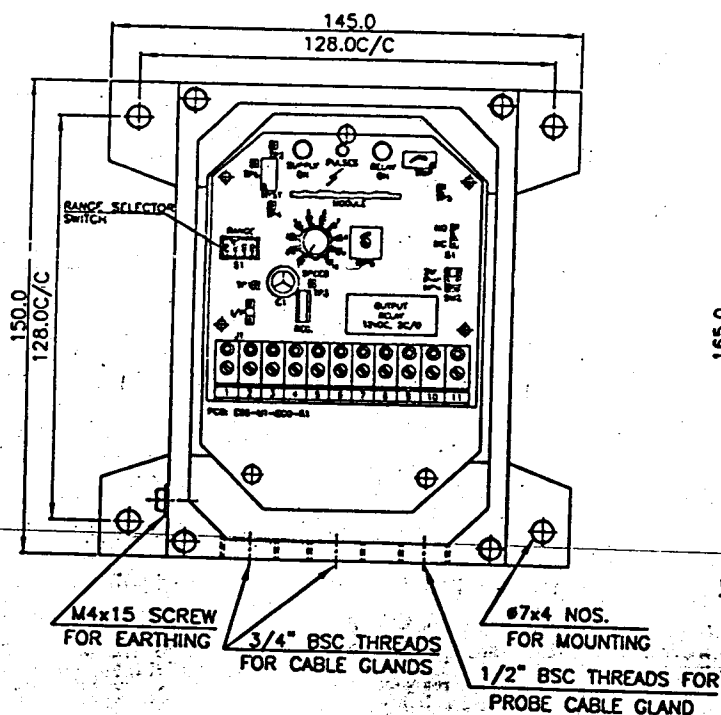
TYPICAL SENSOR PROBE (M30)
(OTHER SIZES POSSIBLE)



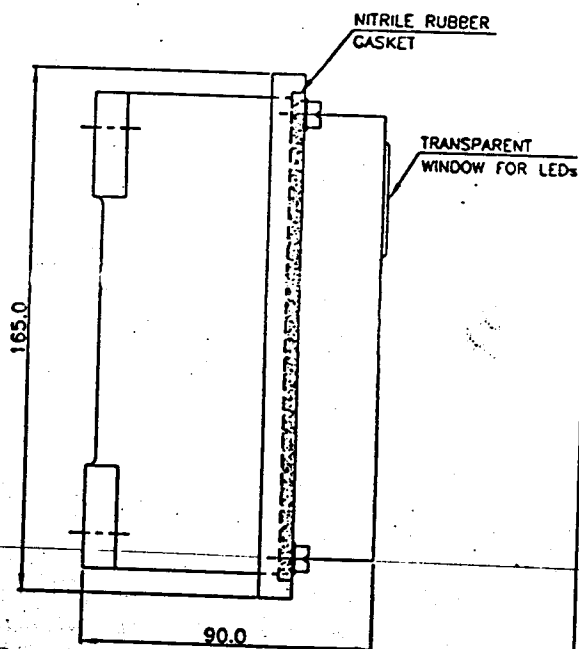
**TYPICAL MOUNTING
ARRANGEMENT FOR
MONITORING UNIT**



ELECTRICAL CONNECTIONS



VIEW WITH COVER OPEN



SIDE VIEW WITH COVER

TYPE : ESS-102
MATERIAL : CAST ALUMINIUM
FINISH : POWDER COATED
COLOUR : SIEMENS GREY
PROTECTION : IP 65
OVERALL DIM : 150x145x90(D)

NOTE : TOLERANCE FOR OVERALL DIMENSIONS : $\pm 3\text{mm}$.

CLIENT :

PROJECT :

REV.	DRN. BY	S.S.R.	10/03/2K
	CHK. BY		
	APP. BY		

**DIMENSIONAL DETAILS AND ELECTRICAL
CONNECTIONS FOR ELECTRONIC SPEED SWITCH
(ESS-ECO-R1)**



KANA ELECTROMECHS
17/18 KOTHKUD IND. ESTATE
PUNE - 411 038.

FILE NO. :

DRG. NO. :

SCALE : N.T.S.

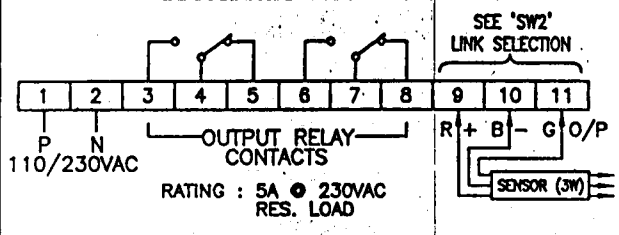
ALL DIMENSIONS IN MM

**SPEED RANGE SELECTION TABLE
FOR RANGE SELECTOR SWITCH**

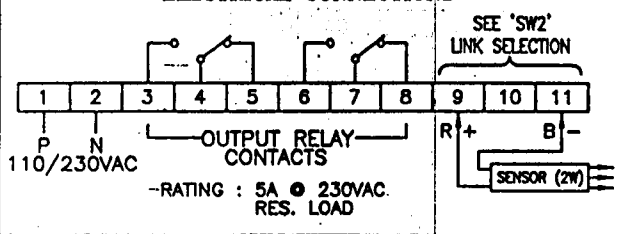
'ON' SWITCH*	RANGE
S1-1	5 - 50 PPM
S1-2	50 - 500 PPM
S1-3	500 - 5000 PPM
S1-4	500 - 5000 PPM

* KEEP ONLY ONE SWITCH 'ON'
AT A TIME.

ELECTRICAL CONNECTIONS



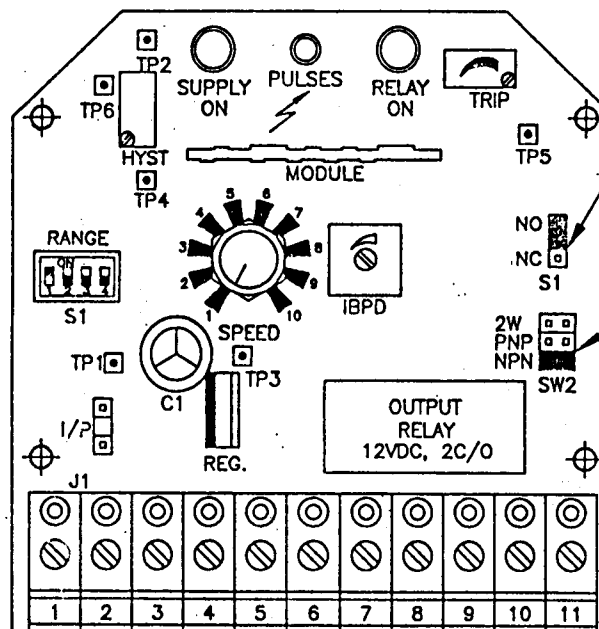
ELECTRICAL CONNECTIONS



SENSING DISTANCE TABLE FOR SENSOR PROBES:

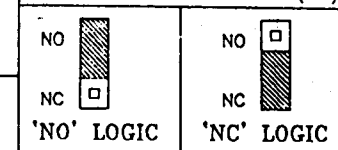
PROBE SIZE	NOMINAL SENSING DISTANCE	
	NON FLUSH	FLUSH TYPE
M30 X 80 mm	12 mm	10 mm
M36 X 80 mm	15 mm	13 mm
M50 X 80 mm	25 mm	21 mm

NOTE : Keep the proper Link shorted at the Link Selection.
Open Link may cause false tripping.

