IV. GENERAL BASIC PRINCIPLES

Air is a mechanical mixture of Oxygen, Nitrogen and other gases (rate) and its physical properties lie between the two but closer to those of Nitrogen. In its normal atmospheric condition , air is a colourless, odourless gas. Air which is normally in gaseous state can be liquefied as steam from gaseous state can be condensed to liquid state.

The Plant manufactured by us have normal operating pressure of 40 Kg/cm2. this is achieved with the incorporation of Expansion Engine alongwith Joule - Thompsons expansion valve. .

1.1 Air is sucked into Air compressor through suction Air filter (1) where dust particles are removed . The Air filter fitted on Air compressor should be 100 Meter away from the Acetylene Plant, if Acetylene Plant is installed on the same premises or near by. Please refer compressor Manual provided by Air compressor manufacturer for Air compressor operation.

1.2 Air can be compressed to max 60 Kg/cm2 (40 to 35 Kg/cm2 in normal running condition) and passed through cascade cooler.(5) The Moisture is removed from the Air in Moisture Separator .(4) The lubricant which is mixed in Air during the compression, is also get cooled in Cascade Cooler and removed i`n Moisture separator. This is drained once in an hour. The separation of moisture helps in getting effective through put of the Compressor. Condensate, if not drained periodically can cause hammering and damage to the compressor.

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1.3 The air then enters an evaporation cooler (5) also known as cascade cooler where it gets cooled to about 20 ° C . This cooler is an elliptical tank having two compartments. In each compartment, there is a pipe coil that is interconnected. The coils are half submerged in water in the tank. Dry Nitrogen bubbles through this water and gets moisturised. As the water vaporizes, it requires latent heat which is absorbed from water itself. Thus water gets cooled and in turn the air in the pipe also gets cooled.

1.4 The air from this evaporation cooler passes into the chilling coil tank, (6) which is having chilled water at a temperature of 6 ° C to 10 ,° C. This chilling of water is done with the help of chilling unit (7). In the chilling tank coil the moisture entrapped in the air further gets condensed which is separated in the form of moisture from the moisture separator (8) and is drained once in half an hour. The separation of moisture is carried out in different stages so that the air entering in the molecular sieve has minimum moisture vapour level . Better adsorption of Co2 can take place in the molecular sieve battery, if the moisture content is low in air.

1.5 The air will then pass through carbon filter packed with Activated Carbon. Here the oil vapour carried over from air compressor will be removed. If this oil vapour is not removed sufficiently, due to spent carbon or due to high temperature of process air, the oil vapour will damage the molecular sieves. To obtain a long life of molecular sieve ensure that carbon filter is well maintained. (A sample of Carbon beads may be taken out from Carbon Filter once in six months checked. and should be checked)

1.6 The Air cooled in chilling unit should be between 6 ° c to 10 ° c for better adsorption of carbon dioxide in the molecular sieve .The chilled Air then passes through Molecular Sieve Drier unit . This unit have two Vessels when one is on line and other is on Reactivation . The regeneration cycle of drier is 8 to 10 hrs (approx).

1.7 The cooled Dried Air is passed through Dust Filter (13) (Hard compressed ceramic filter) where small dust particles are arrested.

1.8 The Dust, Moisture and Oil free cooled Air is passed finally into cold Box (14) which consists of Heat Exchanger 1&2, Lower column, Upper Column, Condenser etc.

1.9. The Air is passed through Heat Exchanger I where Air is cooled to -100 Deg.C by the incoming Oxygen & Nitrogen gas.

1.10 The air will then be bifurcated into two streams. The main air stream, will enter Expansion Engine (15) at 40 kgs./cm2 and will be expanded to 5 kgs./cm2 - 150 ° C. The rest of the air will pass through Heat Exchanger No. 2 to be cooled to about -140 ° C to - 155 deg c by the outgoing Oxygen and Nitrogen. This air will then be expanded by an Expansion Valve R1 to form liquid air. Both the air streams will now enter into a buffer vessel and then to the bottom portion of the lower Column.

1.12 As the air enters the Lower Column, after the Expansion Engine and after Air Expansion valve R1, part of this air condenses into liquid and falls at the bottom of the column. This liquid is about 35% to 40% Oxygen and 60% to 65% Nitrogen and is usually called the 'Rich Liquid' (RL).