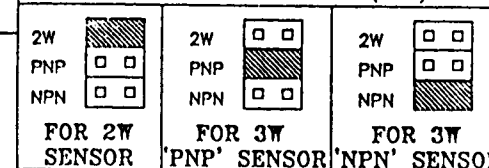


PCB: ESS-U1-ECO-R1

**LINK POSITIONS FOR O/P
RELAY LOGIC SELECTION (S2)**



**LINK POSITIONS FOR
SENSOR TYPE SELECTION (SW2)**



IN WORKING CONDITION FOLLOWING VOLTAGES/WAVEFORMS
SHOULD BE AVAILABLE ACROSS TEST POINTS.

MEASURE BETWEEN	READING APPROX.
TP2 (GND) & TP1	19 VDC UNREGULATED VOLTAGE
TP2 (GND) & TP3	8 VDC
TP2 & MID OF SPEED POT (MODULE PIN NO.4)	FROM 4.4 VDC (MIN) TO 5.5 VDC
TP2 & TP6 (MODULE PIN NO.2)	SAW TOOTH WAVE FORM WHEN INPUT PULSES ARE GIVEN
TP2 & TP4	5.6 VDC
TP2 & TP5	CHARGING OF CAPACITOR DURING SUPPLY ON CONDITON.

* SPEED : TRIP SPEED SET KNOB

IBPD : START UP BY-PASS DELAY SET POTENTIOMETER

TRIP : TRIP DELAY SET POTENTIOMETER

NOTE:

TRANSFORMER PRIMARY : 0-110-230VAC (CONNECT PROPER WINDING AT THE BACKSIDE OF THE FUSE HOLDER.)

TRANSFORMER SECONDARY : 0-14VAC, 100mA (CONNECT WINDING TO 'I/P' CONNECTOR.)

CUSTOMER :

REV.	DRN. BY	S.S.R.	22 J3/02
	CHK. BY		
	APP. BY		

PROJECT :

**COMPONENT LAYOUT & LINK SELECTION
ARRANGEMENT OF ESS (ESS-ECO-R1)**



KANA ELECTROMECHS
17/18 KOTHRUD IND. ESTATE
PUNE - 411 036

FILE NO. :
ORG. NO. :

ALL DIMENSIONS IN MM

OTHERS

DATA SHEET	
GEARED MOTOR	
DESCRIPTION	SPECIFICATION
GENERAL DATA:	
MAKE	M/S. POWER BUILD ELECON GEARS LTD
QUANTITY	1 NO.
MODEL NO.	AMC50S
TYPE OF MOTOR	SQUIRREL CAGE
MOTOR RATING	0.37 KW
OUTPUT SPEED	30.5 RPM
TYPE OF MOUNTING	FOOT MOUNTED
AMBIENT TEMPERATURE	50°C
VOLTAGE & COMBINED VARIATION	±10%
FREQUENCY VARIATION	±5%
ENCLOSURE	TEFC S1
DEGREE OF PROTECTION	IP 55
INSULATION	CLASS 'F'
POWER SUPPLY	415 V, 3 PHASE, 50 HZ
TYPE OF STARTING	DOL
DUTY	CONTINUOUS
LOCATION	OUTDOOR

SUPPLIER'S ADDRESS:

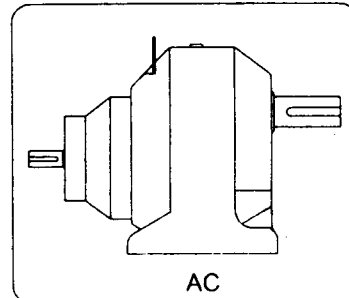
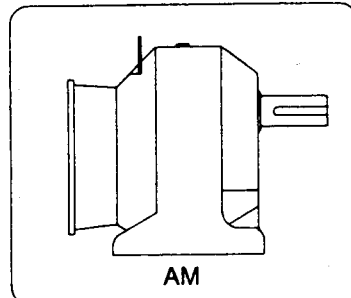
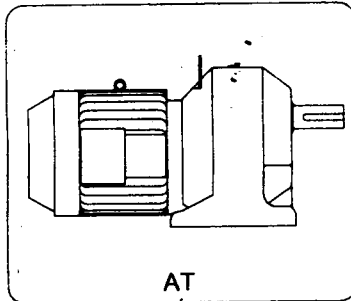
**M/S POWER BUILD ELECON GEARS LTD,
NO. 553, MOUNT ROAD, 3RD FLOOR,
EAST COAST CENTRE, TEYNAMPET,
CHENNAI - 600 018.**

CONTENT

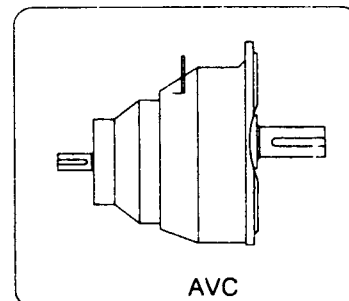
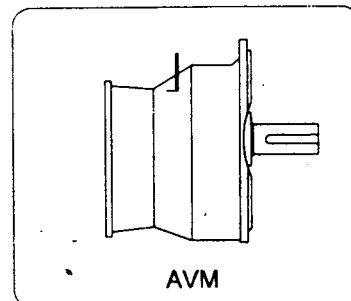
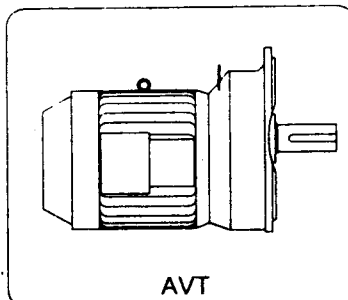
INSTRUCTION MANUAL

SKK JAPANESE TECHNOLOGY FOR GEAR MOTORS AND GEAR REDUCERS IN INDIA

FOOT MOUNTED



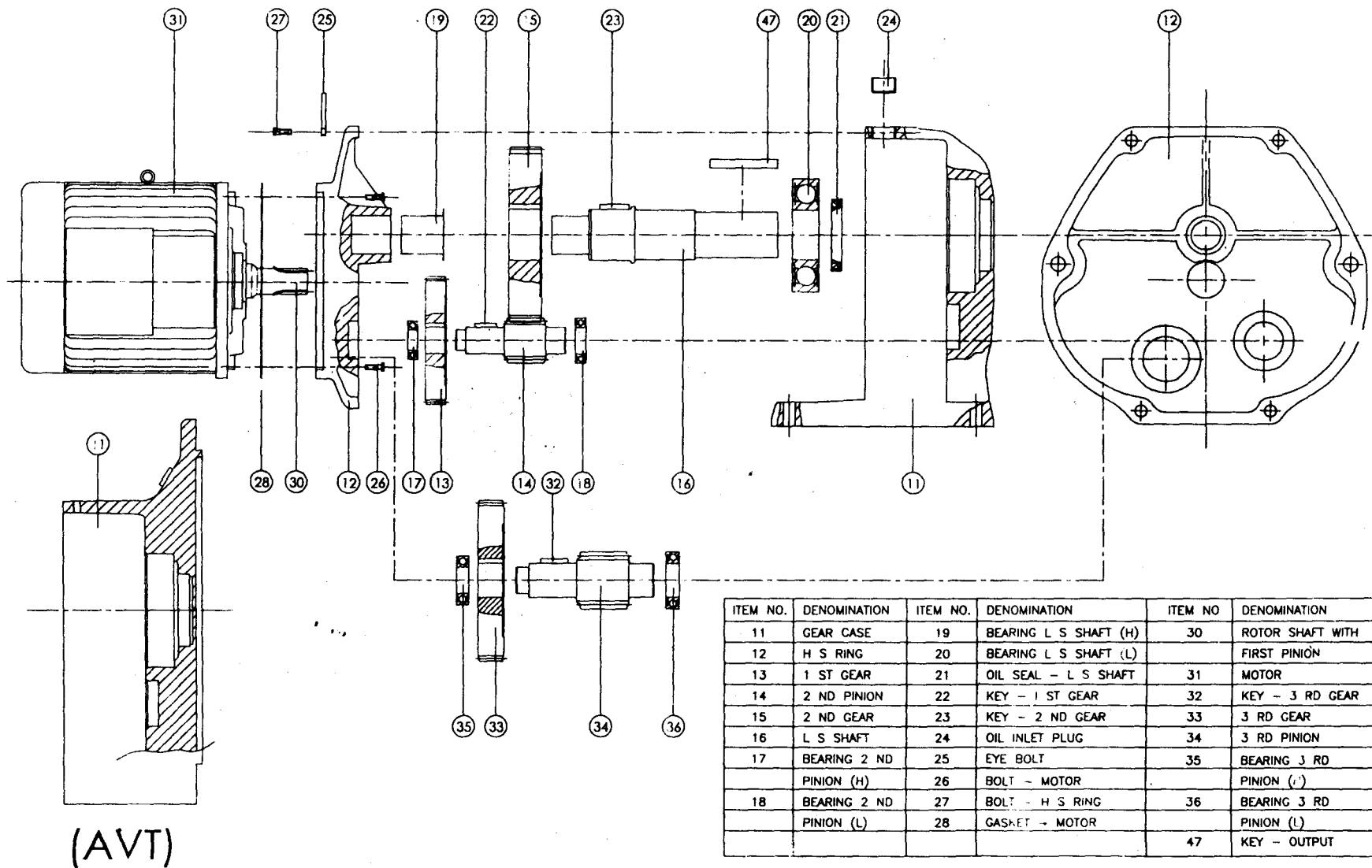
FLANGE MOUNTED



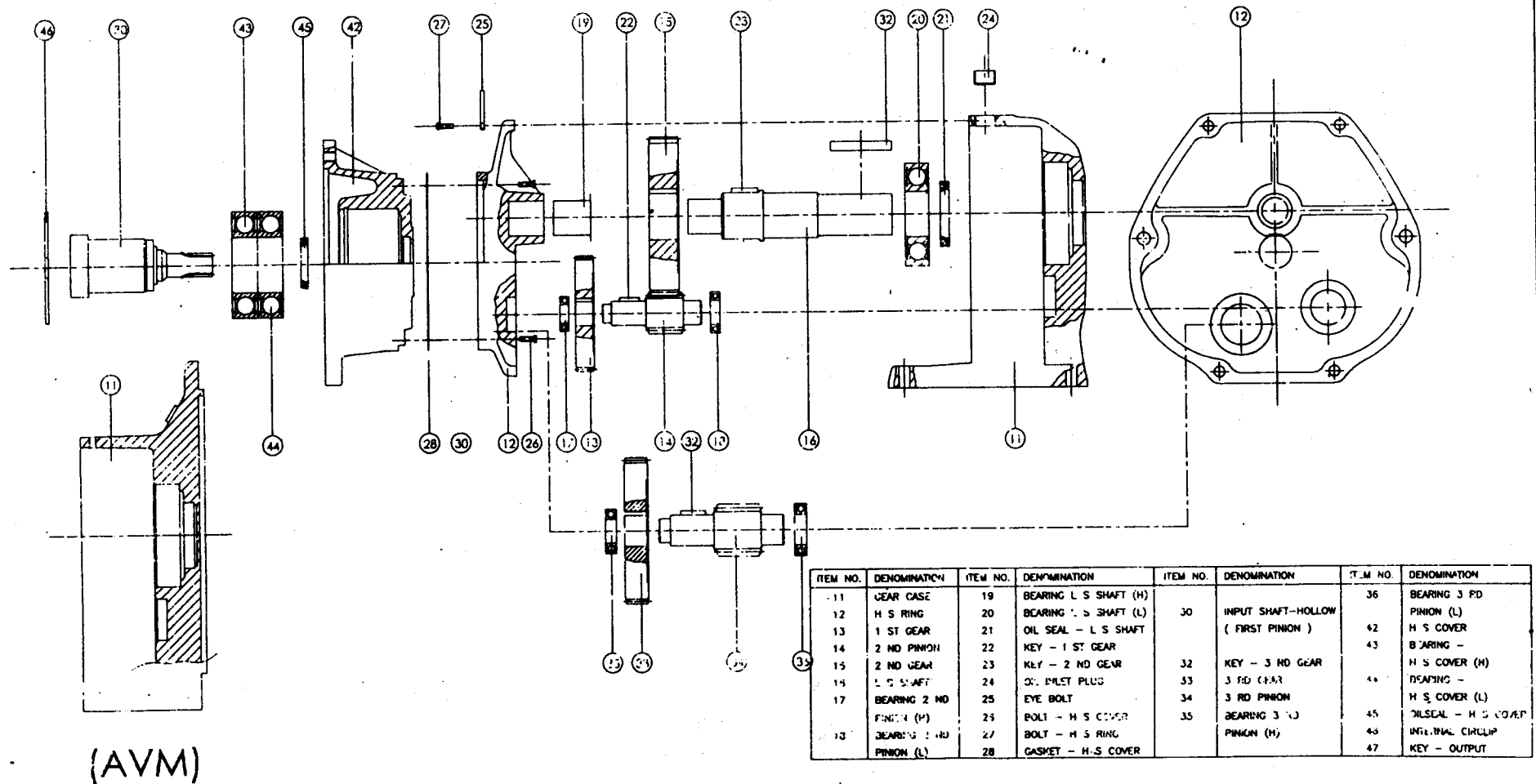
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	• ARRANGEMENT DRAWING - MOTOR MOUNT REDUCER (AM)	3
	• ARRANGEMENT DRAWING - INLINE REDUCER (AC)	4
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3.	TRANSPORTATION	5
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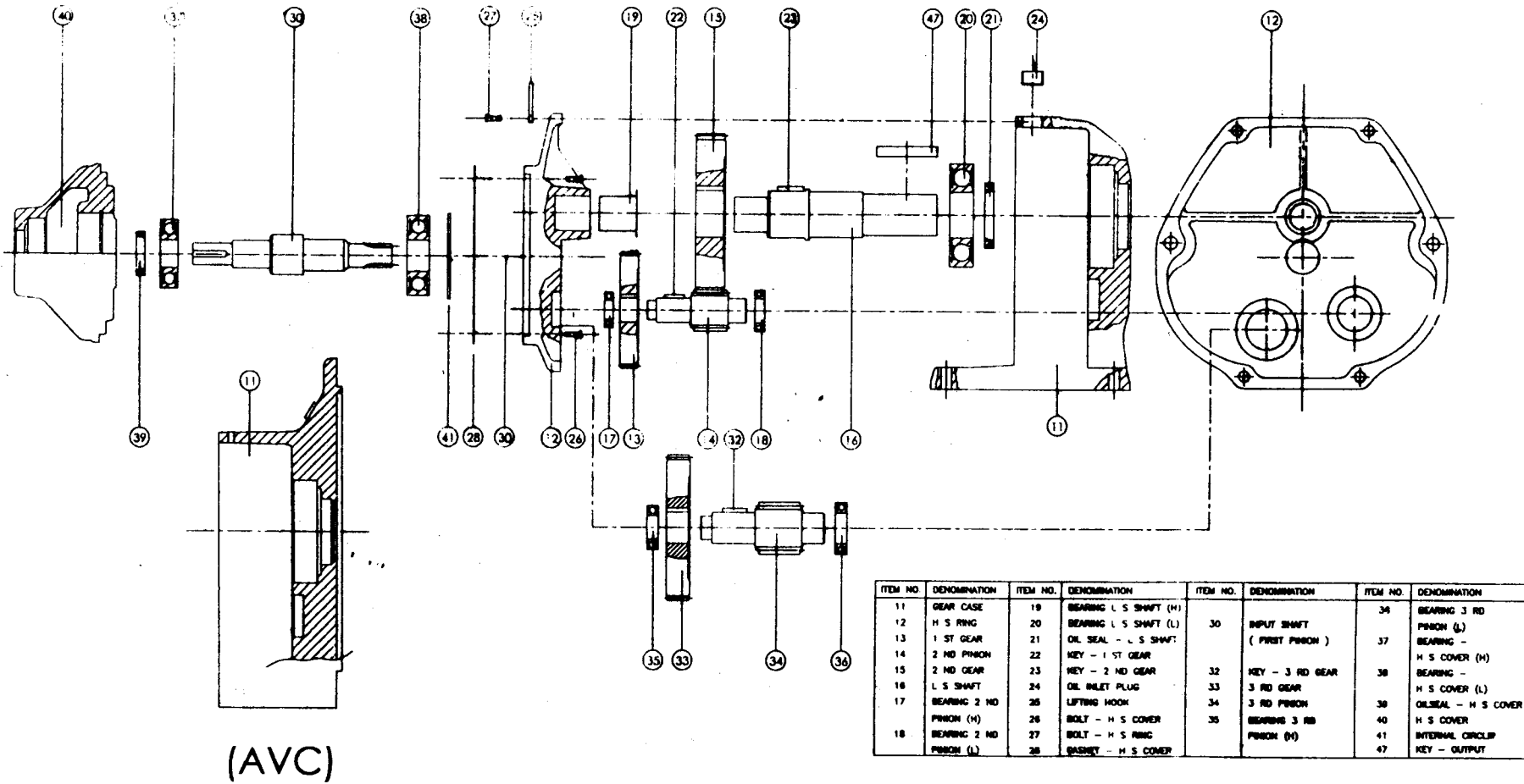
PBEGL - SKK ARRANGEMENT DRAWING - GEAR MOTOR (AT)



PBEGL - SKK ARRANGEMENT DRAWING - MOTOR MOUNT REDUCER (AM)



PBEGL - SKK ARRANGEMENT DRAWING - INLINE REDUCER (AC)



Notes To Users

We are pleased to enter your name in our Customers List and greatly appreciate your decision in choosing PBEGE Geared Motor / Gear Reducers.

Your Model : _____

Model Serial Number : _____

This instruction manual covers some essential procedures for installation, operation and maintenance. Before operating the unit, please thoroughly read this manual.

1. To start with, check the following points to see,

- The items indicated on the nameplates are in conformance with your requirements.
- There is no damage with the units due to humidity or dirt accumulated in transit.
- Operating conditions of driven machine (load, frequency of start/stops and degree of shock), please do not differ from the ones indicated at the time of the order.
- Please contact PBEGE if required.

2. Transportation

- For the type of geared motor / reducer whose weight is more than 20 kg, an eyebolt or a lifting hook is fixed. Please use it for removing from the packing. Please note that an eyebolt or a hanging hook is only for lifting a geared motor / reducer, therefore, do not use it when the unit is assembled with the driven machine, etc.