1.13 A part of the air in this Column evaporates and rises to the top of the Column touching the Condenser which is colder than the Lower Column. As this air touches the Condenser, it condenses into a liquid on top of the Lower Column. This liquid is generally 96% to 99% Nitrogen and being poor in Oxygen, is called "Poor Liquid" (PL). The pressure in the lower column is between 4.7 Kg/cm2 to 5.2 Kg/cm2. in the normal operating condition. Final separation of the 2 traction is achieved in the Upper Column Both the Poor liquid and the Rich Liquid are carried into the Upper Column by two Expansion valves and the pressure, drops from 5 kgs./cm2 in the lower column to 0.5 kgs./cm2 in the upper column. This Rich Liquid enters the middle of the Upper Column and as it flows down, Nitrogen evaporates and Oxygen continues as liquid. The Liquid Nitrogen (poor Liquid) enters the top of the upper column and as if flows down the column, it comes in contact with any evaporating Oxygen and condenses the same into liquid, while

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the nitrogen itself becomes Gas as it is more volatile. This process takes place in each tray. The entire gaseous Nitrogen is piped out from the top of the upper column through the Heat Exchangers. Similarly the liquid Oxygen at the bottom of the condenser is carried away to a liquid Oxygen pump from which it is compressed and again passed through the Heat Exchanger into the Gas Cylinders. As the Liquid Oxygen travels through the Heat Exchangers, it evaporates into the gaseous Oxygen giving up its cold to the incoming air.

1.14 Generally the purity of Oxygen will be 99.5% and Nitrogen about 96% to 97.5% , when the plant is operated exclusively for Oxygen production. If Nitrogen is also required, a part of the RL vapor (Mixture gas) is bled out from the center of the Upper column. By doing so, waste Nitrogen purity will gradually increase to 99.5% and the Oxygen production will fall. The Nitrogen so produced can be compressed by means of a standard Nitrogen Compressor. Small quantity Liquid N2 production is also possible at 0.5 kg/cm2 pressure (Please refer chapter on simultaneous Oxygen & Nitrogen Production). This system is provided to the customer on demand . The normal ASU has no liquid nitrogen drawal facility.

The plant operation should be such that it is not too cold or too warm. If the cold box is too cold, the Nitrogen will condense and mix with Liquid Oxygen and the Oxygen purity will fall. If the plant is too warm the Oxygen will evaporate with the Nitrogen, and reduce the quantity of Oxygen. To obtain optimum result of the plant, check the purity of the waste Nitrogen which should not fall below 96%.

1.15 When the plant works continuously for a few months, it tends to accumulate Carbon Dioxide and Moisture in its internal parts. These are to be removed once in about 4 - 6 months. For details, refer Chapter on Defrosting of plant.

Similarly LO. Pump alone can be defrosted in case of trouble in pumping (Refer LO. Pump chapter)

It is advised to give Carbon Tetra Chloride wash to the Cold Box equipment once in two years when Acetylene contamination in Liquid Oxygen exceeds 2.0 PPM

V. VALVE INDEX AND NOMENCLATURE

Sr. No.	Valve Nomenclature	Valve No.	Types
1.	Main Air Expansion	R1	Expansion
2.	R.L. Expansion	R2	-
3.	P.L. Expansion	R3	-
4.	Bye - Pass	R4	-
	AIR VALVES		
5.	Moisture Separators Drain	A1	Blow Off
6.	Oil trace check Drain	A2	Blow off
7.	Mol. Sieve Drier 'A' Air inlet	A3	Globe
8.	Mol. Sieve Drier 'B' Air inlet	A4	-
9.	Mol. Sieve Drier 'A' Air outlet	A5	-
10.	Mol. Sieve Drier 'B' Air inlet	A6	-
11.	Mol. Sieve Drier 'A' Pressurising	A7	Needle
12.	Mol. Sieve Drier 'B' pressurizing	A8 -	
13.	Moll. Sieve Dryers Depressurizing	A9	-
14.	Air Filter Drain after Drier	A10	-
15.	Main Air inlet to cold Box	A11	Globe

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