3. Storage

If geared motors / reducers have to be stored or is not in operation for more than 3 months, please follow the procedures given below.

1. In case geared motors / reducers are to be stored in packing for a long period of time,
 - a) Geared motors / reducers have to be stored in indoor, clean and dry place where there is no vibration and much change in temperature.
 - b) Rotate shaft by hand every 3 months to prevent bearing from rusting and confirm that shaft rotates smoothly and there is no abnormality.
2. In case geared motors / reducers are stored after installation with machine for a long period of time (over 6 months in general condition, over 3 months in hot and humid place.)
 - a) If geared motors / reducers are exposed to high humidity or if there is possibility to enter water or foreign articles in the units, cover geared motors / reducers with polyethylene sheet, put desiccant inside and seal. Please replace desiccant with new one periodically.
 - b) Please run geared motors / reducers for about 5 minutes for every 3 months to prevent bearing from rusting.
 - c) Before operation, check the insulation resistance and carry out the inspection of bearing and the connection to power supply source, etc. to see that there is no abnormality.

4. Tips on Installation

1. Conditions for installation

- | | | |
|------------------------|---|---|
| a) Ambient Temperature | : | -20°C to 60°C |
| b) Ambient Humidity | : | Below 100% |
| | | (For the units with single-phase motor or brake motor: under 85%) |
| c) Altitude | : | Below 1000m |
| d) Atmosphere | : | Avoid corrosive gas, explosive gas and vapour.
Dustless and well ventilated. |

- e) Installation angle : No limit. (Can be installed at any position).
- f) Installation place : Indoor.

Note :

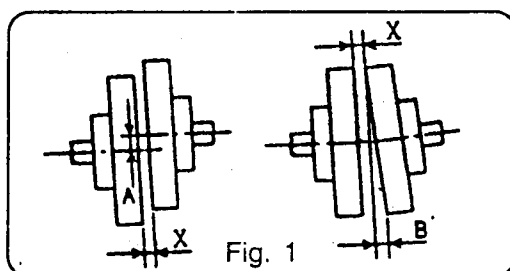
- In case geared motors with brake is installed vertically, the allowable frequency of braking and the life of lining will be reduced.
- g) Cautions for installation of foot mount type
 - a) Care must be exercised to ensure that installation is always performed on a reliable machined foundation.
 - b) Avoid uneven clamping when you lock the unit on the bed.
- h) Cautions for installation of flange mount type
 - a) Care must be exercised to ensure that installation is always performed on a reliable machined face.
 - b) After the geared motor has been positioned by means of the spigot joint of the bracket, tight it firmly.
 - c) Connect the low-speed shaft (output shaft) and the driven shaft by means of a "flexible coupling" or any such similar means.
 - d) When radial load and thrust load are applied to geared motor, install driven shaft block on the machine in which bearings are fixed to absorb the load adequately.
- i) Cautions for installation of motor on motor mount reducers :
 - a) Clean the motor face and rotor shaft thoroughly.
 - b) Apply lubricant on the diameter of rotor shaft to ensure free insertion.

5. Connection with the driven machine

Since low-speed shaft (output shaft) and high-speed shaft (input shaft) are protected with rust preventing coating, remove it with thinner or a similar solvent.

i. Direct connection

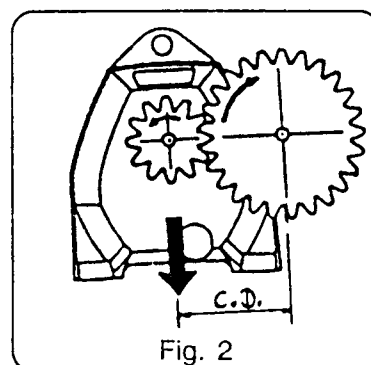
- a) When installing the coupling, etc. on the low-speed shaft (output shaft), the fit should be in the neighbourhood of h6M6-h6P6. In this case slightly heat the coupling, etc. before connecting.
- b) When the input shaft of the driven machine and the low-speed shaft (output shaft) of the geared motor are coupled directly, use a "flexible coupling" and make sure that both ends are in alignment. (Refer to Fig. 1)



Allowance of Dimension A	0.05 mm
Allowance of Dimension B	0.04 mm
Dimension X	Specified by coupling maker

ii. When the machine is driven by V-belt, chain or gearing

Make arrangement to ensure that the Shaft of driven machine and that of geared reducer are positioned parallel. When the machine is driven by V-belt or chain, ensure that the center distance is not too long. When the machine is driven by gearing, geared motor / reducer should be installed setting up the accurate center distance.



- a) Diameter of the chain sprocket wheel or the gearing that is mounted on the output shaft:

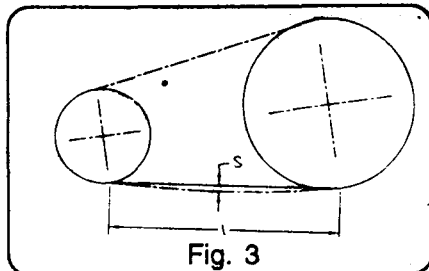
The pitch circle diameter should be at least 3 times larger than the output shaft diameter.

- b) Point of load application on the output shaft :

When load (overhung load) is applied at the end of the shaft, it may cause damage to the shaft. The gearing or chain sprocket wheel must be mounted so that the point of load application is as possible to the face of the unit minimize overhead load.

- c) Tension of chain :

When using chain, it is necessary to give suitable slack to chain. If the tension of chain is too loose, **excessive shock** will be generated at starting or load fluctuations, which may damage both the geared motor and the driven machine. Generally, the recommended amount of slack is 2% of span distance. (Refer Fig. 3)



$$S = 0.02 \, l$$

S = amount of slack for chain
 l = span

- d) Layout of chain driving :

When using chain horizontally for connection with the drive and the driven machine, arrange shafts so as to give tension to the upper side of the chain. Shaft arrangement of vertical transmission is not recommended, however, if necessary, the large wheel should be positioned at lower end as illustrated in Fig. 4.

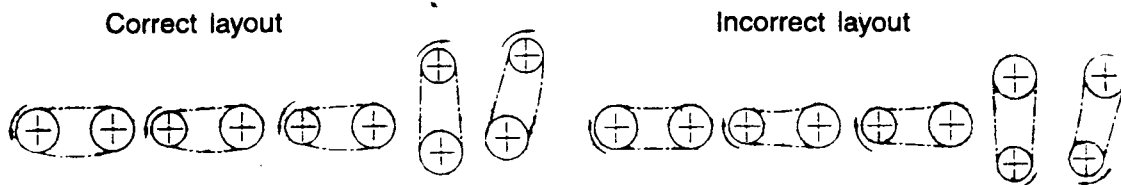
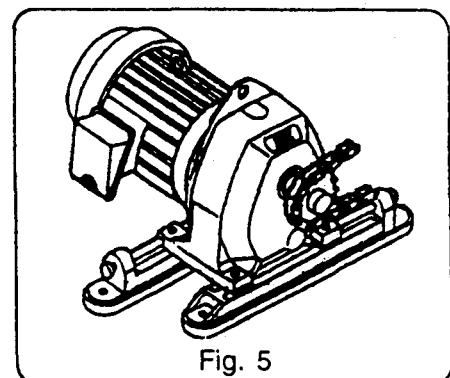


Fig. 4

- e) Installation of slide rails :

When slide rails are used (Optional supply) in V-belt and chain driving, install the push bolts front and back alternately so that they will be set in an opposite direction to external forces, as shown in Fig. 5



6. Operation:

- "A-SERIES" geared motors and reducers are grease lubricated and already filled with grease at the time of delivery. Therefore, there is no need to fill grease before operation.
- After inspection of installation and wiring, carry out no-load running of the machine alone and then proceed to load running.

- Abrupt reversing during operation will damage the geared motor/reducer as well as the driven machine. It is requested to stop by braking before it is operated in reverse.

In case the equipment is used for frequent reversals, please refer to PBGL.

7. Lubrication

- "A-SERIES" geared motors and reducers are grease lubricated and filled with grease before delivery. For the general condition of use, it is not necessary to replace grease. However, it is recommended to replace with new one after 20,000 hours of operation (about 4-5 year) as it will extend the life of the unit.

Table 2. Quantity of grease

Type AT, AC and AM. - FOOT MOUNTED									
Double Reduction (1/5 ~ 1/30)									
Reducer Frame No.	A	B	C	D	E	F	G	H	K
Qty. of grease(kg)	0.14	0.23	0.28	0.42	0.85	1.1	1.9	2.6	3.8
Triple Reduction (1/45 ~ 1/200)									
Reducer Frame No.	-	B	C	D	E	F	G	H	K
Qty. of grease(kg)	-	0.28	0.32	0.51	0.95	1.4	2.3	3.2	4.6

Type AVT, AVC and AVM. - FLANGE MOUNTED							
Double Reduction (1/5 ~ 1/30)							
Reducer Frame No.	A	B	C	D	E	F	G
Qty. of grease (kg)	0.12	0.19	0.37	0.75	1.0	1.0	1.7
Triple Reduction (1/45 ~ 1/200)							
Reducer Frame No.	-	B	C	D	E	F	G
Qty. of grease (kg)	-	0.23	0.32	0.46	0.85	1.3	2.1

Type of grease : "BECHEM LONG LIFE NLGI PD 000" universal EP grease OKS Type.
In case of using grease made by other manufacturers or equivalent, please refer to PBGL.

8. Periodical Inspection / Repair

The frequency of inspection and repair will differ as per operating condition, however, please conduct inspection and repair with reference to the following table. (It is based on the operation of 10 hrs/day.)

Inspection/Repair items	Frequency	How to determine the necessity of parts replacement
Replacement of grease	4-5 years	Replace grease every 20,000 hours or every 5 years. In high temperature environment, or continuous operation under severe conditions, replace grease approximately every 15,000 hours.
Tightening of chain	6 months	If the tension of chain is loose, tighten properly
Improper tightening of bolts	6 months	If tightening of bolts is loose, tighten properly
Replacement of Oil seal	1-2 years	At every overhaul, or when leakage is found, replace oil seal.
Replacement of bearing	5 years	If abnormal noise occurs, replace bearing.
O-ring	1-2 years	At every overhaul, replace o-ring with a new one

9. Trouble Shooting

Trouble		Cause	How to correct
Unit does not rotate even in no load condition		Interruption of service	Check motor terminal voltage or source voltage
		Breakage of wiring Bad contact of switch	1) Inspect circuits and repair defect. 2) Check motor terminal voltage or current, repair defect of connection
		Open circuit exists	Replace fuse, reset overload relay, check tripping of breaker.
		Defect of gear	Replace gear
		Damaged key of shaft, sprocket or pulley	Replace key with a new one.
		Load is too heavy	Lower load to rated, or raise capacity by changing unit
		Bad contact of switch	Check motor terminal voltage or current, repair bad contact of circuit
Unit rotates in No load condition But cause trouble when rotated with load	Noisy continuous load	Inversion of foreign article	Remove foreign article
		Wear or damage of bearing	Replace bearing at PBEGl or at specified place
		Wear or damage of gear	Replace gear at PBEGl or at specified place
	Overload relay acts	Bad setting or improper selection of overload relay	Revise setting value, or replace with regular one
		Load is too heavy	Lower load to rated
	Breakage of fuse or breaker works Over heat	Insufficient capacity of fuse or breaker	Investigate and replace or change setting value
		Load is too heavy	Lower load to rated
		Voltage is too high or too low	Check voltage and repair
		Imbalance of voltage	Check, source of circuit and wiring, and repair
		Short circuit of motor winding	Check winding and repair
		Shortage of lubricant and damage in bearings	Replace bearings and replace Lubricant
Grease Leakage		Improper tightening of each bolt	Tighten properly
		Defective oil seal	Replace oil seal
		Defect of gear case	Replace gear case
		Excessive quantity of grease	Adjust to proper quantity



POWER BUILD ELECON GEARS LIMITED

POST BOX # 42, ANAND-SOJITRA ROAD, VALLABH VIDYANAGAR - 388 120

PHONE : +91 (2692) 31070 / 31120 / 31170, FAX : +91 (2692) 36559

E-mail : plant@pbegl.elecon.com

CONTENT

DATA SHEET**LIST OF MOTORS**

DESCRIPTION		SPECIFICATION					
GENERAL DATA:							
MAKE		M/s. CROMPTON GREAVES LIMITED.					
TYPE		SQUIRREL CAGE INDUCTION MOTOR					
POWER SUPPLY		415 V \pm 10%, 3 PHASE, 50 HZ, \pm 5% AC					
TEMPERATURE		45°C					
ENCLOSURE		TEFC					
PROTECTION		IP 55					
INSULATION		CLASS "F"					
DUTY		CONTINUOUS					
TYPE OF MOUNTING		HORIZONTAL FOOT MOUNTED					
APPLICATIONS							
DESCRIPTION	QTY. (NOS)	CAPACITY (KW)	SPEED (RPM)	FULL LOAD CURRENT (AMPS)	FRAME SIZE	NO. OF POLES	TYPE OF CONN.
FD FAN	1	55	1480	92.0	ND 250M	4	STAR-DELTA
ID FAN	1	75	1480	123.0	ND 280S	4	STAR-DELTA
PA FAN	1	22	2980	41.0	ND 180M	2	STAR-DELTA
POCKET FEEDER	3	1.5	1500	3.2	ND 90L	4	V.F.D.

SUPPLIER'S ADDRESS:

M/s. CROMPTON GREAVES LIMITED,
POST BOX NO.3316, NO.3-A
M.G.R. SALAI, NUNGAMPAKKAM,
CHENNAI - 600 034.

CONTENT

GUARANTEE OF SATISFACTION

This motor is guaranteed to be free of any manufacturing defect.

We undertake to repair or replace this motor at our option or any part thereof, which we are satisfied was originally defective in material or workmanship, provided that the motor or its part/s is returned, freight paid to our nearest branch/dealer within 12 months from the date of purchase by the first user.

We cannot, however, accept responsibility if the motor is found to be repaired by persons other than those authorised by us to carry out such repairs. Guarantee does not cover consequential damage/defects of any nature.

This guarantee excludes every condition or warranty whether statutory or otherwise whatsoever not herein expressly set out.

NOTE : To avail the guarantee facility, this card must be produced at the time of lodging complaints along with the purchase documents, bearing the motor reference number.



Regd. Office : CG House, 6th Floor,
Dr. Annie Besant Road, Prabhadevi, Mumbai 400 025.

CUSTOMER SAFETY INSTRUCTIONS & INSTALLATION CHECK LIST

CAUTION :



All operations must be carried out by appropriately trained personnel. For full installation and maintenance instructions refer this book thoroughly or consult the supplier, if in doubt.







LIFTING

1. Use all lifting facilities provided - Both lifting points if fitted or single lifting point if fitted. Do not use any other part of the motor for lifting.

Note : Maximum handlift is 20Kg below shoulder, but above ground level.

2. Vertical lifting - Prevent uncontrolled rotation of the motor.
3. Do not lift other equipments with motor lifting points only.

MAXIMUM WEIGHTS : (Unpacked)

Weights in KG						
Frame size	160	180	200 225	250 280	315	355

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INSPECTION ON RECEIPT :

1. Make sure the right motor is received.
2. Check for transit damage.
3. If necessary, please open packing case in presence of an authorised Insurance Agent.
4. Please report damages to us giving complete Nameplate details.

STORAGE :

1. Ensure motors are stored in a place with an ambient range of -20°C to +45°C.
2. Store motors under shade and not in open.
3. Ensure that the stored motor does not receive any harmful vibration.
4. Ensure no water drips on motor and no water logging under the motor.
5. Energise heaters if fitted.
6. Ensure all plugs originally provided are in place (e.g. Cable entry hole plugs, drain plugs & fan cover greasing hole plug for TEFC motors.)

PERIODIC REQUIREMENTS	Every 1 Week	Rotate shaft
	Every 3 Months	Check insulation resistance. If less than 10 M.Ohm, dry out.

PRE-INSTALLATION CHECKS :

Ensure TICK WHEN CHECKED

1. Motor not corroded excessively. ☐
2. Fancover not damaged or touching fan. ☐
3. Foot not broken or cracked. ☐
4. Shaft not damaged/bend. ☐
5. All fasteners are tight. ☐
6. Check all the name plate details. ☐
7. Check free running by hand. ☐
8. Check grease condition if motor is idle for more than 6 months. If bad (Ref.: IS900) replenish with fresh grease. ☐
9. Add Lubricating Oil in the oil seal (if provided). ☐

INSTALLATION - MECHANICAL :

1. Level mounting surface. Clean mounting foot/flange & shaft of the motor. ☐
2. Check mounting plane. Add shims if necessary (Maxm. change of indicator reading - 0.075 mm with mounting bolts loose & tight - while checking mounting surface w.r.t. motor foot/flange. ☐
3. Check for any misalignment in motor & drive shaft. (Approx. TIR - 0.050 mm) ☐
4. While mounting use appropriate fasteners & tightening torques. ☐
5. Check all the gaskets, sealants & guards are correctly fitted. ☐
6. Verify belt tension. ☐

INSTALLATION - ELECTRICAL :



1. Ensure power supply system is grounded. ☐
2. Ensure proper earthing. ☐
3. Check insulation resistance of all windings with 500V dc megger. If < 10 Mohm, dry out as per procedure given in IS : 900. ☐
4. Ensure the equipment is fused and isolated correctly. ☐
5. Ensure all the covers are fitted and interior of terminal box is clean & free of cable residues. ☐
6. Seal unused cable entries. ☐

CONNECTIONS :



1. Check connection diagram and ensure correct terminal arrangement. ☐
2. Ensure all the connections are tight and clean. ☐
3. Ensure air clearance between live & live to earth > 10 mm. ☐
4. Check driven equipment is free. ☐
5. Check rotation, uncoupled. ☐
6. Ensure rating of fuse, setting of protecting devices are correct. ☐

Recommended protections :

Overload, Single Phasing, Under Voltage, Earth Fault.

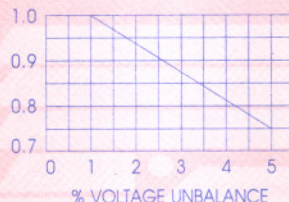
7. Ensure space heater (if provided) is off while starting the motor. ☐

OPERATION :



FREE RUNNING BEFORE COUPLING TO LOAD :

1. Ensure supply voltage as per nameplate & balanced in all three phases. (Maxm. allowable unbalance i.e. Maxm. deviation from average is 1%) For more unbalance, reduce the output by derating factor from the graph. ☐



2. Check three phase currents at No Load (Free Shaft) & tally with the Test Certificate at the back cover of this book. ☐

Note : The currents will be more if the voltage is more. They will be less if the voltage is less. The increase & decrease will not be in linear proportion with voltage.

3. No abnormal noise. (Use a screwdriver as a medium to hear.) ☐
4. Bearing not heating up abnormally. ☐
5. Check direction of rotation. If specific. (Frame 280 & above 2 pole motors may be fitted with unidirectional fan.) ☐
6. Check vibration. (Vibration level on the mounting structure immediately below the motor should be within 30% of horizontal vibration level at the bearing housing) ☐

RUNNING ON LOAD

1. Ensure rated voltage at the motor terminal during startup and check starting time within designed limit. (Any normal application, the time required will not be more than 5 sec. at DOL. For high inertia load the starting time is longer but special design is required to cater this. For star/delta & reduced voltage starter the time will be longer than that in DOL). Refer to Crompton Greaves in case of doubt. ☐
2. Ensure Full Load Currents are balance in all phases (Maxm. unbalance 8% corresponding to 1% unbalance of voltage) and the value is within Nameplate Data. In case of pulsating load we recommend the maximum current to be within Nameplate value. ☐
3. No abnormal vibration. (If change in vibration level is observed, check alignment again preferably in hot condition.) ☐
4. No abnormal noise. ☐
5. Check maxm. air inlet temperature = Ambient temperature mentioned on Nameplate ☐
6. No abnormal heating up.
Total permissible temperature including ambient for Class B rated motors are approximately as follows :
By Thermometer : At Eyebolt : 90 °C
At Bearing Cover : 80 °C
On Slipping Surface : 90 °C
Check the temperature after 4-5 hours of operation, when it is stabilised. ☐
7. Check no sparking is appearing on the slipping in case of Slipping Motor. ☐

PROBLEMS :



Noisy
Vibrating
Tripping
Overheating
Not starting

Refer to supplier with Machine no.

MAINTENANCE :

While carrying out maintenance

1. Ensure that the motor is isolated.
2. Refer to supplier, if in doubt.

SPARE PARTS :

While ordering Spare Parts, always quote Machine Number and Reference number which will be found on the Nameplate. Please use only genuine spares.

HAZARDOUS AREAS :



If motor is marked with "Ex" symbol, special conditions apply. Refer appropriate installation manual and relevant standards. All operations are to be carried out by appropriately trained personnel.

OPERATING & MAINTENANCE TIPS

(ALSO REFER IS : 900 - 1992)

CROMPTON GREAVES Motors have been designed, manufactured and tested to a high standard of excellence. Motors conform to relevant Indian standards as given on the name plate.

These motors are sound in design and robust in construction and will give satisfactory service with correct installation and normal routine maintenance.

SITE

- Check for proper ventilation. TEFC Motors should be provided with at least 2" gap between fan cover and nearest barrier.
- Install DP Motors at a clean dry place.
- Check for ambient conditions, if special treatment on motor is provided for adverse ambient.
- Ensure passages in-between ribs in TEFC Motors are properly cleaned.

FOUNDATION

The foundation of the motor should be preferably of concrete, or structural steel, and must be sufficiently rigid to minimize vibrations and to maintain alignment between the motor and the load. Normally a mixture of four parts of stone and two parts of sand and one part of cement by volume is suitable.

PINIONS, PULLEYS AND COUPLINGS

- Use flexible coupling. For rigid couplings refer to CROMPTON GREAVES.
- Use dynamically balanced (with half key) Pulley / couplings / pinions. (Motor Rotors are balanced with half key)
- For belt drive mount belt nearest to motor bearings. Belts should not be too tight.
- Use pulley diameter and coupling / pulley bore as follows:

PULLEY DIMENSIONS (mm)

FRAME	TOLERANCE ON BORE DIA-OF PULLEY & COUPLING (H-7)			
	MIN DIA	MAX FACE WIDTH	NOMINAL	TOLERANCE
160	150	177	30 to 50	+ 0.0
180	180	203		+ 0.025
200	187	280	50 to 80	+ 0.0
225	197	330		+ 0.030
250	228	380	80 to 120	+ 0.0
280	375	380		+ 0.035
315	400	380		
355	500	400		

STARTING

Squirrel Cage Motors are suitable for DOL, Star/Delta or Auto Transformer Starting.

Slipring motors should be started by stator / rotor starter with suitable external resistance in rotor circuit which should be cut off gradually when motor picks up speed.

- In case of star/delta starter, put to 'Delta' when the motor picks up fully in 'STAR' position.
- While operating on load & the motor is hot, the motor is suitable for 2 starts in one hour, unless it is designed for higher number of starts.
- In case of Slipring Starters, ensure the current and voltage of the starter are same as specified on the motor name plate (RV & RA)

PREVENTIVE MAINTENANCE :

Motor should be kept clean and free from oil, dust and moisture. Care should be taken to see that ventilation passages are not blocked. The earthing conductor should be regularly inspected and checked for continuity. The insulation resistance of stator and rotor windings should be checked regularly between respective terminals and the frame.

In case of slipring motors, carbon dust should be blown out regularly from sliprings and brushes. The pressure on brushes and wear out should be checked.

BEARINGS :

Grease lubricated Roller and Ball Bearings are already charged with right quantity of grease.

For relubrication and replenishing of grease use the following rules :

1. Check relubrication interval on name plate. The regreasing interval should be shortened for high ambient temperature, presence of corrosive vapours or extreme level of contamination.
2. For replenishing fresh grease in the bearing :
 - Quantity of grease to be filled in bearing (in gms.) = Bearing bore dia.
 - Fill 1/3rd of bearing cover cavities with grease.

Recommended grease is Servogem 2 of M/s. IOCL, or MP2 of M/s. Bharat Petroleum or AP2 of CASTROL. MIXING OF DIFFERENT GREASE SHOULD BE AVOIDED.

While removing the bearings from the shaft, use properly designed draw-off tackle or puller to hold the bearing preferably at inner race. While pulling out the bearing, rotate the bearing to avoid damages if the bearing is intended to be used again.

Bearing should be re-fitted on shaft after heating upto approximately 90°C and by slipping on to the shaft.

SLIPRING/BRUSHGEAR

Size of brushes on the Slipring motors are as below -

FRAME	$\alpha \times t \times r$ (Dimensions in mm)		
160-180	12.5 X 16 X 20/24	t	- Thickness
200-250	16 X 20 X 30	α	- Axial width
280-315	20 X 40 X 28	r	- Radial width *

(* Radial width should not be allowed to wear below 15 mm length).

- If Slipring surface is not smooth, smoothen with fine glass paper (DO NOT USE EMERY CLOTH).
- Brushes should be free in holder, recommended brush pressure is 0.2 KG/SQ.CM. ($t \times \alpha$)
- Ensure that Slipring and Brushes are free from oil and Dust. Blow out carbon dust from Sliprings and brushes periodically.
- Use brush grade M15E of Assam Carbon or BE22 of Electro Carbenium.
- For new brushes proper brading is to be done with sand paper, so that curvatures of brushes and slipring are perfectly matched.

NOTE :

In case of the Non-standard motors, wherever necessary, special instructions will be provided.

LT MOTORS DIVISION

A-6/2, MIDC, Ahmednagar 414 111.

Tel.: 0241 - 2777372, 74, 75, 76, 78. Grams : CROMGRE Fax : 0241 - 2777508.

BRANCHES :

NORTHERN REGION :

New Delhi : Vandana, 11, Tolstoy Marg, New Delhi 110 001. Tel.: 3721536 /37.
Jaipur : Church Road, P.O. Box 173, Jaipur. Tel.: 376919, 376307.
Jalandhar : 50, Mahavir Marg, Jalandhar 144 001. Tel.: 59467, 59478.
Lucknow : Speed Building, 2nd Floor, 3 Shahajahan Lucknow 226 001. Tel.: 239443, 239345.

WESTERN REGION :

Mumbai : Kanjur Marg (East), Mumbai 400 042. Tel.: 5782451.
Ahmedabad : 909, Sakar II, Near Ellis Bridge Police Station, Ahmedabad. Tel.: 6581729.
Baroda : 10A Kalpana Apartments, Vrundavan Society, Near Gotri Water Tank, Gotri, Baroda 390 015. Tel.: 330819.
Pune : Surya Bhavan, 5th Floor, 1181, Fergusson College Road, Pune 411 005. Tel.: 5535675, 9665.
Indore : 103 B, Apollo Trade Centre, 2B, Rajgarh Kothi, Mumbai-Agra Rd., Indore. Tel.: 498269, 498276.
Nagpur : 3 West High Court Road, Lal Bahadur Shastri Chowk, Dharampeth, Nagpur 440 010. Tel.: 530537.

EASTERN REGION :

Kolkata : 50, Chowringhee Road, Kolkata 700 071. Tel.: 2829681, 84.
Bhubaneswar : Red Cross Bhavan, Sachivalaya Marg, Bhubaneswar 751 007. Tel.: 531429.

SOUTHERN REGION :

Chennai : No. 3-A, Kodambakkam High Road, P.O. Box 3316, Nungambakkam, Chennai 600 034. Tel.: 8257375.
Bangalore : Mithra Towers, 1st Floor, No. 10/4, Kasturba Road, Bangalore 560 001. Tel.: 2273686.
Coimbatore : Krishna Towers, IV Floor (E), P.O. Box 6329, 1087, E Avavashi Rd., Coimbatore. 641 037. Tel.: 495334.
Cochin : Cherupushpam Building, 5th Floor, 330-6, Shanumugham Road, Emakulam, Cochin 682 031. Tel.: 370860.
Secunderabad : 4th Floor, Minara House, 94, Sarojini Devi Road, Secunderabad 500 003. Tel.: 7847270.

SERVICE CENTRES

New Delhi : 27, Rani Jhansi Road, New Delhi 110 055. Phone : 7516993, 7532349.
Kolkata : 171/1A, "Acharya" J. C. Bose Road, Kolkata 700 014. Phone : 2441557.
Mumbai : Mathuradas Mills Compound, Next to Milton, Lower Parel, Mumbai 400 013. Tel.: 4922572, 4947950.
Chennai : 3 A, Kodambakkam High Rd., Nungambakkam, Chennai 600 034. Tel.: 8274610.